SAFETY DATA

This is a SAFETY ALERT SYMBOL.
When you see this symbol on the product, or in the manual, look for one of the following signal words and be alert to the potential for personal injury, death or major property damage.

**WARNING**

Warms of hazards that **CAN** cause serious personal injury, death or major property damage.

**CAUTION**

Warms of hazards that **CAN** cause personal injury or property damage.

**NOTICE:**

Indicates special instructions which are very important and must be followed.

SAFETY DATA

Blackmer power pumps MUST only be installed in systems which have been designed by qualified engineering personnel. The system MUST conform to all applicable local and national regulations and safety standards.

This manual is intended to assist in the installation and operation of the Blackmer power pump, and MUST be kept with the pump.

Blackmer power pump service shall be performed by qualified technicians ONLY. Service shall conform to all applicable local and national regulations and safety standards.

Thoroughly review this manual, all instructions and hazard warnings, BEFORE performing any work on the Blackmer power pumps.

Maintain ALL system and Blackmer power pump operation and hazard warning decals.
SAFETY DATA

**WARNING**

Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury, death or major property damage.

**WARNING**

Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death.

**WARNING**

Hazardous machinery can cause serious personal injury.

**WARNING**

Failure to relieve system pressure prior to performing pump service or maintenance can cause personal injury or property damage.

**CAUTION**

Hazardous pressure can cause personal injury or property damage.

**WARNING**

Failure to disconnect and lockout electrical power before attempting maintenance can cause serious personal injury or death.

**WARNING**

Hazardous voltage. Can shock, burn or cause death.

**WARNING**

Failure to stop the pump before adjusting the shaft packing can cause severe personal injury.

**WARNING**

Hazardous machinery can cause severe personal injury.

**WARNING**

If pumping hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing maintenance.

**CAUTION**

Hazardous or toxic fluids can cause serious injury.

**WARNING**

Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death.

**WARNING**

Hazardous or toxic fluids can cause serious injury.

**NOTE:** Numbers in parentheses following individual parts indicate reference numbers on the corresponding Blackmer Pump Parts Lists shown in the table at right.

PUMP DATA

<table>
<thead>
<tr>
<th>Technical Data*</th>
<th>Pump Size</th>
<th>1 1/2&quot;, 2&quot;, 2 1/2&quot;, 3&quot;</th>
<th>4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Pump Speed</td>
<td>640 RPM</td>
<td>500 RPM</td>
<td></td>
</tr>
<tr>
<td>Maximum Temperature*</td>
<td>240°F (115°C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Viscosity*</td>
<td>20,000 SSU (4,250 cP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Differential Pressure*</td>
<td>150 psi (10.3 bar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Working Pressure*</td>
<td>175 psi (12 bar)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Standard materials of construction.
For optional materials consult Blackmer Material Specs 103-091. Viscosity shown is in SSU (cP). cP = centistokes at fluid specific gravity of 1.0.

INITIAL START UP INFORMATION

Model No. ____________________________
Serial No. __________________________
Date of Installation: __________________
Pressure Gauge Reading: ________________
Vacuum Gauge Reading: _________________
Flow Rate: __________________________

PUMP PARTS LIST

<table>
<thead>
<tr>
<th>Pump Size</th>
<th>1 1/2&quot;</th>
<th>2&quot;</th>
<th>2 1/2&quot;</th>
<th>3&quot;</th>
<th>4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>103-A01</td>
<td>103-A02</td>
<td>103-A03</td>
<td>103-A04</td>
<td>103-A05</td>
<td></td>
</tr>
</tbody>
</table>
**NOTICE:**
BLACKMER POWER PUMPS MUST ONLY BE INSTALLED IN SYSTEMS DESIGNED BY QUALIFIED ENGINEERING PERSONNEL. SYSTEM DESIGN MUST CONFORM WITH ALL APPLICABLE REGULATIONS AND CODES AND PROVIDE WARNING OF ALL SYSTEM HAZARDS.

