

PRESSURE MODULATING VALVE (Reverse Modulating)



Service Instructions

TABLE 1 (Specifications)

Model Number	Valve Assembly Number	Repair Kit Number	Brake Pressure Setting		Model Number	Valve Assembly Number	Repair Kit Number	Brake Pressure Setting	
			bar	(PSI)				bar	(PSI)
03-460-400	20-100-506	06-400-150	86.2 ± 3.5	(1250 ± 50)	03-460-486	20-200-235	06-400-150	117.2 ± 3.5	(1700 ± 50)
03-460-402	20-100-566	06-400-150	17.3 ± 1.4	(250 ± 20)	03-460-488	20-200-289	06-400-150	121.0 ± 3.5	(1755 ± 50)
03-460-404	20-100-608	06-400-150	103.4 ± 3.5	(1500 ± 50)	03-460-489	20-200-289	06-400-150	121.0 ± 3.5	(1755 ± 50)
* 03-460-406	20-100-611	06-400-150	22.1 ± 1.4	(320 ± 20)	03-460-495	20-200-105	06-400-150	137.9 ± 6.9	(2000 ± 100)
03-460-408	20-100-611	06-400-150	22.1 ± 1.4	(320 ± 20)	03-460-498	20-200-280	06-400-150	112 +3/-2	(1625 +45/-30)
* 03-460-410	20-100-636	06-400-150	137.9 ± 6.9	(2200 ± 100)	03-460-499	20-200-279	06-400-150	112 +3/-2	(1625 +45/-30)
03-460-412	20-100-669	06-400-150	172.4 ± 6.9	(2500 ± 100)	03-460-500	20-200-280	06-400-150	112 +3/-2	(1625 +45/-30)
* 03-460-416	20-100-689	06-400-150	22.1 ± 1.4	(320 ± 20)	03-460-501	20-200-281	06-400-150	112 +3/-2	(1625 +45/-30)
03-460-418	20-100-710	06-400-150	24.8 ± 1.4	(360 ± 20)	03-460-502	20-200-282	06-400-150	112 +3/-2	(1625 +45/-30)
03-460-420	20-100-697	06-400-150	110.3 ± 3.5	(1600 ± 50)	03-460-503	20-200-282	06-400-150	112 +3/-2	(1625 +45/-30)
03-460-426	20-100-757	06-400-150	117.2 ± 3.5	(1700 ± 50)	03-460-505	20-200-312	06-400-150	112 +3/-2	(1625 +45/-30)
* 03-460-430	20-100-689	06-400-150	22.1 ± 1.4	(320 ± 20)	06-466-611	20-200-306	06-400-150	112 +3/-2	(1625 +45/-30)
03-460-432	20-100-795	06-400-150	31.0 ± 1.4	(450 ± 20)	06-466-983	20-100-697	06-400-150	110.3 ± 3.5	(1600 ± 50)
03-460-433	20-100-907	06-400-150	103.4 ± 3.5	(1500 ± 50)	20-100-526	n/a	06-400-150	17.9 ± 1.4	(260 ± 20)
03-460-440	20-100-608	06-400-150	103.4 ± 3.5	(1500 ± 50)	20-100-544	n/a	06-400-150	41.4 ± 1.4	(600 ± 20)
03-460-441	20-200-039	06-400-150	110.3 ± 3.5	(1600 ± 50)	20-100-566	n/a	06-400-150	17.3 ± 1.4	(250 ± 20)
03-460-442	20-100-636	06-400-150	137.9 ± 6.9	(2000 ± 100)	20-100-611	n/a	06-400-150	22.1 ± 1.4	(320 ± 20)
03-460-443	20-100-903	06-400-150	22.1 ± 1.4	(320 ± 20)	20-100-625	n/a	06-400-150	96.5 ± 3.5	(1400 ± 50)
03-460-444	20-100-636	06-400-150	137.9 ± 6.9	(2000 ± 100)	20-100-629	n/a	06-400-150	17.9 ± 1.4	(260 ± 20)
03-460-445	20-100-907	06-400-150	103.4 ± 3.5	(1500 ± 50)	20-100-636	n/a	06-400-150	137.9 ± 6.9	(2000 ± 100)
03-460-446	20-100-636	06-400-150	137.9 ± 6.9	(2000 ± 100)	20-100-637	n/a	06-400-150	69.0 ± 6.9	(1000 ± 100)
03-460-447	20-100-953	06-400-150	151.7 ± 5.2	(2200 ± 75)	20-100-674	n/a	06-400-150	22.1 ± 1.4	(320 ± 20)
03-460-448	20-100-757	06-400-150	117.2 ± 3.5	(1700 ± 50)	20-100-734	n/a	06-400-150	46.5 ± 3.5	(675 ± 50)
03-460-449	20-200-031	06-400-150	155.1 ± 5.2	(2250 ± 75)	20-100-755	n/a	06-400-150	150.0 ± 6.9	(2175 ± 100)
03-460-450	20-100-710	06-400-150	24.8 ± 1.4	(360 ± 20)	20-100-814	n/a	06-400-150	60.3 ± 1.7	(875 ± 25)
03-460-452	20-100-697	06-400-150	110.3 ± 3.5	(1600 ± 50)	20-100-868	n/a	06-400-150	127.6 ± 3.5	(1850 ± 50)
03-460-454	20-200-037	06-400-150	110.3 ± 3.5	(1600 ± 50)	20-100-940	n/a	06-400-150	58.6 ± 2.6	(850 ± 40)
03-460-456	20-200-039	06-400-150	110.3 ± 3.5	(1600 ± 50)	20-100-953	n/a	06-400-150	151.7 ± 5.2	(2200 ± 75)
03-460-457	20-200-055	06-400-150	110.3 ± 3.5	(1600 ± 50)	20-100-959	n/a	06-400-150	117.2 ± 3.5	(1700 ± 50)
03-460-458	20-200-100	06-400-150	103.4 ± 3.5	(1500 ± 50)	20-100-990	n/a	06-400-150	25.2 ± 1.0	(365 ± 15)
03-460-459	20-200-110	06-400-150	103.4 ± 3.5	(1500 ± 50)	20-200-105	n/a	06-400-150	138.0 ± 6.8	(2010 ± 100)
03-460-468	20-200-057	06-400-150	46.5 ± 3.5	(675 ± 50)	407 101 152 0	407 101 149 0	06-400-150	111.5 ± 1.5	(1617 ± 22)
03-460-469	20-100-506	06-400-150	86.2 ± 3.5	(1250 ± 50)	407 101 153 0	407 101 150 0	06-400-150	111.5 ± 1.5	(1617 ± 22)
03-460-470	20-200-072	06-400-150	55.2 ± 3.5	(800 ± 50)	407 101 154 0	407 101 150 0	06-400-150	111.5 ± 1.5	(1617 ± 22)
03-460-471	20-200-100	06-400-150	103.4 ± 3.5	(1500 ± 50)	407 101 155 0	407 101 151 0	06-400-150	111.5 ± 1.5	(1617 ± 22)
03-460-474	20-200-110	06-400-150	103.4 ± 3.5	(1500 ± 50)					
03-460-476	20-200-235	06-400-150	117.2 ± 3.5	(1700 ± 50)					
03-460-480	20-200-263	06-400-150	112.0 +3/-2	(1625 +45/-30)					
03-460-481	20-200-251	06-400-150	117.2 ± 3.5	(1700 ± 50)					
03-460-483	20-100-757	06-400-150	117.2 ± 3.5	(1700 ± 50)					

