

DENISON HYDRAULICS

axial piston pump goldcup series

P24P/S E-mod., P30P/S B-mod.

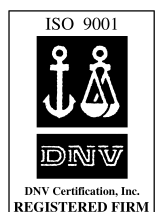
service information



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DENISON | **Hydraulics**



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TECHNICAL CHARACTERISTICS

TECHNICAL CHARACTERISTICS

specification	term	Goldcup 24		Goldcup 30		
•displacement at max. angle	in ³ /rev.	24.6		30.6		
	cm ³ /rev.	403		501,4		
•pressure, continuous	psi	5000		5000		
	bar	345		345		
•speed max. continuous at full stroke <i>consult DENISON HYDRAULICS for higher speeds</i>	rpm	2100 ¹⁾		1800		
•flow, ports A or B <i>theo. at max. displ.</i>	at 1500 rpm	gpm	159.7		198.7	
		Lpm	604,6		752,1	
	at 1800 rpm	gpm	191.7		238.4	
		Lpm	725,5		902,5	
	at 2100 rpm	gpm	223.6		-	
		Lpm	846		-	
•aux. pump theor. displ. / rev. ²⁾	in ³ /rev	P24P	2.81		P30P	
			46,1		46,1	
	in ³ /rev	P24S³⁾	1.05		P30S³⁾	
			17,2		17,2	
	•flow, auxiliary pump at 1500 rpm <i>internal - theo. flow</i>	at 1500 rpm	P24P	18.2		P30P
				69,1		69,1
at 1800 rpm			21.9		21.9	
			82,9		82,9	
at 2100 rpm			25.5		-	
			96,7		-	
at 1500 rpm		P24S³⁾	6.5		P30S³⁾	
			24,5		24,5	
at 1800 rpm			7.8		7.8	
			29,5		29,5	
•flow, auxiliary pump at 1500 rpm ⁴⁾ <i>external - standard T6C-025</i>		at 1500 rpm	P24S³⁾	18.2		P30S³⁾
				69,1		69,1
	at 1800 rpm		21.9		21.9	
			82,9		82,9	
	•aux. pump servo pressure range <i>varies upward with pressure in port A or B, based on 0 psi 0 bar case pressure</i>	psi	P24P	340-640	P24S	490-790
		bar		23-44		34-54
•Aux. pump replenishing pressure <i>based on 0 psi 0 bar case pressure</i>	psi	P24P	180-220	P24S	330-370	
	bar		12-15		23-26	
•mounting	SAE		177-4		177-4	
			("F" 4- bolt)		("F" 4- bolt)	
•shaft-spline or keyed	SAE		50-1,4		50-1,4	
			("F")		("F")	
•weight	lbs	P24P	690	P24S	755	
			313		342	
	kg		710		787	
			322		357	

¹⁾On R & O oils rust and oxidation inhibitor.

²⁾Standard, other sizes available.

³⁾Internal cartridge provides servo flow and must be supercharged from external replenishing flow. from external auxiliary pump

⁴⁾Any SAE 82-2 or SAE 101-2 mounting pump may be used, with the corresponding adapters.

SEAL KITS

FLUID CONNECTIONS

Refer to page 40 for specifications

SEAL KITS

seal kit, P24/30 complete (includes control seals)
 valve block seal kit (all)
 shaft seal kit
 shaft seal
 controls seal kit (all – input & output)

see chart below
 S23-17338-⊕K
 see chart below
 623-00015-5K
 S23-17000-⊕K

Seal Kits for P24-30 Gold Cup Pumps

CIPR	MOD.	SERIES	SHAFT TYPE	ROT.	COMPLETE SEAL KIT	SHUTTLE	SHAFT SEAL KIT	
24,30	E & B	P	2,3	R & L	S23-18006-⊕K	N/A	S23-11516-⊕K	
		R			S23-18016-⊕K			
		X			S23-11514-⊕K			
		P	7,8	R	S23-17038-⊕K			S23-16332-⊕K
		P	7,8	L	S23-17039-⊕K			S23-16333-⊕K
		R	7,8	R	S23-18017-⊕K			S23-16332-⊕K
		R	7,8	L	S23-18018-⊕K			S23-16333-⊕K
		X	7,8	R	S23-18022-⊕K			S23-16332-⊕K
		X	7,8	L	S23-18023-⊕K			S23-16333-⊕K
24,30	E & B	S	2,3	R & L	S23-17040-⊕K	S23-15089-⊕K	S23-11516-⊕K	
		L			S23-18019-⊕K			
		S	7,8	R	S23-17041-⊕K			S23-16332-⊕K
		S	7,8	L	S23-17042-⊕K			S23-16333-⊕K
		L	7,8	R	S23-18020-⊕K			S23-16332-⊕K
		L	7,8	L	S23-18021-⊕K			S23-16333-⊕K

Seal Kits for P24-30 Gold Cup Pumps with T6C Auxiliary Pumps

CIPR	MOD.	SERIES	SHAFT TYPE	ROT.	COMPLETE SEAL KIT	SHUTTLE	SHAFT SEAL KIT	
24,30	E & B	S	2,3	R & L	S23-11600-⊕K	S23-15089-⊕K	S23-11516-⊕K	
			7,8	R	S23-15696-⊕K			S23-16332-⊕K
			7,8	L	S23-15697-⊕K			S23-16333-⊕K

Notes: Add -0 FOR BUNA, -4 for EPR Rubber or -5 for VITON in place of ⊕.

INTRODUCTION

The DENISON HYDRAULICS Goldcup 24 and 30 axial piston pumps feature advance design concepts which are time proven and provide for advanced pumping and control concepts. The instructions contained in this manual cover complete disassembly and re-assembly 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 use of a rocker cam to control the pump displacement provides a small package size, reduces wear, and speeds control response. The control vane actuator eliminates linkage and backlash inherent in typical stroking cylinder designs. Standard controls for the Goldcup units are rotary servo and compensator over-ride. Additional optional controls are also available.

MOUNTING

This pump is designed to operate in any position. The mounting hub and 4 bolt mounting flange are in full conformance with SAE standard. 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 fluid 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 prime mover without a flexible coupling.

REAR PUMP MOUNTING

Caution: P24/30S Only

Shaft seal on coupling shaft isolates internal replenishing pressure from the external pump. An axial load in pounds equal to 1.23 x replenishing pressure, psi, or Newtons equal to 79,3 x replenishing pressure bar, will be exerted on the shaft of the rear mounted pump. Shaft bearing capacity of the external pump must be considered when applying external pump.

In any application it is advisable to check the alignment of the pump shaft to the prime mover to avoid side loading the pump shaft bearing and bending of the shaft.

The maximum allowable offset of the pump shaft and prime mover is 0.006 inch, 0,15 mm T.I.R. (Total indicator reading).

The maximum allowable angular misalignment is ± 0.002 inch per inch radius, 0,002 mm per mm radius.

SHAFT INFORMATION

Splined: The coupling interface must be lubricated. DENISON HYDRAULICS recommends lithium-molybdenum disulfide or similar grease. The female coupling should be hardened to 27-45 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 0.030"-0.040", 0,75-1mm at 45° to clear radii that exist in the keyway.

Note: Do not impact coupling to force it onto the shaft. A threaded hole, size M16 is provided in the end of the shaft.

Both types of shafts will accept a side load of 1000 lbs., 454 kg at the center of the spline or key, with a B10 life of 9880 hours at 1800 rpm or 11856 hours at 1500 rpm.

PIPING

Connect inlet and outlet lines to the port block of the pump.

The maximum case pressure is 75 psi, 5,7 bar continuous, 125 psi, 8,6 bar intermittent. When connecting case drain line make certain that drain plumbing passes above highest point of the pump before passing 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.

Note: High case pressure will result in reduced shaft bearing B10 life.

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 as possible. All fluid lines, whether pipe, tubing, or hose must be adequate size to assure free flow through the pump. We recommend 20 ft., 6,09 m max. per second for main flow and 4 ft., 1,4 m max. limit per second for suction lines. The case drain flow can exceed the steady state repl. pump flow during transient. Size the hose for 10 ft., 3,05 m, max. per second. Pressure rating of piping hose must be adequate for service duty required. An undersize inlet line will prevent the pump from operating at full rated speed. An undersized outlet line will create back pressure and cause heat generation and improper operation. Flexible hose lines are recommended to connect the pump to system piping. 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. Flushing with a large temporary high pressure loop filter is recommended. Piping must be cleaned so that the fluid cleanliness specified below is maintained.

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

INSTALLATION

RECOMMENDED FLUIDS

The fluid recommended for use in these pumps 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 flow, 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

Determine 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 SP0-AM305 for more information.*

FLUID CLEANLINESS

Fluid must be cleaned before 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 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.

COMPARISON OF SOLID CONTAMINATION CLASSIFICATION SYSTEM

NATIONAL AERONAUTICS STANDARD (NAS) 1638

		class													
		00	0	1	2	3	4	5	6	7	8	9	10	11	12
particle size range	5-15µm	125	250	500	1000	2000	4000	8000	16000	32000	64000	128000	256000	512000	1024000
	15-25µm	22	44	89	178	356	712	1425	2850	5700	11400	22800	45600	91200	182400
	25-50µm	4	8	16	32	63	126	253	506	1012	2025	4050	8100	16200	32400
	50-100µm	1	2	3	6	11	22	45	90	180	360	720	1440	2880	5760
	>100µm	0	0	1	1	2	4	8	16	32	64	128	256	512	1024
maximum particles	>5µm	152	304	609	1217	2432	4864	9731	19462	38924	77849	155698	311396	622792	1245584
	>15µm	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	>5µm	250	500	1000	2000	4000	8000	16000	32000	64000	130000	250000	500000	1000000	2000000	4000000
particles	>15µm	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.

FILLING CASE

It is essential to make certain that the case (pump housing) is as full of fluid as possible and remains full during operation and at rest. Always fill to the highest available point. Remove a plug or screw and allow the oil to escape through this point.

Recommended fill points:

Mounting orientation vertical, shaft up. D1 or D2 (drain) port in housing.
Vent DG2 port in mounting flange (new units) or one of the upper screws which attach the control. See installation drawing.

Vertical, shaft down¹⁾ or horizontal drain ports to the side.

D1 or D2 (drain) port in housing.

¹⁾Vent DG (case gage) port in port block.

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.

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 may be accomplished by referring to the disassembly, rework limits of wear parts, and assembly procedures.

START UP PROCEDURES FOR NEW INSTALLATIONS

- Read and understand the instruction manual. Identify components and their function.
- Visually inspect components and lines for possible damage.
- Check reservoir for cleanliness and 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.
- Reduce pressure settings of relief valve or compensator. Make sure accurate pressure readings can be made at appropriate places.
- If solenoids are included in system, check for actuation.
- Start pump drive first by jogging prime mover. Make sure pump and motor fill properly.

Caution: Ensure that the servo/replenish pump primes at startup. This is important on a newly installed application or one that allows the servo/replenish pump to lose its prime during shutdown. Failure to adequately prime can damage the main pump or the servo/replenish pump.

- Bleed system of air. Re-check 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 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.

TROUBLESHOOTING

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 the 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 pump or motor rotating group	fluid too cold fluid too viscous fluid too heavy shaft speed too high suction line too small suction line collapsed suction strainer too small or too fine 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
	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 cavitation	see above see above
high wear in pump & motor	excessive loads	reduce pressure settings reduce speed
	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 temperatures 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 make-up fluid

TROUBLESHOOTING

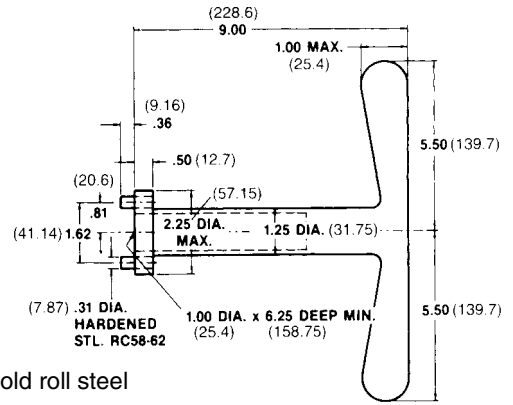
TROUBLESHOOTING

(continued)

effect of trouble	possible cause	fault which needs remedy
pressure shocks	cogging load	mechanical considerations
	worn relief valve	needed repairs
	worn compensator	needed repairs
	slow response in check valves	replace or relocate
	servo pressure too low to maintain firm control	increase pressure and check pressure drop through servo filter
	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 or motor leakage	re-check 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 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

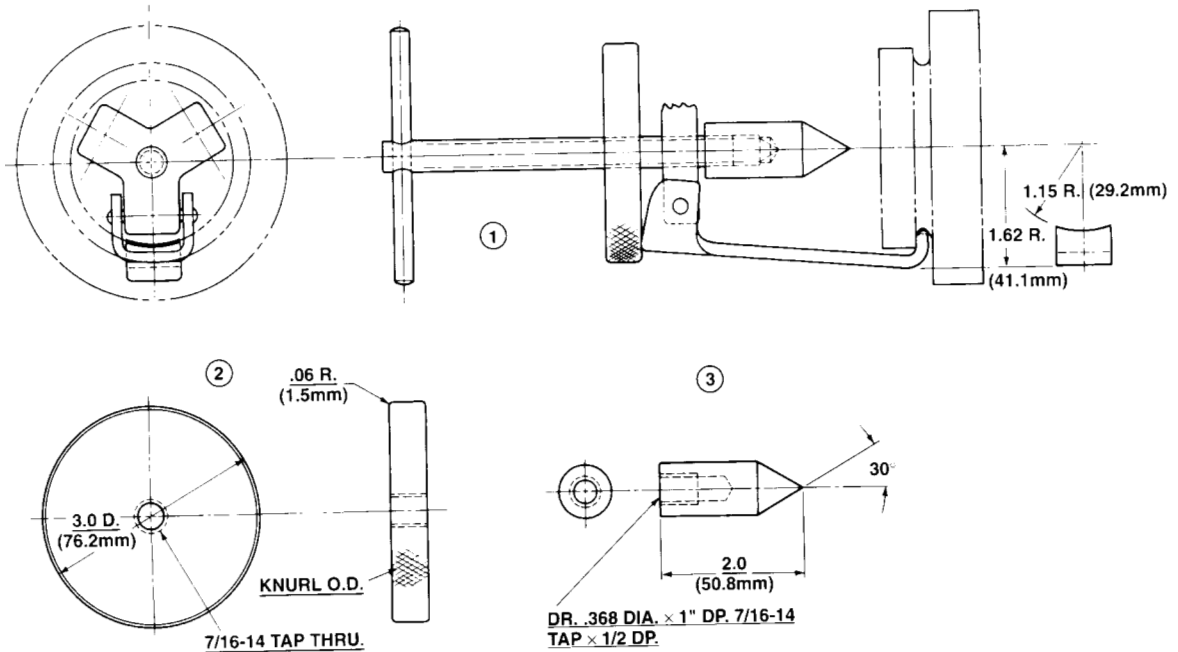
T1 No longer used.

T2 Barrel H.D. adjustment tool



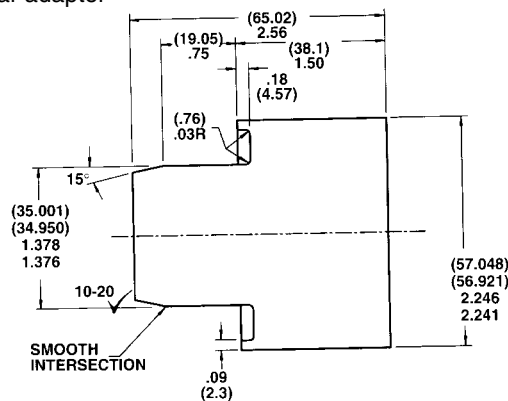
T2 Material - cold roll steel

T3 Replenishing and servo pump removal tool



ITEM	DESCRIPTION	PART NO.	QTY
1	6" (152.4mm) 3-Jaw Gear Puller 2 x 486 Graingers Co.		1
2	1/2 x 3" DIA. 4140 Steel (12.7mm x 76.2mm)		1
3	3/4 (19mm) DIA. x 2 1/2 (54mm) 4140 Steel HDN. GR.		1

T4 Shaft seal installation tool - rear adapter



NOTES:

1. Remove all burrs & break sharp edges .010/.005 R. (.254/.127mm)
2. Part to be heat treated to Rc 50-55
3. Material 4140 or equivalent
4. Dimensions in (mm)

INTRODUCTION

The instructions contained in this section cover a complete teardown of the subject pump. Disassemble only as far as necessary to replace or repair any worn parts.

DISASSEMBLY

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 pump failure.

NOTE: The four main assembly bolts (1, Figure 9) are torqued to 450 lbs-ft., 610,2 Nm. These bolts should be loosened prior to removing unit for disassembly.

Position pump unit so that the valve block assembly (11/12, Figure 10) is on top. A bench or similar suitable surface capable of supporting unit should be used. Disassembly area should be clean.

VALVE BLOCK

See figure 10. Remove the eight hex. head cap screws (12) and lift the entire block assembly from the port block.

See figure 13. Remove the four hex. head cap screws (58) and four soc. hd. screws (53) and lift the entire block assembly from the port block.

(after 7-93)

See figure 12. Remove plugs (20), (23) and pin (21). Remove the 8-32 nut from the bottom of block (1) to remove filter assembly (14). Do not remove the check valves (2).

Remove housing (8), o-ring (9), piston seal (10), o-ring (11), screw (6), nut (7), and acorn nut (45) as a unit.

Remove spring (12) and cone (13). Remove seat (5) and o-ring (4).

NOTE: Seat is made for hex. wrenching. Use 1/2" six point socket with 1/4" drive.

Remove plug (25) and replenishing relief valve (36).

Remove o-rings (37), (48) and (47). Remove four screws (43) and remove the retainer plate (42). Do not remove roll pins (46) unless replacements are needed.

Remove gasket (29) and seats (27) and (28). Remove poppets (30), (31) and springs (32), (33), (35) and retainer (34).

Inspect orifices (3) visually to insure they are open. Do not remove unless damage or clogging is apparent.

CONTROL COVERS

See figure 7. Remove the four screws (13) with nyltite washers (12) from the side cover (15) and remove the input control assembly.

NOTE: The nyltite washers must be replaced at assembly.

Remove the four screws (13) with nyltite washers (12) from the side cover (14). Remove the two screws (11) and spacers (10) and remove the balance plate (9).

See figure 6. Remove the two screws (6) and remove the balance stem (7).

SERVO/REPLENISH PUMP AND BARREL HOLDDOWN

NOTE: P24/30S units will require removing the shuttle valve assembly and external vane pump assembly and tubing.

Removal of External Aux. Pump Shuttle Valve, Mounting Adapter and Internal Aux. Pump

See figure 10. Remove tubing between external pump and main pump.

Remove two screws holding pump. Remove pump from rear drive mounting pad.

Remove four screws holding shuttle (19) in place. Remove shuttle block.

Remove four screws (18) attaching shuttle adapter (17) and remove adapter and o-rings (15) & (16).

Remove six screws (7) and mounting adapter (6), coupling (14), and gasket (22).

On non-rear drive units. Remove plug (9) and o-ring (8).

Remove eight screws (7), and end cover (6), two tetraseals (5) and o-rings (4) and (3).

Remove auxiliary pump assembly (2).

**SERVO/REPLENISH PUMP
AND BARREL HOLDDOWN**
(continued)

(24 series barrel holddown)

NOTE: This is a complete vane cartridge assembly and removed in one step. A puller tool **T3** is recommended.

Remove sealing washer (1).

See figure 4. Remove holddown lock retainer ring (8). (Use internal snap ring pliers.)

See figure 9. Remove four screws (1) and two screws (8). **NOTE:** There is a preload from the barrel holddown which will lift the port block approximately 1/8" (3.2mm) at release.

Carefully lift and remove port block (2) and port plate (4). **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.

See figure 6. Remove the face plate (2) and face plate pins (1) from the face of the barrel assembly.

See figure 4. Remove holddown adjusting screw lock (7), use an 18" blade type screwdriver, with the blade ground down to clear holddown shaft.

See figure 7. Lock main shaft from turning.

See figure 4. Use special tool **T2**, slip over auxiliary shaft (2) and engage dowels into holddown adjusting screw (6). Loosen load but do not remove.

See figure 6. Remove two bolts (5) holding housing and flange together.

See figure 3. Push tubes (4) out of housing slots and toward barrel, do not bend or damage them.

See figure 6. Lift housing (4) over tubes and barrel assembly and remove. Mounting flange must be driven from housing due to tight fit.

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

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!

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

(30 series barrel holddown)

See figure 9. Remove four screws (1) and two screws (8). **NOTE:** There is a preload from the barrel holddown which will lift the port block approximately 1/8" (3.2mm) at release.

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

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.

See figure 6. Remove the face plate (2) and face plate pins (1) from the face of the barrel assembly.

See figure 4.1. Loosen six screws gradually in alternating sequence.

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

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

See figure 7. Lock main shaft from turning.

See figure 4.1. Use special tool **T2**, slip it over auxiliary shaft (2) and engage dowels into barrel holddown nut assy. (5). Loosen load but do not remove.

See figure 6. Remove two bolts (5) holding housing and flange together.

(30 series barrel holddown continued)

See figure 3. Push tubes (4) out of housing slots and to ward barrel, do not bend or damage them.

See figure 6. Lift housing (4) over tubes and barrel assembly and remove. Mounting flange must be driven from the housing due to tight fit.

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

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!

PORT BLOCK

See figure 8. Remove the check valve assemblies (7) from the port block.

Remove plugs (9) and (10).

Remove two screws (4), lockwashers (5), check rings (6) and clamps (3).

DRIVE SHAFT

See figure 7. NOTE: Pump cam must be on center 0° angle before removing shaft.

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

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

Remove shaft and bearing assembly (1).

ROCKER CAM AND CONTROL STROKING ASSEMBLY

See figure 3. Remove pressure feed tubes (4) from the cradle. **DO NOT BEND THESE LINES.** Discard all bent lines.

Remove the rocker cam assembly from the mounting flange by carefully tilting mounting flange on its side and using a 1/4-20 threaded rod as a puller , remove plugs (11) with o-rings (8), and then remove screws (9) attaching cradle to mounting flange.

Position rocker cam assembly on a clean surface with the override tubes (2) in a horizontal position and located at the top .

See figure 2. Mark the cam (21) and cradle (18) as indicated. These marks will determine positioning of parts during assembly.

Position the assembly in an upright position on the flat surface of the cradle.

Remove the retaining ring (1), thrust washer (2), piston and shoe assembly (4) and creep plate (5) from the rocker cam (21).

Remove the four screws (11) and four screws (12) from the control chamber covers (13R) and (13L).

Remove the control chambers (14). Remove the seals (17), four steel balls (16) and dowel pins (15).

Remove the screw (3), vane seal cartridges (23), holddown vanes (22) from the rocker cam (21).

Remove the rocker cam from the cradle (18).

REWORK LIMITS OF WEAR PARTS

wear part	max. rework from original dimension	min. dimension after rework
port plate face	0.010", 0.254 mm	0.735", 18.67 mm
shoe retainer face	0.005", 0.127 mm	0.494", 12.55 mm
¹ piston shoe face, pocket	0.010", 0.254 mm	0.010", 0.254 mm
creep plate face	0.010", 0.524 mm	0.365", 9.27 mm
face plate	none	replace

¹No rework allowed on 30 in.³ piston shoe face.

**REWORK LIMITS OF WEAR
PARTS***(continued)***IMPORTANT:**

The port plate finish must be 8 microinches, .0203 micrometer both faces, flat within 0.00006", 0,0015 mm and parallel within 0.001", 0,0254 mm total indicator reading.

The creep plate wear face finish must be 5 microinches, .0127 micrometer, flat within 0.0005", 0,0127 mm and parallel to the backside within 0.001", 0,0254 mm total indicator reading.

The shoe retainer wear face finish must be 32 microinches, .0813 micrometer and flat within 0.0005", 0,0127 mm. Must not be convex.

The piston shoes wear face finish must be 30 microinches, .0762 micrometer and must be lapped in a set with the retainer plate, all shoe sole thicknesses to be within 0.001", 0,0254 mm after lapping. The maximum permissible shoe and piston axial looseness is 0.010", 0,254 mm.

The special retaining ring service kit S23-12629 may be required to control shoe holddown clearance.

ASSEMBLY PROCEDURE

CLEANING AND INSPECTION

All parts must be inspected and be free of material defects, dirt, scratches or any foreign material.

All parts must be cleaned with a suitable cleaning solvent and all holes and passages blown out with dry, clean, compressed air.

After cleaning and inspection, all parts must be covered with a light film of oil and protected from dirt and moisture. Excessive handling of internal parts should be avoided prior to assembly.

During assembly, lapped and ground surfaces must be lubricated with clean oil and protected from nicks or surface damage.

DRIVE SHAFT AND BEARING ASSEMBLY

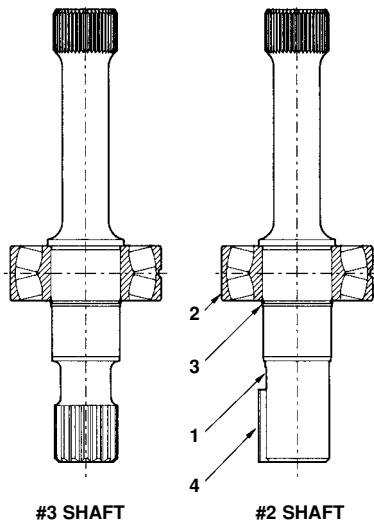


FIGURE 1

See figure 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.

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

PARTS LIST FOR FIGURE 1 S23-12474 DRIVE SHAFT #3 ASSEMBLY SPLINED S23-12475 DRIVE SHAFT #2 ASSEMBLY KEYED

item	description	part no.	quantity	
			#3	#2
1	#3 spline shaft	033-91139	1	-
	#2 keyed shaft	033-91140	-	1
2	shaft bearing	230-82213	1	1
3	retaining ring	033-71712	1	1
4	square key	033-71910	-	1

ROCKER CAM, PISTONS-SHOES & RETAINER

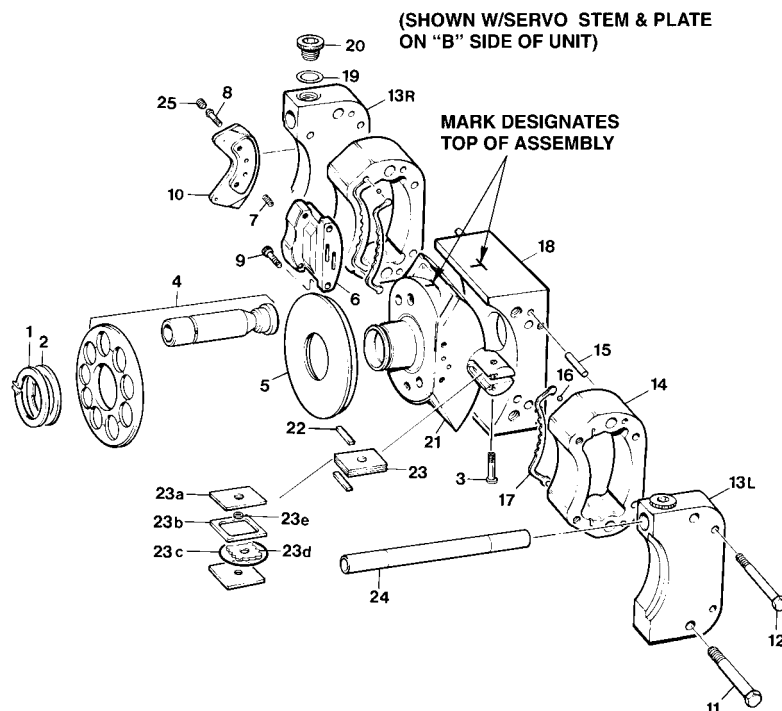


FIGURE 2

ASSEMBLY PROCEDURE

CAM-CRADLE ASSEMBLIES

items 6 through (less item 24) 25,
figure 2

S23-12478 is for RH CW rotation pumps with "B" suffix input control on right side.¹⁾
 S23-12479 is for LH CCW rotation pumps with "B" suffix input control on right side.¹⁾
 S23-12476 is for RH CW rotation pumps with "A" suffix input control on left side.¹⁾
 S23-12477 is for LH CCW rotation pumps with "A" suffix input control on right side.¹⁾
¹⁾Viewed from shaft end of pump with valve block on top 12 o'clock position.¹⁾

ROCKER CAM, PISTONS-SHOES & RETAINER

PARTS LIST FOR FIGURE 2

item	description	part no.	quantity
1	retaining ring-use only one		1
	.089-.087", 2,261-2,210mm thick with yellow dot	033-71716	
	.087-.085", 2,270-2,159mm thick with green dot	033-71717	
	.085-.083", 2,159-2,108mm thick with white dot	033-91130	
	.083-.081", 2,108-2,057mm thick with red dot	033-71718	
	.081-.079", 2,057-2,007mm thick with blue dot	033-59746	
	retaining ring service kit	S23-12629	
2	thrust washer	033-59805	1
3	socket head cap screw	359-13160	2
4	retainer-piston-shoe assy. P24	S13-44470	1
	retainer-piston-shoe assy. P30	S23-12684	
5	creep plate	033-91653	1
6	servo stem	033-71773	1
7	orifice screw	033-70819	2
8	button head cap screw	353-25023	2
9	socket head cap screw	358-10120	2
10	servo plate	033-53874	1
11	hex. head cap screw 1/2-13	306-40174	4
12	hex. head cap screw 3/8-16	306-40035	4
13R	right side chamber cover CW	033-71598	1
	right side chamber cover CCW	033-71595	1
13L	left side chamber cover CW	033-71597	1
	left side chamber cover CCW	033-71593	1
14	control chamber	033-71757	2
15	dowel pin	324-22428	4
16	steel ball	201-06001	4
17	control chamber seal	606-25045	2
18	rocker cradle	033-91141	1
19	o-ring	691-00905	2
20	hexagon socket plug	488-35020	2
21	rocker cam	S23-12482	1
22	holddown vane	033-70816	4
23	vane seal cartridge	see below	2
23a	vane seal backup plate	033-71726	4
23b	vane seal	033-71714	2
23c	o-ring	691-00128	2
23d	vane spacer	033-71727	2
23e	spacer		2
	.2500-.2495", 6,35-6,337 mm blue	033-59806	
	.2515-.2510", 6,39-6,36 mm yellow	033-59983	
	.2530-.2525" 6,43-6,41 mm green	033-59984	
24	override tube P24	033-71731	2
	override tube P30	033-57933	2
25	hex. socket set screw	312-09032	2

ROCKER CAM ASSEMBLY

See figure 2. Position the cradle (18) on a clean surface with the large flat side down.

Lightly oil curved surface of cradle. Position rocker cam (21) on the cradle, aligning match marks made during disassembly.

Place o-ring (23c) on vane spacer (23d) and insert in the vane seal (23b).

Select spacer (23e) such that when installed in cam ear slot there is .0000-.0015", 000-.038 mm total clearance between spacer and slot face. There are three different spacers available for this tolerance. Each spacer is marked: 0.2500-0.2495", 6.35-6.337 mm color blue; 0.2515-0.2510", 6.39-6.36 mm color yellow; 0.2530-0.2525", 6.43-6.41 mm color green.

Install assembled vane seal cartridge in slotted boss on side of rocker cam as indicated. Use a soft mallet and lightly tap assembly in position after rocker cam is positioned in rocker cam.

Install socket head cap screw (3) into cam ear and through vane assembly. Torque to 30 lbs-ft., 40,7 Nm.

Install the four nylon holddown vanes (22) in the slots on each side of the vane seal cartridges (23).

Position both control chambers (14) on a clean surface with seal grooves facing up.

Insert one steel ball (16) in each of the counterbored holes at the end of each of the seal grooves. Coin ball in seat.

Install seals (17) in grooves of the control chambers.

NOTE: The tapered side of the seals must be pushed into the grooves and the ends must cover the steel balls.

Install the assembled control chambers (14) over the seal cartridges by rotating the chambers until they slip over the vane seal cartridges, then rotate in the opposite direction until the 3/8" dowel pin holes in the chambers align with the dowel pin holes in the rocker cradle (18). Install dowel pins (15) through the control chambers and into the cradle.

Install chamber covers (13R) and (13L) on the control chambers (14). The covers must be installed with the override tube (24) holes at the top. Note the marks made during disassembly to indicate the top of the rocker cam and cradle.

NOTE: Two sets of control chamber covers are available. The set marked CW must be installed in the right hand rotation pump and the set marked CCW must be installed in the left hand rotation pump. Rotation is determined from the shaft end of the unit.

Install two 1/2-13 hex. head cap screws (11) in each side. Torque to 75 lbs-ft., 101,75 Nm.

Install two 3/8-16 hex. head cap screws (12) in each side. Torque to 30 lbs-ft., 40,7 Nm.

Install o-ring (19) and hex. socket plug (20) in each chamber cover.

Install override tubes (24) in holes in each cover. These tubes must be a tight fit. If tubes are loose, the ends may be expanded with a tapered punch. Tap the tubes in place with a plastic mallet.

Thread two orifice plugs (7) into servo stem (6).

Determine the proper location of the servo plate and stem. Looking at the projecting center post of the rocker cam with the override tube holes at the top, locate "A" mounted servo plate on right hand side or "B" on the left hand side.

Thread two size #10-24 socket head cap screws (9) thru the servo stem and into the rocker cam (21). Torque to 70 lbs-in., 7,9 Nm.

ASSEMBLY PROCEDURE

ROCKER CAM ASSEMBLY (continued)

Install servo plate (10) to stem (6) with two #10-24 button head screws (8). Torque to 30 lbs-in., 3,4 Nm. Install two set screws (25) in servo plate. Torque to 25 lbs-in., 2,8 Nm.

NOTE: The balance plate cannot be assembled to the rocker cam until after the housing assembly installation has been completed See figure 7.

PISTON AND SHOE ASSEMBLY

Install creep plate (5) over center post on rocker (21).

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

Install thrust washer (2) over center post of cam and against shoe retainer. Grooved side of washer must face shoe retainer.

Install the thickest retaining ring (1) that will fit in the groove on the rocker cam center post which will allow a maximum clearance of 0.002-0.005", 0,05-0,13 mm between the creep plate and shoe faces. To check this clearance, grasp one piston 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: 0.081-0.079", 2,03-1,98 mm thick blue dot; 0.083-0.081", 2,08-2,05 mm thick red dot; 0.085-0.083", 2,159-2,108 mm thick white dot; 0.087-0.085", 2,18-2,16 mm thick green dot; and 0.089-0.087", 2,4-2,21 mm thick yellow dot. The piston and shoe assembly must be free to rotate 360° by hand.

See figure 3. Install two elbow fittings (3) into the threaded holes in the cradle.

NOTE: Check the feed tubes (4) and override tubes (2) by fitting them into the correct port block holes before assembling to the stroking assembly (5). They must be a snug push fit as they rely on a metal to metal seal to contain system pressure. If they fit loose or are damaged they must be replaced.

Install pressure feed tubes (4) to elbow fittings (3). Tighten the connectors until snug.

Position the mounting flange (7) with the large open end facing up and install two dowel pins (6) in the cradle mounting surface and one 3/8", 9,5mm diameter dowel pin (10) in the outer edge of the flange.

Install the rocker cam and cradle assembly (5) over the dowel pins (6) in the mounting flange.

NOTE: Pressure feed tubes to be on the same side of mounting flange center line as the 3/8", 9,5 mm diameter dowel pin (10).

With cam and cradle installed, tilt mounting flange on its side and secure with two soc. hd. cap screws (9). Torque to 50 lbs-ft, 67,8 Nm.

Insert plugs (11) with o-rings (8) into soc. hd. cap screw (9) c'bores. **Be sure tapped hole in plug (11) is visible** after installation. This is used for removal.

Install plugs (12) with o-rings (13).

Install shaft assembly

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

NOTE: Do not tap on end of shaft, but on the bearing outer race only.

MOUNTING FLANGE, CAM & CRADLE, BARREL & AUXILIARY SHAFT ASSEMBLY

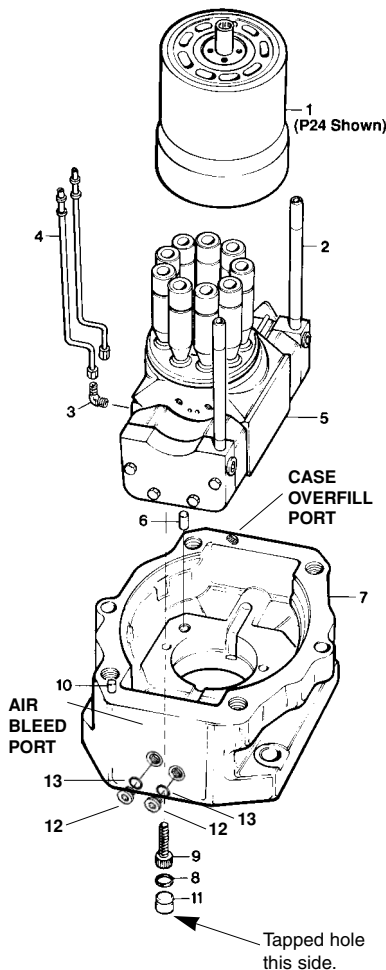


FIGURE 3

**MOUNTING FLANGE,
CAM & CRADLE, BARREL &
AUXILIARY SHAFT ASSEMBLY**
(continued)

PARTS LIST FOR FIGURE 3

item	description	part no.	quantity
1	barrel & aux. shaft assembly	see fig.4 or 4.1	1
2	override tubes item 24	see fig. 2	2
3	male elbow	473-15041	2
4	tube assembly P24	S13-44469	2
	tube assembly P30	S23-12172	2
5	rocker cam & stroking assy.	see fig. 2	1
6	dowel pin	324-24028	2
7	mounting flange	033-91137	1
8	o-ring	671-00111	2
9	soc. hd. cap screw	358-16260	2
10	dowel pin	324-22416	1
11	plug	033-57475	2
12	plug	488-35061	3
13	o-ring	691-00904	3

Return the mounting flange to an upright position and tilt the rocker cam to either extreme attitude on the cradle.

