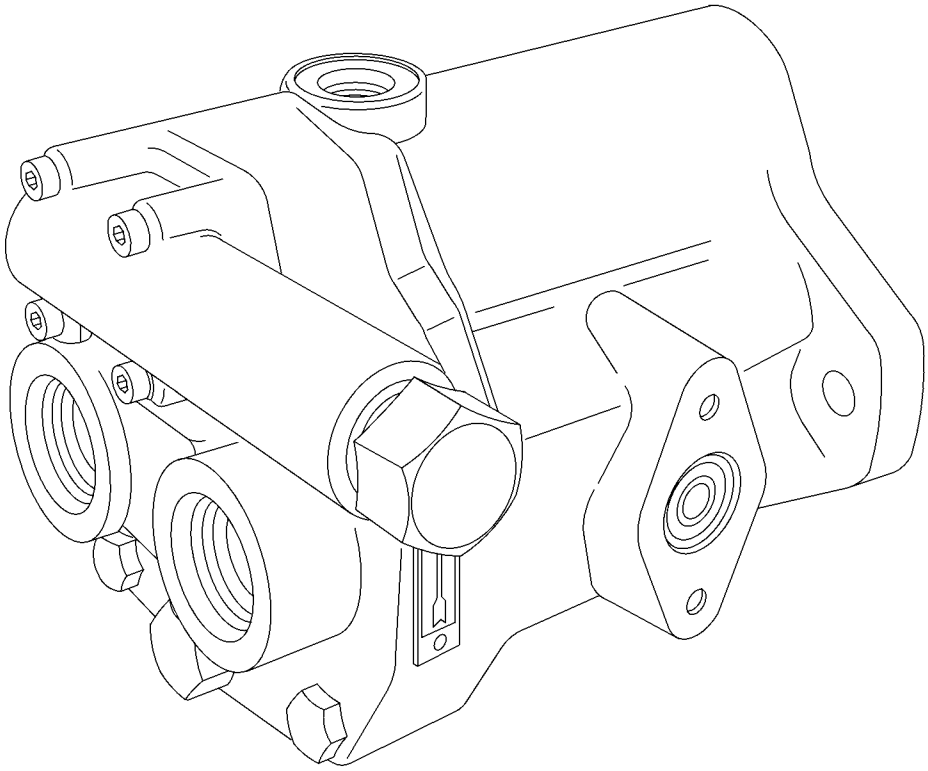
EATON | Vickers

In-line Piston Pumps and Motors

MFB & MVB Series
P(M)FB & P(M)VB Series



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Section I – Introduction

A. Purpose of Manual

This manual describes operational characteristics and overhaul information for the fixed and variable delivery inline piston type pumps and motors. The information contained herein pertains to the latest design series.

B. General Information

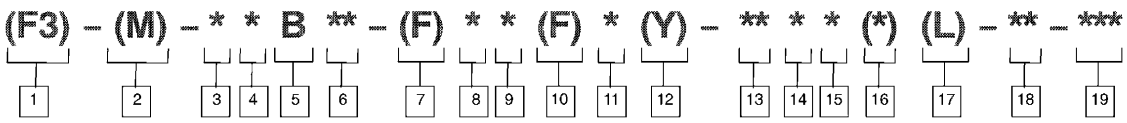
Related Publications – Service parts information and installation dimensions are not contained in this manual. The installation and parts drawings listed in Table 1 are available from Vickers.

Model Codes – Variations within each basic model series, are covered in the model code. Table 2 is a complete breakdown of the codes covering these units. Service inquiries should always include the complete unit model code number as stamped on the nameplate.

Model	Installation Drawing	Parts Catalog
M-MFB5	289420	I-3238-S
MFB5	520300	I-3238-S
MFB10	000324	I-3244-S
M-MFB15	000324	M-2765-S
M-MFB20	289420	M-2763-S
MFB20	000324	I-3247-S
M-MFB29	000324	M-2763-S
MFB29	520310	I-3741-S
MVB5	273831	I-3280-S
MVB10	273838	I-3268-S
M-MVB29	000324	M-2773-S
M-PFB5	289424	I-3238-S
PFB5	507725	I-3238-S
M-PFB10	289419	M-2202-S
PFB10	507727	I-3244-S
M-PFB15	289419	M-2202-S
M-PFB20	289426	M-2203-S
PFB20	507729	I-3247-S
M-PFB29	289426	M-2203-S
PVB5	508300	I-3280-S
PVB6	508300	I-3280-S
PVB6A	508275	I-3281-S
M-PVB10	289419	M-2212-S
PVB10	508400	I-3268-S
M-PVB15	000324	M-2212-S
PVB15	508400	I-3268-S
M-PVB20	000324	M-2213-S
PVB20	508500	I-3267-S
M-PVB29	000324	M-2213-S
PVB29	508500	I-3267-S
PVB45A	508890	I-3294-S

Table 1.

Model Code



1 Special seals
F3 – Mineral oil and fire resistant fluids
F6 – High water base fluids

2 Mobile application
(Omit for industrial application.)

3 Model
M – Motor
P – Pump

4 Delivery type
F – Fixed
V – Variable

5 In-line piston series

6 USgpm rating @ 1800 RPM

5 –	5 USgpm	20	– 20 USgpm
6 –	6 USgpm	29	– 29 USgpm
10 –	10 USgpm	45A	– 45 USgpm
15 –	15 USgpm		

7 Mounting type
F – Foot mounting
Blank – Omit for flange mounting

8 Rotation (viewed from shaft end)
R – Right hand
L – Left hand
U – Either direction (motors only)

9 Displacement
S – One side of center (pressure compensator models)
D – Both sides of center (handwheel and lever models)

10 Port connections
F – Flanged ports (on "W" and "X" optional features only)
Blank – Omit for standard shaft and threaded connections at rear

11 Optional ports and shaft
W – Side ports (flanged - standard shaft)
X – Through shaft - side ports (flanged) "C" and "CM" controls only

12 Drive shaft
Y – Standard shaft (keyed) Omit for short shaft
G – Spline shaft (mobile)

13 Pump or motor design number

14 Control type
C – Pressure compensator (250-3000 PSI)
CM – Pressure compensator (250-1500 PSI)
D – Stem servo control
H – Handwheel
M – Lever
V – No control

15 Control option
C – Adjustable maximum displacement stop (with compensator) (not available with thru shaft models)

16 Compensator variations
D – Dual range (electric control) (not available with thru shaft)
E – Start-up valve
G – Remote compensator (use CCG for LH side port models)

