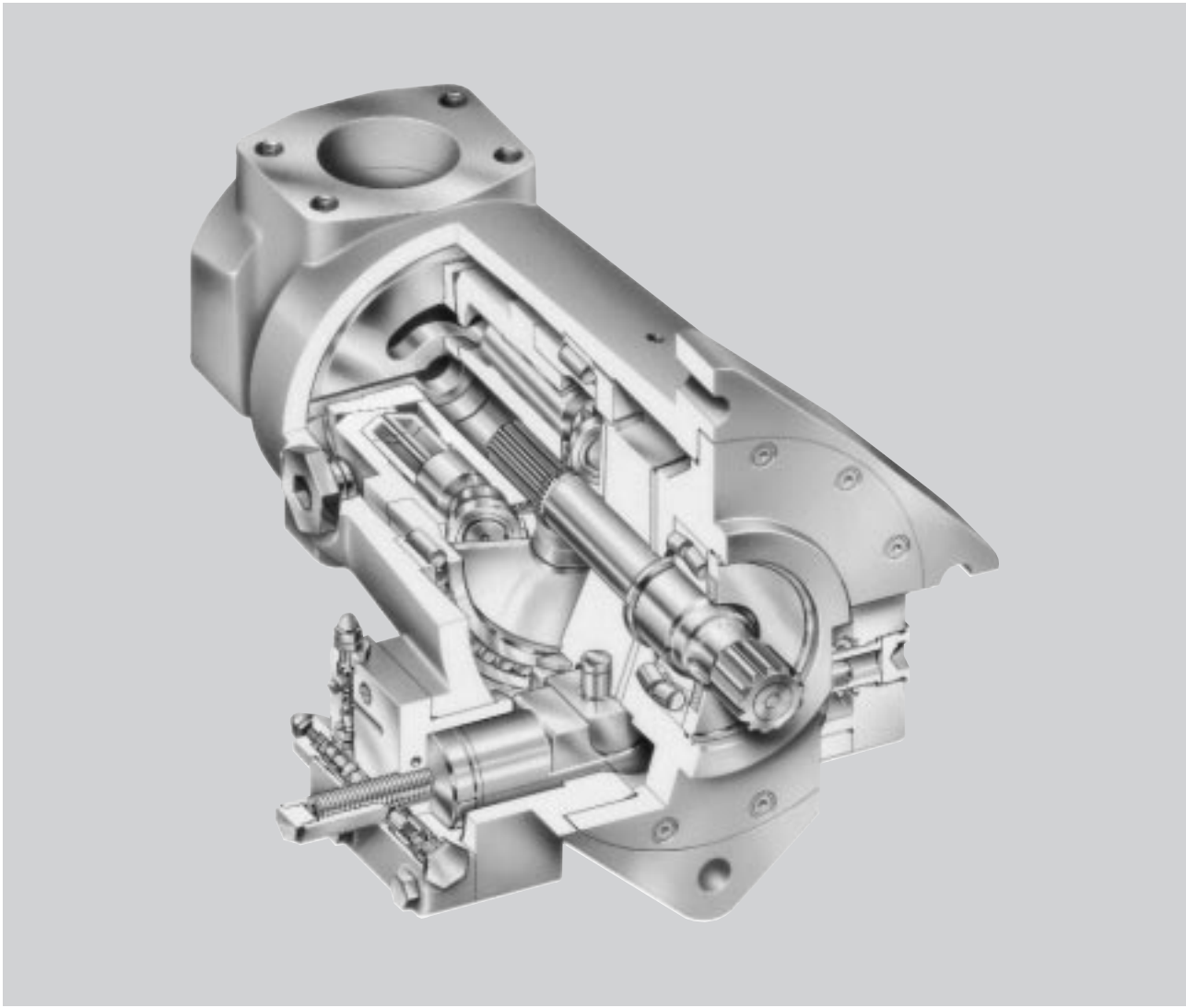
DENISON HYDRAULICS
open loop pump controls
series P140 A-mod, P260 B-mod

service information



Publ. S1-AM024-A *replaces S1-AM024* 01-97

DENISON Hydraulics

TYPICAL CHARACTERISTICS

Specification		Term	P260
• compensator response	off-stroke	sec.	0,100
	on-stroke	sec.	0,150
• compensator adjustment		bar/turn	138
• minimum compensating pressure (comp, torque limiter)		bar	17,2
• minimum compensator override pressure (servo, electric & hyd. str.)		bar	93,1
• torque limiter adjustment range	code J	Nm	282 - 706
	code K	Nm	706 - 1129
• typ. servo & stroker response @ 83 bar servo pressure, zero to full stroke and vice versa		sec.	<0,6
• servo flow required for this response (E, H, R10 controls)		l/min.	11,4
• servo flow required for this response (*1J, *1K, *1P controls)		l/min	15,2
• maximum servo pressure		bar	103
• servo shaft rotation, 0 to full volume		degrees	80
• displacement/rev./degree servo shaft rotation		cc/rev/deg.	3,25
• hydraulic stroker control pressure	0 displacement	bar	3,45
	full displacement	bar	19
• electric stroker control amps (24v.)	0 displacement	mA	150-200
	full displacement	mA	390
pulse width modulation frequency:		Hz	100-150
mating connector: Din 43650 type AF			
part no. 167-10008-8 (provided)			
• 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	10
• torque to turn handwheel @ 70 bar		Nm	17
• torque to turn handwheel @ 500 bar		Nm	40
• torque to turn rotary servo shaft		Nm	2,3

FLUID CONNECTIONS

• port C1, C2 (cylinder gage ports)	BSPP	1/4
• port E (electric stroker control pressure inlet)	BSPP	1/4
• port H (hydraulic stroker control pressure inlet)	BSPP	1/4
• port LS (load sensing port)	BSPP	1/4
• port V (compensator vent)	BSPP	3/8
• port X (rotary servo, electric & hydraulic stroker servo inlet)	BSPP	3/8

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, and limits pilot flow to approximately 1,9 l/m. A spring on this end biases the spool to normally port the control cylinder to pump case. This control cylinder links to the pump cam. On the opposite side of the control cyllinder, a pin connected to system pressure, pump timing forces, and a spring 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 17,2 bar difference, the spool shifts toward the spring, redirecting the control cylinder port to pressure. This pressure applied to the control cylinder 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 17,2 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.

For load sensing, this “V” port is connected to the load. The pump compensator will supply approximately 17,2 bar above the load pressure. The valve between the pump and the load meters the flow. The pump provides the flow to develop 17,2 bar drop across the valve independent of the load pressure and thus becomes a flow control 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 1,9 l/m vent flow cannot be accommodated by the load sensing circuit, 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 21 bar above load pressure. There is essentially no flow in the sensing line.

TORQUE LIMITER

For torque limiting, system pressure and pump displacement are controlled by the formula P•V=K. As pressure increases, displacement must reduce, and vice versa. A linkage to the pump control cylinder slides a spool over a pin. The spool and pin act as a metering valve. 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 cylinder, reducing stroke. The linkage to the control cylinder 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 cylinder. 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=K 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 cylinder. 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, 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 cylinder causing the cam to shift towards full stroke.

The pin described above 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 the above pin. A control pressure of 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 19 bar.

ELECTRIC STROKER

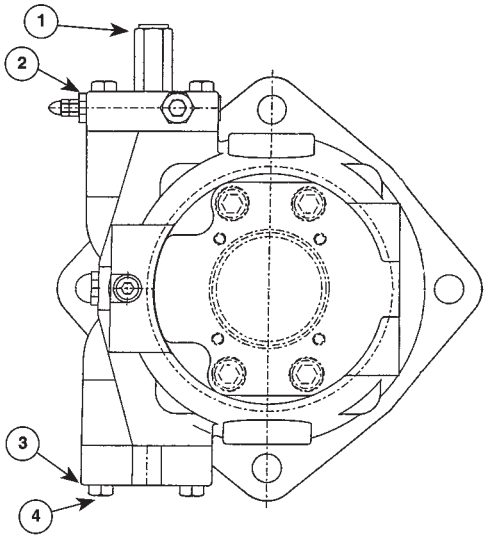
By mounting an electrically modulated pressure control valve on the hydraulic stroker to establish the control pressure, pump stroke is controlled by an electrical signal. At 150 to 200 mA electrical signal, the pump commences to stroke, and at approximately 390 mA, the pump will be at full stroke.

PRESSURE COMPENSATOR AND TORQUE LIMITER OVERRIDE

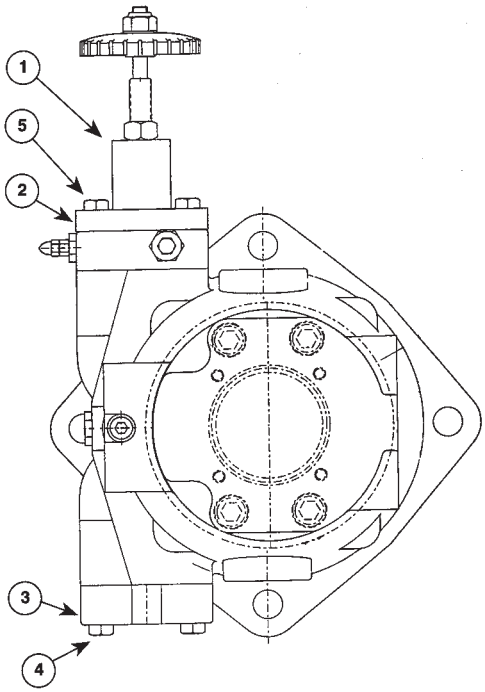
An override pressure compensator or a torque limiter control is mounted on the on-stroke side of the control piston from the servo, hydraulic or electric stroker. The port which connects to cylinder in the at-rest position is connected to servo, allowing normal stroker control. When system pressure or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

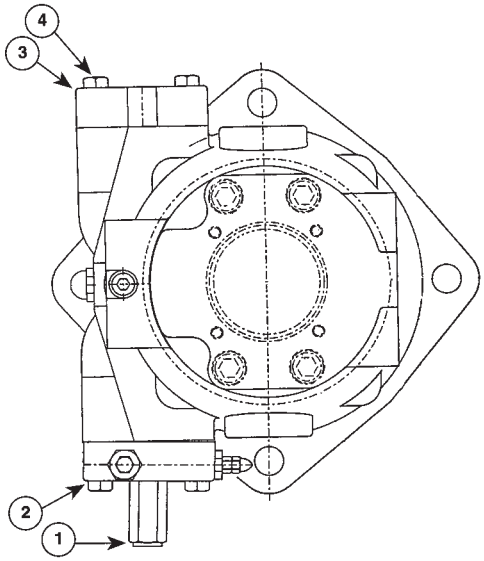
TROUBLESHOOTING CHART

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

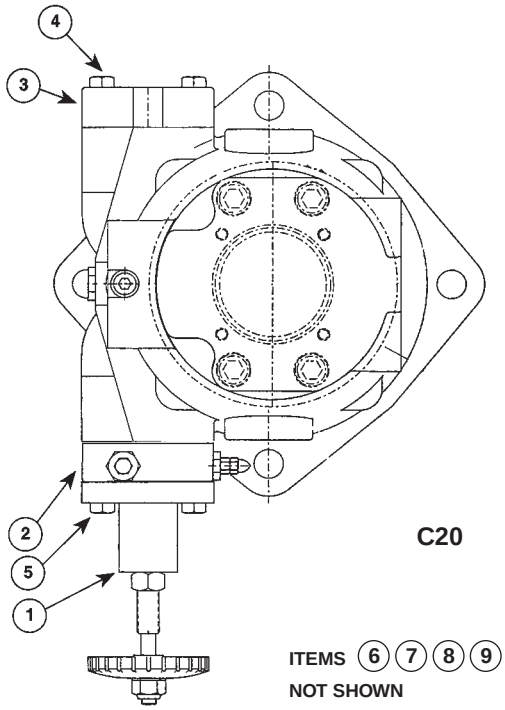


CCW ROTATION





CW ROTATION



C10

PRESSURE COMPENSATOR

C20

ITEMS (6) (7) (8) (9) NOT SHOWN

PRESSURE COMPENSATOR
parts list

ITEM	DESCRIPTION	PART NO.	QTY. C10	QTY. C20
1	Max. Vol. Stop (Fig. 1)	S22-12983	1	—
	Max Vol. Handwheel (Fig. 2)	S22-12915	—	1
2	Compensator Control (Fig. 3)	S22-15312	1	1
3	Buck Up Cap (Fig. 4)	S22-12970	1	1
4	Screw-H.H.C.,M12 x 60 mm	363-12210	8	6
5	Screw-H.H.C., M12 x 80 mm	363-12225	—	2
6	Control Piston	032-91443	1	1
7	O-Ring, 90 S-1 ARP 013	691-00013	2	2
8	O-Ring, 70 S-1 ARP 152	671-00152	2	2
9	Piston Ring	032-91261	2	2

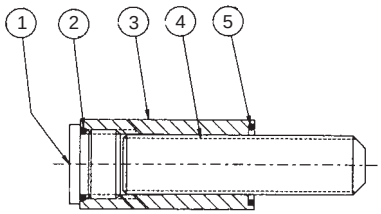


FIGURE 1
MAXIMUM VOLUME STOP

PARTS LIST FOR FIGURE 1, MAX. VOL. STOP S22-12983

ITEM	DESCRIPTION	PART NO.	QTY.
1	Plug 10HP5N-S	488-35055	1
2	O-Ring, 90 S-1 ARP 910	691-00910	1
3	Nut, 3/4-10UNC Hex	031-91049	1
4	Screw, Soc. Set 3/4 10 x 3	311-26320	1
5	O-Ring,70 S-1 ARP 118	671-00118	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 102 N•m

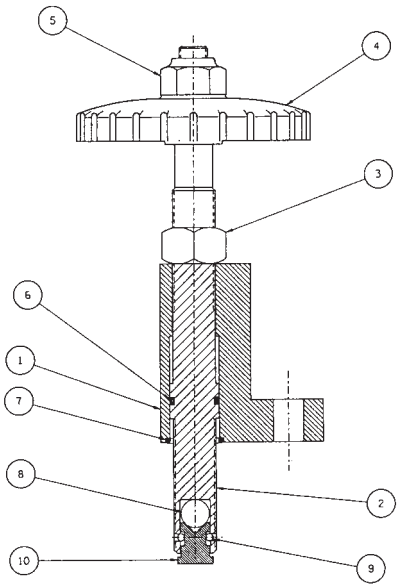


FIGURE 2
HANDWHEEL MAXIMUM VOLUME STOP

PARTS LIST FOR FIGURE 2, HANDWHEEL S22-12915

ITEM	DESCRIPTION	PART NO.	QTY.
1	Bracket	032-91456	1
2	Screw	032-91455	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	201-16001	1
9	Ball	201-04001	2
10	Seat	032-91454	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 (27) 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 (16). Lubricate and install into plug (15). Install plug (15) into cap. Install screw (3), nut (4) and acorn nut (17).

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 (29) to 60 Nm. Torque plug (21) to 35 Nm.

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

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

8. Torque mounting bolts to 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 ports.

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 35 bar. If testing on application, apply a load to pump.

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

6. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 103 bar.

7. Adjust compensator differential spool pressure to 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 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 17 bar to avoid spring going solid, preventing compensator action.)

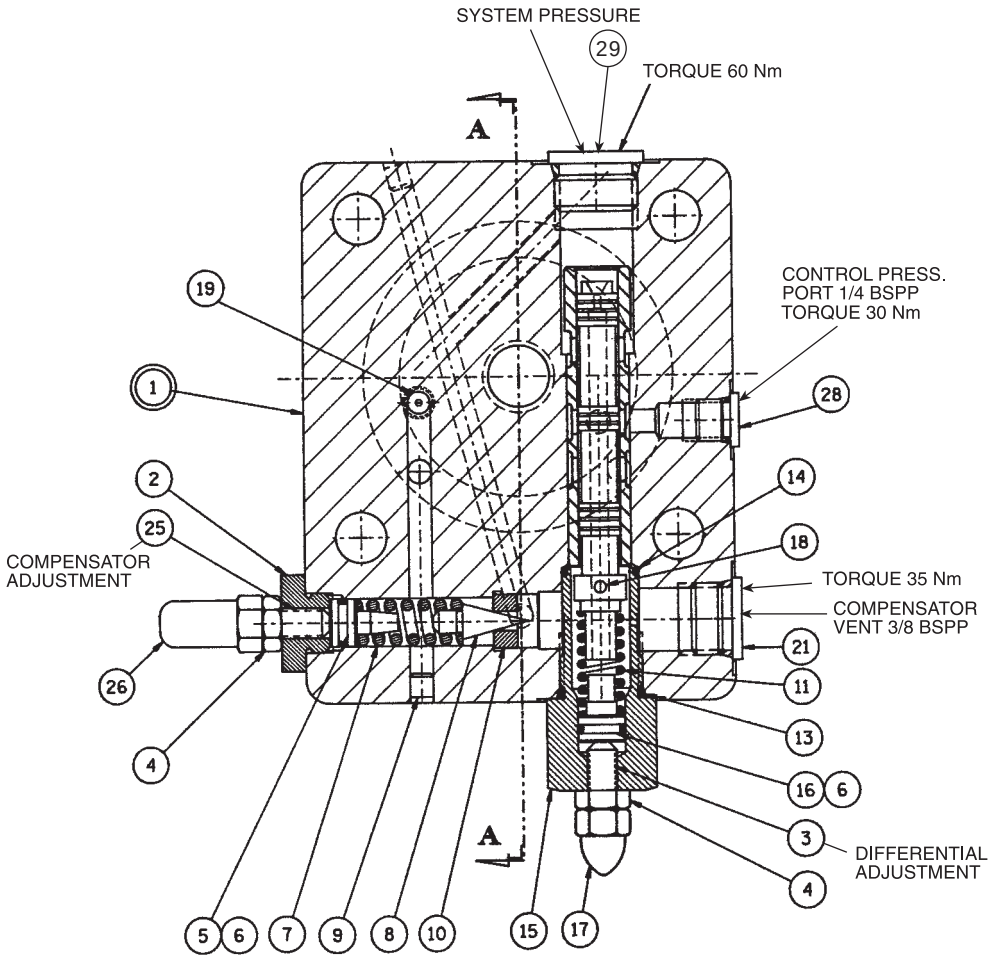
8. Set the compensator to 207 bar, 414 bar, and 500 bar.

