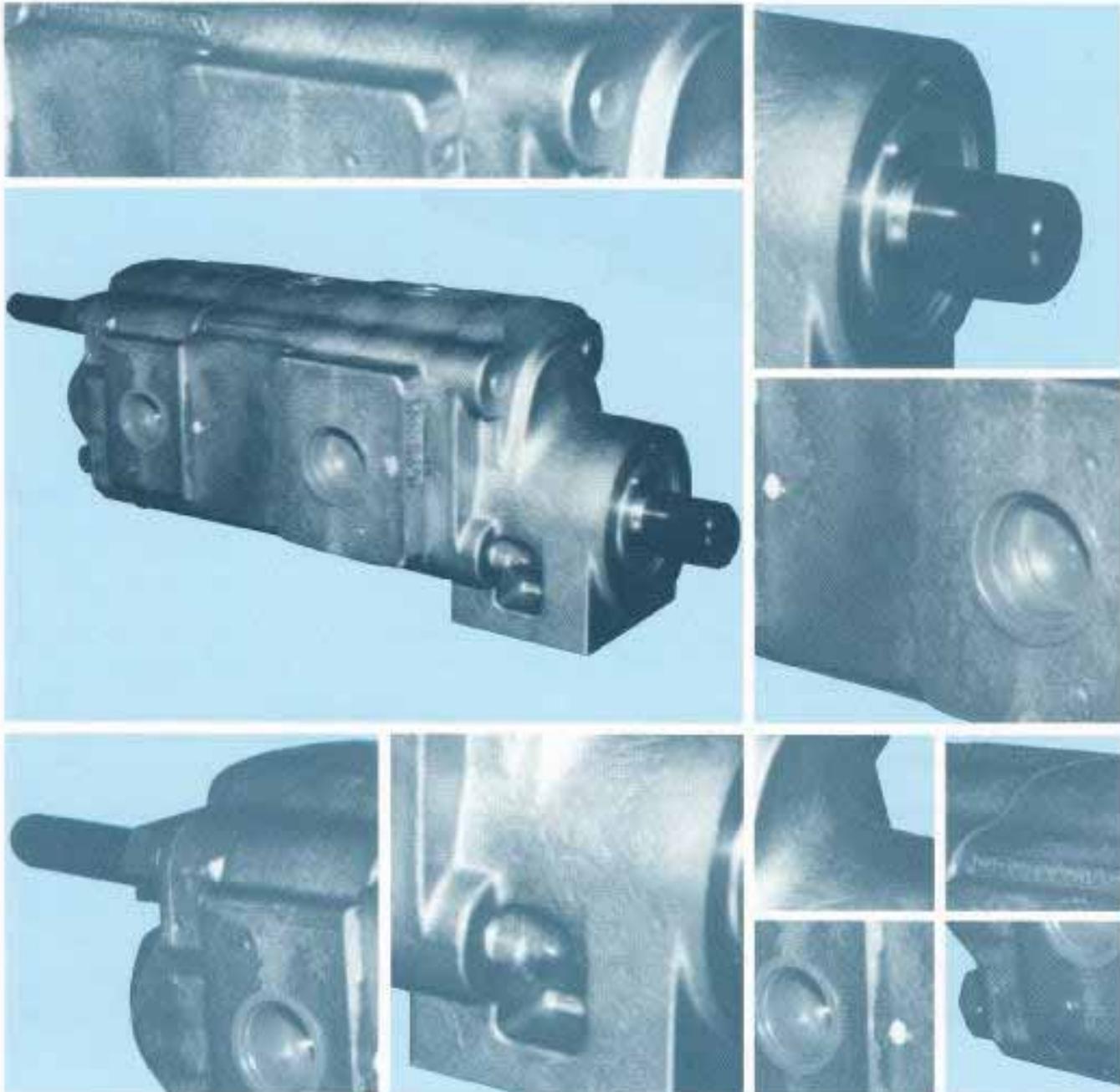
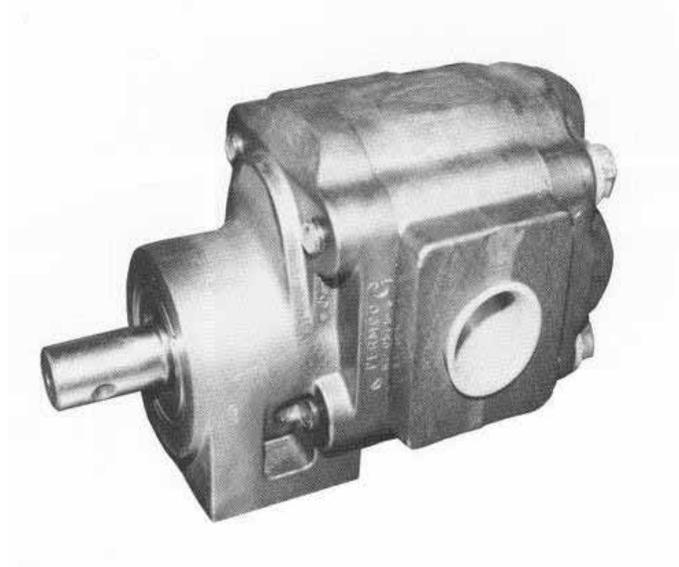


SERIES P2500, P3700 GEAR PUMPS

PERMCO SERVICE MANUAL



Read this manual carefully before you start to assemble, disassemble, or rebuild your Permco pump: and also before you use Permco's patented diverter plates.



PERMCO PUMP MAINTENANCE...

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If you intend to rebuild a pump that has thrust plates and you wish to replace the thrust plates with Permco diverter plates, inspect the original port end cover, shaft end cover, gear housing and bearing carriers very carefully. To obtain the maximum performance from diverter plates, all of the above components must be in good condition with minimal amount of wear. The following areas of wear are the most critical ... and often overlooked:

1. Shaft end covers, port end covers, and bearing carriers . . . Check bearing bores for out -of-roundness or elliptical shape. If more than 0.003" out-of-round, **do not use**.
2. Gear housings. . . If the wear pattern on the inlet side is in excess of 0.003" depth, **do not use**.
3. Gears . . . Inspect very carefully. If you have scored, scuffed or pitted journals, scratched or scuffed tooth faces, deep nicks on tooth edges, do not use; install new drive and driven gear.
4. Bearings . . . A loose fit between gear hub and bearing I D may not mean a bad bearing. The misalignment it can cause is detrimental to good pump performance. We recommend installing a complete set of new bearings at each rebuild.
5. Seals . . . It is recommended that all seals be replaced on any rebuild job.

Putting Permco diverter plates into a pump and re-using the old worn parts will not necessarily re-store the pump to the high efficiency and performance of a new Permco pump. Merely installing new Permco diverter plates cannot restore the pump to its original performance. Permco's high efficiency, performance, and life expectancy are based on using all new Permco parts.

If you are rebuilding a Permco gear pump, you must not install thrust plates of another make. Tolerances and finishes on Permco parts are held closer than those of other manufacturers of pump parts. For warranty repairs under any circumstances, you must not substitute other makes of parts in a Permco pump. **USE ONLY GENUINE PERMCO PARTS.**

You can successfully use Permco diverter plates to rebuild other makes of pumps to obtain increased operating pressures and pump life. However, read the above paragraphs carefully.

If you have any questions about rebuilding Permco pumps or about using Permco parts to up-grade other makes of pumps, call your local Permco pump and parts distributor.

