

BLACKMER LIQUEFIED GAS PUMPS FOR CO2 SERVICE TRUCK AND BASE MOUNTED

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

MODELS: CRL4A

Discontinued Model: CRL4, TCRL4 & TCRLF4A

962009

INSTRUCTIONS NO. 701-C00

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Section 700

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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.

▲ DANGER

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

▲ WARNING

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

▲ CAUTION

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 CO₂ 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 CO₂ pumps, and MUST be kept with the pump.

Blackmer CO₂ 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 CO₂ pumps.

Maintain ALL system and Blackmer CO₂ pump operation and hazard warning decals.

▲ WARNING



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.

NOTE: Numbers in parentheses following individual parts indicate reference numbers on the corresponding Blackmer Parts List.

SAFETY DATA


▲WARNING



Hazardous machinery can cause severe personal injury or property damage.

FAILURE TO SET THE VEHICLE EMERGENCY BRAKE AND CHOCK WHEELS BEFORE PERFORMING SERVICE CAN CAUSE SEVERE PERSONAL INJURY OR PROPERTY DAMAGE.


▲WARNING



Hazardous voltage. Can shock, burn or cause death.

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.

IF PUMPING HAZARDOUS FLUIDS SYSTEM MUST BE FLUSHED PRIOR TO PERFORMING SERVICE.


▲WARNING



Hazardous machinery can cause serious personal injury.

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


▲WARNING



Hazardous pressure can cause personal injury or property damage.

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

▲CAUTION



Hazardous pressure can cause personal injury or property damage.

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

PUMP DATA

TECHNICAL DATA

Model Designations:	
Motor Drive & Truck Mount	CRL4A
Discontinued	TCRL4, TCRLF4A
Torque Required @ 100 psi (6.9 bar)	205 lbs ft (278 Nm)
Maximum Temperature	240°F (115°C)
Minimum Temperature	-30°F (-34°C)
Maximum Pump Speed	640 RPM
Maximum Differential Pressure	100 psi (6.9 bar)
Maximum Working Pressure (Inlet Pressure + Differential Pressure)	525 psi (36.2 bar)

INITIAL START UP INFORMATION

Model No. _____

Serial No. _____

I.D. No. _____

Date of Installation: _____

Discharge Gauge Reading: _____

Inlet Gauge Reading: _____

Flow Rate: _____

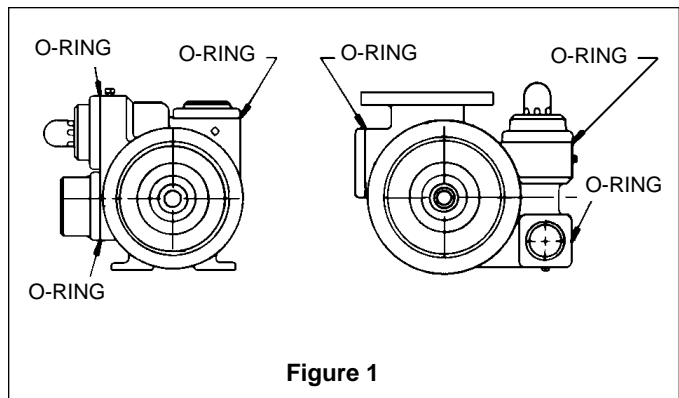
PUMP WITH WELDED CONNECTIONS

NOTICE:

FOR PIPING CONNECTIONS REQUIRING WELDING THE PUMP'S NON-METALLIC O-RINGS MUST BE REMOVED PRIOR TO WELDING. FAILURE TO DO SO WILL DAMAGE THE O-RINGS.

Before welding the piping, remove the O-rings from under the inlet flange, outlet flange and relief valve cover as indicated in Figure 1.

Reinstall the inlet and outlet flanges. Weld the piping to the the inlet and outlet flanges. After the welding is complete, reinstall the O-rings.



INSTALLATION AND OPERATION

CRL BASE MOUNTED MOTOR DRIVEN PUMPS

NOTICE:

BLACKMER CO2 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 CONTAINS SOME RESIDUAL TEST FLUID AND RUST INHIBITOR. IF NECESSARY, FLUSH PUMP PRIOR TO USE.

⚠️ WARNING



Hazardous voltage. Can shock, burn or cause death.

- ⚠️ 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.**

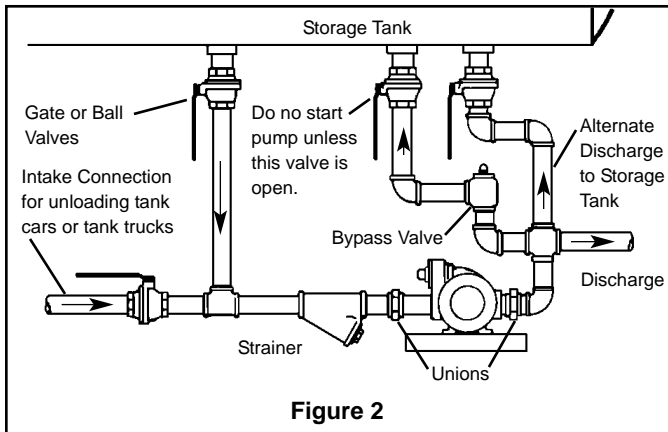


Figure 2

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. See Figure 2.

