SERVICE INSTRUCTIONS

TYPE "PVM" OPEN LOOP PUMPS

PURPOSE OF INSTRUCTIONS

These instructions are written to simplify your work when installing, operating and maintaining these Type "PVM" Pumps. Your acquaintance with the constructions, principle of operation and characteristics of these units will help you attain satisfactory performance, reduce down-time and increase the units' life. Some units have been modified from those described in this bulletin and other changes may be made without notice.

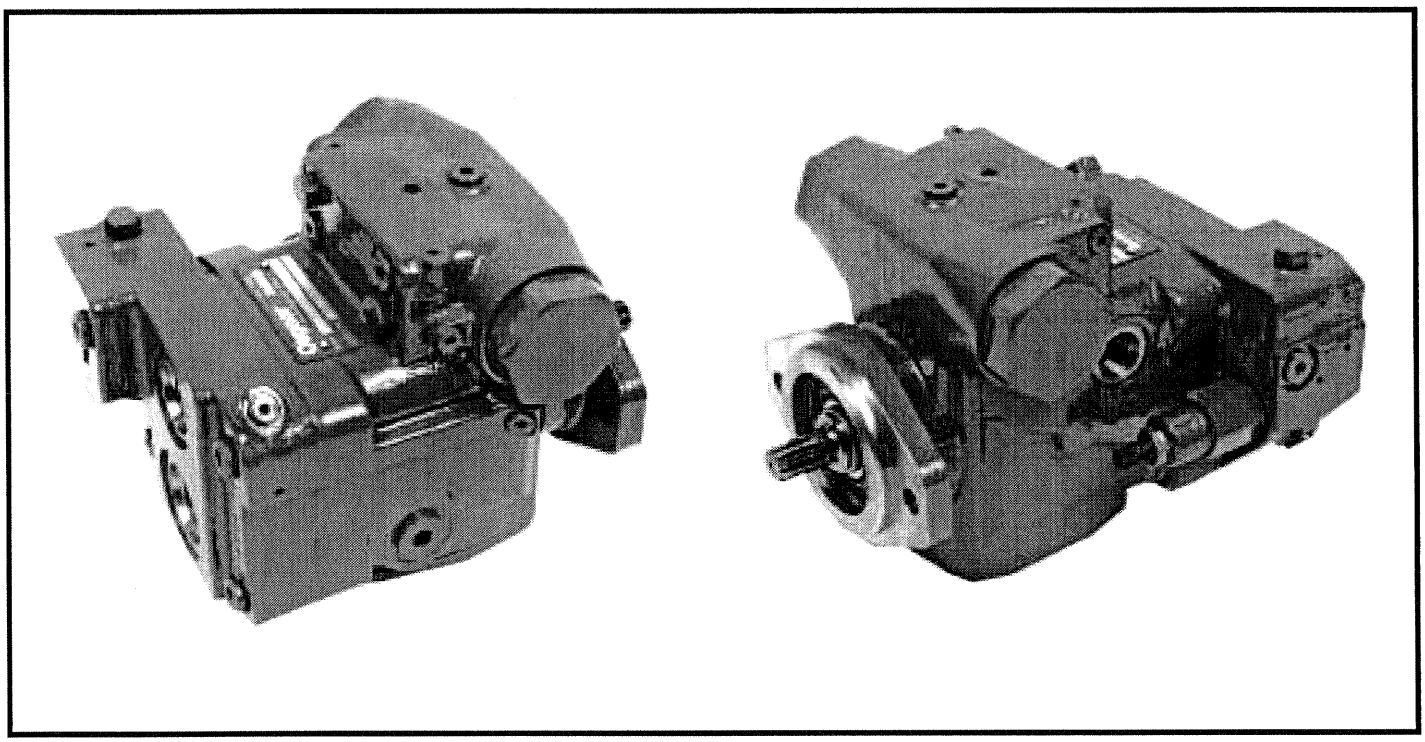

Figure 1. Typical "PVM" Open Loop Pumps

REFERENCE MATERIAL

Fluid Recommendations	Bulletin	90000
Contamination Evaluation Guide	Bulletin	90004
Filtration Recommendations	Bulletin	90007
Piping Information	Bulletin	90011

I. PREPARATION AND INSTALLATION

A. MOUNTING

PUMP WITHOUT RESERVOIR. The pump may be mounted in any position. For convenience, the recommended mounting position is with the driveshaft on a horizontal plane. Secure the unit to a rigid mounting surface. See section "B" on "Piping Information".

PUMP WITH RESERVOIR. These units are usually fully piped and equipped although it may be necessary to connect supercharge circuit when used. Mount reservoir on a level foundation with reservoir bottom at least six (6) inches above the floor level to facilitate fluid changes.

B. PIPING AND FITTINGS

See referenced "Piping Information" bulletin and individual circuit diagram before connecting pump to system. Inlet velocity must not exceed 5 fps (1,5 mps). Inlet should be unrestricted and have a minimum of fittings. An inlet strainer is not recommended.

B. PIPING AND FITTINGS

HORIZONTAL MOUNTING. Arrange line from the highest "case drain" or "alternate case drain" so the case remains full of fluid (non-siphoning). Case pressure should be less than 25 psi (1,7 bar). For higher case pressures and special shaft seals required, contact our factory. Each drain line must be a separate line, unrestricted, full sized and connected directly to the reservoir below the lowest fluid level. Provisions for opening this line without draining (siphoning) reservoir should be made.

VERTICAL MOUNTING. See referenced "Installation of Vertically Mounted Axial Piston Pumps", Bulletin 90014.

WARNING

Running the pump in "Neutral" position (zero delivery) for long periods of time without supercharge can damage the pump.

Systems and pump must be protected against overloads by separate high-pressure relief valves. Install bleed valve(s) at highest point(s) in system.

C. POWER

Power is required in proportion to volume and pressure used. Motor size recommendations for specific applications can be obtained from The Oilgear Company. Standard low starting torque motors are suitable for most applications.

CAUTION

Never start or stop unit under load unless system is approved by Oilgear. It may be necessary to provide delivery bypass in some circuits.

D. DRIVE

See rotation direction plate on unit's housing. Clockwise units should not be driven counter-clockwise. See "Section X, Conversions" for changing clockwise units to counterclockwise or vice versa. Use direct drive coupling. Size and install coupling per manufacture's instructions.

CAUTION

Do not drive coupling onto pump driveshaft. If it is too tight, it may be necessary to heat coupling (see manufacture's instructions).

Misalignment of pump shaft to driver's shaft should not exceed 0.005 inches (0,13 mm) Total Indicator Readout (TIR) in any plane.

E. FILTRATION

To assure long life from your hydraulic system, keep fluid clean at all times. See reference bulletin on "Filtration Recommendations" and on "Contamination Evaluation". Oilgear recommends use of a filter in the pressure return line. Replace filter element(s) when filter condition indicator reaches change area at normal temperature. Drain and thoroughly clean filter case. Use replacement element(s) of same beta 10 ratio (normally a ratio of 4 with hydraulic oils).

F. FLUID COOLING

When pump is operated continuously at rated pressure or frequently at peak load, auxiliary cooling of fluid may be necessary. Fluid temperature should not exceed limits specified in referenced Oilgear bulletin on "Fluid Recommendations".

