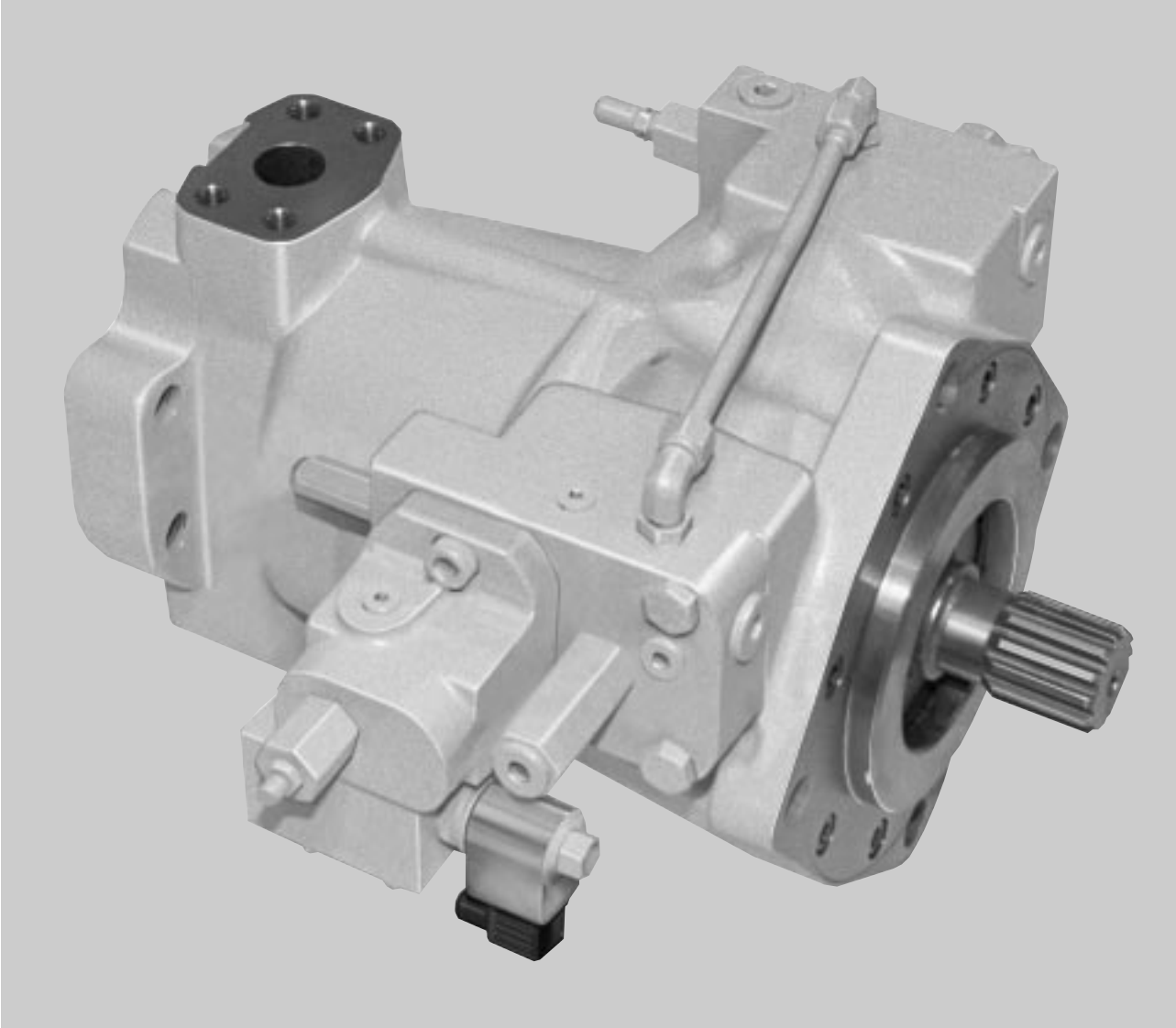
DENISON HYDRAULICS

Premier Series

Open Circuit Pump
Series P05

Service Information



Publ. LT2-00036-2 replaces S1-AM031 Revised 5/03

DENISON Hydraulics

Internet: http://www.denisonhydraulics.com E-mail: denison@ denisonhydraulics.com

DENISON Hydraulics

errata sheet

September 12, 1997

Title: Denison Hydraulics Premier Series P05, P09, P16, P080, P140, P260 Open Loop Pump Service Information

Reference: S1-AM031, S1-AM033, S1-AM022-A, S1-AM032, S1-AM034, S1-AM021-A

caution

The following corrections must be used in place of the original printed data:

Bulletin No.	Pump	Page	Item
S1-AM031	P05	19	add item 54, 0-ring, 671-00904, qty. 3
		23	SAE-D rear drive, item 1 should be 032-91282, item 2 should be 032-91364, item 4 should be 671-00163. ISO 180B4HW rear drive, item 2 should be 032-91389, Adapter kit should be S22-15740
S1-AM033	P09	24	SAE-D rear drive, item 2 should be 032-91364.
S1-AM022-A	P16	24	SAE-D rear drive, item 2 should be 032-91364, item 3 should be 363-16250 SAE-E rear drive, item 3 should be 363-16250. ISO 250 rear drive, item 4 should be 671-00272
S1-AM032	P080	18	item 6 should be 032-92083, item 9 should be 361-10204-8, qty 12.
		19	item 29 should be 447-00032.
		23	SAE-D rear drive, item 1 should be 032-91282, item 2 should be 032-91364, item 4 should be 671-00163. ISO 180B4HW rear drive, item 2 should be 032-91389.Adapter kit should be S22-15740
S1-AM034	P140	3	hydraulic stroker signal pressure, 0 displacement 3,4 bar hydraulic stroker signal pressure, full displacement 15,9 bar handwheel turns, full to zero stroke, 8.1 turns torque to turn handwheel @ 70 bar, 15 Nm torque to turn handwheel @ 500 bar, 32 Nm torque to turn rotary servo shaft, 2,3 Nm maximum case pressure (continuous) 1,7 bar Fluid connections port C1, C2, 1/4 BSPP, Port D, D1, 1 1/2 BSPP, Port LS 1/4 BSPP, Port X, 3/8 BSPP
		24	SAE-D rear drive, item 2 should be 032-91364.
S1-AM021-A	P260	19	Item 41 should be 447-01004-2 ISO 160, 200 and 250 rear drive, item 3 should be 363-16250 ISO 250 rear drive, item 4 should be 671-00272
		24	SAE-D rear drive, item 2 should be 032-91364

DENISON HYDRAULICS Inc.
14249 Industrial Parkway
Marysville, OH 43040
USA

Telephone 937 644 3915
Fax 937-642 3738
E Mail denison@denisonhydraulics.com
Internet http://www.denisonhydraulics.com

CONTENTS

*seal kit (complete, includes all controls)----S22-15646

Note: Throughout this bulletin, metric dimensions decimal point is designated by a period.

TYPICAL CHARACTERISTICS

Specification	Term	P05
• displacement at max. angle	in^3/rev.	4.9
	cm^3/rev	80.3
• pressure continuous	psi	6000
	bar	420
• pressure intermittent (not to exceed 6 sec./minute)	psi	7250
	bar	500
• speed, @ atmospheric inlet	rpm	2550
max. with boost	rpm	3200
• rotating inertia	lbs/in^2	65
	$kg.m^2$	0.019
• compensator response off-stroke, at 5000 psi 345 bar	sec.	0.060
on-stroke	sec.	0.110
• compensator adjustment	psi/turn	2000
	bar/turn	138
• minimum servo pressure for max. rated system pressure	psi	700
	bar	48.3
• minimum compensating pressure (comp, torque limiter,	psi	250
and load sensing controls)	bar	17.2
• minimum compensator override pressure at 700 psi 48	psi	1350
bar servo pressure (servo, electric & hyd. stroker)	bar	93
• typ. servo & stroker response @ 700 psi 48 bar servo	sec.	<0.35
• servo flow required for this response (E, H, R10 controls)	in^3/min.	693
	l/min.	11.4
• servo flow required for this response (*1J, *1K, *1P con-	in^3/min.	924
trols)	l/min	15.2
• maximum servo pressure	psi	1500
	bar	103
• electric stroker nominal coil resistance (24v. coil)	ohms	41
control amps, 0 displacement	ma	165
control amps, full displacement	ma	340
• electric stroker nominal coil resistance (12v. coil)	ohms	10
control amps, 0 displacement	ma	330
control amps, full displacement	ma	680
• electric connector	DIN	43650 type AF
• hydraulic stroker control pressure, 0 displacement	psi	50
	bar	3.45
• hydraulic stroker control pressure, full displacement	psi	210
	bar	14.5
• handwheel turns, full to zero stroke	turns	9
• torque to turn handwheel @ 1000 psi 70 bar	in-lbs	75
	Nm	9
• torque to turn handwheel @ 7250 psi 500 bar	in-lbs	175
	Nm	20
• torque to turn rotary servo shaft	in-lbs	20
	Nm	2.3
• maximum/minimum case pressure (continuous)	psi	25/3
	bar	1.7/0.2
• maximum/minimum case pressure (intermittent)	psi	50/3
	bar	3.4/0.2
• input mounting-4 bolt flange	SAE	152-4 (D)
• input shaft- keyed	SAE	44-1 (D)
• input shaft- splined	SAE	44-4 (D)
• weight	pounds	156
	kg.	71

FLUID CONNECTIONS

• port A (inlet)	in.	2 1/2
SAE code 61 split flange	mm	63.5
• port B (system)	in.	1 1/4
SAE code 62 split flange	mm	31.8
• ports AG, DG (gage conn's)	SAE	-4
• port BG (outlet gage)	SAE	-4
• port BG1 (outlet gage)	SAE	-6
• port C1, C2 (cylinder gage ports)	SAE	-4
• port D, D1 (case drains)	SAE	-12
• port E (electric stroker control pressure inlet)	SAE	-4
• port H (hydraulic stroker control pressure inlet)	SAE	-4
• port LS (load sensing port)	SAE	-4
• port V (compensator vent)	SAE	-8
• port X (servo, electric & hydraulic stroker servo inlet)	SAE	-6

GENERAL

The **DENISON HYDRAULICS** Premier Series is a variable displacement open loop axial piston pump with advance pumping and control concepts.

This manual covers complete disassembly and re-assembly, as well as rework limits and test procedures. Before proceeding with the disassembly or assembly of any unit, this publication should be read carefully to insure proper procedures. Drawings are provided for the special tools that will be required.

DESCRIPTION

The use of a rocker cam to control the pump displacement in the P05, provides a small package size, less noise, and permits fast compensator response. A new rotating group design with angled barrel ports and the use of a barrel bearing, gives the P05 a distinct advantage of superior inlet conditions. The solid piston design reduces trapped oil volume which improves efficiency. The pressure compensator is a standard control for the P05. Additional optional controls are also available.

MOUNTING

This pump is designed to operate in any position. The mounting hub and four bolt mounting flange are in full conformance with SAE standards. The pump shaft must be in alignment with the shaft of the prime mover and should be checked with a dial indicator. The mounting pad or adapter into which the pump pilots must be concentric with the pump 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 .006", 0.15 mm TIR. Angular misalignment at the male and female spline axis must be less than 0.001 in. per in. radius, 0.001 mm per mm. The coupling interface must be lubricated. **DENISON HYDRAULICS** recommends lithium molydisulfide or similar grease. The female coupling should be hardened to 27-34 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", 0.75-1.00 mm at 45° to clear radii that exist in the keyway.

SHAFT BEARING LIFE

speed	***shaft load**		**case pressure**		**B-10 life**
rpm	lbs	N	psi	bar	hours
1000	0	0	0	0	383,000
1000	0	0	50	3.4	186,000
1000	1000	4450	0	0	20,000
1000	1000	4450	50	3.4	15,000
1200	0	0	0	0	319,000
1200	0	0	50	3.4	152,000
1200	1000	4450	0	0	17,000
1200	1000	4450	50	3.4	12,000
1500	0	0	0	0	266,000
1500	0	0	50	3.4	124,000
1500	1000	4450	0	0	14,000
1500	1000	4450	50	3.4	10,000
1800	0	0	0	0	212,000
1800	0	0	50	3.4	103,000
1800	1000	4450	0	0	11,000
1800	1000	4450	50	3.4	8,000

*radial load at center of key

PORTING INFORMATION

Connect inlet and outlet lines to the port block of the pump. Connect case drain line to housing.

The fluid connections are:

Inlet: SAE Code 61, 2-1/2", 63.5 mm, 4 bolt split flange.
Outlet: SAE Code 62, 1-1/4", 31.8 mm, 4 bolt split flange.
Case Drain: SAE-12 straight thread
Gage: (inlet, outlet, case, cylinder) SAE straight thread
(outlet BG1) SAE-6 straight thread.

The maximum case pressure is 25 psi, 1.7 bar continuous, 50 psi, 3.4 bar intermittent. Case pressures must never exceed inlet pressure by more than 25 psi, 1.7 bar. When connecting case drain line make certain that drain plumbing passes above highest point of the pump before returning to the reservoir, if not, install a 5 psi, 0.3 bar case pressure check valve to be certain the case is filled with oil at all times.

The case leakage line must be of sufficient size to prevent back pressure in excess of 25 psi, 1.7 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

PORTING INFORMATION
(continued)

of adequate size and strength to assure free flow through the pump. An undersize inlet line will prevent the pump from reaching full speed and torque. An undersized outlet 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 pump 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 pump. Make sure the entire hydraulic system is free of dirt, lint, scale, or other foreign material.

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

INLET CONDITIONS AT SEA LEVEL

SPEED	GAGE PRESSURE				ABS. PRESSURE	
rpm	psig	bar	in. hg	mm hg	psi	bar
1200	-3	-0.2	-6.1	-155	11.7	0.8
1800	-3	-0.2	-6.1	-155	11.7	0.8
2100	-3	-0.2	-6.1	-155	11.7	0.8
2550	0	0	0	0	14.7	1.01
3200	8.5	.59	17.3	440	23.2	1.60

NOTE: Inlet conditions apply for petroleum base fluids. Contact **DENISON HYDRAULICS** for inlet conditions with other fluids.

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-O.

VISCOSITY

Max at cold start -7500 SUS, 1600 cSt
(at low pressure and, if possible, 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^{o} F, 82^{o} 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 fire-resistant fluids

See **DENISON HYDRAULICS** bulletin **SPO-AM305** for more information

MAINTENANCE

This pump 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 pump does not operate properly, check the troubleshooting 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 adding to the system, and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8 (class 9 for 15 micron and smaller). This approximately corresponds to ISO 17/14. This fluid cleanliness level 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

- Read and understand the instruction manual. Identify components and their function.
- Visually inspect components and lines for possible damage.

START UP PROCEDURE FOR NEW INSTALLATION
(continued)

- Check reservoir for cleanliness. Drain and clean as required
- Check fluid level and fill as required with filtered fluid at least as clean as that recommended. Fill pump case with clean oil prior to starting.
- Check alignment of drive.
- Check oil cooler and activate it, if included in circuit. Check fluid temperature
- Reduce pressure settings of compensator and relief valve. Make sure accurate pressure readings can be made at appropriate places.
- If solenoids in system. check for actuation.
- Start pump drive. Make sure pump fills properly.
- Bleed system of air. Recheck fluid level.
- Cycle unloaded machine at low pressure and observe actuation (at low speed, if possible).
- Increase pressure settings gradually in steps. Check for leaks in all lines especially in pump and motor inlet lines.
- Make correct pressure adjustments.
- Gradually increase speed. Be alert for trouble as indicated by changes in sounds, system shocks and air in fluid.
- Equipment is operational.

COMPARISON OF SOLID CONTAMINATION CLASSIFICATION SYSTEMS

NATIONAL AERONAUTICS STANDARD (NAS) 1638

		class													
		00	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
particle size range	**5-15mm**	125	250	500	1000	2000	4000	8000	16000	32000	64000	128000	256000	512000	1024000
	15-25mm	22	44	89	178	356	712	1425	2850	5700	11400	22800	45600	91200	182400
	25-50mm	4	8	16	32	63	126	253	506	1012	2025	4050	8100	16200	32400
	50-100mm	1	2	3	6	11	22	45	90	180	360	720	1440	2880	5760
	>100mm	0	0	1	1	2	4	8	16	32	64	128	256	512	1024
maximum particles	>5mm	152	304	609	1217	2432	4864	9731	19462	38924	77849	155698	311396	622792	1245584
	>15mm	27	54	109	217	432	864	1731	3462	6924	13849	27698	55396	110792	221584

ISO:DIS 4406; SAE J1165

		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	**>5mm**	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000	1000000	2000000	4000000
	>15mm	32	64	130	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000

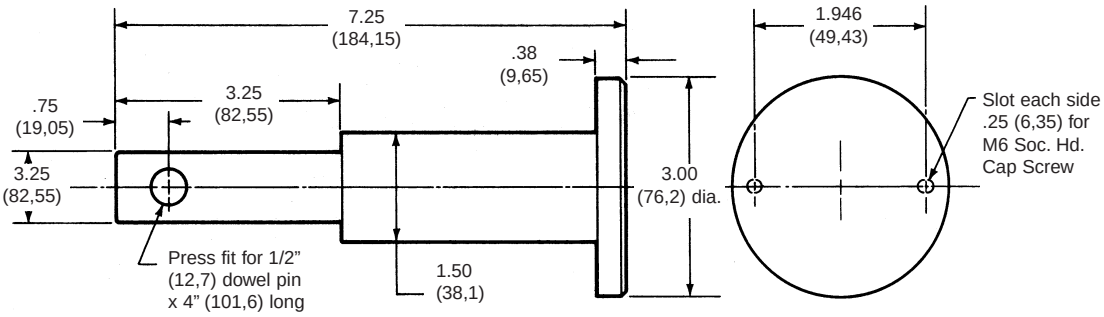
NOTES: All measurements are for a 100 ml sample size.

