2007 TRANSMISSION

Automatic Transaxle - 4T65-E - Relay

SYMPTOMS - AUTOMATIC TRANSMISSION

Symptoms - Automatic Transmission

Diagnostic Category	Diagnostic Information
DEFINITION: This table consists of eight diagnostic categories that are located in the left-hand column. Using this column, choose the appropriate category based on the operating conditions of the vehicle or transmission. After selecting a category, use the right-hand column to locate the specific symptom diagnostic information.	
Fluid Diagnosis: This category contains the following topics: • Fluid condition - appearance, contaminants, smell, overheating • Line pressure - high or low • Fluid leaks	• Refer to **Transmission Fluid Checking**. • Refer to **Incorrect Line Pressure**. • Refer to **Automatic Transmission Fluid Leaks**. • Refer to **Fluid Leak Diagnosis**.
Noise and Vibration Diagnosis: This category contains the following topics: • Noise - drive gear, final drive, whine, growl, hum, rattle, buzz, popping • Torque converter diagnosis • Noise and vibration analysis	• Refer to **Whine Noise Varying with RPM or Fluid Pressure**. • Refer to **Popping Noise**. • Refer to **Buzz Noise or High Frequency Rattle Sound**. • Refer to **Whine/Growl Noise That Changes with Vehicle Speed**. • Refer to **Final Drive Noise or Hum Noise**. • Refer to **Noise in First, Second, Third, or Fourth**. • Refer to **Noise in Random Ranges**. • Refer to **Abnormal Noise in Park or Neutral Range**. • Refer to **Torque Converter Diagnosis**. • Refer to **Noise and Vibration Analysis**.
Range Performance Diagnosis: This category contains the following topics: • No Park • No Reverse or slips • No Drive or slips • No engine braking • Range selector displays incorrect range	• Refer to **No Park Range**. • Refer to **Slips in Reverse or No Reverse**. • Refer to **Slips in Drive or No Drive**. • Refer to **Locked Up in Drive/Reverse**. • Refer to **No Engine Braking in Manual Ranges (Touch Activated Power)**. • Refer to **Range Selector Displays Incorrect Range**.

Shift Quality (Feel) Diagnosis: This category contains the following topics: • Harsh shifts • Soft shifts • Harsh engagement, garage shifts • Delayed engagement, garage shifts	• Refer to **Harsh or Soft 1-2 Shift Feel**. • Refer to **Harsh or Soft 2-3/3-2 Shift Feel**. • Refer to **Harsh or Soft 3-4/4-3 Shift Feel**. • Refer to **Harsh Park to Reverse/Drive Engagement**. • Refer to **Delayed Park to Reverse/Drive Engagement**.
Slipping or Missing Gears: This category contains the following topics: • No upshift • Slipping or missing gears • One forward gear only • Two forward gears only • Non-First gear start	• Refer to **Slipping or No First Gear**. • Refer to **Slipping or No Second Gear**. • Refer to **Slipping or No Third Gear**. • Refer to **Slipping or No Fourth Gear**. • Refer to **First Gear Only**. • Refer to **Second Gear Only**. • Refer to **Third Gear Only**. • Refer to **Fourth Gear Only**. • Refer to **First and Second Gear Only - 2-3 Solenoid Stuck On**. • Refer to **First and Fourth Gear Only - 1-2 Solenoid Stuck On**. • Refer to **Second and Third Gear Only (1-2 Solenoid Stuck Off)**. • Refer to **Third and Fourth Gear Only (2-3 Solenoid Stuck Off)**.
Shift Speed Diagnosis: This category contains the following topic: Incorrect shift points	Refer to **High or Low Upshift or Downshift Speed**.
Torque Converter Diagnosis: This category contains the following topics: • Torque converter diagnosis • TCC does not apply • TCC does not release • TCC shudder	• Refer to **Torque Converter Diagnosis**. • Refer to **No Torque Converter Clutch Apply**. • Refer to **Converter Clutch Stuck On in All Gears**. • Refer to **Converter Clutch Stuck On in Second, Third and Fourth Gear**. • Refer to **Harsh Torque Converter Clutch Apply or Release**. • Refer to **Converter Clutch Apply Rough, Slips, or Shudders**.
Symptom Can Not Be Duplicated or Symptom Not Found: This category contains the following topics:	• Refer to **Transmission Fluid Checking**. • Refer to **Road Test**. • Refer to **Line Pressure Check**.

• Transmission fluid diagnosis • Road testing • Line pressure diagnosis	

RANGE SELECTOR DISPLAYS INCORRECT RANGE

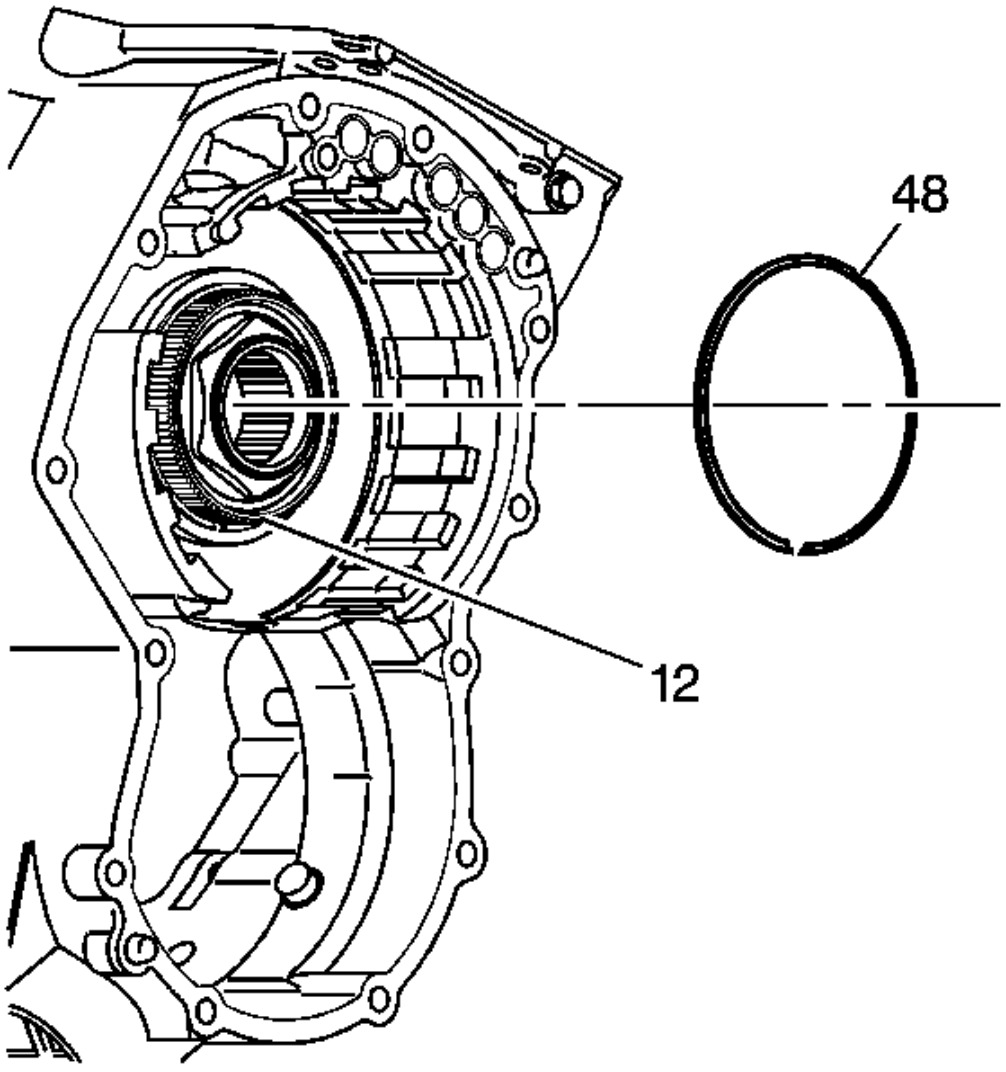

Fig. 1: Transmission Internal Mode Switch (IMS) Schematic
Courtesy of GENERAL MOTORS CORP.

CIRCUIT DESCRIPTION

The transmission internal mode switch (IMS) is a sliding contact switch attached to the selector detent inside the transmission side cover. The 4 inputs to the TCM indicate the position of the transmission range selector. The input voltage level at the TCM is high, B+, when the IMS is open and low when the switch is closed to ground. The 4 input parameters represented are Signals A, B, C and P, Parity. Refer to **Transmission Internal Mode Switch Logic** .

TEST DESCRIPTION

The numbers below refer to the step numbers on the diagnostic table.

2: HI values for all signals in all ranges indicates the ground circuit is OPEN.

3: With the 20-way connector disconnected, all signals should indicate HI.

5: If a circuit affects the other, this indicates a short between the 2 circuits.

11: This step tests the internal transmission harness. If no fault is found in the harness, the fault will be in the switch.

Range Selector Displays Incorrect Range

Step	Action	Value(s)	Yes	No
1	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Select IMS on the scan tool. 4. Place the range selector in each transmission range: P, R, N, D4, D3, D2 and D1. Does each range selected match the scan tool IMS display?	-	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 2**
2	1. Select IMS A/B/C/P on the scan tool. 2. Place the range selector in each transmission range: P, R, N, D4, D3, D2 and D1. Does the IMS A/B/C/P display the specified values for each range?	HI/HI/HI/HI	Go to **Step 12**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the AT Inline 20-way connector. Additional DTCs may set. 3. Turn ON the ignition, with the engine OFF. 4. Select IMS A/B/C/P on the scan tool.	-		

	Do the scan tool IMS A/B/C/P signals all indicate HI?		Go to **Step 4**	Go to **Step 8**
4	1. Turn OFF the ignition. 2. Install the **J 44152** Jumper Harness on the engine side of the AT Inline 20-way connector. See **Special Tools** . 3. Turn ON the ignition, with the engine OFF. 4. Using the **J 39200** Digital Multimeter (DMM) and the **J-35616** GM Terminal Test Kit, measure the voltage at the TR signal A circuit of the **J 44152** . See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 5. Measure the voltage at the TR signal B circuit of the **J 44152** . See **Special Tools** . 6. Measure the voltage at the TR signal C circuit of the **J 44152** . See **Special Tools** . 7. Measure the voltage at the TR signal P circuit of the **J 44152** . See **Special Tools** . Does the voltage measure ignition voltage at all four terminals?	-	Go to **Step 5**	Go to **Step 9**
5	Connect a fused jumper wire from the TR signal A circuit of the **J 44152** to ground while monitoring the scan tool IMS A/B/C/P parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal A circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 6**
6	Connect a fused jumper wire from the TR signal B circuit of the **J 44152** to ground while monitoring the scan tool IMS A/B/C/P parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal B circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 7**
	Connect a fused jumper wire from the TR signal C circuit of the **J 44152** to ground while monitoring the scan tool IMS A/B/C/P			

7	parameter. See **Special Tools** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . When the TR signal C circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 10**	Go to **Step 11**
8	Test the the TR signal circuits of the IMS that did not indicate HI for a short to ground between the TCM and the AT Inline 20-way connector. Refer to **Testing for Short to Ground** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
9	Test the the TR signal circuits of the IMS that did not indicate ignition voltage for an open between the TCM and the AT Inline 20-way connector. Refer to **Testing for Continuity** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
10	Test the affected the TR signal circuits of the IMS for a shorted together condition between the TCM and the AT Inline 20-way connector. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
11	Test the the TR signal circuits of the IMS for an open or shorted condition between the AT Inline 20-way connector and the IMS. Refer to **Circuit Testing** . Did you find the condition?	-	Go to **Step 14**	Go to **Step 15**
12	Test the ground circuit of the IMS for an open between the AT Inline 20-way connector and the ground connection to the chassis. Refer to **Testing for Continuity** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 13**
13	Test the ground circuit of the IMS for an open between the AT Inline 20-way connector and the IMS. Refer to **Testing for Continuity** . Did you find the condition?	-	Go to **Step 14**	Go to **Step 15**
14	Replace the automatic transmission wiring harness assembly. Refer to **Wiring Harness Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
15	Replace the lever assembly-manual shaft detent with internal mode switch. Refer to **Manual Shift Shaft Position (Internal Mode) Switch and Parking System**	-		-

	Components Removal . Did you complete the replacement?		Go to **Step 17**	
16	Replace the TCM. Refer to **Control Module References** for replacement, setup and programming. Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Turn ON the ignition, with the engine OFF. 2. With the scan tool, observe the IMS display while selecting each transmission range: P, R, N, D4, D3, D2, and D1. Does each selected transmission range match the scan tool IMS display?	-	System OK	Go to **Step 1**

TRANSMISSION FLUID CHECKING

Transmission Fluid Checking

Step	Action	Value(s)	Yes	No
1	1. Start the engine and allow the engine to idle until the transmission has reached the value specified. 2. Depress the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each gear. 3. Pull dip stick and check fluid sample for color. Is the fluid color red or light brown with no burnt odor?	82-93°C (180-200°F)	Go to **Step 4**	Go to **Step 2**
2	Check the fluid level. The vehicle must be level, with the engine running and the shift lever in the PARK range. Check both sides of the fluid level indicator, and read the lower level. The proper fluid level should be in the middle of the X-hatch. Is the fluid level too high?	-	Go to **Step 9**	Go to **Step 3**
3	Does the fluid have a burnt odor or a dark brown color?	-	Go to **Step 11**	Go to **Step 4**
4	Does the fluid have a cloudy or milky appearance?	-	Go to **Step 10**	Go to **Step 5**
5	Is the fluid level low?	-	Go to **Step 6**	System OK
6	Add DEXRON® VI automatic transmission fluid in increments of 0.5 L (0.5 qt) until the fluid is in the middle of the X-hatch. Check both sides of	-		

	the fluid level indicator, and read the lower level. Did you add more than 1.5 L (1.6 qt) to the transmission?		Go to **Step 7**	Go to **Step 9**
7	Check for external leaks. Refer to **Fluid Leak Diagnosis**. Did you find any leaks?	-	Go to **Step 8**	Go to **Step 15**
8	Correct the leak condition. Did you correct the leak condition?	-	Go to **Step 15**	-
9	Remove any excess fluid to the proper level, the middle of the X-hatch. Is the fluid level satisfactory?	-	System OK	-
10	The transmission is contaminated with engine coolant. Replace the cooler. Is the replacement complete?	-	Go to **Step 12**	-
11	**IMPORTANT:** **Transmission fluid may turn dark with normal use. This does not always indicate oxidation or contamination.** 1. Drain the fluid to determine if the fluid is contaminated. Refer to **Oil Pan Replacement** . 2. A very small amount of material in the bottom pan is a normal condition, but large pieces of metal or other material in the bottom pan require a transmission overhaul. Was the fluid contaminated?	-	Go to **Step 12**	Go to **Step 13**
12	Perform root cause and repair as necessary. Is the repair complete?	-	Go to **Step 13**	-
13	Flush the cooler. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J45096)** or **Automatic Transmission Oil Cooler Flushing and Flow Test (SA9165T)**. Has the cooler been flushed?	-	Go to **Step 14**	-
14	Change the fluid and the filter. Refer to **Automatic Transmission Fluid Filter and Seal Replacement** . Is the procedure complete?	-	Go to **Step 15**	-
15	Add new fluid to the proper level, in the middle of the X-hatch. Is the procedure complete?	-	System OK	-

LINE PRESSURE CHECK

Tools Required

- **J 21867** Pressure Gage. See **Special Tools** .
- **J-21467-65** Pressure Test Adapter (5.3 only)

IMPORTANT:

- **Before performing a line pressure check, verify that the pressure control (PC) solenoid valve is receiving the correct electrical signal from the PCM.**
- **Some conditions may be intermittent, therefore this test should be performed at least 3 times.**

1. Install a scan tool.

CAUTION: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

2. Start the engine and set the parking brake.
3. Check for a stored Diagnostic Trouble Code (DTC).
4. Repair the vehicle, if necessary.
5. Check the fluid level. Refer to the **Transmission Fluid Checking**.
6. Check the manual linkage for proper adjustment.

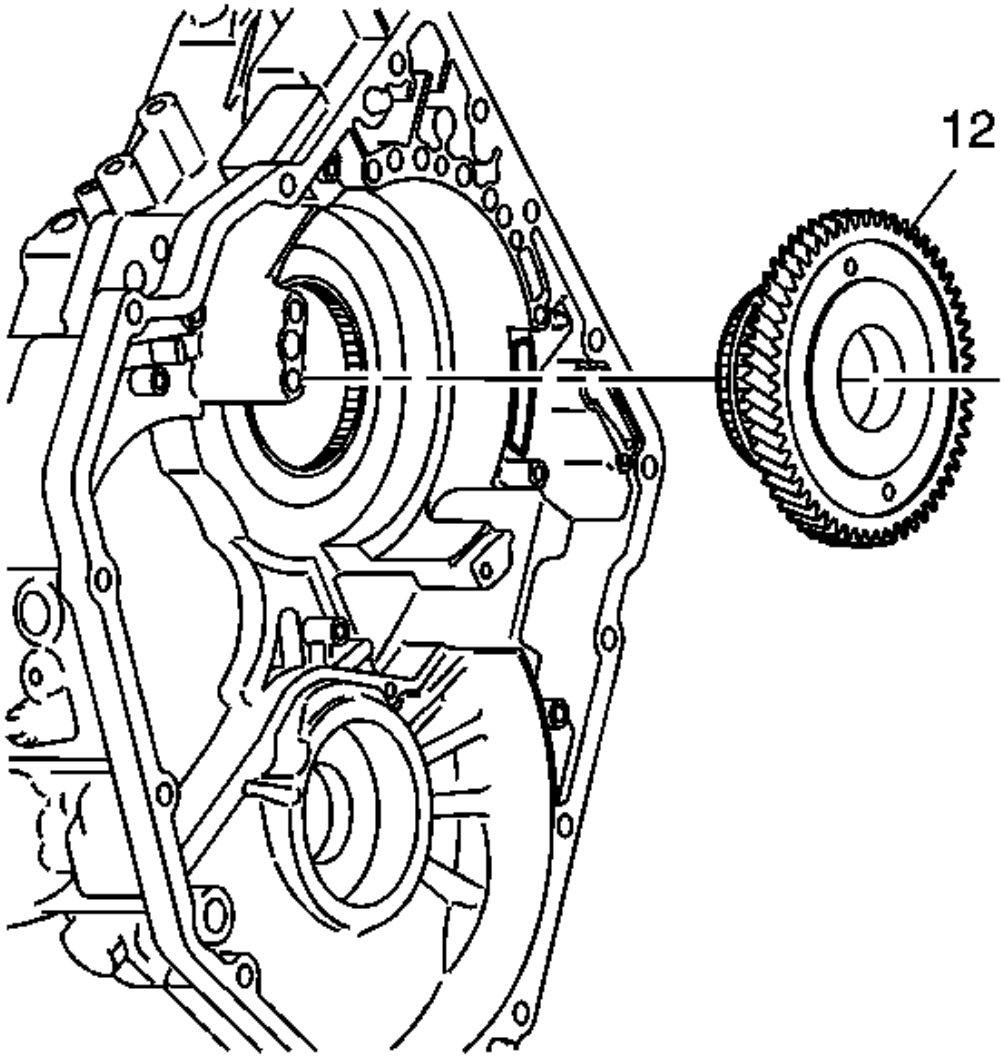

Fig. 2: Checking Line Pressure
Courtesy of GENERAL MOTORS CORP.

7. Turn the engine Off.
8. Loosen Exhaust cross-over pipe to allow attachment of **J-21467-65** adapter (5.3 only).
9. Remove the oil pressure test hole plug and install the **J 21867** and **J-21467-65** adapter (5.3 only). See **Special Tools** .
10. Put the gear selector in PARK range and set the parking brake.
11. Start the engine and allow the engine to warm up at idle.

NOTE: The total test running time should not be longer than 2 minutes. Running the test longer than 2 minutes may damage the transaxle.

12. Access the PC solenoid valve control test on the scan tool.
13. Increase the PC solenoid actual current from 0 to 1 amps in 0.1 amp increments. Allow the pressure to stabilize for five seconds after each pressure change. Read the corresponding line pressure on the **J 21867** . See **Special Tools** .
14. Refer to the **Line Pressure** specification table. Compare the data to the table.
15. If pressure readings differ greatly from the table, refer to **Incorrect Line Pressure**.
16. Shut the engine OFF. Remove the **J 21867** and **J-21467-65** (5.3 only). See **Special Tools** .
17. Apply sealant GM P/N 12345382 (Canadian P/N 1095348) to the oil pressure test hole plug.

NOTE: Refer to FASTENER NOTICE .

18. Install the oil pressure test hole plug.

    Tighten: Tighten the plug to 12 N.m (106 lb in).

19. Re-tighten the exhaust cross-over pipe (5.3 only).

ROAD TEST

The following test provides a method of evaluating the condition of the automatic transmission. The test is structured so that most driving conditions would be achieved. The test is divided into the following parts:

- Electrical Function Check
- Upshift Control and Torque Converter Clutch (TCC) Apply
- Part Throttle Detent Downshifts
- Full Throttle Detent Downshifts
- Manual Downshifts
- Coasting Downshifts
- Manual Gear Range Selection
  - REVERSE
  - Manual FIRST
  - Manual SECOND
  - Manual THIRD

IMPORTANT: Complete the test in the sequence given. Incomplete testing cannot guarantee an accurate evaluation.

Before the road test, ensure the following:

- The engine is performing properly.
- Transmission fluid level is correct. Refer to the **Transmission Fluid Checking**.
- Tire pressure is correct.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- View the scan tool data while conducting this test.

  Take along qualified help in order to operate the vehicle safely.

- Observe any unusual sounds or smells.

After the road test, check the following:

- Transmission fluid level. Refer to the **Transmission Fluid Checking**.
- Diagnostic Trouble Codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Scan tool data for any abnormal readings or data.

ELECTRICAL FUNCTION CHECK

Perform this check first, in order to ensure the electronic transmission components are connected and functioning properly. If these components are not checked, a simple electrical condition could be mis-diagnosed.

1. Connect the scan tool.
2. Ensure the gear selector is in PARK and set the parking brake.
3. Start the engine.
4. Verify that the following scan tool data can be obtained and is functioning properly.

   Refer to **Scan Tool Data List** for typical data values. Data that is questionable may indicate a concern.