17 Other controls or options
L – Left hand location viewing shaft end (handwheel and lever only)

18 Control design number

19 Special features

Table 2

Section II – Description

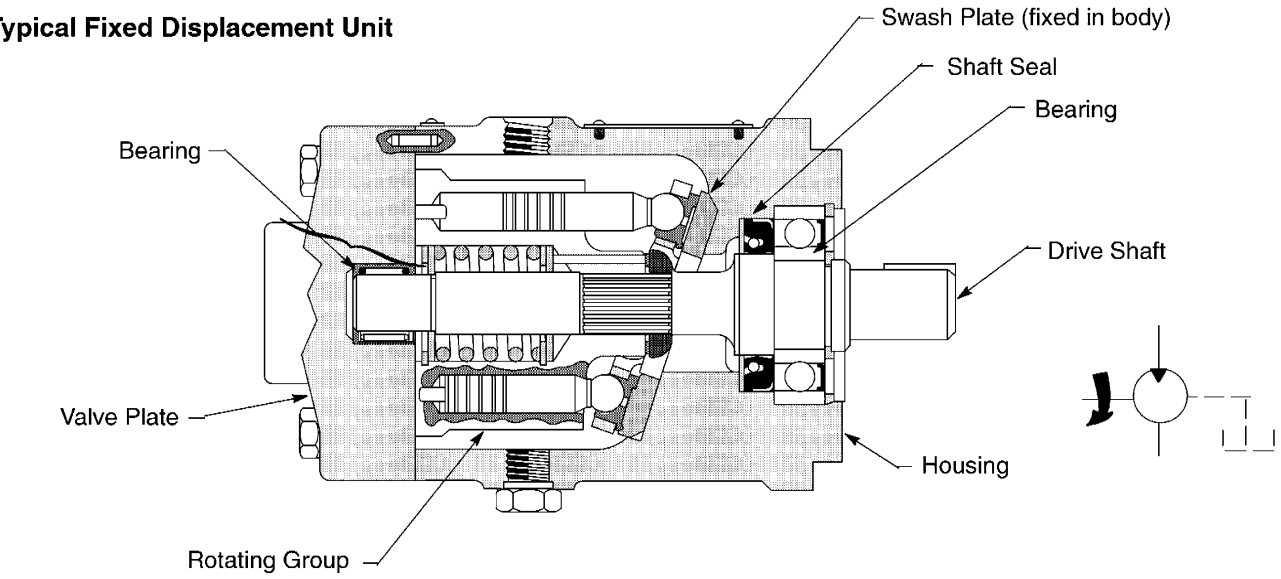
A. General

Inline pumps and motors are of the axial piston, positive displacement type and include both fixed and variable (adjustable) displacement pumps and motors 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 ANSI symbols are shown in Figure 1. As illustrated, the major components of the inline unit are the housing, bearing-supported drive shaft, rotating group, swash plate and valve plate. The pressure compensated variable displacement units incorporate a pressure sensitive control piston which governs the angle of the yoke and swash plate and consequently controls the stroke length of each piston as it rotates with the cylinder block and drive shaft. 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.

Typical Fixed Displacement Unit



Typical Variable Displacement Unit

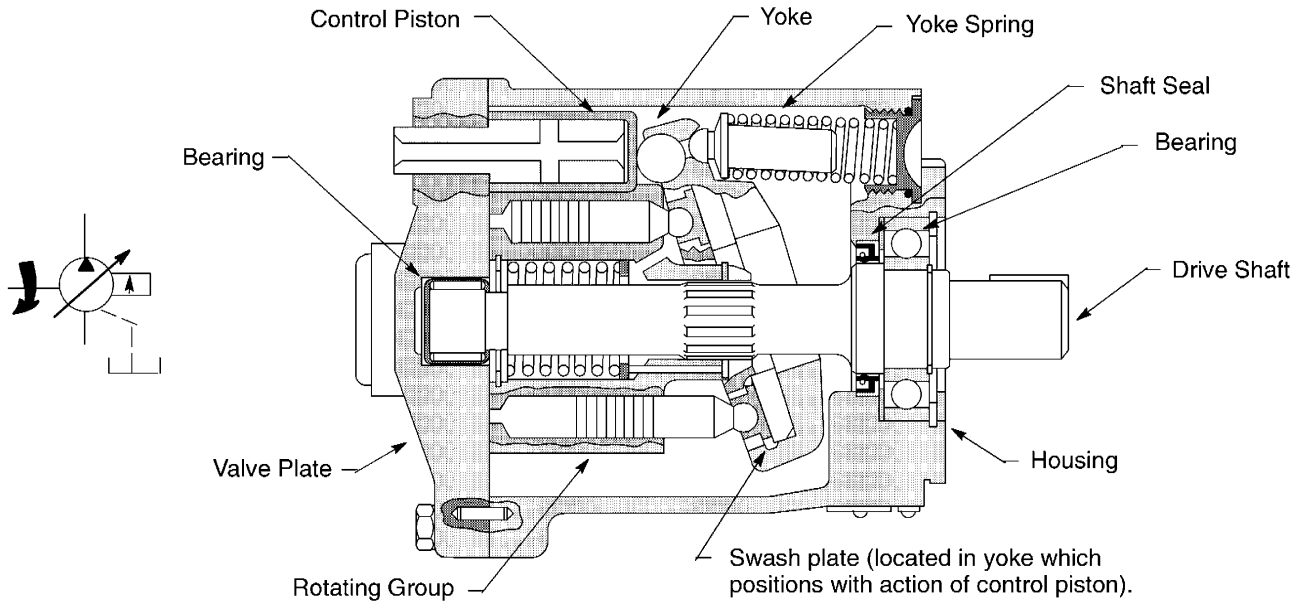


Figure 1.

Section III – Principles of Operation

A. General

Although nearly identical in design, pumps and motors operate essentially in reverse of each other; the pump forcing fluid through the system as it rotates, the motor being rotated by the fluid. Variable displacement units are constructed so that the angle of displacement (angle of the swash plate to the drive shaft axis) can be varied by changing the yoke position.

B. Motors

Motors are positive displacement units which are capable of producing a variable torque and speed. Motor speed is a function of the input fluid volume and torque is a function of the input pressure. On a variable displacement motor, the angle of the swash plate affects the speed and torque.

In operation, pressurized fluid is forced into the cylinder block bores which are open to the inlet port. Inlet pressure causes the pistons to exert a force against the swash plate. At the control point of the piston shoe and swash plate, a component of the angular counter-force causes the cylinder block to move in a rotary direction. The remaining cylinder block bores are either open to the outlet or blocked by the valve plate. When the pistons move across the outlet port, fluid discharges and returns to the reservoir or system.

