2007 TRANSMISSION

Automatic Transmission - 6T70/6T75 - Aura

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - AUTOMATIC TRANSMISSION

IMPORTANT: Use the symptom tables only if the following conditions are met:

- **Refer to Diagnostic Starting Point - Vehicle .**
- **There are no DTCs set.**
- **The control modules can communicate via the serial data link.**
- **Review the system operation in order to familiarize yourself with the system functions. Refer to Transmission General Description and Transmission Component and System Description.**

Visual/Physical Inspection

Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Fluid Diagnosis
  - **Transmission Fluid Check**
  - **Fluid Pressure High or Low**
  - **Automatic Transmission Fluid Leaks**
  - **Fluid Leak Diagnosis**
- Noise and Vibration Diagnosis
  - **Whine/Growl Noise**
  - **Noise and Vibration Analysis**
  - **Torque Converter Diagnosis**
- Range Performance Diagnosis
  - **No Park**
  - **No Drive in All Ranges**

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY INSPECTION

Fig. 1: Identifying Control Solenoid Valve & Transmission Control Module Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the control solenoid (w/body and TCM) valve assembly connectors and pins (1, 2, 4, 6) for the following conditions:
   - Damage
   - Bent pins
   - Debris
   - Broken retaining tab
   - Contamination
2. Ensure no metallic debris is inside the connectors near the terminal pins.
3. Inspect the control solenoid (w/body and TCM) valve assembly solenoid leads (3) for contamination or metallic debris.

4. Inspect the 4 control solenoid (w/body and TCM) valve assembly filter plate retaining tabs (5) for cracks and ensure proper tension when filter plate is attached.

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY INPUT SHAFT SPEED/OUTPUT SHAFT SPEED INPUT TEST

Tools Required

- **J 35616** GM-Approved Terminal Test Kit
- **J 38522** Variable Signal Generator

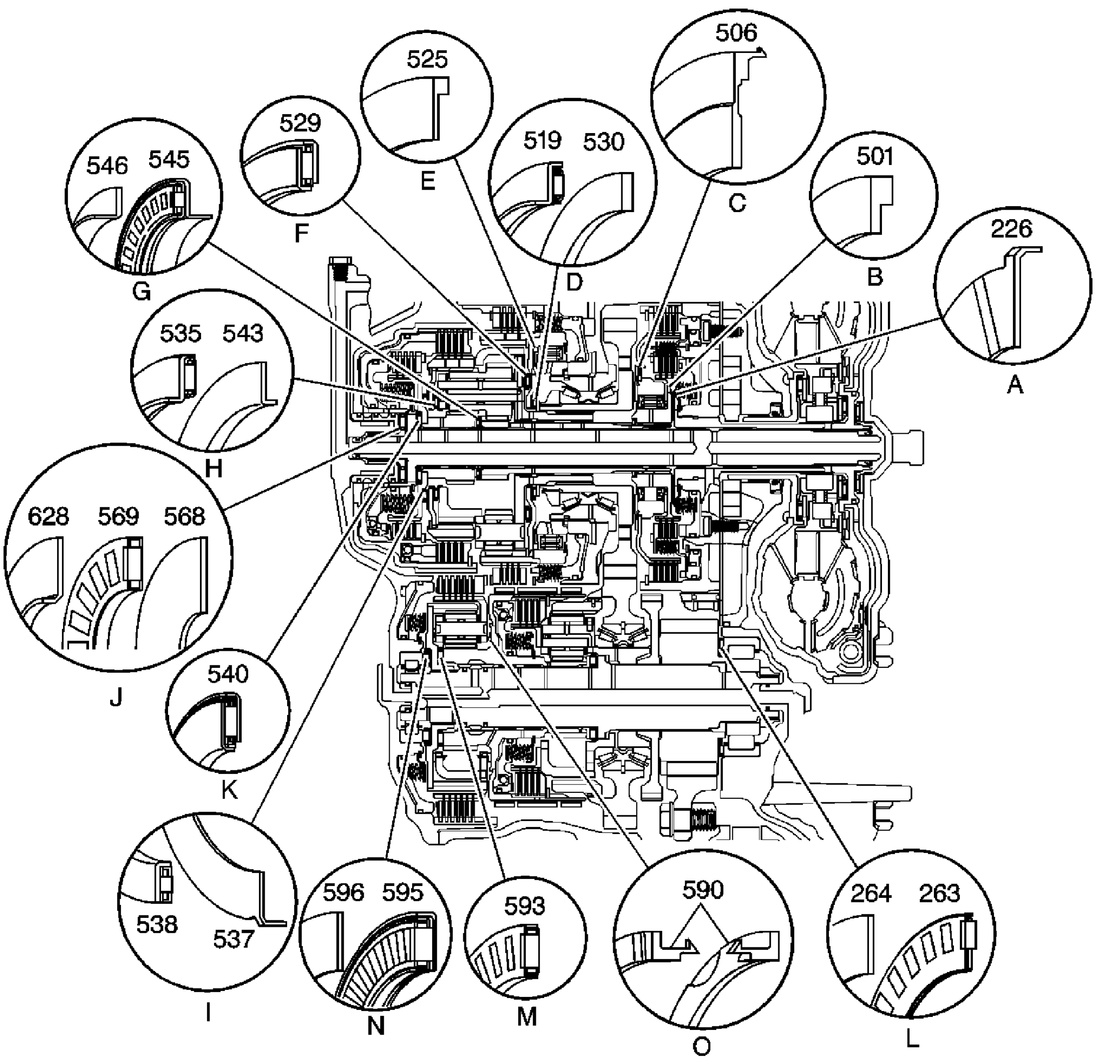

Fig. 2: Identifying Special Tools -- J 38522 And J 35616
Courtesy of GENERAL MOTORS CORP.

The purpose of this test is to provide a simulated input/output speed sensor (ISS/OSS) signal to the control solenoid (w/body and TCM) valve assembly ISS/OSS input circuits.

1. Disconnect the ISS/OSS wiring harness connector from the control solenoid (w/body and TCM) valve assembly.
2. Using the **J 35616** , connect the **J 38522** to the affected ISS or OSS signal circuit on the control solenoid (w/body and TCM) valve assembly.
    1. Set the **J 38522** Signal to 8 volts, the Frequency to 120 and the Percent Duty Cycle to 50.
    2. Ignition On, observe either the scan tool parameter ISS Signal or OSS Signal.
    3. The signal parameter should display between 100-400 RPM.

- If the signal display is not in this range, the control solenoid (w/body and TCM) valve assembly is not reading the input signal correctly and is faulty.

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY CLEANING

The control solenoid (w/body and TCM) valve assembly cleaning procedure is a specific software based routine, which resides in the TCM. This procedure is activated by the scan tool and is used to cycle the solenoids and valves in the control solenoid valve assembly in an attempt to dislodge debris and free up the valves after a performance diagnostic trouble code (DTC) has set. When the cleaning procedure is completed, the DTC enable criteria is run again, and retested to see if the DTC concern has been corrected.

1. Operate the transmission to achieve 70°-90°C (158°-194°F).
2. With a scan tool, select the Service Cleaning Procedure. Initiate the cleaning procedure.
3. When the cleaning procedure is completed, shut OFF the ignition for 30 seconds.

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY SOLENOID PERFORMANCE TEST

Tools Required

- **DT-47825** Control Solenoid Test Plate
- **DT-47825-20** Adapter Harness. See **Special Tools**.

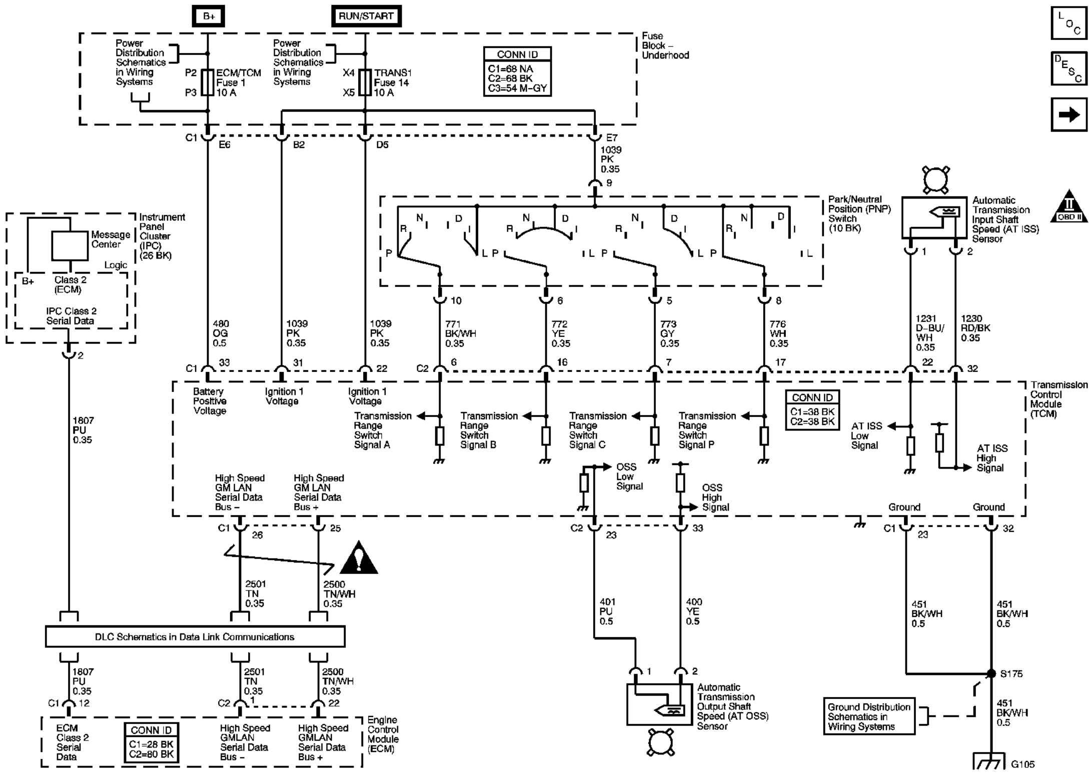

Fig. 3: Identifying Special Tool -- DT-47825-100
Courtesy of GENERAL MOTORS CORP.

The purpose of this procedure is to test the functionality of the control solenoid (w/body and TCM) valve assembly solenoids for a gross stuck open or stuck closed condition. **DT-47825** is bolted to the control solenoid (w/body and TCM) valve assembly on the valve body mounting surface. Pressurized air is passed into the aluminum test block, through the control solenoid (w/body and TCM) valve assembly solenoid passage and back to a pressure gage on the test block. The pressure gage indicates open if air pressure is passed through the solenoid, or closed if the solenoid is unable to pass air through. A scan tool is used to command the solenoids ON and OFF. While watching the pressure gage, one can determine the valve functionality. The recommended shop air pressure for this test is 90-100 psi.

1. Remove the control solenoid (w/body and TCM) valve assembly from the transmission.
2. Bolt the **DT-47825** to the control solenoid (w/body and TCM) valve assembly on the valve body mounting surface. Use the bolts and washers supplied with the tool to attach the test block. Tighten the bolts to 5 N.m (44 lb in) using a center out alternating torque sequence.
3. Install the pressure gage to the affected solenoid air port. Reference component to air port table.
4. Connect the shop air pressure line to the **DT-47825** air psi inlet port.
5. Connect **DT-47825-20** to vehicle and control solenoid (w/body and TCM) valve assembly. See **Special Tools**.

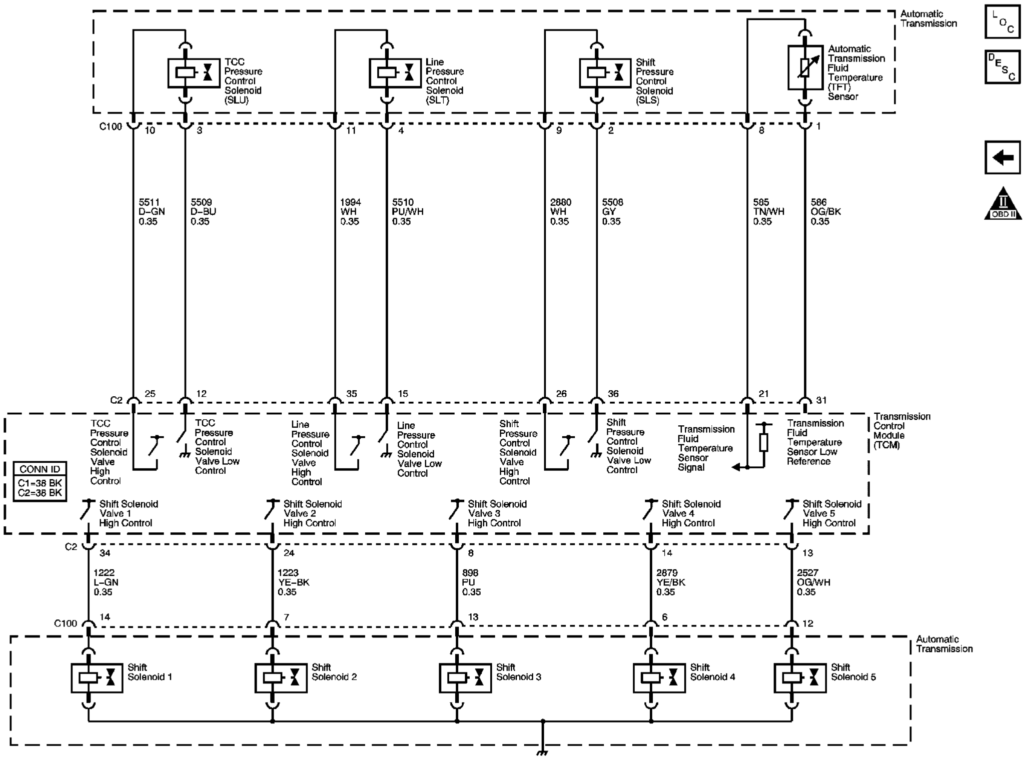

Fig. 4: Identifying Special Tool -- DT-47825-20
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not energize the solenoids for more than two minutes or the solenoids could be damaged.

6. Ignition ON, with a scan tool command the solenoid in question On and Off. Watch the air pressure gage and look for the change in pressure as you command the valve On and Off. The valve should allow air pressure to flow through the valve port to the gage with a result of pressure reading on the gage. If the valve is stuck closed, no pressure change will occur. Command the solenoid valve On and Off several times to determine the state of the solenoid valve in question. Release the air pressure in the gage between pressurization tests.

Control Solenoid (w/Body and TCM) Valve Assembly Solenoid Performance Test Block to Component Identification

COMPONENT	PORT ON TEST BLOCK	Key On, Engine Off (KOEO) Normal State
PC Solenoid 1	A	Regulated PSI flow to gauge
PC Solenoid 2	C	No PSI flow to gauge
PC Solenoid 3	G	Full PSI flow to gauge
PC Solenoid 4	B	No PSI flow to gauge
PC Solenoid 5	F	No PSI flow to gauge

Shift Solenoid 1	H	Full PSI flow to gauge
Shift Solenoid 2	D	No PSI flow to gauge
TCC PC Solenoid	E	No PSI flow to gauge

IMPORTANT: With the key on engine off (KOEO), the TCM will normally cycle some of the transmission solenoids On and Off to facilitate keeping the ports and solenoids clean and free of debris. This dither function is a normal activity and will cause the valves to cycle open and closed quickly when the TCM is powered up. This can cause the psi gage to flicker high and low as the valves open and close. This may cause some air to exit the ports where the psi gage is not connected as those solenoids cycle on and off.

Drain the TCM of excess transmission fluid before attaching to test block and use caution when attaching air to test block air inlet.

SERVICE FAST LEARN ADAPTS

Service Fast Learn Adapts is a procedure for 6 speed automatic transmissions in which a series of tests are run to allow the transmission control module (TCM) to learn individual clutch characteristics. Once the clutch data is learned, Service Fast Learn Adapts translates it into the adaptive data cells, which the TCM uses for clutch control during shifts. The scan tool provides initiation of the Service Fast Learn Adapts procedure. This procedure is to be used following transmission repair.

The Service Fast Learn Adapts procedure must be performed when one of the following repairs have been made to the vehicle. Failure to perform the procedure after one of the following repairs may result in poor transmission performance, as well as transmission DTCs being set:

- Transmission internal service/overhaul
- Valve body repair or replacement
- Control solenoid (w/body and TCM) valve assembly replacement
- TCM software/calibration update
- Any service in response to a shift quality concern

IMPORTANT: Ensure the following conditions are met before performing the Service Fast Learn Adapts procedure:

- **Drive wheels are blocked**
- **Parking brake is applied**
- **Service brake is applied**
- **Zero percent throttle and no external engine RPM control**
- **Transmission fluid temperature (TFT) is between 70-100°C (158-212°F)**
- **Transmission gear selector has been cycled from Park to Reverse 3 times in order to purge air from the reverse clutches.**

1. Use the scan tool to navigate to Service Fast Learn Adapts by selecting the following commands:
    1. F1: Transmission Control Module
    2. F5: Module Setup
    3. F0: Fast Learn Adapts Process

IMPORTANT: If at any time during the procedure, required conditions are not met, Service Fast Learn Adapts may abort and the process may need to be started again from the beginning.

IMPORTANT: There are 3 stages required to successfully complete the Service Fast Learn Adapts procedure:

2. Use the scan tool to perform the Service Fast Learn Adapts procedure.
    1. PARK test setup
    2. DRIVE mode
    3. REVERSE mode

    These stages are automatically initiated and controlled by the scan tool. As the procedure is being performed, the scan tool data display will provide operator instructions. Follow the scan tool instructions as required. For a brief description of each stage, refer to PARK Test Setup, DRIVE Mode, and REVERSE Mode below.

3. Once the procedure is complete, shut OFF the engine and power down the TCM. You will lose communication to the scan tool.
4. Restart the engine. This will complete the Service Fast Learn Adapts procedure.

The following are brief descriptions of each of the 3 different stages.

PARK Test Setup

While the transmission is in PARK, Service Fast Learn Adapts will prepare for test cycles. The test preparation will include the diagnostic criteria checks, safety checks, vehicle status checks, and then will perform internal transmission test preparation functions such as clutch air purging. The scan tool will instruct the operator to select park and apply the brake only.

DRIVE Mode

CAUTION: Block the wheels before selecting DRIVE. While in DRIVE, if the Scan Tool loses communication or becomes disconnected, the vehicle could move forward. Failure to block the wheels could result in personal injury or property damage.

Once the PARK setup has completed, the scan tool instructs the driver to select DRIVE. Once DRIVE is selected, the TCM engages the individual clutches to learn the clutch volume, full feed fill thresholds, and pressure offsets. The TCM will only cycle through this test once. Running the Service Fast Learn Adapts procedure multiple times will give the same results and is not necessary.

REVERSE Mode

CAUTION: Block the wheels before selecting REVERSE. While in REVERSE, if the Scan Tool loses communication or becomes disconnected, the vehicle could move backward. Failure to block the wheels could result in personal injury or property damage.

Next, the scan tool instructs the driver to select REVERSE. The TCM engages the individual clutches to learn the clutch volume, full feed fill thresholds, and pressure offsets. The TCM will only cycle through this test one time. Running the Service Fast Learn Adapts procedure multiple times will give the same results.

IMPORTANT: When the Service Fast Learn Adapts procedure is completed, the transmission will remain in a neutral state.

Troubleshooting

If the Service Fast Learn Adapts will not run and the above stated conditions have been met, ensure the following:

- TFT is between 70-100°C (158-212°F).
- Brakes and brake switch are functioning properly.
- No active DTCs.
- Closed throttle and engine RPM increases above 1500 RPM while in Park Test Setup or at entrance of the test modes.
- Park/Neutral position switch is properly adjusted and functioning.
- Line pressure control is able to provide 1000 kPa and is within specifications.
- Vehicle is not moving, or vibrating excessively.
- Clutches are properly assembled.

TRANSMISSION FLUID CHECK

This procedure checks both the transmission fluid level, as well as the condition of the fluid itself.

NOTE: Use Dexron VI transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

IMPORTANT: Ensure the transmission has enough fluid in it to safely start the vehicle without damaging the transmission. With the vehicle off there must be at least enough fluid to wet the end of the dipstick bullet. This will ensure that there is enough fluid in the sump to fill the components once the vehicle is started.

Level Checking Procedure

1. Park the vehicle on a level surface, apply the parking brake and place the shift lever in PARK (P).
2. Start the engine.
3. Depress the brake pedal and move the shift lever through each gear range, pausing for about 3 seconds in each range. Then move the shift lever back to PARK (P).
4. Allow the engine to idle 500-800 rpm for at least 1 minute. Release the brake pedal.
5. Keep the engine running and observe the transmission fluid temperature (TFT) using the Driver Information Center or a scan tool.

IMPORTANT: If the fluid temperature is below the specified range, perform the following procedure to raise the fluid temperature to the specified range.

6. If the TFT reading is not within the required temperature ranges, allow the vehicle to cool, or operate the vehicle until the appropriate TFT is reached.

   Drive the vehicle in second gear until the fluid temperature is within the specified range.

IMPORTANT: Check the transmission fluid level when the TFT is between 180°F and 200°F (82°C and 93°C). The fluid level rises as fluid temperature increases, so it is important to ensure the transmission fluid temperature is within range.

7. Remove the dipstick and wipe it with a clean rag or paper towel.
8. Inspect the fluid color. The fluid should be red or dark brown.
   - If the fluid color is very dark or black and has a burnt odor, inspect the fluid for excessive metal particles or other debris. A small amount of "friction" material is a "normal" condition. If large pieces and/or metal particles are noted in the fluid, flush the oil cooler and cooler lines and overhaul the transmission. If there are no signs of transmission internal damage noted, replace the fluid, repair the oil cooler, and flush the cooler lines.
   - Fluid that is cloudy or milky or appears to be contaminated with water indicates engine coolant or water contamination. Refer to **Engine Coolant/Water in Transmission** .
9. Install the dipstick and tighten. Wait three seconds and then remove it again.

IMPORTANT: Always check the fluid level at least twice. Consistent readings are important to maintaining proper fluid level. If inconsistent readings are noted, inspect the transmission vent assembly to ensure it is clean and unclogged.

IMPORTANT: It is not necessary to get the fluid level all the way up to the MAX mark. Anywhere within the crosshatch band is acceptable.

10. Check both sides of the dipstick and read the lower level.
11. Install and remove the dipstick again to verify the reading.
12. If the fluid level is not within the crosshatch band, and the transmission temperature is between 180°F and

200°F (82°C and 93°C), add or dranin fluid as necessary to bring the level into the crosshatch band. If the fluid level is low, add only enough fluid to bring the level into the crosshatch band.

IMPORTANT: Do not add more than one pint (0.5L) at a time without rechecking the level. Once the oil is on the dipstick bullet, it will not take much more fluid to raise the fluid level into the crosshatch band. Do not overfill. Also, if the fluid level is low, inspect the transmission for leaks. Refer to Fluid Leak Diagnosis.

13. If the fluid level is in the acceptable range, install the dipstick.
14. If the fluid was changed, reset the transmission oil life monitor if applicable.

Fluid Condition Inspection

- Inspect the fluid color. The fluid should be red in color. The fluid may also turn brown form normal use, and does not always indicate contamination.

IMPORTANT: Fluid that is very dark or black and has a burnt odor usually indicates contamination or overheating.

- If the fluid color is very dark or black and has a burnt odor, inspect the fluid for excessive metal particles or other debris which may indicate transmission damage. Refer to **Road Test** to verify transmission operation. Change the transmission fluid if no other conditions are found.
- Fluid that is cloudy or milky or appears to be contaminated with water indicates engine coolant or water contamination. Refer to **Engine Coolant/Water in Transmission**.

LINE PRESSURE CHECK

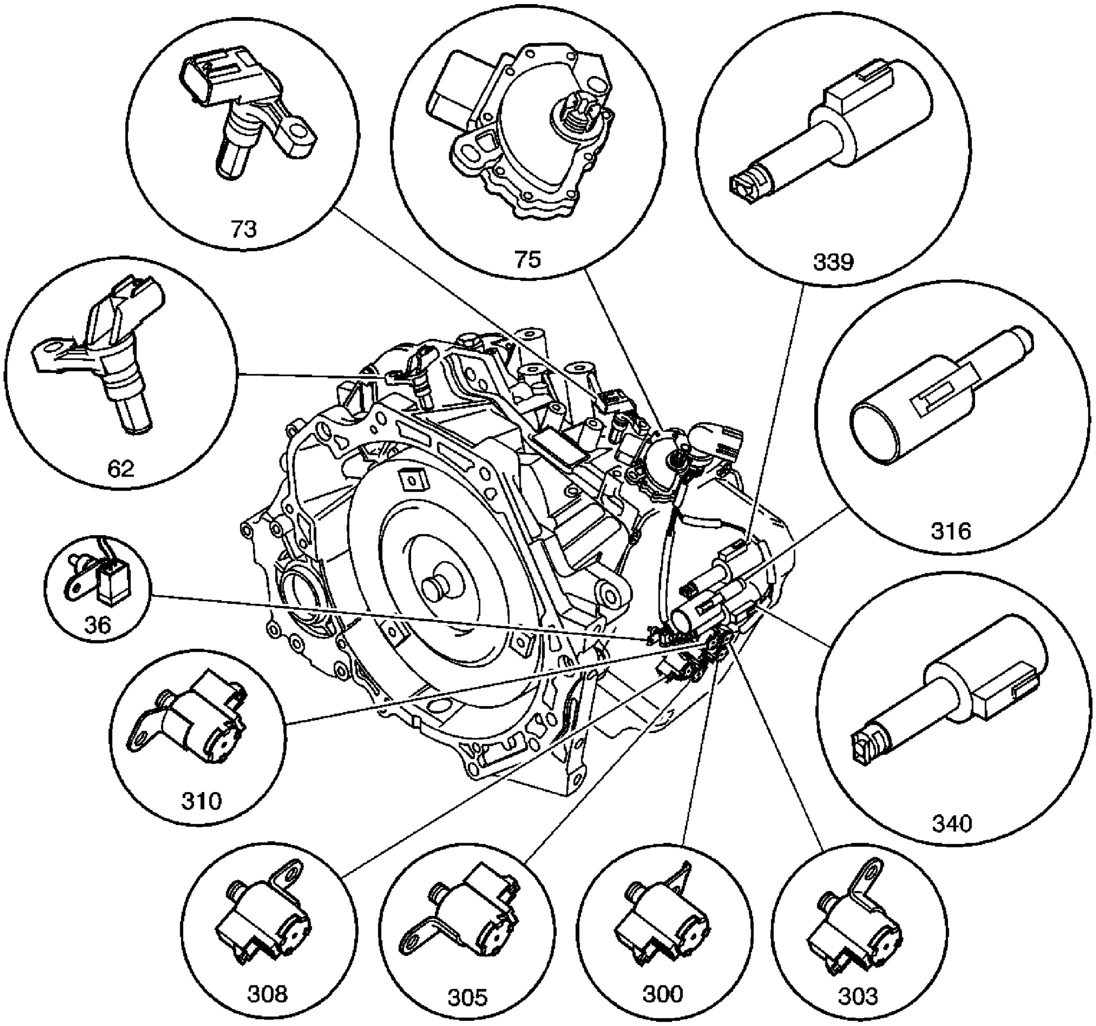

Fig. 5: Identifying Special Tool -- J 21867
Courtesy of GENERAL MOTORS CORP.

Tools Required

J 21867 Pressure Gage

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

1. Install a scan tool.
2. Start the engine.
3. Inspect the transmission for the proper fluid level. Refer to **Transmission Fluid Check**.
4. Use the scan tool to inspect for any active or stored diagnostic trouble codes.

5. Inspect the manual linkage at the transmission for proper function.
6. Turn the engine OFF.
7. Remove the line pressure test hole plug.
8. Install the **J 21867** .
9. Access the Scan Tool Transmission Output Controls for the Line PC Solenoid.
10. Start the engine.

IMPORTANT: In order to achieve accurate line pressure readings, the following procedure must be performed at least 3 times in order to gather uniform pressure readings.
The scan tool is only able to control the line PC solenoid in PARK and NEUTRAL with engine speeds below 1500 RPM. This protects the clutches from extreme high or low line pressures.

11. Use the scan tool to increase and decrease the Line PC Solenoid in increments of approximately 100 KPa (15 psi). The scan tool commands the increment values automatically.
12. Allow the pressure to stabilize between increments.
13. Compare the pressure readings on the scan tool to those indicated on the **J 21867** .
14. If the pressure readings vary greatly, refer to **Fluid Pressure High or Low**.
15. Turn the engine OFF.
16. Remove the **J 21867** .

NOTE: Refer to Fastener Notice .

17. Install the line pressure test hole plug.

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

ROAD TEST

IMPORTANT: The Road Test Procedure should be performed only as part of the Symptom Diagnosis. Refer to Symptoms - Automatic Transmission.

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 Downshifts
- Manual Downshifts
- Coasting Downshifts
- Manual Gear Range Selection

- REVERSE
- Driver Shift Control

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 **Transmission Fluid Check**.
- 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:

- Inspect for proper transmission fluid level. Refer to **Transmission Fluid Check**.
- Inspect for any diagnostic trouble codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Monitor the scan tool data for any abnormal readings or data.
- Inspect for fluid leaks. Refer to **Fluid Leak Diagnosis**.

Electrical Function Check

Perform this procedure first in order to ensure the electronic transmission components are functioning properly. If these components are not checked, a simple electrical condition could be misdiagnosed.

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 ISS
- Transmission OSS
- Vehicle Speed
- IMS
- Commanded Gear
- Gear Ratio
- Line PC Sol. Pressure Cmd.
- TCC Brake Switch
- ECT, Engine Data List
- Trans. Fluid Temp.
- TCM Temperature
- Calc. Throttle Position
- Ignition Voltage
- TFP Switch 1
- TFP Switch 3
- TFP Switch 4
- TFP Switch 5
- PC Sol. 2 Pressure Cmd.
- PC Sol. 3 Pressure Cmd.
- PC Sol. 4 Pressure Cmd.
- PC Sol. 5 Pressure Cmd.
- Shift Solenoid 1
- Shift Solenoid 2
- TCC PC Sol. Duty Cycle
- TCC Slip Speed

5. Monitor the TCC Brake Switch parameter while applying and releasing the brake pedal. The scan tool should display:
    - Open when the brake pedal is applied.
    - Closed when the brake pedal is released.
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 engine idle speed-Compare engine idle speed to desired idle speed.**
- **Commanded low pressure control (PC) solenoid current-Investigate PC Sol. Pressure Cmd. kPa (psi) for all solenoids. High pressure will cause harsh shifts.**
- **A default condition caused by certain DTCs that result in maximum line pressure to prevent clutch slippage.**

IMPORTANT: 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-Investigate PC Sol. Pressure Cmd. kPa (psi) for all solenoids. Low pressure will cause soft or delayed shifts.**
- **Cold transmission fluid temperature (TFT)-Use the scan tool to determine TFT.**
- **Selector linkage-Inspect and adjust as necessary.**

7. Monitor transmission range on the scan tool, engine data list.
    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 position input.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Ensure the gear selector is in PARK.
    3. Monitor the scan tool Calc. Throttle Position while increasing and decreasing engine speed with the throttle pedal. The scan tool Calc. Throttle Position percentage 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 TCM calculates the upshift points based primarily on 2 inputs: throttle position and vehicle speed. When the TCM determines that conditions are met for a shift to occur, the TCM commands the shift by closing or opening the ground circuit for the appropriate solenoid.

Perform the following steps:

1. Refer to **Shift Speed** table in this section and choose a throttle position of 12.5 percent or 25 percent. All throttle positions shown should be tested to cover the normal driving range.
2. Monitor the following scan tool parameters:
    - Calc. Throttle Position
    - Vehicle Speed
    - Engine Speed
    - Transmission ISS
    - Transmission OSS
    - Commanded Gear
    - TCC PC Sol. Pressure Cmd.
    - TCC Pressure Actual
    - TCC Slip Speed
    - TFP Switch 1
    - TFP Switch 3
    - TFP Switch 4
    - TFP Switch 5
    - PC Sol. 2 Pressure Cmd.
    - PC Sol. 3 Pressure Cmd.
    - PC Sol. 4 Pressure Cmd.
    - PC Sol. 5 Pressure Cmd.
    - Shift Solenoid 1 and 2
3. Place the gear selector in the DRIVE position.
4. Accelerate the vehicle using the chosen throttle position. Hold the throttle steady.
5. As the transmission upshifts, there should be a noticeable shift feel or engine speed change within 1 to 2 seconds of the commanded gear change. The TCC feel may not be noticeable. Look for 100-300 RPM engine speed change.
6. Compare the shift speeds to the Shift Speed table. Refer to **Shift Speed** . Shift speeds may vary slightly due to TFT or other operating variables, including hydraulic delays in responding to electronic controls.
    - Note any harsh, soft or delayed shifts or slipping.
    - Note any noise or vibration.

IMPORTANT: This transmission is equipped with an electronically controlled capacity clutch (ECCC), which does not allow the clutch to fully lock to the torque converter cover. The clutch maintains a small amount of slippage, approximately 20 RPM, in 2nd, 3rd, 4th, 5th, and 6th gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration or chuggle caused by TCC apply. 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 <u>Shift Speed</u> . The vehicle must be in a near-cruise condition, not accelerating or coasting, and on a level road surface.

7. Monitor TCC PC solenoid current while driving and make sure the current rises when the TCC is commanded to apply.
   - 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**.
   - Apply and release the brake pedal. The TCC will release on most applications.

Part Throttle Downshift

1. Place the gear selector in the DRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in 6th gear.
3. Quickly increase throttle angle to between 25-30 percent.
4. Verify the following:
   - The TCC releases.
   - The transmission downshifts immediately.

Manual Downshifts

Manual downshift testing is not required for vehicles equipped with Driver Shift Control (DSC). The TCM and shift solenoids will automatically override DSC downshifts to protect the transmission from damage.

Coasting Downshifts

1. Place the gear selector in the DRIVE position.
2. Accelerate the vehicle to 6th gear with the TCC applied.
3. Release the throttle and apply the brakes
4. Verify the following:
   - The TCC releases (on most applications).
   - Downshifts occur as commanded.

Reverse

Perform the following test using a 10-15 percent throttle position.

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.

Driver Shift Control (DSC) / Electronic Range Selection (ERS)

Refer to the owner's manual for specific instructions on DSC. The TCM will override shift commands when maximum engine speed is achieved and will protect from any downshift which may cause excessive engine RPMs.

TORQUE CONVERTER DIAGNOSIS

Torque Converter Stator

The torque converter stator roller clutch can have 2 different malfunctions.

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

Poor Acceleration at Low Speed - Stator Roller Clutch Freewheels at All Times

If the stator is freewheeling at all times, the vehicle tends to have poor acceleration from a standstill and at speeds below 48-55 km/h (30-34 mph). At speeds above 48-55 km/h (30-34 mph), the vehicle may act normally.

For poor acceleration at low speeds, 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 - Stator Roller Clutch is Locked Up at All Times

If the stator is locked up at all times, performance is normal when accelerating from a standstill. Engine RPM and vehicle speed are limited or restricted at speeds above 48-55 km/h (30-34 mph). Visual examination of the converter may reveal a blue color from overheating.

Torque Converter Stator Noise

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

Torque converter whine is noticed 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 verify that the noise is actually coming from the torque 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 six seconds.

A torque converter noise will increase under this load.

Torque Converter Clutch

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

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 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 Shudder Occurs During TCC Apply or Release

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:

- The clutch is not engaging completely.
- The clutch is not releasing completely.
- The clutch is releasing and applying rapidly and continuously.

One of the following conditions may be causing the the TCC Shudder to occur:

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

If Shudder Occurs After TCC has Applied

IMPORTANT: Some transmissions are equipped with an electronically controlled capacity clutch (ECCC), which does not allow the clutch to fully lock to the torque converter cover. The clutch maintains a small amount of slippage, approximately 20 RPM, in 2nd, 3rd, 4th, 5th, and 6th gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration or chuggle caused by TCC apply. Full lockup is only available at highway speeds on some applications.

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

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.

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

Once TCC is applied, there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement. Refer to **Symptoms - Engine Controls** in order to avoid misdiagnosis of TCC shudder and the unnecessary disassembly of a transmission or the unnecessary replacement of a torque converter.

Torque Converter Vibration Test

IMPORTANT: The Noise and Vibration Analysis procedure should be performed prior to performing this test.

Isolating Vibration

IMPORTANT: Some engine/transmission combinations cannot be balanced in this manner due to restricted access or limited clearances between the torque converter bolts and the engine.

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 torque converter access cover and the bolts (if equipped).
5. Mark the relationship of the torque converter to the flywheel.
6. Remove the bolts attaching the converter to the flywheel.
7. Slide the torque converter away from the flywheel.
8. Rotate the flywheel and torque converter to inspect for defects or missing balance weights.
9. Lower the vehicle.
10. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.
11. Turn the engine OFF.
12. If the vibration remains, the vibration is most likely caused by the engine.

NOTE: Refer to Fastener Notice .

13. Install the converter to flywheel bolts.

Tighten: Tighten to 60 N.m (44 lb ft).

NOTE: When installing the torque converter to the flywheel, make sure to use specific bolts. DO NOT use longer bolts. Using longer bolts will result in deformation of the torque converter cover and cause internal damage.

14. If the vibration is gone or changed, perform the Indexing Torque Converter procedure.

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 from the original marked position.
3. Align the torque converter hub (2) in the engine crankshaft (3) and install the torque converter to flywheel bolts.

   Tighten: Tighten to 60 N.m (44 lb ft).

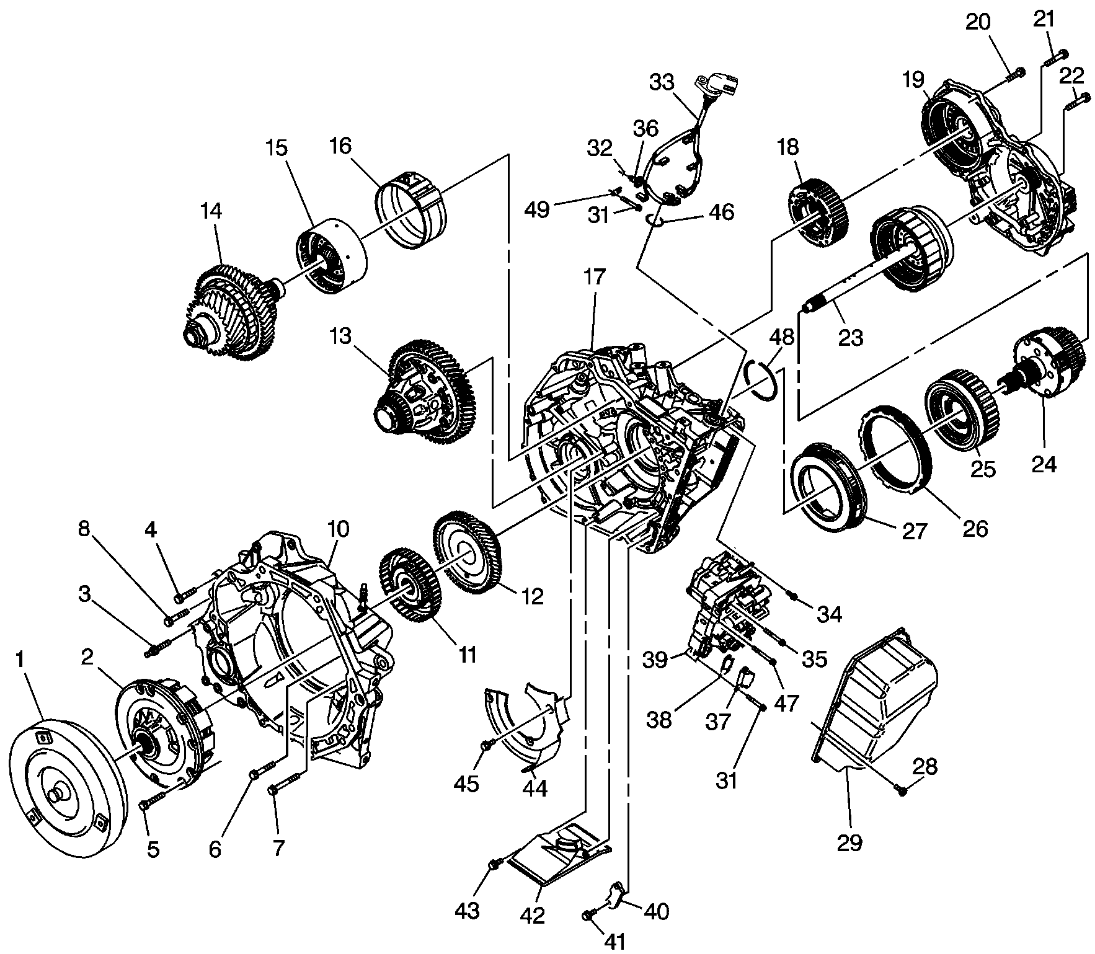

Fig. 6: View Of Torque Converter Hub In Engine Crankshaft
Courtesy of GENERAL MOTORS CORP.

4. Lower the vehicle.
5. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.
   - Repeat this procedure until the best possible balance is obtained.
   - If the vibration does not improve after rotating the torque converter 360 degrees, replace the torque converter assembly.
6. Install the torque converter access cover and bolts (if equipped).

   Tighten: Tighten to 12 N.m (9 lb ft).

Torque Converter Replacement Guide

DO NOT replace the Torque Converter if the following symptoms are found.	
Condition	**Action**
• Transmission Fluid Oxidized/Discolored	Do not replace the torque converter.

• No metal debris • Clutch fiber material	Refer to **Transmission Fluid Check**.
Transmission Fluid Contaminated with Metal Particles	**IMPORTANT:** **Do not replace the torque converter for clutch system or gearset component damage. Fine metallic debris or clutch plate material that is suspended in the fluid will not cause damage to the internal torque converter components nor any internal transmission components.**
Harsh Gear Shifts-TCC Not Applied	Do not replace the torque converter. Refer to **Symptoms - Automatic Transmission**.
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**Torque Converter Vibration Test**.
No Drive/Slips in Drive-TCC Not Applied	Do not replace the torque converter until completing all engine and transmission diagnostics.
Idle Surge/Rough Idle	Do not replace the torque converter. Refer to **Symptoms - Engine Controls**
TCC Apply/Release Shudder	Do not replace the torque converter. Refer to **Torque Converter Clutch Shudder**.
TCC Chuggle	Do not replace the torque converter. Refer to **Symptoms - Engine Controls** .
DTC P0741-TCC Stuck OFF/High Slip-Intermittent Only	Do not replace the torque converter. Refer to **DTC P0741 or P0742** diagnostic table.
DTC P0741-TCC Stuck OFF/High Slip	Do not replace the torque converter. Refer to **DTC P0741 or P0742** diagnostic table.
DTC P0742-TCC Stuck ON	Do not replace the torque converter. Refer to **DTC P0741 or P0742** diagnostic table.
DTC P1887-TCC Release Switch	Do not replace the torque converter.
Transmission Fluid Contaminated with Sludge/Metal Particles as a result of: • Engine Coolant/Oil • Pump damage • Drive sprocket support damage • Turbine/stator shaft damage • No damage found in transmission	Replace the torque converter. Refer to **Torque Converter Removal**.
	Do not replace the torque converter until completing all engine and transmission diagnostics.

Poor Acceleration above 48 km/h (30 mph) - Good Launch	• Refer to **Torque Converter Stator**. • Refer to **Symptoms - Engine Controls** .
Poor Launch - Good Acceleration above 48 km/h (30 mph)	Do not replace the torque converter until completing all engine and transmission diagnostics. • Refer to **Torque Converter Stator**. • Refer to **Symptoms - Engine Controls** .
Stripped Converter Bolt Holes	Replace the torque converter.
Torque Converter Pilot Damaged	Replace the torque converter.
Torque Converter Hub surface is damaged - scored, raised/transferred metal.	Replace the torque converter.
Torque Converter Ballooning	Replace the torque converter.
External Leaks in the weld areas - hub, lug or closure weld.	Replace the torque converter.
Broken/Cracked Flywheel	Replace the torque converter.
Torque Converter Discolored/Overheated	Replace the torque converter.

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 in between channels.
    - The valve train retainers 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.
8. Inspect the rubber hose portion of the oil cooler lines for damage, if applicable. Refer to **Transmission Fluid Cooler Flushing and Flow Test**.

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 leak tracing 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. Operate the vehicle for 24 km (15 mi) or until normal operating temperatures are reached.
3. Detect the leak with the black light.
4. 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 shaft or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Transmission Case Cover and/or Valve Body Cover

- Incorrectly tightened bolts
- Improperly installed or damaged gasket/seal
- Damaged mounting face
- Incorrect gasket seal

Case Leak

- Damaged input speed sensor seal
- Damaged manual shaft seal
- Loose or damaged oil cooler lines/seals
- Worn or damaged axle shaft oil seal
- Loose line pressure pipe plug or fluid level pipe plug
- Porous casting
- Warped torque converter housing
- Damaged converter housing to case seal

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 torque converter housing

Leak at the Vent

- Overfilled system

- Water or coolant in the fluid; The fluid will appear milky
- Transmission case porous
- Incorrect fluid level indicator causing an overfilled system
- Plugged vent

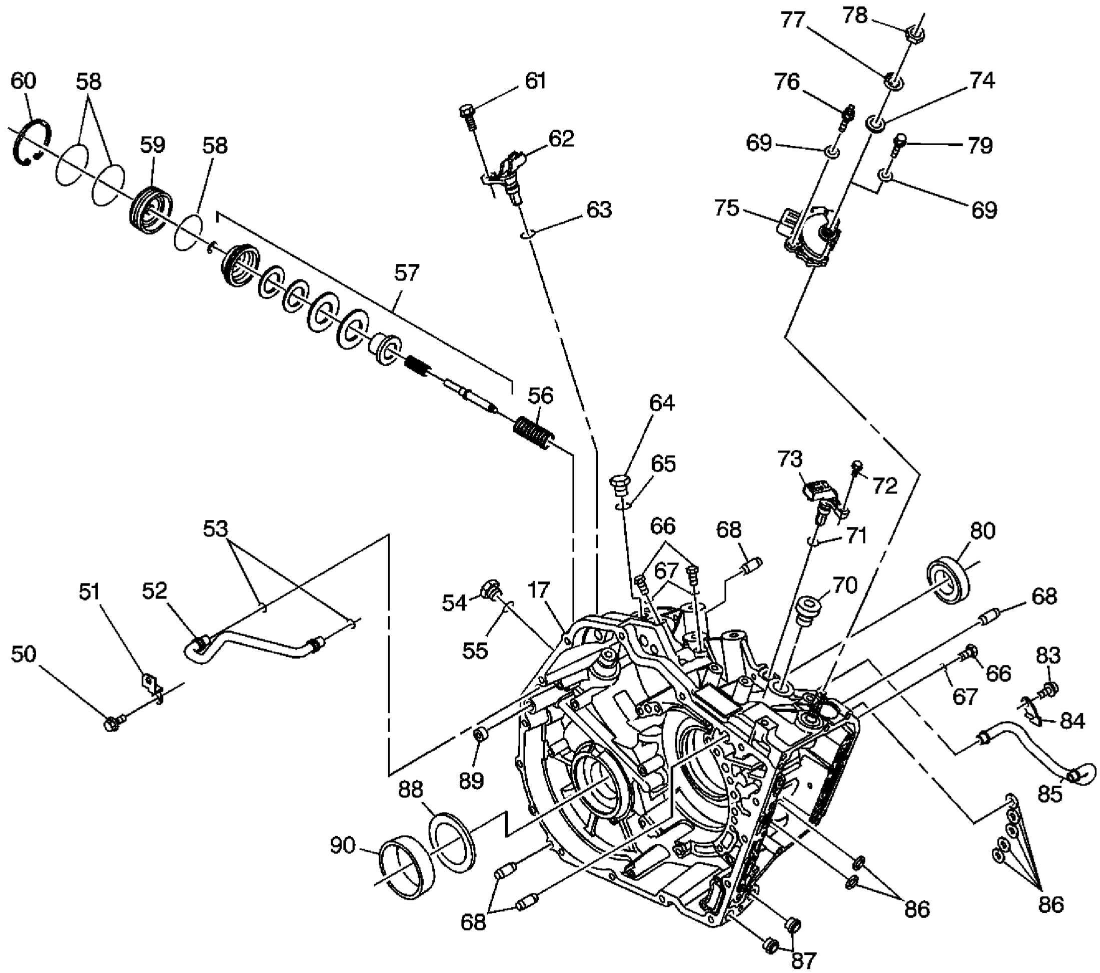

Fig. 7: Leak Inspection Points
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Manual Shift Shaft Seal
2	Automatic Transmission Vent
3	Control Valve Body Cover Wiring Connector Hole Seal
4	Input Speed Sensor Seal
5	Converter Housing to Case Joint
6	Front Wheel Drive Shaft Oil Seal Assembly - Case
7	Torque Converter Fluid Seal Assembly

8	Torque Converter Assembly
9	Front Wheel Drive Shaft Oil Seal Assembly - Torque Converter Housing
10	Control Valve Body Cover Assembly Gasket
11	Fluid Level Hole Plug
12	Fluid Pressure Hole Plug
13	Case Cover Gasket

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas.

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. Apply the epoxy. A clean, dry soldering acid brush can be used 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 three hours before assembling the components.
5. Repeat the fluid leak diagnosis procedures.

TRANSMISSION FLUID COOLER FLUSHING AND FLOW TEST

GM studies indicate that plugged or restricted transmission oil coolers and line 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 or equivalent to flush the transmission oil cooler and the oil cooler line whenever the transmission is removed for the following repairs:

- **Torque converter**
- **Oil pump**
- **transmission overhaul complete**
- **transmission assembly replacement**

Use the appropriate transmission fluid when performing a transmission repair. Only GM Goodwrench DEXRON®VI automatic transmission fluid should be used when doing a repair on a six (6) speed 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

- **DT-48312** Transmission Cooler Flushing Adapter. See **Special Tools**.
- **J 35944-22** Cooler Flushing Fluid. See **Special Tools**.
- **SA9165T** Oil Cooler Line Flusher
- 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 lines.

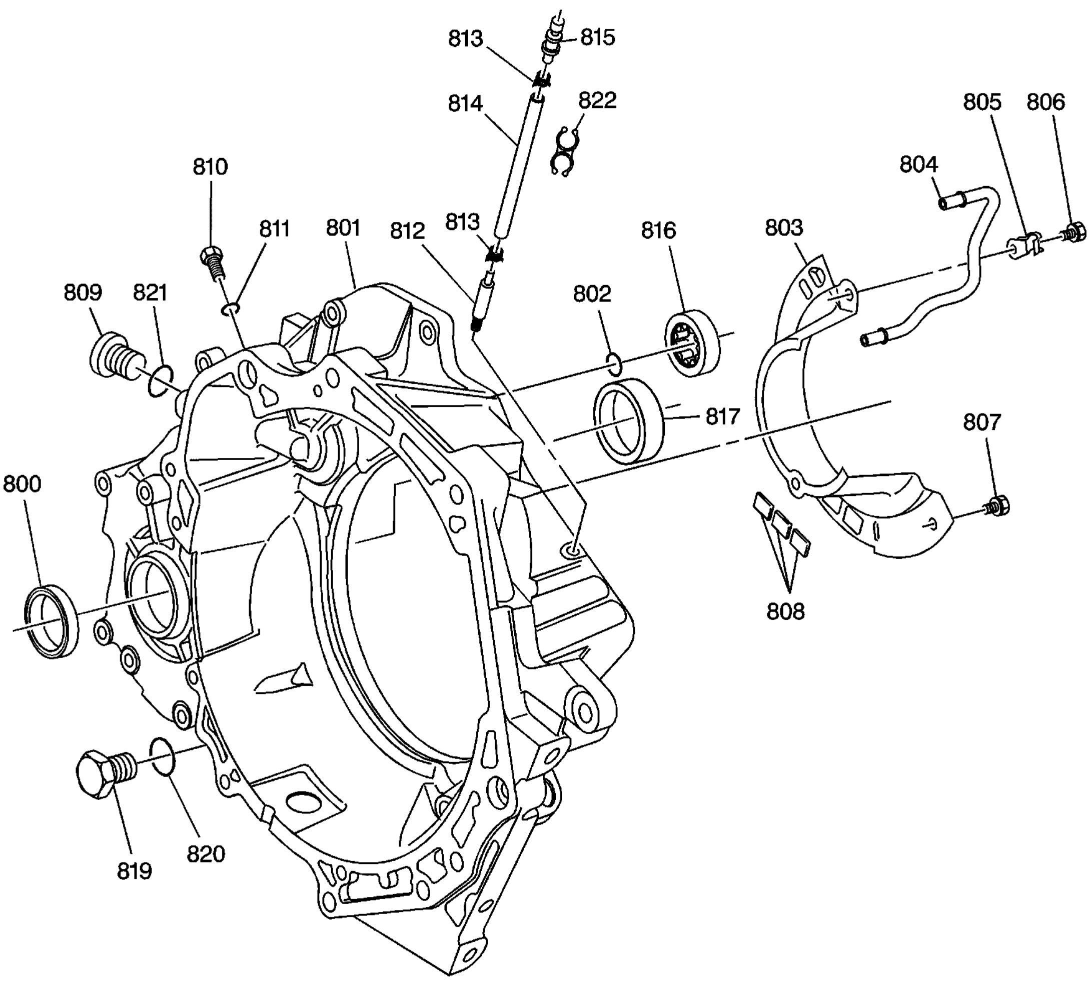

Fig. 8: Identifying Flusher Tank & Components
Courtesy of GENERAL MOTORS CORP.

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 0.6 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).
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.
5. Turn ON the water supply at the faucet.

Back Flush

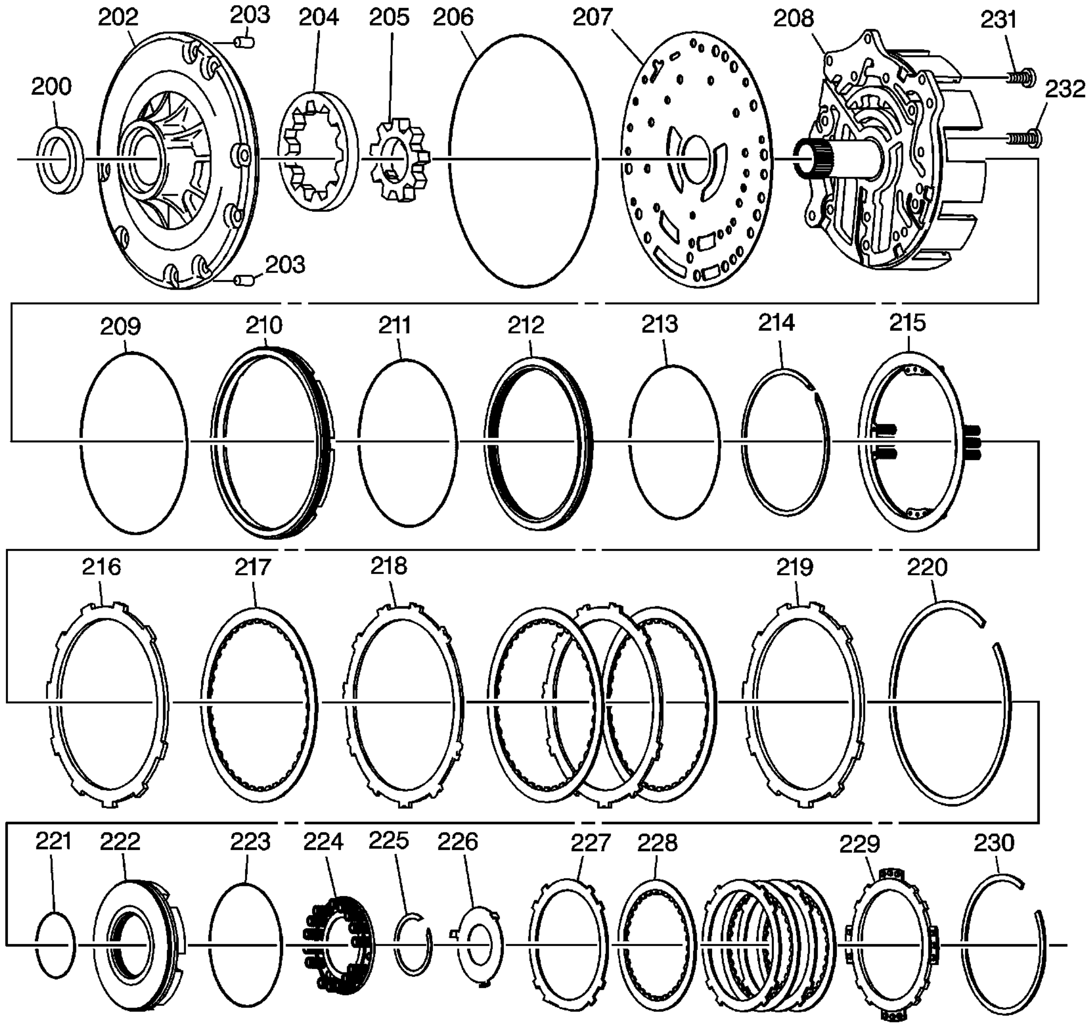

Fig. 9: View Of Oil Cooler Line Flusher
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the transmission oil cooler lines for kinks or damage. Repair as necessary.

1. Connect the **SA9165T** to the oil cooler feed line. Use the **DT-48312** . See **Special Tools**.
2. Clip the discharge hose (2) onto the oil drain container.
3. 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 oil cooler return line. Use the **DT-48312** . See **Special Tools**.
4. Turn the **SA9165T** water supply valve (3) to the ON position and allow water to flow through the oil cooler and lines for 10 seconds to remove any remaining transmission fluid. If water does not flow through the oil cooler and lines, 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.
5. 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.

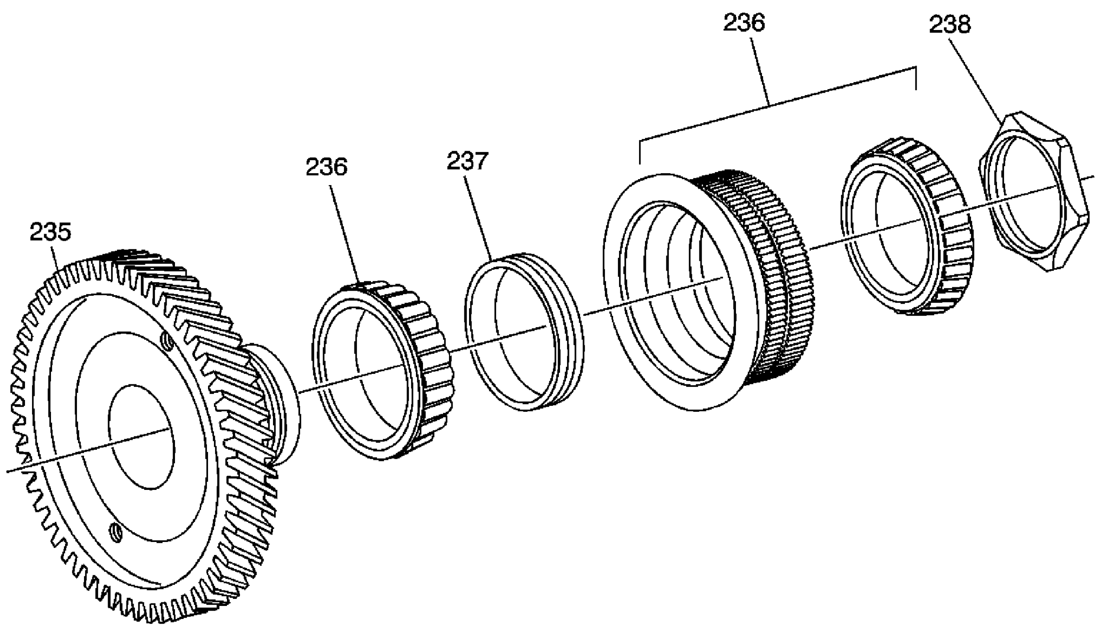

Fig. 10: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

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.

6. 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. 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.
7. Flush the oil cooler and lines with water and solution for 2 minutes. During this flush, attach the shop air supply 550-700 kPa (80-100 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.

8. Release the trigger (1) and turn the **SA9165T** water supply valve (3) to the OFF position.

Forward Flush

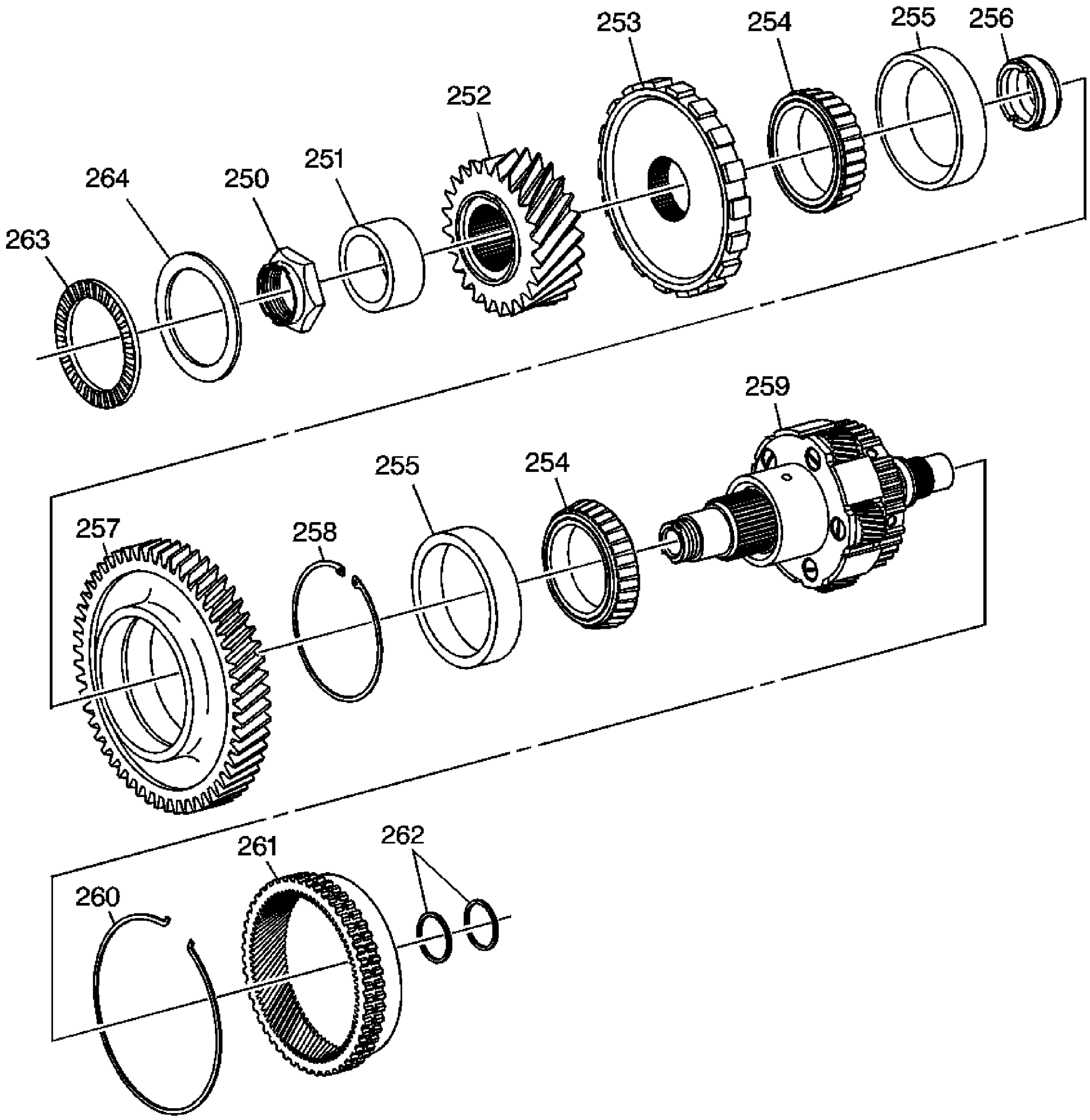

Fig. 11: View Of Oil Cooler Line Flusher
Courtesy of GENERAL MOTORS CORP.

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

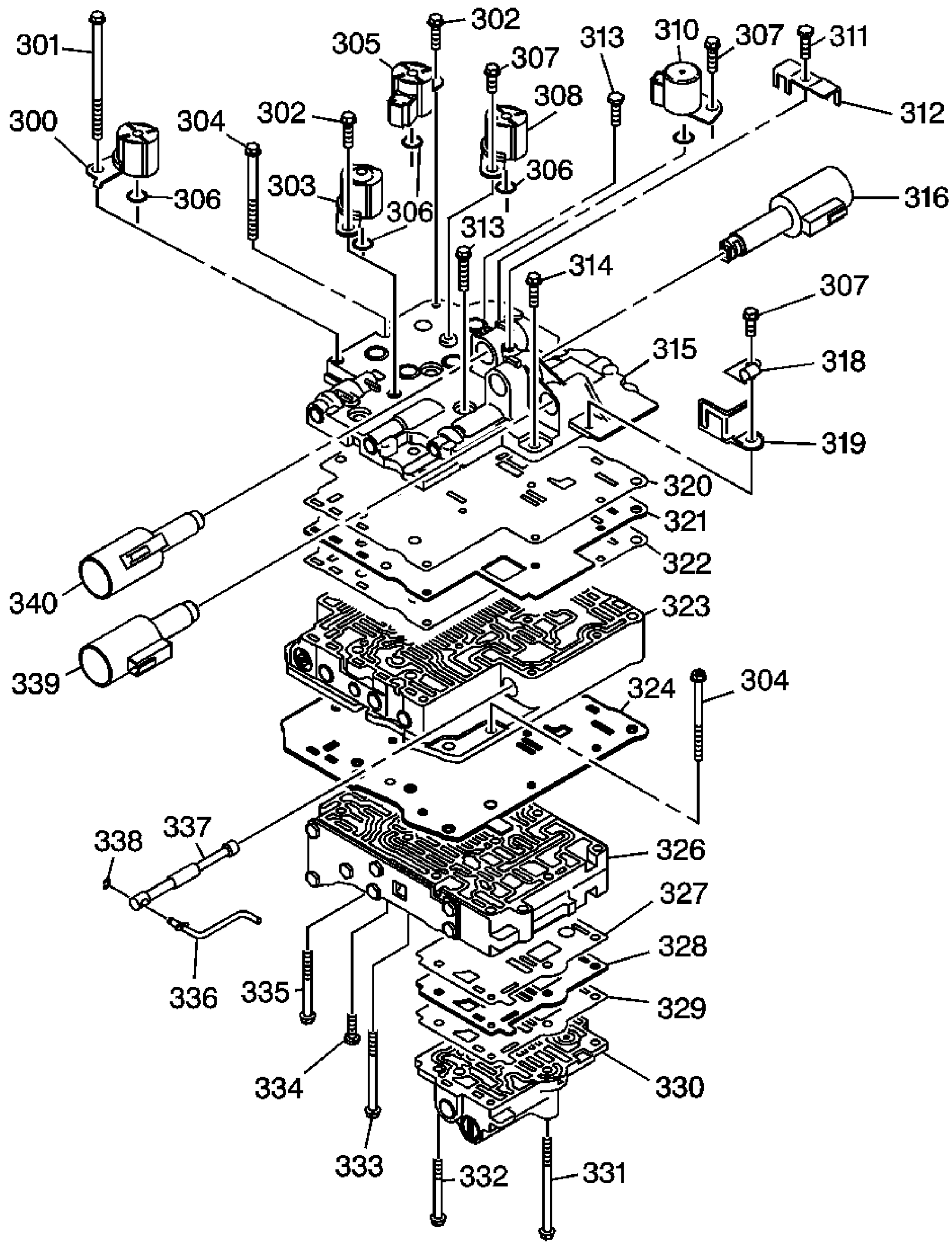

Fig. 12: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

3. Release the trigger (1) of the **SA9165T** and allow water only to rinse the oil cooler and lines for 1 minute.
4. Turn the **SA9165T** water supply valve (3) to the OFF position and turn OFF the water supply at the

faucet.

5. Attach the shop air supply to the flushing system feed air valve (2) on the **SA9165T** and blow out the water from the oil cooler and lines. Continue, until no water comes out of the discharge hose.

Flow Test

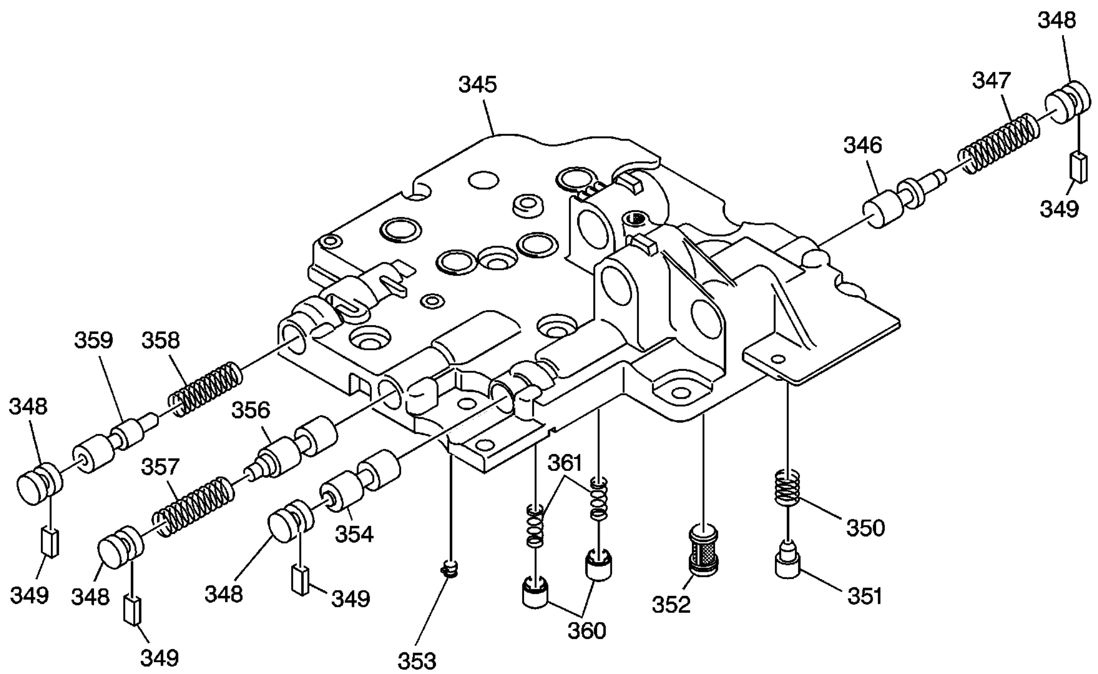

Fig. 13: View Of Flow Test Procedure & Special Tools
Courtesy of GENERAL MOTORS CORP.

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. Corrosion of the oil cooler will occur if water and flushing solution remain in the oil cooling system.

1. Disconnect the hose from the oil cooler line. Connect the oil cooler feed line 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 return line to 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 line.
2. Disconnect the oil cooler feed line at the radiator.
3. Connect the **SA9165T** discharge hose (1) to the oil cooler feed line, radiator end.
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 line 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.
2. Remove the fill cap from the **SA9165T** and return any unused flushing solution to its container. Rinse the **SA9165T** with water. Do not store the**SA9165T** with flushing solution in it.
3. After every third use, clean the **SA9165T** as described in the instructions included with the tool.
4. Dispose of any waste water/solution and transmission fluid in accordance with local regulations.

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. Refer to the General Information **Diagnostic Starting Point - Vibration Diagnosis and Correction** procedure.

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

- Vibration may also be caused by a small amount of water inside the converter.
- 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

- If the noise or vibration is noticeable in PARK and NEUTRAL with the engine at idle, but is more noticeable as RPM increases, the vibration may be an engine imbalance or a transmission imbalance. Refer to **Torque Converter Diagnosis**.

WHINE/GROWL NOISE

Whine/Growl Noise

Checks	Causes
Front Differential Drive Pinion Gear Assembly (23)	• Inspect for proper Taper Roller Bearing Pre-load • Inspect for loose or worn transfer Driven Gear
Differential Assembly (486)	• Inspect for proper Taper Roller Bearing Pre-load • Inspect for worn or damaged Side Gear Thrust Washer (492) or Pinion Gear Thrust Washer (488) • Inspect for loose or worn Side Gear Axle Splines
Input Carrier Assembly (470)	• Inspect for worn or damaged Pinion Gear Thrust Washers and Bushings • Inspect for worn or damaged Pinion Gears, Pins or Needle Bearings • Inspect for loose Hub and Ring Gear
Output Carrier Assembly (474)	• Inspect for worn or damaged Pinion Gear Thrust Washers and Bushings • Inspect for worn or damaged Pinion Gears, Pins or Needle Bearings • Inspect for loose Hub and Ring Gear
Reaction Carrier Assembly (467)	• Inspect for worn or damaged Pinion Gear Thrust Washers and Bushings • Inspect for worn or damaged Pinion Gears, Pins or Needle Bearings • Inspect for loose hub and Ring Gear
Fluid Pump Assembly (203)	• Inspect for proper fluid level • Inspect for loose or worn Drive Link Assembly (218) • Inspect for worn Driven Sprocket Thrust Washer (214) or Drive Sprocket Thrust Washers (219, 220) • Inspect for leaking Transfer Drive Gear Support Seal (213), Pump Fluid Outlet Seal Assembly (57) or Filter Seal (202) • Inspect for worn or damaged Fluid Pump Shaft Splines
3-5-Reverse Clutch Assembly	• Inspect for inadequate Clutch Plate Clearance • Inspect for loose or worn Clutch Plate Splines (423-425) • Inspect for loose or worn Clutch Spring Retainer (427) • Inspect for loose Speed Sensor Reluctor Wheel (416) or

	Retainer (415)
4-5-6 Clutch Assembly	• Inspect for inadequate Clutch Plate Clearance • Inspect for loose or worn Clutch Plate Splines (449, 440) • Inspect for loose or worn Clutch Spring Retainer (442) • Inspect for loose or worn 3-5-Reverse/4-5-6 Clutch Housing Bushing
1-2-3-4 Clutch Assembly	• Inspect for inadequate Clutch Plate Clearance • Inspect for loose or worn Clutch Plate Splines (456-458) • Inspect for loose or worn Clutch Spring Retainer (459)
Low and Reverse Clutch Assembly (OWC) (455)	• Inspect for loose or worn Splines (455) • Inspect for loose or worn Retainer (454)
Low and Reverse Clutch	• Inspect for inadequate Clutch Plate Clearance • Inspect for loose or worn Clutch Plate Splines (449-452) • Inspect for loose or worn Clutch Spring Retainer (410)
2-6 Clutch Assembly	• Inspect for inadequate Clutch Plate Clearance • Inspect for loose or worn Clutch Plate Splines (445-447) • Inspect for loose or worn Clutch Spring Retainer (407)
Case Assembly (51)	• Inspect for loose or broken Transmission Mount Bolts • Inspect for loose Torque Converter and Differential Housing Bolts (26) • Inspect for loose or broken Fluid Trough Bolts (56)

AUTOMATIC TRANSMISSION FLUID LEAKS

Automatic Transmission Fluid Leaks

Checks	Causes
Torque Converter (27)	Inspect for damage.
Case Assembly (21)	• Inspect for porosity or damage on the sealing surfaces • Inspect for loose Oil Cooler Line Bolts or damaged Oil Cooler Line Seals • Inspect for damaged Manual Shift Shaft Seal (58) • Inspect for damaged or worn Axle Seal (61) or Axle Seal Slinger on the axle shafts • Inspect for loose Pressure Test Plug (62) and Fluid Level Plug (63)
	• Inspect for damaged Torque Converter Housing Assembly (25) • Inspect for porosity or damage on the sealing surfaces • Inspect for damaged Torque Converter Housing Seal (22)

Torque Converter Housing Assembly (221)	• Inspect for damaged or worn Torque Converter Fluid Seal (225) • Inspect for loose Torque Converter and Differential Housing Bolts (26) • Inspect for damaged or worn Axle Seal (226) or Axle Seal Slingers on the axle shafts
Case Cover assembly (34)	• Inspect for porosity or damage on the sealing surface • Inspect for damaged Case Cover Gasket (33) • Inpsect for loose Case Cover Assembly Bolts (35) • Inspect for loose Input Speed Sensor (ISS) Bolt (401) • Inspect for damaged Input Speed Sensor (ISS) Seal (402) • Inspect for loose, damaged or leaking Case Cover Assembly bore plugs
Valve Body Cover Assembly (1)	• Inpsect for damaged or warped Valve Body Cover Assembly (1) • Inspect for damaged Valve Body Cover Gasket (5) • Inspect for loose Valve Body Cover Bolts (7) and Valve Body Cover Studs (6) • Inspect for damaged or improperly installed Wire Connector Hole Seal (10) • Inspect for damaged or worn Fluid Level Indicator Seal • Inspect for plugged vent holes in the Fluid Level Indicator (2)

NO PARK

No Park

Checks	Causes
Front Differential Drive Pinion (w/Transfer Gear) Gear Assembly (481)	• Inspect for broken or stripped Park Gear splines • Inspect for broken or worn Park Gear
Front Differential Carrier Assembly (486)	Inspect for damaged, broken or loose Front Differential Ring Gear
Output Carrier Transfer Drive Gear Hub Assembly (477)	• Inspect for worn, stripped or broken splines • Inspect for disengaged hub to Transfer Drive Gear
Reaction Carrier Assembly (467)	• Inspect for worn, stripped or broken splines • Inspect for disengaged to the Output Sun Gear (475)
	• Inspect for broken or damaged Case • Inspect for loose or stripped Park Pawl Actuator Bracket Bolts (500) • Inspect for broken or bent Park Pawl Actuator Bracket (501)

Case Assembly (507)	• Inspect for broken or missing Park Pawl Actuator Guide Pin (505) or Manual Shaft Pin (510) • Inspect for broken, loose or misaligned Park Pawl Guide (506) • Inspect for binding or broken Park Pawl (503) or Actuator Assembly (509)
Manual Shift Detent Lever Assembly (511)	Inspect for broken or disengaged Manual Valve Link Pin

HARSH GARAGE SHIFT

Harsh Garage Shift

Checks	Causes
Input Carrier Assemlby (470)	Inspect for worn or stripped Ring Gear Splines
Case Assembly (51)	• Inspect for damaged or fatigued 1-2-3-4 Clutch Wave Plate (458) and Low & Reverse Clutch Wave Plate (450) • Inspect for stripped or worn splines on 1-2-3-4 Clutch Plate (456) • Inspect for improperly positioned or plugged Low Reverse Piston (408) air bleed • Inspect for correct fluid level

NO DRIVE IN ALL RANGES

No Drive in All Ranges

Checks	Causes
Case Assembly (51)	• Inspect for cracked or broken Case (51) • Inspect for stripped or sheared splines • Inspect for missing Lube Orifice Plug • Inspect for binding Manual Shift Detent Lever Assembly (511) • Inspect for missing Manual Shift Shaft Pin (510) • Inspect for interference or binding Park Pawl Actuator Assembly (509) • Inspect for disengaged or broken 1-2-3-4 Clutch Piston Spring Retainer (459)
Torque Converter	• Inspect for stripped or sheared splines on Turbine Shaft • Inspect for missing bolts from Torque Converter to Flywheel
35R/456 Housing Assembly	• Inspect for damaged or broken Input Shaft Thrust Bearing Assembly (32) • Inspect for stripped, sheared or loose splines on the Input

	Shaft to the 3-5 Reverse/4-5-6 Clutch Housing (422)
Oil Pump Assembly	• Inspect for fluid leaks / improper fluid level • Inspect for disengaged, worn, binding or failed Drive Sprocket (216), Driven Sprocket (215) or Drive Link (217) • Inspect for leaking Fluid Outlet Seal Assembly (57) • Inspect for damaged or worn Drive (219, 220) and Driven Sprocket Thrust Washers (214) • Inspect for loose or missing Oil Pump Bolts (204) • Inspect for stripped or sheared splines on the Oil Pump Shaft or Driven Sprocket (215) • Inspect for damaged, clogged or improperly installed Oil Filter Assembly (201) • Inspect for damaged or leaking Oil Filter Neck Seal (202)
Low & Reverse Clutch Assembly (455)	Inspect for stripped or sheared splines to the Reaction Carrier (467)
Input Carrier Assembly (470)	• Inspect for stripped or sheared splines to ring gear • Inspect for improperly installed carrier pinion gear pins

NO FIRST AND REVERSE GEARS

No First and Reverse Gears

Checks	Causes
Low and Reverse Clutch Assembly (455)	• Inspect for disengaged or broken Low and Reverse Clutch Retainer (454) • Inspect for stripped or sheared splines on Low and Reverse Clutch (455)
Low and Reverse Clutch	• Inspect for stripped or sheared splines on Low and Reverse Clutch Plates (449-453) • Inspect for damaged, deformed or improper surface finish on the Low and Reverse Clutch Plates (449-453)
Case Cover Assembly (403)	• Inspect for disengaged or broken Low and Reverse Clutch Piston Spring Retainer (410) • Inspect for worn, damaged or debonding Low and Reverse Clutch Piston Seals (408) • Inspect for broken or deformed Low and Reverse Clutch Piston (408) • Inspect for improperly position or too large bleed hole in Low and Reverse Piston (408) • Inspect for porosity or improper finish on the Case Cover

NO FIRST, SECOND, THIRD, AND FOURTH GEAR

No First, Second, Third, and Fourth Gear

Checks	Causes
1-2-3-4 Clutch Assembly	• Inspect for damaged or worn 1-2-3-4 clutch plates (456-458). • Inspect for damaged or broken 1-2-3-4 clutch piston (461) and piston seals damaged, worn or delaminating • Inspect for broken or binding 1-2-3-4 clutch piston return spring (460) • Inspect for broken or disengaged 1-2-3-4 clutch piston return spring retainer (459)
Output Sun Gear Assembly (457)	Inspect for stripped or sheared splines on the Output Sun Gear shell
Reaction Carrier Assembly (467)	• Inspect for stripped or sheared splines on the Input Ring Gear • Inspect for disengaged or broken Input Ring Gear Retainer
Output Carrier Assembly (474)	• Low/Reverse Clutch Assembly (OWC) (455) splines sheared or broken • Inspect for disengaged or broken Reaction Ring Gear Retainer

NO SECOND AND SIXTH GEAR

No Second and Sixth Gear

Checks	Causes
2-6 Clutch Assembly	• Inspect for damaged or worn 2-6 Clutch Plates (445-447) • Inspect for damaged, worn, broken, improper surface finish or sheared splines on the 2-6 clutch backing plate (448) • Inspect for damaged or broken 2-6 clutch piston (405) and piston seals damaged, worn or delaminating • Inspect for broken or binding 2-6 clutch piston return spring (406) • Inspect for broken or disengaged 2-6 Clutch Piston Return Spring Retainer (407)
Reaction Carrier Assembly (467)	• Inspect for stripped or sheared splines on the Input Ring Gear • Inspect for disengaged or broken Input Ring Gear Retainer

HARSH OR LATE FIRST, SECOND, THIRD, AND FOURTH SHIFT

Harsh or Late First, Second, Third, and Fourth Shift

Checks	Causes
1-2-3-4 Clutch Assembly	• Inspect for damaged or broken 1-2-3-4 Clutch Piston (461) and piston seals damaged, worn or leaking • Inspect for fatigued or binding 1-2-3-4 Clutch Piston Return Spring (460)

	• Inpsect for improper surface finish on 1-2-3-4 Clutch Plates (456-458)
Case Cover Assembly (403)	Inspect for leaking or loose fitting blow off valve

HARSH FIRST AND REVERSE SHIFT

Harsh First and Reverse Shift

Checks	Causes
Case Cover Assembly (403)	Inspect for plugged or improperly positioned Low & Reverse Piston (408) air bleed
Low and Reverse Clutch	Inspect for improper surface finish on Low & Reverse Clutch Plates (449-453)

NO THIRD, FIFTH, AND REVERSE GEAR

No Third, Fifth, and Reverse Gear

Checks	Causes
3-5-Reverse Clutch Assembly	• Inspect for damaged, worn or stripped splines on 3-5-Reverse Clutch Plates (423-426), Backing Plate (426) • Inspect for sheared or stripped splines on 3-5-Rev/4-5-6 Housing to Turbine Shaft (422) • Inspect for damage, improper surface finish, porosity, deformed or unbalanced 3-5-Rev/4-5-6 Housing (422) • Inspect for damaged, worn, loose or seized hub bushing in the 3-5-Rev/4-5-6 Housing • Inspect for broken, porous or improper surface finish or plugged oil passages of the 3-5-Rev/4-5-6 Housing (422) • Inspect for failure of the Input Shaft Thrust Bearing (32) • Inspect for disengaged or broken 3-5-Reverse Clutch Backing Plate Retainer (427) • Inspect for damaged, worn or leaking 3-5-Reverse Clutch Piston Seals (419-421) • Inspect for damaged or broken 3-5-Rev/4-5-6 Clutch Housing (422) • Inspect for warped, damaged, improper surface finish or debonding 3-5-Reverse Clutch Piston (417) • Inspect for broken or fatigued 3-5-Reverse Clutch Spring (418) • Inspect for disengaged or broken Speed Sensor Reluctor Retainer (415) • Inspect for broken Speed Sensor Reluctor Wheel (416) • Inspect for seized Input Shaft Thrust Bearing (32)

Reaction Carrier (467)	• Inspect for broken or disengaged Input Internal Gear Retainer • Inspect for stripped or sheared splines on the Input Internal Gear
Output Carrier (474)	Inspect for stripped or sheared splines for the Reaction Internal Ring Gear
4-5-6 Clutch Assembly	• Inspect for plugged or missing 4-5-6 Piston Dam Oil Feed hole • Inspect for leaking 4-5-6 Piston Dam

HARSH OR LATE SECOND AND SIXTH SHIFT

Harsh or Late Second and Sixth Shift

Checks	Causes
2-6 Clutch Assembly	• Inspect for worn or improper surface finish on the 2-6 Clutch Plates (446, 447) and Backing Plate (448) • Inspect for fatigued 2-6 Clutch Piston Cushion Spring (445)
Case Cover Assembly (403)	• Inspect for damaged or broken 2-6 Clutch Piston (405) and piston seals damaged, worn or delaminating • Inspect for fatigued 2-6 Clutch Piston Return Spring (406)

NO FOURTH, FIFTH, AND SIXTH GEAR

No Fourth, Fifth, and Sixth Gear

Checks	Causes
4-5-6 Clutch Assembly	• Inspect for damaged or broken 4-5-6 Clutch Piston (433) and Piston Seals (430-432) • Inspect for broken or disengaged 4-5-6 Backing Plate Retainer (442) • Inspect for damaged or broken 4-5-6 Clutch Dam Piston (435) and piston seals damaged, worn or delaminating • Inspect for broken or disengaged 4-5-6 Clutch Dam Retainer (436) • Inspect for sheared or stripped splines on the Reaction Carrier Hub (438) • Inspect for sheared or stripped splines on 3-5-Rev/4-5-6 Housing to Turbine Shaft (422) • Inspect for loose, worn or damaged 3-5-Rev/4-5-6 Housing Bushing • Inspect for broken, porous or improper surface finish or plugged oil passages of the 3-5-Rev/4-5-6 Housing (422) • Inspect for failure of the Input Shaft Thrust Bearing (32)

HARSH OR LATE THIRD, FIFTH, AND REVERSE SHIFT

Harsh or Late Third, Fifth, and Reverse Shift

Checks	Causes
3-5-Reverse Clutch Assembly	• Inspect for improper surface finish on 3-5-Reverse Clutch Plates (423-426), Backing Plate (426) • Inspect for plugged or restricted oil passages and air bleed of the 3-5-Rev/4-5-6 Housing (422) • Inspect for damaged, worn or leaking 3-5-Reverse Clutch Piston Seals (419-421) • Inspect for warped 3-5-Rev/4-5-6 Clutch Housing (422) • Inspect for fatigued 3-5-Reverse Clutch Waved Plate (423)

HARSH FOURTH, FIFTH, AND SIXTH SHIFT

Harsh Fourth, Fifth, and Sixth Shift

Checks	Causes
4-5-6 Clutch Assembly	• Inspect for leaking 4-5-6 Clutch Piston (433) and Piston Seals (430-432) • Inspect for plugged or restricted 4-5-6 Piston Dam air bleed • Inspect for fatigued 4-5-6 Clutch Piston Spring (434) • Inspect for leaking 4-5-6 Clutch Dam Seals (435) • Inspect for improper surface finish on 4-5-6 Clutch Plates (439-441) • Inspect for porous, improper surface finish, seal groove damage or plugged or restricted oil passages of the 3-5-Rev/4-5-6 Housing (422)

NO TORQUE CONVERTER CLUTCH APPLY

No Torque Converter Clutch Apply

Checks	Causes
Torque Converter Assembly (27)	• Inspect for damaged Torque Converter Clutch Seal (inside converter assembly) • Diagnose Torque Converter Assembly for possible internal damage
Upper Valve Body Assembly (349)	Inspect for worn, damaged or sticking TCC Regulator Apply (330) and TCC Regulator Apply Shuttle (331) Valves
Transfer Drive Gear Support Assembly (208)	Inspect for worn or damaged Transfer Drive Gear Support Seal (213)
Torque Converter Housing Assembly (221)	Inspect for worn or damaged Torque Converter Fluid Seal Assembly (225)

NO TORQUE CONVERTER CLUTCH RELEASE

No Torque Converter Clutch Release

Checks	Causes
Torque Converter Assembly (27)	Diagnose Torque Converter Assembly for possible internal damage
Upper Valve Body Assembly (349)	Inspect for worn, damaged or sticking TCC Regulator Apply (330) and TCC Regulator Apply Shuttle (331) Valves

HARSH TORQUE CONVERTER CLUTCH APPLY, OR INOPERATIVE OR NO ELECTRONICALLY CONTROLLED CAPACITY CLUTCH CONTROL

Harsh Torque Converter Clutch Apply, or Inoperative or No Electronically Controlled Capacity Clutch Control

Checks	Causes
Torque Converter Assembly (27)	Inspect for leaking or damaged Torque Converter Clutch Hub Seal
Drive Gear Support Assembly (208)	Inspect for leaking Drive Gear Support Seal (213)

NO REVERSE GEAR

No Reverse Gear

Checks	Causes
3-5-Reverse Clutch Assembly	• Inspect for damaged, worn or stripped splines on 3-5-Reverse Clutch Plates (423-426), Backing Plate (426) • Inspect for sheared or stripped splines on 3-5-Rev/4-5-6 Housing to Turbine Shaft (422) • Inspect for damage, improper surface finish, porosity, deformed or unbalanced 3-5-Rev/4-5-6 Housing (422) • Inspect for damaged, worn, loose or seized hub bushing in the 3-5-Rev/4-5-6 Housing • Inspect for broken, porous or improper surface finish or plugged oil passages of the 3-5-Rev/4-5-6 Housing (422) • Inspect for failure of the Input Shaft Thrust Bearing (32) • Inspect for disengaged or broken 3-5-Reverse Clutch Backing Plate Retainer (427) • Inspect for damaged, worn or leaking 3-5-Reverse Clutch Piston Seals (419-421) • Inspect for damaged or broken 3-5-Rev/4-5-6 Clutch Housing (422) • Inspect for warped, damaged, improper surface finish or debonding 3-5-Reverse Clutch Piston (417) • Inspect for broken or fatiqued 3-5-Reverse Clutch Spring (418) • Inspect for disengaged or broken Speed Sensor Reluctor

	Retainer (415) • Inspect for broken Speed Sensor Reluctor Wheel (416) • Inspect for seized Input Shaft Thrust Bearing (32)

FLUID PRESSURE HIGH OR LOW

Fluid Pressure High or Low

Checks	Causes
Fluid Pump Assembly (203)	• Inspect for loose Fluid Pump Bolts (204) • Inspect for leaking or damaged Fluid Pump Outlet Seals (57) and Oil Filter Seal (202) • Inspect for improperly installed or damaged Oil Filter (201) • Inspect for sticking Line Pressure Blow Off Valve
Front Differential Drive Gear Support Assembly (208)	• Inspect for leaking or damaged Drive Gear Support Torque Converter Seal Assembly (206) or Fluid Passage Tube Gasket (212) • Inspect for leaking or damaged Drive Gear Support Fluid Passage Tube Assembly (209)
Upper Valve Body Assembly (312)	• Inspect for leaking or damaged Upper Valve Body Assembly (309) Gasket • Inspect for worn, sticking or damaged Pressure Regulator Valve (337) or Pressure Regulator Valve Spring (338)
Lower Valve Body Assembly (313)	Inspect for leaking or damaged Lower Valve Body Assembly (313) Gasket
Control Valve (w/Body & TCM) Valve Assembly (15)	Inspect for leaking or damaged Filter Plate Assembly Seals (16)
Case Assembly (51)	Inspect for missing Lube Oil Circuit Orifice or Baffle (229)

ON-VEHICLE REPAIR INSTRUCTIONS

MANUAL SHIFT DETENT LEVER AND SHAFT POSITION SWITCH ASSEMBLY REPLACEMENT

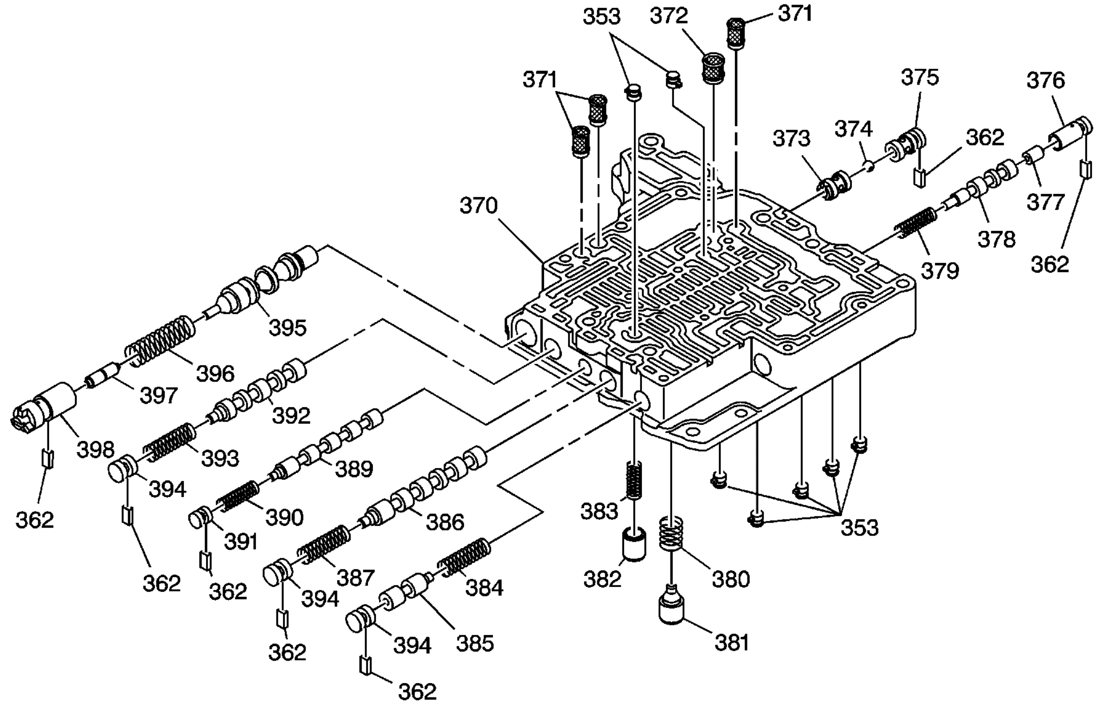

Fig. 14: Identifying Manual Shift Detent Lever & Shaft Position Switch Assembly
Courtesy of GENERAL MOTORS CORP.

Manual Shift Detent Lever and Shaft Position Switch Assembly Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the transmission range selector lever. Refer to **Automatic Transmission Range Selector Lever Replacement**. 2. Remove the lower control valve body. Refer to **Control Valve Lower Body and Upper Body Replacement**.	
1	Manual Shaft Detent Lever Pin **NOTE:** **Use J 41229 to install the manual shaft pin at the correct height in order to properly secure the manual shaft. If you install the pin too deep, the case bore may crack.** **Tip:** • Use a small nail puller to remove the pin. Discard the pin. It is not reusable. • Use **J 41229** Manual Shaft Pin Installer to install the pin. Inspect that the pin installed height is within 6.5 mm-7.5 mm (0.25 in-0.30 in).

2	Manual Shaft Detent Lever Assembly (w/Shift Position Switch) **Tip:** Do not pull the park actuator rod end out beyond the machined oil passage surface in the case. A no park condition will exist if the park pawl actuator assembly is pulled out of the transmission too far and the actuator rod disengages from the park pawl. The transmission assembly will require disassembly to re-install the actuator rod over the park pawl. **Procedure** • Removal: partly lower the manual shaft detent lever assembly (w/shift position switch) in order to rotate the detent lever and disconnect the park actuator rod. Then fully remove the manual shaft detent lever assembly from the transmission case. • Installation: partly install the manual shaft detent lever assembly (w/shift position switch). Rotate the detent lever and connect the park actuator rod. Then fully install the manual shaft detent lever assembly in the transmission case. • Lubricate the manual shaft with automatic transmission fluid (ATF) to prevent damage to the manual shift shaft seal.

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

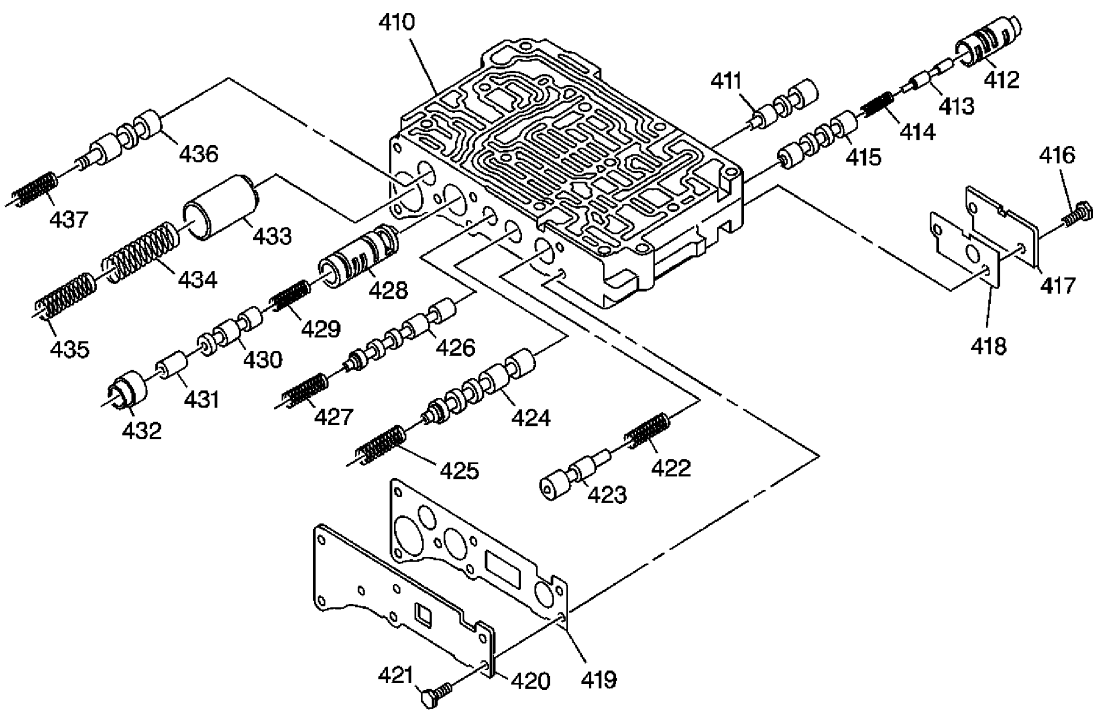

Fig. 15: Floor Shift Control Knob
Courtesy of GENERAL MOTORS CORP.

Transmission Control Lever Knob Replacement

Callout	Component Name

1	Shift Control Knob Retaining Screw. **NOTE:** **Refer to Fastener Notice .** **Tighten:** 4 N.m (35 lb in).
2	Shift Control Knob.

AUTOMATIC TRANSMISSION CONTROL INDICATOR REPLACEMENT

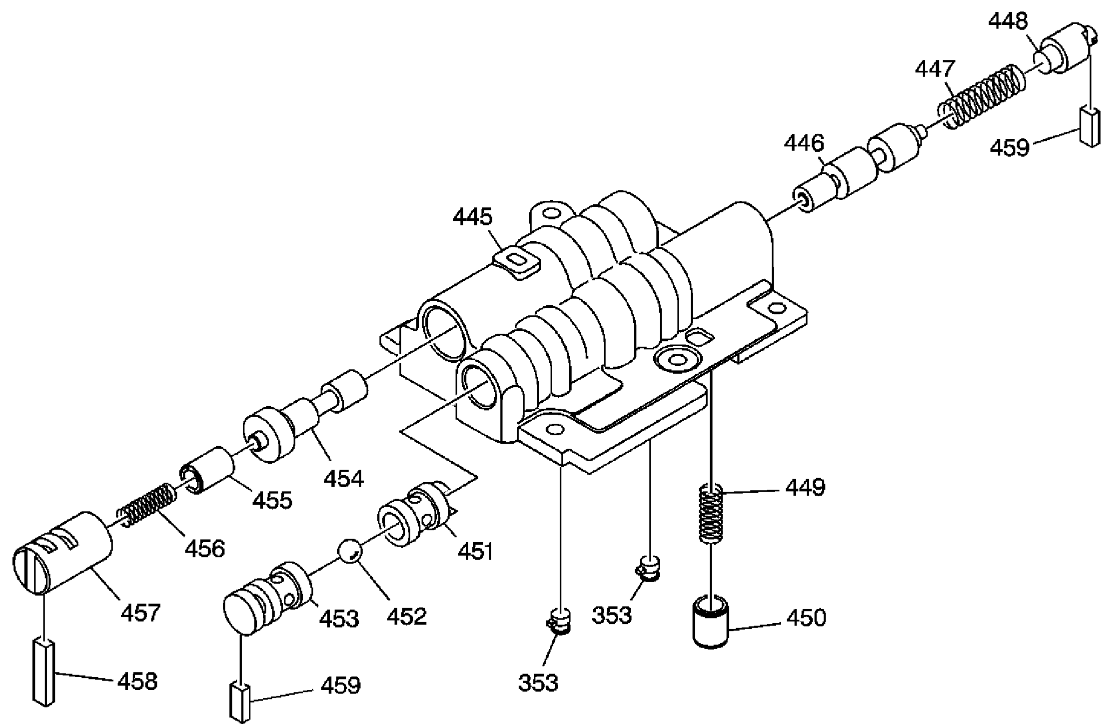

Fig. 16: Automatic Transmission Control Indicator
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Control Indicator Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the console. Refer to **Console Replacement** . 2. Remove the automatic transmission shift control. Refer to **Automatic Transmission Control Replacement**.	
1	Shift Control Knob Retaining Screw **NOTE:**

	Refer to Fastener Notice . **Tighten:** 4 N.m (35 lb in)
2	Shift Control Knob
3	Automatic Transmission Shift Control Indicator Lamp
4	Automatic Transmission Shift Control Indicator

AUTOMATIC TRANSMISSION MANUAL SHIFT AUXILIARY POSITION SWITCH REPLACEMENT

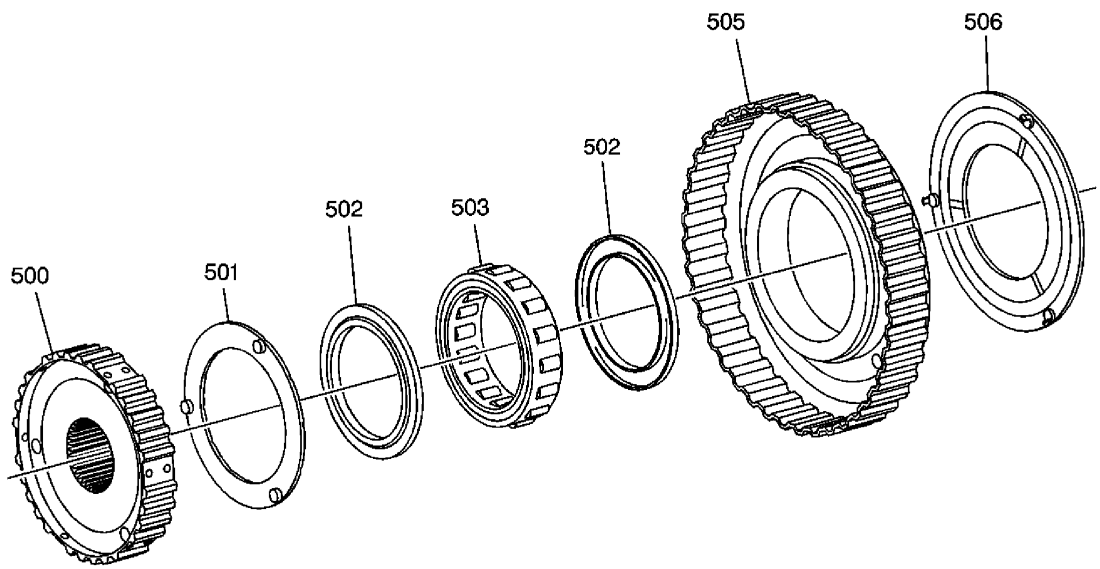

Fig. 17: View Of Manual Shift Auxiliary Position Switch & Screw
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Manual Shift Auxiliary Position Switch Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the inflatable restraint steering wheel module. Refer to **Inflatable Restraint Steering Wheel Module Replacement** . 2. Remove the steering wheel control switches. Refer to **Steering Wheel Control Switch Assembly Replacement** .	
1	Manual Shift Position Switch Screw (Qty: 4) **NOTE:** **Refer to Fastener Notice .**

	Tip: Remove the manual shift position switch screws. **Tighten:** 3.5 N.m (31 lb in)
2	Manual Shift Position Switch (Qty: 2) **Tip:** Disconnect the electrical connectors from the from the switches.

PARK LOCK CABLE REPLACEMENT

Removal Procedure

1. Disable the supplemental inflatable restraint (SIR) system. Refer to **SIR Disabling and Enabling** .
2. Remove the console. Refer to **Console Replacement** .
3. Place the transmission shift control lever in the PARK position.

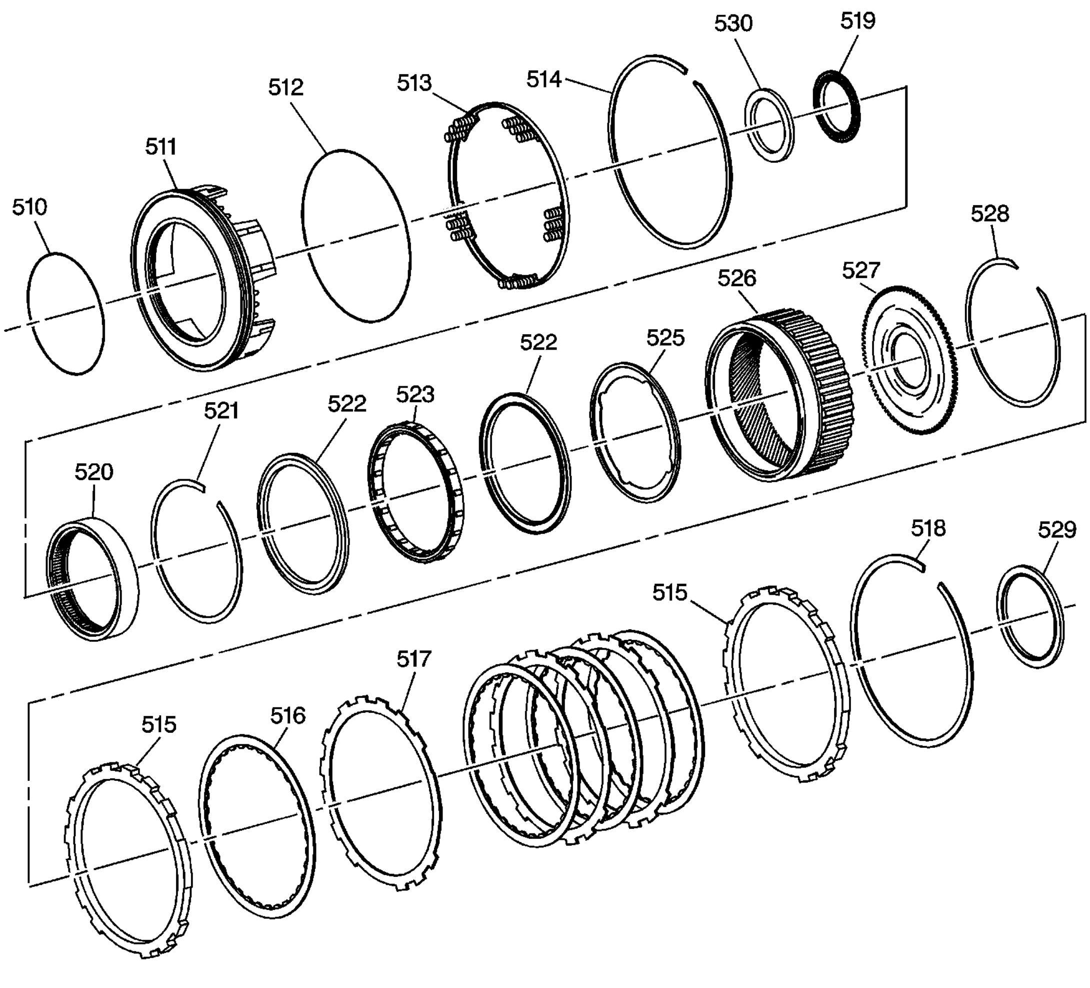

Fig. 18: View Of Park Lock Cable End And Retainer
Courtesy of GENERAL MOTORS CORP.

4. Remove the park lock cable end (1)from the park lock lever by sliding the cable end reward off the park lock lever pin.
5. Release the park lock cable retainer (2) from the shift control base.
6. Remove the knee bolster. Refer to **Knee Bolster Replacement** .
7. Turn the ignition key to the RUN position.

