

# BLACKMER LIQUEFIED GAS PUMPS

INSTALLATION OPERATION AND MAINTENANCE INSTRUCTIONS

**MODELS: LGL156C, LGL158C**

**and Discontinued LGL154C**

960437

INSTRUCTIONS NO. 501-K00

Section	501
Effective	Jan 2019
Replaces	Jun 2016

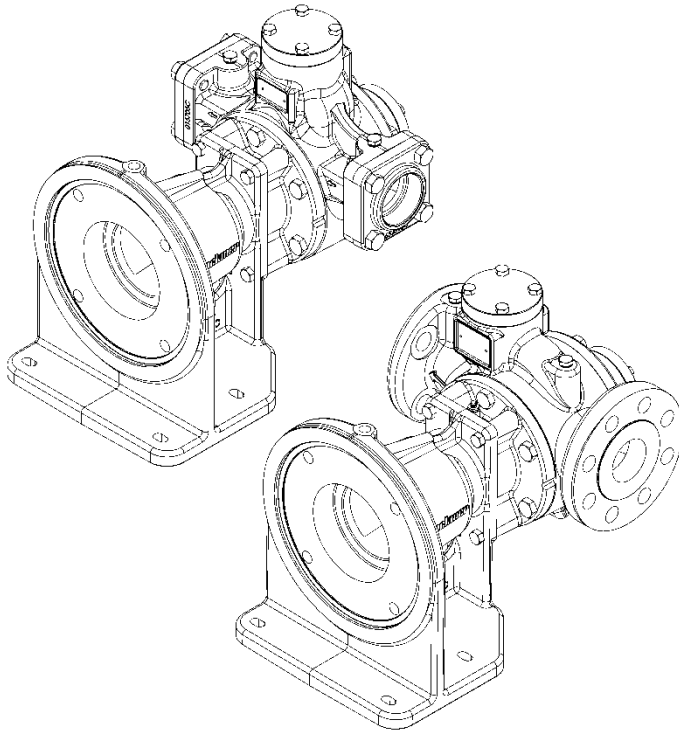


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## SAFETY DATA



**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



Warns of hazards that **WILL** cause serious personal injury, death or major property damage.



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



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

**NOTICE:**

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

**NOTICE:**

Blackmer liquefied gas 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 liquefied gas pumps, and **MUST** be kept with the pump.

Blackmer liquefied gas 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 liquefied gas pumps.


Maintain **ALL** system and Blackmer liquefied gas pump operation and hazard warning decals.

**NOTE:** Numbers in parentheses following individual parts indicate reference numbers on Blackmer Parts List 501-K01.

Blackmer pump manuals and parts lists may be obtained from Blackmer's website ([www.blackmer.com](http://www.blackmer.com)) or by contacting Blackmer Customer Service.

## SAFETY DATA


**⚠WARNING**



**Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death**

Hazardous machinery can cause serious personal injury.


**⚠WARNING**



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

Hazardous voltage. Can shock, burn or cause death.


**⚠WARNING**



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

Hazardous pressure can cause serious personal injury or property damage


**⚠WARNING**



**Failure to relieve system pressure prior to performing pump service can cause serious personal injury or property damage. Systems with meters will still be pressurized even after the hose is emptied**

Hazardous pressure can cause serious personal injury or property damage


**⚠WARNING**



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

Hazardous or toxic fluids can cause serious injury.

**⚠WARNING**



**Operation without guards in place can cause serious personal injury, major property damage, or death.**

Do not operate without guard in place

## PUMP DATA

### PUMP IDENTIFICATION

A pump Identification tag, containing the pump serial number, I.D. number, and model designation, is attached to each pump. It is recommended that the data from this tag be recorded and filed for future reference. If replacement parts are needed, or if information pertaining to the pump is required, this data must be furnished to a Blackmer representative.

#### TECHNICAL DATA

Maximum Pump Speed	1750 RPM
Maximum Operating Temperature	240°F (115°C)
Maximum Differential Pressure	LGL158: 200 PSI (13.8 Bar) LGL156: 160 PSI (11.0 Bar) LGL154: 140 PSI (9.6 Bar)
Maximum Working Pressure	425 PSI (29.3 Bar)

- Technical Data is for standard materials of construction. Consult Blackmer Material Specs for optional materials of construction.
- These pumps are listed by Underwriters' Laboratories' Laboratories for liquefied petroleum gas (LPG) service

#### INITIAL PUMP START UP INFORMATION

<b>Model No.:</b> _____
<b>Serial No.:</b> _____
<b>ID No.:</b> _____
<b>Date of Installation:</b> _____
<b>Inlet Gauge Reading:</b> _____
<b>Discharge Gauge Reading:</b> _____
<b>Flow Rate:</b> _____

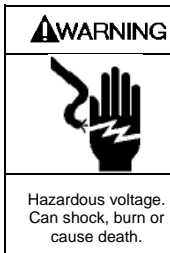
# INSTALLATION

## NOTICE:

Blackmer 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.

## NOTICE:

This pump shall be installed in accordance with the requirements of NFPA 58 all applicable local, state and national regulations.



- ▲ 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 complete specifications

▲ Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.