G. AIR BREATHER

On most installations, an air breather is mounted on top of the fluid reservoir. It is important for the breather to be of adequate size to allow airflow in and out of the reservoir as fluid level changes. Keep breather case filled to the "fluid level" mark. About once every six months remove the cover, wash screen in solvent, clean and refill case to level mark on the screen. See manufacture's recommendations.

H. FLUID, FILLING AND STARTING RECOMMENDATIONS

Refer to instruction plate on the unit, reservoir, machine and/or referenced "Fluid Recommendations" bulletin. Fire resistant fluids and phosphate ester fluids can be used in accordance with fluid manufacture's recommendations.

Pump all fluid into reservoir through a clean (beta 10 ratio 4 or more) filter. Fill reservoir to, but not above, "high level" mark on sight gage. **Remove case drain line and fill pump case with hydraulic fluid.**

Turn driveshaft a few times by hand with a spanner wrench to be sure parts are free.

Table 1. Torque To Turn Shaft

Size Unit	011, 014 & 022
Approx. Torque to turn driveshaft - ft. lbs.	1.7 - 2.1
Nm.	2,3 - 2,8

With pump under "no load", or with pump control at "neutral", turn drive unit on and off several times before allowing pump to attain full speed. Running the pump and operating the control can usually fill the system. Watch the fluid level in the reservoir and stop pump if the level reaches "low level" mark. Add fluid and start again. With differential (cylinder) systems, fluid must not be above "high level" when the ram is retracted or below the "low Level" when extended. Bleed air from the system by loosening connections or opening petcocks at the highest point in the system. Close connections or petcocks tightly when solid stream of fluid appears.

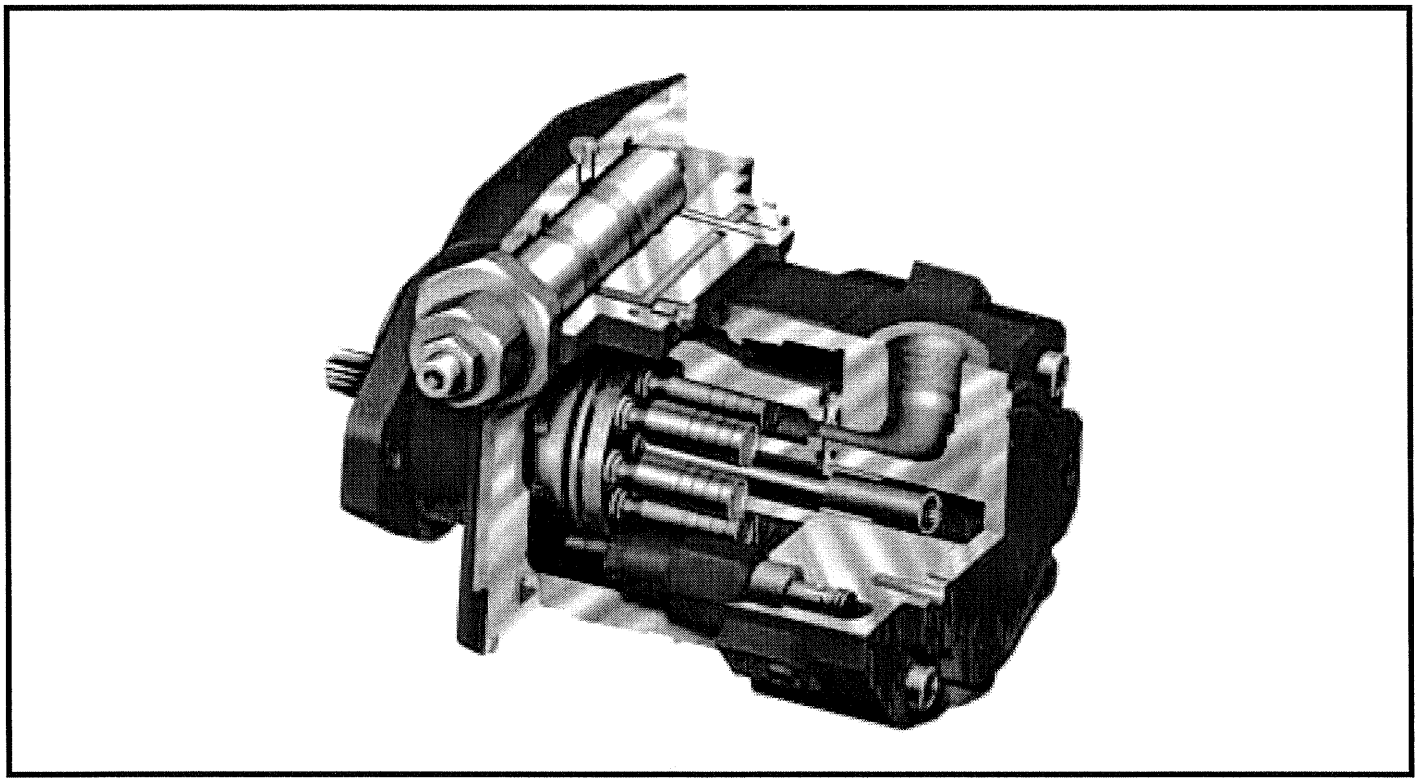

Figure 2. Cut-a-way (cross-section) of typical "PVM" Pump

II. CONSTRUCTION

Refer to Figures 2, 7 and 8. A driveshaft (21) runs through the centerline of pump housing (1) and valve plate (45) with pump cylinder barrel (38) splined to it. A bearing (26) supports the front of the driveshaft and a (bushing type) bearing (67) supports the rear of the driveshaft. The pump cylinder barrel is carried in a hydrodynamic (journal type) cylinder bearing (35). A port plate (43), containing crescent shaped ports, is located on a valve plate (45) that has matching crescent shaped ports. Pumping piston/shoe assemblies (39) in the cylinder barrel are held against a swashblock (29) by a shoe retainer plate (40). The shoe retainer is held in position by the fulcrum ball (41). The fulcrum ball is forced outward by a shoe retainer plate spring (42). The spring acts against the pump cylinder barrel forcing it against the port plate while also forcing the piston shoes against the swashblock. The semi-cylindrical shaped swashblock limits the piston stroke and can be swiveled in an arc shaped saddle-bearing (30). The swashblock is swiveled by a control piston (19).

