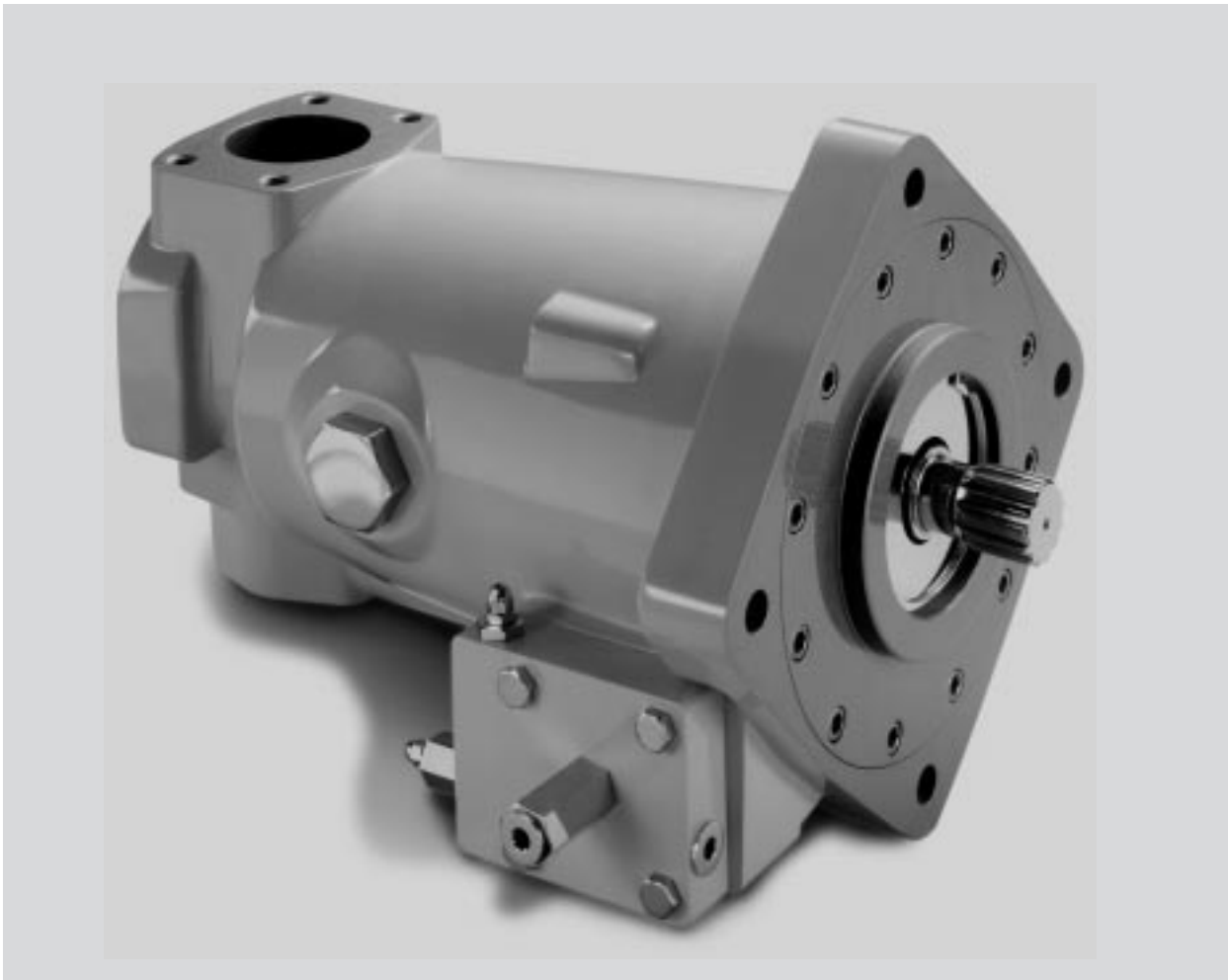


DENISON HYDRAULICS
Premier series
open circuit pumps P16 & 260 C-mod.
service information



Publ. S1-AM022-B replaces S1-AM022-A, S1-AM021-A, S1-AM024-A, S1-AM026-A

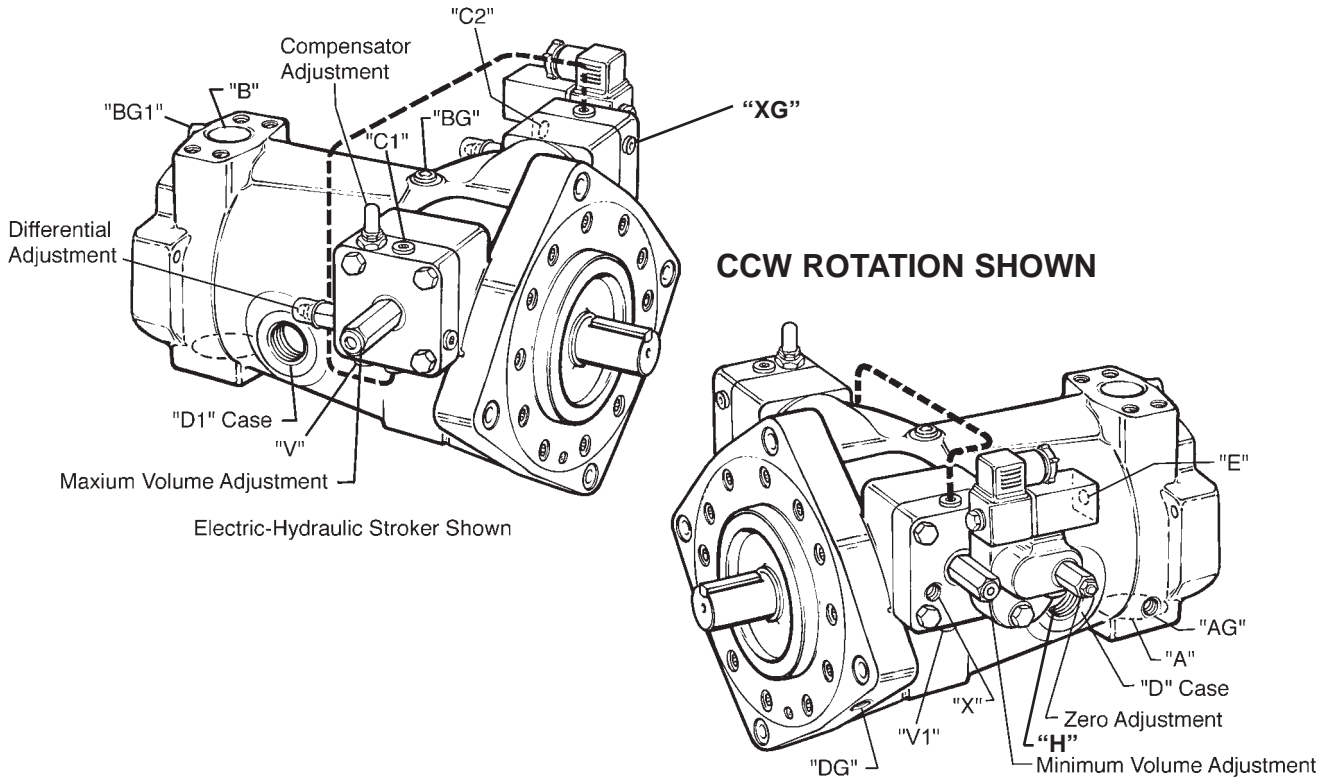
Revised 3/03

DENISON | **Hydraulics**

| TITLE | PAGE |
|-------------------------------|------|
| Port Identification | 3 |
| Start up Procedure | 7 |
| Trouble shooting charts | 8 |
| Disassembly | 10 |
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| | | |
|----------------|-----------------------|-------------|
| Seal kit | P16 | S22-12830-0 |
| | P16 with "X" CONTROL | S22-16220 |
| | P260 ISO | S22-12831-0 |
| | P260 DIN | S22-16160-0 |
| | P260 with "X" CONTROL | S22-16221 |

The shaft seal and all "O" rings necessary for total seal replacement may be obtained by ordering Seal Kit . These seals are suitable for petroleum base fluids. For fire resistant fluids contact **DENISON HYDRAULICS**, Inc. or their authorized distributors to obtain the appropriate seal kit number.



Electric-Hydraulic Stoker Shown

FLUID CONNECTIONS

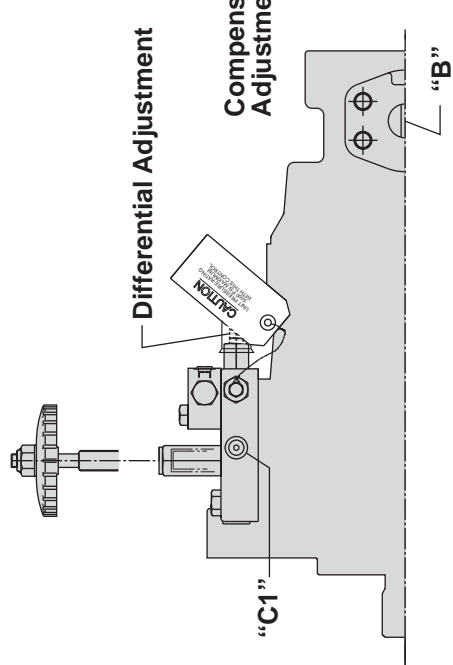
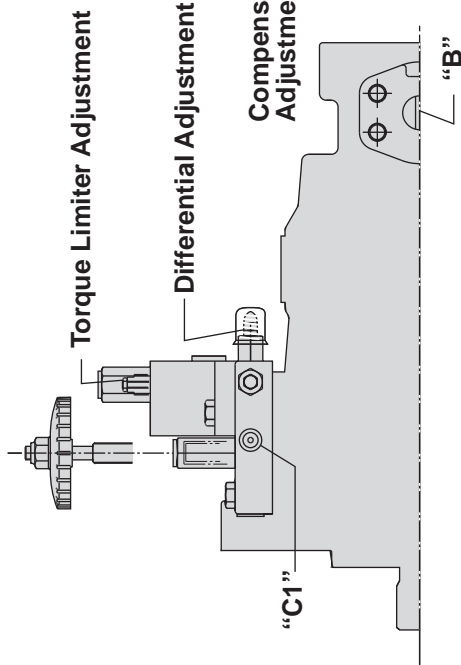
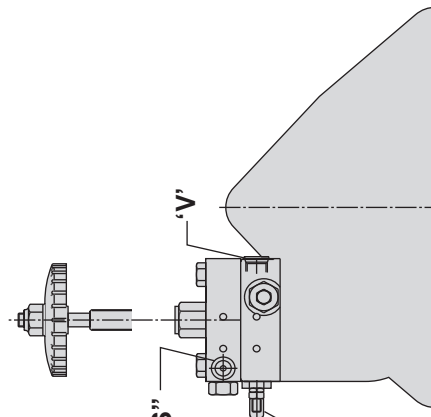
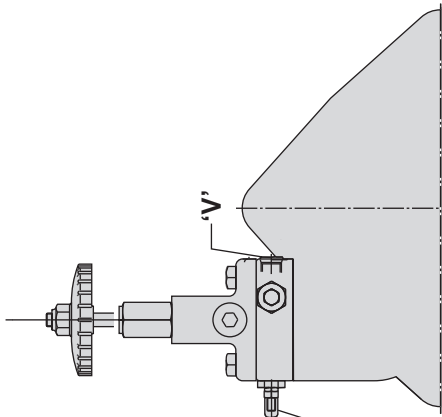
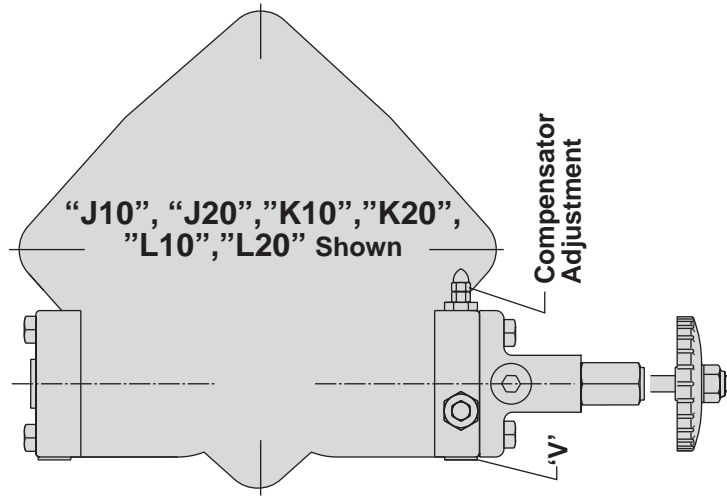
| DESCRIPTION | P16 C MOD | P260 C MOD |
|--|------------------------------------|-----------------------------------|
| PORT AINLET | 3-1/2 SAE CODE 61 5/8-11 SCREWS | 3-1/2 SAE CODE 61 M16-2 SCREWS |
| PORT BSYSTEM | 1-1/2 SAE CODE 62 5/8-11 SCREWS | 1-1/2 SAE CODE 62 M16-2 SCREWS |
| PORT C1OFF-STROKE CYL. GAGE..... | SAE-4 | 1/4 BSPP |
| PORT C2ON-STROKE CYL. GAGE | SAE-4 | 1/4 BSPP |
| PORT DCASE DRAIN | SAE-24 | 1-1/2 BSPP |
| PORT D1CASE DRAIN | SAE-24 | 1-1/2 BSPP |
| PORT DG.....DRAIN GAGE, AIR BLEED PORT | SAE-4 | 1/4 BSPP |
| PORT AG.....INLET GAGE | SAE-4 | 1/4 BSPP |
| PORT BG.....SYSTEM GAGE..... | SAE-4 | 1/4 BSPP |
| PORT BG1....ALT. SYS. GAGE..... | SAE-6 | 1/4 BSPP |
| PORT EELECTROHYDRAULIC STROKER SERVO SUPPLY | SAE-4 | 1/4 BSPP |
| PORT HHYDRAULIC STROKER SIGNAL | SAE-4 | 1/4 BSPP |
| PORT LSLOAD SENSING LINE | SAE-4 | 1/4 BSPP |
| PORT VCOMPENSATOR, TORQUE LIMITER, LOAD SENSING VENT | SAE-8 | 3/8 BSPP |
| PORT VOVERRIDE COMP, OVERRIDE TORQUE LIMITER VENT | SAE-4 | 1/4 BSPP |
| PORT V1SERVO VENT | SAE-4 | 1/4 BSPP |
| PORT XSERVO SUPPLY | SAE-8 | 3/8 BSPP |
| PORT XGSERVO GAGE | SAE-10 | 1/2 BSPP |

CW ROTATION

TORQUE LIMITER WITH ADJ. MAX. VOL. STOP, CCW and

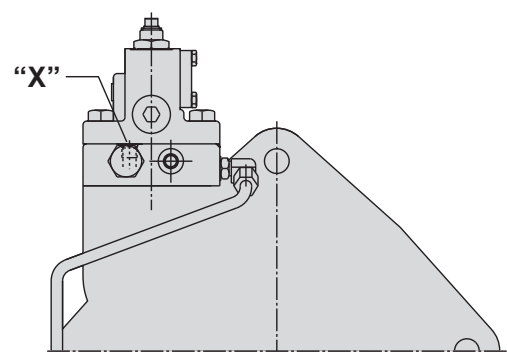
TORQUE LIMITER WITH HANDWHEEL ADJ. MAX. VOL. STOP, CCW

LOAD SENSING WITH ADJ. MAX. VOL. SCREW STOP, CCW

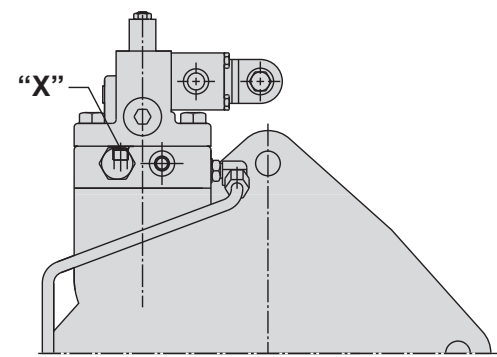


CW ROTATION

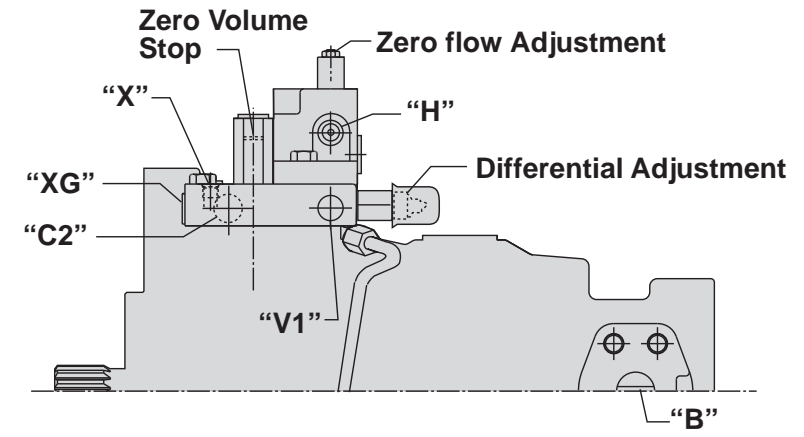
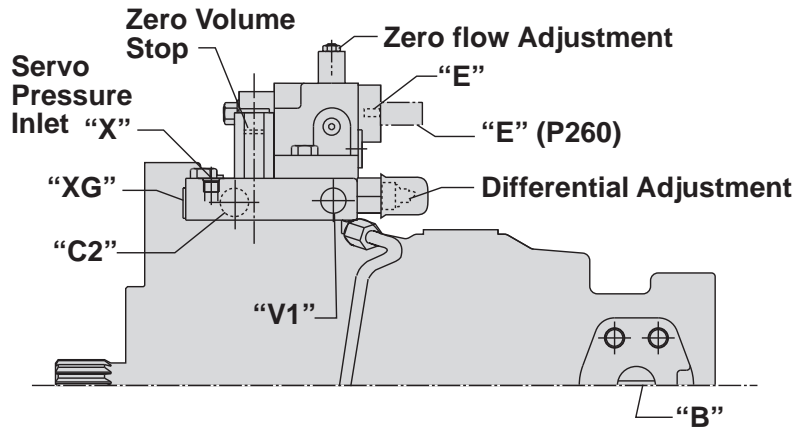
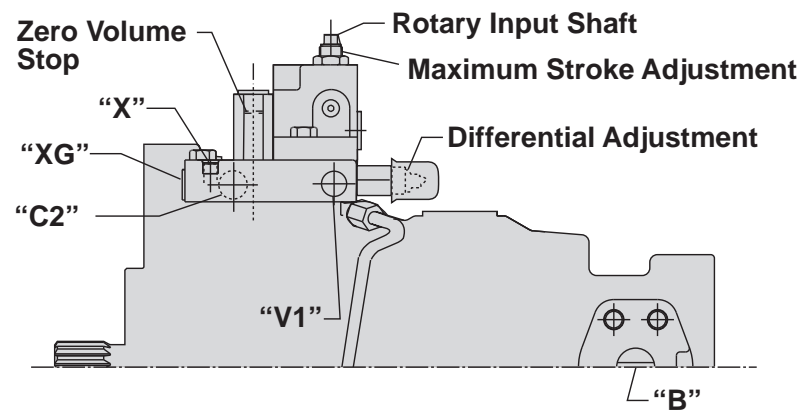
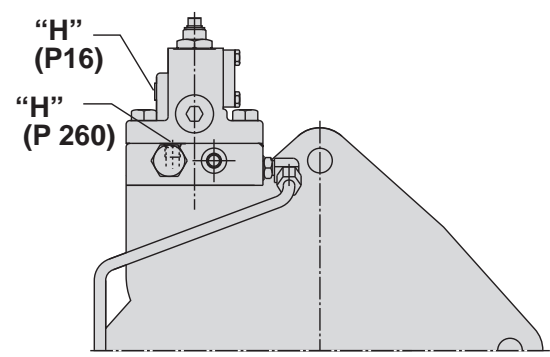
“R” ROTARY SERVO



“E” ELECTRO-HYDRAULIC STROKER



“H” HYDRAULIC STROKER



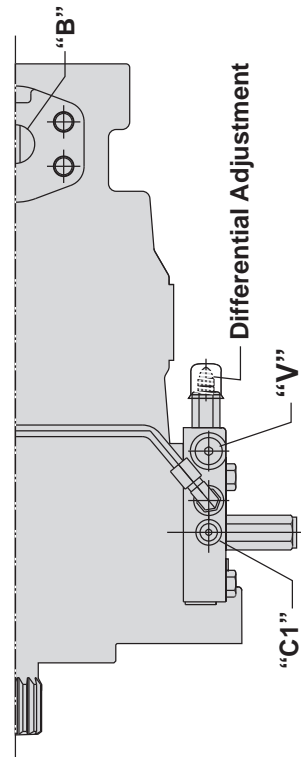
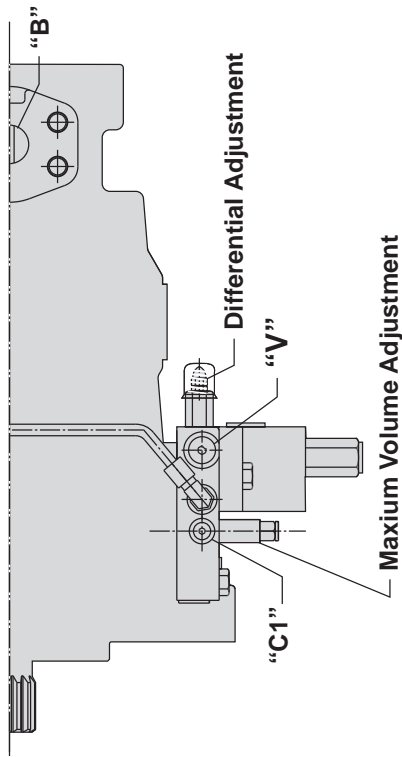
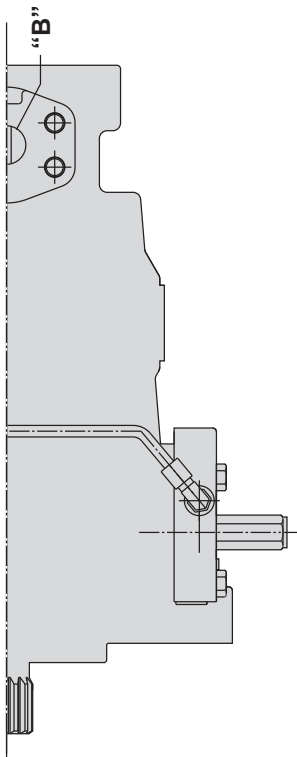
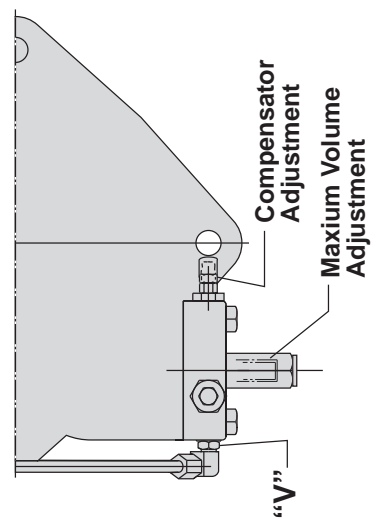
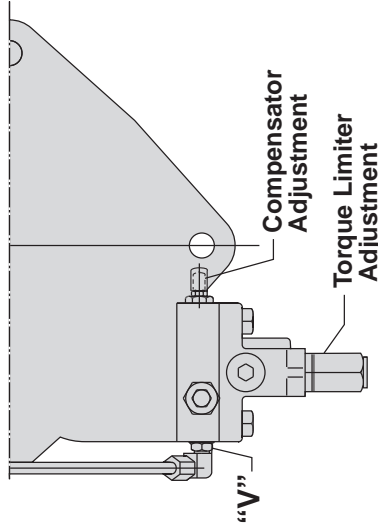
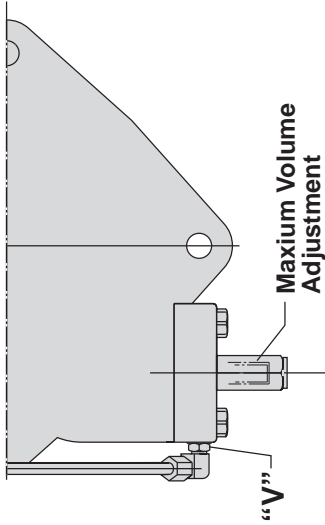
**“*1J” TORQUE LIMITER
OVERRIDE W/MAX. VOLUME STOP
or**

**“*1K” TORQUE LIMITER
OVERRIDE W/MAX. VOLUME STOP**

**“*1P” COMPENSATOR
OVERRIDE W/MAX.
VOLUME STOP**

**“*10” CONTROL CAP
WITH MAX. VOLUME
STOP**

CW ROTATION



START UP PROCEDURE FOR NEW INSTALLATION

- Read and understand the instruction manual. Identify components and their function.
- Visually inspect components and lines for possible damage.
- Check reservoir for cleanliness. Drain and clean as required
- Check fluid level and fill as required with filtered fluid at least as clean as that recommended. Fill pump case with clean oil prior to starting. If pump is mounted vertically with shaft up, bleed air from case by removing plug from port "DG" till fluid runs clear.
- Check alignment of drive.
- Check oil cooler and activate it, if included in circuit. Check fluid temperature
- Reduce pressure settings of compensator and relief valve. Make sure accurate pressure readings can be made at appropriate places.
- If solenoids are in system, check for actuation.
- Start pump drive. Observe for correct shaft rotation. Make sure pump fills properly.
- Bleed system of air. Recheck fluid level.
- Cycle unloaded machine at low pressure and observe actuation (at low speed, if possible).
- Increase pressure settings gradually in steps. Check for leaks in all lines, especially in pump and motor inlet lines.
- Make correct pressure adjustments.
- Gradually increase speed. Be alert for trouble as indicated by changes in sounds, system shocks and air in fluid.
- Equipment is operational.

TROUBLESHOOTING

Component problems and circuit problems are often interrelated. An improper circuit may operate with apparent success but will cause failure of a particular component within it. The component failure is the effect, not the cause of the problem. This general guide is offered to help in locating and eliminating the cause of problems by studying their effects.

| Effect of Trouble | Possible Cause | Fault Which Needs Remedy |
|---|---|--|
| pump noisy | air in system | leak in suction line. low fluid level. turbulent fluid. return lines above fluid level. gas leak from accumulator. excessive pressure drop in the inlet line from a pressurized reservoir. suction line strainer acting as air trap. |
| | cavitation in rotating group. | fluid too cold, too viscous, or too heavy. shaft speed too high. suction line strainer too small, or strainer too dirty. operating altitude too high. boost pressure too low. inlet flow too small for dynamic conditions. |
| | misaligned shaft. | faulty installation. distortion in mounting. axial interference. faulty coupling. excessive overhung loads. |
| | mechanical fault in pump. | piston and shoe looseness or failure. bearing failure. incorrect port plate selection or index. eroded or worn parts in the displacement control. |
| erosion on barrel ports and port plate. | air in fluid. cavitation. | see noisy pump above. see noisy pump above. |
| high wear in pump. | excessive loads. | reduce pressure settings. reduce speeds. |
| | contaminant particles in fluid. | improper filter maintenance. filters too coarse. introduction of dirty fluid to system. reservoir openings. improper reservoir breather. improper line replacement. |
| | Improper fluid. | fluid too thin or thick for operating temperature range. breakdown of fluid with time/temperature/shearing effects. incorrect additives in new fluid. destruction of additive effectiveness with chemical aging |
| | improper repair. | incorrect parts, procedures, dimensions, finishes. |
| | unwanted water in fluid. | condensation. faulty breather/strainer. heat exchanger leakage. faulty clean-up practice. water in makeup fluid. |
| pressure shocks. | cogging load. | mechanical considerations. |
| | worn relief valve. | needed repairs. |
| | worn compensator. | needed repairs. |
| | slow response in check valves. | replace or relocate. |
| | excessive decompression energy rates. | improve decompression control. |
| | excessive line capacitance. (line volume, line stretch, accumulator effects). | reduce line size or lengths. eliminate hose. |
| heating of fluid. | barrel blow-off. | re-check pump holddown, rotating group, drain pressure. |
| | excessive pump leakage. | recheck case drain flow and repair as required. fluid too thin. improper assembly, port timing. |
| | relief valve. | set too low (compared to load or to compensator). instability caused by back pressure, worn parts. |
| | compensator. | set too high (compared to relief). worn parts. |
| | pump too large for fluid needs. | select smaller pump displacement. |
| | heat exchanger. | water turned off, too hot or too little flow. fan clogged or restricted. efficiency reduced by mud or scale deposits. intermittent hydraulic fluid flow. |
| | reservoir. | too little fluid. improper baffles. insulating air blanket that prevents heat rejection. heat pickup from adjacent equipment. |

TROUBLESHOOTING

| 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 | 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 Modulating valve | Differential set too low 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 |

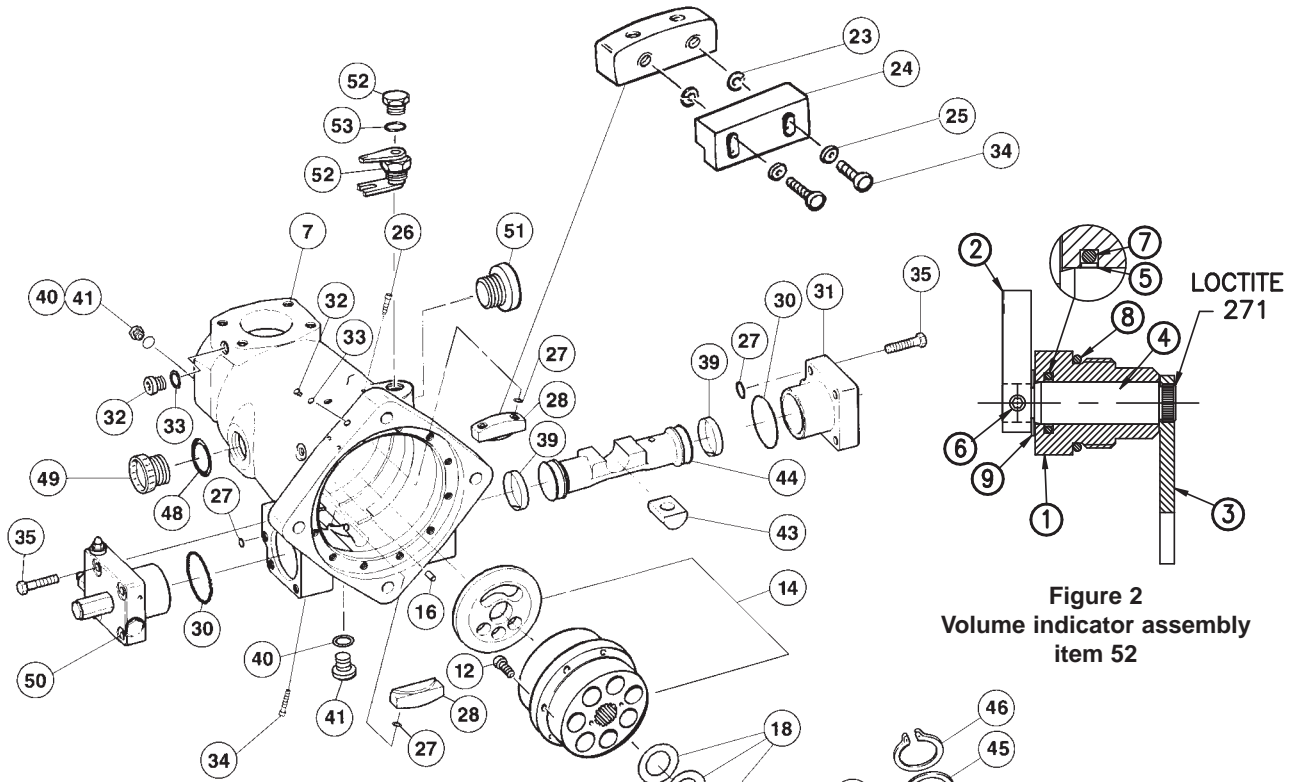


Figure 2
Volume indicator assembly
item 52

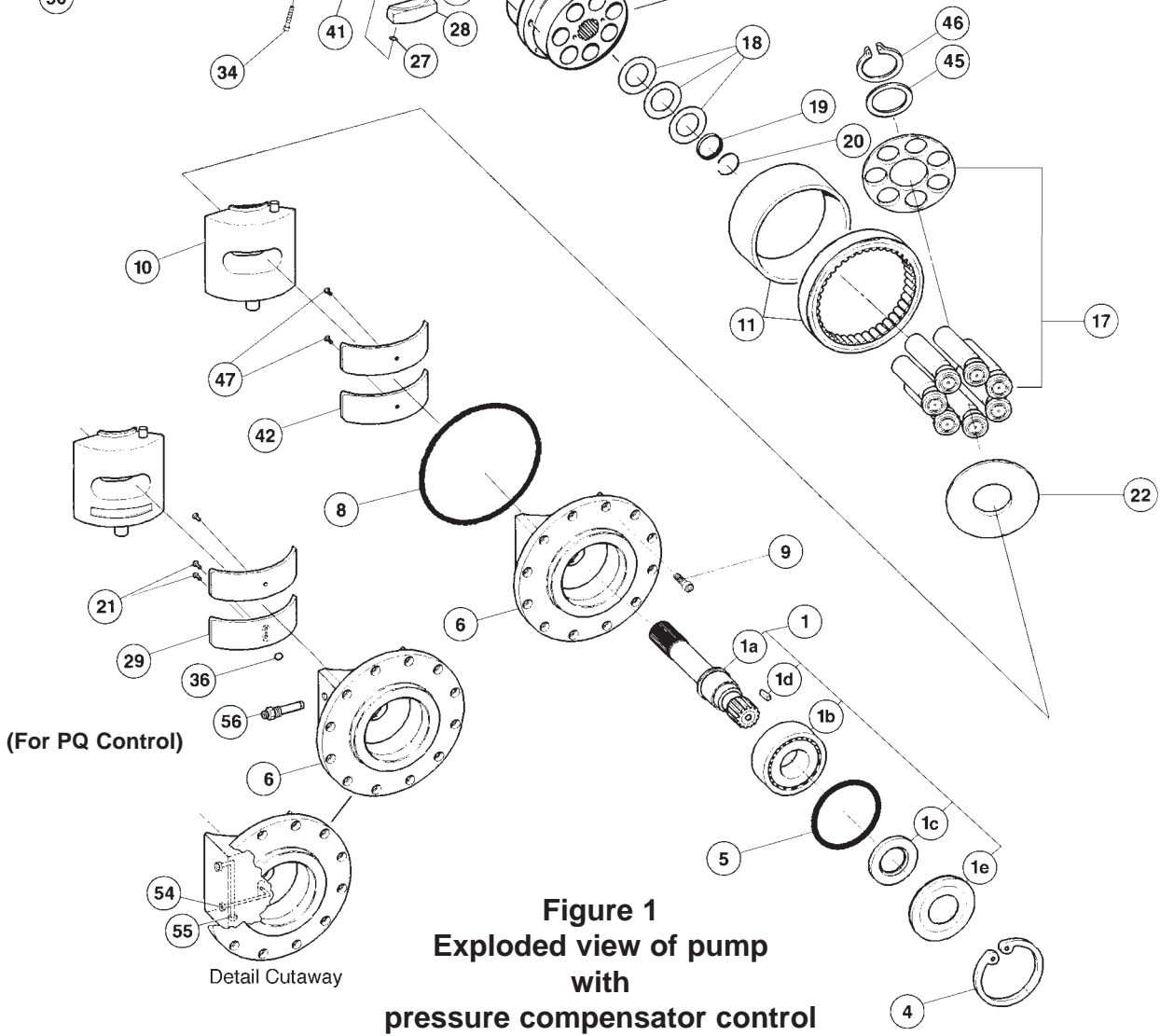


Figure 1
Exploded view of pump
with
pressure compensator control

Disassembly

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

If the pump has a rear drive, the mounting adapter and coupling must be removed prior to pump disassembly *Refer to figure 3 page 16.*

Clean outside surface of the pump before disassembly. Disassembly area should be clean. A suitable surface should be used capable of supporting the pump weight of 325 lbs., 147.5 Kg.

Refer to illustration, see figure 1 and 2

1. Remove plug (49) and drain oil from pump. Position pump with shaft up.
2. Wind maximum volume screw ref. see item (50), CW so that piston (44) bottoms out. This positions the cam at approximately zero stroke allowing removal of the drive shaft. *Reference item 1 page 27.*
3. Remove socket head cap screws (9). If disassembling PQ Control version, remove tubing and pass thru fitting (56).
4. Remove cradle assembly (6) from the housing. The M-10 threaded hole in end of the shaft is provided for lifting this assembly.
5. Remove snap ring (4).
6. Remove screws (21) and (47) to remove cam bearings (29) and (42) as applicable.
7. Remove shaft (1), bearing, and seal retainer. Support flat face of the rocker cradle and press end of shaft opposite the bearing end.
8. Remove the shaft seal (1c) from the retainer (1e) if necessary.
9. Remove retaining ring (20).
10. Press bearing off shaft if necessary. Press against bearing inner race.
11. If pump contains a volume indicator assembly (52): *Refer to. Figure 2:* Remove indicator pointer (2), retaining ring (9) and pivot nut (1) from pump housing. Remove pivot shaft and fork assembly (3) and (4) through the hole.
11. Remove two screws (34), two washers (25), clearance bearing (24), and two washers (23) from retainer (28).
12. Wind maximum volume screw CCW until piston (44) bottoms out.
13. Remove control cap (50) and control cap (31). (*Refer to controls section for control disassembly*).
14. Insert two tools (T-2) (see page 77) into housing supporting each end of the control piston. The piston must be moved outward (away from pump center) to remove cam assembly.
15. Lift cam assembly (10) from pump. (Link (43), pistons and shoes and retainer plate(17), wear plate (22), and hold-down (45 and 46) are part of the cam assembly.)
16. Remove slide link (43), retaining ring (45), thrust washer (46), pistons, shoes & retainer assembly (17) and wear plate (22). The pins for the slide link and for the indicator have been pressed into the rocker cam and should not be removed.
17. Remove two screws (34), two screws (26), and two retainers (28).
18. Remove Belleville washers (18) and barrel stop (19).
19. Attach tool (T-1) (pg. 65) to barrel assembly (14-1). (Two M6 screws are required.) Lift barrel from port plate and housing.
20. The inner race of bearing (11) has a light press fit with barrel. Do not remove the inner race unless bearing needs to be replaced. If replacement is necessary, remove seven socket head cap screws (12). Replace with 5/16-18 UNC x 6 1/2 in. long soc hd cap screws. Rest assembly on the extended screws. Press barrel from inner race. Care must be taken to avoid damage to barrel face.
21. Remove port plate ref. see item (14), and alignment pin (16), from port block.

The barrel bearing outer race (11) should only be removed from housing if worn, damaged or closer inspection is needed. A bearing puller should be used for removal.

REWORK LIMITS OF WEAR PARTS

| item | maximum rework from original dimension | minimum dimension after rework |
|--------------------------|--|--------------------------------|
| wear plate | .010", 0,254 mm | .240", 6,096 mm |
| piston shoe face(pocket) | * | .4175", 10,605 mm |

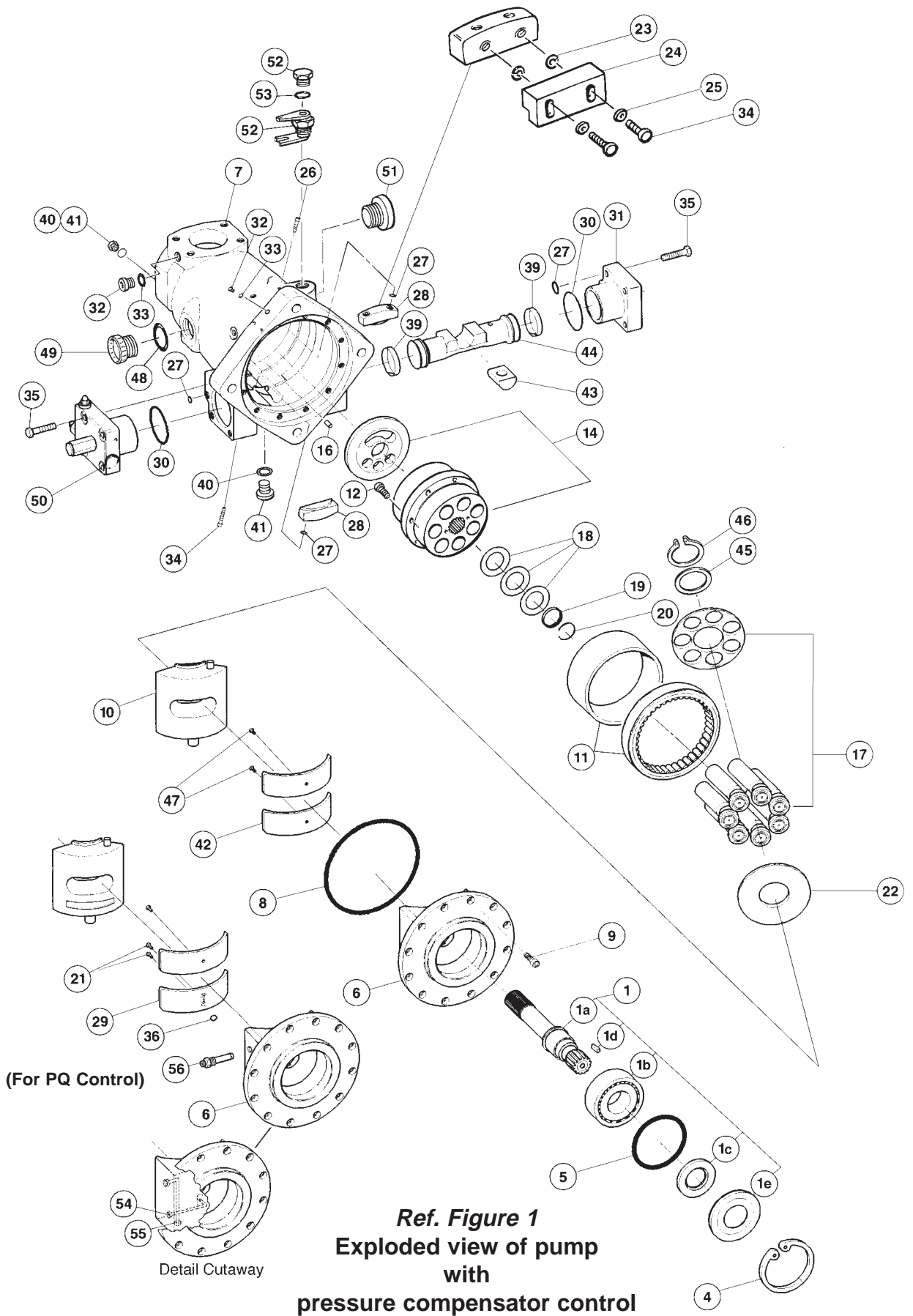
*shoe face pocket depth must be .004", 0,010 mm minimum

WEAR PLATE

The wear plate finish must be 10 µin., 0,25 µm min., flat within .0005", 0,0127 mm and parallel to the backside within .001", 0,0254 mm total indicator reading.

PISTON SHOE

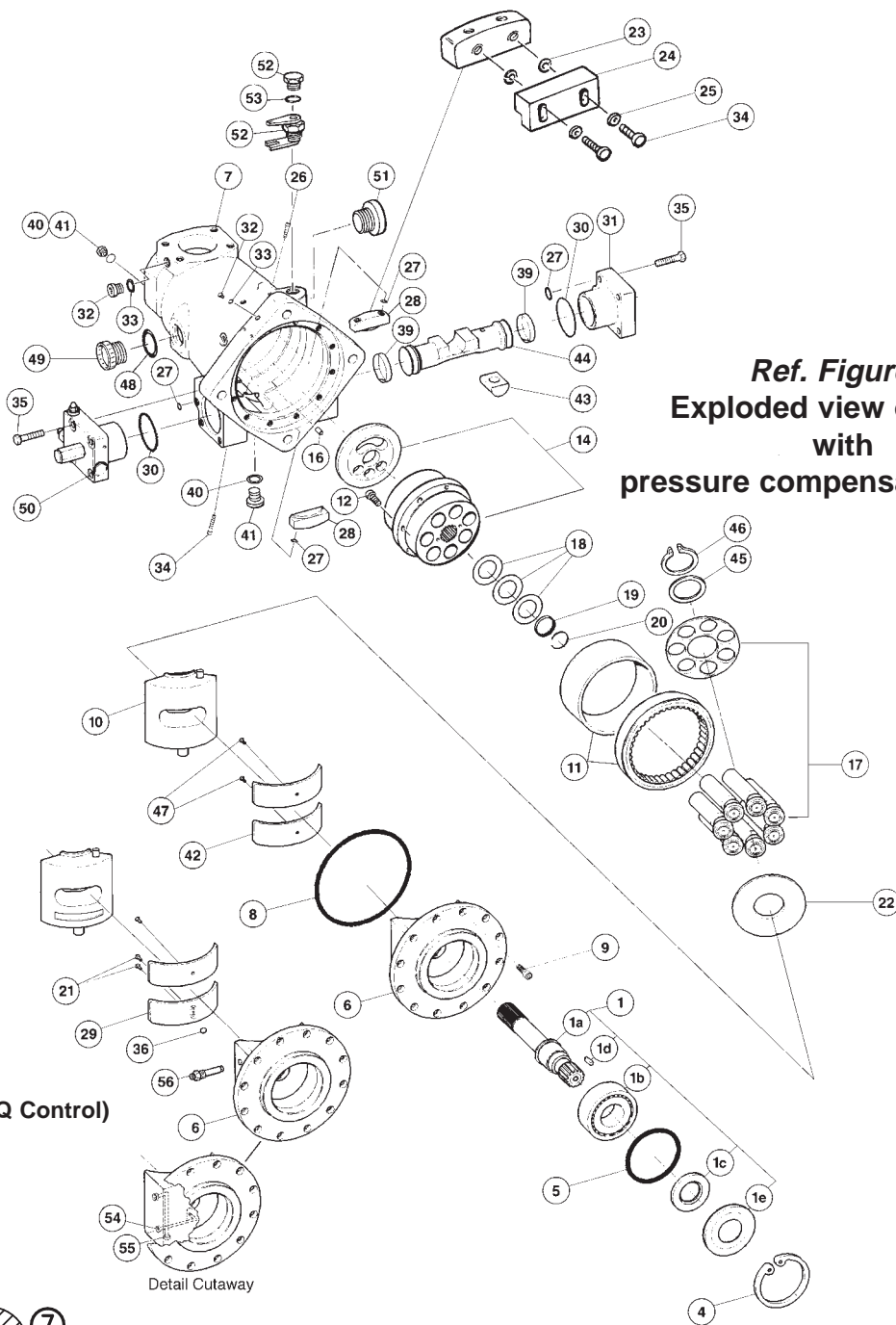
The piston shoe wear face finish must be 45 µin., 1,143 µm min, and must be lapped in a set with the retainer plate. All shoe sole thicknesses to be within .001", 0,0254 mm after lapping. The maximum permissible shoe and piston axial looseness is .010", 0,254 mm.