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.

**BARREL AND AUXILIARY
DRIVE SHAFT 24 SERIES**

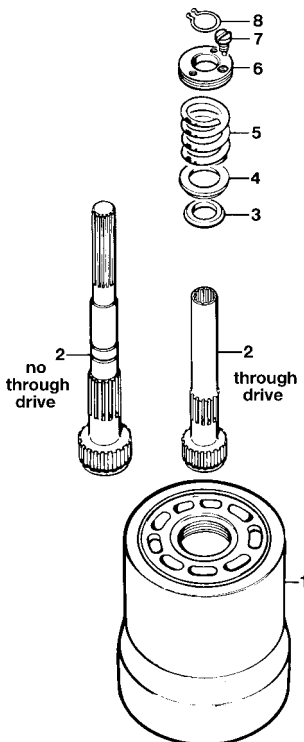


FIGURE 4

See figure 4. Install auxiliary shaft (2) large spline end first into counterbore in face of barrel spline.

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

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

Thread holddown adjusting screw (6) into counterbore approximately four threads.

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

Thread holddown adjusting screw (6) into counterbore until it is flush to 0.060", 1.52 mm maximum below barrel face.

PARTS LIST FOR FIGURE 4 (P24)

item	description	part no.	P24	quantity
1	barrel & sleeve assembly	S23-12091	1	
2	auxiliary drive shaft	033-57257	1	
	(no through drive)			
	auxiliary drive shaft & coupling	SAE-B=S23-17444-0K		1
	(through drive)	SAE-BB=S23-17448-0K		1
		SAE-C=S23-17446-0K		
		SAE-D=S23-17450-0K		
3	spherical seat	033-57147		2
4	spring retainer	033-57138		1
5	spring	033-57136		1
6	holddown adjusting screw	033-57139		1
7	holddown adj. screw lock	033-57241		1
8	holddown lock retaining ring	033-57239		1

ASSEMBLY PROCEDURE

BARREL AND AUXILIARY DRIVE SHAFT 30 SERIES

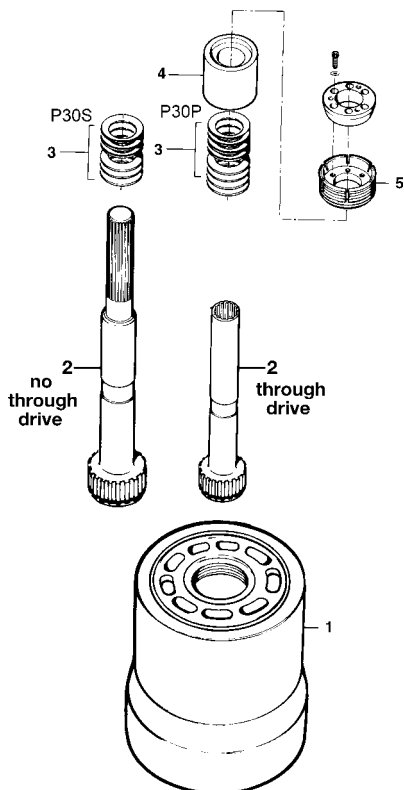


FIGURE 4.1

HOUSING ASSEMBLY

See figure 4.1. Install auxiliary shaft (2) large spline end first into counterbore in face of barrel and engage barrel spline.

Slide holddown spring assembly (3) onto shaft (2). Install spring retainer (4) into counterbore.

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

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

Thread holddown screw assembly (5) into counterbore until it is .25 in., 6,35 mm below barrel face.

PARTS LIST FOR FIGURE 4.1 (P30)

item	description	part no.	quantity	
			P30P	P30S
1	barrel & sleeve assembly	S23-12170	1	1
2	auxiliary drive shaft (no through drive)	033-91188	1	1
	auxiliary drive shaft & coupling (through drive)	SAE-B=S23-17445-0K SAE-BB=S23-17449-0K		
		SAE-C=S23-17447-0K	1	1
		SAE-D=S23-17451-0K	1	1
3	holddown spring	035-71713	6	6
4	spring retainer	033-91138	1	1
5	barrel holddown nut assembly	S23-12171	1	1

See figure 5 Clean housing (1) and position on a flat surface with the large open end up.

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 lbs-ft., 40,8 Nm.

Install two dowel pins (4) in the blind holes in the control cover pads. Repeat step above on the opposite side of the housing.

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

PARTS LIST FOR FIGURE 5

item	description	part no.	quantity
1	housing 24	033-57150	1
	housing 30	033-57925	
2	bearing	033-93046	1
3	screw soc. hd. cap	358-14106	2
	5/16-18 x 5/8 w/nylok		
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

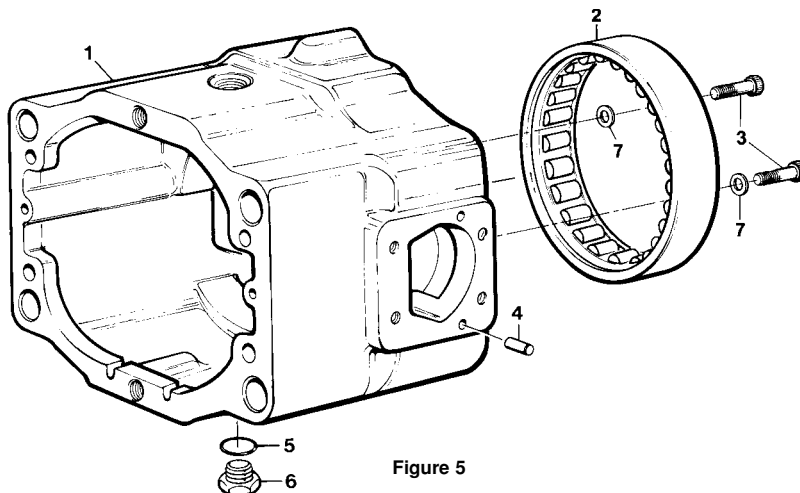


Figure 5

ASSEMBLY PROCEDURE

HOUSING, END CAP, CAM AND BARREL ASSEMBLY

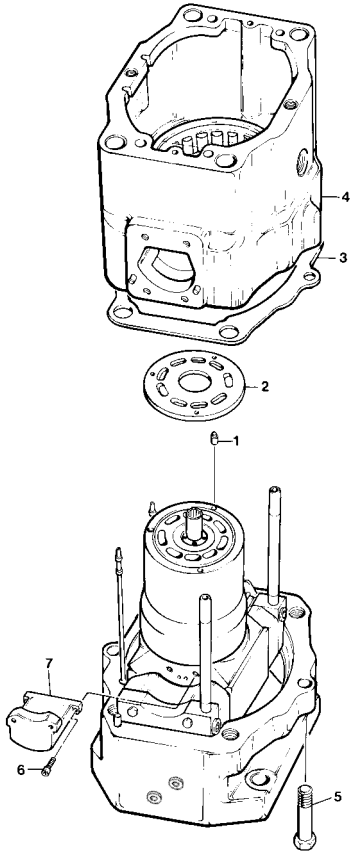


FIGURE 6

See figure 6. Install new gasket (3) over the dowel pin in the mounting flange. Do not use gasket compound.

Insert two socket hd. cap screws (6) through holes in balance stem (7). Attach balance stem to stroking control assembly. Torque to 70 lbs-in., 6,6 Nm.

Install the housing assembly (4) over the barrel and auxiliary shaft assembly. Carefully guide the override tubes and pressure feed tubes items 2 and 4, figure 3 through the housing assembly. Position the pressure feed tubes in the slots in the housing face.

NOTE: Lightly force the pressure feed tubes downward toward the stroking assembly do not bend or crimp the tubes enough so that they must be pulled up a little to snap into the housing slots. This will hold them in position for assembling the port block to the housing.

Insert two hex. hd. cap screws (5) through mounting flange and into housing. Torque to 100 lbs-ft., 135,6 Nm. These must be fully torqued later when main bolts are in place.

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

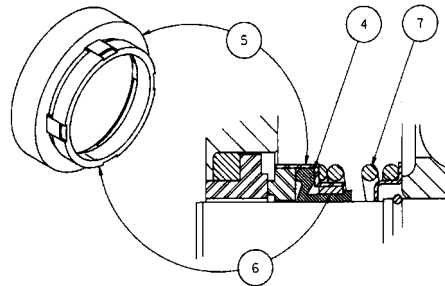
Apply clean heavy grease to the surface of the barrel and install the face plate (2) over the face plate pins. The surfaces must be absolutely free of scratches, dust or dirt to prevent excessive leakage. Lubricate pistons with clean system fluid through the holes in the face plate.

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 6

item	description	part no.	quantity
1	face plate pins	033-59747	3
2	barrel face plate P24	033-71748	1
	barrel face plate P30	033-57571	
3	housing gasket	033-91082	1
4	housing assembly	see fig. 5	1
5	hex. hd. screws	306-40009	2
6	soc. hd. cap screws	358-10120	2
7	balance stem	033-71774	1

MECHANICAL SHAFT SEAL ASSEMBLY PROCEDURE



CAUTION: 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 does not 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: Re-using shaft seal is not recommended practice.

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

SEAL ASSEMBLY

See figure 7.

NOTE: 24 series only - to replace shaft seal only:

Remove unit for disassembly.

Some units require removing an adapter housing and external pump.

Follow steps removing the internal auxiliary pump and seal plate see figure 10.

Remove retaining ring (8), figure 4.

Remove shaft seal. Follow seal assembly in reverse order.

Assemble new shaft seal per instructions below.

After seal is replaced re-install retaining ring (8), figure 4 and reassemble auxiliary pump and unit per assembly instructions.

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

SEAL ASSEMBLY

Procedure for installation of Mechanical Shaft Seals

Use only **clean** hydraulic fluid from the test stand or system to lubricate the seal. The fluid must be compatible with the type of seals being installed. Ensure that your hands are **clean** at all times when installing seals.

Install the shaft into the unit per procedure .

Assure that the seal faces of the stator and carbon ring remain **clean** throughout the installation. These parts have highly polished finishes which must be maintained to seal properly.

Lubricate the seal ring on the outside of the seal stator (ceramic) and install into seal retainer. Inspect the back of the retainer to assure that the seal ring and stator are installed completely and squarely into the retainer and the stator is not tipped. Care must be taken to assure that the stator is not damaged. Avoid any impact on this piece.

Install o-rings into grooves on the seal retainer as required.

Lubricate the shaft in the seal area, the ID of the Rubber boot, the face of the stator and the face of the carbon ring. **Without touching the face of the carbon seat**, slip the assembled spring and rubber boot onto the shaft until the spring retainer bottoms out. Align the seal retainer and mounting flange bolt holes and push this assembly down with the seal stator face against the carbon face until the seal retainer is in the mounting flange pilot, taking care to keep the parts as even as possible. Secure (**Do not use impact tool**) with 4 screws and torque to required specification.

Allow the unit to sit for a minimum of **one hour** before running to allow time for the seal friction ring to adhere to the shaft.

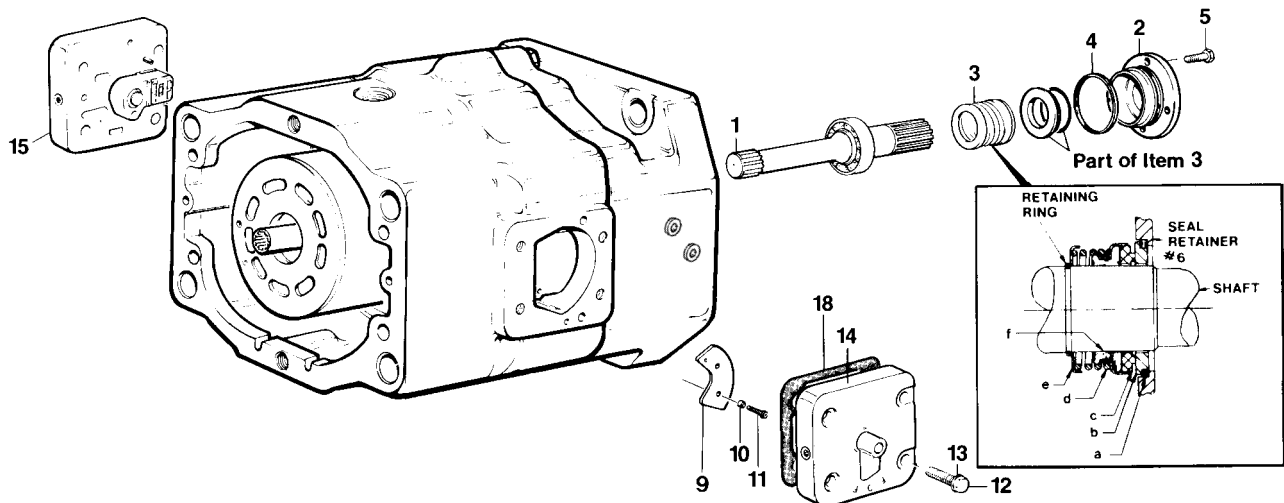


FIGURE 7

"B" mounting position shown

PARTS LIST FOR FIGURE 7

item	description	part no.	quantity
1	No. 3 splined shaft assy. see figure 1	S23-12474	1
	No. 2 keyed shaft assy. see figure 1	S23-12475	
2	seal retainer	033-57472	1
3	shaft seal	623-00015	1
4	seal retainer o-ring	671-00246	1
5	hex. head screw	306-40123	4
6	not used		
7	not used		
8	not used		
9	balance plate	033-70546	2
10	spacer	033-71247	2
11	soc. hd. cap screw	359-09180	2
12	Nyltite® washer	631-45007	8
13	hex. hd. washer screw	353-25018	8
14	control assy. output	see below	1
15	control assy. input	see below	1
16	Not used		
17	Not used		
18	Gasket	033-91058	1

OPTIONAL CONTROLS

See page 64. Also, see catalog S1-2AM-7501-A.

COUNTERBALANCE PLATE ASSEMBLY

See figure 7. Place the two spacers (10) on the screws (11) and install through the balance plate (9).

Align screws with the threaded holes in balance stem and tighten. Torque to 70 lbs-in., 6,6 Nm.

SERVO PLATE ASSEMBLY

Replace servo plate that was removed, refer to servo assembly page 17 to servo stem.

CONTROL COVER ASSEMBLY

Install gaskets (18) on covers.

CONTROL COVER ASSEMBLY
(Continued)

PORT BLOCK ASSEMBLY

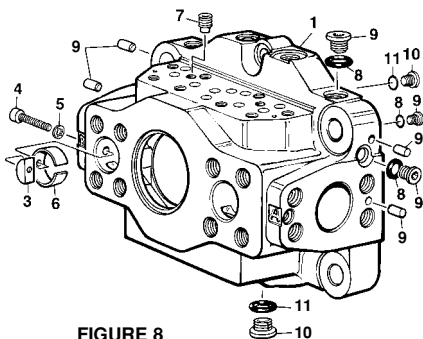


FIGURE 8

Install the cover assemblies (14) & (15) over the dowel pins on the housing pads and secure with seal (12) and screws (13). Torque to 30 lbs-ft., 40,8 Nm.

See figure 8. Position the port block (1) on a clean flat surface with two open ports up. The finished faces must not be scratched or damaged.

Compress the ring checks (3) and install in the two system ports and align holes in the rings with the side holes in the port walls.

Place lockwashers (5) on screws (4) and install screws through port wall and ring checks and thread into nut (3). Torque to 10 lbs-ft., 13,56 Nm.

Install two check valve assemblies (7) in valve face of port block. Torque to 30 lbs-ft., 40.8 Nm.

Install nine hex. hd. soc. plugs (9) and o-rings (8) into port block. Torque to 16 lbs-ft., 22 Nm.

Install hex. soc. plugs (10) and o-ring (11) into port block. Torque to 50 lbs-ft., 68 Nm.

Install "AVSEAL"® plugs (2) into port block.

PARTS LIST FOR FIGURE 8

item	description	part no.	(P24/30P) S23-15105 quantity	(P24/30S) S23-15127 quantity
1	port block	033-91564	1	—
	port block w/shuttle (S)	033-91604	—	1
3	ring check	033-72355	2	2
4	soc. hd. cap screw	359-11140	2	2
5	lockwasher	348-10016	2	2
6	ring check nut	033-72356	2	2
7	check valve assembly	S13-40266	2	2
8	o-ring	691-00906	9	9
9	hex. soc. plug	488-35041	13	13
10	hex. soc. plug	488-35018	3	6
11	o-ring	691-00908	3	6

PORT BLOCK INSTALLATION

See figure 9. Position the pump with open end of the housing assembly (6) facing up. Install new gasket (5) on the housing. Do not use gasket compound.

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

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

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

Temporarily attach port plate to port block by inserting a cord through one of the 2", 50,8 mm diameter ports down through the port block port, through arcuate in the port plate, around web, back through port block and tie ends of the cord to lifting eye. Repeat this step to the other side of the port plate.

Install the port block assembly over the auxiliary shaft and position onto tubes and dowel pins while engaging pressure feed tubes.

CAUTION: Use extreme care and slowly lower the port block carefully onto the four tubes which are precision fit in the port block. Check when the block is within 1/2", 12,7 mm of seating that the tubes are square in the holes and the port plate is seated firmly against the block. Lower the block until the joint is closed.

Install the six bolts and washers (8) & (9) & (1) & (10). Do not drop the bolts in place as the threads will be damaged. Torque bolts evenly. Torque bolts (1) in 50 lb., 67,8 Nm increments to 450 lbs-ft., 610 Nm and the two bolts (8) to 120 lbs-ft., 163 Nm tightening in turn all six bolts. Torque two bolts, Fig.6 items to 120 lbs-ft., 163 Nm.

CAUTION: Exercise extreme care to prevent damage to the valve mounting surface while installing and torquing the top bolts.

PARTS LIST FOR FIGURE 9

item	description	part no.	quantity
1	hex. hd. cap screw P24P	306-40221	4
	hex. hd. cap screw P30P	306-40230	
2	port block assy.	S23-15105	1
	port block assy. w/shuttle (S)	S23-15127	
3	port plate pin	324-21610	2
4	R.H. port plate 24	033-71752	1
	R.H. port plate 30	033-91238	
	L.H. port plate 24	033-71753	
	L.H. port plate 30	033-91237	
5	port block gasket	033-91085	1
6	housing assembly 24	S23-12566	1
	housing assembly 30	S23-12175	
7	dowel pin	324-24832	2
8	hex. hd. cap screw	306-40022	2
9	washer, hdn. stl.	350-10136	2
10	washer, hdn. stl.	350-10135	4

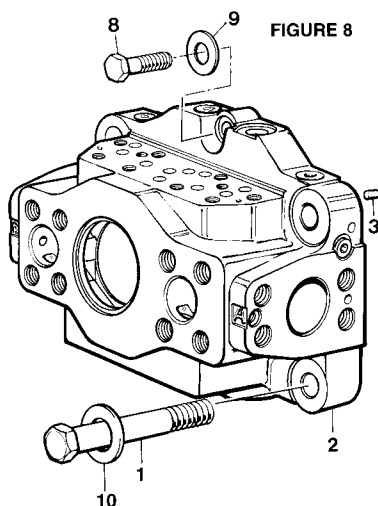


FIGURE 8

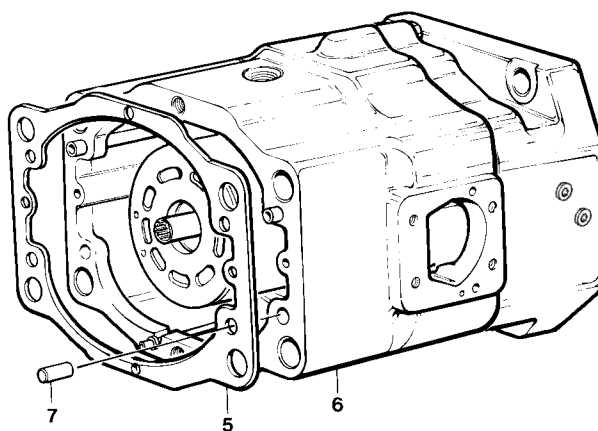


FIGURE 9

**BARREL HOLDDOWN
24 SERIES**

See figure 4 & 10. Use special tool T2 and slip over auxiliary shaft and engage the holes in the holddown adjusting screw (6), figure 4. 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.

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

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.

Barrel lift-off is now set at .030"-.036", .76-.91 mm.

Use a large screw driver with the sides of the blade ground down so it passes along side the aux. shaft and engages the screw slot. Thread holddown adjusting screw lock (7), figure 4 into holddown adjusting screw. Torque to 30 lbs-ft., 40,7 Nm.

Slip holddown lock retaining ring (8), figure 4 over auxiliary shaft into groove which is located 5-3/4", 146.05 mm from end of shaft.

**BARREL HOLDDOWN AND
AUXILIARY PUMP 30 SERIES**

See figure 4.1 & 10. Use special tool T2 and slip over auxiliary shaft and engage dowels into holddown screw assembly (5), figure 4.1. Carefully tighten clockwise until hold-down 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.

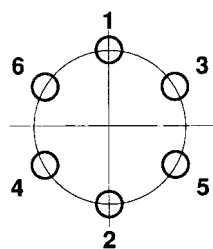
Back off holddown screw assembly 140°, counter-clockwise.

Barrel lift-off is now set at 0.032", 0,81mm.

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

Lock holddown screw assembly in place by tightening the six socket head cap screws gradually in the following torque sequence until 65 lbs-in., 7,4 Nm 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 screws completely. Use the #10-32 UNF threaded 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

AUXILIARY PUMP

See figure 10. Slip sealing washer (1) into bore in port block, over auxiliary shaft and seat at bottom of bore.

With the valve block face of the port block located at 12 o'clock position, the dowel pin hole for vane cartridge assembly (2) in the port block is located between 1 o'clock and 2 o'clock position.

Grease o-rings on vane cartridge assembly.

Install vane cartridge assembly into port block, making sure dowel pin in vane cartridge assembly to seat against sealing washer (1).

NOTE: Distance from end of vane cartridge assembly to face of port block .82" ± 0.02", 20,8 ± 0,05mm.

Untie cords holding port plate and remove.

END COVER

Apply a light film of oil or grease to o-rings (3), (4) and tetraseals (5) and place o-rings (3) and (4) around pilot of end cover (6), place tetraseals (5) in grooves in face of end cover.

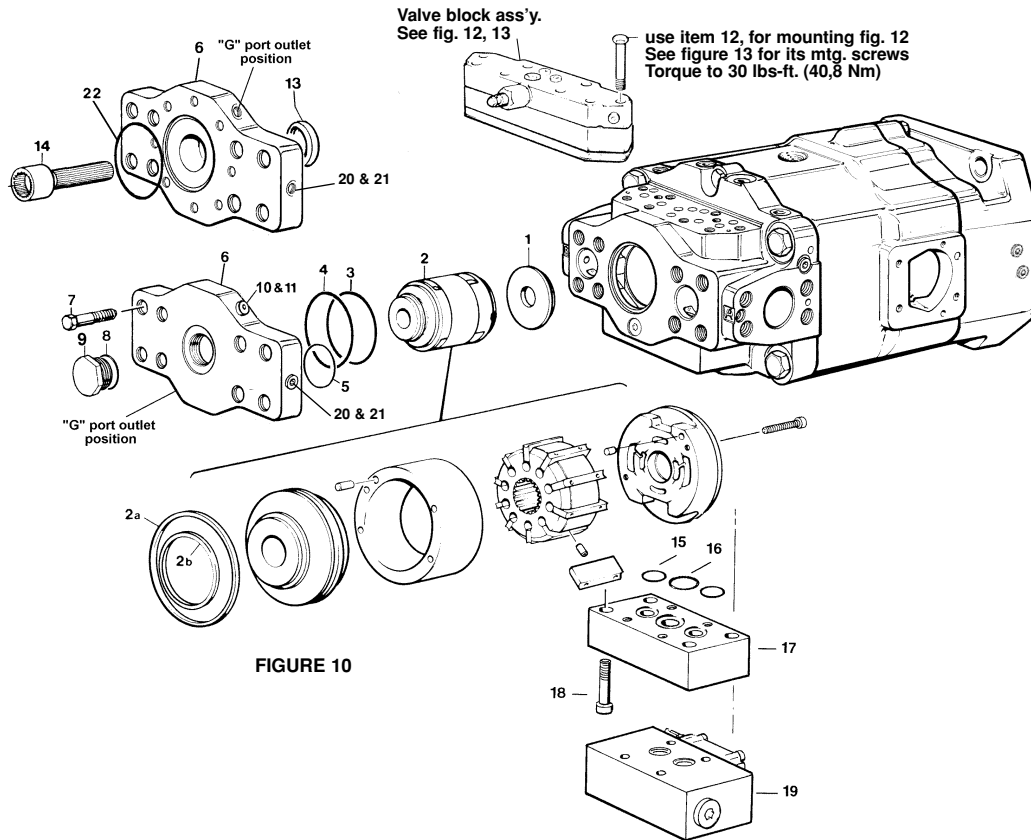
Apply a light film of oil or grease to o-ring (11), and place on plug (10). Thread plug into end cover and tighten.

Engage pilot of end cover into bore of port block. Refer to figure 10 for "G" port positioning. Align holes and secure with screws (7). Torque to 350 lbs-ft., 474.6 Nm.

Apply a light film of oil or grease to o-ring (8), and place on plug (9). Thread plug into end cover and tighten.

Apply a light film of oil or grease to o-ring (21) and place on plug (20). Thread plug into gage port.

ASSEMBLY PROCEDURE



PARTS LIST FOR FIGURE 10

item	description	part no.	qty
1	sealing washer	033-91073	1
2	cartridge assembly CW 2.81 in ³ /rev, 46,1 cc/rev	S24-11918	1
	cartridge assembly CCW 2.81 in ³ /rev, 46,1 cc/rev	S24-05562	
	cartridge assembly CW 1.64 in ³ /rev, 26,9 cc/rev	S24-11789	
	cartridge assembly CCW 1.64 in ³ /rev, 26,9 cc/rev	S24-51206	
	cartridge assembly CW 1.05 in ³ /rev, 17,2 cc/rev	S24-11697	
	cartridge assembly CCW 1.05 in ³ /rev, 17,2 cc/rev	S24-11778	
	cartridge assembly CW 3.56 in ³ /rev, 58,3 cc/rev	S24-05342	
	cartridge assembly CCW 3.56 in ³ /rev, 58,3 cc/rev	S24-05563	
	cartridge assembly CW 4.84 in ³ /rev, 79,3 cc/rev	S24-05509	
	cartridge assembly CCW 4.84 in ³ /rev, 79,3 cc/rev	S24-05510	
	cartridge assembly CW 5.42 in ³ /rev, 88,8 cc/rev	S24-63562-0	
	cartridge assembly CCW 5.42 in ³ /rev, 88,8 cc/rev	S24-44844-0	
	cartridge assembly CW 6.10 in ³ /rev, 100,0 cc/rev	S24-63563-0	
	cartridge assembly CCW 6.10 in ³ /rev, 100,0 cc/rev	S24-63564-0	
	cartridge assembly blank	S24-15102	
2a	o-ring	691-00238	1
2b	tetraseal	691-10229	1
3	o-ring	671-00238	1
4	o-ring	671-00242	1
5	tetraseal	691-10228	2
6	end cover std.	033-91566	1
	end cover w/SAE-101-2 (B)	033-91605	
	end cover w/SAE-127-2 (C)	033-91624	
7	screw, soc. hd. cap	358-26240	8
8	o-ring, std.	691-00932	1
9	plug, std.	488-35059	1
10	plug, std.	488-35024	1
11	o-ring, std.	691-00916	1
12	hex. hd. cap screw	306-40169	8
13	seal SAE-B only	620-82066	1
14	coupling SAE-22-4 (B spline)	033-57214	1
	coupling SAE-32-4 (C spline)	033-57315	
15	tetraseal (P24/30S)	691-10214	2
16	o-ring (P24/30S)	671-00223	1
17	adapter (P24/30S)	033-57188	1

PARTS LIST FOR FIGURE 10 (continued)

item	description	part no.	qty
18	screw 1/2-13 x 2-1/2	358-20280	4
19	shuttle valve assembly	S23-11966	1
20	plug, str. thd.	488-35041	2
21	o-ring	691-00906	2
22	o-ring SAE-B	671-00155	1
	o-ring SAE-C	671-00159	

rear drive adapter

See figure 10. A special tool T4 refer assembly tools is required to press shaft seal (13) into SAE-B adapter. Place adapter on a clean surface with pilot facing up. Use seal tool to drive seal into adapter. Make certain that the white lip of seal numbered side is toward inside of the adapter.

Apply a light film of grease on o-ring (21), install on plug (20) and thread into adapter gage ports and tighten.

Apply a light film of grease in sealing groove on adapter mounting face and on port block face. Place tetraseals (5) in grooves in adapter and o-ring (4) in groove in port block face.

Apply a light film of oil or grease on o-ring (3), and place around pilot dia. of adapter. Engage pilot of adapter into bore of port block. Align holes and secure with screws (7). Torque to 49 lbs-ft., 66,4 Nm.

Install coupling (14) thru vane cartridge (2) and into auxiliary drive shaft (2) fig. 4 or 4.1.

pilot valve assembly

See figure 11. Insert seat (2-8) into cap (2-3) and seat in bottom of bore .

Install small end first of piston (2-6) into block (2-7). Install small end first of block (2-7) into bore and against seat.

Install spacer (2-5) and secure in place with set screw (2-4).

Install spring (2-11) onto cone (2-9). Install spring (2-10) over spring (2-11).

Install o-ring (2-14) on piston (2-13), insert small end into springs, and insert into cap (2-3) and seat (2-8).

Install plug (2-15), screw (2-17) and nut (2-16). Set per requirement and cover with acorn nut (2-18).

Insert plug (2-19) into hole on spring end of cap.

Insert orifice plug (2-1) in center hole in cap. Grease and install o-rings (2-2).

shuttle valve assembly

See figure 11. Lube spool (3) and insert it into valve body (1). When the spool is fully engaged, move the spool back and forth a few times to check for smooth operation. Spool must move freely in body bore.

Install spring stop (4) into one end of valve body (1). Make sure it is seated properly.

Insert spring (8) into valve body (1) over the spool (3). Install plug (12) and o-ring (15) into the valve body (1). Repeat step on the other end of valve body.

Lube o-ring (9) and place over the sleeve (5) and install into bore of valve body (1). Be careful not to jam sleeve in bore.

Insert piston (6) into sleeve (5) and place spring (7) into piston (6).

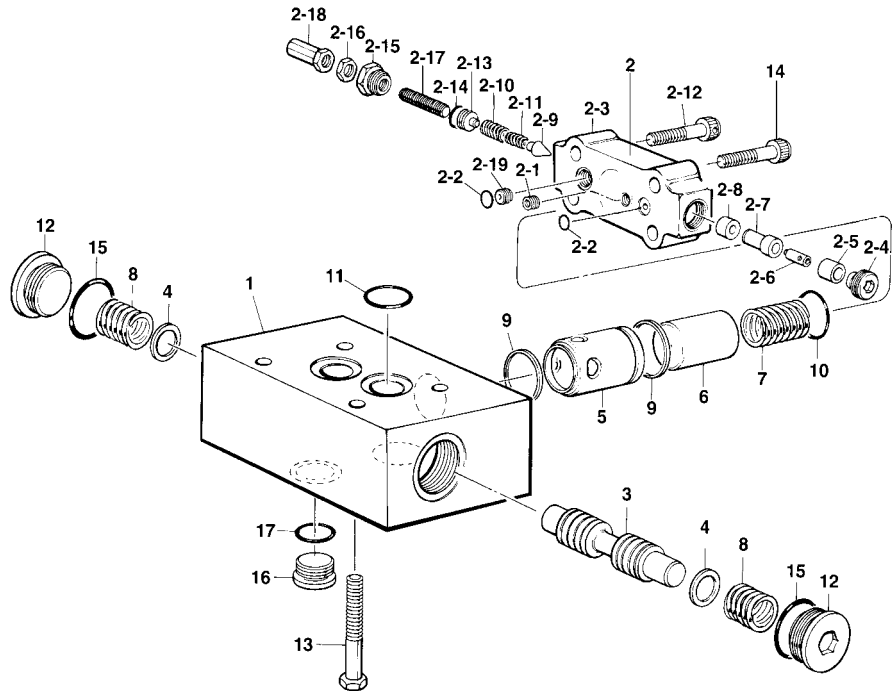
Lube o-ring (10) and place onto the sleeve (5).

Lube o-rings which come on pilot valve sub assembly (2).

Mount pilot valve cap sub-assembly (2) onto shuttle block (1). Use three soc. hd. screws (14) and one drilled head screw which comes with the pilot valve sub-assembly. Make sure that the screw that comes with the valve cap sub-assembly is positioned on end closest to acorn nut. Torque to 50 lbs-ft., 68 Nm. Run lead wire which comes with valve cap sub-assembly through holes in special screw and acorn nut. Twist ends together.

ASSEMBLY PROCEDURE

shuttle valve assembly (continued)



**FIGURE 11 EXPLODED VIEW OF SHUTTLE VALVE
EXPLODED VIEW OF PILOT VALVE EXT. DRAIN**

PARTS LIST FOR FIGURE 11, S23-11966

item	description	part no.	quantity
1	shuttle block	033-57752	1
2	pilot valve external drain	S26-22865	1
3	spool	033-57180	1
4	spring stop washer	033-57182	2
5	sleeve	036-27549	1
6	piston	036-32902	1
7	spring	036-27547	1
8	spring	033-57181	2
9	o-ring	691-00125	2
10	o-ring	691-00026	1
11	tetraseal	691-10221	2
12	plug	488-35024	2
13	screw, hex. hd. cap 1/2-13 x 3-1/2	306-40224	4
14	screw, soc. hd. cap 3/8-24 x 1-3/4	359-15220	3
15	o-ring	691-00916	2
16	plug	488-35014	1
17	o-ring	691-00912	1

PARTS LIST FOR FIGURE 11, S23-11966 ITEM 2

2-1	orifice	036-25528	1
2-2	o-ring	695-00013	2
2-3	cap	036-38910	1
2-4	set screw	312-35051	1
2-5	spacer	036-27548	1
2-6	piston	036-11694	1
2-7	block	036-11710	1
2-8	seat	036-11692	1
2-9	cone	036-12288	1
2-10	spring	036-32465	1
2-11	spring	036-85514	1
2-12	screw soc. hd. cap 3/8-24 x 1-3/4 w / wire hole	036-36749	1
2-13	piston	036-21767	1
2-14	o-ring	675-00012	1
2-15	plug	036-21765	1
2-16	hex. nut 5/16-24	333-13001	1
2-17	screw soc. set 5/16-24 x 1-5/8	312-13200	1
2-18	acorn nut	036-33474	1
2-19	hex. soc. plug	431-90104	1

shuttle valve adapter

See figure 10. Lubricate tetraseals (15) and o-ring (16) and place in c'bores on shuttle valve adapter's (17) mounting surface.

Carefully attach shuttle adapter to port block using soc. hd. cap screws (18). Torque to 75 lbs-ft., 102 Nm.

Note: Bolt pattern for shuttle adapter is non-symmetrical and can be mounted only one way.

shuttle valve mounting

See figure 11. Lubricate tetraseals (11) and place in c'bores of shuttle valve's mounting surface.

Carefully attach shuttle valve to shuttle valve adapter using screws (13). Torque to 75 lbs-ft., 102 Nm.

Note: Bolt pattern for shuttle adapter is non-symmetrical and can be mounted only one way.

VALVE BLOCK ASSEMBLY

Figure 12

NOTE: Prior to assembly of reconditioned parts, check finish of gasket surface on valve block and retainer. Must have 60 rms finish with no grinding marks which might carry oil to outside surface. If lapping is necessary, check depth of pockets for valve seats after lapping. Must be .085", 2,16 mm minimum after lapping to provide clearance for valve seats.

NOTE: Do not use impact tools or over tighten threaded parts.

Wash and dry all parts. During assembly, lapped and ground surfaces should be kept lubricated with clean oil and protected from nicks or surface damage.

Place valve block (1) with the six poppet valve bores up in order to press two roll pins (26) in position. Roll pins to be .12" 3,04 mm below surface of valve block. (Not required after 8-96).

Install four orifice plugs (3) into valve block (1) and tighten in place.