Rotation is reversed by reversing the fluid supply to the motor or if the motor is a variable displacement type, it can be stroked across-center for reversal. If a variable unit is stroked across center, adequate precautions must be taken to prevent overspeed, overpressure and/or cavitation. "Stroking across center" means moving the swash plate from an angle on one side of center, to zero (center) angle of the yoke, and then to the opposite side of center.

Motors are used for continuous, intermittent, or continuously reversing service. They can be stalled indefinitely under load without damage when protected by a relief valve.

C. Pumps

The operation of the pump is essentially in reverse of motor operation. During the time that a piston is moving out of the cylinder block bore, a pressure differential develops which forces fluid into the open cylinder block bores through the inlet port. As the cylinder block rotates past the outlet port, the pistons force fluid out into the system.

On variable displacement pumps, outlet volume is varied by changing the swash plate angle between the swash plate and the drive shaft axis. Since the swash plate angle is not variable on fixed displacement pumps, the flow is determined by pump size and speed driven (RPM).

Section IV – Installation

A. General

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

B. Mounting and Drive Connections

CAUTION

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

A pilot on the pump/motor mounting flange 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.

Mount the unit with the drain line connection at the top. This will allow easy filling of the housing before start-up and also prevent draining of the housing in periods of idleness. There should be no restriction between the drain port and the reservoir. The drain line must terminate below reservoir fluid level.

C. Inlet Line

Inlet lines must have sufficient capacity to allow full flow requirements at the pump or motor inlet for all conditions of operation. The use of restrictive inlet tubing, undersize filter or an improper grade of fluid may result in inlet vacuum conditions exceeding the recommended five inches of mercury and cause cavitation in pumps. Cavitation is the rapid formation and collapse of vapor pockets within the fluid and can cause excessive damage to the unit. Motor inlet lines must be of the high pressure type to withstand the output pressure of the associated pump. Check the appropriate installation drawing for maximum motor/pump speed. (See Table 1.)

D. Filtration

Vickers recommends the use of inlet, pressure and/or return line filtration. Inlet filters can be supplied with magnets and a contamination indicator or an electrical switch. The electrical switch feature can be used to actuate an alarm when the filter element is plugged. Vickers field engineering personnel should be consulted when unusual fluids or viscosity conditions are encountered.

E. Piping and Tubing 4.

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sandblasting, wire brushing and pickling.

NOTE

For instructions 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 radius for bends is three times the inside diameter of the tube.

F. 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 and motors. Any oil selected for use with pumps is acceptable for use with valves or motors.

Data sheet I-286-S for oil selection is available from Vickers Technical Publications, Troy, Michigan 48007-0302.

Oil recommendations noted in the data sheet is 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 Vickers sales engineer.

General Data

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 oil filters, 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 hydraulic systems are:

1. Very high viscosities at start-up temperatures can cause 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 in 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.

G. Overload Protection

Both fixed and compensated pumps require an external relief valve to provide maximum protection of circuit components. An external relief valve is also required in the inlet line of a hydraulic motor to limit the pressure and torque.

H. Starting and Priming

Before initial starting, fill the housing with clean fluid. Normal "leakage" past the pistons or between the cylinder block and valve plate provides internal lubrication of working parts. To assure initial priming of variable displacement units, adjust the controls to provide at least 40% of maximum displacement at start-up. The control may be reset to a lower displacement after priming is accomplished.

It may be necessary to bleed air from the pump outlet line to permit priming and reduce noise. Bleeding may be accomplished by loosening an outlet connection until a solid stream of fluid appears. An automatic air bleed valve (ABT-02-10) can be permanently installed and will eliminate the necessity to loosen a connection.

Section V – Service and Maintenance

A. Service Tools

The following standard tools are required for overhaul of a piston type pump or motor.

1. Torque wrench with socket adapters
2. Set of U.S. hex key wrenches
3. Set of small pin punches
4. 3/8 inch socket set with ratchet
5. Small ball peen hammer
6. Steel scale
7. Micrometer (0-1 inch)
8. Dial indicator

An arbor press is also required for assembly of shaft and pintle bearings.

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 cleaned 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 than normal pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the bypass 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.

5. A pump or motor which is running excessively hot or noisy is a potential failure. Should a unit 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 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 from 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 shaft couplings should be as specified by their manufacturers.

F. Replacement Parts

Reliable operation through the specified operating range is assured only if genuine Vickers parts are used. Sophisticated design processes and materials are used in the manufacture of our parts. Substitutions may result in early failure. Part numbers are shown in the parts drawings listed in Table 1.

G. Troubleshooting

Table 3 lists the common difficulties experienced with piston pumps and motors. It also indicates probable causes and remedies for each of the troubles listed.

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.
	Intake filter or pipe plugged.	Clean filters of lint soon after new fluid is added.
	Air leak in intake line prevents priming.	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 (cylinders or valves).	Test independently by progressively blocking off the circuit.
	Free 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 noise.	Partly clogged intake line, intake filter or restricted intake pipe.	Pump must receive intake fluid freely or cavitation takes place.
	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 filter.
	Pump running too fast.	Conform with recommended maximum speeds on installation drawings.
	Filter too small on intake.	Refer to appropriate installation drawing for proper size filter.
	Coupling misalignment.	Check for damaged shaft bearing or other parts. If necessary, replace and realign the coupled shafts.
Motor shaft does not turn. Insufficient speed or power.	System overload relief valve set too low to permit necessary pressure.	Check pressure and increase relief valve setting, but not above recommended maximum.
	Valve plate and cylinder block surface scored by abrasive in hydraulic fluid.	Check external leakage at drain port. Remove motor. Install new rotating group. Replace scored valve plate. Flush system with clean oil.
Motor turning in wrong direction.	Pump or other components in system not functioning properly.	Check directional control and pump stroke position.
	Incorrect connection.	Check circuit and connect correctly.
External leakage from motor.	Worn seal or gaskets.	Install new seal and/or gaskets.
	Gaskets leaking due to improperly connected reservoir drain.	Connect drain line directly to reservoir below the fluid level.
Speed fluctuations with constant input flow.	Irregular wear between valve plate and cylinder block.	Replace damaged parts.

Table 3. Troubleshooting Chart

A. General

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.

After removing pump or motor from system and before disassembly, cap or plug all ports and disconnected lines. Clean the outside of the unit thoroughly to prevent entry of dirt into the system.

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.

