BLACKMER POWER PUMPS

INSTALLATION OPERATION AND MAINTENANCE INSTRUCTIONS

***ProVane*® Models: PVS10A, 15A, 20A, 30A, 40A, 50A**

INSTRUCTIONS NO. 111-G00

Section	111
Effective	Oct 2008
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Patent Protected by U.S. Patents 6030191, 7134855 & 7316551 B2 and Related Foreign Patents.

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ONLY Pump models listed below are covered in this Manual

Single Liner Models	Material	Parts List
PVS10A, 15A	Stainless Steel	111-G01
PVS20A, 30A	Stainless Steel	111-G02
PVS40A, 50A	Stainless Steel	111-G03

Blackmer manuals and parts lists may be obtained from Blackmer's website (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

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 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.

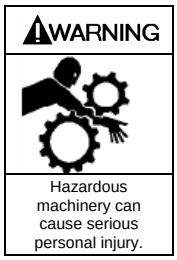
This manual is intended to assist in the installation and operation of the Blackmer ProVane pumps, and **MUST** be kept with the pump.

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

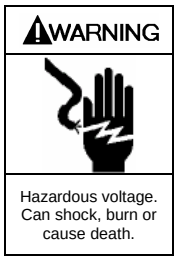
Thoroughly review this manual, all instructions and hazard warnings, **BEFORE** performing any work on the pump.

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

SAFETY DATA



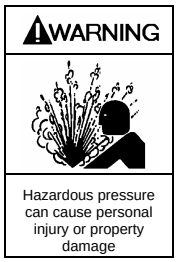
Failure to disconnect and lockout electrical power or engine drive before attempting maintenance can cause severe personal injury or death



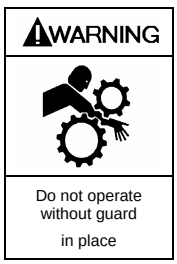
Failure to disconnect and lockout electrical power before attempting maintenance can cause shock, burns or death



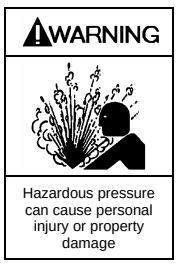
If pumping hazardous or toxic fluids, system must be flushed and decontaminated, inside and out, prior to performing service or maintenance



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



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



Failure to relieve system pressure prior to performing pump service 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	10, 15, 20, 30, 40, 50
Maximum Pump Speed	1750 RPM
Flow Rate at Max. Pump Speed	10-50 GPM (38-189 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

Model No.: _____

Serial No.: _____

ID No.: _____

Date of Installation: _____

Inlet Gauge Reading: _____

Discharge Gauge Reading: _____

Flow Rate: _____

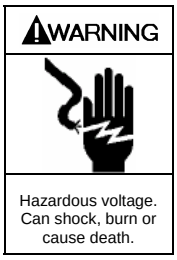
INSTALLATION

NOTICE:

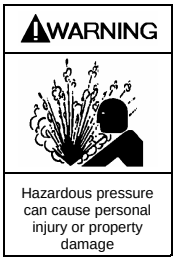
Blackmer pumps must only be installed in systems designed by qualified engineering personnel. System design must conform to all applicable regulations and codes and provide warning of all system hazards.

NOTICE:

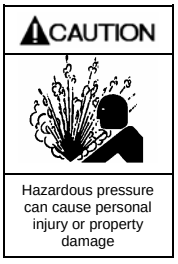
This pump shall be installed in accordance with all applicable local, state and national regulations.



- **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 <u>MUST</u> 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.

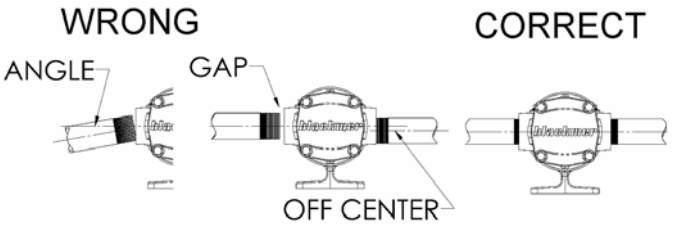


Figure 1

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.