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

10. Reduce pressure to 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 414 Bar if not otherwise noted.

FIGURE 3
COMPENSATOR



PARTS LIST FOR FIGURE 3
compensator S22-15312

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-12881	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
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	Nut, Acorn 5/16-24	327-25006	1
18	Spool	032-59482	1
19	Orifice Plug	033-25528	1
21	Plug, BSPP 3/8	447-00032	1
25	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
26	Acorn Nut	036-33474	1
28	Plug, BSPP 1/4	447-01004	1
29	Plug, BSPP 1/2	447-01008	1

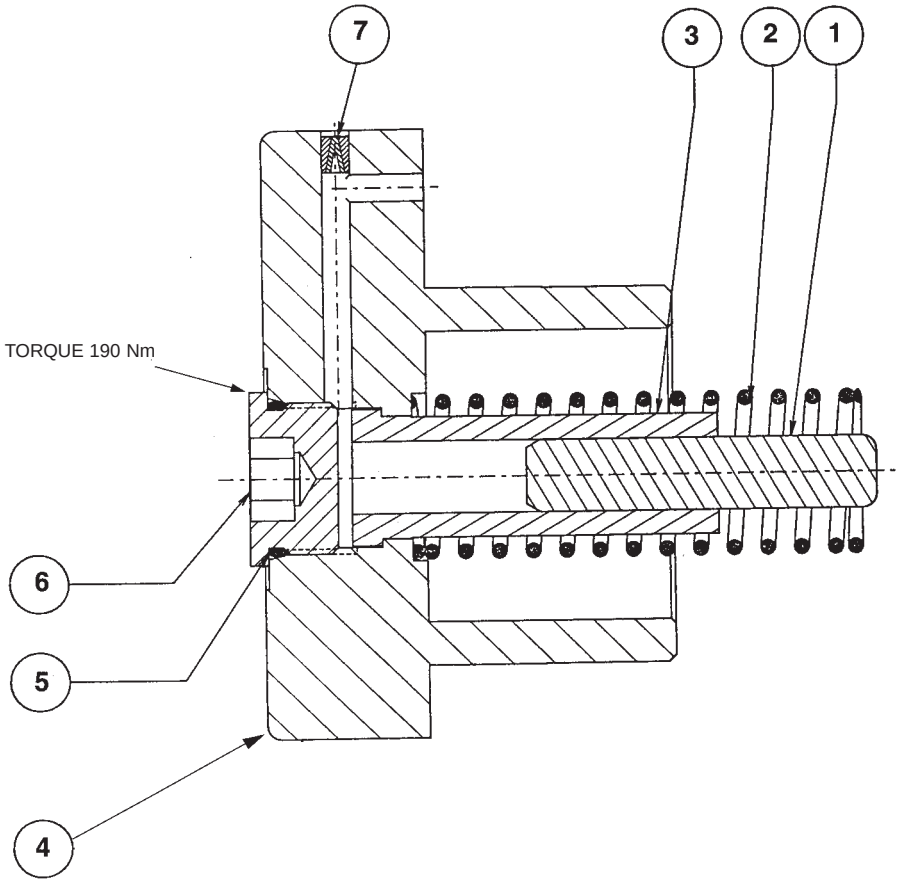


FIGURE 4
BUCK-UP CAP

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 pin (1). If snout (3) is worn, press it out and replace.

ASSEMBLY

1. Install Avseal plug (7) into cap. Press snout (3) into cap to shoulder. Install pin (1), O-ring (5) and plug (6) into cap. Torque plug to 190 Nm.

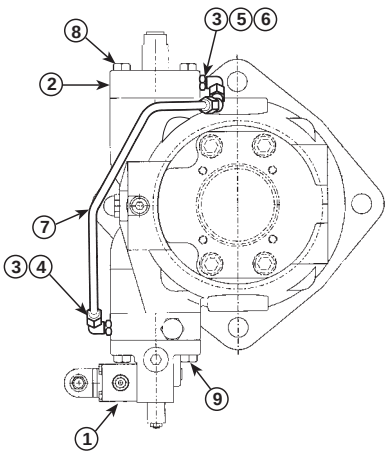
2. Install O-rings on interface between cap and pump control pad. Install spring (2) into control piston. Install cap assembly on pump housing as indicated on the applicable view, guiding the control piston into the bore.

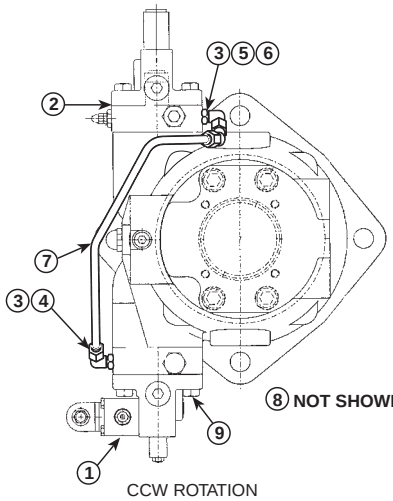
3. Torque the assembly bolts to 102 Nm.

PARTS LIST FOR FIGURE 4

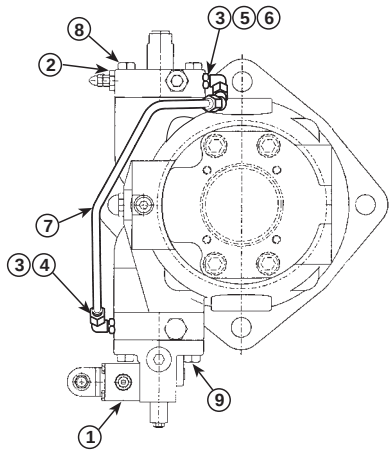
buck-up cap S22-12983

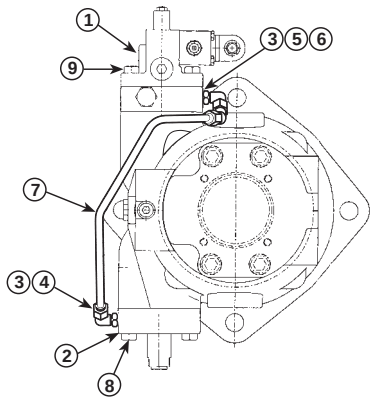
ITEM	DESCRIPTION	PART NO.	QTY.
1	Pin	324-24048	1
2	Spring	032-91273	1
3	Snout	032-91344	1
4	Control Cap	032-91266	1
5	O-Ring, 90 S-1 ARP 916	691-00916	1
6	Plug 16 HP5N-S	488-35024	1
7	Avseal Plug	447-00026	1



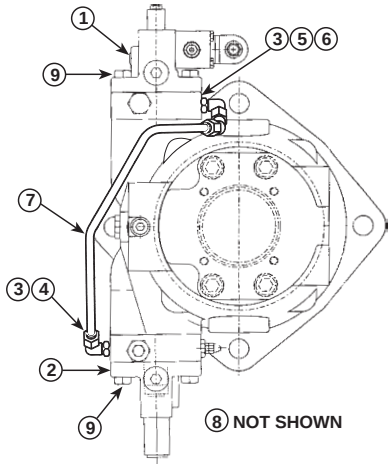


CCW ROTATION



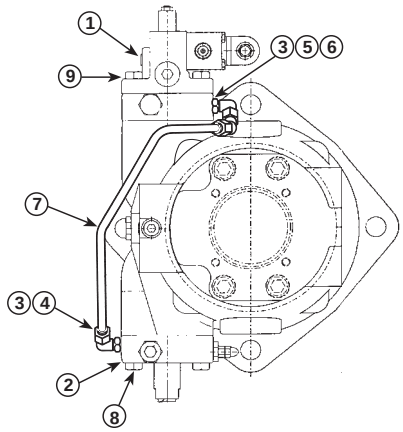


E10



E1J – E1K

CW ROTATION



E1P

ELECTRIC STROKER

parts list

		P140	P260	QUANTITY			
ITEM	DESCRIPTION	PART NO.	PART NO.	E10	E1J	E1K	E1P
1	Electric Stroker (Fig. 5)	S22-15306	S22-15306	1	1	1	1
2	Control Cap (Fig. 7)	S22-15272	S22-15272	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15650	S22-15533	—	1	—	—
	High Torque Override (Fig. 8)	S22-15651	S22-15535	—	—	1	—
	Compensator Override (Fig. 10)	S22-15531	S22-15531	—	—	—	1
*3	O-Ring, 90 S-1 ARP 113	691-00113	691-00113	2	2	2	2
*4	Elbow	494-15019	494-15019	1	1	1	1
*5	Elbow	494-15021	494-15021	1	1	1	1
*6	45° Swivel Nut Ell	492-15389	492-15389	1	1	1	1
*7	Tube	032-91888	032-92190	1	1	1	1
8	Screw-H.H.C., M12 x 60 mm	363-12210	363-12210	6	4	4	6
9	Screw-H.H.C., M12 x 80 mm	363-12225	363-12225	2	4	4	2
10	Control Piston	032-91785	032-91785	1	1	1	1
11	O-Ring, 90 S-1 ARP 013	691-00013	691-00013	2	2	2	2
12	O-Ring, 70 S-1 ARP 152	671-00152	671-00152	2	2	2	2
13	Piston Ring	032-91261	032-91261	1	1	1	1
14	Piston Ring	032-91811	032-91811	1	1	1	1

*Tubing assembly available as S22-15583 (P260)
*Tubing assembly available as S22-15668 (P140)

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 (3) with attached parts. Remove spring (8) and spool (4).
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 screw (14) and nut (15). Push a rod through the cap to remove the retainer (12).

ASSEMBLY

1. **See Figure 6.** Install Avseal plug (6) in cap.
2. Install spool (4) into bore as shown. Install spring (8) over end of spool.
3. Install O-ring (13) on spring retainer (12). Install retainer (12), screw (14), and nut (15) in plug (3).
4. Install O-rings (7) and (16) on plug (3). Install plugs (3) and (9) in body (1). Torque plugs to 60 Nm. Install O-ring (8) in cap.
5. Turn screw (15) in until spring retainer (12) contacts spring (8). 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 102 Nm.
8. **See Figure 5.** Apply Loctite® on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 6,78 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 11,4 +/- 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 6,35 mm below surface, apply Loctite® 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 one orifice (40) in the tapped hole in the block (36). Install the other on top of the first. Torque to 7,9 Nm.
14. Install proportional valve (41) in block. Torque to 27 Nm.
15. Install coil on proportional valve. Torque to 2,2-2,8 Nm max.
16. Assemble all other components into body (16) per above drawing. Torque the plug (12) to 122 Nm.
17. 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 103 Nm.

TEST AND ADJUSTMENT

1. Plumb 82,8 bar servo supply to control. Supply 82,8 bar to the electric stroker servo supply port. **Note:** All pressure references are “above case pressure” (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 (150 to 200 mA) to give 34,5 bar reading on the proportional 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 390 mA. Pump should go to full stroke. Set max. volume screw on opposide control cap for full stroke. Gage in proportional valve gage port should read approximately 18,6 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 (15 figure 6) out to go towards full or in to go towards zero flow.

8. Increase and decrease the amperage between 0 and 390 mA several times at approximately 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 .5 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 18.9 l/m from each other.

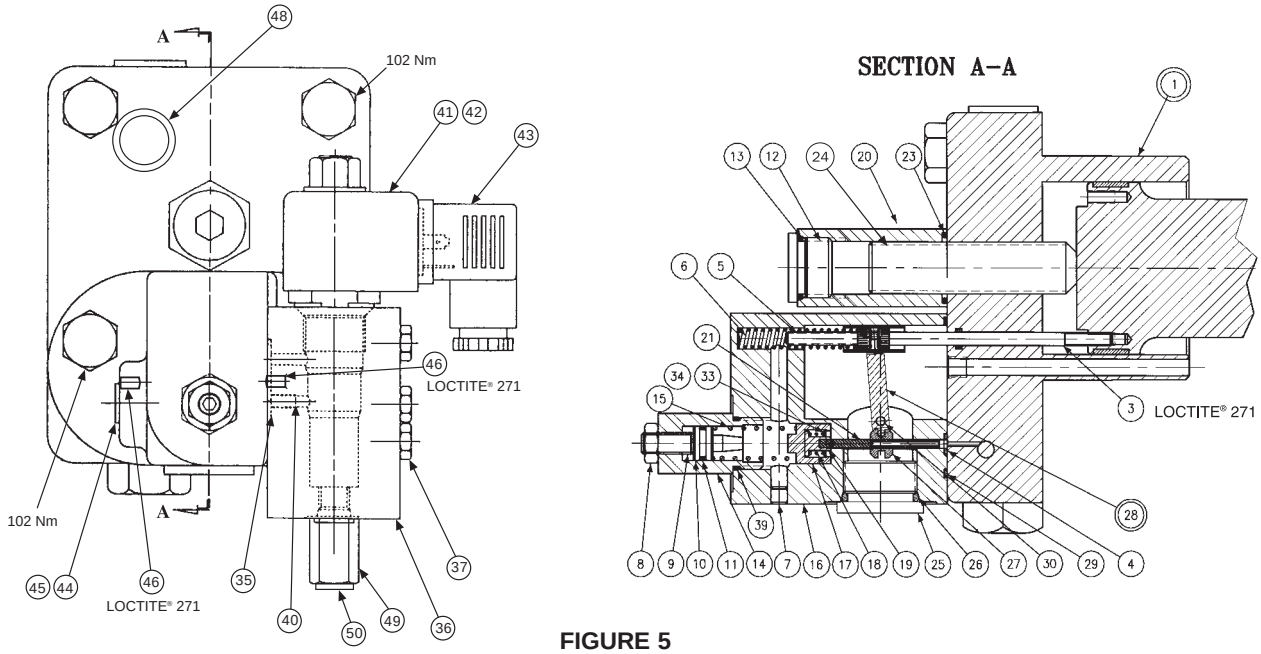


FIGURE 5
ELECTRIC STROKER

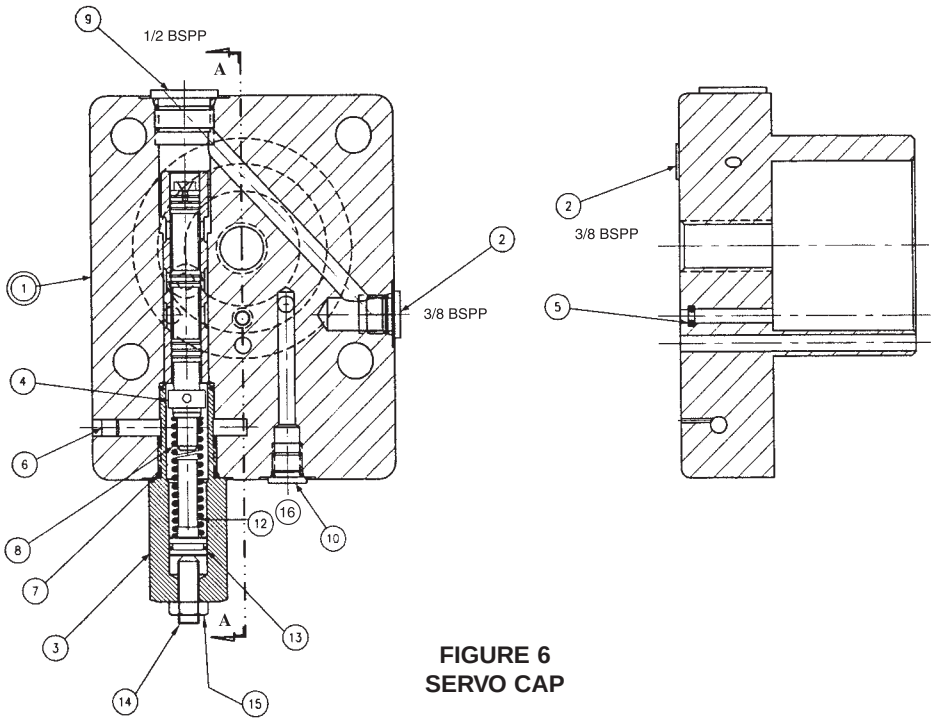


FIGURE 6
SERVO CAP

PARTS LIST FOR FIGURE 5
electric stroker S22-15306

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15268	1
3	Screw	032-91461	1
4	O-Ring, 70 S-1 ARP 010	671-00010	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, 10HP5N-S	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	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, 3/4-10	031-91049	1
21	Spool	032-91438	1
23	O-Ring,70 S-1 ARP 118	671-00118	1
24	Soc. Setscrew, 3/4-10 x 3	311-26320	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 1.75 Lg.	324-20828	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
38	Plug, 7/16-20	449-00013	1
39	O-Ring, 90 S-1 ARP 908	691-00908	1
40	Orifice, 635 mm	033-91225	2
41	Prop. Pr. Cont. Valve	517-00085	1
42	Coil, 24VDC	517-00086	1
43	Connector	167-01008-8	1
44	O-Ring, 90 S-1 ARP 904	691-00904	2
45	Plug, SAE-4	488-35061	1
46	Screw, SHC 10-32 x 1/4	312-09041	2
48	Plug	449-00599	1
49	Adapter SAE-4/BSP 1/4	492-15379	1
50	Seal	449-00603	1

PARTS LIST FOR FIGURE 6
servo cap S22-15268

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap/Sleeve	S22-15267	1
2	Plug	449-00599	2
3	Plug	032-91861	1
4	Spool	032-91820	1
5	O-Ring, 70 S-1 ARP 008	671-00008	1
6	Avseal Plug	447-00026	1
7	O-Ring, 90 S-1 ARP 910	691-00910	1
8	Spring	032-91863	1
9	Plug, BSPP 1/2	447-01008	1
10	Plug, BSPP 1/4	447-01004	1
12	Spring retainer	032-91862	1
13	O-Ring, 90 S-1 ARP 013	691-00013	1
14	Screw, 5/16 -24 x 1	312-13160	1
15	Nut, 5/16-24	335-13100	1
16	O-Ring, 90 S-1 ARP 017	691-00017	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 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 68 Nm.