**WARNING**
- Install, ground and wire to local and National Electrical Code requirements.
- Install an all-leg disconnect switch near the unit motor.
- Disconnect and lockout electrical power before installation or service.
- Electrical supply MUST match motor nameplate specifications.
- Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.

**PRE-INSTALLATION CLEANING**
Foreign matter entering the pump WILL cause extensive damage. The supply tank and intake piping MUST be cleaned and flushed prior to pump installation and operation.

**LOCATION AND PIPING**
An improperly designed piping system or improper unit installation WILL significantly reduce pump performance and life. Blackmer recommends the following piping system layout and unit installation.

1. To minimize intake losses, locate the pump as close as possible to the source of supply.
2. Intake piping and fittings MUST be at least as large in diameter as the pump intake connection.
3. Minimize the number of intake line fittings (valves, elbows, etc.) and piping turns or bends. When used, intake fittings must be located at least 5-10 pipe diameters from the pump intake.
4. Install an intake strainer 5 - 10 pipe diameters from the pump intake. For viscosities less than 1,000 SSU the strainer should have a net open area of at least four times the area of the intake pipe. For viscosities greater than 1,000 SSU consult the strainer manufacturer instructions. Strainers must be cleaned regularly to avoid pump starvation.
5. Intake and discharge piping MUST be free of all leaks.
6. To facilitate piping expansion and contraction, expansion joints should be placed 3 feet (0.9m) from the pump intake and discharge.
7. ALL piping and fittings MUST be properly supported to prevent any piping loads from being placed on the pump.
8. Install vacuum and pressure gauges in the 1/4" NPT ports provided in the pump cylinder to check pump at start up.

**PUMP MOUNTING**
It is recommended the unit be permanently mounted by securing the base plate with adequately sized anchor bolts to a level concrete floor following recommended industry standards. See Figure 1. A solid foundation will reduce system noise and vibration, and will improve pump performance. Refer to ANSI/HI standards or a suitable pump handbook for information on typical pump mounting and foundations. Check coupling alignment after pump and base assembly is secured to the foundation.

**COUPLING ALIGNMENT**
The pump must be directly coupled to a gear reducer and/or driver with a flexible coupling.

Both angular and parallel coupling alignment MUST be maintained between the pump, gear, motor, etc. in accordance with manufacturer’s instructions. See Figure 2.

1. To check for parallel alignment, the use of a dial indicator is preferred. If a dial indicator is not available use a straight edge. Turn both shafts by hand, checking the reading through one complete revolution. Maximum offset should be less than 0.005" (0.127 mm).
2. To check for angular alignment, insert a feeler gauge between the coupling halves. Check the spacing in 90 degree increments around the coupling (four check points). Maximum variation should not exceed 0.005" (0.127 mm).
PUMP ROTATION

To determine pump rotation:

If the intake port and the relief valve are on the right, with the drive end of the shaft pointing towards the observer, the pump is right-hand, or CLOCKWISE rotation.

If the intake port and relief valve are on the left, with the drive end of the shaft pointing towards the observer, the pump is left-hand, or COUNTERCLOCKWISE rotation.

NOTICE:
CONFIRM CORRECT PUMP ROTATION BY CHECKING THE PUMP ROTATION ARROWS RESPECTIVE TO PUMP DRIVER ROTATION.

TO CHANGE PUMP ROTATION

To reverse the pump rotation, remove both the inboard head (20 or 20A) and outboard head (23 or 23A), and rotate the cylinder 180° so that the intake port is on the opposite side. Remove and replace the vanes (14) with the relief grooves facing in the direction of pump rotation. Refer to the "Maintenance" Section of this manual for instructions on pump disassembly and assembly.

OPERATION

OPERATION WITHOUT GUARDS IN PLACE CAN CAUSE SERIOUS PERSONAL INJURY, MAJOR PROPERTY DAMAGE OR DEATH.