NOTE

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

B. Disassembly

All models are disassembled in the same general sequence as shown in the exploded view, Figure 2.

NOTE

This procedure is written for a basic compensator model. If a control other than a compensator is used, refer to the appropriate service parts drawing for information on the control.

Parts should be placed on a clean piece of Kraft paper in the order of disassembly.

1. Remove four screws (1) from compensator body (2).

2. Remove compensator body (2) from valve plate subassembly (7).

3. Remove gasket (3), O-ring (4) and retaining ring (5) from piston rod (9).

4. Remove six screws (6) from valve plate subassembly (7).

5. Remove valve plate subassembly (7) from housing (36). Place valve plate subassembly on a clean piece of Kraft paper with machined surface up. Remove piston rod (9), spacer (10) and piston (11) from valve plate (7). (Note: Spacer does not exist in all models.)

6. Remove gasket (8) and discard.

7. The rotating group consists of retaining ring (12), lift limiter (13), spring (14), thrust washer (15), cylinder block (16), pins (17), backup washer (18), spherical washer (19), shoe plate (20) and piston/shoe subassembly (21). Turn the rotating group slightly to free it from the swash plate (22). Tilt housing (36) and remove the rotating group. During removal, use care to prevent separation of the rotating group. Disassemble the rotating group as follows: (Refer to Figures 2 and 3 during disassembly.)

a. Place the rotating group face down on a clean piece of Kraft paper.

b. Grasp shoe plate (20) and lift nine piston and shoe subassemblies (21) from cylinder block (16) with the shoe plate. Be careful not to strike the pistons together hard enough to create a burr or damage the pistons.

c. Remove spherical washer (19), backup washer (18) and pins (17). (Note: Some units do not use a backup washer.)

d. Observe caution during removal of spring (14) located within the cylinder block. The spring is under high compression and can cause bodily harm if retaining ring (12) is removed without adequate tooling. See Figure 3 for removal procedure.

8. Remove retaining ring (30) from housing (36) with truarc pliers.

9. Remove drive shaft (31), bearing (34), key (33) and retaining ring (37) from mounting flange of housing (36). Set aside for inspection.

10. Remove swash plate (22) from yoke subassembly (27). Rotate swash plate (22) and pull evenly from the yoke. Set aside for inspection.

11. Remove two screws (23) from yoke (27).

12. Remove pintles (24) with O-rings (25) from yoke (27). (Refer to Figures 4 and 5.)

13. Remove yoke (27), refer to Figures 4 and 5, the yoke removal procedure for a variable displacement pump or motor.

14. Variable displacement units require removal of seat (28) and spring (29) from within housing (36).

15. Remove washer (32) and shaft seal (35) from the housing. Be careful during the removal of the shaft seal. DO NOT scratch the housing to seal mounting surface. Leakage can occur between the seal and housing if the aluminum housing is scratched.