1. To minimize intake losses, locate the pump as close as possible to the source of supply and a minimum of two feet (0.6 m) below the tank outlet.
2. Intake piping and fittings **MUST** be at least as large in diameter as the pump intake connection. Inlet piping must be insulated.
3. Use high strength Schedule "80" piping.
4. Minimize the number of intake line fittings (valves, elbows, etc.) and piping turns or bends. The nearest fitting on the intake line must be at least 6 inches (152 mm) from the pump to permit access to the pump relief valve .
5. Install an intake strainer 5 - 10 pipe diameters from the pump intake. The strainer must have a net open area of at

least four times the area of the intake pipe. Strainers must be cleaned regularly to avoid pump starvation.

6. Intake and discharge piping **MUST** be free of all leaks.
7. To facilitate piping expansion and contraction, expansion joints must be placed 3 feet (0.9 m) from the pump intake and discharge.
8. ALL piping and fittings **MUST** be properly supported to prevent any piping loads from being placed on the pump.
9. Install pressure gauges in the NPT ports provided in the pump casing to check pump performance at start up.
10. The use a vapor return line will speed up delivery by preventing back pressure from building up at the receiving tank and reducing pressure in the supply tank.
11. 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 3). 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.

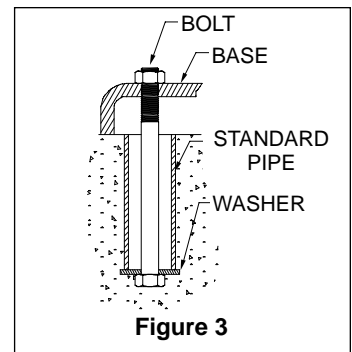


Figure 3

COUPLING ALIGNMENT

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

Both angular and parallel coupling alignment **MUST** be maintained between the pump, gear reducer, motor, etc. in accordance with manufacturer's instructions. See Figure 4.

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 must be less than .005" (125 microns).
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 must not exceed .005" (125 microns).

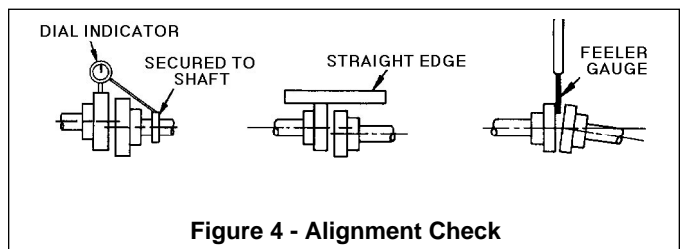


Figure 4 - Alignment Check

INSTALLATION AND OPERATION

CRL BASE MOUNTED MOTOR DRIVEN PUMPS

V-BELT DRIVE

Blackmer also offers V-belt drive for CRL pumps. For installation of Blackmer V-belt units, first mount the pump and the motor base to the unit base. Do not fully tighten the motor mounting bolts until properly installing and adjusting the belts as follows:

1. Wipe the cone surface of the pump QD hub (152A) and the inside of the pump sheave hub with a clean cloth moistened with a light grade of machine oil. This will allow for a more uniform draw and prevent the cone surfaces from "freezing" before being tightened.
2. With the shaft key (35) in place, align the key seat and slide the QD hub (152A) on the shaft, flange end first. Slide the large end of the sheave bore over the taper on the QD hub. Insert the three sheave capscrews (152C) through the clearance holes in the sheave, and start them into the tapped holes of the QD hub (152A). Repeat this procedure to assemble the motor QD hub (152E) and sheave (152D).
3. To install the belts (181), shorten the center distance of the drive by moving the motor towards the pump, until the belts can be put on the sheaves (152 & 152D) without forcing.
4. Align the sheaves so that the faces are parallel, then snug up the sheave capscrews (152C & 152G).
5. Measure the span length as shown in Figure 5.

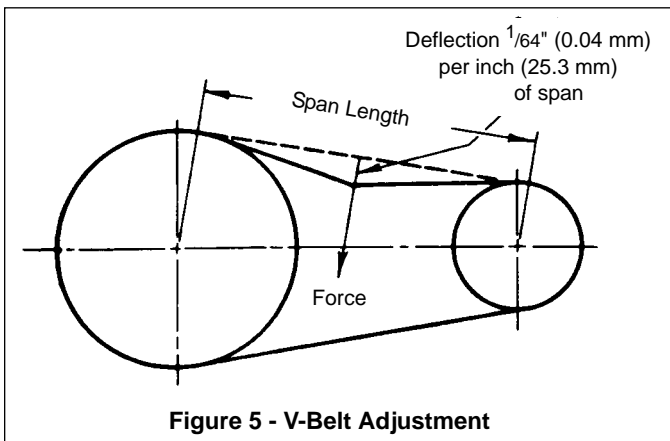


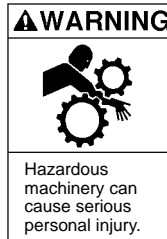
Figure 5 - V-Belt Adjustment

6. Adjust the motor base (183) and apply a specified force (refer to Table 1) against the belt, at the center of the span, so that the belt is deflected $\frac{1}{64}$ inch (0.04 mm) for every inch (25.3 mm) of span. For example, the deflection of a 20 inch span (508 mm) would be $\frac{20}{64}$ or $\frac{5}{16}$ inch (7.9 mm). The force required must be within the range given in Table 1 for a properly tensioned drive. Initially tension a new set of belts to the upper limit.

SMALL SHEAVE OUTSIDE DIAMETER	BELT DEFLECTION FORCE	
	Minimum	Maximum
2.5" to 4.5" (63.5 mm to 114.3 mm)	3.0 lbs. (1.4 kgs.)	4.75 lbs. (2.2 kgs.)
4.75" to 7.0" (120.7 mm to 177.8 mm)	4.0 lbs. (1.8 kgs.)	6.0 lbs. (2.7 kgs.)

