DENISON Hydraulics SERVICE LITERATURE

DENISON VARIABLE VOLUME PUMPS

600, 700, 800 SERIES

GENERAL

The Denison Variable Volume Axial Piston Type pumps are manufactured in three rated capacities. The 600, 700, and 800 series pumps deliver 10, 20, and 35 gallons per minute maximum respectively.

Applying the principle of variable volume permits a greater range of uses. The ability to vary the volume of oil in accordance with circuit demands, allows the user to reduce the horsepower consumption, eliminate many costly valves, and by the same token, greatly reduce heat conditions.

In the Denison pump the volume of oil delivered, is varied by changing the length of piston strokes within the barrel. These piston strokes are controlled by the angle of the creep plate against which they ride. The thrust of the pistons is balanced by the admission of pressure through a drilling in the piston into an area in the surface of the piston shoe that contacts the creep plate. This area is slightly less than the effective piston area, which results from the shoe being supported on an oil film at all times. The cylinder barrel is supported on a conventional type port plate into which are machined support areas hydraulically balancing this portion of the pump.

The radial load created by the angle of the creep plate is supported by a precision roller bearing which is placed at the point of average load, effectively balancing all radial forces. The cylinder barrel is driven by a spline: the center of which is located at the same point of average load resulting in the balancing of all driving forces.

The variable delivery controls are bolted to the pump housing in easily removable units. All working parts are submerged in a bath of oil. Due to the simplicity of design, maintenance and service problems are greatly minimized.

TYPES OF VARIABLE VOLUME CONTROLS

HANDWHEEL CONTROL

This control provides a means of manually setting the volume delivered by the pump. Setting is made by the use of a handwheel which positions the cam plate to the desired volume position. The positions are shown by an indicator on the side of the pump, marked in divisions of 1/4, 1/2, 3/4, and full volume. Adjustment for minimum delivery is made through a threaded regulator on the side opposite the handwheel control.

STEM CONTROL

Stem control is similar in action to the handwheel, described above, wherein the adjustment is made by raising or lowering the minimum stop position for regulating pump delivery. A short stem protrudes from the control body which may be shifted to change the volume delivery of the pump by a push-pull action. These controls are usually actuated during the course of an operation by mechanical linkage, timed to synchronize with some other function of the machine.

CYLINDER CONTROL

Cylinder control is similar in function to the stem control, except that the actuation of the cam plate is accomplished hydraulically instead of mechanically. The cylinder control can either be actuated by pilot lines from any part of the hydraulic system, or by outside sources. It is not confined to the working pressures of the hydraulic system for its operation. Both maximum and minimum adjustment are furnished.

PRESSURE COMPENSATOR WITH HANDWHEEL

The handwheel volume control permits the regulation of the maximum volume delivered by the pump by adjusting the angle of the cam plate through a threaded mechanism within the pump.

The pressure compensator control automatically regulates the volume delivered by changing the length of stroke of the pumping pistons. Stroke change is controlled by system pressure in such a manner that when the pump is operating at a pressure less than the maximum setting of the compensator, the pump delivers full volume. When the system pressure reaches or exceeds the compensator pressure setting, the delivery is automatically reduced to only that amount of flow required to maintain this pressure throughout the working system. The pressure setting is regulated by a knurled knob adjustment which is similar to a relief valve control.

PRESSURE COMPENSATING CONTROL

Pressure compensating controls are used for those systems where it is desirable to operate the pump at full volume at low pressures in conjunction with periods of full pressure at minimum volume. A typical example of this type of installation would be press operation where it is desirable to rapidly close the press, and then reduce the pump volume during the holding cycle to adjust the amount of oil necessary to maintain maximum system pressure. Through the use of this unit, the efficiency is greatly increased, and the horsepower required to drive the pump need only be sufficient to maintain a maximum volume at low pressure, or the minimum volume at high pressure, whichever is greater. This type control can also be used as a one pump circuit in which the minimum volume stop is never encountered.