OPERATING PUMP AGAINST A CLOSED VALVE CAN CAUSE SYSTEM COMPONENT FAILURE, PERSONAL INJURY AND PROPERTY DAMAGE.

PRE-START UP CHECK LIST

1. Inspect complete piping system and supports to ensure that no piping loads are being placed on the pump.
2. Ensure all valves and fittings in piping system are in the start-up or operating positions.
3. If equipped with a gear reducer, check the oil level in the gear reducer. Refer to “Lubrication” in the “Gear Reducer Maintenance” section of this manual.

NOTICE:
BLACKMER GEAR REDUCERS ARE NOT LUBRICATED AT THE FACTORY. OIL MUST BE ADDED BEFORE INITIAL PUMP START-UP.

4. Jog the pump motor to verify proper pump rotation.

START UP PROCEDURES

NOTICE:
CONSULT THE "TROUBLESHOOTING" SECTIONS OF THIS MANUAL IF DIFFICULTIES DURING START UP ARE EXPERIENCED.

1. Start the motor. Priming should occur within one minute.
2. Check the vacuum and pressure gauges to ensure the system is operating within expected parameters. Record the gauge readings in the "Initial Start Up Information" section of this manual for future reference.
3. Inspect piping, fittings, and associated system equipment for leaks, noise, vibration and overheating.
4. Check the flow rate to ensure the pump is operating within the expected parameters. Record flow rate in the “Initial Start Up” section of this manual.

5. Check the pressure setting of the relief valve by momentarily closing a valve in the discharge line and reading the pressure gauge. This pressure should be 10 - 20 psi (0.7-1.4 bar) higher than the maximum system operating pressure, or the external bypass valve setting (if equipped). DO NOT operate the pump against a closed discharge valve for more than 15 seconds. If adjustments need to be made, refer to the “Relief Valve Setting and Adjustment” section of this manual.

INCORRECT SETTINGS OF THE PRESSURE RELIEF VALVE CAN CAUSE SYSTEM COMPONENT FAILURE, PERSONAL INJURY AND PROPERTY DAMAGE.

REVERSE ROTATION

NOTICE:
PUMP SHOULD BE OPERATED IN REVERSE ROTATION FOR NO MORE THAN 10 MINUTES AND ONLY WHEN A SEPARATE PRESSURE RELIEF VALVE IS INSTALLED TO PROTECT THE PUMP FROM EXCESSIVE PRESSURE.

It may be desirable to run the pump in reverse rotation for system maintenance. The pump will operate satisfactorily in reverse rotation for a LIMITED time, at a reduced performance level.

flushing the pump

1. To flush the pump, run the pump with the discharge valve open and the intake valve closed. Bleed air into the pump through the intake gauge plug hole or through a larger auxiliary fitting in the intake piping. Pump air for 30 second intervals to clean out most of the pumpage.

2. Run a system compatible flushing fluid through the pump for one minute to clear out the remainder of the original pumpage.

3. To remove the flushing fluid, follow step 1 above.

NOTICE:
SOME RESIDUAL FLUID WILL REMAIN IN THE PUMP AND PIPING.

NOTICE:
PROPERLY DISPOSE OF ALL WASTE FLUIDS IN ACCORDANCE WITH THE APPROPRIATE CODES AND REGULATIONS.

PUMP RELIEF VALVE

NOTICE:
THE PUMP INTERNAL RELIEF VALVE IS DESIGNED TO PROTECT THE PUMP FROM EXCESSIVE PRESSURE AND MUST NOT BE USED AS A SYSTEM PRESSURE CONTROL VALVE.

Pumping volatile liquids under suction lift may cause cavitation. Partial closing of the discharge valve WILL result in internal relief valve chatter and is NOT recommended. For these applications, install an external system pressure control valve, and any necessary bypass piping, back to the storage tank.

A system pressure control valve is also recommended when operating for extended periods (more than 1 minute) against a closed discharge valve.

