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Service and Parts Bulletin**

Commercial Valves Series VA/VG

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Directional Control Valves

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 **WARNING**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale".

INTRODUCTION

This manual has been prepared to assist you in the proper maintenance of the VA20™/VA35™ and VG20™/VG35™/VG80™ directional control valves. Before any work is done, we suggest that you read the assembly and disassembly instructions completely.

The first rule of good maintenance is cleanliness, which includes a clean environment. **MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA.** Dirt is the natural enemy of any hydraulic system.

GENERAL INFORMATION

The VA and VG model valves are updated versions of our proven A20™ and A35™ units. The VG models are cast from compacted graphite, a high strength iron alloy, which allows the valve to be rated to 3500 psi. VA models are cast from gray iron and are rated at 2500 psi. These open-center, directional-control valves are available in parallel, tandem, and series circuitry. As needed, the sectional, stack-type construction provides flexibility for the addition or subtraction of work sections to an existing valve bank. This design also permits the combination of parallel, tandem, and series circuitry in a single bank. The internal coring of each valve section determines its circuitry and the number of gasket seals required.

All sections with optional features, such as port relief valves, crossover relief valves, and anti-cavitation checks, are dimensionally larger when measured from the top of the port to the bottom of the housing. These are referred to as “hi-boy” sections. Those without work-port options can use the low-profile castings, which are called “lo-boy” sections.

REPLACEMENT PARTS

The illustrations and instructions in this manual apply only to the VA/VG series assemblies, subassemblies, and components. All valve components, except for spools and housings, are available as replacement parts or subassemblies. Spools are hone-fitted to their individual housings, so damage to either of these components means the entire section must be replaced.

We recommend that you use only genuine VA/VG series replacement parts in your service program. Manufactured to the same exacting tolerances and quality controls as the original equipment, genuine VA/VG replacement parts may help prevent premature, component failure and costly downtime. Service parts and assemblies are available through your original equipment dealer or any authorized distributor.

MAINTENANCE

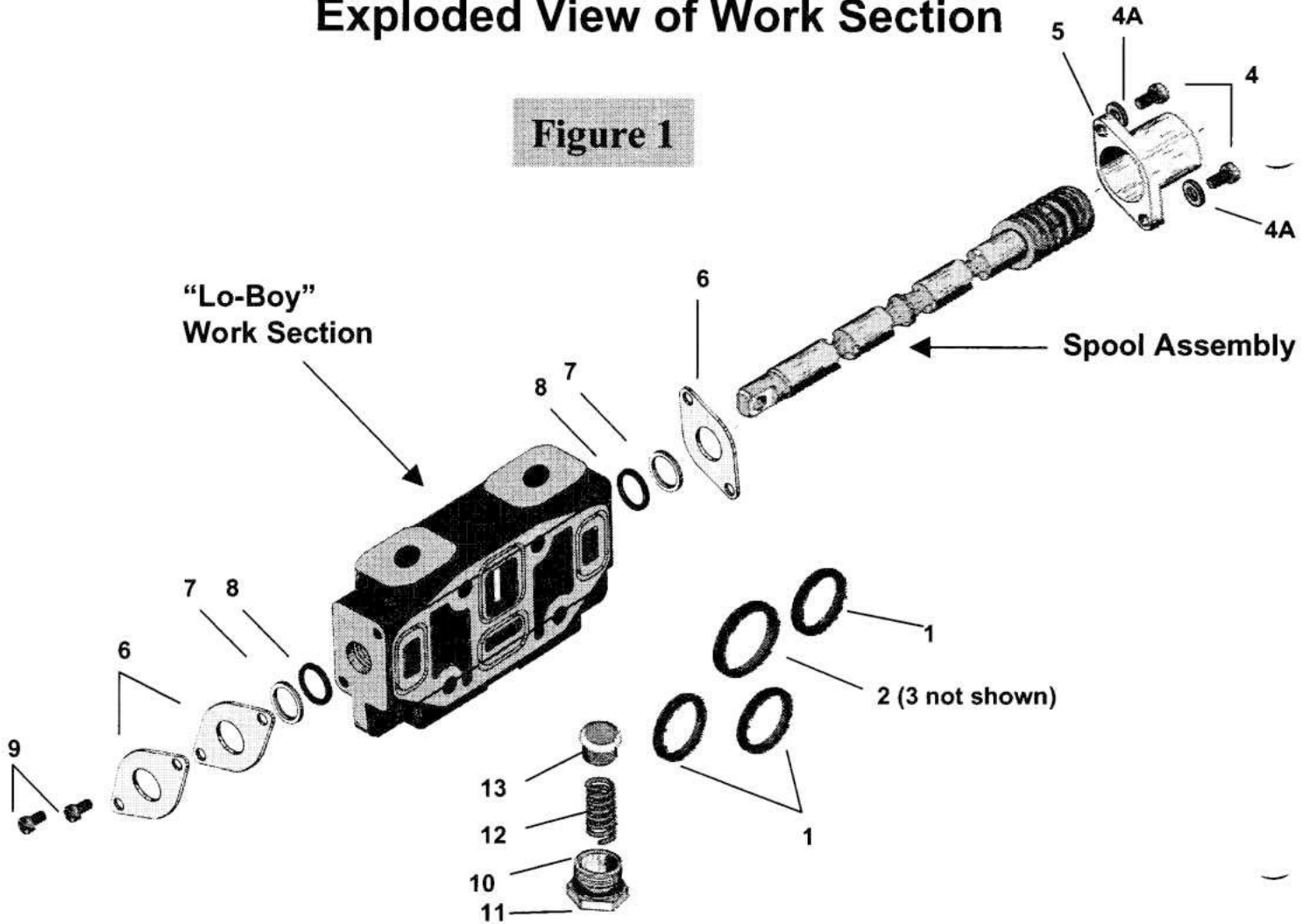
Valves are often used in hazardous environments. Inspect them frequently for damage due to improper use, corrosion or normal wear. If needed, repairs should be made immediately.

Always refer to the machine manual for the proper procedure to remove the valve from the machine.

Remove the valve bank from the equipment, disconnecting all hoses, fittings, control handles and linkage connectors that might be attached to the valve. Plug all ports and thoroughly clean the exterior of the valve bank, then the port plugs can be removed.

Exploded View of Work Section

Figure 1



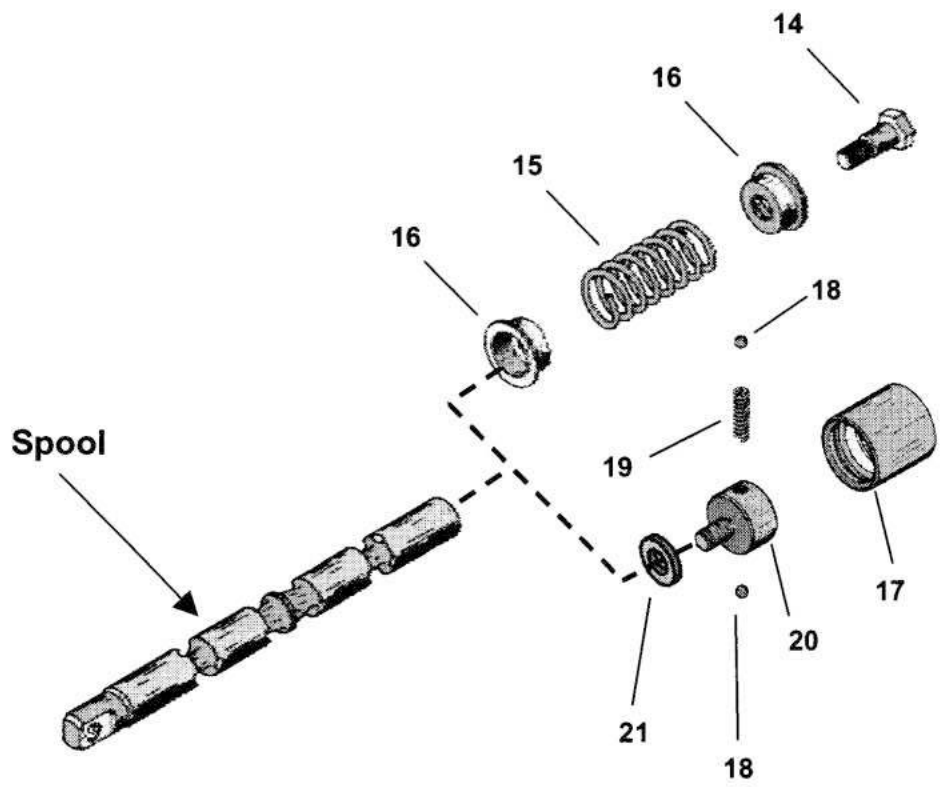
Parts List For Work Section

Item	Description	Qty.	VA/VG20 Part No.	VA/VG35 Part No.	VG80 Part No.
Parallel Section Seals* See Figure 1					
1.	Square Seals	3	391-2881-206	391-2881-200	391-2881-433
2.	Square Seal	1	391-2881-200	391-2881-403	391-2881-670
Series Section Seals					
1.	Square Seals	2	391-2881-206	391-2881-200	.....
3.	Square Seal	1	391-2881-627	391-2881-628	.....
Parallel and Series Section Component Parts. See Figure 1					
4.	Back Cap Screws	2	391-1433-020	391-1433-009	(4) 391-1402-068
4A.	Lock washers	8	.....	.....	391-3783-039
5.	Back Cap	1	341-6000-100	342-6000-100	341-0585-099
6.	Retainer Plates	3	391-2183-001	391-2183-005	391-2183-157
7.	Back up Rings	2	391-2681-378	391-2681-426	391-2681-285
8.	Spool Seals	2	391-1985-014	391-2887-212	391-2881-096
9.	Retainer Plate Screws	2	391-1433-015	391-1433-002	(4) 391-1402-015
10.	Check Valve Cap	1	391-0581-044	391-0581-044	391-0585-099
	Or Valve Cap (F.I.N.)	1	391-2281-015	391-2281-015	.....
11.	O Ring Seal **	1	391-2881-204	391-2881-204	391-2881-249
12.	Check Spring **	1	391-3581-713	391-3581-713	391-3581-778
13.	Check Valve Poppet **	1	391-2481-069	391-2481-069	391-2383-091

*Parallel Sealing Face includes inlets and mid-inlets.

**Not required in Float-in-neutral Sections.

Figure 2



Spring Centered and Detent Spool Operators. See Figure 2

14.Stripper Bolt	1	391-1432-022	391-1432-021	391-1402-452
15.Centering Spring	1	391-3581-608	391-3581-633	391-3581-330
16.Spring Guides	2	391-1642-045	391-1642-013	391-1642-161
17.Detent Sleeve	1	391-3283-015	391-3283-008	391-3384-310
18.Detent Balls	2	391-0282-010	391-0282-009	391-0282-011
19.Detent Spring	1	391-3581-130	391-3581-015	391-3581-316
20.Detent Poppet Retainer	1	391-2583-008	391-2583-006	391-3384-311
21.Detent Spacer	1	.....	.....	391-3782-208

Valve Disassembly Instructions

Reference exploded view and parts list on page 2 and 3 for work section detail.

Step 1 - Valve Bank

This step is the most critical in the disassembly procedure. It should be followed closely to ensure that the valve bank is properly reassembled after repairs have been made.

With a waterproof, quick-drying marker, mark each casting with a sequential number. Start by marking the inlet casting with the #1 and finish by marking the outlet with the highest number.

Next, mark the port boss closest to the back cap on each work section with a "B" (for back cap end).

Then, mark the port boss closest to the spool clevis on each work section with a "C" (for clevis end).

Finally, if relief valves are removed from the valve bank they must be marked with the corresponding number of the casting and port location (B or C) from which they were removed. Inlet and mid-inlet relief valves are marked with a casting number only.

