Bulletin HY14-2101-M1/US
Assembly/Adjustment Guide

Series VPL Proportional Valves

Effective: September 1, 2002
Supersedes: Cat. No. PMF 1028 dated 3/98

Pulsar™ Stackable Valves

⚠ WARNING

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Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

Introduction

"PULSAR™ VPL Series Valve Assembly and Adjustment Instructions" is furnished to assist in the process of taking this product line from the shelf to customer. Primarily, this process consists of stacking the valve, installing the selected options and making final adjustments. Ample page margin is provided for related notes.

Parker recommends performing these procedures in the order in which presented. Assembly drawings for the VPL Series work segment and the VBL Series pressure compensated inlet are included for reference.

As in any assembly procedure, it is beneficial to anticipate the final needs of the included segments and valve stack to avoid unnecessary steps.

Additional useful assembly tools/supplies:

- O-ring pick
- pencil magnet
- torque wrench, 50 Lb-ft (68 Nm) (Minimum) with socket set
- manual override subassembly, VPLH6K2
- clean, light-weight hydraulic oil
- white lithium grease
- allen wrench set
- open end wrench set

VALVE STACK ASSEMBLY

General

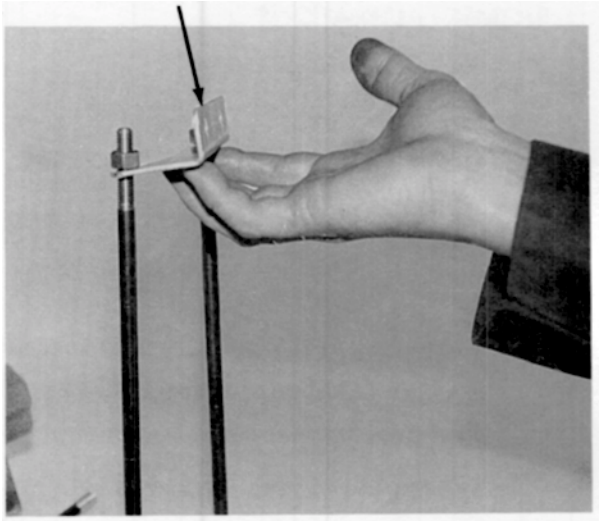
1. Assembly of a VPL Series valve stack requires the following parts or kits:
   - one (1) inlet section
   - one (1) stacking plate (VOL Series Kit)
   - correct number of work segments and accompanying spool kits
   - the tie rod kit corresponding with the number of sections, shown as "#", to be stacked (VAL#K1)
2. Have on hand:
   - clean, flat work area
   - one (1) manual override handle subassembly (VPLH6K2)
   - white lithium grease and a small, clean brush
   - clean, light weight hydraulic oil
   - 50 Lb-ft (68 Nm) (Minimum) torque wrench, with 9/16" socket.

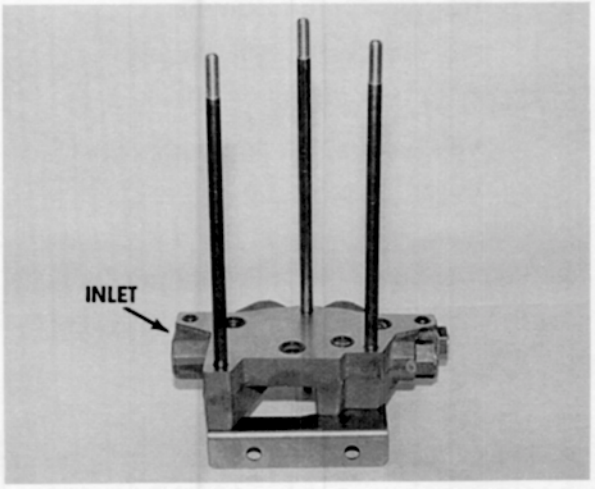
Assembly Procedure

Inlet

1. Thread the three (3) large nuts from the tie rod kit onto each tie rod. Install tie rods through inlet with two (2) of the tie rods through both the inlet bracket and inlet. Lay inlet on a flat work area so the tie rods are vertical.
2. Be sure the surface of the inlet section is clean and free of any foreign material.

IMPORTANT!! A shuttle ball is not installed between the inlet and first working segment.





Work Segment

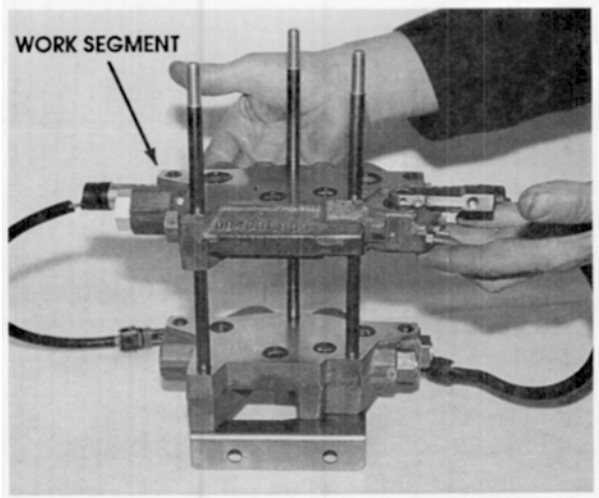
3. Prepare work segments for installation by verifying that all mating surfaces are clean and free of foreign material. Slide the segment over the tie rods, taking care not to allow the tie rods to damage the surface of the segment. Install a shuttle ball, that is included in the VAL#K1 tie rod kit. If stack is being assembled in horizontal position, grease will be required in shuttle ball seat area, (Field Service).

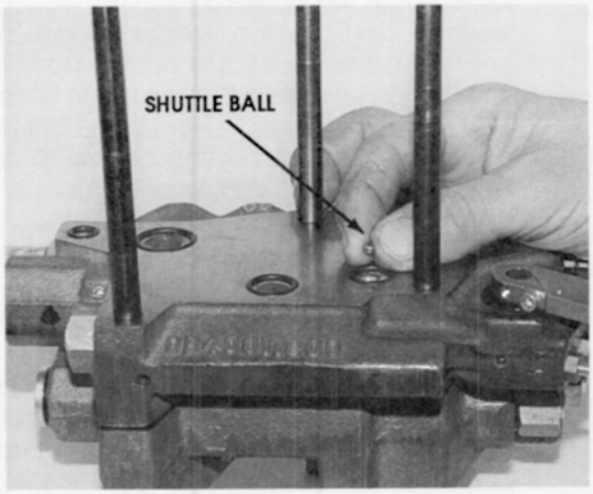
IMPORTANT!! Shuttle ball is installed if: Another work segment is NEXT to be installed,

– OR –

the stacking plate section to FOLLOW is machined with a load sensing seat and shuttle port is to be plumbed with downstream load sensing logic.*

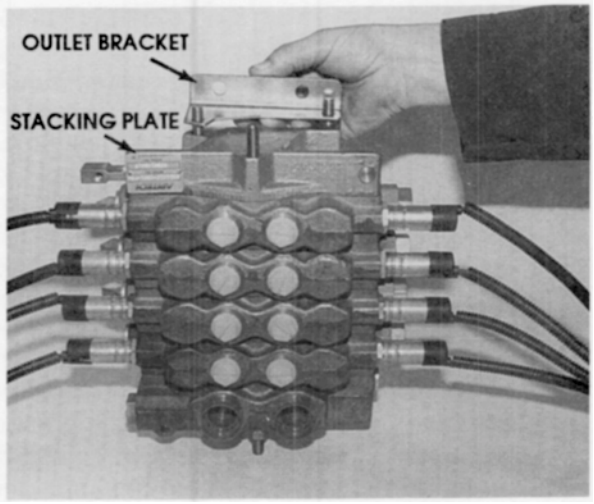
4. Repeat step 3 for additional spool sections.





