

# BLACKMER POWER PUMPS

## INSTALLATION OPERATION AND MAINTENANCE INSTRUCTIONS **ProVane® Models: PV80B, 100B**

|           |          |
|-----------|----------|
| Section   | 111      |
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Patent Protected by U.S. Patents 6030191 & 7134855 and Related Foreign Patents.

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ONLY Pump models listed below are covered in this Manual

| Models     | Material     | Parts List |
|------------|--------------|------------|
| PV80B,100B | Ductile Iron | 111-D01    |

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

Numbers in parentheses following individual parts indicate reference numbers on Blackmer Part Lists.



### 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 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 ProVane 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.

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


**⚠ 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**



Do not operate without guard in place

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

**⚠ 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

|                               |                             |
|-------------------------------|-----------------------------|
| Pump Size                     | 80, 100                     |
| Maximum Pump Speed            | 1750 RPM                    |
| Flow Rate at Max. Pump speed  | 80-100 GPM<br>(303-379 LPM) |
| Maximum Operating Temperature | 240°F (116°C)               |
| Maximum Viscosity             | 5, 000 SSU (1100 cP)        |
| Maximum Differential Pressure | 125 psi (8.6 Bar)           |
| Maximum Working Pressure      | 350 psi (24.1 Bar)          |

Technical Data is for standard materials of construction. Consult Blackmer Material Specs for optional materials of construction

#### 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> _____               |

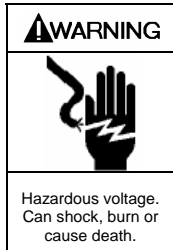
# INSTALLATION

## NOTICE:

Blackmer pumps must only be installed in systems designed by qualified engineering personnel. System design must conform to all applicable regulations and codes and provide warning of all system hazards.

## NOTICE:

This pump shall be installed in accordance with all applicable local, state and national regulations.

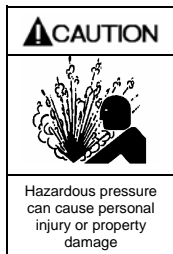


- ⚠ Install ground and wire to local and National Electrical Code requirements.
- ⚠ Install an all-leg disconnect switch near the unit motor.
- ⚠ Disconnect and lockout electrical power before installation or service

- ⚠ Electrical supply **MUST** match motor nameplate specifications.
- ⚠ Motors equipped with thermal protection automatically disconnect motor electrical circuit when overload exists. Motor can start unexpectedly and without warning.



An external bypass valve and/or internal relief valve **MUST** be installed in the system to protect the pump from excessive pressure.



Incorrect bypass valve or internal relief valve settings can cause pump component failure, personal injury, and property damage.

## NOTICE:

Blackmer ProVane pumps may or may not be fitted with an internal relief valve. If an internal relief valve is not supplied, an external bypass valve **MUST** be used.

## PRE-INSTALLATION CLEANING

### NOTICE:

This pump contains some 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 can 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 line 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. Eliminate restrictions such as sharp bends; globe valves, unnecessary elbows, and undersized strainers.
3. Install a system bypass valve that returns excess flow to the supply tank or pump inlet piping as appropriate for the pumping system. Insure that the bypass valve pressure setting is appropriate for the pump and system component working pressures.
4. 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.
5. The intake system must be free of all leaks.
6. 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.
7. 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.
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 (if equipped) to check pump at start up.
10. Check alignment of pipes to pump to avoid strains which might later cause misalignment. See Figure 1. Unbolt flanges or break union joints. Pipes must not spring away or drop down. After pump has been in operation for a week or two, completely recheck alignment.

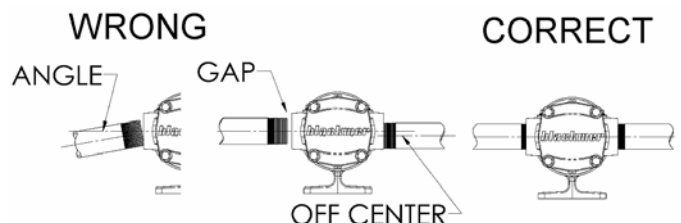


Figure 1

# INSTALLATION

## PUMP MOUNTING

A solid foundation reduces noise and vibration, and will improve pump performance. On permanent installations it is recommended the pumping unit be secured by anchor bolts as shown in Figure 2. This arrangement allows for slight shifting of position to accommodate alignment with the mounting holes in the base plate.

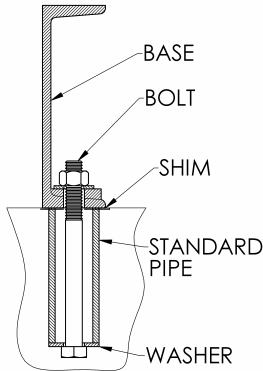


Figure 2 - Pipe Type Anchor Bolt Box

For new foundations, it is suggested that the anchor bolts be set in concrete. When pumps are to be located on existing concrete floors, holes should be drilled into the concrete to hold the anchor bolts.

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. Place shims as needed under the edges of the base prior to tightening of the anchor bolts to prevent distortion.

## COUPLING ALIGNMENT

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 straight edge. Turn both shafts by hand, checking the reading through one complete revolution. Maximum offset should be less than .005" (.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 .005" (.127 mm). Some laser alignment tools will check angular alignment as well.
3. Replace the coupling guards after setting alignment.