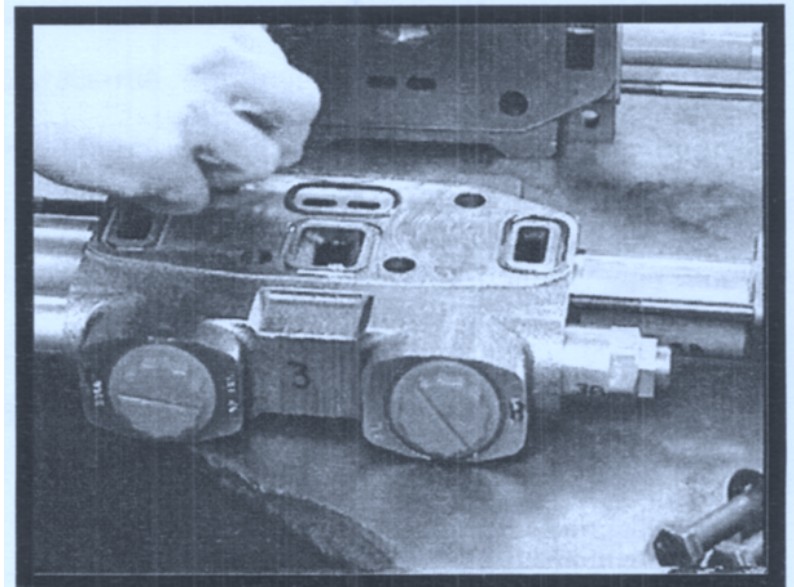
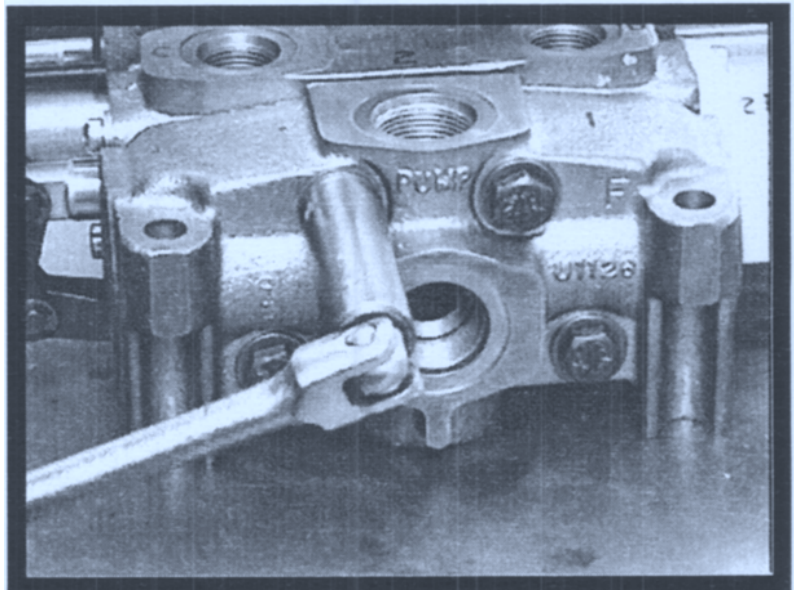
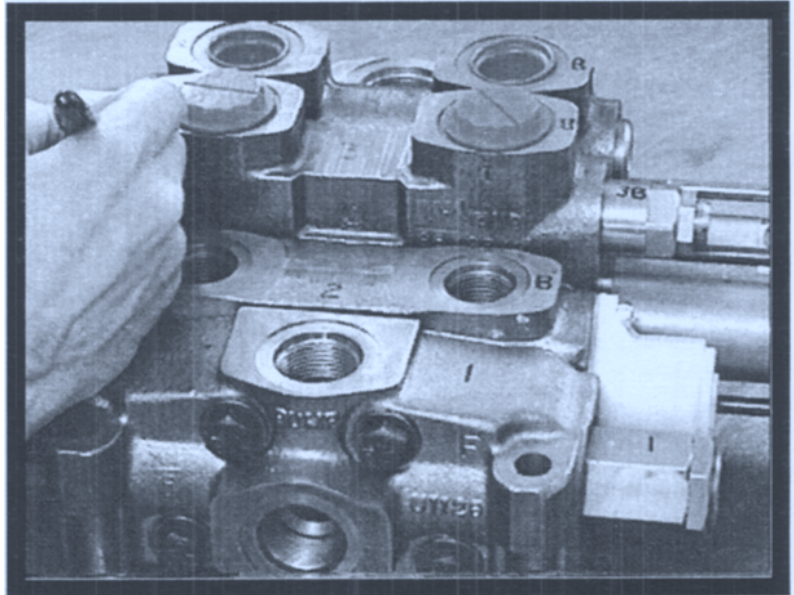
Step 2 - Tie Bolts

Remove the four, tie bolts that hold the bank together and separate the sections.

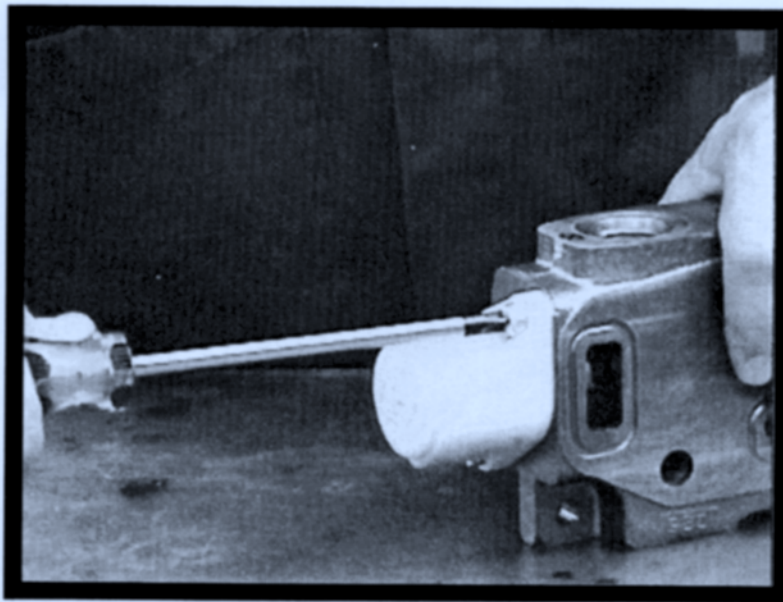
NOTE: VA valve tie bolts thread into the outlet casting. VG valve tie bolts pass through the entire bank, requiring washers and hex nuts to be fastened at both ends of the bolt.

Step 3 - Section Seals

The inlet, mid-inlet and each parallel work section have four, section seals, (Fig. 1, items 1 & 2) on the downstream, mating face. Series work sections and the VA/VG35 split flow mid inlets have three section seals on the downstream mating face, (Fig. 1, items 1 & 3.) These section seals should be removed and discarded.



REMINDER: ALL WORK MUST BE PERFORMED IN A CLEAN AREA.



Step 4 - Valve Back Cap

Using a large, Phillips-head screwdriver, remove the two, cap screws (Fig. 1, item 4) which fasten the back cap to the work section. Lightly tap the end of the screwdriver handle with a hammer to break adhesive. Remove the back cap (Fig. 1, item 5).

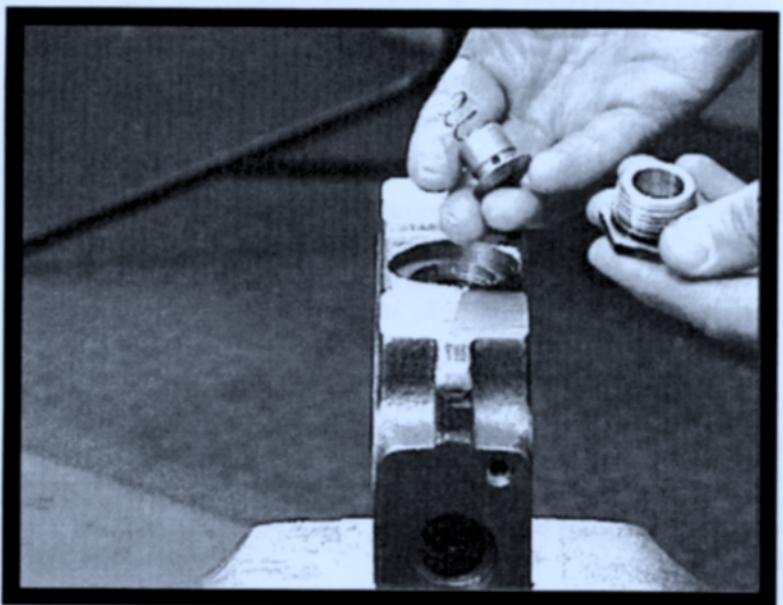


Step 5 - Control Spool and Seals

Grasp the spring end of the spool with a clean, lint-free cloth and pull the spool out of the housing using a twisting motion. Generally, the rear, retainer plate (Fig. 1, item 6) back-up ring (Fig. 1, item 7) and spool seal (Fig. 1, item 8) will come out with the spool.

CAUTION: For detented spool models, be careful not to remove the detent poppet sleeve (Fig. 2, item 17) unless it is to be serviced.

Using a large, Phillips-head screwdriver, remove the two, retainer-plate screws (Fig. 1, item 9) from the spool clevis end of the work section. Lightly tap the end of the screwdriver handle with a hammer to break the adhesive. Remove the two, retainer plates (Fig. 1, item 6) the back-up ring (Fig. 1, item 7) and the spool seal (Fig. 1, item 8). Tag or mark with the appropriate, work section identification number. (See Step 1.) Spool seals (Fig. 1, item 8) and back-up rings (Fig. 1, item 7) should be discarded.



Step 6 - Transition Check

The transition check is located in the bottom center of the work section housing. Carefully clamp the work section in a vise with ports down. Do not clamp on the machined surface. Remove the check-valve cap (Fig. 1, item 10) and its O-ring seal (Fig. 1, item 11). Discard the seal. Remove the check spring (Fig. 1, item 12,) and the check-valve poppet (Fig. 1, item 13).

NOTE: Only cylinder work sections (ports blocked in neutral) have a transition check. Motor sections have only a cap plug.

Valve Disassembly Instructions

Spool Disassembly Spring Centered Spool

The spring assembly should not be removed from the spool unless these parts need to be replaced. Once the spool is free of the work section housing, it must be handled carefully to avoid damage. Place the spool vertically in a soft-jawed vise, clamping on the flat, spool clevis, and remove the stripper bolt (Fig. 1, item 14) with a wrench.

Lightly tap the stripper bolt with a hammer and a punch to help break the adhesive. Cautious application of heat may be required to free the stripper bolt, since an anaerobic thread adhesive was used during its assembly.

CAUTION: Too much heat may distort the spool.

As the stripper-bolt threads disengage, the spring (Fig. 2, item 15) and spring guides (Fig. 2, item 16) will release abruptly from the spool.

Detent Spool

The detent assembly should not be removed from the spool unless these parts need to be replaced. Wrap the detent sleeve (Fig. 2, item 17) with a clean, lint-free cloth. Grip the cloth-covered sleeve and pull firmly. As the sleeve moves backwards, the detent balls (Fig. 2, item 18) and the detent spring (Fig. 2, item 19) will release abruptly. The cloth should capture these parts and prevent their loss.

Next, clamp the spool in a soft-jawed vise and remove the detent poppet retainer (Fig. 2, item 20). Place an undersized bar through the detent ball bore to serve as a wrench. Lightly tap the detent poppet retainer with a hammer and a punch to help break the adhesive. Cautious application of heat may be required again, since an anaerobic adhesive was also used in the detent retainer assembly.

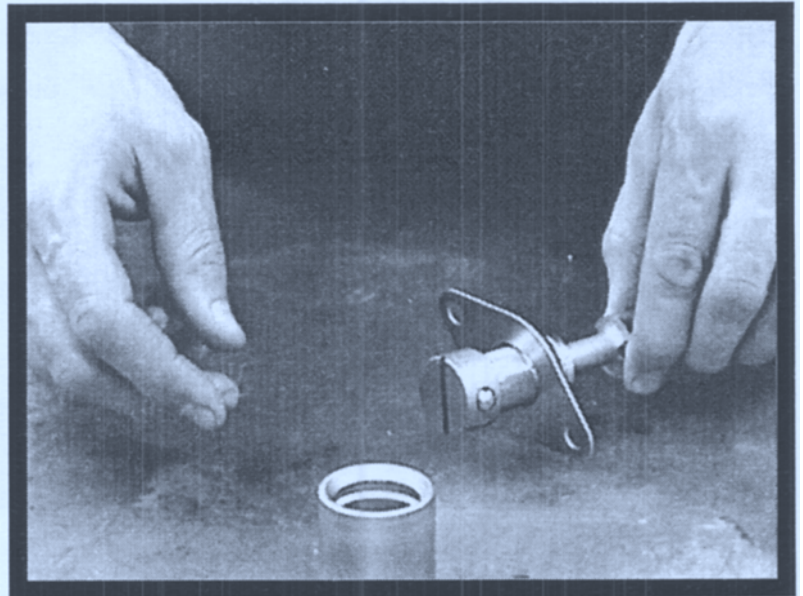
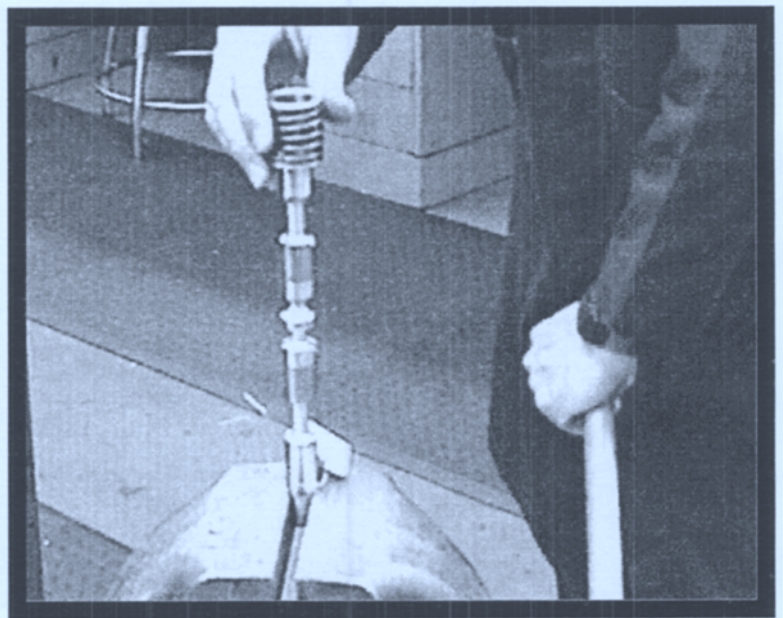
CAUTION: Too much heat may distort the spool!