Stacking Plate

5. Carefully install the stacking plate section.
6. Install the outlet bracket over the lower two (2) tie rods; then thread the three (3) large nuts from the tie rod kit onto the tie rods and hand tighten. Carefully lay the valve on the mounting brackets. Torque the nuts to 15-20 Lb-ft (20-27 Nm).
7. Thread all six (6) small nuts onto tie rods, three (3) on inlet, three (3) on outlet. Torque to 15-20 Lb-ft (20-27 Nm) while holding the large nut underneath it with a 9/16" open end wrench.
8. Based upon the part number ordered, each packaged stacking plate comes configured for either an internal or external pilot drain. However, during assembly it may be converted to the other configuration as described in the accompanying Product Advisory, No. 041.
9. Install manual handle or 1/2" (11/32")** open end wrench and shift each spool. Check that each spool operates freely in both directions.



* *Shuttle balls are installed **between all** work segments and between the last work segment and stacking plate **only** if load sensing is to be continued from downstream valves.*

** Tool measurements in brackets are for the VPL 123 Series

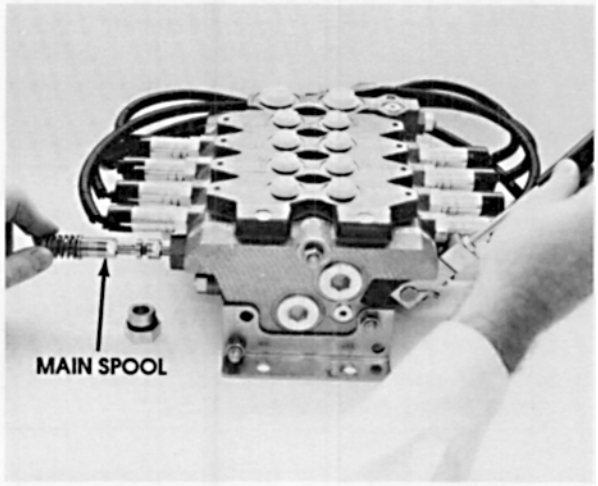
Main Spool Replacement

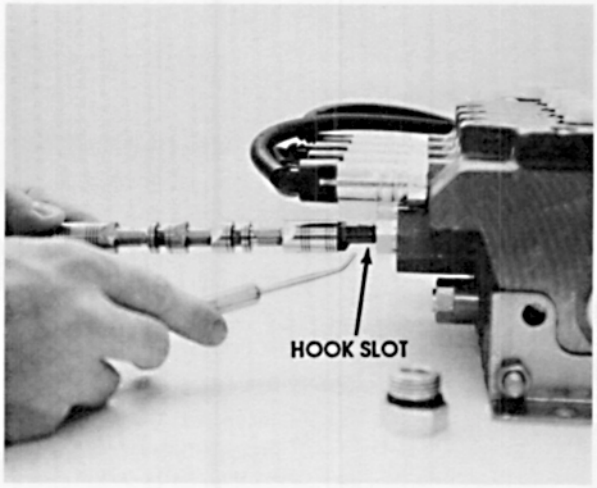
General

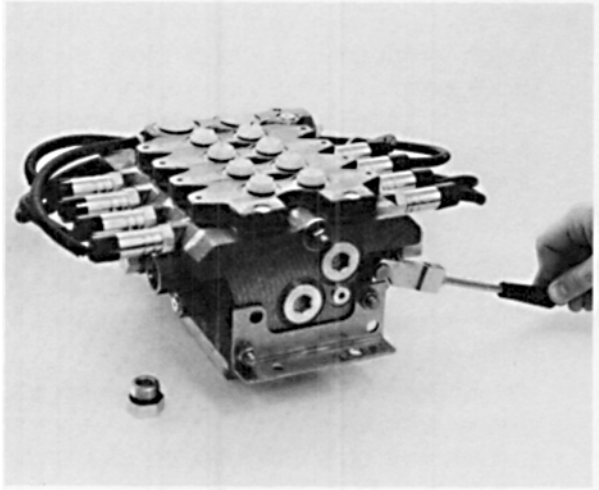
The main spool may be one of two types: proportional or "on/off." The main spool determines the segment type. Therefore, to change flow rates drastically, or to change from proportional to "on/off" operation, it is the main spool which needs to be exchanged.

Main Spool Replacement Procedure

1. Remove the hex head plug (item 35) from the end of the work segment with a 1" socket. Install a manual override handle or use an open-end 1/2" (11/32")** wrench, and bias the handle toward the valve. Do not move the handle hard or fast, for this will cause the linkage to hit the spool bore edge and raise a burr. The flow limiter on the bottom may have to be backed out to allow for rotation. Use care to pull the spool out as straight as possible, as side forces may damage the spool and/or bore.
2. Unpack the new spool assembly. Check that the spool is marked with the same number as shown on the packing. (Example: VPL624K2 on the packing should show #624 on the spool.) Using a hard Arkansas stone, lightly "stone" the spool surface to remove minor nicks and burrs.
3. Make sure the new spool assembly is clean and free of any foreign material. Coat the spool with a thin layer of clean hydraulic oil. With valve stack resting on the mounting brackets, slowly rotate the override handle fully toward the valve. Linkage ball will raise a burr on the edge of the spool bore if contact is made. Carefully slide the spool straight into the bore with the spool hook slot facing downward. Again, exercise caution regarding placing a side load on the spool. Slide the spool in until it contacts the override linkage, then rotate the handle downward, thus pulling the spool the rest of the way into the bore. By slightly rotating the manual override back and forth, it is possible to check for proper installation. Stroke valve handle back and forth, feeling for any binding of spool to bore.

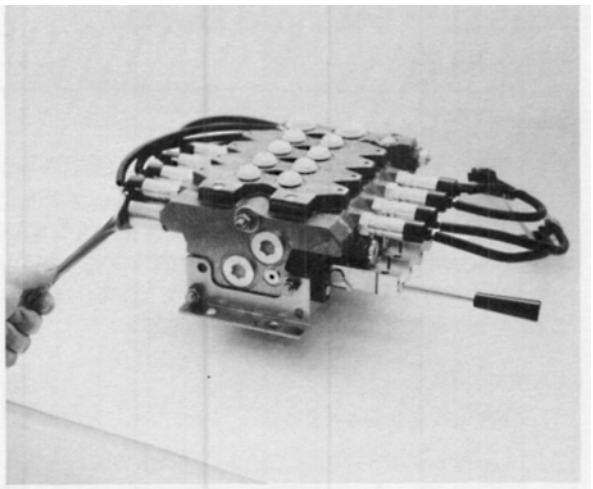






** Tool measurements in brackets are for the VPL 123 Series

4. Install the hex head plug back into the end of the segment. Torque to 15-20 Lb-ft (20-27 Nm). Use the manual override handle or an open-end 1/2" (11/32")** wrench to fully shift the spool in both directions. Spool movement should be free of binding and capable of returning with spring force only. Electrically cycle both Pulsar™ solenoids approximately 10 times for each time the spool is replaced.
5. Check flow for proper flow rate. Re-shim compensator if required using procedure shown on page 12.



