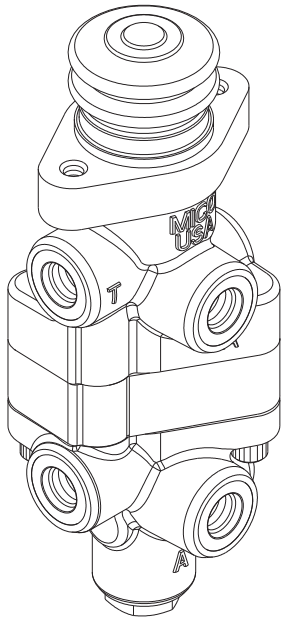
TANDEM MODULATING VALVE

Service Instructions

TABLE 1 (Specifications)

Complete Unit Model Number	Valve Assembly Number	Repair Kit Number	Primary Brake Port Pressure Setting		Secondary Brake Port Pressure Setting	
			bar	(PSI)	bar	(PSI)
06-466-243	20-100-874	06-400-186	86.2 ± 3.5	(1250 ± 50)	85.6	(1242)
06-466-261	20-200-022	06-400-186	103.4 ± 5.2	(1500 ± 75)	80.0	(1160)
06-466-294	n/a	06-400-186	69.0 ± 3.5	(1000 ± 50)	102.7	(1490)
06-466-374	20-200-234	06-400-186	86.2 ± 3.5	(1250 ± 50)	85.6	(1242)
06-466-419	20-200-030	06-400-186	89.6 ± 5.2	(1300 ± 75)	36.9	(535)
06-466-436	20-100-946	06-400-186	131.0 ± 6.9	(1900 ± 100)	73.8	(1070)
06-466-441	20-200-032	06-400-186	134.4 ± 3.5/-6.9	(1950 ± 50/-100)	94.5	(1370)
06-466-518	20-200-128	06-400-186	116.5 ± 5.2	(1690 ± 75)	67.9	(985)
06-466-554	20-200-152	06-400-186	155.1 ± 6.9	(2250 ± 100)	70.0	(1430)
06-466-574	20-200-226	06-400-186	155.1 ± 6.9	(1160 ± 50)	29.3	(425)
06-466-911	20-100-882	06-400-186	103.4 ± 3.5	(1500 ± 50)	30.0	(435)
06-466-921	20-100-915	06-400-186	150.0 ± 5.2	(2175 ± 75)	86.5	(1255)
06-466-962	20-100-630	06-400-186	137.9 ± 3.5	(2000 ± 50)	39.3	(570)
06-466-998	n/a	06-400-186	103.4 ± 3.5	(1500 ± 50)	29.3	(425)
06-466-999	n/a	06-400-186	69.0 ± 3.5	(1000 ± 50)	29.7	(430)
20-100-828	n/a	06-400-186	103.4 ± 3.5	(1500 ± 50)	29.7	(430)

NOTE: If your product number is not listed, contact ZF Off-Highway Solutions Minnesota Inc. for information.



(20-100-828 shown)

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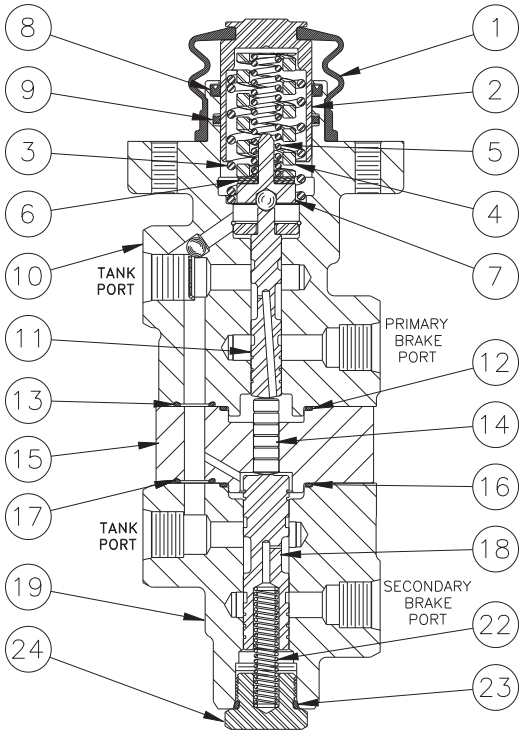