RELIEF VALVE SETTING AND ADJUSTMENT

The factory relief valve pressure setting is marked on a metal tag attached to the valve cover. It is recommended the relief valve be set at least 10 - 20 psi (0.7-1.4 bar) higher than the operating pressure or the system pressure control valve setting.

Relief Valve Adjustment Procedure:

1. To INCREASE the pressure setting, remove the relief valve cap (1) and gasket (88). Loosen the locknut (3), if equipped. Turn the adjusting screw (2) inward, or CLOCKWISE. Inspect R/V cap O-ring/gasket (88) and replace as required. Reattach R/V cap O-ring/gasket and R/V cap.

2. To DECREASE the pressure setting, remove the relief valve cap (1) and gasket (88). Loosen the locknut (3), if equipped. Turn the adjusting screw (2) outward, or COUNTERCLOCKWISE. Inspect R/V cap O-ring/gasket (88) and replace as required. Reattach R/V cap O-ring/gasket and R/V cap.

Refer to corresponding Blackmer Pump Parts Lists for relief valve spring pressure ranges.
MAINTENANCE

NOTICE:
MAINTENANCE SHALL BE PERFORMED BY QUALIFIED TECHNICIANS ONLY, FOLLOWING THE APPROPRIATE PROCEDURES AND WARNINGS AS PRESENTED IN THIS MANUAL.

FAILUPE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.

WARNING
Hazardous machinery can cause severe personal injury.

IF PUMPING HAZARDOUS FLUIDS SYSTEM MUST BE FLUSHED AND DECONTAMINATED, INSIDE AND OUT, PRIOR TO PERFORMING SERVICE.

WARNING
Hazardous or toxic fluids can cause serious injury.

FAILUPE TO STOP THE PUMP BEFORE ADJUSTING THE SHAFT PACKING CAN CAUSE SEVERE PERSONAL INJURY.

WARNING
Hazardous machinery can cause severe personal injury.

FAILUPE TO RELIEVE SYSTEM PRESSURE PRIOR TO PERFORMING PUMP SERVICE OR MAINTENANCE CAN CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

CAUTION
Hazardous pressure can cause personal injury or property damage.

DISCONNECTING FLUID OR PRESSURE CONTAINMENT COMPONENTS DURING PUMP OPERATION CAN CAUSE SERIOUS PERSONAL INJURY, DEATH OR MAJOR PROPERTY DAMAGE.

WARNING
Hazardous pressure can cause personal injury or property damage.

FAILUPE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

WARNING
Hazardous voltage. Can shock, burn or cause death.

SCHEDULED MAINTENANCE

Strainers
Strainers must be cleaned regularly to avoid pump starvation. Schedule will depend upon the application and operating conditions.

Pump Lubrication
Sleeve bearings (bushings) are lubricated by the liquid being pumped. Additional lubrication is not required.

Blackmer helical gear reducers are shipped from the factory without oil in the gearcase. Fill with the grade of oil indicated on the reducer tag. The oil should be changed after the first 48 hours of use, and approximately every 500 hours thereafter.

VANE REPLACEMENT

NOTICE:
FOLLOW ALL HAZARD WARNINGS AND INSTRUCTIONS PROVIDED IN THE “PUMP MAINTENANCE” SECTION OF THIS MANUAL.

1. Drain the pump and system as required.
2. Remove the head assembly from the outboard (non-driven) side of the pump according to step 5 in the “Pump Disassembly” section of this manual.
3. Turn the shaft by hand until a vane (14) comes to the top (12 o’clock) position of the rotor. Remove the vane.
4. Install a new vane, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 3.
5. Repeat steps 2 and 3 until all vanes have been replaced.
6. Reassemble the pump according to the “Pump Assembly” section of this manual.

VANE REPLACEMENT NOTICE:
FOLLOW ALL HAZARD WARNINGS AND INSTRUCTIONS PROVIDED IN THE “PUMP MAINTENANCE” SECTION OF THIS MANUAL.

