Allied Systems COMPANY

Pump Service

(Vickers PVD 45,80, & 120 Series)

80-388 (4-90) Printed in USA

TABLE OF CONTENTS

MODEL CODE BREAKDOWN

(AS STAMPED INTO NAMEPLATE OF UNIT)

PVD* - ******

- PUMP
- VARIABLE DELIVERY
- INLINE SERIES D
- FLOW RATING IN USGPM (AT 1800 RPM)
  - 45 - 45 USGPM
  - 80 - 80 USGPM
  - 120 - 120 USGPM
- UNIT ASSEMBLY NUMBER

NOTE
A CROSS REFERENCE BETWEEN UNIT MODEL CODE AND ASSEMBLY NUMBER IS INCLUDED IN CONTROL DRAWING M-2231-S.

Table 1.

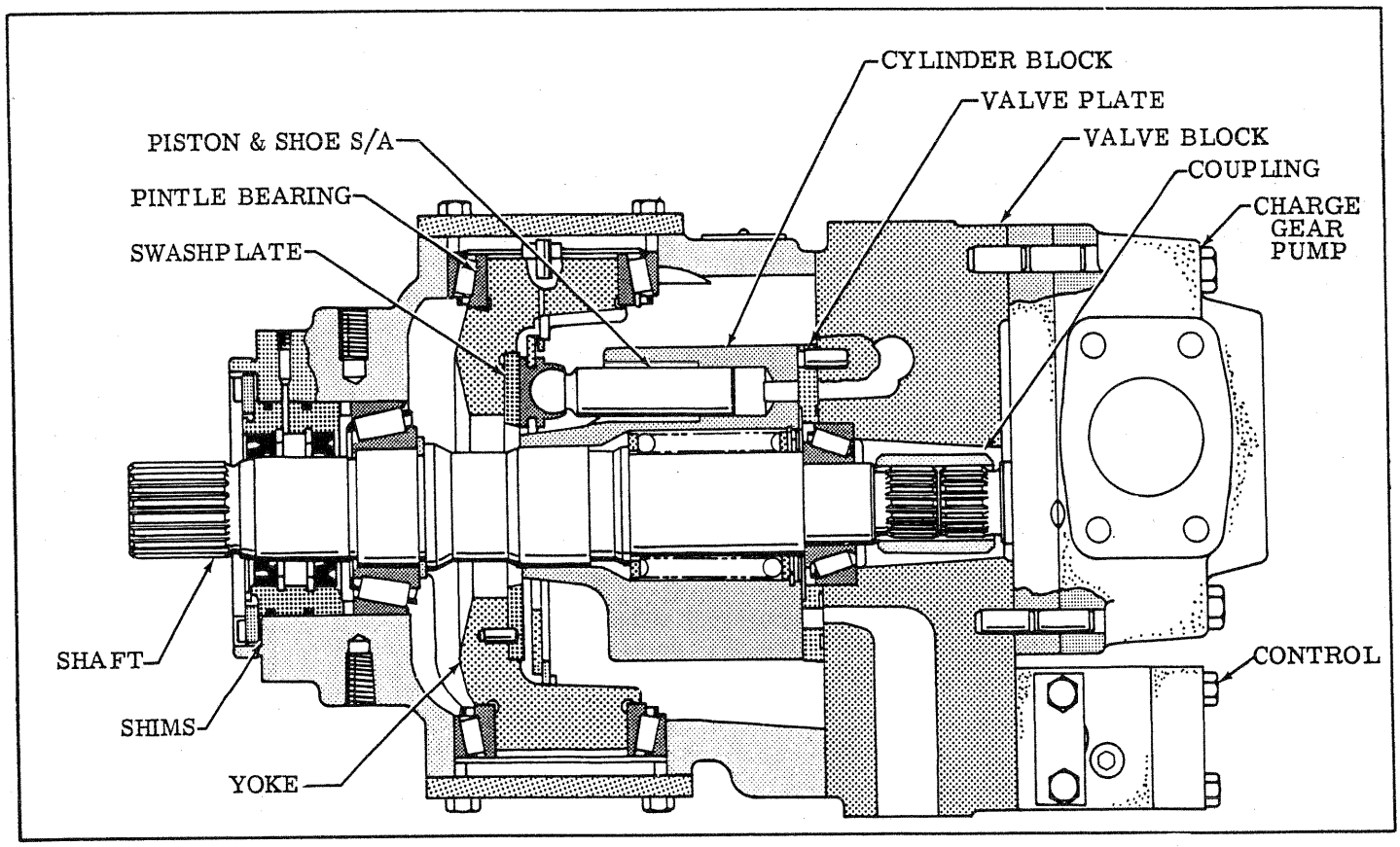


Figure 1. Typical PVD Piston Pump

Section I – INTRODUCTION

A. PURPOSE OF MANUAL

This manual describes the basic operating characteristics and provides service and overhaul information for the PVD series basic pump. Piston pump controls are covered in a separate manual. The information contained herein pertains to the latest design series as listed in Table 1.

B. GENERAL INFORMATION

1. Related Publications - Service parts information and installation dimensions are not contained in this manual. The parts and installation drawings listed in Table 2 are available from your dealer.

Section II – DESCRIPTION

A. GENERAL

Assembly of a typical PVD series piston pump is shown in Figure 1. In general, a piston pump and charge gear pump are connected in tandem on the same shaft. The gear pump provides charge flow to the piston pump inlet. A charge relief valve determines piston pump inlet pressure.

B. CONTROLS

Various controls are available with the PVD series pumps. These controls are covered by a separate service drawing and manual. See Table 1. The following is a brief description of each control:

Standard Pressure Compensator

This control limits system pressure to a desired level and is a standard feature on all pumps. When system pressure reaches the compensator setting, pump displacement starts to decrease to match the load requirements.

The compensator is sensitive to the rate of pressure rise in the system and minimizes pressure overshoot. In a highly responsive system, the pump will begin de-stroking before system pressure reaches the compensator setting. As a result, system shocks which shorten component life and cause leakage are greatly reduced, and in many cases eliminated.

Dual-Pressure Compensator

This control allows a pump to alternately operate between two pressure settings. For example, an excavator may require cylinder pressures limited to 4000 PSIG, but need 5000 PSIG for the propel motors to provide adequate tractive effort. This is easily achieved with a dual-pressure compensator.

Compensator With Remote Pressure Setting

This pressure compensator offers advantages when it is difficult or inconvenient for the vehicle operator to reach the operating pump and adjust the pressure setting. The adjustment for the compensator can be mounted in the vehicle cab or control station where movement of a knob allows the operator to achieve variable control of the compensator setting.

Torque Summation

On vehicles where one engine is driving two pumps, this control assures that pump demands do not exceed available engine torque. The control allows full engine power to be absorbed by either pump but limits the sum of the pump input torques to a level which will prevent engine stall.

Torque Limiter

This control allows maximum performance to be obtained from the vehicle engine. It limits torque at the pump input shaft to prevent engine stall while the pressure compensator limits maximum pressure in the system. When pump input speed remains constant, the torque limiter acts as an input horsepower limiter.

Speed Sensing Control

This control maintains zero displacement of the pump during startup to provide easier engine starting. Also, the control will cause the pump to return to zero displacement if a load causes the engine RPM to decrease below a certain preset level. The speed sensing control is used in place of the torque limit control. The intent of both is to keep the engine from stalling. As load begins to exceed the engine horsepower, engine speed will drop. This is sensed by the control and pump displacement is reduced.

An option provided is a by-pass circuit which permits operation at reduced engine throttle settings.

Load Sensing Control

This control provides a POWER MATCH™ between the pump and load, thereby maximizing system efficiency and improving metering characteristics of the system's directional control valve.

The control senses pump outlet pressure and load pressure, and keeps the difference between these two pressures constant. The differential pressure is measured across a metering land in the system's flow control valve, with the effect that pump flow is determined by valve spool position and is independent of load pressure.

The load pressure signal is generated downstream of the flow control valve metering land, and communicated to the pump's load sensor by a signal line. In a multiple-spool load sensing valve arrangement, the internal logic must sense all load pressures and feed the highest pressure back to the pump control.

C. APPLICATION

Pump deliveries shown in the model code are in USGPM, at 1800 RPM. For flows at other speeds, methods of installation and other application information, sales engineering personnel should be consulted.

Section III – PRINCIPLES OF OPERATION

A. PISTON PUMP

The drive shaft causes the cylinder block, pistons and shoe plate to rotate within the pump. See Figure 2. The angle of the yoke face imparts a reciprocating motion to each piston within the cylinder block. Inlet and outlet ports connect to a kidney slotted valve plate. As the pistons move out of the cylinder block, fluid is forced into the void by charge pressure. The fluid moves with the cylinder block past the intake kidney slot to the outlet (pressure) kidney slot. The motion of the piston reverses and fluid is pushed out of the cylinder block into the outlet port.

B. CHARGE PUMP

An external gear pump (Figure 3) consists essentially of two meshed gears in a closely fitted housing with inlet and outlet ports opposite each other. One gear is driven by the power source and in turning, drives the other. As the gear teeth separate and travel past the inlet, a partial vacuum is formed. Oil is forced into the inlet by atmospheric pressure and carried to the outlet in pumping chambers formed between the gear teeth and housing. As the gear teeth mesh at the outlet, oil is forced out of the pumping chambers into the outlet port. This oil is used to charge the piston pump inlet.