Table 1 - Deflection Force Per Belt

7. Check again to ensure the sheaves (152 & 152D) are parallel, then tighten the sheave capscrews (152C & 152G), the motor mounting nuts (184) and the adjusting screw locknut (183B).
8. Assemble the belt guard (182) and the belt guard brace (182A) to the unit base (32).



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

9. Check the belt tension after 24-48 hours of operating. Recheck the tension periodically and tighten the belts as required. DO NOT overtighten belts. Inspect belts periodically for signs of excessive wear, and replace as required.

V-BELT DISASSEMBLY

1. Remove the belt guard (182) and the guard base (182A).
2. Loosen the adjusting screw locknut (183B) on the motor base (183) and the motor mounting nuts (184).
3. Ease the tension on the belts (181) by moving the motor towards the pump to shorten the center distance of the drive. Remove the belts by sliding them over the sheaves (152D or 152E). DO NOT force the belts over the grooves.
4. To remove the sheave from the hub, first remove the three sheave capscrews (152C & 152G). Then screw two of the capscrews into the threaded holes in the sheave hub (152A or 152E). If the cone grip is hard to break loose, tap the end of the shaft or the QD hub with soft-faced mallet while maintaining pressure on the screw.
5. Carefully and smoothly slide the QD hub off the shaft. If it is tight on the shaft, gently pry it loose with a screwdriver or a small wedge placed in the split part of the flange.

Refer to Blackmer Parts List and Instructions 786/C14 for V-belt drive and guard part numbers.

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. DO NOT pipe the bypass valve back to the intake line. The setting on the external bypass valve must be at least 25 psi (1.7 bar) lower than the internal pump relief valve setting.

INSTALLATION AND OPERATION

CRL BASE MOUNTED MOTOR DRIVEN PUMPS

The bypass valve and piping must be of adequate size to accommodate the full flow from the pump when the discharge line is closed. Shut off valves and couplings must be provided on both sides of the pump and bypass valve for removal and servicing. The pump internal relief valve is factory set at approximately 125 psi (8.6 bar).

Refer to Blackmer Bypass Valve Installation and Maintenance Instructions for bypass valve installation, setting and adjustment procedures.

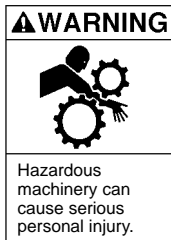
PUMP ROTATION

NOTICE:

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

TO CHANGE PUMP ROTATION

Blackmer **CRL4A** motor driven pump models are equipped with a double ended rotor and shaft, enabling them to be driven from either shaft end. To change rotation, rotate the pump 180 degrees so the opposite shaft becomes the driven shaft. The shaft protector (186) **MUST** be mounted over the non-driven shaft end.



OPERATION WITHOUT SHAFT PROTECTOR IN PLACE CAN CAUSE SERIOUS PERSONAL INJURY, PROPERTY DAMAGE, OR DEATH.

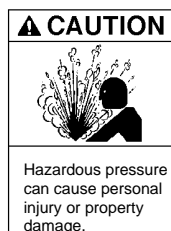
PRE-START UP CHECK LIST

1. Inspect complete piping system and supports to ensure that no piping loads are being placed on the pump.
2. Install pressure gauges in the 1/4" NPT intake and discharge ports located on the pump casing to check pump performance after start-up.
3. Build pressure in the pump by **SLOWLY** cracking the valve in the discharge line. When the internal pump pressure equals tank pressure, check for system leaks.
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.

START UP PROCEDURES

NOTICE:

CONSULT THE "GENERAL PUMP TROUBLESHOOTING" SECTION OF THIS MANUAL IF DIFFICULTIES DURING START UP ARE EXPERIENCED.

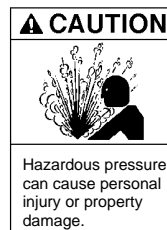


OPERATING PUMP AGAINST A CLOSED VALVE CAN CAUSE SYSTEM COMPONENT FAILURE, PERSONAL INJURY AND PROPERTY DAMAGE.

1. Start the motor.
2. If priming does not occur, shut off the pump and close the pump discharge. Open the bleed valve on the pump discharge gauge hole until "snow" appears at the exhaust. Close the bleed valve, open the discharge line and start the pump. Repeat if necessary.
3. 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.
4. Inspect piping, fittings, and associated system equipment for leaks, noise, vibration and overheating.
5. 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 for future reference.
6. Close the discharge valve and check the differential pressure across the pump. It must not exceed the pressure setting of the external bypass valve.
7. 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 must be at least 25 psi (0.7 - 1.4 bar) higher than the operating pressure or the system pressure control valve setting. Refer to "Relief Valve Setting and Adjustment" section of this manual.
8. The external bypass valve must always be set at least 25 psi (1.7 bar) lower than the pump internal relief valve. **NOTE:** The normal operating pressure must 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.

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.



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

Relief Valve Adjustment Procedure:

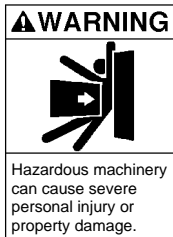
1. **To INCREASE the pressure setting**, remove the relief valve cap (1), loosen the locknut (3), and turn the adjusting screw (2) inward, or **CLOCKWISE**.
2. **To DECREASE the pressure setting**, remove the relief valve cap (1), loosen the locknut (3), and turn the adjusting screw (2) outward, or **COUNTERCLOCKWISE**.