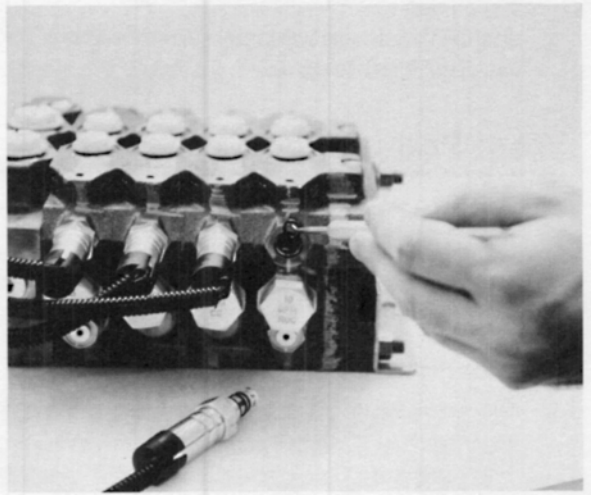
PULSAR™ Solenoid Replacement

General

All individual Pulsar solenoids supplied as service parts provide proportional control to the main spool. Should it be necessary to replace a solenoid, the following procedure applies:

1. Remove the used solenoid.
2. Use a pick to remove the O-ring from the bottom of the cavity if original solenoid doesn't have the O-ring attached to the lower body.
3. All Pulsar solenoids are performance tested, marked and bagged. Therefore, the new parts may be installed directly from the bag.
4. Insert the new O-ring if in bag, making sure it is properly seated.
5. Install the new solenoid with a maximum torque of 6.5 Ft-Lbs.

NOTE: Valve service procedures, except those previously described, should only be performed by authorized personnel or under factory supervision.



Effective 11/96, all Pulsars are manufactured with lower O-ring attached to the lower body.

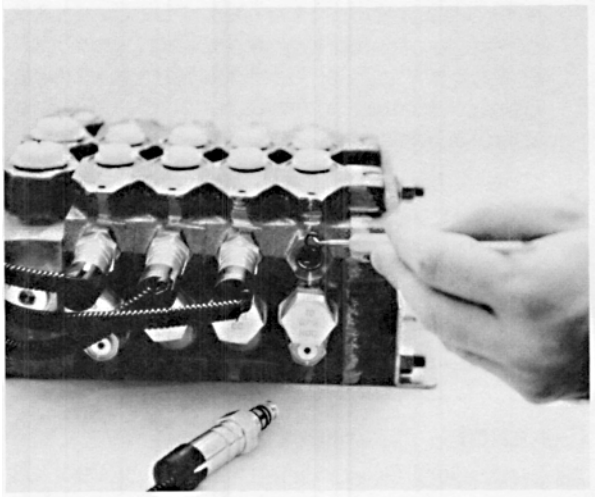
PULSAR™ Solenoid Removal and Plug

General

For applications requiring only 2 position operation, only one PULSAR™ solenoid cartridge is required. Therefore, it is necessary to remove one cartridge, and plug the remaining cavity. Unless otherwise specified, VPL Series valves direct flow to the C_1 cylinder port.

Procedure

1. Remove the existing C_2 solenoid cartridge.
2. Remove the included O-ring with the O-ring pick. As needed, use a clean pencil magnet to remove the orifice disk in the bottom of the cavity, if removing the old design PULSAR™.
3. Unpack the solenoid plug kit (VNPK1) and verify the assembly contents: two (2) solenoid plugs, four (4) O-rings.
4. Install the solenoid plug (item 37) using 6.5 Lb-ft (9 Nm) torque.



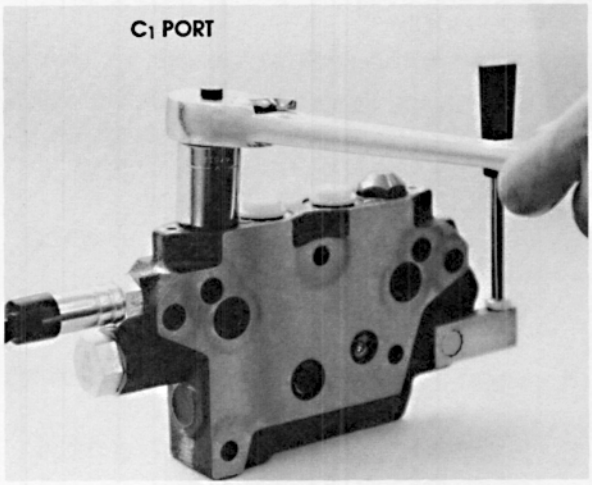
Work Port Option Exchange

General

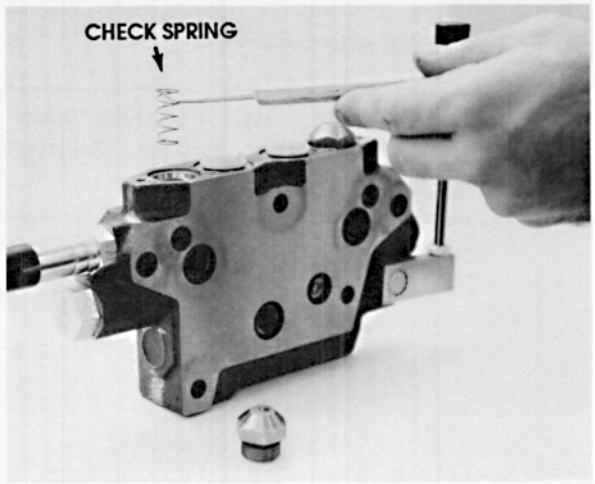
The work segments may have options for the work ports: anti-cavitation check valve, relief with anti-cavitation, and defeat plug.

Replacement or Exchange Procedure

1. Remove the check valve plug (item 38) from either C_1 or C_2 option port on top of the working segment. A 7/8" socket wrench is required.



2. Pull the spring (item 42) out of the cavity. Either the 1/2" ball (item 41) or a relief cartridge (item 39) (VPLRA*KP) will be found under the spring.
3. Now either an exchange for a different setting or a change to a different option can be made. Reinstall the check valve plug (item 38) to 40 Lb-ft (54 Nm).



Specifications

Hydraulic Oil — Parker recommends petroleum-based hydraulic oil having 150 SUS (32 cST) viscosity at 100°F (38°C).

Filtration Level — 10 micron, high pressure, non-bypass.

Temperature Range — Test to be conducted from 100 to 120°F (38°C - 49°C).

Pressure Range & Measurement — Test stand pump, controls and plumbing capable of producing and withstanding pressures from 50 psi - 5000 psi (3.5 bar - 350 bar).

Flow Range — Test stand fixed displacement pump (with bypass inlet included) controls and plumbing to produce and accommodate flow rates of up to 30 GPM (105 L/min.).

Flow measurement — Flow meter capable of measuring 0.1 to 30 GPM (0.4 - 105 L/min.) with acceptable accuracy.

