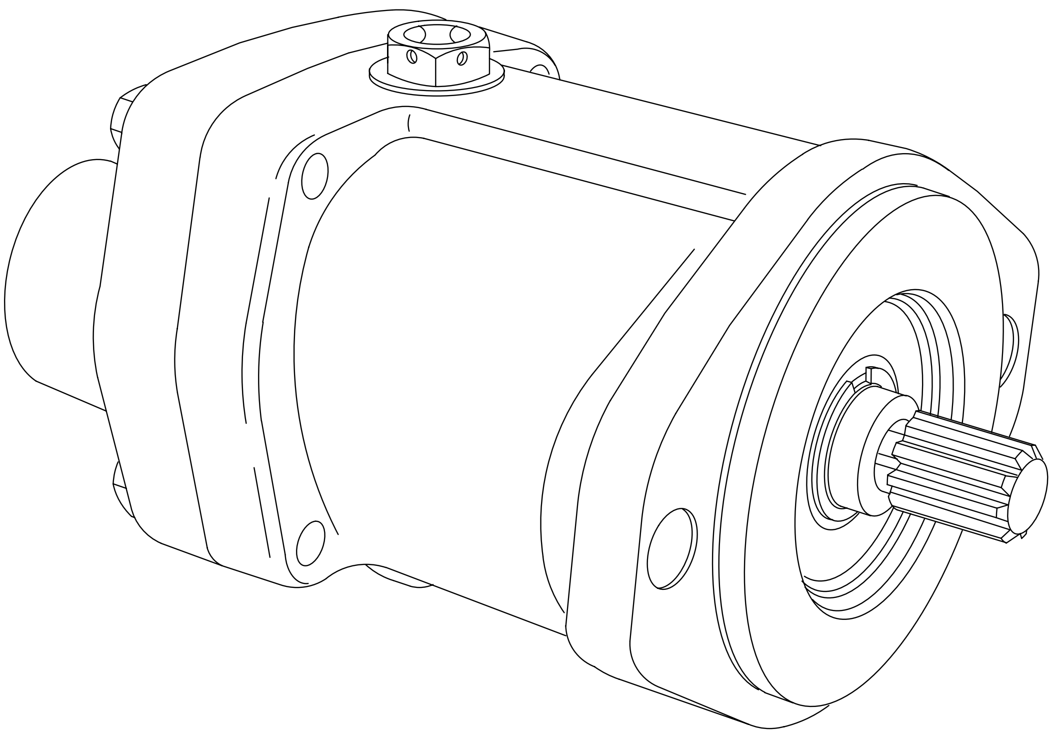
Overhaul Manual

Vickers®

Pumps

Inline Piston Pumps

M-PFB & M-PVB Series



Revised 12/1/85

M-2200-S

Table of Contents

Section I – Introduction

A. Purpose of Manual

The purpose of this manual is to describe the basic operational characteristic and to provide service and overhaul information for Vickers Fixed and Variable Delivery Inline Piston Pumps. Models included in this series are listed in Table 1. Information contained in this manual pertains to the latest designs. Earlier designs are covered only to the extent of their similarity to present equipment.

B. General Information

Related Publications – Service parts information and installation dimensions are not contained in this manual. The installation drawings and parts catalogs listed in Table 1 are available from Vickers.

Model Codes – There are many variations within each basic model series, which are covered by variables in the model code. Table 2 is a complete breakdown of the code covering these units. Service inquiries should always include the complete unit model number, which is stamped on the nameplate.

Model	Installation Drawing	Parts Catalog
M-PFB5	M–289424	M-2201-S
M-PFB10	M–289419	M-2202-S
M-PFB20	M–289426	M-2203-S
M-PVB5	M–289424	M-2211-S
M-PVB10	M–289419	M-2212-S
M-PVB20	M–289426	M-2213-S

Table 1. Installation Drawings and Parts Catalogs

Model Code

M – P V B 20 – R D G – 11 – M L – 10 – ****

1   2 3 4 5   6 7 8   9   10 11   12   13

1 **Mobile release**

2 **Pump**

3 **Delivery type**
F – Fixed displacement
V – Variable displacement

4 **Pump type**
Inline piston

5 **Delivery**
GPM rating at 1800 RPM

6 **Rotation** (viewing from shaft end)
R – Right hand
L – Left hand
U – Either direction

7 **Yoke travel** (variable pumps only)
D – Both sides of center
S – One side of center

8 **Shaft type**
G – SAE splined shaft
***** – Omit for straight keyed shaft

9 **Pump design numbers**
Design numbers subject to change. Installation dimensions remain as shown for design numbers 10 thru 19.

10 **Control type** (variable pumps only)
C – Pressure compensator (250-3000 psi range) The compensator is adjusted to the minimum setting at the factory.
M – Lever
D – Stem servo

11 **Lever control location** (lever models only)
L – Left hand side-viewing shaft end; omit for right hand side as shown on installation data.

12 **Control design numbers**
(Variable Pumps only; omit for fixed pumps)
Design numbers subject to change. Installation dimensions remain as shown for design numbers 10 thru 19.

13 **Special features suffix**

Table 2. Model Code

Section II – Description

A. General

Inline pumps are of the axial piston, positive displacement type and include both fixed and variable (adjustable) displacement pumps capable of high pressure operation. Drive speeds vary with the model, type of fluid used and circuit application.

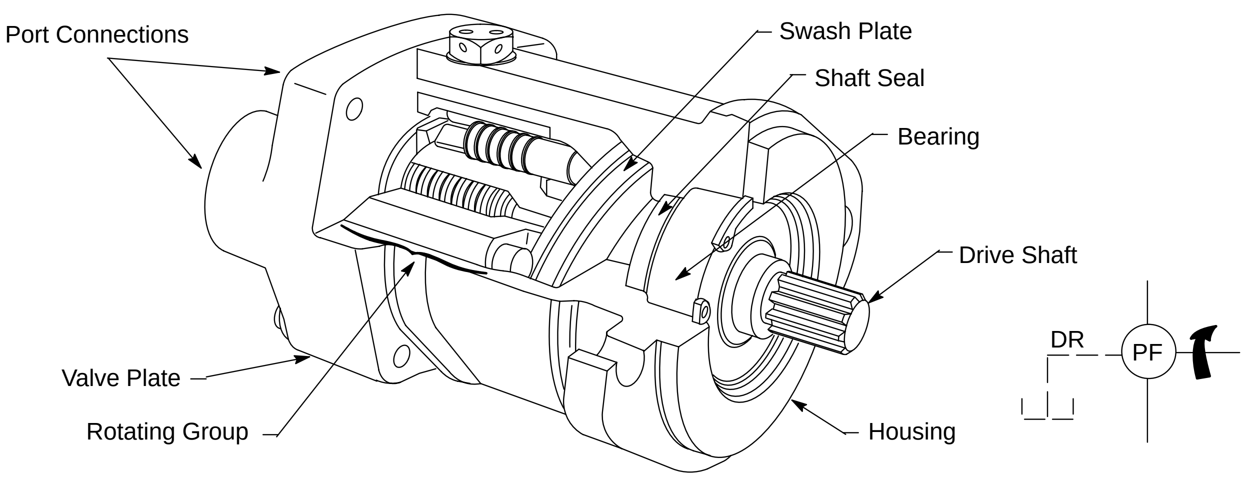
B. Assembly and Construction

The assembly of typical fixed and variable displacement units together with their ASA symbols are shown in Figure 1. As illustrated, the major components of the fixed in-line unit are the housing, drive shaft, rotating group, swash plate and valve plate. The variable displacement units incorporate a mechanism which governs the angle of the swash plate and consequently controls the stroke length of each piston as the cylinder block and drive shaft rotate. The valve plate subassembly also serves as the back cover of the entire unit and includes the inlet and outlet ports. A bearing in the cover and one in the housing support the drive shaft.