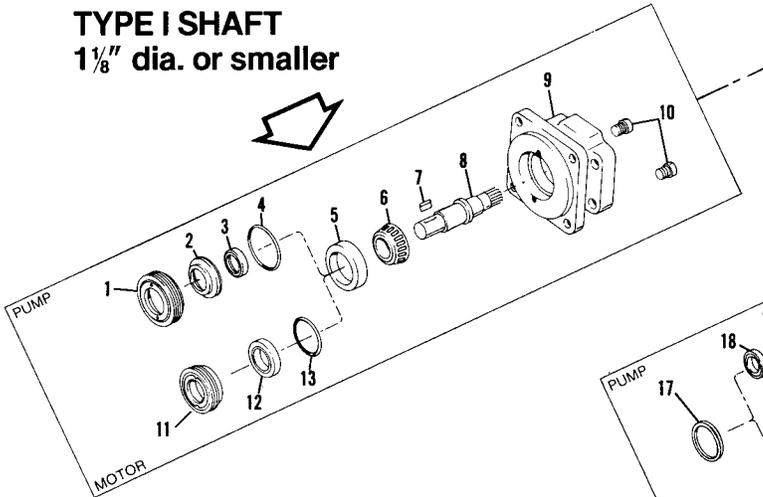
THREE TYPES OF PUMPS

There are three types of Permco pumps, as determined by the configuration of the shaft end covers . . . Type I, Type 11, and Type II. There are slight differences in disassembly and re-assembly procedures, according to each shaft end cover. Also, Type II and Type III are normally longer from front to back than Type I. Be sure you know which type you are working on.

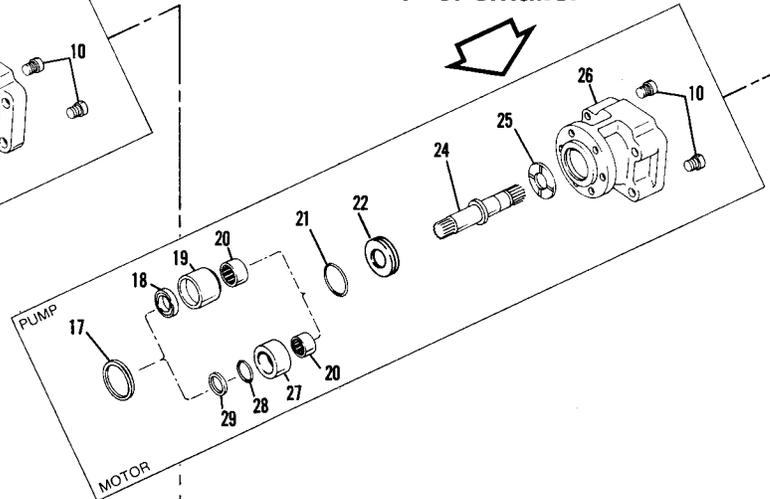
CLEANLINESS IS HIGHLY IMPORTANT WARNING. Before you start disassembling the pump, clean up your work bench. This will avoid the headaches and danger of getting dirt, metal fragments, and foreign objects into the fine -finished cavities and threads of the pump and components, and eventually into the entire hydraulic system. In pump maintenance, extreme cleanliness is most important.

2500 SERIES

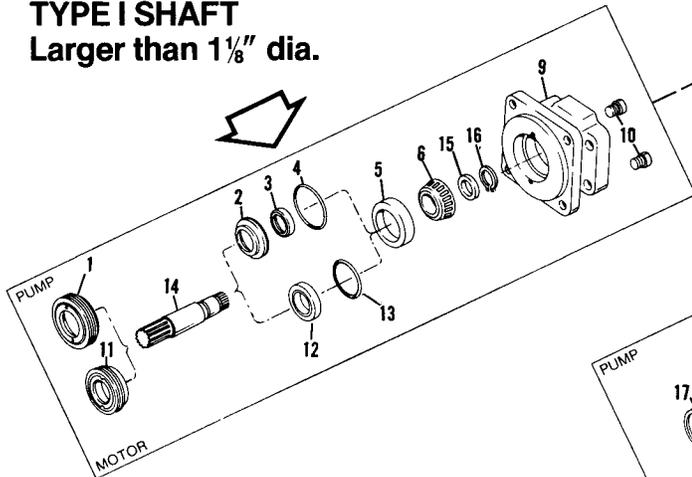
TYPE I SHAFT
1 1/8" dia. or smaller



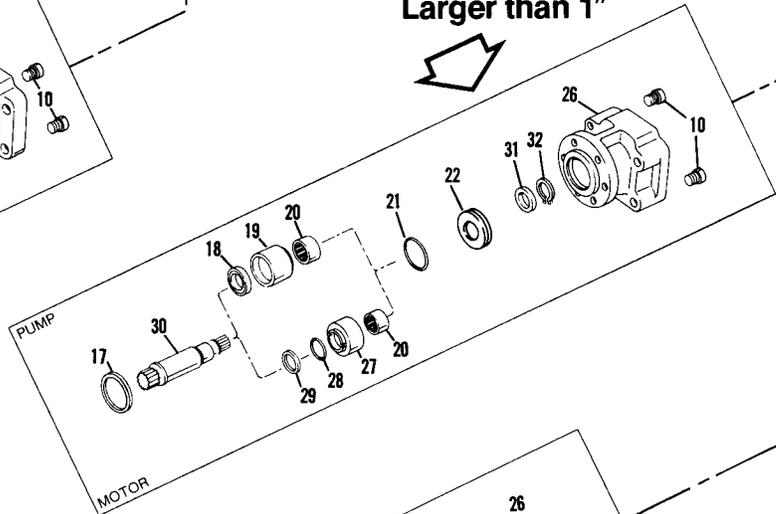
TYPE II SHAFT
1" or smaller



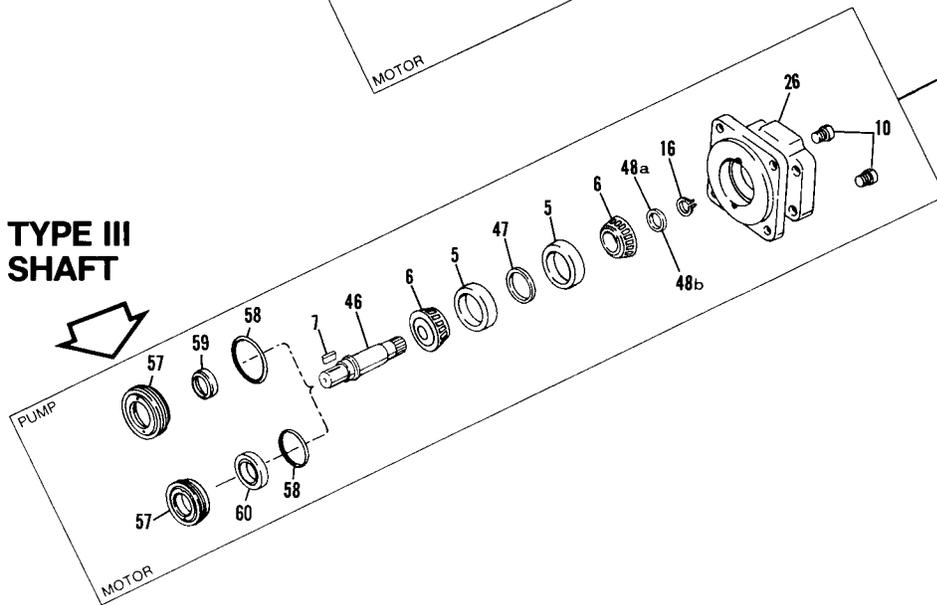
TYPE I SHAFT
Larger than 1 1/8" dia.