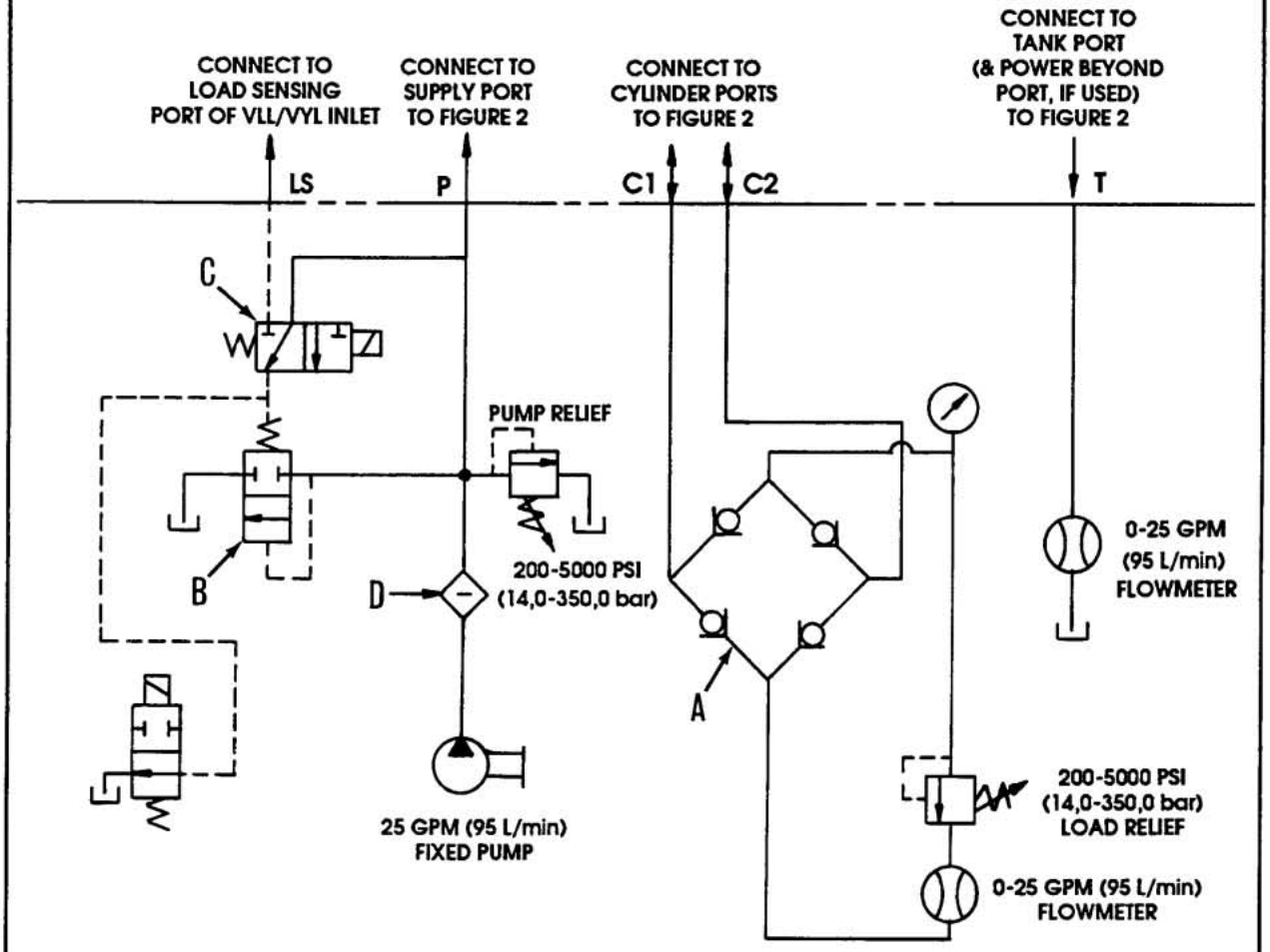
Electrical Solenoid Control —

- Power supply of 12 VDC and 24 VDC with negative voltage spike suppression from -10 to -20 VDC for 12 VDC. For 24 VDC (-20 to -36 VDC).
- Pulse-width modulated frequency output of 33 Hz.
- Recommend using Parker 12 VDC MC3100-0036 power module or 24 VDC MC3202-0111 power module.

Configuration

The test stand arrangement shown (FIGURE 1 and 2) is suggested. Parker recognizes the variety in test facilities of its distributorships. Consequently, it is expected each distributorship will configure a suitable test facility to satisfy requirements of both product qualification and individual needs.

SUGGESTED TEST STAND CONFIGURATION



NOTES

A OPTION TO USE PRE-PACKAGE CIRCUIT SAVER FROM SUN HYDRAULICS, P/N CXHA XCN YSG.

B VB-2211-5001 AND V0-0011-0001

C USE LEFT CONFIGURATION FOR TESTING VB INLET STACK, USE RIGHT FOR VL INLET STACK.

D 10 MICRON, NON-BYPASS FILTER.

FIGURE 1

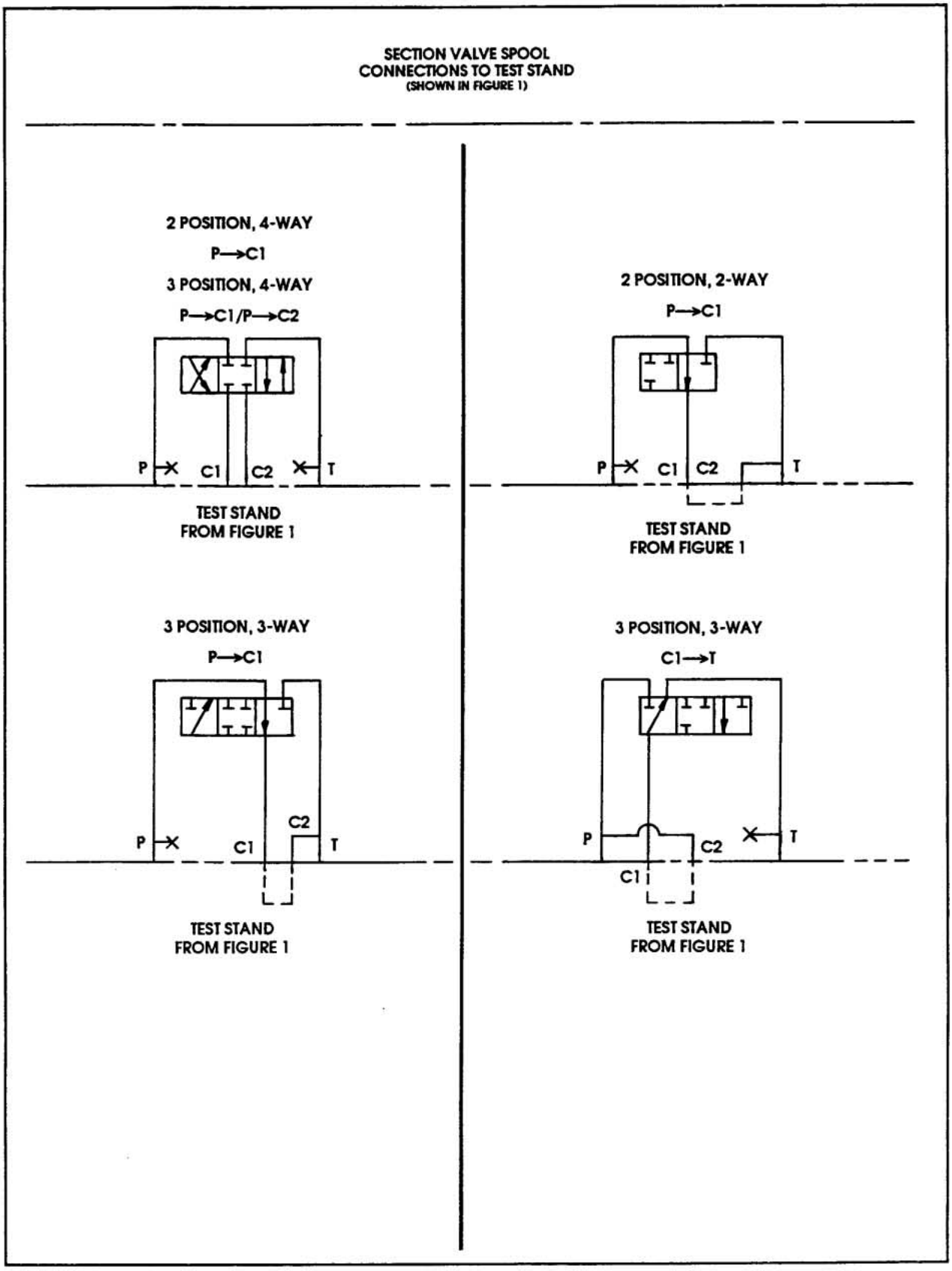

SECTION VALVE SPOOL
CONNECTIONS TO TEST STAND
(SHOWN IN FIGURE 1)
2 POSITION, 4-WAY
P→C1
3 POSITION, 4-WAY
P→C1/P→C2
P
C1
C2
T
TEST STAND
FROM FIGURE 1
2 POSITION, 2-WAY
P→C1
P
C1
C2
T
TEST STAND
FROM FIGURE 1
3 POSITION, 3-WAY
P→C1
P
C1
C2
T
TEST STAND
FROM FIGURE 1
3 POSITION, 3-WAY
C1→T
P
C2
T
C1
TEST STAND
FROM FIGURE 1

FIGURE 2

Bypass/Relief Inlet Adjustment

Bypass Adjustment

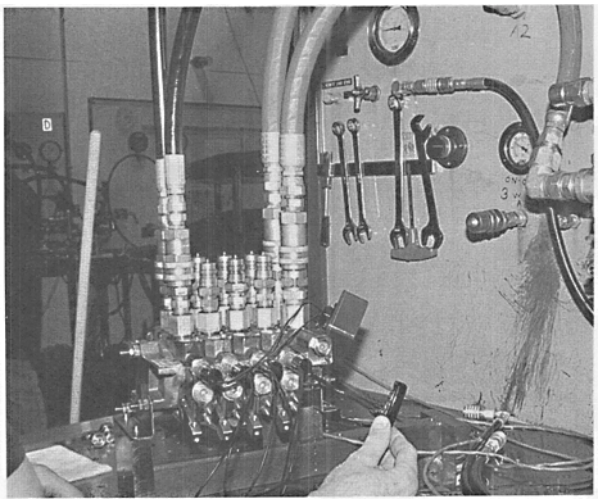
Bypass pressure is set at the factory and is not adjustable.