## PRE-INSTALLATION CLEANING

### NOTICE:

New pumps contain residual test fluid and rust inhibitor. If necessary, flush pump prior to use.

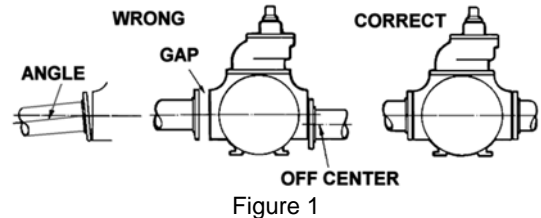
Foreign matter entering the pump WILL cause extensive damage. The supply tank and intake piping MUST be cleaned and flushed prior to pump installation and operation.

## LOCATION AND PIPING

Pump life and performance will be significantly reduced when installed in an improperly designed system. Before starting the layout and installation of the piping system, review the following suggestions:

1. Locate the pump as near as possible to the source of supply to avoid excessive inlet pipe friction.
2. The inlet piping and fittings should be at least as large as the intake port on the pump. It should slope downward to the pump, and should not contain any upward loops. Minimize the number of intake line fittings and eliminate restrictions such as sharp bends; globe valves, unnecessary elbows, and undersized strainers.
3. A strainer must be installed in the inlet line to protect the pump from foreign matter. The strainer should be located at least 24" (0.6m) from the pump, and have a net open area of at least four times the area of the intake piping. Strainers must be cleaned regularly to avoid pump starvation. (Strainers are optional when pumping from underground tanks.)
4. The intake and discharge piping system must be free of all leaks.
5. Expansion joints, placed at least 36" (0.9m) from the pump, will compensate for expansion and contraction of the pipes. Contact the flexible connector/hose manufacturer for required maintenance/care and design assistance in their use.

6. ALL piping and fittings **MUST** be properly supported to prevent any piping loads from being placed on the pump.
7. Check alignment of pipes to pump to avoid strains which might later cause misalignment. See Figure 1. Unbolt flanges or break union joints. Pipes should not spring away or drop down. After pump has been in operation for a week or two, completely recheck alignment.



8. Install pressure gauges in the NPT ports provided in the pump casing to check pump performance at start up.
9. The use of a 1.5" or 2" vapor return line will speed delivery by preventing pressure build up at the receiving tank and pressure reduction in the supply tank.
10. Keeping the liquefied gas systems full of liquid, even when idle, will keep the O-rings from changing shape, shrinking or super cooling. Evaporation of liquefied gas leaves an abrasive powder on the surface which can cause wear to the pump, meter, and seals.

## PUMP MOUNTING

Permanently mount the unit by securing the base plate with adequately sized anchor bolts to a level concrete floor following recommended industry standards (See Figure 2). 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.

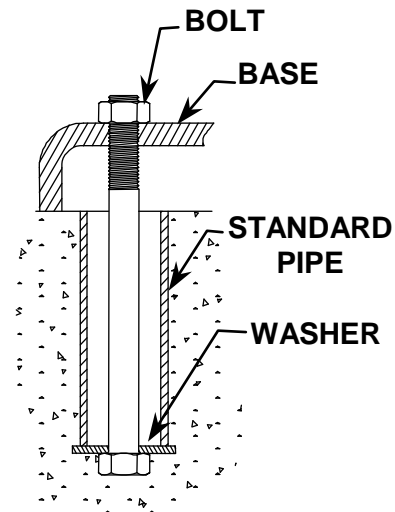
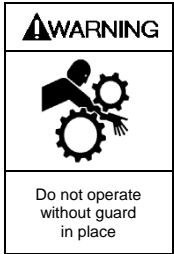


Figure 2. Foundation Anchor

When installing units built on channel or structural steel type bases, use care to avoid twisting the base out of shape when anchor bolts are tightened. Shims should be used under the edges of the base prior to tightening of the anchor bolts to prevent distortion.

# INSTALLATION

## COUPLING ALIGNMENT



Operation without guards in place can cause serious personal injury, major property damage, or death.

The pump must be directly coupled to a gear reducer and/or driver with a flexible coupling. Verify coupling alignment after installation of new or rebuilt pumps. Both angular and parallel coupling alignment **MUST** be maintained between the pump, gear, motor, etc. in accordance with manufacturer's instructions. See Figure 3.

1. Parallel alignment: The use of a laser alignment tool or dial indicator is preferred. If a laser alignment tool or dial indicator is not available, use a straightedge. Turn both shafts by hand, checking the reading through one complete revolution. Maximum offset should be less than .0005" (0.127 mm).
2. Angular alignment: Insert a feeler gauge between the coupling halves. Check the spacing at 90° increments around the coupling (four checkpoints). Maximum variation should not exceed 0.005" (0.127 mm). Some laser alignment tools will check angular alignment as well.
3. Replace the coupling guards after setting alignment.

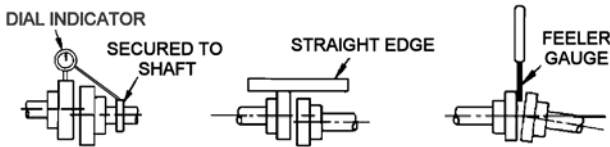


Figure 3 – Coupling Alignment  
Figure 3 – Alignment Check

## INTERNAL PUMP RELIEF VALVE AND EXTERNAL BYPASS 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.

For ALL liquefied gas applications, install an external bypass valve, and any necessary piping, back to the storage tank. External Bypass Valves are integral to the performance and operation of liquefied gas pumps and are included in the boundary / jurisdiction of the pump (Refer to Form 589). DO NOT pipe the bypass valve back to the intake line.