FIGURE 1

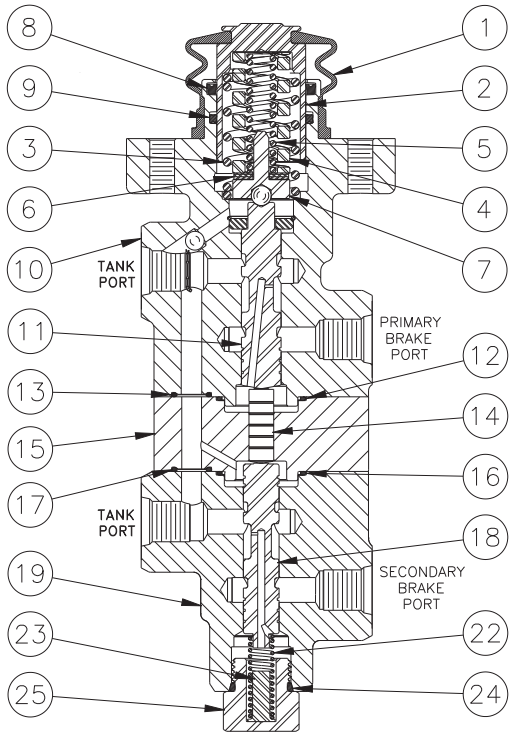

FIGURE 2

⚠ WARNING

Installation and test note: Piston (2) must be retained mechanically. This will prevent it from blowing out at high velocity if an incorrect connection occurs from power source to tank ports. **Be sure the tank portsare connected directly to tank.** Failure to do this can result in serious injury or death.

