

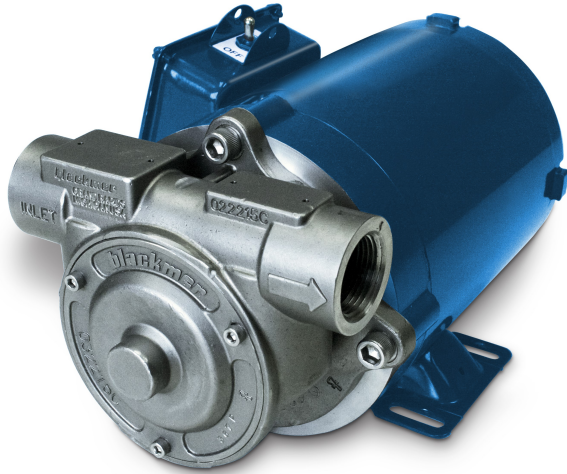
# BLACKMER POWER PUMPS

## INSTALLATION OPERATION AND MAINTENANCE INSTRUCTIONS MODEL: SX1B-DEF

961833

INSTRUCTIONS NO. 203-B00

Section	203
Effective	Nov 2021
Replaces	Jul 2017



### 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.

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### NOTICE:

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

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 pump.


Maintain **ALL** system and pump operation and hazard warning decals.

**NOTE:** Numbers in parentheses following individual parts indicate reference numbers on Blackmer Parts List No. 203-B01.

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**



Hazardous machinery can cause serious personal injury.

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

**⚠WARNING**



Hazardous or toxic fluids can cause serious injury.

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


**⚠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 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

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

## 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

	<b>SX1A-DEF</b>
<b>Maximum Pump Speed</b>	1750 RPM
<b>Maximum Viscosity</b>	50 SSU (7 cP)
<b>Maximum Operating Temperature *</b>	120°F (49°C)
<b>Maximum Differential Pressure</b>	25 psi (1.72 Bar)
<b>Maximum Working Pressure</b>	50 psi (3.44 Bar)
<b>Ports</b>	1" NPT
<b>Relief Valve</b>	Non-Adjustable 25 PSI (1.72 Bar)
<b>Electrical</b>	110 VAC 3 prong grounded plug. ON/OFF switch fitted to the motor. System must be protected by a 20A circuit breaker or fuse.
	12VDC wired to source (using 6AWG wire no longer than 20ft). System must be protected by a 30-40A slow blow fuse.

### 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> _____

\* Pump temperature limited by DEF liquid. Maximum DEF liquid temperature should be limited to 110°F (43°C).

# 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.



- ⚠️ 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

### NOTICE:

New pumps may contain residual deionized water used as test fluid. If necessary, flush pump with clean diesel exhaust fluid 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.

## 12V DC Wiring

The DC motor driven SX1 pump will pull 10-30A in normal operation depending on pump loading. If the pump locks up the current draw can spike to well over 100amps so a fuse should be used to prevent damage to electrical components. It is recommended that the motor be wired to a 12VDC source using 6AWG wire no longer than 20ft with a 30A-40A slow blow fuse (under 60 seconds at 200% of rating). Standard ring terminals are recommended to attach wires to the motor's terminals.

To wire up the motor follow these steps:

1. Remove the four screws holding the lid to the motor's terminal box
2. Remove nut and one washer from each terminal post
3. Run a wire through a grommet and attach the ring terminal to the threaded post
4. Place a washer above the ring terminal and then reinstall the nut
5. Repeat for other terminal post and wire
6. Reinstall the cover for the terminal box

## LOCATION AND PIPING

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

1. Locate the pump as near as possible to the source of supply to avoid excessive inlet pipe friction.
2. The inlet line **MUST** be at least as large as the intake port on the pump. The inlet piping should slope downward to the pump without any upward loops. Eliminate restrictions such as sharp bends; globe valves, unnecessary elbows, and undersized strainers.
3. It is recommended a strainer 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.
4. The intake and discharge piping system must be free of air 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. Install pressure gauges to check pump at start up.
7. ALL piping and fittings **MUST** be properly supported to prevent any piping loads from being placed on the pump.
8. 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.