Refer to corresponding Blackmer pump Parts List for relief valve spring pressure ranges.

INSTALLATION AND OPERATION - CRL TRUCK MOUNTED PUMPS

NOTICE:

BLACKMER CO2 TRUCK 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.



FAILURE TO SET THE VEHICLE EMERGENCY BRAKE AND CHOCK WHEELS BEFORE PERFORMING SERVICE CAN CAUSE SEVERE PERSONAL INJURY OR PROPERTY DAMAGE.

TRUCK MOUNTING

CRL pump models can be bolted to the truck frame or on a saddle hung below the frame, and **MUST** be adequately supported.

Discontinued **TCRLF4A** pump models are designed to flange mount directly to bob tail or transport tank in combination with a commercial internal control valve. See Figure 6.

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. When locating the pump on the tank, safety must be the first consideration. Other considerations include length of drive line, accessibility for maintenance and convenience of connections. See Figure 6.
2. The discharge hose and fittings must be large enough to minimize the pressure drop in the system. The lower the friction loss, the higher the flow rate.
3. Use a 1½" or 2" vapor return line for all transport loading and unloading. Without a vapor return line, back pressure will build up in the receiving tank and pressure will be reduced in the supply tank, resulting in reduced flow rate and fluid bypassing.
4. 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.

AUXILIARY INLET - DISCONTINUED TCRLF4A PUMP MODELS

The auxiliary inlet port can be used as a fill connection for bottom loading of the tank by stationary pumps at the terminal or bulk plant. It can also be used as an auxiliary pump inlet, allowing the pump to unload another tank in an emergency. To minimize vapor formation, the auxiliary intake line must be as large in diameter as the intake connection and as short as possible. The line must be connected through a suitable strainer, minimum 40 mesh. Reduce pump speed to a maximum 400 RPM when using the auxiliary inlet to reduce cavitation.

PUMP DRIVE

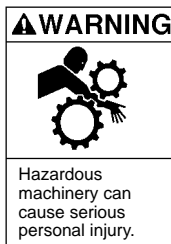
The pump may be driven by a power take-off through universal joints. When using universal joints, a splined slip joint, properly lubricated, must be used on the connecting jack shaft to prevent end thrust on the pump shaft.

It is very important to install a proper drive line to avoid excessive wear, vibration and noise (see Fig. 6 and Table 2).

General guidelines to follow for proper pump drive:

1. Do not use square slip joints.
2. Use the least number of jack shafts as is practical.
3. Use an even number of universal joints.
4. The pump shaft and power take-off shaft must be parallel in all respects. Use an angular level measuring device to ensure the PTO and pump shaft are parallel to each other. The PTO shaft coming off at the transmission does not need to be perfectly horizontal as long as the pump shaft is parallel in all respects to the PTO shaft.
5. The yokes of the universals at both ends of the jack shaft must be parallel and in phase.
6. The maximum recommended angle between the jack shaft and the pump shaft is 15 degrees. Refer to Table 2.

Failure to follow any of these guidelines may result in a gallop or uneven turning of the pump rotor, which will in turn cause a surging vibration to the liquid stream and piping system. Contact the supplier of the drive line components for specific design assistance.



A DRIVE SHAFT GUARD BETWEEN THE PTO AND PUMP MUST BE PROVIDED TO PREVENT PERSONAL INJURY, PROPERTY DAMAGE, OR DEATH.

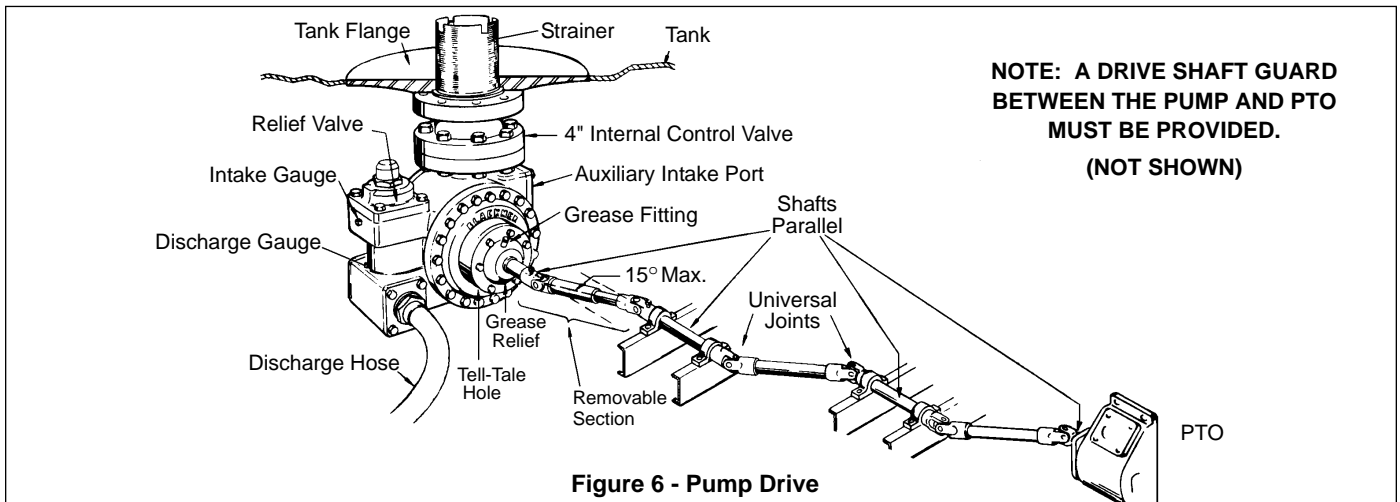
Angle of Drive Shaft		
1° through 5°	6° through 10°	11° through 15°
Very Good	Good	Fair

Table 2

HYDRAULIC DRIVE

CRL pumps may also be driven hydraulically. Hydraulic motors must be well supported with their shafts parallel to the pump shaft in all respects. Blackmer provides an optional close-coupled hydraulic motor adapter. The adapter provides for straight alignment of a hydraulic motor drive through a solid coupling connected to a straight key pump shaft. This coupling connection requires grease lubrication every three months at **minimum**. Refer to the "Lubrication" section of this manual.