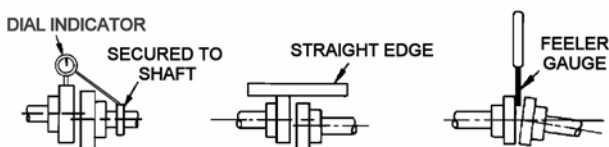


Figure 3 – Alignment Check

## PUMP ROTATION

A right-hand pump rotates clockwise with the intake on the right side, when viewed from the driven end. See Fig. 4.

A left-hand pump rotates counterclockwise with the intake on the left side, when viewed from the driven end. See Fig. 5.

## TO REVERSE PUMP FLOW

To reverse FLOW direction in a ProVane pump, some disassembly and reassembly required. See *Flow Direction Options* in the Maintenance section of this manual.

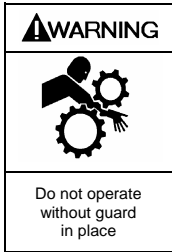
If the rotation of the electric motor driving the pump is incorrect; see the motor manufacturer's instructions to change the rotation of the electric motor to match it to the rotation of the pump.

## 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 system 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. If a check valve is used, install it at the pump discharge.

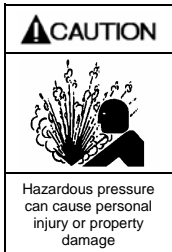
# OPERATION



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



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



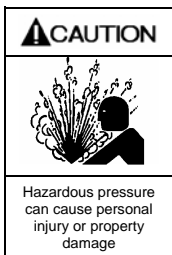
Failure to relieve system pressure prior to performing pump service or maintenance can cause personal injury or property damage.



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



An external bypass valve and/or an internal relief valve **MUST** be installed in the system to protect the pump from excessive pressure.



Incorrect bypass valve or internal relief valve settings can cause pump component failure, personal injury, and property damage.

## PRE-START UP CHECK LIST

1. Check the alignment of the pipes to the pump. Pipes must be supported so that they do not spring away or drop down when pump flanges or union joints are disconnected.
2. Verify proper coupling alignment.
3. 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.
4. Install inlet and discharge pressure gauges on the pump in the threaded connections provided. These can be used to check actual suction and discharge conditions after pump start-up.
5. Check the wiring of the motor, and briefly turn on the power to make sure that the pump rotates in the direction of the rotation arrow.

## START UP PROCEDURES

### NOTICE:

Consult the "General Pump 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 suction and discharge pressure gauges to see if the pump is operating within the expected conditions.
3. Check for leakage from the piping and equipment.
4. Check for overheating of the pump, reducer (if equipped), and motor.
5. If possible, check the flow rate.
6. Check the pressure setting of the system bypass valve by slowly restricting a valve in the discharge line and reading the pressure gauge. This pressure should be 20 psi (1.4 bar) higher than the intended operating pressure.

## RUNNING THE PUMP IN REVERSE

### NOTICE:

When pumps are operated in reverse a separate pressure relief valve must be installed to protect the pump from excessive pressure.

### NOTICE:

Pump should be operated in reverse rotation for no more than 10 minutes and only when a separate pressure relief valve is installed to protect the pump from excessive pressure.

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

# OPERATION

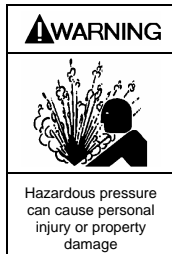
## FLUSHING THE PUMP

### NOTICE:

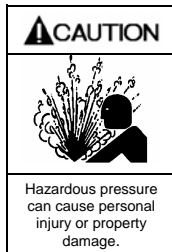
If flushing fluid is to be left in the pump for an extended time, it must be a lubricating, non-corrosive fluid. If a corrosive or non-lubricating fluid is used, it must be flushed from the pump immediately.

1. To flush the pump, run the pump with the discharge valve open and the intake valve closed. Bleed air into the pump through the intake gauge plug hole or through a larger auxiliary fitting in the intake piping. Pump air for 30 second intervals to clean out most of the pumpage.
2. Run a system compatible flushing fluid through the pump for one minute to clear out the remainder of the original pumpage. The valve in the discharge line should be restricted to build up 10 psi (0.7 bar) to force flushing liquid through the bearing seal chamber.
3. To remove the flushing fluid, follow step 1 above.
4. After flushing the pump some residual fluid will remain in the pump and piping.
5. Properly dispose of all waste fluids in accordance with the appropriate codes and regulations.

### OPTIONAL PUMP RELIEF VALVE:



An external bypass valve and/or an internal relief valve **MUST** be installed in the system to protect the pump from excessive pressure.



Incorrect bypass valve or internal relief valve settings can cause pump component failure, personal injury, and property damage.

1. Blackmer ProVane pumps may or may not be fitted with an internal relief valve. If an internal relief valve is not supplied, an external bypass valve must be used.
2. The pump's internal relief valve is designed to protect only the pump from excessive pressure and must not be used as a system pressure control valve.
3. Internal bypassing of liquid elevates liquid temperature. Internal relief valve should only be used for brief periods and for differential pressures below 125 psi. For extended periods, an external bypass returned to source must be used.
4. The pump relief valve cap must be oriented properly to the inlet side of the pump. If pump relief valve is installed improperly, it will not operate and a component failure may result. See Figures 4 and 5.