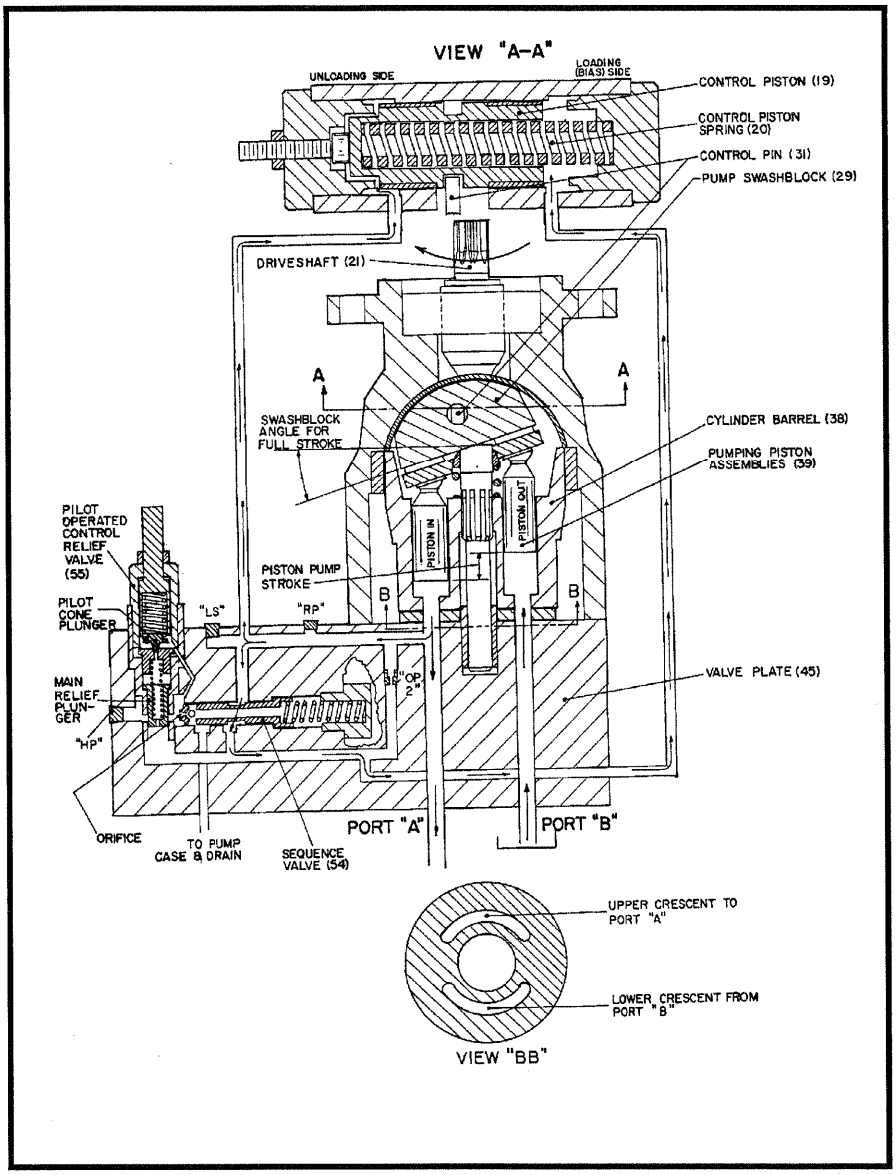

Figure 3. Pump Starting & Raising Pressure

A PUMP DRIVEN CLOCKWISE (RIGHT HAND) IS DESCRIBED. **DIAGRAMS** ARE SHOWN FROM TOP (PLAN) VIEW.

A. STARTING (See Figure 3)

The control piston spring (20) positions the control pin (31) and pump swashblock (29) so the pump will deliver **maximum volume** to raise pressure in the system.

B. RAISING PRESSURE

Pump delivery (and resultant pressure) is fed to both sides of the control piston (19). Flow to the unloading side of the control piston is direct. Flow to the loading (bias) side of the control piston is through the control sequence valve (54). [Note: - flow through the pilot operated control relief valve (55) is blocked]. The areas on either end of the control piston are the same and the pressure acting on either end of the control piston are the same. The resultant hydraulic forces on the ends of the control piston cancel each other out (the control piston is balanced). Therefore, the force of the control piston spring (20) controls the control piston position.

Rotating the driveshaft (21) clockwise turns the splined cylinder barrel (38) that contains the pumping piston assemblies (39). When the cylinder is rotated, the pistons move in and out of their bores as their shoes "ride" against the angled pump swashblock (29).

As the cylinder rotates, the individual piston bores are connected, alternately, to upper (Port A) and lower (Port B) crescent shaped ports in the valve plate (45). While connected to the lower side (suction) Port B, each piston moves outward, drawing fluid from Port B into the piston bore until it's outermost stroke is reached. At that point, the piston bore passes from the lower crescent port to the upper crescent port.

While rotating across the upper crescent port, each piston moves across the angled swashblock face and is forced inward. Each piston displaces (delivers) fluid through the upper crescent to Port A until it's innermost stroke is reached. At that point, the piston bore passes from the upper to the lower crescent again and the operating cycle is repeated.

A study of the diagram will show that the degree of swashblock angle determines the length of piston stroke (difference between outermost and innermost position) thereby determining the amount of delivery from the pump. Reducing the swashblock angle will reduce the pump delivery.

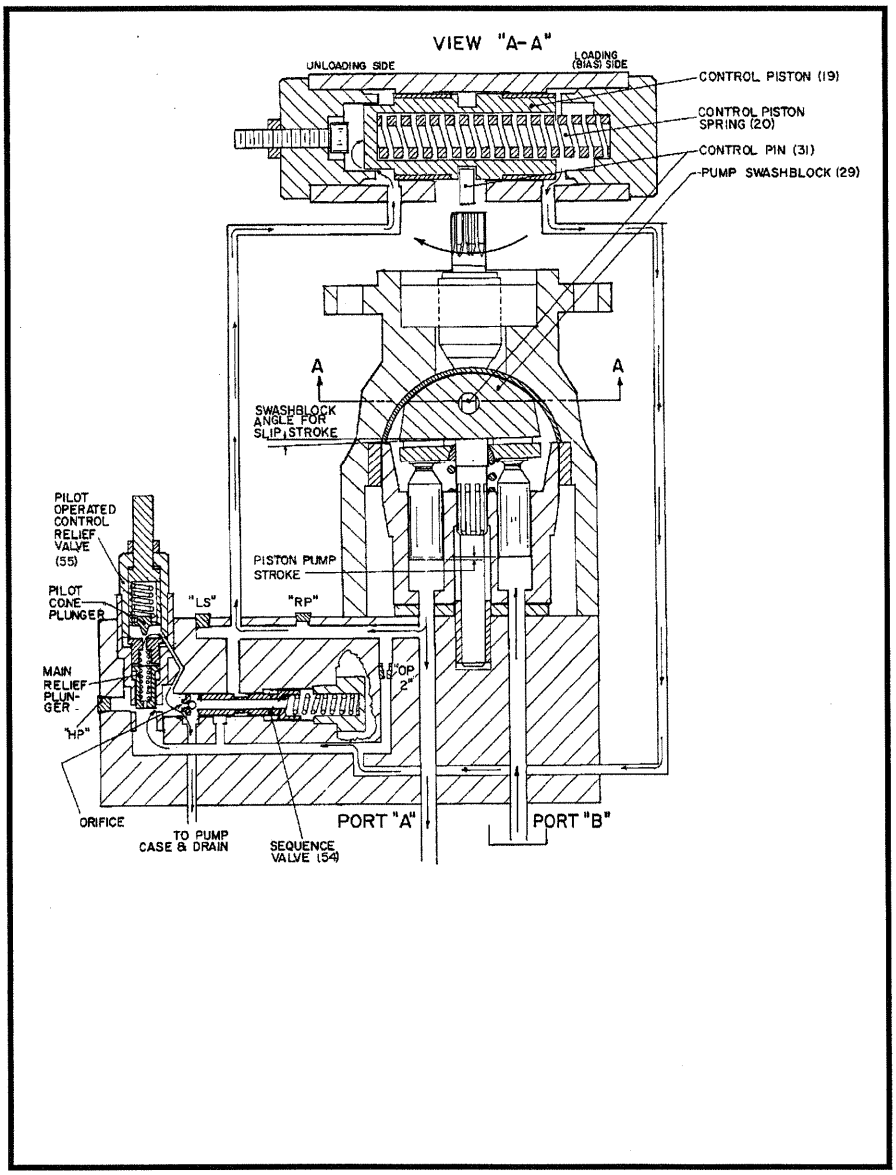

Figure 4. Pump Compensating (Unloading)

C. PRESSURE COMPENSATING (Pump Unloading)

As previously noted, pump delivery flow (and resultant pressure) passes through the control sequence valve (54). Flow (and pressure) is also ported through orifices in the center of the pilot operated control relief valve (55) to the adjustable pilot relief valve (in upper portion of the body).

