DENISON Hydraulics

Axial Piston Motors
Fixed Displacement
Goldcup

Series
M24 Design D
M30 Design A

Service Information

CONTENTS

S2-AM121 12-94 *replaces SFM-M24*

General

This manual contains installation, operation, maintenance and overhaul instructions for Denison Hydraulics Goldcup 24 and Goldcup 30 constant volume motors. The Denison Hydraulics Goldcup 24 and Goldcup 30 axial piston motors feature advance design concepts which are time proven and provide for advance pumping and control concepts. The instructions contained in this manual cover complete disassembly and reassembly of the unit. Before proceeding with the disassembly or reassembly of any unit, this manual should be studied in order to become familiar with proper order and parts nomenclature.

Description

The Goldcup motor is a fixed displacement, axial piston design which uses hydrostatically balanced piston shoes. This feature serves to lubricate as well as absorb much of the force generated by the shoes pressing against the cam, thereby increasing service life of the unit. Rotation of the unit is bi-directional.

TABLE I TYPICAL CHARACTERISTICS

Specification		Term		Goldcup 24		Goldcup 30
Displacement		$in.^3/rev$ cm^3/rev		24.6 (403)		30.6 (501.4)
Pressure Ports A & B max. continuous		psi bar		5000 (345)		5000 (345)
max. intermittent		psi bar		5000 (345)		5000 (345)
Speed, max. continuous @ full stroke		RPM		2100*		1800
Flow, Ports A or B (theoretical)		GPM L/min.	@ 2100 RPM	223.6 (846)	@ 1800 RPM	238 (901)
Rotary Inertia		lb/in^2 kg/m^2		818 (0.239)		974 (0.285)
Torque, Theoretical per 100 PSI (6.9 bar)		in/lb N•m		392 (43)		487 (55)
at 5000 PSI (345 bar)		in/lb N•m		19576 (2158)		24351 (2752)
Power, Theoretical @ 5000 PSI (345 bar) at 100 RPM		hp kW		31.1 (23.1)		38.64 (28.8)
Power, Theoretical at 5000 PSI (345 bar) at Max. RPM		hp kW		621.3 (463.5)		695** (518)**
Torque Efficiency approx.	stalled	% theoretical		81		81
	running	% theoretical		93		93
Mounting-4 bolt flange	SAE	F		F		
Shaft-Spline / Keyed	SAE	F		F		
Fluid Connection Ports A & B SAE-4 bolt pad for 6000 psi split flange	in (414 bar)	2 mm		2 (50.8)		 (50.8)
Weight		lbs. kg.		640 (290)		660 (300)

*On R & O Oils (Rust and Oxidation Inhibitor)
** @ 1800 RPM

Mounting

This motor is designed to operate in any position. The mounting hub and four bolt mounting flange are in full conformance with SAE standard. The motor shaft must be in alignment with the shaft of the driven load and should be checked with a dial indicator. The mounting pad or adaptor into which the fluid motor pilots must be concentric with the motor shaft to prevent bearing failure. This concentricity is particularly important if the shaft is rigidly connected to the driven load without a flexible coupling.

Shaft Information

Splined: The shafts will accept a maximum misalignment of 0.006" TIR (.15 mm). Angular misalignment at the male and female spline axes must be less than ±.002 (0.05 mm) per one inch radius. The coupling interface must be lubricated. Denison Hydraulics recommends lithium molydisulfate or similar grease. The female coupling should be hardened to 45-50 Rc and must conform to SAE-J498B (1971) Class 1 flat root side fit.

Keyed: High strength heat treated keys must be used. Replacement keys must be hardened to 27-34 Rc. The key corners must be chamfered .030"-.040" (.75-1 mm) at 45° to clear radii that exist in the keyway.

Keyed types of shafts will accept a side load of 1000 lbs. (454 kg) at the center of the key, with a B10 life of 9,880 hours at 1800 RPM or 11,856 hours at 1500 RPM.

NOTE: Do not impact coupling to force it onto the shaft.

Piping

Connect inlet and outlet lines to the port block of the motor. The fluid connections are:

System Ports: 2" (50.8 mm)
6000 PSI (414 bar), SAE
4 bolt flange

Other: SAE straight thread, O-ring seal.
See installation drawing for sizes.

The maximum case pressure is 75 PSI (5.17 bar) continuous,125 PSI (8.6 bar) intermittent.

NOTE: High case pressure will result in reduced B-10 life of the shaft bearing.

It is recommended that the case leakage line be connected to the port located between the two system ports on the port block, but it may be connected to the top or bottom connections on the motor housing.

The case leakage line must be of sufficient size to prevent back pressure in excess of 75 PSI (5.7 bar) and returned to the reservoir below the surface of the oil as far from the supply suction as possible. All fluid lines, whether pipe, tubing, or hose must be adequate size to assure free flow through the motor. We recommend 20 ft (6.09 M) max. per second for main flow and 6 ft. (1.8 M) max. limit per second for drain lines. Pressure rating of piping hose must be adequate for service duty required.

An undersized outline line will create back pressure and cause improper operation. Flexible hose lines are recommended. If rigid piping is used, the workmanship must be accurate to eliminate strain on the port block or to the fluid connections. Sharp bends in the lines must be eliminated wherever possible. All system piping must be cleaned with solvent or equivalent before installing motor. Make sure the entire hydraulic system is free of dirt, lint, scale, or other foreign material. Flushing with a large temporary high pressure loop filter is recommended.

CAUTION: Do not use galvanized pipe. Galvanized coating can flake off with continued use.

Service Information

These hydraulic products are designed to give long dependable service when properly applied and their systems properly maintained. These general instructions apply to typical systems. Specific instructions for particular equipment can be developed from them.

Recommended Fluids

The fluid recommended for use in these pumps and motors has a petroleum base and contains agents which provide oxidation inhibition and anti-rust, anti-foam and de-aerating properties as described in Denison Hydraulics standard HF-1. Where anti-wear additive fluids are specified, see Denison Hydraulics standard HF-0.

Viscosity:

Max. at cold start—7500 SUS (1600 Cst)
(at low pressure, low speed)
Max. at full power—750 SUS (160 Cst)
Optimum for max. life—140 SUS (30 Cst)
Minimum at full power—60 SUS (10 Cst)

Viscosity Index:

90 V.I. minimum. Higher values extend the range of operating temperature but may reduce the service life of the fluid.

Temperature

Determined by the viscosity characteristics of the fluid used. Because high temperatures degrade seals, reduce the service life of the fluid and create hazards, fluid temperatures should not exceed 180°F (82°C) at the case drain.

Alternate Fluids

Some applications require fire-resistant fluids. They will give good service if the system is originally designed for their use. Permissible fire resistant fluids include:

Type	Denison Hydraulics Standard
Water-in-oil invert emulsions	HF-3
Water glycol solutions	HF-4
Phosphate esters	HF-5

Consult Denison Hydraulics for design requirements and warranty limitations for service with this class of fluids.

See Denison Hydraulics bulletin SPO-AM305 for more information.

Maintenance

This motor is self-lubricating and preventative maintenance is limited to keeping system fluid clean by changing filters frequently. Keep all fittings and screws tight. Do not operate at pressures and speeds in excess of the recommended limit. If the motor does not operate properly, check the Trouble Shooting Chart before attempting to overhaul the unit. Overhauling is relatively simple and may be accomplished by referring to the Disassembly, Rework Limits of Wear Parts and Assembly Procedures.

Fluid Cleanliness

Fluid must be cleaned before and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8. This approximately corresponds to ISO 17/14. This fluid level cleanliness can usually be accomplished by the effective use of 10 micron filters. Better cleanliness levels will significantly extend the life of the components. As contaminant generation may vary with each application, each must be analyzed to determine proper filtration to maintain the required cleanliness level.

Start Up Procedure for New Installation

1. Read and understand the instruction manual. Identify components and their functions.

2. Check alignment of drive.

3. Visually inspect components and lines for possible damage.

4. Check reservoir for cleanliness and clean as required. White glove test on all internal surfaces is recommended.

5. Check fluid level and fill as required with filtered fluid at least as clean as that recommended. Fill motor case with clean oil prior to starting.

