# TANDEM MODULATING VALVE with Pilot Apply

## Service Instructions

**TABLE 1** (Specifications)

| Complete Unit Model Number | Valve Assembly Number | Repair Kit Number | Brake Pressure Setting | | Complete Unit Model Number | Valve Assembly Number | Repair Kit Number | Brake Pressure Setting | |
|---|---|---|---|---|---|---|---|---|---|
| | | | bar | (PSI) | | | | bar | (PSI) |
| 06-466-342 (HO) | 20-100-661 | 06-400-178 | 55.2 ± 3.5 | (800 ± 50) | 06-466-970 (HO) | 20-100-649 | 06-466-178 | 40.0 ± 3.5 | (580 ± 50) |
| 06-466-389 (HO) | 20-200-202 | 06-400-178 | 77.6 ± 5.2 | (1125 ± 75) | 06-466-982 (HO) | 20-100-661 | 06-400-178 | 55.2 ± 3.5 | (800 ± 50) |
| 06-466-549 (HO) | 20-200-247 | 06-400-178 | 30.0 ± 1.7 | (435 ± 25) | 06-466-992 (HO) | n/a | 06-400-178 | 60.0 ± 3.5 | (870 ± 50) |
| 06-466-947 (HO) | 20-100-904 | 06-400-178 | 44.8 ± 3.5 | (650 ± 50) | 20-100-720 (HO) | n/a | 06-400-238 | 103.4 ± 5.2 | (1500 ± 75) |
| 06-466-954 (HO) | 20-100-601 | 06-400-178 | 77.6 ± 5.2 | (1125 ± 75) | 20-100-802 (HO) | n/a | 06-400-178 | 77.6 ± 5.2 | (1125 ± 75) |
| 06-466-960 (HO) | 20-100-601 | 06-400-178 | 77.6 ± 5.2 | (1125 ± 75) | 20-100-886 (HO) | n/a | 06-400-238 | 144.8 ± 3.5 | (2100 ± 50) |

HO = Mineral Base Hydraulic Oil

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

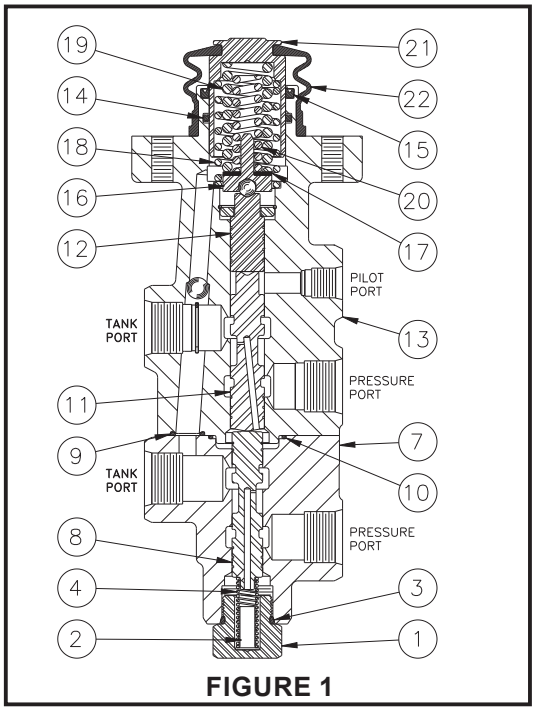


**FIGURE 1**

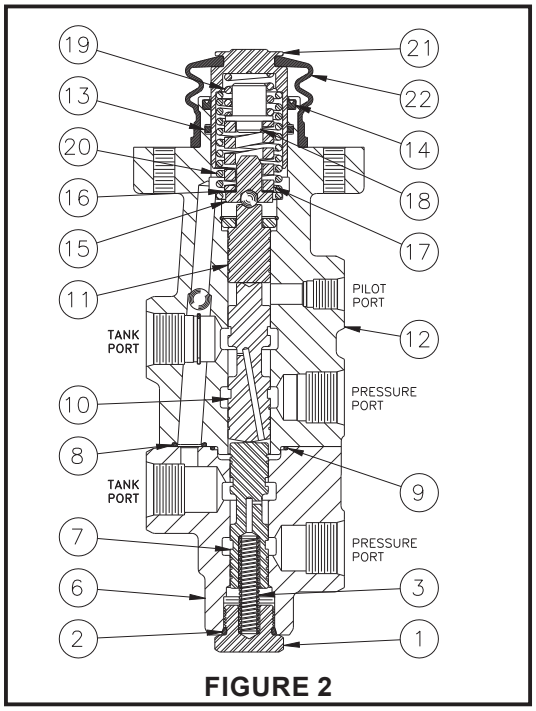


**FIGURE 2**

**⚠ WARNING**

**Installation and test note:** Piston (21) 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 ports are connected directly to tank.** Failure to do this could result in serious injury or death.