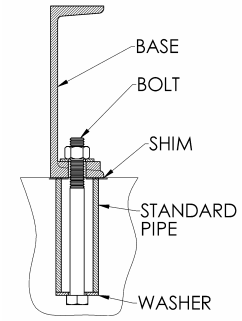


Figure 2 - Pipe Type Anchor Bolt Box

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.

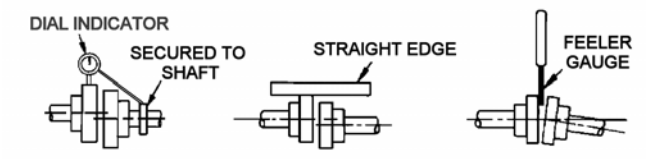


Figure 3 – Alignment Check

PUMP ROTATION

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

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

TO REVERSE PUMP FLOW

To reverse the FLOW direction, some disassembly and reassembly is required. See F*low 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

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

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

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.

CAUTION



Hazardous pressure can cause personal injury or property damage

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

WARNING



Hazardous pressure can cause personal injury or property damage

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

CAUTION



Hazardous pressure can cause personal injury or property damage

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.

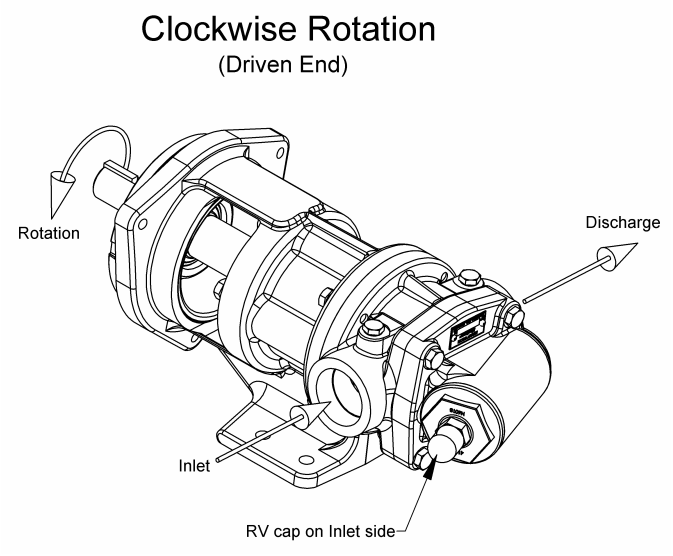


Fig 4 Right Hand Orientation

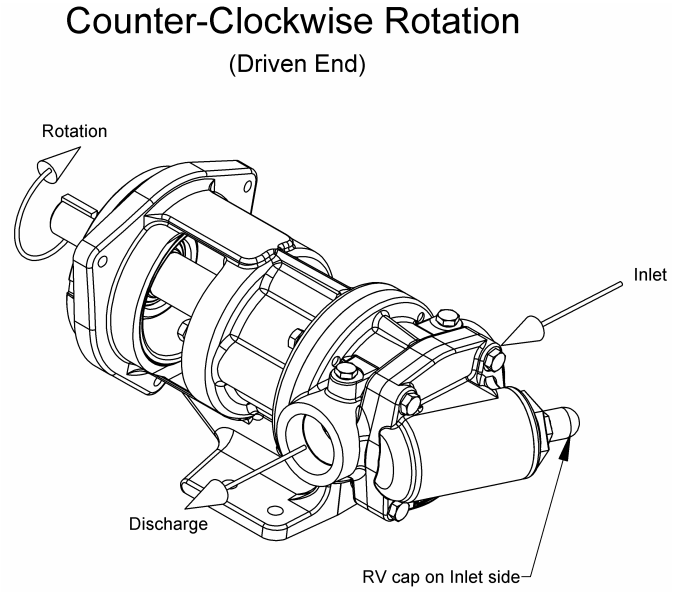
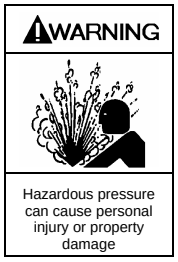
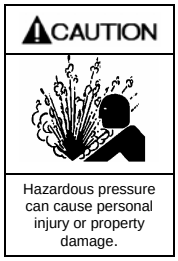


Fig 5 Left Hand Orientation

OPTIONAL PUMP RELIEF VALVE:



An external bypass valve and/or an internal relief valve <u>MUST</u> 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 on 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.