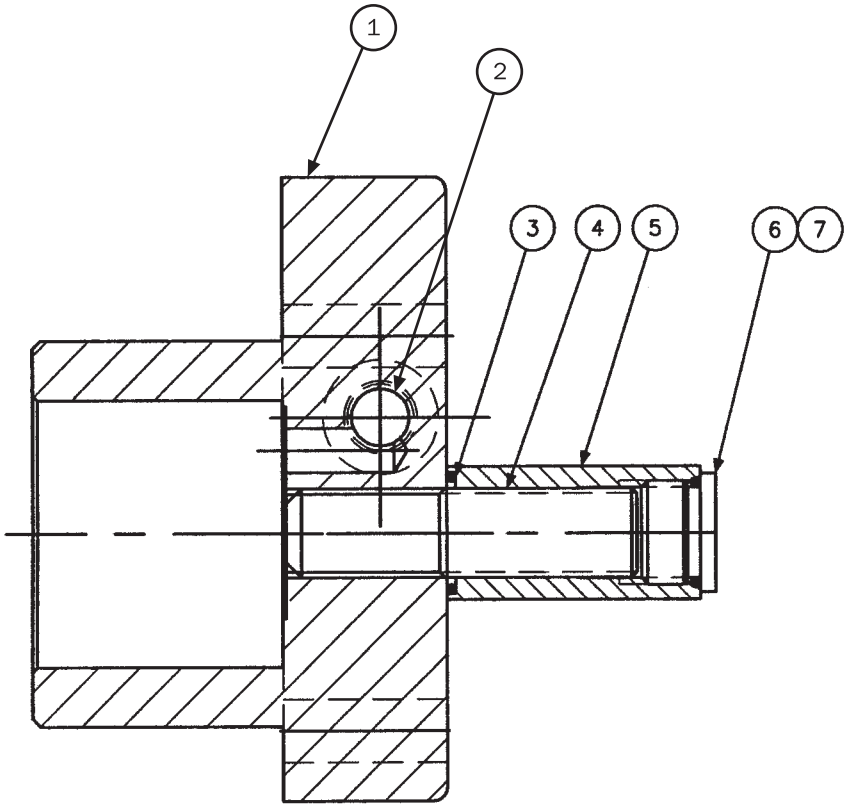


FIGURE 7
CONTROL CAP ASSEMBLY

PARTS LIST FOR FIGURE 7
control cap assembly S22-15272

ITEM	DESCRIPTION	PART NO.	QTY.
1	Control Cap	032-91766	1
2	Plug	449-00599	1
3	O-ring, 70 S-1 ARP 118	671-00118	1
4	Screw, 3/4-10 x 3	311-26320	1
5	Nut	031-91049	1
6	Plug	488-35055	1
7	O-ring 90 S-1 ARP 910	691-00910	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. **See figure 9.** Remove maximum volume stop assembly (items 19, 20, 21, 22, 27).

5. Remove cap assembly (1).

6. 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 (32).

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 (16). Lubricate and install into plug (15). Install O-rings (13) and (14) on plug (15) Install plug (15) into cap. Install screw (3), nut (4) and acorn nut (17).

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 (25).

6. Install plug (12) and torque to 60 Nm. Install plug (21). Torque to 35 Nm.

7. Carefully install O-ring (31) 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 101 Nm.

9. Install maximum stop screw (20), cover (19) ,O-ring (30) and plug (29) with O-ring (24).

10. **See figure 8.** Apply Loctite® on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 6,78 Nm.

11. Measure height from control cap to top of screw. With control piston at zero stroke, dimension must be 11,4 +/- 0,76 mm.

12. Press dowel (30) into body (16), through the link assembly (28), to 6,35 mm below surface. Apply Loctite® 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 plug (11) to 68 Nm.

15. While spring retainer is engaging screw (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 102 Nm.

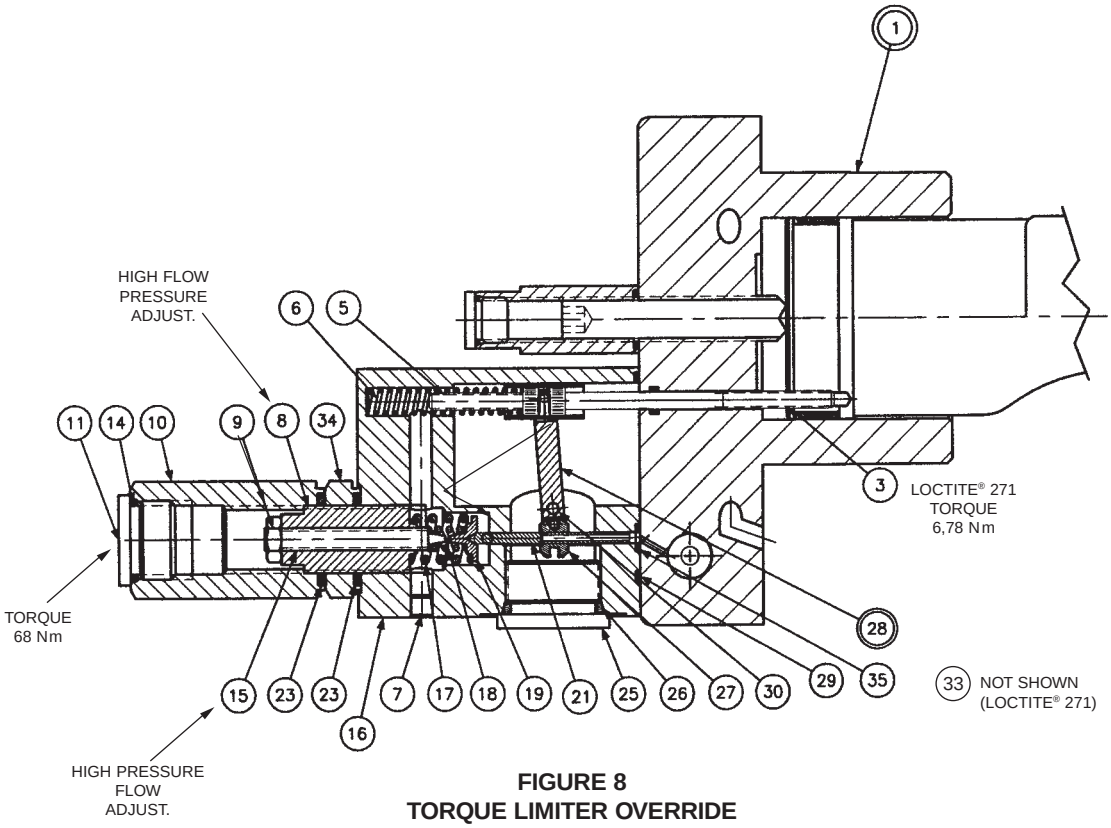


FIGURE 8
TORQUE LIMITER OVERRIDE

PARTS LIST FOR FIGURE 8
torque limiter override
code J S22-15533
code K S22-15535

ITEM	DESCRIPTION	PART NO.	QTY. **J	QTY. **K
1	Cap (Figure 9)	S22-15275	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
14	O-Ring, 90 S-1 ARP 908	691-00908	1	1
15	Screw, Primary Adjust	032-91446	1	1
16	Body assembly	S22-15397	1	1
17	Outer Spring – J Version	032-91440	1	—
	Outer Spring – K Version	032-91448	—	1
18	Inner Spring – J Version	032-91441	1	—
	Inner Spring – K Version	032-91447	—	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.	324-20828	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

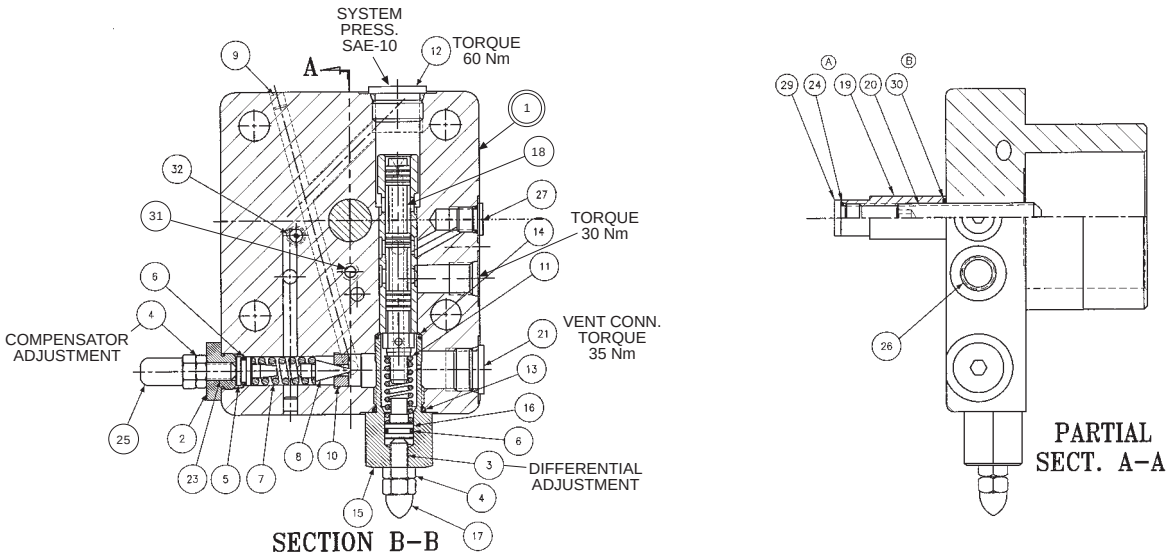


FIGURE 9
TORQUE LIMITER OVERRIDE CAP

PARTS LIST FOR FIGURE 9,
torque limiter override cap S22-15275

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15280	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, BSPP 1/2	447-01008	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	Nut, Acorn 5/16-24	327-25006	1
18	Spool	032-91820	1
19	Cover	032-91761	1
20	Screw, 1/2-20 x 2-1/2	312-35060	1
21	Plug	447-00032	1
23	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
24	O-Ring, 70 S-1 ARP 015	671-00015	1
25	Acorn Nut	036-33474	1
26	Plug	449-00599	1
27	Plug, BSPP 1/4	447-01004	1
28	Plug, BSPP 1/2	447-01008	1
29	Plug	488-35020	1
30	O-Ring, 90 S-1 ARP 905	691-00905	1
31	O-Ring, 70 S-1 ARP 008	671-00008	1
32	Orifice	035-40489	1

TORQUE LIMITER OVERRIDE TEST AND ADJUSTMENT

1. Install gages on system pressure and on compensator vent ports.

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 1,2 Nm torque to avoid damage to internal parts!

6. Start prime mover with system relief set at 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 103 bar.

9. Adjust compensator differential spool pressure to 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 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 17 bar to avoid spring going solid, preventing compensator action.)

10. Set the compensator to 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 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

11. Reduce pressure to 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 34,5 bar above the required setting, or 483 bar.

Set the torque limiter by using the formula:

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

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 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 12, 13, 19, 20, 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.

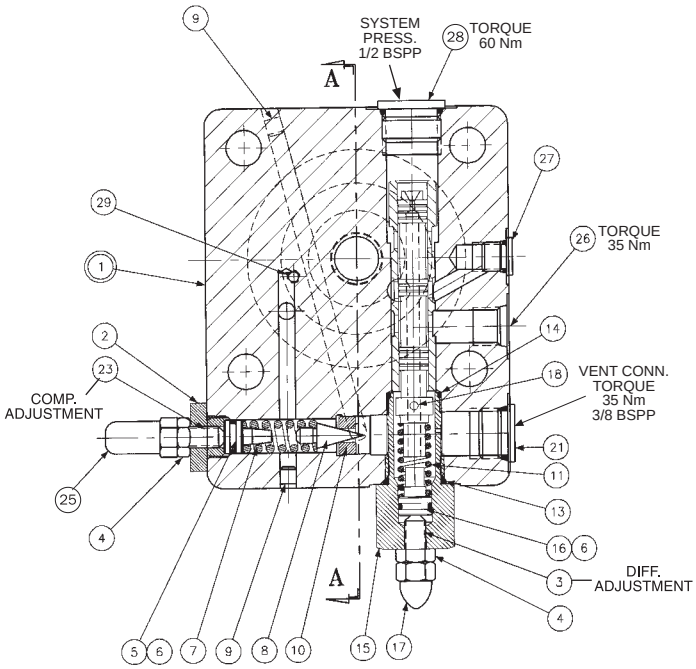
ASSEMBLY

1. Install Avseal plugs (9) in body. Install orifice (29) 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 (16). Lubricate and install into plug (15). Install O-rings (13) and (14) on plug (15). Install plug (15) into cap. Install screw (3), nut (4) and acorn nut (17).
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 68 Nm. Torque plug (21) to 35 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 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 ports.
2. Turn compensator adjustment screw (23) 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 35 bar. Apply a load to the pump.
5. Set pump control to full displacement. Pump should go to full displacement at 35 bar.
6. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 103 bar.
7. Adjust compensator differential spool pressure to 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 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 17 bar to avoid spring going solid, preventing compensator action.)
8. Set the compensator to 207 bar, 414 bar, 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 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
10. Reduce pressure to 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 414 bar if not otherwise noted.



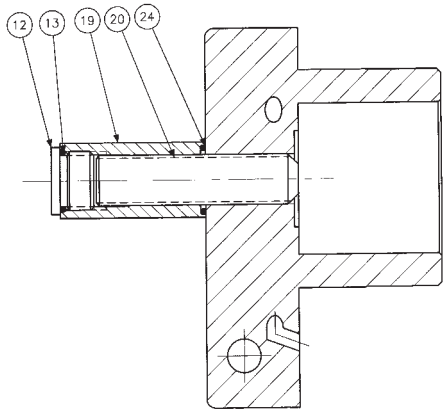
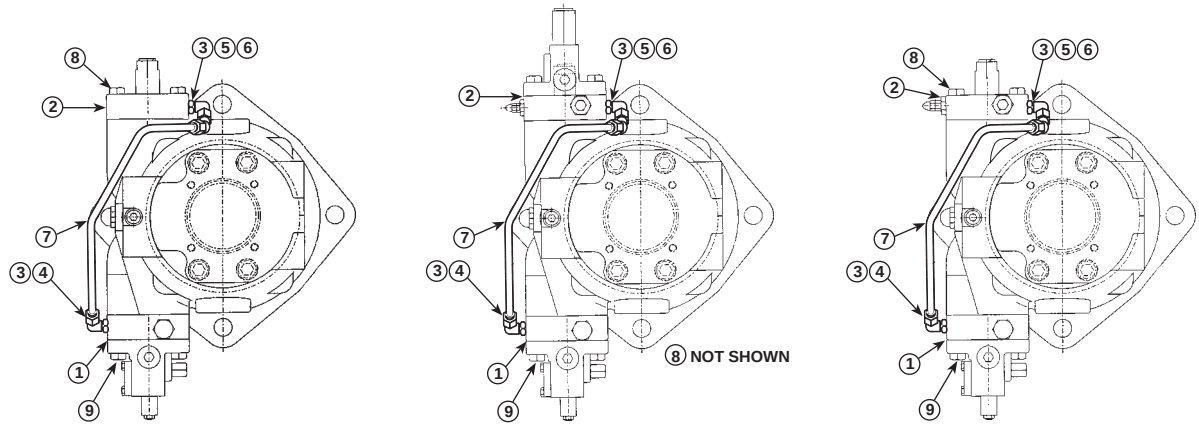


FIGURE 10
COMPENSATOR OVERRIDE CONTROL

PARTS LIST FOR FIGURE 10
compensator override control
S22-15273

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15259	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	3
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	Nut, Acorn 5/16-24	327-25006	2
18	Spool	032-91820	1
19	Cover	032-91049	1
20	Screw, 3/4-10 x 3	311-26320	1
21	Plug	447-00032	2
23	Soc. Setscrew 5/16-24 x 1-1/4	312-13180	1
24	O-ring, 70 S-1 ARP 118	671-00118	1
25	Acorn Nut	036-33474	1
26	Plug	449-00599	1
27	Plug, BSPP 1/4	447-01004	1
28	Plug, BSPP 1/2	447-01008	1
29	Orifice	035-40489	1



HYDRAULIC STROKER
parts list

		P140	P260	QUANTITY			
ITEM	DESCRIPTION	PART NO.	PART NO.	H10	H1J	H1K	H1P
1	Hydraulic Stroker (Fig. 11)	S22-15308	S22-15308	1	1	1	1
2	Control Cap (Fig. 7)	S22-15272	S22-15272	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15650	S22-15533	—	1	—	—
	High Torque Override (Fig. 8)	S22-15651	S22-15535	—	—	1	—
	Compensator Override (Fig. 10)	S22-15531	S22-15531	—	—	—	1
*3	O-ring, 90 S-1 ARP 113	691-00113	691-00113	2	2	2	2
*4	Elbow	494-15019	494-15019	1	1	1	1
*5	Elbow	494-15021	494-15021	1	1	1	1
*6	45° Swivel Nut Ell	492-15389	492-15389	1	1	1	1
*7	Tube	032-91888	032-92190	1	1	1	1
8	Screw-H.H.C., M12 x 60 mm	363-12210	363-12210	6	4	4	6
9	Screw-H.H.C., M12 x 80 mm	363-12225	363-12225	2	4	4	2
10	Control Piston	032-91785	032-91785	1	1	1	1
11	O-Ring, 90 S-1 ARP 013	691-00013	691-00013	2	2	2	2
12	O-Ring, 70 S-1 ARP 152	671-00152	671-00152	2	2	2	2
13	Piston Ring	032-91261	032-91261	1	1	1	1
14	Piston Ring	032-91811	032-91811	1	1	1	1

*Tubing assembly available as S22-15583 (P260)
*Tubing assembly available as S22-15668 (P140)

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 (3) with attached parts. Remove spring (12) and spool (4).