INSTALLATION

The first requisite of an efficiently operating hydraulic system is *CLEAN OIL*, and of the recommended viscosity. (See list of oil specifications attached. The oil must be free of dirt, lint, scale, and other foreign material which can seriously damage the critical surfaces of the parts within the pump. Air breathers in the reservoir and the opening through which the oil is poured is a requisite. *CAUTION: Temperature of oil should never exceed 150° for most efficient operation.*

Direction of rotation for your particular pump is shown by the arrow on the pump housing, and is established as viewed from the shaft end. Clockwise rotation is standard, unless otherwise specified at the time of your order.

OIL MUST IMMEDIATELY REACH THE PUMP AFTER STARTING. It is advisable to fill the pump case through the top drain plug before starting the pump in service. If these instructions are not followed closely, the pump will seize for lack of lubrication. Be sure that the intake line is not clogged and that there are no air leaks in the system anywhere.

Undue wear on shaft seals, or even shaft breakage, can result from misalignment of the pump shaft with the motor shaft; even with flexible couplings.

It is always advisable to have overload protection by the installation of a relief valve in the pressure line to your circuit. This relief valve limits the system pressure in case of compensator failure, to protect the system against excessive loads.

MAINTENANCE OF VARIABLE VOLUME PUMPS

To dismantle the variable volume pump, the following procedure is recommended:

DRAIN PUMP HOUSING. Remove screws (57), end cap (56), gasket (61). By swinging the hanger (39), screws (59 and 60) holding the variable volume portion of the pump proper, can be removed. Lift the large meehanite casting (62) from the cylindrical portion of the pump. The outer bearing race can now be removed exposing bearing rolls and cylinder and piston assembly.

To dismantle, remove piston shoe retainer (29) and pistons (28) as a unit. Care should be taken to reassemble the pistons in the same position in the barrel (25), as originally assembled. The pistons may now be removed from the retainer.

The bearing (26) is released from the cylinder barrel by removing seven bolts (27). When removing the cylinder barrel (25), the port plate (24) may cling to the porting surface of the cylinder barrel due to the film of oil on the surface. The port plate is not attached to the cylinder barrel and a few light bumps may cause it to break loose from the barrel. The plate catches on the splined shaft (6) when this occurs, and can later be removed after the barrel is out of the way. In the event it does not catch on the spline, be careful that the port plate does not drop from the barrel. In handling all parts removed be extremely careful to keep them free from harmful bumps or scratches on critical surfaces.

To remove port plate (24) without removing bearings (7) and seal retainer (13) from the other side, insert two brass rods of the same diameter as the sausage

porting and by placing on opposite sides and squeezing together, a grip on the plate can be obtained so that the plate can be removed. Removing the plate after the shaft (6) and bearing assembly on the other end have been removed, is much simpler. This is not a tight fitting plate and should be removed easily.

Up to this point Denison pumps can be dismantled and serviced in the machine. The work on the other end of the pump necessitates the removal of the pump from the machine. Working from the motor shaft connection end, remove six bolts (14) from the oil seal retainer (13) and remove retainer. Extreme care should be taken in removing the oil seal (12) if it is to be used again. A thin sleeve made of shim stock (soft) will answer the purpose so that the key slot in the shaft is covered during the removal of the seal. Minute scratches on the surface of the seal will cause leakage around the shaft, especially where light fluid is used. Place a brass rod inside the splined end of the shaft and by tapping lightly the shaft and bearing assembly may be removed from the shaft, bend the ear up on the lock washer and remove nut (11) and lock washer (10) from the shaft (6). Bearings (7) can then be pressed off the shaft.

REASSEMBLY

To reassemble shaft and bearing assembly, bearings must be replaced in the proper position in relation to the pre-load conditions of the bearings (7). These are matched, pre-loaded bearings and care should be taken to reassemble them correctly. The assembly consists of the two bearings and an inner (9) and outer spacer (8) which are held firmly in place by the nut (11) and lock washer (10). Direction of pre-load is indicated by the slotted opening on each side of the bearing retainer. the narrow slot should be placed inward toward the spacer in each case. After bearings are in place, the lock washer and nut are tightened against the inner spacer. The inner spacer prevents tightening the nut too tightly and should be turned for a snug fit. Bend the ear down on the washer into the slot in the nut to lock in position.