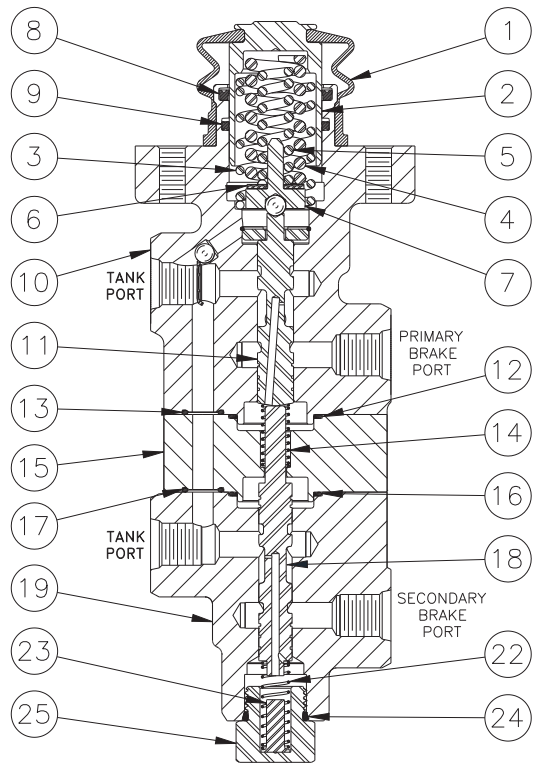

FIGURE 3

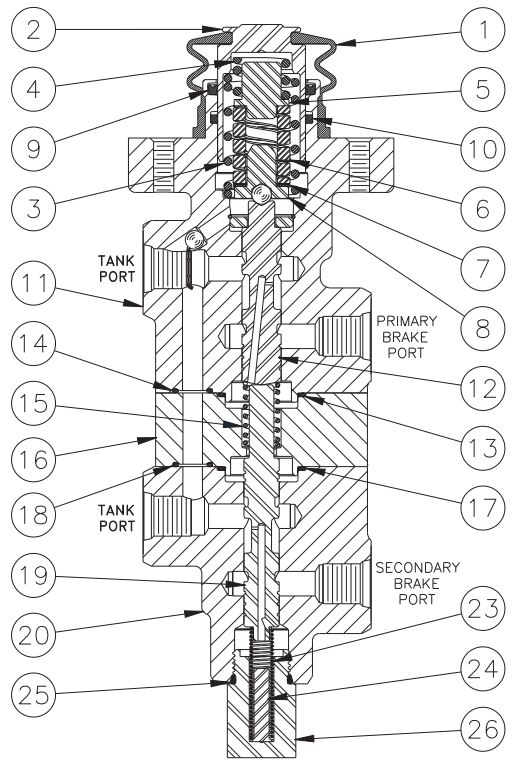

FIGURE 4

Models: 06-466-261 06-466-554
06-466-574 06-466-911
06-466-962 06-466-998
20-100-828

DISASSEMBLY
(Refer to Figures 1 and 5)

NOTE
Housings (10 & 19) and spools (11 & 18), spacer (15) and spool (14) are manufactured as matched sets. These sets must not be intermixed with other parts.

1. Remove boot (1) from piston (2) and housing (10).
2. Remove piston (2), springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) from housing (10). Not all models use spring (5). **NOTE: Be aware of the number of shim(s) (6) being removed from housing (10).**
3. Carefully remove cup (8) and seal (9) from housing (10) bore. **NOTE: Be careful not to scratch or mar housing bore.**
4. Remove end plug (24) and spring (22) from housing (19). Remove o-ring (23) from end plug (24).
5. Separate housings (10 & 19) and spacer (15) by removing cap screws (21) and washers (20). Remove o-rings (12, 13, 16, & 17) from housings (10 & 19) and spacer (15).
6. Carefully remove spools (11 & 18) from housings (10 & 19) and spool (14) from spacer (15). **NOTE: Be careful not to damage spools or housing bores.**

⚠ CAUTION
Do not intermix spools & housings. Spool (11) and housing (10) are a matched set, as are spool (18) and housing (19), and spool (14) and spacer (15).

ASSEMBLY
(Refer to Figures 1 and 5)

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Lubricate spool (11) with clean system fluid and carefully slide into bottom end of housing (10) bore. Note direction of spool (11). **NOTE: Spool must slide freely into bore. If either part is damaged, new valve assembly may be required.**
3. Lubricate spool (14) and carefully slide into spacer (15). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
4. Install new o-rings (12, 13, 16, & 17) in proper o-ring pockets on housings (10 & 19) and spacer (15).
5. Reassemble housings (10 & 19) and spacer (15) using cap screws (21) and washers (20). Use Loctite 242 on cap screws (21) and torque 29.8-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line-up correctly and o-rings (12, 13, 16, & 17) remain in their pockets during assembly.**
6. Lubricate spool (18) with clean system fluid and carefully slide into housing (19) bore. Note direction of spool (18). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**