Ref. Figure 1
Exploded view of pump
with
pressure compensator control

PUMP PARTS LISTS

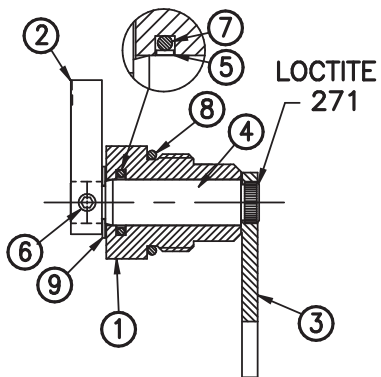
| item | description | part no. P16-SAE | part no. P260-ISO | qty. |
|------|---|---------------------|----------------------|-------|
| 1 | shaft assembly | | | 1 |
| | keyed, no rear drive | S22-12746 | S22-12824 | |
| | a (shaft) | 032-91303 | 032-91319 | |
| | b (bearing) | 230-82213 | 230-82213 | |
| | c (seal) | 620-82080 | 620-82099 | |
| | d (key) | 033-71514 | 032-91429 | |
| | e (seal retainer) | 032-91269 | 032-91269 | |
| | keyed, with rear drive | S22-12859 | S22-12864 | |
| | a (shaft) | 032-91394 | 032-91400 | |
| | b (bearing) | 230-82213 | 230-82213 | |
| | c (seal) | 620-82080 | 620-82099 | |
| | d (key) | 033-71514 | 032-91429 | |
| | e (seal retainer) | 032-91269 | 032-91269 | |
| | splined, no rear drive | S22-12747 | S22-12825 | |
| | a (shaft) | 032-91087 | 032-91320 | |
| | b (bearing) | 230-82213 | 230-82213 | |
| | c (seal) | 620-82080 | 620-82099 | |
| | e (seal retainer) | 032-91269 | 032-91269 | |
| | splined, with rear drive (standard) | S22-12861 | S22-12866 | |
| | a (shaft) | 032-91398 | 032-91399 | |
| | b (bearing) | 230-82213 | 230-82213 | |
| | c (seal) | 620-82080 | 620-82099 | |
| | e (seal retainer) | 032-91269 | 032-91269 | |
| | splined, with rear drive (hi-torque, SAE-F) | S22-12862 | | |
| | a (shaft) | 032-91365 | | |
| | b (bearing) | 230-82213 | | |
| | c (seal) | 620-82099 | | |
| | e (seal retainer) | 032-91269 | | |
| | | | P260-DIN | |
| | keyed, no rear drive | | S22-15680 | |
| | a (shaft) | | 032-92224 | |
| | b (bearing) | | 230-82217 | |
| | c (seal) | | 620-82051 | |
| | d (key) | | 032-92246 | |
| | e (seal retainer) | | 032-92235 | |
| | keyed, with rear drive | | S22-15681 | |
| | a (shaft) | | 032-92225 | |
| | b (bearing) | | 230-82217 | |
| | c (seal) | | 620-82051 | |
| | d (key) | | 032-92246 | |
| | e (seal retainer) | | 032-92235 | |
| | splined, no rear drive | | S22-15682 | |
| | a (shaft) | | 032-92222 | |
| | b (bearing) | | 230-82217 | |
| | c (seal) | | 620-82051 | |
| | e (seal retainer) | | 032-92235 | |
| | splined, with rear drive | | S22-15683 | |
| | a (shaft) | | 032-92223 | |
| | b (bearing) | | 230-82217 | |
| | c (seal) | | 620-82051 | |
| | e (seal retainer) | | 032-92235 | |
| 4 | retainer | 356-65130 | 356-65130 | 1 |
| 5 | O-ring, 70 S-1 ARP 158 | 671-00158 | 671-00158 | 1 |
| 6 | cradle | 032-91753 | 032-91754 | 1 |
| | cradle, PQ control | 032-92504 | 032-92563 | |
| 7 | housing, no rear drive | 032-91744 | 032-91780 | 1 |
| | housing, no rear drive, PQ control | 032-92515 | 032-92510 | |
| | housing, with rear drive | 032-91779 | 032-91781 | |
| | housing, with rear drive, PQ control | 032-92513 | 032-92507 | |
| 8 | O-ring, 70 S-1 ARP 268 | 671-00268 | 671-00268 | 1 |
| 9 | screw, SHC (16 required in P260) | 361-12229 | 361-11224 | 12/16 |
| 10 | cam assembly | S22-15266 | S22-15266 | 1 |
| 10 | cam assembly, PQ control | S22-15960 | S22-15960 | 1 |
| 11 | bearing | 032-91077 | 032-91077 | 1 |
| 12 | screw, SHC | 358-14226 | 358-14226 | 7 |
| 14 | barrel & port plate assembly CW, H* | S22-16100 | S22-16100 | 1 |
| | barrel & port plate assembly CCW, H* | S22-15672 | S22-15672 | |



Ref. Figure 1
Exploded view of pump
with
pressure compensator control

(For PQ Control)

Detail Cutaway



Ref. figure 2
Indicator Assembly (52)
S22-15943

PARTS LIST FOR INDICATOR ASSEMBLY

| item | description | part no. | qty. |
|------|-----------------------------|-----------|------|
| 1 | Pivot nut | 032-92491 | 1 |
| 2 | Indicator | 033-70624 | 1 |
| 3 | fork | 032-92490 | 1 |
| 4 | pivot shaft | 032-92492 | 1 |
| 5 | glyd ring | 679-00030 | 1 |
| 6 | Soc. setscrew, 10-32 x 3/16 | 312-09030 | 1 |
| 7 | O-ring, 70 S-1 ARP 114 | 671-00114 | 1 |
| 8 | O-ring, 90 S-1 ARP 914 | 691-00914 | 1 |
| 9 | Retaining ring | 356-65070 | 1 |

PUMP PARTS LISTS

| item | description | part no. P16-SAE | part no. P260-ISO | qty. |
|------|--|---------------------|----------------------|------|
| | barrel & port plate assembly CW, Q* | S22-16123 | S22-16123 | |
| | barrel & port plate assembly CCW, Q* | S22-16125 | S22-16125 | |
| | barrel & port plate assembly CW, PQ control | S22-15961 | S22-15961 | |
| | barrel & port plate assembly CCW, PQ control | S22-15962 | S22-15962 | |
| 16 | dowel pin | 324-21610 | 324-21610 | 1 |
| 17 | heavy pistons, shoes,retainer assembly (Q, PQ control)* | S22-15893 | S22-15893 | 1 |
| | (17-1) retainer plate (1 req'd) | 032-91750 | 032-91750 | |
| | (17-2) heavy pistons and shoes (7 req'd) | S22-15892 | S22-15892 | |
| | lightweight pistons, shoes,retainer assembly (H)* | S22-15271 | S22-15271 | |
| | (17-1) retainer plate (1 req'd) | 032-91750 | 032-91750 | |
| | (17-2) lightweight pistons and shoes (7 req'd) | S22-12728 | S22-12728 | |
| 18 | Belleville washer | 032-91083 | 032-91083 | 3 |
| 19 | stop | 032-91270 | 032-91270 | 1 |
| 20 | retaining ring | 032-91086 | 032-91086 | 1 |
| 21 | screw, button head (PQ control) | 353-25079 | 353-25079 | 2 |
| 22 | wear plate | 032-91751 | 032-91751 | 1 |
| 23 | lockwasher | 348-10016 | 348-10016 | 2 |
| 24 | bearing | 032-91412 | 032-91412 | 1 |
| 25 | washer | 345-10012 | 345-10012 | 2 |
| 26 | screw, SHC | 361-08200 | 361-08200 | 2 |
| 27 | O-ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 6 |
| 28 | cam/bearing retainer | 032-91749 | 032-91749 | 2 |
| 29 | bearing, hydrostatic cam (PQ control) | 032-92506 | 032-92506 | 1 |
| 30 | O-ring, 70 S-1 ARP 151 | 671-00151 | 671-00151 | 2 |
| 31 | off stroke control side (see page 17) | | | 1 |
| | buck-up cap (comp, torque limiter, load sensing) | S22-15653 | S22-15653 | |
| | electric stroker | S22-16001 | S22-16002 | |
| | hydraulic stroker | S22-16003 | S22-16004 | |
| | rotary servo | S22-16005 | S22-16006 | |
| | PQ control | S22-15963 | S22-15964 | |
| 32 | plug, SAE-4, 1/4 BSPP | 488-35061 | 447-00032 | 2 |
| 33 | O-ring, 90 S-1 ARP 904 | 691-00904 | none | 2 |
| 34 | screw, SHC | 361-08250 | 361-08250 | 4 |
| 35 | Screw, HHC, M12 x 1,75 x 60 mm lg. | 363-12210 | 363-12210 | * |
| | Screw, HHC, M12 x 1,75 x 80 mm lg.(E,H,R,J,K) | 363-12225 | 363-12225 | * |
| | Screw, HHC, M12 x 1,75 x 90 mm lg. (L) | 363-12240 | 363-12240 | * |
| 36 | O-ring, 70 S-1 ARP 010 (PQ control)) | 671-00010 | 671-00010 | 1 |
| 39 | ring (qty. 1 for servo, electric & hyd. stroker) | 032-91261 | 032-91261 | 2 |
| | ring (servo, electric & hydraulic stroker) | 032-91811 | 032-91811 | 1 |
| 40 | O-ring, 90 S-1 ARP 906 | 691-00906 | none | 2 |
| 41 | plug, SAE-6, 1/4 BSPP | 488-35041 | 447-01004 | 2 |
| 42 | bearing (1 for PQ control) | 032-91345 | 032-91345 | 2 |
| 43 | slide link | 032-91259 | 032-91259 | 1 |
| 44 | control piston (compensator, torque limiter) | 032-92318 | 032-92318 | 1 |
| | control piston (servo, electric & hydraulic stroker) | 032-91785 | 032-91785 | |
| | control piston (PQ control) | 032-92505 | 032-92505 | |
| 45 | bearing | 032-91756 | 032-91756 | 1 |
| 46 | retainer, orange, .063", 1,60 mm thk. | 032-92388 | 032-92388 | 1 |
| | retainer, blue, .065", 1,65 mm thk. | 032-91792 | 032-91792 | |
| | retainer, red, .067", 1,70 mm thk. | 032-91793 | 032-91793 | |
| | retainer, green, .069" 1,75 mm thk. | 032-91794 | 032-91794 | |
| | retainer, yellow, .071" 1,80 mm thk. | 032-91795 | 032-91795 | |
| | retainer, white, .073" 1,85 mm thk. | 032-91796 | 032-91796 | |
| 47 | screw, FSHCS (qty. 1 for PQ control) | 316-50001 | 316-50001 | 2 |
| 48 | O-ring, 90 S-1 ARP 924 | 691-00924 | none | 1 |
| 49 | plug, SAE-24, 1-1/2 BSPP | 488-35062 | 447-00034 | 1 |
| 50 | on stroke control side (see page 17) | | | 1 |
| | compensator | S22-15311 | S22-15312 | |
| | low torque limiter | S22-15313 | S22-15314 | |
| | high torque limiter | S22-15315 | S22-15316 | |
| | load sensing | S22-15536 | S22-15537 | |
| | compensator override | S22-16007 | S22-16008 | |
| | low torque limiter override | S22-16009 | S22-16010 | |
| | high torque limiter override | S22-16011 | S22-16012 | |
| | control cap, servo | S22-15256 | S22-15272 | |
| | max. volume stop, PQ control | S22-16126 | S22-16126 | |
| 51 | shipping plug | 449-00021 | 449-00021 | |
| 52 | plug, SAE-14 | 488-35030 | 488-35030 | 1 |
| | indicator assembly (see figure 2) | S22-15943 | S22-15943 | |
| 53 | O-ring, 90 S-1 ARP 914 | 691-00914 | 691-00914 | 1 |
| 54 | plug, 1/4 pipe (PQ Control) | 431-90404 | 431-90404 | 1 |
| 55 | plug, 1/16 pipe (PQ Control) | 431-90104 | 431-90104 | 1 |
| 56 | fitting, pass through (PQ Control) | S22-16161 | S22-16161 | 1 |

*Q means solid piston, H means lightwight piston

REAR DRIVE PARTS LISTS

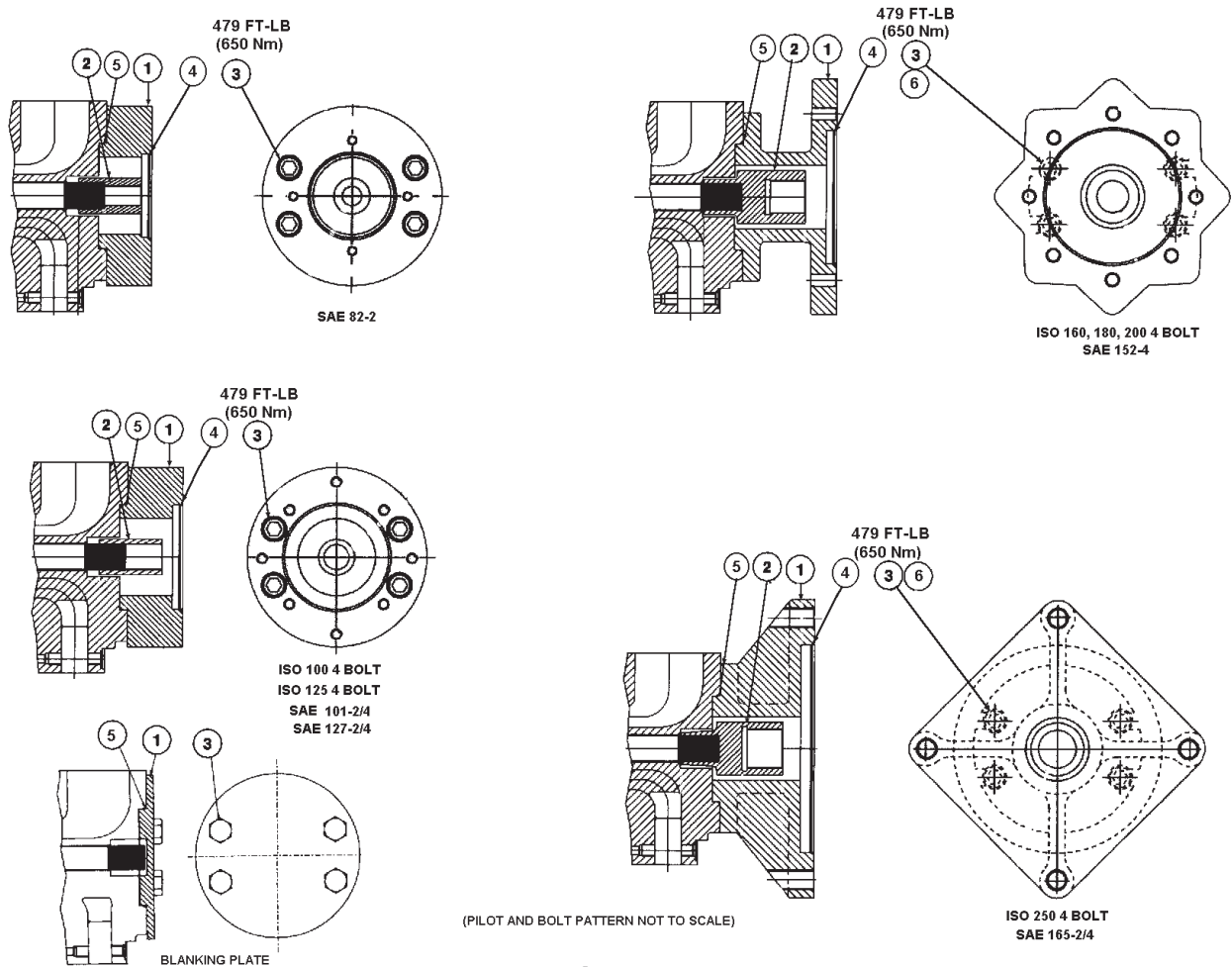


Figure 3
Rear drive options

| | | SAE REAR DRIVES | | | | | | | | |
|------|----------|-----------------|-------------|----------------|-------------|-------------|-------------|-------------|-----------|------------|
| | | code | A | G | B | Q | C | N | D | E |
| | | flange | SAE 82-2 | SAE 82-2 | SAE101-2/4 | SAE101-2/4 | SAE127-2/4 | SAE127-2/4 | SAE152-4 | SAE165-2/4 |
| | | coupling | 16-4 | 22-4 | 22-4 | 25-4 | 32-4 | 38-4 | 44-4 | 44-4 |
| item | part | qty | ("A") | (modified "A") | ("B") | ("B-B") | ("C") | ("C-C") | ("D") | ("E") |
| 1 | adapter | 1 | 032-91900 | 032-91900 | 032-91309 | 032-91309 | 032-91308 | 032-91649 | 032-91282 | 032-91283 |
| 2 | coupling | 1 | 032-91901 | 032-92377 | 032-91361 | 032-91362 | 032-91363 | 032-91648 | 032-91364 | 032-91364 |
| 3 | screw | 4 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 363-16250 | 363-16250 |
| 4 | O-ring | 1 | 671-00152 | 671-00152 | 671-00155 | 671-00155 | 671-00159 | 671-00159 | 671-00163 | 671-00272 |
| 5 | O-ring | 1 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 |
| 6 | washer | 4 | | | | | | | 350-10109 | 350-10109 |
| | assembly | | S22-15372 | S22-15809 | S22-12867 | S22-12868 | S22-12869 | S22-12920 | S22-12870 | S22-12871 |

| | | ISO REAR DRIVES | | | | | | | | | |
|------|----------|-----------------|-------------|-------------|-----------|-------------|-------------|-------------|-------------|-----------|-----------|
| | | code | Z | Y | X | T | U | L | S | W | V |
| | | flange | ISO 100 | ISO 125 | ISO 160 | ISO 180 | ISO 180 | ISO 180 | ISO 180 | ISO 200 | ISO 250 |
| | | coupling | ISO K25N | ISO K32N | ISO K40N | ISO K40N | ISO K50N | DIN 40-18 | DIN 50-24 | ISO K50N | ISO K50N |
| item | part | qty | | | | | | | | | |
| 1 | adapter | 1 | 032-91383 | 032-91384 | 032-91385 | 032-92162 | 032-92162 | 032-92162 | 032-92162 | 032-91386 | 032-91387 |
| 2 | coupling | 1 | 032-91391 | 032-91390 | 032-91389 | 032-91389 | 032-91388 | 032-92345 | 032-92346 | 032-91388 | 032-91388 |
| 3 | screw | 4 | 361-16304-8 | 361-16304-8 | 363-16250 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 361-16304-8 | 363-16250 | 363-16250 |
| 4 | O-ring | 1 | 671-00155 | 671-00159 | 671-00164 | 671-00167 | 671-00167 | 671-00167 | 671-00167 | 671-00170 | 671-00272 |
| 5 | O-ring | 1 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 | 671-00159 |
| 6 | washer | 4 | | | 350-10109 | 350-10109 | 350-10109 | 350-10109 | 350-10109 | 350-10109 | 350-10109 |
| | assembly | | S22-12872 | S22-12873 | S22-12874 | S22-15740 | S22-15570 | S22-15933 | S22-15934 | S22-12875 | S22-12876 |

note: item (1) blanking plate part no. 032-91468 item (3) blanking plate screws 363-16210-8

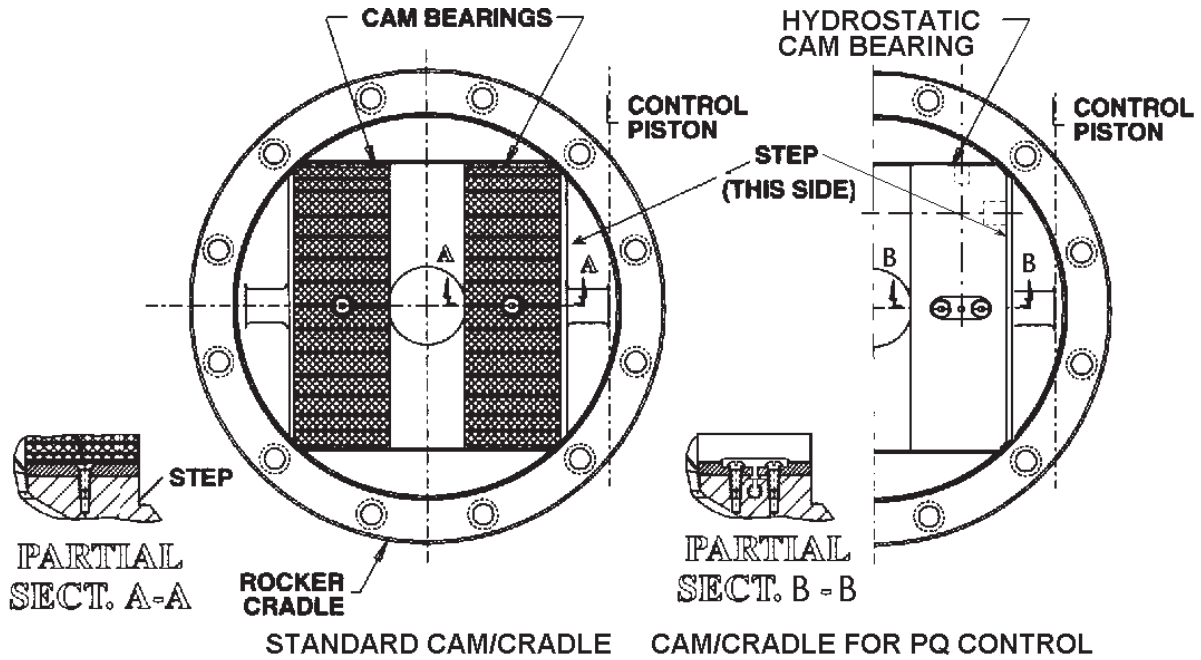


Figure 4
CAM BEARINGS/CRADLE ORIENTATION TO HOUSING

ROTATION CONVERSION

The following parts and assembly are required for changing shaft rotation:

- A different barrel and port plate assembly is required. The barrel and port plate are matched assemblies, and should not be ordered separately. The reference part numbers are:
 CW - Barrel and Port Plate Assembly S22- 16100 (H) S22-16123 (Q) S22-15961 (PQ control)
 CCW - Barrel and Port Plate Assembly S22- 15672 (H) S22-16125 (Q) S22-15962 (PQ control)
- The control piston must be reversed to position it correctly to the control caps. *See step 9 pg. 20*
- The control caps location are reversed. *see illustration below.*

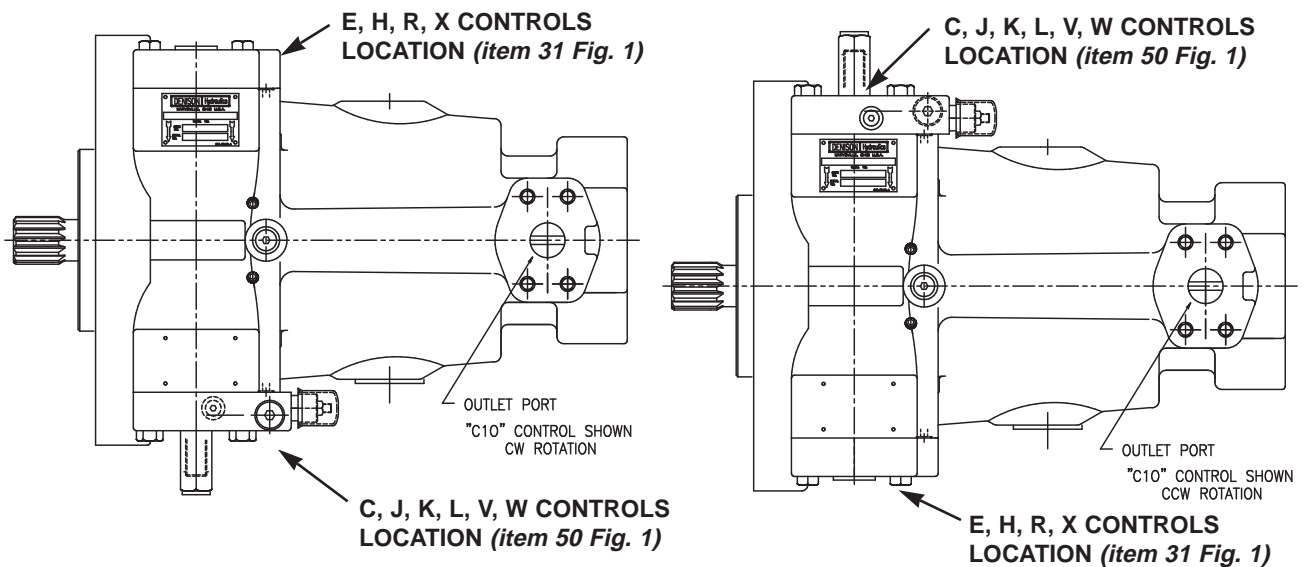
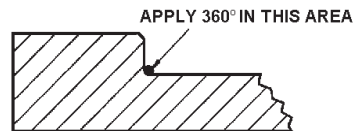


Figure 5
CONTROL ORIENTATION VERSUS PUMP ROTATION

SHAFT SEAL REPLACEMENT

See illustration. Remove worn or damaged seal from retainer. Clean Loctite® "Master Gasket" from retainer. Install new seal by applying "Master Gasket" to retainer and pressing seal in retainer.

| | | |
|------------------------|----------|-------------|
| SEAL KITS | P16 | S22-12830-0 |
| | P260 ISO | S22-12831-0 |
| | P260 DIN | S22-16160-0 |



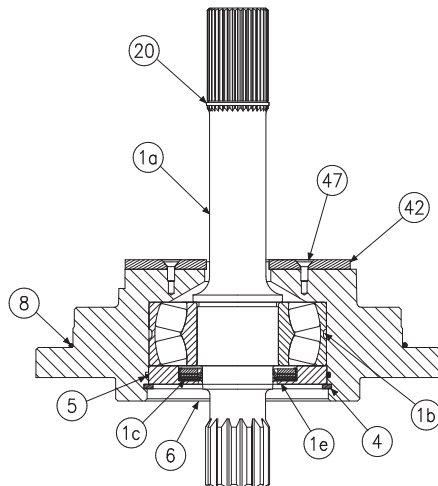
The shaft seal and all "O" rings necessary for total seal replacement may be obtained by ordering the Seal Kit . These seals are suitable for petroleum base fluids. For fire resistant fluids contact **DENISON HYDRAULICS**, Inc. or their authorized distributors to obtain the appropriate seal kit number.

SHAFT ASSEMBLIES

The following assemblies include shaft, key when applicable, bearing and seal:

| | P16-SAE # | P260-ISO # |
|---|------------------|-------------------|
| Keyed, no rear drive assembly | S22-12746 | S22-12824 |
| Keyed, with rear drive assembly | S22-12859 | S22-12864 |
| Splined, no rear drive assembly | S22-12747 | S22-12825 |
| Splined, with rear drive assembly | S22-12861 | S22-12866 |
| Splined, with rear drive (hi-torque) assembly | S22-12862 | |

| | P260-DIN # |
|-----------------------------------|-------------------|
| Keyed, no rear drive assembly | S22-15680 |
| Keyed, with rear drive assembly | S22-15681 |
| Splined, no rear drive assembly | S22-15682 |
| Splined, with rear drive assembly | S22-15683 |



PRE-ASSEMBLY

Depending on the repairs, many steps in this section may not be applicable.

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

During assembly, occasional reference will be made to the use of lubricating oil for proper assembly. It is important that any oil used be compatible with the seals and fluid to be used in operation. Compatibility is also necessary for grease which should be used on all "O" rings to ensure proper assembly without damage.

Several screws require a thread lock liquid for locking in position. When required use Loctite® #242 unless otherwise specified.

ASSEMBLY

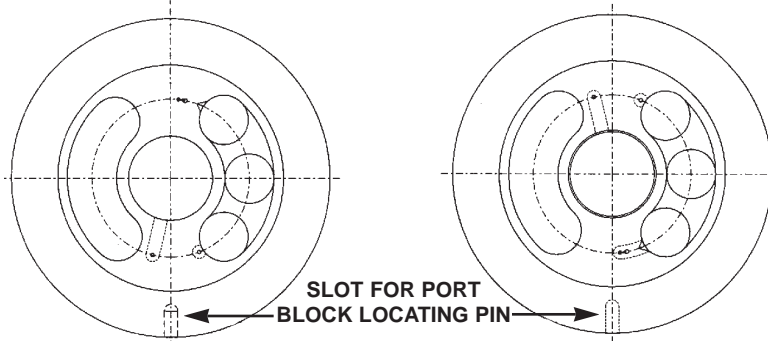
Refer to illustration, see figure 1

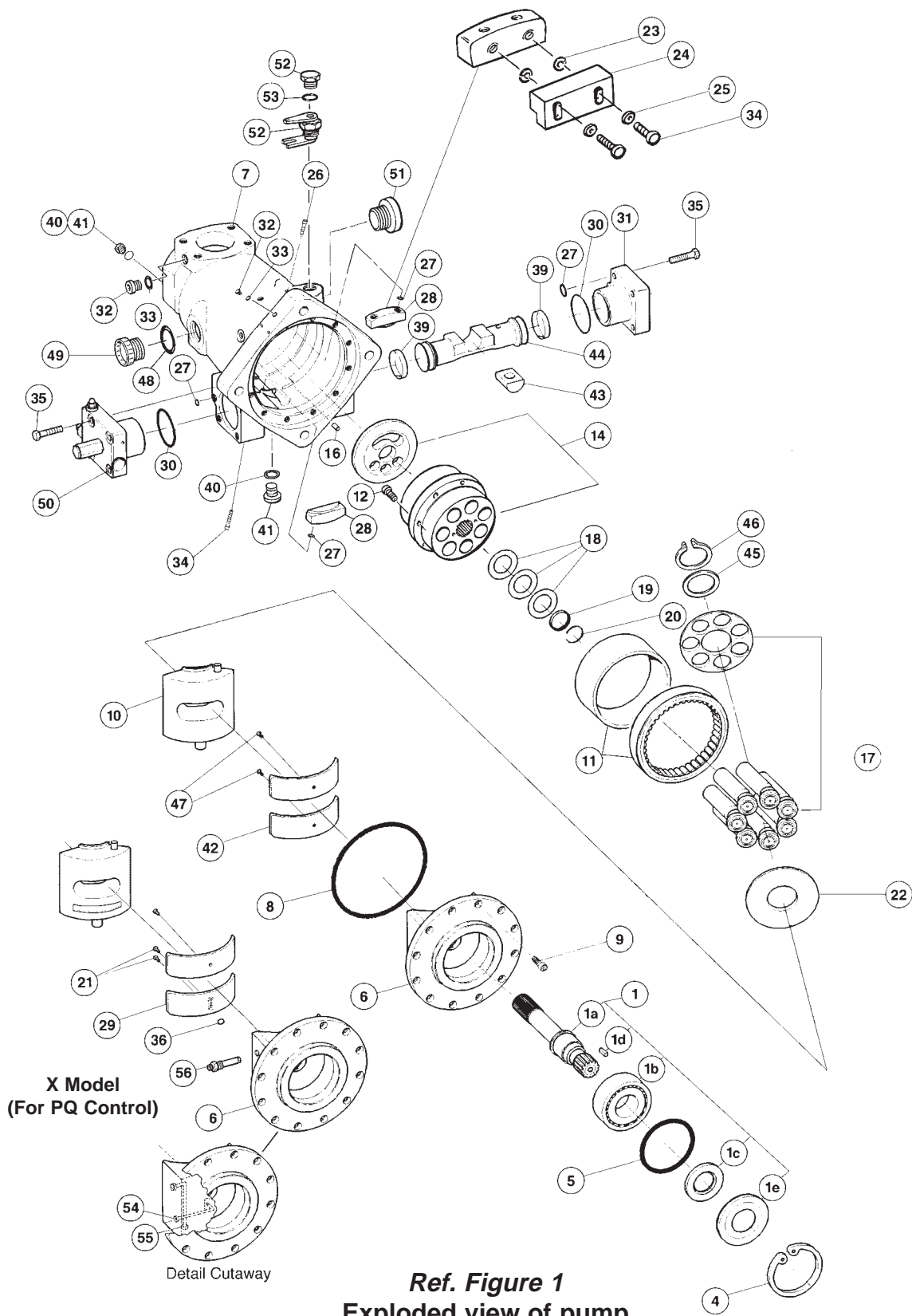
See page 26 for tightening torque on plugs

1. Place the port block end of the housing (7) on a suitable surface capable of supporting the pump weight of 325 lbs, 147.5 Kgs.
2. Install plugs (41) with "O" rings into port block. Install plugs (32) with "O" rings into port block.
3. Install pin (16) in port block. Position port plate (14) on port block and over pin. To view correct port plate for shaft rotation specified, **See illustration, below**

Port Plate for CW Shaft Rotation

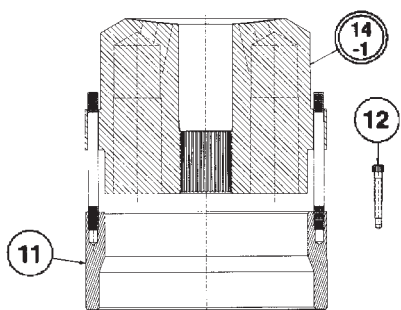
Port Plate for CCW Shaft Rotation





Ref. Figure 1
Exploded view of pump
with
pressure compensator control

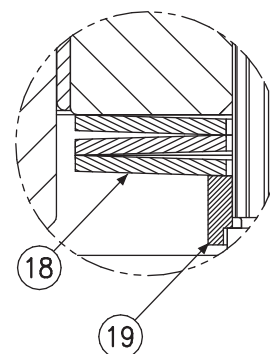
4. Press bearing outer race (11) into housing (7).



BARREL AND INNER RACE ASSEMBLY

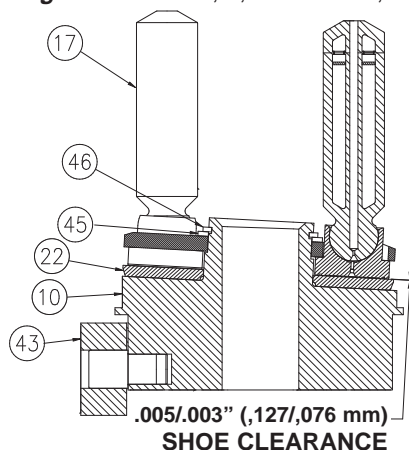
5. Thread seven 5/16-18 studs into bearing inner race. Lower barrel (14) over studs and seat. If the inner race is heated to 150°F, 65°C, barrel will slide into position without force. If race is not heated, longer screws (12) can be used to draw the race and barrel together. Insert screws (12) and torque to 30 lbs ft., 40 Nm. **See illustration**
6. Apply oil to face of port plate and inner bearing race. Attach tool T-1 to barrel with two M6 screws. Carefully lower barrel assembly into housing engaging inner race into rollers of outer bearing race, barrel may then be lowered until it has seated on port plate.
7. Insert two "O" rings (27) into each retainer (28). Apply Loctite® #271 to

- two screws (26) and secure retainer to housing. Torque to 84 lbs-in., 9,5 Nm.
8. Apply Loctite® #271 to two screws (34) and assemble the other retainer on opposite side of housing. Torque to 84 lbs-in., 9,5 Nm.
9. Assemble the two piston rings (39) on control piston (44). Insert control piston (44) into housing bore that is used with the control caps. **For CW shaft rotation**, the long end of the piston must be positioned to the right. (**Ref. fig.1**) **For CCW rotation**, the long end of the piston is to the left. Insert tools T-2 (page 77, two required) into housing bores, support each end of the control piston. The piston must be moved outward (away from pump center) so that clearance is provided for installing the rocker cam assembly.
10. Position Belleville washers (18) on barrel, **See illustration**. To insure proper pump operation and correct barrel holddown force they must be assembled exactly as shown. Place barrel stop (19) on Belleville washers and center the washers and stop on barrel.



CAM ASSEMBLY

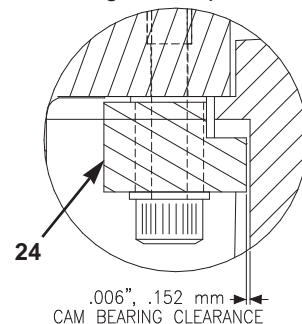
11. Set cam assembly (10) on suitable surface protecting cam surfaces from damage during assembly. **See illustration**
12. Place wear plate (22) on cam.
13. Position pistons-shoes-retainer assembly (17) over center post and against wear plate.
14. Install thrust washer (45) over center post.
15. Six different retainers (46) are available for setting the shoe holddown. Each retainer is marked: **white dot** .073", 1,85 mm thick, **yellow dot** .071", 1,80 mm thick, **green dot** .069", 1,75 mm thick, **red dot** .067", 1,70 mm thick, **blue dot**

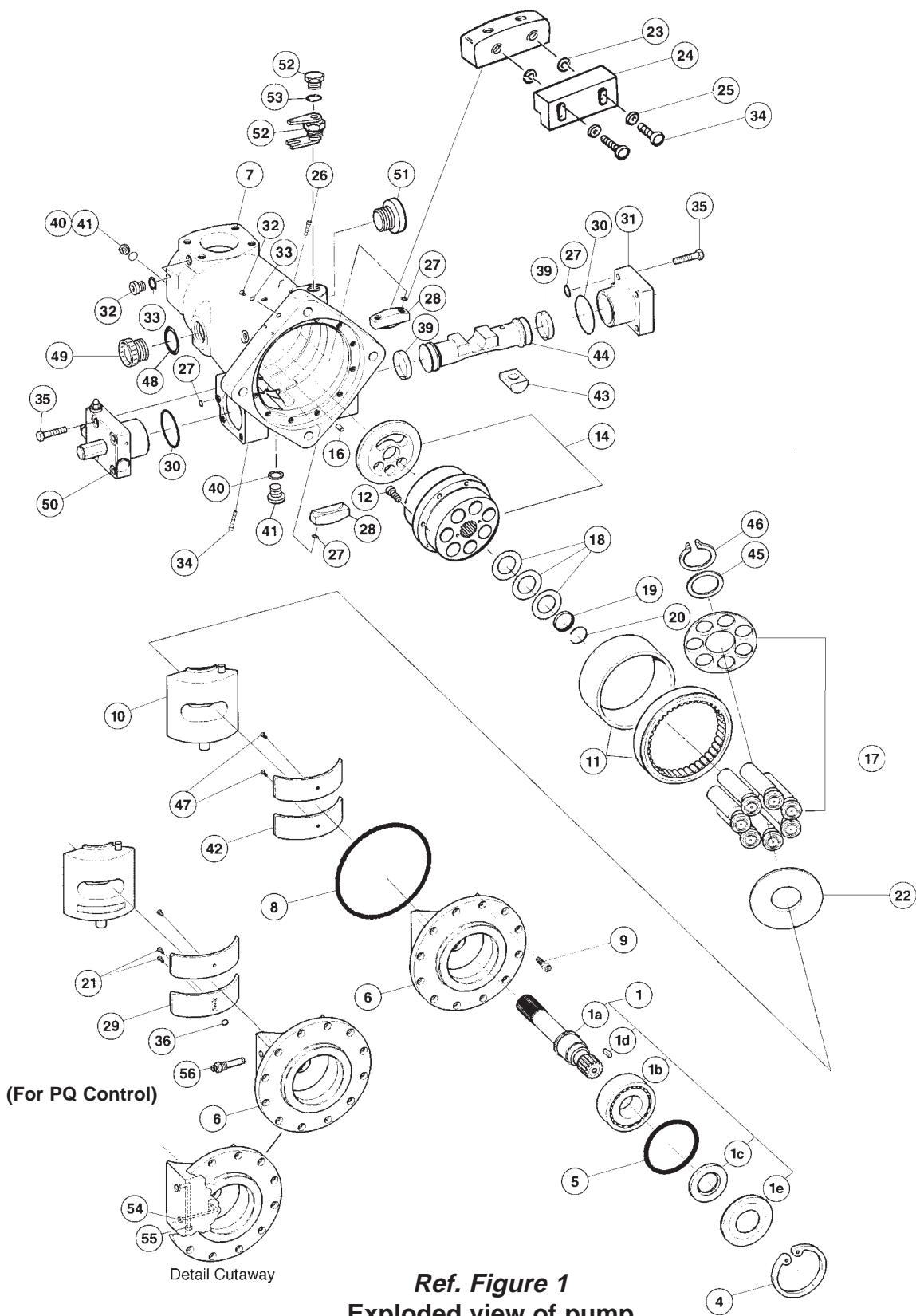


orange dot .065", 1,65 mm thick and **orange dot** .063", 1,60 mm thick. Install the thickest retainer **with the dot side up**, that will fit in the groove on the center post and allow a clearance of .003"-.005", 0,076-0,127 mm between the shoe and wear plate. **A .003", 0,076 mm feeler gage must go completely under any shoe, and a .005", 0,127 mm feeler gage must not go under any shoe while holding a piston and lifting tightly against the shoe retainer.** The piston and shoe assembly must be free to rotate easily by hand. Rotate 360° to confirm there is no binding and that each shoe is free in the retainer plate. Oil the assembly thoroughly.

16. Install slide link (43) on rocker cam pin as shown.
17. Oil barrel bores before installing cam assembly. Lower cam assembly into the housing with the slide link positioned so it will engage into the control piston (44). The seven pistons (17) must first be engaged into the barrel bores. Next the slide link (43) must engage into the control piston (44). Continue lowering rocker cam assembly until it is seated on cam/bearing retain-

- ers(28).
18. Apply Loctite 242 to two screws (34) and assemble clearance-bearing (24) to cam-bearing retainer (28) using the screws (34), two washers (25) and two washers (23). Move rocker cam to the right until it is against stop. **Set clearance** between clearance bearing (24) and cam at .006", 0,152 mm. Torque screws to 6 lbs-ft., 8,1 Nm maintaining the .006", 0,152 mm clearance.
19. Adjust piston (44) toward the **off stroke** control side (31). This will place the cam at approximately zero stroke and provide clearance for the shaft installation.





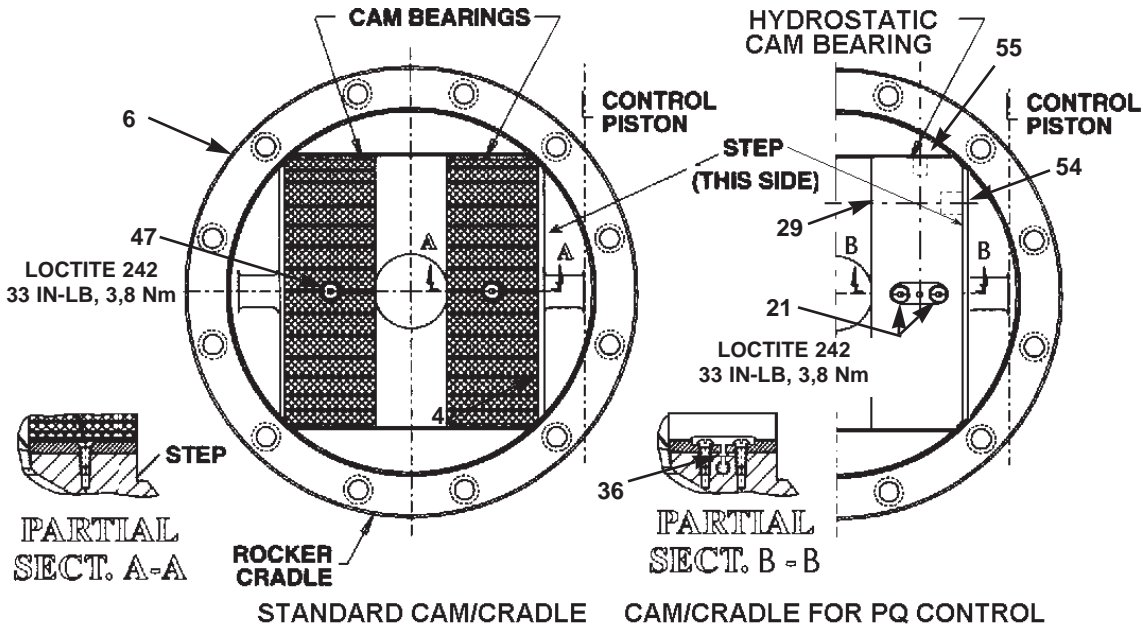
Ref. Figure 1
Exploded view of pump
with
pressure compensator control

- Continued -

Rocker cradle assembly

20. Apply Loctite 242 to two screws (47) and assemble two cam bearings (42) to cradle (6). Torque to 33 lbs-in., 3,8 Nm.

Note: Pumps with PQ control: A special cam, cradle and cam bearing provides a pressure balance to the bearing interface on the control side of the cam. Install plugs (54) and (55) to cradle as shown. Install O-ring (36) in cradle. Apply Loctite 242 to two screws (21) and attach cam bearing (29). Torque to 33 in-lbs, 3,8 Nm.