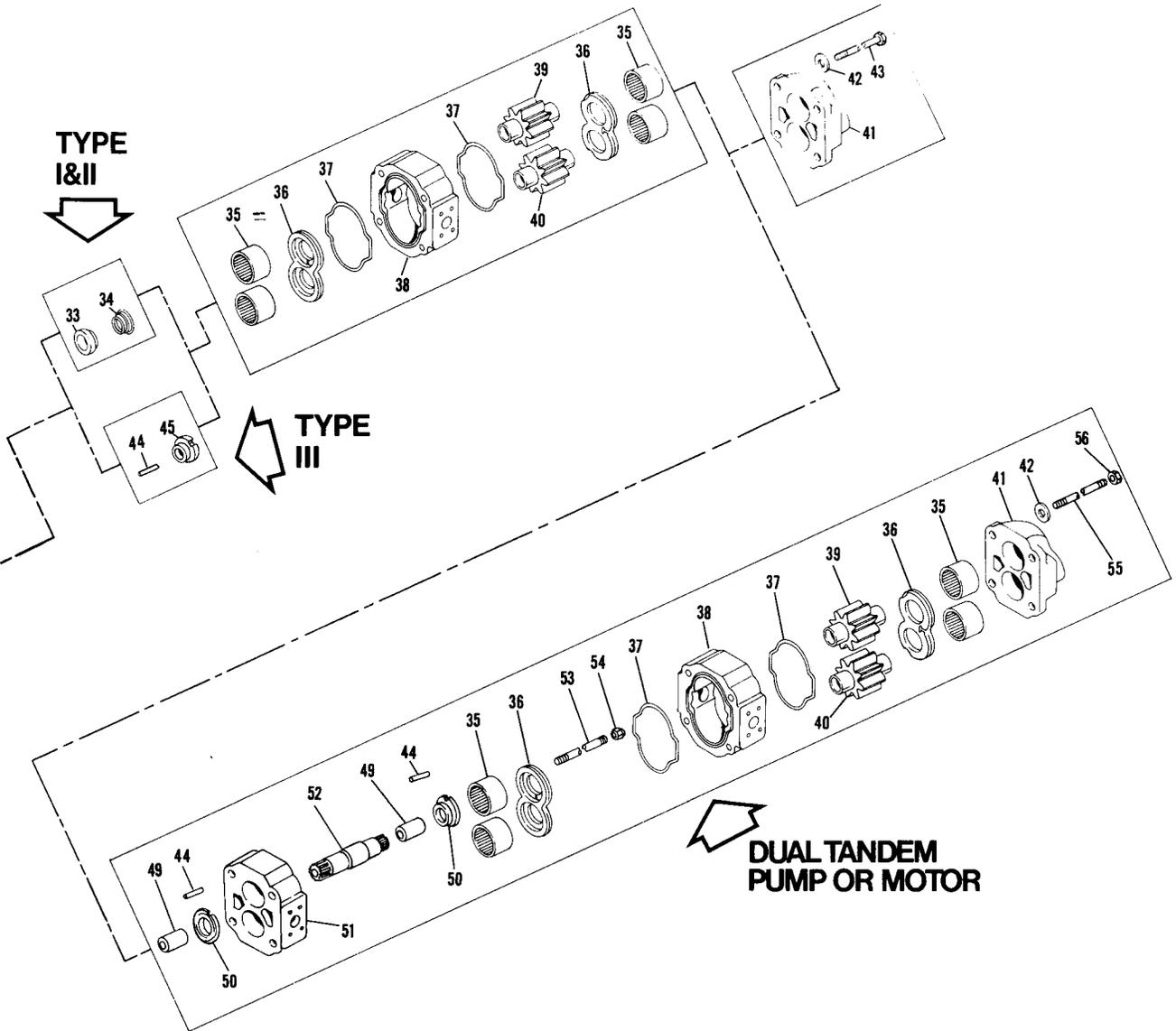


TYPE II SHAFT
Larger than 1"



TYPE III SHAFT





Exploded View of Pump or Motor

PARTS ORDERING NUMBERS

2500 SERIES PUMPS

Item Number On Exploded View	Order This Part Number	Quantity To Order	Item Number On Exploded View	Order This Part Number	Quantity To Order
1	V-0961	1	32	W093-02	1
2	RZ-0558	1	33	ZG-1909	1
3	W62-26-13	1	34	Z-0216-182	1
4 & 13	K-2995-26	1	35	R-0921	4 per section
5 & 6	W015-7	1	36	X-0947	2 per section
7	(Replace original key with identical key).	1		X-0947-TC	2 per section
8, 14, 24, 30, 46	See Engineering Catalog			X-0947-DS	2 per section
9 & 26	** -0575- *	1		X-0947-BRD	2 per section
10	S-0280/L-0280-K	2	37	TA-2995-244	2 per section
11	KZ-0961	1	38	LZ-0577- ** - **	1 per section
12	W62-49-3	1	39 & 40	JZ-0996L- **	1 set/section
15	XZ-0558-1	1	41	QZ-0592- *	1
16	W86-100	1	42	W033-2	4
17	W023-206	1	43 & 55	5/8-11 Grade 8	4
18	W62-26-15	1	44	W004-19	1
19	FZ-0961	1	45	ZQ-1909	1
20	W0921	1	47	FA-0558	1
21	K-2995-109	1	48	XZ-0558-1	1
22	W051-D9	1	49	SZ-0408- *	1
25	DA-0558	1	50	ZQ-1909	2
27	ZU-1909	1	51	J*-0576- * - ***	1
28	Q-2995-8	1	52	SZ-0022	1
29	J-2909-19	1	53	3/8-16 Rod	1
31	CA-0558	1	54	W78-05	1
32	W093-02	1	56	W3-65	4
			57	GZ-0961	1
			58	K-2995-47	1
			59	W62-26-10	1
			60	W62-49-1	1

3700 SERIES PUMPS

Item Number On Exploded View	Order This Part Number	Quantity To Order	Item Number On Exploded View	Order This Part Number	Quantity To Order
1	U-0961 Type I	1	14	W-86-112	1
2	IZ-0961 Type III	1	36	W-0947	2 per section
3	QZ-0558 Type I only	1		W-0947-TC	2 per section
4	W62-26-10	1		W-0947-DS	2 per section
5 & 6	K-2995-33 Type I	1		W-0947-BRD	2 per section
7	K-2995-4 Type III	1	37	TA-2995-249	2 per section
	W015-5	1	38	KZ-0577- ** - **	1 per section
	(Replace original key with identical key).	1	39 & 40	IZ-0996L- **	1 set/section
8 & 46	** -0023	1	41	MZ-0592- *	1
9	** -0575- *	1	42	W033-1	8
10	S-0280/L-0280-K	2	43 & 55	1/2-13 Grade 8	8
11	LZ-0961 Type I	1	44	W004-19	2
12	IZ-0961 Type III	1	49	LZ-0408- **	1
33	W62-49-1	1	50	ZV-1909	1
34	ZF-1909	1	51	*Z-0576- * - ***	1
35	Z-0216-177	2	52	RZ-0022	1
35	Q-0921	4 per section	53	3/8-16 Rod	1
13	ZA-0558- *	1	54	W78-05	1
			56	W3-40	8
			47	GA-0558	1

NOTE: * THIS PORTION OF THE PART NUMBER SHOULD BE IDENTICAL TO ORIGINAL PART NUMBER.
OBTAIN BY REFERRING TO UNIT CODE NUMBER. CONTACT DISTRIBUTION OR PERMCO SALES DFPT



DISASSEMBLING TYPE I PUMP:

1. With a sharp metal scribing tool, grease pencil, Magic Marker, or paint, make an indexing mark that runs straight across a surface of the port end cover (41), gear housing (38), and shaft end cover (9). This will enable you to reassemble these parts into the same position when you put the pump back together.
2. With a face spanner wrench, loosen and un-screw the threaded retainer ring (1) on the shaft end of the pump a couple of turns to relieve the preload on the tapered roller bearing (6). **DO NOT REMOVE** the retainer ring (1) entirely.
3. Install the unit in a vise, shaft end down.
4. Remove the cap screws (43) and washers (42) at the rear of the pump that hold the port end cover (41) and the gear housing (38) together. Re-move the port end cover (41) and diverter plate (36), or the thrust plate. The roller bearings (35) will remain intact with the port end cover (41). (In pumps with thrust plates, the pocket seals will come out easily; Permco pumps with diverter plates do not require pocket seals.)
5. Remove the pump drive gear (39), the driven gear (40), and the gear housing (38) from the shaft end cover (9). **BE CAREFUL** to keep the drive gear and driven gear together; you must reassemble them as the original pair later, since they have worked-in together.