CLEANING, INSPECTION, AND REPAIR

1. Inspect the spool bore, transition check seat and spool from each section for deep scratches, gouges or excessive wear. If any of these conditions exist, replace the section. Minor, surface damage on the control spool and check poppet can be carefully polished away with a very fine, crocus cloth.

2. Examine the machined surfaces of the valve housing for nicks and burrs that could cause leakage between sections. Lightly stone these surfaces to remove any rough spots.

CAUTION: A shallow-milled relief area extends across the O-ring face of the valve housing. This should not be stoned or ground off!



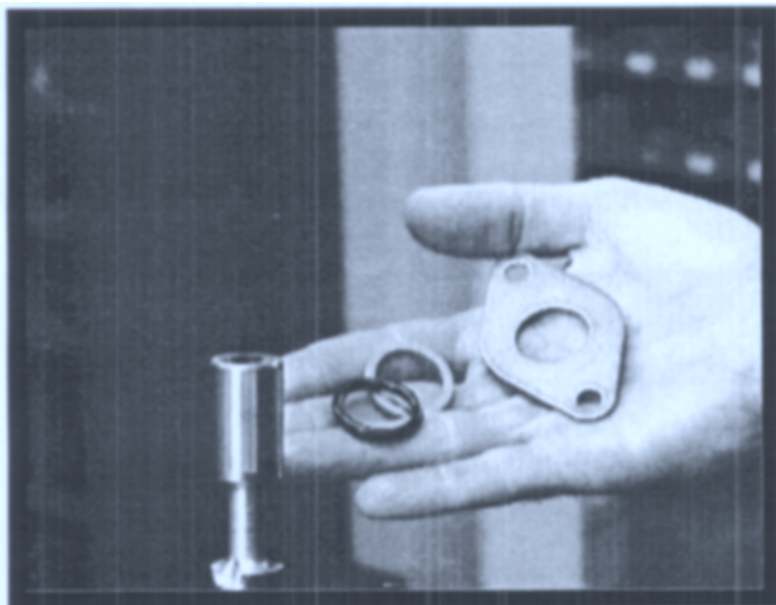
3. Wash all parts thoroughly in a cleaning solvent and blow dry before beginning reassembly. Pay special attention to the number and letters marked on the parts in Step 1. If any marks are removed during cleaning, re-mark immediately.

4. Clean adhesive from threads of spool, stripper bolt, housing, cap screws and hex nut with Loctite™ Chisel Gasket Remover.

Preparation of Parts

Spray the threads of the new stripper bolt (Fig. 2, item 14) tapped-threaded spool end, all screws and screw holes on both ends of the housing with LOCQUIC Primer Grade NF™ and let dry.

Spring Center Spool Assembly



CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is placed back into service.

Step 1 - Spool Assembly-Spring Centered

Clamp the flat, clevis end of the control spool in a soft jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the end of the spool away from the clevis. Slide on the back-up ring (Fig. 1, item 7) and retainer plate (Fig. 1, item 6). Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches.



Step 2 - Attach Spring Guides and Spring

Apply 2 - 3 drops of Loctite 262™ or equivalent anaerobic adhesive near the middle of the female threads in the spool. Assemble the spring guides (Fig. 2, item 16) centering spring (Fig. 2, item 15) and stripper bolt (Fig.2, item 14,) onto the spool (Reverse of Step 7). Torque the stripper bolt to 175 in. lbs. +/-4 in. lbs.

CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding. Check for binding by compressing the spring and guides or by rotating the spring guide nearest the housing.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure!

Lightly coat the centering spring with high- temperature grease to prevent rusting. Set the spool assembly aside and let it cure for a minimum of 1 hour. After curing, test the stripper bolt to make certain it can withstand 125 in. lbs. of breakaway torque.

Detent Spool Assembly

Step 1 - Spool Assembly-Detent

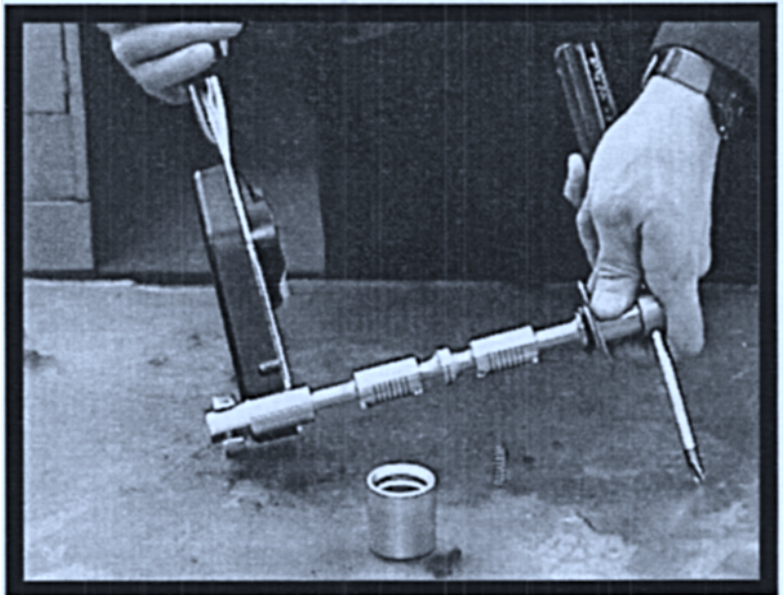
Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide the back-up ring (Fig. 1, item 7) and one, retainer plate (Fig. 1 item 6) onto the spool. Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches. Apply 2 - 3 drops of Loctite 262™ or an equivalent, anaerobic adhesive near the middle of the female threads in the spool.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure.



Step 2 - Spool Assembly-Detent

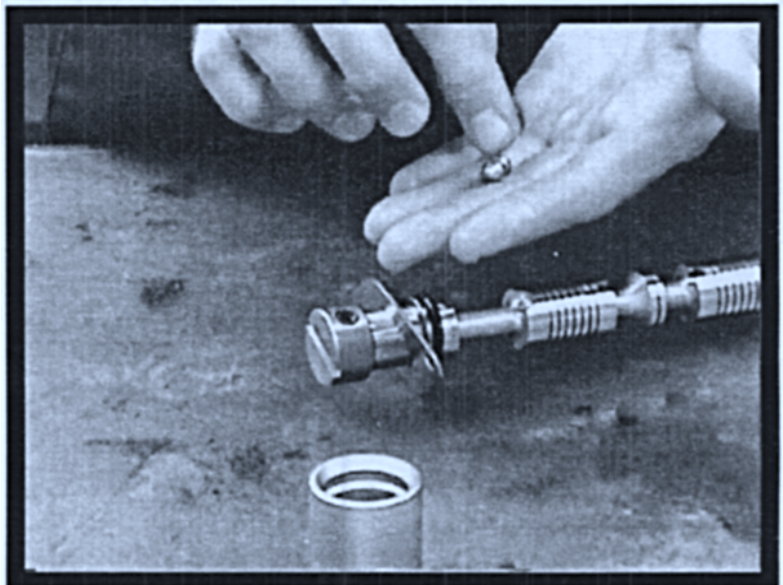
Thread the detent ball retainer (Fig. 2, item 20) into the spool end. Torque the detent ball retainer to 175 in. lbs. +/-4 in. lbs.. This can be accomplished by using a crows-foot socket on the flats of the clevis, and holding the spool by inserting a round, steel rod or screwdriver through the hole in the ball retainer.

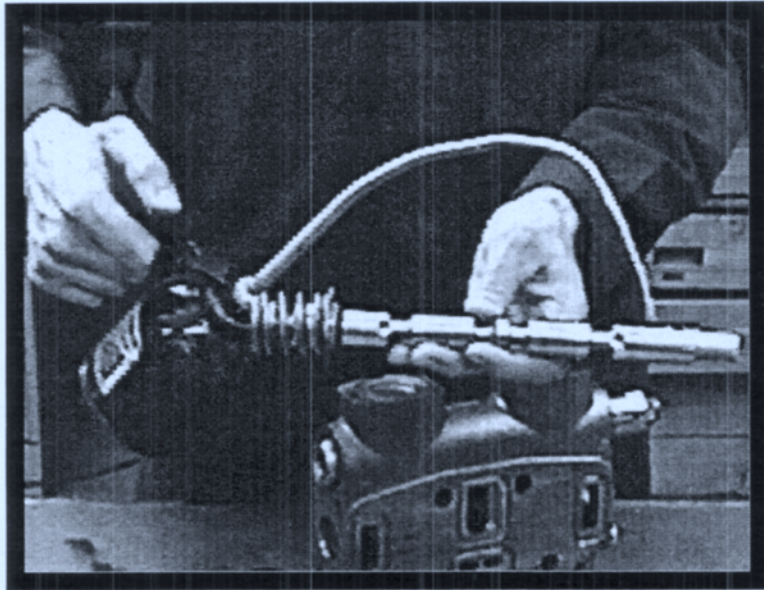


Step 3 - Detent Balls and Spring

Next, lightly coat the detent balls (Fig. 2, item 18) detent spring (Fig. 2, item 19) and entire inside diameter of the detent sleeve (Fig. 2, item 17) with high-temperature grease.

Insert the detent spring into the through hole in the detent ball retainer. Place the steel balls on the ends of the spring. Compress the balls and spring, then slip on the detent sleeve. (Note: The detent sleeve is not symmetrical; one end of the sleeve has a lead-in chamfer. This chamfer must face the spool clevis when assembled.) Move the detent sleeve to the neutral or middle position to prevent the subassembly from separating during subsequent steps.

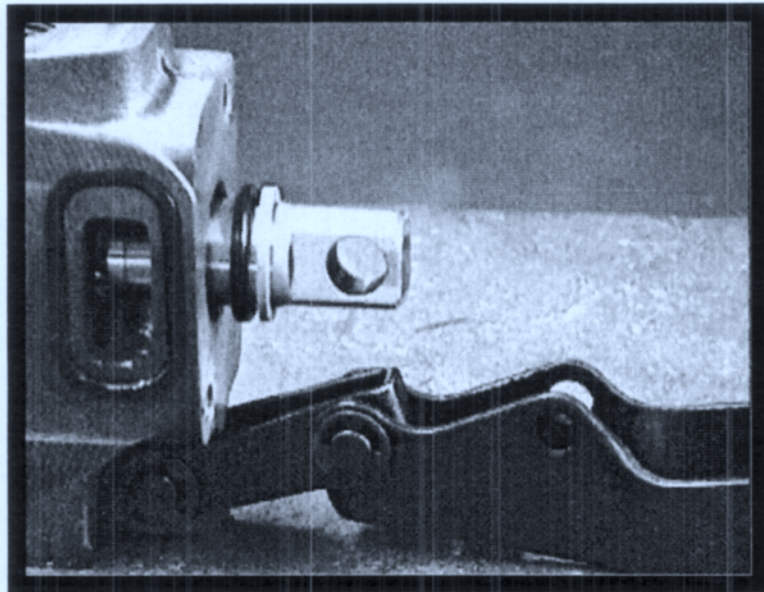




Step 1 - Spool Subassembly

Apply 2 - 3 drops of Loctite 262™ or equivalent to the fillister screw holes on both ends of the housing.

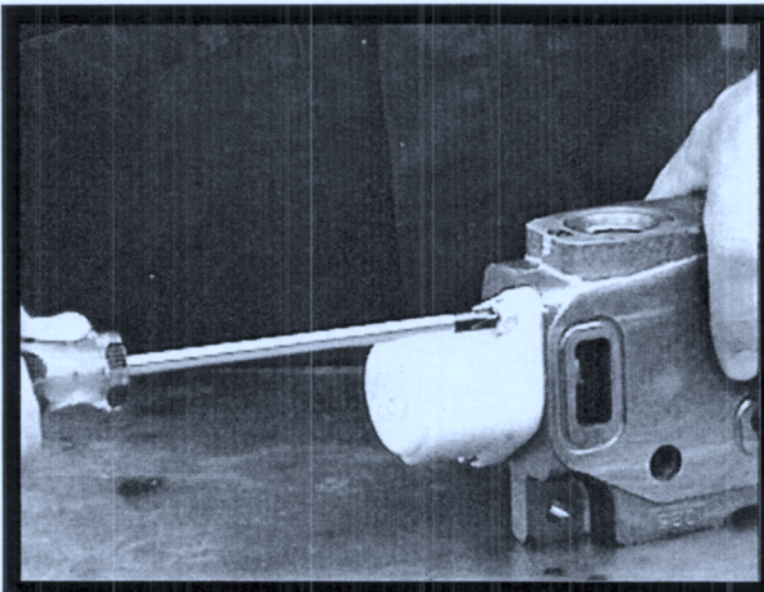
Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool assembly into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage the seals. Make sure that the spool and housing are in the proper orientation (see Step 1, page 6 disassembly).



Step 2 - Spool Seal and Back up

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide on the back-up ring (Fig. 1, item 7). Push both items into the counter-bore until they bottom out.