Disassemble the strainer assembly (14) and reassemble per the following steps:

Install the orifice screw of the strainer assembly into valve block. Thread elastic stop nut onto the orifice screw and torque to 23 lbs-in., 2,6 Nm.

Install clean filter screen on strainer support and secure in place with socket head cap screw, 6-32 X 1/4" lg. Torque #6-32 screw to 13 lbs-in., 1,47 Nm.

Place valve block with poppet valve bores facing up. Position gasket (29) on valve block. Lubricate bores with clean hydraulic fluid.

Place springs (33) 1.43", 36,32 lg. into outer most bores at each end of the valve block. Place sequence poppet (30) over these springs. Position seats (27) small shoulder side first over poppets.

Place springs (35) 1.09", 27,68 mm lg. into bores next to the sequence poppet valves of two steps previous. Place dual relief poppet (31) over these springs. Position seats (28) with the groove side facing up, over poppets.

Place spring (32) into bore next to compensator valve side of block. Install replenish poppet over spring. Position seat (28) with the groove side facing down, over poppet.

Insert spring (35) into the remaining bore. Place spring retainer (34) in spring. Place servo poppet (31) over the retainer and spring. Position seat (28) with the groove side facing down, over poppet.

Carefully position the retainer plate over seats and poppets. Pressing with one hand on the valve, compress seats, poppets and springs far enough to alternately thread two button head cap screws (43) in far enough to hold the retainer plate. Install the other two screws and alternately tighten screws. Torque to 30 lbs-in., 3,39 Nm.

Lubricate o-ring (4) and install on to seat (5), thread seat in valve block. Be careful not to damage bore in the seat. Torque to 15 lbs-in., 20,34 Nm.

Apply vaseline to shank of cone (13) and install spring (12) on cone. Carefully insert cone and spring into valve block positioning point of cone into bore of seat.

Lubricate o-ring (11) install in groove of piston (10) and insert end of piston into spring (12).

Lubricate o-ring (9) and install on housing guide (8) and thread into valve block. Tighten in place.

Thread nut (7) on socket set screw (6) and thread screw into housing guide (8) until it starts to compress spring.

ASSEMBLY PROCEDURE

VALVE BLOCK ASSEMBLY

Figure 12
(continued)

Using a small bladed screw driver, thread the pilot replenishing relief valve assembly (36) into valve block and lightly tighten in place. Do not over tighten. Over tightening can cause sides of slot to break now or at next removal.

Lubricate o-ring (4) and install on plug (25) and tighten plug in place .

Thread check valve (2) into valve block and lightly tighten in place. Do not over tighten. Lubricate o-ring (22) and install on plug (23) and tighten in place . Repeat step on other end of valve block.

Lubricate o-ring (19) and install on plug (20) and tighten plug in place .

Install pin (21). Lubricate o-ring (22) and install over plug (23) and tighten plug in place.

Lubricate o-ring (4) and install on plug (25) and tighten in place .

Lubricate two o-rings (22) and install over two plugs (25) and tighten in place .

Using a small hammer carefully tap roll pins (46) into and thru the retainer plate (42), the pins should bottom out in hole leaving enough length sticking out for piloting into the port block.

Lubricate o-ring (47), (48) and (37) and install in the bottom of retainer plate (42).

Valve is ready to install on pump .

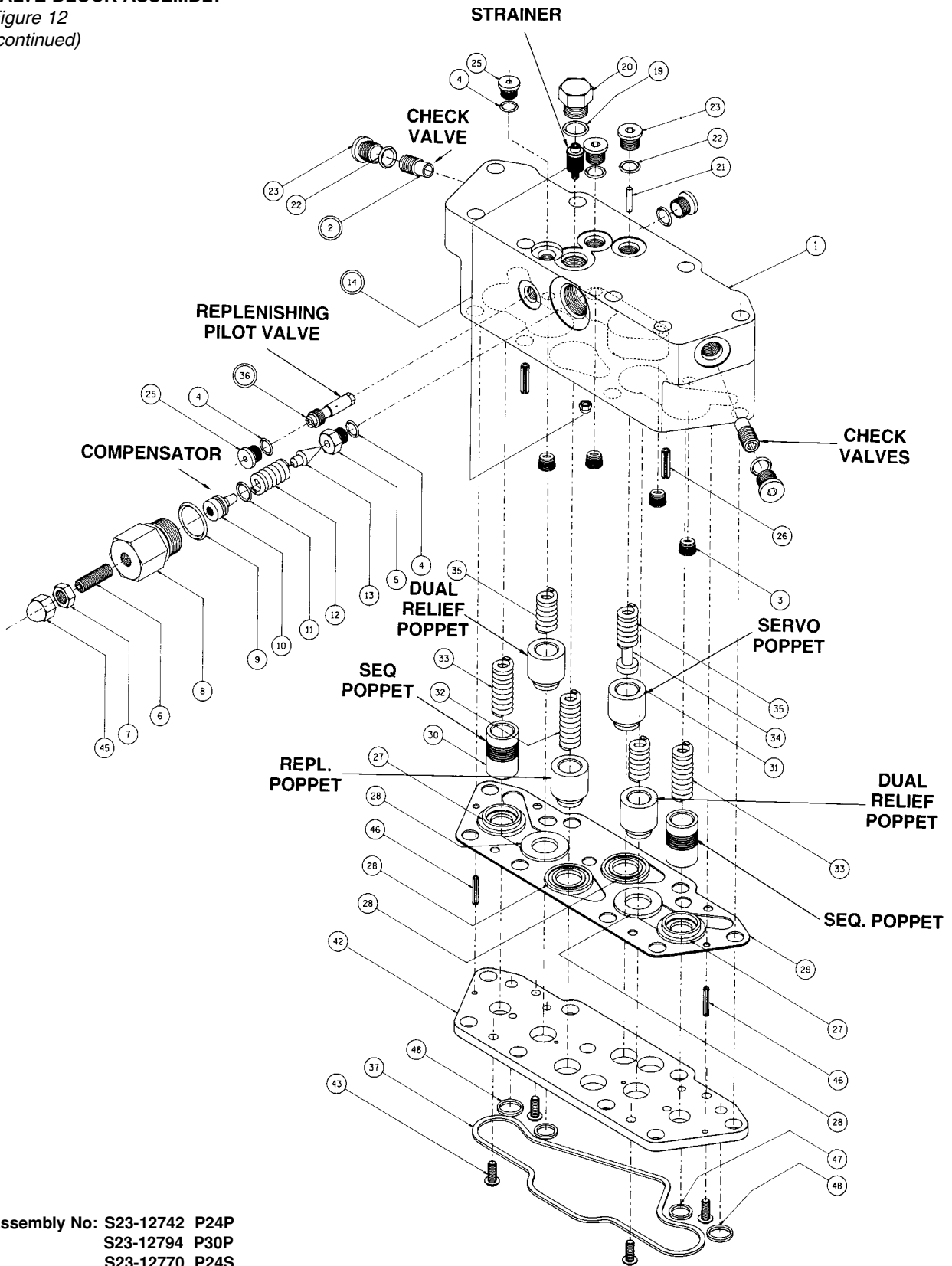
PARTS LIST FOR FIGURE 12

item	description	part no.	quantity
1	valve block P24P/S	033-91221	1
	valve block P30P/S & P24/30P w/ 9A control	033-91334	
2	check valve assembly	S13-40266	2
3	orifice plug	033-91249	4
4	o-ring	691-00903	3
5	seat	033-70508	1
6	soc. hd.screw 5/16-24 x 1" lg.	312-13160	1
7	hex. jam nut 5/16-24	335-13100	1
8	housing guide	033-70545	1
9	o-ring	691-00910	1
10	seal piston	036-21767	1
11	o-ring	671-00012	1
12	spring	032-91798	1
13	cone	036-12288	1
14	servo strainer assembly	S13-43240	1
19	o-ring	691-00906	1
20	plug	488-35003	1
21	roll pin 1/8 x 5/8" lg. P24P/S	324-20810	1
	roller P30P/S & P24/30P w/ 9A control	230-82170	
22	o-ring	691-00904	5
23	plug	488-35001	5
25	plug	488-35049	2
*26	roll pin	325-12120	2
27	sequence seat	033-70507	2
28	replenish & servo seat	033-70500	4
29	valve block gasket	033-91193	1
30	sequence poppet	033-72378	2
31	dual & replenish poppet	033-72379	4
32	replen. spring	033-22141	1
33	sequence & servo spring	033-70512	2
34	spring retainer	033-70482	1
35	dual relief spring	033-71086	3
36	pilot replen. valve	S23-12699	1
	pilot replen. valve P24/30S	S23-12813	
	pilot replen. valve P24/30P w/ 9A control	S23-12814	
37	o-ring	671-00050	1
42	retainer plate	033-91422	1
43	button hd. screw #10-24 x 3/4" lg.	353-25078	4
45	acorn nut 5/16-24	327-25006	1
46	roll pin 1/8 x 3/4" lg.	325-08120	2
47	o-ring	671-00013	2
48	o-ring	671-00014	2

*Not required after 8-96.

VALVE BLOCK ASSEMBLY

Figure 12
(continued)



Assembly No: S23-12742 P24P
 S23-12794 P30P
 S23-12770 P24S
 S23-12795 P30S
 S23-12796 P24/30P w/9A control

FIGURE 12

**VALVE BLOCK ASSEMBLY FOR
SERVO VALVE MOUNTING**

Figure 13

NOTE: Prior to assembly of reconditioned parts, check finish of gasket surface on valve block and retainer. Must have 60 rms finish with no grinding marks which might carry oil to outside surface. If lapping is necessary, check depth of pockets for valve seats after lapping. Must be .085", 2,16 mm minimum after lapping to provide clearance for valve seats.

NOTE: Do not use impact tools or over tighten threaded parts.

Wash and dry all parts. During assembly, lapped and ground surfaces should be kept lubricated with clean oil and protected from nicks or surface damage.

Place valve block (1) with the six poppet valves bores up in order to press two roll pins (26) in position. Roll pins to be .12", 3,04 mm below surface of valve block. (Not required after 8-96).

Install four orifice plugs (3) into valve block (1) and tighten in place.

Disassemble the strainer assembly (14) and reassemble per the following steps:

Install the orifice screw of the strainer assembly into valve block. Thread elastic stop nut onto the orifice screw and torque to 23 lbs-in., 2,6 Nm.

Install clean filter screen on strainer support and secure in place with socket head cap screw, 6-32 X 1/4" lg. Torque #6-32 screw to 13 lbs-in., 1,47 Nm.

Place valve block with poppet valve bores facing up. Position gasket (29) on valve block.

Place springs (33) 1.43", 36,32 mm lg. into outer most bores at each end of the valve block. Place sequence poppet (30) over these springs. Position seats (27) small shoulder side first over poppets.

Place springs (35) 1.09", 27,68 mm lg. into bores next to the sequence poppet valves of two steps previous. Place dual relief poppet (31) over these springs. Position seats (28) with the groove side facing up, over poppets.

Place spring (32) 1.56", 39,6 mm into bore next to compensator valve side of block. Install replenish poppet over spring. Position seat (28) with the groove side facing down, over poppet.

Insert spring (33) 1.43", 36,3 mm into the remaining bore. Place servo poppet (34) over the retainer and spring. Position seat (44) with the tapered bore facing down, over poppet.

Carefully position the retainer plate over seats and poppets. Pressing with one hand on the valve block, compress seats, poppets and springs far enough to alternately thread two button head cap screws (43) in far enough to hold the retainer plate. Install the other two screws and alternately tighten screws. Torque to 30 lbs-in., 3,39 Nm.

Lubricate o-ring (4) and install on to seat (5), thread seat in valve block. Be careful not to damage bore in the seat. Torque to 15 lbs-in., 20,34 Nm.

Apply vaseline to shank of cone (13) and install spring (12) on cone. Carefully insert cone and spring into valve block positioning point of cone into bore of seat.

Lubricate o-ring (11) install in groove of piston (10) and insert end of piston into spring (12).

Lubricate o-ring (9) and install on housing guide (8) and thread into valve block. Tighten in place.

Thread nut (7) on socket set screw (6) and thread screw into housing guide (8) until it starts to compress spring.

Using a small bladed screw driver, thread the pilot replenishing relief valve assembly (36) into valve block and lightly tighten in place. Do not over tighten. Over tightening can cause sides of slot to break now or at next removal.

Lubricate o-ring (4) and install on plug (25) and tighten plug in place.

Thread check valve (2) into valve block and lightly tighten in place. Do not over tighten. Lubricate o-ring (22) and install on plug (23) and tighten in place. Repeat step on other end of valve block.

**VALVE BLOCK ASSEMBLY FOR
SERVO VALVE MOUNTING**

Figure 13
(continued)

Lubricate o-ring (19) and install on plug (20) and tighten plug in place .

Lubricate o-rings (22) and install on plugs (23) and tighten plug in place .

Lubricate o-rings (4) and install on plugs (25) and tighten plug in place .

Lubricate o-ring (19) install on plug (20) and tighten plugs in place .

Lubricate o-rings (47) and install in underside of manifold block (15). Carefully, place manifold block (15) on top of the valve cover (1) making sure the o-rings are correctly seated. Secure with four soc. hd. cap screws (41) to valve block (25).

Insert spring (16) and spool (38) into manifold (15) with the spring guide and spring towards the left side of the manifold (15) when viewing from the top rear. Install orifice plug (61) in manifold (15).

Install temporary plug, (50) in 1/4", 6,35 mm tube port. Insert o-ring (19) and plug (20) in alternate drain port.

Using a small hammer carefully tap roll pins (46) into and thru the retainer plate (42), the pins should bottom out in hole leaving enough length sticking out for piloting into the port block.

Lubricate o-ring (47), (48) and (37) and install in the bottom of retainer plate (42).

Valve is ready to install on pump .

ASSEMBLY PROCEDURE

VALVE BLOCK ASSEMBLY FOR SERVO VALVE MOUNTING

Figure 13
(continued)

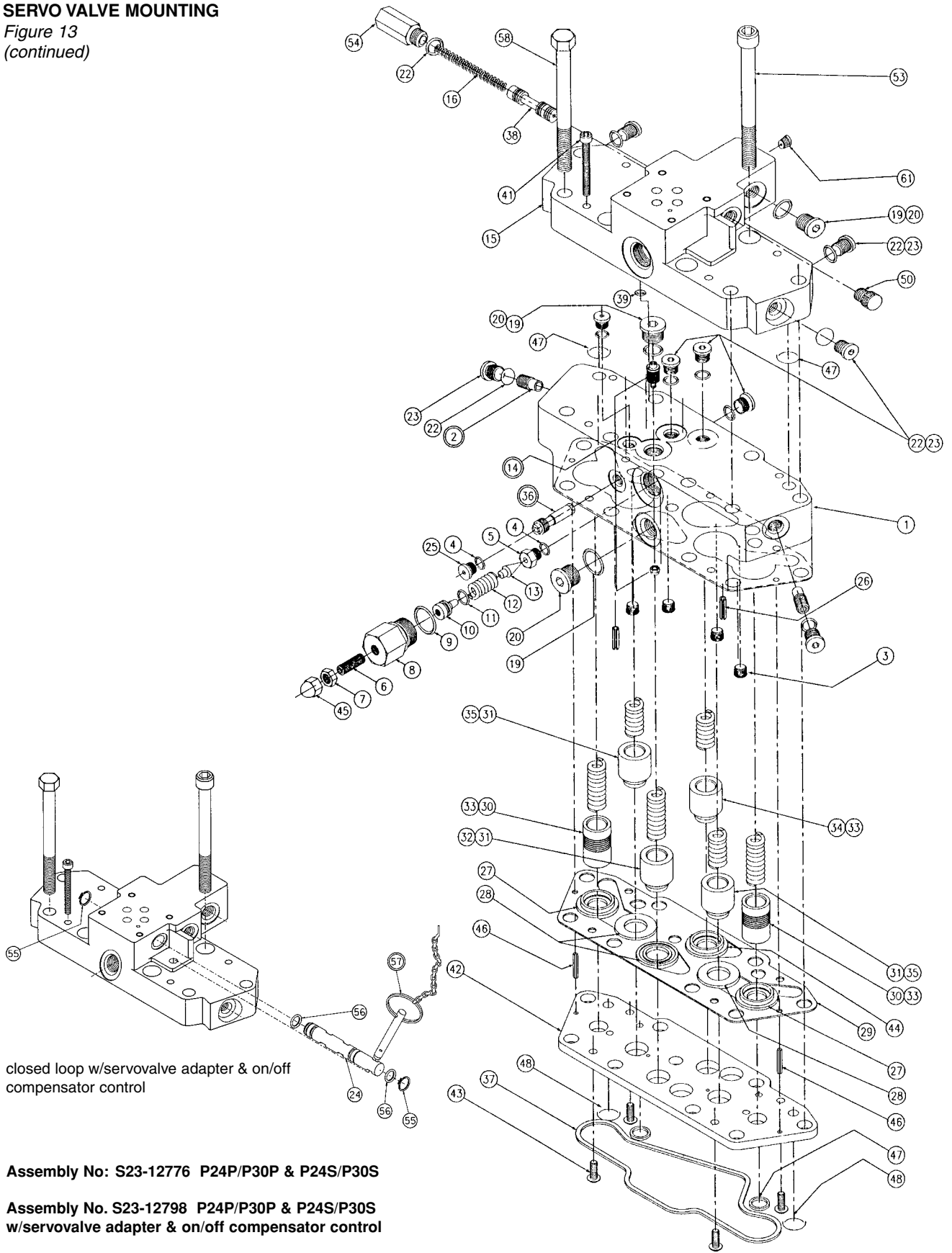
PARTS LIST FOR FIGURE 13

item	description	part no.	quantity
1	valve block	033-91335	1
2	check valve assembly	S13-40266	2
3	orifice plug	033-91249	4
4	o-ring	691-00903	2
5	seat	033-70508	1
6	soc. hd.screw 5/16-24 x 1" lg.	312-13160	1
7	hex. jam nut 5/16-24	335-13100	1
8	housing guide	033-70545	1
9	o-ring	691-00910	1
10	seal piston	036-21767	1
11	o-ring	671-00012	1
12	spring	032-91798	1
13	cone	036-12288	1
14	servo strainer assembly	S13-43240	1
15	manifold	033-54389	1
	manifold, servovalve-use w/ 7F or 7G controls	033-54446	
16	spring	225-92083	1
19	o-ring	691-00906	3
20	plug	488-35041	3
22	o-ring	691-00904	10
23	plug	488-35001	9
24	spool, servovalve-use w/7F or 7G controls	033-54445	
25	plug	488-35049	2
*26	roll pin	325-12120	2
27	sequence seat	033-70507	2
28	replenish & servo seat	033-70500	3
29	valve block gasket	033-91193	1
30	sequence poppet	033-72378	2
31	dual & replenish poppet	033-72379	3
32	replen. spring	033-22141	1
33	sequence & servo spring	033-70512	3
34	servo relief poppet	033-54398	1
35	dual relief spring	033-71086	2
36	pilot replen. valve	S23-12699	1
37	o-ring	671-00050	1
38	spool	033-54392	1
39	o-ring	691-00008	1
41	soc. hd. screw #10-24 x 1-1/4" lg.	358-10180	4
42	retainer plate	033-91422	1
43	screw	353-25078	4
44	servo relief seat	033-54399	1
45	acorn nut 5/16-24	327-25006	1
46	roll pin 1/8 x 3/4" lg.	325-08120	2
47	o-ring	671-00013	2
48	o-ring	671-00014	2
50	plug 7/16-20	449-00013	1
53	soc. hd. screw 3/8-16 x 4" lg.	358-16360	4
54	plug	035-40132	4
55	ring, servovalve-use w/7F or 7G controls	356-31043	2
56	o-ring, servovalve-use w/7F or 7G controls	691-00011	2
57	pin, servovalve-use w/7F or 7G controls	S23-02208	1
58	hex. hd. cap screw	306-40132	4
61	orifice #56 0.0465", 1,18mm	033-25528	1

*Not required after 8-96.

**VALVE BLOCK ASSEMBLY FOR
SERVO VALVE MOUNTING**

Figure 13
(continued)



closed loop w/servo valve adapter & on/off compensator control

Assembly No: S23-12776 P24P/P30P & P24S/P30S

**Assembly No. S23-12798 P24P/P30P & P24S/P30S
w/servo valve adapter & on/off compensator control**

FIGURE 13

TEST PROCEDURE

GENERAL REQUIREMENTS

Maximum runout between pump shaft and electric motor shaft .003", .076 mm total indicator reading.

Electric motor speed - 1800 rpm.

Inlet temperature - 120°-140°F, 500-580C.

Inlet condition - main pump 24 series 150 psi min., 10,3 bar min.
 30 series 225 psi min., 15,5 bar min.

internal vane pump- 10" Hg to 5 psi, 254 mm Hg to .34 bar (e xcept "S" version)

Case pressure 55-75 psi, 3,81-5,19 bar.

Fluid - 200 SSU at 100°F, 46 cSt at 40°C

BASIC PUMP TEST

Mount pump on test stand. Connect system lines and internal (external with auxiliary drive) vane pump inlet to pump. Fill pump case with clean oil. Dry all oil from pump to permit checking for external leaks.

Start electric motor. Jog several times before continuous running.

Rotate pump input control shaft. The servo control should control pump displacement through its full range. Set pump displacement for full volume, and adjust system pressure for 1000 psi, 69 bar. Check and record system flow and case drain flow with cam above and below center. Monitor loop temperature.

Maximum system flow 24 series 194 gpm, 734 Lpm
 30 series 241 gpm, 912 Lpm

Maximum case drain flow 24 series 4.5 gpm, 17 Lpm
 30 series 5.5 gpm, 21 Lpm

Back out compensator adjusting screw until unit is fully compensated count number of turns. Observe volume indicator and stroke rotary servo input shaft from full to full position on each side of center. Indicator should remain on or very near zero position "0". If compensator functions normally, return compensator adjusting screw to its original position and proceed with next step.

Caution: Do not over tighten cap screw.

Cycle pump at 10 second intervals - full volume above center to full volume below center* - as follows:

- 10 minutes at 1000 psi, 69 bar
- 10 minutes at 2500 psi, 172 bar
- 10 minutes at 5000 psi, 345 bar

*Pumps with screw adjustment controls do not need to be cycled.

Adjust system pressure to 5000 psi, 345 bar and set pump displacement f or full volume. Check and record system flow and case drain flow above and below center.

Minimum system flow 24 series 160 gpm, 606 Lpm
 30 series 220.69 gpm, 385 Lpm

Maximum case drain flow 24 series 12 gpm, 45,4 Lpm
 30 series 13 gpm, 49 Lpm

Set pump to compensate at 5000 psi, 345 bar . Servo pressure should be at least 600 psi, 34,5 bar. Check and record internal vane pump flow.

Model: PP-xxxx-xxx-x-xx-xx-__**

		0	1	2	3	4	5	6
Vane pump disp.	in./rev.	2.81	1.61	1.05	3.56	4.84	5.42	6.10
	cc/rev.	46,1	26,4	17,2	58,3	79,3	88,8	100,0
Min. flow at 1800 rpm	gpm	21.3	11.8	7.4	27.0	37.0	41.5	46.8
	Lpm	80,6	44,7	28,0	102,2	140	157,1	177,3

BASIC PUMP TEST

(continued)

Set pump to compensate at minimum psi. Check and record replenishing and servo pressure.

Servo pressure - minus replenish pressure:
30/24 series: 160 to 220 psi, 11 to 15 bar

*Replenish pressure - minus case pressure:
Std-30/24 series: 180 to 220 psi, 12,4 to 15,2 bar
"S" version: 330 to 370 psi, 23-26 bar

If pressures are incorrect, remove replenishing relief valve pilot and increase or decrease pressure as required. One full turn on adjusting screw will cause pressure to change approximately 25 psi, 1,7 bar. Re-torque locknut to 20-25 lbs-in., 2,3-2,8 Nm.

*Replenish pressure may be set to customer requirement, not to exceed 450 psi, 31 bar.

NOTE: There is no servo relief valve adjustment. Increasing or decreasing replenishing pressure will cause both servo and replenishing pressure to change by the same amount.

Set the pump to compensate at 5000 psi, 345 bar record replenishing and servo pressures.

Servo pressure- minus replenish pressure:
24 series: 360 to 420 psi, 24,8 to 30 bar
30 series: 472 to 532 psi, 32,5 to 37 bar

Replenish pressure - minus case pressure:
Std-24 series: 180 to 220 psi, 12,4-15,2 bar
30 series: 200 to 240 psi, 14 to 17 bar
"S" version: 330 to 370 psi, 23-26 bar

Set pump to compensate at minimum psi. Servo pressures should return to the values of the previous step.

NOTE: After completing last step, proceed with pump control test, **refer to control service manual S1-AM030**. Continue with the next steps after controls testing.

Adjust pump displacement for full volume and adjust system pressure to 5000 psi, 345 bar. **Adjust compensator from 5000 psi, 345 bar to minimum pressure in 1000 psi, 69 bar intervals. At each pressure, stroke rotary servo input shaft to the full position on each side of center. Cam indicator should remain on or very near the zero position with no oscillation. System pressure should not vary from port "A" to port "B" more than 150 psi, 10,3 bar and not oscillate.

CAUTION: Do not hold pump at 5000 psi, 345 bar for longer than one minute at any time. This is only an intermittent pressure rating.

Minimum compensator pressure should be under 500 psi, 34,5 bar.

Increase compensator adjustment to 1000 psi, 70 bar and increase and decrease system pressure above and below compensator setting. When system pressure is above compensator setting, the pump should de-stroke and not oscillate. When the system pressure is below the compensator setting the pump should stroke to full volume. Repeat at 5000 psi, 345 bar.

Check pump for external leaks. No external leaks permitted.

After all tests are completed re-torque main housing bolts to 350 lbs-ft., 476 Nm.

ALTERNATE TEST PROCEDURE

The following test procedure may be used if the standard closed loop test stand is not available.

GENERAL REQUIREMENTS

Maximum runout between pump shaft and electric motor shaft 0.003", 0,076 mm total indicator reading.

Electric motor speed - 1800 rpm.

Inlet temperature - 120°-140° F., 500-580C.

Inlet condition - main pump - 24 series 150 psi min., 10,3 bar
30 series 225 psi min., 15,5 bar

Internal vane pump - 10", 254 mm Hg to 5 psi, 0.34 bar

Case pressure 55 - 75 psi, 3,8 - 5,2 bar (except "S" pump)

Fluid - 200 SSU at 100° F., 46 cSt at 40°C

BASIC PUMP TEST

Mount pump on test stand. Connect system lines and internal vane pump inlet to pump. Fill pump case with clean oil. Dry all oil from pump to permit checking for external leaks.

Start electric motor. Jog several times before continuous running.

Rotate pump input control shaft. The servo control should control pump displacement through its full range. Set pump displacement for full volume, and adjust system pressure for 1000 psi, 69 bar. Check and record system flow and case drain flow with cam above and below center. Monitor loop temperature

Maximum system flow	24 series 194 gpm, 734 Lpm 30 series 241 gpm, 912 Lpm
---------------------	----------------------------------------------------------

Maximum case drain flow	24 series 4.5 gpm, 17 Lpm 30 series 5.5 gpm, 21 Lpm
-------------------------	--------------------------------------------------------

Back out compensator adjusting screw until unit is fully compensated count number of turns. Observe volume indicator and stroke rotary servo input shaft from full to full position on each side of center. Indicator should remain on or very near zero position "0". If compensator functions normally, return compensator adjusting screw to its original position and proceed with next step.

Caution: Do not over tighten cap screw.

Cycle pump at 10 seconds intervals - full volume above center to full volume below center* - as follows:

- 10 minutes at 1000 psi, 69 bar
- 10 minutes at 2500 psi, 172 bar
- 10 minutes at 5000 psi, 345 bar

Adjust system pressure to 5000 psi, 345 bar and set pump displacement for full volume. Check and record system flow and case drain flow above and below center.

*Pumps with screw adjustment controls do not need to be cycled.

Minimum system flow	24 series 160 gpm, 606 Lpm 30 series 220.69 gpm, 385 Lpm
---------------------	-------------------------------------------------------------

Maximum case drain flow	24 series 12 gpm, 45.4 Lpm 30 series 13 gpm, 49 Lpm
-------------------------	--------------------------------------------------------

Install special adjusting screw over modulating pin in valve block. Center pump, adjust special adjusting screw to reach 600 psi, 41.4 bar servo pressure. Read case drain flow as internal vane pump flow. See chart, first basic pump test.

CONTROL TEST

Please refer to control service manual No. S1-AM030 for control information.

FLUID CONNECTION

NOMENCLATURE

(For ISO circuits Figures 14 & 15)

item	description
1	piston pump
2	vane chambers
3	rotary servo
4	auxiliary pump
5	servo pressure relief valve (modulated by operating pressure)
6	replenish pressure relief valve
7	sequence valve
8	compensator pilot valve
9	override pressure valve or servo pressure sequence valve
10	replenish ring check valve
11	external auxiliary boost pump
12	shuttle valve

FLUID CONNECTIONS

specification	term	Goldcup P2430P	Goldcup P24/30S
A & B system, SAE code 62 split flange	in. mm	2.0 50,8	2.0 50,8
AG1, BG1, A,B system gage straight thread, o-ring seal	SAE	-6	-6
AG2, BG2, A,B system gage straight thread, o-ring seal	SAE	-8	-8
C, aux. pump inlet, servo & repl. SAE code 61 split flange	in. mm	2.0 50,8	2.0 50,8
D1, D2, case drains, straight thread, o-ring seal	SAE	-20	-20
D3, shuttle drain	SAE	-	-16
DG, case gage straight thread, o-ring seal	SAE	-6	-6
DG2, case filling for vertical mounted units, straight thread, o-ring seal	SAE	-4	-4
DV, external drain pilot valve	SAE	-	-4
FA, FB, control pressure gage straight thread, o-ring seal	SAE	-6	-6
¹ G, aux. pump outlet, servo & repl. to external filter	SAE	-12	-12
H1, aux. pump inlet, servo & repl., from external filter, str. thd., O-ring seal	SAE	-12	-12
H2, servo gage, straight thread, o-ring seal	SAE	-6	-6
K, optional replenishing supply inlet, straight thread, o-ring seal	SAE	-32	-32
KA, shuttle relief inlet	SAE	-	-12
KG, replenishing gage, straight thread, o-ring seal	SAE	-6	-6
V, compensator vent, VA, A-side vent, VB, B-side vent, straight thread, o-ring seal	SAE	-4	-4

¹Reference: viewing main shaft end of pump this port is located at 5 o'clock in the standard adapter cover and at 11 o'clock position in the rear drive adapters.