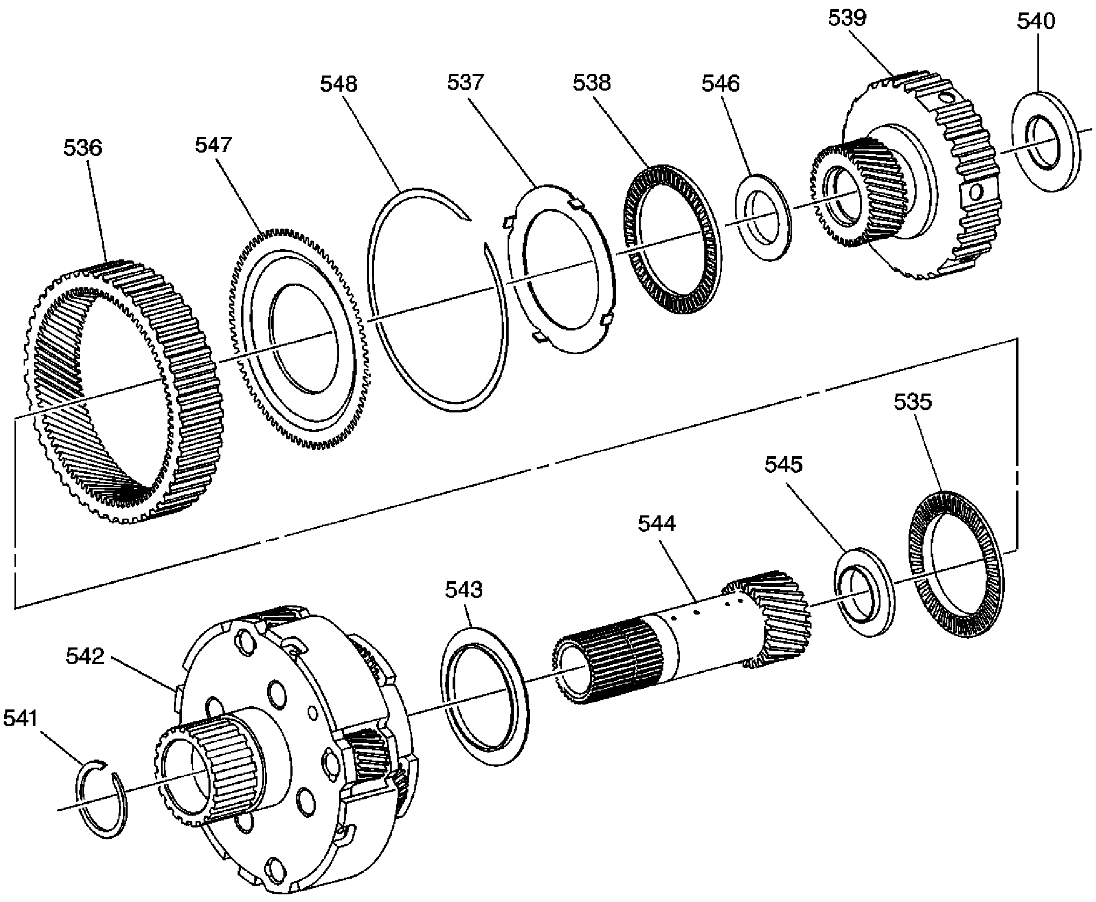

Fig. 19: Identifying Cable Latch
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the ignition key is in the RUN position. Do NOT attempt to remove the park lock cable with the key in any other position.

8. Using a screwdriver, release the cable from the ignition switch inhibitor by depressing the cable latch (1).
9. Remove the park lock cable from the inhibitor housing.
10. Remove the park lock cable from the vehicle.

Installation Procedure

1. Install the park lock cable to the vehicle.

2. Ensure the shift lever is in the PARK position.
3. Ensure that the ignition key is in the RUN position.

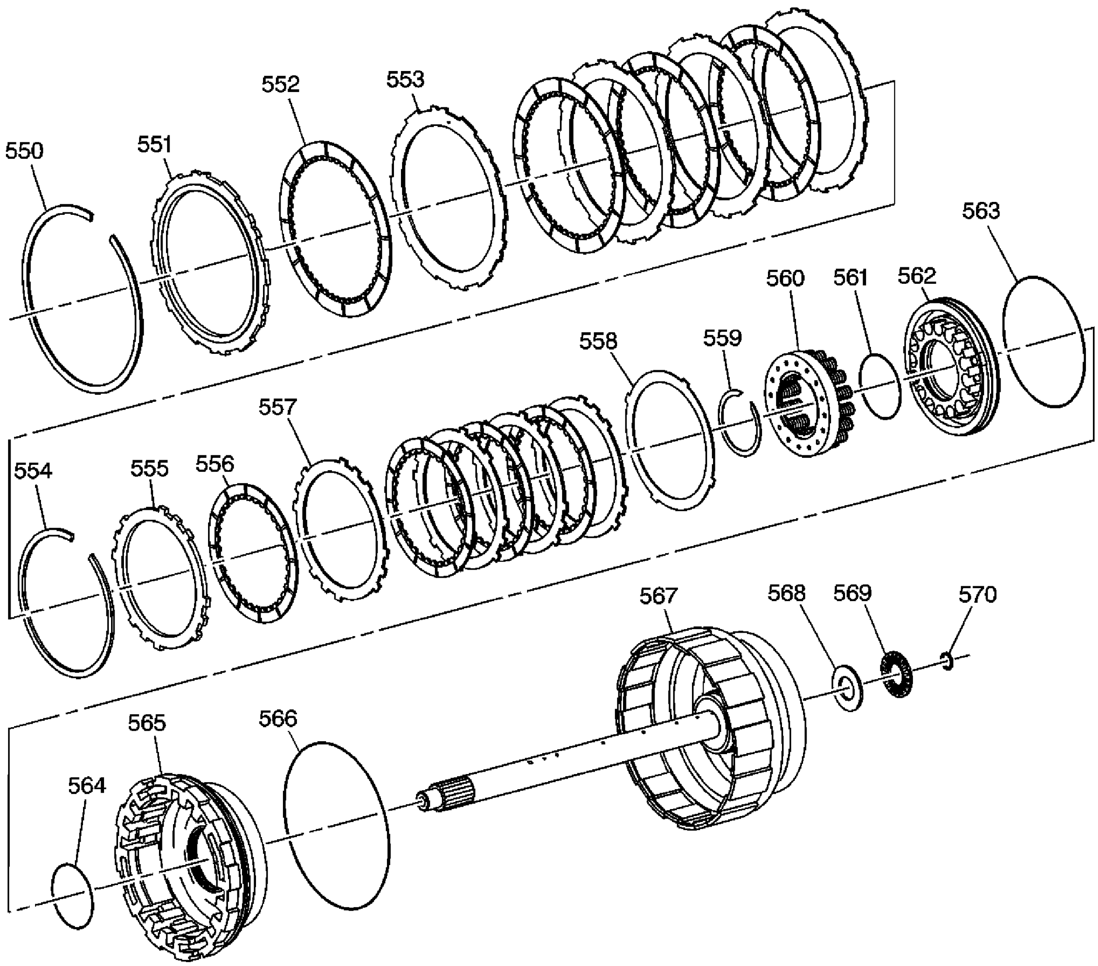

Fig. 20: Identifying Park Lock Cable & Inhibitor Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the ignition key is in the RUN position. Do not attempt to insert the park lock cable with the key in any other position.

4. Install the cable (1) into the inhibitor housing.
5. Turn key to LOCK position.

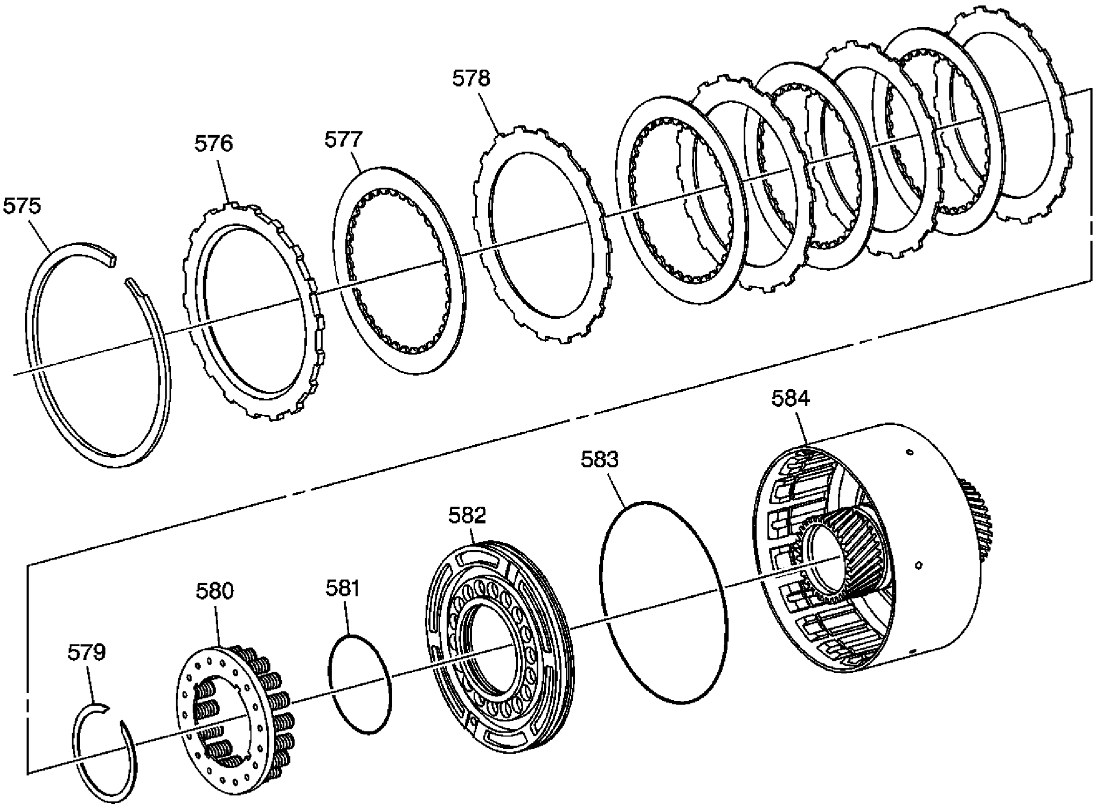

Fig. 21: View Of Park Lock Cable End And Retainer
Courtesy of GENERAL MOTORS CORP.

6. Attach the park lock cable to the shift control base. Ensure the park lock cable retainer (2) is fully secured to the shift control base.
7. Install the park lock cable on the park lock lever by sliding the cable end (1) over the park lock lever pin.
8. Inspect the functional operation of the park/lock cable. Refer to **Park Lock Cable Adjustment** .
9. Install the knee bolster. Refer to **Knee Bolster Replacement** .
10. Install the console. Refer to **Console Replacement** .
11. Enable the SIR system. Refer to **SIR Disabling and Enabling** .

PARK LOCK CABLE ADJUSTMENT

1. Place the floor shift lever in the PARK position.
2. Turn the ignition key cylinder to the LOCK position.
3. If the center console is in place, remove the console. Refer to **Console Replacement** .

IMPORTANT:
- **The key must not be able to be removed from the ignition cylinder with the transmission control lever in any position other than PARK. If they key can be removed in any other position, adjustment or**

repair is necessary.

- **The shift lever must not move from park unless the key is in the ON position. If the lever can be removed from park with the key in the OFF position, adjust or repair the park lock cable.**

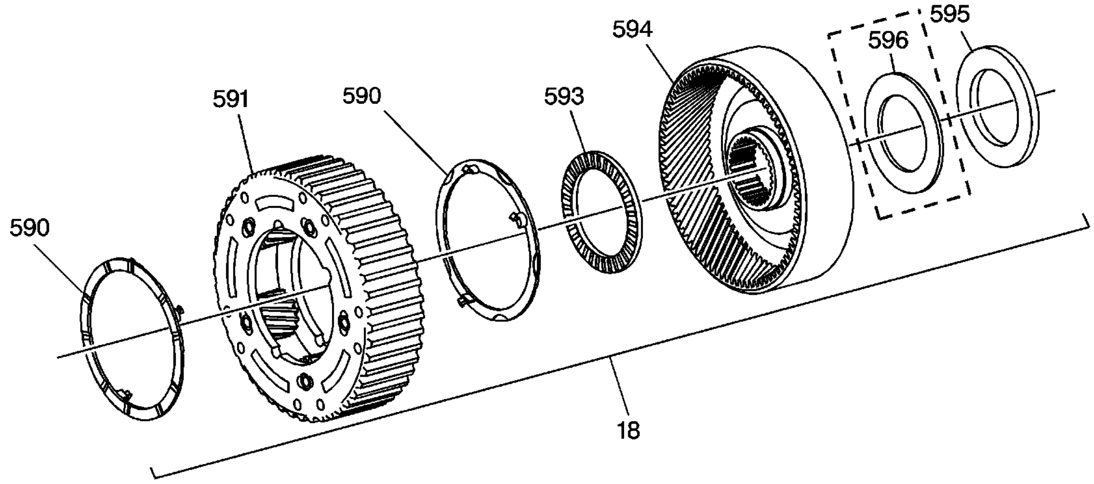

Fig. 22: Locating Park Lock Cable Adjuster
Courtesy of GENERAL MOTORS CORP.

4. While using a small screwdriver to release the adjuster lock tang, rotate the threaded cable adjuster (1) until 3 threads are showing.
5. Re-check park lock operation. If park lock does not function, fine tune the cable 1/2 turn at a time until the proper operation is achieved.

AUTOMATIC TRANSMISSION CONTROL REPLACEMENT

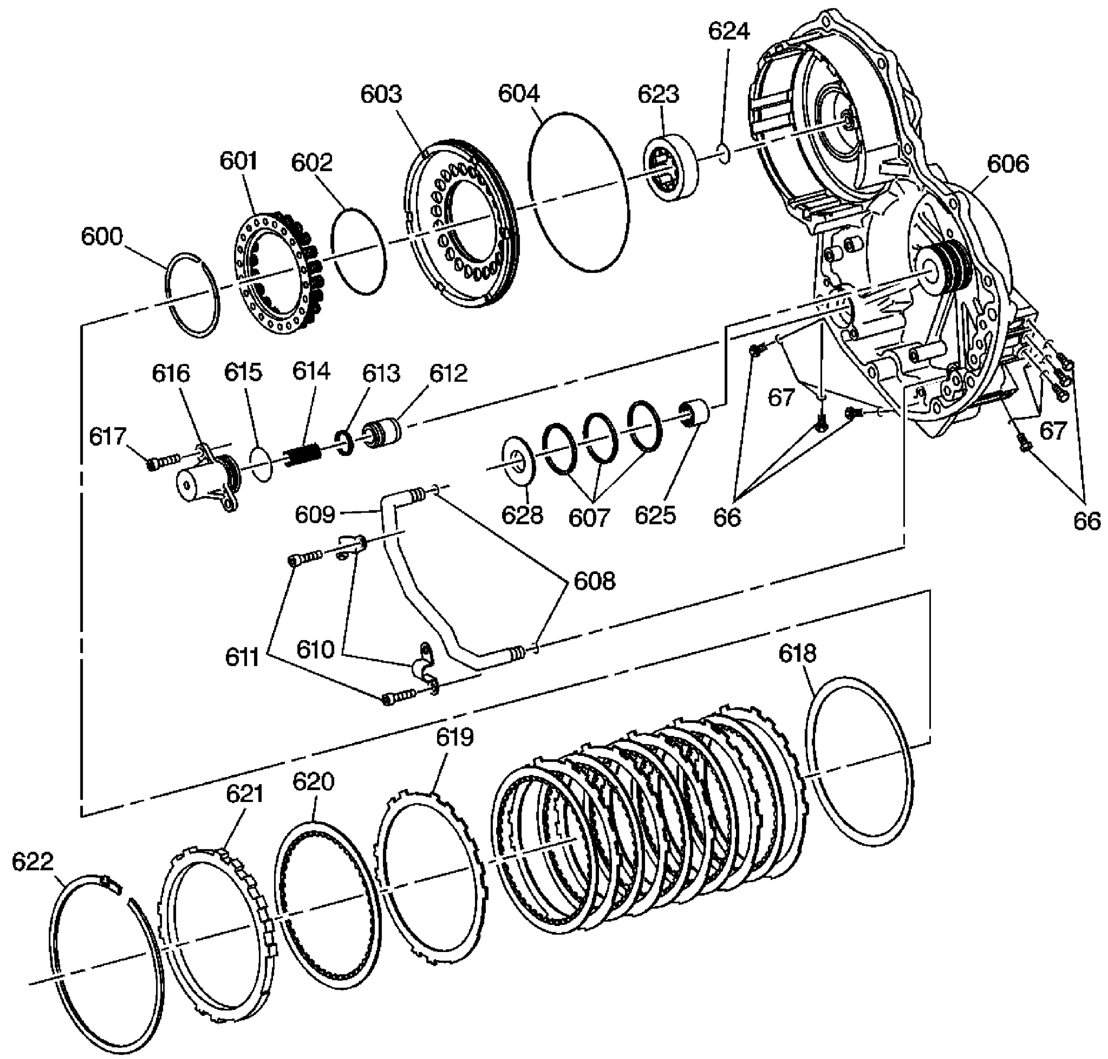

Fig. 23: Automatic Transmission Shift Control
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Control Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the console. Refer to **Console Replacement** . 2. Disconnect the park lock cable. Refer to **Park Lock Cable Replacement** . 3. Disconnect the range select lever cable. Refer to **Automatic Transmission Range Selector Lever Cable Replacement**. 4. Disconnect the shift control electrical connector.	
	Automatic transmission Shift Control Nut (Qty: 4).

1	**NOTE:** **Refer to Fastener Notice .** **Tighten:** 25 N.m (18 lb ft)
2	Automatic transmission Shift Control

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER REPLACEMENT

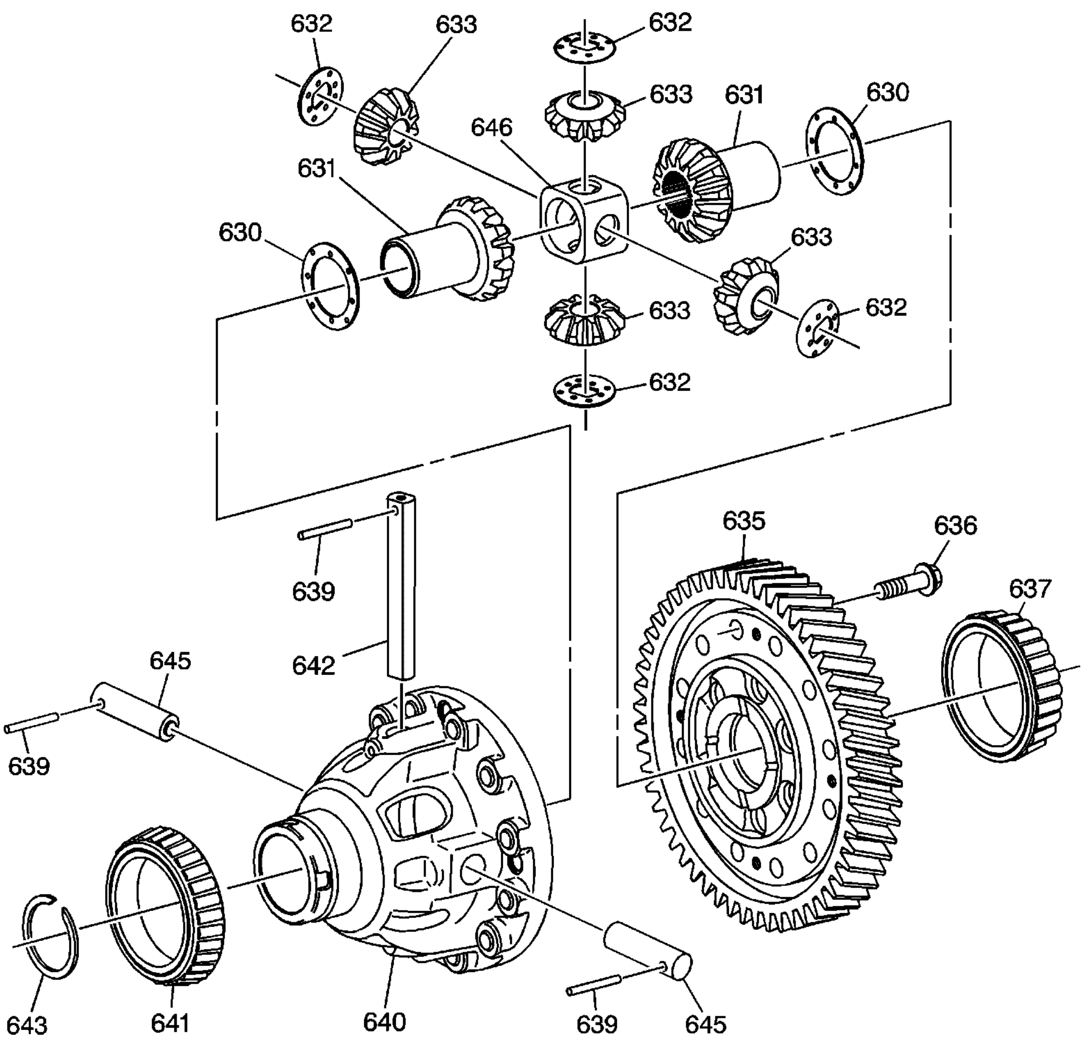

Fig. 24: Identifying A/T Range Selector Lever Components
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Range Selector Lever Replacement

Callout	Component Name
Preliminary Procedures	

1. Set the park brake and chock the wheels. 2. Disconnect the range selector cable from the range selector lever.	
1	Transmission Range Selector Lever Nut **NOTE:** **Refer to Fastener Notice .** **Tighten:** 20 N.m (15 lb ft)
2	Transmission Range Selector Lever

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE REPLACEMENT

Removal Procedure

1. Set the park brake and chock the wheels.

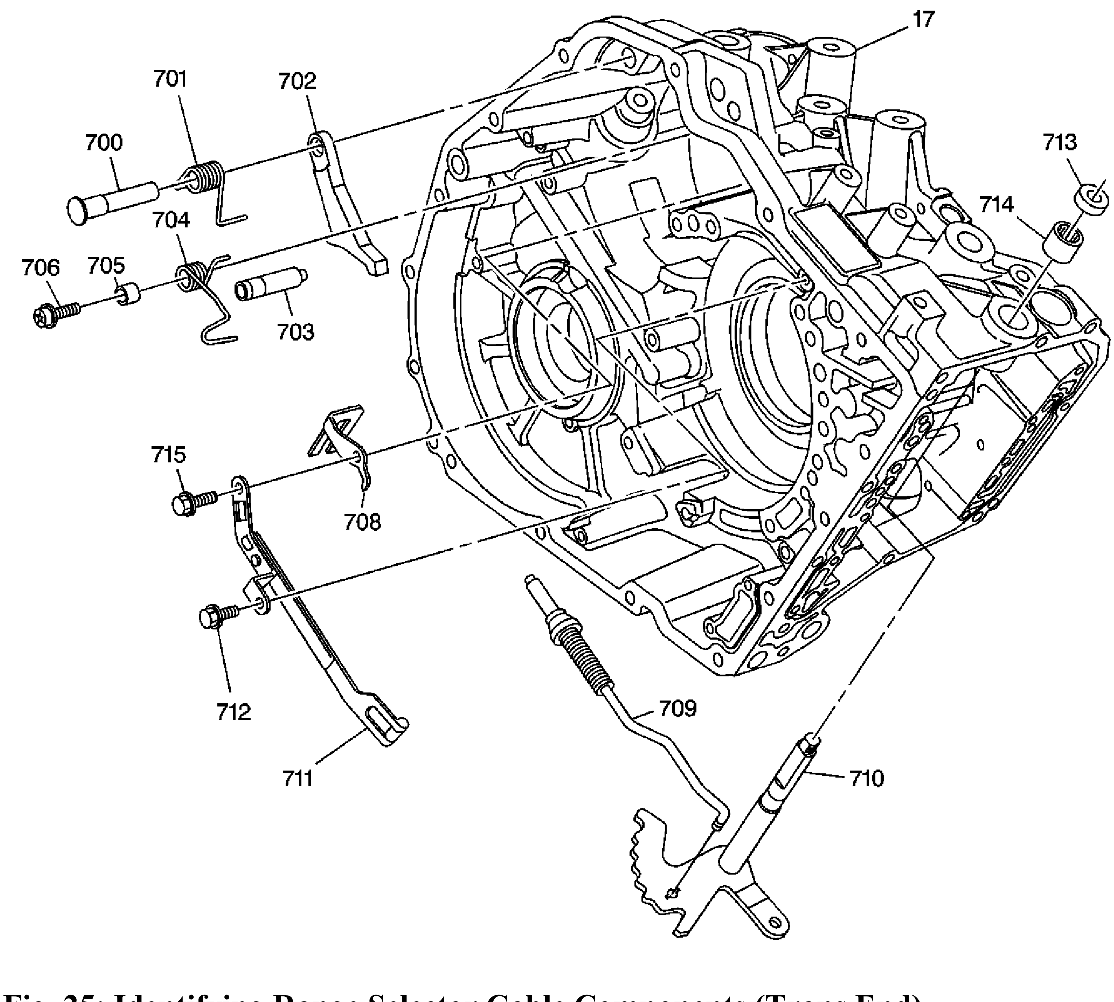

Fig. 25: Identifying Range Selector Cable Components (Trans End)
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual shift lever pin (5).
3. Remove the retainer (2) from the transmission range selector lever cable.
4. Press the locking tabs inward in order to release the transmission range selector lever cable (3) from the cable bracket (4).
5. Remove the console. Refer to **Console Replacement** .

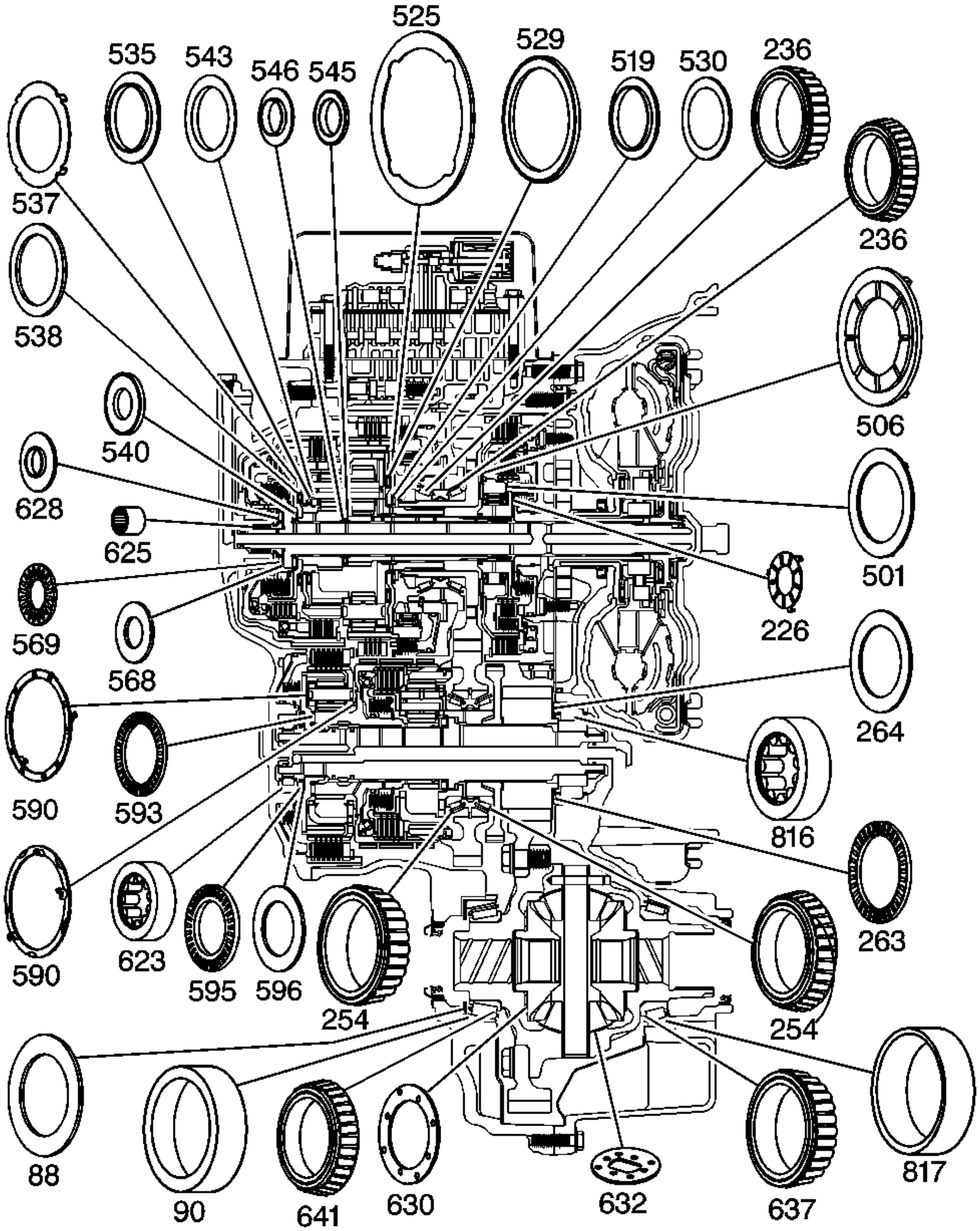

Fig. 26: View Of Shift Control Cable Terminal And Retainer
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the transmission range selector lever cable terminal (1) from the shift lever pin.
7. Release the transmission range selector lever cable retainer (2) and remove the transmission range selector cable from the transmission control lever base.

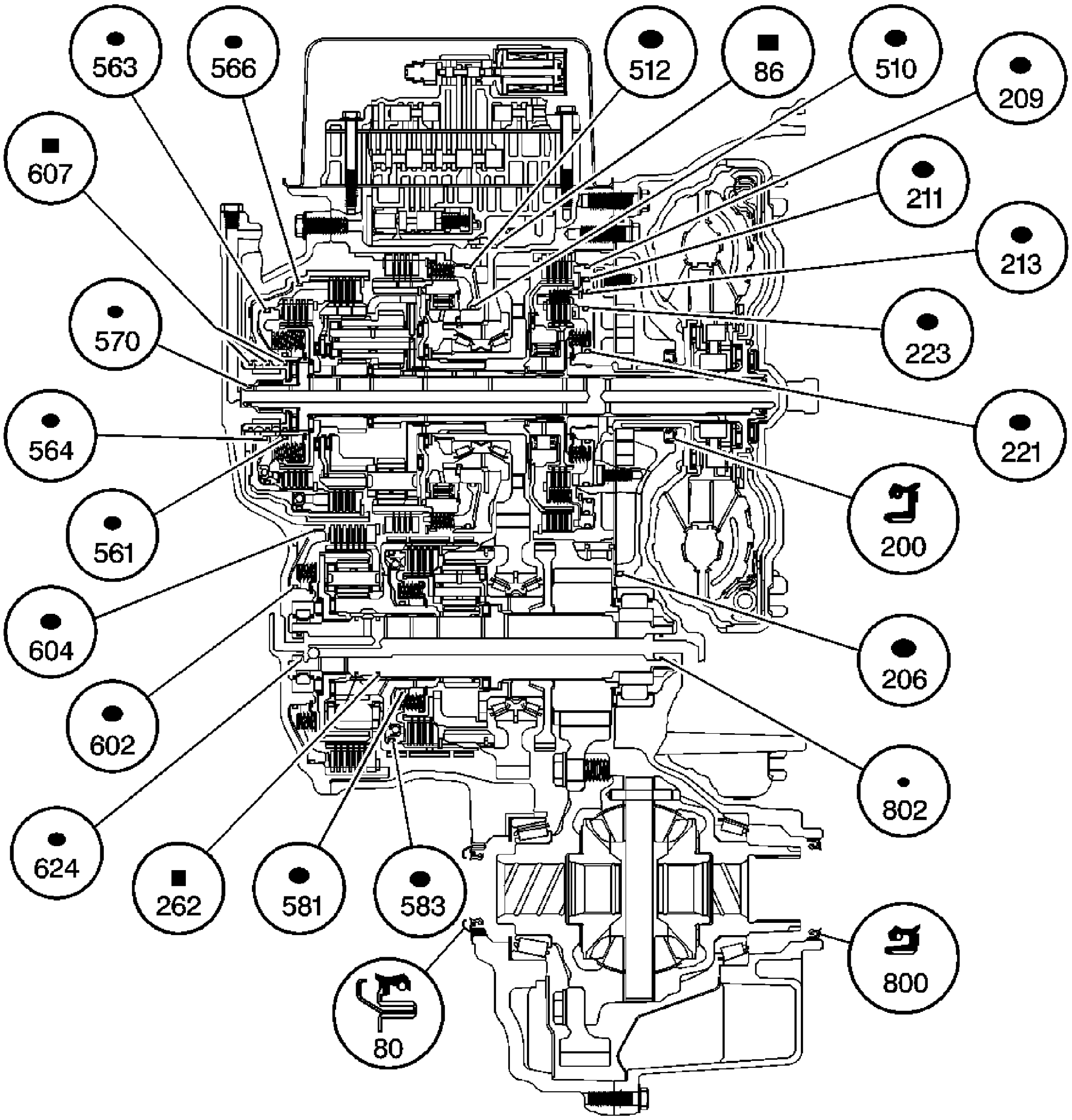

Fig. 27: Locating Grommet
Courtesy of GENERAL MOTORS CORP.

8. Remove the transmission range selector lever cable grommet (1) from the cowl panel.
9. Remove the transmission range selector lever cable from the vehicle.

Installation Procedure

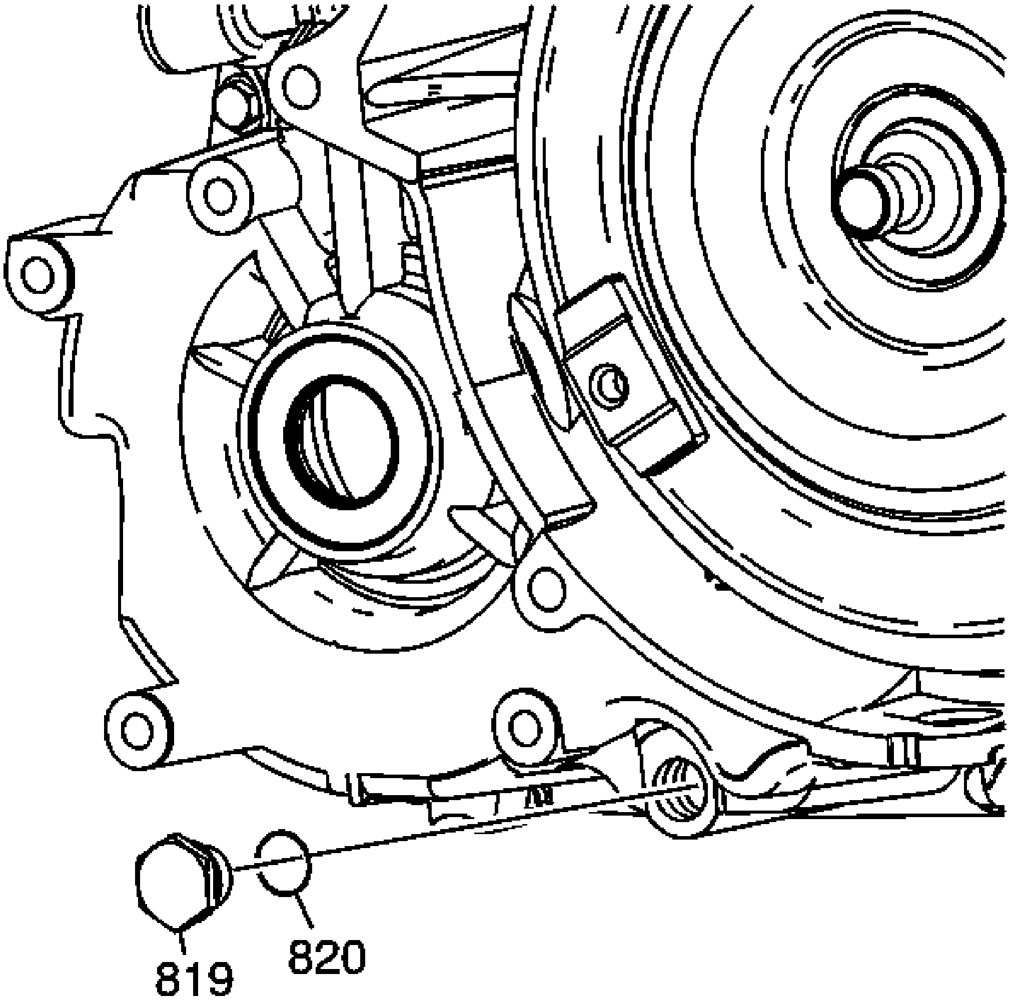

Fig. 28: Locating Grommet
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission range selector lever cable to the vehicle.
2. Install the transmission range selector lever cable grommet (1) to the cowl panel.

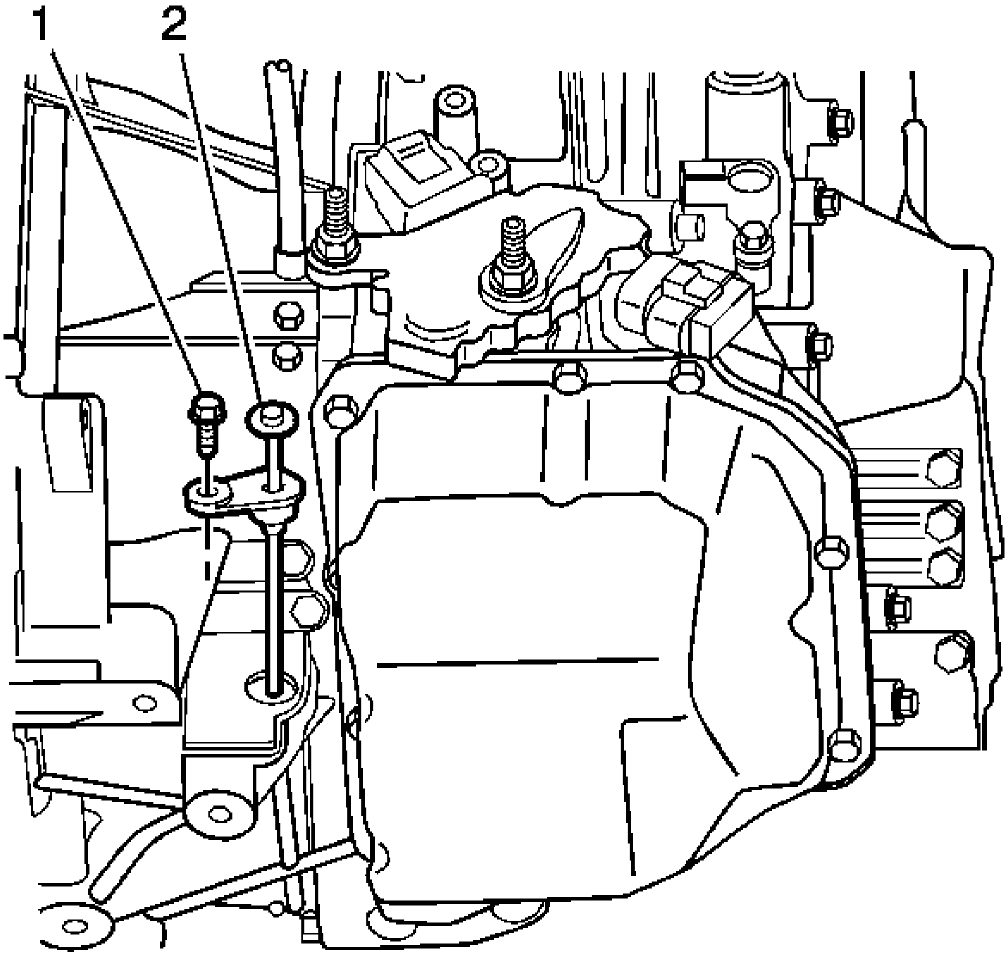

Fig. 29: View Of Shift Control Cable Terminal And Retainer
Courtesy of GENERAL MOTORS CORP.

3. Install the transmission range selector lever cable to the transmission control lever base. Insure the cable retainer (2) is fully secured to the transmission control lever base.
4. Connect the transmission range selector lever cable terminal (1) to the shift lever pin.
5. Install the console. Refer to **Console Replacement** .

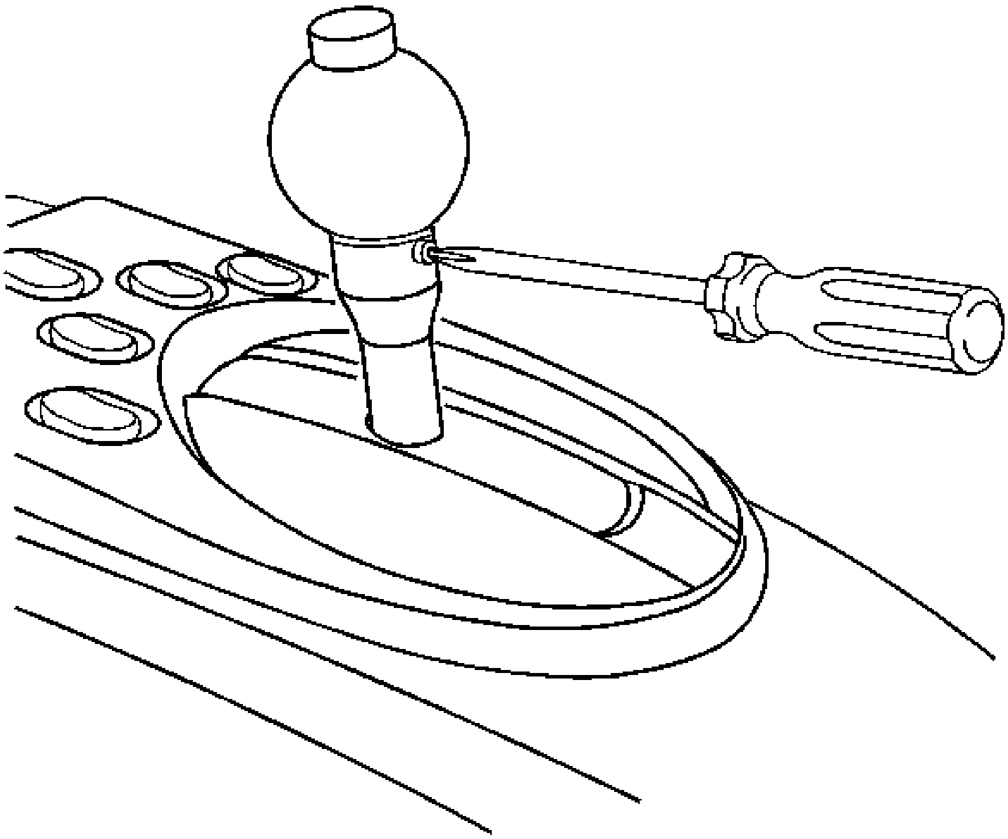

Fig. 30: Identifying Range Selector Cable Components (Trans End)
Courtesy of GENERAL MOTORS CORP.

6. Install the transmission range selector lever cable (3) to the cable bracket (4).
7. Install the retainer (2) to the transmission range selector lever cable.
8. Connect the transmission range selector lever cable terminal (1) to the transmission manual shift lever pin (5).
9. Adjust the automatic transmission range selector lever cable. Refer to **Range Selector Lever Cable Adjustment**.

RANGE SELECTOR LEVER CABLE ADJUSTMENT

CAUTION: The automatic transaxle range selector cable is made out of two cable sections. After initial connection never separate the two metal couplings from one another. Integrity of the connection of the two metal couplings will be lost if separation of the two metal couplings

occurs. When servicing the transaxle remove the cable at the automatic transaxle range selector lever and at the automatic transaxle range selector cable bracket. If either section of the cable needs to be replaced, replace both of the cable sections. Loss of connection integrity of the two metal couplings can cause loss of transaxle shift control which could result in personal injury.

IMPORTANT: Adjust the automatic transmission range selector cable while the transmission and the gear selector are in the Park position only. Failure to do so may cause mis-adjustment.

1. Set the park brake and chock the wheels.
2. Verify the transmission range select lever is in the park position.
3. Verify the transmission manual shift lever is in the park position.

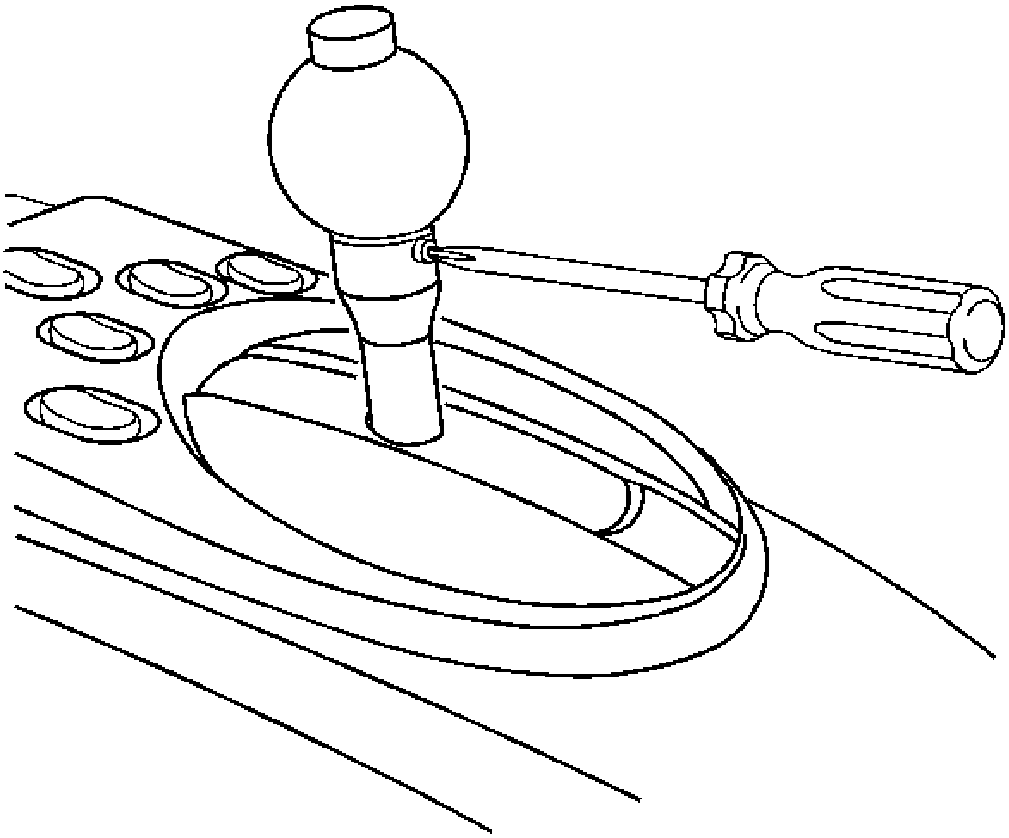

Fig. 31: Identifying Range Select Cable Adjuster Clip

Courtesy of GENERAL MOTORS CORP.

4. Release the range select cable adjuster clip.

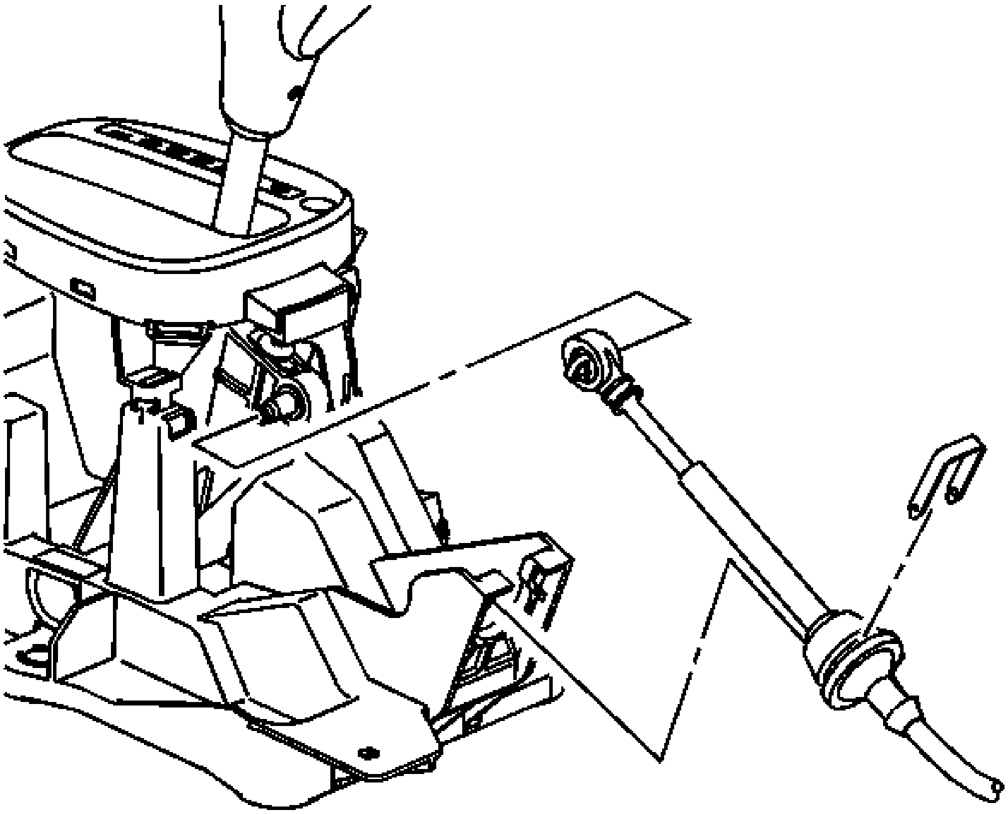

Fig. 32: View Of Two Halves Of Range Select Cable
Courtesy of GENERAL MOTORS CORP.

5. Slide the two halves of the range select cable together until all free play is removed.

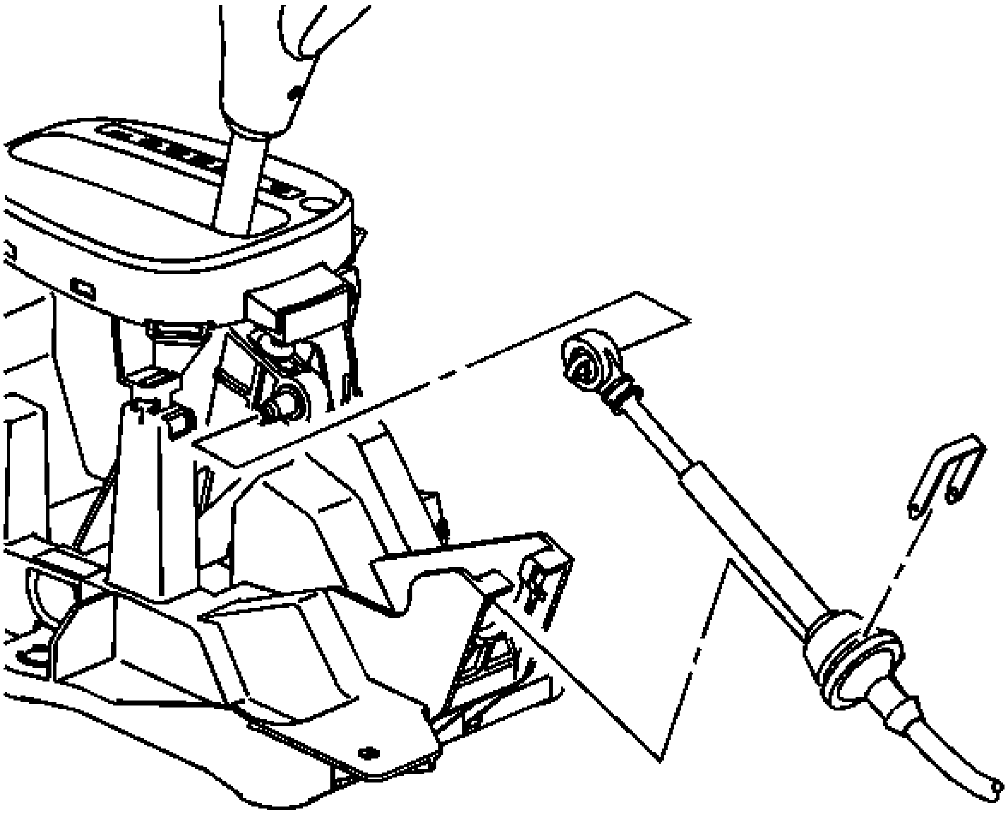

Fig. 33: Identifying Range Select Cable Adjuster Clip
Courtesy of GENERAL MOTORS CORP.

6. Depress the adjuster clip locking the adjuster clip completely.
7. Pull both halves of the range select cable in opposite directions to verify the cable adjuster is secured.
8. Check the transmission range select lever in all gear selections for proper operation.

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE BRACKET REPLACEMENT

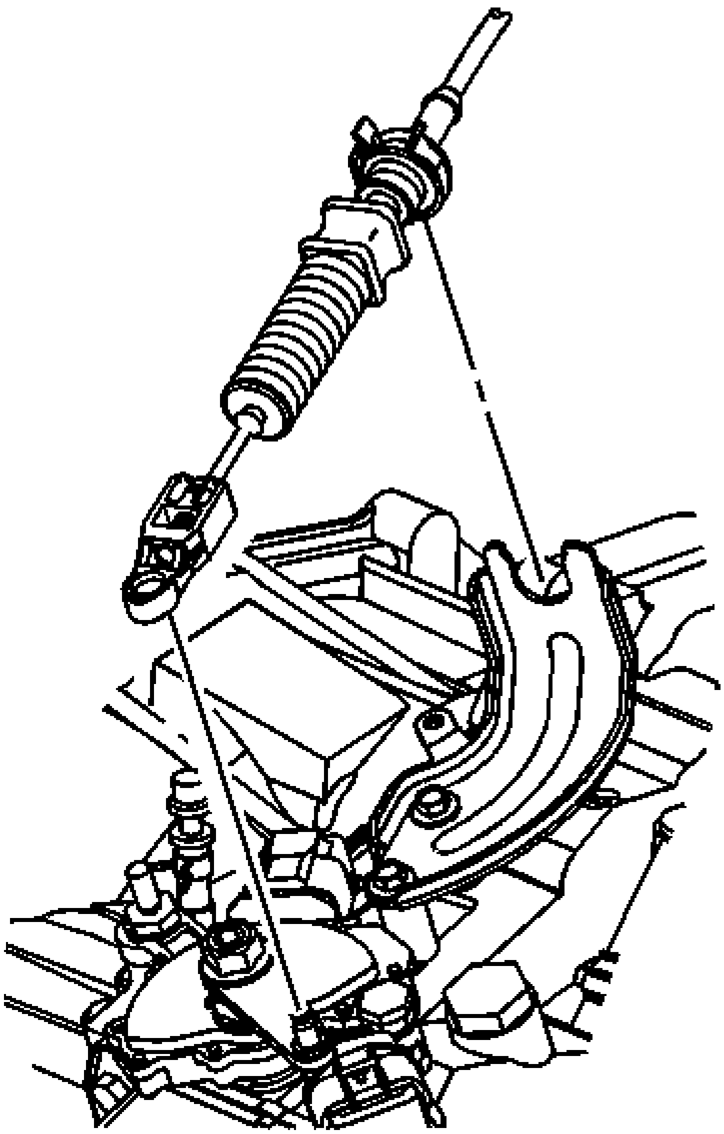

Fig. 34: View Of Automatic Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Range Selector Lever Cable Bracket Replacement

Callout	Component Name
Preliminary Procedures	

1. Set the park brake and chock the wheels.
2. Remove the battery tray. Refer to **Battery Tray Replacement (LAT)** or **Battery Tray Replacement (LZ4/LY7)** .

1	Transmission Range Selector Lever Cable Retainer
2	Transmission Range Selector Lever Cable
3	Transmission Range Selector Lever Cable Bracket Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 25 N.m (18 lb ft)
4	Transmission Range Selector Lever Cable Bracket

TRANSMISSION FLUID REPLACEMENT

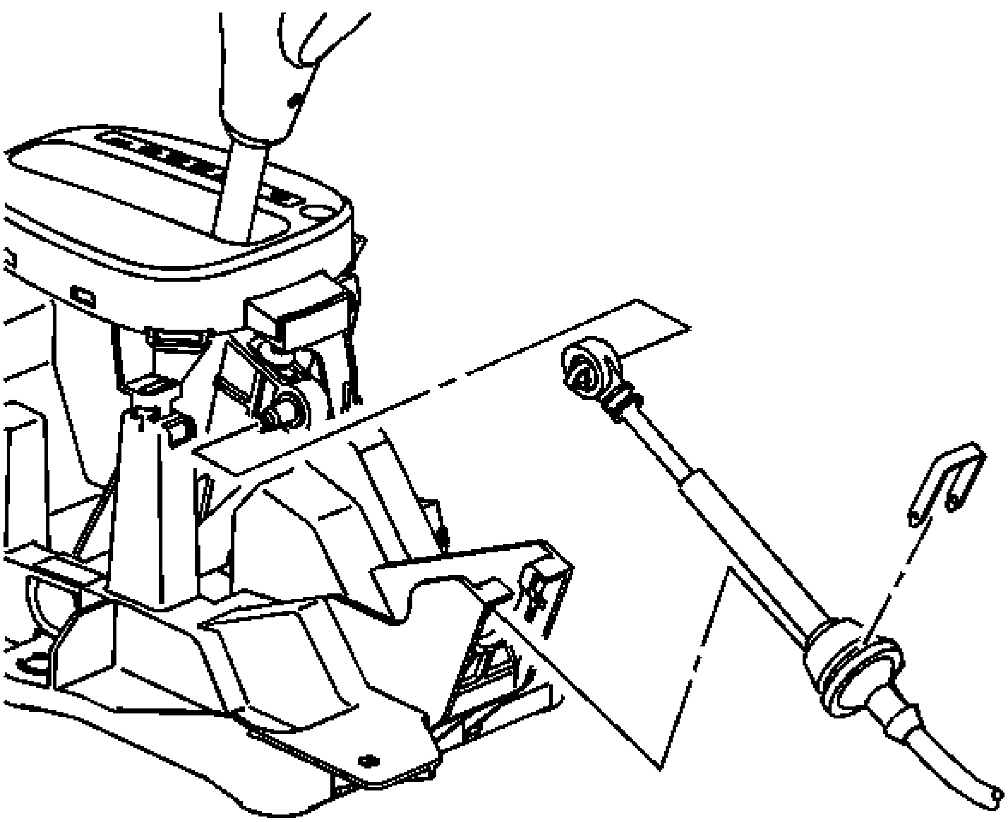

Fig. 35: Identifying Fluid Level Indicator & Drain Plug

Courtesy of GENERAL MOTORS CORP.

Transmission Fluid Replacement

Callout	Component Name
Preliminary Procedure: Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Fluid Level Hole Plug **NOTE:** **Refer to Component Fastener Tightening Notice .** **Tip:** Place a drain pan capable of containing more than 5 quarts of fluid under the transmission before removing the plug to drain the fluid. **Tighten:** 12 N.m (106 lb in)
2	Fluid Level Indicator **Tip:** • Transmission will require approximately 5 quarts of fluid. • Fill the transmission with fluid. Refer to **Transmission Fluid Check**.

TRANSMISSION FLUID COOLER PIPE CONNECTOR REPLACEMENT - RADIATOR

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling System Draining and Filling (LY7, LZ4, Static Fill)** or **Cooling System Draining and Filling (LAT Static Fill)** .
2. Remove the transaxle oil cooler hoses from the oil cooler fittings on the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection**.

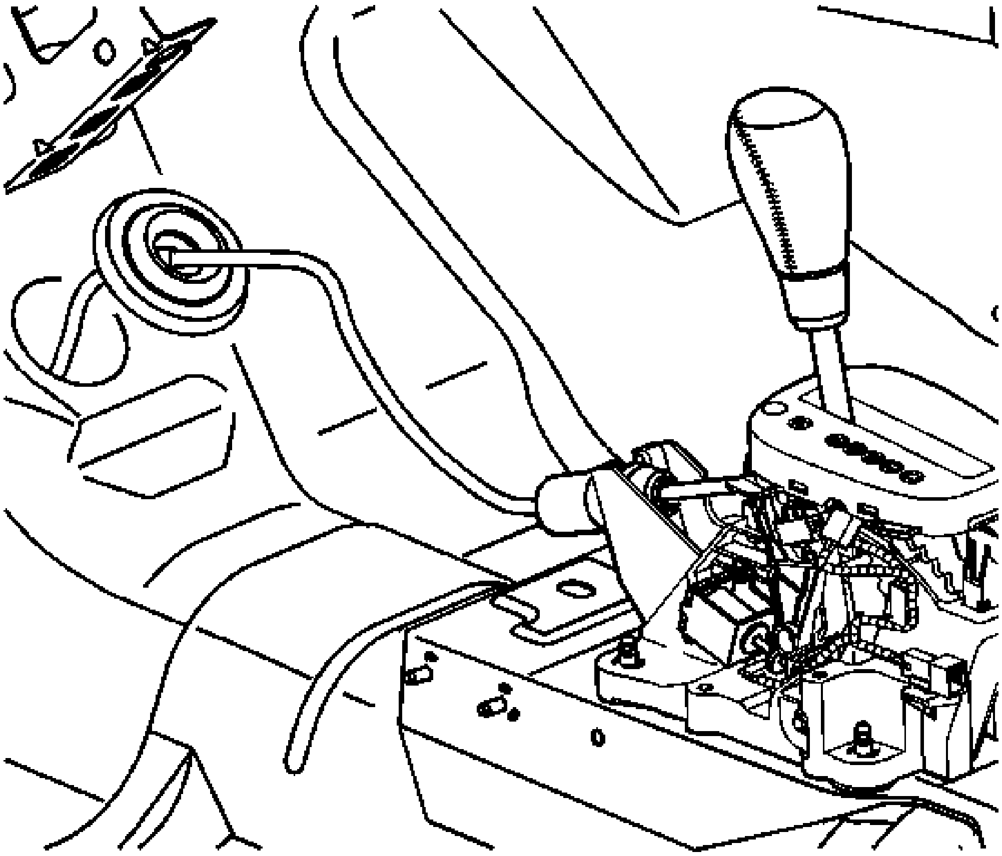

Fig. 36: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the upper and lower transaxle oil cooler fittings from the radiator at the same time other wise the transaxle oil cooler will fall inside the radiator end tank.

3. Remove the oil cooler fitting from the radiator.

Installation Procedure

1. Inspect the new O-ring seals for cracks, cuts or damage. Replace if necessary.

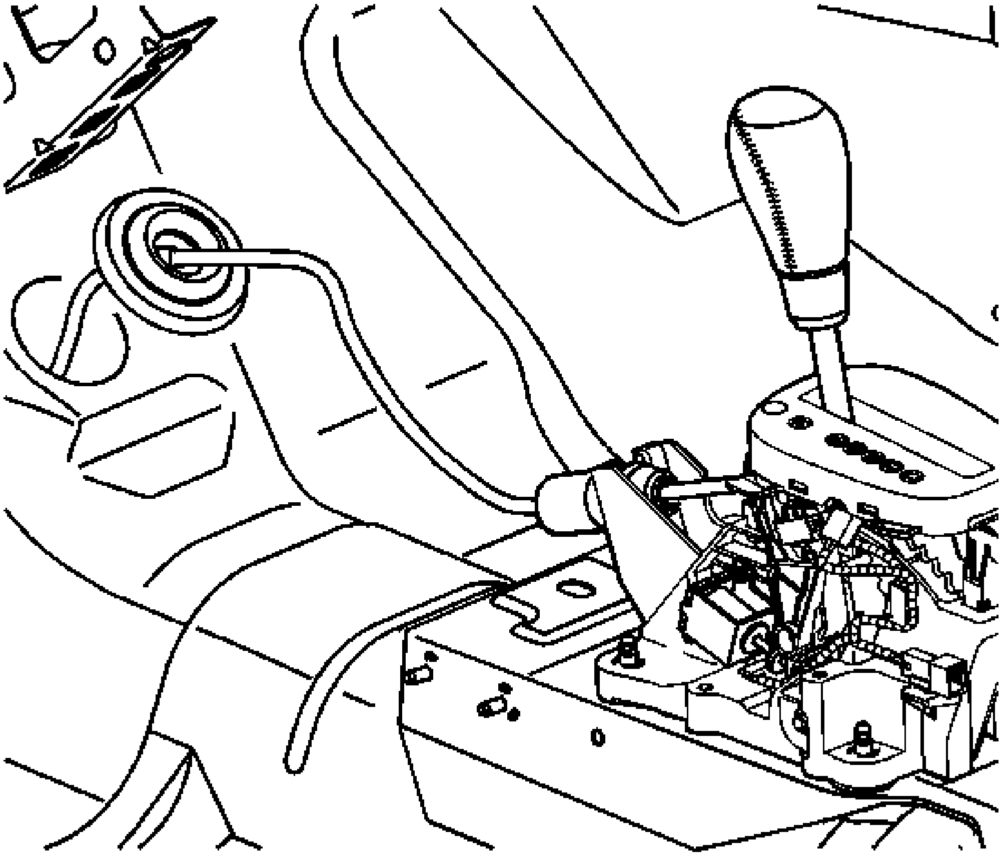

Fig. 37: View Of Oil Cooler Fitting At Radiator
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **The correct thread engagement is critical. Cross-threaded fittings can achieve proper tightness and still leak.**

2. Install the oil cooler fitting to the radiator.

   Tighten: Tighten the fittings to 38 N.m (28 lb ft).

3. Install the transaxle oil cooler hoses to the oil cooler fittings on the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection**.
4. Fill the cooling system. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling**

System Draining and Filling (LY7, LZ4, Static Fill) or **Cooling System Draining and Filling (LAT Static Fill)** .

5. Adjust the transmission fluid level.
6. Inspect for fluid leaks.

TRANSMISSION FLUID COOLER HOSE/PIPE QUICK-CONNECT FITTING DISCONNECTION AND CONNECTION

Removal Procedure

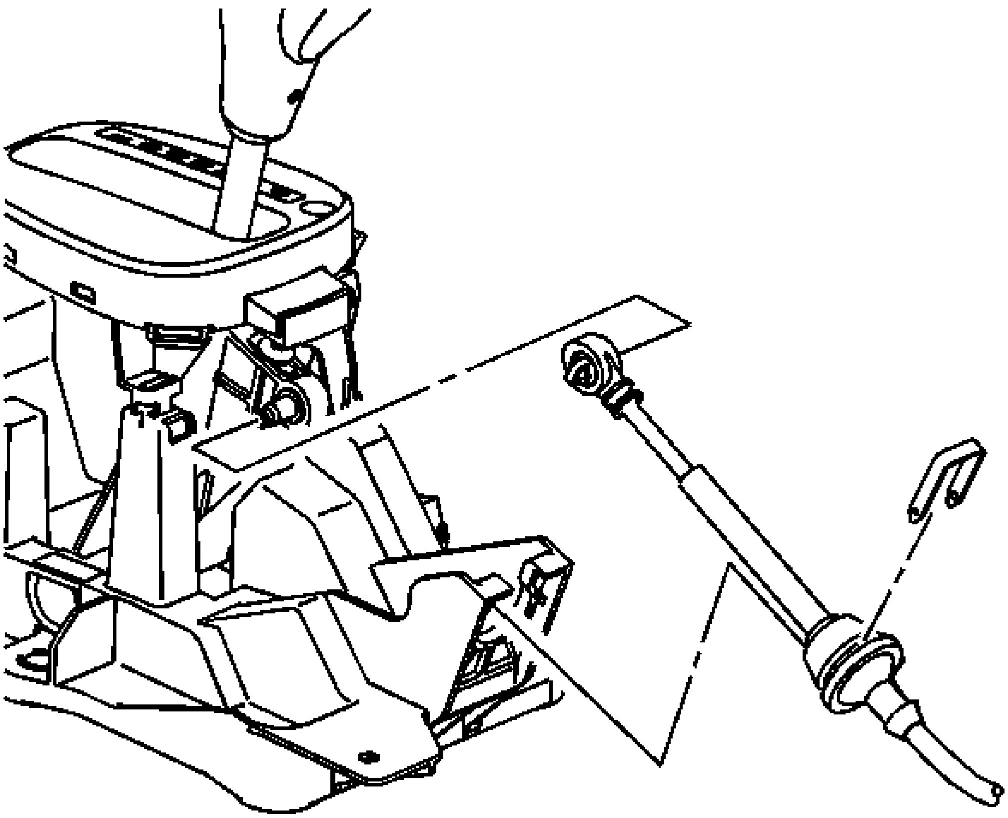

Fig. 38: Identifying Retaining Ring On Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Perform the following procedure when removing the retaining rings and cooler lines from the quick connect fittings located on the radiator and/or the transmission.

1. Pull the plastic cap back from the quick connect fitting and down along the cooler line about 5 cm (2 in).
2. Using a bent-tip screwdriver, pull on one of the open ends of the retaining ring in order to rotate the retaining ring around the quick connect fitting until the retaining ring is out of position and can be completely removed.
3. Remove the retaining ring from the quick connect fitting.
4. Discard the retaining ring.

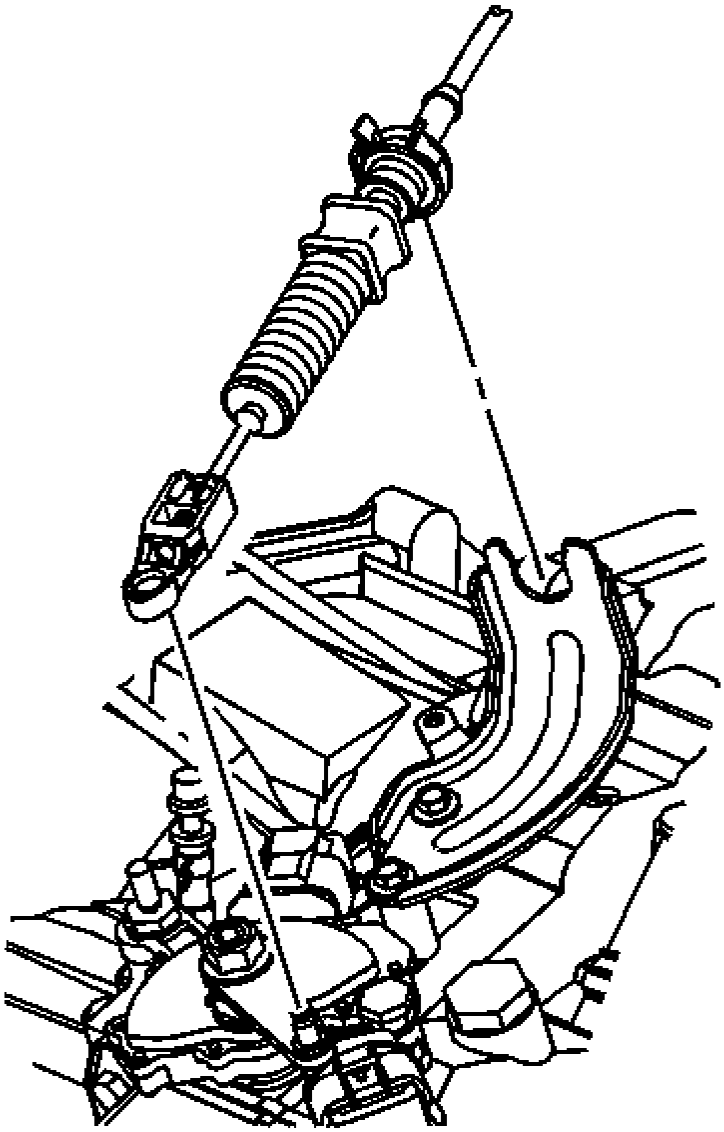

Fig. 39: Cooler Line & Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

5. Pull the cooler line straight out from the quick connect fitting.

Installation Procedure

IMPORTANT:

- **Do not reuse any of the existing oil lines or oil line fittings if there is excessive corrosion.**
- **Do not reuse any of the existing retaining rings that were removed from the existing quick connect fittings. Install new retaining rings.**
- **Ensure the following procedures are performed when installing the new retaining rings onto the fittings.**

1. Install a new retaining ring into the quick connect fitting using the following procedure:

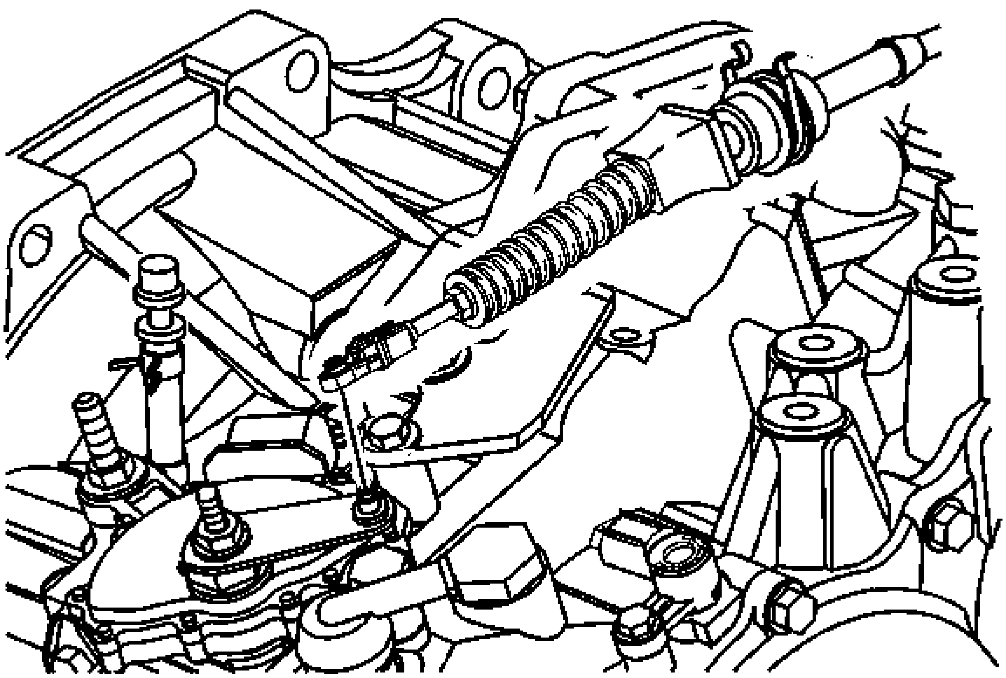

Fig. 40: Hooking Retaining Ring Into Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

2. Hook one of the open ends of the retaining ring in one of the slots in the quick connect fitting.

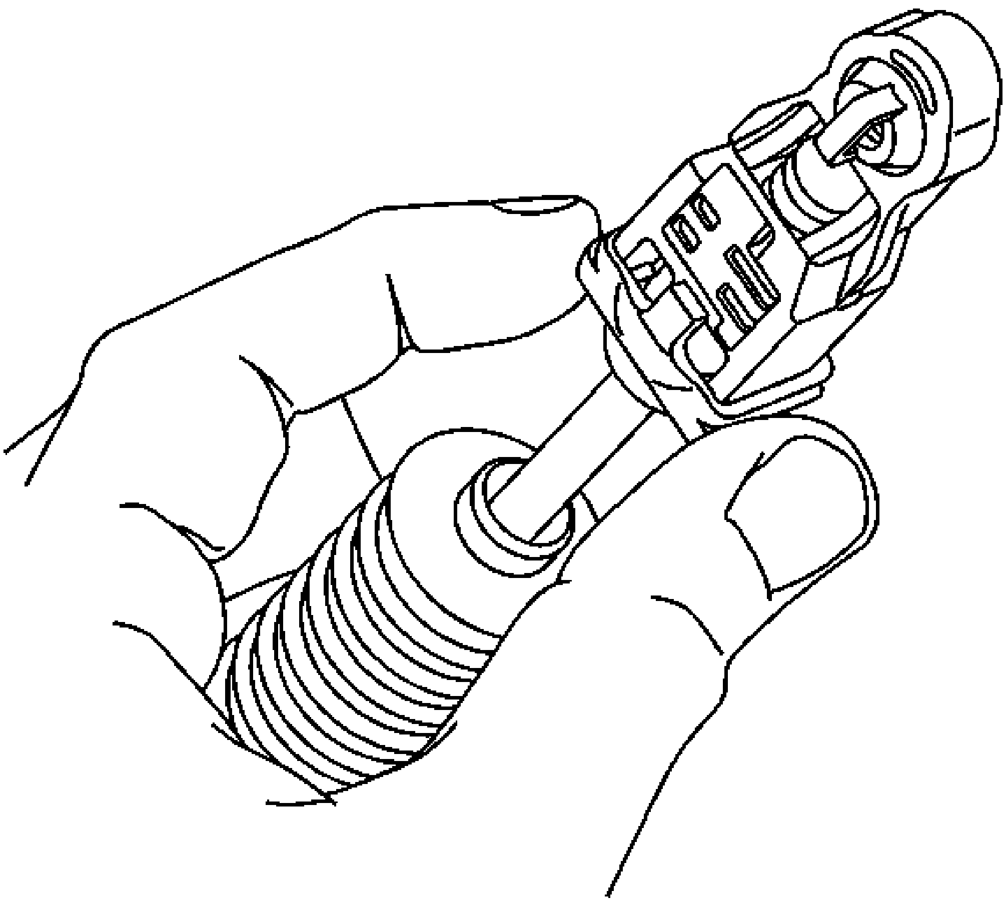

Fig. 41: Rotating Retaining Ring Around Fitting
Courtesy of GENERAL MOTORS CORP.

3. Rotate the retaining ring around the fitting until the retaining ring is positioned with all three ears through the three slots on the fitting.

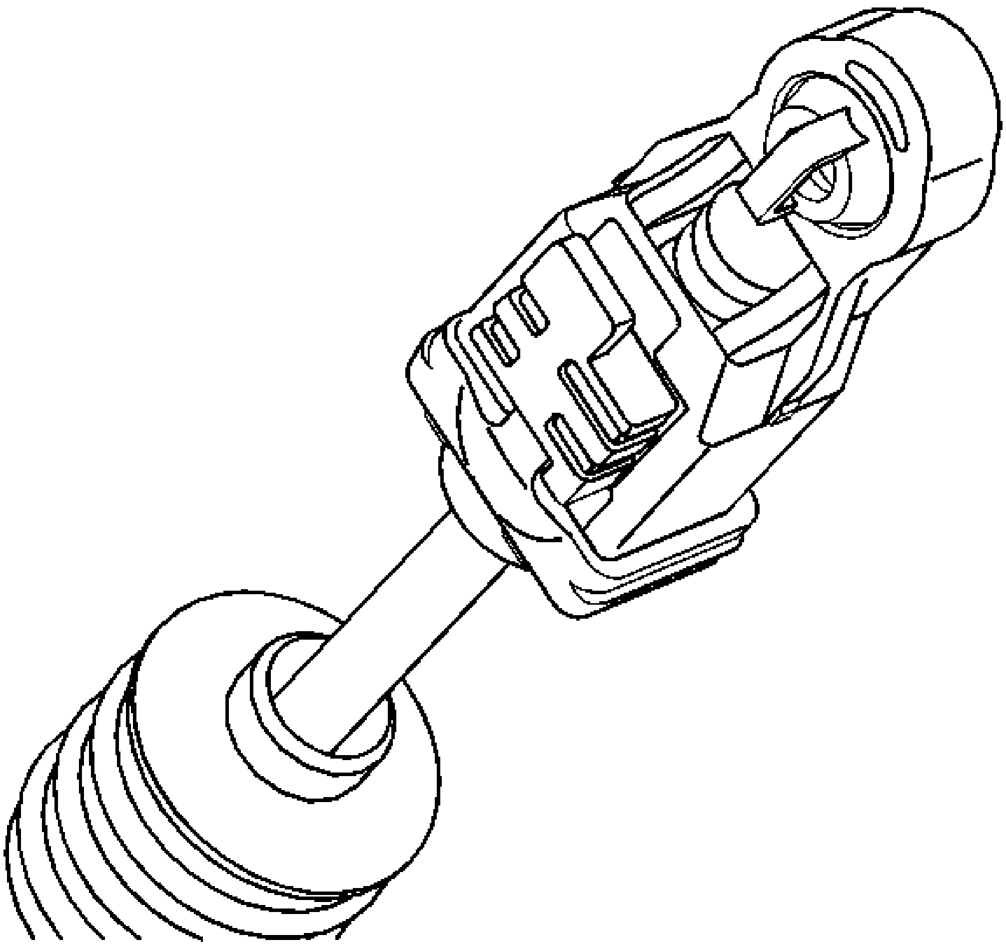

Fig. 42: Identifying Improper Engine Oil Cooler Hose/Pipe Retaining Ring Installation
Courtesy of GENERAL MOTORS CORP.

4. Do not install the new retaining ring onto the fitting by pushing the retaining ring.

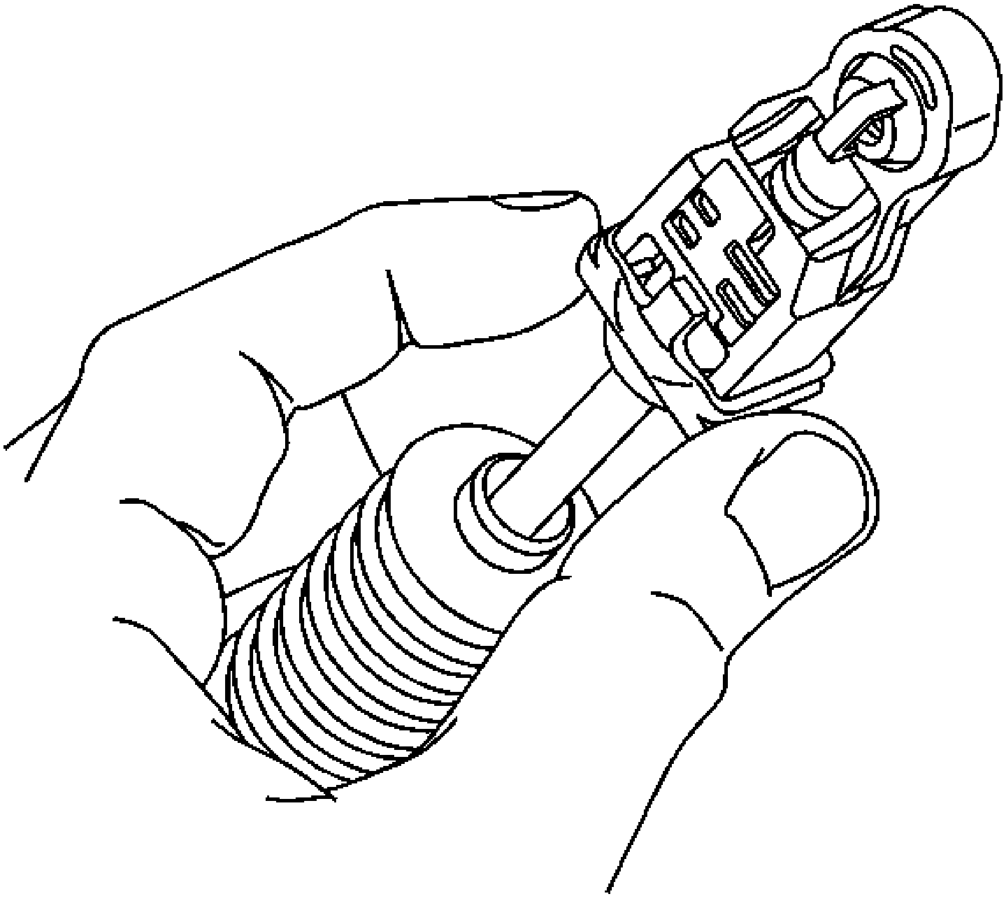

Fig. 43: Ensuring Retaining Ring Is Seated Correctly
Courtesy of GENERAL MOTORS CORP.

5. Ensure that the three retaining ring ears are seen from inside the fitting and that the retaining ring moves freely in the fitting slots.

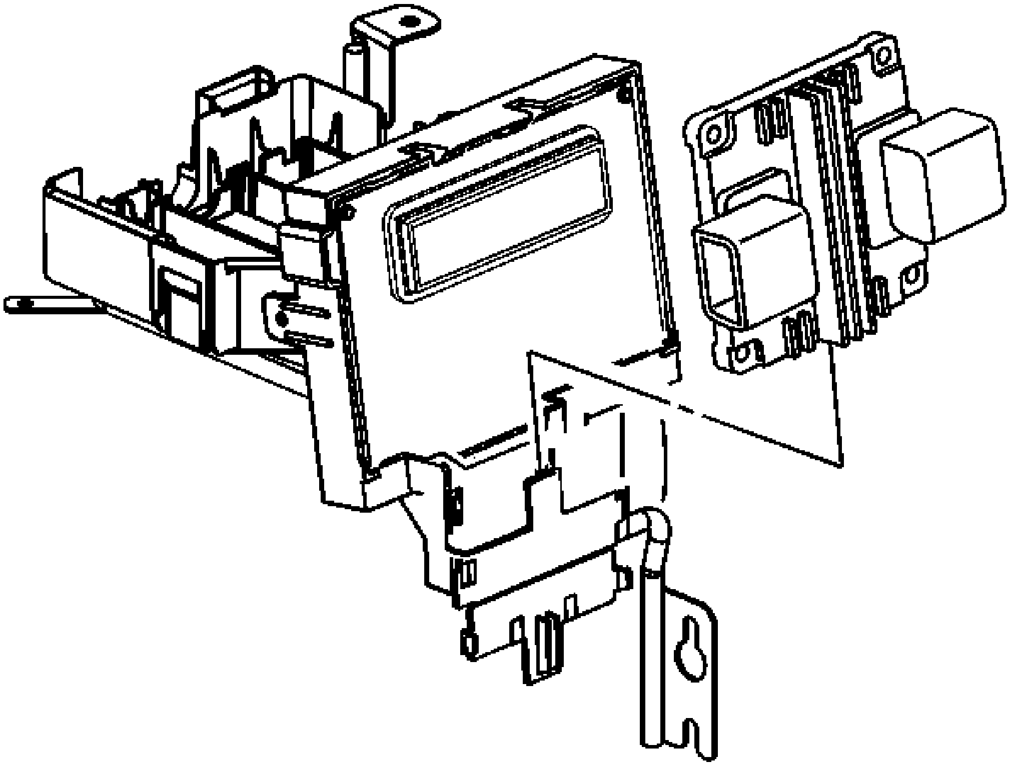

Fig. 44: View Of Cooler Line Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

6. Install the cooler line into the quick connect fitting.
7. Insert the cooler line end into the quick connect fitting until a click is either heard or felt.

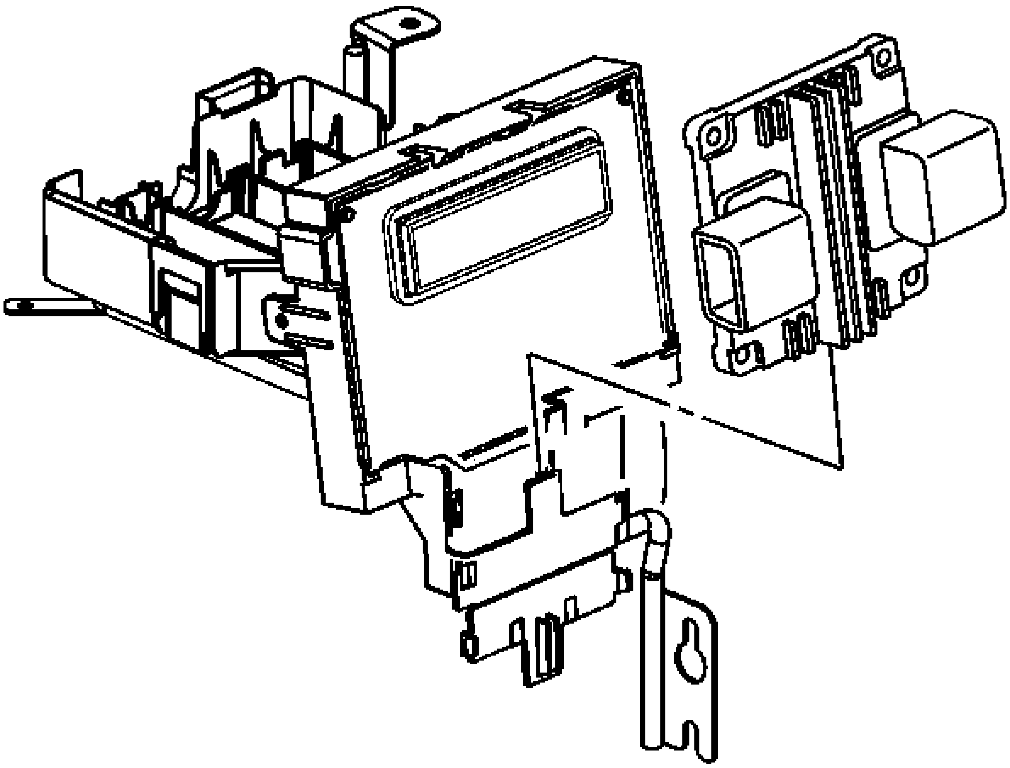

Fig. 45: Do Not Use Plastic Cap On Cooler Line In Order To Install Cooler Line Into The Fitting
Courtesy of GENERAL MOTORS CORP.

8. Do not use the plastic cap on the cooler line in order to install the cooler line into the fitting.
9. Pull back sharply on the cooler line in order to ensure that the cooler line is fastened into the quick connect fitting.

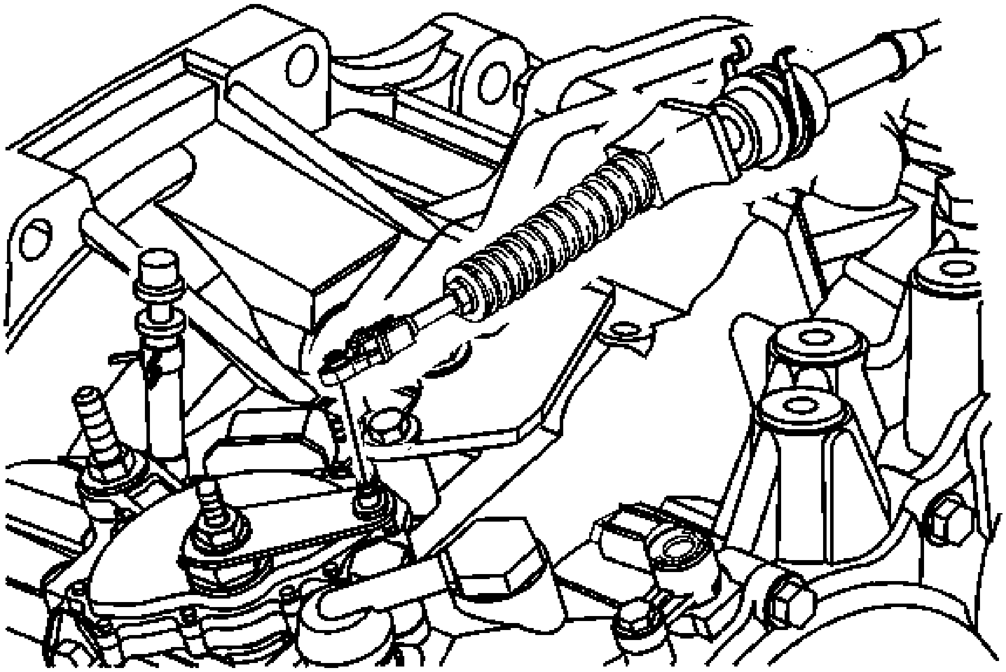

Fig. 46: View Of Cooler Line & Plastic Cap
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not manually depress the retaining clip when installing the plastic cap.

10. Position (snap) the plastic cap onto the fitting. Do not manually depress the retaining ring when installing the plastic cap onto the quick connect fitting.
11. Ensure that the plastic cap is fully seated against the fitting.

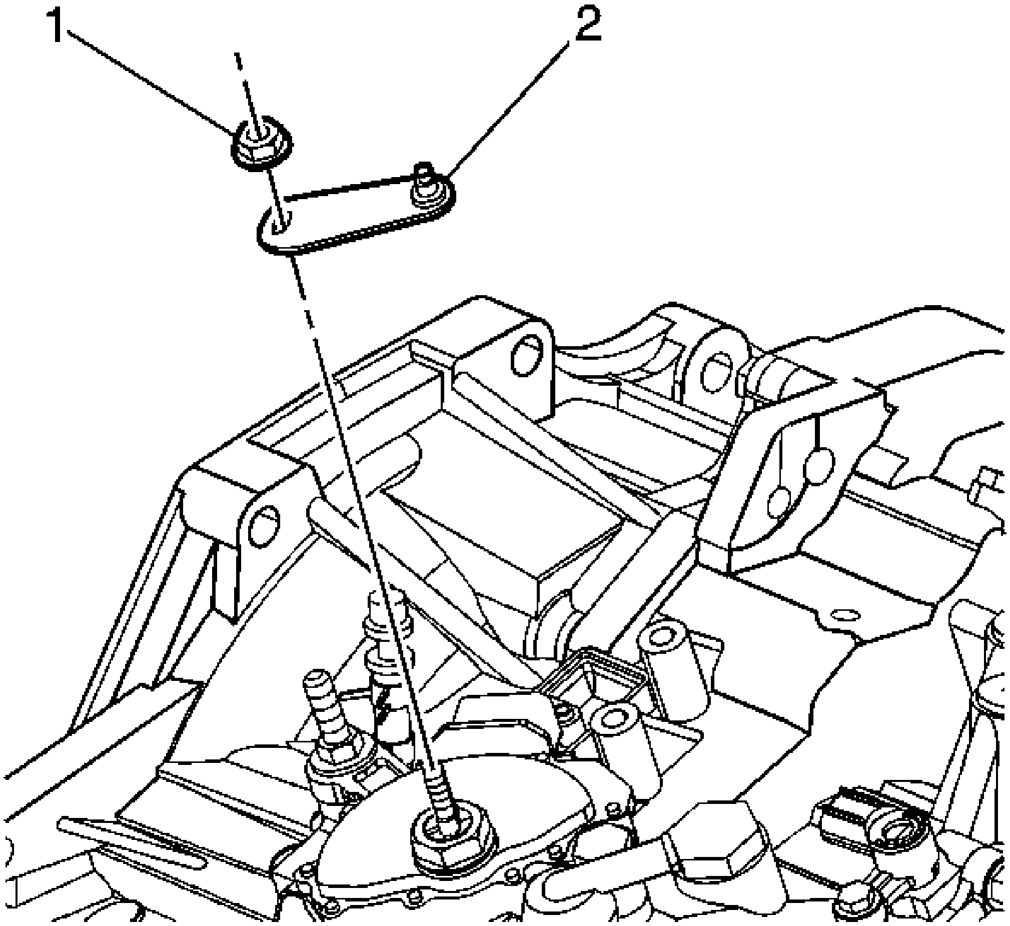

Fig. 47: Checking For Gap Between Cap & Fitting
Courtesy of GENERAL MOTORS CORP.

12. Ensure that no gap is present between the cap and the fitting.

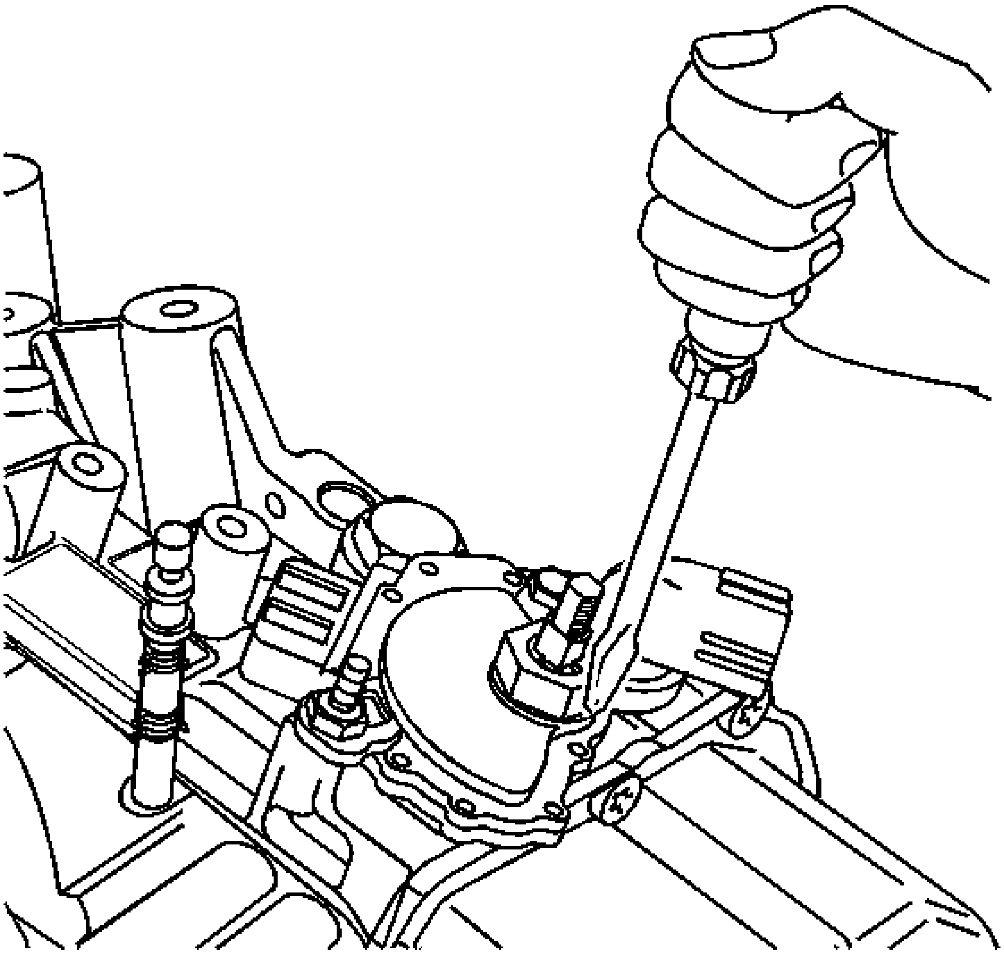

Fig. 48: View Of Cooler Line & Plastic Cap
Courtesy of GENERAL MOTORS CORP.

13. Ensure that the yellow identification band on the tube is hidden within the quick connect fitting.

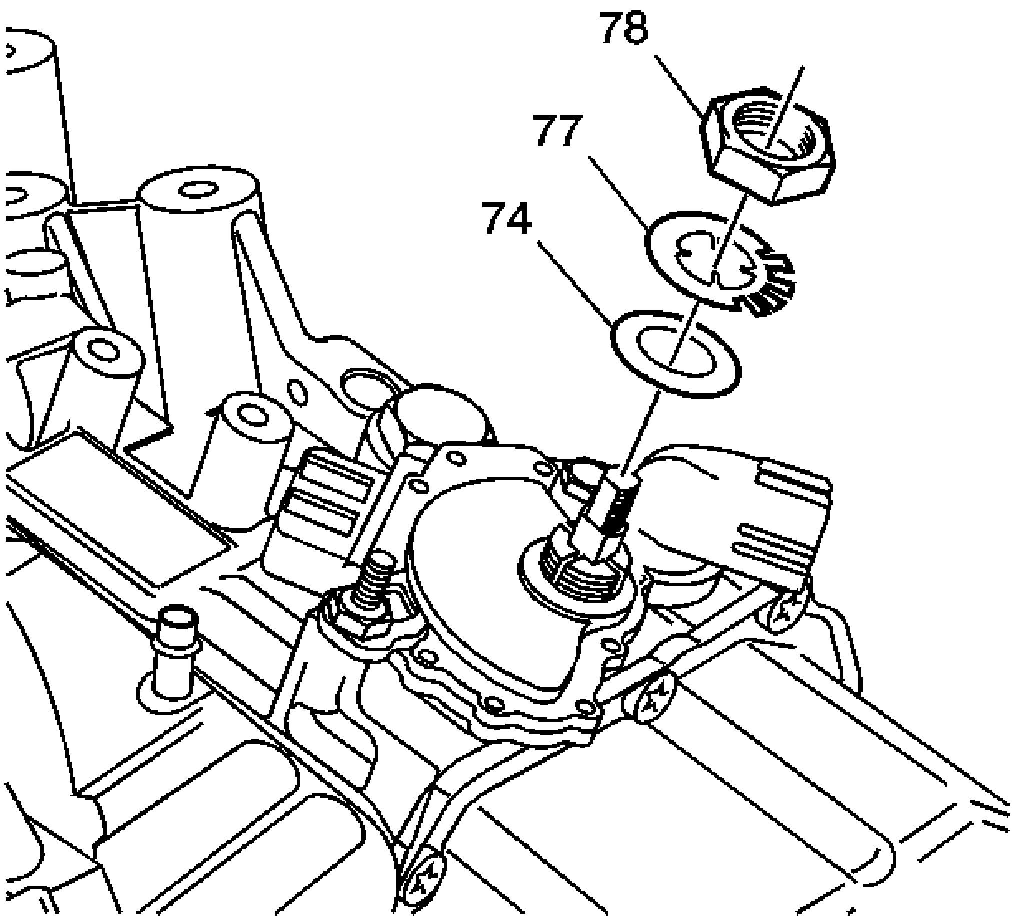

Fig. 49: Identifying Improper Joint Seating
Courtesy of GENERAL MOTORS CORP.

14. A hidden yellow identification band indicates proper joint seating.
15. Fill the transmission to the proper level with DEXRON® VI transmission fluid. Refer to **Transmission Fluid Check**.

TRANSMISSION FLUID COOLER PIPE REPLACEMENT - FRONT

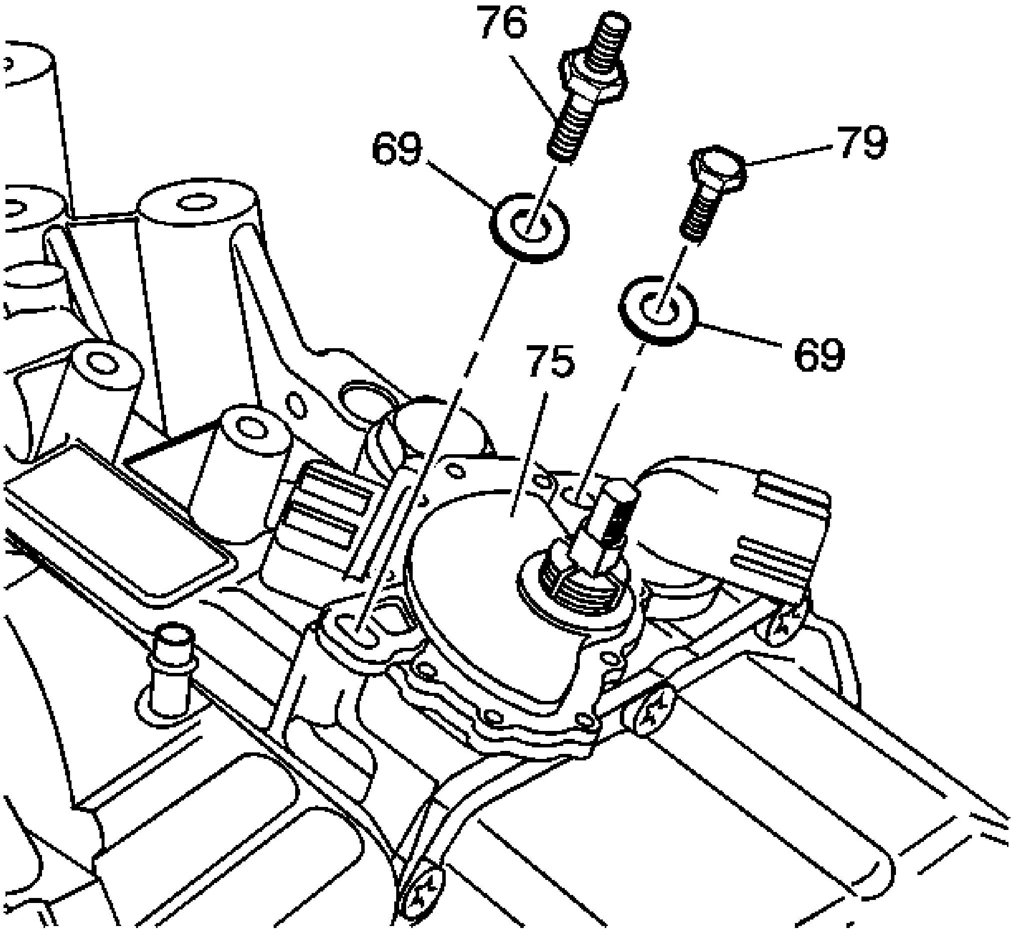

Fig. 50: Locating Transmission Fluid Cooler Inlet Hose
Courtesy of GENERAL MOTORS CORP.

Transmission Fluid Cooler Pipe Replacement - Front

Callout	Component Name
Preliminary Procedure: Remove the air cleaner outlet duct. Refer to **Air Cleaner Inlet Duct Replacement** .	
1	Transmission Fluid Cooler Pipe Nut **NOTE:** **Refer to Fastener Notice .** **Tighten:** 22 N.m (16 lb ft)
	Sealing Washer

2	**Tip:** Remove and discard the sealing washer.
3	Front Transmission Fluid Cooler Inlet Hose 1. Disconnect the transmission line from the radiator and transmission. Refer to **Transmission Fluid Cooler Pipe Replacement - Front** or **Transmission Fluid Cooler Pipe Replacement - Rear**. 2. Note the routing of the transmission line to ensure proper installation. 3. Remove the transmission line from the clips securing the line to the transmission and fan shroud. 4. Inspect the transmission fluid level. Refer to **Transmission Fluid Check**.

TRANSMISSION FLUID COOLER PIPE REPLACEMENT - REAR

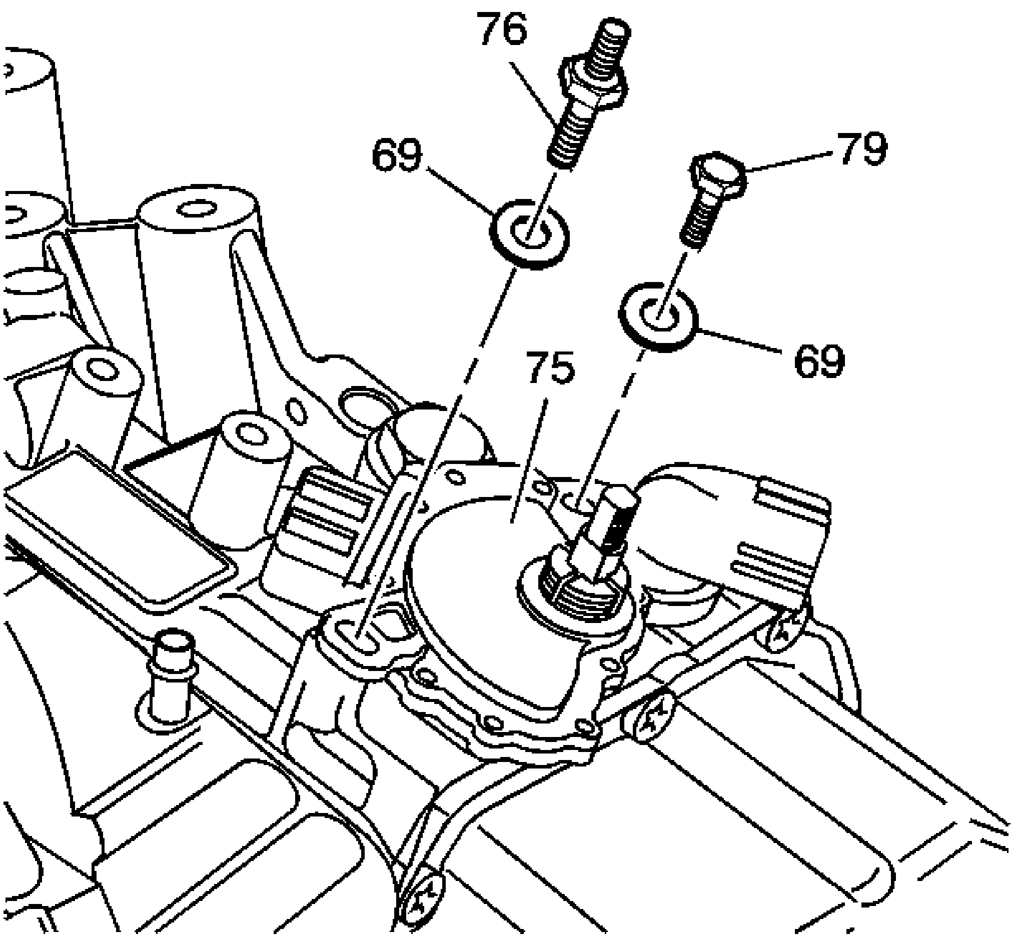

Fig. 51: Locating Transmission Fluid Cooler Outlet Hose

Courtesy of GENERAL MOTORS CORP.

Transmission Fluid Cooler Pipe Replacement - Rear

Callout	Component Name
Preliminary Procedure: Remove the air cleaner outlet duct. Refer to **Air Cleaner Inlet Duct Replacement** .	
1	Transmission Fluid Cooler Pipe Nut **NOTE:** **Refer to Fastener Notice .** **Tighten:** 22 N.m (16 lb ft)
2	Sealing Washer **Tip:** Remove and discard the sealing washer.
3	Rear Transmission Fluid Cooler Outlet Hose 1. Disconnect the transmission line from the radiator and transmission. Refer to **Transmission Fluid Cooler Pipe Replacement - Front** or **Transmission Fluid Cooler Pipe Replacement - Rear**. 2. Note the routing of the transmission line to ensure proper installation. 3. Remove the transmission line from the clips securing the line to the transmission and fan shroud. 4. Inspect the transmission fluid level. Refer to **Transmission Fluid Check**.

