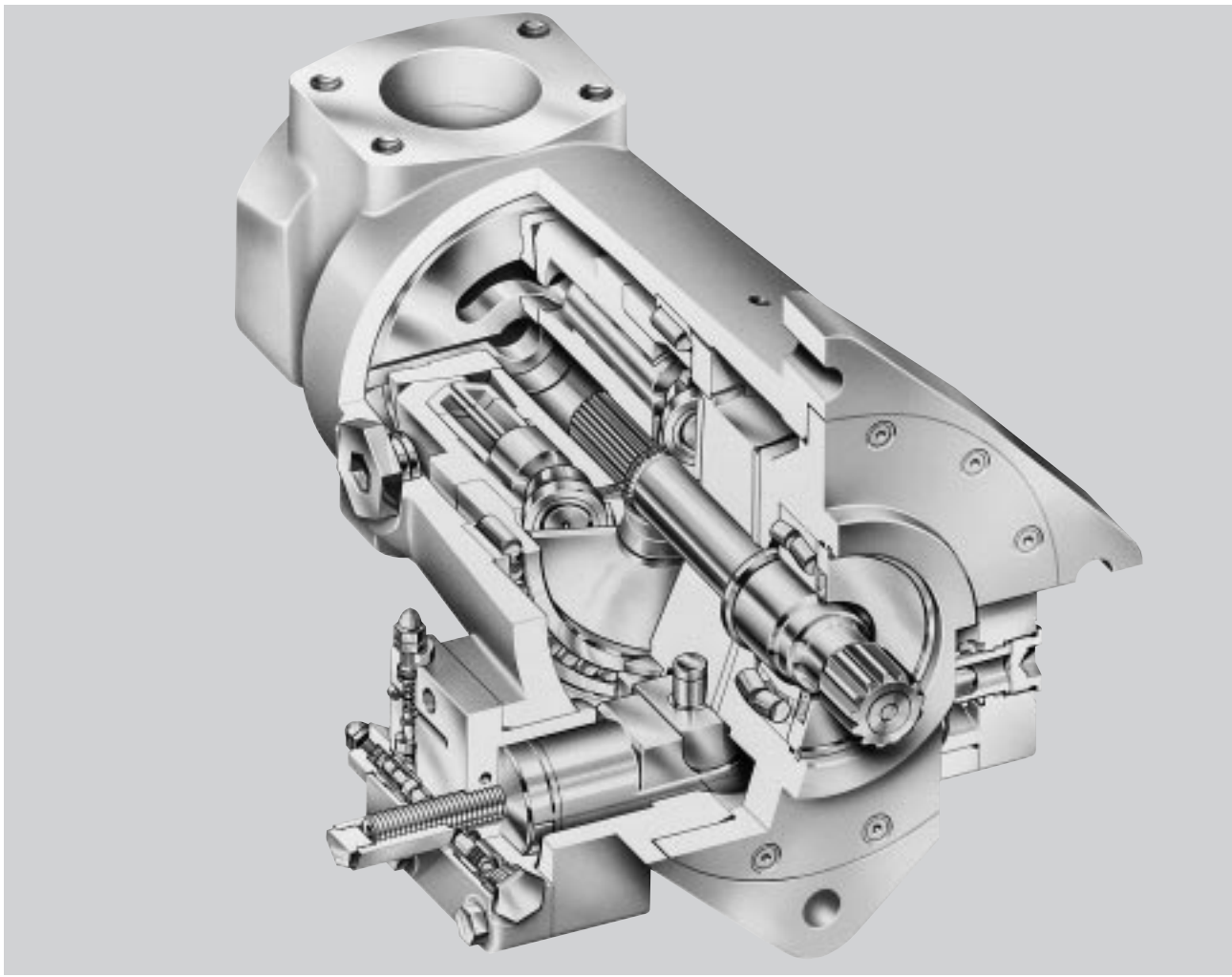
DENISON HYDRAULICS

Premier Series

P05 open loop pump controls

service information



Publ. S1-AM028

DENISON Hydraulics

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

Pump seal kit (includes all controls) S22-15646 See key sheet pg. 45 for information

TYPICAL CHARACTERISTICS

Specification		Term	P05
• compensator response (per SAE J745 @ 5000 psi, 345 bar)	off-stroke	sec.	0.060
	on-stroke	sec.	0.110*
• compensator adjustment		psi/turn	2000
		bar/turn	138
• minimum servo pressure for 7250 psi, 500 bar system pressure		psi	700
		bar	48,3
• minimum compensating pressure (comp, load sensing, torque limiter)		psi	200**
		bar	13,8**
• minimum compensator override pressure at above listed servo pr. (servo, elec. & hyd. str.)		psi	1225**
		bar	84,5**
• torque limiter adjustment range	code J	in-lbs	800-1500
		Nm	90 - 170
	code K	in-lbs	over 1500
		Nm	over 170
• typ. servo & stroker response @ 83 bar servo pressure, zero to full stroke and vice versa		sec.	<0.35
• servo flow required for this response (E, H, R10 controls)		in^3/min	693
		l/min.	11,4
• servo flow required for this response (-1J, -1K, -1P controls)		in^3/min	924
		l/min	15,2
• maximum servo pressure		psi	1500
		bar	103
• servo shaft rotation, 0 to full volume		degrees	56
• displacement/rev./degree servo shaft rotation		in^3/rev/deg	23.5
		cc/rev/deg	1,43
• torque to turn rotary servo shaft		in-lbs	20
		Nm	2,3
• hydraulic stroker control pressure	0 disp.	psi	50
		bar	3,45
	full disp.	psi	210
		bar	14,5
• electric stroker control amps (24V)	0 disp.	mA	125
	full disp.	mA	290
• electric stroker control amps 12V)	0 disp.	mA	250
	full disp.	mA	580
pulse width modulation frequency:		Hz	100-150
Denison Hydraulics electric stroker accessories mating connector: Din 43650 type AF part no. 167-10008-8 (provided) Jupiter driver S20-14078 Jupiter power supply S20-11715 Options card S20-ll716 Venus controller 020-14103			
• electric stroker nominal coil resistance (24v. coil)		ohms	41
• electric stroker nominal coil resistance (12v. coil)		ohms	10
• handwheel turns, full to zero stroke		turns	9
• torque to turn handwheel @ 1000 psi, 70 bar		in-lbs	75
		Nm	9
• torque to turn handwheel @ 7250 psi, 500 bar		in-lbs	175
		Nm	20

FLUID CONNECTIONS

• port C1, C2 (cylinder gage ports)	SAE	-4
• port E (electric stroker control pressure inlet)	SAE	-4
• port H (hydraulic stroker control pressure inlet)	SAE	-4
• port LS (load sensing port)	SAE	-4
• port V (compensator vent)	SAE	-8
• port X (rotary servo, electric & hydraulic stroker servo inlet)	SAE	-6

Note: *on-stroke response for compensator override is determined by servo/stroker response.
**add case pressure

GENERAL

The instructions contained in this manual cover complete disassembly and reassembly of the controls. 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 OF OPERATION

A piloted three-way valve spool and sleeve combination is the nucleus of the control function. For the compensator, torque limiter and load sensing controls, system pressure is applied to the input port of the valve, and to one end of the spool. A small orifice feeds this pressure to the other end of the spool,. A spring on this end biases the spool to normally port the control piston to pump case . This control piston links to the pump cam. On the opposite side of the control piston, a spring and a piston connected to system pressure along with pump timing forces, combine to put the pump on stroke.

PRESSURE COMPENSATOR

A spring-loaded cone and seat connected to the spring end of the three-way spool establishes an adjustable pressure limit on this end of the spool. When system pressure reaches this value, flow through the spool creates a pressure difference across the spool. At approximately 200 psi, 13,8 bar difference, the spool shifts toward the spring, re-directing the control cylinder port to pressure. This pressure applied to the control piston overcomes the forces putting the pump on stroke, causing the pump to reduce displacement. When the pump pressure drops, the spool shifts the other way to maintain the pump pressure at approximately 200 psi, 13,8 bar above the controlled pressure on the spring side. The spring end of this three-way spool may also be connected to a remote pressure control, through the vent port, V. Flow through this port, when controlling, is approximately 0.5 gpm, 1,9 l/m.

PRESSURE COMPENSATOR LOAD SENSING CONFIGURATION

For load sensing, this “V” port is connected to the load. The valve between the pump and the load meters the flow. The pump provides the flow to develop 200 psi, 13,8 bar drop across the valve independent of the load pressure and thus establishes a constant flow independent of operating pressure. Adjustment of spring load on the three-way spool allows precise control of the differential pressure.

LOAD SENSING CONTROL

Where the approximately 0.5 gpm, 1,9 l/m vent flow is unacceptable, and where multiple loads are to be controlled, a load sensing control is available. In the load sensing control, the vent flow is modulated by a valve which senses load pressure and establishes the pump compensator pressure at 300 psi, 21 bar above load pressure. There is essentially no flow in the sensing line.

TORQUE LIMITER

For constant torque, system pressure and pump displacement are interrelated by the formula P•V=C. As pressure increases, displacement must reduce, and vice versa.

A linkage to the pump control piston slides a spool over a pin.. The pin contains a cross drilled hole, and a connecting drilling to one end. This pin passes through a bore in the torque limiter housing connecting to the vent port of the compensator. The pressure in the vent port applies a force on the pin, which is resisted on the other end by a two spring combination.

The pin positions itself to where the vent pressure force on the one end is balanced by the spring force on the other end. When the cross drilled hole opens, it causes the three-way spool to shift to direct system pressure into the control piston, reducing stroke. The linkage to the control piston causes the spool to move in the direction to close the cross-drilled hole. Thus, for every position of the pin, there is a corresponding position for the control piston. The position of the pin is determined by the pressure, the spring rate, and the initial adjustment on the springs. As pressure increases, pump stroke must reduce.

At low pressure, only the outer spring contacts the spool. As pressure increases, the second spring also makes contact. Thus the rate of change of pressure starts at a low initial rate when the pump is at full stroke and changes to a high rate at reduced stroke, to approximate the P•V=C relationship. The normal compensator function is retained to provide a maximum pressure limit.

ROTARY SERVO CONTROL

The rotary servo control is mounted on the off-stroke side of the control piston. The control piston has a large diameter on this side, and a smaller diameter on the opposite side. Servo pressure is connected to the input port on the three-way valve, and also to the smaller diameter side of the control piston.

When the three-way spool is at rest, this end of the control piston is ported to tank, and servo pressure applied to the opposite, smaller diameter piston causes the rocker cam to stroke to minimum. When the three-way spool shifts, pressure is directed into the larger diameter of the control piston causing the cam to shift towards full stroke.

The pin as described for the torque limiter, is spring loaded against a mechanism which converts rotary motion of the input shaft to linear motion of the pin, thus positioning pump stroke proportionately to input shaft rotation.

HYDRAULIC STROKER

In the hydraulic stroker, a spring loaded piston is attached to this pin. A control pressure of 50 psi, 3,45 bar causes the piston to commence to move against the spring, to position the pin in proportion to the control pressure, and thus cause the pump to stroke in proportion to control pressure. Full stroke is achieved at 210 psi, 14,5 bar control pressure.

ELECTRIC STROKER

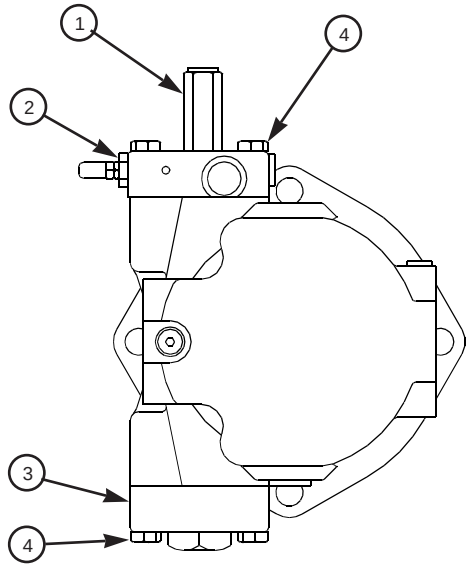
By mounting an electrically modulated pressure control valve on the hydraulic stroker to establish the control pressure, pump stroke is controlled by an electrical signal. At approximately 125 mA electrical signal, the pump commences to stroke, and at approximately 290 mA, the pump will be at full stroke. The Denison Hydraullics Venus controller 020-14103, Jupiter S20-14078, or Jupiter S20-14087 may be used to drive the electric stroker.

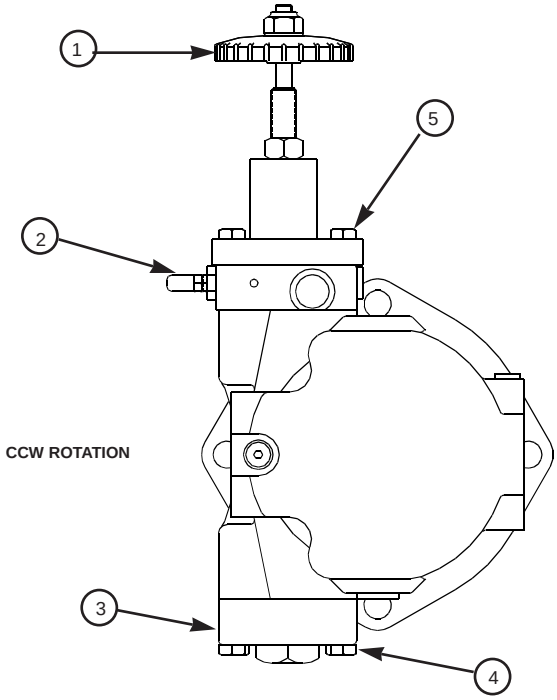
PRESSURE COMPENSATOR AND TORQUE LIMITER OVER-RIDE

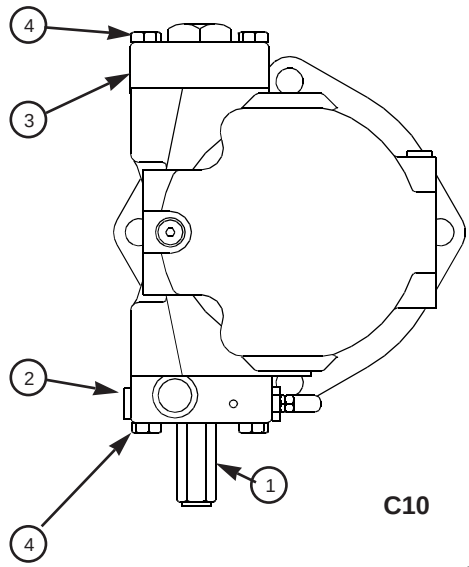
An override pressure compensator or torque limiter control is mounted on the on-stroke side of the control piston opposite the servo, hydraulic or electric stroker. The port on the override control which normally connects to cylinder in the at-rest position is connected to servo, allowing normal stroker control. When system pressure or torque exceed the override setting, system pressure is supplied to the smaller diameter control piston to override the command and reduce stroke to the compensator or torque limiter setting.

TROUBLESHOOTING CHART

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
Compensator, Compensator Override		
Low system pressure	Compensator malfunction	Dirt in spool orifice Damaged cone or seat Broken differential spring Improperly adjusted differential spring
Failure to compensate	Differential adjustment	Differential set too high
Sluggish response	Differential adjustment	Differential set too low
Wide pressure fluctuations (hunting)	Excessive line capacitance	Install check valve near pump outlet
Load Sensing Control		
Low system pressure	See above	
Failure to compensate	See above	
Sluggish response	Differential adjustment Modulating valve	Differential set too high Air in load sensing line
Wide pressure fluctuations (hunting)	Excessive line capacitance Modulating valve	Install check valve near pump outlet Air in load sensing line
Excessive pressure drop across control valve	Differential adjustment	Differential set too high
Poor control of flow	Differential adjustment	Differential set too low
Torque Limiter, Torque Limiter Override		
Torque setting erratic	Torque limiter cap malfunction	Sticking pin
Torque incorrect at high flows	Incorrect torque setting	Outer adjustment screw
Torque incorrect at low flows	Incorrect torque setting	Inner adjustment screw
Too much torque variation	Wrong torque limiter for range	Replace inner/outer springs with correct springs
Low system pressure	Compensator malfunction	Dirt in spool orifice Damaged cone or seat Broken differential spring Improperly adjusted differential spring
Failure to compensate	Differential adjustment	Differential set too high
Sluggish response	Differential adjustment	Differential set too low
Wide pressure fluctuations (hunting)	Excessive line capacitance	Install check valve near pump outlet
Rotary Servo		
Failure to stroke	Differential adjustment	Differential set too low
Goes to full	Differential adjustment	Differential set too high
Sluggish response	Low servo pressure	Check servo pressure
Strokes in steps	Servo cap malfunction	Sticking pin Wear on linkages or input cam surface
Hydraulic Stroker		
Failure to stroke	Differential adjustment	Differential set too low
Goes to full	Differential adjustment	Differential set too high
Strokes in steps	Servo cap malfunction	Wear on linkages, Sticking stroker piston
Electric Stroker		
Failure to stroke	Differential adjustment	Differential set too low
Goes to full	Differential adjustment	Differential set too high
Excessive hysteresis	Electric proportional valve	Change dither on electrical signal
No response	Electric proportional valve	Faulty wiring, Filter screen plugged
Strokes in steps	Servo cap malfunction	Wear on linkages Sticking stroker piston
Instability	Air in control	Bleed air from control Check for air in servo supply
General		
Cannot achieve full volume	Maximum volume stop	Back out max. volume stop
Cannot achieve zero volume	Minimum volume stop	Back out min. volume stop
Noise	Air in system	Aerated reservoir Leaky inlet line Trapped air in system







C10

ITEMS 6 7 8 9

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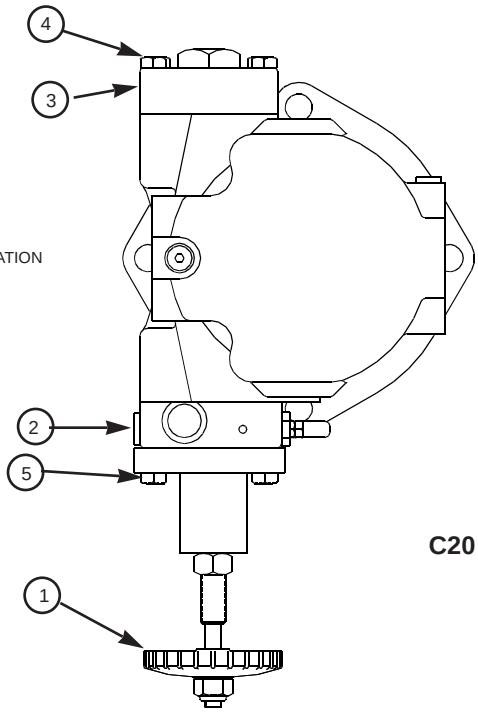


C20

PRESSURE COMPENSATOR
parts list

ITEM	DESCRIPTION	P05 PART NO.	QTY. C10	QTY. C20
1	Max. Vol. Stop (Fig. 1)	S22-15467	1	—
	Max Vol. Handwheel (Fig. 2)	S22-15448	—	1
*2	Compensator Control (Fig. 3)	S22-15394	1	—
	Compensator Control	S22-15626	—	1
3	Buck Up Cap (Fig. 4)	S22-15447	1	1
4	Screw-H.H.C.,M12 x 55 mm	363-12205	8	6
5	Screw-H.H.C., M12 x 75 mm	363-12220	—	2
6	Control Piston	032-91836	1	1
7	O-Ring, 70 S-1 ARP 013	671-00013	2	2
8	O-Ring, 70 S-1 ARP 151	671-00151	2	2
9	Piston Ring	032-91816	2	2

*includes items 1, 4, 5

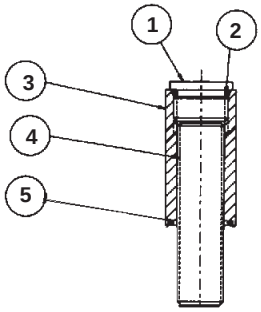


FIGURE 1
MAXIMUM VOLUME STOP

PARTS LIST FOR FIGURE 1, MAX. VOL. STOP S22-15467

ITEM	DESCRIPTION	PART NO.	QTY.
1	Plug 8HP5N-S	488-35018	1
2	O-Ring, 90 S-1 ARP 908	691-00908	1
3	Nut, M16 Hex	032-91822	1
4	Screw, Soc. Set	311-50001	1
5	O-Ring,70 S-1 ARP 115	671-00115	1

MAXIMUM VOLUME HANDWHEEL
DISASSEMBLY

1. **See Fig. 2.** Remove the two screws holding the bracket (1) to the control cap.
2. Turn the handwheel counter-clockwise to remove the stop screw from the control cap.
3. Remove nut (5) and handwheel (4) from the stop screw (2).
4. Remove nut (3). Screw (2) may now be slipped through the bracket (1) to examine parts and to replace O-ring (6).
5. Seat (10) rotates and pivots on ball (8), and is retained by pressing two balls (9) into screw (2). Replace assembly if damaged.

ASSEMBLY

1. Install ball (8) and seat (10) in screw (2).
2. Press balls (9) into screw (2) to retain seat.
3. Install O-ring (6) on screw (2). Lubricate O-ring and slide screw into bracket (1). Install remaining parts.
4. Turn handwheel clockwise into cap till the screw contacts the control piston.
5. Install and torque the assembly screws to 75 ft-lbs, 102 Nm.

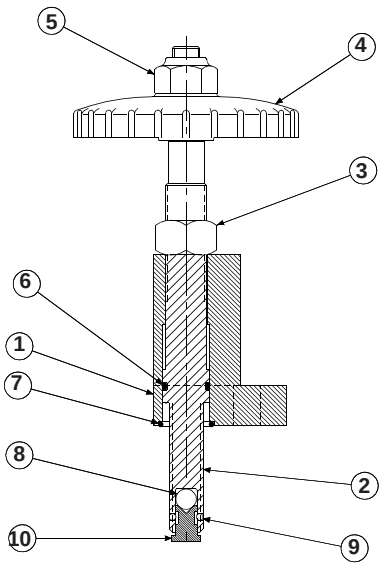


FIGURE 2
HANDWHEEL MAXIMUM VOLUME STOP

PARTS LIST FOR FIGURE 2, HANDWHEEL S22-15448

ITEM	DESCRIPTION	PART NO.	QTY.
1	Bracket	032-92056	1
2	Screw	032-92057	1
3	Nut, Hex 3/4-16 UNC	333-25000	1
4	Handwheel	031-59911	1
5	Nut, Elastic Stop 1/2-13	331-20100	1
6	O-Ring, 90 S-1 ARP 115	691-00115	1
7	O-Ring, 90 S-1 ARP-118	691-00118	1
8	Ball	201-12001	1
9	Ball	201-04001	2
10	Seat	032-92058	1

COMPENSATOR DISASSEMBLY

1. **See Figure 3.** Back off max. volume screw or handwheel to full displacement. Remove max. volume screw or handwheel assembly.

2. Remove bolts holding cap to pump.

3. Remove plug (15) and attached parts. Remove spring (11) and spool (18).

4. Remove adjusting plug (2) and attached parts. Remove seal piston (5). Note: a 10-24 screw may be used to assist in pulling the piston. Remove spring (7) and cone (8).

5. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).

6. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

1. Install Avseal plugs (9) and orifice (19) in body.

2. Press seat (10) into bore squarely against shoulder in bore.

3. Install O-ring (14 in bottom of bore as shown. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal piston (16). Lubricate and install into plug (15). Install O-ring (13) on plug (15). Install plug (15) into cap. Install screw (3) and nut (4).

4. Install O-ring (6) on seal piston (5).

5. Lubricate O-ring and install cone (8), spring (7) and seal piston into bore in cap (1), being careful that cone enters seat (10). Install remaining parts. Torque plug (12) to 90 ft-lbs, 122 Nm. Torque plug (21) to 50 ft-lbs, 68 Nm. Torque plug (28) to 11 ft-lb, 15 Nm.

6. Note proper location for cap on pump. Install O-rings on interface between cap and pump control pad.

7. Install cap on pump control pad, guiding the control piston into the bore. Install maximum volume stop assembly.

8. Torque mounting bolts to 75 ft-lbs, 102 Nm.

COMPENSATOR TEST AND ADJUSTMENT

Compensator is to be tested on pump. Adjust maximum volume stop to full displacement by backing off stop till there is no contact with the control piston.