Assemble the two, front, retainer plates (Fig. 1, item 6) using the two short, fillister screws (Fig. 1, item 9). Check retainer plates for proper alignment. Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs..



Step 3 - Back cap

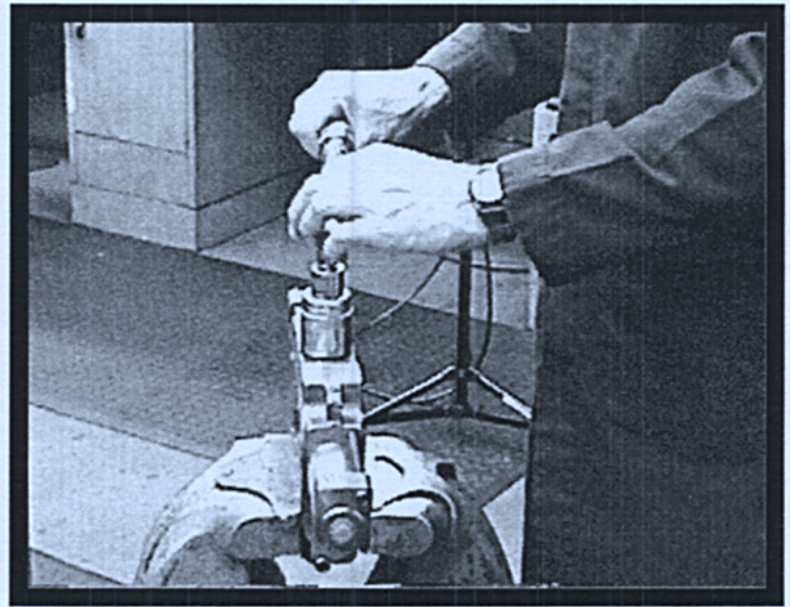
Install the back cap using the two, long, fillister screws (Fig. 1, item 4). Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.

Caution: Excessive torque will damage the back cap ears!

Valve Assembly Instructions

Step 4 - Install Transition Check

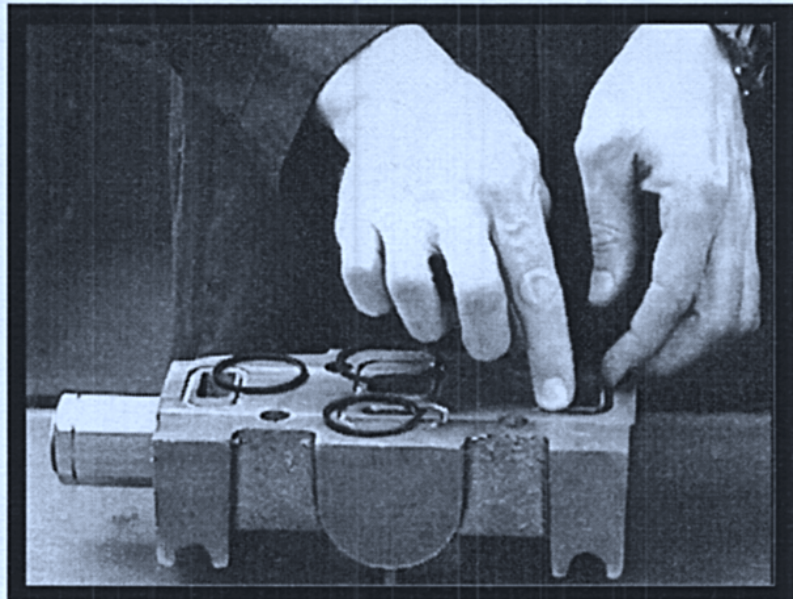
Inspect transition check components for cleanliness. Install check poppet (Fig. 1, item 13) into the transition check cavity. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 11) over the poppet and spring. Turning by hand, engage several threads. Tighten to a final torque of 75 ft. lbs. +/-4ft. lbs..



Step 5 - Relief Valves

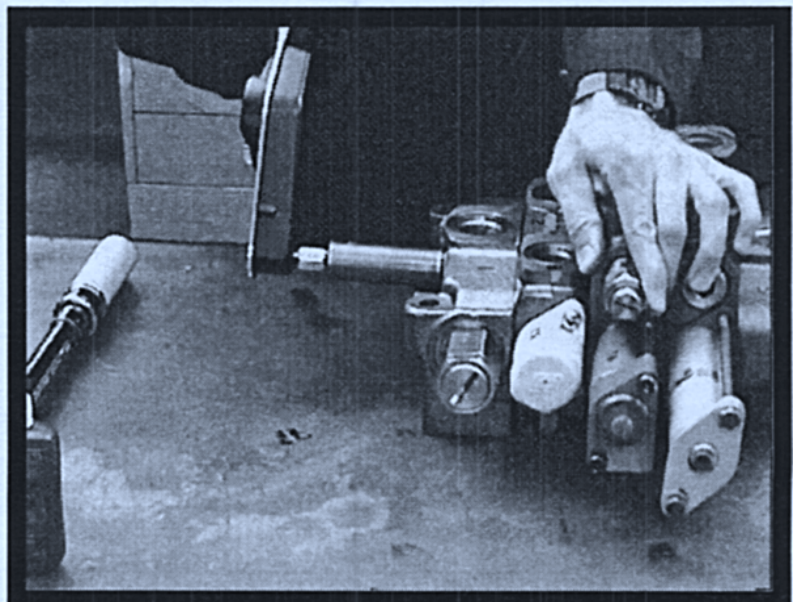
Return all relief valves to their proper positions and torque to 75 ft. lbs.

Install new, section seals. Place section seals (Fig. 1, items 1 & 2, or items 1 & 3) in the proper grooves. Make certain seals stay in their grooves during assembly.



Step 6 - Install Tie Bolts

Slide the tie bolts through the inlet casting. If cap screws are used, place a washer on the cap screw prior to installation. Place the valve sections on the tie bolts in their proper sequence (see Step 1, page 4). Turning by hand, engage several threads in the outlet. If it is a VG series assembly, assemble nut and washer to either end of the stud and follow above instructions. Torque the tie bolts in a cross-corner pattern.



Tie Bolt Torque Values

VA20 - 29 ft. lbs. (348 in. lbs.)

VG20 - 42 ft. lbs. (504 in. lbs.)

VA35 - 34 ft. lbs. (408 in. lbs.)

VG35 - 75 ft. lbs. (900 in. lbs.)

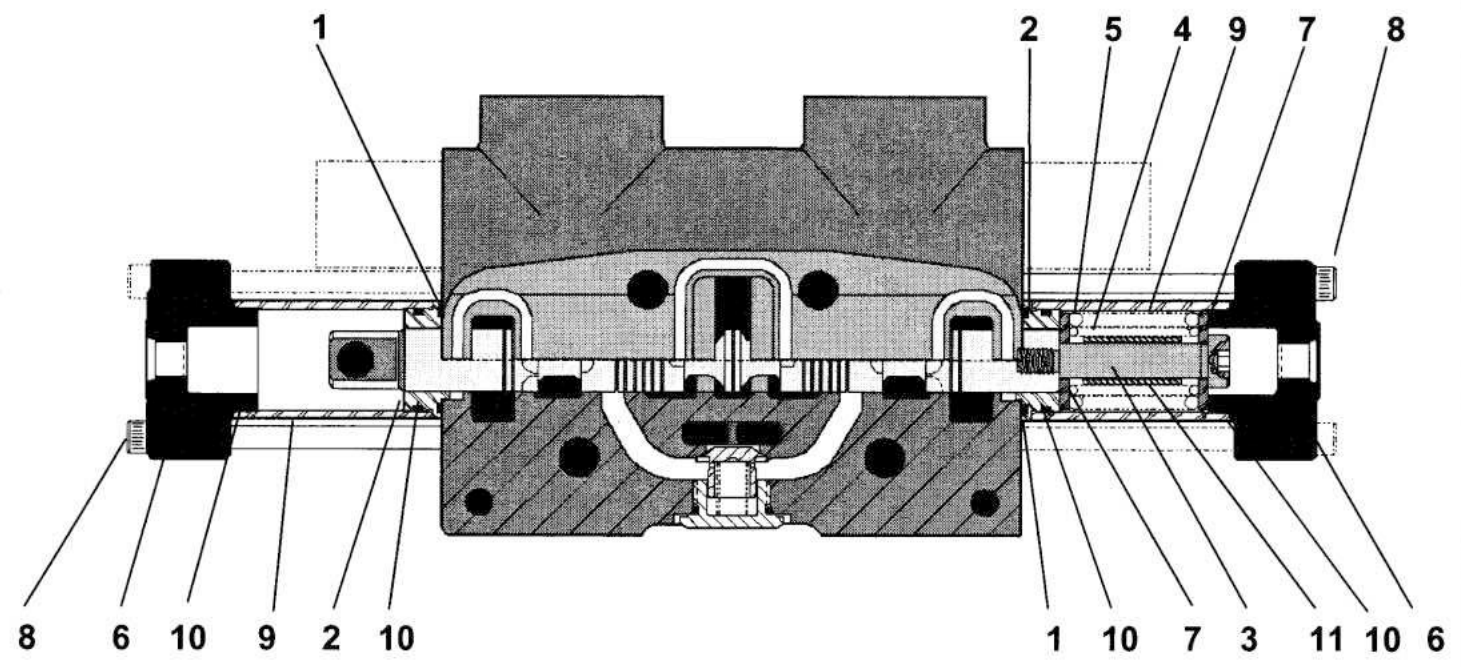
VG80 - 150 ft. lbs. (1800 in. lbs.)

Read these instructions carefully. Failure to follow these procedures can result in poor performance or product

malfunction. Make sure all work is done in a clean area.

REMOTE CAP COMPONENTS - Figure 3

- | | | | |
|-----------------------|-------------------------|-------------------------|-----------------|
| 1. O-rings (2) | 4. Return spring, inner | 7. Spring retainers (2) | 10. O-rings (4) |
| 2. Seal retainers (2) | 5. Return spring, outer | 8. Cap screws (4) (8*) | 11. Stop tube |
| 3. Shoulder bolt | 6. Valve caps (2) | 9. End tubes (2) | |
- * Required for VG80



Hydraulic Remote Control
Figure 3

REMOTE ENDCAP SEAL PARTS LIST

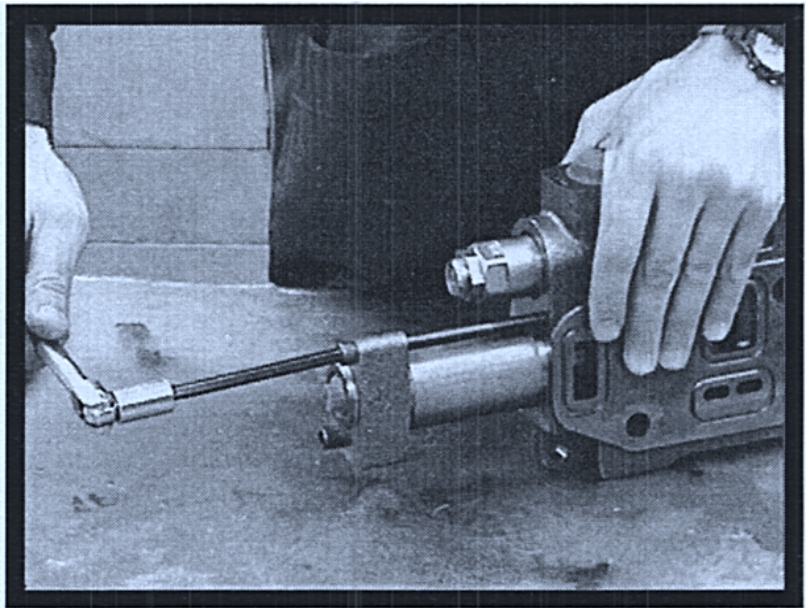
Item	Description	Qty.	VA/VG20	VA/VG35	VG80
1.	O-rings	2	391 2881 625	391 2881 625	391 2881 124
10.	O-rings	4	391 2881 242	391 2881 242	391 2881 106

Remote-Control Operator Disassembly

Step 1 - Remote endcaps

Using an allen wrench, remove cap screws (Fig. 3 item 8) from both ends of the valve section. Lightly tap the wrench with a hammer to help break the bond of the anaerobic adhesive.

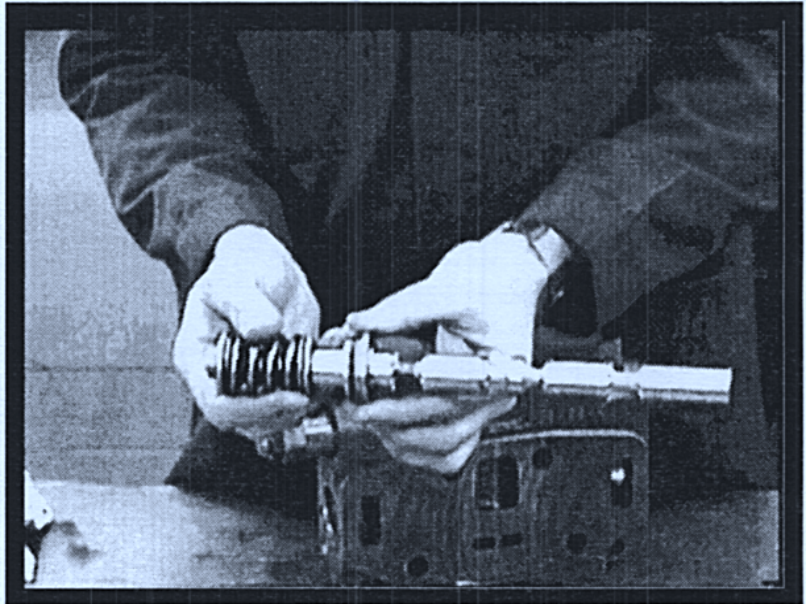
Remove valve caps (Fig. 3, item 6) O-ring seals (Fig. 3, item 10) and end tubes (Fig. 3, item 9) from each end of the valve housing. Discard the O-ring seals.