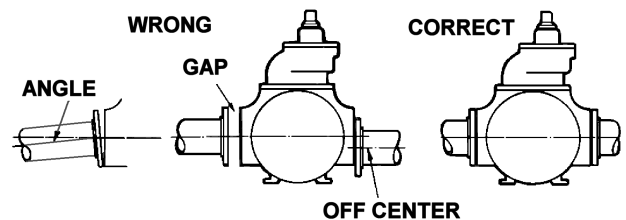


Figure 1

9. When pumping liquids at elevated temperature, provisions should be made to compensate for expansion and contraction of the pipes, especially when long pipe lines are necessary. Steel pipe expands approximately 3/4" (1.9 cm) per 100 feet (30.49 m) per 100°F (37.8°C) rise in temperature.

## PUMP MOUNTING

A solid foundation reduces noise and vibration, and will improve pump performance. Pump should be securely mounted using the motor feet to a rigid base.

**NOTE:** When installing the 12V SX1 into a mobile application take care to protect the pump from water exposure (rain, truck washing, etc.) by installing it within a protective enclosure.

## 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.

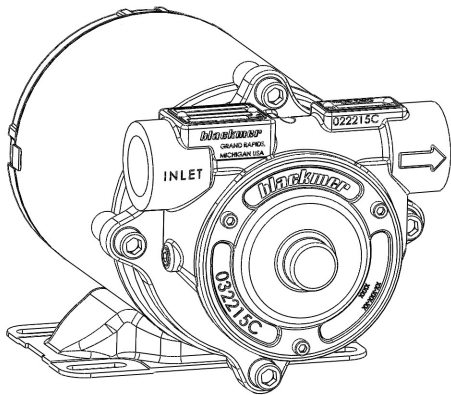


Figure 2 – Inlet and Discharge Port Locations

## PUMP ROTATION

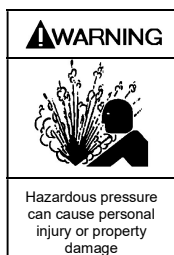
SX1 pumps are RIGHT HAND pumps ONLY, with CLOCKWISE rotation when viewed from the motor end.

When viewing the pump from the motor end, the pump intake port must be on the right, and the discharge port on the left.

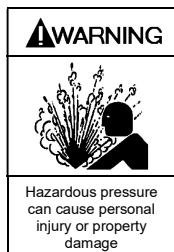
### NOTICE:

**Confirm correct pump rotation by checking the pump rotation arrows and flow direction respective to piping flow direction. Do not operate the pump in reverse rotation to reverse the direction of flow.**

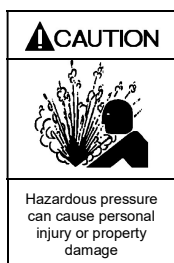
# OPERATION



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



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



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

## PRE-START UP CHECK LIST

### NOTICE:

1. Check the alignment of the pipes to the pump. Pipes should be supported so that they do not spring away or drop down when pump flanges or union joints are disconnected.
2. Check the entire pumping system to verify that the proper inlet and discharge valves are fully open, and that the drain valves and other auxiliary valves are closed.
3. Install vacuum and pressure gauges to check suction and discharge conditions after pump start-up.

## START UP PROCEDURES

### NOTICE:

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

1. If the pump is located above liquid level, it may be necessary to prime the pump. Do this by disconnecting the inlet hose/piping and fill the pump cavity and inlet hose/piping with DEF. Reconnect the inlet hose/piping, and start the motor using the rocker switch located on the junction box. The pump should prime and operate normally. If the pump is located at or below liquid level, start the motor. Priming should occur within one minute.
2. Check the suction and discharge pressure to see if the pump is operating within the expected conditions. Record pressures in the 'Initial Start Up Information' section.
3. Check for leakage from the piping and equipment.
4. Check for overheating, excessive noise or vibration of the pump and motor.

5. Check the flow rate to ensure the pump is operating within the expected parameters. Record flow rate in the 'Initial Start Up Information' section.
6. Verify relief valve operation by slowly closing the discharge valve. **Do not run the pump for more than 15 seconds with the discharge valve completely closed.**
7. Move switch on motor to "off" position to turn off pump.

## REVERSE ROTATION

SX1 pumps should not be operated in reverse rotation. They must be operated in clockwise rotation only (when viewed from the motor end).

## FLUSHING THE PUMP

### NOTICE:

**If flushing fluid is to be left in the pump for an extended time, it must be deionized water. If the pump is to be stored without fluid, it must be flushed with deionized water before storage to prevent diesel exhaust fluid crystallization.**

1. To flush the pump, run the pump with the discharge valve open and the intake valve closed. Bleed air into the pump through auxiliary fitting in the intake piping. Pump air for 30 second intervals to clean out most of the pumpage.
2. Run deionized water 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:

**After flushing the pump 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:

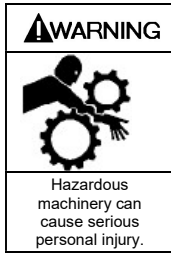
**The pump internal relief valve is designed to protect the pump from excessive pressure and must not be used as a system pressure control valve.**

SX1 pumps are fitted with a non-adjustable internal pressure relief valve that bypasses back to the suction side of the pump.