   - Engine Speed
   - Transmission input speed (turbine)
   - Transmission output speed
   - Vehicle speed
   - TFP manual valve position switch
   - Transmission range
   - Commanded gear (current gear)
   - PC solenoid reference current

- PC solenoid actual current
- PC solenoid duty cycle
- Brake switch
- Engine coolant temperature
- Transmission fluid temperature
- Throttle angle
- Ignition voltage
- 1-2 shift solenoid
- 2-3 shift solenoid
- TCC solenoid duty cycle
- TCC slip speed

5. Monitor the brake switch signal while depressing and releasing the brake pedal. The scan tool should display:
   - Closed when the brake pedal is released.
   - Open when the brake pedal is depressed.
6. Check the garage shifts.
   1. Apply the brake pedal and ensure the parking brake is set.
   2. Move the gear selector through the following ranges:
      1. PARK to REVERSE
      2. REVERSE to NEUTRAL
      3. NEUTRAL to DRIVE
   3. Pause 2 to 3 seconds in each gear position.
   4. Verify the gear engagements are immediate and not harsh.

IMPORTANT:

- **Harsh engagement may be caused by any of the following conditions:**
  - **High idle speed. Compare engine idle speed to desired idle speed.**
  - **Commanded low PC solenoid current. Compare PC solenoid reference current to PC solenoid actual current.**
  - **A default condition caused by certain DTCs that result in maximum line pressure to prevent slippage.**
- **Soft or delayed engagement may be caused by any of the following conditions:**
  - **Low idle speed. Compare engine idle speed to desired idle speed.**
  - **Low fluid level.**
  - **Commanded high PC solenoid current. Compare PC solenoid reference current to PC solenoid actual current.**

- **Cold transmission fluid. Check for low transmission fluid temperature.**

7. Monitor transmission range on the scan tool.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Move the gear selector through all ranges.
    3. Pause 2 to 3 seconds in each range.
    4. Return gear selector to PARK.
    5. Verify that all selector positions match the scan tool display.
8. Check throttle angle input.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Ensure the gear selector is in PARK.
    3. Monitor throttle angle while increasing and decreasing engine speed with the throttle pedal. The scan tool throttle angle should increase and decrease with engine speed.

If any of the above checks do not perform properly, record the result for reference after completion of the road test.

UPSHIFT CONTROL AND TORQUE CONVERTER CLUTCH (TCC) APPLY

The PCM calculates the upshift points based primarily on two inputs: throttle angle and vehicle speed. When the PCM determines that conditions are met for a shift to occur, the PCM commands the shift by closing or opening the ground circuit for the appropriate solenoid.

Perform the following steps:

1. Refer to the **Shift Speed** table and choose a throttle position of 12 percent, 25 percent or 50 percent. All throttle angles shown should be tested to cover the normal driving range.
2. Monitor the following scan tool parameters:
    - Throttle angle
    - Vehicle speed
    - Engine speed
    - Commanded gear
    - Slip speed
    - Solenoid states
3. Place the gear selector in the OVERDRIVE position.
4. Accelerate the vehicle using the chosen throttle angle. Hold the throttle steady.
5. As the transmission upshifts, note the vehicle speed when the shift occurs for each gear change. There should be a noticeable shift feel or engine speed change within 1 to 2 seconds of the commanded gear change.
6. Compare the shift speeds to the Shift Speed table. Refer to **Shift Speed** . Shift speeds may vary slightly due to transmission fluid temperature or hydraulic delays in responding to electronic controls.

- Note any harsh, soft or delayed shifts or slipping.
- Note any noise or vibration.

7. Repeat steps 1 through 6 to complete all throttle angles.

IMPORTANT: This transmission is equipped with an electronically controlled capacity clutch (ECCC). The pressure plate does not fully lock to the torque converter cover. Apply pressure on the clutch plate is controlled to maintain a small amount of slippage (about 20 RPM) in SECOND, THIRD and FOURTH gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration or chuggle caused by TCC apply. Typical apply speeds are 49-52 km/h (30-32 mph) in THIRD gear and 65-73 km/h (40-45 mph) in FOURTH gear. Full lockup is available at highway speeds on some applications.

IMPORTANT: The TCC will not engage until the engine is in closed loop operation and the vehicle speed is as shown in the Shift Speed table. Refer to Shift Speed . The vehicle must be in a near-cruise condition, not accelerating or coasting, and on a level road surface.

8. Check for TCC apply in THIRD and FOURTH gear.
   - Note the TCC apply point. When the TCC applies there should be a noticeable drop in engine speed and a drop in slip speed to below 100 RPM. If the TCC apply can not be detected:
     - Check for DTCs
     - Refer to **Torque Converter Diagnosis**
   - Refer to the **Shift Speed** table for the correct TCC apply speeds.
   - Lightly tap and release the brake pedal. The TCC will release on most applications.

PART THROTTLE DETENT DOWNSHIFT

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to greater than 50 percent.
4. Verify the following:
   - The TCC releases
   - The transmission downshifts immediately to THIRD gear

FULL THROTTLE DETENT DOWNSHIFT

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to speeds of 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to 100 percent (WOT).
4. Verify the following:

- The TCC releases
- The transmission downshifts immediately to SECOND gear

MANUAL DOWNSHIFTS

The shift solenoid valves do not control the 4-3 manual downshift. The 4-3 manual downshift is hydraulic. The 3-2 and 2-1 manual downshifts are electronic. The solenoid states will change during, or shortly after a 4-3 downshift is selected.

Manual 4-3 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Release the throttle while moving the gear selector to THIRD.
4. Verify the following:
   - The TCC releases
   - The transmission downshifts immediately to THIRD gear
   - The engine slows the vehicle

Manual 4-2 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-72 km/h (40-45 mph).
3. Release the throttle while moving the gear selector to SECOND.
4. Verify the following:
   - The TCC releases
   - The transmission downshifts immediately to SECOND gear
   - The engine slows the vehicle

Manual 4-1 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64 km/h (40 mph).
3. Release the throttle while moving the gear selector to FIRST.
4. Verify the following:
   - The TCC releases
   - The transmission downshifts immediately to SECOND Gear.
   - The engine slows the vehicle.
   - The transmission downshifts to FIRST gear at the calibrated speed, typically 48-64 km/h (30-40 mph).

COASTING DOWNSHIFTS

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to FOURTH gear with the TCC applied.
3. Release the throttle and lightly apply the brakes.
4. Verify the following:
    - The TCC releases
    - Downshifts occur at speeds shown in the Shift Speed table. Refer to **Shift Speed** .

MANUAL GEAR RANGE SELECTION

The shift solenoids control the upshifts in the manual gear ranges.

Perform the following tests using 10-15 percent throttle angle.

Reverse

1. With the vehicle stopped, move the gear selector to REVERSE.
2. Slowly accelerate the vehicle.
3. Verify that there is no noticeable slip, noise or vibration.

Manual First

1. With the vehicle stopped, move the gear selector to FIRST.
2. Accelerate the vehicle to 32 km/h (20 mph).
3. Verify the following:
    - No upshifts occur
    - The TCC does not apply
    - There is no noticeable slip, noise, or vibration

Manual Second

1. With the vehicle stopped, move the gear selector to SECOND.
2. Accelerate the vehicle to 57 km/h (35 mph).
3. Verify the following:
    - The 1-2 shift occurs
    - The 2-3 shift does not occur
    - There is no noticeable slip, noise, or vibration

Manual Third

1. With the vehicle stopped, move the gear selector to THIRD.
2. Accelerate the vehicle to 64 km/h (40 mph).
3. Verify the following:

- The 1-2 shift occurs
- The 2-3 shift occurs
- There is no noticeable slip, noise, or vibration

TORQUE CONVERTER DIAGNOSIS

The torque converter clutch (TCC) is applied by fluid pressure, which is controlled by a PWM solenoid valve. This solenoid valve is located inside of the automatic transmission assembly. The solenoid valve is controlled through a combination of computer controlled switches and sensors.

TORQUE CONVERTER STATOR

The torque converter stator roller clutch can have two different malfunctions.

- The stator assembly freewheels in both directions.
- The stator assembly remains locked up at all times.

POOR ACCELERATION AT LOW SPEED

If the stator is freewheeling at all times, the car tends to have poor acceleration from a standstill. At speeds above 50-55 km/h (30-35 mph), the car may act normally. For poor acceleration, you should first determine that the exhaust system is not blocked, and the transmission is in First gear when starting out.

If the engine freely accelerates to high RPM in NEUTRAL, you can assume that the engine and the exhaust system are normal. Check for poor performance in DRIVE and REVERSE to help determine if the stator is freewheeling at all times.

POOR ACCELERATION AT HIGH SPEED

If the stator is locked up at all times, performance is normal when accelerating from a standstill. Engine RPM and car speed are limited or restricted at high speeds. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, you can check the stator roller clutch by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. You should be able to freely turn the inner race clockwise, but you should have difficulty in moving the inner race counterclockwise or you may be unable to move the race at all.

NOISE

IMPORTANT: Do not confuse this noise with pump whine noise, which is usually noticeable in PARK, NEUTRAL and all other gear ranges. Pump whine will vary with line pressure.

You may notice a torque converter whine when the vehicle is stopped and the transmission is in DRIVE or REVERSE. This noise will increase as you increase the engine RPM. The noise will stop when the vehicle is

moving or when you apply the torque converter clutch, because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter:

1. Place your foot on the brake.
2. Put the gear selector in DRIVE.

NOTE: You may damage the transmission if you depress the accelerator for more than 6 seconds.

3. Depress the accelerator to approximately 1,200 RPM for no more than 6 seconds.

A torque converter noise will increase under this load.

TORQUE CONVERTER CLUTCH SHUDDER

The key to diagnosing torque converter clutch (TCC) shudder is to note when it happens and under what conditions.

TCC shudder which is caused by the transmission should only occur during the apply or the release of the converter clutch. Shudder should never occur after the TCC plate is fully applied.

If the shudder occurs while the TCC is applying, the problem can be within the transmission or the torque converter. Something is causing one of the following conditions to occur:

- Something is not allowing the clutch to become fully engaged.
- Something is not allowing the clutch to release.
- The clutch is releasing and applying at the same time.

One of the following conditions may be causing the problem to occur:

- Leaking turbine shaft seals
- A restricted release orifice
- A distorted clutch or housing surface due to long converter bolts
- Defective friction material on the TCC plate

IF SHUDDER OCCURS AFTER TCC HAS APPLIED

If shudder occurs after the TCC has applied, most of the time there is nothing wrong with the transmission.

As mentioned above, the TCC is not likely to slip after the TCC has been applied. Engine problems may go unnoticed under light throttle and load, but they become noticeable after the TCC apply when going up a hill or accelerating. This is due to the mechanical coupling between the engine and the transmission.

Once TCC is applied, there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

Inspect the following components in order to avoid misdiagnosis of TCC shudder. An inspection will also avoid the unnecessary disassembly of a transmission or the unnecessary replacement of a torque converter.

- Spark plugs - Inspect for cracks, high resistance or a broken insulator.
- Plug wires - Look in each end. If there is red dust (ozone) or a black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire. This indicates arcing during hard acceleration.
- Coil-Look for a black discoloration on the bottom of the coil. This indicates arcing while the engine is misfiring.
- Fuel injector - The filter may be plugged.
- Vacuum leak - The engine will not get a correct amount of fuel. The mixture may run rich or lean depending on where the leak occurs.
- EGR valve - The valve may let in too much or too little unburnable exhaust gas and could cause the engine to run rich or lean.
- MAP/MAF sensor - Like a vacuum leak, the engine will not get the correct amount of fuel for proper engine operation.
- Carbon on the intake valves - Carbon restricts the proper flow of air/fuel mixture into the cylinders.
- Flat cam - Valves do not open enough to let the proper fuel/air mixture into the cylinders.
- Oxygen sensor - This sensor may command the engine too rich or too lean for too long.
- Fuel pressure - This may be too low.
- Engine mounts - Vibration of the mounts can be multiplied by TCC engagement.
- Axle joints - Check for vibration.
- TP Sensor - The TCC apply and release depends on the TP Sensor in many engines. If the TP Sensor is out of specification, TCC may remain applied during initial engine loading.
- Cylinder balance - Bad piston rings or poorly sealing valves can cause low power in a cylinder.
- Fuel contamination - This causes poor engine performance.

TORQUE CONVERTER EVALUATION AND DIAGNOSIS

Replace the torque converter if any of the following conditions exist:

- External leaks appear in the hub weld area.
- The converter hub is scored or damaged.
- The converter pilot is broken, damaged, or fits poorly into the crankshaft.
- You discover steel particles after flushing the cooler and the cooler lines.
- The pump is damaged, or you discover steel particles in the converter.
- The vehicle has TCC shudder and/or no TCC apply. Replace the torque converter only after all hydraulic and electrical diagnoses have been made. The converter clutch material may be glazed.
- The converter has an imbalance which cannot be corrected. Refer to **Flexplate/Torque Converter**

Vibration Test.

- The converter is contaminated with engine coolant which contains antifreeze.
- An internal failure occurs in the stator roller clutch.
- You notice excessive end play.
- Overheating produces heavy debris in the clutch.
- You discover steel particles or clutch lining material in the fluid filter or on the magnet, when no internal parts in the unit are worn or damaged. This condition indicates that lining material came from the converter.

Do not replace the torque converter if you discover any of the following symptoms:

- The oil has an odor or the oil is discolored, if there are no metal or clutch facing particles present.
- The threads in one or more of the converter bolt holes are damaged. Correct the condition with a new thread insert.
- Transmission failure did not display evidence of damaged or worn internal parts, steel particles or clutch plate lining material in the unit and inside the fluid filter.
- The vehicle has been exposed to high mileage only. An exception may exist where the lining of the torque converter clutch dampener plate has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery, or police use.

TORQUE CONVERTER REPLACEMENT GUIDE

Torque Converter Replacement Guide

Condition	Action
Fluid	
• Transmission Fluid Oxidized/Discolored • No metal debris • Clutch fiber material	Do not replace the torque converter. Refer to **Transmission Fluid Checking**.
• Transmission Fluid Contaminated with Engine Coolant/Oil	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Transmission Fluid Contaminated with Sludge/Metal Particles	• Replace the torque converter if the following conditions are found: o Pump Damage o Drive sprocket support damage o Turbine/stator shaft damage o No damage found in transmission • Do not replace the torque converter for other transmission component damage.
• Fluid Leaks from Torque Converter	• Perform the powder/dye leak check.

	Refer to **Fluid Leak Diagnosis**. • Replace the torque converter if the following conditions are found: o Leak present at weld areas-hub, lug, or closure weld o Hub surface is damaged-scored, raised/transferred metal o Bushing is damaged
Function/Appearance	
• Torque Converter Discolored/Overheated	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Broken/Cracked Flexplate	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Stripped Converter Bolt Holes	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Torque Converter Pilot Damaged	Replace the torque converter. Refer to **Torque Converter Cover Replacement** .
• Torque Converter Ballooning	Replace the torque converter if end play exceeds 0.7 mm (0.3 in) using **J 35138** . See **Special Tools** .
Driveability - Non TCC	
• Harsh Gear Shifts-Non TCC	Do not replace the torque converter. Refer to **Symptoms - Automatic Transmission**.
• No Drive/Slips in Drive-Non TCC	Do not replace the torque converter until completing all engine and transmission diagnostics. Refer to **Slips in Drive or No Drive**.
• Idle Surge/Rough Idle	Do not replace the torque converter. Refer to **Symptoms - Engine Controls** .
• Poor Acceleration above 48 km/h (30 mph) - Launch	Do not replace the torque converter until completing all engine and transmission diagnostics. • Refer to **Symptoms - Engine Controls** . • Refer to **Symptoms - Automatic Transmission**.
• DTC P0741-TCC Stuck OFF/High Slip-Intermittent Only	Do not replace the torque converter. Refer to **DTC P0741** diagnostic table.
• DTC P0741-TCC Stuck OFF/High Slip	Refer to **DTC P0741** diagnostic table.
• DTC P0742 -TCC Stuck ON	Do not replace the torque converter. Refer to **DTC P0742** diagnostic table.
• TCC Apply/Release Shudder	Refer to **Converter Clutch Apply Rough, Slips, or Shudders**.
• TCC Chuggle	• Refer to **Symptoms - Engine Mechanical** . • Refer to **Symptoms - Engine Controls** .

	• Refer to **Symptoms - Automatic Transmission**.
Noise and Vibration	
• Noise-Whine	• Refer to **Symptoms - Automatic Transmission**. • Do not replace the torque converter if noise is present in Neutral/Park. Refer to **Symptoms - Engine Mechanical** .
Vibration - Out of Balance	• Refer to **Flexplate/Torque Converter Vibration Test**. • Refer to **Vibration Analysis - Engine** .

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST

ISOLATING VIBRATION

NOTE: Some engine/transaxle combinations cannot be balanced in this manner due to restricted access or limited clearances between the torque converter bolts and the engine. Ensure that the bolts do not bottom out in the lug nuts or the torque converter cover which could dent and cause internal damage.

To isolate and correct a flywheel or torque converter vibration, separate the torque converter from the flywheel to determine if vibration is in the engine or transmission.

1. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.
2. Turn the engine OFF.
3. Raise and suitably support the vehicle.

   Refer to **Lifting and Jacking the Vehicle** .

4. Remove the transmission converter cover bolts and the cover.

   Refer to **Torque Converter Cover Replacement** .

5. Mark the relationship of the converter to the flywheel.
6. Remove the bolts attaching the converter to the flywheel.

   Refer to **Flywheel to Torque Converter Bolt Replacement** .

7. Slide the torque converter away from the flywheel.
8. Rotate the flywheel and torque converter to inspect for defects or missing balance weights.

   Refer to **Engine Flywheel Cleaning and Inspection** .

9. Lower the vehicle.
10. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.

    Refer to **Vibration Analysis - Engine** .

11. Turn the engine OFF.

INDEXING TORQUE CONVERTER

To determine and correct a torque converter vibration, the following procedure may have to be performed several times to achieve the best possible torque converter to flywheel balance.

1. Raise and suitably support the vehicle.

   Refer to **Lifting and Jacking the Vehicle** .

2. Rotate the torque converter one bolt position.

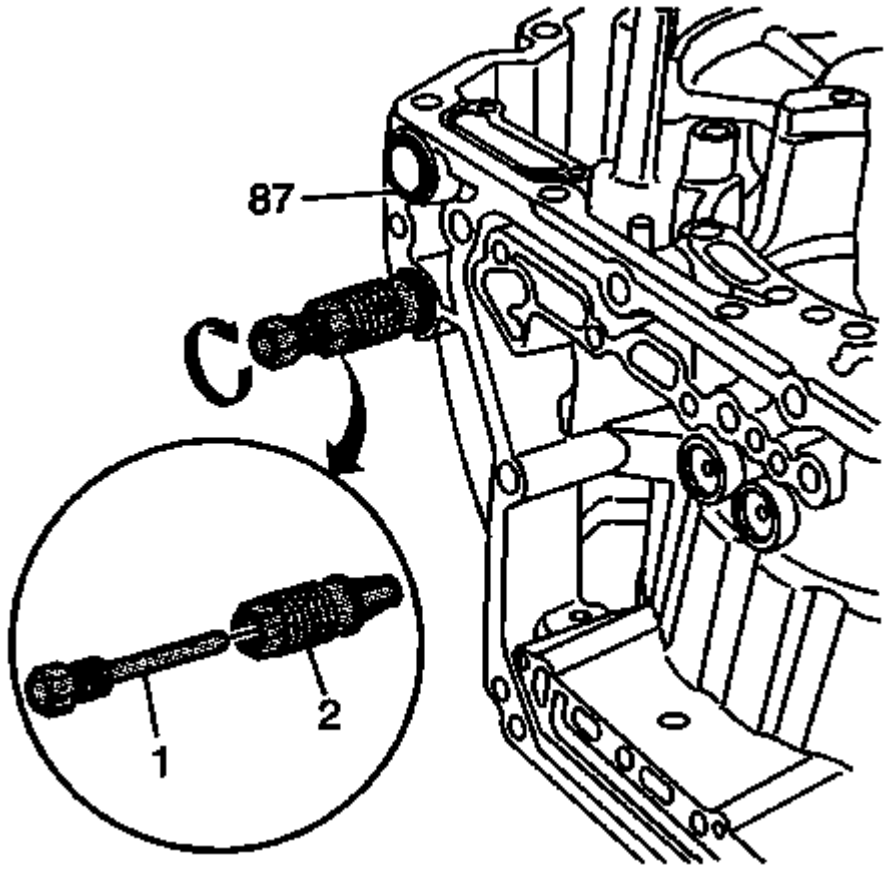

Fig. 3: View Of Torque Converter Hub In Engine Crankshaft
Courtesy of GENERAL MOTORS CORP.

3. Align the torque converter hub (2) in the engine crankshaft (3) and install the torque converter to flywheel

bolts.

Refer to **Flywheel to Torque Converter Bolt Replacement** .

4. Lower the vehicle.
5. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.

   Refer to **Noise and Vibration Analysis**.

   Repeat this procedure until you obtain the best possible balance.

6. Install the transmission converter cover bolts and the cover.

   Refer to **Torque Converter Cover Replacement** .

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

If noise or vibration is noticeable in PARK and NEUTRAL with the engine at idle, but is less noticeable as RPM increases, the cause may be from poor engine performance.

- Vibration may also be caused by a small amount of water inside the converter.
- Inspect the tires for the following conditions:
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
- Inspect the suspension components for the following conditions:
  - Alignment wear or damage
  - Loose fasteners
  - Driveline damage or wear
- Inspect the engine and transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following conditions:
  - Missing bolts, nuts, and studs
  - Stripped threads
  - Cracks
- Inspect the flywheel for the following conditions:
  - Missing or loose bolts
  - Cracks
  - Imbalance

- Inspect the torque converter for the following conditions:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights
  - Imbalance caused by heat distortion or fluid contamination

CLUTCH PLATE DIAGNOSIS

COMPOSITION PLATES

Dry the plates and inspect the plates for the following conditions:

- Pitting
- Flaking
- Delamination-splitting or separation of bonded clutch material
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

STEEL PLATES

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

CAUSES OF BURNED CLUTCH PLATES

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch or apply plates
- Engine coolant or water in the transmission fluid
- A cracked clutch piston
- Damaged or missing seals
- Low line pressure
- Valve body conditions
  - The valve body face is not flat.
  - Porosity is between channels.
  - The valve bushing clips are improperly installed.
  - The checkballs are misplaced.