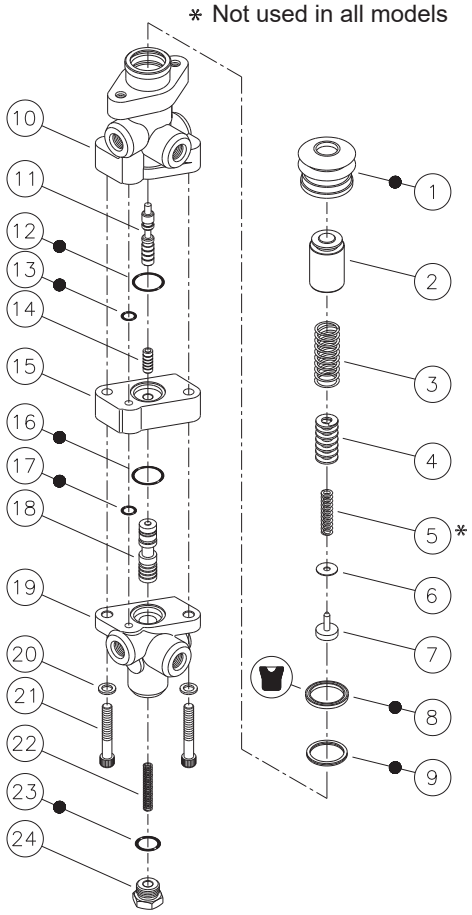

FIGURE 5

7. Install new o-ring (23) on end plug (24).
8. Install spring (22) and end plug (24) into housing (19). Torque end plug (24) 47.5-54.2 N·m (35-40 lb·ft).
9. Carefully install new cup (8) and new seal (9) into housing (10) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**
10. Install springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) in piston (2). Not all models use spring (5).
11. Carefully install piston (2) assembly into housing (10) bore.
12. Install new boot (1) on housing (10) and piston (2).

NOTE
After service, the valve must develop primary brake port pressure as indicated in the specifications, TABLE 1. Shim(s) (6) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if brake pressure setting is not able to be obtained.

Models: 06-466-294 06-466-419 06-466-436
06-466-441 06-466-518 06-466-921
06-466-999

DISASSEMBLY
(Refer to Figures 2 and 6)

NOTE
Housings (10 & 19) and spools (11 & 18), spacer (15) and spool (14) are manufactured as matched sets. These sets must not be intermixed with other parts.

1. Remove boot (1) from piston (2) and housing (10).
2. Remove piston (2), springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) from housing (10). Not all models use spring (5). **NOTE: Be aware of the number of shim(s) (6) being removed from housing (10).**
3. Carefully remove cup (8) and seal (9) from housing (10) bore. **NOTE: Be careful not to scratch or mar housing bore.**
4. Remove end plug (25), retainer (23), and spring (22) from housing (19). Remove o-ring (24) from end plug (24).
5. Separate housings (10 & 19) and spacer (15) by removing cap screws (21) and washers (20). Remove o-rings (12, 13, 16, & 17) from housings (10 & 19) and spacer (15).
6. Carefully remove spools (11 & 18) from housings (10 & 19) and spool (14) from spacer (15). **NOTE: Be careful not to damage spools or housing bores.**

⚠ CAUTION
Do not intermix spools & housings. Spool (11) and housing (10) are a matched set, as are spool (18) and housing (19), and spool (14) and spacer (15).

ASSEMBLY
(Refer to Figures 2 and 6)

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Lubricate spool (11) with clean system fluid and carefully slide into bottom end of housing (10) bore. Note direction of spool (11). **NOTE: Spool must slide freely into bore. If either part is damaged, new valve assembly may be required.**
3. Lubricate spool (14) and carefully slide into spacer (15). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
4. Install new o-rings (12, 13, 16, & 17) in proper o-ring pockets on housings (10 & 19) and spacer (15).
5. Reassemble housings (10 & 19) and spacer (15) using cap screws (21) and washers (20). Use Loctite 242 on cap screws (21) and torque 29.8-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line-up correctly and o-rings (12, 13, 16, & 17) remain in their pockets during assembly.**
6. Lubricate spool (18) with clean system fluid and carefully slide into housing (19) bore. Note direction of spool (18). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**