6. Check oil cooler and activate it, if included in circuit. Check fluid temperature.

7. Reduce pressure settings of pressure control. Make sure accurate pressure readings can be made at appropriate places.

8. If solenoids in system, check for actuation.

9. Start pump drive first by jogging prime mover. Make sure pump and motor fill properly.

10. Bleed system of air. Recheck fluid level.

11. Cycle unloaded machine at low pressure and observe actuation (at low speed, if possible).

12. Increase pressure settings gradually in steps. Check for leaks in all lines especially in pump and motor inlet lines.

13. Make correct pressure adjustments.

14. Gradually increase speed. Be alert for trouble as indicated by changes in sounds, system shocks and air in fluid. Inspect oil surface with a good light while in operation. There must be no surface broken with oil surges and limit surface air bubbles to occasional.

15. Equipment is operational.

TABLE II
COMPARISON OF SOLID CONTAMINATION CLASSIFICATION SYSTEMS
NATIONAL AEROSPACE STANDARD (NAS) 1638

		CLASS														
		00	0	1	2	3	4	5	6	7	8	9	10	11	12
PARTICLE SIZE RANGE	5-15 µm	125	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	128,000	256,000	512,000	1,024,000
	15-25 µm	22	44	89	178	356	712	1,425	2,850	5,700	11,400	22,800	45,600	91,200	182,400
	25-50 µm	4	3	16	32	63	126	253	506	1,012	2,025	4,050	8,100	16,200	32,400
	50-100 µm	1	2	3	6	11	22	45	90	180	360	720	1,440	2,880	5,760
	>100µm	0	0	1	1	2	4	8	16	32	64	128	256	512	1,024
MAXIMUM PARTICLES	>5 µm	152	304	609	1,217	2,432	4,864	9,731	19,462	38,924	77,849	155,698	311,396	622,792	1,245,584
	>15 µm	27	54	109	217	432	864	1,731	3,462	6,924	13,849	27,698	55,396	110,792	221,584

		ISO SOLID CONTAMINANT CODE													
		8/5	9/6	10/7	11/8	12/9	13/10	14/11	15/12	16/13	17/14	18/15	19/16	20/17	21/18	22/19
MAXIMUM PARTICLES	>5 µm	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	130,000	250,000	500,000	1,000,000	2,000,000	4,000,000
	>15 µm	32	64	130	250	500	1,000	2,000	4,000	8,000	16,000	32,000	64,000	130,000	250,000	500,000

Trouble-Shooting

Component problems and circuit problems are often interrelated. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem.

This general guide is offered to help in locating and eliminating the cause of problems by studying their effects:

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
Noisy Motor	Air in Fluid	Leak in suction line Leak at shaft seal Low fluid level Turbulent fluid Return lines above fluid level Gas leak from accumulator Excessive pressure drop in the inlet line from a pressurized reservoir Suction line strainer acting as air trap
	Cavitation in motor rotating group	Fluid too cold Fluid too viscous Fluid too heavy Shaft speed too high Suction line too small Suction line collapsed Operating altitude too high Boost or replenishment pressure too low Replenishment flow too small for dynamic conditions
	Misaligned shaft	Faulty installation Distortion in mounting Axial interference Faulty coupling Excessive overhung loads
	Mechanical fault in motor	Piston and shoe looseness or failure Bearing failure Incorrect port plate selection or index
Erosion on barrel ports and port plate	Air in fluid	See above
	Cavitation	See above
High wear in motor	Excessive loads	Reduce pressure settings Reduce speeds
	Contaminant particles in fluid	Improper filter maintenance Filters too coarse Introduction of dirty fluid to system Reservoir openings Improper reservoir breather Improper line replacement
	Improper fluid	Fluid too thin or thick for operating temperature range Breakdown of fluid with time/temperature/shearing effects Incorrect additives in new fluid Destruction of additive effectiveness with chemical aging
	Improper repair	Incorrect parts Incorrect procedures, dimensions, finishes

(Continued)

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
High Wear in motor	Unwanted water in fluid	Condensation Faulty breather/strainer Heat exchanger leakage Faulty clean-up, practice Water in makeup fluid
Pressure shocks	Cogging load Worn relief valve	Mechanical considerations Needed repairs
	Worn compensator Slow response in check valves	Needed repairs Replace or relocate
	Excessive decompression energy rates	Improve decompression control
	Excessive line capacitance (line volume, line stretch, accumulator effects)	Reduce line size or lengths. Eliminate hose
	Barrel blow-off	Recheck hold-down, rotating group, drain pressure
Heating of fluid	Excessive motor leakage	Recheck case drain flow and repair as required Fluid too thin Improper assembly, port timing
	Relief valve	Set too low (compared to load or to compensator) Instability caused by back pressure, worn parts
	Heat exchanger	Water turned off or too little flow Water too hot Fan clogged or restricted Efficiency reduced by mud or scale deposits Intermittent hydraulic fluid flow
	Reservoir	Too little fluid Entrained air in fluid Improper baffles Insulating air blanket that prevents heat rejection Heat pickup from adjacent equipment

Disassembly

The instructions contained in this section cover a complete teardown of the subject motor. Disassemble only as far as necessary to replace or repair any worn parts. A bench or similar suitable surface capable of supporting unit should be used. Disassembly area should be clean.

CAUTION: On 24 Series units relax barrel holddown prior to removal of shaft seal or main shaft. Failure to follow this procedure may result in motor failure.

NOTE: The four main assembly bolts (1, Figure 9) are torqued to 450 ft. lbs. (610 N•m) These bolts should be loosened prior to removing unit for disassembly.

Shuttle Valve Assembly
See Figure 7

1. Remove three screws (13) and remove valve assembly from port block.

24 Series Barrel Holddown
See Figure 3

1. Remove holddown lock retainer ring (8, Figure 3). (Use internal snap ring pliers.)

2. Remove four screws (1, Figure 7) and two screws (8, Figure 7).

NOTE: There is a preload from the barrel holddown which will lift the port block approx. ⅛" at release.

3. Carefully lift and remove port block (2) and port plate (4, Figure 7).

CAUTION: The port plate may cling to the barrel face because of oil film. Do not allow the port plate to fall and become damaged.

4. Remove the face plate and face plate pins (2, 1, Figure 5) from the face of the barrel assembly.

5. Remove holddown adjusting screw lock (7, Figure 3).

6. Lock main shaft (1, Figure 6) from turning. Use special tool T2, slip over auxiliary shaft (2, Figure 3) and engage dowels into holddown adjusting screw (6, Figure 3). Loosen load but do not remove.

7. Remove two bolts (8, Figure 7) holding housing and flange together.

NOTE: Do not damage gasket faces in process. Do not remove the retaining screws or bearing from the housing unless bearing is damaged and replacement is necessary.

8. Barrel assembly can be removed by lifting with aux. shaft. The pistons will remain with the cam assembly. These parts are precision finished and must be handled with extreme care!

9. Using special tool T2, holddown assembly can be removed from barrel. Remove adjusting screw (6, Figure 3), spring (5), retainer (4), spherical seat (3) and auxiliary shaft (2).

30 Series Barrel Holddown
See Figure 3.1

1. Remove four screws (1, Figure 7) and two screws (8, Figure 7).

NOTE: There is a preload from the barrel holddown which will lift the port block approx. ⅛" at release.

2. Carefully lift and remove port block (2) and port plate (4, Figure 7).

CAUTION: The port plate may cling to the barrel face because of oil film. Do not allow the port plate to fall and become damaged.

3. Remove the face plate and face plate pins (2, 1, Figure 5) from the face of the barrel assembly.

4. Loosen six screws gradually in alternating sequence.

CAUTION: Holddown is under preload. Do not remove screws completely.

5. Insert three #10-32 screws into the three #10-32 tapped holes. Alternately turn in screws till tapered retainer releases. A loud crack sound should be heard when it releases.

6. Lock main shaft (1, Figure 6) from turning. Use special tool T2, slip over auxiliary shaft (2, Figure 3.1) and engage dowels into holddown adjusting screw retainer (6, Figure 3.1). Loosen load but do not remove.

7. Remove two bolts (8, Figure 7) holding housing and flange together.

NOTE: Do not damage gasket faces in process. Do not remove the retaining screws or bearing from the housing unless bearing is damaged and replacement is necessary.

8. Barrel assembly can be removed by lifting with auxiliary shaft. The pistons will remain with the cam assembly. These parts are precision finished and must be handled with extreme care!