AUTOMATIC TRANSMISSION FLUID PRESSURE TEST HOLE PLUG REPLACEMENT

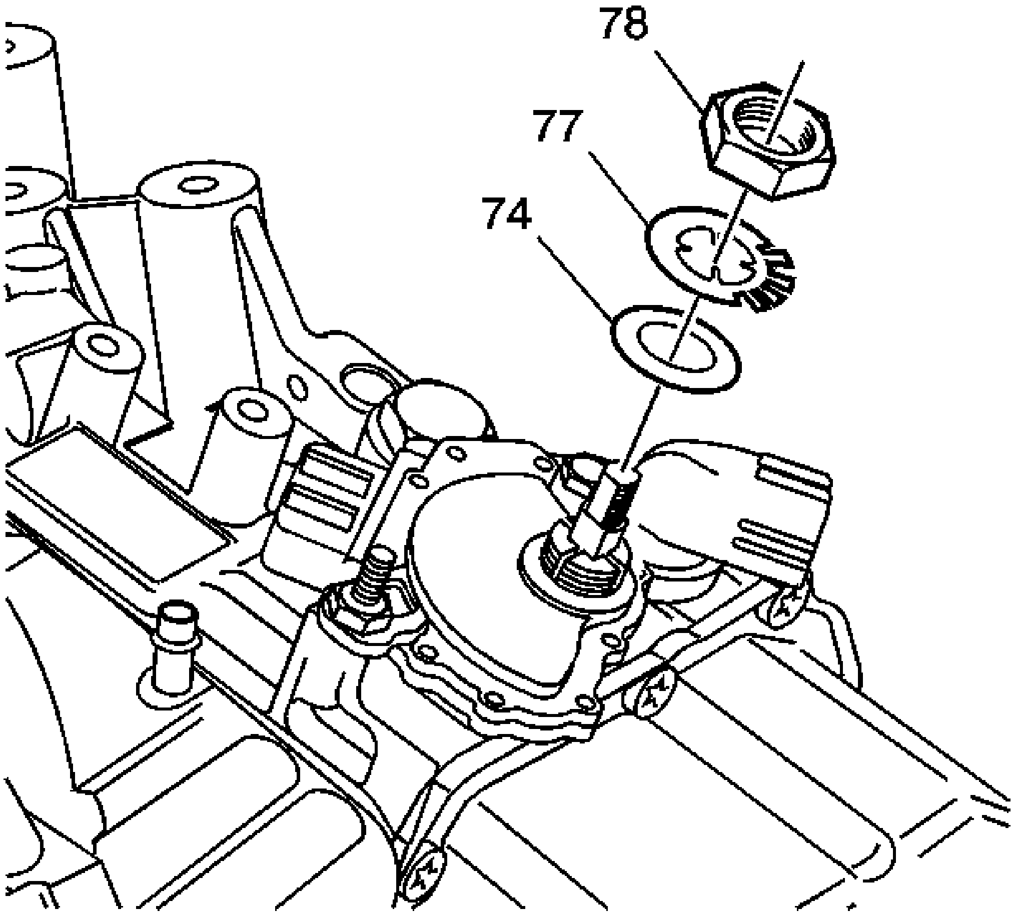

Fig. 52: Identifying Fluid Pressure Test Hole Plug
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Fluid Pressure Test Hole Plug Replacement

Callout	Component Name
Preliminary Procedure: Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Fluid Pressure Test Plug **NOTE:** **Refer to Component Fastener Tightening Notice .** **Tighten:** 12 N.m (106 lb in)

FRONT WHEEL DRIVE SHAFT OIL SEAL REPLACEMENT - LEFT SIDE

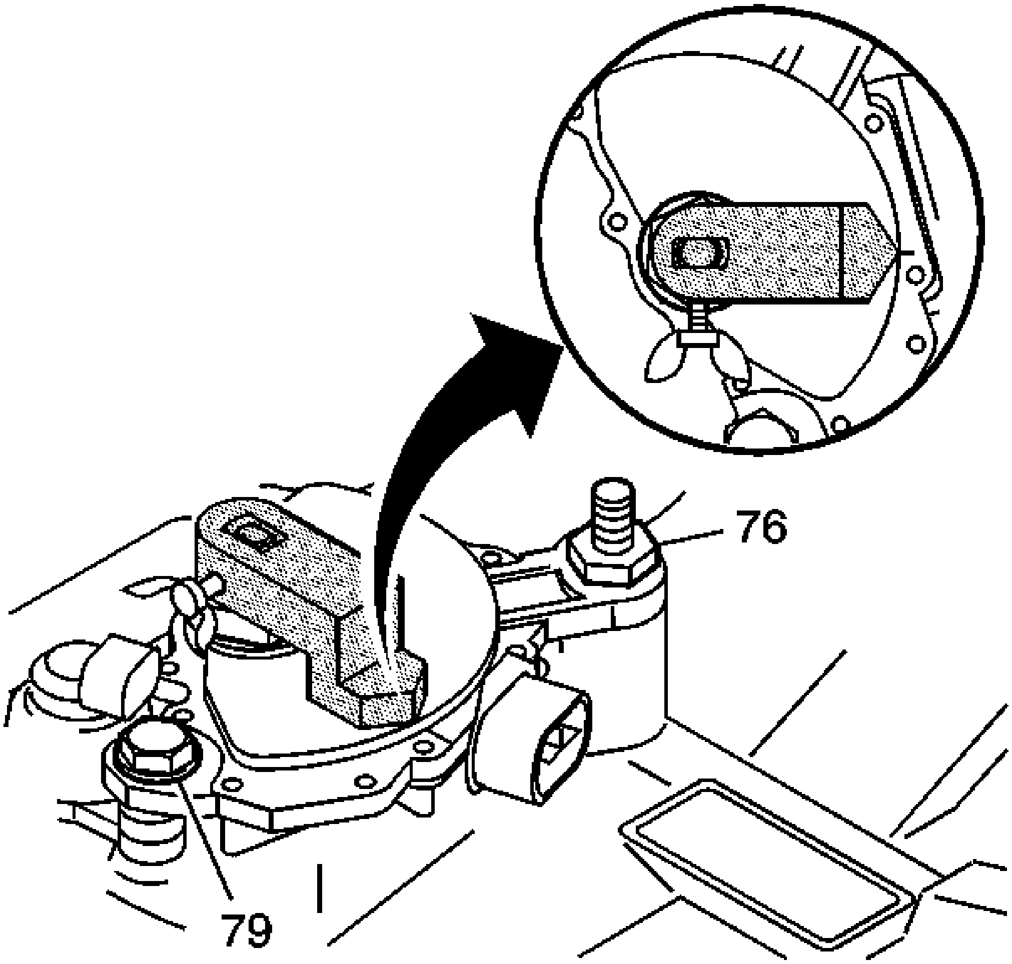

Fig. 53: View Of Front Wheel Drive Shaft Oil Seal - Left Side
Courtesy of GENERAL MOTORS CORP.

Front Wheel Drive Shaft Oil Seal Replacement - Left Side

Callout	Component Name
Preliminary Procedures 1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the left wheel drive shaft. Refer to **Wheel Drive Shaft Replacement** .	
	Left Front Wheel Drive Shaft Oil Seal **Tip:**

1	• For seal removal use **J 6125-1B** Slide Hammer with **J 23129** Universal Seal Remover. • For seal installation use **J 8092** Driver Handle with **J-46629** Axle Seal Installer. See **Special Tools**. **Special Tools** • **J 8092** Driver Handle • **J-46629** Axle Seal Installer. See **Special Tools**.

FRONT WHEEL DRIVE SHAFT OIL SEAL REPLACEMENT - RIGHT SIDE

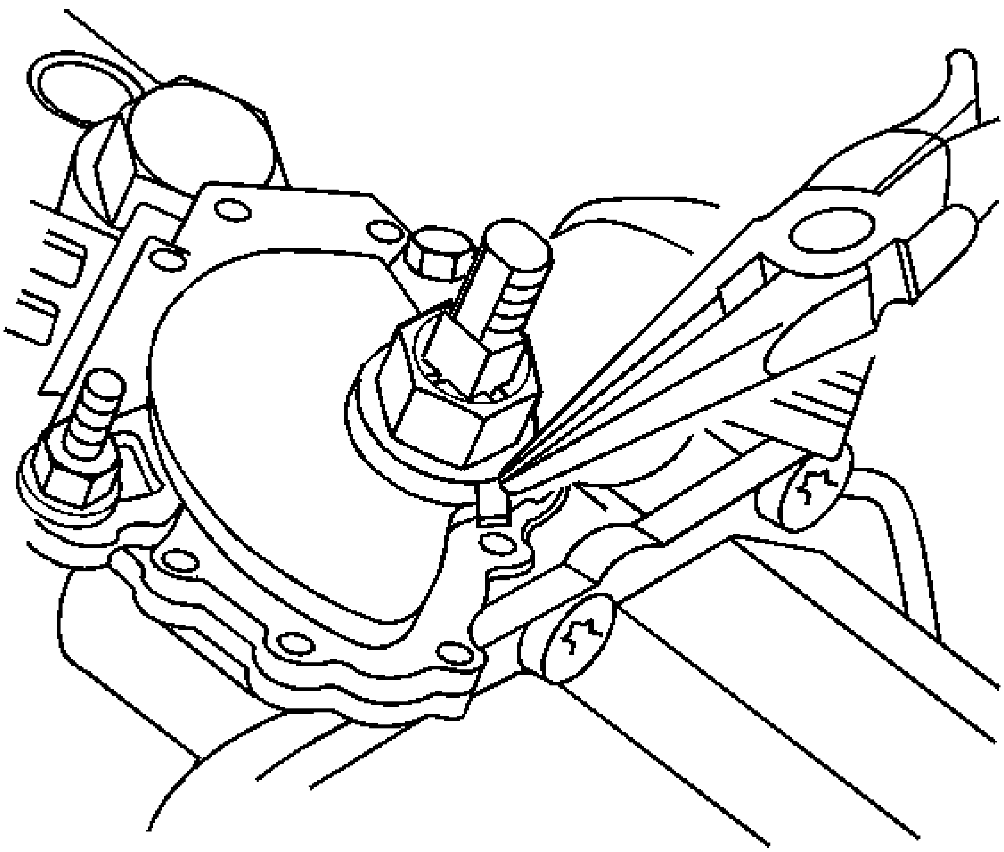

Fig. 54: Identifying Front Wheel Drive Shaft Oil Seal - Right Side
Courtesy of GENERAL MOTORS CORP.

Front Wheel Drive Shaft Oil Seal Replacement - Right Side

Callout	Component Name
Preliminary Procedures 1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the intermediate drive shaft. Refer to **Intermediate Drive Shaft Replacement** .	
1	Right Front Wheel Drive Shaft Oil Seal **Tip:** • For seal removal use **J 6125-1B** Slide Hammer with **J 23129** Universal Seal Remover. • For seal installation use **J 8092** Driver Handle with **J-46629** Axle Seal Installer. See **Special Tools**. **Special Tools** • **J 8092** Driver Handle • **J-46629** Axle Seal Installer. See **Special Tools**.

MANUAL SHIFT SHAFT AND SEAL REPLACEMENT

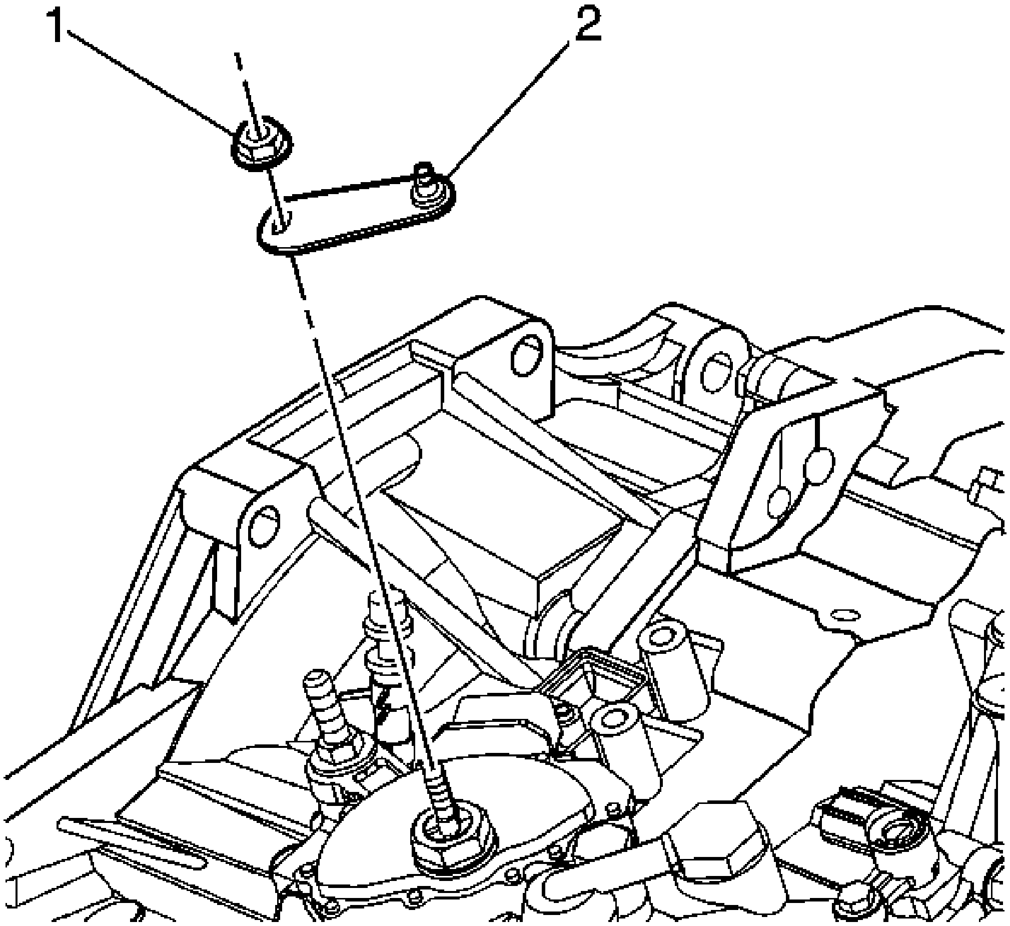

Fig. 55: Identifying Manual Shift Shaft & Seal
Courtesy of GENERAL MOTORS CORP.

Manual Shift Shaft and Seal Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the battery tray. Refer to **Battery Tray Replacement (LAT)** or **Battery Tray Replacement (LZ4/LY7)** . 2. Remove the manual shaft and position switch assembly. Refer to **Manual Shift Detent Lever and Shaft Position Switch Assembly Replacement**.	
	Manual Shift Shaft Seal **Tip:**

1	• For seal removal use **J 45201** Cooler Line Seal Remover. • For seal installation use **J-46626** Seal Installer. See **Special Tools**. • Lubricate the manual shaft with automatic transmission fluid (ATF) to prevent damage to the manual shift shaft seal.

CONTROL VALVE BODY COVER REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LAT)** or **Battery Negative Cable Disconnection and Connection (LZ4/LY7)** .

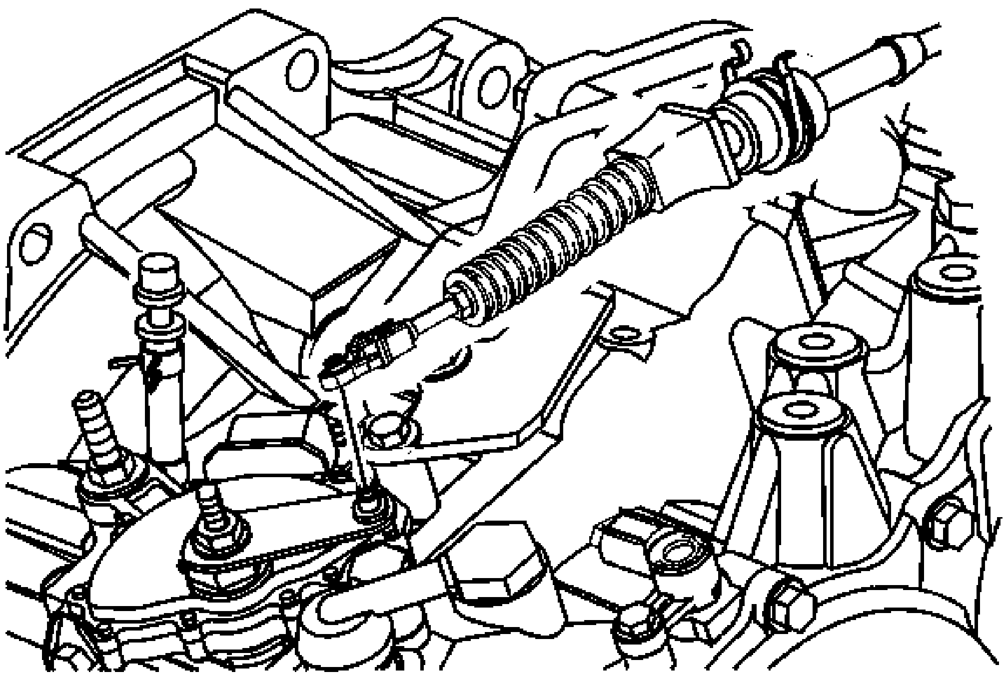

Fig. 56: Identifying Oil Cooler Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil cooler inlet and outlet hoses from the retainer on the control valve body cover.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the left engine splash shield. Refer to **Engine Splash Shield Replacement - Left Side (LY7, LZ4)** or **Engine Splash Shield Replacement - Left Side (LAT)** .
5. Remove the left front fender liner. Refer to **Front Fender Liner Replacement** .

6. Remove the front air dam. Refer to **Front Air Dam Replacement** .
7. Remove the front transmission mount. Refer to **Transmission Front Mount Replacement**.
8. Remove the lower nuts from the left transmission mount. Refer to **Transmission Mount Replacement - Left Side**.
9. Drain the transmission. Refer to **Transmission Fluid Replacement**.

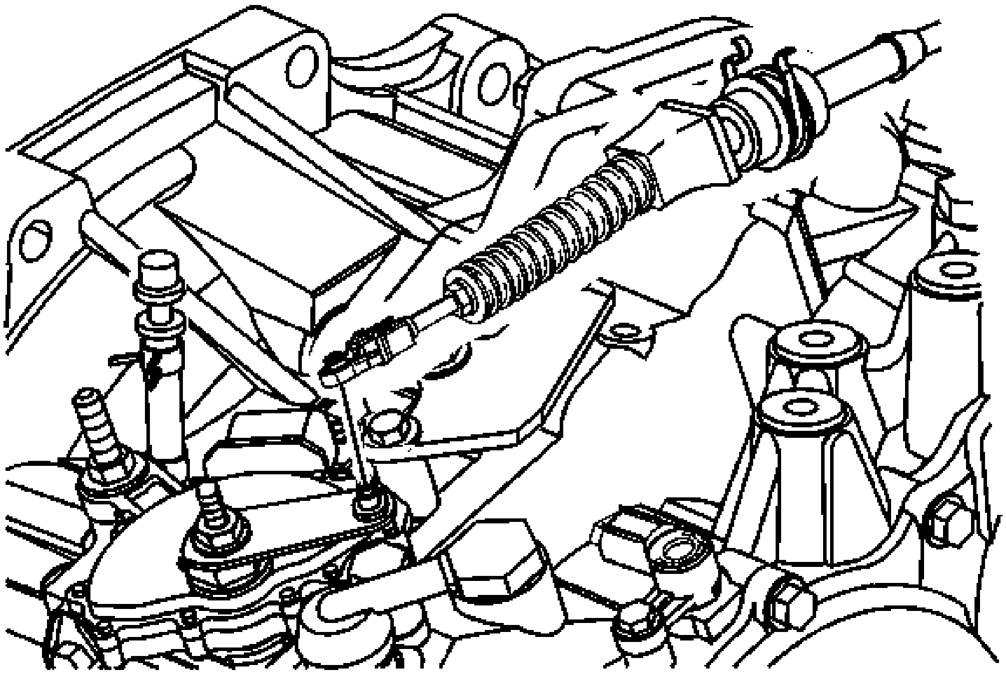

Fig. 57: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Remove the wire harness retainer (2) from the control valve body cover stud.
11. Disconnect the control valve body transmission control module (TCM) electrical connector (1).

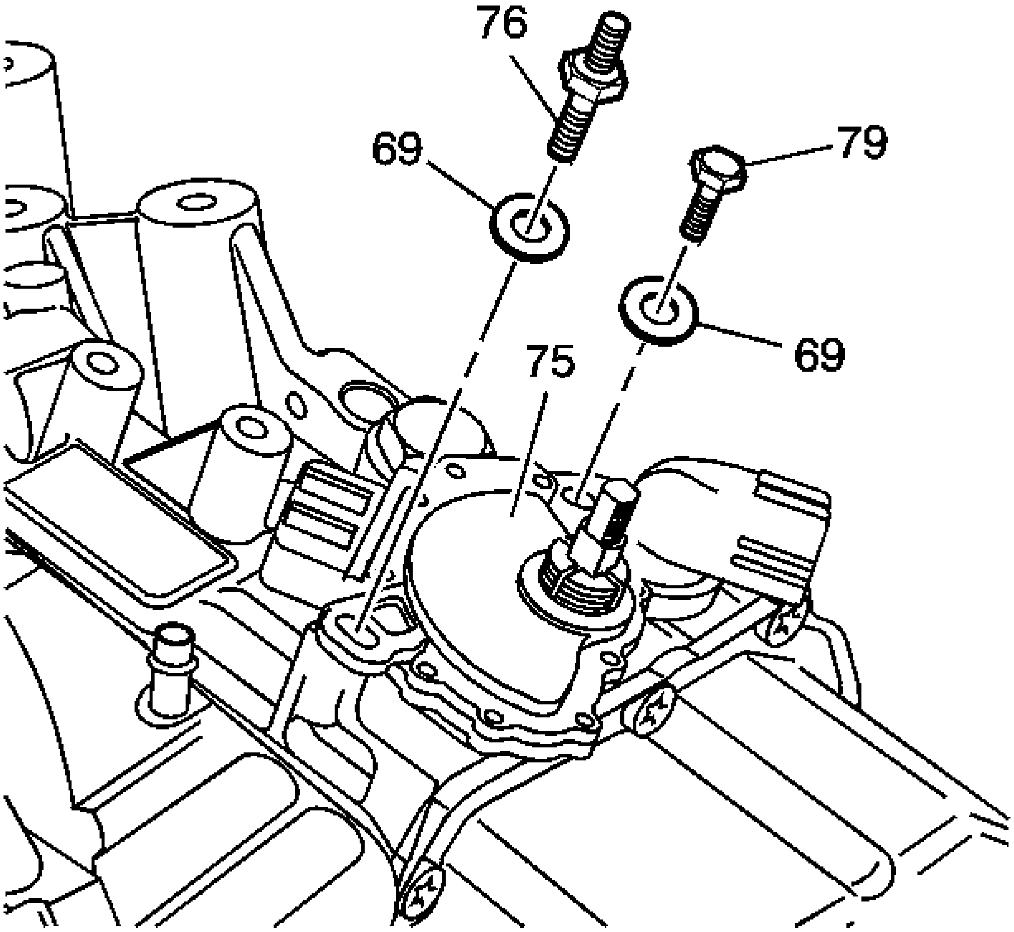

Fig. 58: Identifying Control Valve Body Cover Studs & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the 2 control valve body cover studs M6 x 30.
13. Remove the 12 control valve body cover bolts M6 x 30.
14. Support the transmission with a transmission jack.
15. Using the transmission jack raise the transmission to gain clearance for removal of the control valve body cover.
16. Remove the control valve body cover.
17. Remove the control valve body cover gasket.

NOTE: **Support the control solenoid valve assembly around the connector when removing the seal. Excessive pulling force can damage the internal**

electrical connections.

18. Remove the control valve body cover wiring connector hole seal.
19. Remove all traces of the old gasket material. Clean the transmission case and control valve body cover gasket surfaces.

Installation Procedure

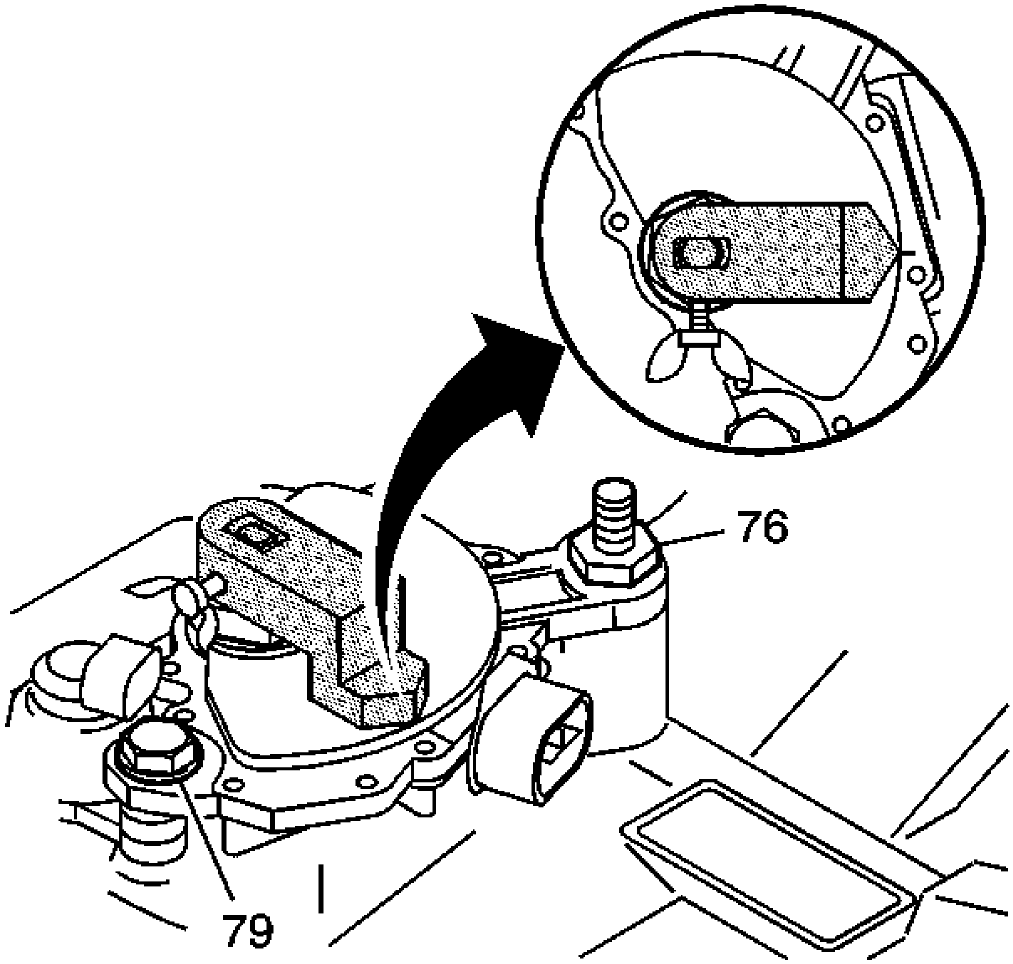

Fig. 59: Control Valve Body Cover Bolts Torque Sequence
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The holes in the control valve body cover wiring connector hole seal must face toward the control solenoid valve assembly. If the holes face toward

the valve body cover, there is a potential for a leak around the seal.

1. Install the control valve body cover wiring connector hole seal.
2. Install the control valve body cover gasket to the control valve body cover.
3. Install the control valve body cover.
4. Lower the transmission and remove the transmission jack.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Install all control valve body cover bolts and studs by hand then torque all bolts and studs in sequence.**

5. Install the 12 control valve body cover bolts (1) M6 x 30.

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

6. Install the 2 control valve body cover studs (2) M6 x 30.

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

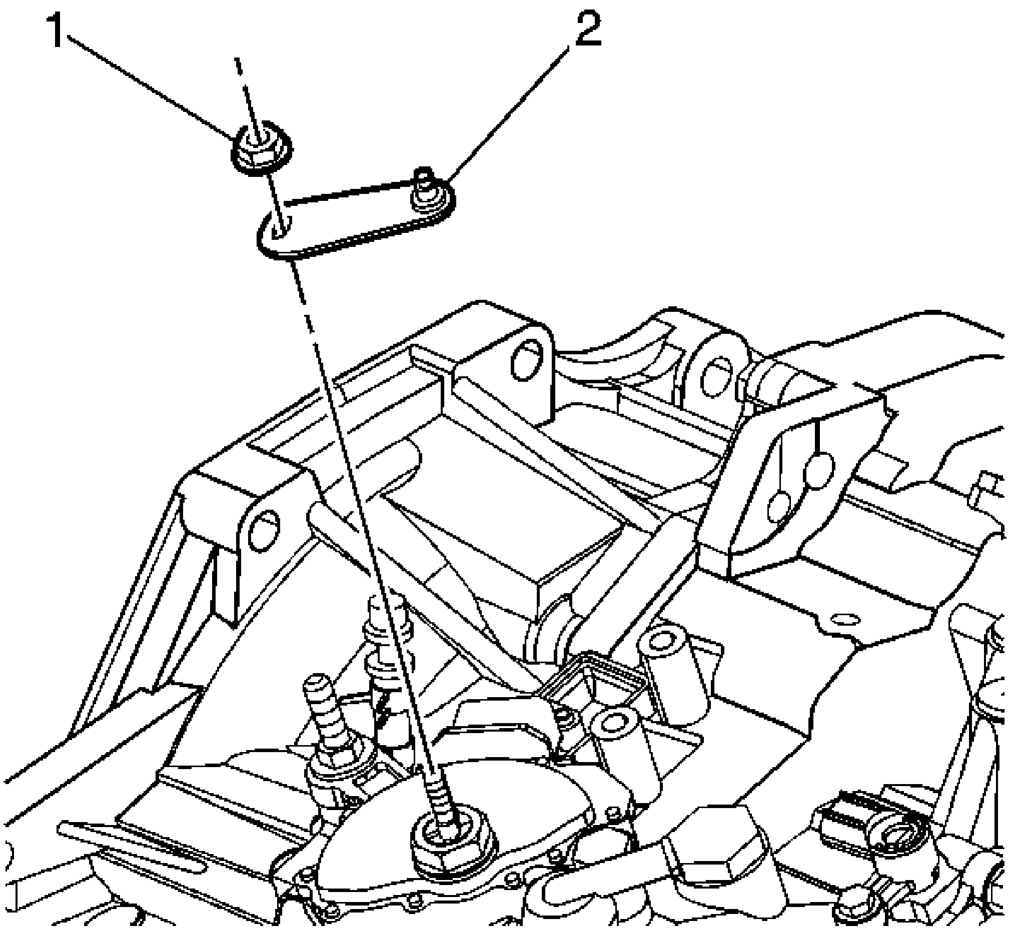

Fig. 60: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect the control valve body TCM electrical connector (1).
8. Install the wire harness retainer (2) to the control valve body cover stud.

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

9. Install the lower nuts to the left transmission mount. Refer to **Transmission Mount Replacement - Left Side**.
10. Install the front transmission mount. Refer to **Transmission Front Mount Replacement**.
11. Install the front air dam. Refer to **Front Air Dam Replacement** .
12. Install the left front fender liner. Refer to **Front Fender Liner Replacement** .

13. Install the left engine splash shield. Refer to **Engine Splash Shield Replacement - Left Side (LY7, LZ4)** or **Engine Splash Shield Replacement - Left Side (LAT)** .
14. Lower the vehicle.

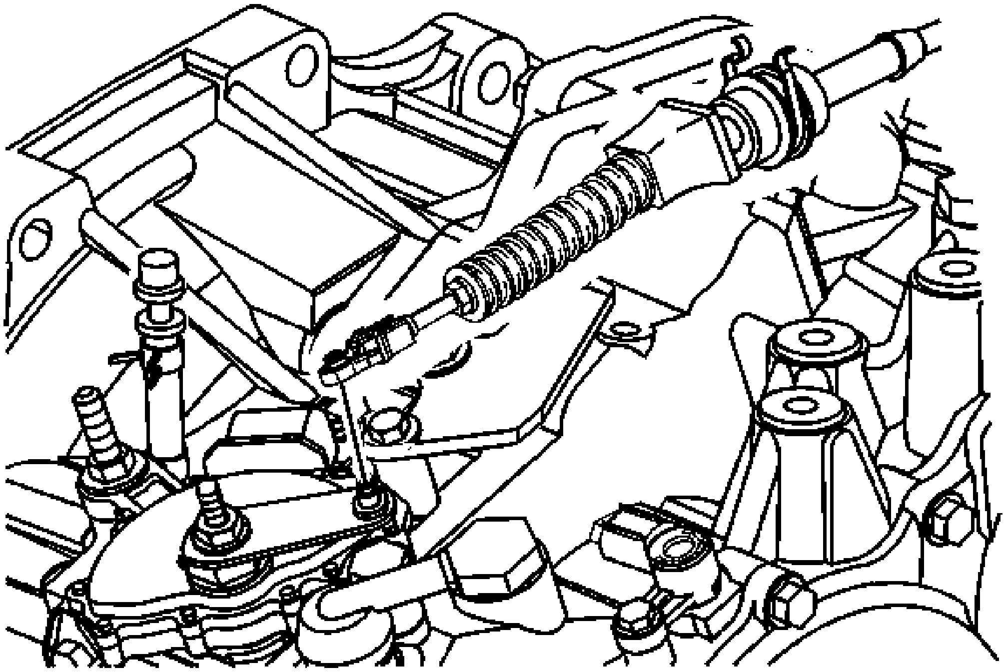

Fig. 61: Identifying Oil Cooler Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

15. Install the oil cooler inlet and outlet hoses to the retainer on the control valve body cover.
16. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LAT)** or **Battery Negative Cable Disconnection and Connection (LZ4/LY7)** .
17. Fill the transmission. Refer to **Transmission Fluid Replacement**.
18. Check for leaks.

CONTROL SOLENOID VALVE AND TRANSMISSION CONTROL MODULE ASSEMBLY REPLACEMENT

Removal Procedure

1. Remove the control valve body cover. Refer to **Control Valve Body Cover Replacement**.

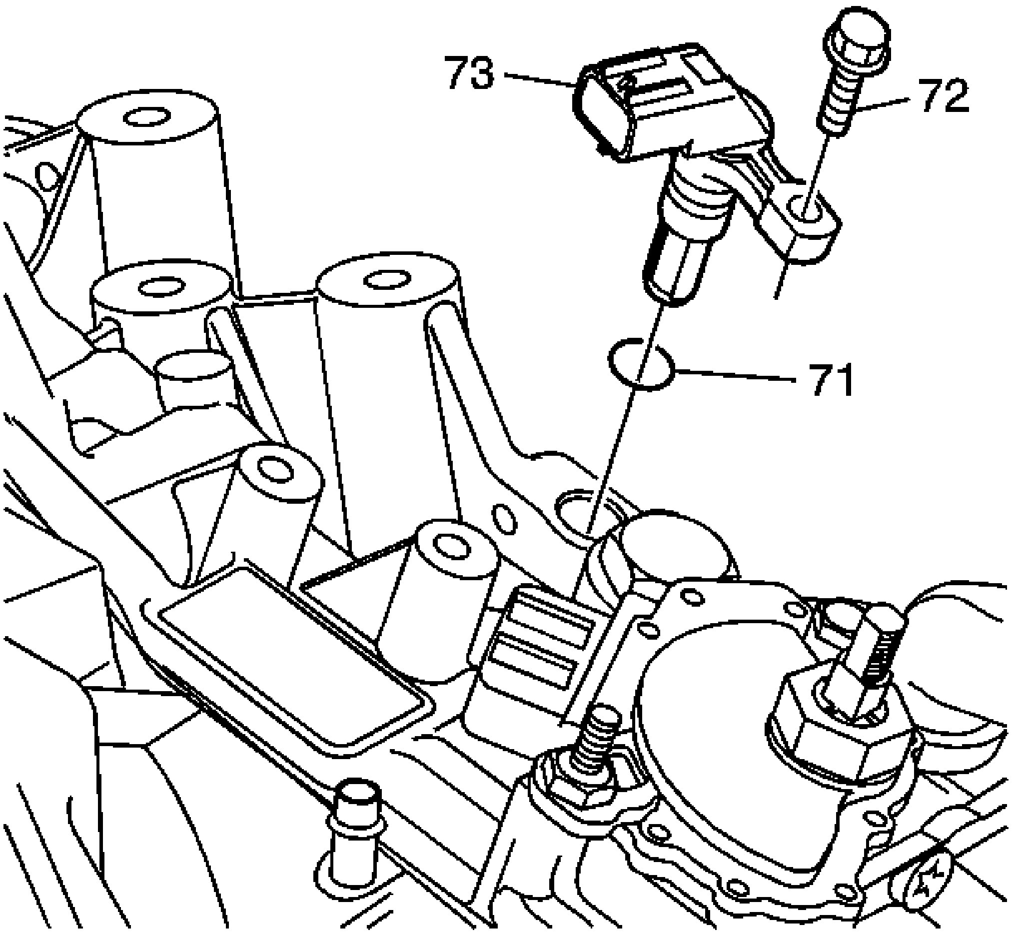

Fig. 62: Identifying Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the input speed sensor electrical connector (1).
3. Disconnect the output speed sensor electrical connector (2).
4. Disconnect the shift position switch electrical connector (3).

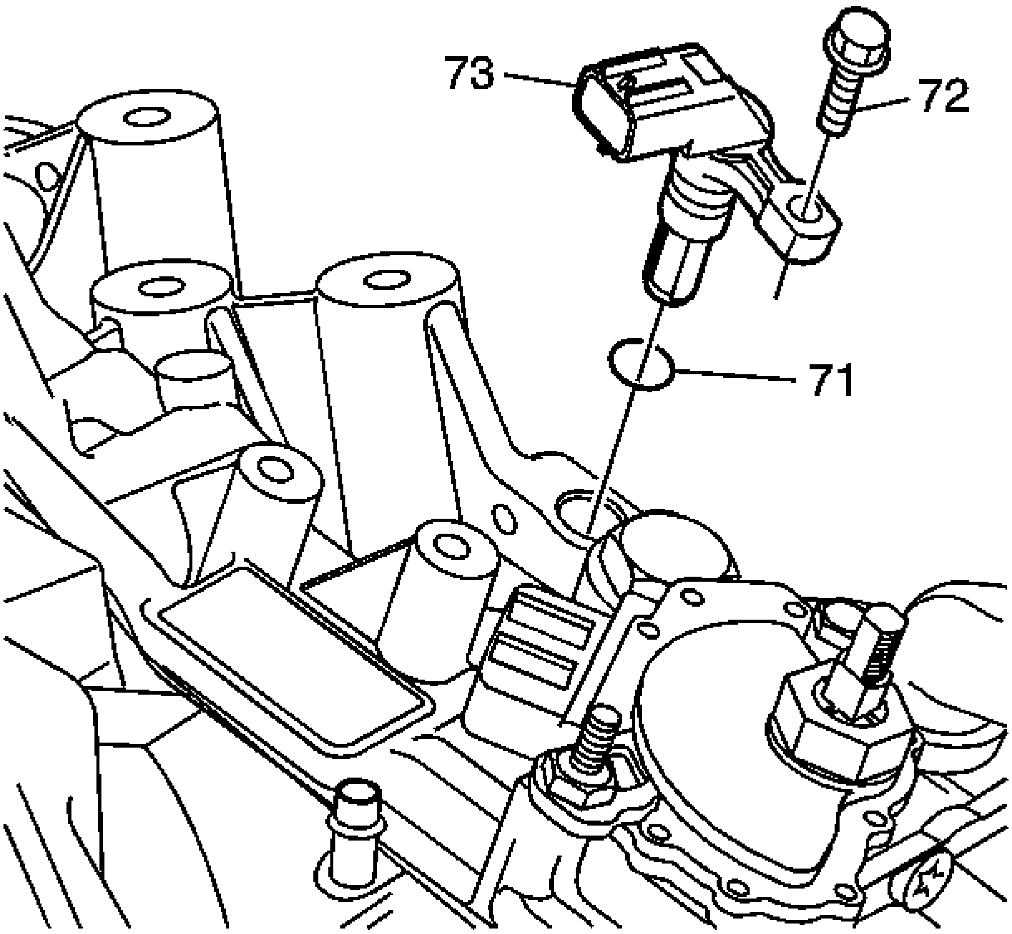

Fig. 63: Identifying Control Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the 4 control valve body bolts (1) M6 x 80.
6. Position the control solenoid valve spring (8) to the side. Spring will be released with the removal of the control valve body assembly.
7. Remove the 2 control valve body bolts (4) M6 x 65.
8. Remove the control valve body bolt (3) M6 x 42.
9. Remove the 3 control valve body bolts (2) M6 x 95.
10. Remove the control valve body bolt (7) M6 x 55.
11. Remove the control solenoid valve body and transmission control module (TCM) assembly (5).

NOTE: Use care when removing or installing the filter plate assembly. A broken or

missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.

12. Remove the control solenoid valve assembly filter plate (6).
    - Discard the filler plate. It is not reusable.
    - Inspect the pressure switch manifold seals for damage or contamination. Replace the control solenoid valve assembly as necessary.
    - Inspect the upper channel plate bolt holes for damage, peening or burnelling. Any damage around the bolt holes near the pressure control switch (PCS) feed holes could cause leakage around the PCS seals. Replace the upper channel plate as necessary.

Installation Procedure

NOTE: **Use care when removing or installing the filter plate assembly. A broken or missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.**

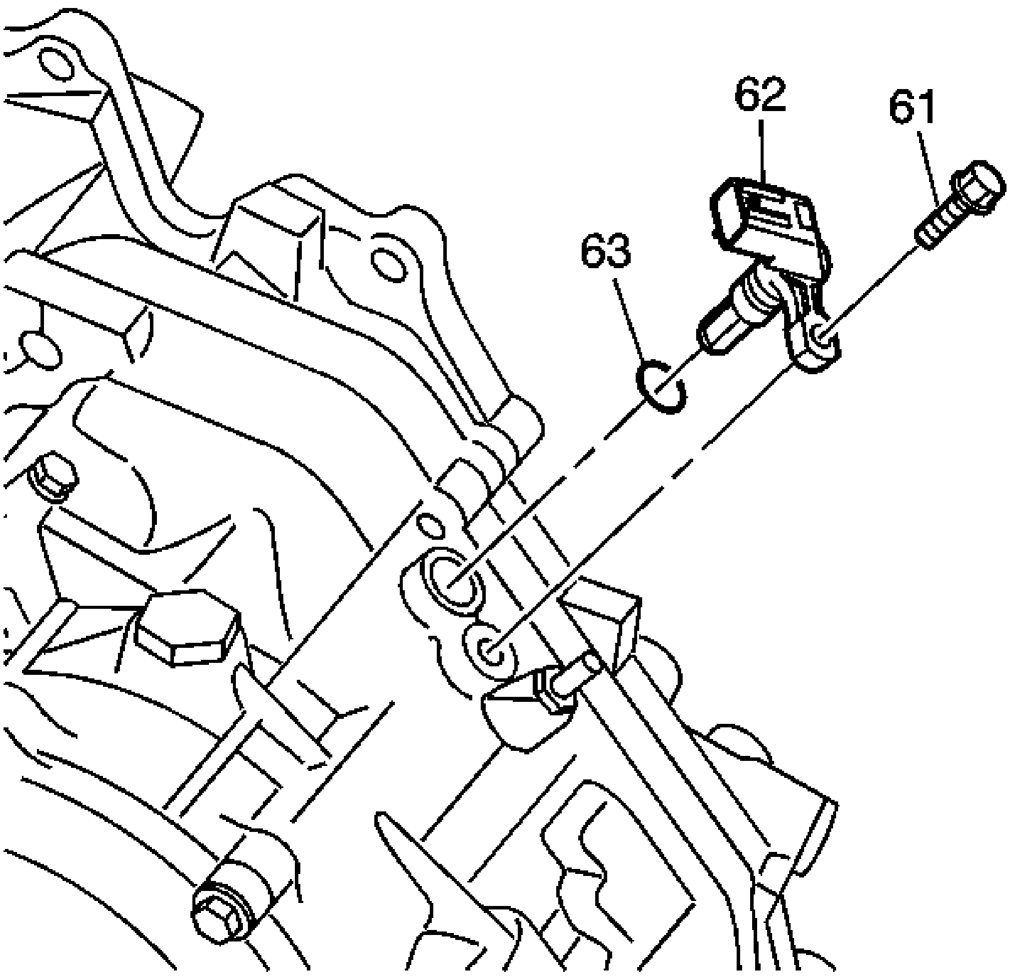

Fig. 64: Identifying Control Solenoid Valve Assembly Filter Plate
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW control solenoid valve assembly filter plate (1).

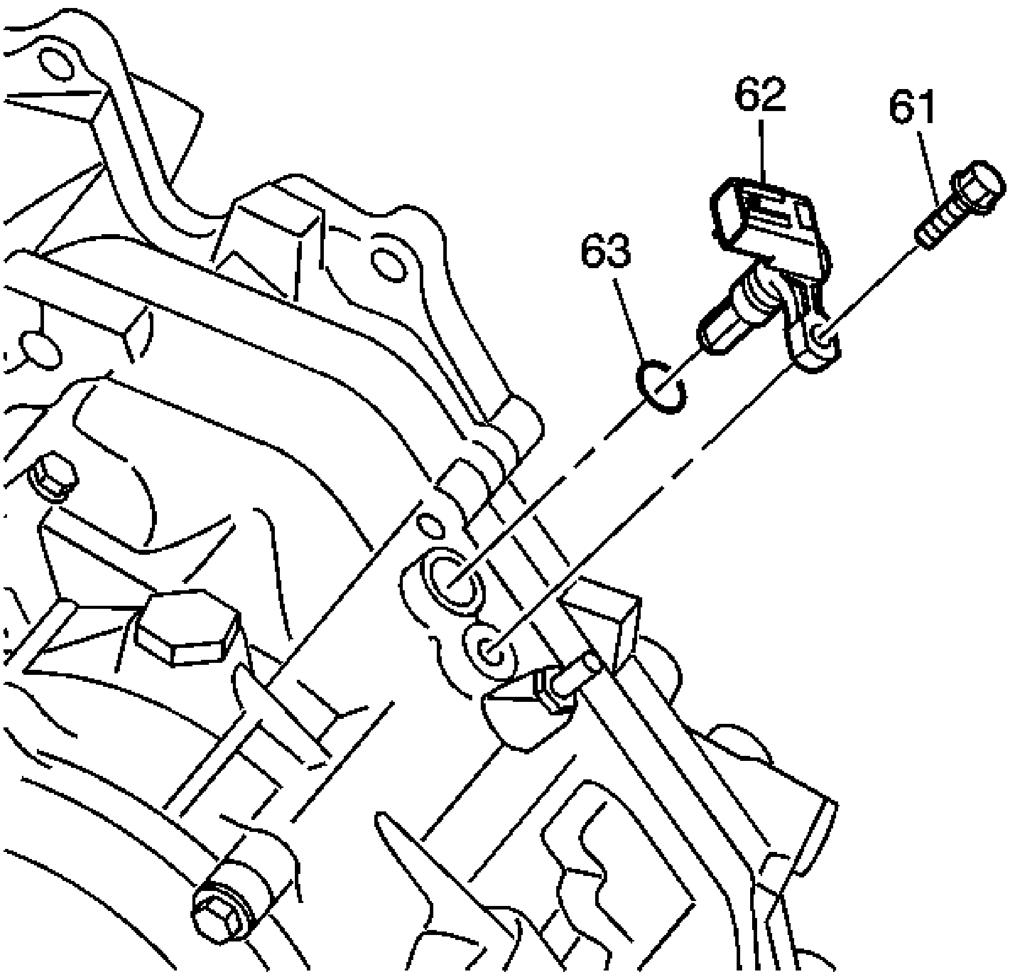

Fig. 65: Control Valve Body Bolts Torque Sequence
Courtesy of GENERAL MOTORS CORP.

2. Install the control solenoid valve body and TCM assembly (5).
3. Rotate the control solenoid valve spring (7) into position.

NOTE: **Refer to Fastener Notice .**

IMPORTANT: Install all bolts before tightening, then tighten in specified sequence.

4. Install the 4 control valve body bolts (1) M6 x 80.
5. Install the control valve body bolt (6) M6 x 55.

6. Install the 3 control valve body bolts (2) M6 x 95.
7. Install the control valve body bolt (3) M6 x 42.
8. Install the 2 control valve body bolts (4) M6 x 65.

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

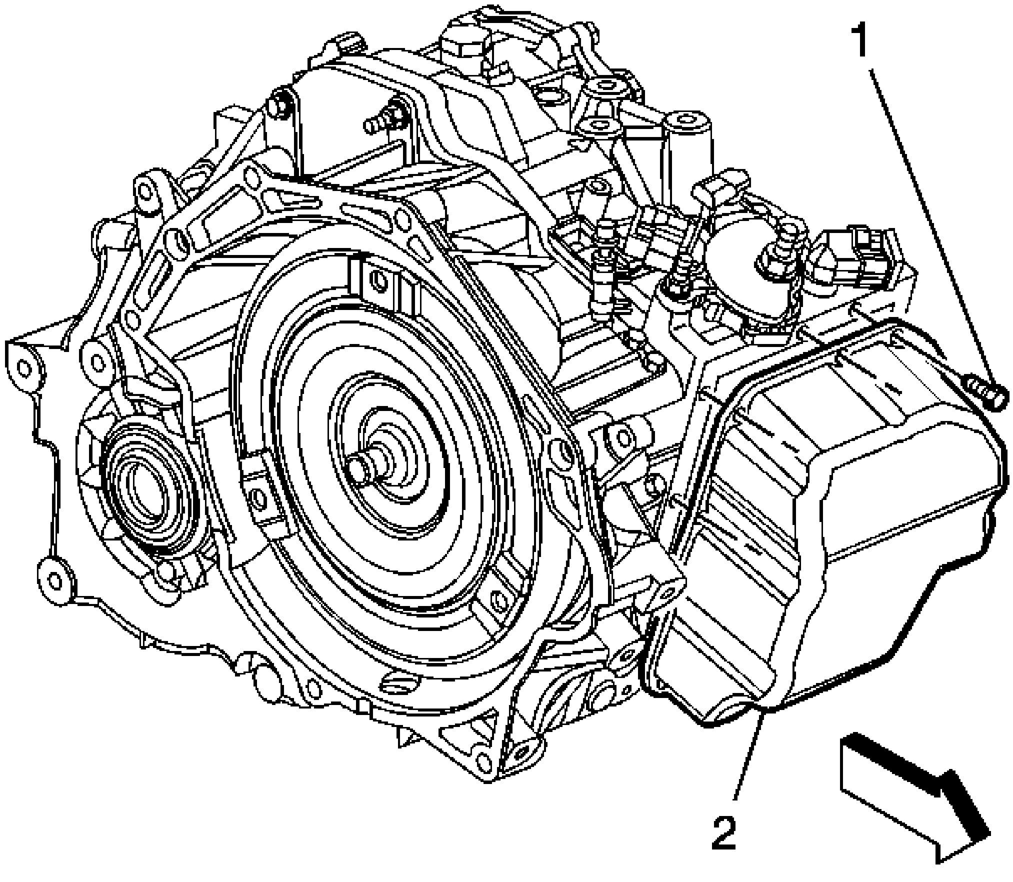

Fig. 66: Identifying Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

9. Connect the input speed sensor electrical connector (1).
10. Connect the output speed sensor electrical connector (2).
11. Connect the shift position switch electrical connector (3).
12. Install the control valve body cover. Refer to **Control Valve Body Cover Replacement**.
13. For transmission control module programming and setup. Refer to **Control Module References** .

IMPORTANT: After an internal transmission repair or internal part replacement the service fast learn adapt procedure should be performed.

14. Perform the service fast learn adapt procedure. Refer to **Service Fast Learn Adapts**.

CONTROL VALVE LOWER BODY AND UPPER BODY REPLACEMENT

Removal Procedure

1. Remove the control valve body cover. Refer to **Control Valve Body Cover Replacement**.

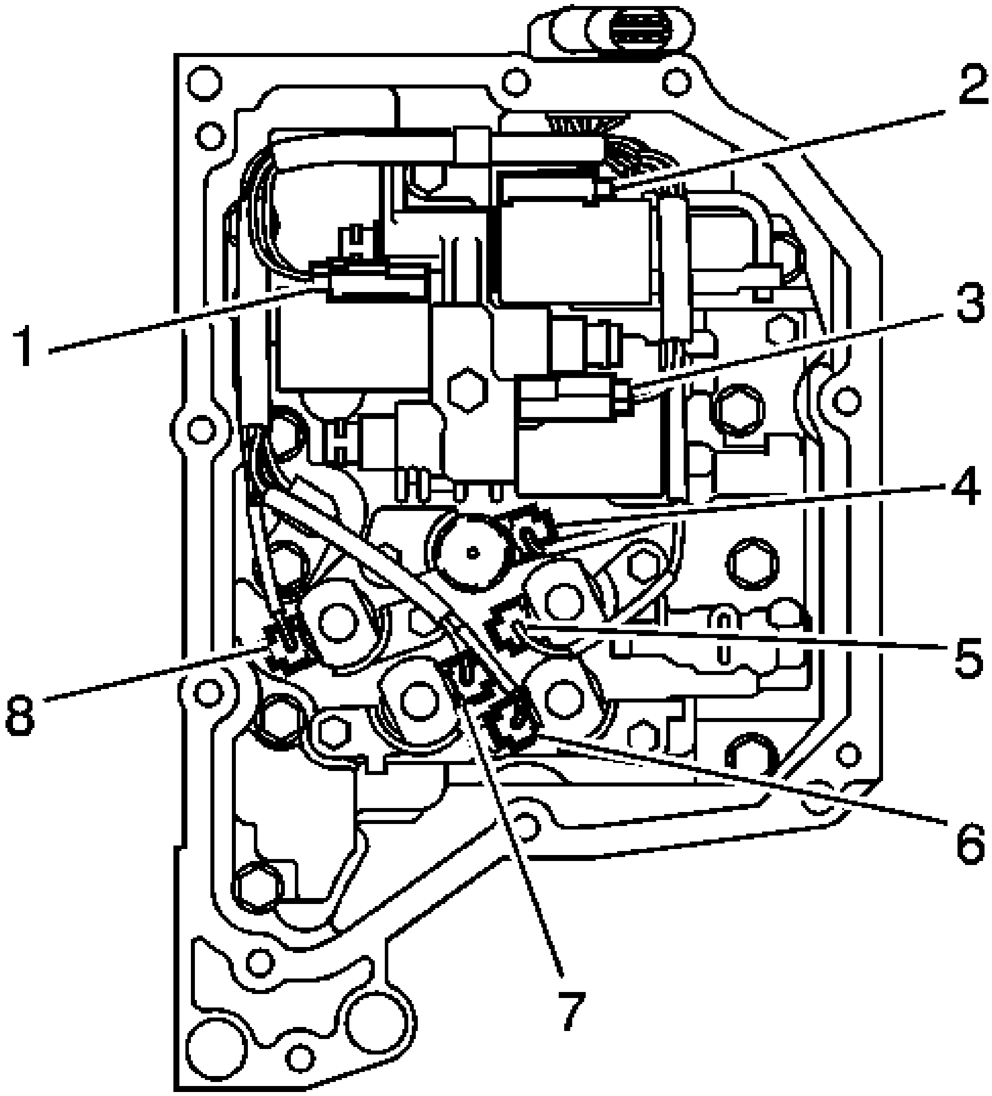

Fig. 67: Identifying Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the input speed sensor electrical connector (1).
3. Disconnect the output speed sensor electrical connector (2).
4. Disconnect the shift position switch electrical connector (3).

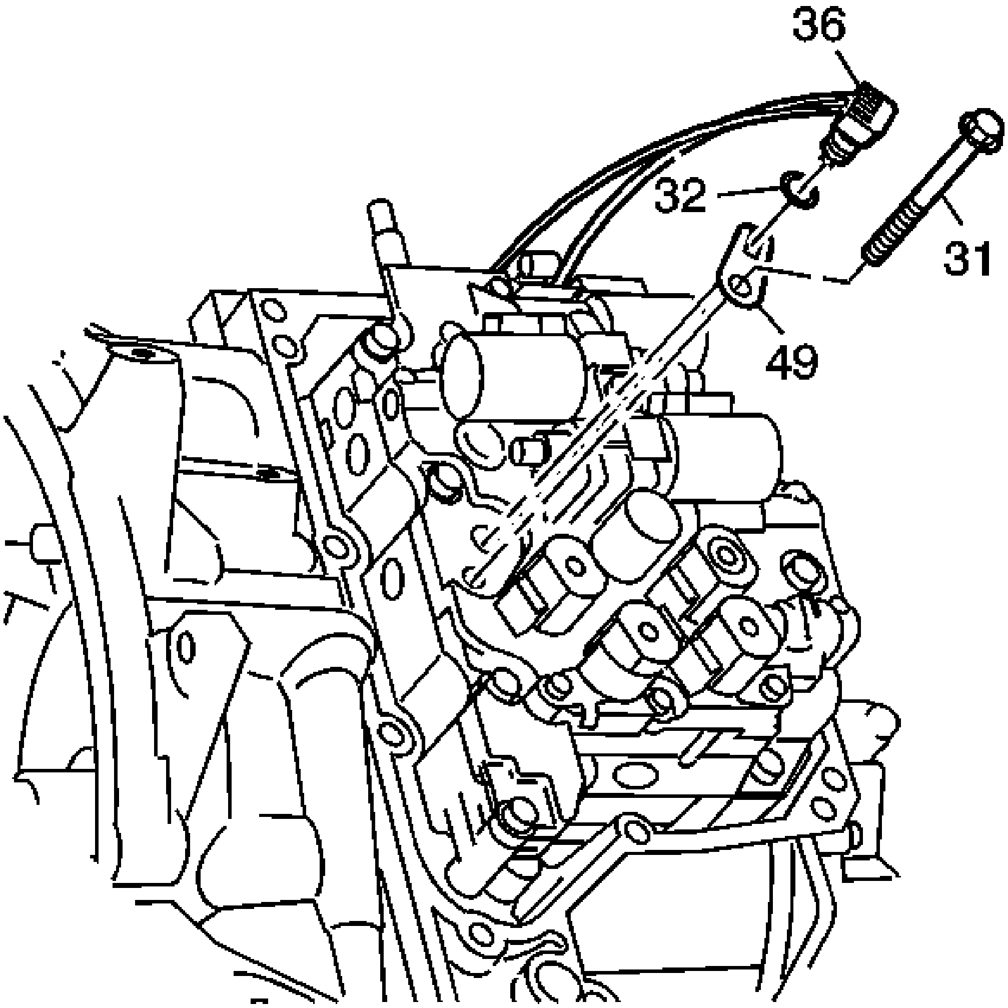

Fig. 68: Identifying Control Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the 4 control valve body bolts (1) M6 x 80.
6. Position the control solenoid valve spring (8) to the side. Spring will be released with removal of lower control valve body.
7. Remove the 2 control valve body bolts (4) M6 x 65.
8. Remove the control valve body bolt (3) M6 x 42.
9. Remove the 3 control valve body bolts (2) M6 x 95.
10. Remove the control valve body bolt (7) M6 x 55.
11. Remove the control solenoid valve body and transmission control module (TCM) assembly (5).

NOTE: **Use care when removing or installing the filter plate assembly. A broken or missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.**

12. Remove the control solenoid valve body assembly filter plate (6).
    - Discard the filler plate. It is not reusable.
    - Inspect the pressure switch manifold seals for damage or contamination. Replace the control solenoid valve assembly as necessary.
    - Inspect the upper channel plate bolt holes for damage, peening or burnelling. Any damage around the bolt holes near the PCS switch feed holes could cause leakage around the PCS switch seals. Replace the upper channel plate as necessary.

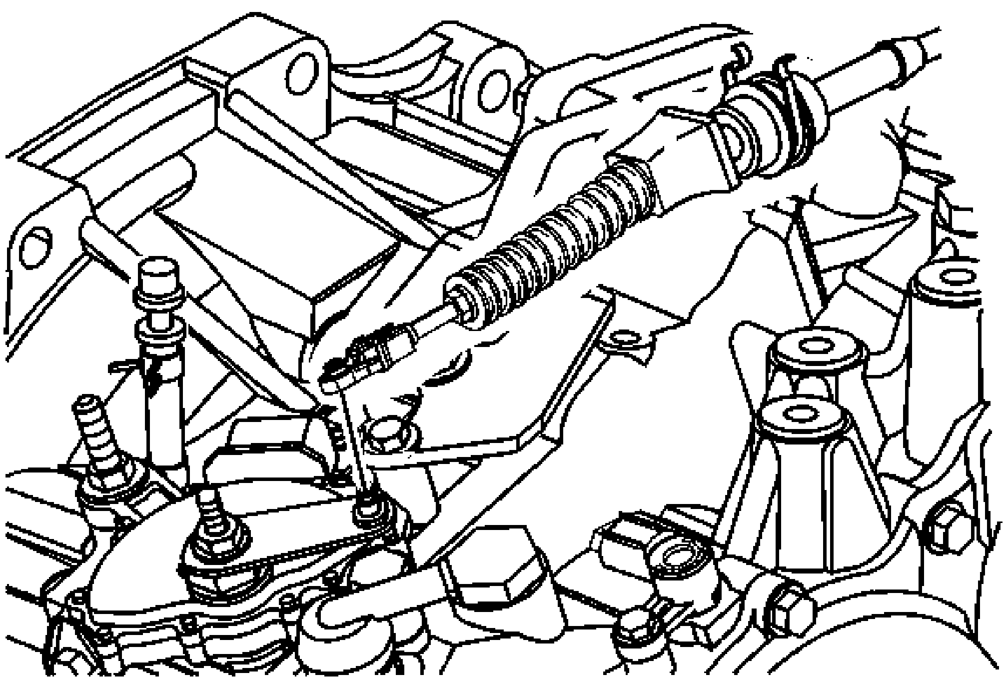

Fig. 69: Identifying Control Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the 8 control valve body bolts (2) M6 x 65.
14. Remove the 2 control valve body bolts (1) M6 x 55.
15. Remove the manual shaft detent assembly (3).
16. Remove the control valve body assembly (4).

17. The control solenoid valve spring can now be fully removed from the lower control valve body assembly.

IMPORTANT: The clutch fluid passage seal is not reusable.

18. Remove the 1-2-3-4 clutch fluid passage seal (5).

Installation Procedure

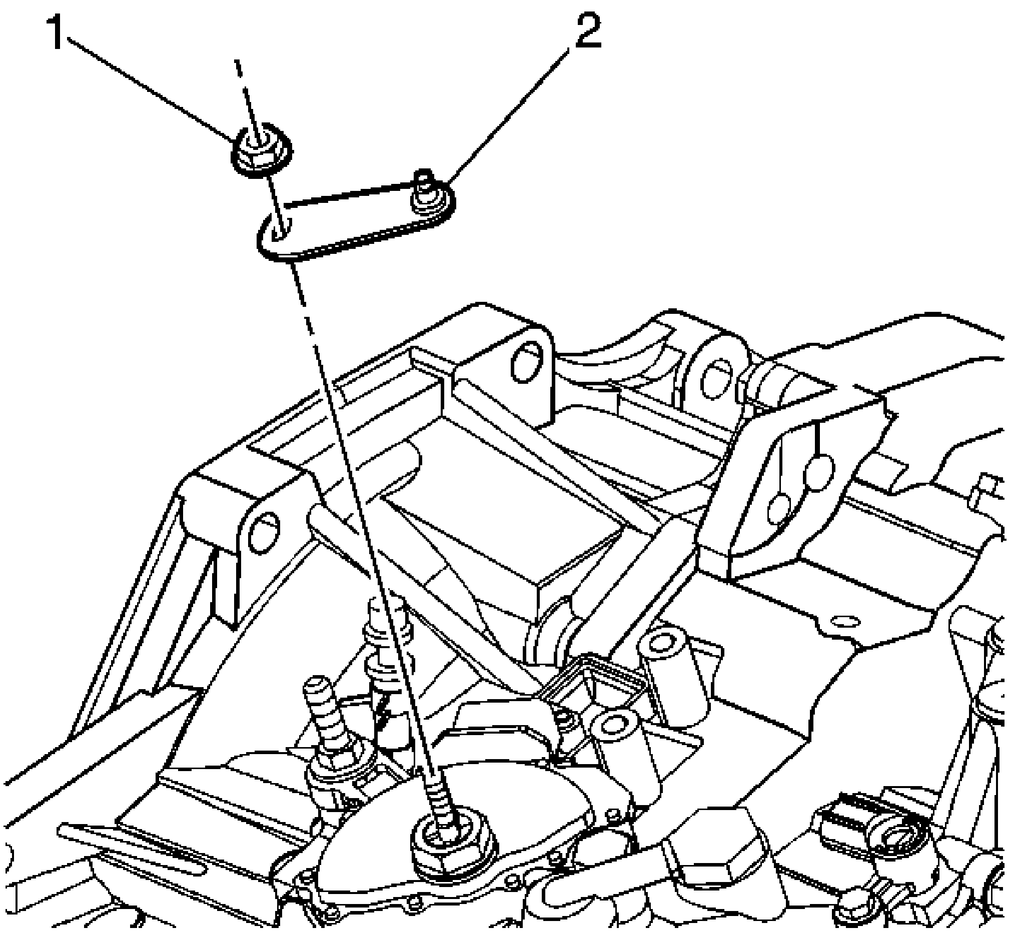

Fig. 70: Identifying Control Valve Body Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The clutch fluid passage seal is not reusable.

1. Install a NEW 1-2-3-4 clutch fluid passage seal (3).

IMPORTANT: Ensure the control solenoid valve spring is attached to the lower control valve body assembly.

IMPORTANT: Align the manual valve (2) to the detent lever assembly while installing the lower control valve body assembly.

2. Install the control valve body assembly (1).

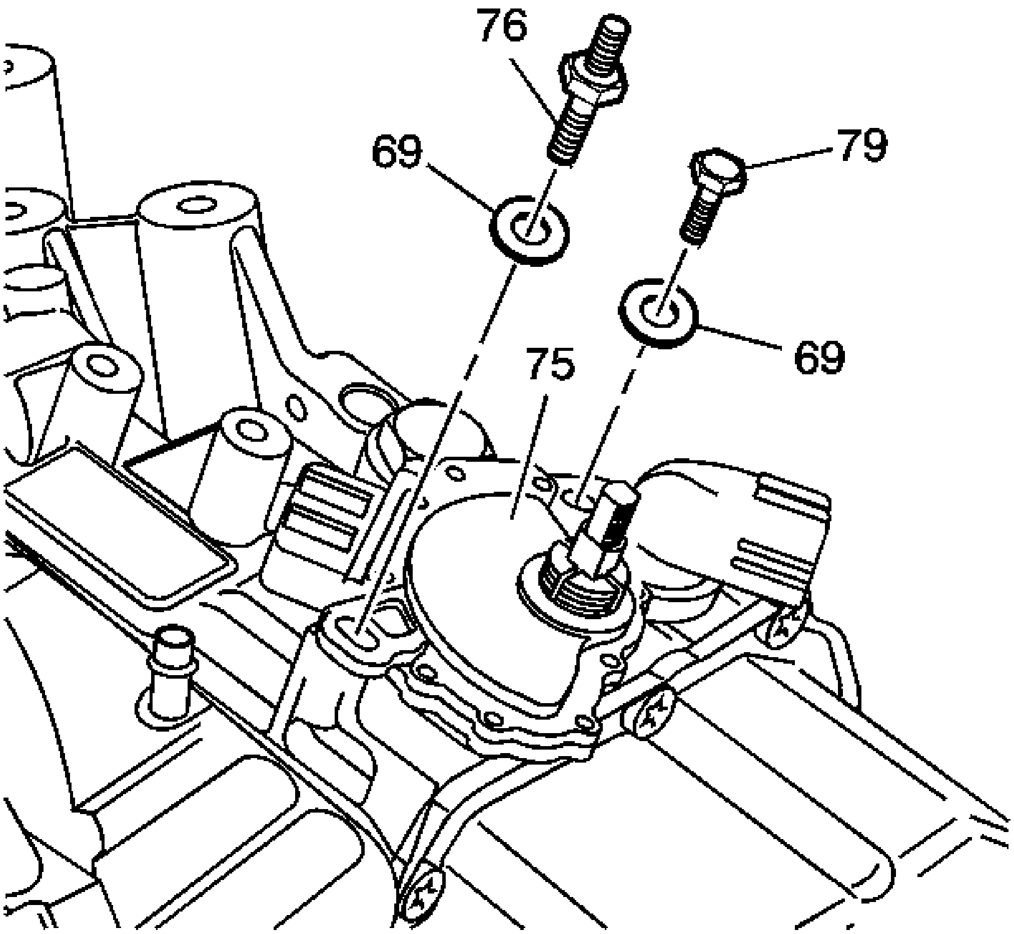

Fig. 71: Control Valve Body Bolts Torque Sequence
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure proper alignment of the detent assembly to the detent lever assembly with position switch while tightening the bolt. The detent assembly can move and hit the valve body assembly that could cause

improper engagement with the detent lever assembly.

3. Install the manual shaft detent assembly (2).

NOTE: **Refer to Fastener Notice .**

IMPORTANT: **Install all bolts before tightening, then tighten in specified sequence.**

4. Install the 8 control valve body bolts (1) M6 x 65.

   Tighten: Tighten the bolts in specified sequence to 12 N.m (106 lb in).

5. Install the 2 control valve body bolts (3) M6 x 55.

   Tighten: Tighten the bolts in specified sequence to 12 N.m (106 lb in).

NOTE: **Use care when removing or installing the filter plate assembly. A broken or missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.**

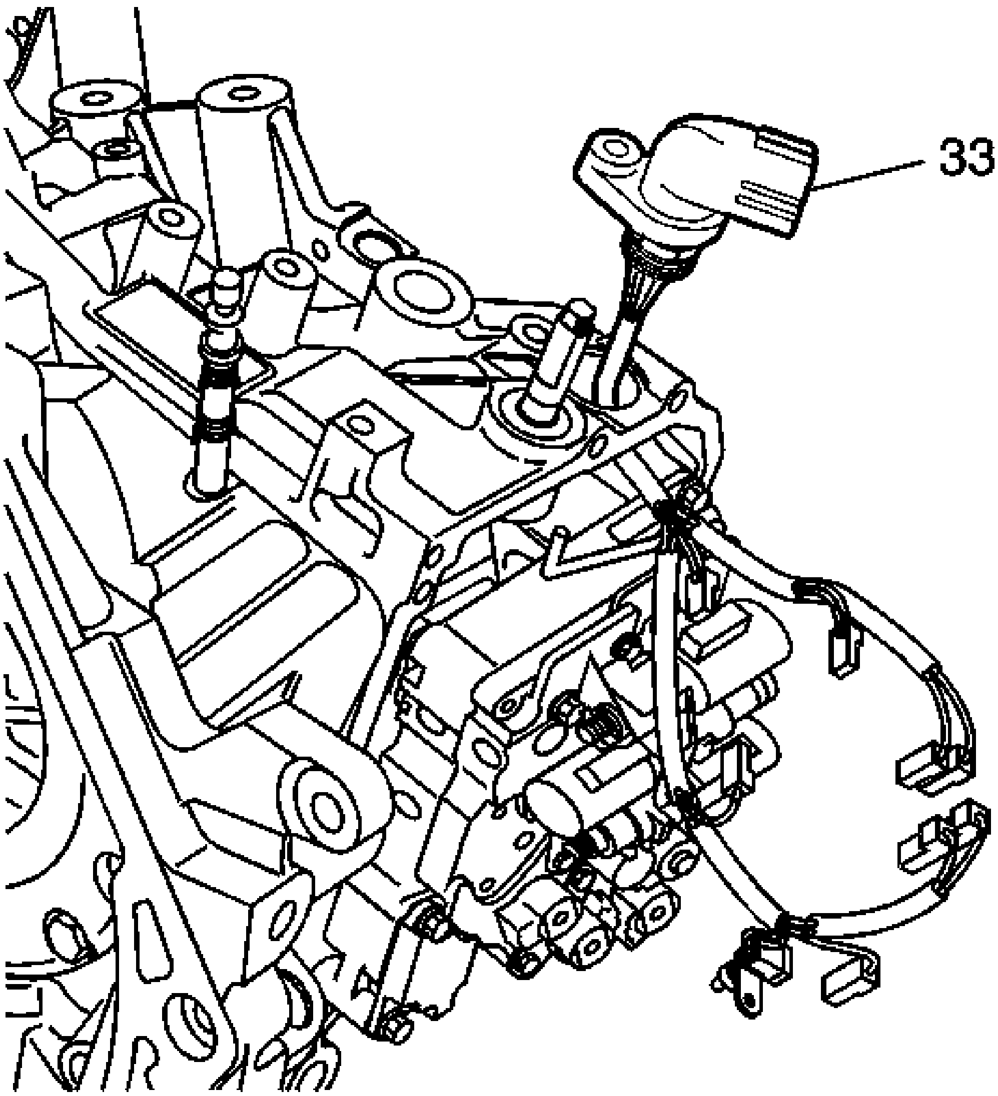

Fig. 72: Identifying Control Solenoid Valve Assembly Filter Plate
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW control solenoid valve assembly filter plate (1).

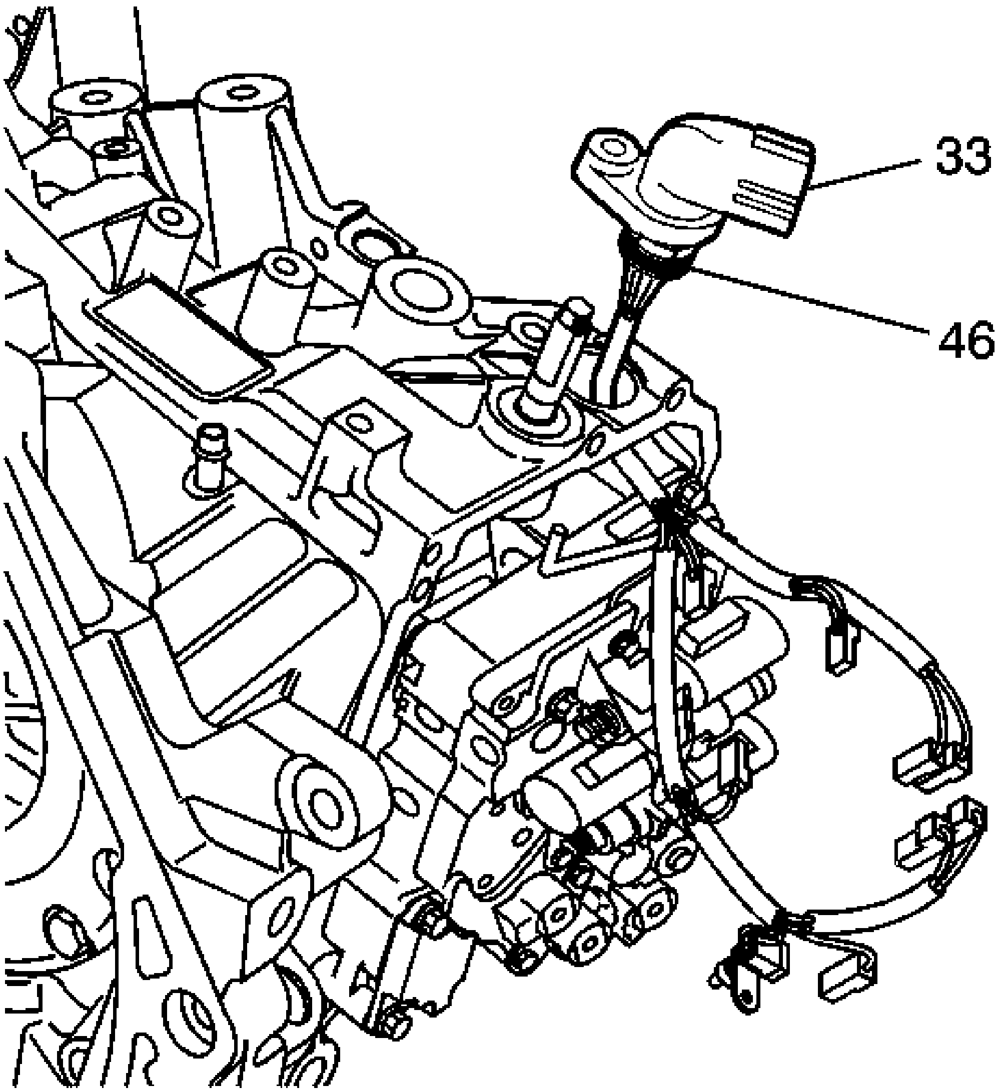

Fig. 73: Control Valve Body Bolts Torque Sequence
Courtesy of GENERAL MOTORS CORP.

7. Install the control solenoid valve body and TCM assembly (5).
8. Rotate the control solenoid valve spring (7) into position.

IMPORTANT: Install all bolts before tightening, then tighten in specified sequence.

9. Install the 4 control valve body bolts (1) M6 x 80.

10. Install the control valve body bolt (6) M6 x 55.
11. Install the 3 control valve body bolts (2) M6 x 95.
12. Install the control valve body bolt (3) M6 x 42.
13. Install the 2 control valve body bolts (4) M6 x 65.

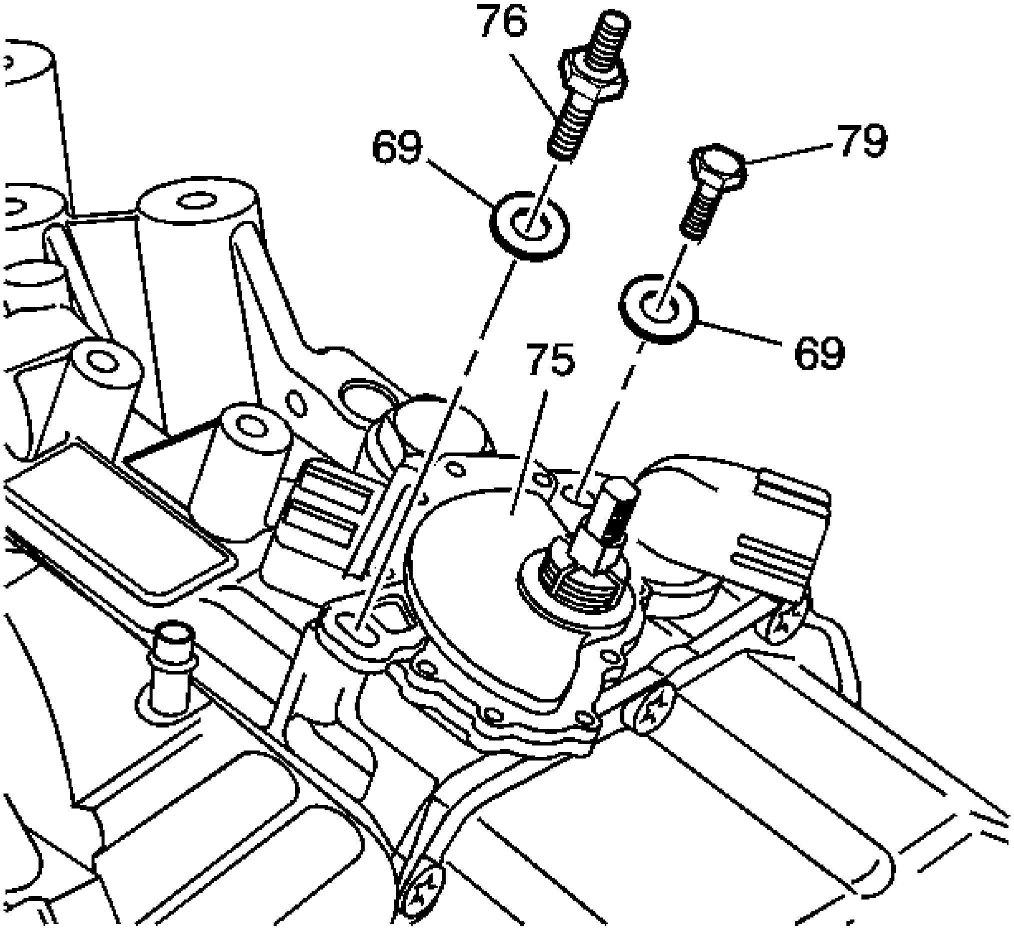

Fig. 74: Identifying Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

14. Connect the input speed sensor electrical connector (1).
15. Connect the output speed sensor electrical connector (2).
16. Connect the shift position switch electrical connector (3).
17. Install the control valve body cover. Refer to **Control Valve Body Cover Replacement**.
18. For transmission control module programming and setup. Refer to **Control Module References** .

IMPORTANT: After an internal transmission repair or internal part replacement the service fast learn adapt procedure should be performed.

19. Perform the service fast learn adapt procedure. Refer to **Service Fast Learn Adapts**.

OUTPUT SPEED SENSOR REPLACEMENT

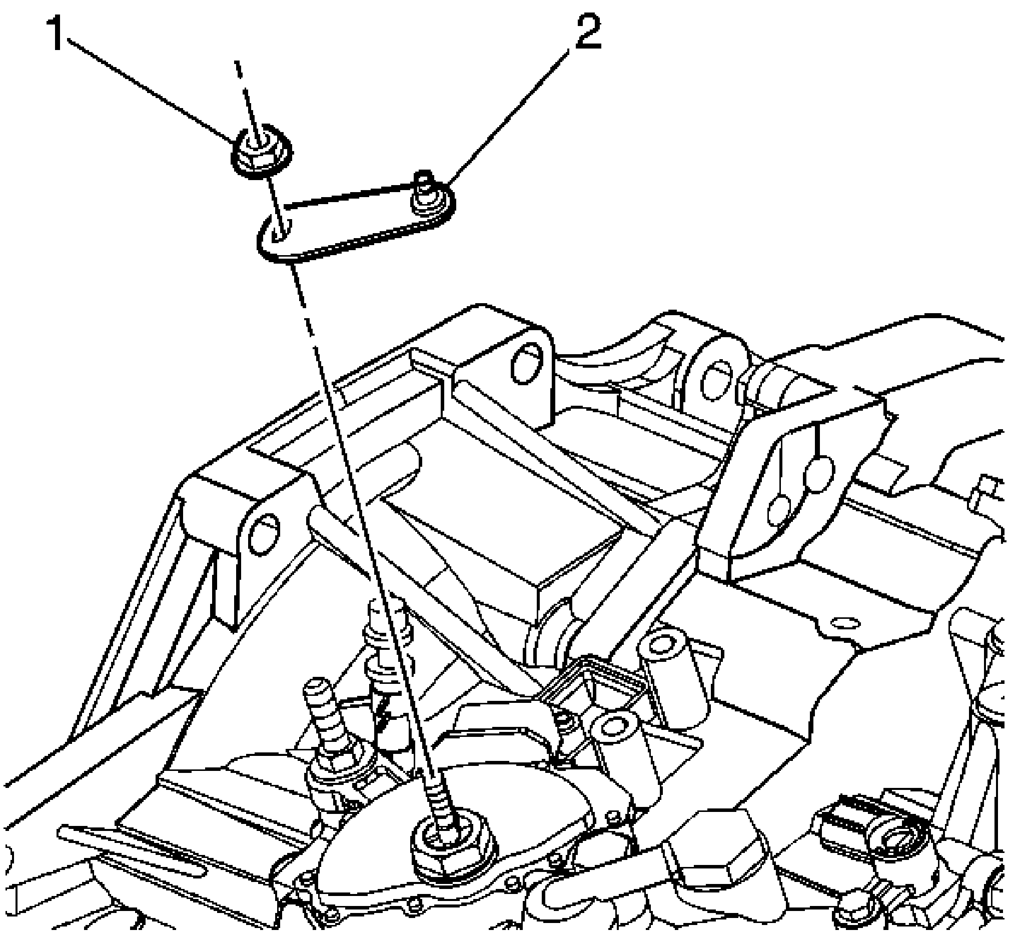

Fig. 75: View Of Output Speed Sensor
Courtesy of GENERAL MOTORS CORP.

Output Speed Sensor Replacement

Callout	Component Name
Preliminary Procedures	

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the control valve lower body and upper body. Refer to **Control Valve Lower Body and Upper Body Replacement**.	
1	Output Speed Sensor Bolt M6 x 25 **NOTE:** **Refer to Fastener Notice .** **Tighten:** 12 N.m (106 lb in)
2	Output Speed Sensor **Procedure:** Perform the service fast learn adapt procedure. Refer to **Service Fast Learn Adapts**. **Tip:** After an internal transmission repair or internal part replacement the service fast learn adapt procedure should be performed.

INPUT SPEED SENSOR REPLACEMENT

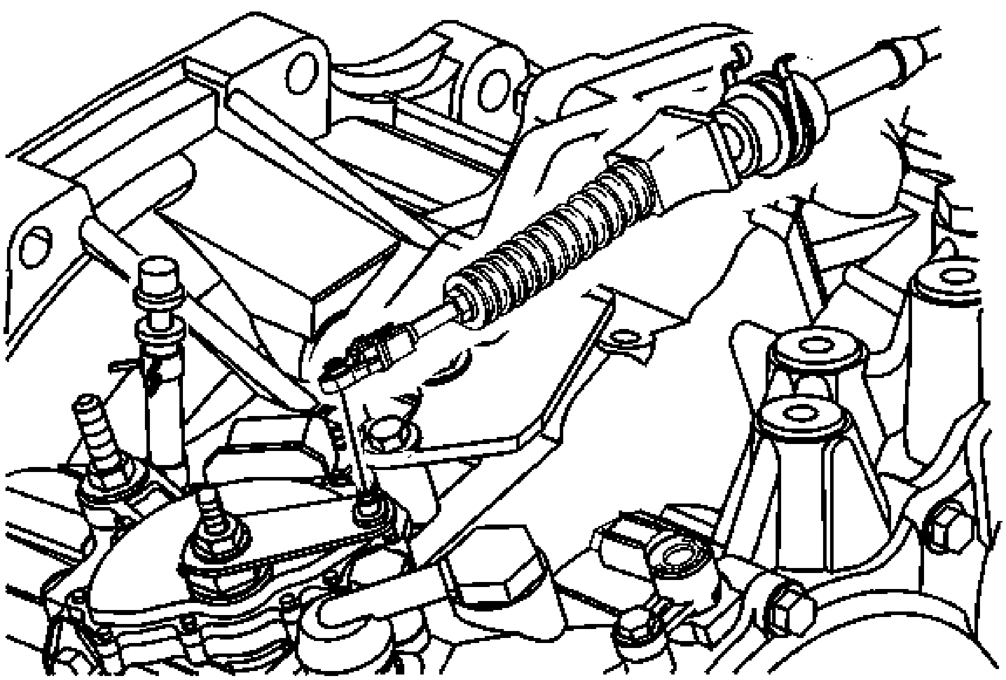

Fig. 76: View Of Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

Input Speed Sensor Replacement

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Remove the control valve body cover. Refer to Control Valve Body Cover Replacement.
IMPORTANT:
After an internal transmission repair or internal part replacement the service fast learn adapt procedure should be performed.
2. Perform the service fast learn adapt procedure. Refer to Service Fast Learn Adapts.</td></tr>
<tr><td>1</td><td>Input Speed Sensor (ISS) Wire Harness
Tip: Attach DT-47734 speed sensor harness tether to the ISS electrical connector locking tab before removal of old ISS to assist in installation of the new ISS. See Special Tools.
Special Tools:
DT-47734 Speed Sensor Harness Tether. See Special Tools.</td></tr>
<tr><td>2</td><td>Input Speed Sensor Bolt M6 x 25
NOTE:
Refer to Fastener Notice .
Tip: Apply threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the input speed sensor bolt.
Tighten: 9 N.m (7 lb in)</td></tr>
<tr><td>3</td><td>Input Speed Sensor</td></tr>
<tr><td>4</td><td>Input Speed Sensor Seal</td></tr>
</table>

INPUT SPEED SENSOR SEAL REPLACEMENT

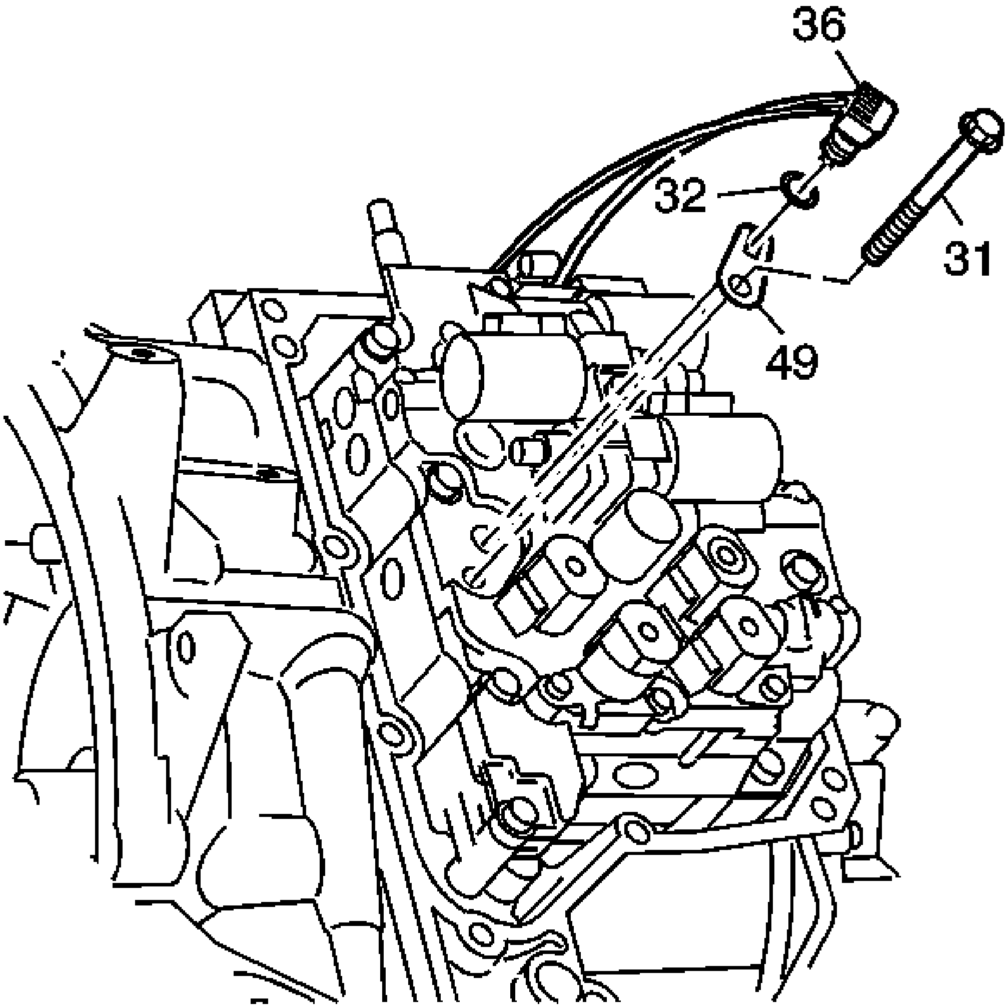

Fig. 77: Identifying Input Speed Sensor Components
Courtesy of GENERAL MOTORS CORP.

Input Speed Sensor Seal Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Drain the transmission, refill when repair is completed. Refer to **Transmission Fluid Replacement**. 3. Remove the left engine splash shield. Refer to **Engine Splash Shield Replacement - Left Side**	

	(LY7, LZ4) or **Engine Splash Shield Replacement - Left Side (LAT)** .
1	Input Speed Sensor Bolt M6 x 25 **NOTE:** **Refer to Fastener Notice .** **Tip:** Apply threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the input speed sensor bolt. **Tighten:** 9 N.m 80 lb in)
2	Input Speed Sensor (ISS) **Tip:** Pull the ISS out of the case cover just far enough to gain access to the ISS seal.
3	Input Speed Sensor Seal **Tip:** • Remove the ISS seal by pulling it over the end of the ISS base. • Install the new ISS Seal by gently stretching it over the ISS base. Overstretching the seal will cause it to not seal properly. The seal is coated with a dry lubricant. If the coating is missing, lubricate the seal with automatic transmission fluid prior to installation.

TRANSMISSION MOUNT BRACKET REPLACEMENT - REAR

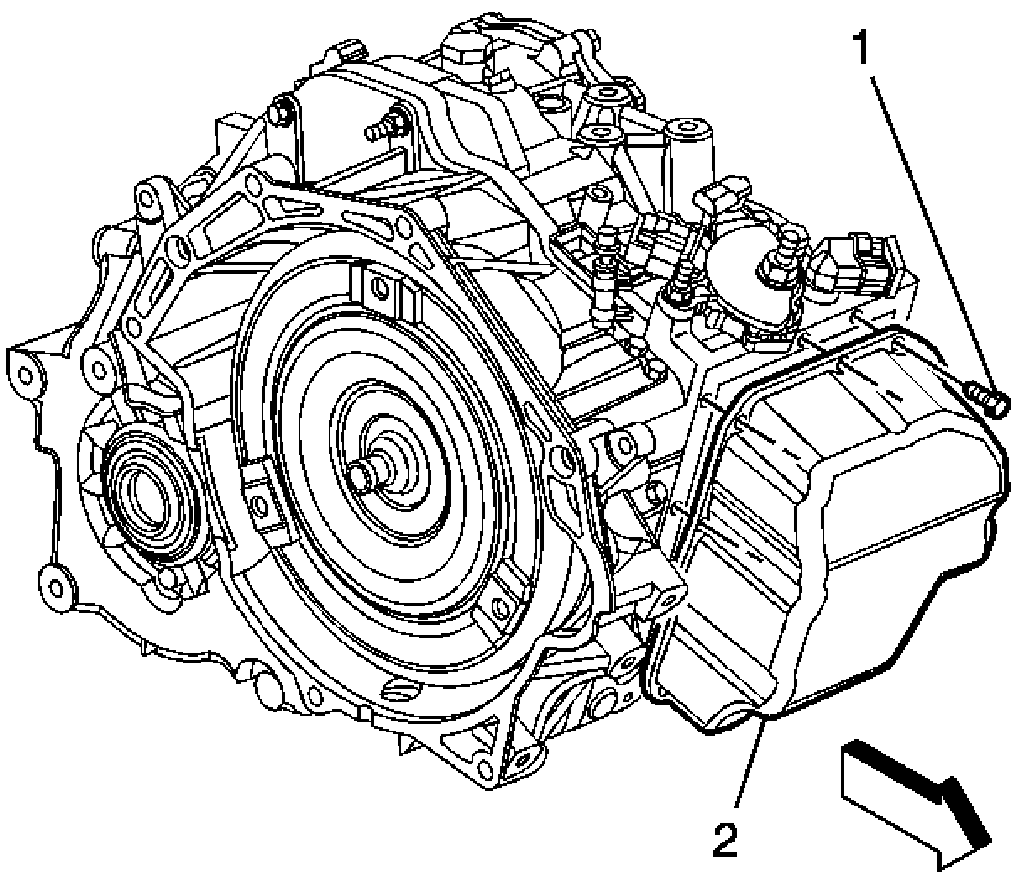

Fig. 78: Identifying Transmission Mount Bracket (Rear)
Courtesy of GENERAL MOTORS CORP.

Transmission Mount Bracket Replacement - Rear

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the right and left catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** or **Catalytic Converter Replacement - Left Side (LY7)** and **Catalytic Converter Replacement - Right Side (LZ4)** or **Catalytic Converter Replacement - Right Side (LY7)** . 3. Support the transmission with a transmission jack.	
	Rear Transmission Mount Thru Bolt **NOTE:**

1	**Refer to Fastener Notice .** **Tip:** Remove the rear transmission mount for additional clearance. Refer to **Transmission Rear Mount Replacement**. **Tighten:** 90 N.m (66 lb ft)
2	Rear Transmission Mount Bracket Nut (Qty: 3) **Tighten:** 50 N.m (37 lb ft)
3	Rear Transmission Mount Bracket

TRANSAXLE BRACE REPLACEMENT

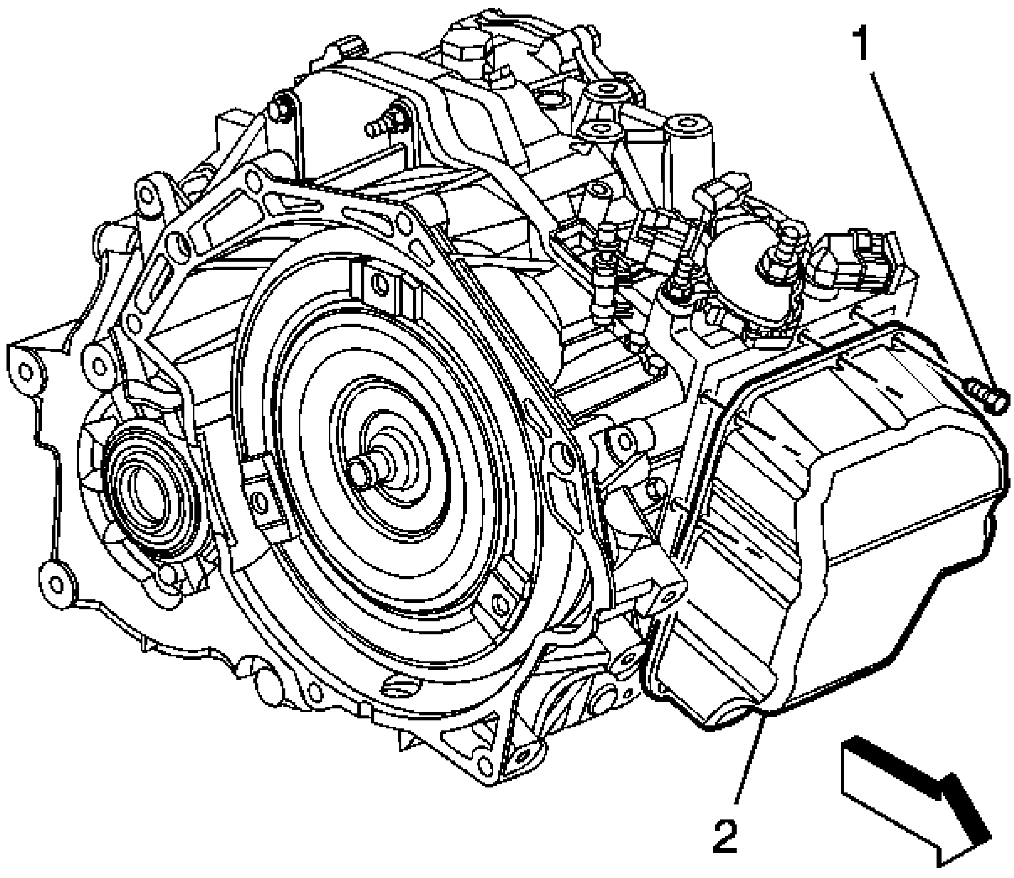

Fig. 79: Identifying Transaxle Brace
Courtesy of GENERAL MOTORS CORP.

Transaxle Brace Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the right and left catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** or **Catalytic Converter Replacement - Left Side (LY7)** and **Catalytic Converter Replacement - Right Side (LZ4)** or **Catalytic Converter Replacement - Right Side (LY7)** . 3. Support the transaxle with a transaxle jack.	
1	Rear Transaxle Brace Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 50 N.m(37 lb ft)
2	Rear Transaxle Brace Bolt **Tighten:** 50 N.m (37 lb ft)
3	Rear Transaxle Brace

TRANSMISSION MOUNT REPLACEMENT - LEFT SIDE

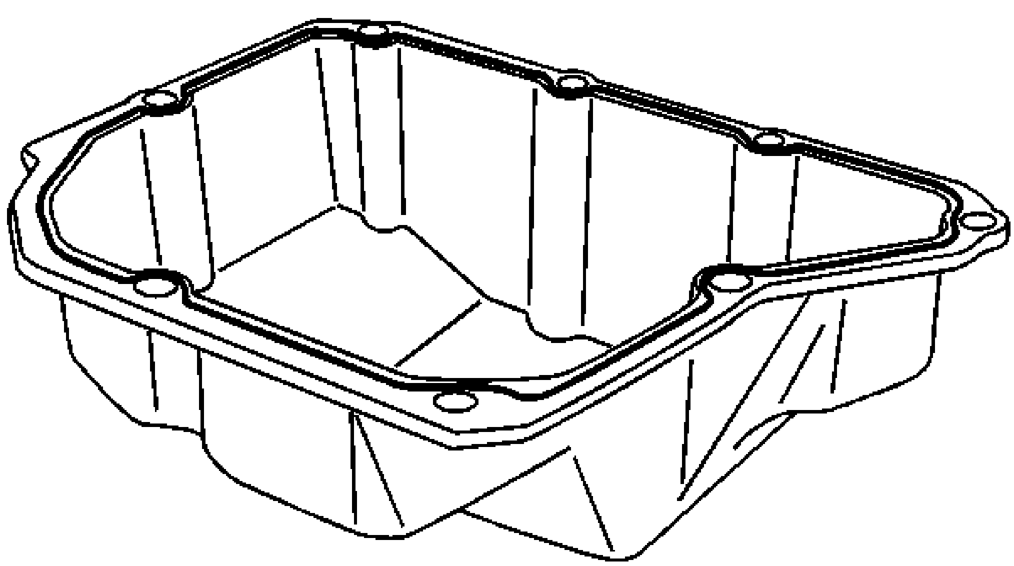

Fig. 80: Identifying Transmission Mount (Left Side)

Courtesy of GENERAL MOTORS CORP.

Transmission Mount Replacement - Left Side

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the left engine splash shield. Refer to **Engine Splash Shield Replacement - Left Side (LY7, LZ4)** or **Engine Splash Shield Replacement - Left Side (LAT)** . 3. Support the transmission with a transmission jack.	
1	Left Transmission Mount Nut (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 50 N.m(37 lb ft)
2	Left Transmission Mount Bolt (Qty: 2) **Tighten:** 90 N.m (66 lb ft)
3	Left Transmission Mount **Tip:** Use the transmission jack to lift the transmission slightly in order to provide additional clearance for removal of the mount.

TRANSMISSION FRONT MOUNT REPLACEMENT

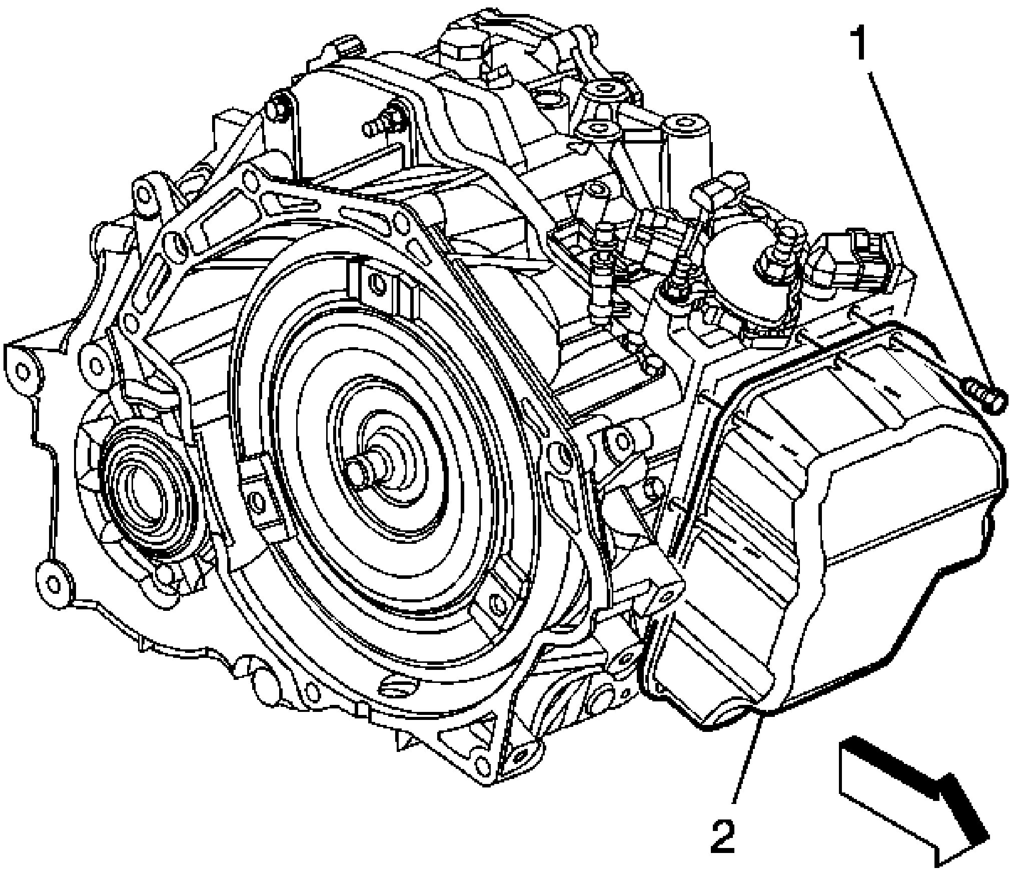

Fig. 81: Identifying Transmission Mount (Front)
Courtesy of GENERAL MOTORS CORP.

Transmission Front Mount Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the front air dam. Refer to **Front Air Dam Replacement** . 3. Support the transmission with a transmission jack.	
1	Front Transmission Mount Nut **NOTE:** **Refer to Fastener Notice .**

	Tighten: 90 N.m (66 lb ft)
2	Front Transmission Mount Thru Bolt
3	Front Transmission Mount Bolt (Qty: 4) **Tighten:** 50 N.m (37 lb ft)
4	Front Transmission Mount

TRANSMISSION REAR MOUNT REPLACEMENT

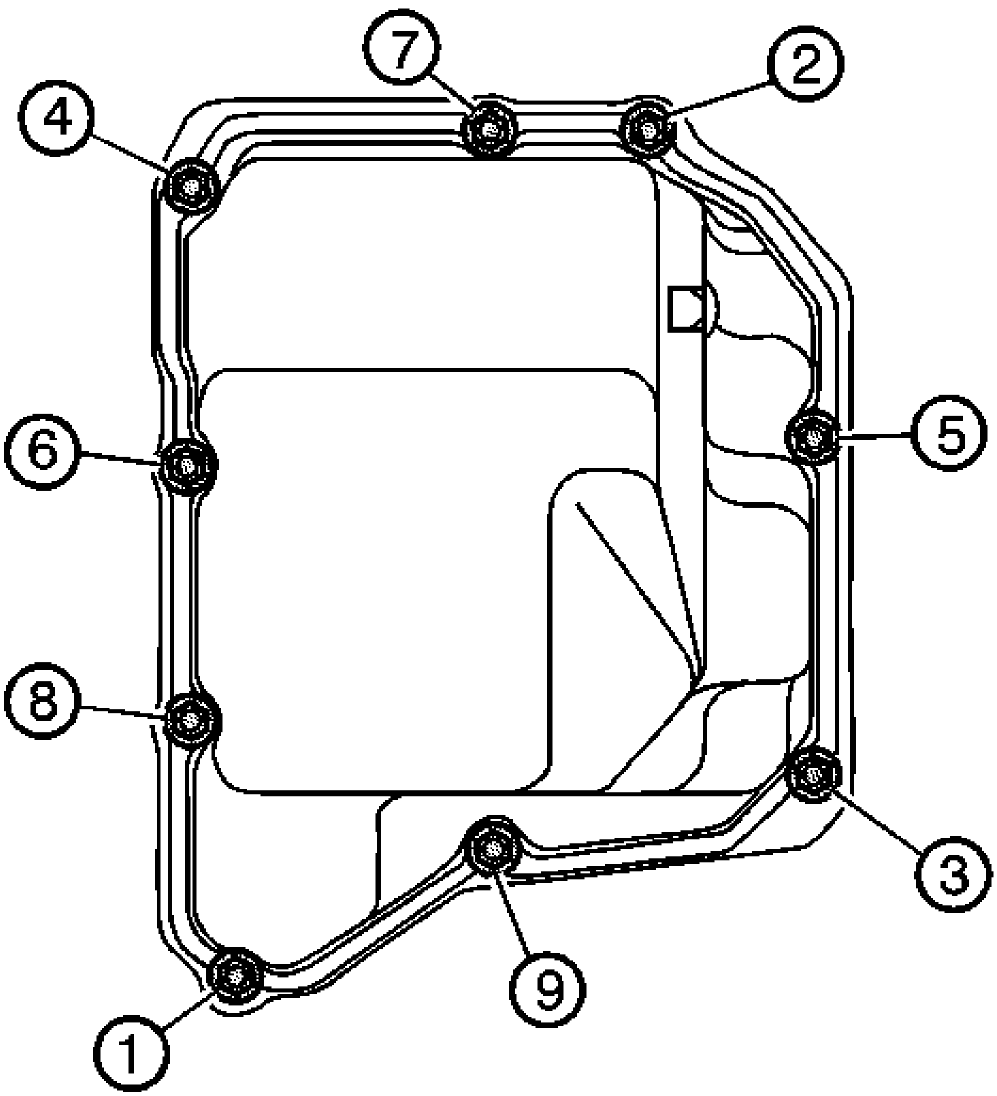

Fig. 82: Identifying Transmission Mount (Rear)
Courtesy of GENERAL MOTORS CORP.

Transmission Rear Mount Replacement

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Remove the right and left catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** or **Catalytic Converter Replacement - Left Side (LY7)** and **Catalytic Converter Replacement - Right Side (LZ4)** or **Catalytic Converter Replacement - Right Side (LY7)** . 3. Support the transmission with a transmission jack.	
1	Rear Transmission Mount Thru Bolt **NOTE:** **Refer to Fastener Notice .** **Tighten:** 90 N.m (66 lb ft)
2	Rear Transmission Mount Bolt **Tighten:** 50 N.m (37 lb ft)
3	Rear Transmission Mount Bolt (Qty: 2) **Tighten:** 50 N.m (37 lb ft)
4	Rear Transmission Mount
5	Rear Transmission Mount Brace Bolt (Qty: 2) **Tighten:** 22 N.m (16 lb ft)
6	Rear Transmission Mount Brace

TRANSMISSION REPLACEMENT

Removal Procedure

1. Remove the battery tray. Refer to **Battery Tray Replacement (LAT)** or **Battery Tray Replacement (LZ4/LY7)** .
2. Remove the transmission range select lever cable and bracket. Refer to **Automatic Transmission Range Selector Lever Cable Bracket Replacement**.
3. Drain the transmission fluid. Refer to **Transmission Fluid Replacement**.

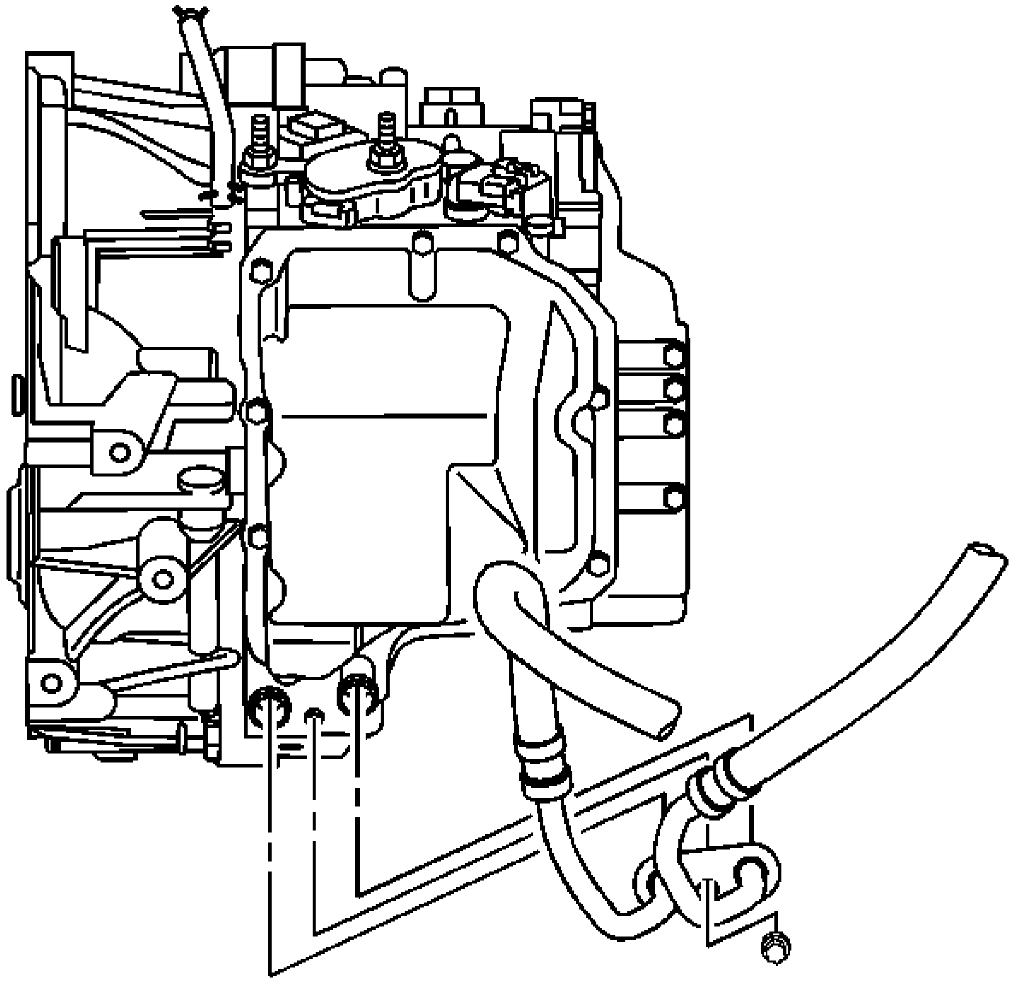

Fig. 83: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Remove the wire harness retainer (2) from the control valve body cover stud.
5. Disconnect the control valve body transmission control module (TCM) electrical connector (1).