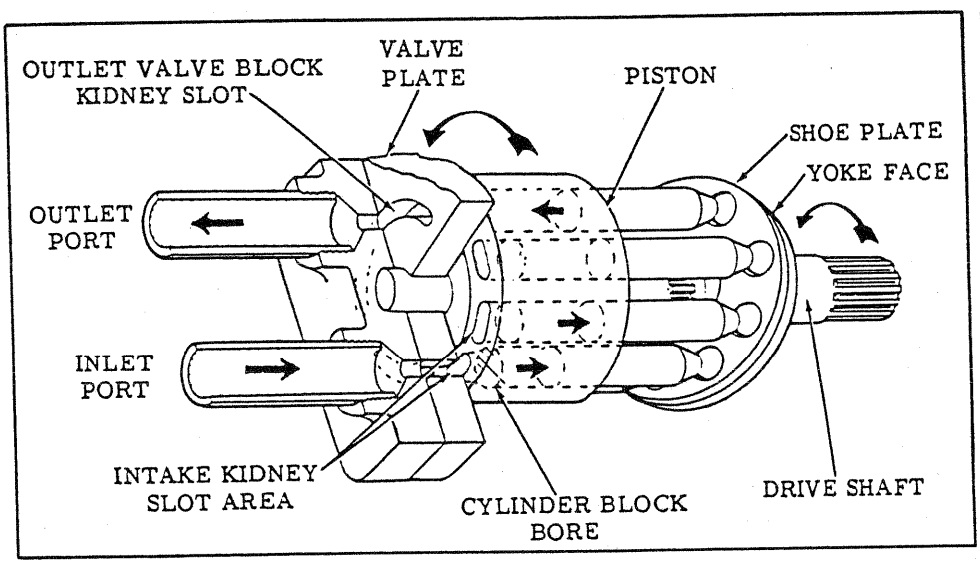


Figure 2. Piston Pump Operation

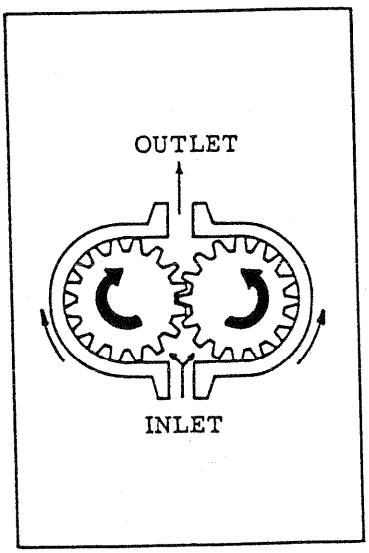


Figure 3. Charge Pump Operation

A. INSTALLATION DRAWINGS

The installation drawing listed in Table 2 will show operating characteristics, installation dimensions and port locations.

B. MOUNTING AND DRIVE CONNECTIONS

CAUTION

Pump shafts are designed to be installed in couplings with a slip fit. Pounding can injure the bearings. Shaft tolerances are shown on the installation drawing. See Table 2.

1. Direct Mounting – A pilot on the pump mounting flange (Figure 4) assures correct mounting and shaft alignment. Make sure the pilot is firmly seated in the accessory pad of the power source. Care should be exercised in tightening the mounting screws to prevent misalignment.

2. Indirect drive is not recommended for these pumps without engineering approval.

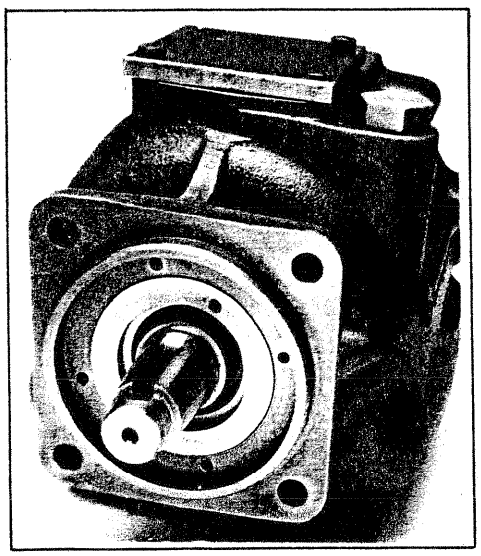


Figure 4. Pump Mounting Flange

C. SHAFT ROTATION

Pumps are assembled for both right-hand (clockwise) and left-hand (counterclockwise) shaft rotation as viewed from the shaft end.

CAUTION

Never drive a pump in the wrong direction of rotation. Seizure will result, necessitating expensive repairs.

D. PIPING AND TUBING

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sandblasting, wire brushing, pickling, and power flushing with clean solvent to remove loose particles.

NOTE

For information on pickling, refer to instruction sheet 1221-S.

2. To minimize flow resistance and the possibility of leakage, only as many fittings and connections as are necessary for proper installation should be used.

3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of oil flow. Tubing must not be bent too sharply. The recommended minimum radius for bends is three times the inside diameter of the tube. In high pressure systems (5000 PSI), steel elbows should be used instead of bending tubing; this provides an increase in circuit life.

E. HYDRAULIC FLUID RECOMMENDATIONS

General Data

Oil in a hydraulic system performs the dual function of lubrication and transmission of power. It constitutes a vital factor in a hydraulic system, and careful selection of it should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components with particular emphasis on hydraulic pumps. Any oil selected for use with pumps is acceptable for use with valves or motors.

Refer to Data sheet M-2950-S for oil selection.

Oil recommendations noted in the data sheet are based on our experience in industry as a hydraulic component manufacturer. Where special considerations indicate a need to depart from the recommended oils or operating conditions, contact your sales engineering representative.

Cleanliness

Thorough precautions should always be observed to insure the hydraulic system is clean.

1. Clean (flush) entire new system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminants into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.

4. Provide continuous protection of system from entry of airborne contamination by sealing the system and/or by proper filtration of the air.

5. During usage, proper oil filling and servicing of filter, breathers, reservoirs, etc. cannot be over emphasized.

6. Thorough precautions should be taken by proper system and reservoir design, to insure that aeration of the oil will be kept to a minimum.

Sound Level

Noise is only indirectly affected by the fluid selection, but the condition of the fluid is of paramount importance in obtaining optimum reduction of system sound levels.

Some of the major factors affecting the fluid conditions that cause the loudest noises in a hydraulic system are:

1. Very high viscosities at start-up temperatures can cause pump noises due to cavitation.

2. Running with a moderately high viscosity fluid will impede the release of entrained air. The fluid will not be completely purged of such air in the time it remains in the reservoir before recycling through the system.

3. Aerated fluid can be caused by ingestion of air through the pipe joints of inlet lines, high velocity discharge lines, cylinder rod packings or by fluid discharging above the fluid level in the reservoir. Air in the fluid causes a noise similar to cavitation.

F. OVERLOAD PROTECTION

Overload protection is required to limit pressure in the system to a prescribed maximum and protect components from excessive pressure.

Experience has shown that on many mobile systems, the PVD series pressure compensator system limits pressure between the pump and directional controls to an acceptable level.

Due to varying system characteristics, it is highly recommended that relief valves be installed in the system.

G. START-UP

With a minimum drive speed of 800 RPM, a pump should prime almost immediately, if provision is made to initially purge the air from the system.

Failure to prime within a reasonable time may result in damage due to lack of lubrication. The pump housing must be filled with fluid and inlet lines must be tight and free from air leaks. It may be necessary to loosen a fitting on the outlet side of the pump to purge air trapped in the system.

Section V – SERVICE AND MAINTENANCE

A. SERVICE TOOLS

The following standard tools for overhauling the piston unit are shown in Figure 5.

1. Torque wrench with short extension and sockets
2. 1" micrometer
3. 1" depth micrometer
4. Internal Truarc pliers (2300)
5. External Truarc pliers (0200)

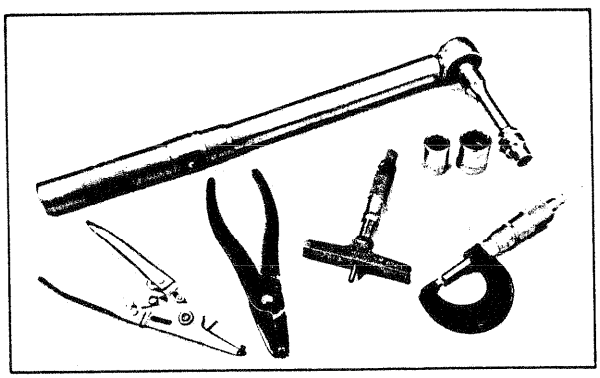


Figure 5. Service Tools

Special Tools

The following special tools are required to service the PVD heavy duty piston pump series.

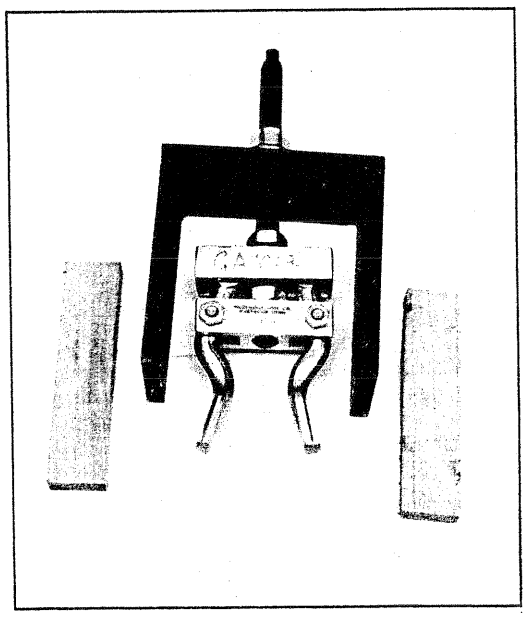
1. Obtain two long screws (tabulated in Table 3). Cut off the heads of the screws to make studs. These studs will be used to assemble and disassemble the valve block.