1. Install gages on system pressure and on compensator vent, port “V”.

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

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

4. System relief valve should be set at 500 psi, 35 bar. If testing on application, apply a load to pump.

5. Start prime mover. Pump should be at full displacement at 500 psi, 35 bar.

6. Increase system relief valve or load until compensator de-strokes pump to zero displacement. Set compensator to 1500 psi, 103 bar.

7. Adjust compensator differential spool pressure to 200 psi, 13,8 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the system pressure and compensator vent gages installed in the compensator cap is 200 psi, 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 250 psi, 17 bar to avoid spring going solid, preventing compensator action.)

8. Set the compensator to 3000 psi, 207 bar, 6000 psi, 414 bar, and 7250 psi, 500 bar.

9. At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

10. Reduce pressure to 150 psi, 10,3 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator setting should be repeatable.

11. Set compensator adjustment to the required setting, or 6000 psi, 414 Bar if not otherwise noted. Install cap (17) on differential adjustment.

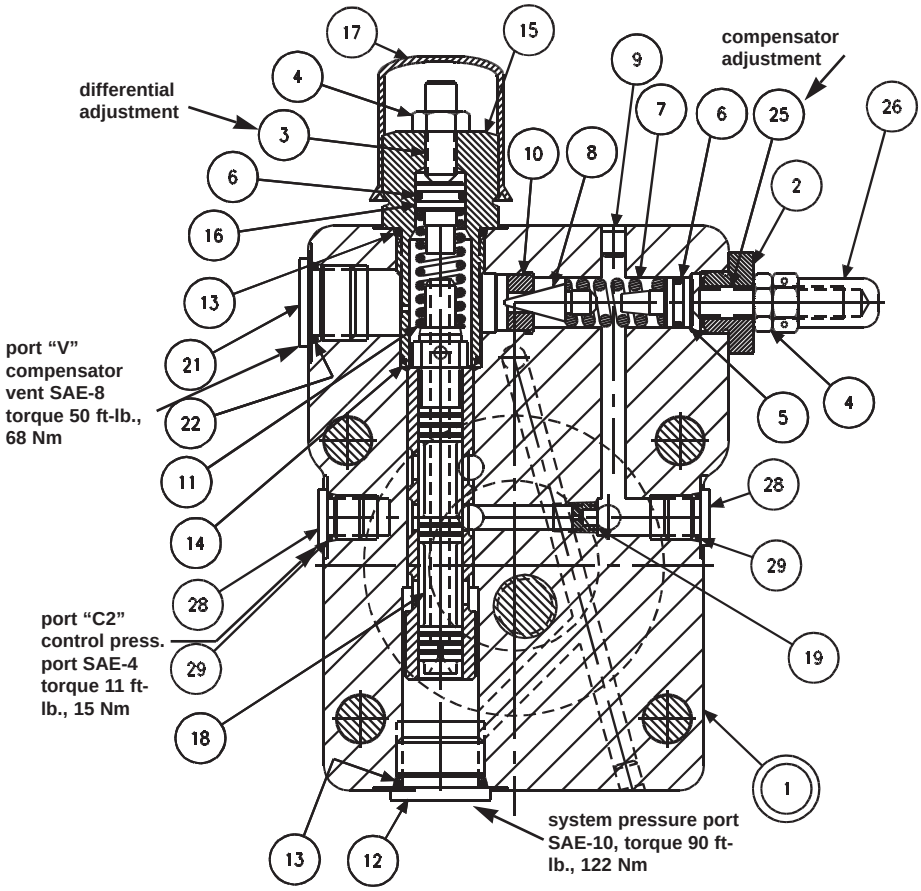


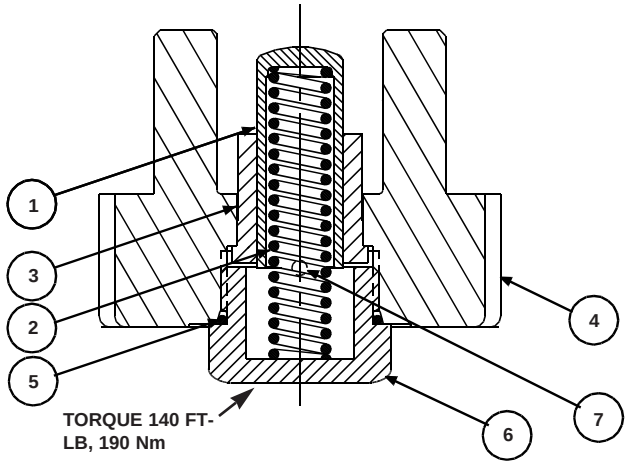
FIGURE 3
COMPENSATOR

PARTS LIST FOR FIGURE 3

compensator C10, S22-15394
compensator C20, S22-15626

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15321	1
2	Adj. Plug	032-91814	1
3	Soc. Setscrew 5/16-24 x 1	312-13160	1
4	Nut, 5/16-24	335-13100	2
5	Seal Piston	031-59367	1
6	O-Ring, 90 S-1 ARP 012	691-00012	2
7	Spring	032-91798	1
8	Cone	036-12288	1
9	Avseal Plug	447-00026	2
10	Seat	036-11692	1
11	Spring	033-71086	1
12	Plug, 10HP5N-S	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	2
14	O-Ring, 90 S-1 ARP 017	691-00017	1
15	Plug	031-57368	1
16	Seal Piston	032-91305	1
17	Cap	449-00612	1
18	Spool	032-59482	1
19	Orifice Plug	033-25528	1
21	Plug, SAE-8	488-35018	1
22	O-ring, 90 S1-ARP 908	691-00908	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	Acorn Nut	036-33474	1
28	Plug, SAE-4	488-35061	2
29	O-ring, 90 S1-ARP 904	691-00904	2

FIGURE 4
BUCK-UP CAP



BUCK-UP CAP DISASSEMBLY

1. **See Figure 4** Set maximum volume stop to full stroke. Remove 4 screws holding cap to pump. Caution! Spring load could cause injury!

2. Remove cap assembly from pump.

3. Remove and examine spring (2) and piston (1). If sleeve (3) is worn, press it out and replace.

ASSEMBLY

1. Install Avseal plug (7) into cap. Press sleeve (3) into cap to shoulder. Install O-ring (5) and plug (6) into cap. Torque plug to 140 ft-lbs, 190 Nm. Install spring (2) and piston (1).

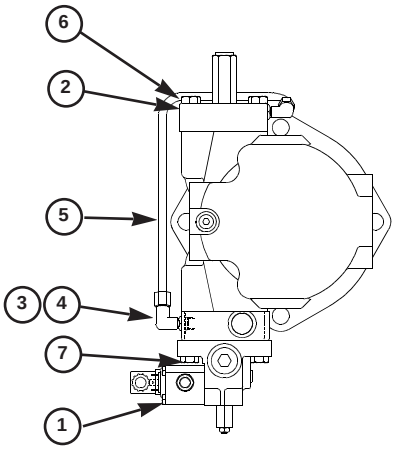
2. Install O-rings on interface between cap and pump control pad. Install cap assembly on pump housing as indicated on the applicable view, guiding the control piston into the bore.

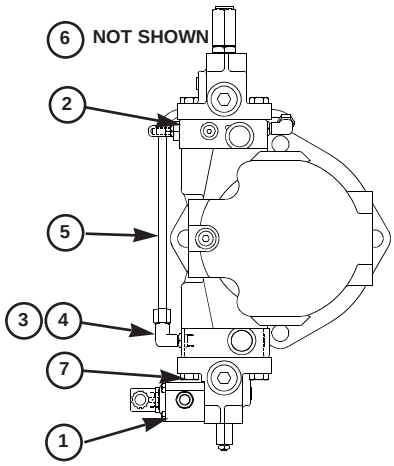
3. Torque the assembly bolts to 75 ft-lbs, 102 Nm.

PARTS LIST FOR FIGURE 4

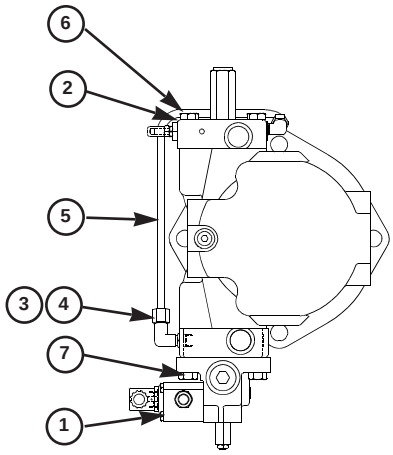
P05 buck-up cap S22-15447

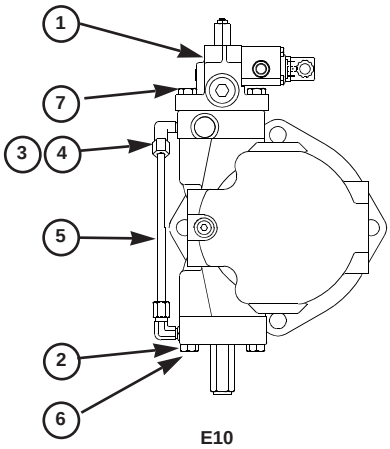
		P05	
ITEM	**DESCRIPTION**	**PART NO.**	**QTY.**
1	Piston	032-92202	1
2	Spring	032-92205	1
3	Sleeve	032-92203	1
4	Control Cap	032-91832	1
5	O-Ring	691-00920	1
6	Plug	032-92204	1
7	Avseal Plug	447-00026	1



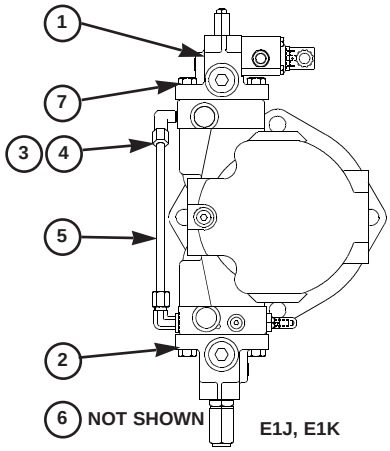


CCW ROTATION



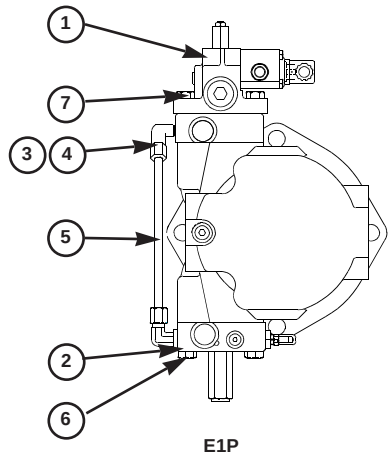


E10



E1J, E1K

CW ROTATION



E1P

NOT SHOWN 8 9 10 11 12

ELECTRIC STROKER

parts list

		P05	QUANTITY			
ITEM	DESCRIPTION	PART NO.	E10	E1J	E1K	E1P
1	Electric Stroker (Fig. 5)	S22-15399	1	1	1	1
2	Control Cap (Fig. 7)	S22-15325	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15405	—	1	—	—
	High Torque Override	S22-15630	—	—	1	—
	Comp. Override (Fig. 10)	S22-15404	—	—	—	1
3	O-Ring, 90 S-1 ARP 906	691-00906	2	2	2	2
4	Elbow	492-15017	2	2	2	2
5	Tube, CW Tube, CCW	032-91864 032-92049	1	1	1	1
*6	Screw-H.H.C., M12 x 55 mm	363-12205	6	4	4	6
*7	Screw-H.H.C., M12 x 75 mm	363-12220	2	4	4	2
8	Control Piston	032-91785	1	1	1	1
9	O-Ring, 70 S-1 ARP 013	671-00013	2	2	2	2
10	O-Ring, 70 S-1 ARP 151	671-00151	2	2	2	2
11	Piston Ring	032-91816	1	1	1	1
12	Piston Ring	032-91811	1	1	1	1

*Included with items 1, 2

ELECTRIC STROKER DISASSEMBLY

1. **See Figure 5.** Remove 3 screws (37) holding block (36) to body (16).
2. Remove 2 screws holding body (16) to cap assembly (1).
3. Remove all parts from body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.
4. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.
5. **See Figure 6.** Remove tube lines to cap assembly.
6. Remove screws holding cap assembly to pump body.
7. Remove cap assembly (1). Remove plug (4) with attached parts. Remove spring (11) and spool (6).
8. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).
9. Remove cap (19), screw (13) and nut (14). Remove the retainer (7).

ASSEMBLY

1. **See Figure 6.** Install Avseal plug (9) in cap.
2. Install spool (6) into bore as shown. Install spring (11) over end of spool.
3. Install O-ring (8) on spring retainer (7). Install retainer (7), screw (13), and nut (14) in plug (4).
4. Install O-ring (15) in bottom of bore as shown. Install O-ring (10) on plug (4). Install plugs (4) and (12) in body (1). Torque plugs to 90 ft-lb., 122 N m . Install O-ring (18) in cap.
5. Turn screw (13) in until spring retainer (7) contacts spring (11). Turn an additional 1-1/2 turns and lock in position.
6. Note proper location for control on pump. Install O-rings on interface between cap and pump control pad. Install cap on pump control pad, guiding the control piston into the bore.
7. Torque two assembly bolts to 75 ft-lb, 102 N m.
8. **See Figure 5.** Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 ft-lb., 6,8 N m.
9. Install minimum stop screw (24) and turn clockwise to stroke pump to full volume. Measure height from control cap to top of screw (3). With control piston at full stroke, dimension must be 0.75 +/- .03 in., 19,2 +/- 0,76 mm. Back out minimum stop screw (24) till there is no contact with control piston.
10. Press dowel (30) into body (16), through the link (28), to 0.25 in., 6,35 mm below surface, apply Loctite hydraulic sealant to threads of screws (46) and install over dowel (30).
11. Press spool (21) into retainer (19). Caution: do not use excessive force. Place spool/retainer assembly into spool (17) with spring (18) and washer (34). Secure with retaining ring (33).
12. While sleeve (27) is engaged into dowel on link (28), slide above spool assembly into bore of body (16), and through sleeve (27). Spool (21) must move freely and easily at all positions of the link (28).
13. Install proportional valve (41) in block. Torque to 20 ft-lb., 27 N m.
14. Install coil on proportional valve. Torque to 20-25 in. lb., 2,2-2,8 N m max.
15. Assemble all other components into body (16) per figure 5. Torque the plug (12) to 90 ft-lb., 122 N m.
16. While spring retainer is engaging clevis pin (5) under dowel of link (28), slide the other opening of spring retainer over the top of the screw (3). Attach body assembly (16) to cap (1) with two screws and torque to 75 ft-lb., 102 N m.

TEST AND ADJUSTMENT

1. Plumb 1200 psi, 83 bar servo supply to control port “X”. Supply 1200 psi, 83 bar to the electric stroker servo supply port “E”. **Note:** All pressure references are “above case pressure” (25 psi, 1,7 bar max.)
2. Thread zero screw (24) so that pump is on stroke.
3. Place a gage in the proportional valve gage port.
4. Start pump.
5. Adjust amperage (approx. 125 mA) to give 50 psi, 3,45 bar reading on the propor-

tional valve gage port. Back out zero screw (24) and adjust screw (9) until output flow is at zero stroke position. Lock both adjustments in place.

6. Increase amperage to 290 mA. Pump should go to full stroke. Set max. volume screw on opposite control cap for full stroke. Gage in proportional valve gage port should read approximately 210 psi, 14,5 bar.

7. If pump fails to go towards full stroke, or fails to go towards zero stroke, differential pressure may be improperly adjusted. Re-adjust the screw (13 figure 6) out to go towards full or in to go towards zero flow. When correct, lock in place and install cap on differential adjustment.

8. Increase and decrease the amperage between 0 and 290 mA several times at approximately 500 psi, 3000 psi, 6000 psi, (34,5 bar, 207 bar and 414 bar) system pressure. Pump stroke should follow amperage smoothly and proportionally. Full to zero or zero to full stroke should be achieved in 0.7 second. Adjust amperage up to 275 mA from zero stroke, then adjust down from full stroke to 275 mA. The flows at the two 275 mA settings shall not vary more than 2.5 gpm, 10 l/m from each other.

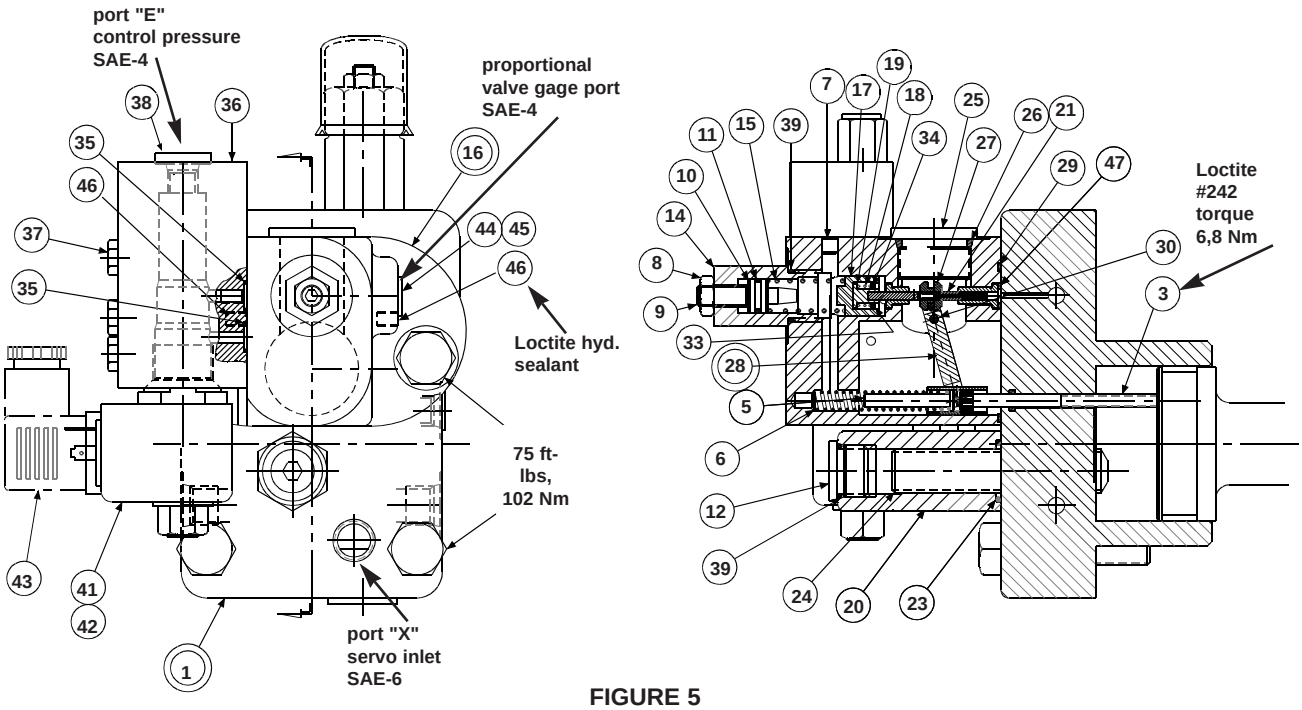


FIGURE 5
ELECTRIC STROKER

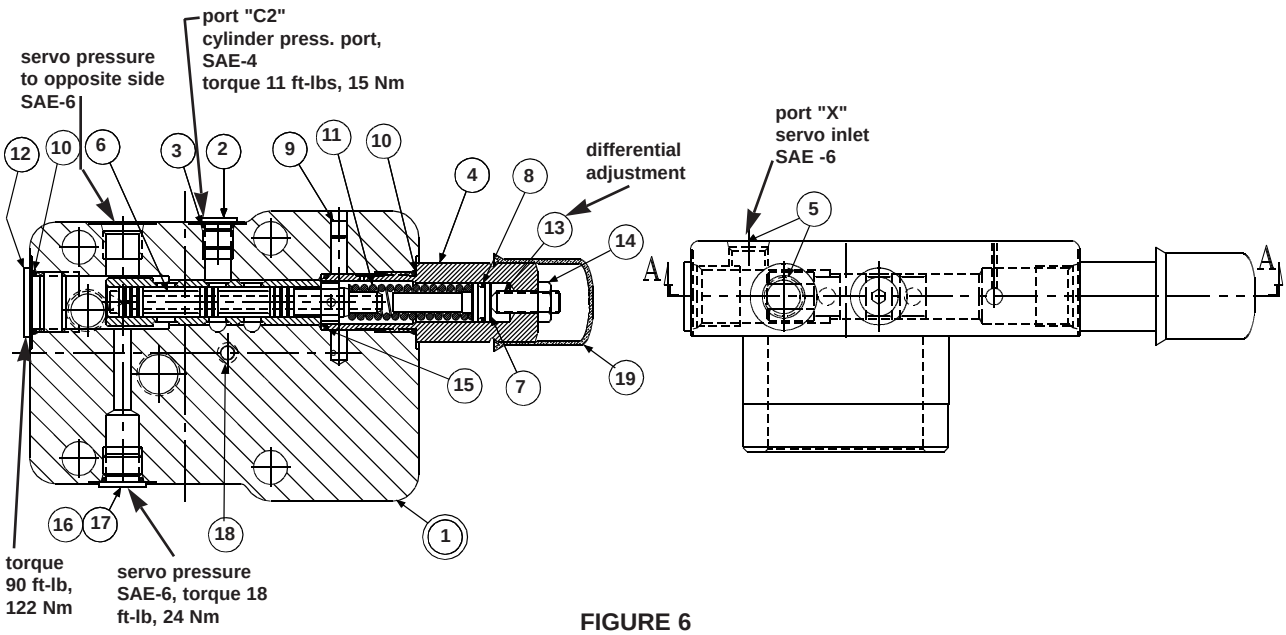


FIGURE 6
SERVO CAP

PARTS LIST FOR FIGURE 5
electric stroker S22-15399

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15327	1
3	Screw	032-91461	1
5	Clevis pin	321-40000	1
6	Spring, Compression	032-92100	1
7	Plug, Avseal	447-00026	1
8	Nut, 5/16-24	335-13100	1
9	Soc. Setscrew, 5/16-24 x 1-1/4	312-13180	1
10	Seal Piston	032-91918	1
11	O-Ring, 90 S-1 ARP 012	691-00012	1
12	Plug	488-35018	1
14	Spring Cap	032-91511	1
15	Spring	225-92101	1
16	Body	S22-15393	1
17	Spool	032-91512	1
18	Spring	225-92109	1
19	Spring Retainer	032-91516	1
20	Nut, M16	032-91822	1
21	Spool	032-91438	1
23	O-Ring,70 S-1 ARP 115	671-00115	1
24	Soc. Setscrew	311-50001	1
25	Plug, 12 HP5N-S	488-35014	1
26	O-Ring, 90 S-1 ARP 912	691-00912	1
27	Sleeve	032-91437	1
28	Arm assembly	S22-15520	1
29	O-Ring, 70 S-1 ARP 035	671-00035	1
30	Dowel Pin, 1/8 Dia x 1.50 Lg.	324-20824	1
33	Ret. Ring	356-30037	1
34	Washer	032-91517	1
35	O-Ring, 70 S-1 ARP 011	671-00011	2
36	Block	032-91509	1
37	Screw, HHC, 1/4-20 x 2 1/4	306-40187	3
38	Plug, Alum.	449-00013	1
39	O-Ring, 90 S-1 ARP 908	691-00908	2
41	Prop. Pr. Cont. Valve	517-00095	1
42	Coil, 24VDC	517-00096	1
43	Connector	167-01008-8	1
44	O-Ring, 90 S-1 ARP 904	691-00904	1
45	Plug, SAE-4	488-35061	1
46	Screw, SHC 10-32 x 1/4	312-09041	2
47	O-ring, 70 S-1 ARP 010	671-00010	1

PARTS LIST FOR FIGURE 6
servo cap S22-15327

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap/Sleeve	S22-15332	1
2	Plug	488-35061	1
3	O-ring, 90 S-1 ARP 904	691-00904	1
4	Plug	032-91861	1
5	Plug	449-00599	2
6	Spool	032-59482	1
7	Spring retainer	032-91862	1
8	O-Ring, 90 S-1 ARP 013	691-00013	1
9	Avseal Plug	447-00026	1
10	O-ring, 90 S-1 ARP 910	691-00910	2
11	Spring	032-91863	1
12	Plug	488-35055	1
13	Screw, 5/16 -24 x 1	312-13160	1
14	Nut, 5/16-24	335-13100	1
15	O-ring, 90 S-1 ARP 017	691-00017	1
16	O-ring, 90 S-1 ARP 906	691-00906	1
17	Plug	488-35041	1
18	O-Ring, 70 S-1 ARP 008	671-00008	1
19	Cap	449-00612	1

CONTROL CAP DISASSEMBLY

1. **See Figure 7.** Remove cover (5) and Max. volume screw (4).
2. Remove 4 screws holding cap to pump.
3. Remove cap assembly from pump.