See Figure 4. When system pressure exceeds the pilot valve setting the pilot cone plunger opens. Pressure on the topside of the main relief plunger is relieved. A pressure imbalance now exists (across the main spool); the pressure on the lower side of the main relief plunger raises the main spool and allows flow (and pressure) through the relief valve. Exhaust flow from the main relief plunger is ported to the stem end of the control sequence valve. The orifice in the end of the control sequence valve spool results in a pressure drop and the spool is forced against the opposing spring. Flow from the relief valve is now allowed past the sequence valve, into the pump case and drain. At the same time, the control sequence valve blocks flow from the pump high-pressure line to the pilot operated control relief valve (high-pressure flow must now go through the stability orifice "OP2"). Flow from the bias side of the control piston is allowed to bleed through the control relief valve and control sequence valve into the case and drain. Note that pressure is still ported to the unloading side of the control piston (19). The control piston is no longer 'balanced' and the pressure on the unloading side of the control piston forces the control piston to compress the control piston spring.

The control piston now moves the **control pin** (31) and shifts the **swashblock** (29) to a position towards neutral (no delivery) where the pump (is unloaded) delivers "just enough" volume to maintain (make-up for component slip losses or leakage) system pressure as regulated by the adjustable pilot operated control relief valve (55).

D. HOLDING PRESSURE (See Figure 3).

If the system pressure drops below preset compensating pressure (in the event of increased leakage of system components and/or opening of system valves etc.), the control relief valve conical plunger seats (stopping flow to drain). Pressure on both ends of the main relief plunger is now balanced, the main relief plunger closes, the spring shifts the position of the control sequence valve to allow additional flow to the bias side of the control piston. The control piston spring positions the control piston (and control pin/swashblock) for increased delivery until the control relief valve preset pressure is reached again.

IV. SPECIFICATIONS

See Referenced material and individual application circuit for exceptions.

Table 2. Nominal Performance Data with 150-300 SSU viscosity fluids

UNIT	THEORETICAL MAXIMUM DISPLACEMENT		RATED CONTINUOUS PRESSURE		MAXIMUM PRESSURE		FLOW RATE at 1800 rpm, rated continuous pressure & 14,7 psia (bar $_{abs}$) inlet condition		MINIMUM INLET PRESSURE psia (bar $_{abs}$)			MAXI-MUM SPEED	POWER INPUT at rated continuous pressure & 1800 rpm	
	in 3/rev	ml/rev	psi	bar	psi	bar	gpm	l/min	1800 rpm	2400 rpm	3600 rpm	rpm	hp	kw
011	0.66	10,8	3750	258,6	4250	293,1	4.2	15,9	5.5 (0,38)	8.2 (0,57)	17.2 (1,19)	3600	12.8	9,5
014	0.86	14,1	3750	258,6	4250	293,1	5.9	22,4	4.6 (0,32)	7.8 (0,54)	17.4 (1,20)	3600	16.4	12,1
022	1.35	22,1	3750	258,6	4250	293,1	9.5	36,0	9.5 (0,66)	11.1 (0,77)	22.5 (1,55)	3600	26.1	19,5

Table 3 Nominal Dimensions and Weights

UNIT	WIDTH		LENGTH		HEIGHT		WEIGHT		FACE MOUNT
	in.	mm.	in.	mm.	in.	mm.	lb.	kg.	
011 014 022	7.03	178,5	7.95	201,9	6.48	164,6	36	16,3	SAE "A" 2 Bolt

See Installation drawings for more detailed dimensions and port configurations

V. MALFUNCTIONS AND CAUSES

A. UNRESPONSIVE OR SLUGGISH CONTROL

1. Swashblock saddle bearing (30) worn or damaged.
2. Control piston (19) or sequence spool (54) binding in bore.
3. Control piston spring (20) broken, sequence valve spool spring (53) binding or otherwise damaged.

B. INSUFFICIENT PUMP VOLUME

1. Delivery limited by stroke limiter screw (70),
2. Delivery limited by faulty control piston (19), or control relief valve (55) operation.
3. Obstructed suction circuit or insufficient supercharge volume.
4. Insufficient drive motor speed.
5. Worn or grooved cylinder barrels (38), port plate (43) and/or valve plate (45) matching surfaces.
6. Worn or broken saddle bearing (30).
7. Worn or damaged piston and shoe assemblies (39) or piston bores in cylinder (38).
8. Worn or damaged piston shoe or swashblock (29).

C. IRREGULAR OR UNSTEADY OPERATION

1. Faulty control piston (19), sequence valve (54) or control valve (55) operation.
2. Fluid level in reservoir is low or supercharge is insufficient.
3. Air entering hydraulic system.
4. Worn axial piston pump.
5. Faulty output circuit components (cylinders, motors, valves etc.).

D. LOSS OF PRESSURE

1. Worn piston pump.
2. Worn or grooved cylinder barrel (38), port plate (43) and/or valve plate (45) matching surfaces.
3. Worn piston and shoe assemblies (39) or piston bores in cylinder (38).
4. Faulty output circuit components.
5. Worn or broken saddle bearing (30).

E. EXCESSIVE or HIGH PEAK PRESSURE

1. Faulty control piston (19), sequence valve (54) or control valve (55) operation.
2 Faulty output circuit components (pay particular attention to system relief valves).
3. Worn or broken saddle bearing (30).

F. EXCESSIVE NOISE

1. Pump incorrectly being stopped or started under load.
2. Low fluid level in reservoir or insufficient supercharge resulting in cavitation.
3. Air entering hydraulic system.
4. Fluid too cold or viscosity too low.
5. Suction line problem i.e.; obstructions in line, line too long, line diameter too small or too many bends and/or loops in line.
6. Broken or worn piston and shoe assemblies (39).
7. Pump rotating in wrong direction.

G. EXCESSIVE HEATING

1. Operating pump above rated or peak pressure.
2. Low fluid level in reservoir or insufficient superchargers.
3. Air entering hydraulic system.
4. Worn piston pump.
5. Worn or grooved cylinder barrel (38), port plate (43) and/or valve plate (45).
6. Faulty output circuit components (continuous blowing relief valves or "slip" through valves, cylinder, etc.).
7. Insufficient cooling provision or clogged coolers.

VI. TESTING AND ADJUSTING

WARNING – Shut pump off and release pressure from system before disassembling components. Failure to comply with these instructions could result in personal injury or death. **Blocking pressure line between pump and system (or pump) high-pressure relief valve will result in damage and could result in personal injury.**

Table 4. Nominal Case Slip vs. High Pressure at 1800 rpm (viscosity of 160 SSU).

Pump Size		Case Slip at Full Stroke and Indicated Pressure at 1800 rpm				
		500 psi	1000 psi	2000 psi	3000 psi	3750 psi
011	cipm	25	45	85	135	180
	lpm	0,41	0,74	1,39	2,21	2,95
014	cipm	35	50	105	160	220
	lpm	0,54	0,82	1,72	2,62	3,61
022	cipm	40	60	110	170	240
	lpm	0,66	0,98	1,80	2,79	3,94

A. PISTON PUMP

To check for worn piston pump, measurement of the leakage can be made from the case drain while pump is under pressure. After the unit is warm, either install a flow meter in the drain line or have the flow from the drain line directed into a large container or reservoir. The pump case must remain full of fluid during this test.