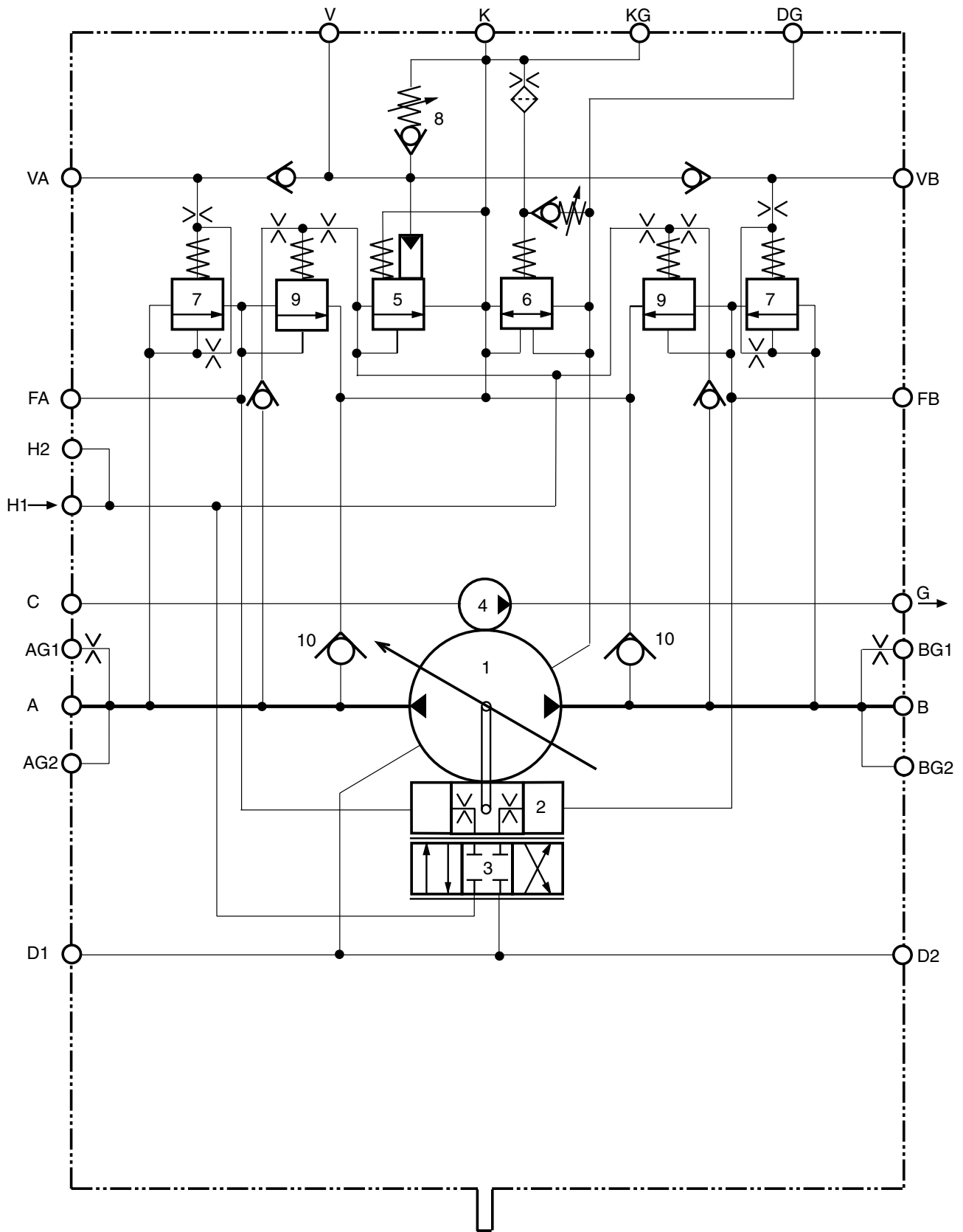


Figure 14
P24/30P

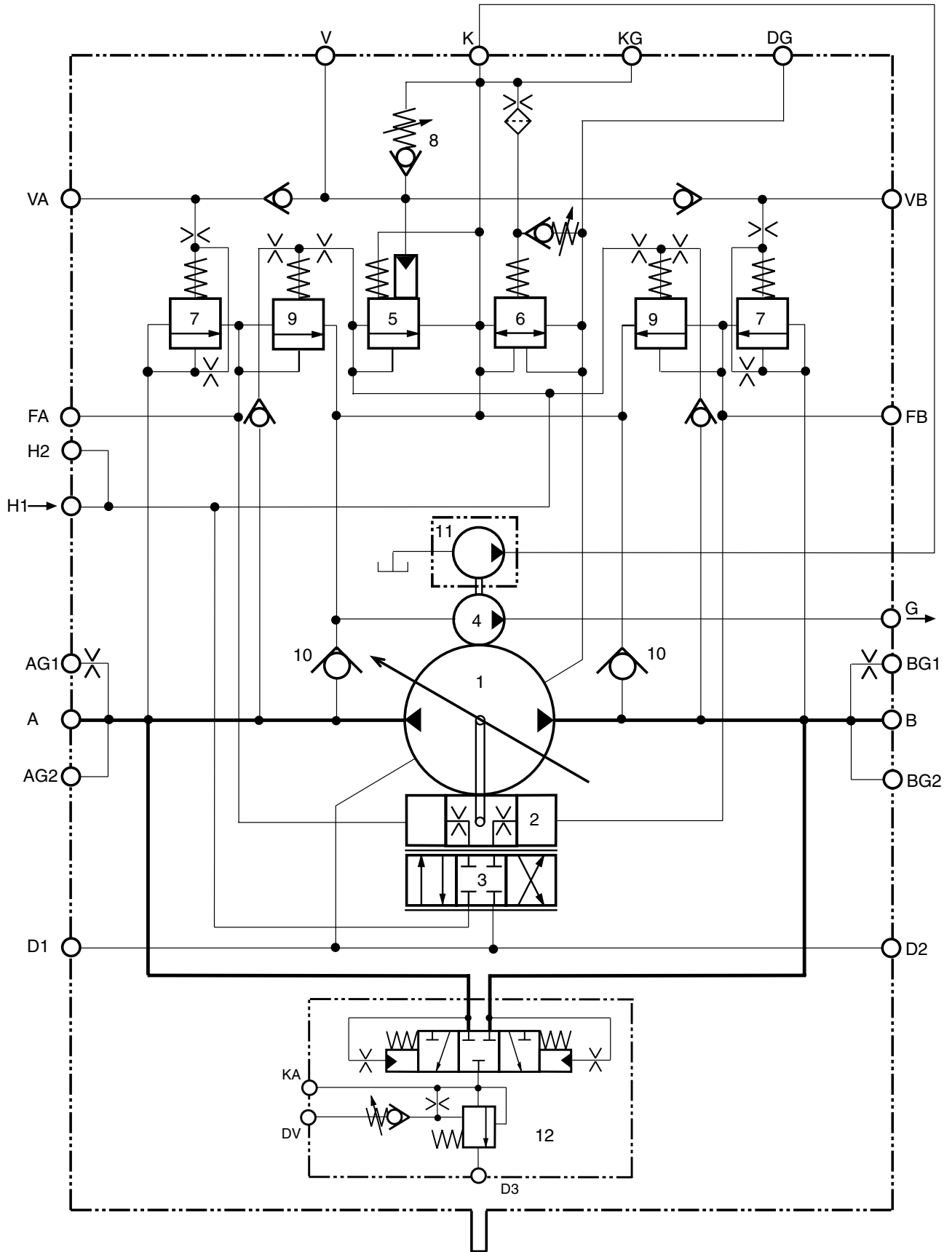
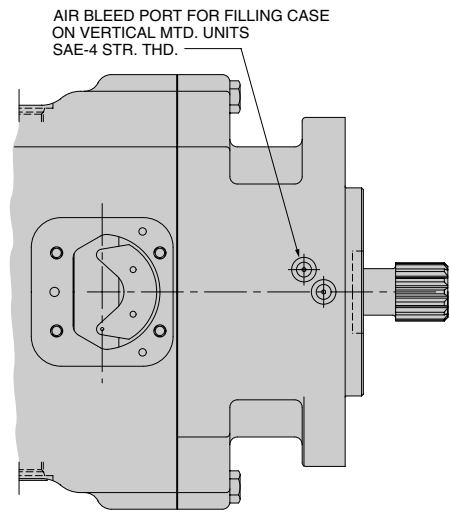
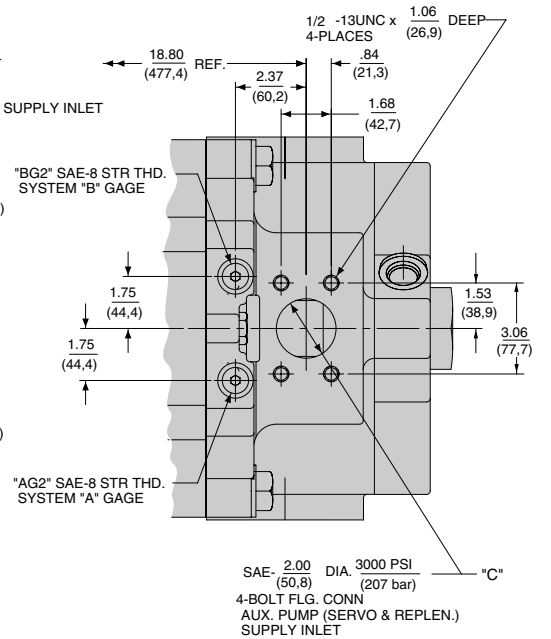
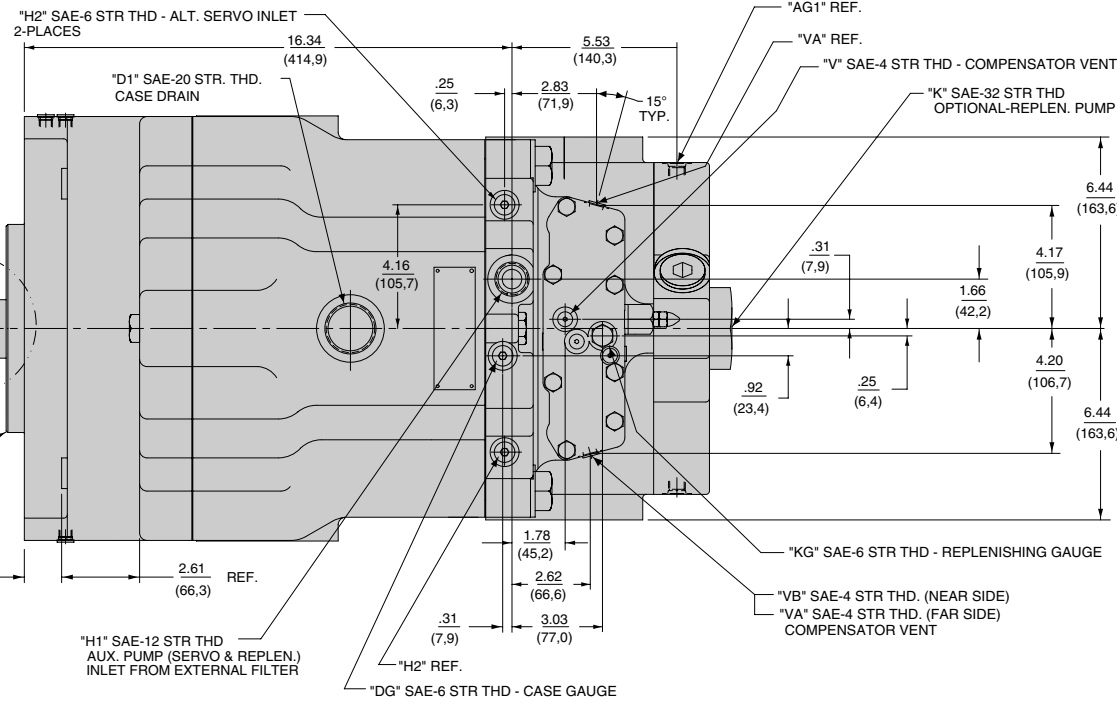
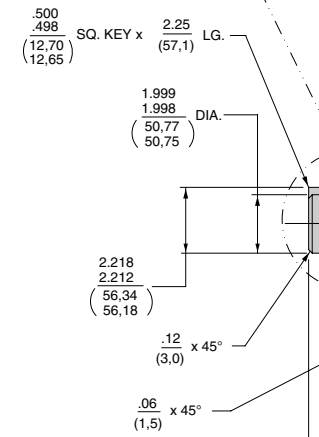


Figure 15
P24/30S

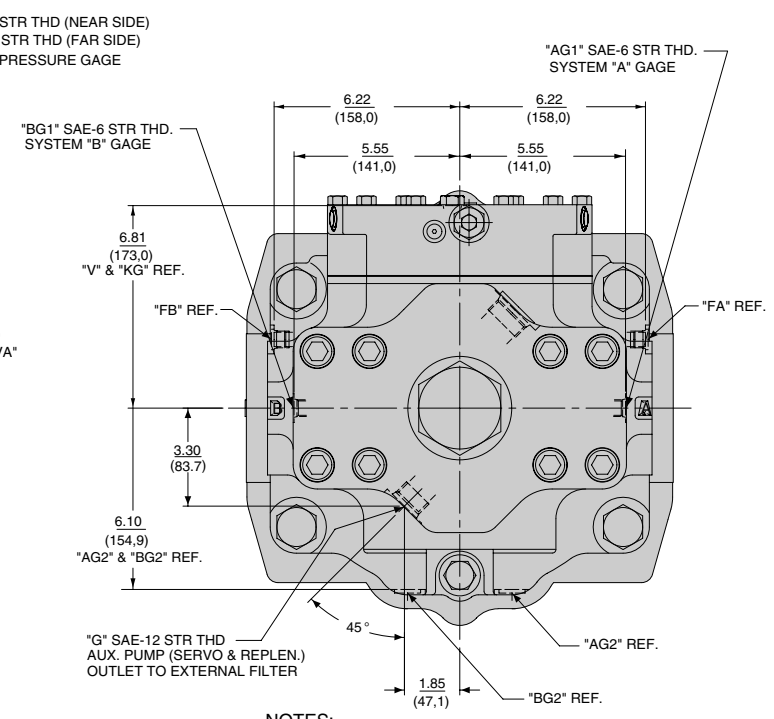
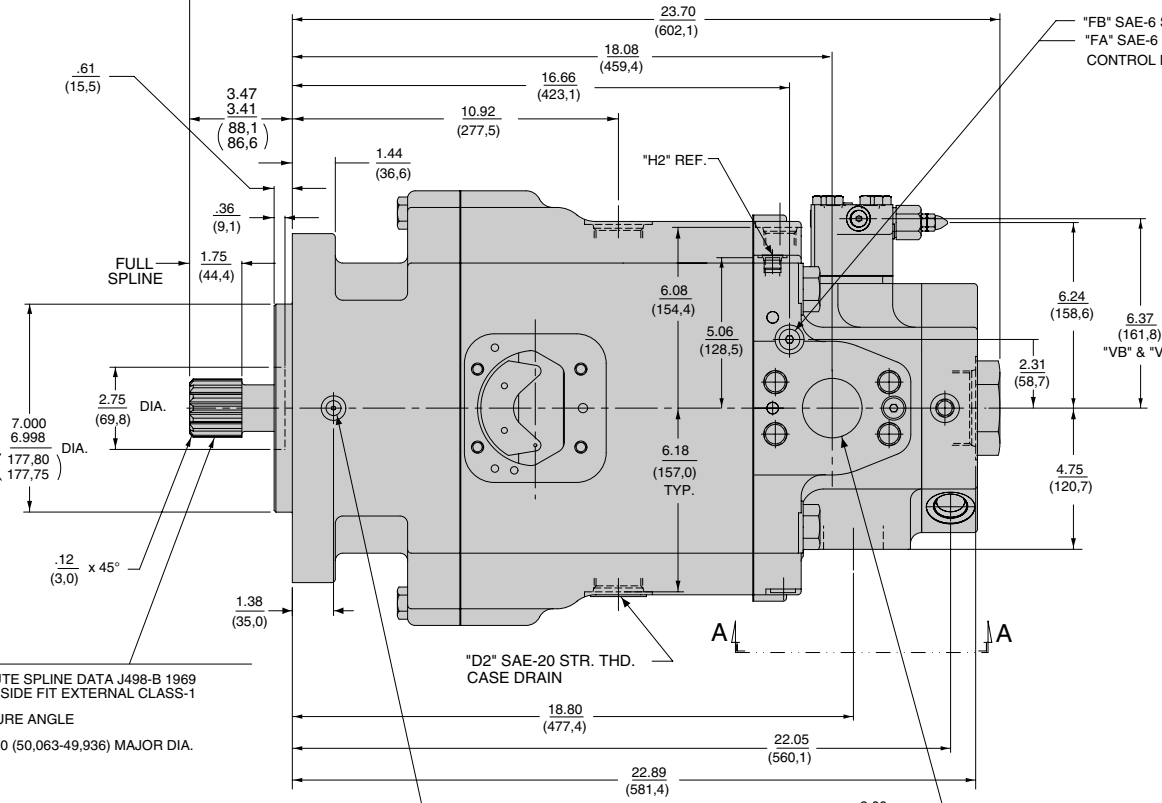
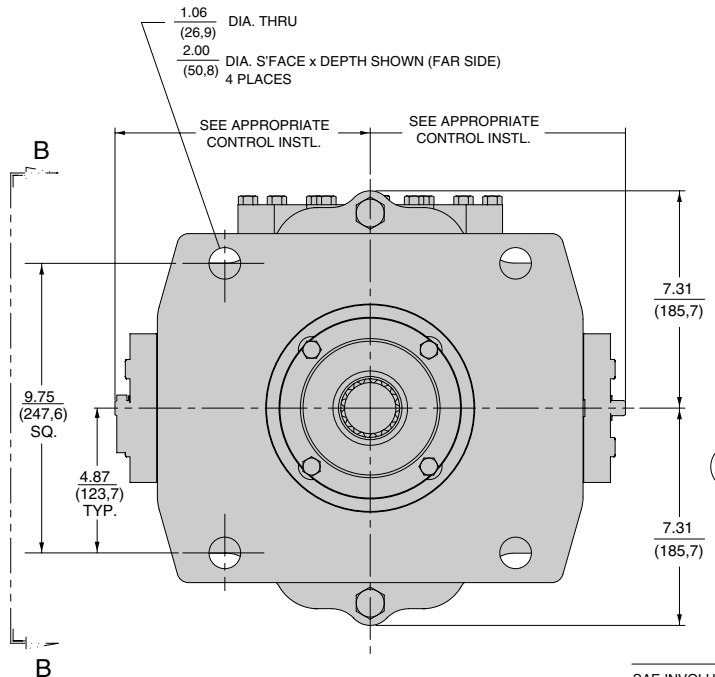


PARTIAL VIEW B-B

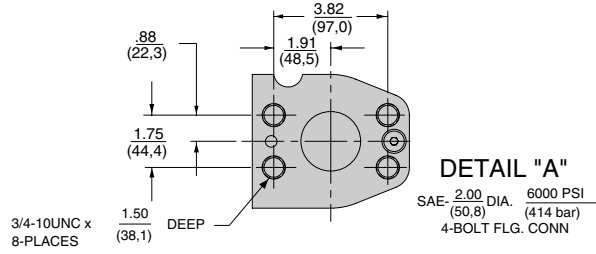
OPTIONAL KEYED SHAFT



PARTIAL VIEW A-A

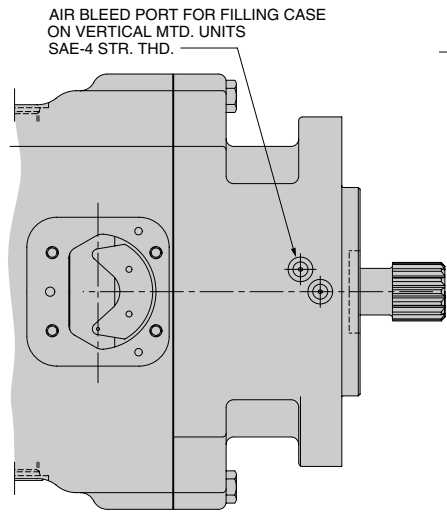


- NOTES:
1. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
 2. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



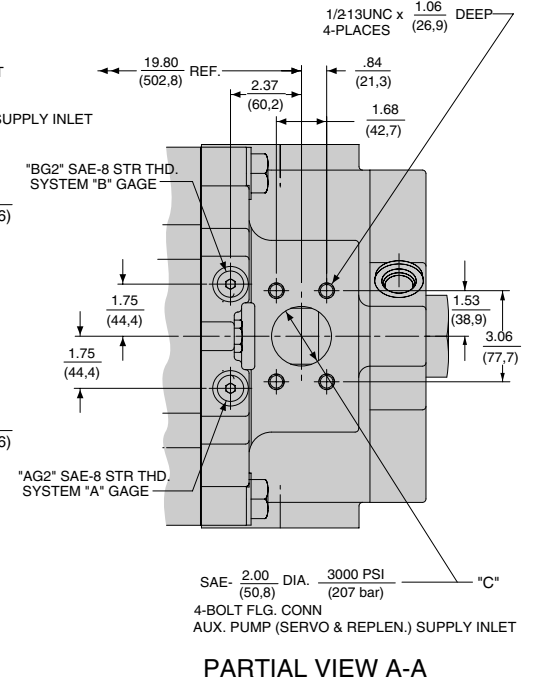
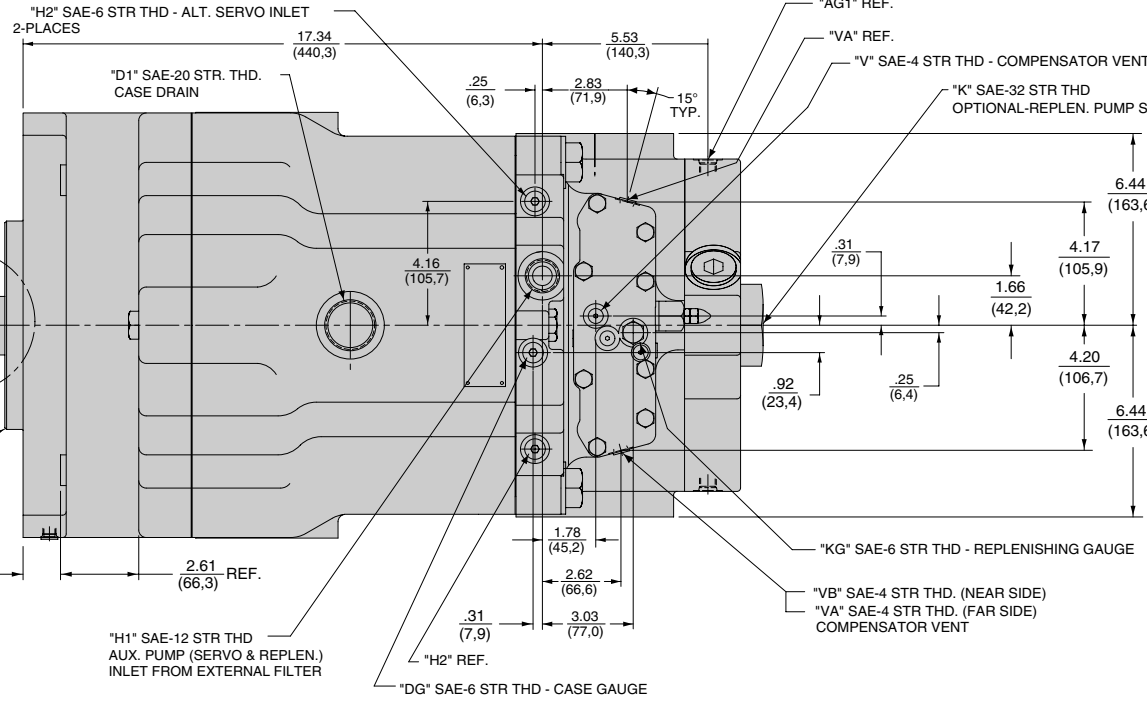
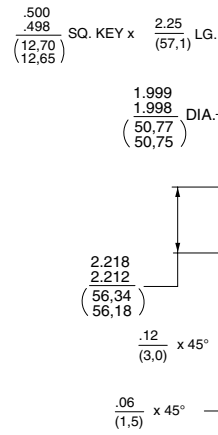
BASIC 24 CIPR "E" MOD. V.V. PUMP WITHOUT CONTROLS SAE-F 4-BOLT MOUNTING

23-9922

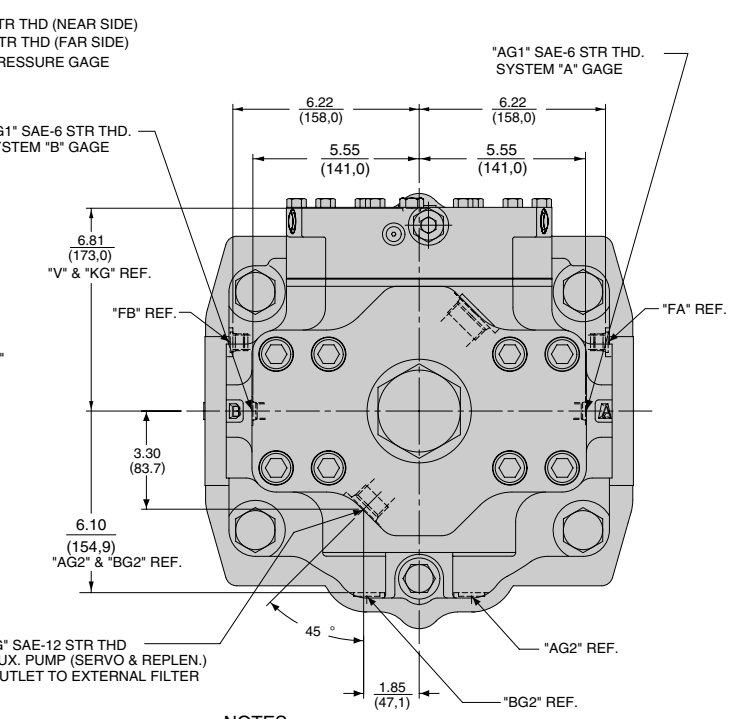
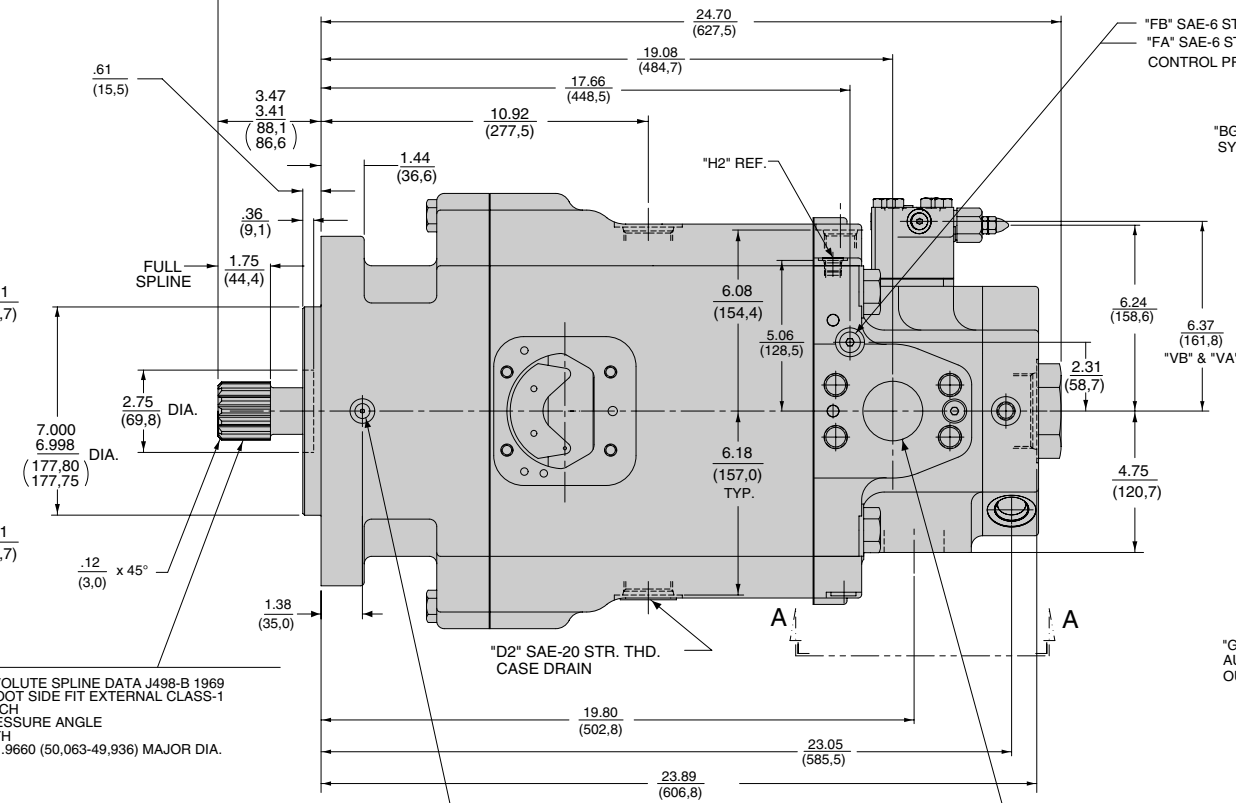
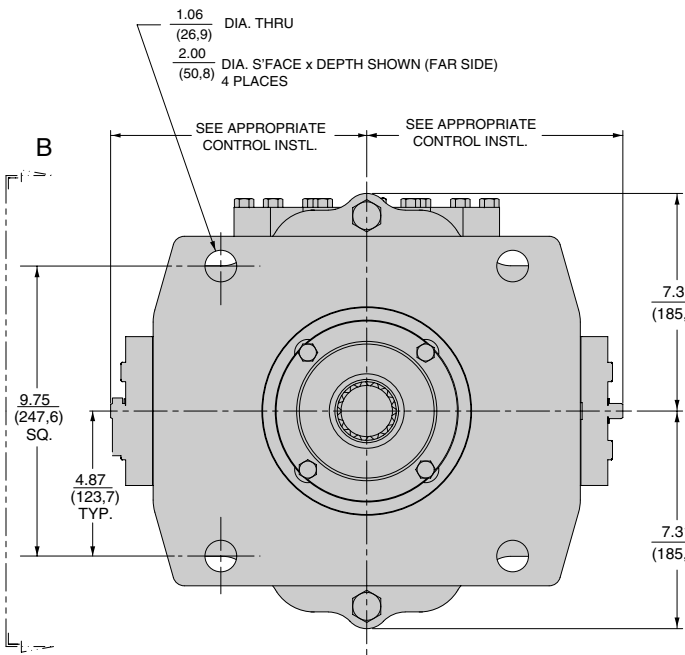


PARTIAL VIEW B-B

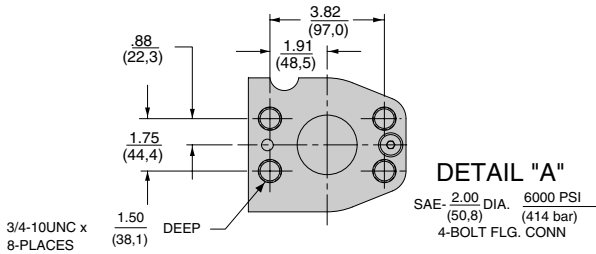
OPTIONAL KEYED SHAFT



PARTIAL VIEW A-A



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

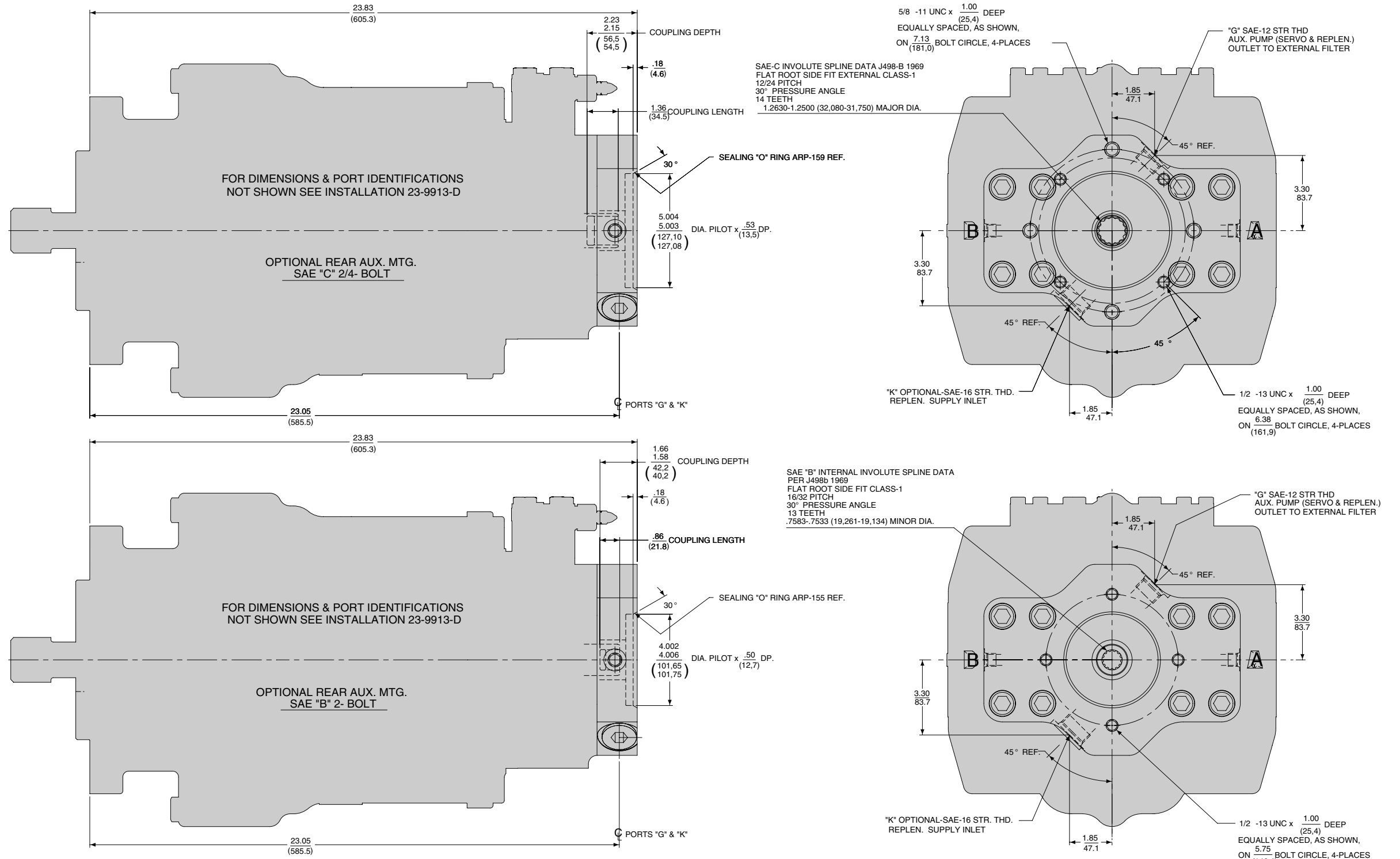


DETAIL "A"

BASIC 30 CIPR "B" MOD. V.V. PUMP WITHOUT CONTROLS SAE-F 4-BOLT MOUNTING

23-9913

INSTALLATION DRAWING



NOTES:

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

BASIC 30 CIPR "B" MOD. V.V. PUMP
WITH SAE-B or SAE-C AUX. REAR MTG.
W/O CONTROLS; SAE-F 4-BOLT MOUNTING

23-9919

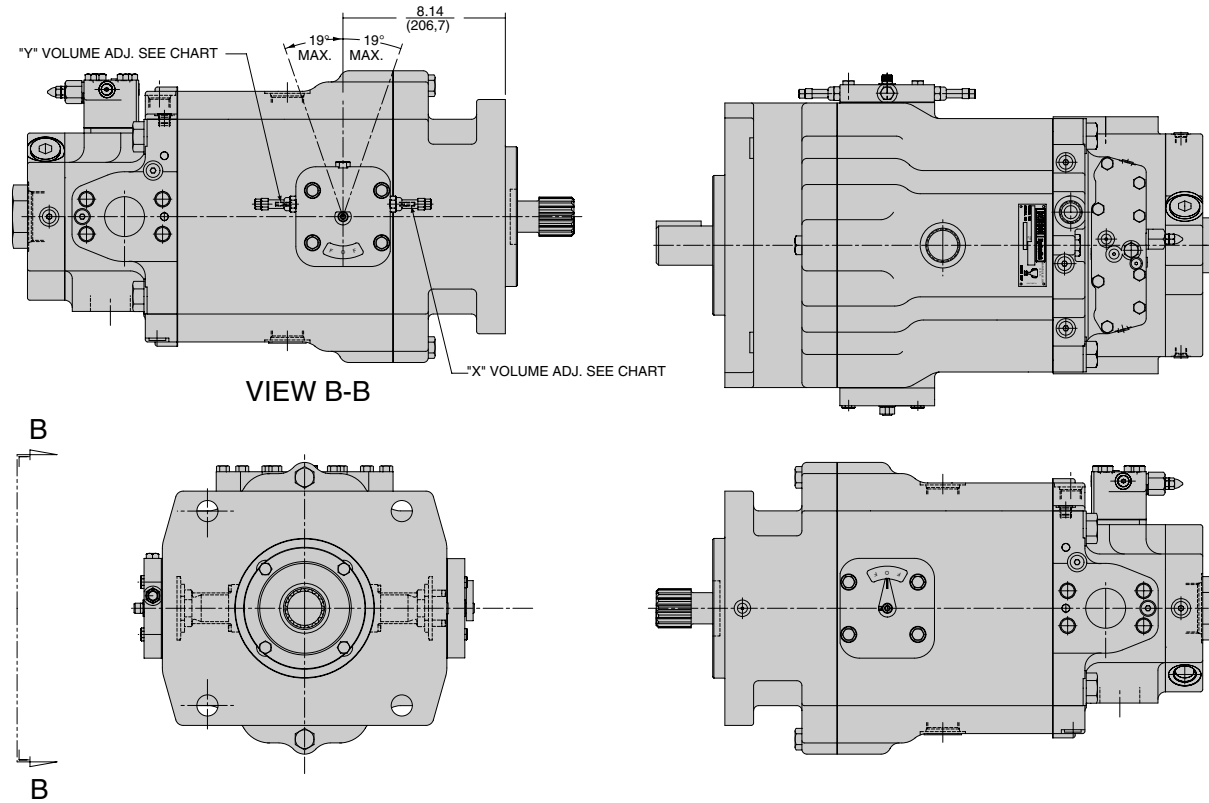
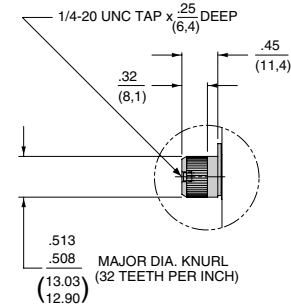


FIGURE - 2

-A- CONTROL MTG. POSITION								
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SPRG. OFF-SET TO FULL	PORT "A"	PORT "B"	"X" VOL. ADJ.	"Y" VOL. ADJ.
"102"	P24P & P30P	2	CW	CCW ROT. FULL TO MIN.	INLET	OUTLET	MAX. VOLUME STOP	MIN. VOLUME STOP
		2	CCW	CW ROT. FULL TO MIN.	INLET	OUTLET	MIN. VOLUME STOP	MAX. VOLUME STOP



MANUAL OVERRIDE SHAFT DETAIL

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION: P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).

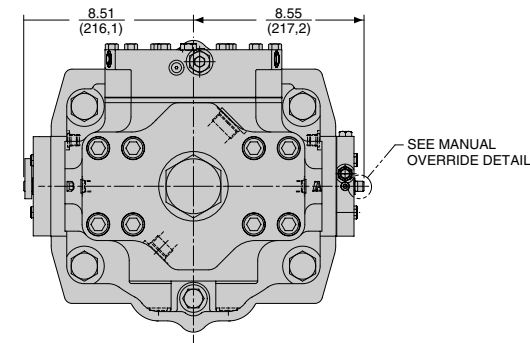
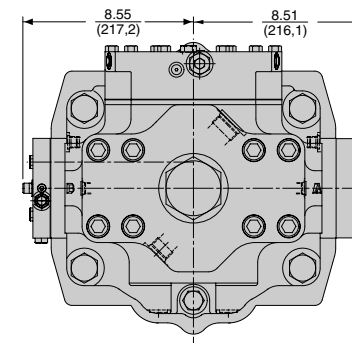
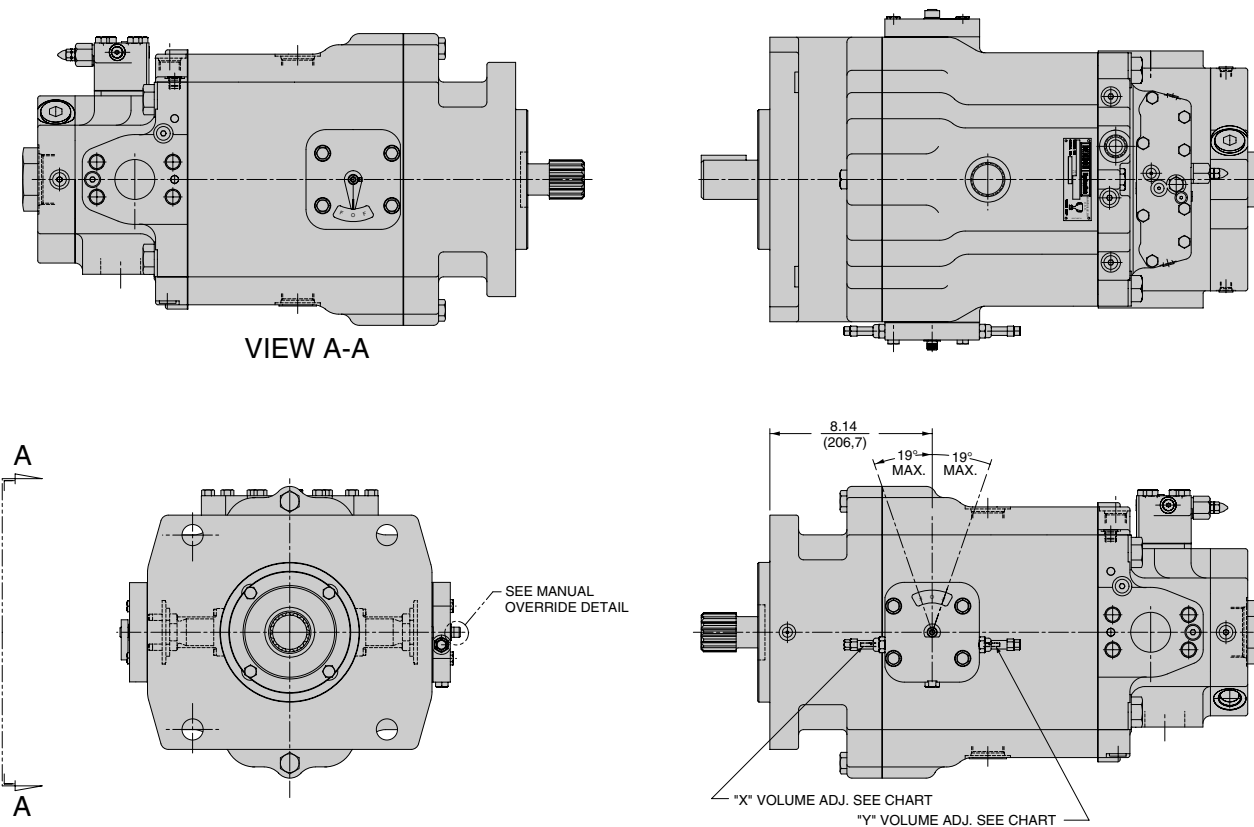


FIGURE - 1

-B- CONTROL MTG. POSITION								
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SPRG. OFF-SET TO FULL	PORT "A"	PORT "B"	"X" VOL. ADJ.	"Y" VOL. ADJ.
"102"	P24P & P30P	1	CW	CW ROT. FULL TO MIN.	INLET	OUTLET	MIN. VOLUME STOP	MAX. VOLUME STOP
		1	CCW	CCW ROT. FULL TO MIN.	INLET	OUTLET	MAX. VOLUME STOP	MIN. VOLUME STOP



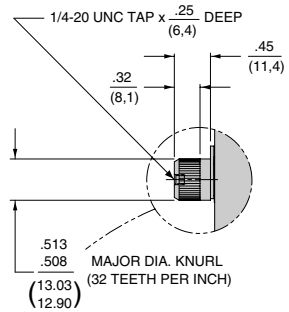
P24P OR P30P WITH "102" CONTROL WITH INTERNAL CARTRIDGE CW/CCW ROTATION-SAE-F 4 BOLT MTG.