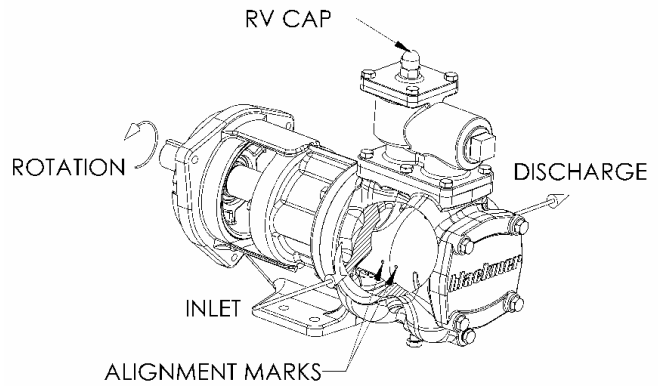


Fig 4 Right Hand (Clockwise) Orientation

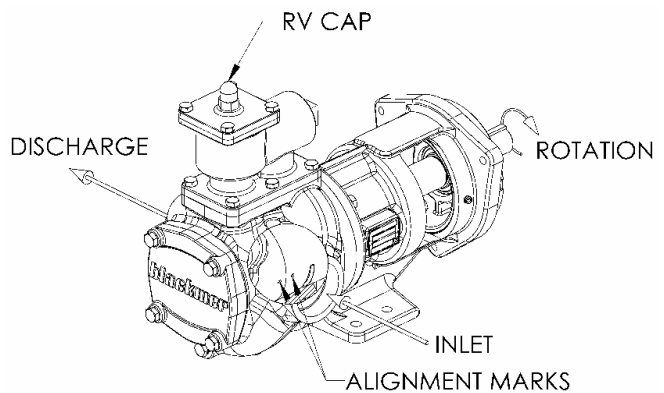
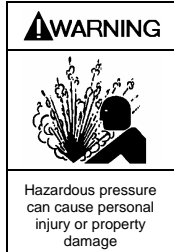


Fig 5 Left Hand (Counterclockwise) Orientation

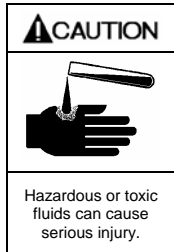
# OPERATION

## RELIEF VALVE SETTING AND ADJUSTMENT

The relief valve pressure setting/range is marked on a metal tag attached to the valve cover. The relief valve should be set at 20 PSI (0.7-1.4 Bar) higher than the operating pressure or system pressure control valve, but no higher than the maximum working pressure of the pump.



**Incorrect settings of the pressure relief valve can cause pump component failure, personal injury, and property damage.**



**Relief valve cap is exposed to pumpage and will contain some fluid.**

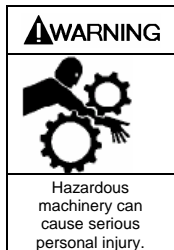
**DO NOT** remove the R/V cap OR adjust the relief valve pressure setting while the pump is in operation.

1. **To INCREASE the pressure setting**, remove the relief valve cap (1) and O-ring (88). Loosen the locknut (3). Turn the adjusting screw (2) *inward*, or *clockwise*. Inspect R/V cap O-rings and replace as required. Reattach R/V cap O-ring and RV cap.
2. **To DECREASE the pressure setting**, remove the relief valve cap (1) and O-ring (88). Loosen the locknut (3). Turn the adjusting screw (2) *outward*, or *counterclockwise*. Inspect R/V cap O-rings and replace as required. Reattach R/V cap O-ring and RV cap.

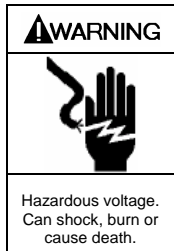
Refer to the individual Blackmer pump parts lists for various spring pressure ranges. Unless specified otherwise, pumps are supplied from the factory with the relief valve adjusted to the mid-point of the spring range.

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# MAINTENANCE



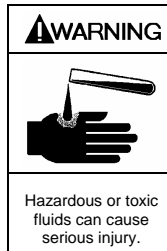
**Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death**



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



**Disconnecting fluid or pressure containment components during pump operation can cause serious personal injury, death or major 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 relieve system pressure prior to performing pump service or maintenance can cause personal injury or property damage.**

### NOTICE:

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

# MAINTENANCE

**Torque Table 1**

| Pump Size                            |        |  | PV80,100 |
|--------------------------------------|--------|--|----------|
| Head / Casing/ Seal Cover Cap Screws | Ft-Lbs |  | 30.0     |
|                                      | N-m    |  | 40.5     |
| Rotor Capscrews                      | Ft/Lbs |  | 38.00    |
|                                      | N/m    |  | 51.53    |
| Bearing Adjuster Set Screw (189)     | Ft-Lbs |  | 13.1     |
|                                      | N-m    |  | 17.8     |
| Ball Bearing Set Screws (24C)        | Ft-Lbs |  | 3.1      |
|                                      | N-m    |  | 4.2      |

## Suggested Tool List

Allen Wrenches: 1/4", 2mm - 4mm  
 Combination Wrenches: 10mm - 12mm, 23mm  
 Pliers: Standard & Long Nose  
 Spanner Wrench  
 Strap Wrench  
 Ball Peen Hammer: 8oz.  
 Ratchet & Socket Set: 10mm - 12mm, 23mm  
 Mallet: shot loaded rubber  
 Self indicating torque tool: PN 165811

## SCHEDULED MAINTENANCE

### LUBRICATION

The Blackmer ProVane pumps are equipped with ball bearings that require no additional lubrication.