TABLE IV Rework Limits of Wear Parts		
24 and 30 in³	**Max. Rework From Original Dimension**	**Min. Dimension After Rework**
Port plate face	.010" (.254 mm)	.735" (18.67 mm)
Shoe retainer face	.005" (.127 mm)	.494" (12.55 mm)
*Piston shoe face (pocket)	.002" (.051 mm)(24 in³)	.018" (.457 mm)(24in³)
Creep plate face	.010" (.254 mm)	.365" (9.27 mm)
Face plate	None	Replace

*** NO REWORK PERMITTED ON 30 in³ SHOE.**

IMPORTANT:
The port plate both sides, face finish must be 8 microinches, (0, 20 µmm) flat within .00006 (0, 0015) and parallel within .001 (0, 025 mm) T.I.R.
The creep plate wear face finish must be 5 microinches (127 µmm), flat within .0005 (0, 012 mm) and parallel to the back-side with .001 (0, 0254 mm) T.I.R.
The shoe retainer wear face finish must be 32 microinches (813 µmm), and flat within .0005 (0, 012 mm) (must not be convex).
The piston shoes wear face finish must be 30 microinches (760 µmm), and must be lapped in a set with the retainer plate, all shoe sole thicknesses to be within .001 (0, 0254 mm) after lapping. The maximum permissible shoe and piston axial looseness is .010 (0, 254 mm).
The special retaining ring service kit (S23-12629) may be required to control shoe holddown clearance.

Drive Shaft
See Figure 6

1. Remove four screws (5), seal retainer (2), gaskets (4), and stationary part of shaft seal assembly (4). Refer to view of item 3.

2. Remove the carbon ring and the remainder of the shaft seal from the shaft.

3. Remove shaft and bearing assembly (1).

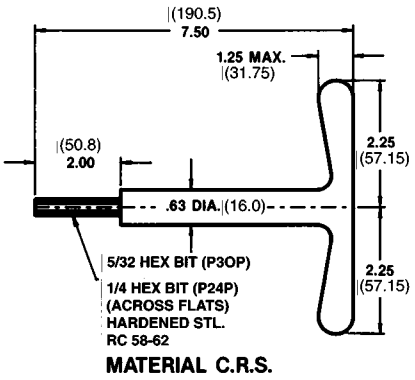
Cam and Piston/Shoe Assembly

1. Remove the retaining ring (2, figure 2), thrust washer (3), piston and shoe assembly (4) and creep plate (5) from the cam (6).

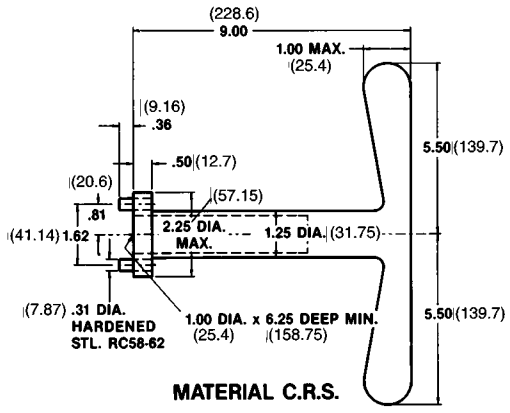
2. Remove the cam from the mounting flange by carefully tilting mounting flange on its side and removing plugs (12, Figure 2) with O-rings (9, Figure 2) using ¼-20 threaded rod as a puller, and removing screws (10, Figure 2) attaching cradle to mounting flange.

Disassembly & Assembly Tool Drawings

T1



T2



Removal & Replacement Tool for H.D. Lock Screw — Barrel H.D. Adjustment Tool

Drive Shaft Assembly
Figure 1

1. Slide the bearing (2) over the short end of the shaft and seat against the shoulder. *Support only the inner race of the bearing and press on the long end of the shaft to install bearing.*

DO NOT USE EXCESSIVE FORCE. USE EXTREME CARE PASSING THE RING OVER THE SEAL SURFACE.

2. Install the retaining ring (3) in the groove. Be sure that the ring is fully seated.

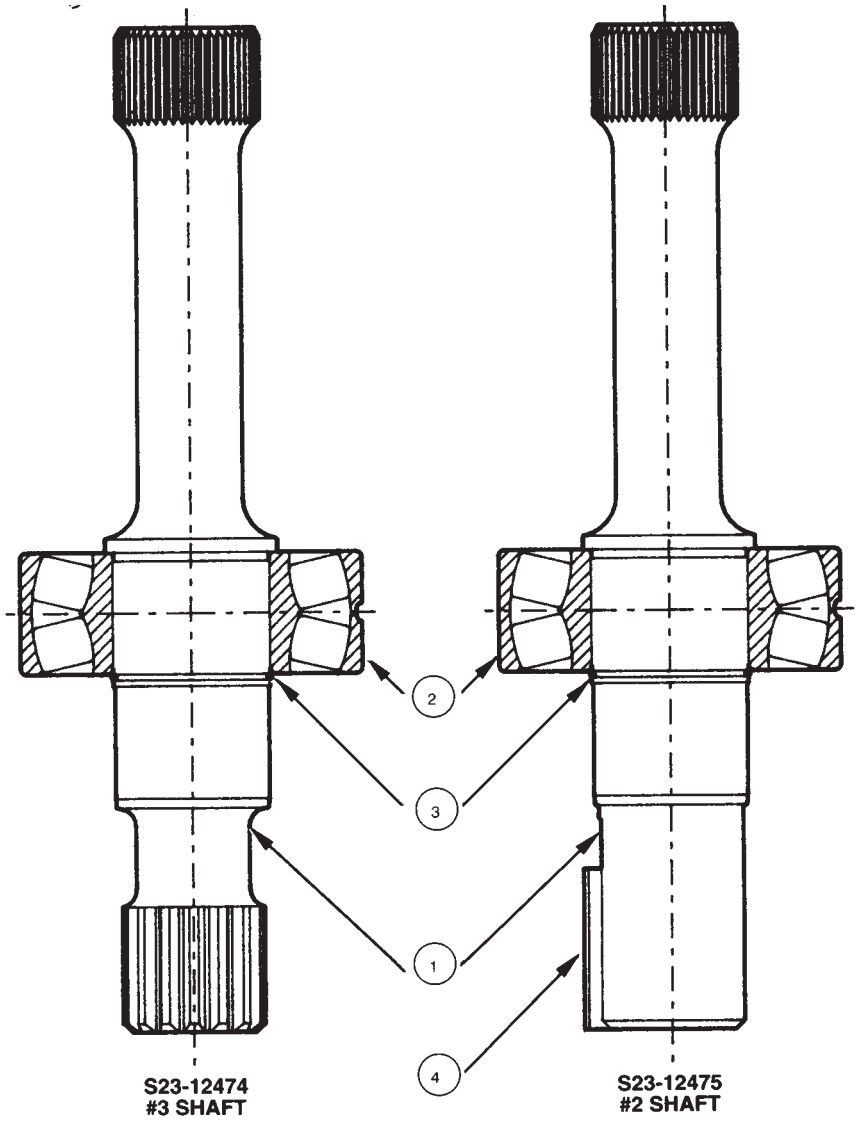


FIGURE 1

S23-12474 #3 Drive Shaft Assembly (spline)
S23-12475 #2 Drive Shaft Assembly (w/keyway)

ITEM	DESCRIPTION	PART NO.	QTY #1	QTY #2
1	#3 (splined) Drive shaft	033-91139	1	—
	#2 (keyed) Drive shaft	033-91140	—	1
2	Shaft bearing	230-82213	1	1
3	Retaining ring	033-71712	1	1
4	Square key	033-71910	—	1

Barrel, Cam to Mounting Flange
Figure 2

3. Position the mounting flange (8) with the large open end facing up and install two dowel pins (7) in the cradle mounting surface and one-3/8" (9.52 mm) dia. dowel pin (11) in the outer edge of the flange.

4. Install the cam (6) over the dowel pins (7) in the mounting flange. Position cam so that the thick part of the cam is on the same side as the 3/8" (9.52 mm) dowel (11).

5. With cam installed, tilt mounting flange on its side and secure with two Soc. Hd. cap screws (10). Torque to 50 ft.-lbs. (67.8 N•m).

6. Insert plugs (12) with o-rings (9) into Soc. Hd. cap screw (9) c'bores. Be sure tapped hole in plug (12) is visible after installation, this is used for removal.

7 Install shaft and bearing assembly (1) Figure 6 (either splined or keyed as specified) by inserting shaft through bores, a few light taps are required on the bearing outer race to completely engage and seat bearing.

NOTE: Do not tap on end of shaft.