ASSEMBLY

1. Install O-rings on interface between cap and pump control pad. Install cap on pump housing as indicated on the applicable view, guiding the control piston into the bore.
2. Torque the assembly bolts to 75 ft-lbs, 102 Nm.
3. Install screw (4) in cap. Install O-ring (3) on nut (5). Install nut (5) on screw.
3. Adjust screw till pump is slightly on stroke and lock nut (5).
4. Install O-ring (7) on plug (6). Install plug in nut (5). Torque plug (6) to 50 ft-lb, 68 Nm.

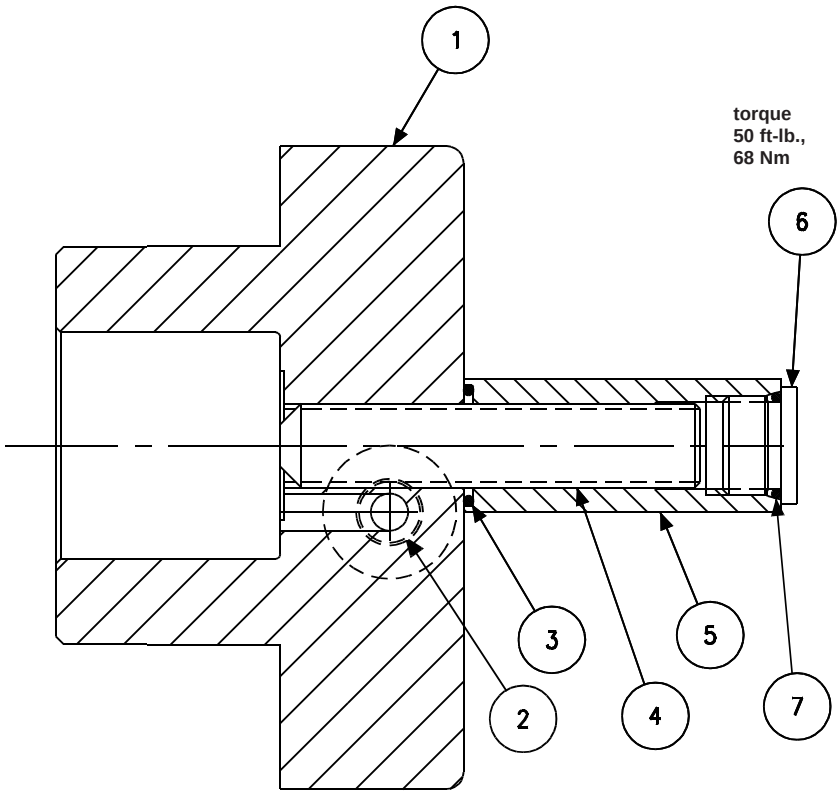


FIGURE 7
CONTROL CAP ASSEMBLY

PARTS LIST FOR FIGURE 7
control cap assembly S22-15325

ITEM	DESCRIPTION	PART NO.	QTY.
1	Control Cap	032-91842	1
2	Plug	449-00015	1
3	O-ring, 70 S-1 ARP 115	671-00115	1
4	Screw, M16 -2 x 80	311-50001	1
5	Nut	032-91822	1
6	Plug	488-35018	1
7	O-ring 90 S-1 ARP 908	691-00908	1

TORQUE LIMITER OVERRIDE DISASSEMBLY

1. **See figure 8.** Remove 2 screws holding torque limiter body (16) to cap assembly (1).

2. Remove all parts from torque limiter body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.

3. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.

4. Remove maximum volume stop assembly (items 11, 13, 14, 20 and 24).

5. Remove cap assembly (1).

6. See fig. 9. Remove plug (15) and attached parts. Remove spring (11) and spool (18).

7. Remove adjusting plug (2) and attached parts. Remove seal piston (5). Note: a 10-24 screw may be attached to assist in pulling the piston. Remove spring (7) and cone (8).

8. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve, snout or cap is worn, replace the cap-sleeve assembly (1).

9. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

1. **See figure 9.** Install Avseal plugs (9) and orifice (19).

2. Press seat (10) into bore squarely against shoulder in bore.

3. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal piston (16). Lubricate and install into plug (15). Install O-ring (14) in bottom of bore as shown. Install O-ring (13) on plug (15). Install plug (15) into cap. Install screw (3) and nut (4).

4. Install O-ring (6) on seal piston (5).

5. Lubricate O-ring and install cone (8), spring (7) and seal piston into bore in cap (1), being careful that cone enters seat (10). Install adj. plug (2), screw (25), nut (4), and acorn nut (26).

6. Install plug (12) and torque to 90 ft-lb, 122 Nm. Install plug (21). Torque to 50 ft-lb, 68 Nm. Install plug 28. Torque to 11 ft-lb, 15 Nm.

7. Carefully install O-ring (30) into the cap.

8. Note proper location for cap. Install O-rings on interface between cap and pump control pad. Install cap assembly on pump, guiding the control piston into the bore. Torque two mounting screws to 75 ft-lb., 102 Nm.

9. **See figure 8.** Install maximum stop screw (24), cover (20), O-ring (14) and plug (11) with O-ring (13).

10. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 ft-lb, 6,8 Nm.

11. Measure height from control cap to top of screw. With control piston at zero stroke, dimension must be .75 +/- .03 in., 19,2 +/- 0,76 mm.

12. Press dowel (30) into body (16), through the link assembly (28), to .25 in., 6,35 mm below surface. Apply Loctite hydraulic sealant to threads of screws (33) and install over dowel (30).

13. While sleeve (27) is engaged into dowel on link (28), slide spool (21) into bore of body (16), and through sleeve (27). Spool (21) must move freely and easily at all positions of the link (28).

14. Assemble remaining parts per drawing. Torque plugs (11) to 50 ft-lb, 68 Nm.

15. While spring retainer is engaging clevis pin (5) under dowel of link (28), slide the other opening of spring retainer over the top of the screw (3). Attach body assembly (16) to cap (1) and torque assembly screws to 75 ft-lb, 102 Nm.

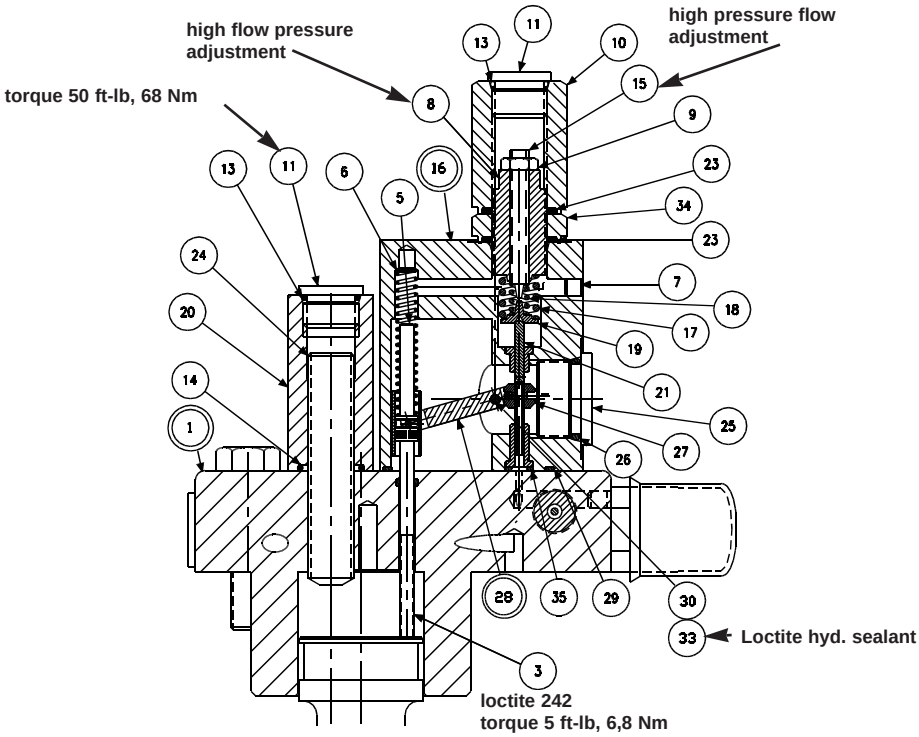


FIGURE 8
TORQUE LIMITER OVERRIDE

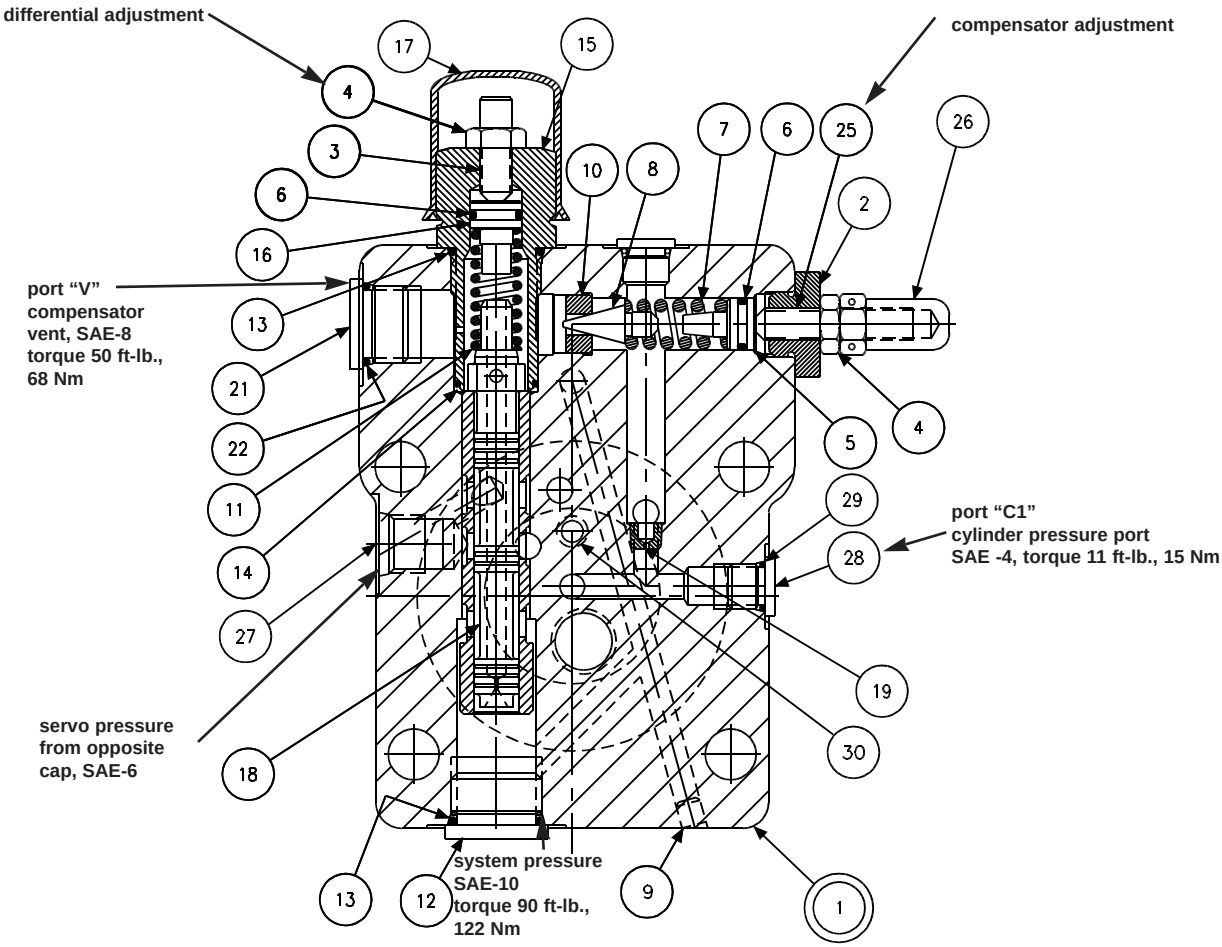


FIGURE 9
TORQUE LIMITER OVERRIDE CAP

PARTS LIST FOR FIGURE 8
torque limiter override
code J S22-15405
code K S22-15630

		P05	QTY.	
ITEM	DESCRIPTION	PART NO.	**J	**K
1	Cap (Figure 9)	S22-15412	1	1
3	Screw	032-91461	1	1
5	Clevis pin	321-40000	1	1
6	Spring, Compression	032-92100	1	1
7	Plug, Avseal	447-00026	1	1
8	Screw	032-91445	1	1
9	Nut, Hex Jam 1/4-20 UNC	340-00038	1	1
10	Hex Nut, 3/4-16 UNF	032-91449	1	1
11	Plug, 8HP N-S	488-35018	2	1
13	O-ring, 90 S-1 ARP 908	691-00908	2	1
14	O-ring, 70 S-1 ARP 115	671-00115	1	1
15	Screw, Primary Adjust	032-91446	1	1
16	Body assembly	S22-15396	1	1
17	Outer Spring – J Version	032-91440	1	—
	Outer Spring – K Version	032-91440	—	1
18	Inner Spring – J Version	032-92240	1	—
	Inner Spring – K Version	032-91441	—	1
19	Spring Retainer	032-91819	1	1
20	Nut, M16	032-91822	1	1
21	Spool	032-91438	1	1
23	O-ring, 70 S-1 ARP 118	671-00118	2	2
24	Screw, M16 - 2 x 80 mm	311-50001	1	1
25	Plug, 12 HP5N-S	488-35014	1	1
26	O-Ring, 90 S-1 ARP 912	691-00912	1	1
27	Sleeve	032-91437	1	1
28	Arm assembly	S22-15520	1	1
29	O-Ring, 70 S-1 ARP 035	671-00035	1	1
30	Dowel Pin, 1/8 Dia. x 1.50 Lg..	324-20824	1	1
33	Screw, SHC 10-32 x 1/4	312-09041	2	2
34	Nut	032-91645	1	1
35	O-Ring, 70 S-1 ARP 010	671-00010	1	1

PARTS LIST FOR FIGURE 9,
torque limiter override cap S22-15412

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15445	1
2	Adj. Plug	032-91814	1
3	Soc. Setscrew 5/16-24 x 1	312-13160	1
4	Nut, 5/16-24	335-13100	2
5	Seal Piston	031-59367	1
6	0-Ring, 90 S-1 ARP 012	691-00012	2
7	Spring	032-91798	1
8	Cone	036-12288	1
9	Avseal Plug	447-00026	2
10	Seat	036-11692	1
11	Spring	033-71086	1
12	Plug, SAE-10	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	2
14	O-Ring, 90 S-1 ARP 017	691-00017	1
15	Plug	031-57368	1
16	Seal Piston	032-91305	1
17	Cap	449-00612	1
18	Spool	032-91820	1
19	Orifice	036-12819	1
21	Plug, SAE-8	488-35018	1
22	O-ring, 90 S-1 ARP 908	691-00908	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	Nut, Acorn	036-33474	1
27	Plug	449-00015	1
28	Plug, SAE-4	488-35061	2
29	O-ring, 90 S-1 ARP 904	691-00904	2
30	O-ring, 70 S-1 ARP 008	671-00008	1

TORQUE LIMITER OVERRIDE TEST AND ADJUSTMENT

1. Install gages on system pressure and on compensator vent port “V”.

2. Turn compensator adjustment screw out to remove spring load, then 1/2 turn in.

3. Turn differential adjustment screw out to remove spring load, then 1/2 turn in.

4. Back out maximum volume stop to full volume.

5. For setting and testing compensator override function, disable torque limiter in this manner: Back out primary adjusting screw (15) figure 8, to remove all load. Turn in outer adjusting screw (8) to go solid. Caution! do not apply over 10 in-lb, 1,2 Nm torque to avoid damage to internal parts!

6. Start prime mover with system relief set at 500 psi, 35 bar.

7. Stroke pump to full displacement. Apply a load to the pump.

8. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 1500 psi, 103 bar.

9. Adjust compensator differential spool pressure to 200 psi, 13,8 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the system pressure and compensator vent gages installed in the compensator cap is 200 psi, 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 250 psi, 17 bar to avoid spring going solid, preventing compensator action.) When correct, lock in place and install cap on differential adjustment.

10. Set the compensator to 1500 psi, 3000 psi, and 6000 psi, (207 bar, 414 bar, and 500 bar). At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

11. Reduce pressure to 150 psi, 10,3 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator setting should be repeatable.

12. Set compensator adjustment to at least 500 psi, 34,5 bar above the required setting, or 7000 psi, 483 bar.

Set the torque limiter by using the formula:

$$HP = P \cdot Q / (Eff. \cdot 1714)$$

where P = pressure in psi
Q = flow in gpm

$$kW = P \cdot Q / (Eff. \cdot 600)$$

where P = pressure in Bar
Q = flow in l/m

calculate these two values:
a. System pressure at full pump flow.
b. Pump flow at full system pressure.

13. Set system relief valve to pressure (a) calculated above. Back out primary adjusting screw to remove all load. Set outer adjusting screw (8) so that pump just commences to de-stroke.

14. Set the system relief valve to the required maximum system pressure. Set primary adjusting screw (15) to obtain the calculated flow (b) at full system pressure.

15. Set compensator adjustment to the required setting, or 6000 psi, 414 bar if not otherwise noted.

Note: Electric motor current may be used instead of calculated flows to set power. In step 13, set the outer adjusting screw (8) to achieve the rated motor current. In step 14, set the adjustment (15) to achieve the rated motor current.

COMPENSATOR OVERRIDE DISASSEMBLY

1. **See Figure 10.** Remove tube line to cap.
2. Remove maximum volume stop assembly (items 20, 21, 22, 23, 24).
3. Remove cap assembly.
4. Remove plug (15) and attached parts. Remove spring (11) and spool (18).
5. Remove adj. plug (2) and attached parts. Remove seal piston (5). Note: a 10-24 screw may be attached to assist in pulling the piston. Remove spring (7) and cone (8).
6. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve, snout or cap is worn, replace the cap-sleeve assembly (1).
7. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

1. Install Avseal plugs (9) in body. Install orifice (19) in body.
2. Press seat (10) into bore to shoulder in bore.
3. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal piston (16). Lubricate and install into plug (15). Install O-ring (14) in bottom of bore as shown. Install O-ring (13) on plug (15). Install plug (15) into cap. Install screw (3) and nut (4).
4. Install O-ring (6) on seal piston (5).
5. Lubricate O-ring and install cone (8), spring (7) and seal piston into bore in cap (1), being careful that cone enters seat (10).
6. Install remaining parts. Torque plug (12) to 90 ft-lb., 122 Nm. Torque plug (21) to 50 ft-lb., 68 Nm. Torque plugs (28) to 11 ft-lb., 15 Nm.
7. Note proper location for cap on pump. Install O-rings on interface between cap and pump control pad.
8. Install cap assembly on pump, guiding the control piston into the bore.
9. Torque mounting bolts to 75 ft-lb., 102 Nm.
10. Install tube fitting and tube line connecting to opposite cap.

TEST AND ADJUSTMENT

Compensator is to be tested on pump. Adjust maximum volume stop to full displacement.

1. Install gages on system pressure and on compensator vent port “V”.
2. Turn compensator adjustment screw (25) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.
3. Turn differential adjustment screw (3) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.
4. Start prime mover with system relief valve set at 500 psi, 35 bar. Apply a load to the pump.
5. Set pump control to full displacement. Pump should go to full displacement at 500 psi, 35 bar.
6. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 1500 psi, 100 bar.
7. Adjust compensator differential spool pressure to 200 psi, 13,8 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the system pressure and compensator vent gages installed in the compensator cap is 200 psi, 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 250 psi, 17 bar to avoid spring going solid, preventing compensator action.) When correct, lock in place and install cap.on differential adjustment.
8. Set the compensator to 3000, 6000 and 7250 psi, (207, 414, and 500 bar).
9. At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
10. Reduce pressure to 150 psi, 10,3 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator setting should be repeatable.
11. Set compensator adjustment to the required setting, or 6000 psi, 414 bar if not otherwise noted.

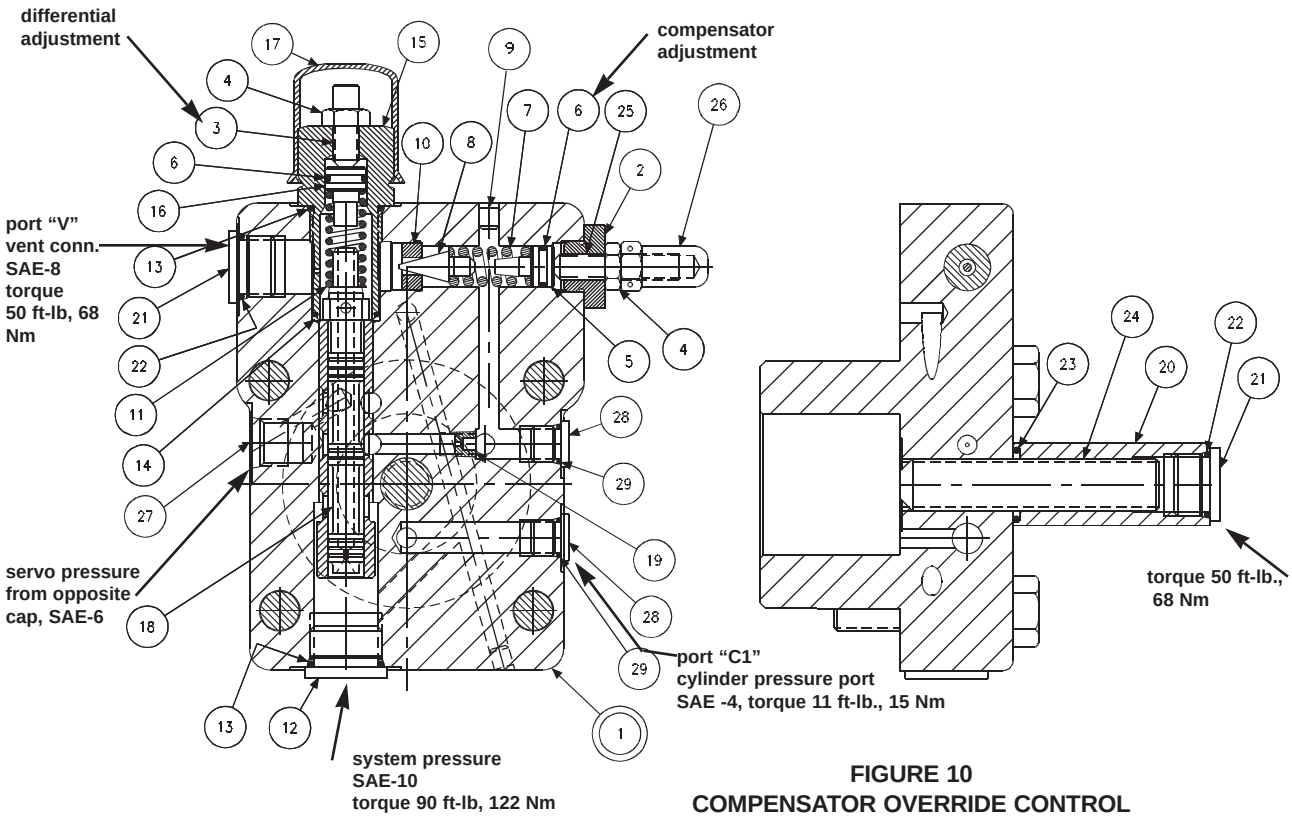
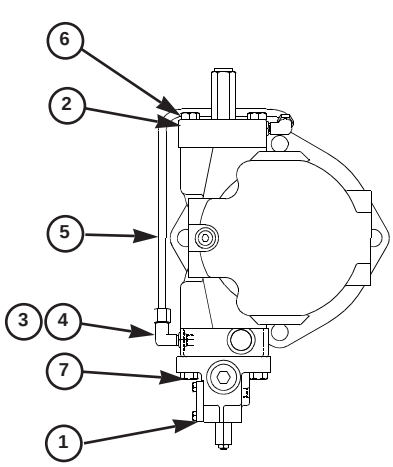
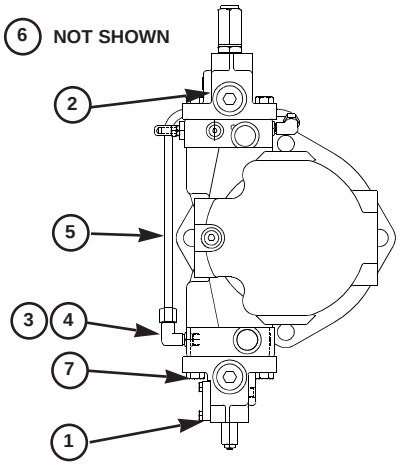