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

* Pressure setting is based on approximately 1800 cu. cm (110 cu. inch) per minute leakage to tank.

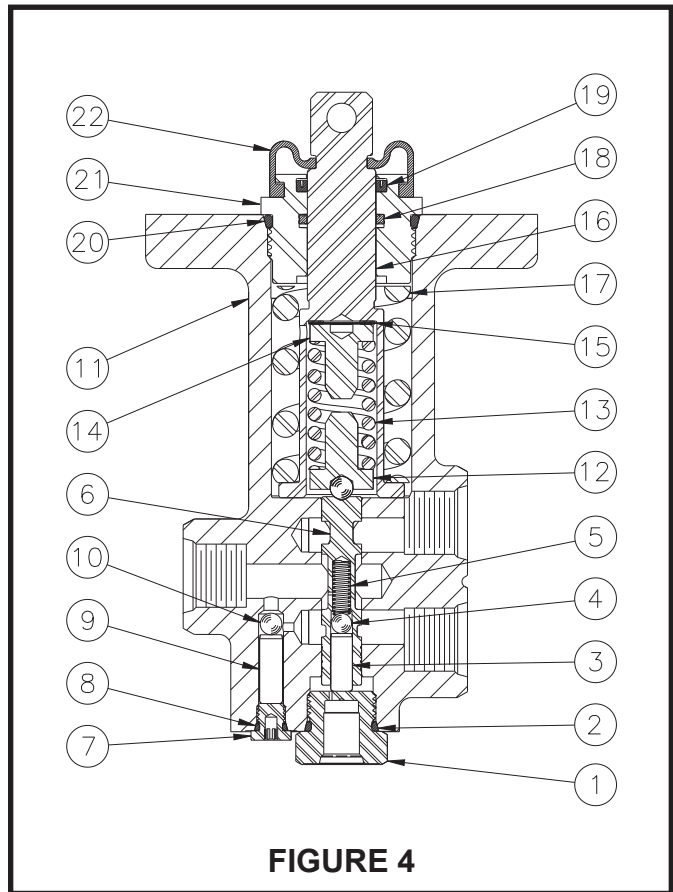
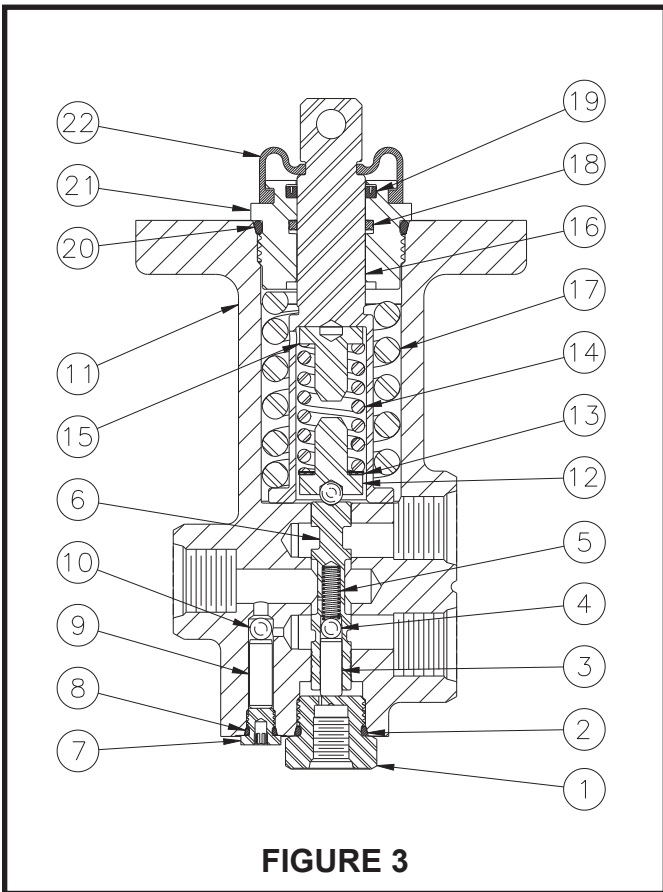
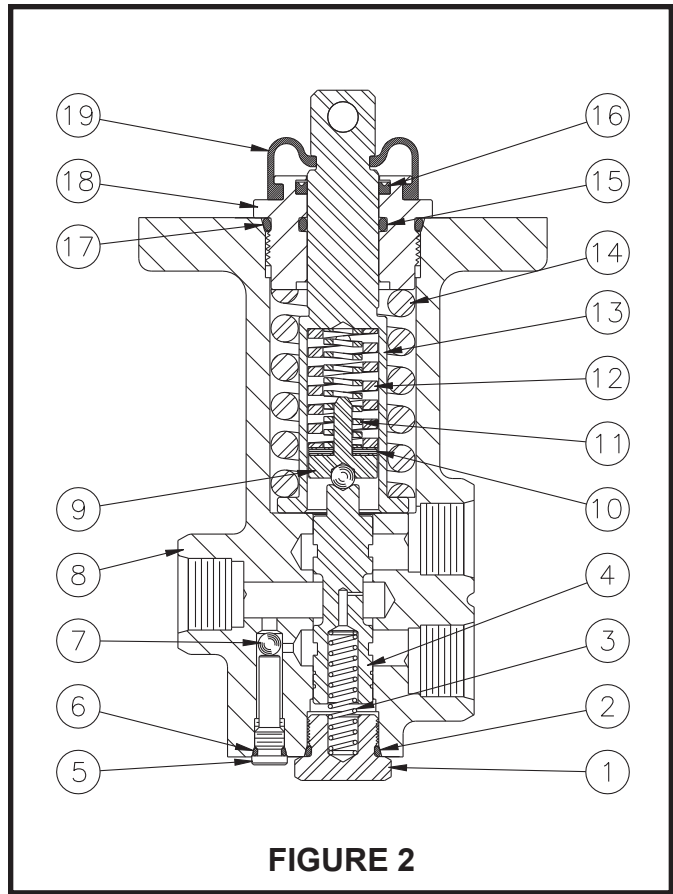
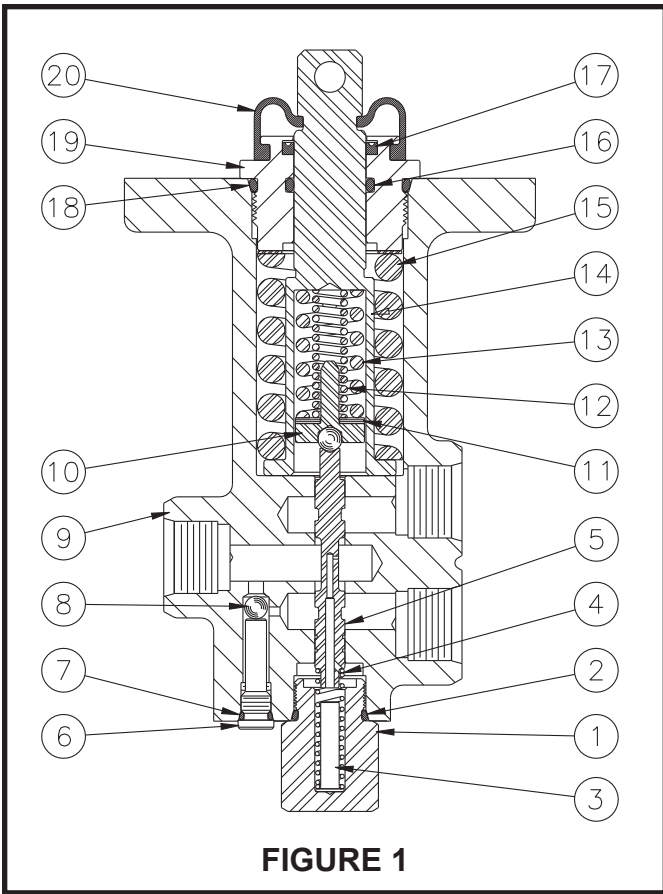
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Models: 03-460-400	03-460-447	03-460-505
03-460-404	03-460-448	06-466-983
03-460-410	03-460-449	20-100-625
03-460-412	03-460-452	20-100-636
03-460-420	03-460-454	20-100-637
03-460-426	03-460-456	20-100-755
03-460-433	03-460-468	20-100-814
03-460-440	03-460-469	20-100-868
03-460-441	03-460-470	20-100-940
03-460-442	03-460-483	20-100-953
03-460-444	03-460-498	20-100-959
03-460-445	03-460-499	
03-460-446	03-460-500	

