Testing And Adjusting

Troubleshooting The Transmission Hydraulic System

Make reference to the following warning and pressure tap locations for all checks and tests of the transmission hydraulic system. If the problem area is not known, do the checks and tests in the order they are given. For all tests, the oil must be at normal temperature of operation.

![WARNING]

Sudden movement of the machine or release of oil under pressure can cause injury to persons on or near the machine. To prevent possible injury, do the procedure that follows before testing and adjusting the transmission.

1. Move the machine to a smooth horizontal location. Move away from working machines and personnel.

2. Put the transmission forward/reverse shuttle control in the NEUTRAL position. Stop the engine.

3. Permit only one operator on the machine. Keep all other personnel either away from the machine or in view of the operator.

4. Activate the parking brakes.

5. Lower the buckets or implements (loader and backhoe) and stabilizers to the ground.
6. Make sure all hydraulic pressure is released before any fitting, hose or component is loosened, tightened, removed or adjusted.

Troubleshooting can be difficult. A list of possible problems and corrections is on the pages that follow.

This list of problems and corrections will only give an indication of where a problem can be and what repairs are needed. Normally, more or other repair work is needed beyond the recommendations on the list. Remember that a problem is not necessarily caused only by one part, but by the relation of one part with other parts. This list cannot give all possible problems and corrections. The serviceman must find the problem and its source, then make the necessary repairs.

Always make visual checks first. Check the operation of the machine and then check with instruments.

<table>
<thead>
<tr>
<th>Tools Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6V3121</strong> Multitach Group</td>
</tr>
<tr>
<td><strong>6V3965</strong> Nipple Assembly</td>
</tr>
<tr>
<td>400 kPa (60 psi) Pressure Gauge</td>
</tr>
<tr>
<td>700 kPa (100 psi) Pressure Gauge</td>
</tr>
<tr>
<td>4000 kPa (600 psi) Pressure Gauge</td>
</tr>
</tbody>
</table>
Transmission Hydraulic System In Forward (Engine Running)


**Location Of Pressure Taps**

![Typical Example](image1)

(A) Pressure tap for reverse clutch. (C) Pressure tap for forward clutch. (F) Pressure tap for lubrication and cooling.

![Typical Example](image2)

(B) Pressure tap for pump. (D) Pressure tap for torque converter inlet.

![Typical Example](image3)

(E) Pressure tap for torque converter outlet.

**Visual Checks**

During these checks, use a magnet to separate ferrous particles from nonferrous particles.
1. Check the oil level in the transmission. Look for air (bubbles) or water on the dipstick. Many problems in the transmission are caused by low oil level or air in the oil. Add oil to the transmission if it is needed.

   a. Air (bubbles) is usually caused by a loose tube or damaged casting that allows air to enter the suction side of the system along with allowing oil to leak out.
   b. Water in the oil can be caused by a bad transmission oil cooler.

2. Check all oil lines, hoses and connections for leaks and damage. Look for oil on the ground under the machine.

3. Move the levers for the speed control and the direction control to REVERSE and FORWARD and all SPEED positions. The detents must be felt in each speed position. The direction control actuation must give the same positive activation to the hydraulic control circuit for clutch engagement in both directions.

   NOTE: There is an oil filter bypass valve on the inlet side of the transmission oil filter. The oil filter bypass valve will open and let oil bypass the oil filter element whenever the pressure difference between inlet oil and outlet oil through the oil filter gets above 117 to 131 kPa (17 to 19 psi). Any oil that does not go through the filter element goes directly into the hydraulic circuit. Dirty oil can cause a restriction in valve orifices and cause valves to stick.

4. Drain the oil from the transmission case. Inspect the strainer behind the transmission oil plug and the bottom of the case for debris. Remove and inspect the transmission oil filter for foreign material.

   a. Rubber particles indicate seal or hose failure.
   b. Shiny steel particles indicate mechanical failure or gear wear of the transmission or pump.
   c. A heavy accumulation of black fiber material indicate worn clutch discs.
   d. Aluminum particles indicate a clutch piston failure.
   e. Iron or steel chips indicate broken components in the transmission.

