

## Transmission

### Manual Transmission - Tremec 7-Speed (MEL MEP) - Corvette

## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

#### Fastener Tightening Specifications

| Application                                                                 | Specification |          |
|-----------------------------------------------------------------------------|---------------|----------|
|                                                                             | Metric        | English  |
| Backup Lamp Switch                                                          | 27 N.m        | 20 lb ft |
| Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Bolt      | 24 N.m        | 18 lb ft |
| Manual Transmission Fluid Temperature Sensor                                | 41 N.m        | 30 lb ft |
| Manual Transmission Gear Position Sensor Bolt                               | 8 N.m         | 71 lb in |
| Manual Transmission Reverse Gear Blockout Solenoid                          | 41 N.m        | 30 lb ft |
| Reverse Idler Gear Shaft Bracket Bolt                                       | 52 N.m        | 38 lb ft |
| Reverse Lockout Solenoid Cover Hex Bolt                                     | 31 N.m        | 23 lb ft |
| Reverse Lockout Solenoid Cover Shoulder Bolt                                | 22 N.m        | 16 lb ft |
| Shift Control Shaft Detent Plug                                             | 27 N.m        | 20 lb ft |
| Shift Guide Plate Bolt                                                      | 22 N.m        | 16 lb ft |
| Shift Interlock Detent                                                      | 41 N.m        | 30 lb ft |
| Shift Shaft Detent Plug - Transmission Adapter                              | 27 N.m        | 20 lb ft |
| Shift Shaft Detent Plug - Extension Housing                                 | 27 N.m        | 20 lb ft |
| Shift Shaft Detent Spring Cover Bolt                                        | 27 N.m        | 20 lb ft |
| Skip Shift Solenoid                                                         | 41 N.m        | 30 lb ft |
| Transmission Adapter Bolt                                                   | 49 N.m        | 36 lb ft |
| Transmission Extension Bolt                                                 | 62 N.m        | 46 lb ft |
| Transmission Extension Stud                                                 | 34 N.m        | 25 lb ft |
| Transmission Fluid Cooler Pipe Quick Connect Fitting - Transmission Adapter | 22 N.m        | 16 lb ft |
| Transmission Fluid Cooler Pipe Quick Connect Fitting - Transmission Case    | 22 N.m        | 16 lb ft |
| Transmission Gap Magnet Bolt                                                | 7 N.m         | 62 lb in |
| Transmission Interlock Bolt                                                 | 27 N.m        | 20 lb ft |
| Transmission Oil Drain Plug                                                 | 27 N.m        | 20 lb ft |
| Transmission Oil Fill Plug                                                  | 27 N.m        | 20 lb ft |
| Transmission Speed Sensor Bolt                                              | 9 N.m         | 80 lb in |
| Wiring Harness Bracket Bolt                                                 | 8 N.m         | 71 lb in |

## Adhesives, Fluids, Lubricants and Sealers

| Application                                  | Type Of Material          | GM Part Number |          |
|----------------------------------------------|---------------------------|----------------|----------|
|                                              |                           | United States  | Canada   |
| Backup Lamp Switch                           | Sealant                   | 12346004       | 10953480 |
| Manual Transmission Fluid Temperature Sensor | Sealant                   | 12346004       | 10953480 |
| Reverse Idler Gear Shaft Bracket Bolt        | Threadlocker              | 12345382       | 10953489 |
| Shift Guide Plate Bolt                       | Sealant                   | 12346004       | 10953480 |
| Transmission Extension Bolt                  | Sealant                   | 12346004       | 10953480 |
| Transmission Fluid                           | Manual Transmission Fluid | 88861800       | 88861801 |
| Transmission Oil Drain Plug                  | Sealant                   | 12346004       | 10953480 |

## LUBRICATION SPECIFICATIONS

### Lubrication Specifications

| Application                                                       | Metric     | English     |
|-------------------------------------------------------------------|------------|-------------|
| Manual Transmission Fluid GM P/N 88861800 (Canadian P/N 88861801) |            |             |
| Base Domestic                                                     | 3.5 liters | 3.70 quarts |
| Base Export                                                       | 4.0 liters | 4.23 quarts |
| Z51 Domestic                                                      | 4.0 liters | 4.23 quarts |
| Z51 Export                                                        | 4.0 liters | 4.23 quarts |

## SHIM SIZE SPECIFICATIONS

### Shim Size Specifications

| Application                             | Specification      |                    |
|-----------------------------------------|--------------------|--------------------|
|                                         | Metric             | English            |
| Counter Shaft Extension Shim Axial Play | 0.0254 - 0.1016 mm | 0.001 - 0.004 in   |
| Input Shaft Shim Axial Play             | 0.038 - 0.1143 mm  | 0.0015 - 0.0045 in |
| Counter Shaft Shim Preload              | 0.0 - 0.05 mm      | 0.0 - 0.002 in     |
| Input Shaft/Main Shaft Shim Preload     | 0.0 - 0.05 mm      | 0.0 - 0.002 in     |

## SCHEMATIC WIRING DIAGRAMS

### MANUAL TRANSMISSION WIRING SCHEMATICS

MEL or MEP

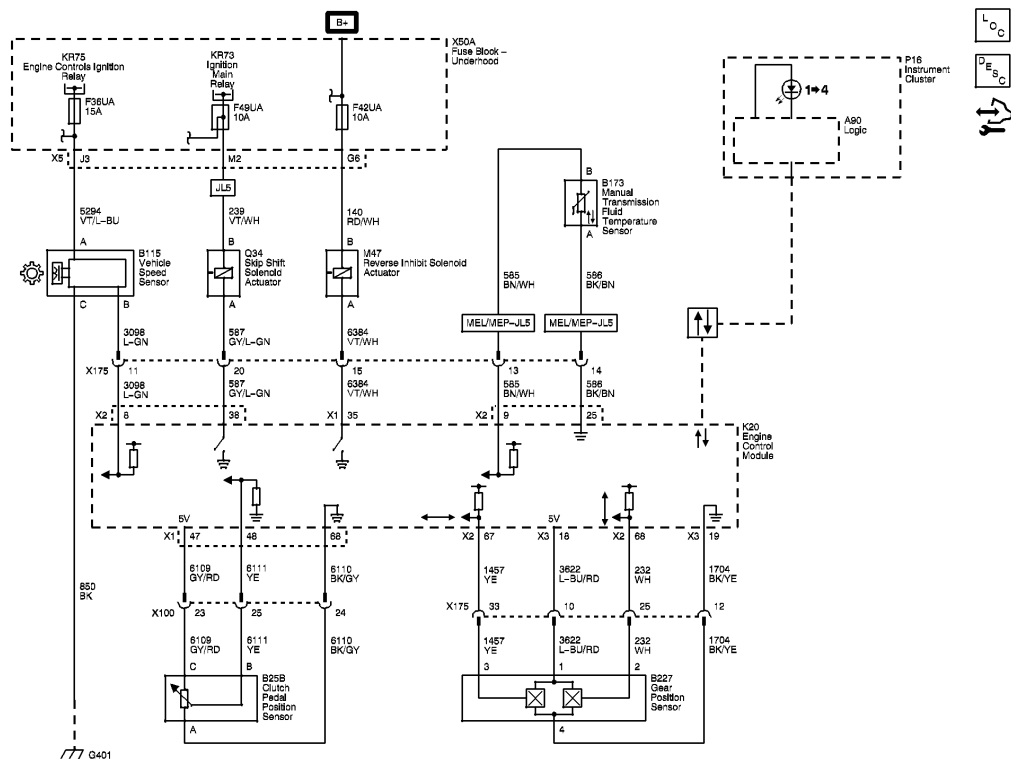


**Fig. 1: MEL or MEP Wiring Schematic**  
 Courtesy of GENERAL MOTORS COMPANY

## VISUAL IDENTIFICATION

### DISASSEMBLED VIEWS

#### Transmission Adapter Assembly

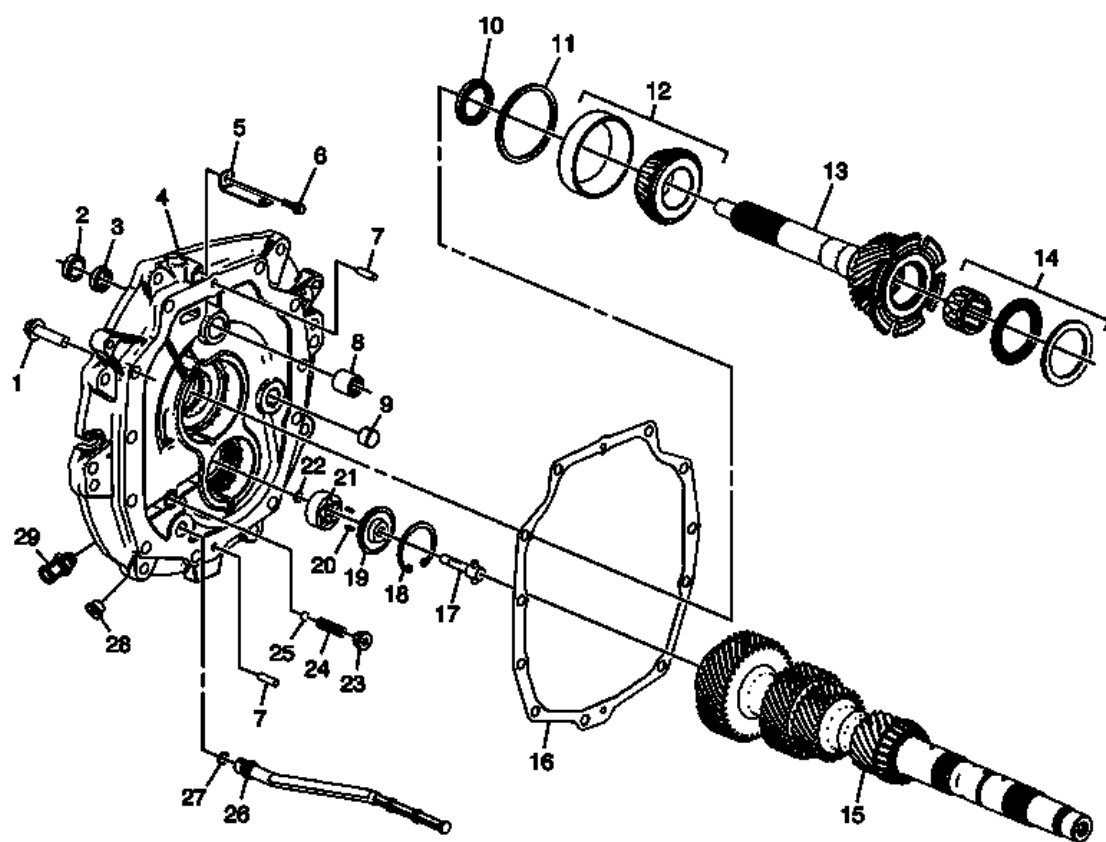


**Fig. 2: Transmission Adapter Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | Transmission Adapter Bolt            |
| 2       | Shift Shaft Inner Seal               |
| 3       | Shift Control Shaft Cover Outer Seal |
| 4       | Transmission Adapter                 |
| 5       | Wiring Harness Bracket               |
| 6       | Wiring Harness Bracket Bolt          |
| 7       | Transmission Case Locating Pin       |
| 8       | Shift Shaft Bearing                  |
| 9       | Shift Shaft Bushing                  |
| 10      | Input Shaft Seal                     |
| 11      | Input Shaft Bearing Shim             |
| 12      | Input Shaft Bearing Assembly         |
| 13      | Input Shaft                          |

|    |                                                      |
|----|------------------------------------------------------|
| 14 | Main Shaft Bearing Assembly                          |
| 15 | Counter Gear Assembly                                |
| 16 | Transmission Case-to-Adapter Plate Gasket            |
| 17 | Transmission Fluid Pump Shaft                        |
| 18 | Transmission Fluid Pump Retaining Ring               |
| 19 | Transmission Fluid Pump Cover                        |
| 20 | Transmission Fluid Pump Pin                          |
| 21 | Transmission Fluid Pump Assembly                     |
| 22 | Transmission Fluid Pump Shaft Clip                   |
| 23 | Shift Shaft Detent Plug                              |
| 24 | Shift Detent Ball Spring                             |
| 25 | Transmission Detent Ball                             |
| 26 | Transmission Fluid Pump Inlet Tube                   |
| 27 | Transmission Fluid Pump Inlet Tube Seal              |
| 28 | Shift Control Shaft Detent Plug                      |
| 29 | Transmission Fluid Cooler Pipe Quick Connect Fitting |

#### Transmission Case Assembly

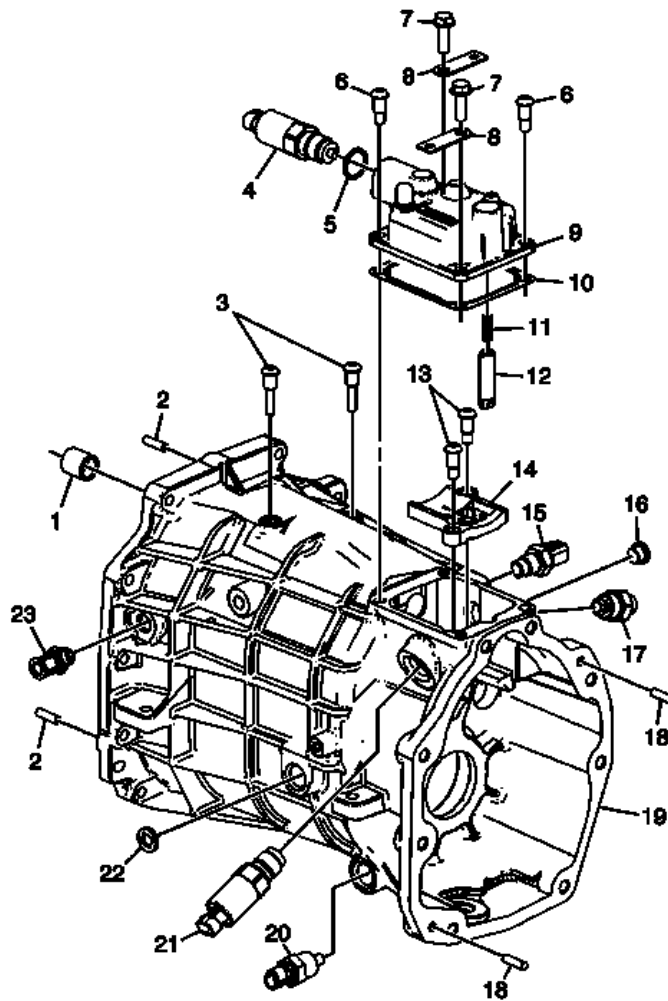


**Fig. 3: Transmission Case Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                                                    |
|---------|-------------------------------------------------------------------|
| 1       | Shift Shaft Bearing                                               |
| 2       | Transmission Case Locating Pin                                    |
| 3       | Transmission Interlock Bolt                                       |
| 4       | Manual Transmission Reverse Gear Blockout Solenoid                |
| 5       | Manual Transmission Reverse Gear Blockout Solenoid O-Ring Seal    |
| 6       | Reverse Lockout Solenoid Cover Shoulder Bolt                      |
| 7       | Reverse Lockout Solenoid Cover Hex Bolt                           |
| 8       | Wiring Harness Bracket                                            |
| 9       | Manual Transmission Reverse Gear Blockout Solenoid Housing        |
| 10      | Manual Transmission Reverse Gear Blockout Solenoid Housing Gasket |
| 11      | Shift Shaft Detent Spring                                         |
| 12      | Shift Shaft Detent Roller                                         |
| 13      | Shift Guide Plate Bolt                                            |

|    |                                                      |
|----|------------------------------------------------------|
| 14 | Shift Guide Detent Plate                             |
| 15 | Backup Lamp Switch                                   |
| 16 | Shift Shaft Detent Spring Cover Bolt                 |
| 17 | Shift Interlock Detent                               |
| 18 | Transmission Case Locating Pin                       |
| 19 | Transmission Case                                    |
| 20 | Manual Transmission Fluid Temperature Sensor         |
| 21 | Skip Shift Solenoid                                  |
| 22 | Transmission Oil Fill Plug                           |
| 23 | Transmission Fluid Cooler Pipe Quick Connect Fitting |

#### Extension Housing Assembly

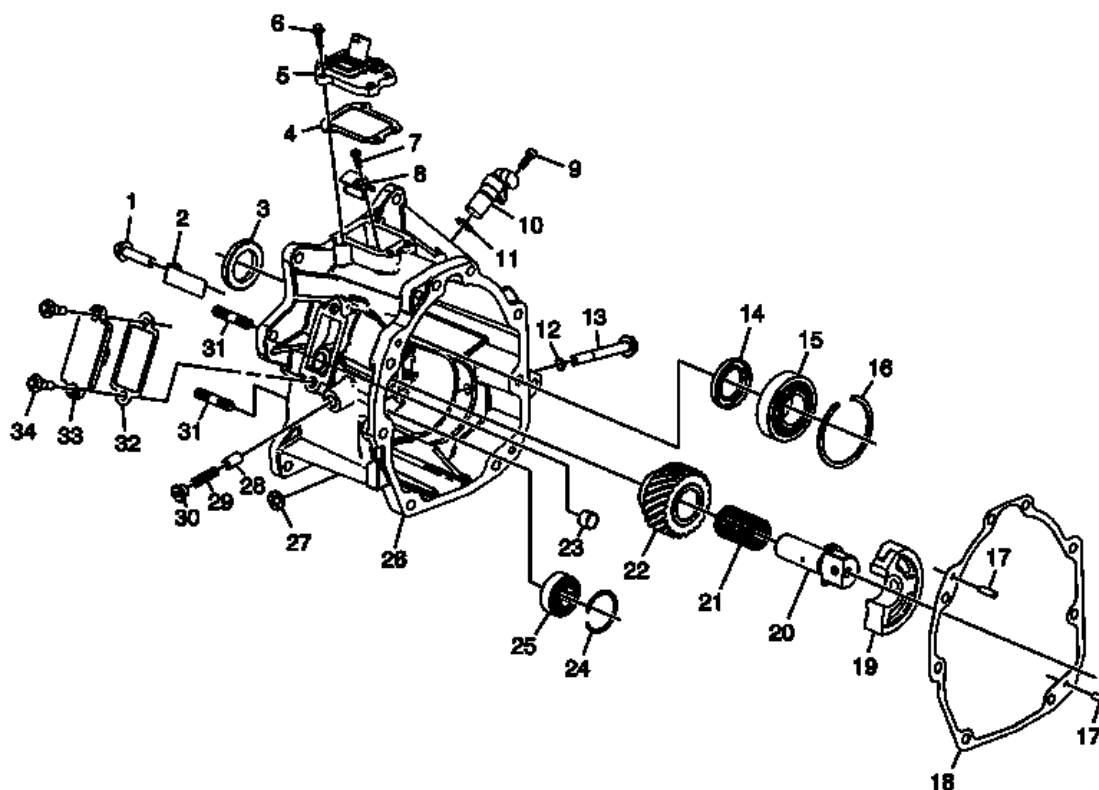


**Fig. 4: Extension Housing Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|---------|----------------|

|    |                                                                          |
|----|--------------------------------------------------------------------------|
| 1  | Transmission Extension Bolt                                              |
| 2  | Transmission Identification Tag                                          |
| 3  | Main Shaft Rear Outer Seal                                               |
| 4  | Manual Transmission Gear Position Sensor Gasket                          |
| 5  | Manual Transmission Gear Position Sensor                                 |
| 6  | Manual Transmission Gear Position Sensor Bolt                            |
| 7  | Transmission Gap Magnet Bolt                                             |
| 8  | Transmission Gap Magnet                                                  |
| 9  | Transmission Speed Sensor Bolt                                           |
| 10 | Manual Transmission Output Speed Sensor                                  |
| 11 | Vehicle Speed Sensor O-ring Seal                                         |
| 12 | Reverse Idler Gear Shaft Bracket Bolt                                    |
| 13 | Reverse Idler Gear Shaft Bracket Bolt O-ring Seal                        |
| 14 | Main Shaft Rear Inner Seal                                               |
| 15 | Main Shaft Rear Bearing                                                  |
| 16 | Main Shaft Rear Bearing Retainer                                         |
| 17 | Transmission Case Locating Pin                                           |
| 18 | Transmission Extension Gasket                                            |
| 19 | Reverse Idler Gear Shaft Bracket                                         |
| 20 | Reverse Idler Gear Shaft                                                 |
| 21 | Reverse Idler Gear Bearing                                               |
| 22 | Reverse Idler Gear                                                       |
| 23 | Shift Shaft Bushing                                                      |
| 24 | Counter Gear Rear Bearing                                                |
| 25 | Counter Gear Rear Bearing Retainer                                       |
| 26 | Extension Housing                                                        |
| 27 | Transmission Oil Drain Plug                                              |
| 28 | Transmission Detent Ball                                                 |
| 29 | Shift Detent Ball Spring                                                 |
| 30 | Shift Shaft Detent Plug                                                  |
| 31 | Transmission Extension Stud                                              |
| 32 | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Gasket |
| 33 | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover        |
| 34 | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Bolt   |

#### Main Shaft Assembly

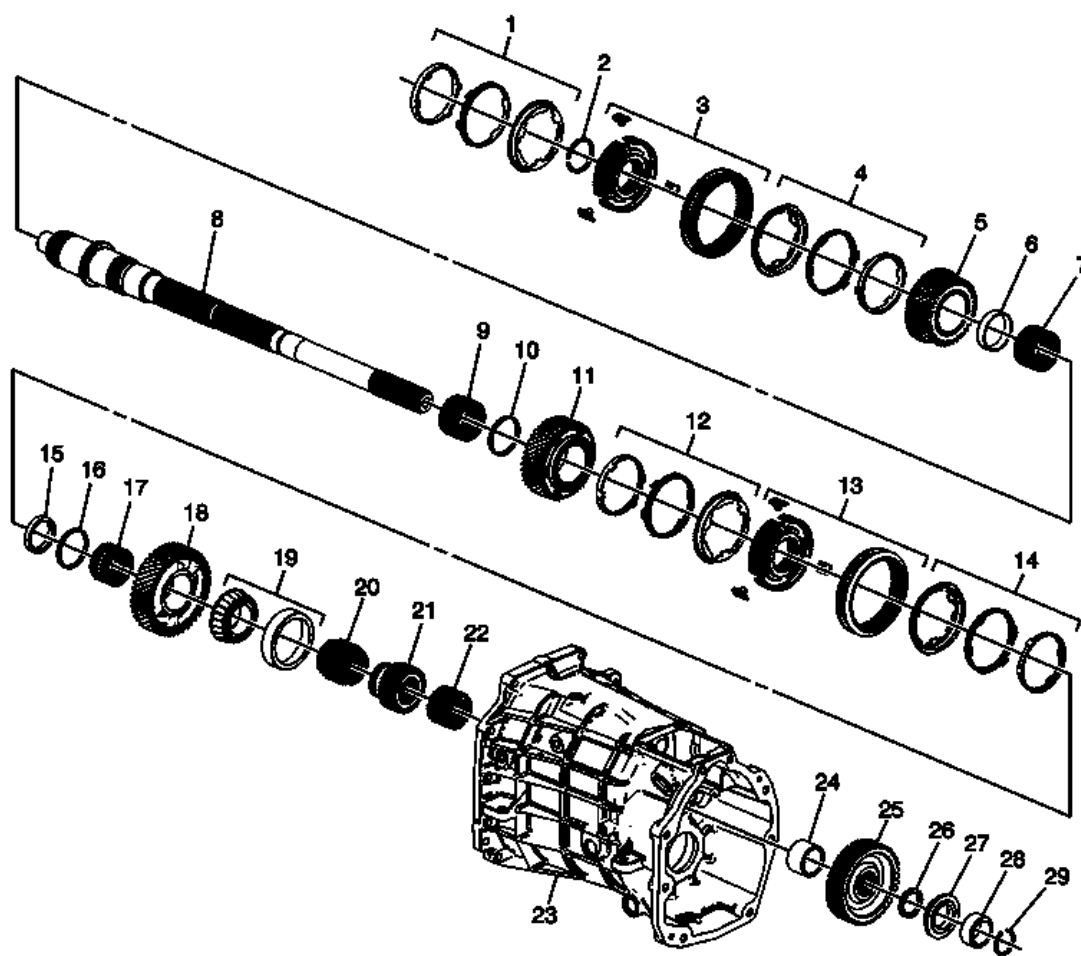


**Fig. 5: Main Shaft Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | 4th Gear Blocking Ring Assembly      |
| 2       | 4th Gear Retaining Ring              |
| 3       | 3rd Gear Synchronizer Assembly       |
| 4       | 3rd Gear Blocking Ring Assembly      |
| 5       | 3rd Gear - Drive                     |
| 6       | 3rd Gear Bearing Spacer              |
| 7       | 3rd Gear Bearing                     |
| 8       | Main Shaft                           |
| 9       | 2nd Gear Bearing                     |
| 10      | 2nd Gear Bearing Spacer              |
| 11      | 2nd Gear - Drive                     |
| 12      | 2nd Gear Blocking Ring Assembly      |
| 13      | 1st & 2nd Gear Synchronizer Assembly |

|    |                                      |
|----|--------------------------------------|
| 14 | 1st Gear Blocking Ring Assembly      |
| 15 | Transmission Main Shaft Split Washer |
| 16 | Transmission Main Shaft Washer       |
| 17 | 1st Gear Bearing                     |
| 18 | 1st Gear - Drive                     |
| 19 | Main Shaft Bearing Assembly          |
| 20 | 6th Gear - Driven                    |
| 21 | 5th Gear - Driven                    |
| 22 | 7th Gear - Driven                    |
| 23 | Transmission Case                    |
| 24 | Reverse Driven Gear Spacer           |
| 25 | Reverse Driven Gear                  |
| 26 | Reverse Gear Split Washer            |
| 27 | Transmission Main Shaft Split Washer |
| 28 | Main Shaft Bushing                   |
| 29 | Reverse Gear Retaining Ring          |

#### Counter Gear Assembly

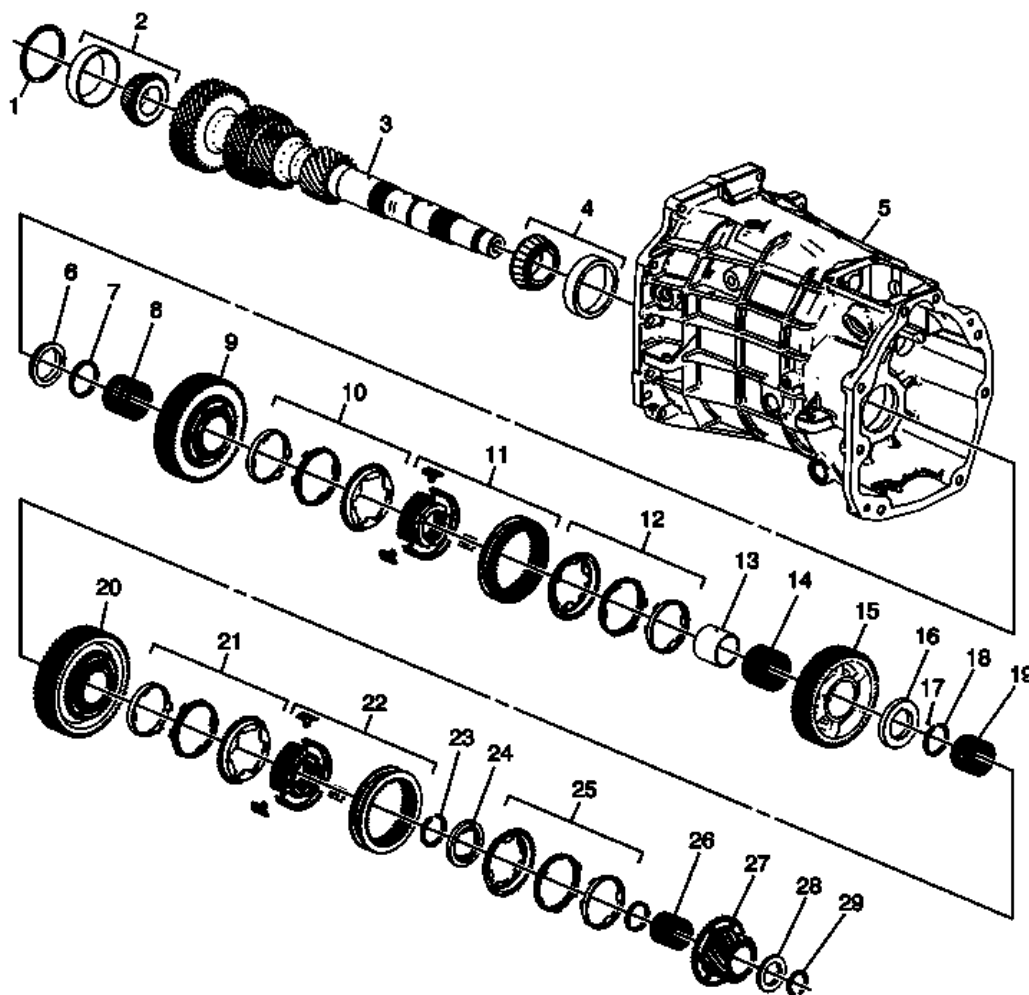


**Fig. 6: Counter Gear Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | Counter Gear Front Bearing Shim      |
| 2       | Counter Gear Front Bearing Assembly  |
| 3       | Counter Gear Assembly                |
| 4       | Counter Gear Bearing Assembly        |
| 5       | Transmission Case                    |
| 6       | Thrust Washer                        |
| 7       | 6th Gear Bearing Spacer              |
| 8       | 6th Driven Gear Bearing              |
| 9       | 6th Gear - Drive                     |
| 10      | 6th Gear Blocking Ring Assembly      |
| 11      | 5th & 6th Gear Synchronizer Assembly |
| 12      | 5th Gear Blocking Ring Assembly      |
| 13      | 5th Gear Bearing Bushing             |

|    |                                          |
|----|------------------------------------------|
| 14 | 5th Gear Bearing                         |
| 15 | 5th Gear - Drive                         |
| 16 | 5th Gear Thrust Washer                   |
| 17 | 5th Gear Thrust Washer Location Ball     |
| 18 | 5th Gear Retaining Ring                  |
| 19 | 7th Gear Bearing                         |
| 20 | 7th Gear - Drive                         |
| 21 | 7th Gear Blocking Ring Assembly          |
| 22 | 7th & Reverse Gear Synchronizer Assembly |
| 23 | 7th Gear Blocking Ring Retainer          |
| 24 | 7th Gear Bearing Spacer                  |
| 25 | Reverse Gear Blocking Ring Assembly      |
| 26 | Reverse Gear Bearing                     |
| 27 | Reverse Gear - Drive                     |
| 28 | Reverse Gear Thrust Washer               |
| 29 | Reverse Gear Retaining Ring              |

#### Shift Shaft Assemblies

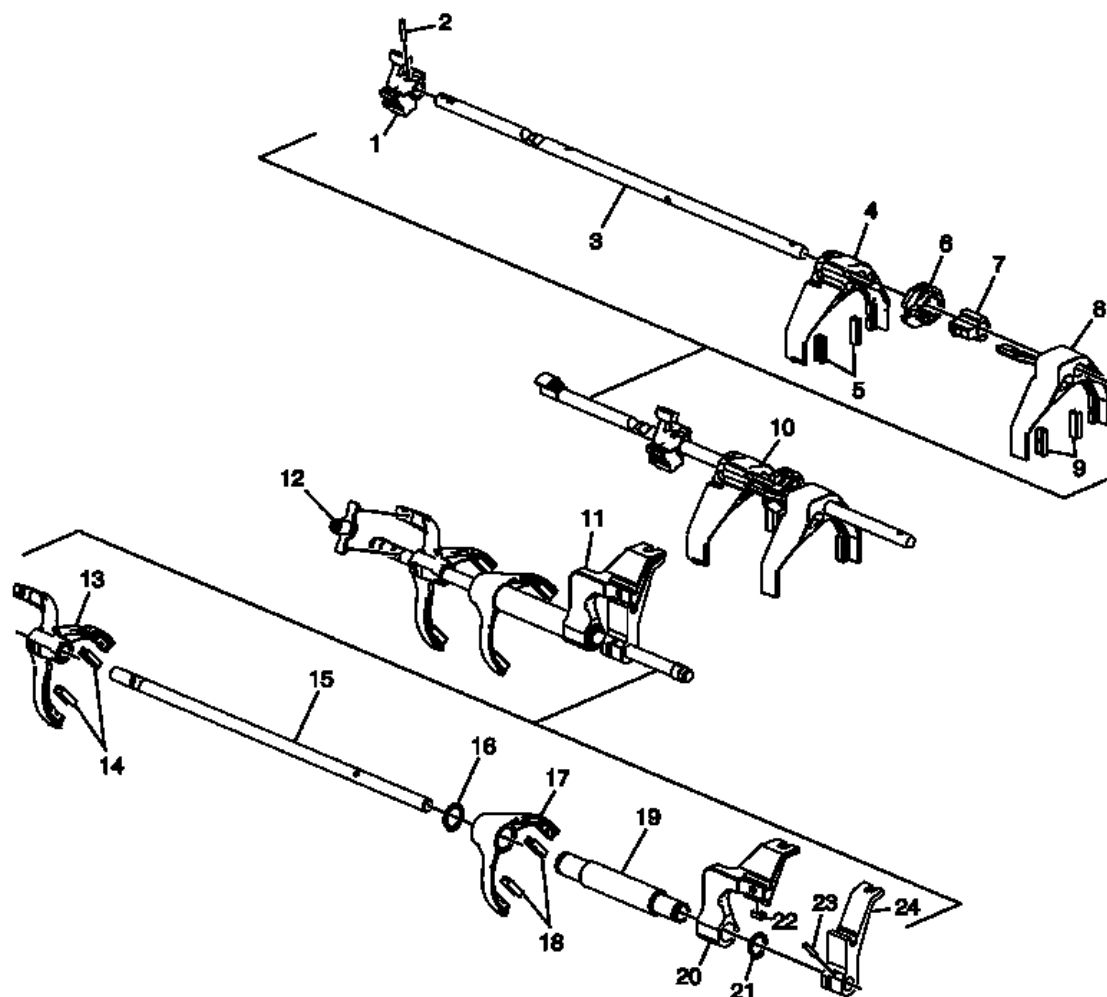


**Fig. 7: Shift Shaft Assemblies**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                                    |
|---------|---------------------------------------------------|
| 1       | Offset Shift Lever                                |
| 2       | Roll Pin                                          |
| 3       | 1st/2nd & 3rd/4th Shift Shaft                     |
| 4       | 1st & 2nd Shift Fork                              |
| 5       | 1st & 2nd Shift Fork Insert                       |
| 6       | Manual Transmission Shift Lever Interlock Bracket |
| 7       | Shift Control Lever                               |
| 8       | 3rd & 4th Shift Fork                              |
| 9       | 3rd & 4th Shift Fork Insert                       |
| 10      | 1st/2nd & 3rd/4th Shift Shaft Assembly            |
| 11      | 5th/6th & 7th/Reverse Shift Shaft Assembly        |
| 12      | Manual Transmission Selector Lever Pivot Pin      |
| 13      | 7th & Reverse Shift Fork                          |

|    |                                   |
|----|-----------------------------------|
| 14 | 7th & Reverse Shift Fork Insert   |
| 15 | 5th/6th & 7th/Reverse Shift Shaft |
| 16 | 5th & 6th Shift Fork Retainer     |
| 17 | 5th & 6th Shift Fork              |
| 18 | 5th & 6th Shift Fork Insert       |
| 19 | 5th & 6th Shift Shaft             |
| 20 | 5th & 6th Shift Lever             |
| 21 | 5th & 6th Shift Lever Retainer    |
| 22 | 5th & 6th Shift Lever Insert      |
| 23 | Roll Pin                          |
| 24 | Reverse Shift Lever               |

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC CODE INDEX

#### DIAGNOSTIC CODE INDEX

| DTC                                           | Description                                                                                                                                                                                                                                                            |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><u>DTC P0502 or P0503</u></b>              | DTC P0502 Vehicle Speed Sensor (VSS) Circuit Low Voltage<br>DTC P0503 Vehicle Speed Sensor (VSS) Circuit Intermittent                                                                                                                                                  |
| <b><u>DTC P0712 or P0713</u></b>              | DTC P0712 Transmission Fluid Temperature Sensor Circuit Low Voltage<br>DTC P0713 Transmission Fluid Temperature Sensor Circuit High Voltage                                                                                                                            |
| <b><u>DTC P0729, P0731-P0735 or P076F</u></b> | DTC P0729 6th Gear Ratio Incorrect<br>DTC P0731 1st Gear Ratio Incorrect<br>DTC P0732 2nd Gear Ratio Incorrect<br>DTC P0733 3rd Gear Ratio Incorrect<br>DTC P0734 4th Gear Ratio Incorrect<br>DTC P0735 5th Gear Ratio Incorrect<br>DTC P076F 7th Gear Ratio Incorrect |
| <b><u>DTC P0801, P088C or P088D</u></b>       | DTC P0801 Reverse Inhibit Solenoid Actuator Control Circuit<br>DTC P088C Reverse Inhibit Solenoid Actuator Control Circuit Low Voltage<br>DTC P088D Reverse Inhibit Solenoid Actuator Control Circuit High Voltage                                                     |
| <b><u>DTC P0803, P080C or P080D</u></b>       | DTC P0803 Skip Shift Solenoid Actuator Control Circuit<br>DTC P080C Skip Shift Solenoid Actuator Control Circuit Low Voltage                                                                                                                                           |

|                                  |                                                                                                                                                                                                   |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | Circuit High Voltage                                                                                                                                                                              |
| <b><u>DTC P0806-P0808</u></b>    | DTC P0806 Clutch Pedal Position (CPP) Sensor Performance<br>DTC P0807 Clutch Pedal Position (CPP) Sensor Circuit Low Voltage<br>DTC P0808 Clutch Pedal Position (CPP) Sensor Circuit High Voltage |
| <b><u>DTC P080A</u></b>          | DTC P080A Clutch Pedal Position (CPP) Not Learned                                                                                                                                                 |
| <b><u>DTC P18C4 or P18C5</u></b> | DTC P18C4 Gear Position Sensor Circuit 1 Low Voltage<br>DTC P18C5 Gear Position Sensor Circuit 1 High Voltage                                                                                     |
| <b><u>DTC P18C6 or P18C7</u></b> | DTC P18C6 Gear Position Sensor Circuit 2 Low Voltage<br>DTC P18C7 Gear Position Sensor Circuit 2 High Voltage                                                                                     |
| <b><u>DTC P18C9</u></b>          | DTC P18C9 Gear Position Sensor - Gear Ratio Not Plausible                                                                                                                                         |
| <b><u>DTC P18CA</u></b>          | DTC P18CA Gear Position Sensor Not Learned                                                                                                                                                        |

## **DTC P0502 OR P0503: VEHICLE SPEED SENSOR (VSS)**

### **Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

### **DTC Descriptors**

#### **DTC P0502**

Vehicle Speed Sensor (VSS) Circuit Low Voltage

#### **DTC P0503**

Vehicle Speed Sensor (VSS) Circuit Intermittent

### **Circuit/System Description**

The vehicle speed sensor (VSS) is a 3 wire sensor. B+ power to the sensor is supplied to the through a fuse and a ground is provided through the chassis. The VSS is a Hall Effect type sensor that produces a square wave output signal to the engine control module (ECM). As vehicle speed increases, the output frequency of the VSS signal increases. The ECM converts the square wave output signal into vehicle speed shown as km/h (MPH). The ECM supplies the VSS signal to other

control modules on the vehicle through the serial data communications line.