OPERATION

OPTIONAL 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.

WARNING



Hazardous pressure can cause personal injury or property damage

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

CAUTION



Hazardous or toxic fluids can cause serious injury.

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.

MAINTENANCE:

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

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.

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 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

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		10, 15	20, 30, 40, 50
Head / Casing/ Seal Cover Cap Screws	Ft-Lbs	16.2	30.0
	N-m	22	40.5
Rotor Capscrews	Ft/Lbs	4.50	38.00
	N/m	6.10	51.53
Bearing Adjuster Set Screw (189)	Ft-Lbs	3.4	13.1
	N-m	4.7	17.8
Ball Bearing Set Screws (24C)	Ft-Lbs	3.1	3.1
	N-m	4.2	4.2

Suggested Tool List

Allen Wrenches: 5/32",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.

See the table on page 1 of this manual to determine your pump model.

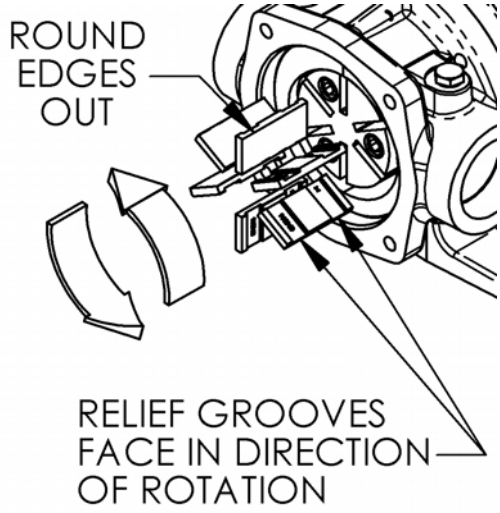


Figure 6 – Vane Replacement

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. Turn the shaft by hand until a worn vane comes to the top (12 o'clock) position of the rotor. Remove the vane.
4. Install a new vane, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 6.
5. Repeat steps 3 and 4 until all vanes have been replaced. This method of vane installation ensures the push rods do not fall out of their rotor slots.
6. Carefully install the head (23) into the casing. If equipped with optional relief valve, to insure proper orientation see Figures 4 and 5 in "Optional Pump Relief Valve" section. 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 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. 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. As the rotor & shaft are removed further, carefully support the shaft so it does not drop and damage the sleeve bearing or 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 Inboard Head (20). Remove the casing O-ring (71) from between the inboard head 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 inboard head 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 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**. Disassemble the rotor (13B) and shaft (13A) by removing the cap-screws (13C). See figure 7.

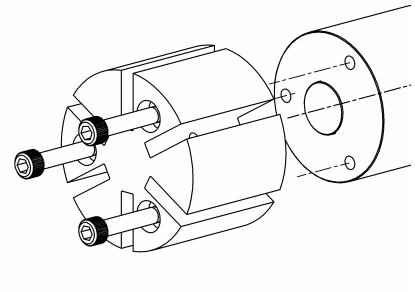


Figure 7 (PVS10/15 rotor shown)

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.

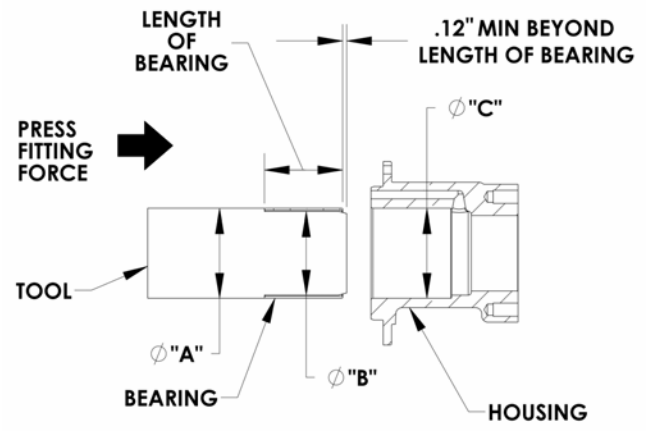


Figure 8 – Sleeve Bearing Installation

Pump Model	Bearing Bore Dia. "C"	Tool Dim "A"	Tool Dim "B"
PVS10, 15	1.89 IN. (48.2 mm)	2.76 IN. (70 mm)	1.76 IN. (44.75 mm)
PVS20, 30, 40, 50	2.68 IN. (68 mm)	3.35 IN. (85 mm)	2.55 IN. (64.75 mm)