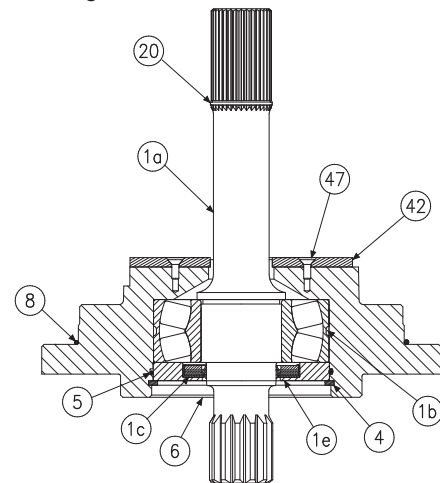
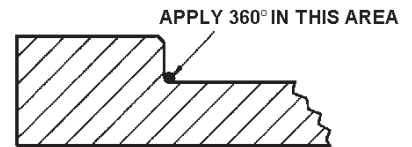
21. Press bearing (1b) on shaft (1a). Press on inner race only.

22. Apply over 360° bead of Loctite® 44 Master Gasket to seal retainer (1e) per following sketch. Press shaft seal (1c) into seal retainer (1e).

23. Install shaft seal and retainer on shaft using Tool T-4 to protect seal.

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

25. Press seal retainer and bearing and shaft assembly into bore of cradle (6) using Tool T-3.



26. Install snap ring (4) to cradle.

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

28. Install retaining ring (20) on shaft.

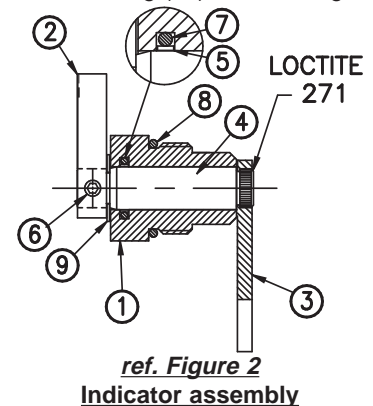
29. Center Belleville washers and barrel stop. Lower rocker cradle assembly into pump housing with the step in the rocker cradle correctly positioned so that clearance is provided for slide link (43). The M-10 threaded hole in the end of shaft should be used to support the assembly. The shaft spline must first engage the splined barrel stop (19), thru the Belleville washers (18) and engage the barrel spline. The assembly will then rest on the cam.

30. Install socket head cap screws (9) as shown. Torque evenly to 45-55 ft-lbs (61-75 Nm). Install case drain plug (49) and shipping plug (51). If pump does not contain stroke indicator, install plug (52) and "O" ring (53) in indicator hole.

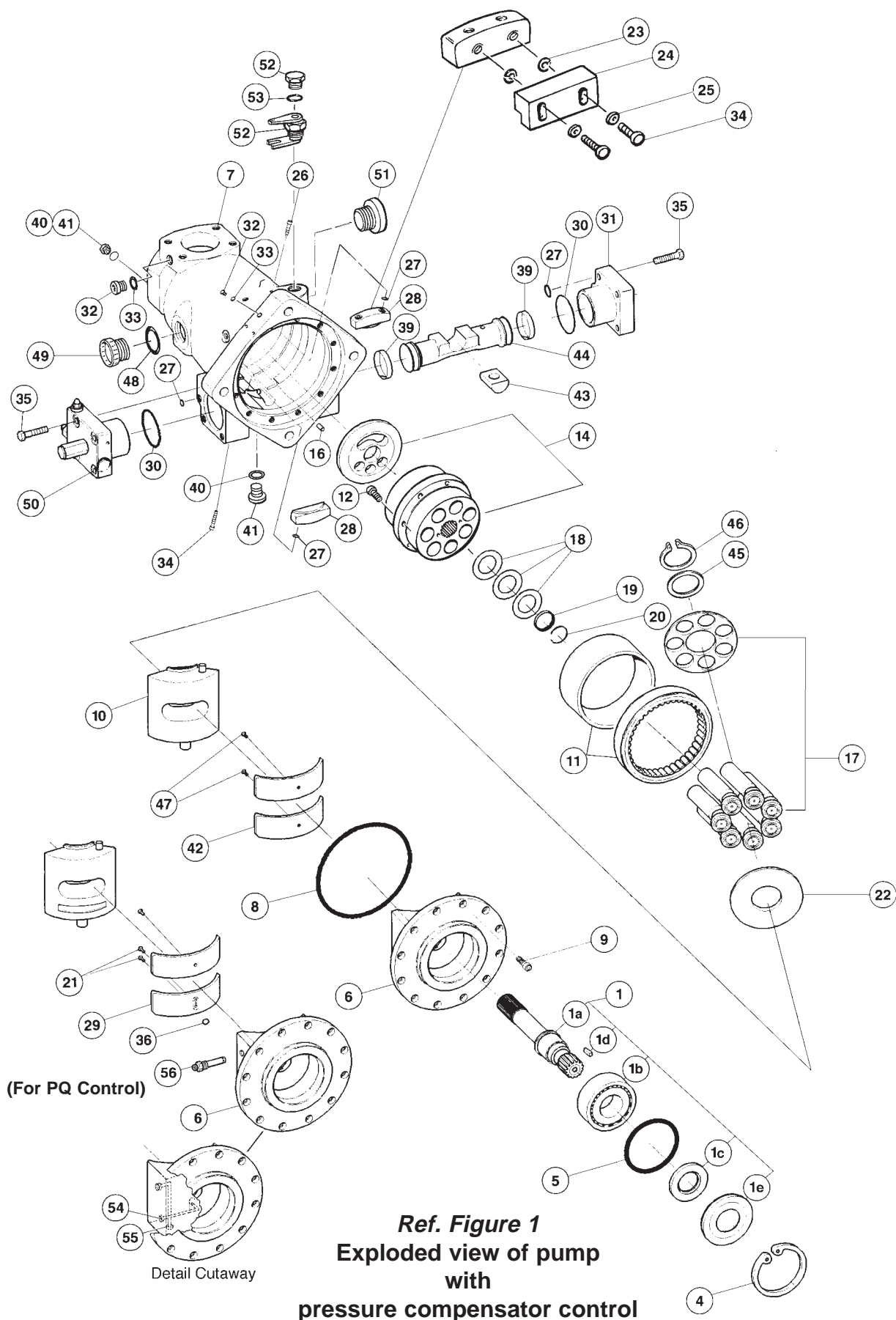
31. If assembling "X" Model pump, install pass thru fitting (56) into housing, being careful that O-ring enters hole in cradle without damage.

INDICATOR ASSEMBLY OPTION

See figure 2. To install indicator assembly, loosen setscrew (6), remove indicator (2) and slide shaft out of nut (1). Guide fork into indicator hole in housing to engage the pin on the hanger. a 1/4-20 SHCS or threaded rod may be used to hold the shaft. Slide nut (1) over shaft and tighten nut in threaded hole. Pull shaft out to slip retaining ring (9) into groove in shaft. Use maximum volume stop to set pump on zero stroke (10.2 turns from full). Install indicator, set pointer on "0" and lock in position.

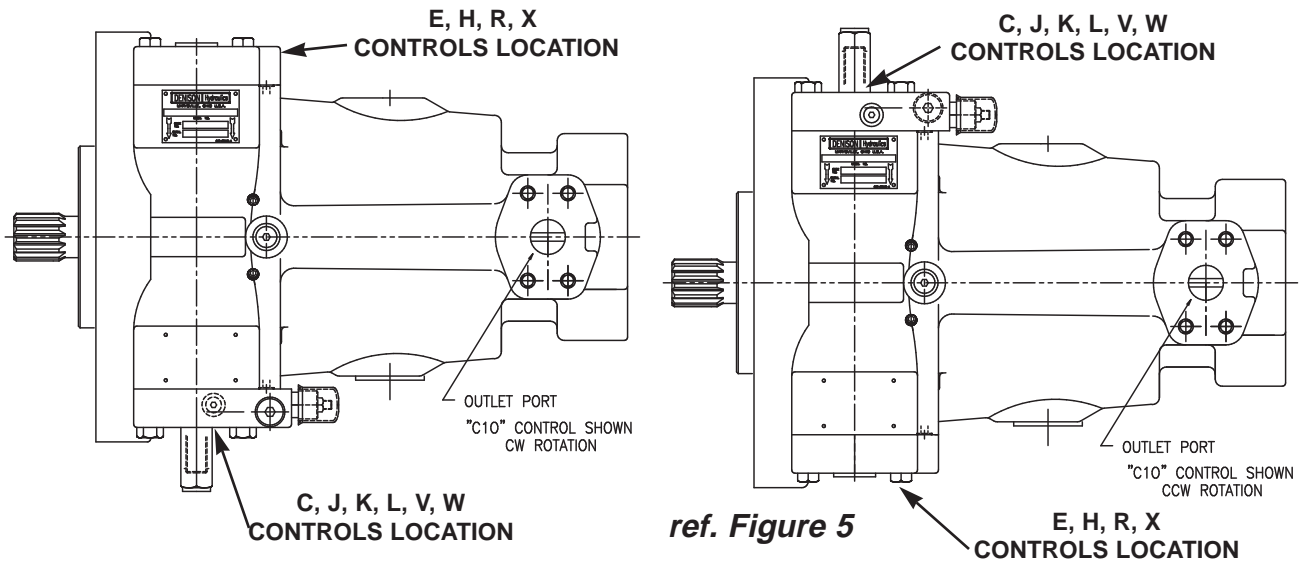


ref. Figure 2
Indicator assembly

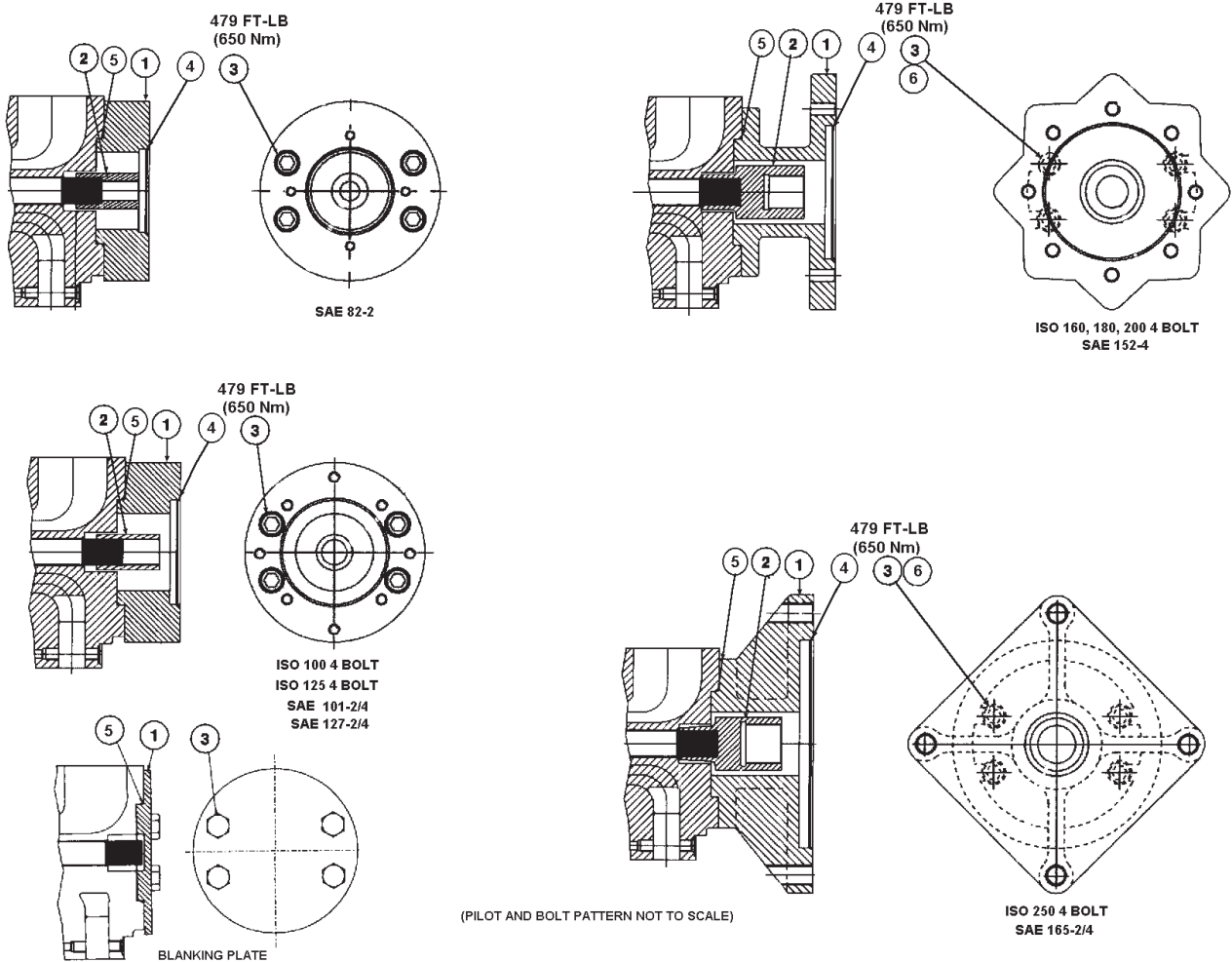


CONTROLS ASSEMBLY

Remove cap tools T-2 from housing and replace with control cap assemblies (50) and (31). The control caps must be positioned on the housing for either CW or CCW pump rotation. See figure 5 for correct orientation. The control piston (44) was assembled previously for the correct pump rotation. Install eight hex head cap screws (35) into caps and torque to housing with 75 lbs-ft., 102 Nm.



If the pump has a rear drive feature, assemble coupling and adapter. See illustration, figure 4.



Ref. Figure 4

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 pilot operated valve spool and sleeve combination is the core of the control function. For the compensator, torque limiter and load sensing controls, system pressure is applied to the input port of a three-way valve, and to one end of the valve spool. A small orifice feeds this pressure to the other end of the spool, and limits pilot flow to approximately 115 in³/min., 1,9 lpm. 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 end of the control piston a small buck-up piston connects to system pressure. This force, 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 250 psi, 17,2 bar difference, the spool shifts toward the spring, re-directing the control piston port to system 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 meters to maintain the pump pressure at approximately 250 psi, 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".

COMPENSATOR WITH LOAD SENSING CONFIGURATION

To use the compensator for load sensing, the "V" port is connected to the load downstream of a metering valve. The pump will supply approximately 250 psi, 17,2 bar difference in pressure across the metering valve, and thus controls flow independent of operating pressure. Adjustment of spring load on the three-way spool allows precise control of the differential pressure.

LOAD SENSING CONTROL

To eliminate the pilot flow, and to control multiple loads, a control designed for load sensing 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 approximately 350 psi to 435 psi, 24,1 to 30 bar above load pressure. There is essentially no flow in the sensing line, and the pump supplies the flow required to develop 350 psi to 435 psi, 24,1 to 30 bar across the metering valve to the load.

TORQUE LIMITER

The product of system pressure and pump displacement must be kept constant for torque limiting. As pressure increases, displacement must reduce, and vice versa. A linkage to the pump control piston slides a sleeve over a pin. The sleeve and pin act as a metering valve. The pin contains a cross drilled hole, and a connecting drilling to one end which is ported 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 sleeve 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 where balance is achieved. At low pressure, high flow, only the outer spring contacts the pin. 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 a constant product of pressure times displacement. The normal compensator function is retained to provide a maximum pressure limit.

TORQUE LIMITER WITH LOAD SENSING

A modulating valve is mounted to a torque limiter body to provide a load sensing control with torque limiting and pressure compensator override

ROTARY SERVO CONTROL

The rotary servo control is mounted on the off-stroke side of the control piston. Servo pressure is connected to the input port of a four-way valve, and to the end of this valve spool. A drilling and orifice connects to the opposite end of the spool. One cylinder port connects to the "off stroke" end of the control piston, while the other cylinder port connects to the "on stroke" end of the control piston, through the control on the opposite side.

A rotatable shaft converts to a linear motion on a pin. A sleeve over the pin is driven by a linkage to the control piston. The sleeve/pin combination meters pilot flow from the four-way valve controlling the shifting of the four-way valve, in such a manner that the four-way valve shifts to hold the cylinder position to the corresponding position for the input rotation.

HYDRAULIC STROKER

In the hydraulic stroker, a spring loaded piston is attached to the 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 275 psi, 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. For a 24 volt coil, the pump commences to stroke at approximately 175 mA electrical signal, and will be at full stroke at approximately 320 mA.

PRESSURE COMPENSATOR AND TORQUE LIMITER OVERRIDE

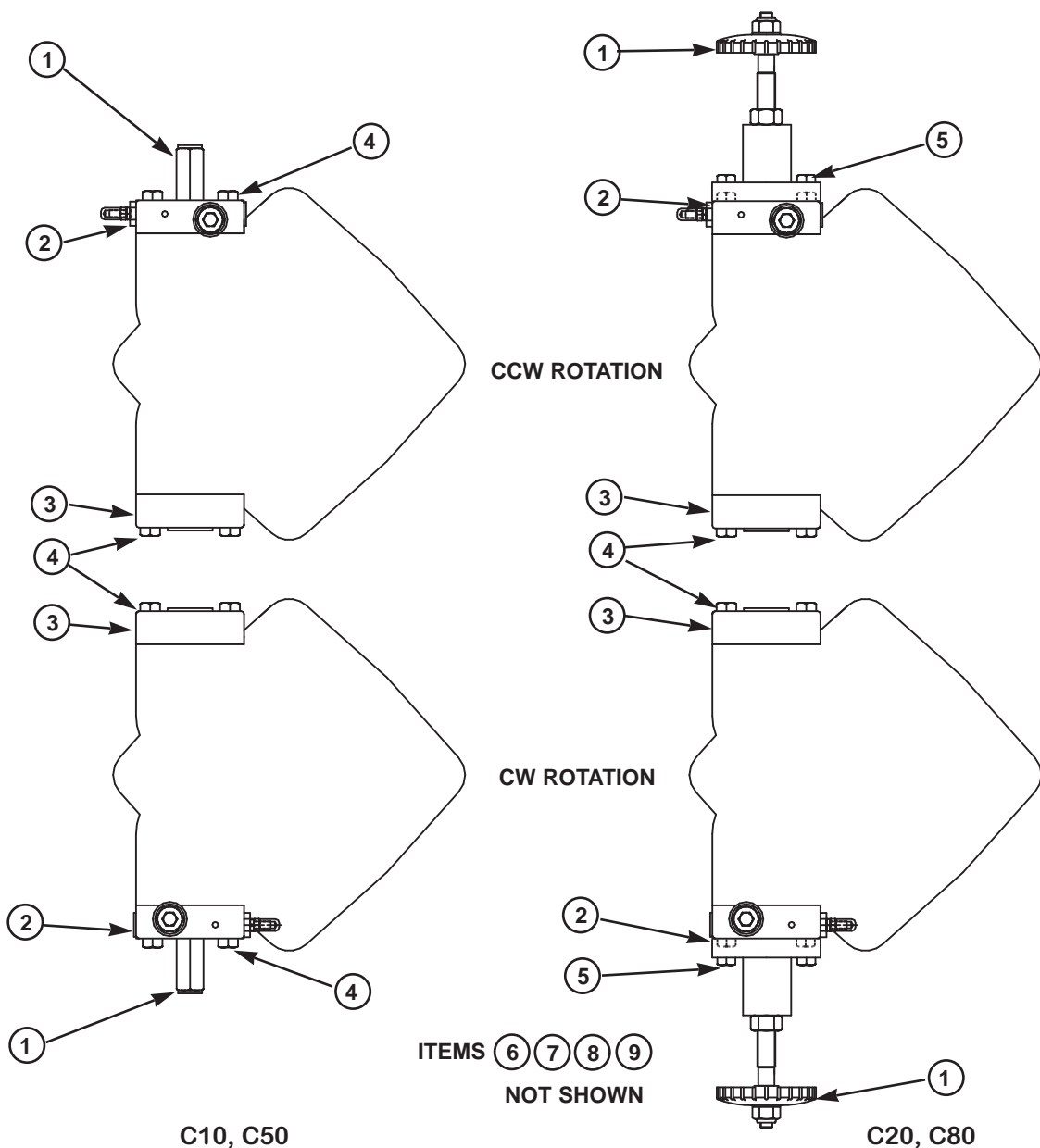
An override pressure compensator or a torque limiter control mounts on the smaller diameter of the control piston, opposite the servo, hydraulic or electric stroker. In the normal position, the spool in the override control connects this piston to the control valve on the opposite side, allowing control by the stroker. When system pressure or torque exceed the override setting, this spool connects system pressure to the smaller diameter control piston, to override the rotary servo, hydraulic or electric stroker command and reduce stroke according to the compensator or torque limiter setting. Override pressure must be sufficient to overcome servo pressure acting on the larger diameter piston.

TIGHTENING TORQUE FOR HYDRAULIC PLUGS

| PORT SIZE | ft-lbs | Nm |
|-----------|--------|-----|
| SAE-4 | 11 | 15 |
| SAE-6 | 18 | 24 |
| SAE-8 | 46 | 62 |
| SAE-10 | 75 | 102 |
| SAE-14 | 130 | 175 |
| SAE-24 | 250 | 339 |
| 1/4 BSPP | 18 | 24 |
| 3/8 BSPP | 18 | 24 |
| 1/2 BSPP | 93 | 126 |
| 1-1/2 BSP | 288 | 390 |

PORT SIZES

| DESCRIPTION | P16 C MOD | P260 C MOD |
|--|-----------|-------------|
| PORT C1OFF-STROKE CYL. GAGE..... | SAE-4 | .1/4 BSPP |
| PORT C2ON-STROKE CYL. GAGE | SAE-4 | .1/4 BSPP |
| PORT DCASE DRAIN | SAE-24 | .1-1/2 BSPP |
| PORT D1CASE DRAIN | SAE-24 | .1-1/2 BSPP |
| PORT DG.....DRAIN GAGE, AIR BLEED PORT | SAE-4 | .1/4 BSPP |
| PORT AG.....INLET GAGE | SAE-4 | .1/4 BSPP |
| PORT BG.....SYSTEM GAGE..... | SAE-4 | .1/4 BSPP |
| PORT BG1....ALT. SYS. GAGE..... | SAE-6 | .1/4 BSPP |
| PORT EELECTROHYDRAULIC STROKER SERVO SUPPLY | SAE-4 | .1/4 BSPP |
| PORT HHYDRAULIC STROKER SIGNAL | SAE-4 | .1/4 BSPP |
| PORT LSLOAD SENSING LINE | SAE-4 | .1/4 BSPP |
| PORT VCOMPENSATOR, TORQUE LIMITER, LOAD SENSING VENT | SAE-8 | .3/8 BSPP |
| PORT VOVERRIDE COMP, OVERRIDE TORQUE LIMITER VENT | SAE-4 | .1/4 BSPP |
| PORT V1SERVO VENT | SAE-4 | .1/4 BSPP |
| PORT XSERVO SUPPLY | SAE-8 | .3/8 BSPP |
| PORT XG.....SERVO GAGE | SAE-10 | .1/2 BSPP |



PRESSURE COMPENSATOR

parts list

| ITEM | DESCRIPTION | P16 PART NO. | P260 PART NO. | QTY. | |
|------|-------------------------------|-----------------|------------------|----------|----------|
| | | | | C10, C50 | C20, C80 |
| 1 | Max. Vol. Stop (Fig. 7) | S22-12983 | S22-12983 | 1 | — |
| | Max Vol. Handwheel (Fig. 8) | S22-12915 | S22-12915 | — | 1 |
| 2 | *Compensator Control (Fig. 6) | S22-15311 | S22-15312 | 1 | - |
| 3 | Buck Up Cap (Fig. 9) | S22-15653 | S22-15653 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 8 | 6 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | — | 2 |
| 6 | Control Piston | 032-92318 | 032-92318 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 |
| 9 | Piston Ring | 032-91261 | 032-91261 | 2 | 2 |

*Include items 1 (Maximum Volume Stop), 4, 5, 7 and 8

COMPENSATOR DISASSEMBLY

1. **See Figure 6.** Back off max. volume screw or handwheel to full displacement. Remove max. volume screw or hand wheel 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***See page 26 for tightening torque on plugs***

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 plug (15) into cap. Install screw (3), nut (4) and plastic cap (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 plugs (12) and (21)
6. Note proper location for cap on pump (pg. 24). 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 lbs.*ft., 102 Nm.

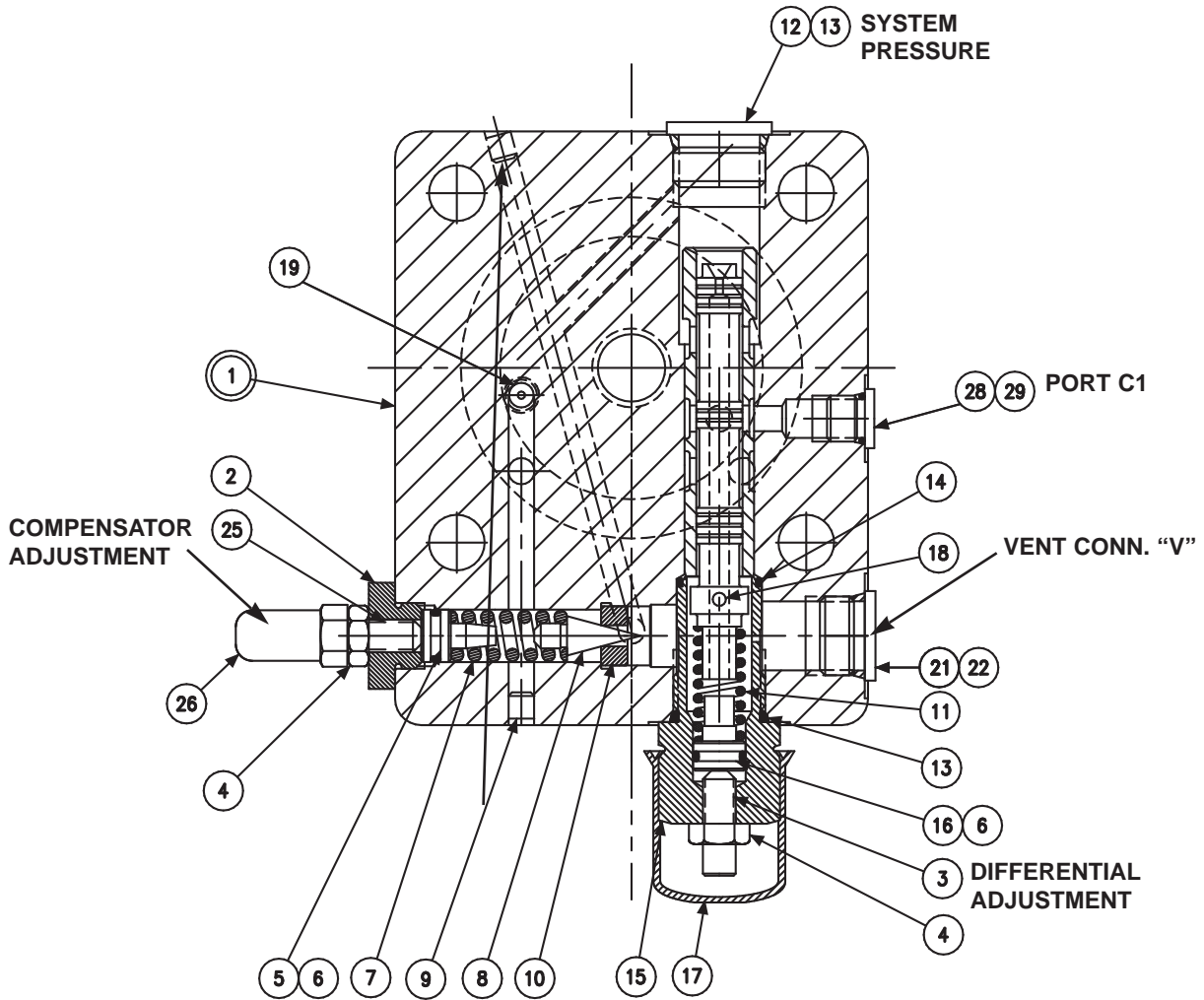


FIGURE 6

PARTS LIST FOR FIGURE 6

P16 code C10, C50 S22-15311

P260 code C10, C50, S22-15312

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap-Sleeve Assembly | S22-12880 | 1 | S22-12881 | 1 |
| 2 | Adj. Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Soc. Setscrew 5/16-24 x 1 | 312-13160 | 1 | 312-13160 | 1 |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 2 | 447-00026 | 2 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 033-71086 | 1 | 033-71086 | 1 |
| 12 | Plug, SAE-10, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal Piston | 032-91305 | 1 | 032-91305 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-59482 | 1 | 032-59482 | 1 |
| 19 | Orifice Plug | 033-25528 | 1 | 033-25528 | 1 |
| 21 | Plug, SAE-8, 3/8 BSPP | 488-35018 | 1 | 447-00032 | 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 | 312-13180 | 1 |
| 26 | Acorn Nut | 036-33474 | 1 | 036-33474 | 1 |
| 28 | Plug, SAE-4, 1/4 BSPP | 488-35061 | 1 | 447-01004 | |
| 29 | O-ring, 90 S-1 ARP 904 | 691-00904 | 1 | - | - |

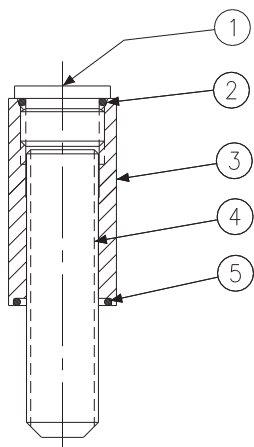


Figure 7
max. volume stop

PARTS LIST FOR FIGURE 7

max. volume stop S22-12983

| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|----------------------------|-----------|------|
| 1 | Plug, SAE-10 | 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 |

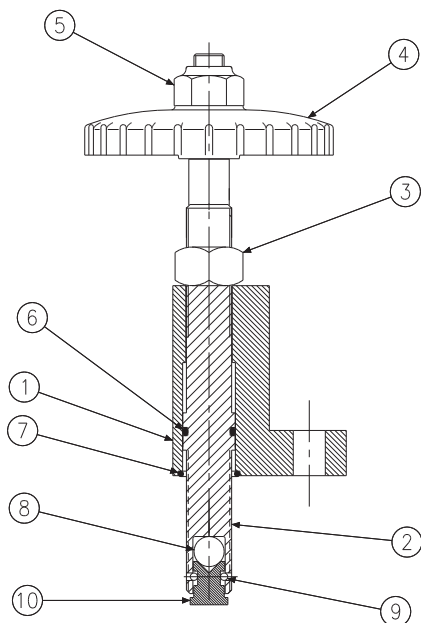


Figure 8
Handwheel maximum volume stop

PARTS LIST FOR FIGURE 8

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 |

MAXIMUM VOLUME HANDWHEEL DISASSEMBLY

1. See Fig. 8. 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) pivots and rotates 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-lb, 102 Nm.

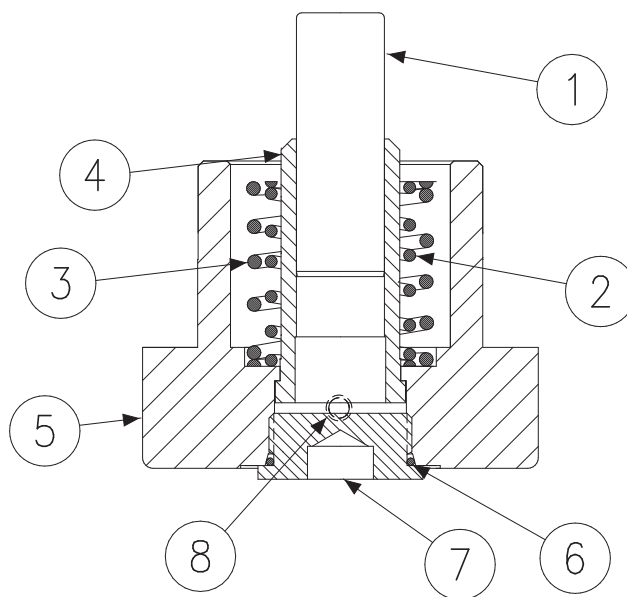


FIGURE 9
Buck-up cap assembly

PARTS LIST FOR FIGURE 9
buck-up cap S22-15653

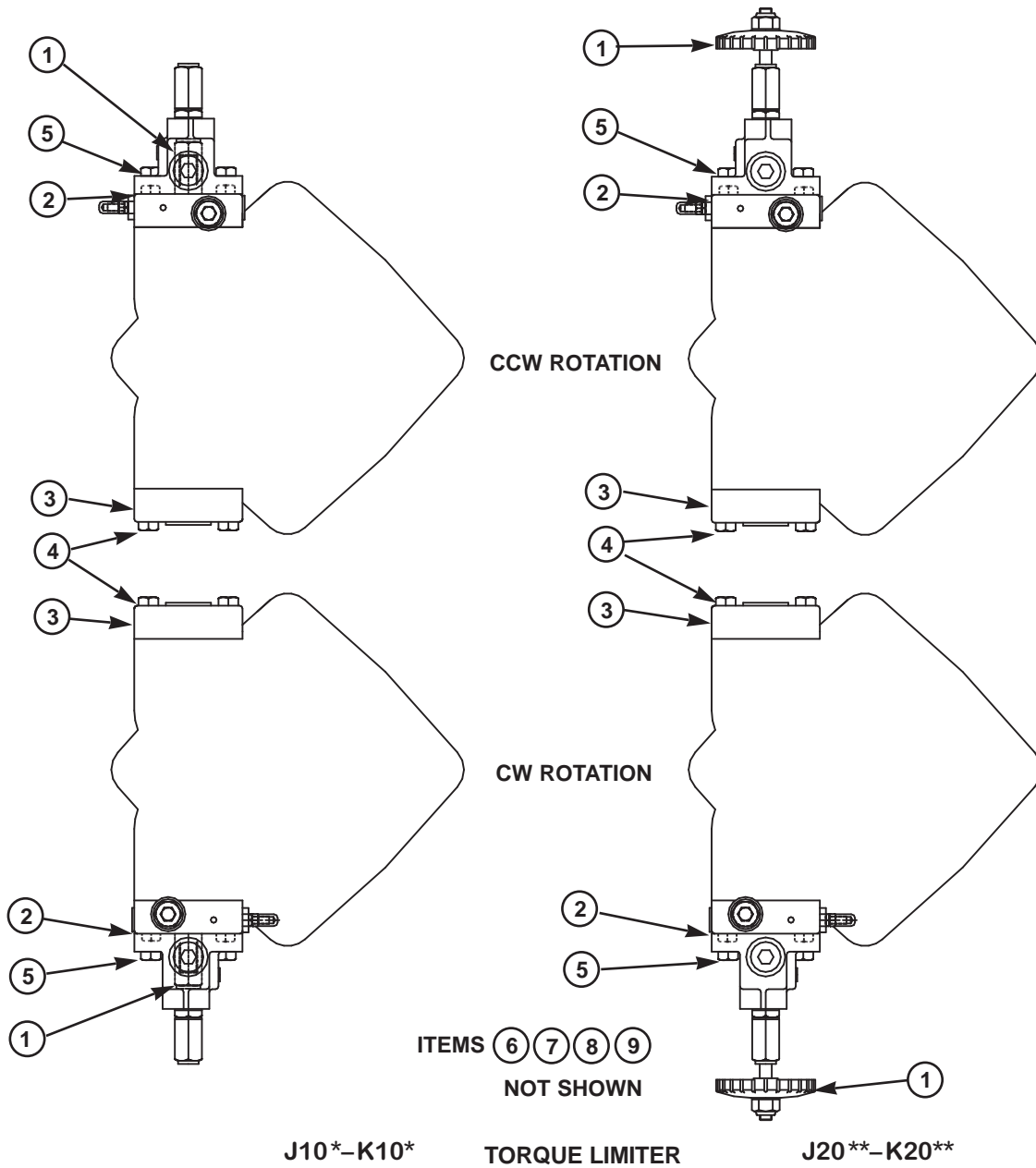
| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|--------------|-----------|------|
| 1 | Piston | 324-26448 | 1 |
| 2 | Spring | 032-92244 | 1 |
| 3 | Spring | 032-92316 | 1 |
| 4 | Sleeve | 032-92247 | 1 |
| 5 | Control Cap | 032-92248 | 1 |
| 6 | O-Ring | 691-00920 | 1 |
| 7 | Plug, SAE-20 | 488-35019 | 1 |
| 8 | Avseal Plug | 447-00026 | 1 |

BUCK-UP CAP DISASSEMBLY

1. **See Figure 9.** 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 springs (2), (3) and piston (1). If sleeve (4) is worn, press it out and replace.

ASSEMBLY

1. Install Avseal plug (8) into cap. Press sleeve (4) into cap to shoulder. Install piston (1), O-ring (6) and plug (7) into cap.
2. Install O-rings on interface between cap and pump control pad. Install spring (2) and spring (3) into control piston. Install cap assembly on pump housing as indicated on page 17 Fig. 5, guiding the control piston into the bore.
3. Torque the assembly bolts to 75 ft-lb, 102 Nm. Torque plug (7) to 225 lb-ft, 305 Nm.



PARTS LIST
torque limiter

| ITEM | DESCRIPTION | P16 PART NO | P260 PART NO. | QUANTITY | | | |
|------|----------------------------------|----------------|------------------|----------|------|-------|-------|
| | | | | J10* | K10* | J20** | K20** |
| 1 | Maximum Volume Stop (Fig. 7) | S22-12983 | S22-12983 | 1 | 1 | — | — |
| | Max Vol. Handwheel (Fig. 8) | S22-12915 | S22-12915 | — | — | 1 | 1 |
| 2 | ***Low Torque Limiter (Fig. 11) | S22-15313 | S22-15314 | 1 | — | - | — |
| | ***High Torque Limiter (Fig. 11) | S22-15315 | S22-15316 | — | 1 | — | - |
| 3 | Buck Up Cap (Fig. 9) | S22-15653 | S22-15653 | 1 | 1 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 6 | 4 | 4 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | 2 | 2 | 4 | 4 |
| 6 | Control Piston | 032-92318 | 032-92318 | 1 | 1 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 | 2 | 2 |
| 9 | Piston ring | 032-91261 | 032-91261 | 2 | 2 | 2 | 2 |

* Also J50, K50

**Also J80, K80

***Include items 1 (Maximum Volume Stop), 4, 5, 7 and 8

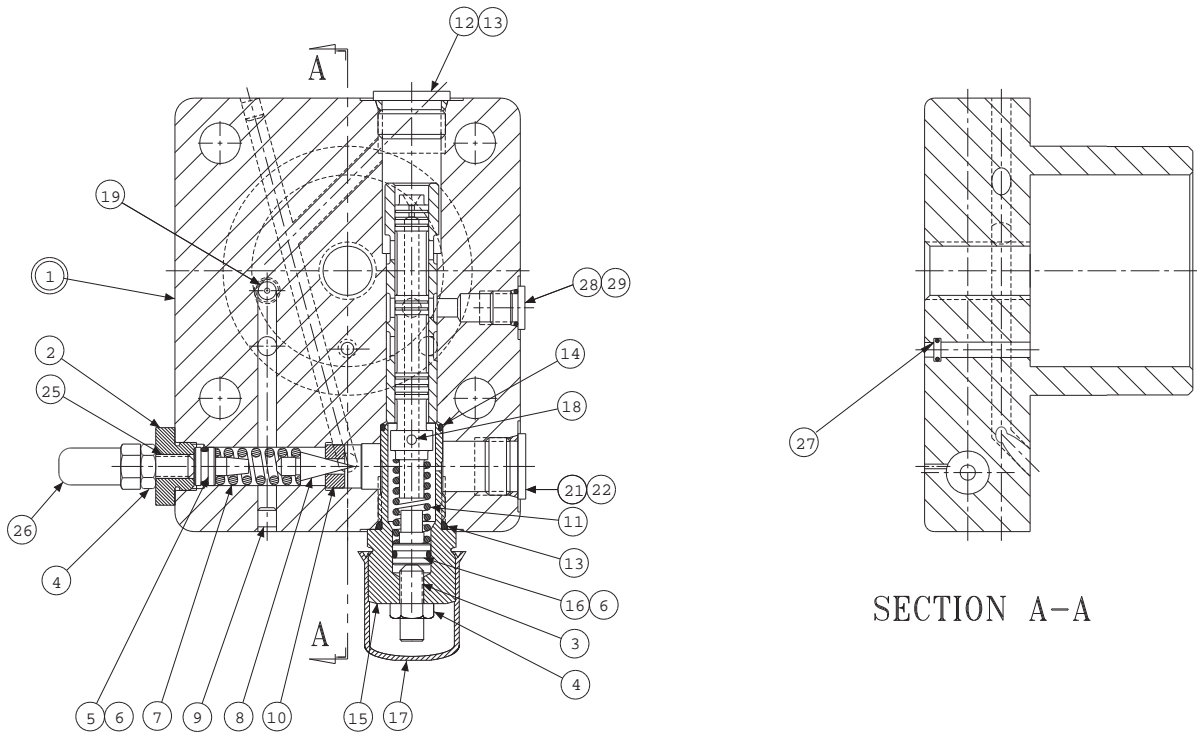


FIGURE 10
Torque limiter cap

PARTS LIST FOR FIGURE 10
P16 torque limiter cap S22-12913
P260 torque limiter cap S22-12923

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap-Sleeve Assembly | S22-12912 | 1 | S22-12922 | 1 |
| 2 | Adj. Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Soc. Setscrew 5/16-24 x 1 | 312-13160 | 1 | 312-13160 | 1 |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 2 | 447-00026 | 2 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 033-71086 | 1 | 033-71086 | 1 |
| 12 | Plug- SAE-10, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal Piston | 032-91305 | 1 | 032-91305 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-59482 | 1 | 032-59482 | 1 |
| 19 | Orifice | 033-25528 | 1 | 033-25528 | 1 |
| 21 | Plug- SAE-8, 3/8 BSPP | 488-35018 | 1 | 447-00032 | 1 |
| 22 | O-ring, 70 S-1 ARP 908 | 691-00908 | 1 | - | - |
| 25 | Soc. Setscrew 5/16-24 x 1-1/4 | 312-13180 | 1 | 312-13180 | 1 |
| 26 | Nut, Acorn 5/16-24 | 036-33474 | 1 | 036-33474 | 1 |
| 27 | O-Ring, 70 S-1 ARP 008 | 671-00008 | 1 | 671-00008 | 1 |
| 28 | Plug - SAE-4, 1/4 BSPP | 488-35061 | 1 | 447-01004 | 1 |
| 29 | O-ring 90 S-1 ARP 904 | 691-00904 | 1 | - | - |