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 (14) and nut (15). Push a rod through the cap to remove the retainer (12).

ASSEMBLY

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

2. Install spool (4) into bore as shown. Install spring (8) over end of spool.

3. Install O-ring (13) on spring retainer (12). Install retainer (12), screw (14), and nut (15) in plug (3).

4. Install O-rings (7) and (16) on plug (3). Install plugs (3) and (9) in body (1). Torque plugs to 60 Nm. Install O-ring (5) in cap.

5. Turn screw (14) in until spring retainer (12) contacts spring (8). 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 102 Nm.

8. **See figure 11.** Apply Loctite® on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 6,78 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 11,4 +/- 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 6,35 mm below surface. Apply Loctite® 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 above drawing. Torque plug (12) to 122 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 103 Nm.

TEST AND ADJUSTMENT

1. Plumb 82,8 bar servo supply to control.

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

3. Start pump.

4. Supply 20,7 bar to hydraulic stroker control port.

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

6. Reduce control pressure to 0 bar. Back out zero screw (24) until pump is at zero stroke. Lock in place.

7. Increase and decrease control pressure between 0 and 20,7 bar several times at approximately 34,5 bar, 207 bar, and 414 bar system pressure. Pump stroke should follow control pressure smoothly and proportionally. Full to zero or zero to full stroke should be achieved in no more than .5 second. Full stroke should be achieved at 19 +/- 1 bar. Zero stroke should be achieved at 3,45 +/- 1 bar. Adjust control pressure up to 12 bar from zero stroke, then adjust down from full stroke to 12 bar. The flows at the two settings shall not vary more than 15 l/m from each other.

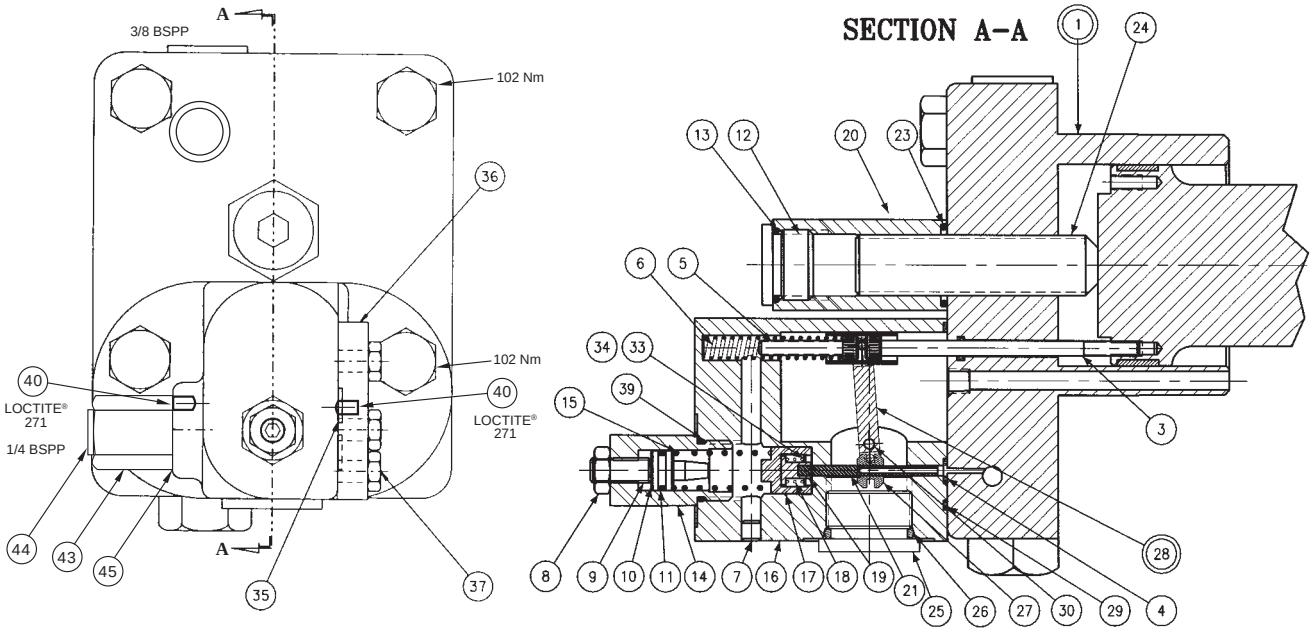
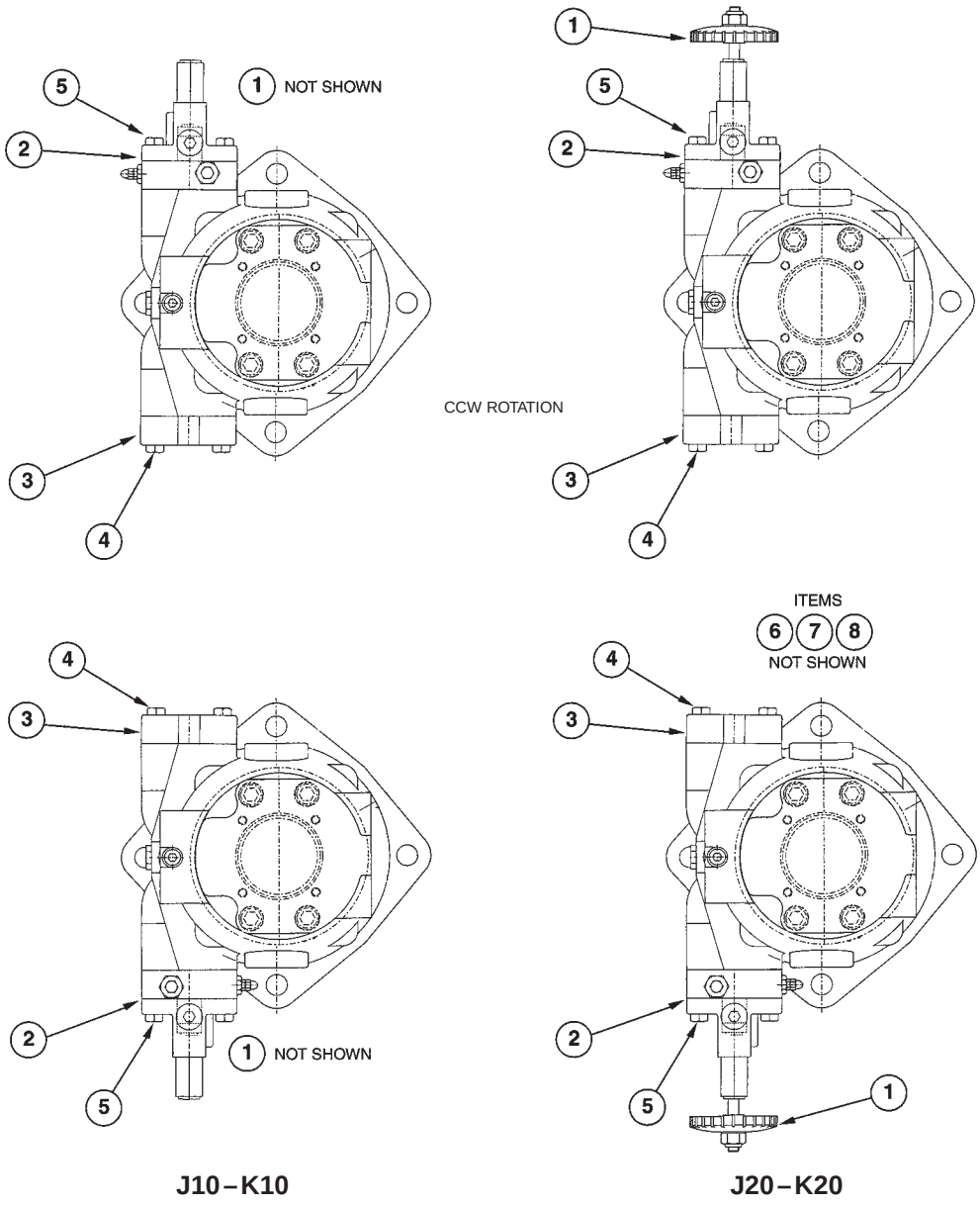


FIGURE 11
HYDRAULIC STROKER

PARTS LIST FOR FIGURE 11
hydraulic stroker S22-15308

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15268	1
3	Screw	032-91461	1
4	O-Ring, 70 S-1 ARP 010	671-00010	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, 10HP5N-S	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	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, 3/4-10	031-91049	1
21	Spool	032-91438	1
23	O-Ring,70 S-1 ARP 118	671-00118	1
24	Soc. Setscrew, 3/4-10 x 3	311-26320	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 1.75 Lg.	324-20828	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
39	O-Ring, 90 S-1 ARP 908	691-00908	1
40	Screw, SHC 10-32 x 1/4	312-09041	2
43	Fitting, BSPP - 4	492-15379	1
44	Seal	449-00603	1
45	O-ring, 90 S-1 ARP 904	691-00904	1



TORQUE LIMITER

PARTS LIST
torque limiter

			QUANTITY			
ITEM	DESCRIPTION	PART NO.	J10	K10	J20	K20
1	Max. Vol. Stop (Fig. 1)	S22-12983	1	1	—	—
	Max Vol. Handwheel (Fig. 2)	S22-12915	—	—	1	1
2	Low Torque Limiter (Fig. 12)	S22-15314	1	—	1	—
	High Torque Limiter (Fig. 12)	S22-15316	—	1	—	1
3	Buck Up Cap (Fig. 4)	S22-12970	1	1	1	1
4	Screw-H.H.C., M12 x 60 mm	363-12210	6	6	4	4
5	Screw-H.H.C., M12 x 80 mm	363-12225	2	2	4	4
6	Control Piston	032-91443	1	1	1	1
7	O-Ring, 90 S-1 ARP 013	691-00013	2	2	2	2
8	O-Ring, 70 S-1 ARP 152	671-00152	2	2	2	2
9	Piston ring	032-91261	2	2	2	2

TORQUE LIMITER DISASSEMBLY

1. **See Figure 12.** 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 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 (16). Lubricate and install into plug (15). Install plug (15) into cap. Install screw (3), nut (4) and acorn nut (17). Install plug (12). Torque plugs to 60 Nm. Install plug (21). Torque to 35 Nm. Install plug (28). Torque to 30 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. Torque mounting screws to 101 Nm.

7. Install maximum volume handwheel or screw assembly. Set stop to clear control piston.

8. **See Figure 12.** Apply Loctite® on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 6,78 Nm

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

10. Press dowel (30) into body (16), through the link assembly (28), to 6,35 mm below surface. Apply Loctite® 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 102 Nm.

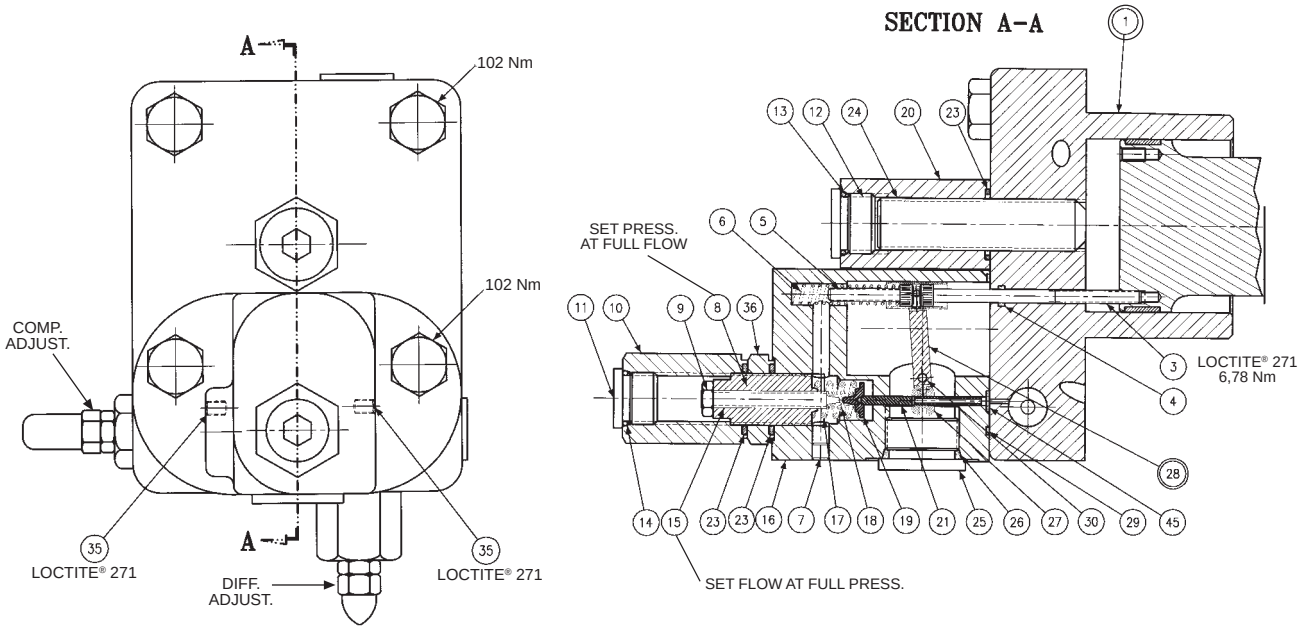


FIGURE 12 – TORQUE LIMITER ASSEMBLY

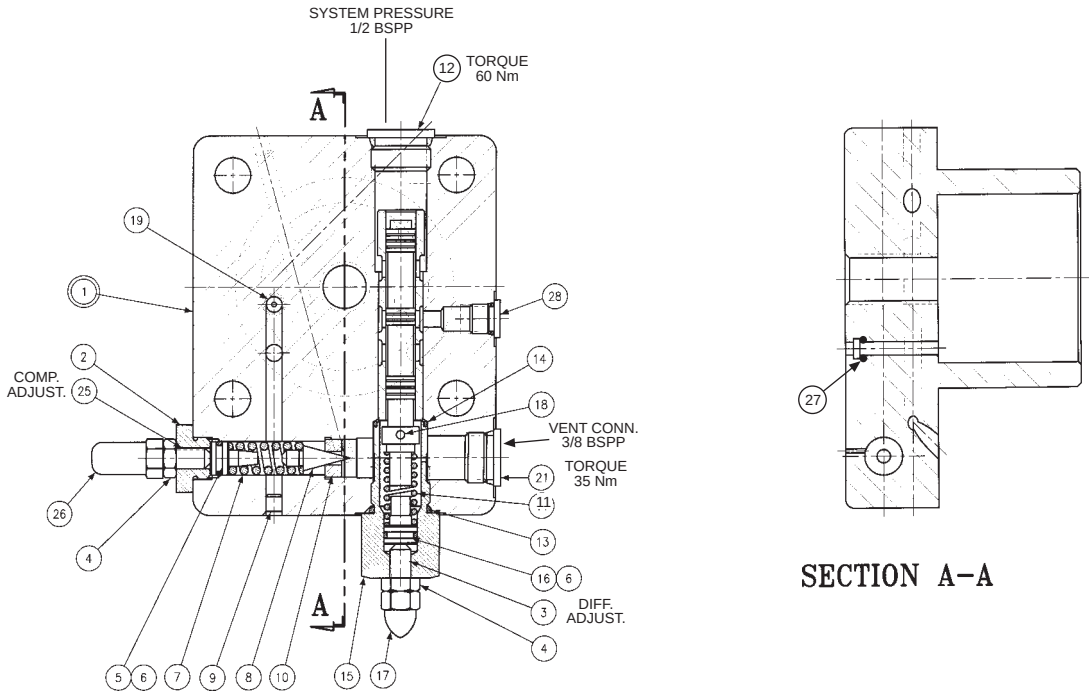


FIGURE 13
TORQUE LIMITER CAP

PARTS LIST FOR FIG. 12
code J, S22-15533
code K, S22-15535

ITEM	DESCRIPTION	PART NO.	QTY. J**	QTY. K**
1	Cap (Figure 13)	S22-12923	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, 8HP5N-S	488-35018	1	1
14	O-Ring, 90 S-1 ARP 908	691-00908	1	1
15	Screw, Primary Adjust	032-91446	1	1
16	Body	S22-15396	1	1
17	Outer Spring – J Version	032-91440	1	—
	Outer Spring – K Version	032-91448	—	1
18	Inner Spring – J Version	032-91441	1	—
	Inner Spring – K Version	032-91447	—	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.	324-20828	1	1
35	Screw, SHC 10-32 x 1/4 Lg.	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 S22-12923

ITEM	DESCRIPTION	PART NO.	QTY.	
1	Cap-Sleeve Assembly	S22-12922	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, BSPP 1/2	447-01008	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	Nut, Acorn 5/16-24	327-25006	1	
18	Spool	032-59482	1	
19	Orifice	033-25528	1	
21	Plug BSPP 3/8	447-00032	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, BSPP 1/4	447-01004	1	

TORQUE LIMITER TEST AND ADJUSTMENT

1. Install gages on system pressure and on compensator vent ports.
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 1,2 Nm torque to avoid damage to internal parts!
6. Start prime mover with system relief set at 35 bar. Apply a load to the pump.
7. Pump should be at full displacement at 35 bar.
8. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 103 bar.
9. Adjust compensator differential spool pressure to 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 13,8 bar. (It may be necessary to change differential to gain stability. Use caution when exceeding 17 bar to avoid spring going solid, preventing compensator action.)
10. Set the compensator to 207 bar, 414 bar, 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 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
12. Reduce pressure to 10,3 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 34,5 bar above the required setting, or 483 bar.