MODEL	SCREW (2 Req'd.)	DIA. THD.	SAE COARSE
PVD45	214689	0.437-14	CL-2A
PVD80	214776	0.625-11	
PVD120	46671	0.625-11	

Table 3. Special Screws

2. One length of 1/8 inch drill rod approximately 18 inches (457.2mm) long.

3. Valve block bearing race removal tool and shims. (See Figure 6.)



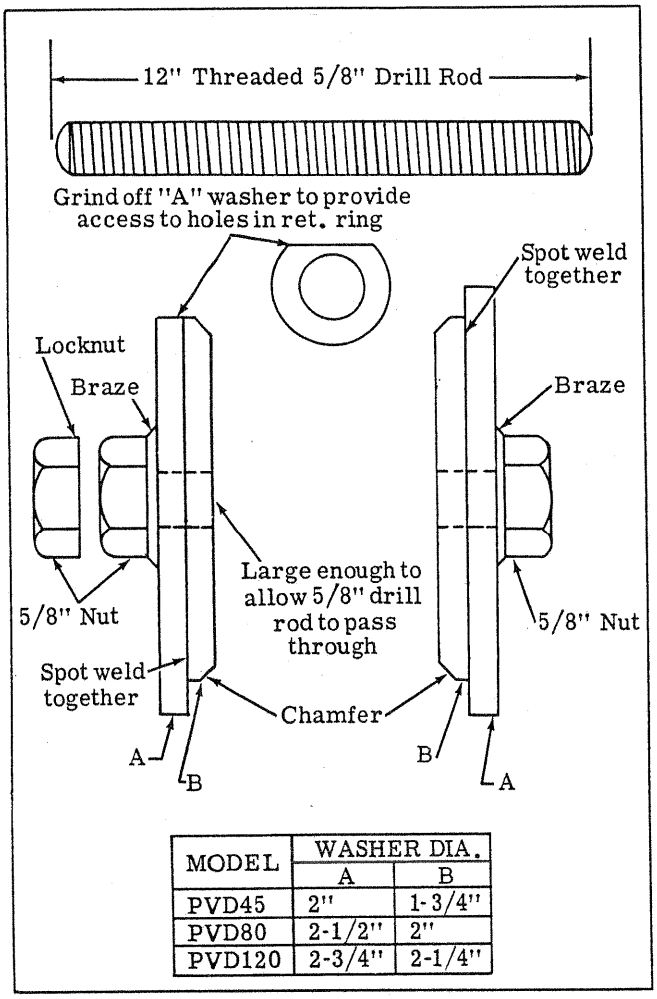
Tool #MD956
This tool is manufactured by:
Owatanna Tool Company
376 North Street
Owatanna, WI 55060

Figure 6. Bearing Race Removal Tool

4. A Torx type TX-30 insert bit is required for removal of outer seal retainer screws on the PVD45 and PVD120 units. The PVD80 uses standard hex head screws.

5. Dial indicator and accessories.

6. Cylinder block disassembly tool. See Figure 7.



MODEL	WASHER DIA.	
	A	B
PVD45	2"	1-3/4"
PVD80	2-1/2"	2"
PVD120	2-3/4"	2-1/4"

Figure 7. Cylinder Block Spring Decompression Tool

NOTE
In addition to the above tools, an arbor press is required to service bearings, etc. A chain fall is required to handle the pump and valve block assembly. Repair of this unit is intricate and should not be attempted without the proper tools.

B. INSPECTION

Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly:

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result.

In suction or return lines, loose connections permit air to be drawn into the system resulting in noisy and/or erratic operation.

2. Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants. If the fluid becomes contaminated, the system should be drained and the reservoir cleaned before new fluid is added.

3. Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

4. Air bubbles in the reservoir can ruin the pump and other components. If bubbles are seen, locate the source of the air and seal the leak. See Table 4.

5. A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

C. ADDING FLUID TO THE SYSTEM

When hydraulic fluid is added to replenish the system, it should always be poured through a clean fine wire screen (200 mesh or finer) or preferably pumped through a 10 micron (absolute) filter.

It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

D. ADJUSTMENTS

No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

E. LUBRICATION

Internal lubrication is provided by the fluid in the system. Lubrication of the shaft couplings should be as specified by their manufacturers. Coat shaft splines with a dry lubricant (Molycoat or equivalent) to prevent wear.

F. REPLACEMENT PARTS

Reliable operation throughout the specified operating range is assured only if genuine Vickers parts are used. Sophisticated design processes and material are used in the manufacture of our parts. Substitutes may result in early failure. Part numbers are shown in the parts drawings listed in Table 2.

G. PRODUCT LIFE

The service life of these products is dependent upon environment, duty cycle, operating parameters and system cleanliness. Since these parameters vary from application to application, the ultimate user must determine and establish the periodic maintenance required to maximize life and detect potential component failure.

H. TROUBLESHOOTING

Table 4 lists the common difficulties experienced with pumps and hydraulic systems. It indicates probable causes and remedies for each of the troubles listed.

TROUBLE	PROBABLE CAUSE	REMEDY
I. Excessive noise in pump.	Low oil level in the reservoir.	Fill reservoir to proper level with the recommended fluid. *Do not* over fill or damage may result.
	Air in the system.	1. Open reservoir cap and operate hydraulic system until purged. 2. "Bleed" hydraulic lines at highest point downstream of pump while system is under pressure.
	Vacuum condition.	1. Check inlet (suction) lines and fittings for air leaks. 2. Check charge pump.
	Oil too thick.	Be certain correct type of oil is used for refilling or adding to the system.
	Cold weather.	Run hydraulic system until unit is warm to the touch and noise disappears.
II. Hydraulic pump overheating.	Internal leakage.	If established that excessive internal leakage exists within the pump, return to maintenance shop for evaluation and repair.
	Heat exchanger not functioning.	Locate trouble and repair or replace.
	Fluid level low.	Add oil to operating level.
III. System not developing pressure.	Overload protection improperly set.	Replace or repair.
	Loss of fluid internally (slippage).	Return to maintenance shop for evaluation and repair.
IV. Loss of fluid.	Ruptured hydraulic line.	Check all external connections, tubing and hoses. Tighten connections, replace ruptured tube or hose.
	Leaking gaskets or seals in the system.	Observe mating sections of pump for leaks. Replace seals or gaskets if possible. Check all system components for leaks.
V. Miscellaneous.	Misadjusted or broken pump control.	Locate and repair. See parts drawing M-2231-S for control information.
	Disconnected or broken drive mechanism.	Locate and repair.

Table 4. Troubleshooting Chart

Section VI – OVERHAUL

A. GENERAL

CAUTION

Block vehicle if it is on a slope to prevent uncontrolled movement.

CAUTION

Before breaking a circuit connection, make certain that power is off and system pressure has been released. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure.

Drain oil from the vehicle hydraulic system. Use new clean oil when restoring the unit to service.

Before breaking a circuit connection, hose off or otherwise clean the outside of the unit thoroughly to prevent entry of dirt into the system.

After removing the PVD pump from the vehicle and before disassembly, cap or plug all ports and disconnected hydraulic lines.

CAUTION

Absolute cleanliness is essential when working on a hydraulic system. Always work in a clean area. The presence of dirt and foreign materials in the system can result in serious damage or inadequate operation.

Repair of the PVD pump will generally not require disassembly to the extent described here. The sequence can also be used as a guide for partial disassembly. In general, disassembly is accomplished in the item number sequence shown in Figures 8, 9 and 10. Special procedures are included in the following steps.

NOTE

Discard and replace all "O" rings, gaskets and shaft seals removed during disassembly.

NOTE

All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Clean all removed parts using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful in cleaning the valve poppet and valve block passages.

B. REMOVAL OF CONTROL AND CHARGE PUMP

CAUTION

Use a chain fall to handle the weight of the pump and valve block in the following steps. Thread appropriate eyebolts into the housing and valve block.

1. Set the piston pump on a steel work bench that will support the weight of the unit to be repaired.

2. Insert the chain fall hook into the valve block eyebolt and take up slack. *Do not* lift the pump from the workbench.

3. Remove existing control tubing, then, remove the four control attaching screws (1). Remove control (2) and set aside. Discard interface "O" rings. (Refer to Figure 10.)

(2) on PVD80 and PVD120 units. The spline coupling (5) (Figure 10) may or may not be removed with the charge pump. Remove spline coupling (5) from the shaft.

NOTE

If further disassembly of the PVD45 charge pump is required, perform steps (6 through 10). If further disassembly of the PVD80 or PVD120 charge pump is necessary, omit steps (6 through 10) and perform steps (11 through 15). If disassembly of the charge pump is not required, omit steps (6 through 15) and proceed to Section VI-E.

6. Place the charge pump in a vise. Use thin plywood shims between the vise and pump to prevent scratching machined surfaces. The spine shaft should point up.