**Operational Checks**

Make reference to WARNING on the first page of the section Troubleshooting The Transmission Hydraulic System.

With the engine running and brakes on, move the lever for the forward/reverse shuttle and the lever for the transmission speeds.

Operate the machine in each direction and in all speeds. Make note of noises that are not normal and find their source. If the operation is not correct, make reference to the Check List During Operation for "problems" and "probable causes".

**Problem:** Transmission does not operate in any speed or does not engage (slips) in all speeds.
Probable Cause:

1. Low oil pressure caused by:
   a. Low oil level.
   b. Failure of oil pump (11).
   c. Air leaks on inlet side of the pump.
   d. Leakage inside transmission.
   e. Solenoid rod unscrewed.

2. Mechanical failure in transmission.
   a. Clutch discs and plates have too much wear.
   b. Leakage at the seals.

Problem: Transmission does not shift.

Probable Cause:

1. Air leaks on inlet side of pump (11).
2. Orifice (14) for load piston is dirty (plugged).
3. Control linkage worn, broken or adjustment is not correct.
4. Low oil pressure - see Oil Pressure Too Low, Probable Cause.

Problem: Transmission gets hot.

Probable Cause:

1. Bad temperature gauge.
2. High oil level.
3. Core of oil cooler not completely open.
4. Too much slipping in the clutch.
   a. Low oil pressure - see Oil Pressure Too Low, Probable Cause.
   b. Damaged clutch.
5. Low oil flow as a result of pump wear or extra leakage in the hydraulic system.
6. Wrong application for vehicle. Too much torque converter slippage caused by too much load.
7. Air in the oil. Air leaks on intake side of pump (11).
8. Low oil flow through torque converter (19), caused by torque converter relief valve (15) being stuck open.

Problem: Pump noise not normal.

Probable Cause:

1. A loud sound at short time periods gives an indication that foreign material is in the transmission hydraulic system.
2. A constant loud noise is an indication of pump failure.

Problem: Noise in the transmission which is not normal.

Probable Cause:
1. Parts have wear or damage.

Problem: Transmission operates in forward speeds only.

Probable Cause:

1. Discs and plates have too much wear in reverse direction clutches.
2. Leakage at seal rings.
3. Reverse clutch components have damage.
4. Control linkage has damage or wrong adjustment.
5. Control valve gasket has damage.
6. Forward clutch warped.

Problem: Transmission operates in reverse speeds only.

Probable Cause:

1. Discs and plates have too much wear in forward direction clutches.
2. Leakage at seal rings.
3. Forward clutch components have damage.
4. Control linkage has damage or wrong adjustment.
5. Control valve gasket has damage.
6. Reverse clutch warped.

Problem: Clutch engagement is slow and makes rough shifts.

Probable Cause:

1. Low transmission oil pressure - see Oil Pressure Too Low, Probable Cause.
2. Internal (inner) oil leaks.
3. Control valve springs are weak or have damage.
4. Check valve (13) for load piston not closing (open to drain), or orifice (14) is dirty.

Transmission Hydraulic System Tests

<table>
<thead>
<tr>
<th>Tools Needed</th>
<th></th>
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<tbody>
<tr>
<td>6V3121</td>
<td>Multitach Group</td>
</tr>
<tr>
<td>8T0151</td>
<td>Adapter with 3J1907 Seal</td>
</tr>
<tr>
<td>8T9107</td>
<td>Tee with 3J1907 Seal</td>
</tr>
<tr>
<td>6V3965</td>
<td>Nipple Assembly</td>
</tr>
<tr>
<td></td>
<td>400 kPa (60 psi) Pressure Gauge</td>
</tr>
<tr>
<td></td>
<td>700 kPa (100 psi) Pressure Gauge</td>
</tr>
<tr>
<td></td>
<td>4000 kPa (600 psi) Pressure Gauge</td>
</tr>
</tbody>
</table>
Test 1: Transmission Oil Pump Pressure

This test will show if transmission oil pump is good.