CAUTION:

Do not run a pump on stroke against a blocked output unless it is protected by a high pressure relief valve and then run no longer than necessary to check slip. Limit discharge to prevent dropping reservoir fluid below low level.

With an accurate high-pressure gage in the pressure line, start the pump and stall (or block) output device to raise system pressure to maximum (as set by system relief valve). Read the flow meter or time the case drain flow used to fill a known size container and calculate the flow rate in terms of cubic inches per minute (cipm). The leakage should conform to Table 4 (page 7). Additional leakage indicates wear, but does not become critical until it impairs performance.

VII. DISASSEMBLY

A. PREPARATION

When disassembling or assembling unit, we recommend choosing an area where no traces of dust, sand or other abrasive particles, which could damage the unit, are in the air. We also recommend not working near welding, sandblasting, grinding benches and the like. Place all parts on a CLEAN surface. To clean parts, which have been disassembled, it is important to use CLEAN solvents. All tools and gages should be clean prior to working with these units and new CLEAN threadless rags used to handle and dry parts.

WARNING: NEVER attempt to remove or install any component or assembly while unit or system is running. Always stop the pump, shut-off power and release pressure from the system before servicing or testing. Be sure provisions have been made so case drain line can be disconnected from the unit without causing the line to drain (siphon) the reservoir.

Disconnect case drain from upper most case drain port and drain pump case through the other (lower) drain port. If plugs are inaccessible, it may be necessary to remove pump from mounting (and drive motor) before draining it.

Refer to figures 7 and 8. Depending upon what part or parts are to be inspected, it may not be necessary to completely take apart all assemblies.

WARNING- Assistance from others and use of a hoist and/ or proper lifting techniques are strongly recommended to prevent personal injury.

It will be advantageous to tag similar parts (particularly screws plugs and o'rings) during disassembly to be certain they don't become confused with similar parts and to assure they will be returned to original location. Do not remove (locator) roll pins unless they are deformed or other wise in need of replacement.

B. VALVE PLATE GROUP

If pump is a THRU-SHAFT unit with another pump or other device coupled to the rear of the pump, it will be necessary to remove that unit and o'ring (59). If thru-shaft convertible cover (63) is used, remove socket head cap screws (64) and o'ring (62).

Block unit on bench with of driveshaft horizontal. Remove valve plate assembly (45) by removing four socket head cap screws (50 & 56) and valve plate assembly. When used, shaft coupling (57) with retaining rings (58) will come with valve plate assembly. The port plate (43) is located on the valve plate assembly by dowel pin (44). Remove the port plate from the valve plate assembly. **Extreme care must be taken not to damage the faces of the port plate and the matching faces of both the valve plate and cylinder barrel.**

The control sequence valve can be removed if necessary by removing sequence valve spool plug (51) with o'ring (52), withdrawing sequence valve spool spring (53) and sequence valve spool (54). The relief valve control cartridge assembly (55) can also be unscrewed from the valve plate if necessary.

Rear shaft bearing (67 or 77) is pressed into valve plate. The rear shaft bearing can be removed if necessary.

C. ROTATING GROUP

Extreme care must be taken not to damage cylinder wear surface (that matches against the port plate), the bearing diameters or the piston shoes. Remove o'rings (13 & 14) from the pump housing (1). Do not remove roll pins (12) unless damaged.

Remove the rotating group by slowly turning the driveshaft (21) while pulling the cylinder barrel (38) from the housing. Mark (number) each pump piston shoe assembly (39) and its respective bore in cylinder barrel and shoe retainer plate (40). See Figure 5. Lift out shoe retainer plate (40) with pistons and remove fulcrum ball (41) and shoe retainer plate spring (42).

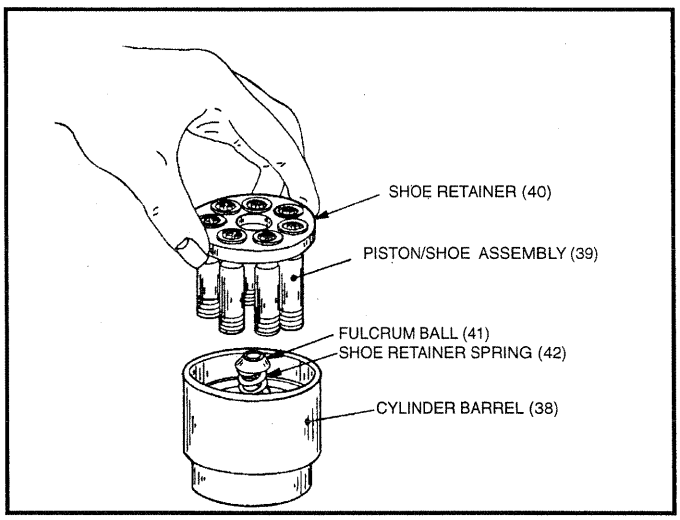

Figure 5 Rotating Group Disassembly

Remove cylinder bearing retainer ring (37) and pull the hydrodynamic cylinder bearing (35) and roll pin (36), if necessary, from the housing. **Note the position of the roll pin inside the case.**

D. DRIVESHAFT GROUP

Remove driveshaft key (22 or 23) if used and driveshaft bearing retainer ring (28). Grasp outboard end of driveshaft (21) and pull out from pump housing. Remove shaft retaining ring (27) and front driveshaft bearing (26). Remove shaft seal retainer (25) and driveshaft seal (24) from housing only if necessary (if seal is removed it can not be reused... it must be replaced). If used, do not remove screw (61) and thru-shaft coupling spacer (60) unless necessary.

E. SWASHBLOCK GROUP

Remove socket head cap screws (34), housing cover (33) and o'ring (32). Reach into the housing through the opening and pull out the swashblock (29) along with control pin (31). The saddle bearing (30) is seated in the housing by an integral pintle that engages a hole in the housing. Pull saddle bearing (30) back (parallel to driveshaft axis) until pintle disengages from the housing and then pull the saddle bearing out in the same manner that the swashblock was removed.

F. CONTROL GROUP

Do not remove flow reversing plugs (8). For flow reversal procedure, see "X. CONVERSIONS. If used, **note which side of the control cylinder the stroke limiter screw (70) is on.** Control piston spring (20) may be under compression. Therefore, slowly turn control end plugs (17) with o'rings (18) slowly out of the control piston cylinder in the unit housing. If used, remove maximum volume stop assembly (70 thru 76 &18). Before removing the control piston (19) and the control piston spring (20) **note which side of the control cylinder they were in.** Remove the control piston spring (20) and the control piston (19) from the control cylinder bore.

VII. INSPECTION

A. GENERAL

Clean all parts thoroughly. Inspect all seals and o'rings for hardening, cracking or deterioration and replace if necessary. Check all locating pins for damage and springs for cracking or signs of fatigue.

WARNING- always wear safety goggles when using solvents or compressed air. Failure to wear safety goggles could result in serious personal injury.

B. VALVE PLATE GROUP

Inspect the valve plate (45) and hardened port plate (43) surfaces, that mate with each other, and the rear of the cylinder barrel (38) for excessive wear. Remove minor defects by lightly stoning the surface with a hard stone that is flat to within 0.001" (0,03 mm). Be sure to stone lightly. Any excessive stoning will remove the hardened surfaces. If wear or damage of these components is extensive, replace the component.