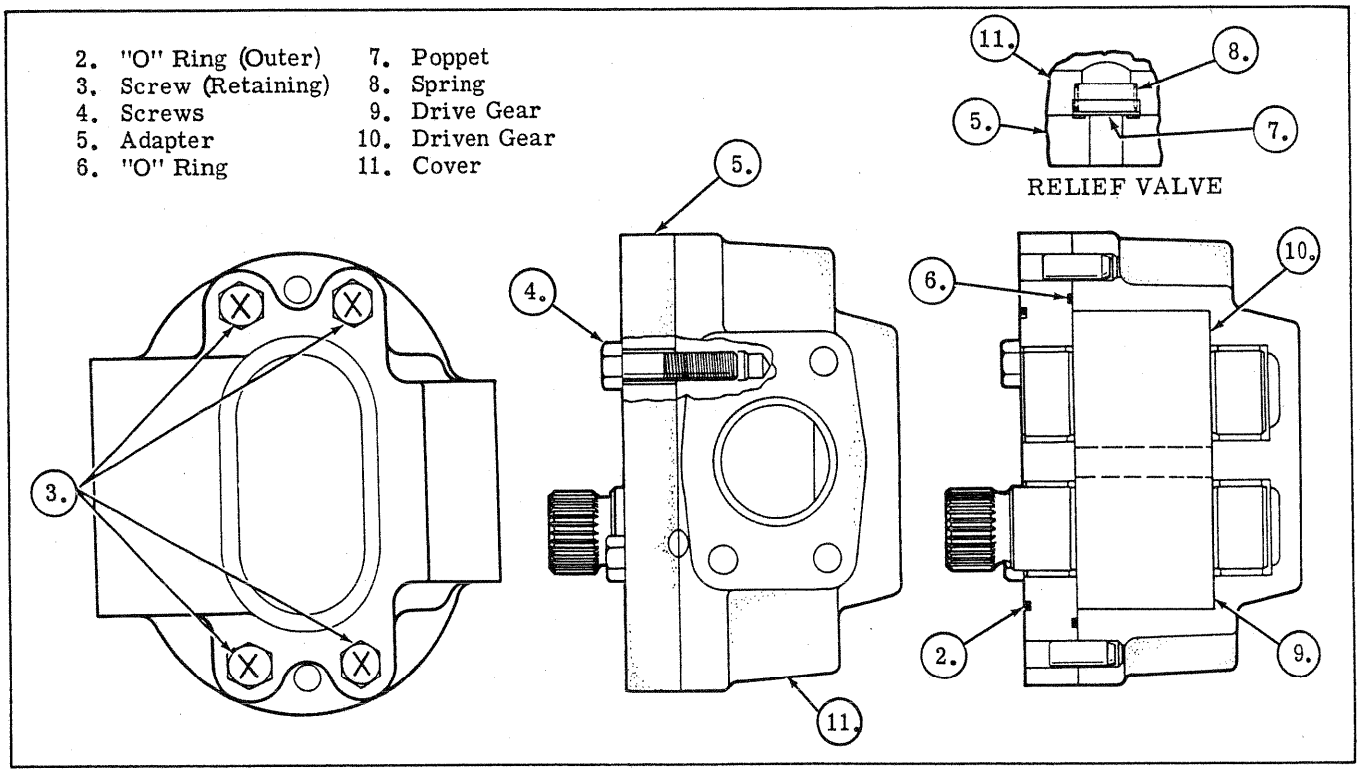


Figure 8. PVD45 Charge Pump

NOTE

This manual does not cover repair of controls. Refer to parts drawing and overhaul manual M-2231-S for this information.

NOTE

Do not disassemble the charge pump except to clean or replace seals. If other problems exist within the pump, replacement of the complete unit is recommended. If the gear pump is opened for cleaning, replace the seals.

4. Remove four retaining screws (3) located in charge pump cover. See Figure 8 for PVD45 units and Figure 9 for PVD80 and PVD120 units. Remove screws indicated by an "X".

5. Slide the charge pump away from the valve block. Discard the outer "O" ring (2) on PVD45 units. Discard the gasket

7. Remove four screws (4) that connect adapter (5) to cover (11) on the PVD45 unit, and remove adapter (5) from cover (11) exposing the gears. Discard "O" ring (6).

8. Remove the internal relief valve poppet (7) and spring (8) from their location beneath adapter (5).

NOTE

The poppet (7), spring (8) and seat (part of adapter (5)) form an internal relief valve (5-15 PSIG). The function of this valve is to pressurize the housing, while providing an internal drain path from the housing to the inlet of the charge pump.

9. Remove the drive gear (9) and driven gear (10) from the cover pocket.

10. Clean all gear pump parts and set aside for inspection.

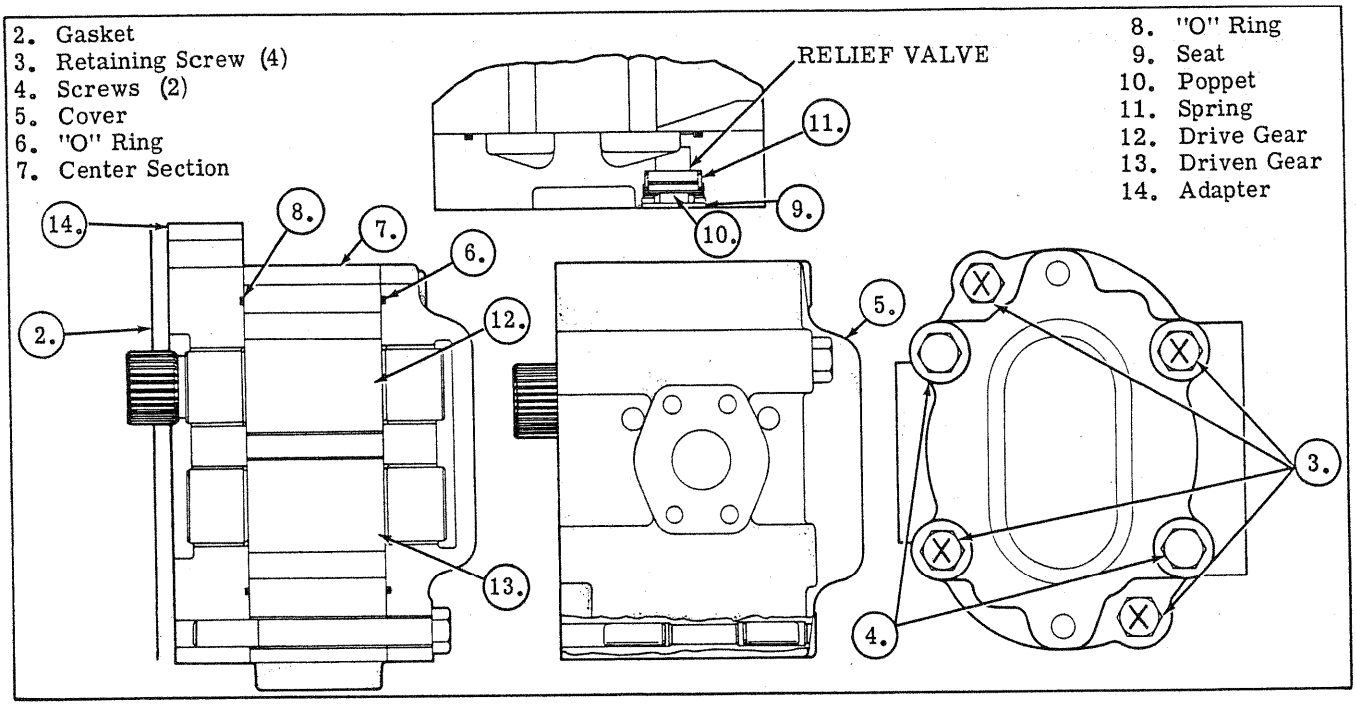


Figure 9. PVD80 and PVD120 Charge Pump

NOTE

The following steps (11) through (15) pertain to disassembly of the PVD80 and PVD120 units. Refer to Figure 9.

11. Install the charge pump into a vise with the jaws holding adapter (14) and the cover (5) pointing up.

12. Remove two retaining screws (4) from cover (5) and separate the cover from the balance of the pump. Discard "O" ring (6).

13. Remove center section (7) from adapter (14). Discard "O" ring (8). *Do not* remove relief valve seat (9) from adapter (14) unless inspection reveals a possible malfunction. Use a small tool to move poppet (10) against spring (11). The poppet should return to the seated position upon release of the tool.

14. Remove drive gear (12) and driven gear (13) from adapter (14).

15. Clean and set parts aside for inspection.

C. INSPECTION, REPAIR AND REPLACEMENT

NOTE

Replace the charge pump if parts do not meet the following specifications.

1. Inspect all components for wear, erosion and/or seizure.

2. Check the center section or cover for porosity, erosion, or heavy wear pattern.

3. Check the shaft splines and gear tips for wear or damage.

4. Check journals for burnishing and heat discoloration.

5. Check cover and adapter for excessive wear in the area of the gears.

D. ASSEMBLY OF CHARGE PUMP

NOTE

Cover the assembly area with clean Kraft paper to prevent contamination of parts.

1. Obtain a seal kit for the unit being repaired. Refer to parts drawing for seal kit information. See Table 2.

2. Assemble the charge pump as follows: Refer to sectional view Figure 8 for PVD45 units and Figure 9 for the PVD80 and PVD120 units.

NOTE

Flood all parts with clean system fluid at assembly. Perform steps (9) through (16) for PVD120 units.

3. Place cover (11) in the jaws of a vise with pocket pointing up. Figure 8 shows the pump assembled in the right hand configuration. Reverse the location of the drive and driven gears (9 and 10) for left hand rotation.

4. Install drive and driven gears (9 and 10) into charge pump cover (11). Make sure gears are located to provide proper shaft rotation for the unit.