23-9933

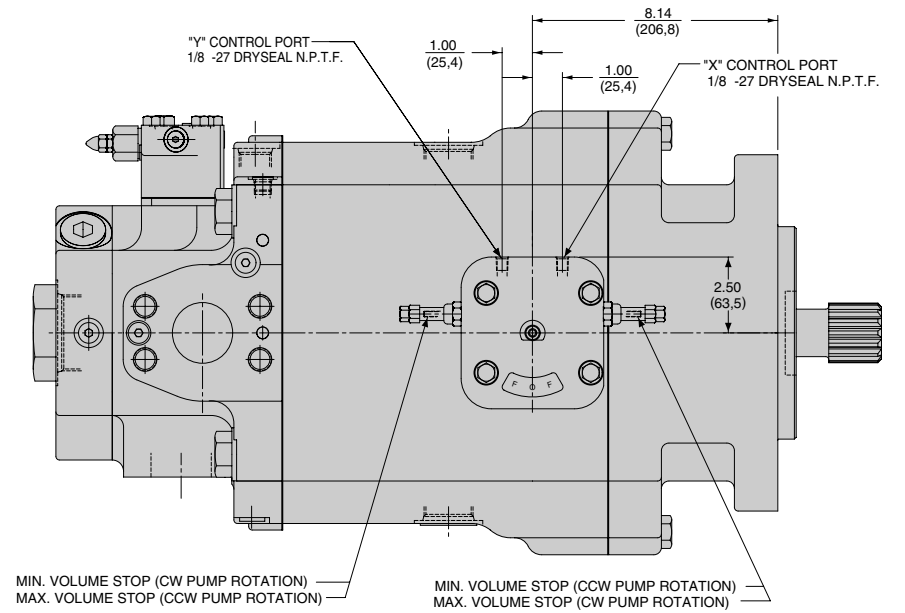
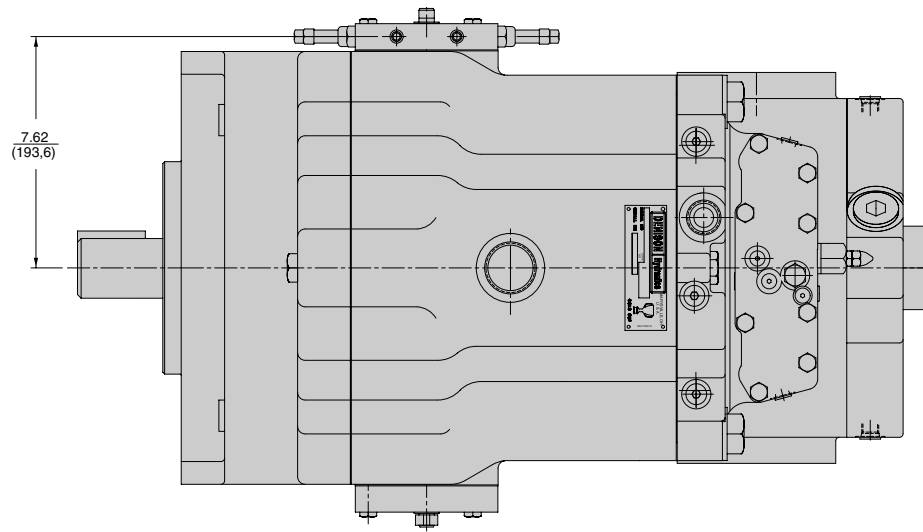
INSTALLATION DRAWING

NOTES:

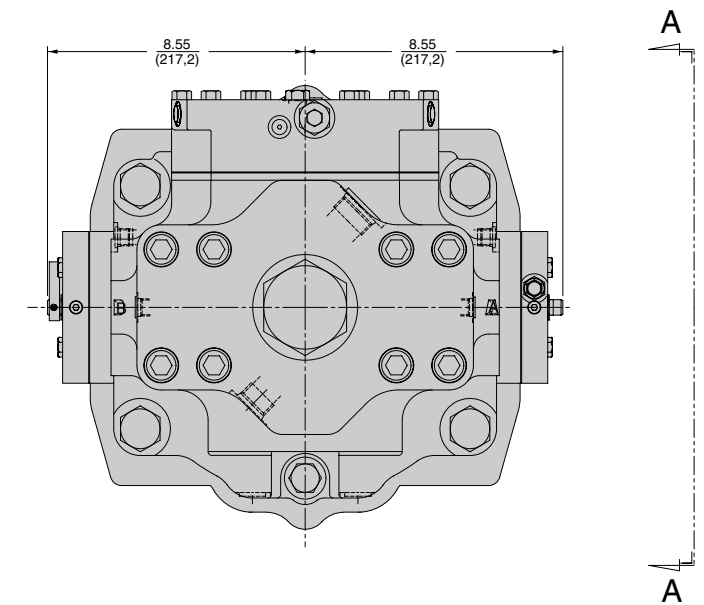
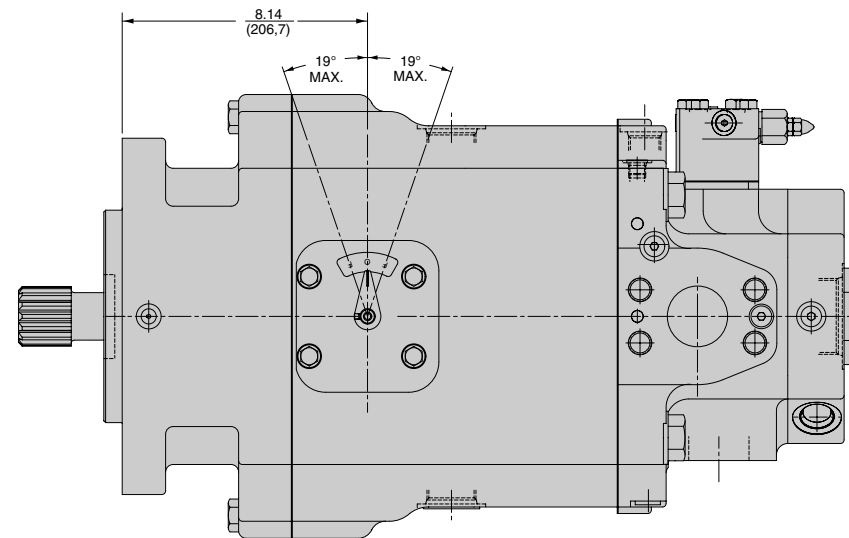
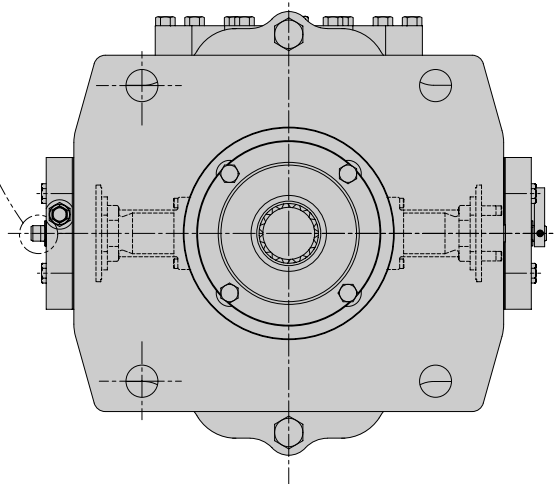
- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MAJOR DIA. KNURL (32 TEETH PER INCH)
MANUAL OVERRIDE SHAFT DETAIL
TO OPERATE DISCONNECT OIL SUPPLY TO CONTROL PORTS
SCALE=NONE



VIEW A-A



-A- CONTROL MTG. POSITION

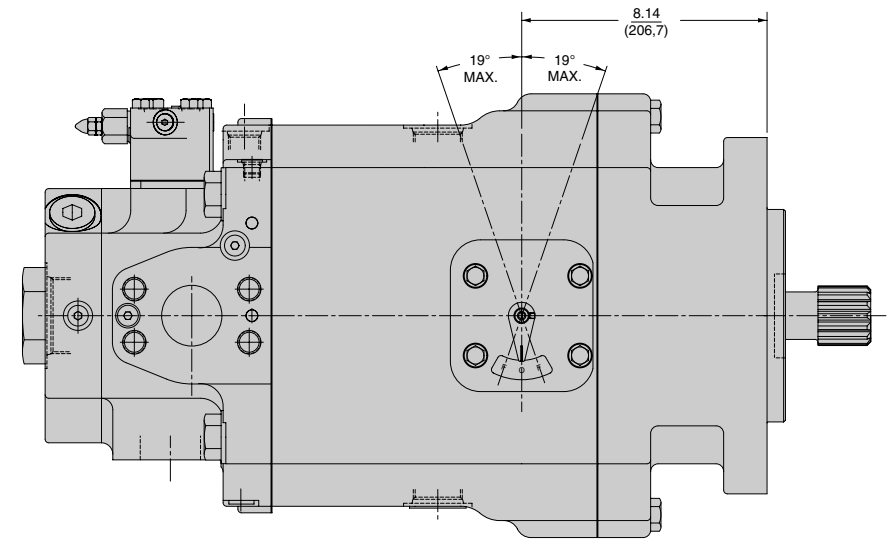
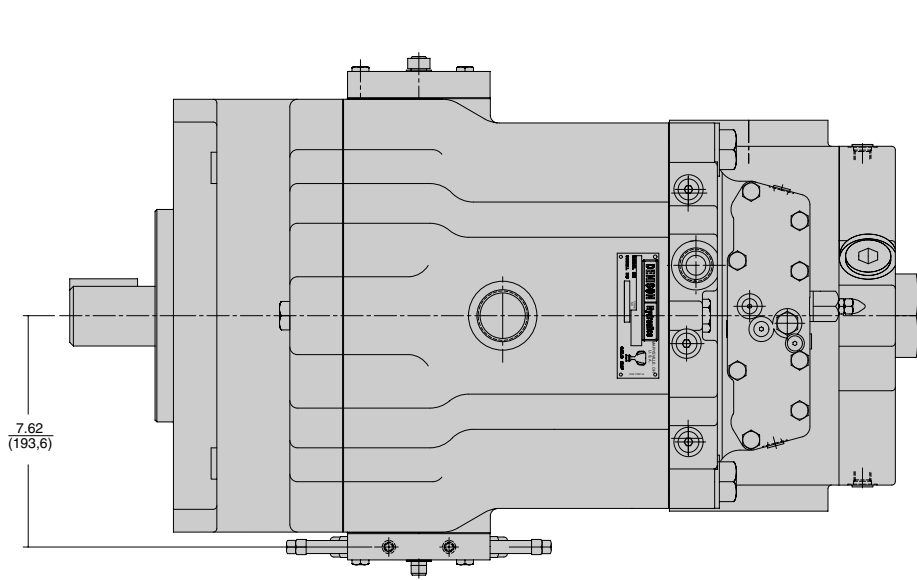
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO:		MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
			PORT "X"	PORT "Y"			
"2A2" (SPRING OFFSET TO ZERO)	P24P & P30P						
		CW	MIN. VOLUME	MAX. VOLUME	CW	INLET	OUTLET
		CCW	MAX. VOLUME	MIN. VOLUME	CCW	INLET	OUTLET

P24P OR P30P WITH "2A2" CONTROL WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

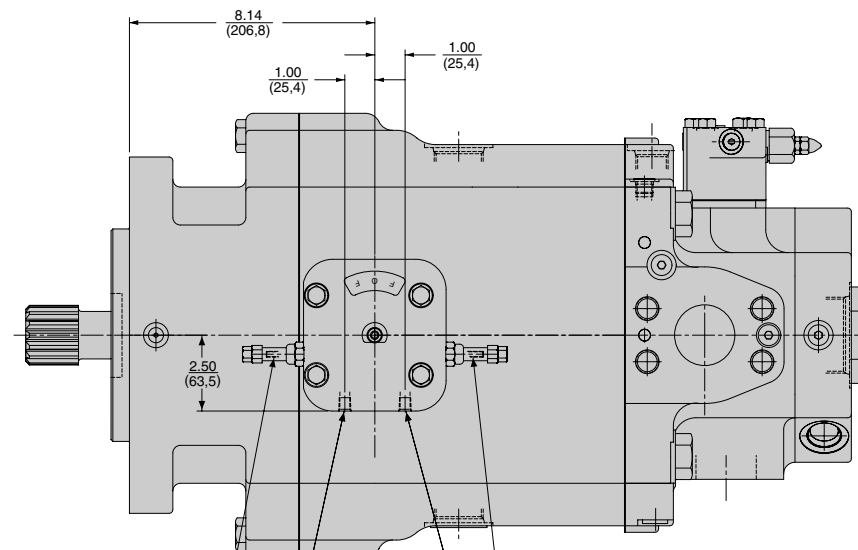
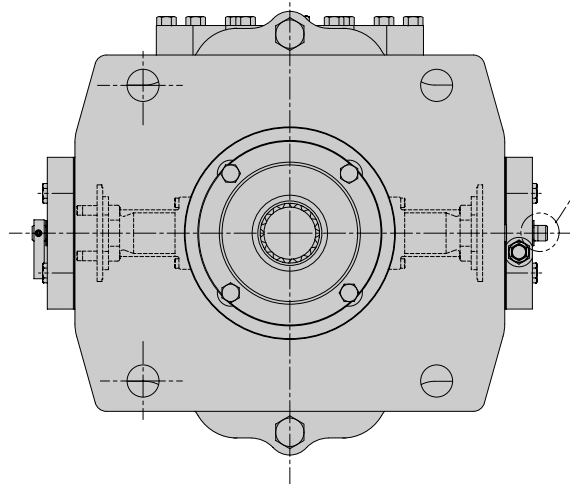
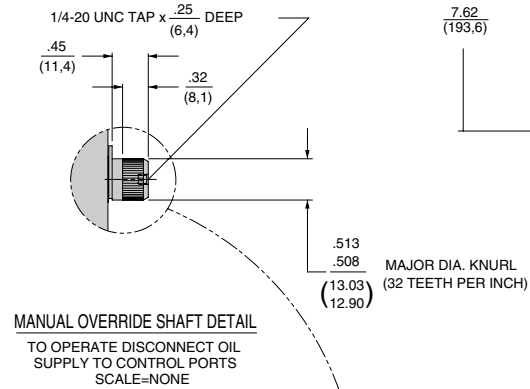
INSTALLATION DRAWING

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



VIEW A-A

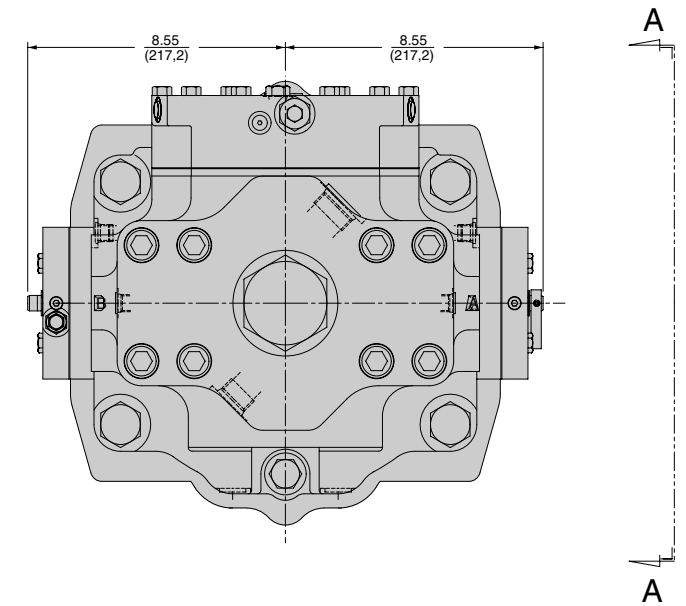


MIN. VOLUME STOP (CW PUMP ROTATION)
MAX. VOLUME STOP (CCW PUMP ROTATION)

"X" CONTROL PORT
1/8 -27 DRYSEAL N.P.T.F.

MIN. VOLUME STOP (CCW PUMP ROTATION)
MAX. VOLUME STOP (CW PUMP ROTATION)

"Y" CONTROL PORT
1/8 -27 DRYSEAL N.P.T.F.



-B- CONTROL MTG. POSITION

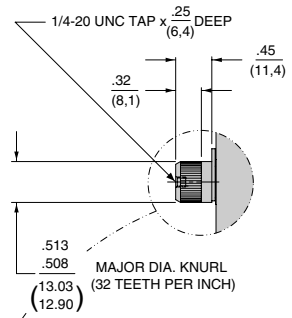
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO:		MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
			PORT "X"	PORT "Y"			
"2A2" (SPRING OFFSET TO ZERO)	P24P & P30P	CW	MAX. VOLUME	MIN. VOLUME	CCW	INLET	OUTLET
		CCW	MIN. VOLUME	MAX. VOLUME	CW	INLET	OUTLET
		CW					
		CCW					

P24P OR P30P WITH "2A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

INSTALLATION DRAWING

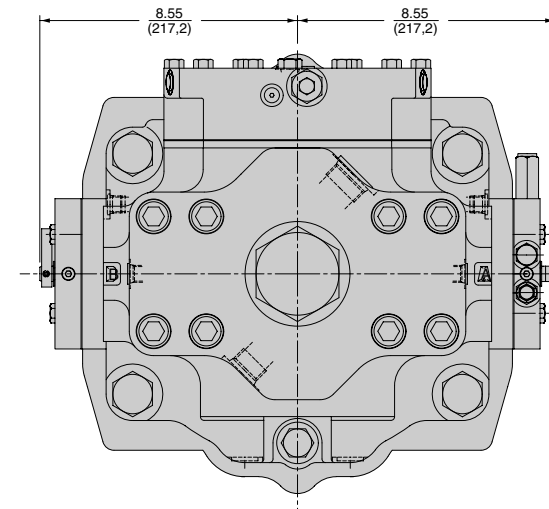
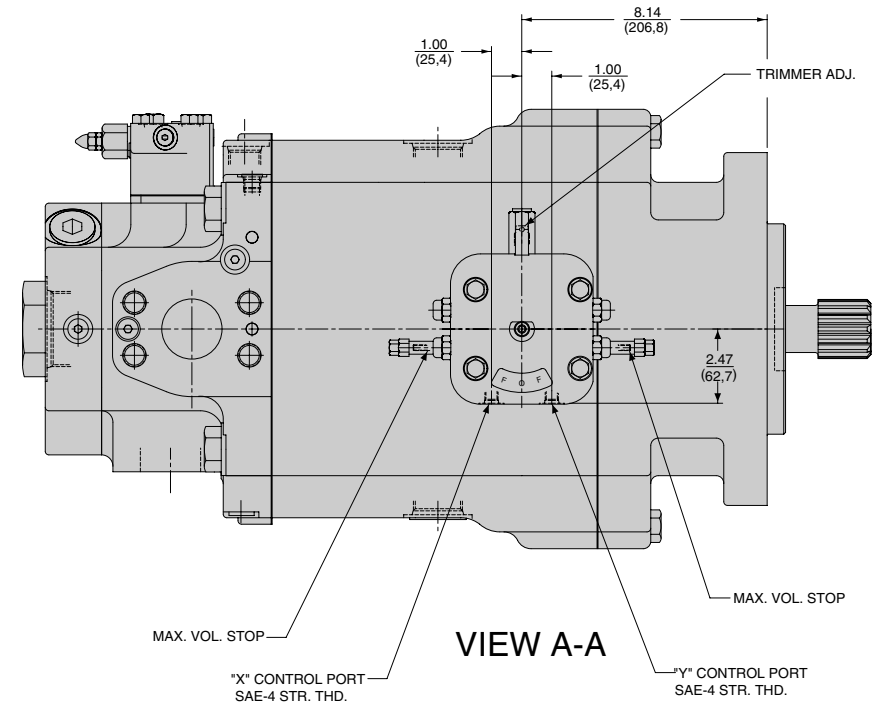
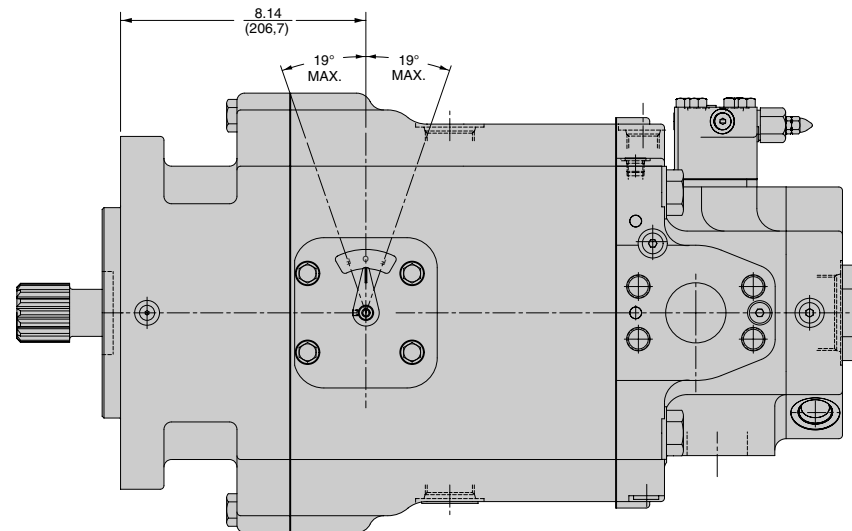
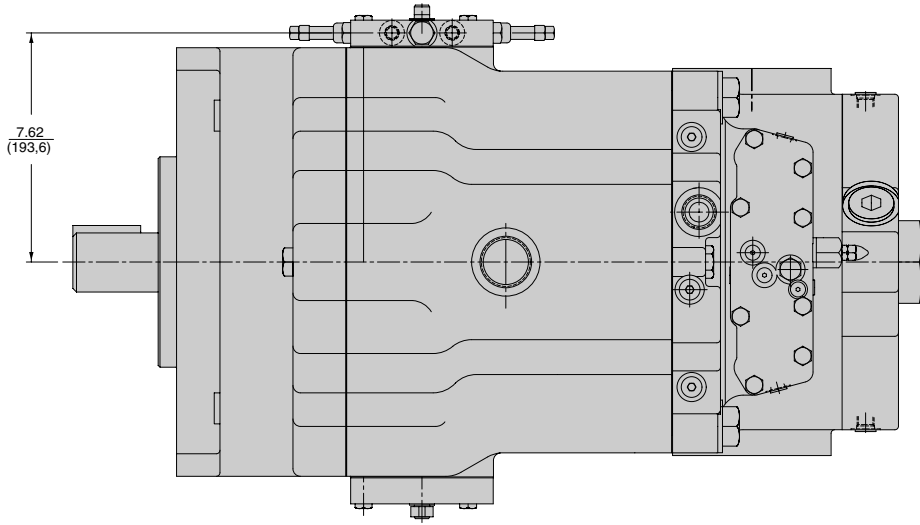
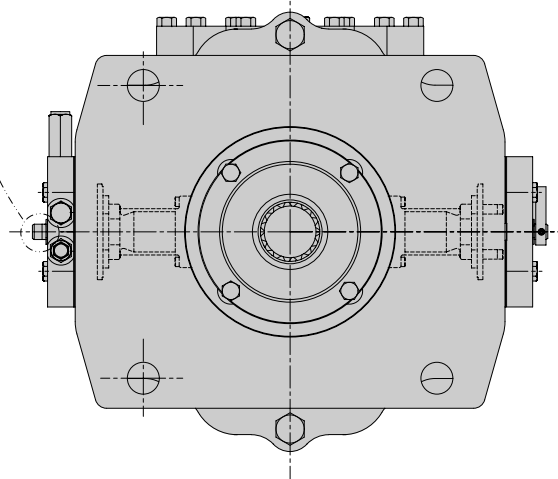
NOTES:

1. FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
2. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
3. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MANUAL OVERRIDE SHAFT DETAIL

TO OPERATE DISCONNECT OIL SUPPLY TO CONTROL PORTS
SCALE=NONE



A
A

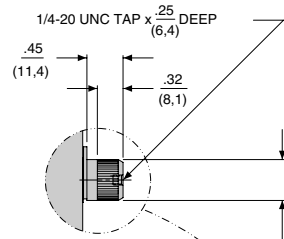
-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO CONTROL PORT	MANUAL OVERRIDE SHAFT ROTATION	PORT 'A'	PORT 'B'
"2H2"	P24P & P30P	CW	"X"	CCW	OUTLET	INLET
		CCW	"Y"	CW	OUTLET	INLET
		CW	"Y"	CW	INLET	OUTLET
		CCW	"X"	CCW	INLET	OUTLET

P24P OR P30P WITH "2H2" CONTROL WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

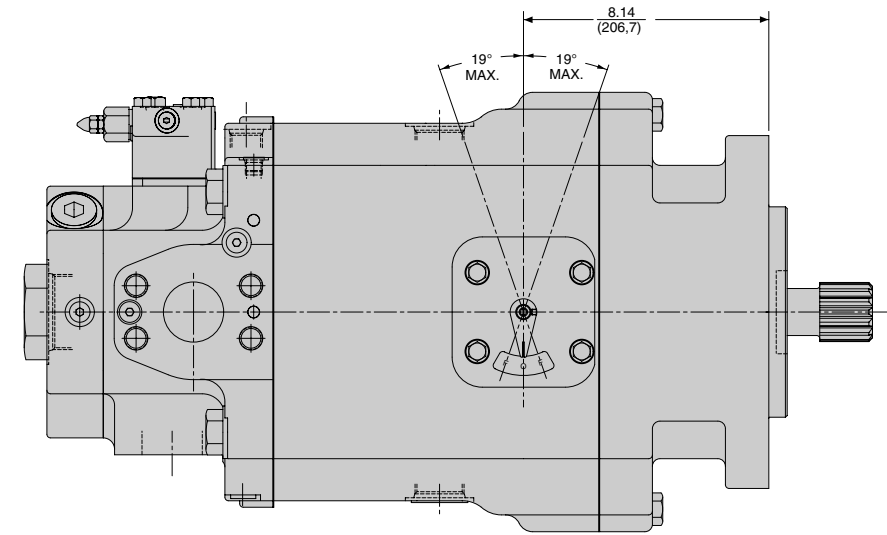
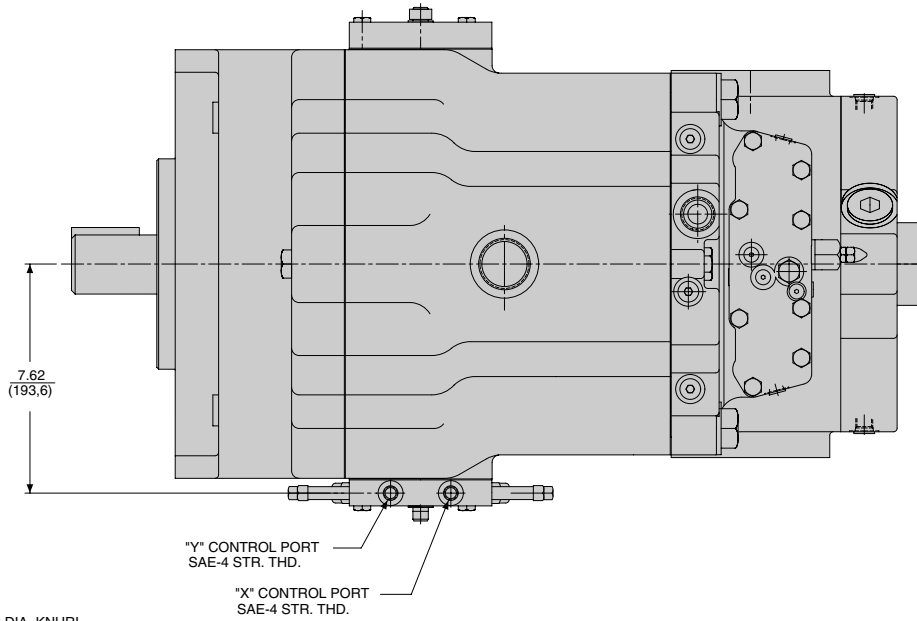
INSTALLATION DRAWING

NOTES:

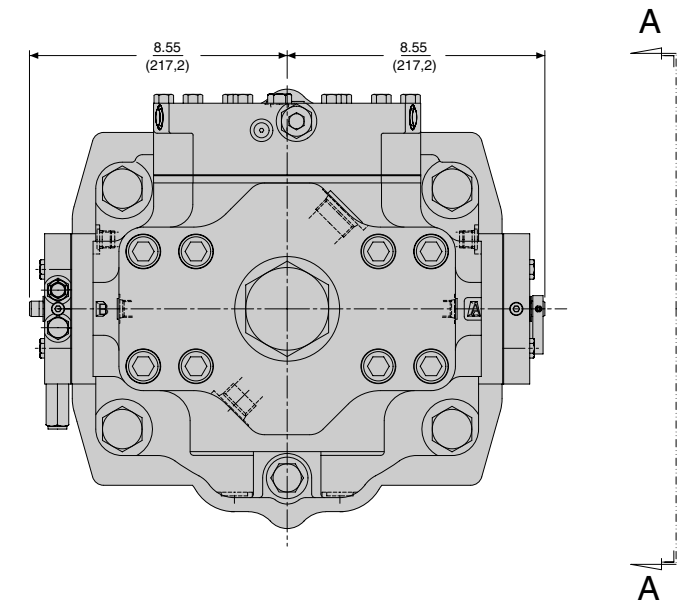
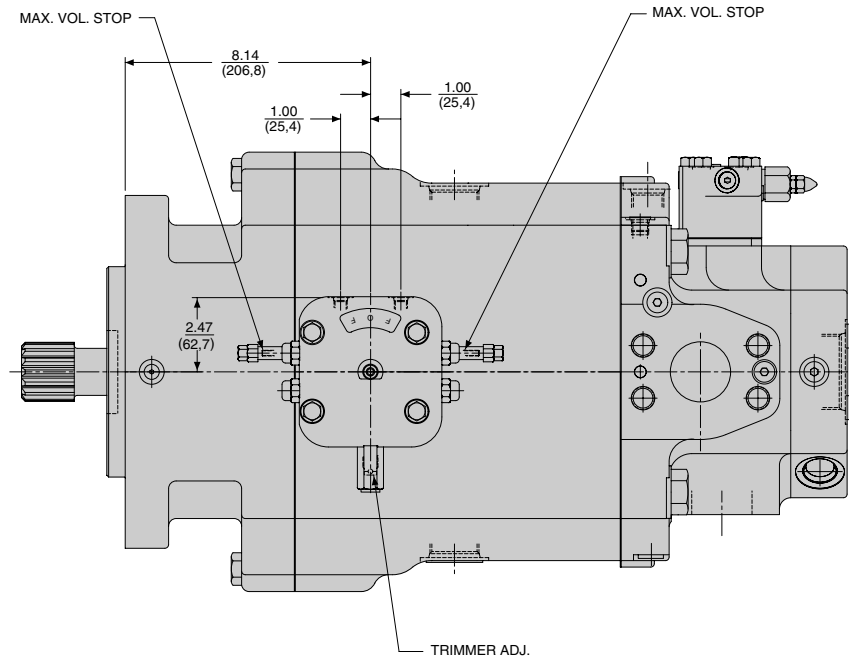
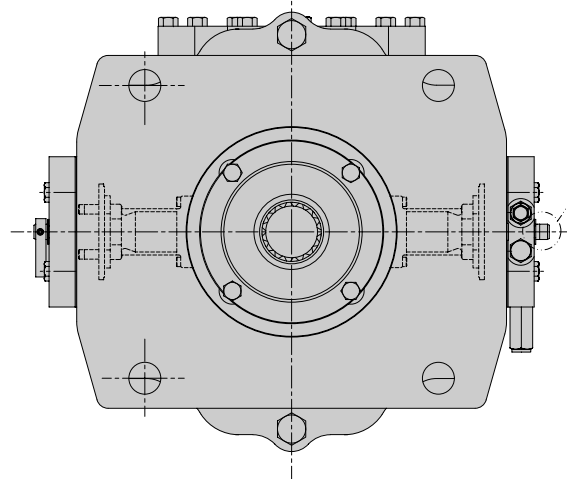
1. FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
2. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
3. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MANUAL OVERRIDE SHAFT DETAIL
TO OPERATE DISCONNECT OIL SUPPLY TO CONTROL PORTS
SCALE=NONE



VIEW A-A



-B- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO CONTROL PORT	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
"2H2"	P24P & P30P	CW	"X"	CCW	INLET	OUTLET
		CCW	"Y"	CW	INLET	OUTLET
		CW	"Y"	CW	OUTLET	INLET
		CCW	"X"	CCW	OUTLET	INLET

P24P OR P30P WITH "2H2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

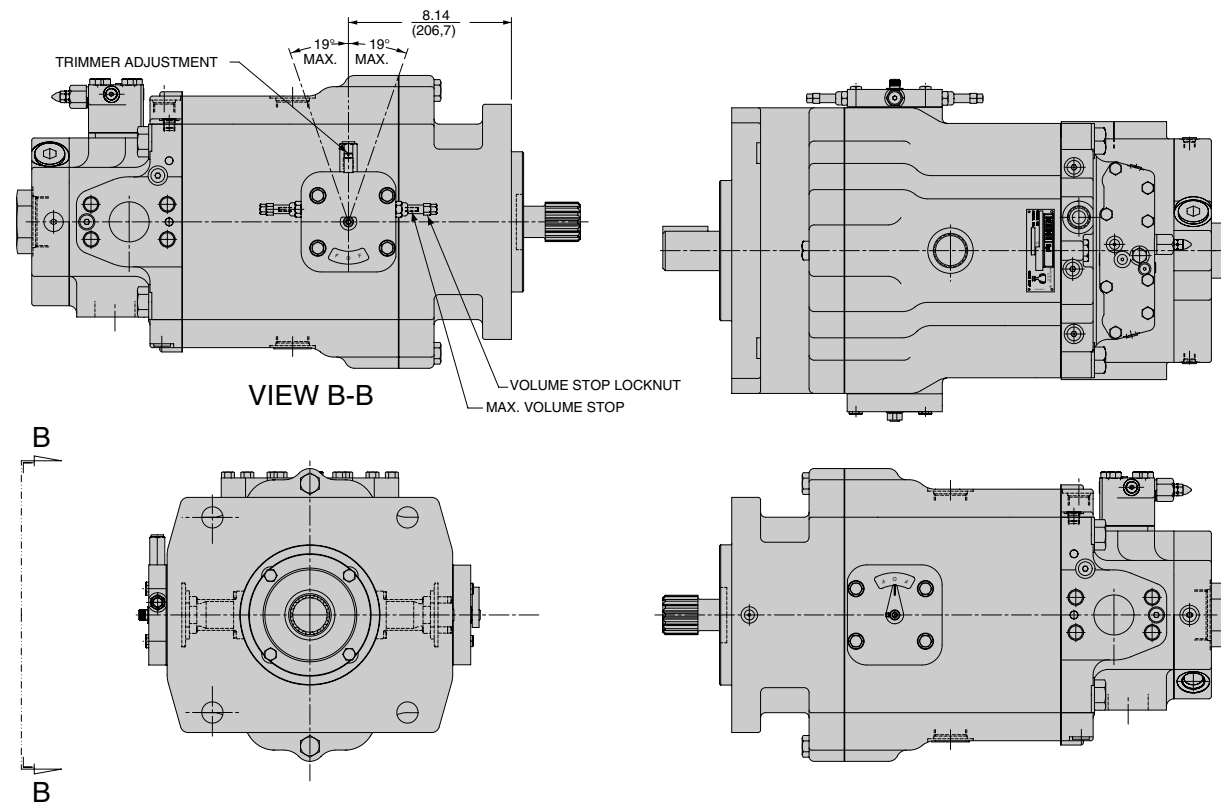


FIGURE - 2

-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"4A2"	P24P & P30P	2	CW	CW	INLET	OUTLET
		2	CCW	CCW	INLET	OUTLET
		2	CW	CCW	OUTLET	INLET
		2	CCW	CW	OUTLET	INLET