Check the fit of the control sequence valve spool (51) in the port plate. It should move smoothly in the bore. Check the sequence valve spool spring (53) for cracks or signs of fatigue. It, too should be able to move (compress and decompress) smoothly in the bore. Inspect and flush out the relief valve control cartridge assembly (55). Be sure plunger operates smoothly and orifice in bottom of plunger is clean and clear.

Check the rear shaft bearing (67 or 77) in the valve plate for signs of excessive wear. This bearing (67 or 77) can be pressed out and replaced.

C. ROTATING GROUP

Inspect cylinder barrel (38), piston bores and the face that mates with port plate (43) for wear. Remove minor defects on the face by lightly stoning or lapping the surface. If defects can not be removed by this method, replace the cylinder barrel.

Inspect hydrodynamic cylinder bearing (35) for damage and replace if necessary. Check all piston and shoe assemblies (38) to be sure they ride properly on the swashblock (29).

See Figure 6. Check each shoe face for nicks and/or scratches. Check the shoe for smooth pivot action on the piston. If one or more piston/shoe assembly needs to be replaced, replacement of all piston/shoe assemblies is necessary. When installing new piston/shoe assemblies or rotating group, make sure pistons are free in their respective bores.

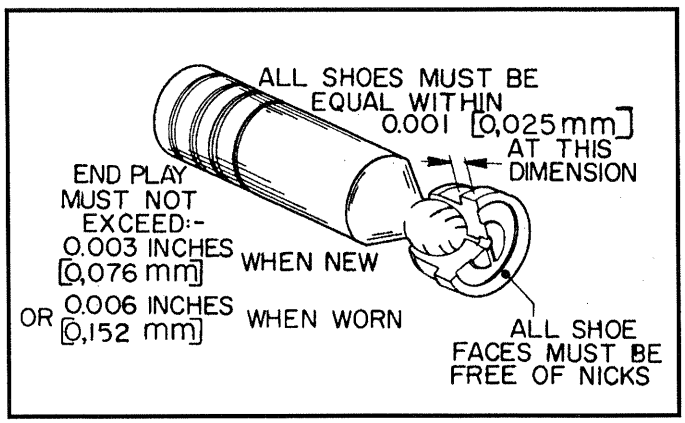

Figure 6. Piston and Shoe Inspection

D. DRIVESHAFT GROUP

Check driveshaft seal (24) for deterioration or cracks. Seal can not be reused if removed from housing. Replace (press out) only if necessary. Check front driveshaft bearing (26) for binding or roughness. See section "B" and check rear shaft bearing (67 or 77). Check driveshaft and it's splines for wear. Replace any part necessary.

E. SWASHBLOCK GROUP

Inspect the swashblock (29) face for wear and/or scoring. If defects are minor, stone the hardened swashblock lightly. Be sure to stone lightly. If damage is extensive replace the swashblock.

Compare saddle bearing (30) thickness in worn area to thickness in an unworn area. Replace saddle bearing if difference is more than 0.010 inches (0,254 mm). Check mating surface of swashblock for cracks or excessive wear. There is a small hole in the pintle of the saddle bearing (where saddle bearing plugs into pump housing). This hole ports fluid through the swashblock to the face of the saddle bearing (providing lubrication). Check this hole and orifice OP1 (5) to be sure they are open. Swashblock movement in saddle bearing must be smooth. Replace swashblock and/or saddle bearing if necessary.

F. CONTROL GROUP

Inspect seals and o'rings for hardening, cracking or deterioration and replace if necessary. Check control piston spring (20) for cracks or signs of wear, be sure it does not bind in the control piston (19). Be sure the control piston does not show signs of excessive wear and that it slides smoothly in the control cylinder bore. Check OP2 (68) to be sure orifice is not blocked.

IX. ASSEMBLY

A. PREPARATION

Refer to figures 7 and 8. The procedure for assembling the unit is basically the reverse order of disassembly procedures. During assembly, install new gaskets, seals and o'rings apply a thin film of CLEAN grease or hydraulic fluids to sealing components to ease assembly. If a new rotating group is used, lubricate thoroughly with CLEAN hydraulic fluid. Apply fluid generously to all wear surfaces.

B. CONTROL GROUP

If used, install maximum volume stop assembly [stroke limiter screw (70) with o'rings (72) and back-up ring (71) in place], maximum volume stop body (73) with o'ring (18), stroke limiter bonnet (74) with o'ring (75) and jam nut (76)] from the side they were removed from. From the other side of the control piston cylinder bore, insert the control piston (19) with spring bore facing out. Slide the control piston spring (20) into the bore and then insert and screw the control end plug (17) with o'ring (18) in tightly.

C. SWASHBLOCK GROUP

If removed, press new driveshaft seal (24) into pump housing. Working through the bore for the housing cover (33), insert the saddle bearing (30) in the pump housing so the integral pintle engages the hole in the housing. Place the control pin (31) in the swashblock (29) in a position to engage the slot in the control piston. Again, reaching through the bore for the housing cover, insert the pin into the control piston slot and push the swashblock (29) against the saddle bearing being sure the raised surface of the swashblock is received by the indented surface of the saddle bearing. Visually, be sure the holes (to receive the driveshaft) align up with the center of the hole in the pump housing for the driveshaft. Place housing cover (33) with o'ring (32) in place and secure with socket head cap screws (34).

D. DRIVESHAFT GROUP

Place seal retainer (25) in its bore. Press front driveshaft bearing (26) onto driveshaft (21) and lock in place with shaft retainer ring (27). Insert the driveshaft assembly (21) through the shaft seal, into the case, through the hole in the saddle bearing and swashblock until the front driveshaft bearing bottoms in its bore. Lock in place with bearing retainer ring (28).

E. ROTATING GROUP

With roll pin (36) in place, slide the hydrodynamic cylinder bearing (35), returning the roll pin into the position noted upon disassembly, into the pump housing. Lock in place with cylinder bearing retainer ring (37). **Note: - ends of retaining ring must be in groove machined in housing (1).**

See Figure 5. Place the cylinder barrel (38), wear surface down, on a clean cloth. Place the shoe retainer spring (42) in the center of the barrel with the fulcrum ball (41) on top of it. Insert the piston and shoe assemblies (numbered on disassembly) into their corresponding (numbered) holes of the shoe retainer plate (40). As a unit, fit the pistons into their corresponding (numbered) bores in the cylinder barrel. **DO NOT FORCE.** If aligned properly, the pistons will fit smoothly.

WARNING-The assembled rotating groups for some sizes of pumps may be heavy, assistance from others and proper lifting techniques is strongly recommended to prevent personal injury. The rotating group can now be carefully installed over the tail of the driveshaft and into the pump housing (1). While installing the rotating group, support the weight of the cylinder barrel, as cylinder spline is passed over the tail shaft, to avoid scratching or damage. Push cylinder barrel forward on the driveshaft, until the cylinder spline reaches the driveshaft spline; rotate the cylinder barrel slightly to engage the shaft splines. Continue to slide the cylinder barrel forward until it encounters the hydrodynamic cylinder bearing (35). Lifting the tail end of the driveshaft slightly helps cylinder barrel and hydrodynamic cylinder bearing engagement. Continue pushing cylinder barrel forward until the piston and shoe assemblies (39) contact the swashblock (29). On units with thru type driveshafts, place the rear shaft-coupling etc. on the rear of the driveshaft. If removed, install roll pins (12) in pump housing (1). Install o'rings (13 & 14) in pump housing.