The setting on the external bypass valve should be at least 25 PSI (1.7 bar) lower than the internal pump relief valve setting. The valve and piping must be of adequate size to accommodate the full flow from the pump when the discharge line is closed.

The non-adjustable pump internal relief valve is factory set at approximately 225 PSI (15.5 bar).

A Blackmer Model BV bypass valve can be mounted as shown in Figure 4 for bulk plant installation. Refer to

Blackmer Bypass Valve Installation and Maintenance Instructions for bypass valve settings and adjustments.

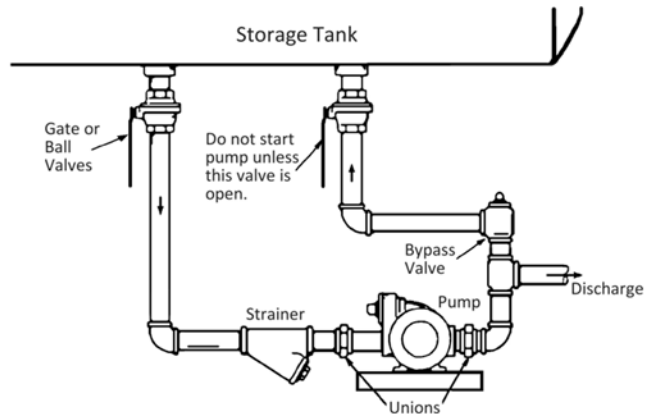


Figure 4. Bypass Valve Installation

## CHECK VALVES

The use of check valves or foot valves in the supply tank is not recommended with self-priming, positive displacement pumps.

If the possibility of liquid backflow exists when the pump is off, a check valve in the pump discharge piping is recommended because the pump can motor in the reverse rotation and create undue stress on all attached components. Never start a pump when it is rotating in the reverse rotation as the added starting torque can damage the pump and related equipment.

## PUMP ROTATION

When viewed from the driven end:

a **right-hand** pump (clockwise rotation) will have the intake flange on the right side.

a **left-hand** pump (counter-clockwise rotation) will have the intake flange on the left side.

### NOTICE:

Confirm correct pump rotation by checking the pump flow / rotation arrows respective to pump driver rotation.

## TO REVERSE PUMP ROTATION

To reverse rotation, the pump must be disassembled then reassembled with the shaft on the opposite side of the pump. See the 'Maintenance' section for instructions.

# INSTALLATION

## GUIDE TO UNDERGROUND TANK APPLICATIONS

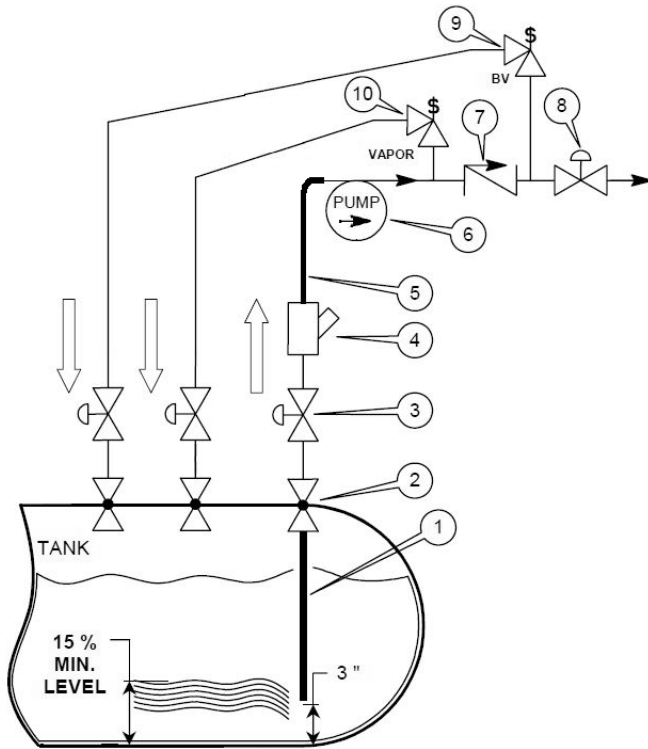


Fig. 5 – Underground Tank Schematic

No.	Description	LGL150 Series Pumps
1	Dip Tube	2"
2	Excess Flow Valve	Fisher F190, Rego A2137A, or equivalent
3	Control Valve - Full Flow Ball	2"
4	Strainer (Optional)	2"
5	Inlet Piping	2"
6	Pump Speeds	1150, 1450, & 1750 RPM
7	Back Check Valve	Fisher G200-16, Rego A7794 (sight glass) or equivalent
8	Control Valve - Full Flow Ball	1.5"
9	Bypass Valve	BV1.5"
10	Priming Valve	Fisher F138* or equivalent
11	Minimum Tank Size	2,000 Gal (7570 liters)

\* Blackmer PN: 455750

When pumping from an underground tank, the change in elevation from the fluid level in the tank to the inlet of the pump will cause significant vaporization of the fluid in the inlet piping. For this reason alone, it is impossible to prevent vaporization at the inlet of the pump for an underground tank installation. However, there are many things that can be done to minimize these effects. Refer to figure 5. See Bulletin 500-002 "Underground Tank Application Guide" for more detailed information.