1. Drain the pump and system as required.
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4. Install a new vane, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 3.
5. Repeat steps 2 and 3 until all vanes have been replaced.
6. Reassemble the pump according to the “Pump Assembly” section of this manual.

Figure 3 - Vane Installation*
*1 1/2 and 2 - inch models use only four vanes.
MAINTENANCE

PUMP DISASSEMBLY

If the pump is equipped with an optional shaft support bearing, it should be removed prior to removing the inboard head. Refer to "Optional Shaft Support Bearing" for disassembly and assembly instructions.

1. Drain the pump and system as required.
2. Starting on the inboard (driven) end of the pump, clean the pump shaft thoroughly, making sure the shaft is free of nicks and burrs. This will prevent damage to the packing or mechanical seal when the inboard head assembly is removed.
3. Remove the packing follower stud nuts (18) and slide the packing follower (75) out of the stuffing box. A slight pry may be necessary.
4. Pull the packing rings (19) from the stuffing box with the use of a packing removal tool. Use care not to scratch or damage the shaft. Discard packing. Remove the pack washer (58) from the stuffing box.

NOTE: If the pump is equipped with a commercial mechanical seal refer to the seal manufacturer's instructions for removal.

5. Remove the inboard head capscrews (21) and pry the head assembly away from the cylinder and off the shaft. Remove head O-ring (72) and discard.
6. The sleeve bearing (24) is press fit into the head and should not be removed unless replacement is necessary (see Step 1 of "Pump Assembly").
7. Gently pull the rotor & shaft (13) out of the cylinder. While one hand is pulling the shaft, the other should be cupped underneath to prevent the vanes and push rods from falling out. Set the rotor & shaft aside for future vane replacement and reassembly.
8. From the opposite (outboard) side of the pump, remove the bearing cover capscrews (28), bearing cover (27), and bearing cover O-ring (26). Discard the O-ring.
9. Remove the outboard head (23) as instructed in steps 5 through 6 above.

PUMP ASSEMBLY

Before reassembling the pump, inspect all component parts for wear or damage, and replace as required. Wash out the bearing/seal recess of the head and remove any burrs or nicks from the rotor and shaft.

1. Inspect the sleeve bearing in both heads for wear or damage and replace as required.

To replace bearings:

a. Using an appropriately sized arbor press, remove the old bearing from the head.

b. To aid installation and prevent bearing damage, heat the head in an oven at 200°F (93°C) before installing the bearing.

c. Coat the bearing with grease and place it on the inside face of the head, with the notched end UP. Align the notch in the bearing with the groove in the head (see Figure 5).

d. Using an arbor press, press the bearing into the head in one continuous motion, until it is flush with the inside face of the head or slightly recessed (.015" maximum). 

NOTE: Ensure the bearing does not become misaligned during the pressing motion. Starting and stopping the pressing motion may result in a cracked bearing.

2. Reassemble the OUTBOARD side of the pump first:

a. For a CLOCKWISE rotation pump, position the pump cylinder with the INTAKE port to the left.

b. For a COUNTERCLOCKWISE rotation pump, position the pump cylinder with the INTAKE port to the right.

3. Apply a small amount of quality O-ring lubricant on a new head O-ring (72), and install in the groove on the inside face of the outboard head (23).

4. For clockwise (right-hand) rotation, place the outboard head (23) on the cylinder with the V-notch upward, in the 12 o'clock position. For counterclockwise (left-hand) rotation, place the outboard head (23) on the cylinder with the V-notch downward, in the 6 o'clock position.

5. Install the head capscrews (21) and uniformly tighten, torquing to 15 lbs ft (20.3 Nm).

6. Install a new bearing cover O-ring (26) and attach the bearing cover (27) to the outboard head. Install and uniformly tighten the bearing cover capscrews (28) to 11 lbs ft (15 Nm).