Relief Valve Adjustment Procedure

1. To set main inlet relief, a work segment must be "deadheaded." This segment must not have any option ports or pressure limiters with a setting lower than the main relief setting.
2. **NOTE:** Test stand pressure relief must be higher than the specified setting for the valve.
3. To change the setting, a gauge must be plumbed in a supply line. The adjustment screw is behind a #2 SAE plug in the relief cartridge. Use a 1/8" allen wrench to remove the #2 SAE plug and a 5/32" allen wrench to adjust the relief setting.
   NOTE: Adjustment screw is not self-contained. Adjustment is not limited to a maximum pressure setting. Do not adjust the screw all the way in or out.
4. When finished, re-install the #2 SAE plug.

WARNING

ALWAYS USE SAFE WORK HABITS. HYDRAULIC OIL IS UNDER HIGH PRESSURE.



Individual Segment Pressure Compensator Adjustment

Before beginning adjustment it is advised to review this entire procedure first.

General

Proportional work segments are adjusted to deliver the indicated flow rate, i.e., the main spool is specific to the rated flow, and the individual compensator spool is adjusted/shimmed in accordance with the flow rate.

All on/off (VQL0) segments contain the same main spool and have individual compensators which are adjusted the same. As a standard, on/off segments are set at 15 GPM (57 L/min.). Therefore, proportional and on/off (VQL0) segments are discussed individually.

Have on hand:

- 3/4" socket or open end wrench
- 5/16" allen wrench

Shim stock information

Available shim thicknesses are as follows:

P/N DB1546.248 = 0.025 inches (0,635 mm)
P/N DB1547.248 = 0.008 inches (0,203 mm)
P/N DB1548.258 = 0.003 inches (0,076 mm)

Percentage (%) of rated flow for every .010" (0,25 mm) of shims is as follows:

4.0% for spool No's A thru 4
5.5% for spool No. 5
7.0% for spool No. 6

TABLE 1
Flow Range of Main Spools for 4,5,6 and "Y" Series

Spool I.D. No.	Rated Flow GPM	(L/min)	Flow Range GPM	(L/min)
7	30	(114)	30-24.1	(114-91)
6	24	(90)	24-17.1	(90-66)
5	17	(65)	17-11.1	(65-41)
4	11	(40)	11-7.1	(40-26)
3	7	(25)	7-4.1	(25-16)
2	4	(15)	4-2.6	(15-11)
1	2.5	(10)	2.5-1.4	(10-6)
A	1.3	(5)	1.3-0.7	(5-2.5)

IMPORTANT!! STAY WITHIN THESE RANGES!
(Maximum shim pack size=.125")

Individual Compensator Adjustment Procedure, ON/OFF Segments ("VQL0" Only)

1. To achieve flow rates of less than 15 GPM (57 L/min.), adjust the appropriate flow limiter(s). All ON/OFF spools are set at the factory for 15 GPM (57 L/min.). The following is recommended for segments used in ON/OFF operation:

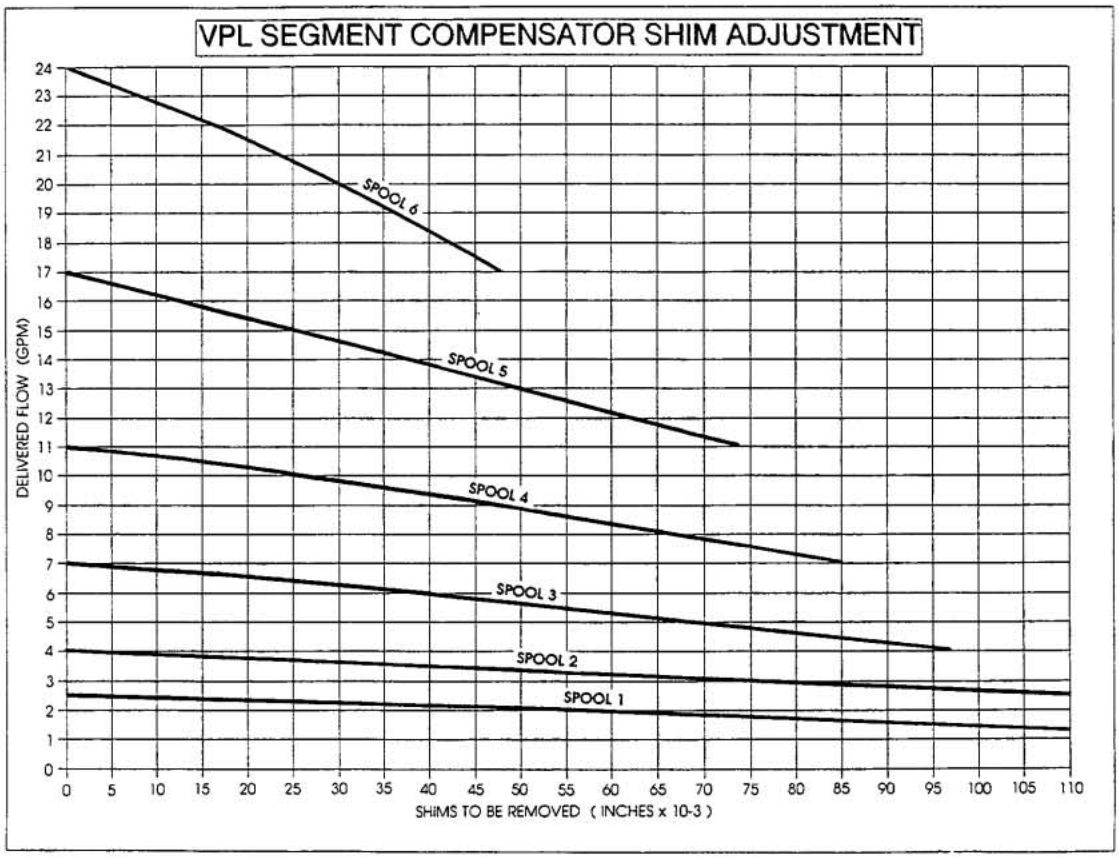
Spool Type	Flow Range
VQLZ	0-4.0 GPM (0-15,1 L/min)
VQL0***-	4.1-24.0 GPM (15,2-90,8 L/min)

Individual Compensator Adjustment Procedure, Proportional Segments

To change the flow rating of a proportional segment, it will be necessary to:

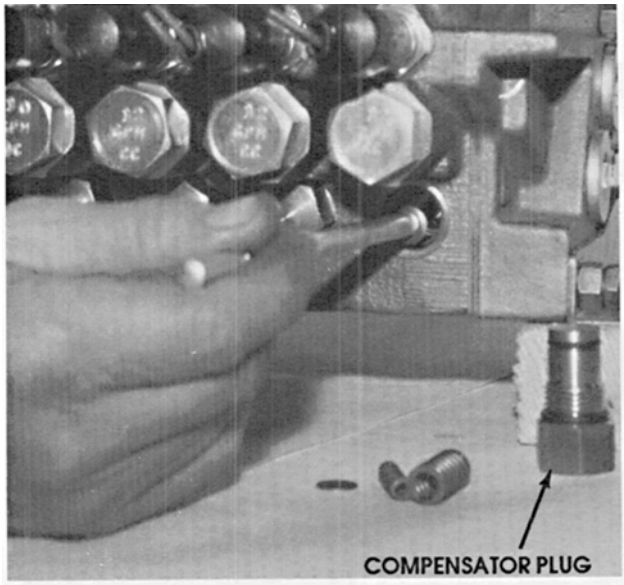
a. re-shim the individual compensator spool per graph (below) or;

b. change the main spool. Re-shim the individual compensator spool, if necessary. Table 1 provides the flow range for each spool.