DISASSEMBLY

(Refer to Figures 1 and 5)

NOTE

Housing (9) and spool (5) are manufactured as a matched set. This set, housing and spool, must not be intermixed with other parts.

1. Remove boot (21) from plug (20) and push rod (14).
2. Remove plug (20) from housing (9). Push rod (14), washer (15), and spring (16) should remain part of plug (20) assembly. **NOTE: Not all models use washer (15).**
3. Carefully separate plug (20), washer (15), spring (16) and push rod (14). **NOTE: Not all models use washer (15).**
4. Carefully remove o-rings (17 & 19) and cup (18) from plug (20). **NOTE: Be careful not to damage plug bore or seal grooves.**
5. Remove springs (12 & 13), shim(s) (11) and retainer assembly (10) from housing (9) bore. Note the number of shims removed for reassembly purposes. **NOTE: Not all models use spring (12).**
6. Remove end plug (1), retainer (3), spring (4) and spool (5) from housing (9). **NOTE: Be careful not to scratch or mar housing bore or spool.**

⚠ CAUTION

Do not intermix spools and housings. Spool (5) and housing (9) are a matched set.

7. Remove o-ring (2) from end plug (1).
8. Remove plug (6) and ball (8) from housing (9).
9. Remove o-ring (7) from plug (6).

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. Carefully install new o-rings (17 & 19) and new cup (18) on plug (20). Note direction of cup (18). **NOTE: Be careful not to damage plug bore or seal grooves.**
3. Install washer (15) and spring (16) over push rod (14). Carefully slide push rod into plug (20). Note direction of push rod and plug. **NOTE: Not all models use washer (15).**