#### Conditions for Running the DTC

##### P0502

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308, P0503, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E or P217F is not set.
- Ignition voltage is between 9-32 V.
- Throttle position is 8 % or greater.
- Engine speed is between 1, 500-6, 500 RPM.
- Engine torque is 54 Nm (40 lb ft) or greater

##### P0503

- Ignition voltage is between 9-32 V.
- Engine speed is between 200-7, 500 RPM for 5 s or greater.
- Change in VSS signal is 150 RPM or less for 2 s or greater.

#### Conditions for Setting the DTC

##### P0502

VSS signal is less than 60 RPM for 4.5 s.

##### P0503

Change in VSS signal is 350 RPM or greater for 3.3 s.

#### Action Taken When the DTC Sets

P0502 and P0503 are Type B DTCs.

#### Conditions for Clearing the DTC

P0502 and P0503 are Type B DTCs.

#### Diagnostic Aids

The battery must be fully charged. Refer to **Battery Inspection/Test** .

#### Reference Information

Schematic Reference

### **Manual Transmission Schematics**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Manual Transmission Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

### **K20 Engine Control Module: Scan Tool Information**

Special Tools

**J-38522-A** Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

**CAUTION:** Support the lower control arms in the normal horizontal position in order to avoid damage to the drive axles. Do not operate the vehicle in gear with the wheels hanging down at full travel.

1. Raise and support the drive wheels in a horizontal position.
2. Start and idle the engine.
3. Place the transmission in second gear and release the clutch pedal.
4. Verify the scan tool Vehicle Speed Sensor parameter increases as the drive wheel speed increases.
  - **If the Vehicle Speed Sensor parameter does not increase**

Refer to Circuit/System Testing.

- **If the Vehicle Speed Sensor parameter does increase**

5. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

#### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the B115 Vehicle Speed Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal C and ground.

- **If 10 ohms or greater**

1. Test for less than 2 ohms in the ground circuit end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal A and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp.
2. Test for less than 2 ohms in the B+ circuit end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF, remove the test lamp.
2. Disconnect the harness connector from the components listed below.
  - B52D Heated Oxygen Sensor-Bank 1 Sensor 2
  - B52F Heated Oxygen Sensor-Bank 2 Sensor 2
  - B75C Multifunction Intake Air Sensor
3. Test for infinite resistance between the B+ circuit at the B115 Vehicle Speed Sensor harness connector and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance

4. Reconnect the harness connector to each component listed below one at a time and retest to verify if a component is shorted.
  - B52D Heated Oxygen Sensor-Bank 1 Sensor 2
  - B52F Heated Oxygen Sensor-Bank 2 Sensor 2
  - B75C Multifunction Intake Air Sensor
  - If a component is shorted, replace as necessary.
  - If none of the components listed above are shorted, replace the B115 Vehicle Speed Sensor.
  - **If the test lamp illuminates**
5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit terminal B at the B115 Vehicle Speed Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 50% or normal position.
7. Ignition ON.
8. Verify the scan tool Vehicle Speed Sensor parameter displays between 32-39 km/h (20-24 mph).
  - **If the vehicle speed sensor parameter is not within the specified range**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal B and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the signal circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the vehicle speed sensor parameter is within the specified range**
9. Replace the B115 Vehicle Speed Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Output Speed Sensor Replacement**
- **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2**
- **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**

- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup.

## DTC P0712 OR P0713: TRANSMISSION FLUID TEMPERATURE SENSO

### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0712

Transmission Fluid Temperature Sensor Circuit Low Voltage

#### DTC P0713

Transmission Fluid Temperature Sensor Circuit High Voltage

### Diagnostic Fault Information

| Circuit                                                                     | Short to Ground | Open/High Resistance | Short to Voltage   | Signal Performance |
|-----------------------------------------------------------------------------|-----------------|----------------------|--------------------|--------------------|
| Transmission Fluid Temperature Sensor Signal                                | P0712           | P0713                | P0713 <sup>1</sup> | -                  |
| Low Reference                                                               | -               | P0713                | P0713 <sup>1</sup> | -                  |
| <sup>1</sup> Internal ECM damage may occur if the circuit is shorted to B+. |                 |                      |                    |                    |

### Circuit/System Description

The transmission fluid temperature sensor is a variable resistor that measures the temperature of the transmission fluid. The engine control module (ECM) supplies 5 volts to the transmission fluid temperature sensor signal circuit and supplies a ground to the low reference circuit.

The following table illustrates the difference between temperature, resistance and voltage:

| Transmission Fluid Temperature Sensor | Transmission Fluid Temperature Sensor Resistance | Transmission Fluid Temperature Sensor Signal Voltage |
|---------------------------------------|--------------------------------------------------|------------------------------------------------------|
| Cold                                  | High                                             | High                                                 |
| Warm                                  | Low                                              | Low                                                  |

## **P0712**

- The engine speed is above 1, 000 RPM for 7 seconds.
- This DTC runs continuously when the above condition is met.

## **P0713**

- The engine speed is above 1, 000 RPM for 7 seconds.
- This DTC runs continuously when the above condition is met.

### **Conditions for Setting the DTC**

## **P0712**

The transmission fluid temperature is greater than 145°C (299°F) for more than 5 seconds.

## **P0713**

The transmission fluid temperature is less than -35°C (-31°F) for more than 5 seconds.

### **Action Taken When the DTC Sets**

DTC P0712 and P0713 are Type C DTCs.

### **Conditions for Clearing the MIL/DTC**

DTC P0712 and P0713 are Type C DTCs.

### **Reference Information**

Schematic Reference

### **Manual Transmission Schematics**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Manual Transmission Description and Operation**
- **Transmission Fluid Temperature Sensor Description and Operation**

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

### **Control Module References**

#### **Circuit/System Verification**

1. Engine running.
2. Operate the vehicle within the conditions for running the DTC to verify DTC P0712 or P0713 does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
3. All OK.

#### **Circuit/System Testing**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector of the B13 Transmission Fluid Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal A and ground.
  - **If 10 ohms or greater**
    1. Disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the low reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Transmission Fluid Temperature Sensor parameter is at -40°C (-40°F).
  - **If greater than -40°C (-40°F)**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal B and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.
- **If at -40°C (-40°F)**

**NOTE:**        **If the signal circuit of the B13 Transmission Fluid Temperature Sensor is shorted to voltage the sensor may be damaged.**

5. Install a 3-amp fused jumper wire between the signal circuit terminal B and the low reference circuit terminal A.
6. Verify the scan tool Transmission Fluid Temperature Sensor parameter is greater than 128°C (262°F).
  - **If 128°C (262°F) or less**
    1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 1 V between the signal circuit terminal B and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Test for less than 2 ohms in the signal circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 128°C (262°F)**
7. Replace the B13 Transmission Fluid Temperature Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Fluid Temperature Sensor Replacement**
- **Control Module References** for ECM replacement, setup and programming.

#### **DTC P0729, P0731-P0735 OR P076F: GEAR RATIO INCORRECT**

#### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

#### DTC Descriptors

#### **DTC P0729**

**DTC P0731**

1st Gear Ratio Incorrect

**DTC P0732**

2nd Gear Ratio Incorrect

**DTC P0733**

3rd Gear Ratio Incorrect

**DTC P0734**

4th Gear Ratio Incorrect

**DTC P0735**

5th Gear Ratio Incorrect

**DTC P076F**

7th Gear Ratio Incorrect

**Diagnostic Fault Information**

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage | Signal Performance                                     |
|---------------|---------------------|----------------------|------------------|--------------------------------------------------------|
| 5 V Reference | P0651, P18C5, P18C7 | P18C5, P18C7         | P0651            | -                                                      |
| Signal 1      | P18C4               | P18C5                | P18C5            | P0729, P0731, P0732, P0733, P0734, P0735, P076F, P18C9 |
| Signal 2      | P18C6               | P18C7                | P18C7            | P0729, P0731, P0732, P0733, P0734, P0735, P076F, P18C9 |
| Low Reference | -                   | P18C5, P18C7         | -                | -                                                      |

**Circuit/System Description**

The gear position sensor is a switching transistor mounted to the top of the transmission extension housing. The four wire sensor interfaces directly with the Engine Control Module (ECM). The ECM supplies 5 V to the gear position sensor on a 5 V reference circuit and also provides a ground path on

a low reference circuit. The sensor provides a Pulse Width Modulated (PWM) duty cycle to the ECM on two signal circuits that is proportional to the linear and radial position of the corresponding magnet assembly mounted to the shift shaft. The vehicle uses the gear position sensor information primarily for Active Rev Matching and Active Fuel Management. The ECM monitors the sensor signal input for an incorrect forward gear condition.

#### **Conditions for Running the DTC**

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0171, P0172, P0174, P0175, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308, P0401, P042E, P0502, P0503, P0806, P0807, P0808, P080A, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P18C4, P18C5, P18C6, P18C7, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F or P2771 is not set.
- Ignition voltage is between 9-32 V.
- Throttle position is 8 % or greater.
- Engine torque is 50 Nm (37 lb ft) or greater
- Gear position sensor learn status is Learned
- Clutch pedal is released
- Transmission output speed is 120 RPM or greater
- The above conditions are met for 1.5 s.

#### **Conditions for Setting the DTC**

##### **P0729**

ECM detects the measured gear ratio indicates 6th gear but the gear position sensor does not indicate 6th gear for 1 s.

##### **P0731**

ECM detects the measured gear ratio indicates 1st gear but the gear position sensor does not indicate 1st gear for 1 s.

##### **P0732**

ECM detects the measured gear ratio indicates 2nd gear but the gear position sensor does not indicate 2nd gear for 1 s.

##### **P0733**

ECM detects the measured gear ratio indicates 3rd gear but the gear position sensor does not indicate 3rd gear for 1 s.

ECM detects the measured gear ratio indicates 4th gear but the gear position sensor does not indicate 4th gear for 1 s.

### **P0735**

ECM detects the measured gear ratio indicates 5th gear but the gear position sensor does not indicate 5th gear for 1 s.

### **P076F**

ECM detects the measured gear ratio indicates 7th gear but the gear position sensor does not indicate 7th gear for 1 s.

#### **Action Taken When the DTC Sets**

- P0729, P0731, P0732, P0733, P0734, P0735 and P076F are Type A DTCs.
- ECM inhibits Active Rev Matching.

#### **Conditions for Clearing the DTC**

P0729, P0731, P0732, P0733, P0734, P0735 and P076F are Type A DTCs.

#### **Reference Information**

Schematic Reference

#### **Manual Transmission Schematics**

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

#### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

## Scan Tool Reference

### **K20 Engine Control Module: Scan Tool Information**

#### Special Tools

**J-38522-A** Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

#### Circuit/System Verification

**WARNING:** Refer to **Road Test Warning** .

1. Test drive the vehicle shifting the transmission through all gear ranges.
2. Verify the transmission shifts smoothly through all gears, the clutch engagement is firm and engine speed remains constant during steady state driving.
3. Verify the scan tool Current Gear parameter matches the Gear Shift Position parameter when the clutch is released for each forward gear.

- **If the transmission does not shift smoothly**

Refer to **Symptoms - Manual Transmission**.

- **If the engine speed flares during steady state driving and the Current Gear and Gear Shift Position parameters don't match**

Refer to **Symptoms - Clutch** .

- **If the Current Gear and Gear Shift Position parameters don't match**

Refer to Circuit/System Testing.

- **If the transmission shifts smoothly, engine speed remains constant during steady state driving and Current Gear and Gear Shift Position parameters match**

4. Ignition ON.
5. Verify the scan tool Gear Shift Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
  - 12-28% duty cycle for Gear 1 and Gear 2
  - 32-47% duty cycle for Gear 3, Neutral 3-4 Gate and Gear 4
  - 49-64% duty cycle for Gear 5 and Gear 6
  - 61-85% duty cycle for Gear 7 and Reverse Gear
  - **If the Gear Shift Position Sensor parameter is not within the specified range**

Refer to Circuit/System Testing.

- **If the Gear Shift Position Sensor parameter is within the specified range**

6. Verify the scan tool Gate Select Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
  - 71-88% duty cycle for Gear 1, Gear 3, Gear 5 and Gear 7
  - 43-60% duty cycle for Neutral 3-4 Gate
  - 17-40% duty cycle for Gear 2, Gear 4, Gear 6 and Reverse Gear
- **If the Gate Select Position Sensor parameter is not within the specified range**

Refer to Circuit/System Testing.

- **If the Gate Select Position Sensor parameter is within the specified range**

7. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
  - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

#### Circuit/System Testing

**WARNING:** Refer to Hot Exhaust System Warning .

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B227 Gear Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
  - **If 10 ohms or greater**
    1. Disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2 ohms in the 5 V reference circuit end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 1 terminal 2 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
7. Ignition ON.
8. Verify the scan tool Gear Shift Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
9. Set duty cycle switch to 20%, then 30% and so on through 90%.
10. Verify the scan tool Gear Shift Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gear Shift Position Sensor parameter is not within the specified range**
1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the signal circuit 1 terminal 2 and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Ignition OFF.
4. Test for infinite resistance between the signal circuit 1 terminal 2 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
5. Test for less than 2 ohms in the signal circuit 1 end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gear Shift Position Sensor parameter is within the specified range**
11. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
    - Red test lead to the signal circuit 2 terminal 3 at the B227 Gear Position Sensor wire harness connector.
    - Black test lead to ground at the transmission case.
    - Double black power and ground lead wire to B+ and ground.
  12. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
    - Signal switch to 5 V.
    - Frequency switch to 600 Hz.
    - Duty cycle switch to 10%.
  13. Ignition ON.
  14. Verify the scan tool Gate Select Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
  15. Set duty cycle switch to 20%, then 30% and so on through 90%.
  16. Verify the scan tool Gate Select Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
    - **If the Gate Select Position Sensor parameter is not within the specified range**
      1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
      2. Test for less than 1 V between the signal circuit 2 terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Ignition OFF.
      4. Test for infinite resistance between the signal circuit 2 terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      5. Test for less than 2 ohms in the signal circuit 2 end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the K20 Engine Control Module.
    - **If the Gate Select Position Sensor parameter is within the specified range**

**NOTE:**      **The gear position sensor magnet can be viewed with a mirror when the gear position sensor is removed from the top of the transmission extension housing.**

17. Verify the gear position sensor magnet is undamaged and fastened in proper position on the shift shaft.
  - **If the gear position sensor magnet is damaged or out of position**

Replace the gear position sensor magnet.

- **If the gear position sensor is undamaged and fastened properly on the shift shaft**

18. Replace the B227 Gear Position Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Gear Position Sensor Replacement**
- **Disassembled Views**
- **Transmission Disassemble**
- **Transmission Assemble**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P0801, P088C OR P088D: REVERSE INHIBIT SOLENOID ACTUATOR

##### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

##### DTC Descriptor

#### DTC P0801

Reverse Inhibit Solenoid Actuator Control Circuit

#### DTC P088C

Reverse Inhibit Solenoid Actuator Control Circuit Low Voltage

#### DTC P088D

Reverse Inhibit Solenoid Actuator Control Circuit High Voltage

##### Diagnostic Fault Information

| Circuit                                         | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| B+ Circuit to Reverse Inhibit Solenoid Actuator | P0801, P088C    | P0801, P088C         | -                | -                  |
| Reverse Inhibit Solenoid Actuator Control       | P0801, P088C    | P0801, P088C         | P0801, P088D     | -                  |

## Typical Scan Tool Data

### Reverse Inhibit Solenoid Command

| Circuit                                                                                            | Short to Ground | Open/High Resistance | Short to Voltage |
|----------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|
| <b>Operating Conditions:</b> Engine Running.<br><b>Parameter Normal Range:</b> Inhibit or Allowed. |                 |                      |                  |
| Reverse Inhibit Solenoid Control                                                                   | Allowed         | Allowed              | Allowed          |

### Circuit/System Description

Battery voltage (B+) is supplied directly to the reverse lockout solenoid. The engine control module (ECM) controls the reverses lockout solenoid by grounding the control circuit via an internal switch called a low side driver. The low side driver has a fault line which monitors the control circuit. When the ECM commands the reverse lockout solenoid ON, the voltage on the control circuit should be low, near 0 volts. When the ECM commands the control circuit to the reverse lockout solenoid OFF, the voltage should be high, near battery voltage.

### Conditions for Running the DTC

- The engine is running.
- The vehicle speed is less than 3 km/h (2 mph).

### Conditions for Setting the DTC

- The ECM detects that the commanded state of the driver and the actual state of the control circuit does not match.
- The condition exists for 2 seconds.

### Action Taken When the DTC Sets

P0801, P088C and P088D are Type C DTCs.

### Conditions for Clearing the MIL/DTC

P0801, P088C and P088D are Type C DTCs.

### Diagnostic Aids

The battery must be fully charged and pass a battery test. Refer to **Battery Inspection/Test** .

### Reference Information

### Schematic Reference

### **Manual Transmission Schematics**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Manual Transmission Description and Operation**
- **Reverse Inhibit Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

Circuit/System Verification

1. Ignition ON, verify the scan tool Reverse Inhibit parameters listed below change states between OK and Not Run or Not Run and OK while commanding the Reverse Inhibit Solenoid Actuator to Enable and Disable.
  - Reverse Inhibit Solenoid Actuator Control Circuit Low Voltage Test Status
  - Reverse Inhibit Solenoid Actuator Control Circuit Open Test Status
  - Reverse Inhibit Solenoid Actuator Control Circuit High Voltage Test Status
  - **If each parameter does not change between OK and Not Run or Not Run and OK**

Refer to Circuit/System Testing.

  - **If each parameter changes between OK and Not Run or Not Run and OK**
2. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
  - **If the DTC sets**

Refer to Circuit/System Testing.

3. All OK.

#### Circuit/System Testing

**NOTE:** You must perform the Circuit/System Verification first.

1. Ignition OFF, disconnect the M47 Reverse Inhibit Solenoid Actuator harness connector.
2. Verify that a test lamp illuminates between the B+ circuit terminal B and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Remove the test lamp.
    2. Test for less than 2 ohms in the B+ circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the M47 Reverse Inhibit Solenoid Actuator.
  - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the B+ circuit terminal B and the control circuit terminal A.
  - **If the test lamp illuminates**
    1. Remove the test lamp, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K20 Engine Control Module.
  - **If the test lamp does not illuminate**
4. Ignition ON.
5. Verify that a test lamp illuminates between the B+ circuit terminal B and the control circuit terminal A.
  - **If the test lamp does not illuminate**
    1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the control circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the test lamp illuminates**
6. Remove the test lamp.

7. Verify the scan tool Reverse Inhibit Solenoid Actuator Control High Voltage Test Status parameter displays OK.
  - **If not OK**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If OK**
8. Replace the M47 reverse inhibit solenoid actuator.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Reverse Lockout Solenoid Replacement**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P0803, P080C OR P080D: SKIP SHIFT SOLENOID ACTUATOR

##### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

##### DTC Descriptor

##### DTC P0803

Skip Shift Solenoid Actuator Control Circuit

##### DTC P080C

Skip Shift Solenoid Actuator Control Circuit Low Voltage

##### DTC P080D

Skip Shift Solenoid Actuator Control Circuit High Voltage

##### Diagnostic Fault Information

| Circuit | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------|-----------------|----------------------|------------------|--------------------|
|---------|-----------------|----------------------|------------------|--------------------|

|                                              |       |       |       |   |
|----------------------------------------------|-------|-------|-------|---|
| Ignition Circuit                             | P080C | P0803 | -     | - |
| Skip Shift Solenoid Actuator Control Circuit | P080C | P0803 | P080D | - |

#### Typical Scan Tool Data

#### Skip Shift Solenoid Actuator Command

| Circuit                                                                                         | Short to Ground | Open/High Resistance | Short to Voltage |
|-------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|
| <b>Operating Conditions:</b> Engine Running.<br><b>Parameter Normal Range:</b> Skip or No Skip. |                 |                      |                  |
| Skip Shift Solenoid Actuator Control Circuit                                                    | No Skip         | No Skip              | No Skip          |

#### Circuit/System Description

Ignition voltage is supplied directly to the skip shift solenoid actuator. The engine control module (ECM) controls the skip shift solenoid actuator by grounding the control circuit via an internal switch called a low side driver. The low side driver has a fault line which monitors the control circuit. When the ECM commands the skip shift solenoid actuator ON, the voltage on the control circuit should be low, near 0 volts. When the ECM commands the control circuit to the skip shift solenoid actuator OFF, the voltage should be high, near battery voltage.

#### Conditions for Running the DTC

- Ignition voltage is between 9-32 V.
- Engine speed is greater than 250 RPM.

#### Conditions for Setting the DTC

##### P0803

The ECM detects that the voltage on the control circuit is low during the driver OFF state, indicating an open, for 1.5 s.

##### P080C

The ECM detects that the voltage on the control circuit is low during the driver OFF state, indicating a short to ground, for 1.5 s.

##### P080D

The ECM detects that the voltage on the control circuit is high during the driver ON state for 1.5 s.

#### Action Taken When the DTC Sets

P0803, P080C and P080D are Type B DTCs.

## Conditions for Clearing the MIL/DTC

P0803, P080C and P080D are Type B DTCs.

## Diagnostic Aids

The battery must be fully charged and pass a battery test. Refer to **Battery Inspection/Test** .

## Reference Information

Schematic Reference

## **Manual Transmission Schematics**

Connector End View Reference

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- **Skip Shift Description and Operation**
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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

## **Control Module References**

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Skip Shift Solenoid Actuator Control Circuit Status parameters listed below toggle between OK and Not Run or Not Run and OK while commanding the skip shift solenoid actuator ON and OFF.
  - Skip Shift Solenoid Actuator Control Circuit Low Voltage Test Status

- Skip Shift Solenoid Actuator Control Circuit High Voltage Test Status
- **If each parameter does not change between OK and Not Run or Not Run and OK**

Refer to Circuit/System Testing.

- **If each parameter changes between OK and Not Run or Not Run and OK**

3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

4. All OK.

#### Circuit/System Testing

**IMPORTANT: You must perform the Circuit/System Verification first.**

1. Ignition OFF, disconnect the Q34 Skip Shift Solenoid Actuator harness connector.
2. Ignition ON.
3. Verify that a test lamp illuminates between the Ignition circuit terminal B and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 ohms in the Ignition circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the Ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the Q34 Skip Shift Solenoid Actuator.
  - **If the test lamp illuminates**
4. Verify that a test lamp does not illuminate between the Ignition circuit terminal B and the control circuit terminal A.
  - **If the test lamp illuminates**
    1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit

- If infinite resistance, replace the K20 Engine Control Module.
- **If the test lamp does not illuminate**
- 5. Remove the test lamp.
- 6. Verify the scan tool Skip Shift Solenoid Actuator Control Circuit High Voltage Test Status parameter is OK while commanding the Q34 Skip Shift Solenoid Actuator ON.
  - **If not OK**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If OK**
- 7. Install a 3A fused jumper wire between the control circuit terminal A and the Ignition circuit terminal B.
- 8. Verify the scan tool Skip Shift Solenoid Actuator Control Circuit High Voltage Test Status parameter is displaying Fault while commanding the Q34 Skip Shift Solenoid Actuator ON.
  - **If not Fault**
    1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the control circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If Fault**
- 9. Replace the Q34 Skip Shift Solenoid Actuator.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Skip Shift Solenoid Replacement**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P0806-P0808: CLUTCH PEDAL POSITION (CPP) SENSOR

##### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

##### DTC Descriptors

## DTC P0806

Clutch Pedal Position (CPP) Sensor Performance

## DTC P0807

Clutch Pedal Position (CPP) Sensor Circuit Low Voltage

## DTC P0808

Clutch Pedal Position (CPP) Sensor Circuit High Voltage

### Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference | P0651, P0807    | P0807                | P0651, P0808     | -                  |
| Signal        | P0807           | P0807                | P0808            | P0806              |
| Low Reference | -               | P0808                | P0808            | -                  |

### Typical Scan Tool Data

#### CPP Sensor Voltage

| Circuit                                                                                                                                                            | Short to Ground | Open | Short to Voltage |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------------|
| <b>Operating Conditions:</b> Ignition ON.<br><b>CPP Sensor Voltage Parameter Normal Range:</b> 0 V with clutch pedal applied to 5 V when clutch pedal is released. |                 |      |                  |
| 5 V Reference                                                                                                                                                      | 0 V             | 0 V  | 5 V              |
| Signal                                                                                                                                                             | 0 V             | 0 V  | 5 V              |
| Low Reference                                                                                                                                                      | -               | 5 V  | -                |

#### CPP Sensor Percentage

| Circuit                                                                                                                                                            | Short to Ground | Open | Short to Voltage |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------------|
| <b>Operating Conditions:</b> Ignition ON.<br><b>CPP Sensor Percent Parameter Normal Range:</b> 0% with clutch pedal released to 100% when clutch pedal is applied. |                 |      |                  |
| 5 V Reference                                                                                                                                                      | 100%            | 100% | 0-100%           |
| Signal                                                                                                                                                             | 100%            | 100% | 100%             |
| Low Reference                                                                                                                                                      | -               | 0%   | -                |

### Circuit/System Description

low reference circuit and a signal circuit. The engine control module supplies 5 V to the CPP sensor and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage near 5 V when the clutch pedal is released, to a voltage less than or equal to 1.5 V when the clutch pedal is applied.

#### **Conditions for Running the DTC**

##### **P0806**

- DTC P0335, P0336, P0502, P0503, P0807 or P0808 is not set.
- The vehicle speed is greater than 3 kmh (2 mph).
- The ignition is ON.
- Transmission is in gear.

##### **P0807 and P0808**

- No other DTCs are set.
- The system voltage is more than 9 V.
- The ignition is ON.

#### **Conditions for Setting the DTC**

##### **P0806**

The CPP sensor is stuck in range.

##### **P0807**

The CPP sensor voltage is less than 0.1 V for more than 1 s.

##### **P0808**

The CPP sensor voltage is more than 5.0 V for more than 1 s.

#### **Action Taken When the DTC Sets**

DTC P0806 - P0808 are Type A DTCs.

#### **Conditions for Clearing the DTC**

DTC P0806 - P0808 are Type A DTCs.

#### **Reference Information**

##### **Schematic Reference**

## **Manual Transmission Schematics**

Connector End View Reference

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- **Circuit Testing**
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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**K20 Engine Control Module: Scan Tool Information** for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool CPP Sensor percent parameter varies from 0% when the clutch pedal is released, to 100% when the clutch pedal is in the apply position.
  - **If the percentage does not vary from 0% to 100%**

Refer to Circuit/System Testing.

- **If the percentage varies from 0% to 100%**
3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
4. All OK.

## Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the B25B Clutch Pedal Position Sensor.
2. Test for less than 5 ohms between the low reference circuit terminal A and ground:
  - **If 5 ohms or greater**
    1. Disconnect the X1 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal C and ground:
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the 5 V reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
5. Verify the scan tool CPP Sensor voltage parameter is less than 0.1 V.
  - **If 0.1 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, Ignition ON.
    2. Test for less than 1 V between the signal circuit terminal B and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If less than 0.1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal B and the 5 V reference circuit terminal C.
7. Verify the scan tool CPP Sensor voltage parameter is greater than 4.9 V.
  - **If 4.9 V or less**

1. Ignition OFF, remove the jumper wire, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal B and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2 ohms in the signal circuit end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.

- **If greater than 4.9 V**

8. Test or replace the B25B Clutch Pedal Position Sensor.

### Component Testing

#### Static Test

1. Ignition OFF, disconnect the harness connector of the B25B Clutch Pedal Position Sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal A at the B25B Clutch Pedal Position Sensor. Depress the clutch pedal through the entire range. The resistance should vary from low to high and vice versa without any spikes or dropouts.

- **If the resistance is erratic with spikes or dropouts**

Replace the B25B Clutch Pedal Position Sensor.

- **If the resistance is not erratic without spikes or dropouts**

3. All OK.

### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Clutch Pedal Position Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup.

### DTC P080A: CLUTCH PEDAL POSITION (CPP)

#### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

#### DTC Descriptor

## Clutch Pedal Position (CPP) Not Learned

### Circuit/System Description

The clutch pedal position (CPP) is a three wire sensor, connected to a 5-volt reference circuit, a low reference circuit and a signal circuit. The engine control module (ECM) supplies 5-volts to the CPP sensor and also provides a sensor ground path on the low reference circuit. The CPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage less than or equal to 5-volts when the clutch pedal is released to a voltage less than or equal to 1.5-volts when the clutch pedal is applied.

### Conditions for Running the DTC

Clutch pedal fully applied.

### Conditions for Setting the DTC

Clutch pedal position not learned.

### Action Taken When the DTC Sets

P080A is a Type B DTC.

### Conditions for Clearing the MIL/DTC

P080A is a Type B DTC.

### Reference Information

Schematic Reference

### Manual Transmission Schematics

Connector End View Reference

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DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information.

Circuit/System Verification

Perform the clutch pedal position sensor learn procedure.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Clutch Pedal Position Sensor Learn**
- **Control Module References** for ECM replacement, setup and programming

### **DTC P18C4 OR P18C5: GEAR POSITION SENSOR CIRCUIT 1**

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

#### **DTC P18C4**

Gear Position Sensor Circuit 1 Low Voltage

#### **DTC P18C5**

Gear Position Sensor Circuit 1 High Voltage

Diagnostic Fault Information

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|---------------------|----------------------|------------------|--------------------|
| 5 V Reference | P0651, P18C5, P18C7 | P18C5, P18C7         | P0651            | -                  |
| Signal 1      | P18C4               | P18C5                | P18C5            | P0729, P0731,      |

|               |       |              |       |                                                                 |
|---------------|-------|--------------|-------|-----------------------------------------------------------------|
|               |       |              |       | P0734, P0735,<br>P076F, P18C9                                   |
| Signal 2      | P18C6 | P18C7        | P18C7 | P0729, P0731,<br>P0732, P0733,<br>P0734, P0735,<br>P076F, P18C9 |
| Low Reference | -     | P18C5, P18C7 | -     | -                                                               |

#### Circuit/System Description

The gear position sensor is a switching transistor mounted to the top of the transmission extension housing. The four wire sensor interfaces directly with the Engine Control Module (ECM). The ECM supplies 5 V to the gear position sensor on a 5 V reference circuit and also provides a ground path on a low reference circuit. The sensor provides a Pulse Width Modulated (PWM) duty cycle to the ECM on two signal circuits that is proportional to the linear and radial position of the corresponding magnet assembly mounted to the shift shaft. The vehicle uses the gear position sensor information primarily for Active Rev Matching and Active Fuel Management. The ECM monitors the signal 1 circuit for low and high voltage conditions.

#### Conditions for Running the DTC

Ignition voltage is between 9-32 V.

#### Conditions for Setting the DTC

##### **P18C4**

Gear position sensor signal 1 duty cycle is less than 10% for 3 s.

##### **P18C5**

Gear position sensor signal 1 duty cycle is more than 90% for 3 s.

#### Action Taken When the DTC Sets

- P18C4 and P18C5 are Type A DTCs.
- ECM inhibits Active Rev Matching.

#### Conditions for Clearing the DTC

P18C4 and P18C5 are Type A DTCs.

#### Reference Information

#### Schematic Reference

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DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

### **K20 Engine Control Module: Scan Tool Information**

Special Tools

**J-38522-A** Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Gear Shift Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
  - 12-28% duty cycle for Gear 1 and Gear 2
  - 32-47% duty cycle for Gear 3, Neutral 3-4 Gate and Gear 4
  - 49-64% duty cycle for Gear 5 and Gear 6
  - 61-85% duty cycle for Gear 7 and Reverse Gear
  - **If the Gear Shift Position Sensor parameter is not within the specified range**  
  
Refer to Circuit/System Testing.
  - **If the Gear Shift Position Sensor parameter is within the specified range**
3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set.

You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

4. All OK.

#### Circuit/System Testing

**WARNING: Refer to Hot Exhaust System Warning .**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B227 Gear Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
  - **If 10 ohms or greater**
    1. Disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the 5 V reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**

5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 1 terminal 2 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
7. Ignition ON.
8. Verify the scan tool Gear Shift Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
9. Set duty cycle switch to 20%, then 30% and so on through 90%.
10. Verify the scan tool Gear Shift Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gear Shift Position Sensor parameter is not within the specified range**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit 1 terminal 2 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Ignition OFF.
    4. Test for infinite resistance between the signal circuit 1 terminal 2 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    5. Test for less than 2 ohms in the signal circuit 1 end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gear Shift Position Sensor parameter is within the specified range**
11. Replace the B227 Gear Position Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Gear Position Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P18C6 OR P18C7: GEAR POSITION SENSOR CIRCUIT 2

#### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

#### DTC Descriptors

#### DTC P18C6

Gear Position Sensor Circuit 2 Low Voltage

#### DTC P18C7

Gear Position Sensor Circuit 2 High Voltage

#### Diagnostic Fault Information

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage | Signal Performance                                     |
|---------------|---------------------|----------------------|------------------|--------------------------------------------------------|
| 5 V Reference | P0651, P18C5, P18C7 | P18C5, P18C7         | P0651            | -                                                      |
| Signal 1      | P18C4               | P18C5                | P18C5            | P0729, P0731, P0732, P0733, P0734, P0735, P076F, P18C9 |
| Signal 2      | P18C6               | P18C7                | P18C7            | P0729, P0731, P0732, P0733, P0734, P0735, P076F, P18C9 |
| Low Reference | -                   | P18C5, P18C7         | -                | -                                                      |

#### Circuit/System Description

The gear position sensor is a switching transistor mounted to the top of the transmission extension housing. The four wire sensor interfaces directly with the Engine Control Module (ECM). The ECM supplies 5 V to the gear position sensor on a 5 V reference circuit and also provides a ground path on a low reference circuit. The sensor provides a Pulse Width Modulated (PWM) duty cycle to the ECM on two signal circuits that is proportional to the linear and radial position of the corresponding magnet assembly mounted to the shift shaft. The vehicle uses the gear position sensor information primarily for Active Rev Matching and Active Fuel Management. The ECM monitors the signal 2 circuit for low and high voltage conditions.

#### Conditions for Running the DTC

Ignition voltage is between 9-32 V.

## Conditions for Setting the DTC

### **P18C6**

Gear position sensor signal 2 duty cycle is less than 10% for 3 s.

### **P18C7**

Gear position sensor signal 2 duty cycle is more than 90% for 3 s.

## Action Taken When the DTC Sets

- P18C6 and P18C7 are Type A DTCs.
- ECM inhibits Active Rev Matching.

## Conditions for Clearing the DTC

P18C6 and P18C7 are Type A DTCs.

## Reference Information

Schematic Reference

### **Manual Transmission Schematics**

Connector End View Reference

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DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

## **K20 Engine Control Module: Scan Tool Information**

### Special Tools

#### **J-38522-A** Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

### Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Gate Select Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
  - 71-88% duty cycle for Gear 1, Gear 3, Gear 5 and Gear 7
  - 43-60% duty cycle for Neutral 3-4 Gate
  - 17-40% duty cycle for Gear 2, Gear 4, Gear 6 and Reverse Gear
  - **If the Gate Select Position Sensor parameter is not within the specified range**

Refer to Circuit/System Testing.

- **If the Gate Select Position Sensor parameter is within the specified range**
3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
    - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
4. All OK.

### Circuit/System Testing

**WARNING:** Refer to **Hot Exhaust System Warning** .

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B227 Gear Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
  - **If 10 ohms or greater**
    1. Disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.
- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the 5 V reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
- 5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 2 terminal 3 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
- 6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
- 7. Ignition ON.
- 8. Verify the scan tool Gate Select Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
- 9. Set duty cycle switch to 20%, then 30% and so on through 90%.
- 10. Verify the scan tool Gate Select Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gate Select Position Sensor parameter is not within the specified range**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit 2 terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V
- 3. Ignition OFF.
- 4. Test for infinite resistance between the signal circuit 2 terminal 3 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
- 5. Test for less than 2 ohms in the signal circuit 2 end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gate Select Position Sensor parameter is within the specified range**
- 11. Replace the B227 Gear Position Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Gear Position Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P18C9: GEAR POSITION SENSOR

##### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

##### DTC Descriptors

#### DTC P18C9

Gear Position Sensor - Gear Ratio Not Plausible

##### Diagnostic Fault Information

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage | Signal Performance                                     |
|---------------|---------------------|----------------------|------------------|--------------------------------------------------------|
| 5 V Reference | P0651, P18C5, P18C7 | P18C5, P18C7         | P0651            | -                                                      |
| Signal 1      | P18C4               | P18C5                | P18C5            | P0729, P0731, P0732, P0733, P0734, P0735, P076F, P18C9 |

|               |       |              |       |                                                                 |
|---------------|-------|--------------|-------|-----------------------------------------------------------------|
| Signal 2      | P18C6 | P18C7        | P18C7 | P0729, P0731,<br>P0732, P0733,<br>P0734, P0735,<br>P076F, P18C9 |
| Low Reference | -     | P18C5, P18C7 | -     | -                                                               |

#### Circuit/System Description

The gear position sensor is a switching transistor mounted to the top of the transmission extension housing. The four wire sensor interfaces directly with the Engine Control Module (ECM). The ECM supplies 5 V to the gear position sensor on a 5 V reference circuit and also provides a ground path on a low reference circuit. The sensor provides a Pulse Width Modulated (PWM) duty cycle to the ECM on two signal circuits that is proportional to the linear and radial position of the corresponding magnet assembly mounted to the shift shaft. The vehicle uses the gear position sensor information primarily for Active Rev Matching and Active Fuel Management. The ECM monitors the sensor signal input for an incorrect neutral condition.

#### Conditions for Running the DTC

- DTC P0502, P0503, P0806, P0807, P0808, P080A, P18C4, P18C5, P18C6 or P18C7 is not set.
- Ignition voltage is between 9-32 V.
- Engine speed is 450 RPM or greater.
- Gear position sensor learn status is Learned.
- Clutch pedal is released.
- Transmission output shaft speed is 10 RPM or less.

#### Conditions for Setting the DTC

##### P18C9

ECM detects the transmission is in neutral and gear position sensor does not indicate neutral for 3 s.

#### Action Taken When the DTC Sets

- P18C9 is a Type A DTC.
- ECM inhibits Active Rev Matching.

#### Conditions for Clearing the DTC

P18C9 is a Type A DTC.

#### Reference Information

#### Schematic Reference

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Manual Transmission Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

### **K20 Engine Control Module: Scan Tool Information**

Special Tools

**J-38522-A** Vehicle Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

**WARNING:** Refer to **Road Test Warning** .

1. If DTC P0502 or P0503 is set, diagnose those first, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Engine running, clutch pedal applied, place the gear shift lever in Gear 1 or Reverse.
3. Release the clutch pedal.
4. Verify the vehicle moves without any mechanical clutch symptoms.
  - **If mechanical clutch symptoms exist**

Refer to **Symptoms - Clutch** .

- **If no mechanical clutch symptoms exist**

5. Ignition ON.
6. Verify the scan tool Gear Shift Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
  - 12-28% duty cycle for Gear 1 and Gear 2
  - 32-47% duty cycle for Gear 3, Neutral 3-4 Gate and Gear 4
  - 49-64% duty cycle for Gear 5 and Gear 6
  - 61-85% duty cycle for Gear 7 and Reverse Gear
  - **If the Gear Shift Position Sensor parameter is not within the specified range**

Refer to Circuit/System Testing.

- **If the Gear Shift Position Sensor parameter is within the specified range**
7. Verify the scan tool Gate Select Position Sensor parameter displays the following duty cycle as the gear shift lever is moved through each gear position:
    - 71-88% duty cycle for Gear 1, Gear 3, Gear 5 and Gear 7
    - 43-60% duty cycle for Neutral 3-4 Gate
    - 17-40% duty cycle for Gear 2, Gear 4, Gear 6 and Reverse Gear
    - **If the Gate Select Position Sensor parameter is not within the specified range**

Refer to Circuit/System Testing.