Set the torque limiter by using the formula:

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

where P = pressure in Bar

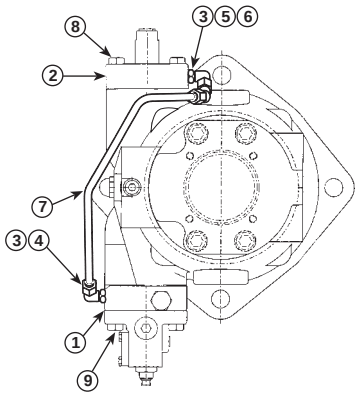
Q = flow in l/m

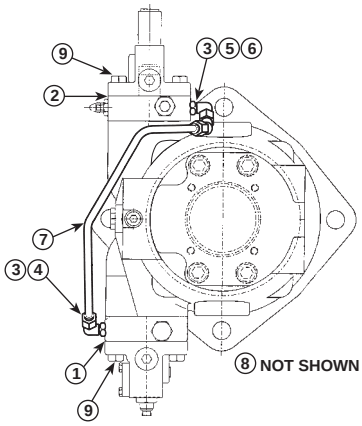
calculate these two values:

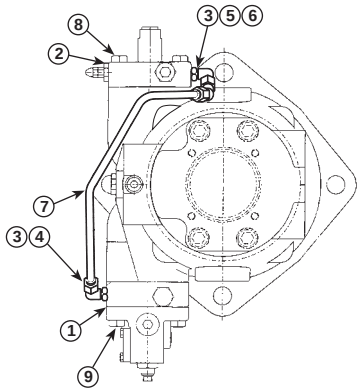
a. System pressure at full pump flow.
b. Pump flow at full system pressure.

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 414 bar if not otherwise noted.

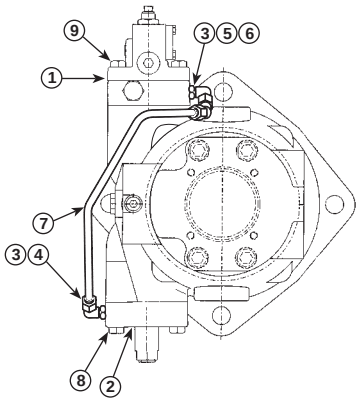
Note: Electric motor current may be used instead of calculated flows to set power. In step 14, set the outer adjusting screw (8) to achieve the rated motor current. In step 15, set the adjustment (15) to achieve the rated motor current.



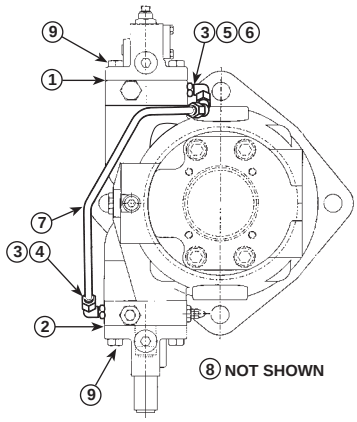




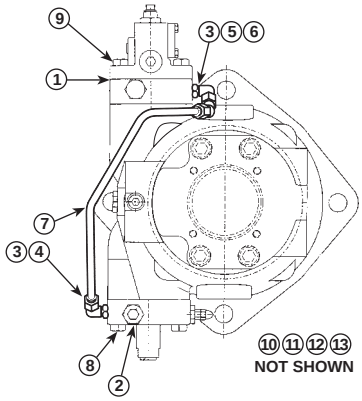
CCW ROTATION



R10



R1J – R1K



R1P

CW ROTATION

PARTS LIST

rotary servo

		P140	P260	QUANTITY			
ITEM	DESCRIPTION	PART NO.	PART NO.	R10	R1J	R1K	R1P
1	Rotary Servo (Fig. 14)	S22-15310	S22-15310	1	1	1	1
2	Control Cap (Fig. 7)	S22-15272	S22-15272	1	—	—	—
	Low Torque Override (Fig. 8)	S22-15650	S22-15533	—	1	—	—
	High Torque Override (Fig. 8)	S22-15651	S22-15535	—	—	1	—
	Compensator Override (Fig. 10)	S22-15531	S22-15531	—	—	—	1
*3	O-Ring, 90 S-1 ARP 113	691-00113	691-00113	2	2	2	2
*4	Elbow	494-15019	494-15019	1	1	1	1
*5	Elbow	494-15021	494-15021	1	1	1	1
*6	45° Swivel Nut Ell	492-15389	492-15389	1	1	1	1
*7	Tube	032-91888	032-92190	1	1	1	1
8	Screw-H.H.C., M12 x 60 mm	363-12210	363-12210	6	4	4	6
9	Screw-H.H.C., M12 x 80 mm	363-12225	363-12225	2	4	4	2
10	Control Piston	032-91785	032-91785	1	1	1	1
11	O-Ring, 90 S-1 ARP 013	691-00013	691-00013	2	2	2	2
12	O-Ring, 70 S-1 ARP 152	671-00152	671-00152	2	2	2	2
13	Piston Ring	032-91261	032-91261	1	1	1	1
14	Piston Ring	032-91811	032-91811	1	1	1	1

*Tubing assembly available as S22-15583 (P260)
*Tubing assembly available as S22-15668 (P140)

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 (3) with attached parts. Remove spring (8) and spool (4).
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 (14) and nut (15). Push a rod through the cap to remove the retainer (12).

ASSEMBLY

1. **See Figure 6.** Install Avseal plug (6) in cap.
2. Install spool (4) into bore as shown. Install spring (8) over end of spool.
3. Install O-ring (13) on spring retainer (12). Install retainer (12), screw (14) and nut (15) in plug (3).
4. Install O-rings (7) and (16) on plug (3). Install plugs (3) and (9) in body (1). Torque plugs to 60 Nm. Install O-ring (8) in cap.
5. Turn screw (12) in until spring retainer (12) contacts spring (8). 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 102 Nm.
8. **See Figure 14,** Apply Loctite® on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 6,78 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 11,4 +/- 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 1/4 in. (6.35 mm) below surface. Apply Loctite® 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 above drawing. Torque plug (12) to 122 Nm.
15. While spring retainer is engaging screw (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 103 Nm.

TEST AND ADJUSTMENT

1. Plumb 82,8 bar servo supply to control.
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 (15 figure 6) out to go towards full or in to go towards zero flow.
7. Rotate shaft clockwise and counterclockwise at approximately 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 .5 second.

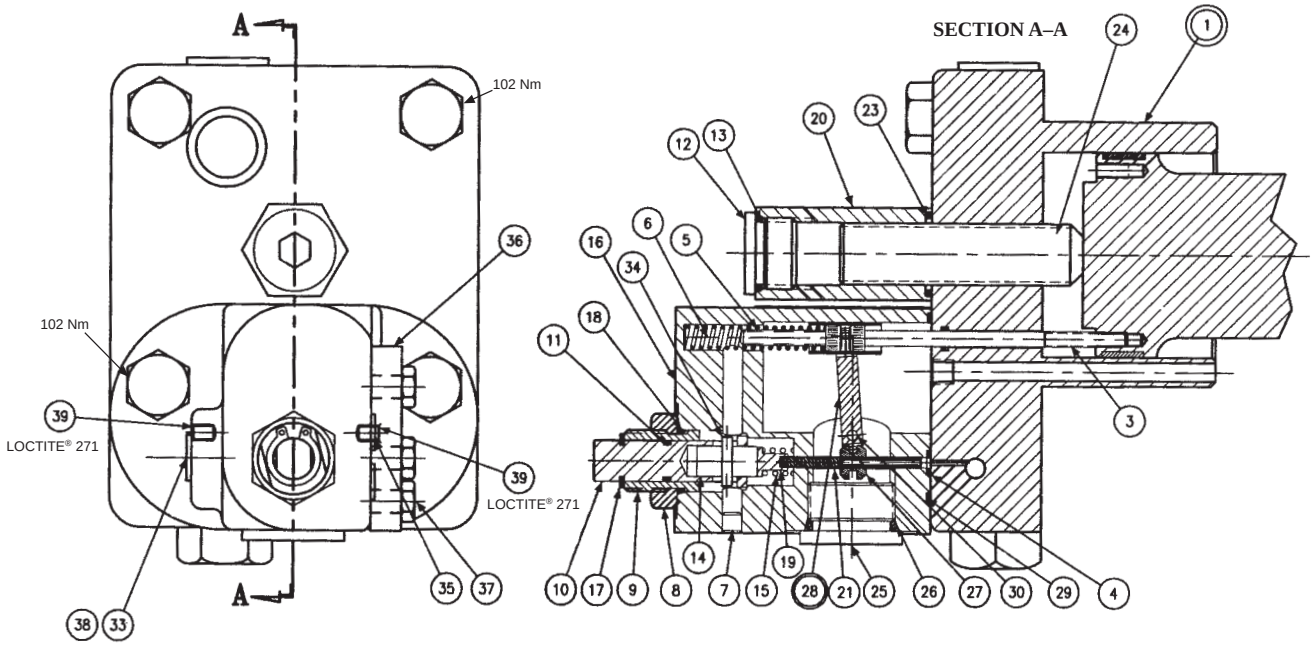
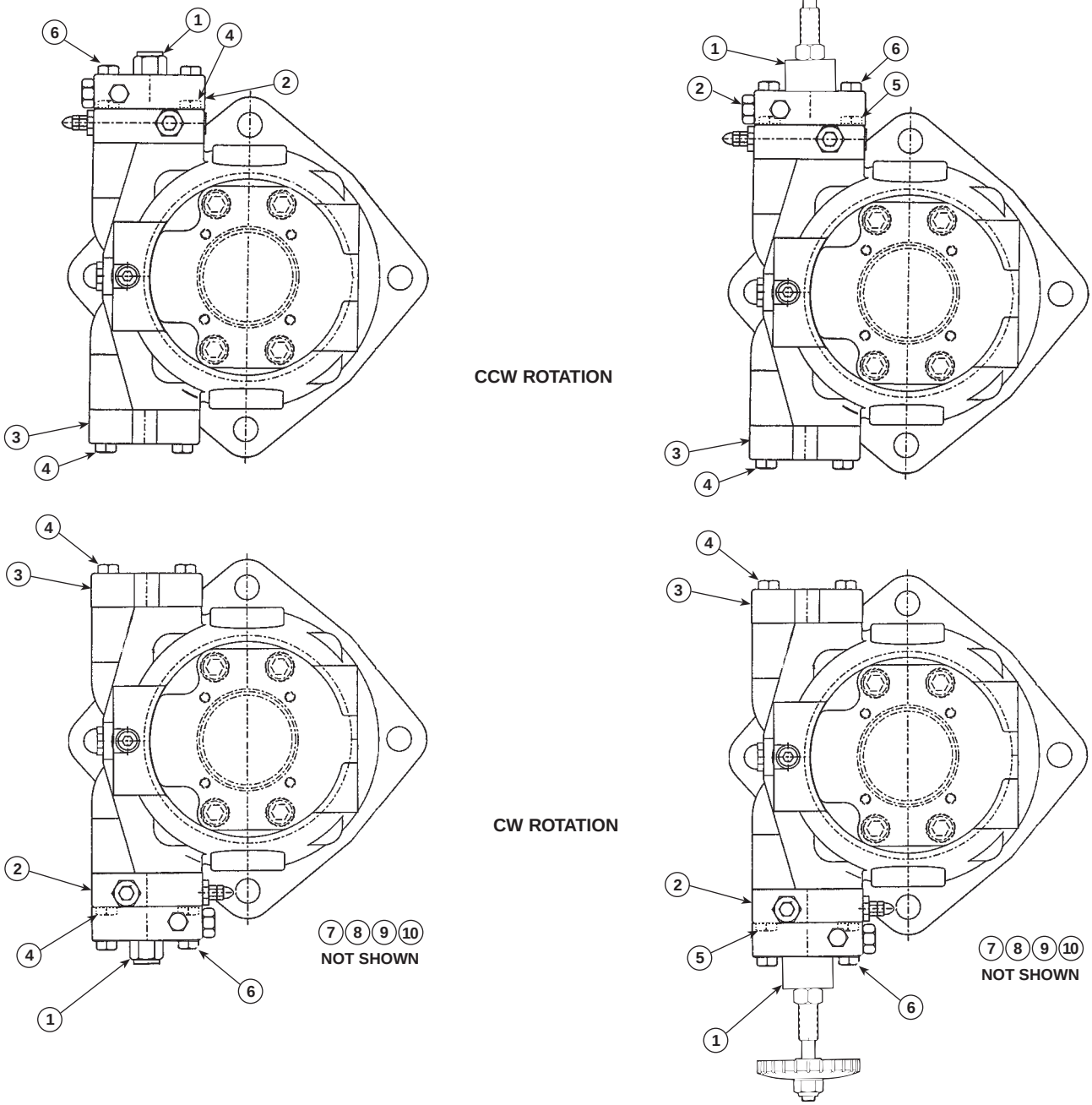


FIGURE 14
ROTARY SERVO

PARTS LIST FOR FIGURE 14
Assembly No.. S22-15310

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap (Figure 6)	S22-15268	1
3	Screw	032-91461	1
4	O-Ring, 70 S-1 ARP 010	671-00010	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, 10HP5N-S	488-35055	1
13	O-Ring, 90 S-1 ARP 910	691-00910	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	1
19	Spring Retainer	032-91516	1
20	Nut, 3/4-10	031-91049	1
21	Spool	032-91438	1
23	O-Ring, 70 S-1 ARP 118	671-00118	1
24	Soc. Setscrew, 3/4-10 x 3	311-26320	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 1.75 Lg.	324-20828	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



L10 L20

LOAD SENSING CONTROL
parts list

ITEM	DESCRIPTION	PART NO.	QTY. L10	QTY. L20
1	Max. Vol. Stop (Fig. 1)	S22-12983	1	—
	Max Vol. Handwheel (Fig. 2)	S22-12915	—	1
2	Load Sensing Control (Fig. 15)	S22-15537	1	1
3	Buck Up Cap (Fig. 4)	S22-12970	1	1
4	Screw-H.H.C.,M12 x 60 mm	363-12210	6	4
5	Screw-H.H.C., M12 x 80 mm	363-12225	—	2
6	Screw-H.H.C., M12 x 90 mm	363-12240	2	2
7	Control Piston	032-91443	1	1
8	O-Ring, 90 S-1 ARP 013	691-00013	2	2
9	O-Ring, 70 S-1 ARP 152	671-00152	2	2
10	Piston Ring	032-91261	2	2

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

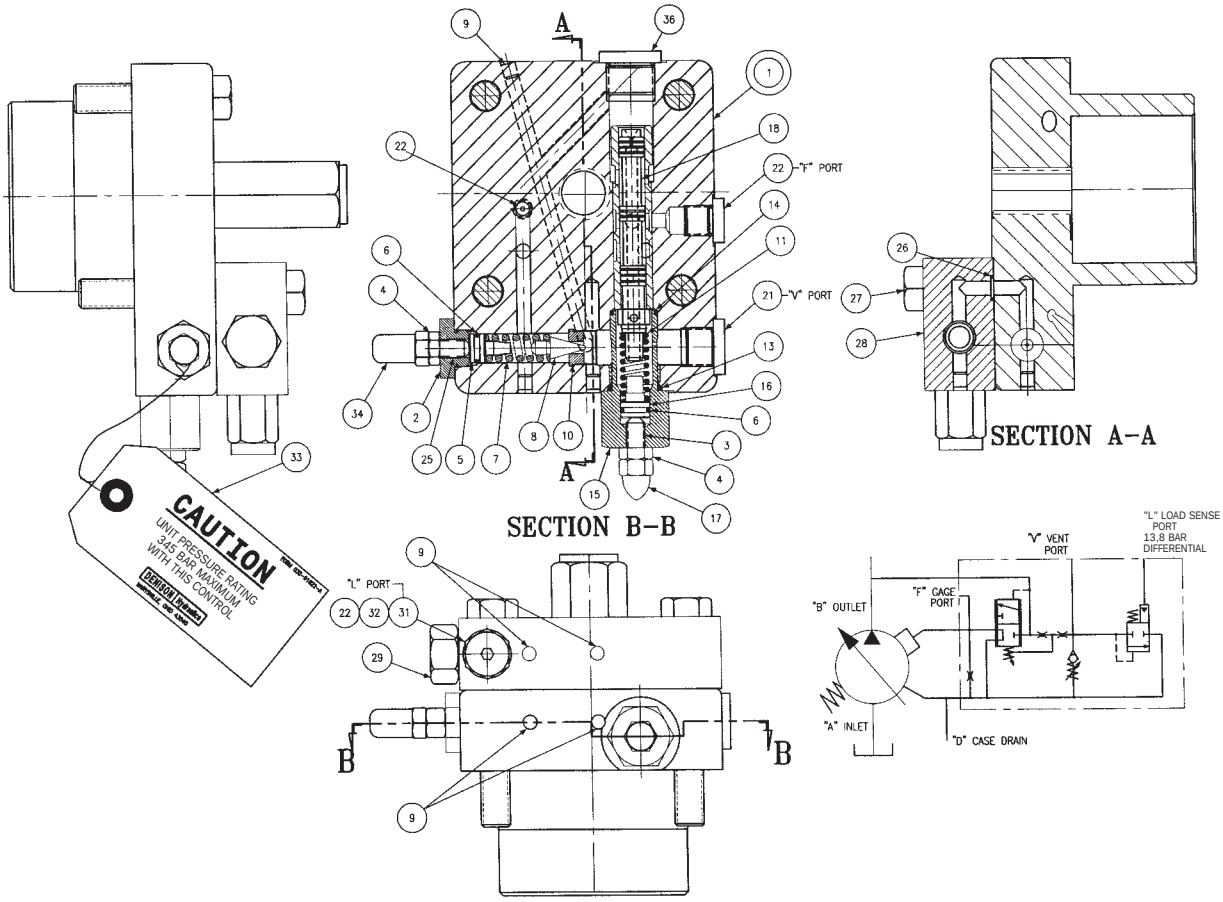
1. Install Avseal plugs (9) and orifice (35) in body.
2. Press seat (10) into bore squarely against shoulder in bore.
3. Install spool (18) into bore as shown. Install spring (11) over end of spool. Install O-ring (6) on seal (16). Lubricate and install into plug (15). Install plug (15) into cap. Install screw (3), nut (4) and acorn nut (17).
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 (36) to 60 Nm. Torque plug (21) to 35 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 67.8 Nm.
7. Install O-ring (32) on plug (31). Install plug in block (28). Install plug (22) in adapter.
8. 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).
9. Install on pump control pad, guiding the control piston into the bore. Install maximum volume stop parts.
10. Torque mounting bolts to 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 downstream of the metering valve. Connect gage to pump output, and to load sensing line, capable of measuring 20,7 bar pressure difference at 345 bar.