For an underground tank installation, the piping between the pump and the tank is filled with vapor when the pump is at rest. This vapor must be removed before the pump can prime. Reducing the amount of vapor during startup and operation will greatly enhance the pump's performance.

### Inlet Piping Length

Keep the inlet piping as short as possible. Install the pump directly over the tank and as close to the ground as possible.

### Minimize the Number of Fittings

Every fitting, valve, and piece of straight piping causes a pressure drop and adds to the startup vapor volume. Use a minimum number of fittings on the inlet side of the pump. Eliminate all possible elbows in the inlet piping by moving the pump so that they will not be necessary. Size the inlet piping per the table.

### Strainers (4)

Suction strainers should not normally be used on underground tank installations. The end of the dip tube should be placed 2 – 3" (5 – 8 cm) above the bottom of the tank. In applications with known high levels of contaminants, install a strainer that is one or two sizes larger than the pump.

### Vapor Priming Valve (10)

Install a vapor priming (excess flow) valve on the discharge side of the pump, between the soft seat back check valve and the pump. Refer to figures 5 and 6. The vapor excess flow valve provides a path to return the vapors to the tank during startup. When liquid flow is established, the vapor excess flow valve will close. When piping the return line from the vapor excess flow valve to the tank, ensure that there are no low spots where liquid can collect. Pipe the vapor return line to the vapor space in the tank, NOT to the liquid space of the tank or to the inlet of the pump.

### Soft Seat Back Check Valve (7)

Install a soft seat back check valve on the discharge side of the pump as close as possible. A swing valve is preferred. Refer to figure 6.

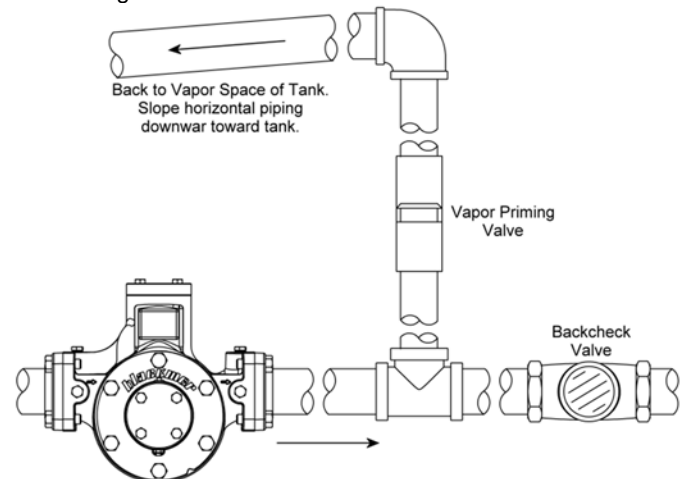
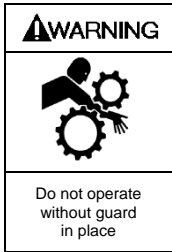
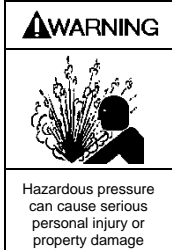


Fig. 6 – Vapor Priming Valve and Back Check Valve

# OPERATION



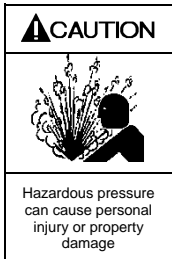
Operation without guards in place can cause serious personal injury, major property damage, or death.



Failure to relieve system pressure prior to performing pump service can cause serious personal injury or property damage. Systems with meters will still be pressurized even after the hose is emptied



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



Pumps operating against a closed valve can cause system failure, personal injury and property damage

## START UP PROCEDURES

### NOTICE

Consult the "Troubleshooting" section of this manual if difficulties during start up are experienced.

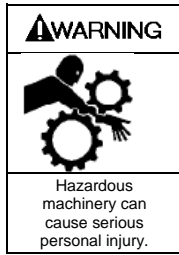
1. Start the motor. Priming should occur within one minute.
2. Check the pressure gauges to ensure the system is operating within expected parameters. Record the gauge readings in the "Initial Start Up Information" section of this manual for future reference.
3. Inspect piping, fittings, and associated 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. Close the discharge valve and check the differential pressure across the pump. It should not exceed the pressure setting of the external bypass valve.
6. With the discharge valve still closed, momentarily close the manual shut-off valve in the bypass return line to check the pump relief valve. The pressure should be at least 25 PSI (1.7 bar) higher than the maximum system operating pressure or the system pressure control valve setting.
7. The external bypass valve must always be set at least 25 PSI (1.7 bar) lower than the internal pump relief valve.

**NOTE** - The normal operating pressure should be at least 5 - 15 PSI (0.3 -1.0 bar) less than the external bypass setting. Pump speeds which result in higher pressures (nearing the valve setting) forces the liquid to be recirculated, creating excessive wear on the pump and equipment.