- **If the Gate Select Position Sensor parameter is within the specified range**
8. Operate the vehicle within the conditions for running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
    - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
9. All OK.

#### Circuit/System Testing

**WARNING:** Refer to Hot Exhaust System Warning .

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B227 Gear Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
  - **If 10 ohms or greater**

2. Test for less than 2 ohms in the circuit end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the 5 V reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
    - **If greater than 5.2 V**
      1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
      2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.
      - **If between 4.8-5.2 V**
5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 1 terminal 2 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
7. Ignition ON.
8. Verify the scan tool Gear Shift Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
9. Set duty cycle switch to 20%, then 30% and so on through 90%.
10. Verify the scan tool Gear Shift Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gear Shift Position Sensor parameter is not within the specified range**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit 1 terminal 2 and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Ignition OFF.
4. Test for infinite resistance between the signal circuit 1 terminal 2 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
5. Test for less than 2 ohms in the signal circuit 1 end to end.
  - If 2 ohms or greater, repair the open/high resistance in the circuit.
  - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gear Shift Position Sensor parameter is within the specified range**
11. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 2 terminal 3 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
12. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
13. Ignition ON.
14. Verify the scan tool Gate Select Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
15. Set duty cycle switch to 20%, then 30% and so on through 90%.
16. Verify the scan tool Gate Select Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gate Select Position Sensor parameter is not within the specified range**
  1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
  2. Test for less than 1 V between the signal circuit 2 terminal 3 and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
  3. Ignition OFF.
  4. Test for infinite resistance between the signal circuit 2 terminal 3 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  5. Test for less than 2 ohms in the signal circuit 2 end to end.
    - If 2 ohms or greater, repair the open/high resistance in the circuit.
    - If less than 2 ohms, replace the K20 Engine Control Module.

- **If the Gate Select Position Sensor parameter is within the specified range**
- 17. Verify the gear position sensor magnet is undamaged and fastened in proper position on the shift shaft.
  - **If the gear position sensor magnet is damaged or out of position**  
  
Replace the gear position sensor magnet.
  - **If the gear position sensor is undamaged and fastened properly on the shift shaft**
- 18. Replace the B227 Gear Position Sensor.

#### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Gear Position Sensor Replacement**
- **Disassembled Views**
- **Transmission Disassemble**
- **Transmission Assemble**
- **Control Module References** for ECM replacement, programming and setup.

#### DTC P18CA: GEAR POSITION SENSOR

##### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

##### DTC Descriptor

#### DTC P18CA

Gear Position Sensor Not Learned

##### Circuit/System Description

The gear position sensor is a switching transistor mounted to the top of the transmission extension housing. The four wire sensor interfaces directly with the Engine Control Module (ECM). The ECM supplies 5 V to the gear position sensor on a 5 V reference circuit and also provides a ground path on a low reference circuit. The sensor provides a Pulse Width Modulated (PWM) duty cycle to the ECM on two signal circuits that is proportional to the linear and radial position of the corresponding magnet assembly mounted to the shift shaft. The vehicle uses the gear position sensor information primarily for Active Rev Matching and Active Fuel Management.

##### Conditions for Running the DTC

Ignition ON.

#### **Conditions for Setting the DTC**

Gear position sensor not learned.

#### **Action Taken When the DTC Sets**

- P18CA is a Type A DTC.
- ECM inhibits Active Rev Matching.

#### **Conditions for Clearing the DTC**

P18CA is a Type A DTC.

#### **Reference Information**

Schematic Reference

#### **Manual Transmission Schematics**

Connector End View Reference

#### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

#### **Manual Transmission Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

#### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

#### **K20 Engine Control Module: Scan Tool Information**

Special Tools

## **J-38522-A Vehicle Signal Generator**

For equivalent regional tools, refer to **Special Tools**.

### **Circuit/System Verification**

1. Perform the gear position sensor learn procedure.
  - **If the gear position sensor learn was not successful**

Refer to Circuit/System Testing.

- **If the gear position sensor learn was successful**
2. All OK.

### **Circuit/System Testing**

**WARNING:** Refer to **Hot Exhaust System Warning** .

**NOTE:**        **You must perform the Circuit/System Verification first.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B227 Gear Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
  - **If 10 ohms or greater**
    1. Disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 ohms in the circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2 ohms in the 5 V reference circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If greater than 5.2 V**

1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
5. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 1 terminal 2 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.
  - Double black power and ground lead wire to B+ and ground.
6. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
7. Ignition ON.
8. Verify the scan tool Gear Shift Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
9. Set duty cycle switch to 20%, then 30% and so on through 90%.
10. Verify the scan tool Gear Shift Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gear Shift Position Sensor parameter is not within the specified range**
  - 1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, Ignition ON.
  - 2. Test for less than 1 V between the signal circuit 1 terminal 2 and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
  - 3. Ignition OFF.
  - 4. Test for infinite resistance between the signal circuit 1 terminal 2 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  - 5. Test for less than 2 ohms in the signal circuit 1 end to end.
    - If 2 ohms or greater, repair the open/high resistance in the circuit.
    - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gear Shift Position Sensor parameter is within the specified range**
11. Ignition OFF, connect the test leads of the J-38522-A vehicle signal generator as follows:
  - Red test lead to the signal circuit 2 terminal 3 at the B227 Gear Position Sensor wire harness connector.
  - Black test lead to ground at the transmission case.

- Double black power and ground lead wire to B+ and ground.
- 12. Set and adjust the J-38522-A vehicle signal generator to the following switch positions:
  - Signal switch to 5 V.
  - Frequency switch to 600 Hz.
  - Duty cycle switch to 10%.
- 13. Ignition ON.
- 14. Verify the scan tool Gate Select Position Sensor parameter duty cycle is  $10\% \pm 2\%$ .
- 15. Set duty cycle switch to 20%, then 30% and so on through 90%.
- 16. Verify the scan tool Gate Select Position Sensor parameter duty cycle matches the duty cycle for each switch position on the vehicle signal generator  $\pm 2\%$ .
  - **If the Gate Select Position Sensor parameter is not within the specified range**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit 2 terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Ignition OFF.
    4. Test for infinite resistance between the signal circuit 2 terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    5. Test for less than 2 ohms in the signal circuit 2 end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the K20 Engine Control Module.
  - **If the Gate Select Position Sensor parameter is within the specified range**

**NOTE:**      **The gear position sensor magnet can be viewed with a mirror when the gear position sensor is removed from the top of the transmission extension housing.**

17. Verify the gear position sensor magnet is undamaged and fastened in proper position on the shift shaft.
  - **If the gear position sensor magnet is damaged or out of position**

Replace the gear position sensor magnet.
  - **If the gear position sensor is undamaged and fastened properly on the shift shaft**
18. Replace the B227 Gear Position Sensor.

#### Repair Instructions

- **Gear Position Sensor Learn**
- **Gear Position Sensor Replacement**
- **Disassembled Views**
- **Transmission Disassemble**
- **Transmission Assemble**
- **Control Module References** for replacement, programming and setup.

## **CLUTCH PEDAL POSITION SENSOR LEARN**

**NOTE:** The clutch pedal position (CPP) sensor learn procedure is required when the following service procedures have been performed regardless of whether DTC P080A is set:

- An engine control module (ECM) replacement
- A CPP sensor replacement
- Any repairs which affect the CPP sensor relationship

1. Set the parking brake.

**NOTE:** For vehicles equipped with the push button ignition switch, ensure the power mode is in RUN.

2. Engine OFF, with the ignition ON.
3. Install a scan tool.
4. Monitor the ECM for DTCs with a scan tool. If other DTCs are set, except DTC P080A, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
5. With a scan tool, select Clutch Pedal Position Learn under Learn Functions in Configuration/Reset Functions and perform the following instructions displayed on the scan tool screen.

**NOTE:** The CPP sensor learn procedure cannot be performed more than once per ignition cycle.

6. Fully depress and hold the clutch pedal and select Continue.
7. Select Learn.
8. The scan tool will display under CPP Learn Status: Not Learned, In Progress, Unsuccessful - Sensor Low Voltage, Unsuccessful - Sensor High Voltage or Unsuccessful - Sensor Detected Movement. The scan tool will display under CPP Learn Status: Complete or Performed Successfully if the process was successful.
9. If the scan tool indicates that DTC P080A ran and passed this ignition the CPP sensor learn procedure is complete. If the scan tool indicates DTC P080A failed or did not run this ignition, refer to **DTC P080A**. If any other DTC is set, refer to **Diagnostic Trouble Code (DTC) List -**

10. Turn OFF the ignition for 30 s after the learn procedure has successfully completed in order to store the CPP sensor variation values in ECM history.

## GEAR POSITION SENSOR LEARN

**NOTE:** The gear position sensor learn procedure is required after any of the conditions listed below regardless of whether DTC P18CA is set or not:

- An engine control module (ECM) replacement
- A gear position sensor replacement
- A gear position sensor magnet replacement
- Any repairs which affect the gear position sensor relationship

1. No DTCs should be set, except DTC P18CA.

- If other DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If no other DTCs are set

2. Perform each step listed below:

- Set parking brake
- Block drive wheels

3. Ignition ON, using a scan tool verify the Power Mode parameter is Run.

4. Place the transmission gear shifter in the Neutral 3-4 gate position.

**NOTE:** When starting the learn process a timer in the Engine Control Module is activated. The learn process should be completed within 2 min.

5. With the scan tool, select Gear Position Sensor Learn procedure and select Learn.
6. The scan tool Gear Position Sensor Learn Status parameter should change from Not Learned to Stage 1.
7. Place the transmission gear shifter in the Neutral 1-2 gate position or the Neutral 5-6 gate position.
8. The scan tool Gear Position Sensor Learn Status parameter should change from Stage 1 to Stage 2.
9. Return the transmission gear shifter to the Neutral 3-4 gate position.
10. The scan tool Gear Position Sensor Learn Status parameter should change from Stage 2 to Stage 3.
11. The scan tool Gear Position Sensor Learn Status parameter should change from Stage 3 to Complete if the learn was successful. The scan tool Gear Position Sensor Learn Status parameter will display Abort if the process was not successful and the Gear Position Sensor Learn Abort Reason parameter will give the reason.

- **If the gear position sensor learn was not successful**

Repeat the gear position sensor learn procedure or refer to **DTC P18CA** for further diagnosis.

- **If the gear position sensor learn was successful**

12. Clear DTCs with a scan tool.

## **SYMPTOMS - MANUAL TRANSMISSION**

### **Strategy Based Diagnostics**

Review the system operations in order to familiarize yourself with the system functions. Refer to **Manual Transmission Description and Operation**.

### **Visual/Physical Inspection**

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the manual transmission for the correct fluid level.
- Inspect the manual transmission for fluid leaks.
- Inspect the manual transmission for broken or loose transmission mounts.

### **Intermittent**

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

### **Symptom List**

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

- **Transmission Shifts Hard**
- **Transmission Gear Clash When Shifting Gears**
- **Transmission Noisy**
- **Transmission Jumps Out of Gear**
- **Transmission Does Not Shift into One Gear**
- **Transmission Locked in One Gear**
- **Transmission Clunk on Acceleration or Deceleration**
- **Transmission Fluid Leak Diagnosis**

## **TRANSMISSION SHIFTS HARD**

### **Diagnostic Aids**

An intermittent hard shift may be caused by an intermittent clutch condition. With a self adjusting clutch, the clutch may be in between adjustments and not give full clutch release. This might be felt by a low clutch pedal. After several applications, the clutch may adjust properly to give the proper pedal feel.

### Test Description

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

**3**

A static shift test is performed by shifting into all of the gear positions with the engine not operating. While performing the test one should note how the shift lever movement is felt. Also while shifting from one gear to the other feel for binding in the shift rails. You should be able to feel the detent plungers operating when coming out of a gear and going into a gear.

**6**

A dynamic shift test is performed by shifting into of the gear positions with the engine operating. Test for the correct mesh of the synchronizers and for the clutch releasing correctly. When shifting into a gear and out of the gear feel the shift detent plungers and for the synchronizers sleeve for moving freely.

**8**

The transmission uses transmission fluid that allows proper synchronizer operation. The incorrect fluid may cause hard shifting, from varnish build up or not enough lubrication for proper synchronizer operation. Refer to **Lubrication Specifications**.

### Transmission Shifts Hard

| Step                                                                                                   | Action                                                                                                                                                                                       | Yes           | No                                                 |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------|
| DEFINITION: The transmission does not shift smoothly or without difficulty from one gear to the other. |                                                                                                                                                                                              |               |                                                    |
| 1                                                                                                      | Did you review the <b><u>Symptoms - Manual Transmission</u></b> operations and perform the necessary inspections?                                                                            | Go to Step 11 | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                                                      | Inspect the clutch system for proper operation. Refer to <b><u>Clutch System Description and Operation</u></b> .<br>Did you find or repair the condition?                                    | Go to Step 11 | Go to Step 3                                       |
|                                                                                                        | 1. Perform a static shift test on the transmission.<br>2. Test for the following conditions: <ul style="list-style-type: none"><li>• Blockage preventing full shift lever movement</li></ul> |               |                                                    |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                               |               |               |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|
| 3 | <ul style="list-style-type: none"> <li>• Excessive movement in the shift lever</li> <li>• Binding in the shift lever</li> <li>• Detent plungers or shift rails binding</li> <li>• Shift linkage binding</li> <li>• Shift linkage proper adjustment</li> </ul> <p>Are you able to shift into all gears?</p>                                                                                                                    | Go to Step 7  | Go to Step 4  |
| 4 | <p>Remove the transmission control lever boot. Refer to <b><u>Transmission Control Lever Boot Replacement</u></b>.</p> <p>Inspect for the following:</p> <ul style="list-style-type: none"> <li>• Loose mounting</li> <li>• Foreign debris</li> </ul> <p>Did you find and repair the condition?</p>                                                                                                                           | Go to Step 11 | Go to Step 5  |
| 5 | <ol style="list-style-type: none"> <li>1. Perform a dynamic shift test on the transmission.</li> <li>2. Test for the following conditions: <ul style="list-style-type: none"> <li>• Detent plungers or shift rails binding</li> <li>• Synchronizer sleeve binding</li> <li>• Gear clash into only one gear</li> <li>• Gear clash into all gears</li> </ul> </li> </ol> <p>Did the transmission shift hard into all gears?</p> | Go to Step 6  | Go to Step 10 |
| 6 | <p>Inspect the transmission for the correct fluid level and the correct type of transmission fluid. Refer to <b><u>Transmission Fluid Drain and Fill</u></b>.</p> <p>Is the transmission at the correct level and proper fluid being used?</p>                                                                                                                                                                                | Go to Step 8  | Go to Step 7  |
| 7 | <p>Drain and fill the transmission with the correct type fluid. Refer to <b><u>Transmission Fluid Drain and Fill</u></b>.</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                   | Go to Step 11 | Go to Step 8  |
| 8 | <p>Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</p> <p>Inspect the clutch pressure plate and/or clutch driven plate.</p> <p>Is the clutch pressure plate and/or clutch driven plate worn or faulty?</p>                                                                                                                                                                                          | Go to Step 9  | Go to Step 10 |
| 9 | <p>Replace the clutch assembly. Refer to <b><u>Clutch Assembly Replacement</u></b>.</p>                                                                                                                                                                                                                                                                                                                                       |               |               |

|    | Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Go to Step 11 | Go to Step 10         |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 10 | <ol style="list-style-type: none"> <li>1. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</li> <li>2. Inspect the transmission for the following faulty components in the gear that is hard to shift or clashing: <ul style="list-style-type: none"> <li>• Excessive synchronizers blocking ring to gear clearance</li> <li>• Synchronizer hub external splines worn or damaged</li> <li>• Excessive axial clearance in the speed gear</li> <li>• Mainshaft to speed gear bearing or journal worn</li> <li>• Shift rail and the internal shift control lever components for wear or damage</li> </ul> </li> <li>3. Replace worn or damaged components as necessary.</li> </ol> |               |                       |
|    | Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Go to Step 11 | Go to Diagnostic Aids |
| 11 | Operate the system in order to verify the repair.<br>Did you correct the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | System OK     | Go to Step 1          |

## TRANSMISSION GEAR CLASH WHEN SHIFTING GEARS

### Diagnostic Aids

Gear clashing may be caused by shifting at too high of an engine RPM or by rushing the shift. If gear clashing is occurring in more than one gear, the clutch may not be releasing properly for proper synchronizer operation.

### Test Description

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

#### 2

This step tests for the proper release of the clutch. If the clutch reserve is not correct, the mainshaft gears may be turning, causing the gear to clash.

#### 5

This step inspects for the proper transmission fluid. The proper fluid is required for the correct

A static shift test is performed by shifting into all of the gear positions with the engine not operating. While performing the test, you should note how the shift lever movement feels. Also, while shifting from one gear to another, feel for binding in the shift rails. You should be able to feel the detent plungers operating when coming out of a gear and going into a gear. Excessive play in the gear shift lever may prevent the shift forks from fully engaging the synchronizer.

## 10

A dynamic shift test is performed by shifting into all of the gear positions with the engine operating. Test for the correct mesh of the synchronizers and for the clutch releasing correctly. Move the shift lever and feel for the synchronizer sleeve to just release from the gear then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to engage that gear again. If the transmission shifts back into the gear without clashing, the clutch is releasing correctly and the synchronizer is operating. If clashing occurs, test another gear. If all gears clash, the clutch is not releasing correctly.

### Transmission Gear Clash When Shifting Gears

| Step                                                                                                                                                                                                                                                               | Action                                                                                                                                                                                            | Yes           | No                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------------------------|
| DEFINITION: Noise from the transmission when shifting gears. A grinding or grating sound when the synchronizer sleeve is engaging with the selector teeth on the speed gear. A suspected internal transmission condition if the noise is only happens in one gear. |                                                                                                                                                                                                   |               |                                                |
| 1                                                                                                                                                                                                                                                                  | Did you review the <b>Symptoms - Manual Transmission</b> and perform the necessary inspections?                                                                                                   | Go to Step 2  | Go to <b>Transmission Fluid Drain and Fill</b> |
| 2                                                                                                                                                                                                                                                                  | With the engine operating, does the transmission shift from neutral to any gear without the vehicle lurching or gear clashing?                                                                    | Go to Step 5  | Go to Step 3                                   |
| 3                                                                                                                                                                                                                                                                  | Inspect for proper clutch operation. Refer to <b>Clutch System Description and Operation</b> . Does the clutch operate properly?                                                                  | Go to Step 5  | Go to Step 4                                   |
| 4                                                                                                                                                                                                                                                                  | Repair the clutch system. Refer to <b>Symptoms - Clutch</b> . Did you find and repair the condition?                                                                                              | Go to Step 11 | Go to Step 5                                   |
| 5                                                                                                                                                                                                                                                                  | Inspect for the correct transmission fluid level and for the correct fluid. Refer to <b>Transmission Fluid Drain and Fill</b> . Is the transmission fluid level correct and at the correct level? | Go to Step 7  | Go to Step 6                                   |
| 6                                                                                                                                                                                                                                                                  | Fill the transmission to the correct level or change the fluid if it is the incorrect type. Does the transmission still have gear clash?                                                          | Go to Step 7  | Go to Step 11                                  |
|                                                                                                                                                                                                                                                                    | 1. Perform a static shift test on the transmission.                                                                                                                                               |               |                                                |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |               |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------|
| 7  | <p>2. Test for the following conditions:</p> <ul style="list-style-type: none"> <li>• Blockage preventing full shift lever movement</li> <li>• Excessive movement in the shift lever</li> <li>• Binding in the shift lever</li> <li>• Detent plungers or shift rails binding</li> <li>• Shift linkage binding</li> <li>• Shift linkage proper adjustment</li> </ul> <p>Did the transmission shift smoothly into the gear that is clashing?</p>                    | Go to Step 9                                 | Go to Step 8  |
| 8  | <p>1. Remove the shift lever.</p> <p>2. Inspect for damaged or worn components. Refer to <b><u>Transmission Control Replacement</u></b>.</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                                        | Go to Step 11                                | Go to Step 9  |
| 9  | <p>1. Perform a dynamic shift test on the transmission.</p> <p>2. Test for the following conditions:</p> <ul style="list-style-type: none"> <li>• Detent plungers or shift rails binding</li> <li>• Synchronizer sleeve binding</li> <li>• Gear clashing in more than the suspected gear</li> </ul> <p>Is the transmission hard to shift into all gears?</p>                                                                                                      | Go to <b><u>Transmission Shifts Hard</u></b> | Go to Step 10 |
| 10 | <p>1. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</p> <p>2. Inspect the following transmission components for the suspect gear that is clashing:</p> <ul style="list-style-type: none"> <li>• Excessive synchronizer blocking ring to gear clearance</li> <li>• Synchronizer sleeve to hub lash or rock excessive</li> <li>• Excessive axial clearance in the speed gear</li> <li>• Mainshaft to speed gear bearing</li> </ul> |                                              |               |

|    |                                                                                                                                                                                                                                                   |               |                       |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
|    | or journal worn <ul style="list-style-type: none"> <li>• Shift fork worn or damaged</li> <li>• Internal shift control worn or damaged</li> <li>• Mainshaft bearing worn or damaged</li> <li>• Input gear bearing or pilot bearing worn</li> </ul> |               |                       |
|    | Did you find and repair the condition?                                                                                                                                                                                                            | Go to Step 11 | Go to Diagnostic Aids |
| 11 | Operate the system and verify the repair.<br>Did you correct the condition?                                                                                                                                                                       | System OK     | Go to Step 1          |

## TRANSMISSION NOISY

### Diagnostic Aids

If the transmission is in neutral with the engine operating and a whirling noise - neutral gear rattle - is heard outside the vehicle, this is a normal condition.

### Test Description

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

#### 5

This step inspects for the correct transmission fluid level. If the transmission fluid level is excessively low, damage may have occurred to the transmission components.

#### 7

This step inspects for the correct type of transmission fluid. If the incorrect fluid was used, there may have been an overheating condition. Overheating may cause damage to the transmission components.

#### 9

This step inspects for noise coming into the driver compartment. Improper sealing of the shift tower may be allowing normal transmission noise to be heard by the driver.

#### 13

This step tests to determine if clutch components are making the noise. Depress the clutch pedal slowly and listen for the change in noise. If the noise changes while pressing the pedal, it may be a faulty clutch component. If the noise does not change until the clutch is completely disengaged, the transmission component is faulty.

## Transmission Noisy

| Step                                                                                                                                                                                                    | Action                                                                                                                                                                      | Yes                   | No                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------|
| DEFINITION: The transmission is making a noise. The noise may be a whine or a growl caused by faulty bearings or gears. The noise may also be caused from a faulty component causing a vibration noise. |                                                                                                                                                                             |                       |                                                    |
| 1                                                                                                                                                                                                       | Did you review the <b><u>Symptoms - Manual Transmission</u></b> operations and perform the necessary inspections?                                                           | Go to <b>Step 2</b>   | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                                                                                                                                                       | Is the noise present while in neutral, with the engine operating?                                                                                                           | Go to Diagnostic Aids | Go to <b>Step 3</b>                                |
| 3                                                                                                                                                                                                       | Is the noise present in all gears?                                                                                                                                          | Go to <b>Step 5</b>   | Go to <b>Step 4</b>                                |
| 4                                                                                                                                                                                                       | Is the noise present in just one gear?                                                                                                                                      | Go to <b>Step 15</b>  | Go to <b>Step 5</b>                                |
| 5                                                                                                                                                                                                       | Inspect the transmission fluid level.<br>Is the fluid level correct?                                                                                                        | Go to <b>Step 7</b>   | Go to <b>Step 6</b>                                |
| 6                                                                                                                                                                                                       | Add transmission fluid. Refer to <b><u>Transmission Fluid Drain and Fill</u></b> .<br>Did you find and repair the condition?                                                | Go to <b>Step 16</b>  | Go to <b>Step 7</b>                                |
| 7                                                                                                                                                                                                       | Inspect the transmission for the correct fluid type. Refer to <b><u>Lubrication Specifications</u></b> .<br>Is the transmission fluid the correct type?                     | Go to <b>Step 9</b>   | Go to <b>Step 8</b>                                |
| 8                                                                                                                                                                                                       | Drain and fill the transmission with the correct type of fluid. Refer to <b><u>Transmission Fluid Drain and Fill</u></b> .<br>Did you find and repair the condition?        | Go to <b>Step 16</b>  | Go to <b>Step 9</b>                                |
| 9                                                                                                                                                                                                       | Inspect the shift tower boot.<br>Is the closeout boot loose or damaged?                                                                                                     | Go to <b>Step 10</b>  | Go to <b>Step 11</b>                               |
| 10                                                                                                                                                                                                      | Position and tighten the shift tower boot to specifications. Refer to <b><u>Transmission Control Lever Boot Replacement</u></b> .<br>Did you find and repair the condition? | Go to <b>Step 16</b>  | Go to <b>Step 11</b>                               |
| 11                                                                                                                                                                                                      | Inspect for torque tube to transmission alignment and loose transmission mounting bolts.<br>Are there any loose transmission mounting bolts?                                | Go to <b>Step 12</b>  | Go to <b>Step 15</b>                               |
| 12                                                                                                                                                                                                      | Replace and tighten the transmission mounting bolts. Refer to <b><u>Fastener Tightening Specifications</u></b> .<br>Is the noise still present?                             | Go to <b>Step 13</b>  | Go to <b>Step 16</b>                               |
| 13                                                                                                                                                                                                      | With the engine operating, depress the clutch pedal.<br>Is the noise still present?                                                                                         | Go to <b>Step 14</b>  | Go to <b>Step 15</b>                               |
|                                                                                                                                                                                                         | 1. Remove the clutch. Refer to <b><u>Clutch Assembly Replacement</u></b> .                                                                                                  |                       |                                                    |

|    |                                                                                                                                                                                                                                                                                                                                                                        |                      |                      |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| 14 | <p>2. Inspect the following components for being the cause of the noise:</p> <ul style="list-style-type: none"> <li>• The release bearing</li> <li>• The pilot bearing</li> <li>• The dual mass flywheel, if equipped</li> <li>• The pressure plate</li> <li>• The clutch disc</li> <li>• The input shaft bearing</li> <li>• The engine crankshaft end play</li> </ul> |                      |                      |
|    | Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                 | Go to <b>Step 16</b> | Go to <b>Step 15</b> |
| 15 | <p>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</p> <p>2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>. Use the information in the Cleaning and Inspection section to determine if any of the transmission components are faulty.</p>                                                                 |                      | -                    |
|    | Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                 | Go to <b>Step 16</b> |                      |
| 16 | <p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>                                                                                                                                                                                                                                                                         | System OK            | Go to <b>Step 1</b>  |

## TRANSMISSION JUMPS OUT OF GEAR

### Diagnostic Aids

If the transmission jumps out of gear during deceleration, inspect the components that may allow for the gears or shafts to tip. If the gears or shafts tip, the synchronizer sleeve can disengage from the selector teeth on the speed gear. If the transmission jumps out of gear during acceleration, inspect the components that may not allow full engagement of the synchronizer sleeve to the selector teeth on the speed gear. Insufficient engagement of the selector teeth under torque may cause the transmission to jump out of gear.

### Test Description

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

## 2

A static shift test is performed by shifting into all gear positions with the engine not operating. While performing the test, slowly move the shift lever. Feel for proper movement of the shift

lever and transmission internal shift components.

5

A dynamic shift test is performed by shifting into all gear positions with the engine operating. Test for the correct mesh of the synchronizers sleeve and the speed gear selector teeth. Move the shift lever and feel for the synchronizer sleeve to release from the gear, then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to engage the gear again, to ensure full travel of the shift components.

6

This step inspects for worn or damaged transmission or engine mounts. Loose mounts may cause a shock on the transmission allowing for gear disengagement.

7

This step inspects for the misalignment of the torque tube to transmission. Misalignment may put a bind on the input shaft, allowing for the input shaft or the mainshaft to tip.

9

This step inspects the pilot bearing and the pilot bearing journal on the input shaft. A worn pilot bearing or input shaft may allow the input shaft to tip, causing gear disengagement.

#### Transmission Jumps Out of Gear

| Step                                                                       | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes          | No                                             |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------------|
| DEFINITION: Gear disengagement occurs during acceleration or deceleration. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |                                                |
| 1                                                                          | Did you review the <b>Symptoms - Manual Transmission</b> operations and perform the necessary inspections?                                                                                                                                                                                                                                                                                                                                                                      | Go to Step 2 | Go to <b>Transmission Fluid Drain and Fill</b> |
| 2                                                                          | <ol style="list-style-type: none"><li>1. Perform a static shift test.</li><li>2. Test for the following conditions:<ul style="list-style-type: none"><li>• Blockage preventing full shift lever movement</li><li>• Excessive movement in the shift lever</li><li>• Detent plungers engaging in the shift rails</li><li>• Synchronizer pressure pieces on the synchronizer sleeves</li><li>• Shift linkage binding</li><li>• Shift linkage proper adjustment</li></ul></li></ol> |              |                                                |

|   |                                                                                                                                                                                                                                                                                                                                                                                                               |               |              |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|
|   | Did the transmission shift completely into all gears?                                                                                                                                                                                                                                                                                                                                                         | Go to Step 5  | Go to Step 3 |
| 3 | <p>Remove the transmission control lever boot. Refer to <b><u>Transmission Control Lever Boot Replacement</u></b>.</p> <p>Inspect for the following:</p> <ul style="list-style-type: none"> <li>• Loose mounting</li> <li>• Foreign debris</li> </ul> <p>Did you find and repair the condition?</p>                                                                                                           | Go to Step 10 | Go to Step 4 |
| 4 | <ol style="list-style-type: none"> <li>1. Perform a dynamic shift test on the transmission.</li> <li>2. Test for the following conditions: <ul style="list-style-type: none"> <li>• Synchronizer sleeve engagement to the speed gear selector teeth</li> <li>• Detent plungers engaging in the shift rails</li> </ul> </li> </ol> <p>Did the transmission shift completely into all gears?</p>                | Go to Step 5  | Go to Step 8 |
| 5 | <p>Inspect the engine and/or transmission mounts. Refer to <b><u>Transmission Mount Replacement</u></b>.</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                    | Go to Step 10 | Go to Step 6 |
| 6 | <p>Inspect the clutch housing for loose bolts or misalignment.</p> <p>Are there any loose bolts or misalignment?</p>                                                                                                                                                                                                                                                                                          | Go to Step 10 | Go to Step 7 |
| 7 | <p>Tighten any loose housing bolts and/or align the housing. Refer to <b><u>Clutch Assembly Replacement</u></b>.</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                            | Go to Step 10 | Go to Step 8 |
| 8 | <ol style="list-style-type: none"> <li>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</li> <li>2. Remove the clutch assembly. Refer to <b><u>Clutch Assembly Replacement</u></b>.</li> <li>3. Inspect the pilot bearing for being faulty.</li> <li>4. Inspect the input shaft for excessive wear at the pilot bearing.</li> </ol> <p>Did you find and repair the condition?</p> | Go to Step 10 | Go to Step 9 |
|   | <ol style="list-style-type: none"> <li>1. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</li> </ol>                                                                                                                                                                                                                                                                           |               |              |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                       |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 9  | <p>2. Inspect the following components for wear or damage:</p> <ul style="list-style-type: none"> <li>• The shift rails</li> <li>• The detent plungers and springs</li> <li>• The shift forks</li> <li>• The synchronizer sleeve and speed gear selector teeth</li> <li>• The mainshaft to input shaft bearing and journals</li> <li>• The speed gear bearings and journals</li> <li>• The speed gear axial clearance</li> <li>• The mainshaft center and rear bearings</li> </ul> |               |                       |
|    | Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                             | Go to Step 10 | Go to Diagnostic Aids |
| 10 | <p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>                                                                                                                                                                                                                                                                                                                                                                                     | System OK     | Go to Step 1          |

## TRANSMISSION DOES NOT SHIFT INTO ONE GEAR

### Diagnostic Aids

If the transmission shifts into gear and then jumps out of gear, refer to **Transmission Jumps Out of Gear**. If it is an intermittent condition, other driveline components may be faulty.

### Test Description

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

#### 2

This test is to confirm that the clutch is not slipping. During certain conditions, the clutch may slip and feel as though the transmission is not in gear.

#### 3

A static shift test is performed by shifting into all gears with the engine not operating. While performing the test, you should note how the shift lever movement feels. Also feel for the shift rails moving freely, the detent plungers operating when coming out of a gear and going in the next gear and the synchronizer sleeve movement.

#### 6

correct mesh of the synchronizers sleeve and the speed gear selector teeth. Move the shift lever and feel for the synchronizer sleeve to just release from the gear, then let up on the clutch pedal. Depress the clutch pedal and move the shift lever to engage that gear again, to ensure full travel of the shift components.

### Transmission Does Not Shift into One Gear

| Step                                                                                                                                                   | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes          | No                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------|
| DEFINITION: The shift lever will not move into a particular gear position or when in a gear position, power is not delivered through the transmission. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |                                                    |
| 1                                                                                                                                                      | Did you review the <b><u>Symptoms - Manual Transmission</u></b> and perform the necessary inspections?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Go to Step 2 | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                                                                                                      | Inspect the clutch system for slipping. Refer to <b><u>Clutch Slipping</u></b> .<br>Is the clutch operating properly?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Go to Step 3 | Go to <b><u>Clutch Assembly Replacement</u></b>    |
| 3                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. Perform a static shift test on the transmission.</li> <li>2. Test for the following conditions: <ul style="list-style-type: none"> <li>• Blockage preventing full shift lever movement</li> <li>• Excessive movement in the shift lever</li> <li>• Binding in the shift lever</li> <li>• Detent plungers or shift rails binding</li> <li>• Synchronizer sleeve moving on the hub and pressure pieces</li> <li>• Shift linkage binding</li> <li>• Shift linkage proper adjustment</li> </ul> </li> </ol> <p>Were you able to shift into the gear position with the concern?</p> | Go to Step 5 | Go to Step 4                                       |
| 4                                                                                                                                                      | <p>Remove the transmission control lever boot. Refer to <b><u>Transmission Control Lever Boot Replacement</u></b>.</p> <p>Inspect for the following:</p> <ul style="list-style-type: none"> <li>• Loose mounting</li> <li>• Foreign debris</li> </ul> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                                                                                      | Go to Step 8 | Go to Step 5                                       |
|                                                                                                                                                        | 1. Perform a dynamic shift test on the transmission.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                                    |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |                       |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|
| 5 | <p>2. Test for the following conditions:</p> <ul style="list-style-type: none"> <li>• Detent plungers or shift rails binding</li> <li>• Synchronizer sleeve binding</li> <li>• Synchronizer sleeve engaging on the speed gear selector teeth</li> </ul> <p>Were you able to shift into the gear position with the concern?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                             | Go to Step 7 | Go to Step 6          |
| 6 | <p>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</p> <p>2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</p> <p>3. Inspect the following transmission internal components for wear or damage:</p> <ul style="list-style-type: none"> <li>• The shift forks</li> <li>• The internal shift control lever</li> </ul> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                                                                                                            | Go to Step 8 | Go to Step 7          |
| 7 | <p>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</p> <p>2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</p> <p>3. Inspect the following transmission internal components for wear or damage:</p> <ul style="list-style-type: none"> <li>• The synchronizer sleeve selector teeth</li> <li>• The speed gear selector teeth</li> <li>• The speed gear axial clearance for being excessive</li> <li>• The speed gear to mainshaft bearings and journals</li> <li>• The countershaft for being broken</li> <li>• The mainshaft for being broken</li> <li>• The countershaft gear for being stripped</li> <li>• The mainshaft gear for being stripped</li> </ul> <p>Did you find and repair the condition?</p> | Go to Step 8 | Go to Diagnostic Aids |
| 8 | <p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | System OK    | Go to Step 1          |

## TRANSMISSION LOCKED IN ONE GEAR

### Test Description

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

**2**

This step is to ensure the use of the proper transmission fluid. The transmission fluid is used to ensure proper synchronizer operation and for sufficient lubrication. Improper fluid may cause the synchronizers to stick or cause overheating of the transmission components.

**4**

A static shift test is performed by shifting into all gears with the engine not operating. By confirming that the transmission can be shifted into all positions, ensures that the shift lever is not excessively worn or damaged.

**6**

A dynamic shift test is performed by shifting into all of the gear positions with the engine operating. Test to ensure that the internal shift components are properly functioning.

### Transmission Locked in One Gear

| Step                                                                                                                          | Action                                                                                                                                                            | Yes                 | No                                                 |
|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------|
| DEFINITION: The transmission cannot be shifted out of a gear or the vehicle will not move because the transmission is locked. |                                                                                                                                                                   |                     |                                                    |
| 1                                                                                                                             | Did you review the <b><u>Symptoms - Manual Transmission</u></b> and perform the necessary inspections?                                                            | Go to <b>Step 2</b> | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                                                                             | Inspect for the correct type of transmission fluid. Refer to <b><u>Lubrication Specifications</u></b> . Is the correct type of transmission fluid being used?     | Go to <b>Step 6</b> | Go to <b>Step 5</b>                                |
| 3                                                                                                                             | Drain and fill the transmission with the correct type of fluid. Refer to <b><u>Transmission Fluid Drain and Fill</u></b> . Did you find and repair the condition? | Go to <b>Step 9</b> | Go to <b>Step 6</b>                                |
| 4                                                                                                                             | 1. Perform a static shift test on the transmission.<br>2. Test for the shift lever moving to all positions.<br><br>Were you able to shift into all positions?     | Go to <b>Step 6</b> | Go to <b>Step 5</b>                                |
|                                                                                                                               | 1. Remove the shift lever. Refer to                                                                                                                               |                     |                                                    |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                       |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------|
| 5 | <p><b><u>Transmission Control Replacement.</u></b></p> <p>2. Inspect for worn or faulty components.</p> <p>Did you find and repair the conditions?</p>                                                                                                                                                                                                                                                                                                                     | Go to <b>Step 9</b> | Go to <b>Step 6</b>   |
| 6 | <p>1. Perform a dynamic shift test on the transmission.</p> <p>2. Test for being able to shift in and out of the gear with the concern.</p> <p>Were you able to shift the transmission correctly?</p>                                                                                                                                                                                                                                                                      | Go to <b>Step 7</b> | Go to <b>Step 8</b>   |
| 7 | <p>1. Remove the transmission. Refer to <b><u>Transmission Replacement.</u></b></p> <p>2. Inspect the clutch system for the clutch not releasing properly. Refer to <b><u>Clutch System Description and Operation</u></b> .</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                              | Go to <b>Step 9</b> | Go to <b>Step 8</b>   |
| 8 | <p>1. Disassemble the transmission. Refer to <b><u>Transmission Disassemble.</u></b></p> <p>2. Inspect the following transmission internal components for wear or damage:</p> <ul style="list-style-type: none"> <li>• The shift rail</li> <li>• The internal shift control lever</li> <li>• The synchronizer components for being broken or faulty</li> <li>• The speed gears for being seized to the mainshaft</li> </ul> <p>Did you find and repair the conditions?</p> | Go to <b>Step 9</b> | Go to Diagnostic Aids |
| 9 | <p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>                                                                                                                                                                                                                                                                                                                                                                             | System OK           | Go to <b>Step 1</b>   |

## TRANSMISSION CLUNK ON ACCELERATION OR DECELERATION

### Diagnostic Aids

All manual transmissions have gear play that might cause a clunk. If the transmission is suspected of causing the clunk, compare it with a similar vehicle. An internal clunk in the transmission is usually caused by wear between two components or from improper assembly, which would also cause other symptoms.