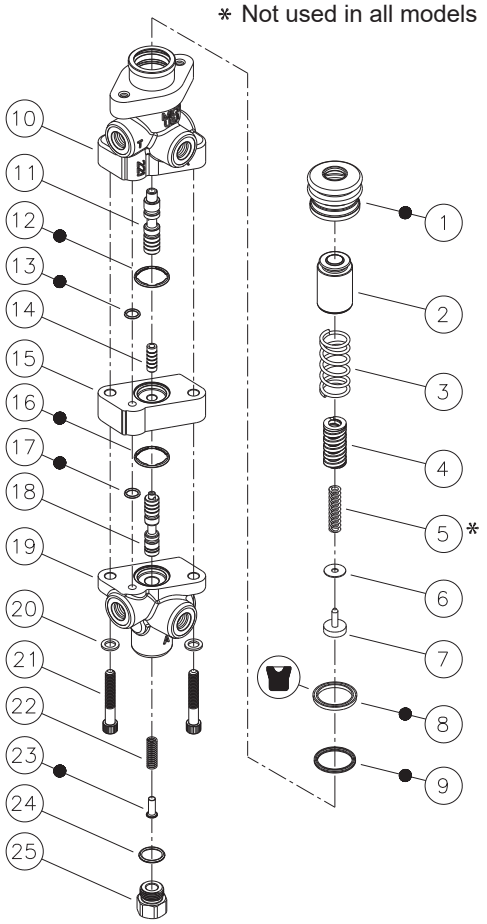

FIGURE 6

7. Install new o-ring (24) on end plug (25).
8. Install retainer (23), spring (22), and end plug (25) into housing (19). Torque end plug (25) 47.5-54.2 N·m (35-40 lb·ft).
9. Carefully install new cup (8) and new seal (9) into housing (10) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**
10. Install springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) in piston (2). Not all models use spring (5).
11. Carefully install piston (2) assembly into housing (10) bore.
12. Install new boot (1) on housing (10) and piston (2).

NOTE
After service, the valve must develop primary brake port pressure as indicated in the specifications, TABLE 1. Shim(s) (6) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if brake pressure setting is not able to be obtained.

DISASSEMBLY
(Refer to Figures 3 and 7)

NOTE
Housing (10) and spool (11), and housing (19) and spool (18) are manufactured as matched sets. These sets must not be intermixed with other parts.

1. Remove boot (1) from piston (2) and housing (10).
2. Remove piston (2), springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) from housing (10). Not all models use spring (5). **NOTE: Be aware of the number of shim(s) (6) being removed from housing (10).**
3. Carefully remove cup (8) and seal (9) from housing (10) bore. **NOTE: Be careful not to scratch or mar housing bore.**
4. Remove end plug (25), retainer (23), and spring (22) from housing (19). Remove o-ring (24) from end plug (25).
5. Separate housings (10 & 19) and spacer (15) by removing cap screws (21) and washers (20). Remove o-rings (12, 13, 16, & 17) and spring (14) from housings (10 & 19) and spacer (15).
6. Carefully remove spools (11 & 18) from housings (10 & 19). **NOTE: Be careful not to damage spools or housing bores.**

⚠ CAUTION
Do not intermix spools & housings. Spool (11) and housing (10) are a matched set, as are spool (18) and housing (19).

ASSEMBLY
(Refer to Figures 3 and 7)

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Lubricate spool (11) with clean system fluid and carefully slide into bottom end of housing (10) bore. Note direction of spool (11). **NOTE: Spool must slide freely into bore. If either part is damaged, new valve assembly may be required.**
3. Install spring (14) in spacer (15).
4. Install new o-rings (12, 13, 16, & 17) in proper o-ring pockets on housings (10 & 19) and spacer (15).
5. Reassemble housings (10 & 19) and spacer (15) using cap screws (21) and washers (20). Use Loctite 242 on cap screws (21) and torque 29.8-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line-up correctly and o-rings (12, 13, 16, & 17) remain in their pockets during assembly.**
6. Lubricate spool (18) with clean system fluid and carefully slide into housing (19) bore. Note direction of spool (18). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**