INSTALLATION AND OPERATION - CRL TRUCK MOUNTED PUMPS



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 tank. DO NOT pipe the bypass valve back to the intake line. The setting on the external bypass valve must 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 pump internal relief valve is factory set at approximately 125 psi (8.6 bar).

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

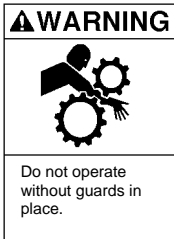
PUMP ROTATION

NOTICE:

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

TO CHANGE PUMP ROTATION

Blackmer CRL4A and discontinued TCRLF4A pump models are equipped with a double ended rotor and shaft, enabling them to be driven from either shaft end. To change rotation, rotate the pump 180 degrees so that the opposite shaft becomes the driven shaft. Mount the shaft protector (186) over the non-driven shaft end.



OPERATION WITHOUT SHAFT PROTECTOR IN PLACE CAN CAUSE SERIOUS PERSONAL INJURY, PROPERTY DAMAGE, OR DEATH.

PRE-START UP CHECK LIST

1. Install pressure gauges in the 1/4" NPT ports located on the pump casing. These can be used to check the actual inlet and discharge conditions after pump start-up.

2. Inspect complete piping system to ensure that no piping loads are being placed on the pump.
3. Connect the hose to the receiving tank.

START UP PROCEDURES

NOTICE:

CONSULT THE "GENERAL PUMP TROUBLESHOOTING" SECTION OF THIS MANUAL IF DIFFICULTIES DURING START UP ARE EXPERIENCED.

1. Open the shut-off valve in the bypass return line.
2. If the tank outlet valve is:
 - a. **Lever Operated** - Pull the control knob all the way out. Manually check the lever under the truck to see that it is in the completely OPEN position.
 - b. **Discharge Pressure Operated** - Keep the discharge line valve closed. When pump is started, it will build up enough pressure to open the tank outlet valve. NOTE: This type of valve usually requires approximately 20 psi (1.4 bar) differential pressure to open and approximately 15 psi (1.0 bar) differential pressure to keep it open. If the piping is quite large, it may be necessary to restrict the discharge line shut-off valve in order to maintain sufficient pressure to keep the tank outlet valve open.
3. Start the pump. Confirm proper pump rotation by checking the pump rotation arrows.
4. Check the pump speed. Pump speed must never exceed the recommended maximum. Refer to "Technical Data" section of this manual.
5. Check the pressure gauges and flowrate to ensure the system is operating within expected parameters. Record the gauge readings and flowrate in the "Initial Start Up Information" section of this manual for future reference.
6. Inspect piping, fittings, and associated system equipment for leaks, noise, vibration and overheating.
7. Close the discharge valve and check the differential pressure across the pump. It must not exceed the pressure setting of the external bypass valve.
8. 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 differential pressure will be approximately 100 psi (6.9 bar).

INSTALLATION AND OPERATION - CRL TRUCK MOUNTED PUMPS

10. 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 must be at least 5 - 15 psi (0.3 - 1.0 bar) less than the external bypass setting. Pump speeds which result in higher pressures (near the valve setting) forces the liquid to be recirculated, creating excessive wear on the pump and equipment.

▲WARNING



Hazardous pressure can cause personal injury or property damage.

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

RELIEF VALVE SETTING AND ADJUSTMENT

The pump internal relief valve factory pressure setting is marked on a metal tag attached to the valve cover. The relief valve must 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), loosen the locknut (3), and turn the adjusting screw (2) inward, or CLOCKWISE.
2. To **DECREASE** the pressure setting, remove the relief valve cap (1), loosen the locknut (3), and turn the adjusting screw (2) outward, or COUNTERCLOCKWISE.

PUMP SPEED

PTO and hydraulically driven units MUST contain speed control devices to prevent pump speeds above the maximum RPM specifications, regardless of the truck engine unloading speeds. Should fluid delivery be appreciably less than expected, see the "General Pump Troubleshooting" section.

MAINTENANCE

NOTICE:

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

▲WARNING



Hazardous voltage. Can shock, burn or cause death.

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

▲WARNING



Hazardous machinery can cause serious personal injury.

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

▲WARNING



Hazardous pressure can cause personal injury or property damage.

DO NOT ATTEMPT TO OPEN THE PUMP UNTIL YOU HAVE BLED OFF THE PRESSURE. ON SYSTEMS WITH METERS, THE DIFFERENTIAL VALVE WILL KEEP LIQUID UNDER PRESSURE IN THE PUMP, METER AND PIPING EVEN WHEN THE HOSE IS EMPTIED.

▲WARNING



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.

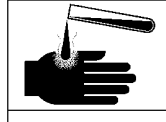
▲WARNING



Hazardous machinery can cause severe personal injury or property damage.