FIGURE 10
COMPENSATOR OVERRIDE CONTROL

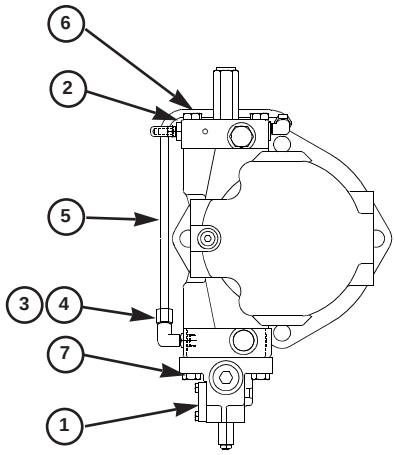
PARTS LIST FOR FIGURE 10
compensator override control
S22-15404

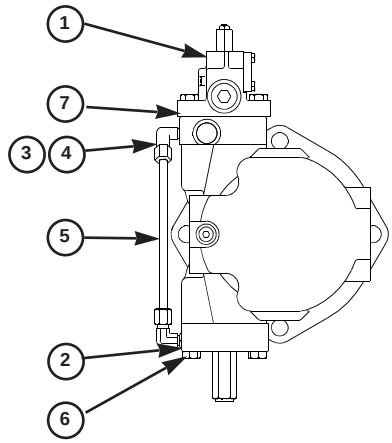
ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15330	1
2	Adj. Plug	032-91814	1
3	Soc. Setscrew 5/16-24 x 1	312-13160	1
4	Nut, 5/16-24	335-13100	2
5	Seal Piston	031-59367	1
6	0-Ring, 90 S-1 ARP 012	691-00012	2
7	Spring	032-91798	1
8	Cone	036-12288	1
9	Avseal Plug	447-00026	2
10	Seat	036-11692	1
11	Spring	033-71086	1
12	Plug, SAE-10	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	1
14	O-Ring, 90 S-1 ARP 017	691-00017	1
15	Plug	031-57368	1
16	Seal Piston	032-91305	1
17	Cap	449-00612	1
18	Spool	032-91820	1
19	Orifice	033-25528	1
20	Nut, M16	032-91822	1
21	Plug	488-35018	2
22	O-ring, 90 S-1 ARP 908	691-00908	2
23	O-ring, 70 S-1 ARP 115	671-00115	1
24	Soc.setscrew	311-50001	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	Acorn Nut	036-33474	1
27	Plug	449-00015	1
28	Plug, SAE-4	488-35061	2
29	O-ring, 90 S-1 ARP 904	691-00904	2



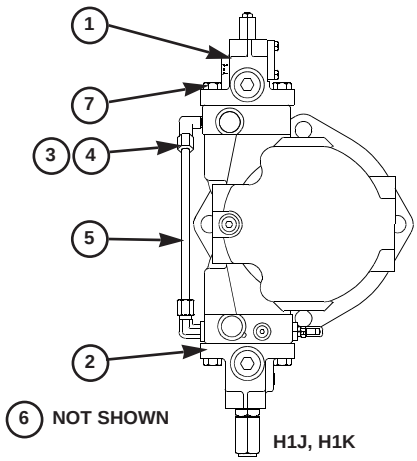


CCW ROTATION



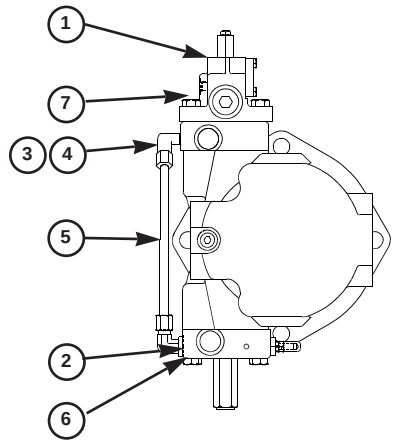


H10



H1J, H1K

CW ROTATION



H1P

NOT SHOWN 8 9 10 11 12

HYDRAULIC STROKER
parts list

		P05	QUANTITY			
ITEM	DESCRIPTION	PART NO.	H10	H1J	H1K	H1P
1	Hydraulic Stroker (Fig. 11)	S22-15400	1	1	1	1
2	Control Cap (Fig. 7)	S22-15325	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15405	—	1	—	—
	High Torque Override	S22-15630	—	—	1	—
	Comp. Override (Fig. 10)	S22-15404	—	—	—	1
3	O-Ring, 90 S-1 ARP 906	691-00906	2	2	2	2
4	Elbow	492-15017	2	2	2	2
5	Tube, CW	032-91864	1	1	1	1
	Tube, CCW	032-92049				
*6	Screw-H.H.C., M12 x 55 mm	363-12205	6	4	4	6
*7	Screw-H.H.C., M12 x 75 mm	363-12220	2	4	4	2
8	Control Piston	032-91785	1	1	1	1
9	O-Ring, 70 S-1 ARP 013	671-00013	2	2	2	2
10	O-Ring, 70 S-1 ARP 151	671-00151	2	2	2	2
11	Piston Ring	032-91816	1	1	1	1
12	Piston Ring	032-91811	1	1	1	1

*Included with items 1, 2

HYDRAULIC STROKER DISASSEMBLY

1. **See figure 11.** Remove 2 screws holding body (16) to cap assembly (1).

2. Remove all parts from body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.

3. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.

4. **See figure 6.** Remove tube lines to cap assembly.

5. Remove screws holding cap assembly to pump body.

6. Remove cap assembly (1). Remove plug (4) with attached parts. Remove spring (11) and spool (6).

7. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).

8. Remove screw (13) and nut (14). Remove the retainer (7).

ASSEMBLY

1. **See figure 6.** Install Avseal plug (9) in cap.

2. Install spool (6) into bore as shown. Install spring (11) over end of spool.

3. Install O-ring (8) on spring retainer (7). Install retainer (7), screw (13), and nut (14) in plug (4).

4. Install O-ring (15) in bottom of bore as shown. Install O-ring (10) on plug (4). Install plugs (4) and (12) in body (1). Torque plugs to 90 ft-lb., 122 Nm . Install O-ring (18) in cap.

5. Turn screw (13) in until spring retainer (17) contacts spring (11). Turn an additional 1-1/2 turns and lock in position.

6. Note proper location for control on pump. Install O-rings on interface between cap and pump control pad. Install cap on pump control pad, guiding the control piston into the bore.

7. Torque two assembly bolts to 75 ft-lb., 102 Nm.

8. **See figure 11.** Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 ft-lb., 6,8 Nm.

9. Install minimum stop screw (24) and turn clockwise to stroke pump to full volume. Measure height from control cap to top of screw (3). With control piston at full stroke, dimension must be 0.75 +/- .03 in., 19,2 +/- 0,76 mm. Back out minimum stop screw (24) till there is no contact with control piston.

10. Press dowel (30) into body (16), through the link (28), to 0.25 in., 6.35 mm below surface. Apply Loctite hydraulic sealant to threads of screws (40) and install over dowel (30).

11. Press spool (21) into retainer (19). Caution: do not use excessive force. Place spool/retainer assembly into spool (17) with spring (18) and washer (34). Secure with retaining ring (33).

12. While sleeve (27) is engaged into dowel on link (28), slide above spool assembly into bore of body (16), and through sleeve (27). Spool (21) must move freely and easily at all positions of the link (28).

13. Assemble all other components into body (16) per figure 11. Torque plug (12) to 90 ft-lb., 122 Nm. Torque plug (21) to 50 ft-lb., 68 Nm. Torque plug (28) to 11 ft-lb., 15 Nm.

14. While spring retainer is engaging clevis pin (5) under dowel of link (28), slide the other opening of spring retainer over the top of the screw (3). Attach body assembly (16) to cap (1) with two screws and torque to 75 ft-lb., 102 Nm.

TEST AND ADJUSTMENT

1. Plumb 1200 psi, 82.8 bar servo to servo supply port “X”.

2. Thread zero screw (24) so that pump is on stroke.

3. Start pump.

4. Supply signal pressure, to 250 psi, 17,2 bar to hydraulic stroker signal port “H”.

5. Adjust screw (9) until output flow is at the full stroke position. Lock in place.

6. Reduce signal pressure on port “H” to minimum. Back out zero screw (24) until pump is at zero stroke. Lock in place.

7. Increase and decrease signal pressure between 0 and 250 psi, 17,2 bar several times at approximately 500, 3000 and 6000 psi, (34,5, 207, and 414 bar) system pressure. Pump stroke should follow signal pressure smoothly and proportionally. Full to zero or zero to full stroke should be achieved in no more than 0.7 second. Full stroke should be achieved at 210 psi, 145 bar. Zero stroke should be achieved at 50 +/-15 psi, 3,45 +/- 1 bar. Adjust signal pressure up to 175 psi, 12 bar from zero stroke, then adjust down from full stroke to 175 psi, 12 bar. The flows at the two settings shall not vary more than 2.5 gpm, 10 l/m from each other. When all adjustments are correct, lock in place and install cap.on differential adjustment.

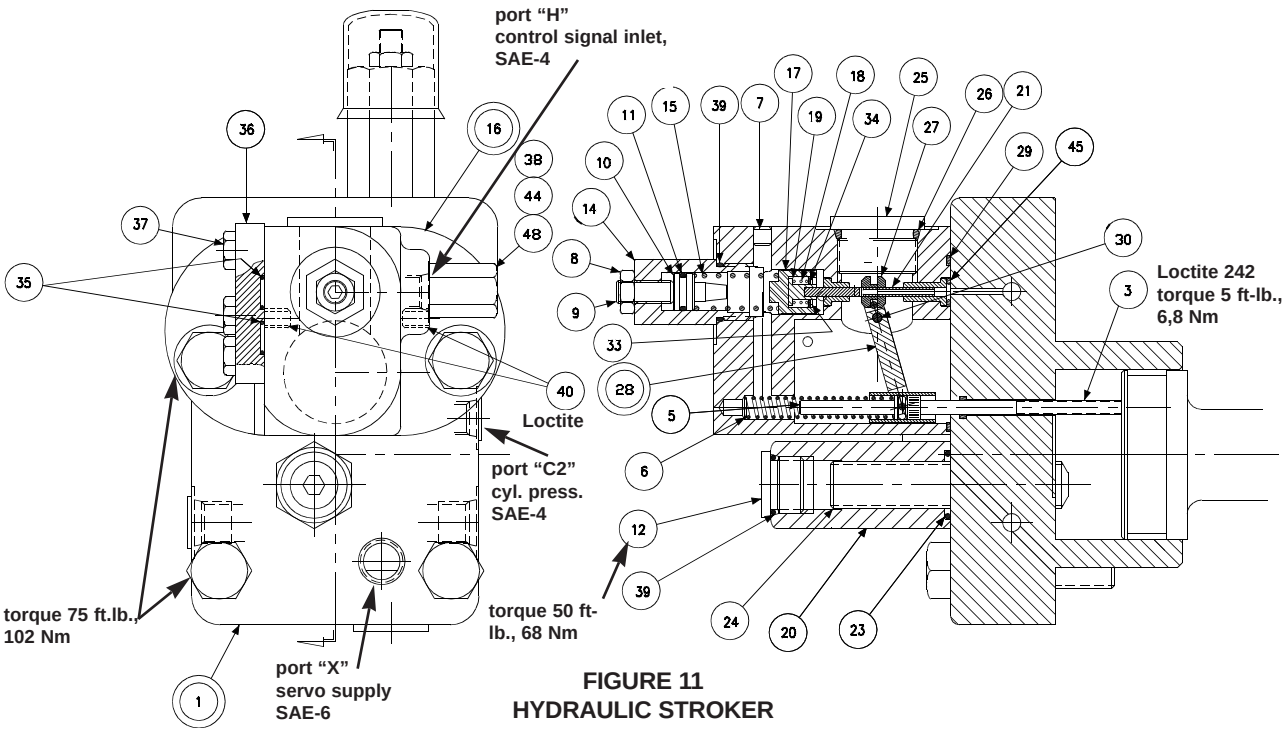
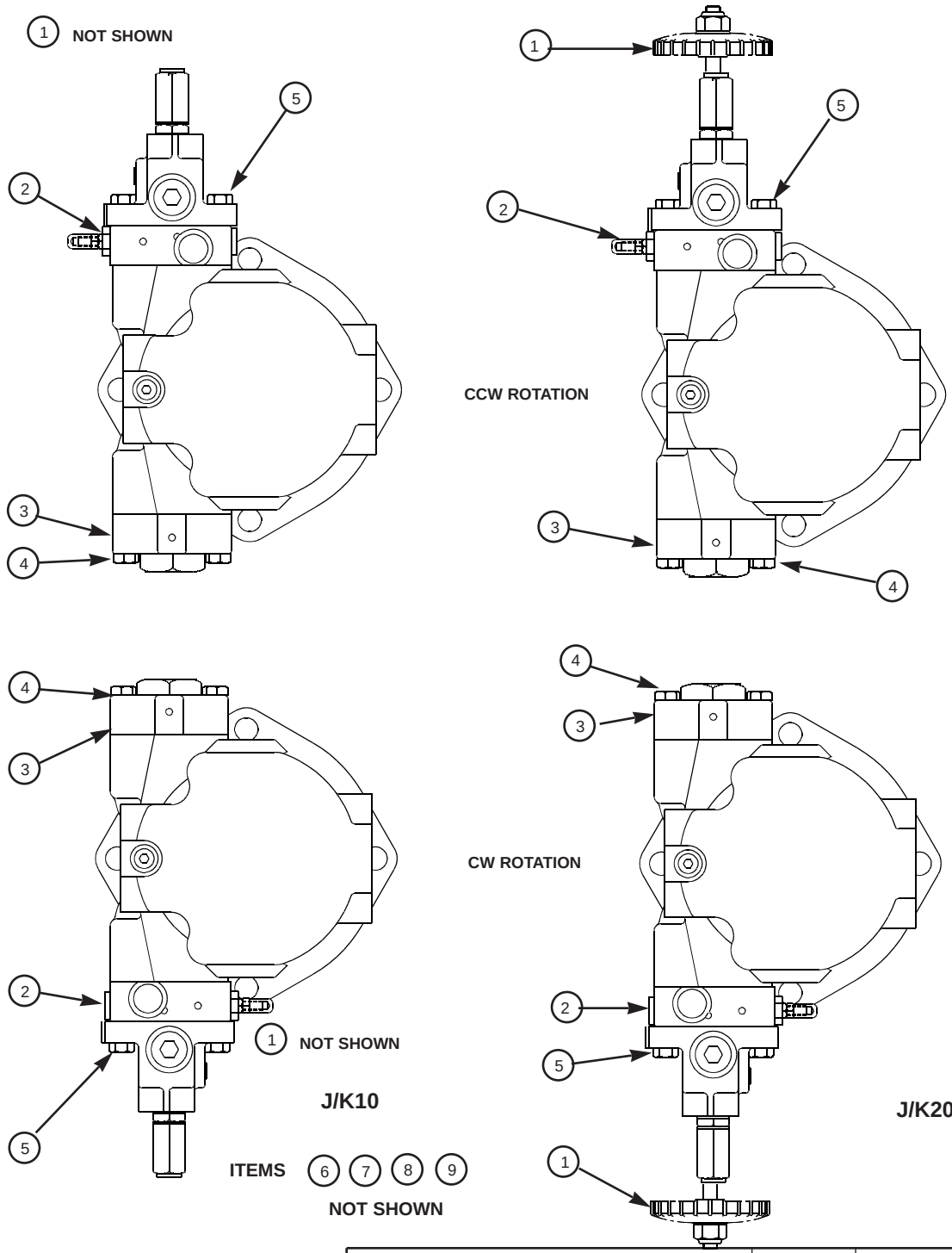


FIGURE 11
HYDRAULIC STROKER

PARTS LIST FOR FIGURE 11
hydraulic stroker S22-15400

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15327	1
3	Screw	032-91461	1
5	Clevis pin	321-40000	1
6	Spring, Compression	032-92100	1
7	Plug, Avseal	447-00026	1
8	Nut, 5/16-24	335-13100	1
9	Soc. Setscrew, 5/16-24 x 1-1/4	312-13180	1
10	Seal Piston	032-91918	1
11	O-Ring, 90 S-1 ARP 012	691-00012	1
12	Plug, 8 HP5N-S	488-35018	1
14	Spring Cap	032-91511	1
15	Spring	225-92101	1
16	Body	S22-15393	1
17	Spool	032-91512	1
18	Spring	225-92109	1
19	Spring Retainer	032-91516	1
20	Nut, M16	032-91822	1
21	Spool	032-91438	1
23	O-Ring,70 S-1 ARP 115	671-00115	1
24	Soc. Setscrew, M16 - 2 x 80 mm	311-50001	1
25	Plug, 12 HP5N-S	488-35014	1
26	O-Ring, 90 S-1 ARP 912	691-00912	1
27	Sleeve	032-91437	1
28	Arm assembly	S22-15520	1
29	O-Ring, 70 S-1 ARP 035	671-00035	1
30	Dowel Pin, 1/8 Dia x 1.50 Lg.	324-20824	1
33	Ret. Ring	356-30037	1
34	Washer	032-91517	1
35	O-Ring, 70 S-1 ARP 011	671-00011	2
36	Plate	032-91510	1
37	Screw, HHC,1/4-20 x 3/4	306-40142	3
38	Plug, aluminum	449-00013	1
39	O-Ring, 90 S-1 ARP 908	691-00908	1
40	Screw, SHC 10-32 x 1/4	312-09041	2
45	O-ring, 70 S-1 ARP 010	671-00010	1



PARTS LIST
torque limiter

		P05	QUANTITY			
ITEM	DESCRIPTION	PART NO.	J10	K10	J20	K20
1	Max. Vol. Stop (Fig. 1)	S22-15467	1	1	—	—
	Max Vol. Handwheel (Fig. 2)	S22-15448	—	—	1	1
*2	Low Torque Limiter (Fig. 12)	S22-15401	1	—	—	—
	High Torque Limiter	S22-15629	—	1	—	—
	Low Torque Limiter	S22-15627	—	—	1	—
	High Torque Limiter	S22-15635	—	—	—	1
3	Buck Up Cap (Fig. 4)	S22-15447	1	1	1	1
4	Screw-H.H.C., M12 x 55 mm	363-12205	6	6	4	4
5	Screw-H.H.C., M12 x 75 mm	363-12220	2	2	4	4
6	Control Piston	032-91836	1	1	1	1
7	O-Ring, 70 S-1 ARP 013	671-00013	2	2	2	2
8	O-Ring, 70 S-1 ARP 151	671-00151	2	2	2	2
9	Piston ring	032-91816	2	2	2	2

*Includes items 1, 4, 5

TORQUE LIMITER DISASSEMBLY

1. **See Figure 12.** Remove two screws holding torque limiter body (16) to cap assembly (1).

2. Remove all parts from torque limiter body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.

3. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.

4. Remove maximum stop handwheel assembly or maximum stop screw assembly.

5. Remove cap assembly (1).

6. **See Figure 13** Remove plug (15) and attached parts. Remove spring (11) and spool (18).

7. Remove adjusting plug (2) and attached parts. Remove spring (7) and cone (8).

8. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).

9. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

1. **See Figure 13** Install Avseal plugs (9) and orifice (19) in body.

2. Press seat (10) into bore squarely against shoulder in bore.

3. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal piston (16). Lubricate and install into plug (15). Install O-ring (14) in bottom of bore as shown. Install O-ring (13) on plug (15). Install plug (15) into cap. Install screw (3) and nut (4). Install plug (12). Torque plugs (12) and (15) to 90 ft-lb., 122 Nm. Install plug (21). Torque to 50 ft-lb., 68 Nm. Install plug (28). Torque to 11 ft-lb., 15 Nm.

4. Install O-ring (6) on seal piston (5). Lubricate O-ring and Install cone (8), spring (7) and seal piston (5) into bore in cap (1), being careful that cone enters seat (10). Install adj. plug (2), screw (25), nut (4) and acorn nut (26).

5. Carefully install O-ring (27) in the cap.

6. Note proper location for control cap. Install O-rings on interface between cap and pump control pad. Install cap, guiding control piston into bore.

7. Install maximum volume handwheel or screw assembly. Set stop to clear control piston. Install two mounting screws and torque to 75 ft-lb., 102 Nm.

8. **See Figure 12.** Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap, and turn into the control piston. Torque to 5 ft-lb., 6,8 Nm.

9. Measure height from control cap to top of screw. With control piston at full stroke, dimension must be 1.5 +/- .03 in., 38,1 +/- 0,76 mm.

10. Press dowel (30) into body (16), through the link assembly (28), to .25 in., 6,35 mm below surface. Apply Loctite hydraulic sealant to threads of screws (35) and install over dowel (30).

11. While sleeve (27) is engaged into dowel on link (28), slide spool (21) into bore of body (16), and through sleeve (27). Spool (21) must move freely and easily at all positions of the link (28).

12. Assemble remaining parts per drawing. While spring retainer is engaging clevis pin (5) under dowel of link (28), slide the other opening of spring retainer over the top of the screw (3). Attach body assembly (16) to cap (1) and torque screws to 75 ft-lb., 102 Nm.