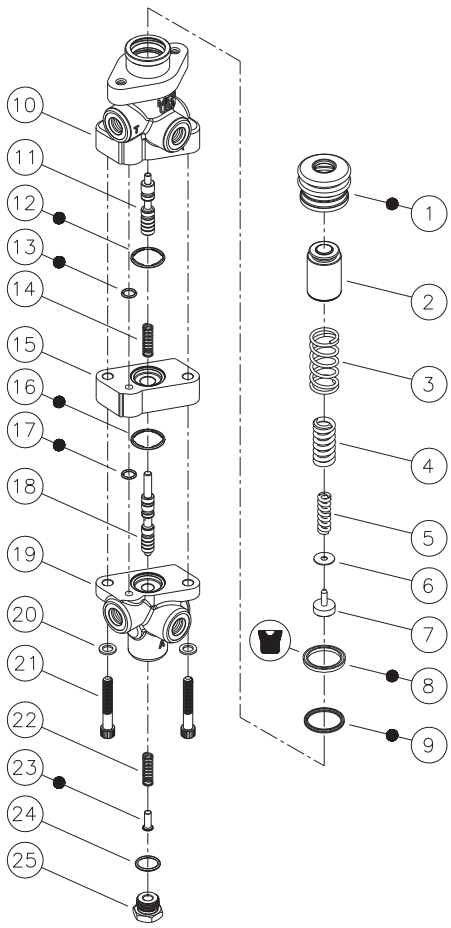

FIGURE 7

7. Install new o-ring (24) on end plug (25).
8. Install spring (22) and end plug (25) into housing (19). Torque end plug (25) 47.5-54.2 N·m (35-40 lb·ft).
9. Carefully install new cup (8) and new seal (9) into housing (10) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**
10. Install springs (3, 4, & 5), shim(s) (6), and retainer assembly (7) in piston (2).
11. Carefully install piston (2) assembly into housing (10) bore.
12. Install new boot (1) on housing (10) and piston (2).

NOTE
After service, the valve must develop primary brake port pressure as indicated in the specifications, TABLE 1. Shim(s) (6) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if brake pressure setting is not able to be obtained.

DISASSEMBLY
(Refer to Figures 4 and 8)

NOTE
Housings (11) and spool (12), and housing (20) and spool (19) are manufactured as matched sets. These sets must not be intermixed with other parts.

1. Remove boot (1) from piston (2) and housing (11).
2. Remove piston (2), springs (3 & 4), retainer (5), spring (6), shim(s) (7), and and retainer assembly (8) from housing (11). **NOTE: Be aware of the number of shim(s) (7) being removed from housing (11).**
3. Carefully remove cup (9) and seal (10) from housing (11) bore. **NOTE: Be careful not to scratch or mar housing bore.**
4. Remove end plug (26), retainer (24), and spring (23) from housing (20). Remove o-ring (25) from end plug (26).
5. Separate housings (11 & 20) and spacer (16) by removing cap screws (22) and washers (21). Remove o-rings (13, 14, 17, & 18) and spring (15) from housings (11 & 20) and spacer (16).
6. Carefully remove spools (12 & 19) from housings (11 & 20) and spacer (16). **NOTE: Be careful not to damage spools or housing bores.**

⚠ CAUTION
Do not intermix spools & housings. Spool (12) and housing (11) are a matched set, as are spool (19) and housing (20).

ASSEMBLY
(Refer to Figures 4 and 8)

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Lubricate spool (12) with clean system fluid and carefully slide into bottom end of housing (11) bore. Note direction of spool (12). **NOTE: Spool must slide freely into bore. If either part is damaged, new valve assembly may be required.**
3. Install spring (15) in spacer (16).
4. Install new o-rings (13, 14, 17, & 18) in proper o-ring pockets on housings (11 & 20) and spacer (16).
5. Reassemble housings (11 & 20) and spacer (16) using cap screws (22) and washers (21). Use Loctite 242 on cap screws (22) and torque 29.8-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line-up correctly and o-rings (13, 14, 17, & 18) remain in their pockets during assembly.**
6. Lubricate spool (19) with clean system fluid and carefully slide into housing (20) bore. Note direction of spool (19). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**