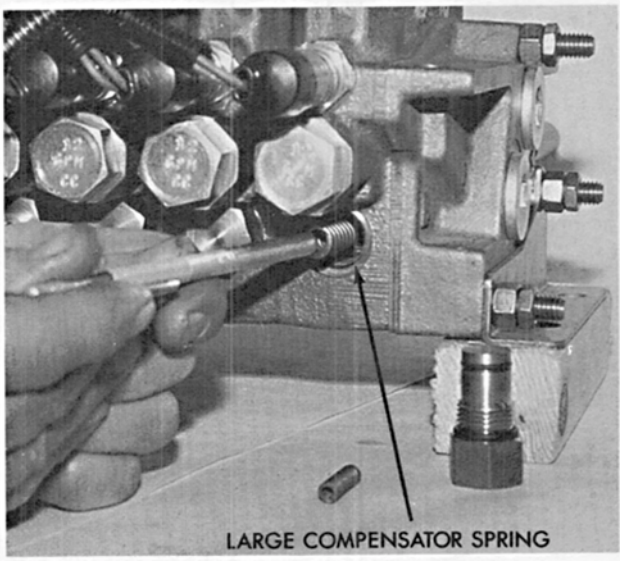


Procedure

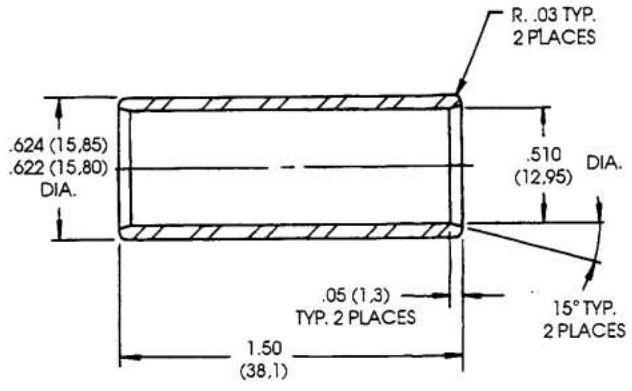
1. Remove the compensator plug (item 29). Next, remove the compensator springs, watching for shim stock that may adhere to the bottom.
2. Use the shim insertion tool (shown below) to either add or subtract the shims. Use the shim adjustment chart to decide how many shims to subtract (or add). Refer to Table 2 and the NOTE that follows it, so that the flow is adjusted within the specified ranges.



3. Re-assemble the compensator springs. All main spools use dual springs (items 24 and 25).
4. Install compensator plug (item 29) and torque to 15-20 Lb-ft (20-27 Nm).
5. Retest to verify the correct flow. If the correct flow has not been achieved, repeat steps 1-5.



SHIM INSERTION TOOL - PART NO. DB1851.268



MATERIAL = STEEL

TABLE 2
Flow Range of Main Spools for 1,2,3,Series

Spool I.D. No.	Rated Flow GPM	(L/min)	Flow Range GPM	(L/min)
6	15	(57)	15-20 *	(57-76)
5	10	(38)	8-13	(30-49)
4	7	(25)	5-7	(19-26)
3	5	(19)	3.5-5	(13-19)
2	3.5	(13)	2.5-3.5	(9,5-13)
1	2.5	(10)	1.5-2.5	(6,5-9,5)
A	1.3	(5)	.75-1.3	(2,5-5)

IMPORTANT!! STAY WITHIN THESE RANGES!

- Spool #6 uses dual compensator springs for optimum performance and allows for an increase in flow, up to 20 GPM (76 L/min.) by **ADDING** shims. Do not set lower than 15 GPM (57 L/min.).
- Spool #5 uses dual compensator springs for optimum performance. Only this spool allows for either an increase or decrease in flow by **ADDING OR SUBTRACTING** shims, when using the dual compensator springs.
- Spools #4 through A use only the large diameter compensator spring which must only have shims **SUBTRACTED** for lower flows.
- Never add shims to set flow higher or lower than the rated flow.
- If a main spool is replaced but the wrong spring combination exists in the valve, the valve will work with a slight loss of compensation performance. As long as the springs are not changed, the compensator should not have to be reshimmed.

Individual Compensator Adjustment Procedure, ON/OFF Segments ("VQL0" Only)

1. To achieve flow rates of less than 15 GPM (57 L/min.), adjust the appropriate flow limiter(s). All ON/OFF spools are set at the factory for 15 GPM (57 L/min.).

Individual Compensator Adjustment Procedure, Proportional Segments

To change the flow rating of a proportional segment, it will be necessary to:

a. re-shim the individual compensator spool per Table 2 or;

b. change the main spool. Re-shim the individual compensator spool, if necessary. Table 2 provides the flow range for each spool.

Procedure

1. Remove the compensator plug (item 29). Next, remove the compensator spring, watching for shim stock that may adhere to the botton.
2. Use the shim insertion tool (shown on page 11) to either add or subtract the shims. Use the shim stock information to decide how many shims to subtract (or add). Refer to Table 2 and the NOTES that follow it, so that the flow is adjusted within the specified ranges.
3. Re-assemble the compensator spring(s). Main spools 5 and 6 use dual springs (items 24 and 25). Main spools A-4 use only the large spring (item 24).
4. Install compensator plug (item 29) and torque to 15-20 Lb-ft (20-27 Nm).
5. Retest to verify the correct flow. If the correct flow has not been achieved, repeat steps 1-5.

Flow Limiter Adjustment

General

Adjustment of the spool flow limiter is required:

a. In all on/off segments.

b. In four-way proportional segments if a lower flow rate is specified for one of the cylinder ports.

c. In three-way segments if lower return flow (C_1 to T) is specified.

Have on hand:

- 3/8" open end wrench
- 3/32" allen wrench

* FOR FLOW REQUIREMENTS OVER 15 GPM (57 L/min.), CONSULT FACTORY

Adjustment Procedure

1. **Four-way work segment adjustment:**

   With the flow meter connected to the segment cylinder ports and the test stand "on," energize the PULSAR™ solenoid with 100% modulation ratio (M.R.) to produce flow through the cylinder port to be adjusted. Check that pump relief valve is set high enough to saturate the cylinder port flow.

   Use upper screw to adjust C_2 flow and lower screw to adjust C_1 flow. While holding the adjustment screw (item 11) turn the seal nut (item 12) until loose, then turn the adjustment screw in while holding the seal nut, until the output flow equals the specified flow setting. After adjustment, hold the adjustment screw and tighten the seal nut with a torque of 2-3 Lb-ft (3-4 Nm). To adjust flow through the other cylinder port, repeat this process with other solenoid and flow limiter.