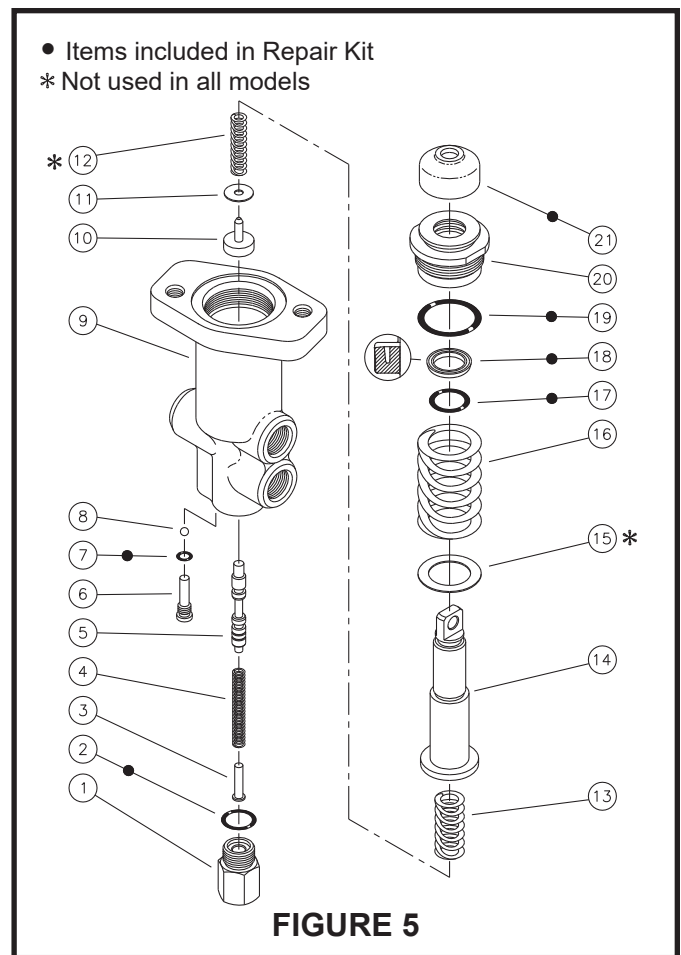


FIGURE 5

4. Insert springs (12 & 13), shim(s) (11) and retainer assembly (10) into of push rod (14). Note direction of retainer assembly. Carefully install assembly in housing (9). Torque plug (20) 81.4-94.9 N·m (60-70 lb-ft). Be sure to install the same number of shim(s) as were removed during disassembly. **NOTE: Not all models use spring (12).**
5. Install new boot (21) over push rod (14) and attach to plug (20).
6. Install new o-ring (2) on end plug (1).
7. Lubricate spool (5) and carefully insert into housing (9) bore. Note direction of spool. **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
8. Install spring (4), retainer (3) and end plug (1) into housing (9) bore. Torque end plug 47.5-54.2 N·m (35-40 lb-ft). Note direction of retainer.
9. Install new o-ring (7) on plug (6). Install ball (8) and plug (6) into housing (9) bore. Torque plug (6) 6.8-8.5 N·m (65-75 lb-in).

NOTE

After service, the valve must develop the pressure indicated in the specifications TABLE 1 on the front cover. Shim(s) (11) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if correct pressure setting is not able to be obtained.

Models: 03-460-402 03-460-432 20-100-611
 03-460-406 03-460-443 20-100-629
 03-460-408 03-460-450 20-100-674
 03-460-416 20-100-526 20-100-734
 03-460-418 20-100-544 20-100-990
 03-460-430 20-100-566

DISASSEMBLY

(Refer to Figures 2 and 6)

NOTE

Housing (8) and spool (4) are manufactured as a matched set. This set, housing and spool, must not be intermixed with other parts.

1. Remove boot (21) from plug (20) and push rod (14).
2. Remove plug (20) from housing (8). Push rod (14), washer (15), and spring (16) should remain part of plug (20) assembly. **NOTE: Not all models use washer (15).**
3. Remove springs (11 & 12), spacer (13), shim(s) (10) and retainer assembly (9) from housing (8) bore. Note the number of shims removed for reassembly purposes. **NOTE: Not all models use spring (11) or spacer (13).**
4. Carefully separate plug (20), washer (15), and spring (16) and push rod (14). **NOTE: NOT all models use washer (15).**
5. Carefully remove o-rings (17 & 19) and cup (18) from plug (20). **NOTE: Be careful not to damage plug bore or seal grooves.**
6. Remove end plug (1), spring (3) and spool (4) from housing (8). **NOTE: Be careful not to scratch or mar housing bore or spool.**

CAUTION

Do not intermix spools and housings. Spool (4) and housing (8) are a matched set.

7. Remove o-ring (2) from end plug (1).
8. Remove plug (5) and ball (7) from housing (8).
NOTE: Not all models use ball (7).
9. Remove o-ring (6) from plug (5).