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 pump	air in fluid	leak in suction line 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 rotating group	fluid too cold fluid too viscous fluid too heavy shaft speed too high suction line too small suction strainer too small suction strainer too dirty 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

TROUBLESHOOTING
(continued)

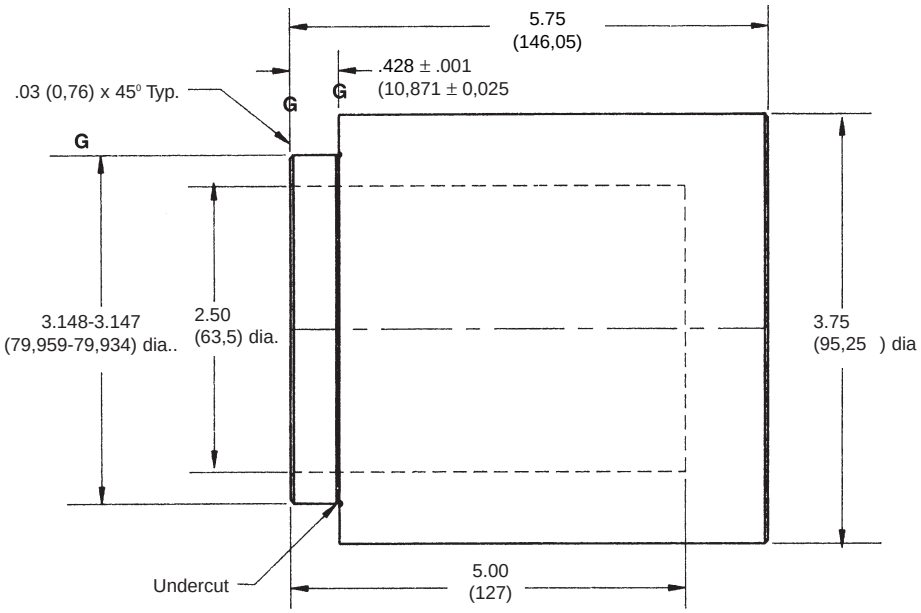
effect of trouble	possible cause	fault which needs remedy
noisy pump (continued)	mechanical fault in pump	piston and shoe looseness or failure bearing failure incorrect port plate selection or index eroded or worn parts in the displacement control
erosion on barrel ports and port plate	air in fluid	see noisy pump above
	cavitation	see noisy pump above
high wear in pump	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
	unwanted water in fluid	condensation faulty breather/strainer heat exchanger leakage faulty clean-up practice water in makeup fluid
pressure shocks	cogging load	mechanical considerations
	worn relief valve	needed repairs
	worn compensator	needed repairs
	slow response in check valves	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	re-check pump hold-down, rotating group, drain pressure
heating of fluid	excessive pump 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
	compensator	set too high (compared to relief) worn parts
	pump too large for fluid needs	select smaller pump displacement
	heat exchanger	water turned off or too little flow water too hot fan clogged or restricted efficiency reduced by mud or scale deposts intermittent hydraulic fluid flow
	reservoir	too little fluid improper baffles insulating air blanket that prevents heat rejection heat pickup from adjacent equipment



T-1

Disassembly and Assembly Tool

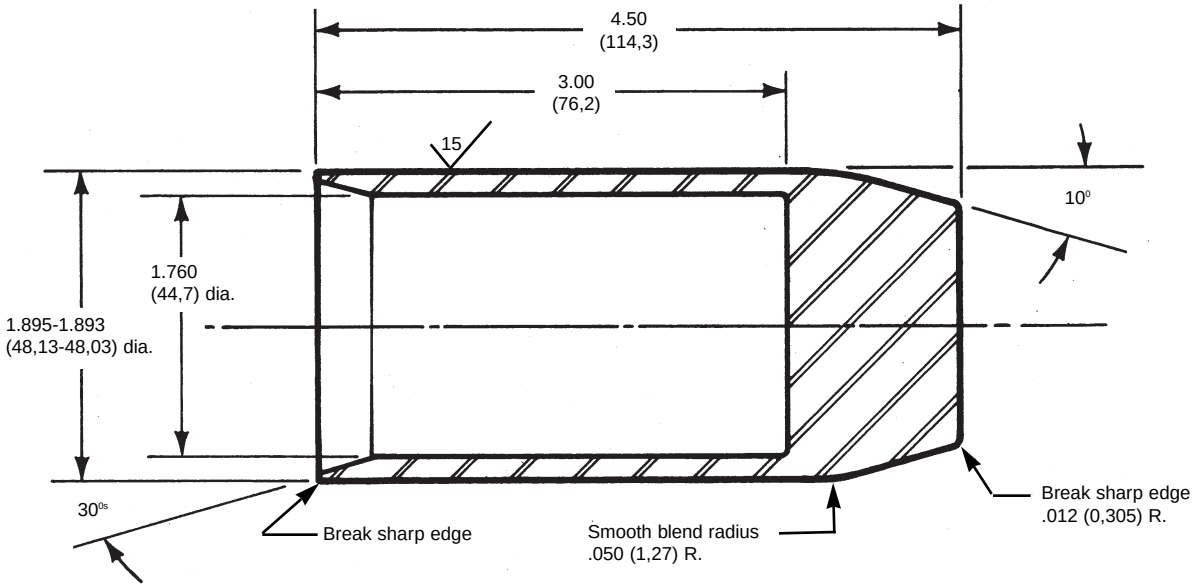
Removal and assembly of Barrel & Inner race assem-



T-2

Assembly Tool

Tool used to install seal retainer and shaft bearing into rocker cradle



T-3

Assembly Tool

Tool used to install shaft seal on shaft

GENERAL

This section contains complete pump disassembly procedures for a P05 pump with pressure compensator control and a standard maximum volume adjusting screw.

Disassemble only as far as necessary to replace or repair worn parts.

DISASSEMBLY

The procedures outlined are for a P05 pump without rear drive option. If the pump has a rear drive, the mounting adapter and coupling must be removed prior to pump disassembly. See Figure 13.

Remove case drain plug (46) and drain any oil that may be inside pump housing.

Clean outside surface of the pump before disassembly. Disassembly area should be clean. A suitable surface should be used capable of supporting the pump weight of 156 pounds, 71 Kg.

Refer to Figures 3 through 7 for part references.

Rest pump on port block so shaft is up.

See Figure 5. Adjust maximum volume screw CW so that piston (41) bottoms out in spring cap (31). This will place the pump at approximately zero stroke which is necessary for the removal of the pump shaft.

See Figure 6. Remove socket head cap screws (9) that secure rocker cradle assembly to the housing/port block (7).

Lift rocker cradle assembly from the housing. The 3/8-16 tapped hole in the end of the shaft should be used for lifting this assembly. The rocker cradle assembly is shown in Figure 10.

Remove snap ring (4) from rocker cradle (6).

Remove two screws (44) so that cam bearings (39) may be removed from rocker cradle.

Remove shaft (1), shaft bearing (3), and seal retainer (2) by supporting the face of the rocker cradle surface and pressing the end of the shaft that is opposite the end where the shaft bearing is located.

Remove O rings (5) and (8) from rocker cradle.

Remove the seal retainer (2) from the shaft.

Remove the shaft seal (13) from the seal retainer (2) if it is worn or damaged. If removal is necessary, seal must be pressed out of its seated position in the retainer.

Remove retaining ring (20) from shaft.

Press bearing (3) off shaft if necessary for replacement. Remove by pressing on bearing inner race.

See Figure 3. Remove two screws (26), two washers (33), clearance bearing (25), and two washers (32) from cam/bearing retainer (28).

See Figure 5. Adjust maximum volume screw CCW until piston (41) has bottomed out on control cap.

See Figures 5, 6 and 7. Remove control cap assembly (53) and spring cap (31) by removing eight hex head cap screws.

Remove spring (31-3), piston (31-1), O ring (36), O ring (31-5), and plug (31-6) from spring cap (31). Buckup snout (31-2) has been pressed into position and should not be removed unless worn or damaged.

See Figure 7. Remove all parts from compensator cap assembly (53) except the sleeve, & seat (10) which have been pressed into the cap. The cap and sleeve are assembly (1). If the sleeve is worn or damaged, cap and sleeve assembly (1) must be replaced. Remove seat (10) only if damaged. The sleeve inside diameter is machined to its final close tolerance dimension after it has been pressed into the compensator control cap.

The piston must be moved outward (away from pump center) in order to remove rocker cam assembly.

DISASSEMBLY
(continued)

Lift rocker cam (10) from pump. Slide link, pistons and shoes, wear plate, and hold-down parts will be removed as a part of the rocker cam assembly. Rocker cam assembly is shown in Figure 9.

Remove slide link (40). Remove retaining ring (21), thrust washer (24), piston, shoe & retainer assembly (17) and wear plate (22). The pin that accepts the slide link has been pressed into the rocker cam and should not be removed. The rocker cam assembly is now disassembled.

See Figure 5. Remove four screws (34), and two cam/bearing retainers (28).

Remove four O rings (27) from cam/bearing retainers.

See Figure 6. Remove Belleville washers (18) and barrel stop (19) from barrel.

Attach tool T-1 to barrel and sleeve assembly (14-1). Two M6 screws are required.

Lift barrel from port plate and remove from housing.

See Figure 8. The inner race of barrel bearing (11) has a light press fit with barrel and sleeve assembly (14-1). Do not remove the inner race unless bearing (11) needs to be replaced. If replacement is necessary, remove seven socket head cap screws (12). Replace with M-8 soc hd cap screws of sufficient length to permit race to be pressed from barrel. Set assembly so that it is resting on the extended screws. Press barrel away from inner race. Care must be taken that barrel face is not damaged during this disassembly.

See Figure 3. Remove port plate (14-2) from port block.

Remove port plate alignment pin (16), figure 4, from port block.

The outer race of barrel bearing (11) should be removed from housing if worn, damaged or if closer inspection is needed. A light force from the back side of the bearing will be required to free it from the housing. A bearing puller should be used for the outer race removal.

REWORK LIMITS OF WEAR PARTS

item	maximum rework from original dimension	minimum dimension after rework
wear plate	.005", 0.127 mm	.184", 4.674 mm
shoe retainer face	.005", 0.127 mm	.289", 7.341 mm
piston shoe face(pocket	*	.302", 7.67 mm

*shoe face pocket depth must be .004", .010mm minimum

IMPORTANT INSTRUCTIONS

The wear plate finish must be 10µin., 0.25 µm min. , flat within .0005", 0.0127 mm and parallel to the backside within .001", 0.0254 mm total indicator reading (T.I.R.).

The shoe retainer wear face finish must be 32µin. min., 0.80 µm, flat within .0015", 0.0381 mm (must not be convex).

The piston shoe wear face finish must be 45µin. min., 1.125 µm, and must be lapped in a set with the retainer plate. All shoe sole thicknesses to be within .001", 0.025 mm after lapping. The maximum permissible shoe and piston axial looseness is .010", 0.25 mm.

BARREL AND PORT PLATE REWORK

The barrel face and port plate may be reworked by lapping to remove scratches. The barrel face is plated with bronze. The maximum stock removal is .010", 0.38 mm which is approximately one half the bronze plating. The barrel must NOT be used if any part of the bronze plating on the barrel face has been removed and the steel surface can be seen.

Use coarse lapping compound for initial lap then very fine compound to complete the rework.

See figure 1: The following lapping procedure is recommended:

(a) Supply post that is slightly smaller than the inside diameter of the port plate.

(b) Rest port plate on solid surface and insert post as shown.

(c) Apply coarse lapping compound to port plate.

BARREL AND PORT PLATE REWORK
(continued)

(d) Lower barrel over post onto the port plate.

(e) Rotate barrel by hand to lap port plate and barrel face surfaces.

(f) Clean parts then apply very fine lapping compound.

(g) Repeat d & e until all the surface cleans up.

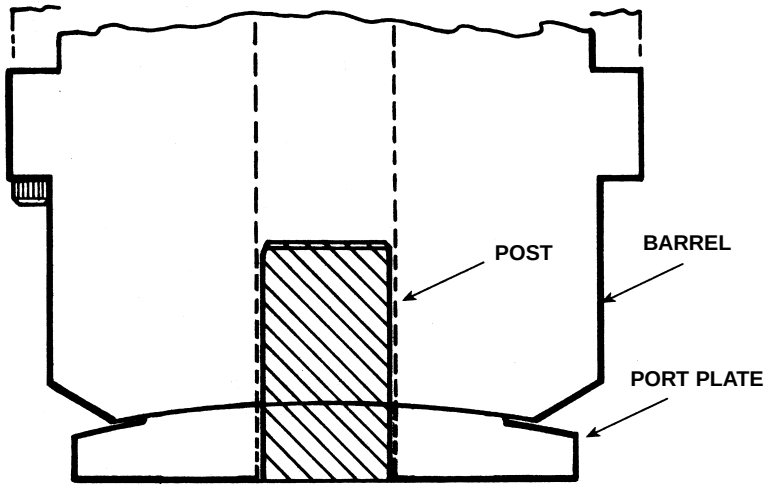


FIGURE 1 BARREL AND PORT PLATE LAP PROCEDURE

SHAFT SEAL REPLACEMENT

See figure 3. Press worn or damaged seal from seal retainer.

Clean Loctite® "Master Gasket" from seal retainer.

Install new shaft seal by reapplying "Master Gasket" to retainer and pressing shaft seal in retainer.

SEAL KIT

The shaft seal and all "O" rings necessary for total seal replacement may be obtained by ordering Seal Kit Part No. S22-15646-0. These seals are suitable for petroleum base fluids. For fire resistant fluids contact **DENISON HYDRAULICS**, Inc. or their authorized distributors to obtain the appropriate seal kit number.

SHAFT ASSEMBLIES

The following part numbers include shaft, key as applicable, shaft bearing and shaft seal:

description	part no.
Standard keyed shaft assembly	S22-15337
Rear drive keyed shaft assembly	S22-15339
Standard splined shaft assembly	S22-15338
Rear drive splined shaft assembly	S22-15340

ASSEMBLY

This section contains complete assembly procedures for a P05 pump with pressure compensator control. The compensator with maximum volume screw adjustment is S22-15394. Depending on the extent of disassembly and repair, many steps in this section may not be applicable.

The assembly area should be clean and the environment such that foreign matter will not be introduced to the pump during assembly. All parts must be absolutely clean and free from rust, contamination, lint, or any other foreign matter. Critical surfaces must be free of dings or scratches. All "O" rings and seals must be clean and carefully examined for cuts or other damage before installation.

In the assembly procedures, occasional reference will be made to the use of lubricating oil for proper assembly. It is important that any oil used be compatible with the seals and fluid to be used in operation. Compatibility is also necessary for grease which should be used on all "O" rings to ensure proper assembly without damage. Several screws require a thread lock fluid for securely locking in position. When required use Loctite® #242 unless otherwise specified.

Refer to Figures 3 through 7: Place the smaller port block end of the housing (7) on a suitable surface capable of supporting the pump weight of 156 lbs., 71 Kgs.
Install plugs (38) with "O" rings into port block. Torque to 18 ft-lb, 24 Nm. Install plugs

ASSEMBLY
(continued)

(58) with "O" rings into port block. Torque to 11 ft-lb, 15 Nm).

Install pin (16 figure 4) into port block.

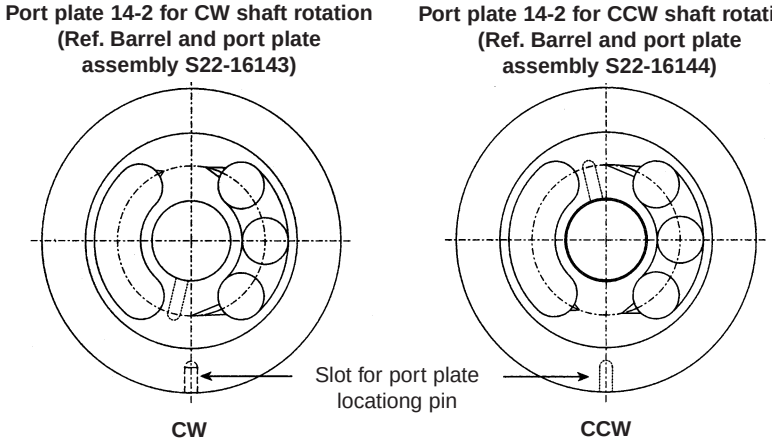


FIGURE 2
(port plates)

See Figure 3. Install port plate (14-2) on port block, engaging pin (16). Insure that correct barrel and port plate assembly is being used for shaft rotation specified. **See Figure 2.**
Press outer race of barrel bearing (11) into housing (7) figure 3. The race may also be installed by tapping into position with a brass rod. Care must be taken to tap only the race and not the rollers or roller retainer. **See Figure 8**. Assemble inner bearing race (11) to barrel and sleeve assembly (14-1).

Oil face of port plate and inner bearing race. Carefully lower barrel and inner race assembly into housing with tool T-1. Two M6 screws are required to attach T-1 to barrel. Inner bearing race must first be engaged into rollers of outer bearing race. Barrel may then be lowered until it has seated on port plate.

See Figures 3 and 5. Install "O" rings (27) to cam/bearing retainers (28). Assemble cam/bearing retainers to housing. Secure to housing with screws (34) using Loctite® #242. Torque to 84 in.-lb., 9.5 Nm.

Assemble piston rings (36) and (57) to control piston (41). Place control piston (41) into the housing bore that will be used to accept the piston caps. The long end of the piston (the larger diameter for the stroker piston) must be positioned on the bottom as shown in figure 5 for CW shaft rotation. For CCW rotation, the long end of the piston would be on the top. The piston must be moved outward (away from pump center) so that clearance will be provided for installing the rocker cam assembly.