Seal Assembly
Figure 6

NOTE: See warning information below

1. The shaft seal is available only as a complete assembly. Prior to installation examine all the seal parts. Handle the lapped seal seat and the carbon ring with extreme care. Both parts must be free of scratches, cracks or other damage.

2. Install the spring retainer (e) over the shaft and against the bearing retaining ring.

3. Install the spring (d) against the retainer.

4. Apply oil to the inner surface of the rubber friction ring (f) and install the shell containing the friction and the carbon ring (c) over the shaft with the carbon ring exposed.

5. Apply grease to the square section rubber seal (a) and install on the seat.

6. Install the seat and seal in the seal retainer (2). The lapped surface of the seat must face the carbon ring.

7. Install the seal retainer assembly and O-ring (4) over the shaft with the lapped surface against the carbon face.

8. Install the screws (5) and the seal retainer.

9. Depress the seal retainer only far enough to start the screws and tighten evenly in a criss-cross pattern. Torque to 30 ft.-lbs. (40.8 N•m).

Seal Replacement
Figure 6

NOTE: 24 Series only–To replace shaft seal only.

1. Remove unit for disassembly.

2. Remove retaining ring (8, Fig. 3).

3. Replace shaft seal. (Follow seal assembly in reverse order.)

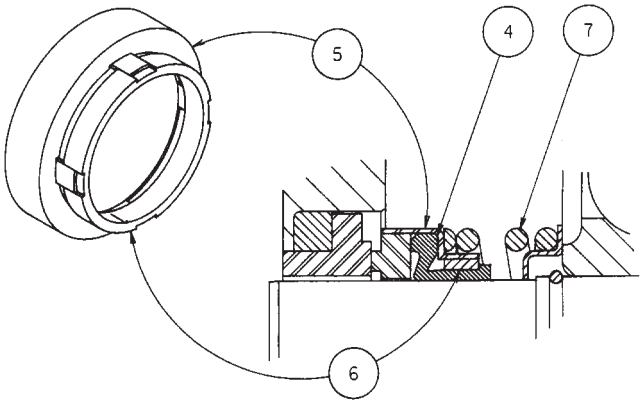
4. After seal is replaced re-install retaining ring (8, Fig. 3).

CAUTION Failure to follow these instructions may result in pump failure.

Mechanical shaft seal assembly procedure

Warning: When installing a new mechanical shaft seal, exercise care to insure that all of the parts fit together properly. This is particularly important if the seal was once assembled and disassembled for some reason. If the rubber boot, item 4, grips the shaft and doesn't slide on the shaft, as it is disassembled, then the spring, item 7, can disengage the shell, item 5, from the band, item 6, so that they do not re-engage properly when reassembled. Be sure the shell and the band are properly engaged before reassembling the seal, and stays engaged during assembly.

Note:
Lubricate seal and shaft with clean hydraulic fluid of the same type that will be used in the system.



Piston/Shoe Assembly to Cam
Figure 2

1. Return the mounting flange to an upright position.

2. Install creep plate (5) over center post on cam (6) chamfered end first.

3. Insert piston and shoes into retainer and install entire assembly (4) against creep plate.

4. Install thrust washer (3), over center post of cam and against shoe retainer. Grooved side of washer must face shoe retainer.

5. Install the thickest retaining ring (2) that will fit in the groove on the rocker cam center post which will allow a maximum clearance of .002-.005" (.05-.13 mm) between the creep plate and shoe faces. To check this clearance, grasp one piston and lift and lift until tight against shoe retainer. Insert thickness gage. If this clearance is not correct, select the appropriate retaining ring and repeat the checking procedure.

NOTE: If metallic thickness gage is used, caution should be exercised not to scratch shoe face. There are five different retaining rings available for this tolerance. Each retaining ring is marked: .081/079" (2.06/2.01 mm) thick, blue dot; .083/.081" (2.11/2.06 mm) thick, red dot; .087/.085" (2.21/2.16 mm) thick, green dot; .089/.087" (2.26/2.21 mm) thick, yellow dot; and .085-.083 (2.16/2.11mm) white dot. The piston and shoe assembly must be free to rotate 360° by hand.

6. Position the barrel assembly (1) directly over the pistons. Starting with the uppermost piston, guide them one at a time into the barrel bores.

NOTE: Support the barrel on the main shaft but tilted slightly so as not to allow the barrel to drop and fully engage the barrel and shaft splines, now the holddown assembly can be installed without any load against it.

PARTS LIST FOR FIGURE 2

ITEM	DESCRIPTION	PART NO.	QTY.
1	Barrel & aux. shaft assy.	See Fig. 3	1
2	Retaining ring — use one only		1
	.089/.087 thick w/yellow dot (2.26/2.21 mm)	033-71716	
	.087/.085 thick w/green dot (2.21/2.16 mm)	033-71717	
	.083/.081 thick w/red dot (2.11/2.06 mm)	033-71718	
	.081/.079 thick w/blue dot (2.06/2.01 mm)	033-59746	
	.085/.083 thick w/white dot (2.16/2.11 mm)	033-91130	
	Retaining ring service kit	S23-12629	
3	Thrust washer	033-59805	1
4	Piston & shoe assy. P24	S13-44470	1
	Piston & shoe assy. P30	S23-12684	
5	Creep plate	033-71747	1
6	Cam	033-91148	1
7	Dowel pin	324-24028	2
8	Mounting flange	033-91137	1
9	O-ring	671-00111	2
10	Soc. Hd. cap screw	358-16260	2
11	Dowel pin	324-22416	1
12	Plug	033-57475	2

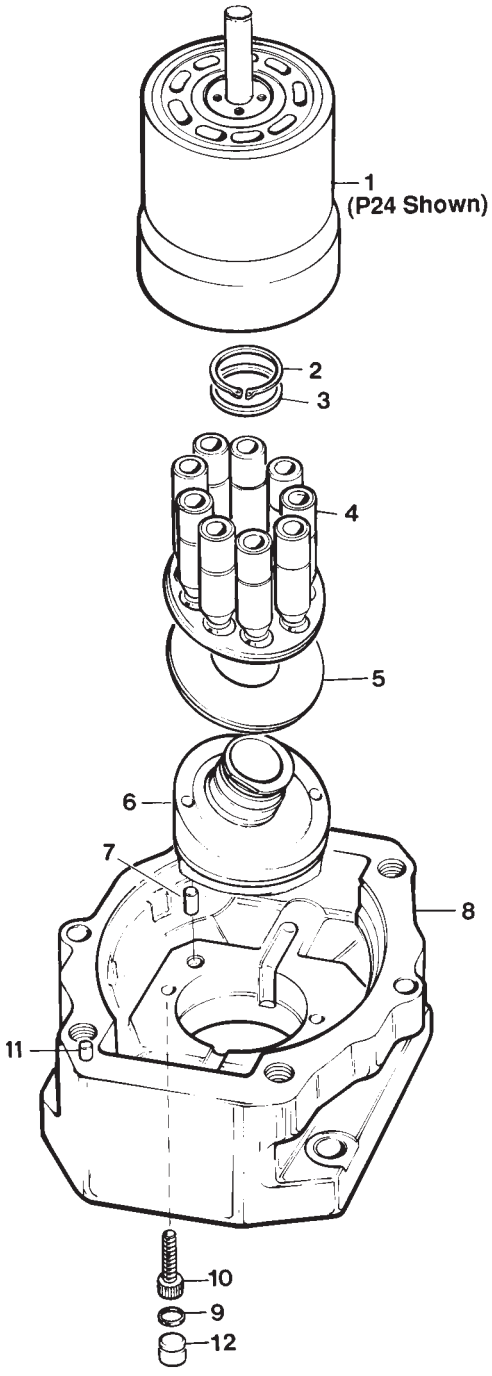


Figure 2

Barrel and Auxiliary Shaft Assembly Figure 3 (24 Series)

1. Install auxiliary shaft (2) large spline end first into counterbore in face of barrel and engage barrel spline.

2. Install spherical seat (3) round or spherical face up into counterbore in face of barrel.

3. Install spring retainer (4) socket side down into counterbore, install spring (5) and seat against spring retainer.

4. Thread holddown adjustment screw (6) into counterbore approx. four threads.

5. Tilt barrel vertically and engage main shaft spline with the barrel spline allowing barrel to drop in place.

6. Thread holddown adjusting screw (6) into counterbore until it is flush to .060" (1.52 mm) max. below barrel face.

PARTS LIST FOR FIGURE 3 (24 SERIES)