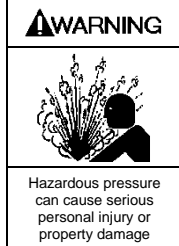
## PRE-START UP CHECK LIST

1. Inspect complete piping system and supports to ensure that no piping loads are being placed on the pump.
2. Verify proper coupling alignment.
3. Install pressure gauges in the 1/4" NPT intake and discharge ports located on the pump casing to check pump performance after start-up.
4. Ensure all valves and fittings in piping system are in the start-up or operating positions.
5. Jog the pump motor to verify proper pump rotation. If rotation is incorrect, reverse rotation of motor.

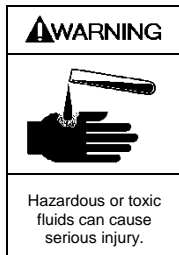
# MAINTENANCE



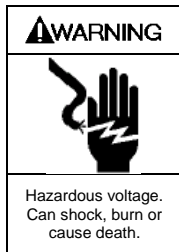
Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death



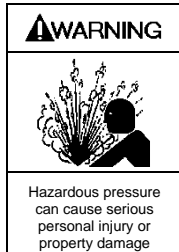
Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury or property damage.



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



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



Failure to relieve system pressure prior to performing pump service can cause serious personal injury or property damage. Systems with meters will still be pressurized even after the hose is emptied

## NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

**Torque Table 1**

Head / Casing Capscrews (21)	Ft-lbs	30
	N-m	40.7
Relief Valve Cover Capscrews	Ft-lbs	20
	N-m	27
Bearing Cap Capscrews (28)	Ft-lbs	20
	N-m	27

## STRAINERS

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

## LUBRICATION

### NOTICE:

To avoid possible entanglement in moving parts do not lubricate pump bearings, hydraulic adapter coupling or any other parts while pump is running

### NOTICE:

If pumps are repainted in the field, ensure that the grease relief fittings (76A) are functioning properly after painting. Do NOT paint them closed. Remove any excess paint from the fittings.

Pump bearings and hydraulic motor couplings (if equipped) must be lubricated every three months at a minimum. More frequent lubrication may be required, depending on the application and the operating conditions.

### Recommended Grease:

Mobil® - Mobilgrease XHP222,  
Exxon® - Ronnex MP Grease  
or equivalent Lithium grease.

### Greasing Procedure:

1. Remove the grease relief fittings (76A) from the bearing covers (27) or hydraulic motor adapter (135).
2. SLOWLY apply grease with a hand gun until grease begins to escape from the grease relief fitting port. Discard excess grease in accordance with the proper codes and regulations.
3. Replace the grease relief fittings (76A).

DO NOT over grease pump bearings. While it is normal for some grease to escape from the grease tell-tale hole after lubrication, excessive grease can cause mechanical seal failure. The tell-tale hole is located in the head (20) between the bearing (24) and the mechanical seal (153).

# MAINTENANCE

## VANE REPLACEMENT

### NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

1. Drain and relieve pressure from the pump and system as required.
2. Remove the head assembly from the outboard (non-driven) side of the pump according to steps 1 through 6 in the "Pump Disassembly" section of this manual.
3. Turn the shaft by hand until a vane (14) comes to the bottom (6 o'clock) position of the rotor. Remove the vane.
4. Install a new vane (14), ensuring that the rounded edge is DOWN, and the relief grooves are facing towards the discharge port. See Figure 7.
5. Repeat steps 3 and 4 until all vanes have been replaced.
6. Reassemble the pump according to the "Pump Assembly." section of this manual.

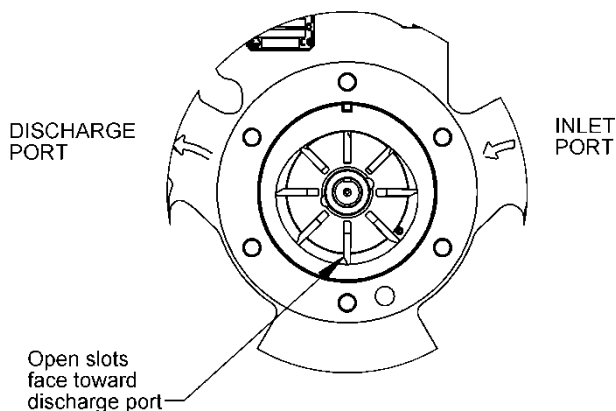


Figure 7. Vane Installation

## PUMP DISASSEMBLY

### NOTICE:

Follow all hazard warnings and instructions provided in the "Pump Maintenance" section of this manual.

1. Drain and relieve pressure from the pump and system as required.
2. Remove the outboard head capscrews (21) and slide the outboard head (23) off the shaft. The bearing (24), grease seal (104A), mechanical seal stationary seat and stationary O-ring (153A & 153D) will come off with the head assembly.
3. To disassemble the outboard head:
  - a. Remove the bearing cover capscrews (28), bearing cover (27A) and shims (26) from the outboard head.
  - b. Evenly tap bearing outer race with a soft-faced drift punch to remove the mechanical seal stationary seat (153A), grease seal (104A), and bearing outer race.