Place Belleville washers (18) on barrel as shown in Figure 3. They must be assembled exactly as shown to obtain correct barrel holddown force and insure proper pump operation. Place barrel stop (19) on Belleville washers as shown in Figure 3. Center the washers and the stop on barrel.

The rocker cam assembly must next be completed. Assemble per Figure 9.

Oil barrel bores before installing rocker cam assembly. Lower rocker cam assembly into the pump housing with the slide link positioned so it will engage into the control piston (41). The seven pistons (17) must first be engaged into the barrel bores. Next the slide link (40) must engage into the control piston (41). Continue lowering rocker cam assembly until it is seated on cam/bearing stops (28).

Assemble clearance bearing (25) to cam/bearing retainer (28) using two screws (26), two washers (33) and two washers (32). Move rocker cam to the right until it is securely against stop. Set clearance between clearance bearing (25) and rocker cam at .006", 0.15 mm. Apply Loctite® to screws (26) and torque to 6 ft-lb, 8 Nm maintaining the .006", 0.15 mm clearance.

For pumps with compensator control, assemble compensator control (53) as shown in Figure 7. The cap subassembly (1) contains a sleeve that is pressed into position and machined to its final inside diameter. Seat (10) must be assembled first. Press into bore and securely seat. Lubricate lands on spool (18) and install into sleeve. All other parts must be assembled as shown in Figure 7. Compensator pressure adjustment screw (25) and differential adjustment screw (3) should be backed out so that no force is applied to springs. These adjustments will be made during pump testing. Torque on

plug (12) is 90 ft-lb, 122 Nm. Torque on plug (21) is 50 ft-lb, 68 Nm. Torque on plug (28) is 11 ft-lb, 15 Nm.

Assemble maximum volume adjustment screw (24), O-ring (23), nut (20), O ring (13) and plug (12) to compensator cap (1).

Press buckup snout (31-3) into spring cap (31-4). Assemble spring (31-2), dowel pin (31-1), Avseal plug (31-7), O ring (31-5) and plug (31-6) to spring cap (31-4) as shown. Torque plug (31-6) to 140 ft-lb, 190 Nm.

The compensator cap and spring cap must be positioned on the housing for either CW or CCW pump rotation. See Figure 12 for correct orientation. The control piston (41) was assembled previously for the correct pump rotation. Install eight hex head cap screws (31-8 and item30 fig. 7) into caps and torque to housing with 75 ft-lb, 102 Nm.

Adjust maximum stop screw (24 figure 5) CW until piston (41) bottoms out on spring cap (31) This will place the rocker cam at approximately zero stroke and provide clearance for the shaft installation.

The rocker cradle assembly must next be completed. See Figures 10 and 11 for assembly.

See Figure 3. Center Belleville washers and barrel stop. Lower rocker cradle assembly into pump housing with the step in the rocker cradle correctly positioned so that clearance is provided for slide link (40). The 3/8-16 threaded hole in the end of the shaft should be used to support the assembly. The shaft spline must first engage the splined barrel stop (19). It must then pass Belleville washers (18) and then engage the barrel spline. The assembly will then come to rest on the rocker cam.

See figure 5. Adjust maximum volume screw (24 figure 7) CCW until piston (41) bottoms out in control cap (1).

See figure 4. Install socket head cap screws (9) as shown. Torque to 30 ft-lb, 41 Nm. Install case drain plugs (42) and (46).

If the pump has a rear drive feature, assemble coupling and adapter as shown in Figure 13.

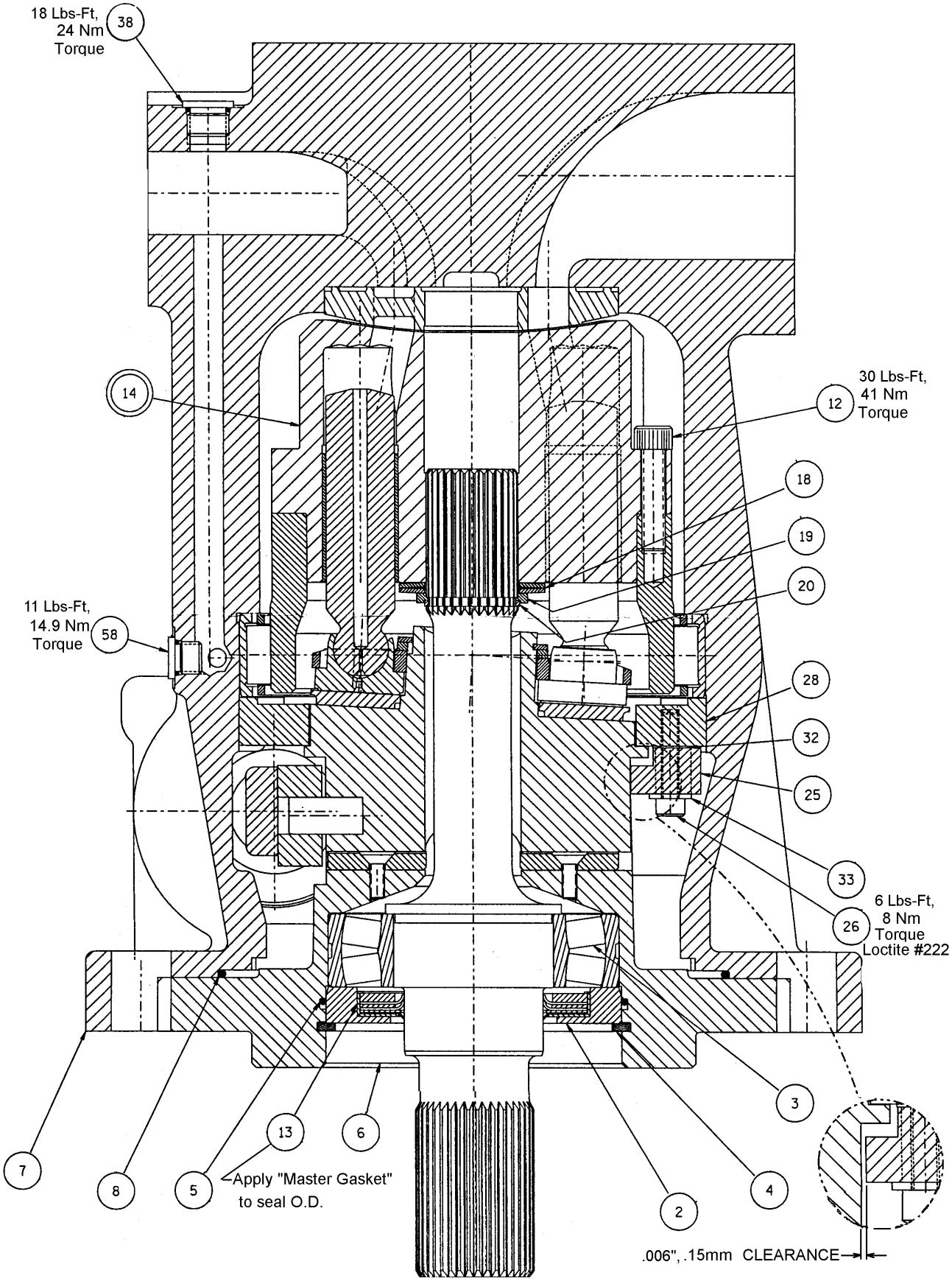


FIGURE 3
(SD-01635)

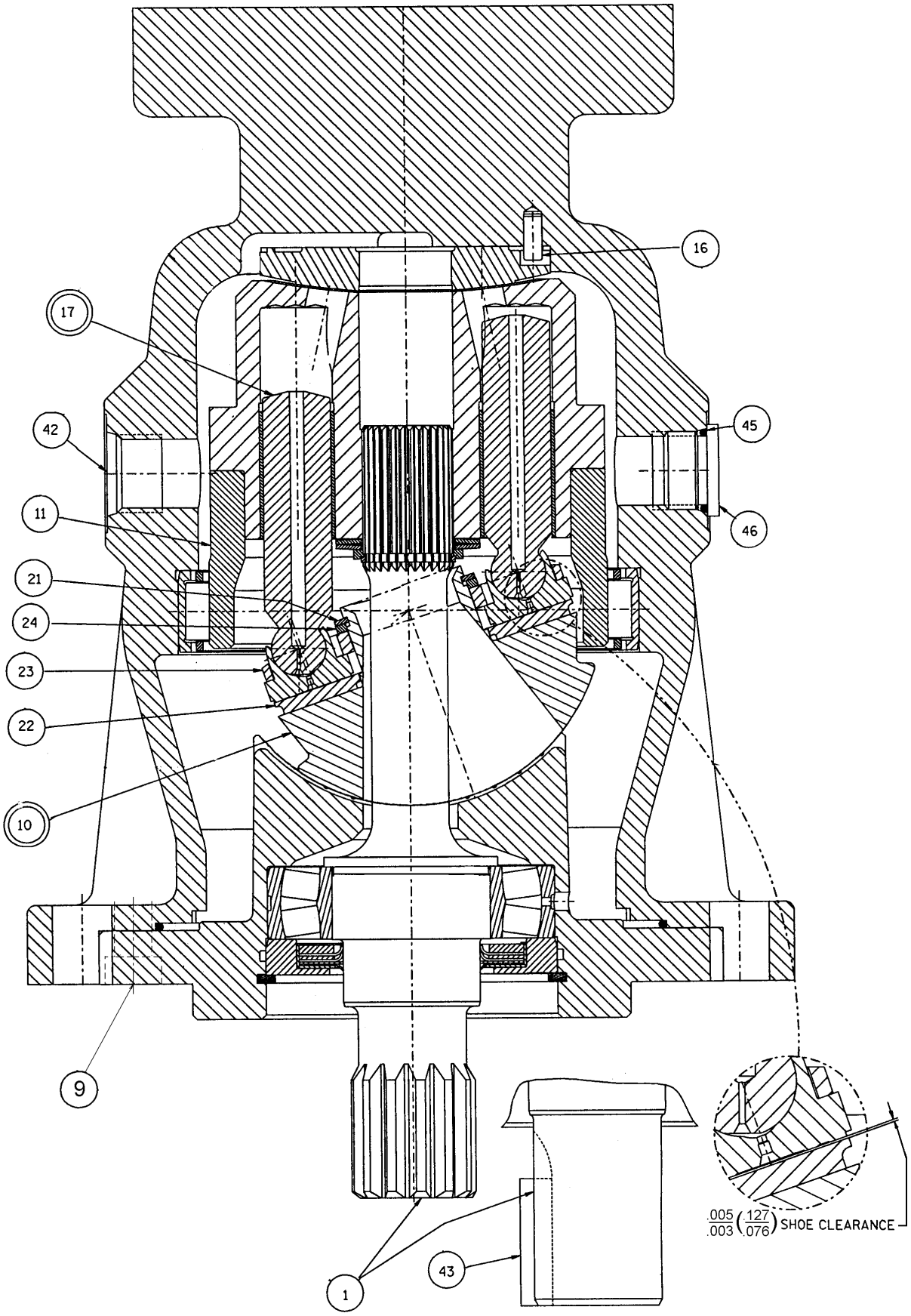


FIGURE 4
(SD-01635)

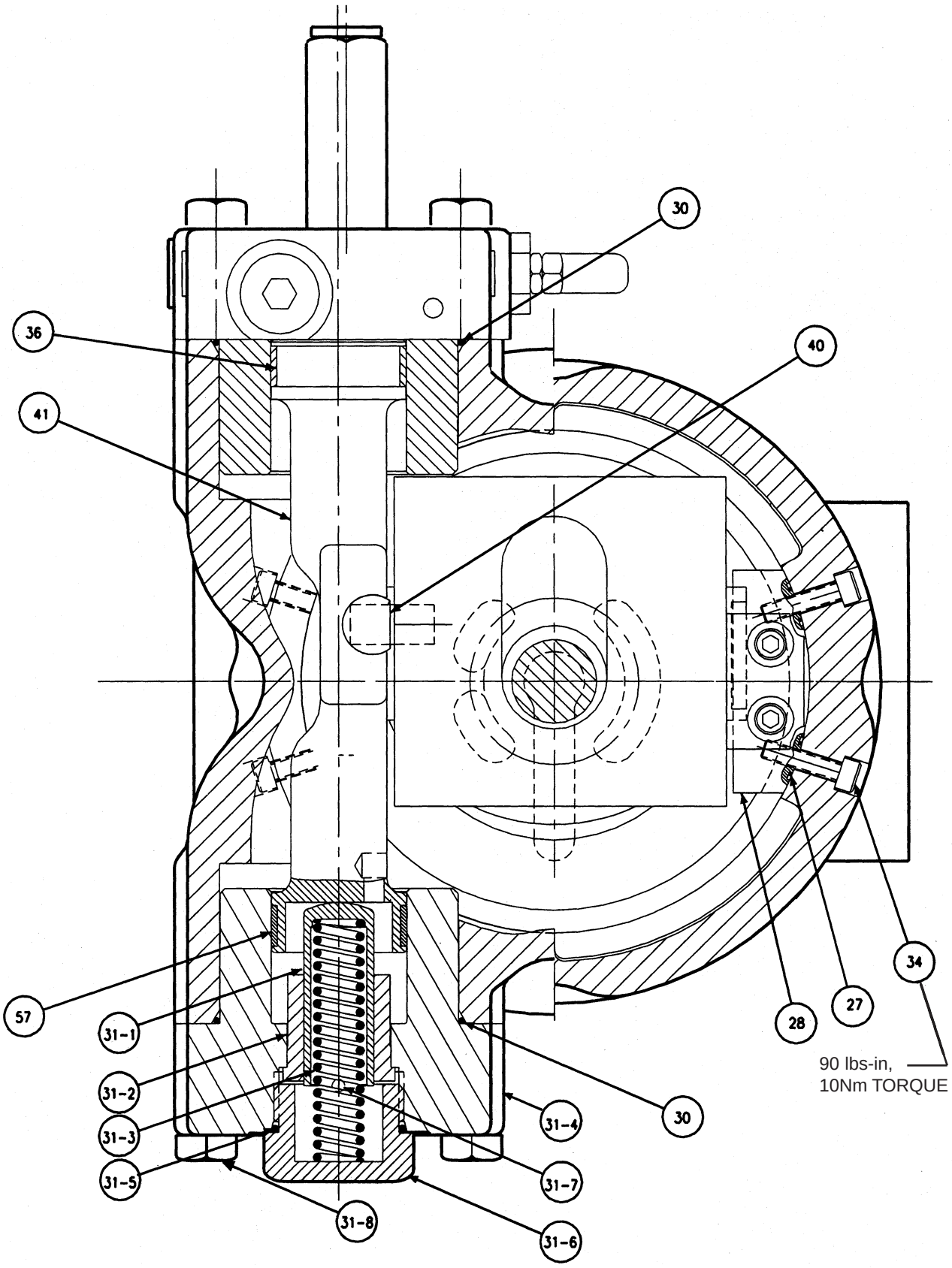


FIGURE 5
(SD-01635)

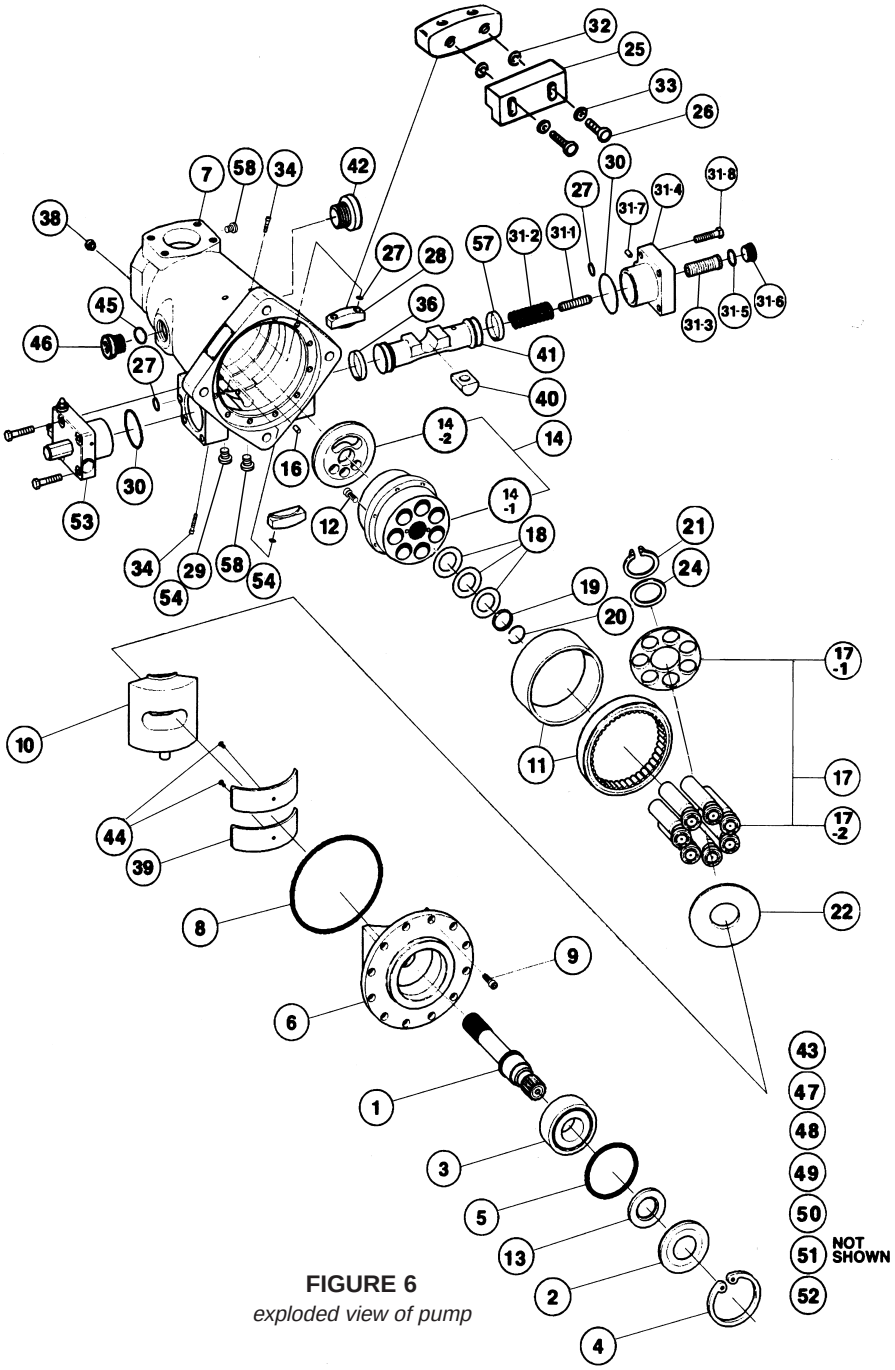


FIGURE 6
exploded view of pump

PARTS LIST FOR SD-01635

item	description	part no.	qty.
1	splined shaft, without rear drive	032-91828	1
	splined shaft, with rear drive	032-91851	
	keyed shaft, without rear drive	032-91829	
	keyed shaft, with rear drive	032-91852	
2	seal retainer	032-91835	1
3	shaft bearing	230-82216	1
4	retaining ring	356-65086	1
5	O-ring, 70 S-1 ARP 158	671-00155	1
6	rocker cradle	032-91818	1
7	housing/port block, without rear drive	032-91817	1
	housing/port block, with rear drive	032-91879	
8	O-ring, 70 S-1 ARP 268	671-00261	1
9	screw, SHC	361-11213-8	8
10	rocker cam/pin assembly	S22-15335	1
11	barrel bearing	032-91807	1
12	screw, SHC	361-10234-8	7
13	shaft seal	620-82080	1