- The Teflon® seal rings are worn or damaged.

ENGINE COOLANT/WATER IN TRANSMISSION

NOTE: The antifreeze or water will deteriorate the seals, gaskets and the glue that bonds the clutch material to the pressure plate. Both conditions may cause damage to the transmission.

If antifreeze or water has entered the transmission, perform the following:

1. Disassemble the transmission.
2. Replace all of the rubber type seals. The coolant will attack the seal material which will cause leakage.
3. Replace the composition-faced clutch plate assemblies. The facing material may separate from the steel center portion.
4. Replace all of the nylon parts - washers.
5. Replace the torque converter.
6. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

FLUID LEAK DIAGNOSIS

GENERAL METHOD

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

POWDER METHOD

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder, such as foot powder, to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

DYE AND BLACK LIGHT METHOD

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Detect the leak with the black light.
3. Make the necessary repairs.

FIND THE CAUSE OF THE LEAK

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

POSSIBLE POINTS OF FLUID LEAKS

Transmission Oil Pan

- Incorrectly tightened oil pan bolts
- Improperly installed or damaged oil pan gasket
- Damaged oil pan or mounting face
- Incorrect oil pan gasket

Case Leak

- Damaged or missing fill tube seal
- Mislocated fill tube bracket
- Damaged vehicle speed sensor seal
- Damaged manual shaft seal
- Loose or damaged oil cooler connector fittings
- Worn or damaged propeller shaft oil seal
- Loose line pressure pipe plug
- Warped
- Distorted torque converter housing
- Porous casting

Leak at the Torque Converter End

- Converter leak in the weld area
- Converter seal lip cut. Check the converter hub for damage
- Converter seal bushing moved forward and damaged
- Converter seal garter spring missing from the seal
- Porous casting of the transmission case or the oil pump

Leak at the Vent Pipe or the Fluid Fill Tube

- Overfilled system
- Water or coolant in the fluid-the fluid will appear milky.
- Transmission case porous
- Incorrect fluid level indicator
- Plugged vent
- Drain-back holes plugged
- Mispositioned oil pump to case gasket, if equipped

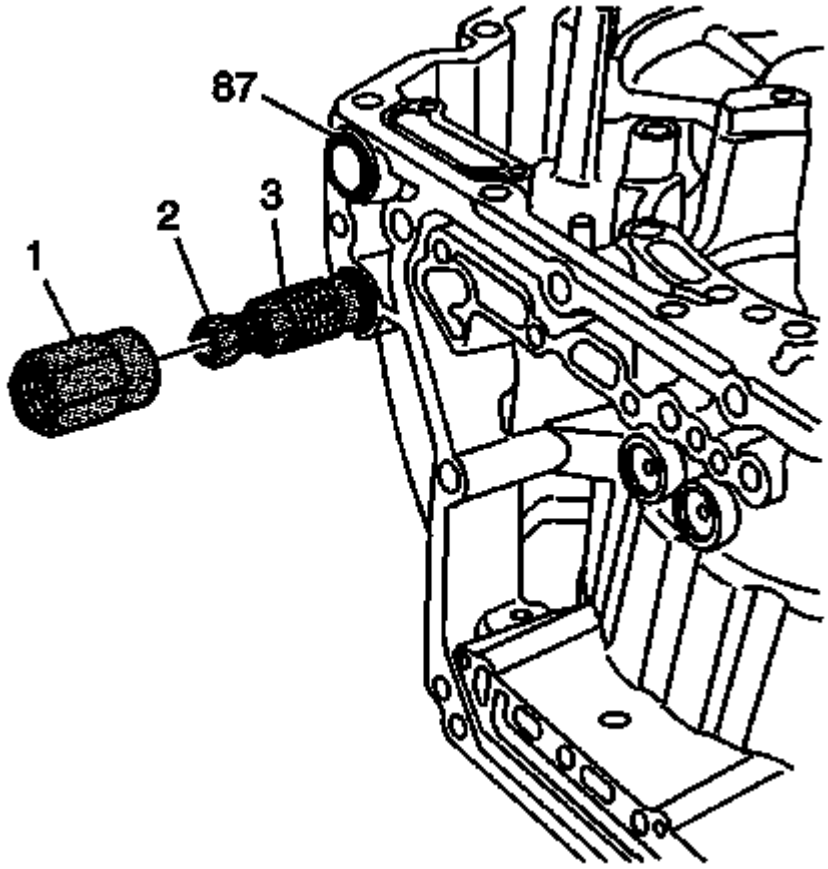

Fig. 4: Possible Leak Points
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Manual Shift Shaft Seal Assembly
2	Oil Pressure Test Hole Plug
3	Vent Assembly
4	Reverse Band Servo Cover Seal
5	Oil Fill Tube Seal
6	Vehicle Speed Sensor Seal
7	Drive Shaft Oil Seal Assembly (Right)
8	Forward Band Servo Cover Seal
9	Park Pawl Actuator Guide Seal
10	Torque Converter Oil Seal Assembly
11	Torque Converter Assembly (Welds/Cracks)
12	Oil Cooler Pipe Fittings
13	Case Assembly (Porosity/Cracks)
14	Case Side Cover Gasket
15	Electrical Connector Seal
16	Drive Shaft Oil Seal Assembly (Left)

17	Case Side Cover Inner Gasket
18	Oil Pan Gasket

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the vehicle.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.

CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.
3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for 3 hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures.

SHIFT SOLENOID LEAK TEST

TOOLS REQUIRED

J 44246 Solenoid Testing Kit. See **Special Tools** .

Leak Test Procedure

IMPORTANT:

- **This procedure tests On/Off type solenoid valves.**
- **Visually inspect the physical condition of the solenoid before testing. Inspect the O-rings before and after the test to be sure that they are not cut or damaged.**

1. Remove the solenoid from the control valve body. Refer to **1-2 Shift Solenoid Valve Replacement** or **2-3 Shift Solenoid Valve Replacement** .

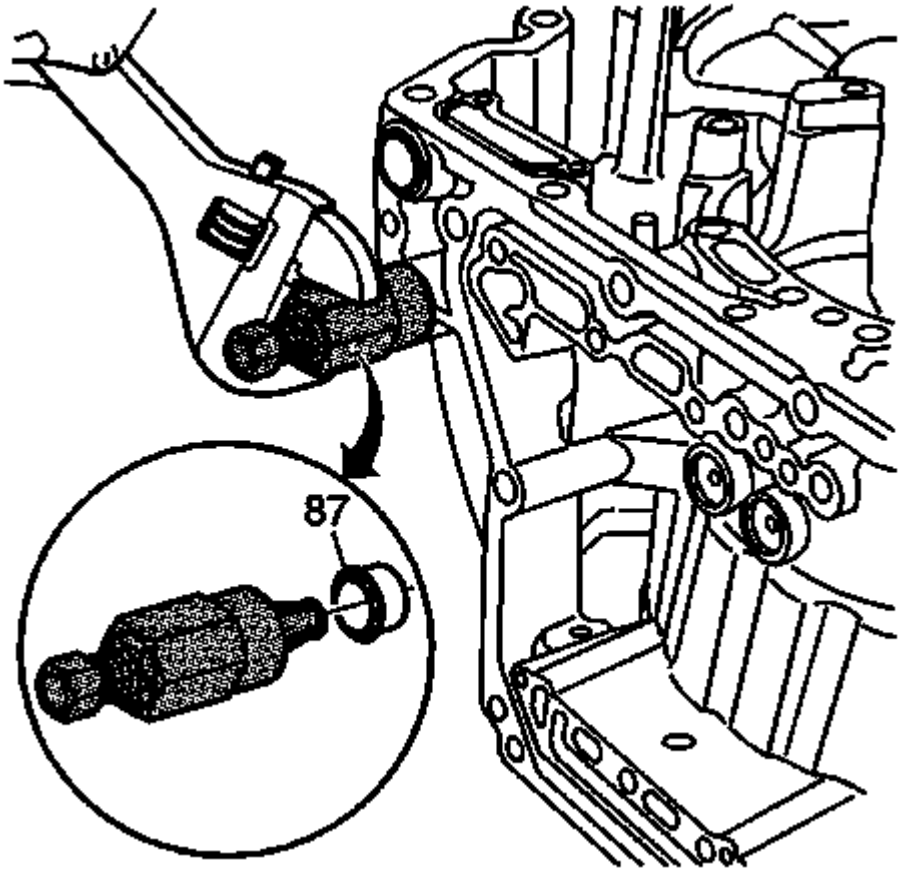

Fig. 5: Installing Valve Into Bore No. 2 Of J 44246
Courtesy of GENERAL MOTORS CORP.

2. Install the 1-2, 3-4 or the 2-3 shift solenoid valve into bore number 2 of the **J 44246** and install the factory retainer clip to retain the solenoid. See **Special Tools** .

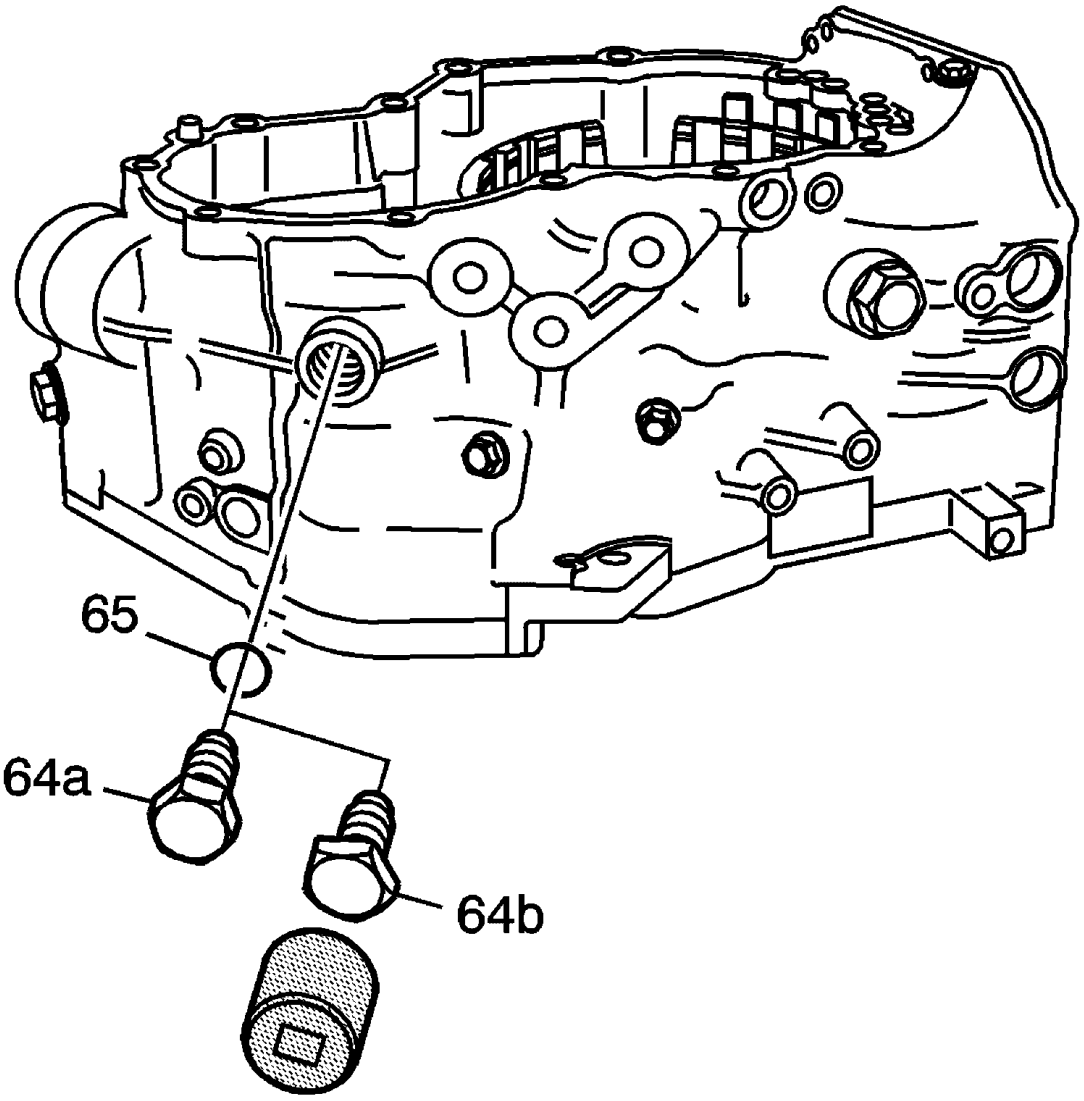

Fig. 6: Solenoid Testing Harness And Solenoid
Courtesy of GENERAL MOTORS CORP.

3. Connect the solenoid testing harness supplied with the **J 44246** to the solenoid. See **Special Tools** .

IMPORTANT: Do not use air pressure in excess of 827 kPa (120 psi). Excessive pressure will not allow the solenoid ball check valve to seat properly. Recommended air pressure is 345 kPa (50 psi).

4. Apply compressed air to the **J 44246** . See **Special Tools** .
5. Air should flow through the solenoid. If air does not flow through the solenoid, replace the solenoid.
6. Connect the solenoid testing harness to the (12 volt) positive and negative (-) battery terminals.
7. Observe if the solenoid is operating electrically. An audible clicking noise can be heard when connecting

or disconnecting power.

IMPORTANT:
- **All solenoids need to be energized to seal.**
- **A small amount of air leakage is normal, 21 kPa (3 psi).**

8. Observe the air flow through the solenoid. The flow will completely or nearly completely stop. Replace the solenoid if there continues to be an obvious air leak when the solenoid is energized.

IMPORTANT: Inspect the O-rings after the test to be sure that they are not cut or damaged.

9. Install the solenoid into the control valve body. Refer to **1-2 Shift Solenoid Valve Replacement** or **2-3 Shift Solenoid Valve Replacement** .

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (J45096)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the J 45096 or equivalent to flush and flow test the transmission oil cooler and the oil cooler pipes after the transaxle is removed for repairs. See Special Tools .

Only GM Goodwrench DEXRON®VI automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

COOLER FLOW CHECK AND FLUSHING STEPS

1. Machine Set-up
2. Determine Minimum Flow Rate
3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Tools Required

- **J 45096** Transmission Oil Cooling System Flush and Flow Test Tool. See **Special Tools** .
- Shop air supply with water/oil filters, regulator and pressure gage - minimum 90 psi
- Eye protection
- Rubber gloves

MACHINE SET-UP

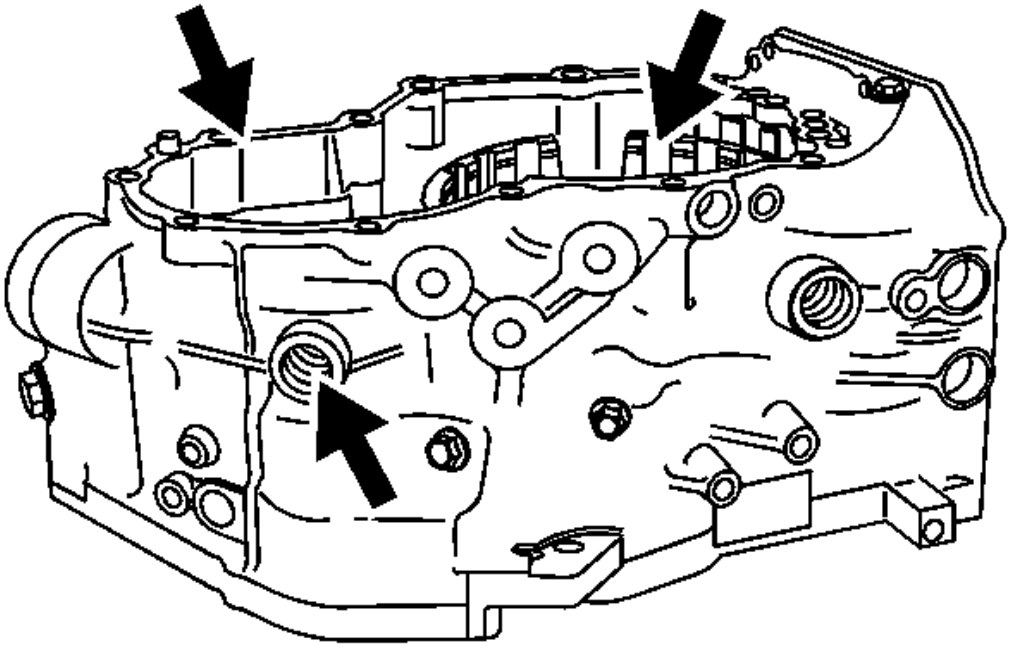

Fig. 7: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS CORP.

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

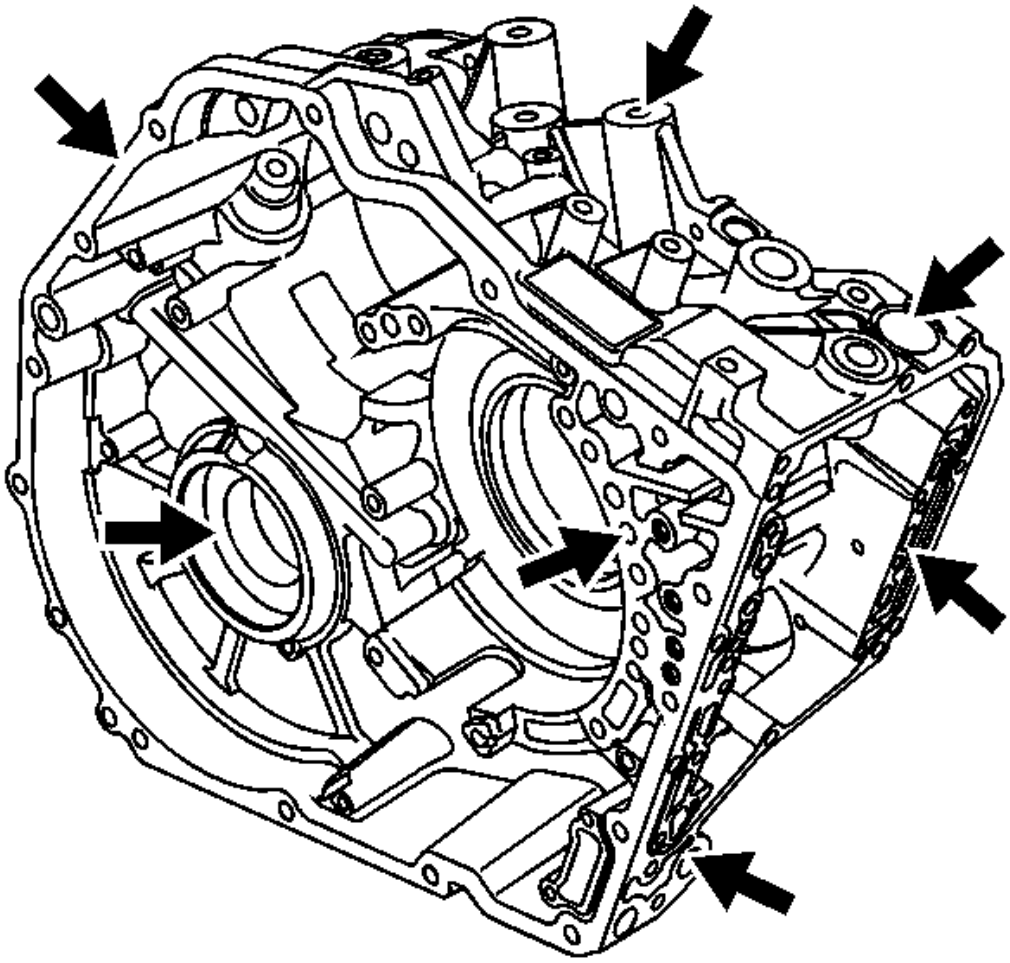

Fig. 8: Connecting To 12V DC Power Source
Courtesy of GENERAL MOTORS CORP.

3. Connect **J 45096** to the vehicle 12V DC power source by connecting the red battery clip to the positive, +, battery post on the vehicle and connect the negative lead to a known good chassis ground. See **Special Tools** .
4. Turn the main power switch to the ON position.

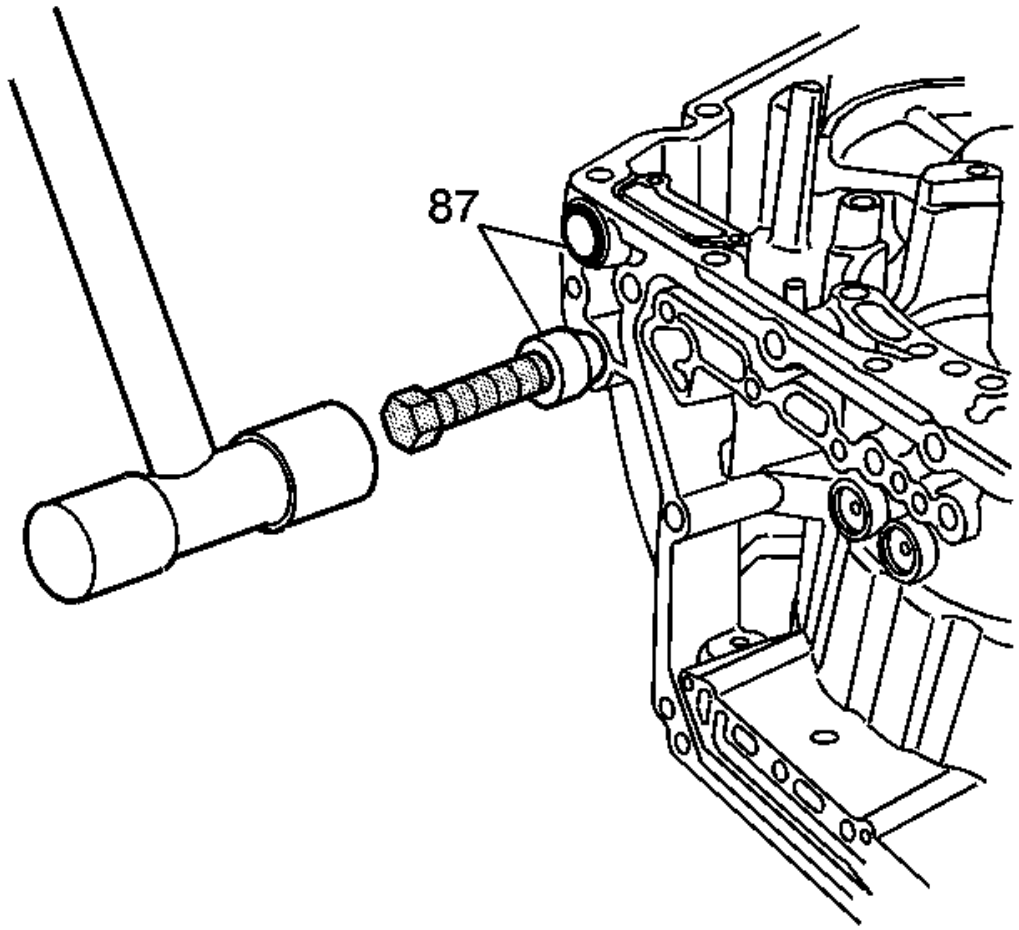

Fig. 9: Filling Supply Tank With Transmission Fluid
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).