DISASSEMBLY:

SHAFT END COVER (9)

1. Set the partially disassembled pump (shaft end cover(9) from which the gear housing was separated in the vise with the pilot up. The drive end of the shaft will be pointing straight up.
2. Now finish unscrewing threaded retainer ring (1), loosened at the start, and remove from shaft (8 or 14).
3. Pull entire drive shaft assembly (2 thru 8) out of shaft end cover (9). Carefully note direction of bearing taper, so bearing can be reassembled correctly.
4. Turn the shaft end cover (9) pilot-down; the end of which the drive shaft assembly (2 thru 8) was removed. Diverter plate (36) will now be accessible.



5. With a knife blade or thin-blade screwdriver, **VERY** gently pry the diverter plate (36) off the bearings of the shaft end cover (9). If working on another make of pump to be refitted with **PERMCO** diverter plates, remove and throw away the pocket seals; **PERMCO** pumps require no pocket seals.

6. With a bearing puller, pull the shaft bearings (35) out of the shaft end cover (9) if you plan to replace the bearings. If you pull the bearings, check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round, **DO NOT USE**. If you need to remove only the conical spring (34) and shaft bushing (33), pull **ONLY** the shaft-end **drive** bearing; **do not pull** the shaft-end **driven** bearing.

NOTE: Skip Step 7 If the pump drive shaft is 1-1/8" or smaller in diameter; go directly to Step 8. **If** the shaft is larger than 1-1/8" in diameter--

7. Remove snap ring (16) and spacer (15) from gear end of shaft.

8. **If** the drive shaft is 1-1/8" or smaller in diameter, press the tapered bearing (6), the cup (5), seal retainer (2), and lip seal (3) off the **DRIVE** end of the shaft. **If** the shaft is larger than 1-1/8" in diameter, press these four parts off the **GEAR** end of the shaft.

9. Remove and discard the "0" ring from bore in shaft end cover (9). Have an identical new replacement "0" ring ready for reassembly. Remove and discard lip seal (3) from seal retainer (2); have re-placement lip seal on hand for reassembly.

GEAR HOUSING

1. Remove square gasket seals (37) from gear housing (38) and discard. Have identical replacements on hand for reassembly. **Do Not** re-use "0" rings. Check for depth of wear at this time, using a telescoping gage and a micrometer with the depth tolerance as described on Page 3, Paragraph 2.

PORT END COVER

1. With a knife blade or thin-blade screwdriver, gently pry the diverter plate (36) or thrust plate off the bearings of the port end cover (41).

2. On makes of pumps other than PERMCO, re-move and discard the pocket seals. You do not need pocket seals when installing PERMCO diverter plates; these patented diverter plates do not use pocket seals.

3. Only if you are replacing the two shaft roller bearings (35) with new ones, pull the bearings out of the port end cover (41) with a bearing puller.

TYPE II PUMP:

1. With a sharp metal scribe, grease pencil, magic marker or paint, make an indexing mark that runs straight across a surface of the port end cover (41), gear housing (38), and shaft end cover (26). This will enable you to reassemble these parts into the same position when you put the pump back together.
2. Remove the cap screws (43) and washers (42) from the port end cover (41).
3. Separate the port end cover (41) from the gear housing (38) and the diverter plate (36), or thrust plate from the bearings of the port end cover. The roller bearings (35) will remain intact with the port end cover. (In pumps with thrust plates, the pocket seals will be easily removable; Permco pumps with diverter plates do not require pocket seals.)
4. The drive gear (39) and the driven gear (40) will still be in the gear housing (38). Remove them. **BE CAREFUL** to keep the drive gear (39) and driven gear (40) together; it's recommended that you reassemble them as the original pair later, since they have worked-in together. Now separate the gear housing (38) from the shaft end cover (26).

DISASSEMBLY:

SHAFT END COVER

1. Turn the shaft end cover (26) on end so that the drive end of the shaft (24) is pointing upward. With a pointed tool or thin screwdriver blade, snap out the retaining ring (17) **WARNING USE EYE PROTECTION**.
2. Pull the entire drive shaft assembly out of the shaft end cover (26). If the drive shaft is smaller than 1" diameter, you will have to remove the thrust washer (25) from the base of the bearing bore separately after pulling out the drive shaft assembly. (18 thru 25 for a pump with a 1" diameter drive shaft and smaller; 18-32 for a pump with a drive shaft larger than 1" diameter).
3. Upend the shaft end cover (26) to expose the diverter plate (36) or thrust plate. Gently pry the diverter plate (36) or thrust plate away from the shaft end cover (26), using a knife blade or thin blade screwdriver. On pumps other than Permco's, remove and discard the pocket seals; Permco pumps require no pocket seals.
4. To remove roller bearings (35), pull them out of the shaft end cover (26), using a bearing puller. After bearings have been removed check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round **do not use**.
5. (a) For drive shafts 1" in diameter and smaller: Slip the needle bearing assembly (18 thru

20) off the drive end of the shaft (24). The two thrust bearings races (22) and thrust bearing roller (23) can now be slipped off the drive end of the drive shaft (24).

5. (b) For drive shafts larger than 1" in diameter:

- (1) Hold the needle bearing assembly (18 thru 23, 31, and 32) forward towards the drive end of the drive shaft (30). Remove snap ring (32) with snap ring pliers.

- (2) Slip the snap ring retainer (31), two thrust bearing races (22), thrust bearing roller (23), "0" ring (21), needle bearing (20), bearing and seal retainer (19), and double-lip seal (18) off the gear end of the drive shaft (30).

6. On both diameters of shafts, remove seal (18) and "0" ring (21) from seal and bearing retainer (19). Be sure you have new replacement seal and "0" ring available for replacement.

7. When installing needle bearing (20), press the old bearing out of the seal and bearing retainer (19). Have a new bearing on hand for reassembly.

GEAR HOUSING

Remove square gasket seals (37) from grooves in gear housing (38) and discard. Have replacement seals at hand for re-assembly. Check for depth of wear at this time, using telescoping gage and micrometer with the depth tolerance as described on Page 3, Paragraph 2.

PORT END COVER

1. Gently pry off the diverter plate (36) or thrust plate with a knife blade or thin-blade screwdriver. (On other makes, the pocket seals should be re-moved and discarded —**PERMCO** diverter plates require no pocket seals.)

2. To install new roller bearings (35), pull these bearings from the port end cover (41) bearing bores with a bearing puller. After bearings have been removed check bores for out-of-roundness and elliptical shape. If more than 0.003" out-of-round, **do not use**.