1. Inspect the sleeve bearing (24) for wear or damage and replace as required. To replace sleeve bearing:

PVS10,15

a. Using an appropriately sized arbor press, remove the old bearing (24) from the bearing housing (57).
b. To aid installation and prevent bearing damage. Coat the bearing (24) with grease and place it on the face of the bearing housing (57).
c. Using an arbor press, press the bearing (24) into the housing (57) until it is **flush** with the face of the bearing housing.

PVS20-50

a. 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.
b. To aid installation and prevent bearing damage, coat the bearing (24) with grease and place it on the face of the bearing housing (57).
c. 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.

2. Inspect the ball bearing (24C) for wear or damage and replace as required. To replace ball bearing:
   a. Using an appropriately sized arbor press, remove the old bearing (24C) from the bearing adjuster (188). Discard the old bearing after removal.
   b. To aid installation and prevent bearing damage, coat the bearing with grease and place it on the face of the bearing adjuster (188)
   c. Using an arbor press, press outer race of the bearing into the bearing adjuster until it is seated in the bearing adjuster.
3. 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, 9

Installing the Stationary Seat
a. Apply a small amount of lubricant in the seal access of the seal cover (126).
b. 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

5. Install a new O-ring (51) into the seal cover (126A).
6. 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.
7. Secure the seal cover to the inboard head (20) by installing the cap-screws (21A) Torque per table 1.

8. Install inboard head into bearing housing until it is fully seated in bore.
   a. For PVS10, 15. Place bearing feed hole in 12:00 position opposite the pump feet. See Figure 10
   b. For PVS20, 30, 40, 50. Insert inboard head into bearing housing with hole located on pin in bearing housing. See Figure 11
9. Install a new O-ring (71) over the dowel of the Inboard Head (20).
10. Reassemble the casing to the inboard head/bearing housing. Install cap screws (21A) through the bearing housing into the casing. Torque per Table 1.

Inboard Head Orientation

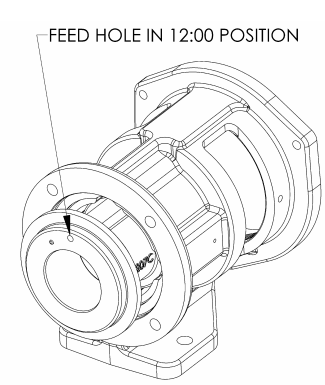


Figure 10
PVS10,15

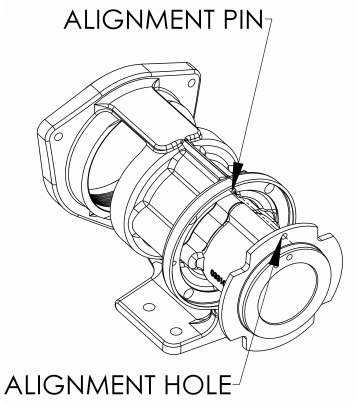
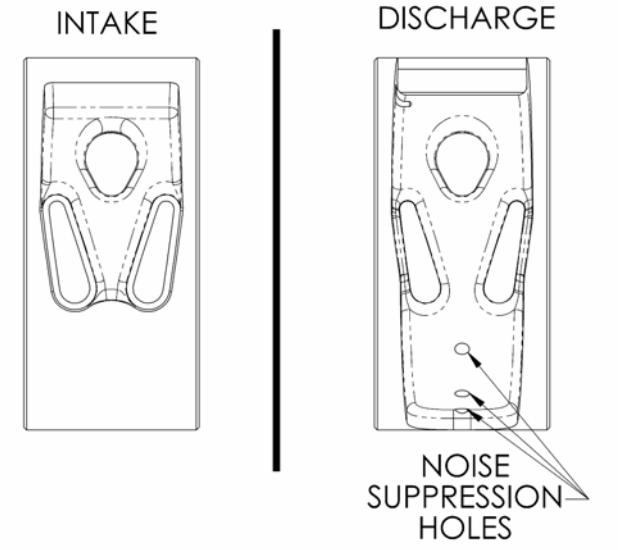