Before replacing port block (1), be sure that the porting surface of the port block, that the port plate rests upon, is clean and free from any scratches or burrs incurred during the dismantling of the pump. This is a lapped surface, and unless perfectly smooth and flat, will not seal against the port plate (24). To replace shaft and bearing assembly in the port block, place the block on the bench and insert shaft (6), splined end first, through the block. Lift the assembly vertically, so that the shaft rests on a wooden bench, and holding the block in both hands, bump the shaft lightly. Do not allow the bearing race to bump the shoulder too hard as it reaches the extreme in position, as damage may occur to the bearing race.

"O" ring is next inserted in the grooved shoulder of the seal retainer (13). Seal retainer is next mounted to the port block (1) and again care must be taken in sliding the seal over the shaft to avoid even slight scratching. Always use some method of protecting the seal from the shaft while this is being done. Place "O" ring (17) on the port block pilot. Place body on bench with small opening up. Insert port block and shaft assembly with splined end of shaft down, carefully fitting the block to the body. Insert six bolts (15) and tighten securely. These bolt holes are not equally spaced so that block should be rotated until all holes are in correct alignment. Lay pump on side and insert port plate over shaft and into the pilot bore of the body, making sure that dowell pin (23) is inserted in the center hole in the port plate. Be sure port plate is not on a bind. After locating, check with the hand to see if it will move slightly and freely. Before replacing cylinder barrel (25) in position, examine surface of porting to be sure no scratches or burrs have been incurred during the removal. Replace, making sure the face of the barrel is not bumped. With the pump in upright position, the barrel will fall easily in place. In replacing spring retainer (19) of the hold down assembly, be sure it rests correctly on end of splines in the barrel, and is located on the small dowell pin (18). Insert spring (20) and bronze spring socket (21) and place ball (22) in position on the socket.

Replace pistons (28) and piston shoe retainer (29). Piston shoes should lie flat in the piston shoe retainer. The lapped surfaces should be free of scratches. Replace the piston assembly in the cylinder barrel (25), making sure the pistons are replaced as nearly as possible in the same position as before they were removed. Replace bearing race, replacing "O" ring (30) on body of pump before assembly, lining up holes with the holes in the pump body. Holes are unevenly spaced and can be mounted in two positions, 180° apart. Attach bronze index plate (36) to hanger (39) with screw (42) on dowel pins (43). Apply light oil between index plate and creep plate (32), as grease might prevent it from rotating. Replace the large meehanite housing (62). Insert screws (59 and 60), holding the housing to body (16). Replace gasket (61), end cap (56), screws (57).

CAUTION: Always refill the housing with clean oil of the type being used before operation again.

REVERSING DIRECTION

OF PUMP ROTATION VARIABLE VOLUME PUMP

DISASSEMBLY:

Disassemble the pump, after draining, if full of oil, by removing the socket head cap screws (57), end cap (56) and gasket (61). By swinging the hanger (39), screws (59) and (60) holding the variable volume portion of the pump, can be removed. Lift the large meehanite casting (62) from the cylindrical portion of the pump. The outer bearing race can now be removed exposing bearing rolls and cylinder and piston assemblies. Remove piston shoe retainer (29) and pistons (28) as a unit, taking care not to lose the ball (22) from the hold down as-

sembly and marking the position of the pistons in the cylinder barrel so that they may be reassembled in the same position.

Next, remove the cylinder assembly (25) by pulling on the inner bearing race (26). When removing this part, the port plate (24) may cling to the porting surface of the cylinder barrel due to the film of oil on the surface. The port plate is not attached to the cylinder barrel and a few light taps should cause it to break loose. The plate catches on the splined shaft (6) when this occurs and can later be removed. In the event that it does not catch on the spline, be careful that the port plate does not drop from the barrel after the latter has cleared the pump. In handling all parts removed, be extremely careful to keep them clean and free from harmful bumps or scratches on critical surfaces.

To remove the port plate (24), should it stick in place in the body (16), insert on opposite sides, two brass rods of the same diameter as the width of the sausage porting. By squeezing together on the rods a grip can be obtained and the plate removed.

REASSEMBLY:

To change rotation, requires a different port plate. The bleed slot must be on the pressure port, at the end which is uncovered first as the piston port moves past it.