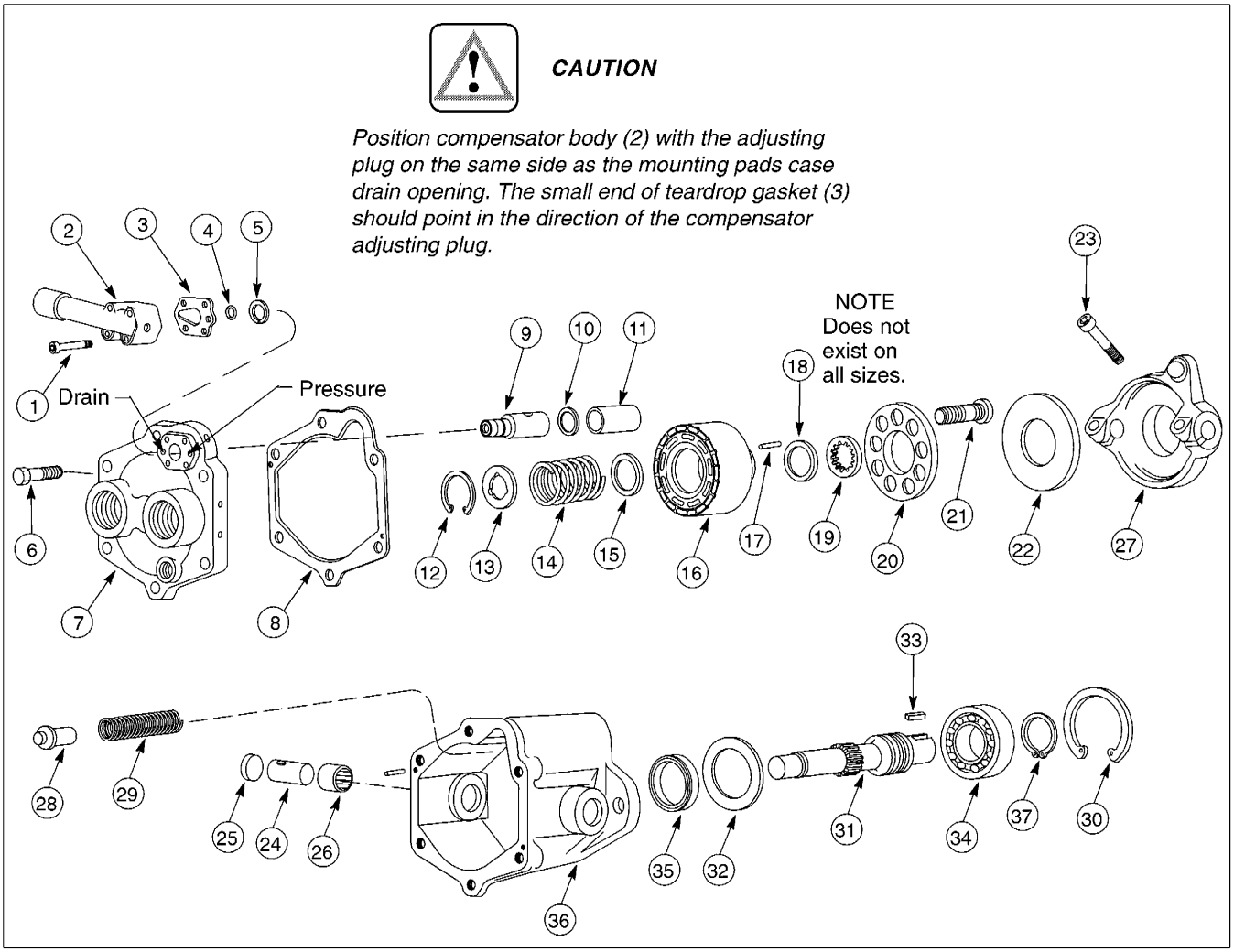


Figure 2. Exploded Parts Breakdown

Item	Nomenclature	Qty.	Item	Nomenclature	Qty.
1	Screw (Compensator)	4	19	Spherical Washer	1
2	Body (Compensator)	1	20	Shoe Plate	1
3	Gasket (Compensator)	1	21	Piston/Shoe Subassembly	9
4	O-ring (Compensator)	1	22	Swash Plate	1
5	Retaining Ring (Compensator)	1	23	Screw (Yoke)	2
6	Screw	6	24	Pintles	2
7	Valve Plate	1	25	O-ring (Pintle)	2
8	Gasket	1	26	Bearing (Pintle)	2
9	Piston Rod	1	27	Yoke Subassembly	1
10	Spacer	1	28	Seat	1
11	Piston	1	29	Spring	1
12	Retaining Ring	1	30	Retaining Ring	1
13	Lift Limiter Washer	1	31	Drive Shaft	1
14	Spring	1	32	Shaft Seal Retainer	1
15	Thrust Washer	1	33	Drive Shaft Key	1
16	Cylinder Block	1	34	Bearing (Drive Shaft)	1
17	Pin	3	35	Shaft Seal	1
18	Backup Washer	1	36	Housing	1
			37	Retaining Ring (Bearing)	1