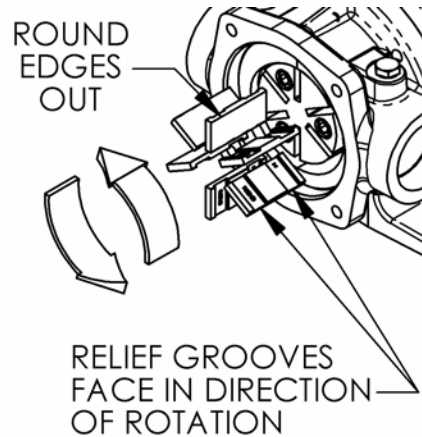
### STRAINERS

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 following the appropriate procedures and warnings as presented in this manual.



**Figure 6 – Vane Replacement**

1. Flush the pump per instructions in this manual. Drain and relieve pressure from the pump and system as required.
2. Remove the head cap screws (21). Gently remove the head from the casing. The head O-ring should come off with the head assembly.
3. Remove the outboard rotor (13D) vanes (14) & pushrods (77) by removing the socket cap-screws (13C). Set aside for reassembly.
4. Remove the outboard liner (41A) and rotating disc (13E) to access the inboard vanes.
5. Turn the shaft by hand until a worn vane comes to the top (12 o'clock) position of the rotor. Remove the vane.
6. Install a new vane, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 7.
7. Repeat steps 5 and 6 until all inboard vanes have been replaced. This method of vane installation ensures the push rods do not fall out of their rotor slots.
8. Install the rotating disc (13E) into the recess of the inboard liner. Positioning it over the threaded holes for the outboard rotor.
9. Install the outboard liner over the disc aligning "pumping chamber" opposite of the inboard Liner.
10. Install the pushrods (77) & 3 vanes (14) in the outboard rotor (13D). Position at the bottom so pushrods are held in place. Place in the pump aligning the holes for the socket cap-screws with the holes in the rotating disc and Inboard liner.
11. Install the socket cap-screws (13C) torque per table 1.
12. Install new vanes in the top 3 vane slots, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 7.
13. Carefully install the head (23) into the casing. Install and tighten four head cap screws (21). Torque per Table 1 shown at the beginning of the maintenance section.

# MAINTENANCE

## PUMP DISASSEMBLY

### NOTICE:

Maintenance shall be performed by qualified technicians only. Follow the appropriate procedures and warnings as presented in 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. 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 removed.
3. Remove the head cap screws (21A). Gently remove the head from the casing. The head O-ring should come off with the head assembly.
4. Loosen the three set screws of the ball bearing 1-2 full turns with a 2.5mm hex key wrench. Lightly tap the end of the exposed shaft with a hard wood drift and a hammer until the bearing shaft sleeve releases the shaft.
5. Remove the rotor and shaft (13) from the casing. While one hand is pushing the shaft, the other hand should be cupped underneath the rotor to prevent the vanes (14) and pushrods (77) from falling out. The outboard liner will come out with the rotor and shaft assembly. As the rotor & shaft are removed further, carefully support the shaft so it does not drop and damage the sleeve bearing, finished surfaces of the shaft or the rotating seal face as it is removed. Carefully set the rotor and shaft aside for future vane replacement and reassembly.
6. To remove the casing. Lay the pump on end with the bearing housing facing upward and remove the 4 cap screws (21A). Lift off the bearing housing and remove the Bearing Housing (57). Remove the casing o-ring (71) from between the Bearing Housing and the casing.
7. The mechanical seal & spring assembly should come out with the shaft. The stationary seat and stationary seal ring need to be removed from the seal cover (126).
  - a. To remove the seal cover remove the 4 cap-screws (21A) holding it in place.
  - b. Slowly slide the seal cover away from the Bearing Housing until it can be removed. Remove and discard the seal cover O-ring (51).
8. Carefully pry the stationary seal elements (153A) from the seal cover (126). Be sure not to scratch the seal face or damage the elastomer seal seat.
9. If necessary, remove the Inboard liner (41) from the casing (12) by tapping around the outside diameter of the liner with a hard wood drift and a hammer until it is driven from the casing.
10. Remove the ball bearing adjuster (188) by loosening the set screw (189) and turning it counter clockwise with a strap wrench or spanner wrench.

11. If necessary for replacement, remove the ball bearing (24C) from the bearing adjuster. Turn the bearing adjuster so the threaded side is up. Using an appropriately sized arbor press remove the bearing (24C) from the bearing adjuster. Discard old bearing and replace with new one. See step 2 of "Pump Assembly"
12. **Only disassemble rotor & shaft if necessary for part replacement.** Remove the outboard set of socket cap screws (13C), the outboard rotor (13D), the rotating disc (13E), the inboard set of socket cap screws (13C) and the inboard rotor (13B). See figure 7.