The pump housing assembly is now ready to receive the valve plate group.

F. VALVE PLATE GROUP

Extreme care must be taken not to damage the faces of the valve plate and matching faces of both the valve plate and cylinder barrel.

If rear shaft bearing (66 or 77) was removed, press bearing into the valve plate until it protrudes from the face of the valve plate the amount shown in Table 5.

Table 5. Rear Shaft Bearing Protrusion

PROTRUSION	PUMP SIZE 011 014 022
For Thru Shaft Valve Plates	
in.	0.075 +.01
mm.	1,905 +,25
For Non Thru Shaft Valve Plates	
in.	0.20 +.03
mm.	5,08 +,76

Screw the relief valve control cartridge (55) into the valve plate. Slide (narrow end first) control sequence spool (54) into it's bore in the valve plate. Place sequence valve spool spring (53) into the counter bore of the control sequence valve and secure by screwing the sequence valve spool plug (51) with o'ring (52) into place.

When used, install rear shaft coupling (57) with retainer rings (58) in place on driveshaft before installing valve plate group assembly to pump housing (1).

Using dowel pin (44) to locate, place port plate (43) on the face of valve plate (45). On units with non-thru type driveshafts, the rear shaft bearing fits through the port plate and will center the port plate on the face of the valve plate. On units with thru type driveshafts, the rear shaft bearing (77 or 67) fits in a groove of the port plate and will center it on the face of the valve plate.

Assistance from others and proper lifting techniques is strongly recommended for the following procedure to prevent personal injury. Be sure o'rings (13) and (14) are in place. The valve plate (45) group can now be carefully installed over the tail of driveshaft (21) and slide up to mate with the pump housing (1). Roll pins (12) should engage matching bores in the valve plate assembly. Finger tighten socket head cap screws (50 and or 56) and then alternately tighten down.

For convertible thru-shaft units, place thru-shaft coupling spacer (60) on end of shaft and secure with screw (61). Install o'ring (62) in thru-shaft convertible cover (63) and tighten to backside of valve plate with screw (64). For thru-shaft coupled units, install o'ring (59) and secure rear unit to valve plate group with screws (78) and lock washers (79).

X. CONVERSIONS

A. LEFT HAND TO RIGHT HAND DRIVE OR VICE VERSA

To convert a pump built for right hand (clockwise) driven rotation to a pump for left hand (counter –clockwise) drive, or vice-versa, the following four steps will be necessary.

1. The position of the two flow reversing plug assemblies (8, 9, 10 & 11) and the two SAE plugs (6) with o'rings (7) will have to be interchanged. See illustrations (parts of Figure 8) for proper positions for either left hand or right hand rotation.
2. Reverse the orientation of the control piston (19) and control piston spring. See illustrations (parts of Figure 8) for proper positions for either left or right hand rotation. Also note that if an optional maximum volume stop assembly (70, 71, 72, 73, 74,75, 76 & 18) is used, it will have to be switched with control end plug assembly (17 & 18).
3. The valve plate assembly (45) will have to be removed and the port plate (43) replaced with a port plate manufactured for the new rotation direction.
4. The type designation on the unit's nameplate (65) will have to be changed accordingly.

SEE SECTION "I. PREPARATION and INSTALLATION"

XI. PARTS LIST

Parts used in this assembly are per Oilgear Specifications. Use Oilgear parts to ensure compatibility with assembly requirements. When ordering replacement parts, be sure to include pump type designation and serial number stamped on nameplate, bulletin and item number. To assure seal and packing compatibility, specify type of hydraulic fluid used.

ITEM NO.	DESCRIPTION
1.	Housing, Pump
2.	Plug, SK
3.	Plug, SAE
4.	Seal, O'ring
5.	Plug, Orifice
6.	Plug, SAE
7.	Seal, O'ring
8.	Plug, Flow Reversing
9.	Seal , O'ring
10.	Seal, O'ring
11.	Ring, Back-up
12.	Pin, Roll
13.	Seal, O'ring
14.	Seal, O'ring
15.	Plug, SAE
16.	Seal, O'ring
17.	Plug, Control End
18.	Seal, O'ring
19.	Piston, Control
20.	Spring, Control Piston
21.	Driveshaft
22 or 23.	Key, Driveshaft
24.	Seal, Driveshaft
25.	Retainer, Seal
26.	Bearing, Front Driveshaft
27.	Ring, Shaft Retainer
28.	Ring, Bearing Retainer
29.	Swashblock
30.	Bearing, Saddle
31.	Pin, Control
32.	Seal, O'ring
33.	Cover, Housing
34.	Screw, SHC
35.	Bearing, Hydrodynamic Cylinder
36.	Pin, Roll
37.	Ring , Cylinder Bearing Retainer
38.	Barrel, Cylinder
39.	Assembly, Piston & Shoe
40.	Plate, Shoe Retainer
41.	Ball, Fulcrum
42.	Spring, Shoe Retainer Plate
43.	Plate, Port
44.	Pin, Dowel
45.	Plate, Valve
46.	Plug, SAE
47.	Seal, O'ring
48.	Plug, SAE
49.	Seal, O'Ring
50.	Screw, SHC
51.	Plug, Control Sequence Valve Spool
52.	Seal, O'ring
53.	Spring, Control Sequence Valve
54.	Spool, Control Sequence Valve
55.	Assembly, Relief Valve Control Cartridge
56.	Screw, SHC
57.	Coupling, Thru-shaft
58.	Ring, Retainer
59.	Seal, O'ring
60.	Spacer, Thru-shaft Coupling
61.	Screw, SHC
62.	Seal, O'ring
63.	Cover, Thru-shaft Convertible
64.	Screw, SHC
65.	Plate, Name
66.	Screw, Drive
67.	Bearing, Rear Shaft
68.	Plug, Orifice
69.	Plug, NPTF
70.	Screw, Stroke Limiter
71.	Ring, Backup
72.	Seal, O'ring
73.	Body, Max. Volume Stop
74.	Bonnet, Stoke Limiter
75.	Seal, O'ring
76.	Nut, Jam
77.	Bearing, Rear Shaft
78.	Screw, SHC
79.	Washer, Lock

O'RING & BACK-UP RING SIZES

ARP 568 Uniform Size Number with Durometer

ITEM NO.	PUMP SIZE 011, 014 & 022	ITEM NO.	PUMP SIZE 011, 014 & 022
4	902-90	47	902-90
7	904-90	48	904-90
9	904-90	49	904-90
10	008-90	52	904-90
11	008	59	042-70
13	242-70	62	028-70
14	010-90	71	014
15	908-90	72	014-90
18	920-90	75	912-90
32	151-70		