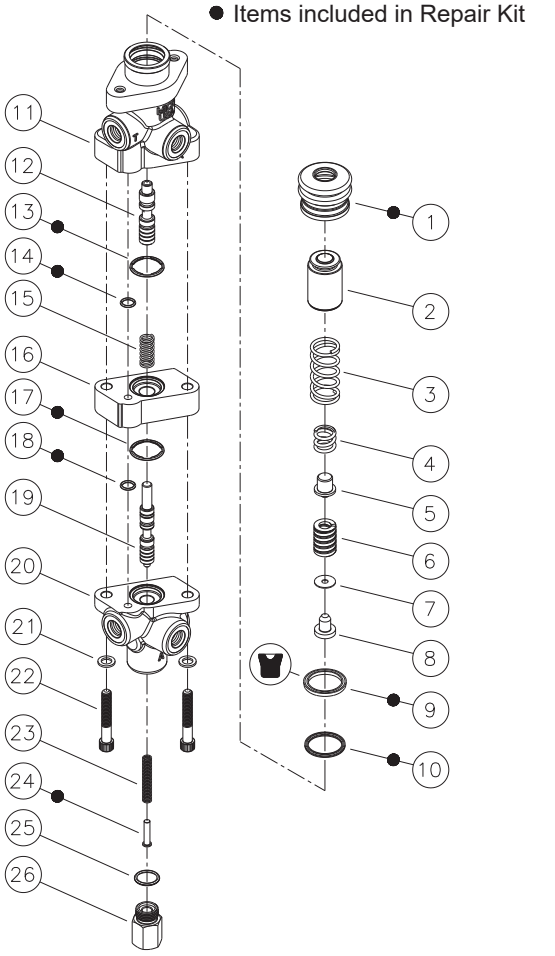

FIGURE 8

7. Install new o-ring (25) on end plug (26).
8. Install retainer (24), spring (23), and end plug (26) into housing (20). Torque end plug (26) 47.5-54.2 N·m (35-40 lb·ft).
9. Carefully install new cup (9) and new seal (10) into housing (11) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**
10. Install springs (3 & 4), retainer (5), spring (6), shim(s) (7), and retainer assembly (8) in piston (2).
11. Carefully install piston (2) assembly into housing (11) bore.
12. Install new boot (1) on housing (11) and piston (2).

NOTE
After service, the valve must develop primary brake port pressure as indicated in the specifications, TABLE 1. Shim(s) (7) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesoate Inc. if brake pressure setting is not able to be obtained.

BLEEDING

Brake lines should be bled very carefully as soon as the valve is installed in the machine. Air in the system will not allow the brakes to release properly and may severely damage them.

1. Start engine and allow accumulator to reach full charge. Shut down engine, then slowly apply and release brakes, waiting one minute between applications until brakes will not apply. Repeat this step three times.
2. Operate engine to maintain accumulator pressure within working limits throughout the bleeding procedure.
3. Open bleeder screw at wheel closest to brake valve and apply brakes cautiously until all air is bled out of line. Then close bleeder screw. Repeat this step at each wheel, moving to the next farthest wheel from the brake valve each time, as follows:
   a. Left front
   b. Right front
   c. Right rear
   d. Left rear
4. Release brake pressure for at least one (1) minute.
5. Apply brakes, holding pedal down 10 seconds; then release pressure for one (1) minute. Repeat this step two more times.