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.

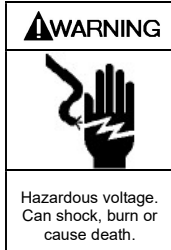
A system pressure control valve is also recommended when operating for extended periods (more than 1 minute) against a closed discharge valve.

# MAINTENANCE



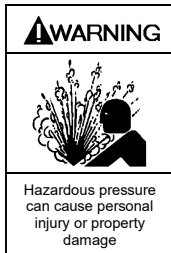
**Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death**

Hazardous machinery can cause serious personal injury.



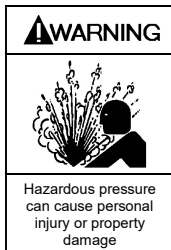
**Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death**

Hazardous voltage. Can shock, burn or cause death.



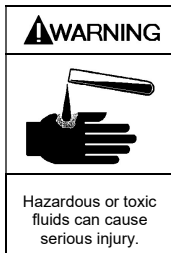
**Failure to relieve system pressure prior to performing pump service or maintenance can cause personal injury or property damage.**

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**

Hazardous pressure can cause 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**

Hazardous or toxic fluids can cause serious injury.

## SCHEDULED MAINTENANCE

### NOTICE:

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

## LUBRICATION

SX1-DEF pump does not require lubrication maintenance.

## STRAINERS

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

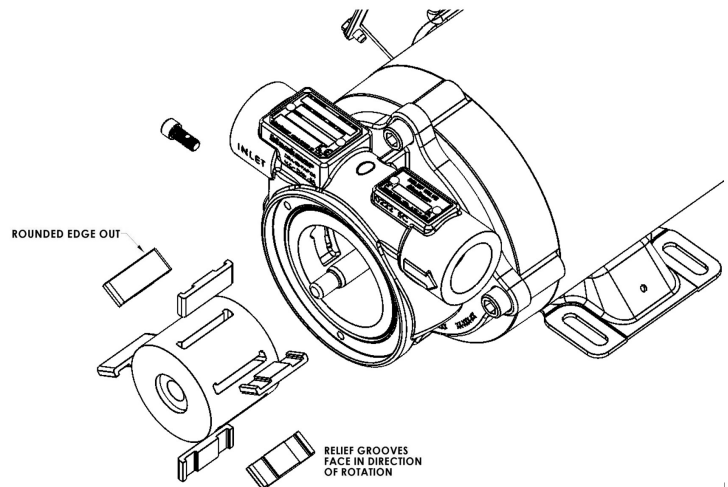
## VANE REPLACEMENT

### NOTICE:

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

1. Flush the pump per instructions in this manual. Drain and relieve pressure from the pump and system as required.
2. Remove the head assembly steps 5 - 8 in the "Pump Disassembly" section of this manual.
3. Remove pipe plug (18) to gain access to rotor capscrew (6)
4. Turn the shaft by hand until rotor capscrew (6) can be accessed through port in side of cylinder (2).
5. Turn rotor capscrew (6) counterclockwise approximately 1 full turn. Rotor (5) can be removed at this time by pulling firmly away from motor.
6. Remove and discard worn vanes (7),
7. Install new vanes, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 3. Vanes (7) should move freely within slots in rotor (5).
8. Repeat steps 6 and 7 until all vanes have been replaced.
9. Reassemble the pump according to the "Pump Assembly." section of this manual.