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

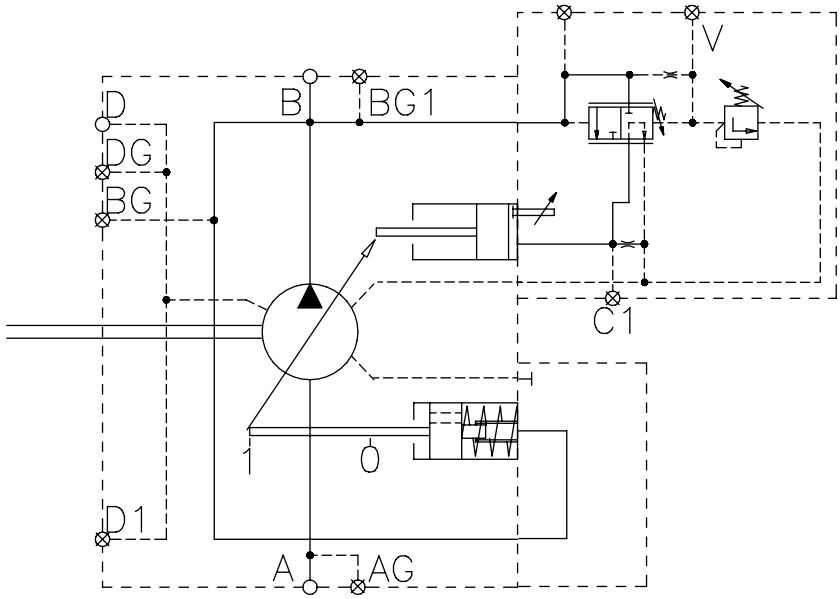
1. Adjust maximum volume stop to full displacement by backing off stop till there is no contact with the control piston.
2. Turn compensator adjustment screw (25) CCW until there is no contact with spring, then adjust 1/2 turn CW after contact is made with spring.
3. Turn differential adjustment screw (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 35 bar.
5. Start prime mover. Pump should be at full displacement at 35 bar.
6. Increase system relief valve until compensator de-strokes pump to zero displacement. Set compensator to 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 24,1 ± 1.7 bar or shop order requirement.
8. Set the compensator to 207 bar, and 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 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.
9. Open the metering valve to 454 ± 3,8 l/m flow at 69 bar. Raise the relief valve setting till the pump compensates at 345 bar. Reduce relief valve setting 13,8 bar. Flow to return to 454 ± 7,4 l/m.
10. Check pressure differential at 69, 138, and 207 bar ± 6,9 bar. Pressure differential to remain the same as in (7) above.
11. Set the flow to 37.8 l/m at 69 bar. Observe flow as pressure is varied from 34,5 bar to 331 bar. Flow shall not vary by more than ±7,6 l/m).
12. Repeat at 113 ± 3,78 l/m.
13. Set load relief valve at 138 bar. Check pressure differential at 37,8, 114, and 189 l/m ± 7,6 l/m. Pressure differential shall be the same as in (7) above.
14. Set compensator adjustment to the required setting, or 345 bar if not otherwise noted.



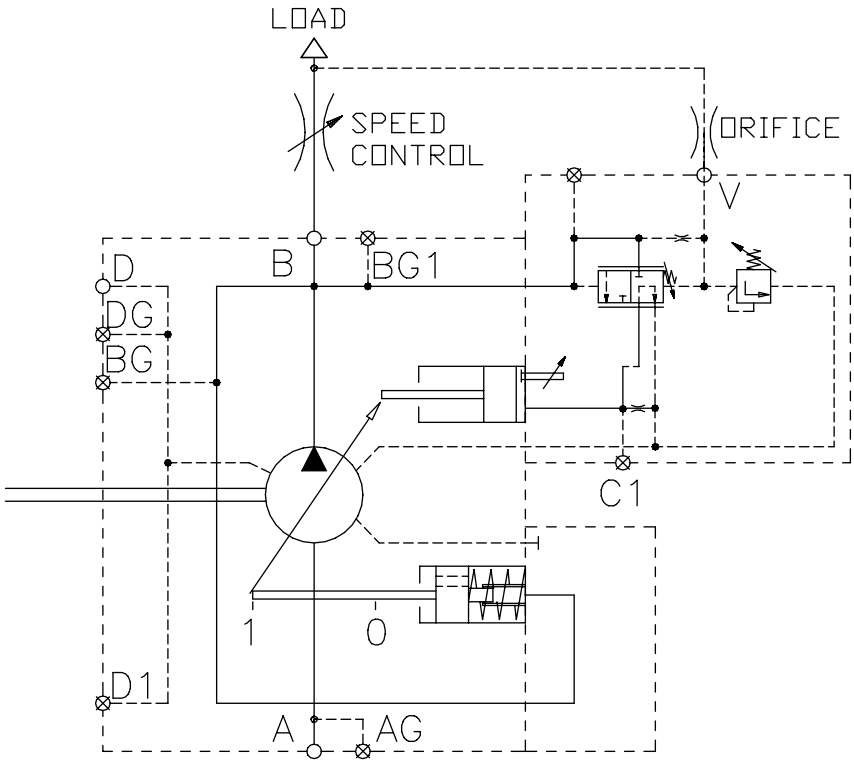
PARTS LIST FOR FIGURE 15
Assembly No. S22-15537

ITEM	DESCRIPTION	PART NO.	QTY.
1	Cap-Sleeve Assembly	S22-15176	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
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	Nut, Acorn 5/16-24	327-25006	1
18	Spool	032-59482	1
21	Plug, BSPP 3/8	447-00032	1
22	Plug, BSPP 1/4	447-01004	2
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	Adapter	032-91507	1
32	O-Ring, 90 S-1 ARP 904	691-00904	1
33	Tag, Caution	032-91622	1
34	Nut, Acorn	036-33474	1
35	Orifice Plug	033-25528	1
36	Plug BSPP 1/2	447-01008	1

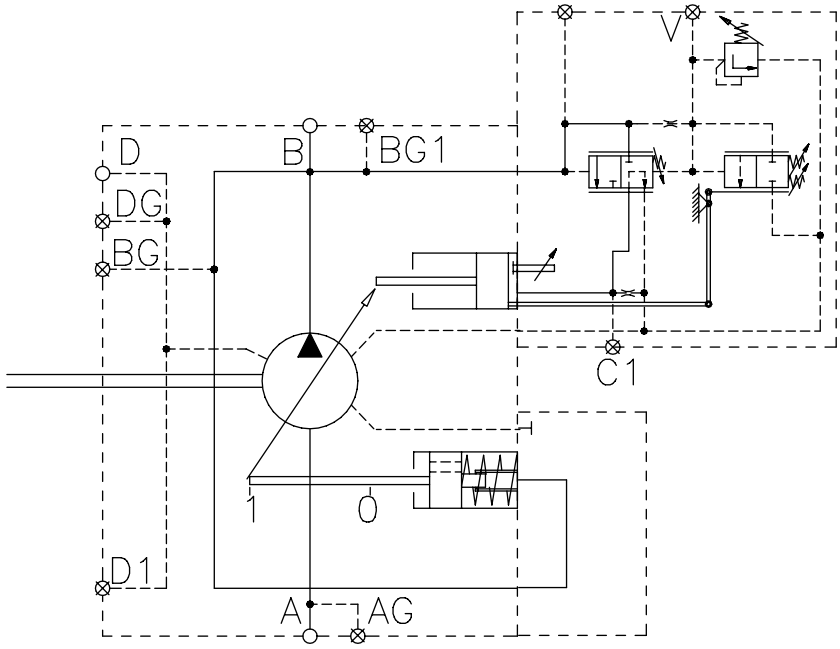
HYDRAULIC CIRCUIT PRESSURE COMPENSATOR (C10)



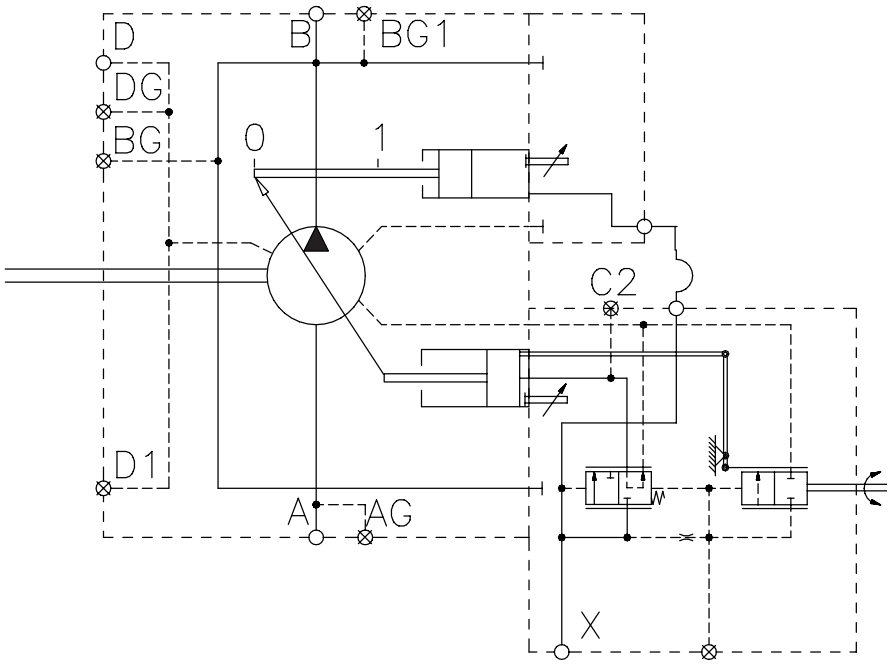
HYDRAULIC CIRCUIT PRESSURE COMPENSATOR, LOAD SENSING CONFIGURATION (C10)



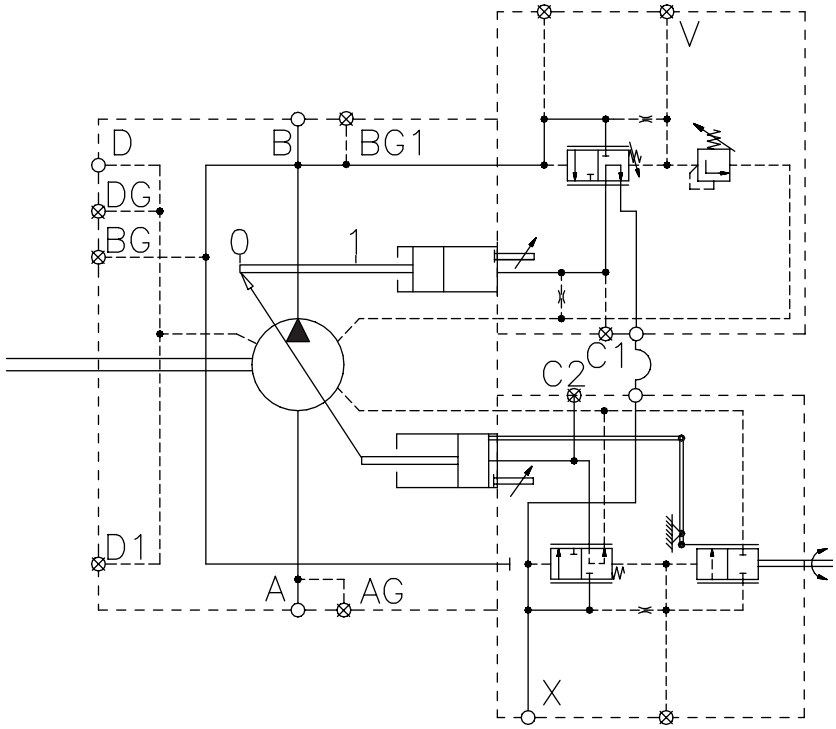
HYDRAULIC CIRCUIT
TORQUE LIMITER (J & K10)



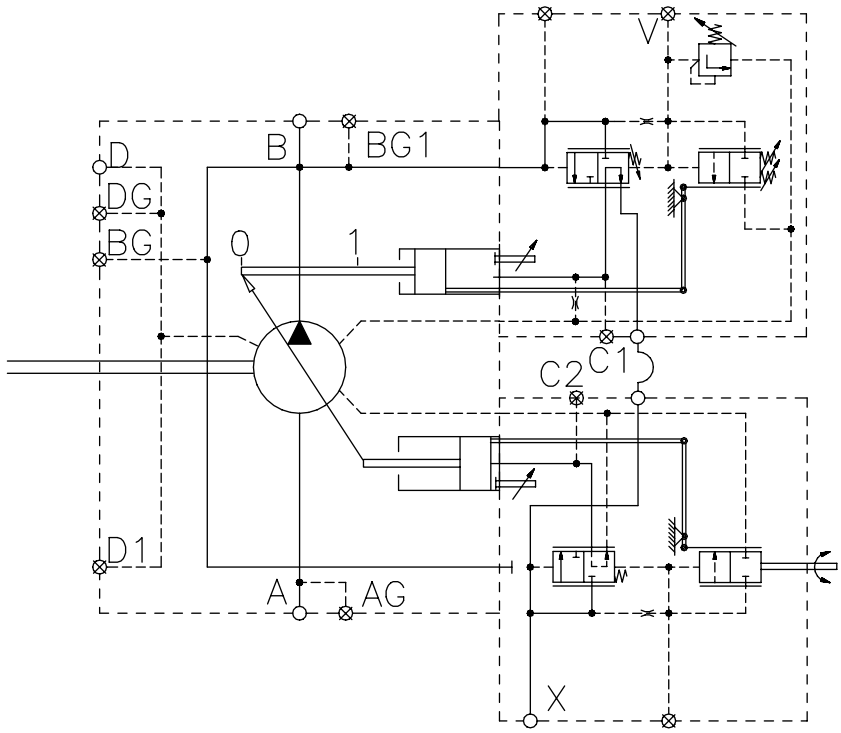
HYDRAULIC CIRCUIT
ROTARY SERVO (R10)



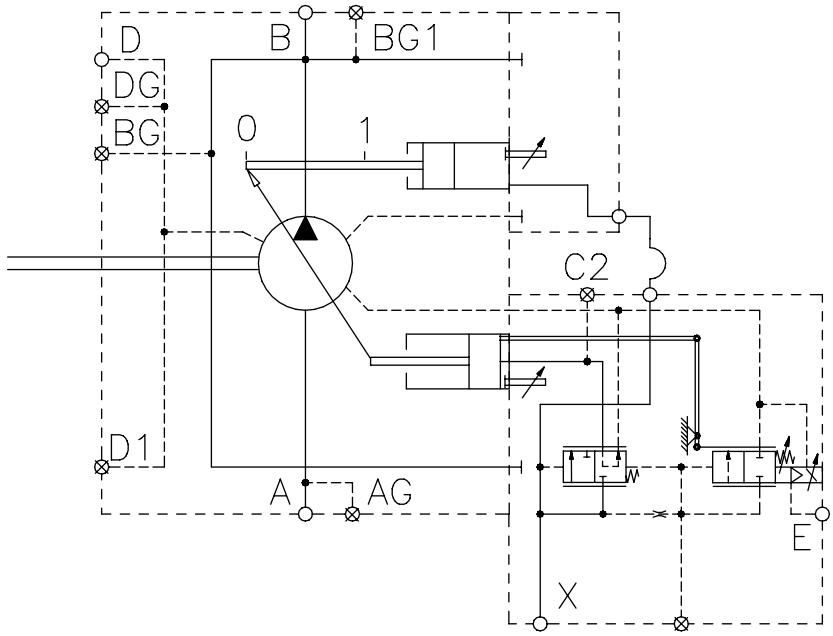
HYDRAULIC CIRCUIT ROTARY SERVO WITH COMPENSATOR OVERRIDE (R1P)