C. Application

The installation drawings give the nominal pump performance characteristics and limits. For applications outside of the given limits the mobile sales application engineer should be consulted.

Typical Fixed Displacement Pump



Typical Variable Displacement Pump

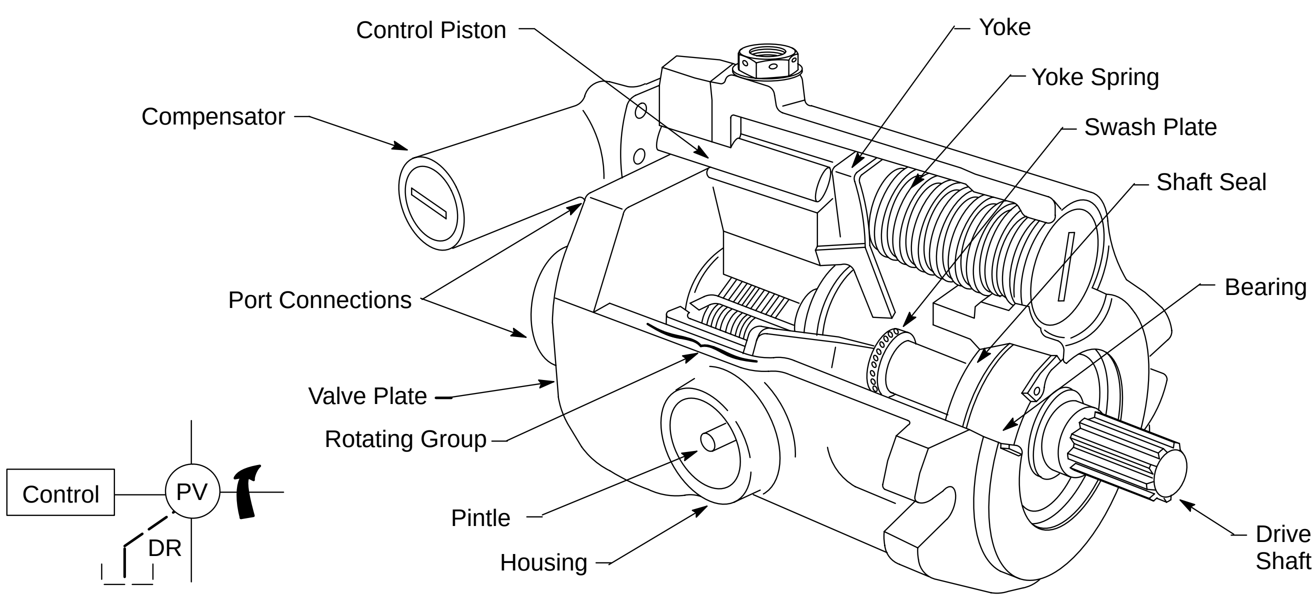


Figure 1.

Section III – Principles of Operation

A. General

Rotation of the drive shaft imparts a reciprocating motion to the pistons with respect to their cylinder block bores, as a result of the angularity between the axis of rotation of the drive shaft and the plate of the piston shoe bearing surface on the swash plate (see Figure 2). Each piston reaches two dead-center positions in one revolution or cycle.

As the piston revolves past the top dead-center position (when the piston is nearest the valve plate), it begins to withdraw from the cylinder block bores and thus begin its intake or suction stroke. During the intake stroke of the piston, fluid is drawn into the corresponding cylinder block bore through a porting arrangement located on the face of the valve plate and cylinder block.

As the piston reaches bottom dead-center position (when the piston is furthest from the valve plate) its withdrawing motion ceases, ending the intake stroke. This point is 180° from top dead-center. Further rotation of the cylinder block, and piston, creates a return motion of the piston towards the valve plate and thereby establishes the discharge stroke of the piston. During the discharge stroke, fluid is expelled from the cylinder block bore through the outlet port of the valve plate in a reverse manner to the intake stroke.

When the piston reaches top dead-center, axial piston motion ceases, and the discharge stroke is ended. The pumping cycle described above is made by each piston as it and the cylinder block are revolved through 360°.

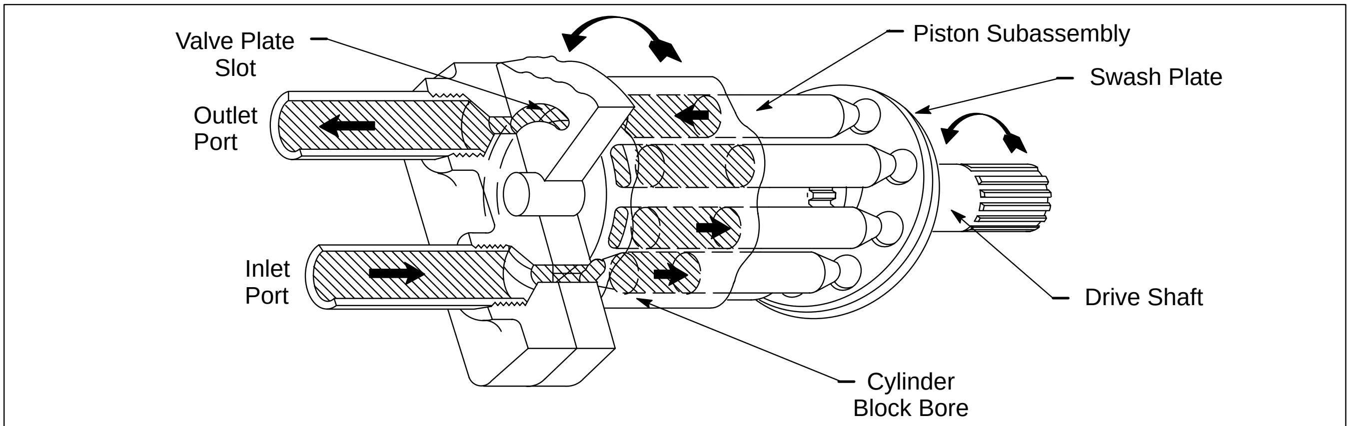


Figure 2.