5. Lubricate relief valve spring (8) and poppet (7) with system fluid. Assemble spring in place within cover (11) and place poppet on top of spring.

6. Lubricate journals in adapter (5). Install a new internal "O" ring (6). Orient adapter (5) to align pins and relief valve hole with cover (11). Push relief valve down into cover. Insert a cover screw through adapter hole and hold the poppet in position until adapter is in place. *Do not* pinch "O" ring (6). Check movement of poppet with screw after adapter (5) is in place.

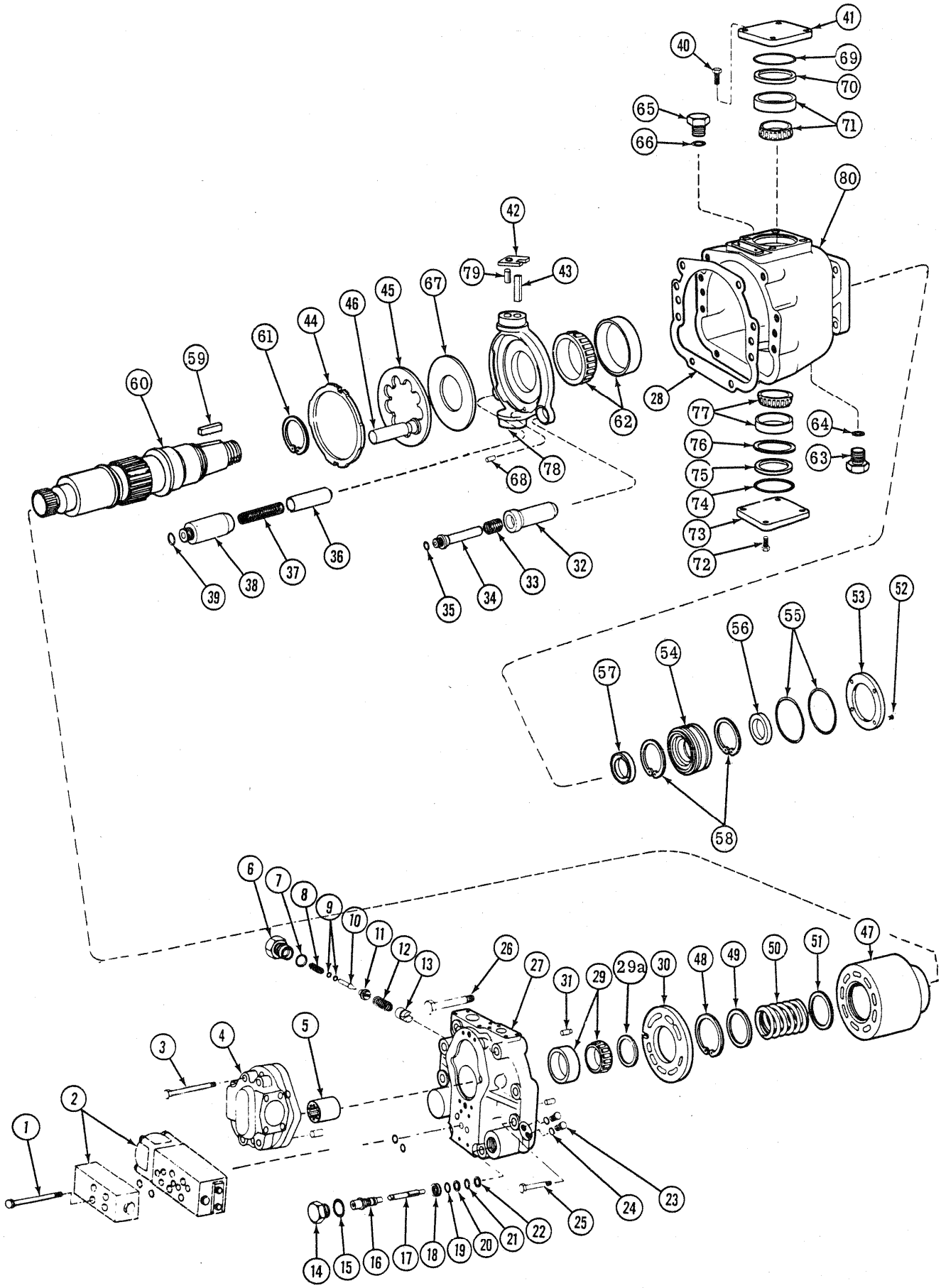


Figure 10. Piston Pump Exploded View (PVD45 shown)

ITEM	NOMENCLATURE	QTY.	ITEM	NOMENCLATURE	QTY.
1	Screw	4	41	Cover	1
2	Control	1	42	Pin Lock	1
3	Screw	4	43	Key	1
4	Charge Pump	1	44	Lock Spacer	1
5	Coupling	1	45	Shoe Plate	1
6	Plug	1	46	Piston & Shoe S/A	9
7	"O" Ring	1	47	Cylinder Block	1
8	Spring	1	48	Retaining Ring	1
9	Shims	A/R	49	Washer	1
10	Poppet	1	50	Spring	1
11	Seat	1	51	Washer	1
12	Spring	1	52	Screw	4
13	Valve	1	53	Retainer	1
14	Plug	1	54	Seal Retainer	1
15	"O" Ring	1	55	"O" Ring	2
16	Sleeve	1	56	Outer Shaft Seal	1
17	Spool	1	57	Inner Shaft Seal	1
18	Shims	A/R	58	Retaining Ring	2
19	"O" Ring	1	59	Shaft Key	1
20	Back-Up Ring	1	60	Shaft	1
21	"O" Ring	1	61	Retaining Ring	1
22	Back-Up Ring	1	62	Shaft Bearing	1
23	Plug	2	63	Plug	1
24	"O" Ring	2	64	"O" Ring	1
25	Screw	7	65	Plug	1
26	Screw	1	66	"O" Ring	1
27	Valve Block	1	67	Swash Plate	1
28	Gasket	1	68	Pin	1
29	Tail Bearing	1	69	"O" Ring	1
29a	Spacer	1	70	Spacer	1
30	Valve Plate	1	71	Bearing	1
31	Pin	2	72	Screw	4
32	Bias Piston	1	73	Cover	1
33	Spring	1	74	"O" Ring	1
34	Bias Piston Rod	1	75	Spacer	1
35	"O" Ring	1	76	Shims	A/R
36	Control Piston	1	77	Bearing	1
37	Spring	1	78	Yoke	1
38	Control Piston Sleeve	1	79	Roll Pin	1
39	"O" Ring	1	80	Housing	1
40	Screw	4			

Figure 10. Piston Pump Exploded View Part Nomenclature
(PVD45 shown)

7. Thread four screws (4) through adapter (5) into cover (11). Tighten the screws to 35-45 lb. ft. (47.2-60.8 N.m.)

8. Drive shaft must turn freely by hand after assembly. Install a new "O" ring (2) into adapter (5). Cover the unit to prevent dirt contamination.

9. Place the PVD80 or PVD120 cover (5) in the jaws of a vice with interface pointing up. Figure 9 shows the pump assembled in the right hand configuration. Reverse the location of the drive and driven gears (12 & 13) for left hand units.

10. Install the drive and driven gears (12 & 13) into charge pump cover (5). Make sure of proper shaft rotation for the unit. (See Figure 9.)

11. If the relief valve was removed, install spring (11), poppet (10) and seat (9) as shown in Figure 9. Press seat (9) in place within adapter (14). Check movement of poppet (10) after installation.

12. Install a new "O" ring (6) into the groove of cover (5).

13. Install center section (7) over the gears. Right hand units will have the inlet positioned as shown in Figure 9. Flood gears with system fluid. *Do not* pinch "O" ring (6) during installation.

14. Install "O" ring (8) into adapter (14) and lubricate journals. Orient the adapter to align pins and then install over drive and driven gears (12 & 13) and up against center section (7). Alignment pins will hold adapter (14) and center section (7) in the proper position. *Do not* pinch "O" ring (8) at assembly.

15. Thread the two retaining screws (4) through cover (5) into adapter (14) hand tight. Turn the pump over and place in the vise with the jaws connected to adapter (14). Tighten the two screws to 118-127 lb. ft. (160-172 N.m).

NOTE
Torque required to turn pump after assembly must not exceed 8.85 lb. ft. (12 N.m).

16. Install gasket (2) over alignment pins and set aside for assembly. Cover to prevent contamination from entering unit

E. DISASSEMBLY OF PISTON PUMP

1. Remove charge relief valve parts, items (6 through 13). A small pencil magnet may be found useful during this operation. See Figure 10.

NOTE

Units that do not use the yoke feedback parts will omit the following steps, items (14 through 22) (See Figure 10).

2. Remove yoke feedback parts, items (14 through 22). Use care during removal of sleeve (16) to prevent scoring feedback spool (17).

3. Remove plugs (23) and "O" rings (24). Discard "O" rings.

4. Remove two valve block screws (25) located across from each other. Install the studs noted under special tools for this unit into housing (80). Tighten in place with vise grip pliers.

5. Remove the remaining valve block screws (25) and set aside for inspection.

6. Use the chain fall to help remove the valve block (27) from the housing (80). Slide the valve block away from the housing slowly. Valve plate (30) may stick to cylinder block (47) during removal of the valve block. Be careful not to damage the valve plate, valve block or housing faces during this operation. Once the valve block moves away, do not allow the valve block to move back against the housing as the valve plate may be damaged. Discard gasket (28).