Figure 11
PVS 20,30,40,50

LINER INTAKE & DISCHARGE IDENTIFICATION



FLOW DIRECTION AND ROTATION OPTIONS

For a CLOCKWISE rotation pump; install the liner in the casing with the Inlet to the **right**. As viewed from the driven end of the pump. See Figure 4

For a COUNTERCLOCKWISE rotation pump; install the liner in the casing with the Inlet to the **left**. As viewed from the driven end of the pump. See Figure 5

11. Assemble Rotor and Shaft (if disassembled).

a. Loosely assemble rotor (13B) on to shaft (13A) securing with socket cap screws (13C).

   DO NOT damage the OD surface finish of the rotor and shaft.

b. 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.

c. Hold the assembly securely without damaging the OD of the rotor or shaft.

d. Tighten the socket cap screws (13C). Torque per Table 1.

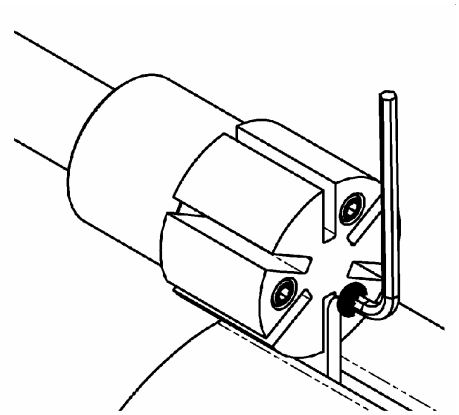


Figure 12 – Rotor / Shaft Assembly Torque

12. Seal Rotating Assembly

Type 51

a. Apply a small amount of Flowserve Pac-Ease™ or equivalent water based lubricant on the shaft between the shaft end and the rotor.

b. 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.

c. Align the rotating assembly with the seal jacket polished face outward. Clean the polished face with a clean tissue and alcohol.

Type 8,9

a. Apply a small amount of Flowserve Pac-Ease™ or equivalent water based lubricant on the shaft between the shaft end and the rotor.

b. 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.

c. Tighten set screws on seal per manufacturer's directions.

d. Remove spacer clips per manufacturer's directions.

e. Align the rotating assembly with the seal jacket polished face outward. Clean the polished face with a clean tissue and alcohol.

Cartridge Seal:

a. Remove bearing adjuster from bearing housing.

b. Insert cartridge seal through bearing adjuster opening in bearing housing. Fasten to inboard head and shaft per manufacturer's directions.

13. PUSHROD INSTALLATION

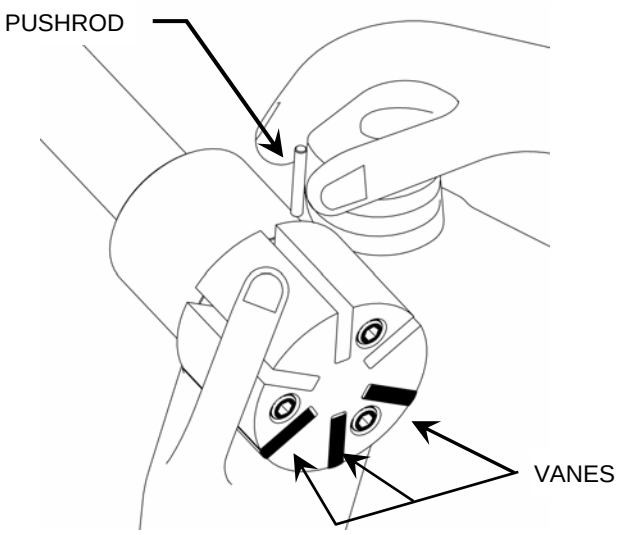


Figure 13 – Pushrod Installation

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 Figures 6 & 13
15. Hold the three bottom vanes in place while inserting the three 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. After the bottom vanes and push rods are installed, carefully insert the driven end of rotor and shaft into the casing.
17. Install the rotor and shaft assembly (13) with the rotating seal elements into the INBOARD Head from the sleeve bearing end. Rotor may protrude slightly due to mechanical seal spring force.
18. Install the new vanes by rotating the shaft until an empty vane slot is in the 12 o'clock position, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation. See Figure 6.