4. Carefully pull the rotating seal assembly, consisting of seal jacket (153C), rotating seal face and rotating O-ring (153B & 153E) from the shaft. Remove and discard the rotating O-ring (153E).
5. Carefully remove the disc (71).
6. Clean inboard end of pump shaft thoroughly, making sure the shaft is free of nicks and burrs. This will prevent damage to the mechanical seal and grease seals when the rotor and shaft assembly is removed.
7. Pull the rotor and shaft assembly (13) from the casing (12). While one hand is pulling the shaft, the other hand should be cupped underneath the rotor to prevent the vanes (14) from falling out.
8. Remove vanes (14) and inboard rotating mechanical seal parts from rotor and shaft assembly.
9. Remove the head capscrews (21) and inboard head (20) from casing (12). The bearing (24), grease seal (104A), mechanical seal stationary seat and stationary O-ring (153A & 153D) will come off with the head assembly.
10. To remove the mechanical seal stationary seat (153A), grease seal (104A), bearing outer race, and bearing spring, evenly tap bearing outer race with a soft-faced drift punch.
11. Carefully remove the disc (71).
12. If necessary, remove the liner (41) by tapping around the outside diameter of the liner with a hard wood block and a hammer until it is driven from the casing (12).
13. Remove liner key (74).

## PARTS REPLACEMENT

1. Any O-rings removed or disturbed during disassembly must be replaced with new O-rings.
2. Excessive or continuous leakage from the tell-tale hole in the bearing cover may be an indication of a damaged mechanical seal. If a mechanical seal has been leaking, it is recommended the entire seal be replaced. Refer to "Troubleshooting" for possible causes of seal leakage.



# MAINTENANCE

## 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. Remove any burrs from the liner. Note the arrows cast into the casing to identify the intake and discharge ports.

1. Install liner key (74) in casing (12).
2. Align the liner (41) keyway with the key (74) in the pump casing (12) and start the liner into the casing. The word "INTAKE" cast on the liner must face the intake port of the pump casing.
3. Uniformly tap the outer edge of the liner with a rubber mallet to fully insert into the casing.
4. **Reassemble the INBOARD (driven) side of the pump first.**

For a right-hand (clockwise) rotation pump, position the pump case with the intake flange to the right.

For a left-hand (counterclockwise) rotation pump, position the pump case with the intake flange to the left.

5. Place the inboard disc (71) against the liner (41) on the inboard side of pump with the seal cavity outward and disc relief hole located as shown in Figure 8.

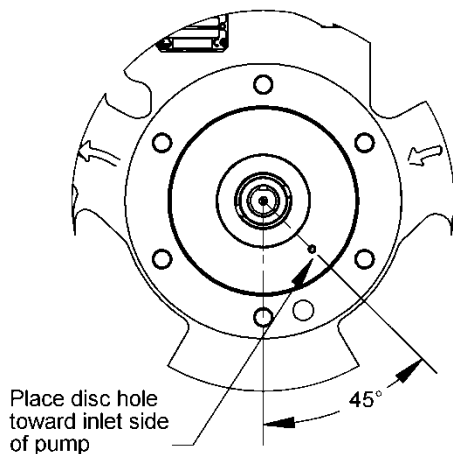


Figure 8. Disc Installation

6. Apply a light coat of grease to the grease seal journal in the inboard head (20).
7. Install new small grease seal (104) into inboard head (20). Flat side of grease seal must face outside of head, with spring and lip side facing inside of head.
8. Install bearing spring (24C) in inboard head (20).
9. Install outer race of bearing (24) into bearing pocket in inboard head (20).
10. Install grease seal (104A) into bearing pocket of head with open side toward bearing and flat side facing outward. Gently push or tap the grease seal until flat face of grease seal is about 1/8" (4 mm) past the larger diameter flat face in head. Refer to Figure 9.