B. Fixed Displacement Pumps

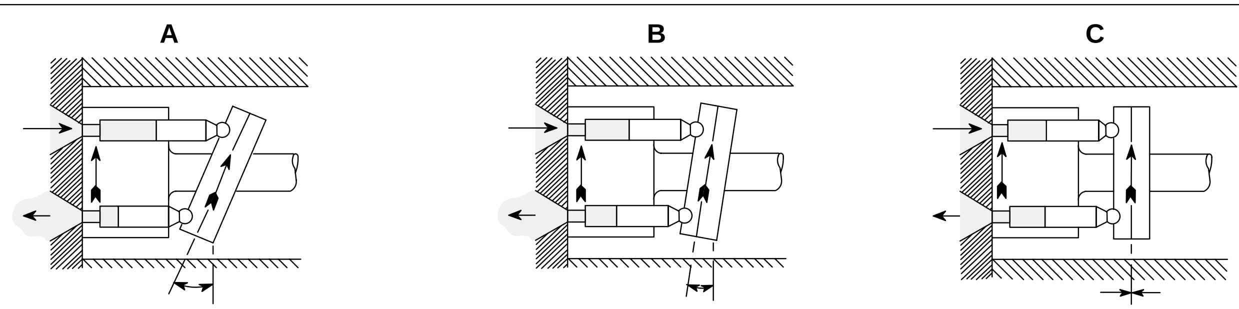
Since the swash plate angle in fixed displacement pumps is not variable, the output is determined by pump size and the speed of rotation.

C. Variable Displacement Pumps

Variable displacement is affected by altering the angularity between the swash plate and the drive shaft axis as shown by views A, B and C in Figure 3.

The pressure compensator is a spring-biased, pressure actuated, three-way valve incorporated onto the valve plate.

The operation of the compensator is such that when the system pressure (pump outlet) reaches a pre-set value, determined by the compensator spring setting, the valve moves to regulate the control pressure acting on the actuating piston. As the force produced by the actuating piston overcomes the force of the opposing springs, the swash plate angle moves toward the minimum displacement position, view C, Figure 3. The amount of angular movement of the swash plate (i.e., displacement change) is determined by system flow demand and the resulting system pressure. Equilibrium is achieved when the new displacement (i.e., pump delivery) matches the system requirement.



Maximum swash plate angle (maximum displacement)

Decreased swash plate angle (partial displacement)

Zero swash plate angle (minimum displacement)

Figure 3.

Section IV – Installation and Operating Instructions

A. Installation

Installation drawings shown in Table 1 should be consulted for installation information.

B. Drive Connections

CAUTION

Pump shafts are designed to be installed in flexible couplings with a slip fit or very light tap. Pounding can injure the bearings. Shaft tolerances are shown on the installation drawings. (See Table 1.)

1. **Direct Drives** – Care must be exercised when mounting the pump so that the pilot diameter fits properly into the mating section of the prime mover (see Figure 4). The pilot should not be forced into the mating part under any condition. Care should be exercised in tightening all flange mounting screws to prevent misalignment of shaft connections.

Shaft alignment is critical. Displacement or angularity can cause shaft breakage or bearing problems quickly, due to overloading.

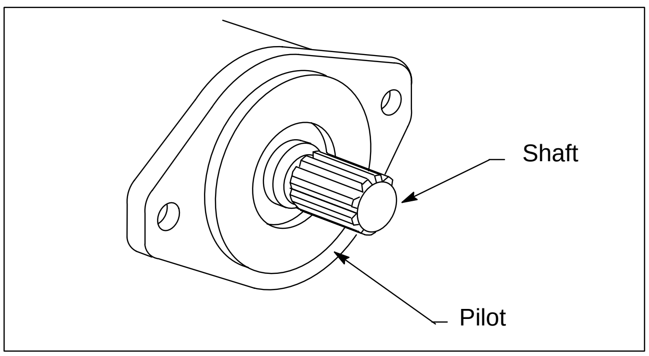


Figure 4.

2. **Indirect Drives** – For indirect drive applications the magnitude of side force, shown on the installation drawings (Table 1) relative to the mounting face must not exceed the indicated value at rated speed and pressure. For combined thrusts and side loads or other speeds and pressures, consult your local Vickers application engineer.

C. Mounting

Mounting position is unrestricted. An unrestricted housing drain line must be connected from the upper-most drain port directly to the reservoir in such a manner that the housing remains filled with oil at all times. The drain line should be at least full size, or oversize depending upon its length. Proper drain line size will prevent a build-up of housing pressure and also allows oil to flow freely into the pump housing under certain severe operating conditions. No other drain line should tie into the housing drain line.

The housing drain line connection to the reservoir must be submerged in oil at all times. If the drain line is above the oil level, damage to the unit may result due to air being drawn into the pump.

If pump mounting will not permit the housing drain line connection to be at the highest point, the drain line should be rigid, such as metal pipe or tubing. Loop the drain line above the highest point of the pump (as shown in Figure 5) to prevent the oil from siphoning or draining from the housing during shut-down periods.

Before initial start-up, fill the pump housing with oil through the uppermost drain port. The housing must be kept full to provide internal lubrication.

NOTE

Pipe threaded ports are not available because of valve plate distortion. Plumbing should be attached in a manner that will not cause valve plate distortion.

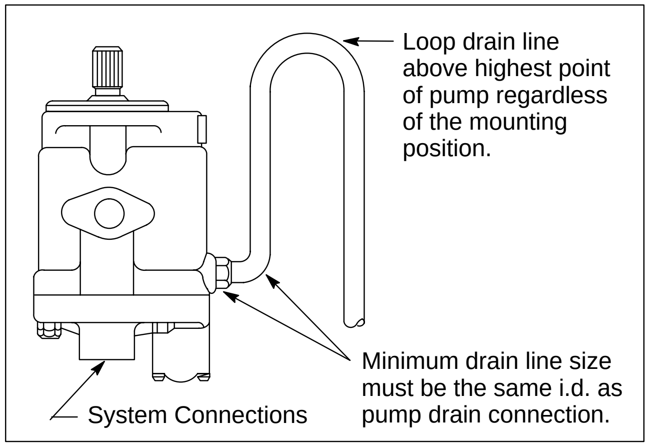


Figure 5.

D. Shaft Rotation

The rotation of Vickers pumps are always viewed from the shaft end of the pump as shown in Table 2.

E. Hydraulic Tubing

1. The number of bends in tubing must be kept to a minimum to prevent excessive turbulence and friction of oil flow (contributing to system inefficiency).

2. Tubing must not be bent too sharply. The recommended minimum radius for bends is three times the inside diameter of the tube.

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

4. All tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are wire brushing and pickling.

F. Inlet Line

The inlet line must be full size or oversize and not restricted at any point between pump inlet connection and the reservoir. A line size allowing less than 5 ft. per sec. fluid velocity should be your goal. The use of restrictive inlet tubing, undersize filter or an improper grade of fluid may result in inlet vacuum conditions exceeding the recommended value and cause cavitation in the pump.

These pumps should not be operated with a vacuum greater than 5 inches at the inlet or a housing pressure greater than 5 psi, unless specifically approved by Vickers engineering.