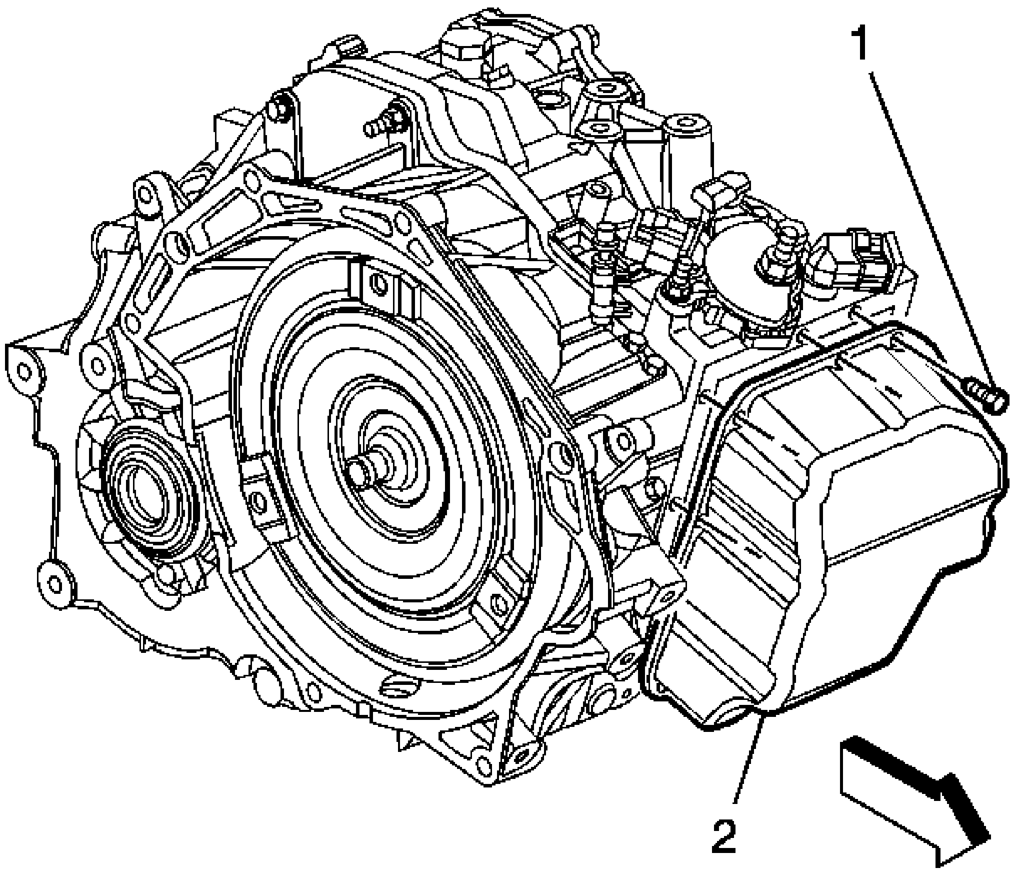

Fig. 84: Identifying Transmission Fluid Cooler Inlet Hose Components
Courtesy of GENERAL MOTORS CORP.

6. Remove the transmission fluid cooler pipe retainer nut (1).
7. Remove the transmission fluid cooler inlet hose and seal (2) from the transmission.
8. Plug and/or cap the hose and transmission to prevent contamination.

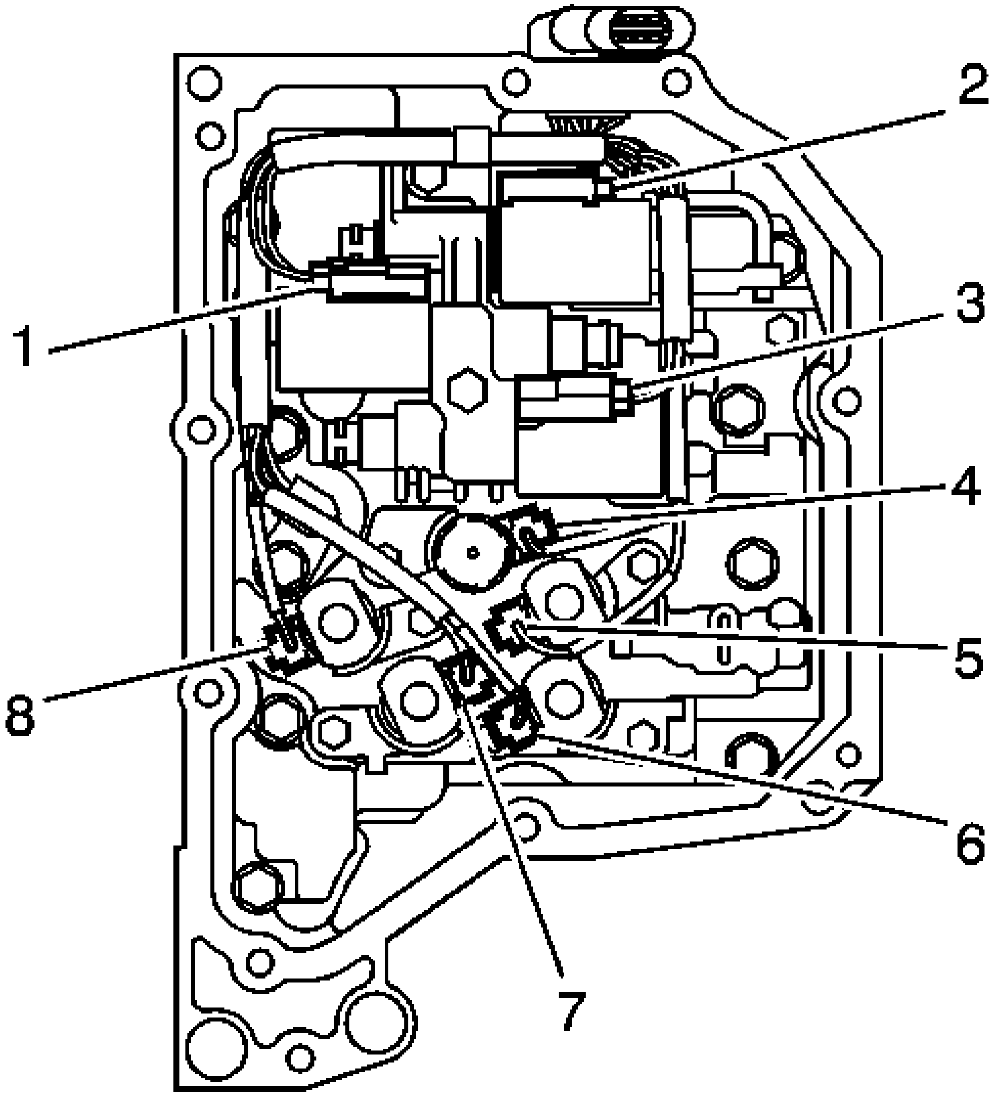

Fig. 85: Identifying Transmission Fluid Cooler Pipe Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the transmission fluid cooler pipe retainer nut (1).
10. Remove the transmission fluid cooler outlet hose and seal (2) from the transmission.
11. Plug and/or cap the hose and transmission to prevent contamination.

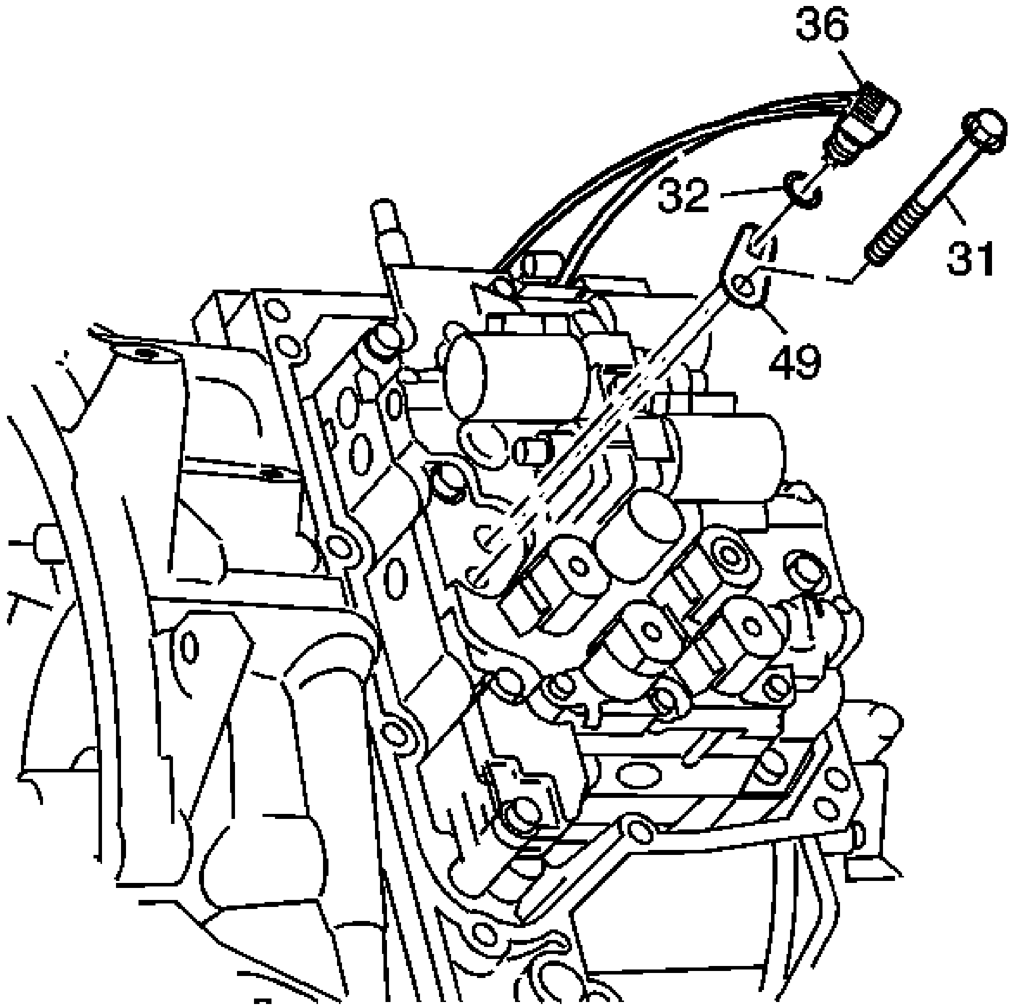

Fig. 86: Identifying Upper Transmission To Engine Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the upper transmission to engine bolts (1, 2).
13. Install the engine support fixture for the 3.6 L engine.
14. Support the radiator and condenser from above using the condenser tabs on each side.
15. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
16. Remove the frame. Refer to **Frame Replacement (2.4L)** or **Frame Replacement (3.5L)** or **Frame Replacement (3.6L)** .
17. Disconnect the wheel drive shafts from the transmission. Refer to **Wheel Drive Shaft Replacement** .
18. Remove the intermediate drive shaft. Refer to **Intermediate Drive Shaft Replacement** .

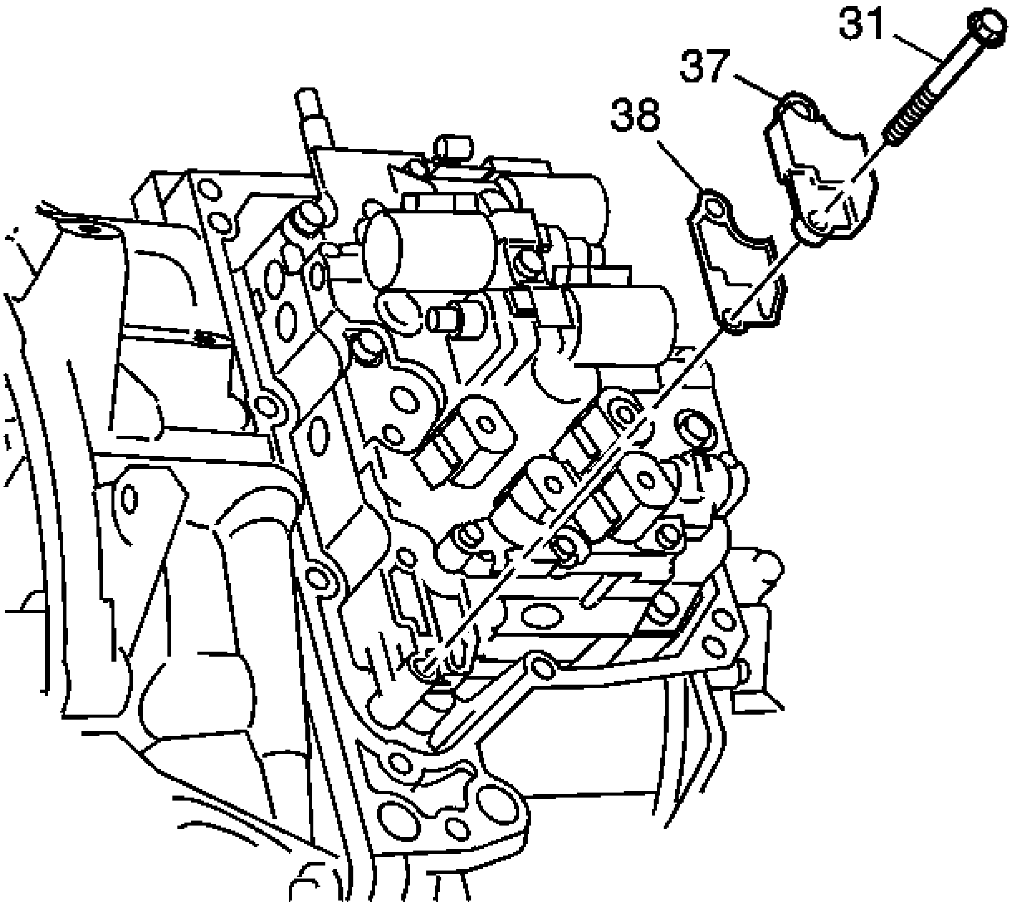

Fig. 87: Identifying Transmission Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

19. Remove the transmission brace bolts (1, 3).
20. Remove the transmission brace (2).
21. Remove the rear transmission mount from the transmission. Refer to **Transmission Rear Mount Replacement**.
22. Remove the front transmission mount from the transmission. Refer to **Transmission Front Mount Replacement**.

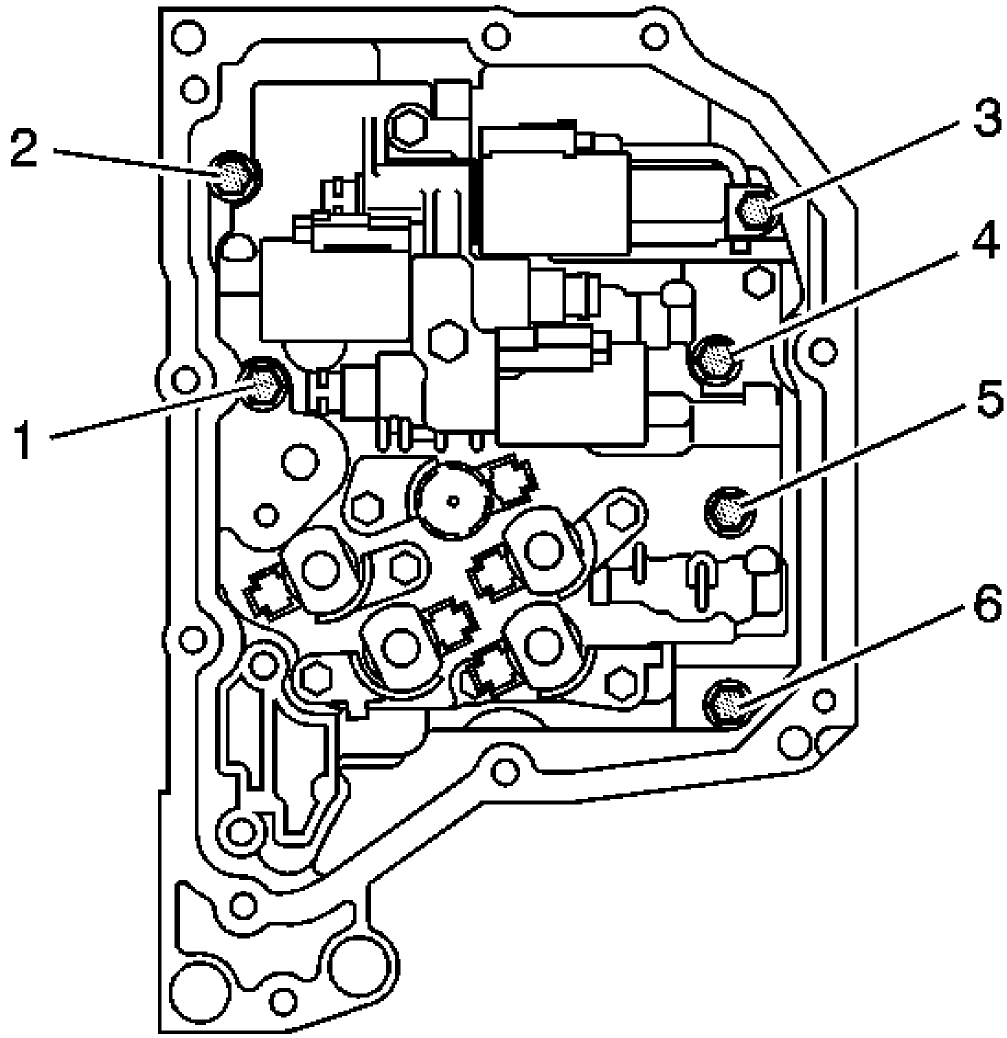

Fig. 88: Identifying Starter
Courtesy of GENERAL MOTORS CORP.

23. Remove the starter. Refer to **Starter Motor Replacement (LAT)** or **Starter Motor Replacement (LZ4)** or **Starter Motor Replacement (LY7)** .
24. Mark the relationship of the flywheel to the torque converter for reassembly.
25. Remove the torque converter to flywheel bolts.
26. Use a transmission jack in order to support the transmission.

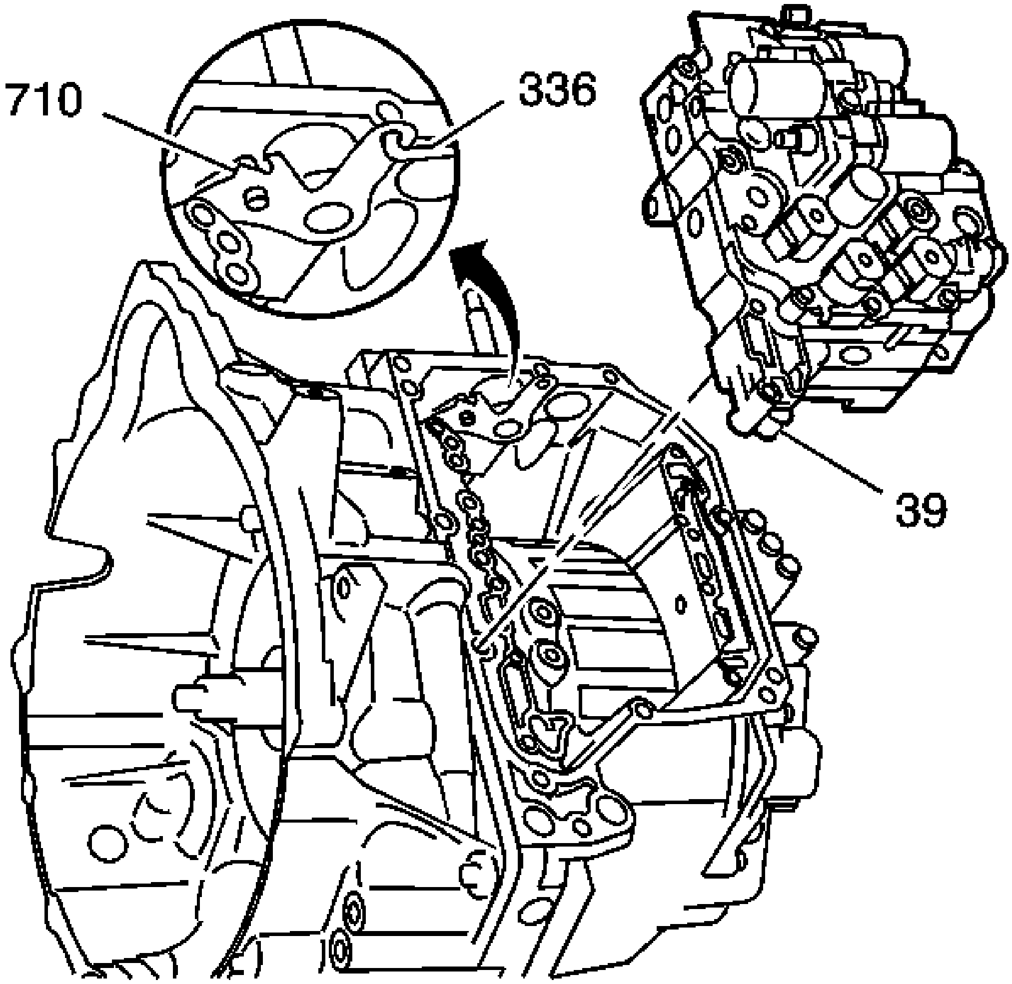

Fig. 89: Identifying Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

27. Remove the flywheel inspection cover bolts (2, 3).
28. Remove the flywheel inspection cover (1).
29. Remove the remaining transmission bolts (4).

IMPORTANT: Insure the torque converter remains securely in place on the transmission input shaft while separating and removing the transmission.

30. Separate the transmission from the engine.
31. Lower the transmission with the transmission jack far enough to remove the transmission.

Installation Procedure

1. Raise the transmission with the transmission jack and position the transmission to the engine.

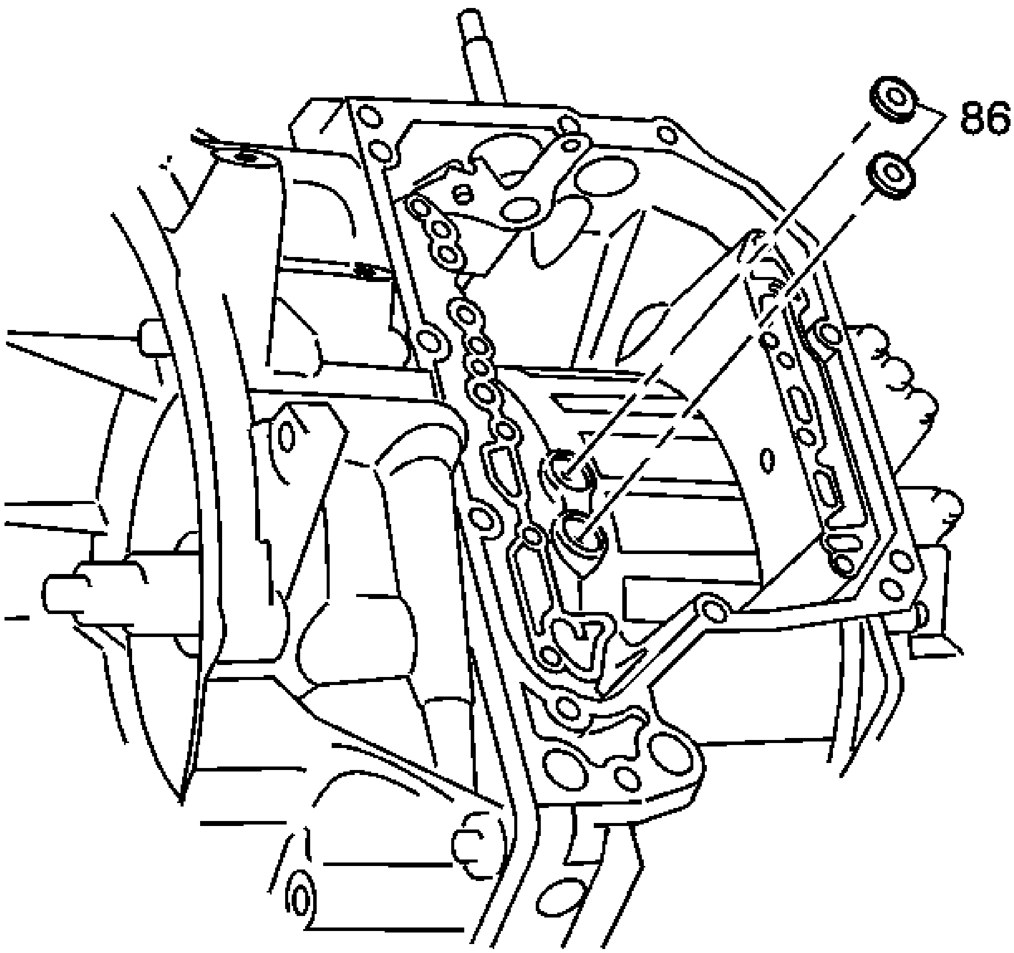

Fig. 90: Identifying Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2. Install the transmission bolts (4).

   Tighten: Tighten the bolt to 75 N.m (55 lb ft).

3. Install the flywheel inspection cover (1).

4. Install the flywheel inspection cover bolts (2, 3).

   Tighten: Tighten the bolt to 75 N.m (55 lb ft).

5. Remove the transmission jack.

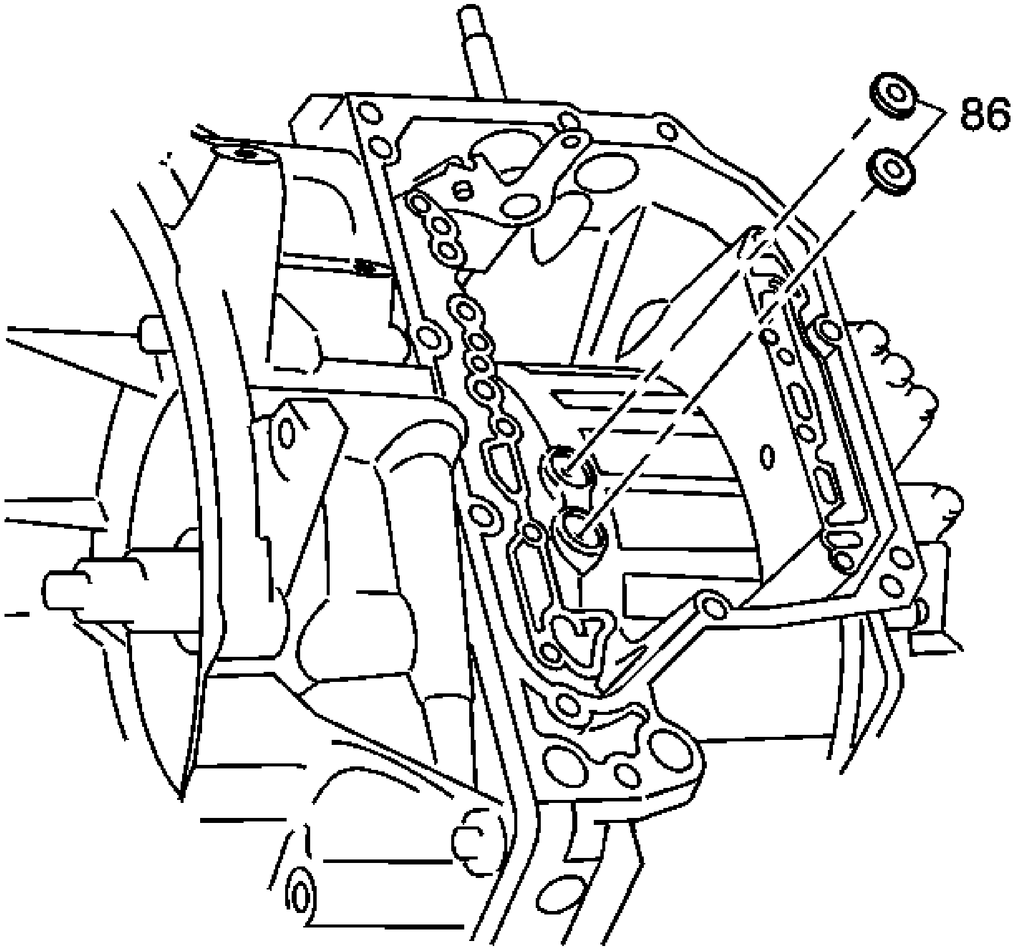

Fig. 91: Identifying Starter
Courtesy of GENERAL MOTORS CORP.

6. Install the torque converter to flywheel bolts.

   Tighten: Tighten the bolts to 62 N.m (46 lb ft).

7. Install the starter. Refer to **Starter Motor Replacement (LAT)** or **Starter Motor Replacement (LZ4)**

or **Starter Motor Replacement (LY7)** .

8. Install the front transmission mount to the transmission. Refer to **Transmission Front Mount Replacement**.
9. Install the rear transmission mount to the transmission. Refer to **Transmission Rear Mount Replacement**.

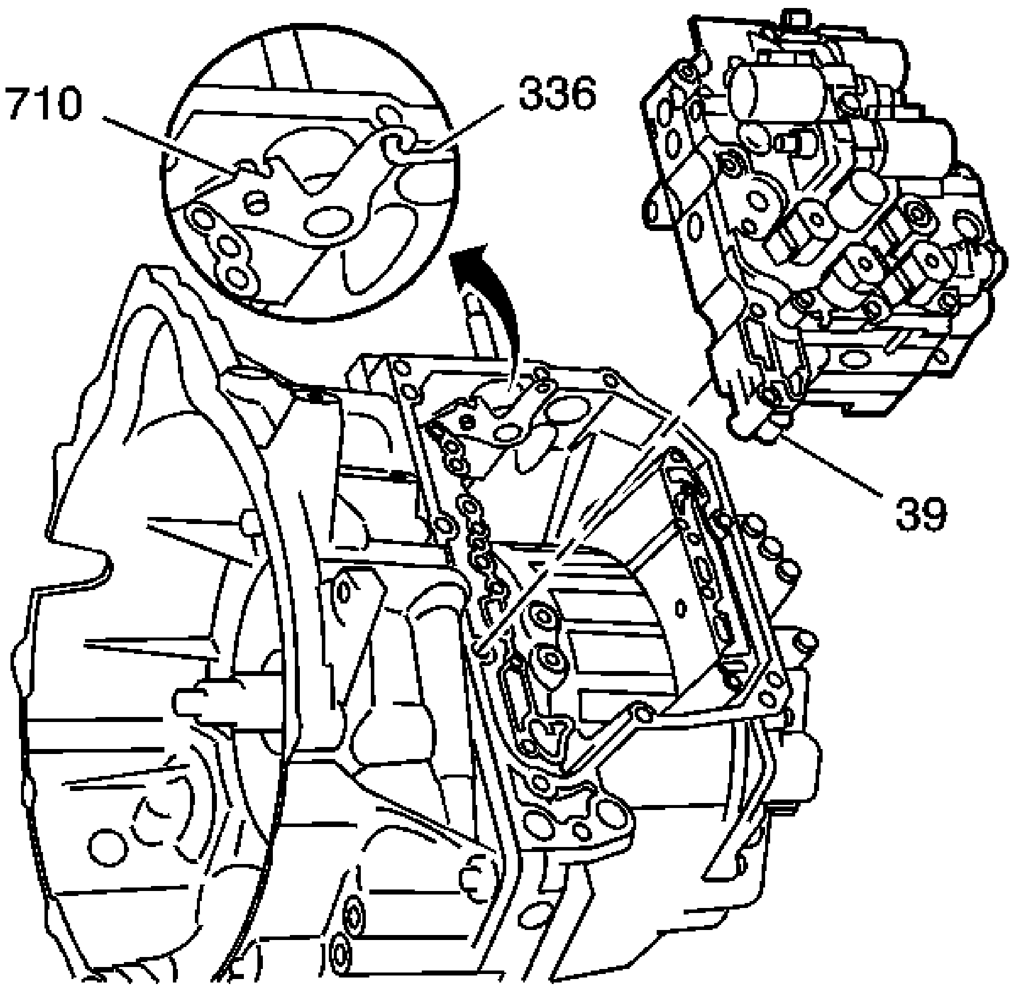

Fig. 92: Identifying Transmission Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Install the transmission brace (2).
11. Install the transmission brace bolts (1, 3).

Tighten: Tighten the bolt/stud to 50 N.m (37 lb ft).

12. Install the intermediate drive shaft. Refer to **Intermediate Drive Shaft Replacement** .
13. Install the wheel drive shafts to the transmission. Refer to **Wheel Drive Shaft Replacement** .
14. Install the frame. Refer to **Frame Replacement (2.4L)** or **Frame Replacement (3.5L)** or **Frame Replacement (3.6L)** .
15. Lower the vehicle.
16. Remove the radiator and condenser support.
17. Remove the engine support fixture.

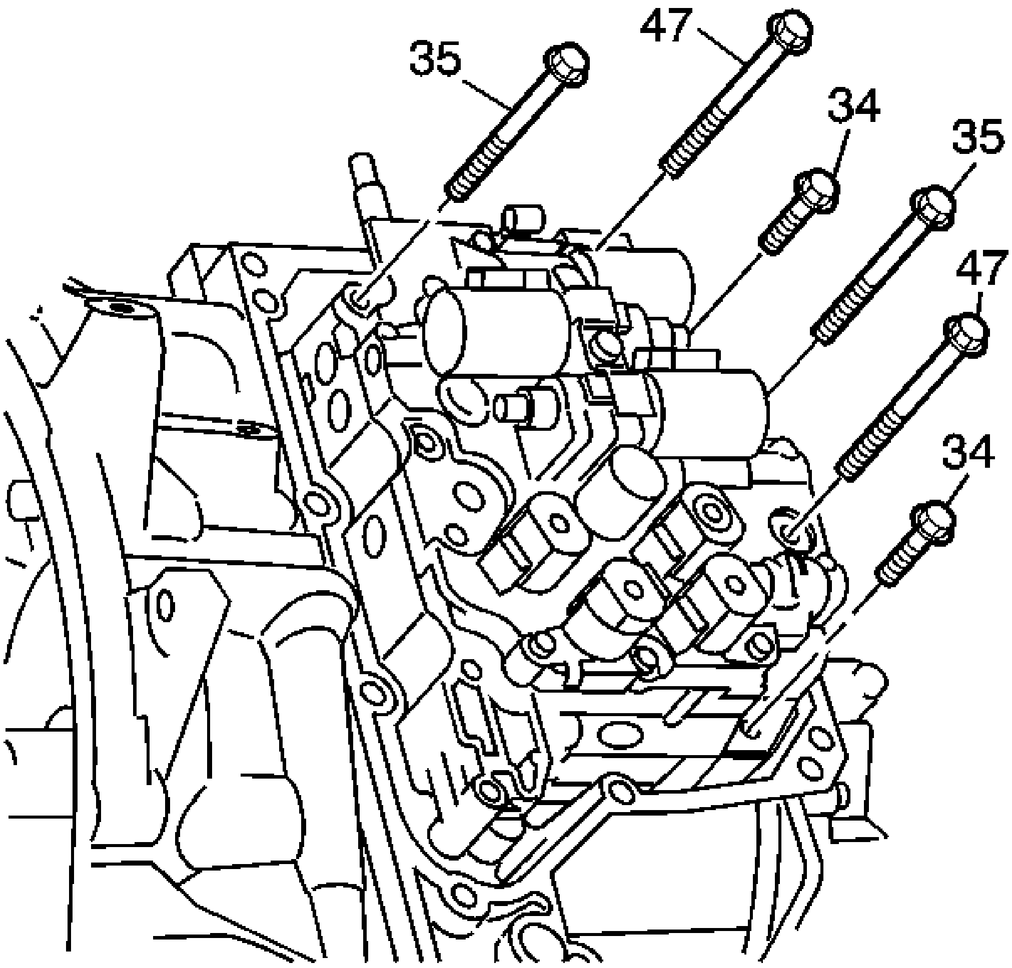

Fig. 93: Identifying Upper Transmission To Engine Bolts
Courtesy of GENERAL MOTORS CORP.

18. Install the upper transmission to engine bolt (1, 2).

    Tighten: Tighten the bolt to 75 N.m (55 lb ft).

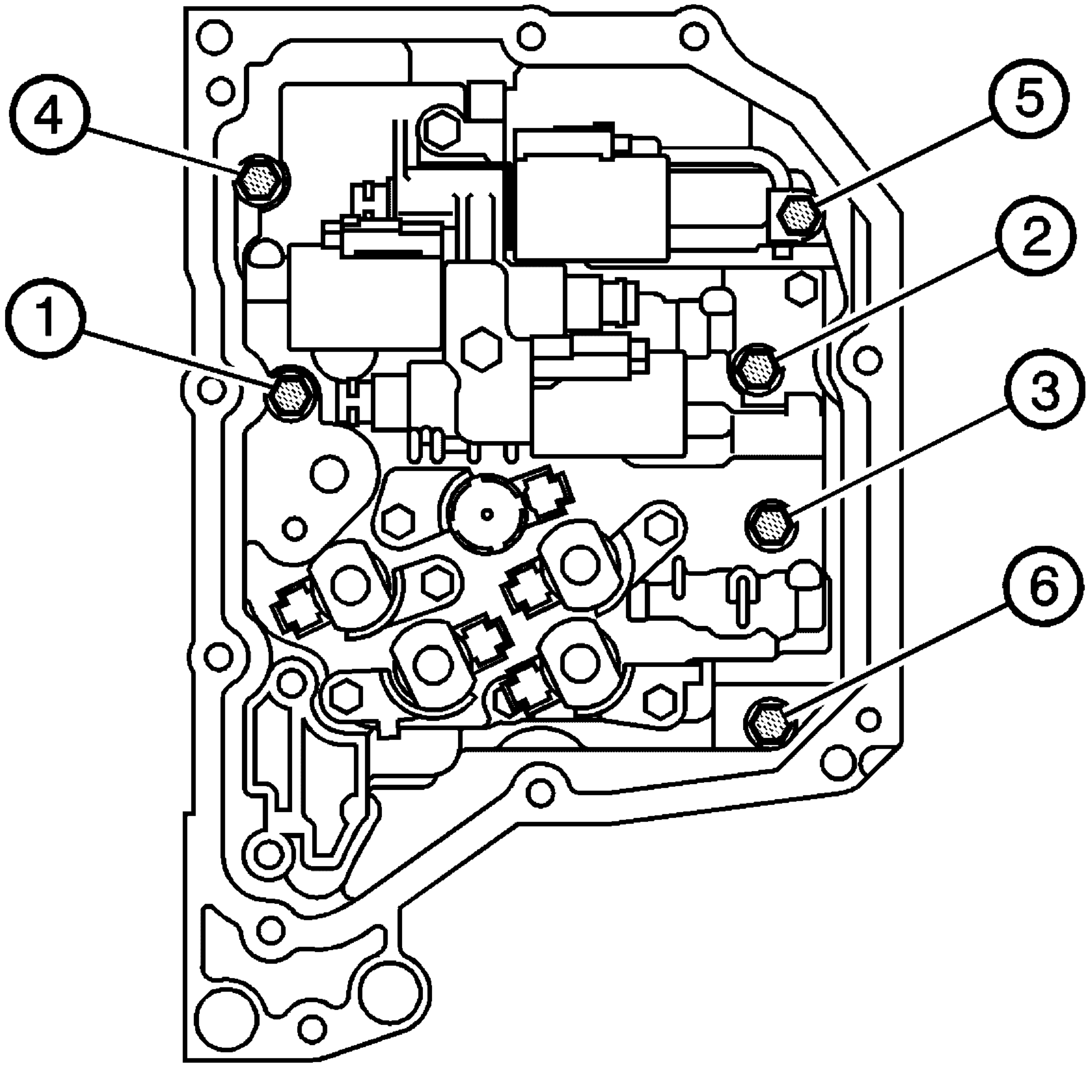

Fig. 94: Identifying Transmission Fluid Cooler Pipe Components
Courtesy of GENERAL MOTORS CORP.

19. Install the transmission fluid cooler outlet hose and seal (2) to the transmission.
20. Install the transmission fluid cooler pipe retainer nut (1).

    Tighten: Tighten the nut to 22 N.m (16 lb ft).

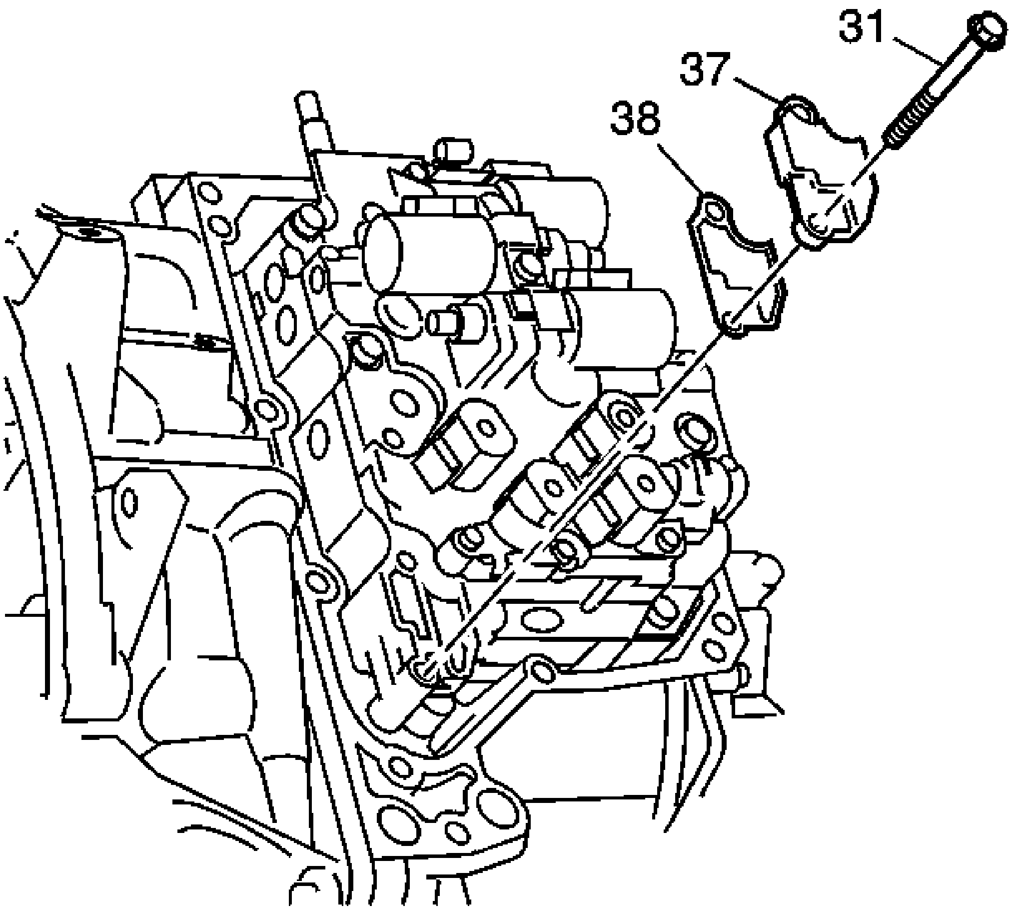

Fig. 95: Identifying Transmission Fluid Cooler Inlet Hose Components
Courtesy of GENERAL MOTORS CORP.

21. Install the transmission fluid cooler inlet hose and seal (2) to the transmission.
22. Install the transmission fluid cooler pipe retainer nut (1).

    Tighten: Tighten the nut to 22 N.m (16 lb ft).

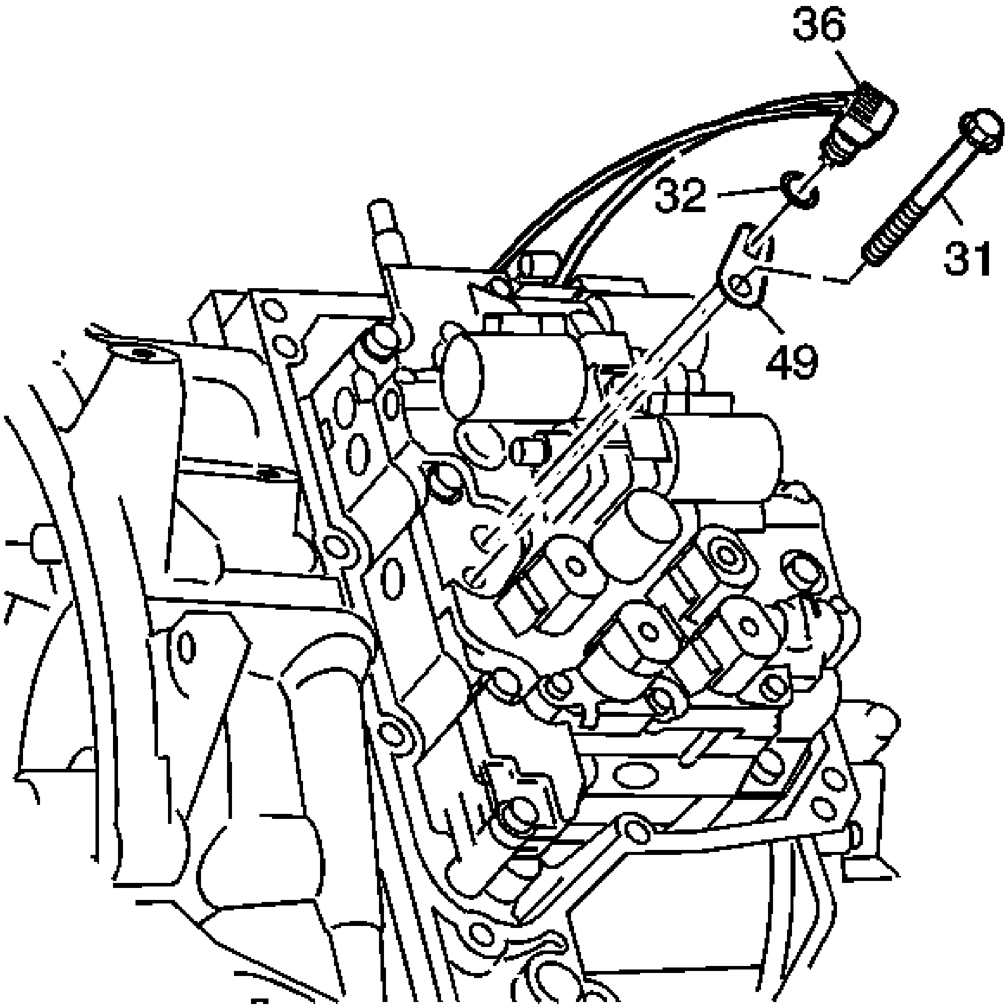

Fig. 96: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the control valve body TCM electrical connector (1).
24. Install the wire harness retainer (2) to the control valve body cover stud.

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

25. Install the transmission range select lever cable and bracket. Refer to **Automatic Transmission Range Selector Lever Cable Bracket Replacement**.
26. Install the battery tray. Refer to **Battery Tray Replacement (LAT)** or **Battery Tray Replacement (LZ4/LY7)** .

27. Adjust the automatic transmission range selector lever cable. Refer to **Range Selector Lever Cable Adjustment**.
28. Fill the transmission with fluid. Refer to **Transmission Fluid Replacement**.
29. For transmission control module programming and setup, refer to **Control Module References** .

IMPORTANT: After an internal transmission repair or internal part replacement the service fast learn adapt procedure should be performed.

30. Perform the service fast learn adapt procedure. Refer to **Service Fast Learn Adapts**.
31. Road test the vehicle.

OFF-VEHICLE REPAIR INSTRUCTIONS

LIFT PLATE AND HOLDING FIXTURE INSTALLATION

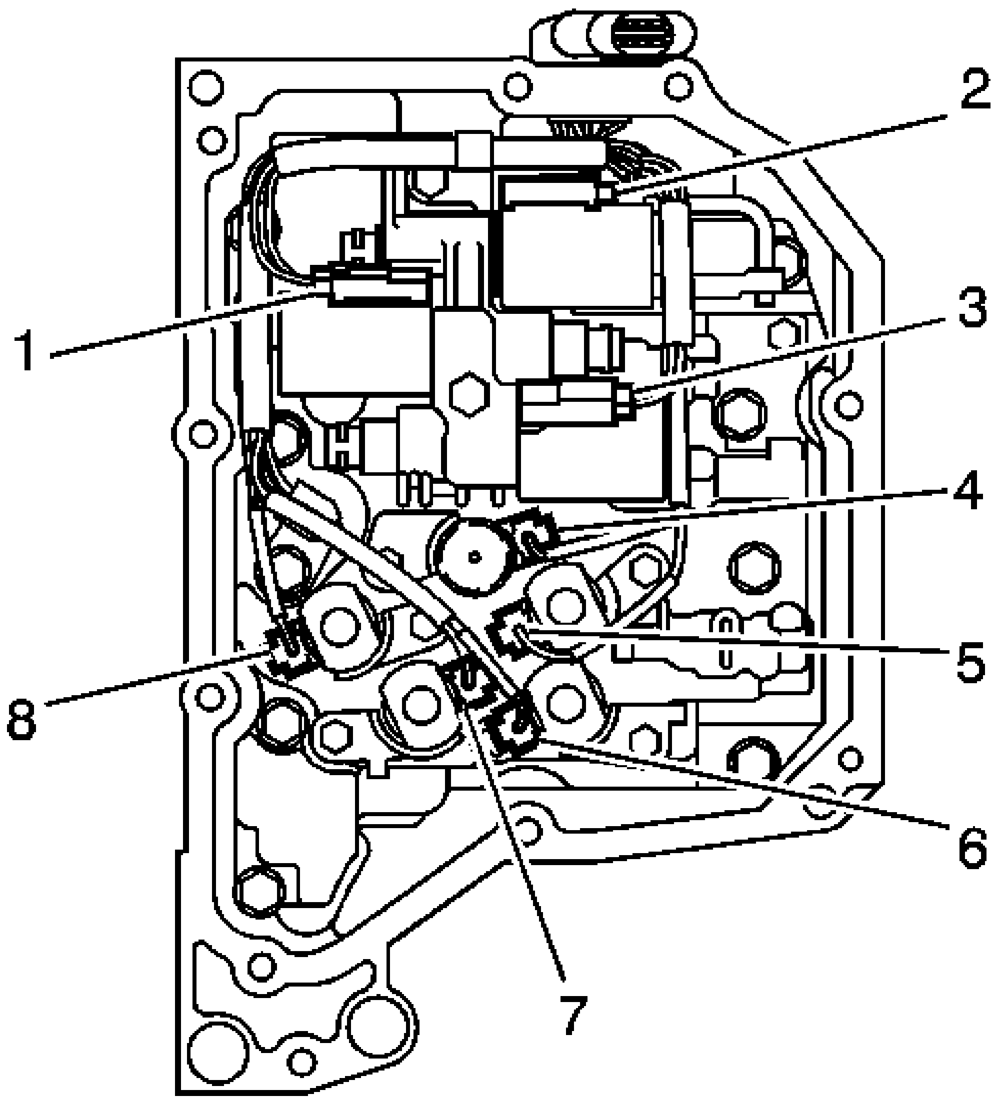

Fig. 97: Identifying Lift Plate & Holding Fixture
Courtesy of GENERAL MOTORS CORP.

Lift Plate and Holding Fixture Installation

Callout	Component Name
	DT-47811 Transmission Lift Plate. See **Special Tools**.

1	**CAUTION:** **Handle with care, the transmission assembly weighs over 200 lbs. Bodily injury could occur if not handled properly.** **Tip:** After Installation of lift plate, raise the transmission with an overhead hoist. **Tighten:** 12 N.m (9 lb ft) **Special Tool:** **DT-47811** Transmission Lift Plate. See **Special Tools**.
2	**J-46625** Transmission Holding Fixture. See **Special Tools**. **NOTE:** **Refer to Fastener Notice .** **Tip:** Adjust mounting block on fixture to match bosses on case, then tighten bolts to: **Tighten:** 13 N.m (10 lb ft) **Special Tool:** **J-46625** Transmission Holding Fixture. See **Special Tools**.

TORQUE CONVERTER REMOVAL

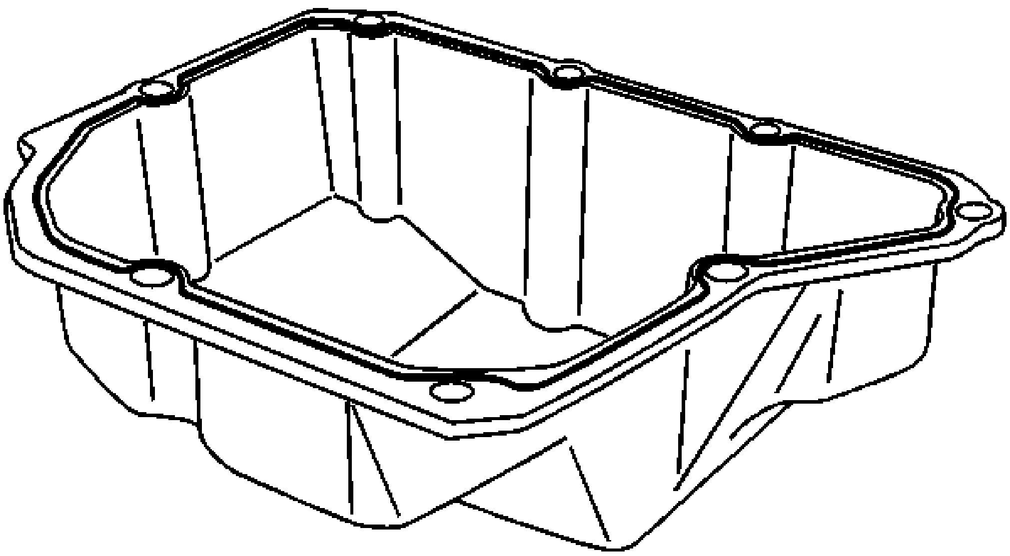

Fig. 98: View Of Torque Converter
Courtesy of GENERAL MOTORS CORP.

Torque Converter Removal

Callout	Component Name
1	Lock Pin **CAUTION:** **Lock pin must be secured into the bench fixture to hold the transmission and prevent bodily injury.**
2	**J 21366** Converter Holding Strap
3	Dust Cover Bolts M10 x 25, model dependent (Qty: 2)
4	Dust Cover Push Pin, model dependant
5	Dust Cover, model dependant
6	Torque Converter Assembly **NOTE:** **Only install the lift assist handles until it stops. Do not tighten. Over tightening the lift assist handles can cause damage to the torque converter housing.**

	Tip: Failure to raise the torque converter straight up could damage the torque converter clutch lip seal inside the torque converter clutch assembly. **Special Tool:** **J 46409** Torque Converter Lifting Handles. See **Special Tools**.

CONTROL VALVE BODY ASSEMBLY REMOVAL

Control Valve Body Cover Removal

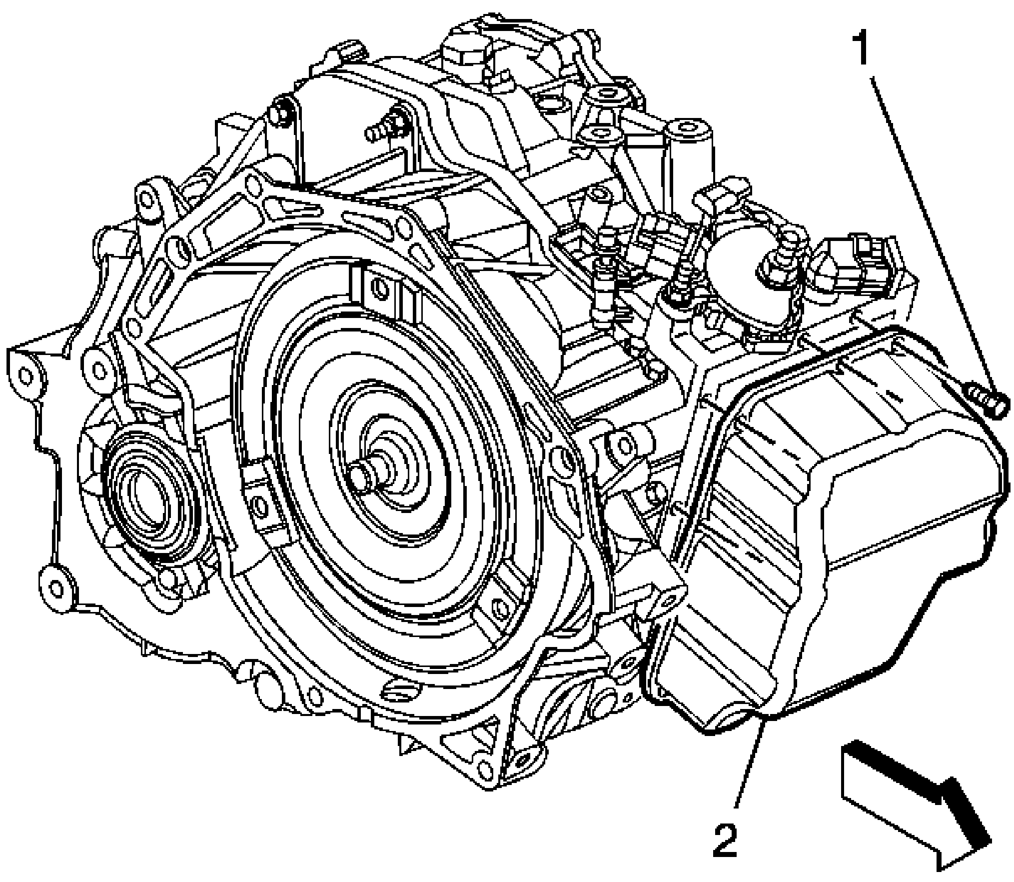

Fig. 99: View Of Control Valve Body Cover
Courtesy of GENERAL MOTORS CORP.

Control Valve Body Cover Removal

Callout	Component Name

1	Control Valve Body Cover Stud M6 x 30 (Qty: 2)
2	Control Valve Body Cover Bolt M6 x 30 (Qty: 12)
3	Control Valve Body Cover
4	Control Valve Body Cover Gasket **Tip:** Do not re-use the valve body cover gasket.
5	Control Valve Body Cover Wiring Connector Hole Seal **NOTE:** **Support the control solenoid valve assembly around the connector when removing the seal. Excessive pulling force can damage the internal electrical connections.**
6	Shift Position Switch Connector
7	Output Speed Sensor Connector
8	Input Speed Sensor Connector

Control Solenoid (w/Body and TCM) Valve Assembly Removal

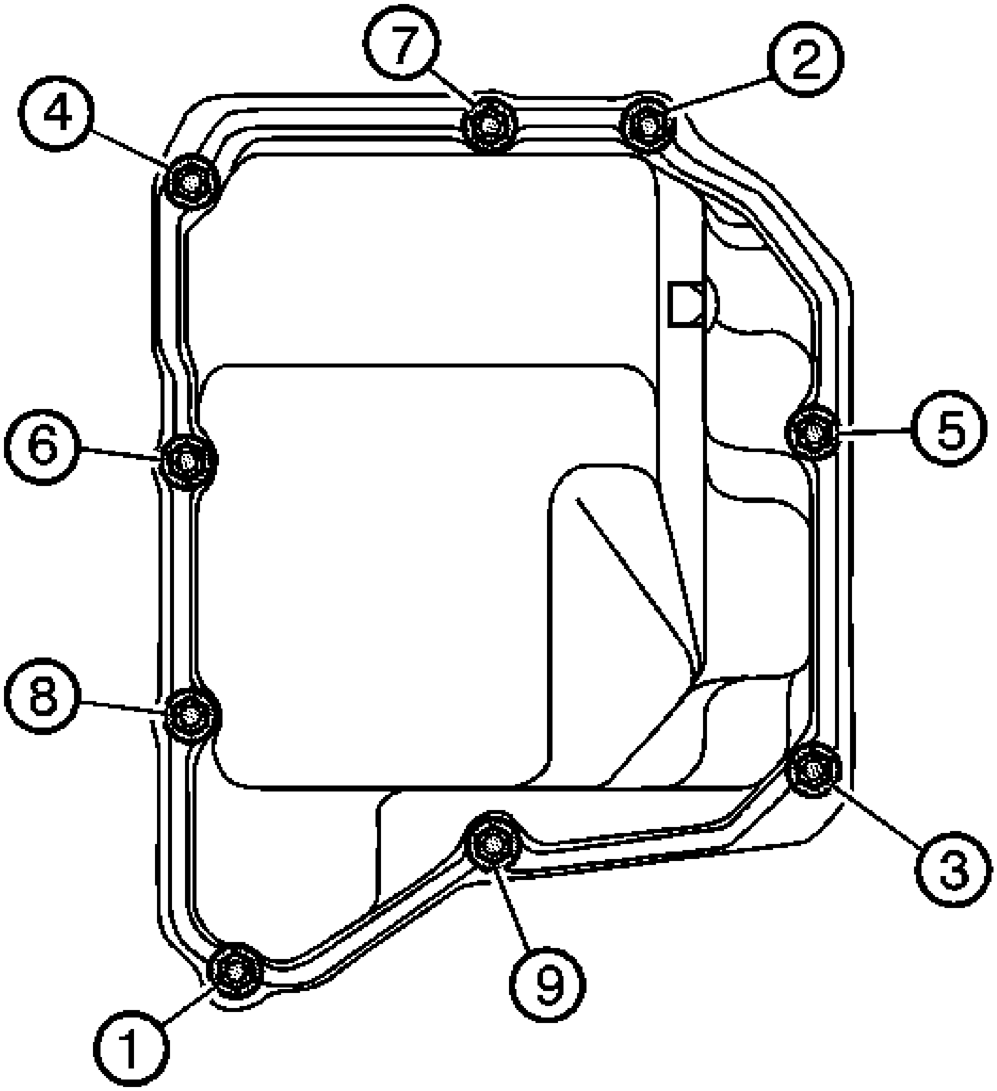

Fig. 100: Identifying Control Solenoid (w/Body & TCM) Valve Assembly
Courtesy of GENERAL MOTORS CORP.

Control Solenoid (w/Body and TCM) Valve Assembly Removal

Callout	Component Name
1	Control Valve Body Bolt M6 x 80 (Qty: 4)
2	Control Solenoid Valve Spring
3	Control Valve Body Bolt M6 x 65 (Qty: 2)

4	Control Valve Body Bolt M6 x 42 (Qty: 1)
5	Control Valve Body Bolt M6 x 95 (Qty: 3)
6	Control Valve Body Bolt M6 x 55 (Qty: 1)
7	Control Solenoid (w/Body and TCM) Valve Assembly
8	Control Solenoid Valve Assembly Filter Plate **NOTE:** **Use care when removing or installing the filter plate assembly. A broken or missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.** **Tip:** • Discard the filter plate. It is not reusable. • Inspect the pressure switch manifold seals for damage. Replace the control valve assembly as necessary.

Control Valve Body Assembly and Output Speed Sensor Removal

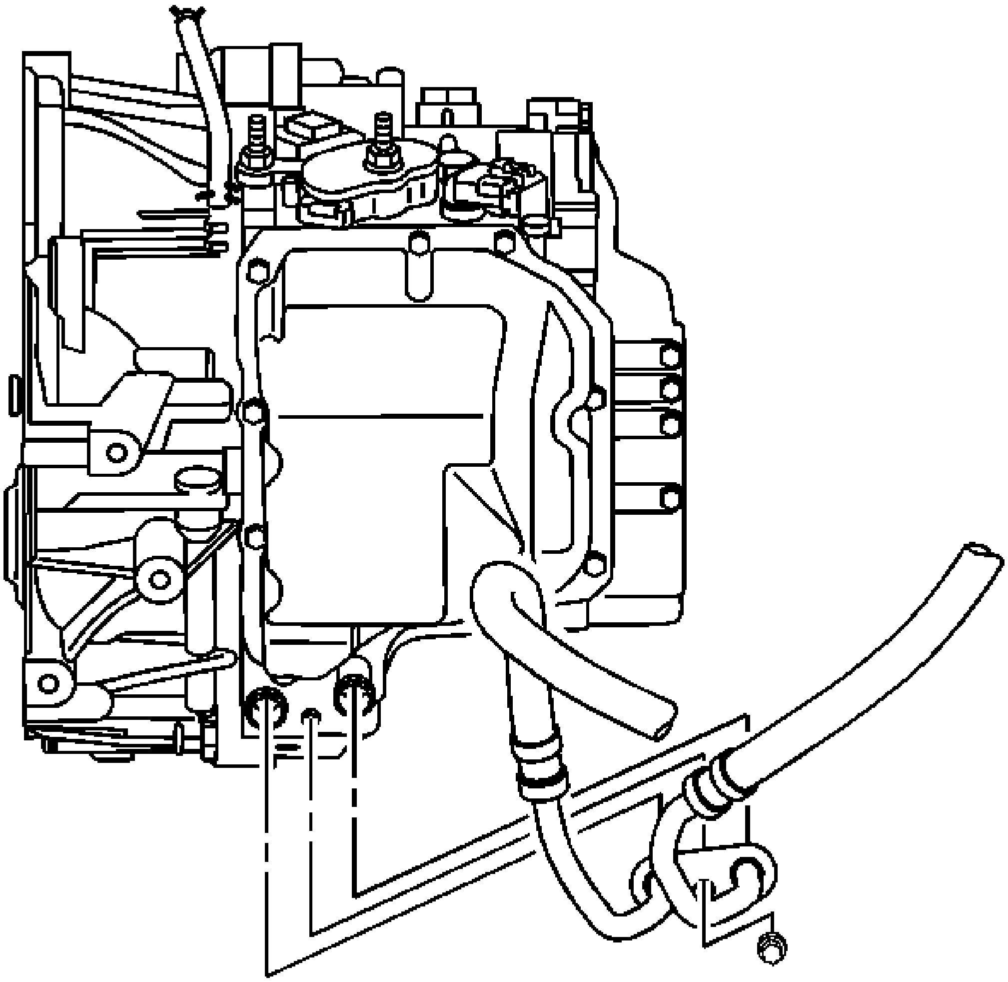

Fig. 101: Identifying Control Valve Body Assembly & Output Speed Sensor
Courtesy of GENERAL MOTORS CORP.

Control Valve Body Assembly and Output Speed Sensor Removal

Callout	Component Name
1	Control Valve Body Bolt M6 x 65 (Qty: 8)
2	Control Valve Body Bolt M6 x 55 (Qty: 2)
3	Manual Shaft Detent Assembly
4	Control Valve Body Assembly
5	A/Trans Output Speed Sensor Bolt M6 x 25
6	A/Trans Output Speed Sensor
	1-2-3-4 Clutch Fluid Passage Seal

7	**Tip:** The seal is not reusable.

CASE COVER AND 3-5-REVERSE AND 4-5-6 CLUTCH HOUSING REMOVAL

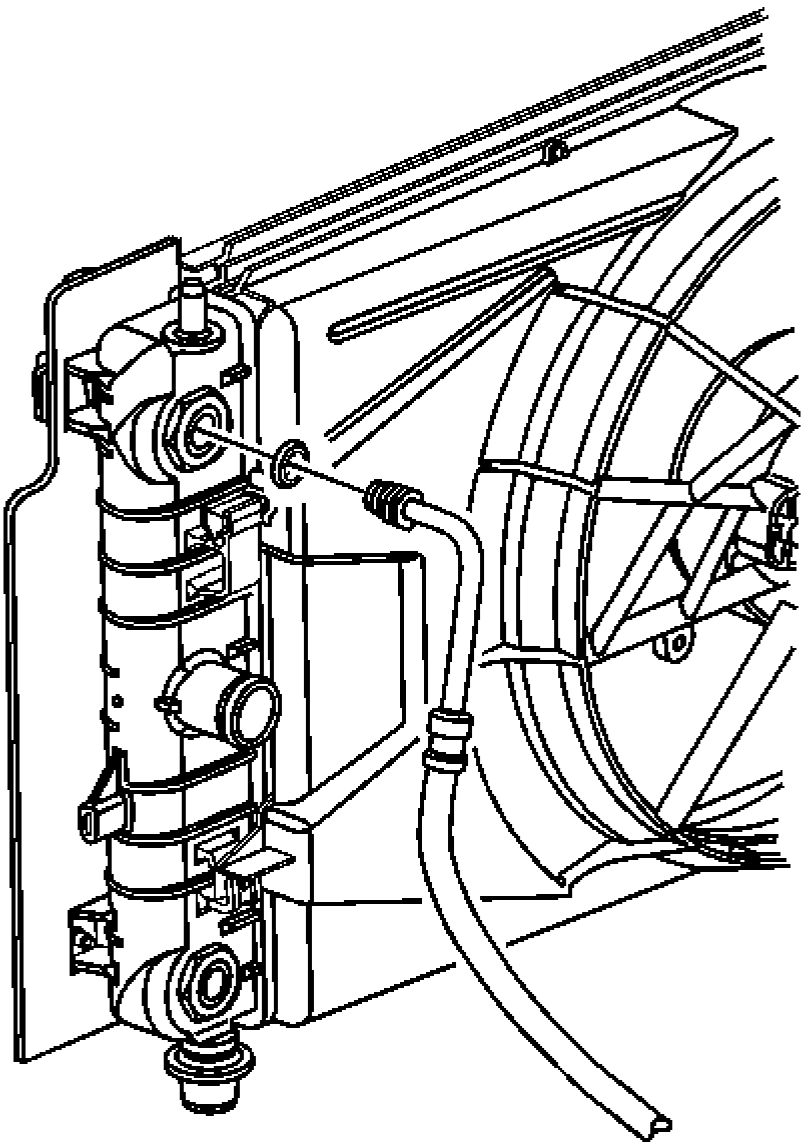

Fig. 102: Identifying Case Cover, 3-5-Reverse & 4-5-6 Clutch Housing
Courtesy of GENERAL MOTORS CORP.

Case Cover and 3-5-Reverse and 4-5-6 Clutch Housing Removal

Callout	Component Name
1	A/Trans Case Cover Assembly Bolt M6 x 30 (Qty: 10)
2	A/Trans Case Cover Assembly **NOTE:** **Use care when pulling the input speed sensor wire harness through the case to avoid damaging the harness.**
3	A/Trans Case Cover Gasket **Tip:** The gasket is not reusable.
4	Input Shaft Thrust Bearing Assembly **Tip:** The bearing may be stuck to the case cover.
5	3-5 Rev / 4-5-6 Clutch Housing Assembly

REACTION CARRIER HUB AND 2-6 CLUTCH PLATE REMOVAL

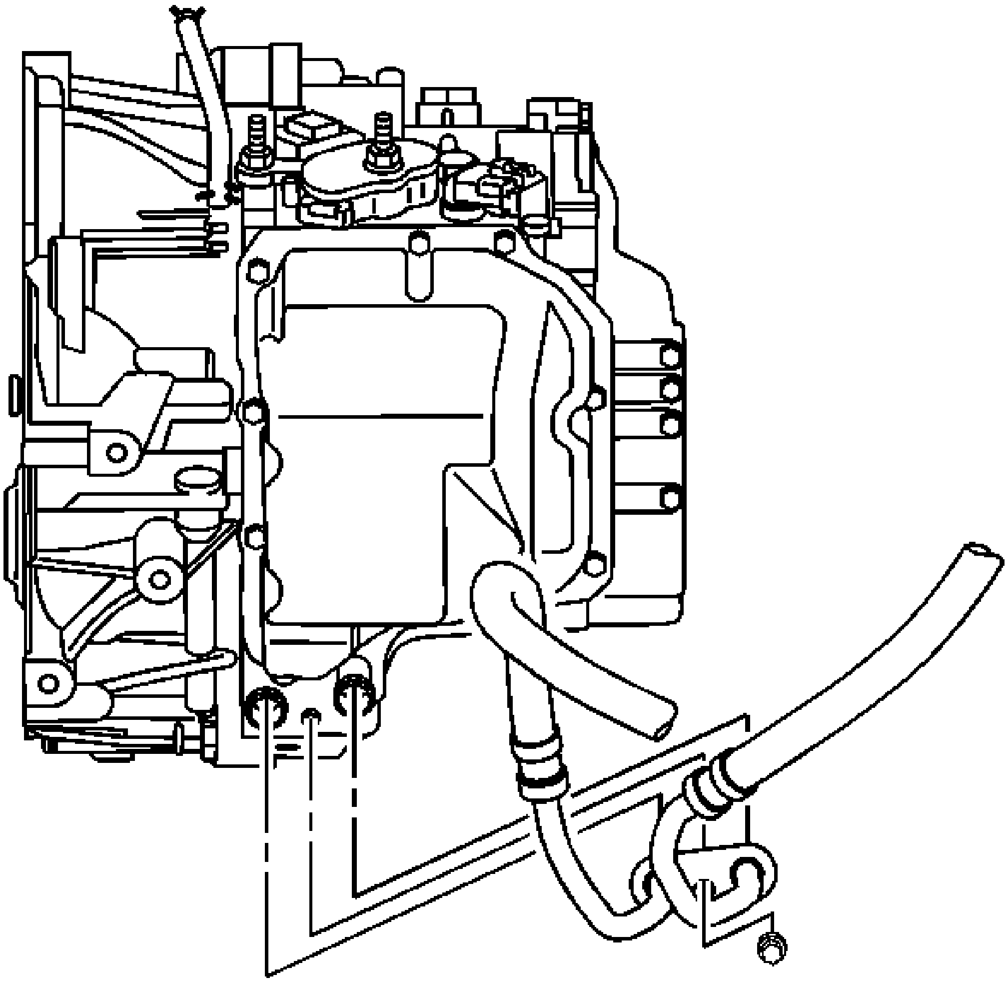

Fig. 103: Identifying Reaction Carrier Hub & 2-6 Clutch Plate
Courtesy of GENERAL MOTORS CORP.

Reaction Carrier Hub and 2-6 Clutch Plate Removal

Callout	Component Name
1	2-6 Clutch Hub Thrust Bearing Assembly **Tip:** The 2-6 clutch hub thrust bearing assembly may be stuck to the reaction carrier hub assembly.
2	Reaction Sun Gear Assembly
3	2-6 Clutch Cushion Spring
4	2-6 Clutch Plate (Qty: 3)
5	2-6 Clutch (w/Friction Material) Plate Assembly

	(Qty: 3)
6	2-6 Clutch Backing Plate

INPUT, REACTION, AND OUTPUT CARRIER REMOVAL

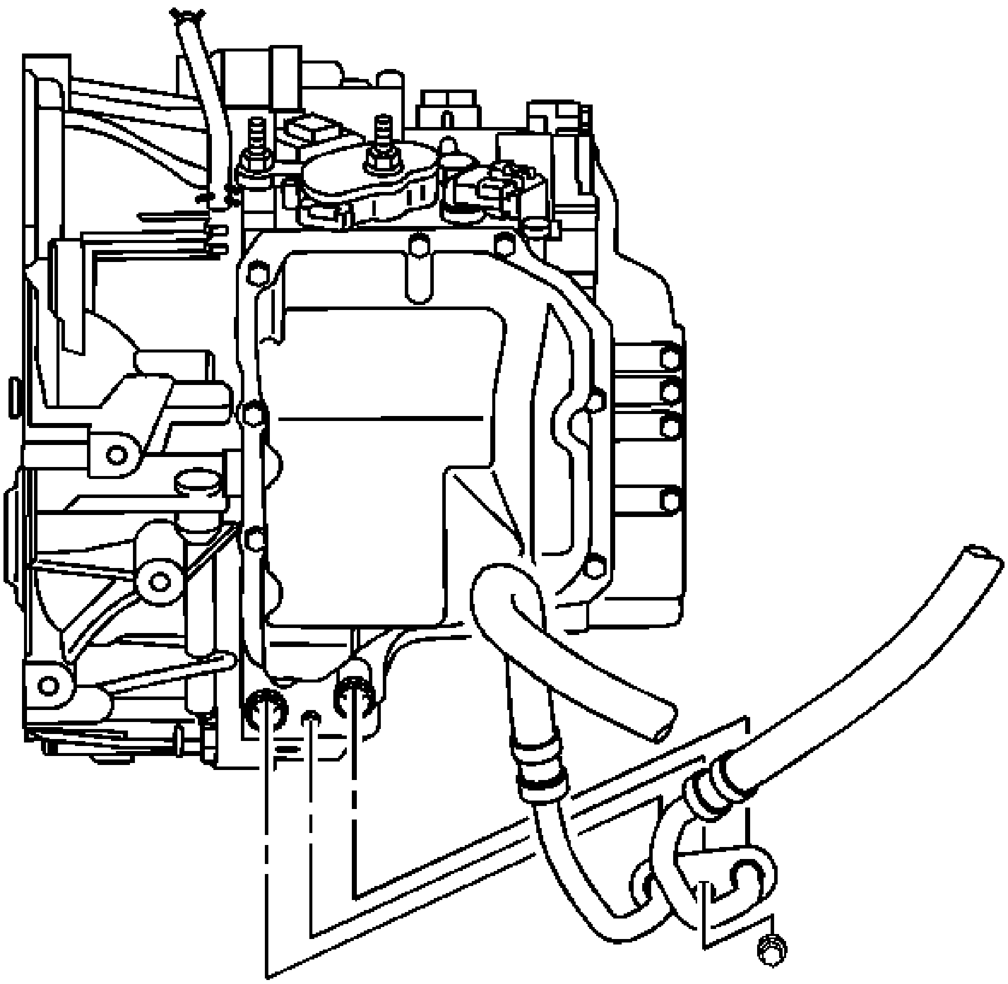

Fig. 104: View Of Input, Reaction & Output Carriers
Courtesy of GENERAL MOTORS CORP.

Input, Reaction, and Output Carrier Removal

Callout	Component Name
1	Reaction (w/Input Internal Gear) Carrier Assembly

2	Input Carrier Thrust Bearing Assembly
3	Input Sun Gear Thrust Bearing Assembly
4	Input (w/Output Internal Gear) Carrier Assembly
5	Input Sun Gear
6	Output Carrier Thrust Bearing Assembly
7	Output Carrier Thrust Bearing Assembly
8	Output Carrier Assembly
9	Output Sun Gear Assembly
10	Front Differential Transfer Drive Gear Input Hub Bearing Assembly
11	Output Carrier Transfer Drive Gear Hub Assembly
12	Output Carrier Transfer Drive Gear Hub Bearing Assembly **Tip:** The bearing may be stuck to the support assembly.

LOW AND REVERSE CLUTCH PLATE REMOVAL

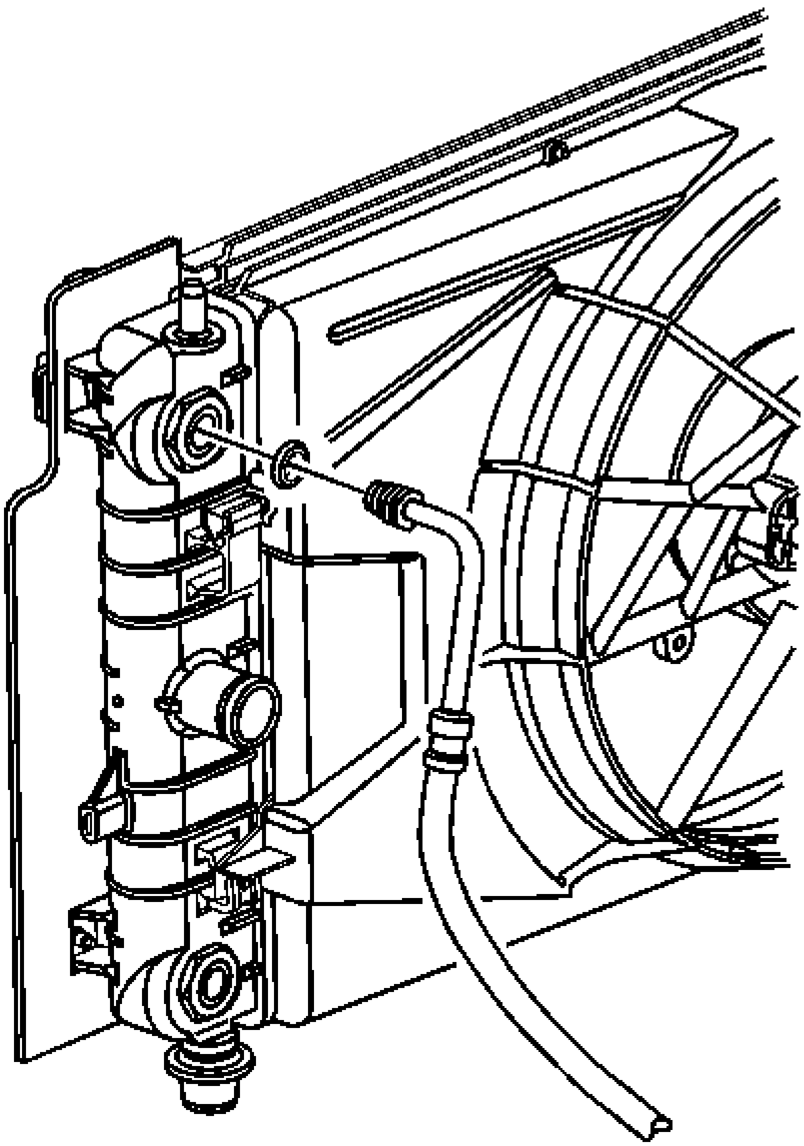

Fig. 105: Identifying Low & Reverse Clutch Plate
Courtesy of GENERAL MOTORS CORP.

Low and Reverse Clutch Plate Removal

Callout	Component Name
1	Low and Reverse Clutch Cushion (Waved) Spring
2	Low and Reverse Clutch Apply Plate

3	Low and Reverse Clutch (w/Friction Material) Plate Assembly (Qty: 4)
4	Low and Reverse Clutch Plate (Qty: 3)
5	Low and Reverse Clutch Backing Plate

LOW AND REVERSE CLUTCH AND 1-2-3-4 CLUTCH PLATE REMOVAL

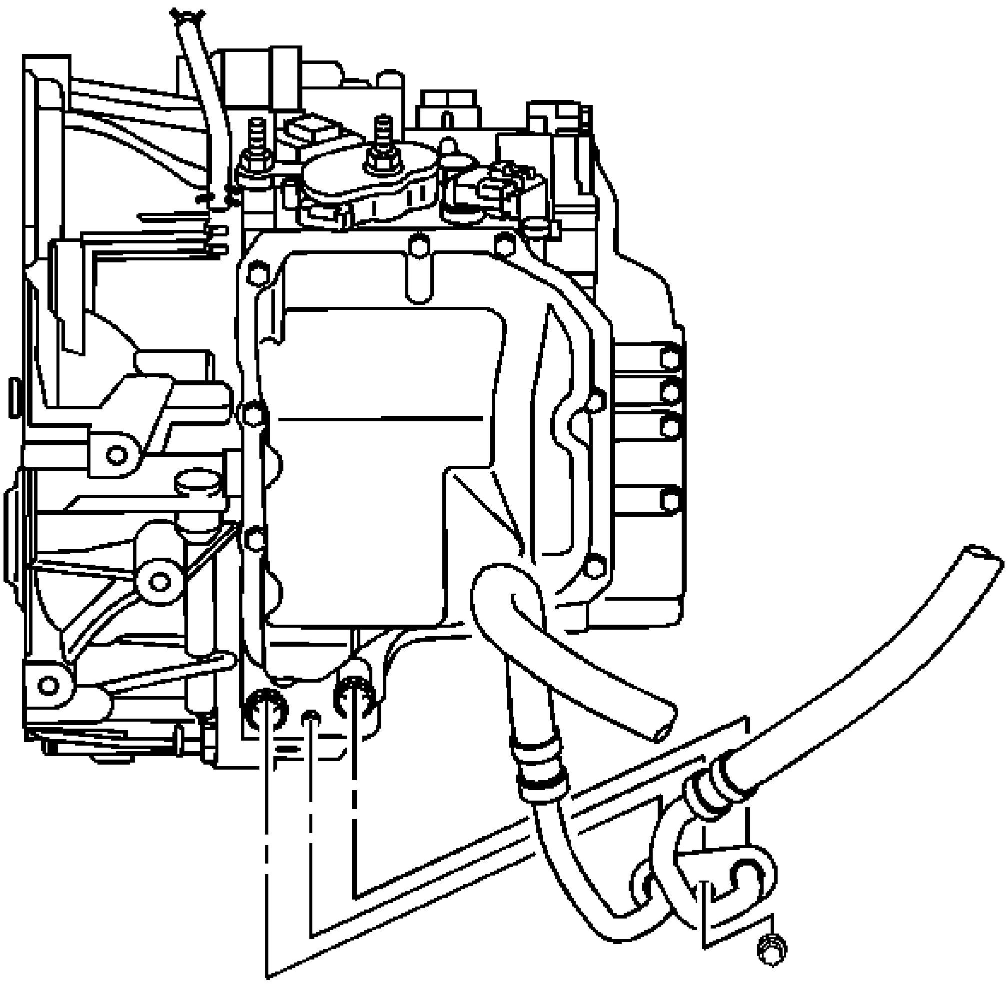

Fig. 106: Identifying Low and Reverse Clutch and 1-2-3-4 Clutch Plate
Courtesy of GENERAL MOTORS CORP.

Low and Reverse Clutch and 1-2-3-4 Clutch Plate Removal

Callout	Component Name

1	Low and Reverse Clutch Retainer Ring
2	Low and Reverse Clutch Assembly
3	1-2-3-4 Clutch (w/Friction Material) Plate Assembly (Qty: 2)
4	1-2-3-4 Clutch Plate (Qty: 2)
5	1-2-3-4 Clutch (Waved) Plate
6	1-2-3-4 Clutch Spring Retainer Ring
7	1-2-3-4 Clutch Spring
8	1-2-3-4 Clutch Piston **Tip:** • Use pliers to remove the piston. • Inspect the piston seals for damage and/or wear. The piston is reusable.

TORQUE CONVERTER AND DIFFERENTIAL HOUSING, FRONT DIFFERENTIAL TRANSFER DRIVE GEAR, AND FRONT DIFFERENTIAL CARRIER REMOVAL

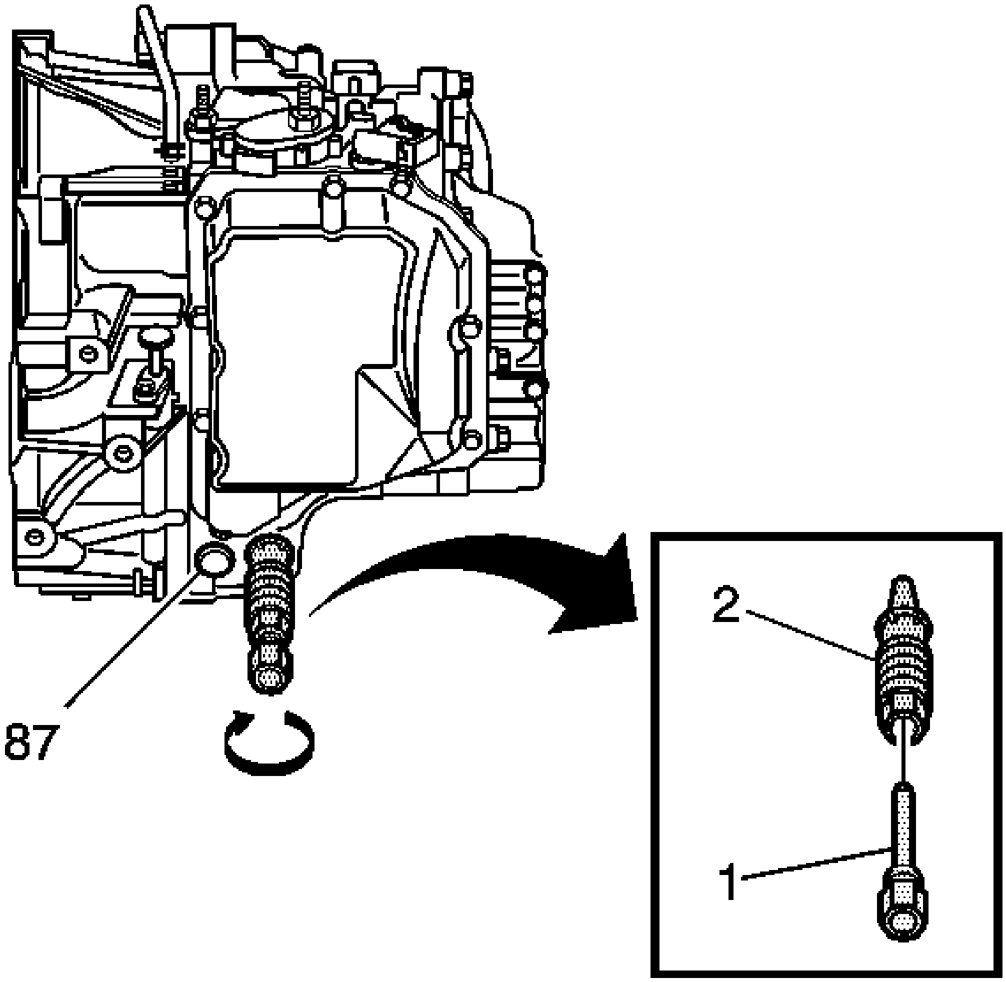

Fig. 107: Identifying Torque Converter, Differential Housing, Front Differential Transfer Drive Gear & Front Differential Carrier
Courtesy of GENERAL MOTORS CORP.

Torque Converter and Differential Housing, Front Differential Transfer Drive Gear, and Front Differential Carrier Removal

Callout	Component Name
1	Torque Converter and Differential Housing Bolt M8 x 35 (Qty: 17)
2	Torque Converter, Support and A/Trans Fluid Pump Housing Assembly
3	Torque Converter Housing Outer Seal

	Tip: The seal is not reusable.
4	Front Differential Drive Pinion Gear Lube Tube
5	Front Differential Drive Pinion (w/Transfer Gear) Gear Assembly
6	Front Differential Carrier Assembly

FLUID TROUGH REMOVAL

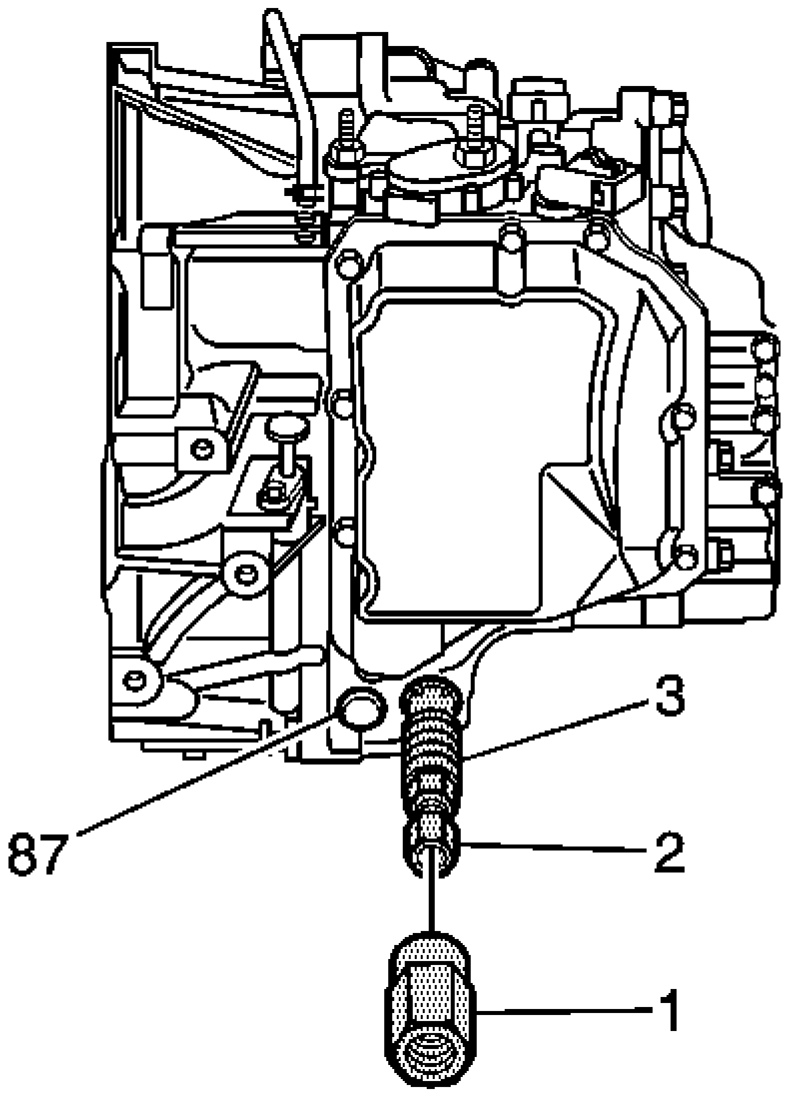

Fig. 108: Identifying Fluid Trough
Courtesy of GENERAL MOTORS CORP.

Fluid Trough Removal

Callout	Component Name
1	A/Trans Fluid Trough Bolt M6 x 25 (Qty: 2)
2	A/Trans Fluid Trough
3	A/Trans Fluid Trough (O-Ring) Seal
4	A/Trans Fluid Pump Outlet Seal Assembly **Tip:** The seal assembly is not reusable.

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR REMOVAL

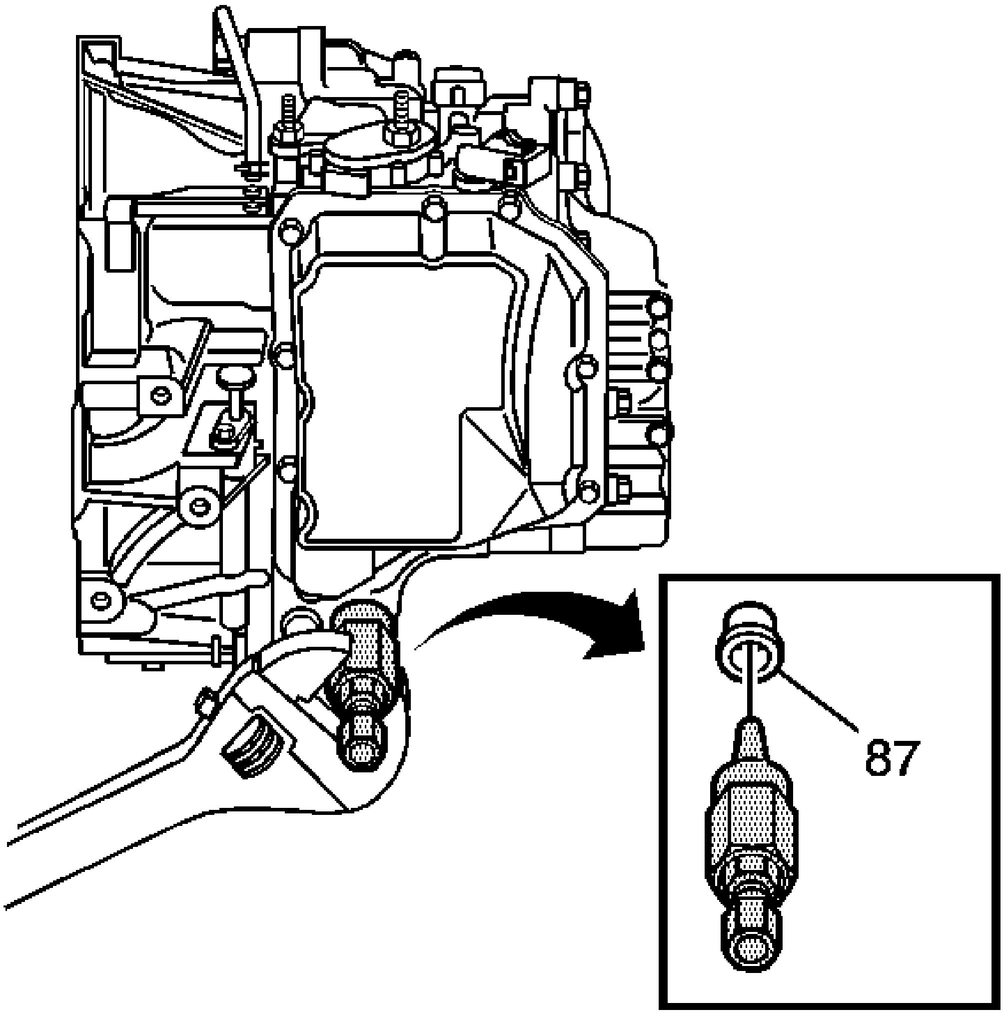

Fig. 109: Identifying Manual Shift Detent Lever, with Shaft Position Switch Assembly & Park Pawl Actuator
Courtesy of GENERAL MOTORS CORP.

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal

Callout	Component Name
1	Park Pawl Actuator Bracket Bolt M6 x 25 (Qty: 2)
2	Park Pawl Actuator Bracket
3	Park Pawl Shaft
4	Park Pawl
5	Park Pawl Spring

6	Park Pawl Actuator Guide Pin
7	Park Pawl Actuator Guide
8	Manual Shift Detent Lever Pin **Tip:** • Use a small nail puller or other suitable tool. • Discard the pin. The pin is not reusable. **Special Tools** • **J 6125-1B** Slide Hammer with Adapter • **J 23129** Universal Seal Remover
9	Manual Shaft Detent (w/Shift Position Switch) Lever Assembly **Tip:** Rotate the assembly counterclockwise so the actuator rod will fit through the case opening.
10	Park Pawl Actuator Assembly

MANUAL SHIFT SHAFT SEAL REPLACEMENT

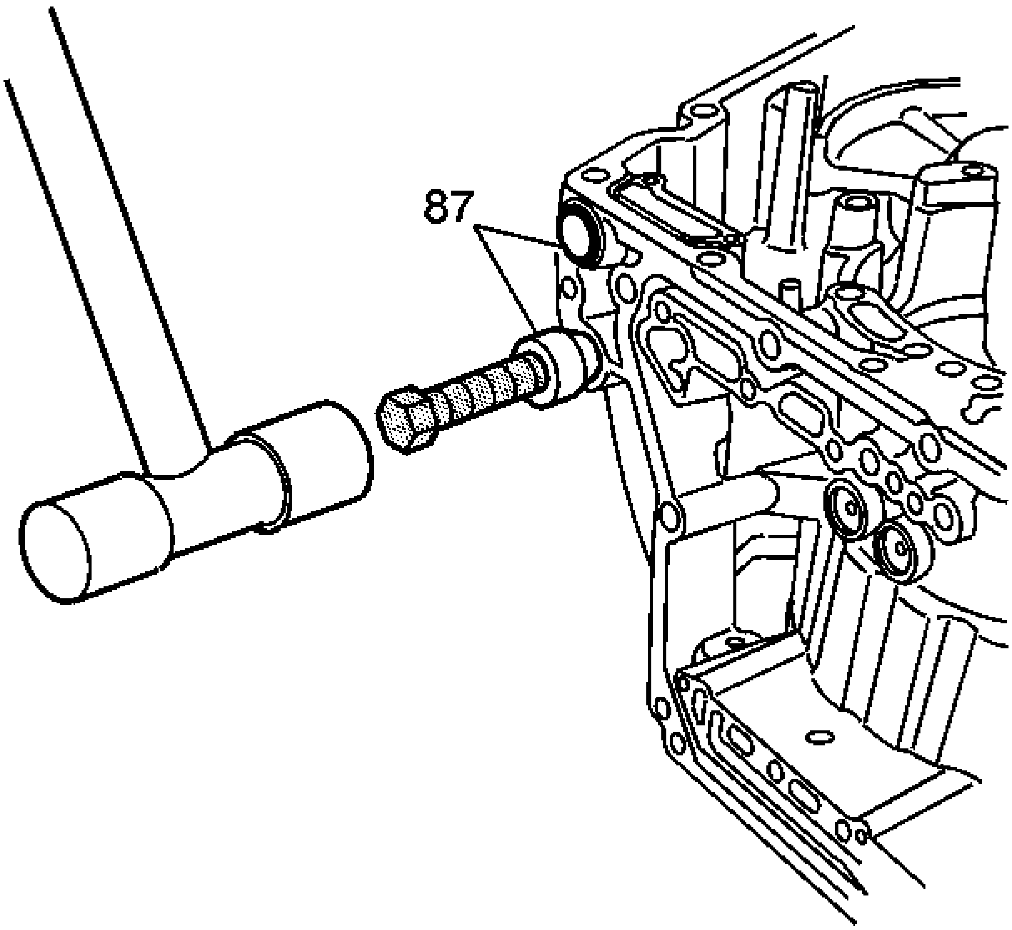

Fig. 110: Identifying Manual Shift Shaft Seal
Courtesy of GENERAL MOTORS CORP.

Manual Shift Shaft Seal Replacement

Callout	Component Name
1	Manual Shift Shaft Seal **Special Tools:** • **J 45201** Cooler Line Seal Remover • **J-46626** Seal Installer. See **Special Tools**.

FRONT WHEEL DRIVE SHAFT OIL SEAL REPLACEMENT - CASE SIDE

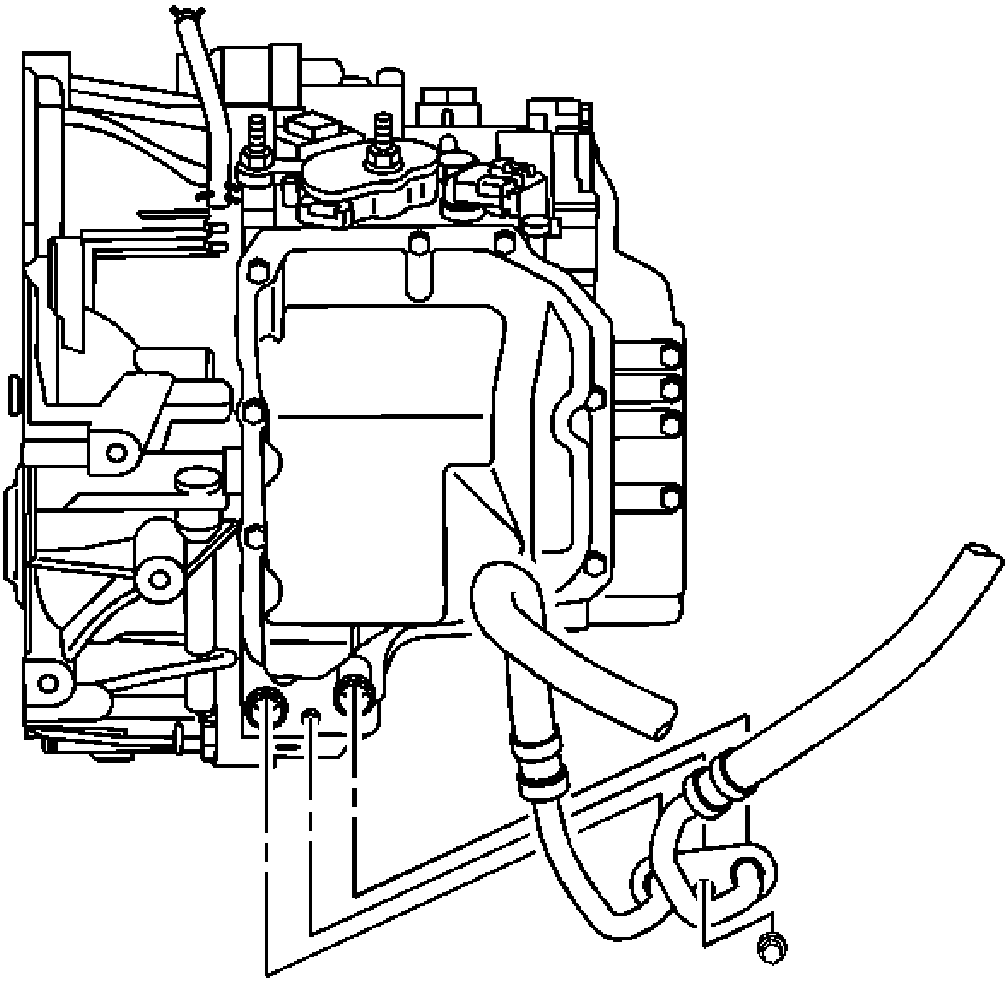

Fig. 111: Identifying Front Wheel Drive Shaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

Front Wheel Drive Shaft Oil Seal Replacement - Case Side

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Assemble **Tip:** Use the flat side of **J-46629** to seat the seal to the case surface. See **Special Tools**. **Special Tools** • **J 6125-1B** Slide Hammer

	• **J 8092** Driver Handle • **J 23129** Universal Seal Remover • **J-46629** Axle Seal Installer. See **Special Tools**.

FRONT DIFFERENTIAL CARRIER BEARING CUP REPLACEMENT - CASE SIDE

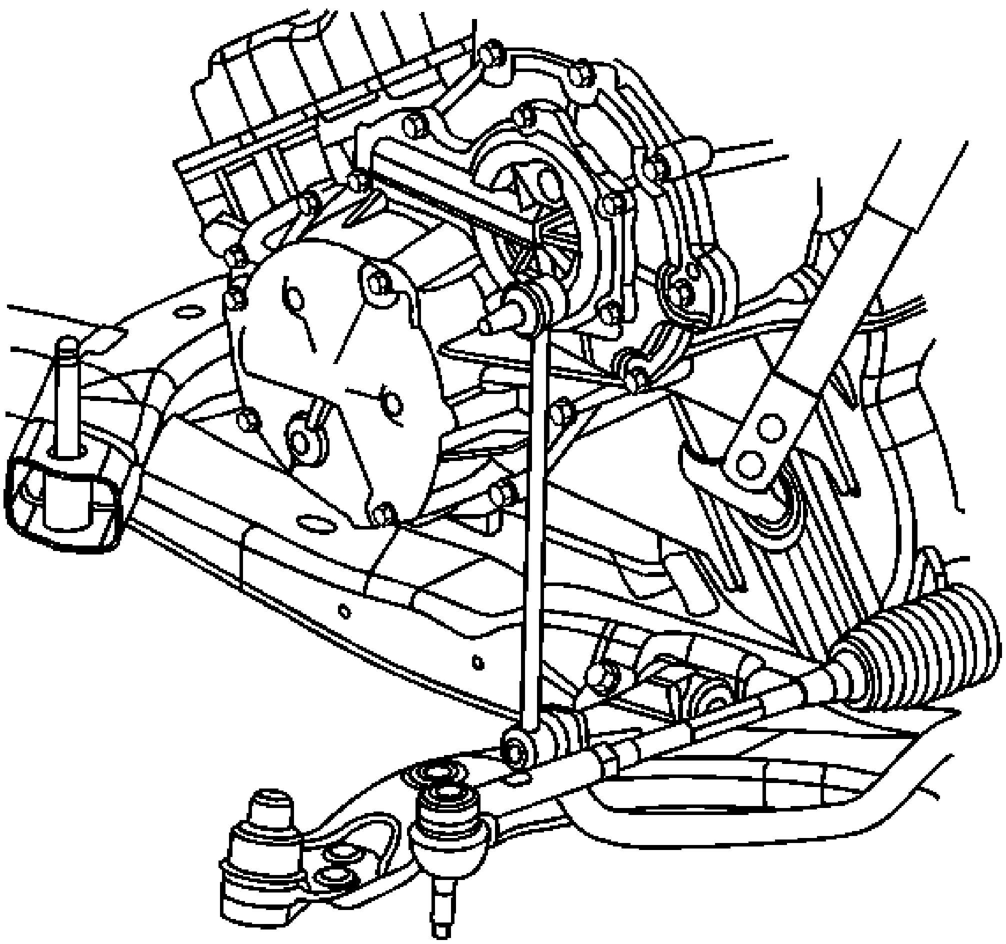

Fig. 112: Identifying Front Differential Carrier Bearing Cup
Courtesy of GENERAL MOTORS CORP.

Front Differential Carrier Bearing Cup Replacement - Case Side

Callout	Component Name
	Front Differential Bearing Cup

<table>
<tr>
<td>1</td>
<td>
NOTE:
Support the back side of the torque converter housing while installing the bearing cup. Install the bearing cup until it stops moving. Applying excessive pressure to the bearing cup once it is seated could cause damage to the torque converter housing casting.
NOTE:
Failure to apply the lubricant will cause damage to the bolt and nut threads.
Tip:

Tighten DT-47927-2 which is part of DT-47927 until it fits snugly on the bearing cup. See <u>Special Tools</u>.
Adjust J 45124 so it sits on the torque converter housing surface just beyond the bearing cup opening. See <u>Special Tools</u>.
Apply the extreme pressure lubricant J 23444-A to the puller bolt threads to prevent damage to the bolt threads during bearing cup removal. See <u>Special Tools</u>.
Hold the puller bridge bolt and turn the nut to remove the bearing cup.

Special Tools

DT-47927 Bearing Cup Remover. See <u>Special Tools</u>.
J 23444-A Extreme Press Lubricant - 1/4 Ounce Tube. See <u>Special Tools</u>.
J 45124 Removal Bridge. See <u>Special Tools</u>.
J-45087 Bearing Cup Installer. See <u>Special Tools</u>.

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FRONT DIFFERENTIAL DRIVE PINION GEAR BEARING CUP AND LUBRICANT DAM REPLACEMENT

Removal

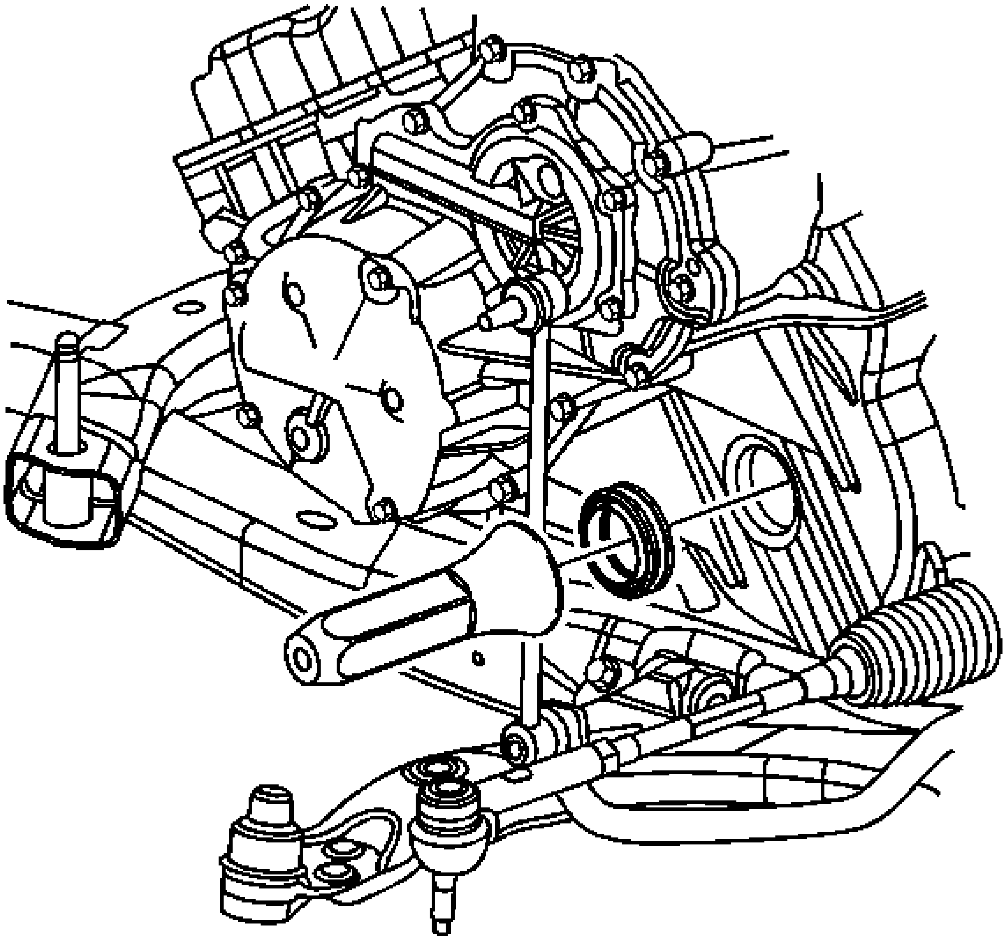

Fig. 113: Identifying Front Differential Drive Pinion Gear Bearing Cup & Lube Dam
Courtesy of GENERAL MOTORS CORP.