END OF DISASSEMBLY OF TYPES I AND II PUMPS

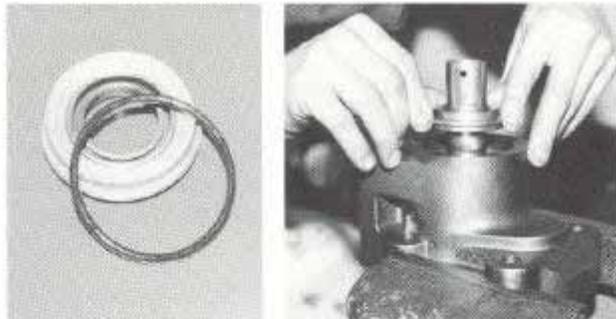
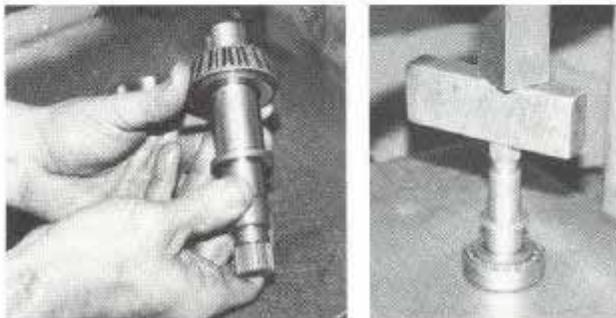
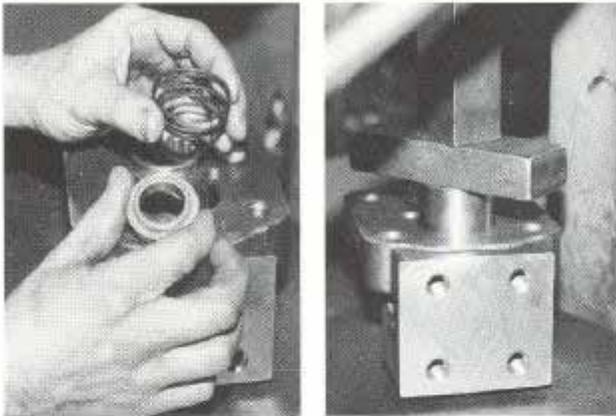
TYPE III PUMP:

For Type III, disassembly is the same as Type I larger than 1-1/8" diameter. However, there are two tapered roller bearings (5 and 6) on shaft (46).



REASSEMBLING

TYPE I PUMP:



REASSEMBLING THE TYPE I PUMP

1. Grip shaft end cover (9), gear end up. Place bronze shaft bushing (33) in the bearing bore of the shaft end cover (9) with bushing flange down.
2. Place conical spring (34) against bronze shaft bushing (33) with smaller end of spring over pilot shoulder of bushing.
3. Replace the two roller bearings (35) in the bores of the shaft end cover (9). Take care that the top of the conical spring (34) does not cock and wedge between bearing (35) and bottom of bearing counter-bore.
4. Place shaft end cover in a soft jaw vise. Turn cover end-for-end and clamp with flange end up.

FOR PUMP WITH DRIVE SHAFT SMALLER THAN 1-1/8" DIAMETER

5. Repack tapered roller bearing (6) with good lithium-base high-temperature bearing grease, No. 2 consistency.
6. Carefully press the bearing (6) on the drive shaft (8). Be sure the larger diameter of the bearing (6) is seated against the shoulder of the drive shaft (8).
7. Insert the assembled drive shaft (8) into shaft end cover (9). Be sure shaft bushing (33) is centered in the shaft cover bore (9).
8. Place bearing cup (5) over tapered roller bearing (6). Carefully press or tap cup down to seat firmly against bottom of bearing bore.
9. Press lip seal (3) into recess in seal retainer (2) with lip of seal facing up. Put "O" ring into bearing bore on top of bearing cup (5).
10. Install this seal retainer subassembly (1,2,3,4) over drive shaft, being careful to seat it firmly against top side of bearing cup (5).

NOTE: If you are reassembling a unit used as a **MOTOR**, with either diameter shaft, press a motor shaft seal (12) into the seal retainer (11), using proper shaft seal tool.

FOR PUMP WITH DRIVE SHAFT 1-1/8" DIAMETER AND LARGER

5. Carefully press lip seal (3) into seal retainer (2) with lip of seal facing outward.
6. Next, press this seal retainer subassembly (2-3) onto drive shaft (14). Small end of subassembly should face outer or drive end of shaft (14).

7. Put "O-ring (4) into groove in seal retainer (2).
8. Repack tapered bearing (6) with good lithium-base high-temperature bearing grease, No. 2 consistency.
9. Carefully press bearing (6) on drive shaft (14). Be sure smaller diameter of bearing (6) is facing towards the seal retainer (2). Place bearing cup (5) over bearing (6).
10. Push the spacer (15) over gear end of shaft (14). Put snap ring (16) in correct groove on shaft (14).
11. Press seal retainer assembly (2, 3, 4), bearing (5, 6), and spacer(15) tightly against snap ring(16).
12. Insert assembled drive shaft (14etc.) in shaft end cover (9).
13. Thread the retainer ring (1) **loosely** into shaft end cover (9), but **DO NOT** tighten retainer ring (1) enough to preload bearing (5, 6); this will be done later.
14. Release shaft end cover (9) from vise, turn cover end-for-end, and clamp with flange end down.
15. If you are reassembling a single-rotation pump, and **if** you removed the plug (10) installed on the high-pressure side of the pump, replace it; leave the low-pressure opening unplugged. If your pump is a double rotation unit, and **if** you re-moved the two check assemblies (10), replace with new valves.

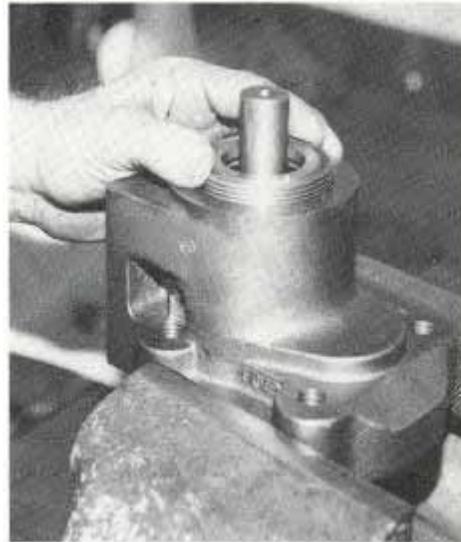
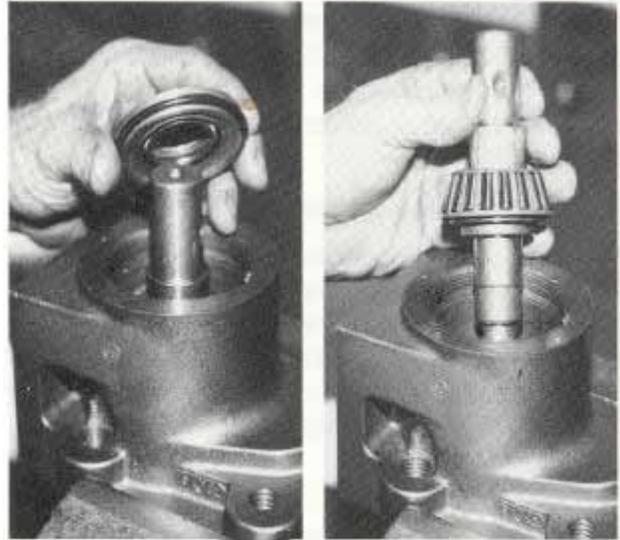
TO COMPLETE THE ASSEMBLY OF A TYPE I PUMP, skip to Page 13: Port End Cover Assembly.