NOTE

In the following step, it is sometimes difficult to remove valve plate (30) from cylinder block (47). If this is the case, remove bearing (29). This allows valve plate (30) to drop down for easy removal.

7. Remove valve plate (30). Remove rear shaft bearing cone (29) and spacer (29a) from shaft (60). Do not remove rear shaft bearing race (29) from the valve block.

8. Remove valve plate pin (31) from the valve block. Do not damage the valve block during removal.

9. Remove bias piston (32) and spring (33). Do not remove bias piston rod (34) and "O" ring (35) unless inspection of the bias rod indicates a problem.

10. Remove control piston (36) and spring (37). Do not remove control piston sleeve (38) and "O" ring (39) unless inspection of the control piston indicates a problem.

11. Remove the four screws (40) which hold the pintle cover (41) to the housing. Remove cover (41). Located under the cover on PVD45 units is a key locking arrangement, items (42 & 79). These will not exist on the PVD80 and PVD120 models. Item (43) is a key that fits in the slot of spacer (44) and retains the rotating group. After removal of the key, replace the pintle cover and screws. Tighten the pintle cover and screws. Tighten the pintle screws hand tight.

12. Reach into the housing with the special length of 1/8 inch drill rod prepared in the special tools section of this manual. Rotate lock spacer (44) with the drill rod to unlock shoe plate (45) from within yoke (78). Reach in with both hands and grab the complete rotating group as a unit and withdraw from the housing.

NOTE

The rotating group consists of the following items: spacer (44), shoe plate (45), 9 piston and shoe S/A (46), cylinder block S/A (47), retaining ring (48), washer (49), spring (50) and washer (51).

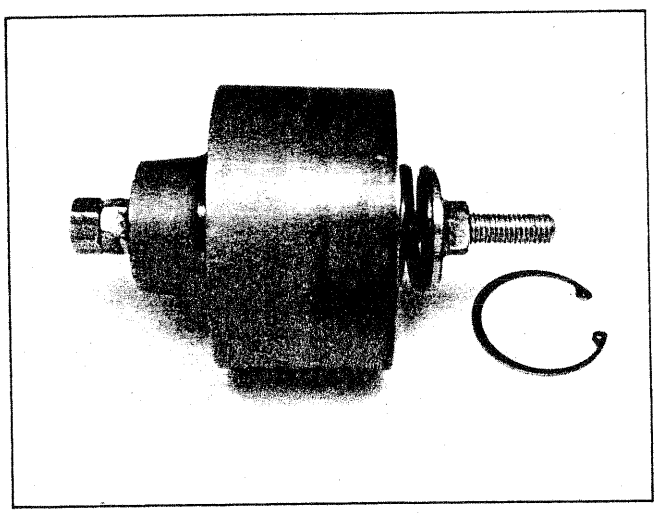


Figure 11.

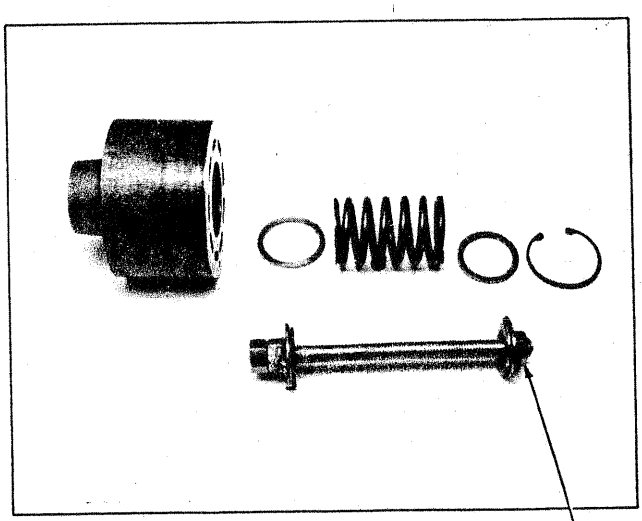


Figure 11a.

Cylinder Block Disasembly Procedure

Install tool with slotted washer toward retaining ring end of cylinder block S/A. Position slot so retaining ring can be removed. Tighten nuts to compress spring and washer. Remove retaining ring. Loosen nuts to relieve spring compression.

See Figure 7 for this tool

CAUTION

Spring (50) located within the cylinder block is under a high compression and can cause bodily harm if retaining ring (48) is removed without adequate caution. See Figure 11 for disassembly instructions.

13. Remove shaft key (59) from shaft (60). Remove the front shaft seal arrangement, items (52 through 58). Disassemble "O" rings (55) and shaft seals (56 & 57) from retainer (54). Discard seals and "O" rings. *Do not* remove retaining rings (58) unless they are defective. PVD45 and PVD120 units require a TX-30 Torx tool for removal of screws (52). See special tools.

14. Remove shaft (60) from housing (80). Slide shaft (60), retaining ring (61) and bearing (62) as an assembly out of the flange end of housing. *Do not* remove retaining ring and bearing from shaft unless inspection determines the parts defective.

15. Remove plugs and "O" rings (63 through 66). Discard "O" rings.

16. Remove swash plate (67) and pin (68) from yoke (78).

NOTE

In the following step, the yoke and bearings may not require removal from the housing. The top yoke bearing (71) can be removed without disturbing the yoke bearing preload adjustment. Inspection of the yoke and top yoke bearing will give an indication of the condition of these parts. If any signs of wear or cracks in the yoke are found, or if the bearing has signs of brinelling, pitting of the rollers or demonstrates roughness when turned in the race, remove both bearings and the yoke for further inspection. If the yoke is replaced, a yoke bearing preload adjustment must be performed at assembly. Each set of pintle parts must be kept separated from each other during the following inspection. Pintle bearings may show marks caused by static loading of roller and race. These marks are called "false brinelling" by the manufacturer. If rotation of the bearing within its race is smooth, the bearing is usually serviceable even though it may appear bad.

17. Remove the four screws (40) and cover (41). Remove parts (69 through 71). Inspect the bearing and yoke as noted above. If found defective, remove parts (72 through 79) from housing (80). If the bearing and yoke are found serviceable, install bearing (71), bearing spacer (70), cover (41) and screws (40) back into the housing. Thread screws (40) hand tight. Do not remove special valve block alignment screws during inspection. They will be used to assemble the unit.

F. INSPECTION, REPAIR AND REPLACEMENT

NOTE

Replace all parts that do not meet the following specifications.

NOTE

All parts must be thoroughly cleaned and kept clean during inspection and assembly. Clean all removed parts, using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful in cleaning valve block passages, cylinder blocks, etc.

NOTE

Shaft (60) on the PVD45 model was changed to allow easier shimming at the rear bearing on the -23 design instead of the front bearing as on the older -22 design. The new shaft can be used to repair the -22 design, if necessary, when spacer (29a) is used. Follow shimming procedure G9.

Refer to Service Drawing M-2239-S for shim kits.

1. Inspect all screws for burrs, broken or stripped threads and worn corners on the hex head. Use an India stone to clean up burrs. If threads or hex heads are defective, replace the screw.

2. Inspect coupling (5) for worn and broken splines. Replace coupling if defective.

3. Inspect the threaded plugs for worn corners on the hex head, stripped threads and burrs in the "O" ring groove. Use an India stone to remove burrs. If threads are defective, replace the plug.

4. Inspect springs for wear and damaged coils. Replace spring if worn or damaged. Inspect springs for distortion. The ends of the spring must be parallel to each other and ground square with axis within 3°. Replace if distorted.

5. Inspect charge relief valve poppet (10) for wear. Replace if worn.

6. Inspect charge relief valve seat (11) for wear and erosion. Replace if defective.

7. Inspect the charge relief valve (13) for wear, galling, erosion and burrs. If wear is found, replace the part. Check wear by inserting the valve into the valve block bore. Move the part in and out while rotating through 360°. If the valve hangs up or binds, use an India stone on the exterior of the valve to eliminate any possibility of burrs. Check the bore of the valve block for scratches and worn areas. Replace both the valve block (27) and relief valve (13) if parts are found defective.

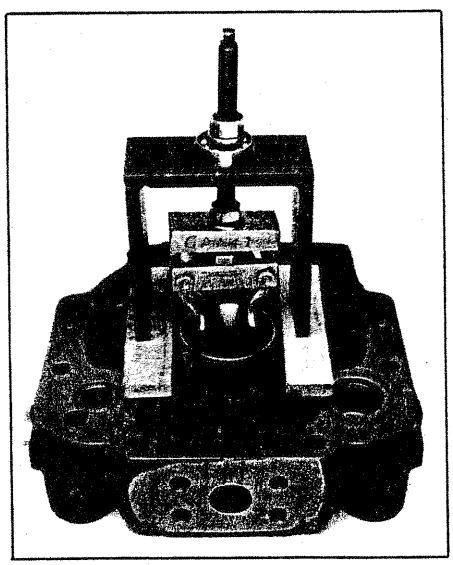


Figure 12. Removal of Bearing Race from Valve Block

8. Inspect feedback spool (17) for scratches on exterior of the lands. If scratches are found, replace spool (17) and sleeve (16) as a subassembly. The spool and sleeve are critical parts and cannot be replaced individually. Feedback spool subassemblies are tabulated on the control parts drawing. See Table 2.

9. Inspect bearings (29, 62, 71 & 77) for brinelling, pitting of rollers and roughness when turned in the bearing race. If a bearing is defective, both the bearing cone and bearing race must be replaced. If bearing race located in valve block (27) requires removal, refer to the procedure shown in Figure 12.