Removal

Callout	Component Name
	Front Differential Drive Pinion Gear Bearing Cup **NOTE:** **Failure to apply the lubricant will cause damage to the bolt and nut threads.** • Tighten **J-45094** until it fits snugly on the bearing cup. See **Special Tools**.

1	• Adjust **J 45124** so it sits on the case surface just beyond the bearing cup opening. See **Special Tools**. • Apply the extreme pressure lubricant **J 23444-A** to the puller bolt threads to prevent damage to the bolt threads during bearing cup removal. See **Special Tools**. • Hold the puller bridge nut and turn the bolt to remove the bearing cup. **Special Tools** • **J 23444-A** Extreme Press Lubricant - 1/4 Ounce Tube. See **Special Tools**. • **J-45094** Bearing Cup Remover. See **Special Tools**. • **J 45124** Removal Bridge. See **Special Tools**.
2	Front Differential Drive Pinion Gear Lube Dam **Special Tools** • **J 6125-1B** Slide Hammer with Adapter • **DT-48055** Lube Dam Removal. See **Special Tools**.

Installation

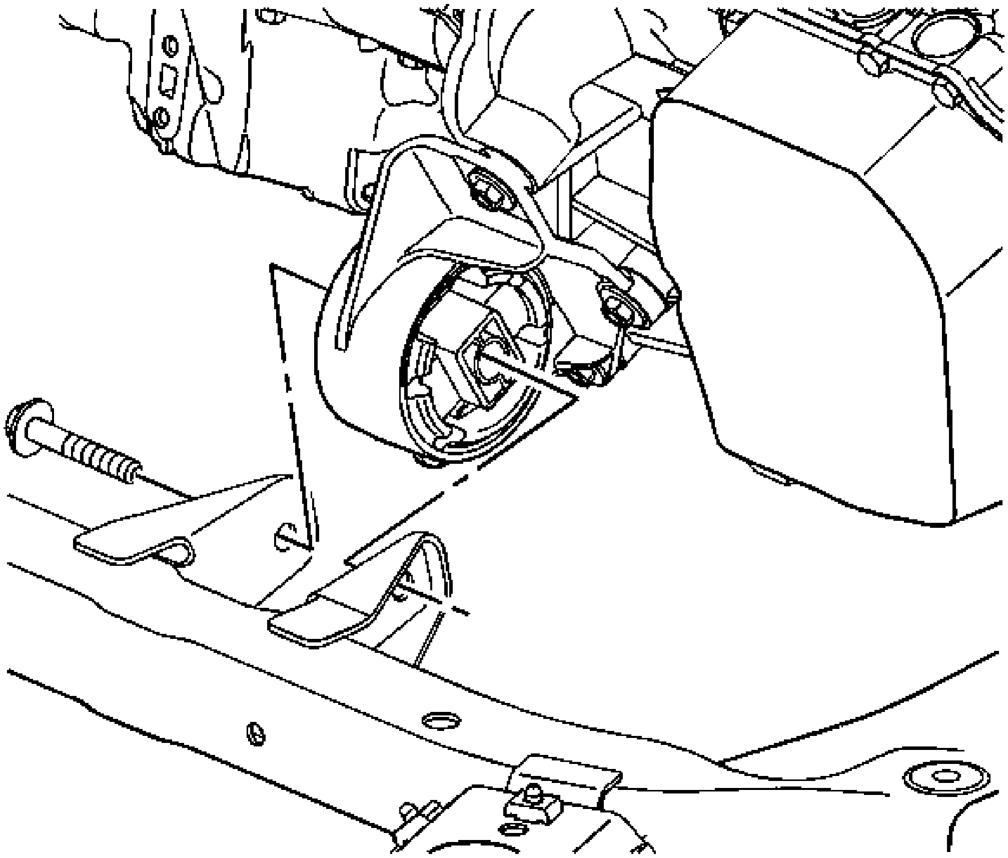

Fig. 114: View Of Front Differential Drive Pinion Gear Bearing Cup & Lube Dam
Courtesy of GENERAL MOTORS CORP.

Installation

Callout	Component Name
1	Front Differential Drive Pinion Gear Lube Dam **Special Tools** • **J 8092** Driver Handle • **J-46630** Lube Dam Installer. See **Special Tools**.
	Front Differential Drive Pinion Gear Bearing Cup **NOTE:** **Support the back side of the torque converter**

2	**housing while installing the bearing cup. Install the bearing cup until it stops moving. Applying excessive pressure to the bearing cup once it is seated could cause damage to the torque converter housing casting.** **Special Tool:** **J-45087** Bearing Cup Installer. See **Special Tools**.

TRANSMISSION CASE CLEANING AND INSPECTION

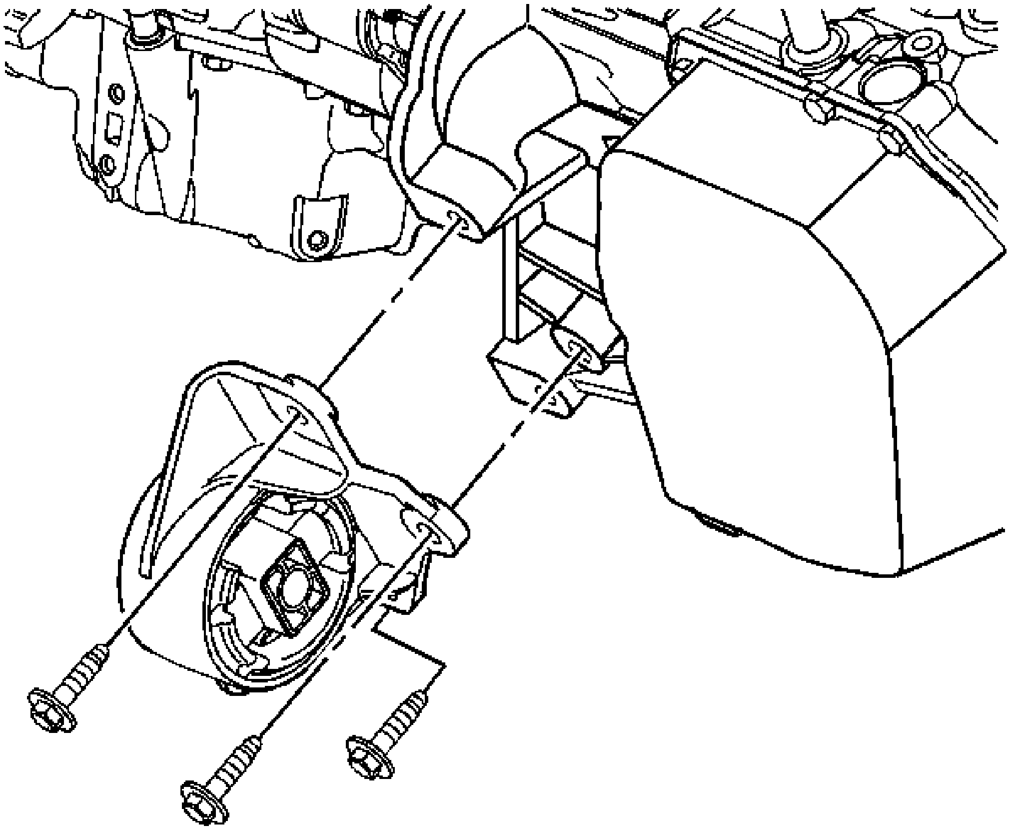

Fig. 115: Identifying Transmission Case Components
Courtesy of GENERAL MOTORS CORP.

Transmission Case Cleaning and Inspection

Callout	Component Name

NOTE:
Do not use abrasive pads or bristle devices to clean the sealing surfaces. Abrasive pads produce a fine grit that can effect transmission function. Abrasive pads can also remove enough metal to create oil leaks.

NOTE:
After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.

NOTE:
Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

Preliminary Procedures

1. Thoroughly clean the transmission case assembly, including case threads, with clean solvent.
2. Clean gasket sealing surfaces. Remove all residual gasket material.
3. Inspect all threaded holes. If necessary, repair any thread damage.

1	Case Cover Sealing Surface
2	Manual Shift Shaft Seal Surface **Tip:** Refer to **Manual Shift Shaft Seal Replacement**.
3	Fluid Pressure Test Plug
4	Fluid Level Hole Plug
5	Control Valve Body Cover Sealing Surface
6	Torque Converter Housing Sealing Surface
7	Transmission Fluid Cooler Pipe Stud M8 x 30.5 (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tip:** Re-torque to: **Tighten:** 12 N.m (106 lb in)
8	Inspect the locating pins to be fully seated in case.

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR INSTALLATION

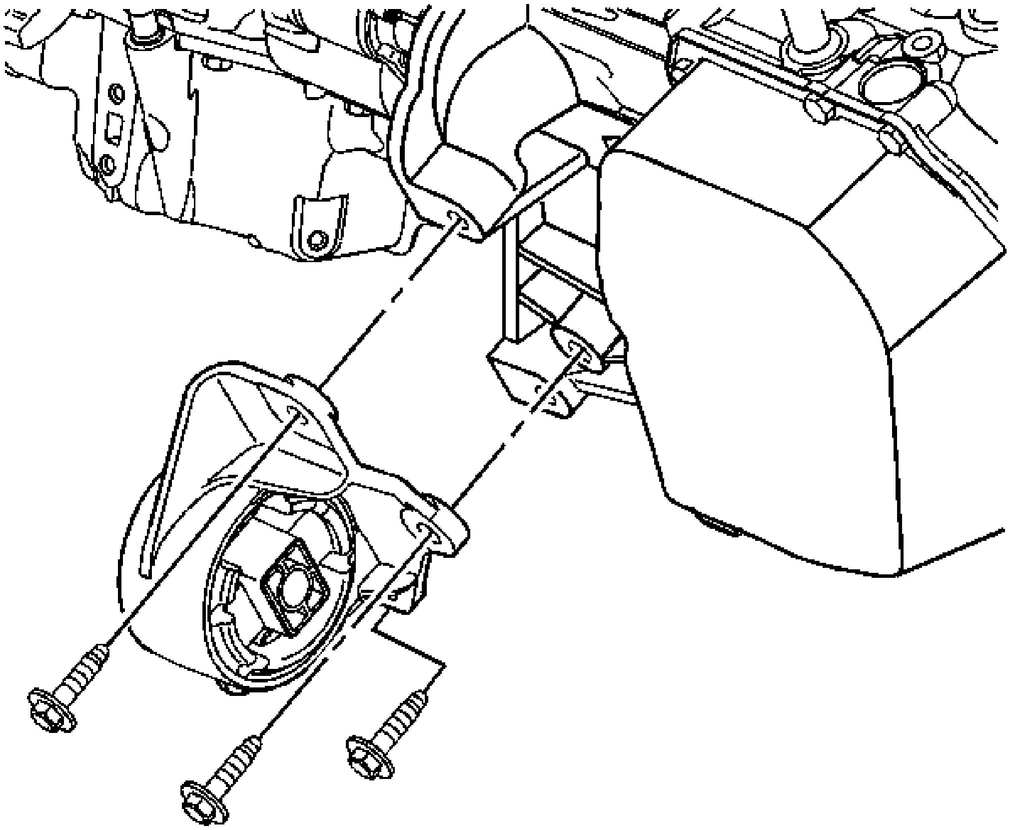

Fig. 116: Identifying Manual Shift Detent Lever With Shaft Position Switch Assembly & Park Pawl Actuator
Courtesy of GENERAL MOTORS CORP.

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation

Callout	Component Name
1	Park Pawl Actuator Guide
2	Park Pawl Actuator Guide Pin
3	Park Pawl
4	Park Pawl Shaft
5	Park Pawl Spring
6	Park Pawl Actuator Bracket
7	Park Pawl Actuator Bracket Bolt M6 x 25 (Qty: 2) **Tighten:** 12 N.m (106 lb in).
	Park Pawl Actuator Assembly

8	**Tip:** Install the park pawl actuator assembly onto the detent lever assembly.
9	Manual Shaft Detent (w/Shift Position Switch) Lever Assembly **Tip:** • Rotate the assembly clockwise so the actuator rod will fit through the case opening. • Lubricate shaft with ATF to prevent damage to the manual shift shaft seal.
10	Manual Shift Shaft Pin **NOTE:** **Use J 41229 to install the manual shaft pin at the correct height in order to properly secure the manual shaft. If you install the pin too deep, the case bore may crack.** **Tip:** 1. Use a NEW pin to ensure proper engagement to the case. 2. Inspect pin installed height is within 6.5-7.5 mm (0.25-0.30 in). **Special Tools:** **J 41229** Manual Shaft Pin Installer

FLUID TROUGH INSTALLATION

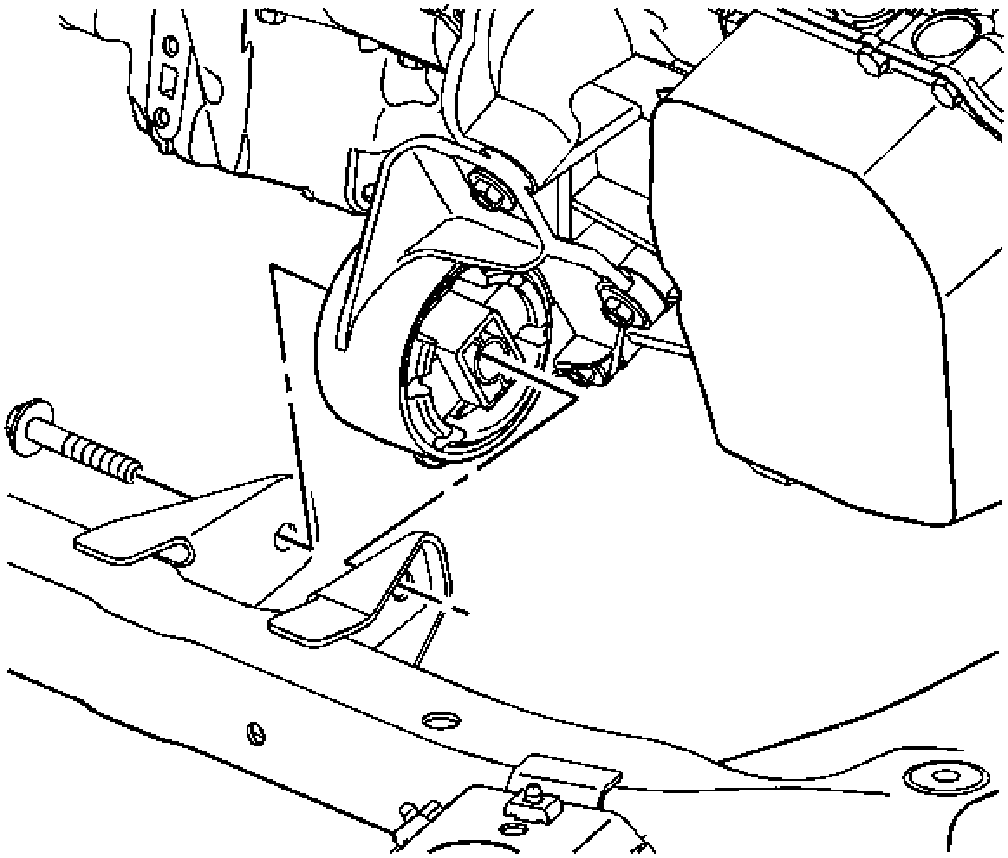

Fig. 117: Identifying Fluid Trough Components
Courtesy of GENERAL MOTORS CORP.

Fluid Trough Installation

Callout	Component Name
1	A/Trans Fluid Pump Outlet Seal Assembly
2	A/Trans Fluid Trough (O-Ring) Seal
3	A/Trans Fluid Trough
4	A/Trans Fluid Trough Bolt M6 x 25 (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 12 N.m (106 lb in).

TORQUE CONVERTER AND DIFFERENTIAL HOUSING ASSEMBLY DISASSEMBLE

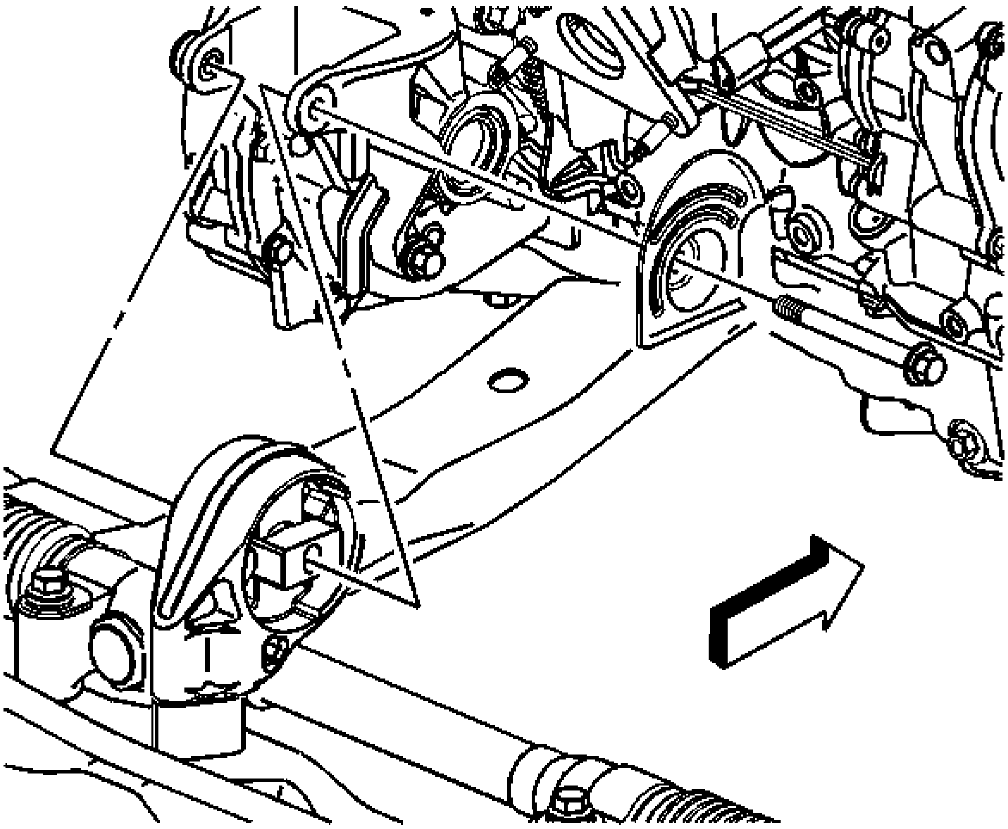

Fig. 118: Identifying Torque Converter & Differential Housing Assembly Components
Courtesy of GENERAL MOTORS CORP.

Torque Converter and Differential Housing Assembly Disassemble

Callout	Component Name
1	Front Differential Carrier Baffle Bolt M6 x 25
2	Front Differential Carrier Baffle
3	Front Differential Transfer Drive Gear Support Bolt M8 x 25 (Qty: 10)
4	Front Differential Transfer Drive Gear Support Assembly
5	Drive Sprocket Thrust Washer
6	A/Trans Fluid Pump Bolt M6 x 25 (Qty: 3)
7	A/Trans Fluid Pump Assembly

8	Drive Link Assembly **Tip:** Link and sprockets will be removed as an assembly.
9	Drive Sprocket Thrust Washer **Tip:** Drive sprocket thrust washer may be stuck to the torque converter housing.
10	Driven Sprocket Thrust Washer

FRONT DIFFERENTIAL CARRIER BEARING CUP AND WASHER REPLACEMENT - TORQUE CONVERTER HOUSING SIDE

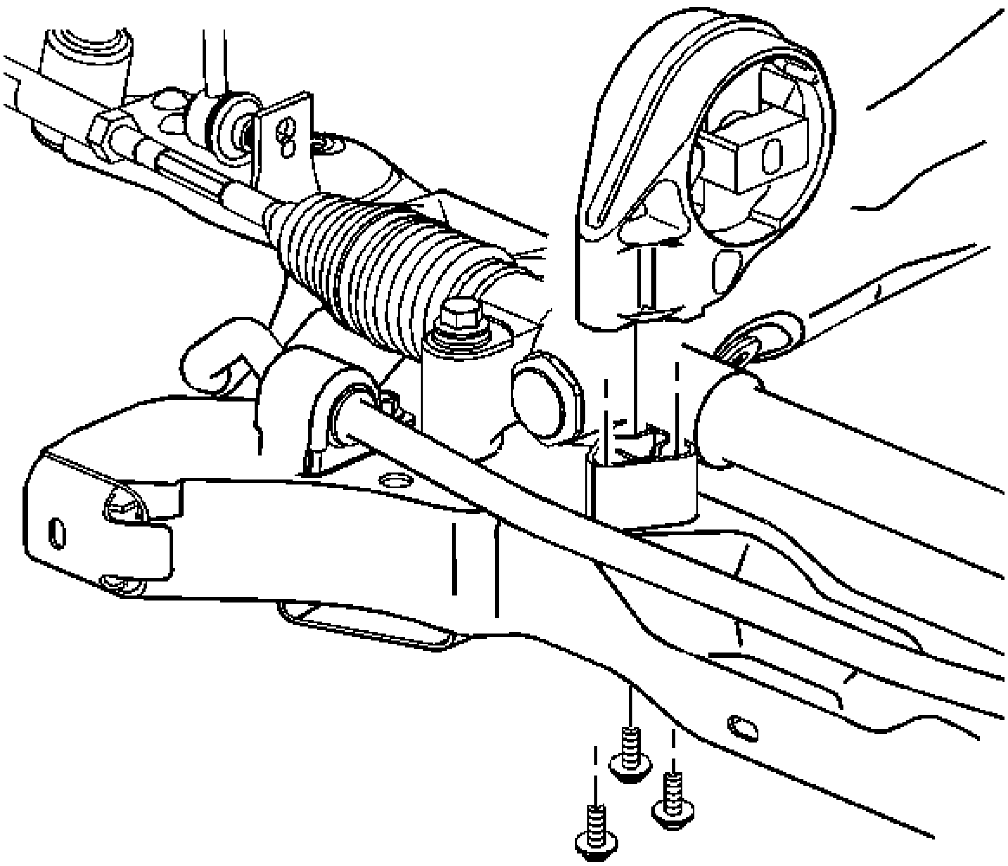

Fig. 119: Identifying Front Differential Carrier Bearing Cup & Washer
Courtesy of GENERAL MOTORS CORP.

Front Differential Carrier Bearing Cup and Washer Replacement - Torque Converter Housing Side

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures

Do not install the bearing cup until after the selective washer measurement has been performed.
Install the correct differential bearing washer as determined by the thrust washer measurement procedure. Refer to Front Differential Drive Pinion Gear Bearing Thrust Washer and Front Differential Bearing Washer Measurement.
</td></tr>
<tr><td>1</td><td>Front Differential Bearing Thrust Washer</td></tr>
<tr><td>2</td><td>Front Differential Carrier Bearing Cup

NOTE:
Support the back side of the torque converter housing while installing the bearing cup. Install the bearing cup until it stops moving. Applying excessive pressure to the bearing cup once it is seated could cause damage to the torque converter housing casting.

NOTE:
Failure to apply the lubricant will cause damage to the bolt and nut threads.

Tip:

Tighten DT 47927-1 which is part of DT-47927 until it fits snugly on the bearing cup. See Special Tools.
Adjust J 45124 so it sits on the torque converter housing surface just beyond the bearing cup opening. See Special Tools.
Apply the extreme pressure lubricant supplied with J 23444-A to the puller bolt threads to prevent damage to the bolt threads during bearing cup removal. See Special Tools.
Hold the puller bridge bolt and turn the nut to remove the bearing cup.

Special Tools

DT-47927 Bearing Cup Remover. See Special Tools.
J 23444-A Extreme Press Lubricant - 1/4 Ounce Tube. See Special Tools.
J-45087 Bearing Cup Installer. See Special Tools.
</td></tr>
</table>

	• **J 45124** Remover Bridge. See **Special Tools**.

FRONT DIFFERENTIAL DRIVE PINION BEARING CUP, WASHER, AND LUBRICANT DAM REPLACEMENT - TORQUE CONVERTER HOUSING SIDE

Bearing Cup, Washer and Lubricant Dam Removal

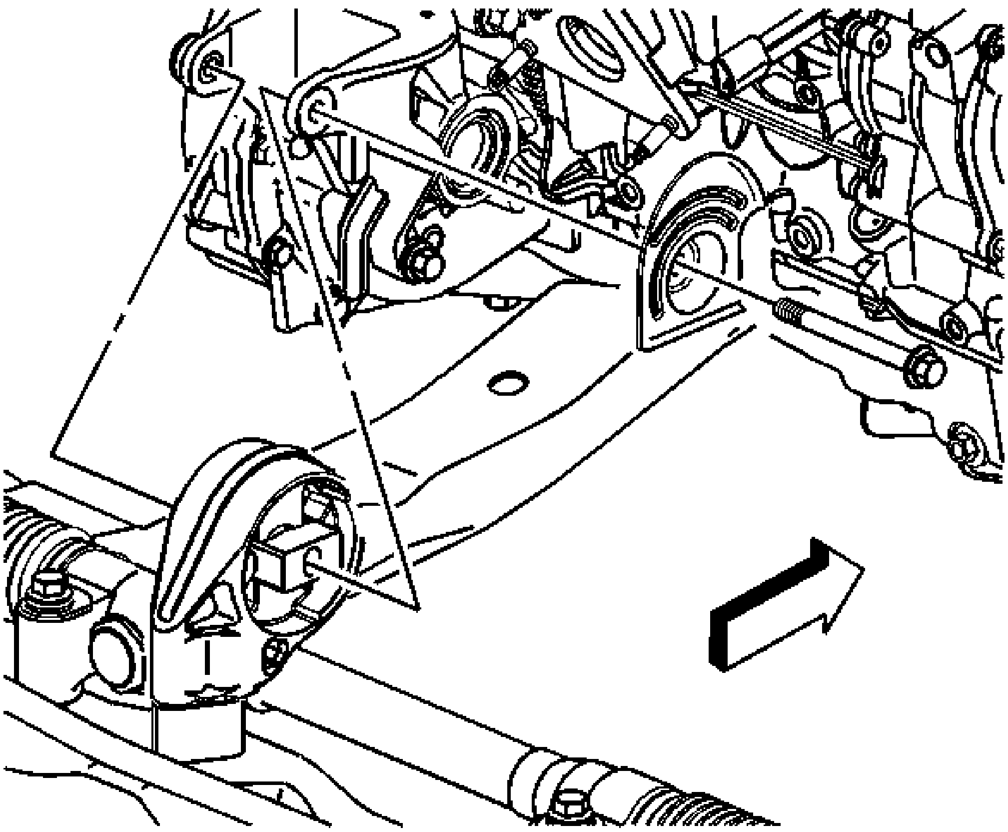

Fig. 120: View Of Front Differential Drive Pinion Bearing Cup, Washer & Lube Dam
Courtesy of GENERAL MOTORS CORP.

Bearing Cup, Washer and Lubricant Dam Removal

Callout	Component Name
Preliminary Procedure: Do not install the bearing cup until after the selective washer measurement has been performed.	
	Front Differential Drive Pinion Gear Bearing Cup

1	**NOTE:** **Failure to apply the lubricant will cause damage to the bolt and nut threads.** **Tip:** 1. Tighten **J-45094** until it fits snugly on the bearing cup. See **Special Tools**. 2. Adjust **J 45124** so it sits on the torque converter housing surface just beyond the bearing cup opening. See **Special Tools**. 3. Apply the extreme pressure lubricant **J 23444-A** to the puller bolt threads to prevent damage to the bolt threads during bearing cup removal. See **Special Tools**. 4. Hold the puller bridge bolt and turn the nut to removal the bearing cup. **Special Tools** • **DT-47927** Bearing Cup Remover. See **Special Tools**. • **J 23444-A** Extreme Press Lubricant - 1/4 Ounce Tube. See **Special Tools**. • **J-45087** Transfer Shaft and Differential Bearing Cup Installer. See **Special Tools**. • **J-45094** Bearing Cup Remover. See **Special Tools**. • **J 45124** Removal Bridge. See **Special Tools**.
2	Front Differential Drive Pinion Gear Bearing Thrust Washer **Tip:** Install the correct drive pinion gear bearing thrust washer as determined by the thrust washer measurement procedure.
3	Front Differential Drive Pinion Gear Lube Dam **Special Tools** • **DT-48055** Lube Dam Remover. See **Special Tools**. • **J 6125-1B** Slide Hammer with Adapter or equivalent

Bearing Cup, Washer and Lubricant Dam Installation

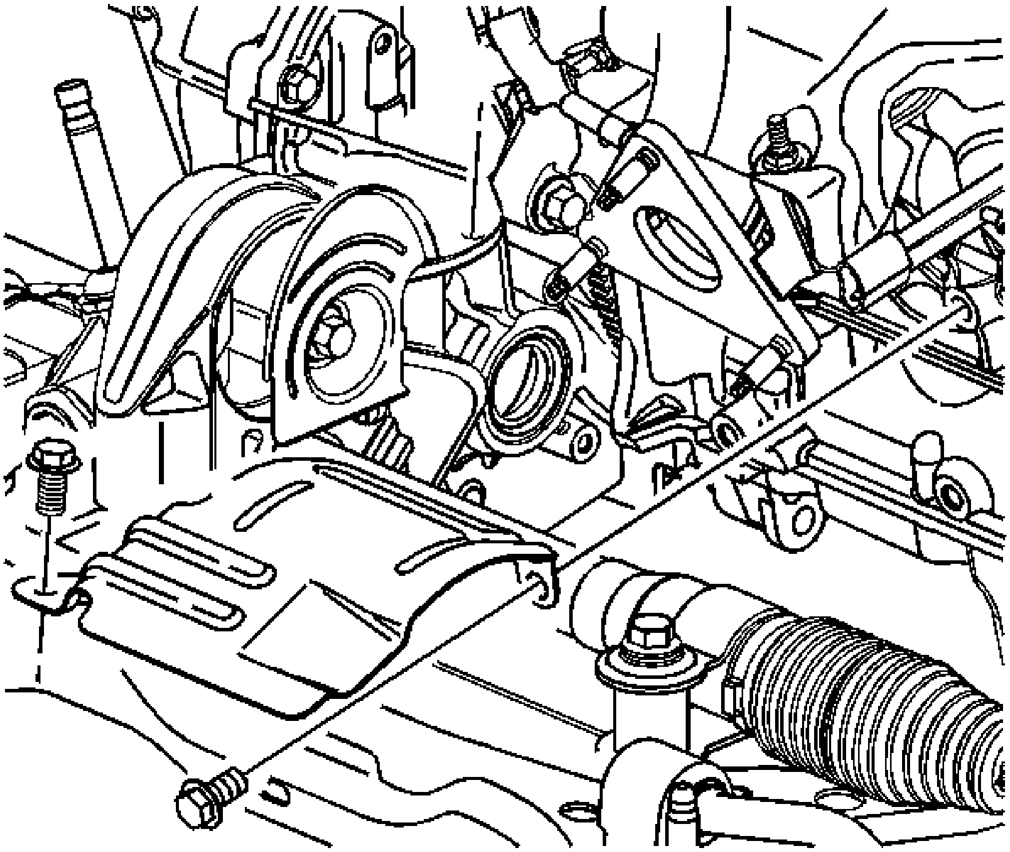

Fig. 121: Identifying Front Differential Drive Pinion Bearing Cup, Washer & Lube Dam
Courtesy of GENERAL MOTORS CORP.

Bearing Cup, Washer and Lubricant Dam Installation

Callout	Component Name
Preliminary Procedure: Do not install the bearing cup until after the selective washer measurement has been performed.	
1	Front Differential Drive Pinion Gear Lube Dam **Special Tools** • **J 8092** Driver Handle • **J-46630** Lube Dam Installer. See **Special Tools**.
	Front Differential Drive Pinion Gear Bearing Thrust Washer **Tip:** Install the correct drive pinion gear bearing thrust

2	washer as determined by the thrust washer measurement procedure. Refer to **Front Differential Drive Pinion Gear Bearing Thrust Washer and Front Differential Bearing Washer Measurement**.
3	Front Differential Drive Pinion Gear Bearing Cup **NOTE:** **Support the back side of the torque converter housing while installing the bearing cup. Install the bearing cup until it stops moving. Applying excessive pressure to the bearing cup once it is seated could cause damage to the torque converter housing casting.** **Special Tool:** **J-45087** Bearing Cup Installer. See **Special Tools**.

FRONT WHEEL DRIVE SHAFT OIL SEAL REPLACEMENT - TORQUE CONVERTER HOUSING SIDE

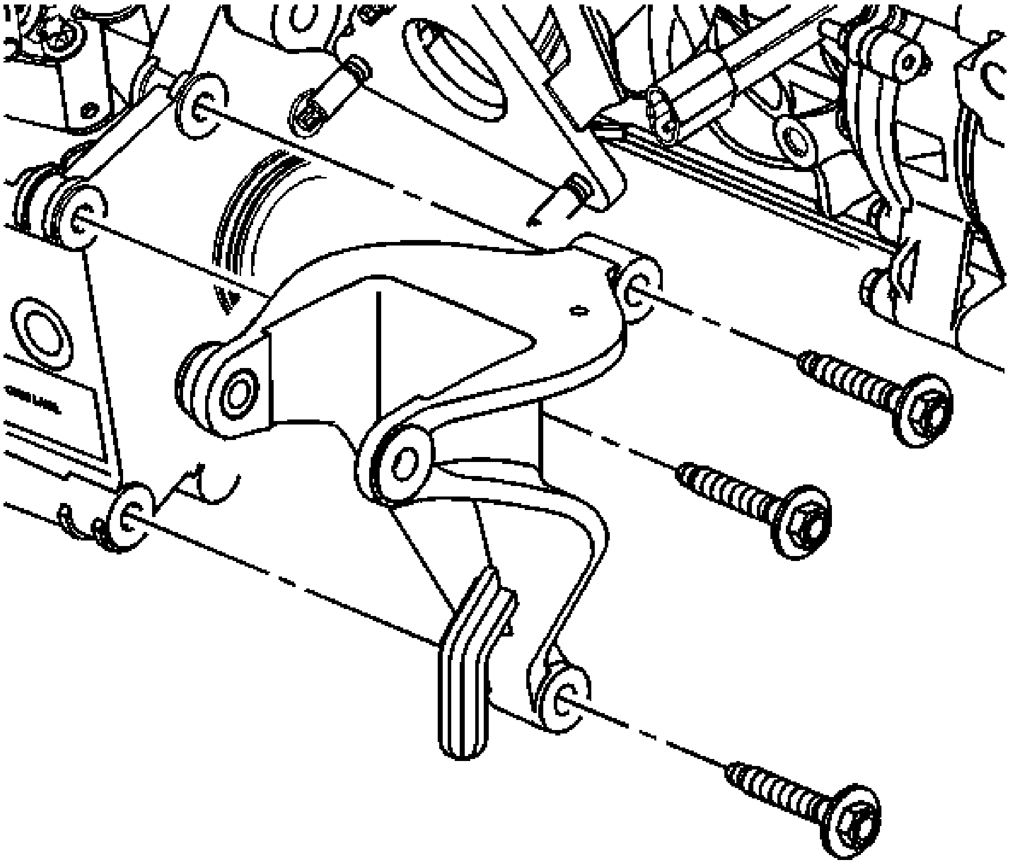

Fig. 122: Identifying Front Wheel Drive Shaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

Front Wheel Drive Shaft Oil Seal Replacement - Torque Converter Housing Side

Callout	Component Name
1	Torque Converter - Front Wheel Drive Shaft Oil Seal Assembly **Tip:** Use the open side of **J-46629** to avoid seal lip damage and to install the seal to the proper depth. See Special Tools. **Special Tools** • **J 6125-1B** Slide Hammer with Adapter or equivalent • **J 8092** Driver Handle or equivalent

	• **J 23129** Universal Seal Remover • **J-46629** Axle Seal Installer. See **Special Tools**.

TORQUE CONVERTER HOUSING CLEANING AND INSPECTION

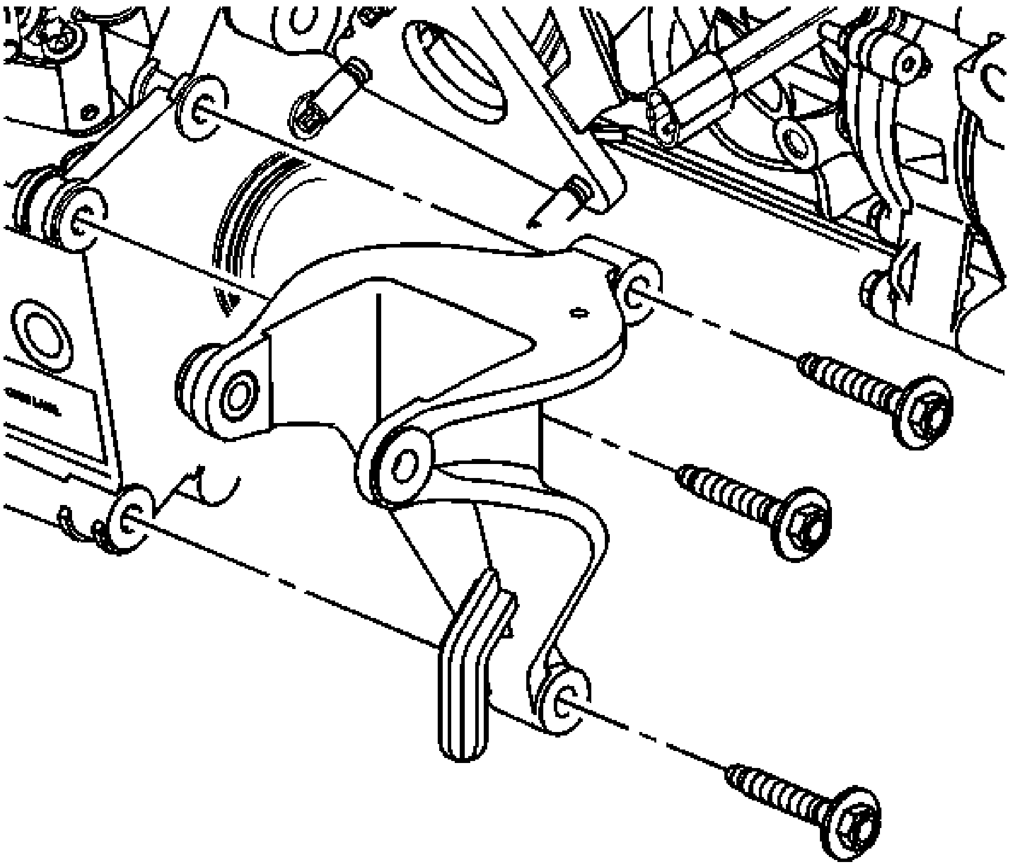

Fig. 123: Identifying Torque Converter Housing
Courtesy of GENERAL MOTORS CORP.

Torque Converter Housing Cleaning and Inspection

Callout	Component Name
NOTE: **After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.** **NOTE:**	

Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

NOTE:

Do not use abrasive pads or bristle devices to clean the sealing surfaces. Abrasive pads produce a fine grit that can effect transmission function. Abrasive pads can also remove enough metal to create oil leaks.

Preliminary Procedure: Thoroughly clean the torque converter and differential housing, including threads, with clean solvent.

1	Threaded Holes
2	Gasket Sealing Surfaces

TORQUE CONVERTER FLUID SEAL REPLACEMENT

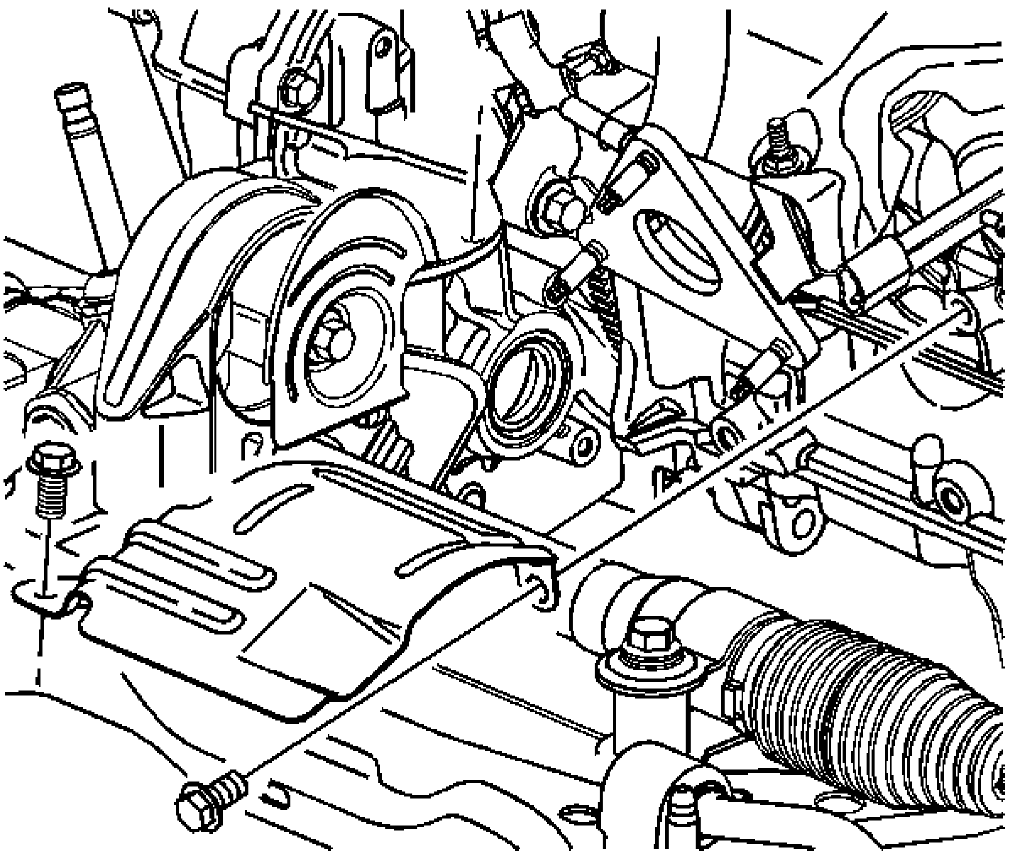

Fig. 124: Identifying Torque Converter Fluid Seal

Courtesy of GENERAL MOTORS CORP.

Torque Converter Fluid Seal Replacement

Callout	Component Name
1	Torque Converter Fluid Seal **NOTE:** **Support the back side of the torque converter housing while installing the bearing cup. Install the bearing cup until it stops moving. Applying excessive pressure to the bearing cup once it is seated could cause damage to the torque converter housing casting.** **Special Tools** • **J 6125-1B** Slide Hammer with Adapter or equivalent • **J 23129** Universal Seal Remover • **J 38693** Seal Installer. See **Special Tools**.

FRONT DIFFERENTIAL TRANSFER DRIVE GEAR SUPPORT ASSEMBLY DISASSEMBLE

Seal Removal

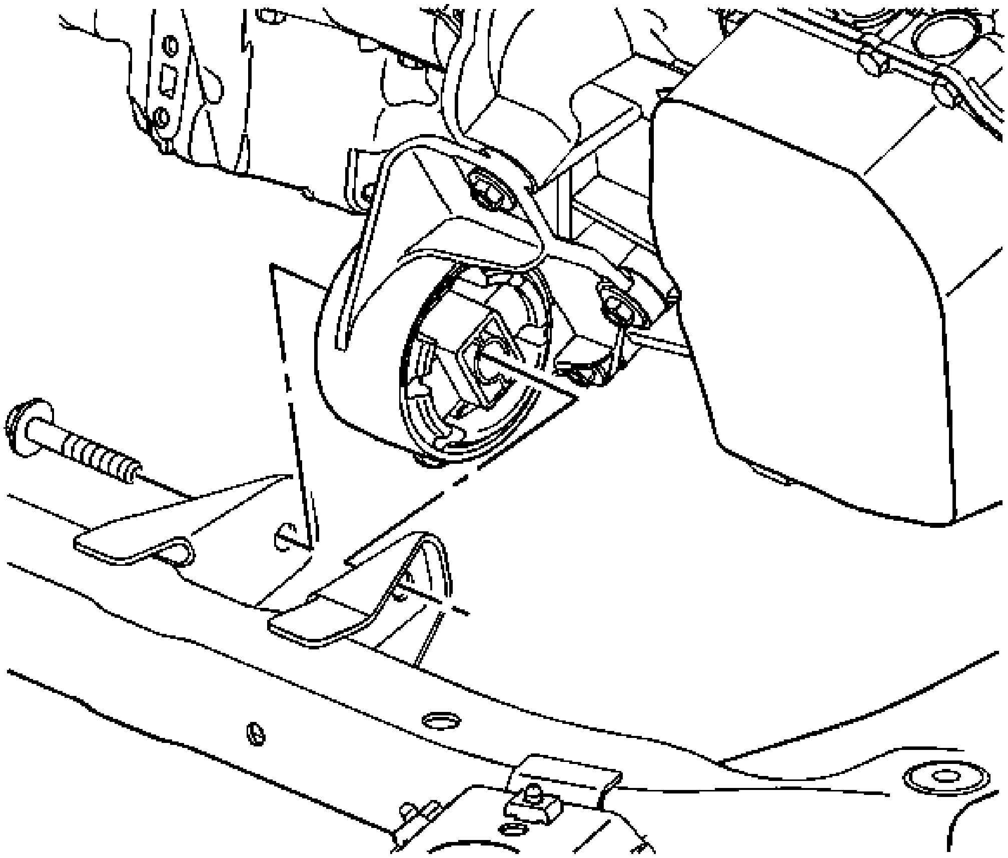

Fig. 125: Identifying Front Differential Transfer Drive Gear Support Seal
Courtesy of GENERAL MOTORS CORP.

Seal Removal

Callout	Component Name
NOTE: **Do not remove the transfer drive gear bearing retaining nut. The drive gear and bearing are not serviceable. Removing the retaining nut will damage the support.** **Preliminary Procedure** • Inspect the support assembly for damage or wear to the splines, bushings, machined surfaces and threaded holes. • Inspect the transfer drive gear for damage or wear. • Inspect the transfer drive gear bearing assembly for proper operation.	

• The bearing should roll smoothly and quietly.	
1	Front Differential Transfer Drive Gear Support Seal **Special Tools** • **J 6125-1B** Slide Hammer with Adapter or equivalent • **J 23129** Universal Seal Remover
2	Front Differential Transfer Drive Gear Support Torque Converter Fluid Seal Assembly

Fluid Passage Tube Removal

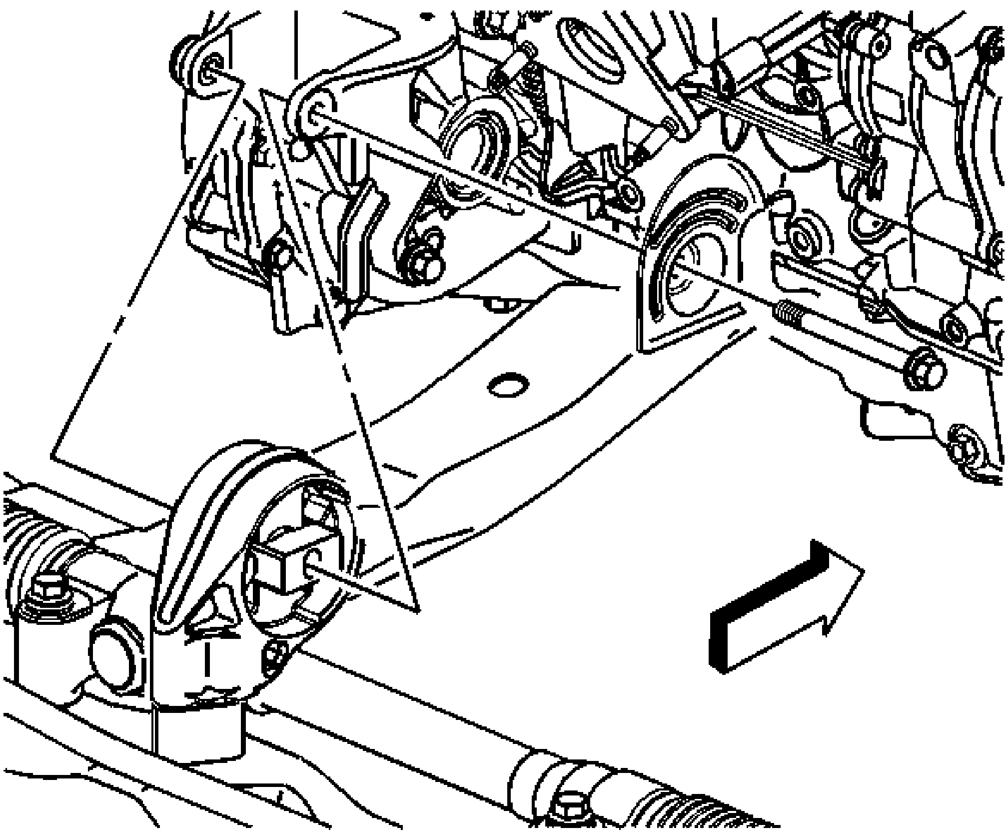

Fig. 126: Identifying Fluid Passage Tube Assembly
Courtesy of GENERAL MOTORS CORP.

Fluid Passage Tube Removal

Callout	Component Name
NOTE: **Do not remove the transfer drive gear bearing retaining nut. The drive gear and bearing are not serviceable. Removing the retaining nut will damage the support.** **Preliminary Procedures** • Inspect the support assembly for damage or wear to the splines, bushings, machined surfaces and threaded holes. • Inspect the transfer drive gear for damage or wear. • Inspect the transfer drive gear bearing assembly for proper operation. • The bearing should roll smoothly and quietly.	
1	Front Differential Transfer Drive Gear Fluid Passage Tube Bolt M6 x 15 (Qty: 2)
2	Front Differential Transfer Drive Gear Fluid Passage Tube Bolt M5 x 12 (Qty: 2)
3	Fluid Passage Tube Assembly **Tip:** Inspect the tubes for damage, wear or cracked welds.
4	Front Differential Transfer Drive Gear Support Fluid Passage Tube Gasket
5	Front Differential Transfer Drive Gear Support Seal

FRONT DIFFERENTIAL TRANSFER DRIVE GEAR SUPPORT ASSEMBLY ASSEMBLE

Drive Support Seal Installation

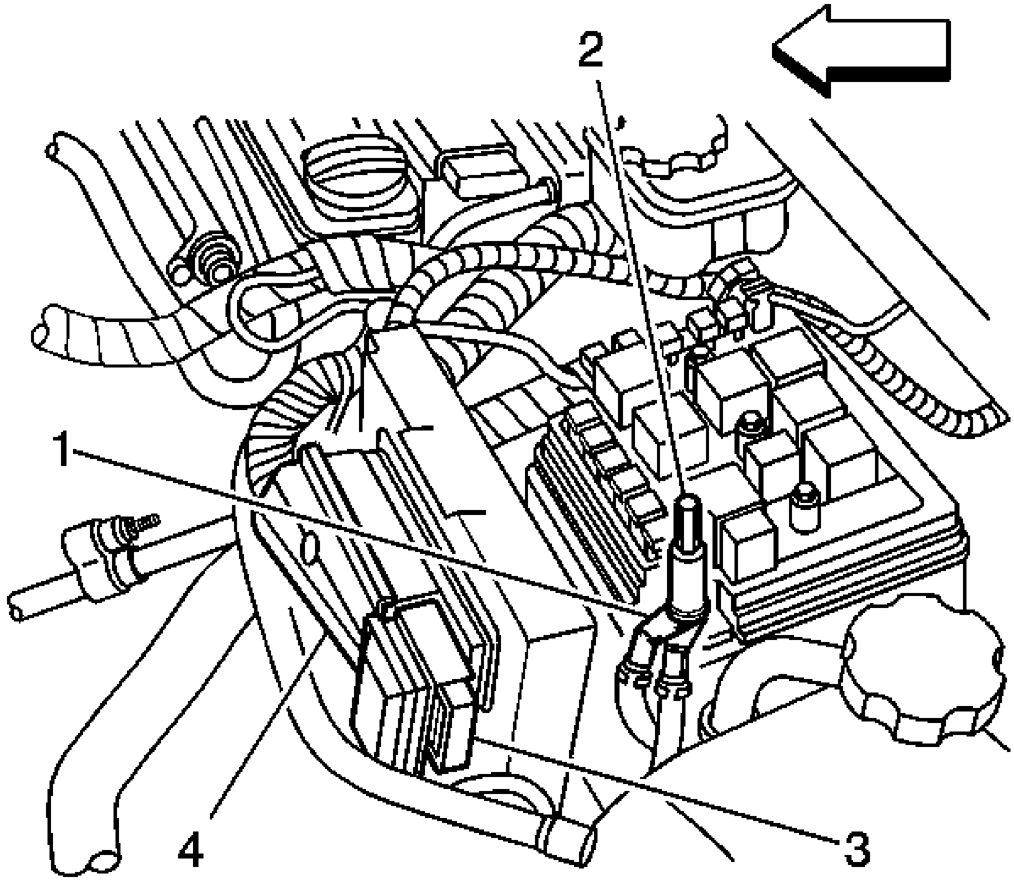

Fig. 127: Identifying Front Differential Transfer Drive Gear Support Seal
Courtesy of GENERAL MOTORS CORP.

Drive Support Seal Installation

Callout	Component Name
1	Front Differential Transfer Drive Gear Support Seal **Tip:** A NEW seal must be installed. **Special Tool:** **J-46624** Support Seal Installer. See **Special Tools**.
2	Small Chamfer Faces Up **NOTE:** **To avoid damaging the seal, first place J 46624-**

	1 with the small chamfer end facing up and leave in place for at least 60 seconds.
3	Large Chamfer Faces Up **Tip:** Turn J 46624-1 which is part of **J-46624** , over with the large chamfer end facing up for 60 seconds to ensure that the seal has been properly sized. See **Special Tools**.

Fluid Passage Tube Installation

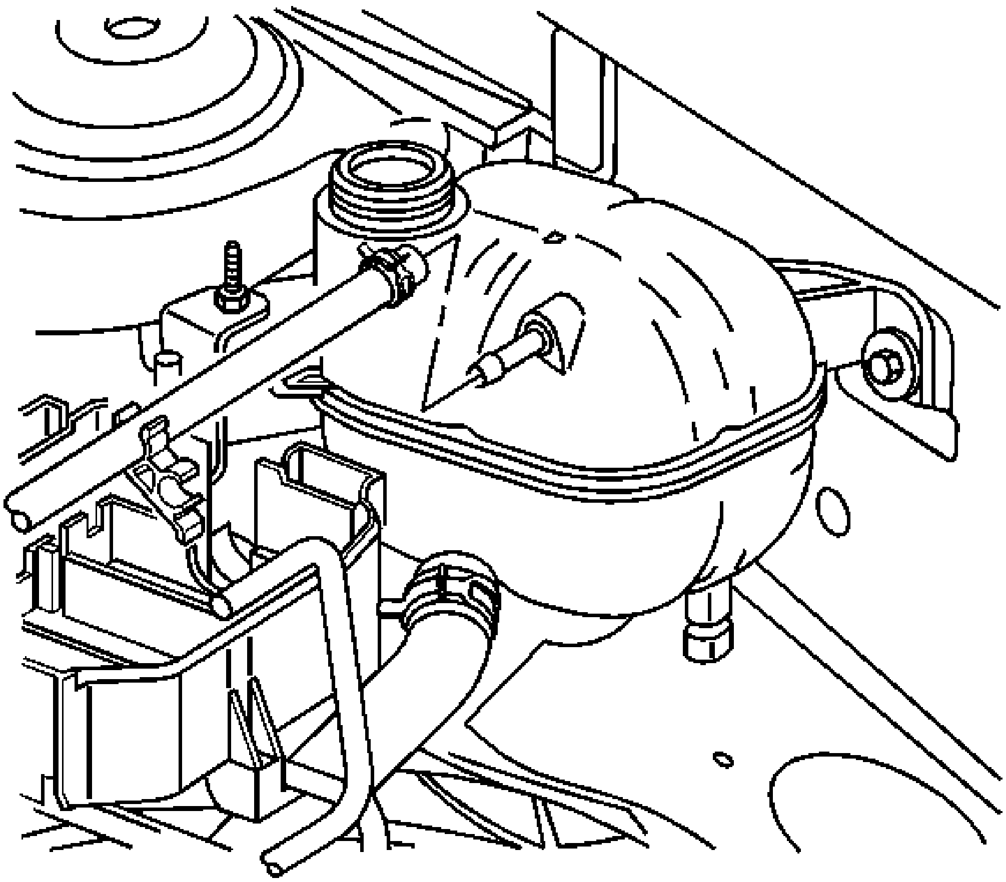

Fig. 128: Identifying Front Differential Transfer Drive Gear Support Fluid Passage Tube
Courtesy of GENERAL MOTORS CORP.

Fluid Passage Tube Installation

Callout	Component Name

1	Front Differential Transfer Drive Gear Support Fluid Passage Tube Gasket
2	Fluid Passage Tube Assembly
3	Front Differential Transfer Drive Gear Fluid Passage Tube Bolt M6 x 15 (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 12 N.m (106 lb in)
4	Front Differential Transfer Drive Gear Fluid Passage Tube Bolt M5 x 12 (Qty: 2) **Tighten:** 7 N.m (62 lb in)

Seal Installation

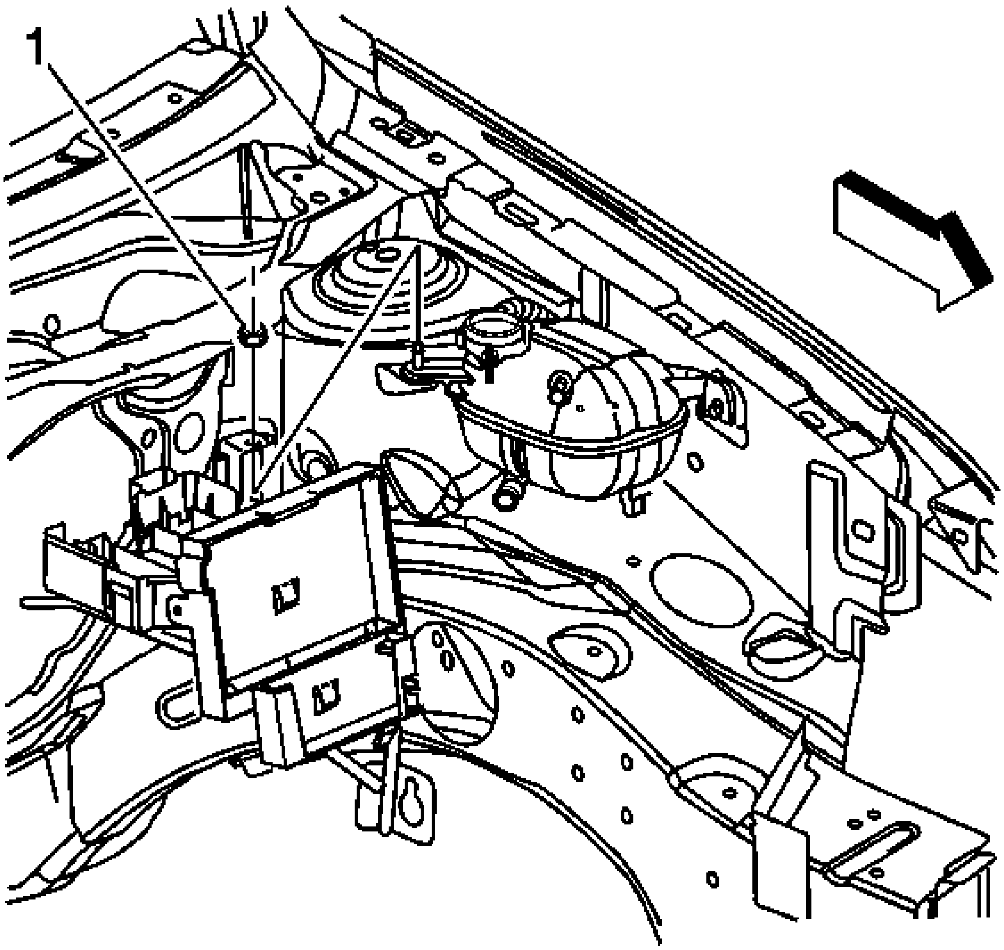

Fig. 129: View Of Front Differential Transfer Drive Gear Support Seal
Courtesy of GENERAL MOTORS CORP.

Seal Installation

Callout	Component Name
1	Front Differential Transfer Drive Gear Support Seal **Special Tool:** **J-46627** Seal Installer. See **Special Tools**.
2	Front Differential Transfer Drive Gear Support Torque Converter Fluid Seal Assembly

FLUID PUMP CLEANING AND INSPECTION

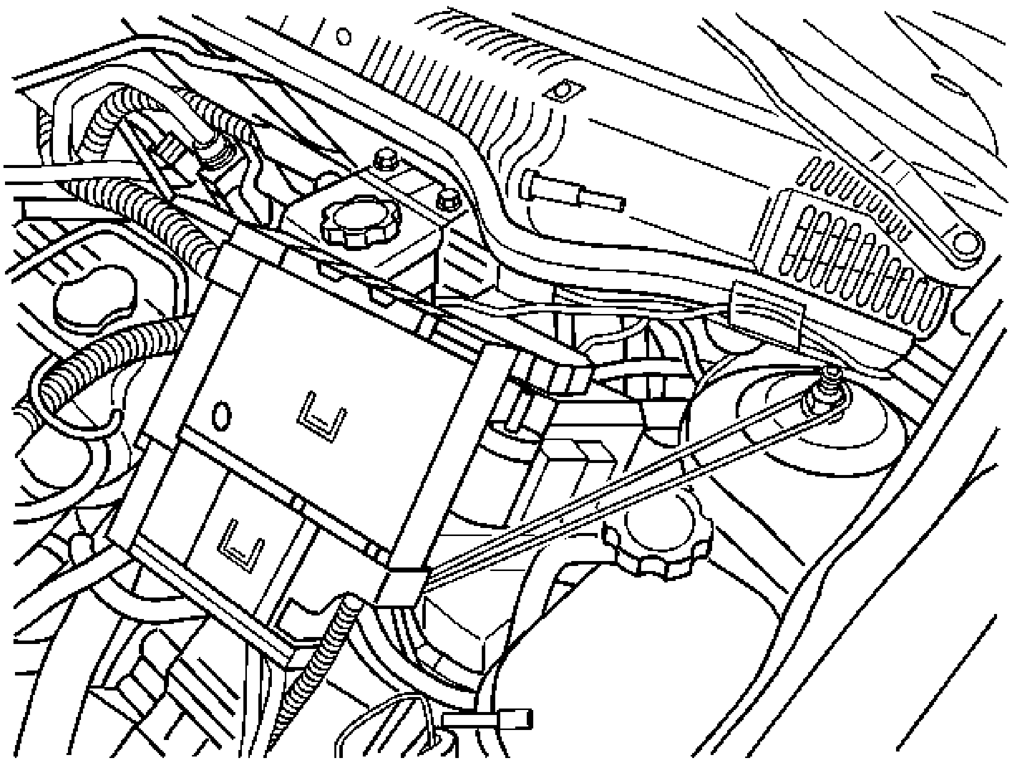

Fig. 130: Identifying Fluid Pump Components
Courtesy of GENERAL MOTORS CORP.

Fluid Pump Cleaning and Inspection

Callout	Component Name
NOTE: After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure. **NOTE:** Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component. **Preliminary Procedure:** The fluid pump assembly is not serviceable.	
1	Filter Neck Seal **Tip:** Install a NEW filter neck seal. **Special Tool:** **J 28585** Snap ring Remover or equivalent

2	A/Trans Fluid Filter Assembly **Tip:** Install a NEW fluid filter assembly.
3	Fluid Pump Drive Shaft **Tip:** • Inspect the fluid pump drive shaft splines for damage or wear. • Rotate the fluid pump drive shaft for free operation.

FRONT DIFFERENTIAL DRIVE PINION GEAR BEARING THRUST WASHER AND FRONT DIFFERENTIAL BEARING WASHER MEASUREMENT

Differential Thrust Washer Gage Installation

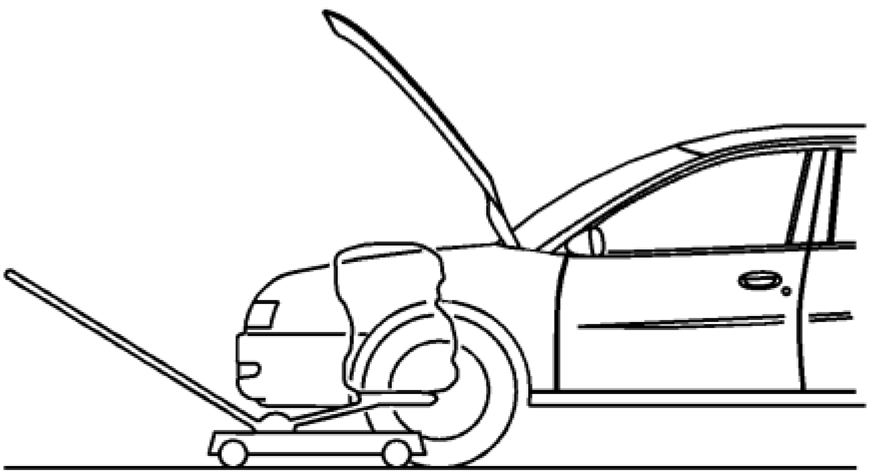

Fig. 131: Identifying Differential Thrust Washer Gage
Courtesy of GENERAL MOTORS CORP.

Differential Thrust Washer Gage Installation

Callout	Component Name
	Front Differential Carrier Assembly

1	**Tip:** Install the differential assembly and the pinion gear assembly together to avoid interference with the gears during installation.
2	Front Differential Drive Pinion (w/Transfer Gear) Gear Assembly **Tip:** Install the differential assembly and the pinion gear assembly together to avoid interference with the gears during installation.
3	Front Differential Drive Pinion Gear Bearing Cup **Tip:** After placing the bearing cup on the gear, place DT 47800-2 which is part of **DT-47800** , onto the bearing cup. See **Special Tools**. **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.
4	Front Differential Carrier Bearing Cup **Tip:** After placing the bearing cup on the gear, place DT 47800-1 which is part of **DT-47800** , onto the bearing cup. See **Special Tools**. **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.
5	Torque Converter Housing Outer Seal
6	Torque Converter and Support and A/Trans Fluid Pump Housing Assembly **IMPORTANT:** **Install 2 DT 47800-6 which is part of DT-47800 , into a case threaded hole at approximately 180 degrees apart. See Special Tools.** **Tip:** Some alignment of DT 47800-1 and 2 which is part of **DT-47800** , may be required while lowering the TC housing onto the case. See **Special Tools**. Install DT 47800-3 which is part of **DT-47800** , spacer over DT 47800-6. See **Special Tools**. **Special Tool:** **DT-47800** SThrust Washer Selection Gage Kit. See **Special Tools**.

Torque Sequence

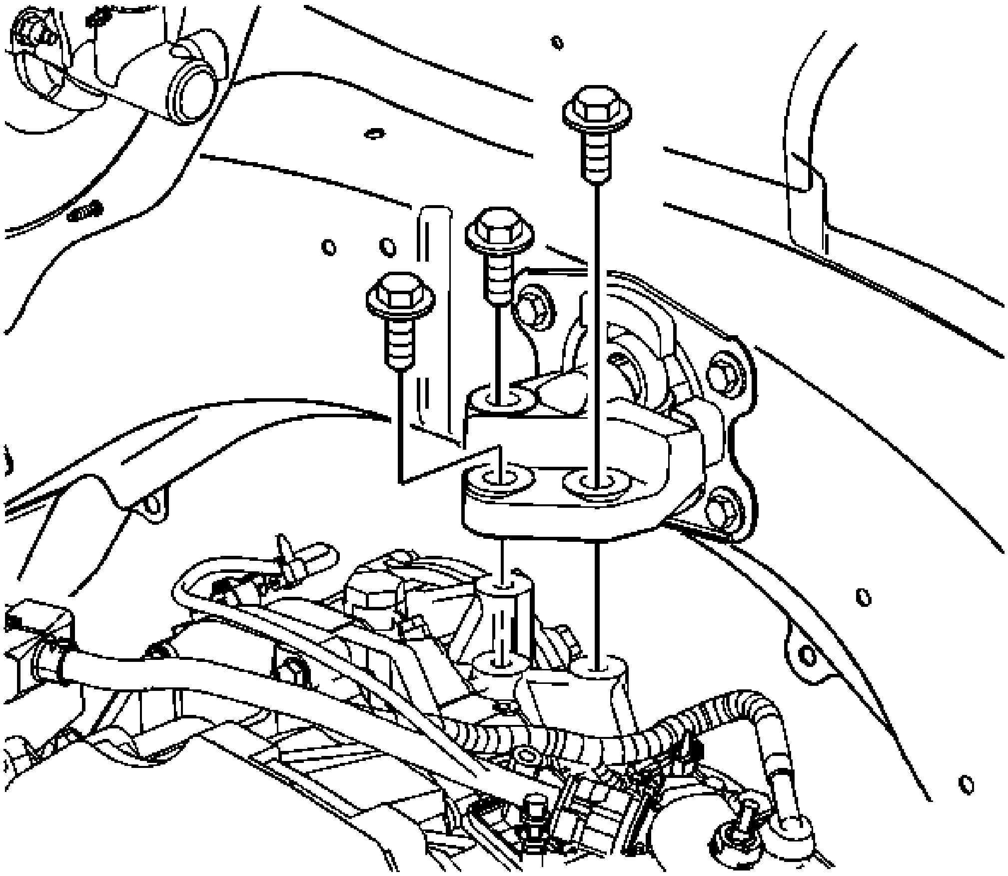

Fig. 132: Identifying Front Differential Carrier Assembly Torque Sequence
Courtesy of GENERAL MOTORS CORP.

Torque Sequence

Callout	Component Name
NOTE: **Refer to Fastener Notice .** Refer to **Fastener Tightening Specifications** .	
	Spacer Bolts M8 x 127 (Quantity: 8) **IMPORTANT:** **1. Install the remaining spacers evenly at every other bolt hole.** **2. Remove the DT 47800-6 which is part of DT-**

1	**47800 , guide pins and install spacer bolts in all bolt holes at spacer locations. See Special Tools.** **3. Tighten the bolts in sequence to 30 N.m (22 lb ft).** **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.
2	Front Differential Carrier Assembly **NOTE:** **If the bearings are not properly seated into the bearing cups, the washer selection will be inaccurate and the bearing pre-load will be set too low. Low bearing pre-load will cause premature failure of the front differential drive pinion gear.** Rotate the differential assembly 10 revolutions to allow the bearings to seat into the cups. **Tip:** Differential rotating tool **DT-47793** can be used to rotate the differential from the case side. See **Special Tools**. **Special Tool:** **DT-47793** Differential Rotating Tool. See **Special Tools**.

Differential Thrust Washer Selection

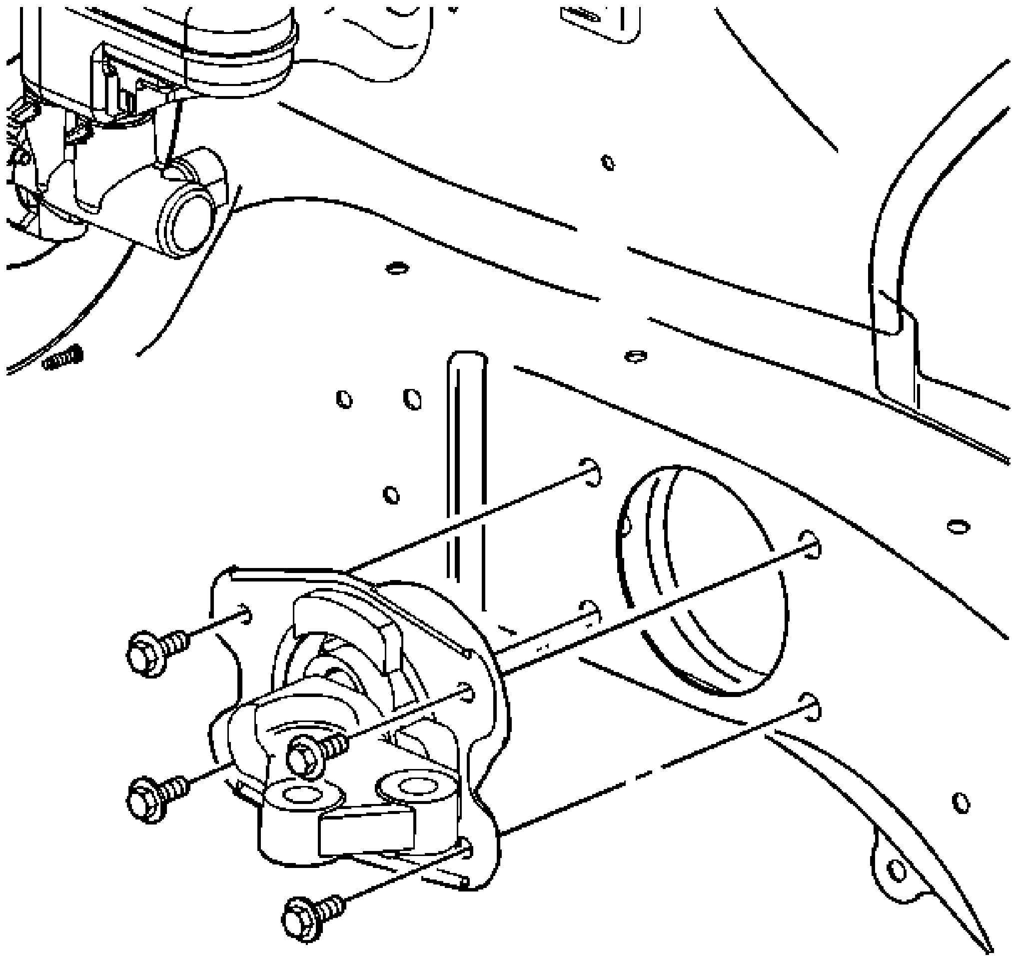

Fig. 133: Identifying Differential Thrust Washer Selection
Courtesy of GENERAL MOTORS CORP.

Differential Shim Selection

Callout	Component Name
NOTE: **Improper thrust washer selection can cause insufficient taper bearing pre-load which will cause premature failure of the front differential drive pinion gear.**	
	Front Differential Bearing Washer **IMPORTANT:** **Place DT 47800-7 in the gap in DT 47800-2 which are both part of DT-47800 , to determine the proper thrust washer.**

1	**See Special Tools. Choose the correct thrust washer. Refer to Taper Bearing Preload Selective Specifications .** **Tip:** • Continue trying different sizes of DT 47800-7 which is part of **DT-47800** , until the gage will no longer fit into the gap. See **Special Tools**. The correct thrust washer size is equal to the largest blade gage that fits into the gap. • Match the sizer of the correct DT 47800-7 blade which is part of **DT-47800** , to the color code in the thrust washer specification chart. See **Special Tools**. The washer color coding is on the outside diameter of the washer. • The gap in DT 47800-2 which are both part of **DT-47800** may not be even. See **Special Tools**. Hold the top of the gage and rotate the bottom of the gage to even out the gap. Take two gap measurements 180 degrees apart. Average the two measurements and select the thrust washer that is closest to the average. • The washer color coding is on the outside diameter of the washer. **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.
2	Front Differential Drive Pinion Gear Bearing Thrust Washer **IMPORTANT:** **Place DT 47800-7 in the gap in DT 47800-1 which are both part of DT-47800 , to determine the proper thrust washer. See Special Tools. Choose the correct thrust washer. Refer to Taper Bearing Preload Selective Specifications .** **Tip:** • Continue trying different sizes of DT 47800-7 which is part of **DT-47800** , until the gage will no longer fit into the gap. See **Special Tools**. The correct thrust washer size is equal to the largest gage that fits into the gage. • Match the size of the correct DT 47800-7 blade which is part of **DT-47800** to the color code in the thrust washer selection chart. See **Special Tools**.

	• The gap in DT 47800-1 which is part of **DT-47800** may not be even. See **Special Tools**. Hold the top of the gage and rotate the bottom of the gage to even out the gap. Take two gap measurements 180 degrees apart. Average the two measurements and select the thrust washer that is closest to the average. • The washer color coding is on the outside diameter of the washer. **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.
3	Torque Converter and Support and A/Trans Fluid Pump Housing Assembly **IMPORTANT:** **1. Remove DT 47800-3 which are both part of DT-47800 , bolts and spacers. See Special Tools.** **2. Remove the torque converter housing.** **3. Remove DT 47800-1 and DT 47800-2 which are both part of DT-47800 . See Special Tools.** **4. Remove the torque converter housing seal.** **5. Remove the pinion gear and differential bearing cups.** **6. Install the bearing cups and thrust washers into the torque converter housing per the replacement procedures. Refer to Front Differential Carrier Bearing Cup and Washer Replacement - Torque Converter Housing Side andFront Differential Drive Pinion Gear Bearing Cup and Lubricant Dam Replacement.** **Tip:** DT 47800-1 and DT 47800-2 which are both part of **DT-47800** , may stick in the torque converter housing. See **Special Tools**. Be careful not to drop the gages. **Special Tool:** **DT-47800** Thrust Washer Selection Gage Kit. See **Special Tools**.

TORQUE CONVERTER AND DIFFERENTIAL HOUSING ASSEMBLY ASSEMBLE

Pump Assembly Installation

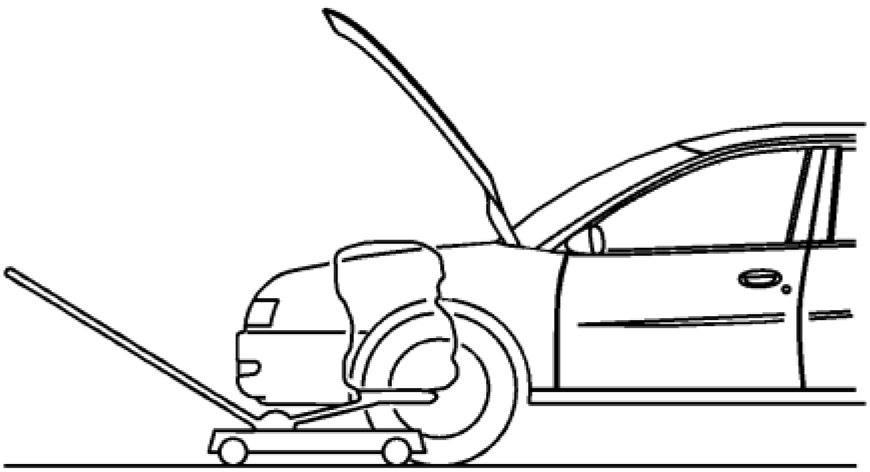

Fig. 134: View Of Pump Assembly
Courtesy of GENERAL MOTORS CORP.

Pump Assembly Installation

Callout	Component Name
1	Driven Sprocket Thrust Washer
2	Drive Sprocket Thrust Washer
3	Install Drive Link Assembly **Tip:** Install as an assembly.
4	A/Trans Fluid Pump Assembly **Tip:** Rotating the drive sprocket and link assembly while installing the oil pump will aid in aligning the driven sprocket and oil pump drive shaft splines.
5	A/Trans Fluid Pump Bolt M6 x 25 (Qty: 3) **NOTE:** **Refer to Fastener Notice .** **Tighten:** Tighten in sequence to 12 N.m (106 lb in).

Transfer Drive Gear Assembly Installation

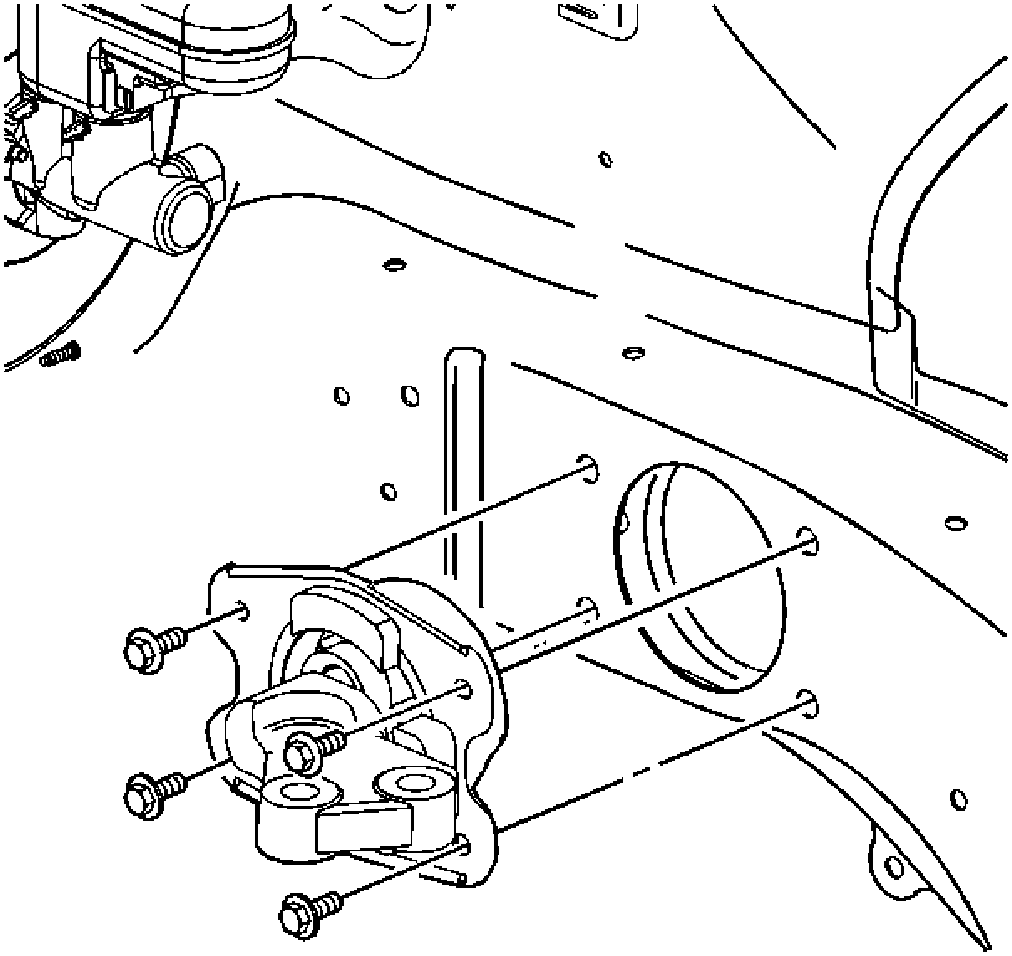

Fig. 135: Identifying Transfer Drive Gear Assembly
Courtesy of GENERAL MOTORS CORP.

Transfer Drive Gear Assembly Installation

Callout	Component Name
1	Drive Sprocket Thrust Washer
2	Front Differential Transfer Drive Gear Support Assembly
	Front Differential Transfer Drive Gear Support Bolt M8 x 25 (Qty: 10)

3	**NOTE:** **Refer to Fastener Notice .** **Tighten:** Tighten in sequence to 10 N.m (89 lb in) plus 50 degrees + /- 4 degrees.
4	Front Differential Carrier Baffle
5	Front Differential Carrier Baffle Bolt M6 x 25 **Tighten:** 12 N.m (106 lb in).

FRONT DIFFERENTIAL DRIVE PINION GEAR BEARING REPLACEMENT

Removal

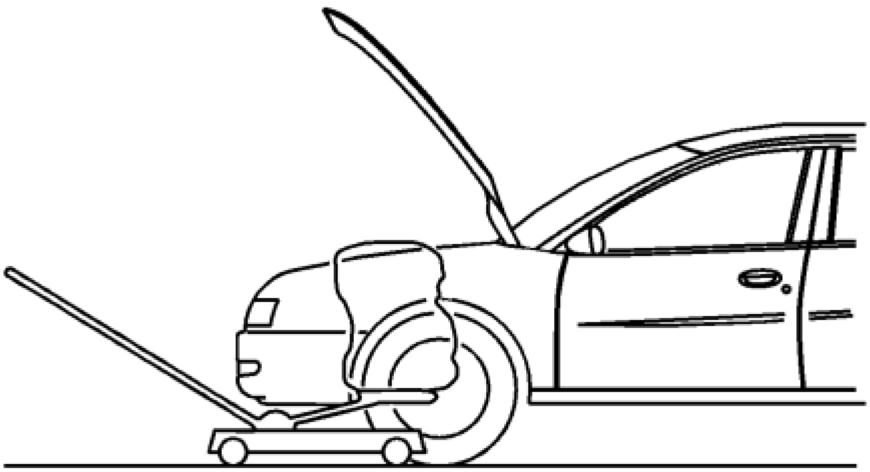

Fig. 136: View Of Front Differential Drive Pinion Gear Bearing
Courtesy of GENERAL MOTORS CORP.

Removal

Callout	Component Name
	Front Differential Drive Pinion Gear Bearing

1	**Tip:** • When removing the front differential drive pinion gear bearing use **J 41816-2** . See **Special Tools**. • Use **J 8433-1** with bolts 2-3/8" x 3" x 24. See **Special Tools**. **Special Tools** • **J 8433-1** Puller Bar or equivalent. See **Special Tools**. • **J 22912-B** Split Plate Bearing Remover or equivalent. See **Special Tools**. • **J 41816-2** Step Plate. See **Special Tools**.

Installation

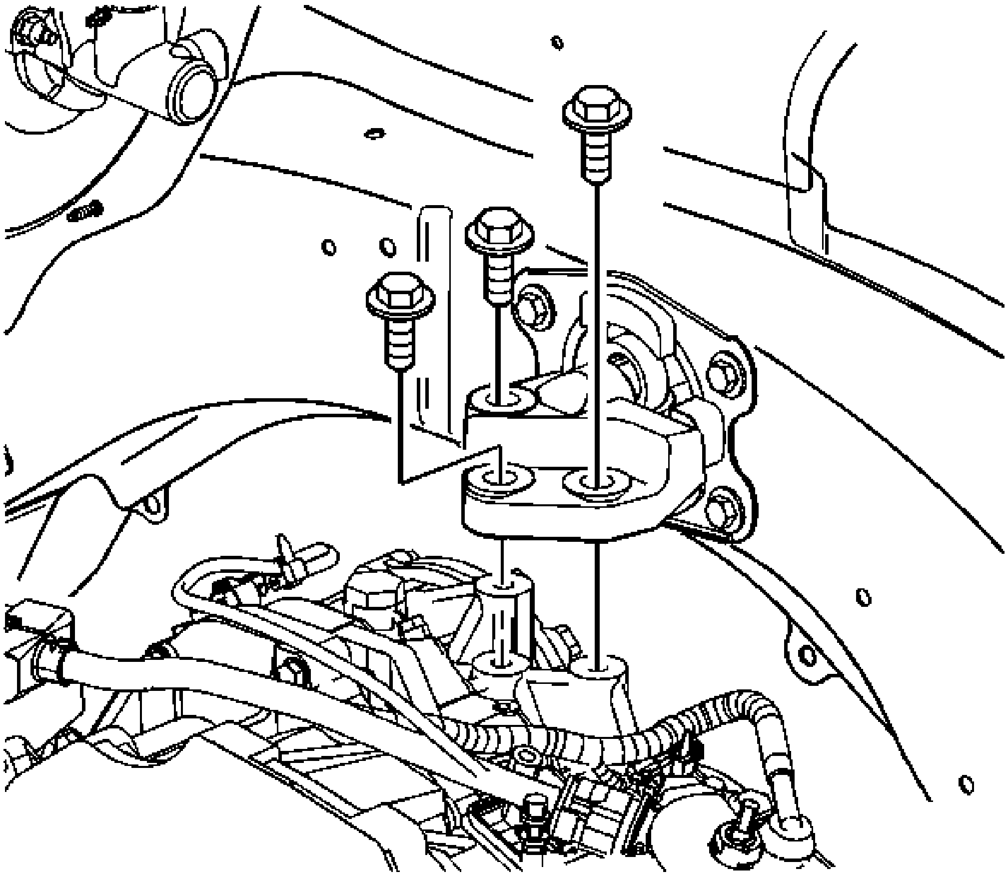

Fig. 137: Identifying Front Differential Drive Pinion Gear Bearing
Courtesy of GENERAL MOTORS CORP.

Installation

Callout	Component Name
1	Front Differential Drive Pinion Gear Bearing **NOTE:** **Pressing against the bearing assembly can damage the bearing and cause premature bearing failure.** **Special Tools:** **DT-47928** Bearing Installer. See **Special Tools**.

FRONT DIFFERENTIAL CARRIER BEARING REPLACEMENT

Removal

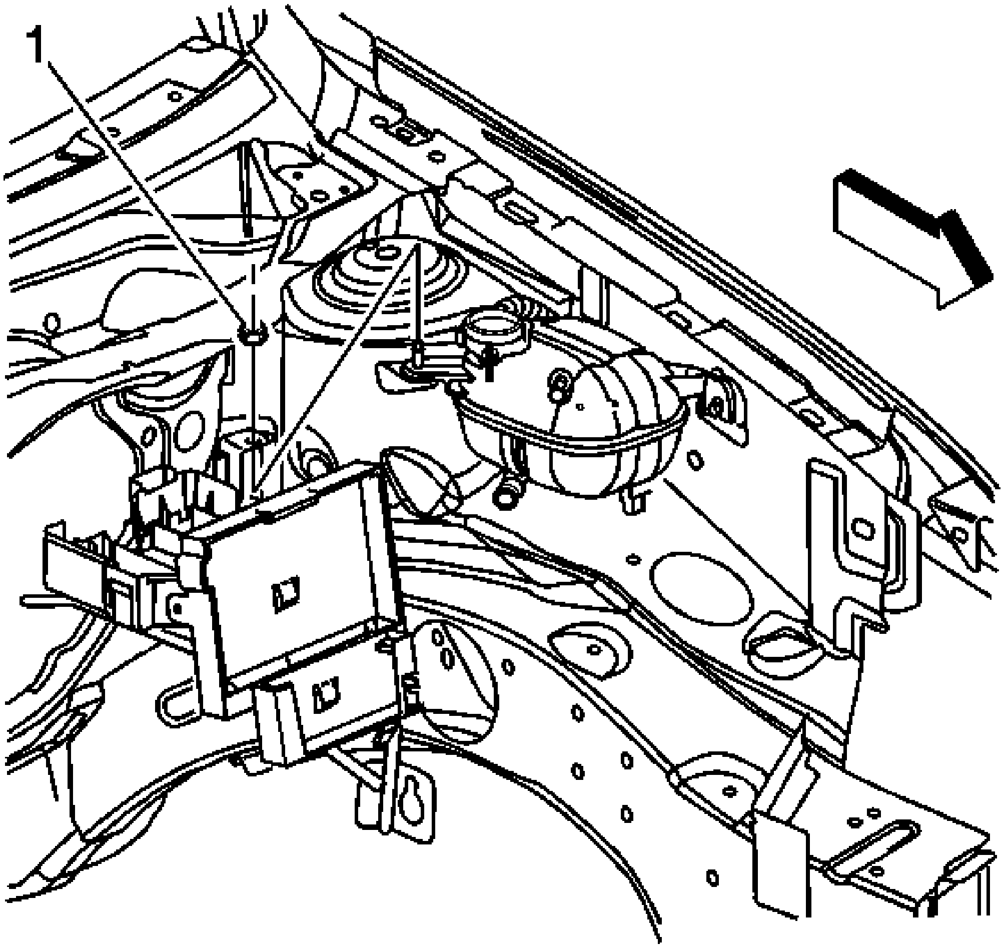

Fig. 138: Identifying Front Differential Carrier Bearing
Courtesy of GENERAL MOTORS CORP.

Removal

Callout	Component Name
1	Front Differential Carrier Bearing Assembly **Special Tools**

	• **J-41816** Three Legged Puller. See **Special Tools**. • **J 41816-2** Step Plate. See **Special Tools**.
2	Inner Race **Tip:** Ensure all 3 legs of the puller make contact with the inner race of the bearing.
3	Front Differential Carrier Bearing Assembly **Tip:** • AWD differential may need longer bolts, 2-3/8" x 5" x 24 thread bolts. • When removing the front differential carrier bearing assembly use **J 41816-2** . See **Special Tools**. **Special Tools** 1. **J 8433-1** Puller Bar or equivalent. See **Special Tools**. 2. **J 22912-B** Split Plate Bearing Remover or equivalent. See **Special Tools**. 3. **J 41816-2** Step Plate. See **Special Tools**.

Installation

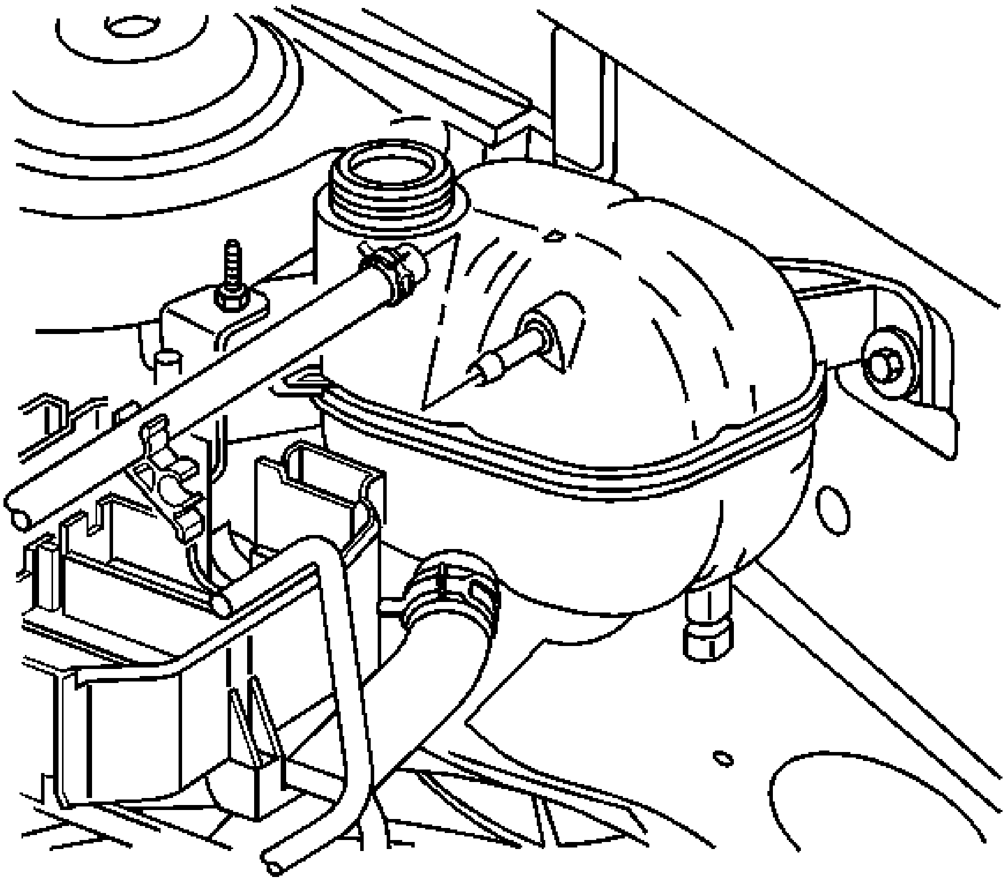

Fig. 139: View Of Front Differential Carrier Bearing
Courtesy of GENERAL MOTORS CORP.

Installation

Callout	Component Name
1	Front Differential Carrier Bearing Assembly **NOTE:** **Pressing against the bearing assembly can damage the bearing and cause premature bearing failure.** **Special Tool:** **DT-47928** Bearing Installer. See **Special Tools**.

2	Front Differential Carrier Bearing Assembly **NOTE:** **Pressing against the bearing assembly can damage the bearing and cause premature bearing failure.** **Special Tool:** **DT-47928** Bearing Installer. See **Special Tools**.

FRONT DIFFERENTIAL CARRIER CLEANING AND INSPECTION

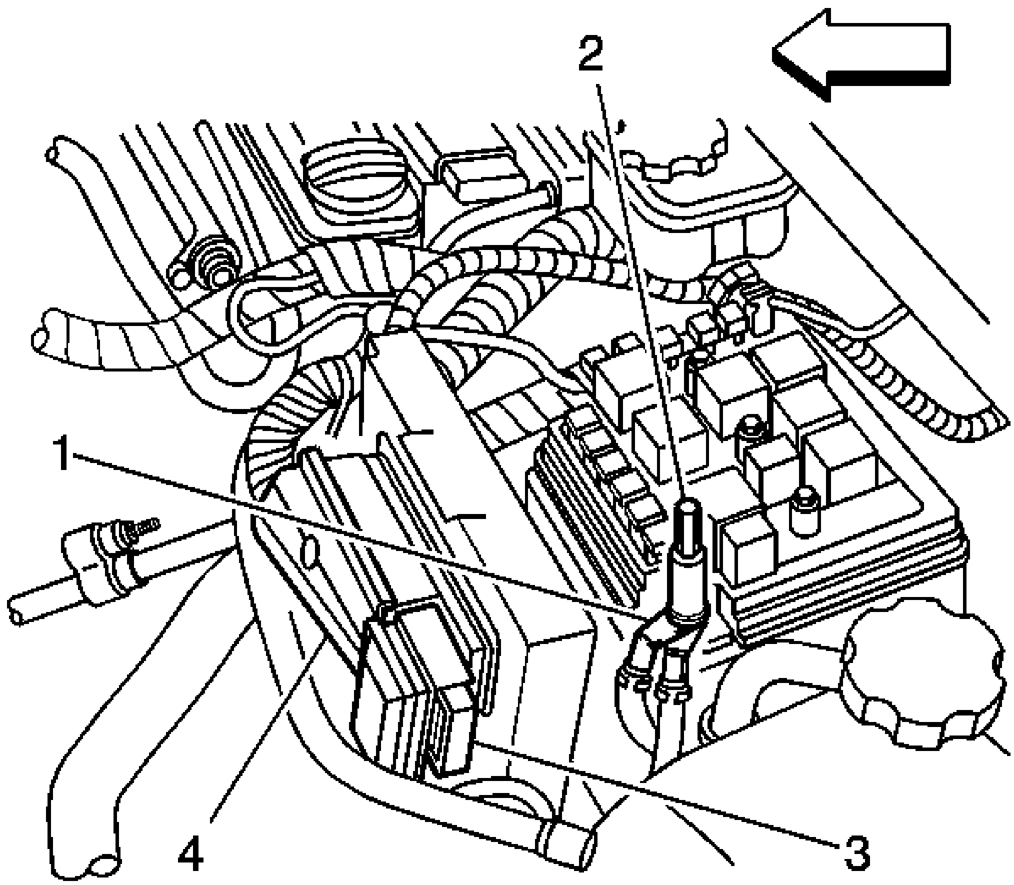

Fig. 140: Identifying Front Differential Carrier Components
Courtesy of GENERAL MOTORS CORP.

Front Differential Carrier Cleaning and Inspection

Callout	Component Name
NOTE: **After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.** **NOTE:** **Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.** **NOTE:** **Keep the thrust washers with gear it was matched to. The thrust washers are selective sizes and it is difficult to identify the proper washer thickness. Improper assembly can cause premature failure of the differential assembly.** **Preliminary Procedure:** Clean and inspect the differential assembly, pinion gears and thrust washers for scoring, wear or damage. The differential assembly is only serviced as an assembly.	
1	Front Differential Pinion Gear Shaft Retainer **Tip:** Discard and use a new retainer. **Special Tools:** 3/16" (5 mm) 7" Punch or equivalent
2	Front Differential Pinion Gear Shaft
3	Front Differential Pinion Gears
4	Front Differential Carrier Thrust Washers
5	Front Differential Pinion Side Gears
6	Front Differential Side Gear Thrust Washer

FRONT DIFFERENTIAL DRIVE PINION GEAR AND CARRIER INSTALLATION

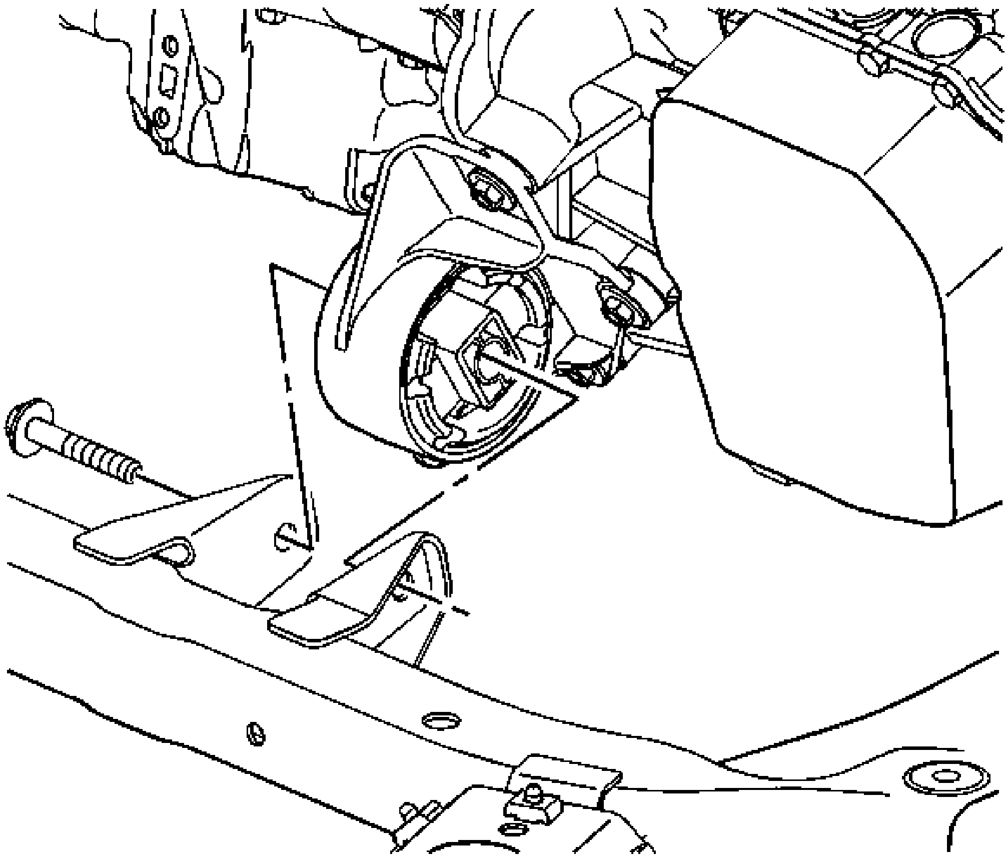

Fig. 141: Identifying Front Differential Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

Front Differential Drive Pinion Gear and Carrier Installation

Callout	Component Name
1	Front Differential Carrier Assembly **Tip:** Install the differential assembly and the pinion gear assembly together to avoid interference with the gears during installasion.
2	Front Differential Drive Pinion (w/Transfer Gear) Gear Assembly
3	Front Differential Drive Pinion Gear Lube Tube

TORQUE CONVERTER AND DIFFERENTIAL HOUSING INSTALLATION

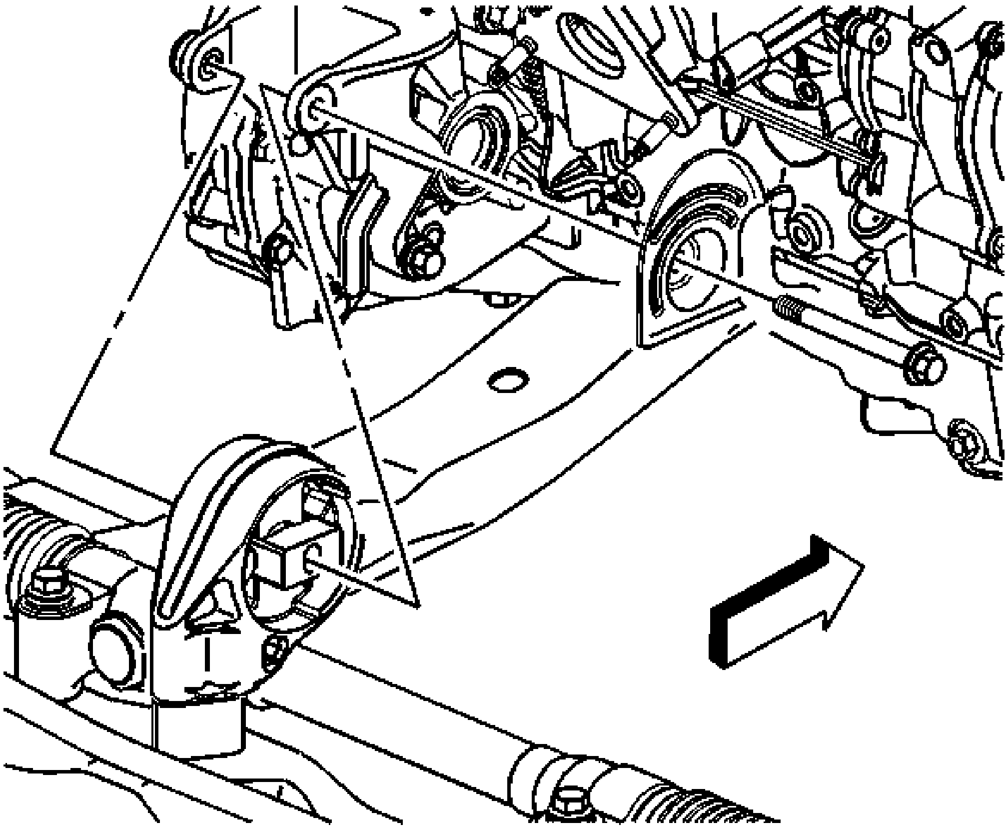

Fig. 142: Identifying Torque Converter & Differential Housing
Courtesy of GENERAL MOTORS CORP.

Torque Converter and Differential Housing Installation

Callout	Component Name
1	Torque Converter Housing Outer Seal
2	Torque Converter and Support and A/Trans Fluid Pump Housing Assembly
3	Torque Converter and Differential Housing Bolts M8 x 35 (Qty: 17) **NOTE:** **Some bolt torques specifications are different. Over tightening the bolts at the 12, 15 and 17 positions in the sequence could cause damage to the case threads.**

	NOTE: **Refer to Fastener Notice .** **Tighten:** Tighten in sequence to 36 N.m (27 lb ft). Tighten the 3 bolts at the 9 o'clock position as shown above (torque sequence 12, 15, 17) to 30 N.m (22 lb ft).

FRONT DIFFERENTIAL CARRIER PRELIMINARY ROTATIONAL TORQUE MEASUREMENT

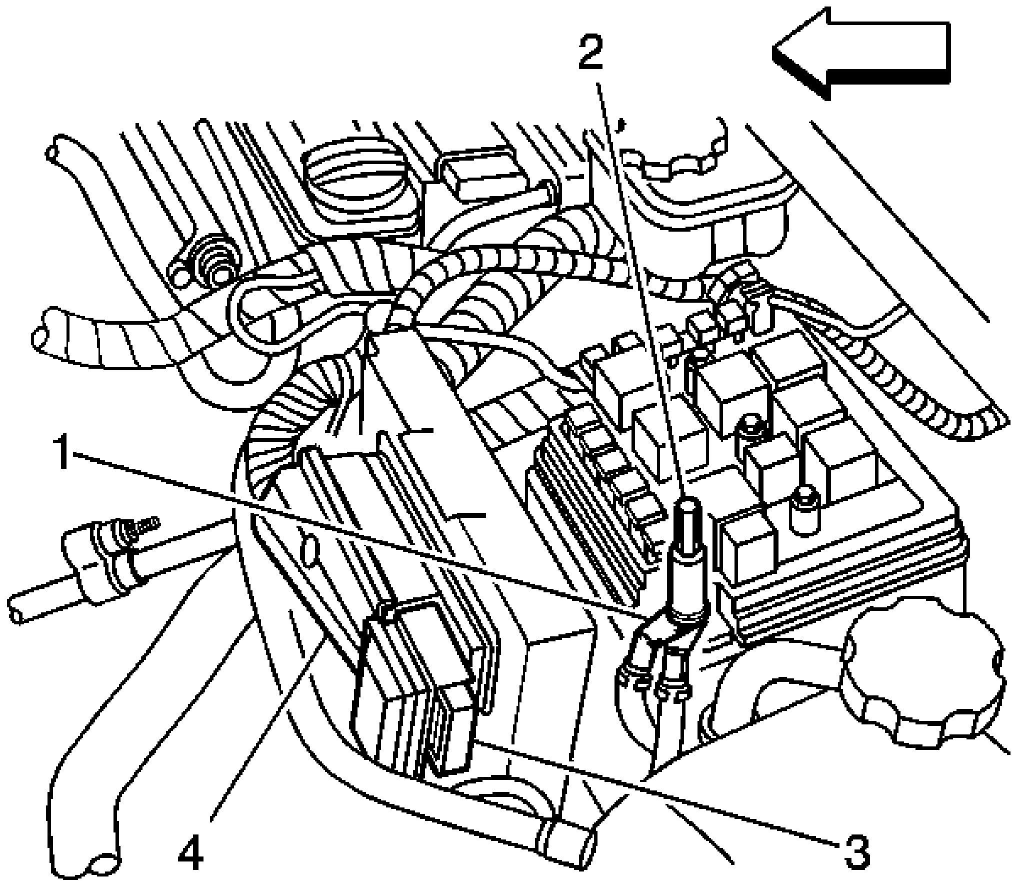

Fig. 143: Identifying Special Tools - DT-47793
Courtesy of GENERAL MOTORS CORP.