item	description	part no.	qty.
14	CW barrel & port plate assembly, consisting of:	S22-16143	1
	(14-1) barrel & sleeve assembly	S22-15323	
	(14-2) CW port plate	032-92230	
	CCW barrel & port plate assembly, consisting of:	S22-16144	
	(14-1) barrel & sleeve assembly	S22-15323	
	(14-2) CCW port plate	032-91834	
15	O-ring, 90 S-1 ARP 906	691-00906	2
16	dowel pin	324-21610	1
17	piston shoe & retainer assembly, consisting of:	S22-15342	1
	(17-1) retainer, qty 1	032-91840	
	(17-2) piston/shoe assembly, qty 7	S22-15336	
18	Belleville washer	032-91827	2
19	barrel stop	032-91824	1
20	retaining ring	032-91825	1
21	retaining ring, white, .062", 1.57mm thk.	032-91853	1
	retaining ring, red, .064", 1.63mm thk.	032-91854	
	retaining ring, green, .067," 1.70mm thk.	032-91855	
	retaining ring, yellow, .069", 1.75mm thk.	032-91856	
	retaining ring, blue, .071", 1.80mm thk.	032-91857	
22	wear plate	032-91826	1
24	thrust washer	032-91830	1
25	clearance bearing	032-91602	1
26	screw, SHC	361-08704-8	2
27	O-ring, 90 S-1 ARP 013	691-00013	6
28	cam/bearing retainer	032-91815	2
29	plug, SAE-4	488-35061	1
30	O-ring, 70 S-1 ARP 151	671-00151	2
31	cap, consisting of:	S22-15447	1
	(31-1) plunger"	032-92202	(1)
	(31-2) spring	032-92205	(1)
	(31-3) snout, buckup	032-92203	(1)
	(31-4) control cap, spring	032-91832	(1)
	(31-5) O-ring, 90 S-1 ARP 920	691-00920	(1)
	(31-6) plug	032-92204	(1)
	(31-7) plug, avseal	447-00026	(1)
	(31-8) screw, HHC	363-12205-0	(4)
32	washer, internal shakeproof	348-10016	2
33	washer	345-10012	2
34	screw, SHC	361-08200	4
36	piston ring	032-91816	1
38	plug	488-35041	1
39	cam bearing	032-91808	2
40	slide link	032-91823	1
41	control piston (compensator, torque limiter)	032-91836	1
	control piston (servo, electric & hydraulic stroker)	032-91848	
42	shipping plug	449-00018	1
43	key (keyed shaft only)	035-71514	1
44	screw, FHSHCS	316-50001	2
45	O-ring, 90 S-1 ARP 912	691-00912	1
46	plug, SAE -12	488-35014	1
47	nameplate	034-30873	1
48	drive screw	320-10203	4
49	port cover, 2-1/2"	S21-11559	1
50	port cover, 1 1/4"	S21-11445	1
51	inspection tag	033-14292	1
52	fill tag	form 2435	1
53	compensator (C10 control) (figure 7)	S22-15394	1
57	piston ring (C, J, K and L controls)	032-91816	1
	piston ring (E, H, and R controls)	032-91811	
58	plug	488-35061	2

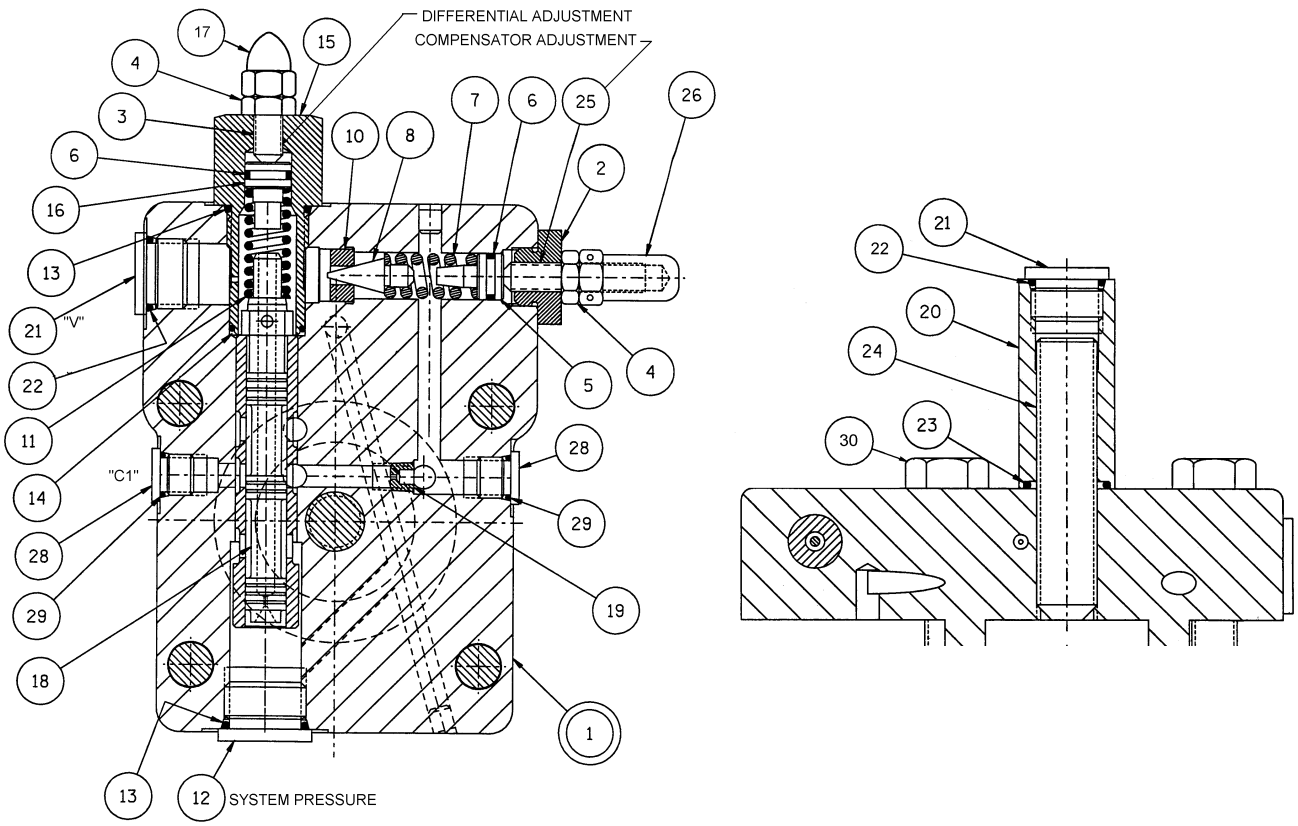


FIGURE 7
COMPENSATOR CONTROL, ITEM 53

PARTS LIST FOR COMPENSATOR S22-15394

item	description	part no.	qty.
1	cap-sleeve assembly	S22-15321	1
2	adjusting plug	032-91814	1
3	screw, SHSS	312-13160	1
4	nut	335-13100	2
5	seal piston	031-59367	1
6	O-ring, 90 S-1 ARP 012	691-00012	2
7	spring	032-91798	1
8	cone	036-12288	1
9	Avseal plug	447-00026	2
10	seat	036-11692	1
11	spring	033-71086	1
12	plug, SAE -10	488-35055	2
13	O-ring, 90 S-1 ARP 910	691-00910	3
14	O-ring, 90 S-1 ARP 017	691-00017	1
15	compensator plug	031-57368	1
16	seal piston	032-91305	1
17	acorn nut	327-25006	1
18	spool	032-59482	1
19	orifice plug (.047)	033-25528	1
20	nut, M16 hex	032-91822	1
21	plug, SAE -8	488-35018	1
22	O-ring, 90 S-1 ARP 908	691-00908	1
23	O-ring, 70 S-1 ARP 115	671-00115	1
24	screw, SHSS, M16 x 2 x 80mm lg.	311-50001	1
25	screw, SHSS	312-13180	1
26	acorn nut	036-33474	1
28	plug, SAE -4	488-35061	1
29	O-ring, 90 S-1 ARP 904	691-00904	1
30	screw, HHC M12 x 55	363-12205	4

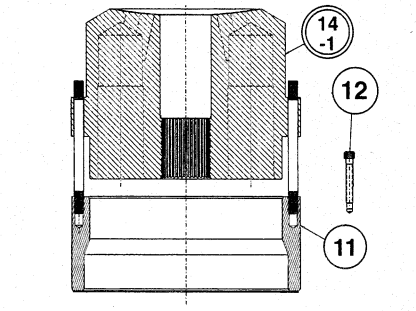


FIGURE 8

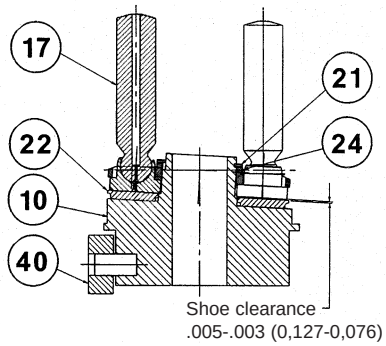


FIGURE 9

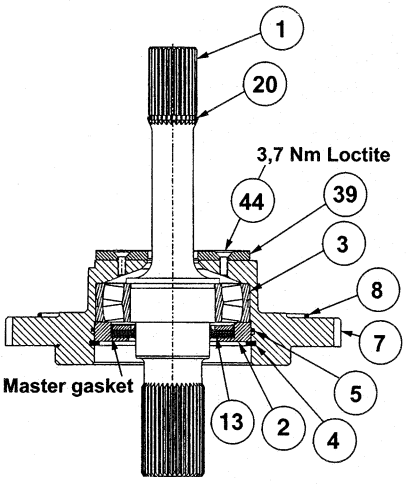


FIGURE 10

BARREL AND RACE ASSEMBLY

See figure 8. Thread seven M8 studs in inner race of barrel bearing (11) as shown.

Lower barrel and sleeve assembly (14-1) over studs and onto inner race. If inner race is heated to 150° F,. 65° C, barrel should slip into assembled position without force. If race is not heated, a light force may be required to seat barrel flange on inner race. Longer screws than the specified barrel/inner race screws (12) can be used for this purpose.

After barrel is seated properly, install seven screws (12) to secure barrel to inner race. Torque to 30 ft-lb, 40.7 Nm.

ROCKER CAM ASSEMBLY

See figure 9. Set rocker cam and pin assembly (10) on suitable surface protecting cylindrical rocker cam surfaces from damage during assembly.

Assemble wear plate (22) to rocker cam.

Assemble piston/shoe/retainer assembly (17) over snout on cam and against wear plate.

Install thrust washer (24) over center post.

Five different retaining rings (21) are available for the holddown assembly. Each ring is marked: white dot .062", 1.57 mm thick, red dot .064", 1.63 mm thick, green dot .067", 1.70 mm thick, yellow dot .069", 1.75 mm thick, and blue dot .071", 1.80 mm thick. Install the thickest ring (21) with the dot up, that will fit in the groove on the center post and allows a clearance of .003"-.005", 0.076-0.127 mm between the shoe and creep plate. A .003", 0.076 mm feeler gage must slip completely under any shoe, and a .005", 0.127 mm feeler gage must not slip under any shoe while grasping the piston and lifting tightly against the shoe retainer.

The piston and shoe assembly (17) must be free to rotate easily by hand. The assembly must be rotated through 360° to confirm there is no binding and that each shoe is always free in the retainer plate. Oil the assembly thoroughly.

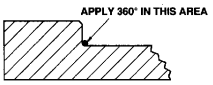
Install slide link (40) on rocker cam pin as shown.

ROCKER CRADLE ASSEMBLY

See figure 10. Assemble two cam bearings (39) to rocker cradle (6) with two screws (44). Apply Loctite to screws and torque to 33 in.-lb, 3.8 Nm. The cam bearings have lubricating groves where the rocker cam makes contact. The cam bearings must be oriented on the rocker cradle to correspond to the side-of-center that the rocker cam will be stroking for CW or CCW shaft rotation. See Figure 11.

Press bearing (3) on shaft (1). Press on inner race only.

Apply bead of Loctite® 44 Master Gasket to seal retainer (2) per following sketch:



Press shaft seal (13) into seal retainer (2).

Install shaft seal and retainer on shaft using Tool T-3 to protect seal.

Install "O" ring (5) in rocker cradle (6).

Press seal retainer and bearing and shaft assembly into bore of rocker cradle (6) using Tool T-2.

Install snap ring (4) to rocker cradle.

Install "O" ring (8) to rocker cradle.

Install retaining ring (20) on shaft.

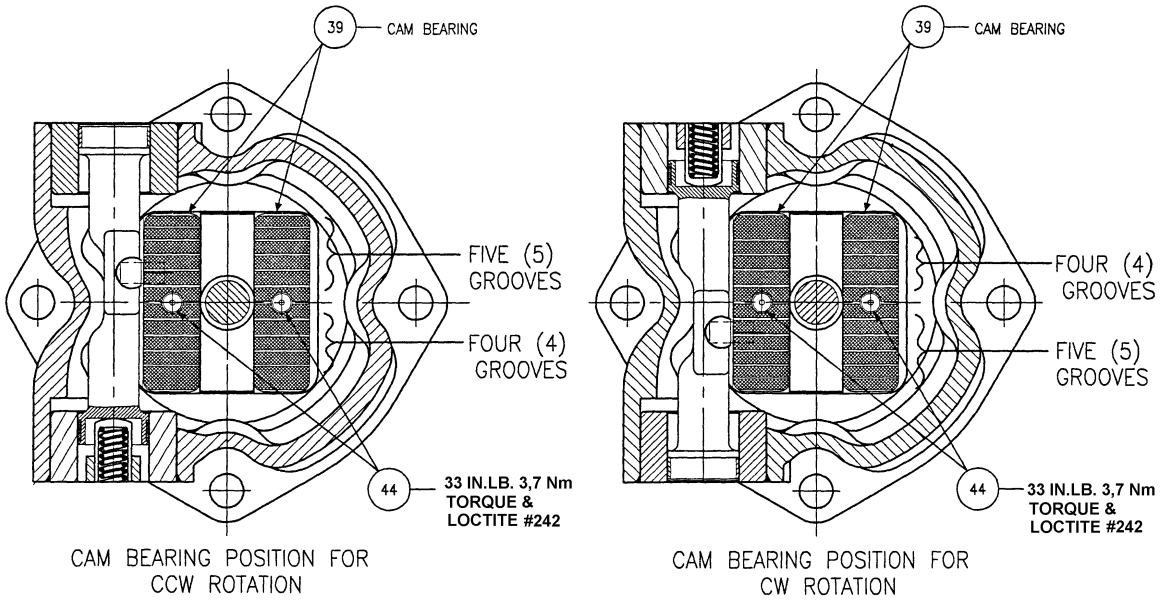


FIGURE 11
cam bearings/cradle orientation to housing

ROTATION CONVERSION

The following part changes and assembly changes are required for changing shaft rotation:

• A different barrel and port plate assembly will be required. The barrel and port plate are lapped assemblies, therefore barrel and sleeve assemblies, and port plates can not be ordered separately. For reference, the part numbers are as follows:

CW - Barrel and Port Plate Assembly S22- 16143
CCW - Barrel and Port Plate Assembly S22- 16144

• The control piston must be reversed so that it is oriented correctly with the control caps. See figure 11.

• The control caps are reversed as shown in Figure 12.

• The rocker cam bearings must be removed from the rocker cradle, rotated 180° from the original position and reinstalled on the rocker cradle. See Figure 11.