TYPE II PUMP:

REASSEMBLING THE TYPE II PUMP:

SHAFT END COVER

1. With the shaft end cover (26), gear end up, install bronze shaft bushing (33), with flange down.
2. Place conical spring (34) against bronze shaft bushing (33) with smaller end of spring over pilot shoulder of bushing.
3. **If** you removed them, replace the two roller bearings (35) in the bores of the shaft end cover (26). Take care that the top of the conical spring (34) does not cock or wedge between bearings (35) and bottom of bearing counter bore.
4. Place shaft end cover (26) in a soft jaw vise flange end up.
5. With lip of seal (18) facing up, press seal into



recess in bearing- and-seal retainer (19). If you removed needle bearing (20) during disassembly, press it into bearing-and-seal retainer (19). Put "0" ring (21) over small diameter of bearing-and-seal retainer (19).

6. For double bearing units, see Page 12.

NOTE: If you are reassembling a unit used as a **MOTOR**, with either diameter shaft (smaller or larger than 1" diameter), install the special motor seal retainer (27) which combines an "0" ring (28) and a back-up ring (29) in the I.D. of the seal retainer (27). (Place "0" ring in retainer first and then install back-up ring).

A. FOR PUMP WITH DRIVE SHAFT 1" IN DIAMETER AND SMALLER

6a. Put thrust washer (25) in bottom of bearing bore of shaft end cover (26), with grooves facing up.

7a. Put one of the two thrust bearing races (22) over drive end of drive shaft (24) so race rests against shaft shoulder. Put thrust bearing roller (23) on drive shaft (24), followed by second thrust bearing race (22). Slide needle bearing (20) and "0" ring (21) on drive shaft (24) with "0" ring against outer thrust bearing race (22).

(NOW SKIP TO STEP 10)

B. FOR PUMP WITH DRIVE SHAFT LARGER THAN 1" IN DIAMETER

6b. Install the complete seal retainer subassembly (18-21) (Step 5, above) over the drive shaft (30); seal should bear on shoulder of drive end of drive shaft (30).

7b. Put one of the two thrust bearing races (22) on the drive shaft (30) next to the "0" ring (21). Next, slip thrust bearing roller (23) on drive shaft (30). Slide the second thrust bearing race (22) on, follow with snap ring retainer (31).

8b. Push this entire bearing assembly (18-23,31) together on drive shaft (30); hold firmly against shaft shoulder on drive of shaft (30).

9b. Install the snap ring (32) to hold the bearing assembly (18-23,31) in place.

(NOW RESUME ASSEMBLY OF PUMPS WITH EITHER DIAMETER DRIVE SHAFT)

10. Insert complete drive shaft assembly (18-23, or 18-23, 31, 32) into shaft end cover (26).

11. Install retaining ring, either spiralox or snap ring (17) into groove in shaft end cover.

12. Release shaft end cover (26) from vice; turn

cover end-for-end; re-clamp with gear end up. At this point, check to be sure plugs or check assemblies are firmly in place. **NOTE:** Double-rotation pumps require **TWO** check assemblies (10); single rotation pumps **DO NOT** require check assemblies, but **DO** require a plug in the high pressure side of the pump, and **NO** plug in the low-pressure opening.

TYPE III PUMP:

REASSEMBLING THE TYPE III PUMP:

1. Put the PERMCO diverter plate (36) in position over the two bearings (35). Counter-bored side of the diverter plate should be placed over the bearings; high-pressure crescent recesses should be on the pump inlet side; gear relief recess should be on the high-pressure side. Double-check this for correct position.

REASSEMBLING THE TYPE III DOUBLE-BEARING SHAFT END COVER.

Where double outboard bearing assemblies are to be installed:

Pack both tapered roller bearings (6) with a No. 2 consistency lithium base high temperature bearing grease. Press the bearings with a spacer (47) between them onto the shaft (46). Be sure that the larger diameter end of the bearing (6) is seated against shaft shoulder. Next, install spacer (48) to insure proper running clearance. Try using the 0.133" thick spacer (48a) and snap ring (16) first. If spacer does not fit, use the 0.128" thick spacer (48b).

Double tapered roller bearing units **do not** have a conical spring (34) behind the bronze shaft bushing.

Double bearing units have a roll pin (44) pressed into the drive bearing bore of the shaft end cover (as shown). Next the bronze bushing (45) is install-ed with the slot placed over the roll pin and this flange portion up.

Before inserting the assembled shaft into the shaft end cover, make sure that the shaft bushing (45) is centered around the shaft. Take care not to nick or damage bronze shaft bushing when inserting the shaft assembly.

Continue assembly procedure.

In the final assembly procedure, the threaded retainer ring (1) should be tightened securely and

staked. **DO NOT BACK OFF RETAINING RING BEFORE STAKING.**

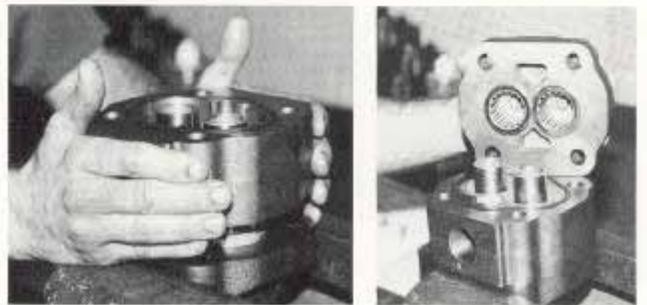
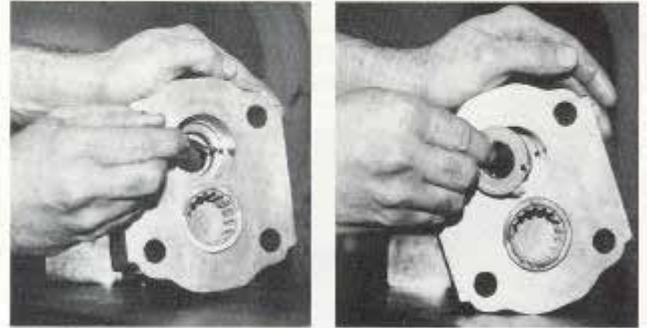
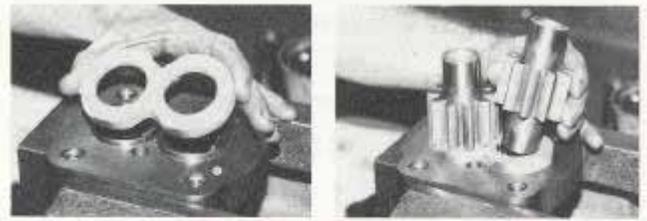
It is not necessary to back off the retainer ring, since the use of the spacer (48) of the proper thickness assures correct running clearance. (With single bearing assemblies, as before, the retaining ring must be backed off 1/2" before staking.)