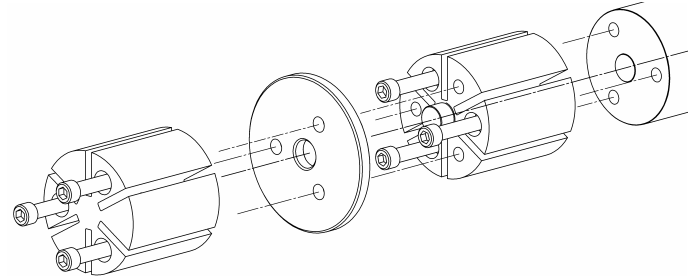


Figure 7

## PARTS REPLACEMENT

1. If any of the O-rings have been removed or disturbed during disassembly, they need to be replaced with new O-rings.

**NOTE:** PTFE O-rings should be heated in hot water to aid installation.
2. Excessive or continuous leakage from around the seal housing or in the bearing housing 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 "General Pump Troubleshooting" for possible causes of seal leakage.
3. Inspect bearings for wear and replace as necessary.

# 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.

### Reassemble the BEARING Components first:

To aid in the installation of the sleeve bearing (24) the creation and use of a tool similar to the one shown in Figure 8 may be useful.

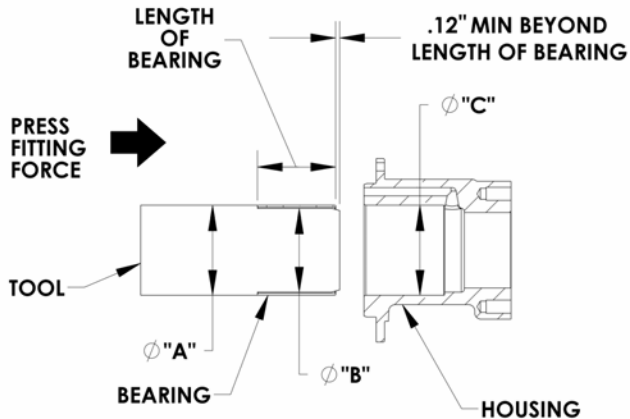


Figure 8 – Sleeve Bearing Installation

| Pump Model | Bearing Bore Dia. "C" | Tool Dim "A"        | Tool Dim "B"           |
|------------|-----------------------|---------------------|------------------------|
| PV80,100   | 2.68 in.<br>(68 mm)   | 3.35 in.<br>(85 mm) | 2.55 in.<br>(64.75 mm) |

- Inspect the sleeve bearing (24) for wear or damage and replace as required.  
To replace sleeve bearing:
  - To remove old bearing, pry bearing away from housing at seam using appropriate small chisel or similar prying tool. Use mallet and chisel to separate seam inward and apart until bearing separates and becomes loose. Although some damage may occur to bearing housing ID, take care to minimize damage. If damage does occur, lightly sand damaged surface until all raised edges of damage are removed.
  - To aid installation and prevent bearing damage, coat the bearing (24) with grease and place it on the face of the bearing housing (57).
  - Using an arbor press, press the bearing (24) into the housing (57) until it is flush with the face of the bearing housing

NOTE: Ensure the bearing does not become misaligned during the pressing motion.

- Inspect the ball bearing (24C) for wear or damage and replace as required.  
To replace ball bearing:
  - Using an appropriately sized arbor press, remove the old bearing (24C) from the bearing adjuster (188). Discard the old bearing after removal.
  - To aid installation and prevent bearing damage, coat the bearing with grease and place it on the face of the bearing adjuster (188)
  - Using an arbor press, press outer race of the bearing into the bearing adjuster until it is seated in the bearing adjuster.

- Screw the bearing adjuster (188) to the bearing housing (57) until they are flush. Be sure that the setscrew (189) is not interfering with the flush fit of the bearing adjuster to the bearing housing.

### 4. Seal stationary assembly

Refer to the seal manufacturer's instructions for detailed removal and replacement instructions.

#### Mechanical seal type 51, 8, 9

Installing the Stationary Seat

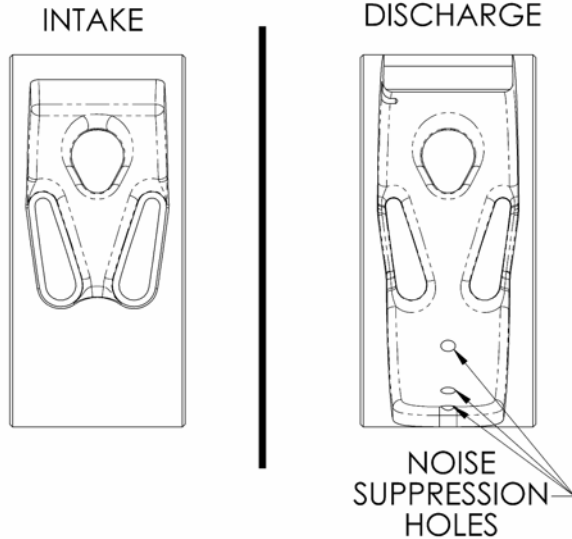
- Apply a small amount of lubricant in the seal access of the seal cover (126).
- Install a new stationary seal-ring and stationary seat  
Clean the polished face with a clean tissue and alcohol.

**Cartridge seal:** Follow manufacturer's instructions

- Install a new O-ring (51) into the seal cover (126A).
- Lubricate the O-ring seal area on the bearing housing (57) with a light coating of oil. Insert the seal cover (126) into the bearing housing.
- Secure the seal cover to the Bearing Housing (57) by installing the cap-screws (21A) Torque per table 1.
- Install a new O-ring (71) over the dowel of the Bearing Housing (57).
- Reassemble the casing to the Inboard head/bearing housing. Install cap screws (21A) through the bearing housing into the casing. Torque per Table 1.