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. Carefully install new o-rings (17 & 19) and new cup (18) on plug (20). Note direction of cup (18). **NOTE: Be careful not to damage plug bore or seal grooves.**
3. Install washer (15) and spring (16) over push rod (14). Carefully slide push rod into plug (20). Note direction of push rod and plug. **NOTE: Not all models use washer (16).**

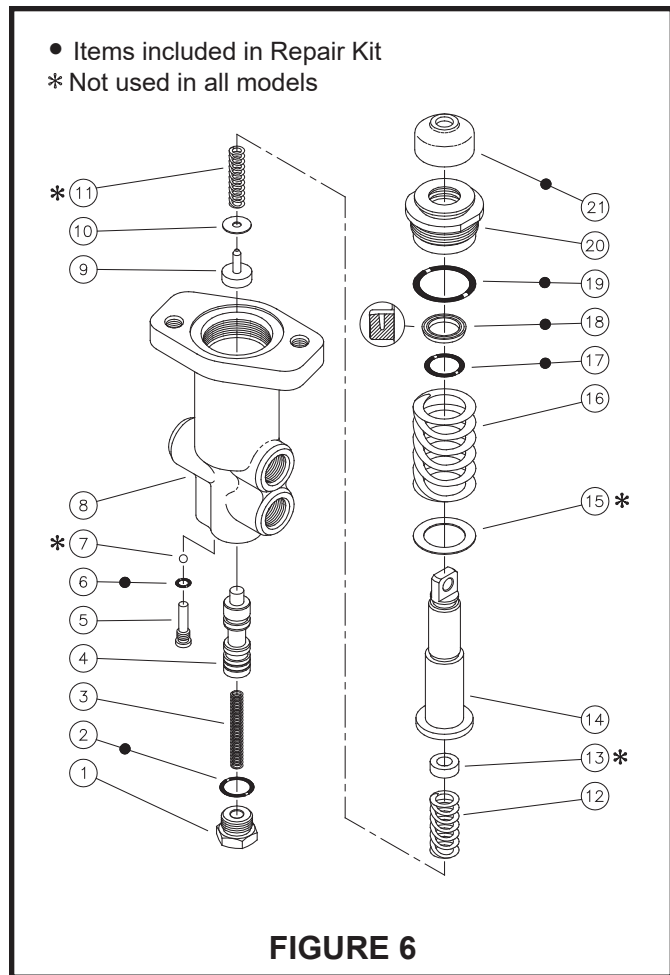


FIGURE 6

4. Insert springs (11 & 12), spacer (13), shim(s) (10) and retainer assembly (9) into end of push rod (14). Note direction of retainer assembly. Carefully install assembly in housing (8). Torque plug (20) 81.4-94.9 N·m (60-70 lb-ft). Be sure to install the same number of shim(s) as were removed during disassembly. **NOTE: Not all models use spring (11) or spacer (13).**
5. Install new boot (21) over push rod (14) and attach to plug (20).
6. Install new o-ring (2) on end plug (1).
7. Lubricate spool (4) and carefully insert into housing (8) bore. Note direction of spool. **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
8. Install spring (3) and end plug (1) into housing (8) bore. Torque end plug 47.5-54.2 N·m (35-40 lb-ft).
9. Install new o-ring (6) on plug (5). Install ball (7) and plug (5) into housing (8) bore. Torque plug (5) 6.8-8.5 N·m (65-75 lb-in). **NOTE: Not all models use ball (7).**

NOTE

After service, the valve must develop the pressure indicated in the specifications TABLE 1 on the front cover. Shim(s) (10) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if correct pressure setting is not able to be obtained.

Models: 03-460-457
 03-460-458
 03-460-459
 03-460-471
 03-460-474
 20-200-105

DISASSEMBLY
 (Refer to Figures 3 and 7)

NOTE

Housing (11) and spool (6) are manufactured as a matched set. This set, housing and spool, must not be intermixed with other parts.

1. Remove boot (22) from plug (21) and push rod (16).
2. Remove plug (21) from housing (11). Push rod (16) and spring (17) should remain part of plug (21) assembly.
3. Remove retainer (15), spring (14), shim(s) (13), and retainer assembly (12) from housing (11) bore. Note the number of shims removed for reassembly purposes.
4. Carefully separate end plug (21), spring (17), and push rod (16).
5. Carefully remove o-ring (20), cup (19), and quad ring (18) from end plug (21). **NOTE: Be careful not to damage end plug bore or seal grooves.**
6. Remove end plug (1), from housing (11).
7. Remove dowel pin (3), ball (4) and spring (5) from spool (6)
8. Carefully remove spool (6) from housing (11). **NOTE: Be careful not to scratch or mar housing bore or spool.**

CAUTION

Do not intermix spools and housings. Spool (6) and housing (11) are a matched set.

9. Remove o-ring (2) from end plug (1).
10. Remove plug (7), dowel pin (9), and ball (10) from housing (11).
11. Remove o-ring (8) from plug (7).