FAILURE TO SET THE VEHICLE EMERGENCY BRAKE AND CHOCK WHEELS BEFORE PERFORMING SERVICE CAN CAUSE SEVERE PERSONAL INJURY OR PROPERTY DAMAGE.

▲WARNING



Hazardous or toxic fluids can cause serious injury.

IF PUMPING HAZARDOUS FLUIDS SYSTEM MUST BE FLUSHED PRIOR TO PERFORMING SERVICE.

LUBRICATION

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

Recommended Grease:

Exxon® - RONNEX MP Grease;

Mobil® MOBILITH AW-2 (64353-6) 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 overgrease 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).

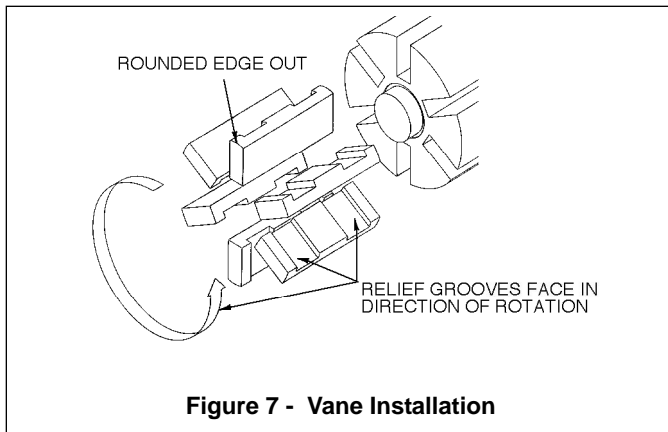
MAINTENANCE

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 4 - 7 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 (14), ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. 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.



PUMP DISASSEMBLY

NOTICE:

FOLLOW ALL HAZARD WARNINGS AND INSTRUCTIONS PROVIDED IN THE "MAINTENANCE" SECTION OF THIS MANUAL.

1. Drain and relieve pressure from 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 mechanical seal when the inboard head assembly is removed.
3. Remove the inboard bearing cover capscrews (28) and slide the inboard bearing cover (27) and gasket (26) off the shaft. Discard the bearing cover gasket.
4. Remove the outboard bearing cover capscrews (28) and slide the outboard bearing cover (27) and gasket (26) off the shaft. Discard the bearing cover gasket.
5. To remove locknuts and lockwashers (24A and 24B):
 - a. Bend up the engaged lockwasher tang and rotate the locknut (24A) counterclockwise to remove it from the shaft

- b. Slide the lockwasher (24B) off the shaft. Inspect the lockwasher for damage and replace as required.

- c. Repeat steps a and b on the opposite shaft end.

6. Remove the head capscrews (21) and carefully pry the head (20) away from the casing (12).
7. Slide the head (20) off the shaft. The head O-ring (72), disc (71), bearing (24), and mechanical seal (153) will come off with the head assembly. Remove and discard the head O-ring.
 - a. Remove the four disc machine screws and lockwashers (71A & 71B) to release the disc (71) from the head (20).
 - b. Carefully pull the rotating seal assembly, consisting of seal jacket (153C), rotating seal face and rotating O-ring (153B & 153E) from the head (20). Remove and discard the rotating O-ring.
 - c. Pull the bearing (24) from the housing in the head (20).
 - d. To remove the mechanical seal stationary seat (153A), use the blunt end of a screw driver to gently push the backside of the stationary seat from the head. Place a cloth under the seal to avoid damage. Be careful not to contact the polished face of the seal during removal. Remove and discard mechanical seal stationary O-ring.
8. Carefully pull the rotor and shaft (13) from the casing (12). While one hand is pulling the shaft, cup the other hand underneath the rotor to prevent the vanes (14) and push rods (77) from falling out. Carefully set the rotor and shaft (13) aside for future vane replacement and reassembly.

NOTICE:

THE ROTOR AND SHAFT WEIGHS APPROXIMATELY 69 POUNDS (31KG). BE CAREFUL NOT TO PINCH THE HAND UNDER THE ROTOR AND SHAFT WHEN REMOVING FROM THE CASING.

9. Lay the pump flat with the remaining head (20) facing upward to remove the head assembly, mechanical seal (153) and disc (71) from the outboard side of the pump, as instructed in steps 6 - 7 above.
10. If necessary, remove the liner (41) by tapping around the outside diameter of the liner with a hard wood drift and a hammer until it is driven from the casing (12).

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.

Reassemble the OUTBOARD side of the pump first:

1. Apply a small amount of grease to the liner key (74) to hold the key in place during liner installation. Install the liner key in groove of the liner before starting liner into pump casing (12).

MAINTENANCE

2. Align the liner key (74) with the pump casing keyway and start the liner (41) into the casing (12) with the slots in the liner towards the INTAKE port and the hole pattern in the liner towards the DISCHARGE port. Uniformly tap the outer edge of the liner with a rubber mallet to fully insert into the casing. **NOTE:** If the liner is installed backwards, it will restrict the port openings and cause noise and loss of capacity.

3. MECHANICAL SEAL INSTALLATION

Stationary Seat -

- a. Apply a small amount of lubricating oil in the seal recess of the head.
- b. Install a new stationary O-ring (153D) in the stationary seat (153A). Clean the polished face with a clean tissue and alcohol. Align the pin in the stationary seat with the slot in the head recess and push the seat fully into the seal recess with the polished face outward.

Rotating Assembly -

- a. Install a new rotating O-ring (153E) in the rotating seal face (153B). Clean the polished face with a clean tissue and alcohol. Place the polished face of the rotating seal against the face of the stationary seat in the head recess.
- b. Align the seal jacket assembly (153C) with the notches of the rotating face and install jacket with the drive tangs of the jacket outward.