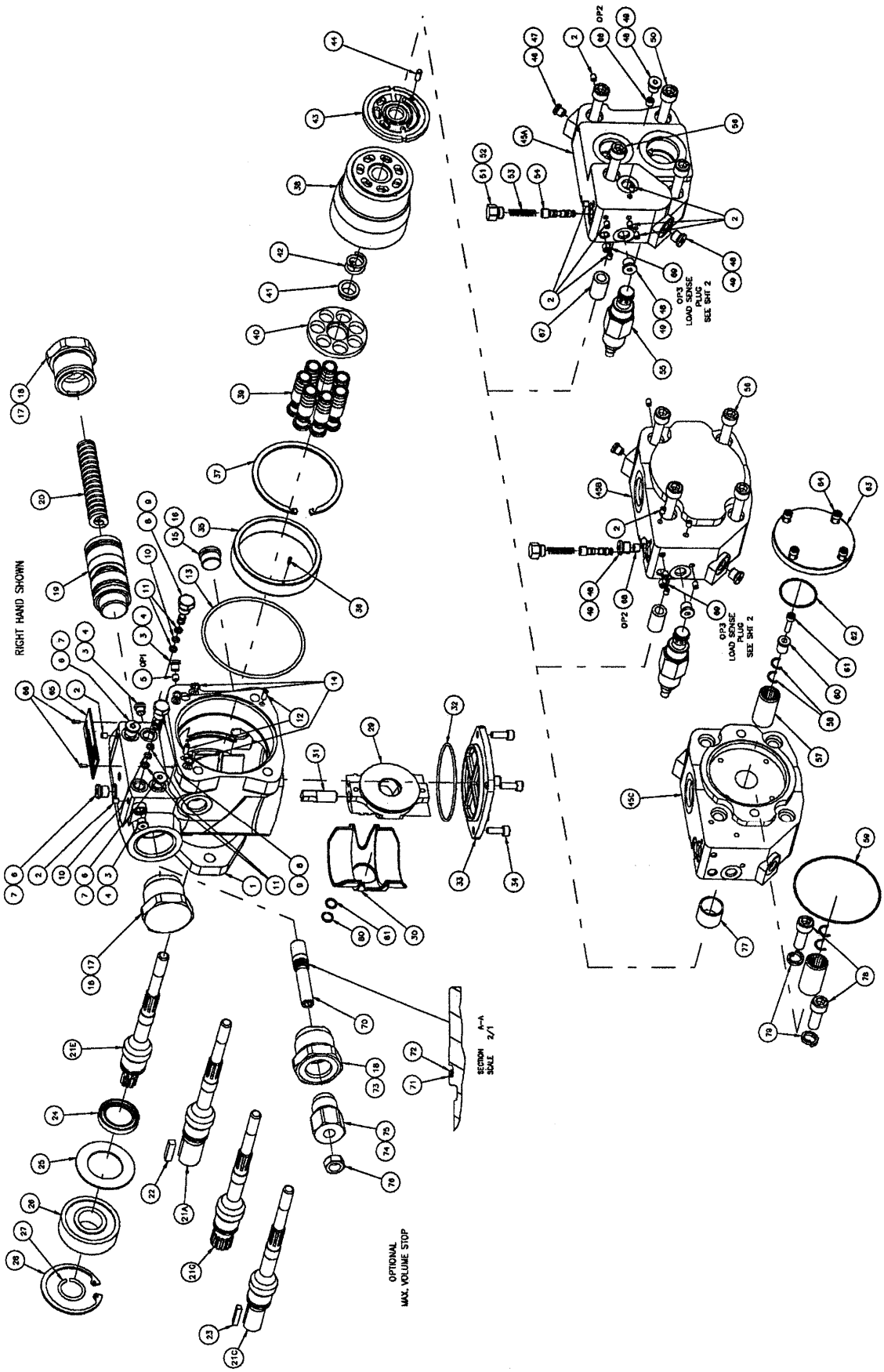

Figure 7. Exploded Parts Drawing

Parts list on page 12

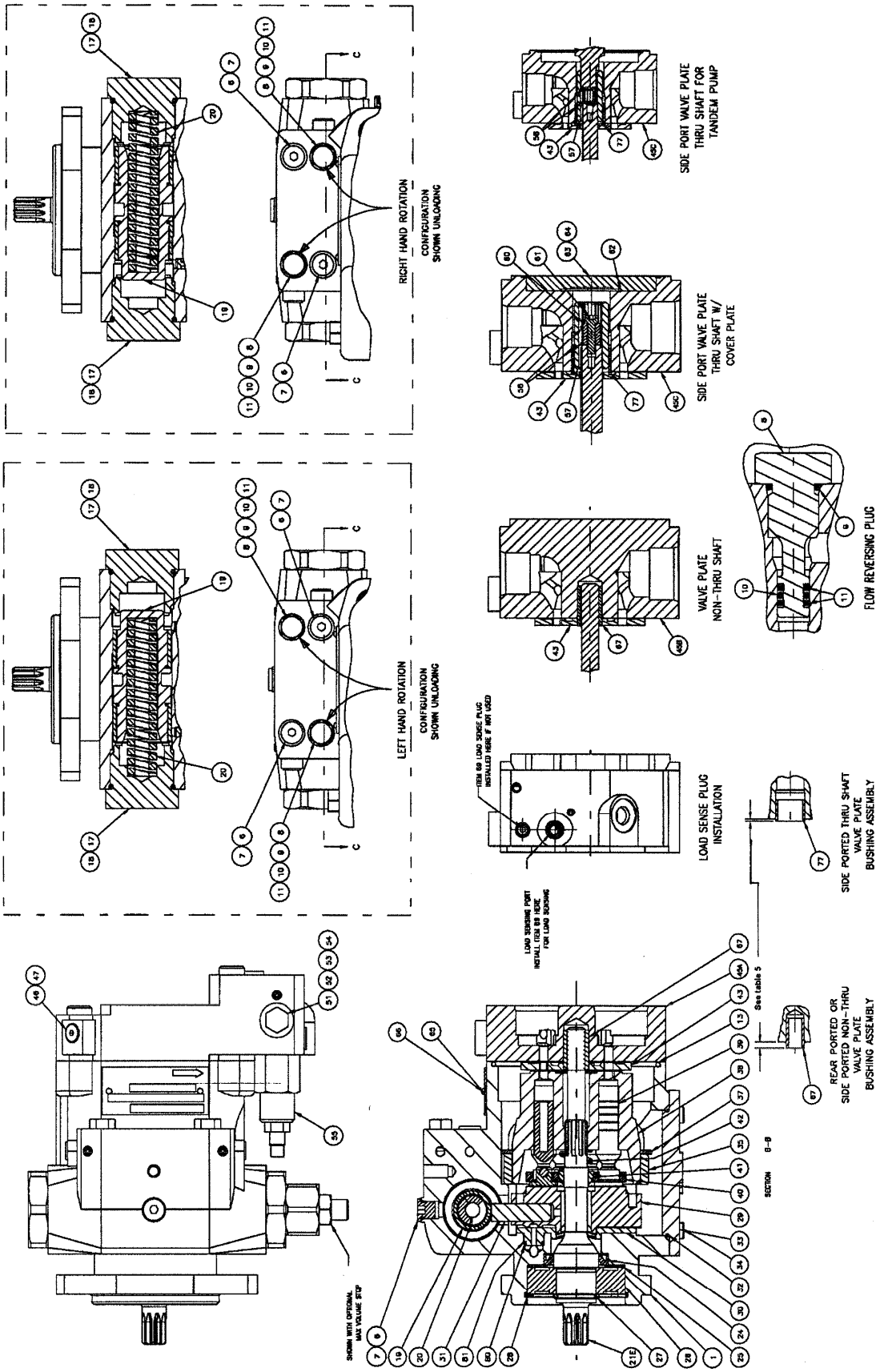

Figure 8. Cross Section and Plan View Parts Drawing

Parts list on page 12

NOTES