5. Fill the supply tank with Dexron®VI/Mercon®, or equivalent, through the fill port.
6. Reinstall and tighten the fill cap.

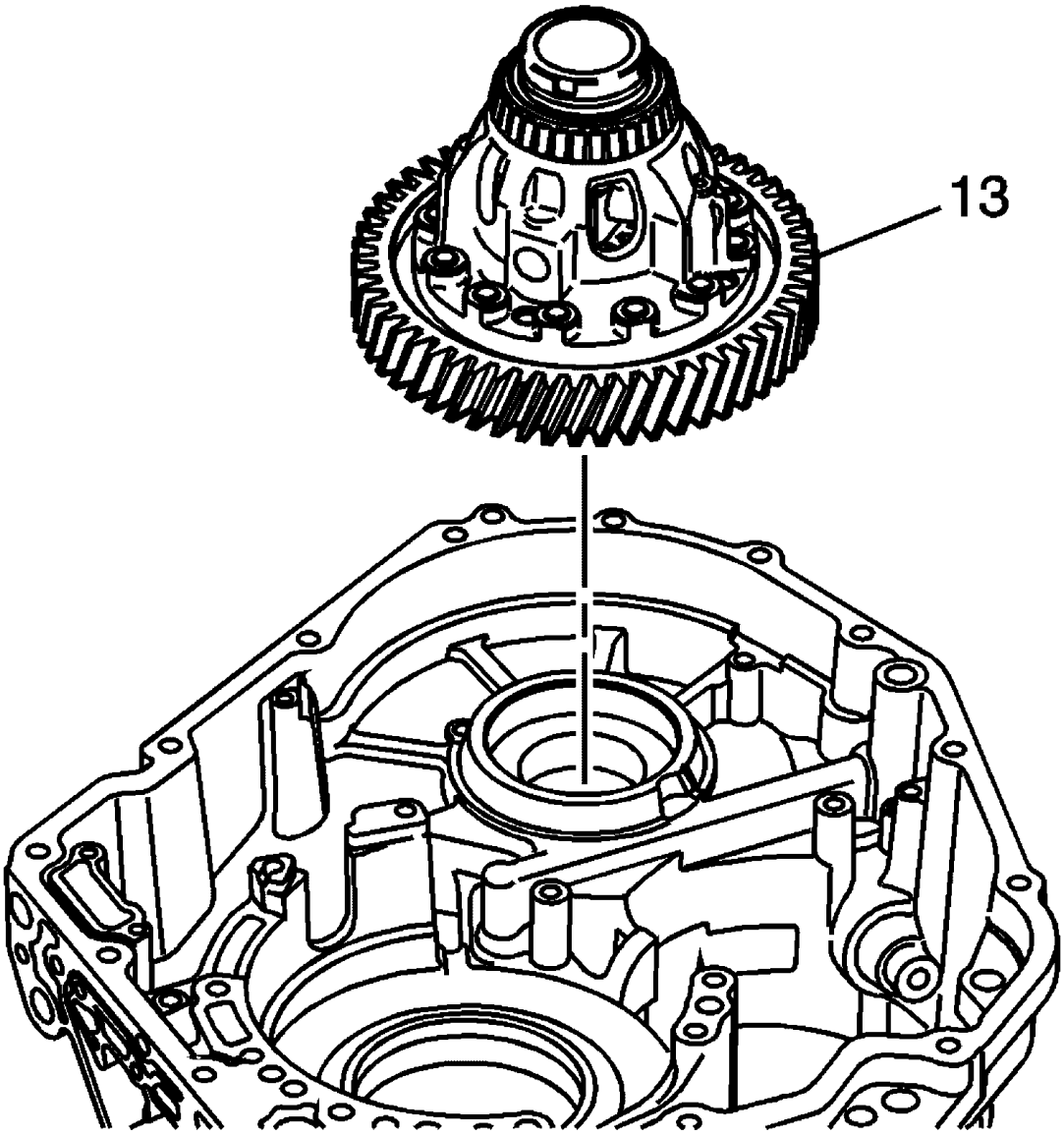

Fig. 10: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

DETERMINE MINIMUM FLOW RATE

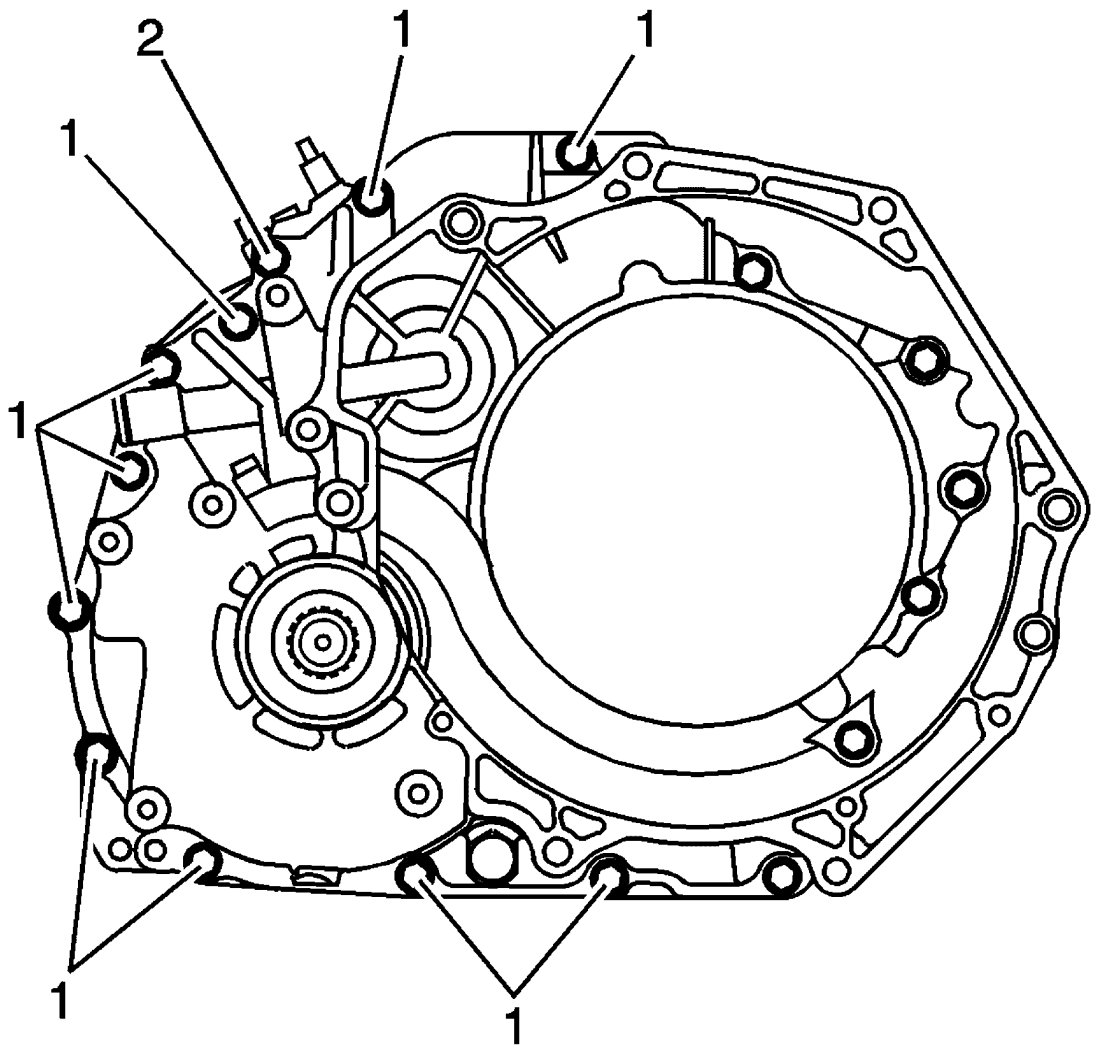

Fig. 11: Identifying Machine Display Of Automatic Transmission Fluid Temperature
Courtesy of GENERAL MOTORS CORP.

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **J 45096** . See **Special Tools** .

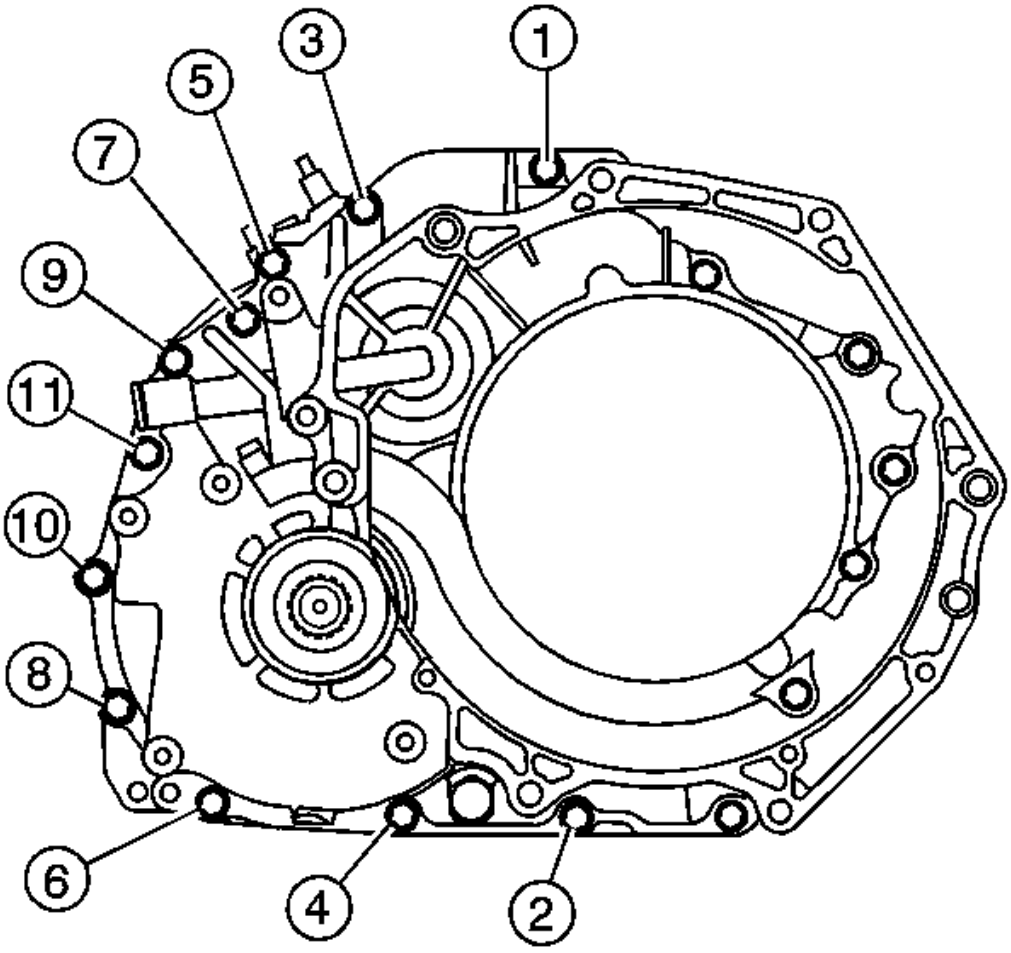

Fig. 12: Identifying Transmission Oil Cooler Metal Composition
Courtesy of GENERAL MOTORS CORP.

2. Determine whether the transmission oil cooler is steel or aluminum by using a magnet (1) at the cooler flange (2) at the radiator.
3. Refer to the table below. Using the temperature from step 1, locate on either the Steel MINIMUM Flow Rate table or the Aluminum MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.

Example::

- Fluid temperature: 75°F
- Cooler type: Steel

The MINIMUM flow rate for this example would be 0.8 GPM.

4. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow. Repair as needed and refer to the appropriate GM service procedures.

Minimum Flow Rate in Gallons Per Minute (GPM)

Temperature Range	Steel	Aluminum
65 - 66°F	0.6 gpm	0.5 gpm
67 - 70°F	0.7 gpm	0.6 gpm
71 - 75°F	0.8 gpm	0.7 gpm
76 - 80°F	0.9 gpm	0.8 gpm
81 - 84°F	1.0 gpm	0.9 gpm
85 - 89°F	1.1 gpm	1.0 gpm
90 - 94°F	1.2 gpm	1.1 gpm
95 - 98°F	1.3 gpm	1.2 gpm
99 - 103°F	1.4 gpm	1.3 gpm
104 - 108°F	1.5 gpm	1.4 gpm
109 - 112°F	1.6 gpm	1.5 gpm
113 - 117°F	1.7 gpm	1.6 gpm
118 - 120°F	1.8 gpm	1.7 gpm

BACK FLUSH PROCEDURE

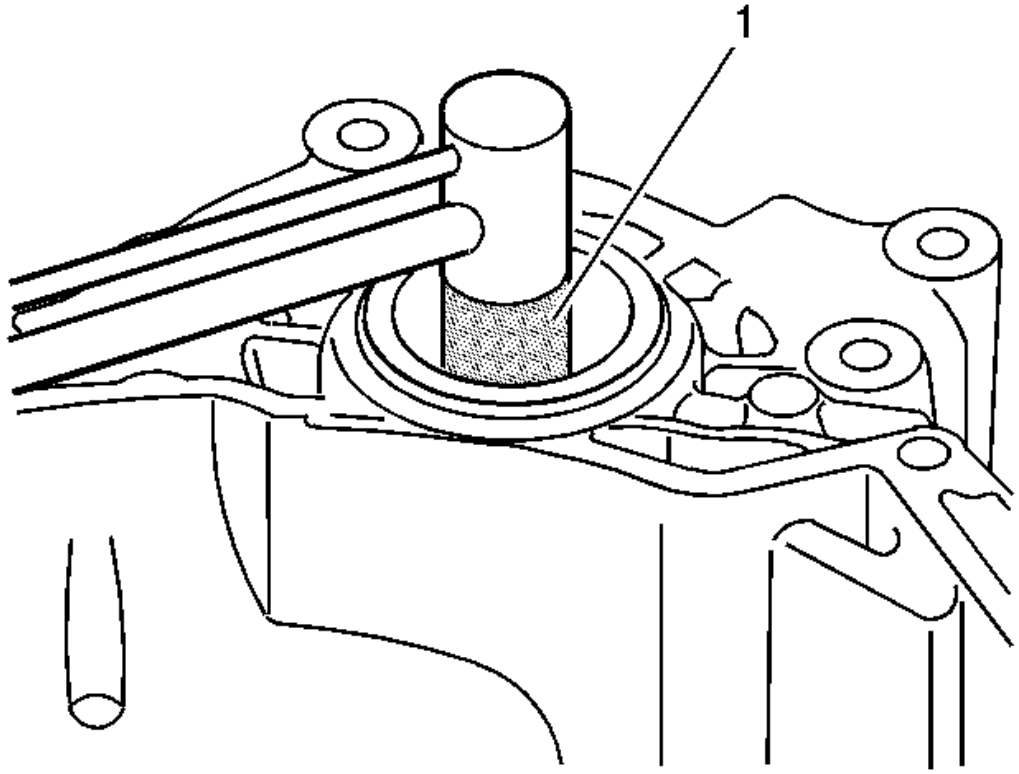

Fig. 13: Connecting J 45096 Adapters To Oil Cooler Supply And Return Lines
Courtesy of GENERAL MOTORS CORP.

1. Connect the **J 45096** adapters (1) to the vehicle's transmission oil cooler supply and return lines at the transmission. See **Special Tools** .

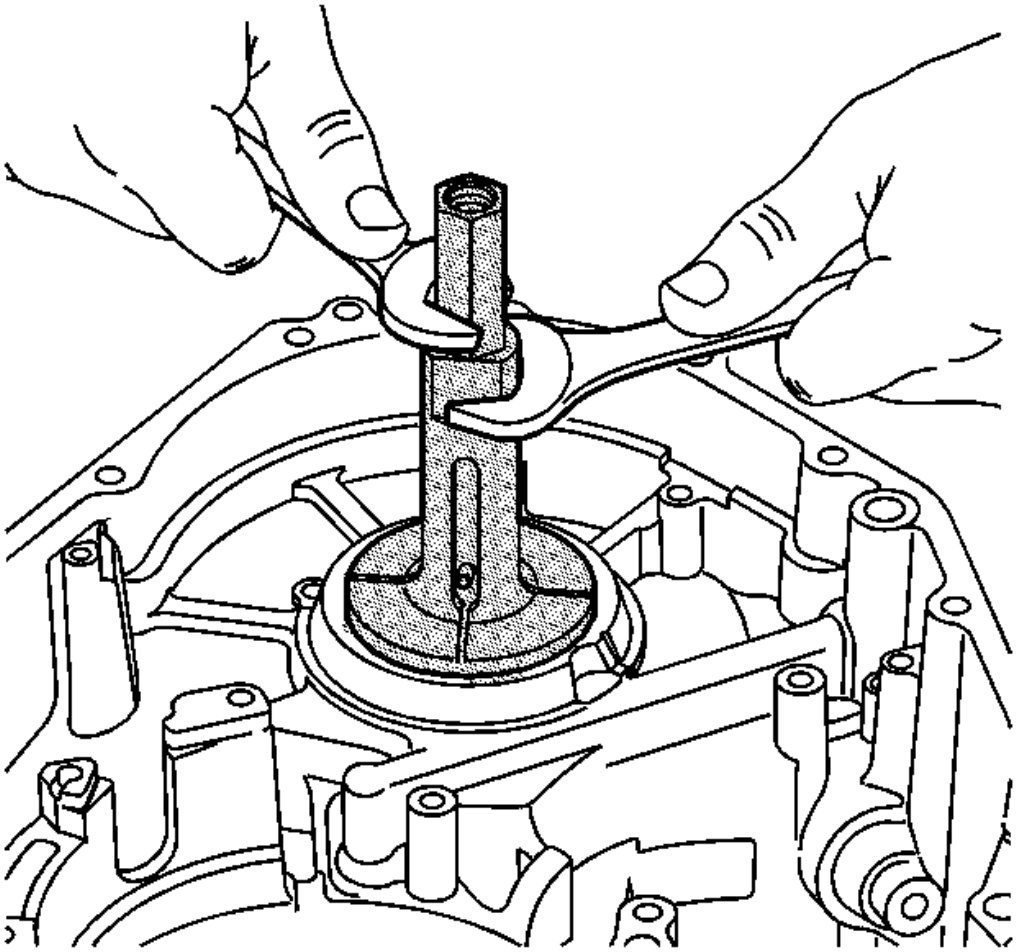

Fig. 14: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the black supply hose (1) to the return line, top connector of the transmission, and the clear waste hose (2) to the feed line, bottom connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