7. Turn the pump cylinder around and begin assembly on the opposite, Inboard end.

8. Remove the vanes and push rods from the rotor and shaft assembly and inspect for wear or damage. Replace as follows:

Figure 5 - Bearing Location
**MAINTENANCE**

a. Insert the vanes (14) into the bottom rotor slots with the rounded edges facing outward, and the relief grooves facing in the direction of rotation. (Refer to Figure 3.)

b. Hold the vanes in place while inserting the push rods (77) from the top, as shown in Figure 6.

c. While holding the vanes in place, carefully slide the non-driven end (shorter end) of the pump shaft into the open end of the pump cylinder and into the installed outboard head.

d. Install the remaining vanes into the top slots of the rotor with the relief grooves facing in the direction of rotation and the rounded edges outward.

![Figure 6 - Push Rod Installation*](image)

*1½ and 2 - inch models use four vanes and two push rods.

9. Install the inboard head (20) as instructed previously in steps 3 through 6.

**10. PACKING AND PACKING FOLLOWER**

When necessary to re-pack, use a full set of new packing rings. Packing is furnished in sets with the correct number of rings. Never add new rings to an old set of packing.

a. Insert the pack washer (58) into the stuffing box of the inboard head (20).

b. Insert each of the packing rings (19) separately into the stuffing box, staggering the split joints 180 degrees, so that they are not overlapping or near the joint of the preceding ring. Use the packing follower to properly seat each ring after placement.

c. After all of the packing rings are in place, slide the packing follower (75) against the packing. Install and hand-tighten the stud nuts (18) evenly.

**NOTE:** Adjustment to the packing follower should be made after the running the pump for 10 to 15 minutes (see "Packing Adjustment").

**11. PACKING ADJUSTMENT**

It is important that the packing be properly adjusted to prevent overheating.

a. While the liquid is being pumped, check for leakage from the stuffing box. If necessary, **STOP** the pump and uniformly tighten the packing follower stud nuts (18) 1/4 turn at a time to reduce leakage.

![WARNING](image)

**FAIL URE TO STOP THE PUMP BEFORE ADJUSTING THE SHAFT PACKING CAN CAUSE SEVERE PERSONAL INJURY.**

b. Restart the pump and check the stuffing box temperature several minutes after each adjustment for signs of overheating.

c. Repeat steps a and b until leakage is controlled, and no excess heat develops.

d. Check the packing again after 20 to 30 minutes of running the pump, and readjust, if necessary.

**NOTE:** Some leakage is desirable to lubricate the packing, but in some cases it is unacceptable, depending on the application. A commercial mechanical seal should be used for applications requiring minimal shaft leakage.

**12. OPTIONAL LIP SEAL ASSEMBLY**

a. Insert the wave spring (152D) into the stuffing box of the inboard head.

b. Lightly grease the inboard shaft to facilitate lip seal installation. With the lip seal spring facing the pump, slide the lip seal assembly (152) into the stuffing box, against the wave spring.

c. Install the seal follower (75) against the lip seal assembly. Install and tighten the follower capscrews (16).

**NOTE:** When installed properly, lip seals should require no adjustment.

**13. COMMERCIAL MECHANICAL SEAL**

On pumps equipped with a commercial mechanical seal, refer to the separate literature accompanying the mechanical seal for installation instructions.
## PUMP TROUBLESHOOTING

### NOTICE:
MAINTENANCE SHALL BE PERFORMED BY QUALIFIED TECHNICIANS ONLY, FOLLOWING THE APPROPRIATE PROCEDURES AND WARNINGS AS PRESENTED IN THIS MANUAL.