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**www.mico.com**

**MODELS:**

| | |
|---|---|
| **06-466-389** | **06-466-954** |
| **06-466-960** | **20-100-720** |
| **06-466-970** | **20-100-802** |
| **06-466-992** | **20-100-886** |

## DISASSEMBLY

(Refer to Figures 1, 3, and Table 2)

**NOTE**

Housings (7 & 13) and spools (8, 11 & 12) are manufactured as matched sets. These sets, housing and spool(s), should not be intermixed with other parts.

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

**⚠ CAUTION**

Do not intermix spools and housings. Spool (8) and housing (7) are a matched set as are spools (11 & 12) and housing (13).

7. Remove bleeder screw (23). Remove o-ring (24) from bleeder screw (23).

## ASSEMBLY

(Refer to Figures 1, 3, and Table 2)

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

1. lean all parts thoroughly before assembling.
2. Install new o-rings (9 & 10) in proper o-ring pockets on housings (7 & 13).
3. Lubricate spools (11 & 12) with clean system fluid and carefully slide into bottom end of housing (13) bore. Note direction and order of spools (11 & 12). **NOTE: Spools must slide freely into bore. If any parts are damaged, a new valve assembly may be required.**
4. Reassemble housings (7 & 13) using cap screws (5) and washers (6). Use Loctite 242 on cap screws and torque 27.1-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line up correctly and that o-rings (9 & 10) remain in the pockets during assembly.**
5. Lubricate spool (8) with clean system fluid and carefully slide into housing (7) bore. Note direction of spool (8). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
6. Install new o-ring (3) on end plug (1).
7. Install spring (4), retainer (2) and end plug (1) into housing (7). Torque end plug 47.5-54.2 N·m (35-40 lb·ft). **NOTE: Retainer (2) is not used in all models.**
8. Carefully install new cup (15) and new seal (14) into housing (13) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**

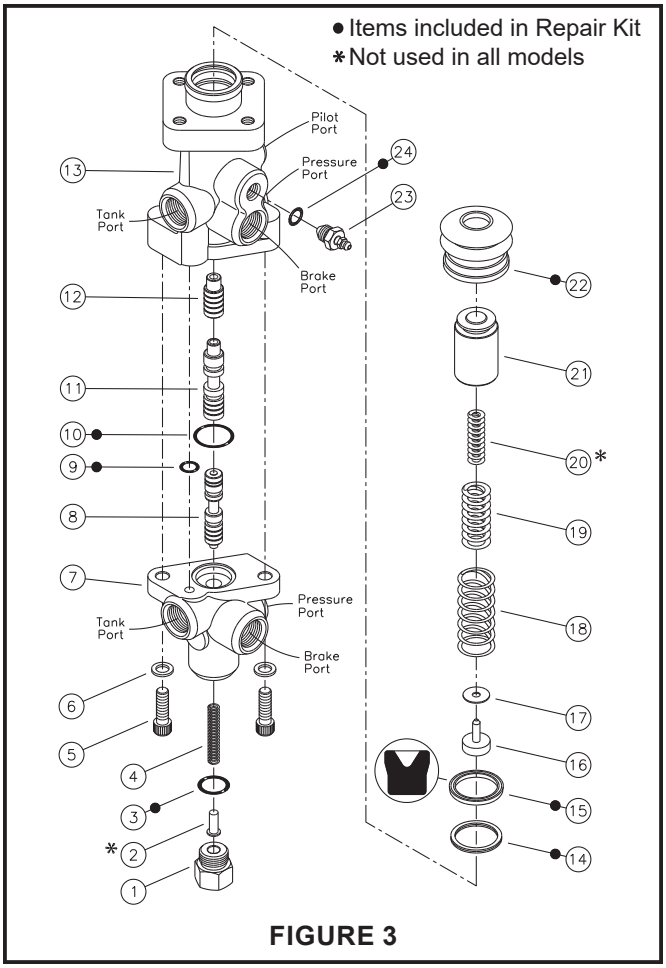


**FIGURE 3**

## TABLE 2 O-ring Identification

| Item Number | Description | Quantity |
|---|---|---|
| 3 | O-ring, 0.644 I.D. x 0.830 O.D. x 0.093 thick | 1 |
| 9 | O-ring, 0.364 I.D. x 0.504 O.D. x 0.070 thick | 1 |
| 10 | O-ring, 0.980 I.D. x 1.120 O.D. x 0.070 thick | 1 |
| 24 | O-ring, 0.351 I.D. x 0.495 O.D. x 0.072 thick | 1 |