Figure 3 – Vane Replacement



# MAINTENANCE

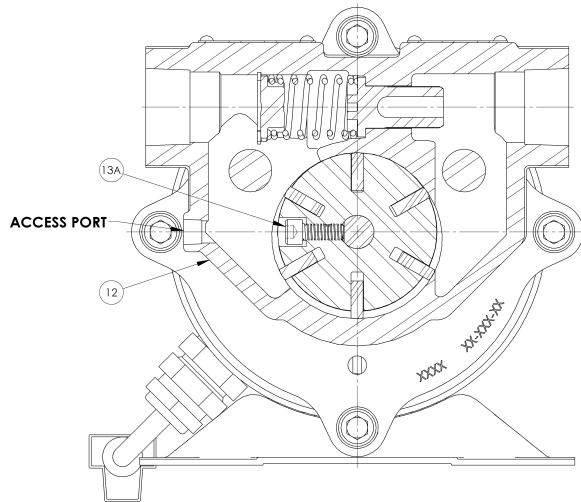
## PUMP DISASSEMBLY

### NOTICE:

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

**NOTE:** The numbers in parentheses following individual parts indicate reference numbers on the Pump Parts List.

1. Flush the pump per instructions in this manual. Drain and relieve pressure from the pump and system as required.
2. Remove the head capscrews (19). Slide head out of cylinder pocket, remove and discard the head O-ring (8).
3. Remove pipe plug (18) to gain access to rotor capscrew (6)
4. Turn the shaft by hand until rotor capscrew (6) can be accessed through access port in side of cylinder (12).



**Figure 4: Rotor Capscrew Access**

5. Turn rotor capscrew counterclockwise approximately 1 full turn. Rotor (5) can be removed at this time by pulling firmly away from motor. Do not disassemble the rotor (5).
6. Remove seal retaining ring (4), set aside
7. Firmly pull on seal (3) until seal is removed. For ease of disassembly, a small amount of liquid soap can be used to lubricate motor shaft. DO NOT use petroleum products to lubricate seals.
8. To remove stationary seat, cylinder (2) must be removed from motor (1).
9. To remove cylinder (2), loosen and remove all cylinder mounting capscrews (20) and remove cylinder from motor. Use a properly sized dowel to press out the stationary seat...the head of the cylinder capscrew (20) may be used if needed. Discard seal and stationary seat once removed from pump.

## PARTS REPLACEMENT

1. If any of the O-rings have been removed or disturbed during disassembly, they must be replaced with new O-rings.
2. Excessive or continuous leakage from the tell-tale hole in the cylinder may be an indication of a damaged mechanical seal. Diesel Exhaust Fluid (DEF) will crystalize causing a white buildup. If buildup continues to form after removal, the mechanical seal may be leaking. If a mechanical seal has been leaking, it is recommended the entire seal be replaced. Refer to "General Pump 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 cylinder and remove any burrs or nicks from the rotor and shaft.

1. For ease of assembly, build pump with motor shaft facing up.
2. If seal replaced, install stationary seat fully into cylinder. It is advised to lubricate the stationary seat elastomer boot with a small amount of dish soap. Clean stationary seat with alcohol after installation.
3. Install cylinder over shaft. Take care to protect stationary seat from damage. Install the four (19) capscrews loosely securing the cylinder to the motor.
4. Install rotating portion of seal over the motor shaft. Take care not to chip or damage the seal face. Press the rotating seal down until it contacts the stationary seat.
5. Using snap-ring pliers, install the seal retaining ring (4) over the shaft. Depress the seal/spring and press down on the retaining ring until it engages the groove in the shaft.
6. Replace rotor capscrew (6) into rotor (5). Tighten until the tip slightly protrudes into the rotor ID. This will allow the rotor to be installed into cylinder (2) and over the motor shaft flat to properly align the rotor during reassembly.
7. Replace vanes (7). Refer to "Vane Replacement" section of this manual
8. Slide rotor (5) with newly installed vanes into cylinder and over shaft. Rotate rotor/disc assembly until rotor capscrew is accessible through port in side of cylinder. See figure 4.
9. Install head O-ring (8) into cylinder. Take care that the O-ring does not protrude from O-ring groove in cylinder..
10. Install head (10) onto motor shaft and into the cylinder head pocket.
11. Install and tighten the three head capscrews (19). Torque to 40 in lbf (4.5 Nm)
12. If removed, install and tighten the cylinder capscrews (20) to 215 in lbf (24 Nm)
13. Tighten rotor capscrew to 30 in lbf (13.5 Nm).
14. Install and tighten pipe plug (18) using approved thread sealant for use with Diesel Exhaust Fluid. Recommend Loctite #567.

## 15. RELIEF VALVE ASSEMBLY

In the unlikely event that the relief valve needs replacement, follow these steps.