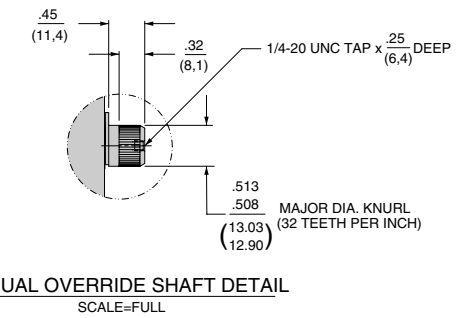
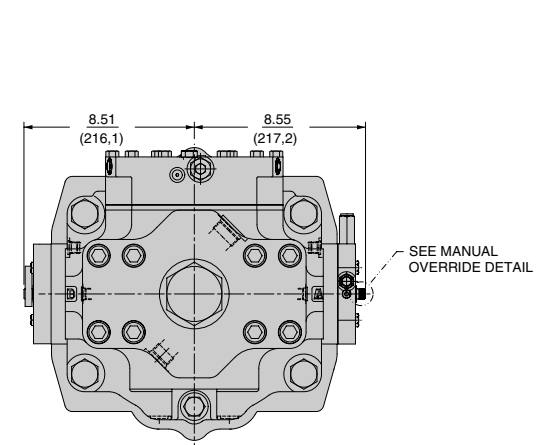
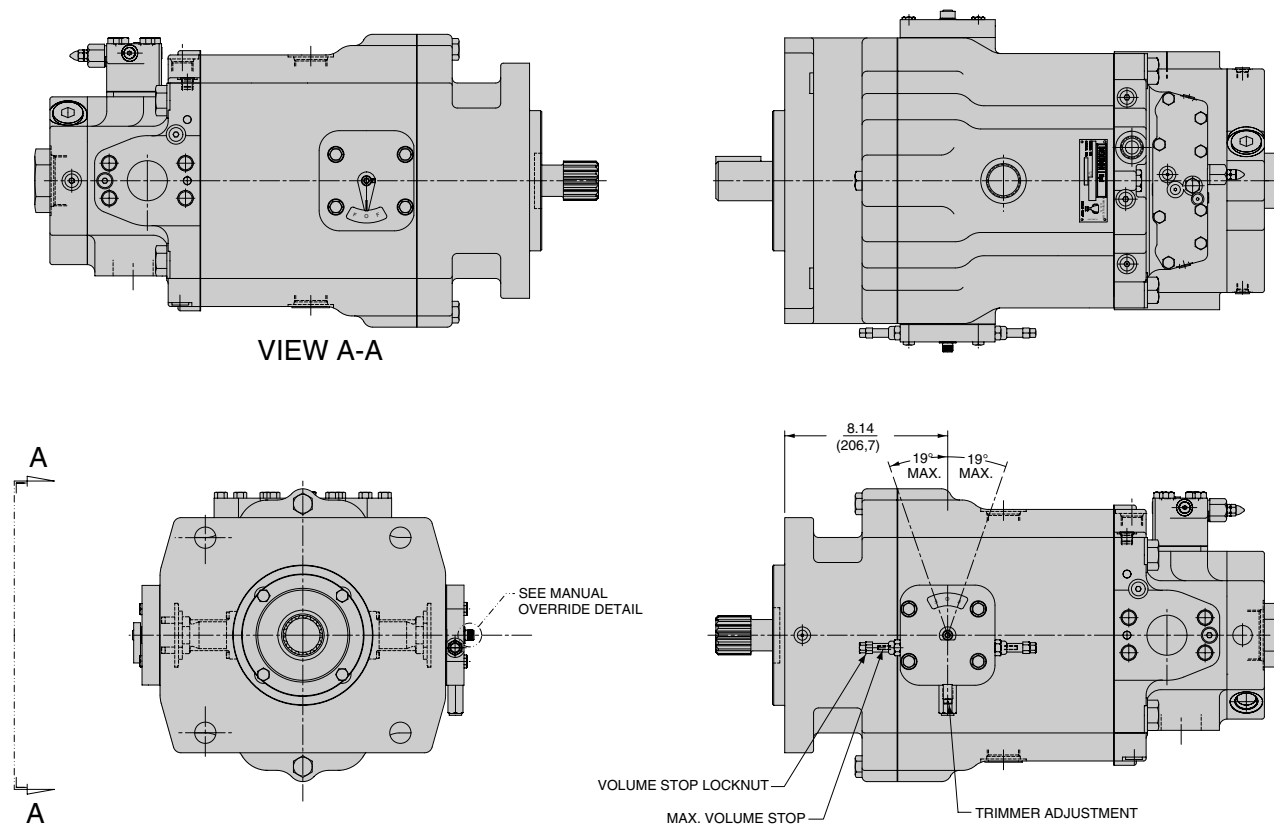


FIGURE - 1

- NOTES:
- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
 - REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
 - DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



-B- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"4A2"	P24P & P30P	1	CW	CCW	INLET	OUTLET
		1	CCW	CW	INLET	OUTLET
		1	CW	CW	OUTLET	INLET
		1	CCW	CCW	OUTLET	INLET

P24P OR P30P WITH "4A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

23-9927

FIGURE - 2

-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"5A2"	P24P & P30P	2	CW	CW	INLET	OUTLET
		2	CCW	CCW	INLET	OUTLET
		2	CW	CCW	OUTLET	INLET
		2	CCW	CW	OUTLET	INLET

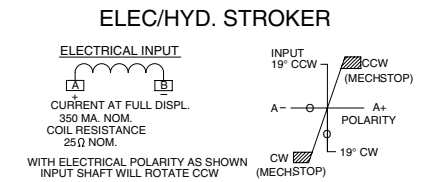
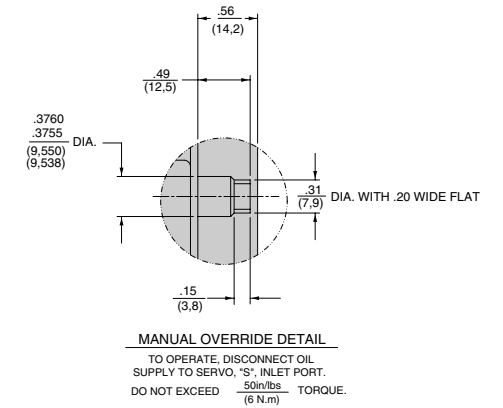
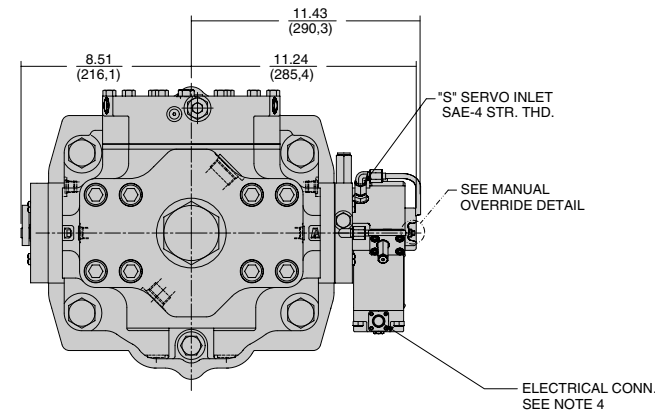
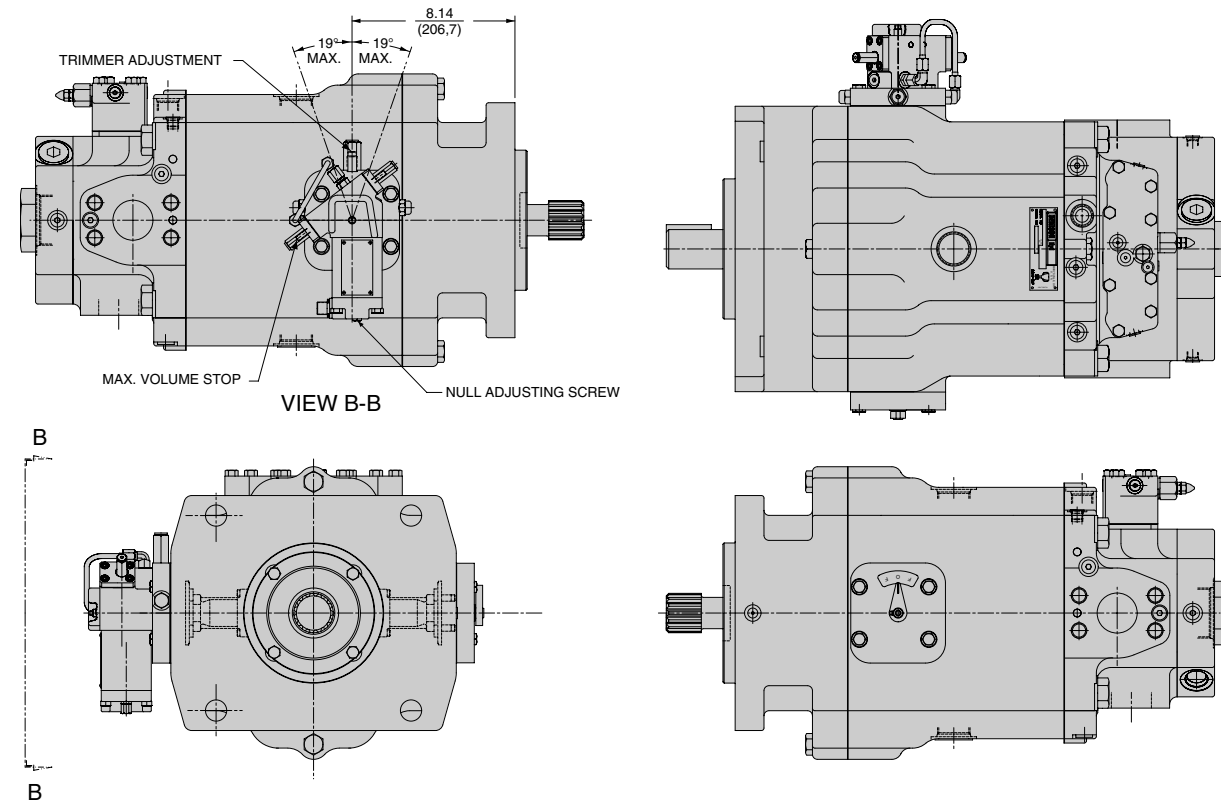
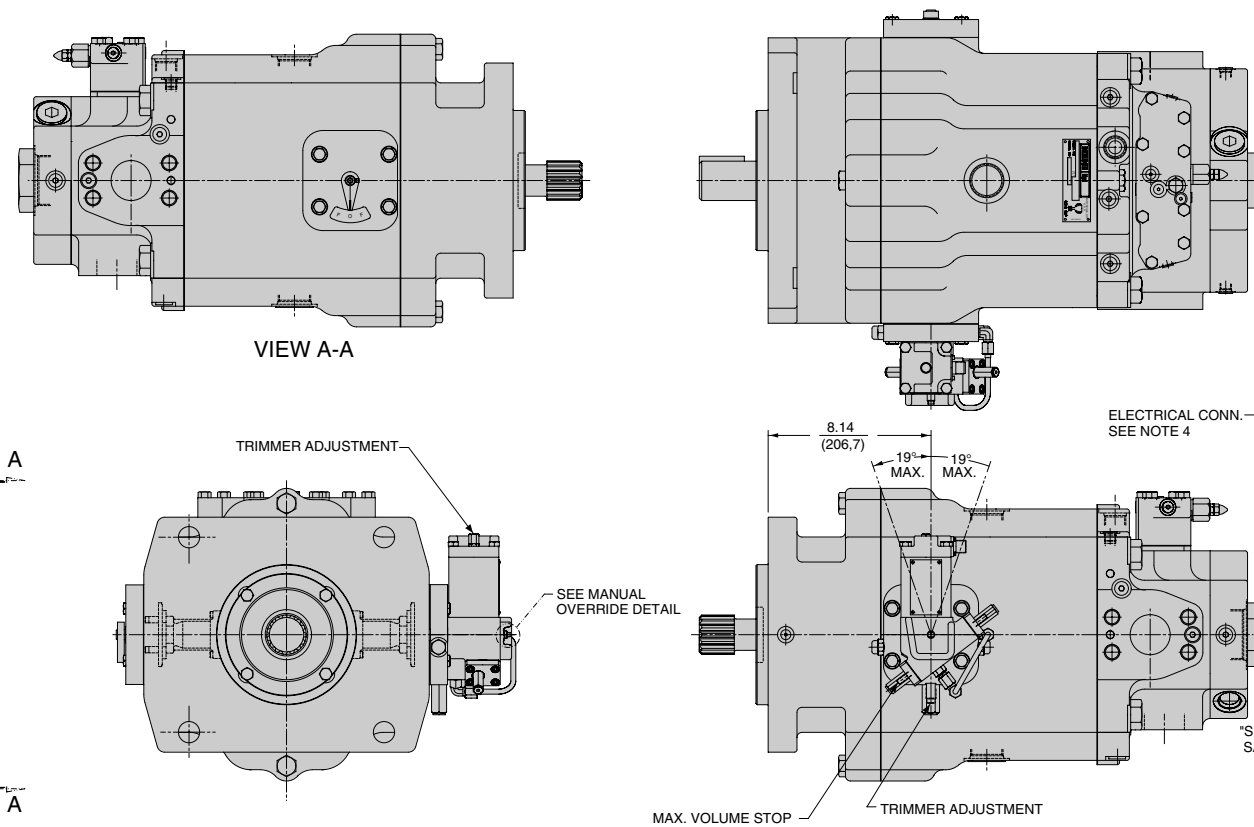


FIGURE - 1

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).
- ELECT. RECEPTACLE CONN. 5/8-24 UNEF x .390 MAX. MATING CONNECTOR HALF, MS3106E-10SL-4S (9.91)



-B- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"5A2"	P24P & P30P	1	CW	CCW	INLET	OUTLET
		1	CCW	CW	INLET	OUTLET
		1	CW	CW	OUTLET	INLET
		1	CCW	CCW	OUTLET	INLET

P24P OR P30P WITH "5A2" CONTROL WITH INTERNAL CARTRIDGE CW/CCW ROTATION-SAE-F 4 BOLT MTG.

23-9914

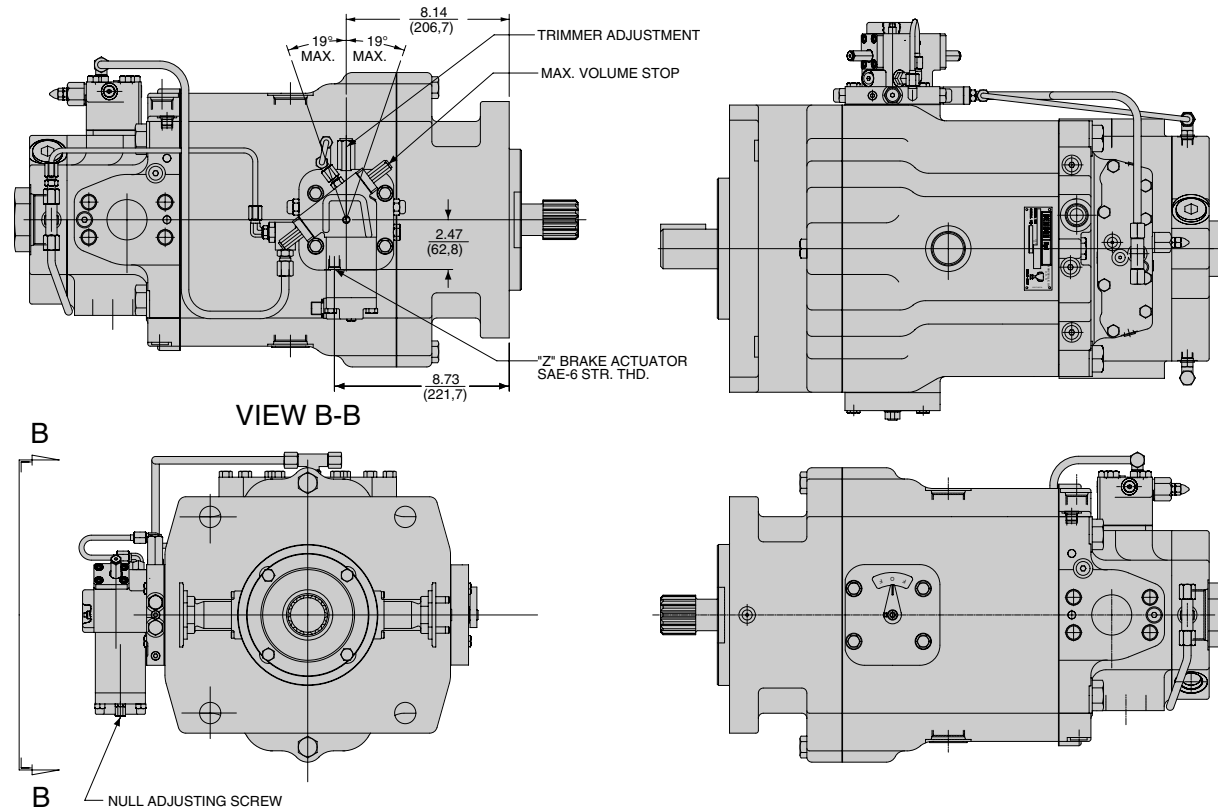


FIGURE - 2

-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"5C2"	P24P & P30P	2	CW	CW	INLET	OUTLET
		2	CCW	CCW	INLET	OUTLET
		2	CW	CCW	OUTLET	INLET
		2	CCW	CW	OUTLET	INLET

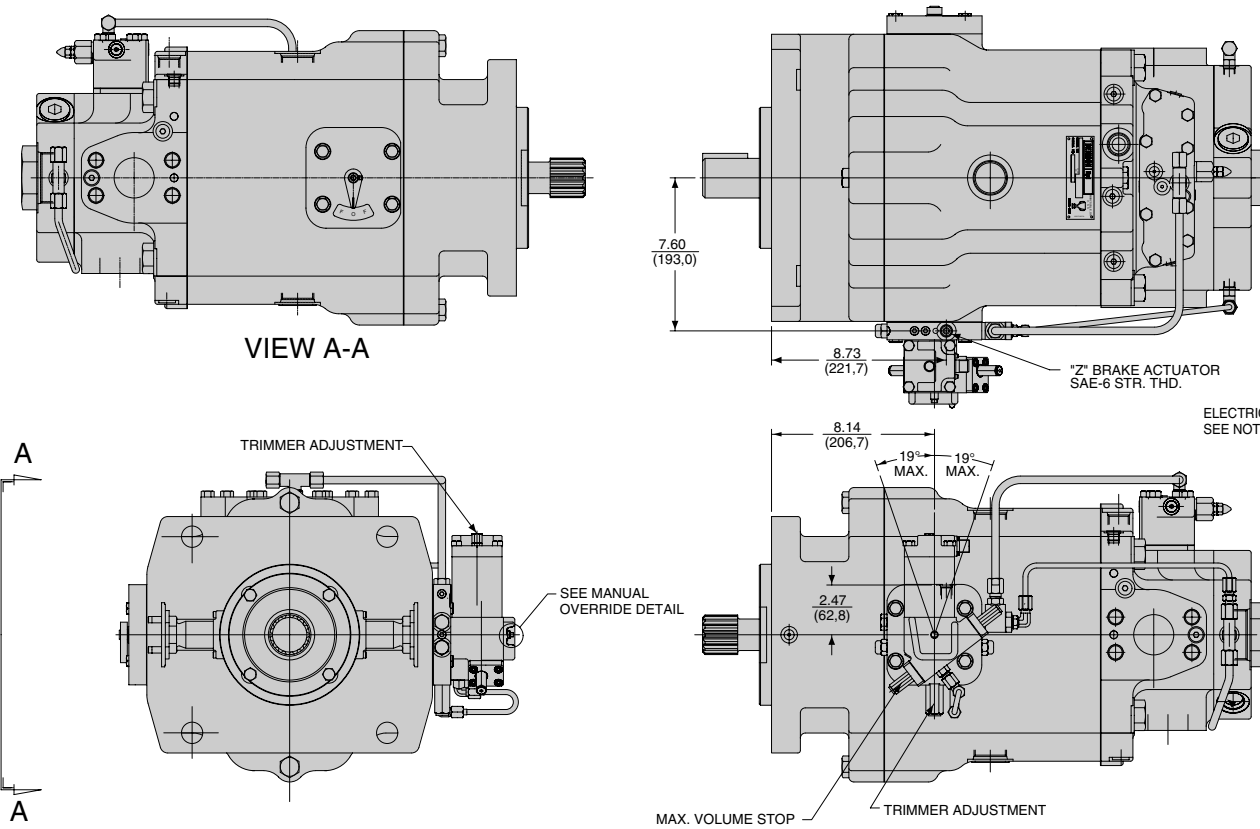
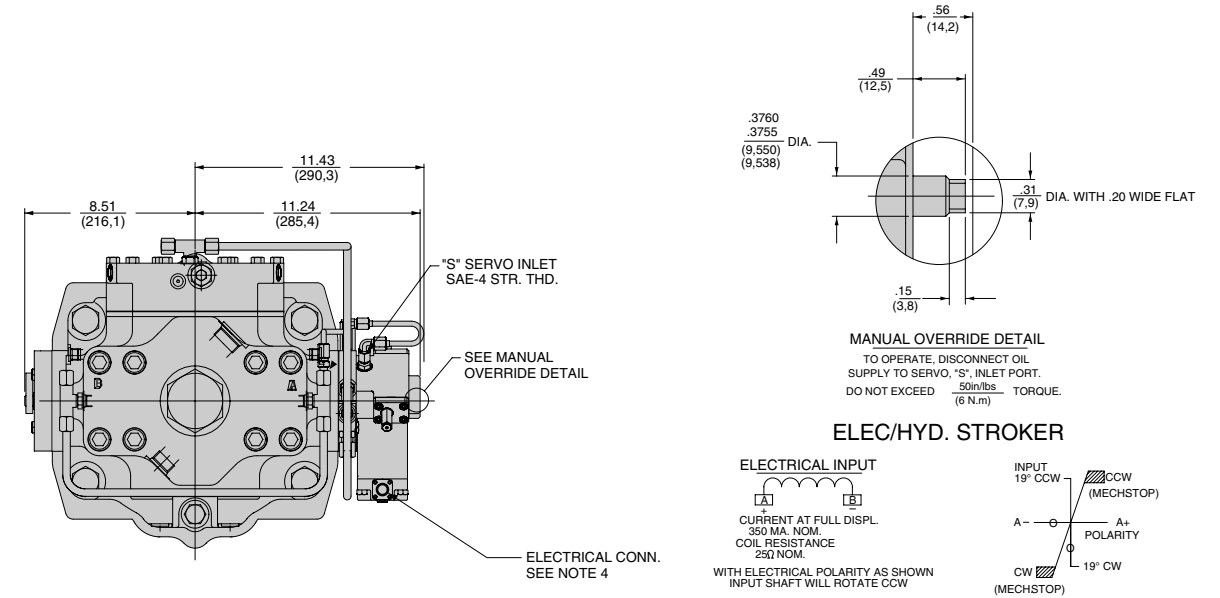


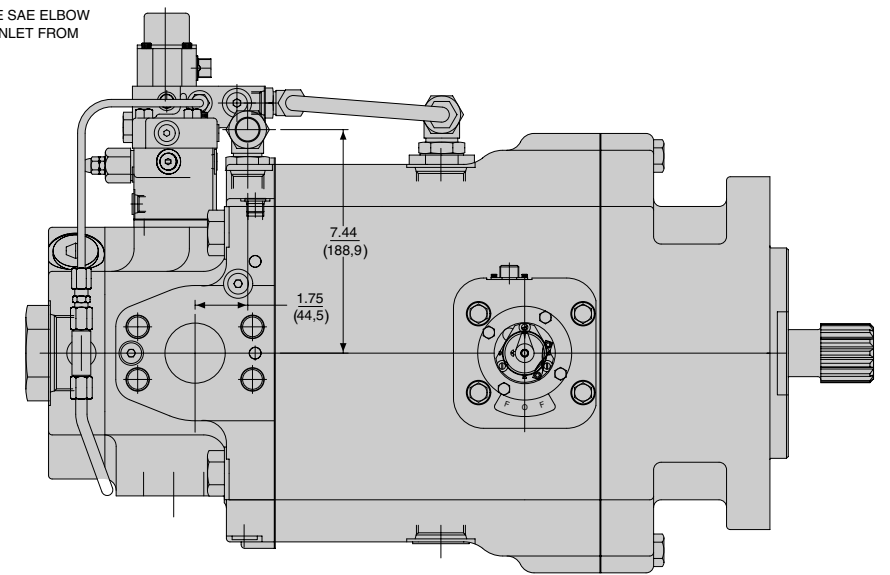
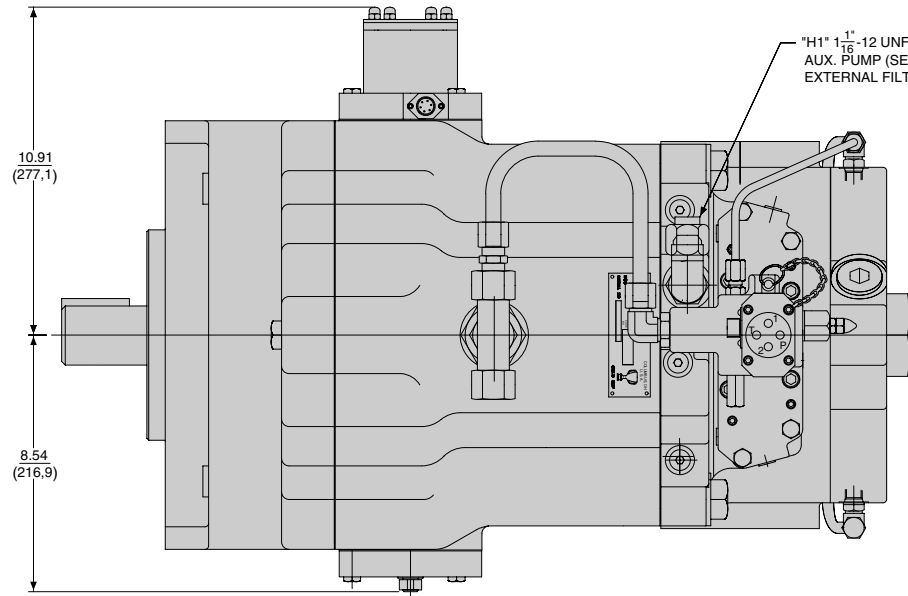
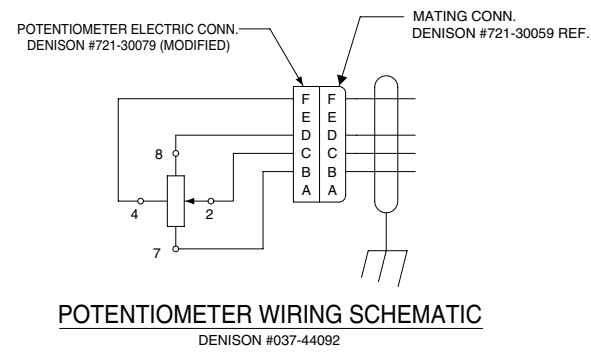
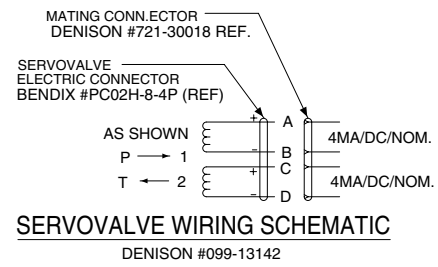
FIGURE - 1

- NOTES:
- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION: P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
 - REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
 - DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).
 - ELECT. RECEPTACLE CONN. 5/8-24 UNEF x $\frac{.390}{(9.91)}$ MAX. MATING CONNECTOR HALF, MS3106E-10SL-4S

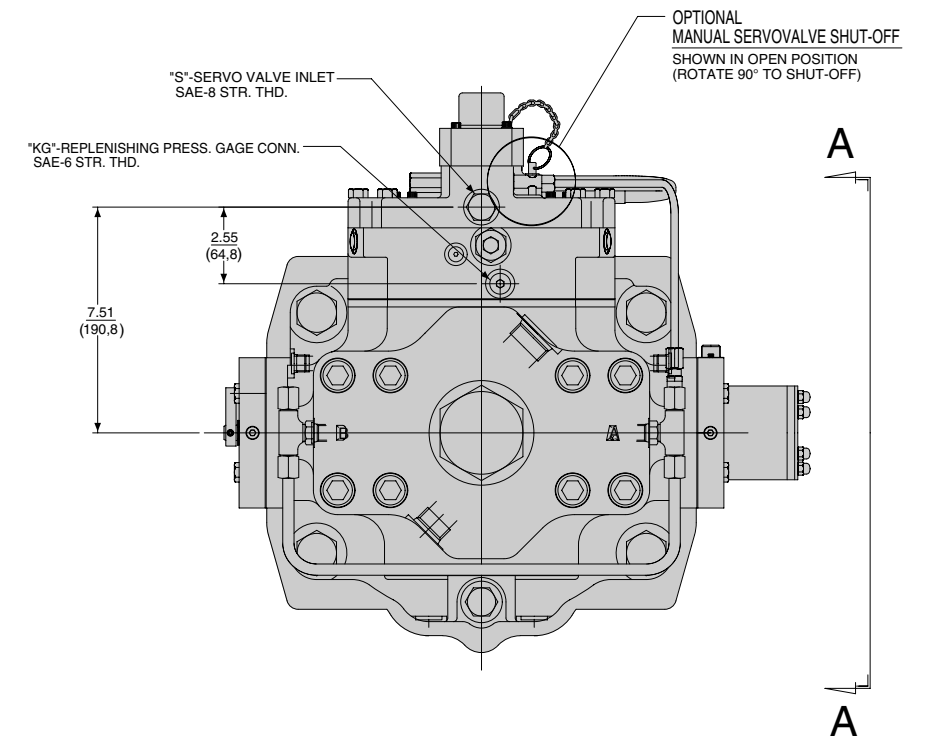
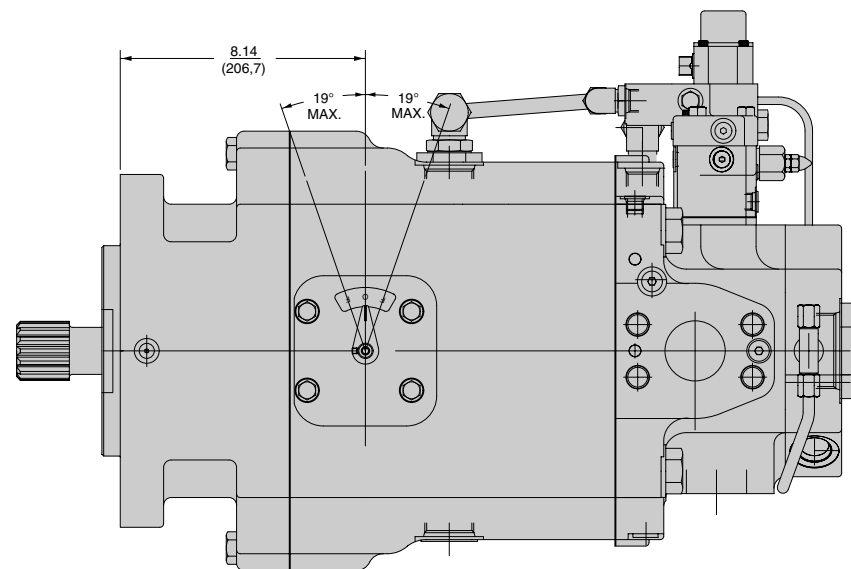
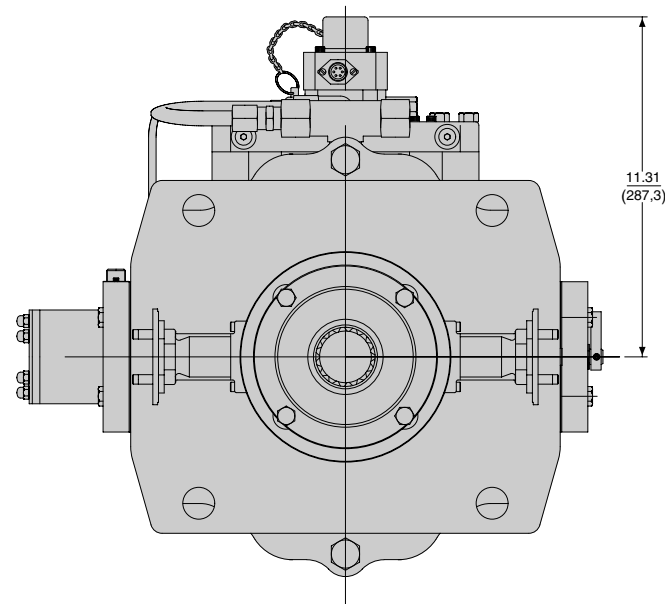
-B- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	FIND FIGURE	PUMP ROT.	ROTARY SERVO INPUT SHAFT ROTATION	PORT "A"	PORT "B"
"5C2"	P24P & P30P	1	CW	CCW	INLET	OUTLET
		1	CCW	CW	INLET	OUTLET
		1	CW	CW	OUTLET	INLET
		1	CCW	CCW	OUTLET	INLET

P24P OR P30P WITH "5C2" CONTROL WITH INTERNAL CARTRIDGE CW/CCW ROTATION-SAE-F 4 BOLT MTG.

23-9936



VIEW A-A



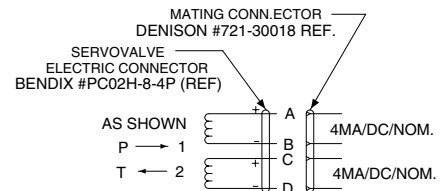
NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).