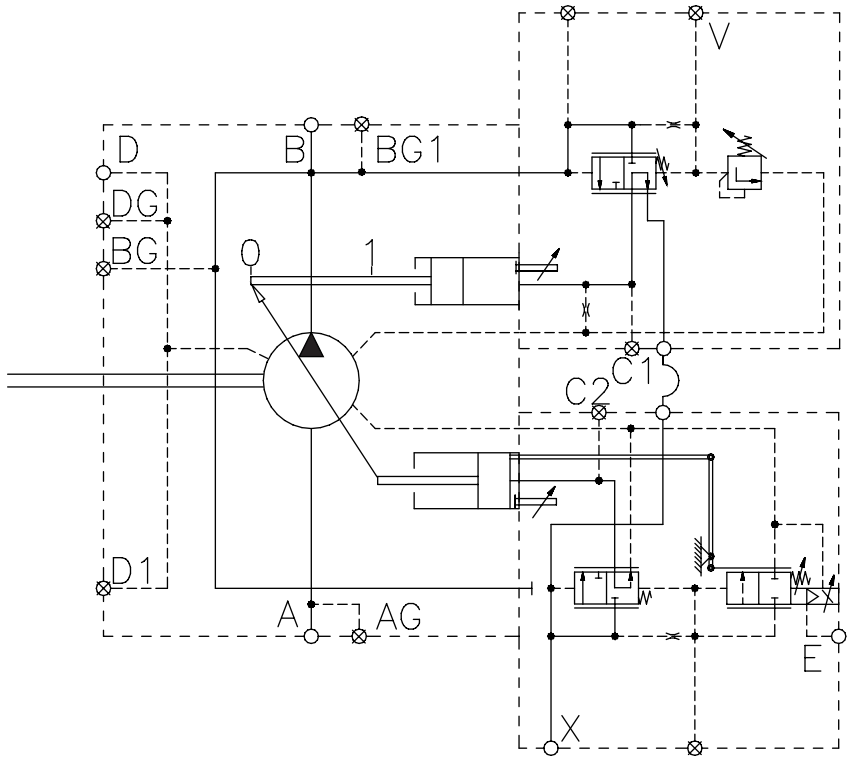
HYDRAULIC CIRCUIT ROTARY SERVO WITH TORQUE LIMITER OVERRIDE (R1J & R1K)



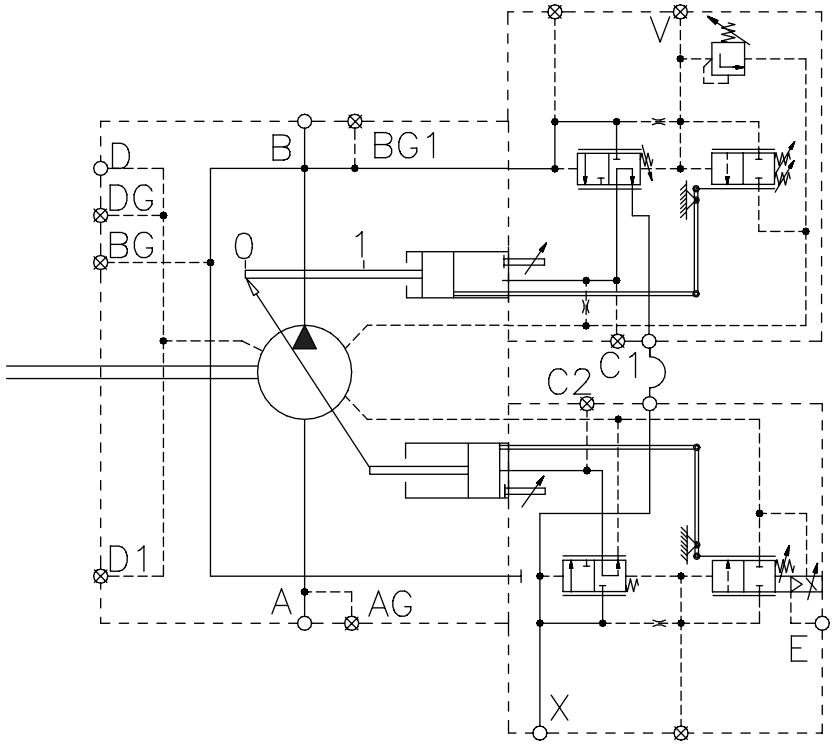
HYDRAULIC CIRCUIT ELECTRIC STROKER (E10)



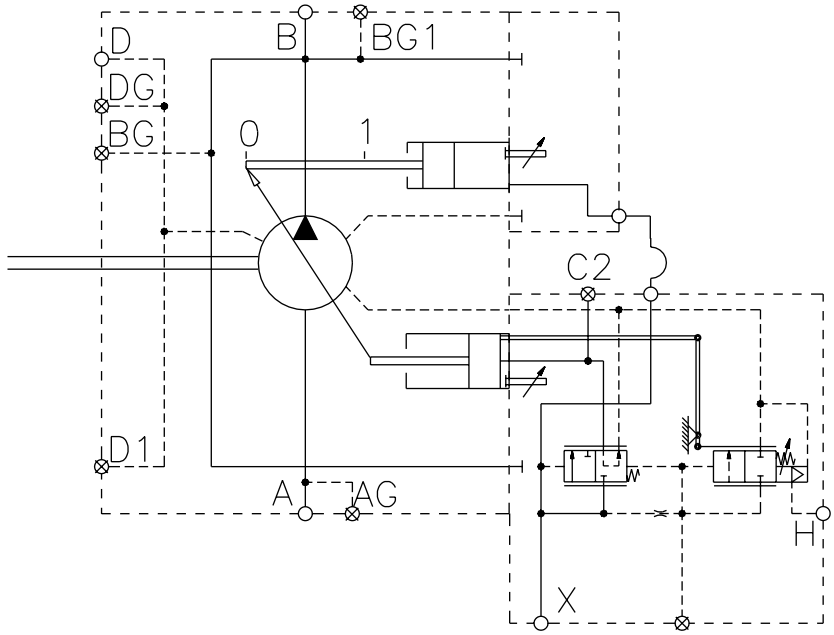
HYDRAULIC CIRCUIT ELECTRIC STROKER WITH COMPENSATOR OVERRIDE (E1P)



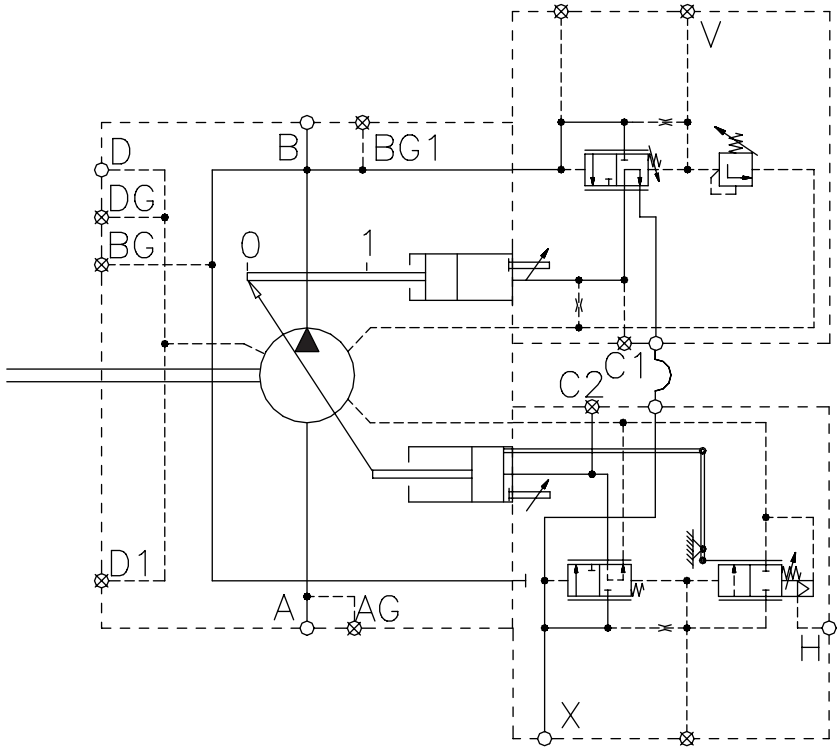
HYDRAULIC CIRCUIT
ELECTRIC STROKER WITH
TORQUE LIMITER OVERRIDE
(E1J & E1K)



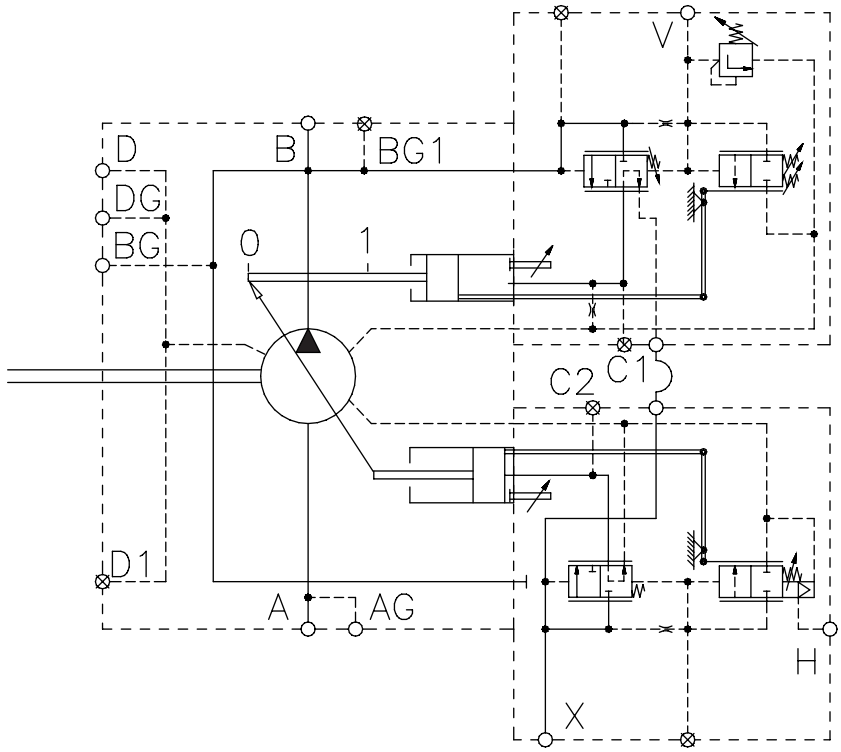
HYDRAULIC CIRCUIT
HYDRAULIC STROKER (H10)



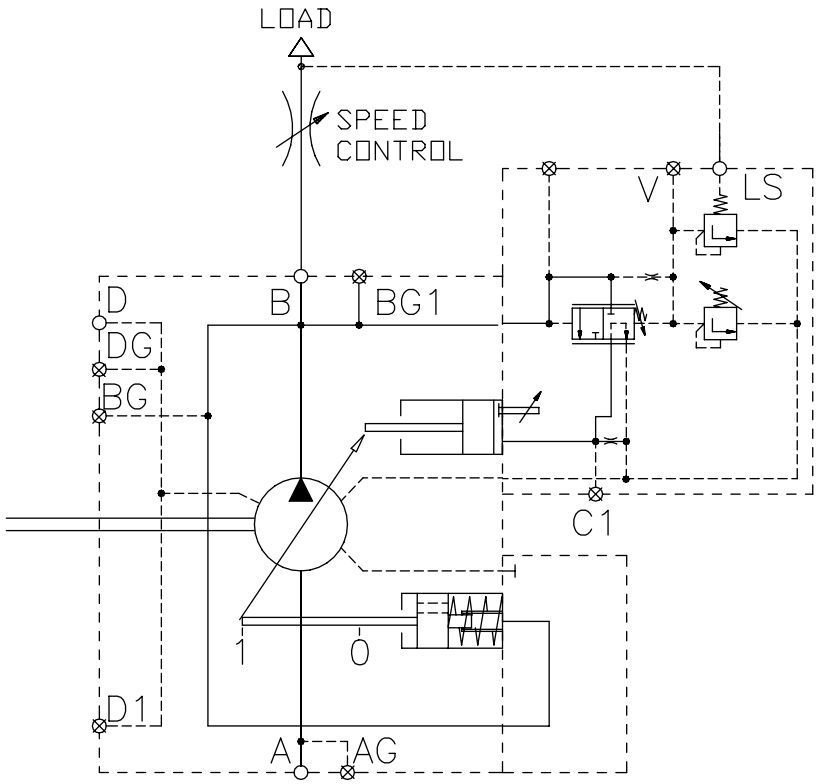
HYDRAULIC CIRCUIT
HYDRAULIC STROKER WITH COMPENSATOR OVERRIDE (H1P)

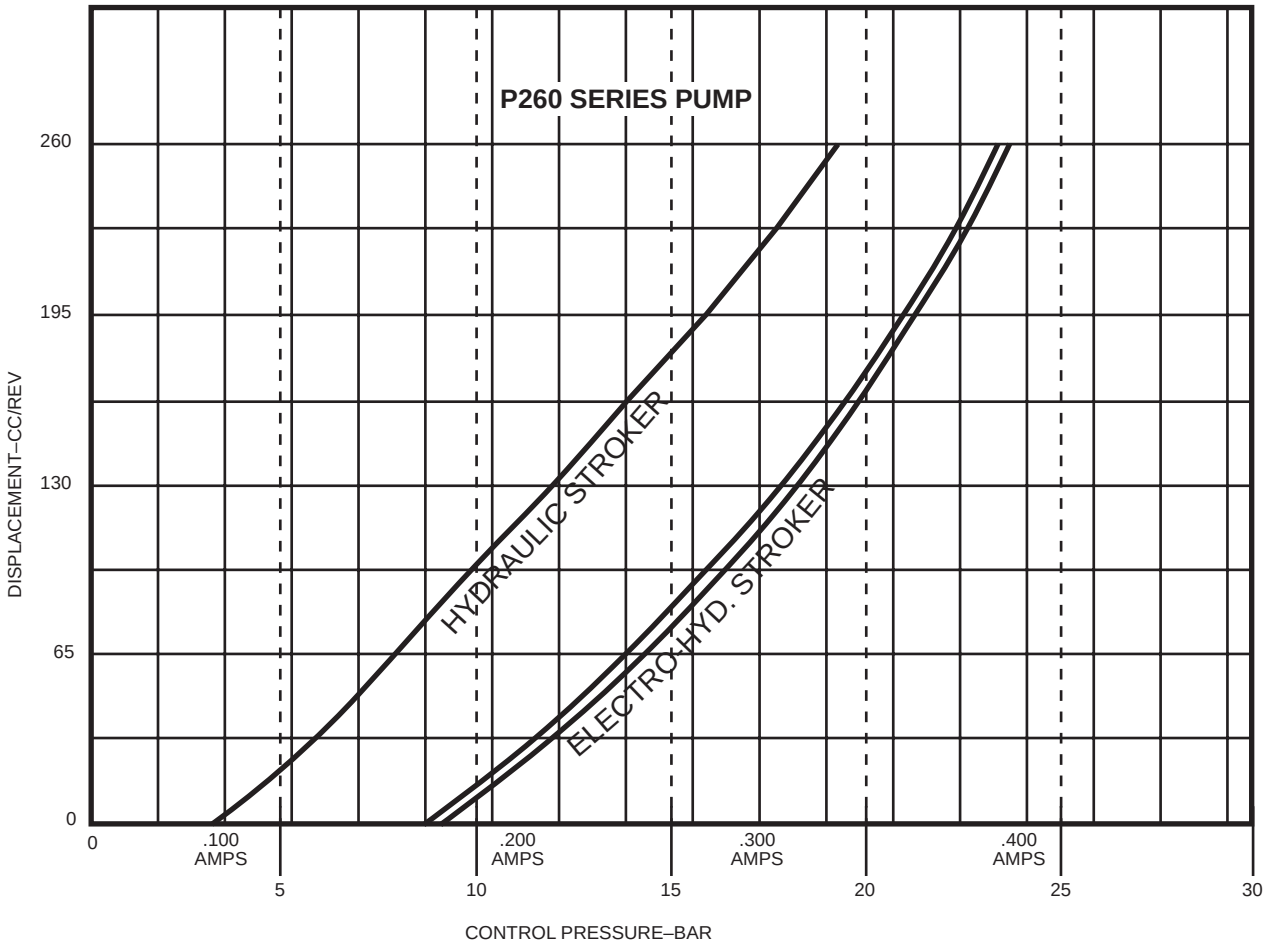


HYDRAULIC CIRCUIT
HYDRAULIC STROKER WITH TORQUE LIMITER OVERRIDE (H1J & H1K)