9. Assemble springs (18, 19, & 20), shim(s) (17) and retainer assembly (16) in piston (21). **NOTE: Not all models use spring (20).**
10. Carefully install piston (21) assembly into housing (13) bore.
11. Install new boot (22) on housing (13) and piston (21).
12. Install new o-ring (24) on bleeder screw (23). Install bleeder screw (23) in housing (13) and torque 13.6-20.3 N·m (10-15 lb·ft).

**NOTE**

After service, the valve must develop the pressure indicated in the specifications, TABLE 1. Shim(s) (17) 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:**
**06-466-342**
**06-466-549**
**06-466-947**
**06-466-982**

## DISASSEMBLY

(Refer to Figures 2, 4, and Table 3)

**NOTE**

Housings (7 & 13) and spools (8, 11 & 12) are manufactured as matched sets. These sets, housing and spool(s), should not be intermixed with other parts.

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

**⚠ CAUTION**

Do not intermix spools and housings. Spool (8) and housing (7) are a matched set as are spools (11 & 12) and housing (13).

7. Remove bleeder screw (23). Remove o-ring (24) from bleeder screw (23).

## ASSEMBLY

(Refer to Figures 2, 4, and Table 3)

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

1. Clean all parts thoroughly before assembling.
2. Install new o-rings (8 & 9) in proper o-ring pockets on housings (6 & 12).
3. Lubricate spools (10 & 11) with clean system fluid and carefully slide into bottom end of housing (12) bore. Note direction and order of spools (10 & 11). **NOTE: Spools must slide freely into bore. If any parts are damaged, a new valve assembly may be Required.**
4. Reassemble housings (6 & 12) using cap screws (4) and washers (5). Use Loctite 242 on cap screws and torque 27.1-33.9 N·m (22-25 lb·ft). **NOTE: Make sure housings line up correctly and that o-rings (8 & 9) remain in the pockets during assembly.**
5. Lubricate spool (7) with clean system fluid and carefully slide into housing (6) bore. Note direction of spool (7). **NOTE: Spool must slide freely into bore. If either part is damaged, a new valve assembly may be required.**
6. Install new o-ring (2) on end plug (1).
7. Install spring (3) and end plug (1) into housing (6). Torque end plug 47.5-54.2 N·m (35-40 lb·ft).
8. Carefully install new cup (14) and new seal (13) into housing (12) bore. Note direction and order of cup and seal. **NOTE: Be careful not to scratch or mar housing bore.**