Procedure:

1. At pressure tap (B), use a coupler and connect a pressure gauge [4000 kPa (600 psi)] to the nipple.
2. Place the forward/reverse shuttle in NEUTRAL, also place the speed shift lever in NEUTRAL.
3. With the parking brake activated, start and run the engine at LOW IDLE rpm.
4. Shift forward/reverse shuttle to FORWARD. Leave the transmission speed shift lever in NEUTRAL. The pressure on the gauge must be 1200 ± 100 kPa (175 ± 15 psi).
5. With the forward/reverse shuttle still in FORWARD and the speed shift lever in NEUTRAL, run the engine at HIGH IDLE rpm. The pressure on the gauge must be 1400 ± 100 kPa (205 ± 15 psi).
6. When this test is complete, place forward/reverse shuttle in NEUTRAL, stop engine and remove the test equipment.

Problem 1: Oil pressure too low.

Probable Cause:

a. Failure of transmission oil pump.
b. Suction leak.

Test 2. Torque Converter Outlet Pressure

This test will show if:

a. Engine performance is good.
b. Torque converter operates correctly.
c. There is oil flow through oil cooler.

Procedure:

1. Install the 6V3121 Multitach Group on the engine. The 6V3121 Multitach Group can measure engine rpm by the use of the photo pickup and reflective tape. Special Instruction Form No. SEHS7807 has instructions for its use.
2. At pressure tap (E), disconnect wire from temperature sender and remove sender and seal.

3. Install 8T9107 Tee and 8T0151 Adapter with 3J1907 Seal.

4. Reinstall temperature sender and seal in the top part of the 8T9107 Tee.

5. Install 6V3965 Nipple Assembly in the port. This will be pressure tap (E).

6. Reconnect wire to temperature sender.

7. Connect a pressure gauge [700 kPa (100 psi)] to the nipple assembly.

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**NOTICE**

To make sure that the transmission oil does not get hot, do not hold the transmission in a stall condition for more than ten seconds. After the transmission is stalled, put the controls in NEUTRAL and run the engine at 1200 to 1500 rpm to cool the oil.

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8. With the transmission shift lever in NEUTRAL position, make sure that HIGH IDLE rpm and LOW IDLE rpm are correct according to the specifications in the book titled "3054 Engine for Caterpillar Built Machines", Form SENR5815.

9. With engine running at HIGH IDLE rpm and the transmission at normal operating temperature [59 to 71°C (138 to 160°F)], shift to FOURTH SPEED position. Shift forward/reverse shuttle to FORWARD and stall the torque converter until converter temperature reaches 90 to 93°C (194 to
200°F). With these conditions, stall rpm should be as per Stall RPM Chart and the pressure on the gauge should be 290 ± 50 kPa (42 ± 8 psi).

<table>
<thead>
<tr>
<th>STALL RPM</th>
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<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>416</td>
</tr>
<tr>
<td>426</td>
</tr>
<tr>
<td>428</td>
</tr>
<tr>
<td>436, 438</td>
</tr>
</tbody>
</table>

10. When the test is complete, put the forward/reverse shuttle in NEUTRAL and the shift lever in NEUTRAL. Stop the engine and remove test equipment.

**NOTICE**

Do not keep the torque converter in a stall condition for very long periods of time. This will cause the torque converter, engine and brakes to get hot.

<table>
<thead>
<tr>
<th>TRANSMISSION TEST PRESSURES</th>
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<tbody>
<tr>
<td><strong>Test Points</strong></td>
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<tr>
<td>Pump Pressure - At High Idle</td>
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<tr>
<td>Forward Clutch Pressure - At Low Idle</td>
</tr>
<tr>
<td>Reverse Clutch Pressure - At Low Idle</td>
</tr>
<tr>
<td>Lubrication Pressure - At Low Idle</td>
</tr>
<tr>
<td>4-WD Clutch Pressure</td>
</tr>
</tbody>
</table>
Problem 1: Torque converter outlet pressure is too low.

Probable Cause:

a. Inlet relief valve (15) is open.
b. Weak or bad pump.