10. Inspect the bronze surface of valve plate (30) for excessive wear, scoring, or heavy erosion. If any of these conditions are noted, replace the valve plate. In most cases, the bronze surface will have a slight circular wear pattern and brown, burnishing areas. This is normal. The overall condition of the valve plate is attributed to the amount of service life, system fluid conditions and actual operating conditions of the pump.

11. Inspect bias piston (32) and bias rod (34) for proper fit. Make sure the parts fit together without binding. Also, make sure the end of bias piston (32) is not worn at the area of yoke (78) contact. If wear is found, check yoke (79) ball socket for bind. The yoke ball should rotate freely a total of 17.5° spherical without binding.

12. Inspect control piston (36) and sleeve (38) as noted in previous step.

13. If yoke (78) was removed from housing (80), check for wear at the area of the yoke pintles (yoke bearing area). Check yoke for stress cracks. Replace yoke if wear or cracks are found. If yoke is replaced on a PVD45 unit, install a new roll pin (79) into the yoke pintle.

14. Inspect pintle cover(s) (41) and (73) if removed. Check for flatness and burrs. Remove burrs with an India stone.

15. Inspect lock spacer key (43) for wear. Replace if worn or deformed.

16. Inspect lock spacer (44) for excessive wear, heavy scratches and burrs. Replace if the part shows evidence of wear. Remove burrs with an India stone.

17. Inspect shoe plate (45) for cracks and heavy wear. If wear is evident, replace the part. The PVD45 shoe plate is shown in Figure 10. PVD80 and 120 shoe plates differ from the one shown. PVD80 and 120 shoe plates have nine circular openings instead of the nine half circles of the PVD45 shoe plate.

18. Inspect cylinder block (47) for wear, scratches and/or erosion between cylinders. Check each cylinder block bore for excessive wear. Use the piston and shoe subassemblies (46) for this purpose. The piston should be a very close fit and slide easily in and out of the bore. No bind can be tolerated. If binding is evident, clean the cylinder block and piston, lubricate with clean system fluid and try again. Even minor contamination of the fluid could cause the piston to freeze up within the cylinder block bore.

19. Check retaining ring (48), washer (49), spring (50) and washer (51) which were removed from the cylinder block for wear and burrs. Replace if defective.

20. Inspect each piston shoe subassembly (46) for a maximum end play of 0.003 inch (0.0762 mm); also, check for freedom of movement of the shoe. The shoe must be free to rotate through 17° minimum (spherical). Replace the complete set of piston/shoe subassemblies if one is defective.

21. Check retainer (53) for burrs and heavy scratches. Remove scratches and burrs with an India stone or small file.

22. Check inner seal retainer (54) for burrs, especially check "O" ring groove areas. Remove burrs with an India stone.

23. Do not remove retaining rings (58) from within seal retainer (54) unless they are bent or broken.

24. Inspect shaft key (59) for evidence of wear. Replace if worn.

25. Inspect shaft (60) for wear and chipped splines, also check for wear in the area of the shaft seal. If the shaft is worn more than 0.005 inch (0.127 mm) total indicator reading (TIR), replace the shaft. Do not remove retaining ring (60) from the shaft unless it shows evidence of wear or the shaft requires replacement.

26. Inspect swash plate (67) for wear, pickup, heavy scratches and excessive wear. Replace the swash plate if evidence of wear is shown or if piston shoe wear was noted in step **F.**20.

27. Inspect pin (68) and two spacers (70 & 75) for burrs. Clean up with an India stone.

28. *Do not* remove roll pin (79) from yoke (78) on PVD45 models unless damaged or the yoke is replaced.

29. Inspect housing (80) for burrs, nicks, cracks, cross threads and wear in the area of the pintle bearings. Check each pintle face for flatness and burrs. Inspect mounting face for deep scratches that could cause leakage past the gasket. Clean up burrs and small scratches with an India stone.

G. ASSEMBLY OF PISTON PUMP

1. If yoke (78), pintle bearings (71, 77) or housing (80) are replaced, obtain a new shim kit and perform the pintle bearing preload shimming procedure (steps a through k).

a. Insert the yoke (78) into housing (80) so that both yoke hubs are centered at pintle opening of housing.

b. Lubricate bearing cones (71, 77) with clean system fluid. Install the bearing cones into housing and onto yoke hubs.

c. Install matching bearing races (71, 77) into housing opening over the bearing cones. *Do not* force the bearing races into housing.

d. Position the housing (80) so that the pin hole at end of yoke hub is exposed.

e. Assemble spacer (70) on top of bearing race (71). Install "O" ring (69) into housing groove. Fasten the pintle cover (41) to housing with four screws (40). Tighten the screws to value noted in Table 5.

MODEL	TORQUE SCREWS TO:	
	N.m	lb. ft.
PVD45	14.7 - 16.9	10.8 - 12.5
PVD80	41 - 49	30.2 - 36.1
PVD120	40 - 50	29.5 - 36.9

Table 5. Pintle Cover Screw Torque

f. Reposition the housing to assemble the other pintle parts. Install approximately .025/.027 shim (76) thickness on top of bearing race (77). Install spacer (75). Install "O" ring (74) into housing groove. Assemble pintle cover (73) onto housing with four screws (72). Tighten the screws to value noted in Table 5.

g. Place the housing mounting surface on a suitable workbench. See Figure 13.

h. Push the yoke up and down two or three times by hand.

i. Place a force indicator at highest yoke ball location. See Figure 13. Apply force to the yoke ball and observe the force required to start yoke movement. The force required to move the yoke is noted in Table 6. If the force is too high, the shim (76) thickness must be reduced. If the force is too low, the shim (76) thickness must increase. (NOTE: One pound of force equals approximately .001 shim thickness.)

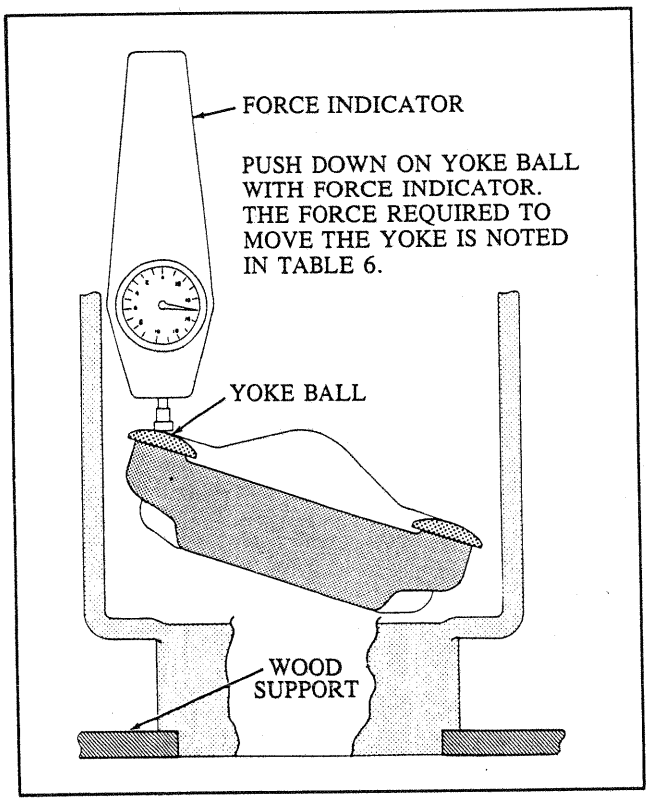


Figure 13. Force Measurement

MODEL	FORCE	
	Newtons (N)	Pounds (lb.)
PVD45	44.5 - 66.75	10 - 15
PVD80		
PVD120		

Table 6. Force Required To Move Yoke

j. Repeat steps 'h' and 'i' if necessary. Adjust shim (76) thickness to Table 6.

k. Remove pintle cover (41) so that pin hole in yoke hub is exposed.

2. Install swash plate pin (68) into yoke (78) and assemble swash plate (67) in place over the pin. Check height of pin in yoke and depth of hole in swash plate. There should be clearance to allow swash plate to set flat against yoke surface. Make sure swash plate pin hole is aligned properly with the pin before assembly.

3. Install "O" rings (66 & 64) over plugs (65 & 63 Lubricate and thread plugs into housing (80). Tighten plugs the value noted in Table 7.

MODEL	PLUG TORQUE	
	N.m	lb. ft.
PVD45	140 - 150	103 - 111
PVD80	129 - 142	95 - 105
PVD120	170 - 190	125 - 140

Table 7. Housing Plug Torques

NOTE

Perform the following step if bearing (62) was removed from shaft (60) during inspection. Omit the following step if bearing was not removed from the shaft.

4. Install retaining ring (61) in place on shaft (60).

a. Press bearing (62) on shaft (60). Make sure small end of cone points toward end of shaft at completion of press. Use an arbor press for this operation.

b. Clean bearing with a solvent compatible with system fluid. Lubricate and set bearing race in place over the cone.

c. Rotate the bearing race and cone to verify freedom of movement and smooth operation. Bearing must not bind or have a feeling of roughness.

NOTE

If bearing race (29) was removed from valve block (27), press a new bearing race in place as noted in the following step. If the bearing race is in place within the valve block, omit the following step.

5. Position valve block (27) on the clean surface of an arbor press. Use a piece of wood to protect lower surface of valve block. Position new bearing race (29) with small I.D. facing into valve block. Press in place. Use a suitable socket wrench or piece of hardwood as a pressing tool. Press bearing race (29) into valve block until it bottoms against shoulder.