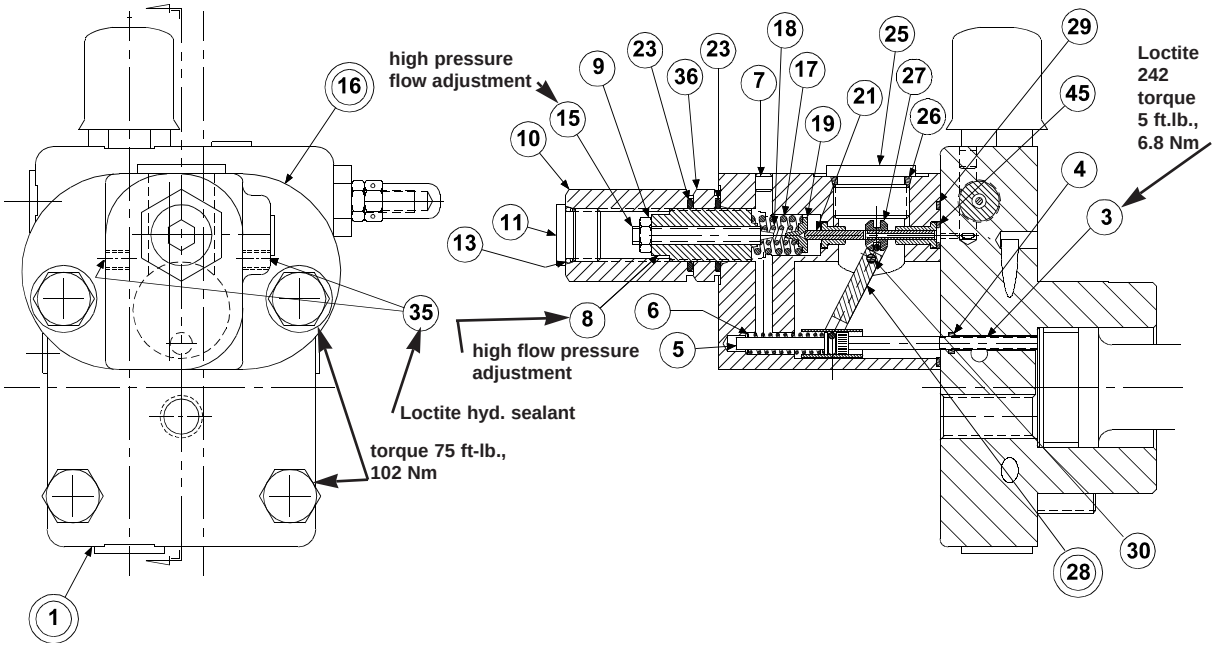


FIGURE 12 – TORQUE LIMITER ASSEMBLY

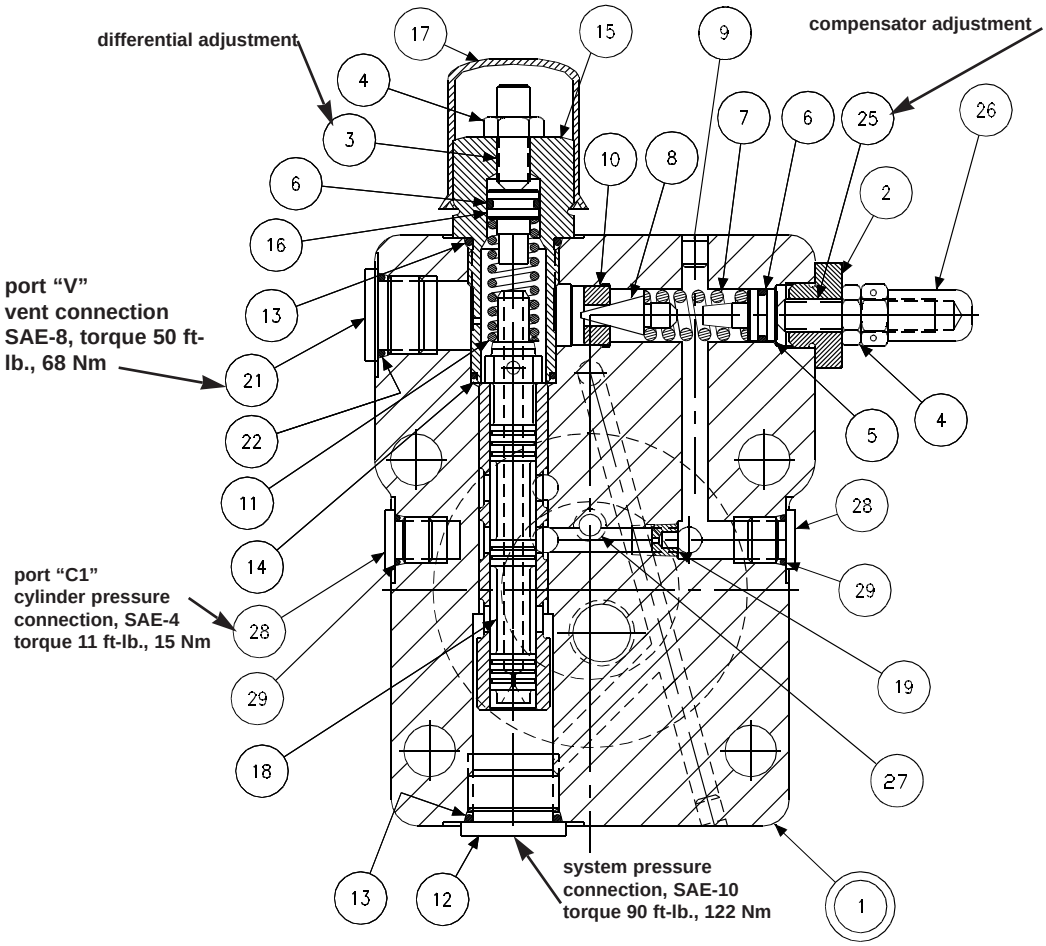


FIGURE 13
TORQUE LIMITER CAP

PARTS LIST FOR FIG. 12

code J10, S22-15401
code K10, S22-15629
code J20, S22-15627
code K20, S22-15635

		P05	QTY.	
ITEM	DESCRIPTION	PART NO.	J*0	K*0
1	Cap (Figure 13)	S22-15407	1	1
3	Screw	032-91461	1	1
5	Clevis pin	321-40000	1	1
6	Spring, Compression	032-92100	1	1
7	Plug, Avseal	447-00026	1	1
8	Screw	032-91445	1	1
9	Nut, Hex Jam 1/4-20 UNC	340-00038	1	1
10	Hex Nut, 3/4-16 UNF	032-91449	1	1
11	Plug, 8HP N-S	488-35018	1	1
13	O-ring, 90 S-1 ARP 908	691-00908	1	1
15	Screw, Primary Adjust	032-91446	1	1
16	Body assembly	S22-15396	1	1
17	Outer Spring – J Version	032-91440	1	—
	Outer Spring – K Version	032-91440	—	1
18	Inner Spring – J Version	032-92240	1	—
	Inner Spring – K Version	032-91441	—	1
19	Spring Retainer	032-91819	1	1
21	Spool	032-91438	1	1
23	O-ring, 70 S-1 ARP 118	671-00118	2	2
25	Plug, 12 HP5N-S	488-35014	1	1
26	O-Ring, 90 S-1 ARP 912	691-00912	1	1
27	Sleeve	032-91437	1	1
28	Arm assembly	S22-15520	1	1
29	O-Ring, 70 S-1 ARP 035	671-00035	1	1
30	Dowel Pin, 1/8 Dia. x 1.75 Lg..	324-20824	1	1
35	Screw, SHC 10-32 x 1/4	312-09041	2	2
36	Nut	032-91645	1	1
45	O-Ring, 70 S-1 ARP 010	671-00010	1	1

PARTS LIST FOR FIGURE 13

torque limiter cap S22-15407

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15408	1
2	Adj. Plug	032-91814	1
3	Soc. Setscrew 5/16-24 x 1	312-13160	1
4	Nut, 5/16-24	335-13100	2
5	Seal Piston	031-59367	1
6	O-Ring, 90 S-1 ARP 012	691-00012	2
7	Spring	032-91798	1
8	Cone	036-12288	1
9	Avseal Plug	447-00026	3
10	Seat	036-11692	1
11	Spring	033-71086	1
12	Plug, SAE-10	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	2
14	O-Ring, 90 S-1 ARP 017	691-00017	1
15	Plug	031-57368	1
16	Seal Piston	032-91305	1
17	Cap	449-00612	1
18	Spool	032-59482	1
19	Orifice	033-25528	1
21	Plug SAE-8	488-35018	1
22	O-ring, 90 S-1 ARP 908	691-00908	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	Nut, Acorn 5/16-24	036-33474	1
27	O-Ring, 70 S-1 ARP 008	671-00008	1
28	Plug, SAE-4	488-35061	2
29	O-ring, 90 S-1 ARP 904	691-00904	2

TORQUE LIMITER TEST AND ADJUSTMENT

1. Install gages on system pressure and on compensator vent port “V”.
2. Turn compensator adjustment screw out to remove spring load, then 1/2 turn in.
3. Turn differential adjustment screw out to remove spring load, then 1/2 turn in.
4. Back out maximum volume stop to full volume.
5. For setting and testing compensator override function, disable torque limiter in this manner: Back out primary adjusting screw (15) to remove all load. Turn in outer adjusting screw (8) to go solid. Caution! do not apply over 10 in.-lb., 1,2 Nm torque to avoid damage to internal parts!
6. Start prime mover with system relief set at 500 psi, 35 bar. Apply a load to the pump.
7. Pump should be at full displacement at 500 psi, 35 bar.
8. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 1500 psi, 103 bar.
9. Adjust compensator differential spool pressure to 200 psi, 13,8 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the system pressure and compensator vent gages installed in the compensator cap is 200 psi, 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 250 psi, 17 bar to avoid spring going solid, preventing compensator action.) When correct, lock in place and install cap on differential adjustment.
10. Set the compensator to 3000, 6000, and 7250 psi, (207, 414, and 500 bar).
11. At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
12. Reduce pressure to 150 psi, 10,3 bar bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator setting should be repeatable.
13. Set compensator adjustment to at least 500 psi, 34,5 bar above the required setting, or 7000 psi, 483 bar.

Set the torque limiter by using the formula:

$HP = P \cdot Q / (Eff. \cdot 1714)$

where P = pressure in psi

Q = flow in gpm

$kW = P \cdot Q / (Eff. \cdot 600)$

where P = pressure in bar

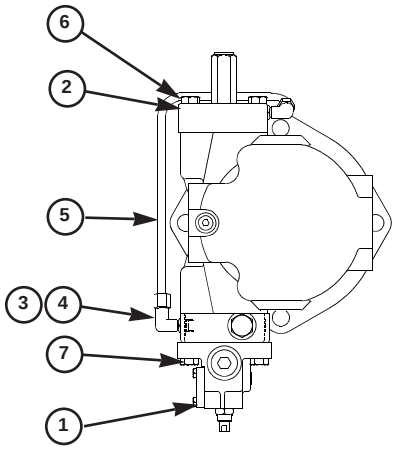
Q = flow in l/m

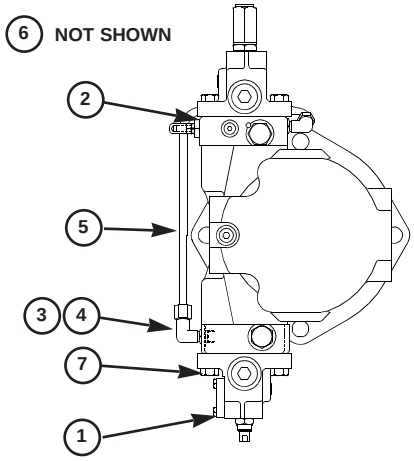
calculate these two values:

a. System pressure at full pump flow.
b. Pump flow at full system pressure.

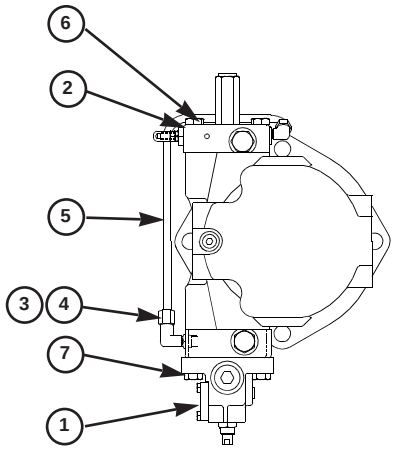
14. Set system relief valve to pressure (a) calculated above. Back out primary adjusting screw to remove all load. Set outer adjusting screw (8) so that pump just commences to de-stroke.
15. Set the system relief valve to the required maximum system pressure. Set primary adjusting screw (15) to obtain the calculated flow (b) at full system pressure.
16. Set compensator adjustment to the required setting, or 6000 psi, 414 bar if not otherwise noted.

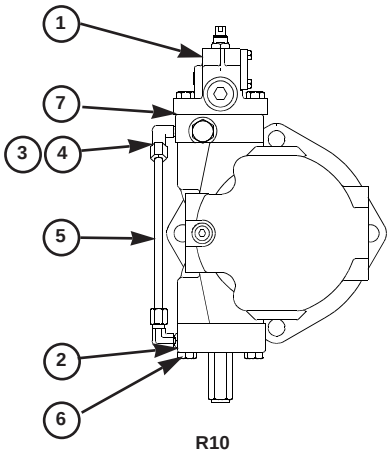
Note: Electric motor current may be used instead of calculated flows to set power. In step 14, set the outer adjusting screw (8) to achieve the rated motor current. In step 15, set the adjustment (15) to achieve the rated motor current.



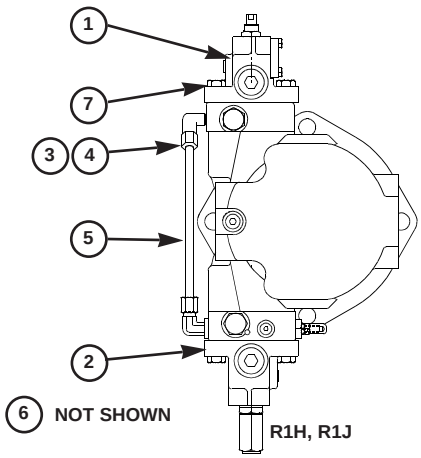


CCW ROTATION



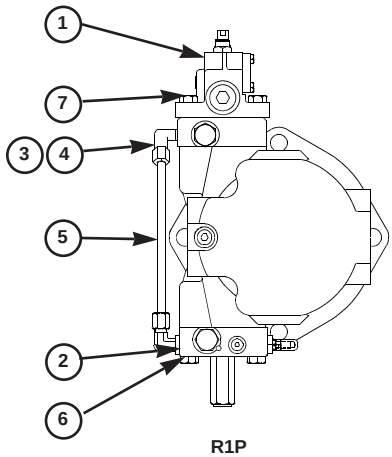


R10



R1H, R1J

CW ROTATION



R1P

NOT SHOWN 8 9 10 11 12

PARTS LIST

rotary servo

		P05	QUANTITY			
ITEM	DESCRIPTION	PART NO.	R10	R1J	R1K	R1P
1	Rotary Servo (Fig. 14)	S22-15403	1	1	1	1
2	Control Cap (Fig. 7)	S22-15325	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15405	—	1	—	—
	High Torque Override	S22-15630	—	—	1	—
	Comp. Override (Fig. 10)	S22-15404	—	—	—	1
3	O-Ring, 90 S-1 ARP 906	691-00906	2	2	2	2
4	Elbow	492-15017	2	2	2	2
5	Tube, CW	032-91864	1	1	1	1
	Tube, CCW	032-92049				
*6	Screw-H.H.C., M12 x 55 mm	363-12205	6	4	4	6
*7	Screw-H.H.C., M12 x 75 mm	363-12220	2	4	4	2
8	Control Piston	032-91785	1	1	1	1
9	O-Ring, 70 S-1 ARP 013	671-00013	2	2	2	2
10	O-Ring, 70 S-1 ARP 151	671-00151	2	2	2	2
11	Piston Ring	032-91816	1	1	1	1
12	Piston Ring	032-91811	1	1	1	1

*Included in items 1, 2

ROTARY SERVO DISASSEMBLY

1. **See Figure 14.** Remove 2 screws holding body (16) to cap assembly (1).
2. Remove all parts from body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.
3. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.
4. **See Figure 6.** Remove tube lines to cap assembly.
5. Remove screws holding cap assembly to pump body.
6. Remove cap assembly (1). Remove plug (4) with attached parts. Remove spring (11) and spool (6).
7. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).
8. Remove screw (13) and nut (14). Remove the retainer (7).

ASSEMBLY

1. **See Figure 6.** Install Avseal plug (9) in cap.
2. Install spool (6) into bore as shown. Install spring (11) over end of spool.
3. Install O-ring (8) on spring retainer (7). Install retainer (7), screw (13) and nut (14) in plug (4).
4. Install O-ring (15) in bottom of bore as shown. Install O-ring (10) on plug (4). Install plugs (4) and (12) in body (1). Torque plugs to 90 ft-lb, 122 Nm. Install O-ring (18) in cap.
5. Turn screw (13) in until spring retainer (7) contacts spring (11). Turn an additional 1-1/2 turns and lock in position.
6. Note proper location for control on pump. Install O-rings on interface between cap and pump control pad. Install cap on pump control pad, guiding the control piston into the bore.
7. Install and torque two assembly bolts to 75 ft-lb, 102 Nm.
8. **See Figure 14,** Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 ft-lb, 6,8 Nm.
9. Install minimum stop screw (24) and turn clockwise to stroke pump to full stroke. Measure height from control cap to top of screw (3). With control piston at full stroke, dimension must be 19,2 +/- 0,76 mm. Back out minimum stop screw (24) till there is no contact with control piston, and pump is at zero stroke..
10. Press dowel (30) into body (16), through the link (28), to 1/4 in. (6.35 mm) below surface. Apply Loctite hydraulic sealant to threads of screws (39) and install over dowel (30).
11. Press spool (21) into retainer (19). Caution: do not use excessive force.
12. While sleeve (27) is engaged into dowel on link (28), slide above spool assembly with spring (15) into bore of body (16), and through sleeve (27). Spool (21) must move freely and easily at all positions of the link (28).
13. Press dowel (34) through slide pin (14), while inside shaft (10). Dowel (34) must evenly extend from both sides of slide pin (14).
14. Assemble all other components into body (16) per figure 14. Torque plug (12) to 90 ft-lb, 122 Nm.
15. While spring retainer is engaging clevis pin (5) under dowel of link (28), slide the other opening of spring retainer over the top of the screw (3). Attach body assembly (16) to cap (1) with two screws and torque to 102 Nm.

TEST AND ADJUSTMENT

1. Plumb 1200 psi, 82,8 bar servo supply to port “X”.
2. Thread zero screw (24) so that pump is on stroke.
3. Start pump.
4. With shaft (10) rotated fully clockwise, thread cam (9) until output flow is at the full stroke position. Lock in place.
5. Fully rotate shaft (10) counter-clockwise. Pump flow should go towards zero stroke. Back out zero screw (24) until pump is at zero stroke. Lock in place.
6. If pump fails to go towards full stroke, or fails to go towards zero stroke, differential pressure may be improperly adjusted. Re-adjust the screw (13 figure 6) *out* to go towards full or *in* to go towards zero flow. When correct, lock in place and install cap on differential adjustment.
7. Rotate shaft clockwise and counterclockwise at approximately 500, 3000 and 6000 psi (34,5 bar, 207 bar and 414 bar) system pressure. Pump stroke should follow shaft rotation between full and zero stroke smoothly and proportionally. Full to zero or zero to full stroke should be achieved in no more than 0,7 second.

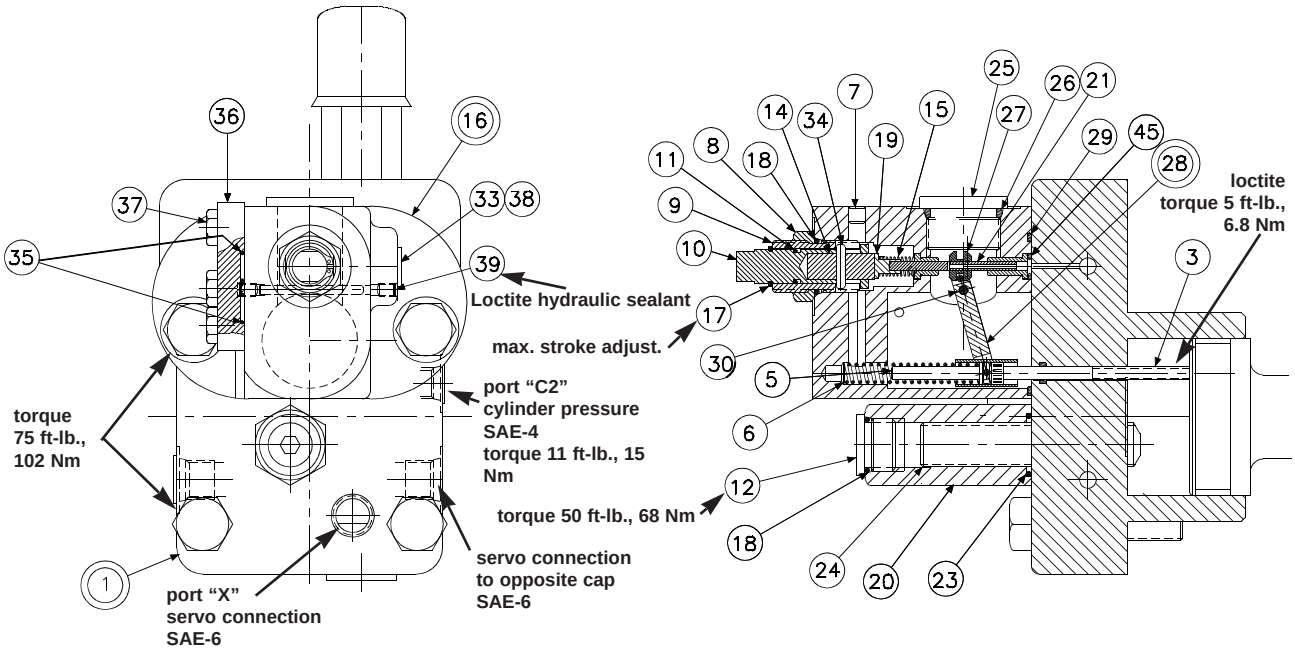
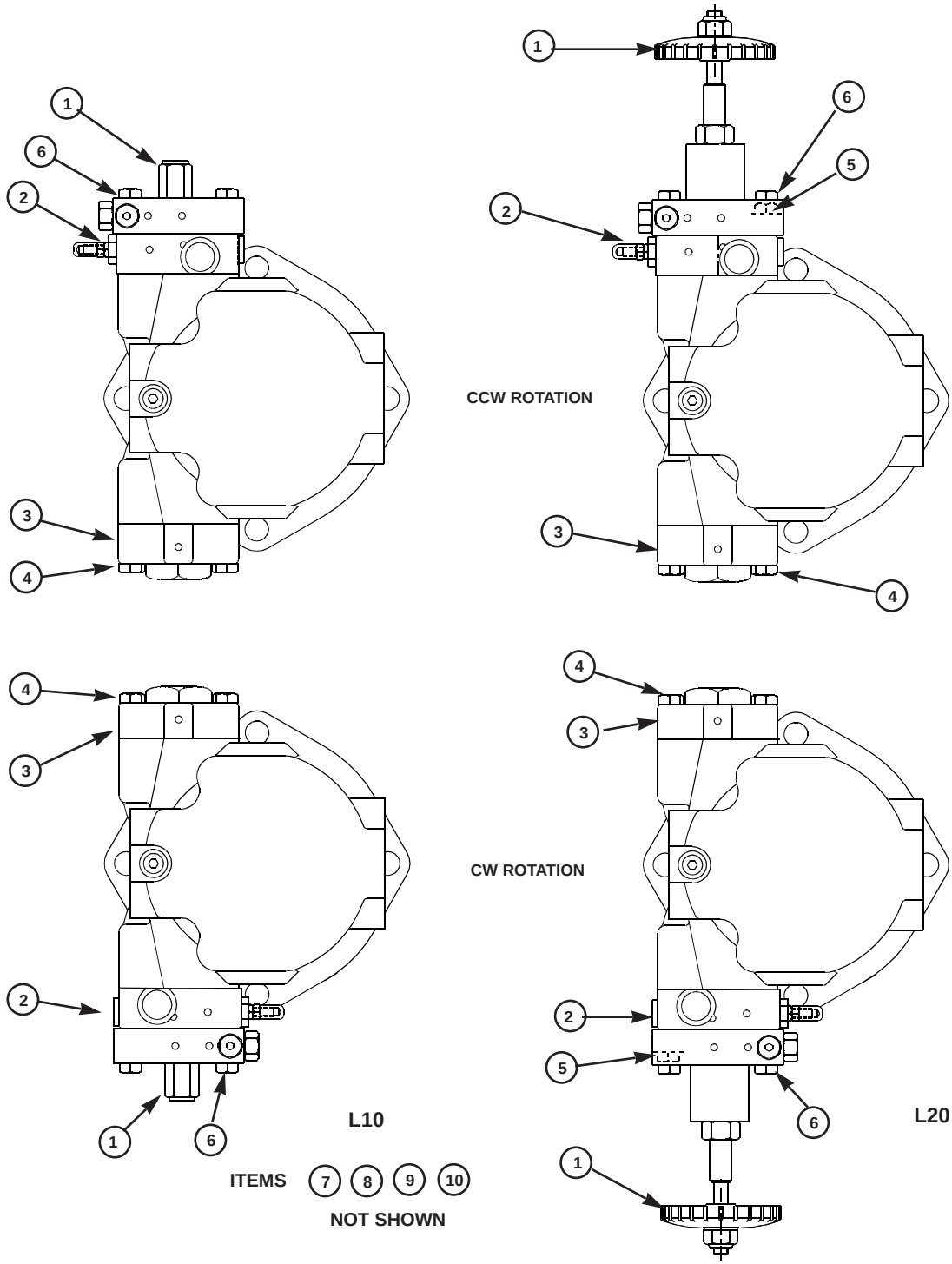