Front Differential Carrier Preliminary Rotational Torque Measurement

Callout	Component Name
	Front Differential Carrier Assembly

1	**NOTE:** **Low bearing pre-load will cause premature failure of the front differential drive pinion gear.** **NOTE:** **Refer to Fastener Notice .** **Tip:** • If the turning torque is not within specifications, the transfer gear assembly and differential bearing thrust whasher is incorrect and must be corrected. Refer to **Front Differential Drive Pinion Gear Bearing Thrust Washer and Front Differential Bearing Washer Measurement**. • Use a dial or beam torque wrench with **DT-47793** to measure turning torque. See **Special Tools**. **Tighten:** 4-12 N.m (35-106 lb in) **Special Tool:** **DT-47793** Differential Rotating Tool. See **Special Tools**.

1-2-3-4 CLUTCH PLATE AND LOW AND REVERSE CLUTCH INSTALLATION

Piston and Spring Installation

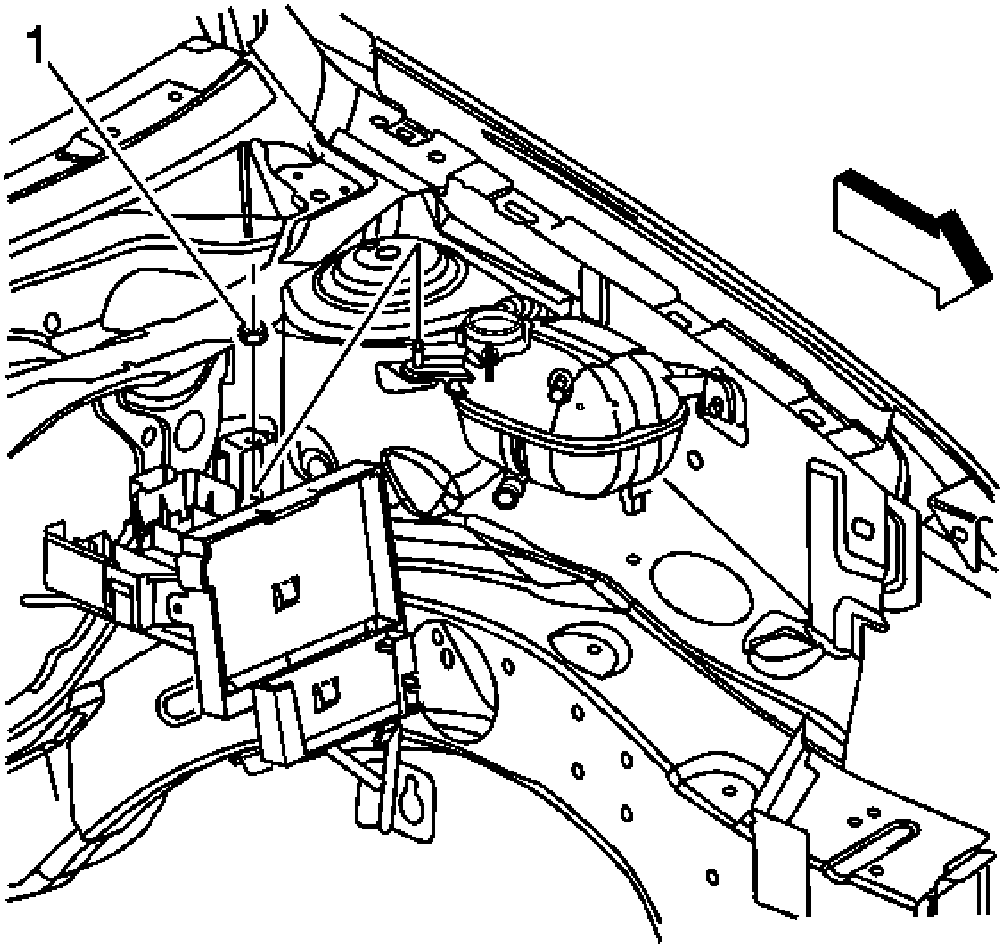

Fig. 144: Identifying 1-2-3-4 Clutch Components
Courtesy of GENERAL MOTORS CORP.

Piston and Spring Installation

Callout	Component Name
1	1-2-3-4 Clutch Piston **Tip: J-46623** prevents the piston seal lip from damage during installation. See **Special Tools**. Apply a thin coat of ATF to the I.D. of **J-46623** to ease the installation of the piston. See **Special Tools**. **Special Tool:** **J-46623** Piston Seal Protector. See **Special Tools**.
2	1-2-3-4 Clutch Spring

<table>
<tr>
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<td>
1-2-3-4 Clutch Spring Retainer Ring

NOTE:
Refer to <u>Fastener Notice</u> .

Tip:

The retainer opening should be supported by a spline tooth of the case.
Install J-46632 and DT-48056 and retain to the case using 2 case cover assembly bolts. See <u>Special Tools</u>.

Tighten: 12 N.m (9 lb ft).
Turn the DT-48056 compressor bolt to compress the 1-2-3-4 Clutch Spring until the retaining ring groove is exposed. See <u>Special Tools</u>.
Push retainer ring into the groove.
Remove DT-48056 and J-46632 . See <u>Special Tools</u>.
Air check the piston operation by applying air to the 1-2-3-4 clutch feed passage in the case.
Excessive air leaks indicate damage to the clutch piston seal.

Special Tools

DT-48056 Spring Compressor Bridge. See <u>Special Tools</u>.
J-46632 Piston Spring Compressor. See <u>Special Tools</u>.

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1-2-3-4 Clutch Plates and Low Reverse Clutch Installation

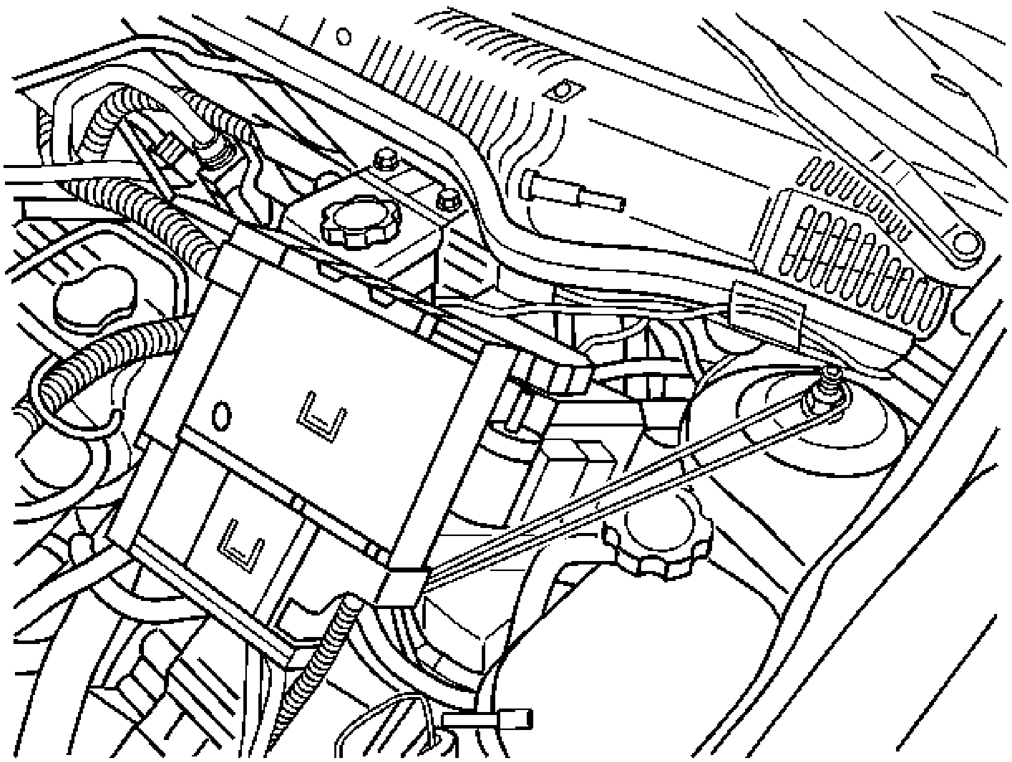


Fig. 145: Identifying 1-2-3-4 Clutch Plates & Low Reverse Clutch Installation Order
Courtesy of GENERAL MOTORS CORP.

1-2-3-4 Clutch Plates and Low Reverse Clutch Installation

Callout	Component Name
1	1-2-3-4 Clutch (Waved) Plate **Tip:** The tab on the clutch plate faces the bottom of the case.
2	1-2-3-4 Clutch Plate (Qty: 2) **Tip:** The tab on the clutch plate faces the bottom of the case.
3	1-2-3-4 Clutch (w/Friction Material) Plate Assembly (Qty: 2)
4	Low and Reverse Clutch Assembly
5	Low and Reverse Clutch Retaining Ring **Tip:** The retaining ring opening should face the control side of the case (9 o'clock). Do not align the retainer opening with other retaining ring openings.

Low and Reverse Clutch Plate Installation

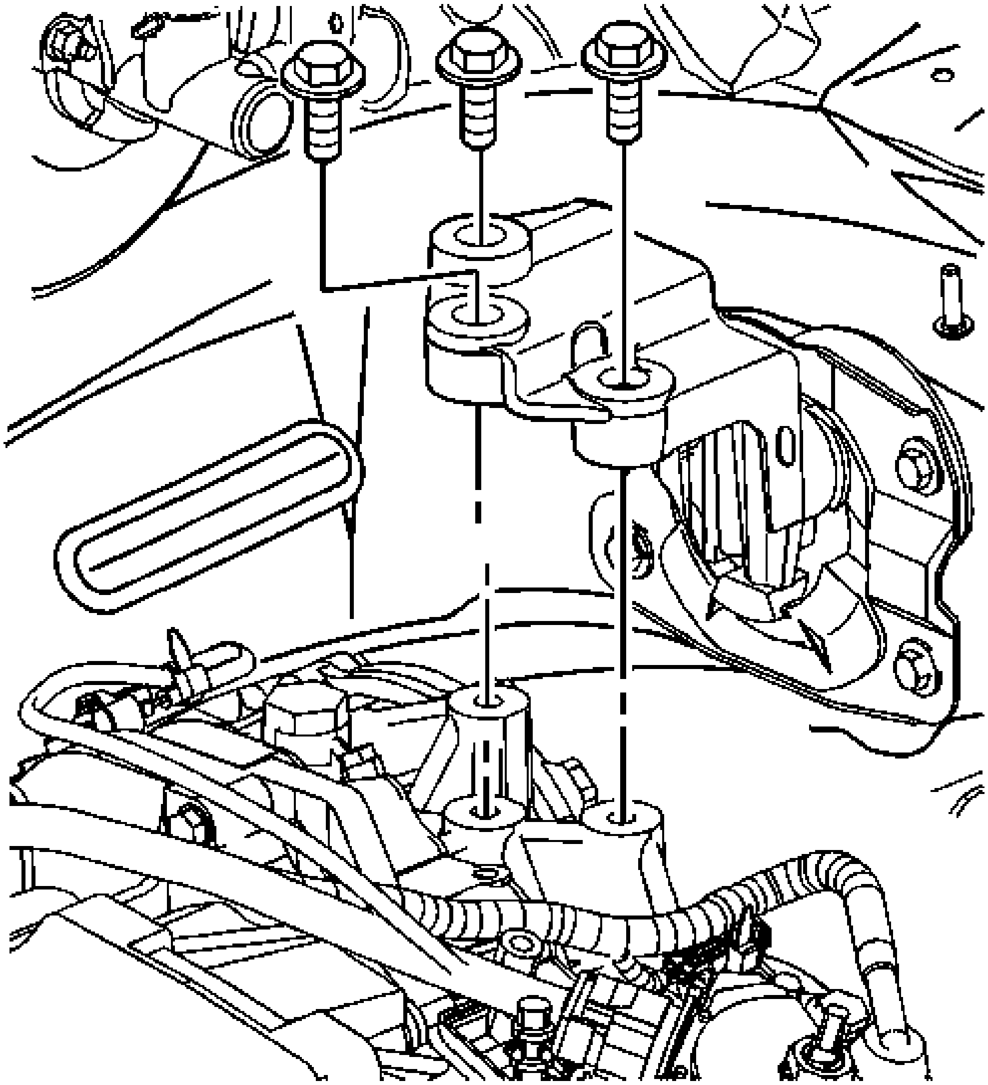


Fig. 146: Identifying Low And Reverse Clutch Plate
Courtesy of GENERAL MOTORS CORP.

Low and Reverse Clutch Plate Installation

Callout	Component Name
1	Low and Reverse Clutch Backing Plate **Tip:** The tab on the clutch plate faces the bottom

	of the case.
2	Low and Reverse Clutch (w/Friction Material) Plate Assembly (Qty: 4)
3	Low and Reverse Clutch Plate (Qty: 3) **Tip:** The tab on the clutch plate faces the bottom of the case.
4	Low and Reverse Clutch Apply Plate **Tip:** The tab on the clutch plate faces the bottom of the case.
5	Low and Reverse Clutch Cushion (Waved) Spring **Tip:** The tab on the clutch plate faces the bottom of the case.

INPUT, REACTION, AND OUTPUT CARRIER INSTALLATION

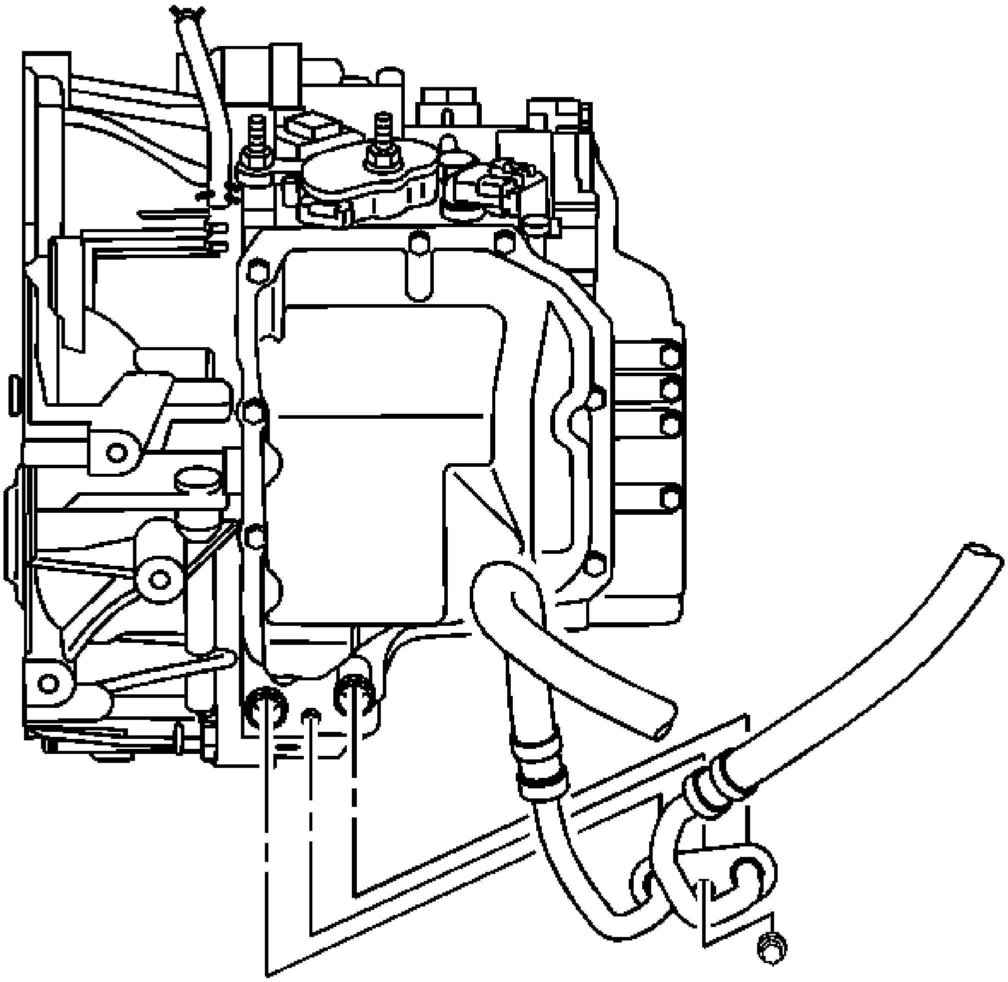


Fig. 147: Identifying Input, Reaction & Output Carrier
Courtesy of GENERAL MOTORS CORP.

Input, Reaction, and Output Carrier Installation

Callout	Component Name
Preliminary Procedure: Note location of the orientation lip on bearings. All thrust bearings can only be assembled one way.	
1	Input Shaft Thrust Bearing Assembly
2	Output Carrier Transfer Drive Gear Hub Assembly
3	Front Differential Transfer Drive Gear Input Hub Bearing Assembly

4	Output Sun Gear Assembly
5	Output Carrier Assembly
6	Output Carrier Thrust Bearing Assembly
7	Output Carrier Thrust Bearing Assembly
8	Input (w/Output Internal Gear) Carrier Assembly
9	Input Sun Gear
10	Input Sun Gear Thrust Bearing Assembly
11	Input Carrier Thrust Bearing Assembly
12	Reaction (w/Input Internal Gear) Carrier Assembly

2-6 CLUTCH PLATE INSTALLATION

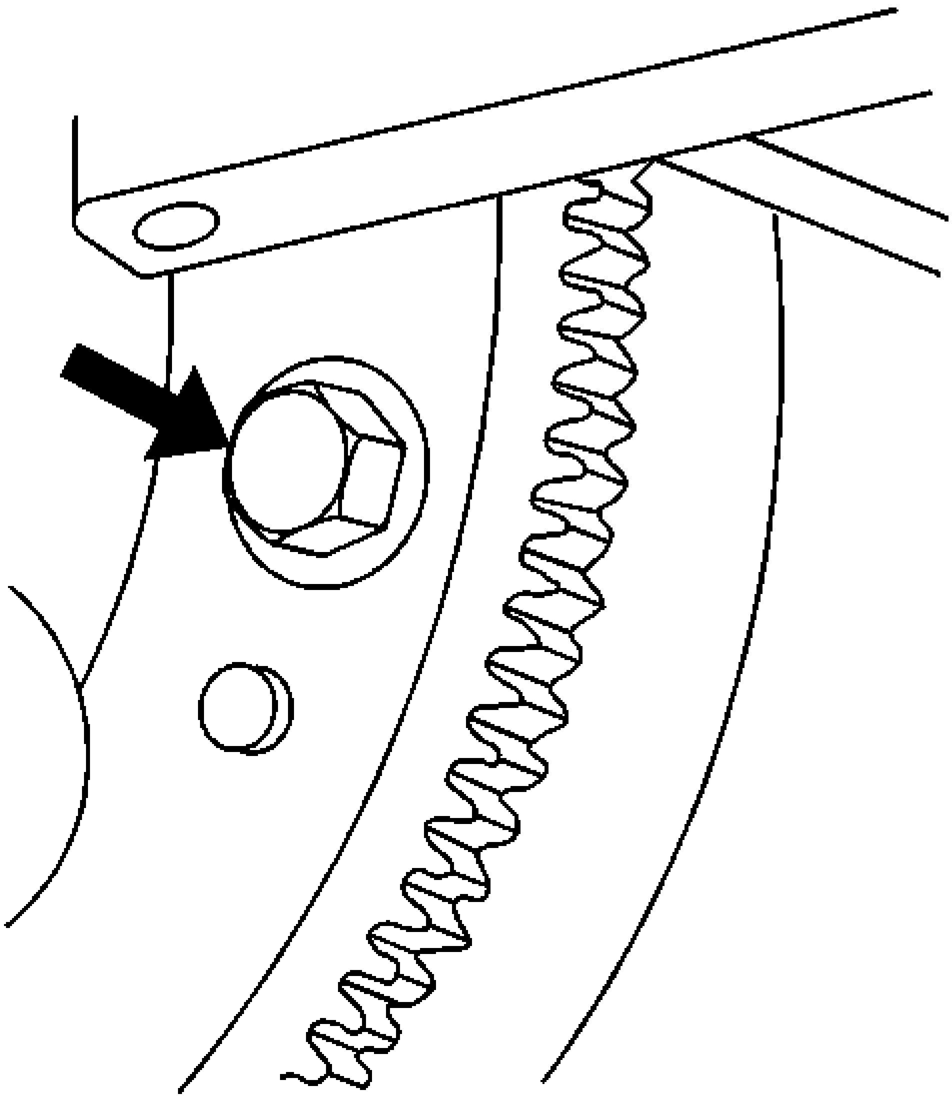


Fig. 148: Identifying 2-6 Clutch Plate
Courtesy of GENERAL MOTORS CORP.

2-6 Clutch Plate Installation

Callout	Component Name
1	2-6 Clutch Backing Plate **Tip:** The tab on the clutch plate faces the bottom of the case.

2	2-6 Clutch (w/Friction Material) Plate Assembly (Qty: 3)
3	2-6 Clutch Plate (Qty: 3) **Tip:** The tab on the clutch plate faces the bottom of the case.
4	2-6 Clutch Cushion Spring
5	Reaction Sun Gear Assembly
6	2-6 Clutch Hub Thrust Bearing Assembly **Tip:** Note location of the orientation lip on bearing. All thrust bearings can only be assembled one way.

3-5 REVERSE AND 4-5-6 CLUTCH HOUSING DISASSEMBLE

Reluctor Wheel and Piston Removal

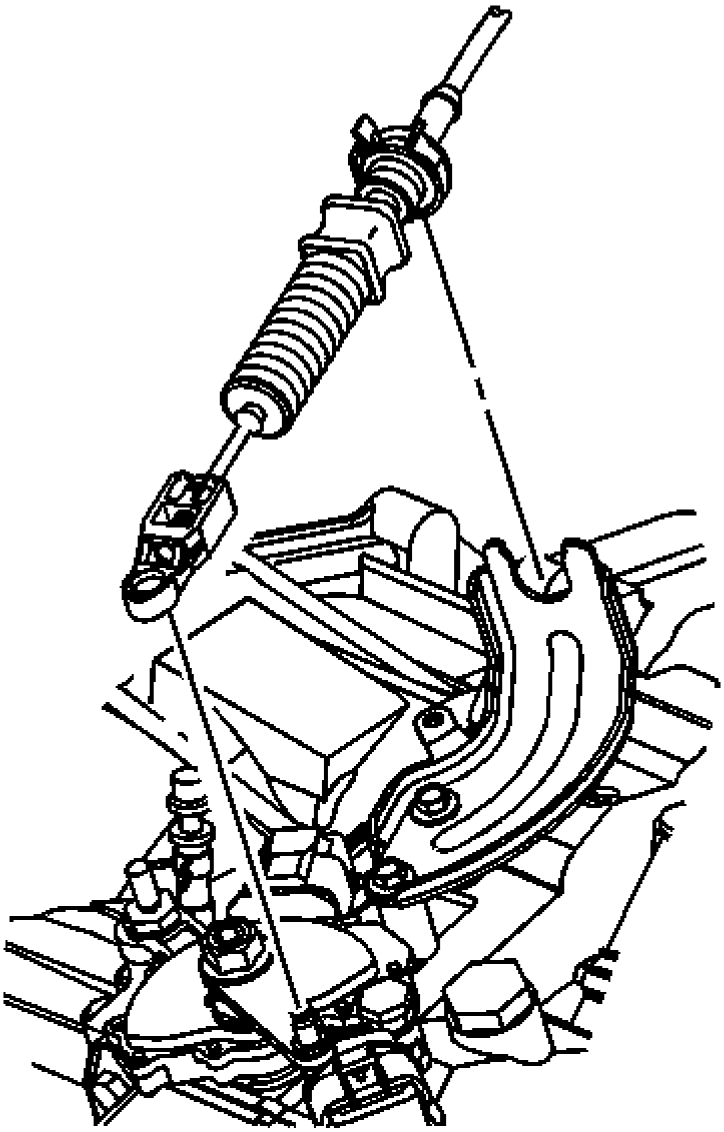


Fig. 149: View Of A/Trans Input Shaft Speed Sensor Reluctor Wheel And Piston3-5 Reverse Clutch Piston
Courtesy of GENERAL MOTORS CORP.

Reluctor Wheel and Piston Removal

Callout	Component Name
	A/Trans Input Shaft Speed Sensor Reluctor Ring

1	Retaining Ring **NOTE:** **Compress the reluctor wheel just enough to clear the retainer. Over compressing the reluctor wheel will break the alignment tab and the clutch housing.** **Special Tool:** **DT-47694** Piston Spring Compressor. See **Special Tools**.
2	A/Trans Input Shaft Speed Sensor Reluctor Wheel
3	3-5 Reverse Clutch Piston **Tip:** Inspect piston seals for damage and/or wear. Piston is reusable.
4	3-5 Reverse Clutch Spring Assembly
5	3-5 Reverse Clutch Piston Inner Seal (Orange)
6	3-5 Reverse Clutch Piston Inner Seal (Black)
7	3-5 Reverse Clutch Piston Dam Seal

Clutch Plate Removal

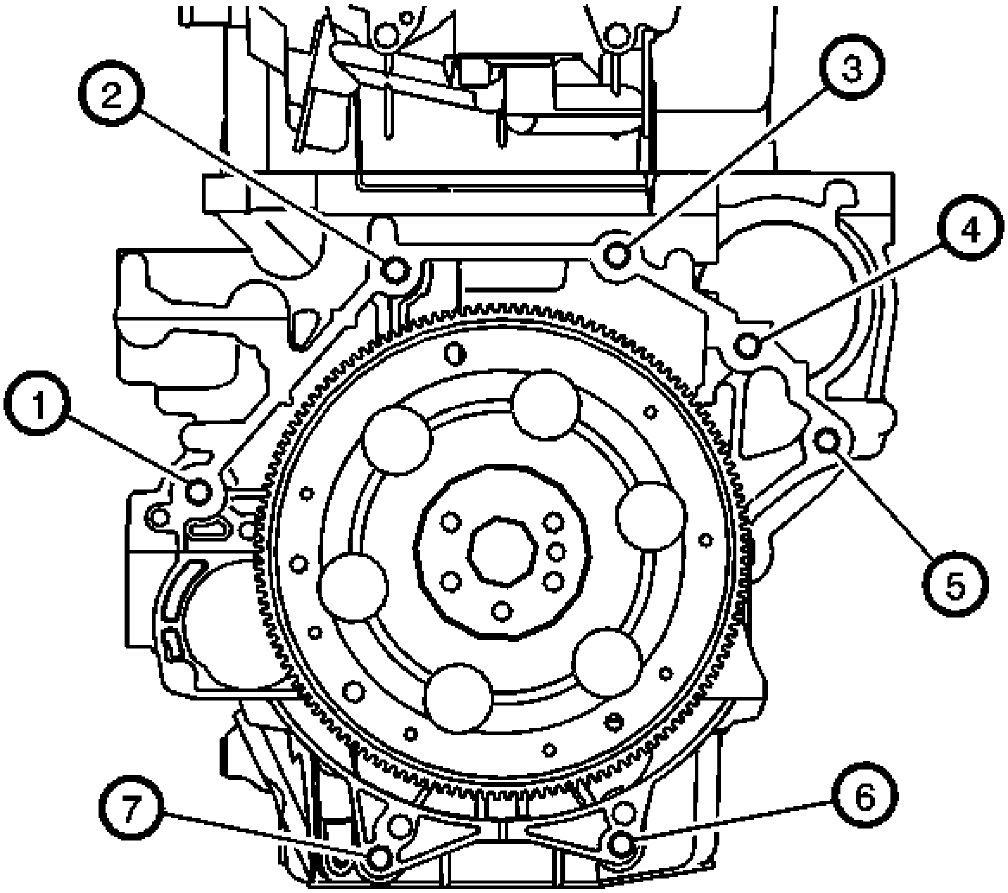


Fig. 150: View Of 3-5 Reverse Clutch Plates
Courtesy of GENERAL MOTORS CORP.

Clutch Plate Removal

Callout	Component Name
1	3-5 Reverse Clutch Backing Plate Retaining Ring
2	3-5 Reverse Clutch Backing Plate
3	3-5 Reverse Clutch (w/Friction Material) Plate Assembly (Qty: 4)
4	3-5 Reverse Clutch Plate (Qty: 4)
5	3-5 Reverse Clutch (Waved) Plate

4-5-6 Clutch Hub Removal

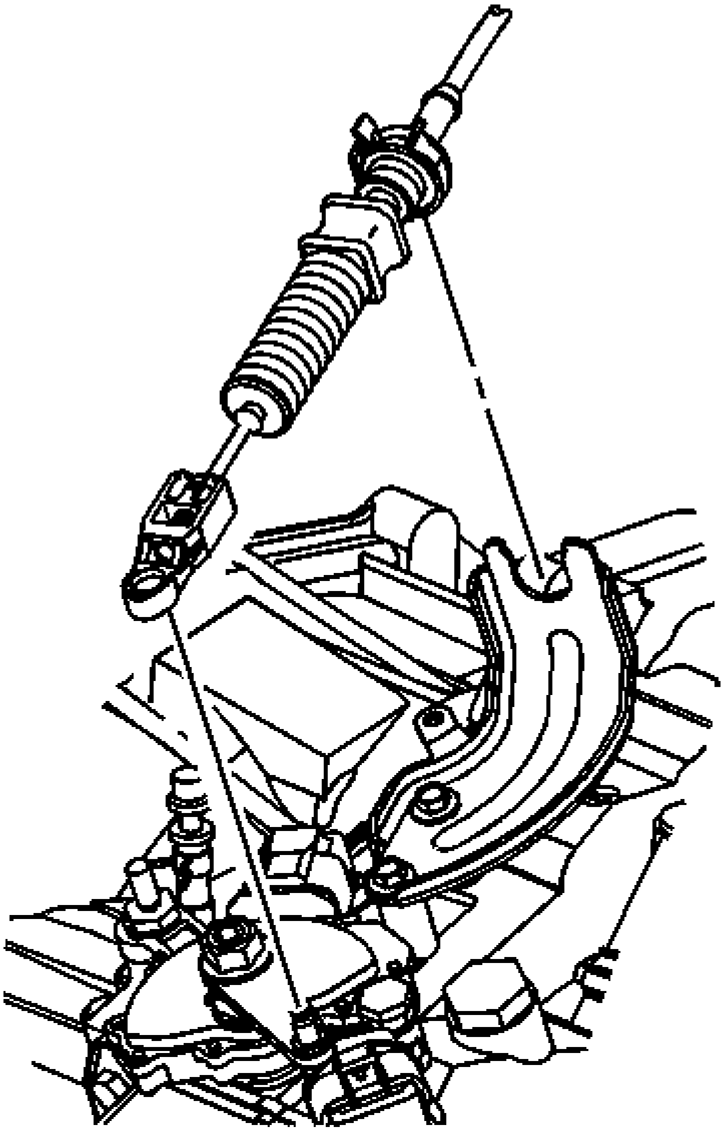


Fig. 151: View Of Reaction Carrier Hub Assembly
Courtesy of GENERAL MOTORS CORP.

4-5-6 Clutch Hub Removal

Callout	Component Name
1	4-5-6 Backing Plate Retaining Ring **Tip:** Gently push down on the backing plate to

	get enough clearance between the backing plate and retainer.
2	Reaction Carrier Hub Assembly **Tip:** The clutch plates will come out of the housing with the hub assembly.
3	4-5-6 Clutch Backing Plate
4	4-5-6 Clutch Plate (Qty: 6)
5	4-5-6 Clutch (w/Friction Material) Plate Assembly (Qty: 6)
6	4-5-6 Clutch Hub Thrust Bearing Assembly **Tip:** The bearing may stick to the reaction carrier hub.

4-5-6 Clutch Piston Removal

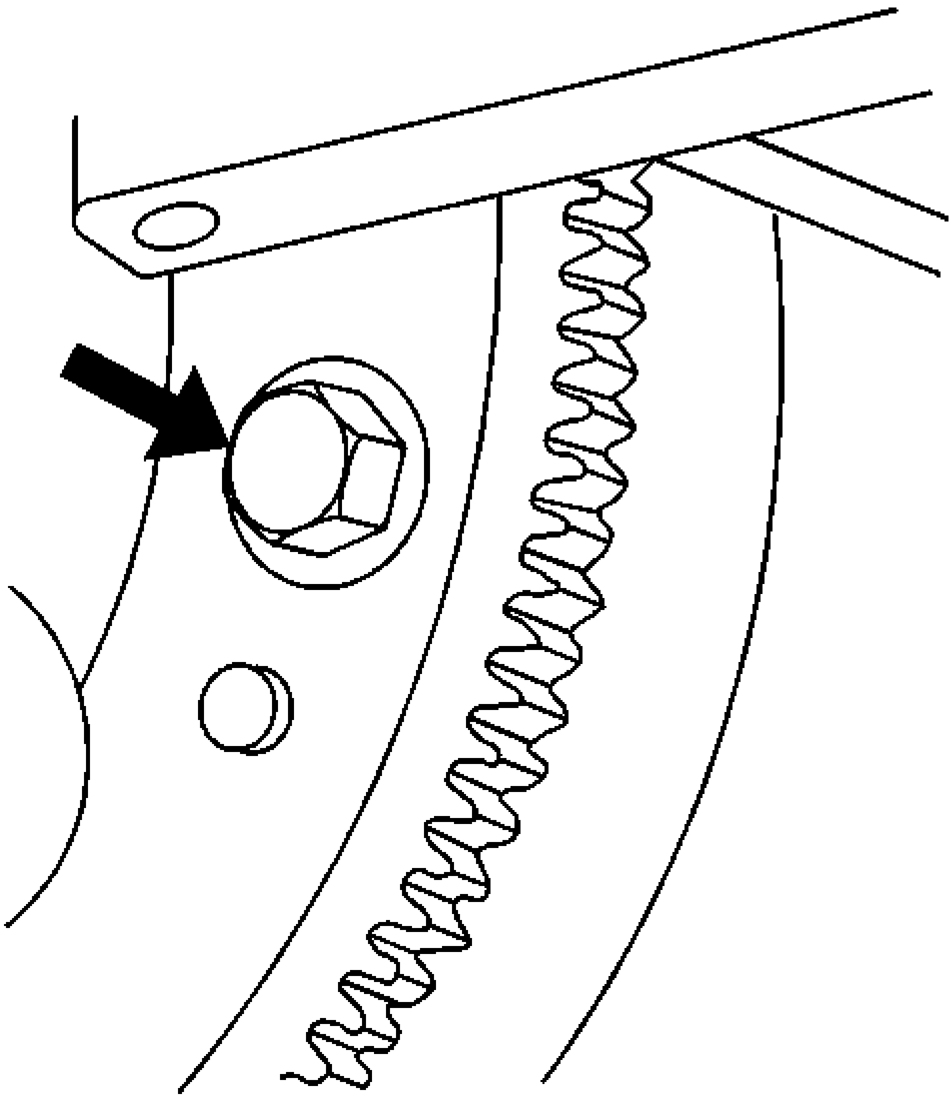


Fig. 152: Identifying 4-5-6 Clutch Piston
Courtesy of GENERAL MOTORS CORP.

4-5-6 Clutch Piston Removal

Callout	Component Name
1	4-5-6 Clutch Dam Retaining Ring **Special Tools**

	• **DT-47693** Dam Protector. See **Special Tools**. • **J 8059** Snap Ring Pliers-Parallel Jaw or equivalent
2	4-5-6 Clutch Piston Fluid Dam **Tip:** 1. Place the 3-5-R and 4-5-6 clutch housing onto the case cover assembly. 2. Apply shop air to the 4-5-6 clutch feed hole using a rubber tipped air gun to dislodge the dam piston and the 4-5-6 clutch piston from the clutch housing.
3	4-5-6 Clutch Spring Assembly
4	4-5-6 Clutch Piston
5	4-5-6 Clutch Piston Outer Seal (Stepped)
6	4-5-6 Clutch Piston Outer Seal (Rounded)
7	4-5-6 Clutch Piston Inner Seal

3-5 REVERSE AND 4-5-6 CLUTCH HOUSING ASSEMBLE

4-5-6 Clutch Piston Installation

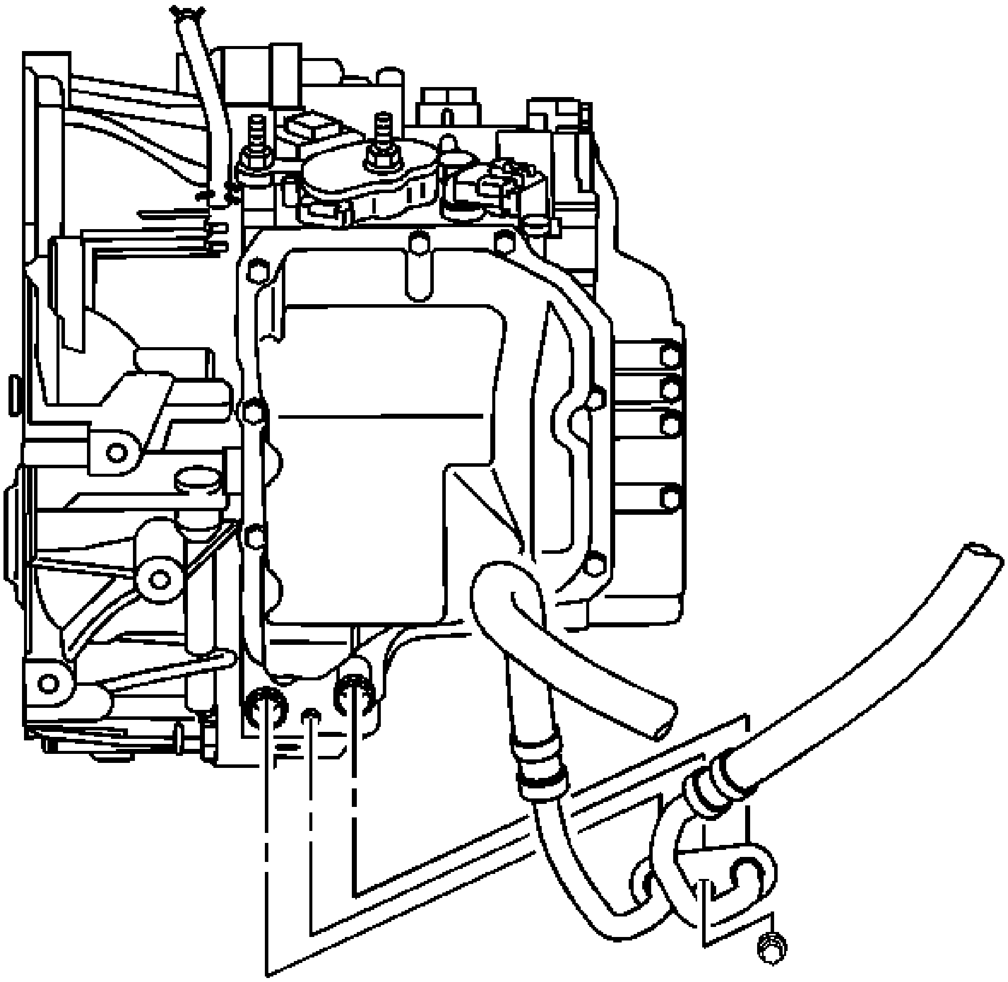


Fig. 153: Identifying 4-5-6 Clutch Piston
Courtesy of GENERAL MOTORS CORP.

4-5-6 Clutch Piston Installation

Callout	Component Name
1	4-5-6 Clutch Piston Inner Seal
2	4-5-6 Clutch Piston Outer Seal (Rounded)
3	4-5-6 Clutch Piston Outer Seal (Stepped) (Orange)
	4-5-6 Clutch Piston **Tip: DT-47859** prevents the piston seal lip from damage during installation. See **Special Tools**.

4	Apply a thin coat of ATF to the I.D. of **DT-47859** to ease the installation of the piston. See **Special Tools**. **Special Tool:** **DT-47859** Piston Outer Seal Protector. See **Special Tools**.

4-5-6 Clutch Dam Installation

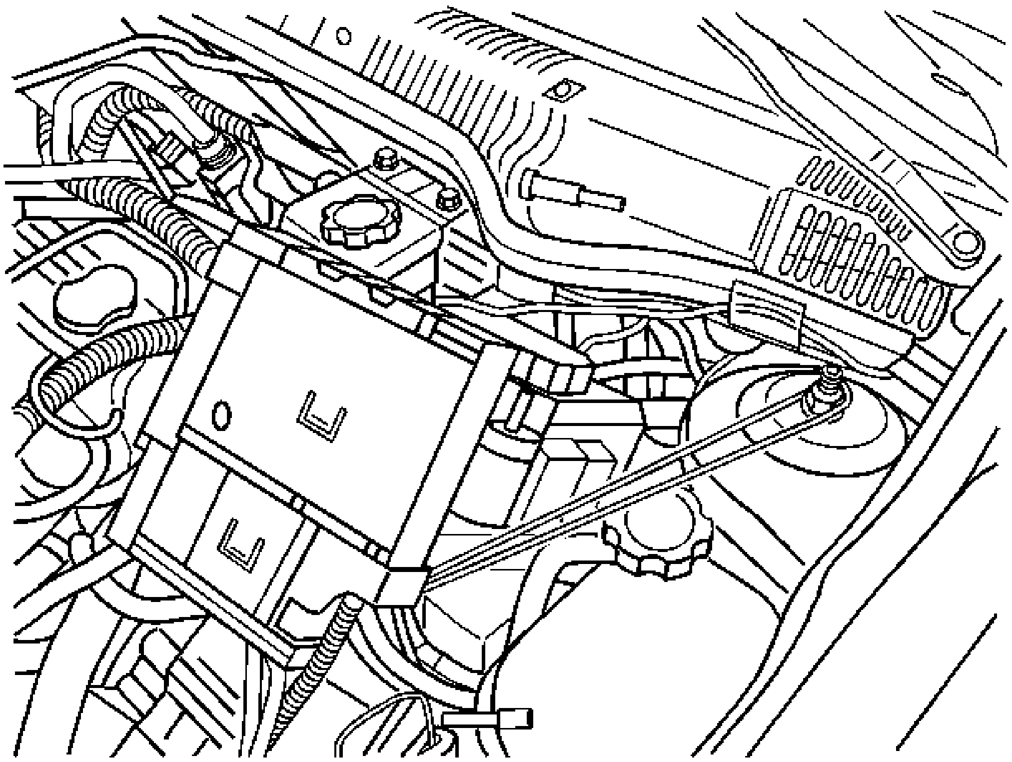


Fig. 154: View Of 4-5-6 Clutch Dam
Courtesy of GENERAL MOTORS CORP.

4-5-6 Clutch Dam Installation

Callout	Component Name
1	4-5-6 Clutch Spring
	4-5-6 Clutch Piston Fluid Dam **Tip:** DT 47693-1 which is part of **DT-47693** prevents the dam seal lip from damage during installation. See **Special Tools**. Apply a thin coat of ATF to the I.D. of DT 47693-1

2	which is part of **DT-47693** to ease the installation of the dam. See **Special Tools**. **Special Tool:** **DT-47693** Dam Protector. See **Special Tools**.
3	4-5-6 Clutch Dam Retaining Ring **Special Tools** • DT 47693-2 Clutch Spring Compressor which is part of **DT-47693** Dam Protector. See **Special Tools**. • **J 8059** Snap Ring Pliers-Parrallel Jaw or equivalent

4-5-6 Clutch Plates Installation

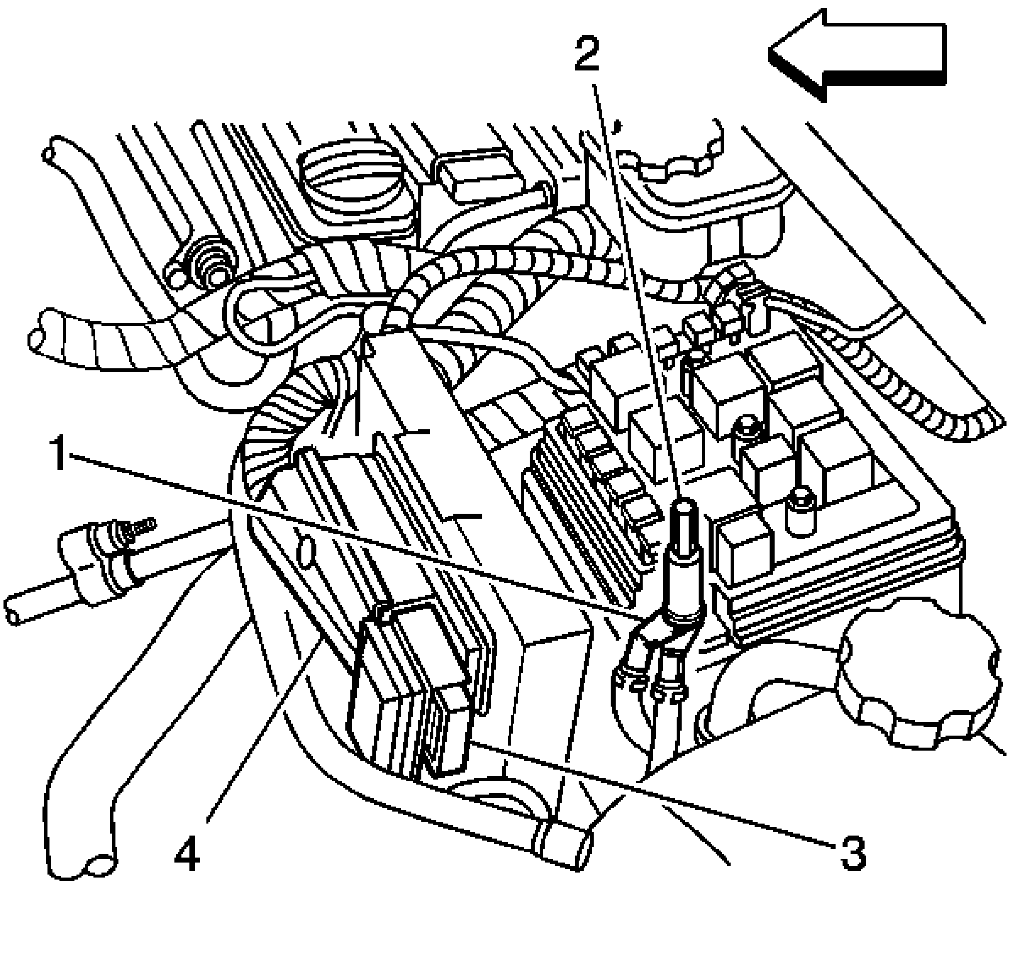


Fig. 155: Locating 4-5-6 Clutch Plates

Courtesy of GENERAL MOTORS CORP.

4-5-6 Clutch Plates Installation

Callout	Component Name
1	4-5-6 Clutch Hub Thrust Bearing **Tip:** Note location of the orientation lip on bearing. All thrust bearings can only be assembled one way.
2	Reaction Carrier Hub Assembly **NOTE:** **Failure to use DT 48551 could cause damage to the hub assembly bushings which could cause premature transmission failure.** **Tool Required:** **DT-48551** Reaction Hub Bushing Protector
3	4-5-6 Clutch Plate (Qty: 6)
4	4-5-6 Clutch (w/Friction Material) Plate Assembly (Qty: 6)
5	4-5-6 Clutch Backing Plate
6	4-5-6 Clutch Backing Plate Retaining Ring **Tip:** Gently push down on the backing plate to get enough clearance between the backing plate and retainer.

3-5 Reverse Clutch Plates Installation

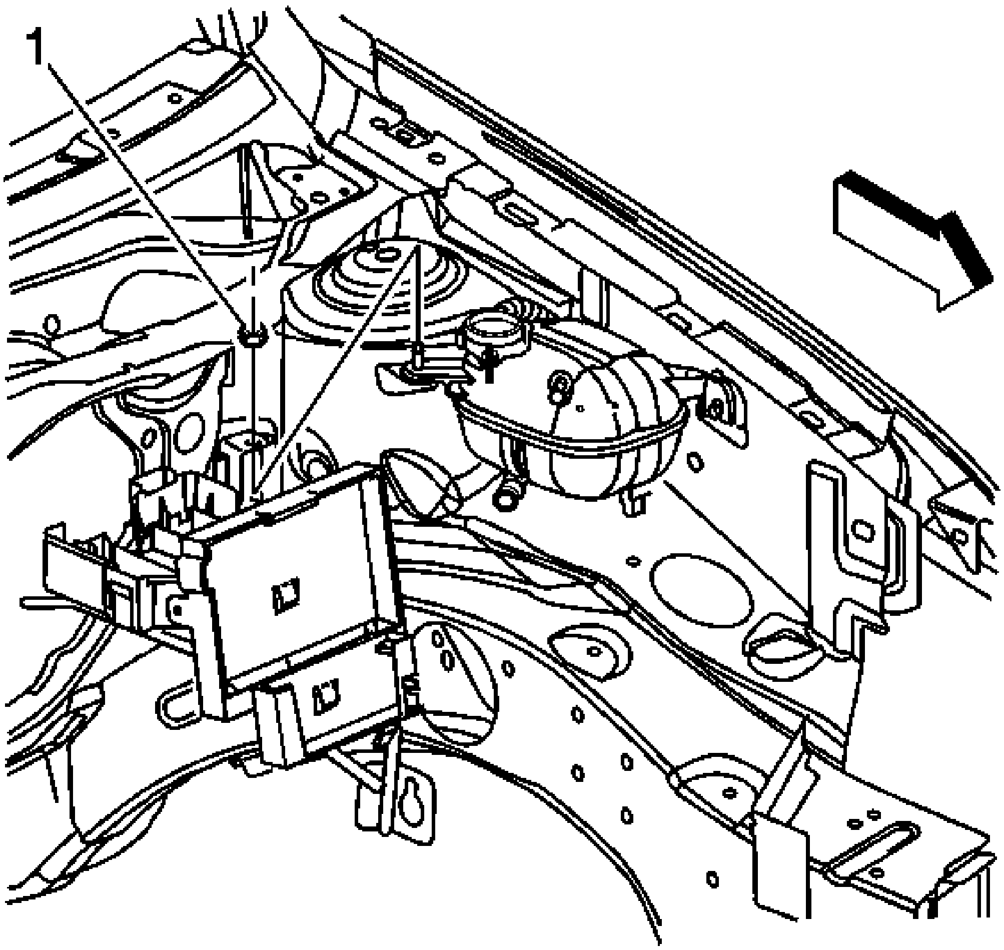


Fig. 156: Identifying 3-5 Reverse Clutch Plates
Courtesy of GENERAL MOTORS CORP.

3-5 Reverse Clutch Plates Installation

Callout	Component Name
1	3-5 Reverse Clutch (Waved) Plate
2	3-5 Reverse Clutch Plate (Qty: 4)
3	3-5 Reverse Clutch (w/Friction Material) Plate Assembly (Qty: 4)
4	3-5 Reverse Clutch Backing Plate
5	3-5 Reverse Clutch Backing Plate Retaining Ring

Piston and Reluctor Wheel Installation

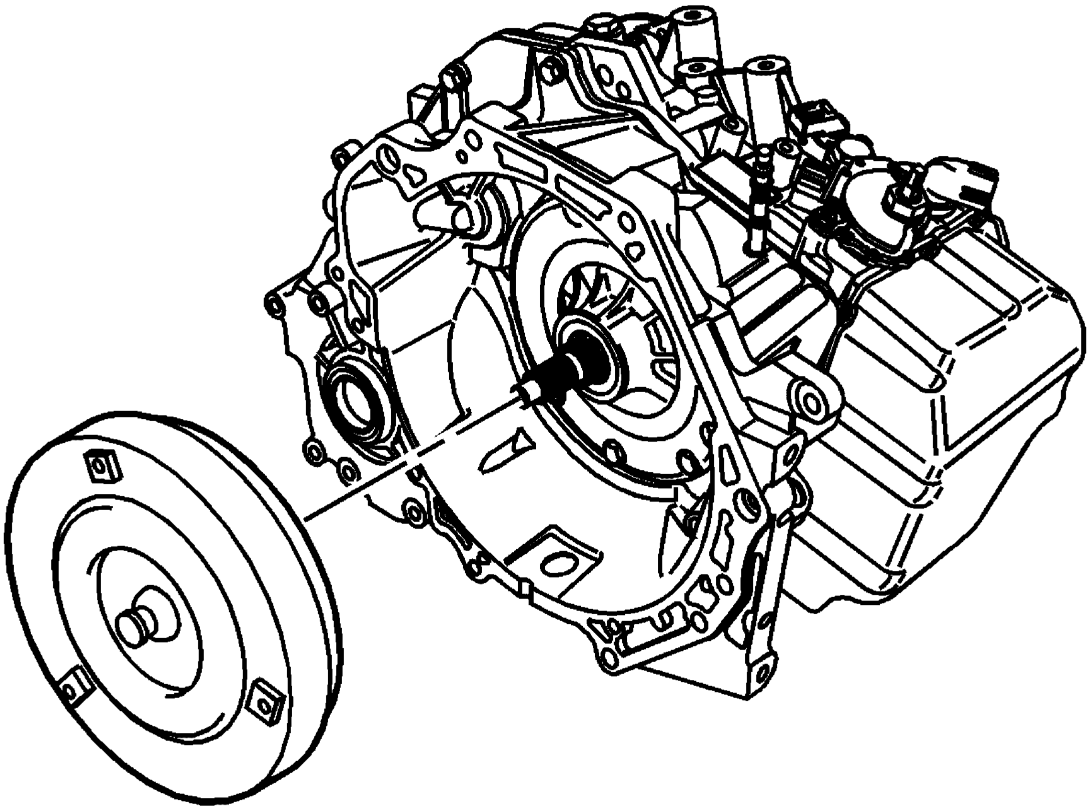


Fig. 157: View Of Piston And Reluctor Wheel
Courtesy of GENERAL MOTORS CORP.

Piston and Reluctor Wheel Installation

Callout	Component Name
1	3-5 Reverse Clutch Piston Dam Seal
2	3-5 Reverse Clutch Piston Inner Seal (Black) **Tip:** Apply a thin coat of ATF to the seal to ease the installation of the piston.
3	3-5 Reverse Clutch Piston Inner Seal (Orange) **Tip:** Apply a thin coat of ATF to the seal to ease the installation of the piston.
4	3-5 Reverse Clutch Spring Assembly
5	3-5 Reverse Clutch Piston **Tip:** • **J-46622** prevents the piston seal lip from damage during installation. See **Special Tools**. Apply a thin coat of ATF to the I.D. of **J-46622** to ease the installation of the piston. See **Special Tools**. • Install **J-46622** onto the speed sensor reluctor wheel.

	See **Special Tools**. Push the 3-5 Reverse Clutch piston into the reluctor wheel until it stops against **J-46622** . See **Special Tools**. Remove **J-46622** by seperating it at the opening. See **Special Tools**. **Special Tool:** **J-46622** Piston Seal Protector. See **Special Tools**.
6	A/Trans Input Shaft Speed Sensor Reluctor Wheel
7	A/Trans Input Shaft Speed Sensor Reluctor Wheel Retaining Ring **NOTE:** **Compress the reluctor wheel just enough to clear the retainer ring groove. Over compressing the reluctor wheel will break the alignment tab and the clutch housing.** **Special Tool:** **DT-47694** Piston Spring Compressor. See **Special Tools**.

35R and 456 Clutch Piston Air Check

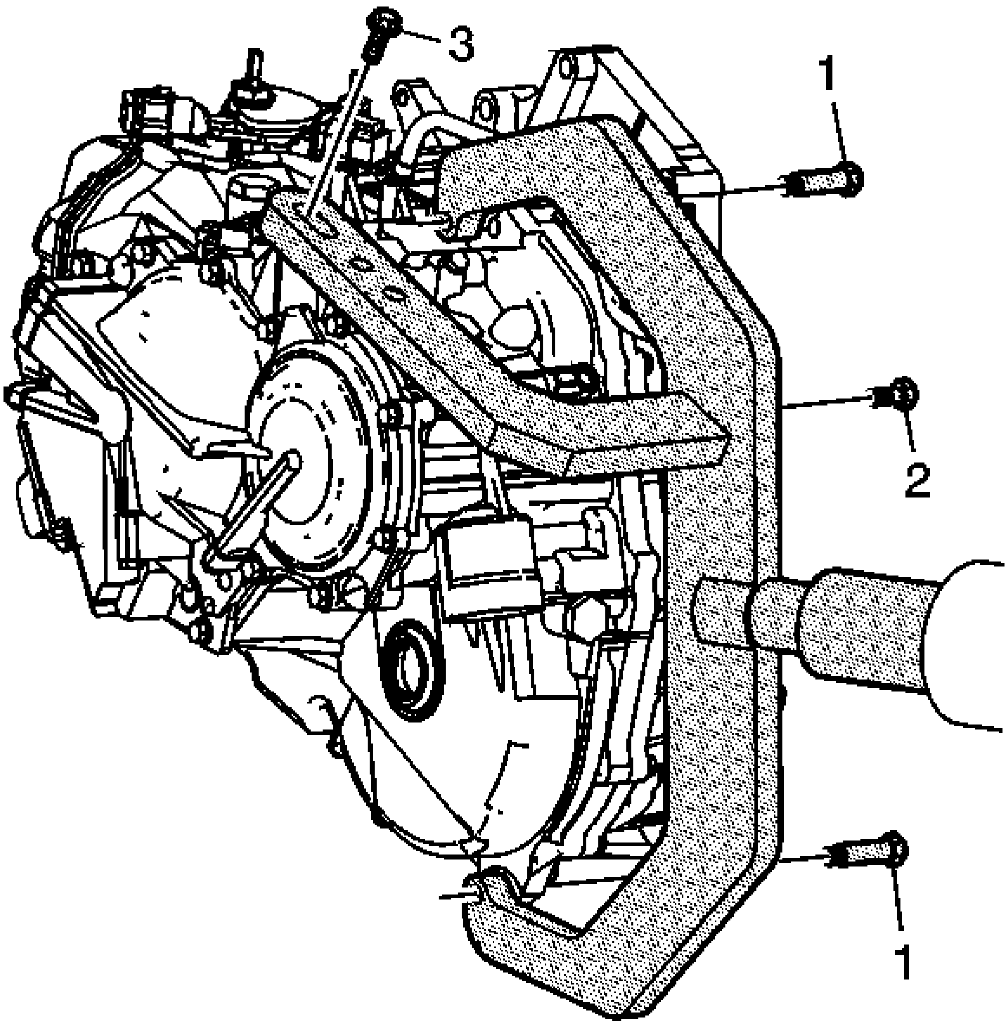


Fig. 158: 35R and 456 Clutch Piston Air Check
Courtesy of GENERAL MOTORS CORP.

35R and 456 Clutch Piston Air Check

Callout	Component Name
1	Case Cover Assembly **Tip:** The fluid seal rings should be in place and not damaged.
	Apply shop air to the 4-5-6 clutch feed. Observe the 4-5-6 piston movement.

2	**NOTE:** **Regulate the air pressure to 40 psi maximum. High pressure could cause the piston to over travel and damage the piston seals.** **Tip:** Minimal piston movement and excessive air leaking could indicate damage to the 4-5-6 piston seals or improper assembly.
3	Apply shop air to the 3-5-Rev clutch feed. Observe the 3-5-Rev piston movement. **NOTE:** **Regulate the air pressure to 40 psi maximum. High pressure could cause the piston to over travel and damage the piston seals.** **Tip:** Minimal piston movement and excessive air leaking could indicate damage to the 3-5-Rev piston seals or improper assembly.

3-5 REVERSE AND 4-5-6 CLUTCH HOUSING INSTALLATION

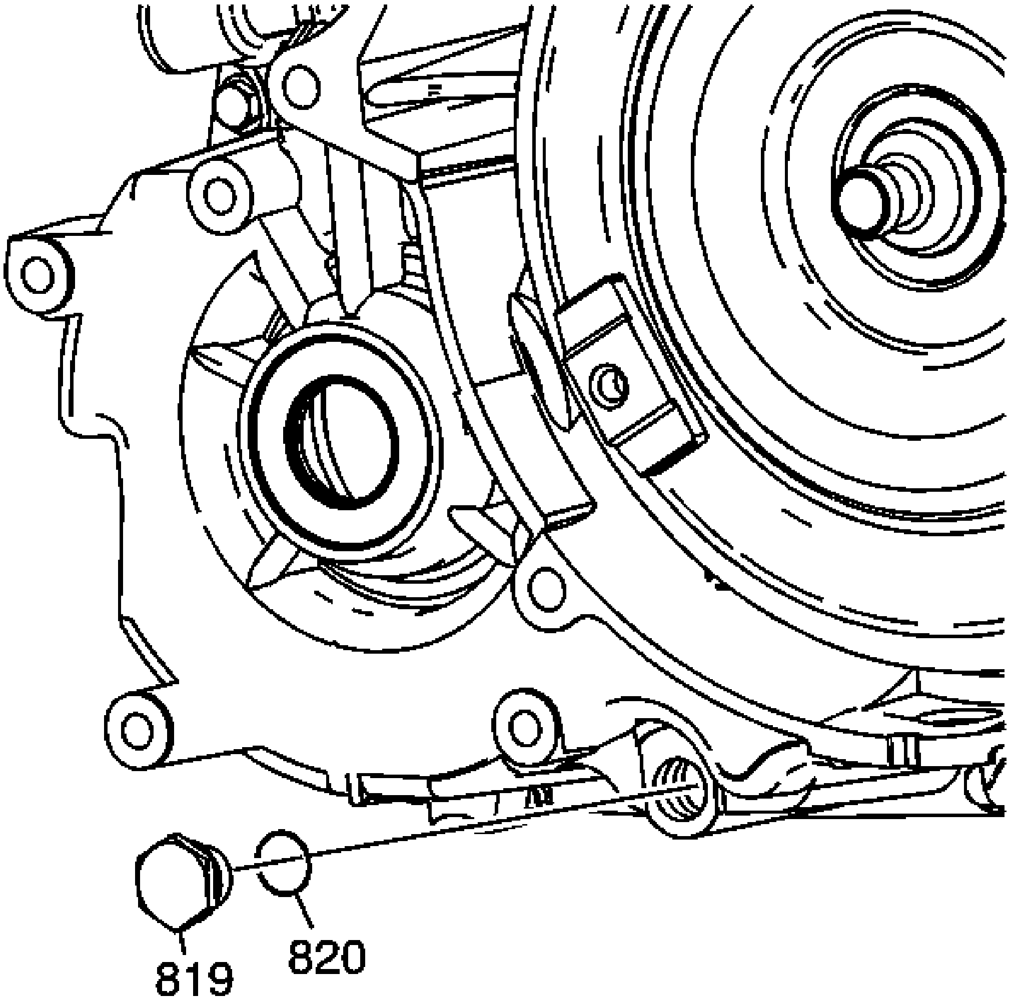


Fig. 159: Identifying 3-5 Reverse & 4-5-6 Clutch Housing
Courtesy of GENERAL MOTORS CORP.

3-5 Reverse and 4-5-6 Clutch Housing Installation

Callout	Component Name
1	3-5 Reverse and 4-5-6 Clutch Assembly **Tip:** Rotate the assembly back and forth to align the 3-5 reverse clutch plates with the reaction sun gear housing.

CASE COVER ASSEMBLY DISASSEMBLE

ISS Removal

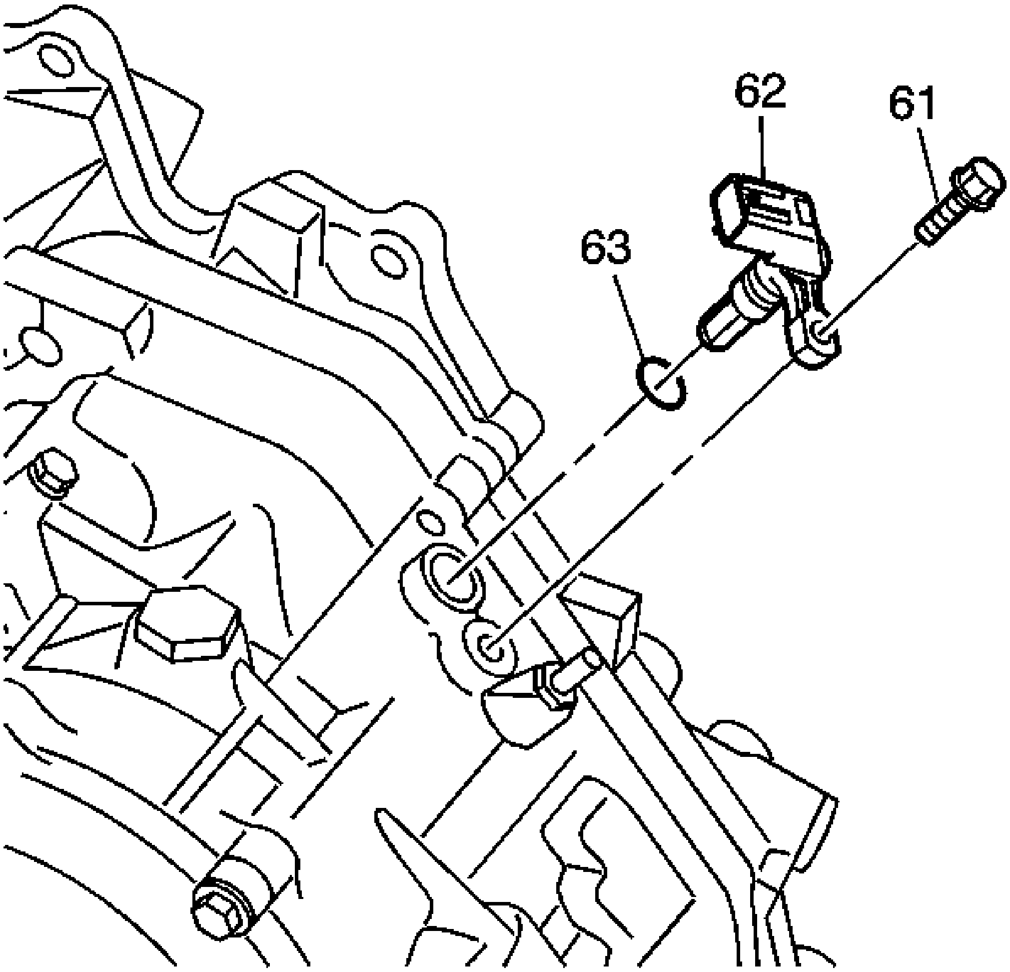


Fig. 160: View Of Clutch Cover Components
Courtesy of GENERAL MOTORS CORP.

ISS Removal

Callout	Component Name
1	A/Trans Input Speed Sensor Bolt M6 x 25
2	A/Trans Input Speed Sensor
3	A/Trans Input Speed Sensor Seal **Tip:** Discard the seal.
4	3-5 Reverse and 4-5-6 Clutch Fluid Seal Ring **Tip:** Discard the seals.

Low and Reverse Clutch Piston Removal

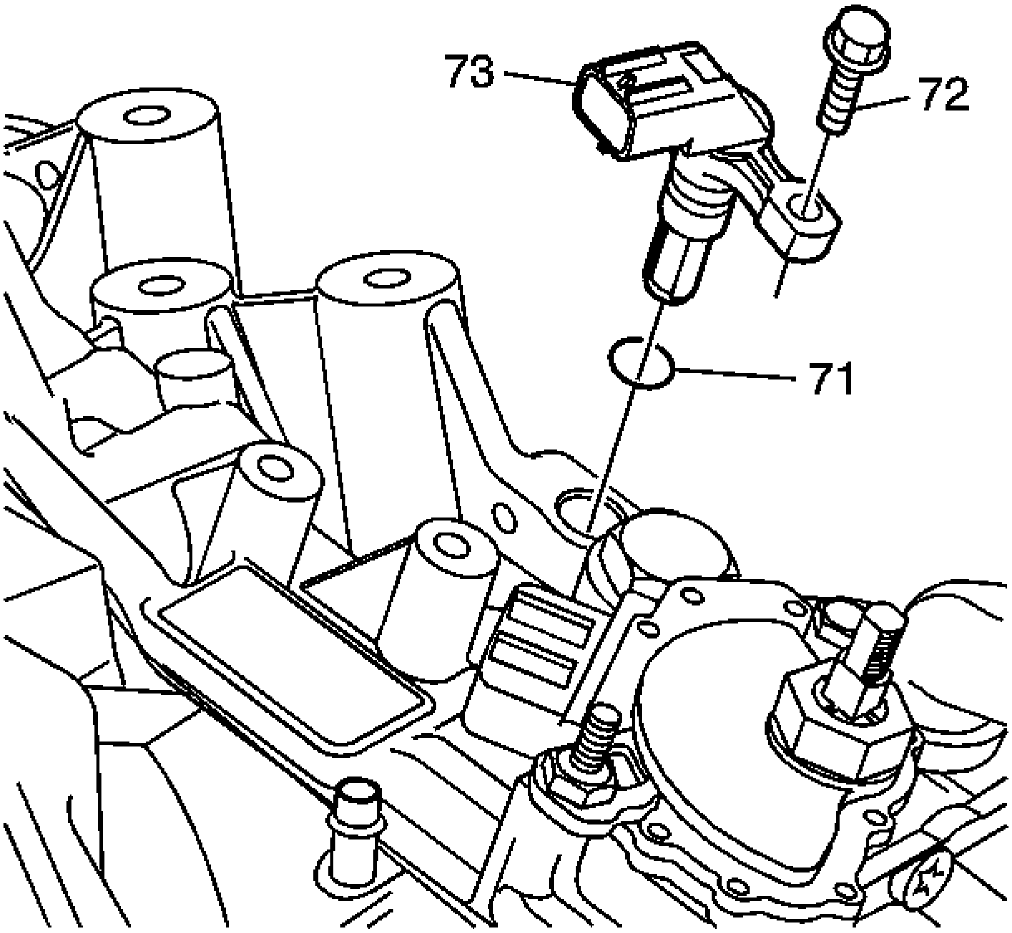


Fig. 161: Identifying Low And Reverse Clutch Piston
Courtesy of GENERAL MOTORS CORP.

Low and Reverse Clutch Piston Removal

Callout	Component Name
1	Low and Reverse Clutch Spring Retaining Ring
2	Low and Reverse Clutch Spring
3	Low and Reverse Clutch Piston Assembly **Tip:** Inspect piston seals for damage and/or wear. Piston is reusable.

2-6 Clutch Piston Removal

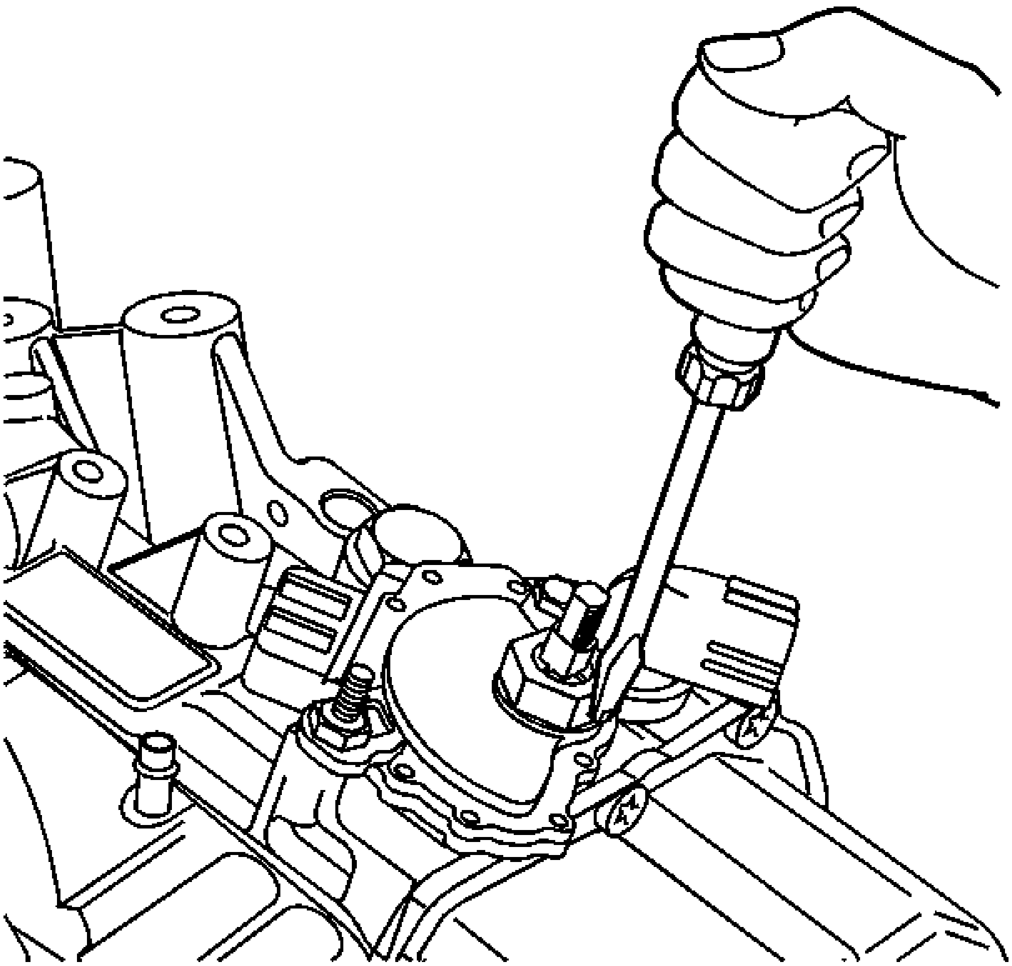


Fig. 162: View Of 2-6 Clutch Piston
Courtesy of GENERAL MOTORS CORP.

2-6 Clutch Piston Removal

Callout	Component Name
Tip: Note location of the orientation lip on bearings. All thrust bearings can only be assembled one way.	
1	2-6 Clutch Spring Retaining Ring **Special Tool:** **J-46632** Spring Compressor. See **Special Tools**.
2	2-6 Clutch Spring Assembly
3	2-6 Clutch Piston **Tip:** Inspect piston seals for damage and/or wear. Piston is reusable.

Clean and Inspect

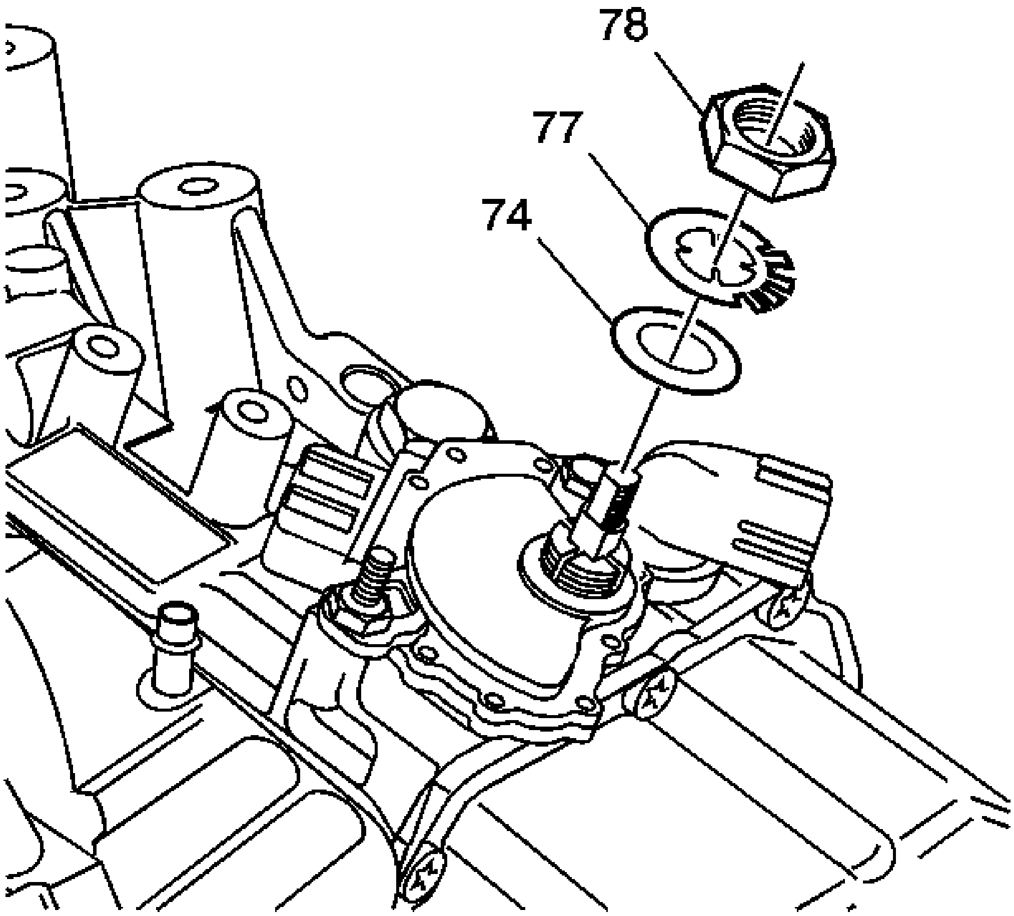


Fig. 163: Identifying Case Cover Assembly Components
Courtesy of GENERAL MOTORS CORP.

Clean and Inspect

Callout	Component Name
NOTE: After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure. **NOTE:** Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.	

Preliminary Procedures

1. Thoroughly clean the case cover assembly, including threads, with clean solvent.
2. Clean gasket sealing surfaces. Remove all residual gasket material.
3. Inspect all threaded holes. If necessary, repair any thread damage.

1	Gasket Sealing Surface
2	Fluid Passages
3	Piston Bores
4	Cover to Case Passages
5	A/Trans Input Speed Sensor Assembly Bore
6	Cover Casting
7	Passage Cup Plugs
8	Input Shaft Support Bolts **Tighten:** Tightened bolts in sequence to 12 N.m (106 lb in).

CASE COVER ASSEMBLY ASSEMBLE

Fluid Seal Ring Installation

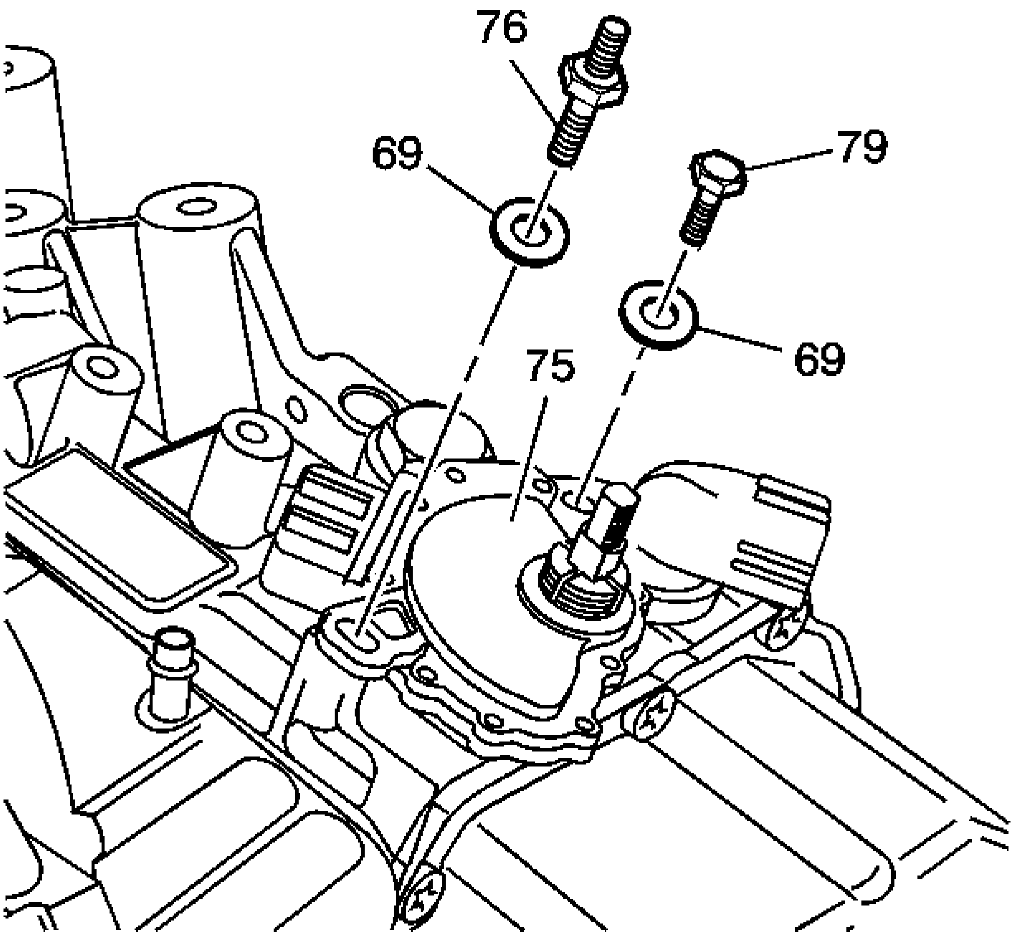


Fig. 164: Identifying Fluid Seal Ring
Courtesy of GENERAL MOTORS CORP.

Fluid Seal Ring Installation

Callout	Component Name
	3-5 Reverse and 4-5-6 Clutch Fluid Seal Ring **Tip:** 1. Place J 46620-3 which is part of **J-46620** over the case cover hub and adjust it so that only the bottom seal ring is exposed. See **Special Tools**. 2. Place a NEW fluid seal ring onto J 46620-3 which is part of **J-46620** . See **Special Tools**. 3. Use J 46620-2 which is part of **J-46620** to push the

1	fluid seal ring down over J 46620-3 which is part of **J-46620** into the hub ring groove. See **Special Tools**. 4. Repeat the above steps to install all 4 seal rings, adjusting J 46620-3 which is part of **J-46620** to the appropriate ring groove. See **Special Tools**. **Special Tool:** **J-46620** Seal Installer. See **Special Tools**.
2	Small Chamfer Up **NOTE:** **Do not force J 46620-1 down over the seals as this will roll and damage the seals. The large chamfer is designed to fit over the over stretched seal. Use a hand to help shrink the seal if J 46620-1 is difficult to install over the seal rings.** **Tip:** Install J 46620-1 which is part of **J-46620** with the large chamfer end down over the fluid seal rings and leave J 46620-1 which is part of **J-46620** on the seals for at least 60 seconds. See **Special Tools**.
3	Large Chamfer Up **Tip:** 1. Install J 46620-1 which is part of **J-46620** with the small chamfer end facing down for at least 60 seconds. See **Special Tools**. This will properly size the bottom seal ring. 2. Leaving J 46620-1 which is part of **J-46620** on the fluid seal rings for an extended period of time could cause a fluid leak on the initial clutch piston circuit until the seal rings warm up and expand to the proper dimension. See **Special Tools**.

2-6 Clutch Piston Installation

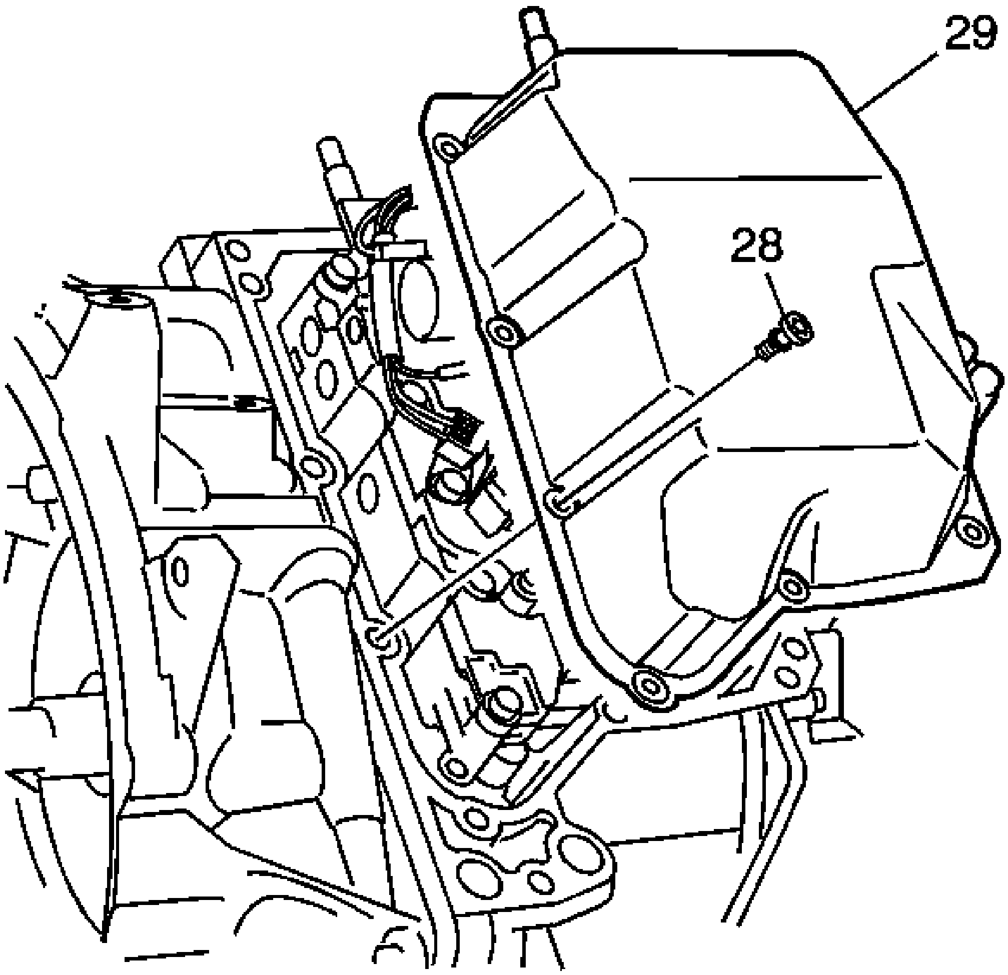


Fig. 165: View Of 2-6 Clutch Piston
Courtesy of GENERAL MOTORS CORP.

2-6 Clutch Piston Installation

Callout	Component Name
1	2-6 Clutch Piston **Tip: J-46621** prevents the piston seal lip from damage over the retaining ring groove during installation. See **Special Tools**. Apply a thin coat of ATF to the O.D. of **J-46621** to ease the installation of the piston. See **Special Tools**. **Special Tool:** **J-46621** Seal Protector. See **Special Tools**.

2	2-6 Clutch Spring Assembly
3	2-6 Clutch Spring Assembly **Tip:** 1. Install the retaining ring with the opening positioned to the top of the case cover. 2. Place the retainer ring inside **J-46632** prior to placing **J-46632** onto the spring. See **Special Tools**. **Special Tool:** **J-46632** Spring Compressor. See **Special Tools**.

Low and Reverse Clutch Piston Installation

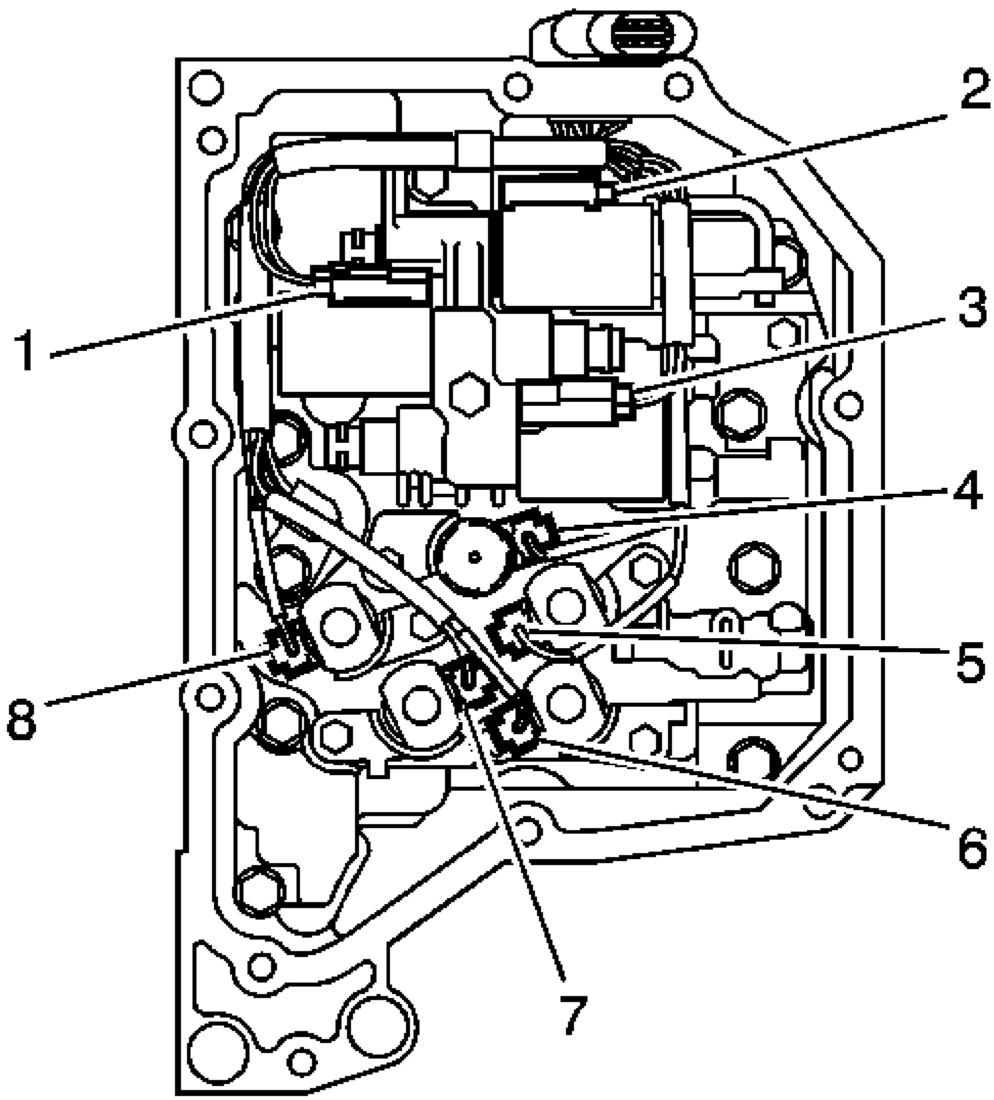


Fig. 166: Identifying Low & Reverse Clutch Piston
Courtesy of GENERAL MOTORS CORP.

Low and Reverse Clutch Piston Installation

Callout	Component Name
	Low and Reverse Clutch Piston Assembly **Tip:**

1	1. Install the L/R piston with the air bleed positioned at the alignment feature on the cover, using J-46628-1 which is part of **J-46628-1** . See **Special Tools**. This will orient the piston fingers with the openings in the case. 2. J-46628-1 which is part of **J-46628-1** prevents the piston seal lip from damage during installation. See **Special Tools**. Apply a thin coat of ATF to the I.D. of J-46628-1 to ease the installation of the piston. **Special Tool:** **J-46628-1** Piston Seal Protector. See **Special Tools**.
2	Low and Reverse Clutch Spring
3	Low and Reverse Clutch Spring Retaining Ring **Tip:** Do not align the retainer opening with other retaining ring openings. **Special Tool:** **J-46628-2** Spring Compressor. See **Special Tools**.

2-6 and Low-Reverse Piston Function Inspection

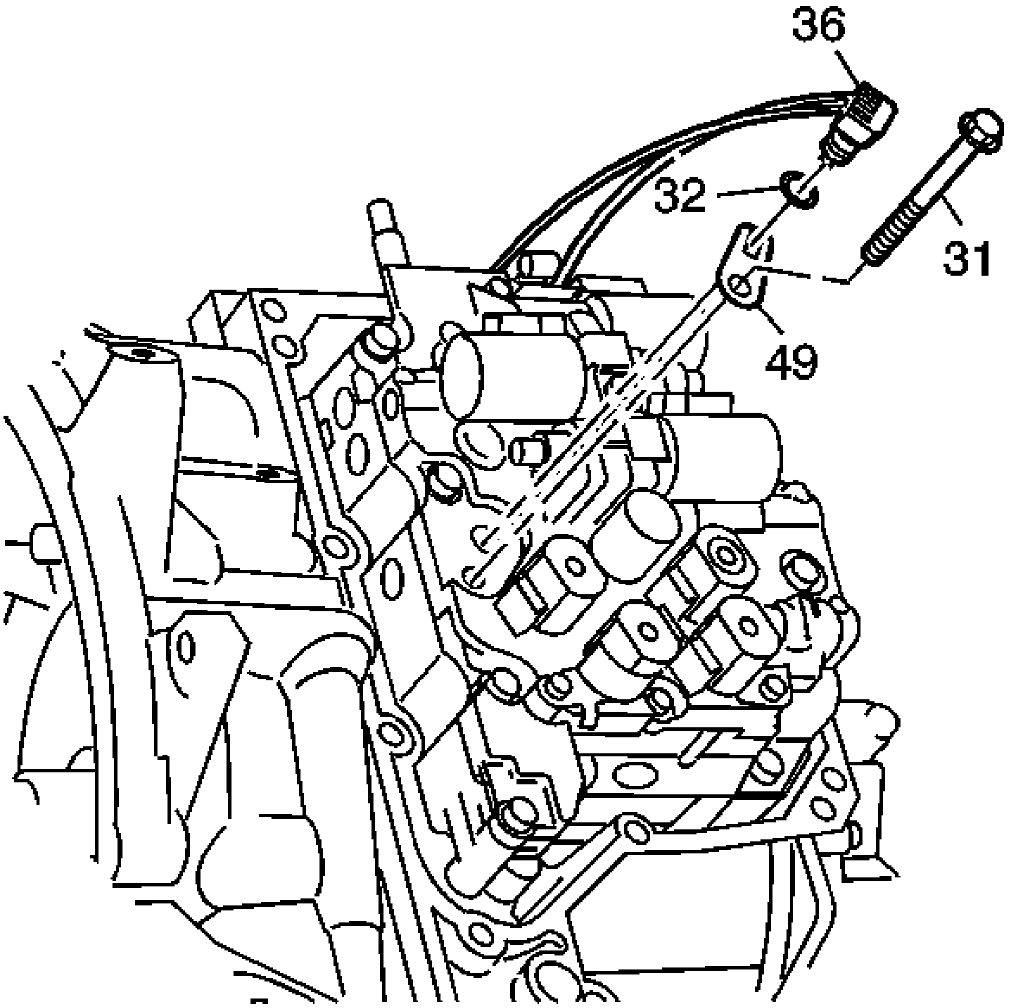


Fig. 167: 2-6 and Low-Reverse Piston Function Inspection
Courtesy of GENERAL MOTORS CORP.

2-6 and Low-Reverse Piston Function Inspection

Callout	Component Name
1	Case Cover Assembly **Tip:** The fluid seal rings should be in place and not damaged.
	Apply shop air to the 2-6 clutch feed. Observe the 2-6 piston movement. **NOTE:**

2	**Regulate the air pressure to 40 psi maximum. High pressure could cause the piston to over travel and damage the piston seals.** **Tip:** Minimal piston movement and excessive air leaking could indicate damage to the 2-6 piston seals or improper assembly.
3	Apply shop air to the Low and Reverse clutch feed. Observe the Low and Reverse piston movement. **NOTE:** **Regulate the air pressure to 40 psi maximum. High pressure could cause the piston to over travel and damage the piston seals.** **Tip:** Minimal piston movement and excessive air leaking could indicate damage to the Low and Reverse piston seals or improper assembly.

Input Speed Sensor Installation

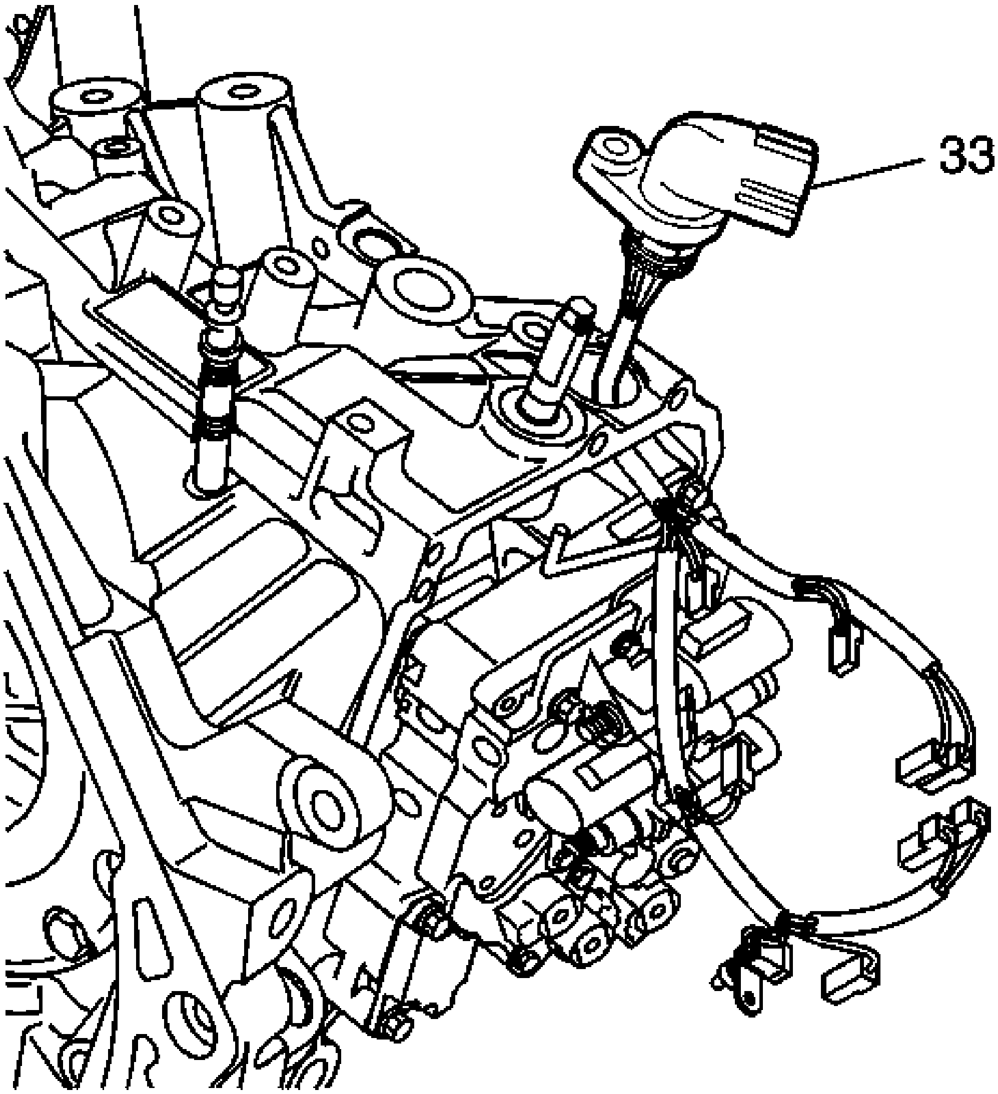


Fig. 168: View Of Input Speed Sensor
Courtesy of GENERAL MOTORS CORP.

Input Speed Sensor Installation

Callout	Component Name
1	Input Speed Sensor Seal
2	A/Trans Input Speed Sensor Assembly
	A/Trans Input Speed Sensor Bolt M6 x 25

3	**NOTE:** **Refer to Fastener Notice .** **Tip:** Apply threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the input speed sensor bolt. **Tighten:** 9 N.m (7 lb ft)

CASE COVER ASSEMBLY INSTALLATION

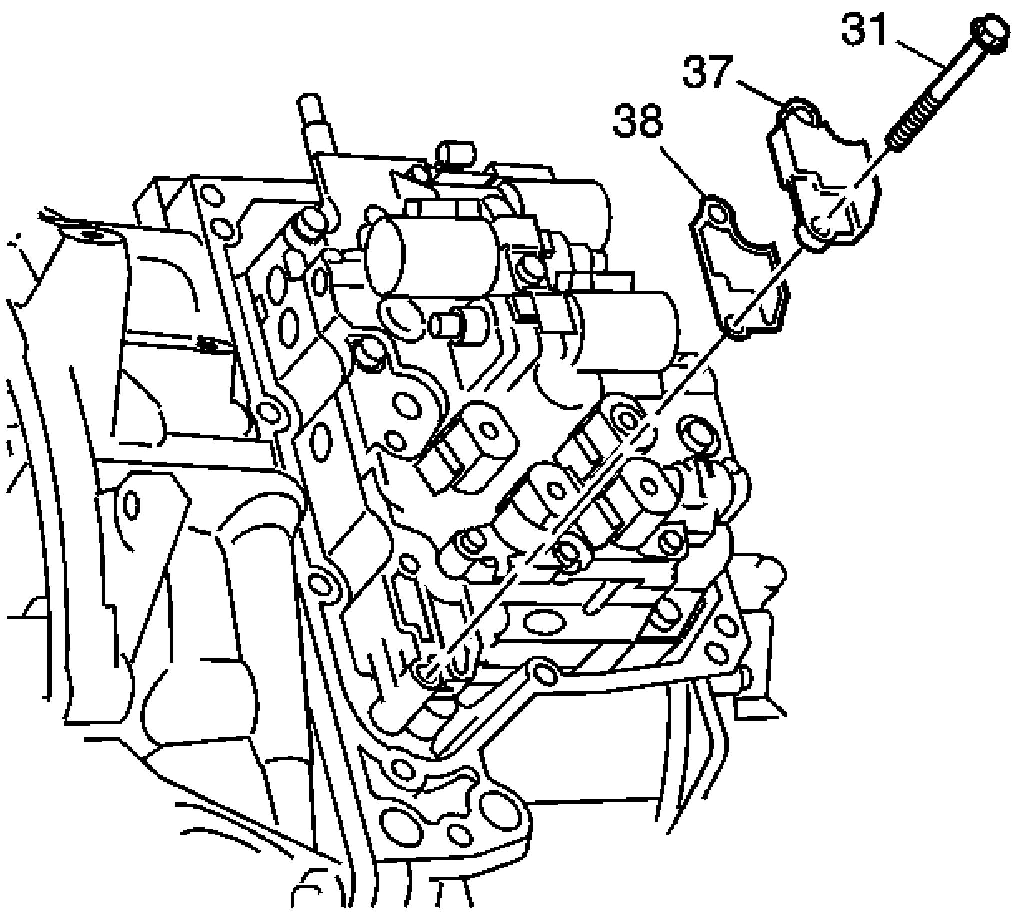


Fig. 169: Identifying Case Cover Assembly Components
Courtesy of GENERAL MOTORS CORP.

Case Cover Assembly Installation

Callout	Component Name
1	Input Shaft Thrust Bearing **Tip:** Note location of the orientaion lip on bearing. All thrust bearings can only be assembled one way.
2	A/Trans Case Cover Gasket
3	Input Speed Sensor Wire Harness **Tip:** Route the input speed sensor wire harness through the case passage.
4	A/Trans Case Cover Assembly **Tip:** Pull the input speed sensor wire harness through the case passage while lowering the cover assembly onto the case.
5	A/Trans Case Cover Assembly Bolt M6 x 30 (Qty: 10) **NOTE:** **Refer to Fastener Notice .** **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).

FRONT DIFFERENTIAL CARRIER FINAL ROTATIONAL TORQUE MEASUREMENT

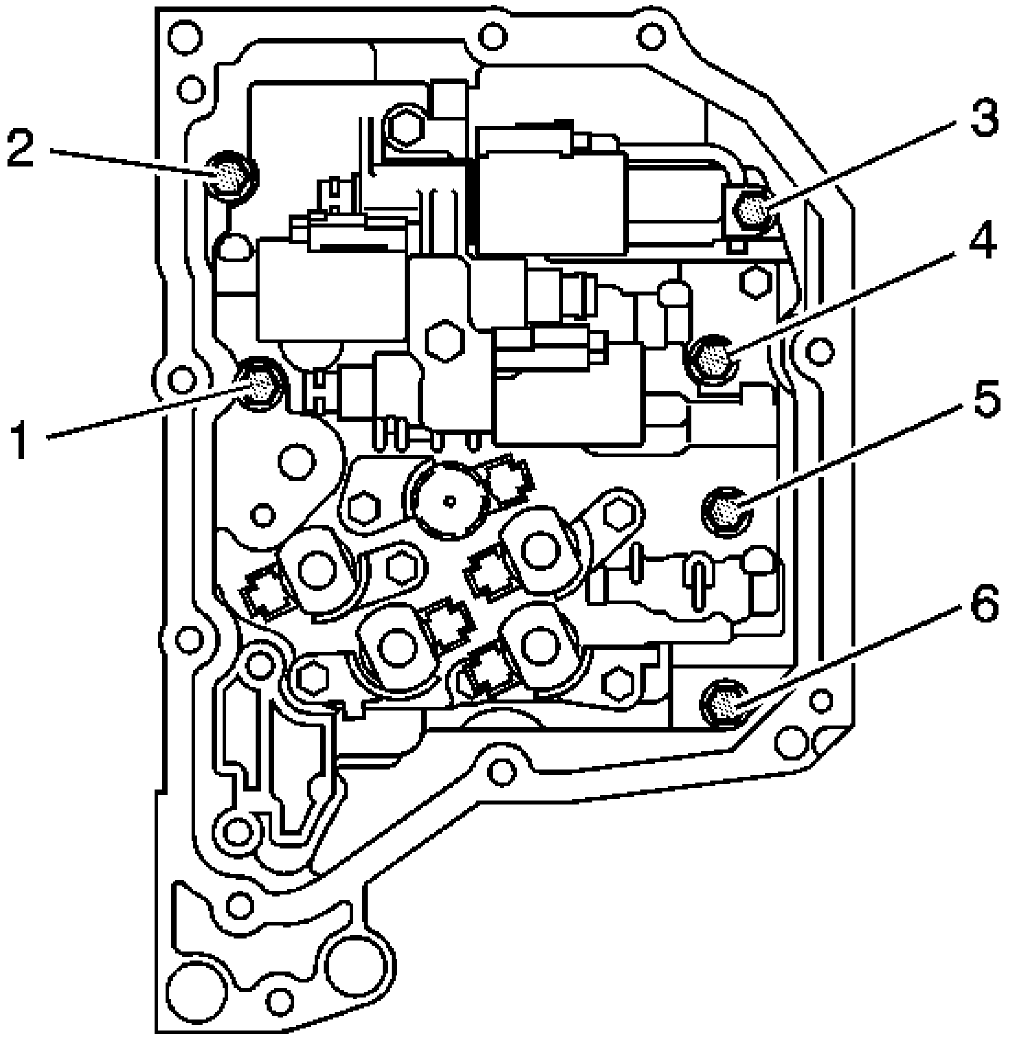


Fig. 170: Front Differential Carrier Final Rotational Torque Measurement
Courtesy of GENERAL MOTORS CORP.

Front Differential Carrier Final Rotational Torque Measurement

Callout	Component Name
	Front Differential Carrier Assembly **NOTE:** **Low bearing pre-load will cause premature failure of the front differential drive pinion gear.**

1	**NOTE:** **Refer to Fastener Notice .** **Tip:** If the turning torque is not within specifications, the transfer gear assembly and differential bearing thrust washer is incorrect and must be corrected. Refer to **Front Differential Drive Pinion Gear Bearing Thrust Washer and Front Differential Bearing Washer Measurement**. **Tip:** Use a dial or beam torque wrench with **DT-47793** to measure turning torque. See **Special Tools**. **Tighten:** 14-22 N.m (10-16 lb ft) **Special Tool:** **DT-47793** Differential Rotating Tool. See **Special Tools**.

CONTROL VALVE BODY ASSEMBLY DISASSEMBLE

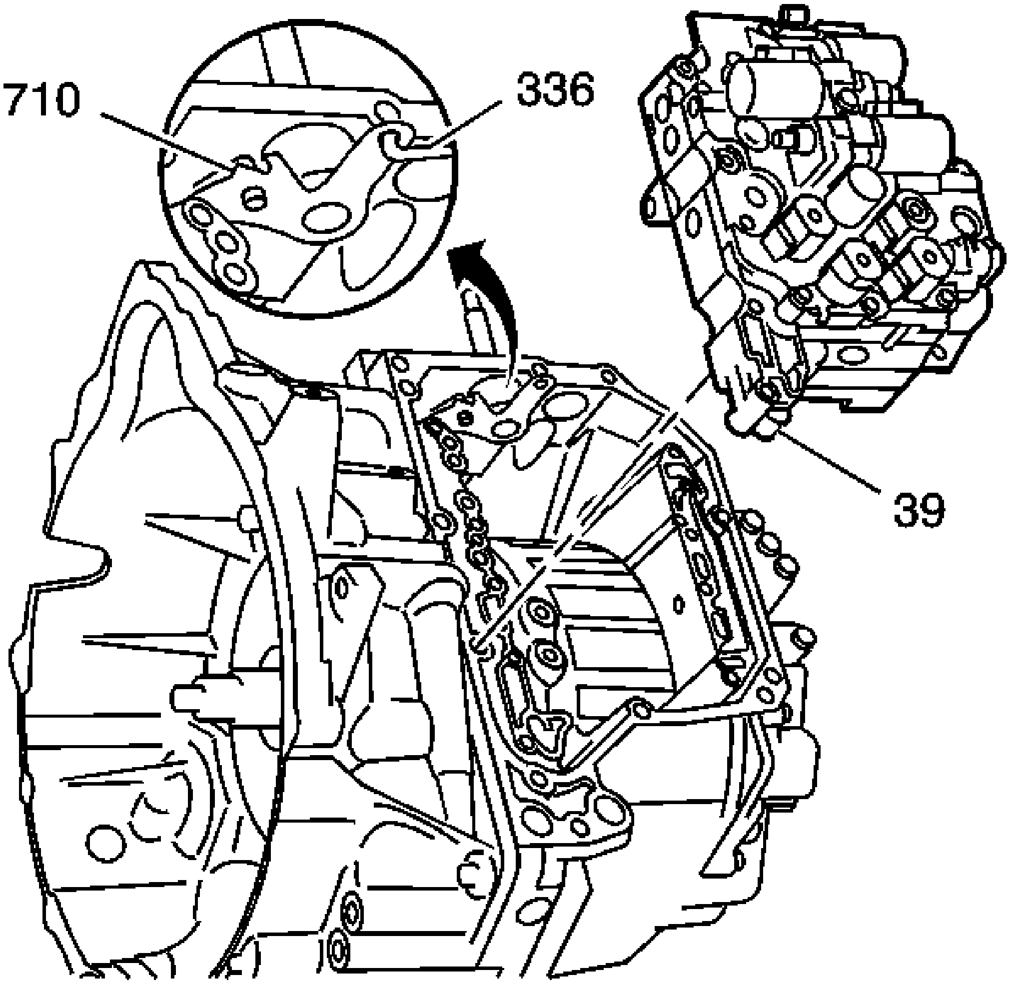


Fig. 171: Identifying Control Valve Body Assembly Components
Courtesy of GENERAL MOTORS CORP.