-B- CONTROL MTG. POSITION					
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	VOLUME INDICATOR SHAFT ROTATION	PORT "A"	PORT "B"
"7D2"	P24P & P30P	CW	CCW	INLET	OUTLET
		CCW	CW	INLET	OUTLET
		CW	CW	OUTLET	INLET
		CCW	CCW	OUTLET	INLET

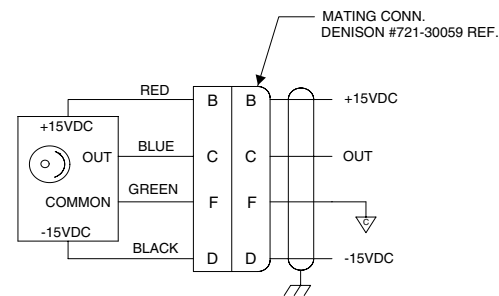
P24/30P W/ "7D2-B" CONTROL W/WO COMPENSATOR
SHUT-OFF & WITH FEEDBACK POTENTIOMETER
CW/CCW ROTATION, SAE-F 4-BOLT MOUNTING

23-9928



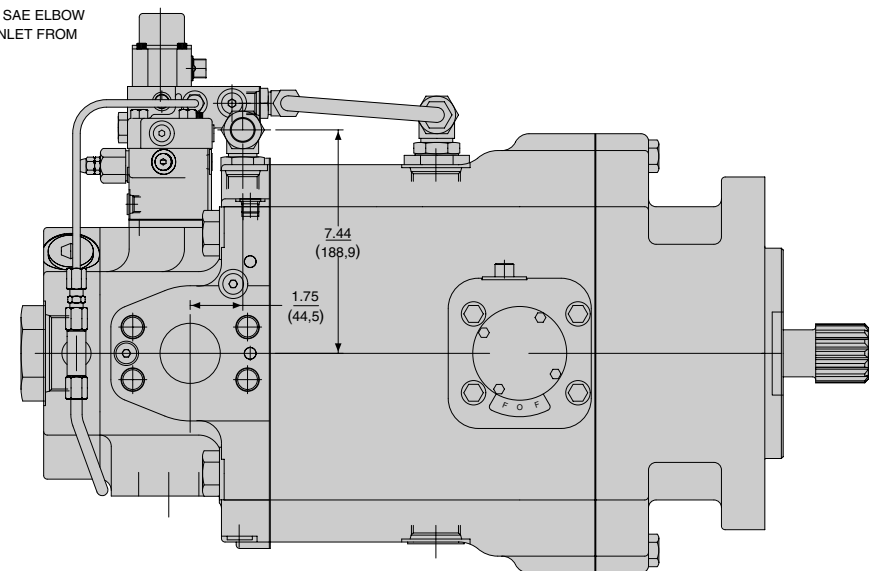
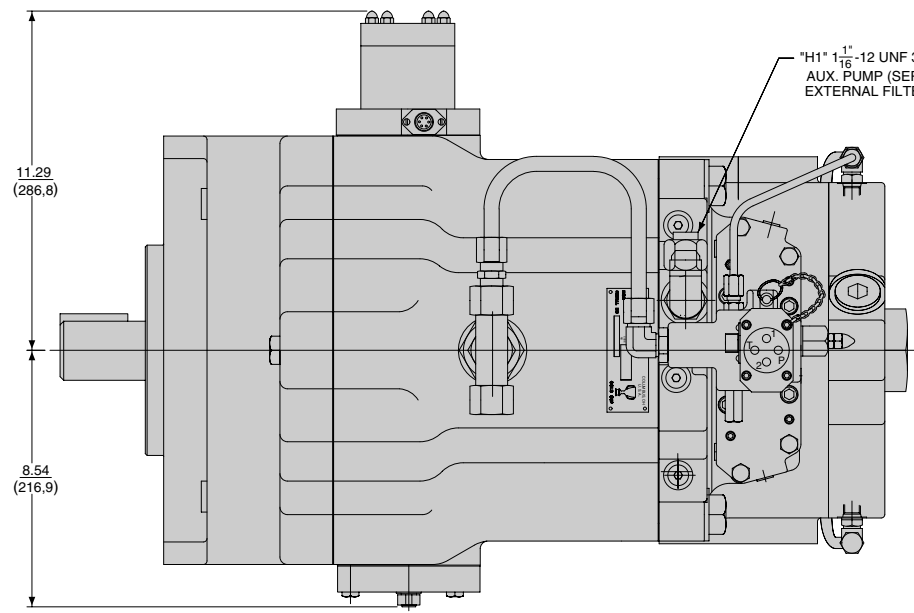
SERVOVALVE WIRING SCHEMATIC

DENISON #099-13142

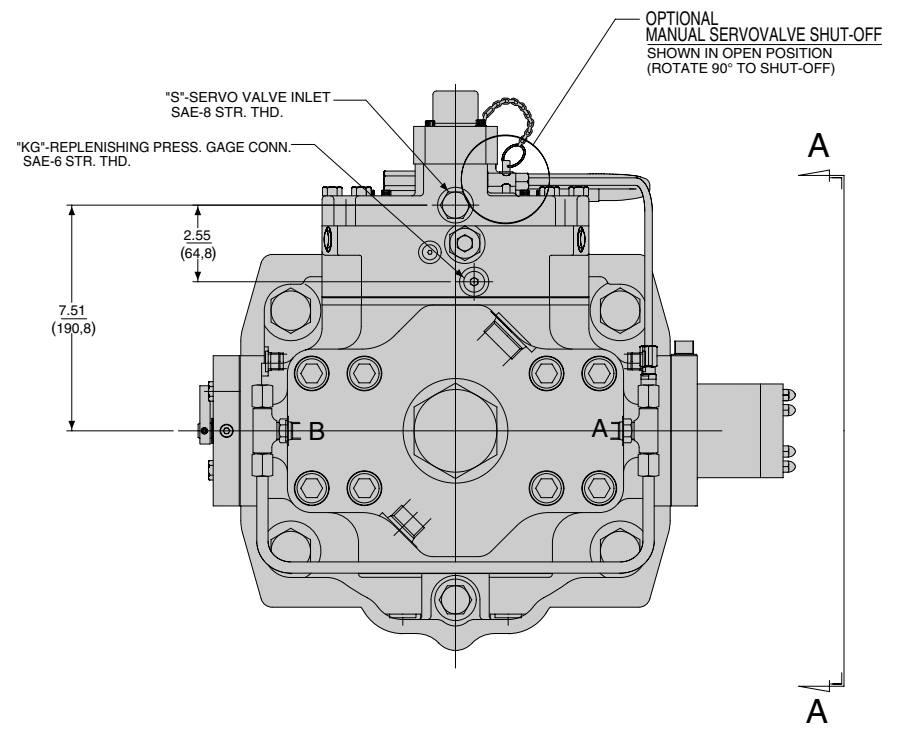
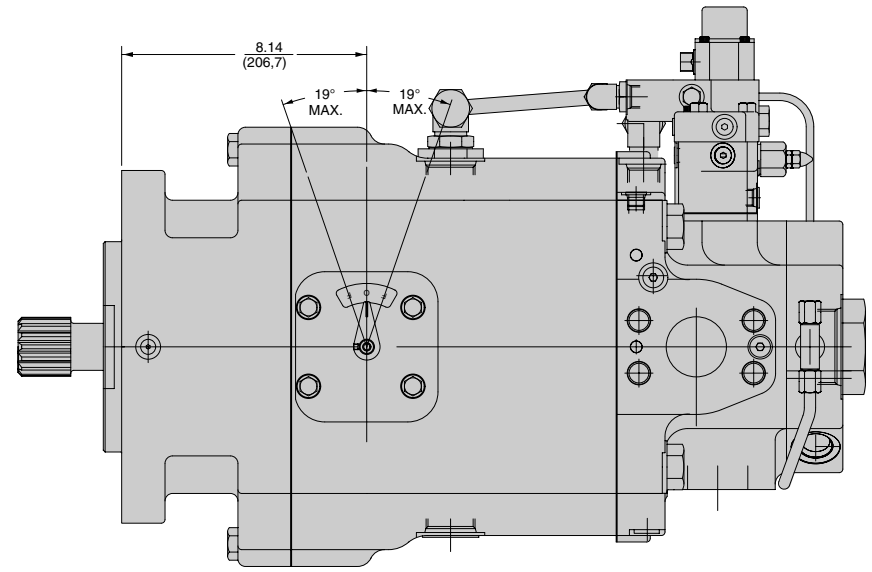
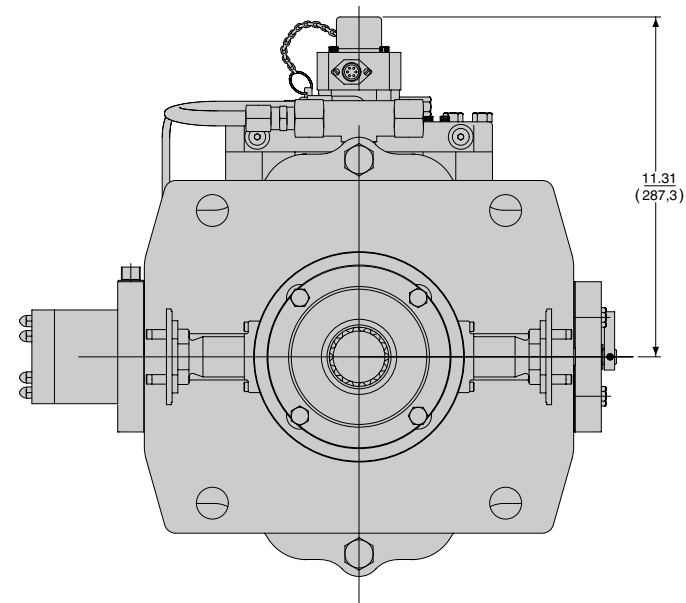


RVDT WIRING SCHEMATIC

DENISON #788-20002
2.4VDC OUT AT 19° CAM ANGLE



VIEW A-A



NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).

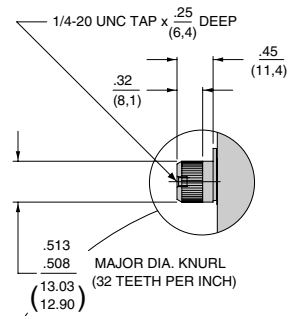
-B- CONTROL MTG. POSITION					
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	VOLUME INDICATOR SHAFT ROTATION	PORT "A"	PORT "B"
"7E2"	P24P & P30P	CW	CCW	INLET	OUTLET
		CCW	CW	INLET	OUTLET
		CW	CW	OUTLET	INLET
		CCW	CCW	OUTLET	INLET

P24/30P W/ "7E2-B" CONTROL W/WO COMPENSATOR SHUT-OFF & WITH RVDT
CW/CCW ROTATION, SAE-F 4-BOLT MOUNTING

23-9923

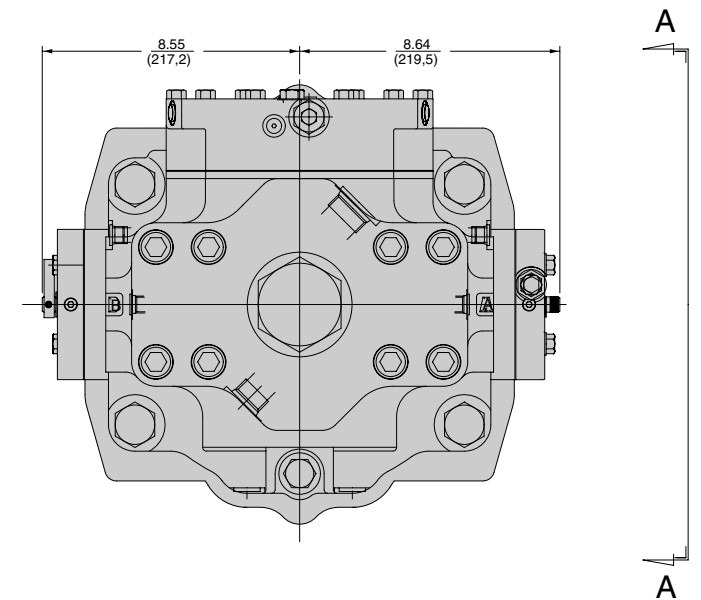
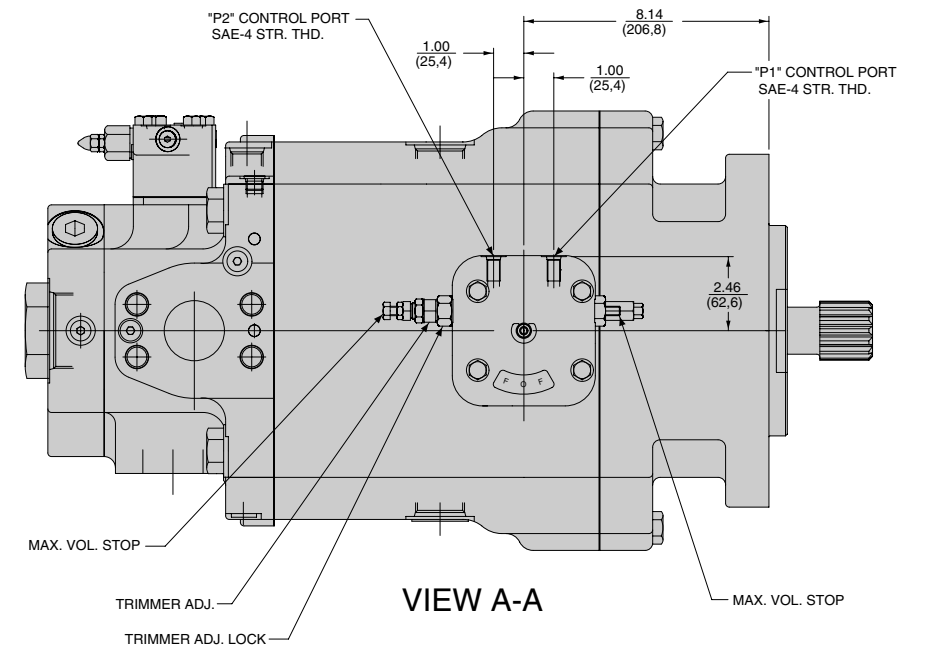
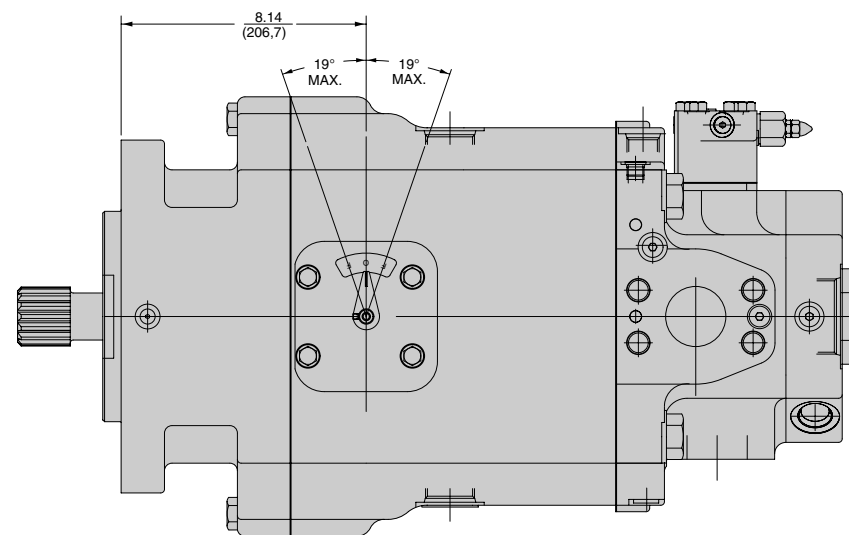
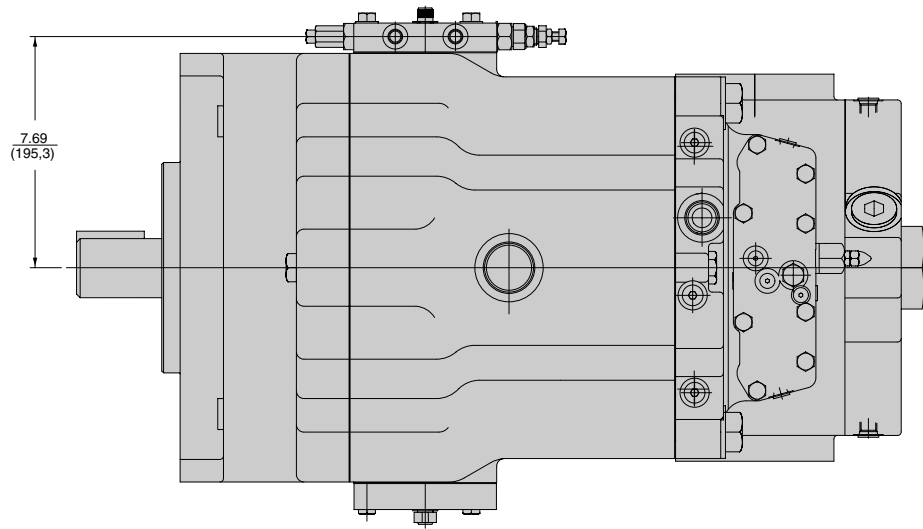
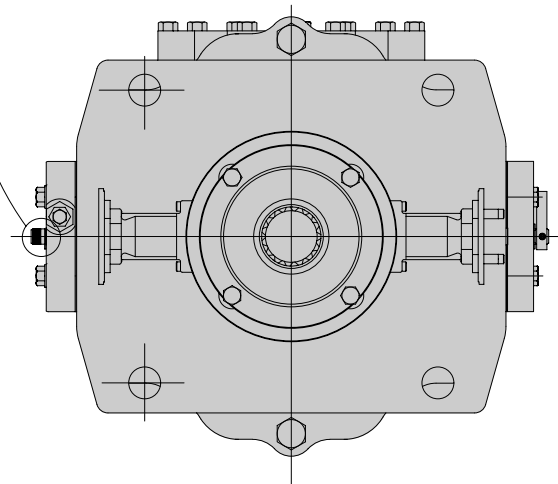
NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MANUAL OVERRIDE SHAFT DETAIL

TO OPERATE DISCONNECT OIL SUPPLY TO CONTROL PORTS
SCALE=NONE

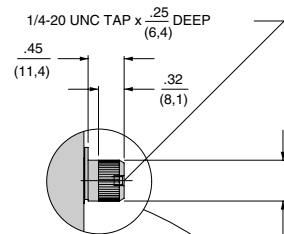


-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO SAE-4 STR. THD. CONTROL PORT	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
"8A2"	P24P & P30P	CW	"P1"	CCW	OUTLET	INLET
		CCW	"P2"	CW	OUTLET	INLET
		CW	"P2"	CW	INLET	OUTLET
		CCW	"P1"	CCW	INLET	OUTLET

P24P OR P30P WITH "8A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

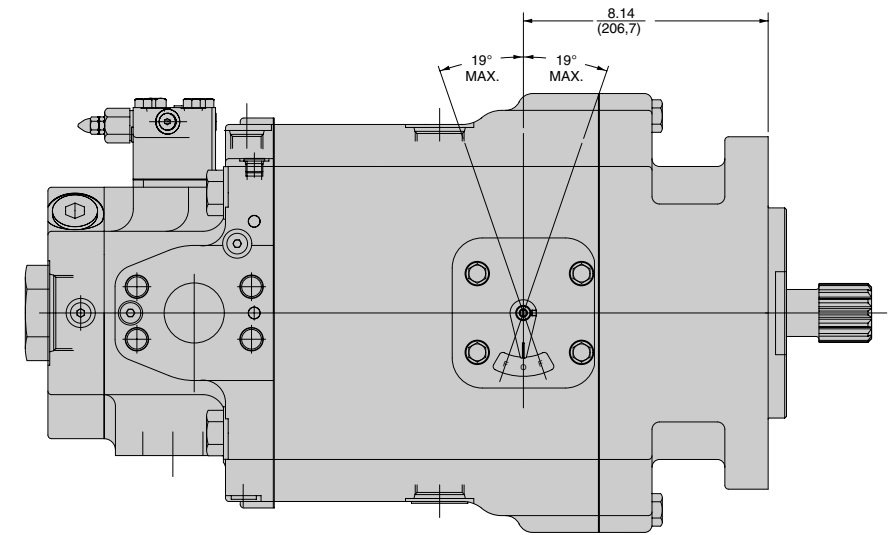
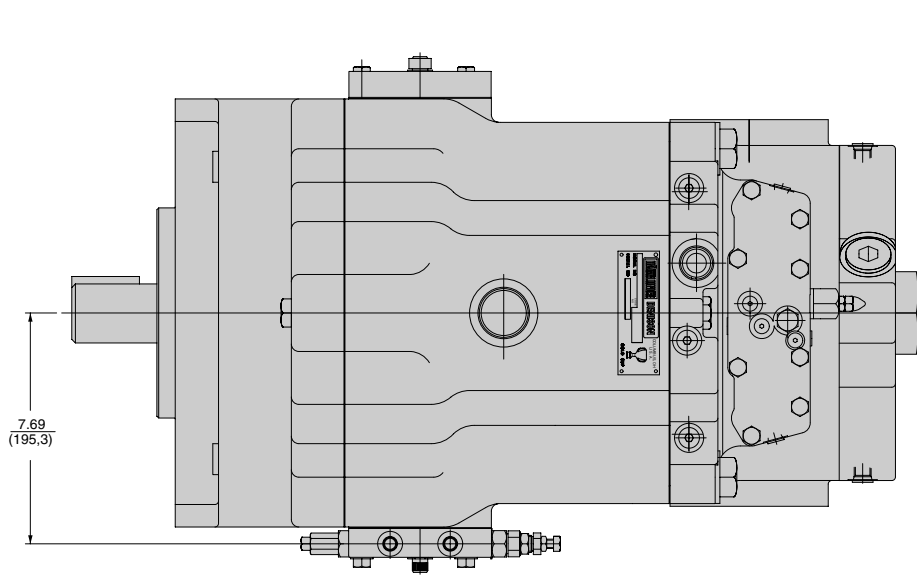
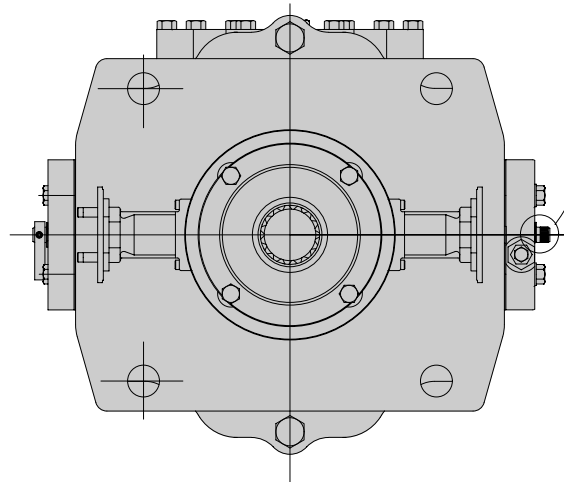
NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).

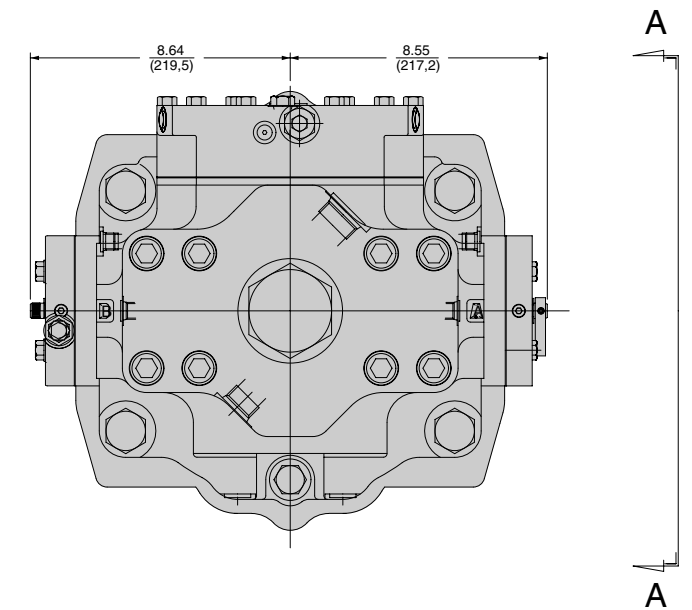
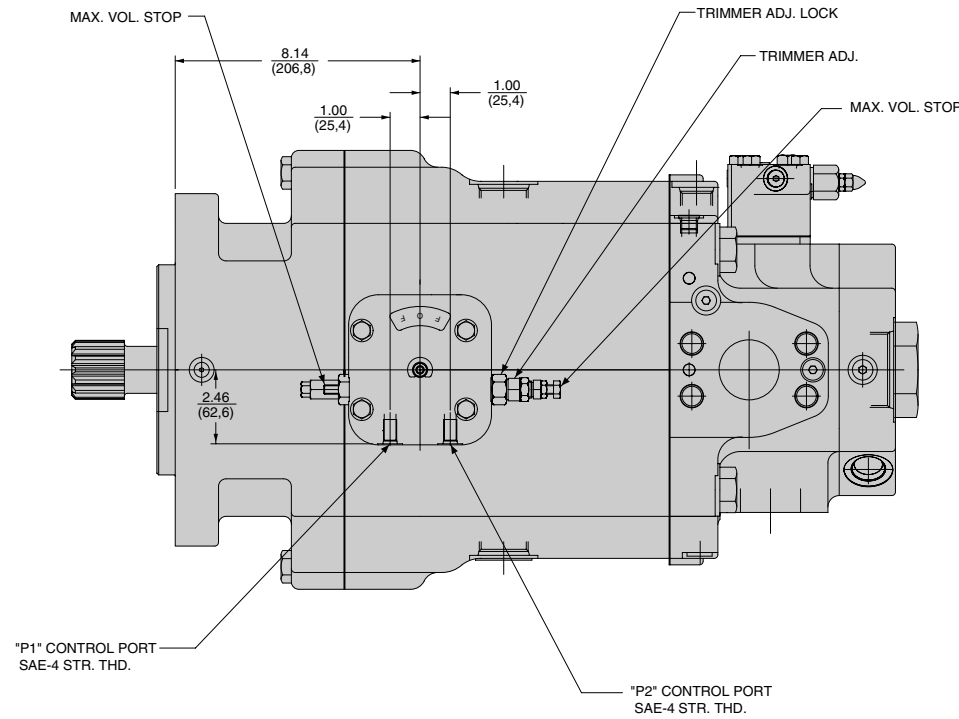


MANUAL OVERRIDE SHAFT DETAIL

TO OPERATE DISCONNECT OIL SUPPLY TO CONTROL PORTS
SCALE=NONE



VIEW A-A



-B- CONTROL MTG. POSITION

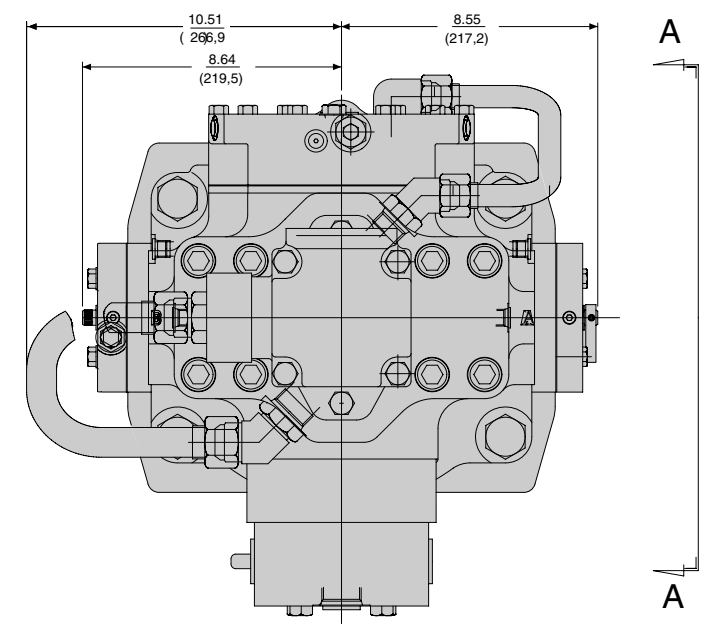
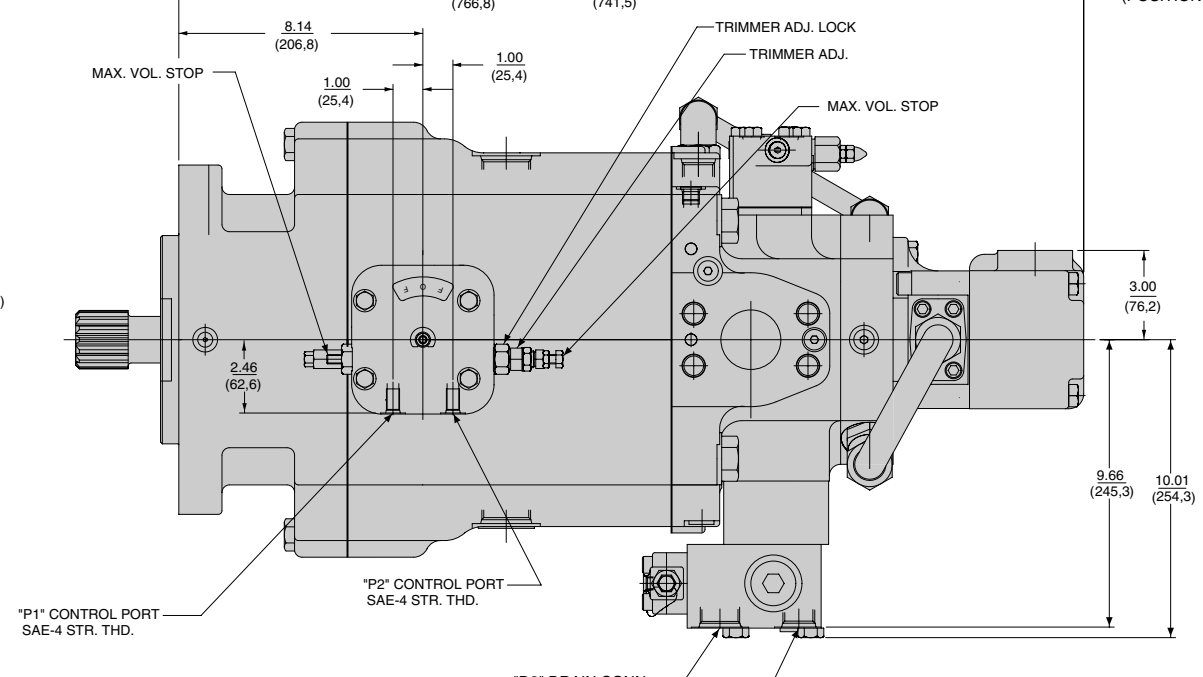
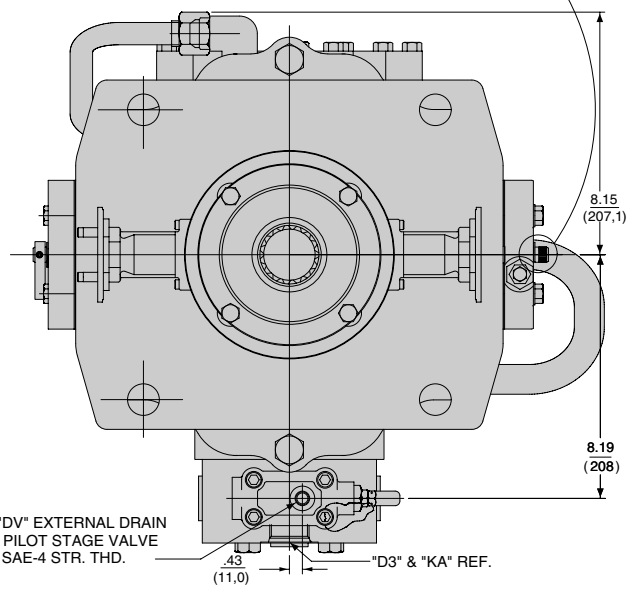
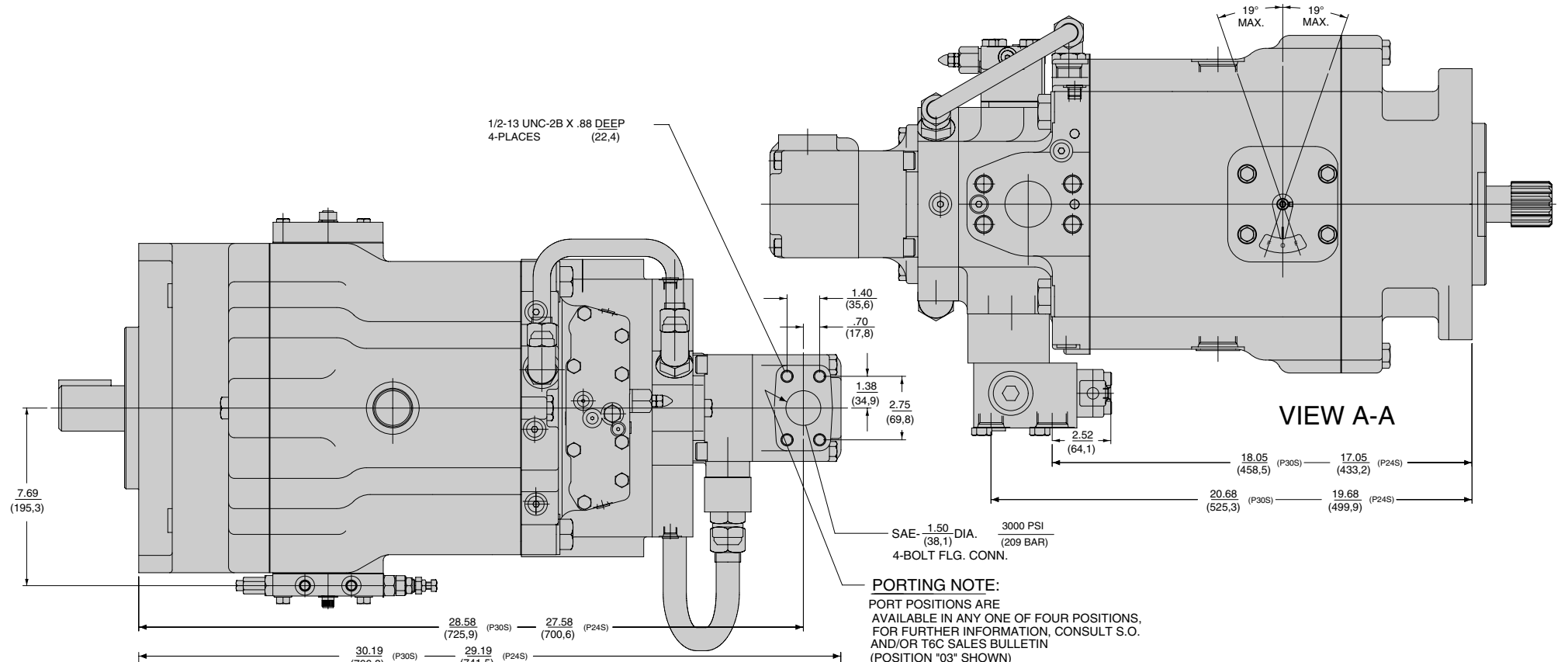
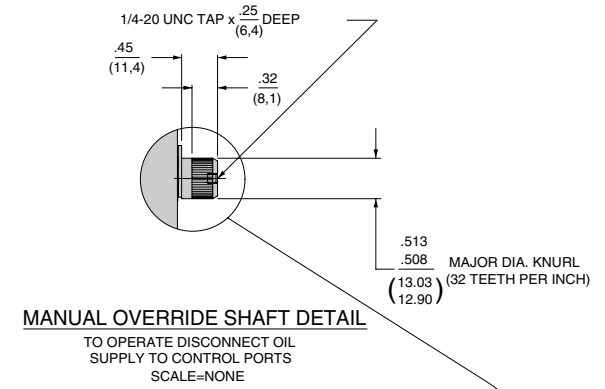
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO SAE-4 STR. THD. CONTROL PORT	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
"8A2"	P24P & P30P	CW	"P1"	CCW	INLET	OUTLET
		CCW	"P2"	CW	INLET	OUTLET
		CW	"P2"	CW	OUTLET	INLET
		CCW	"P1"	CCW	OUTLET	INLET

P24P OR P30P WITH "8A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

INSTALLATION DRAWING

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



-B- CONTROL MTG. POSITION

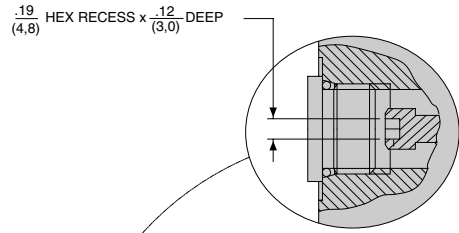
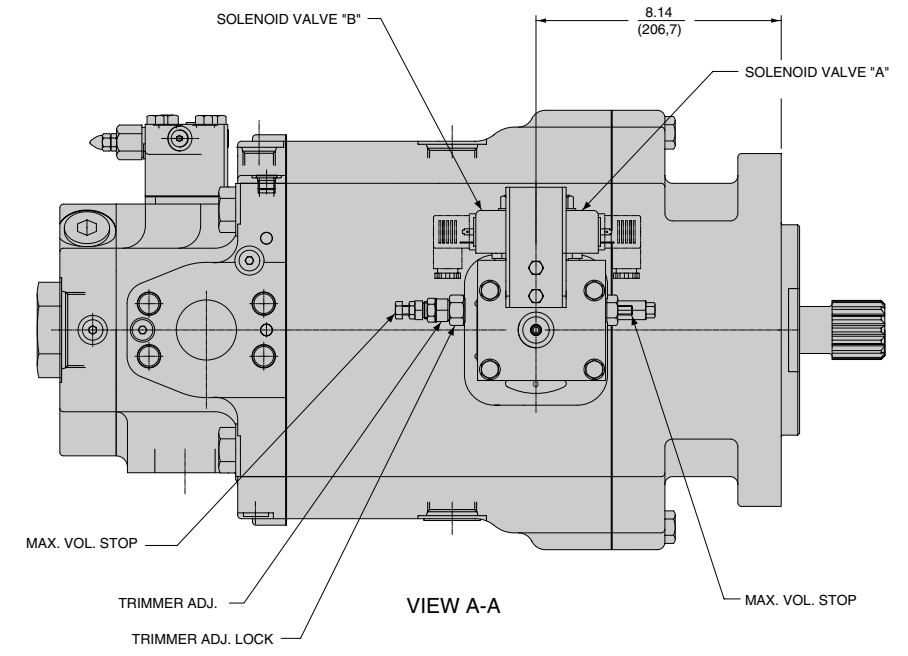
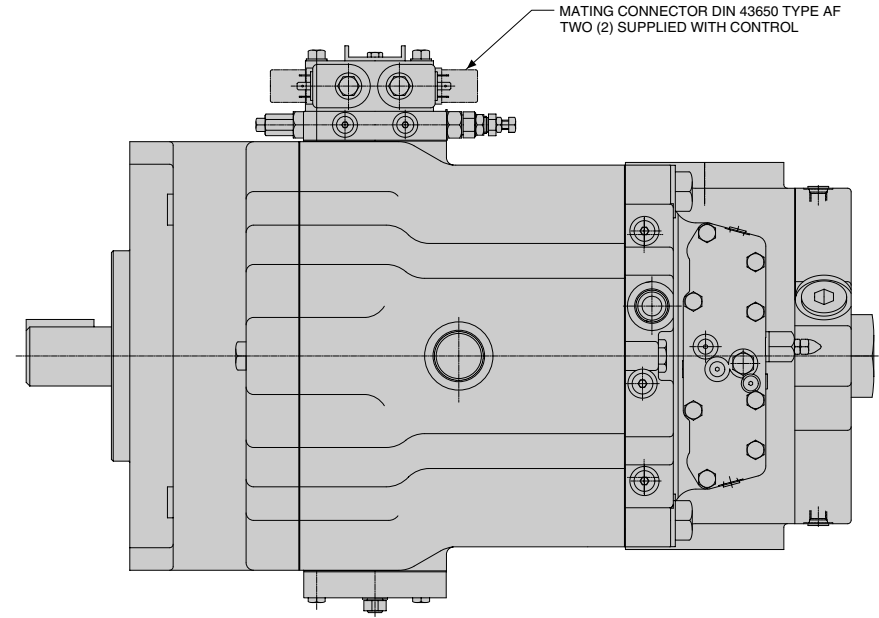
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	CONTROL PRESSURE TO SAE-4 STR. THD. CONTROL PORT	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
"8A2"	P24S & P30S	CW	"P1"	CCW	INLET	OUTLET
		CCW	"P2"	CW	INLET	OUTLET
		CW	"P2"	CW	OUTLET	INLET
		CCW	"P1"	CCW	OUTLET	INLET

P24S OR P30S WITH "8A2" CONTROL & T6C AUX. PUMP WITH INTERNAL CARTRIDGE CW/CCW ROTATION-SAE-F 4 BOLT MTG.