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
</tr>
</thead>
</table>
| **Pump Not Priming** | 1. Pump not wetted.  
2. Suction valve closed.  
3. Air leaks in the suction line.  
4. Strainer clogged.  
5. Suction line or valves clogged or too restrictive.  
6. Wrong rotation on motor.  
7. Broken drive train.  
10. Worn Vanes. |
| **Reduced Capacity** | 1. Suction valves not fully open.  
2. Air leaks in the suction line.  
3. Excessive restriction in the suction line (i.e.: undersized piping, too many elbows & fittings, clogged strainer, etc.).  
4. Damaged or worn parts.  
5. Excessive restriction in discharge line causing partial flow through the relief valve.  
6. Relief Valve worn, set too low, or not seating properly.  
7. Vanes installed incorrectly (see "Vane Replacement"). |
| **Noise**            | 1. Excessive vacuum on the pump due to:  
a. Undersized or restricted fittings in the suction line.  
b. Pump speed too fast for the viscosity or volatility of the liquid.  
c. Pump too far from fluid source.  
2. Running the pump for extended periods with a closed discharge line.  
3. Misalignment of the pump.  
4. Baseplate not securely mounted.  
5. Sleeve Bearings worn or damaged.  
6. Vibration from improperly anchored piping.  
7. Bent shaft, or drive coupling misaligned.  
8. Excessively worn rotor.  
9. Malfunctioning valve in the system.  
10. Insufficient oil in the gear reducer.  
11. Damaged vanes (see following category). |
| **Damaged Vanes**    | 1. Foreign objects entering the pump.  
2. Running the pump dry for extended periods of time.  
3. Cavitation.  
4. Viscosity too high for the vanes and/or the pump speed.  
5. Incompatibility with the liquids pumped.  
7. Worn or bent push rods, or worn push rod holes.  
8. Settled or solidified material in the pump at start-up.  
10. Vanes installed incorrectly (see "Vane Replacement"). |

*Troubleshooting continued on following page*
## PUMP TROUBLESHOOTING

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Broken Shaft</strong></td>
<td>1. Foreign objects entering the pump.</td>
</tr>
<tr>
<td></td>
<td>2. Viscosity too high for the pump speed.</td>
</tr>
<tr>
<td></td>
<td>3. Relief valve not opening.</td>
</tr>
<tr>
<td></td>
<td>5. Pump/driver misalignment.</td>
</tr>
<tr>
<td></td>
<td>6. Overtightened V-belts, if equipped.</td>
</tr>
<tr>
<td></td>
<td>7. Excessively worn vanes or vane slots.</td>
</tr>
<tr>
<td></td>
<td>8. Settled or solidified material in the pump at start-up.</td>
</tr>
<tr>
<td><strong>Overload on Motor</strong></td>
<td>1. Horsepower of motor not sufficient for application.</td>
</tr>
<tr>
<td></td>
<td>2. Improper wire size or wiring.</td>
</tr>
<tr>
<td></td>
<td>3. Misalignment.</td>
</tr>
<tr>
<td></td>
<td>4. Excessive viscosity, pressure or speed.</td>
</tr>
<tr>
<td></td>
<td>5. Faulty or worn sleeve bearings.</td>
</tr>
<tr>
<td></td>
<td>6. Rotor rubbing into head.</td>
</tr>
<tr>
<td></td>
<td>7. Excessively tight packing (see &quot;Packing Adjustment&quot;).</td>
</tr>
<tr>
<td></td>
<td>8. Unevenly tightened stud nuts, causing shaft interference with packing follower.</td>
</tr>
<tr>
<td><strong>Mechanical Seal Leakage</strong></td>
<td>1. Seal Rings/O-rings not compatible with the liquids pumped.</td>
</tr>
<tr>
<td><em>(if equipped)</em></td>
<td>2. Seal Rings/O-rings nicked, cut or twisted.</td>
</tr>
<tr>
<td></td>
<td>3. Shaft at seal area damaged, worn or dirty.</td>
</tr>
<tr>
<td></td>
<td>4. Excessive cavitation.</td>
</tr>
<tr>
<td></td>
<td>5. Mechanical seal faces cracked, scratched, pitted or dirty.</td>
</tr>
<tr>
<td></td>
<td>6. Pump sleeve bearings worn excessively.</td>
</tr>
</tbody>
</table>

**NOTE:** Consult commercial mechanical seal manufacturer for more information on mechanical seal troubleshooting.