6. Install shaft (60) with bearing into flange end of housing (80).

7. Install "O" rings (55) and retaining rings (58) (if removed). Install appropriate shaft seals (56 & 57). Single shaft seal units will use seal (57) only. The spring loaded member of seal (56) is pointing out of the pump. The spring loaded member of seal (57) points into the pump. Lubricate shaft seals and "O" rings with system fluid and install inner seal retainer (54) in place within the pump. Use a layer of plastic tape over shaft splines to prevent cutting the seals.

8. Install the outer seal retainer (53). Thread screws (52) through outer seal retainer (53) and into housing (80). Cross tighten the screws to value indicated in Table 8.

MODEL	TORQUE SCREWS TO:	
	N.m	lb. ft.
PVD45	7 - 9	5.1 - 6.6
PVD80	20 - 25	14.8 - 18.4
PVD120	11 - 13	8.1 - 17.0

Table 8. Torque Retainer Screws (52) As Indicated

9. Obtain a spacer kit and perform the shaft end play shimming procedure (steps 'a' through 'l').

a. Select the thinnest spacer (29a) from the spacer kit and install it on end of shaft.

b. Install tail bearing cones (29) on end of shaft against spacer (29a).

c. Install gasket (28) onto pump housing (80).

d. Install valve block (27) on housing. Secure the valve block with screws (26). Tighten the screws to value noted in Table 9.

MODEL	VALVE BLOCK SCREW TORQUES	
	N.m	lb. ft.
PVD45	47.5 - 54.2	35 - 40
PVD80	180 - 200	133 - 147.5
PVD120	251 - 278	185 - 205

Table 9. Valve Block Screw Torque

e. Position the unit so that the shaft (60) is in a vertical position.

f. Rotate the shaft by hand and lift up and down on the shaft to seat the bearings.

g. Place a dial indicator at end of shaft and measure shaft movement. Repeat this step two times to obtain an average reading.

h. Remove the valve block (27), tail bearing cone (29) and spacer (29a).

i. Select the proper spacer thickness from spacer kit to obtain .001-.004 shaft end play.

j. Install spacer (29a) on end of shaft.

k. Repeat steps 'b' through 'g'. Perform steps 'h' through 'j', if required, until .001-.004 shaft end play is obtained.

l. Remove valve block (27), gasket (28), bearing cone (29) and spacer (29a). Set these parts aside.

10. Assemble rotating group as follows:

NOTE

If cylinder block (47) was disassembled during inspection, install washer (51), spring (50), washer (49) and retaining ring (48). Refer to Figure 11 and reverse removal procedures. *Make sure* that sharp edge of retaining ring (48) points outward and is seated properly within its groove before removing threaded tool from cylinder block.

a. Set cylinder block (47) on a clean surface. Use Kraft paper between cylinder block face and work bench to prevent scratching the machined surface. Lubricate cylinder block bores with system fluid.

NOTE

In the following step, make sure lock spacer (44) is positioned properly for insertion of lock key (43). The lock key fits into the off center slot of the lock spacer. If in doubt, insert lock spacer into yoke (78) without rotating group to verify correct orientation.

b. Place lock spacer (44) on top of cylinder block (47) then install nine piston and shoe subassemblies (46) with shoe plate (45) into the cylinder block. See Figure 10. Piston shoe subassemblies and shoe plates differ between the PVD45 and the PVD80/120 units. The PVD45 uses a scalloped shoe plate and the PVD80/120uses a full round hole type shoe plate. The PVD45 scalloped shoe plate assembles into a groove located in the side of each shoe. The PVD80/120 shoe plate assembles behind the shoes (between shoe and cylinder block).

NOTE

The rotating group should be installed in the horizontal plane.

c. Install the complete rotating group over the shaft end and slide the group forward until the shoes rest against swash plate (67) located within yoke (78). Rotate slightly to align spline of shaft to cylinder block.

d. Use special tool (a length of 1/8" drill rod) to position lock spacer (44) into yoke (78). Turn lock spacer with tool until its slot is in line with key (43). Insert key (43). Verify that key is located within the slot. This is very important. If the key is not positioned properly, destruction of the pump may result at start-up. (NOTE: PVD45 units have an additional pin lock (42) and roll pin (79) arrangement. Install pin lock (42) over key (43). Then install roll pin (79)). Install pintle cover (41) and screws (40). Tighten screws to value noted in Table 5.

e. Install spacer (29a) in place on the shaft. Then install bearing cone (29) on the shaft.

11. Assemble valve block (27) to housing as follows:

NOTE

If bias piston rod (34) and control piston (38) were removed from valve block (27), perform the following steps 'a' and 'b'. If the parts were not removed from valve block (27), omit the following two steps and perform step 'c'.

a. Install a new "O" ring (35) on bias piston rod (34). Thread the bias piston rod into valve block (27) and torque to value noted in Table 10.

MODEL	TORQUE	
	N.m	lb. ft.
PVD45	203	150
PVD80	240 - 260	177 - 192
PVD120	300 - 350	221 - 258

Table 10. Piston Rod Torque

b. Install a new "O" ring (39) on control piston (38). Thread the control piston into valve block (27) and torque to value noted in Table 10.

c. Install bias piston spring (33) and bias piston (32) over bias piston rod (34).

d. Install control piston spring (37) and control piston rod (36) within control piston (38).

e. Install valve plate pin (31) into valve block (27). Install valve plate (30) over the valve plate pin. (Use grease on the back side of valve plate to prevent separation from valve block during installation.) Make sure valve plate is flush against the valve block. Lubricate face of the valve plate with system fluid and then lubricate cylinder block (47).

CAUTION

In the following step *do not* allow valve plate (30) to touch cylinder block (47) and then back away. Valve plate (30) may adhere to the cylinder block and if pulled away, can fall out of position with valve plate pin (31). If valve block (27) is then moved against housing (80), damage to valve plate and cylinder block may result.

f. Install gasket (28) over the two alignment studs. Position valve block (27) on alignment studs and slide up against housing (80). Make sure shaft (60) is aligned with bearing and does not hit against the valve plate during installation. Thread screws (25 & 26) through valve block and into housing (80). Remove alignment studs and replace them with the appropriate screws. Tighten valve block screws to value noted in Table 9.

12. Install a new shaft key (59) into the end of shaft (60). Turn piston pump from the vertical position and set it on the workbench with shaft in the horizontal position.

NOTE

At this time, turn the pump shaft in both directions with a wrench. There should be a slight breakaway torque and the shaft should turn free in both directions. If there is resistance to turning in either direction, investigate.

NOTE

The following steps 13 and 14 will vary with different control arrangements. Perform these steps as required for your control. Refer to control parts drawing M-2231-S.

13. Assemble "O" rings (24) on plugs (23) and thread plugs into valve block (27). Torque plugs to 15-18.4 lb. ft. (20-25 N.m).

14. Assemble items (22 through 19) on sleeve (16). Assemble all shims (18) over sleeve. Lubricate seals with system fluid and insert sleeve (16) into valve block (27). Insert feedback spool (17) into sleeve (16), with short land pointing out of valve block. Refer to Figure 10. Install a new "O" ring (15) on plug (14). Lubricate and thread plug (14) into valve block over sleeve (16). Tighten plug (14) to the value noted in Table 11. Final adjustment of feedback spool shims will be accomplished during test.

MODEL	PLUG TORQUE	
	N.m	lb. ft.
PVD45	244 - 257.6	180 - 190
PVD80	300 - 330	221 - 243
PVD120	130 - 140	96 - 103

Table 11. Feedback Spool Plug Torque

15. Assemble the charge relief valve parts as follows:

a. Lubricate and install spring (12) into piston (13). Slide piston and spring into valve block (27).

b. Assemble "O" ring (7) on plug (6). Assemble spring (8) into plug (6). Assemble shims (9) over poppet (10). Insert poppet into spring, located in plug (6). Thread seat (11) into plug (6). Tighten seat (11) into plug to the values noted in Table 12.

MODEL	SEAT TORQUE	
	N.m	lb. ft.
PVD45	14 - 18	10 - 13
PVD80	12 - 15	8.85 - 11
PVD120	31 - 37	23 - 27

Table 12. Charge Relief Valve Seat Torque

c. Install plug (6) into valve block (27). Make sure spring guide portion of seat is located within spring (12) at assembly. Torque plug (6) into valve block (27). The torque figures are the same as for the feedback spool plug shown in Table 11.

16. Assemble the charge pump to the piston pump as follows:

a. Clean the charge pump pad located on the valve block. Make sure the area of contact is clean.

b. Install coupling (5) over end of piston pump shaft (60).

c. Install charge pump assembly and seal (4) to the valve block (27). Install screws (3) and tighten to value noted in Table 13.

MODEL	SCREW TORQUES	
	N.m	lb. ft.
PVD45	46 - 48	34 - 35.4
PVD80	180 - 200	132.8 - 147.5
PVD120	160 - 172	118 - 127

Table 13. Charge Pump Screw Torque

17. Assemble control (2) to valve block (27) with screws (1). Be sure to assemble various control sections in the order of removal. Make sure control seals are in place before installation. Install control tubing in place. To check orientation of control, refer to control parts drawing M-2231-S.

Section VII – TEST PROCEDURE

NOTE

Due to the nature of the PVD heavy duty piston series, the use of a hydraulic pump control is mandatory. Refer to controls drawing and overhaul manual M-2231-S for appropriate control parts and testing of PVD piston units with controls.