Problem 2: The oil gets too hot during normal operation.

Probable Cause:

a. Bad temperature gauge. Make replacement of the gauge and the sending unit.
b. Not enough oil in torque converter (19) because torque converter inlet relief valve (15) is open.
c. Failure in oil pump (11) or torque converter (19).

Problem 3: Torque converter outlet pressure is too high.

Probable Cause:

a. Too much restriction in oil cooler (17).

Problem 4: High idle is correct (Step 8), but stall rpm speed (in Step 9) is too high. Torque converter outlet pressure is correct.

Probable Cause:

a. Bad torque converter (19).

Test 3. Forward and Reverse Clutch Pressure and Transmission Lubrication

This test will show if:

a. Oil pressure to the forward and reverse clutch is good.
b. Oil pressure to the transmission lubrication circuit is good.

Procedure:

1. Install the 6V3121 Multitach Group on the engine. The 6V3121 Multitach Group can measure engine rpm by the use of the photo pickup and reflective tape. Special Instruction Form No. SEHS7807 has instructions for it use.

2. At pressure taps (C), (A) and (F) connect a hose group to the nipple assemblies.

3. At pressure tap (C) and (A) connect a pressure gauge \([4000 \text{ kPa (600 psi)}]\) to the hose group.

4. At pressure tap (F) connect a pressure gauge \([400 \text{ kPa (60 psi)}]\) to the hose group.

5. Start and run the engine at LOW IDLE rpm.

6. With the transmission speed shift lever in NEUTRAL, shift the forward/reverse shuttle to FORWARD. The pressure on the forward clutch gauge must be 950 ± 100 kPa (138 ± 15 psi) and the lubrication gauge must be 45 ± 30 kPa (6.5 ± 4.5 psi). Reverse clutch gauge must be 0 kPa (0 psi).
7. Now shift the forward/reverse shuttle to REVERSE, transmission shift lever in NEUTRAL. The reverse clutch pressure shall be within ± 25 kPa (± 3.5 psi) of that in FORWARD, Step 11, at the same engine speed and lubrication must be 45 ± 30 kPa (6.5 ± 4.5 psi). Forward clutch gauge must be 0 kPa (0 psi).

8. When the test is complete, put the forward/reverse shuttle in NEUTRAL, engage the parking brakes and stop the engine. Remove test equipment.

**Problem 1: Forward and reverse clutch pressure too low.**

**Probable Cause:**

- a. Oil level low.
- b. Oil filter (9) is plugged. Make a replacement of dirty filter.
- c. Oil pump (11) failure.
- d. Neutralizer valve (5) stuck open.
- e. Neutralizer button shorted causing neutralizer solenoid (6) to be energized. Neutralizer valve (5) open to drain.

**Problem 2: Forward or reverse clutch pressure too low.**

**Probable Cause:**

- a. Clutch piston seals bad.

### Torque Converter Turbine Hub End Play Check

<table>
<thead>
<tr>
<th>Tools Needed</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8S2328 Dial Indicator Group</td>
<td>1</td>
</tr>
<tr>
<td>6V2169 Converter Checking Fixture</td>
<td>1</td>
</tr>
</tbody>
</table>

1. Remove the transmission and torque converter from the vehicle as a unit.
2. Remove the torque converter from the transmission.
3. Put the flywheel side of the torque converter face down on blocks.
4. Make an adjustment to 6V2169 Converter Checking Fixture so that the legs will go inside of turbine hub (1).

5. Install the fixture into hub (1) and adjust the fixture until the points on the legs are below the hub.

6. Install the 8S2328 Dial Indicator Group so that the stylus is in contact with the fixture. Set the dial indicator to 0.

7. Move the fixture up against the dial indicator with two screw drivers as shown.

8. The end play must not be more than 1.65 mm (.065 in.). If the end play is more than 1.65 mm (.065 in.), the torque converter must be replaced.
Transmission Shift Blockout Adjustment

(1) Lever. (2) Bolt. (3) Locknut. (4) Lug.
(4 Speed)

1. Place shift lever (1) into fourth gear.
2. Turn adjustment bolt (2) until it touches the shift lug (4).
3. Back bolt (2) out one turn and tighten locknut (3).