Figure 2. Part Nomenclature

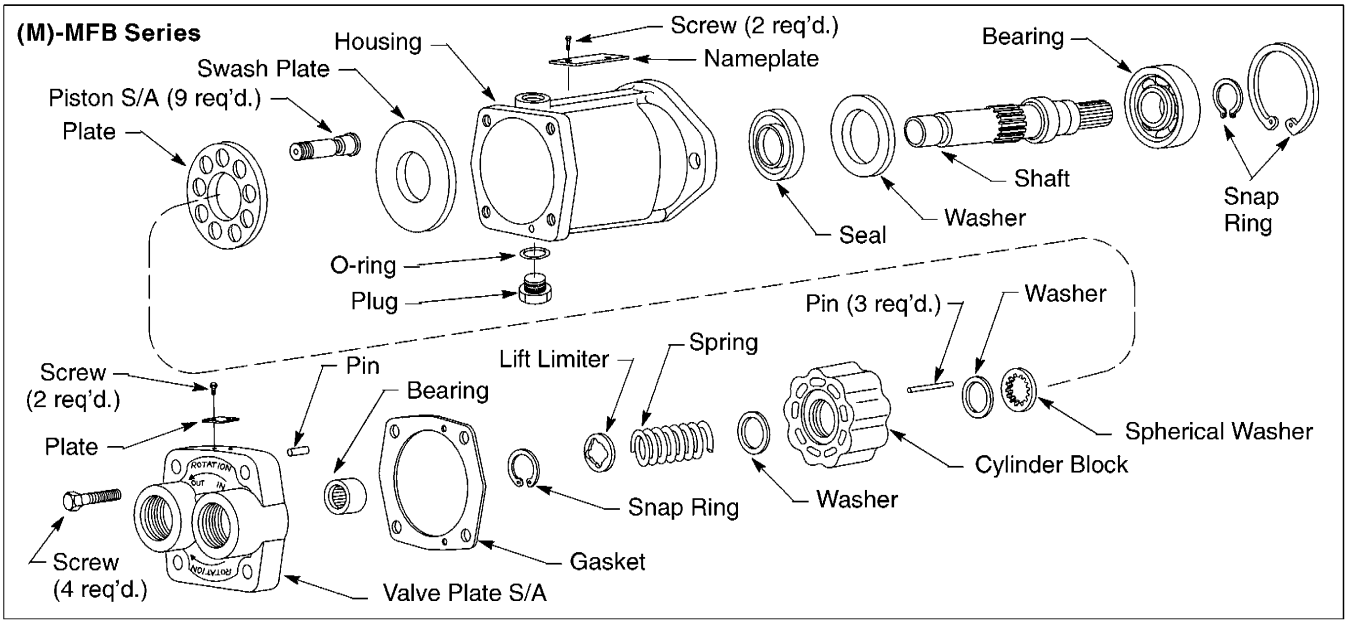


Figure 2a. Typical Fixed Displacement Motor

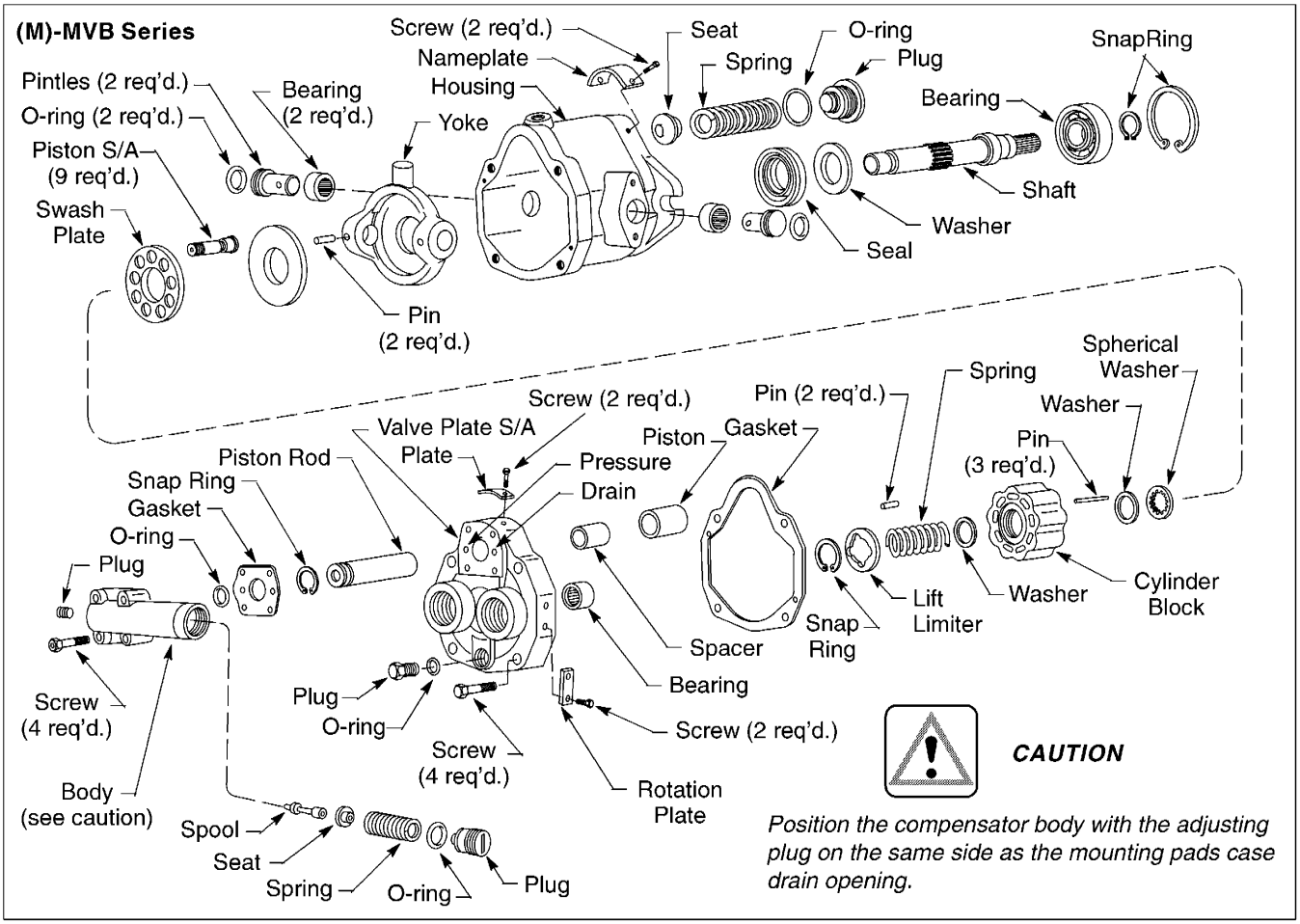


Figure 2b. Typical Variable Displacement Motor

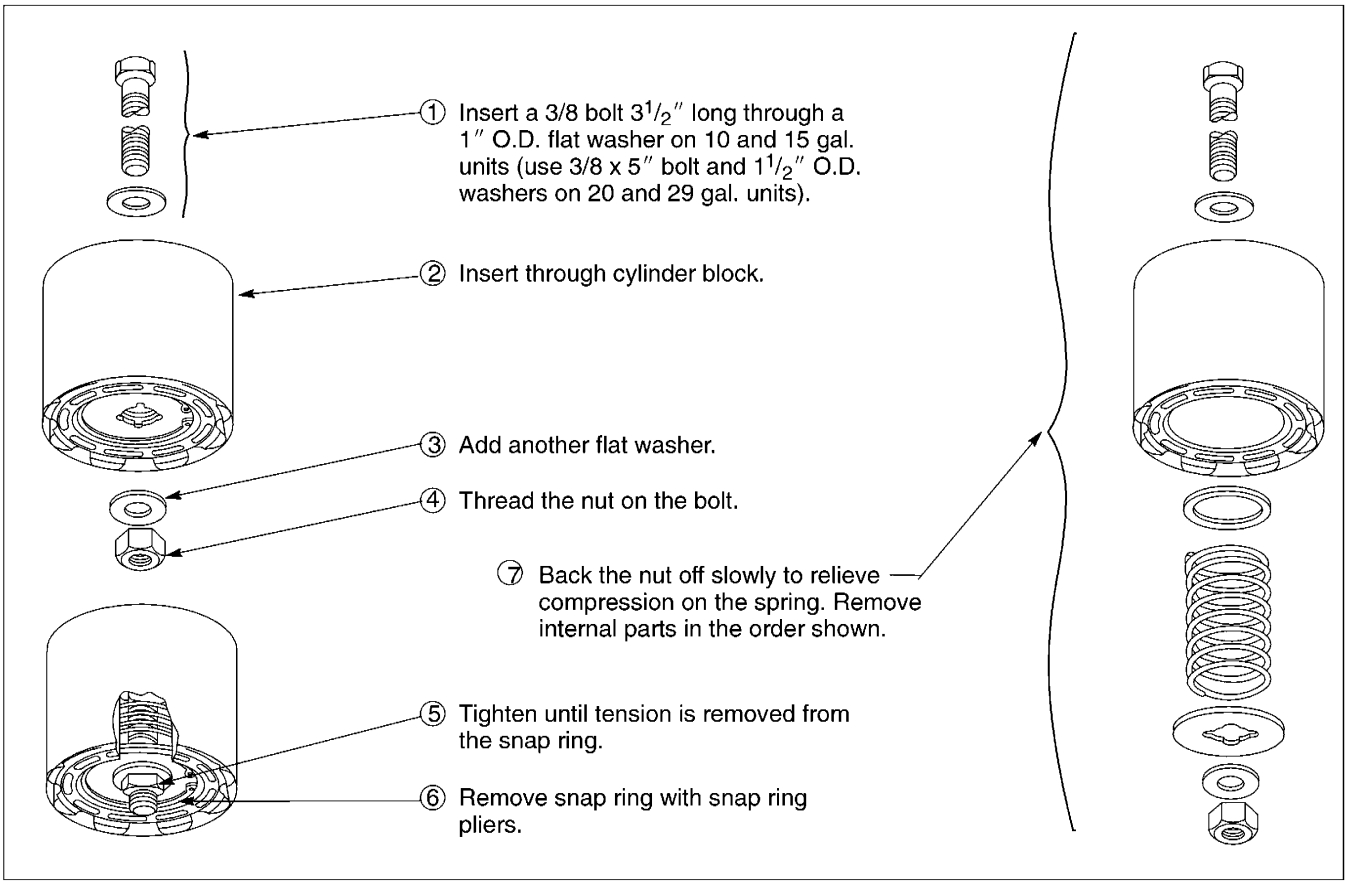


Figure 3. Cylinder Block Disassembly

C. Inspection, Repair and Replacement

Prior to inspection, clean all parts thoroughly with a solvent that is compatible with system fluid. Replace all parts that do not meet the following specifications.

1. Valve Plate (7) – Lapping of the valve plate is not recommended. If wear or scoring is apparent, replace the valve plate. Check the shaft bearing located within the valve plate for roughness and pitting of the rollers. Replace if defective. Remove paint and/or burrs from outer edge of valve plate with an India stone.

2. Piston Rod (9), Spacer (10) and Piston (11) – Inspect compensator piston rod and piston for fit and/or wear. Spacer (10) is used on some models to limit maximum flow. Replace if defective.