# MAINTENANCE

## LINER INTAKE & DISCHARGE IDENTIFICATION

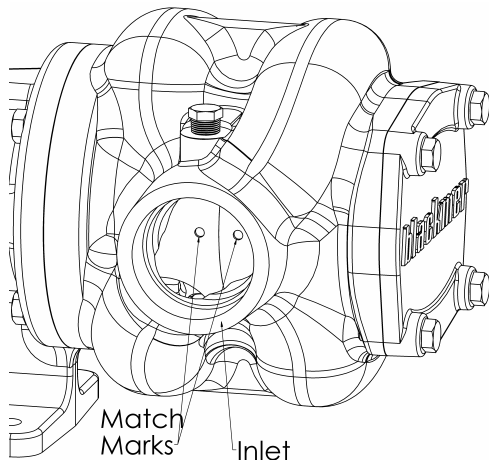


## FLOW DIRECTION AND ROTATION OPTIONS

For a CLOCKWISE rotation pump, install the pump casing, then install liner (41A) with the inlet in the 6 o'clock position.

For a COUNTERCLOCKWISE rotation pump, install the pump casing, then install liner (41B) with the inlet in the 12 o'clock position.

Note: Match marks on the liners must align and will be positioned toward the pump inlet.



### 10. Assemble Rotor and Shaft (if disassembled).

- Loosely assemble inboard rotor (13B) on to shaft (13A) securing with socket cap screws (13C). DO NOT damage the OD surface finish of the rotor and shaft.
- Secure a piece of steel sized to fit the width and length of a vane slot in a vise or other holding device. Place the loosely assembled rotor and shaft on to the piece of steel in one of the vane slots; completely filling the entire vane slot.
- Hold the assembly securely without damaging the OD of the rotor or shaft.
- Tighten the socket cap screws (13C). Torque per Table 1.

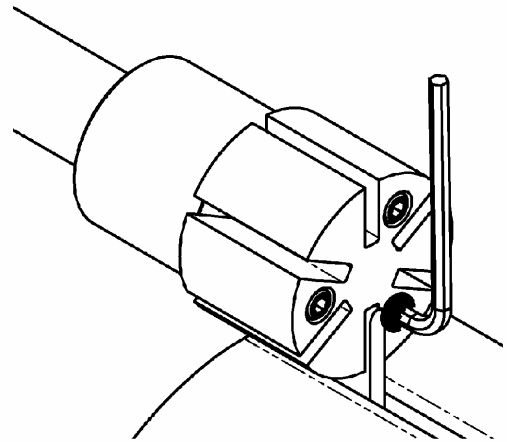


Figure 12 – Rotor / Shaft Assembly Torque

### 11. Seal Rotating Assembly

#### Type 51

- Apply a small amount of Flowserve Pac-Ease™ or equivalent water based lubricant on the shaft between the shaft end and the rotor.
- Slide the seal rotating assembly (153B) over the shaft with the rotating face away from the rotor until contact is made with the large diameter of the shaft.
- Align the rotating assembly with the seal jacket polished face outward. Clean the polished face with a clean tissue and alcohol.

#### Type 8, 9

- Apply a small amount of Flowserve Pac-Ease™ or equivalent water based lubricant on the shaft between the shaft end and the rotor.
- Slide the seal rotating assembly (153B) over the shaft with the rotating face away from the rotor until contact is made with the large diameter of the shaft.
- Tighten set screws on seal per manufacturer's directions.
- Remove spacer clips per manufacturer's directions.
- Align the rotating assembly with the seal jacket polished face outward. Clean the polished face with a clean tissue and alcohol.

#### Cartridge Seal:

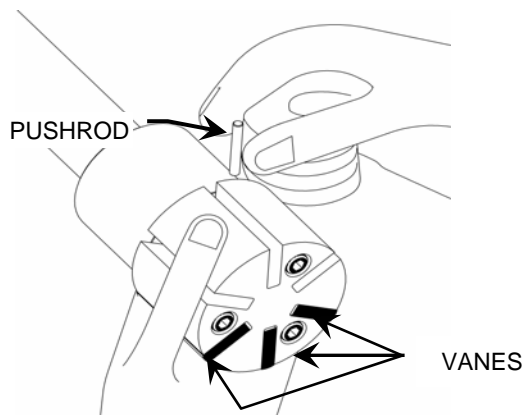
- Remove bearing adjuster from bearing housing.
- Insert cartridge seal through bearing adjuster opening in bearing housing. Fasten to Bearing Housing and shaft per manufacturer's directions.

### 12. Inboard Liner Installation

Carefully slide Inboard Liner into casing while aligning with locating pin on Bearing Housing. To insure proper flow direction, see "Flow Direction and Rotation Options".