ITEM	DESCRIPTION	PART NO.	QTY P24P
1	Barrel & sleeve assy. 24 series only	S23-12091	1
2	Auxiliary drive shaft	033-57211	1
3	Spherical seat	033-57147	2
4	Spring retainer	033-57138	1
5	Spring	033-57136	1
6	Holddown adj. screw	033-57139	1
7	Holddown adj. scr. lock	033-57241	1
8	Holddown lock retaining ring	033-57239	1

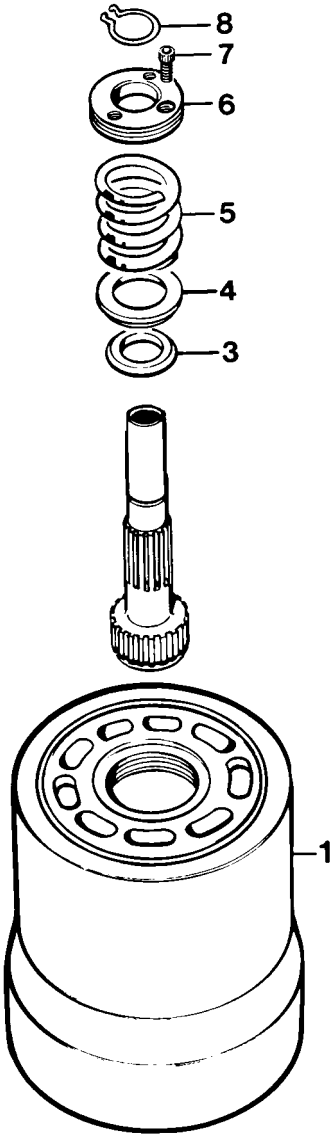


FIGURE 3

Barrel and Auxiliary Shaft Assembly Figure 3.1 (30 Series)

1. Install auxiliary shaft (2) spline end first into counterbore in face of barrel and engage barrel spline.

2. Slide holddown spring assembly (see enlargement for proper spring arrangement) (3) onto shaft (2).

3. Install spring retainer (4) into counterbore.

4. Thread holddown screw assembly (5) into barrel's counterbore approx. four threads.

5. Tilt barrel vertically and engage main shaft spline with the barrel spline allowing barrel to drop in place.

6. Thread holddown screw assembly (5) into counterbore until it is .25 (6.35 mm) below barrel face.

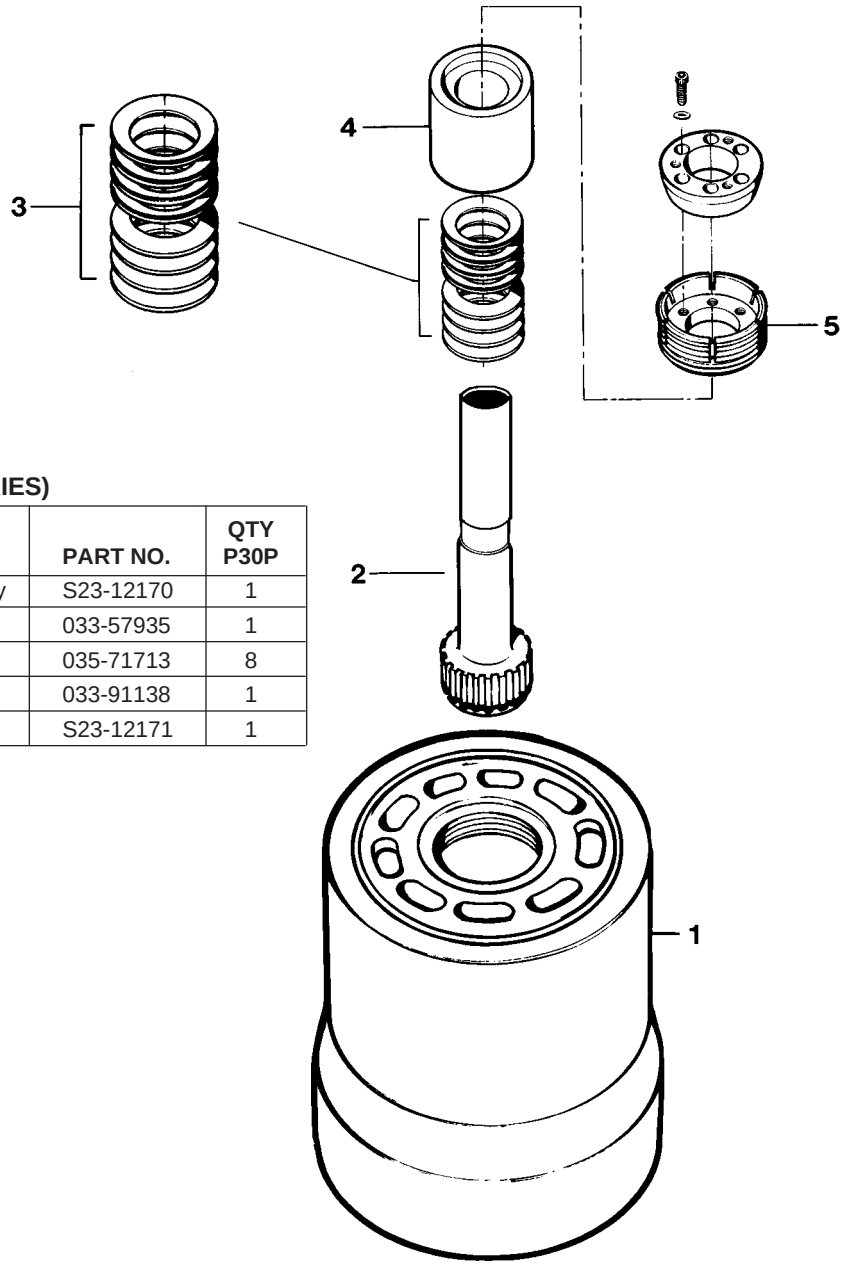


FIGURE 3.1

PARTS LIST FOR FIGURE 3.1 (30 SERIES)

ITEM	DESCRIPTION	PART NO.	QTY P30P
1	Barrel & sleeve assy. 30 series only	S23-12170	1
2	Auxiliary drive shaft	033-57935	1
3	Holddown spring	035-71713	8
4	Spring retainer	033-91138	1
5	Barrel holddown nut assy.	S23-12171	1

S23-12566 (P24) P23-12175 (P30) Housing Assembly Figure 4

1. Clean housing (1) and position on a flat surface with the large open end up.

2. Apply Loctite primer grade "T" & Loctite retaining compound #609 per A.P. 01433 to bearing O.D. & bearing bore of housing. Immediately align & press bearing into housing bore with a smooth steady force until seated. Install socket head cap screw (3) with washer (7). Typical two places. Torque to 30 ft. lbs. (40.8 N•m).

3. Install two dowel pins (4) in the blind holes in the control cover pads.

4. Repeat step 3 on the opposite side of the housing.

5. Install O-ring (5) and plug (6) in the bottom of housing.

PARTS LIST FOR FIGURE 4

ITEM	DESCRIPTION	PART NO.	QTY.
1	Housing (P24)	033-57150	1
	Housing (P30)	033-57925	1
2	Bearing	033-91150	1
3	Screw Soc Head Cap 5/16 x 18 x 5/8 w/Nylock	358-14106	2
4	Dowel pin	324-21608	4
5	O-ring	691-00920	1
6	Plug	488-35019	1
7	Washer 11/32 (8.73 mm) steel	345-10020	2