The port plate (24) is assembled in the pump by inserting it over the shaft (6) and into the pilot bore on the body (31), making sure the dowel pin (23) is fitted in the proper hole causing the port plate to be aligned symmetrically with respect to the center lines of the pump. Be sure the port plate is not binding. Check by hand to see that it will move slightly and freely.

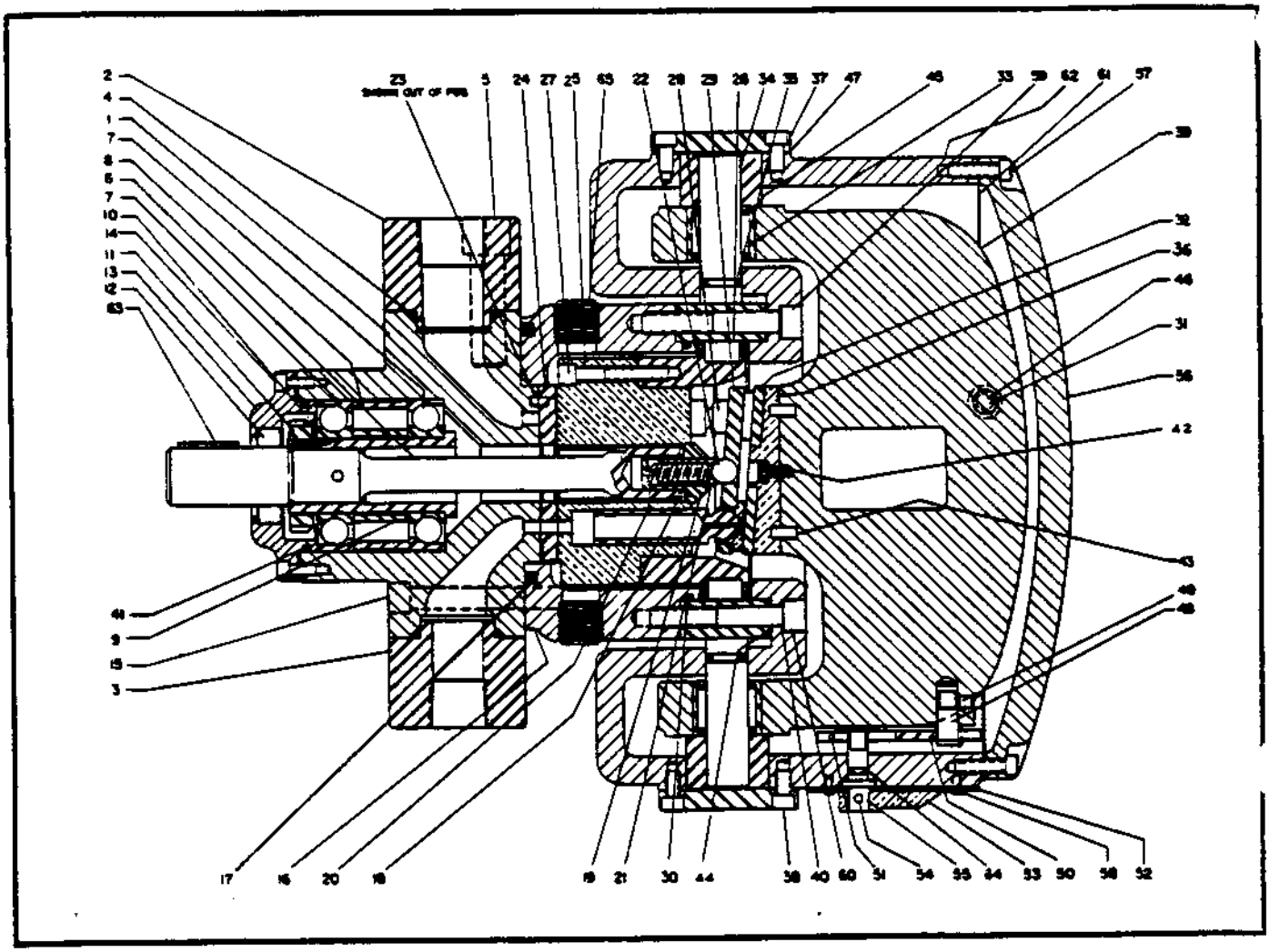
Replace the cylinder and hold down assemblies and place the ball (22) in the socket, holding it in place with a light grease. Replace the piston assembly (28) with the pistons in the same position as when removed. The lapped surfaces must be free of scratches. Check to see that the pistons move freely in the cylinders.