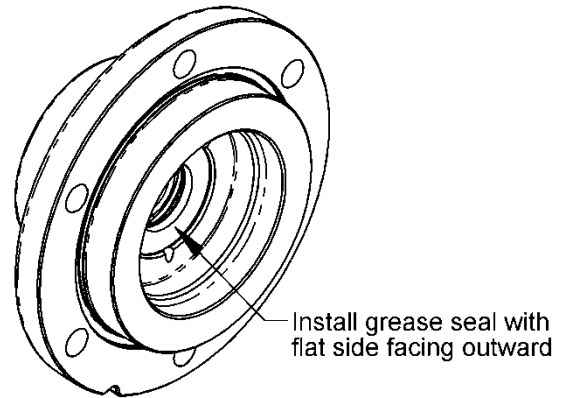


Figure 9. Grease Seal Installation

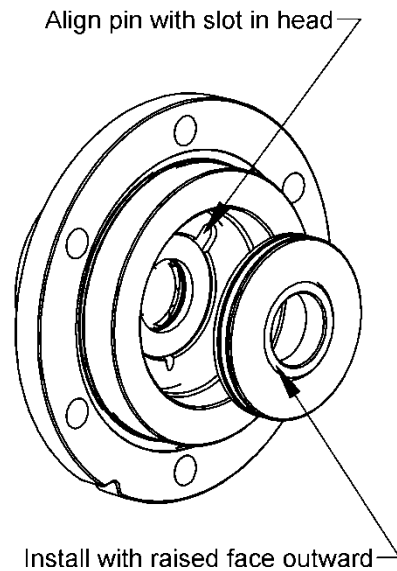


Figure 10. Stationary Seat Installation

11. Place new stationary seat O-ring (153D) in groove of stationary seat (153A).
12. Lubricate the stationary seat journal in the inboard head (20) with a light coating of grease.
13. Align stationary seat (153A) into inboard head (20) with raised face outward and location pin on opposite side aligned with the anti-rotation slot in the head. Refer to Figure 10.
14. Gently push stationary seat into head. Be careful not to nick the raised face on the stationary seat. Clean the polished face with a clean tissue and alcohol.
15. Without installing the head O-ring (72) or rotating mechanical seal components, temporarily attach the inboard head (20) to the casing (12). Install and hand-tighten two head capscrews (21), 180 degrees apart.
16. Grease the inboard end of the shaft of the rotor and shaft assembly (13).
17. Gently slide rotor and shaft assembly (13) into the casing (12) and through the grease seals (104 & 104A) and bearing (24) in the inboard head (20).

# MAINTENANCE

18. Turn the shaft by hand until a vane slot is at the bottom (6 o'clock) position of the rotor.
19. Install a new vane (14), ensuring that the rounded edge is DOWN, and the relief grooves are facing towards the discharge port. See Figure 7. Repeat for all eight vanes.
20. Install disc (71) on the outboard side of the pump with the seal cavity facing outward and the disc relief hole towards the inlet side. Refer to Figure 8.
21. If used, install seal spacer ring (159) on shaft with outward tangs of spacer ring engaged with drive holes in rotor.
22. Slide the seal jacket assembly (153C) over the shaft and into the disc cavity with the drive tangs of the jacket towards the rotor. Rotate the jacket assembly to engage the drive tangs in the rotor slots.
23. Apply a small amount of grease to the shaft and the inner ring of the bearing (24).
24. Install a new rotating O-ring (153E) in the rotating seal face (153B). With the raised face outward, gently push the seal face and O-ring over the bearing inner race and onto the shaft.
25. Align the notches of the seal face (153B) with the tangs on the seal jacket assembly (153C). Clean the polished face with a clean tissue and alcohol.
26. Install outer race of bearing (24), grease seal (104A) and stationary seat (153A) into outboard head according to steps 8 and 10 above.
27. Install new head O-ring (72) into O-ring groove in outboard head (23).
28. Apply a small amount of grease to the shaft and the inner ring of the bearing (24).
29. Carefully install the outboard head assembly (23) over the shaft. Do not contact the end of the shaft with the polished face of the stationary seat. Center the head on the pump casing (12). Install and uniformly tighten all six head capscrews (21) and torque per Torque Table 1.
30. Turn the pump casing around and remove the inboard head (20) previously installed.
31. Install the mechanical seal (153), O ring (72), and inboard head (20) as instructed in steps 21 through 29.
32. Install bearing cap (27) in outboard head (23) without capscrews. Press bearing cap into head by hand. Measure gap between bearing cap (27) and outboard head surface. Refer to Figure 11.

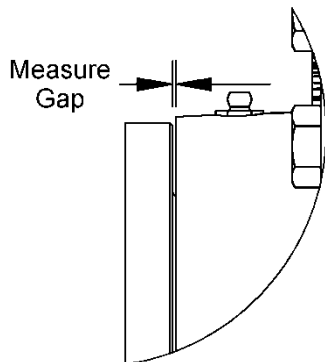
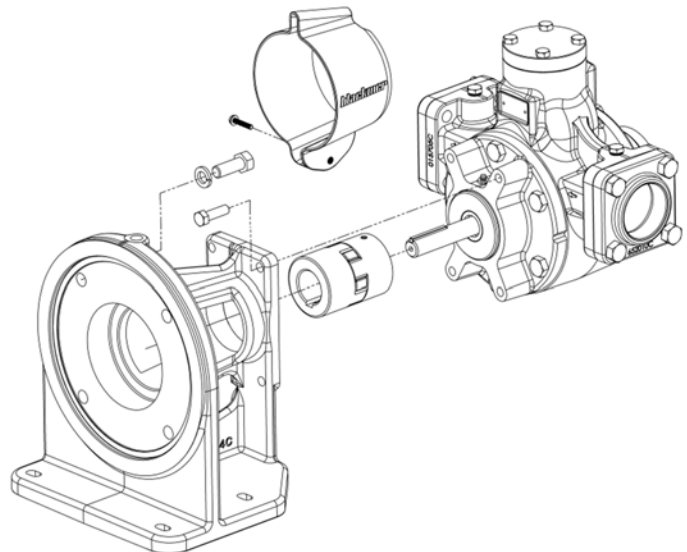


Figure 11. Bearing Cap Installation

33. Remove bearing cap and install shims (26) with total thickness equal to measurement of gap between bearing cap and head. Reinstall bearing cap, and torque the capscrews (28) per Torque Table 1.
34. Rotate the shaft by hand to test for binding. If the rotor does not turn freely, remove bearing cap (27) and install another 0.005" shim between bearing cap and head. Check for free rotation of rotor and shaft. Repeat this procedure, adding more shims until rotor spins freely.
35. Mount the motor adaptor to the inboard head with the four mounting bolts (28A) as shown in the figure below.