Step 2 - Spool Subassembly

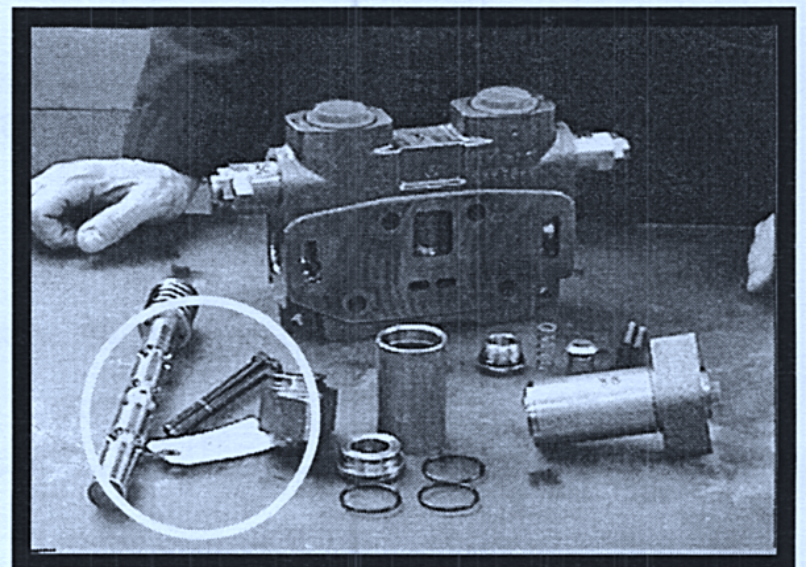
Slide the seal retainer (Fig. 3, item 2) from the clevis end of the spool assembly. Grasp the spool assembly by the spring end and slide it out of the housing. Remove the remaining seal retainer by sliding it over the spool.

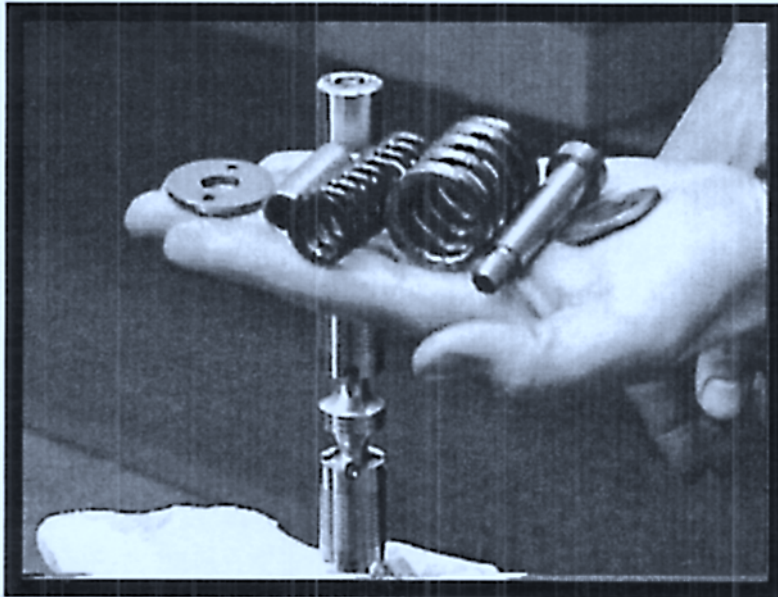
Now, remove the O-ring seals (Fig. 3, items 1 & 10) from both seal retainers and discard the seals.



Step 3 - Spool Identification

The spool should now be tagged or marked with the appropriate work section identification number (see Step 1, page 4).





Step 4 - Spring Pack

The spring assembly should not be removed from the spool unless it needs to be replaced. Insert the clevis end of the spool in a soft-jawed vice. It may be necessary to apply heat to the stripper bolt to loosen the anaerobic adhesive.

Use heat carefully to avoid warping the spool.

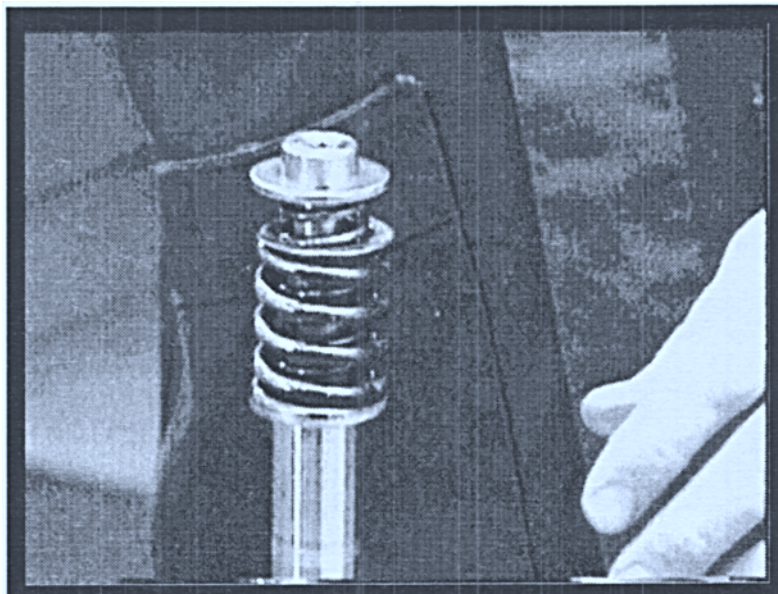
Always Work In A Clean Environment

Remote Control Operator Assembly

Step 1 - Spring Pack

If the shoulder bolt and spring assembly were disassembled, place the spool in a soft-jawed vise with the tapped and threaded end up. Carefully clamp on the flat, spool clevis. Apply 2 - 3 drops of Loctite 262™ or equivalent to the middle of the female threads in the spool end. Assembled joints should be allowed to cure for a minimum of one hour before being subjected to hydraulic testing.

Slide a spring retainer (Fig. 3, item 7) onto the shoulder bolt (Fig. 3, item 3) followed by the stop tube (Fig. 3, item 11). Next, slide springs (Fig. 3, items 4 & 5) onto the shoulder bolt. Place the remaining spring retainer on the end of the spool and thread the shoulder bolt into the hole by hand. Torque the shoulder bolt to 175 in. lbs. using a torque wrench.

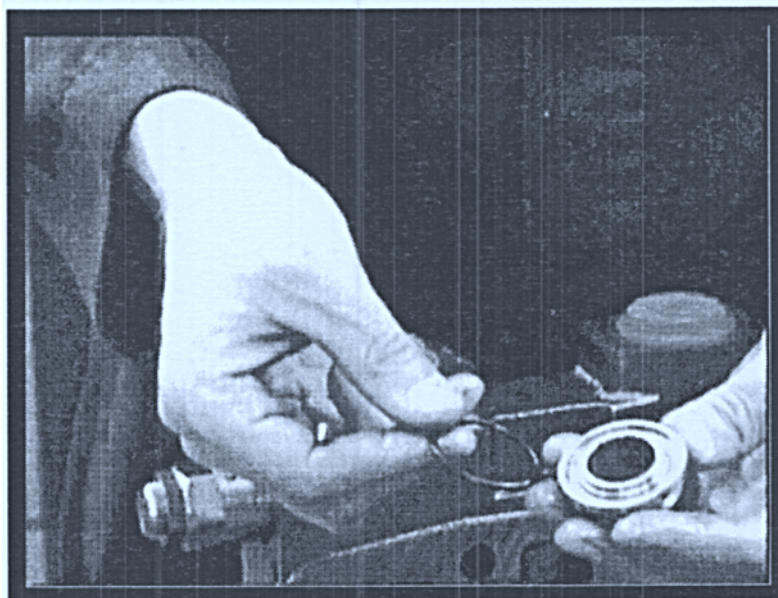


CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding.

Step 2 - Seal Retainers

Install the two, O-ring seals (Fig. 3, items 1 & 10) on both seal retainers (Fig. 3, item 2). Apply Parker Super-O-Lube™ to the O-ring seals.

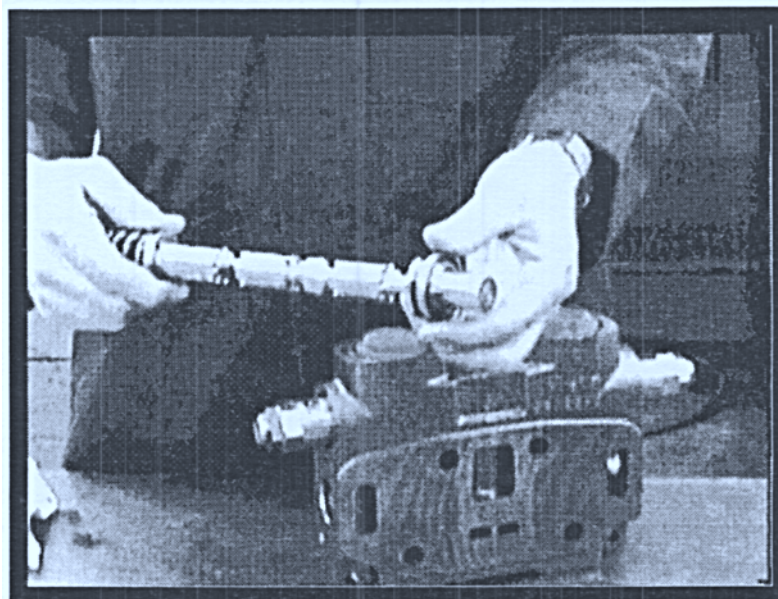
CAUTION: The O-ring seals are similar in size. Be sure to insert O-ring seals 1 & 10 in their proper position. They are not interchangeable!

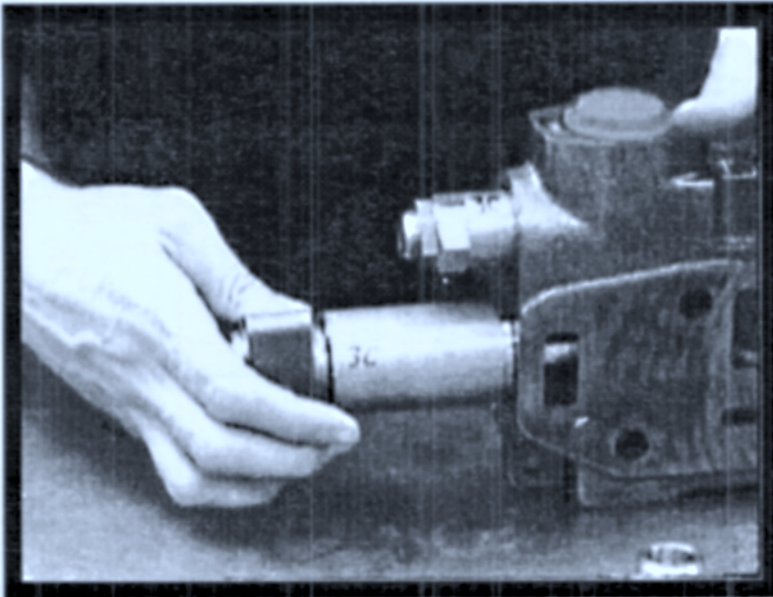


Step 3 - Spool Installation

Apply 2 - 3 drops of Loctite 262™ or equivalent to the cap screw holes on both ends of the housing.

Slide one seal retainer over the spool, resting against the spring retainer. Make sure the O-ring (Fig. 3, item 1) is facing the section casting. Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool into the housing. Use caution to avoid causing burrs.





Step 4 - Assemble Endcaps

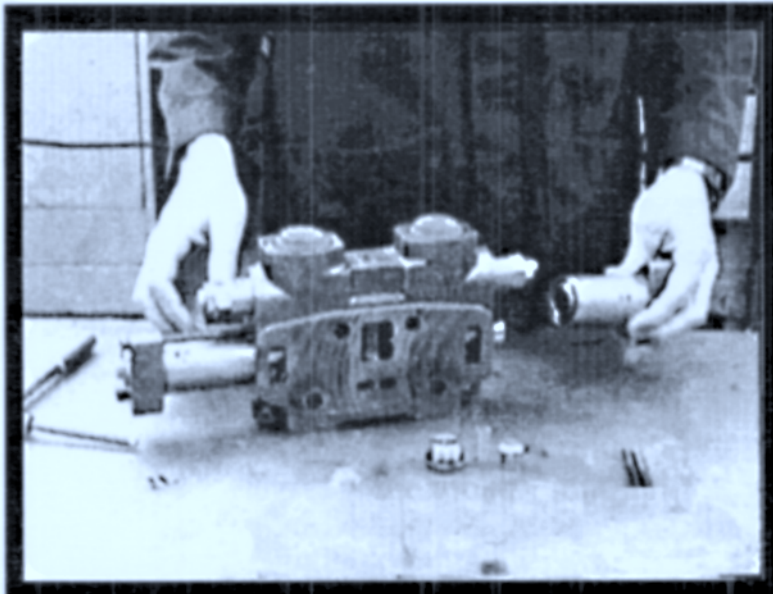
Apply a light coat of grease to the valve-cap O-rings (Fig. 3, item 10). Assemble the O-rings onto both of the cast-iron valve caps (Fig. 3, item 6). Slide the end tube (Fig. 3, item 9) over the spring end of the spool. Position the cast-iron valve cap, as shown, on the end tube and push into place. Be careful not to shear the valve-cap seal during installation.