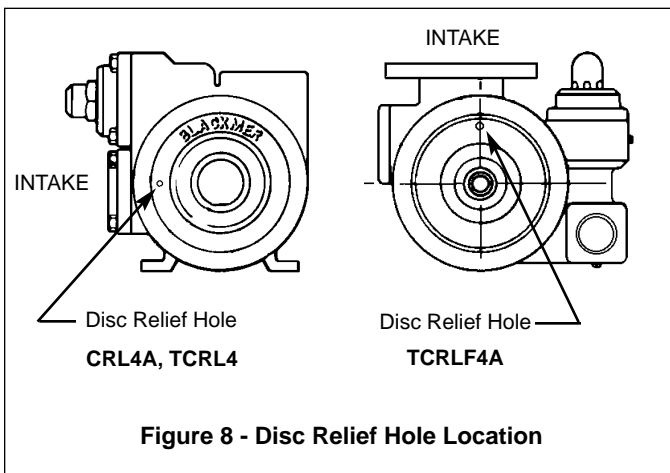


Figure 8 - Disc Relief Hole Location

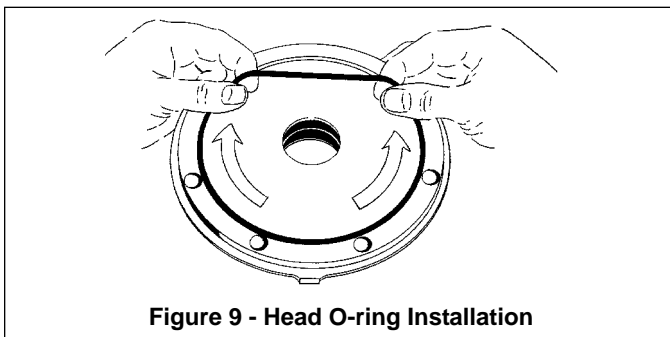


Figure 9 - Head O-ring Installation

4. Place the disc (71) against the head (20) with disc relief hole located so that when the head is mounted on the pump with the "Blackmer" name in an upright position, the relief hole will be at the pump intake, 9 o'clock position on CRL4 pump and 12 o'clock position on discontinued TCRLF4A pumps (see Figure 8). Install and tighten the disc machine screws and lockwashers (71A & 71B). The drive tangs of the seal jacket must protrude through the center hole of the disc.
5. Install a new head O-ring (72) in the groove on the inside face of the head (20). Lay the O-ring flat and start in on one side of the groove, stretching ahead with the fingers, as shown in Figure 9.
6. Carefully install the head assembly (20) on the pump casing (12). Rotate the head so that the drain hole, located at the back of the bearing cavity, faces downward when the pump is mounted for operation and the disc relief hole is located at the intake port. Install and uniformly tighten four head capscrews (21) 90° apart, torquing to 30 lbs ft (47 Nm).
7. Hand pack the ball bearing (24) with grease. Refer to the "Lubrication" section for the recommended grease.
8. Install the bearing (24) into the head recess. The bearing balls must face outward, with the grease shield inward. Ensure the bearing is fully and squarely seated in the head (20).
9. Turn the pump casing around to begin work on the opposite side of the pump.
10. Remove the vanes (14) and push rods (77) from the rotor and shaft assembly (13). Inspect for wear and damage, and replace as follows:
 - a. Apply a small amount of lubricating oil on the shaft between the shaft threads and the rotor.
 - b. Partially install the non-driven end of the rotor and shaft (13) into the open side of the pump casing (12).
 - c. Leave part of the rotor outside of the casing (12) so that the bottom vanes (14) can be installed and held in place as the push rods (77) are installed in the push rod holes of the rotor. Insert the new vanes into the rotor slots with the rounded edges outward, and the vane relief grooves facing TOWARDS the direction of rotation. Refer to Figure 7.
 - d. After the bottom vanes (14) and push rods (77) are installed, carefully insert the rotor and shaft (13) fully into the casing (12) and through the installed head (20).
 - e. Install the remaining vanes (14) into the top positions of the rotor.
 - f. Turn the shaft by hand to engage the seal drive tangs.
11. Install the inboard head with O-ring (72), mechanical seal (153), disc (71) and bearing (24) as instructed in steps 3 through 8.
12. Rotate the shaft by hand to engage the mechanical seal drive tangs, and to test for binding or tight spots. If the rotor does not turn freely, lightly tap the rims of the heads (20) with a soft faced mallet until the correct position is found. Install all of the remaining head capscrews (21) for each head (20) and uniformly torque to 30 lbs ft (47 Nm).

MAINTENANCE

13. LOCKNUT ADJUSTMENT

It is important that the bearing locknuts (24A) and lockwashers (24B) be installed and adjusted properly. Overtightening locknuts can cause bearing (24) failure or a broken lockwasher tang. Loose locknuts will allow the rotor to shift against the discs (71), causing wear. See Figure 10.

- On both ends of the pump shaft, install a lockwasher (24B) with the tangs facing outward, followed by a locknut (24A) with the tapered end inward. Ensure the inner tang "A" of the lockwasher is located in the slot in the shaft threads, bending it slightly, if necessary.
- Tighten both locknuts (24A) to ensure that the bearings (24) are bottomed in the head recess. **DO NOT** over-tighten and bend or shear the lockwasher inner tang.
- Loosen both locknuts (24A) one complete turn.
- Tighten one locknut (24A) until a slight rotor drag is felt when turning the shaft by hand.
- Back off the locknut (24A) the width of one lockwasher tang "B". Secure the locknut by bending the closest aligned lockwasher tang into the slot in the locknut. The pump must turn freely when rotated by hand.