NOTE

No application factor is more important to the success of a pump than the inlet line. Considering the large flow in such lines and the very little pressure available to move the fluid, line size is obviously important.

Cavitation is the rapid formation and collapse of vapor pockets within the fluid and can cause excessive damage to the unit. Check the appropriate installation drawing for maximum pump speed foryour inlet pressure.

G. Filtration

Provide a check valve by-pass around the filters to provide a fluid path in the event that clogging of the filter occurs. We recommend the use of 25 micron pressure or return line filter.

All intake type filters should be equipped with magnets. In addition, all new and make-up fluid to the reservoir should be filtered through a 25 micron rated filter. Vickers engineering should be consulted when any unusual fluid or viscosity conditions are encountered.

H. Hydraulic Fluid Recommendations

1. **Oil Type** – Oils used in hydraulic systems perform the dual function of lubrication and transmission of power. Oil must be selected with care and with the assistance of a reputable supplier.

Crankcase oils meeting or exceeding the “Five Engine Test Sequence” for evaluating oils for API (American Petroleum Institute) service MS (Maximum Severity) best serve the needs of mobile hydraulic systems. These engine sequence tests are adopted by the Society of Automotive Engineers, American Society for Testing Materials and Automotive Engine Builders. The MS classification is the key to selection of oils containing the type of compounding that will extend the operating life of the hydraulic system. Oils meeting diesel engine requirements, DG through DS classifications, may or may not have the type of compounding desired for high performance hydraulic systems.

Table 3 summarizes the oil types (viscosity and service classification) that are recommended for use with Vickers equipment. This selection is most important and should be made with considerable care.

For moderate service applications use oil in accordance with specifications shown in Table 3. For high speed, high pressure applications or speeds below 100 rpm at high pressure, use one viscosity heavier oil.

Good oils are the most economical. Specifications can be set up which will indicate, to a limited degree, the characteristics essential in a good hydraulic oil. These are listed herein and should be checked with the oil manufacturer prior to its use.

Hydraulic System Operating Range (Min. to Max.)	SAE Viscosity	API Service Classification
0°F to 180°F	10W	MS
15°F to 210°F	20-20W	MS
32°F to 230°F	30W	MS
0°F to 210°F	10W-30	MS

Table 3.

2. **Operating Temperatures** – The temperature ranges for each grade of oil are satisfactory if suitable speed control procedures are followed for low temperature start-up conditions and if sustained operation is avoided at the upper temperature limits. Operation in excess of these temperatures results in increased wear of the system components and causes rapid deterioration of the oil. For optimum operation, a maximum oil viscosity of 4000 SSU at the low temperature start-up condition and a minimum oil viscosity of 60 SSU for the sustained high temperature operating condition are recommended.

3. **Viscosity** – Viscosity is the measure of fluidity. The oil must have sufficient body to provide adequate lubrication and sealing effect between working parts of pumps, valving, cylinders, etc. but not enough to cause pump intake cavitation or sluggish valve action. Viscosity recommendations must at best be a compromise which takes into consideration the working temperature range, the type of hydraulic equipment used and the class of service. Refer to Table 3.

4. **Viscosity Index** – The viscosity index is a measure of the rate at which temperature changes cause a change in oil viscosity. It is very desirable that the oil viscosity remain as nearly constant as possible under the wide range of temperature conditions encountered in operating mobile and construction machinery. The viscosity index (V.I.) of hydraulic oil should be not less than 90 for this type of service.

5. **Additives** – Research has developed a number of additive agents which materially improve various characteristics of oils for hydraulic systems. They may be selected for compounding with a view toward reducing wear, increasing chemical stability, inhibiting corrosion, depressing pour point and improving the anti-foam characteristics. Proper use of additive agents requires specialized knowledge, and they should be incorporated by the oil manufacturer only, as serious trouble may otherwise result.

Most companies have several brands of crankcase oils of somewhat varying formulation that will meet the API service classification of MS. The more desirable of these oils for hydraulic service will contain higher amounts of the type of compounding that avoids scuffing and wear of cam lobes and valve lifters. These oils will also be formulated to be stable under oxidative conditions and when in contact with small amounts of moisture. There should also be reasonable protection against rust to any ferrous materials submerged in the oil or covered by the oil film.

6. **Cleanliness** – Thorough precautions should be taken to filter the oil in the entire hydraulic system prior to its initial use to remove paint, metal chips, welding slag, lint, etc. If this is not done, damage to the hydraulic system will probably result. In addition, continuing filtration is required to remove sludge and products of wear and corrosion, throughout the life of the system.

Precautions should be taken in the design of hydraulic circuits to assure that a means is provided to keep the oil clean. This can best be accomplished by the use of a 25 micron full-flow filter or a 10 micron by-pass filter plus a micronic filter type air breather or sealed reservoir.

7. **Miscellaneous** – The performance of hydraulic valves and cylinders is less affected by the lubricating quality of the oil, and, therefore, selection of the oil is less critical than for pumps and motors. It is always good practice, however, to use the best quality oil available for all components.

I. Overload Protection

Normally, a pump equpped with a pressure compensator requires no external relief valve. In some applications, a relief valve may be desirable for maximum system protection. The setting of the relief valve should be at least 250 psi above the maximum pressure setting of the compensator.

J. Starting and Priming

NOTE

In most cases “break in” is not a problem but when it is, it can be compared with new engines, gear boxes and other products. A by-product of “break in” is self generated dirt. Generous filters and good filter maintenance are required to be sure a unit is “broken in” and not “broken up”.

1. **Precautions**

a. Make sure the reservoir air cleaner is clean and of ample size to handle the system breathing requirements.

b. Make certain the hydraulic system is clean and free of dirt, metal chips, paint, welding slag and foreign material. System filtration should be 25 microns or finer.

c. Make sure all inlet and return line fittings are tight so that air is not drawn into the system.

d. Make sure the system is full of oil. Most of the MS crankcase oils will serve the needs of inline pump applications (refer to fluid recommendations in Section IV, H).

e. Make sure shaft rotation direction and coupling alignment are correct.

2. **Starting Procedure**

a. Variable pumps must be started with the yoke position exceeding 40% of full stroke. Back off system relief valve so that the pump will start under no-load conditions. If the system relief valve is not adjustable, start the engine and let it run at low speed.

CAUTION

Be absolutely sure the housing is full of oil before starting. Fill the housing with system fluid through the uppermost drain port.

b. Be sure the pump primes within the first minute of operation. If it does not prime, recheck the reservoir to make sure it is full of oil.

c. Bleed the pump outlet line until a clear stream of oil results with no air bubbles present. This is best accomplished by loosening an outlet fitting next to the pump. Slowly extend and retract all hydraulic cylinders in the circuit and again bleed the outlet line. It may be necessary to bleed the circuit several times in order to remove all the air trapped in the circuit.