## 36. RELIEF VALVE ASSEMBLY

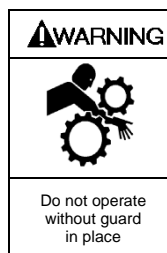
- a. Insert the valve (9) into the relief valve bore of the



casing with the fluted end inward.

- b. Install the relief valve spring (8) against the valve.
- c. Attach a new relief valve O-ring (10) and the valve cover (4) on the casing. Torque the capscrews (28) per Torque Table 1.

37. Reinstall coupling, shaft key, and coupling guards.



**Operation without guards in place can cause serious personal injury, major property damage, or death.**

38. Refer to "Pre-Start Up Check List" and "Start Up Procedures" sections of this manual prior to restarting pump operation.

# TROUBLESHOOTING

## NOTICE:

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

SYMPTOM	PROBABLE CAUSE
<b>Pump Not Priming</b>	<ol style="list-style-type: none"> <li>1. Pump not wetted.</li> <li>2. Worn vanes.</li> <li>3. Internal control valve closed.</li> <li>4. Strainer clogged.</li> <li>5. Inlet line or valves clogged or too restrictive.</li> <li>6. Pump vapor-locked.</li> <li>7. Pump speed too low for priming.</li> <li>8. Relief valve partially open, worn or not seating properly.</li> </ol>
<b>Reduced Capacity</b>	<ol style="list-style-type: none"> <li>1. Pump speed too low.</li> <li>2. Internal control valve not fully open.</li> <li>3. Excessive inlet line restrictions (undersized piping, too many elbows &amp; fittings, clogged strainer, etc.).</li> <li>4. Damaged or worn parts (vanes, cylinder, or rotor).</li> <li>5. Excessive restriction in discharge line causing partial flow through the relief valve.</li> <li>6. Relief Valve worn, set too low, or not seating properly.</li> <li>7. External Bypass Valve set too low.</li> <li>8. Operating without a vapor return line.</li> <li>9. Vanes installed incorrectly (see "Vane Replacement").</li> <li>10. Liner installed backwards.</li> </ol>
<b>Noise</b>	<ol style="list-style-type: none"> <li>1. Excessive pressure drop on the pump due to:               <ol style="list-style-type: none"> <li>a. Undersized or restricted fittings in the inlet line.</li> <li>b. Pump speed too fast.</li> <li>c. Pump too far from fluid source.</li> </ol> </li> <li>2. Running the pump for extended periods with a closed discharge line.</li> <li>3. Pump not securely mounted.</li> <li>4. Improper drive line – truck mounted pumps (See "Pump Drive").</li> <li>5. Misalignment of pump, reducer, or motor - base mounted pumps.</li> <li>6. Bearings worn or damaged.</li> <li>7. Vibration from improperly anchored piping.</li> <li>8. Bent shaft, or drive coupling misaligned.</li> <li>9. Excessively worn rotor.</li> <li>10. Malfunctioning valve in the system.</li> <li>11. Relief valve setting too low.</li> <li>12. Liner installed backwards.</li> <li>13. Damaged vanes (see following category).</li> </ol>
<b>Damaged Vanes</b>	<ol style="list-style-type: none"> <li>1. Foreign objects entering the pump.</li> <li>2. Running the pump dry for extended periods of time.</li> <li>3. Cavitation.</li> <li>4. Excessive heat.</li> <li>5. Hydraulic hammer - pressure spikes.</li> <li>6. Vanes installed incorrectly (see "Vane Replacement").</li> <li>7. Incompatibility with the liquids pumped.</li> </ol>
<b>Broken Shaft</b>	<ol style="list-style-type: none"> <li>1. Foreign objects entering the pump.</li> <li>2. Relief valve not opening.</li> <li>3. Hydraulic hammer - pressure spikes.</li> <li>4. Pump/driver, driveline/drive shaft misalignment.</li> <li>5. Excessively worn vanes or vane slots.</li> </ol>
<b>Mechanical Seal Leakage</b>	<ol style="list-style-type: none"> <li>1. O-rings not compatible with the liquids pumped.</li> <li>2. O-rings nicked, cut or twisted.</li> <li>3. Shaft at seal area damaged, worn or dirty.</li> <li>4. Bearings over-greased.</li> <li>5. Excessive cavitation.</li> <li>6. Mechanical seal faces cracked, scratched, pitted or dirty.</li> </ol>
<b>Overload on Motor</b>	<ol style="list-style-type: none"> <li>1. Motor Horsepower not sufficient for application.</li> <li>2. Improper wiring and/or low voltage to motor.</li> <li>3. Misalignment</li> <li>4. Excessive pressure or speed.</li> <li>5. Faulty or worn bearings.</li> <li>6. Rotor rubbing against discs or liner.</li> <li>7. Dirty mechanical seal faces.</li> </ol>



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1809 Century Avenue, Grand Rapids, Michigan 49503-1530 U.S.A.  
Telephone: (616) 241-1611 • Fax: (616) 241-3752  
E-mail: [blackmer@blackmer.com](mailto:blackmer@blackmer.com) • Internet Address: [www.blackmer.com](http://www.blackmer.com)