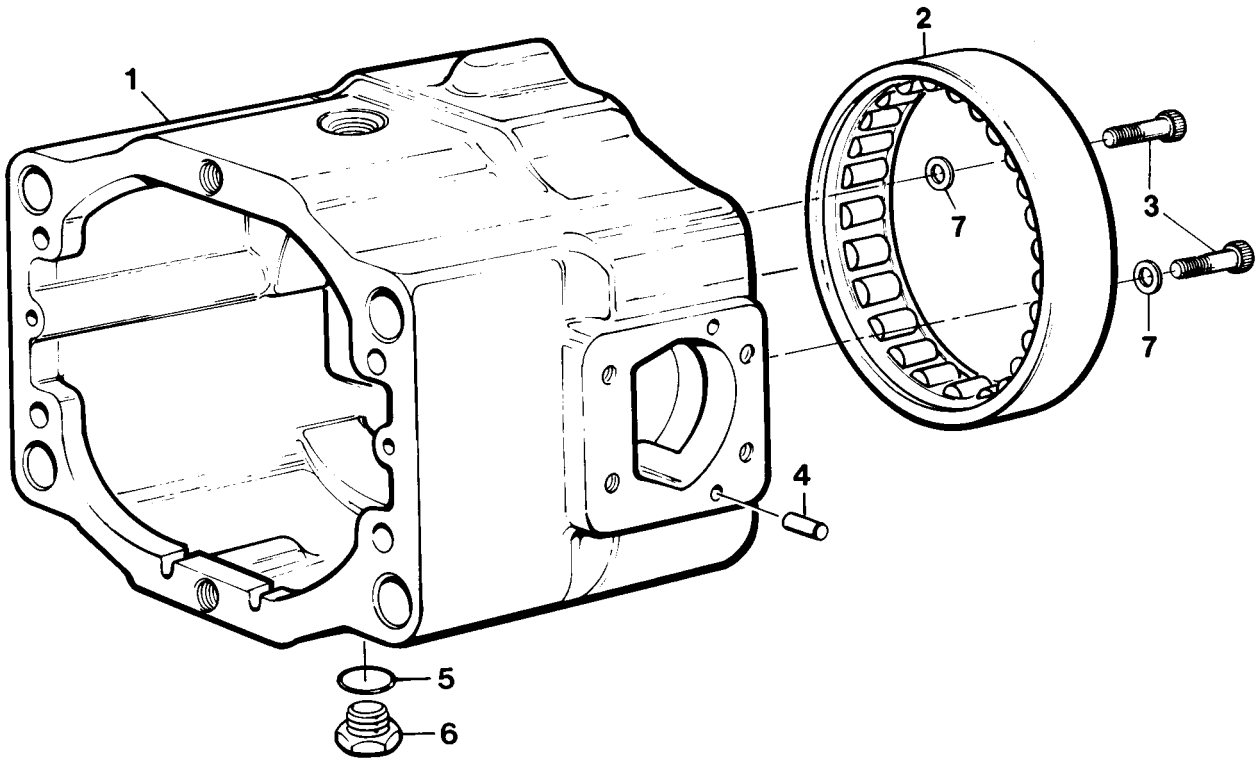


FIGURE 4

Housing Assembly Installation
Figure 5

1. Install gasket (3) over the dowel pin in the mounting flange. Do not use gasket compound.

2. Install the housing assembly (4) over the barrel and auxiliary shaft assembly.

3. Insert two Hex. Hd. cap screws (5) through mounting flange and into housing. Torque to 100 ft.-lbs. (135.6 N•m). These must be fully torqued later when main bolts are in place.

4. Install face plate pins (1) in the holes provided in the barrel face.

5. Apply clean heavy grease to the surface of the barrel and install the face plate (2) over the face plate pins. The surfaces must be absolutely free of scratches, dust or dirt to prevent excessive leakage. Lubricate pistons with clean system fluid through the holes in the face plate.

CAUTION: The face plate has a black break-in coating on top of bronze which is bonded to a steel backing. Lightly sand the edge of the plate to identify the bronze coated side. The bronze side should go toward the port plate.

PARTS LIST FOR FIGURE 5

ITEM	DESCRIPTION	PART NO.	QTY.
1	Face plate pins	033-59747	3
2	Barrel face plate (P24)	033-71748	1
	Barrel face plate (P30)	033-57571	1
3	Housing gasket	033-91082	1
4	Housing assembly	See Fig. 4	1
5	Hex Hd. screws	306-40009	2

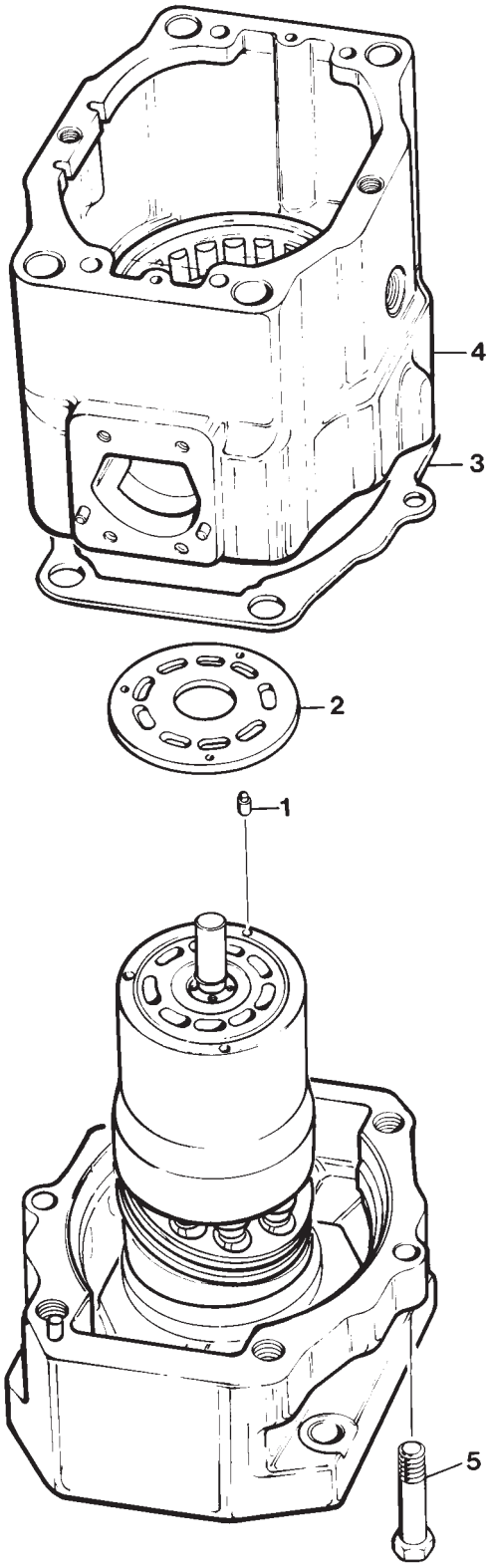
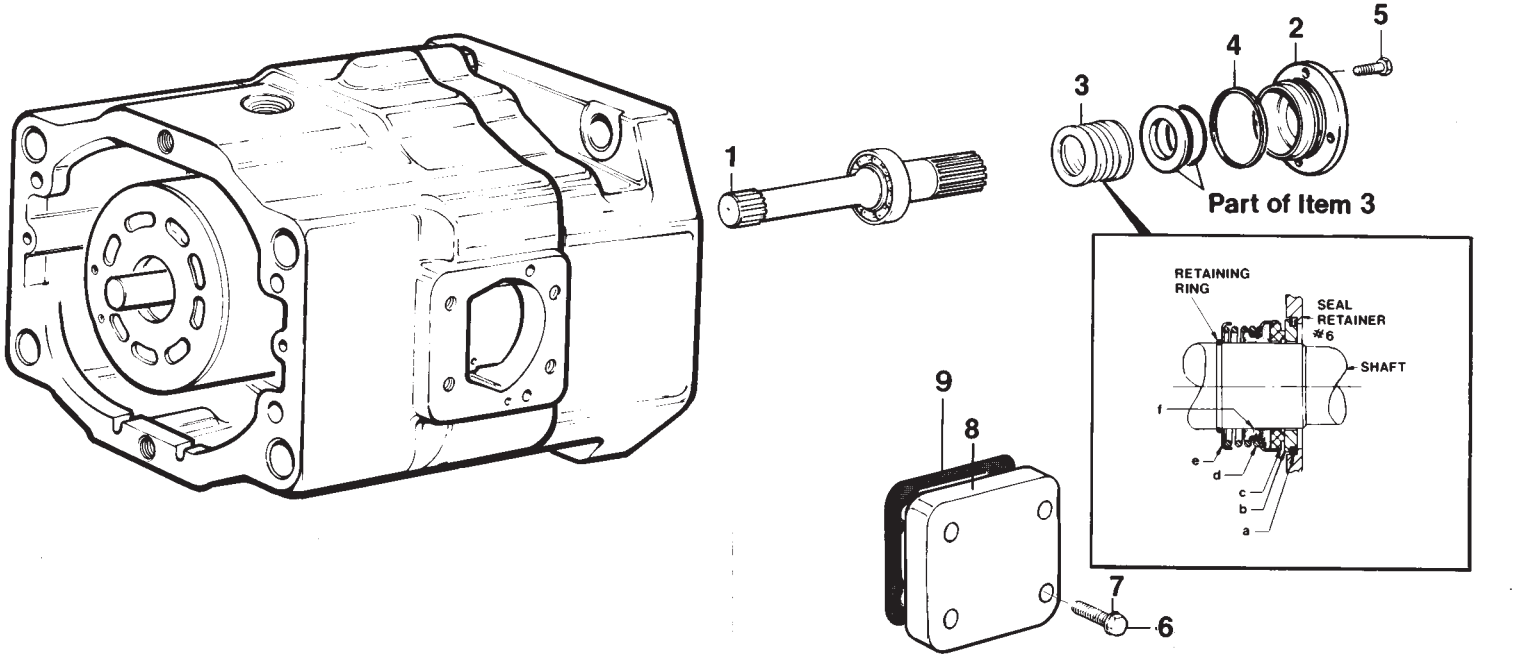