3. Rotating Group Parts

a. Inspect shoe plate (20) for wear or cracking in the area of spherical washer (19). If wear or cracks are found, replace the shoe plate and spherical washer at the same time.

b. Check spherical washer (19) for burrs and wear. Replace if defective.

c. Inspect pins (17) for equal length, wear and possible bending. Replace all pins simultaneously if one is defective.

d. Backup washer (18) does not exist in all models. Check for wear and replace if necessary.

e. Check each cylinder block (16) bore for excessive wear. Use the piston/shoe subassemblies (21) 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 occurs, clean the cylinder block and piston, lubricate with clean hydraulic fluid and try again. Even minor contamination of the fluid can cause the piston to freeze up in the cylinder block bore.

f. Inspect each piston and shoe subassembly (21) for a maximum end play of 0.003 inch between the piston and shoe. The face thickness dimension, as shown in Figure 6, of each shoe must be within 0.001 inch of each other. A variation greater than 0.001 inch between all nine shoes indicates excessive wear. If one shoe needs replacement, replace all piston/shoe subassemblies. Replacement as a matter of procedure is recommended to obtain maximum overhaul life of the unit.

g. Inspect retaining ring (12), lift limiter washer (13), spring (14) and thrust washer (15) within cylinder block (16) for wear. Replace if necessary.

4. Inspect the face of swash plate (22) for wear, scratches and possible fracture. If the swash plate needs replacement, make sure the new swash plate rests flat against the face of yoke subassembly (27).

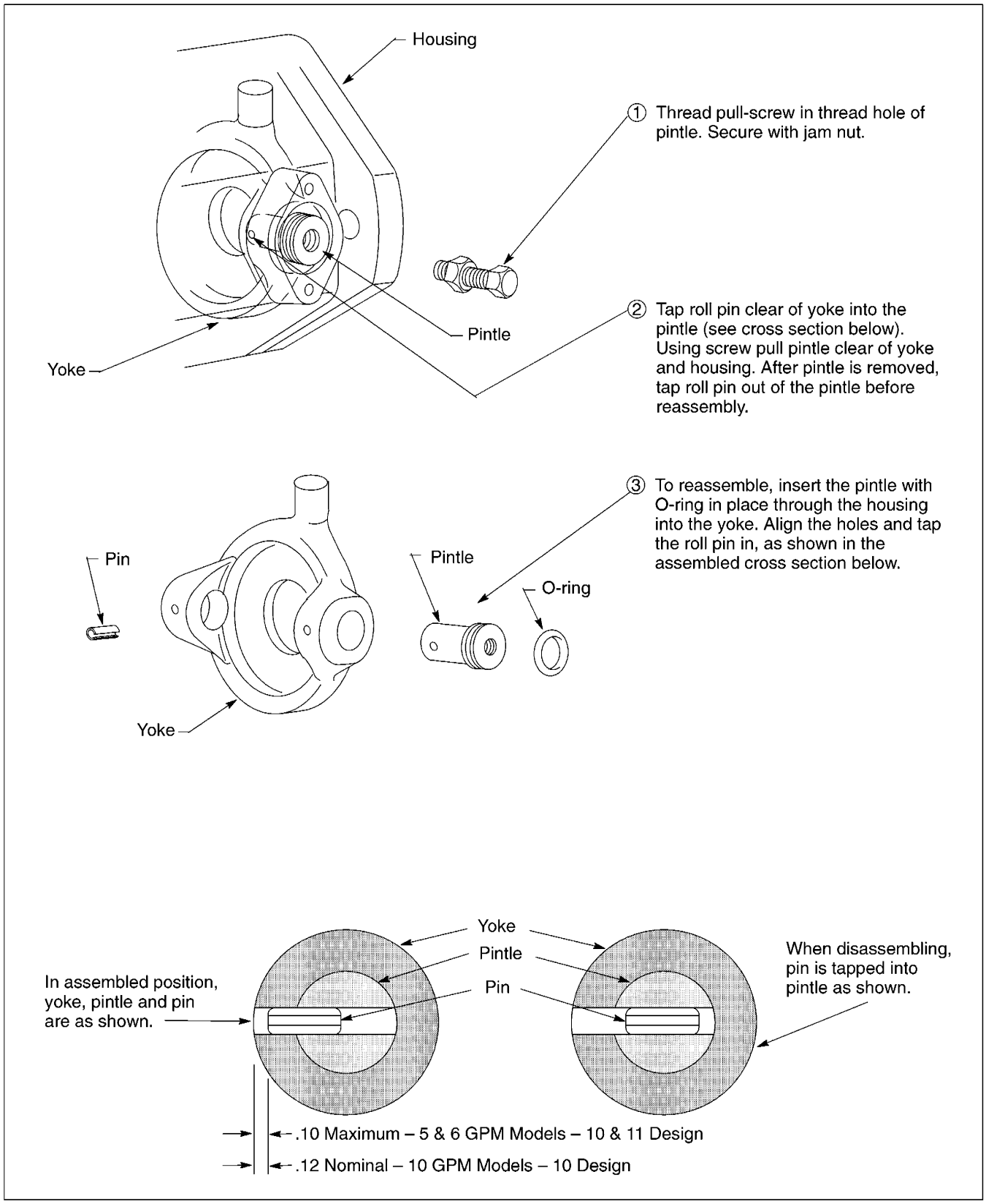
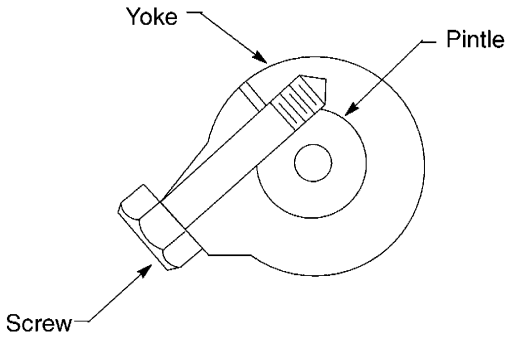


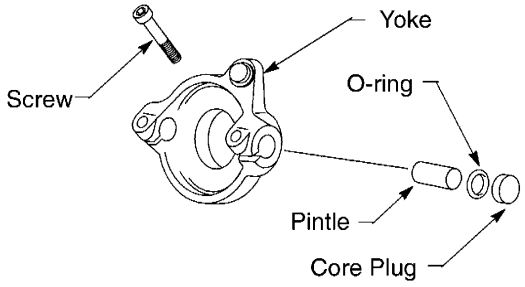
Figure 4. Removal of Pintle and Yoke, Smaller Models

The 10 and 15 GPM units of the -20/-30/-31 designs use a screw in lieu of the roll pin for securing pintles. The pintles are provided with a groove in place of the drilled hole to accept the screw (see cross section below).