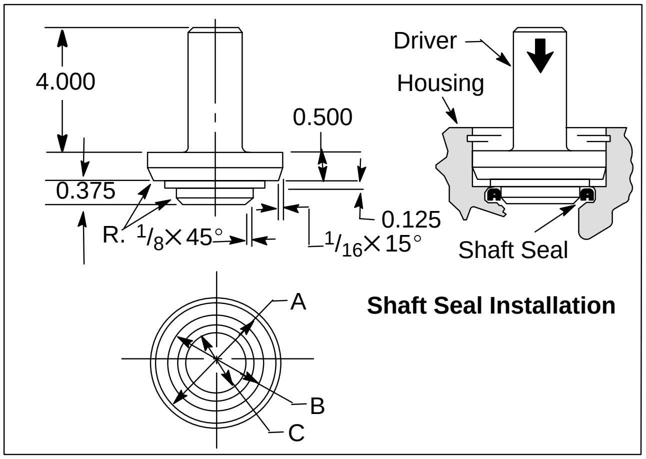
If the air is not expelled from the circuit after several attempts, check the inlet lines to the pump to make sure all the fittings are tight. When a hose is used for the inlet line, it is not uncommon for it to leak where it is attached to the fitting and allow air to be drawn into the system.

d. Allow the unit to run at minimum operating speed for as long as possible while checking the system for leaks and bleeding air out of the lines. *Do not remove the compensator adjustment plug while the pump is in operation.*

Section V – Service, Inspection and Maintenance

A. Service Tools

Special tools required for these units are a shaft seal driver and a bearing puller of suitable size. The seal driver can be made from round stock machined as shown in Figure 6.



Pump Size	Dimensions in Inches		
	A	B	C
5 USgpm	2.043	1.625	0.968
10 USgpm	2.437	2.062	1.375
20 USgpm	3.145	2.375	1.750

Figure 6

B. Inspection and Service

Periodic inspection of the fluid condition and tube or pipe connections can prevent both time consuming breakdowns and unnecessary repairs.

Since pumps depend on the fluid in the system for internal lubrication, clean fluid is important to service life. If the fluid becomes contaminated, thoroughly drain the system and clean the reservoir before new fluid is added. Insure that all hydraulic connections are kept tight. In a pressure line, a loose connection permits 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 may result. In the suction or return lines a loose connection will permit air to be drawn into the system resulting in noisy or erratic operation or pump breakdown, also “spongy” operation.

Check and replace filter elements periodically. A clogged filter element results in a higher pressure drop, forcing particles through the filter which would ordinarily be trapped, or causing the by-pass to open resulting in a partial or complete loss of filtration.

C. Adding Fluid to the System

When hydraulic fluid is added to replenish the system, it should always be poured through a micron filter. If such a filter is not available, a funnel with a fine wire screen (200 mesh or better) can be used.

It is important that oil be clean and free of all substance which will cause improper operation and excessive wear of any unit in the system.

D. Lubrication

Internal lubrication is provided by system oil flow, except main bearing which must be packed 1/3 full of high temperature grease when unit is rebuilt.

E. Replacement Parts

Only genuine parts manufactured or sold by Vickers, Incorporated should be used as replacement parts for these pumps. They are shown in the parts catalogs listed in Table 1. Copies are available on request.

F. Adjustments

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

G. Product Life

The longevity 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

The cause of improper functioning in a hydraulic system is best diagnosed with the use of proper and adequate testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic pump exhibiting an excessive increase in heat or noise is a potential failure. When either of these conditions are noticed, immediately shut down the machine, locate the trouble and correct it.

Table 4 lists some of the common difficulties found in hydraulic components and systems, their probable cause and remedies.

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid.	Reservoir fluid level low.	Add fluid and check level on both sides of reservoir baffle to insure pump intake line is submerged.
	Inlet strainer plugged.	Clean strainer after new fluid is added.
	Air leak in inlet line prevents priming and causes irregular control circuit action.	Pour fluid on intake joints while listening for change in sound of operation. Tighten as required.
	Coupling or shaft sheared or disengaged.	Disassemble pump and check shaft, and rotating group for damage. Replace necessary parts.
	Pump driven in wrong direction of shaft rotation.	Check installation. Reverse the drive or convert pump as discussed in the overhaul section.
System not developing pressure.	Contamination in actuating control.	Clean control.
	Pump not delivering fluid for any of the above reasons.	Check circulation by watching fluid in reservoir.
	Relief valve setting not high enough.	Block machine travel. Test with pressure gauge.
	Relief valve sticking open.	Remove contamination in relief valve.
	Leak in hydraulic control system (cyulinders or valves).	Test independently by progressively blocking off the circuit.
	Free re-circulation of fluid to reservoir.	Insure that directional valve is not in open center (neutral) position or that fluid is not discharging to tank through an open line or improperly adjusted valve.
Pump making excessive noise.	Partly clogged inlet line, inlet strainer or restricted inlet pipe.	Service the inlet strainers. Check the fluid condition and, if necessary, drain and flush the system. Refill with clean fluid.
	Air leak at pump intake pipe joints.	Tighten as required. Pour fluid on joints while listening for change in sound of operation.
	Air bubbles in fluid.	Check to be certain return lines are below fluid level and well separated from intake line.
	Reservoir air vent plugged.	Must be open through breather opening or air filler.
	Pump running too fast.	Conform with recommended maximum speeds shown in installation drawings.
	Filter too small on inlet.	Refer to appropriate installation drawings for proper size filter.
	Coupling misalignment.	Check for damaged shaft bearing or other parts. If necessary, replace and realign the coupled shaft.