FIGURE 14
ROTARY SERVO

PARTS LIST FOR FIGURE 14

Assembly No.. S22-15403

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15327	1
3	Screw	032-91461	1
5	Pin, Clevis	321-40000	1
6	Spring, Compression	032-92100	1
7	Plug, Avseal	447-00026	1
8	Locknut 8-LSN-S	492-15116	1
9	Cam	032-91515	1
10	Shaft	032-91514	1
11	O-Ring, 90 S-1 ARP 012	691-00012	1
12	Plug, 8HP5N-S	488-35018	1
14	Slide Pin	032-91513	1
15	Spring	225-92105	1
16	Body	S22-15393	1
17	Retaining Ring	356-31050	1
18	O-Ring, 90 S-1 ARP 908	691-00908	2
19	Spring Retainer	032-91516	1
20	Nut	032-91822	1
21	Spool	032-91438	1
23	O-Ring, 70 S-1 ARP 115	671-00115	1
24	Soc. Setscrew, M16 -2 x 80mm	311-50001	1
25	Plug, 12 HP5N-S	488-35014	1
26	O-Ring, 90 S-1 ARP 912	691-00912	1
27	Sleeve	032-91437	1
28	Arm assembly	S22-15520	1
29	O-Ring, 70 S-1 ARP 035	671-00035	1
30	Dowel Pin, 1/8 Dia x 1.50 Lg.	324-20824	1
33	O-Ring, 70 S-1 ARP 904	671-00904	1
34	Dowel Pin, 1/8 x 5/8	324-20810	1
35	O-Ring, 70 S-1 ARP 011	671-00011	2
36	Plate	032-91510	1
37	Screw, HHC,1/4-20 x 3/4	306-40142	3
38	Plug, SAE-4	488-35061	1
39	Screw, SHC 10-32 x 1/4	312-09041	2
45	O-ring, 70 S-1 ARP 010	671 00010	1



LOAD SENSING CONTROL
parts list

ITEM	DESCRIPTION	P05 PART NO.	QTY. L10	QTY. L20
1	Max. Vol. Stop (Fig. 1)	S22-15467	1	—
	Max Vol. Handwheel (Fig. 2)	S22-15448	—	1
*2	Load Sensing Control (Fig. 15)	*S22-15402	1	—
	Load Sensing Control	*S22-15628	—	1
3	Buck Up Cap (Fig. 4)	S22-15447	1	1
4	Screw-H.H.C., M12 x 55 mm	363-12205	6	4
5	Screw-H.H.C., M12 x 75 mm	363-12220	—	2
6	Screw-H.H.C., M12 x 85 mm	363-12233	2	2
7	Control Piston	032-91836	1	1
8	O-Ring, 70 S-1 ARP 013	671-00013	2	2
9	O-Ring, 70 S-1 ARP 151	671-00151	2	2
10	Piston Ring	032-91816	2	2

*Includes items 1, 4, 5, 6

LOAD SENSING CONTROL DISASSEMBLY

1. **See Figure 15** Back off max. volume screw to full displacement. Remove max. volume screw assembly.
2. Remove bolts holding cap to pump.
3. Remove isolation valve (29) from block (28). Remove plug (15) and attached parts. Remove spring (11) and spool (18).
4. Remove adj. plug (2) and attached parts. Remove seal piston (5). Note: a 10-24 screw may be used to assist in pulling the piston. Remove spring (7) and cone (8).
5. Do not remove sleeve in body (1). Sleeve is pressed into cap and finished to size. If sleeve or cap is worn, replace the cap-sleeve assembly (1).
6. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

1. Install Avseal plugs (9) and orifice (19) in body.
2. Press seat (10) into bore squarely against shoulder in bore.
3. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal piston (16). Lubricate and install into plug (15). Install O-ring (14 in bore as shown. Install O-ring (13) on plug (15) and install plug into cap. Install screw (3) and nut (4). Cap (17) will be installed after test and final adjustment.
4. Install O-ring (6) on seal piston (5).
5. Lubricate O-ring and install cone (8), spring (7) and seal piston into bore in cap (1), being careful that cone enters seat (10). Install remaining parts in body (1). Torque plug (12) to 90 ft-lb.,122 Nm. Torque plug (21) to 50 ft-lb., 68 Nm.
6. Install O-rings (29-a) and (29-b) on valve (29). Observe that backup ring on inside groove is toward the outside, the one on the middle groove is toward the inside, and the one on the outside groove is toward the outside. Lubricate and install valve (29) in block (28), being careful to avoid damaging the O-rings. Torque to 50 ft-lb., 68 Nm.
7. Note proper location for cap on pump. Install O-rings on interface between cap and pump control pad. Install O-rings (26) in block (28).
8. Install block (28) on cover (1) with M24 x 85 mm lg mounting bolts. Install on pump control pad, guiding the control piston into the bore.
9. Install maximum volume stop. Torque mounting bolts to 75 ft-lb., 102 Nm.

TEST AND ADJUSTMENT

Connect pump to a circuit with system flow metered by a needle valve or suitable metering valve. Connect load sensing line from downstream of the metering valve to load sensing port “LS”. Connect gage to pump output, and to load sensing line, capable of measuring 300 psi, 20,7 bar pressure difference at 5000 psi, 345 bar.

Connect a relief valve downstream of the metering valve, and a flowmeter to measure pump flow.

1. Adjust maximum volume stop to full displacement by backing off stop till there is no contact with the control piston.
2. Turn compensator adjustment screw (25) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.
3. Turn differential adjustment screw (3) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.
4. Open metering valve and set relief valve at 500 psi, 35 bar.
5. Start prime mover. Pump should be at full displacement at 500 psi, 35 bar.
6. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 1500 psi, 103 bar.
7. Close the metering valve. Check the pressure difference from pump output to load sensing line. Using the differential adjustment, set this pressure difference to 350 ± 25 psi, 24 ± 1,7 bar or shop order requirement.
8. Set the compensator to 3000 psi, 207 bar, and 5000 psi, 345 bar. At each condition, increase the system pressure until the pump fully de-strokes. At no time should the system pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
9. Open the metering valve till pump reaches full flow at 1000 psi, 69 bar. Reduce flow by 10 gpm, 38 L/m. Raise the relief valve setting till the pump compensates at 5000 psi, 345 bar. Reduce relief valve setting 200 psi, 14 bar. Flow to return to previous value ± 2 gpm, 7,6 L/m.
10. Check pressure differential at1000, 2000, and 3000 psi ±100 psi (69, 138, and 207 bar ± 6,9 bar). Pressure differential to remain the same as in (7) above.
11. Set the flow to 10 gpm, 38 l/m at 1000 psi, 69 bar. Observe flow as pressure is varied from 500 psi to 4800 psi (34.5 bar to 331 bar). Flow shall not vary by more than ±2 gpm, 7.6 l/m.
12. Set load relief valve at 2000 psi,138 bar. Check pressure differential at 10 and 30 gpm ±2 gpm (38 and 114 ± 7,6 l/m). Pressure differential shall be the same as in (7) above.
13. Set compensator adjustment to the required setting, or 5000 psi, 345 bar if not otherwise noted. Install cap on differential adjustment.

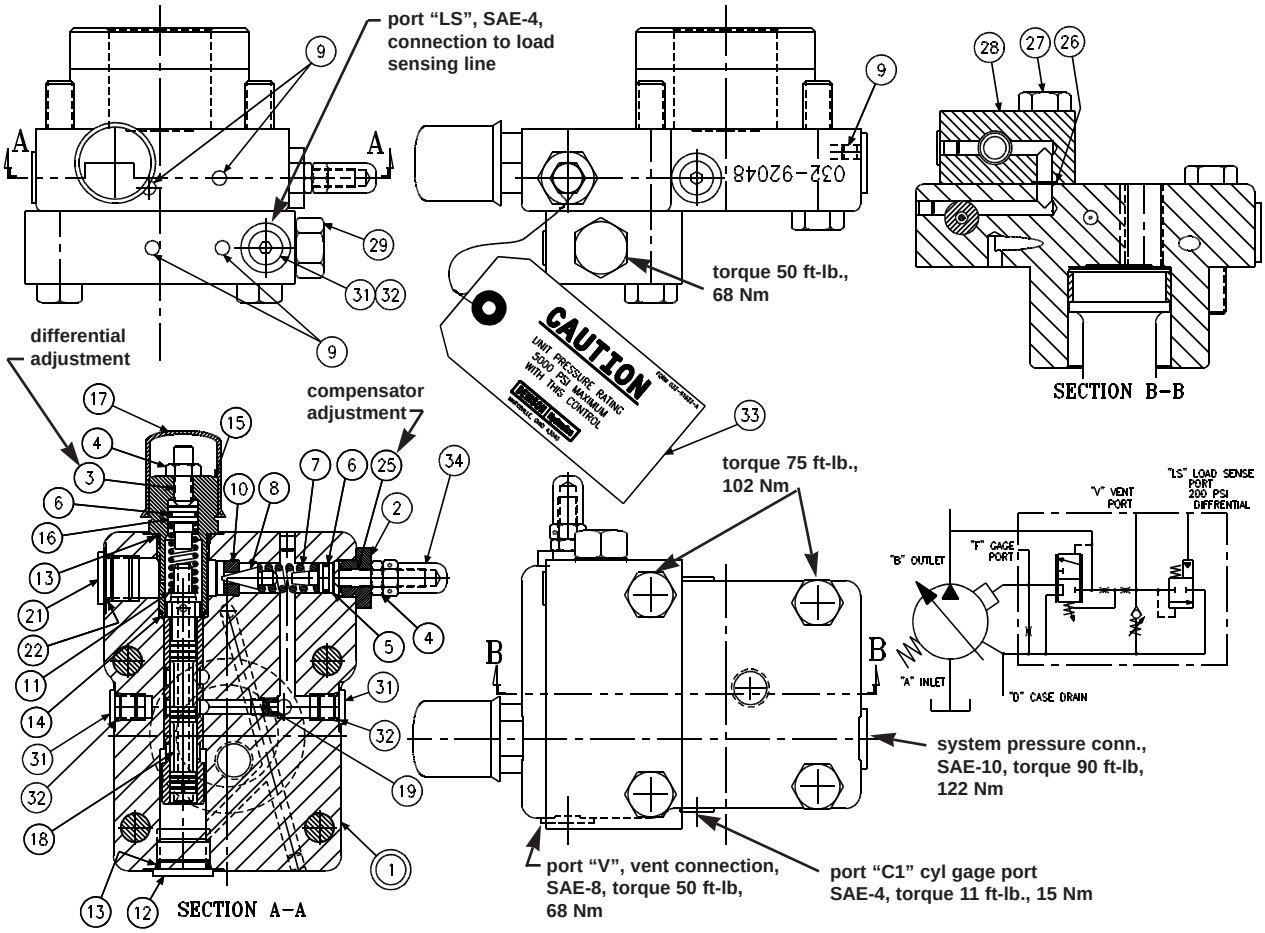
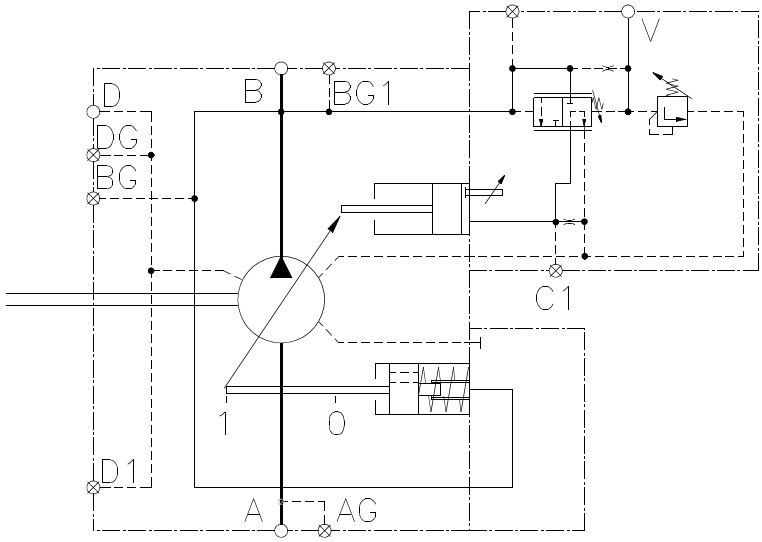


FIGURE 15
LOAD SENSING CONTROL

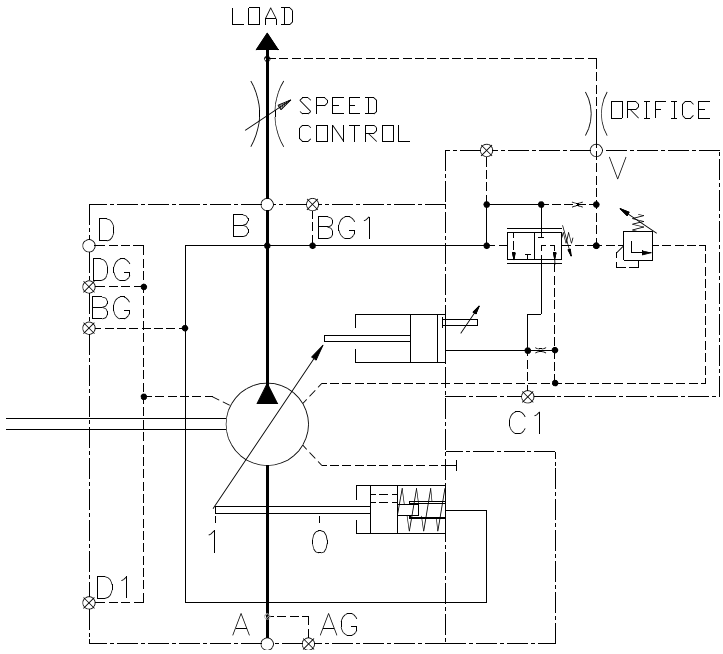
PARTS LIST FOR FIGURE 15
Code L10, S22-15402
Code L20, S22-15628

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15409	1
2	Adj. Plug	032-91814	1
3	Soc. Setscrew	312-13160	1
4	Nut, 5/16-24	335-13100	2
5	Seal Piston	031-59367	1
6	O-Ring, 90 S-1 ARP 012	691-00012	2
7	Spring	032-91798	1
8	Cone	036-12288	1
9	Avseal Plug	447-00026	5
10	Seat	036-11692	1
11	Spring	033-71086	1
12	Plug SAE-10	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	2
14	O-Ring, 90 S-1 ARP 017	691-00017	1
15	Plug	031-57368	1
16	Seal Piston	032-91305	1
17	Cap	449-00612	1
18	Spool	032-59482	1
19	Orifice Plug	033-25528	1
21	Plug, SAE-8	488-35018	1
22	O-ring, 90 S-1 ARP 908	691-00908	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	O-Ring, 70 S-1 ARP 011	671-00011	2
28	Body-Valve	032-91620	1
29	Isolation Valve	517-00063	1
29-A	O-Ring 90 S-1 ARP 017	691-00017	2
29-B	O-Ring 90 S-1 ARP 015	691-00015	1
31	Plug, SAE-4	488-35061	3
32	O-Ring, 90 S-1 ARP 904	691-00904	3
33	Tag, Caution	032-91622	1
34	Nut, Acorn	036-33474	1

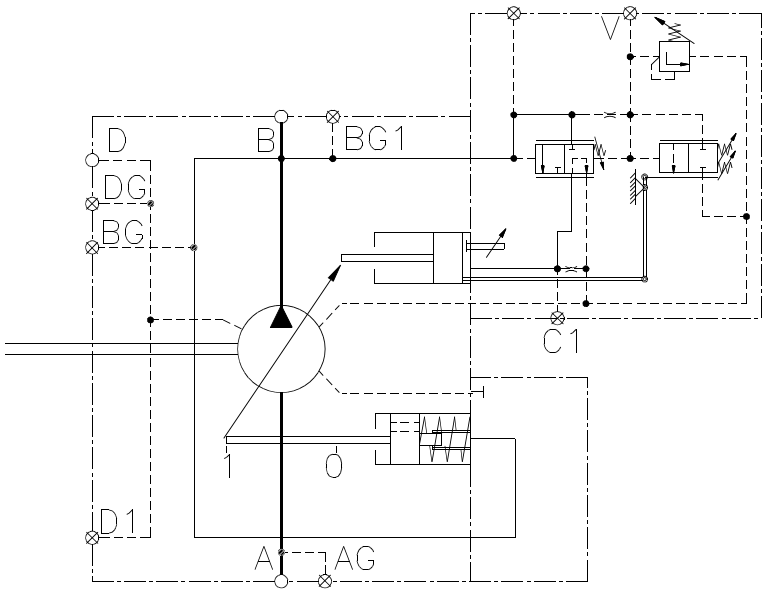
HYDRAULIC CIRCUIT PRESSURE COMPENSATOR (C1O)



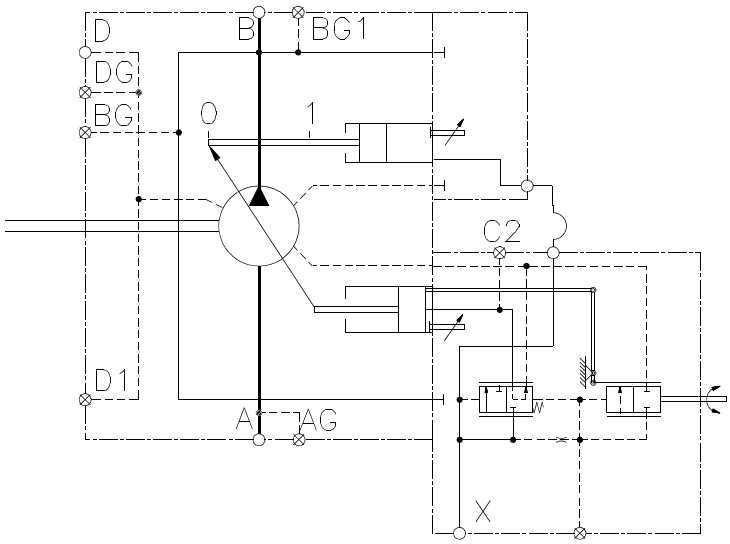
HYDRAULIC CIRCUIT PRESSURE COMPENSATOR, LOAD SENSING CONFIGURATION (C10)



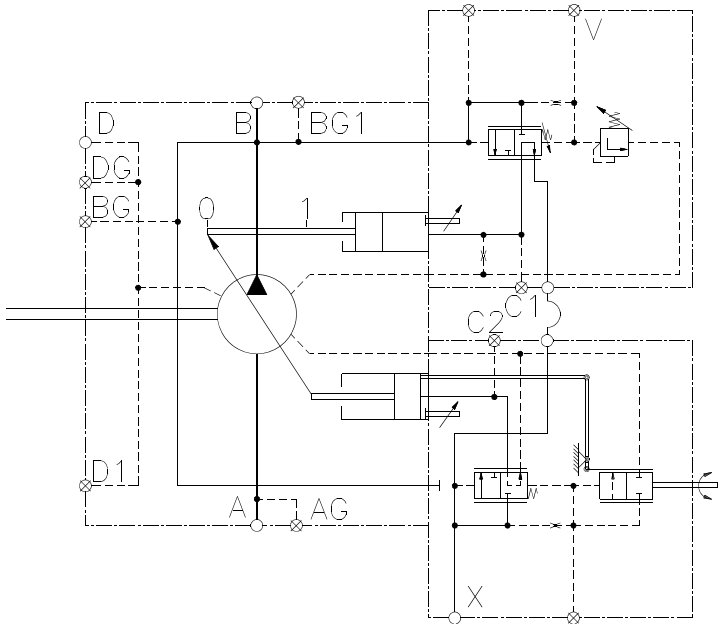
HYDRAULIC CIRCUIT TORQUE LIMITER (J10 & K10)



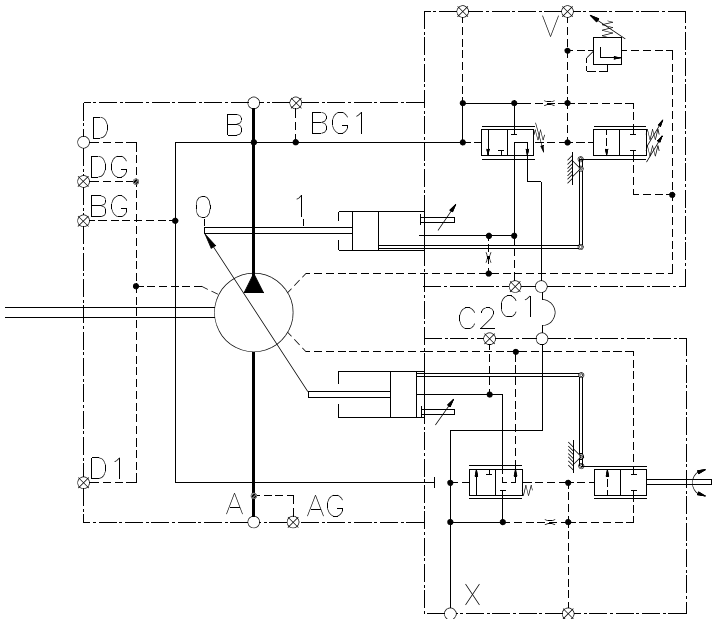
HYDRAULIC CIRCUIT
ROTARY SERVO
(R10)



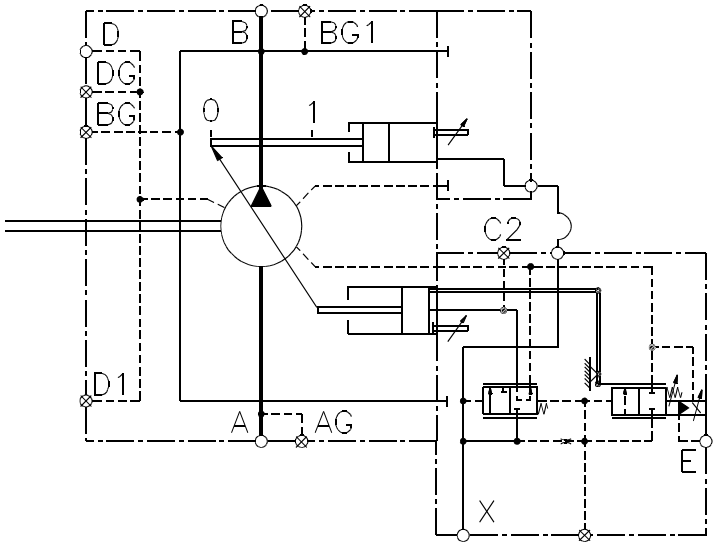
HYDRAULIC CIRCUIT
ROTARY SERVO WITH
COMPENSATOR OVERRIDE
(R1P)



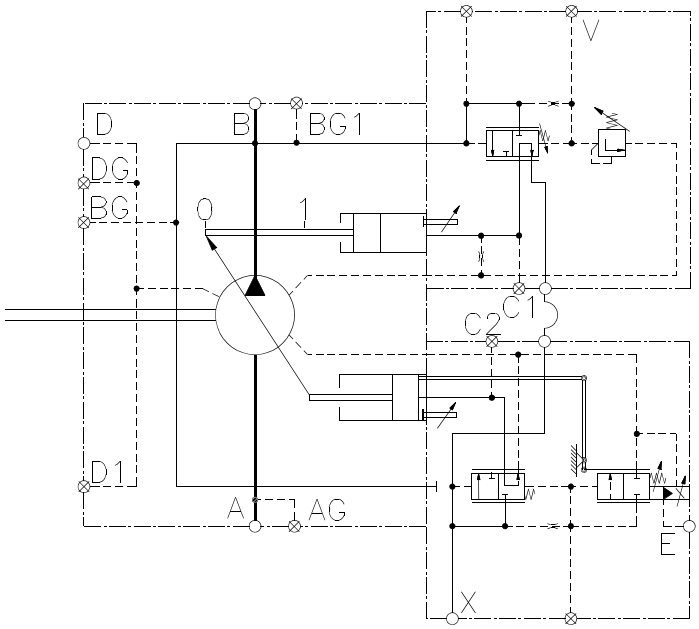
HYDRAULIC CIRCUIT
ROTARY SERVO WITH TORQUE
LIMITER OVERRIDE
(R1J & R1K)