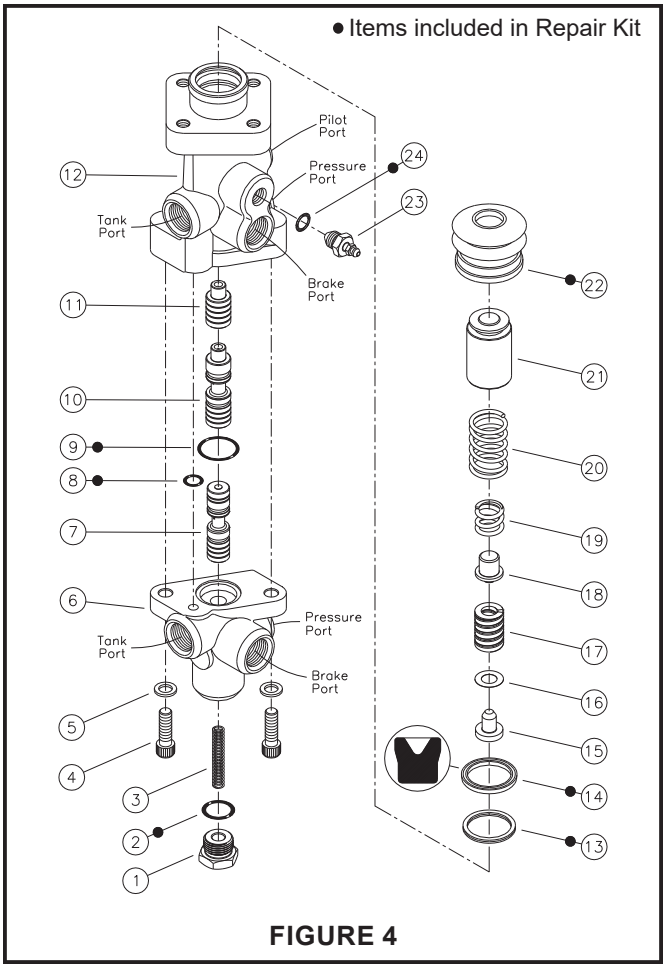


**FIGURE 4**

### TABLE 3 O-ring Identification

| Item Number | Description | Quantity |
|---|---|---|
| 2 | O-ring, 0.644 I.D. x 0.830 O.D. x 0.093 thick | 1 |
| 8 | O-ring, 0.364 I.D. x 0.504 O.D. x 0.070 thick | 1 |
| 9 | O-ring, 0.980 I.D. x 1.120 O.D. x 0.070 thick | 1 |
| 24 | O-ring, 0.351 I.D. x 0.495 O.D. x 0.072 thick | 1 |

9. Assemble springs (19 & 20), retainer (18), spring (17), shim(s) (16) and retainer assembly (15) in piston (21).
10. Carefully install piston (21) assembly into housing (12) bore.
11. Install new boot (22) on housing (12) and piston (21).
12. Install new o-ring (24) on bleeder screw (23). Install bleeder screw (23) in housing (12) and torque 13.6-20.3 N·m (10-15 lb·ft).

**NOTE**

After service, the valve must develop the pressure indicated in the specifications, TABLE 1. Shim(s) (16) 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.

## BLEEDING

Brakelines 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.
6. Repeat step 3.
7. Check for system leaks and be sure of proper brake operation.

## SERVICE CHECKS FOR MODULATING 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 (Goodrich Hi-torque Brakes only)
5. **Check adjuster operation**
6. Damaged hydraulic brake lines
6. **Check lines for dents that restrict flow of oil**

**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**
8. Brake valve inoperative
8. **Replace valve**

**EXCESSIVE BRAKING**

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

**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. Inoperative brake valve
7. **Replace brake valve**
8. Back pressure on return line too high
8. **Remove restriction**

**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 1 and 3)

**BRAKES WILL NOT RELEASE COMPLETELY**

1. Piston (21) binding
2. Pedal angle out of adjustment
3. Spring (4) broken

**BRAKES WILL NOT RELEASE**

1. Binding spool (8, 11, or 12)
2. Piston (21) binding

**NO BRAKES**

1. Piston (21) binding
2. Broken spring (19)

**OUTLET PRESSURE TOO HIGH (EXCESSIVE BRAKING)**

1. Too many shims (17) installed in valve

**EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE APPLIED**

1. Damaged spool (8, 11, or 12)
2. Damaged housing (7 & 8)

**EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE NOT BEING USED**

1. Damaged spool (8, 11, or 12)
2. Spring (bottom) (7 & 13) broken

**INSUFFICIENT BRAKES**

1. Broken pressure regulating spring (19)
2. Pedal travel is inhibited

## SERVICE DIAGNOSIS

(Refer to Figures 2 and 4)

**BRAKES WILL NOT RELEASE COMPLETELY**

1. Piston (21) binding
2. Pedal angle out of adjustment
3. Spring (3) broken

**BRAKES WILL NOT RELEASE**

1. Binding spool (7, 10, or 11)
2. Piston (21) binding

**NO BRAKES**

1. Piston (21) binding
2. Broken spring (17)

**OUTLET PRESSURE TOO HIGH (EXCESSIVE BRAKING)**

1. Too many shims (16) installed in valve

**EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE APPLIED**

1. Damaged spool (7, 10, or 11)
2. Damaged housing (6 & 12)

**EXCESSIVE ACCUMULATOR LEAKAGE WHEN BRAKES ARE NOT BEING USED**

1. Damaged spool (4)
2. Spring (bottom) (3) broken

**INSUFFICIENT BRAKES**

1. Broken pressure regulating spring (10)
2. Pedal travel is inhibited