Install two, cap screws (Fig. 3, item 8) tighten evenly and torque to the final specification.

VA20™/VG20™ to 100 in. lbs.

VA35™/VG35™ to 175 in. lbs.

VG80™ to 175 in. lbs.



Step 5 - Complete Endcap Assembly

Install seal retainer (Fig. 3, item 2) with seals on the clevis end of the spool. Install the end-cap tube (Fig. 3, item 9) the valve cap (Fig. 3, item 6) and the cap screws (Fig. 3, item 8) as previously explained.

Step 6 - Assemble Transition Check

Inspect the transition-check components for cleanliness. Install a new O-ring seal (Fig. 1, item 11) on the check-valve cap. Place the check poppet (Fig. 1, item 13) into the housing. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 10) over the check poppet. Turning by hand, engage several threads. Tighten to final torque of 75 ft. lbs. +/- 4 ft. lbs.

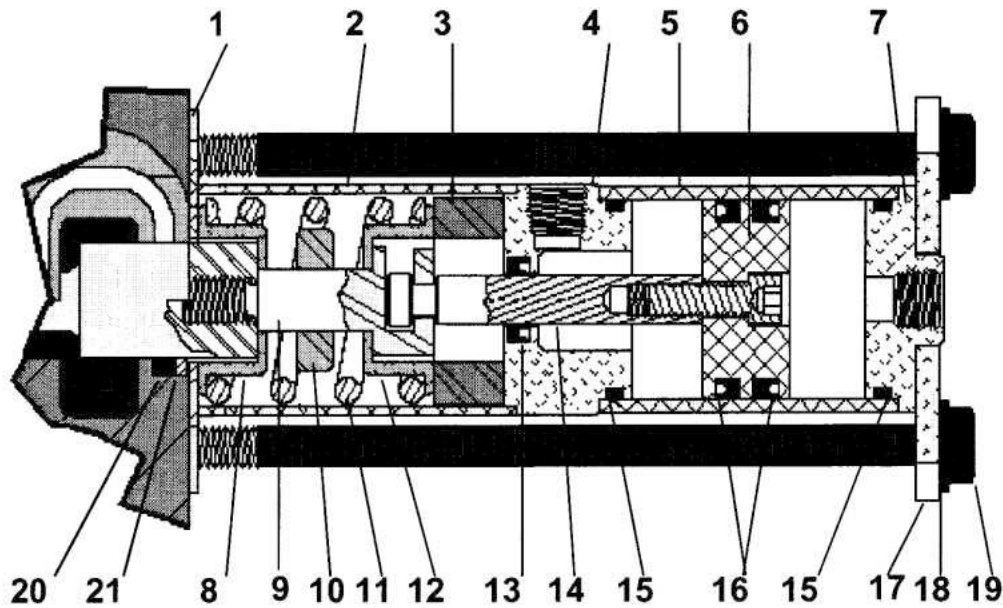
CAUTION: Failure to follow these recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is put back into service.

USE ONLY ORIGINAL VA/VG™ SERIES REPLACEMENT PARTS

PNEUMATIC CAP COMPONENTS VA/VG20 AND VA/VG35 - Figure 4

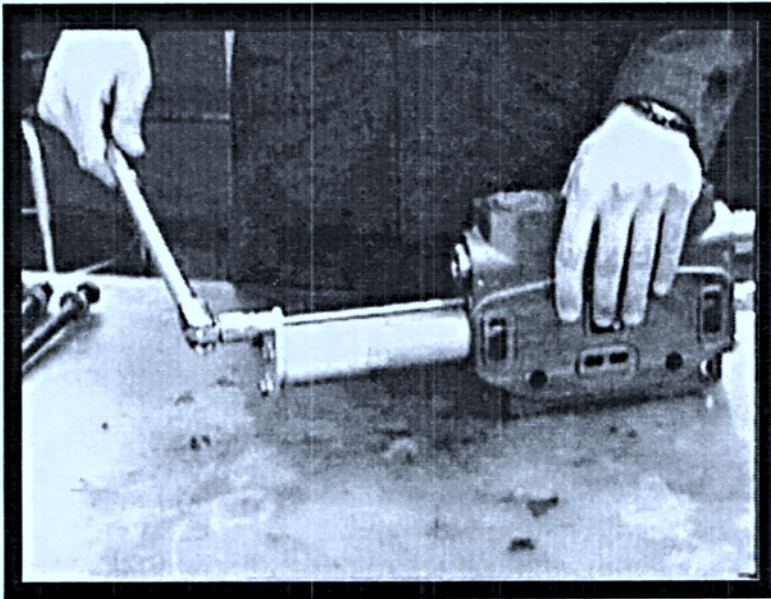
- | | | | |
|--------------------|---------------------|---------------------|-----------------------|
| 1. Retaining plate | 7. Seal retainer | 13. Wiper seal | 19. Cap screws (2) |
| 2. Spacer tube | 8. Spring retainer | 14. Piston rod | 20. Spool Seals (2) |
| 3. Spacer | 9. Stripper bolt | 15. O-rings (2) | 21. Back up rings (2) |
| 4. Flange | 10. Stop tube | 16. Wiper seals (2) | |
| 5. Pressure tube | 11. Spring | 17. Retainer plate | |
| 6. Piston | 12. Spring retainer | 18. Washers (2) | |

Single-Ended Pneumatic Cap Figure 4



SEAL PARTS LIST - Figure 4

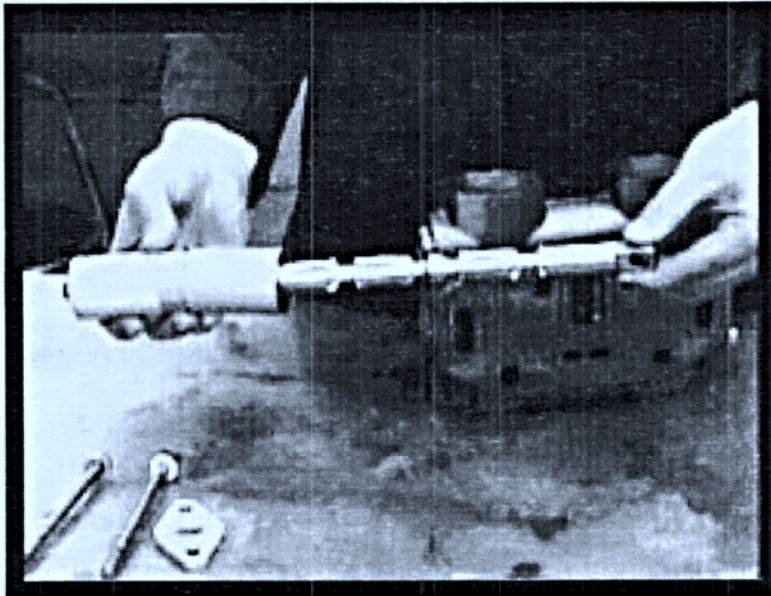
Item	Description	Qty.	VA/VG20™	VA/VG35™
13.	Wiper seal	1	391 2883 165	391 2883 165
15.	O-rings	2	391 2881 625	391 2881 625
16.	Wiper seals	2	391 2883 164	391 2883 164



Step 1 - Pneumatic Endcap

Remove the two, hex-head cap screws (Fig. 4, item 19) and retainer plate (Fig. 4, item 17). Since Loctite™ was used to hold fasteners, slide the Endcap and spool out of the valve body as one assembly.

Remove the two, retainer screws (not shown) from the clevis end of the spool, lightly tapping the end of the screwdriver handle with a hammer to break adhesive. Remove the two, retainer plates, back-up ring and spool seal. Discard the spool seals and back-up rings from both ends of the work section.



Step 2 - Spacer Tube

Next, slide the spacer tube (Fig. 4, item 2) off of the spool to expose the spring (Fig. 4, item 11) and spring retainers (Fig. 4, items 8 and 12). Disconnect the piston rod (Fig. 4, item 14) from the stripper bolt (Fig. 4, item 9). Slide the spacer (Fig. 4, item 3,) and flange (Fig. 4, item 4) off the piston rod. Remove the wiper seal (Fig. 4, item 13) and O-ring (Fig. 4, item 15) from the flange and discard.



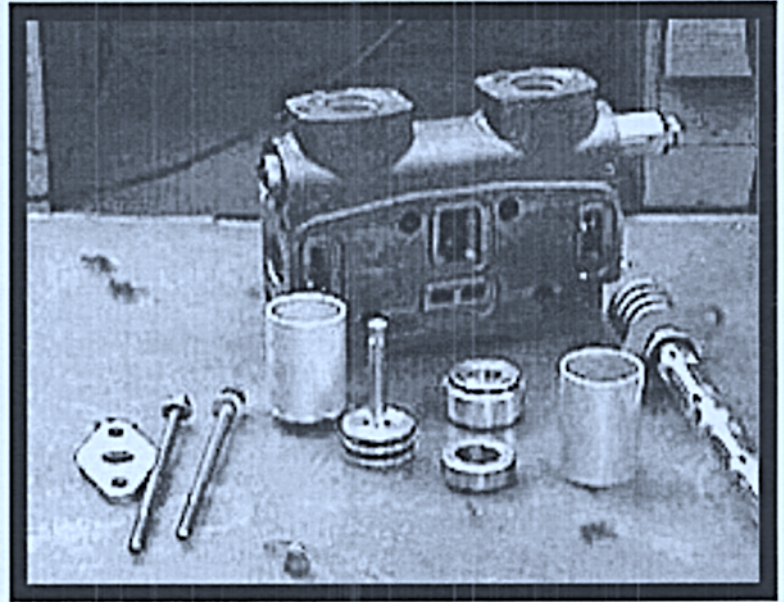
Step 3 - Spool Identification

The spool should now be tagged or marked with the respective, work-section identification number (see Step 1, page 6).

Pneumatic Section Disassembly

Step 4 - Pneumatic Endcap

Slide piston (Fig. 4, item 6) and piston rod assembly out of the pressure tube, exposing the two, wiper seals (Fig. 4, item 16). Remove the wiper seals and discard. Insert a screwdriver handle into the pressure tube and dislodge the seal retainer (Fig. 4, item 7). Remove the O-ring (Fig. 4, item 15) and discard.



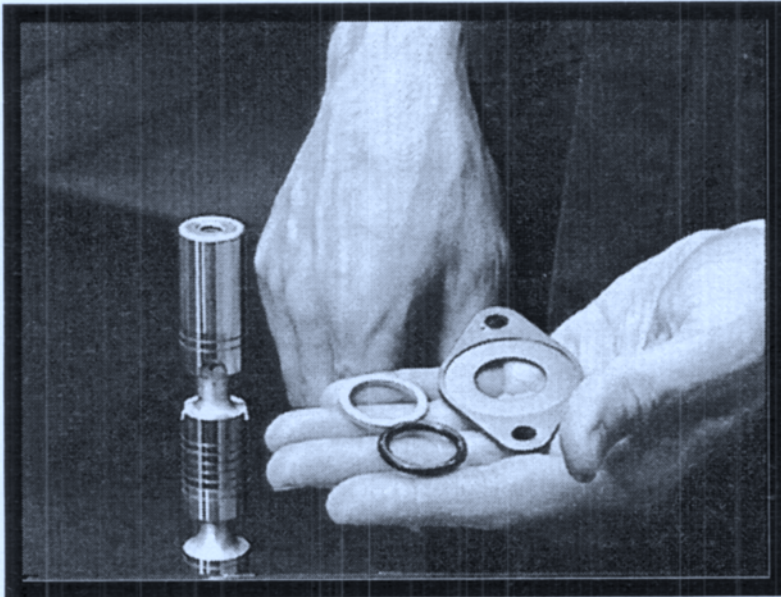
Step 5 - Stripper Bolt

The spring assembly should not be removed from the spool unless these parts are being replaced. Carefully place the spool clevis in a soft-jawed vise. Lightly tap the stripper bolt with a hammer and punch to break the adhesive. If it does not release, cautiously apply heat.

Caution: Too much heat may distort the spool.