- a. Remove RV retaining ring (16) using long nosed snapping pliers. Caution: Clip ring carries spring force and may move upon disassembly.
- b. Remove RV retaining ring (16), spring guide (15), spring (14), and relief valve (13).
- c. Insert the valve (13) into the relief valve bore of the casing with the fluted end inward.
- d. Install the relief valve spring (14) and spring guide (15) against the valve.
- e. Insert RV retaining ring (16) by pressing against spring force. **IMPORTANT:** RV retaining ring **MUST** axially fully fit into retaining ring groove in cylinder. Failure to fully support RV retaining ring may lead to catastrophic pump damage if retaining ring becomes dislodged during operation. **NOTICE:** the retaining ring groove does not form a full circle. See Figure 5

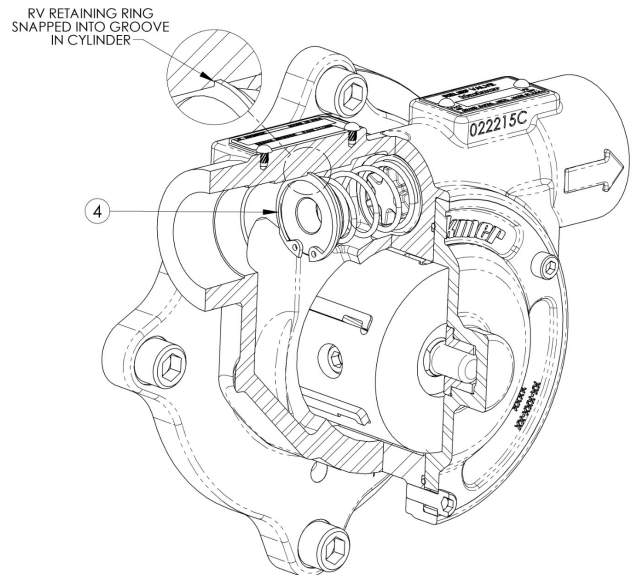


Figure 5 – Correct RV Retaining Ring Position

### NOTICE:

**The relief valve setting MUST be tested before putting the pump into service. Refer to "Relief Valve Setting"**

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



# 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
<b>Pump Not Priming</b>	<ol style="list-style-type: none"> <li>1. Pump not wetted.</li> <li>2. Worn vanes</li> <li>3. Suction valve closed.</li> <li>4. Air leaks in the suction line.</li> <li>5. Strainer clogged.</li> <li>6. Suction line or valves clogged or too restrictive.</li> <li>7. Pump vapor-locked.</li> <li>8. Pump cannot build enough pressure to overcome nozzle restriction when dry</li> <li>9. 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. Suction valves not fully open.</li> <li>3. Air leaks in the suction line.</li> <li>4. Excessive restriction in the suction line (undersized piping, too many elbows &amp; fittings, clogged strainer, etc.).</li> <li>5. Damaged or worn parts.</li> <li>6. Excessive restriction in discharge line causing partial flow through the relief valve.</li> <li>7. Relief Valve worn or not seating properly.</li> <li>8. Vanes installed incorrectly (see "Vane Replacement").</li> </ol>
<b>Noise</b>	<ol style="list-style-type: none"> <li>1. Excessive vacuum on the pump due to:               <ol style="list-style-type: none"> <li>a. Undersized or restricted fittings in the suction line.</li> <li>b. Pump speed too fast for the viscosity or volatility of the liquid.</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. Bearings worn or damaged.</li> <li>5. Vibration from improperly anchored piping.</li> <li>6. Bent motor shaft</li> <li>7. Excessively worn rotor.</li> <li>8. Malfunctioning valve in the system.</li> <li>9. Relief valve setting too low.</li> <li>10. Damaged vanes (see following category).</li> <li>11. Vanes installed incorrectly (see "Vane Replacement").</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. Freezing or solidifying of diesel exhaust fluid</li> <li>5. Excessive heat.</li> <li>6. Hydraulic hammer - pressure spikes.</li> <li>7. Vanes installed incorrectly (see "Vane Replacement").</li> </ol>
<b>Broken Shaft</b>	<ol style="list-style-type: none"> <li>1. Foreign objects entering the pump.</li> <li>2. Freezing or solidifying of diesel exhaust fluid</li> <li>3. Relief valve not opening.</li> <li>4. Hydraulic hammer - pressure spikes.</li> <li>5. Pump/driver misalignment.</li> <li>6. Excessively worn vanes or vane slots.</li> <li>7. Frozen or solidified diesel exhaust fluid in the pump at start-up.</li> </ol>
<b>Mechanical Seal Leakage</b>	<ol style="list-style-type: none"> <li>1. Elastomers nicked, cut or twisted</li> <li>2. Shaft at seal area damaged, worn or dirty.</li> <li>3. Excessive cavitation.</li> <li>4. 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 bushing.</li> <li>6. Rotor rubbing against head or cylinder.</li> <li>7. Dirty mechanical seal faces.</li> </ol>

# NOTES



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)