(3 Speed)

1. Place shift lever (1) in NEUTRAL.
2. Turn adjustment bolt (2) until it touches the shift lug (4).
3. Back bolt (2) out one turn and tighten locknut (3).

**Shuttle Control Adjustment Procedure**

Forward/Reverse Control
(1) Forward/reverse hand control. (2) Neutral lock.

Transmission Control Valve
(3) Control lever. (4) Adjustable rod.

1. Put forward/reverse hand control lever (1) in neutral position and engage neutral lock (2).
2. Put control lever (3) on transmission control valve in the neutral position (center detent position).
3. Adjust rod end (4) until it slips easily into hole in lever (3).
4. Attach rod end (4) and tighten all locknuts.
Transfer Box
Transfer Box.

The illustration shown is for a Series II transfer box. The internal arrangement is similar and the operation is the same.

The drive input enters the transfer box at gear (9). When the operator activates the electric switch on the side console, solenoid (10) is powered and pushes solenoid valve spool (13) down against spring (12).

When spool (13) moves far enough, a passage is opened that allows oil under pressure to flow to drive shaft (6). The oil flows through shaft (6) to engage clutch pack (8). With the clutch pack engaged, the drive input at gear (9) is then transmitted through clutch pack (8), shaft (6), to output drive flange (5).

**Troubleshooting The Four Wheel Drive System**

![WARNING]

To prevent possible injury, do the procedure that follows before testing and adjusting the differential, rear axle and brakes:

1. Move the machine to a smooth horizontal location. Move away from working machines and personnel. Stop the backhoe loader engine.

2. Permit only one operator on the machine. Keep all other personnel either away from the machine or in view of the operator.

3. Activate the parking brakes. Lower the buckets or implements (loader and backhoe) and stabilizers to the ground.

**Visual Checks**

Before any operational checks are made to the 4-wheel drive attachment, visually inspect all components.

1. Check the electrical connections.

2. Check for oil leaks around solenoid and transfer box, the differential and the wheel planetary assemblies.
**Operational Checks**

An operational check can be made to quickly see if the 4-wheel drive attachment is functional.

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**NOTICE**

Any unusual noises during this check should be noted. Loud noises could indicate that repairs are needed.

1. Start the engine.

2. Lower the stabilizers and lift the rear wheels about 150 mm (6 in.) off the ground.

3. Place the bucket hydraulic controls in the bucket lowering position and lift the front wheels about 150 mm (6 in.) off the ground.

4. Shift the transmission to low/forward and note if a rear wheel or wheels rotate.

5. Activate the front wheel drive switch and note if a front wheel or wheels rotate. If the front wheel or wheels rotate, the 4-wheel drive attachment is operational. If there is no front wheel rotation, troubleshoot the system.

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**Troubleshooting Methods**

**Electrical Testing**

Electrical connections between harnesses may not be tight. This can cause electrical problems, either permanent or intermittent (come and go). Make sure the connections at the front drive axle solenoid and the switch are tight before other tests are made.

5P7277 Voltage Tester.
The 5P7277 Voltage Tester can be used to check for voltage at the solenoid when the switch is activated. It cannot measure voltage. The light will come on at a voltage indication between 12 and 36 volts.

**Pressure Testing**

The transfer box contains a clutch pack for front wheel drive engagement. The pressure needed for proper clutch engagement is 1550 ± 100 kPa (225 ± 15 psi).

**Test Procedure**

1. Remove plug from solenoid valve and install a 0 to 2000 kPa (0 to 290 psi) gauge and long hose.

![Diagram](C10052X1)

Install Gauge.

2. Start the engine and run at high idle speed. At normal operating temperature, with gear selector in neutral and the forward-reverse selector in forward, activate the front wheel drive solenoid.

3. Read pressure at the pressure gauge. If the oil pressure is not 1400 ± 100 kPa (205 ± 15 psi), refer to the Transmission Hydraulic System Tests.