# MAINTENANCE

## 13. PUSHROD INSTALLATION



**Figure 13 – Pushrod Installation**

14. Insert the vanes into the bottom three rotor slots with the relief grooves facing in the direction of pump rotation, and with the rounded edges outward. See Fig. 7 & 13
15. Hold the three bottom vanes in place on Inboard Rotor while inserting the six push rods (77). NOTE: a small amount of grease can be used to help hold the pushrods in the rotor during assembly. See Figure 13
16. Install push rods into Outboard Rotor. NOTE: a small amount of grease can be used to help hold the pushrods in the rotor during assembly
17. Install remaining vanes on Inboard Rotor and carefully insert into casing.
18. Install the rotor and shaft assembly (13) with the rotating seal elements into the Bearing Housing from the sleeve bearing end. Rotor may protrude slightly due to mechanical seal spring force.
19. **Assemble Rotor and Shaft** (if disassembled).
  - a. Install the rotating disc, outboard rotor, and liner AFTER the shaft is in place in the pump and the inboard vanes are installed.
  - b. Install the rotating disc (13E) into the recess of the inboard liner. Positioning it so the threaded holes are exposed on the inboard rotor.
  - c. Install the outboard liner over the disc positioning it to align to the pin on the outboard head.
  - d. Install the pushrods (77) & 3 vanes (14) in the outboard rotor (13D) position at the bottom so pushrods are held in place. Place in the pump aligning the holes for the socket cap-screws with the holes in the rotating disc and inboard rotor.
  - e. Install socket cap screws (13C). Torque per table 1.
  - f. Install new vanes in the top 3 vane slots, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Fig 6.

### Bearing Adjustment

20. Install a new head O-ring (72) on the dowel of the head.
21. Carefully install the head (23) into the casing with "BLACKMER" lettering on head is parallel to and above the foot of the pump see fig 4,5. Install and tighten four head cap screws (21A). Torque per table 1.

22. If bearing adjuster was removed during seal assembly, Screw the bearing adjuster (188) to the bearing housing (57) until they are flush. Be sure that the setscrew (189) is not interfering with the flush fit of the bearing adjuster to the bearing housing.
23. Back off the bearing adjuster 1 full turn to allow for setting of pump end clearance.
24. Secure the ball bearing (24C) to the shaft by uniformly tightening the setscrews on the ball bearing. Bearing MUST be tightened with allen wrench per Torque Table1 or by using the special self indicating torque tool supplied with the bearing.  
NOTE: Pump shaft may not turn after ball bearing set screws are tightened. If this happens, turn bearing adjuster CLOCKWISE (viewed from driven end) until pump shaft is able to be turned by hand.
25. Turn the bearing adjuster counterclockwise, as viewed from the driven end of the pump, until the shaft is snug and is no longer easily turned by hand. Mark a line across the bearing adjuster and drive housing.
26. Turn the bearing adjuster clockwise, as viewed from the driven end of the pump the distance prescribed per table 2. Measurement to be taken on outside of drive housing.

Table 2

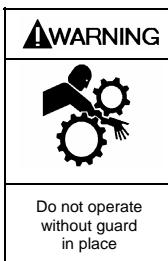
| Pump size | Distance on OD of Drive Housing |
|-----------|---------------------------------|
| PV 80-100 | 3/4" (19.05 mm)                 |

27. Tighten the bearing adjuster lock setscrew and torque per table 1.
28. **Relief Valve Assembly**
  - a. Insert the valve (9) into the relief valve body (6) with the fluted end inward.
  - b. Install the relief valve spring (8) and spring guide (7) against the valve.
  - c. Attach a new relief valve O-ring (10) and the valve cover (4) on the relief valve body (6).
  - d. Screw the relief valve adjusting screw (2) into the valve cover (4) until it makes contact with the spring guide (7).
  - e. After the relief valve has been adjusted, install the relief valve cap(1) and O-ring (88).

### NOTICE:

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

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



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

30. Refer to "Pre-Startup Check List" and "Startup Procedures" sections of this manual prior to restarting pump operation.

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# GENERAL PUMP TROUBLESHOOTING

## NOTICE:

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

---

### LEAKAGE

#### Location

Between the head & casing

Around the shaft

#### Probable Cause/Corrective Action

Damaged head O-ring: Inspect and replace if necessary.

Burrs/dirt in head O-ring groove or casing: File and clean as necessary.

New Mechanical Seals: New seals may leak slightly at start up, but should seal up shortly thereafter.

Damaged mechanical seals: Check for damaged O-rings or cracked, scratched or worn seal faces

---

### SHAFT BINDING

#### Probable Cause

Burrs, dirt or foreign particles on the heads or discs.

Improper bearing adjustment.

Contaminated mechanical seal faces.

#### Corrective Action

During assembly, both heads and discs must be clean and smooth. File any burrs or rough spots, and wipe the discs with a clean cloth and alcohol to remove any dirt or foreign particles.

Bearings must be adjusted properly to center the rotor and shaft between the head & bearing housing. Refer to the "Pump assembly " section of this manual.

Any trace of grease or dirt on the seal faces will prevent the faces from mating properly, causing the rotor and shaft to bind or turn hard. Use a tissue paper & alcohol to clean the seal faces. NOTE: Apply a light oil or suitable lubricant to bronze seal faces only.

#### OTHER POSSIBLE CAUSES OF SHAFT BINDING:

- Foreign particles on rotor, liner or vanes.
- Damaged vanes or rotor.

- Bent push rods.
  - Liquids that "set up" when inactive.
- 

### OVERHEATING

#### Probable Cause

Pump is in bypass (internal or external) mode too long or the bypass loop is too short

#### Corrective Action

Adjust the bypass valve and/or internal relief valve so that the pump does not operate in bypass mode so long.

Route the external bypass line back to the supply tank.

#### OTHER POSSIBLE CAUSES OF OVERHEATING:

- Improper system bypass valve and/or internal relief valve adjustment
  - Plugged discharge line.
  - Closed valve.
- 

### LOW DELIVERY RATE

#### Probable Cause

Bypass valve and/op internal relief valve setting too low, causing the liquid to bypass.