The number below refers to the step number on the diagnostic table.

**5**

This step inspects the driveline components that may be the cause of the clunk noise. The noise may resonate to the transmission.

#### Transmission Clunk on Acceleration or Deceleration

| Step                                                                      | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes                 | No                                                 |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------|
| DEFINITION: A clunk is heard and/or felt on acceleration or deceleration. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |                                                    |
| 1                                                                         | Did you review the <b><u>Symptoms - Manual Transmission</u></b> and perform the necessary inspections?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Go to <b>Step 2</b> | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                         | Inspect the engine mounts for being loose or damaged..<br>Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 7</b> | Go to <b>Step 3</b>                                |
| 3                                                                         | Inspect the transmission mounts for being loose or damaged. Refer to <b><u>Transmission Mount Replacement</u></b> .<br>Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Go to <b>Step 7</b> | Go to <b>Step 4</b>                                |
| 4                                                                         | Inspect the transmission to engine fasteners for being loose or missing. Refer to <b><u>Fastener Tightening Specifications</u></b> .<br>Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Go to <b>Step 7</b> | Go to <b>Step 5</b>                                |
| 5                                                                         | Inspect the driveline for causing the clunk. Refer to <b><u>Symptoms - Propeller Shaft</u></b> .<br>Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Go to <b>Step 7</b> | Go to <b>Step 6</b>                                |
| 6                                                                         | <ol style="list-style-type: none"> <li>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</li> <li>2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</li> <li>3. Inspect the following transmission components that maybe causing the clunk: <ul style="list-style-type: none"> <li>• Faulty mainshaft bearings</li> <li>• Faulty countershaft bearings</li> <li>• Worn speed gear teeth</li> <li>• Worn countershaft gear teeth</li> <li>• Worn synchronizer sleeve to hub</li> <li>• Worn thrust washers and thrust surfaces on the speed gears or mainshaft</li> </ul> </li> </ol><br>Did you find and repair the condition? | Go to <b>Step 7</b> | Go to Diagnostic Aids                              |

|   |                                                                                     |           |                     |
|---|-------------------------------------------------------------------------------------|-----------|---------------------|
| 7 | Operate the system in order to verify the repair.<br>Did you correct the condition? | System OK | Go to <b>Step 1</b> |
|---|-------------------------------------------------------------------------------------|-----------|---------------------|

## TRANSMISSION FLUID LEAK DIAGNOSIS

### Diagnostic Aids

Using the incorrect type of transmission fluid may affect the sealing ability of the seals. Ensure the use of the correct type of transmission fluid. The incorrect type of sealer may not be compatible with the transmission fluid or may not have the correct characteristics for sealing the affected components. Ensure the use of the correct type of sealers. Refer to **Adhesives, Fluids, Lubricants and Sealers**.

### Test Description

The number below refers to the step number on the diagnostic table.

**5**

Use an approved method to clean the transmission to ensure the leak location is correctly identified. If using a powder method or dye method, ensure the products are compatible with the transmission fluid.

### Transmission Fluid Leak Diagnosis

| Step                                                                              | Action                                                                                                                                                                                                                                                                                                                     | Yes           | No                                                 |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------|
| DEFINITION: Visible sign of the transmission fluid leaking from the transmission. |                                                                                                                                                                                                                                                                                                                            |               |                                                    |
| 1                                                                                 | Did you review the <b><u>Symptoms - Manual Transmission</u></b> and perform the necessary inspections?                                                                                                                                                                                                                     | Go to Step 2  | Go to <b><u>Symptoms - Manual Transmission</u></b> |
| 2                                                                                 | <ol style="list-style-type: none"> <li>Inspect for the transmission fluid level higher than the recommended level. Refer to <b><u>Transmission Fluid Drain and Fill</u></b>.</li> <li>Adjust the transmission level if incorrect.</li> </ol> <p>Was the transmission fluid level too high?</p>                             | Go to Step 18 | Go to Step 3                                       |
| 3                                                                                 | Inspect the transmission vent for a blockage.<br>Is the transmission vent blocked?                                                                                                                                                                                                                                         | Go to Step 4  | Go to Step 5                                       |
| 4                                                                                 | <p>Verify the location of the leak.</p> <ol style="list-style-type: none"> <li>Clean the transmission assembly.</li> <li>Operate the vehicle for 24 km (15 mi) or until normal operating temperatures are reached.</li> <li>Visual inspect or use the powder method or dye and black light method to locate the</li> </ol> |               |                                                    |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
|   | Is the leak occurring at the drain or fill plug?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Go to Step 5  | Go to Step 7          |
| 5 | Replace the drain or fill plug. Refer to <b><u>Transmission Fluid Drain and Fill</u></b> .<br>Did you find and repair the condition?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Go to Step 18 | Go to Diagnostic Aids |
| 6 | Is the leak at the transmission output shaft seal?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Go to Step 7  | Go to Step 9          |
| 7 | Remove the output shaft seal and inspect for the following. Refer to <b><u>Extension Disassemble</u></b> and <b><u>Extension Assemble</u></b> . <ul style="list-style-type: none"> <li>• Damaged or worn seal</li> <li>• Damaged seal bore</li> <li>• Improper installation</li> <li>• Cracks in the component</li> <li>• Propeller shaft yoke sealing surface is scratched, nicked, damaged or worn</li> <li>• Loose or worn bearing causing excessive seal wear</li> <li>• Yoke flange nut loose</li> </ul> Did you find and repair the condition?                                                                                                                                                                                                  | Go to Step 18 | Go to Diagnostic Aids |
| 8 | Is the leak at the front of the transmission?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Go to Step 9  | Go to Step 11         |
| 9 | <ol style="list-style-type: none"> <li>1. Inspect for the leak at the input shaft seal.</li> <li>2. Inspect for the following if the input shaft seal is leaking: <ul style="list-style-type: none"> <li>• Damaged or worn seal</li> <li>• Damaged seal bore</li> <li>• Improper installation</li> <li>• Cracks in the component</li> <li>• Input shaft sealing surface is scratched, nicked, damaged or worn</li> <li>• Loose or worn bearing causing excessive seal wear</li> </ul> </li> <li>3. Replace the input shaft seal if leaking. Refer to the Adapter Plate section of <b><u>Transmission Case and Adapter Disassemble</u></b> and <b><u>Transmission Case and Adapter Assemble</u></b>.</li> </ol> Did you find and repair the condition? | Go to Step 18 | Go to Step 10         |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                       |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------|
| 10 | <p>2. Replace the transmission front case half if it is faulty. Refer to <b><u>Transmission Disassemble</u></b>.</p> <p>Did you find and repair the condition?</p>                                                                                                                                                                                                                                                   | Go to Step 18 | Go to Diagnostic Aids |
| 11 | Is the leak at the backup light switch?                                                                                                                                                                                                                                                                                                                                                                              | Go to Step 12 | Go to Step 14         |
| 12 | <p>1. Remove the backup light switch. Refer to <b><u>Backup Lamp Switch Replacement</u></b>.</p> <p>2. Inspect for the following:</p> <ul style="list-style-type: none"> <li>• Cross threaded or damaged threads</li> <li>• Insufficient sealant</li> <li>• Leaking switch</li> <li>• Improper installation</li> </ul> <p>Did you find and repair the condition?</p>                                                 | Go to Step 18 | Go to Step 1          |
| 13 | <p>1. Remove the shift shaft detent sleeve. Refer to <b><u>Transmission Disassemble</u></b> and <b><u>Transmission Assemble</u></b>.</p> <p>2. Inspect for the following:</p> <ul style="list-style-type: none"> <li>• Cross threaded or damaged threads</li> <li>• Insufficient sealant</li> <li>• Cracked sleeve or case</li> <li>• Improper installation</li> </ul> <p>Did you find and repair the condition?</p> | Go to Step 18 | Go to Step 1          |
| 14 | Is the leak at the sealing flanges of the transmission case?                                                                                                                                                                                                                                                                                                                                                         | Go to Step 15 | Go to Step 16         |
| 15 | <p>1. Remove the transmission. Refer to <b><u>Transmission Replacement</u></b>.</p> <p>2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b>.</p> <p>3. Inspect the sealing surfaces. Refer to <b><u>Transmission Case and Adapter Cleaning and Inspection</u></b> and <b><u>Extension Cleaning and Inspection</u></b>.</p> <p>Did you find and repair the condition?</p>                 | Go to Step 18 | Go to Step 16         |
| 16 | Is the leak coming from a crack or porosity in the transmission case ?                                                                                                                                                                                                                                                                                                                                               | Go to Step 17 | Go to Diagnostic Aids |
|    | 1. Remove the transmission. Refer to                                                                                                                                                                                                                                                                                                                                                                                 |               |                       |

|    |                                                                                     |               |                       |
|----|-------------------------------------------------------------------------------------|---------------|-----------------------|
| 17 | 2. Disassemble the transmission. Refer to <b><u>Transmission Disassemble</u></b> .  |               |                       |
|    | 3. Replace the faulty case. Refer to <b><u>Transmission Assemble</u></b> .          |               |                       |
|    | Did you find and repair the condition?                                              | Go to Step 18 | Go to Diagnostic Aids |
| 18 | Operate the system in order to verify the repair.<br>Did you correct the condition? | System OK     | Go to Step 1          |

## REPAIR INSTRUCTIONS - ON VEHICLE

### TRANSMISSION FLUID LEVEL INSPECTION

1. Raise and suitably support the vehicle; ensure that the vehicle is level. Refer to **Lifting and Jacking the Vehicle**.

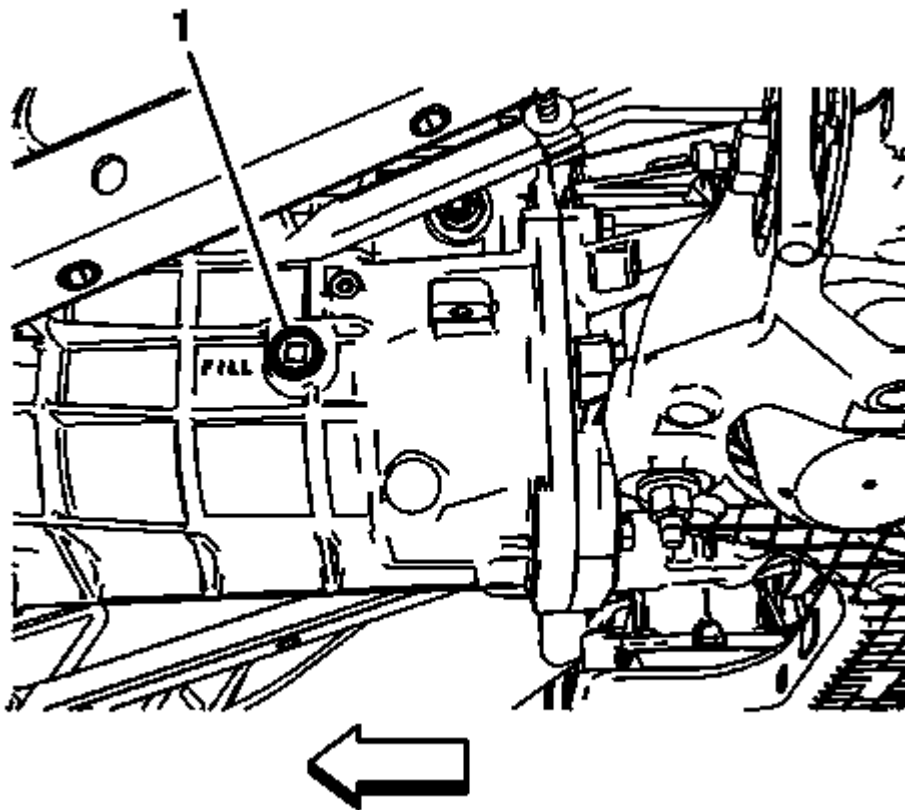


**Fig. 8: Transmission Fluid Fill Plug**  
Courtesy of GENERAL MOTORS COMPANY

2. Clean any dirt from around the fill plug hole (1).

3. Remove the transmission fluid fill plug.
4. Inspect the transmission fluid level. Ensure that the fluid level is even with the bottom of the fill plug hole.
5. Add transmission fluid, if necessary. Refer to **Lubrication Specifications**.

**CAUTION: Refer to Fastener Caution .**

6. Install the transmission fluid fill plug hole and tighten to 27 (20 lb ft).
7. Lower the vehicle.

## TRANSMISSION MOUNT INSPECTION

**CAUTION: Phenolic spacer must be present to prevent galvanic/corrosive reaction and/or excessive temperature conduction between engine mount bracket and engine mount. Replace mount if phenolic spacer is missing or damaged. Failure to ensure phenolic spacer is intact and not damaged can lead to premature failure of engine mount and/or engine mount bracket.**

**NOTE: Before replacing any transmission mount due to suspected fluid loss, verify that the source of the fluid is the transmission mount, not the transmission or accessories.**

1. Install the transmission support fixture. Slightly raising the transmission removes the weight from the transmission mount and creates slight tension in the rubber.
2. Observe the transmission mount while raising the transmission. Replace the transmission mount if the transmission mount exhibits any of the following conditions:
  - The hard rubber surface is covered with heat check cracks.
  - The rubber is separated from the metal plate of the transmission mount.
  - The rubber is split through the center of the transmission mount.
  - The GLYCOL™ fluid is leaking from the transmission mount.
3. If there is movement between the metal plate of the transmission mount and its attaching points, lower the transmission on the transmission mount. Tighten the bolts or nuts attaching the transmission mount to the frame or transmission. Refer to **Transmission Mount Replacement**.

## TRANSMISSION MOUNT REPLACEMENT

### Special Tools

- **CH-50732** Socket 18 mm
- **J-33432-B** Transverse Spring Compressor

For equivalent regional tools, refer to **Special Tools** .

#### Removal Procedure

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
3. Place a screw jack and a piece of wood under the transmission where it mates with the driveline support assembly.
4. Remove the underbody side rail cross braces from the vehicle. Refer to **Underbody Side Rail Cross Brace Replacement (Rear)** , **Underbody Side Rail Cross Brace Replacement (Front)** .

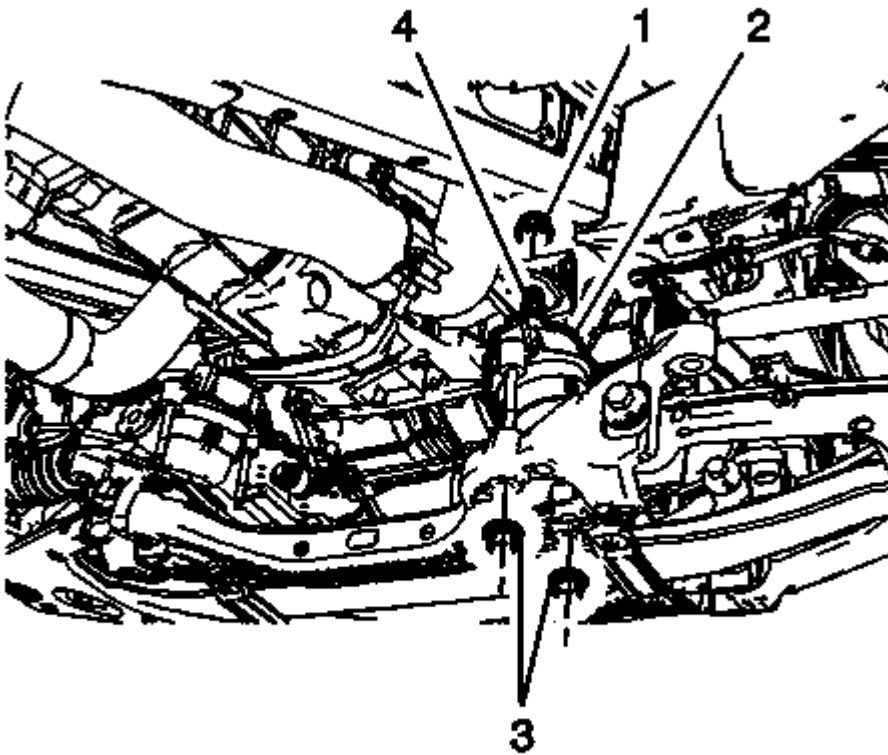


**Fig. 9: Transmission Mounts**  
Courtesy of GENERAL MOTORS COMPANY

5. Remove the upper transmission mount fastener (1).
6. Remove the lower transmission mount-to-lower rear suspension crossmember fasteners (3).
7. Using the **J-33432-B** compressor, compress the transverse spring until the spring adjuster is not contacting the lower control arm.

8. Place a screw jack under the rear center section of the crossmember.
9. Remove the lower shock bolt. Refer to **Shock Absorber Replacement (without FE2, FE4)** , **Shock Absorber Replacement (with FE2, FE4)** .

**NOTE:** Spring may require further compression to allow crossmember to lower.

10. Remove the crossmember mounting fasteners, then lower the screw jack and crossmember to gain mount removal clearance.
11. Remove the transmission mount.

#### **Installation Procedure**

1. Install the transmission mount.
2. Using the **J-33432-B** compressor, release compression on spring.
3. Using a screw jack under the rear center section of the crossmember, raise the crossmember.
4. Align the crossmember dowel pins to the frame rails.

**CAUTION:** Refer to **Fastener Caution** .

5. Using ONLY hand tools, install the crossmember mounting fasteners.
6. Using a torque wrench and the appropriate socket, alternately and evenly tighten to 160 (118 lb ft).
7. Install the lower shock bolt. Refer to **Shock Absorber Replacement (without FE2, FE4)** , **Shock Absorber Replacement (with FE2, FE4)** .
8. Remove the **J-33432-B** compressor from the transverse spring.
9. Remove the screw jacks.

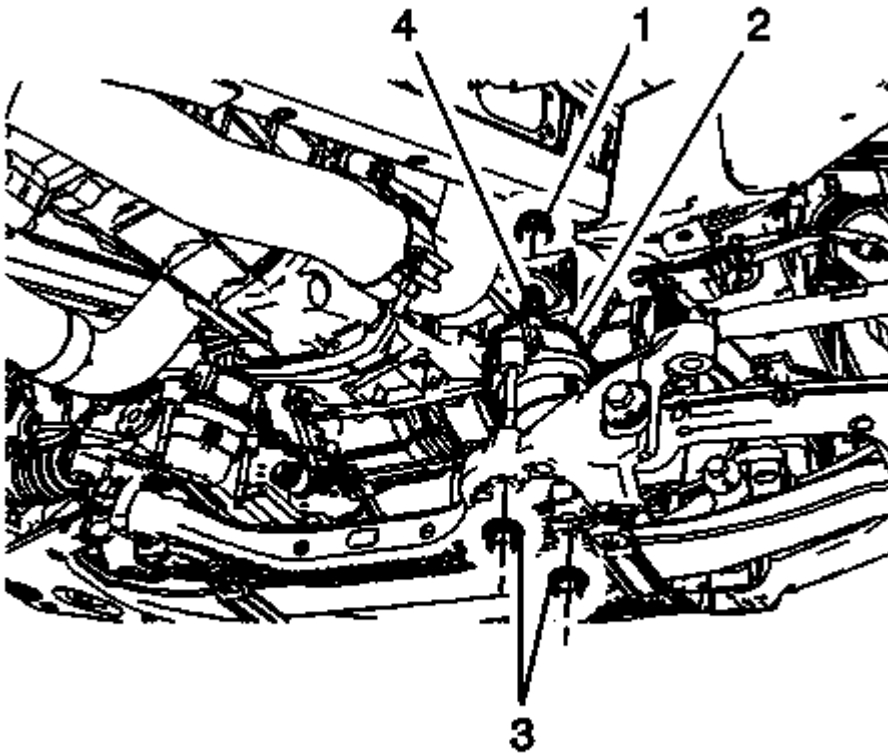


**Fig. 10: Transmission Mounts**

Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Hold the transmission mount stud (4) with a suitable socket to prevent the stud from rotating in the mount. If the stud becomes loose, replace the transmission mount.

10. Using **CH-50732** socket or equivalent, install the transmission mount fastener (1) and tighten to 70 (52 lb ft).
11. Install the lower mount-to-rear suspension crossmember fasteners and tighten to 43 (32 lb ft).
12. Install the underbody side rail cross braces to the vehicle. Refer to **Underbody Side Rail Cross Brace Replacement (Rear)** , **Underbody Side Rail Cross Brace Replacement (Front)** .
13. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
14. Lower the vehicle.

## TRANSMISSION CONTROL LEVER BOOT REPLACEMENT

### Removal Procedure

1. Remove the shift control knob. Refer to **Transmission Control Lever Knob Replacement**.

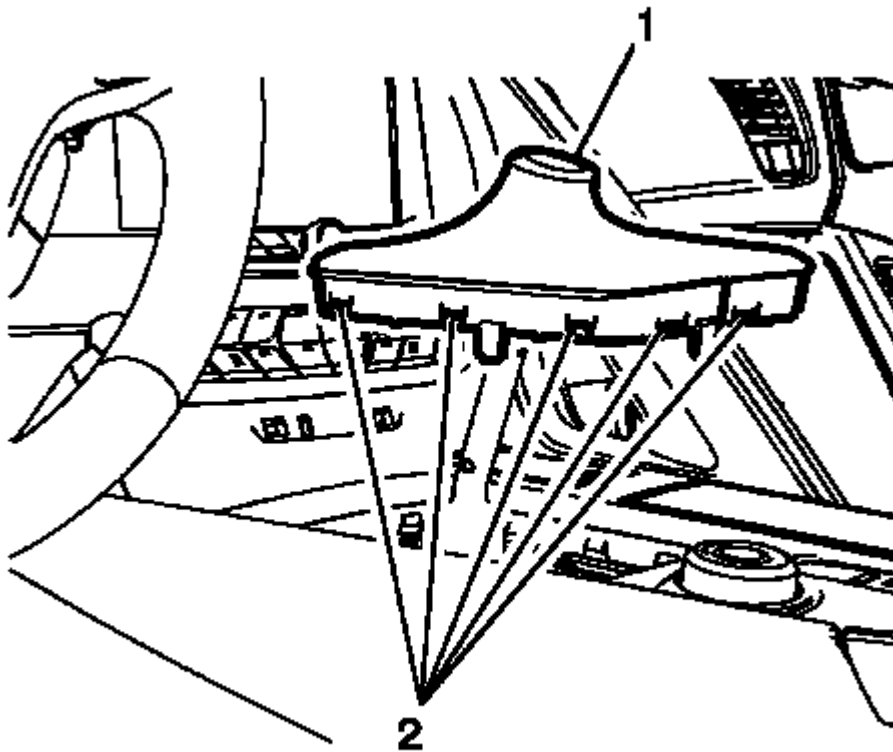


**Fig. 11: Releasing Shift Boot Retaining Tabs**  
**Courtesy of GENERAL MOTORS COMPANY**

2. Using a soft tipped trim tool, apply light pressure in toward the shift control lever to begin to release the shift boot retaining tabs (2) from the front floor console trim plate.
3. Using light pressure, continue to release the remaining boot retaining tabs.
4. Lift the boot away from the trim plate and remove the boot.

#### **Installation Procedure**

1. Install the shift control boot over the shift control lever.

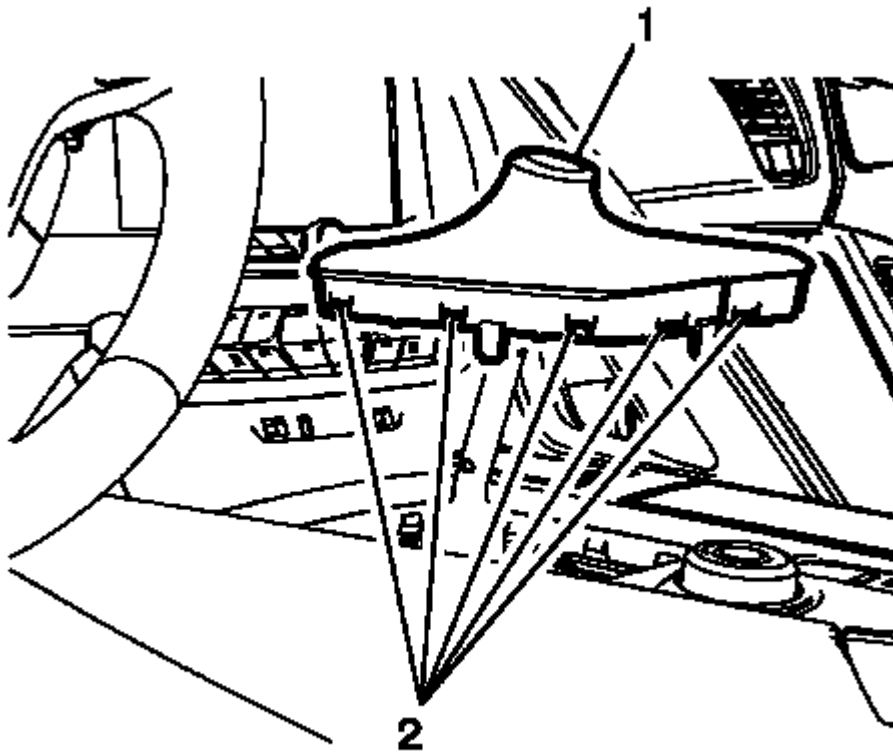


**Fig. 12: Releasing Shift Boot Retaining Tabs**  
**Courtesy of GENERAL MOTORS COMPANY**

2. Align the shift control boot (1) to the front floor console trim plate opening, then press to lock the boot retaining tabs.
3. Install the shift control knob. Refer to **Transmission Control Lever Knob Replacement**.

## **TRANSMISSION CONTROL LEVER KNOB REPLACEMENT**

### **Removal Procedure**

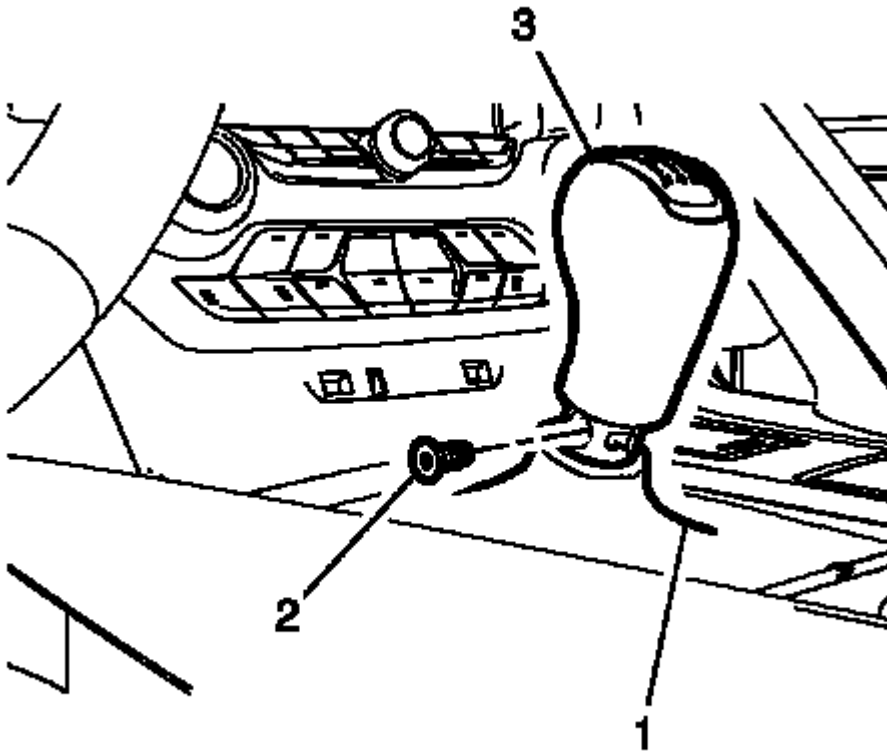


**Fig. 13: Shift Control Knob Trim Ring**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Carefully remove the shift control knob trim ring (1) by turning counter-clockwise and pulling downward.
2. Remove the shift control knob retaining screw (2).
3. Remove the shift control knob (3).

#### **Installation Procedure**

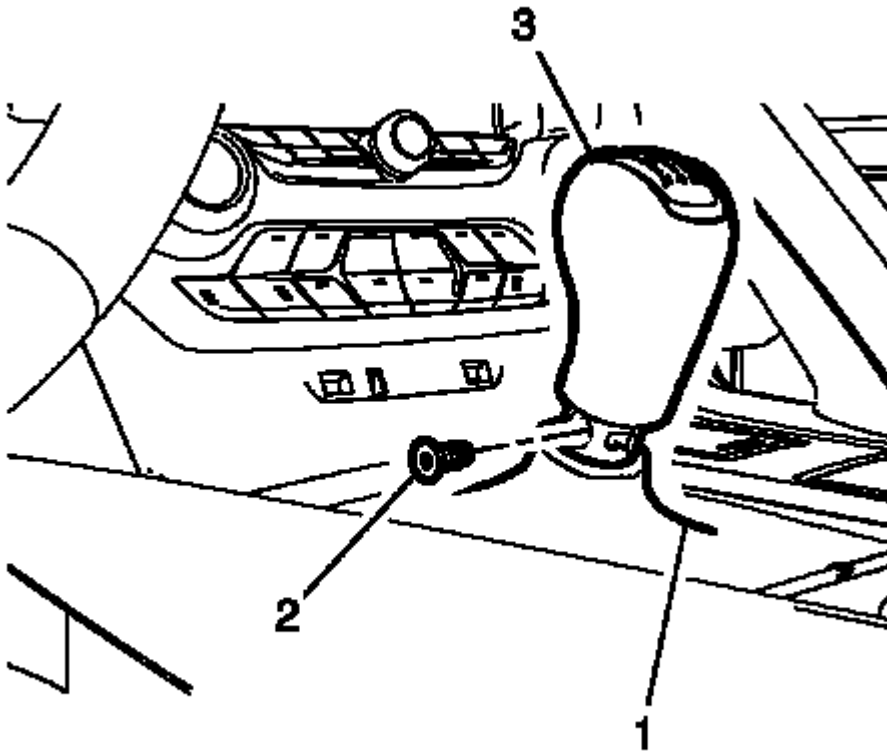


**Fig. 14: Shift Control Knob Trim Ring**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the shift control knob (3) onto the shift control lever.

**CAUTION:** Refer to Fastener Caution .

2. Install the shift control knob retainer screw (2) and tighten to 2 (18 lb in).
3. Install the shift control knob trim ring (1) and turn clockwise to lock into place.

## **SHIFT ROD REPLACEMENT**

### **Removal Procedure**

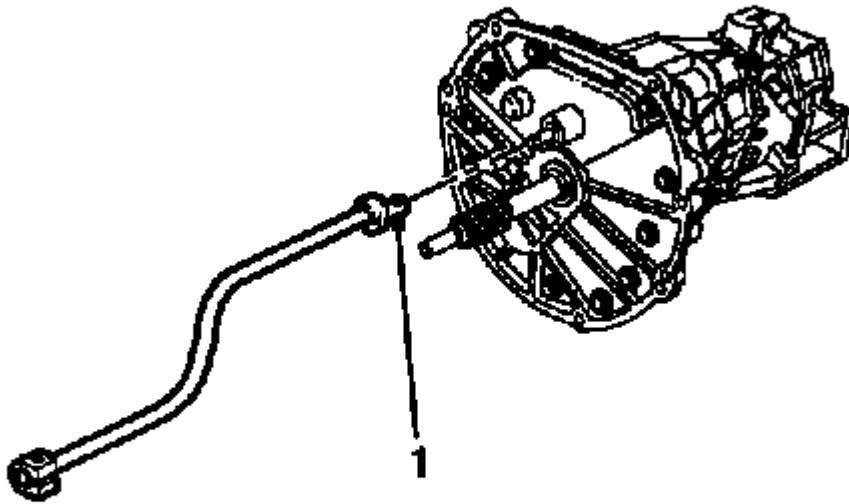


**Fig. 15: Roll Pin, Transmission Shift Rod & Transmission Shift Shaft**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Remove the transmission control assembly. Refer to **Transmission Control Replacement**.
2. Remove the driveline support assembly, the transmission and the differential from the vehicle, then separate the transmission from the driveline support assembly. Refer to **Transmission Replacement**.
3. Slide the transmission shift rod toward the transmission until the transmission shift shaft seats in the rear-most detent position.

Placing the shift rod close to the transmission housing provides additional support for the transmission shift shaft.

4. Using a drift or punch, remove the roll pin (1) retaining the transmission shift rod to the transmission shift shaft.
5. Remove the transmission shift rod from the transmission shift shaft.

#### **Installation Procedure**

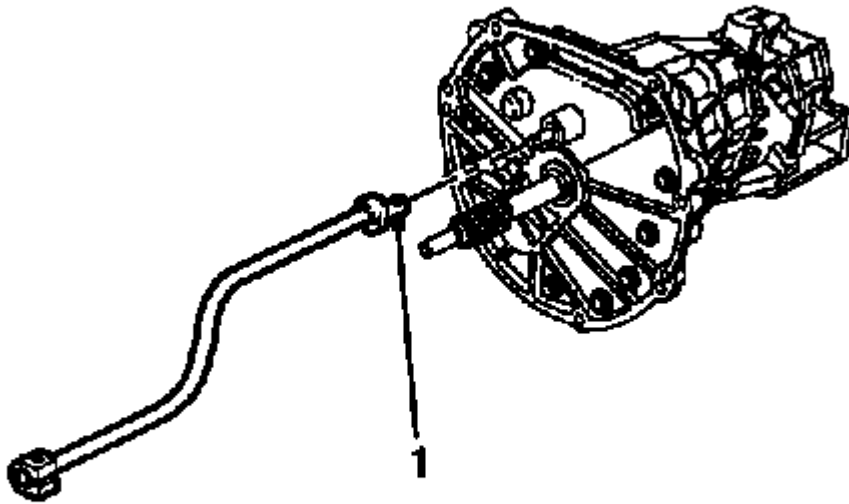


**Fig. 16: Roll Pin, Transmission Shift Rod & Transmission Shift Shaft**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Install the transmission shift rod to the transmission shift shaft.
2. Using a drift or punch, install the roll pin (1) to retain the transmission shift rod to the shift shaft.
3. Pull the transmission shift rod away from the transmission to the middle detent position (NEUTRAL).
4. Install the transmission to the driveline support assembly, then install the driveline support assembly, transmission and differential to the vehicle. Refer to **Transmission Replacement**.
5. Install the transmission control assembly. Refer to **Transmission Control Replacement**.

## **SKIP SHIFT SOLENOID REPLACEMENT**

### **Special Tools**

**DT-48827** Gear Select/Reverse Lockout Solenoid Socket

For equivalent regional tools, refer to **Special Tools**.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the skip shift solenoid electrical connector.

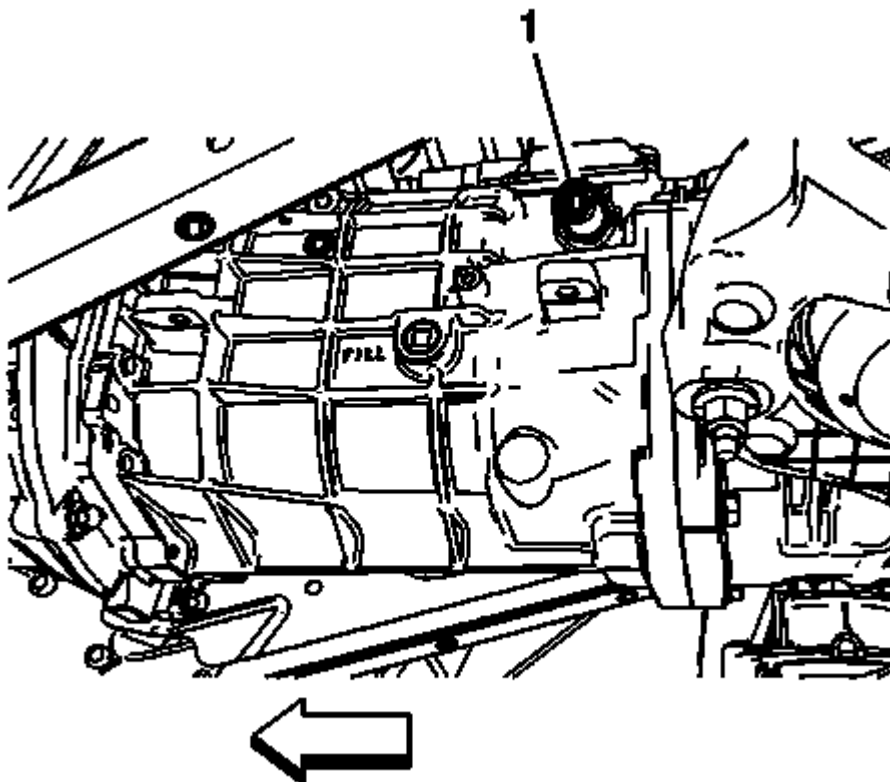


**Fig. 17: Skip Shift Solenoid**  
Courtesy of GENERAL MOTORS COMPANY

3. Using the **DT-48827** socket, remove the skip shift solenoid (1).

#### **Installation Procedure**

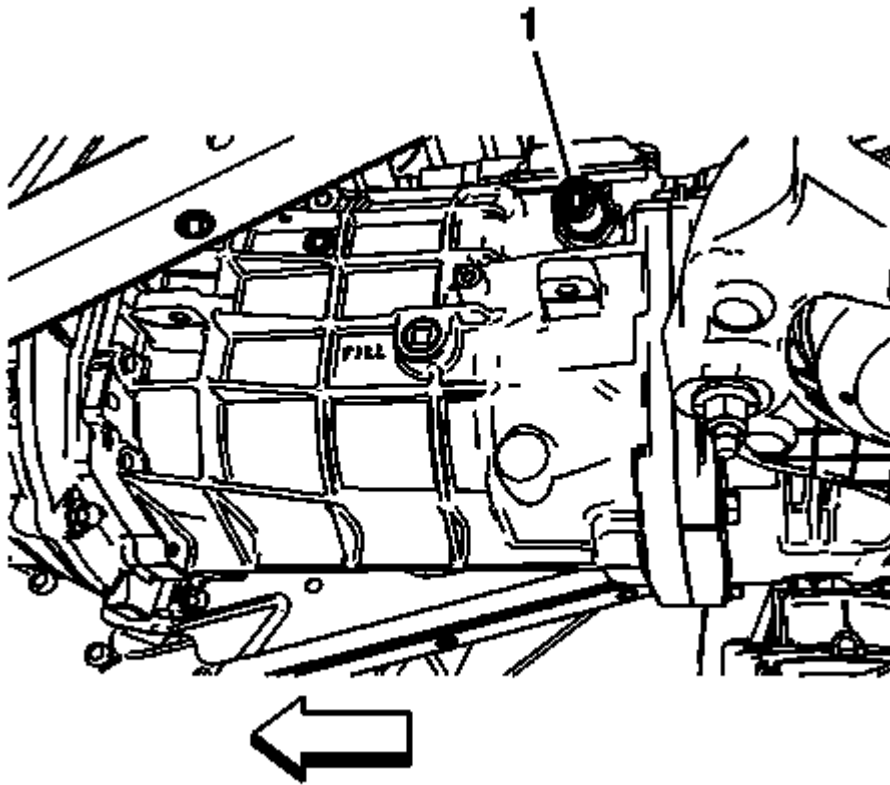


**Fig. 18: Skip Shift Solenoid**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

1. Using the **DT-48827** socket, install the skip shift solenoid (1) and tighten to 40 N.m (30 lb ft).
2. Connect the gear select solenoid electrical connector.
3. Lower the vehicle.