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. Carefully install new o-ring (20), new cup (19), and new quad ring (18) on plug (21). Note direction of cup (19). **NOTE: Be careful not to damage end plug bore or seal grooves.**
3. Install spring (17) over push rod (16). Carefully slide push rod into end plug (21). Note direction of push rod and plug.
4. Insert retainer (15), spring (14), shim(s) (13) and retainer assembly (12) into end of push rod (16). Note direction of retainer assembly. Carefully install assembly in housing (11). Torque plug (21) 81.4-94.9 N·m (60-70 lb·ft). Be sure to install the same number of shim(s) as were removed during disassembly.

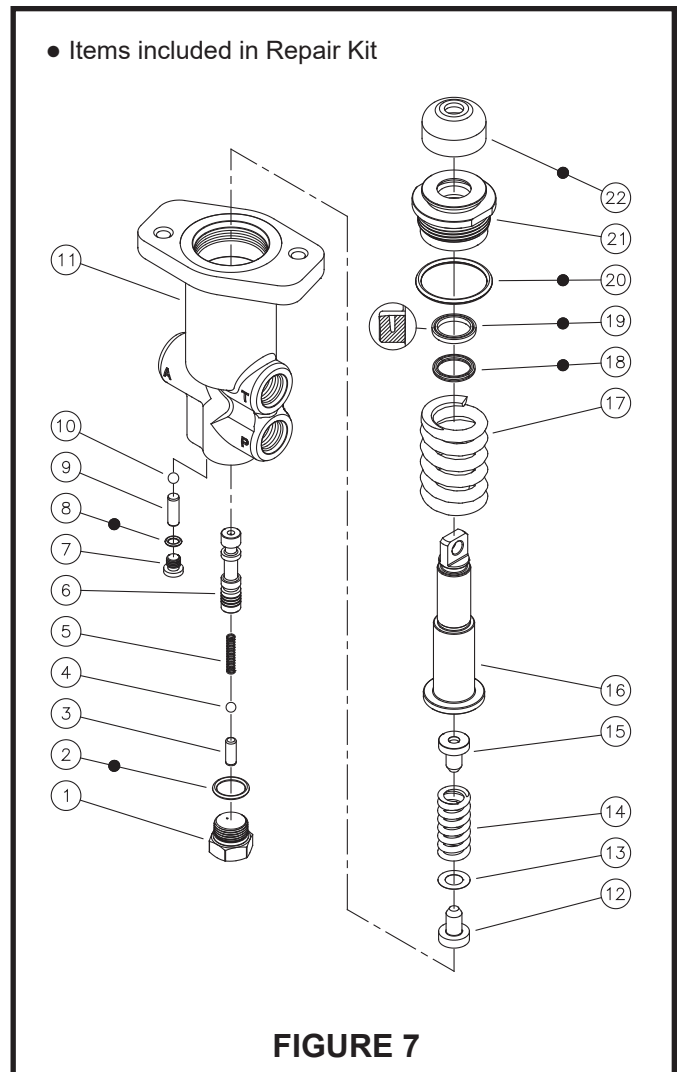


FIGURE 7

5. Install new boot (22) over push rod (16) and attach to plug (21).
6. Lubricate spool (6) and carefully insert into housing (11) bore. Note direction of spool. **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
7. Install spring (5), ball (4) and dowel pin (3) into spool (6).
8. Install new o-ring (2) on end plug (1). Install end plug (1) in housing (11) and torque 47.5-54.2 N·m (35-40 lb·ft)
9. Install new o-ring (8) on plug (7). Install ball (10), dowel pin (9) and plug (7) into housing (11) bore. Torque plug (7) 4.5+2.0 / -0.5 N·m (40 +18/-4 lb·in).

NOTE

After service, the valve must develop the pressure indicated in the specifications TABLE 1 on the front cover. Shim(s) (13) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if correct pressure setting is not able to be obtained.

Models: 03-460-476 03-460-489 06-466-611
 03-460-480 03-460-495 407 101 152 0
 03-460-481 03-460-501 407 101 153 0
 03-460-486 03-460-502 407 101 154 0
 03-460-488 03-460-503 407 101 155 0

DISASSEMBLY

(Refer to Figures 4 and 8)

NOTE

Housing (11) and spool (6) are manufactured as a matched set. This set, housing and spool, must not be intermixed with other parts.