Table 4. Troubleshooting Chart

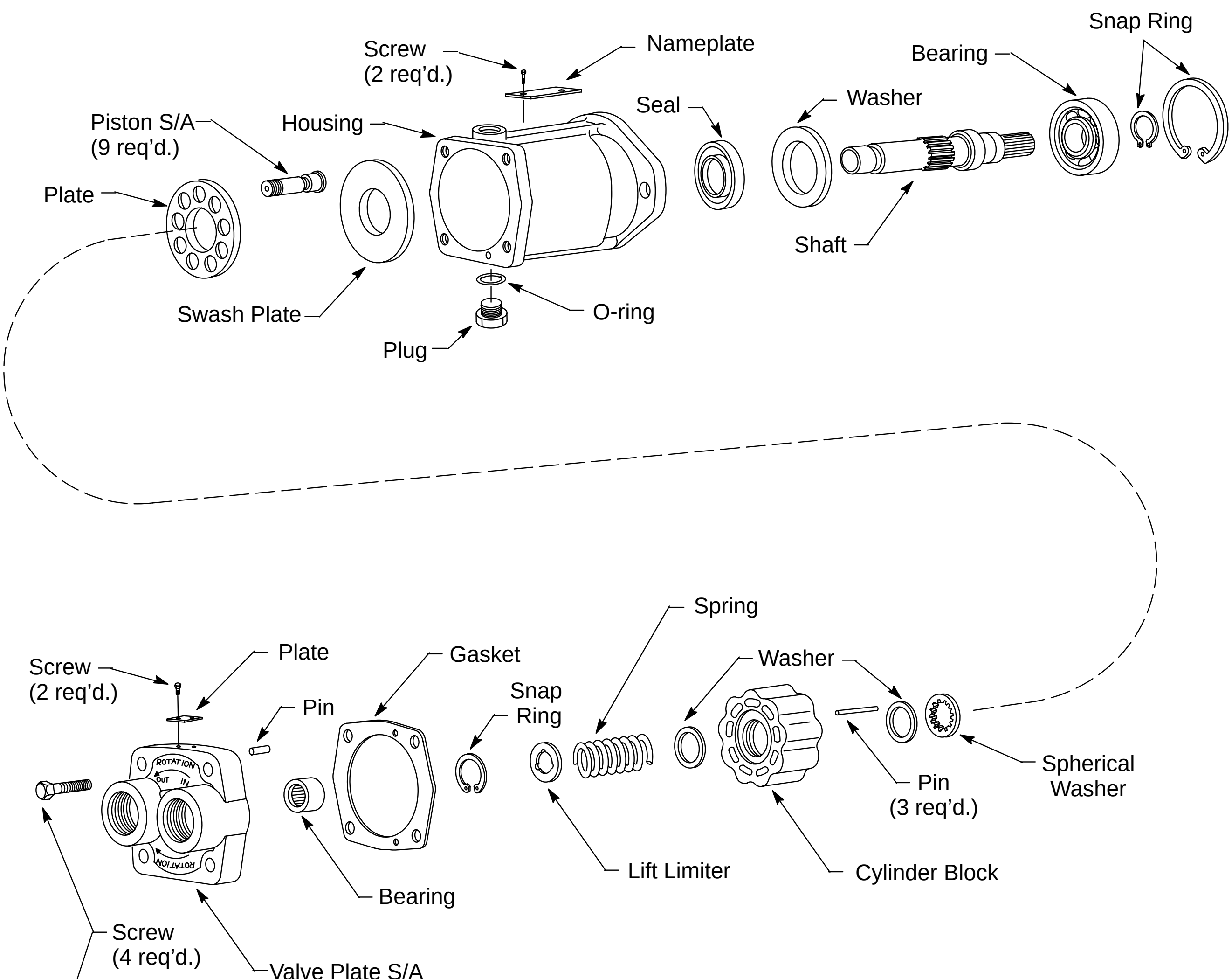
Section VI – Overhaul

A. General

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

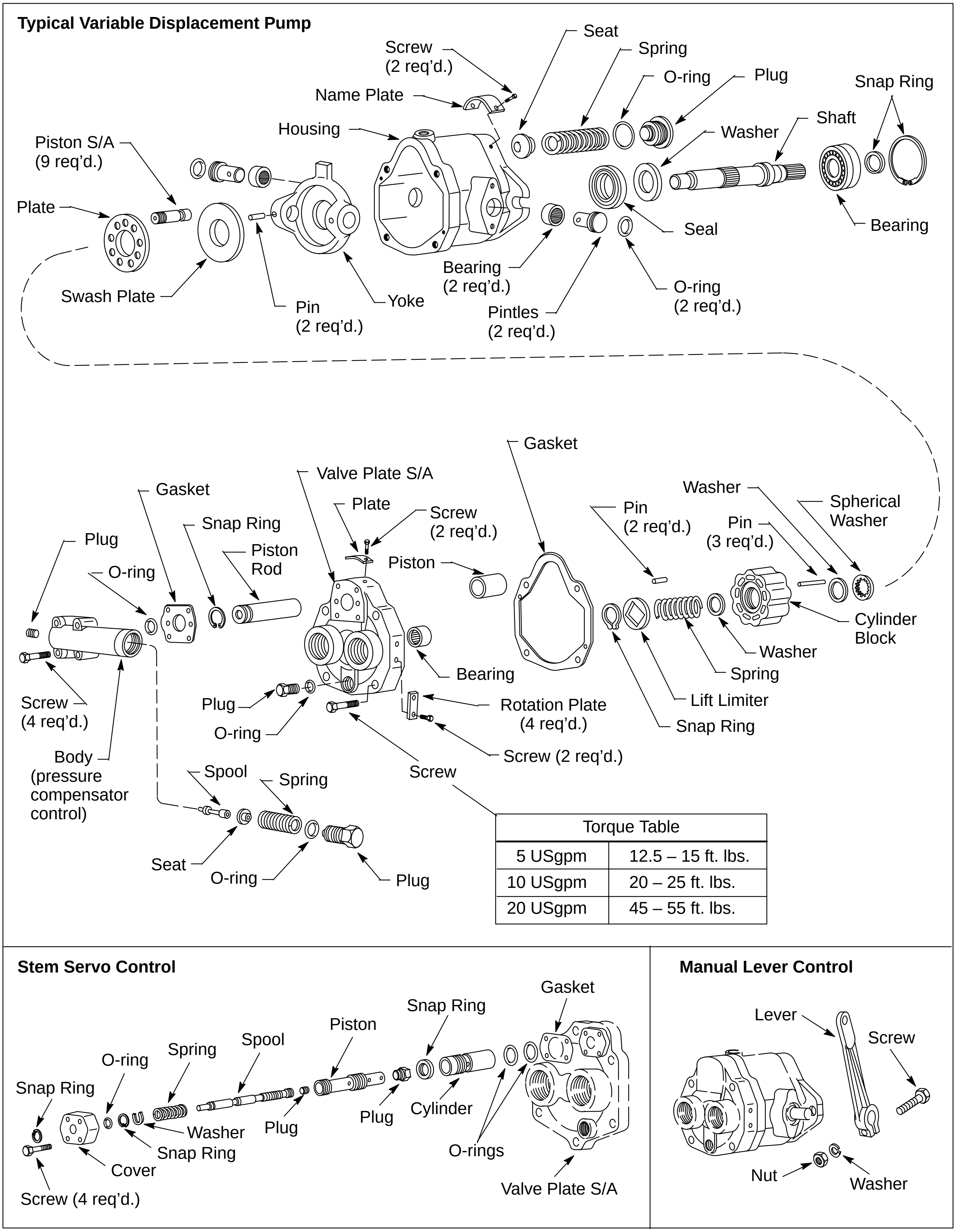
During overhaul, plug all units and cap all lines to prevent entry of dirt into the system. During disassembly, pay special attention to identification of parts, especially those of the rotating group, for correct reassembly. Figure 7 is a disassembled view of a typical fixed displacement pump, while Figure 8 is a disassembled view of a typical variable displacement pump. Figure 1 may be referred to for the correct relationship of the parts.

Typical Fixed Displacement Pump



Torque Table	
5 USgpm	12.5 – 15 ft. lbs.
10 USgpm	25 – 35 ft. lbs.
20 USgpm	70 – 80 ft. lbs.

Figure 7.



Torque Table	
5 USgpm	12.5 – 15 ft. lbs.
10 USgpm	20 – 25 ft. lbs.
20 USgpm	45 – 55 ft. lbs.

Figure 8.

B. Disassembly

All models are disassembled in the same general sequence as shown in the exploded views of Figures 7 and 8.