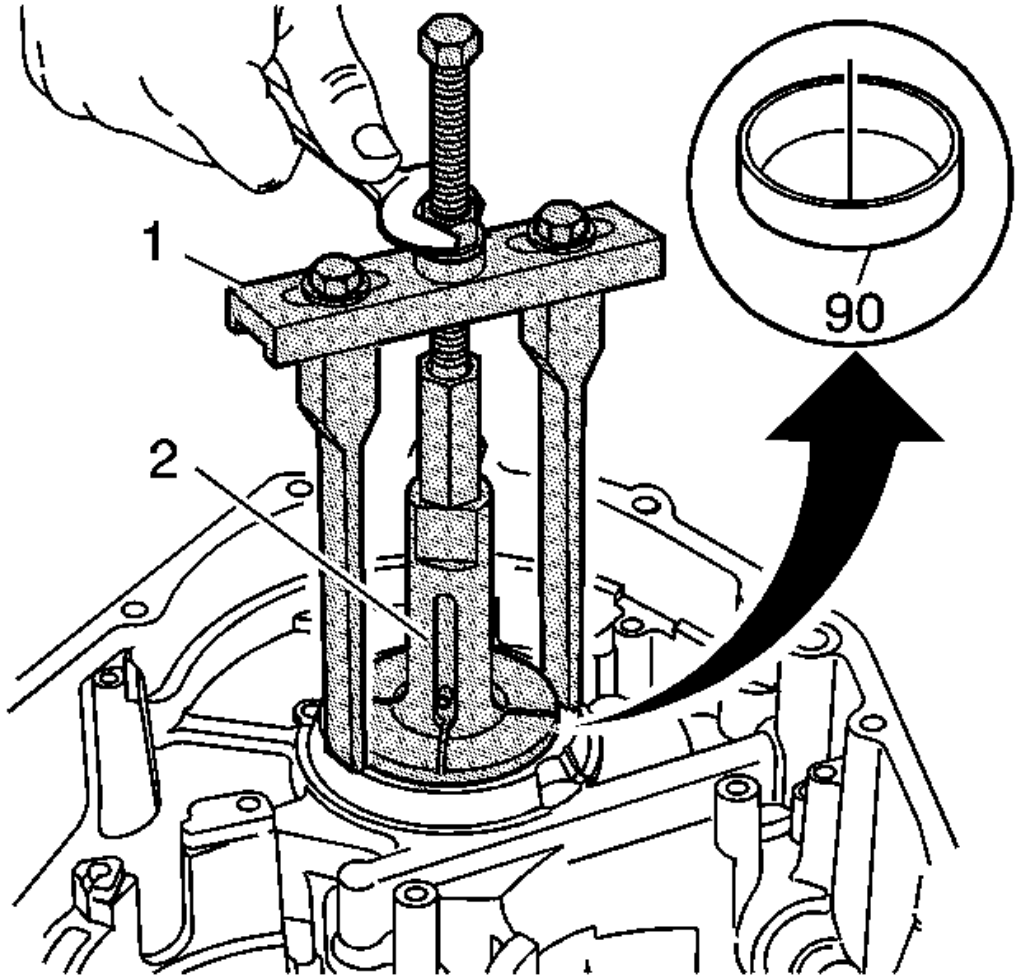

Fig. 15: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

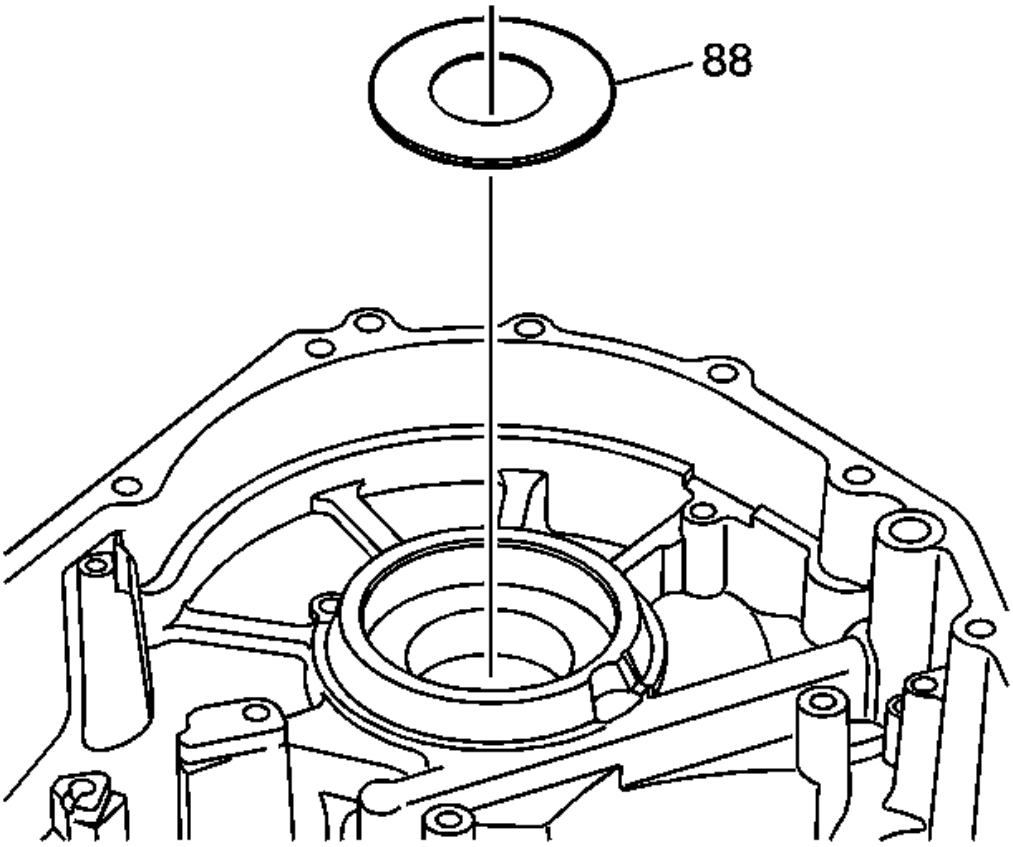

Fig. 16: Setting Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

FORWARD FLUSH

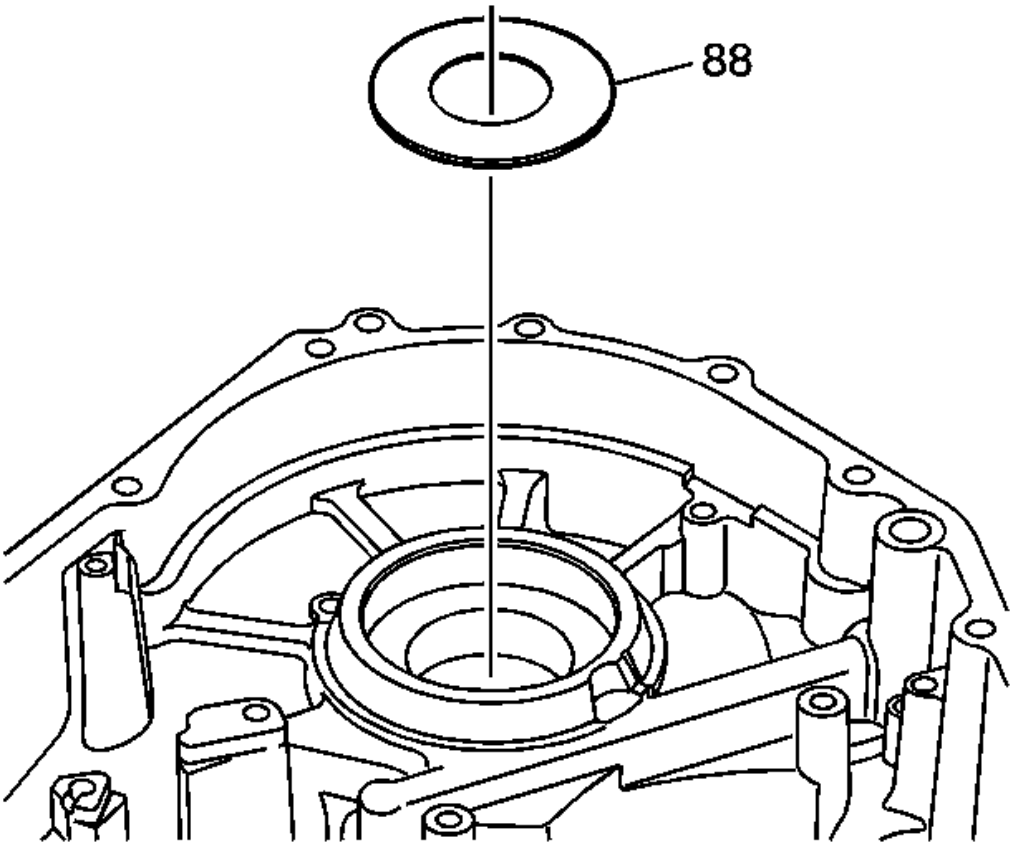

Fig. 17: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

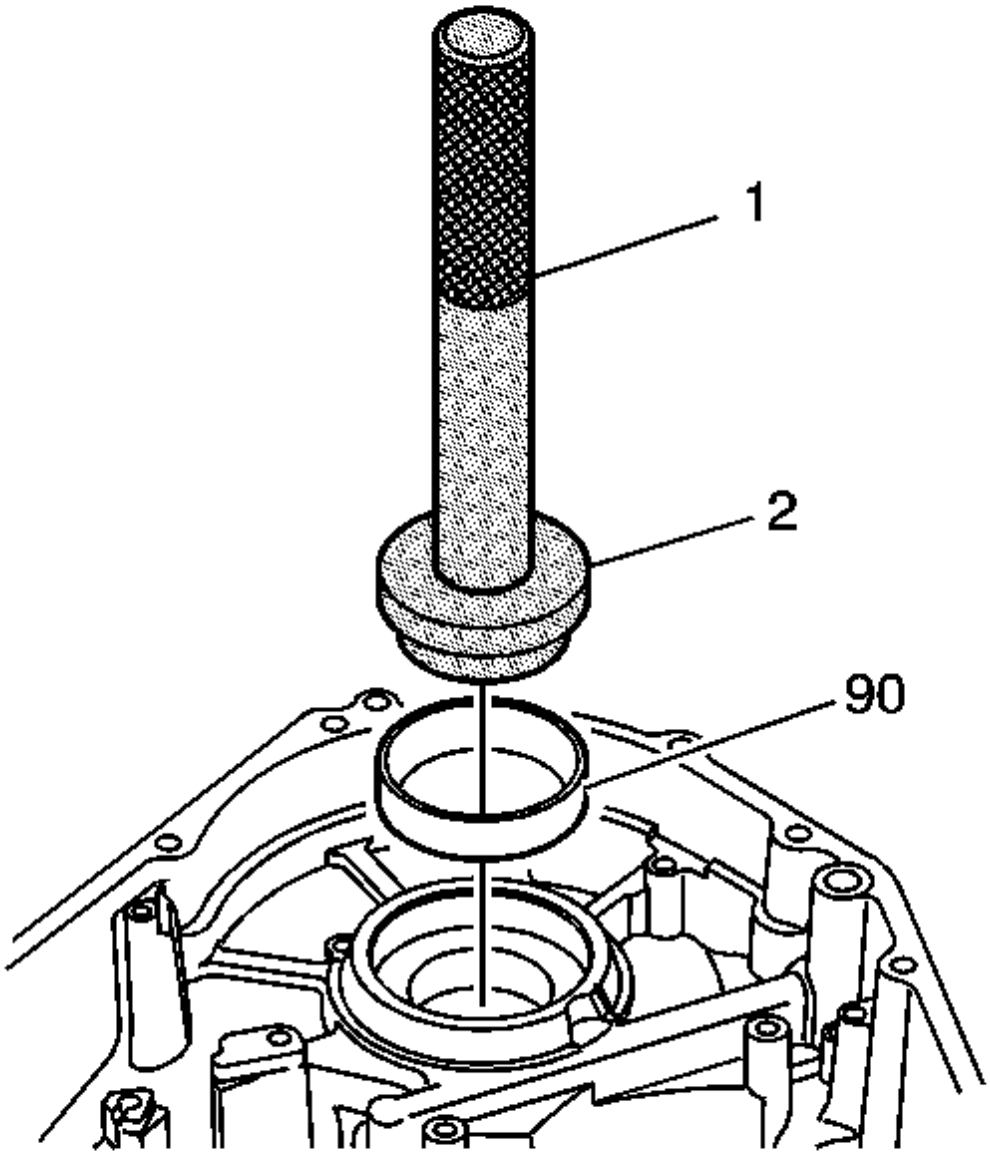

Fig. 18: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

FLOW TEST

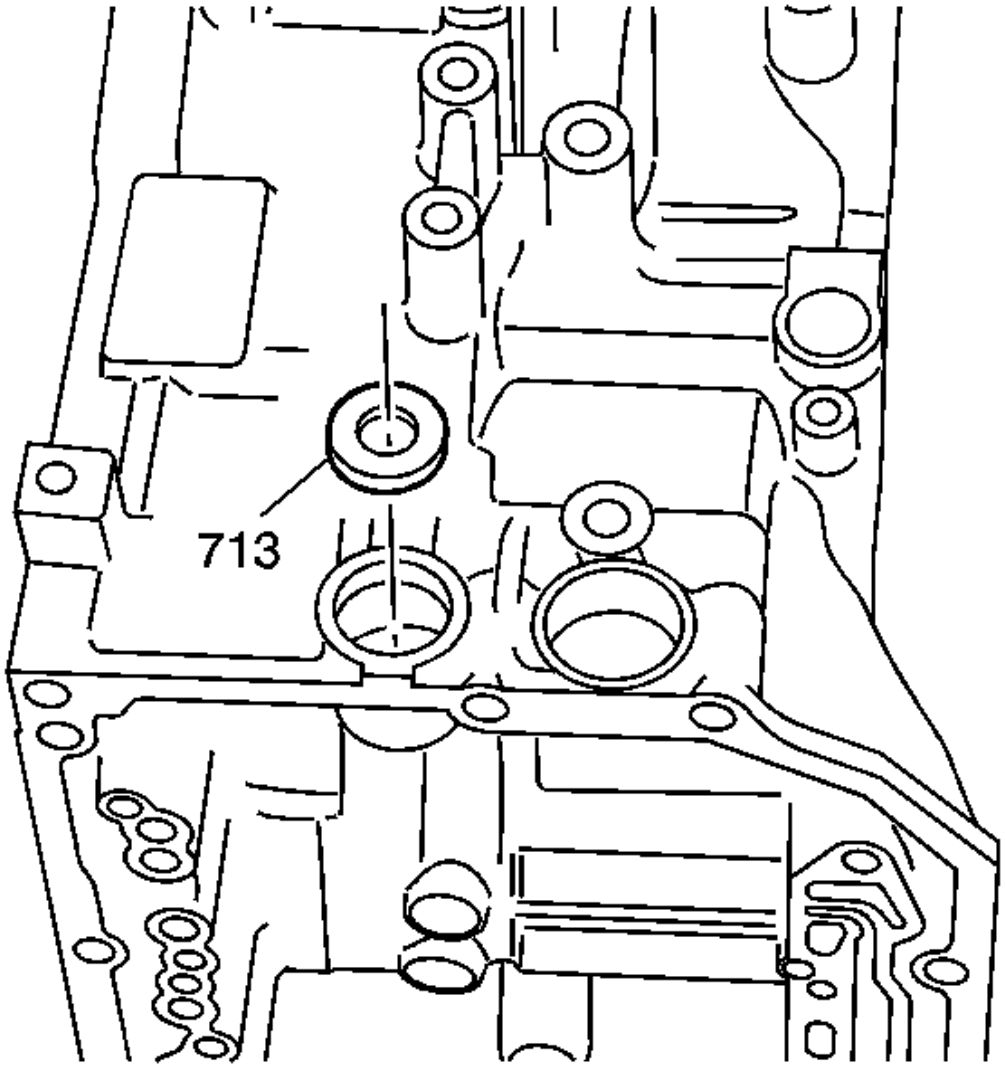

Fig. 19: Setting Main Function Switch To FLOW Position
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the tester operation manual.

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate; this is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
    - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil

cooling system is functioning properly. Perform Code Recording Procedure.

- If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.

3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.
    1. Replace the transmission oil cooler.
    2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
    3. Perform Code Recording Procedure.

CODE RECORDING PROCEDURE

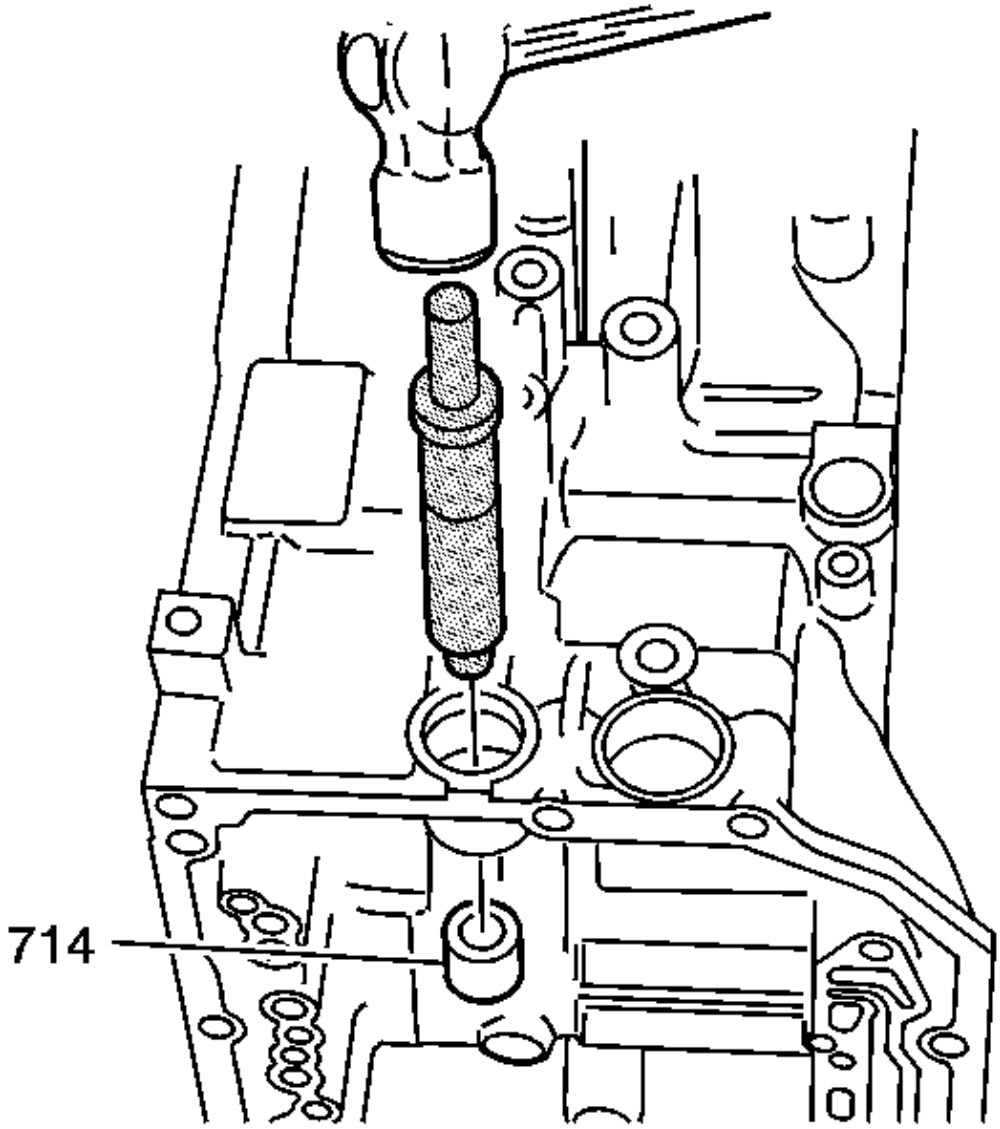

Fig. 20: Setting Main Function Switch To CODE Position
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch to the CODE position.

IMPORTANT:

- **If power is interrupted prior to the recording of the seven-character code, the code will be lost and the flow rate test will need to be repeated.**

- **The flow test must run for a minimum of 8-10 seconds and be above 0.5 gpm for a code to be generated.**

2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

CLEAN-UP

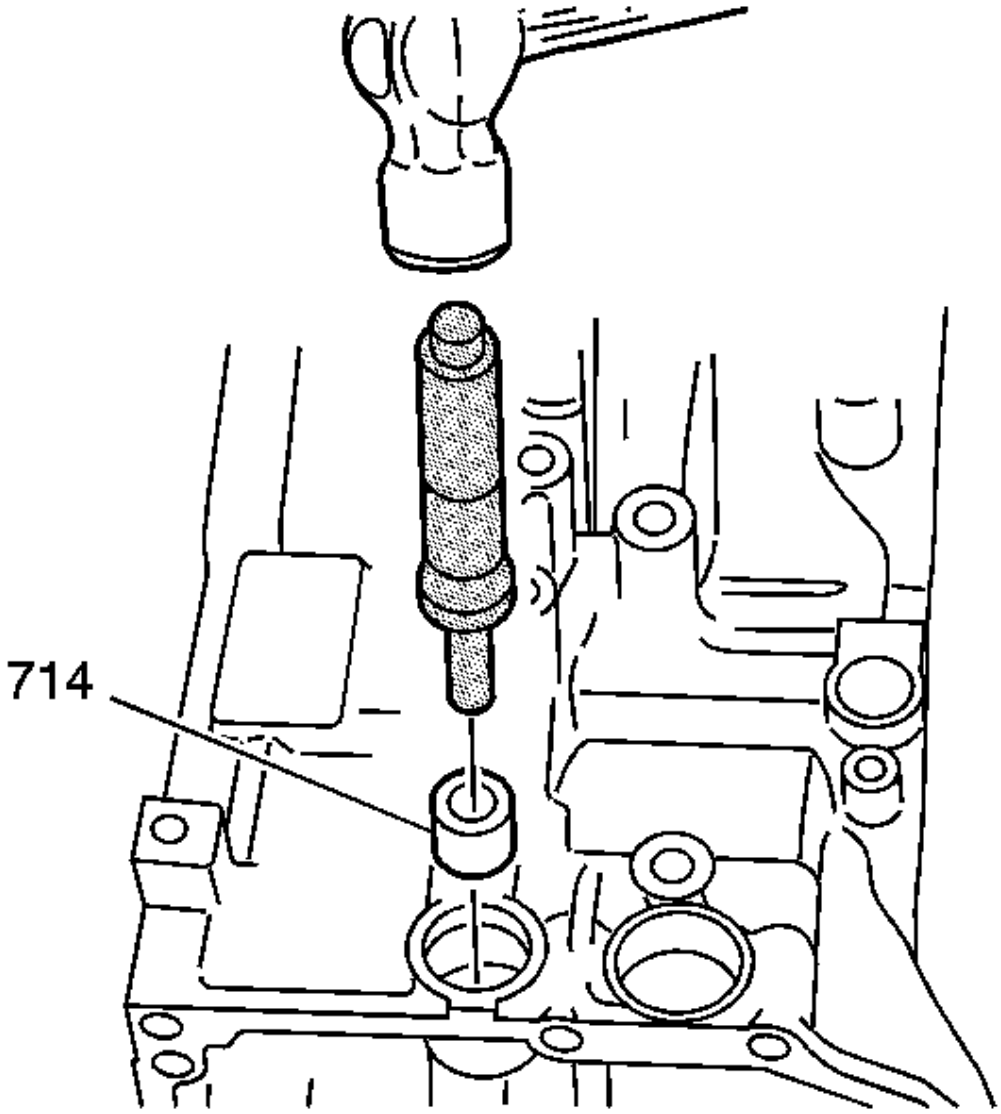

Fig. 21: View Of Main Power Switch & Main Function Switch

Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.
2. Turn the main power switch (1) to the OFF position.
3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

Note: A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water separator.