1. Remove boot (22) from plug (21) and push rod (16).
2. Remove plug (21) from housing (11). Push rod (16) and spring (17) should remain part of plug (21) assembly.
3. Remove Shim(s) (15), retainer (14), spring (13), and retainer assembly (12) from housing (11) bore. Note the number of shims removed for reassembly purposes.
4. Carefully separate end plug (21), spring (17) and push rod (16).
5. Carefully remove o-ring (20), cup (19) and quad ring (18) from end plug (21). **NOTE: Be careful not to damage end plug bore or seal grooves.**
6. Remove end plug (1), from housing (11).
7. Remove dowel pin (3), ball (4), and spring (5) from spool (6)
8. Carefully remove spool (6) from housing (11).
NOTE: Be careful not to scratch or mar housing bore or spool.

CAUTION

Do not intermix spools and housings. Spool (6) and housing (11) are a matched set.

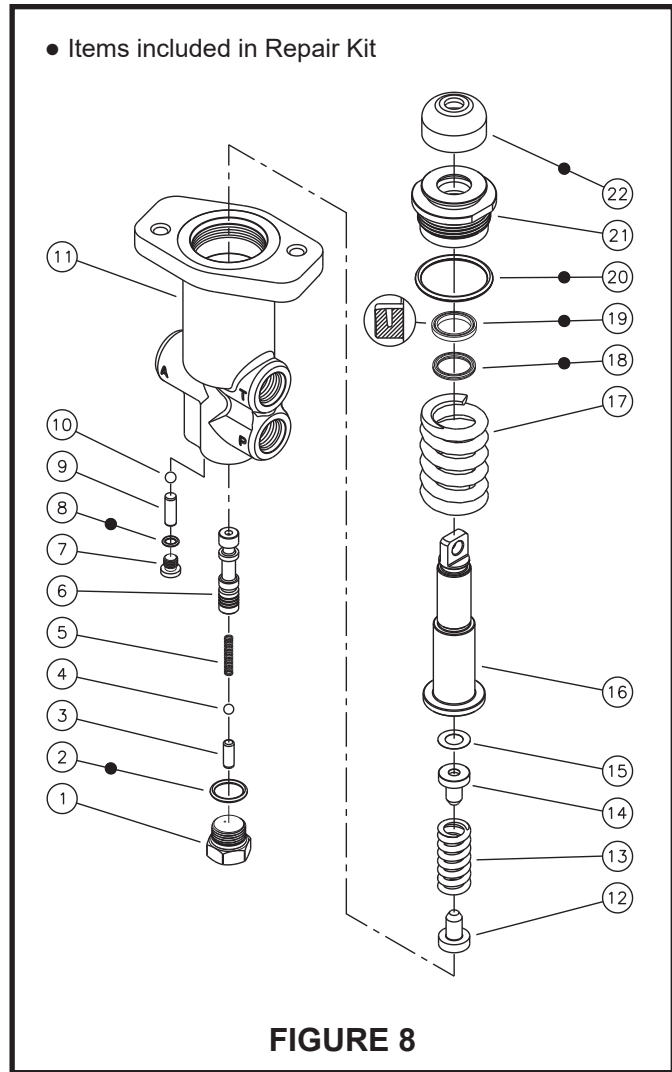
9. Remove o-ring (2) from end plug (1).
10. Remove plug (7), dowel pin (9) and ball (10) from housing (11).
11. Remove o-ring (8) from plug (7).

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. Carefully install new o-ring (20), new cup (19), and new quad ring (18) on plug (21). Note direction of cup (19).
NOTE: Be careful not to damage end plug bore or seal grooves.
3. Install spring (17) over push rod (16). Carefully slide push rod into end plug (21). Note direction of push rod and plug.
4. Insert shim(s) (15), retainer (14), spring (13), and retainer assembly (12) into end of push rod (16). Note direction of retainer assembly. Carefully install assembly in housing (11). Torque plug (21) 81.4-94.9 N·m (60-70 lb·ft). Be sure to install the same number of shim(s) as were removed during disassembly.



5. Install new boot (22) over push rod (16) and attach to plug (21).
6. Lubricate spool (6) and carefully insert into housing (11) bore. Note direction of spool. **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
7. Install spring (5), ball (4) and dowel pin (3) into spool (6).
8. Install new o-ring (2) on end plug (1). Install end plug (1) in housing (11) and torque 47.5-54.2 N·m (35-40 lb·ft)
9. Install new o-ring (8) on plug (7). Install ball (10), dowel pin (9) and plug (7) into housing (11) bore. Torque plug (7) 4.5+2.0 / -0.5 N·m (40 +18/-4 lb·in).

NOTE

After service, the valve must develop the pressure indicated in the specifications TABLE 1 on the front cover. Shim(s) (15) are used to obtain the correct pressure setting. Contact ZF Off-Highway Solutions Minnesota Inc. if correct pressure setting is not able to be obtained.