## **FLUID TEMPERATURE SENSOR REPLACEMENT**

### **Removal Procedure**

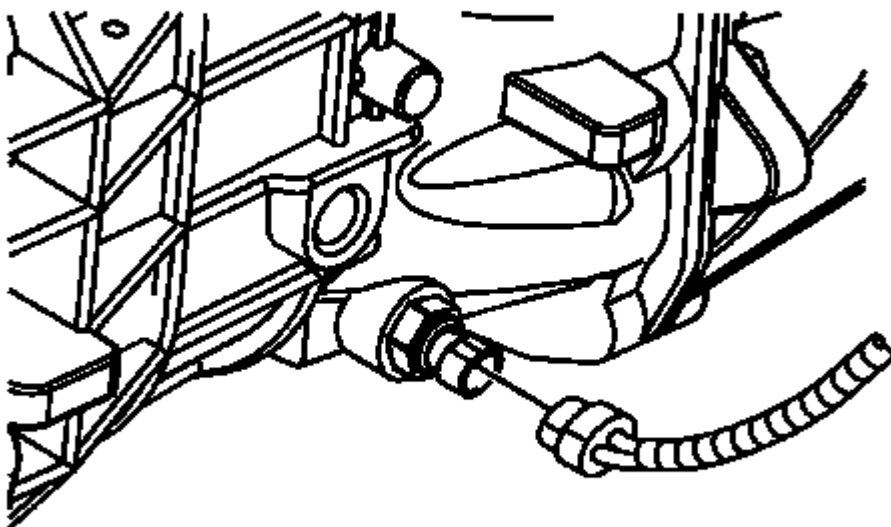


**Fig. 19: View Of Temperature Sensor Electrical Connector**  
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Drain the transmission fluid. Refer to **Transmission Fluid Drain and Fill**.
3. Disconnect the transmission fluid temperature sensor electrical connector.

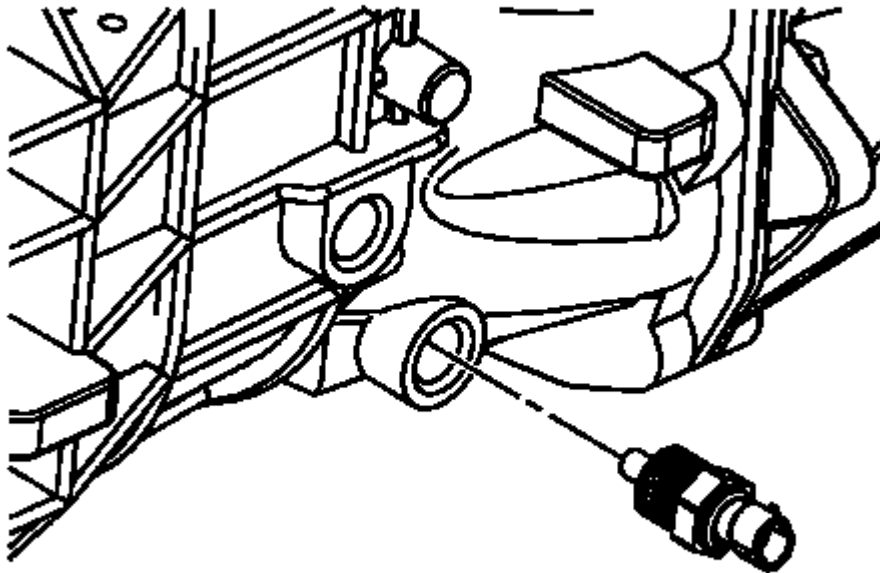


**Fig. 20: View Of Temperature Sensor**  
Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission fluid temperature sensor.

#### **Installation Procedure**

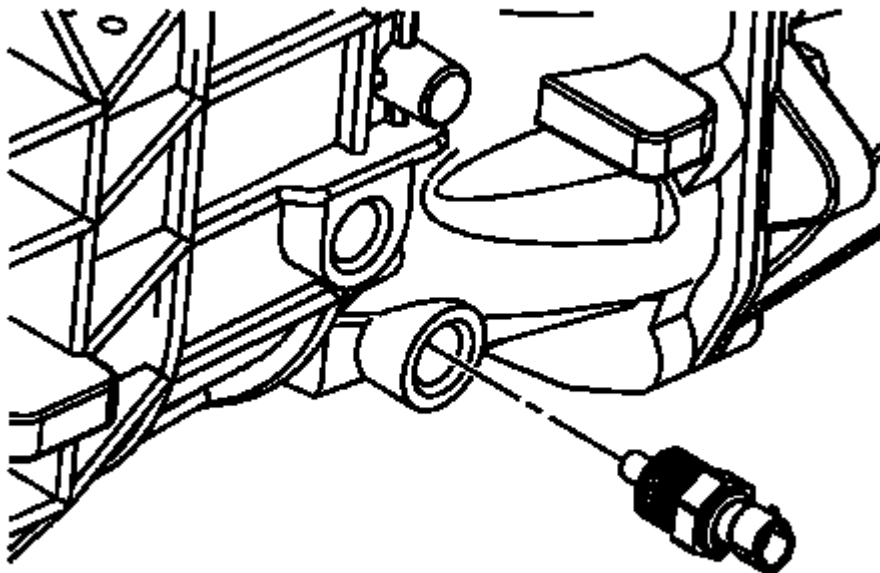


**Fig. 21: View Of Temperature Sensor**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

1. Install the transmission fluid temperature sensor and tighten to 27 (20 lb ft).

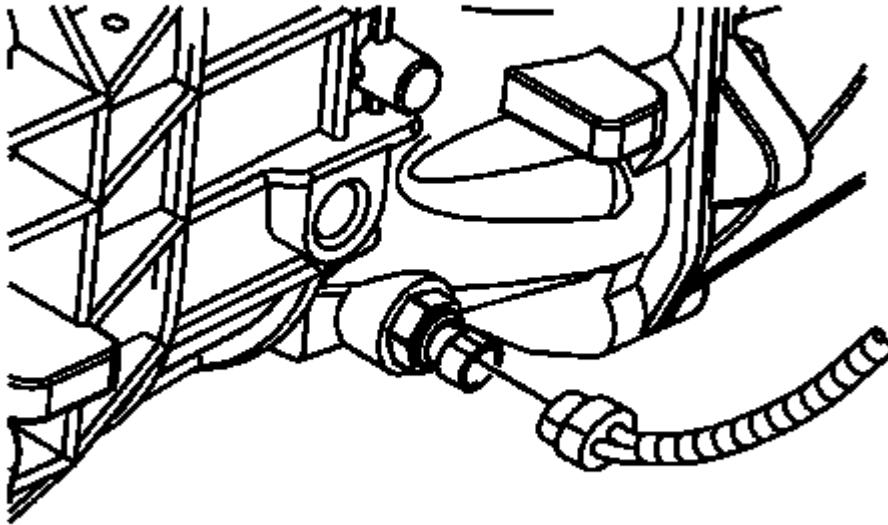


**Fig. 22: View Of Temperature Sensor Electrical Connector**  
Courtesy of GENERAL MOTORS COMPANY

2. Connect the transmission fluid temperature sensor electrical connector.
3. Fill the transmission with fluid. Refer to **Transmission Fluid Drain and Fill**.
4. Lower the vehicle.

## **OUTPUT SPEED SENSOR REPLACEMENT**

### **Removal Procedure**

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the transmission output speed sensor electrical connector.

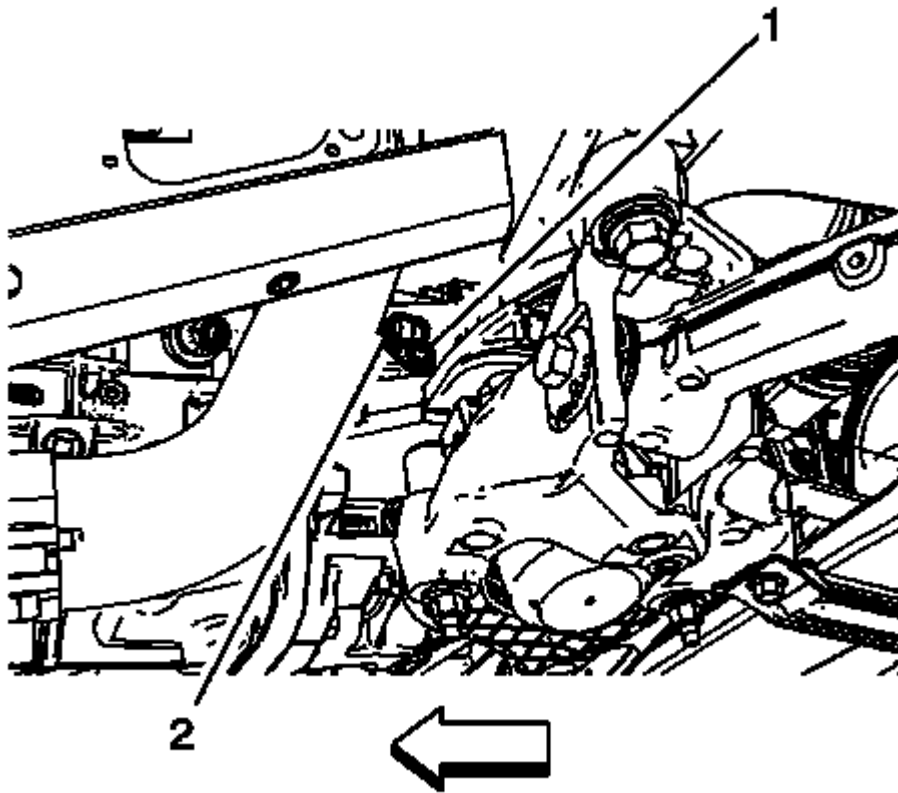


**Fig. 23: Transmission Output Speed Sensor Retaining Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Remove the transmission output speed sensor retaining bolt (1).
4. Remove the transmission output speed sensor (2).

#### **Installation Procedure**

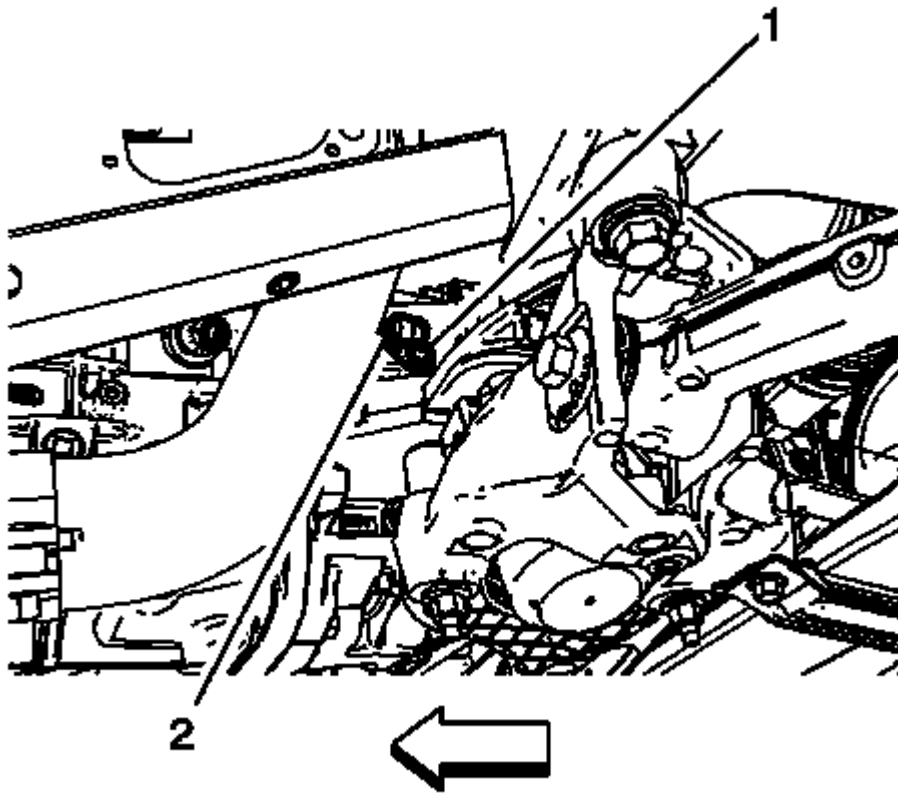


**Fig. 24: Transmission Output Speed Sensor Retaining Bolt**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission fluid temperature sensor (2).

**CAUTION: Refer to Fastener Caution .**

2. Install the transmission output speed sensor retaining bolt (1).
3. Connect the transmission output speed sensor electrical connector.
4. Lower the vehicle.

## **TRANSMISSION CONTROL REPLACEMENT**

### **Removal Procedure**

1. Remove the front floor lower console. Refer to **Front Floor Lower Console Replacement** .

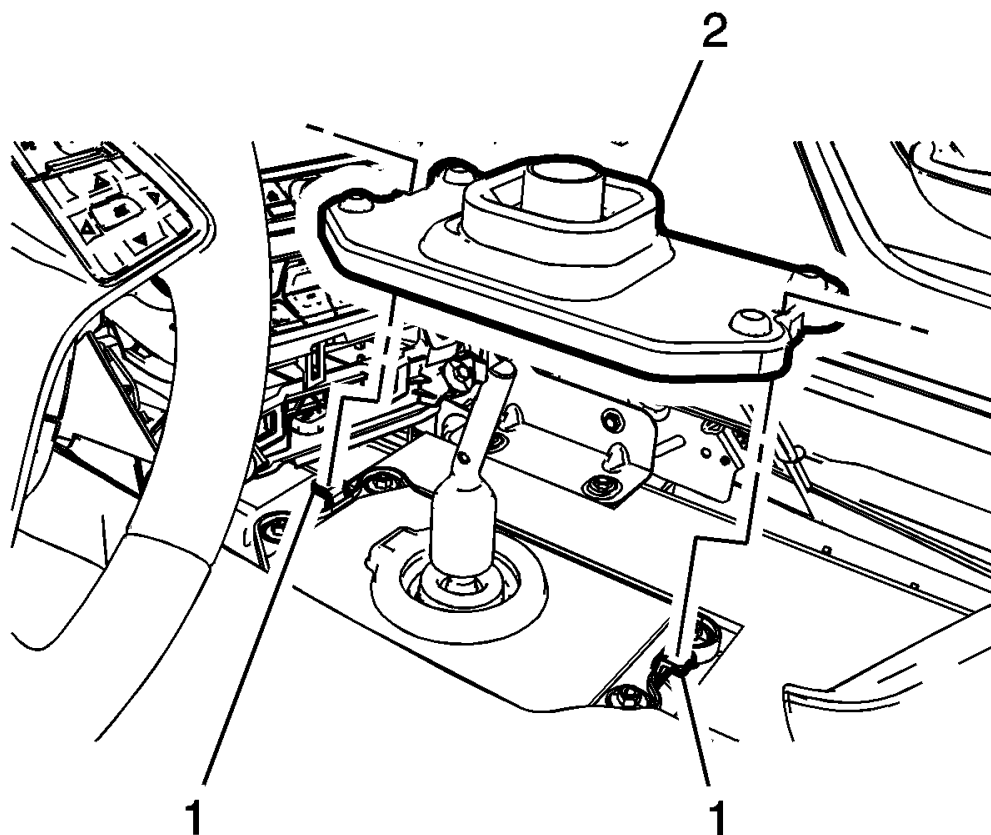


**Fig. 25: Upper Closeout Boot**  
**Courtesy of GENERAL MOTORS COMPANY**

2. Remove the upper closeout boot (2) from the transmission control assembly.

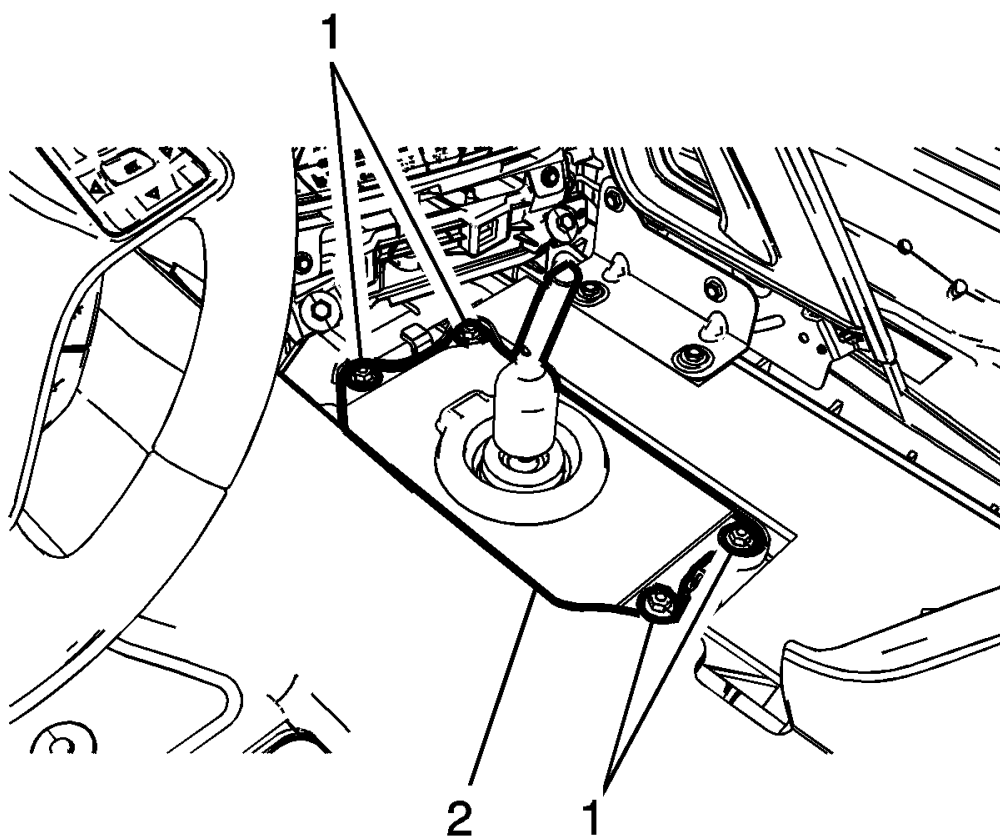


**Fig. 26: Transmission Control Lower Closeout Boot Retaining Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Remove the transmission control lower closeout boot retaining nuts (1).
4. Remove the transmission lower closeout boot (2) assembly.

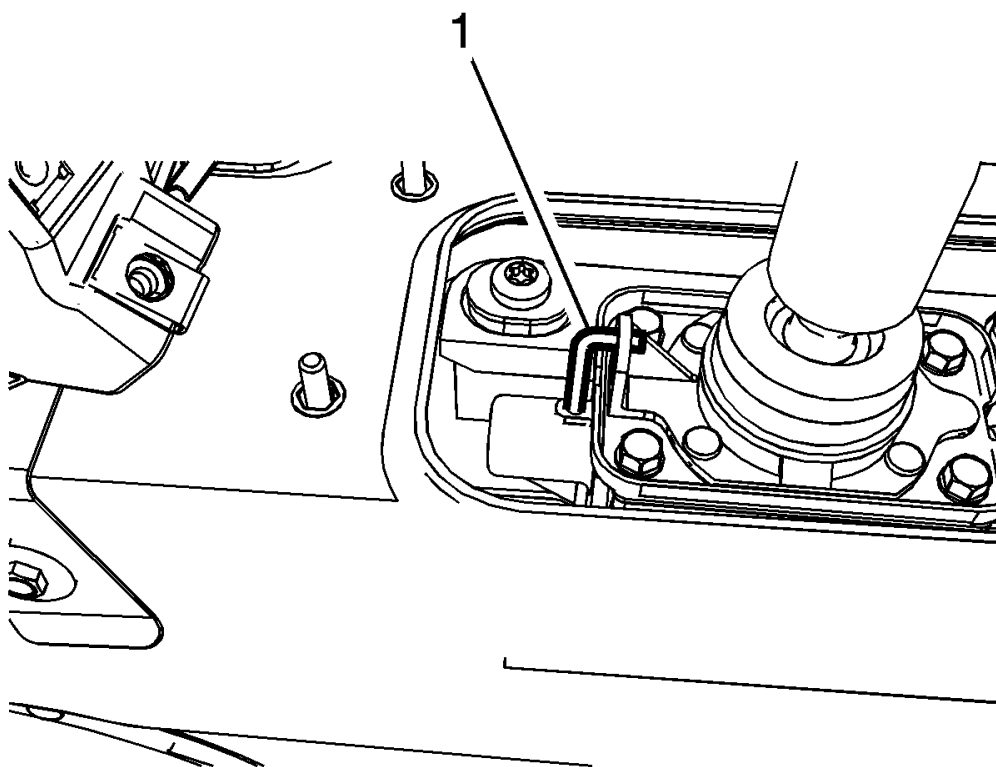


**Fig. 27: Shift Control Neutral Lock Pin**  
**Courtesy of GENERAL MOTORS COMPANY**

5. Place the shifter into NEUTRAL.
6. Press down to engage the shift control neutral lock pin (1).

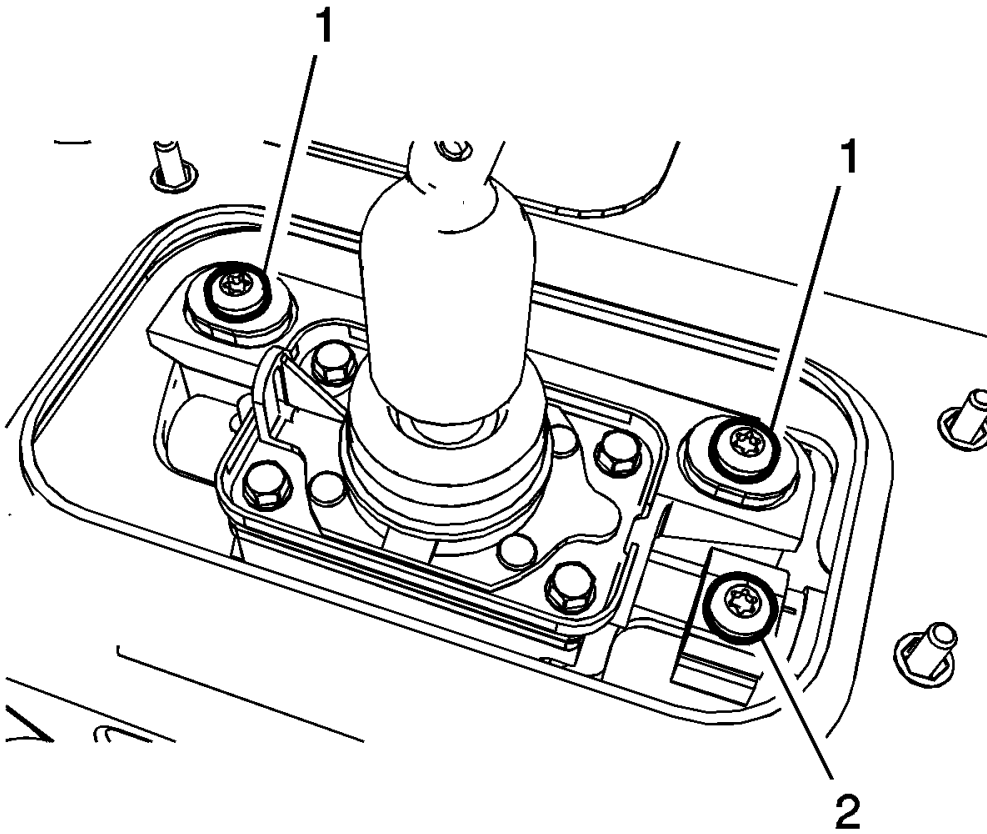


**Fig. 28: Transmission Shift Rod Clamp Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Remove the transmission shift rod clamp bolt (2).
8. Remove the shift control mounting bolts (1).
9. Raise the shift control to release the locator from the transmission control bracket on the side of the driveline support assembly.
10. Remove the transmission control assembly from the vehicle.

#### **Installation Procedure**

1. Install the shift control assembly to the transmission shift rod clamp.
2. Lower the shifter into position and insert the locator into the shifter bracket on the side of the driveline support assembly.

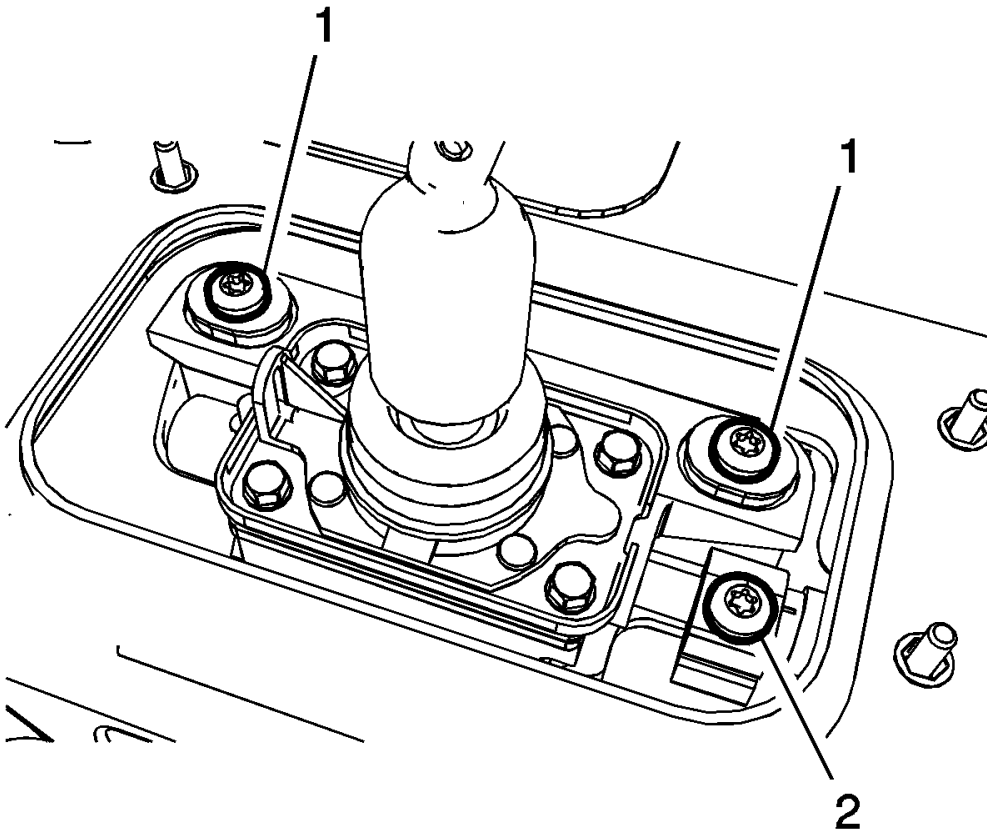


**Fig. 29: Transmission Shift Rod Clamp Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

**CAUTION: Refer to Fastener Caution .**

3. Install the shift control mounting bolts (1) and tighten to 30 (22 lb ft).
4. Install the transmission shift rod clamp bolt (2) and tighten to 30 (22 lb ft).

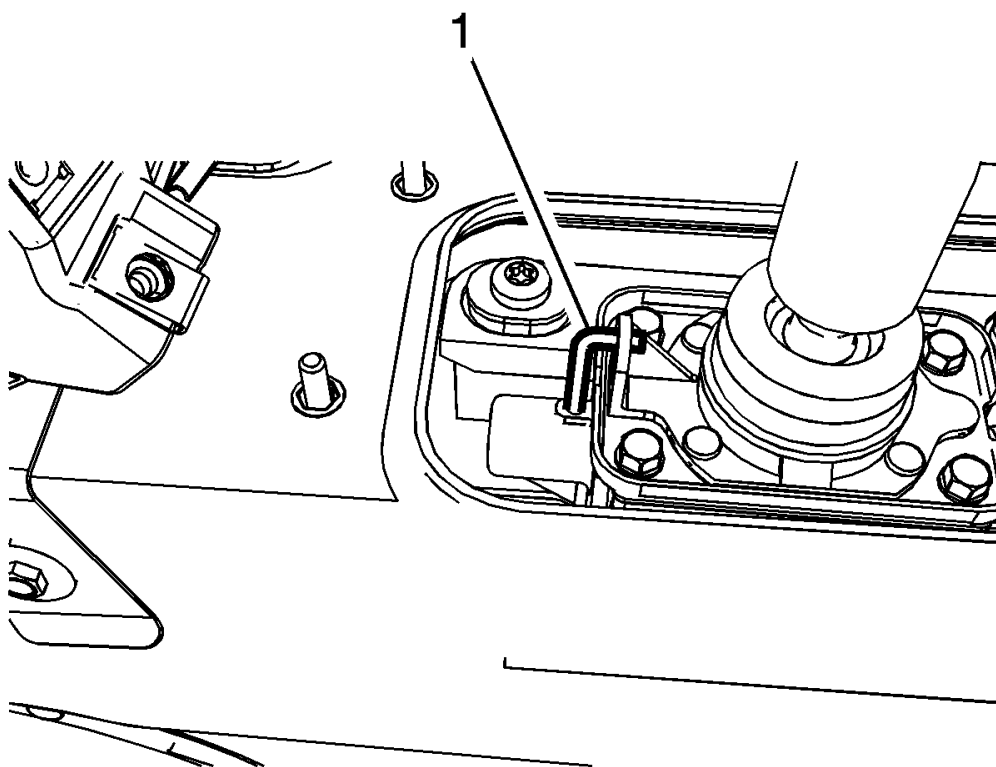


**Fig. 30: Shift Control Neutral Lock Pin**  
**Courtesy of GENERAL MOTORS COMPANY**

5. Lift to release the shift control neutral lock pin (1).

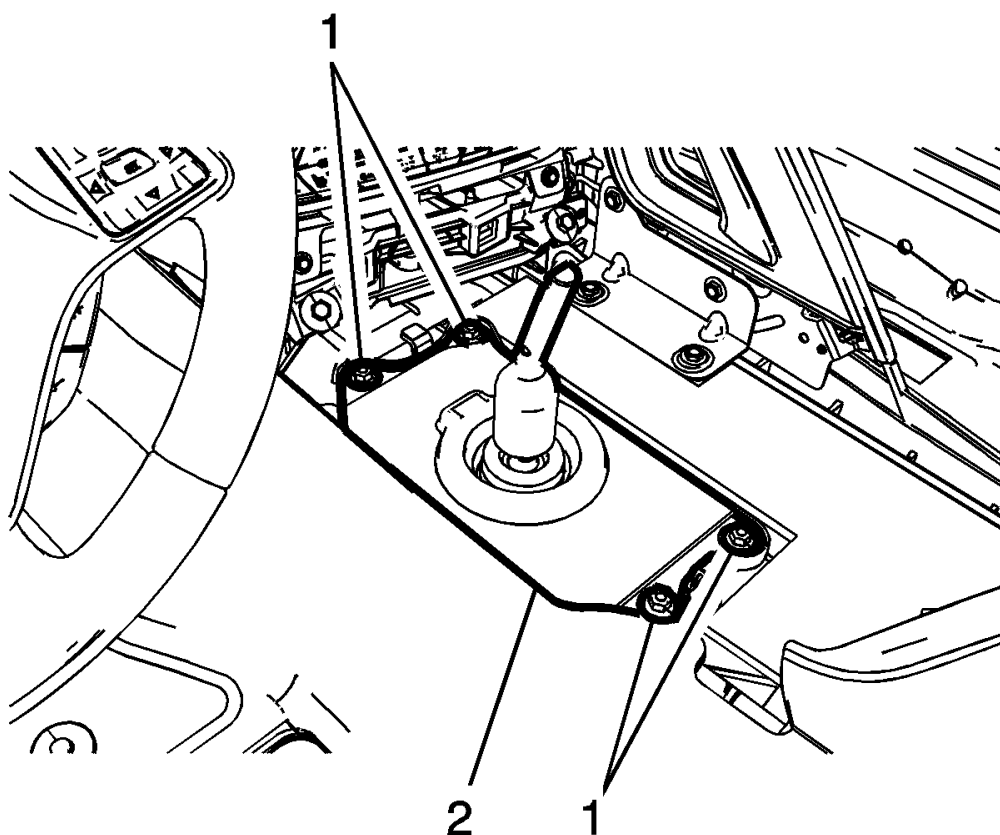


**Fig. 31: Transmission Control Lower Closeout Boot Retaining Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

6. Install the lower transmission control closeout boot (2).

Check that the closeout boot fully seats to the shift control lever seal and the base of the shift control assembly.

7. Install the shift control closeout boot retaining nuts and tighten to 6 (53 lb in).

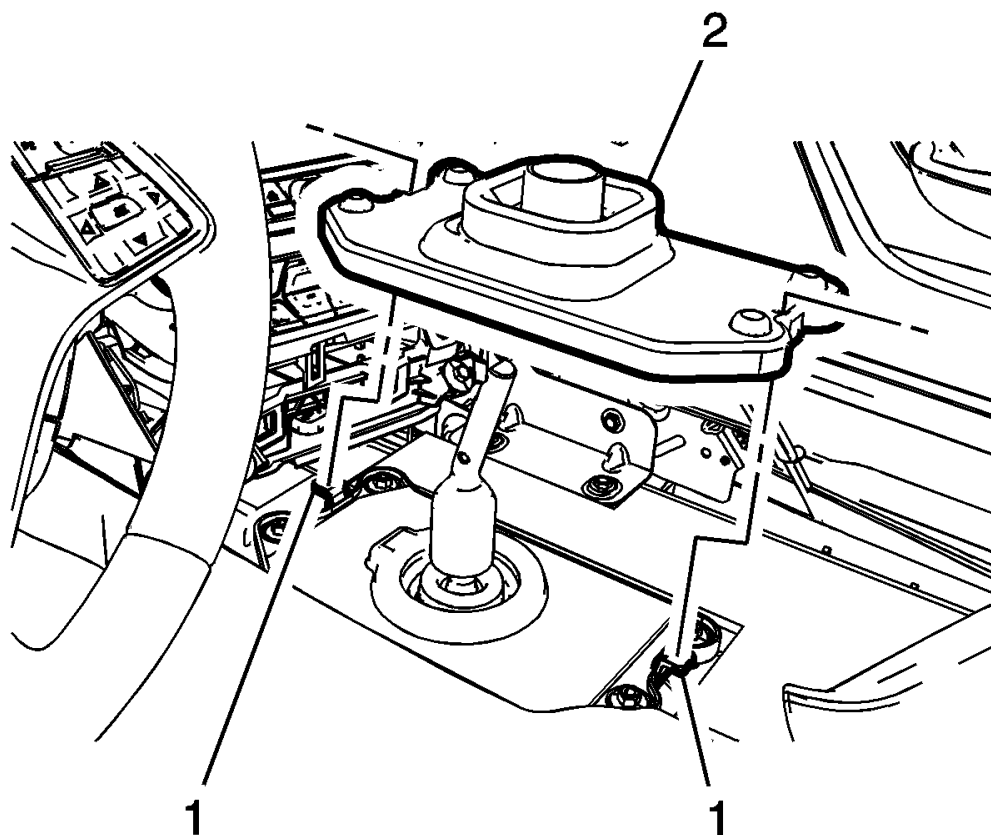


**Fig. 32: Upper Closeout Boot**  
Courtesy of GENERAL MOTORS COMPANY

8. Install the upper closeout boot to the transmission control assembly.
9. Install the front floor lower console. Refer to **Front Floor Lower Console Replacement** .

## **GEAR POSITION SENSOR REPLACEMENT**

### **Removal Procedure**

1. Lower the driveline support assembly with the transmission. Refer to **Transmission Replacement**.
2. Disconnect the gear position sensor electrical connector.

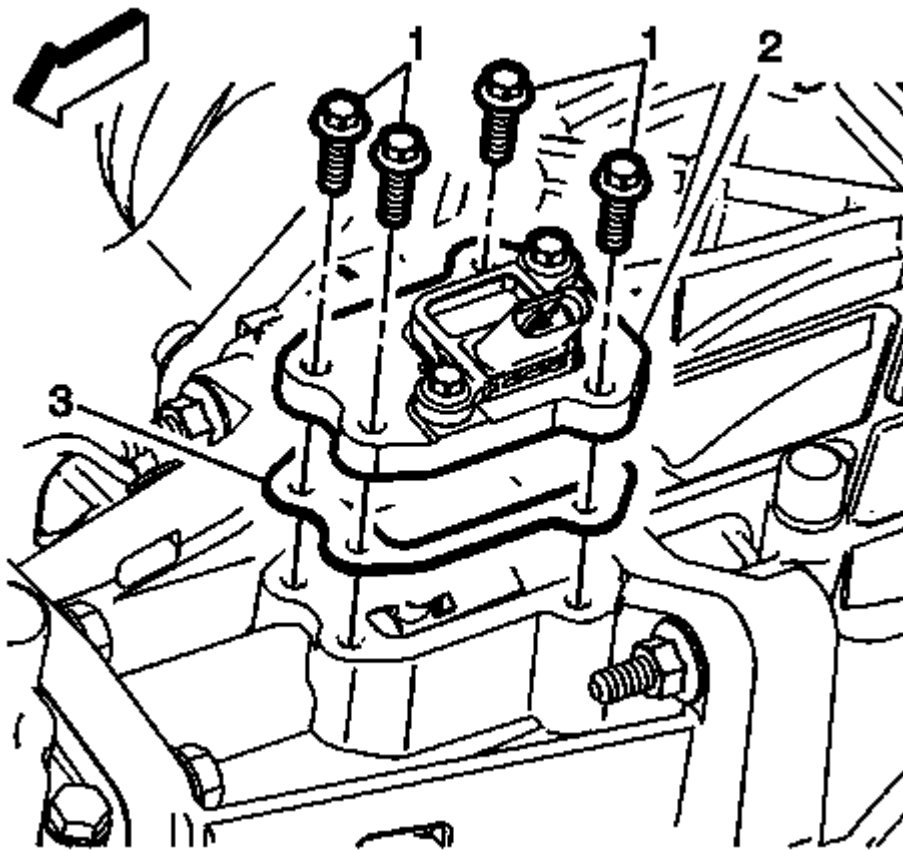


**Fig. 33: Gear Position Sensor Fasteners And Gasket**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Remove the gear position sensor fasteners (1).
4. Remove the gear position sensor assembly (2) and gasket (3).

#### **Installation Procedure**

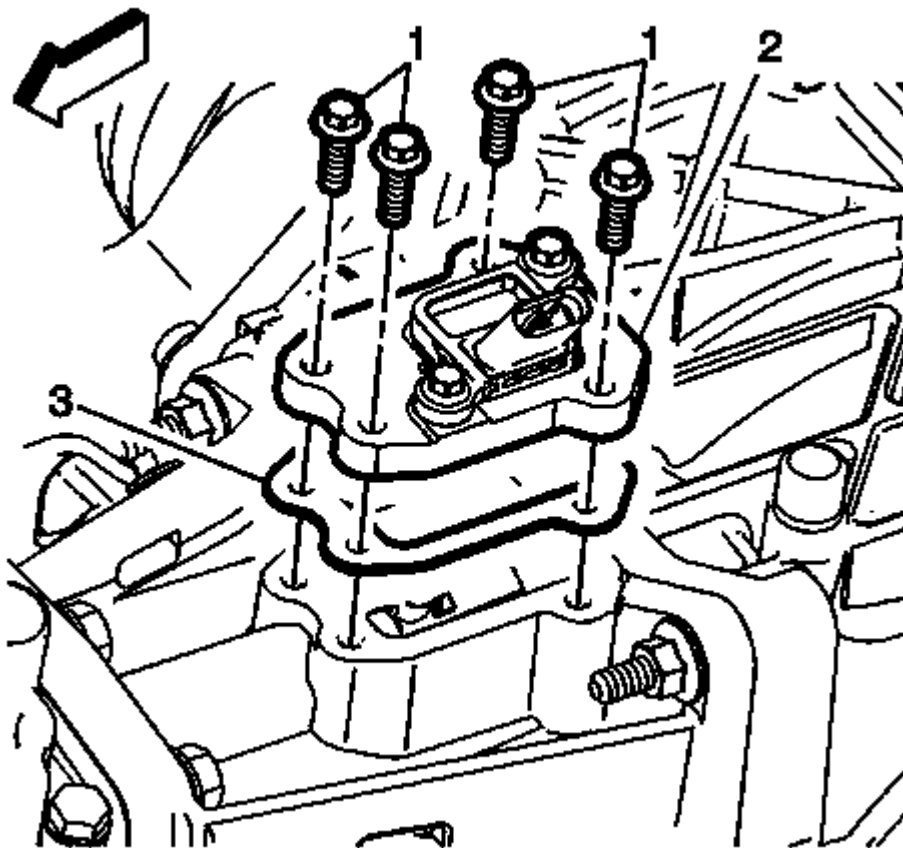


**Fig. 34: Gear Position Sensor Fasteners And Gasket**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW gear position gasket (2) and sensor assembly (2).