PORT END COVER ASSEMBLY

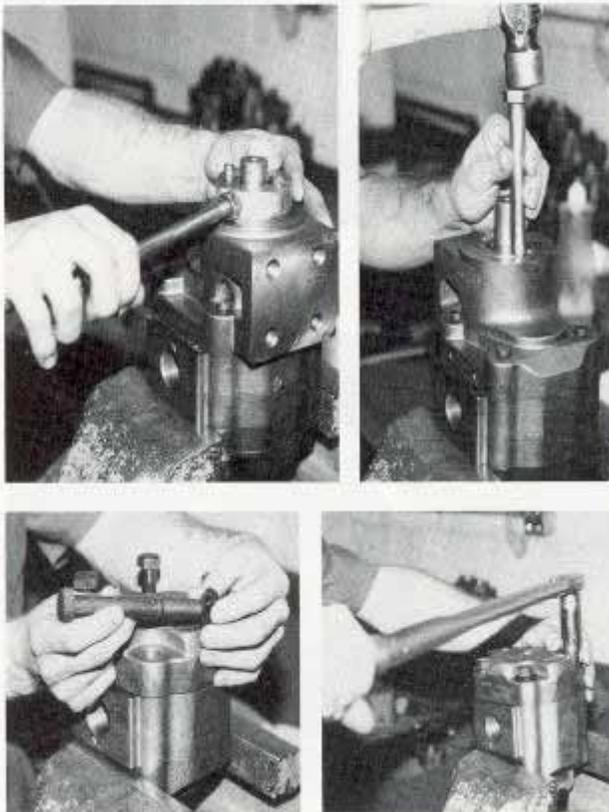
1. If you removed the two roller bearings (35) during disassembly, install new bearings in the two bores in the port end cover (41). Fit should be at least a light press fit.
2. Put the diverter plate (36) over the two roller bearings (35). Counter-bored side of the diverter plate should be placed over the bearings with the high pressure crescent recesses on the inlet side and the gear relief recess on the high pressure side of the pump. Double check this.

FINAL ASSEMBLY

1. Clamp the shaft end cover assembly (26), etc.) in a soft jaw vise, gear end up.
2. Pour a little hydraulic or "STP" oil over face of diverter plate (36) to lubricate gears on startup. Gently stone the sides of each gear (39 and 40) to remove any burrs. Dip whole gear into cleaning solvent to remove dirt and metallic dust particles. Install the drive gear (39) in bore over spline of the shaft. Next install the driven gear (40). Be sure both gears firmly contact plate.
3. Lightly grease square gasket seals (37); carefully install them in the grooves in the two faces of the gear housing (38). Be sure they are properly seated.
4. Carefully place the gear housing subassembly (38 etc.) over the gears, on top of the shaft end cover (26). Making sure that the square gasket (37) is not being pinched or cocked, gently tap the gear housing (38) down on the shaft end cover (26) with a plastic or rawhide mallet. Pour a little hydraulic oil or "STP" over the gears while ro-tating the drive shaft for startup lubrication.
5. Place the Permco diverter plate (36) over the gear hubs - and into the gear housing, face down - counter bores up. The plate should rest slightly below the housing surface. Next, place the port end cover assembly (41) on top of the gear housing guiding the hubs of the gears (39 and 40) into the I.D. of the roller bearings. Gently tap the port end cover (41) down onto the housing with a rubber or rawhide mallet. Be sure the square gasket is not cocked or pinched.



RECOMMENDED TORQUE FOR PUMPS ASS'Y AND MOTORS			
SERIES	SIZE	REQUIRED	TORQUE
2500	5/8-11 UNC-2A THREAD	4	200 Ft.-lbs.
3700	1/2-13 UNC-2A THREAD	8	120 Ft.-lbs.
NOTE: ALL BOLTS OR TIE RODS MUST BE SAE CLASS 8 (TENSILE STRENGTH 150,00 PSI MIN)			



6. Put flat washers (42) on the cap screws (43) and drop them into the port end cover (41) holes. Alternately tighten the cap screws (43) evenly to required torque with a torque wrench. **(See chart)**

7. Test the assembled pump for free rotation by turning the drive shaft. **CAUTION:** Wrap several layers of cloth around the shaft ends before applying the wrench. The shaft should rotate with very little effort, and **NO** hard spots and **NO** rubbing noises.

A. YOUR TYPE II OR TYPE III PUMP IS NOW READY TO GO BACK INTO SERVICE

B. YOUR TYPE I PUMP STILL NEEDS THE FOLLOWING:

8. Release the Type I Pump from the vise; turn it end-for-end so drive shaft (8 and 14) is facing up; re-clamp in vise.

9. Use a face spanner wrench to tighten the retainer ring (1) snugly.

10. Provide required preload on the pump bearings and correct running clearance for the pump as follows:

a. With the threaded retainer ring (1) snugged up, scribe a match mark across the face of the retainer ring (1) and the face of the flange of the shaft end cover (9).

b. Using the face spanner wrench, unscrew the retainer ring (1) so that the two ends of the match mark are 1/2" apart, measuring from the outer end of the mark on the outside diameter of the retainer ring (1). This amount of relief will provide the desired 0.005" clearance to produce the required bearing preload and adjustment.

c. After you have checked the distance between the two halves of the match mark to be 1/2", stake the outer edge of the retainer ring (1) into the groove or slot provided in the I.D. of the pilot of the shaft end cover (9). Use a blunt tool and hammer to force the metal of the retainer ring (1) into the pilot groove or slot of the shaft end cover. Check to be sure the ring is firmly locked in place.

C. YOUR TYPE I PUMP IS NOW READY TO GO BACK INTO SERVICE

START-UP INSTRUCTIONS FOR PERMCO PUMPS

FOLLOW THESE INSTRUCTIONS CAREFULLY. If you don't, you can instantly ruin your pump if the relief pressure setting is too high.

1. Before you operate the pump, unscrew the main relief valve adjusting screw on the main hydraulic system. **OR** remove adjusting shims or spacers.
2. Run the pump about five minutes under **ZERO PRESSURE**, with all control valves in neutral position. If the test system has a throttling valve, set it at 100 psi. above user's expected operating pressure.
3. If everything seems to function properly and no unusual noises are heard, back-off the throttling valve to zero. Shut down the system.
4. Adjust the relief valve pressure to the setting your hydraulic system requires.

LUBRICATION OF PERMCO PUMPS

1. The hydraulic oil used in the entire circuit provides the lubrication for all parts of the pump. **KEEP THIS OIL CLEAN AND FREE OF DIRT.** PERMCO recommends a 25-micron return filter and a 149-micron (100-mesh screen) suction filter to fully protect the pump and system from excessive wear and damage from dirt.
2. If the pump fails and you think metal particles have gotten in the circuit:
 - a. Drain **ALL** oil from the whole system,
 - b. Flush the system with kerosene,
 - c. Refill the system with fresh oil of correct grade,
(These are correct oils:
Viscosity index at 100°F (37°C): 90 or higher;
Viscosity SUS at 100 F (37°C): 150 to 300 (32-65 CST);
Aniline point: 165 or higher;
Anti-foam and anti-oxidant additives.)
3. Temperature of oil should never exceed 185°F (85°C.)
4. **NEVER** use low-viscosity naphtha-base oils, aircraft hydraulic fluids, or automotive brake fluids without consulting **PERMCO, INC.** or a Permco distributor.
5. For extended operation at temperatures below 20° F (-7° C) always use a low-pour-point oil of top quality.