Assemble the bearing outer race (26), making sure that the "O" ring (30) is in place and in good condition, and replace the large meehanite housing (62).

The index plate (36) must be revolved 180° when reversing the direction of pump rotation. The high or thick side of the index plate must always be on the pressure side of the pump.

Insert screws (59 and 60) holding to the body (31). Replace gasket (61), end cap (56), and screws (57). Interchange the pressure (3) and suction (2) flanges.

CAUTION: Always refill the housing with clean oil of the type being used before operating again.

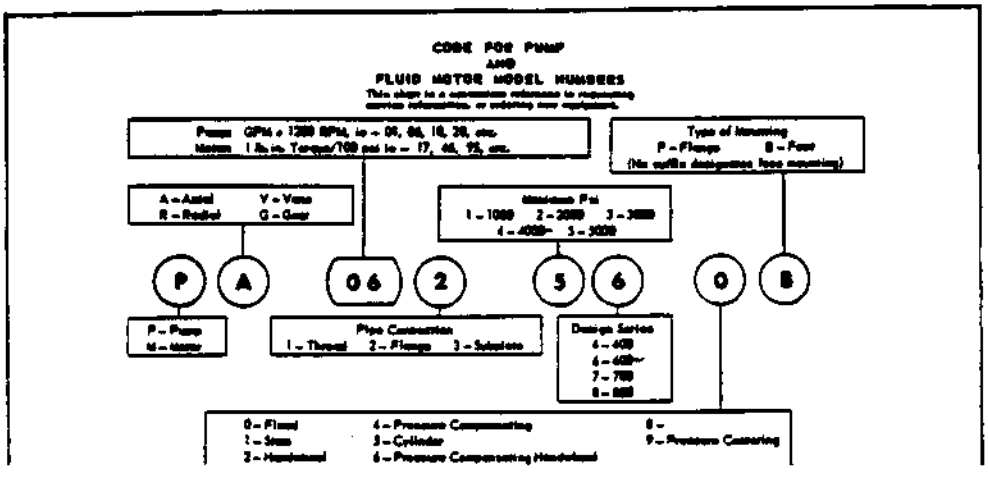


PARTS LIST

REF. NO.	ITEM	"600"	"700"	"800"	QTY
1	Port block	035–11836	035–11812	035–15450	1
2	Suction flange	035–11840	035–11831	035–11267	1
3	Pressure flange	035–10233	035–11832	035–11761	1
	Pressure flange w/side outlet	035–14208	035–14127	035–14279	1
4	"O" ring 70 – 6227–25 (ARP–220)	671–00220	-------	-------	2
	"O" ring 70 – 6230–4 (ARP–226)	-------	671–00226	-------	2
	"O" ring 70 – 6230–8 (ARP–230)	-------	-------	671–00230	2
5	S.H.C. screw 5/8–11 x 2	308–24240	-------	-------	4
	S.H.C. screw 3/4–10 x 2	-------	308–26240	-------	8
	S.H.C. screw 3/4–10 x 2½	-------	-------	308–26280	8
6	Shaft assembly	015–00465	015–00509	015–00494	1
7	Shaft bearing (matched pairs)	230–20207 (20207 DB)	230–20210 (20210 DB)	230–20213 (20213 DB)	1 pr
8–9	Spacers (sets only)	015–99887	015–99888	015–99889	1
10	Lock washers	350–01007	350–01010	350–01013	1
11	Lock nut	341–10007	035–17681	035–18132	1
12	Shaft seal	620–50326	620–50771	620–51326	1
13	Shaft seal retainer	035–14368	035–11821	035–11281	1
14	S.H.C. screws 10–24 x 1/2	308–10080	-------	-------	4
	S.H.C. screws 1/4–20 x 1¼	-------	308–12180	-------	6
	S.H.C. screws 5/16–18 x 1½	-------	-------	308–14200	6
15	S.H.C. screws 3/8–16 x 2¾	308–16300	-------	-------	6
	S.H.C. screws 1/2–13 x 3½	-------	308–20340	-------	6
	S.H.C. screws 5/8–11 x 4	-------	-------	308–24360	6