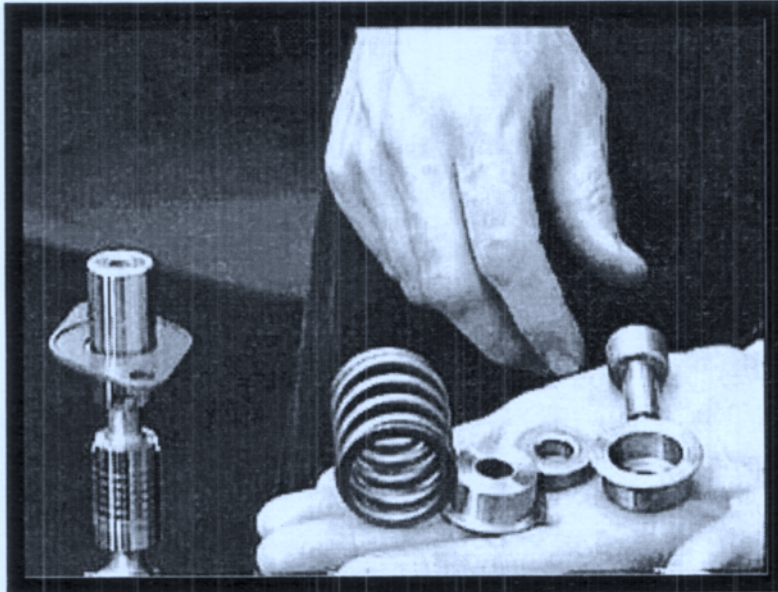
As the stripper-bolt threads disengage, the spring (Fig. 4, item 11) and spring retainers (Fig. 4, items 8 and 12) will release abruptly.





Step 1 - Spool Assembly

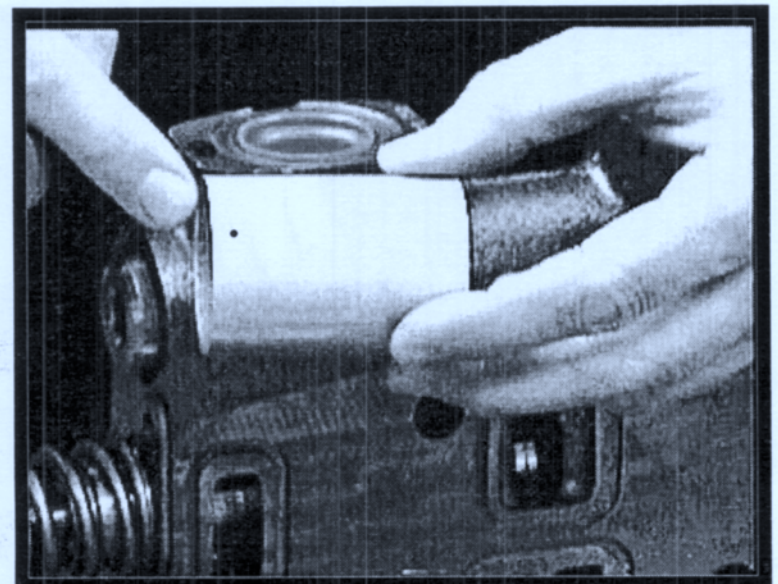
Clamp the flat, clevis end of the control spool in a soft-jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 4, item 20) and slide it onto the end of the spool, away from the clevis. Slide on the back up ring (Fig. 4, item 21) and retainer plate (Fig. 4, item 6). Position these items onto the spool so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches.



Step 2 - Spring Assembly

Apply 2 - 3 drops of Loctite RC680™ or equivalent, anaerobic adhesive near the middle of the female threads in the spool. Place the spring retainer (Fig. 4, item 8) over the end of the spool followed by the centering spring (Fig 4, item 11). Place the stop tube (Fig. 4, item 10) in the spring and cap with the other spring retainer (Fig. 4, item 12). Insert the stripper bolt (Fig. 4, item 9) and torque to 180 in. lbs..

Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage seals. Be certain the spool and the housing are in their original orientation.



Step 3 - Spacer Tube

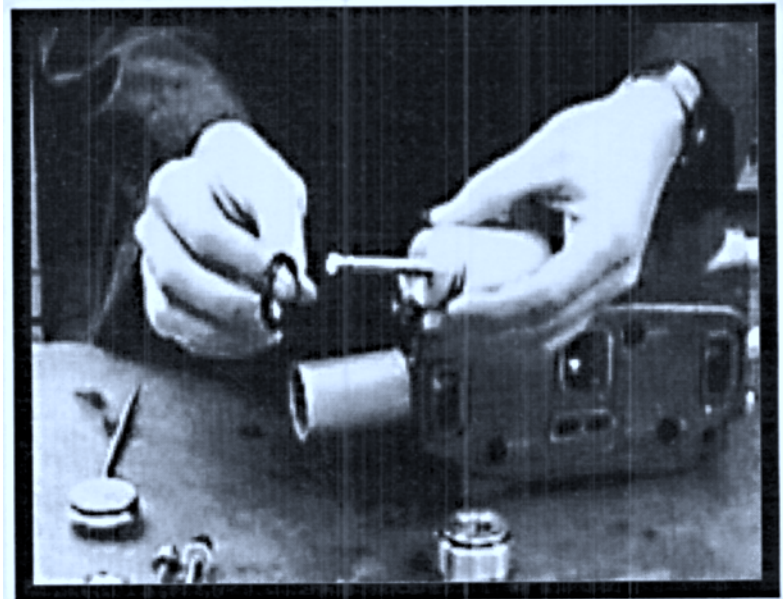
Install the spacer tube (Fig. 4, item 2) over the spring with the vent hole positioned away from the section casting.

Step 4 - Air Piston Assembly

Apply Parker Super-O-Lube™ to the wiper seals (Fig. 4, item 16) and install one seal in the groove farthest from the piston rod (Fig. 4, item 6). The wiper seal has a cup design that must be installed with the open cup facing the end of the piston. Slide the piston, rod-end first, into the pressure tube (Fig. 4, item 5).

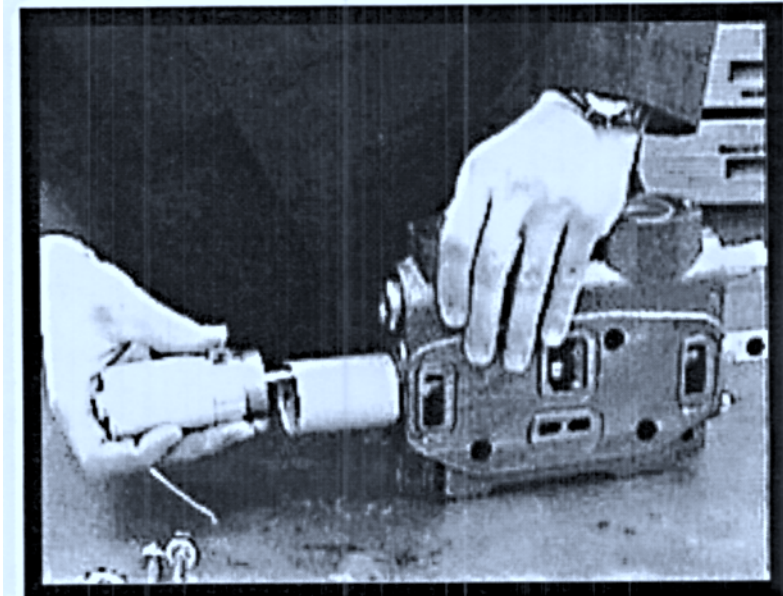


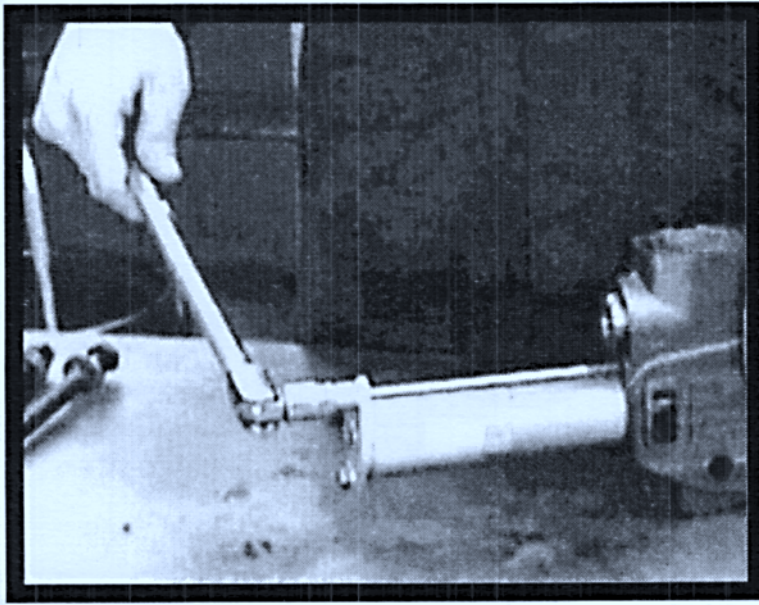
Push the piston through the pressure tube and expose the wiper seal groove closest to the rod. Install the second wiper seal with open cup facing the piston rod. Slide the piston into the pressure tube and leave the piston rod extended beyond the pressure tube.



Step 5 - Piston Subassembly

Apply Parker Super-O-Lube™ to the wiper seal (Fig. 4, item 13) and O-rings (Fig. 4, item 15). Facing the open cup inward, squeeze the wiper seal and insert it into the flange's seal groove (Fig. 4, item 4). Install one O-ring (Fig. 4, item 15) on the flange. Carefully slide the flange onto the piston rod. Pull the piston rod through the flange until the piston bottoms on the flange. Slide the spacer (Fig. 4, item 3) over the piston rod. Insert the end of the piston rod into the slot in the stripper bolt.





Step 6 - Endcap Assembly

Place the remaining O-ring (Fig. 4, item 15) on the seal retainer (Fig. 4, item 7). Install the retainer plate (Fig. 4, item 17) over the seal retainer (Fig. 4, item 7). Apply 2 to 3 drops of Loctite 262™ inside the tapped holes in the housing. Place the washers (Fig. 4, item 18) on the 6 1/4" cap screws (Fig. 4, item 19). Push the cap screws through the retainer plate and screw them into the valve housing. Make sure all parts are properly aligned and seated. Torque the cap screws to 25 - 30 in. lbs.

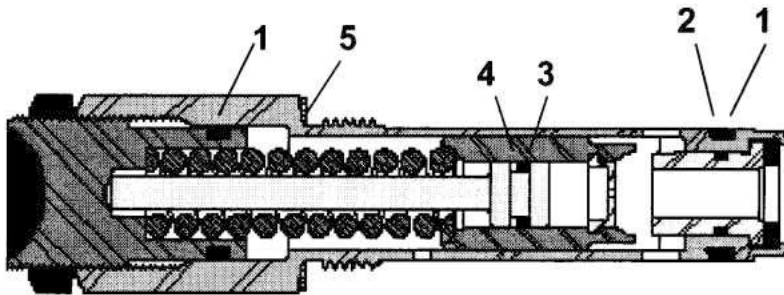
CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. The product should be thoroughly tested to ensure proper operation before the valve is placed back into service.

Cutaways for Main Relief Valves

Main System Relief Valve

The main relief valve protects the hydraulic system against overload pressures. It is typically located in the inlet casting and the mid-inlet sections used in the valve bank. Figure 6 illustrates the arrangement of the parts and serviceable seals for the differential-area main relief valve. Figure 7 illustrates the serviceable components found in the pilot-operated main relief. These cartridge-type relief valves are removed from the valve bank as a subassembly and replaced or serviced.

Figure 6



SERVICE PARTS LIST - Figure 6

Item	Description	Qty	VA/VG20™	VA/VG35™
1.	O-rings	2	391-2881-332	391-2881-336
2.	Back up Ring	1	391-2681-373	.....
3.	O-ring	1	391-2881-156	391-2881-137
4.	Back up Ring	1	391-2681-163	391-2681-165
5.	Gasket Washer	1	391-1583-013	391-1583-012

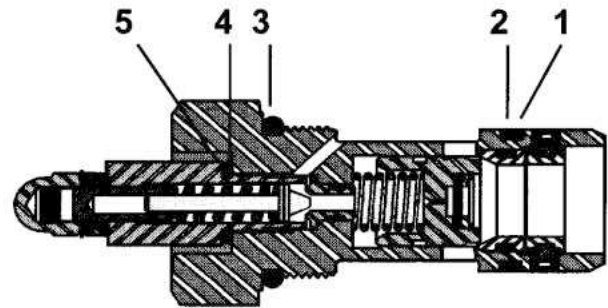
*All seals in the relief cartridge are not serviceable.

VA20/VG20™, VA35/VG35™

Main Differential Area Relief Valve Part Numbers:

- 355-9107-035
- 355-9107-061
- 355-9107-013
- 355-9001-082
- 355-9107-385

Figure 7



SERVICE PARTS LIST - Figure 7

Item	Description	Qty	VG80™
1.	O-ring	1	391-2881-342
2.	Back up Ring	1	391-2681-303
3.	O-ring	1	391-2881-344
4.	O-ring	1	391-2881-208
5.	Gasket Washer	1	391-1581-001

*All seals in the relief cartridge are not serviceable.