**CAUTION:** Refer to Fastener Caution .

2. Install the gear position sensor fasteners (1) and tighten to 8 (71 lb in).
3. Connect the gear position sensor electrical connector.
4. Install the driveline support assembly with the transmission. Refer to Transmission Replacement.

## **BACKUP LAMP SWITCH REPLACEMENT**

### **Removal Procedure**

1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Disconnect the backup lamp switch electrical connector.

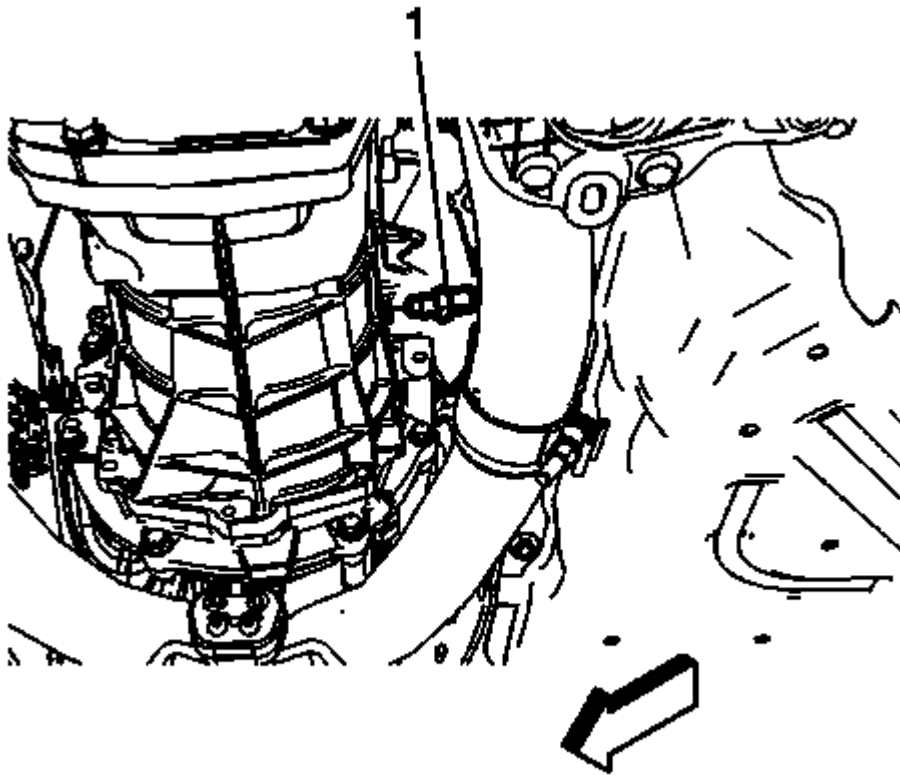


**Fig. 35: Backup Lamp Switch**  
Courtesy of GENERAL MOTORS COMPANY

3. Remove the backup lamp switch (1).

#### Installation Procedure

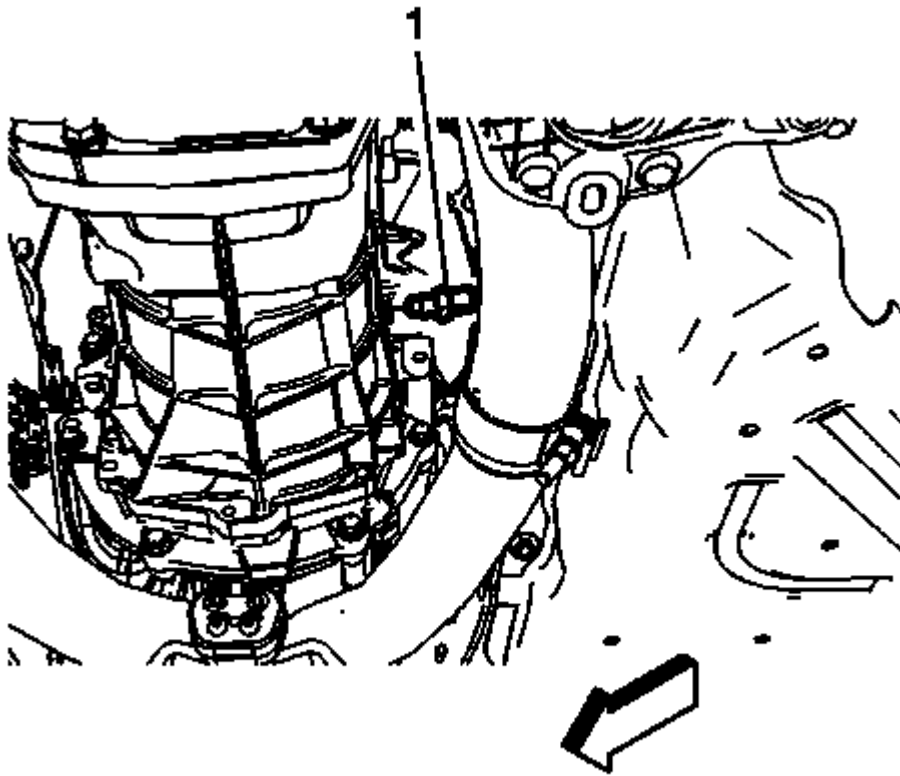


**Fig. 36: Backup Lamp Switch**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

1. Install the backup lamp switch (1) and tighten to 20 (15 lb ft).
2. Connect the backup lamp switch electrical connector.
3. Lower the vehicle.

## **REVERSE LOCKOUT SOLENOID REPLACEMENT**

### **Special Tools**

**J 41099** Gear Select/Reverse Lockout Solenoid Socket

For equivalent regional tools, refer to Special Tools.

### **Removal Procedure**

1. Lower the driveline support assembly with the transmission. Refer to **Transmission Replacement**.
2. Disconnect the reverse lockout solenoid electrical connector.

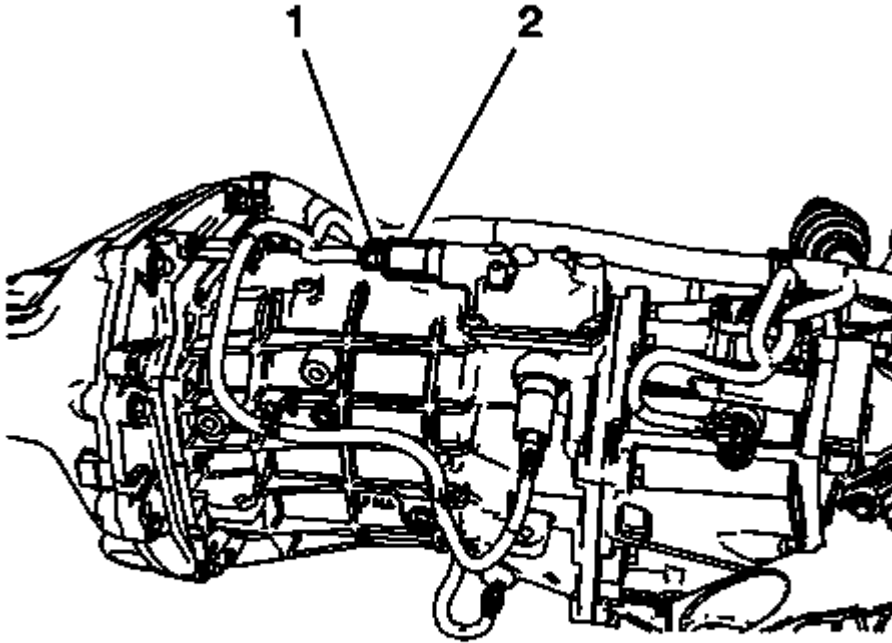


**Fig. 37: J 41099 socket And reverse lockout solenoid**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Using the **J 41099** socket, remove the reverse lockout solenoid.

#### **Installation Procedure**

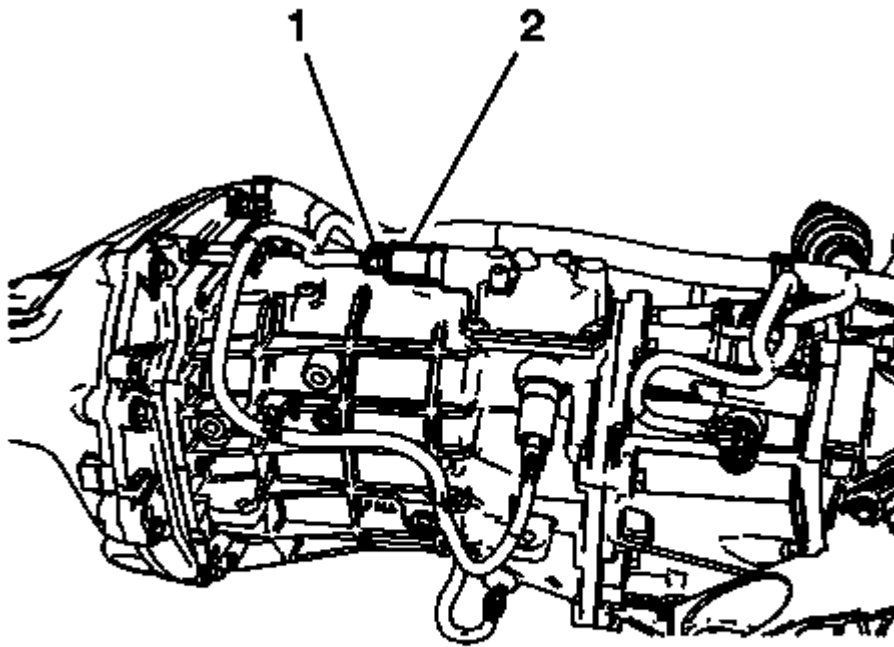


**Fig. 38: J 41099 socket And reverse lockout solenoid**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

1. Using the **J 41099** socket, install the reverse lockout solenoid. Tighten the reverse lockout solenoid to 40 (30 lb ft).
2. Connect the reverse lockout solenoid electrical connector.
3. Install the driveline support assembly with the transmission. Refer to **Transmission Replacement**.

## **TRANSMISSION FLUID DRAIN AND FILL**

### **Draining Procedure**

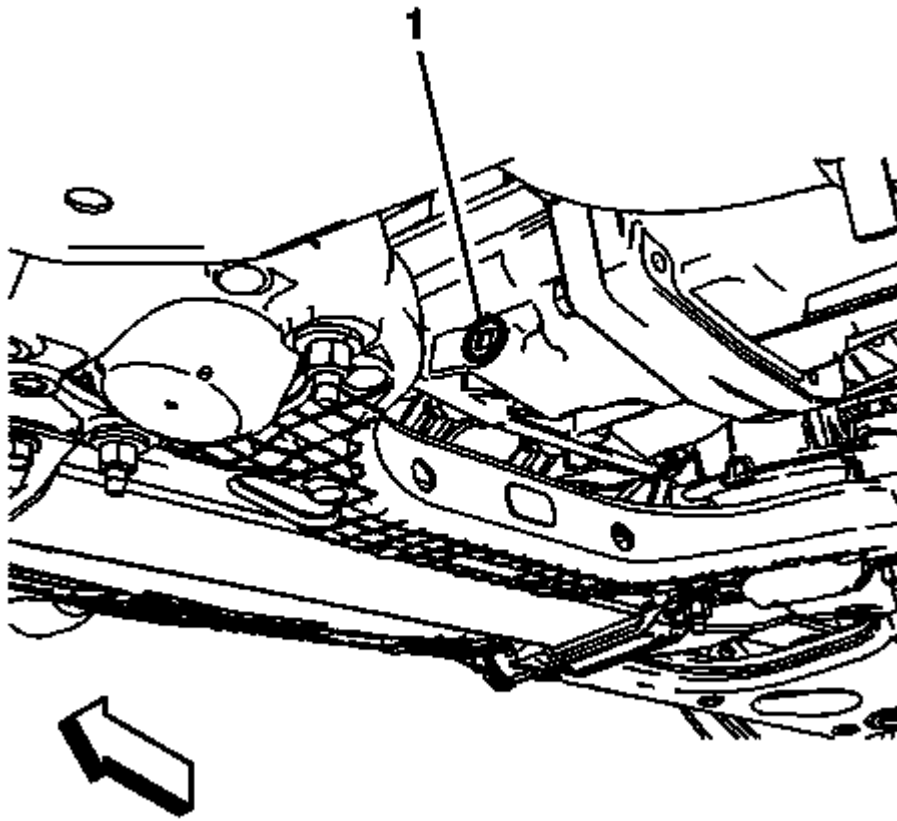


**Fig. 39: Transmission Fluid Drain Plug**  
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle; ensure that the vehicle is level. Refer to **Lifting and Jacking the Vehicle** .
2. Place a suitable drain pan under the transmission.
3. Clean away all dirt and debris from the transmission fluid drain plug area.
4. Remove the drain plug (1).
5. Allow the system to drain.

#### **Filling Procedure**

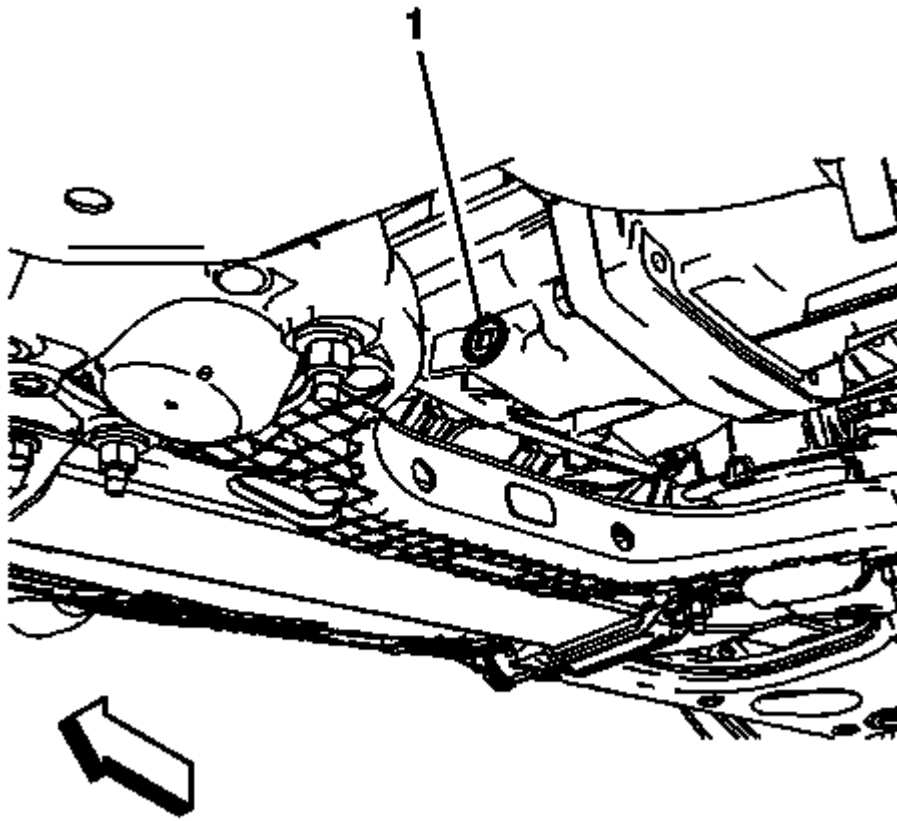


**Fig. 40: Transmission Fluid Drain Plug**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Component Fastener Tightening Caution .

1. Install the transmission fluid drain plug (1) and tighten to 27 (20 lb ft).

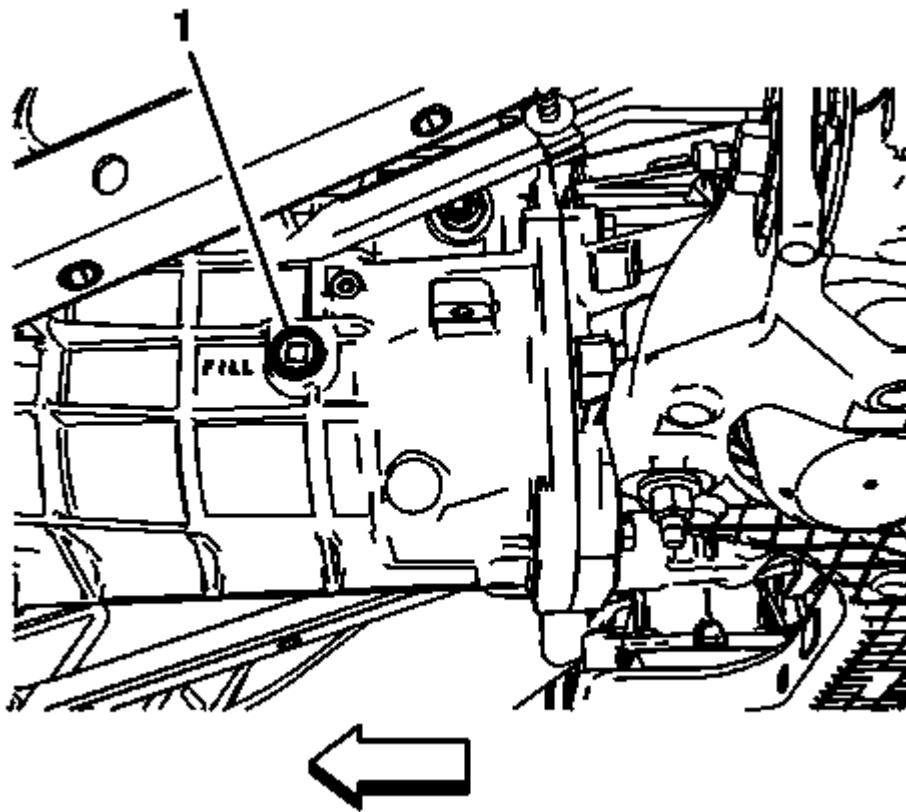


**Fig. 41: Transmission Fluid Fill Plug**  
Courtesy of GENERAL MOTORS COMPANY

2. Clean away all dirt and debris from the transmission fluid fill plug area.
3. Remove the fill plug (1).
4. Fill the transmission with manual transmission fluid, until even with the bottom of the fill plug hole. For fluid recommendations, refer to **Lubrication Specifications**.
5. Install the transmission fluid fill plug and tighten to 27 (20 lb ft).
6. Remove the drain pan.
7. Lower the vehicle.

## TRANSMISSION REPLACEMENT

### Special Tools

- **J-42055** Transmission Support Fixture
- **J-33432-B** Leaf Spring Compressor

For equivalent regional tools, refer to **Special Tools**.

## Removal Procedure

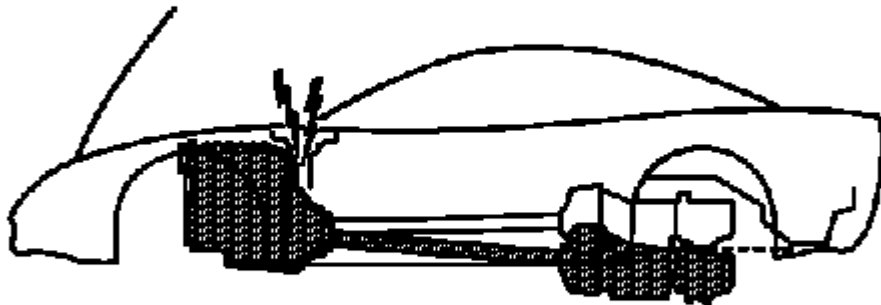


**Fig. 42: Tilting Down Rear Of Driveline**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** When tilting down the rear of the driveline, observe the clearance between the rear of the engine and the composite dash panel. Do not allow the engine to rest unsupported against the composite dash panel or vehicle damage may result.

**CAUTION:** When lowering and removing the rear of the driveline, observe the clearance between the rear of the transaxle assembly and the underbody to prevent damage.

- 1.
2. Remove the front floor lower console. Refer to **Front Floor Lower Console Replacement** .
3. Remove the shift control assembly. Refer to **Transmission Control Replacement**.
4. Remove the windshield washer solvent container. Refer to **Windshield Washer Solvent Container Replacement** .

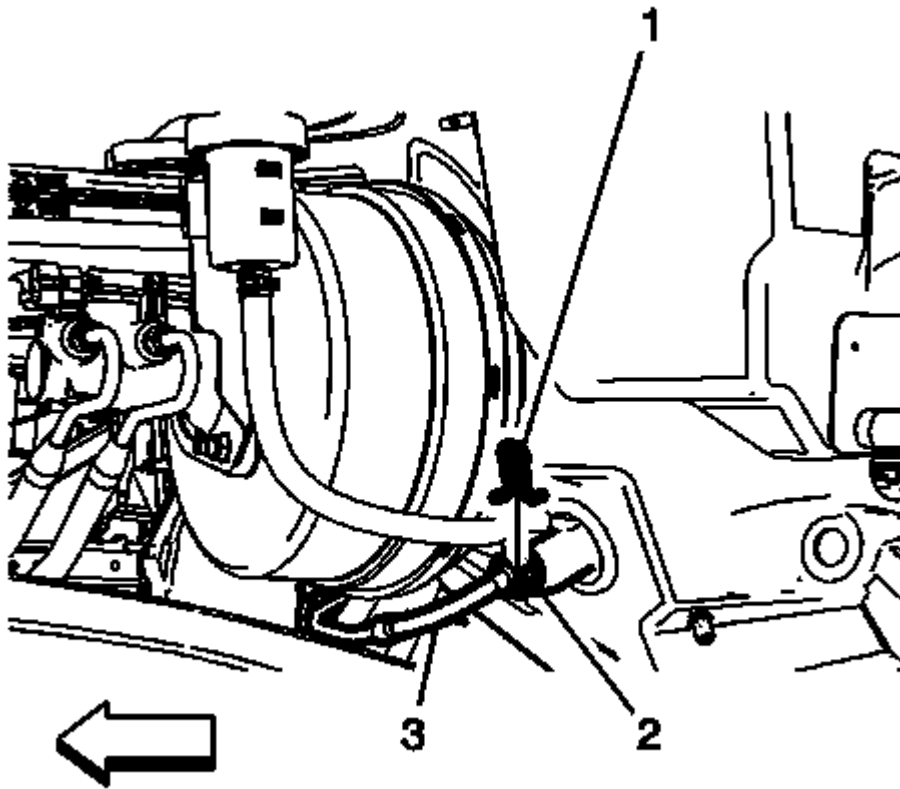


**Fig. 43: Clutch Pipe Connection Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

5. Remove the clutch hose/pipe retaining clip from the clutch master cylinder (1).
6. Disconnect the clutch hose/pipe (3) from the clutch master cylinder (2).
7. Disconnect the clutch actuator cylinder hose from the hose retaining clip below the power brake booster.
8. Remove the intermediate pipe. Refer to **Intermediate Pipe Replacement** .
9. Remove the rear spring. Refer to **Rear Spring Replacement** .

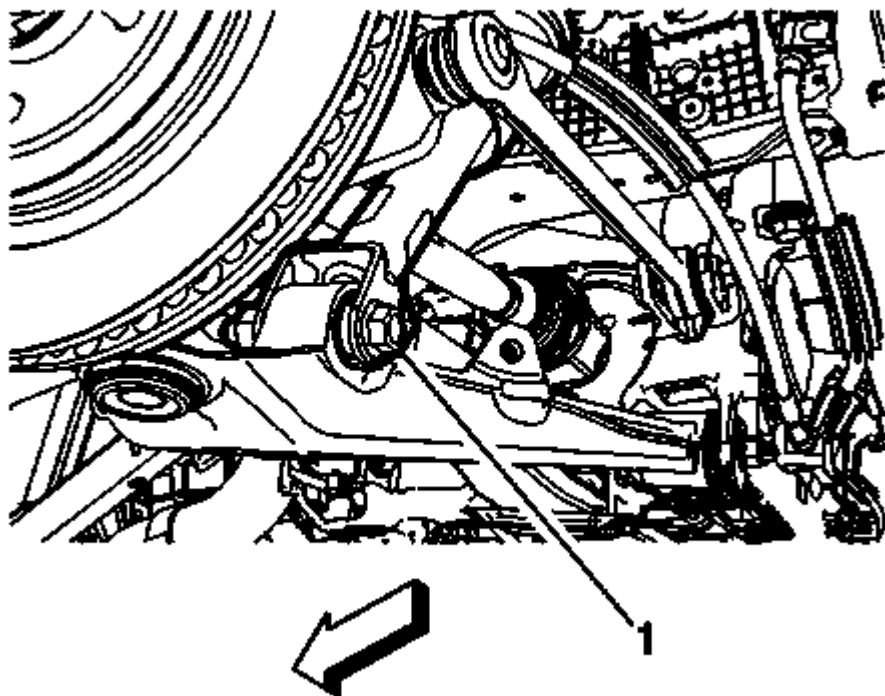


**Fig. 44: Shock Absorber Lower Mounting Bolt**  
Courtesy of GENERAL MOTORS COMPANY

10. Remove the shock absorber lower mounting bolt (1).
11. Disconnect the lower ball joint from the suspension knuckle. Refer to **Knuckle Replacement (without J55)** , **Knuckle Replacement (with J55)** .
12. Install the **J-42055** transmission support fixture to a transmission jack.
13. Position and firmly secure the **J-42055** transmission support fixture with the transmission jack to the transmission.
14. Disconnect the wiring harness and brake pipe clip retainers from the rear suspension crossmember.

**NOTE:** Removing the nuts at this time will aid in separating the differential from the transmission after the driveline has been removed from the vehicle.

15. Remove the differential to transmission lower nuts.

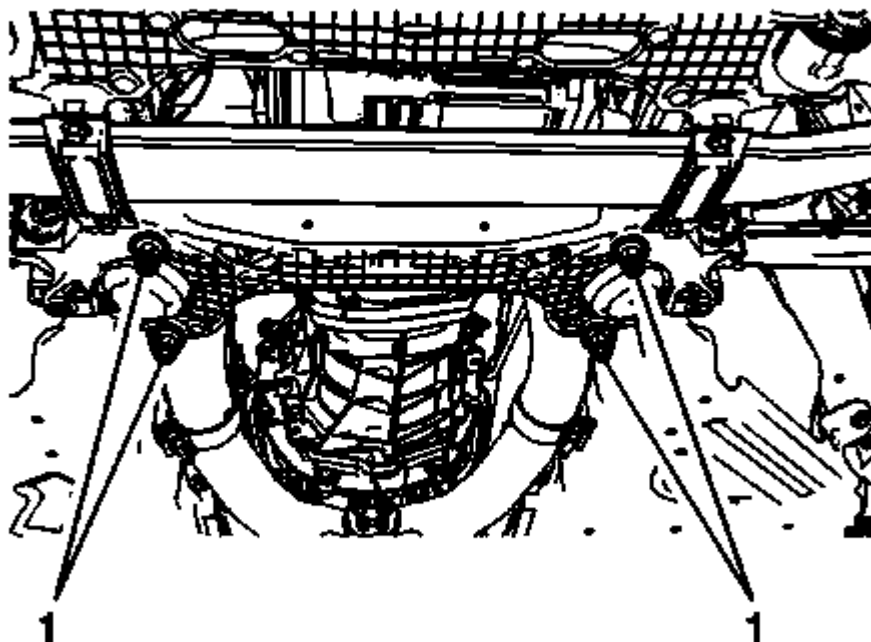


**Fig. 45: Transmission Mount To Rear Crossmember Nuts**  
Courtesy of GENERAL MOTORS COMPANY

16. Remove the transmission mount to rear crossmember nuts (1).

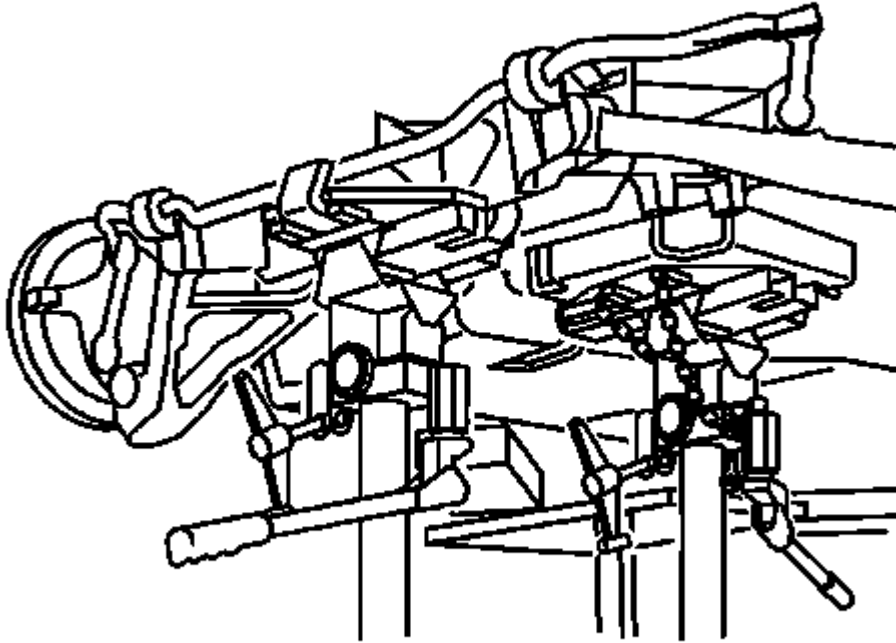


**Fig. 46: View Of Correct Transmission Jack Placement**  
**Courtesy of GENERAL MOTORS COMPANY**

17. Position a transmission jack under the rear suspension crossmember and firmly secure the crossmember to the jack.
18. Using ONLY HAND TOOLS, remove the rear suspension crossmember retaining nuts.

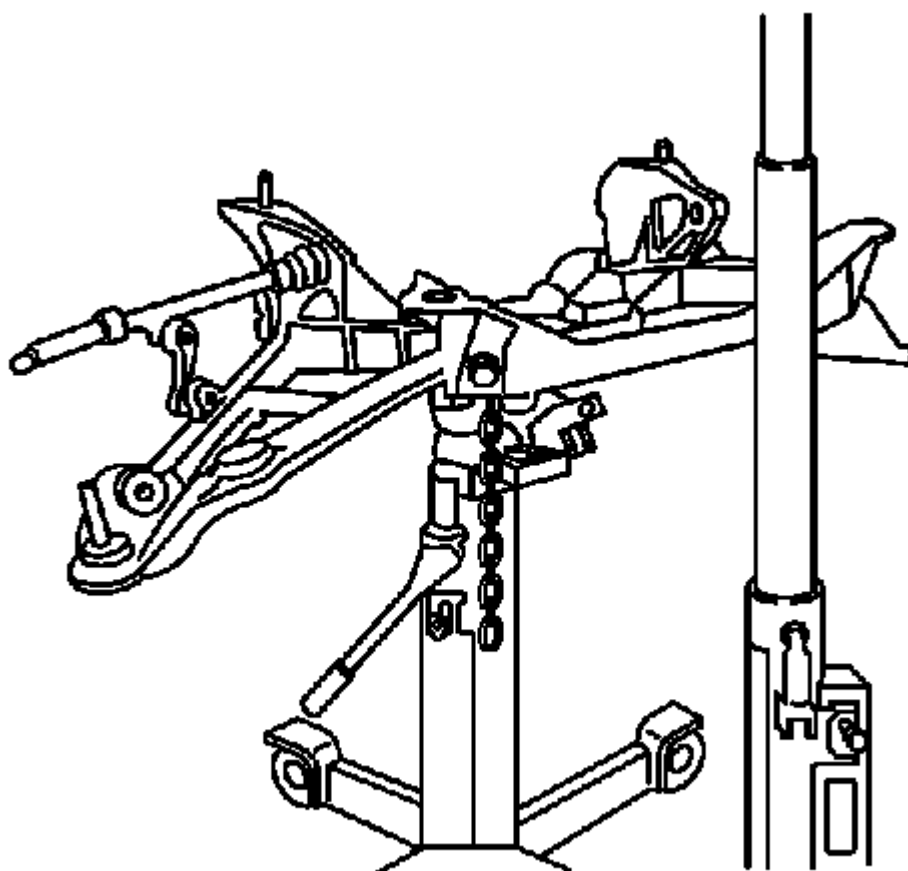


**Fig. 47: View Of Rear Suspension Crossmember**  
**Courtesy of GENERAL MOTORS COMPANY**

19. With the aid of an assistant, slowly lower the rear suspension crossmember away from the vehicle frame rails and remove the crossmember.

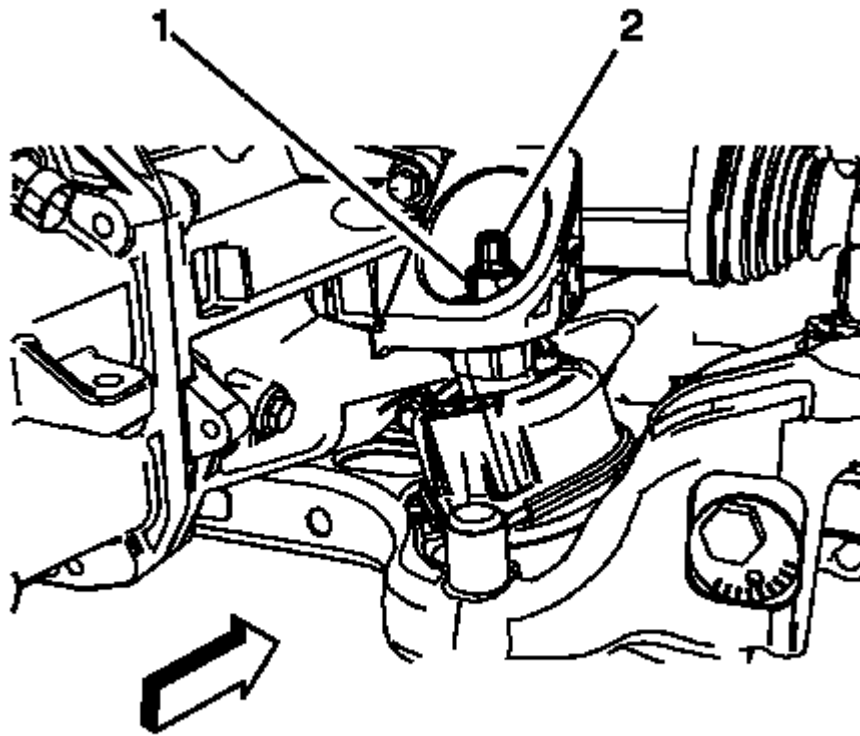


**Fig. 48: Transmission Mount Stud**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Hold the transmission mount stud (2) with a suitable wrench to prevent the stud from rotating in the mount. If the stud becomes loose, replace the transmission mount.

20. Remove the mount to differential retaining nuts (1).
21. Release the axle shafts from the differential.
22. Using mechanics wire, secure the axle shafts to the underbody and position out of the way.
23. Disconnect the transmission electrical connectors from the transmission.

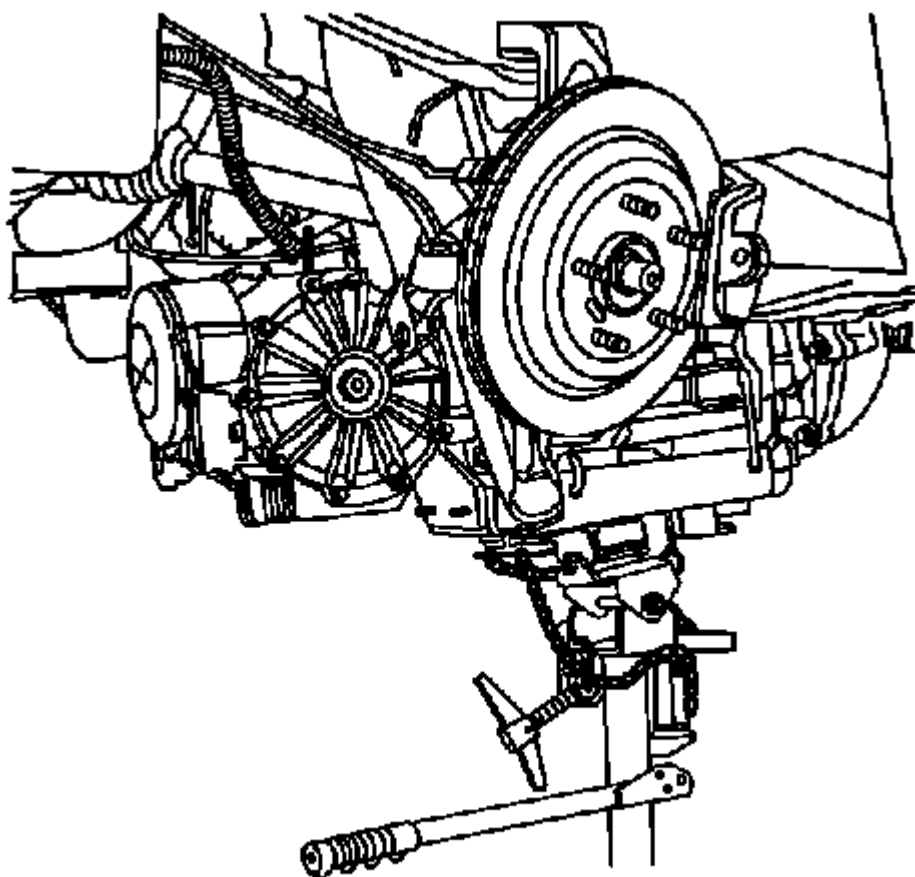


**Fig. 49: Wiring Harness To Harness Retainer At Top Of Transmission**  
**Courtesy of GENERAL MOTORS COMPANY**

24. SLOWLY lower the driveline, while simultaneously adjusting the angle of tilt and observe the relationship between the top rear of the differential and the lowest part of the rear compartment panel floor (the center storage compartment between the frame rails). The differential should not be lowered more than approximately EVEN with the specified body point of reference.
25. Release the wiring harness from the harness retainer along the top of the transmission.
26. Check to be sure that the wiring harness is free from the driveline when being removed.