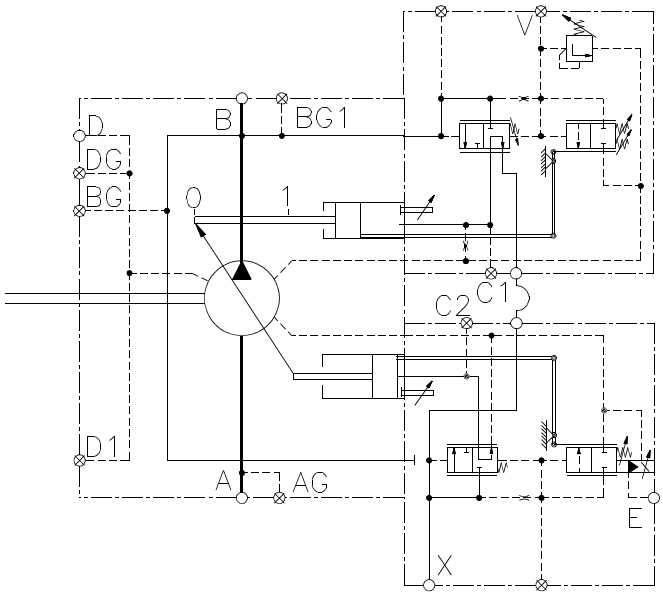
HYDRAULIC CIRCUIT ELECTRIC STROKER (E10)



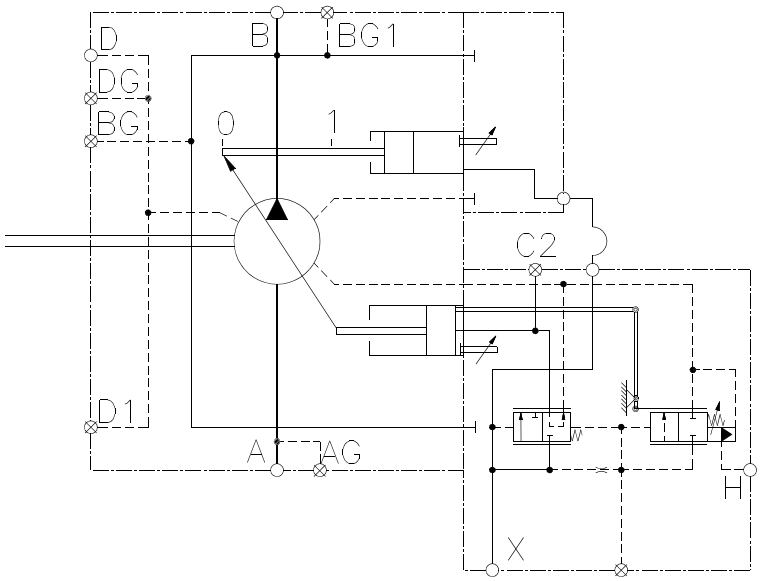
HYDRAULIC CIRCUIT ELECTRIC STROKER WITH COMPENSATOR OVERRIDE (E1P)



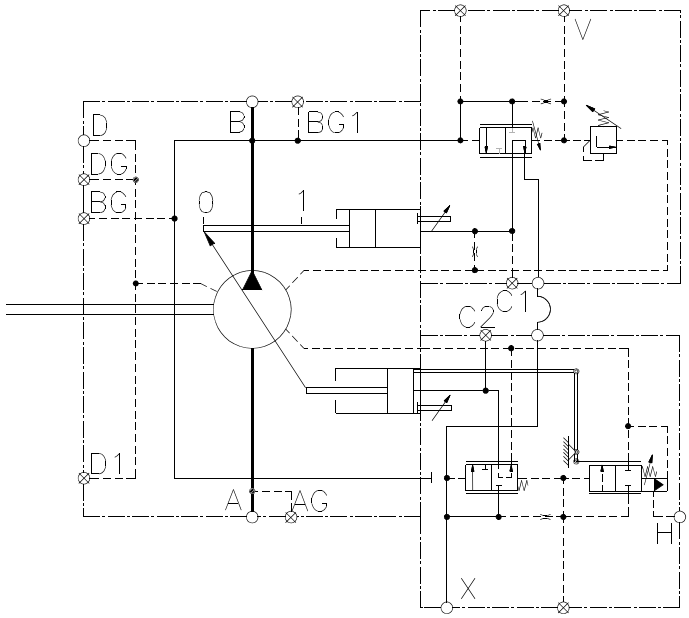
HYDRAULIC CIRCUIT ELECTRIC STROKER WITH TORQUE LIMITER OVERRIDE (E1J & E1K)



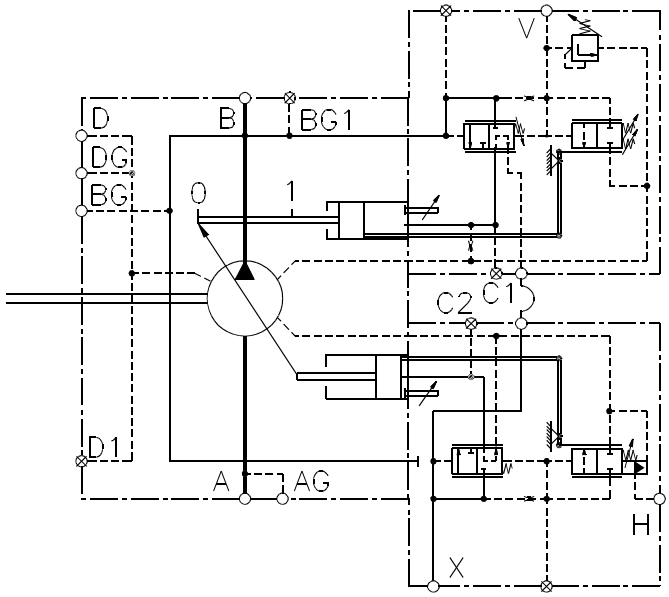
HYDRAULIC CIRCUIT
HYDRAULIC STROKER
(H10)



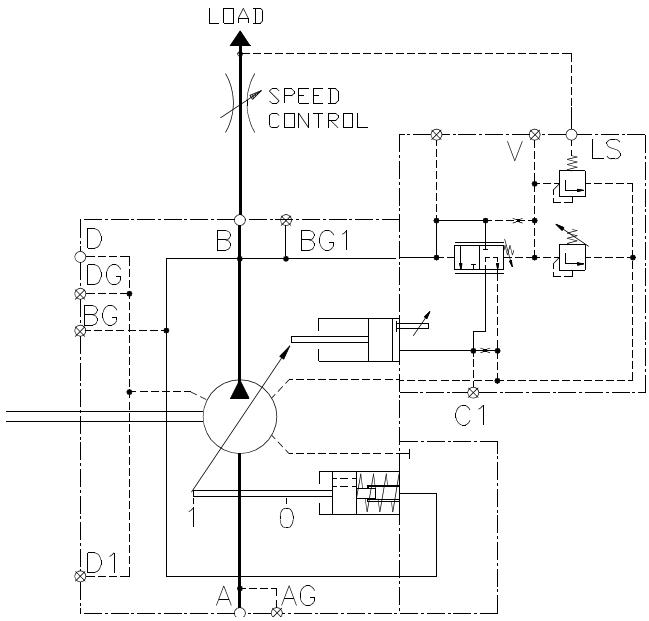
HYDRAULIC CIRCUIT
HYDRAULIC STROKER WITH
COMPENSATOR OVERRIDE
(H1P)



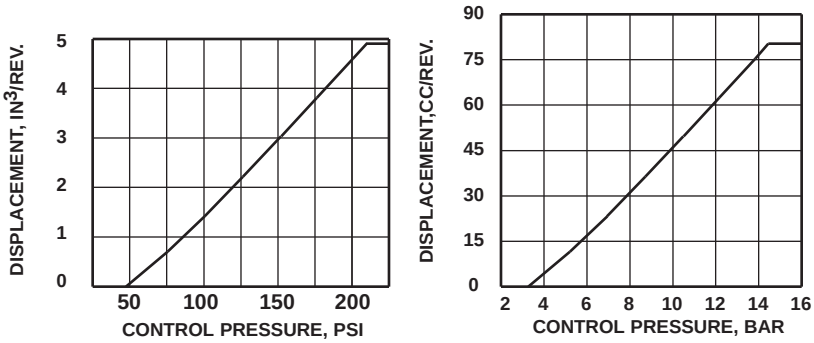
HYDRAULIC CIRCUIT
HYDRAULIC STROKER WITH
TORQUE LIMITER OVERRIDE
(H1J & H1K)



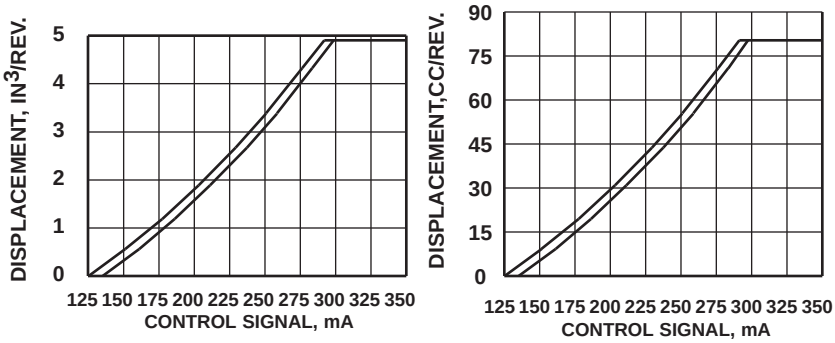
HYDRAULIC CIRCUIT LOAD SENSING CONTROL (L10)



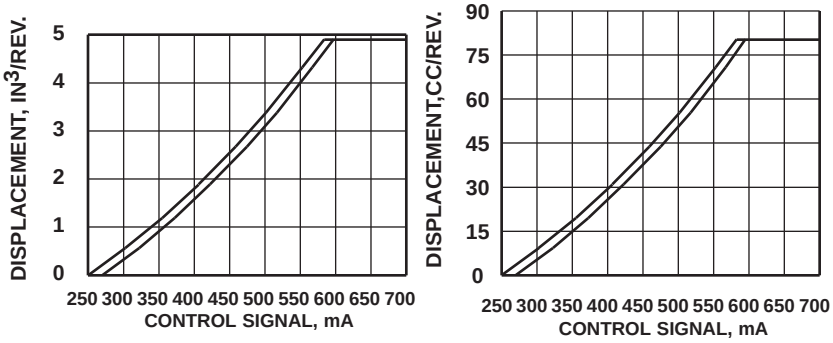
HYDRAULIC STROKER PERFORMANCE



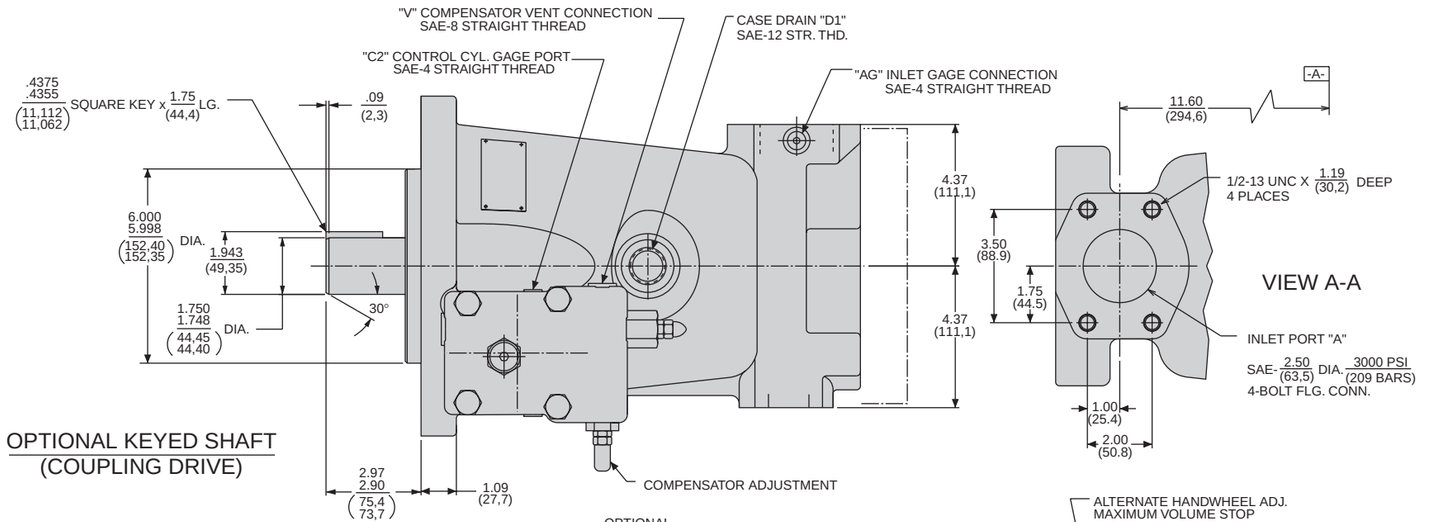
ELECTRIC STROKER PERFORMANCE, 24 V. COIL

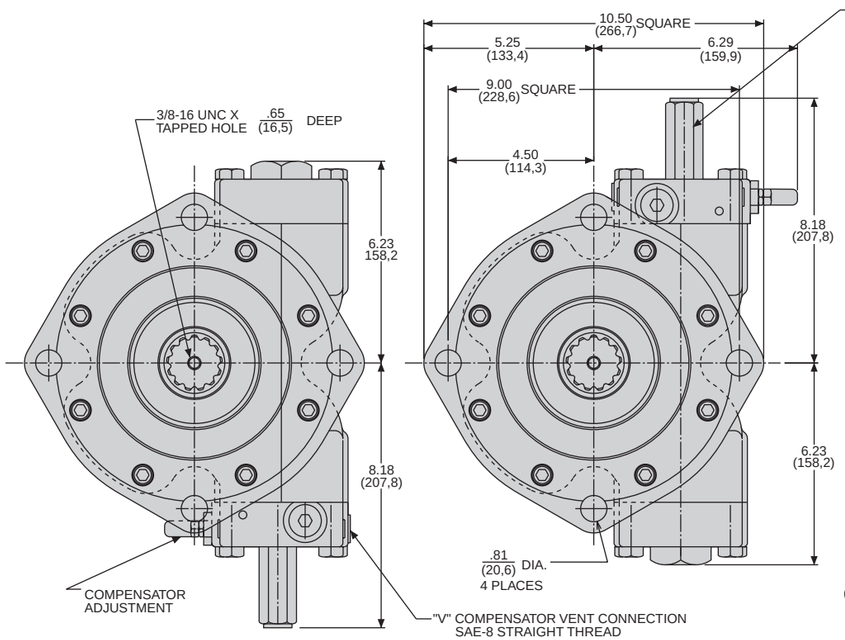


ELECTRIC STROKER PERFORMANCE, 12 V. COIL

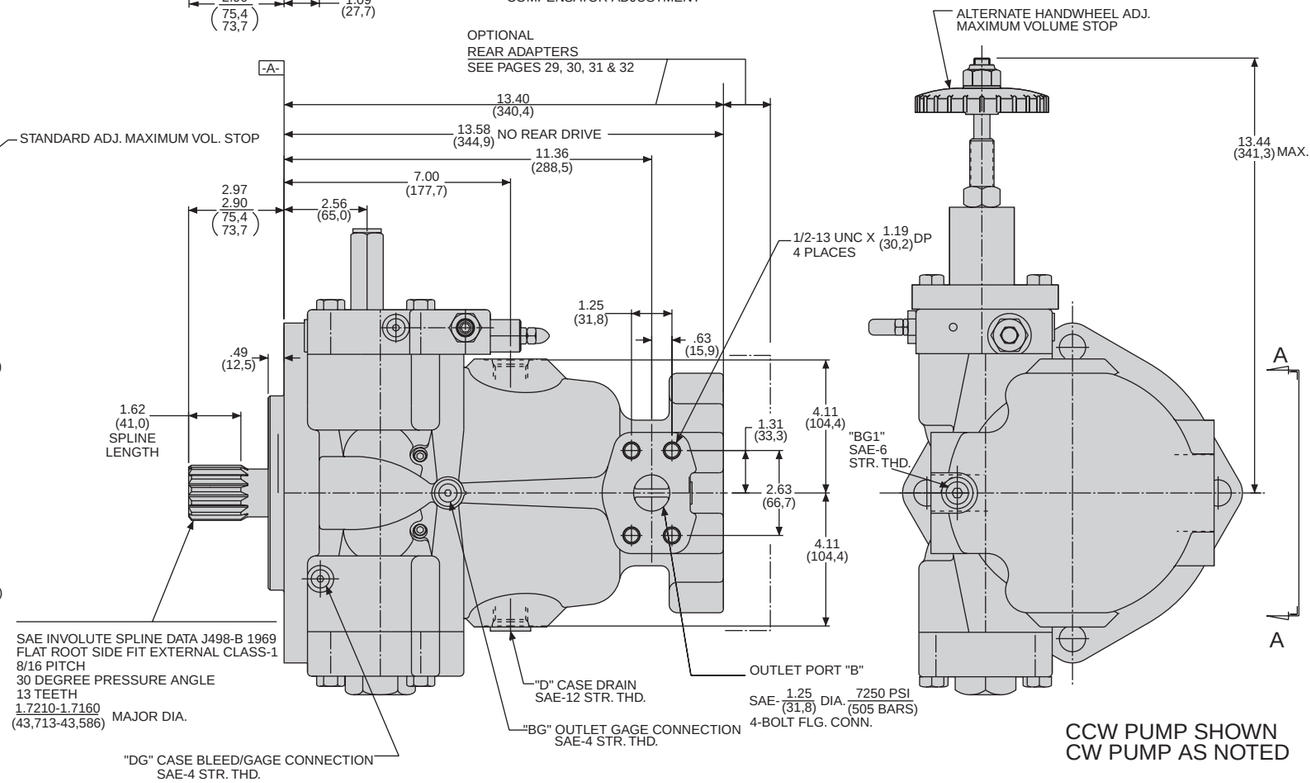


NOTES:
1. REFERENCE TO PUMP ROTATION, R-CW & L-CCW, IS AS VIEWED FROM SHAFT END.
2. DIMENSIONS IN PARENTHESIS ARE METRIC (SI UNITS).





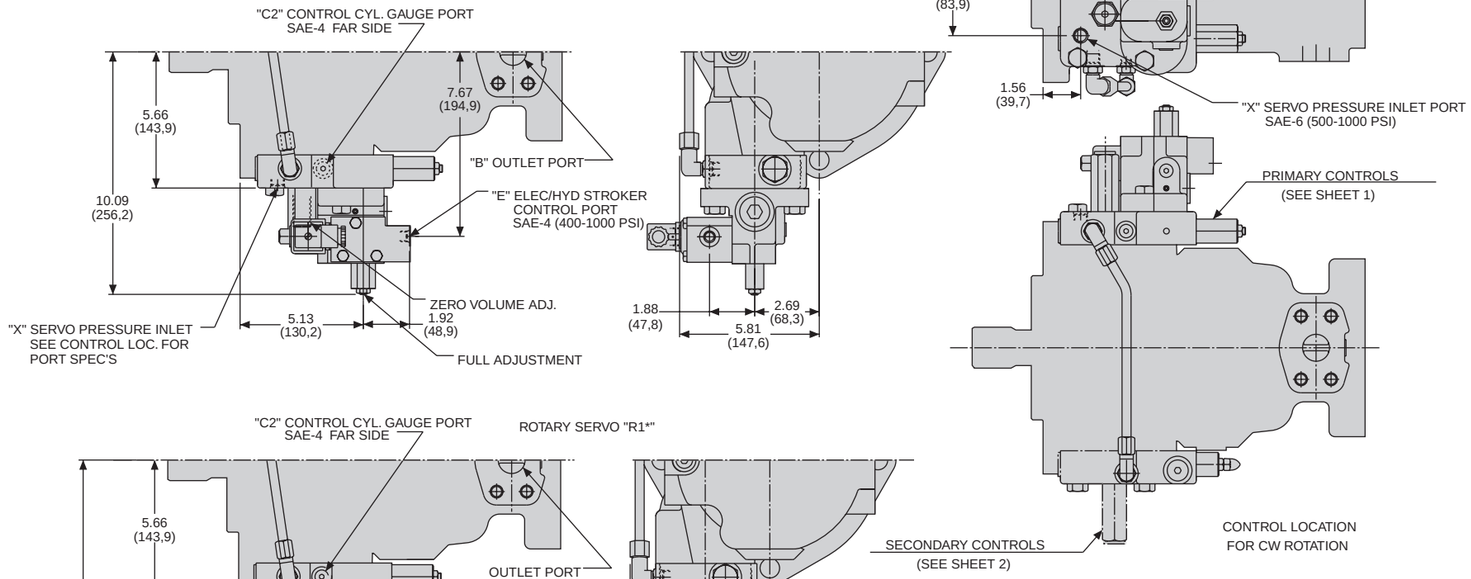
END VIEW
COMPENSATOR LOCATION
FOR CW PUMP ROTATION

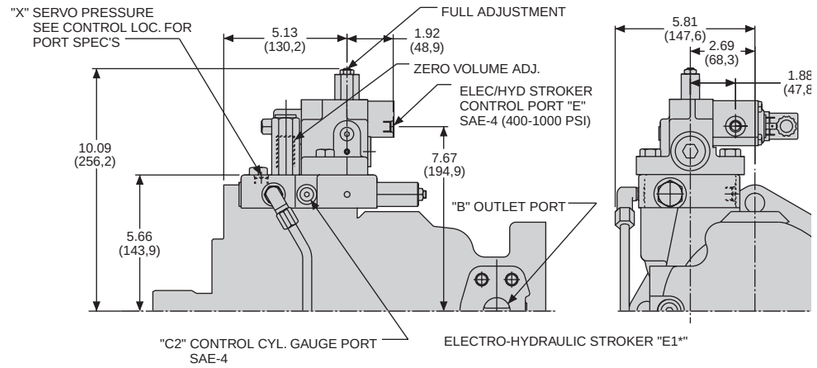


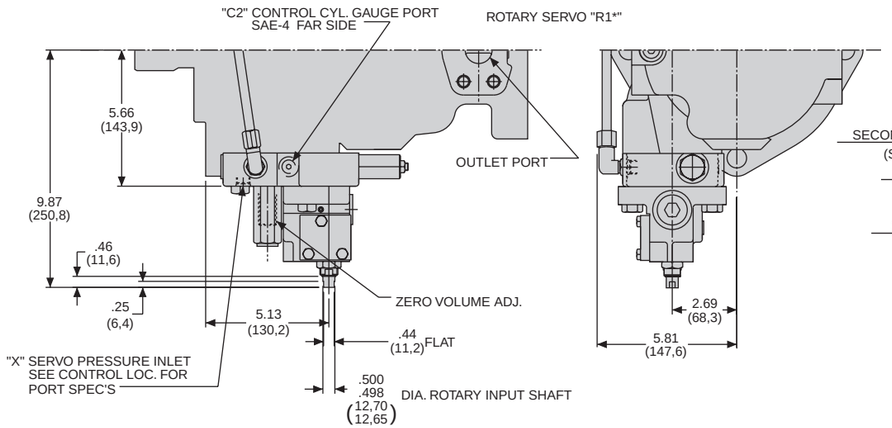
"C1" COMPENSATOR WITH ADJ. MAX. VOLUME SCREW STOP
or
"C2" COMPENSATOR WITH HANDWHEEL ADJ. MAX. VOLUME STOP

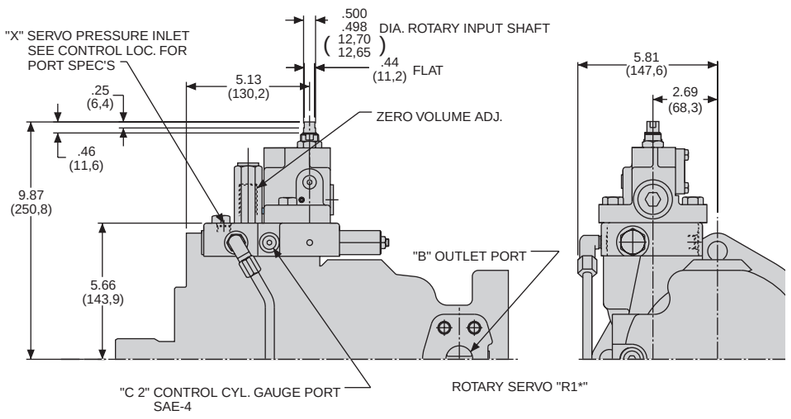
CCW PUMP SHOWN
CW PUMP AS NOTED

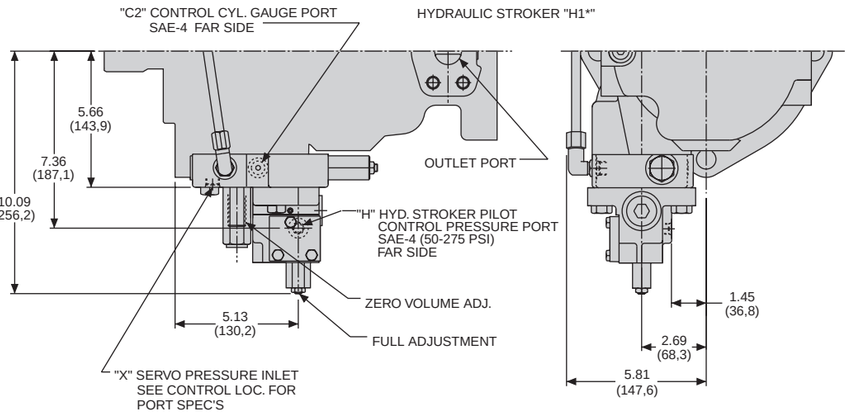
PRIMARY SERVO CONTROLS (CCW ROTATION SHOWN) ELECTRO-HYDRAULIC STROKER "E1*"