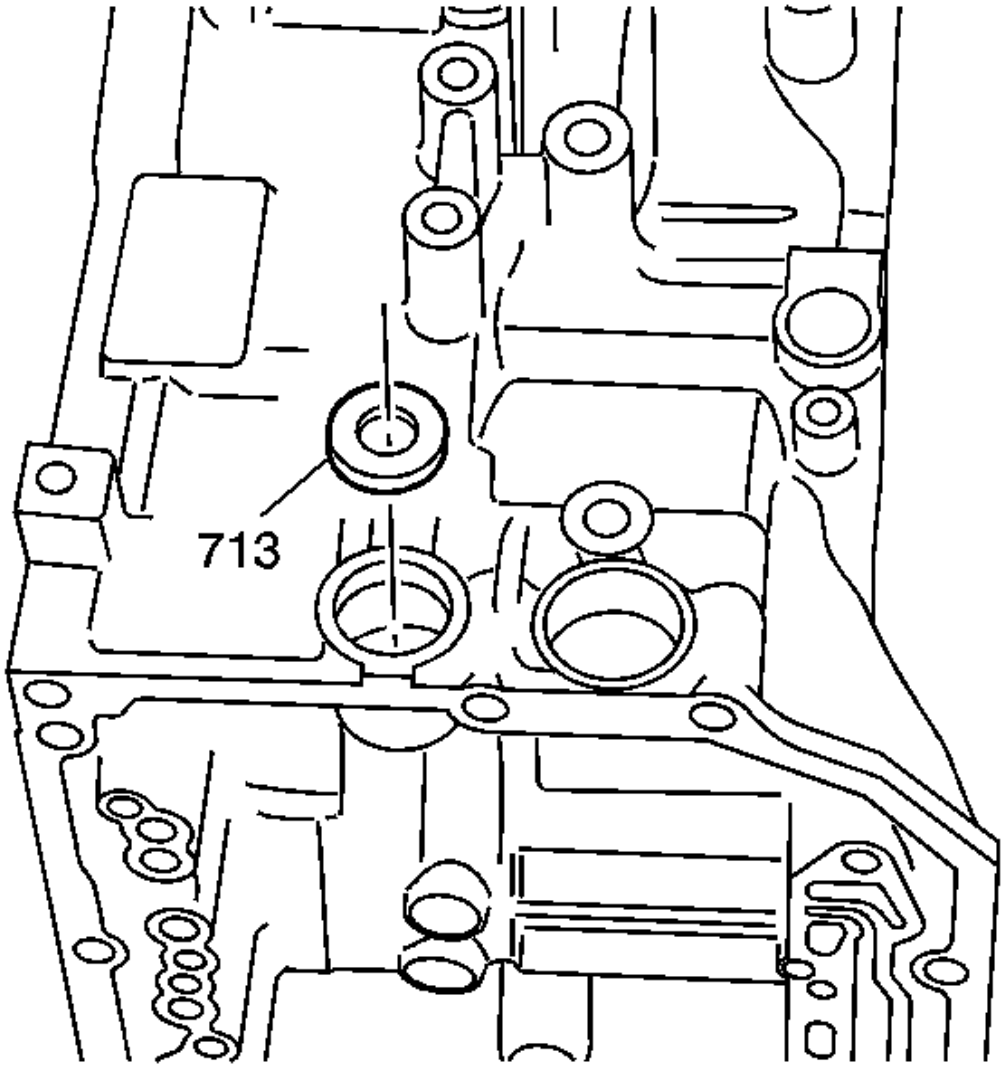

Fig. 22: Applying Shop Air Supply Hose To Quick-Disconnect

Courtesy of GENERAL MOTORS CORP.

4. Disconnect the air supply hose from **J 45096** . See **Special Tools** .
5. Dispose of the waste ATF in accordance with all applicable federal, state, and local requirements.

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (SA9165T)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission wear-out. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the SA9165T Oil Cooler Line Flusher or equivalent to flush the transmission oil cooler and the oil cooler pipes whenever the transaxle is removed for the following repairs:. See Special Tools .

- **Torque converter**
- **Oil pump**
- **Oil pump drive shaft**
- **Drive sprocket support**
- **Transaxle overhaul complete**
- **Transaxle assembly replacement**

IMPORTANT: Use the SA9165T or equivalent to flush the transmission oil cooler and the oil cooler pipes whenever the transmission is removed for the following repairs:. See Special Tools .

- **Torque converter**
- **Oil pump**
- **Turbine shaft**
- **Transmission overhaul complete**
- **Transmission assembly replacement**

Only GM Goodwrench DEXRON®VI automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing are as follows:

Cooler Flow Check and Flushing Steps

1. Tools Required
2. Preparation
3. Back Flush
4. Forward Flush
5. Flow Check
6. Clean-up

Tools Required

- **SA9165T** Oil Cooler Line Flusher. See **Special Tools** .
- **J 35944-22** Transmission Oil Cooler Flushing Fluid. See **Special Tools** .
- Measuring cup
- Funnel
- Water supply - hot water recommended
- Water hose, at least 16 mm (5/8 in) ID
- Shop air supply with water/oil filters, regulator and pressure gage
- Air chuck with clip, if available
- Oil drain container
- Pail with lid - 19 L (5 gallon)
- Eye protection
- Rubber gloves

PREPARATION

1. During the installation of the repaired or replacement transmission, do not connect the oil cooler pipes.

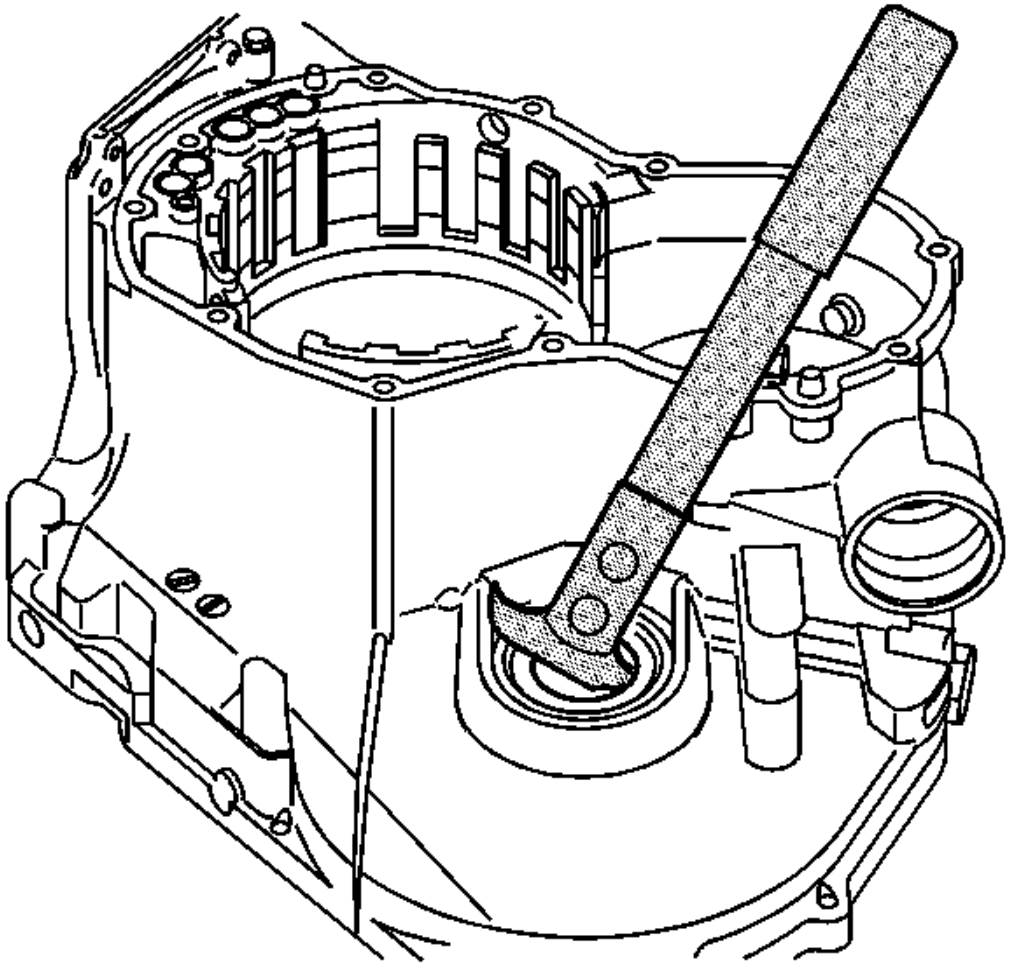

Fig. 23: Identifying Flusher Tank & Components
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not use solutions that contain alcohol or glycol. Use of solutions that contain alcohol or glycol may damage the oil cooler line flusher, oil cooler components and/or transmission components.**

IMPORTANT: **The J 35944-22 is environmentally safe, yet powerful enough to cut through transmission fluid to dislodge any contaminants from the cooler. See Special Tools . The safety precautions on the label, regarding potential skin and eye irritations associated with prolonged exposure, are typical precautions that apply to many similar cleaning solutions. It should be noted that according to GM, use of other non-approved fluids**

for cooler flushing can have an adverse reaction to the seals inside the transmission.

2. Remove the fill cap (9) on the **SA9165T** and fill the flusher tank (4) with 0. See **Special Tools** .6 L (20-21 oz) of **J 35944-22** , using the measuring cup (6). See **Special Tools** . Do not overfill.
3. Install the fill cap (9) on the **SA9165T** and pressurize the flusher tank (4) to 550-700 kPa (80-100 psi), using the shop air supply at the tank air valve (2). See **Special Tools** .
4. With the water supply valve (1) on the **SA9165T** in the OFF position, connect the water supply hose from the **SA9165T** to the water supply at the faucet. See **Special Tools** .
5. Turn ON the water supply at the faucet.

BACK FLUSH

1. Inspect the transmission oil cooler pipes for kinks or damage. Repair as necessary.

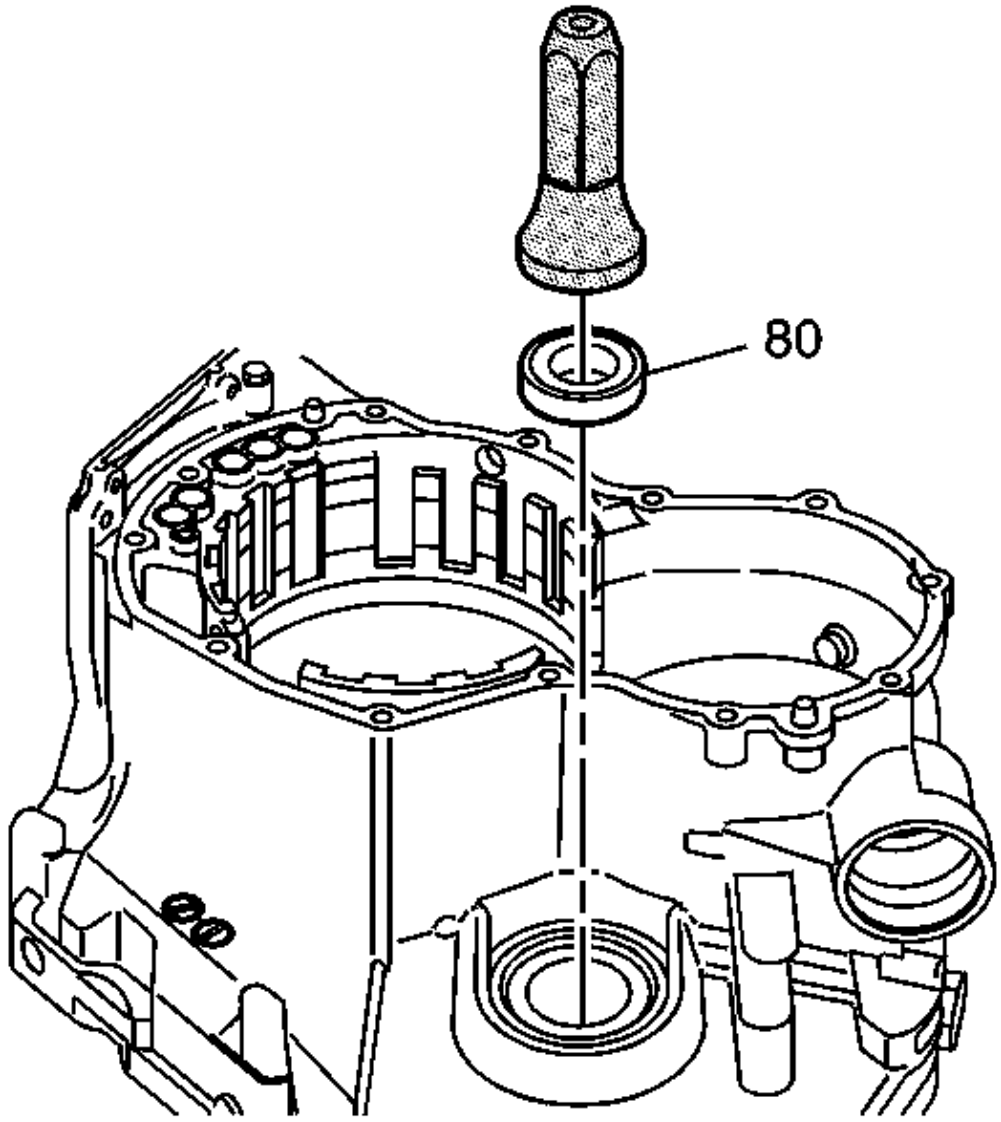

Fig. 24: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

2. Connect the **SA9165T** to the oil cooler feed top connector. See **Special Tools** .
3. Clip the discharge hose (2) onto the oil drain container.
4. Attach the **SA9165T** to the undercarriage of the vehicle with the hook provided and connect the flushing system feed supply hose (1) from the **SA9165T** to the bottom connector oil cooler return pipe. See **Special Tools** .

5. Turn the **SA9165T** water supply valve (3) to the ON position and allow water to flow through the oil cooler and pipes for 10 seconds to remove any remaining transmission fluid. See **Special Tools** . If water does not flow through the oil cooler and pipes, the cause of the blockage must be diagnosed and the plugged component must be repaired or replaced. Continue with the cooler flushing and flow check procedure once the blockage is corrected.
6. Turn the **SA9165T** water supply valve (3) to the OFF position and clip the discharge hose onto a 19 liter (5 gallon) pail with a lid, to avoid splashback. See **Special Tools** .

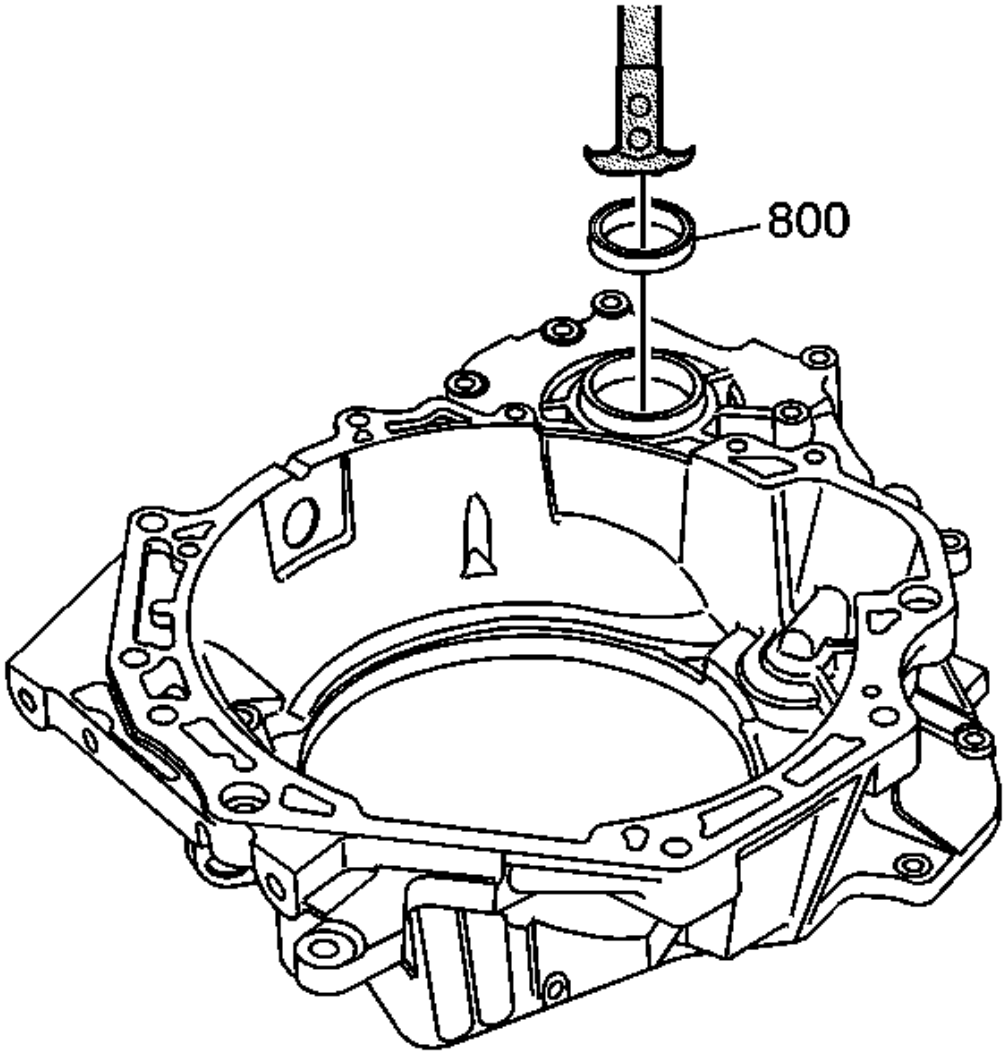

Fig. 25: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Flushing for approximately 2 minutes in each cooler line direction will result in a total of about 8-10 gallons of waste fluid. This mixture of water and flushing fluid is to be captured in a bucket or similar container.

7. Turn the **SA9165T** water supply valve (3) to the ON position and depress the trigger (1) to mix cooler flushing solution into the water flow. See **Special Tools** . Use the clip provided on the handle to hold the trigger (1) down. The discharge will foam vigorously when the solution is introduced into the water stream.
8. Flush the oil cooler and pipes with water and solution for 2 minutes. During this flush, attach the shop air supply 825 kPa (120 psi) to the flushing system feed air valve (2) located on the **SA9165T** , for 3-5 seconds at the end of every 15-20 second interval to create a surging action. See **Special Tools** .
9. Release the trigger (1) and turn the **SA9165T** water supply valve (3) to the OFF position. See **Special Tools** .

FORWARD FLUSH

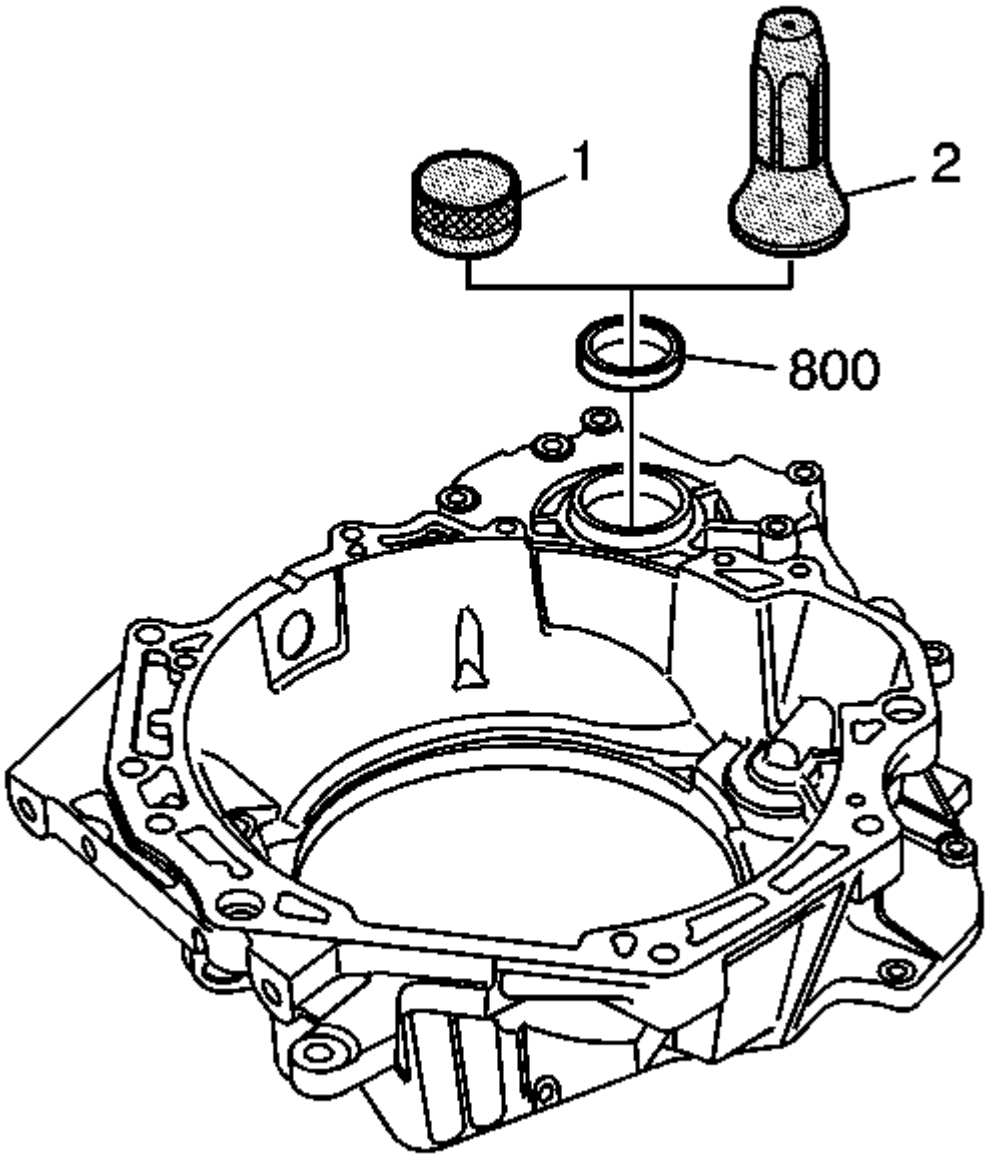

Fig. 26: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Disconnect both hoses (1 and 2) from the oil cooler pipes and connect them to the opposite oil cooler pipe. This will allow the oil cooler and pipes to be flushed in the normal flow direction.
2. Repeat Step 6 and 7 of the Back Flush.