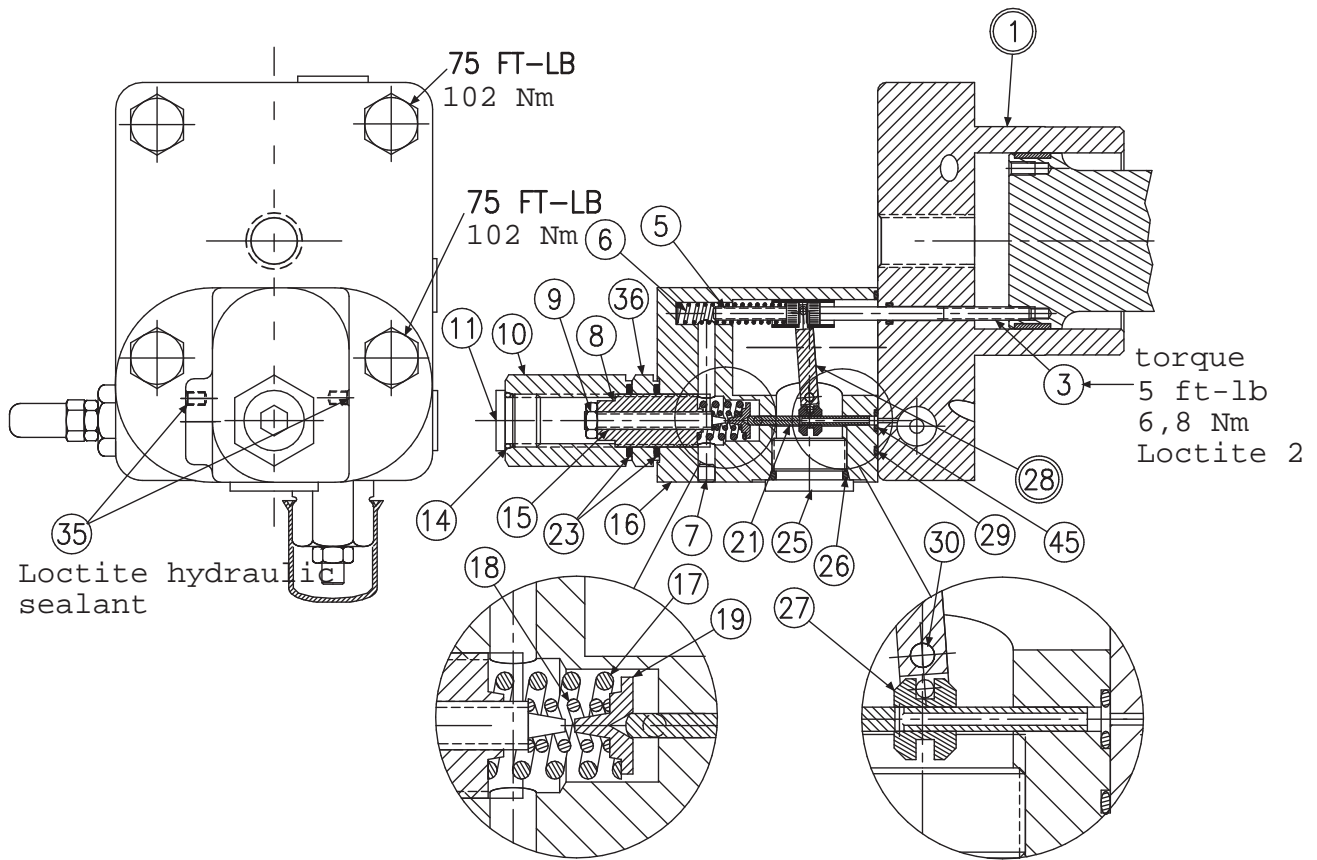


FIGURE 11
Torque Limiter

PARTS LIST FOR FIGURE 11

P16 code J10, J50, S22-15313

P16 code K10, K50, S22-15315

P260 code J10,, J50, S22-15314

P260 code K10, K50, S22-15316

| ITEM | DESCRIPTION | P16 | P260 | QTY. | |
|------|--------------------------------|-----------|-----------|------|---|
| | | PART NO. | PART NO. | J | K |
| 1 | Cap (Figure 10) | S22-12913 | S22-12923 | 1 | 1 |
| 3 | Screw | 032-91461 | 032-91461 | 1 | 1 |
| 5 | Clevis pin | 321-40000 | 321-40000 | 1 | 1 |
| 6 | Spring, Compression | 032-92100 | 032-92100 | 1 | 1 |
| 7 | Plug, Avseal | 447-00026 | 447-00026 | 1 | 1 |
| 8 | Screw | 032-91445 | 032-91445 | 1 | 1 |
| 9 | Nut, Hex Jam 1/4-20 UNC | 340-00038 | 340-00038 | 1 | 1 |
| 10 | Hex Nut, 3/4-16 UNF | 032-91449 | 032-91449 | 1 | 1 |
| 11 | Plug, SAE-8 | 488-35018 | 488-35018 | 1 | 1 |
| 14 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 691-00908 | 1 | 1 |
| 15 | Screw, Primary Adjust | 032-91446 | 032-91446 | 1 | 1 |
| 16 | Body assembly | S22-15396 | S22-15396 | 1 | 1 |
| 17 | Outer Spring – J Version | 032-91440 | 032-91440 | 1 | — |
| | Outer Spring – K Version | 032-91448 | 032-91448 | — | 1 |
| 18 | Inner Spring – J Version | 032-91441 | 032-91441 | 1 | — |
| | Inner Spring – K Version | 032-91447 | 032-91447 | — | 1 |
| 19 | Spring Retainer | 032-91819 | 032-91819 | 1 | 1 |
| 21 | Spool | 032-91438 | 032-91438 | 1 | 1 |
| 23 | O-ring, 70 S-1 ARP 118 | 671-00118 | 671-00118 | 2 | 2 |
| 25 | Plug, 12 SAE-12 | 488-35014 | 488-35014 | 1 | 1 |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 691-00912 | 1 | 1 |
| 27 | Sleeve | 032-91437 | 032-91437 | 1 | 1 |
| 28 | Arm assembly | S22-15520 | S22-15520 | 1 | 1 |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 671-00035 | 1 | 1 |
| 30 | Dowel Pin, 1/8 Dia. x 1.75 Lg. | 324-20828 | 324-20828 | 1 | 1 |
| 35 | Screw, SHC 10-32 x 1/4 | 312-09041 | 312-09041 | 2 | 2 |
| 36 | Nut | 032-91645 | 032-91645 | 1 | 1 |
| 45 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 671-00010 | 1 | 1 |

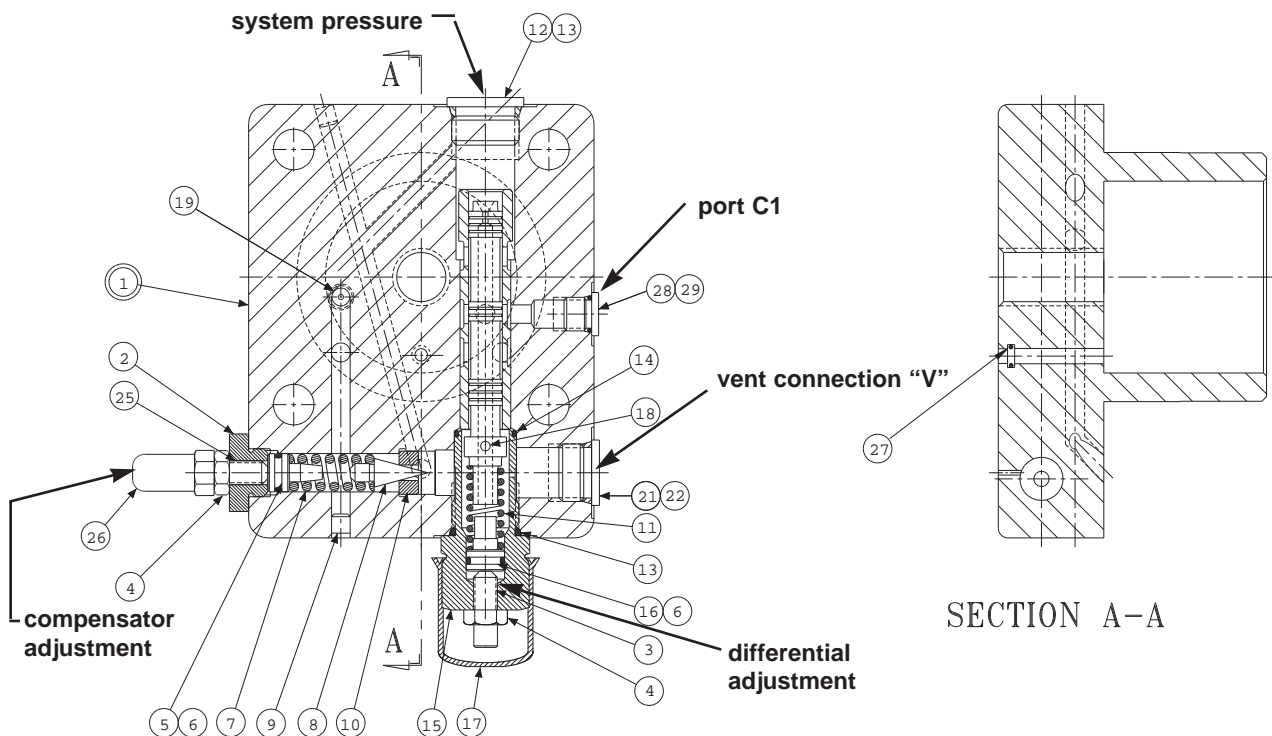
DISASSEMBLY

1. See Figure 11. 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 10. 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.

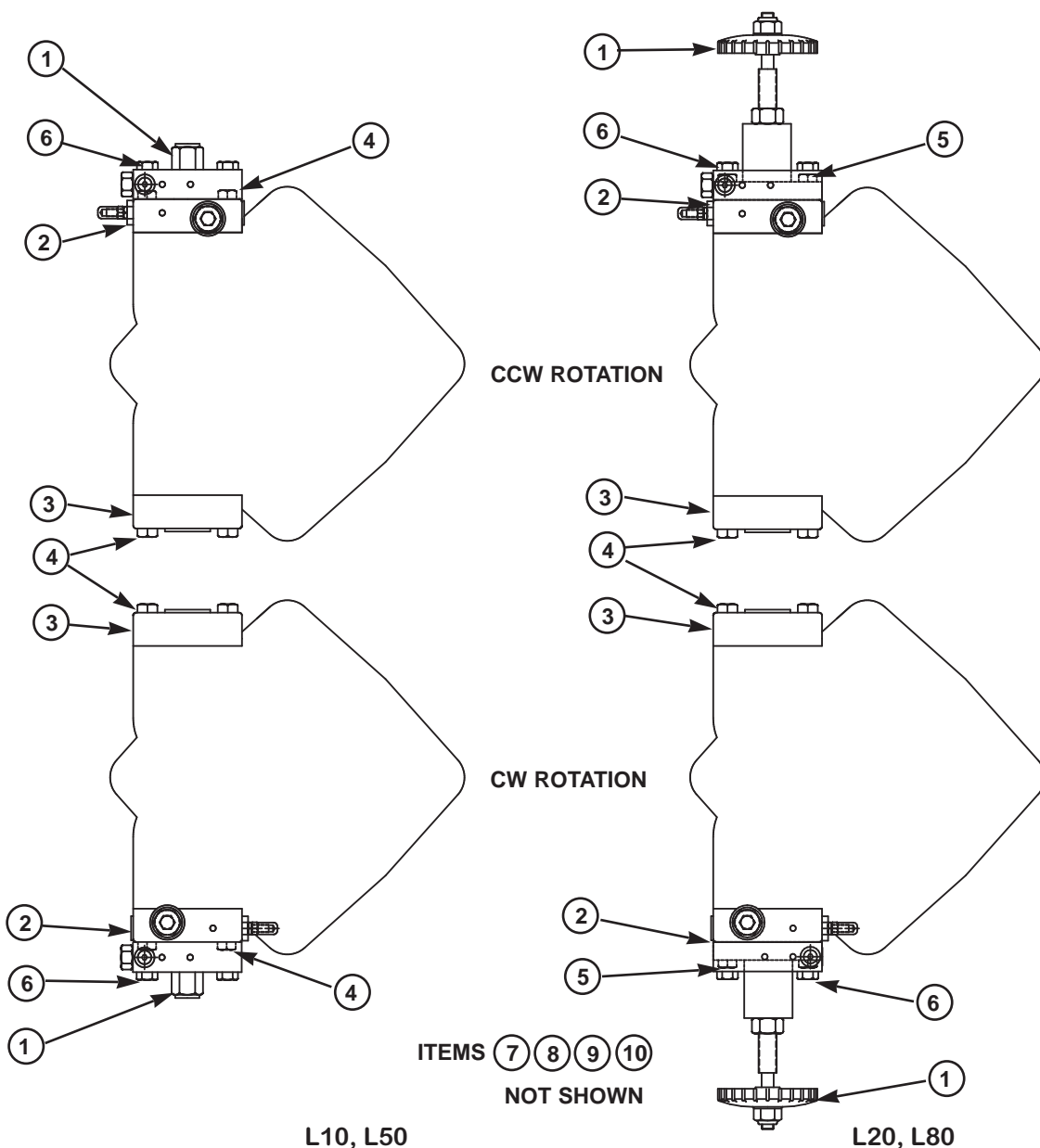
ASSEMBLY

See page 26 for tightening torque on plugs

1. See Figure 10. 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 plug (15) into cap. Install screw (3), nut (4) and acorn nut (17). Install plug (12). Torque plugs to 75 lb.*ft., 102 Nm. Install plug (21). Torque to 46 lb.*ft., 62 Nm. Install plug (28). Torque to 11 lb.*ft., 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 (pg. 24). Install O-rings on interface between cap and pump control pad. Install cap, guiding control piston into bore. Torque mounting screws to 75 lb.*ft., 102 Nm.
7. Install maximum volume handwheel or screw assembly. Set stop to clear control piston.
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 lb.*ft., 6,8 Nm
9. Measure height from control cap to top of screw. With control piston at full stroke, dimension must be 1.50 +/- .03 in., 38,1 +/- 0,76 mm.
10. Press dowel (30) into body (16), through the link assembly (28), to 1/4", 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 lb.*ft., 102 Nm.



Ref. Figure 10
Torque limiter cap



LOAD SENSING CONTROL

parts list

| ITEM | DESCRIPTION | PART NO. | | QTY. | |
|------|---------------------------------|-----------|-----------|----------|----------|
| | | P16 | P260 | L10, L50 | L20, L80 |
| 1 | Maximum Volume Stop (Fig. 7) | S22-12983 | S22-12983 | 1 | — |
| | Max Volume Handwheel (Fig. 8) | S22-12915 | S22-12915 | — | 1 |
| 2 | *Load Sensing Control (Fig. 12) | S22-15536 | S22-15537 | 1 | — |
| 3 | Buck Up Cap (Fig. 13) | S22-15653 | S22-15653 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 4 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | — | 2 |
| 6 | Screw-H.H.C. M12 x 90 mm | 363-12240 | 363-12240 | 2 | 2 |
| 7 | Control Piston | 032-92318 | 032-92318 | 1 | 1 |
| 8 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 |
| 9 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 |
| 10 | Piston Ring | 032-91261 | 032-91261 | 2 | 2 |

*Include items 1 (Maximum Volume Stop), 4, 6, 8 and 9

LOAD SENSING PRESSURE COMPENSATOR CONTROL

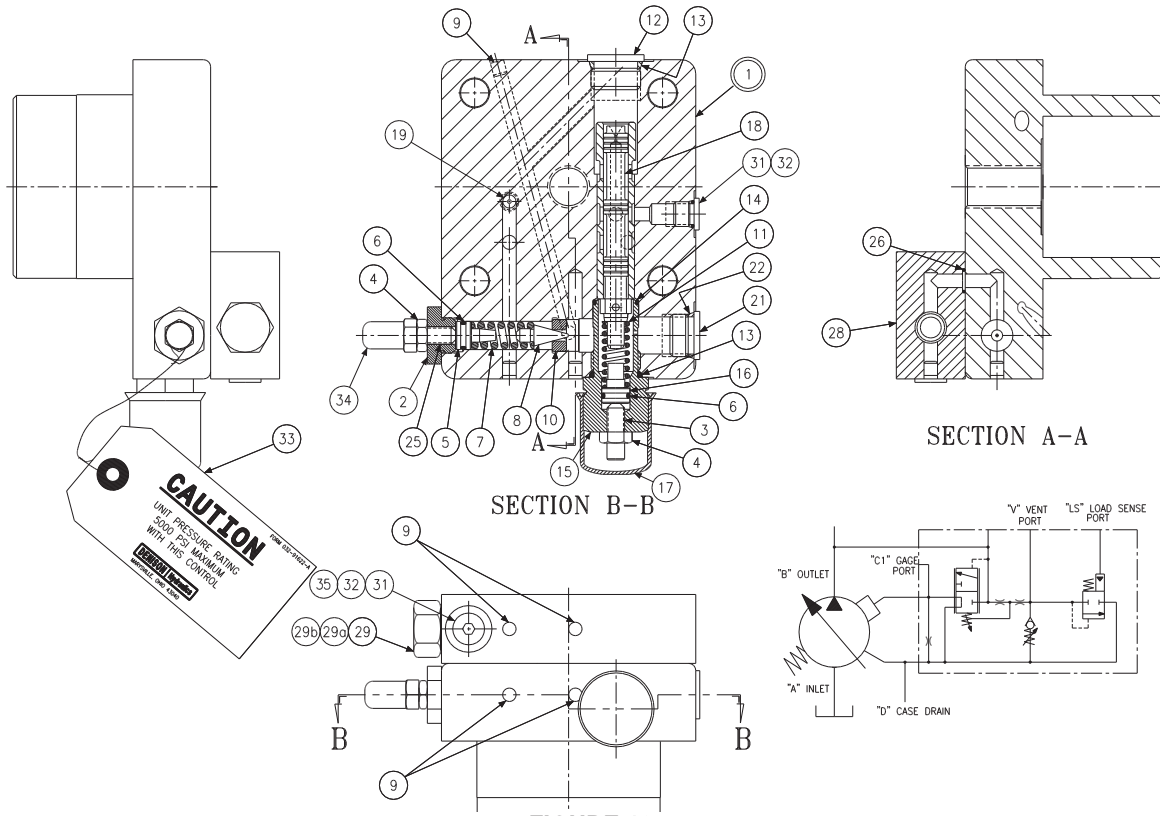


FIGURE 12

load sensing compensator control

PARTS LIST FOR FIG. 12
LOAD SENSING
COMPENSATOR
 P16 S22-15536
 P260 S22-15537

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|-----|-----------|-----|
| | | PART NO. | QTY | PART NO. | QTY |
| 1 | Cap-Sleeve Assembly | S22-15143 | 1 | S22-15176 | 1 |
| 2 | Adusting Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Socket Setscrew | 312-13160 | 1 | 312-13160 | 1 |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 5 | 447-00026 | 5 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 033-71086 | 1 | 033-71086 | 1 |
| 12 | Plug, SAE-8, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal Piston | 032-91305 | 1 | 032-91305 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-59482 | 1 | 032-59482 | 1 |
| 19 | Orifice Plug | 033-25528 | 1 | 033-25528 | 1 |
| 21 | Plug, SAE-10, 1/2 BSPP | 488-35018 | 1 | 447-00032 | 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 | 312-13180 | 1 |
| 26 | O-Ring, 70 S-1 ARP 011 | 671-00011 | 2 | 671-00011 | 2 |
| 28 | Body-Valve | 032-91620 | 1 | 032-91620 | 1 |
| 29 | Isolation Valve Cartridge | 517-00063 | 1 | 517-00063 | 1 |
| 29-A | O-Ring 90 S-1 ARP 017 | 691-00017 | 2 | 691-00017 | 2 |
| 29-B | O-Ring 90 S-1 ARP 015 | 691-00015 | 1 | 691-00015 | 1 |
| 31 | Plug, SAE-4, 1/4 BSPP | 488-35061 | 2 | 447-01004 | 2 |
| 32 | O-Ring, 90 S-1 ARP 904 | 691-00904 | 2 | 691-00904 | 1 |
| 33 | Tag, Caution | 032-91622 | 1 | 032-91622 | 1 |
| 34 | Nut, Acorn | 036-33474 | 1 | 036-33474 | 1 |
| 35 | Adapter | - | - | 032-91507 | 1 |

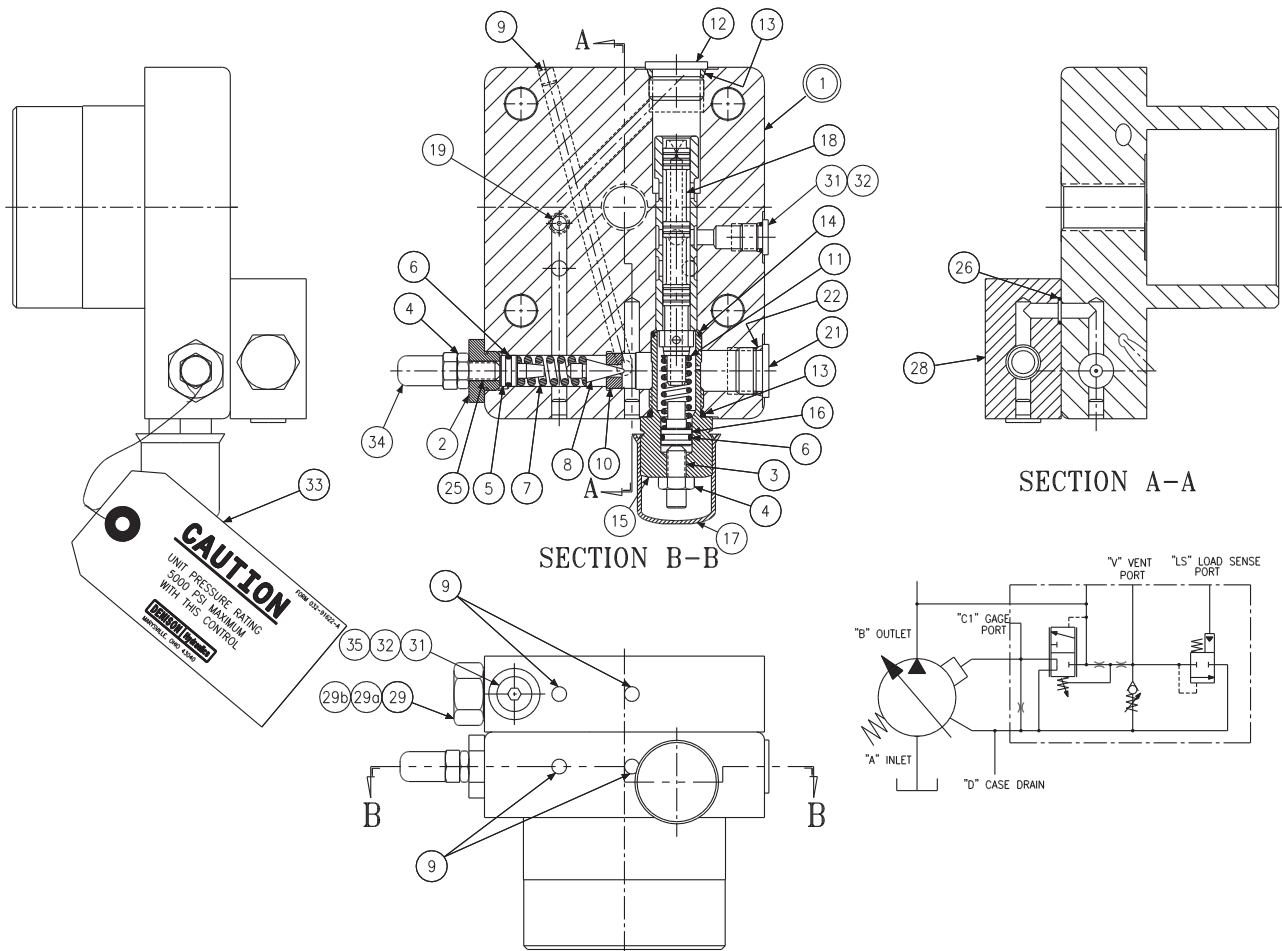
DISASSEMBLY

1. See Figure 12 Back off max. volume screw or handwheel to full displacement. Remove max. volume 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.

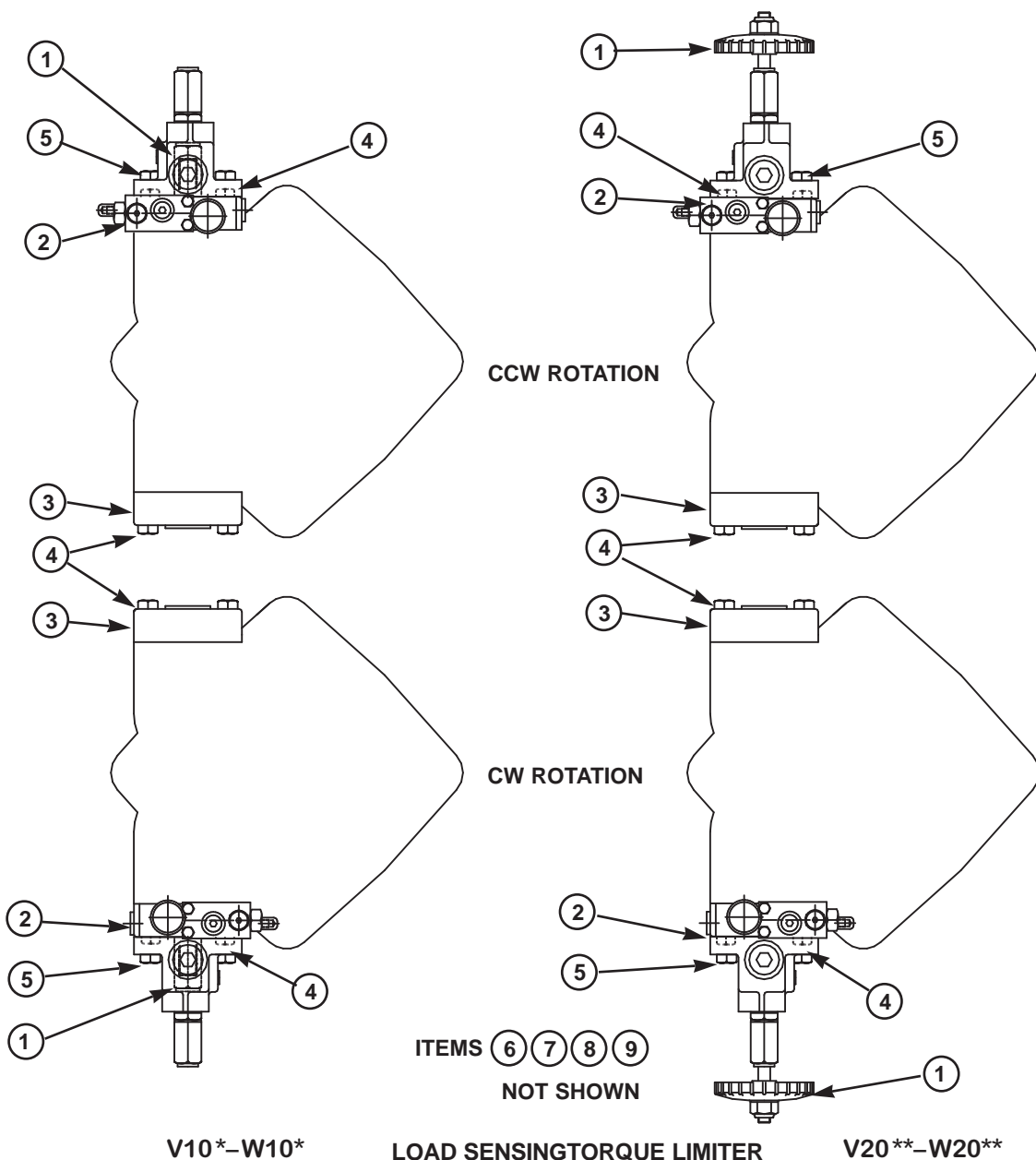
ASSEMBLY

See page 26 for tightening torque on plugs

1. Install Avseal plugs (9) and orifice (19) in body.
2. Press seat (10) into bore squarely against shoulder in bore.
3. Install plug (12) and 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 plug (15) into cap. Install screw (3), nut (4) and cover (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).
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 lb.*ft., 67,8 Nm.
7. For the P260 only, install O-ring (32) on adapter (35). Install adapter in block (28). Install plug (31) in adapter (35). For the P16 only, install O-ring (32) on plug (31). Install plug (31) in block (28).
8. Note proper location for cap on pump (pg. 24). 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 75 lb.*ft., 102 Nm.



Ref. Figure 12
load sensing compensator control



PARTS LIST

load sensing torque limiter

| ITEM | DESCRIPTION | P16 | P260 | QUANTITY | | | |
|------|---|-----------|-----------|----------|------|-------|-------|
| | | PART NO | PART NO. | V10* | W10* | V20** | W20** |
| 1 | Maximum Volume Stop (Fig. 7) | S22-12983 | S22-12983 | 1 | 1 | — | — |
| | Maximum Volume Handwheel (Fig. 8) | S22-12915 | S22-12915 | — | — | 1 | 1 |
| 2 | ***Low Torque Limiter Load Sensing (Fig. 13) | S22-15790 | S22-15802 | 1 | — | — | — |
| | ***High Torque Limiter Load Sensing (Fig. 13) | S22-16191 | S22-16192 | — | 1 | — | — |
| 3 | Buck Up Cap (Fig. 9) | S22-15653 | S22-15653 | 1 | 1 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 6 | 4 | 4 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | 2 | 2 | 4 | 4 |
| 6 | Control Piston | 032-92318 | 032-92318 | 1 | 1 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 | 2 | 2 |
| 9 | Piston ring | 032-91261 | 032-91261 | 2 | 2 | 2 | 2 |

* Also V50, W50

** Also V80, W80

*** Include items 1 (Maximum Volume Stop), 4, 5, 7 and 8

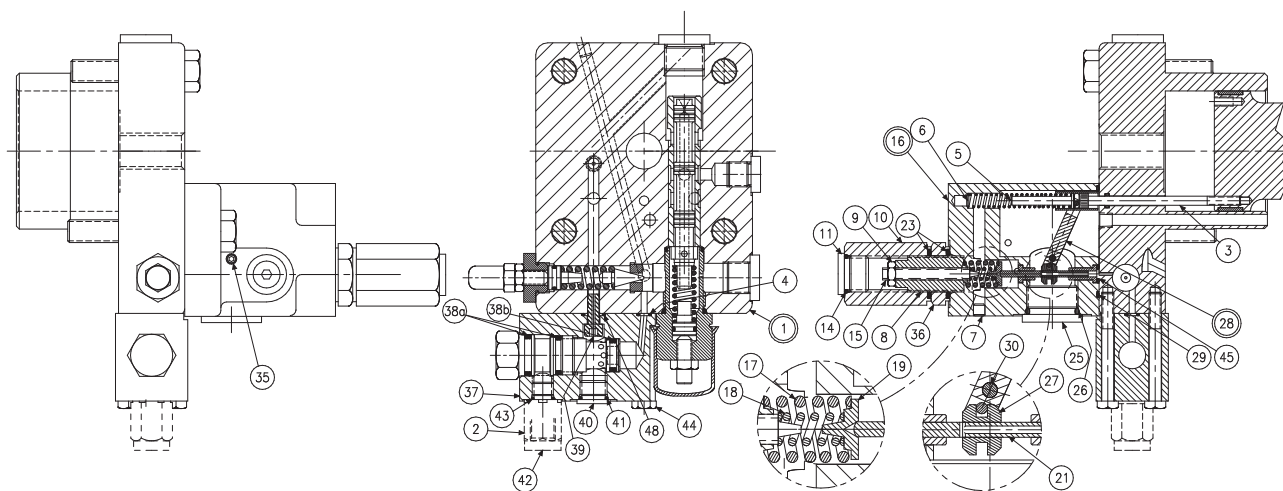


FIGURE 13

Load Sensing Torque Limiter

PARTS LIST FOR FIGURE 13

P16 code V10, V50, S22-15790

P16 code W10, W50, S22-16191

P260 code V10, V50, S22-15802

P260 code W10, W50, S22-16192

| ITEM | DESCRIPTION | P16 | | P260 | | QTY. | |
|------|--------------------------------|-----------|-----------|------|---|------|--|
| | | PART NO. | PART NO. | V | W | | |
| 1 | Cap (Figure 14) | S22-15791 | S22-15411 | 1 | 1 | | |
| 2 | Adapter | - | 032-91507 | - | 1 | | |
| 3 | Screw | 032-91461 | 032-91461 | 1 | 1 | | |
| 4 | O-ring, 70 S-1 ARP 008 | 671-00008 | 671-00008 | 1 | 1 | | |
| 5 | Clevis pin | 321-40000 | 321-40000 | 1 | 1 | | |
| 6 | Spring, Compression | 032-92100 | 032-92100 | 1 | 1 | | |
| 7 | Plug, Avseal | 447-00026 | 447-00026 | 1 | 1 | | |
| 8 | Screw | 032-91445 | 032-91445 | 1 | 1 | | |
| 9 | Nut, Hex Jam 1/4-20 UNC | 340-00038 | 340-00038 | 1 | 1 | | |
| 10 | Hex Nut, 3/4-16 UNF | 032-91449 | 032-91449 | 1 | 1 | | |
| 11 | Plug, SAE-8 | 488-35018 | 488-35018 | 1 | 1 | | |
| 14 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 691-00908 | 1 | 1 | | |
| 15 | Screw, Primary Adjust | 032-91446 | 032-91446 | 1 | 1 | | |
| 16 | Body assembly | S22-15396 | S22-15396 | 1 | 1 | | |
| 17 | Outer Spring – J Version | 032-91440 | 032-91440 | 1 | — | | |
| | Outer Spring – K Version | 032-91448 | 032-91448 | — | 1 | | |
| 18 | Inner Spring – J Version | 032-91441 | 032-91441 | 1 | — | | |
| | Inner Spring – K Version | 032-91447 | 032-91447 | — | 1 | | |
| 19 | Spring Retainer | 032-91819 | 032-91819 | 1 | 1 | | |
| 21 | Spool | 032-91438 | 032-91438 | 1 | 1 | | |
| 23 | O-ring, 70 S-1 ARP 118 | 671-00118 | 671-00118 | 2 | 2 | | |
| 25 | Plug, 12 SAE-12 | 488-35014 | 488-35014 | 1 | 1 | | |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 691-00912 | 1 | 1 | | |
| 27 | Sleeve | 032-91437 | 032-91437 | 1 | 1 | | |
| 28 | Arm assembly | S22-15520 | S22-15520 | 1 | 1 | | |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 671-00035 | 1 | 1 | | |
| 30 | Dowel Pin, 1/8 Dia. x 1.75 Lg. | 324-20828 | 324-20828 | 1 | 1 | | |
| 35 | Screw, SHC 10-32 x 1/4 | 312-09041 | 312-09041 | 2 | 2 | | |
| 36 | Nut | 032-91645 | 032-91645 | 1 | 1 | | |
| 37 | Body, load sense | 032-92359 | 032-92359 | 1 | 1 | | |
| 38 | Valve, modulating | 517-00063 | 517-00063 | 1 | 1 | | |
| 38a | O-ring, 90 S-1 ARP 017 | 691-00017 | 691-00017 | 2 | 2 | | |
| 38b | O-ring, 90 S-1 ARP 015 | 691-00015 | 691-00015 | 1 | 1 | | |
| 39 | Screw, special | 033-70908 | 033-70908 | 1 | 1 | | |
| 40 | Plug, SAE-6 | 488-35003 | 488-35003 | 1 | 1 | | |
| 41 | O-ring, 90 S-1 ARP 906 | 691-00906 | 691-00906 | 1 | 1 | | |
| 42 | Plug, SAE-4, 1/4 BSPP | 488-35013 | 447-01004 | 1 | 1 | | |
| 43 | O-ring, 90 S-1 ARP 904 | 691-00904 | 691-00904 | 1 | 1 | | |
| 44 | Screw, HHC, 1/4-20x2-1/4 | 306-40187 | 306-40187 | 2 | 2 | | |
| 45 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 671-00010 | 1 | 1 | | |
| 48 | O-Ring, 70 S-1 ARP 012 | 671-00012 | 671-00012 | 1 | 1 | | |

DISASSEMBLY

1. **See Figure 13.** 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 modulating valve (38) from body (37). Remove body (37) from cap assembly (1) Note plug (40) must be removed to remove special screw (39). Remove cap assembly (1).
1. **See Figure 14.** Remove plug (15) and attached parts. Remove spring (11) and spool (18).
2. 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).
3. 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).
4. Examine seat (10) for wear. Do not remove unless damaged.

ASSEMBLY

See page 26 for tightening torque on plugs

1. **See Figure 14.** Install Avseal plug (9) and orifice (19) in body.
2. Press seat (10) into bore squarely against shoulder in bore.
3. Install plug (12) and 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 plug (15) into cap. Install screw (3), nut (4) and cover (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)
6. Note proper location for cap on pump (pg.24). 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 or handwheel parts.
8. **See Figure 13.** Install block (37) on cap (1) with O-rings (4) and (48). Use special screw (39) through the block.
7. Install O-rings (38a) and (38b) on valve (38). 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 (38) in block (37), being careful to avoid damaging the O-rings. Torque to 50 lb.*ft., 67,8 Nm.
7. For the P260 only, install O-ring (43) on adapter (2). Install adapter in block (37). Install plug (31) in adapter (35). For the P16 only, install O-ring (43) on plug (42). Install plug (42) in block (37).
- 8.. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 lb.*ft., 6,8 Nm
9. Measure height from control cap to top of screw. With control piston at full stroke, dimension must be 1.50 +/- .03 in., 38,1 +/- 0,76 mm.
10. Press dowel (30) into body (16), through the link assembly (28), to 1/4", 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 mounting screws to 75 lb.*ft., 102 Nm.

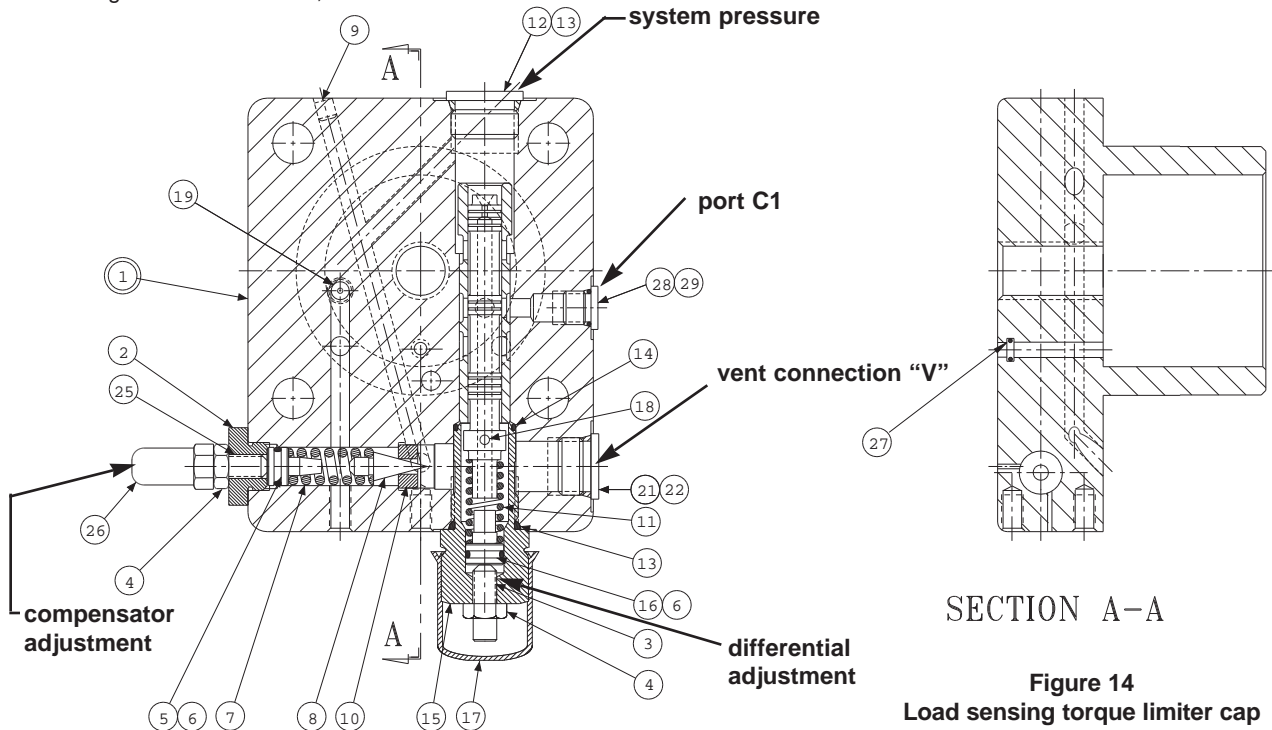
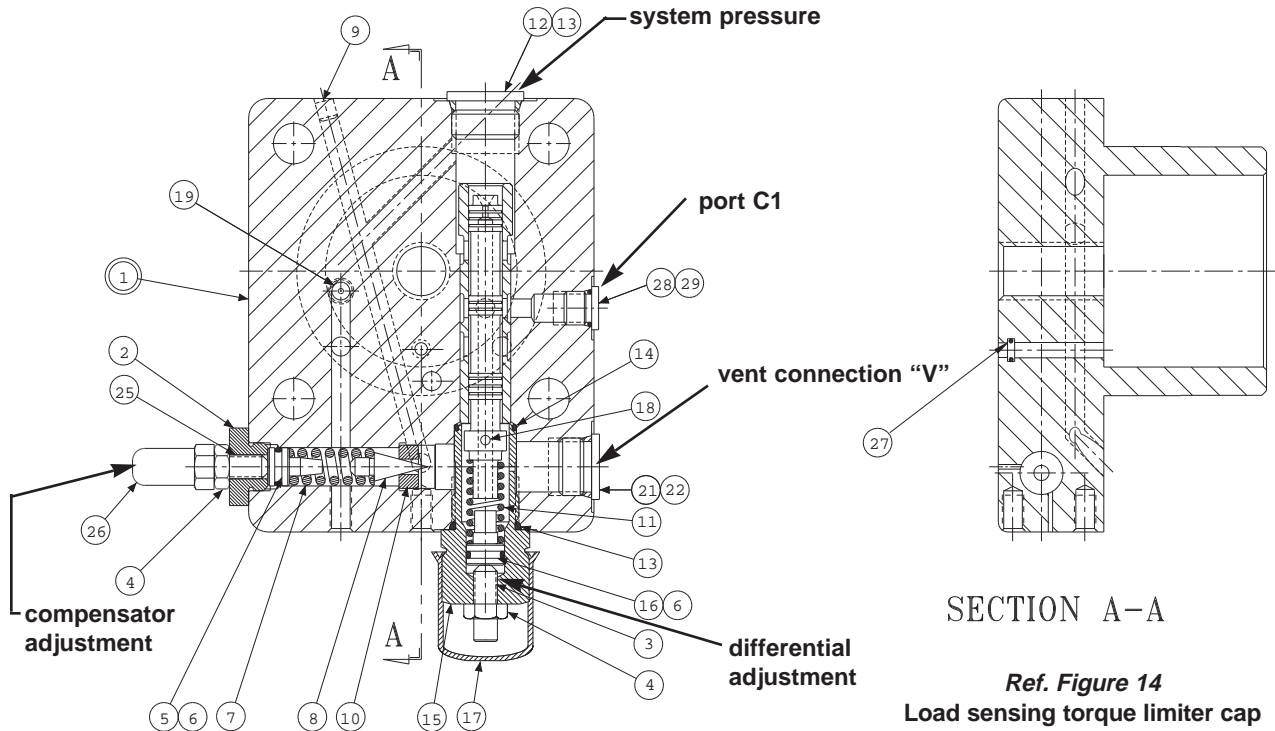


Figure 14
Load sensing torque limiter cap



Ref. Figure 14
Load sensing torque limiter cap

PARTS LIST FOR FIGURE 14

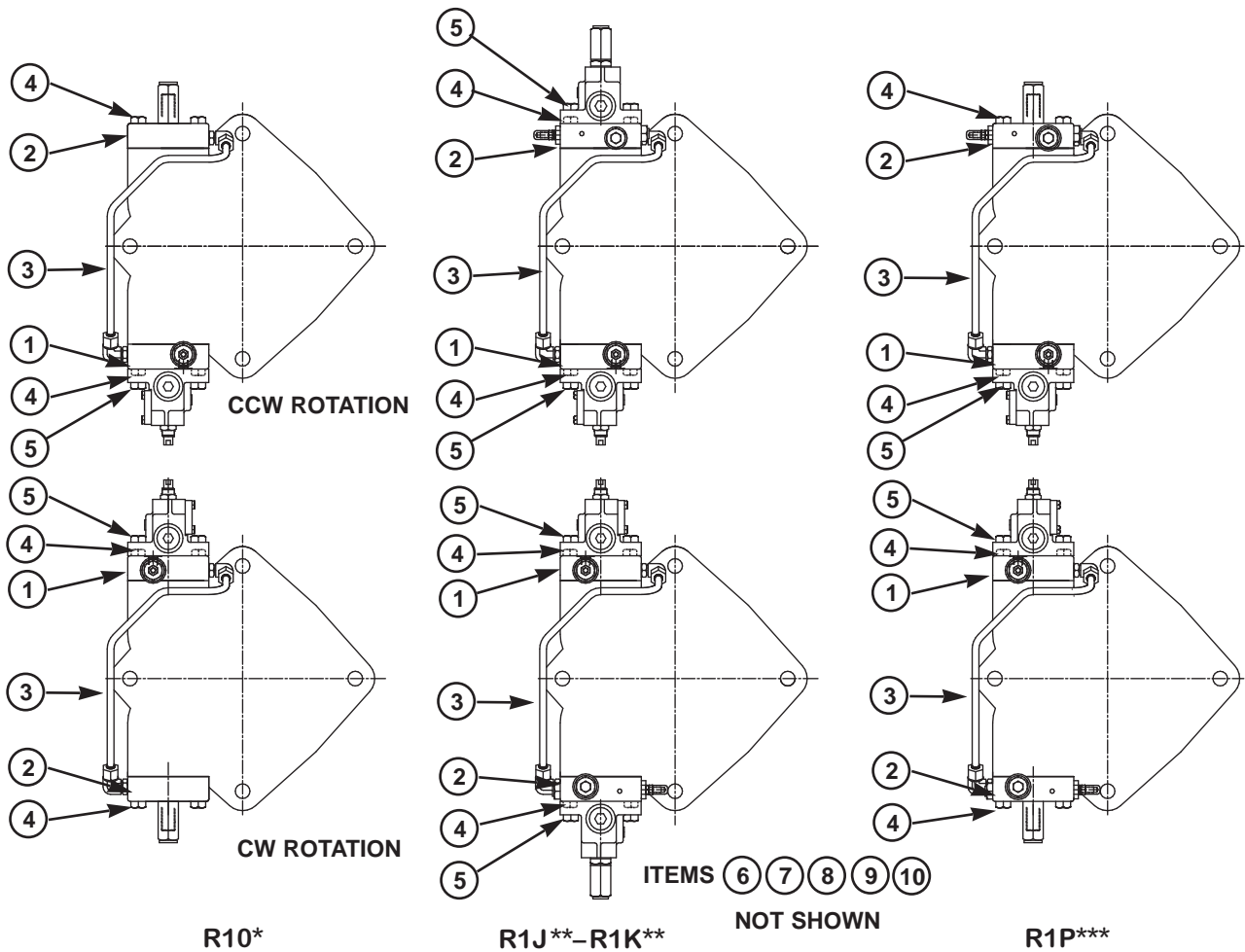
P16 load sensing torque limiter cap

S22-15791

P260 load sensing torque limiter cap

S22-15411

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap-Sleeve Assembly | S22-15792 | 1 | S22-15410 | 1 |
| 2 | Adj. Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Soc. Setscrew 5/16-24 x 1 | 312-13160 | 1 | 312-13160 | 1 |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 1 | 447-00026 | 1 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 033-71086 | 1 | 033-71086 | 1 |
| 12 | Plug- SAE-10, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal Piston | 032-91305 | 1 | 032-91305 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-59482 | 1 | 032-59482 | 1 |
| 19 | Orifice | 033-25528 | 1 | 033-25528 | 1 |
| 21 | Plug- SAE-8, 3/8 BSPP | 488-35018 | 1 | 447-00032 | 1 |
| 22 | O-ring, 70 S-1 ARP 908 | 691-00908 | 1 | - | - |
| 25 | Soc. Setscrew 5/16-24 x 1-1/4 | 312-13180 | 1 | 312-13180 | 1 |
| 26 | Nut, Acorn 5/16-24 | 036-33474 | 1 | 036-33474 | 1 |
| 27 | O-Ring, 70 S-1 ARP 008 | 671-00008 | 1 | 671-00008 | 1 |
| 28 | Plug - SAE-4, 1/4 BSPP | 488-35061 | 1 | 447-01004 | 1 |
| 29 | O-ring 90 S-1 ARP 904 | 691-00904 | 1 | - | - |