TROUBLE SHOOTING

PROBLEM	REMEDY	PROBLEM	REMEDY
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EXCESSIVE NOISE IN PUMP:

Insufficient Fluid	Replenish fluid to proper level, with proper grade
Fluid is too heavy	Drain system and refill with specified grade of fluid
Oil filter is dirty	Clean or replace filter element
Suction line too small	Install larger suction line
Clogged suction line	Clean line thoroughly
Pump over-speeding	Check pump maximum speed; Slow down pump driver; Or install larger pump
Air vent on fluid reservoir clogged	Clean or replace breather on reservoir
Air bubbles in fluid	Drain system and refill with non-foaming hydraulic fluid
Filter too small	Replace with larger filter
Coupling misalignment	Realign flexible coupling between pump and driver
Air leaks at pump intake on pump shaft packing or inlet pipe	Drip oil over suspected joint; listen for change in sound of pump; tighten joints
Worn or broken pump parts	Replace parts as necessary

FOAMING FLUID:

Improper fluid	Drain system and refill to correct level with proper grade of anti-foaming fluid
Low fluid level	Top off with proper grade of anti-foaming fluid
Inadequate baffling in tank	Install correct baffling
Air leaking into suction line between reservoir and pump	Tighten all connections

OIL LEVEL IN TANK CONTINUES TO DROP

Oil level in tank continues to drop	Indicates a broken pipe line or a pipe left out between a bulkhead coupling and the bottom of the tank after cleaning tank. Replace pipe.
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Pump rotating in wrong direction	IMMEDIATELY STOP PUMP DRIVER to prevent damaging pump. Then reverse direction of pump rotation
Pump fails to prime itself a. Air leak into suction line b. Oil is too heavy	Tighten up joints. Drain system and replace fluid with proper grade of anti-foaming fluid
c. System not in Neutral	Open valve on pressure side of pump, or install air bleed valve

SYSTEM LACKS ANY PRESSURE WITH PUMP RUNNING:

Relief valve not set correctly	Use pressure gauge and reset valve to specified pressure
Relief valve leaking	Check relief valve seat for score marks. Reseat by grinding. Or replace.
Broken relief valve spring	Replace spring; reset relief valve
Flow of fluid to tank is unrestricted	Check for control valve in "Neutral" or for open return line
Internal leakage in control valve or power cylinder	Repair or replace leaking valve or cylinder

EXCESSIVE WEAR IN PUMP:

Abrasive contaminants in fluid	Drain and flush entire system. Install new filter. Fill system with fresh oil of proper grade or filter contaminated oil through a 10-micron filter before refilling. Operate pump an hour. Drain system again. Install new filter element and fluid.
Fluid too light for pump service	Drain and replace with anti-foaming fluid of proper grade.
Sustained pressure above pump maximum rating	Check and reset relief valve pressure, using pressure gauge.



PROBLEM	REMEDY	PROBLEM	REMEDY
Sustained excessive speed at pressure above pump maximum rating	Recheck pump rated speed. Slow down driver to produce this speed.	Internal leak in control valve or cylinder.	Repair or replace control valve. Replace cylinder packing. Check cylinder walls for scoring and replace if necessary.
Drive misalignment; Tight belt; weight of pump supported by its drive shaft	Check pump/driver coupling or belt alignment. Install adequate support for pump.	Erratic pump performance:	a. Drain system and refill with lighter grade anti-foaming fluid.
Entrapped air in hydraulic system	Bleed air from hydraulic system	a. If pump runs slow on startup, and speeds up after fluid is warm, fluid grade is too heavy.	b. Drain system and refill with heavier grade anti-foaming fluid.
		b. If pump slows down after fluid has heated up, fluid is too light	

OVERHEATED FLUID:

Fluid too heavy	Drain system and refill with lighter grade of anti-foaming fluid.
Fluid too light for high temperature pump location	Drain system and refill with heavier weight anti-foaming fluid.
Dirty fluid	Drain and flush system; refill with proper grade of anti-foaming fluid; replace filter element.
Dirt or chip caught between plunger and seat of relief valve	Disassemble relief valve and remove contaminant. Check condition of filter to prevent recurrence.
Incorrect setting on relief valve	Use gauge and adjust relief valve setting to correct pressure
Worn pump permits oil to bypass internally	Repair worn pump parts or replace pump.
Relief valve leaks or not operating	Repair or replace relief valve
Excessive friction caused by pump components over-torqued	Disassemble pump and back off over-torqued component to tightness specified in this maintenance manual
Undersize hoses and valves in system	Replace with proper size hose and valves
Restrictions and excessive bends in lines	Re-plumb system to eliminate restrictions
Inadequate reservoir prevents adequate cooling of fluid	Install larger reservoir or add fluid radiator
Internal leaks not in pump	Locate and repair leaks

PUMP NOT EFFICIENT:

Worn pump parts reduce pump efficiency	Repair or replace pump
Air in system	Bleed air from system; check line connections for air leaks

MOTOR DOESN'T DEVELOP PROPER TORQUE OR SPEED (when pump is used as a motor)

Relief valve incorrectly adjusted	Use a pressure gauge and increase relief valve pressure setting to proper level
Relief valve sticking open	Disassemble relief valve and remove dirt from under ball or piston. Check condition of filter to prevent recurrence.
Flow of fluid to tank is unrestricted	Check for control valve in "Neutral" or for open return line.
Insufficient pump pressure or volume	Use pressure and flow gauges to check pump out-put and pressure.
Misalignment of pump/driver	Realign belt drive or coupling, recheck torque requirements of pump for maximum input.

MOTOR SUBJECTED TO OVERPRESSURE. (when pump is used as hydraulic motor)

If you have used a standard control valve to control a hydraulic motor, serious and catastrophic harm can result. When the standard control valve is returned to "Neutral", to start or stop the motor sudden excessive pressure develops. This pressure can burst seals, fracture drive shafts, burst housings, and rupture hoses.

HOW TO ORDER PARTS

ALWAYS GIVE US THE SERIES NUMBER, please. It instantly tells us what PERMCO Pump or Motor you want parts for. You will find this Series Number on the nameplate.

IF YOU CANNOT SUPPLY THE SERIES NUMBER, Please answer these questions:

1. Is the unit a pump or a hydraulic motor?
2. If a pump, which way does it rotate when you look at it from the shaft end? Clockwise? Or Counter-Clockwise?
3. How many gear housing sections does the unit have?
4. Check "Series Identification Table" below to determine series.

STEPS IN IDENTIFICATION:

1. Shaft end cover:
Mounting flange: Is it pad mounting or foot mounting? How many bolts, 2, 4, 6, 8? If round flange, measure pilot diameter, center diameter, and bolt-hole diameters.

2. Bearing arrangement:
With or without outboard bearings? Double outboard bearings? Bearing measurements? Any drains or grease fittings?
3. Drive shaft:
Diameter of shaft end? Keyed or not? Length of spline? Number of spline teeth O.D.? Total length of shaft?
4. Housing:
Width of housing? Inside diameter of ports?
5. Port end cover:
Inside diameter of ports?
6. Bearing carrier:
Inside diameter of ports? Direction of flow thru internal passage or coring?
7. Gears:
Gear tooth width? Gear O.D. measured over teeth? If gears are integral, describe drive end of drive gear, as in Paragraph 3 above.

SERIES IDENTIFICATION

SERIES	STUD HOLES No. and Dia.	STUD DIA.	CONTINENTAL (Two-Piece Drive Shaft & Gear Set)	INTEGRAL (One-Piece Drive Shaft & Gear Set)	HOUSING Height	HOUSING WIDTH= GEAR WIDTH, +
1200	10-9/16"	1/2"	X		7"	1/2"
1500	4-9/16"	1/2"	X		5-1/4"	3/4"
2500	4-11/16"	5/8"	X		6"	3/4"
3700	8-9/16"	1/2"	X		7-5/16"	1"
3000 3100 (Doweled)	4-11/16"	5/8"	*	X	5-3/8"	3/4"
5000 5100 (Doweled)	4-11/16"	5/8"	*	X	6"	3/4"
7500 7600 (Doweled)	8-11/16"	5/8"	*	X	7-7/8"	1"

* Continental (Two-Piece Drive Shaft & Gear Set) available on Series 3000, 5000 and 7500 as specials; consult factory.