10 and 15 GPM models
-20/-30/-31 Design

(1) Remove the core plug. Back-off lock screw at yoke until pintle groove clears for 20 and 29 GPM models. Lightly tap pintle toward inside of unit to remove. NOTE: Swash plate must be removed from yoke to remove these pintles.



(2) To reassemble, insert the pintle through the housing into the yoke. Align the grooves and thread in lock screw.

20 and 29 GPM models

Figure 5. Removal of Pintle and Yoke, Larger Models

5. Inspect drive shaft (31) for wear, a chipped spine and burrs. Remove burrs with an India stone. Inspect the contact area of the shaft seal for wear and/or scoring. Replace the drive shaft if wear or scoring is greater than 0.005 T.I.R. (total indicator reading).

6. Inspect drive shaft bearing (34) for roughness in turning, pitting of the rollers and excessive end play. Replace if defective. If the bearing or shaft require replacement, removal of the bearing from the shaft is required. Use appropriate tooling to hold the inner race of the bearing and press the shaft from the bearing. Assemble new parts together in a similar manner, always applying force to the shaft and inner race of the bearing. DO NOT apply force to the outside bearing race. Install retaining ring (37).

7. Inspect yoke subassembly (27) face for wear, roughness or scoring. Check pintle bores of yoke for wear. Replace if defective.

8. Inspect pintles (24) and pintle bearings (26) for wear. Replace if defective. If a pintle bearing requires replacement, use a tool smaller than the housing bore and drive the pintle bearing into the housing and remove. Be careful not to score the housing bore during removal. Clean up the bore and lubricate both the bore and new pintle bearing with system fluid. Be very cautious during installation of new pintle bearings. If a bearing is misaligned with the bore at start of press, the bearing cage will warp and a bind will occur. Use an arbor press to install new pintle bearings. DO NOT press a bearing past the inside lip of the housing or interference with the yoke will result.

9. Inspect housing (36) mounting flange for nicks and burrs. Remove with an India stone. Remove paint and/or burrs from outer edge of housing.

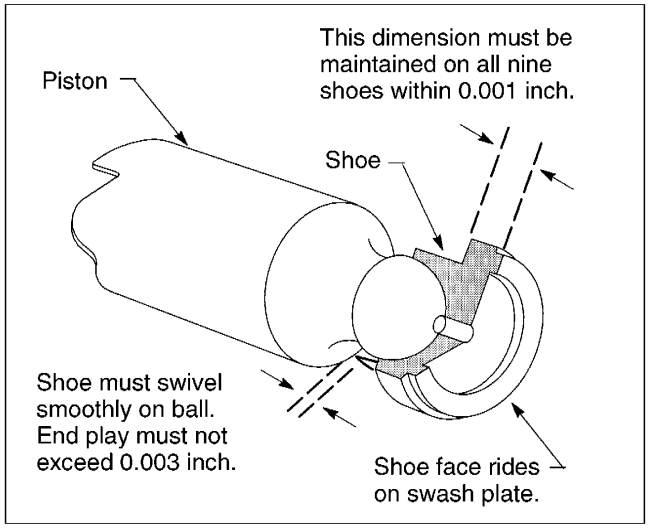


Figure 6. Piston and Shoe Assembly Tolerances

D. Assembly

Assembly is performed in the reverse order of disassembly. Special procedures are noted in the following text.

A new seal kit should be obtained. Refer to the parts drawing for your model (see Table 1). Replace all seals, gaskets and O-rings with new ones from the kit. A light film of clean hydraulic fluid will provide ease of assembly and initial lubrication of moving parts. Assemble as follows:

1. Install new shaft seal (35) into housing (36) with spring loaded member facing into the housing.

2. Install spring (29) over spring guide in housing. Insert seat (28) into spring.

3. Install yoke (27) in housing (36) as illustrated in Figures 4 and 5. Make sure seat (28) is in position and engages within the yoke.

4. Install pintles (24) and O-rings (25) as illustrated in Figures 4 and 5. Install screws (23) and torque to recommended values. Refer to parts drawing for applicable unit found in Table 1.

5. Place shaft seal retainer (32) over shaft seal. Install drive shaft (31) and retaining ring (30) up against bearing into housing groove.

6. Lubricate and install swash plate (22) with chamfer side facing yoke (27). It is important that the swash plate be properly seated within the yoke and can be freely moved (rotated) with the fingers.

7. If the cylinder block was disassembled, refer to Figure 3 for assembly. Place the cylinder block face down on a clean piece of Kraft paper and insert three pins (17) into the cylinder block. Lubricate back-up washer (18) (not used on some models) and spherical washer (19), place them over pins (17). Lubricate the cylinder block bores and pistons with system fluid. Install the nine pistons (21) through shoe plate (20) and into the cylinder block bores.

The rotating group is now assembled and ready for installation into the pump or motor housing. Hold cylinder block (16) and shoe plate (20) together to keep pins (17) and washer(s) (18 & 19) intact, then install rotating group over the drive shaft. A slight rotation of the drive shaft during assembly will help align spherical washer (19) and cylinder block (16) splines with those of the shaft.

8. Lubricate the face of the valve plate. Make sure paint and burrs have been removed from the outer edge of housing (36) and valve plate (7). Install gasket (8) on housing (36).

9. Install piston rod (9) into valve plate. Slide retaining ring (5) over piston rod (9) and into retaining ring groove. Install spacer (10) (used only on models with reduced flow capability, and piston (11) over piston rod (9).

10. Align drive shaft to bearing and install valve plate (7) on housing (36). Thread retaining screws (6) through valve plate and into housing. Torque to the values noted in parts drawing for the unit.

11. Lubricate and install "O" ring (4) in "O" ring groove of piston rod (9). Install gasket (3) on valve plate (7).

CAUTION

Position gasket as shown in Figure 2 with teardrop hole pointing toward compensator adjusting screw.

12. Place compensator body (2) over gasket (3) on valve plate (7). Make sure body of compensator and gasket are installed in the correct position for shaft rotation (see Figure 2). Thread retaining screws (1) through compensator into valve plate. Torque screws to the values noted on parts drawings for the unit.

13. Install drive shaft key (33) into drive shaft (31). Make sure key is seated properly.

E. Conversions

When changing the direction of rotation of an inline hydraulic pump, it will become necessary to change to the respective valve plate for that rotation. If the pump happens to be a compensated type, the compensator must be rotated 180° and the compensator gasket must follow. Consult the appropriate parts drawing listed in Table 1 for the proper valve plate selection.

Hydraulic motors with "V" in the model code require only the rotation of the compensator to change direction. When a change such as this is made, it should be noted by a change in the name plate and any directional arrows as an aid in future identification.

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