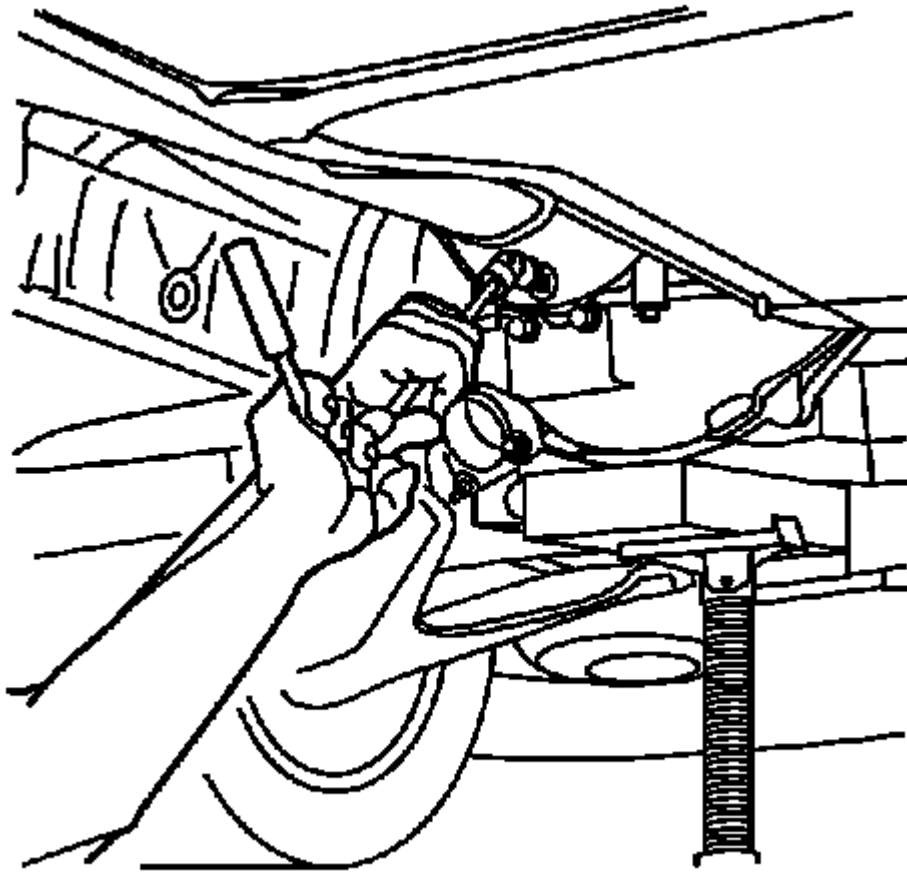


**Fig. 50: Driveline Support Assembly To Engine Flywheel Housing Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

27. Using a block of wood to protect the engine oil pan, place a straight jack under the rear of the engine oil pan to support the engine from stressing the composite dash panel.
28. Remove the five driveline support assembly to engine flywheel housing bolts.
29. Carefully bend the wiring harness bracket away from the driveline toward the driveline tunnel wall in order to make a clear removal path for the driveline.

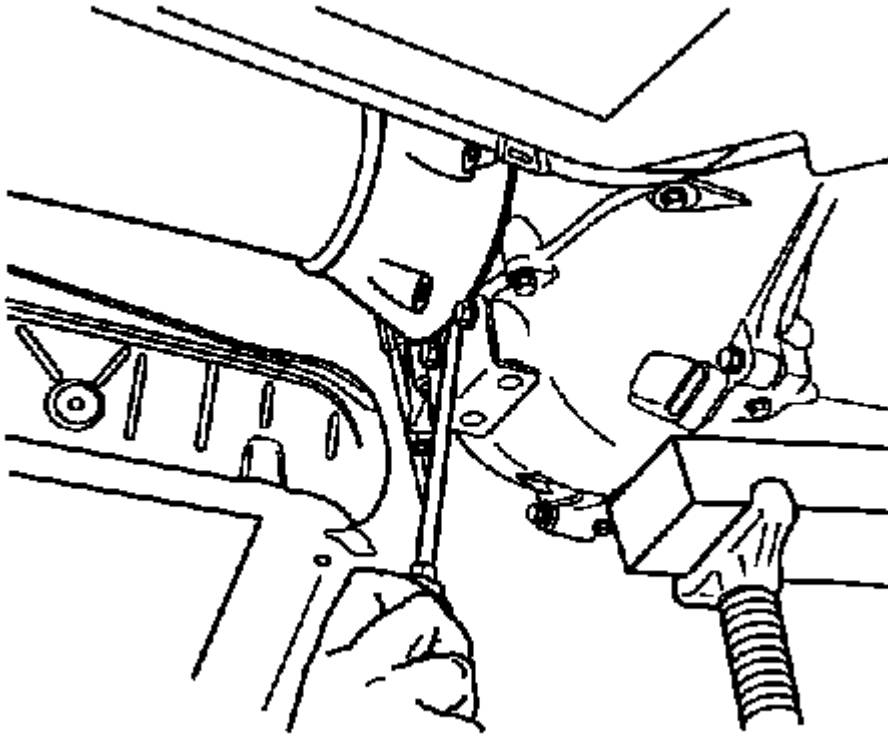


**Fig. 51: Edge Of Driveline Support Assembly & Engine Flywheel Housing**  
**Courtesy of GENERAL MOTORS COMPANY**

**NOTE:** The aid of an assistant will be necessary for the remaining steps.

30. Have an assistant insert a flat bladed screwdriver or similar tool, between the edge of the driveline support assembly and the engine flywheel housing, then begin to pry the driveline loose from the engine.

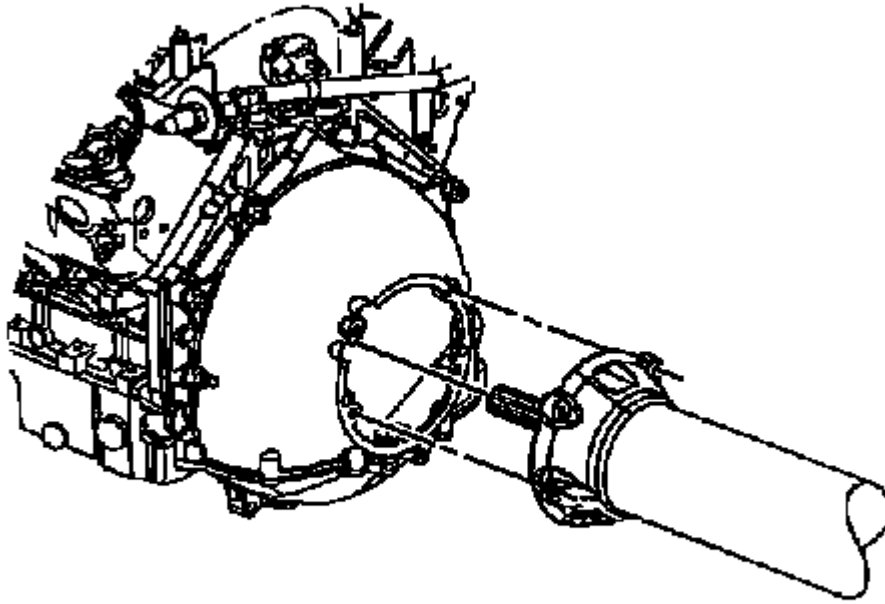


**Fig. 52: Propeller Input Shaft At Rear Of Engine Flywheel Housing**  
**Courtesy of GENERAL MOTORS COMPANY**

31. Have an assistant guide the front of the driveline during the removal of the driveline from the vehicle.
32. SLOWLY lower the driveline, while simultaneously adjusting the angle of tilt and pulling the driveline away from the engine UNTIL the propeller input shaft at the front of the driveline support assembly just clears the engine flywheel housing.
33. SLOWLY lower the driveline completely out of the vehicle.

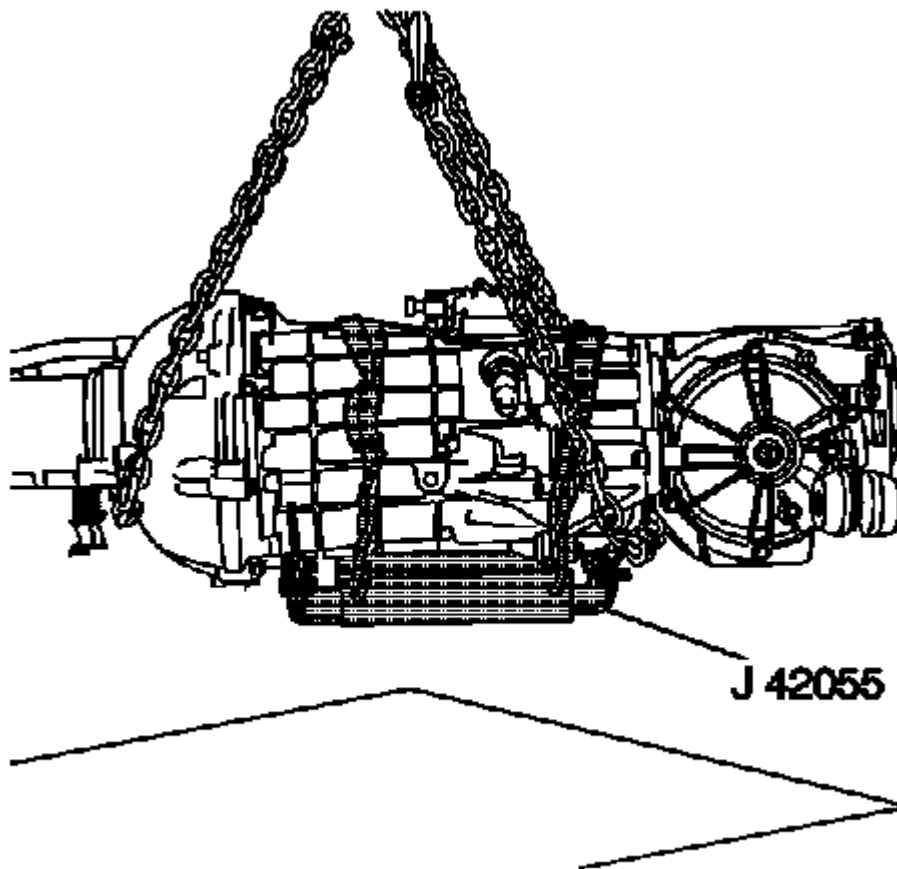


**Fig. 53: Rear Exhaust Hangers At Driveline Support Assembly**  
**Courtesy of GENERAL MOTORS COMPANY**

34. Position the chainfall or equivalent, of a lift device in a way which will protect the rear exhaust hangers located on the driveline support assembly.
35. Using the lift device, raise the driveline to relieve the weight from the transmission jack.
36. Disconnect the **J-42055** transmission support fixture from the transmission jack ONLY; the **J-42055** transmission support fixture will provide stability to the driveline components while working on a bench.
37. Position the driveline on a workbench with the lift device still attached.
38. Support the driveline support assembly and the differential for additional balance.
39. Remove the lift device from the driveline.

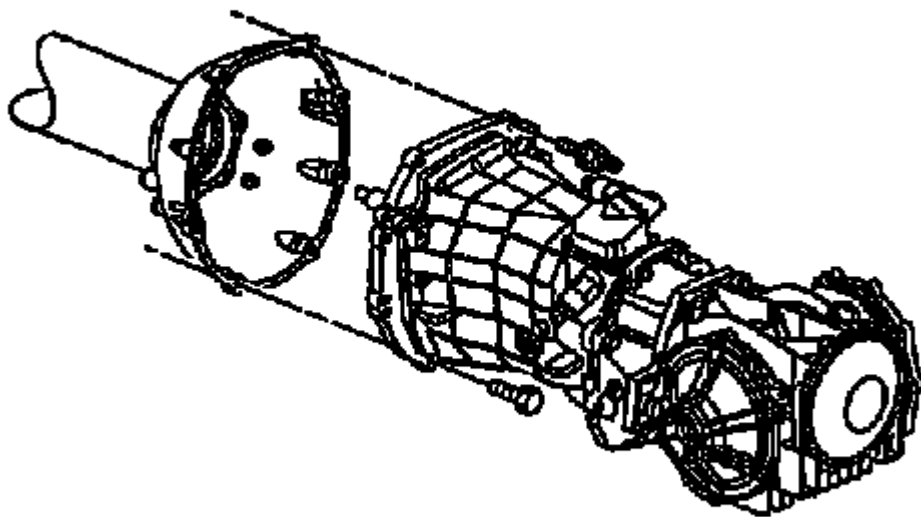


**Fig. 54: Transmission To Driveline Support Assembly Bolts/Studs**  
**Courtesy of GENERAL MOTORS COMPANY**

40. Remove the transmission to driveline support assembly bolts/studs.
41. Insert a flat bladed screwdriver or similar tool, between the edge of the driveline support assembly and the transmission, then begin to pry the driveline support assembly loose from the transmission.

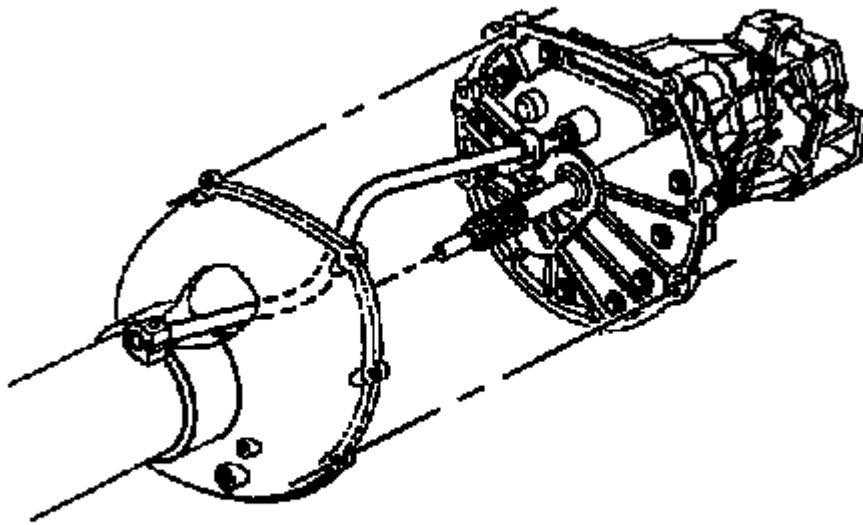


**Fig. 55: Driveline Support Assembly To Transmission Shift Rod**  
**Courtesy of GENERAL MOTORS COMPANY**

42. Slowly slide the driveline support assembly away from the transmission while guiding the transmission shift rod through the opening in the driveline support assembly.

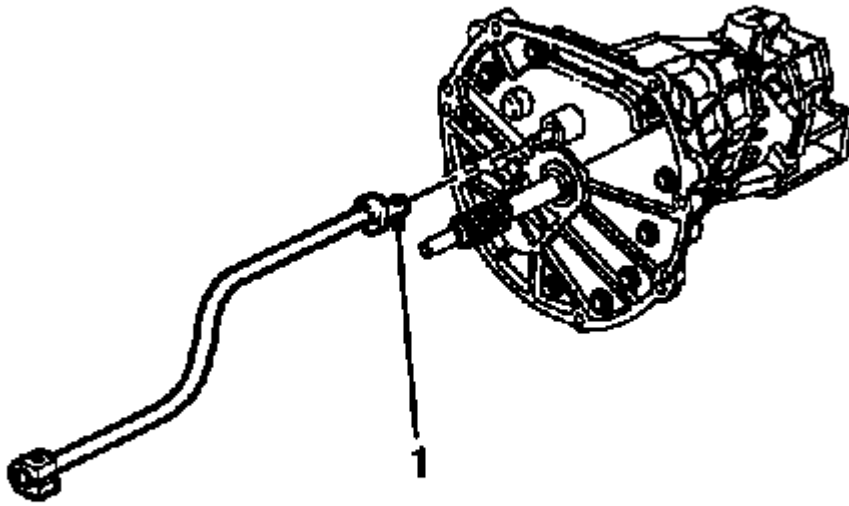


**Fig. 56: Roll Pin, Transmission Shift Rod & Transmission Shift Shaft**  
**Courtesy of GENERAL MOTORS COMPANY**

43. Using a drift or punch, remove the roll pin (1) retaining the transmission shift rod to the transmission shift shaft.
44. Remove the transmission shift rod.

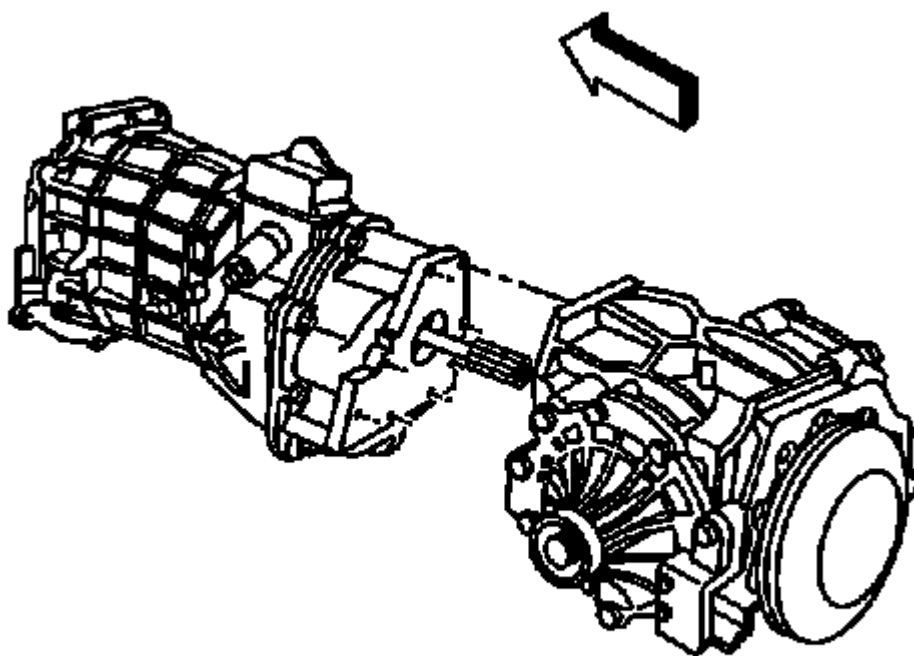


**Fig. 57: Differential, Transmission Bolts & Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

45. Remove the differential to transmission bolts and nuts.
46. SLOWLY slide the differential from the transmission.
47. Remove the transmission from the **J-42055** transmission support fixture, if necessary.
48. Flush and flow test the transmission cooler lines. Refer to **Transmission Fluid Cooler Flushing and Flow Test (6L80)** , **Transmission Fluid Cooler Flushing and Flow Test (Tremec 7-Speed)** .

#### Installation Procedure

**WARNING:** Use care when cleaning the clutch hub. The clutch hub may have sharp edges and can cause personal injury if contact is made. Wear protective gloves to avoid personal injury.

**CAUTION:** Ensure that the clutch hydraulic hoses are positioned away from nearby vehicle components or vehicle damage may result.

1. Clean the clutch hub and the input shaft from any debris and contaminants with a lint-free towel.

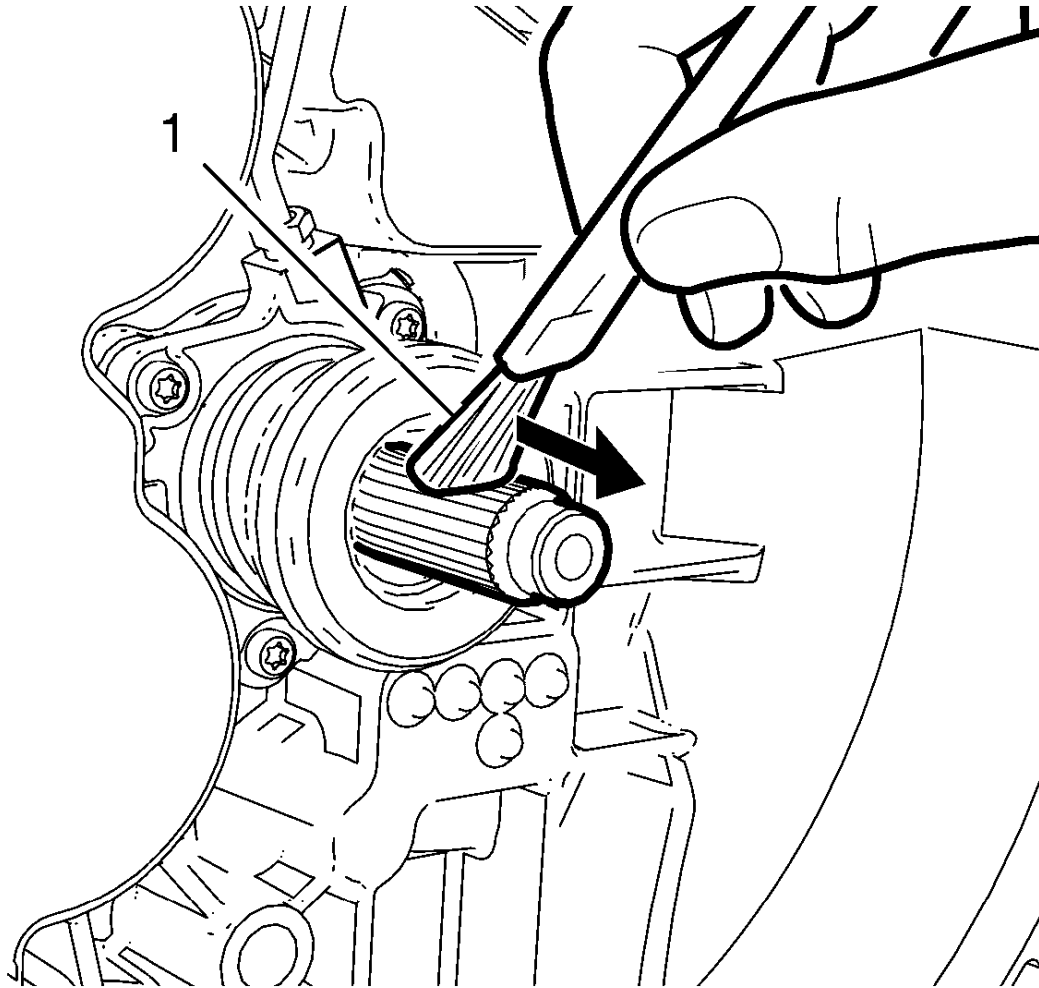


**Fig. 58: Using Flat Brush To Apply Light Coating Of Multi-Purpose Grease**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Applying too much or the wrong type of grease on the transmission input shaft may cause damage, clutch slippage or failure. Always apply the correct type of grease. Never apply more grease than is necessary to coat the transmission input shaft with a very thin film of grease.

2. Use a clean flat brush (1) to apply very light coating of multi-purpose grease to input shaft until the metal is only shiny. No visible clumps of grease are permissible regardless of size. Smear away from the transmission in direction of the shown arrow.

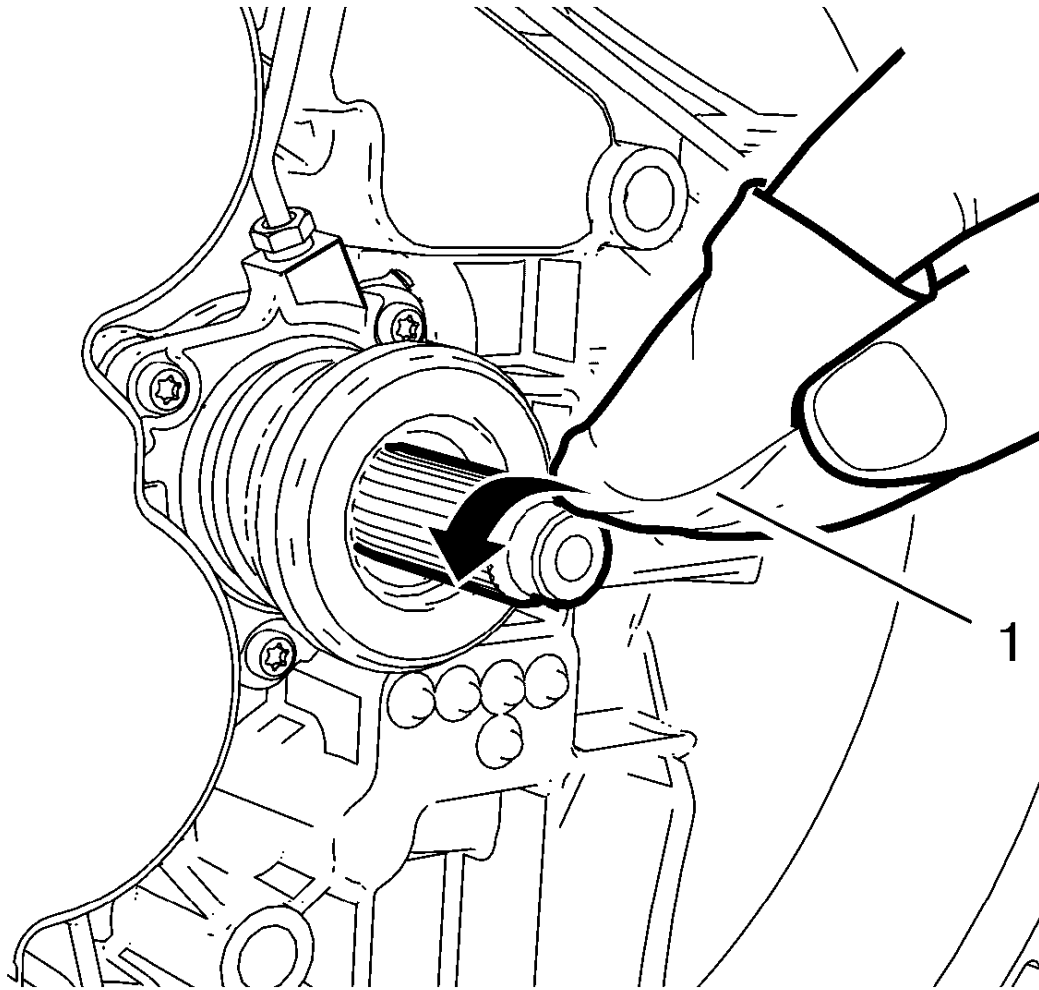


**Fig. 59: Lint Free Towel**

**Courtesy of GENERAL MOTORS COMPANY**

**CAUTION:** Ensure that no grease remains on the lead surface of the transmission input shaft. Clean the lead surface of the transmission input shaft prior to the assembly of the transmission to the engine. Failure to maintain a clean surface may cause clutch slippage or failure.

3. Clean the entire lead surface of the input shaft with a NEW, lint-free towel (1).

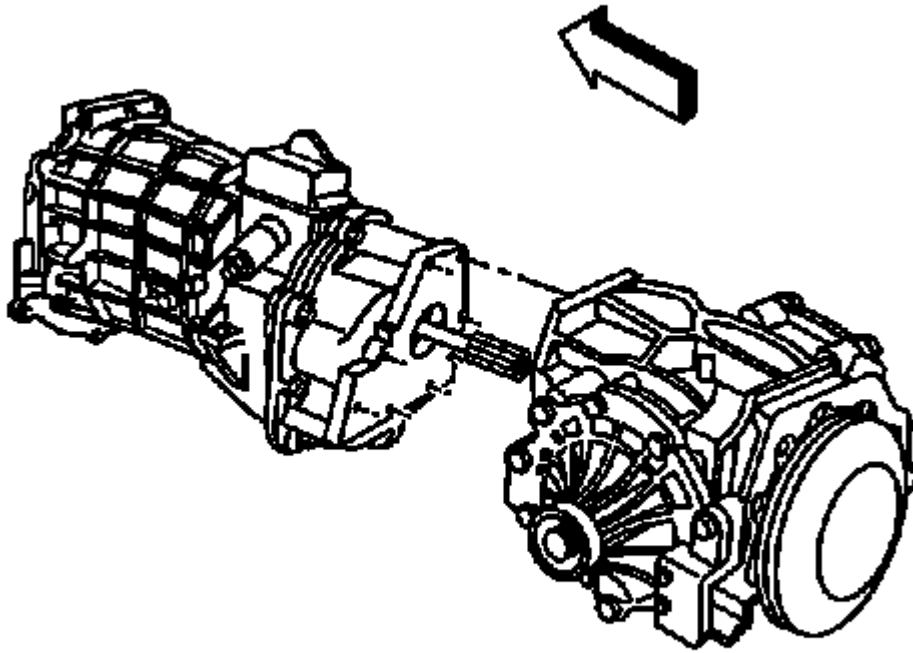


**Fig. 60: Differential, Transmission Bolts & Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

4. Install the transmission to the **J-42055** transmission support fixture, if removed.
5. SLOWLY slide the differential to the transmission.

**CAUTION:** Refer to **Fastener Caution** .

6. Install the differential to transmission bolts and nuts and tighten to 50 (37 lb ft).

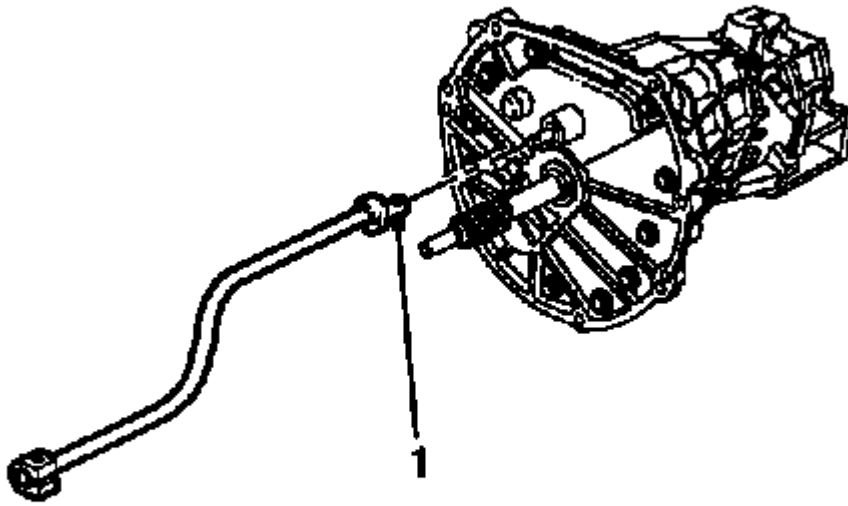


**Fig. 61: Roll Pin, Transmission Shift Rod & Transmission Shift Shaft**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Install the transmission shift rod to the transmission shift shaft.
8. Using a drift or punch, install the roll pin (1) to retain the transmission shift rod to the shift shaft.

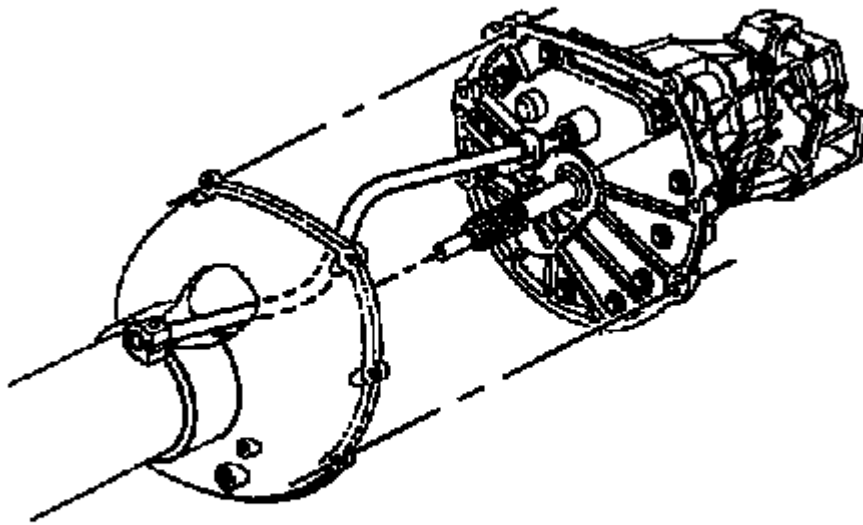


**Fig. 62: Driveline Support Assembly To Transmission Shift Rod**  
**Courtesy of GENERAL MOTORS COMPANY**

9. Slowly slide the driveline support assembly to the transmission, while guiding the transmission shift rod through the opening in the driveline support assembly.
10. Install the transmission to driveline support assembly bolts/studs and tighten to 50 (37 lb ft).

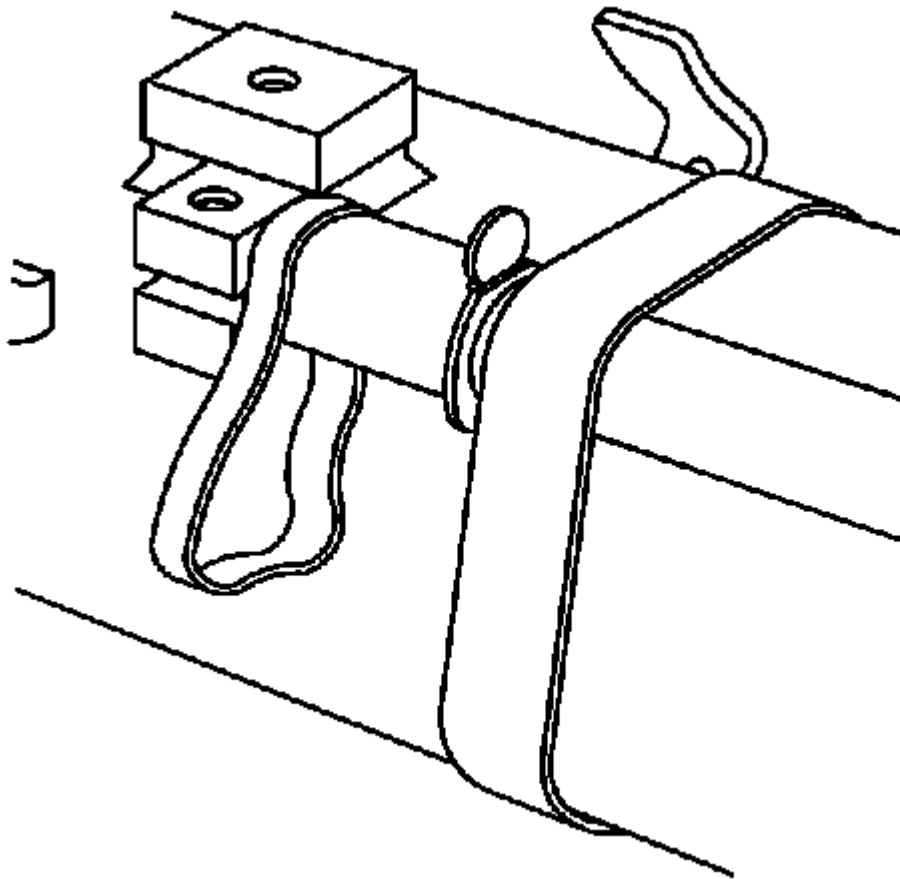


**Fig. 63: Rubber Band To Transmission Shift Rod**  
Courtesy of GENERAL MOTORS COMPANY

11. Loosely install a rubber band onto the transmission shift rod and position just behind the shift rod clamp.

The rubber band will be used to aid in installing the shift control assembly after the driveline has been installed.

**NOTE:** The tape is intended to keep the shift rod in position to aid in shift control installation after the driveline has been installed.

12. Using a piece of masking tape or similar tape which can be easily broken, affix the transmission shift rod to the driveline support assembly and position the rod just to the outside of the mounting boss used for the shift control.

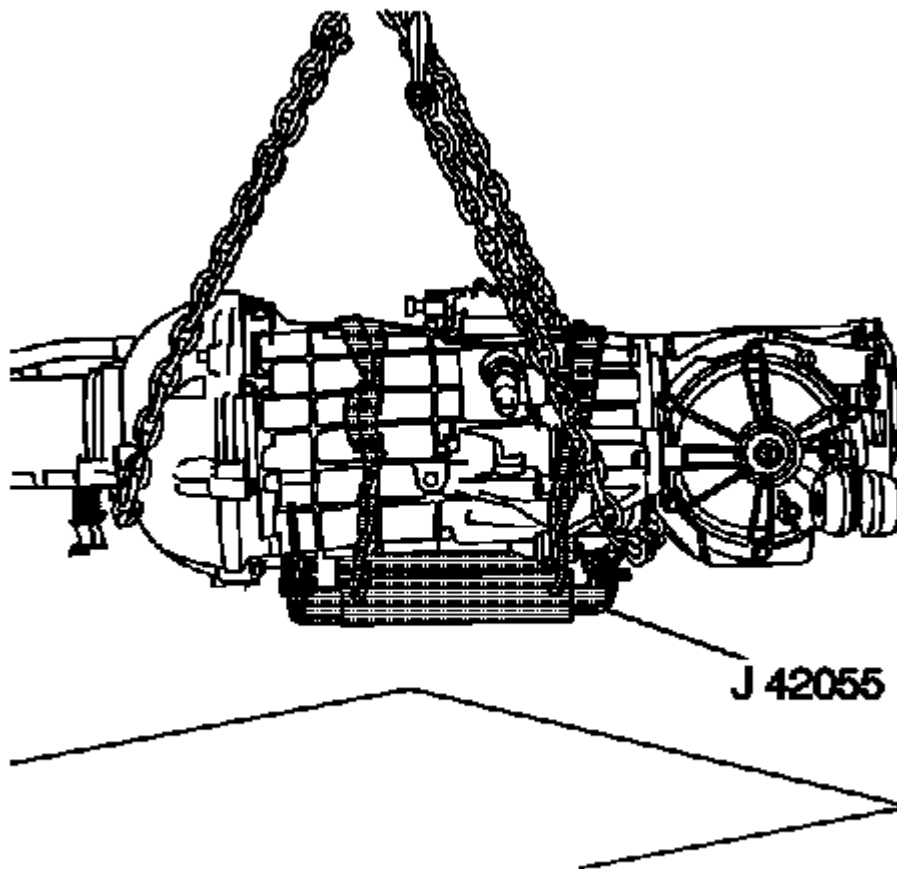


**Fig. 64: Rear Exhaust Hangers At Driveline Support Assembly**  
**Courtesy of GENERAL MOTORS COMPANY**

13. Position the chainfall or equivalent, of a lift device in a way which will protect the rear exhaust hangers located on the driveline support assembly.

**NOTE:** The aid of an assistant will be necessary for the following steps until the driveline is installed into the vehicle.

14. Using the lift device, raise the driveline off the workbench and position the driveline with the **J-42055** transmission support fixture onto a transmission jack.
15. Connect the **J-42055** transmission support fixture to the transmission jack.

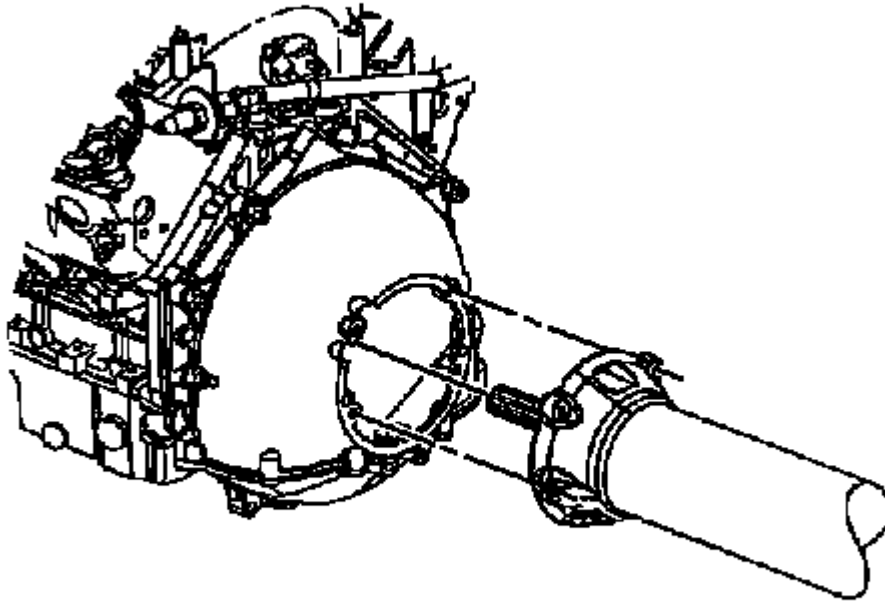


**Fig. 65: Propeller Input Shaft At Rear Of Engine Flywheel Housing**  
**Courtesy of GENERAL MOTORS COMPANY**

16. Remove the lift device from the driveline.
17. Position the driveline under the vehicle.
18. Begin to raise the driveline at the approximate angle used during removal.
19. Position the wiring harness along the driveline support assembly and LOOSELY install the harness into the harness retaining slots.
20. Have an assistant guide the front of the driveline so the propeller input shaft is just to the rear of the engine flywheel housing, then raise the driveline to the PROPER HEIGHT and the PROPER ANGLE to install it to the engine.
21. Have an assistant begin to insert the propeller input shaft into the clutch driven plate hub while maintaining the proper angle of the driveline; if necessary, use a screwdriver to rotate the shaft slightly to bring the splines into alignment.