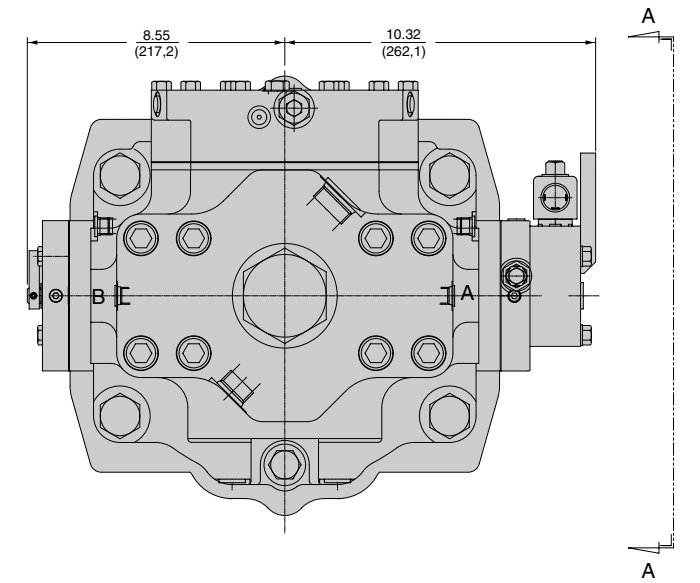
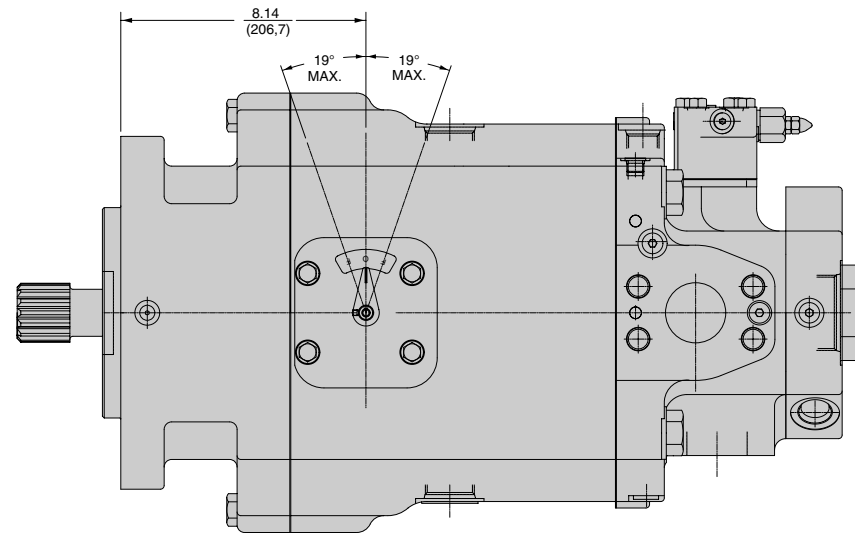
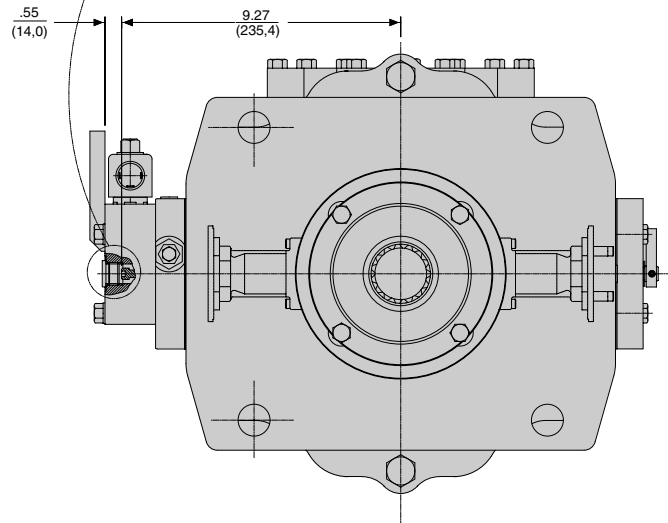
23-9916

NOTES:

1. FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
2. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
3. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MANUAL OVERRIDE SHAFT DETAIL
SCALE=4X

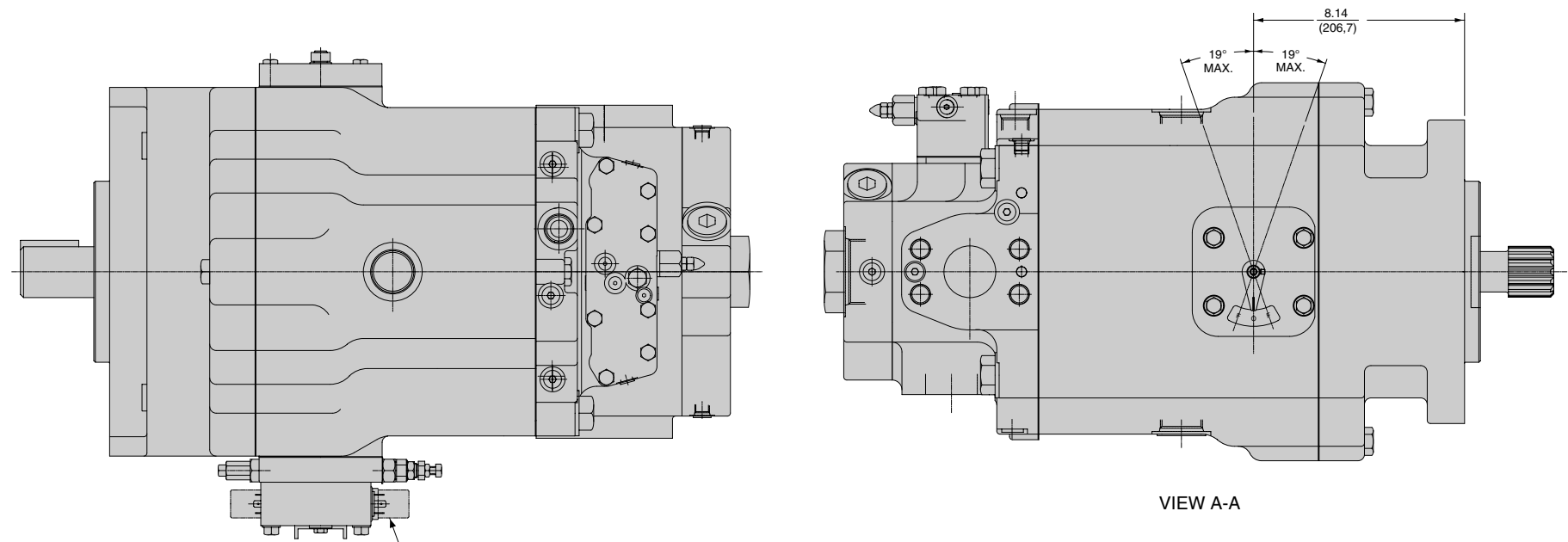


-A- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	ENERGIZE SOLENOID:	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
"9A2"	P24P & P30P	CW	"B"	CCW	OUTLET	INLET
		CCW	"A"	CW	OUTLET	INLET
		CW	"A"	CW	INLET	OUTLET
		CCW	"B"	CCW	INLET	OUTLET

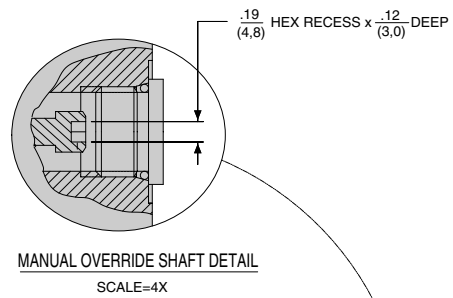
P24P OR P30P WITH "9A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
 P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
 P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).

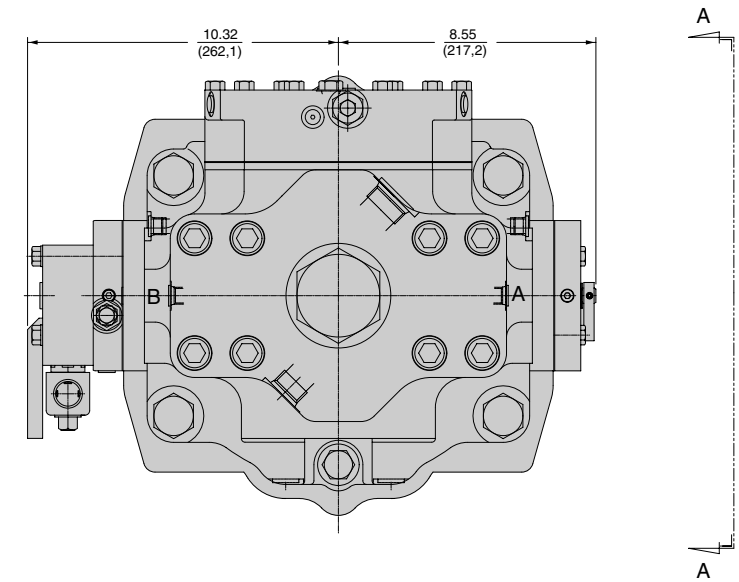
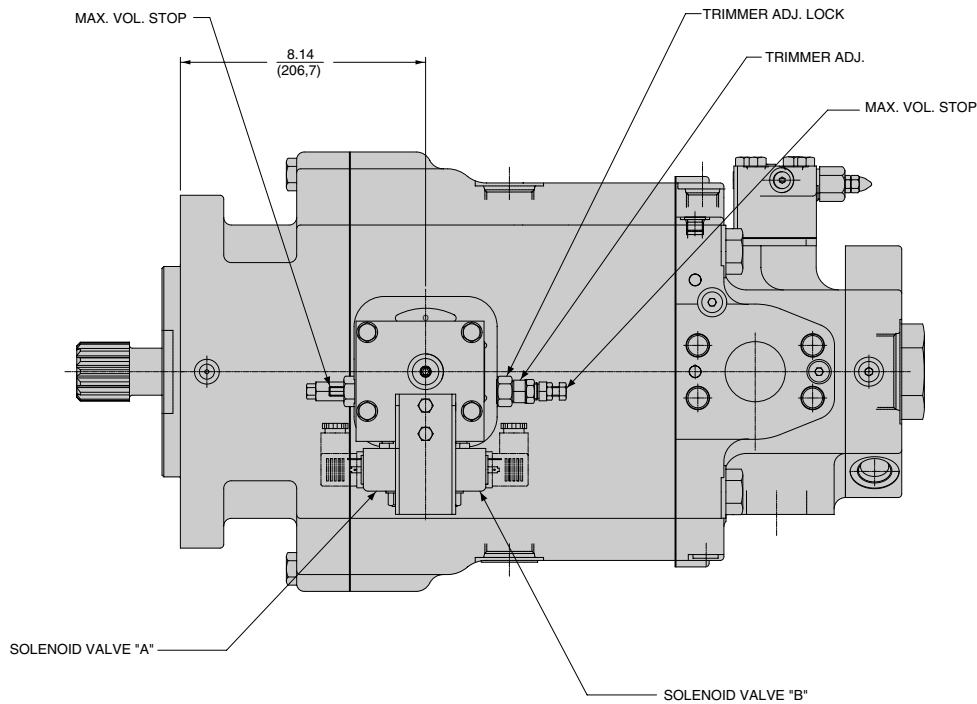
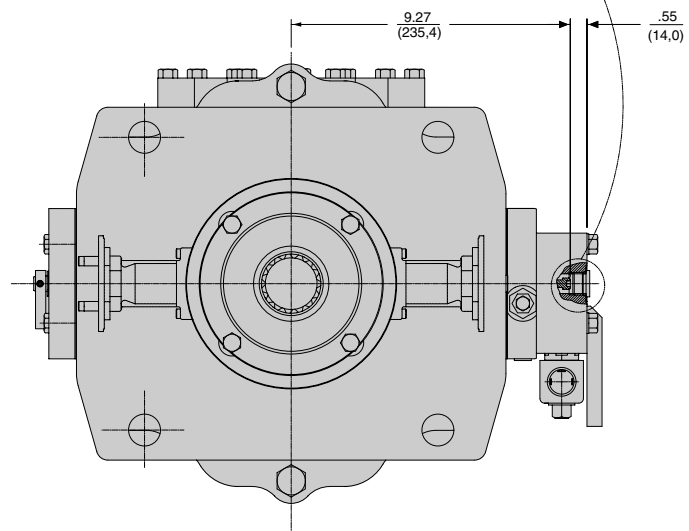


VIEW A-A



MANUAL OVERRIDE SHAFT DETAIL
SCALE=4X

MATING CONNECTOR DIN 43650 TYPE AF
TWO (2) SUPPLIED WITH CONTROL



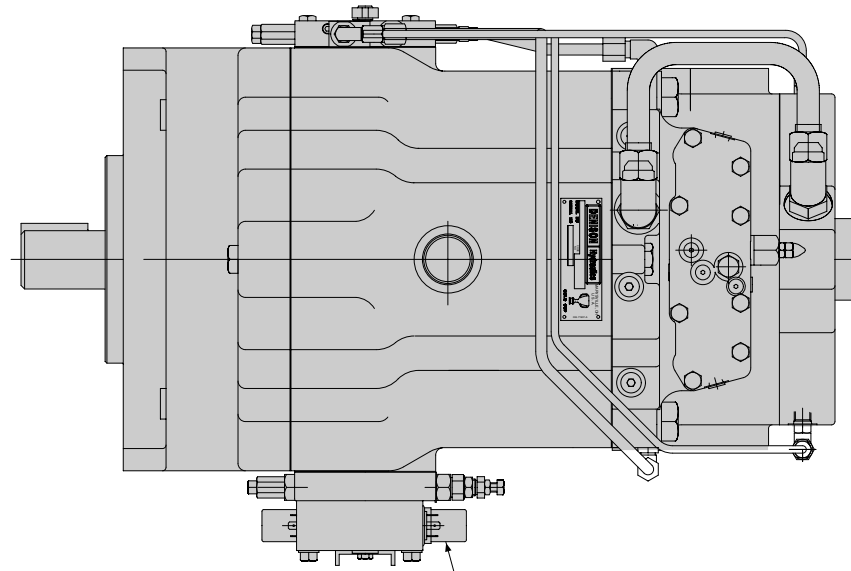
-B- CONTROL MTG. POSITION						
CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	ENERGIZE SOLENOID:	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"
9A2	P24P & P30P	CW	"A"	CCW	INLET	OUTLET
		CCW	"B"	CW	INLET	OUTLET
		CW	"B"	CW	OUTLET	INLET
		CCW	"A"	CCW	OUTLET	INLET

P24P OR P30P WITH "9A2" CONTROL
WITH INTERNAL CARTRIDGE
CW/CCW ROTATION-SAE-F 4 BOLT MTG.

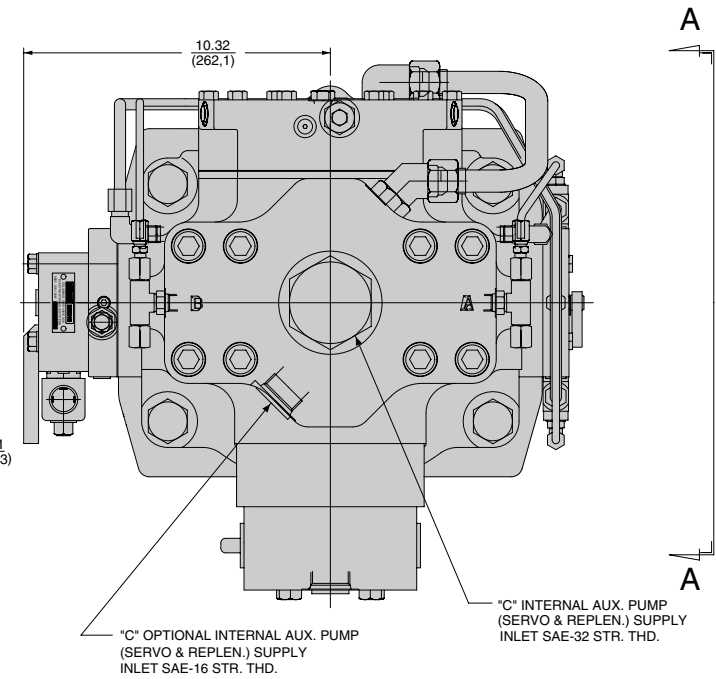
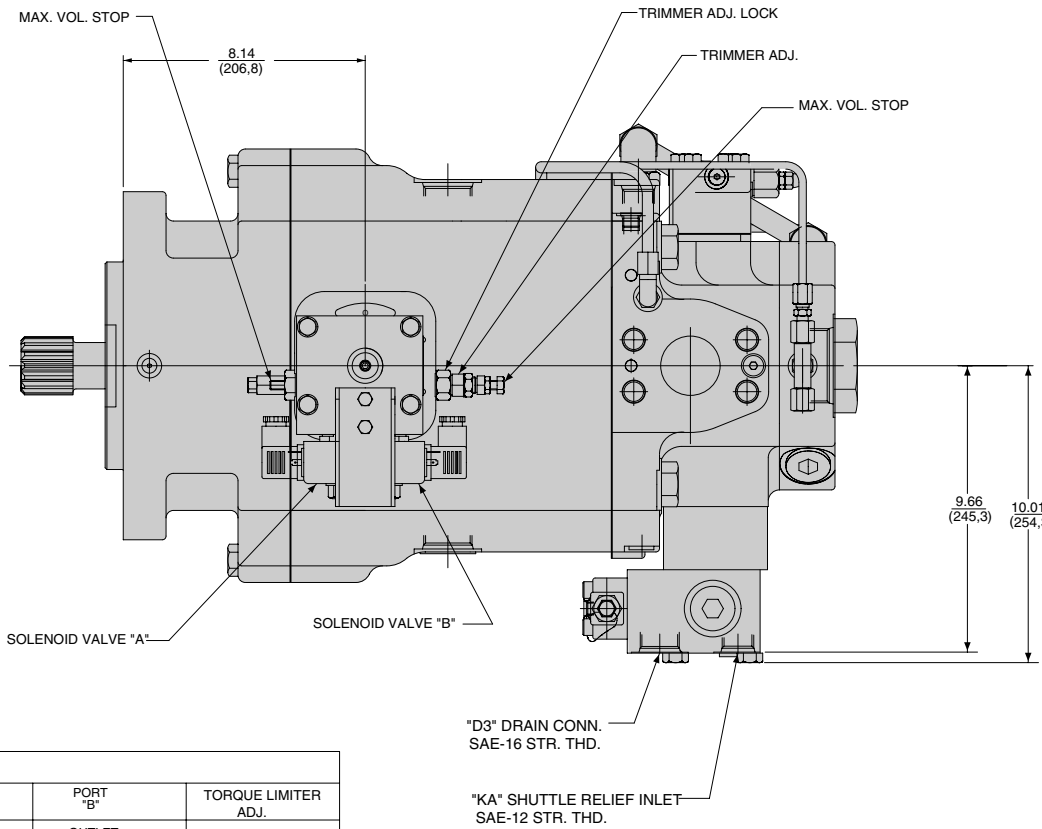
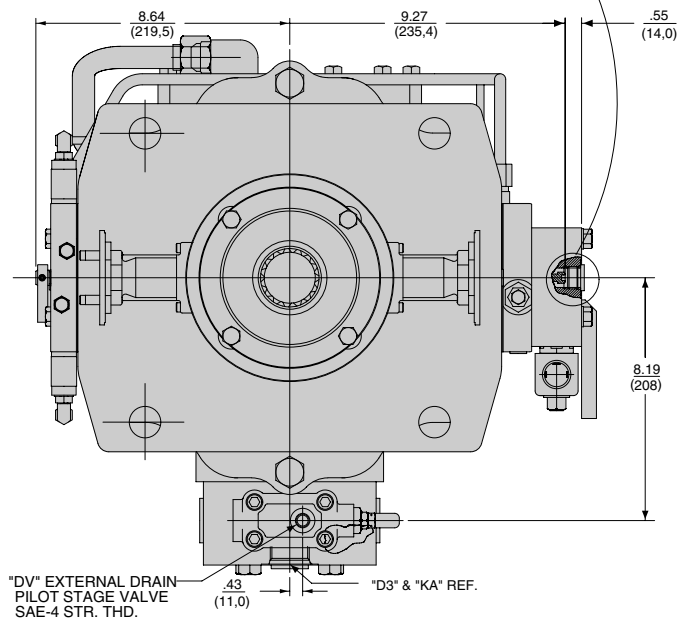
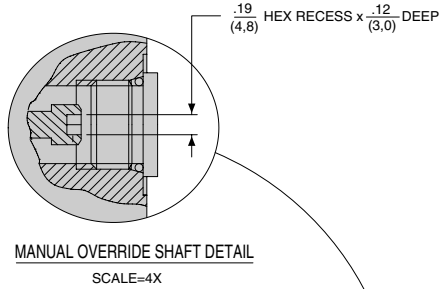
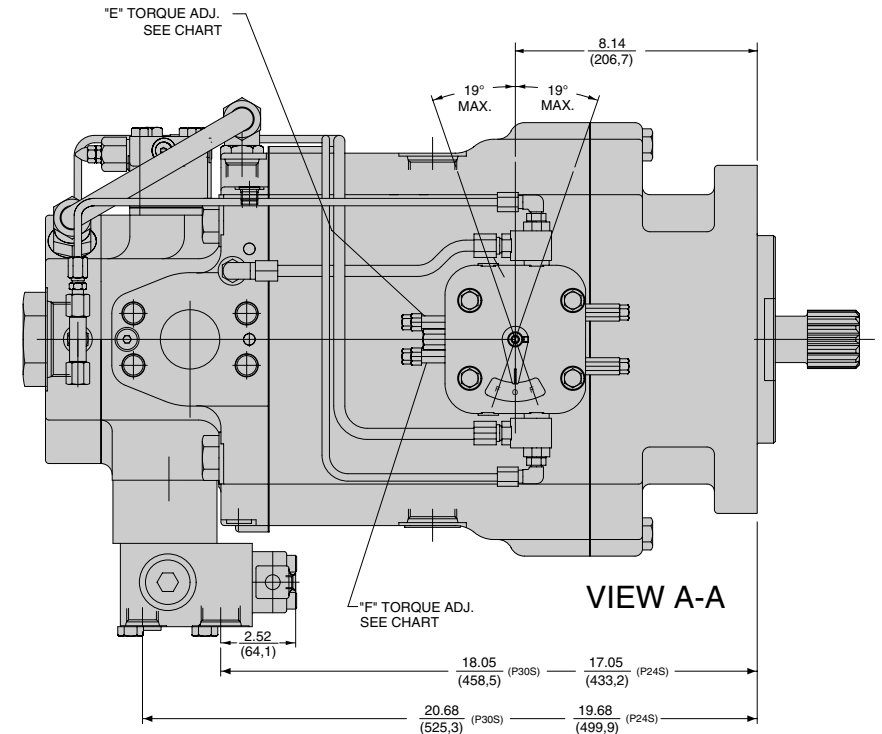
INSTALLATION DRAWING

NOTES:

- FOR DIMENSIONS & PORT IDENTIFICATIONS NOT SHOWN SEE THE APPROPRIATE BASIC PUMP INSTALLATION:
P24P BASIC INSTALLATION (LESS CONTROLS) 23-9922-D
P30P BASIC INSTALLATION (LESS CONTROLS) 23-9913-D
- REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
- DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).



MATING CONNECTOR DIN 43650 TYPE AF
TWO (2) SUPPLIED WITH CONTROL



-B- CONTROL MTG. POSITION

CONTROL OPTION	PUMP PACKAGE	PUMP ROT.	ENERGIZE SOLENOID:	MANUAL OVERRIDE SHAFT ROTATION	PORT "A"	PORT "B"	TORQUE LIMITER ADJ.
"9A4"	P24S OR P30S	CW	"A"	CCW	INLET	OUTLET	"F"
		CW	"B"	CW	OUTLET	INLET	"E"

P24S OR P30S WITH "9A4" CONTROL W/
INTERNAL CARTRIDGE, LESS REAR DRIVE
CW "B" MTG.-SAE-F 4 BOLT MTG.

23-9935

Model number sheet

Gold Cup pumps

Example model code:

	P	24	P	-2	R	1	*	-40	2	-B	00	-0	B	0
Pump	P		P											
Displacement														
24.6 cuin./rev. (403 cc/rev.)		24												
30.6 cuin./rev. (501 cc/rev.)		30												
Type														
Fixed displacement, closed circuit			F											
Fixed displacement with high torque thru-drive, closed circuit			M											
Variable displacement, closed circuit			P											
Variable displacement with medium torque thru-drive, closed circuit			X											
Variable displacement with medium torque thru-drive & shuttle package, closed circuit			S											
Variable displacement with high torque thru-drive, closed circuit			R											
Variable displacement with high torque thru-drive & shuttle package, closed circuit			L											
Variable displacement, open circuit (for P6, 7, 8, 11, & 14 only)			V											
Variable displacement, open & closed circuit (for P6, 7, & 8 only)			D											
Efficiency														
High efficiency (for P24 only)			H											
Standard efficiency														
leave blank														
Shaft														
Keyed SAE - mechanical shaft seal (single lip seal on P6/7/8F/M)				2 or -02										
Splined SAE - mechanical shaft seal (single lip seal on P6/7/8F/M)				-3 or -03										
Keyed SAE-D (mounting & shaft) - mechanical shaft seal (for P6/7/8 only) (single lip seal on P6/7/8F/M)				-4 or -04										
Splined SAE-D (mounting & shaft) - mechanical shaft seal (for P6/7/8 only) (single lip seal on P6/7/8F/M)				-5 or -05										
Keyed SAE - double lip shaft seal				-7 or -07										
Splined SAE - double lip shaft seal				-8 or -08										
Keyed (long) SAE - double lip shaft seal				-9 or -09										
Keyed (long) SAE - mechanical shaft seal				-10										
Rotation														
Clockwise					R									
Counter-clockwise					L									
Seals														
Nitrile (Buna N)						1								
EPK (not available when using "5A" or "5C" primary controls) (pump will be unpainted unless otherwise specified)						4								
Fluorelcon (Viton)						5								
Design letter (assigned by manufacturer)							*							
Primary controls														
None (for fixed displacement units only)														omit
Screw adjustment (spring offset to maximum displacement)														-10
Cylinder control w/ adjustable maximum volume stops														-2A
Cylinder control - 3 position (spring centered with zero adjustment)														-2H
Cylinder control - 2 position electro-hydraulic w/ adjustable maximum volume stop (spring offset to maximum displacement)														-2M
Cylinder control - 3 position (spring centered) electro-hydraulic														-2N
Rotary servo - spring centered														-40
Rotary servo - spring centered w/ adjustable maximum volume stops														-4A
Rotary servo - spring centered w/ automatic brake control														-4B
Rotary servo - spring centered w/ adjustable maximum volume stops & automatic brake control														-4C
Electro-hydraulic stroker w/ adjustable maximum volume stops														-5A
Electro-hydraulic stroker w/ adjustable maximum volume stops & automatic brake control														-5C
High IQ with 10 gpm servovalve & volume indicator														-7D
High IQ with 10 gpm servovalve & 4A (rotary servo) control														-7E
High IQ with 4DC01 valve & volume indicator														-7I
High IQ with 4DC01 valve & 4A (rotary servo) control														-7K
Hydraulic stroker w/ adjustable maximum volume stops														-8A
Hydraulic stroker w/ adjustable maximum volume stops & automatic brake control														-8C
Electro-hydraulic stroker w/ adjustable maximum volume stops														-9A
Electro-hydraulic stroker w/ adjustable maximum volume stops & automatic brake control														-9C
Secondary controls														
None (for fixed displacement units only)														omit
Volume indicator														2
Torque limiter & volume indicator														4
Cam position feedback potentiometer														6
Cam position feedback R VDT (DC)														8
Control location														
None (for fixed displacement units only)														omit
Primary control on port A side														-A
Primary control on port B side														-B
Control and displacement features														
2M* & 2N* controls														
4D01 valve, 110VAC/60Hz with Hirschmann connector														00
4D01 valve, 12VDC with Hirschmann connector														01
4D01 valve, 240VAC/50Hz with Hirschmann connector														02
4D01 valve, 110VAC/60Hz wiring box														03

4201 valve, 12VDC, wiring box	04
Cetop3 (D03YNG6) interface, no directional valve	05
4F01 valve, 24VDC with Hirschmann connector	06
4P01 valve, 110VAC/50Hz with Hirschmann connector	07
5** controls	
with deadband	00
without deadband	01
7** controls	
without manual override shutoff	00
with manual override shutoff (required for F, G, L, & K primary options)	01
8** controls	
7.5 - 350 psi (5 - 24 bar)	00
7.5 - 435 psi (5 - 30 bar)	01
100 - 380 psi (7 - 26 bar)	02
150 - 460 psi (10 - 28 bar)	03
7.5 - 250 psi (5 - 17 bar)	04
9** controls	
24VDC	00
12VDC	01
11 other controls	
Reduced displacement options for P*F & P*M	00
Standard cam (19-degree)	00
P24 with 17-degree cam (22.0 cu.in./rev. (360 cc/rev.))	10
P30 with 17-degree cam (27.2 cu.in./rev. (446 cc/rev.))	10
Internal pump	
2.81 cu.in./rev. (46 cc/rev.) (P24/30P/SX only) (standard)	-0 (omit if no external drive is required)
1.61 cu.in./rev. (26.4 cc/rev.) (P24/30P/SX only) (auxiliary external replenishing flow required)	-1
1.05 cu.in./rev. (17.2 cc/rev.) (P24/30P/SX only) (auxiliary external replenishing flow required)	-2
3.56 cu.in./rev. (58.3 cc/rev.) (P24/30P/SX only)	-3
4.84 cu.in./rev. (79.3 cc/rev.) (P24/30P/SX only)	-4
5.42 cu.in./rev. (88.8 cc/rev.) (P24/30P/SX only)	-5
6.10 cu.in./rev. (100.0 cc/rev.) (P24/30P/SX only)	-6
No internal pump (standard on P*R/L/F/M)	-X
External drive	
None	omit
SAE-B (SAE 101-2 for P6/78S/XR/L/M & P11/1424/30S/XX/SAE 101-2 & SAE 101-4 for P11/1424/30R/L/M)	B
SAE-C (SAE 127-2 for P6/78R/L/M & P24/30S/XX/SAE 127-2 & SAE 127-4 for P11/1424/30R/L/M)	C
SAE-D (SAE 152-4YP/11/1424/30R/L/M only)	D
SAE-E (SAE 165-4YP/11/1424/30R/L/M only)	E
SAE-F (SAE 177-4)/(P24/30R/L/M only)	F
External mounting	
No external pump mounted	0 (omit if no external drive is required)
External pump mounted (requires special modification "-M2") (must be separately specified)	1
Special modification	
None	omit
No paint	-NP
Other special modification (example: bronze eased barrel bearing for low viscosity fluids, tandem pumps, etc.)	-M2

GOLD CUP PUMP CONTROL COMBINATIONS

102	2M2 *00	2N2 *00	402	5A2 *00	7D6 *00	8A2 *00	8C2 *00	9A2 *00
104	2M2 *01	2N2 *01	404	5A2 *01	7D6 *01	8A2 *01	8C2 *01	9A2 *01
106	2M2 *02	2N2 *02	406			8A2 *02	8C2 *02	
107	2M2 *03	2N2 *03	407	5A4 *00	7D7 *00	8A2 *03	8C2 *03	9A4 *00
108	2M2 *04	2N2 *04	408	5A4 *01	7D7 *01	8A2 *04		9A4 *01
	2M2 *05	2N2 *05					8C4 *00	
2A2	2M2 *06	2N2 *06	4A2	5A6 *00	7D8 *00	8A4 *00	8C4 *01	9A6 *00
2A4	2M2 *07	2N2 *07	4A4	5A6 *01	7D8 *01	8A4 *01	8C4 *02	9A6 *01
2A6			4A6			8A4 *02	8C4 *03	
2A7	2M4 *00	2N4 *00	4A7	5A7 *00	7F6 *01	8A4 *03		9A7 *00
2A8	2M4 *01	2N4 *01	4A8	5A7 *01	7F7 *01	8A4 *04	8C6 *00	9A7 *01
	2M4 *02	2N4 *02			7F8 *01		8C6 *01	
2H2	2M4 *03	2N4 *03	4B2	5A8 *00		8A6 *00	8C6 *02	9A8 *00
2H4	2M4 *04	2N4 *04	4B4	5A8 *01	7J6 *00	8A6 *01	8C6 *03	9A8 *01
2H6	2M4 *05	2N4 *05	4B6		7J6 *01	8A6 *02		
2H7	2M4 *06	2N4 *06	4B7	5C2 *00		8A6 *03	8C7 *00	9C2 *00
2H8	2M4 *07	2N4 *07	4B8	5C2 *01	7J7 *00	8A6 *04	8C7 *01	9C2 *01
					7J7 *01		8C7 *02	
	2M6 *00	2N6 *00	4C2	5C4 *00		8A7 *00	8C7 *03	9C4 *00
	2M6 *01	2N6 *01	4C4	5C4 *01	7J8 *00	8A7 *01		9C4 *01
	2M6 *02	2N6 *02	4C6		7J8 *01	8A7 *02	8C8 *00	
	2M6 *03	2N6 *03	4C7	5C6 *00		8A7 *03	8C8 *01	9C6 *00
	2M6 *04	2N6 *04	4C8	5C6 *01	7K6 *01	8A7 *04	8C8 *02	9C6 *01
	2M6 *05	2N6 *05			7K7 *01		8C8 *03	
	2M6 *06	2N6 *06		5C7 *00	7K8 *01	8A8 *00		9C7 *00
	2M6 *07	2N6 *07		5C7 *01		8A8 *01		9C7 *01
						8A8 *02		
	2M7 *00	2N7 *00		5C8 *00		8A8 *03		9C8 *00
	2M7 *01	2N7 *01		5C8 *01		8A8 *04		9C8 *01
	2M7 *02	2N7 *02						
	2M7 *03	2N7 *03						
	2M7 *04	2N7 *04						
	2M7 *05	2N7 *05						
	2M7 *06	2N7 *06						
	2M7 *07	2N7 *07						
	2M8 *00	2N8 *00						
	2M8 *01	2N8 *01						
	2M8 *02	2N8 *02						
	2M8 *03	2N8 *03						
	2M8 *04	2N8 *04						
	2M8 *05	2N8 *05						
	2M8 *06	2N8 *06						
	2M8 *07	2N8 *07						

- Unless otherwise specified on purchase order, the following **factory setting** will be used.
- Maximum Stop: Full Displacement
- Minimum Stop: Zero Displacement
- Pressure Compensator Override: 5000 psi
- Torque Limiter (**4): P6 @ 1800 rpm = 60 hp
- P7 @ 1800 rpm = 72.5 hp
- P8 @ 1800 rpm = 80 hp
- P11 @ 1800 rpm = 110 hp
- P14 @ 1800 rpm = 140 hp
- P24 @ 1800 rpm = 240 hp
- P30 @ 1800 rpm = 300 hp

CONVERSIONS & FORMULAS

DEFINITION & UNIT

<i>displacement</i>	$\text{in}^3/\text{rev} \times 16.387 = \text{cm}^3/\text{rev}$	$\text{cm}^3/\text{rev} \times 0.06102 = \text{in}^3/\text{rev}$
<i>flow</i>	$\text{gpm} \times 3.78 = \text{L}/\text{min}$	$\text{L}/\text{min} \times 0.2642 = \text{gpm}$
<i>power</i>	$\text{hp} \times 0.7457 = \text{kW}$	$\text{kW} \times 1.341 = \text{hp}$
<i>torque</i>	$\text{lb}\cdot\text{ft} \times 1.3567 = \text{Nm}$	$\text{Nm} \times 0.7376 = \text{lb}\cdot\text{ft}$
<i>pressure</i>	$\text{lbs}/\text{in}^2 \text{ (psi)} \times 0.06895 = \text{bar}$ $\text{lbs}/\text{in}^2 \text{ (psi)} \times 6.895 = \text{kPa}$	$\text{bar} \times 14.50 = \text{lbs}/\text{in}^2 \text{ (psi)}$ $\text{kPa} \times 0.1450 = \text{lbs}/\text{in}^2 \text{ (psi)}$
<i>weight</i>	$\text{lb} \times 0.4536 = \text{kg}$	$\text{kg} \times 2.205 = \text{lbs}$
<i>force</i>	$\text{lb} \times 4.448 = \text{N}$	$\text{N} \times 0.2248 = \text{lbs}$
<i>volume</i>	$\text{in}^3 \times 16.387 = \text{cm}^3$	$\text{cm}^3 \times 0.06102 = \text{in}^3$
<i>area</i>	$\text{in}^2 \times 6.452 = \text{cm}^2$	$\text{cm}^2 \times 0.1550 = \text{in}^2$
<i>length</i>	$\text{in} \times 25.4 = \text{mm}$	$\text{mm} \times 0.03937 = \text{in}$
<i>temperature</i>	$\text{degree F} - 32 = \text{°C}$ 1.8	$1.8 \times \text{°C} + 32 = \text{°F}$
<i>viscosity</i>	$\text{cSt} \times 1.0 = \text{mm}^2/\text{sec}$ $\text{SSU} = \text{cSt} \times 4.25 + 14$	$\text{mm}^2/\text{sec} \times 1.0 = \text{cSt}$ $20 \text{ cSt} = 99 \text{ SSU}$

FLUID POWER FORMULAS

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

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