PARTS LIST
rotary servo

| ITEM | DESCRIPTION | P16 | P260 | QUANTITY | | | |
|------|---------------------------------|-----------|-----------|----------|-------|-------|--------|
| | | PART NO. | PART NO. | R10* | R1J** | R1K** | R1P*** |
| 1 | #Rotary Servo (Fig. 15) | S22-16005 | S22-16006 | 1 | 1 | 1 | 1 |
| 2 | #Control Cap (Fig.26) | S22-15256 | S22-15272 | 1 | — | — | — |
| | #Low Torque Override (Fig. 29) | S22-16009 | S22-16010 | — | 1 | — | — |
| | #High Torque Override (Fig. 29) | S22-16011 | S22-16012 | — | — | 1 | — |
| | #Compensator Override (Fig. 27) | S22-16007 | S22-16008 | — | — | — | 1 |
| 3 | Tube Assembly (Fig. 24, 25) | P22-15981 | P22-15998 | 1 | 1 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 4 | 4 | 6 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | 2 | 4 | 4 | 2 |
| 6 | Control Piston | 032-91785 | 032-91785 | 1 | 1 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 | 2 | 2 |
| 9 | Piston Ring | 032-91261 | 032-91261 | 1 | 1 | 1 | 1 |
| 10 | Piston Ring | 032-91811 | 032-91811 | 1 | 1 | 1 | 1 |

*Also R50

**Also R5J, R5K

***Also R5P

#Includes items 4, 5, 7 and 8

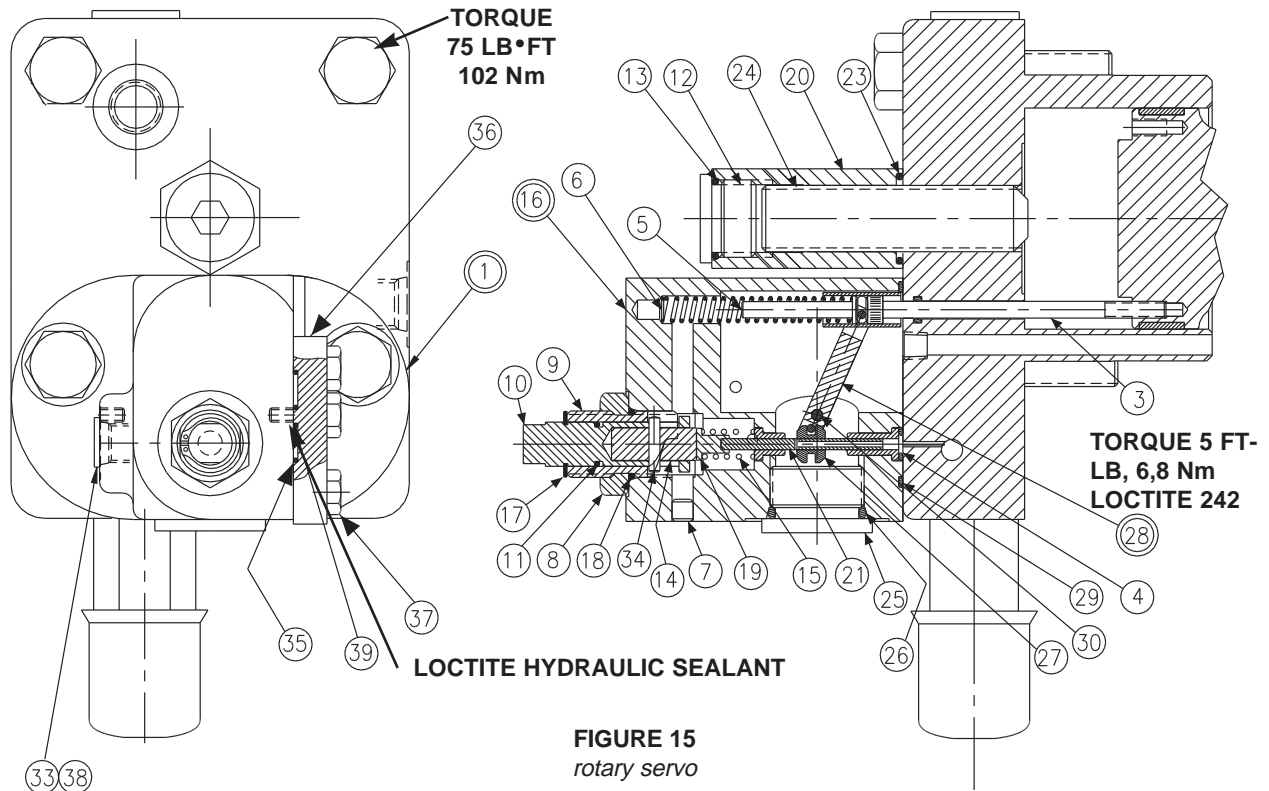


FIGURE 15
rotary servo

PARTS LIST FOR FIGURE 15
ROTARY SERVO

P16 S22-16005
P260 S22-16006

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap (Figure 16) | S22-15900 | 1 | S22-15901 | 1 |
| 3 | Screw | 032-91461 | 1 | 032-91461 | 1 |
| 4 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 1 | 671-00010 | 1 |
| 5 | Pin, Clevis | 321-40000 | 1 | 321-40000 | 1 |
| 6 | Spring, Compression | 032-92100 | 1 | 032-92100 | 1 |
| 7 | Plug, Avseal | 447-00026 | 1 | 447-00026 | 1 |
| 8 | Locknut | 492-15116 | 1 | 492-15116 | 1 |
| 9 | Cam | 032-91515 | 1 | 032-91515 | 1 |
| 10 | Shaft | 032-91514 | 1 | 032-91514 | 1 |
| 11 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 1 | 691-00012 | 1 |
| 12 | Plug, 10HP5N-S | 488-35055 | 1 | 488-35055 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 1 | 691-00910 | 1 |
| 14 | Slide Pin | 032-91513 | 1 | 032-91513 | 1 |
| 15 | Spring | 225-92105 | 1 | 225-92105 | 1 |
| 16 | Body | S22-15393 | 1 | S22-15393 | 1 |
| 17 | Retaining Ring | 356-31050 | 1 | 356-31050 | 1 |
| 18 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 1 | 691-00908 | 1 |
| 19 | Spring Retainer | 032-91516 | 1 | 032-91516 | 1 |
| 20 | Nut, 3/4-10 | 031-91049 | 1 | 031-91049 | 1 |
| 21 | Spool | 032-91438 | 1 | 032-91438 | 1 |
| 23 | O-Ring, 70 S-1 ARP 118 | 671-00118 | 1 | 671-00118 | 1 |
| 24 | Soc. Setscrew, 3/4-10 x 3 | 311-26320 | 1 | 311-26320 | 1 |
| 25 | Plug, 12 HP5N-S | 488-35014 | 1 | 488-35014 | 1 |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 1 | 691-00912 | 1 |
| 27 | Sleeve | 032-91437 | 1 | 032-91437 | 1 |
| 28 | Arm assembly | S22-15520 | 1 | S22-15520 | 1 |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 1 | 671-00035 | 1 |
| 30 | Dowel Pin, 1/8 Dia x 1.75 Lg. | 324-20828 | 1 | 324-20828 | 1 |
| 33 | O-Ring, 70 S-1 ARP 904 | 671-00904 | 1 | 671-00904 | 1 |
| 34 | Dowel Pin, 1/8 x 5/8 | 324-20810 | 1 | 324-20810 | 1 |
| 35 | O-Ring, 70 S-1 ARP 011 | 671-00011 | 2 | 671-00011 | 2 |
| 36 | Plate | 032-91510 | 1 | 032-91510 | 1 |
| 37 | Screw, HHC, 1/4-20 x 3/4 | 306-40142 | 3 | 306-40142 | 3 |
| 38 | Plug, SAE-4 | 488-35061 | 1 | 488-35061 | 1 |
| 39 | Screw, SHC 10-32 x 1/4 | 312-09041 | 2 | 312-09041 | 2 |

DISASSEMBLY

1. See Figure 15. 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 16. 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

See page 26 for tightening torque on plugs

1. See Figure 16. 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). Install orifice (20) and plugs (10). Torque plugs. 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 (pg. 24). 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 lb.·ft., 102 N m.
8. See Figure 15. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 lb.·ft., 6,78 N m.
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 .45 +/- .03 in., 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 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 18. Torque plug (12)
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 75 lb.·ft., 103 N m.
16. Install tubing assembly (Figure 24, 25).

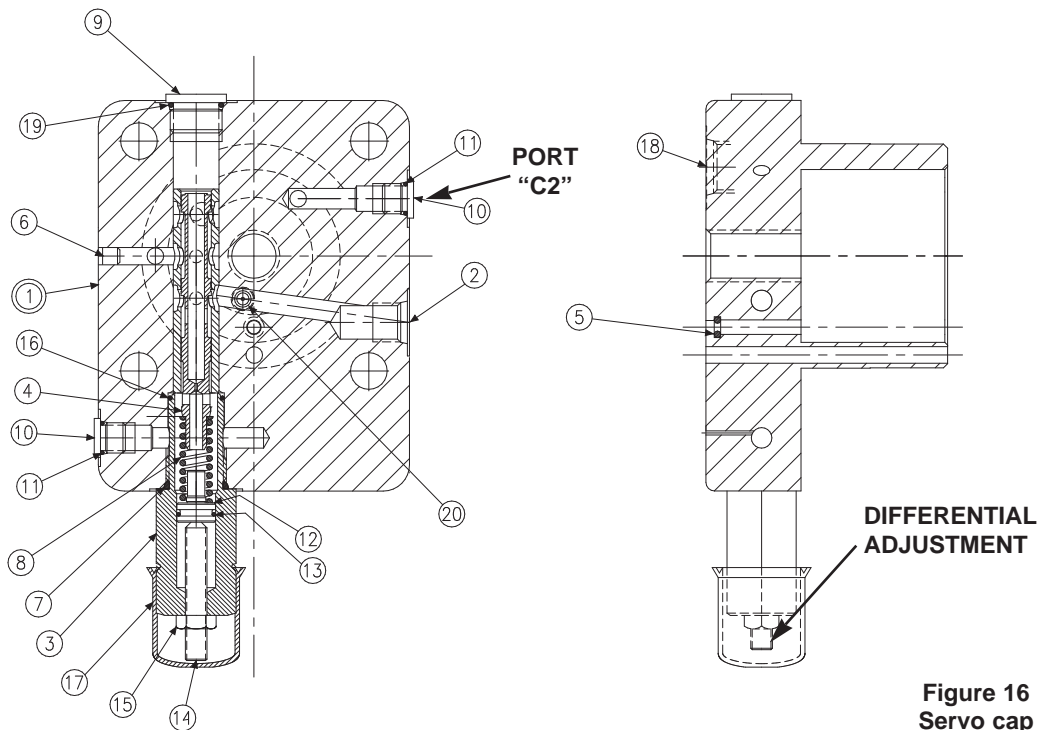
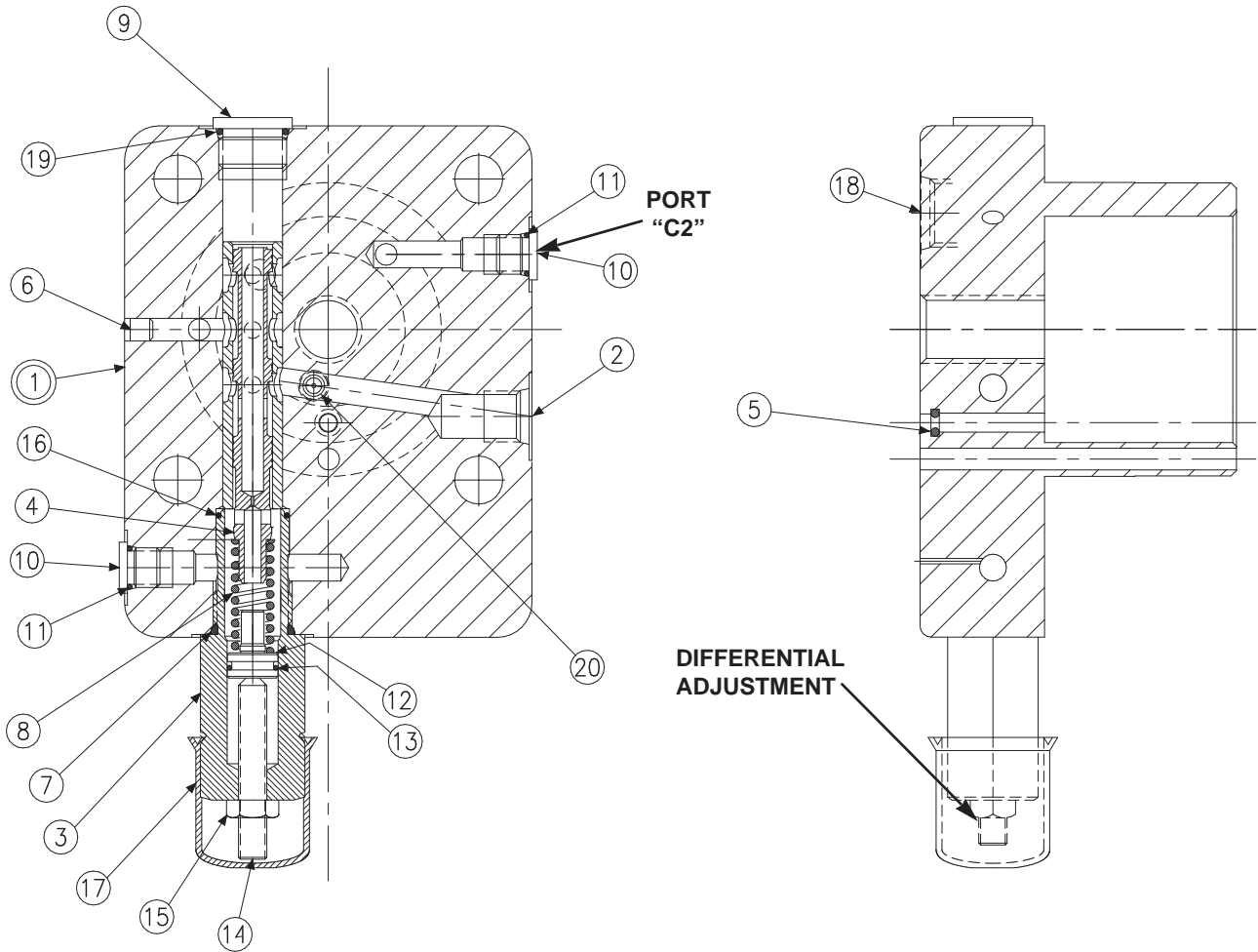


Figure 16
Servo cap

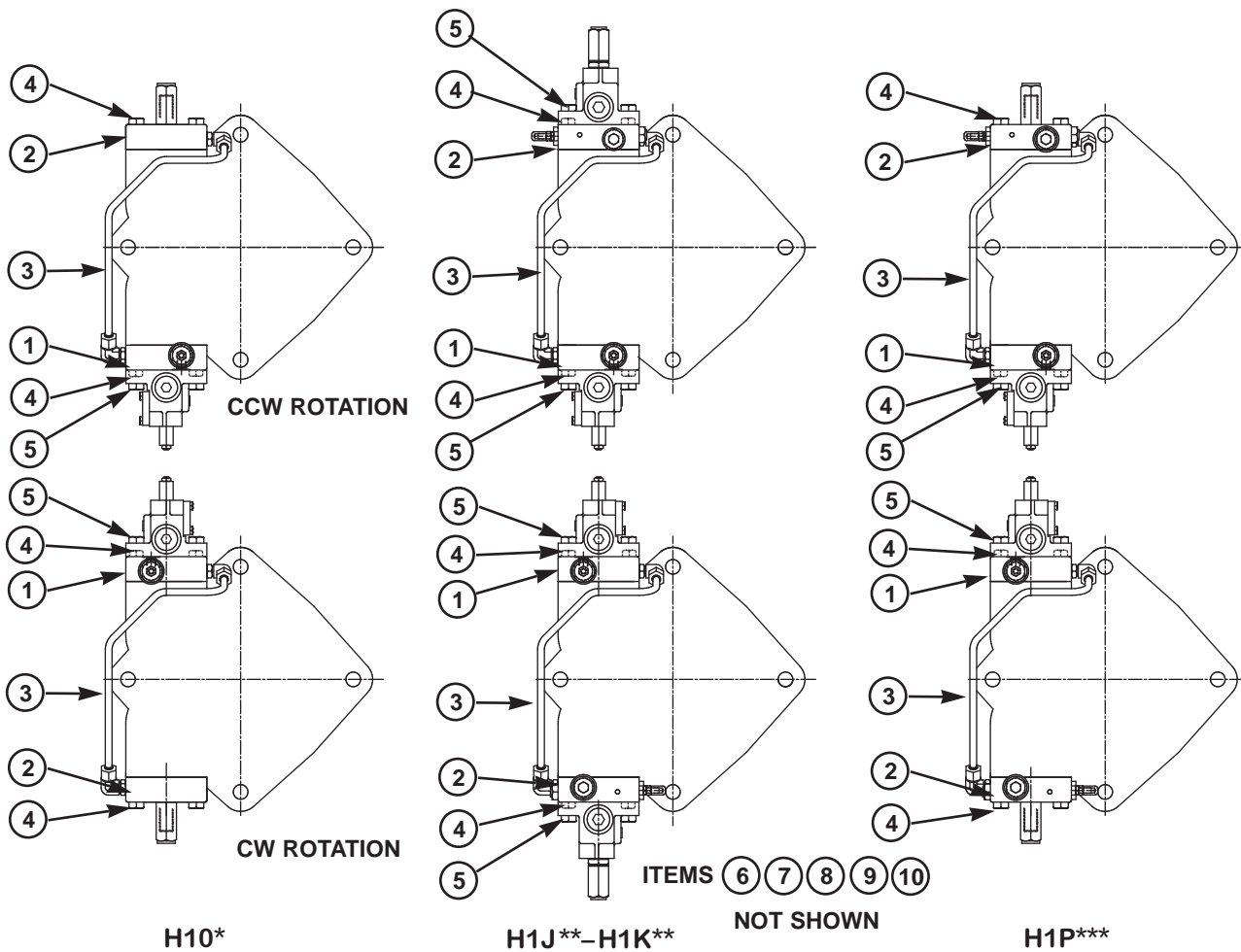


Ref. Figure 16
Servo cap

PARTS LIST FOR FIGURE 16

P16 servo cap S22-15900
P260 servo cap S22-15901

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|------------------------|-----------|-----|-----------|------|
| | | PART NO. | QTY | PART NO. | QTY. |
| 1 | Cap/Sleeve | S22-15914 | 1 | S22-15915 | 1 |
| 2 | Plug | 449-00015 | 2 | 449-00599 | 2 |
| 3 | Plug | 032-91861 | 1 | 032-91861 | 1 |
| 4 | Spool | 032-92409 | 1 | 032-92409 | 1 |
| 5 | O-Ring, 70 S-1 ARP 008 | 671-00008 | 1 | 671-00008 | 1 |
| 6 | Avseal Plug | 447-00026 | 1 | 447-00026 | 1 |
| 7 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 8 | Spring | 032-92098 | 1 | 032-92098 | 1 |
| 9 | Plug, SAE-10, 1/2 BSPP | 488-35018 | 1 | 447-01008 | 1 |
| 10 | Plug, SAE-4, 1/4 BSPP | 488-35061 | 1 | 447-01004 | 1 |
| 11 | O-ring, 90 S-1 ARP 904 | 691-00904 | 1 | - | - |
| 12 | Spring retainer | 032-92550 | 1 | 032-92550 | 1 |
| 13 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 1 | 691-00013 | 1 |
| 14 | Screw, 5/16 -24 x 2 | 312-35062 | 1 | 312-35062 | 1 |
| 15 | Nut, 5/16-24 | 335-13100 | 1 | 335-13100 | 1 |
| 16 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Plug | 449-00016 | 1 | 449-00016 | 1 |
| 19 | O-ring, 90 S-1 ARP 908 | 691-00908 | 1 | 691-00908 | 1 |
| 20 | Orifice | 033-25528 | 1 | 033-25528 | 1 |



PARTS LIST
hydraulic stroker

| ITEM | DESCRIPTION | P16 | P260 | QUANTITY | | | |
|------|---------------------------------|-----------|-----------|----------|-------|-------|--------|
| | | PART NO. | PART NO. | H10* | H1J** | H1K** | H1P*** |
| 1 | #Hydraulic Stroker (Fig. 17) | S22-16003 | S22-16004 | 1 | 1 | 1 | 1 |
| 2 | #Control Cap (Fig. 26) | S22-15256 | S22-15272 | 1 | — | — | — |
| | #Low Torque Override (Fig. 29) | S22-16009 | S22-16010 | — | 1 | — | — |
| | #High Torque Override (Fig. 29) | S22-16011 | S22-16012 | — | — | 1 | — |
| | #Compensator Override (Fig. 27) | S22-16007 | S22-16008 | — | — | — | 1 |
| 3 | Tube Assembly (Fig. 24, 25) | P22-15981 | P22-15998 | 1 | 1 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 4 | 4 | 6 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | 2 | 4 | 4 | 2 |
| 6 | Control Piston | 032-91785 | 032-91785 | 1 | 1 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 | 2 | 2 |
| 9 | Piston Ring | 032-91261 | 032-91261 | 1 | 1 | 1 | 1 |
| 10 | Piston Ring | 032-91811 | 032-91811 | 1 | 1 | 1 | 1 |

*Also H50

**Also H5J, H5K

***Also H5P

#Includes items 4, 5, 7 and 8

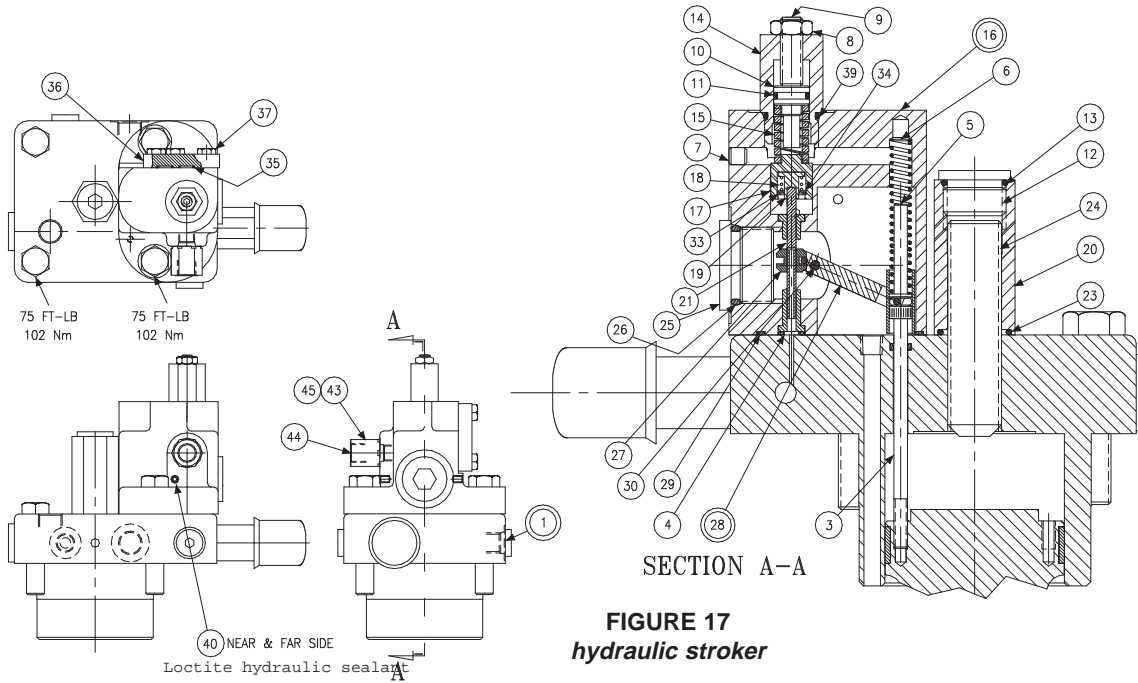


FIGURE 17
hydraulic stroker

PARTS LIST FOR FIG. 17
P16 hydraulic stroker S22-16003
P260 hydraulic stroker S22-16004

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|--------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap (Figure 16) | S22-15900 | 1 | S22-15901 | 1 |
| 3 | Screw | 032-91461 | 1 | 032-91461 | 1 |
| 4 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 1 | 671-00010 | 1 |
| 5 | Clevis pin | 321-40000 | 1 | 321-40000 | 1 |
| 6 | Spring, Compression | 032-92100 | 1 | 032-92100 | 1 |
| 7 | Plug, Avseal | 447-00026 | 1 | 447-00026 | 1 |
| 8 | Nut, 5/16-24 | 335-13100 | 1 | 335-13100 | 1 |
| 9 | Soc. Setscrew, 5/16-24 x 1-1/4 | 312-13180 | 1 | 312-13180 | 1 |
| 10 | Seal Piston | 032-91918 | 1 | 032-91918 | 1 |
| 11 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 1 | 691-00012 | 1 |
| 12 | Plug, 10HP5N-S | 488-35055 | 1 | 488-35055 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 1 | 691-00910 | 1 |
| 14 | Spring Cap | 032-91511 | 1 | 032-91511 | 1 |
| 15 | Spring | 225-92101 | 1 | 225-92101 | 1 |
| 16 | Body | S22-15393 | 1 | S22-15393 | 1 |
| 17 | Spool | 032-91512 | 1 | 032-91512 | 1 |
| 18 | Spring | 225-92109 | 1 | 225-92109 | 1 |
| 19 | Spring Retainer | 032-91516 | 1 | 032-91516 | 1 |
| 20 | Nut, 3/4-10 | 031-91049 | 1 | 031-91049 | 1 |
| 21 | Spool | 032-91438 | 1 | 032-91438 | 1 |
| 23 | O-Ring,70 S-1 ARP 118 | 671-00118 | 1 | 671-00118 | 1 |
| 24 | Soc. Setscrew, 3/4-10 x 3 | 311-26320 | 1 | 311-26320 | 1 |
| 25 | Plug, SAE-12 | 488-35014 | 1 | 488-35014 | 1 |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 1 | 691-00912 | 1 |
| 27 | Sleeve | 032-91437 | 1 | 032-91437 | 1 |
| 28 | Arm assembly | S22-15520 | 1 | S22-15520 | 1 |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 1 | 671-00035 | 1 |
| 30 | Dowel Pin, 1/8 Dia x 1.75 Lg. | 324-20828 | 1 | 324-20828 | 1 |
| 33 | Retaining. Ring | 356-30037 | 1 | 356-30037 | 1 |
| 34 | Washer | 032-91517 | 1 | 032-91517 | 1 |
| 35 | O-Ring, 70 S-1 ARP 011 | 671-00011 | 2 | 671-00011 | 2 |
| 36 | Plate | 032-91510 | 1 | 032-91510 | 1 |
| 37 | Screw, HHC,1/4-20 x 3/4 | 306-40142 | 3 | 306-40142 | 3 |
| 39 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 1 | 691-00908 | 1 |
| 40 | Screw, SHC 10-32 x 1/4 | 312-09041 | 2 | 312-09041 | 2 |
| 43 | Fitting | - | - | 032-91507 | 1 |
| 44 | Seal | - | - | 449-00603 | 1 |
| 45 | O-ring, 90 S-1 ARP 904 | - | - | 691-00904 | 1 |

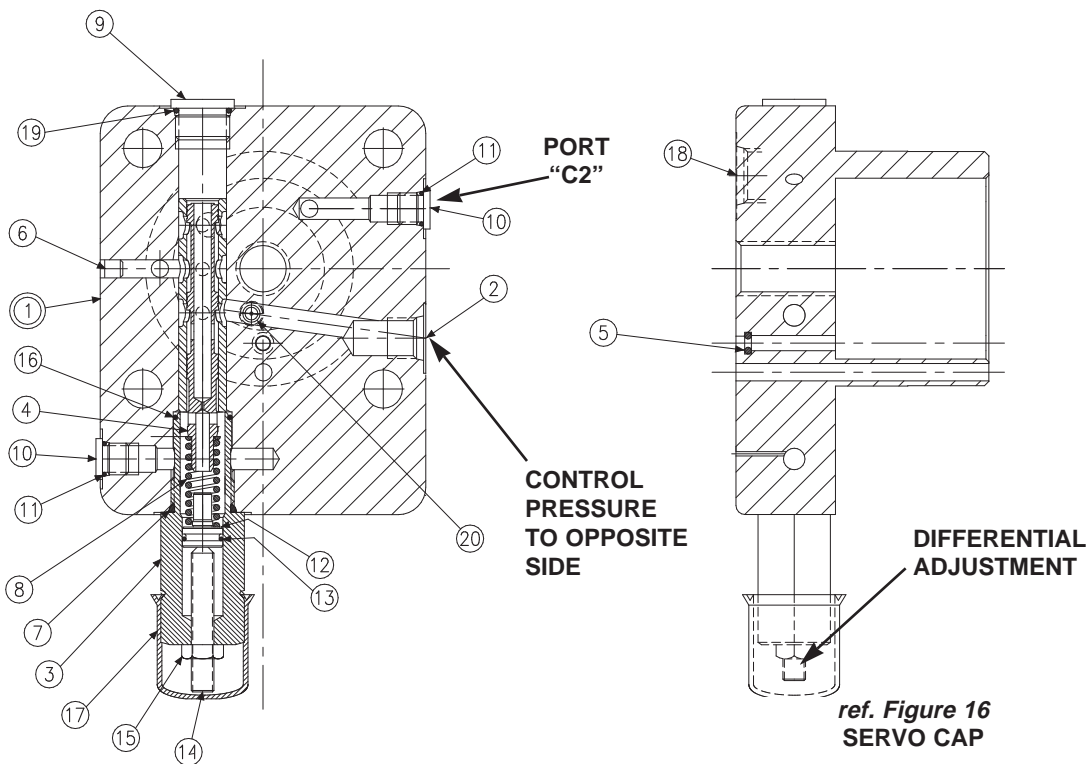
DISASSEMBLY

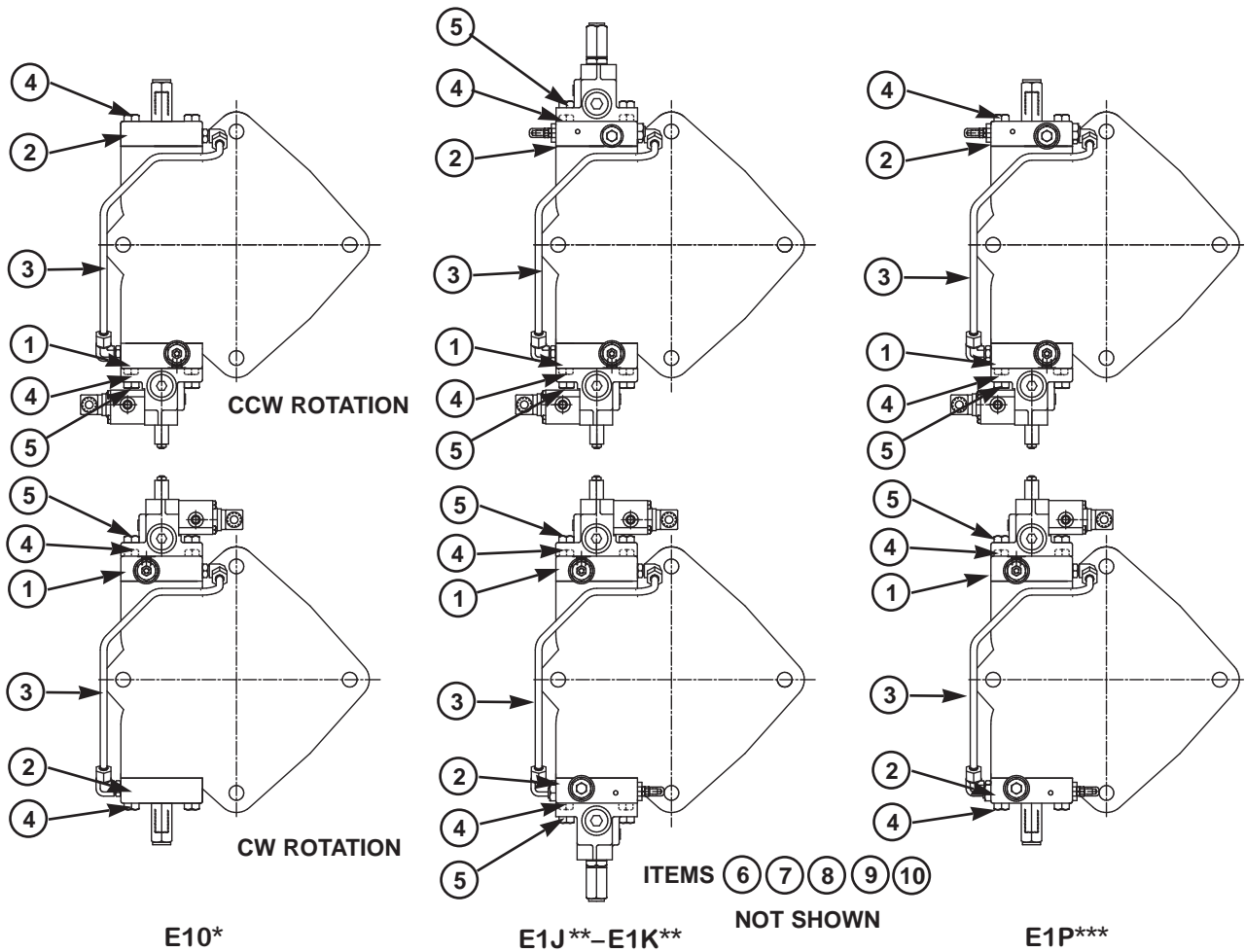
1. See figure 17. Remove 2 screws holding body (16) to cap assembly (1).
2. Remove all parts from body (16) except pin (30) and arm assembly (28). It is not necessary to remove these parts unless broken or worn. Examine parts for wear or damage.
3. Remove screw (3). Examine head for excessive wear, and body for smooth sealing surface with O-ring.
4. See figure 16. 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

See page 26 for tightening torque on plugs

1. See figure 16. 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). Install orifice (20) and plugs (10). Torque plugs. 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 (pg. 24). 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 lb.·ft., 102 Nm.
8. See figure 17. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 lb.·ft., 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 .45 +/- .03 in., 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", 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 above drawing. Torque plug (12).
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 lb.·ft., 102 Nm.
15. Install tubing assembly (Figure 24, 25).





PARTS LIST
electrohydraulic stroker

| ITEM | DESCRIPTION | P16 | P260 | QUANTITY | | | |
|------|-------------------------------------|-----------|-----------|----------|-------|-------|--------|
| | | PART NO. | PART NO. | E10* | E1J** | E1K** | E1P*** |
| 1 | #Electrohydraulic Stroker (Fig. 18) | S22-16001 | S22-16002 | 1 | 1 | 1 | 1 |
| 2 | #Control Cap (Fig. 26) | S22-15256 | S22-15272 | 1 | — | — | — |
| | #Low Torque Override (Fig. 29) | S22-16009 | S22-16010 | — | 1 | — | — |
| | #High Torque Override (Fig. 29) | S22-16011 | S22-16012 | — | — | 1 | — |
| | #Compensator Override (Fig. 27) | S22-16007 | S22-16008 | — | — | — | 1 |
| 3 | Tube Assembly (Fig. 24, 25) | P22-15981 | P22-15998 | 1 | 1 | 1 | 1 |
| 4 | Screw-H.H.C., M12 x 60 mm | 363-12210 | 363-12210 | 6 | 4 | 4 | 6 |
| 5 | Screw-H.H.C., M12 x 80 mm | 363-12225 | 363-12225 | 2 | 4 | 4 | 2 |
| 6 | Control Piston | 032-91785 | 032-91785 | 1 | 1 | 1 | 1 |
| 7 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 | 2 | 2 |
| 8 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 | 2 | 2 |
| 9 | Piston Ring | 032-91261 | 032-91261 | 1 | 1 | 1 | 1 |
| 10 | Piston Ring | 032-91811 | 032-91811 | 1 | 1 | 1 | 1 |

*Also E50

**Also E5J, E5K

***Also E5P

#Includes items 4, 5, 7 and 8

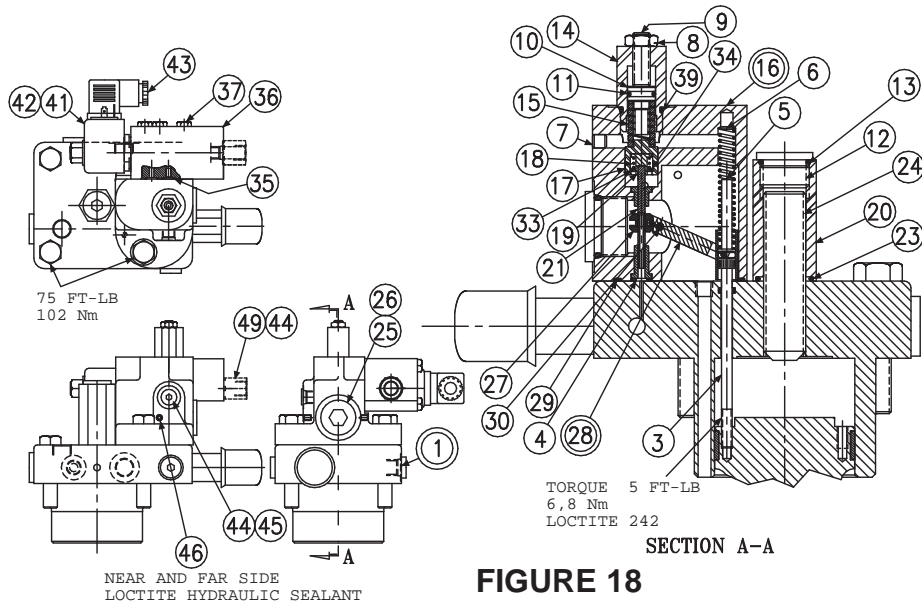


FIGURE 18
Electrohydraulic Stroker

PARTS LIST FOR FIGURE 18

P16 electrohydraulic stroker
S22-16001
P260 electrohydraulic stroker
S22-16002

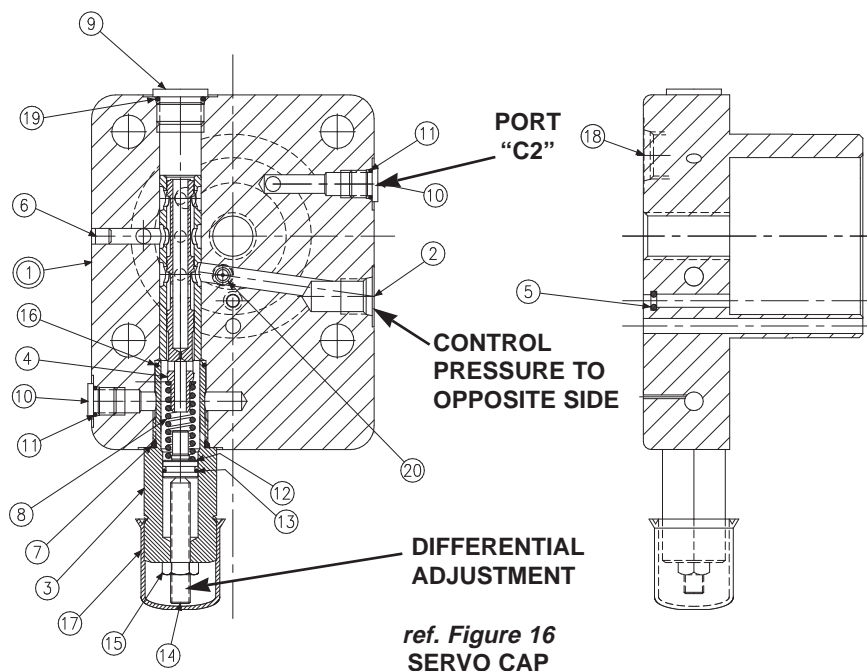
| ITEM | DESCRIPTION | P16 | | P260 | |
|------|---------------------------------|-------------|------|-------------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap (Figure 16) | S22-15900 | 1 | S22-15901 | 1 |
| 3 | Screw | 032-91461 | 1 | 032-91461 | 1 |
| 4 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 1 | 671-00010 | 1 |
| 5 | Clevis pin | 321-40000 | 1 | 321-40000 | 1 |
| 6 | Spring, Compression | 032-92100 | 1 | 032-92100 | 1 |
| 7 | Plug, Avseal | 447-00026 | 1 | 447-00026 | 1 |
| 8 | Nut, 5/16-24 | 335-13100 | 1 | 335-13100 | 1 |
| 9 | Soc. Setscrew, 5/16-24 x 1-1/4 | 312-13180 | 1 | 312-13180 | 1 |
| 10 | Seal Piston | 032-91918 | 1 | 032-91918 | 1 |
| 11 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 1 | 691-00012 | 1 |
| 12 | Plug, SAE-10 | 488-35055 | 1 | 488-35055 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 1 | 691-00910 | 1 |
| 14 | Spring Cap | 032-91511 | 1 | 032-91511 | 1 |
| 15 | Spring | 225-92101 | 1 | 225-92101 | 1 |
| 16 | Body | S22-15393 | 1 | S22-15393 | 1 |
| 17 | Spool | 032-91512 | 1 | 032-91512 | 1 |
| 18 | Spring | 225-92109 | 1 | 225-92109 | 1 |
| 19 | Spring Retainer | 032-91516 | 1 | 032-91516 | 1 |
| 20 | Nut, 3/4-10 | 031-91049 | 1 | 031-91049 | 1 |
| 21 | Spool | 032-91438 | 1 | 032-91438 | 1 |
| 23 | O-Ring, 70 S-1 ARP 118 | 671-00118 | 1 | 671-00118 | 1 |
| 24 | Socket Setscrew, 3/4-10 x 3 | 311-26320 | 1 | 311-26320 | 1 |
| 25 | Plug, SAE-12 | 488-35014 | 1 | 488-35014 | 1 |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 1 | 691-00912 | 1 |
| 27 | Sleeve | 032-91437 | 1 | 032-91437 | 1 |
| 28 | Arm assembly | S22-15520 | 1 | S22-15520 | 1 |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 1 | 671-00035 | 1 |
| 30 | Dowel Pin, 1/8 Dia x 1.75 Lg. | 324-20828 | 1 | 324-20828 | 1 |
| 33 | Retaining Ring | 356-30037 | 1 | 356-30037 | 1 |
| 34 | Washer | 032-91517 | 1 | 032-91517 | 1 |
| 35 | O-Ring, 70 S-1 ARP 011 | 671-00011 | 2 | 671-00011 | 2 |
| 36 | Block | 032-91509 | 1 | 032-91509 | 1 |
| 37 | Screw, 1/4-20 x 2-1/4 | 306-40187 | 3 | 306-40187 | 3 |
| 39 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 1 | 691-00908 | 1 |
| 41 | Proportional Press. Cont. Valve | 517-00095 | 1 | 517-00095 | 1 |
| 42 | Coil, 24VDC | 517-00096 | 1 | 517-00096 | 1 |
| | Coil, 12VDC | 517-00097 | | 517-00097 | |
| 43 | Connector | 167-01008-8 | | 167-01008-8 | 1 |
| 44 | O-Ring, 90 S-1 ARP 904 | 691-00904 | 1 | 691-00904 | 2 |
| 45 | Plug, SAE-4 | 488-35061 | 1 | 488-35061 | 1 |
| 46 | Screw, SHC 10-32 x 1/4 | 312-09041 | 2 | 312-09041 | 2 |
| 49 | Fitting | - | | 032-91507 | 1 |

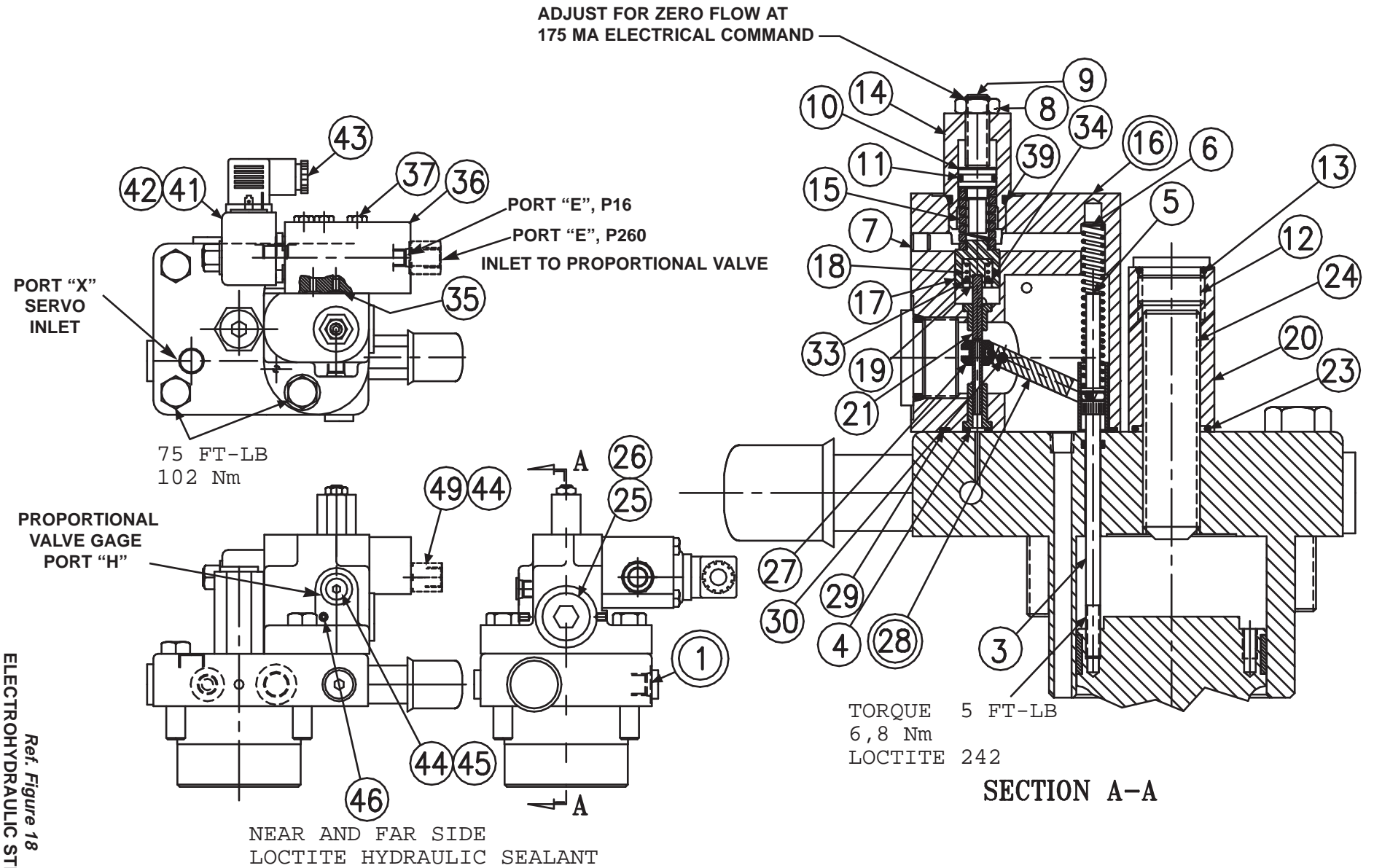
DISASSEMBLY

1. See Figure 18. 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 16. 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).