Control Valve Body Assembly Disassemble

Callout	Component Name
1	Control Valve Body Bolt M6 x 65 (Qty: 5)
2	Control Valve Body Bolt M6 x 35 (Qty: 3)
3	Control Valve Channel Upper Plate Assembly **Tip:** Inspect the upper channel plate bolt pass through holes for damage or burnelling. Any damage near the PCS feed hole could cause leaking around the PCS switch seal. Replace as

	necessary.
4	Control Valve Body Bolt M6 x 55 (Qty: 2)
5	Control Valve Body Bolt M6 x 55 (Qty: 1)
6	Control Valve Channel Plate Assembly
7	Control Valve Body Ball Check Valve (Qty: 9)
8	Control Valve Upper Body Assembly
9	Control Valve Lower Body Spacer Plate Assembly **Tip:** Discard the spacer plate assembly.
10	Control Valve Lower Body Assembly

CONTROL VALVE LOWER BODY ASSEMBLY CLEANING AND INSPECTION

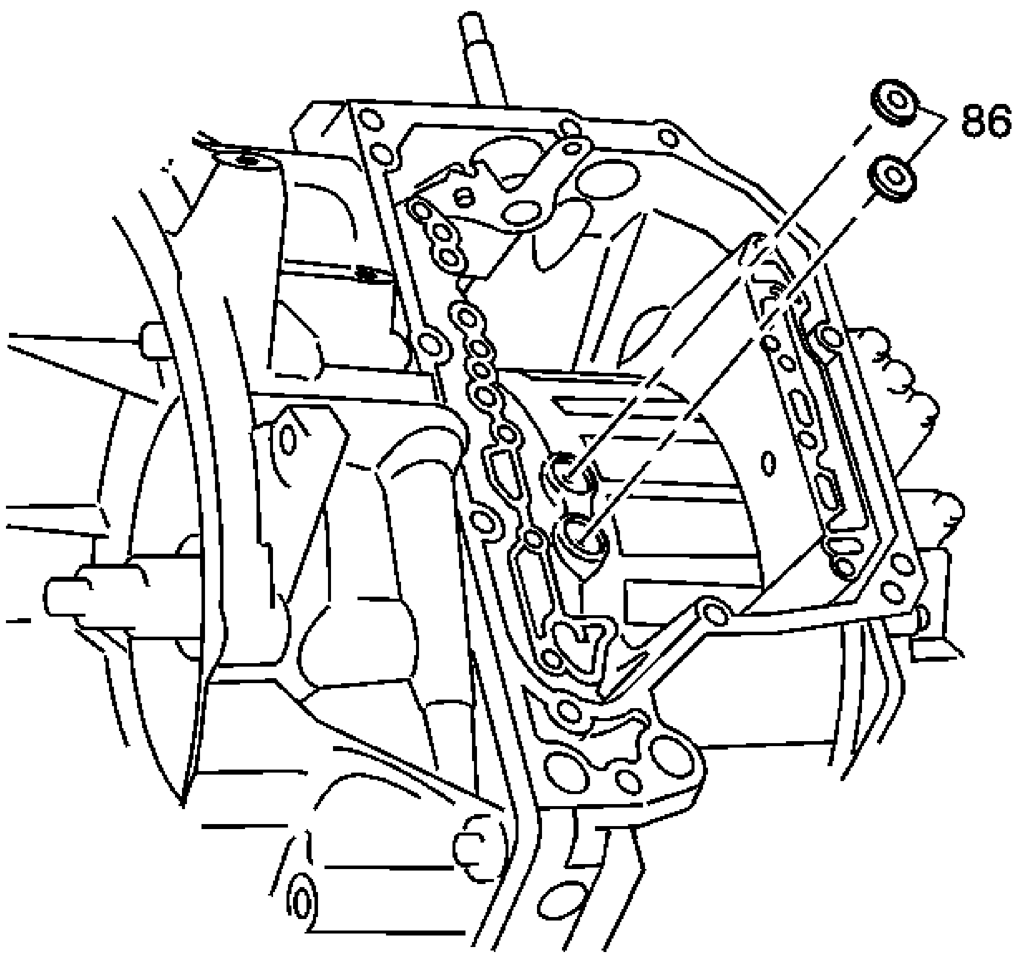


Fig. 172: Identifying Control Valve Lower Body Assembly Components
Courtesy of GENERAL MOTORS CORP.

Control Valve Lower Body Assembly Cleaning and Inspection

Callout	Component Name
CAUTION: **Valve springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.** **NOTE:** **After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.** **NOTE:** **Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.** **Preliminary Procedure:** Clean and inspect all valve components and the valve body. The control valve lower body is replaceable only as an assembly.	
1	3-5 Reverse Clutch Boost Valve Train
2	Accumulator Feed Limit Valve Train
3	4-5-6 Clutch Boost Valve Train
4	4-5-6 Clutch Accumulator Piston Assembly
5	1-2-3-4 Clutch Boost Valve Train
6	1-2-3-4 Clutch Regulator Valve Train
7	Control Valve Body Locating Pins (Qty: 2) **Tip:** Inspect Valve Body locating pins for proper installed height of 4.25 mm (0.17 in).

CONTROL VALVE UPPER BODY ASSEMBLY CLEANING AND INSPECTION

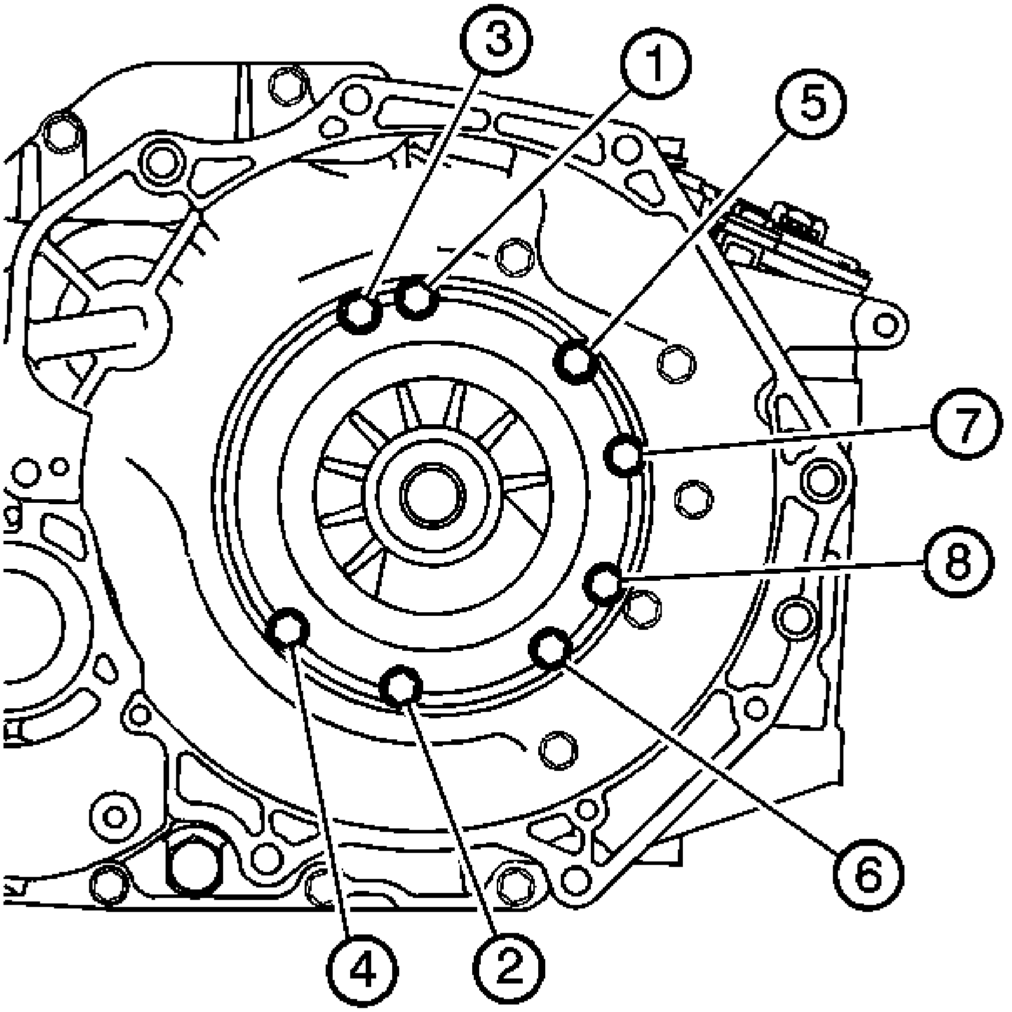


Fig. 173: Identifying Control Valve Upper Body Assembly Components
Courtesy of GENERAL MOTORS CORP.

Control Valve Upper Body Assembly Cleaning and Inspection

Callout	Component Name
CAUTION: Valve springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result. **NOTE:** After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in	

order to dry any transmission components. Lint from the towels can cause component failure.

NOTE:

Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

Preliminary Procedure: Clean and inspect all valve components and the valve body. The control valve upper body is replaceable only as an assembly.

1	1st Reverse and 4-5-6 Clutch Regulator Valve Train
2	TCC Regulator Apply Valve Train
3	2-6 Clutch Regulator Valve Train
4	3-5 Reverse Clutch Regulator Valve Train
5	Pressure Regulator Valve Train
6	Isolator Valve Train
7	TCC Control Valve Train
8	Clutch Select Solenoid #3 Valve Train
9	Clutch Select Solenoid #2 Valve Train
10	Manual Valve

CONTROL VALVE CHANNEL PLATE CLEANING AND INSPECTION

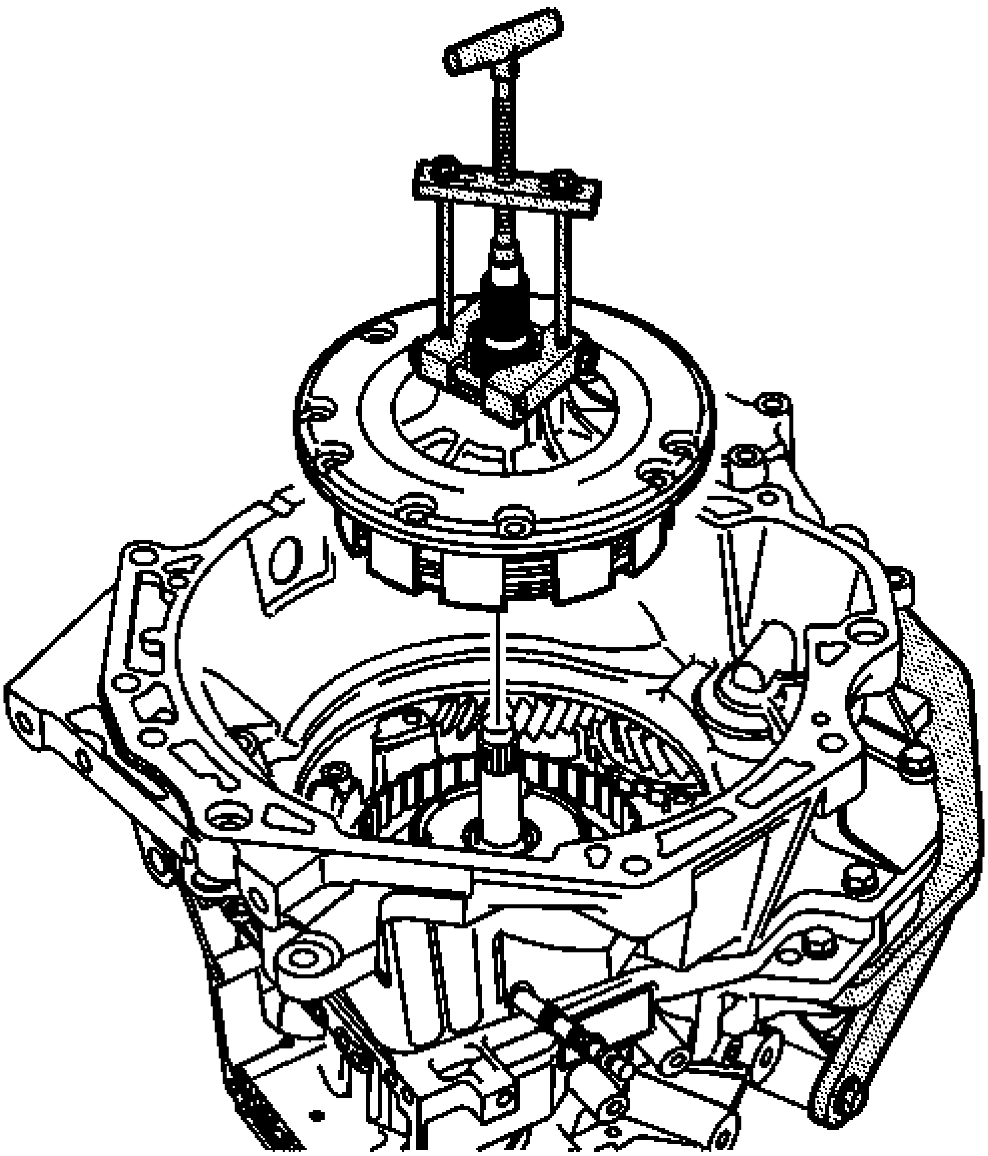


Fig. 174: Identifying Control Valve Channel Plate Components
Courtesy of GENERAL MOTORS CORP.

Control Valve Channel Plate Cleaning and Inspection

Callout	Component Name
NOTE:	

After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.

NOTE:

Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

1	Control Valve Body Spacer Plate Retainer (Qty: 2)
2	Control Valve Upper Body Spacer Plate Assembly
3	Actuator Feed Accumulator Spring (Qty: 3)
4	Actuator Feed Accumulator Piston (Qty: 3)
5	Control Valve Body Locating Pin (Qty: 2) **Tip:** Inspect locating pins for proper installed height of 4.25 mm (0.17 in).

CONTROL VALVE BODY ASSEMBLY ASSEMBLE

Lower and Upper Body Assemble

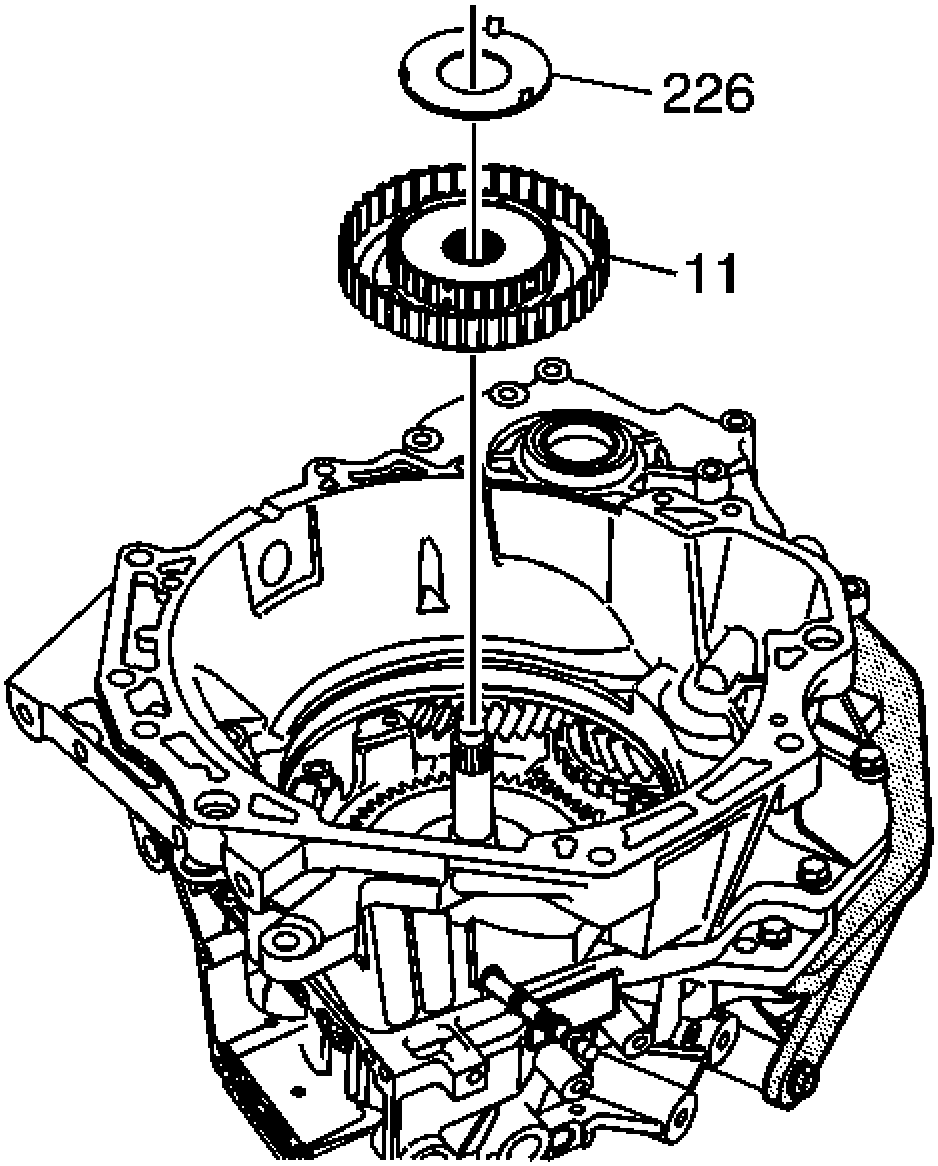


Fig. 175: Identifying Control Valve Body And Bolt
Courtesy of GENERAL MOTORS CORP.

Lower and Upper Body Assemble

Callout	Component Name
	Control Valve Lower Body Spacer Plate

1	Assembly **Tip:** Inspect the upper channel plate bolt through holes for damage or burnelling. Any damage around the PCS switch feed holes could cause leakage around the PCS switch seals. Replace as necessary.
2	Control Valve Upper Body Assembly
3	Control Valve Body Ball Check Valve (Qty: 9)
4	Control Valve Channel Plate Assembly
5	Control Valve Body Bolt 6 x 55 (Qty: 1) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 12 N.m (9 lb ft)

Channel Plate and Upper Channel Plate Assemble

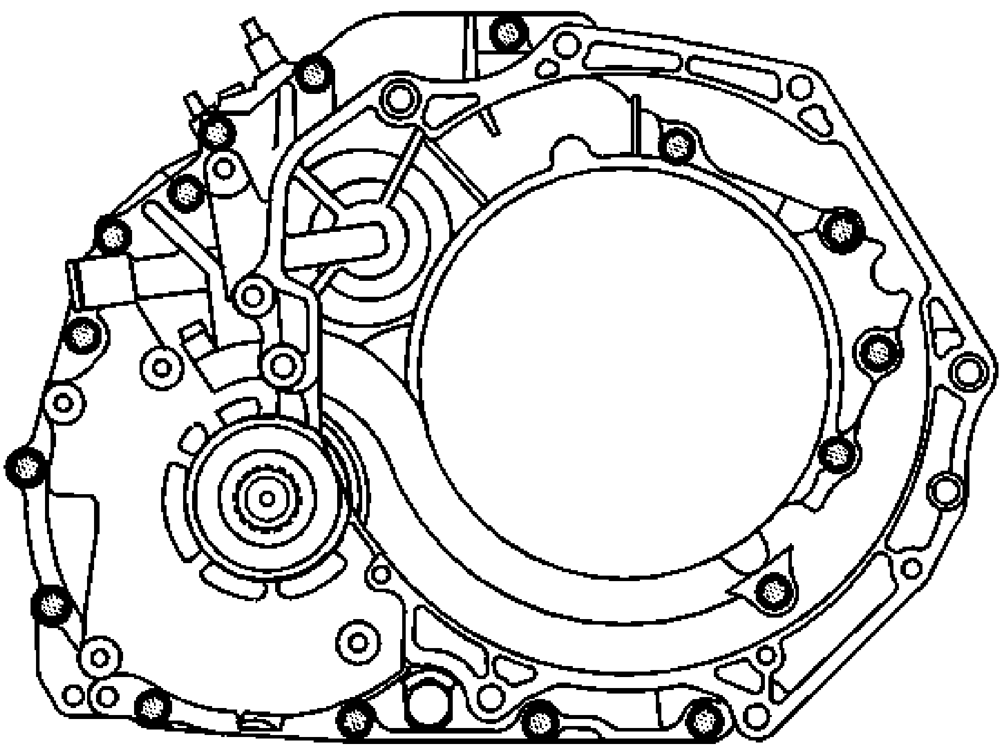


Fig. 176: Channel Plate and Upper Channel Plate Assembly
Courtesy of GENERAL MOTORS CORP.

Channel Plate and Upper Channel Plate Assemble

Callout	Component Name
1	Control Valve Channel Upper Plate Assembly **Tip:** Inspect the upper channel plate bolt pass through holes for damage or burnelling. Any damage near the PCS feed holes could cause leaking around the PCS switch seal. Replace as necessary.
2	Control Valve Body Bolt M6 x 35 (Qty: 3) **NOTE:** **Refer to Fastener Notice .** **Tighten:** Hand tighten for alignment, then tighten in sequence to 12 N.m (9 lb ft) after all bolts are installed.
3	Control Valve Body Bolt M6 x 65 (Qty: 5) **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).
4	Control Valve Body Bolt M6 x 55 (Qty: 2) **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).

CONTROL VALVE BODY ASSEMBLY INSTALLATION

Output Speed Sensor and Valve Body Installation

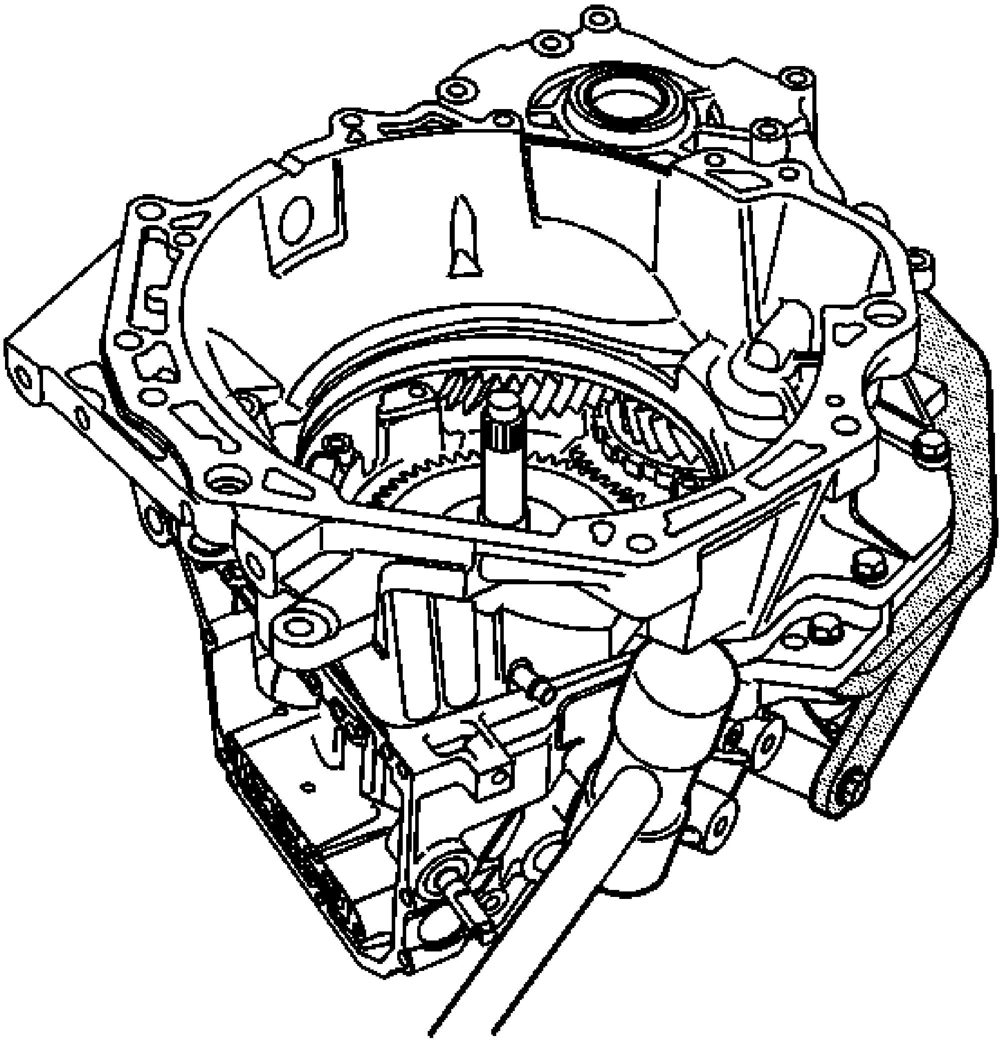


Fig. 177: View Of Output Speed Sensor & Valve Body
Courtesy of GENERAL MOTORS CORP.

Output Speed Sensor and Valve Body Installation

Callout	Component Name
1	1-2-3-4 Clutch Fluid Passage Seal
2	A/Trans Output Speed Sensor Assembly
3	A/Trans Output Speed Sensor Assembly Bolt M6 x 25 **NOTE:**

	Refer to Fastener Notice . **Tighten:** 12 N.m (9 lb ft)
4	Control Valve Body Assembly
5	Manual Valve **Tip:** • Align the manual valve to the detent lever assembly. • Removing the manual shaft assembly pin will aid in aligning the manual valve to the detent lever. Install the manual shaft pin after the valve body assembly is installed using **J 41229** , if it was not installed previously. Refer to **Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal**. **Special Tool:** **J 41229** Manual Shaft Pin Installer

Control Valve Body Bolts Installation

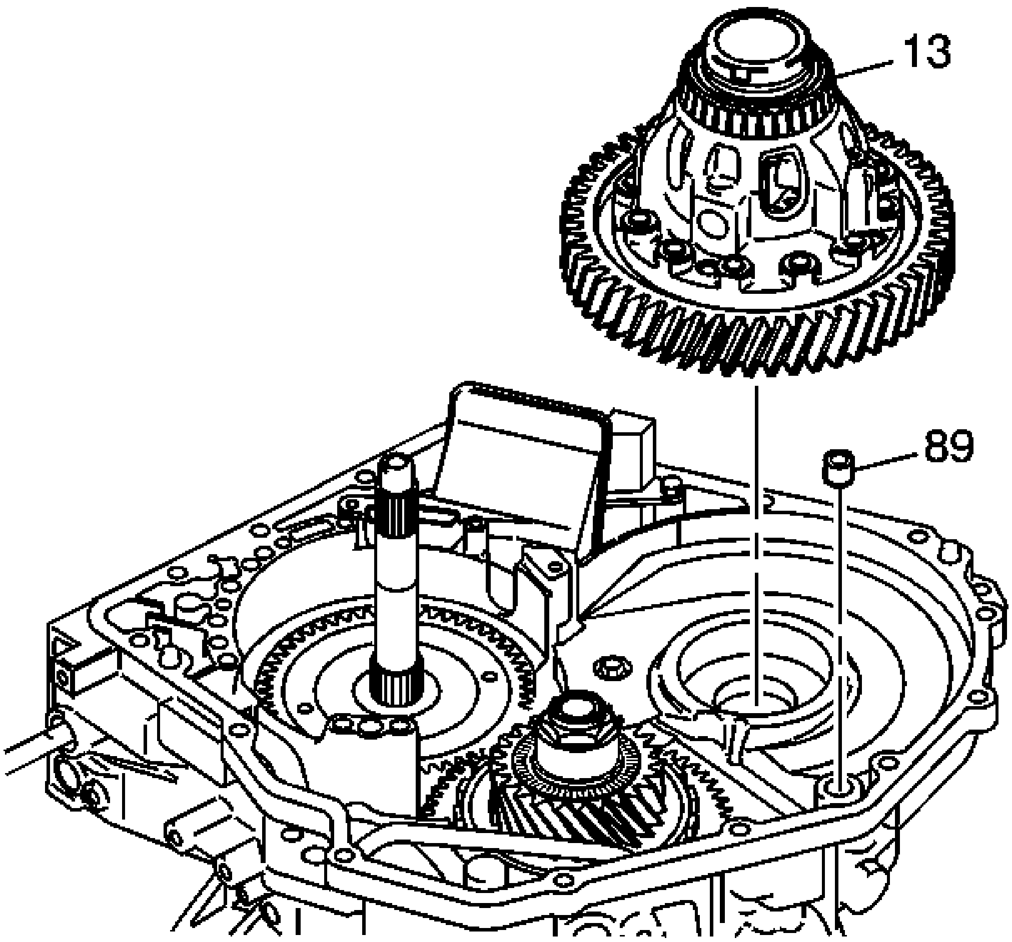


Fig. 178: Identifying Control Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

Control Valve Body Bolts Installation

Callout	Component Name
1	Manual Shaft Detent Assembly **Tip:** Ensure proper alignment of the detent assembly to the detent lever assembly with position switch while tightening the bolt. The detent assembly can move and hit the valve body assembly that could cause improper engagement with the detent lever assembly.
	Control Valve Body Bolt M6 x 65 (Qty: 8)

2	**NOTE:** **Refer to Fastener Notice .** **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).
3	Control Valve Body Bolt M6 x 55 (Qty: 2) **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).

Filter Plate Installation

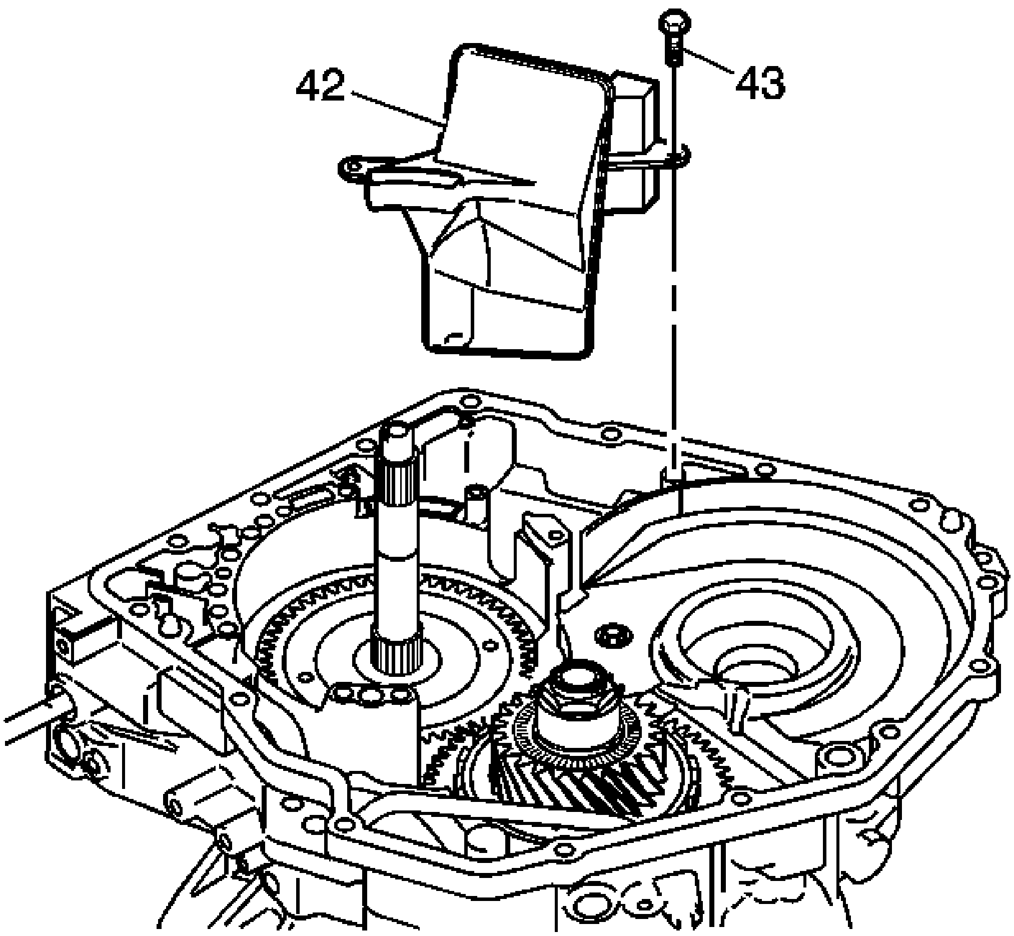


Fig. 179: View Of Filter Plate
Courtesy of GENERAL MOTORS CORP.

Filter Plate Installation

Callout	Component Name
1	Control Solenoid Valve Assembly Filter Plate **NOTE:** **Use care when removing or installing the filter plate assembly. A broken or missing retaining tab may not adequately secure the filter plate to the control solenoid valve assembly, resulting in possible damage or contamination.** **Tip:** Install a NEW filter plate to prevent fluid leaks past the oil seals.

Control Solenoid (w/Body and TCM) Valve Assembly Installation

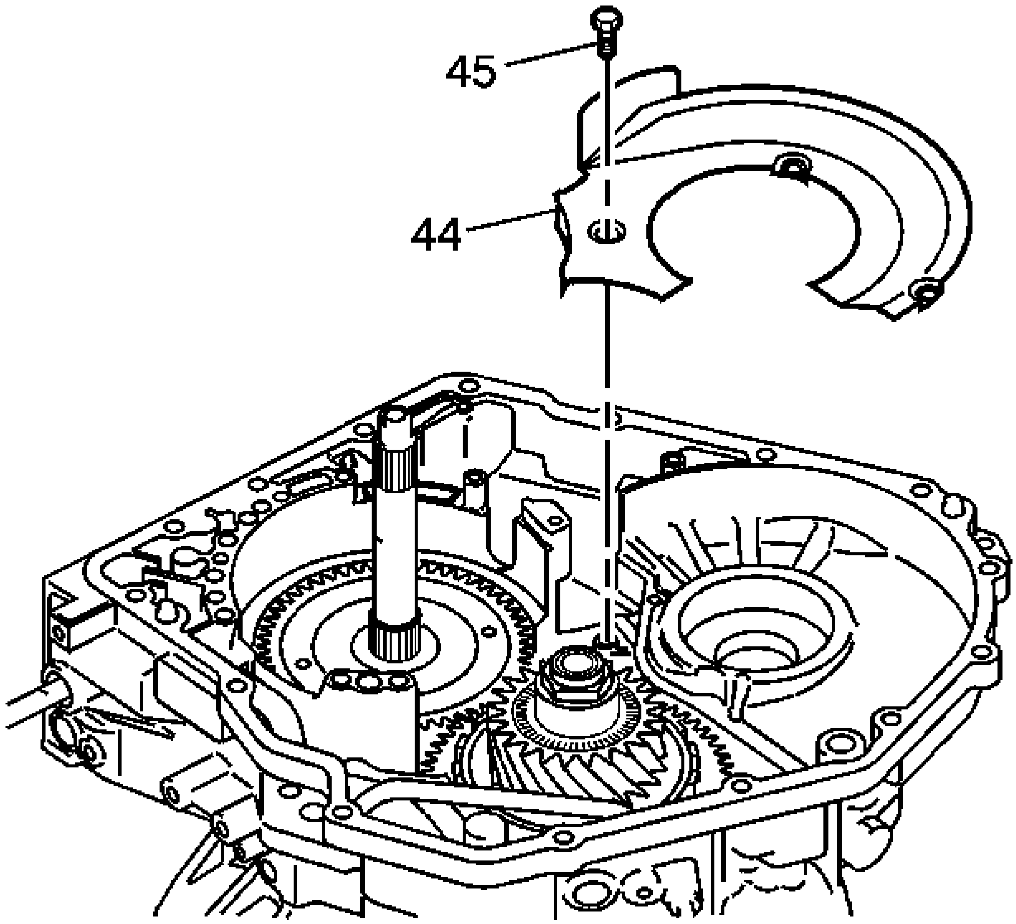


Fig. 180: Identifying Control Solenoid (w/Body & TCM) Valve Assembly
Courtesy of GENERAL MOTORS CORP.

Control Solenoid (w/Body and TCM) Valve Assembly Installation

Callout	Component Name
NOTE: **Refer to Fastener Notice .** **Preliminary Procedure:** Install all bolts before tightening, then tighten in sequence to 12 N.m (9 lb ft).	
1	Control Solenoid (w/Body and TCM) Valve Assembly **NOTE:** **Do not drop the control solenoid with body and transmission control module (TCM) valve assembly.**

	Internal damage can occur if the control solenoid with body and TCM valve assembly is dropped. DO NOT reuse the control solenoid with body and TCM valve assembly if it is dropped.
2	Control Solenoid Valve Spring **Tip:** • If the control solenoid spring is missing or improperly installed, the TCM may overheat causing the TCM to shut down. The transmission will default to 3rd or 5th gear. • Insert tab of spring into slot on spacer plate, then rotate into position.
3	Control Valve Body Bolt M6 x 80 (Qty: 4)
4	Control Valve Body Bolt M6 x 55 (Qty: 1)
5	Control Valve Body Bolt M6 x 95 (Qty: 3)
6	Control Valve Body Bolt M6 x 42 (Qty: 1)
7	Control Valve Body Bolt M6 x 65 (Qty: 2)

Wire Routing and Connector Locations

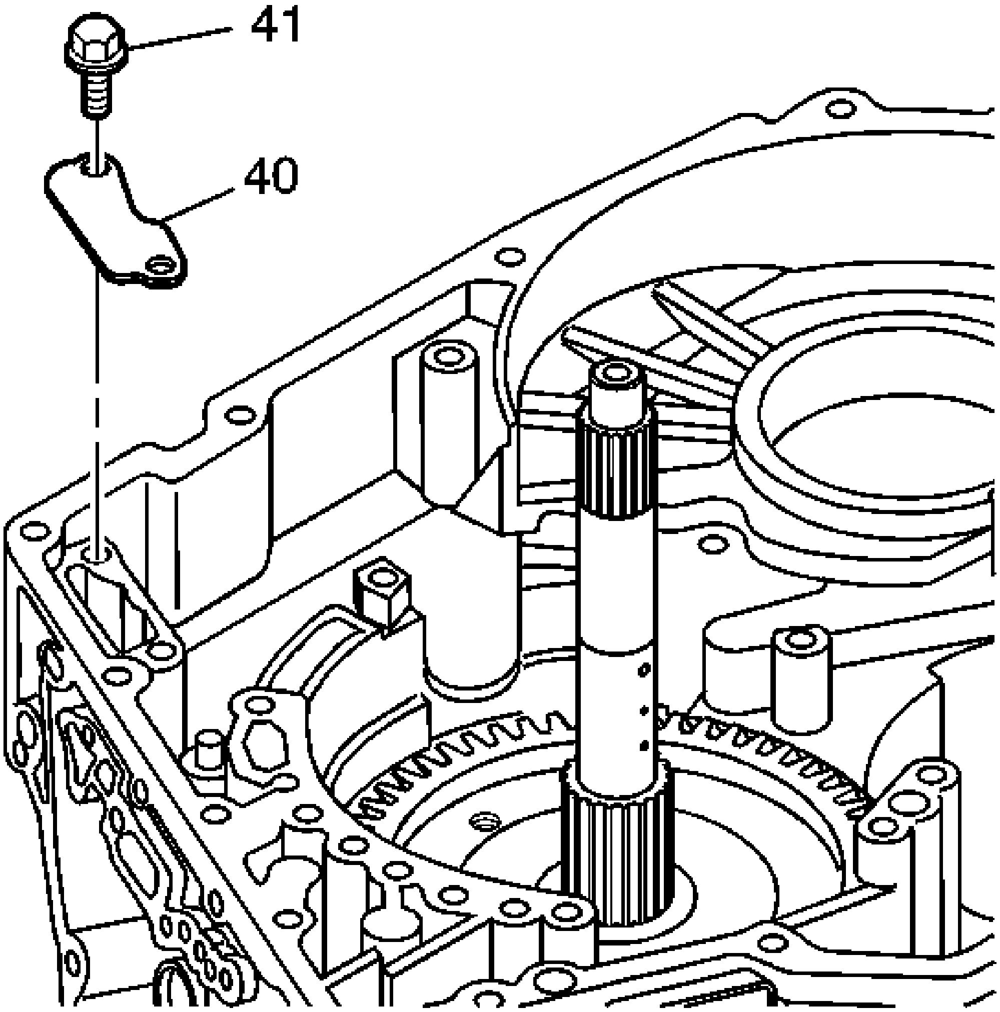


Fig. 181: Identifying Wire Routing & Connector Locations
Courtesy of GENERAL MOTORS CORP.

Wire Routing and Connector Locations

Callout	Component Name
Preliminary Procedure: Route all wires as shown.	
1	Shift Position Switch Connector
2	Output Speed Sensor Connector
3	Input Speed Sensor Connector

Control Valve Body Cover Installation

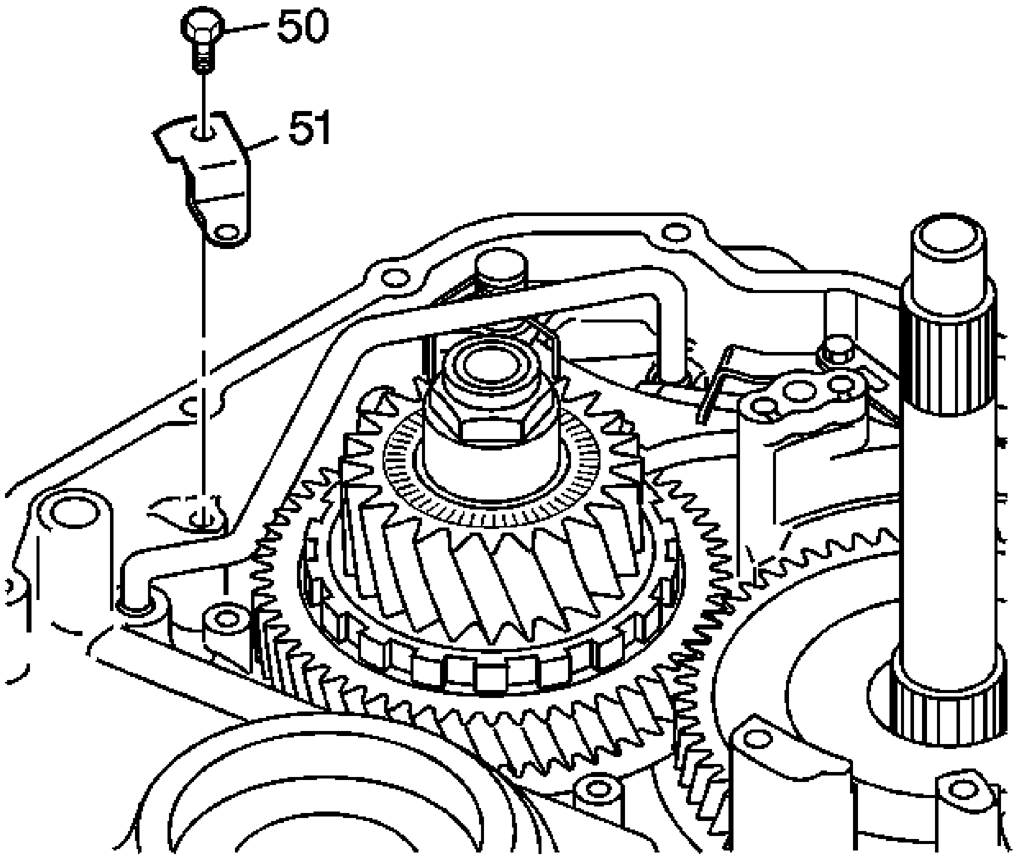


Fig. 182: Identifying Control Valve Body Cover Wiring Connector Hole Seal
Courtesy of GENERAL MOTORS CORP.

Control Valve Body Cover Installation

Callout	Component Name
1	Control Valve Body Cover Wiring Connector Hole Seal **Tip:** Holes in the seal must face down.
2	Control Valve Body Cover Assembly Gasket
3	Control Valve Body Cover Assembly
4	Control Valve Body Cover Bolt M6 x 30 (Qty: 12) **NOTE:**

	Refer to Fastener Notice . **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).
5	Control Valve Body Cover Stud M6 x 30 (Qty: 2) **Tighten:** Tighten in sequence to 12 N.m (9 lb ft).

TORQUE CONVERTER INSTALLATION

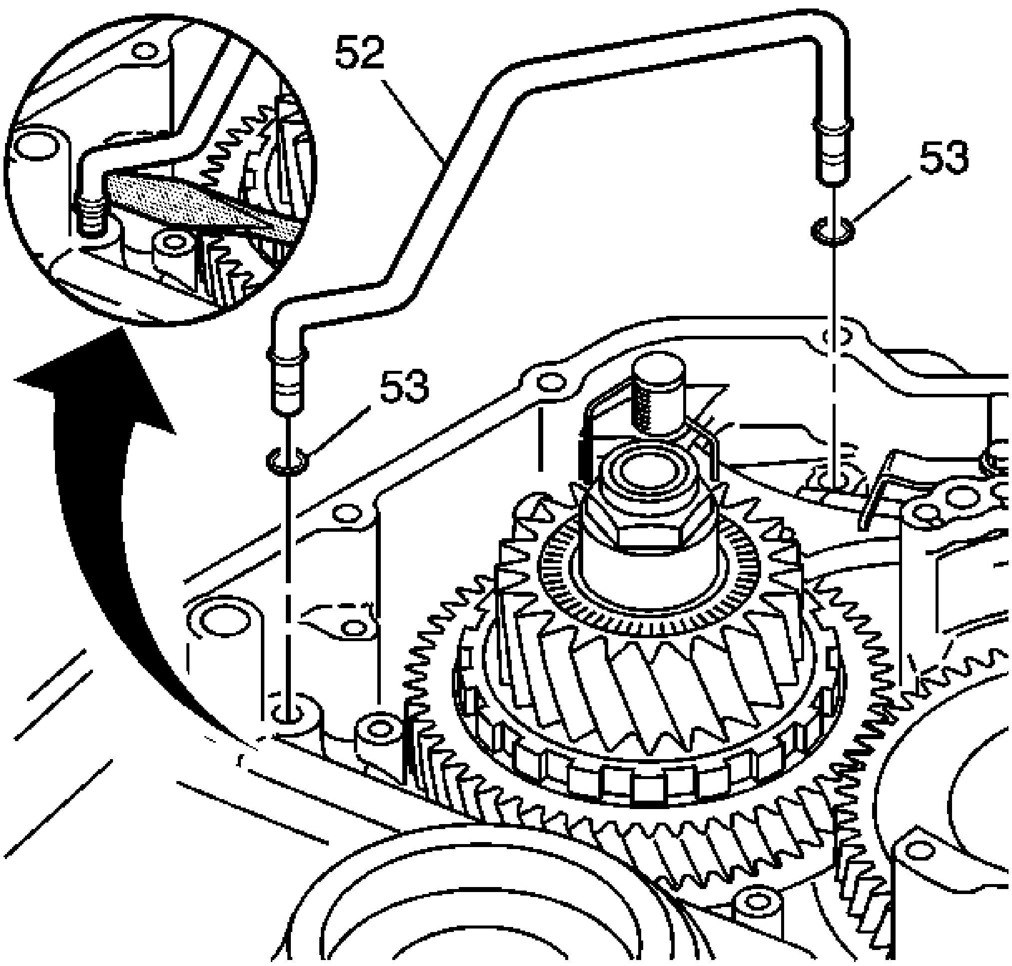


Fig. 183: View Of Torque Converter
Courtesy of GENERAL MOTORS CORP.

Torque Converter Installation

Callout	Component Name
1	Torque Converter Assembly **NOTE:** **Lower the torque converter straight down. Failure to lower the torque converter straight down could damage the torque converter clutch lip seal inside the torque converter clutch assembly.** **Special Tool:** **J 46409** Torque Converter Lifting Handles. See **Special Tools**.
2	**J 21366** Converter Holding Strap **CAUTION:** **The torque converter must be held to the torque converter housing by a retaining device such as shipping brackets. Without the retaining device, the torque converter may slide forward, disengaging the oil pump, or may fall completely out of the transmission causing personal injury and/or property damage.**
3	Dust Cover - Model Dependant
4	Dust Cover Push Pin - Model Dependant (Qty: 2)
5	Dust Cover Bolt - Model Dependant **NOTE:** **Refer to Fastener Notice .** **Tighten:** 75 N.m (37 lb ft)

LIFT PLATE AND HOLDING FIXTURE REMOVAL

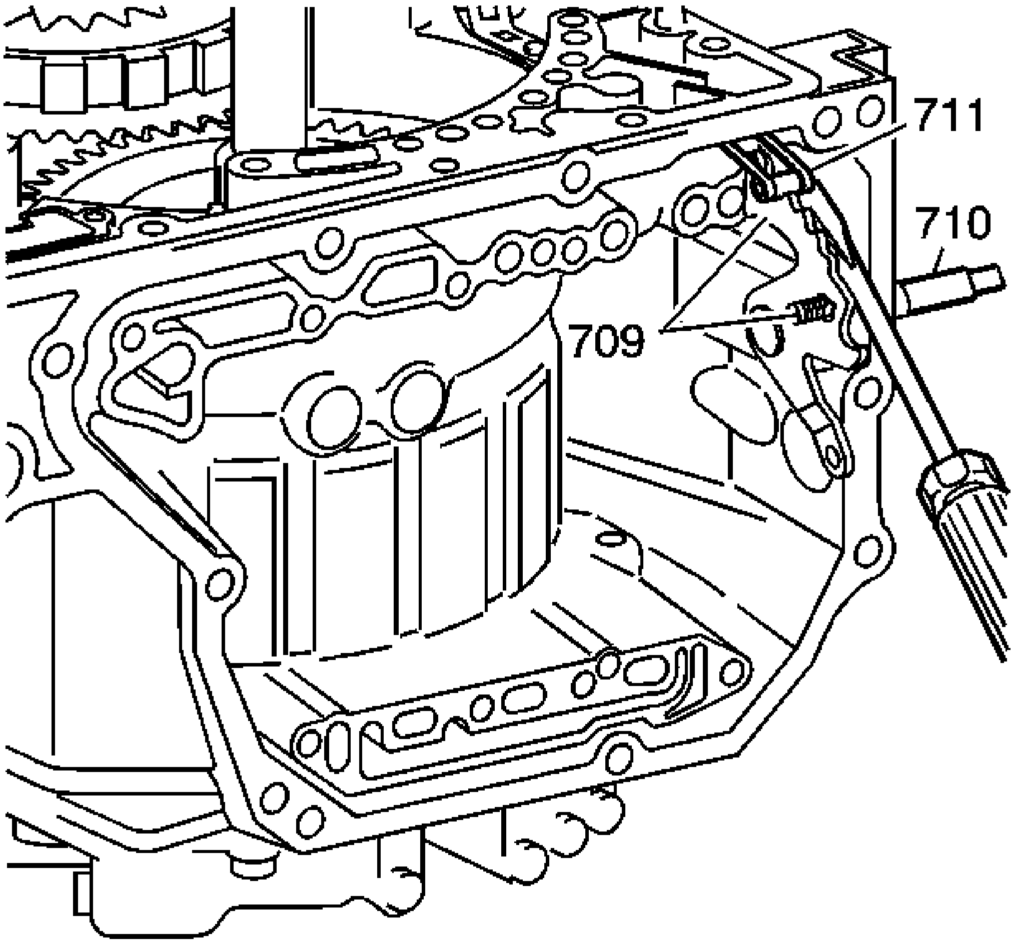


Fig. 184: Identifying Lift Plate & Holding Fixture
Courtesy of GENERAL MOTORS CORP.

Lift Plate and Holding Fixture Removal

Callout	Component Name
1	**J-46625** Transmission Holding Fixture. See **Special Tools**. **Tip:** Raise the transmission in order to remove the holding fixture.
2	**DT-47811** Lift Plate. See **Special Tools**. **Tip:** Lower the transmission assembly onto the transmission jack in order to remove the lift plate.

DESCRIPTION AND OPERATION

DEFINITIONS AND ABBREVIATIONS

Throttle Positions

Engine Braking

A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Full Throttle Downshift

A quick apply of the accelerator pedal to its full travel, forcing a downshift.

Heavy Throttle

Approximately 3/4 of accelerator pedal travel, 75 percent throttle position.

Light Throttle

Approximately 1/4 of accelerator pedal travel, 25 percent throttle position.

Medium Throttle

Approximately 1/2 of accelerator pedal travel, 50 percent throttle position.

Minimum Throttle

The least amount of throttle opening required for an upshift.

Wide Open Throttle (WOT)

Full travel of the accelerator pedal, 100 percent throttle position.

Zero Throttle Coastdown

A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Shift Condition Definitions

Bump

A sudden and forceful apply of a clutch or a band.

Chuggle

A bucking or jerking. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed

A condition where a shift is expected but does not occur for a period of time. This could be described as a clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator, or during manual downshifting to a lower range. This term is also defined as LATE or EXTENDED.

Double Bump - Double Feel

Two sudden and forceful applies of a clutch or a band.

Early

A condition where the shift occurs before the car has reached proper speed. This condition tends to labor the engine after the upshift.

End Bump

A firmer feel at the end of a shift than at the start of the shift. This is also defined as END FEEL or SLIP BUMP.

Firm

A noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. This apply should not be confused with HARSH or ROUGH.

Flare

A quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. This condition is also defined as SLIPPING.

Harsh - Rough

A more noticeable apply of a clutch or band than FIRM. This condition is considered undesirable at any throttle position.

Hunting

A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM, such as a 4-3-4 shift pattern. This condition is also defined as BUSYNESS.

Initial Feel

A distinctly firmer feel at the start of a shift than at the finish of the shift.

Late

A shift that occurs when the engine RPM is higher than normal for a given amount of throttle.

Shudder

A repeating jerking condition similar to CHUGGLE but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Slipping

A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band apply.

Soft

A slow, almost unnoticeable clutch or band apply with very little shift feel.

Surge

A repeating engine related condition of acceleration and deceleration that is less intense than CHUGGLE.

Tie-Up

A condition where two opposing clutch and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

Drive Link Noise

A whine or growl that increases or fades with vehicle speed, and is most noticeable under a light throttle acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light throttle acceleration.

Planetary Gear Noise

A whine related to vehicle speed, which is most noticeable in FIRST gear, SECOND gear, FOURTH gear or REVERSE. The condition may become less noticeable, or go away, after an upshift.

Pump Noise

A high pitched whine that increases in intensity with engine RPM. This condition may also be noticeable in all operating ranges with the vehicle stationary or moving.

Torque Converter Noise

A whine usually noticed when a vehicle is stopped, and the transmission is in DRIVE or REVERSE. The noise will increase with engine RPM.

Driver Shift Control

Driver shift control (DSC) allows the driver to change gears similar to a manual transmission. Refer to the vehicle owner's manual for specific DSC operating instructions.

Transmission Abbreviations

A/C

Air Conditioning

AC

Alternating Current

AT

Automatic Transmission

CCDIC

Climate Control Driver Information Center

DC

Direct Current

DIC

Driver Information Center

DLC

Diagnostic Link Connector

DMM

Digital Multimeter

DSC

Driver Shift Control

DTC

Diagnostic Trouble Code

EBTCM

Electronic Brake/Traction Control Module

ECCC

Electronically-Controlled Capacity Clutch

ECT

Engine Coolant Temperature

EMI

Electromagnetic Interference

IAT

Intake Air Temperature

IGN

Ignition

IMS

Internal Mode Switch

ISS

Input Speed Sensor

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

OBD

On Board Diagnostic

OSS

Output Speed Sensor

PC

Pressure Control

PCM

Powertrain Control Module

PCS

Pressure Control Solenoid

PS

Pressure Switch

PWM

Pulse Width Modulation

RPM

Revolutions Per Minute

SS

Shift Solenoid

STL

Service Transmission Lamp

TAP

Transmission Adaptive Pressure

TCC

Torque Converter Clutch

TFP

Transmission Fluid Pressure

TFT

Transmission Fluid Temperature

TP

Throttle Position

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

TRANSMISSION IDENTIFICATION INFORMATION

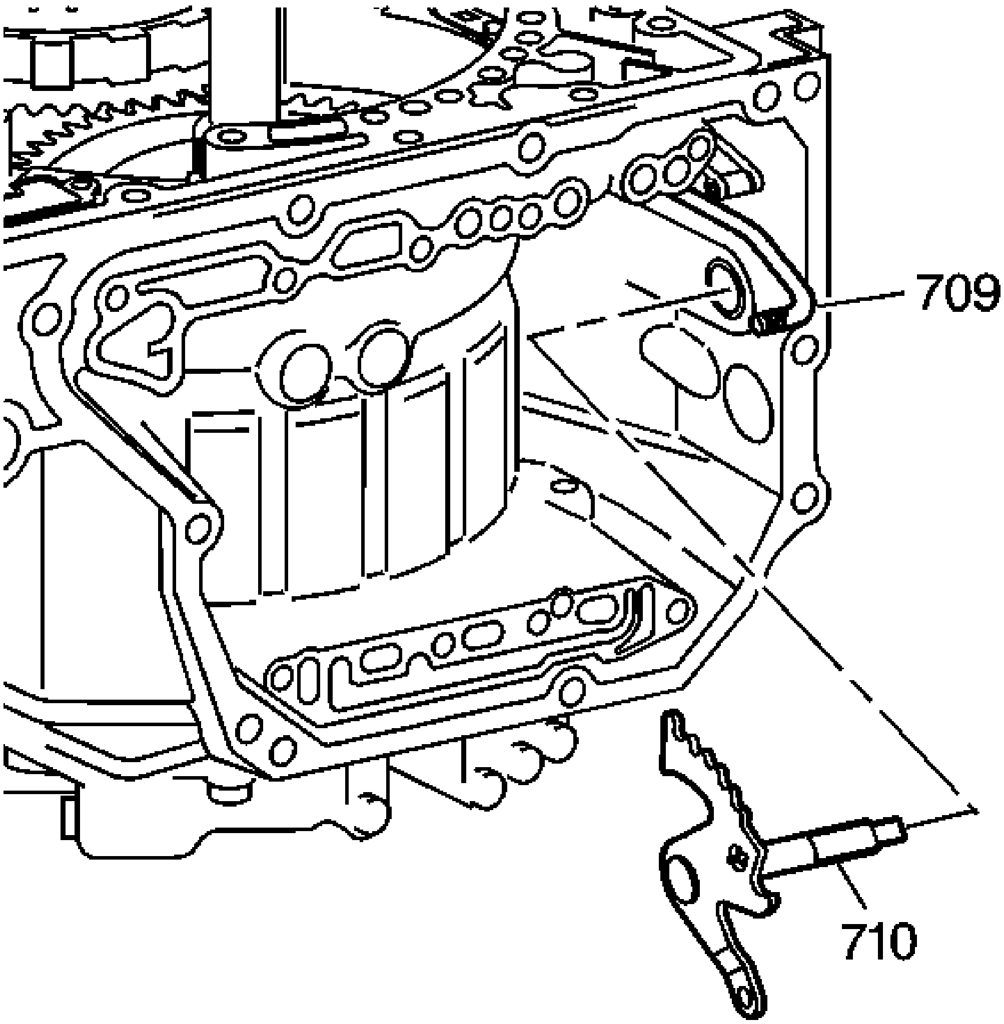


Fig. 185: Locating Transmission Identification Label
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Code for Automatic Transmission
2	Model Year
3	Model for Transmission
4	Level of TCM Software
5	Source Code for Plant
6	Calendar Year

7	Julian Date
8	Shift/Line (A/B)
9	Numeric sequence starting at 0001 @ 12:01 AM each day

Source Code for Plant

- 4 - Ramos Arizpe, Mexico
- H - Ypsilanti, Michigan
- J - Windsor, Ontario
- S - Strasbourg, France
- W - Warren, Michigan
- Y - Toledo, Ohio

TRANSMISSION GENERAL DESCRIPTION

The Hydra-matic 6T70/75 is a fully automatic, 6-speed, front-wheel drive, electronic-controlled transmission. It consists primarily of a 4-element torque converter, a compound planetary gear set, friction and mechanical clutch assemblies, and a hydraulic pressurization and control system. There are 2 variants of the transmission, based on torque capacity. Architecture is common between the variants, and component differences are primarily related to size.

The 4-element torque converter contains a pump, a turbine, a pressure plate splined to the turbine, and a stator assembly. The torque converter acts as a fluid coupling to smoothly transmit power from the engine to the transmission. It also hydraulically provides additional torque multiplication when required. The pressure plate, when applied, provides a mechanical direct drive coupling of the engine to the transmission.

The planetary gear sets provide the 6 forward gear ratios and reverse. Changing gear ratios is fully automatic and is accomplished through the use of a transmission control module (TCM) located inside the transmission. The TCM receives and monitors various electronic sensor inputs and uses this information to shift the transmission at the optimum time.

The TCM commands shift solenoids and variable bleed pressure control solenoids to control shift timing and feel. The TCM also controls the apply and release of the torque converter clutch which allows the engine to deliver the maximum fuel efficiency without sacrificing vehicle performance. All the solenoids, including the TCM, are packaged into a self-contained control solenoid valve assembly.

The hydraulic system primarily consists of a vane-type pump, 2 control valve body assemblies, transfer drive gear support assembly and case. The pump maintains the working pressures needed to stroke the clutch pistons that apply or release the friction components. These friction components, when applied or released, support the automatic shifting qualities of the transmission.

The friction components used in this transmission consist of 5 multiple disc clutches. The multiple disc clutches combine with one way clutch to deliver 7 different gear ratios, 6 forward and one reverse, through the gear sets. The gear sets then transfer torque through the transfer drive gear, transfer driven gear and differential assembly.

The transmission may be operated in any of the following gear ranges:

PARK (P)

This position locks the front wheels and prevents the vehicle from rolling either forward or backward. PARK is the best position to use when starting the vehicle. Because the transmission utilizes a shift lock control system, it is necessary to fully depress the brake pedal before shifting out of PARK. For safety reasons, use the parking brake in addition to the PARK position.

REVERSE (R)

This position allows the vehicle to be operated in a rearward direction.

NEUTRAL (N)

This position allows the engine to be started and operated while driving the vehicle. If necessary, you may select this position in order to restart the engine with the vehicle moving. This position should also be used when towing the vehicle.

DRIVE (D)

Drive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Drive range allows the transmission to operate in each of the 6 forward gear ratios. Downshifts to a lower gear, or higher gear ratio, are available for safe passing by depressing the accelerator or by manually selecting a lower gear in the manual mode range.

Driver Shift Control (DSC) or Electronic Range Selection (ERS)

This position (M-Manual / L-Low) allows the driver to utilize the DSC/ERS system. When the shift selector lever is moved to this position, the driver may select upshifts or downshifts by using the paddle switches located on the steering wheel/shifter. An upshift is requested by pushing either + button. Refer to the vehicle owner's manual for more specific DSC/ERS information.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the 6T70/75 are as follows:

- A torque converter with an electronically controlled capacity clutch (ECCC)
- Off axis chain driven vane-type fluid pump assembly
- Input sun gear and carrier assembly
- 4-5-6 and 3-5 reverse clutch assembly with turbine shaft
- Low and reverse clutch (one way clutch) assembly
- Control valve body assembly
- Front differential transfer drive gear support assembly
- Front differential transfer drive gear assembly
- Front differential carrier assembly
- Case cover assembly

The electrical components of the 6T70/75 are as follows:

- Output speed sensor assembly
- Input speed sensor assembly
- Manual shift shaft with internal mode switch
- Control solenoid valve assembly, which contains the following components:
  - Transmission control module (TCM)
  - 5 variable bleed line pressure control (PC) solenoids
  - Transmission fluid pressure (TFP) switch assembly
  - Torque converter clutch (TCC) pressure control solenoid
  - 2 shift solenoids
  - Transmission fluid temperature sensor

For more information, refer to **Electronic Component Description**.

TRANSMISSION ADAPTIVE FUNCTIONS

The 6T70/75 transmission utilizes a line pressure control system during upshifts to compensate for the normal wear of transmission components. As the apply components within the transmission wear or change over time, shift time (the time required to apply a clutch) increase or decreases. In order to compensate for these changes, the transmission control module (TCM) adjusts the pressure commands to the various PC solenoids, to maintain the originally calibrated shift timing. The automatic adjusting process is referred to as "adaptive learning" and it is used to ensure consistent shift feel plus increase transmission durability. The TCM monitors the A/T input speed sensor (ISS) and the A/T output speed sensor (OSS) during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the corresponding pressure control (PC) solenoid signal to maintain the set shift feel.

The purpose of the adapt function is to automatically compensate the shift quality for the various vehicle shift control systems. The adapt function is a continuous process that will help to maintain optimal shift quality throughout the life of the vehicle.

TRANSMISSION INDICATORS AND MESSAGES

The following transmission-related indicators and messages may be displayed on the Instrument Panel Cluster (IPC). For a complete listing and description of all vehicle indicators and messages, refer to **Indicator/Warning Message Description and Operation** .

"TRANSMISSION HOT IDLE ENGINE"

This message is displayed when the TCM detects a transmission fluid temperature (TFT) equal to or greater than 130°C (266°F) for 5 seconds.

"SERVICE TRANSMISSION"

This message displays when there is a problem with the transmission.

ELECTRONIC COMPONENT DESCRIPTION

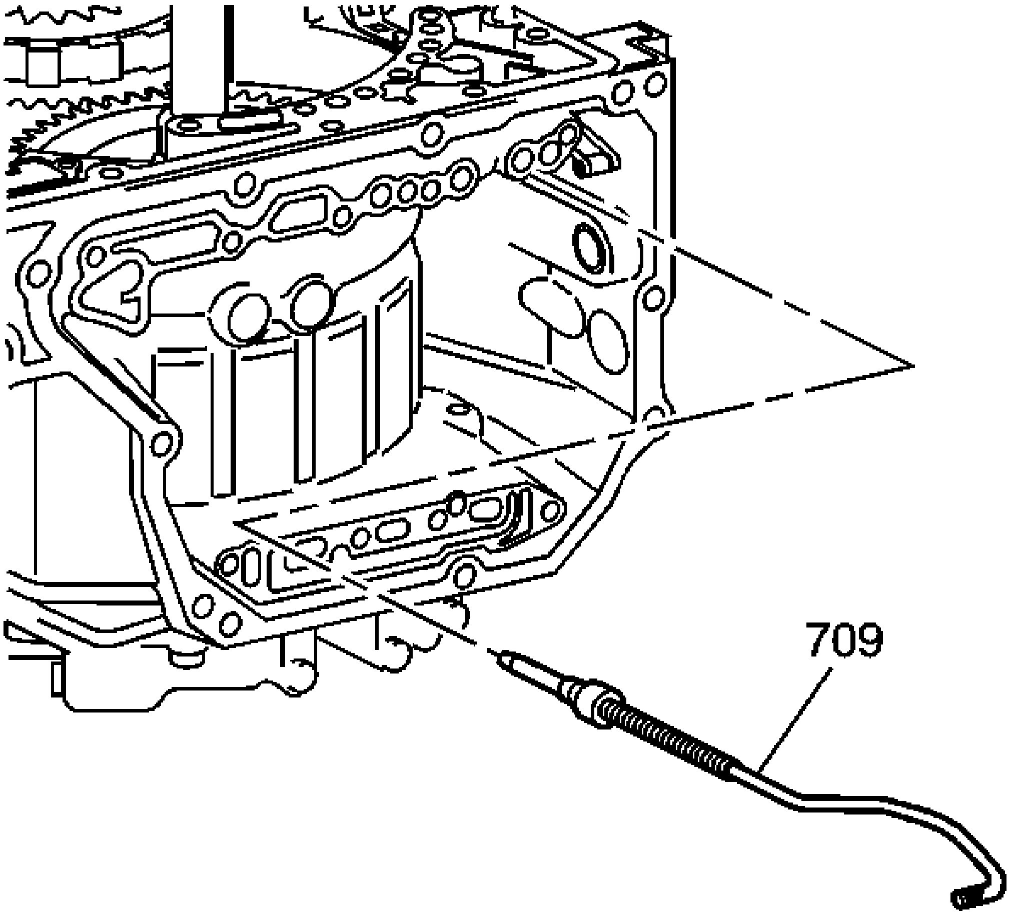


Fig. 186: Control Solenoid (W/Body and TCM) Valve Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Shift Solenoid 1
2	Pressure Control Solenoid 3 (R1/456)
3	Pressure Control Solenoid 5 (1234)
4	Torque Converter Clutch (TCC) Pressure Control Solenoid
5	Shift Solenoid 2
6	Pressure Control Solenoid 2 (35R)
7	Pressure Control Solenoid 4 (26)
8	Line Pressure Control Solenoid

9	Transmission Fluid Pressure (TFP) Switch 5 (35R)
10	Transmission Fluid Pressure (TFP) Switch 3 (26)
11	Transmission Fluid Pressure (TFP) Switch 4 (456/R1)
12	Pass Through Connector
13	Transmission Fluid Pressure (TFP) Switch 1 (1234)

The control solenoid (w/body and TCM) valve assembly contains the following components:

- Transmission control module (TCM)
- Clutch pressure control solenoids (Clutch PC Sol)
- Shift solenoids (SS)
- Line pressure control solenoid (Line PC Sol)
- Torque converter clutch pressure control solenoid (TCC PC Sol)
- Transmission fluid temperature sensor (TFT Sensor)
- TCM temperature sensor
- Power-up temperature sensor
- Transmission fluid pressure switches (TFP Sw)

These components are not serviced separately. The control solenoid (w/body and TCM) valve assembly utilizes a lead-frame system to connect these components electrically to the TCM. No wires are used for these components. The control solenoid (w/body and TCM) valve assembly bolts directly to the lower and upper valve body assemblies inside the transmission. The control solenoid (w/body and TCM) valve assembly connects to the engine harness 20-way connector.

Manual Shift Detent Lever with Shaft Position Switch Assembly

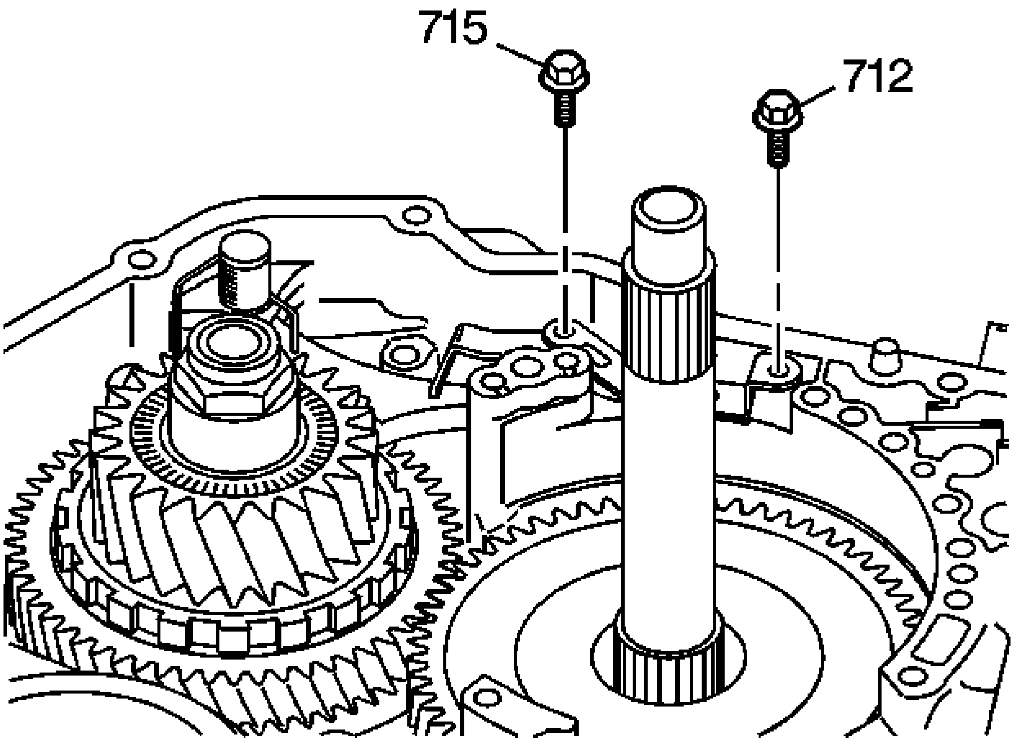


Fig. 187: Identifying Manual Shift Detent Lever with Shaft Position Switch
Courtesy of GENERAL MOTORS CORP.

The transmission shaft position switch assembly is a sliding contact switch attached to the manual shaft detent lever assembly inside the transmission case. The five inputs to the TCM from the transmission manual shift shaft switch assembly indicate the transmission gear selector lever position. This information is used for engine controls as well as determining the transmission shift patterns. The state of each input is available for display on the scan tool. The five input parameters represented are Signal A, Signal B, Signal C, Signal P (Parity) and Signal N (P/N Start).

Input Speed Sensor (ISS)

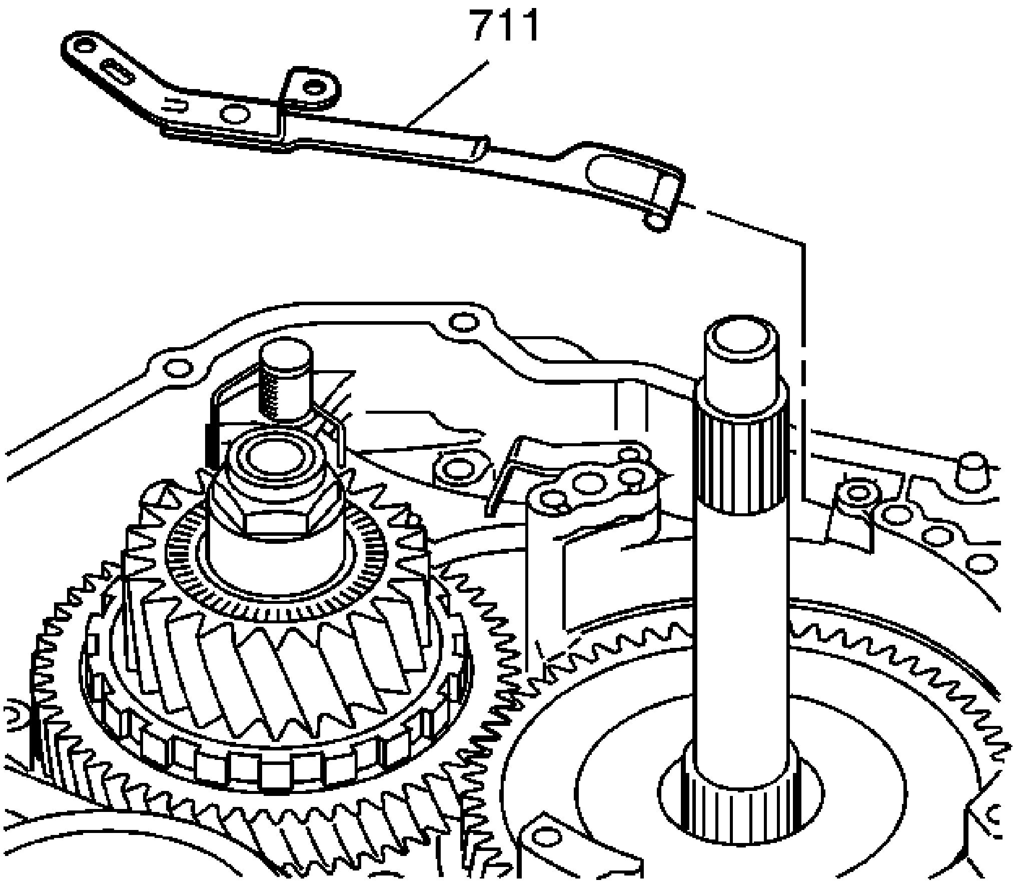


Fig. 188: Identifying Input Speed Sensor (ISS)
Courtesy of GENERAL MOTORS CORP.

The input speed sensor (ISS) is a hall-effect type sensor. The ISS mounts to the transmission case cover assembly and connects to the control solenoid (w/body and TCM) valve assembly through a wire harness and connector. The sensor faces the 3-5-R clutch piston housing machined teeth surface. The sensor receives 8.3-9.3 volts on the ISS/OSS Supply Voltage circuit from the TCM. As the 3-5-R/4-5-6 clutch piston housing rotates, the sensor produces a signal frequency based on the machined surface of the 3-5-R/4-5-6 clutch piston housing. This signal is transmitted through the ISS signal circuit to the control solenoid (w/body and TCM) valve assembly. The TCM uses the ISS signal to determine line pressure, transmission shift patterns, torque converter clutch (TCC) slip speed and gear ratio.

Output Speed Sensor (OSS)

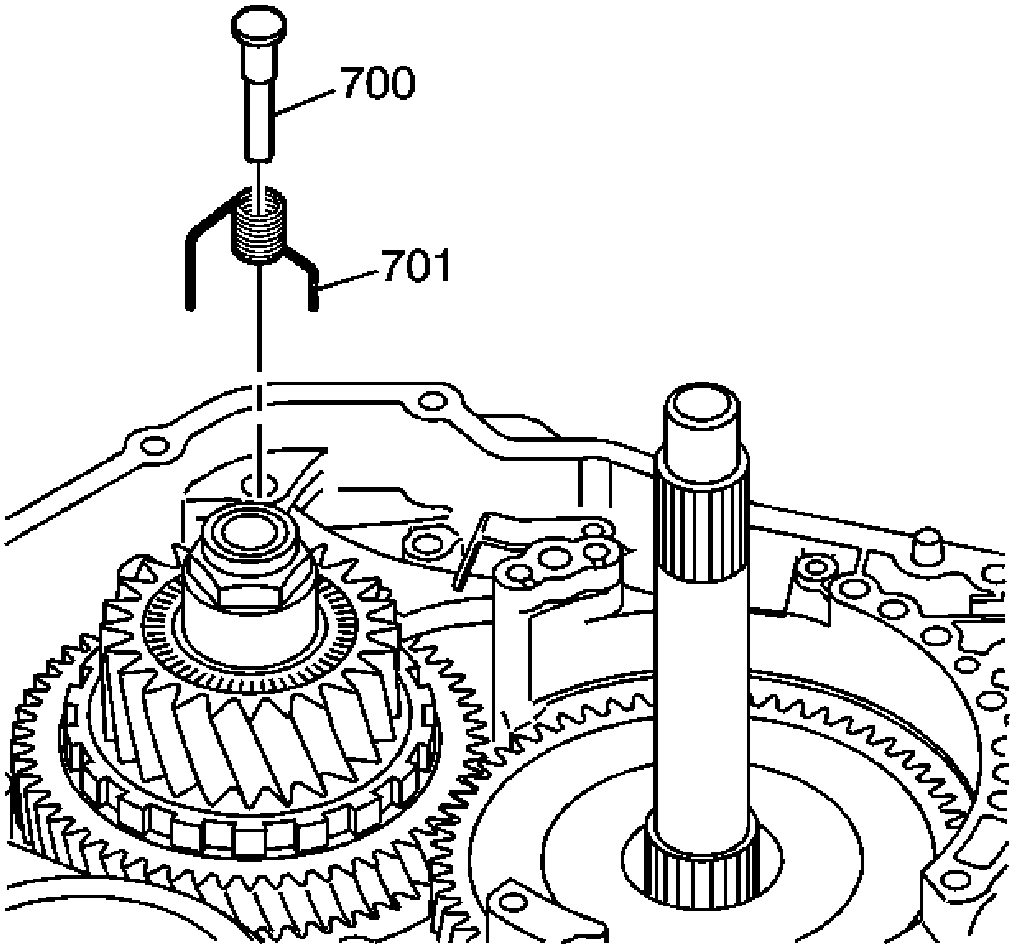


Fig. 189: Identifying Output Speed Sensor (OSS)
Courtesy of GENERAL MOTORS CORP.

The output speed sensor (OSS) is a hall-effect type sensor. The OSS mounts to the transmission case below the control valve body assembly and connects to the control solenoid (w/body and TCM) valve assembly through a wire harness and connector. The sensor faces the Park gear machined teeth surface. The sensor receives 8.3-9.3 volts on the ISS/OSS supply voltage circuit from the TCM. As the front differential transfer drive gear assembly rotates, the sensor produces a signal frequency based on the machined surface of the Park gear. This signal is transmitted through the OSS signal circuit to the TCM. The TCM uses the OSS signal to determine line pressure, transmission shift patterns, torque converter clutch (TCC) slip speed and gear ratio.

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR DESCRIPTION

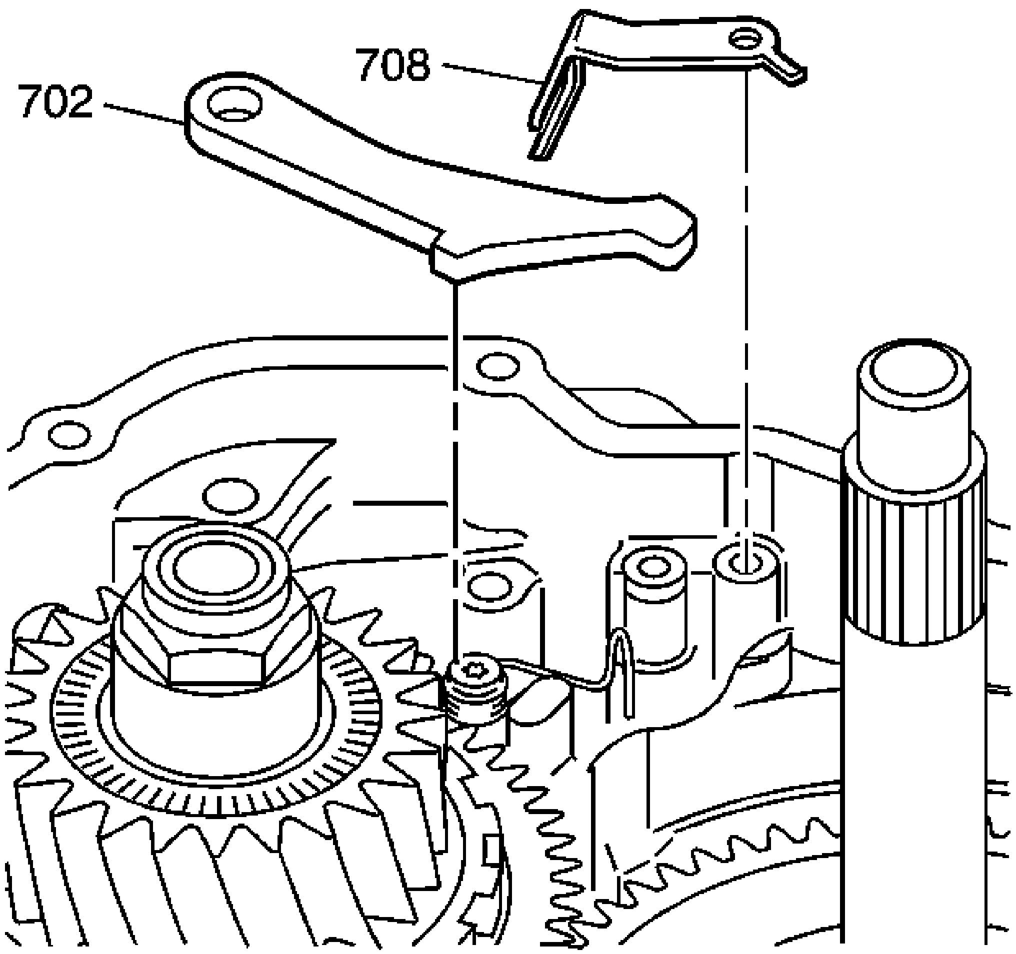


Fig. 190: Identifying Wire Harness Retainer & TCM Electrical Connector
Courtesy of GENERAL MOTORS CORP.

The transmission electrical connector is an important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set diagnostic trouble codes or affect proper operation. The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection
- Wires backing away from the pins or coming uncrimped, in the external wiring harness
- Dirt contamination entering the connector when disconnected
- Transmission fluid leaking into the connector, wicking up into the external wiring harness and degrading the wire insulation
- Moisture intrusion in the connector

- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly
- Pin corrosion from contamination
- Damaged connector assembly

Remember the following points:

- Limit twisting or wiggling the connector during removal. Bent pins can occur.
- Do not pry the connector off with a screwdriver or other tool.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating, DTCs will set. Clear these DTCs after reconnecting the external connector.

AUTOMATIC TRANSMISSION HYDRAULIC DIAGRAMS

Park - Engine Running

When the gear selector lever is in the Park (P) position, fluid is drawn into the pump through the transmission fluid filter assembly. Line pressure is then directed to the following valves:

Fluid Pressure Directed in Preparation for a Shift

Manual Valve

Mechanically controlled by the gear selector lever, the manual valve is in the Park (P) position and prevents line pressure from the pressure regulator valve from entering the reverse and drive circuits.

R1/456 Pressure Control (PC) Solenoid 3

The R1/456 pressure control solenoid (PCS) is energized (HIGH) allowing actuator feed limit fluid to enter the PCS R1/456 CL fluid circuit. PCS R1/456 CL fluid is then routed through orifice #22 to the 4-5-6 clutch boost valve and through orifice #21 to the R1/ 456 clutch regulator valve.

R1/456 Clutch Regulator Valve

PCS R1/456 CL fluid at the R1/4-5-6 clutch regulator valve moves the valve against R1/4-5-6 clutch regulator spring force and R1/FDBK fluid. This allows line pressure to pass through the valve and enter the R1/456CL FD circuit. R1/456CL FD is then routed to clutch select valve 2.

Shift Solenoid 1

Shift solenoid 1 is energized (ON) allowing actuator feed limit fluid to enter the solenoid 1 circuit. Solenoid 1 fluid is routed to the #2 ball check valve and through orifice #10 to the torque converter clutch (TCC) regulator valve and shuttle valve (SHTL).

TCC Regulator Valve and Shuttle Valve

Solenoid 1 fluid is routed to the TCC regulator valve and shuttle valve and moves the valve against TCC regulator valve spring force.

#2 Ball Check Valve

Solenoid 1 fluid seats the #2 ball check valve against the reverse fluid passage and fluid is forced through orifice #15 into the CSV2 enable fluid circuit.

Clutch Select Valve 2

CSV2 enable fluid is routed to the clutch select valve 2 and moves the valve against clutch select valve 2 spring force. This allows R1/456 CL FD fluid to pass through the valve and enter the R1 supply circuit. R1 Supply fluid is then routed into the R1 fluid circuit and, through orifice #18. R1 fluid is then routed to the low & reverse clutch assembly in preparation for a shift into low or reverse gear.

Shift Solenoid 2

Shift solenoid 2 is energized (ON) allowing actuator feed limit fluid to enter the solenoid 2 fluid circuit and is then routed to the #3 ball check valve and through orifice #13 to the clutch select valve #3.

3-5 Reverse Clutch Regulator Valve

Actuator feed limit fluid is routed through the valve and into the PS2 fluid passage. PS2 fluid is then sent to the normally closed #2 pressure switch and opens the switch.

#3 Ball Check Valve

Solenoid 2 fluid seats the #3 ball check valve against 456 CL fluid passage and fluid is forced through orifice #13 into the CSV3 enable fluid circuit. CSV3 enable fluid is then routed to the clutch select valve 3.

Clutch Select Valve #3

CSV3 enable fluid moves the clutch select valve 3 against clutch select valve 3 spring force.

Compensator Blow Off

Line pressure is routed through orifice #17 to the compensator feed circuit. Compensator feed fluid enters the compensator blow off circuit and fills the 4-5-6 dam piston area.

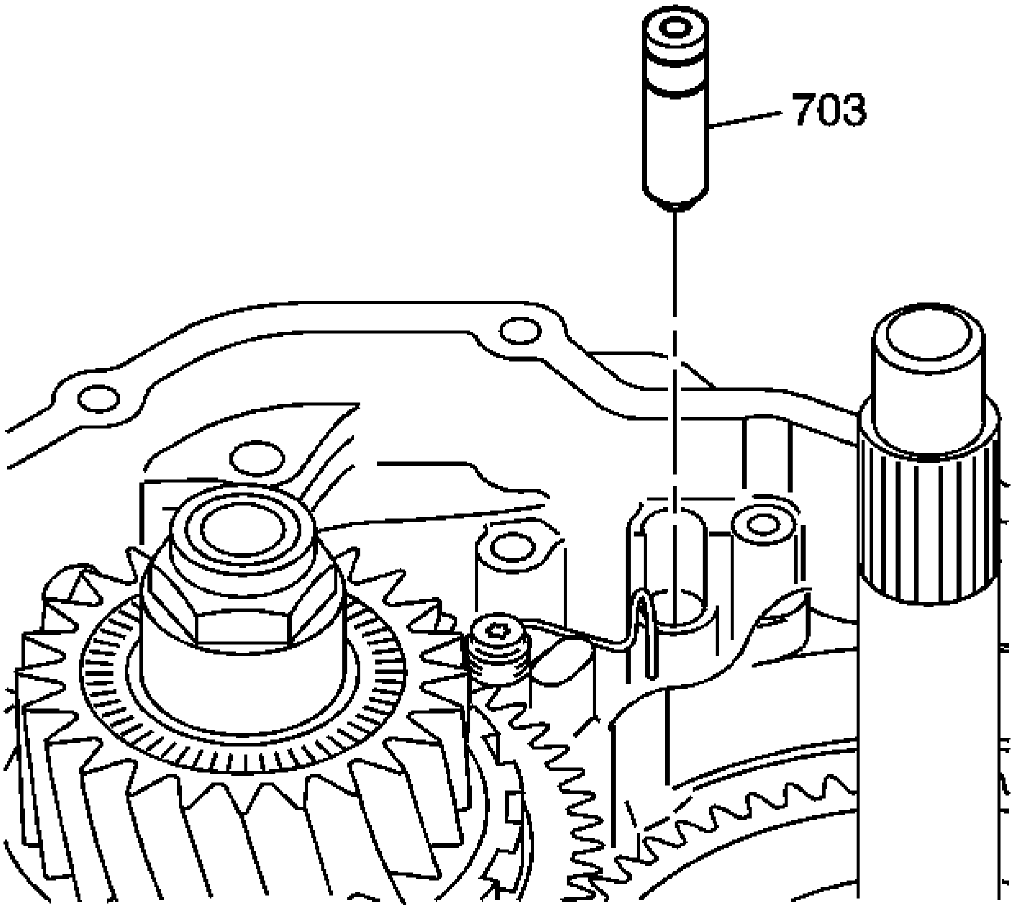


Fig. 191: Park - Engine Running
Courtesy of GENERAL MOTORS CORP.

Reverse

When the gear selector lever is moved to the Reverse (R) position (from the Park position) the normally high 35R pressure control solenoid 2 is commanded ON and the following changes occur in the transmission's hydraulic and electrical systems:

Fluid Pressure Directed in Preparation for a Shift

Manual Valve

With the manual valve in the reverse position, line pressure is directed into the reverse fluid circuit to the #2 ball check valve and clutch select valve 3.

#2 Ball Check Valve

Reverse fluid seats the #2 ball check valve against the solenoid 1 fluid passage and fluid is forced through orifice #15 into the CSV2 enable circuit.

Clutch Select Valve 2

CSV2 enable fluid, present at the valve from Park position, continues to hold the clutch select valve 2 against clutch select valve 2 spring force.

Low & Reverse Clutch Applies

Clutch Select Valve 3

Reverse fluid from the manual valve is routed to clutch select valve 3 to combine with clutch select valve 3 spring force to keep the valve in the off position. This allows reverse fluid to pass through the valve and enter the 3-5 clutch reverse feed circuit. The 3-5 clutch reverse feed fluid from the clutch select valve 3 is also routed to #5 ball check valve.

Low & Reverse Clutch

R1 supply fluid passes through orifice #18 and unseats check ball #8. R1 supply fluid enters the low & reverse clutch piston circuit and moves the piston against the spring force to apply the low & reverse clutch plates.

#5 Ball Check Valve

The 3-5 clutch reverse feed fluid seats #5 ball check valve against the drive 1-6 circuit allowing 3-5 clutch reverse feed fluid to enter the 3-5 reverse supply circuit. The 3-5 reverse supply fluid is then routed to #7 ball check valve and through orifice #16 where is enters the 3-5 reverse feed circuit. The 3-5 reverse feed passes through orifice #34 and then is routed to the 3-5 reverse clutch regulator valve.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is energized (HIGH) allowing actuator feed limit fluid to enter the PCS 3-5 reverse clutch circuit. PCS 3-5 reverse clutch fluid is then routed through orifice #36 to the 3-5 reverse clutch regulator valve and through orifice #37 to the 3-5 reverse boost valve.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch and the 3-5 reverse boost valve. PS2 fluid from pressure switch 2 exhausts through the valve allowing the switch to close.

3-5 Reverse Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 clutch reverse feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5R/456 clutch housing to move the piston against spring force and compensator feed fluid to apply the 3-5 reverse clutch plates.

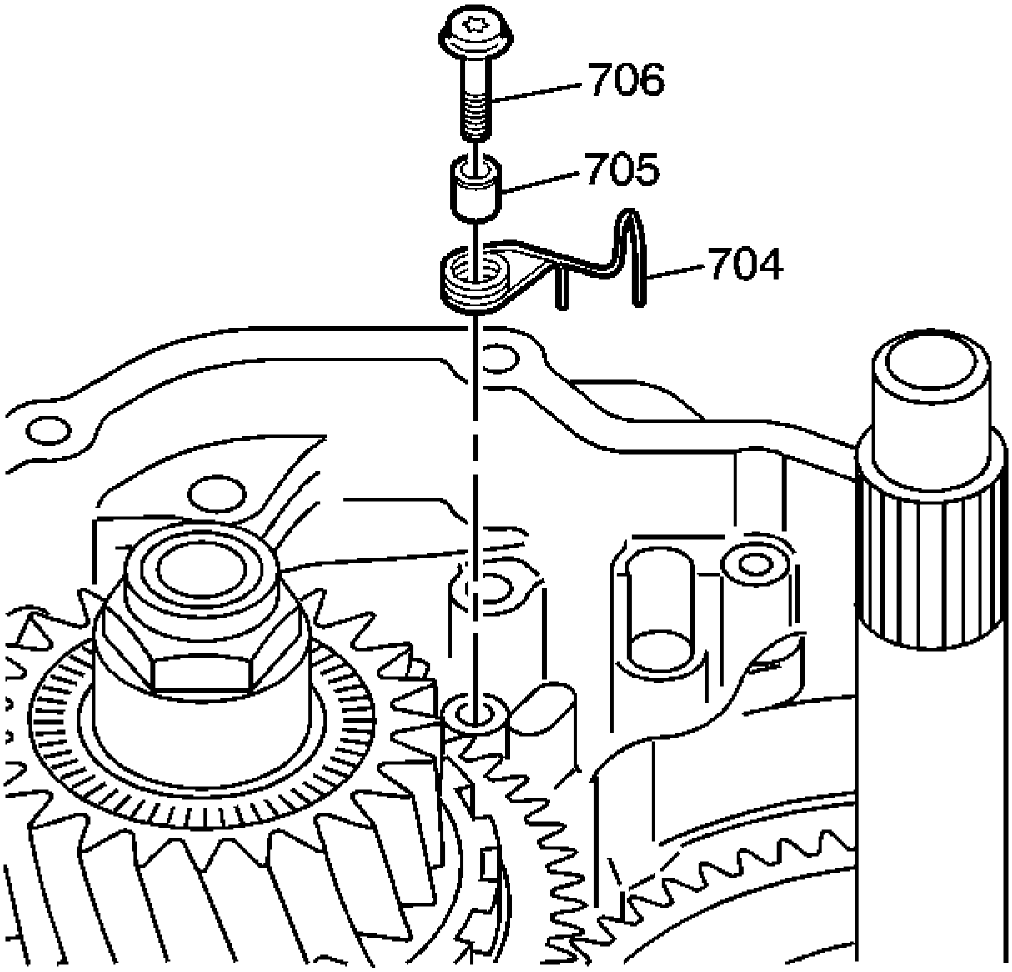


Fig. 192: Reverse
Courtesy of GENERAL MOTORS CORP.

Neutral - Engine Running

When the gear selector is moved to the Neutral (N) position, the hydraulic and electrical system operation is identical to Park (P) range. However, if Neutral is selected after the vehicle was operating in Reverse (R), the normally high 35R pressure control solenoid 2 is commanded OFF and the following changes would occur in the hydraulic system:

3-5 Reverse Clutch Releases

Manual Valve

The manual valve is moved to the Neutral position and blocks line pressure from entering the reverse and drive fluid circuits. The reverse fluid from the #2 ball check valve and clutch select valve 3 is opened to an exhaust passage at the manual valve.

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF allowing PCS 3-5 reverse clutch fluid from the 3-5 reverse clutch boost valve and 3-5 reverse clutch regulator valve to exhaust.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 3-5 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 3-5 reverse clutch circuit and exhaust.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow 3-5 reverse clutch fluid from the 3-5 reverse clutch and clutch select valve 2 to pass through the valve and enter the 35 reverse clutch feed circuit through orifice #16 past check ball #5 to clutch select valve 3 to exhaust back fill circuit to exhaust.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force moves the 3-5 reverse clutch piston to release t h e 3-5 reverse clutch plates and force 3-5 reverse clutch fluid to exhaust from the 3-5/4-5-6 reverse clutch housing. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve allowing the 3-5 reverse clutch to release.

Clutch Select Valve 3

When reverse fluid exhausts through the manual valve, CSV3 enable fluid moves the valve against clutch select valve 3 spring force. The 3-5 reverse feed fluid is routed into the exhaust back fill circuit and exhausts.

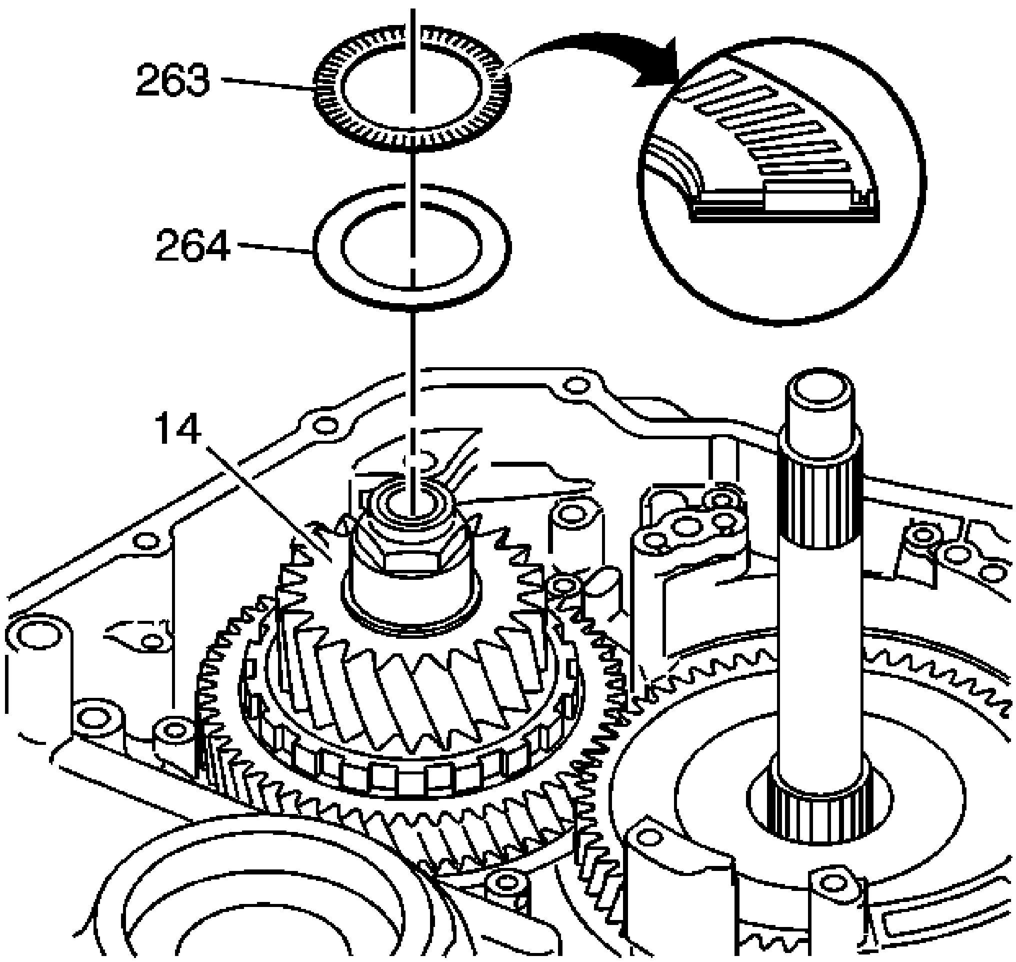


Fig. 193: Neutral - Engine Running
Courtesy of GENERAL MOTORS CORP.

Drive Range, First Gear Engine Braking

When the gear selector lever is moved to the Drive (D) range from the Neutral (N) position, the transmission will provide engine braking. In this operating range, the normally-low 1234 pressure control solenoid 5 is commanded ON and in the engine braking mode the following changes occur within the hydraulic circuits:

Fluid Pressure is Directed to the 1-2-3-4 Clutch and the Low & Reverse Clutch to Provide Engine Braking

Manual Valve

The manual valve is moved to the Drive (D) position and allows line fluid pressure to enter the drive fluid circuit. Drive fluid is then routed to the clutch select valve 2.

Clutch Select Valve 2

Drive fluid at the clutch select valve 2 passes through the valve and enters the drive brake circuit. Drive brake fluid is then routed to the clutch select valve 3.

Clutch Select Valve 3

Drive brake fluid at the clutch select valve 3 passes through the valve and enters the Drive B fluid circuit. Drive B fluid is then routed to #1 ball check valve.

#1 Ball Check Valve

Drive B fluid seats the #1 ball check valve against drive 1-6 fluid to force drive B fluid into the 26/1234 feed passage. The 26/ 1234 feed fluid is routed through orifice #31 and, to the 2-6 clutch regulator valve. The 26/1234 feed fluid passes through the 2-6 clutch regulator valve and enters the pressure switch 3 (PS3) fluid circuit. PS3 fluid is then routed to the normally closed pressure switch 3 and opens the switch.

#6 Ball Check Valve

26/1234 feed fluid unseats the #6 ball check valve allowing 26/1234 feed fluid to enter the 1234 clutch feed circuit. The 1234 clutch feed fluid is routed through orifice #25 and then to the 1-2-3-4 clutch regulator valve.

1-2-3-4 Clutch Applies

1234 Pressure Control Solenoid 5

The 1234 pressure control solenoid 5 is commanded ON allowing actuator feed limit to enter the PCS 1234 clutch fluid circuit. PCS 1234 clutch fluid is then routed throught orifice #27 to the 1-2-3-4 clutch regulator valve. PCS1234 clutch fluid is also routed through orifice #29 and then to the 1-2-3-4 clutch boost valve.

1-2-3-4 Clutch Regulator Valve

PCS1234 clutch fluid moves the 1-2-3-4 clutch regulator valve against 1-2-3-4 clutch regulator valve spring force to allow 1234 clutch feed fluid to pass through the valve and enter the 1234 clutch fluid circuit. The 1234 clutch fluid is then routed to the 1234 clutch boost valve and the 1-2-3-4 clutch.

1-2-3-4 Clutch Boost Valve

PCS1234 clutch fluid pressure acts on a differential area moving the 1234 clutch boost valve against the 1234 clutch boost valve spring. The 1234 clutch fluid passes through the valve and enters the 1234 clutch feedback circuit. As PCS 1234 clutch fluid pressure is increased to a given value, the 1234 clutch boost valve opens the 1234 clutch feedback circuit to exhaust. This results in the 1234 clutch regulator valve moving to the full feed position sending full 26 CL/1234 CL feed pressure (full line pressure) to the clutch.

1-2-3-4 Clutch

The 1234 clutch fluid enters the 1234 clutch to move the piston against spring force to apply the 1-2-3-4 clutch plates.

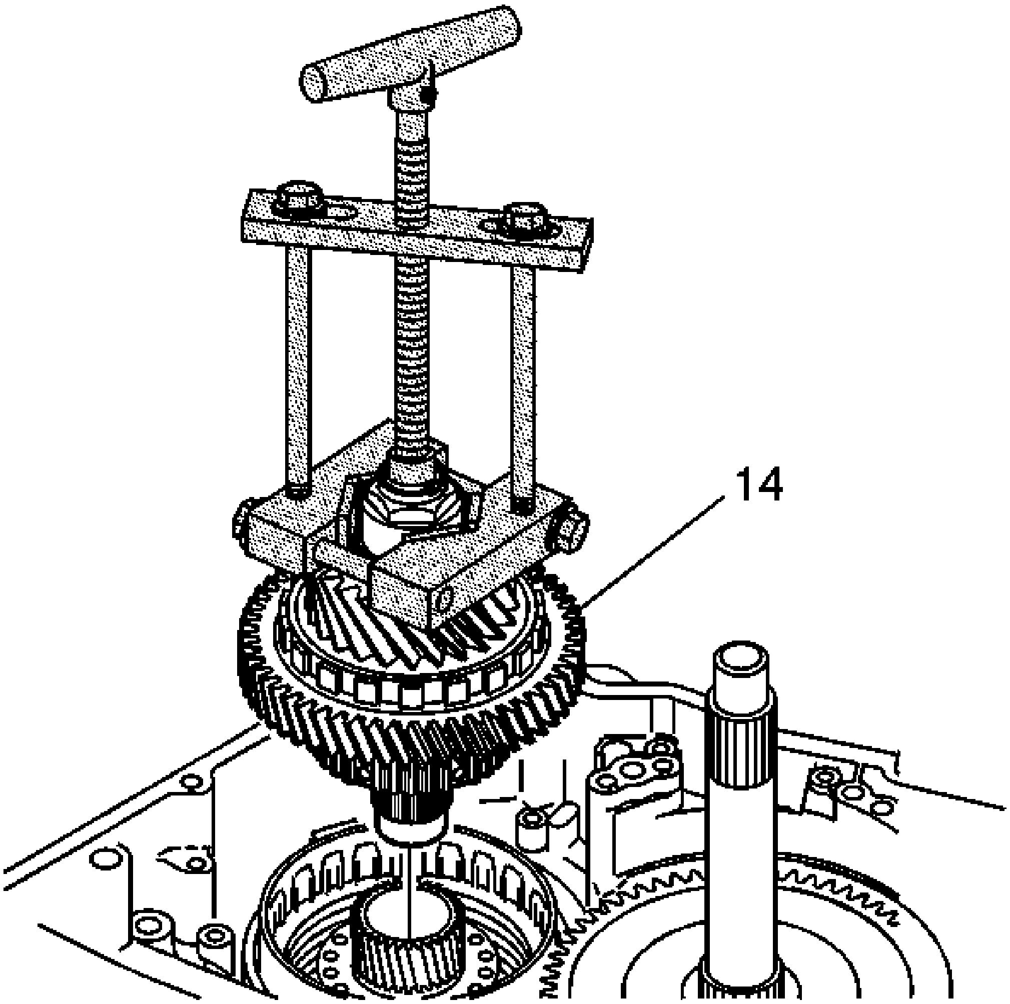


Fig. 194: Drive Range, First Gear Engine Braking
Courtesy of GENERAL MOTORS CORP.

Drive Range, First Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, throttle position sensor and other vehicle sensors to determine the precise moment to deenergize or "turn off" shift solenoid 1 and command OFF the normally-high R1/456 pressure control solenoid 3.

Low & Reverse Clutch Releases

Shift Solenoid 1

When shift solenoid 1 is "turned OFF", CSV2 enable fluid from the clutch select valve 2 passes by the #2 ball check valve and enters the solenoid 1 fluid circuit. Solenoid 1 fluid from the #2 ball check valve and TCC regulator valve is then routed to the solenoid where it exhausts.

Clutch Select Valve 2

Clutch select valve 2 (CSV2) enable fluid is exhausted from the clutch select valve 2 and clutch select valve 2 spring force moves the valve to the released position. With clutch select valve 2 in the released position, drive fluid from the manual valve passes through the valve and enters the drive 1-6 fluid circuit. Drive 1-6 fluid then feeds the R1/456 and 35 reverse clutch regulator valves and the TCC regulator valve.

R1/456 Pressure Control Solenoid 3

The R1/456 pressure control solenoid 3 is commanded OFF allowing PCS R1/456 fluid from the R1/456 clutch regulator valve and 456 clutch boost valve to exhaust.

R1/456 Clutch Regulator Valve

R1/456 clutch regulator valve spring force moves the valve to exhaust the R1/456 clutch feed circuit and allow drive 1-6 fluid to enter the PS4 fluid circuit. PS4 fluid is then routed to the normally-closed pressure switch 4 and opens the switch. PS4 fluid is also routed to the #4 ball check valve and flows into the CSV2 latch fluid circuit.

#4 Ball Check Valve

PS4 fluid pressure seats the #4 ball check valve against the 456 clutch fluid circuit. PS4 fluid is then directed into the CSV2 latch fluid circuit and routed to the clutch select valve 2. CSV2 latch fluid combines with clutch select valve 2 spring force and holds the valve in this position during all 6 forward gear ranges.

#5 Ball Check Valve

Drive 1-6 fluid pressure seats the #5 ball check valve against the 35 reverse clutch feed fluid passage. Drive 1-6 fluid is then directed into the 35R supply fluid circuit which is routed to the #7 ball check valve and orifice #16.

#7 Ball Check Valve

The 35R supply fluid seats the #7 ball check valve against the 35R feed fluid passage to force 35R supply fluid through orifice #16 before entering the 35R feed circuit. The 35R feed fluid is then routed to the 3-5 reverse clutch regulator valve.

Low and Reverse Clutch

Low and reverse clutch spring force moves the low and reverse clutch piston which forces R1 fluid out. R1 fluid is routed to the clutch select valve 2 where it enters the exhaust backfill circuit. The low and reverse clutch is in the released position.

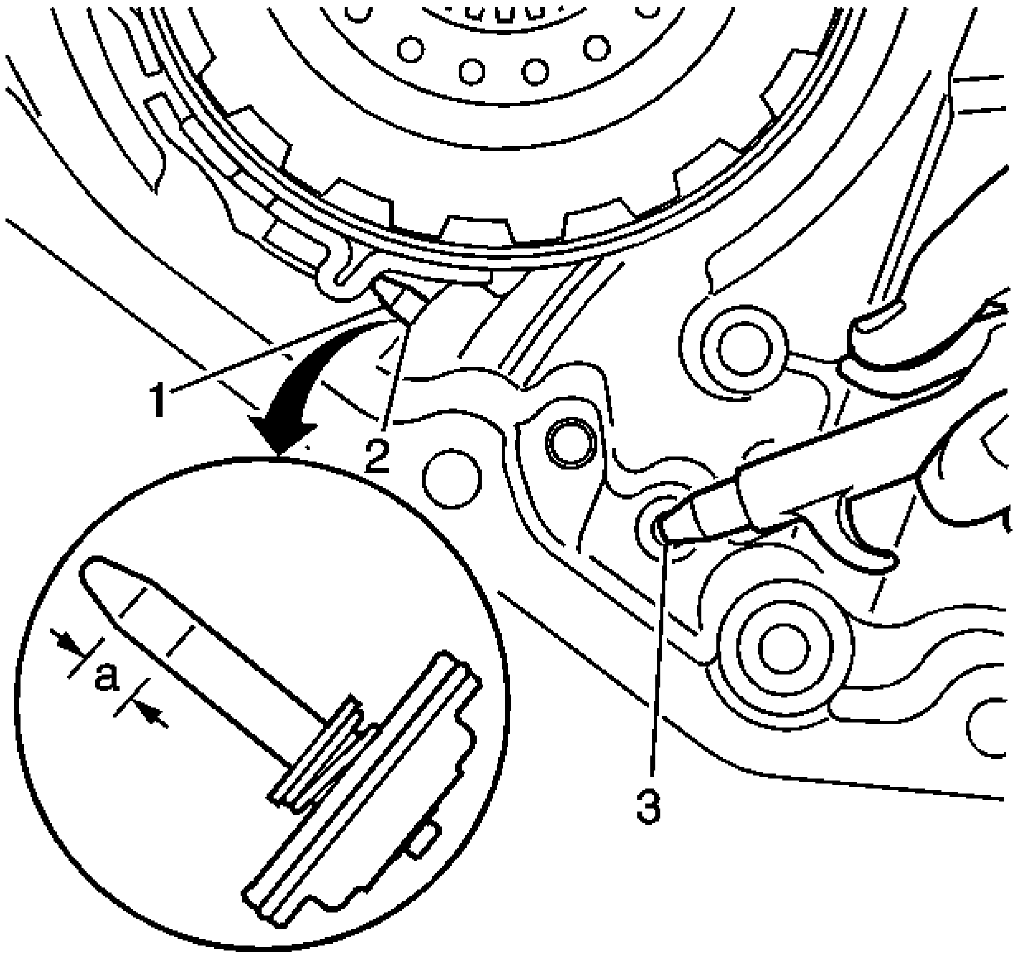


Fig. 195: Drive Range, First Gear
Courtesy of GENERAL MOTORS CORP.