1. **Valve Plate** – On pressure compensated models, remove the compensator body first to permit removal of the valve plate retaining bolts. Remove the valve plate from the unit. A commercially available bearing puller should be used for removal of the valve plate bearing if it is to be replaced.

2. **Rotating Group Removal** – Turn the rotating group slightly to free it from the swash plate. Tilt the housing and remove the rotating group. Care should be taken to prevent the separation of the cylinder block from the rotating group during removal from the housing.

3. **Rotating Group Disassembly** – Lift the piston and shoe sub-subassemblies from the cylinder block. Keep the pistons from striking hard objects during handling of the rotating group sub-assembly.

WARNING

If the spring and washer are to be removed from the cylinder block, follow the procedure outlined in Figure 9 to prevent bodily injury from the sudden release of the cylinder block spring.

4. **Swash Plate Removal** – The swash plate outside diameter is smaller than the inside diameter of the recess in the yoke. A properly seated swash plate can be freely rotated with the fingertips. Removal, however, might be slightly difficult due to oil suction under the swash plate. Rotate the swash plate and pull out evenly from the yoke.

5. **Drive Shaft Removal** – Remove the retaining snap ring with snap ring pliers. Tap the end of the drive shaft with a soft tip hammer to free the shaft and bearing from the housing. It may be necessary to use a commercial bearing puller to remove the main bearing from the housing. Removal of these bearings often destroys them and replacement parts should be available prior to removal.

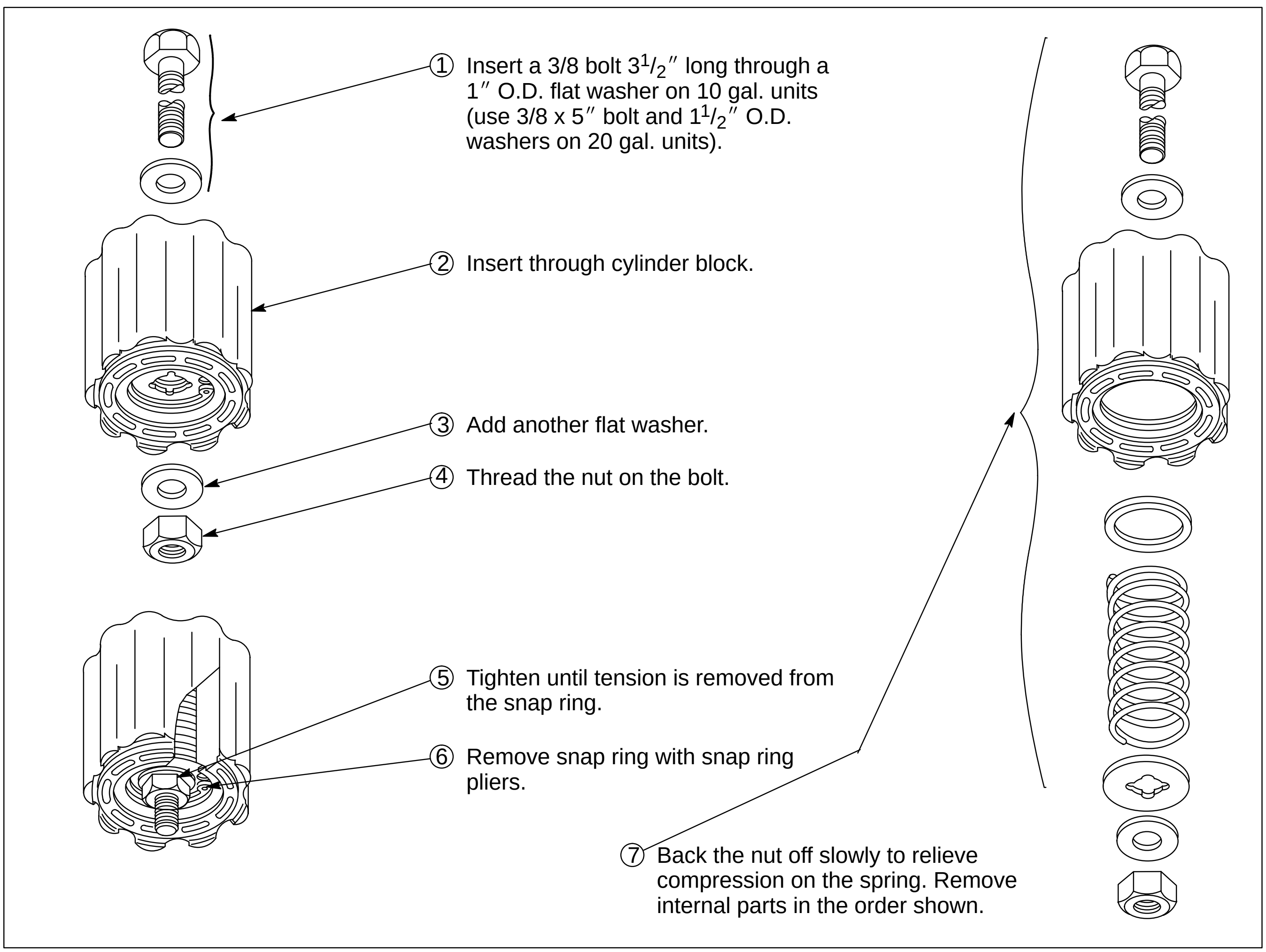
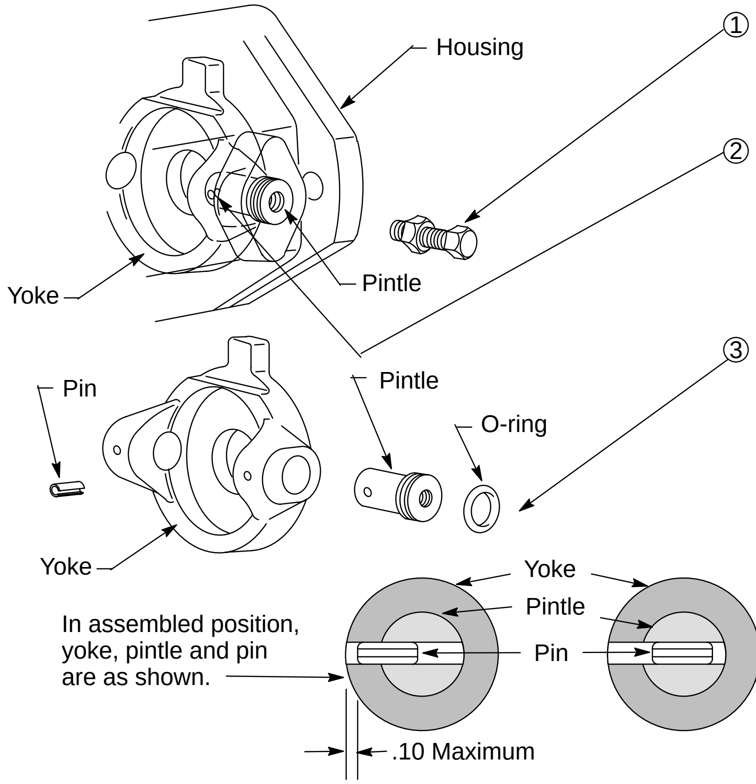


Figure 9.