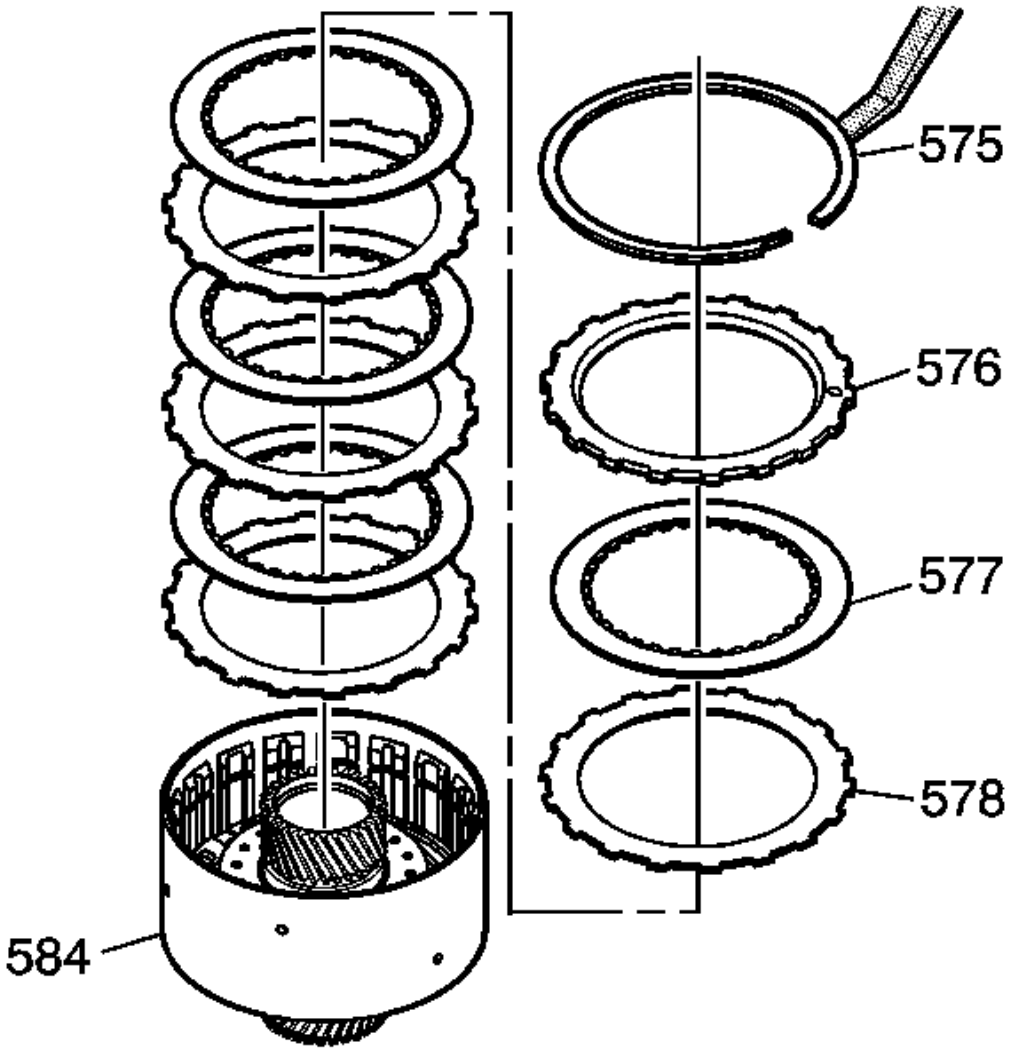

Fig. 27: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

3. Release the trigger (1) of the **SA9165T** and allow water only to rinse the oil cooler and pipes for 1 minute. See **Special Tools** .
4. Turn the **SA9165T** water supply valve (3) to the OFF position and turn OFF the water supply at the faucet. See **Special Tools** .
5. Attach the shop air supply to the flushing system feed air valve (2) on the and **SA9165T** blow out the water from the oil cooler and pipes. See **Special Tools** . Continue, until no water comes out of the discharge hose.

FLOW TEST

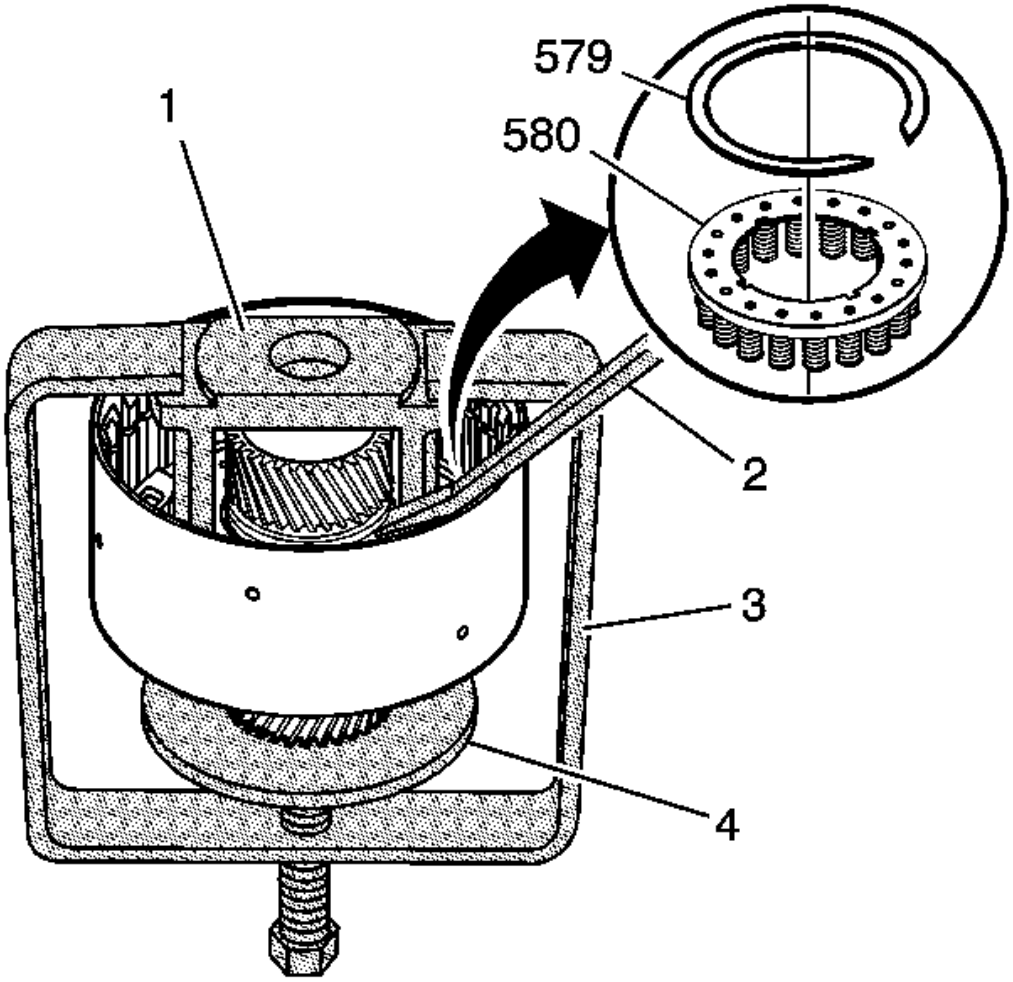

Fig. 28: Clipping The Discharge Hose To An Empty Oil Container
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The Flow Test must be performed after the flush to ensure that all flushing solution and water is removed from the oil cooling system.

1. Disconnect the hose from the oil cooler pipe. Connect the oil cooler feed pipe, top connector, to the transmission for normal flow.
2. Clip the discharge hose (1) to an empty oil container.
3. Confirm the transmission is filled with automatic transmission fluid. Refer to **Fluid Capacity**

Specifications for the correct automatic transmission fluid capacity.

4. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 quarts) must be discharged during this 30 second run time.
5. If the fluid flow meets or exceeds 1.9 L (2 quarts) in 30 seconds, connect the oil cooler feed pipe to the front connector on the transmission.
6. If fluid flow is less than 1.9 L (2 qt) in 30 seconds, perform the following diagnosis:
    1. Disconnect the **SA9165T** discharge hose (1) from the oil cooler return pipe. See **Special Tools** .
    2. Disconnect the oil cooler feed pipe at the radiator.
    3. Connect the **SA9165T** discharge hose (1) to the oil cooler feed pipe, radiator end. See **Special Tools** .
    4. Clip the discharge hose (1) onto the oil drain container.
    5. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 qt) must be discharged during this 30 second run time.
7. If the amount of transmission fluid flow remains less than 1.9 L (2 qt) in 30 seconds, inspect the oil cooler feed pipe, top connector, for restrictions or damage. If no condition is found with the feed pipe, inspect the transmission.

CLEAN-UP

1. Disconnect the water supply hose from the **SA9165T** and bleed any remaining air pressure from the flusher tank. See **Special Tools** .
2. Remove the fill cap from the **SA9165T** and return any unused flushing solution to its container. See **Special Tools** . Rinse the **SA9165T** with water. See **Special Tools** . Do not store the**SA9165T** with flushing solution in it. See **Special Tools** .
3. After every third use, clean the **SA9165T** as described in the instructions included with the tool. See **Special Tools** .
4. Dispose of any waste water/solution and transmission fluid in accordance with local regulations.

AUTOMATIC TRANSMISSION FLUID LEAKS

Automatic Transmission Fluid Leaks

Checks	Cause
DEFINITION: Automatic transmission fluid leaks that occur on the transmission.	
Automatic Transmission Fluid Level	High fluid level - causing an oil leak at the vent assembly (37).
Automatic Transmission Fluid Condition	• Contaminated with engine coolant, engine oil, brake fluid, etc. • Oxidized and degraded - causing oil foaming and an oil leak at the vent assembly
Vent Assembly	• The vent assembly (37) is plugged or damaged - causing high internal pressure inside the transmission and causing oil leakage at another component.

	• Channel plate gasket (430) improperly torqued.
Oil Pan Assembly	• The oil pan bolts and screws are loose, cross-threaded, or missing. • The oil pan (24) is damaged. • The oil pan gasket (25) is out of position or damaged.
Oil Filter and Seal Assembly	• The oil filter assembly (100) is damaged. • The oil filter seal assembly (101) is missing or damaged - causing oil foaming and an oil leak at the vent assembly.
Thermo Element Assembly	• The thermo element plate pins (120, 123) are misadjusted. • The thermo element (121) or thermo element plate (122) is out of position, missing, or damaged - causing a high fluid level in the oil pan, oil foaming, and an oil leak at the vent assembly (37).
Control Valve Body Cover Assembly	• The control valve body cover bolts and screws (56, 57, 58) are loose, cross-threaded, or missing. • The control valve body cover (53) is porous or damaged. • The control valve body cover gaskets (54, 59) are out of position or damaged. • The wiring harness assembly (224) is damaged or is leaking at the electrical connector terminals.
Front Wheel Drive Shaft Oil Seal Assemblies	The front wheel drive shaft oil seal assemblies (4, 409) are loose or damaged.
Forward Band Servo Assembly	• The forward band servo cover bolts and screws (12) are loose, cross-threaded, or missing. • The forward band servo cover (13) is porous or damaged. • The forward band servo cover seal (14) is out of position or is damaged.
Reverse Band Servo Assembly	• The reverse band servo cover retaining ring (39) is out of position or is damaged. • The reverse band servo cover (40) is porous or is damaged. • The forward band servo cover seal (14) is out of position or is damaged.
Oil Cooler Pipe Fitting Assemblies	The oil cooler pipe fitting assemblies (28, 29) are loose, cross-threaded, damaged, or are missing a sealer.
Case Extension Assembly	• The case extension bolts and screws (5) are loose, cross-threaded, or are missing. • The case extension assembly (6) is porous or damaged. • The case extension seal (8) is out of position or is damaged. • The front differential carrier bushing (7A) or the output shaft bearing assembly (7B) is worn or damaged. • The case extension assembly (6) oil drain back holes are plugged

	or missing - causing repeat leaks at the right side front wheel drive shaft oil seal assembly (4).
Vehicle Speed Sensor Assembly	• The vehicle speed sensor bolt or screw (9) is loose, cross-threaded, or missing. • The vehicle speed sensor O-ring seal (11) is out of position or is damaged.
Oil Pressure Test Hole Plug	The oil pressure test hole plug (38) is loose, cross-threaded, damaged, or is missing a sealer.
Manual Shift Shaft Assembly	• The manual shift shaft seal assembly (806) is out of position or is damaged. • The manual shift shaft (807) sealing surface is damaged.
Park Pawl Actuator Guide Assembly	• The park pawl actuator pin (808) is loose or missing. • The park pawl actuator guide (809) is damaged. • The park pawl actuator guide O-ring seal (810) is out of position, missing, or damaged.
Torque Converter Oil Seal Assembly	The torque converter oil seal assembly (525) is loose or damaged.
Drive Sprocket Support Assembly	The drive sprocket support (522) oil drain back holes are plugged or missing - causing repeat leaks at the torque converter oil seal assembly (525).
Case Assembly	The case assembly (3) is porous or damaged.

INCORRECT LINE PRESSURE

Incorrect Line Pressure

Checks	Cause
DEFINITION: Transmission main line pressure that is determined to be high or low. Refer to **Line Pressure Check**.	
Automatic Transmission Fluid Level - low pressure only	Low fluid level
Thermo Element Assembly - low pressure only	• The thermo element plate pins (120, 123) are misadjusted. • The thermo element (121) or the thermo element plate (122) is out of position, missing, or damaged - causing low fluid level in the oil pan.
Oil Filter and Seal Assembly	• The oil filter assembly (100) is missing or damaged. • The oil filter seal assembly (101) is missing or damaged, low pressure only.
Wiring Harness Assembly	The wiring harness assembly (224) is disconnected or damaged.
Oil Pump Assembly	• The following components are worn or damaged - low pressure only: ○ The oil pump cover (201)

	○ The oil pump body (202) ○ The oil pump vane ring (209) ○ The oil pump rotor (210) ○ The oil pump vanes (211) ○ The oil pump slide oil seal ring (212) ○ The oil pump slide O-ring seal (213) ○ The oil pump slide (214) • The oil pump slide (214) is binding, high pressure only. • The oil pump prime springs (222, 223) or the oil pump slide pivot pin (215) is missing or damaged, low pressure only. • The oil pump slide seal (220) or the oil pump slide seal support (221) is missing or damaged, high pressure only.
Pressure Control Solenoid Valve Assembly	• The pressure control solenoid valve assembly (322) is damaged. • The solenoid valve O-ring seals (305, 316) are missing or damaged. • The valve retainer (314) is missing or damaged.
Torque Signal Regulator Valve Assembly	• The torque signal regulator valve (321) is binding or damaged. • The valve retainer (314) is missing or damaged.
Pressure Regulator Valve Assembly	• The pressure regulator valve (313) is binding or is damaged. • The pressure regulator valve springs (311, 312) is missing or damaged. • The reverse boost valve (310) is binding or is damaged, high pressure only. • The line boost valve (304) is binding or is damaged, high pressure only. • The valve retainer (302) is missing or is damaged.
Actuator Feed Limit Valve Assembly - low pressure only	• The actuator feed limit valve (414) is binding or is damaged. • The actuator feed limit valve spring (415) is missing or is damaged. • The actuator feed limit valve spring retainer (416) is missing or damaged.
Low Blow Off Valve Assembly - low pressure only	• The low blow off valve spring (323) is missing or is damaged. • The low blow off ball valve (324) is missing, binding, or is damaged. • The low blow off valve spring retainer (325) is missing or is damaged.

DELAYED PARK TO REVERSE/DRIVE ENGAGEMENT

Delayed Park to Reverse/Drive Engagement

Checks	Cause
DEFINITION: Gear engagement that takes longer than 3 seconds when the engine is idling in Park or Neutral, and the gear selector is moved to Drive or Reverse range.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Reverse Band Servo Assembly - Reverse engagement only	The reverse band servo piston oil seal ring (43) is damaged or rolled.
Forward Band Servo Assembly - Drive engagement only	The forward band servo piston oil seal ring (18) is damaged or rolled.
Control Valve Body Assembly - Reverse engagement only	The reverse servo boost valve (367A) is binding or is damaged.
Control Valve Body Assembly - Drive engagement only	The forward servo boost valve (367B) is binding or is damaged.
Control Valve Body Spacer Plate Assembly - Drive engagement only	The thermal element is damaged or is not functioning properly.
TCC Blowoff Ball Valve Assembly	The TCC blowoff ball valve (420) is not seating - causing torque converter drain back.
Input Clutch Assembly	• The input clutch housing oil seal rings (628) are damaged or rolled. • The input clutch housing assembly (632) sealing surfaces are damaged. • The input clutch housing ball check valve assembly (633) is plugged or damaged. • The input clutch inner piston seal (634) is damaged or rolled. • The input clutch outer piston seal (635) is damaged or rolled. • The input clutch piston assembly (636) sealing surfaces are damaged.

HARSH PARK TO REVERSE/DRIVE ENGAGEMENT

Harsh Park to Reverse/Drive Engagement

Checks	Cause
DEFINITION: Gear engagement that is harsh when the engine is idling in Park or Neutral, and the gear selector is moved to Drive or Reverse range.	
Transmission Main Line Pressure	High transmission main line pressure
Reverse Band Servo Assembly - Reverse engagement only	The reverse band servo piston cushion spring (45) is broken or is missing.
Forward Band Servo Assembly -	The forward band servo piston cushion spring (19) is broken or is

Drive engagement only	missing.
Transmission Case Cover Ball Check Valve - Reverse engagement only	The #5 Ball check valve (372) is mislocated or is missing.
Transmission Case Cover Ball Check Valve - Drive engagement only	The #6 Ball check valve (372) is mislocated or is missing.
Control Valve Body Assembly - Reverse engagement only	The reverse servo boost valve (367A) is binding or is damaged.
Control Valve Body Assembly - Drive engagement only	The forward servo boost valve (367B) is binding or is damaged.
Control Valve Body Spacer Plate Assembly - Drive engagement only	The thermal element is damaged or is not functioning properly.

SLIPS IN DRIVE OR NO DRIVE

Slips in Drive or No Drive

Checks	Cause
DEFINITION: A large engine RPM increase is noted with little or no vehicle forward speed increase during the following conditions: • The engine is running. • The transmission is in Drive range. • The vehicle is stopped or moving slowly. • The vehicle brakes are not applied. • The throttle is opened 25 percent or greater.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Manual Linkage	Misadjusted
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged forward band servo oil pipe (124). • Loose manual 2-1 band servo cover or accumulator cover bolts (103, 131). • Missing or damaged manual 2-1 servo cover gasket (105). • A damaged accumulator cover spacer plate assembly (134).
Forward Band Servo Assembly	• A servo piston oil seal ring (18) is missing or is damaged. • A servo piston (16) is damaged or is stuck in the servo cover (13).

	• The servo piston cushion spring (19) or the retainer (20) is missing or damaged. • The servo piston pin (21) is not engaged to the forward band assembly (688). • The forward band assembly (688) is worn or burned. • The forward band assembly (688) is disengaged from the anchor pin (117A). • The anchor pin (117A) is loose or missing.
Control Valve Body Assembly	The #3 Ball check valve (372) is missing.
Torque Converter Assembly	• The torque converter assembly (1) stator clutch is not holding • The torque converter assembly (1) blades are broken or damaged
Drive Link Assembly	• The drive link assembly (507) is broken. • The drive/driven sprockets (516/506) are damaged.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or are damaged. • The input clutch housing ball check valve assembly (633) is missing or is damaged. • The input clutch piston inner/outer seals (634/635) are missing or are damaged. • The input clutch piston (636) is damaged. • The input clutch plates (654-658) are worn.
1-2 Clutch Roller Assembly	The 1-2 clutch roller assembly (683) is damaged.
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.
Forward Band Servo	Forward band servo piston apply pin (21) nicked or scratched

SLIPS IN REVERSE OR NO REVERSE

Slips in Reverse or No Reverse

Checks	Cause
DEFINITION: A large engine RPM increase is noted with little or no vehicle rearward speed increase during the following conditions: • The engine is running. • The transmission is in Reverse range.	

	• The vehicle is stopped or moving slowly. • The vehicle brakes are not applied. • The throttle is opened 25 percent or greater.
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Manual Linkage	Misadjusted
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
Reverse Band Servo Assembly	• A servo piston oil seal ring (43) is missing or is damaged. • A servo piston (44) is damaged or is stuck in the case bore. • The servo piston cushion springs (45, 47) or the retainer (46) is missing or damaged. • The servo piston pin (48) is not engaged to the reverse band assembly (615). • The reverse band assembly (615) is worn or burned. • The reverse band assembly (615) is disengaged from the anchor pin (117B) band. • The anchor pin (117B) is loose or missing.
Torque Converter Assembly	The torque converter assembly (1) stator clutch is not holding.
Drive Link Assembly	• The drive link assembly (507) is broken. • The drive/driven sprockets (516/506) are damaged.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or are damaged. • The input clutch housing ball check valve assembly (633) is missing or is damaged. • The input clutch piston inner/outer seals (634/635) are missing or are damaged. • The input clutch piston (636) is damaged. • The input clutch plates (654-658) are worn.
Reverse Reaction Drum	The reverse reaction drum (669) splines are damaged.
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.

LOCKED UP IN DRIVE/REVERSE

Locked up in Drive/Reverse

Checks	Cause
DEFINITION: The vehicle cannot be moved forward or backward during the following conditions: • The engine is running. • The transmission is in Drive or Reverse range. • The vehicle brakes are not applied. • The throttle is closed (idling).	
Manual Linkage	Misadjusted
Input and Reaction Carrier Assemblies	The input carrier assembly (672) or the reaction carrier assembly (675) components are damaged.
Differential Carrier Assembly	• The park pawl assembly (694) is broken or damaged. • The sun gear shaft (689), the internal gear assembly (693), or the carrier assembly (700) components are damaged.

NO PARK RANGE

No Park Range

Checks	Cause
DEFINITION: One of the two following conditions occur: • The transmission range selector cannot be moved into Park. • The vehicle can move forward or backward more than 1 meter (3 ft) after the transmission range selector is moved into Park.	
Manual Linkage	Misadjusted
Differential Carrier Assembly	The park pawl assembly (694) is broken or damaged.
Park Pawl Actuator Assembly	• The actuator assembly (800) is damaged. • The actuator guide (809) is damaged or debris is present.

HARSH OR SOFT 1-2 SHIFT FEEL

Harsh or Soft 1-2 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a first to second gear steady throttle upshift, or a second to first gear coast, or a light to moderate throttle detent downshift: • Harsh shift feel - an unacceptable quick gear change occurs. • Soft shift feel - an unacceptable long gear change occurs.	
Automatic Transmission Fluid Level - soft shift only	Low fluid level

Transmission Main Line pressure	Low or high transmission main line pressure
Oil Filter Assembly - soft shift only	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
1-2 Accumulator Assembly	• Misassembled or upside down 1-2 accumulator assembly • Damaged or missing 1-2 accumulator piston oil seal ring (137A) • A damaged or missing 1-2 accumulator piston cushion spring (139) or outer spring (142) • A stuck or binding 1-2 accumulator piston (136A) • Debris in the passages of the accumulator cover spacer plate (134)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or spacer plate assembly (370) • Missing or mislocated #2 ball check valve (372) • Misassembled 1-2 accumulator valve (340-345) line-up • Stuck or binding 1-2 accumulator valve (341) • Damaged or missing 1-2 accumulator valve spring (340) • Missing, damaged, or misassembled 2-3 accumulator valve bushing (345), bore plug (343), or retainers (342, 385)
Driven Sprocket Support Assembly - soft shift only	• A damaged second clutch housing oil seal rings (613) or the four lobe oil seal ring seals (612) • Worn or damaged second clutch housing bushings (616, 619)
Second Clutch Assembly	• Missing or not seated second clutch basking plate retaining ring (627) • Missing or misassembled second clutch backing plate (626) • Worn, damaged or misassembled clutch plates (623-625) • Missing or not seated second clutch spring retaining ring (622) • A damaged spring assembly (621) or piston (620) • A missing or damaged second clutch housing ball check valve assembly (618) • A damaged second clutch housing assembly (617)

HARSH OR SOFT 2-3/3-2 SHIFT FEEL

Harsh or Soft 2-3/3-2 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a second to third gear steady throttle upshift, or a third to second gear coast, or a light to moderate throttle detent downshift: • Harsh shift feel - an unacceptable quick gear change occurs.	