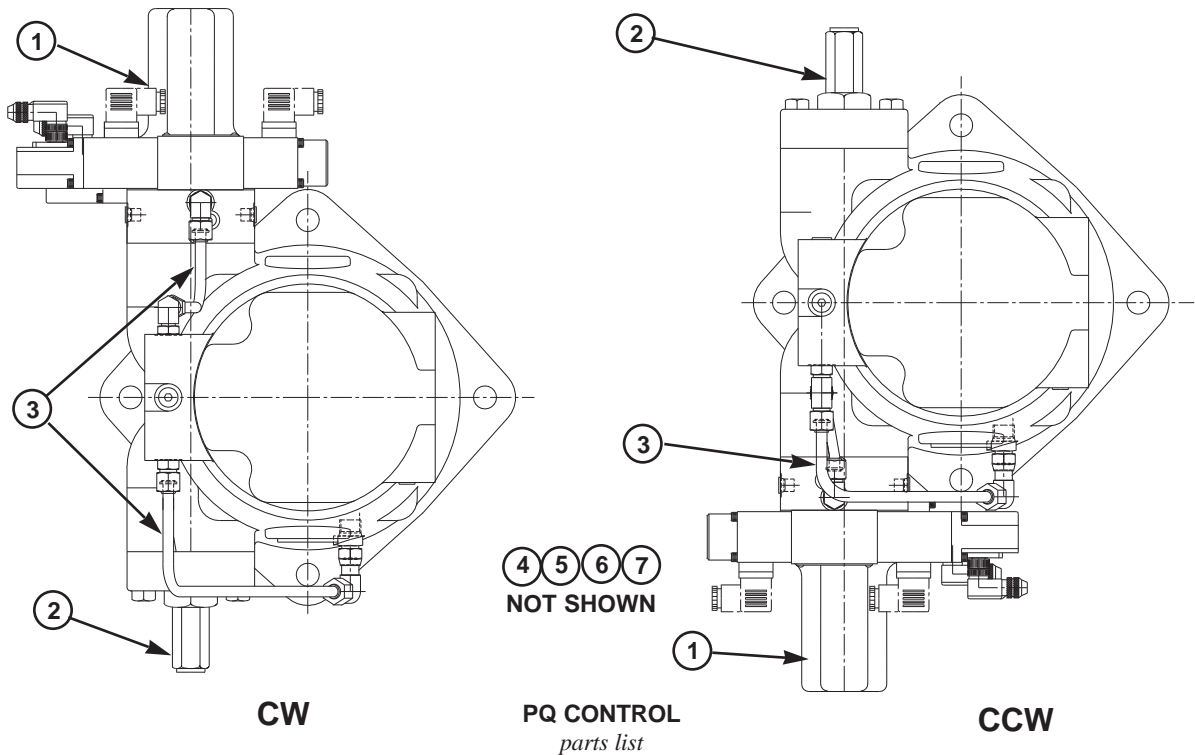
ASSEMBLY**See page 26 for tightening torque on plugs**

1. See Figure 16. 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). Install orifice (20) and plugs(10). Torque plugs. 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 (pg 24). 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 lb.·ft., 102 N m.
8. See Figure 18. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 lb.·ft., 6.78 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 .45 +/- .03 in., 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, 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.·lbs., 27 N m.
14. Install coil on proportional valve. Torque to 20-25 in.·lbs., 2,2-2,8 N m max.
15. Assemble all other components into body (16) per above drawing. Torque the plug (12).
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 lb.·ft., 102 N m.
17. Install tubing assembly (Figure 24, 25).





Ref. Figure 18
ELECTROHYDRAULIC STROKER



| ITEM | DESCRIPTION | P16 PART NO. | P260 PART NO. | QTY. | |
|------|---------------------------|-----------------|------------------|------|-----|
| | | | | CW | CCW |
| 1 | PQ Control (Fig.21) | S22-15963 | S22-15964 | 1 | 1 |
| 2 | Max Volume Stop (Fig. 23) | S22-16126 | S22-16126 | 1 | 1 |
| 3 | Tube Assembly (Fig. 19) | P22-16070 | P22-16071 | 1 | - |
| | Tube Assembly (Fig. 20) | P22-16118 | P22-16119 | - | 1 |
| 4 | Control Piston | 032-92505 | 032-92505 | 1 | 1 |
| 5 | O-Ring, 90 S-1 ARP 013 | 691-00013 | 691-00013 | 2 | 2 |
| 6 | O-Ring, 70 S-1 ARP 152 | 671-00152 | 671-00152 | 2 | 2 |
| 7 | Piston Ring | 032-91261 | 032-91261 | 2 | 2 |

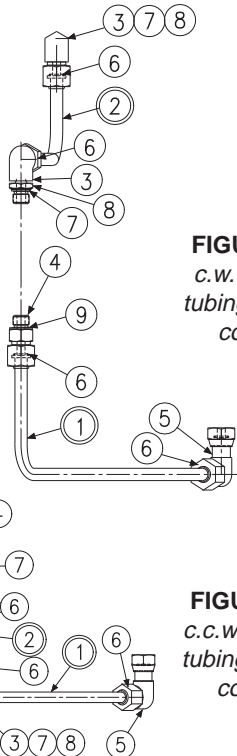


FIGURE 19
c.w. control
tubing for pq
control

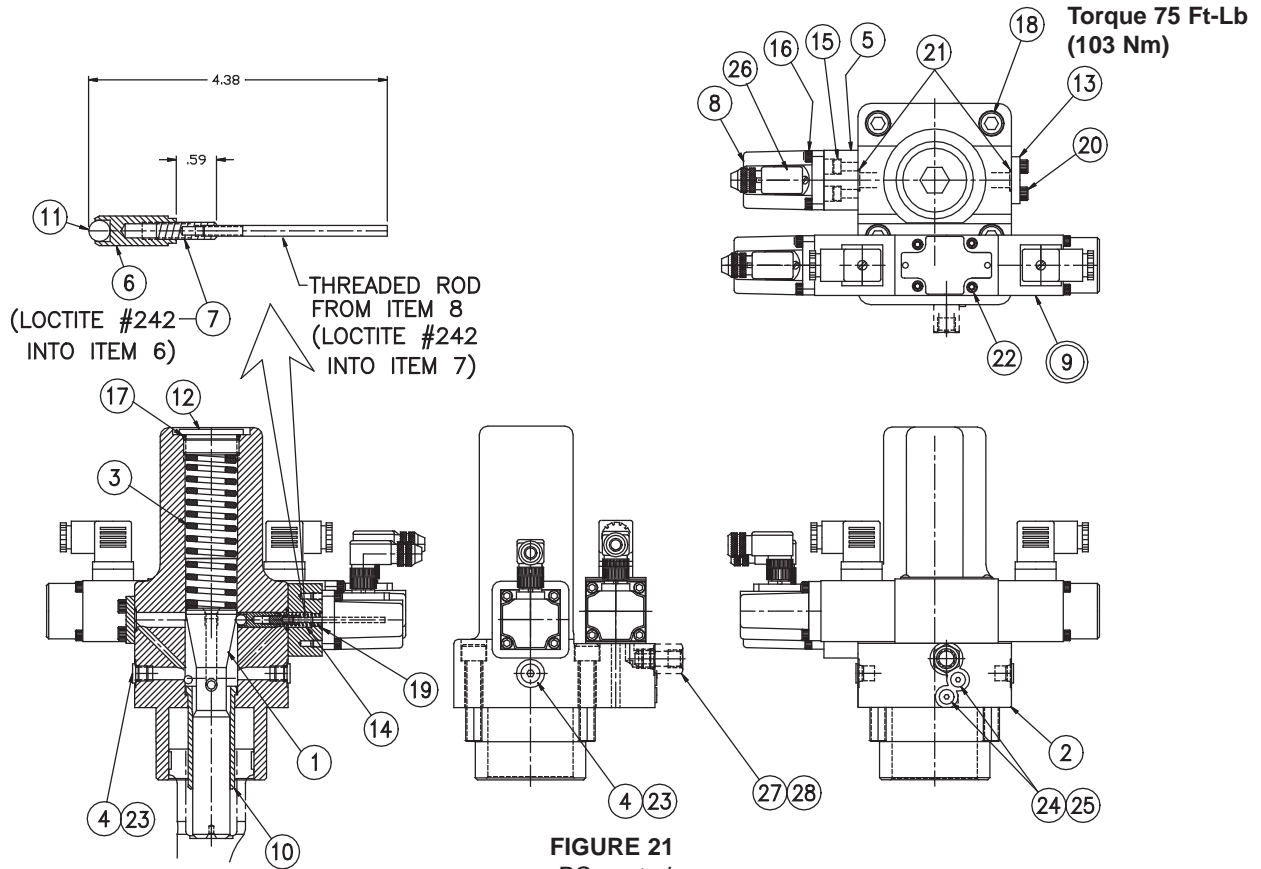
FIGURE 20
c.c.w. control
tubing for pq
control

PARTS LIST FOR FIGURE 19
CW control tubing for PQ control

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|----------------------------|-----------|------|-----------|-----|
| | | PART NO. | QTY. | PART NO. | QTY |
| 1 | Float tube w/nut & sleeve | S22-15965 | 1 | S22-16120 | 1 |
| 2 | Servo tube w/nut & sleeve | S22-15966 | 1 | S22-16121 | 1 |
| 3 | Male elbow fitting | 492-15382 | 2 | 492-15436 | 2 |
| 4 | Fitting, male conn. | 492-15433 | 1 | 492-15433 | 1 |
| 5 | Swivel nut elbow fitting | 492-15431 | 1 | 492-15428 | 1 |
| 6 | O-ring, 90 S-1 ARP 012 | 691-00012 | 4 | 691-00012 | 4 |
| 7 | O-ring | 691-00906 | 3 | 691-00111 | 2 |
| 8 | Fitting retaining ring 1/4 | - | - | 492-15416 | 2 |
| 9 | Ring, soft seal VSTI 1/4 | - | - | 605-10061 | 1 |

PARTS LIST FOR FIGURE 20
CCW control tubing for PQ control

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|----------------------------|-----------|------|-----------|-----|
| | | PART NO. | QTY. | PART NO. | QTY |
| 1 | Float tube w/nut & sleeve | S22-16122 | 1 | S22-16124 | 1 |
| 2 | Servo tube w/nut & sleeve | S22-15966 | 1 | S22-16121 | 1 |
| 3 | Male elbow fitting | 492-15382 | 2 | 492-15436 | 1 |
| 4 | Fitting, male conn. | 492-15438 | 1 | 492-15437 | 1 |
| 5 | Swivel nut elbow fitting | 492-15431 | 1 | 492-15428 | 1 |
| 6 | O-ring, 90 S-1 ARP 012 | 691-00012 | 4 | 691-00012 | 4 |
| 7 | O-ring | 691-00906 | 3 | 691-00111 | 2 |
| 8 | Fitting retaining ring 1/4 | - | - | 492-15416 | 2 |



PARTS LIST FOR FIGURE 21

P16 PQ control S22-15963

P260 PQ control S22-15964

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Piston servo cone | 032-92509 | 1 | 032-92509 | 1 |
| 2 | Cap | 032-92578 | 1 | 032-92578 | 1 |
| 3 | Spring | 225-92119 | 1 | 225-92119 | 1 |
| 4 | Plug, SAE-4 | 488-35061 | 2 | 488-35061 | 2 |
| 5 | Sensor base | 032-92309 | 1 | 032-92309 | 1 |
| 6 | Guide | 032-92275 | 1 | 032-92275 | 1 |
| 7 | Feedback extender | 032-92310 | 1 | 032-92310 | 1 |
| 8 | DC/DC LVDT | 788-30012 | 1 | 788-30012 | 1 |
| 9 | Valve, 4DC01 F40 A (Fig. 22) | 026-65909 | 1 | 026-65909 | 1 |
| 10 | Buckdown sleeve | 032-92503 | 1 | 032-92503 | 1 |
| 11 | Ball, 5/16 chrome | 201-10001 | 1 | 201-10001 | 1 |
| 12 | Plug, SAE-20 | 488-35019 | 1 | 488-35019 | 1 |
| 13 | Cover | 032-92565 | 1 | 032-92565 | 1 |
| 14 | Spring | 225-92117 | 1 | 225-92117 | 1 |
| 15 | Screw, SHC, M6 x 18 mm | 361-08184 | 4 | 361-08184 | 4 |
| 16 | Screw, SHC, M5 x 16 mm | 361-07164 | 4 | 361-07164 | 4 |
| 17 | O-ring, 90 S-1 ARP 920 | 691-00920 | 1 | 691-00920 | 1 |
| 18 | Screw, SHC M12 x 60 mm | 361-12284 | 4 | 361-12284 | 4 |
| 19 | O-ring, 70 S-1 ARP 012 | 671-00012 | 1 | 671-00012 | 1 |
| 20 | Screw, SHC, M6 x .12 mm | 361-08124 | 4 | 361-08124 | 4 |
| 21 | O-ring, 70 S-1 ARP 014 | 671-00014 | 2 | 671-00014 | 2 |
| 22 | Screw, SHC 10-24 x 1-1/4 | 358-10180 | 4 | 358-10180 | 4 |
| 23 | O-ring, 90 S-1 ARP 904 | 691-00904 | 2 | 691-00904 | 2 |
| 24 | Plug, SAE-2 | 488-35046 | 2 | 488-35046 | 2 |
| 25 | O-ring, 90 S-1 ARP 902 | 691-00902 | 2 | 691-00902 | 2 |
| 26 | Connector | 721-30108 | 1 | 721-30108 | 1 |
| 27 | Fitting, Adapter | - | - | 492-15435 | 1 |
| 28 | O-ring, 90 S-1 ARP 906 | - | - | 691-00906 | 1 |

DISASSEMBLY

1. See Figure 21. With pump on full stroke, remove plug (12) and spring (3) from cap (2).
2. Remove LVDT feedback assembly (8) from cap. Remove sensor base (5), spring (14) and feedback rod assembly (6, 7, and 11)
3. Remove tubing assembly. Remove proportional valve with LVDT, item (9).
4. Remove screws (18) and slip cap off pump.
5. Examine servo cone piston (1) and sleeve (10) for wear or binding in the bore.

ASSEMBLY

See page 26 for tightening torque on plugs

1. Press sleeve (10) into cap (2). Slip piston (1) into cap and check for free travel over the full to zero stroke range.
2. Note proper location of cap on pump (pg. 24). Install O-rings to interface between cap and pump. Install cap on pump. Torque assembly bolts (18) to 75 ft-lbs, 103 Nm.
3. Insert spring (3) over spool (1) and install plug (12) with O-ring (17).
4. Thoroughly degrease feedback rod assembly (6), (7) and rod from (8). Apply loctite 242 on threads. Assemble to the dimensions indicated. Allow loctite to set then check to see that rod assembly is firmly retained.
5. Use vaseline to retain ball (11) in guide (6). Insert guide in cap (2). Sensor may be installed on either side.
6. Install O-rings (21) to cover (13) and sensor base (5). Install to cap (1). Torque screws (15) and (20) to 106 in.-lb, 12 Nm.
7. Install stroke sensor LVDT (8) with O-ring (19) over sensor rod on cap. Torque screws (16) to 62,8 in.-lb, 7,1 Nm.
7. Install proportional valve with LVDT, (9). Torque screws (22) to 66 in.-lb, 7,5 Nm.
8. For 260 series, install adapter, (27).
9. Install tubing assembly (Figure 19, 20).

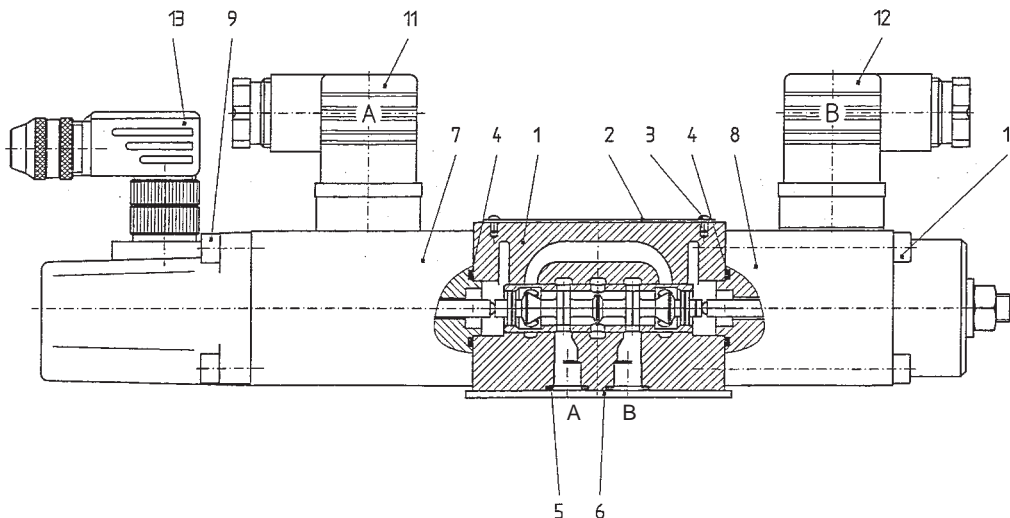
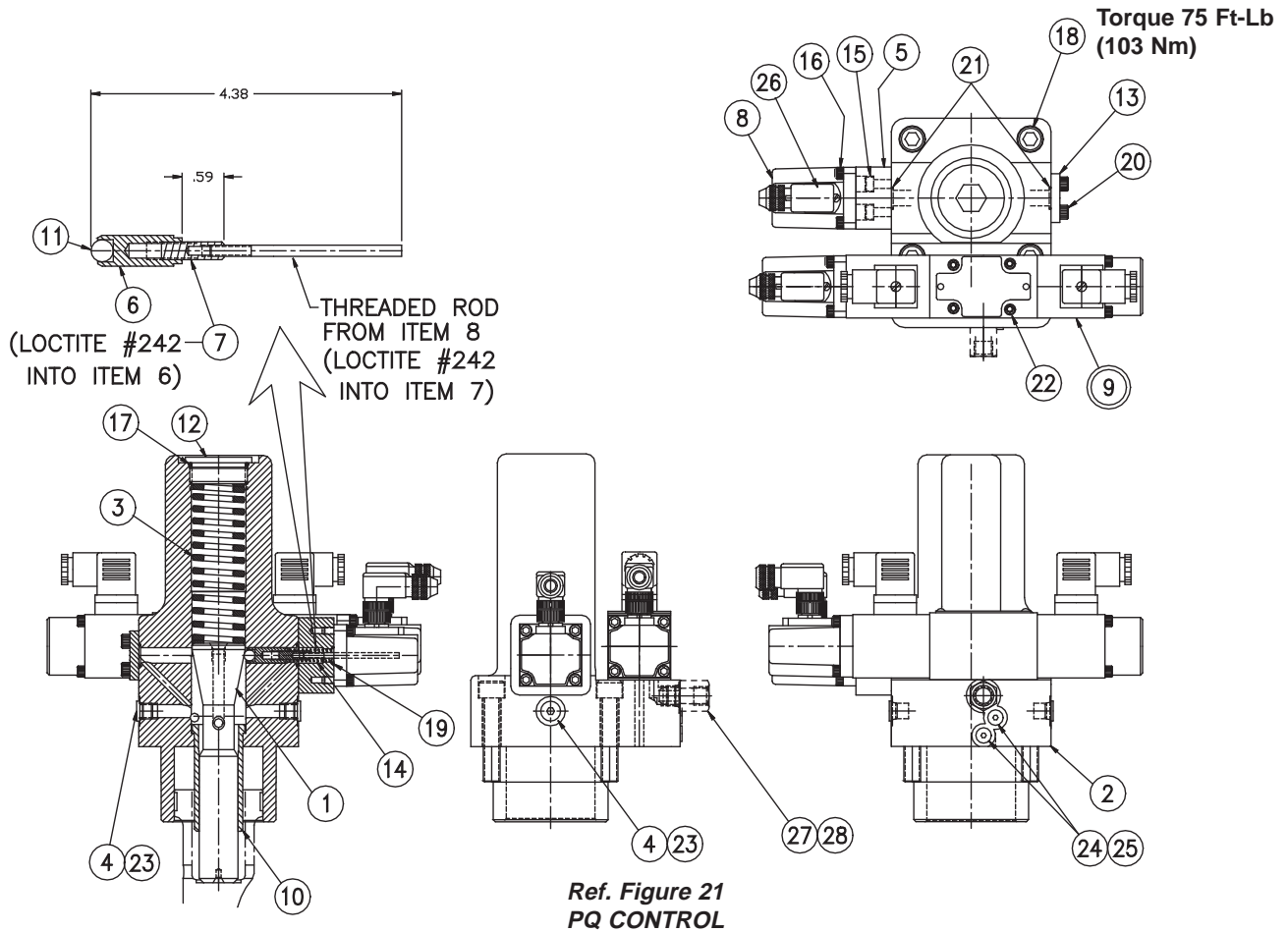


FIGURE 22
proportional valve with LVDT

PARTS LIST FOR FIGURE 22
proportional valve with LVDT 026-65909

| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|--------------------------------|-------------|------|
| 1 | Body, micro-lap 40L | S26-58777 | 1 |
| 2 | Data plate | 036-84770 | 1 |
| 3 | Drive screw | 320-10203 | 2 |
| 4 | O-ring, 90 S-1 ARP 018 | 691-00018 | 2 |
| 5 | O-ring, 90 S-1 ARP 012 | 691-00012 | 4 |
| 6 | Dust plate | 036-39820 | 1 |
| 7 | Solenoid with LVDT | 120-03044-8 | 1 |
| 8 | Solenoid without LVDT | 120-03043-8 | 1 |
| 9 | Screw, SHC, M5 x 80mm | 361-00033-8 | 4 |
| 10 | Screw, SHC, M5 x 55mm | 361-00013-8 | 4 |
| 11 | Plug-in connector, "A" (grey) | 167-01007-8 | 1 |
| 12 | Plug-in connector, "B" (black) | 167-01008-8 | 1 |
| 13 | Connector, LVDT | 167-01106-8 | 1 |



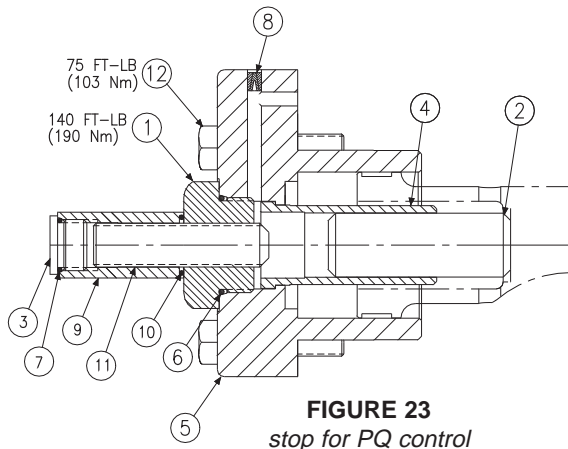
CONTROL CAP DISASSEMBLY

1. See Figure 23. Remove nut (9) and Max. volume screw (11).
2. Remove guide (1).
3. Remove 4 screws (12) holding cap to pump.
4. Remove cap assembly from pump. Check piston and sleeve for wear and free motion.

ASSEMBLY

See page 26 for tightening torque on plugs

1. Install Avseal plug (8). Press sleeve (4) into cap to shoulder. Install piston (1), checking for free motion.
2. Install O-rings on interface between cap and pump control pad. Install cap on pump housing as indicated on the applicable view (pg. 24), guiding the control piston into the bore.
3. Torque the assembly bolts (12) to 75 lb.-ft., 103 Nm.
4. Install O-ring (6) on guide (1). Install guide in cap (5). Torque guide (1) to 140 Ft-Lbs, 190 Nm..
5. Install screw (11) in cap. Install O-ring (10) on nut (9). Install nut (9) on screw.
6. Adjust screw till pump is slightly off full stroke and lock nut (9).
7. Install O-ring (7) on plug (3). Install plug in nut (9). Torque plug (3) to 75 lb.-ft., 103 Nm.



PARTS LIST FOR FIGURE 23
stop S22-16126 for PQ control

| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|------------------------|-----------|------|
| 1 | Guide | 032-92519 | 1 |
| 2 | Buckdown piston | 032-92554 | 1 |
| 3 | Plug, SAE-10 | 488-35055 | 1 |
| 4 | Sleeve | 032-92503 | 1 |
| 5 | Control Cap | 032-92248 | 1 |
| 6 | O-ring, 90 S-1 ARP 920 | 691-00920 | 1 |
| 7 | O-ring 90 S-1 ARP 910 | 691-00910 | 1 |
| 8 | Plug, Avseal | 447-00026 | 1 |
| 9 | Nut | 031-91049 | 1 |
| 10 | O-ring, 70 S-1 ARP 118 | 671-00118 | 1 |
| 11 | Screw, 3/4-10 x 3 | 311-26320 | 1 |
| 12 | Screw, SHC M12 x 60mm | 363-12210 | 4 |

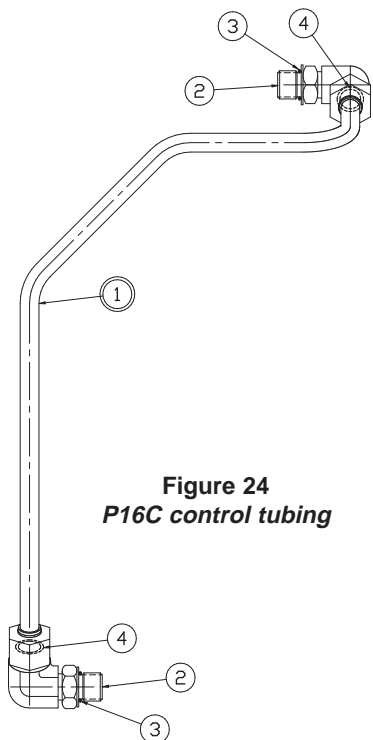


Figure 24
P16C control tubing

PARTS LIST FOR FIGURE 24
P16C control tubing S22-15981

| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|---------------------------|-----------|------|
| 1 | Servo tube w/nut & sleeve | S22-15982 | 1 |
| 2 | Elbow fitting | 492-15382 | 2 |
| 3 | O-ring, 90 S-1 ARP 906 | 691-00906 | 2 |
| 4 | O-ring, 90 S-1 ARP 012 | 691-00012 | 2 |

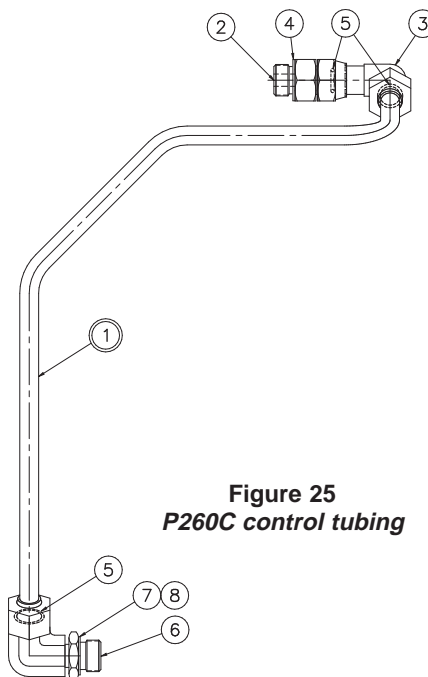


Figure 25
P260C control tubing

PARTS LIST FOR FIGURE 25
P260C control tubing S22-15998

| ITEM | DESCRIPTION | PART NO. | QTY. |
|------|----------------------------|-----------|------|
| 1 | Servo tube w/nut & sleeve | S22-15999 | 1 |
| 2 | Male connection fitting | 492-15427 | 1 |
| 3 | Swivel nut elbow fitting | 492-15428 | 1 |
| 4 | Ring, soft seal VSTI 3/8 | 605-10062 | 1 |
| 5 | O-ring, 90 S-1 ARP 012 | 691-00012 | 3 |
| 6 | Male elbow fitting | 492-15426 | 1 |
| 7 | Fitting retaining ring 3/8 | 492-15417 | 1 |
| 8 | O-ring, 90 S-1 ARP 113 | 691-00113 | 1 |

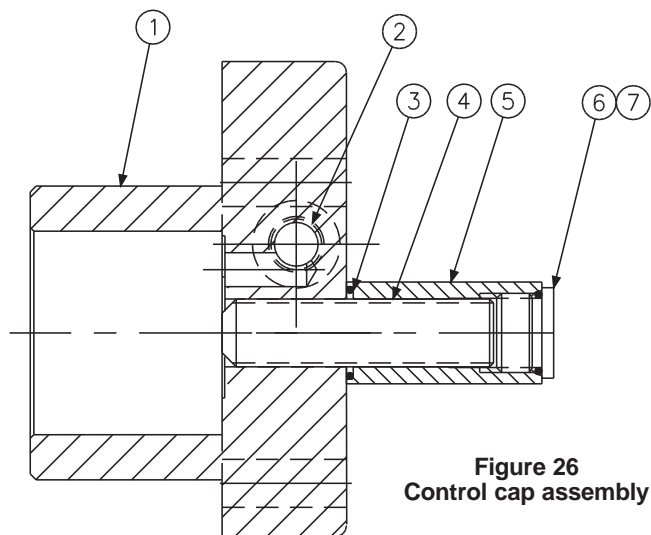


Figure 26
Control cap assembly

PARTS LIST FOR FIGURE 26
P16 control cap assembly S22-15256
P260 control cap assembly S22-15272

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Control Cap | 032-91764 | 1 | 032-91766 | 1 |
| 2 | Plug | 449-00015 | 1 | 449-00599 | 1 |
| 3 | O-ring, 70 S-1 ARP 118 | 671-00118 | 1 | 671-00118 | 1 |
| 4 | Screw, 3/4-10 x 3 | 311-26320 | 1 | 311-26320 | 1 |
| 5 | Nut | 031-91049 | 1 | 031-91049 | 1 |
| 6 | Plug, SAE-10 | 488-35055 | 1 | 488-35055 | 1 |
| 7 | O-ring 90 S-1 ARP 910 | 691-00910 | 1 | 691-00910 | 1 |

CONTROL CAP DISASSEMBLY

1. See Figure 26. Remove nut (5) and Max. volume screw (4).
2. Remove 4 screws holding cap to pump.
3. Remove cap assembly from pump.

ASSEMBLY

See page 26 for tightening torque on plugs

1. Install O-rings on interface between cap and pump control pad. Install cap on pump housing as indicated on the applicable view (pg. 24), guiding the control piston into the bore.
2. Torque the assembly bolts to 75 lb.·ft., 102 Nm.
3. Install screw (4) in cap. Install O-ring (3) on nut (5). Install nut (5) on screw.
4. Adjust screw till pump is slightly on stroke and lock nut (5).
5. Install O-ring (7) on plug (6). Install plug in nut (5). Torque plug (6).

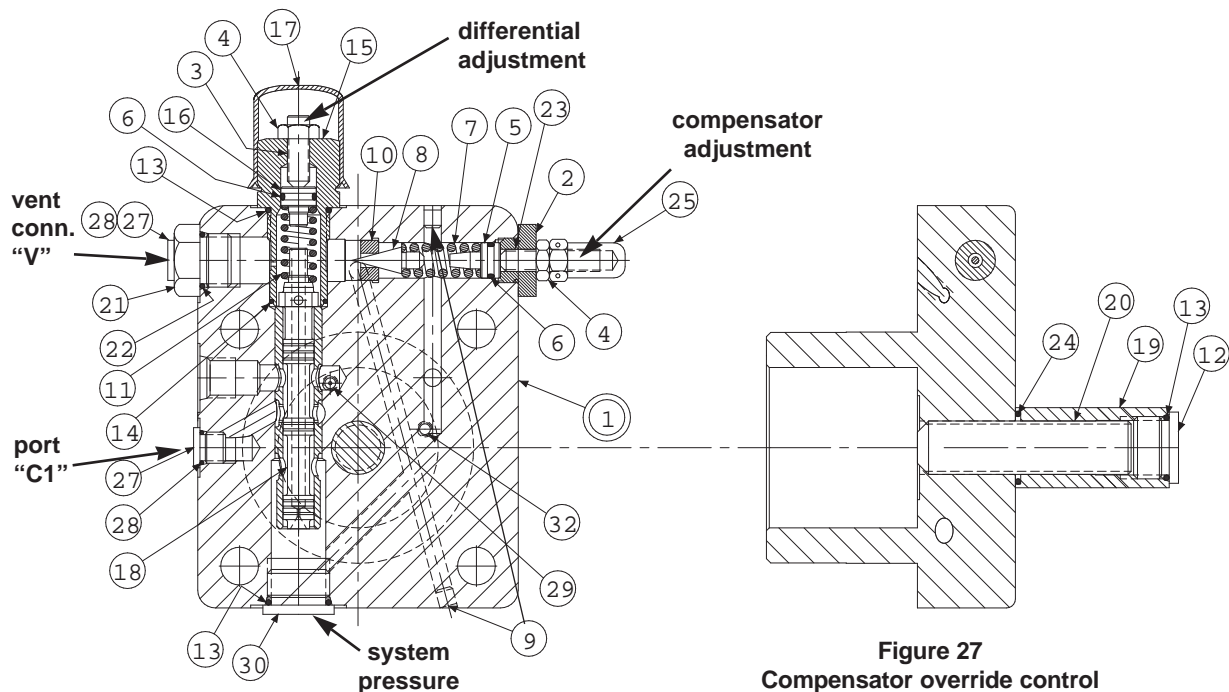


Figure 27
Compensator override control

PARTS LIST FOR FIGURE 27
 compensator override control
 P16 compensator override S22-16007
 P260 comp. override S22-16008

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-------------------------------|-----------|------|-----------|------|
| | | PART NO. | QTY. | PART NO. | QTY. |
| 1 | Cap-Sleeve Assembly | S22-15989 | 1 | S22-15990 | 1 |
| 2 | Adustment Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Socket Setscrew 5/16-24 x 1 | 312-13160 | 1 | 312-13160 | |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 2 | 447-00026 | 2 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 225-92101 | 1 | 225-92101 | 1 |
| 12 | Plug, SAE-10 | 488-35055 | 1 | 488-35055 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 3 | 691-00910 | 2 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal piston | 032-92480 | 1 | 032-92480 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-92549 | 1 | 032-92549 | 1 |
| 19 | Cover | 032-91049 | 1 | 032-91049 | 1 |
| 20 | Screw, 3/4-10 x 3 | 311-26320 | 1 | 311-26320 | 1 |
| 21 | Plug | 492-15423 | 1 | 492-15425 | 1 |
| 22 | O-ring, 90 S-1 ARP 908 | 691-00908 | 1 | - | - |
| 23 | Soc. Setscrew 5/16-24 x 1-1/4 | 312-13180 | 1 | 312-13180 | 1 |
| 24 | O-ring, 70 S-1 ARP 118 | 671-00118 | 1 | 671-00118 | 1 |
| 25 | Acorn Nut | 036-33474 | 1 | 036-33474 | 1 |
| 27 | Plug, SAE-4, 1/4 BSPP | 488-35061 | 2 | 447-01004 | 2 |
| 28 | O-ring, 90 S-1 ARP 904 | 691-00904 | 2 | - | - |
| 29 | Orifice | 035-40489 | 1 | 035-40489 | 1 |
| 30 | Plug, SAE-10, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 32 | Screw, SHC | 311-10041 | 1 | 311-10041 | 1 |

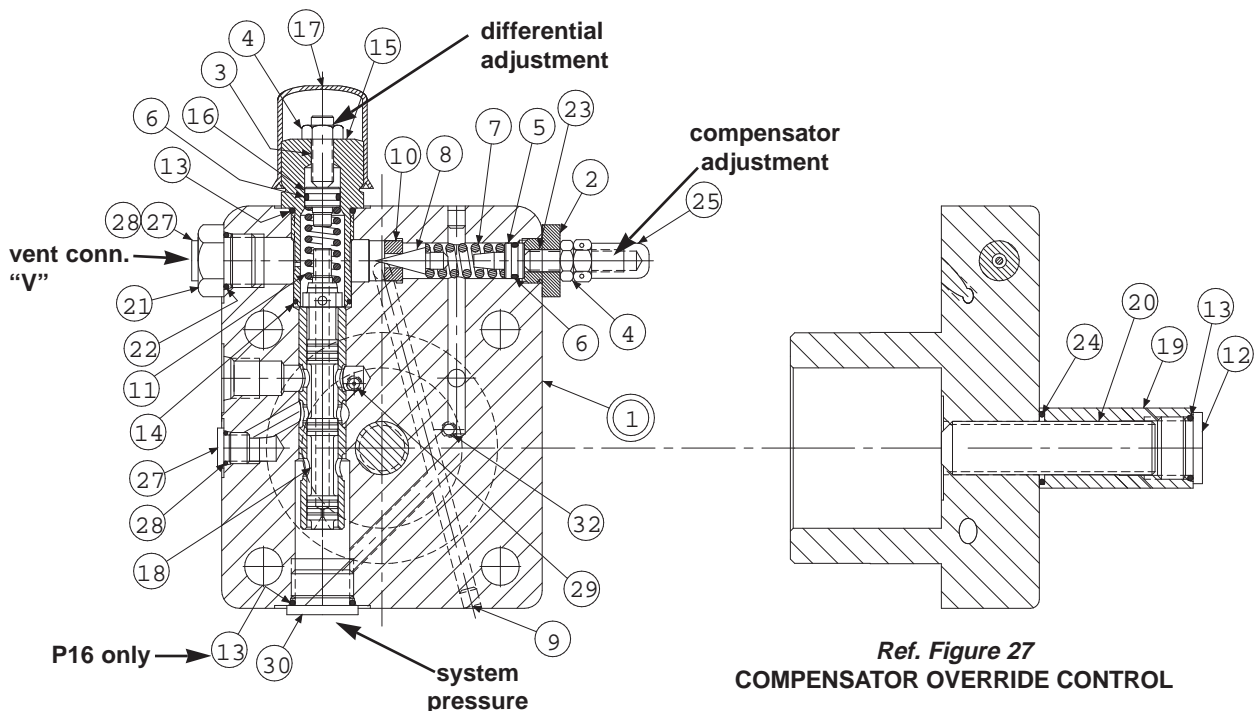
DISASSEMBLY

1. See Figure 27. 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

See page 26 for tightening torque on plugs

1. Install Avseal plugs (9) in body. Install orifice (29) and plug (32) as shown.
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-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 plugs (12) (21) (27) and (30).
7. Note proper location for cap on pump (pg. 24). 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 lb.·ft., 102 Nm.
10. Install tubing assembly (Figure 24, 25).