FIGURE 5



PARTS LIST FOR FIGURE 6

ITEM	DESCRIPTION	PART NO.	QTY.
1	No. 3 Splined shaft assy. (See fig. 1)	S23-12474	1
	No. 2 Keyed shaft assy. (See fig. 1)	S23-12475	
2	Seal retainer	033-57472	
3	Shaft seal	623-00015	1
4	Seal retainer O-ring	671-00246	1
5	Hex. head screw	306-40123	4
6	Nyltite washer	631-45007	8
7	Hex. hd. washer screw	353-25039	8
8	Cover	033-53252	2
9	Gasket	033-91058	2

FIGURE 6

Port Block Installation
Figure 7

1. Position the motor with open end of the housing assembly (6) facing up. Install new gasket (5) on the housing. Do not use gasket compound.

2. Install two port plate pins (3) in the face of the port block (2) and the dowel pins (7) into mounting surface of port block.

3. Insert lifting eyes into tapped holes in each system port mounting surface.

4. Apply heavy grease to the rear of the port plate (4) and install over the port plate pins.

5. Temporarily attach port plate to port block by inserting a cord through one of the 2" (50.8 mm) dia. ports down through the port block port, around arcuate divider in port plate, back through port block and tie ends of the cord to lifting eye. Repeat this step to the other side of the port plate.

6. Install the port block over the auxiliary shaft and position onto dowel pins.

7. Install the six bolts (1 & 8) with washers (9, 10). Do not drop the bolts in place as the threads may be damaged. Torque bolts evenly. Torque bolts (1) in 50 lb. (67.8 N•m) increments to 450 ft.-lbs. (610 N•m) and the two bolts (8) to 120 ft.-lbs. (163 N•m) tightening in turn all six bolts. Re-torque the two bolts (5) Fig. 5 to 120 ft.-lbs (163 N•m).

PARTS LIST FOR FIGURE 7

ITEM	DESCRIPTION	PART NO.	QTY.
1	Hex head cap screw (P24P)	306-40221	4
	Hex head cap screw (P30P)	306-40230	4
2	Port block	033-57898	1
3	Port plate pins	324-21610	2
4	Port plate (24)	033-71751	1
	Port plate (30)	033-91149	1
5	Port block gasket	033-91085	1
6	Housing assembly (24)	S23-12566	1
	Housing assembly (30)	S23-12175	1
7	Dowel pin	033-57020	2
8	Hex head cap screw	306-40022	2
9	Washer, Hdn. St'l.	350-10136	2
10	Washer, Hdn. St'l.	350-10135	4
11	Seal/shuttle valve	691-10016	3
	Seal/cover	691-10014	2
	Seal/cover	691-10019	1
12	Shuttle valve/2 orif.	S13-48776	1
	Shuttle valve/Int. dr.	S13-48273	
	Cover	033-71649	
13	Screw-hex hd./shuttle	306-48273	3
	Screw-hex hd./cover	306-40071	
14	O-ring	671-00147	1
15	End cover	033-72100	1
16	Retaining ring	356-65082	1
17	O-ring	691-00906	1
18	Hex. soc. plug	488-35041	1
19	O-ring	691-00920	1
20	Plug	488-35019	1

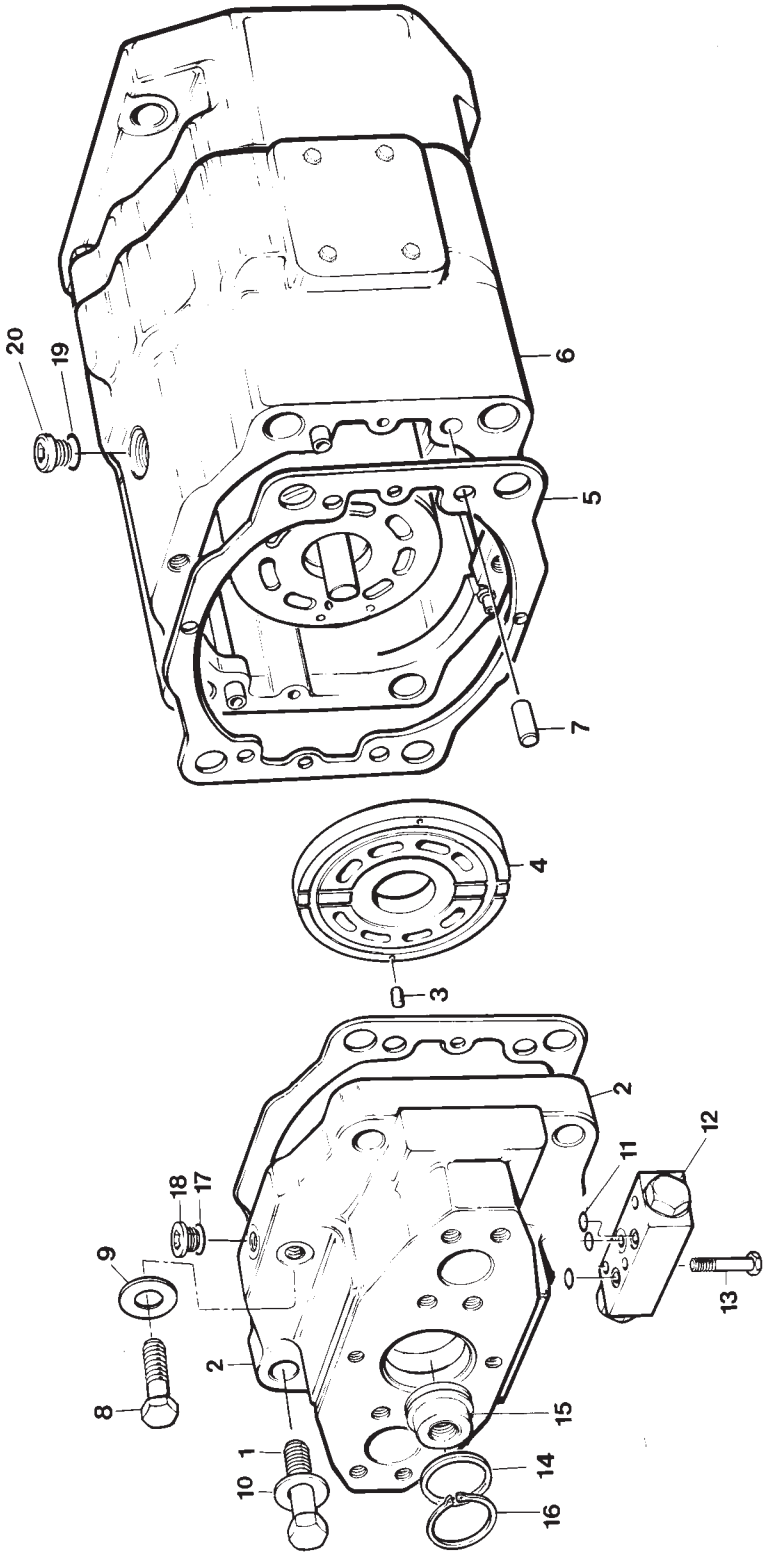


FIGURE 7

Barrel Holddown
Figure 3 & 7 (24 Series)

1. Use special tool T2 and slip over auxiliary shaft and engage the holes in the holddown adjusting screw (6, figure 3). Carefully tighten until screw bottoms out.

NOTE: The main drive shaft must be held to prevent barrel assembly from turning. If barrel assembly turns, the adjustment cannot be made.