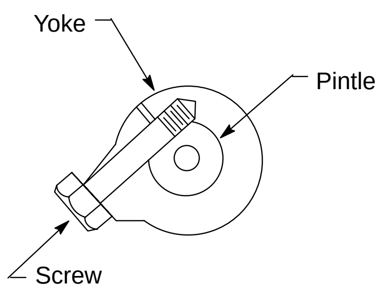
1. Thread pull-screw in thread hole of pintle. Secure with jam nut.
2. Tap roll pin clear of yoke into the pintle (see cross section below). Using screw pull pintle clear of yoke and housing. After pintle is removed, tap roll pin out of the pintle before reassembly.
3. To reassemble, insert the pintle with O-ring in place through the housing into the yoke. Align the holes and tap the roll pin in, as shown in the assembled cross section below.

When disassembling, pin is tapped into pintle as shown.

5 USgpm models

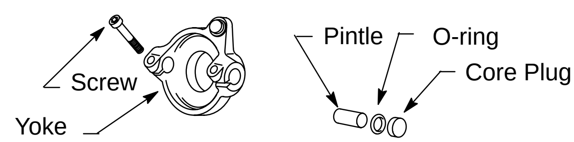
Figure 10.

The 10 USgpm units of the -20 design use a screw in lieu of the roll pin for securing pintles. The pintles are provided with a grove in place of the drilled hole to accept the screw (see cross section below). Removal of the pintle is the same as shown in Figure 10 after loosening the retaining screws at the yoke.



10 USgpm models

1. Remove the core plug, back-off lock screw at yoke until pintle grove clears for 20 USgpm models. Note: Swash plate must be removed from yoke to remove these pintles. Lightly tap pintle toward inside of unit to remove.



2. To reassemble, insert the pintle through the housing into the yoke. Align the groves and thread in lock screw. Remove pull-screw, insert O-ring and core plug. Press plug in with tool 12319-K. Approximately 350 lbs. force is required to properly seat plug against O-ring for leak-proof seal.

20 USgpm models

Figure 11.

6. **Yoke Removal** – Figures 10 and 11 illustrate the procedure for removal of the yoke from a variable displacement unit. Yokes of the smaller units are similar in design to the larger units. Only the methods of retaining are different.

C. Inspection and Repair

Clean all parts thoroughly with a mineral oil cleaning solvent prior to inspection and after any lapping or machining operation.

1. **Valve Plate** – Inspect the flat surface which mates with the cylinder block for wear or scoring. Minor defects can be removed by lightly stoning the surface, however, any lapping should not exceed 0.0002 inches. The surface is hardened and excessive lapping will remove this hardened surface. If the wear or damage is extensive, replace the valve plate.

2. **Rotating Group** – Inspect the bores and valve plate mating surface of the cylinder block for wear and scoring. Minor defects on valve plate mating face can be removed by lightly stoning the surface. If the defects cannot be removed by this method, the cylinder block should be replaced.

When conditions indicate that one or more piston and shoe sub-assembly should be replaced, all piston and shoe sub-assemblies in the unit should be checked as in Figure 12 to insure that all piston shoes ride properly on the swash plate. Variations greater than .001 of an inch from one shoe to another result in excessive internal leakage and shoe wear. At overhaul the replacement of all nine piston and shoe sub-assemblies in the unit, as well as the cylinder block, is recommended for maximum overhaul life.

If necessary, hand lap the shoes using a 400 A or 500 A emery paper (Tuff-Bak Durite Silicon Carbide) backed by a lapping plate. Good results may be obtained if the paper is dipped in kerosene and kept wet during polishing.

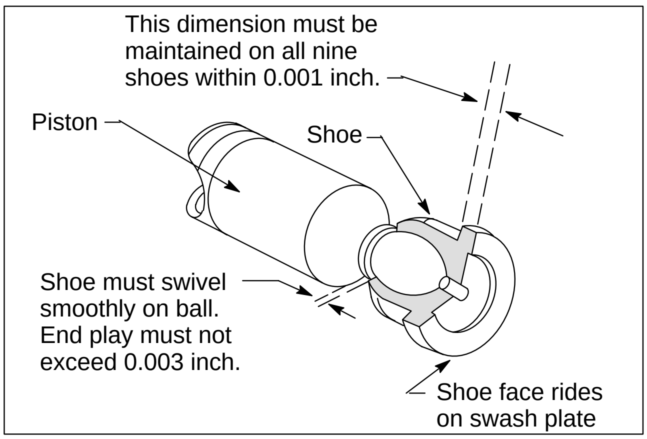


Figure 12.

3. **Swash Plate** – Inspect the swash plate for wear and scoring. If the defects are minor, stone the swash plate but do not remove more than 0.0004 of an inch. If wear or damage is extensive, replace the swash plate.

4. **Bearings and Drive Shaft** – Inspect all bearings for roughness or excessive play and replace if necessary. Inspect the shaft seal area of the shaft for scoring or wear. Replace the drive shaft if bent or wear is excessive.

D. Assembly

Assembly is basically the reverse of disassembly. Install new gasket, seals, and O-rings when assembling the unit. A light film of clean hydraulic fluid will ease assembly and provide initial lubrication.

1. **Yoke** – Install the yoke in the housing as illustrated in Figures 10 and 11.

2. **Drive Shaft and Bearing** – Install a new shaft seal in the housing. Place the washer over the shaft seal. Assure that bearing is 1/3 to 1/2 filled with a good grade of high temperature ball bearing grease, then install the drive shaft and bearing in the housing. Secure the drive shaft bearing with the retaining ring.

3. **Swash Plate** – Install the swash plate chamfered edge toward shaft seal. It is important that the swash plate be properly seated in the yoke and can be freely rotated with the fingers.

4. **Rotating Group Assembly** – If the spring and washers were removed from the cylinder block, assemble them as shown in Figure 9.

Place the cylinder block face down on a smooth clean surface for ease of assembly. Insert the three pins in the cylinder block. Grease the back-up and spherical washers and place them on the pins. Put the nine piston and shoe sub-assemblies in the shoe plate. Carefully holding the shoe plate so that the pistons do not strike each other, align the pistons with the bores and maneuver them into place. The pistons must move freely in a lubricated block bore.

5. **Rotating Group Insertion** – Holding the cylinder block and shoe plate to keep the pins, washers and spherical washer intact, install the rotating group onto the drive shaft. slight rotation during assembly will help align the spherical washer and cylinder block splines with those of the drive shaft.

6. **Valve Plate** – Replace the valve plate to body gasket if required and then install the valve plate with the retaining bolts. Install the compensator body on units containing the compensator feature.

Section VII – Testing

Vickers application engineering personnel should be consulted for test stand circuit requirements and construction. If test equipment is available, the pump should be tested at recommended speeds and pressures shown on the installation drawing (see Table 1).

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