SERVICE CHECKS FOR 466 SERIES POWER BRAKE VALVES

BRAKES SLOW TO APPLY

1. No or improper gas charge in accumulator
1. **Check gas charge**
2. Brakes not properly adjusted
2. **Adjust brakes**
3. Inoperative brakes
3. **Check brakes**
4. Hydraulic lines or fittings leaking
4. **Check for leaks and repair**
5. Inoperative automatic adjuster
5. **Check adjuster operation**
6. Damaged hydraulic brake lines
6. **Check lines for dents that restrict flow of oil**
8. Brake valve inoperative
8. **Replace valve**
9. Inoperative system relief valve
9. **Check pressure in pressure line to valve**
10. Worn pump
10. **Check pressure in pressure line to valve**

EXCESSIVE BRAKING

1. Inoperative brakes
1. **Check brakes**
2. Inoperative brake valve
2. **Replace brake valve**

INSUFFICIENT BRAKES

1. No oil or low oil level in tank
1. **Check oil level in tank**
2. Brakes not properly adjusted
2. **Check brake adjustment**
3. Oil or grease on brake lining
3. **Clean or install new linings**
4. Brake line damaged
4. **Check lines and replace**
5. Inoperative automatic adjusters
5. **Check operation of adjusters**
6. No or improper gas charge in accumulator
6. **Check gas charge**
7. Inoperative brakes
7. **Check brakes**

BRAKES WILL NOT RELEASE COMPLETELY

1. Brakes not properly adjusted
1. **Adjust brakes**
2. Inoperative brakes
2. **Check brakes**
3. Pedal angle out of adjustment
3. **Adjust pedal angle**
4. Inoperative wheel cylinders
4. **Replace wheel cylinders**
5. Inoperative automatic adjuster
5. **Check operation of adjusters**
6. Air in brakes (when automatic adjusters used Goodrich Hi-torque Brakes only)
6. **Bleed brakes**
7. Pressure on return line too high
7. **Reduce pressure**
8. Inoperative brake valve
8. **Replace brake valve**

NO BRAKES

1. No oil in hydraulic system
1. **Check oil level in tank**
2. Broken or damaged brake line
2. **Check lines for breaks or damaged condition**
3. Brakes not properly adjusted
3. **Adjust brakes**
4. Inoperative system relief valve
4. **Check pressure in pressure line to valve**
5. Worn pump
5. **Check pressure in pressure line to valve**
6. Inoperative automatic adjuster
6. **Check brake line pressure**
7. Inoperative or worn brakes
7. **Check brakes**
8. Inoperative brake valve
8. **Replace brake valve**

PEDAL KICKBACK WHEN BRAKES ARE APPLIED

1. Air in brakes
1. **Bleed brakes**

SERVICE DIAGNOSIS

(Refer to Figures 5, 6, and 7)

BRAKES WILL NOT RELEASE COMPLETELY

1. Piston (2) binding
2. Pedal angle out of adjustment
3. Spring (22) broken

BRAKES WILL NOT RELEASE

1. Binding spools (11 & 18)
2. Piston (2) binding

NO BRAKES

1. Piston (2) binding
2. Broken spring (4)

OUTLET PRESSURE TOO HIGH (EXCESSIVE BRAKING)

1. Too many shims (6) installed in valve.

EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE APPLIED

1. Damaged spools (11 & 18)
2. Damaged housings (10 & 19)

EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE NOT BEING USED

1. Damaged spools (11 & 18)
2. Damaged housings (10 & 19)

INSUFFICIENT BRAKES

1. Pedal travel is inhibited

SERVICE DIAGNOSIS

(Refer to Figure 8)

BRAKES WILL NOT RELEASE COMPLETELY

1. Piston (2) binding
2. Pedal angle out of adjustment
3. Spring (23) broken

BRAKES WILL NOT RELEASE

1. Binding spools (12 & 19)
2. Piston (2) binding

NO BRAKES

1. Piston (2) binding
2. Broken spring (4)

OUTLET PRESSURE TOO HIGH (EXCESSIVE BRAKING)

1. Too many shims (7) installed in valve.

EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE APPLIED

1. Damaged spools (12 & 19)
2. Damaged housings (11 & 20)

EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE NOT BEING USED

1. Damaged spools (12 & 19)
2. Damaged housings (11 & 20)

INSUFFICIENT BRAKES

1. Broken pressure regulating spring (6)
2. Pedal travel is inhibited