16	Pump body	035–11835	035–11811	035–15451	1
17	"O" ring 70 – 6230–19 (ARP–241)	671–00241	-------	-------	1
	"O" ring 70 – 6230–32 (ARP–254)	-------	671–00254	-------	1
	"O" ring 70 – 6227–68 (ARP–441)	-------	-------	671–00441	1
18	Spring retainer pin	325–04040 1/16 x 1/4	325–04040 1/16 x 1/4	324–20806 1/8 x 3/8	1
19	Spring retainer	035–10240	035–11818	035–11278	1
20	Hold down spring	035–18530	035–22174	035–22215	1
21	Spring socket	035–13343	035–13342	035–13344	1
22	Steel ball	201–16001 (1/2")	201–24001 (3/4")	201–28001 (7/8")	1
23	Pin	324–20808 1/8 x 1/2	324–21208 3/16 x 1/2	324–21610 1/4 x 5/8	1
24	Port plate (clockwise) Rt. Hand	035–16506	035–18543	035–15455	1
	Port plate (cross-center CW) Rt. Hand	035–17205	035–17092	035–17094	1
	Port plate (CCW) Left Hand	035–16507	035–18542	035–16464	1
	Port plate (cross-center CCW) Left Hand	035–17206	035–17208	035–17209	1
25	Cylinder barrel	035–11837	035–11816	035–15452	1
26	Barrel bearing	035–12421	035–11897	035–12420	1
27	S.H.C. screw 1/4–20 x 1½	308–12200	-------	-------	7
	S.H.C. screw 5/16–18 x 2¼	-------	308–14260	-------	7
	S.H.C. screw 3/8–16 x 2½	-------	-------	308–16280	7
28	Piston Assy (consists of 7 pistons, 7 shoes and one of item No. 29, shoe retainer)	015–01017 (25–2378)	015–00511 (25–1523)	015–01021 (25–2437)	1
29	Shoe retainer	035–10241	035–11826	035–15453	1
30	"O" ring 70— 6230–24 (ARP–246)	671–00246	-------	-------	1
	Gasket	-------	035–11899	-------	1
	"O" ring 70 – 6230–43 (ARP–265)	-------	-------	671–00265	1
31	H.H. Cap screw 1/2–13 x 1	306–20160	306–20160	306–20160	1
32	Creep plate	035–14205	035–14074	035–14254	1
33	Needle bearings	230–10018	230–10019	230–10020	2
34	Trunnion pin	035–12996	035–12955	035–12862	2
35	"O" ring 70 – 6227–11 (ARP–113)	671–00113	-------	-------	2
	"O" ring 70 – 6227–15 (ARP–210)	-------	671–00210	-------	2
	"O" ring 70 – 6227–21 (ARP–216)	-------	-------	671–00216	2

PARTS LIST (continued)