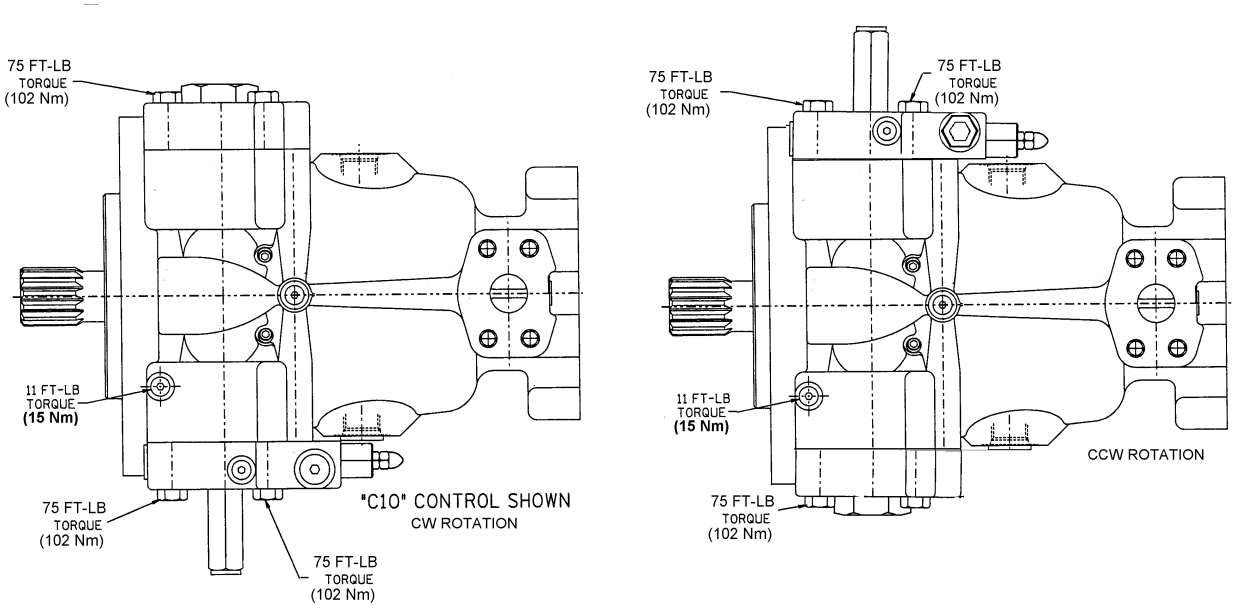


FIGURE 12
control orientation

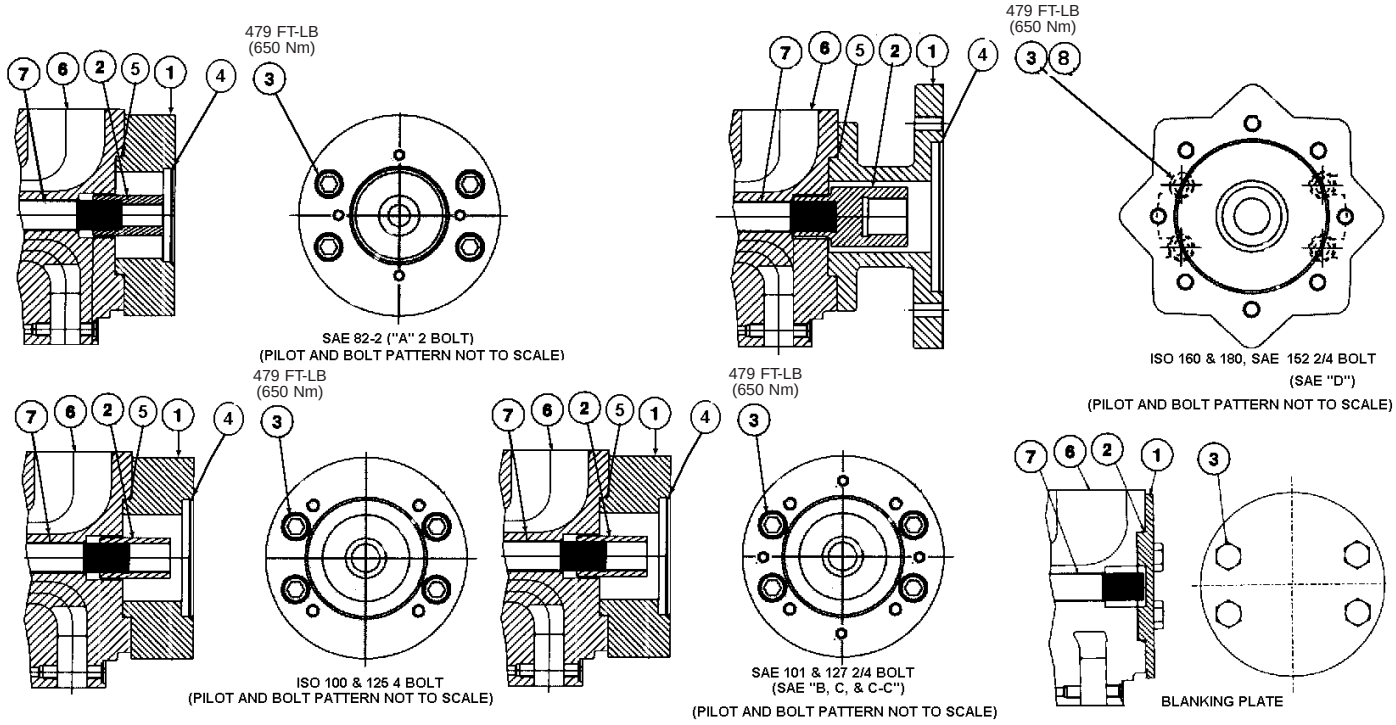


FIGURE 13
REAR DRIVE OPTIONS

PARTS LIST FOR FIGURE 13

SAE J744 REAR DRIVES

item	part	FLANGE SHAFT qty	SAE 82-2 16-4 (SAE-A)	SAE 101-2/4 22-4 (SAE-B)	SAE 101-2/4 25-4 (SAE-B-B)	SAE 127-2/4 32-4 (SAE-C)	SAE 127-2/4 38-4 (SAE-C-C)	SAE 152-2/4 44-4 (SAE-D)
1	adapter	1	032-91900	032-91309	032-91309	032-91308	032-91649	032-91387
2	coupling	1	032-91901	032-91361	032-91362	032-91363	032-91648	032-91388
3	screw	4	361-16304-8	361-16304-8	361-16304-8	361-16304-8	361-16304-8	363-16250
4	O-ring	1	671-00152	671-00155	671-00155	671-00159	671-00159	671-00178
5	O-ring	1	671-00159	671-00159	671-00159	671-00159	671-00159	671-00159
6	*housing	1	032-91879	032-91879	032-91879	032-91879	032-91879	032-91879
7	*shaft (keyed)	1	032-91852	032-91852	032-91852	032-91852	032-91852	032-91852
	*shaft (splined)		032-91851	032-91851	032-91851	032-91851	032-91851	032-91851
8	washer	4						350-10109
	adapter kit		S22-15372	S22-12867	S22-12868	S22-12869	S22-12920	S22-12870

ISO 3019-2 REAR DRIVES

item	part	FLANGE SHAFT qty	100 B4HW K25N	125 B4HW K32N	160 B4HW K40N	180 B4HW K40N
1	adapter	1	032-91383	032-91384	032-91385	032-92162
2	coupling	1	032-91391	032-91390	032-91389	032-91388
3	screw	4	361-16304-8	361-16304-8	363-16250	363-16250
4	O-ring	1	671-00155	671-00159	671-00164	671-00167
5	O-ring	1	671-00159	671-00159	671-00159	671-00159
6	*housing	1	032-91879	032-91879	032-91879	032-91879
7	*shaft (keyed)	1	032-91852	032-91852	032-91852	032-91852
	*shaft (splined)		032-91851	032-91851	032-91851	032-91851
8	washer	4			350-10109	350-10109
	adapter kit		S22-12872	S22-12873	S22.12874	S22-15570

*** note:** not included in rear drive adapter kits

note: item (1) blanking plate part no. 032-91468 item (2) O-ring 671-00159 item (3) blanking plate screws 363-16210-8 blanking plate kit 072-06210

P05 PUMP AND COMPENSATOR TEST PROCEDURE

Test Conditions:

Fluid: Mobil 4259 DE ISO V6-32 or equivalent
RPM: 1750 ± 50 RPM
Inlet Temp: 120° F ± 10° F, 49° C ± 4° C
Inlet Condition: Atmospheric to + 5 ps,i 0.3 bar
Case Pressure: 25 psi ±5 psi, 1.7 bar ± 0.3 bar

PRE-ADJUSTMENT AND GAGE REQUIREMENTS

See figure 7.
Adjust maximum volume stop to full displacement by backing off screw (24) CCW until there is no contact with control piston.

Turn compensator adjustment screw (25) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.

Turn differential adjustment screw (3) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.

Install gages on compensator cap at plug locations (12) and (21). They will be used for differential pressure setting required in start-up. Pressure will be approximately 1000 psi, 70 bar for this adjustment.

START-UP

Mount pump on test stand. Connect system lines and case drain line. Fill pump case with clean oil. Dry all oil from exterior of pump to permit checking for external leaks.

Test stand relief valve should be set at 500 psi, 35 bar.

Jog electric motor to verify correct rotation. Start electric motor. Pump should be at full displacement at 500 psi, 35 bar.

Adjust test stand relief valve higher until compensator destrokes pump to zero displacement. Compensator pressure should be approximately 1000 psi, 70 bar with the 1/2 turn pre-adjustment.

Adjust compensator differential spool pressure at 250 psi ± 25 ps, 17 bar ± 1.7 bar. This is accomplished by adjusting differential screw (50-3) until the difference in pressure readings between the two gages installed in the compensator cap is 250 psi, 17 bar. The gages can be removed after this test as the pressures in these ports will later be at 7250 psi, 500 bar.

BREAK-IN

The compensator must be adjusted above the test stand relief valve setting for the break-in test. Operate the pump with the following discharge pressures for the times indicated. Pump must be at full displacement.

1000 psi ± 100 psi, 69 bar ± 9 bar	3 minutes minimum
3000 psi ± 100 psi, 207 bar ± 9 bar	2 minutes minimum
5000 psi ± 100 psi, 345 bar ± 9 bar	1 minute minimum
6000 psi ± 100 psi, 414 bar ± 9 bar	1 minute minimum

While breaking in, adjust the compensator to destroke the pump two or three times at each pressure setting.

ACCEPTANCE CRITERIA

A. Minimum pump flow at 6000 psi ± 100 psi, 414 bar ± 7 bar: 34 gpm, 129 L/min.

B. Compensator leakage: 5.0 gpm, 19 L/min (The additional case drain leakage between 5000 psi, 414 bar full stroke and 5000 psi, 414 bar compensated).

COMPENSATOR TEST

Set the compensator at 3000 psi ± 100 psi, 207 bar ± 7 bar, 5000 psi ± 100 psi, 414 bar ± 7 bar, and 7250 psi ± 100 psi, 500 bar ± 7 bar. Settings to be made at full stroke.

At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary over 150 psi, 10.3 bar from the compensator setting. The control should be steady and stable at all conditions.

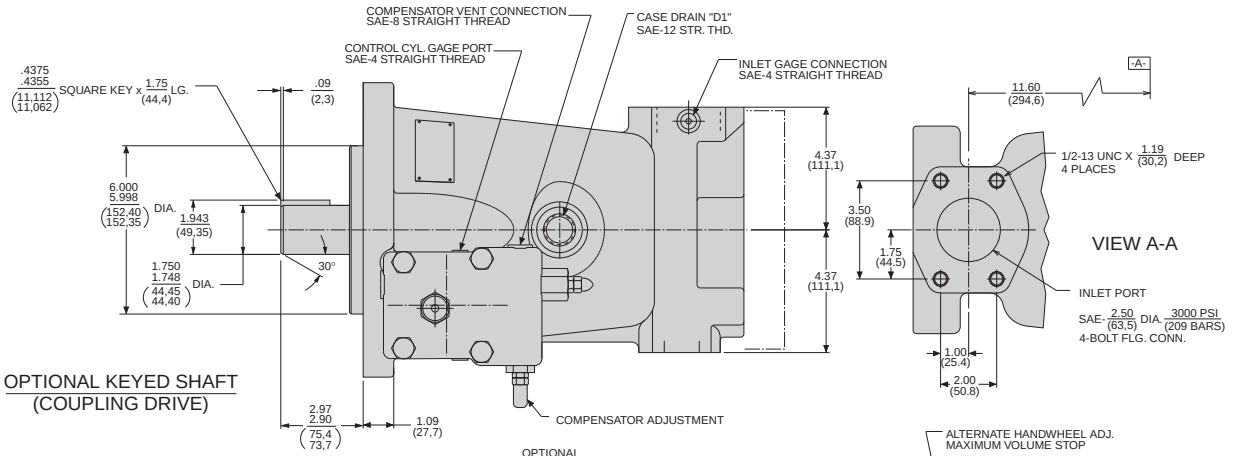
Reduce pressure to 150 psi, 10 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator settings should be repeatable. Set compensator at 1000 psi ± 100 psi, 70 bar ± 9 bar standard, or desired value.

OPTIONAL CONTROLS

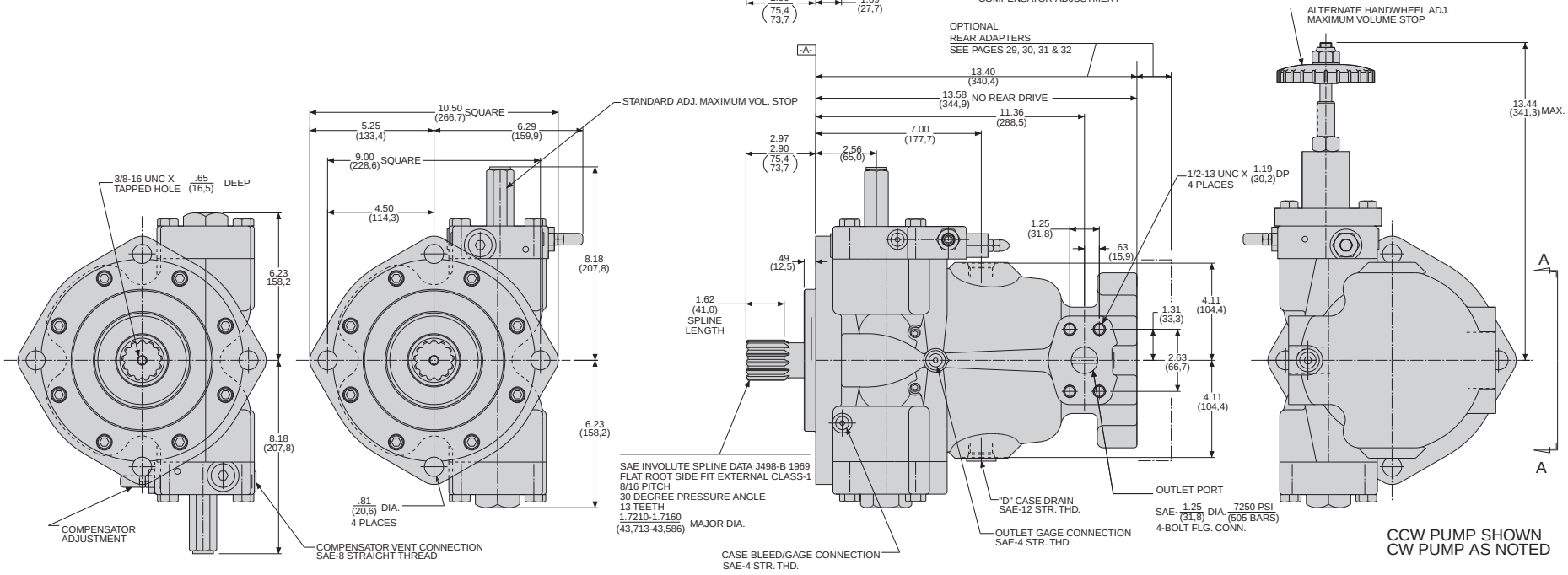
EXTERNAL LEAKS

Check for leaks during and after testing. NO external leaks permitted. The shaft seal can be dry or damp (Damp: a very small amount of oil at the seal and shaft joint, but NOT running onto the seal face).