• Soft shift feel - an unacceptable long gear change occurs.	
Automatic Transmission Fluid Level, soft shift only	Low fluid level
Transmission Main Line Pressure	Low or high transmission main line pressure
Oil Filter Assembly, soft shift only	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
2-3 Accumulator Assembly	• Misassembled upside down 2-3 accumulator assembly • Damaged or missing 2-3 accumulator piston oil seal ring (137B) • A damaged or missing 2-3 accumulator piston cushion spring (143) or outer spring (138) • A stuck or binding 2-3 accumulator piston (136B) • Debris in the passages of the accumulator cover spacer plate (134)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or control valve body spacer plate assembly and gasket assembly (396) • Missing or mislocated #4 or #9 ball check valves (372) • Misassembled 2-3 accumulator valve (340-345) line-up • Stuck or binding 2-3 accumulator valve (344) • Missing, damaged, or misassembled 2-3 accumulator valve bushing (345), bore plug (343), or retainers (342, 385)
Driven Sprocket Support Assembly, soft shift only	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Third Clutch Assembly	• The input clutch housing oil seal rings (628) are missing or are damaged. • The third clutch ball check valve assembly (724) is missing or is damaged. • The third clutch piston (642) is damaged. • The third clutch piston inner seal (641) is missing or damage. • The third clutch plates (645-648) are worn or misassembled.

HARSH OR SOFT 3-4/4-3 SHIFT FEEL

Harsh or Soft 3-4/4-3 Shift Feel

Checks	Cause
DEFINITION: One of the two following conditions occurs during a third to fourth gear steady throttle upshift, or a fourth to third gear coast, or a light to moderate throttle detent downshift: • Harsh shift feel - an unacceptable quick gear change occurs. • Soft shift feel - an unacceptable long gear change occurs.	

Automatic Transmission Fluid Level, soft shift only	Low fluid level
Transmission Main Line Pressure	Low or high transmission main line pressure
Oil Filter Assembly, soft shift only	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or damaged.
3-4 Accumulator Assembly	• Misassembled upside down 3-4 accumulator assembly • Damaged or missing 3-4 accumulator piston oil seal ring (427) • A damaged or missing 3-4 accumulator piston outer spring (423) • A stuck or binding 3-4 accumulator piston (428) • A damaged 3-4 accumulator piston cylinder (421) or O-ring seal (422)
Control Valve Body Assembly	• Debris in the passages of the control valve body (301) or spacer plate and gasket assembly (396). • Misassembled 3-4 accumulator valve (339, 350, 351) line-up • Stuck or binding 3-4 accumulator valve (350) • Missing, damaged, or misassembled 3-4 accumulator valve spring (351) or retainer (314A)
Driven Sprocket Support Assembly, soft shift only	• A missing or damaged fourth clutch orifice (607) • A damaged driven sprocket support assembly (609)
Fourth Clutch Assembly	• Worn, damaged, or misassembled clutch plates (500-502) • A missing or not seated fourth clutch spring retaining ring (601) • A damaged spring assembly (602) or piston (603) • Worn or damaged fourth clutch piston seals (604, 605)

HIGH OR LOW UPSHIFT OR DOWNSHIFT SPEED

High or Low Upshift or Downshift Speed

Checks	Cause
DEFINITION: An upshift or a downshift, or TCC apply, that occurs at a speed outside of the calibrated range. Refer to **Shift Speed** .	
ECM/PCM Calibration Information	Incorrect calibration in the ECM/PCM.
Throttle Position (TP) Sensor	Misadjusted or faulty TP sensor.

FIRST AND SECOND GEAR ONLY - 2-3 SOLENOID STUCK ON

First and Second Gear Only - 2-3 Solenoid Stuck On

Checks	Cause
DEFINITION: The transmission only provides first and second gear in Drive range. The shift pattern as	

the vehicle accelerates from a stop is 1-2-2-1. First gear ratio is 2.921:1 and second gear ratio is 1.568:1.	
Control Valve Body Assembly	• A faulty 2-3 shift solenoid valve assembly (315B) is stuck On. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

FIRST AND FOURTH GEAR ONLY - 1-2 SOLENOID STUCK ON

First and Fourth Gear Only - 1-2 Solenoid Stuck On

Checks	Cause
DEFINITION: The transmission only provides first and fourth gear in Drive range. The shift pattern as the vehicle accelerates from a stop is 1-1-4-4. First gear ratio is 2.921:1 and fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	• A faulty 1-2, 3-4 shift solenoid valve assembly (315A) is stuck On. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

SECOND AND THIRD GEAR ONLY (1-2 SOLENOID STUCK OFF)

Second and Third Gear Only (1-2 Solenoid Stuck Off)

Checks	Cause
DEFINITION: The transmission only provides second and third gear in Drive range. The transmission has no engine braking in manual ranges, touch activated power models. The shift pattern as the vehicle accelerates from a stop is 2-2-3-3. Second gear ratio is 1.568:1 and third gear ratio is 1.000:1.	
Control Valve Body Assembly	• A faulty 1-2, 3-4 shift solenoid valve assembly (315A) is stuck Off. • A missing or damaged shift solenoid valve O-ring seal (316) • Plugged or damaged solenoid valve screen/seal assembly (382) • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)
Case Cover Assembly	A stuck, binding, or missing actuator feed limit valve line-up (414-416)

THIRD AND FOURTH GEAR ONLY (2-3 SOLENOID STUCK OFF)

Third and Fourth Gear Only (2-3 Solenoid Stuck Off)

Checks	Cause
DEFINITION: The transmission only provides third and fourth gear in Drive range. The shift pattern as the vehicle accelerates from a stop is 4-3-3-4. Third gear ratio is 1.000:1 and fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	• A faulty 2-3 shift solenoid valve assembly (315B) is stuck Off. • A missing or mislocated 2-3 shift solenoid valve (315B) and retainer (314C) • A missing or damaged shift solenoid valve O-ring seal (316)

	• Plugged or damaged solenoid valve screen/seal assembly (382) • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

FIRST GEAR ONLY

First Gear Only

Checks	Cause
DEFINITION: The transmission only provides first gear in Drive range. The vehicle accelerates from a stop in first gear and does not upshift. First gear ratio is 2.921:1.	
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396) • The spacer plate and gaskets (369-371) are misassembled.
Second Clutch Assembly	• A missing or not seated second clutch backing plate retaining ring (627) • A missing or misassembled second clutch backing plate (626) • Worn, damaged, or misassembled clutch plates (623-625) • A missing or not seated second clutch spring retaining ring (622) • A damaged spring assembly (621) or piston (620) • A missing or damaged second clutch housing ball check valve assembly (618) • A damaged second clutch housing assembly (617)
Reverse Reaction Drum	Damaged splines of the reverse reaction drum (669)

SECOND GEAR ONLY

Second Gear Only

Checks	Cause
DEFINITION: The transmission only provides second gear in Drive range. The vehicle accelerates from a stop in second gear and does not upshift. Second gear ratio is 1.568:1.	
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)
Input Carrier Assembly	• A damaged input sun gear (668) • Damaged input carrier (672) planetary pinions

THIRD GEAR ONLY

Third Gear Only

Checks	Cause
DEFINITION: The transmission only provides third gear in Drive range. The vehicle accelerates from a stop in third gear and does not upshift. Third gear ratio is 1.000:1.	
Control Valve Body Assembly	Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396).

FOURTH GEAR ONLY

Fourth Gear Only

Checks	Cause
DEFINITION: The transmission only provides fourth gear in Drive range. The vehicle accelerates from a stop in fourth gear and does not upshift. Fourth gear ratio is 0.705:1.	
Control Valve Body Assembly	Debris is found in the control valve body (301) or the control valve body spacer plate and gasket assembly (396)

SLIPPING OR NO FIRST GEAR

Slipping or No First Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in first gear, Drive range, with little or no vehicle forward speed increase. Second, third, and fourth gear operation are normal. Shifts into first gear are soft or do not occur. First gear ratio is 2.921:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged forward band servo oil pipe (124) • Loose manual 2-1 band servo cover of accumulator cover bolts (103, 131) • A missing or a damaged manual 2-1 servo cover gasket (105) • A damaged accumulator cover spacer plate assembly (134)
Forward Band Servo Assembly	• The servo piston oil seal ring (18) is missing or damaged. • The servo piston (16) is damaged or stuck in the servo cover (13). • The servo piston cushion spring (19) or the retainer (20) is missing or damaged. • The servo piston pin (21) is not engaged to the forward band assembly (688). • The forward band assembly (688) is worn or burned. • The forward band assembly (688) is disengaged from the anchor

	pin (117A). • The band anchor pin (117A) is loose or missing.
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • The #3 ball check valve (372) is missing.
Input Clutch Assembly	• The input clutch sprag assembly (722) is damaged or misassembled. • The input clutch housing oil seal rings (628) are missing or damaged. • The input clutch housing ball check valve assembly (633) is missing or damaged. • The input clutch piston inner/outer seals (634/635) are missing or damaged. • The input clutch piston (636) is damaged. • The input clutch plates (645-658) are worn.
1-2 Clutch Roller Assembly	The 1-2 clutch roller assembly (683) is damaged.

SLIPPING OR NO SECOND GEAR

Slipping or No Second Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in second gear, Drive range, with little or no vehicle forward speed increase. First, third, and fourth gear operation are normal. Shifts into second gear are soft or do not occur. Second gear ratio is 1.568:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 1-2 shift valve (318) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396)
Driven Sprocket Support Assembly	• Damaged second clutch housing oil seal rings (613) • Damaged four lobe oil seal ring seals (612) • Worn or damaged second clutch housing bushings (616, 619)
Second Clutch Assembly	• Missing or not seated second clutch backing plate retaining ring (627) • Missing or misassembled second clutch backing plate (626) • Worn, damaged, or misassembled clutch plates (623-625) • Missing or not seated second clutch spring retaining ring (622)

	• Damaged spring assembly (621) or piston (620) • Missing or damaged second clutch housing ball check valve assembly (618) • Damaged second clutch housing assembly (617)

SLIPPING OR NO THIRD GEAR

Slipping or No Third Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in third gear, Drive range, with little or no vehicle forward speed increase. First, second, and fourth gear operation are normal. Shifts into third gear are soft or do not occur. Third gear ratio is 1.000:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 2-3 shift valve (357) or the 3-2 manual downshift valve (356) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396) • The #4 or the #9 ball check valve is missing or mislocated.
Driven Sprocket Support Assembly	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Third Clutch Assembly	• Input clutch housing oil seal rings (628) are missing or damaged. • The third clutch ball check valve assembly (724) is missing or damaged. • The third clutch piston (642) is damaged. • The third clutch piston inner seal (641) is missing or damaged. • The third clutch plates (645-648) are worn or misassembled.
Third Clutch Sprag Assembly	• The sprag (720) was misassembled or backwards on the inner race (661). • A damaged third clutch sprag assembly (653, 661, 719-721)

SLIPPING OR NO FOURTH GEAR

Slipping or No Fourth Gear

Checks	Cause
DEFINITION: A large engine RPM increase is noted in fourth gear, Drive range, with little or no vehicle forward speed increase. First, second, and third gear operation are normal. Shifts into fourth gear are soft	

or do not occur. Fourth gear ratio is 0.705:1.	
Automatic Transmission Fluid Level	Low fluid level
Transmission Main Line Pressure	Low transmission main line pressure
Oil Filter Assembly	• The oil filter assembly (100) is missing, plugged, or damaged. • The oil filter seal assembly (101) is missing or is damaged.
Control Valve Body Assembly	• The 3-4 shift valve (362) or the 4-3 manual downshift valve (360) is stuck or binding. • Debris is found in the passages of the control valve body (301) or of the control valve body spacer plate and gasket assembly (396)
Case Cover Assembly	Distortion or damage occurs at the manual valve (404) or at the case cover (401), causing PRN oil leak.
Driven Sprocket Support Assembly	A plugged third clutch oil passage in the driven sprocket support assembly (609)
Fourth Clutch Assembly	• The clutch plates (500-502) are worn, damaged, or misassembled. • A missing or not seated fourth clutch spring retaining ring (601) • A damaged spring assembly (602) or piston (603) • Worn or damaged fourth clutch piston seals (604, 605)
Third Clutch Sprag Assembly	• The sprag (720) was misassembled or backwards on the inner race (661). • A damaged third clutch sprag assembly (653, 661, 719-721)

NO ENGINE BRAKING IN MANUAL RANGES (TOUCH ACTIVATED POWER)

No Engine Braking in Manual Ranges (Touch Activated Power)

Checks	Cause
DEFINITION: A large engine RPM increase and forward vehicle speed decrease do not immediately occur when the transmission is shifted from Drive to manual ranges or a coast condition occurs in any manual range.	
Accumulator and Manual 2-1 Band Servo Assembly	• A loose or damaged manual 2-1 band servo oil pipe (125) • Loose manual 2-1 band servo cover or accumulator cover bolts (103, 131) • A damaged accumulator cover spacer plate assembly (134) • A damaged or missing servo piston seal (107) or a servo piston cylinder O-ring seal (113) • A missing servo exhaust screen assembly (115), allowing debris into the cylinder • A misassembled manual 2-1 servo assembly (103-115)
Manual 2-1 Band Assembly	• A band assembly (680) that is worn or burned

	• A band assembly (680) that is disengaged from the anchor pin (102) • A band anchor pin (102) that is loose or missing
Low Regulator Valve	Valve stuck or missing spring
1-2 Shift Solenoid	Valve stuck OFF

WHINE NOISE VARYING WITH RPM OR FLUID PRESSURE

Whine Noise Varying with RPM or Fluid Pressure

Checks	Action
DEFINITION: In all ranges, a whine which may be sensitive to RPM load, or which ceases when the TCC engages, or which is sensitive to the oil pressure	
Torque Converter (1)	Verify that the noise is internal to the torque converter by placing your left foot on the brake with the gear or selector in Drive. Momentarily stall the engine. Torque Converter noise increases under load.
Oil Pump System	Verify that the noise is internal to the oil pump during a preliminary oil pressure check. An increase in line pressure will vary an oil pump noise.

POPPING NOISE

Popping Noise

Checks	Action
DEFINITION: A popping noise, similar to popcorn popping	
Oil Pump System	• Check fluid level. • Inspect for pump cavitation, indicated by bubbles in fluid. • Inspect the transmission fluid filter for a leaky seam. • Inspect the transmission fluid filter seal for improper positioning or for a cut seal.

BUZZ NOISE OR HIGH FREQUENCY RATTLE SOUND

Buzz Noise or High Frequency Rattle Sound

Checks	Action
DEFINITION: A buzz or high frequency rattle	
• Trace Cooler Pipes • Check for binding or contact at the Radiator, other than at the Cooler Pipe connectors	Verify a pressure buzz by watching for a needle vibration of the pressure gage. A road test may be necessary. Refer to **Road Test**.

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Whine/Growl Noise That Changes with Vehicle Speed

Checks	Action
DEFINITION: A whine or growl that increases and fades with vehicle speed and is most noticeable under light acceleration	
Drive Link Assembly System	Verify that the noise comes from the sprockets or the from the drive link assembly chain by placing your left foot on the brake and by moving the gear selector from Park or Reverse. If the noise stops, check the following items.
Drive Sprocket Support (522) and Driven Sprocket Support (609)	The bearing outer race support is rough or nicked.
Drive Sprocket (516) and Driven Sprocket (506)	• Broken or sheared teeth • Nicked or scored bearing surfaces • The bearing race or roller bearing surfaces on the gear support inner bearing are rough or pitted • A damaged bearing
Drive Chain (507)	Stretched

FINAL DRIVE NOISE OR HUM NOISE

Final Drive Noise or Hum Noise

Checks	Cause
DEFINITION: A final drive noise or hum is most noticeable under light throttle acceleration or turns	
• Final Drive Gear Set (700) • Final Drive Internal Gear (693)	• Worn planet pinions • Worn washers • Worn or damaged teeth
• Differential Carrier (700) • Differential Side Gears (705)	• Worn or pitted gears • A damaged thrust washer

NOISE IN FIRST, SECOND, THIRD, OR FOURTH

Noise in First, Second, Third or Fourth

Checks	Cause
• Final Drive Sun Gear (697) • Final Drive Pinions (711)	Worn or damaged gears

NOISE IN RANDOM RANGES

Noise in Random Ranges

Checks	Action
DEFINITION: Noise only in certain gear ranges	
Refer to **Range Reference (Without Touch Activated Power)** . Determine the power flow and the	

applicable components that may be causing this noise.

ABNORMAL NOISE IN PARK OR NEUTRAL RANGE

Abnormal Noise in Park or Neutral Range

Checks	Cause
DEFINITION: Noise only in Park or Neutral	
Drive Sprocket Support (522) and Driven Sprocket Support (609)	• Nicked or scored bearing surfaces • The bearing race or roller bearing on the gear support inner bearing are rough or pitted. • The bearing outer race support is rough or nicked. • A damaged bearing
Forth Clutch Assembly	Clutch plates (501) damaged or worn

CONVERTER CLUTCH STUCK ON IN ALL GEARS

TCC Stuck On in All Gears

Checks	Cause
DEFINITION: No difference in RPM is noted between the engine speed and the transmission input, turbine, speed in any transmission range. This condition may also cause the engine to stall when the vehicle is slowed to a stop or when the transmission is shifted from Park or Neutral range into Reverse or Drive range.	
Control Valve Body Assembly	• The TCC control valve (335) or the TCC regulator apply valve (327) is stuck or binding. • The spacer plate and gaskets (369-371) are misassembled or contain incorrect parts.

CONVERTER CLUTCH STUCK ON IN SECOND, THIRD AND FOURTH GEAR

Converter Clutch Stuck On in 2nd, 3rd and 4th Gear

Checks	Cause
DEFINITION: No difference in RPM is noted between the engine speed and the transaxle input (turbine) shaft speed in second, third and fourth gear, DRIVE range. TCC is not ON in first gear and the engine does not stall when the vehicle slows to a stop or is shifted from PARK or NEUTRAL range to REVERSE or DRIVE range.	
Control Valve Body Assembly	• The TCC PWM solenoid valve assembly (334) is faulty (stuck ON). • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts. • The PWM internal O-ring is missing or damaged.

HARSH TORQUE CONVERTER CLUTCH APPLY OR RELEASE

Harsh TCC Apply or Release

Checks	Cause
DEFINITION: An unacceptably quick TCC apply or release occurs in third or fourth gear, Drive or Manual third range, with the throttle held steady.	
Control Valve Body Assembly	• The TCC regulator apply valve (327) is stuck or binding. • The TCC regulator apply valve spring (326) is missing or damaged. • The TCC control valve spring (336) is missing or damaged. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts. • TCC PWM Solenoid faulty.

CONVERTER CLUTCH APPLY ROUGH, SLIPS, OR SHUDDERS

Soft TCC Apply (Shudder)

Checks	Cause
DEFINITION: An unacceptably long TCC apply occurs in third or fourth gear, Drive or Manual Third range, with the throttle held steady. This can cause a momentary rapid jerking sensation in the vehicle during the TCC apply.	
Control Valve Body Assembly	• The TCC regulator apply valve (327) is stuck or binding. • The TCC regulator apply valve spring (326) is missing or damaged. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts. • TCC control valve stuck or binding. • TCC control valve spring is missing or damaged. • TCC PWM solenoid faulty.
Case Cover Assembly	The TCC blowoff ball valve (420B) or the spring (418) is damaged or is not seating.
Turbine Shaft Assembly	• The turbine shaft O-ring seal (520) is damaged or is missing. • The turbine shaft oil seal rings (513, 519) are damaged or missing. • The turbine shaft (518) is damaged.
Drive Sprocket Support Assembly	The turbine shaft bushing (523) is worn or damaged.

Torque Converter Assembly	• The torque converter bushing is worn or damaged
	• The torque converter cover surface is damaged under lug thread (s) due to the flexplate bolt bottoms out.
	• The torque converter is damaged internally
	  ○ The TCC friction material is missing or damaged
	  ○ The TCC plate is distorted or damaged

	○ The torque converter internal O-ring seal is missing or damaged

NO TORQUE CONVERTER CLUTCH APPLY

No TCC Apply

Checks	Cause
DEFINITION: A large difference in RPM is noted between the engine speed and the transmission input, turbine, speed in third or fourth gear, Drive or Manual Third range when the TCC is commanded On by the PCM.	
Control Valve Body Assembly	• The TCC PWM solenoid valve assembly (334) is stuck Off. • The TCC control valve (335) or the TCC regulator apply valve (327) is stuck or binding. • The #10 ball check valve (372) is missing or is mislocated. • The control valve body spacer plate gaskets assembly (396) are misassembled or contain incorrect parts.
Case Cover Assembly	The TCC blowoff ball valve (420B) or the spring (418) is damaged or is not seating.
Turbine Shaft Assembly	• The turbine shaft O-ring seal (520) is damaged or is missing. • The turbine shaft oil seal rings (513, 519) are damaged or missing. • The turbine shaft (518) is damaged.
Drive Sprocket Support Assembly	• The turbine shaft bushing (523) is worn or damaged. • Bearing damage
Torque Converter Assembly	• The torque converter bushing is worn or damaged • The torque converter cover surface is damaged under lug thread (s) due to the flexplate bolt bottoms out • The torque converter is damaged internally ○ The TCC friction material is missing or damaged ○ The TCC plate is distorted or damaged ○ The torque converter internal O-ring seal is missing or damaged