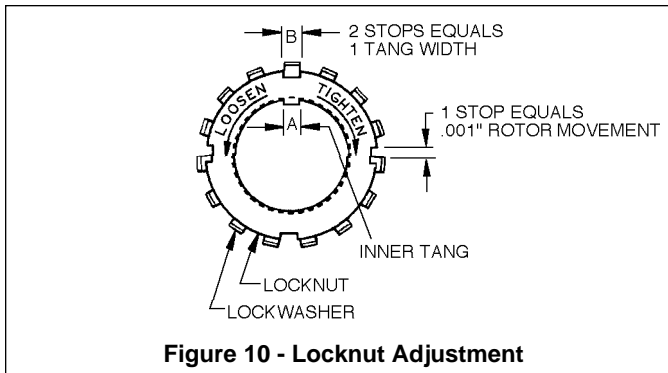
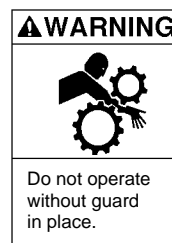


Figure 10 - Locknut Adjustment

- Tighten the opposite locknut (24A) by hand until it is snug against the bearing (24). Then, using a spanner wrench, tighten the nut the width of one lockwasher tang. Tighten just past the desired tang, then back off the nut to align the tang with the locknut slot. Secure the nut by bending the aligned lockwasher tang into the slot in the locknut. The pump must continue to turn freely when rotated by hand.
- To check adjustment, grasp the locknut (24A) and lockcollar (24B) with fingers and rotate back and forth. If this cannot be done, one or both locknuts are too tight and must be alternately loosened one stop at a time (.001" - 25 microns). Begin by loosening the locknut adjusted last.

- Inspect the grease seal (104) for wear or damage and replace as required. Grease the outside diameter of the grease seal and push it into the inboard bearing cover (27) with the lip of the seal inward.
- Attach a new bearing cover gasket (26) and the bearing cover (27) to the inboard head (20). Make sure the grease fittings (76) are accessible. Install and torque the bearing cover capscrews (28) to 30 lbs ft (47 Nm).
- Install the grease seal (104) in the outboard bearing cover (27) as instructed in step 14.
- Attach a new bearing cover gasket (26) and the outboard bearing cover (27) to the outboard head (20). Make sure the grease fittings (76) are accessible. Install and torque the bearing cover capscrews (28) to 30 lbs ft (47 Nm).
- Attach the shaft protector (186) to the non-driven shaft end.



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

GENERAL PUMP TROUBLESHOOTING

NOTICE:

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

SYMPTOM	PROBABLE CAUSE
Pump Not Priming	<ol style="list-style-type: none"> Pump not wetted. Worn vanes. Internal control or inlet valve closed. Strainer clogged. Inlet line or valves clogged or too restrictive. Broken drive train (truck mounted pumps). Pump vapor-locked. Pump speed too low for priming. Relief valve partially open, worn or not seating properly.

Pump Troubleshooting continued on back page.

GENERAL PUMP TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE
Reduced Capacity	<ol style="list-style-type: none"> 1. Pump speed too low. 2. Internal control valve and/or inlet control valves not fully open. 3. Excessive restriction in the inlet line (i.e.: undersized piping, too many elbows & fittings, clogged strainer, etc.). 4. Damaged or worn parts (vanes, discs, liner or rotor). 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. External Bypass Valve set too low. 8. Operating without a vapor return line. 9. Vanes installed incorrectly (see "Vane Replacement"). 10. Liner installed backwards
Noise	<ol style="list-style-type: none"> 1. Excessive pressure drop in inlet line due to: <ol style="list-style-type: none"> a. Undersized or restricted fittings in the inlet line. b. Pump speed too fast. c. Pump too far from fluid source. 2. Running the pump for extended periods with a closed discharge line. 3. Pump not securely mounted. 4. Improper drive line - truck mounted pumps (see "Pump Drive"). 5. Misalignment of pump, reducer or motor - base mounted pumps. 6. Bearings worn or damaged. 7. Vibration from improperly anchored piping. 8. Bent shaft, or drive coupling misaligned. 9. Excessively worn rotor. 10. Malfunctioning valve in the system. 11. Relief valve setting too low. 12. Liner installed backwards. 13. Damaged vanes (see following category).
Damaged Vanes	<ol style="list-style-type: none"> 1. Foreign objects entering the pump. 2. Running the pump dry for extended periods of time. 3. Cavitation. 4. Excessive heat. 5. Worn or bent push rods, or worn push rod holes. 6. Hydraulic hammer - pressure spikes. 7. Vanes installed incorrectly (see "Vane Replacement"). 8. Incompatibility with the liquids pumped.
Broken Shaft	<ol style="list-style-type: none"> 1. Foreign objects entering the pump. 2. Relief valve not opening. 3. Hydraulic hammer - pressure spikes. 4. Pump/driver, driveline/driveshaft misalignment. 5. Excessively worn vanes or vane slots.
Mechanical Seal Leakage	<ol style="list-style-type: none"> 1. O-rings not compatible with the liquids pumped. 2. O-rings nicked, cut or twisted. 3. Shaft at seal area damaged, worn or dirty. 4. Ball bearings overgreased. 5. Excessive cavitation. 6. Mechanical seal faces cracked, scratched, pitted or dirty.

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