NOTES:
1. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
2. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



OPTIONAL KEYED SHAFT
(COUPLING DRIVE)

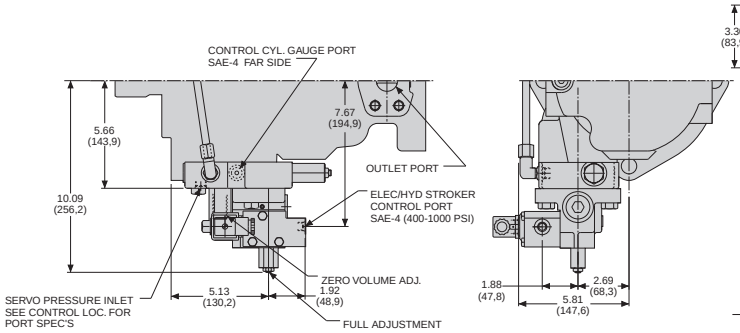


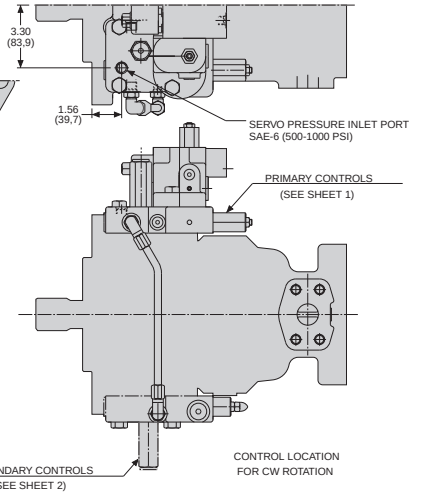
END VIEW
COMPENSATOR LOCATION
FOR CW PUMP ROTATION

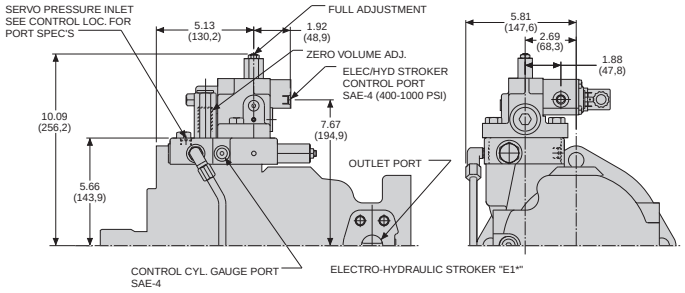
CCW PUMP SHOWN
CW PUMP AS NOTED

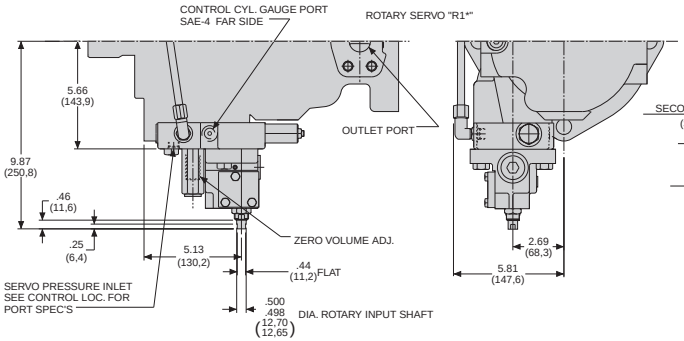
"C1" COMPENSATOR WITH ADJ. MAX. VOLUME SCREW STOP
or
"C2" COMPENSATOR WITH HANDWHEEL ADJ. MAX. VOLUME STOP

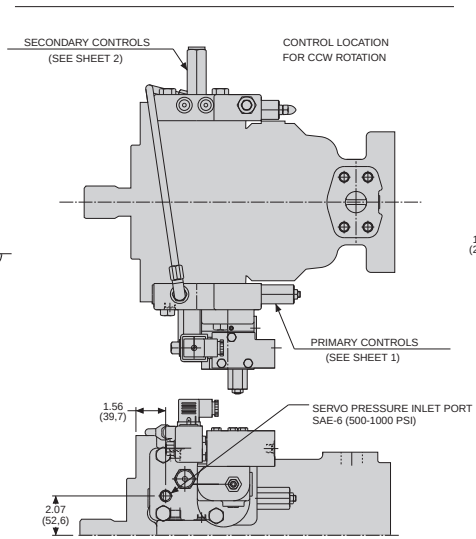
PRIMARY SERVO CONTROLS
(CCW ROTATION SHOWN)
ELECTRO-HYDRAULIC STROKER "E1*"

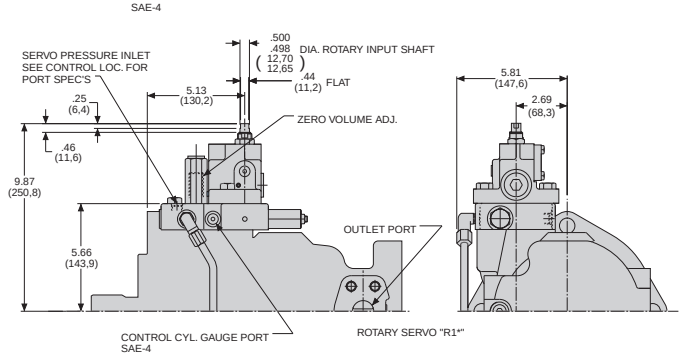


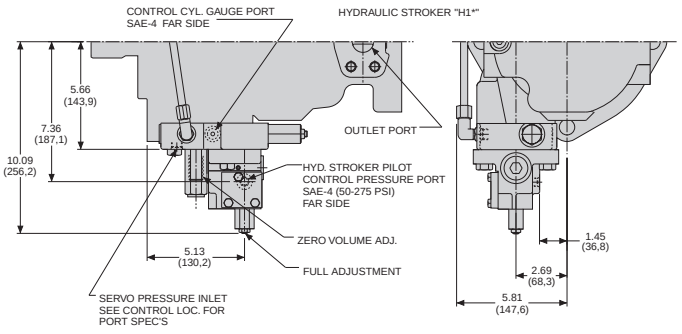


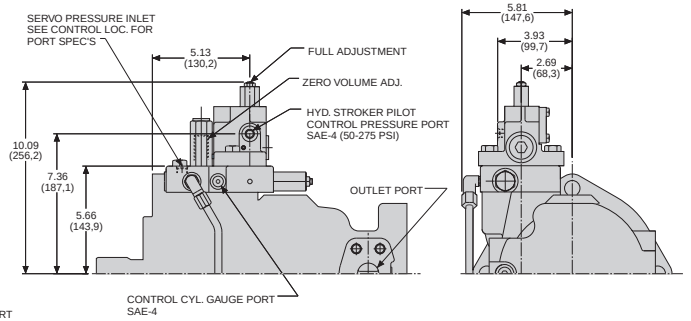




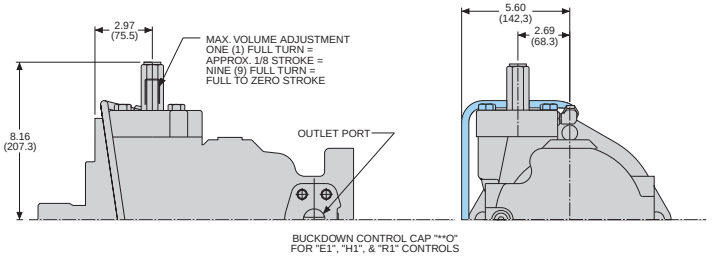




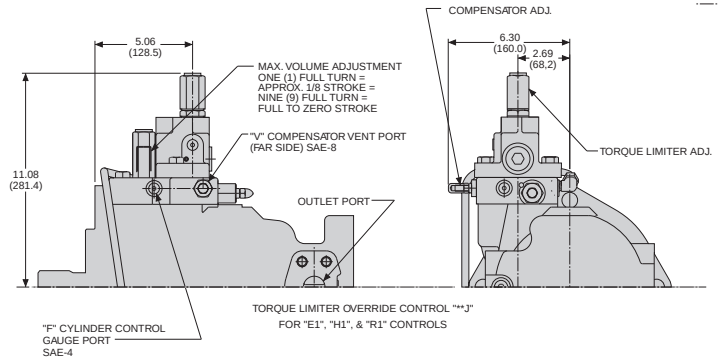




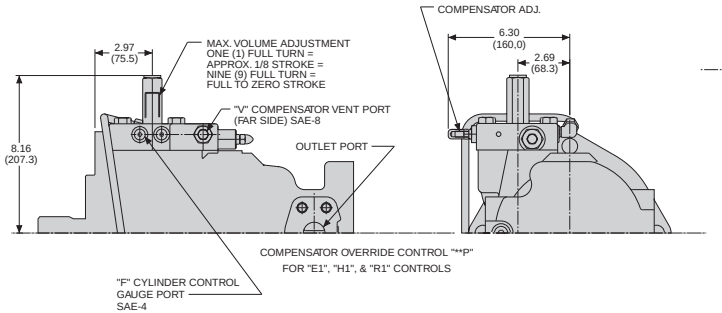
HYDRAULIC STROKER "H1*"
PRIMARY SERVO CONTROLS
(CW ROTATION SHOWN)



BUCKDOWN CONTROL CAP "**O"
FOR "E1", "H1", & "R1" CONTROLS



TORQUE LIMITER OVERRIDE CONTROL "**J"
FOR "E1", "H1", & "R1" CONTROLS

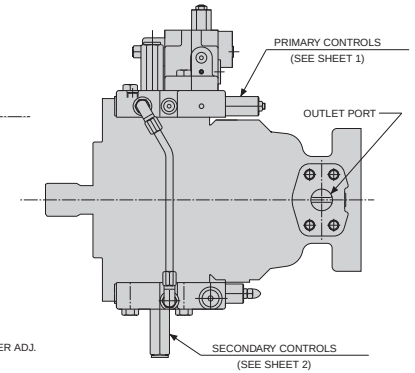


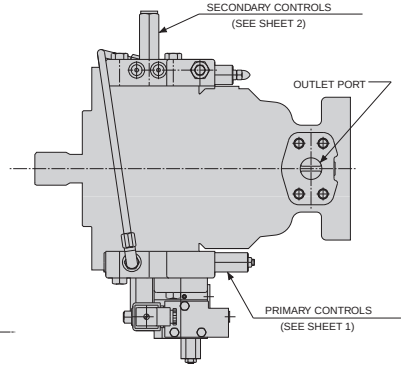
COMPENSATOR OVERRIDE CONTROL "**P"
FOR "E1", "H1", & "R1" CONTROLS

SECONDARY SERVO CONTROLS

FOR "E", "H", & "R" PRIMARY CONTROLS
(CCW ROTATION SHOWN)

CONTROL LOCATION FOR CW ROTATION





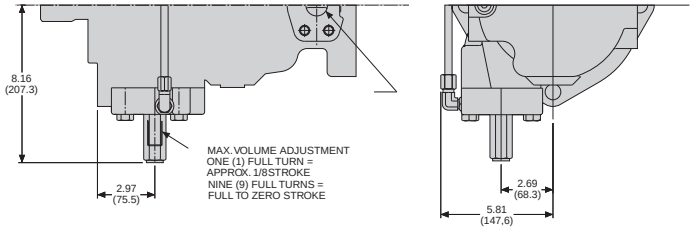
CONTROL LOCATION FOR CCW ROTATION

SECONDARY SERVO CONTROLS

FOR "E", "H", & "R" PRIMARY CONTROLS

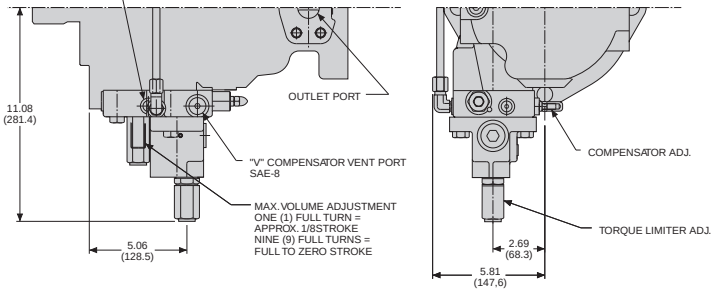
(CW ROTATION SHOWN)

BUCKDOWN CONTROL CAP "**O"
FOR "E1", "H1", & "R1" CONTROLS



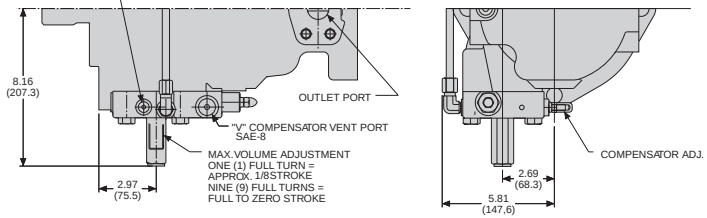
"F" CYLINDER CONTROL
GAUGE PORT (FAR SIDE)
SAE-4

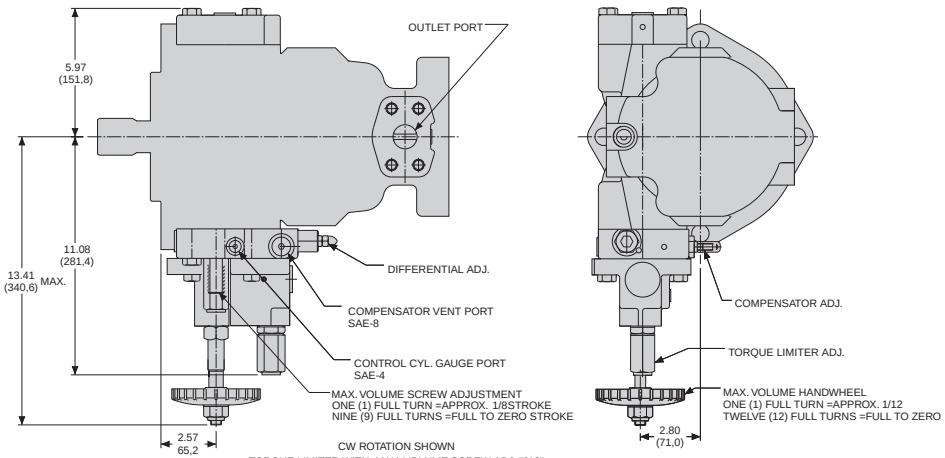
TORQUE LIMITER OVERRIDE CONTROL "**J"
FOR "E1", "H1", & "R1" CONTROLS



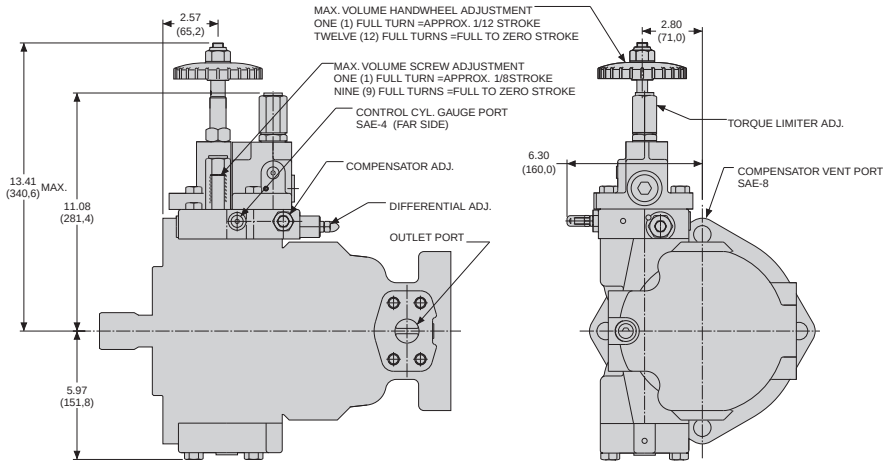
"F" CYLINDER CONTROL
GAUGE PORT (FAR SIDE)
SAE-4

COMPENSATOR OVERRIDE CONTROL "**P"
FOR "E1", "H1", & "R1" CONTROLS

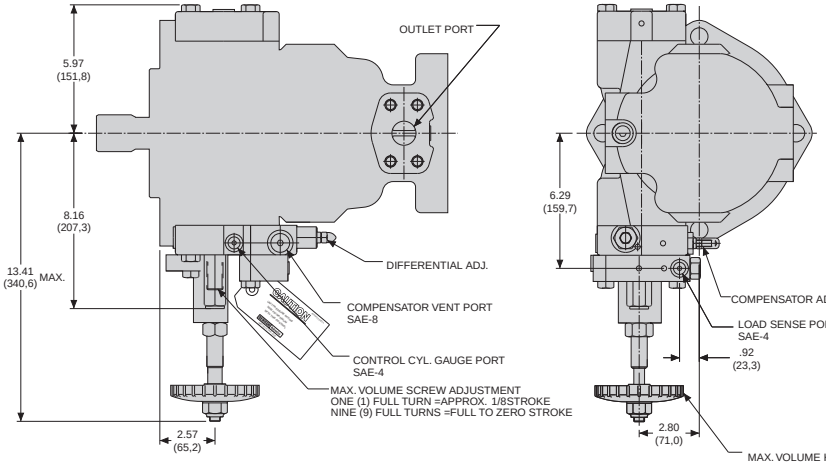




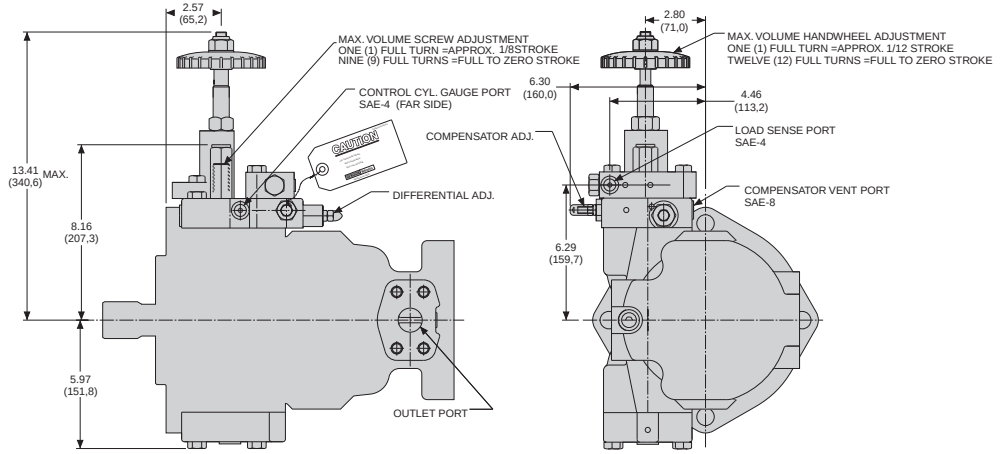
CW ROTATION SHOWN
TORQUE LIMITER WITH MAX. VOLUME SCREW ADJ. "J10"
AND
TORQUE LIMITER WITH HANDWHEEL MAX. VOLUME ADJ. "J20"



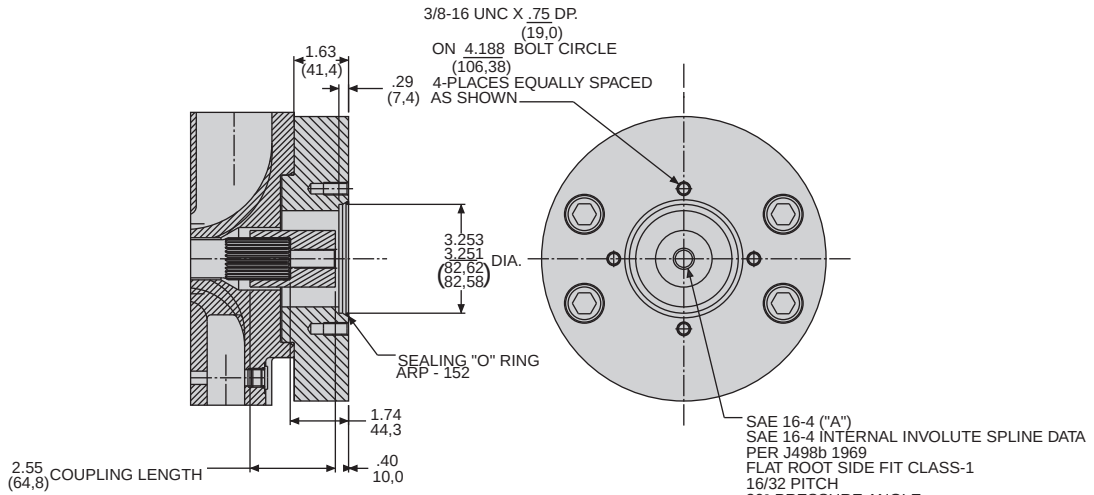
CCW ROTATION SHOWN
TORQUE LIMITER WITH MAX. VOLUME SCREW ADJ. "J10"
AND
TORQUE LIMITER WITH HANDWHEEL MAX. VOLUME ADJ. "J20"