2. **Three-way (one cylinder port plugged) work segment adjustment:**

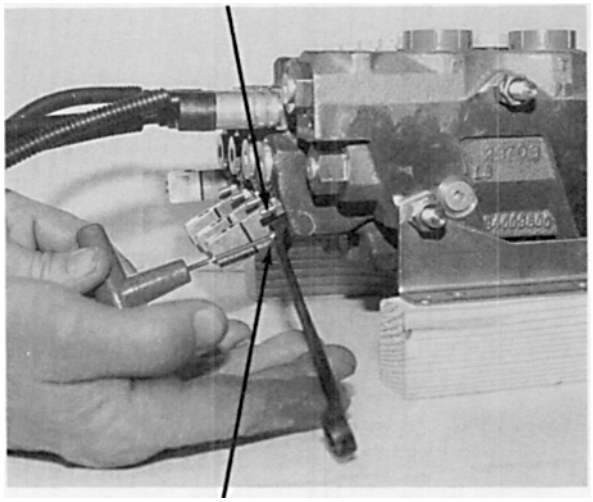
   For three-way segments it is necessary to furnish the singular cylinder port with access to a supply pressure line and flow meter to verify return flow. This access may be accomplished by (a) using a flow rectifier circuit, (b) by connecting a parallel pressure supply line to the cylinder port. Set supply pressure equal to load pressure on the application. Energize for 100% modulation ratio at the C_2 solenoid.

   While holding the lower adjustment screw (item 11), turn the seal nut (item 12) until loose. Then turn adjustment screw in, while holding the seal nut until the output flow is equal to specified setting. After adjustment, hold the adjustment screw and tighten the seal nut with a torque of 2-3 Lb-ft (3-4 Nm).

3. **For flow limiters which do not require adjustment:**

   All flow limiters are assembled at the factory in a retracted position, unless otherwise specified.

C_2 FLOW ADJUSTMENT SCREW



C_1 FLOW ADJUSTMENT SCREW

Pressure Limiter Adjustment

General

There are three (3) different configurations of pressure limiters in a work segment.

1. A common pressure limiter having both cylinder ports controlled by the same setting.
2. Individual pressure limiters for each cylinder port.
3. C_1 pressure limiter only. The body is not machined for C_2 pressure limiter.

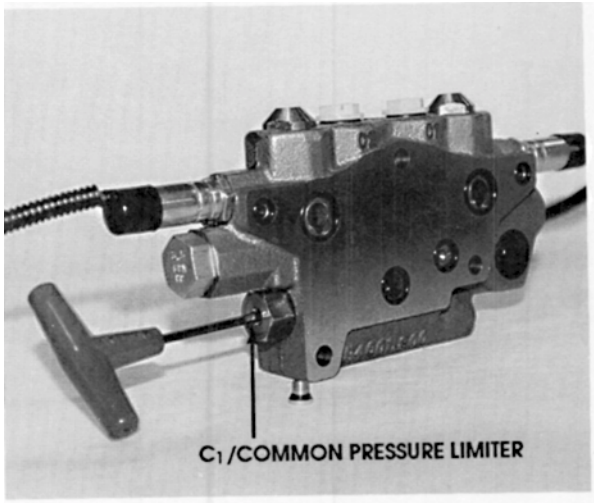
Have on hand:

- 1/8" allen wrench
- 5/32" allen wrench

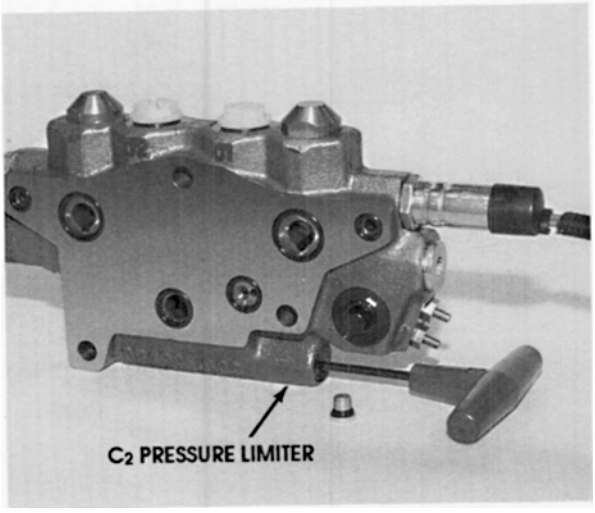
Adjustment Procedure

1. Flow is not required through the segment whenever setting a pressure limiter. A gauge must be connected to either the deadheaded cylinder port that is being tested or the #4 load sense port on the inlet. Energize the appropriate Pulsar™ solenoid with 100% M.R. to produce a pressure at the deadheaded cylinder port. Turn the adjustment screw until the pressure is equal to the specified setting. Adjustment range is 200 to 4,000 PSI (13,8 to 275,9 bar), with pressure per turn being approximately equal to 750 PSI (51,7 bar).
2. The common pressure limiter is set by turning the adjustment screw within the compensator plug behind a #2 SAE plug (item 14).
3. Individual pressure limiters are set in two (2) different locations on the valve. C_1 cylinder port is controlled by the limiter adjustment screw located behind a #2 SAE plug (item 14) in the compensator plug. C_2 cylinder port is controlled by the limiter (items 15, 16, and 18) located in the body. An adjustment screw is behind the #2 SAE plug (item 14).
4. A working segment can also be ordered with only a C_1 pressure limiter. This is set by turning the adjustment screw within the compensator plug behind a #2 SAE plug (item 14).