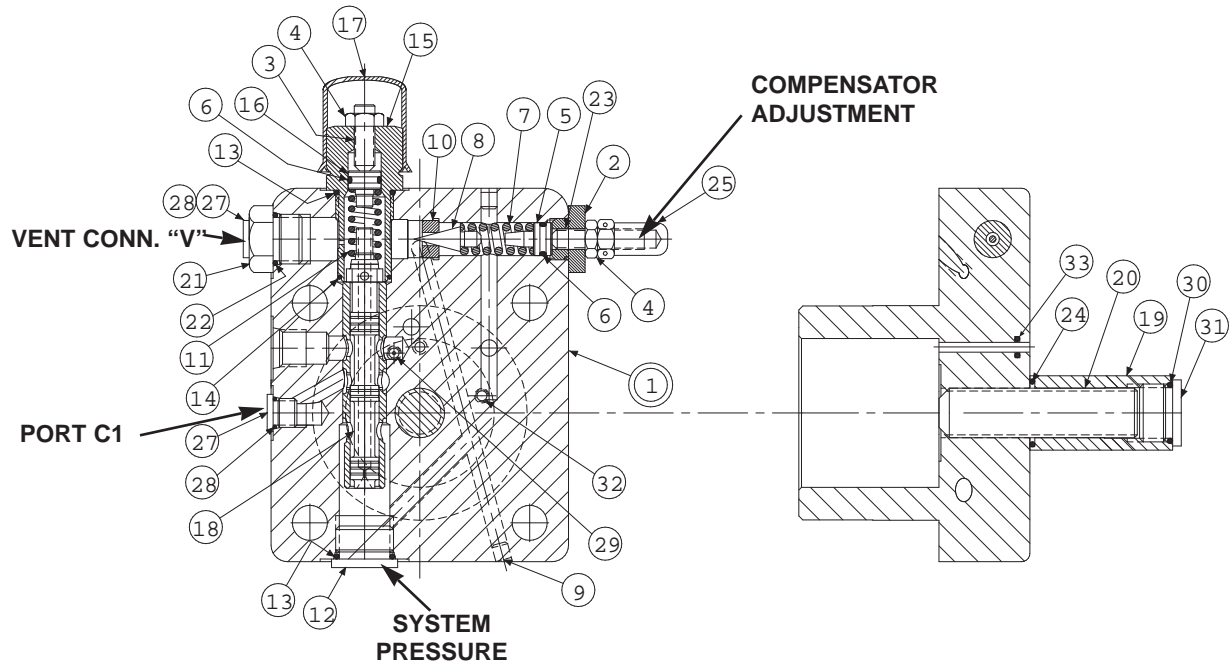


FIGURE 28
torque limiter override cap

PARTS LIST FOR FIGURE 28

torque limiter override cap
 P16 cap S22-15993
 P260 cap S22-15994

| ITEM | DESCRIPTION | P16 | | P260 | |
|------|-----------------------------|-----------|------|-----------|-----|
| | | PART NO. | QTY. | PART NO. | QTY |
| 1 | Cap-Sleeve Assembly | S22-15991 | 1 | S22-15992 | 1 |
| 2 | Adjustment. Plug | 032-91814 | 1 | 032-91814 | 1 |
| 3 | Socket Setscrew 5/16-24 x 1 | 312-13160 | 1 | 312-13160 | 1 |
| 4 | Nut, 5/16-24 | 335-13100 | 2 | 335-13100 | 2 |
| 5 | Seal Piston | 031-59367 | 1 | 031-59367 | 1 |
| 6 | O-Ring, 90 S-1 ARP 012 | 691-00012 | 2 | 691-00012 | 2 |
| 7 | Spring | 032-91798 | 1 | 032-91798 | 1 |
| 8 | Cone | 036-12288 | 1 | 036-12288 | 1 |
| 9 | Avseal Plug | 447-00026 | 2 | 447-00026 | 2 |
| 10 | Seat | 036-11692 | 1 | 036-11692 | 1 |
| 11 | Spring | 225-92101 | 1 | 225-92101 | 1 |
| 12 | Plug, SAE-10, 1/2 BSPP | 488-35055 | 1 | 447-01008 | 1 |
| 13 | O-Ring, 90 S-1 ARP 910 | 691-00910 | 2 | 691-00910 | 1 |
| 14 | O-Ring, 90 S-1 ARP 017 | 691-00017 | 1 | 691-00017 | 1 |
| 15 | Plug | 031-57368 | 1 | 031-57368 | 1 |
| 16 | Seal Piston | 032-92480 | 1 | 032-92480 | 1 |
| 17 | Cap | 449-00612 | 1 | 449-00612 | 1 |
| 18 | Spool | 032-92549 | 1 | 032-92549 | 1 |
| 19 | Cover | 032-91761 | 1 | 032-91761 | 1 |
| 20 | Screw, 1/2-20 x 2-1/2 | 312-35060 | 1 | 312-35060 | 1 |
| 21 | Fitting | 492-15423 | 1 | 492-15425 | 1 |
| 22 | O-ring 90 S-1 ARP 908 | 691-00908 | 1 | - | - |
| 23 | Soc. Setscrew | 312-13180 | 1 | 312-13180 | 1 |
| 24 | O-Ring, 70 S-1 ARP 015 | 671-00015 | 1 | 671-00015 | 1 |
| 25 | Acorn Nut | 036-33474 | 1 | 036-33474 | 1 |
| 26 | Plug | 449-00015 | 1 | 449-00599 | 1 |
| 27 | Plug, SAE-4, 1/4 BSPP | 488-35061 | 2 | 447-01004 | 2 |
| 28 | O-ring, 90 S-1 ARP 904 | 691-00904 | 2 | - | - |
| 29 | Orifice | 035-40489 | 1 | 035-40489 | 1 |
| 30 | O-Ring, 90 S-1 ARP 905 | 691-00015 | 1 | 691-00015 | 1 |
| 31 | Plug, SAE-5 | 488-35020 | 1 | 488-35020 | 1 |
| 32 | Screw, SHC | 311-10041 | 1 | 311-10041 | 1 |
| 33 | O-Ring, 70 S-1 ARP 008 | 671-00008 | 1 | 671-00008 | 1 |

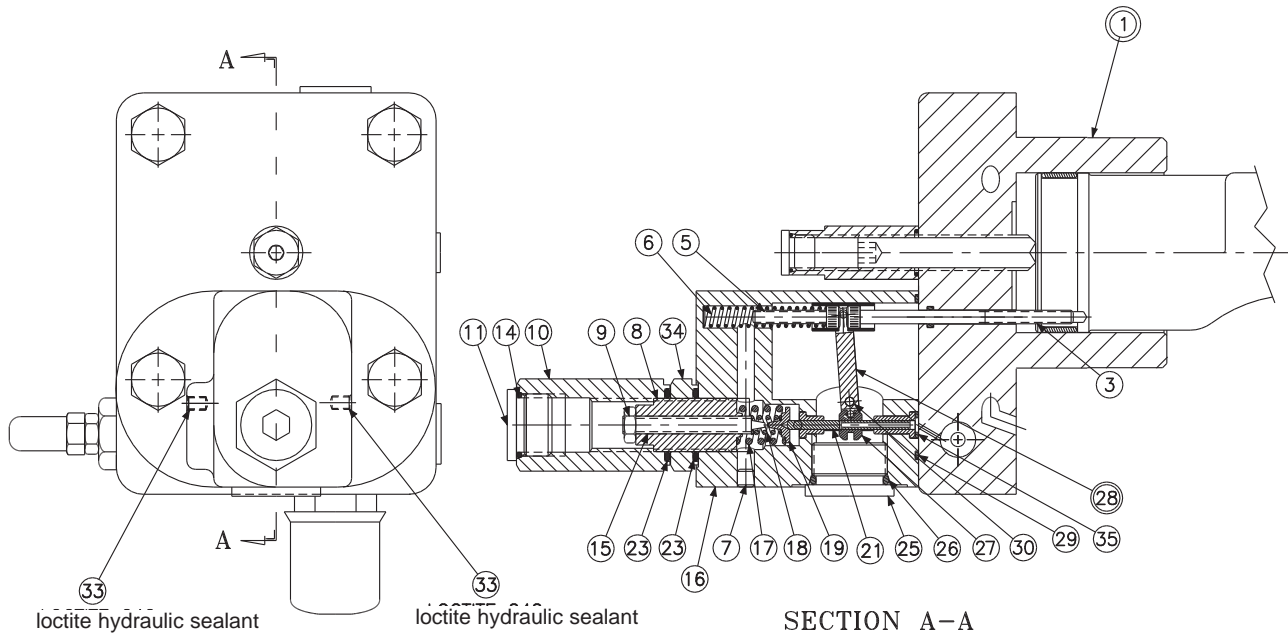


FIGURE 29
TORQUE LIMITER OVERRIDE

PARTS LIST FOR FIGURE 29

torque limiter override
P16 code J S22-16009
P16 code K S22-16011
P260 code J S22-16010
P260 code K S22-16012

| ITEM | DESCRIPTION | P16 | P260 | QTY. | |
|------|---------------------------|-----------|-----------|------|-----|
| | | PART NO. | PART NO. | **J | **K |
| 1 | Cap (Figure 28) | S22-15993 | S22-15994 | 1 | 1 |
| 3 | Screw | 032-91461 | 032-91461 | 1 | 1 |
| 5 | Clevis pin | 321-40000 | 321-40000 | 1 | 1 |
| 6 | Spring, Compression | 032-92100 | 032-92100 | 1 | 1 |
| 7 | Plug, Avseal | 447-00026 | 447-00026 | 1 | 1 |
| 8 | Screw | 032-91445 | 032-91445 | 1 | 1 |
| 9 | Nut, Hex Jam 1/4-20 UNC | 340-00038 | 340-00038 | 1 | 1 |
| 10 | Hex Nut, 3/4-16 UNF | 032-91449 | 032-91449 | 1 | 1 |
| 11 | Plug, SAE-8 | 488-35018 | 488-35018 | 1 | 1 |
| 14 | O-Ring, 90 S-1 ARP 908 | 691-00908 | 691-00908 | 1 | 1 |
| 15 | Screw, Primary Adjustment | 032-91446 | 032-91446 | 1 | 1 |
| 16 | Body assembly | S22-15397 | S22-15397 | 1 | 1 |
| 17 | Outer Spring – J Version | 032-91440 | 032-91440 | 1 | — |
| | Outer Spring – K Version | 032-91448 | 032-91448 | — | 1 |
| 18 | Inner Spring – J Version | 032-91441 | 032-91441 | 1 | — |
| | Inner Spring – K Version | 032-91447 | 032-91447 | — | 1 |
| 19 | Spring Retainer | 032-91819 | 032-91819 | 1 | 1 |
| 21 | Spool | 032-91438 | 032-91438 | 1 | 1 |
| 23 | O-ring, 70 S-1 ARP 118 | 671-00118 | 671-00118 | 2 | 2 |
| 25 | Plug, SAE-12 | 488-35014 | 488-35014 | 1 | 1 |
| 26 | O-Ring, 90 S-1 ARP 912 | 691-00912 | 691-00912 | 1 | 1 |
| 27 | Sleeve | 032-91437 | 032-91437 | 1 | 1 |
| 28 | Arm assembly | S22-15520 | S22-15520 | 1 | 1 |
| 29 | O-Ring, 70 S-1 ARP 035 | 671-00035 | 671-00035 | 1 | 1 |
| 30 | Dowel Pin | 324-20828 | 324-20828 | 1 | 1 |
| 33 | Screw, SHC 10-32 x 1/4 | 312-09041 | 312-09041 | 2 | 2 |
| 34 | Nut | 032-91645 | 032-91645 | 1 | 1 |
| 35 | O-Ring, 70 S-1 ARP 010 | 671-00010 | 671-00010 | 1 | 1 |

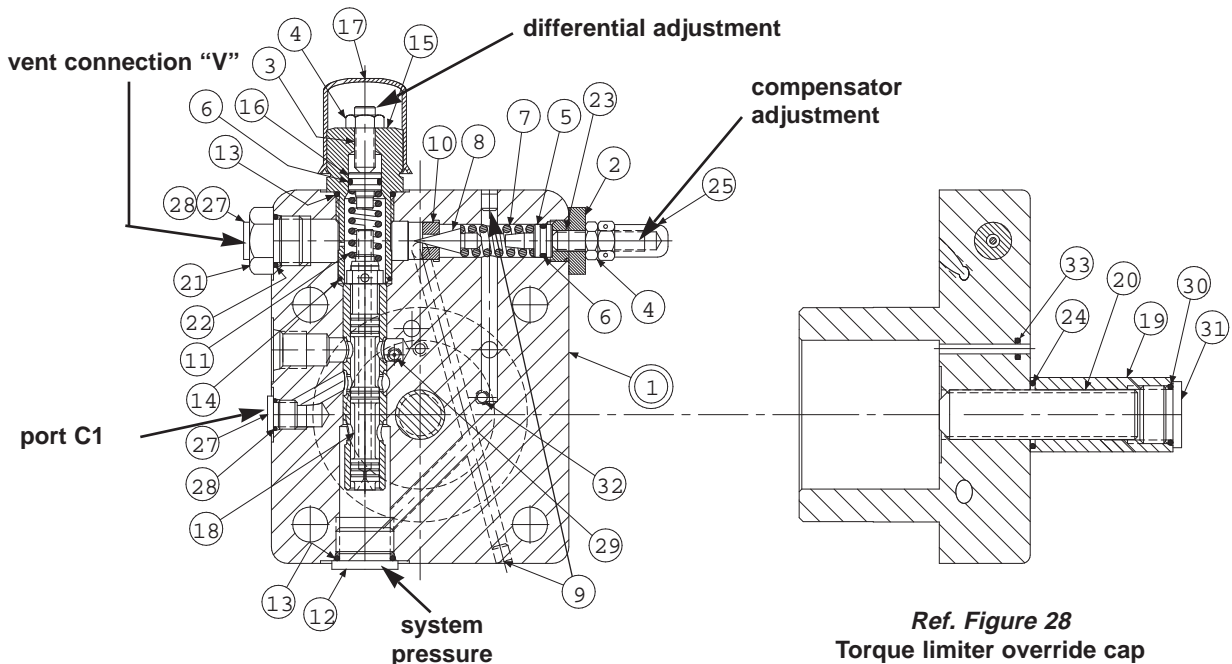
DISASSEMBLY

1. See figure 29. 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 28. Remove maximum volume stop assembly (items 19, 20, 24, 30, 31).
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

See page 26 for tightening torque on plugs

1. See figure 28. Install Avseal plugs (9) orifice (29) and screw (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 piston (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 plugs (12), (21) and (27) and torque.
7. Carefully install O-ring (33) into the cap.
8. Note proper location for cap (pg. 24). 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 lb.*ft., 102 Nm.
9. Install maximum stop screw (20), cover (19), O-ring (24) and plug (31) with O-ring (30).
10. See figure 29. Apply Loctite 242 on threads of screw (3), lubricate the shank, thread through the cap into the control piston, and torque to 5 lb.*ft., 6,78 Nm.
11. Measure height from control cap to top of screw. With control piston at zero stroke, dimension must be .45 +/- .03 in., 11,4 +/- 0,76 mm.
12. Press dowel (30) into body (16), through the link assembly (28), to 1/4", 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 plug (11).
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 75 lb.*ft., 102 Nm.
16. Install tubing assembly (Figure 24, 25).



Test Conditions: (If using service facility test stand)

Fluid: Mobil 4259 DE (ISO V6-32 or equivalent)

RPM: 1450 or 1750 ± 50 RPM

Inlet Temp: 120° F ± 10° F, 49° C ± 4° C

Inlet Condition: Atmospheric to + 5 psi, 0,345 bar

Case Pressure: 25 psi ±5 psi, 1,72 bar ± 0,345 bar

Mount pump on test stand, or customer system. System line must have a relief valve. Connect system lines and case drain line. Fill pump case with clean oil. If pump is mounted vertically with the shaft up, vent the case by removing the plug from port "DG" to purge trapped air. Dry all oil from exterior of pump to permit checking for external leaks. If leaks are detected at any time, they shall be repaired before proceeding.

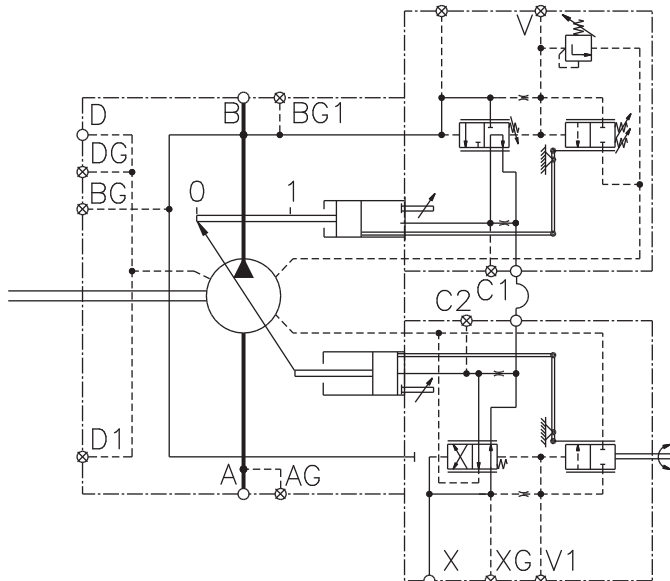
Adjust maximum volume stop to full displacement by backing off screw or handwheel CCW until there is no contact with control piston.

ROTARY SERVO TEST

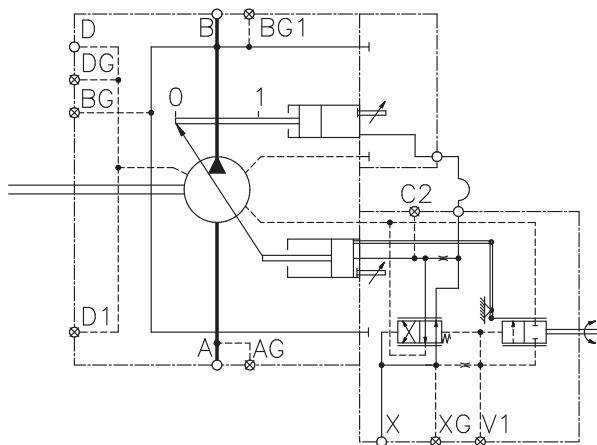
The rotary servo mounts on the minimum stroke side of the pump. It utilizes a rotating shaft containing a cam to position a pin, and a sleeve positioned by a feedback link to the control cylinder. The sleeve/pin combination meters pilot flow to position a 4-way valve. This valve is ported to both ends of the control cylinder. The 4-way spool directs oil to/from the control cylinder such that it moves in a direction to maintain the metered position between the sleeve and spool. The pump stroke is thus established by the position of the shaft.

A compensator or torque limiter override may be installed on the opposite side of the control piston. When the set pressure or torque is reached, system pressure is directed into the piston to reduce stroke, overriding the servo commanded position.

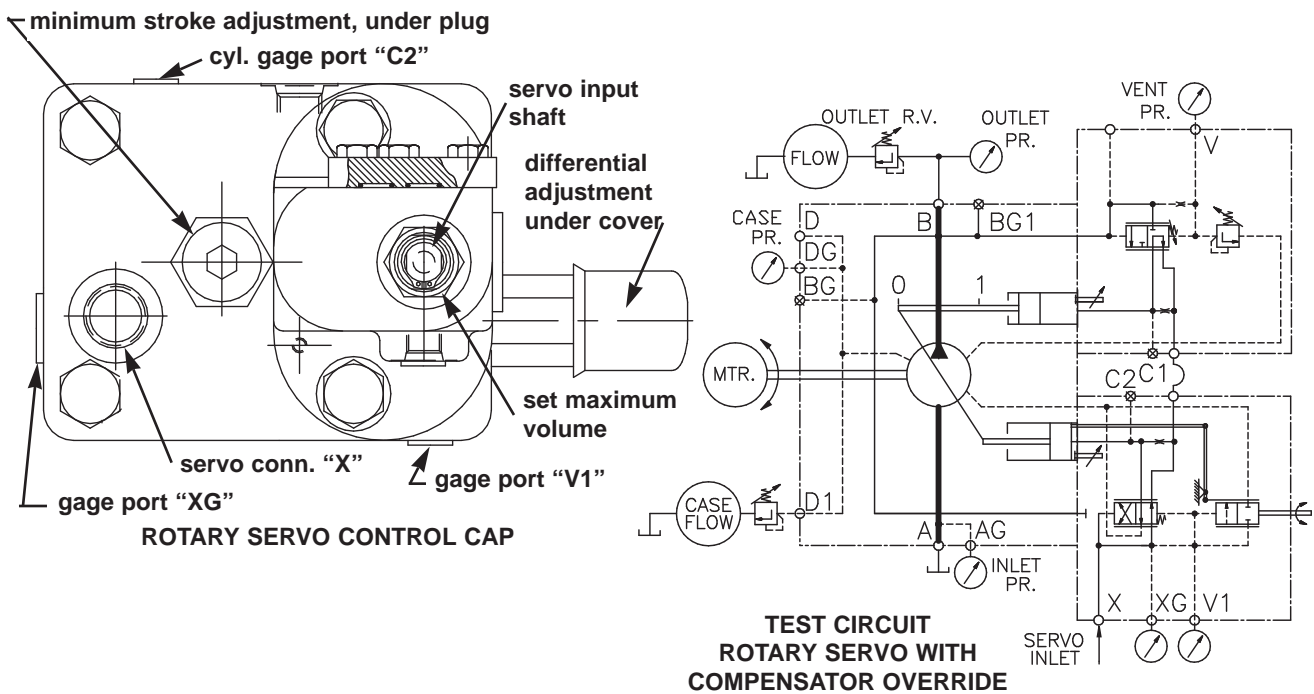
Before testing the rotary servo, disable the compensator or torque limiter override, if applicable, by turning the compensator differential adjustment fully in. **CAUTION:** System must contain a relief valve to limit system pressure. System relief valve should be set to minimum pressure.



**HYDRAULIC CIRCUIT
ROTARY SERVO TORQUE
LIMITER OVERRIDE**



**HYDRAULIC CIRCUIT
ROTARY SERVO**



ROTARY SERVO TEST (continued)

Plumb servo supply (5 gpm, 19 lpm minimum at 1500 psi, 103 bar maximum) to control port "X".

Thread minimum stroke adjustment so that pump is on stroke.

Install gages on servo pressure gage port XG and on gage port V1, capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for servo pressure.

Turn servo differential adjustment screw in till solid, then seven turns out.

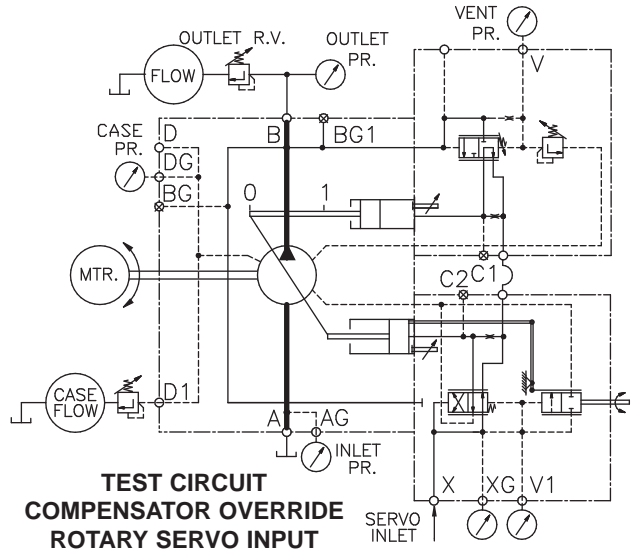
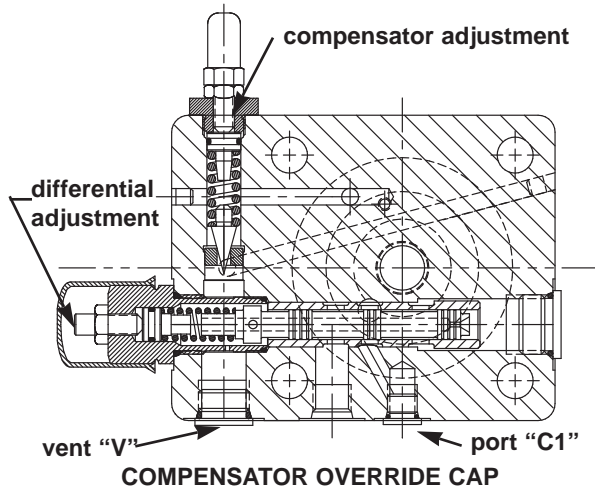
Start pump. Adjust rotary servo shaft till pump is at some stroke between zero and full. Adjust differential pressure by adjusting the differential screw until the difference in pressure readings between port XG and V1 is 250 psi, 17,2 bar. Install cover over differential adjustment. Remove gages and plug gage ports.

With rotary servo shaft rotated fully clockwise, adjust maximum volume adjustment on servo until output flow is at the full stroke position. Lock in place.

Fully rotate servo shaft counter-clockwise. Pump flow should go towards zero stroke. Back out minimum volume stop until pump is at zero stroke. Lock in place.

Rotate shaft clockwise and counterclockwise at various outlet pressures. 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 .3 second.

Proceed to **COMPENSATOR TEST (pg. 66)**, **TORQUE LIMITER TEST (pg. 70)**, or **FINAL PUMP TEST (pg. 75)**, as applicable.



COMPENSATOR TEST

Outlet relief valve should be set to minimum pressure.

If the pump contains a servo, hydraulic or electrohydraulic stroker control, test that control first, (pg. 64, 68 or 69) then set the control to give full stroke on the pump.

Install gages on outlet pressure and "V" capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for outlet pressure.

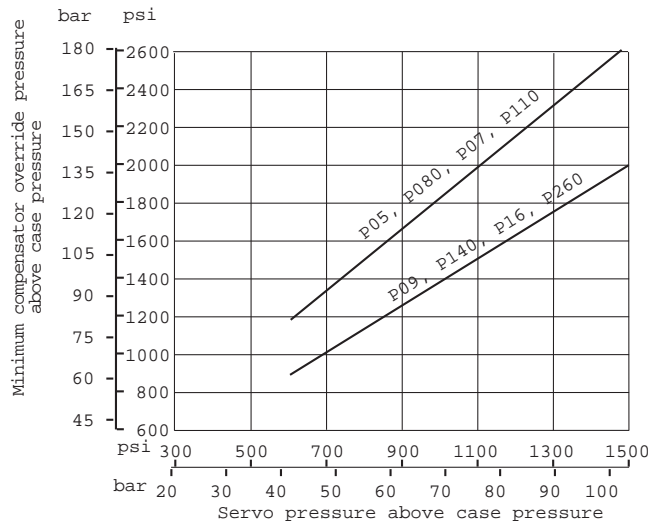
If testing pump with load sensing compensator or torque limiter control, the test stand must include a gage on the line from "LS" capable of measuring pressure difference to 10 psi, 0,69 bar and the other components shown in the load sensing test circuit. Open speed control valve fully, and close load valve to first test the compensator function.

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

Turn differential adjustment screw out till there is no contact with spring, then in 1-1/2 turns. (Approximately one nut width exposure of screw thread)

Start prime mover. Observe for correct rotation. Pump should be at full displacement at minimum pressure.

Adjust outlet relief valve until compensator destrokes pump to zero displacement. Compensator pressure should be approximately 1000 psi, 69 bar with the 1/2 turn pre-adjustment. Note: With servo type controls, minimum compensator override pressure will be higher, depending on the servo supply pressure. See chart below.

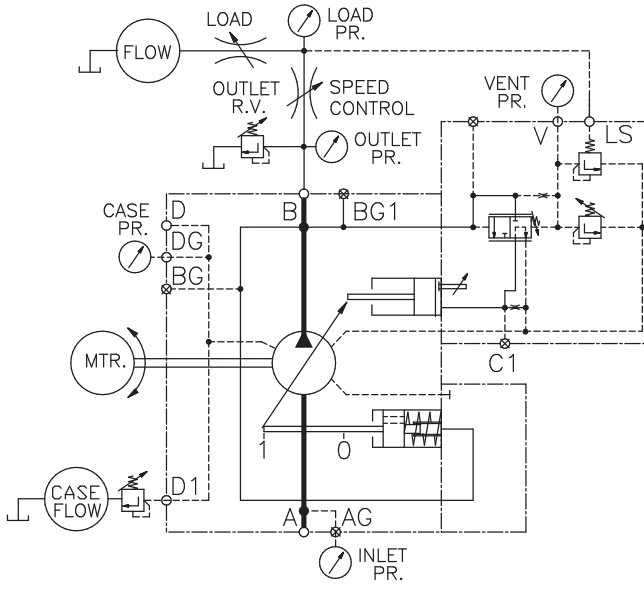


Raise compensator from minimum to maximum outlet pressure. At each condition, increase the outlet pressure until the pump fully de-strokes. At no time should the outlet pressure vary over 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

Calculate compensator leakage by subtracting leakage flow at full flow from leakage flow fully compensated. Compensator leakage: 5 gpm, 18.9 lpm. max.

Reduce outlet pressure to 150 psi, 10,3 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator settings should be repeatable. Proceed to **FINAL PUMP TEST (pg. 75)**, or **LOAD SENSING TEST (below)** if applicable.

LOAD SENSING TEST



**TEST CIRCUIT
LOAD SENSING**

Caution: Load sensing control is limited to 5000 psi, 345 bar maximum pressure.

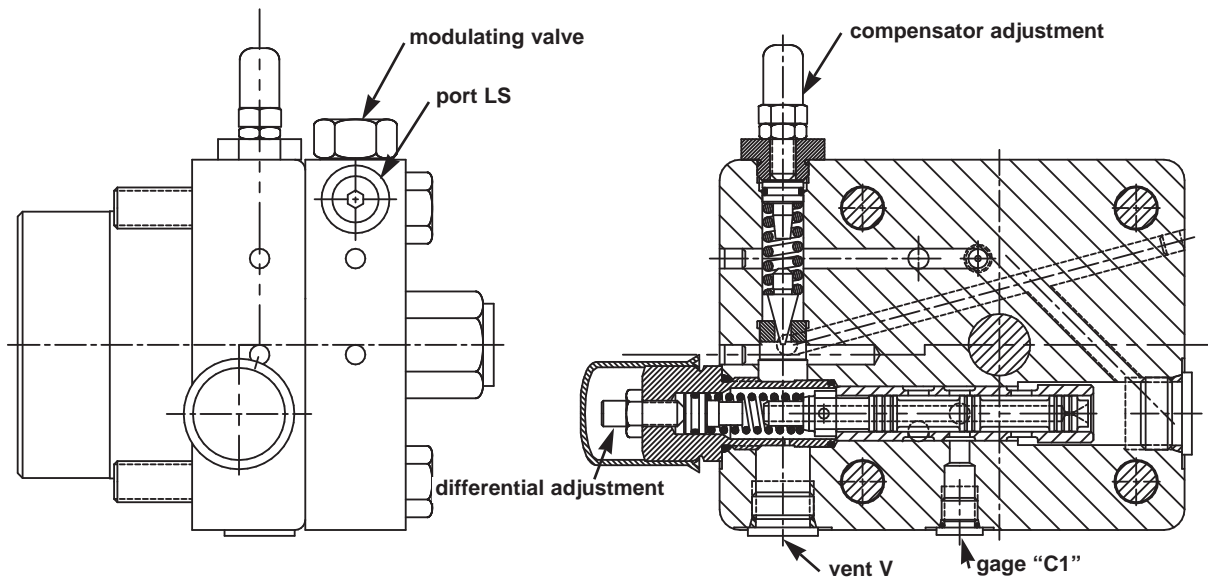
Pump should be connected to speed control valve, load sensing line and load valve as shown.

Close the speed control valve. Check the pressure difference from outlet pressure to load pressure. Using the differential adjustment, set this pressure difference to 450 psi ± 25 psi, 31,0 ± 1,72 bar or shop order requirement. Caution: Too low or too high a setting will cause the control to malfunction. Install cap on differential adjustment.

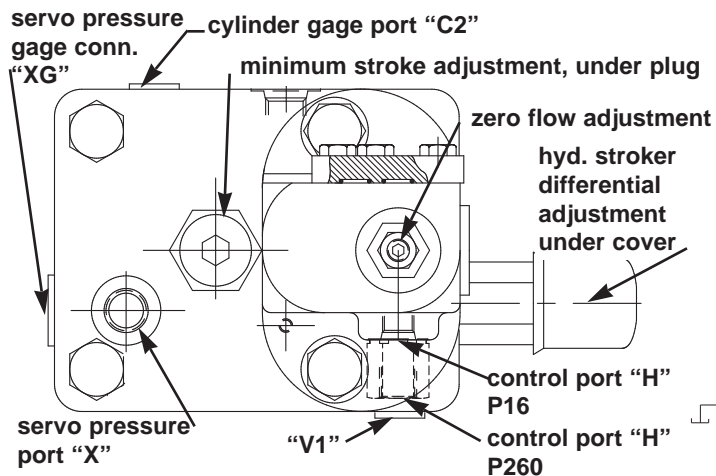
Fully open the speed control valve. Set the compensator to 3000 psi, 207 bar, and 5000 psi, 345 bar. (One turn of adjustment equals approximately 2000 psi, 138 bar.) At each condition, increase the outlet pressure by closing the load valve until the pump fully de-strokes. At no time should the outlet pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

With pump at full flow and 5000 psi, 345 bar outlet pressure, close speed control valve till flow reduces slightly. Note flow. Open load valve slowly, to drop outlet pressure toward minimum. Flow shall remain constant within 10 gpm, 37,8 lpm at all pressures.

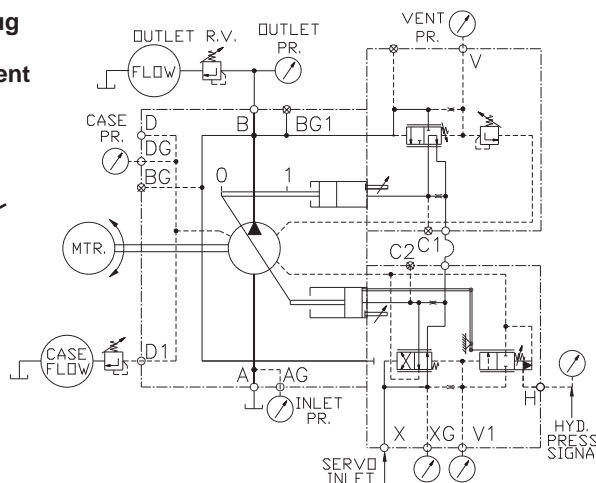
Adjust the speed control valve till flow is at a low value. Note flow. Raise and lower outlet pressure by closing and opening the load valve. Flow shall remain constant within 10 gpm, 37,8 lpm. Proceed to **FINAL PUMP TEST (pg. 75)**.



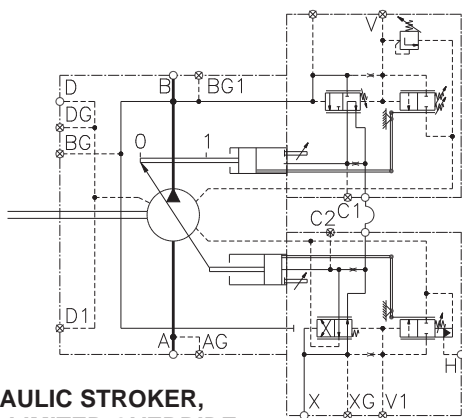
LOAD SENSING CONTROL



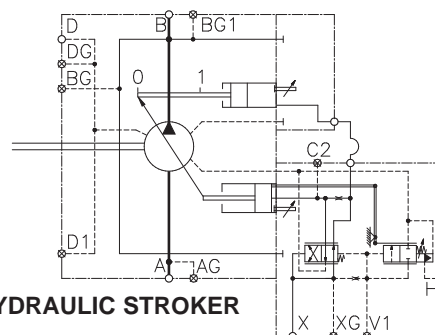
HYDRAULIC STROKER CAP



TEST CIRCUIT
 HYDRAULIC STROKER
 COMPENSATOR OVERRIDE



HYDRAULIC STROKER,
 TORQUE LIMITER OVERRIDE



HYDRAULIC STROKER

HYDRAULIC STROKER TEST

Before testing hydraulic stroker, disable the compensator or torque limiter override, if applicable, by turning the compensator differential adjustment fully in. (See compensator or torque limiter test). **CAUTION:** System must contain a relief valve to limit outlet pressure. Outlet relief valve should be set to minimum pressure.

Plumb servo supply (5 gpm, 19 lpm minimum at 1500 psi, 103 bar maximum) to control port "X". Plumb adjustable hydraulic pressure (50 to 350 psi, 3,45 to 24 bar) to control port "H".

Thread minimum stroke adjustment screw so that pump is on stroke.

Install gages on servo pressure gage port XG and on gage port V1, capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for servo pressure.

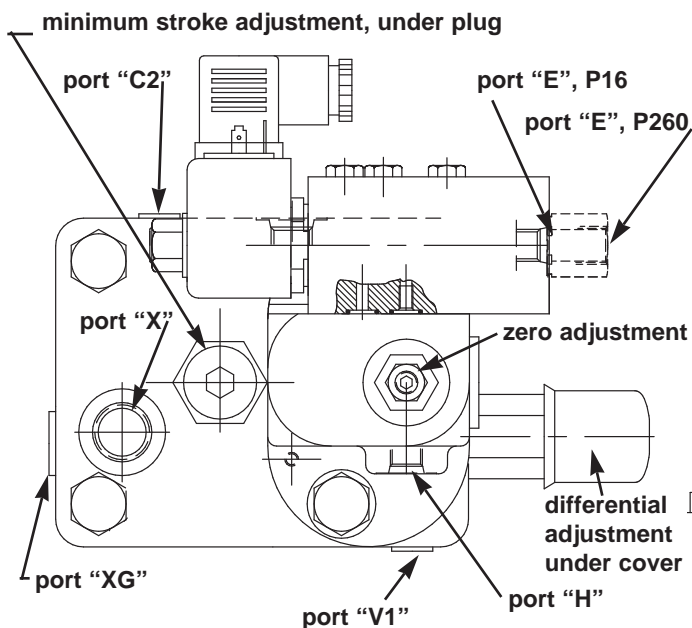
Turn hydraulic stroker differential adjustment screw in till solid, then out 7 turns.

Start pump. Apply hydraulic control signal to port "H" till pump is at some stroke between zero and full. Adjust differential pressure by adjusting the differential screw until the difference in pressure readings between port XG and V1 is 250 psi, 17,2 bar. Install cover over differential adjustment.

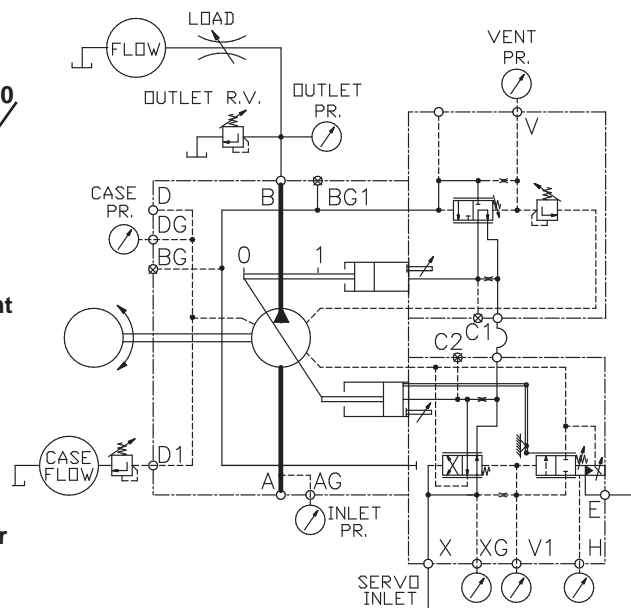
Set signal pressure to 50 psi, 3,45 bar. Back out zero volume stop and set zero flow adjustment until pump is at zero stroke. Lock both adjustments in place.

Slowly increase and decrease signal pressure between 0 and 275 psi, 19,0 bar several times at minimum and maximum operating outlet pressure. Pump stroke should follow control pressure smoothly and proportionally. Rapidly adjust signal pressure between 0 and 275 psi, 19,0 bar. Full to zero or zero to full stroke should be achieved in no more than 0,3 second.

Proceed to **COMPENSATOR TEST (pg. 66)**, **TORQUE LIMITER TEST (pg. 70)**, or **FINAL PUMP TEST (pg. 75)**, as applicable.



ELECTROHYDRAULIC STROKER CAP



**TEST CIRCUIT
ELECTROHYDRAULIC STROKER
COMPENSATOR OVERRIDE**

ELECTROHYDRAULIC STROKER TEST

Before testing electrohydraulic stroker, disable the compensator or torque limiter override, if applicable, by turning the compensator differential adjustment fully in. (See compensator or torque limiter test) **CAUTION:** System must contain a relief valve to limit outlet pressure. Outlet relief valve should be set to minimum pressure.

Plumb servo supply (5 gpm, 19 lpm minimum at 1500 psi, 103 bar maximum) to control port "X", and to the electric stroker port, "E"

Install gages on servo pressure gage port XG and on gage port V1, capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for servo pressure.

Thread zero volume stop screw so that pump is on stroke.

Turn electrohydraulic stroker differential adjustment screw in till solid, then 7 turns out.

Start pump. Observe for correct rotation. Adjust current to proportional valve till pump is at some stroke between zero and full. Adjust differential pressure by adjusting the differential screw until the difference in pressure readings between port XG and V1 is 250 psi, 17,2 bar. Install cover over differential adjustment.

Adjust current to 170 mA. Back out zero volume stop and set zero flow adjustment until pump is at zero stroke. Lock both adjustments in place. If pump fails to respond, measure pressure at port "H", pressure to be 50 psi, 3,45 bar minimum, for 170 mA current with 24 V. coil. Remove gage after checking, to avoid unstable operation.

Increase current to 300 mA. Pump should go to full stroke. Set max. volume screw on opposite control cap for full stroke.

Increase and decrease the amperage between 0 and 300 mA several times at minimum to maximum outlet pressure. Pump stroke should follow amperage smoothly and proportionally. Full to zero or zero to full stroke should be achieved in .3 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 10 gpm, 37,8 lpm from each other.

Proceed to **COMPENSATOR TEST (pg. 66)**, **TORQUE LIMITER TEST (pg. 70)**, or **FINAL PUMP TEST (pg. 75)**, as applicable.

TORQUE LIMITER AND TORQUE LIMITER OVERRIDE TEST

The torque limiter design is a compensator with a means of varying pump stroke with pressure in this manner: The compensator vent port applies pressure to a pin. The pin moves against two independently adjustable springs. A sleeve, sliding over the pin, opens or closes the vent passage, to control the compensator pressure. The sleeve is connected through a linkage to the control piston. As pressure increases, the stroke must reduce, and vice versa, to provide approximate constant torque.

Install gages on outlet pressure and "V" capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for outlet pressure.

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

Turn differential adjustment screw out till there is no contact with spring, then in 1-1/2 turns. (Approximately one nut width exposure of screw thread)

If the pump contains a servo, hydraulic or electrohydraulic stroker control, test that control first (pg. 64, 68 or 69) then set the control to give full stroke on the pump. **CAUTION:** System must contain a relief valve to limit outlet pressure. Outlet relief valve should be set at 500 psi, 34,5 bar.

To test and set compensator function, disable torque limiter in this manner: Back out high pressure flow adjustment screw (inner) to remove all load. Turn in high flow pressure adjustment screw (outer) to go solid. Caution! do not apply over 10 in.*lb, 1,2 Nm torque to avoid damage to internal parts!

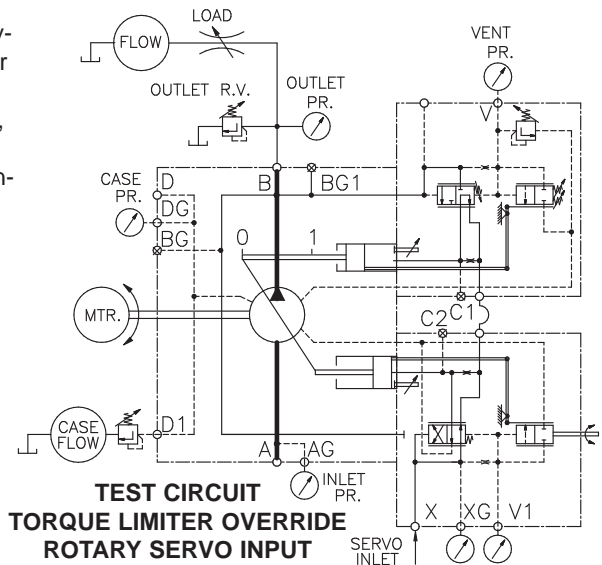
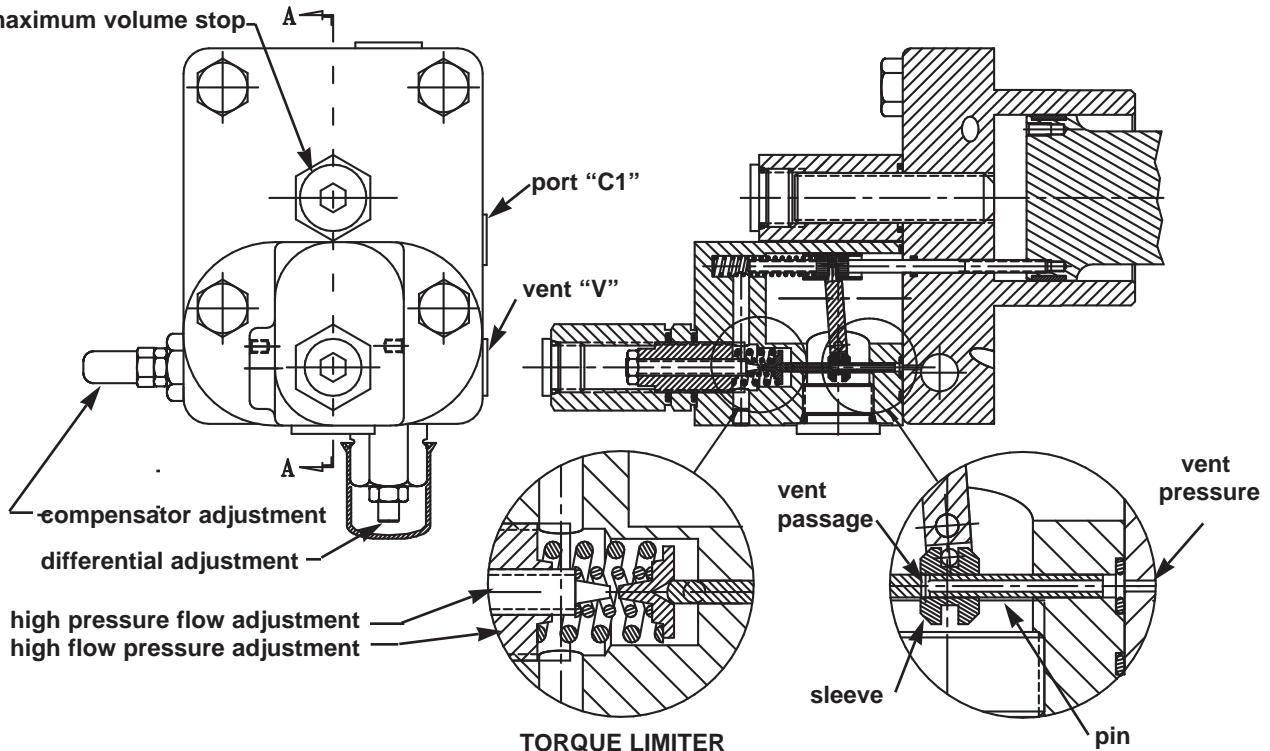
Start prime mover with outlet relief set at 500 psi, 34,5 bar. Apply a load to the pump.

Pump should be at full displacement at 500 psi, 34,5 bar.

Increase outlet pressure until compensator de-strokes pump to zero displacement. Note minimum compensated pressure versus servo pressure in chart on page 66. Set compensator to minimum compensated pressure.

Adjust compensator differential spool pressure to 250 psi, 17,2 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the outlet pressure and compensator vent "V" gages installed in the compensator cap is 250 psi, 17,2 bar. Install cover over differential adjustment.

maximum volume stop



**TEST CIRCUIT
TORQUE LIMITER OVERRIDE
ROTARY SERVO INPUT**

Set the compensator to 3000 psi, 207 bar, 6000 psi, 414 bar, and 7250 psi, 500 bar. (One turn approximately equals 2000 psi, 138 bar)

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

Reduce outlet pressure below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator setting should be repeatable.