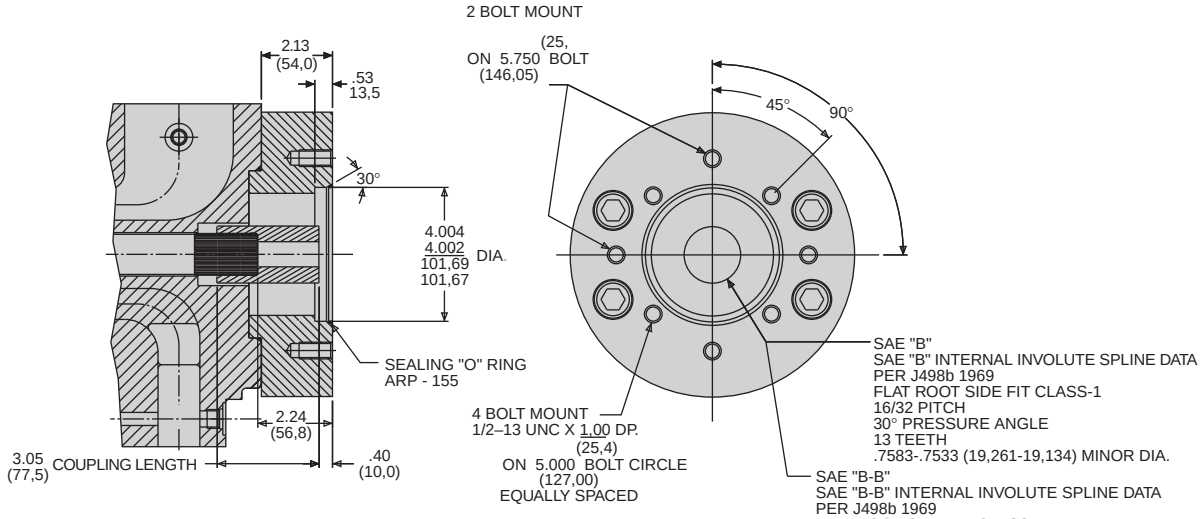
CW ROTATION SHOWN
LOAD SENSING WITH MAX. VOLUME SCREW ADJ. "L10"
AND
LOAD SENSING WITH HANDWHEEL MAX. VOLUME ADJ. "L20"



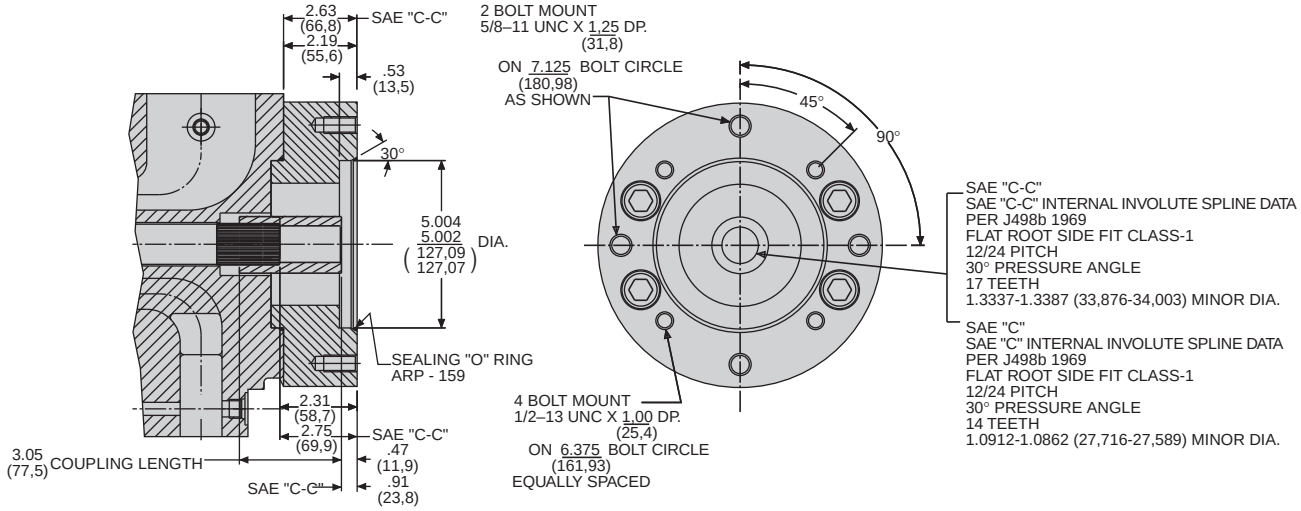
CCW ROTATION SHOWN
LOAD SENSING WITH MAX. VOLUME SCREW ADJ. "L10"
AND
LOAD SENSING WITH HANDWHEEL MAX. VOLUME ADJ. "L20"



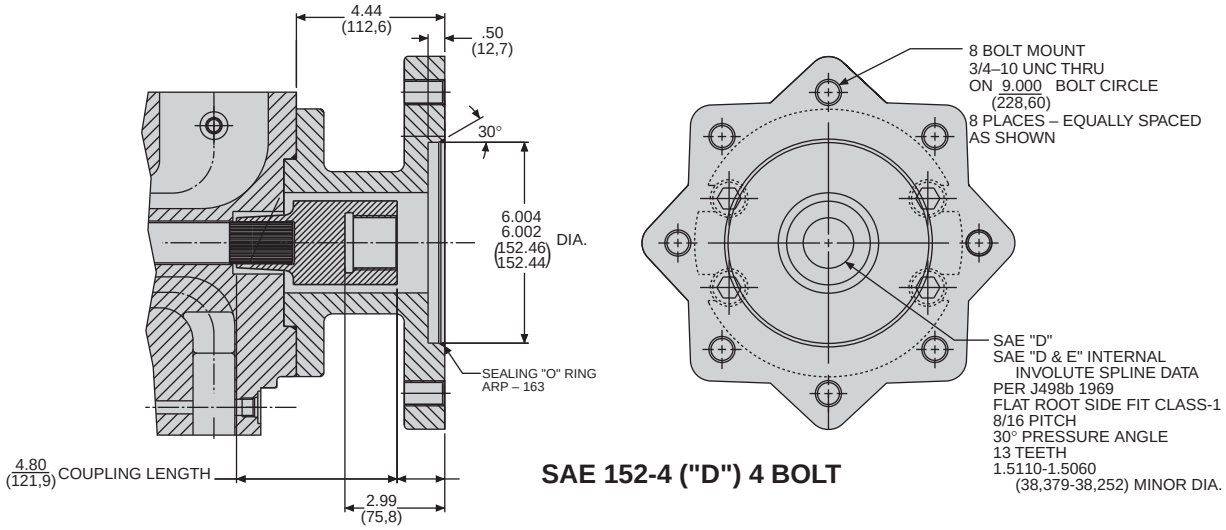
SAE 82-2 ("A" 2 BOLT)



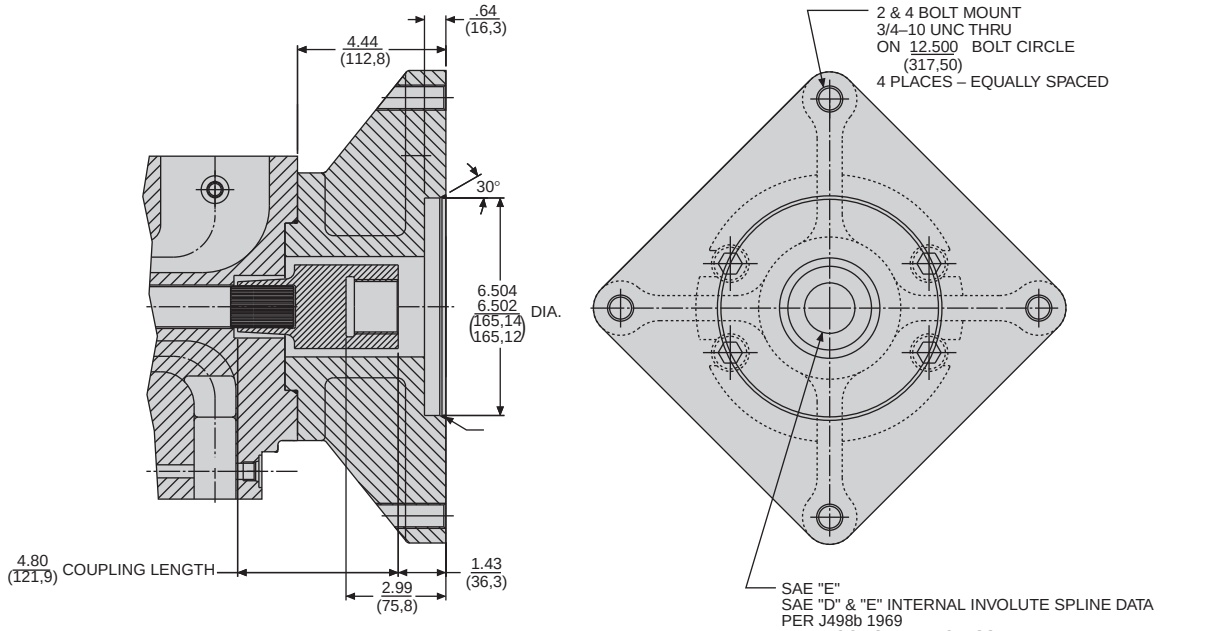
SAE 101-2 ("B" & "B-B") 2 BOLT
SAE 101-4 ("B" & "B-B") 4 BOLT



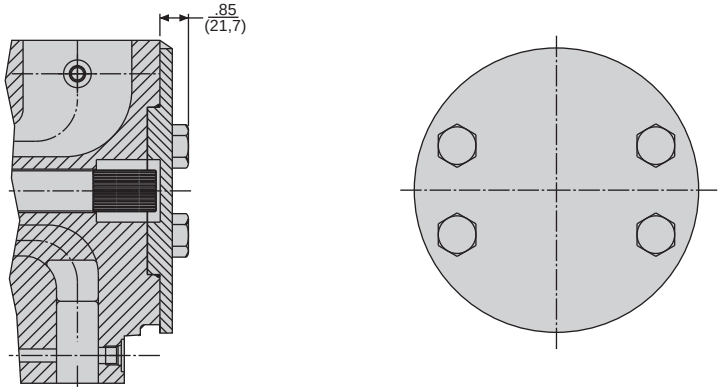
SAE127-2 ("C" & "C-C") (AS NOTED) 2 BOLT
SAE127-4 ("C" & "C-C") (AS NOTED) 4 BOLT



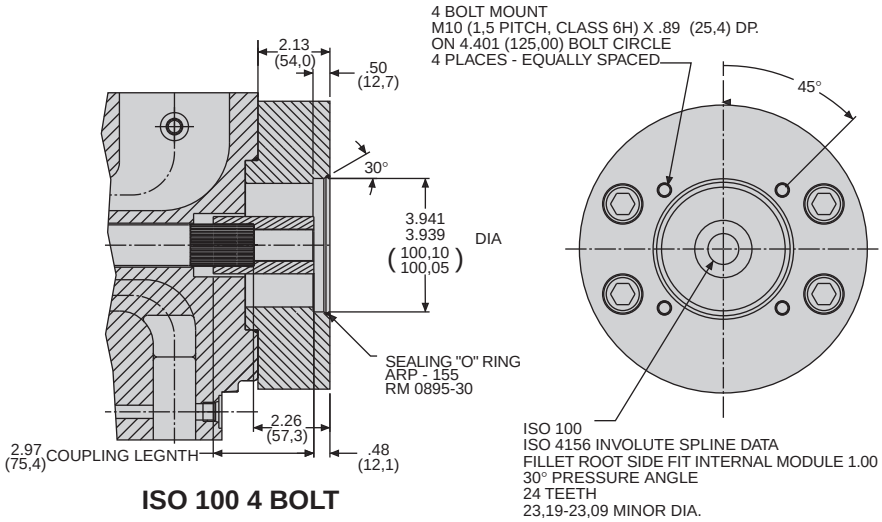
SAE 152-4 ("D") 4 BOLT



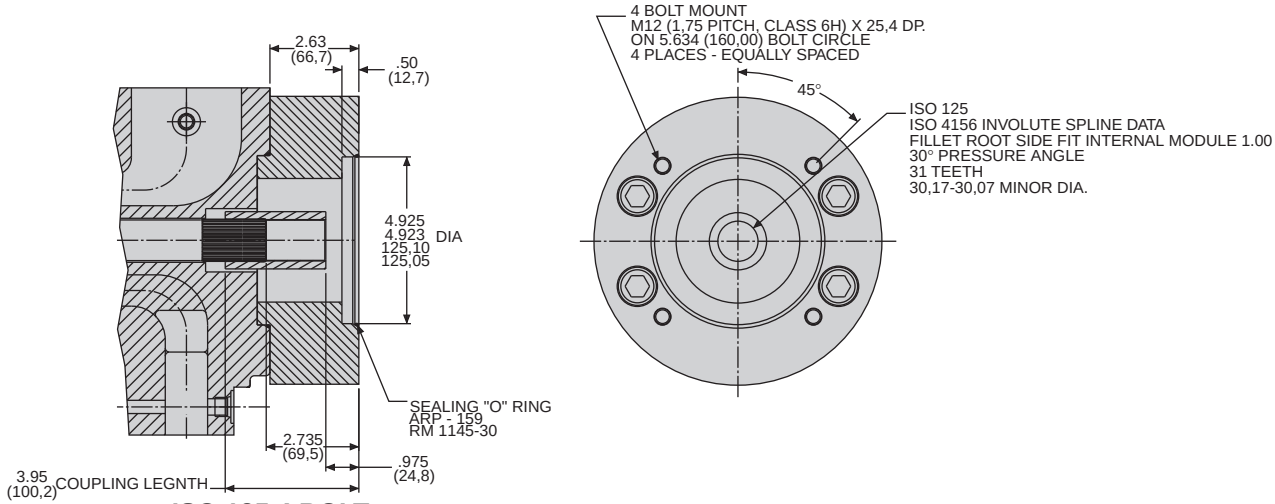
SAE 165-2 ("E") 2 BOLT
SAE 165-4 ("E") 4 BOLT