VG80™ Main Pilot Operated Relief Valve Part Numbers:

- 355-9001-008
- 355-9001-031

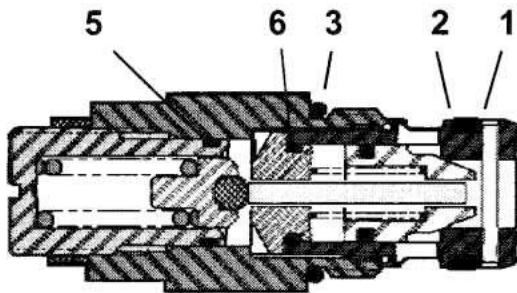
NOTE: When installing relief valve, torque to 75 ft. lbs.

Work Port Relief Valve Options

The full-flow work port relief valve normally functions when the valve spool is in the neutral position. During over pressurization, fluid is discharged from the work-port passage into the tank-return passage of the valve work section. The pressure setting is normally higher than that of the main, relief valve.

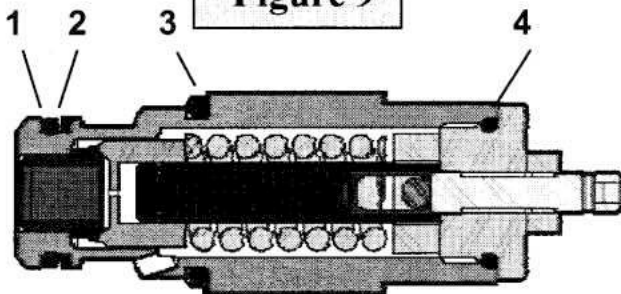
Avoid setting the main and port relief valves at the same pressure setting. If these relief-valve settings are set too close, interaction will occur causing chatter and possible instability of the load.

Figure 8



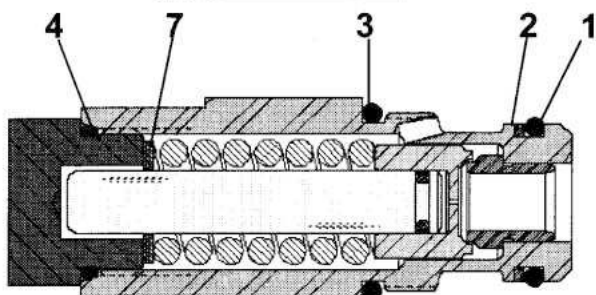
Pilot operated with anti-cavitation
355-9001-115

Figure 9



Differential area - screw adjusted
355-900X-308

Figure 10



Differential area - shim adjusted
355-900X-143

SERVICE PARTS LIST FOR FIG. 8-10

Item	Description	Qty.	Part No.
1.	O-ring	1	391-2881-333
2.	Back up Ring	1	391-2681-510
3.	O-ring	1	391-2881-204
4.	O-ring	1	391-2881-246
5.	O-ring	1	391-2881-801
6.	O-ring	1	391-2881-363
7.	Shims	...	see chart above

* All seals in the relief cartridge are not serviceable

NOTE: When installing relief valve, torque to 75 ft. lbs.

The pilot-operated, port relief (Fig. 8) with the anti-cavitation check can be used in all hi-boy work sections in the VA20/VG20™, VA/VG35™ and VG80™ series. The differential-area, work-port, relief valve (Fig. 9) can be used in VA20/VG20™, VA/VG35™ hi-boy sections if the section has the appropriate machining.

SHIMS FOR FIG. 10

Part No.	Pressure
391-3782-103	502 psi
391-3782-104	122 psi
391-3782-105	40 psi

Screw-Adjustable, Relief-Valve Pressure Ranges and Adjustments

<u>R/V #</u>	<u>Valve Series</u>	<u>Pressure Range - PSI</u>	<u>1/4 turns Part Equals PSI *</u>
355-9107-035	VA/VG20	800 - 2500	165
355-9001-061	VA/VG20	2501 - 3800	160
355-9107-013	VA/VG35	800 - 2000	80
355-9107-082	VA/VG35	2001 - 2500	121
355-9107-385	VA/VG35	2501 - 3500	249
355-9001-008	VG80	1000 - 2500	196
355-9001-031	VG80	2500 - 3500	290
355-9001-115	VA/VG20, 35, 80	500 - 5000	446
355-9001-308	VA/VG20, 35, 80	500 - 1250	95
355-9002-308	VA/VG20, 35, 80	1251 - 2650	138
355-9003-308	VA/VG20, 35, 80	2651 - 4200	188

*Adjustment pressures are approximate.

Guidelines for Setting Hydraulic, Relief-Valve Pressure :

- Release hydraulic pressure before connecting or disconnecting any gauge.
- Install an accurate pressure gauge as close to the pump as possible.
- Back-out the relief-valve adjustment screw without removing it.
- Warm the hydraulic oil by idling the engine with the power take-off and hydraulic pump engaged.
- As applicable, fully engage the control valve for the circuit being tested. Allow the cylinder to reach full extension.
- Raise the engine RPM to operating speed.
- If adjustment is necessary, do not bring the pressure to a higher setting then lower it to the desired setting. Obtain each final pressure by bringing the pressure gradually up to the proper setting.
- Tighten the lock nut and apply a sealant to avoid tampering.



Warning

Relief-valve pressures should be set according to the original, equipment manufacturer's specifications. Exceeding the specifications could cause a failure in the hydraulic system or with the mechanical structure of the equipment. These failures could cause serious personal injury or death.

DVA20 - DVG20 - VA20 - VG20 - VALVE SEAL KITS

NOTE: PART NUMBERS IN BOLD ARE DISTRIBUTOR PROGRAM ITEMS

PART NUMBER	KIT DESCRIPTION	APPLICATION / WHERE USED
391 1873 035 391 1803 055	SECTION SEAL KIT (BETWEEN SECTIONS)	INLET SECTIONS PARALLEL AND TANDEM WORKSECTIONS MIDSECTION INLET
391 1873 083	SECTION SEAL KIT (BETWEEN SECTIONS)	SERIES WORKSECTIONS
391 1873 036 391 1803 457	WORK SECTION REPAIR KIT (ALL SEALS)	MANUAL, PARALLEL, AND TANDEM WORKSECTIONS
391 1803 846	SPOOL SEAL KIT	STANDARD MANUAL WORKSECTIONS
391 1873 039 391 1803 469	MAIN-RELIEF SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 001, 391 1873 128 355 9107 035, 355 9001 061
391 1803 674	MAIN-RELIEF, PLUG SEAL KIT CONVERTIBLE-OUTLET, PLUG SEAL KIT	391 1873 002
391 1873 042 391 1803 737	SCREW ADJUSTED, PILOT-OPERATED, PORT RELIEF VALVE WITH ANTI-CAVITATION SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 006, 355 9001 115
391 1823 038	PORT-ACCESSORY SEAL KIT (EXTERNAL SEALS ONLY)	391 1873 006 , 355 9001 115 391 1873 007, 008, 009 355 900X 143 391 1873 010 , 355 9001 164 391 1873 011 , 391 2283 075
391 1873 037 391 1823 122	SLUG-ADJUSTED, RELIEF VALVE KIT (ALL SERVICEABLE SEALS)	391 1873 007, 008, 009 355 900X 143
391 1873 207 391 1803 387	PNEUMATIC, ENDCAP SEAL KIT (NEW COMMERCIAL INTERTECH DESIGN)	391 1873 206 , 391 1803 553
391 1803 694	PNEUMATIC, ENDCAP SEAL KIT (OLD RMH DESIGN)	391 1873 022 , 391 1803 606 391 1803 767

DVA35 - DVG35 - VA35 - VG35 - VALVE SEAL KITS**NOTE: PART NUMBERS IN BOLD ARE DISTRIBUTOR PROGRAM ITEMS**

PART NUMBER	KIT DESCRIPTION	APPLICATION / WHERE USED
391 1873 040 391 1803 093	SECTION SEAL KIT (BETWEEN SECTIONS)	INLET SECTIONS PARALLEL AND TANDEM WORK SECTIONS COMBINED-FLOW, MIDSECTION INLETS MIDSECTION SELECTORS
391 1803 150	SECTION SEAL KIT (BETWEEN SECTIONS)	SERIES WORK SECTIONS SPLIT-FLOW, MIDSECTION INLETS
391 1873 041 391 1803 722	WORK SECTION REPAIR KIT (ALL SEALS)	MANUAL, PARALLEL, AND TANDEM WORK SECTIONS
391 1823 121	WORK SECTION REPAIR KIT (ALL SEALS)	MANUAL, SERIES WORK SECTIONS
391 1823 146	WORK SECTION REPAIR KIT (ALL SEALS) AND TANDEM WORKSECTIONS	REMOTE, PARALLEL,
391 1873 044 391 1803 272	MAIN RELIEF-VALVE SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 003 , 355 9107 013 391 1873 004 , 355 9107 085 391 1873 137 , 355 9107 385
391 1803 682	MAIN RELIEF-VALVE PLUG SEAL KIT CONVERTIBLE-OUTLET, PLUG SEAL KIT	391 1873 005
391 1873 042 391 1803 737	SCREW ADJUSTED, PILOT-OPERATED, PORT RELIEF VALVE WITH ANTI-CAVITATION SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 006 , 355 9001 115
391 1823 038	PORT-ACCESSORY SEAL KIT (EXTERNAL SEALS ONLY)	391 1873 006 , 355 9001 115 391 1873 007, 008, 009 355 900X 143 391 1873 010 , 355 9001 164 391 1873 011 , 391 2283 075
391 1873 037 391 1823 122	SLUG-ADJUSTED, RELIEF VALVE KIT (ALL SERVICEABLE SEALS)	391 1873 007, 008, 009 355 900X 143
391 1873 207 391 1803 387	PNEUMATIC ENDCAP SEAL KIT (NEW COMMERCIAL INTERTECH DESIGN)	391 1873 203 , 391 1803 554
391 1803 695	PNEUMATIC ENDCAP SEAL KIT (OLD RMH DESIGN)	391 1873 203 , 391 1803 591
391 1823 121	WORK SECTION REPAIR KIT (ALL SEALS)	SERIES WORK SECTIONS

DVG80 - VG80 VALVE SEAL KITS

NOTE: PART NUMBERS IN BOLD ARE DISTRIBUTOR PROGRAM ITEMS

PART NUMBER	KIT DESCRIPTION	APPLICATION / WHERE USED
391 1873 160 391 1803 484	SECTION SEAL KIT (BETWEEN SECTIONS)	INLET SECTIONS ALL WORK SECTIONS
391 1873 161 391 1803 594	WORK SECTION REPAIR KIT (ALL SEALS)	MANUAL WORK SECTIONS
391 1823 101	MAIN, RELIEF-VALVE SEAL KIT (ALL SERVICEABLE SEALS)	355 9001 008, 031
391 1803 041	MAIN, RELIEF-VALVE SEAL KIT (EXTERNAL SEALS)	355 9001 008, 031
391 1803 054	MAIN, RELIEF-VALVE AND PLUG SEAL KIT (EXTERNAL SEALS)	391 1873 146, 391 1873 147 355 9001 103
391 1803 770	MAIN, RELIEF-VALVE SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 146 , 355 9001 103
391 1873 042 391 1803 737	SCREW-ADJUSTED, PILOT-OPERATED, PORT RELIEF VALVE WITH ANTI-CAVITATION SEAL KIT (ALL SERVICEABLE SEALS)	391 1873 006 , 355 9001 115
391 1823 038	PORT ACCESSORY SEAL KIT (EXTERNAL SEALS ONLY)	391 1873 006 , 355 9001 115 391 1873 011 , 391 2283 075 391 1873 010 , 355 9001 164
391 1823 175	WORK SECTION REPAIR KIT (ALL SEALS)	HYDRAULIC-REMOTE OPERATED

Troubleshooting

TROUBLE

PROBABLE CAUSE

REMEDY

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks between sections	Pinched, blown or missing section seal	Replace section seal
	Stud fasteners not correctly torqued	Replace section seals and re-torque
	Mounting plate not level	Loosen mounting bolts and shim as required
	Contamination/burrs on seal	Clean seal groove, replace section seal
Oil leaks at either end of spool	Over-pressurized tank core	Correct high, back-pressure condition
	Worn or damaged spool seals	Replace seals and seal retainers
Spring - centered spools do not return to neutral	Broken centering spring	Replace centering spring
	Misalignment of operating linkage	Check linkage for mechanical binding
	Foreign particles in system	Clean valve and system
Load will not hold	Cylinder leaking or worn	Check cylinder - repair
	Port relief valve not holding	Remove and clean or replace
	Spool or housing scored or worn excessively	Replace section
Load drops when spool moved from neutral	Dirt or foreign particles lodged between check-valve poppet and seat	Disassemble, clean & reassemble
	Scored or sticking check-valve poppet	Replace poppet
No motion, slow, or erratic system operation	Worn pump	Check flow & pressure
	Defective cylinder or motor	Repair or replace
	Low-reservoir oil level	Add oil to specifications
	Clogged suction strainer	Clean or replace
	Suction line restricted	Check lines
	Relief valve not properly set	Check pressure setting
	Relief valve poppet or seat scored & sticking open	Replace relief valve
Valve spool not shifted to full stroke	Check spool linkage travel	

Offer of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any such items, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from Parker Hannifin Corporation. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED. NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.**

5. Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges

paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property, Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. Patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights. If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

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