REF. NO.	ITEM	"600"	"700"	"800"	QTY
36	Index plate	035-14207	035-15206	035-15111	1
37	End plate	035-12622	035-12610	035-12257	2
38	S.H.C. screw 1/4-20 x 1/2	308-12080	308-12080	308-12080	8
39	Hanger	035-14712	035-15205	035-15030	1
40	Copper gasket	035-22731	035-22733	--------	6
	Copper gasket	--------	--------	035-22735	2
41	"O" ring 70 - 6230-8 (ARP-230)	671-00230	--------	--------	1
	"O" ring 70 - 6230-14 (ARP-236)	--------	671-00236	--------	1
	"O" ring 70 - 6230-24 (ARP-246)	--------	--------	671-00246	1
42	S.H.C. screw 1/4-20 x 5/8	308-12100	--------	--------	1
	S.H.C. screw 5/16-18 x 3/4	--------	308-14120	308-14120	1
43	Dowel pin	324-21608 (1/4 x 1/2)	324-21610 (1/4 x 5/8)	324-22410 (3/8 x 5/8)	2
44	Gasket	035-11900	035-11899	--------	1
	"O" ring 70 - 6230-43 (ARP-265)	--------	--------	671-00265	1
45	Trunnion spacer	035-12995	035-12958	035-12866	2
46	S.S. screw cup point 1/2-13 x 7/8	311-20140	311-20140	311-20140	1
47	Gasket	035-15023	035-15090	035-15038	2
48	Indicator operating pin	035-14857	035-14857	035-14857	1
49	S.S. screw cone point 1/4-20 x 3/8	311-12063	311-12063	311-12063	1
50	Indicator link	035-14856	035-14391	035-14391	1
51	S.H.C. screw 10-32 x 1	309-09160	309-09160	309-09160	1
52	Indicator plate	035-12870	035-12870	035-12870	1
53	Indicator	035-12871	035-12871	035-12871	1
54	Driv-Lok pin 1/8 x 3/4	323-10812	323-10812	323-10812	1
55	Indicator shaft	035-13000	035-12956	035-12869	1
56	End cap	035-18297	035-18438	035-12864	1
57	S.H.C. screws 1/4-20 x 7/8	308-12140	--------	--------	14
	S.H.C. screws 1/4-20 x 7/8	--------	308-12140	--------	20
	S.H.C. screws 3/8-16 x 1	--------	--------	308-16160	14
58	R.H.M. screw 10-24 x 3/8	310-10060	310-10060	310-10060	3
59	S.H.C. screw 3/8-16 x 2½	308-16280	--------	--------	6
	S.H.C. screw 1/2-13 x 3½	--------	308-20340	--------	4
	S.H.C. screw 5/8-11 x 6	--------	--------	308-24440	4
60	S.H.C. screws 1/2-13 x 3	--------	308-20320	--------	2
	S.H.C. screws 5/8-11 x 4	--------	--------	308-24360	2
61	Gasket	035-18064	035-18437	035-12863	1
62	Hanger housing	035-12990	035-12951	035-12861	1
63	Shaft Key	211-10016 (No. 16)	035-20101	035-20102	1
64	"O" ring 70 - 6227-5 (ARP-010	671-00010	--------	--------	1
	"O" ring 70 - 6227-7 (ARP-012)	--------	671-00012	671-00012	1
65	Soc. pipe plug	431-90800 (1/2")	431-91200 (3/4")	431-91200 (3/4")	5



SERVICE TIPS FOR PUMPS

Difficulties	Probable Cause	Remedy
INSUFFICIENT FLOW	1. Clogged filters; restriction in suction lines.	1. Flush filters and replace elements; remove and blow out lines.
	2. Air in suction lines due to loose unions, low oil level or pump worn internally.	2. Tighten all unions in suction lines, check oil level, examine pump parts.
INSUFFICIENT PRESSURE	1. Pump not delivering oil due to wear.	1. Check internal parts.
	2. Relief valve faulty.	2. Check relief valve parts.
CHATTERING OR VIBRATION IN HYDRAULIC SYSTEM	1. Air in system.	1. Cycle pressure in system by opening and closing bypass valve.
	2. Coupling misaligned.	2. Correct
PUMP MAKING NOISE	1. Restricted intake line.	1. Pump must receive oil freely or pump will cavitate.
	2. Air leak in pump intake lines.	2. Test by pouring oil on all pipe joints. Listen for change in sound of operation. Tighten joints as required.

Table I Recommended Oil Specifications*

Viscosity Index	90 min.
Maximum Viscosity at Starting temperature (At low pressure, low flow and/or low speed)	7500 SUS
Maximum viscosity at full power	750 SUS
Minimum viscosity at full power	70 SUS
Optimum viscosity for maximum life	130 SUS
Rust and oxidation inhibitors	yes
Anti-foam additive	yes

It is recommended that the fluid used be a petroleum base R & O oil meeting Denison standard HF-1. These preferred fluids do not contain anti-wear additives.

Fluids meeting Denison standard HF-2 are acceptable for use but may require reduced operating conditions. These fluids are similar to HF-1 but do contain anti-wear additives.

CAUTION: For most effecient operation, inlet oil temperature should be 125 F – 135 F and should not exceed 160 F.

When it becomes necessary to use petroleum base fluids which do not meet this specification or special fire resistant hydraulic fluids, a Denison representative should be consulted.

* It is suggested that a fluid certification be provided to insure conformance to this specification.

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