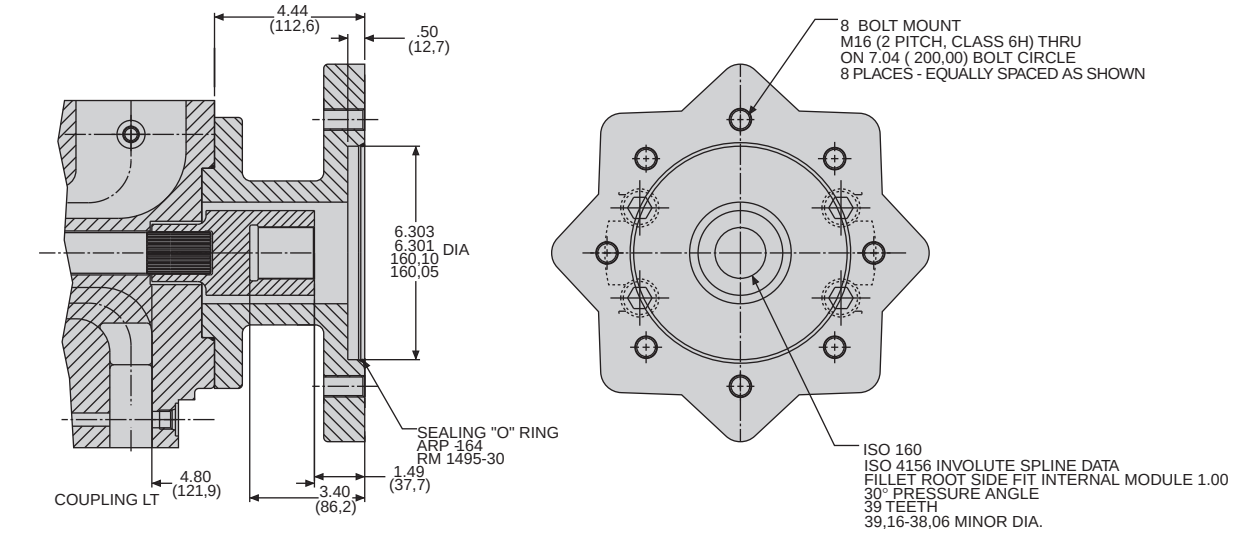
BLANKING PLATE



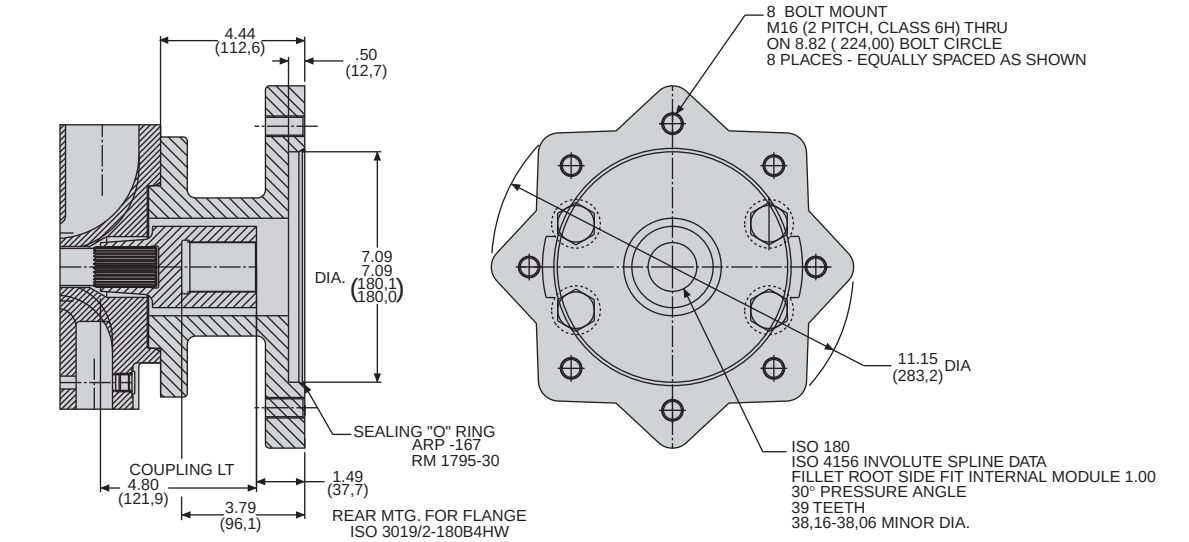
ISO 100 4 BOLT



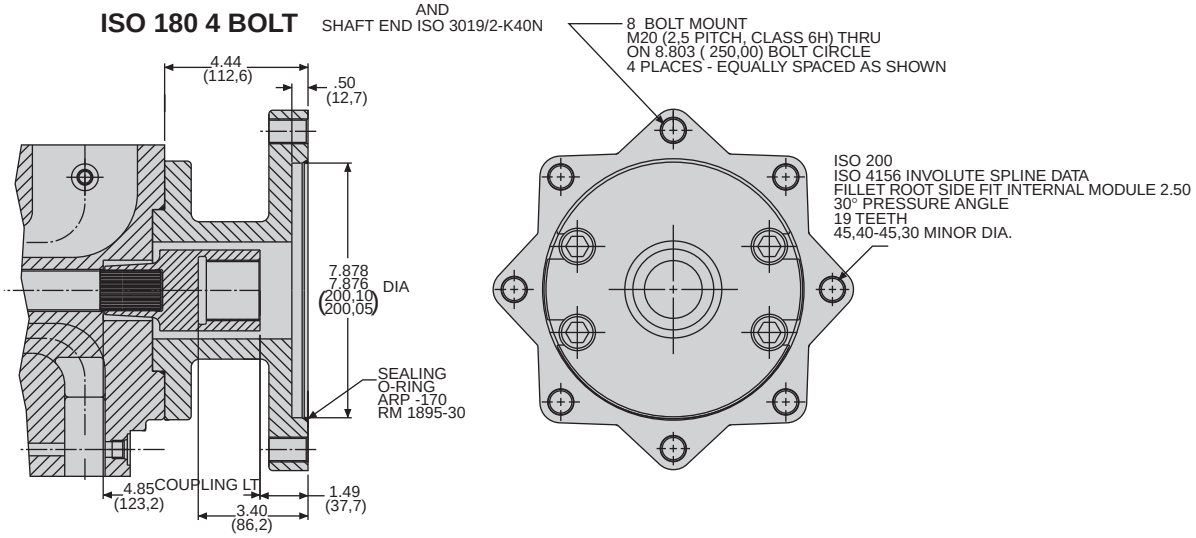
ISO 125 4 BOLT



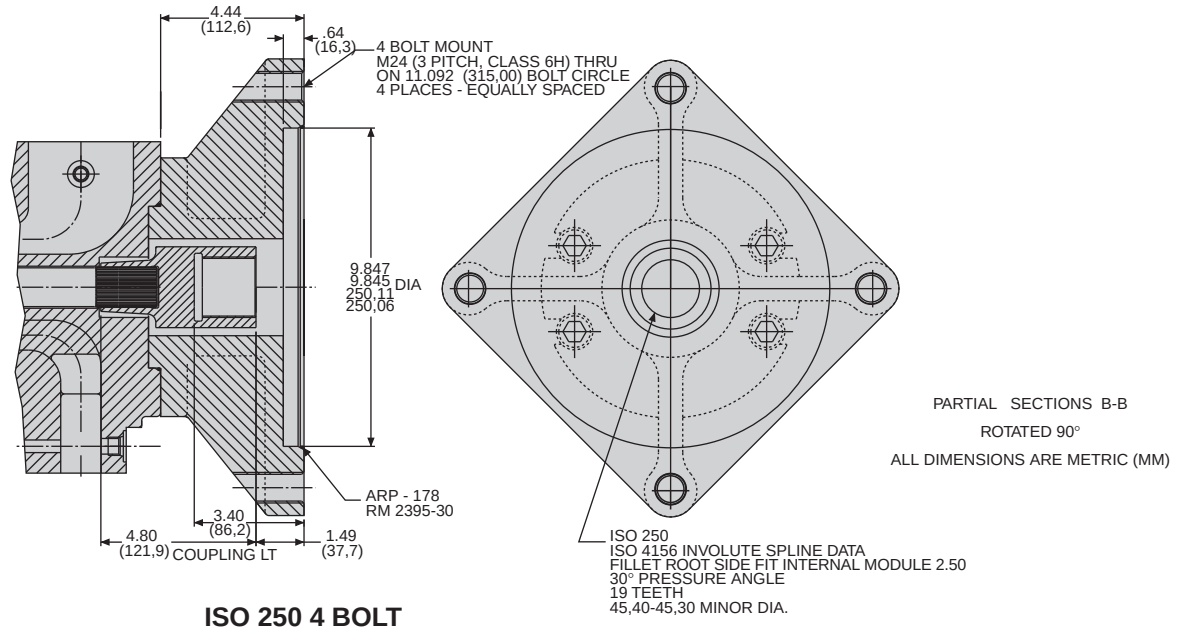
ISO 160 4 BOLT



ISO 180 4 BOLT



ISO 200 4 BOLT



ISO 250 4 BOLT

FLUID CONNECTIONS	Term	P05
• port A (inlet)	in.	2-1/2
SAE code 61 3000 psi, 209 bars split flange	mm	63.5
• port B (system)	in.	1-1/4
SAE code 62 7250 psi, 500 bars split flange	mm	31.7
• port C1, C2 (cylinder gage ports)	SAE	-4
• port D, D1 (case drains)	SAE	-12
• port AG, DG (inlet, drain gage conn's)	SAE	-4
• port BG (outlet gage connection)	SAE	-4
• port BG1 (alternate outlet gage connection)	SAE	-4
• port E (electric stroker control pressure inlet)	SAE	-4
• port H (hydraulic stroker control pressure inlet)	SAE	-4
• port LS (load sensing port)	SAE	-4
• port V (compensator vent)	SAE	-8
• port X (rotary, electric & hydraulic stroker servo inlet)	SAE	-6

Ordering Code **P05 - 2R1 A - C10 - 00**

Pump service

Displacement, max*
05 - 4.9 in³/rev.

Shaft
SAE
2-Keyed SAE-44-1. (D)
3-Splined SAE 44-4 (D)

Shaft rotation
(viewed from shaft end)
R-CW
L-CCW

Fluid class
1-compatible with Buna N
4-compatible with EPR
5-compatible with Viton

Design letter
(assigned by manufacturer)

Primary controls
C-Pressure compensator
E-Electric stroker
H-Hydraulic stroker
J-Low torque limiter 800-1500 in-lbs, 90-170 N•m
K-High torque limiter 1500-3500 in-lbs, 170-400 N•m
L-Load sensing
R-Rotary servo

Modification
O-No pump mounted
(if rear pump is to be mounted, it must be designed as separate line on order**

Rear drive***
O-None
M-Rear drive blanking plate
A-SAE 82-4 Flange, SAE 16-4 Shaft (SAE-A)
B-SAE 101-4 Flange, SAE 22-4 Shaft (SAE-B)
Q-SAE 101-4 Flange, SAE 25-4 Shaft (SAE-B-B)
C-SAE 127-4 Flange, SAE 32-4 Shaft (SAE-C)
N-SAE 127-4 Flange, SAE 38-4 Shaft (SAE-C-C)
D-SAE 152-4 Flange, SAE 44-4 Shaft (SAE-D)
Z-ISO 3019/2 (100 B4HW Flange, K25N Shaft)
Y-ISO 3019/2 (125 B4HW Flange, K32N Shaft)
X-ISO 3019/2 (160 B4HW Flange, K40N Shaft)
U-ISO 3019/2 (180 B4HW Flange, K40N Shaft)

Secondary controls
O-None
P-Pressure compensator override
J-Torque limiter override (low) 800-1500 in-lbs, 90-170 N•m
K-Torque limiter override (high) 1500-3500 in-lbs, 170-400 N•m

Primary control options
1- Standard maximum volume screw
2- Handwheel (available on compensator, torque limiter and load sensing controls)

Available control combinations
C10, C20
E10, E1J, E1K, E1P
H10, H1J, H1K, H1P
J10, J20
K10, K20
L10, L20
R10, R1J, R1K, R1P

***05** Designates SAE 152-4 mounting, SAE 44-2/4 shaft, SAE porting
Note: ISO version available, see bulletin S1-AM032
**User must advise attitude of rear pump mounting
***Appropriate coupling and seals are included in shipment

DEFINITION & UNIT

displacement	in^3/rev x 16.387 = cm^3/rev	cm^3/rev x 0.06102 = in^3/rev
flow	U.S.gpm x 3.78 = L/min	L/min x 0.264 =U.S. gpm
power	hp x 0.7457 = kW	kW x 1.341 = hp
torque	lb-ft x 1.3558 = Nm	Nm x 0.7376 = lb-ft
pressure	lbs/in^2 (psi) x 0.0690 = bar lbs/in^2 (psi) x 6.90 = kPa	bar x 14.50 = lbs/in^2 (psi) kPa x 0.1450 = lbs/in^2 (psi)
weight	lb x 0.4535 = kg	kg x 2.205 = lbs
force	lb x 4.448 = N	N x 0.2248 = lbs
volume	in^3 x 16.387 = cm^3	cm^3 x 0.06102 = in^3
area	in^2 x 6.452 = cm^2	cm^2 x 0.1550 = in^2
length	in x 25.4= mm	mm x 0.03937 = in
temperature	$\frac{\text{degree F-32}}{1.8}$ = ϒC	1.8 x ϒC+32 = ϒ F
viscosity	*c*St x 1.0 = mm^2/sec	mm^2/sec x 1.0 = *c*St
	$\frac{\text{(SSU-14)}}{4.25} \cong$ cSt	cSt x 4.25 + 14≅ SSU

FLUID POWER FORMULAS

Pump input torque	*lbs. in.*	$\frac{\text{pressure(psi) x displacement (in}^3\text{/rev)}}{2\pi \text{ x mech. eff.}}$
Pump input power	*hp*	$\frac{\text{rpm x (in}^3\text{/rev) x (psi)}}{395934 \text{ x overall eff.}}$
Pump output flow	*U.S. gpm*	$\frac{\text{rpm x (in}^3\text{/rev) x volumetric eff.}}{231}$
Fluid motor speed	*rpm*	$\frac{231 \text{ x flow rate(U.S. gpm) x volumetric eff.}}{\text{displacement (in}^3\text{/rev)}}$
Fluid motor torque	*lbs. in.*	$\frac{\text{pressure(psi) x displacement (in}^3\text{/rev) x mech. eff.}}{2\pi}$
Fluid motor power	*hp*	$\frac{\text{rpm x (in}^3\text{/rev) x (psi) x overall eff.}}{395934}$
(metric)		
Pump input torque	*Nm*	$\frac{\text{pressure(bar) x displacement (cm}^3\text{/rev}}{20\pi \text{ x mech. eff.}}$
Pump input power	*kW*	$\frac{\text{rpm x (cm}^3\text{/rev) x (bar)}}{600000 \text{ x overall eff.}}$
Pump output flow	*Lpm*	$\frac{\text{rpm x (cm}^3\text{/rev) x volumetric eff.}}{1000}$
Fluid motor speed	*rpm(min^{-1}) (tr/mn)*	$\frac{1000 \text{ x flow rate (Lpm) x volumetric eff.}}{\text{displacement (cm}^3\text{/rev)}}$
Fluid motor torque	*Nm*	$\frac{\text{pressure(bar) x displacement (cm}^3\text{/rev) x mech. eff.}}{20\pi}$
Fluid motor power	*kW*	$\frac{\text{rpm x (cm}^3\text{/rev) x (bar) x overall eff.}}{600000}$

SALES & SERVICE WORLDWIDE

International Distributors
In Europe:
Cyprus
Eastern Europe
The Faroe Islands
Finland
Greece
Iceland
Norway
Portugal
Switzerland
Turkey

In Africa:
Algeria
Egypt
Ivory Coast
Morocco
Nigeria
South Africa
Togo
Tunisia

In Middle East:
Iran
Israel
Lebanon
Pakistan
Qatar
Saudi Arabia
Syria
United Arab Emirates

In Far East:
Indonesia
Korea
Malaysia
New Zealand
Philippines
Thailand

Australia
DENISON HYDRAULICS Pty. Ltd.
41-43 St. Hillers Road
P.O. Box 192
Auburn, N.S.W. 2144
Tel. (612) 9646 5200
Fax (612) 9643 1305
Other sales offices:
Queensland
South Wantirna Victoria
Western Australia

Austria
DENISON HYDRAULIK GmbH
Zweigniederlassung Linz
Haidbachstraße 69
A-4061 Pasching
Tel. (43) 7229 4887
Fax (43) 7229 63092

Benelux
DENISON HYDRAULICS
BENELUX B. V.
Pascalstraat 100
3316 Dordrecht
Holland
Tel. (31) 786179 900
Fax (31) 786175 755

Canada
DENISON HYDRAULICS
CANADA Inc.
2320 Bristol Circle, Unit 1
Oakville, ON L6H 5S2
Tel. (905) 829 5800
Fax (905) 829 5805
Other sales offices:
Montreal, QC
Calgary, AB

China, P.R.
DENISON HYDRAULICS Ltd.
3F, No. 1, Mao Jia Zhai, Bai Lian Jing
Pudong New Area
Shanghai 200126,
Tel. (86) 21 5886 8991
Fax (86) 21 5886 1978

Denmark
DENISON HYDRAULIK
DENMARK A/S
Industrikrogen 2
DK-2635 Ishöj
Tel. (45) 4371 15 00
Fax (45) 4371 15 16

Finland
DENISON HYDRAULICS
P.O. Box 36
FIN-08101 Lohja
Tel. (358) 208 33 045
Fax (358) 207 33 045

France
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon
Tel. (33) 2 48 53 01 20
Fax (33) 2 48 75 02 91
Other sales offices:
Bordeaux
Lyon
Paris

Germany
DENISON HYDRAULIK GmbH
Herderstrasse 26
D-40721 Hilden
Tel. (49) 2103 940-6
Fax (49) 2103 940-880
Other sales offices:
Dresden
Hanover
Stuttgart

Great Britain
DENISON HYDRAULICS U.K.
Ltd.
Kenmore Road
Wakefield 41, Industrial Estate
Wakefield, WF20XE
West Yorkshire
England
Tel. (44) 19 24 826 021
Fax (44) 19 24 826 146
Other sales offices:
Burgess Hill

Hong Kong, N. T.
DENISON HYDRAULICS Ltd.
Unit 3, 25/F Wharf Cable Tower
9 Hoi Shing Road
Tsuen Wan
Tel. (852) 24988381
Fax (852) 24991522

Italy
DENISON HYDRAULICS S.r.l.
Viale Europa 68
20090 Cusago (MI)
Tel. (39) 2 90 33 01
Fax (39) 2 90 39 06 94

Japan
DENISON JAPAN Inc.
4-2-1 Tsujido-Shinmachi
Fujisawa 251,
Tel. (81) 466 35 3257
Fax (81) 466 35 2029
Other sales office:
Osaka

Mexico, Central America, South America and Caribbean Countries Contact
DENISON HYDRAULICS Inc.
6167 NW 181 Terrace Circle North
Miami, FL 33015, USA
Tel. (305) 362 2246
Fax (305) 362 6220

Other European, Middle East and African Countries Contact
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon Cedex
France
Tel. (33) 2 48 53 01 45
Fax (33) 2 48 53 01 46

Singapore
DENISON HYDRAULICS S.E.A.
Pte. Ltd.
No. 11 Lorong Tukang Dua
2261 Singapore
Tel. (65) 2687840
Fax (65) 2687847

Spain
DENISON HYDRAULICS, S.A.
Gomis, 1
08023 Barcelona
Tel. (34) 3418 46 87
Fax (34) 3211 65 07
Other sales offices:
San Sebastian

Sweden
DENISON HYDRAULICS
SVENSKA AB
Sporregatan 13
213 77 - Malmö
Tel. (46) 40 21 04 40
Fax (46) 40 21 47 26
Other sales offices:
Spånga

Taiwan, R.O.C.
DENISON HYDRAULICS Ltd.
6F-10, No. 79, Sec. 2, Roosevelt Road
Taipei,
Tel. (886) 2 3645101 / 3645102
Fax (886) 2 3639025

USA
DENISON HYDRAULICS Inc.
14249 Industrial Parkway
Marysville, OH 43040
Tel. 937 644 3915
Fax 937 642 3738
For nearest Distributor:
Call toll free 1 800 551 5956
Other sales offices:
Fulton, CA
Mulberry, FL
Moline, IL
Rock Island, IL
Kentwood, MI
Portland, OR
Collierville, TN
Arlington, TX
Houston, TX

Your local DENISON representative

Printed in U.S.A. 5-98

DENISON Hydraulics

Internet: http://www.denisonhydraulics.com E-mail: denison@ denisonhydraulics.com