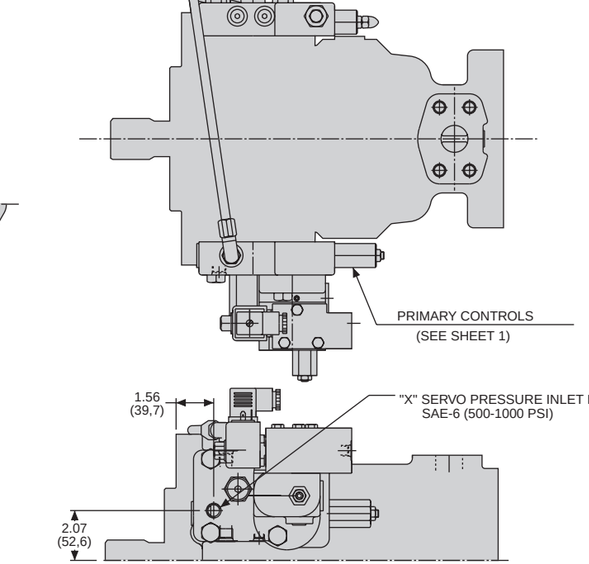


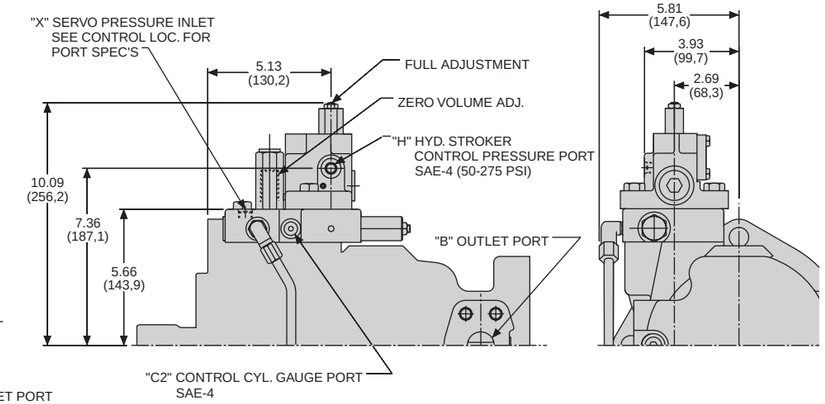




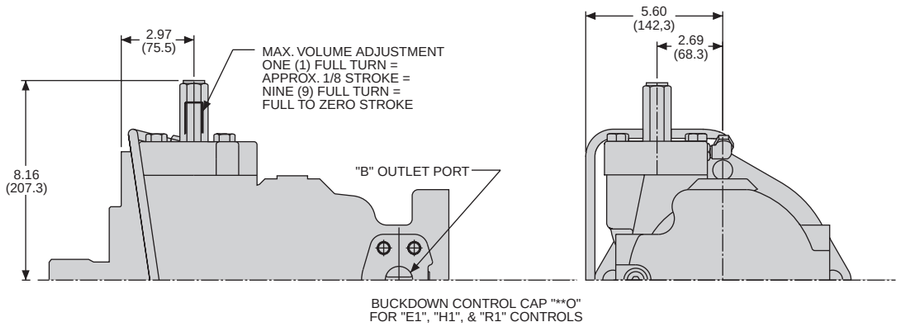




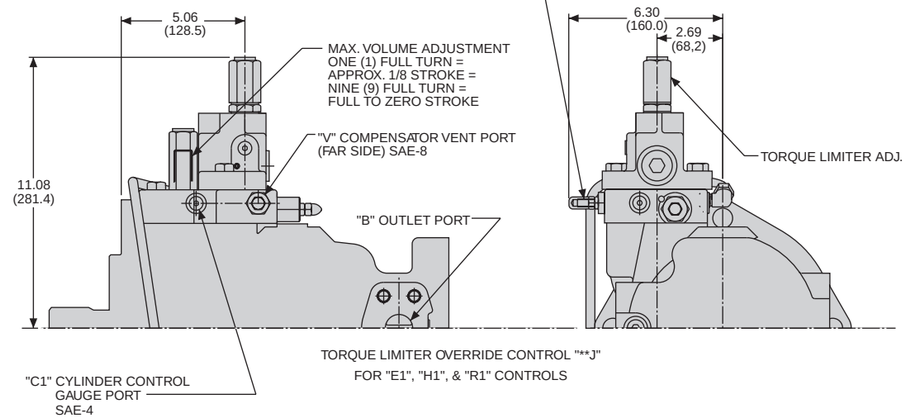




HYDRAULIC STROKER "H1*" PRIMARY SERVO CONTROLS (CW ROTATION SHOWN)

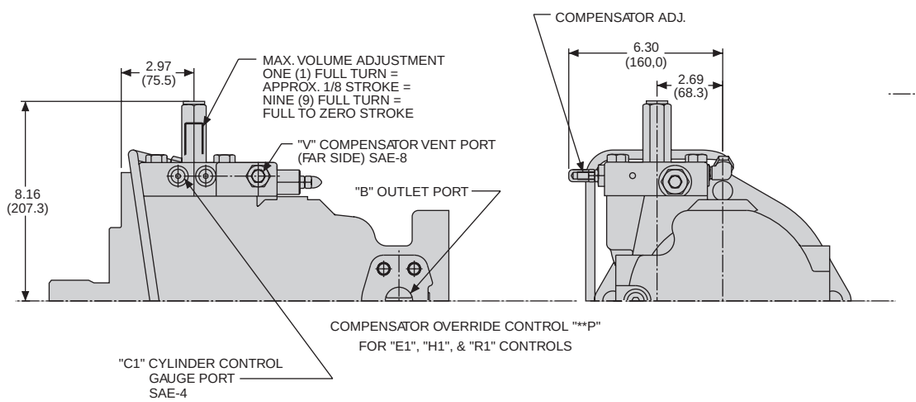


BUCKDOWN CONTROL CAP "**O"
FOR "E1", "H1", & "R1" CONTROLS



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

"C1" CYLINDER CONTROL
GAUGE PORT
SAE-4



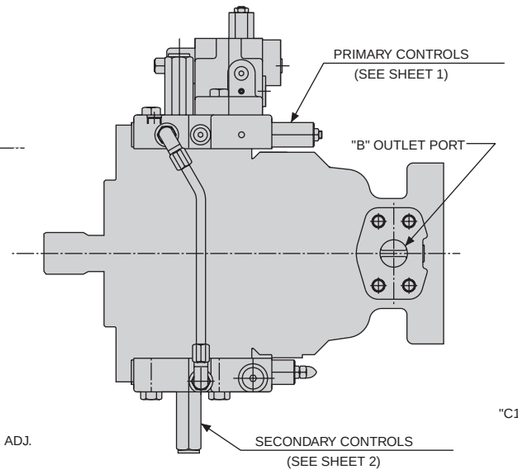
COMPENSATOR OVERRIDE CONTROL "**P"
FOR "E1", "H1", & "R1" CONTROLS

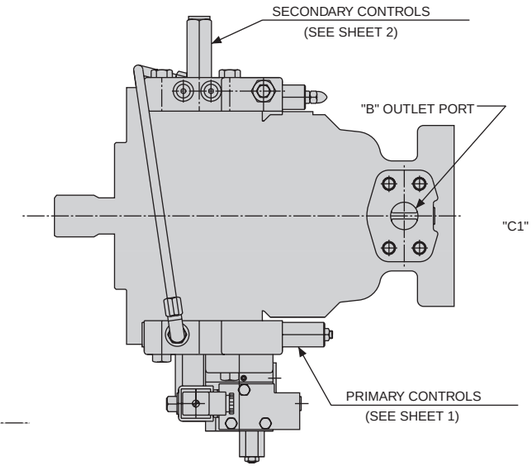
"C1" CYLINDER CONTROL
GAUGE PORT
SAE-4

SECONDARY SERVO CONTROLS

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

CONTROL LOCATION FOR CW ROTATION



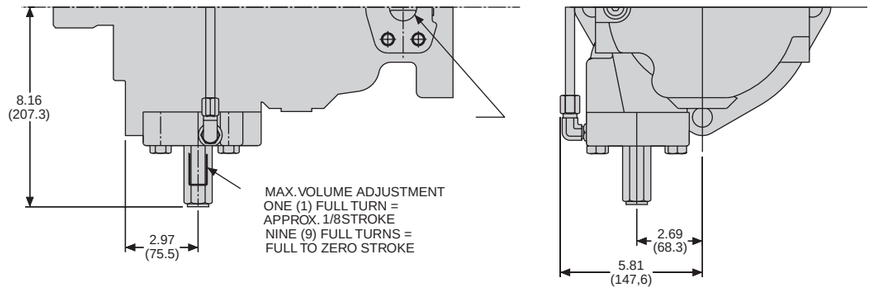


CONTROL LOCATION FOR CCW ROTATION

SECONDARY SERVO CONTROLS

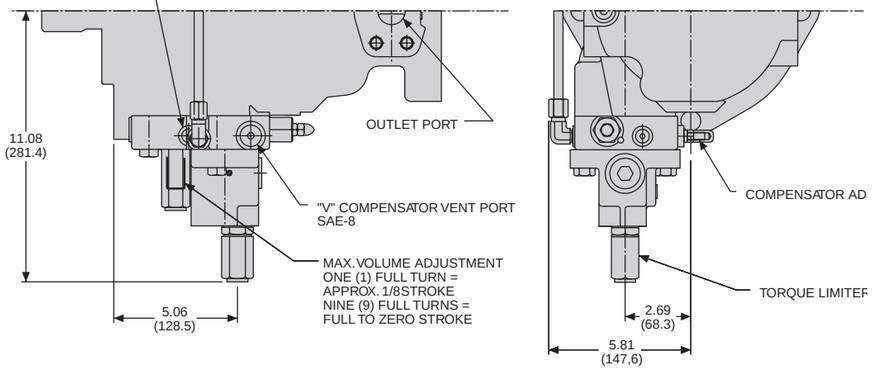
FOR "E", "H", & "R" PRIMARY CONTROLS
(CW ROTATION SHOWN)

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



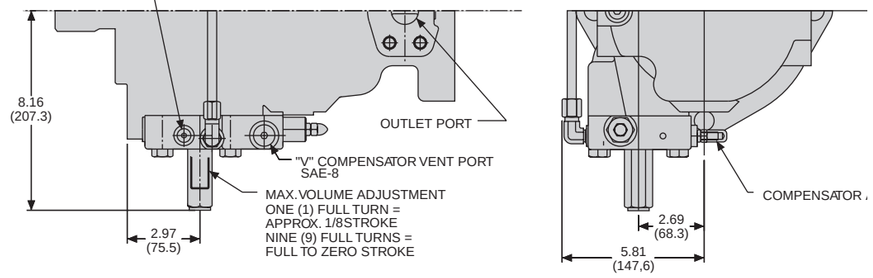
TORQUE LIMITER OVERRIDE CONTROL "**J"
FOR "E1", "H1", & "R1" CONTROLS

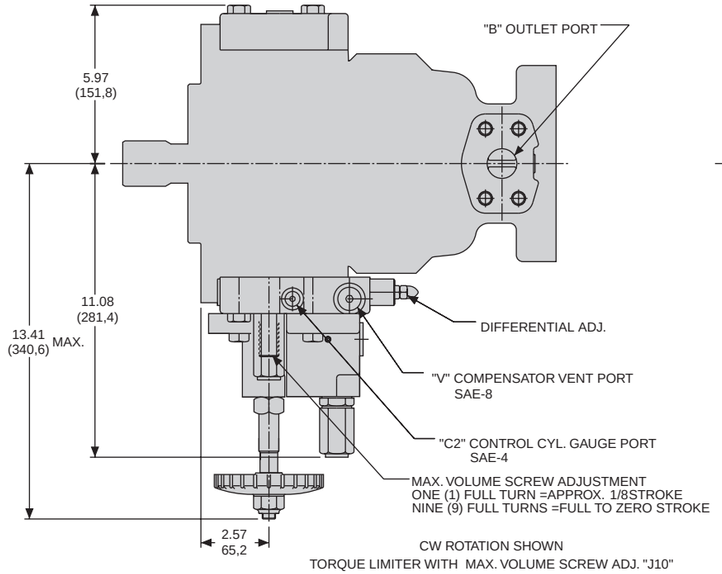
"C1" CYLINDER CONTROL
GAUGE PORT (FAR SIDE)
SAE-4



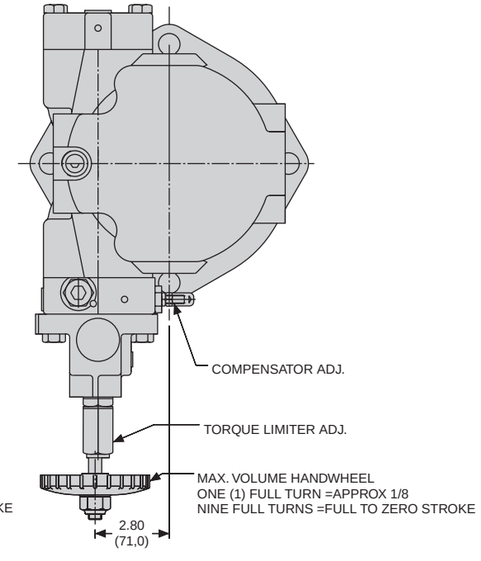
"C1" CYLINDER CONTROL
GAUGE PORT (FAR SIDE)
SAE-4

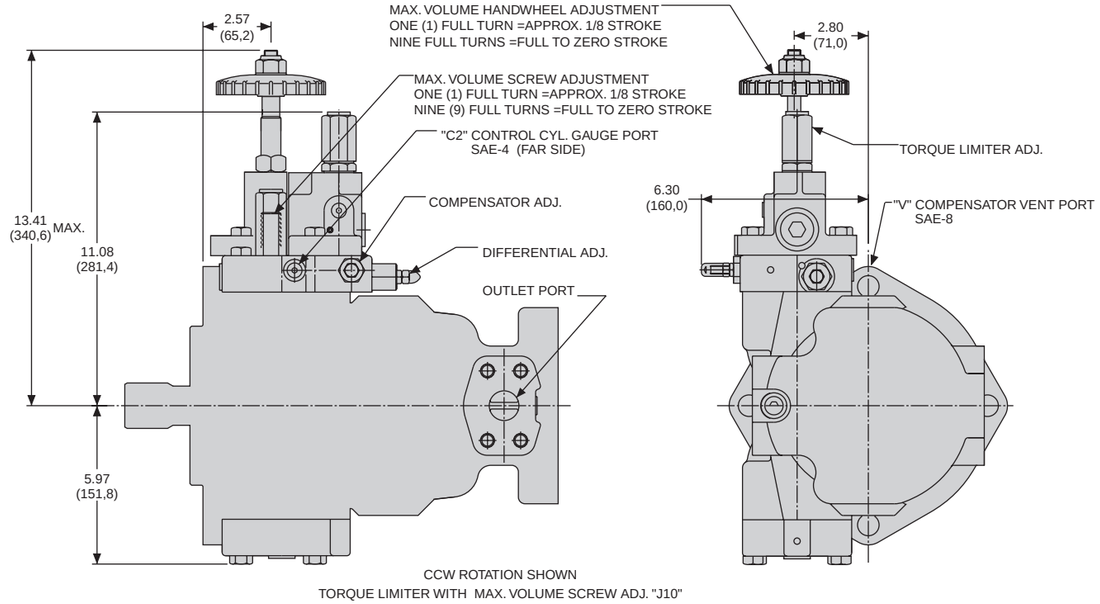
COMPENSATOR OVERRIDE CONTROL "**P"
FOR "E1", "H1", & "R1" CONTROLS



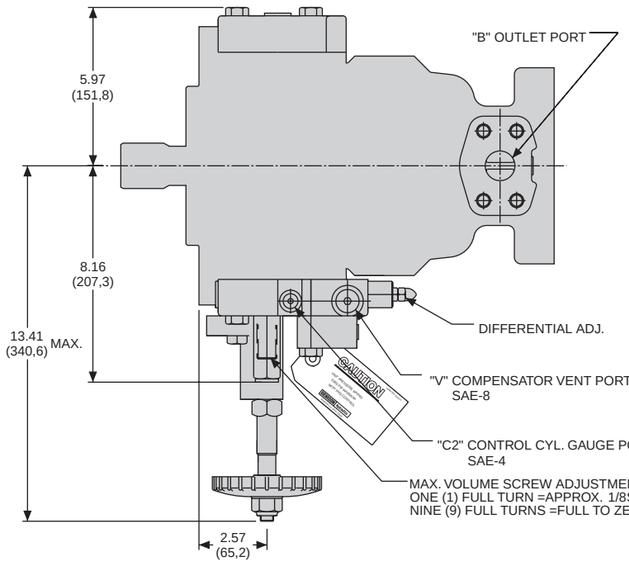


CW ROTATION SHOWN
TORQUE LIMITER WITH MAX. VOLUME SCREW ADJ. "J10"
AND
TORQUE LIMITER WITH HANDWHEEL MAX. VOLUME ADJ. "J20"

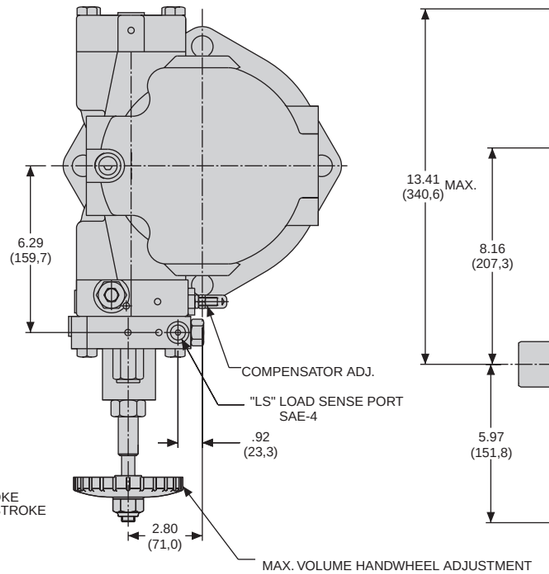


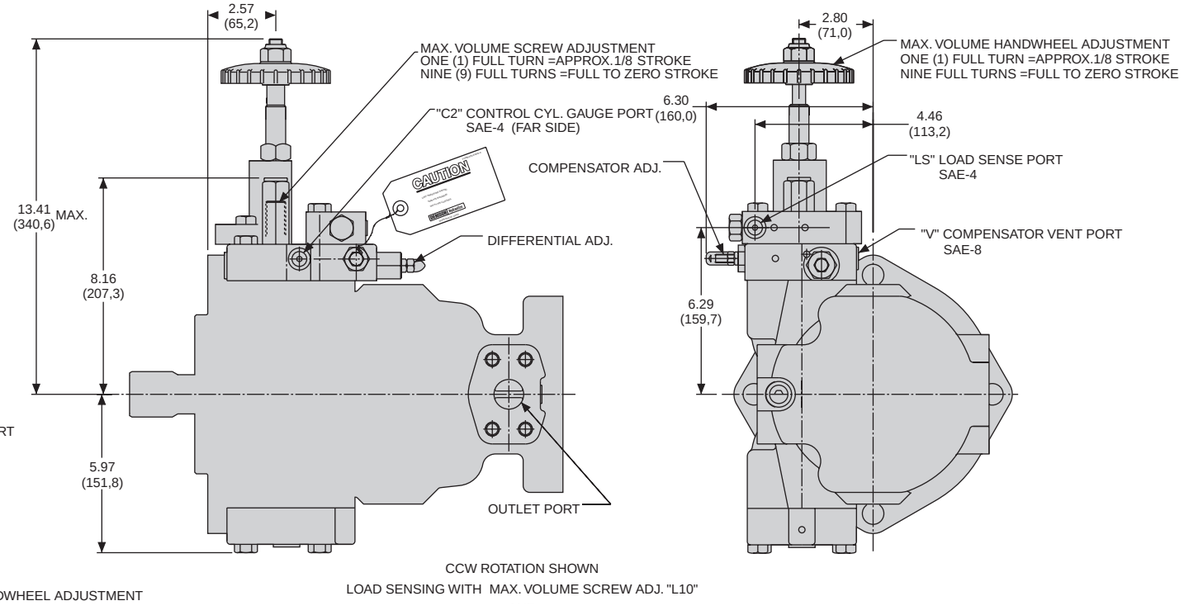


CCW ROTATION SHOWN
TORQUE LIMITER WITH MAX. VOLUME SCREW ADJ. "J10"
AND
TORQUE LIMITER WITH HANDWHEEL MAX. VOLUME ADJ. "J20"



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





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

P05 - * * 1 * - C 1 0 - *

Secondary control options	**Pre-tested control assembly**
O-None	S22-15325
J-Low Torque Limiter Override 800 - 1500 in-lb., 90 - 170 Nm	S22-15405
K-High Torque Limiter Override (over 1500 in-lb., 170 Nm)	S22-15630
P-Compensator Override	S22-15404

Primary control options	**control assembly**
1-Maximum volume screw	S22-15467
2-Handwheel (available on Compensator, Torque limiter and Load sensing controls)	S22-15448

Primary controls	**Pre-tested control assembly**	
C-Pressure Compensator	C1*, S22-15394	C2*, S22-15626
E-Electric Stroker	E1*, S22-15399	
H-Hydraulic Stroker	H1*, S22-15400	
J-Low Torque Limiter (800 - 1500 in-lb., 90 - 170 Nm)	J1*, S22-15401	J2*, S22-15627
K-High Torque Limiter (over 1500 in-lb., 170 Nm)	K1*, S22-15629	K2*, S22-15635
L-Load Sensing	L1*, S22-15402	L2*, S22-15628
R-Rotary Servo	R1*, S22-15403	

Fluid class	**Pump seal kit**
1- compatable with Buna N	S22-15646-0
4 - compatable with EPR	S22-15646-4
5 - compatable with Viton	S22-15646-5

Seal kits include all seals required for pump and controls.

Available control combinations

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

DEFINITION & UNIT

displacement	in^3/rev x 16,387 = cm^3/rev	cm^3/rev x 0,06102 = in^3/rev
flow	gpm x 3,78 = l/min	l/min x 0,2642 = gpm
power	hp x 0,7457 = kW	kW x 1,341 = hp
torque	lb-ft x 1,3567 = Nm	Nm x 0,7376 = lb-ft
pressure	lbs/in^2 (psi) x 0,06895 = bar lbs/in^2 (psi) x 6,895 = kPa	bar x 14,50 = lbs/in^2 (psi) kPa x 0,1450 = lbs/in^2 (psi)
weight	lb x 0,4536 = kg	kg x 2,205 = lbs
force	lb x 4,448 = N	N x 0,2248 = lbs
volume	in^3 x 16,387 = cm^3	cm^3 x 0,06102 = in^3
area	in^2 x 6,452 = cm^2	cm^2 x 0,1550 = in^2
length	in x 25,4= mm	mm x 0,03937 = in
temperature	$\frac{\text{degree F-32}}{1,8}$ = ϒC	1,8 x ϒC+32 = ϒ F
viscosity	*c*St x 1,0 = mm^2/sec	mm^2/sec x 1,0 = *c*St
	$\frac{\text{(SSU-14)}}{4,25} \cup$cSt	cSt x 4,25 + 14∪SSU

FLUID POWER FORMULAS

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

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