Set compensator adjustment to at least 500 psi, 34,5 bar above the maximum outlet pressure.

TORQUE LIMITER TEST AND ADJUSTMENT

Set the torque limiter by using the formula:

$$HP = \frac{P \cdot Q}{(Eff. \cdot 1714)}, \text{ or } P = \frac{HP(Eff. \cdot 1714)}{Q}, \text{ or } Q = \frac{HP(Eff. \cdot 1714)}{P}$$

where P = Pressure in psi

Q = flow in GPM

Eff. = overall efficiency

$$\text{or } kW = \frac{P \cdot Q}{(Eff. \cdot 600)}, \text{ or } P = \frac{kW(Eff. \cdot 600)}{Q}, \text{ or } Q = \frac{kW(Eff. \cdot 600)}{P}$$

where P = pressure in Bar

Q = flow in lpm

Eff. = overall efficiency

calculate these two values:

- a. Outlet pressure at full pump flow.
- b. Pump flow at full outlet pressure.

1. Set outlet to pressure (a) calculated above. Back out high pressure flow adjusting screw (inner screw) to remove all load. Set the high flow pressure adjusting screw (outer) so that pump just commences to de-stroke.

2. Set the system to the required maximum outlet pressure. Set high pressure flow adjusting screw (inner) to obtain the calculated flow (b) at full outlet pressure.

Note: Electric motor current or engine load may be used instead of calculated flows to set power. In step 1, set the high flow adjustment to achieve the rated motor current or engine load. In step 2, set the high pressure adjustment to achieve the rated motor current or engine load.

Proceed to **FINAL PUMP TEST (pg. 75)**

LOAD SENSING TORQUE LIMITER

Caution: Load sensing control is limited to 5000 psi, 345 bar maximum pressure.

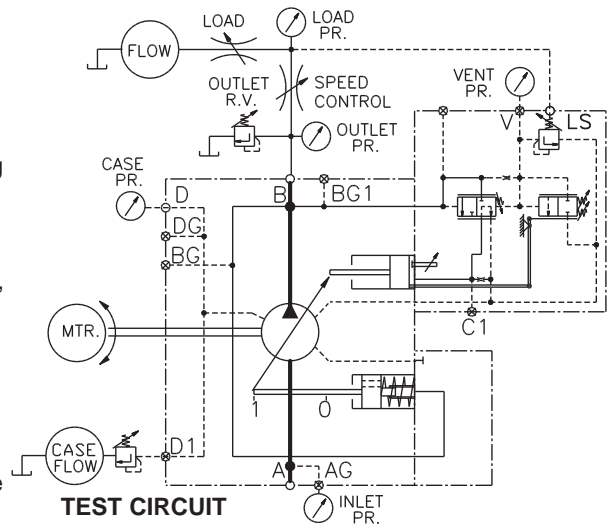
Pump should be connected to speed control valve, load sensing line and load valve as shown.

Install gages on outlet pressure and "V" capable of measuring pressure difference to 10 psi, 0,69 bar. Gages must be adequate for outlet pressure.

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

Turn differential adjustment screw out till there is no contact with spring, then in 1-1/2 turns. (Approximately one nut width exposure of screw thread)

To test and set compensator and load sensing function, disable torque limiter in this manner: Back out high pressure flow adjustment screw (inner) to remove all load. Turn in high flow pressure adjustment screw (outer) to go solid. Caution! do not apply over 10 in.*lb, 1,2 Nm torque to avoid damage to internal parts!



**TEST CIRCUIT
LOAD SENSING
TORQUE LIMITER**

Start prime mover with outlet relief set at 500 psi, 34,5 bar. Apply a load to the pump.

Pump should be at full displacement at 500 psi, 34,5 bar.

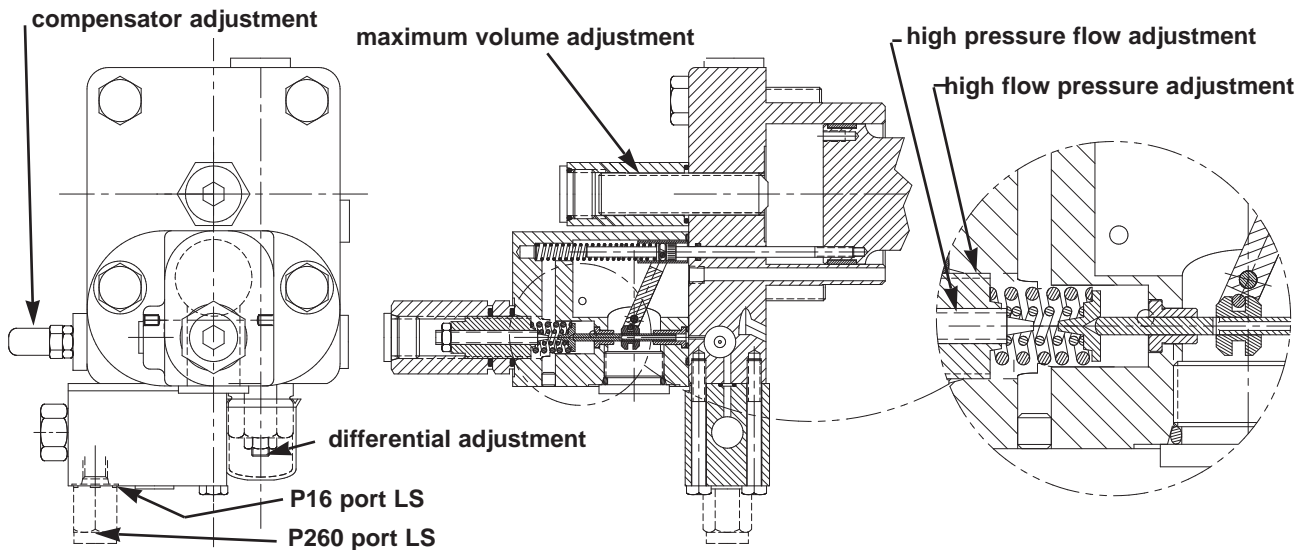
Increase outlet pressure until compensator de-strokes pump to zero displacement. Note minimum compensated pressure versus servo pressure in chart on page 58. Set compensator to minimum compensated pressure.

Adjust compensator differential spool pressure to 250 psi, 17,2 bar. This is accomplished by adjusting the differential screw until the difference in pressure readings between the outlet pressure and compensator vent "V" gages installed in the compensator cap is 250 psi, 17,2 bar. Install cover over differential adjustment.

Close the speed control valve. Check the pressure difference from outlet pressure to load pressure. Using the differential adjustment, set this pressure difference to 450 psi ± 25 psi, 31,0 ± 1,72 bar or shop order requirement. Caution: Too low or too high a setting will cause the control to malfunction. Install cap on differential adjustment.

Fully open the speed control valve. Set the compensator to 3000 psi, 207 bar, and 5000 psi, 345 bar. (One turn of adjustment equals approximately 2000 psi, 138 bar.) At each condition, increase the outlet pressure by closing the load valve until the pump fully de-strokes. At no time should the outlet pressure vary more than 150 psi, 10,3 bar from the compensator setting. The control should be steady and stable at all conditions.

With pump at full flow and 5000 psi, 345 bar outlet pressure, close speed control valve till flow reduces slightly. Note flow.



Open load valve slowly, to drop outlet pressure toward minimum. Flow shall remain constant within 10 gpm, 37,8 lpm at all pressures.

Adjust the speed control valve till flow is at a low value. Note flow. Raise and lower outlet pressure by closing and opening the load valve. Flow shall remain constant within 10 gpm, 37,8 lpm.

Fully open the speed control valve.

Set the torque limiter by using the formula:

$$HP = P \cdot Q / (\text{Eff.} \cdot 1714), \text{ or } P = HP(\text{Eff.} \cdot 1714) / Q, \text{ or } Q = HP(\text{Eff.} \cdot 1714) / P$$

where P = Pressure in psi

Q = flow in GPM

Eff. = overall efficiency

$$\text{or } kW = P \cdot Q / (\text{Eff.} \cdot 600), \text{ or } P = kW(\text{Eff.} \cdot 600) / Q, \text{ or } Q = kW(\text{Eff.} \cdot 600) / P$$

where P = pressure in Bar

Q = flow in lpm

Eff. = overall efficiency

calculate these two values:

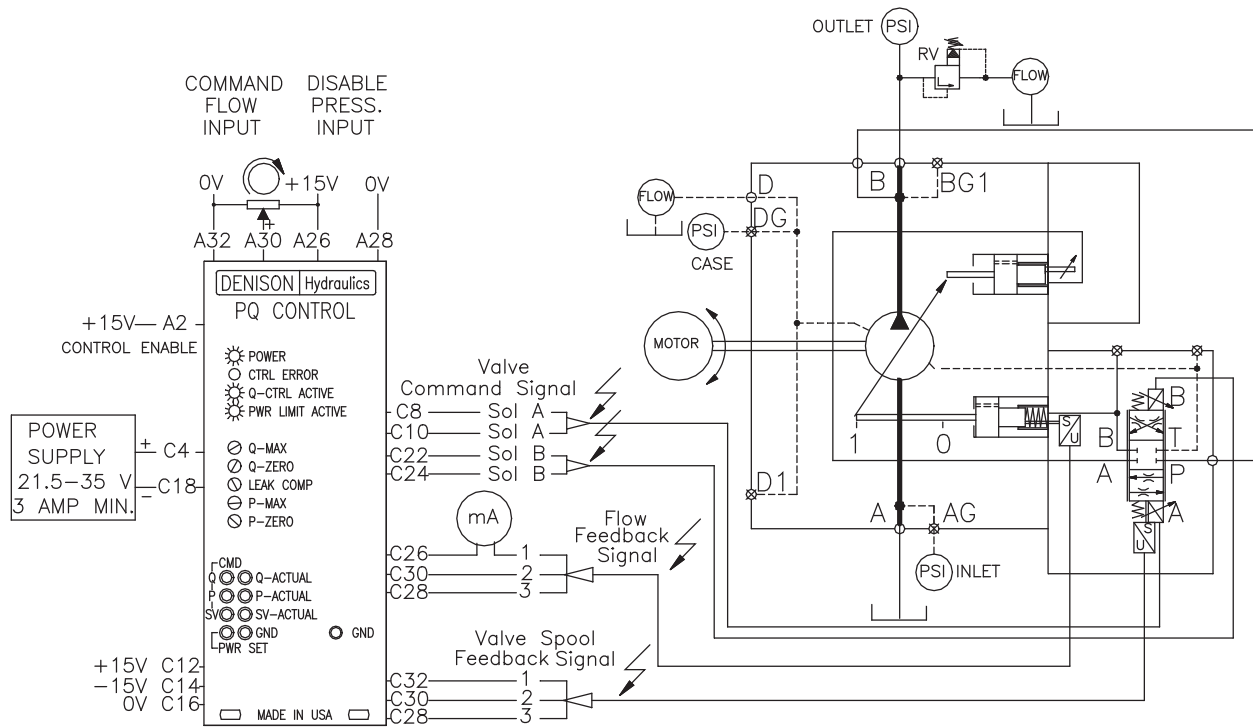
- a. Outlet pressure at full pump flow.
- b. Pump flow at full outlet pressure.

1. Set outlet to pressure (a) calculated above. Back out high pressure flow adjusting screw (inner screw) to remove all load. Set the high flow pressure adjusting screw (outer) so that pump just commences to de-stroke.

2. Set the system to the required maximum outlet pressure. Set high pressure flow adjusting screw (inner) to obtain the calculated flow (b) at full outlet pressure.

Note: Electric motor current or engine load may be used instead of calculated flows to set power. In step 1, set the high flow adjustment to achieve the rated motor current or engine load. In step 2, set the high pressure adjustment to achieve the rated motor current or engine load.

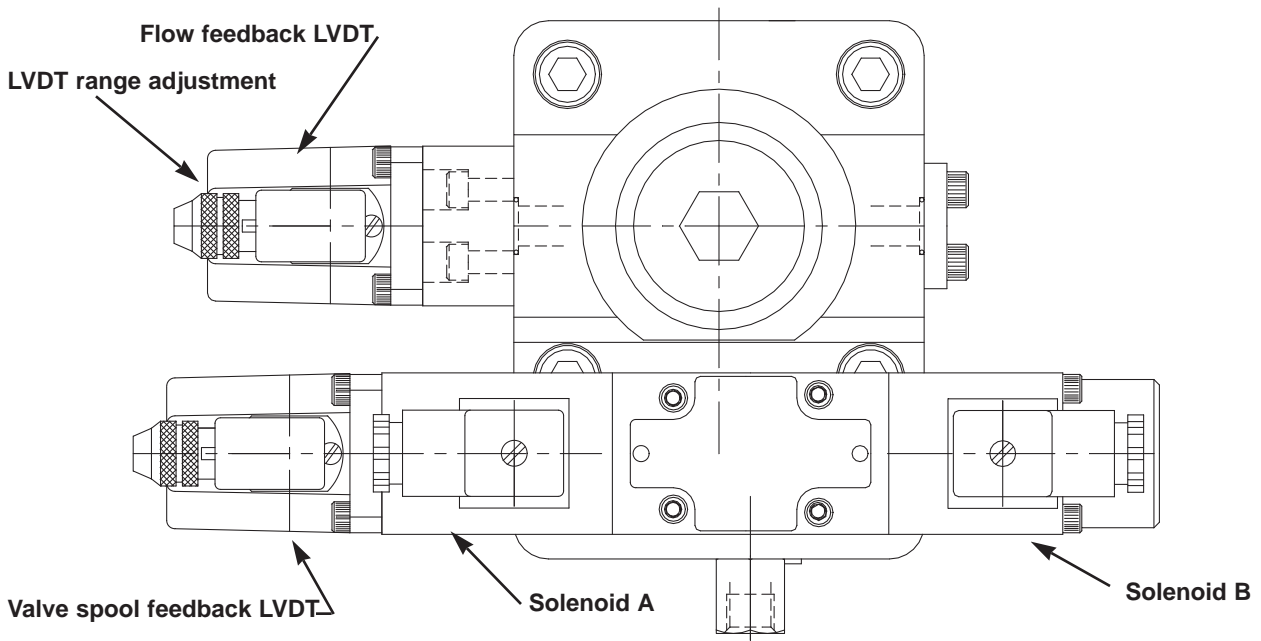
Proceed to **FINAL PUMP TEST (pg. 75)**



PRESSURE/FLOW (PQ) CONTROL

Connect PQ control driver card 020-14133 to pump as indicated.

1. Adjust maximum volume stop to full displacement by backing off screw CCW until there is no contact with control piston.
2. Set test stand relief valve at 500 psi. Jog electric motor to verify correct rotation. Start electric motor. With power off to the control, pump should be at full displacement at 500 psi, about 120 gpm.
3. Apply power to control. With command pot at 0 volts, the pump should go to zero displacement, at approximately 300 psi.
4. Check mA reading of flow feedback signal. At zero displacement, flow feedback signal shall be 6.67 mA +/- 0.2 mA. If incorrect, adjust left side screw on rear of flow feedback lvdt until output is within range.
5. Rotate command from 0 to 10 volts to 0 volts. Pump shall stroke from zero to full stroke to zero stroke as signal goes from 0 to 10 to 0 volts. Proceed to **Final Pump Test, (pg. 75)**.



FINAL PUMP TEST

Operate the pump with the following outlet pressures for the times indicated.

| | |
|---------------------------------------|-------------------|
| 3000 psi ± 100 psi, 207 bar ± 6,9 bar | 2 minutes minimum |
| 5000 psi ± 100 psi, 345 bar ± 6,9 bar | 1 minute minimum |
| 6000 psi ± 100 psi, 414 bar ± 6,9 bar | 1 minute minimum |

While breaking in, destroke the pump several times at each pressure setting, by either reducing compensator setting, servo/stroker command, or Q command to PQ control, as applicable.

FULL STROKE REQUIREMENTS AT 6000 PSI, 414 BAR

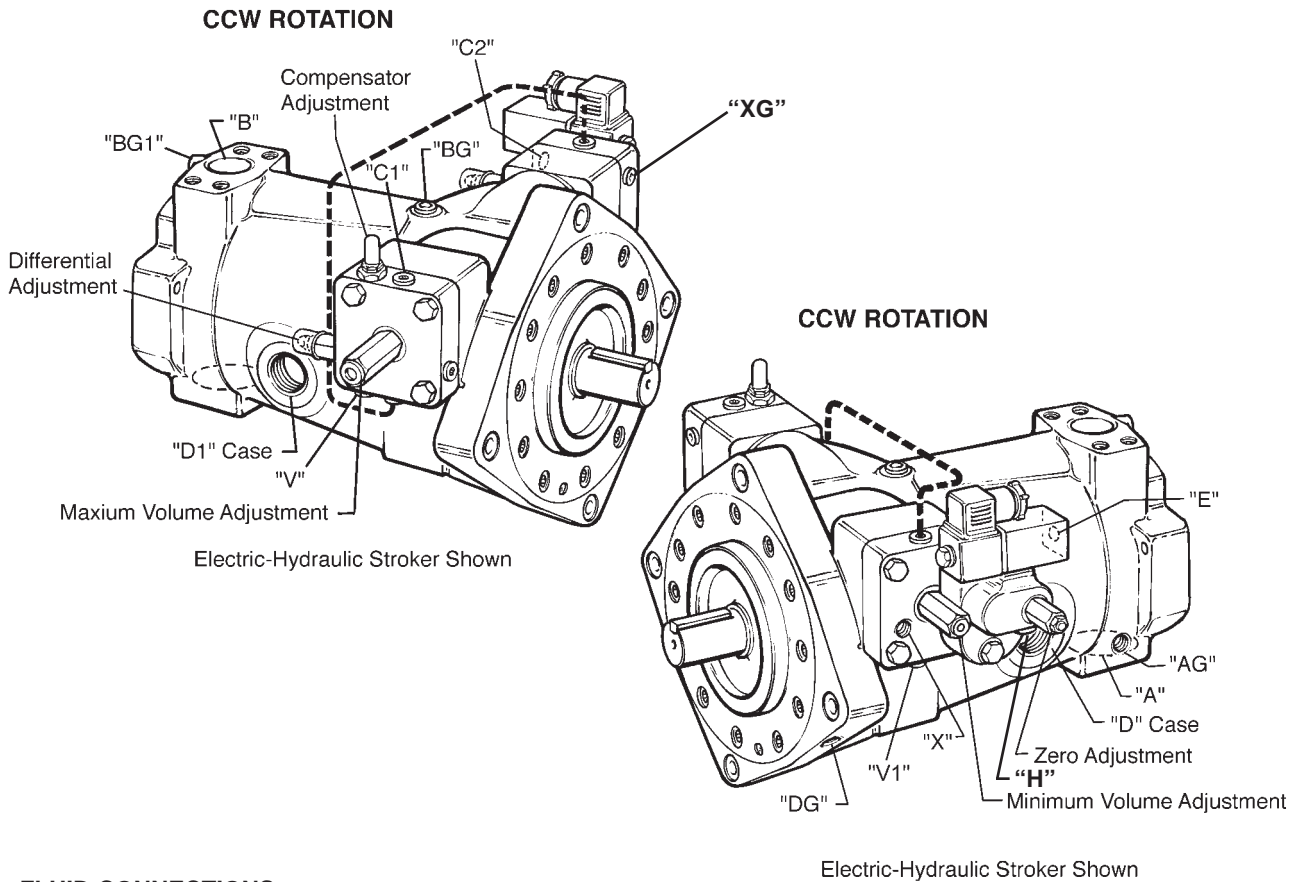
| PUMP SERIES | MINIMUM OUTPUT FLOW | | MAX CASE DRAIN FLOW | |
|---------------------|---------------------|-----|---------------------|------|
| | GPM | LPM | GPM | LPM |
| P16/P260 @ 1750 RPM | 115.0 | 435 | 7.5 | 28,4 |
| P16/P260 @ 1450 RPM | 94.5 | 358 | 7.5 | 28,4 |

Raise compensator setting from minimum to maximum outlet pressure. **Caution:** Load sensing control is limited to 5000 psi, 345 bar maximum pressure.

At each condition, increase the outlet pressure until the pump fully de-strokes. At no time should the outlet pressure vary over 150 psi, 10,3 bar from full to zero flow. The control should be steady and stable at all conditions.

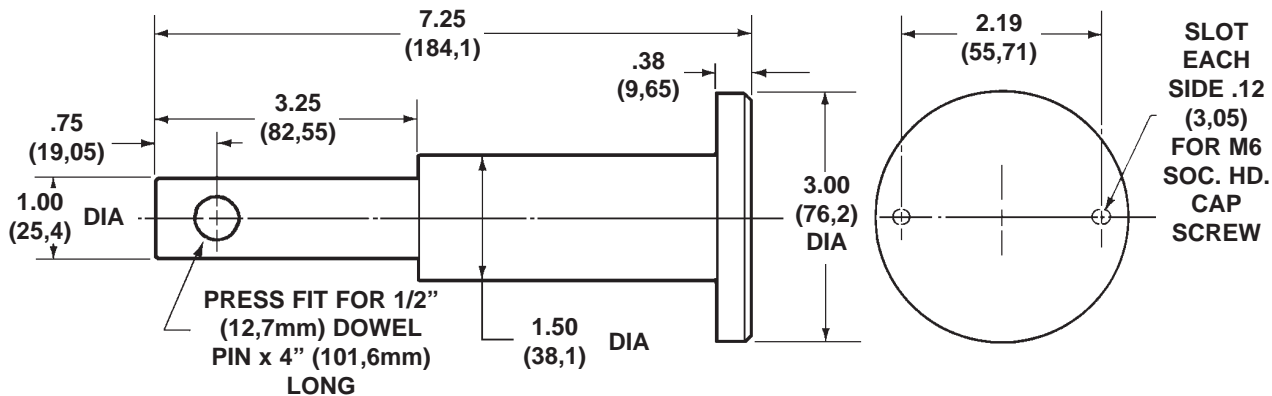
Reduce outlet pressure to 150 psi, 10,3 bar below the compensator setting. Pump should return to full stroke. Repeat two or more times. Compensator settings should be repeatable. Set compensator at 1000 psi ± 100 psi, 69 bar ± 6,9 bar standard, or desired value.

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

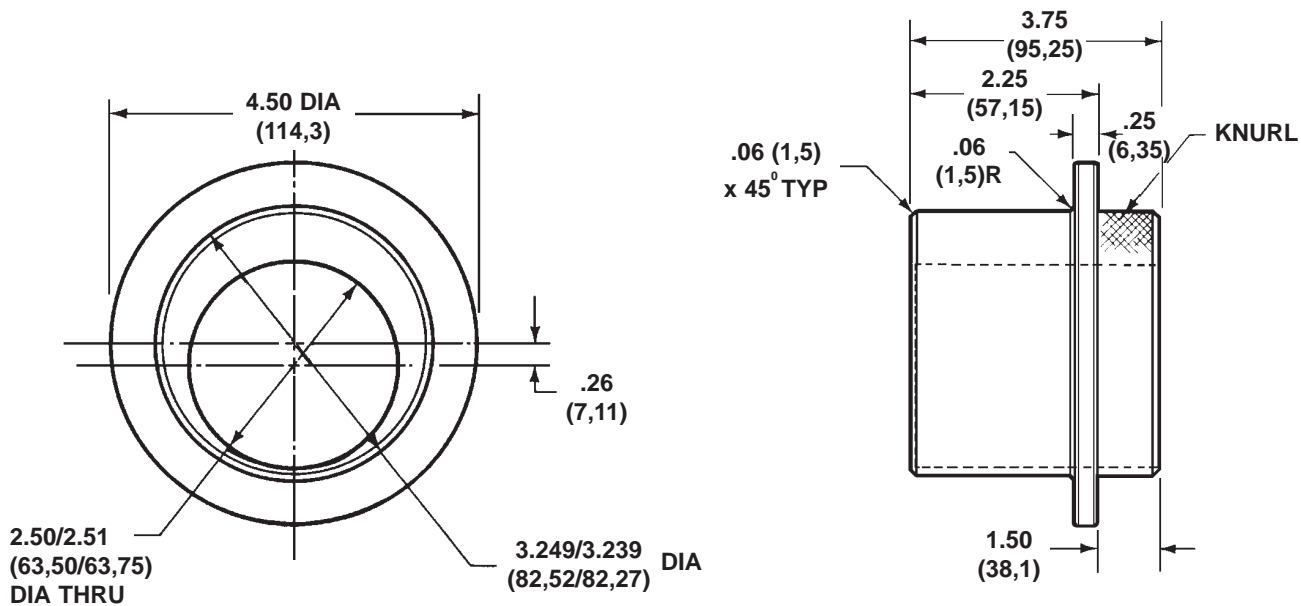


FLUID CONNECTIONS

|DESCRIPTION |P16 C MOD |P260 C MOD |
|--|------------------------------------|-----------------------------------|
| PORT AINLET | 3-1/2 SAE CODE 61 5/8-11 SCREWS | 3-1/2 SAE CODE 61 M16-2 SCREWS |
| PORT BSYSTEM..... | 1-1/2 SAE CODE 62 5/8-11 SCREWS | 1-1/2 SAE CODE 62 M16-2 SCREWS |
| PORT C1OFF-STROKE CYL. GAGE..... | SAE-4 | 1/4 BSPP |
| PORT C2ON-STROKE CYL. GAGE | SAE-4 | 1/4 BSPP |
| PORT DCASE DRAIN | SAE-24 | 1-1/2 BSPP |
| PORT D1CASE DRAIN | SAE-24 | 1-1/2 BSPP |
| PORT DG.....DRAIN GAGE, AIR BLEED PORT | SAE-4 | 1/4 BSPP |
| PORT AG.....INLET GAGE..... | SAE-4 | 1/4 BSPP |
| PORT BG.....SYSTEM GAGE..... | SAE-4 | 1/4 BSPP |
| PORT BG1....ALT. SYS. GAGE..... | SAE-6 | 1/4 BSPP |
| PORT EELECTROHYDRAULIC STROKER SERVO SUPPLY | SAE-4 | 1/4 BSPP |
| PORT HHYDRAULIC STROKER SIGNAL | SAE-4 | 1/4 BSPP |
| PORT LSLOAD SENSING LINE | SAE-4 | 1/4 BSPP |
| PORT VCOMPENSATOR, TORQUE LIMITER, LOAD SENSING VENT | SAE-8 | 3/8 BSPP |
| PORT VOVERRIDE COMP, OVERRIDE TORQUE LIMITER VENT | SAE-4 | 1/4 BSPP |
| PORT V1SERVO VENT | SAE-4 | 1/4 BSPP |
| PORT XSERVO SUPPLY | SAE-8 | 3/8 BSPP |
| PORT XG.....SERVO GAGE | SAE-10 | 1/2 BSPP |



T-1
(Lifting tool)
 Barrel & inner race assembly

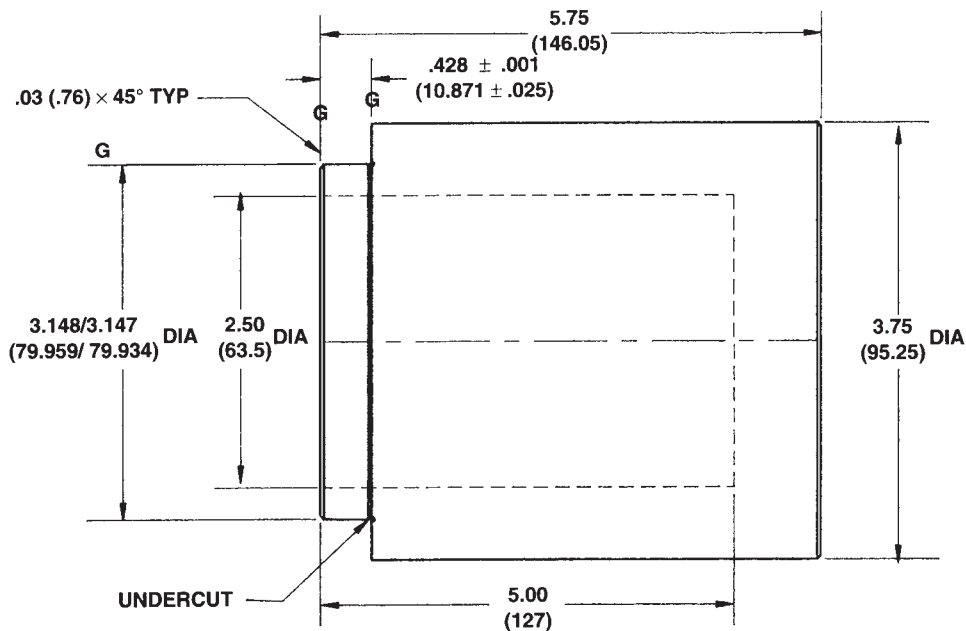


T-2
(Positioning tool)
 For positioning the stroking piston
 during cam installation
 (2 required)

T-3

(Installation tool)

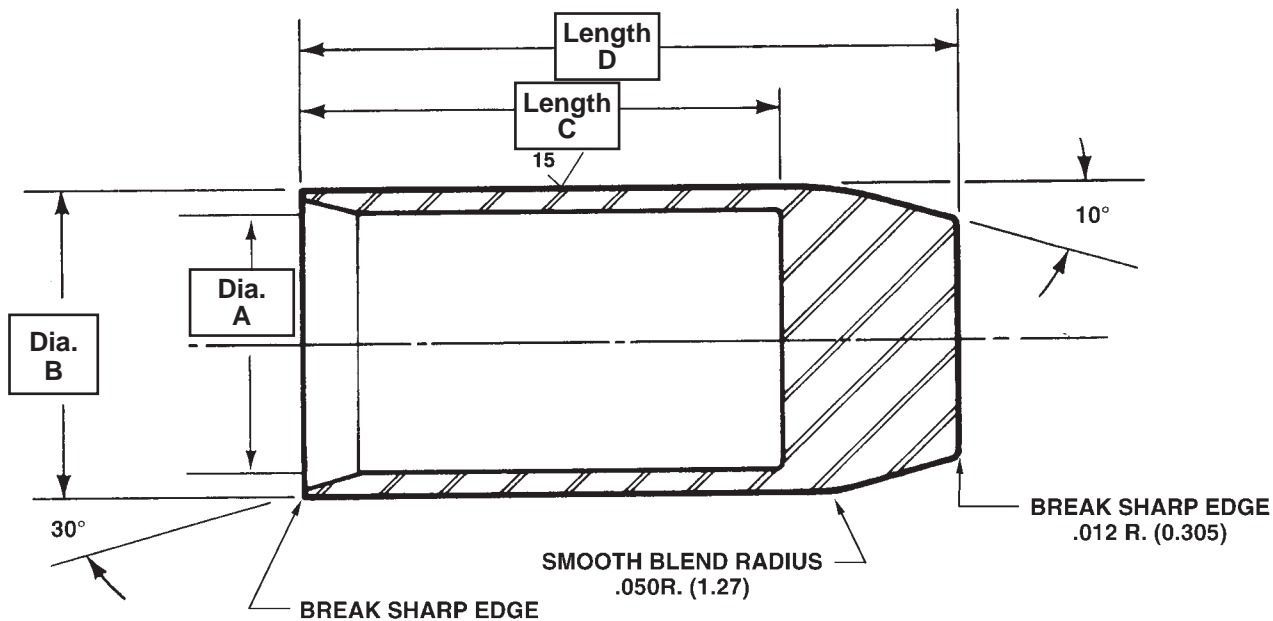
Retainer & shaft bearing In cradle



T-4

(Installation tool)

Shaft seal over shaft



| Shaft | A | | B | | C | | D | |
|-------------------------|-------------|-------------|-------------|-------------|------|-------|------|-------|
| | in. | mm | in. | mm | in. | mm | in. | mm |
| P16 keyed | 1.755/1.760 | 44,58/44,70 | 1.878/1.880 | 47,70/47,75 | 3.00 | 76,2 | 4.50 | 114,3 |
| P16 splined | 1.725/1.730 | 43,82/43,94 | 1.878/1.880 | 47,70/47,75 | 3.00 | 76,2 | 4.50 | 114,3 |
| P16 splined (Hi-torque) | 2.005/2.010 | 50,93/51,05 | 2,130/2,135 | 54,10/54,23 | 3.50 | 88,9 | 5.00 | 127,0 |
| P260 ISO keyed/splined | 1,974/1,976 | 50,14/50,19 | 2,130/2,135 | 54,10/54,23 | 3,67 | 93,2 | 5.17 | 131,3 |
| P260 DIN keyed/splined | 2.351/2.353 | 59,72/59,77 | 2.505/2.510 | 63,63/63,75 | 4.63 | 117,6 | 6.13 | 155,7 |

TYPICAL CHARACTERISTICS

| Specification | Term | P16H | P260H | P16Q | P260Q |
|---|----------------------------|-------------|--------------|-------------|--------------|
| • displacement at max. angle | in³/rev. | 16 | 16 | 16 | 16 |
| | cm³/rev | 262,2 | 262,2 | 262,2 | 262,2 |
| • pressure continuous | psi | 6000 | 6000 | 6000 | 6000 |
| | bar | 420 | 420 | 420 | 420 |
| • pressure intermittent (not to exceed 6 sec./minute) | psi | 7250 | 7250 | 7250 | 7250 |
| | bar | 500 | 500 | 500 | 500 |
| • speed, @ atmospheric inlet | rpm | 1850 | 1850 | 1850 | 1850 |
| max. with boost | rpm | 2100 | 2100 | 1850 | 1850 |
| • rotating inertia | lbs/in² | 349 | 349 | 360 | 360 |
| | kg.m² | 0,102 | 0,102 | 0,105 | 0,105 |
| • compensator response off-stroke | sec. | 0.100 | 0,100 | 0.100 | 0,100 |
| on-stroke | sec. | 0.150 | 0,150 | 0.150 | 0,150 |
| • compensator adjustment | psi/turn | 2000 | 2000 | 2000 | 2000 |
| | bar/turn | 138 | 138 | 138 | 138 |
| • minimum compensating pressure (comp, torque limiter) .. | psi | 200* | 200* | 200* | 200* |
| | bar | 13,8* | 13,8* | 13,8* | 13,8* |
| • minimum compensating pressure (override controls) (at 700 psi, 48,3 bar servo) | psi | 1350* | 1350* | 1350* | 1350* |
| | bar | 93* | 93* | 93* | 93* |
| • typ. servo & stoker response @ 700 psi, 48,3 bar servo pressure, zero to full stroke and vice versa | sec. | <0.35 | <0,35 | <0.35 | <0,35 |
| • servo flow required for this response | gpm | 5 | 5 | 5 | 5 |
| | l/min | 19 | 19 | 19 | 19 |
| • minimum servo pressure | psi | 700 | 700 | 700 | 700 |
| | bar | 48 | 48 | 48 | 48 |
| • maximum servo pressure | psi | 1500 | 1500 | 1500 | 1500 |
| | bar | 103 | 103 | 103 | 103 |
| • PQ control response (10% to 90% & 90% to 10% flow) .. | sec. | <.09 | <.09 | <.09 | <.09 |
| • electric stoker nominal coil resistance (24v. coil) | ohms | 41 | 41 | 41 | 41 |
| • electric stoker nominal coil resistance (12v. coil) | ohms | 10 | 10 | 10 | 10 |
| • handwheel turns, full to zero stroke | turns | 10 | 10 | 10 | 10 |
| • torque to turn handwheel @ 1000 psi,, 70 bar | in-lbs | 150 | 150 | 150 | 150 |
| | Nm | 17 | 17 | 17 | 17 |
| • torque to turn handwheel @ 7250 psi,, 500 bar | in-lbs | 350 | 350 | 350 | 350 |
| | Nm | 40 | 40 | 40 | 40 |
| • rotary servo shaft rotation, 0 to full stroke | degrees | 65-70 | 65-70 | 65-70 | 65-70 |
| • torque to turn rotary servo shaft | in-lbs | 20 | 20 | 20 | 20 |
| | Nm | 2,3 | 2,3 | 2,3 | 2,3 |
| • maximum/minimum case pressure (continuous) | psi | 25/3 | 25/3 | 25/3 | 25/3 |
| | bar | 1,7/0,2 | 1,7/0,2 | 1,7/0,2 | 1,7/0,2 |
| • maximum/minimum case pressure (intermittent) | psi | 50/3 | 50/3 | 50/3 | 50/3 |
| | bar | 3,4/0,2 | 3,4/0,2 | 3,4/0,2 | 3,4/0,2 |
| • input mounting-4 bolt flange | SAE | 165-4 (E) | | 165-4 (E) | |
| | ISO 3019/2 | | 250 B4HW | | 250 B4HW |
| • input shaft, keyed | SAE | 44-1 (E) | | 44-1(E) | |
| • input shaft, splined | SAE | 44-4 (E) | | 44-4 (E) | |
| • input shaft, keyed ISO 3019/2 | ISO | | G50N | | G50N |
| • input shaft, splined ISO 3019/2 | ISO | | K50N | | K50N |
| • input shaft, keyed DIN | DIN | | 6885 60 mm | | 6885 60 mm |
| • input shaft, splined DIN | DIN | | 5480 60 mm | | 5480 60 mm |
| • input shaft high torque splined | SAE | 50-4 (F) | | 50-4 (F) | |
| • weight | pounds | 325 | 325 | 325 | 325 |
| | kg. | 147,4 | 147,4 | 147,4 | 147,4 |

*plus case pressure

GENERAL

The **DENISON HYDRAULICS** P16/P260 Series is a variable displacement open circuit axial piston pump with advance pumping and control concepts.

MOUNTING

This pump is designed to operate in any position. The pump shaft must be in alignment with the shaft of the prime mover and should be checked with a dial indicator. The mounting pad or adapter into which the pump pilots must be concentric with the pump shaft to prevent bearing failure. This concentricity is particularly important if the shaft is rigidly connected to the driven load without a flexible coupling.

SHAFT INFORMATION

Splined: The shafts will accept a maximum misalignment of .006", 0.15 mm TIR. Angular misalignment at the male and female spline axis must be less than 0.001 in. per in. radius, 0.001 mm per mm. The coupling interface must be lubricated. DENISON HYDRAULICS recommends lithium molydisulfide or similar grease. The female coupling should be hardened to 27-34 Rc. The P16 must conform to SAE J498B (1971) class 1 flat root side fit, the P260 must conform to either ISO 4156 fillet root side fit module 2,50 or DIN 5480 (9H) flat root side fit module 2.00 as applicable

Keyed: High strength heat treated keys must be used. Replacement keys must be hardened to 27-34 Rc. The key corners must be chamfered .030"-.040", 0.75-1.00 mm at 45° to clear radii that exist in the keyway.

PORTING INFORMATION

See port identification section for port locations and sizes.

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

The case leakage line must be of sufficient size to prevent back pressure in excess of 25 psi, 1.7 bar and returned to the reservoir below the surface of the oil as far from the supply suction as possible. All fluid lines, whether pipe, tubing, or hose must be of adequate size and strength to assure free flow through the pump. An undersize inlet line will prevent the pump from reaching full speed and torque. An undersized outlet line will create back pressure and cause improper operation. Flexible hose lines are recommended. If rigid piping is used, the workmanship must be accurate to eliminate strain on the pump port block or to the fluid connections. Sharp bends in the lines must be eliminated wherever possible. All system piping must be cleaned with solvent or equivalent before installing pump. Make sure the entire hydraulic system is free of dirt, lint, scale, or other foreign material.

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

INLET CONDITIONS AT SEA LEVEL

| SPEED | GAGE PRESSURE | | | | ABS. PRESS. | |
|-------|---------------|-------|--------|-------|-------------|------|
| | psig | bar | in. hg | mm hg | psi | bar |
| 1200 | -3 | -0.2 | -6.1 | -155 | 11.7 | 0.8 |
| 1500 | -3 | -0.2 | -6.1 | -155 | 11.7 | 0.8 |
| 1800 | -0.8 | -0.05 | -1.6 | -41 | 13.9 | 0.95 |
| 1850 | 0 | 0 | 0 | 0 | 14.7 | 1.01 |
| *2100 | 4.3 | 0.30 | 8.8 | 224 | 19.0 | 1.30 |

*P16/P260 H only

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

RECOMMENDED FLUIDS

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

MAINTENANCE

This pump is self-lubricating and preventative maintenance is limited to keeping system fluid clean by changing filters frequently. Keep all fittings and screws tight. Do not operate at pressures and speeds in excess of the recommended limit. If the pump does not operate properly, check the troubleshooting chart before attempting to overhaul the unit. Overhauling is relatively simple and may be accomplished by referring to the disassembly, rework limits of wear parts and assembly procedures.

FLUID CLEANLINESS

Fluid must be cleaned before adding to the system, and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8. This approximately corresponds to ISO 17/14.

DEFINITION & UNIT

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

FLUID POWER FORMULAS

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

"The product information specifications and descriptions contained in this catalog have been compiled for the use and convenience of our customers from information furnished by the manufacturer, and we cannot and do not accept any responsibility for the accuracy or correctness of any description, calculation, specification or information contained herein. No such description, calculated, specified or information regarding the products being sold has been made part of the basis of the bargain nor has same created or amounted to an express warranty that the products would conform thereto. **We are selling the goods and merchandise illustrated and described in this catalog on an as is basis and disclaim any implied warranty, including any warranty of merchantability or warranty of fitness for any particular purposes whatsoever, with respect to the goods and merchandise sold.** All manufacturer warranties shall be passed on to our customers, but we shall not be responsible for special, indirect, incidental or consequential damages resulting from the use of any of the products or information contained or described in the catalog."

Ordering Code **P16/260H - 02R1C - C10 - 00 - M2**

Pump service _____

Displacement, max* -----
16 - 16.0 in³/rev.
260 - 262,2 cm³/rev.

Model _____
Q-Quiet
H-High speed

Shaft -----
02-Keyed -SAE 44-1 (E) (P16)
 - ISO 3019/2 G50N (P260)
03-Splined -SAE 44-4 (E) (P16)
 - ISO 3019/2 K50N (P260)
05-Splined SAE 50-4 (F) Hi-Torque (P16)
06-Keyed - DIN 6885 60mm (P260)
07-Splined DIN 5480 60mm (P260)

Shaft rotation _____
 (viewed from shaft end)
R-CW (standard, high speed)
L-CCW (standard, high speed)

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

Design letter _____

Primary controls -----
C-Pressure compensator
E-Electric stroker
H-Hydraulic stroker
J-Low torque limiter *2500-6000 lbs-in., 282.5-678 Nm
K-High torque limiter *over 6000 lbs-in., 678 Nm
L-Load sensing
R-Rotary servo
V- Low torque limiter with Load sensing
W- High torque limiter with Load sensing
X- 24 VDC PQ high response

* Minimum torque values to maintain 5000 psi, 345 bar at 1800 rpm. Consult DENISON Hydraulics for minimums at lesser pressures and speeds.

Omit-Standard model
M2- Special modification to standard units
NP- No paint

Modification
O No pump mounted
1- Auxiliary pump (only) with M- modification
 (user must advise attitude of rear pump/s mounting. For ordering two *standard* or three or more units refer to ordering code for multiple units)

Rear drive mounting
 (Appropriate coupling and seals are included)

O-None
M-Rear drive blanking plate
A-SAE 82-2 (A) flange, SAE 16-4 (A) shaft
G-SAE 82-2 (A) flange, SAE 22-4 (B) shaft
B-SAE 101-2/4 (B) flange, SAE 22-4 (B) shaft
Q-SAE 101-2/4 (B) flange, SAE 25-4 (BB) shaft
C-SAE 127-2/4 (C) flange, SAE 32-4 (C) shaft
N-SAE 127-2/4 (C) flange, SAE 38-4 (CC) shaft
D-SAE 152-4 (D) flange, SAE 44-4 (D&E) shaft
E-SAE 165-4 (E) flange, SAE 44-4 (D&E) shaft
Z-ISO 3019/2 (100 B4HW) flange, K25N shaft
Y-ISO 3019/2 (125 B4HW) flange, K32N shaft
X-ISO 3019/2 (160 B4HW) flange, K40N shaft
T-ISO 3019/2, (180 B4HW) flange, K40N shaft
U-ISO 3019/2, (180 B4HW) flange, K50N shaft
L-ISO 3019/2, (180 B4HW flange, DIN 40-18 shaft
S-ISO 3019/2, (180 B4HW) flange, DIN 50-24 shaft
W-ISO 3019/2, (200 B4HW) flange, K50N shaft
V-ISO 3019/2, (250 B4HW) flange, K50N shaft

Secondary controls

O-None
P-*Pressure compensator override
J-*Torque limiter override (low) 2500-6000 in-lbs., 282.5-678 Nm
K-*Torque limiter override (high) over 6000 in-lbs., 678 Nm
 (*E, H & R primary controls only)

Primary control options

1-Standard maximum volume screw, without indicator
2-Handwheel maximum volume control without indicator
 available on C, J, K, L, V & W primary controls only)
5-Maximum volume screw with cam position indicator
8-Handwheel max. vol. control with cam position indicator (available on C, J, K, L, V & W primary controls only)

Available control combinations

C10, C20, C50, C80
 E10, E50, E1P, E5P,
 E1J, E5J, E1K, E5K,
 H10, H50, H1P, H5P,
 H1J, H5J, H1K, H5K
 R10, R50, R1P, R5P,
 R1J, R5J, R1K, R5K
 J10, J20, J50, J80
 K10, K20, K50, K80
 L10, L20, L50, L80
 V10, V20, V50, V80
 W10, W20, W50, W80
 X10

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