Drive Range, Second Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-low pressure control solenoid 4.

Second Clutch Applies

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded ON, allowing actuator feed limit fluid to enter the pressure control solenoid (PCS) 26 clutch fluid circuit. PCS 26 clutch fluid is then routed through orifice #32 to the 2-6 clutch regulator valve.

2-6 Clutch Regulator Valve

PCS 26 clutch fluid moves the 2-6 clutch regulator valve assembly against the 2-6 clutch regulator valve spring force to allow 26 clutch/1234 clutch feed fluid to pass through the valve. The 26 clutch/1234 clutch feed fluid is routed into the 26 clutch fluid circuit where it passes through orifice #46 and then to the spring end of the 2-6 clutch regulator valve, and to the 2-6 clutch within the case cover.

2-6 Clutch

The 26 clutch fluid from the 2-6 clutch regulator valve is routed through the case cover and to the 2-6 clutch piston assembly. The 26 clutch fluid pressure moves the piston against 2-6 clutch spring force to apply the 2-6 clutch plates.

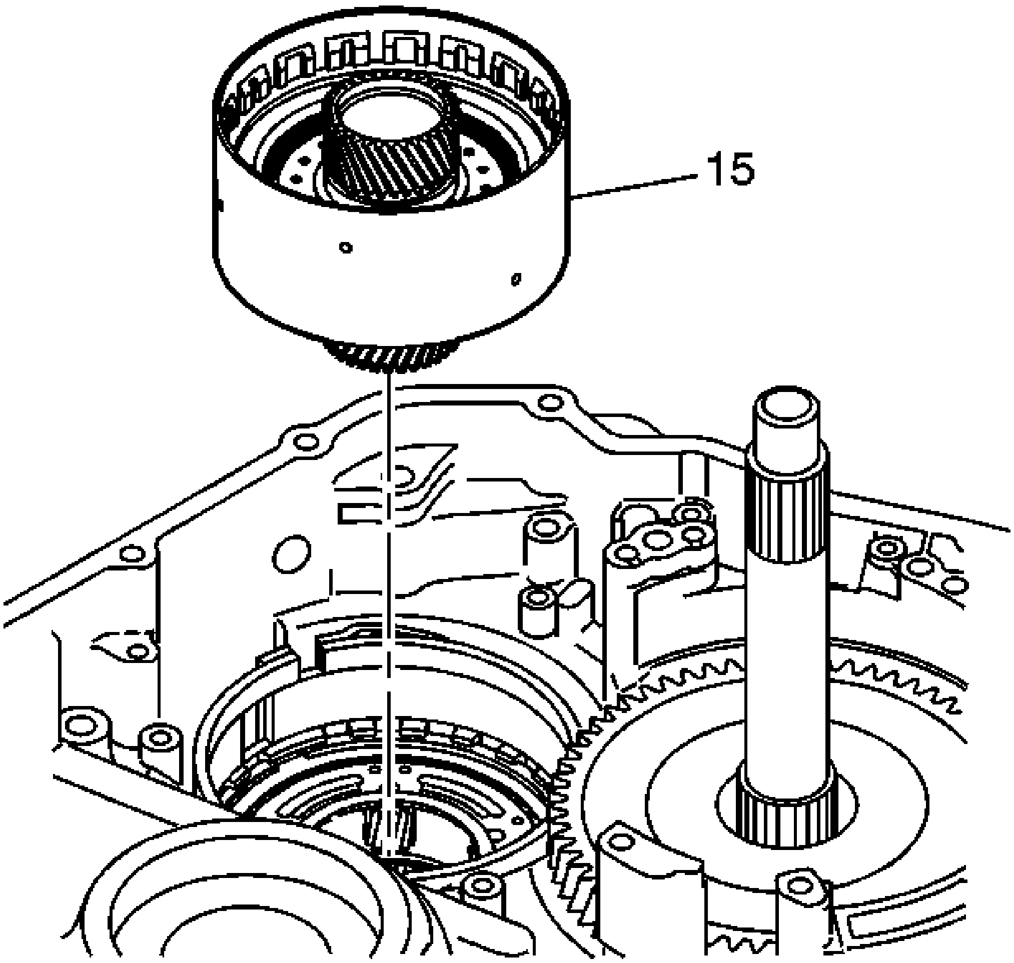


Fig. 196: Drive Range, Second Gear
Courtesy of GENERAL MOTORS CORP.

Drive Range, Third Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command OFF the normally-low 26 pressure control solenoid 4. At the same time the 35R pressure control solenoid 2 is also commanded ON to regulate 3-5 clutch apply.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded ON allowing actuator feed fluid to enter the pressure control solenoid (PCS) 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 35 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 35 reverse clutch fluid passes through the valve and enters the 35 reverse clutch feedback circuit. As PCS 35 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 35 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 35 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 35 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 35 reverse clutch feedback fluid. This allows 35 reverse feed to pass through the valve and enter the 35 reverse clutch circuit. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve allowing the switch to close.

3-5 Reverse Clutch

The 35 reverse clutch fluid enters the 3-5 reverse/4-5-6 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

2-6 Clutch Releases

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded OFF allowing PCS 26 clutch fluid from the 2-6 clutch regulator valve to exhaust. The 26 clutch/1234 clutch feed fluid at the 2-6 clutch regulator valve passes through the valve and enters the PS3 fluid circuit. PS3 fluid is then routed to pressure switch 3 and opens the normally-closed switch.

2-6 Clutch Regulator Valve

The 2-6 clutch regulator valve spring force moves the valve to allow 26 clutch fluid from the 2-6 clutch to pass through the valve and enter the exhaust backfill fluid circuit.

2-6 Clutch

The 2-6 clutch spring force moves the 2-6 clutch piston to release the 2-6 clutch plates and forces 26 clutch fluid to exhaust. The 26 clutch fluid is routed through the 2-6 clutch regulator valve where it enters the exhaust backfill fluid circuit and is exhausted.

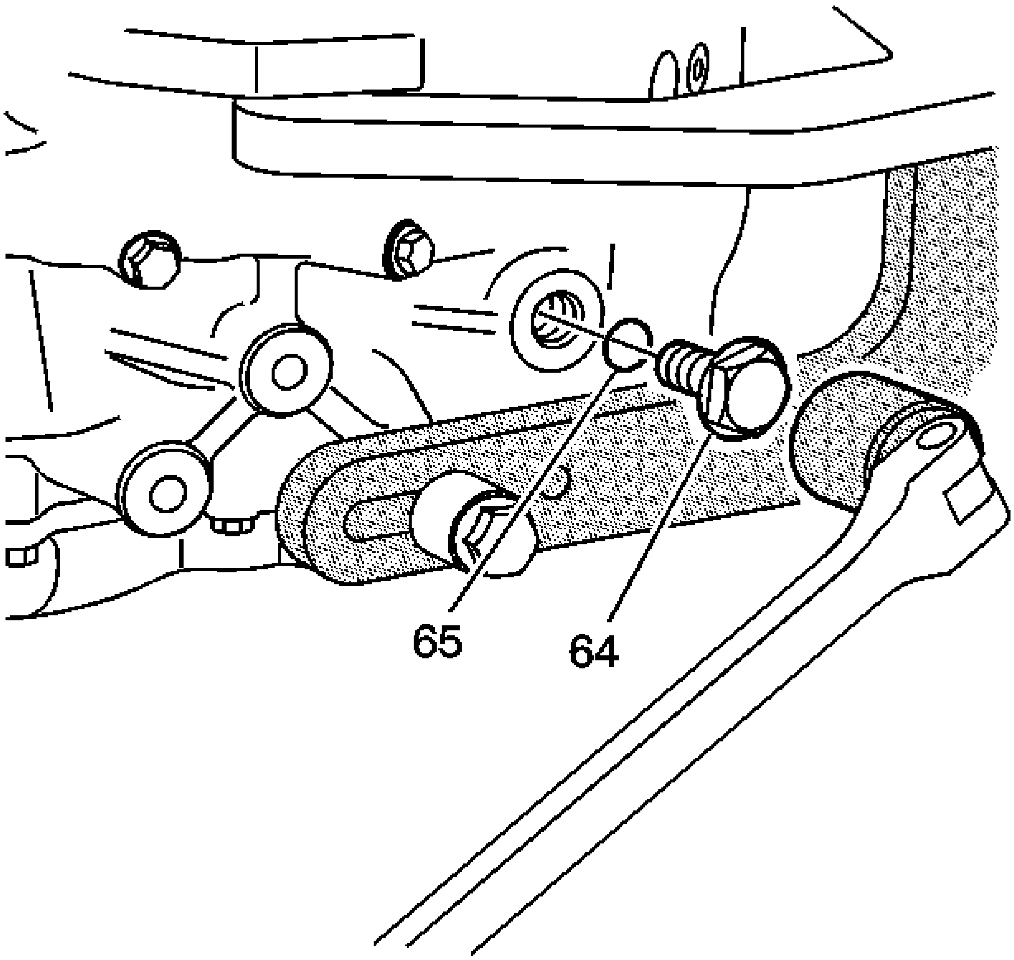


Fig. 197: Drive Range, Third Gear
Courtesy of GENERAL MOTORS CORP.

Drive Range, Third Gear Default

If the transmission is in 1st, 2nd or 3rd gear during a transmission electrical component failure, the transmission will default to 3rd gear. All solenoids will default to their normal state. If the torque converter clutch was applied, it will release. This default action will enable the vehicle to be safely driven to a service center.

1-2-3-4 Clutch Stays Applied

Shift Solenoid 2

Shift solenoid 2 defaults to it's normally-closed state (OFF), and SOL 2 fluid exhausts through the solenoid.

Clutch Select Valve 3

Solenoid 2 fluid pressure no longer holds the clutch select valve 3 open. When the valve moves back to the closed position, it opens the 1234 clutch default fluid circuit, and 1234 default fluid is routed to the 1-2-3-4 clutch regulator valve.

1-2-3-4 Clutch Regulator Valve

With the absence of PCS 1234 clutch fluid, due to the default state of the 1234 pressure control solenoid 5, the 1-2-3-4 regulator valve would close from spring force. However, the 1234 clutch default fluid enters behind the 1-2-3-4 regulator shuttle valve and keeps the valve in the open position.

1-2-3-4 Clutch

With the 1-2-3-4 clutch regulator valve still held in the open position, the 1-2-3-4 clutch will stay applied.

3-5 Reverse Clutch Applied or Applies

35R Pressure Control Solenoid 2

The normal state for the 35R pressure control solenoid 2 is ON, therefore PSC 35 reverse clutch fluid will still be routed to the 3-5 reverse clutch regulator valve and the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve, allowing the switch to close.

3-5 Reverse Clutch Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

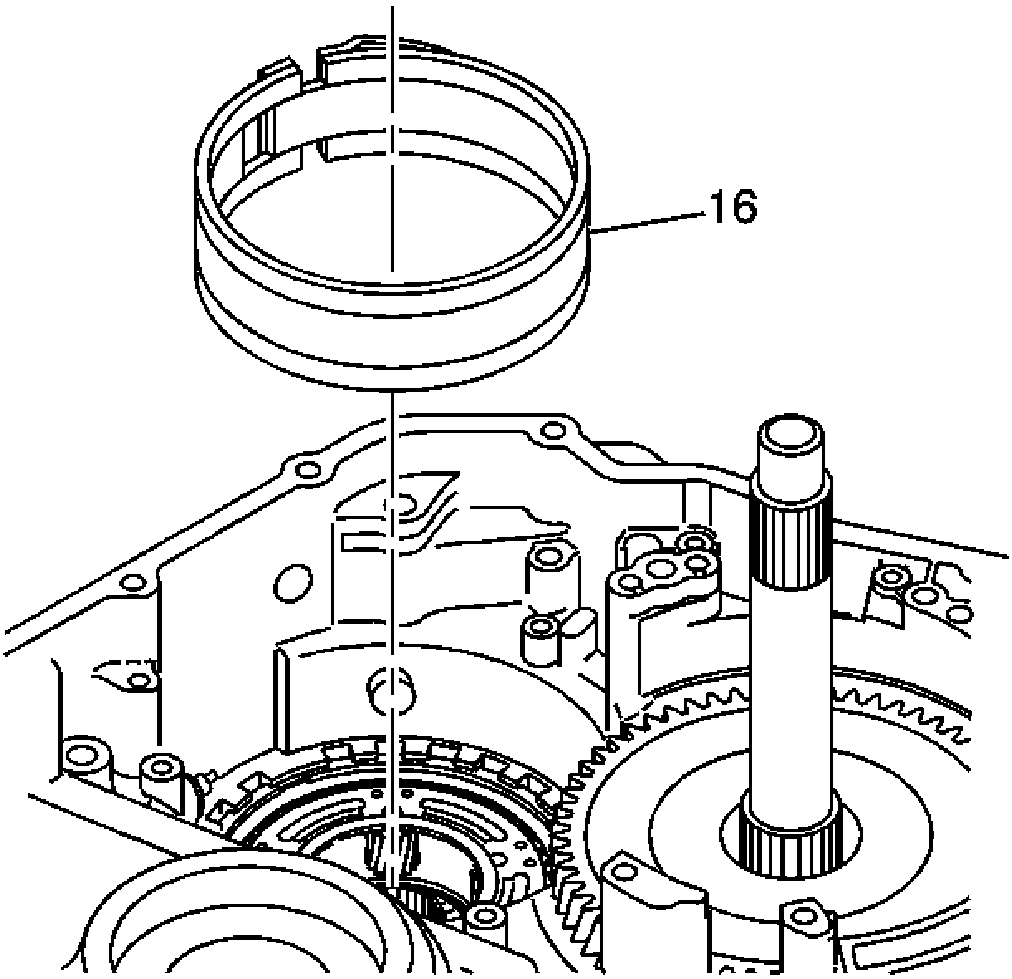


Fig. 198: Drive Range, Third Gear Default
Courtesy of GENERAL MOTORS CORP.

Drive Range - Fourth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command OFF the normally-high 35R pressure control solenoid 2. At the same time the normally-low R1/456 pressure control solenoid 3 is commanded ON to regulate 4-5-6 clutch apply.

4-5-6 Clutch Applies

R1/456 Pressure Control Solenoid 3

The R1/456 pressure control solenoid 3 (PCS) is commanded ON allowing actuator feed fluid to enter the PCS R1/456 clutch fluid circuit. PCS R1/456 clutch fluid is routed through orifice #21 to the R1/456 clutch regulator valve and, through orifice #22 to the R1/456 clutch boost valve.

R1/456 Clutch Regulator Valve

PCS R1/456 clutch fluid moves the R1/456 clutch regulator valve against R1/456 clutch regulator valve spring force to allow line fluid to pass through the valve an enter the R1/456 clutch feed circuit. R1/456 clutch feed is then routed to the 4-5-6 clutch boost valve and clutch select valve 2.

4-5-6 Clutch Boost Valve

PCS R1/456 clutch fluid pressure acts on a differential area moving the R1/456 clutch boost valve against the R1/456 clutch boost valve spring. R1/456 clutch fluid passes through the valve and enters the R1/456 clutch feedback circuit. As PCS R1/456 clutch fluid pressure is increased to a given value, the R1/456 clutch boost valve opens the R1/456 clutch feedback circuit to exhaust. This results in the R1/456 clutch regulator valve moving to the full feed position, sending full line pressure to the clutch.

Clutch Select Valve 2

R1/456 clutch feed fluid passes through the clutch select valve 2 and enters the 456 clutch feed circuit. The 456 clutch feed fluid is routed to the clutch select valve 3 where it passes through the valve and enters the 456 clutch fluid circuit. The 456 clutch fluid is routed to the 4-5-6 clutch, the 4-5-6 accumulator, #9 ball check valve and to the #4 ball check valve. The 456 clutch fluid seats the #9 ball check valve and routes fluid through orifice #39. The 456 clutch fluid passes through orifice #14, seats #4 ball check valve against the PS4 fluid circuit and routes fluid to the CSV2 latch circuit.

4-5-6 Clutch

The 456 clutch fluid enters the 4-5-6 clutch housing to move the piston against spring force, combined with force from the compensator to apply the 4-5-6 clutch plates.

3-5 Reverse Clutch Releases

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF, allowing PCS 35 reverse clutch fluid from the 3-5 reverse clutch boost valve and the 3-5 reverse clutch regulator valve to exhaust through the solenoid.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 35 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 35 reverse clutch fluid circuit and exhaust.

#9 Ball Check Valve

The 456 clutch fluid pressure seats #9 ball check valve to force fluid through orifice #39 and applies the 456 clutch.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow 35 reverse clutch fluid from the 3-5 reverse clutch to pass through the valve and enter the exhaust backfill fluid circuit. The 35 reverse clutch fluid then enters the exhaust backfill fluid circuit and is routed through orifice #30 to the exhaust backfill pressure relief valve where excess pressure is exhausted.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force combined with force from the compensator move the 3-5 reverse clutch piston to release the 3-5 clutch plates and forces 35 reverse clutch fluid to exhaust from 3-5 reverse/456 clutch housing. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve and exhausted.

#4 Ball Check Valve

The 456 clutch fluid pressure passes through orifice #14 to seat #4 ball check valve against PS4 fluid passage. The 456 clutch fluid is then directed into the CSV2 latch circuit.

456 Accumulator

The 456 clutch fluid enters the 456 accumulator to move the piston against spring force to cushion the 456 clutch piston apply.

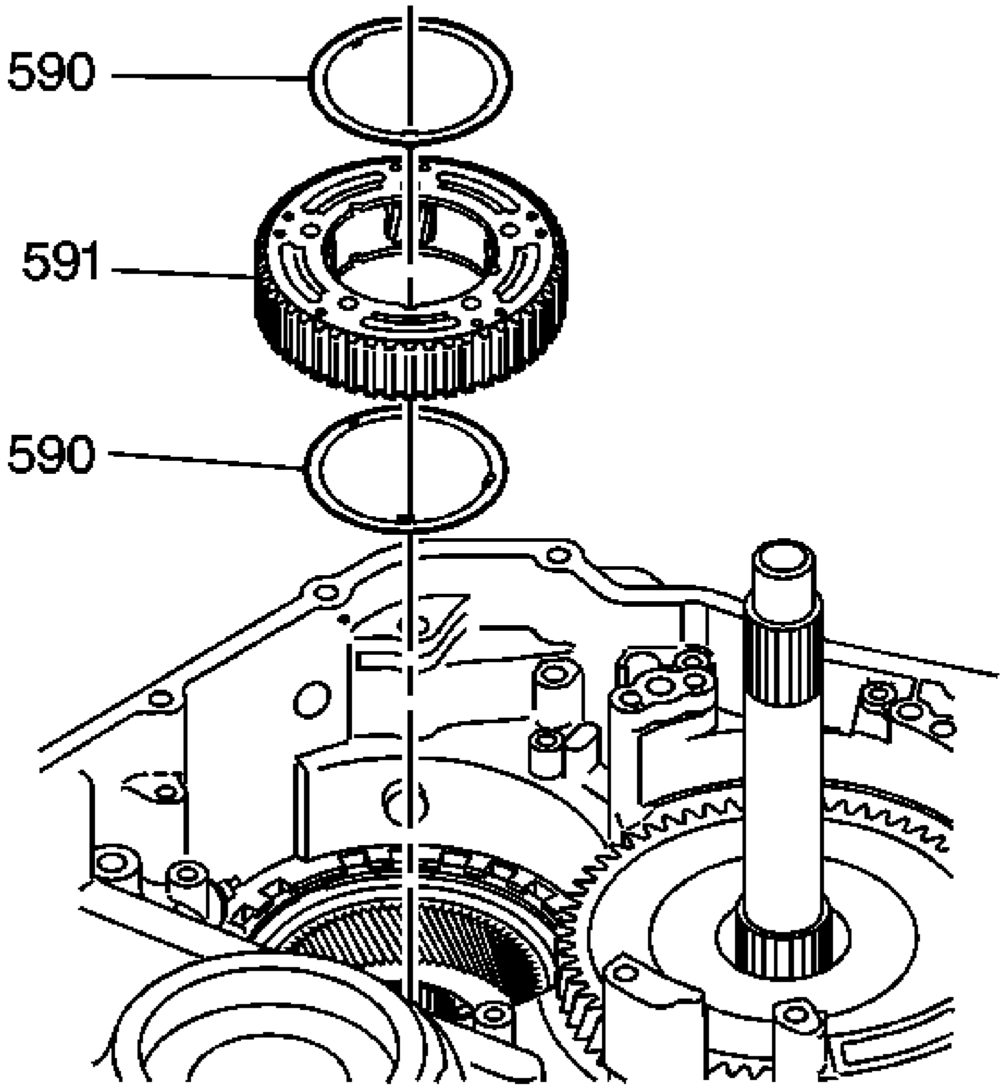


Fig. 199: Drive Range, Fourth Gear
Courtesy of GENERAL MOTORS CORP.

Drive Range, Fifth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-high 35R pressure control solenoid 2. At the same time the normally-low 1234 pressure control solenoid 5 is commanded OFF.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded ON, allowing actuator feed fluid to enter the PCS 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 35 reverse clutch fluid pressure acts on a differential area moving the PCS 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 35 reverse clutch fluid passes through the valve and enters the 35 reverse clutch feedback circuit. As PCS 35 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 35 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 35 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 35 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 35 reverse clutch feedback fluid. This allows 35 reverse feed to pass through the valve and enter the 35 reverse clutch circuit. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve allowing the switch to close.

Clutch Select Valve 2

The 35 reverse clutch fluid passes through the clutch select valve 2 and enters the 1234 clutch default feed fluid circuit. The 1234 clutch default feed fluid is then routed to the clutch select valve 3.

3-5 Reverse Clutch

The 35 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force combined with force from the compensator to apply the 3-5 reverse clutch plates.

1-2-3-4 Clutch Releases

1234 Pressure Control Solenoid 5

The 1234 pressure control solenoid 5 is commanded OFF, allowing PCS 1234 clutch fluid from the 1-2-3-4 clutch regulator valve and 1-2-3-4 clutch boost valve to exhaust.

1-2-3-4 Clutch Regulator Valve

The 1-2-3-4 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid from the 1-2-3-4 clutch to pass through the valve and enter the exhaust backfill fluid circuit. The 1234 clutch fluid the enters the exhaust backfill fluid circuit and is routed through orifice #26 where excess pressure is exhausted. Also, 1234 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid to pass through the valve and enter the PS1 fluid circuit. PS1 fluid is then routed to pressure switch 1 and opens the normally-closed switch.

1-2-3-4 Clutch Boost Valve

The 1-2-3-4 clutch boost valve spring force moves the valve to allow 1234 clutch feedback fluid from the 1-2-3-4 clutch regulator valve to enter the 1234 clutch circuit and exhaust.

1-2-3-4 Clutch

The 1-2-3-4 clutch spring force moves the 1-2-3-4 clutch piston to release the clutch plates and force 1234 clutch fluid from the 1-2-3-4 clutch. The 1234 clutch fluid is routed through the 1-2-3-4 clutch regulator valve where it enters the exhaust backfill fluid circuit.

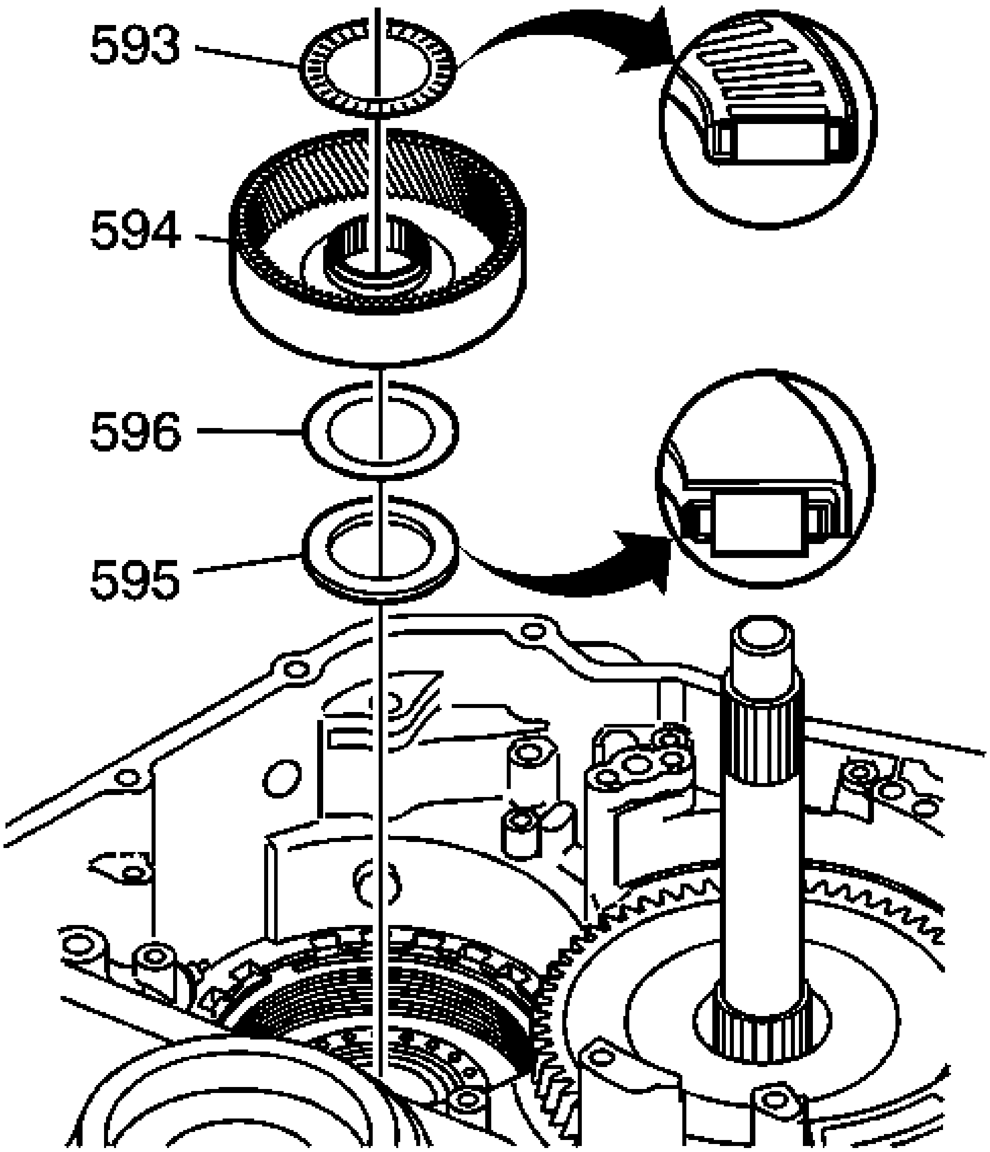


Fig. 200: Drive Range, Fifth Gear
Courtesy of GENERAL MOTORS CORP.

Drive Range, Fifth Gear Default

If the transmission is in 4th, 5th or 6th gear during a transmission electrical component failure, the transmission will default to 5th gear. All solenoids will default to their normal state. If the torque converter clutch was applied, it will release. The transmission will stay in 5th gear default range until the ignition has been turned off or transmission shifted to reverse. When the vehicle is restarted, and shifted back into drive, the transmission will then operate in the 3rd gear default range. This default action will enable the vehicle to be safely driven to a service center.

3-5 Reverse Clutch Applies

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 defaults to ON, allowing actuator feed fluid to enter the pressure control solenoid (PCS) 35 reverse clutch fluid circuit. PCS 35 reverse clutch fluid is routed through orifice #36 and then to the 3-5 reverse clutch regulator valve. PCS 35 reverse clutch fluid is also routed through orifice #37 and then to the 3-5 reverse clutch boost valve.

3-5 Reverse Clutch Boost Valve

PCS 3-5 reverse clutch fluid pressure acts on a differential area moving the PCS 3-5 reverse clutch boost valve against the 3-5 reverse clutch boost valve spring. The 3-5 reverse clutch fluid passes through the valve and enters the 3-5 reverse clutch feedback circuit. As PCS 3-5 reverse clutch fluid pressure is increased to a given value, the 3-5 reverse clutch boost valve opens the 3-5 reverse clutch feedback circuit to exhaust. This results in the 3-5 reverse clutch regulator valve moving to the full feed position sending full 3-5 reverse clutch feed pressure (full line pressure) to the clutch.

3-5 Reverse Clutch Regulator Valve

PCS 3-5 reverse clutch fluid moves the 3-5 reverse clutch regulator valve against 3-5 reverse clutch regulator valve spring force and 3-5 reverse clutch feedback fluid. This allows 3-5 reverse feed to pass through the valve and enter the 3-5 reverse clutch circuit. The 3-5 reverse clutch fluid is then routed to the 3-5 reverse clutch, the 3-5 reverse boost valve and the clutch select valve 2. When the 3-5 reverse clutch regulator valve is in this position, PS2 fluid from the pressure switch 2 exhausts through the valve, allowing the switch to close.

3-5 Reverse Clutch

The 3-5 reverse clutch fluid enters the 3-5 reverse/456 clutch housing to move the piston against spring force to apply the 3-5 reverse clutch plates.

Clutch Select Valve 3

Once the clutch select valve 3 is moved to the ON position in 4th gear, it will remain in this position throughout the 5th gear default range, until the ignition has been turned OFF. When the ignition is OFF, fluid will exhaust from the valve, thus when the vehicle is restarted, the transmission will then be in the 3rd gear default range.

1-2-3-4 Clutch Releases or 2-6 Clutch Releases

1234 Pressure Control Solenoid 5

If the transmission was in 4th gear when an electrical condition commands a protection mode, the 1234 pressure control solenoid 5 defaults to the OFF position, allowing PCS 1234 clutch fluid from the 1-2-3-4 clutch, the 1-2-3-4 clutch regulator valve and 1- 2-3-4 clutch boost valve to exhaust.

2-6 26 Pressure Control Solenoid 4

If the transmission was in 6th gear when an electrical condition commands a protection mode, the 26 pressure control solenoid 4 defaults to the OFF position, allowing PCS 26 clutch fluid from the 2-6 clutch regulator valve, and the 2-6 clutch to exhaust.

Torque Converter Clutch Releases

TCC Pressure Control Solenoid

The torque converter clutch (TCC) pressure control solenoid will default to it's normal state, OFF. PCS TCC fluid will exhaust from the TCC control valve, and spring force will shuttle the valve to the off position. TCC apply fluid will then be routed to the cooler, and TCC release fluid will be routed to the torque converter for complete TCC release.

1234 Clutch Regulator Valve

The 1234 clutch regulator valve spring force moves the valve to allow 1234 clutch feed fluid to enter the PS1 fluid circuit which opens PS1 switch. The 1234 clutch fluid passes through orifice #51 to the 1234 clutch regulator valve, through orifice #26 and enters the exhaust backfill circuit.

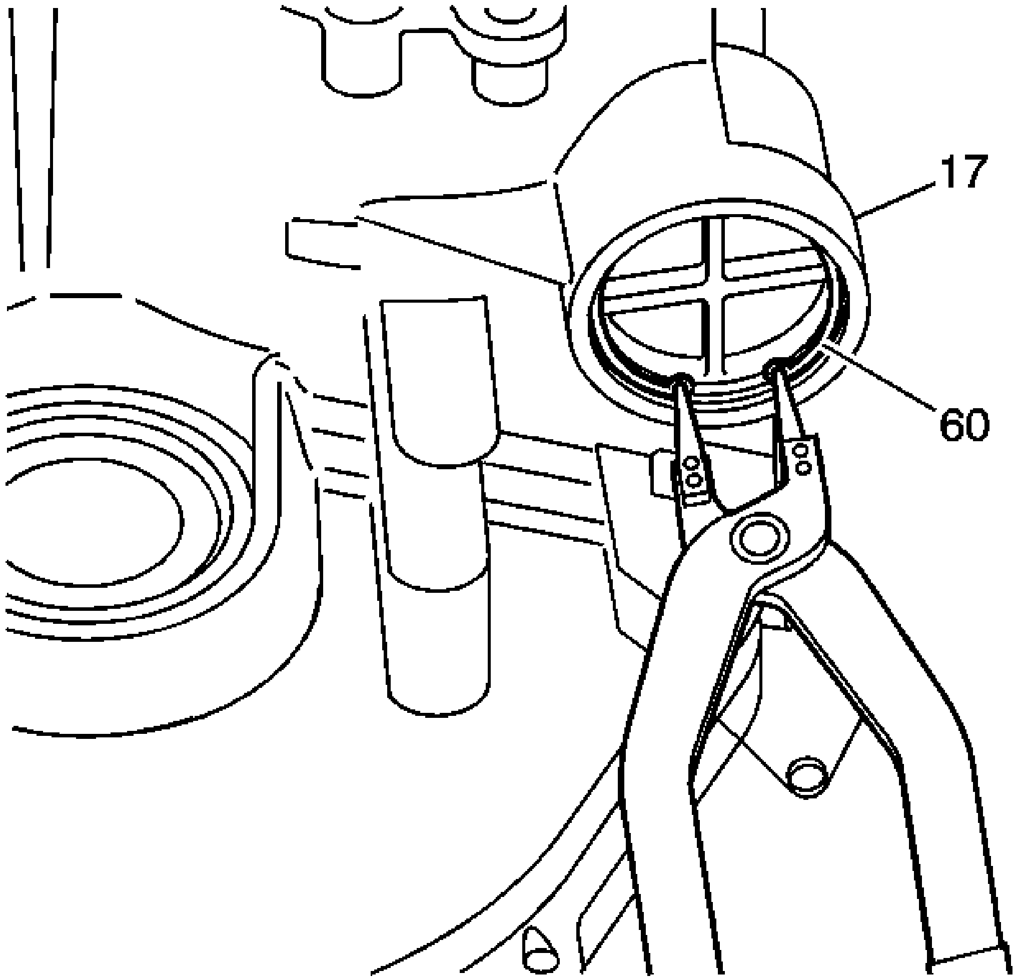


Fig. 201: Drive Range, Fifth Gear Default
Courtesy of GENERAL MOTORS CORP.

Drive Range, Sixth Gear

As the vehicle speed increases, the transmission control module (TCM) receives input signals from the automatic transmission input and output speed sensors, the throttle position sensor and other vehicle sensors to determine the precise moment to command ON the normally-low 26 pressure control solenoid 4 (PCS). At the same time the normally-high 35R pressure control solenoid 2 is commanded OFF.

2-6 Clutch Applies

26 Pressure Control Solenoid 4

The 26 pressure control solenoid 4 is commanded ON, allowing actuator feed fluid to enter the PCS 26 clutch fluid circuit. PCS 26 fluid is routed through orifice #32 and then to the 2-6 clutch regulator valve.

2-6 Clutch Regulator Valve

PCS 26 clutch fluid moves the 2-6 clutch regulator valve assembly against the 2-6 clutch regulator valve spring force to allow 26 clutch/1234 clutch feed fluid to pass through the valve. The 26 clutch/1234 clutch feed fluid is routed into the 26 clutch fluid circuit where it passes through orifice #46 and then to the spring end of the 2-6 clutch regulator valve, and to the 2-6 clutch.

2-6 Clutch

The 26 clutch fluid from the 2-6 clutch regulator valve is routed to the 2-6 clutch piston assembly. The 26 clutch fluid pressure moves the piston against 2-6 clutch spring force to apply the 2-6 clutch plates.

3-5 Clutch Releases

35R Pressure Control Solenoid 2

The 35R pressure control solenoid 2 is commanded OFF, allowing PCS 35 reverse clutch fluid from the 3-5 reverse clutch boost valve and the 3-5 reverse clutch regulator valve to exhaust through the solenoid.

3-5 Reverse Clutch Boost Valve

The 3-5 reverse boost valve spring force moves the valve to allow 35 reverse clutch feedback fluid from the 3-5 reverse clutch regulator valve to enter the 35 reverse clutch circuit and exhaust.

3-5 Reverse Clutch Regulator Valve

The 3-5 reverse clutch regulator valve spring force moves the valve to allow actuator feed limit fluid to pass through the valve and enter the PS2 fluid circuit which opens PS2. The 35 reverse clutch fluid then enters the exhaust backfill fluid circuit and is routed through orifice #30 to the exhaust backfill pressure relief valve where excess pressure is exhausted.

3-5 Reverse Clutch

The 3-5 reverse clutch spring force moves the 3-5 reverse clutch piston to release the 3-5 clutch plates and forces 35 reverse clutch fluid to exhaust from 3-5 reverse/456 clutch housing. The 35 reverse clutch fluid is then routed to the 3-5 reverse clutch regulator valve where it exhaust excess pressure.

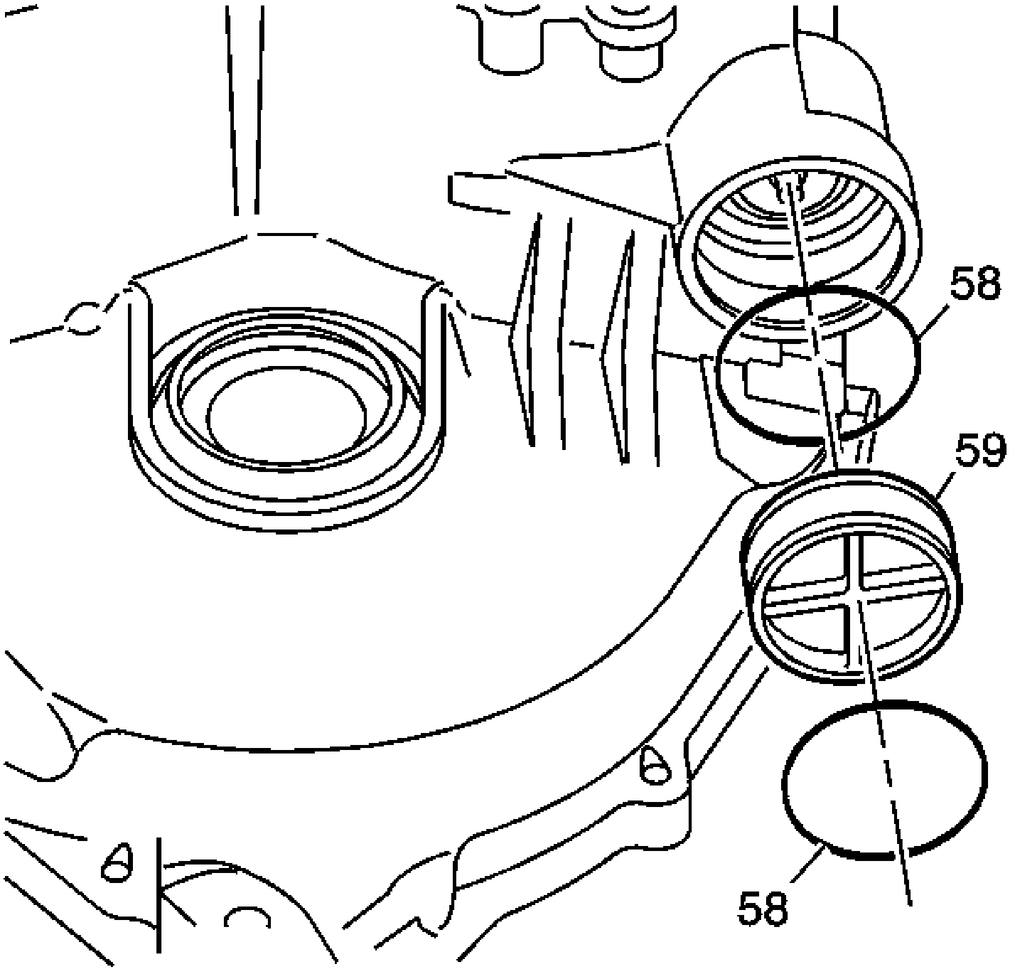


Fig. 202: Drive Range, Sixth Gear
Courtesy of GENERAL MOTORS CORP.

FLUID PASSAGES

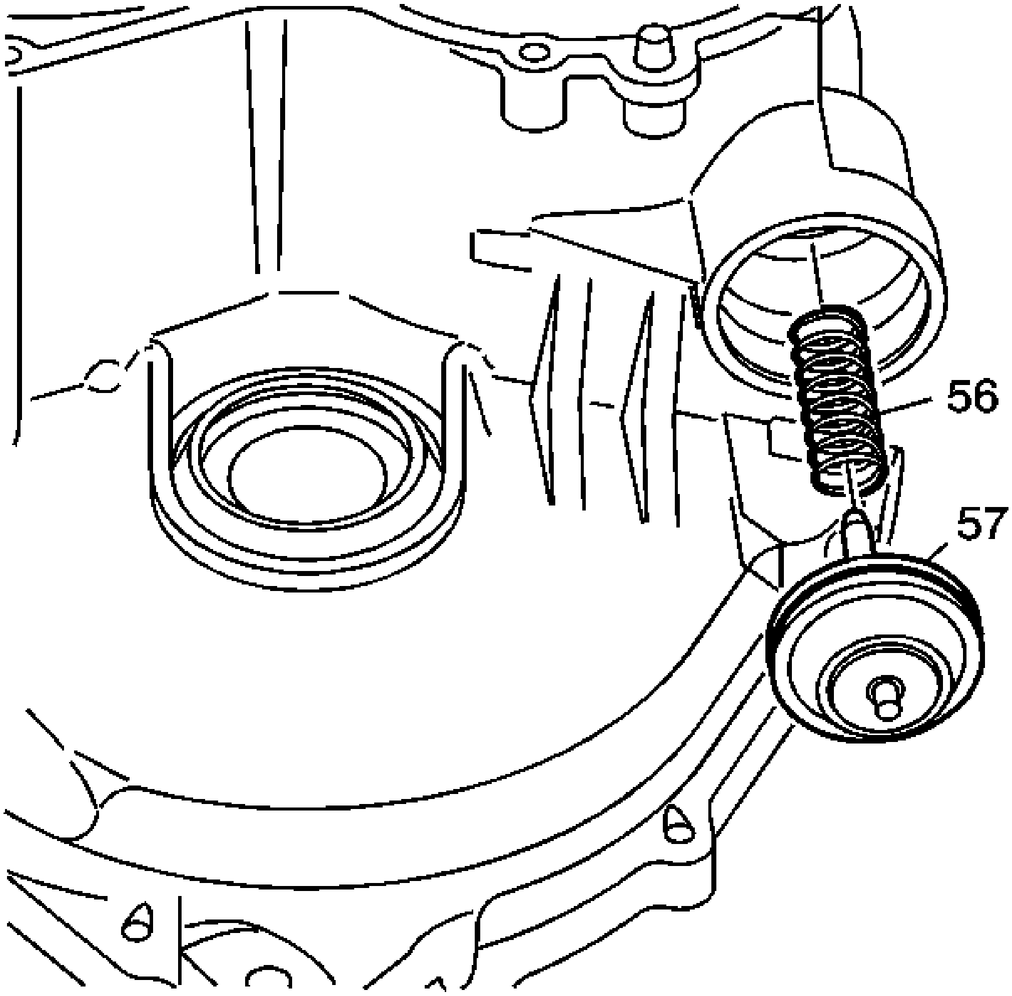


Fig. 203: Control Solenoid (w/Body and TCM) Valve Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
11	Actuator Feed Limit
12	PS2
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
23	PCS 35 Reverse Clutch

30	PCS 1234 Clutch
35	PS3
40	PS4
42	PCS 26 Clutch
48	PCS TCC
49	PS1

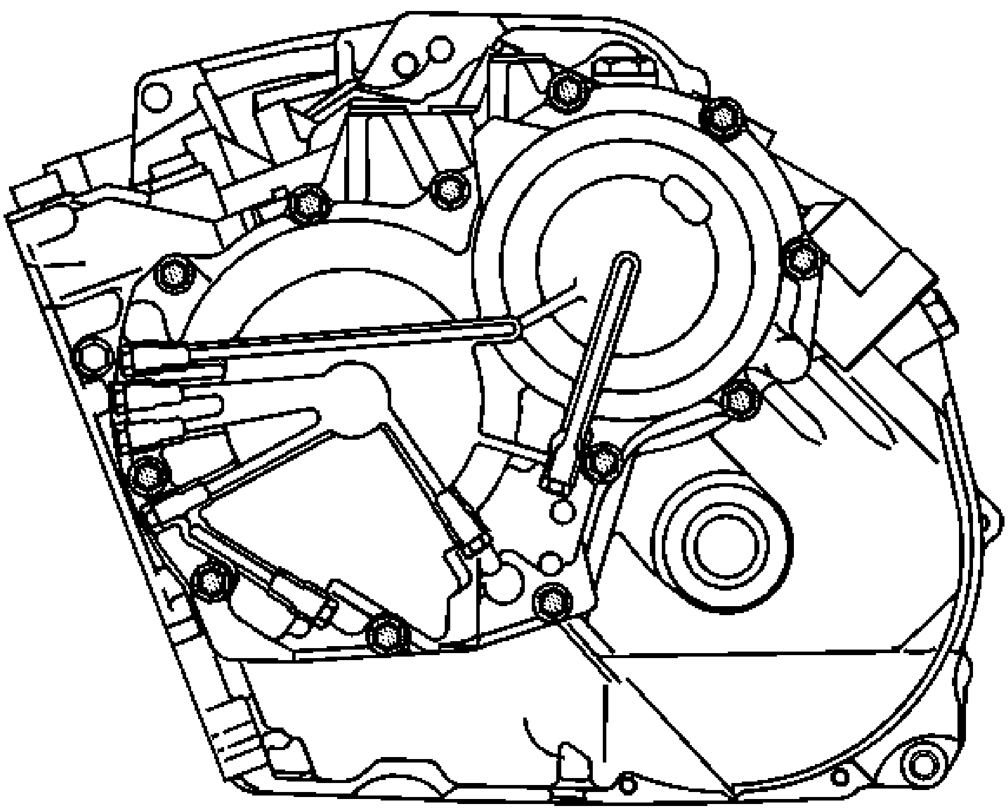


Fig. 204: Control Valve Channel Upper Plate Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
11	Actuator Feed Limit
12	PS2
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1

16	Solenoid 2
23	PCS 35 Reverse Clutch
30	PCS 1234 Clutch
35	PS3
40	PS4
42	PCS 26 Clutch
48	PCS TCC
49	PS1
51	Exhaust
53	Void

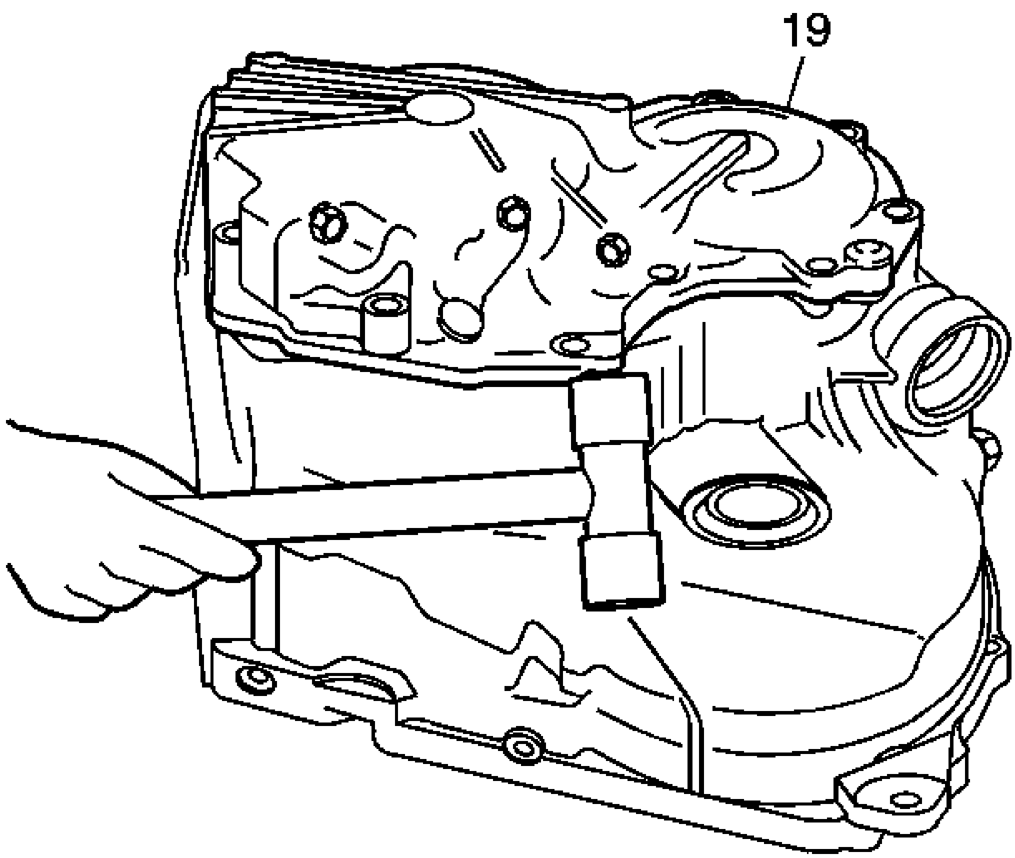


Fig. 205: Control Valve Channel Plate - Upper Plate Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

11	Actuator Feed Limit
12	PS2
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
23	PCS 35 Reverse Clutch
30	PCS 1234 Clutch
35	PS3
40	PS4
42	PCS 26 Clutch
47	456 Clutch
48	PCS TCC
49	PS1
51	Exhaust
53	Void

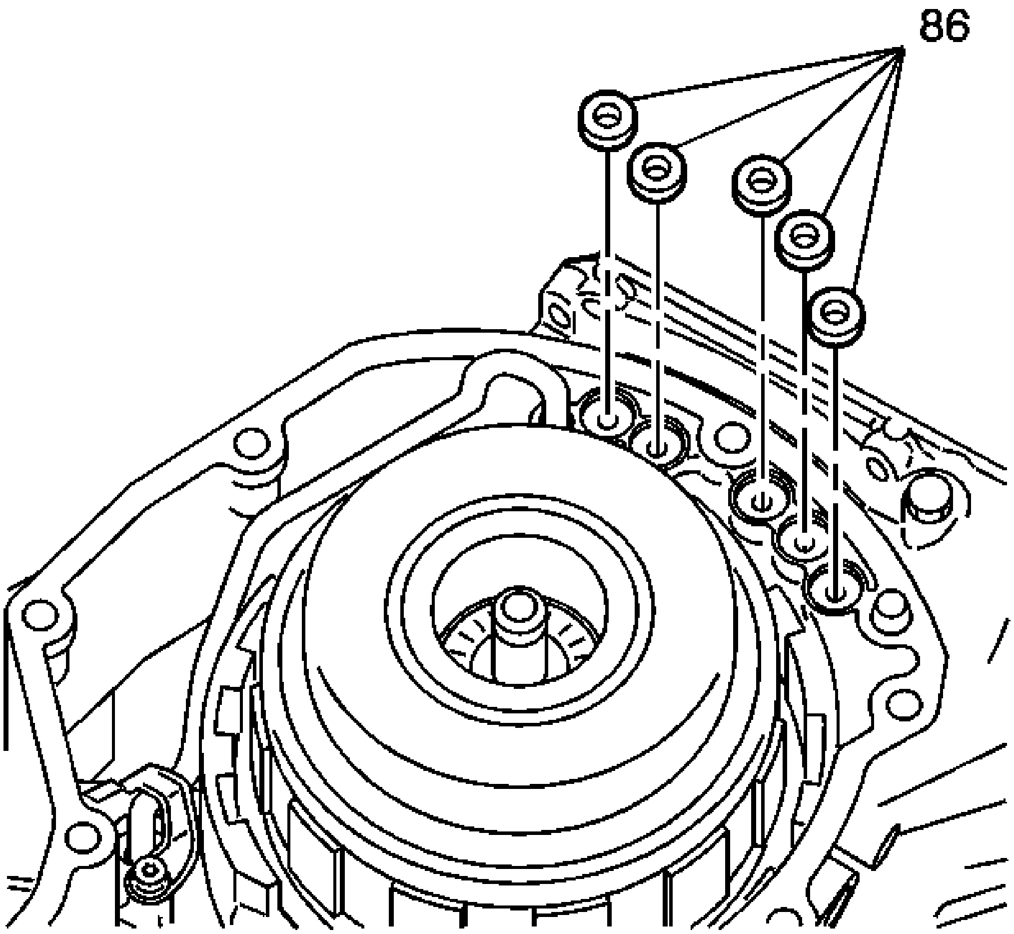


Fig. 206: Control Valve Channel Plate - Upper Body Spacer Plate Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
4	Converter Feed
7	Cooler Feed
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1

16	Solenoid 2
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
23	PCS 35 Reverse Clutch
24	Reverse
26	35 Reverse Supply
27	35 Reverse Feed
28	35 Reverse Clutch
30	PCS 1234 Clutch
31	Drive
32	Drive Brake
34	26 Clutch/1234 Clutch Feed
35	PS3
39	Drive 1-6
40	PS4
42	PCS 26 Clutch
43	26 Clutch
47	456 Clutch
48	PCS TCC
49	PS1
50	Exhaust Backfill
51	Exhaust
53	Void

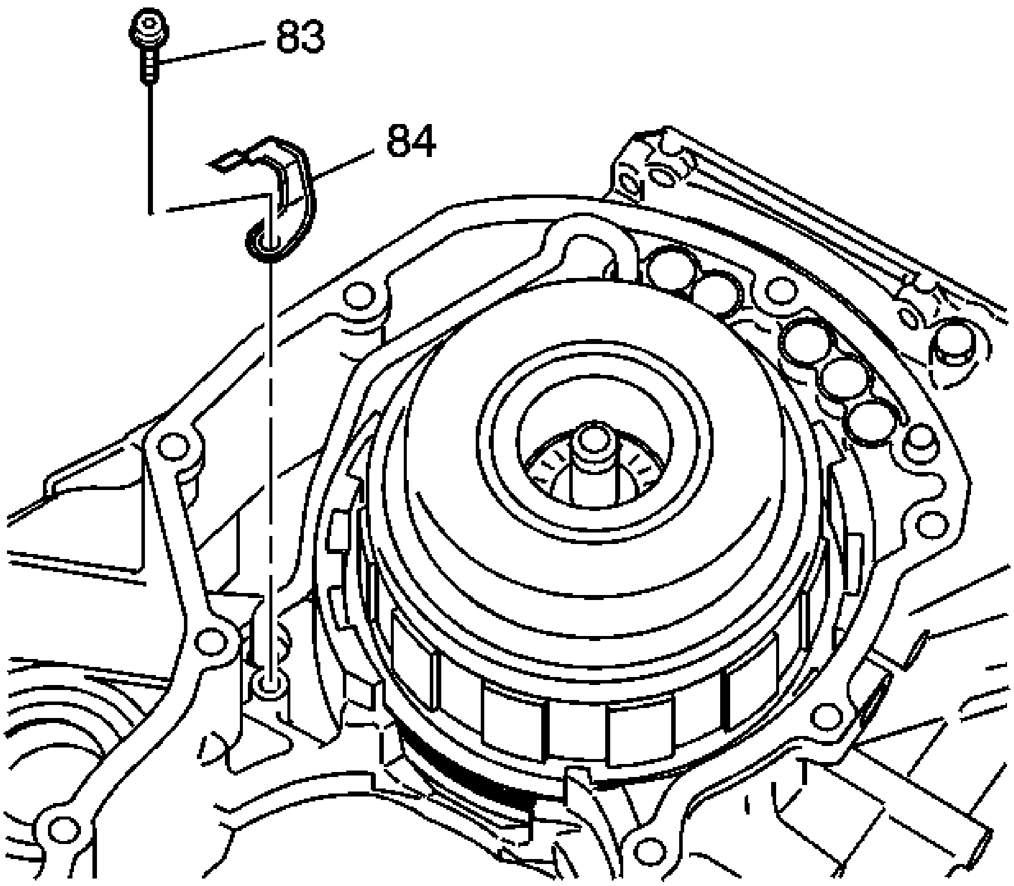


Fig. 207: Control Valve Upper Body Spacer Plate Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
4	Converter Feed
5	TCC Release
7	Cooler Feed
8	Lube
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
12	PS2

13	PCS Line
14	PCS R1/456 Clutch
15	Solenoid 1
16	Solenoid 2
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
26	35 Reverse Supply
27	35 Reverse Feed
28	35 Reverse Clutch
30	PCS 1234 Clutch
31	Drive
32	Drive Brake
33	Drive B
34	26 Clutch/1234 Clutch Feed
35	PS3
36	1234 Clutch Feed
39	Drive 1-6
40	PS4
41	CSV2 Latch
42	PCS 26 Clutch
43	26 Clutch
45	1234 Clutch Default
46	456 Clutch Feed
47	456 Clutch
48	PCS TCC
49	PS1
50	Exhaust Backfill
51	Exhaust

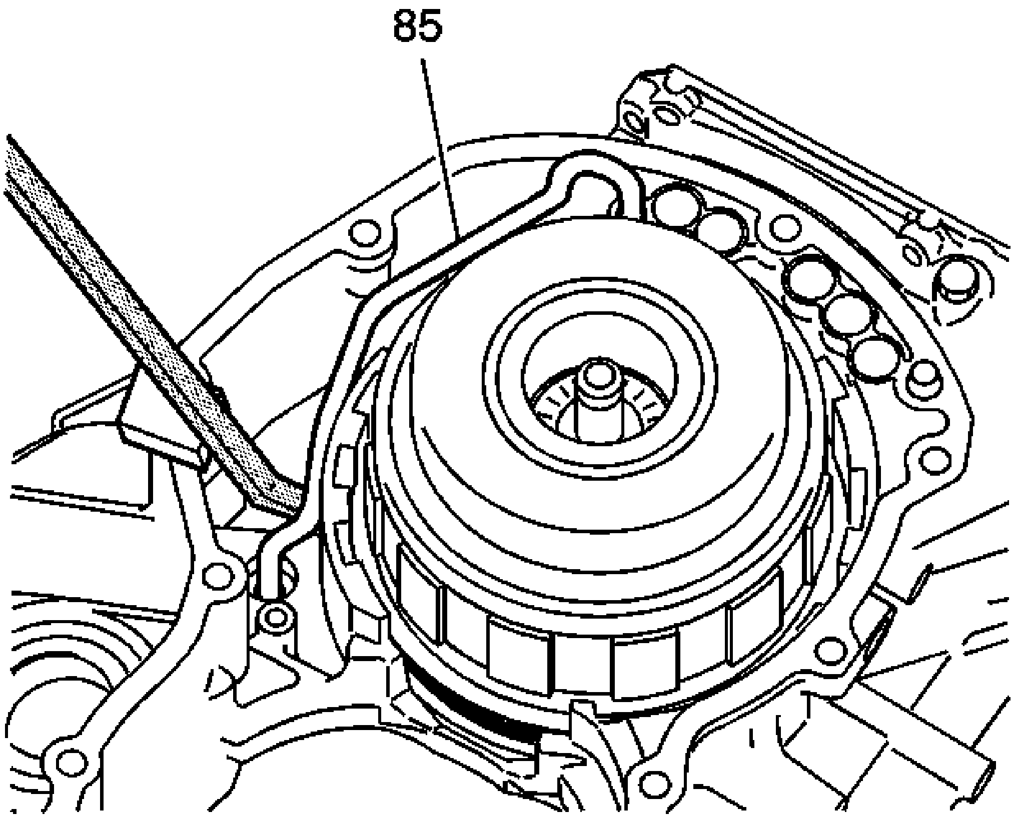


Fig. 208: Control Valve Upper Body Assembly - Upper Body Spacer Plate Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
4	Converter Feed
5	TCC Release
6	TCC Apply
7	Cooler Feed
9	Regulated Apply
10	Compensator Feed
11	Actuator Feed Limit
12	PS2
13	PCS Line
14	PCS R1/456 Clutch

15	Solenoid 1
17	CSV2 Enable
18	CSV3 Enable
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
27	35 Reverse Feed
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
31	Drive
32	Drive Brake
33	Drive B
34	26 Clutch/1234 Clutch Feed
35	PS3
36	1234 Clutch Feed
39	Drive 1-6
40	PS4
41	CSV2 Latch
42	PCS 26 Clutch
43	26 Clutch
44	1234 Clutch Default Feed
45	1234 Clutch Default
46	456 Clutch Feed
47	456 Clutch
48	PCS TCC
49	PS1
50	Exhaust Backfill
51	Exhaust
53	Void

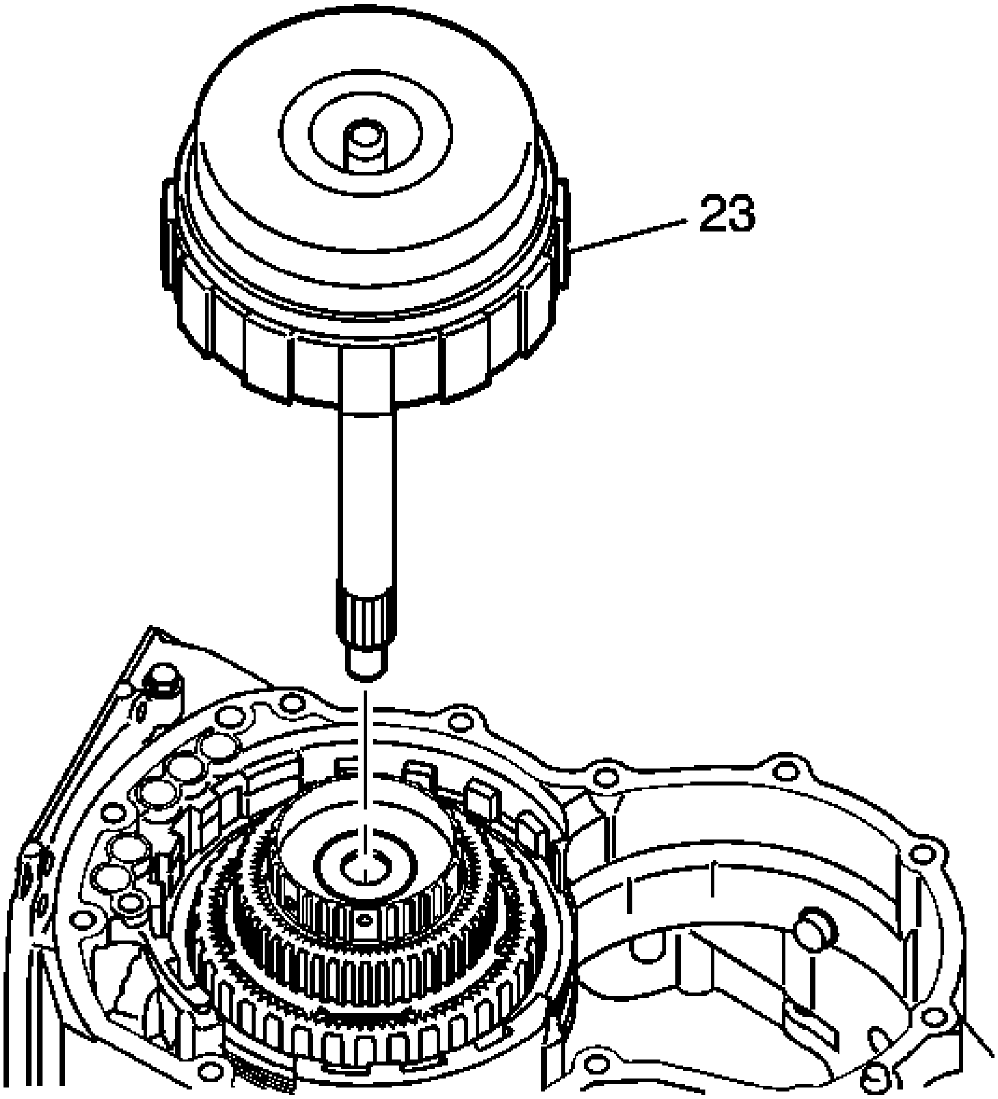


Fig. 209: Control Valve Upper Body Assembly - Lower Body Spacer Plate Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply

7	Cooler Feed
10	Compensator Feed
11	Actuator Feed Limit
14	PCS R1/456 Clutch
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
26	35 Reverse Supply
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
33	Drive B
36	1234 Clutch Feed
38	1234 Clutch Feedback
39	Drive 1-6
41	CSV2 Latch
43	26 Clutch
45	1234 Clutch Default
47	456 Clutch
49	PS1
50	Exhaust Backfill
51	Exhaust
53	Void

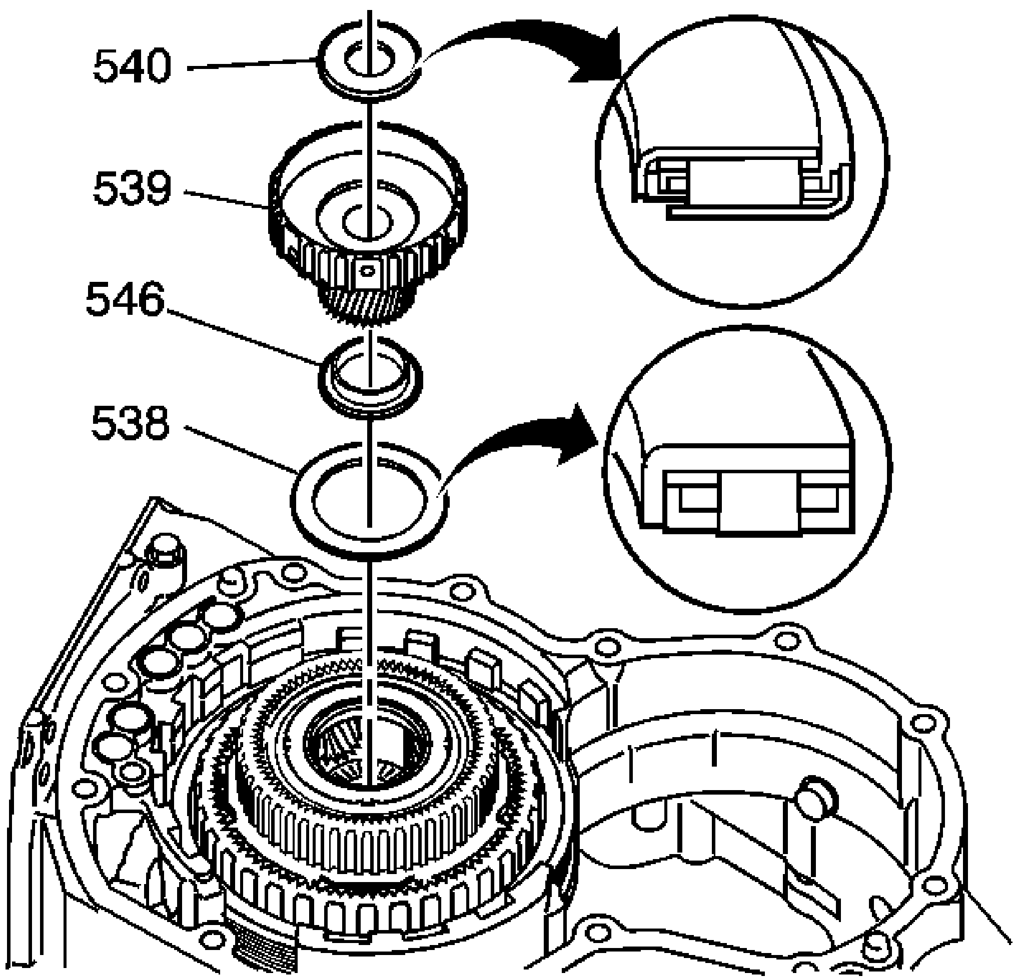


Fig. 210: Control Valve Lower Body Spacer Plate Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply
10	Compensator Feed
11	Actuator Feed Limit
14	PCS R1/456 Clutch
18	CSV3 Enable

19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
22	R1
23	PCS 35 Reverse Clutch
24	Reverse
25	35 Reverse Clutch Feed
26	35 Reverse Supply
27	35 Reverse Feed
28	35 Reverse Clutch
29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
33	Drive B
36	1234 Clutch Feed
37	1234 Clutch
38	1234 Clutch Feedback
43	26 Clutch
44	1234 Clutch Default Feed
45	1234 Clutch Default
47	456 Clutch
49	PS1
50	Exhaust Backfill
51	Exhaust
53	Void

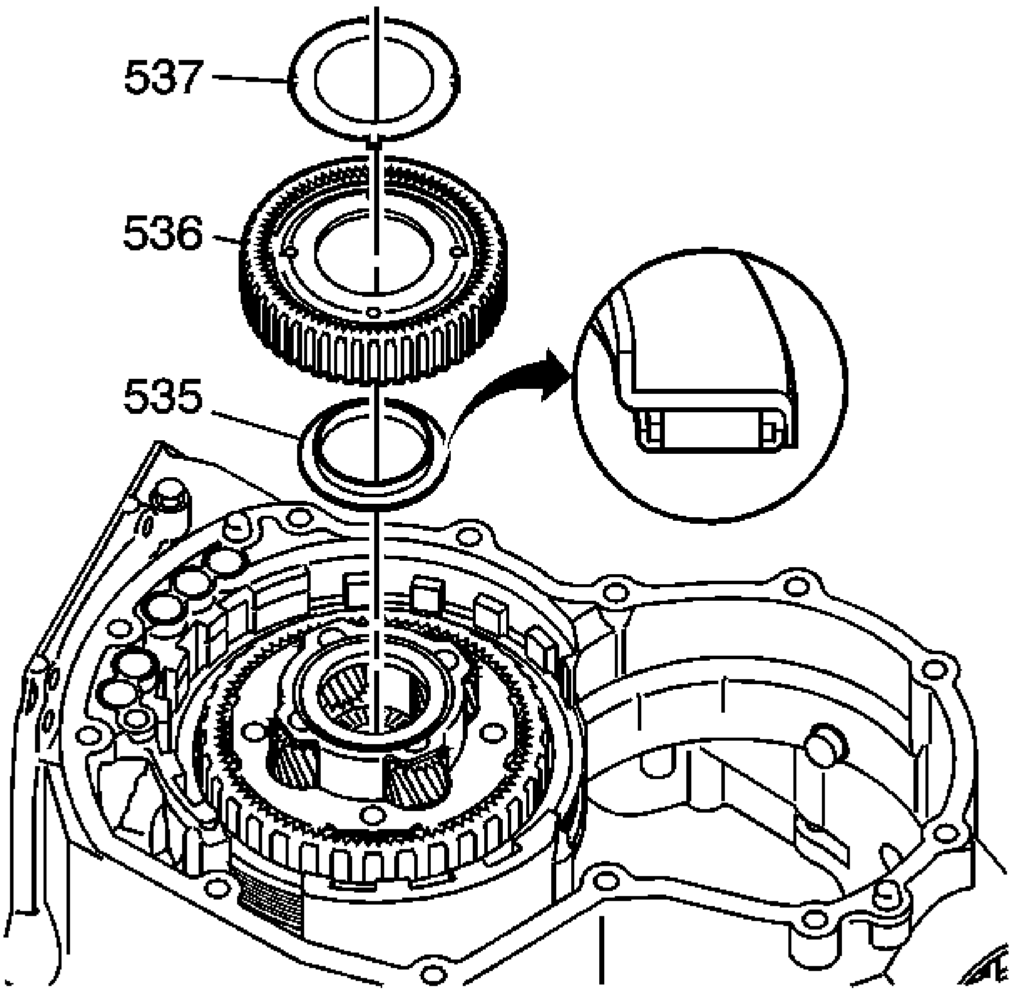


Fig. 211: Control Valve Lower Body
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
11	Actuator Feed Limit
14	PCS R1/456 Clutch
19	R1/456 Clutch Feed
20	R1 Feedback
21	R1 Supply
23	PCS 35 Reverse Clutch
28	35 Reverse Clutch

29	35 Reverse Clutch Feedback
30	PCS 1234 Clutch
36	1234 Clutch Feed
37	1234 Clutch
38	1234 Clutch Feedback
45	1234 Clutch Default
47	456 Clutch
49	PS1
50	Exhaust Backfill
51	Exhaust
53	Void

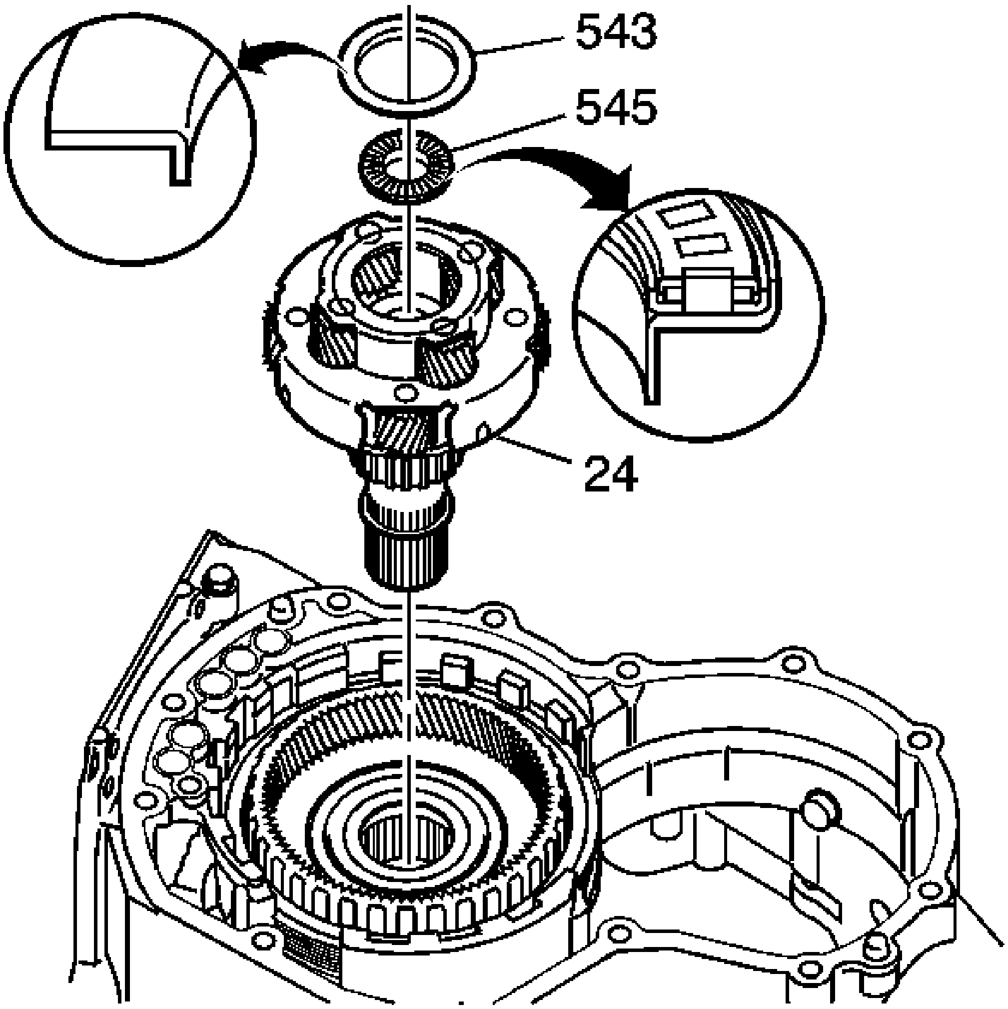


Fig. 212: A/Trans Case Assembly - Control Valve Body Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
5	TCC Release
6	TCC Apply
7	Cooler Feed
10	Compensator Feed
22	R1

28	35 Reverse Clutch
37	1234 Clutch
43	26 Clutch
47	456 Clutch
53	Void

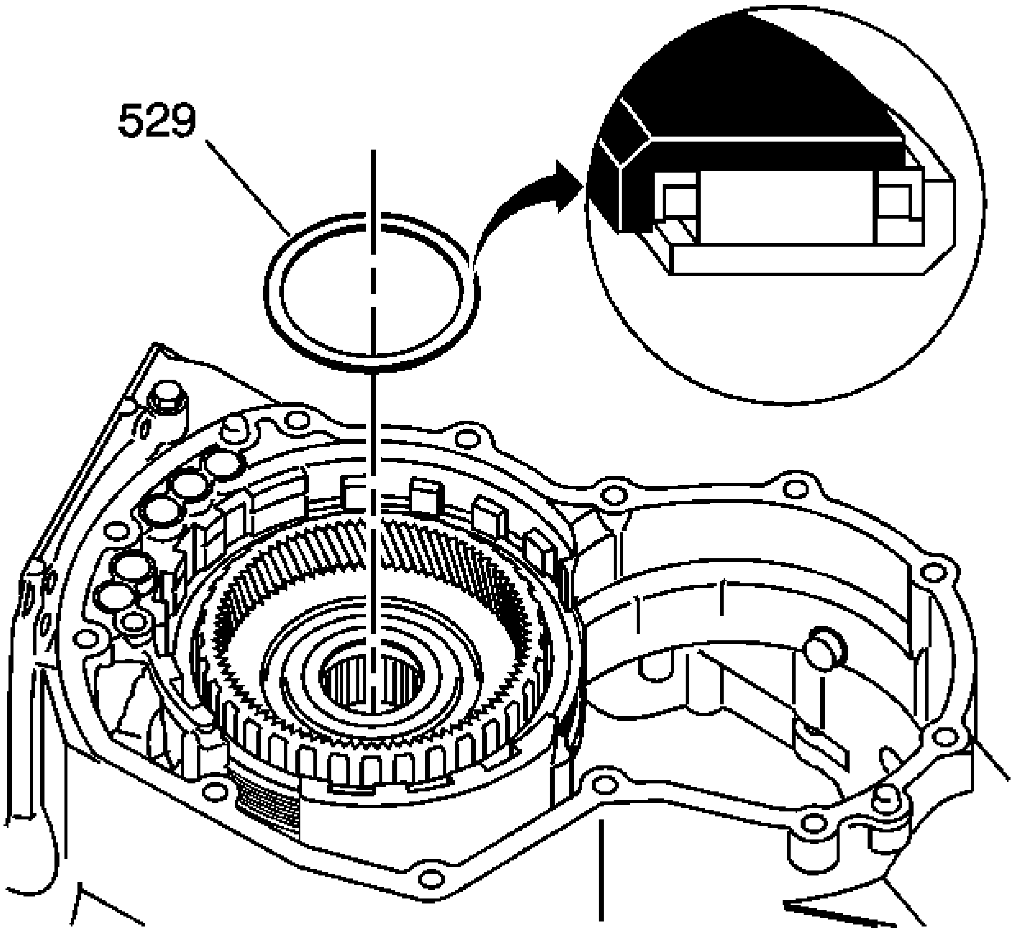


Fig. 213: A/Trans Case Assembly - Torque Converter and Differential Housing Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
3	Decrease
5	TCC Release

6	TCC Apply
7	Cooler Feed
8	Lube
53	Void

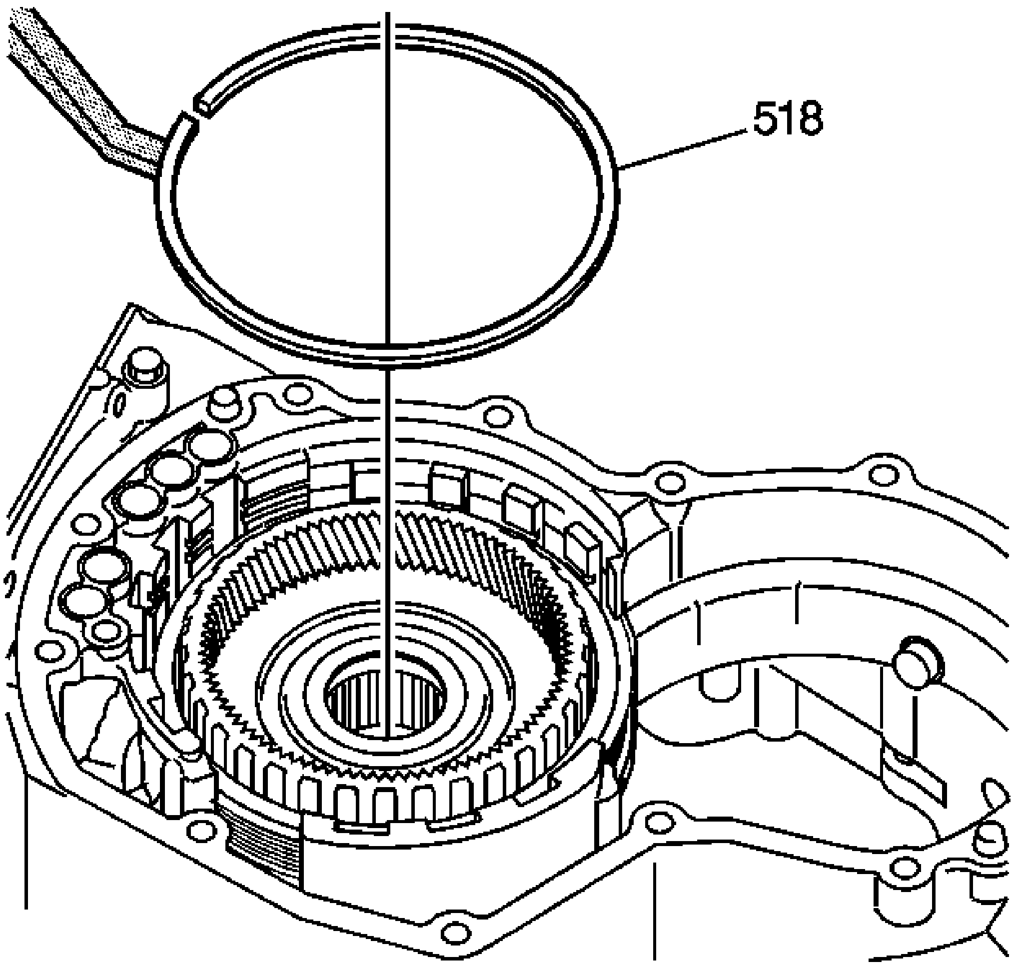


Fig. 214: A/Trans Case Assembly Case Cover Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
2	Line
7	Cooler Feed
8	Lube

10	Compensator Feed
22	R1
28	35 Reverse Clutch
37	1234 Clutch
43	26 Clutch
47	456 Clutch
53	Void

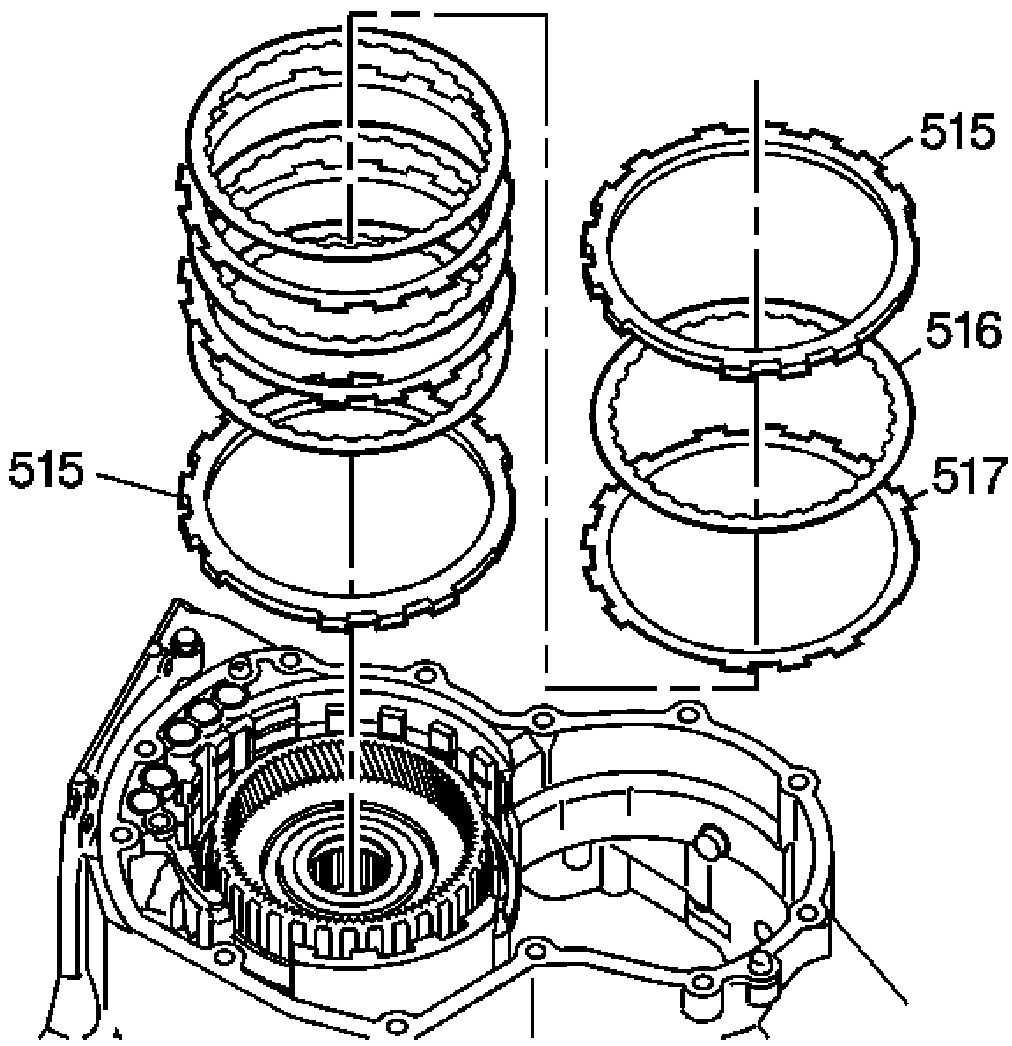


Fig. 215: A/Trans Case Cover Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
8	Lube
10	Compensator Feed
22	R1
28	35 Reverse Clutch
43	26 Clutch
47	456 Clutch
51	Exhaust

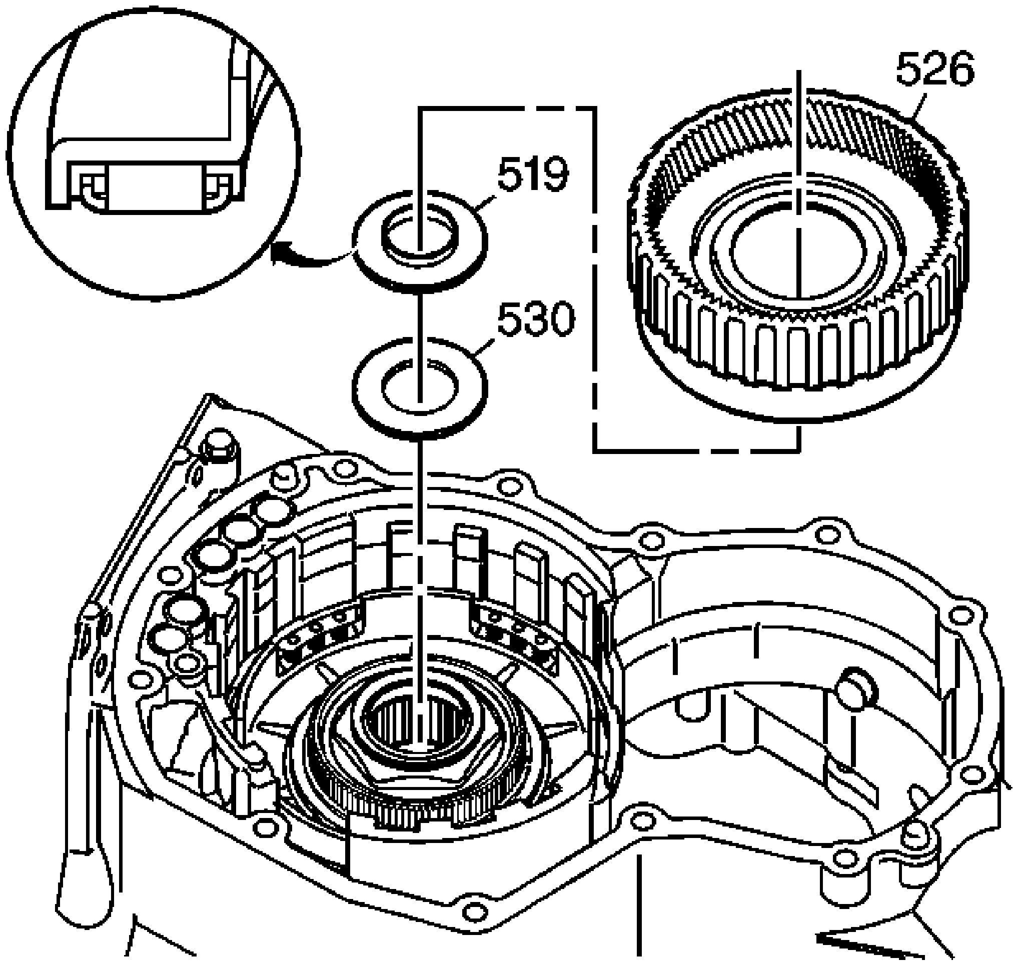


Fig. 216: Front Differential Transfer Drive Gear Support - Case Side
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
5	TCC Release
6	TCC Apply

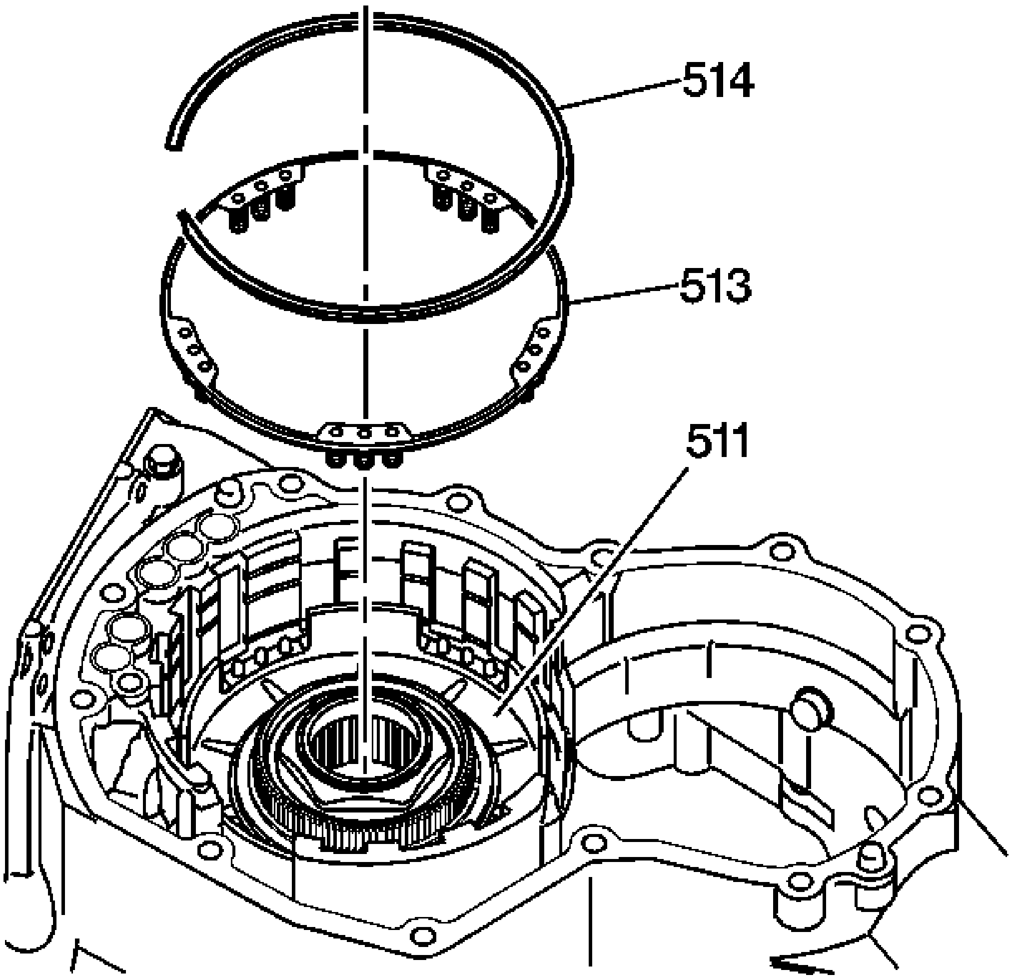
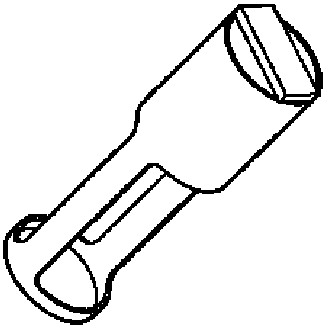
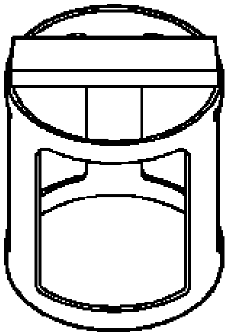
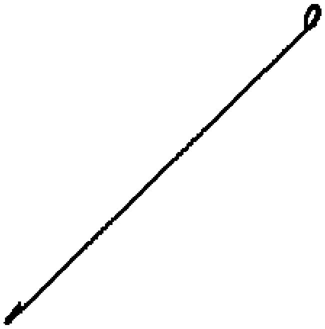
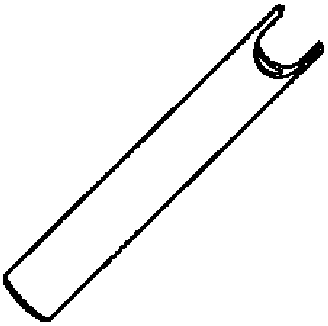


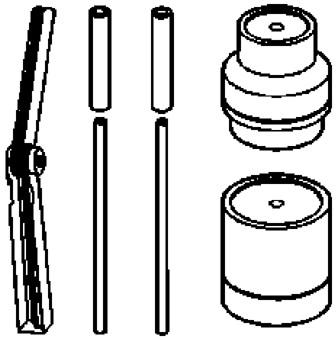
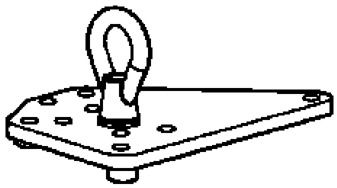
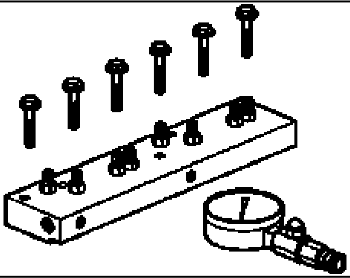
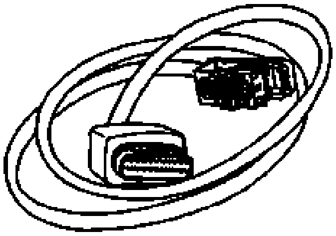
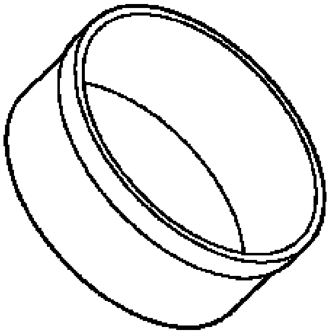
Fig. 217: Front Differential Transfer Drive Gear Support - Torque Converter and Differential Housing Side
Courtesy of GENERAL MOTORS CORP.

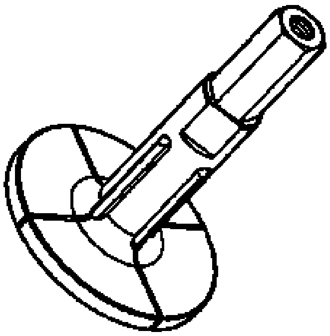
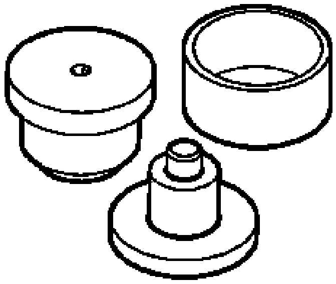
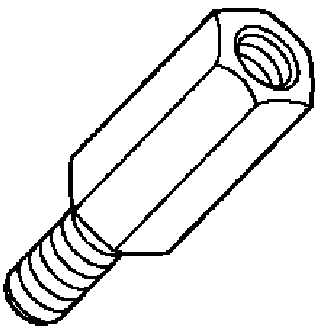
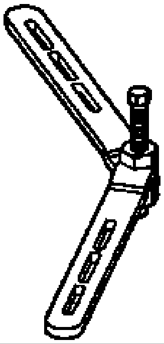
Callout	Component Name
5	TCC Release
6	TCC Apply

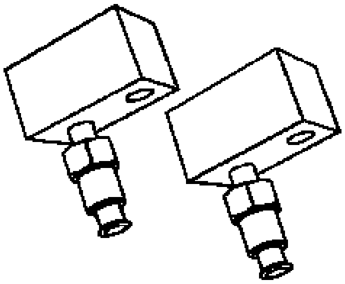
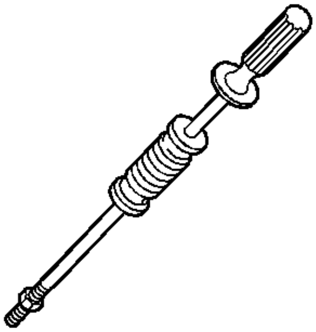
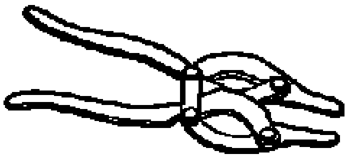
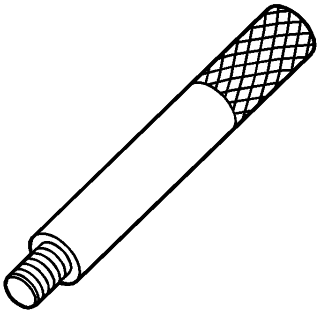
SPECIAL TOOLS

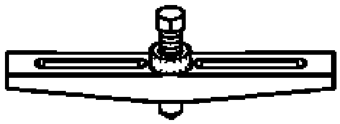
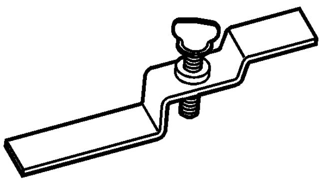
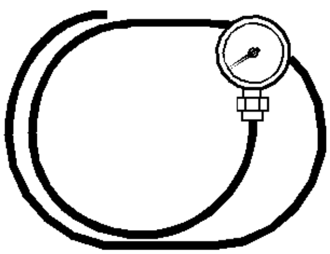
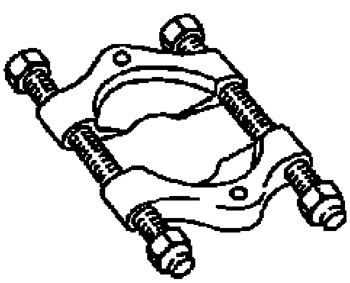
Special Tools

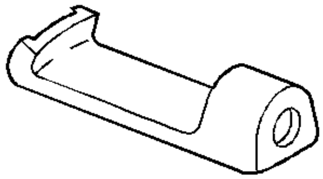
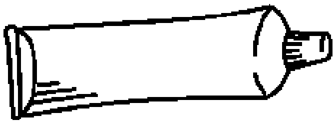
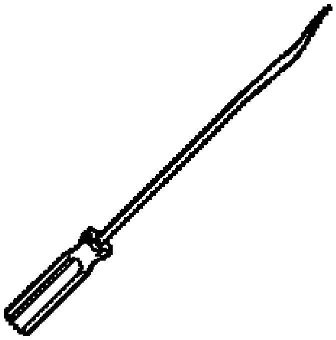
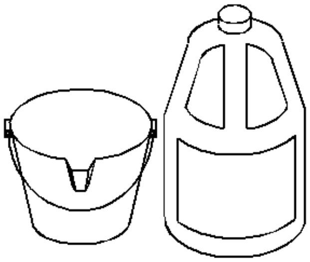
Illustration	Tool Number/Description
	DT 47693 Dam Protector
	DT 47694 Piston Spring Compressor
	DT 47734 Speed Sensor Harness Tether
	DT 47793 Differential Rotating Tool

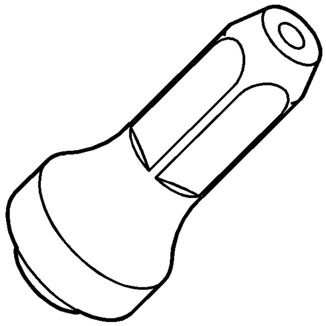
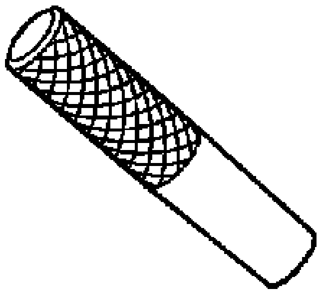
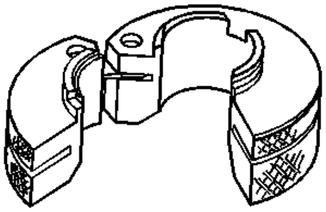
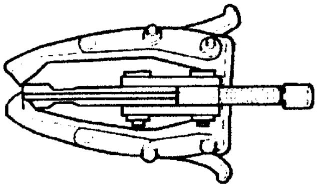
	DT 47800 Shim Selection Gage
	DT 47811 Lift Plate
	DT 47825-100 Solenoid Test Plate
	DT 47825-20 Adapter Harness
	DT 47859 Piston Outer Seal Protector

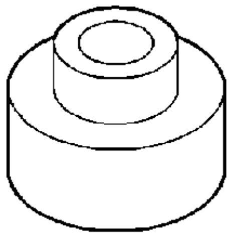
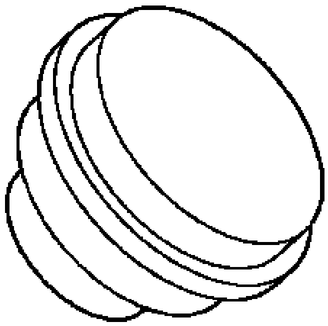
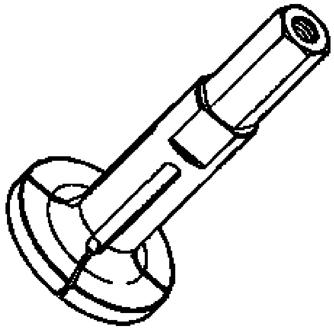
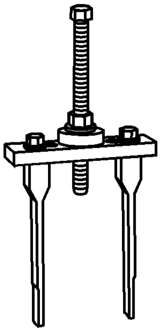
	DT 47927 Bearing Cup Remover
	DT 47928 Bearing Installer
-	DT 47928-2 Bearing Support
	DT 48055 Lube Dam Remover
	DT 48056 Spring Compressor Bridge
	DT 48312 Transmission Cooler Flushing Adapter

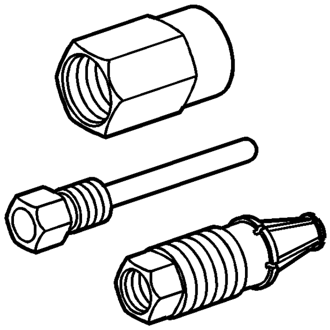
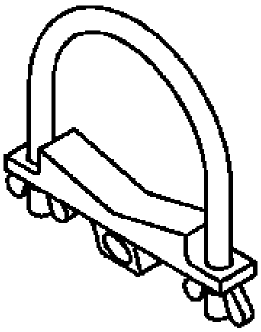
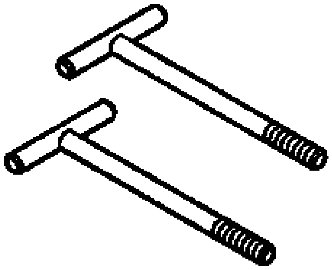
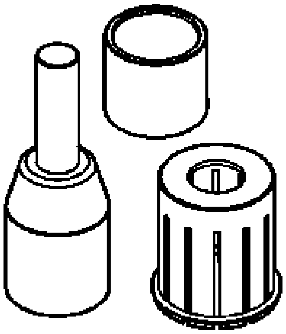
	
	J 6125-1B Slide Hammer with Adapter
	J 8059 Snap Ring Plier-Parallel Jaw
	J 8092 Driver Handle
	J 8433-1 Puller Bar

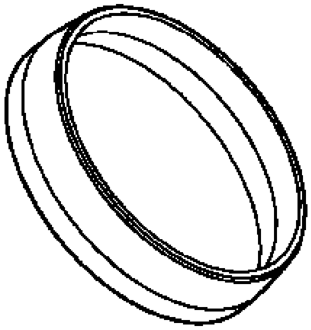
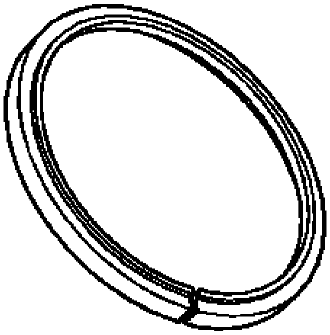
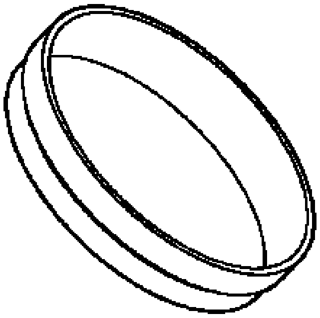
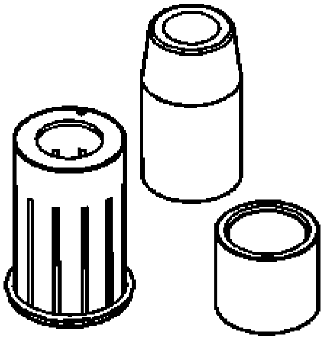
	
	J 21366 Converter Holding Strap
	J 21867 Pressure Gage
	J 22912-01 Split Plate Bearing Remover
	J 23129 Universal Seal Remover

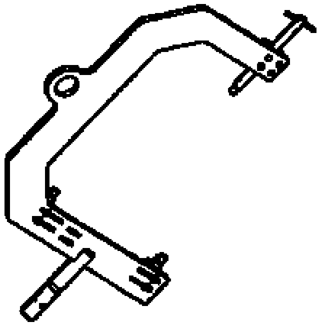
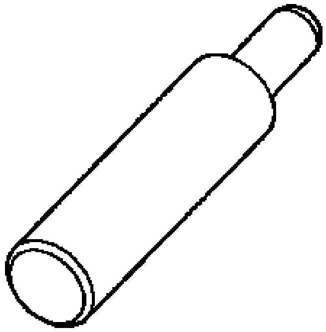
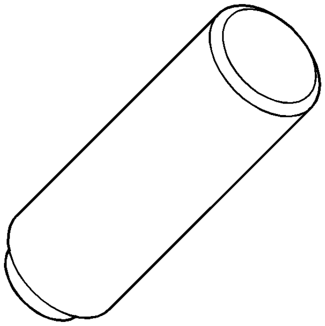
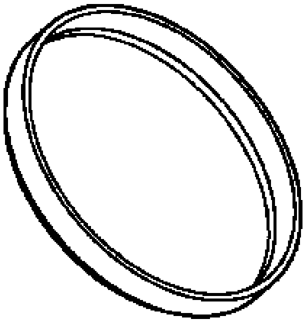
	
	J 23444-A Extreme Press Lubricant-1/4 Ounce Tube
	J 28585 Snap Ring Remover
	J 35944-22 Cooler Flushing Fluid
	J 38693 Seal Installer

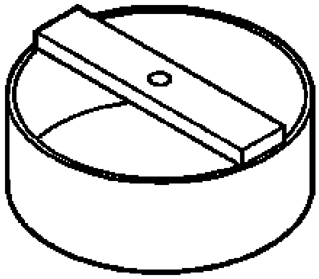
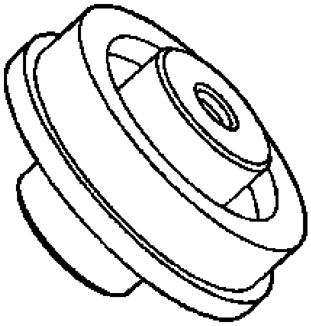
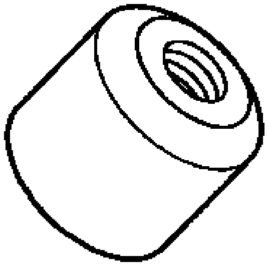
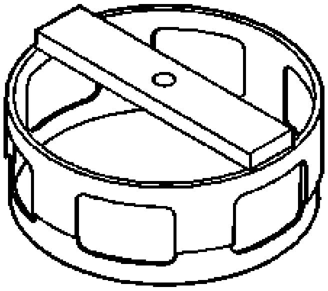
	
	J 41229 Manual Shaft Pin Installer
	J 41623-B Cooler Quick Connect Tool
	J 41816 Three Legged Puller
	J 41816-2 Crankshaft Step Plate

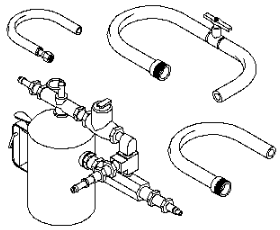
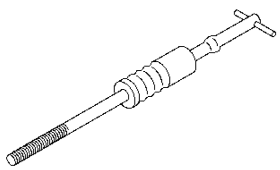
	
	J 45087 Bearing Cup Installer
	J 45094 Bearing Cup Remover
	J 45124 Removal Bridge
	J 45201 Cooler Line Seal Remover

	
	J 45341 Rear Wheel Drive Shaft Removal Tool
	J 46409 Torque Converter Lifting Handles
	J 46620 Seal Installer
	J 46621 Piston Seal Protector

	
	J 46622 Piston Seal Protector
	J 46623 Piston Seal Protector
	J 46624 Seal Installer
	J 46625 Transmission Holding Fixture

	
	J 46626 Seal Installer
	J 46627 Seal Installer
	J 46628-1 Piston Seal Protector
	J 46628-2 Spring Compressor

	
	J 46629 Axle Seal Installer
	J 46630 Lube Dam Installer
	J 46632 Spring Comressor
	SA 9165T Oil Cooler Line Flusher

	
	SA 9173G Slide Hammer