#### Corrective Action

The Bypass valve and/or internal relief valve setting should be 20 psi (1.4 bar) higher than the differential pressure.

#### OTHER POSSIBLE CAUSES OF A LOW DELIVERY RATE:

- Restriction in the suction line.
- Resistance in the discharge line.
- Air leaks in the suction line.
- Damaged or worn pump parts.
- Pump speed too low or too high.
- Bypass valve leaking.
- Bypass valve sticking open, or not properly seating.
- Dirty strainer.
- Liner installed backwards
- Pump running in reverse

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# GENERAL PUMP TROUBLESHOOTING

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## EXCESSIVE NOISE AND VIBRATION

### Probable Cause

Cavitation or vaporization of the liquid resulting from excessive vacuum on the pump due to starved suction.

Entrained air or vapors in the pump.

Pump speeds exceed the recommended maximum.

Liner Installed Backwards

Continual or long term bypassing of liquid through system bypass valve.

### Corrective Action

Check for:

- Inlet piping too long or too small in diameter.
- Strainer plugged or dirty.
- Undersized or restrictive fittings, such as globe valves or partially closed valves.
- Excessive amount of elbows.
- Suction lift too great.
- Pump speed too high for the viscosity of the liquid being pumped.

Check pipe joints for leakage of air. Sometimes when recirculating liquid in a tank, the returning liquid falling through the air carries air down into the tank, which eventually gets back into the pump.

Check the recommended RPM for your specific application.

The word "INTAKE", which is cast on the liner MUST be towards the intake side of the pump

Check for restriction in the discharge line, or an improper bypass valve adjustment

### OTHER POSSIBLE CAUSES OF NOISE AND VIBRATION:

- Excessively worn vanes
- Bearing Worn or Damaged.
- Loose or improperly installed piping.
- Misalignment of pump and driver.
- Pump base not properly mounted.

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## POOR OR NO PRIMING

### Probable Cause

- Air leaks in the suction line.
- Restriction in the suction line.
- Damaged or worn pump parts.
- Too much lift for the vapor pressure of the fluid.
- A dirty or clogged strainer.
- Worn vanes.
- Suction Valve Closed.
- Incorrect pump rotation
- Bypass Valve partially open, valve not seating properly.

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## DAMAGED VANES

### Probable Cause

- Foreign objects entering the pump.
- Running the pump dry for extended periods of time.
- Cavitation.
- Viscosity too high for the vanes and /or the pump speed.
- Incompatibility with the liquids pumped.
- Excessive heat.
- Worn or bent push rods, or worn push rod holes.
- Settled or solidified material in the pump at start-up.
- Hydraulic hammer - pressure spikes.
- Vanes installed incorrectly (see "Vane Replacement").

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## BROKEN SHAFT

### Probable Cause

- Foreign objects entering the pump.
- Viscosity too high for the pump speed.
- Bypass valve not opening.
- Hydraulic hammer - pressure spikes.
- Pump/driver, driveline/drive shaft misalignment.
- Excessively worn vanes or vane slots.
- Settled or solidified material in the pump at start-up.

---

## SEAL LEAKAGE

### Probable Cause

- O-rings not compatible with the liquids pumped.
- O-rings nicked, cut or twisted.
- Shaft at seal area damaged, worn or dirty.
- Excessive cavitation.
- Mechanical seal faces cracked, scratched, pitted or dirty.
- Ball bearings worn.

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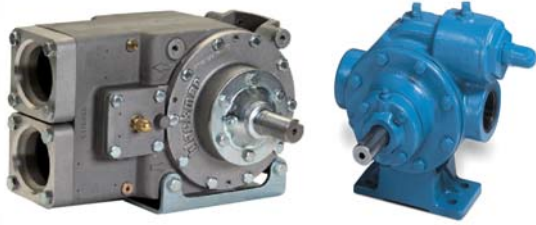
## MOTOR OVERLOAD

### Probable Cause

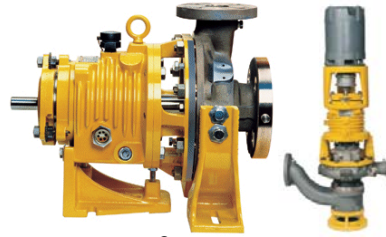
- Horsepower of motor not sufficient for application
- Improper wire size / wiring and/or voltage to motor.
- Misalignment in pump drive system.
- Excessive viscosity, pressure or speed.
- Faulty or worn bearings.
- Rotor rubbing against head or liner.
- Dirty mechanical seal faces.

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## NOTES



Sliding Vane Pumps: 5 to 2200 GPM  
Refined Fuels, Liquefied Gases, Process,  
Transport, Marine



System One® Centrifugal Pumps  
10 to 7500 GPM  
Process, Marine



C-Series Eccentric Disc Pumps  
Stainless Steel & Ductile Iron, 1 to 150 GPM  
Shear Sensitive, Food, Process



Abaque Peristaltic Hose Pumps  
0.5 to 220 GPM  
High Lift, Solids, Abrasives



Rotary Vane and Screw Compressors  
Dry Bulk Unloading



Reciprocating Gas Compressors  
Liquefied Gas Transfer, Boosting, Vapor Recovery



Hydraulic Coolers  
Complete Packages



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Hand Operated Pumps  
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