CAUTION: THESE ADJUSTMENT SCREWS ARE NOT SELF-CONTAINED. DO NOT ADJUST THE SCREW ALL THE WAY IN OR OUT



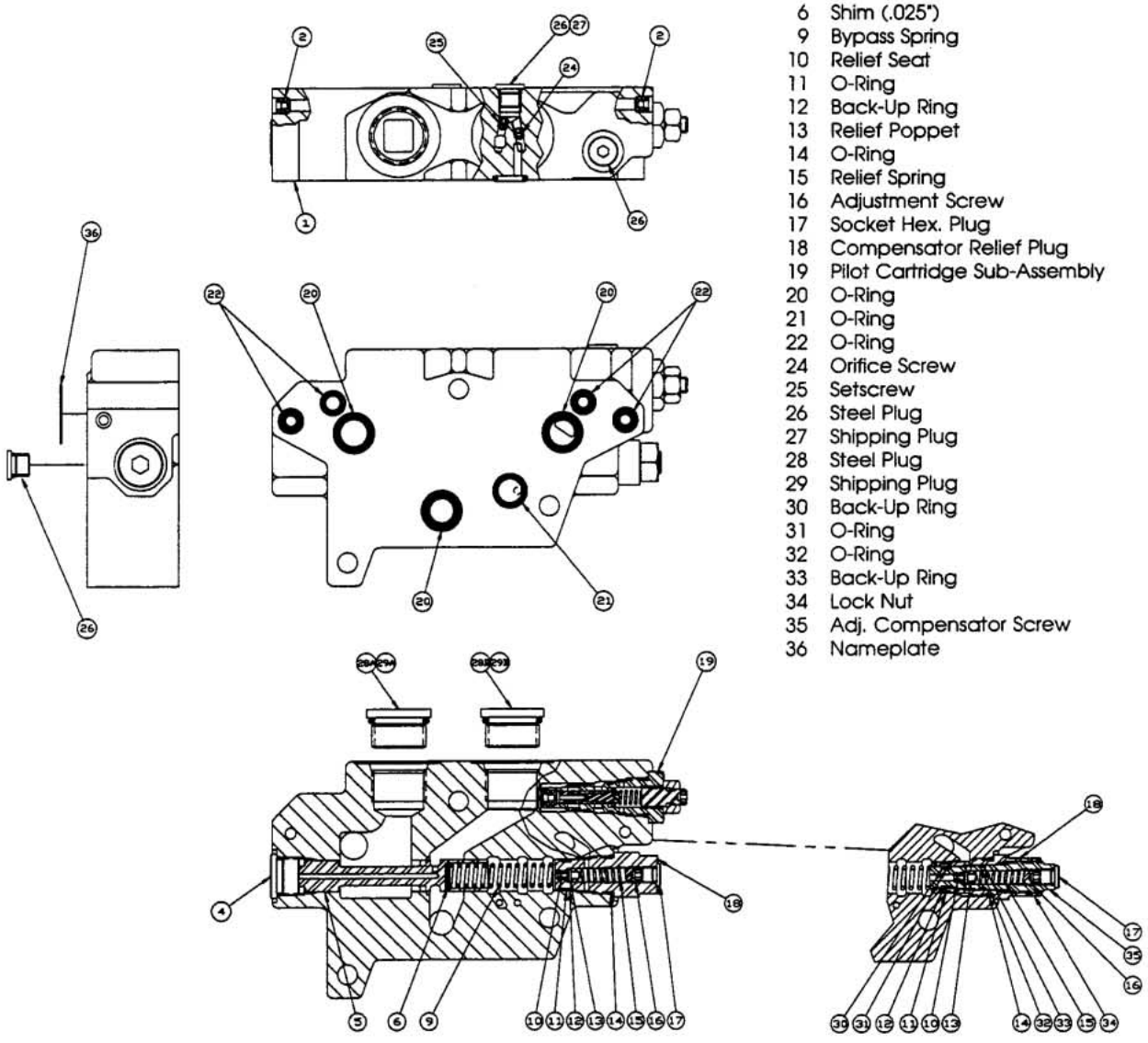
C_1/COMMON PRESSURE LIMITER



C_2 PRESSURE LIMITER

ASSEMBLY DRAWING

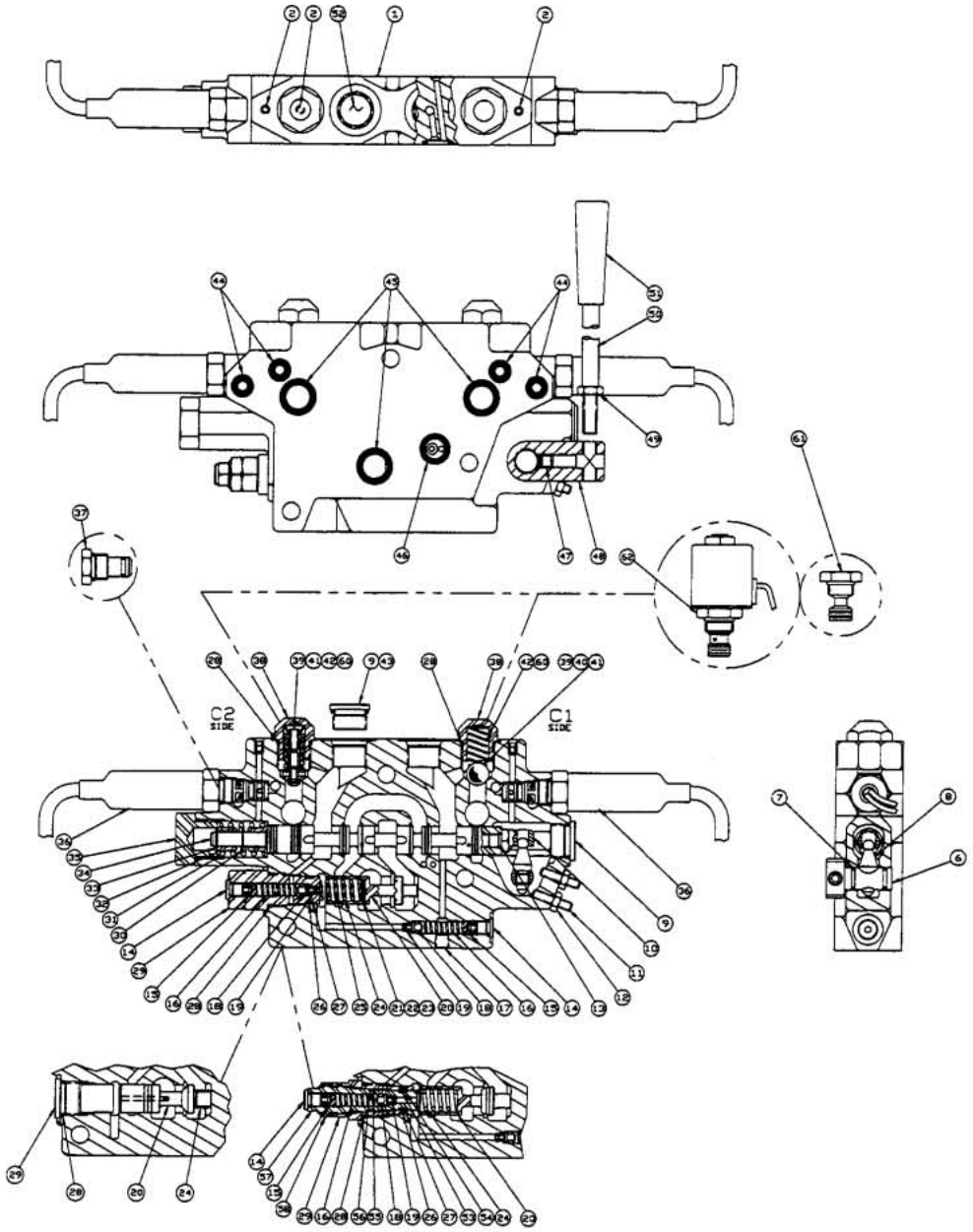
VBL BYPASS INLET SEGMENT PARTS LIST



1 Inlet Valve Body
2 Construction Plug
4 Socket Hex Plug
5 Inlet Spool
6 Shim (.025")
9 Bypass Spring
10 Relief Seat
11 O-Ring
12 Back-Up Ring
13 Relief Poppet
14 O-Ring
15 Relief Spring
16 Adjustment Screw
17 Socket Hex. Plug
18 Compensator Relief Plug
19 Pilot Cartridge Sub-Assembly
20 O-Ring
21 O-Ring
22 O-Ring
24 Orifice Screw
25 Setscrew
26 Steel Plug
27 Shipping Plug
28 Steel Plug
29 Shipping Plug
30 Back-Up Ring
31 O-Ring
32 O-Ring
33 Back-Up Ring
34 Lock Nut
35 Adj. Compensator Screw
36 Nameplate

ASSEMBLY DRAWING

VPL WORK SEGMENT PARTS LIST



1 Main Segment Valve Body
2 Construction Plug
6 Shaft
7 Shaft Seal
8 Linkage
9 Socket Hex Plug
10 Hook
11 F. L. Set Screw
12 Seal Nut
13 O-Ring
14 Socket Hex Plug
15 Adjustment Screw
16 Relief Spring
17 Pipe Plug
18 Relief Poppet
19 Relief Seat
20 Compensator Spool
21 Comp. Shim (.025")
22 Comp. Shim (.008")
23 Comp. Shim (.003")
24 Compensator Spring
25 Secondary Comp. Spring
26 O-Ring
27 Back-Up Ring
28 O-Ring
29 Compensator Plug
30 Main Spool Shim
31 Centering Spring
32 Spring Guide
33 Retaining Ring
34 Main Spool
35 Hex Head Plug
36 Solenoid Assembly
37 Solenoid Plug Sub-Assembly
38 Relief Plug
39 Relief / A.C. Cartridge
40 Relief / A.C. Cartridge
41 Check Ball (1/2")
42 Check Spring
43 Port Plug
44 O-Ring
45 O-Ring
46 O-Ring
47 Adapter Screw
48 Handle Adaptor
49 Jam Nut
50 Handle Rod
51 Knob
52 Shipping Plug
53 O-Ring
54 Back-Up Ring
55 O-Ring
56 Back-Up Ring
57 Adj. Compensator Screw
58 Lock Nut
60 Defeat Spring
61 Delta Defeat Plug
62 Solenoid Valve S/A

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