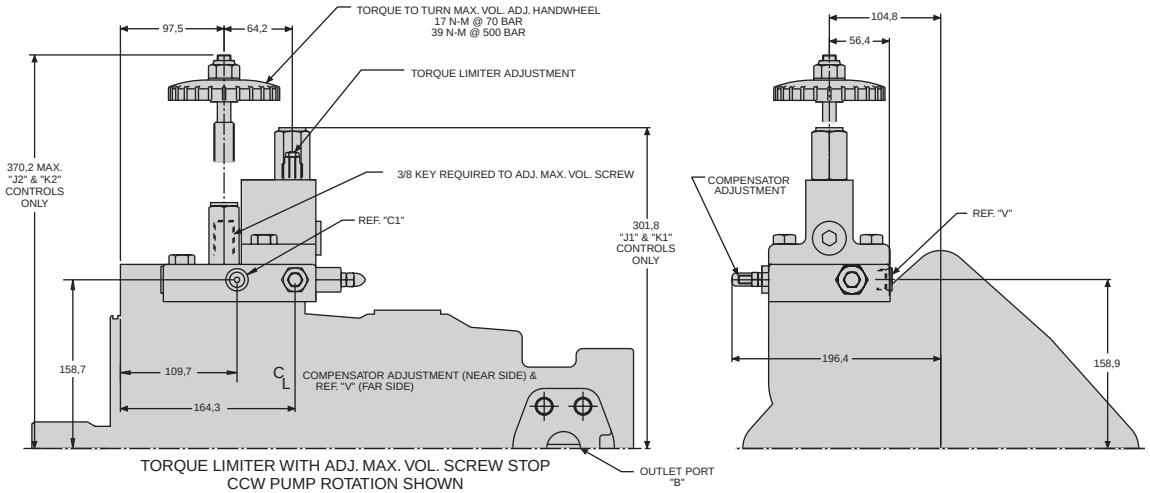


HYDRAULIC CIRCUIT
LOAD SENSING CONTROL
(L10)

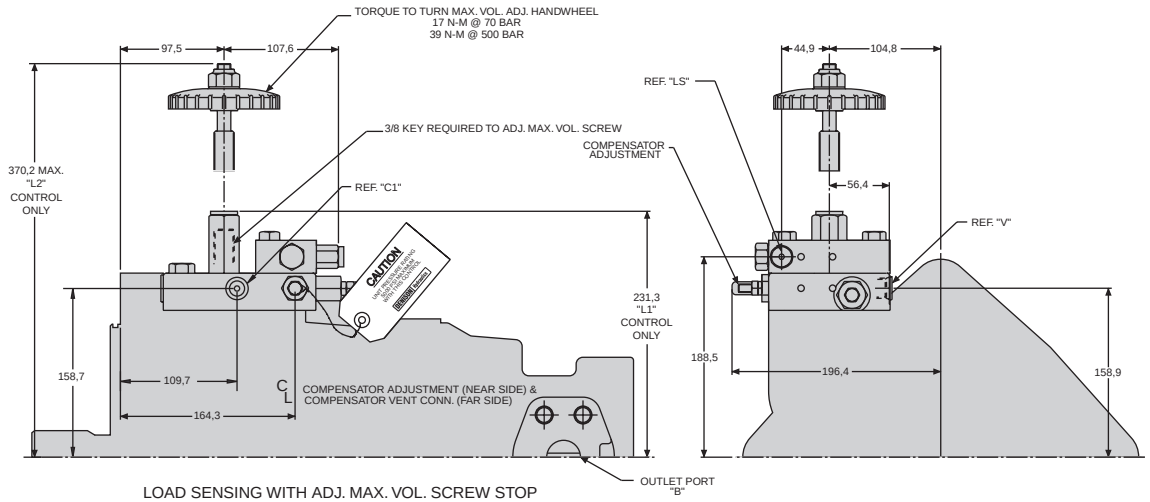




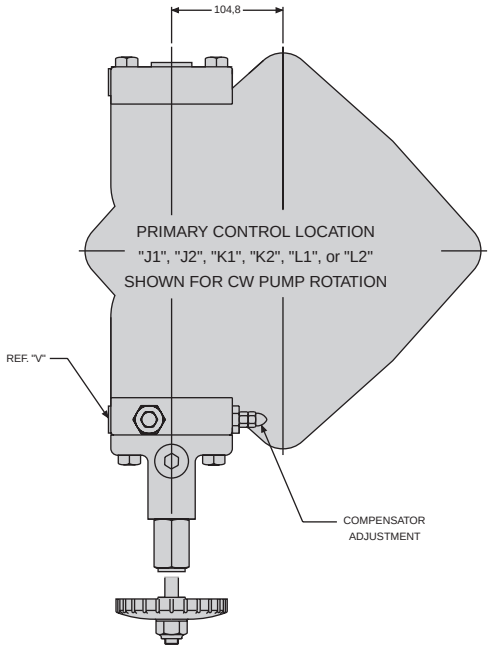
HYDRAULIC AND ELECTROHYDRAULIC STROKER PERFORMANCE

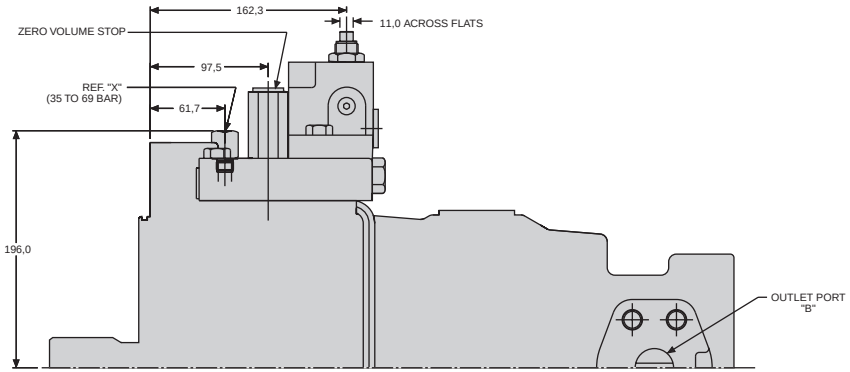


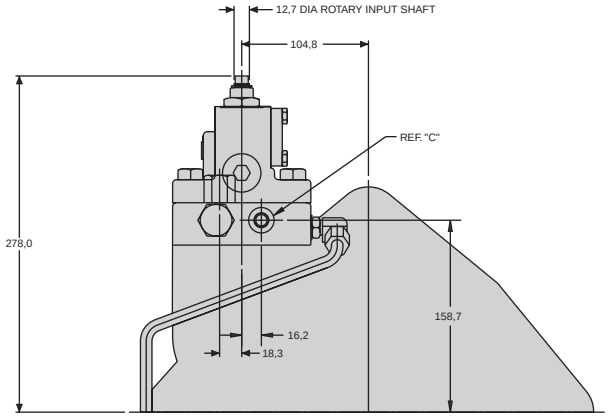
TORQUE LIMITER WITH ADJ. MAX. VOL. SCREW STOP
CCW PUMP ROTATION SHOWN
"J1" OR "K1" AS NOTED
AND
TORQUE LIMITER WITH HANDWHEEL ADJ. MAX. VOL. STOP
CCW PUMP ROTATION SHOWN
"J2" OR "K2" AS NOTED



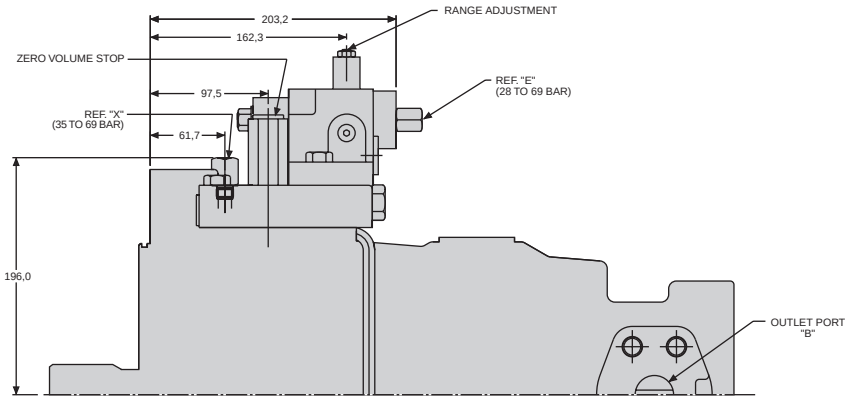
LOAD SENSING WITH ADJ. MAX. VOL. SCREW STOP
CCW PUMP ROTATION SHOWN
"L1" AS NOTED
AND
LOAD SENSING WITH HANDWHEEL ADJ. MAX. VOL. STOP
CCW PUMP ROTATION SHOWN
"L2" AS NOTED

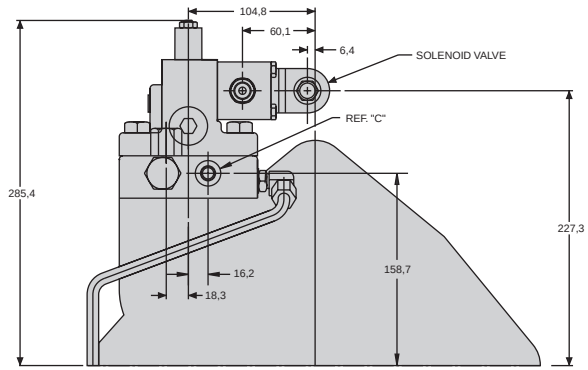




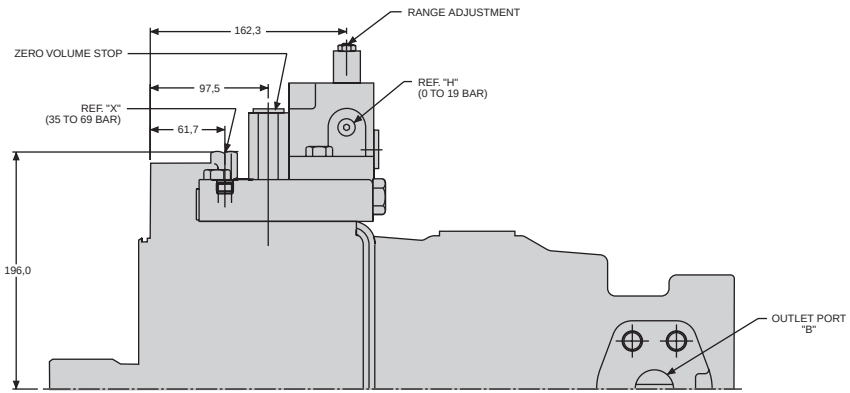


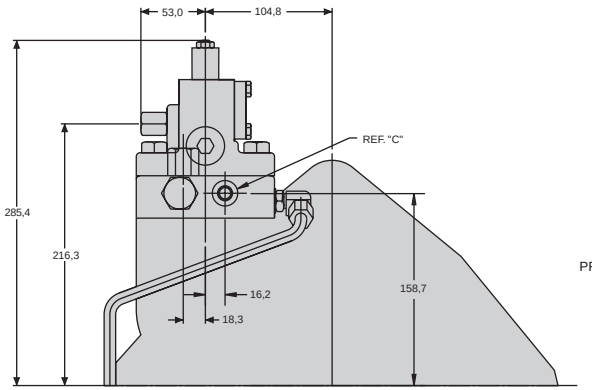
ROTARY SERVO
"R"





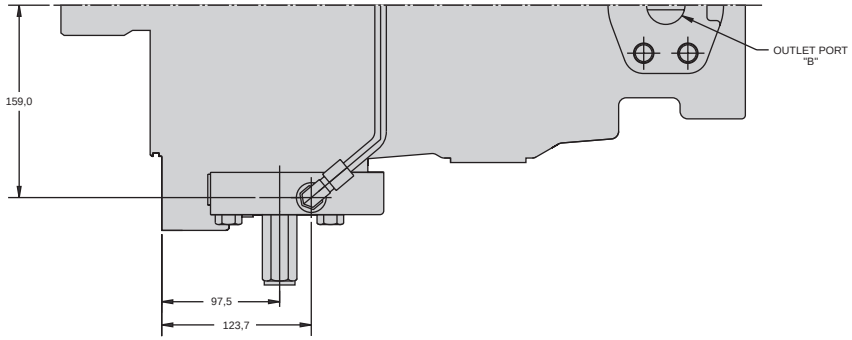
ELECTRO-
HYDRAULIC STROKER
"E"

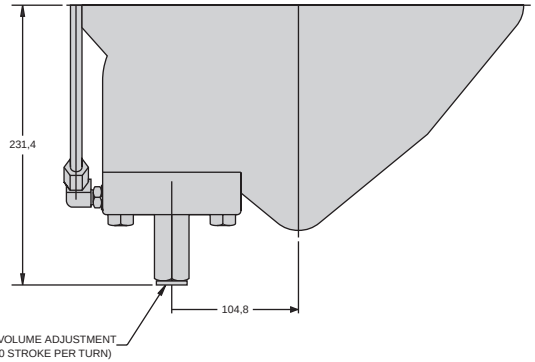




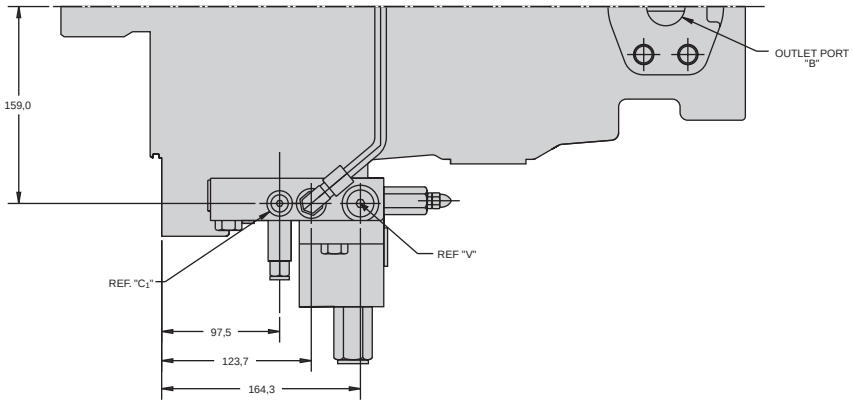
HYDRAULIC STROKER
"H"

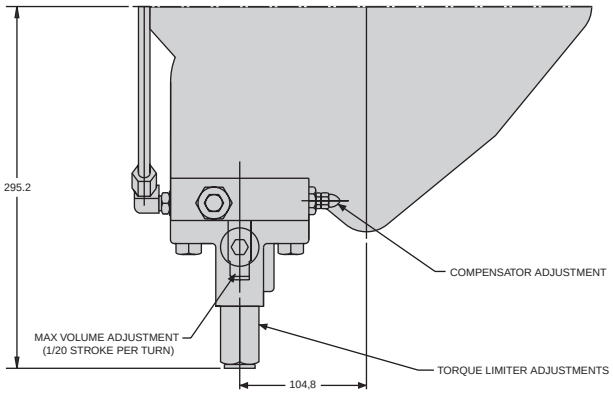
PRIMARY CONTROLS CW PUMP ROTATION



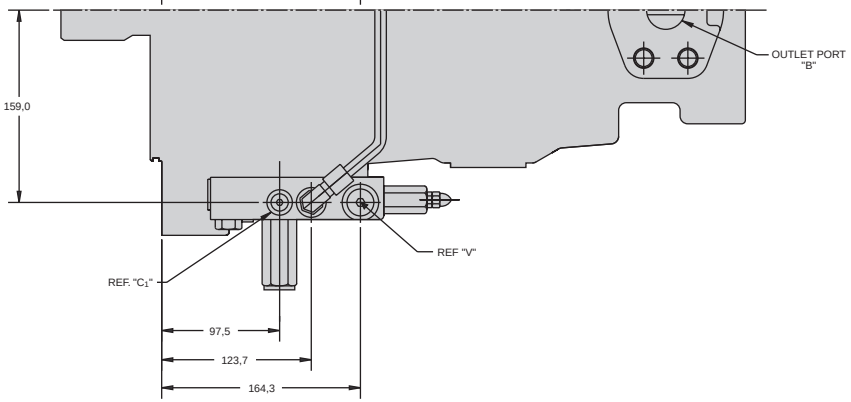


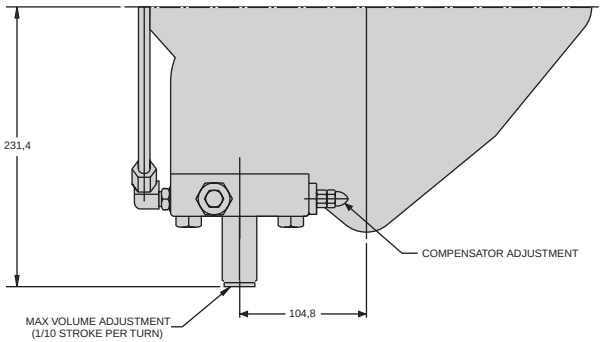
CONTROL-CAP
SPRING BUCKDOWN
"O"





TORQUE LIMITER OVERRIDE
W/MAX VOLUME STOP
"J" OR "K"





COMPENSATOR OVERRIDE
WITH MAX VOLUME STOP
"P"

SECONDARY CONTROLS CW PUMP ROTATION

P260 - * * * * - C 1 0 - *

Secondary control options
O-S22-15272– None
P-S22-15531 – Compensator Override
J-S22-15533 – Low Torque Limiter Override
282-706 Nm
K-S22-15535– High Torque Limiter Override
706-1129 Nm

Primary control options
1-S22-12983 – Standard maximum volume screw
2-S22-12915 – Handwheel (Available on Compensator and Torque Limiter)

Primary controls
C-S22-15312– Pressure Compensator
E-S22-15306 – Electric Stroker
H-S22-15308– Hydraulic Stroker
J-S22-15314 – Low Torque Limiter
282-706 Nm
K-S22-15316– High Torque Limiter
706-1129 Nm
L-S22-15537 – Load Sensing
R-S22-15310– Rotary Servo

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	$\frac{\text{degree F-32}}{1.8}$ = °C	1.8 x °C+32 = °F
viscosity	*c*St x 1.0 = mm^2/sec	mm^2/sec x 1.0 = *c*St
	$\frac{\text{(SSU-14)}}{4.25} \approx$ 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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