2. Remove special tool T2 and sight through holddown screw and note where tooth of auxiliary shaft spline is located.

3. Back off holddown screw (loosen) 5 to 6 spline teeth on auxiliary shaft (approx. 135°).

NOTE: Tapped hole in holddown screw must line up with space between spline teeth.

4. Barrel lift-off is now set at .030-.036 (.76-.91 mm).

5. Use special tool T1 and thread holddown adjusting screw lock (7, figure 3) into holddown adjusting screw. Torque to 30 ft.-lbs. (40.7 N•m).

6. Slip holddown lock retaining ring (8, figure 3) over auxiliary shaft into groove which is located 2 3/16" (55.2 mm) from end of shaft.

7. Untie cords holding port plate and remove.

Barrel Holddown
Figure 3.1 & 7 (30 Series)

1. Use special tool T2 and slip over auxiliary shaft and engage dowels into holddown screw assembly, (5, Figure 3.1). Carefully tighten clockwise until holddown screw assembly bottoms out.

NOTE: The main drive shaft must be held to prevent barrel assembly from turning. If barrel assembly turns, the adjustment cannot be made.

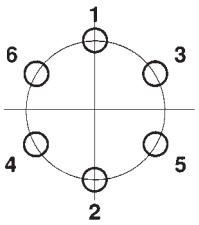
2. Back off holddown screw assembly 140°, counter-clockwise.

3. Barrel lift-off is now set at .032" (.81 mm).

4. Remove spanner wrench. Rotate drive shaft, item 31, to check if any binding occurs.

5. Lock holddown screw assembly in place by tightening the six socket head cap screws gradually in the following torque sequence until 65 in.-lbs. (7.4 N•m) torque is reached.

NOTE: If barrel holddown has to be reset for any reason all six socket head cap screws must be loosened gradually in the same order they were tightened. Do not remove socket head screws completely. Use the #10-32 UNF tapped holes in the insert to disengage insert from holddown screw assembly. Insert must be loose before resetting barrel holddown.



**Torque sequence for locking holddown screw assembly.

6. Untie cords holding port plate and remove.

End Cover
Figure 7

1. Apply a light film of oil or grease to O-ring (14) and place in groove in end cover (15). Insert end cover (15) into bore of port block.

2. Install retaining ring (16) into groove.

Shuttle Valve Assembly Internal Drain

1. Place valve assembly (12, fig. 7) in a horizontal position with the O-ring groove up.

2. Press seat (11) in the .500" (12.7 mm) diameter bore until it is flush with the body surface.

3. Install spring centering washer (4) over each end of spool.

5. Install springs (3) over ends of spool and into sockets of centering washers.

6. Lubricate O-rings (2) and install over plugs (1). Install the plugs over springs and into body.

7. Install spool (10) in bore against seat (11).

8. Install spring (9) in spool (10).

9. Lubricate O-ring (8) and install on groove of plug (7) on internally drained shuttle.

10. Install plug (7) over spring (9) and tighten.

11. Install seal (11, fig. 7) in counterbore in center of shuttle valve assembly. Hold in place with a coating of grease. Install the two seals in remaining counterbores.

12. Install orifices, (15) if required.

13. Install the shuttle valve assembly on port block pad and secure with screws (13). Torque screws to 20 ft.-lbs. (27.2 N•m)

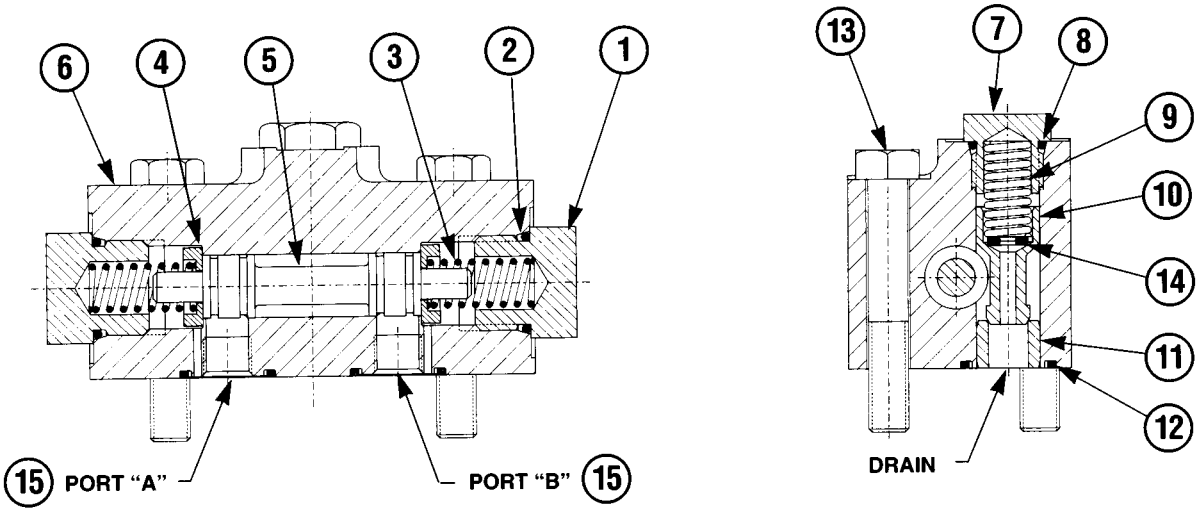


FIGURE 8

S13-48273 Assembly, Shuttle Valve without orifices
S13-48776 Assembly, Shuttle Valve with orifices

Item	Qty.	Part No.	Description
1	2	488-35002	Plug
2	2	691-00908	O-ring
3	2	033-70515	Spring
4	2	033-70495	Washer, spring centered
5	1	033-70529	Spool
6	1	033-53117	Body
7	1	033-72129	Plug
8	1	691-00906	O-ring

Item	Qty.	Part No.	Description
9	1	033-71923	Spring, relief valve
10	1	033-71925	Spool, relief valve
11	1	033-53154	Seat
12	3	691-10016	Tetraseal
13	3	306-48273	Screws, 5/16-18 x 2 3/4
14	2	345-20004	Shim washer
15	2	033-53523	Orifice .78 (mm) (optional)

General Requirements

1. Maximum runout between motor shaft and electric motor shaft .003 T.I.R.

2. Electric motor speed—1800 RPM.

3. Inlet temperature—130° ± 10°F. (54°C ± 4°C).

4. Inlet condition—24 Series
100 to 150 PSI.
(6.9 to 10.3 bar)
30 Series
225 to 275 PSI.
(15.5 to 19 bar)

5. Case pressure 50 PSI ± 5 PSI. (3.4 ± .34 bar).

6. Fluid—200SSU @ 100°F. (37.8°C).

Basic Motor Test

1. Mount motor on test stand. Connect system lines to motor. Fill case with clean oil. Dry all oil from motor to permit checking for external leaks.

2. If motor contains a shuttle, replace the hex. plugs on the shuttle block with hex. socket plugs prior to running test. After checking leakage, replace plugs. Adjust system pressure for 1000 PSI (69 bar). Check and record system flow and case drain flow both directions of rotation. Monitor loop temperature.

24 Series	30 Series
Maximum System Flow 194 GPM (734 l/m)	241 GPM (912 l/m)
Maximum Case Drain Flow 3 GPM (11.3 l/m)	4 GPM (15 l/m)

3. Break in motor as follows: Run break in for both directions of rotation.

10 minutes at 1000 PSI (69 bar)
10 minutes at 2500 PSI (172 bar)
10 minutes at 5000 PSI (345 bar)

4. Adjust system pressure to 5000 PSI (345 bar). Check and record system flow and case drain flow both directions of rotation.

24	30
Minimum System Flow 180 GPM (680 l/m)	220 GPM (833 l/m)
Maximum Case Drain Flow 5.0 GPM (19 l/m)	6 GPM (23 l/m)

M 24 G - 2 N 1 D - 00- M 2 - X X X X X

Motor series

Displacements, max
24-24.6 in³/rev., 403 cc/rev.
30-30.6 in³/rev., 501.4 cc/rev.

F-Fixed w/o shuttle
G-Fixed displ. w/ shuttle

Shaft
SAE-F
2-Keyed
3-Splined

Shaft rotation
(viewed from shaft end)
N-Bi-directional

Fluid class
1-compatible w/Buna N
4-compatible w/EPR
5-compatible w/Viton

Design letter
(assigned by manufacturer)

Designates special

Shuttle Features
M * G
00-Without orifices
02-With orifices

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