    Repeat until all vanes have been installed. This method of vane installation ensures the push rods do not fall out of their rotor slots.

Bearing Adjustment

19. Install a new head O-ring (72) on the dowel of the head.
20. Carefully install the head (23) into the casing. If equipped with optional relief valve, to insure proper orientation see fig 4, fig 5 in *Optional Pump Relief Valve* section. Install and tighten four head cap screws (21A). Torque per table 1.
21. 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.
22. Back off the bearing adjuster 1 full turn to allow for setting of pump end clearance.
23. 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 Table 1 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.
24. 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.
25. 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(S) 10,15	11/16" (17.46 mm)
PV(S) 20-100	3/4" (19.05 mm)

26. Tighten the bearing adjuster lock setscrew (189) and torque per table 1.

27. 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).

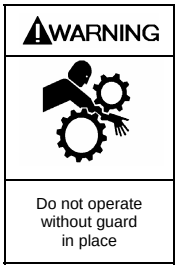
d. Screw the relief valve adjusting screw (1) with locknut (3) into the valve cover (4) until it makes contact with the spring guide (7).

e. After the relief valve has been adjusted, tighten the locknut (3) and 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".

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



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

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

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	Probable Cause/Corrective Action
Between the head & casing	Damaged head O-ring: Inspect and replace if necessary. Burrs/dirt in head O-ring groove or casing: File and clean as necessary.
Around the shaft	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	Corrective Action
Burrs, dirt or foreign particles on the heads or discs.	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.
Improper bearing adjustment.	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.
Contaminated mechanical seal faces.	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	Corrective Action
Pump is in bypass (internal or external) mode too long or the bypass loop is too short	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	Corrective Action
Bypass valve and/or internal relief valve setting too low, causing the liquid to bypass.	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

GENERAL PUMP TROUBLESHOOTING

EXCESSIVE NOISE AND VIBRATION

Probable Cause	Corrective Action
Cavitation or vaporization of the liquid resulting from excessive vacuum on the pump due to starved suction.	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.
Entrained air or vapors in the pump.	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.
Pump speeds exceed the recommended maximum.	Check the recommended RPM for your specific application.
Liner Installed Backwards	The word “INTAKE”, which is cast on the liner MUST be towards the intake side of the pump
Continual or long term bypassing of liquid through system bypass valve.	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.

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.

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").

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

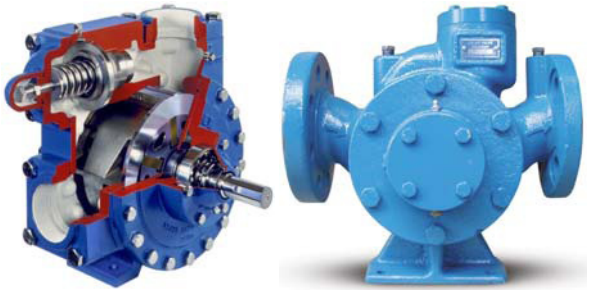
- O-rings not compatible with the liquids pumped.
- O-rings nicked, cut or twisted.
- Shaft at seal area damaged, worn or dirty.
- Excessive cavitation.
- Mechanical seal faces cracked, scratched, pitted or dirty.
- Ball bearings worn.

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.

NOTES



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



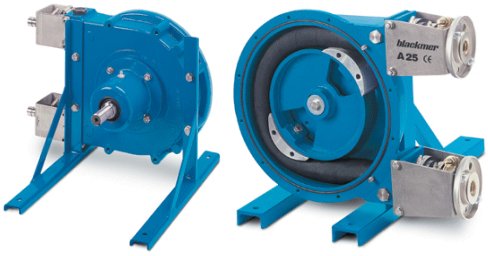
Stainless Steel Sliding Vane Pumps
1 to 265 GPM: Acids, Brines, Sugars, Syrups,
Beer, Beet Juice, Cider, Flavor Extracts, etc.



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



Magnetic Drive Pumps
Stainless Steel: 14 to 215 GPM



Abaque Peristaltic Hose Pumps
0.1 to 210 GPM
High Lift, Solids, Abrasives



Reciprocating Gas Compressors
Liquefied Gas Transfer, Boosting, Vapor Recovery



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