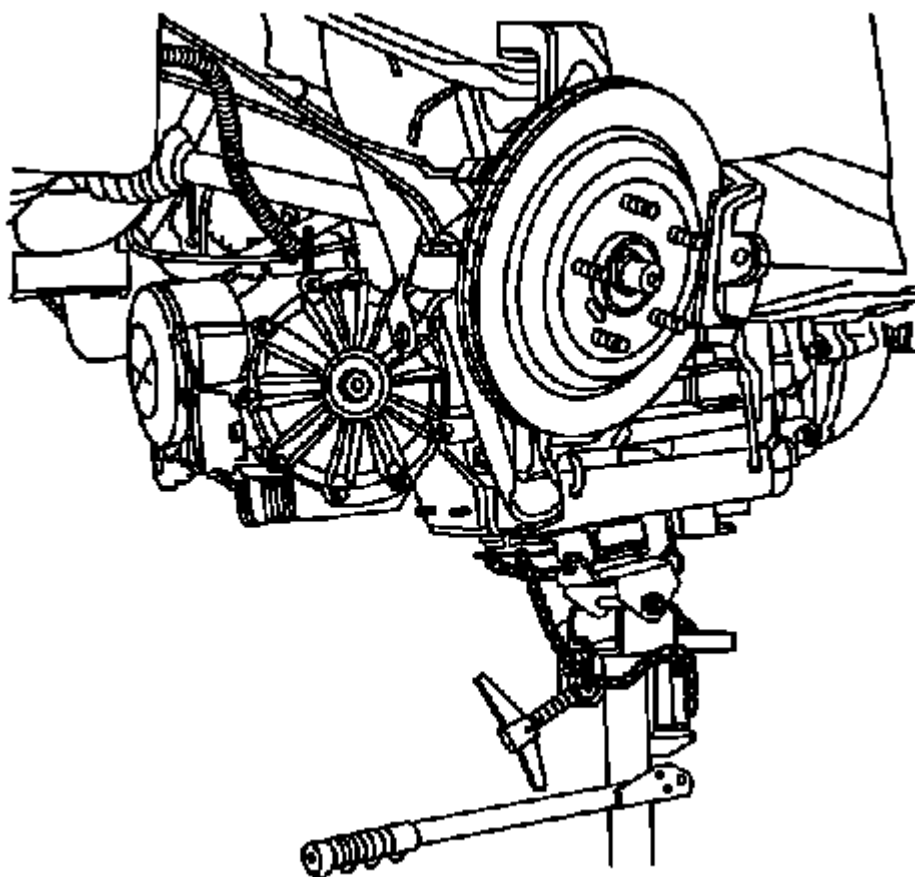


**Fig. 66: Wiring Harness To Harness Retainer At Top Of Transmission**  
**Courtesy of GENERAL MOTORS COMPANY**

22. SLOWLY seat the driveline to the engine flywheel housing while maintaining the proper angle of the driveline.
23. Reposition the wiring harness bracket from near the driveline tunnel wall to align with the appropriate driveline support assembly bolt hole.

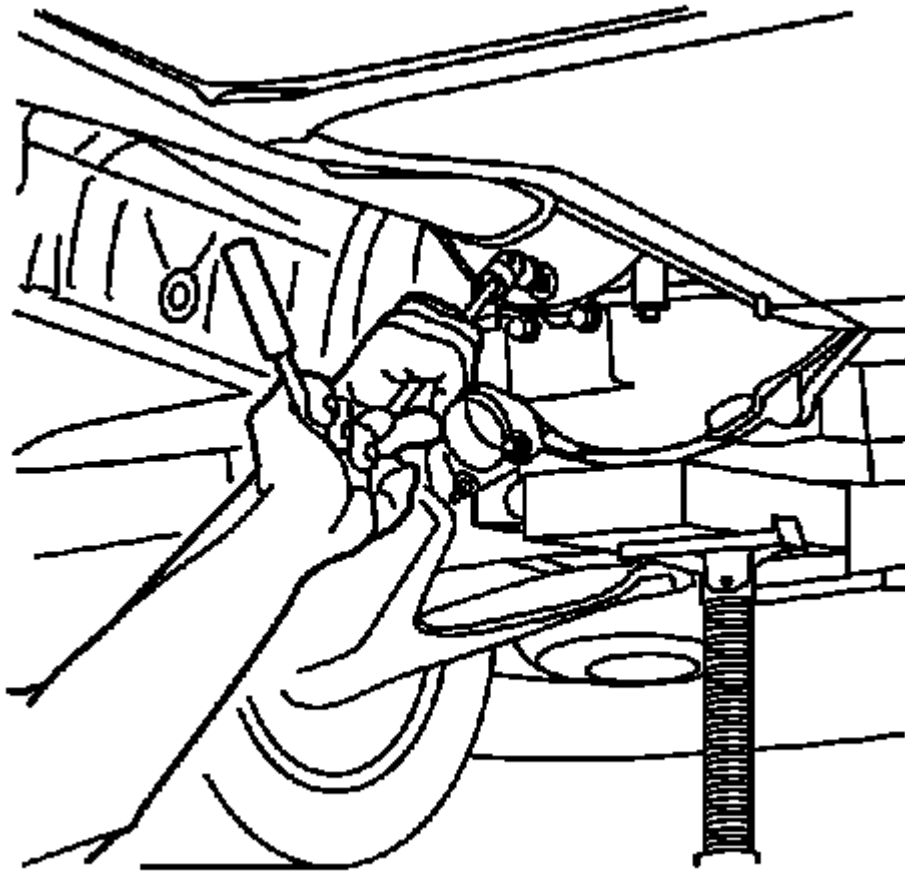


**Fig. 67: Driveline Support Assembly To Engine Flywheel Housing Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

24. Install the five driveline support assembly to engine flywheel housing bolts and tighten to 50 (37 lb ft).
25. Install the wiring harness to the wiring harness retainer along the top of the transmission.
26. SLOWLY raise the driveline to approximately 5 cm (2 in) BELOW the final installed height.
27. Connect the transmission electrical connectors to the transmission.
28. Slowly raise the driveline to final installation height.
29. Remove the jack which supported the rear of the engine.
30. Remove the tie-off retainers from the axle shafts.
31. CAREFULLY align and seat the axle shafts to the differential.
32. Position the transmission mounts to the differential.

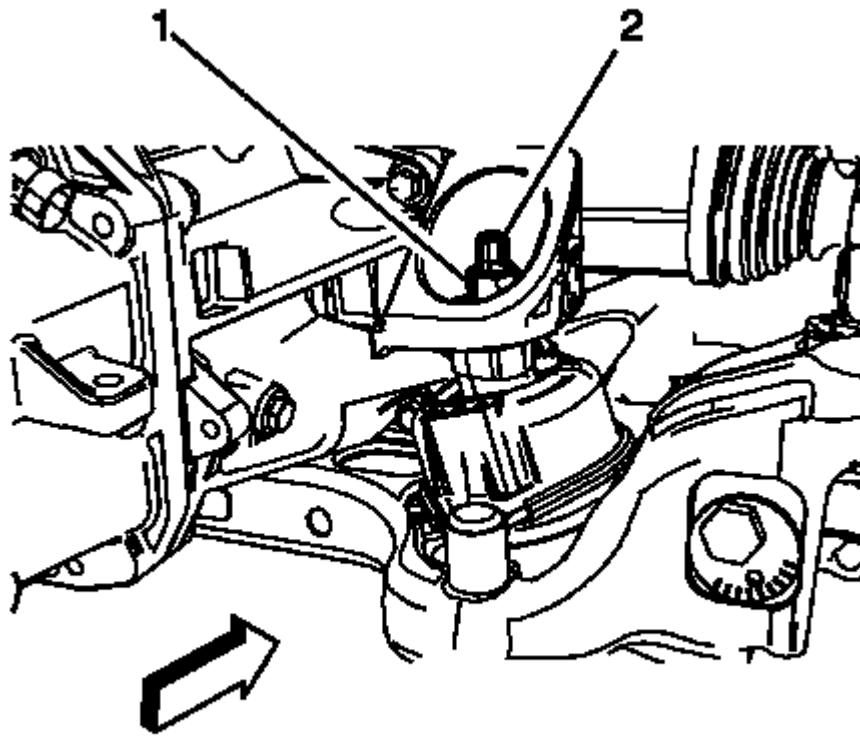


**Fig. 68: Transmission Mount Stud**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Hold the transmission mount stud (2) with a suitable wrench to prevent the stud from rotating in the mount. If the stud becomes loose, replace the transmission mount.

33. Install the transmission mount nuts (1) and tighten to 50 (37 lb ft).

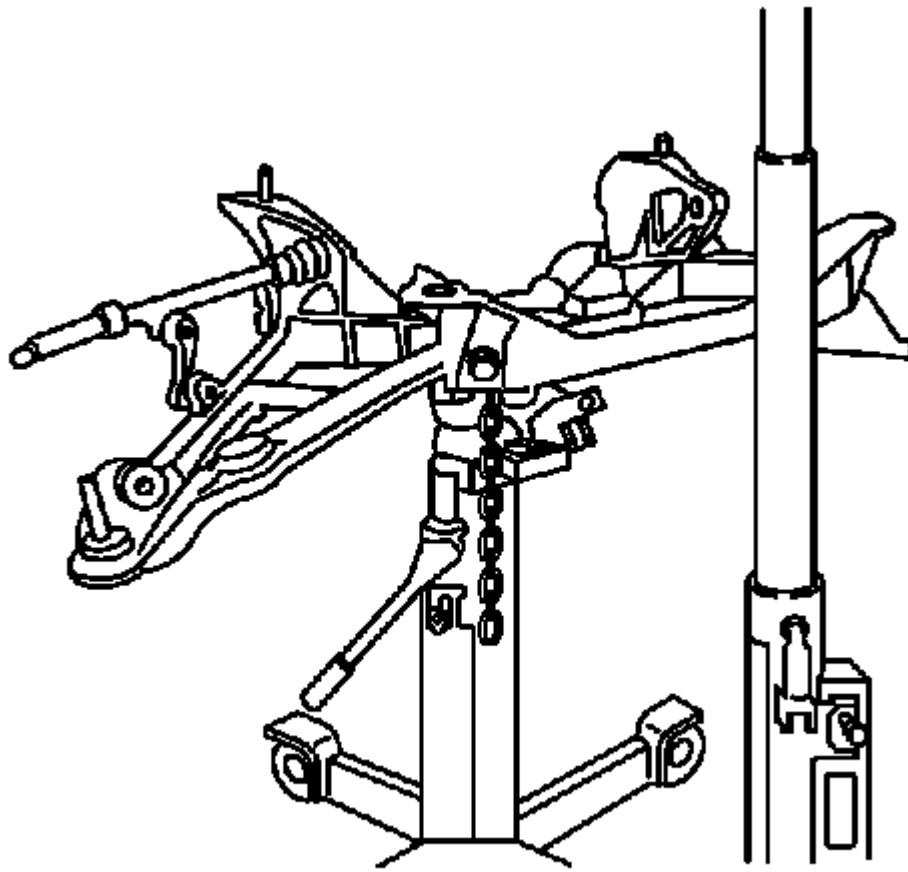


**Fig. 69: View Of Rear Suspension Crossmember**  
**Courtesy of GENERAL MOTORS COMPANY**

34. With the aid of an assistant, begin to raise the rear suspension crossmember (still firmly attached to a transmission jack), to the vehicle frame rails.
35. Guide the rear suspension crossmember alignment pins into the alignment holes in the vehicle frame rails and guide the transmission mount studs into the mounting holes in the crossmember, then raise the crossmember to seat to the frame rails.

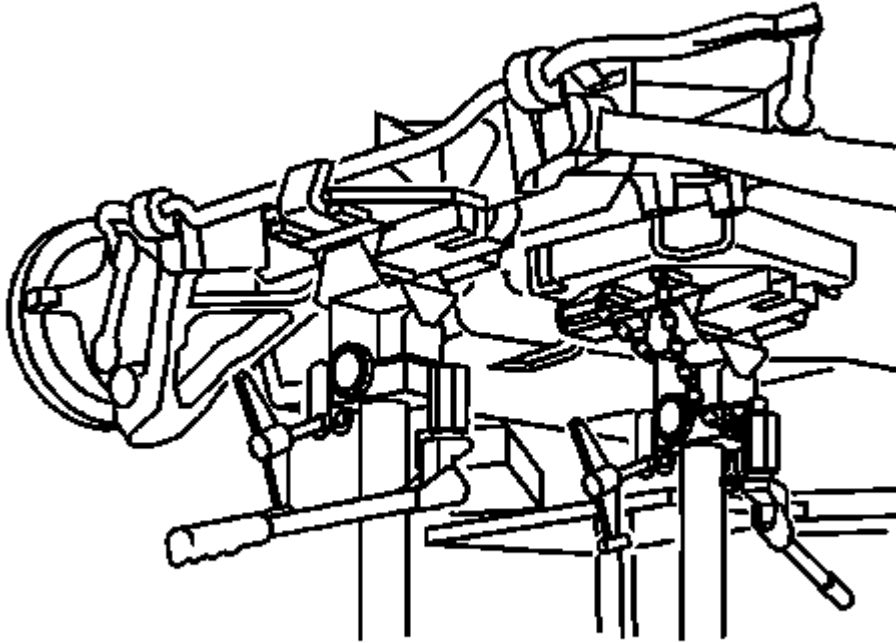


**Fig. 70: View Of Correct Transmission Jack Placement**  
**Courtesy of GENERAL MOTORS COMPANY**

36. Using ONLY HAND TOOLS, install NEW rear suspension crossmember mounting nuts. Tighten the rear suspension crossmember mounting nuts to 110 (81 lb ft).
37. Remove the transmission jack from the rear suspension crossmember.
38. Release the **J-42055** transmission support fixture from the transmission, then remove the **J-42055** transmission support fixture and transmission jack.

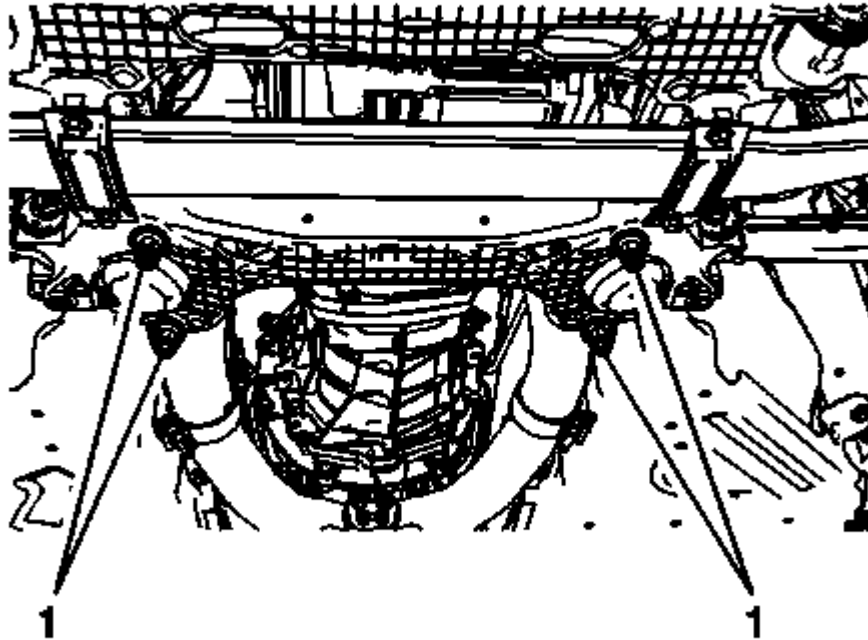


**Fig. 71: Transmission Mount To Rear Crossmember Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

39. Install the transmission mount to rear suspension crossmember nuts (1) and tighten to 43 (32 lb ft).
40. Install the differential to transmission lower nuts and tighten to 50 (37 lb ft).
41. Connect the wiring harness and brake pipe clip retainers to the rear suspension crossmember.
42. Support the lower control arm with a jack.
43. Connect the lower ball joint to the suspension knuckle. Refer to **Knuckle Replacement (without J55)** , **Knuckle Replacement (with J55)** .

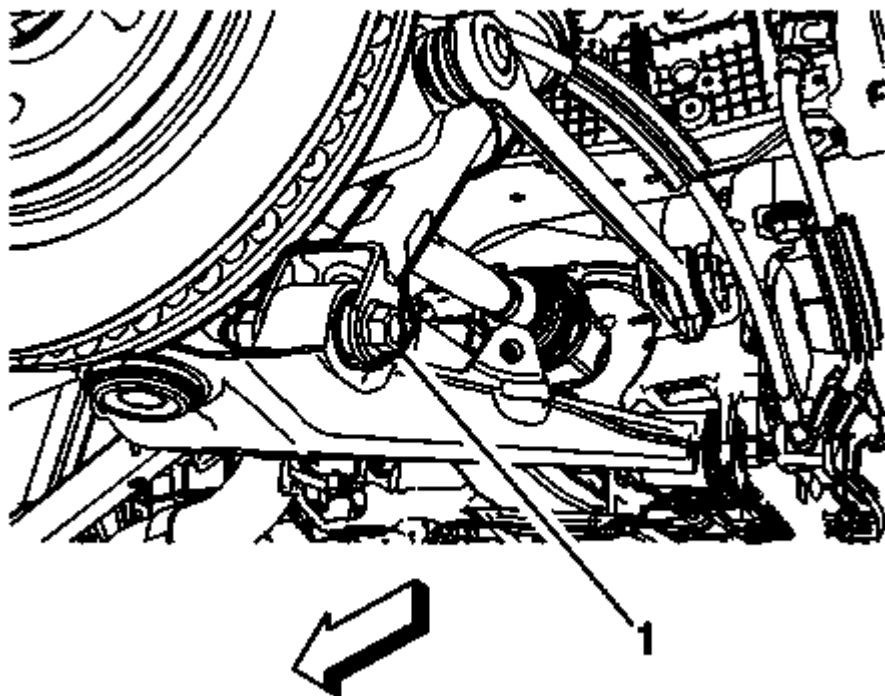


**Fig. 72: Shock Absorber Lower Mounting Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

44. Install the shock absorber lower mounting bolt (1) and tighten to 220 (162 lb ft).
45. Remove the jack from the suspension control arm.
46. Install the rear spring. Refer to **Rear Spring Replacement** .
47. Install the intermediate pipe. Refer to **Intermediate Pipe Replacement** .
48. Install the clutch actuator cylinder hose to the hose retaining clip below the power brake booster.
49. Check and if necessary, add transmission fluid. Refer to **Adhesives, Fluids, Lubricants and Sealers**.

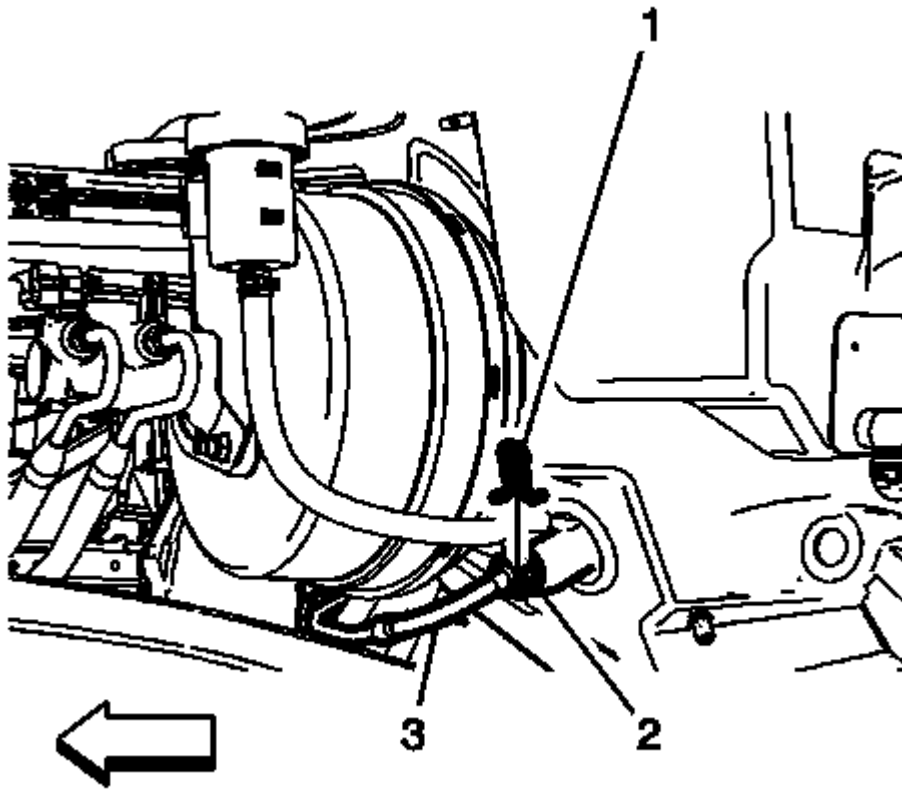


**Fig. 73: Clutch Pipe Connection Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

50. Connect the clutch hose/pipe (3) to the clutch master cylinder (2).
51. Install the clutch hose/pipe retaining clip to the clutch master cylinder (1).
52. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch System Bleeding** .
53. Install the windshield washer solvent container. Refer to **Windshield Washer Solvent Container Replacement** .
54. Install the shift control assembly. Refer to **Transmission Control Replacement**.
55. Install the front floor lower console. Refer to **Front Floor Lower Console Replacement** .

## **REPAIR INSTRUCTIONS - OFF VEHICLE**

### **TRANSMISSION DISASSEMBLE**

#### **Holding Fixture Installation**

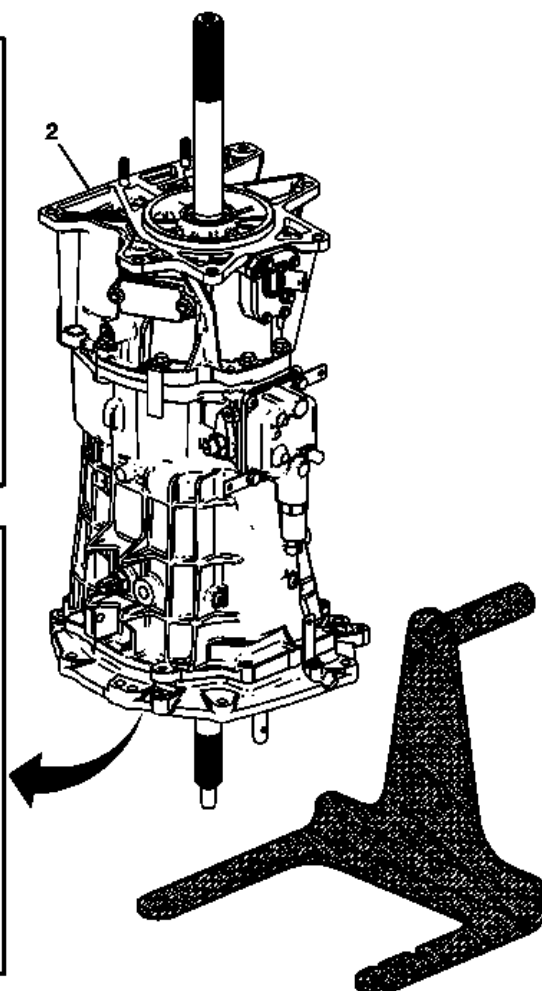
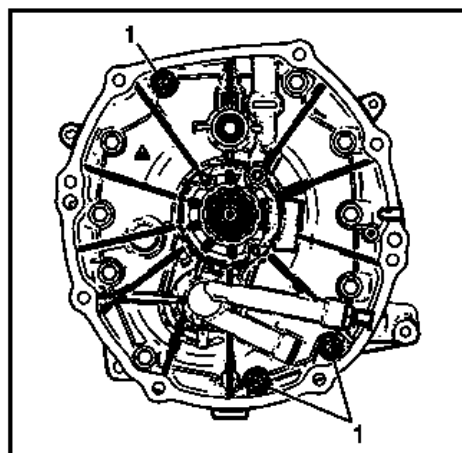
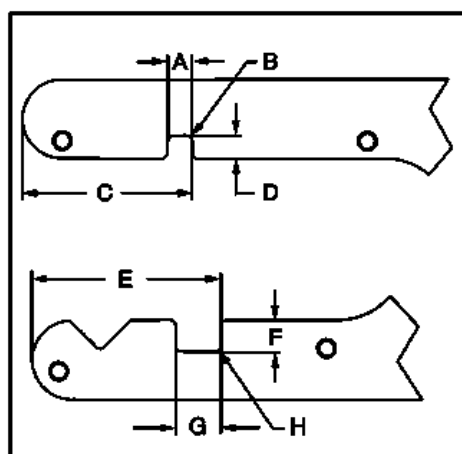


**Fig. 74: Transmission Holding Fixture**  
 Courtesy of GENERAL MOTORS COMPANY

#### Holding Fixture Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Transmission Adapter Bolt (Qty: 3)<br><b>Procedure</b><br>Remove the three adapter plate bolts shown before installing the holding fixture.                                                                                                                                                                                                                                                                                                                                     |
|         | Transmission Assembly<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Install the <b>DT-44395-B</b> holding fixture to the transmission assembly.</li> <li>2. Mount the transmission on a workbench using the <b>DT-03289-20</b> fixture.</li> <li>3. Rotate the transmission into a horizontal position.</li> <li>4. Remove the transmission drain plug and drain the transmission if necessary.</li> <li>5. Shift the transmission into neutral (N).</li> </ol> |

**NOTE:**

The transmission holding fixture must be modified in order to mount the 7-speed manual transmission. Dimensions are provided for reference to assist in this modification. Mark the areas to be removed and use a grinding wheel or hand-held grinder to remove the marked material. Paint the exposed metal. This will update your fixture to DT-44395-B .

- (A) 14.0 mm (0.550 in)
- (B) 3.2 mm (0.125 in)
- (C) 95.3 mm (3.750 in)
- (D) 12.7 mm (0.500 in)
- (E) 105.4 mm (4.150 in)
- (F) 17.8 mm (0.700 in)
- (G) 25.0 mm (0.984 in)
- (H) 3.2 mm (0.125 in)

**Special Tools**

- **DT-03289-20** Holding Fixture
- **DT-44395-B** Transmission Holding Fixture

For equivalent regional tools, refer to **Special Tools**.

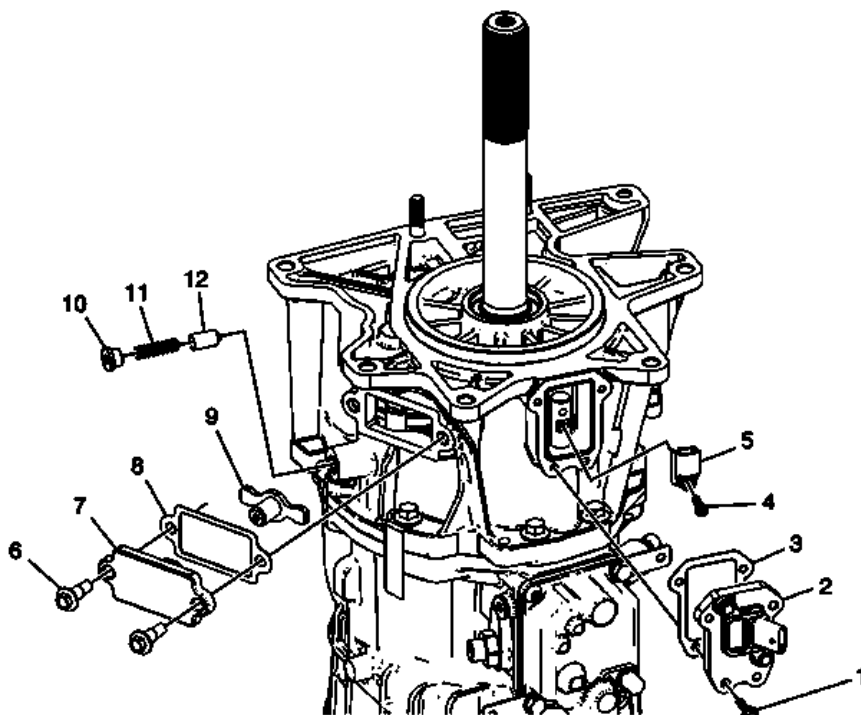
**7th/Reverse Inverter Link Cover and Gear Position Sensor Removal**

**Fig. 75: 7th/Reverse Inverter Link Cover and Gear Position Sensor**  
**Courtesy of GENERAL MOTORS COMPANY**

**7th/Reverse Inverter Link Cover and Gear Position Sensor Removal**

| Callout | Component Name                                                           |
|---------|--------------------------------------------------------------------------|
| 1       | Manual Transmission Gear Position Sensor Bolt                            |
| 2       | Manual Transmission Gear Position Sensor                                 |
| 3       | Manual Transmission Gear Position Sensor Gasket                          |
| 4       | Transmission Gap Magnet Bolt                                             |
| 5       | Transmission Gap Magnet                                                  |
| 6       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Bolt   |
| 7       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover        |
| 8       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Gasket |
| 9       | Manual Transmission Selector Lever Pivot Pin                             |
| 10      | Shift Shaft Detent Plug                                                  |
| 11      | Shift Detent Ball Spring                                                 |
| 12      | Transmission Detent Ball                                                 |

**Extension Housing Removal**

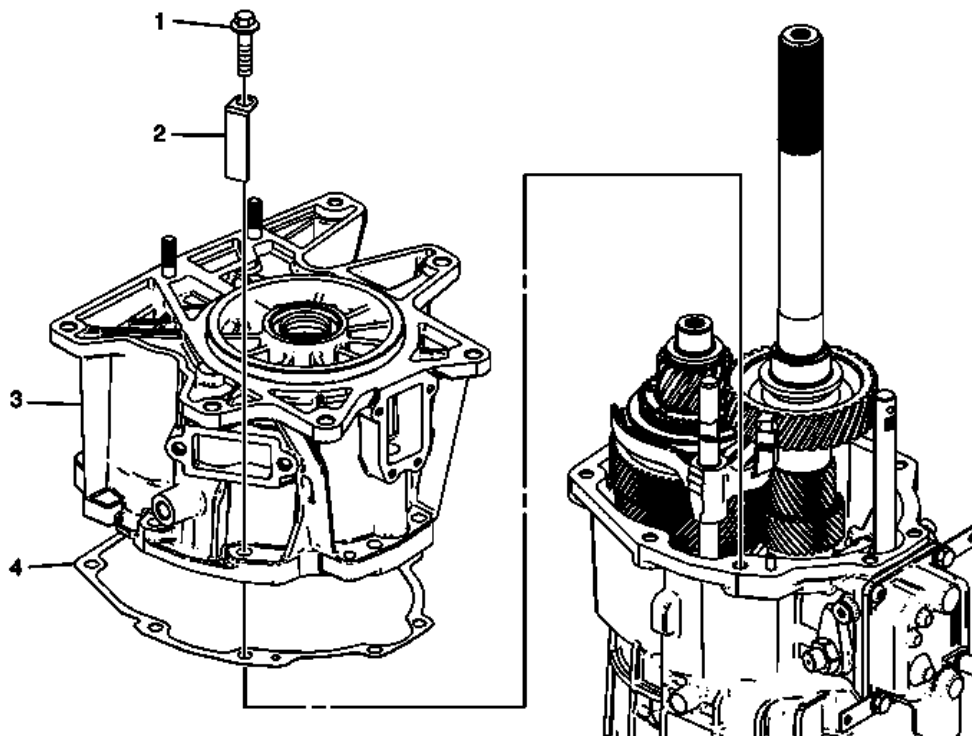


**Fig. 76: Extension Housing**  
**Courtesy of GENERAL MOTORS COMPANY**

**Extension Housing Removal**

| Callout | Component Name                  |
|---------|---------------------------------|
| 1       | Transmission Extension Bolt     |
| 2       | Transmission Identification Tag |
| 3       | Extension Housing               |
| 4       | Transmission Extension Gasket   |

#### Split Washer and Bushing Removal

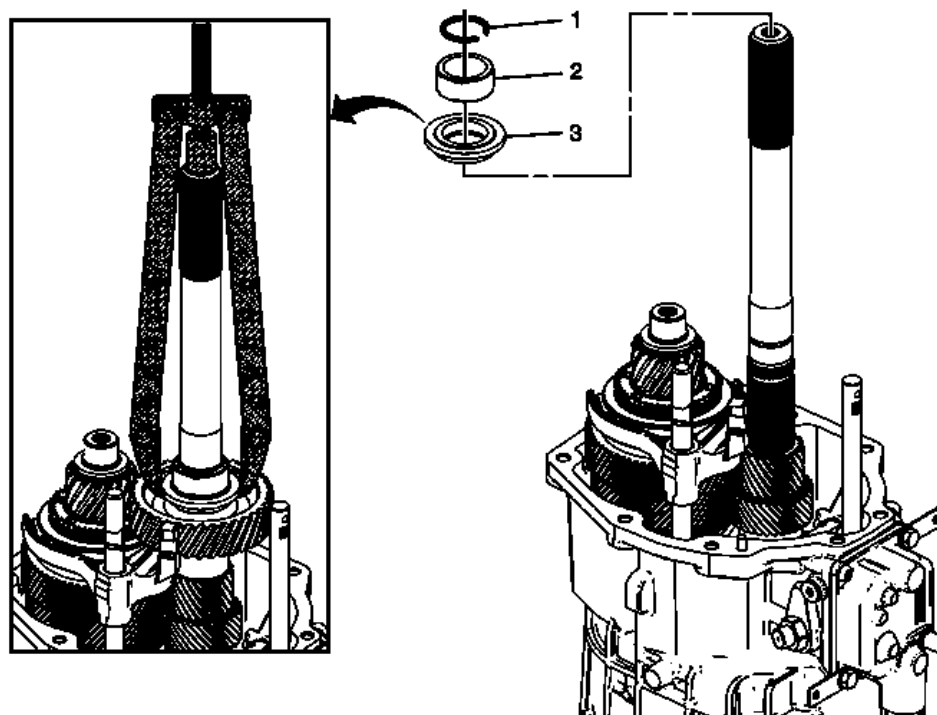


**Fig. 77: Split Washer and Bushing**  
Courtesy of GENERAL MOTORS COMPANY

#### Split Washer and Bushing Removal

| Callout | Component Name                                                                                                                                                                           |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Reverse Gear Retaining Ring                                                                                                                                                              |
| 2       | Main Shaft Bushing<br><b>NOTE:</b><br>This part is pressed on and is removed with the split washer (3).                                                                                  |
|         | Transmission Main Shaft Split Washer<br><b>Procedure</b><br>1. Install the <b>DT-22888-60</b> legs to the <b>DT-22888-20A</b> puller.<br>2. Remove the Split washer (3) and Bushing (2). |

3

**Special Tools**

- **DT-22888-D** Side Bearing Remover Kit
- **DT-22888-60** Puller Leg Adapter Kit

For equivalent regional tools, refer to **Special Tools**.

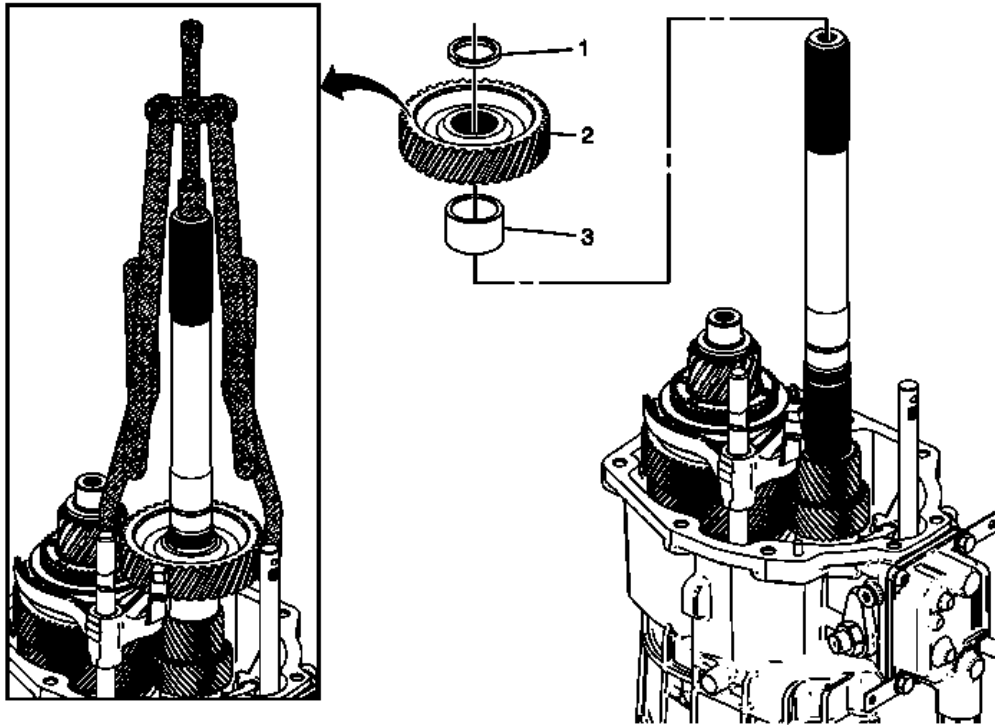
**Reverse Driven Gear Removal**

**Fig. 78: Reverse Driven Gear**  
Courtesy of GENERAL MOTORS COMPANY

**Reverse Driven Gear Removal**

| Callout | Component Name                                                                                                                                                                            |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Reverse Gear Split Washer                                                                                                                                                                 |
| 2       | Reverse Driven Gear                                                                                                                                                                       |
|         | <b>Procedure</b> <ol style="list-style-type: none"><li>1. Install the <b>DT-22888-60</b> legs to the <b>DT-22888-20A</b> puller.</li><li>2. Remove the reverse driven gear (2).</li></ol> |

- **DT-22888-D** Side Bearing Remover Kit
- **DT-22888-60** Puller Leg Adapter Kit

For equivalent regional tools, refer to **Special Tools**.

3 Reverse Driven Gear Spacer

### Reverse Gear Removal

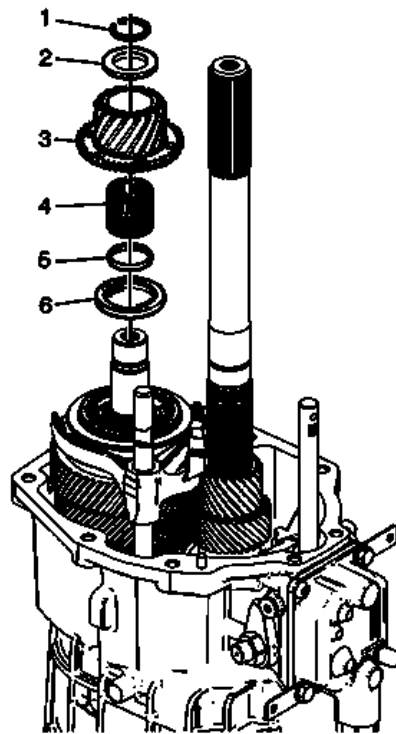


**Fig. 79: Reverse Gear**  
Courtesy of GENERAL MOTORS COMPANY

### Reverse Gear Removal

| Callout | Component Name              |
|---------|-----------------------------|
| 1       | Reverse Gear Retaining Ring |
| 2       | Reverse Gear Thrust Washer  |
| 3       | Reverse Gear                |
| 4       | Reverse Gear Bearing        |
| 5       | Reverse Gear Bearing Spacer |
| 6       | 7th Gear Bearing Spacer     |

### 7th & Reverse Shift Fork Removal

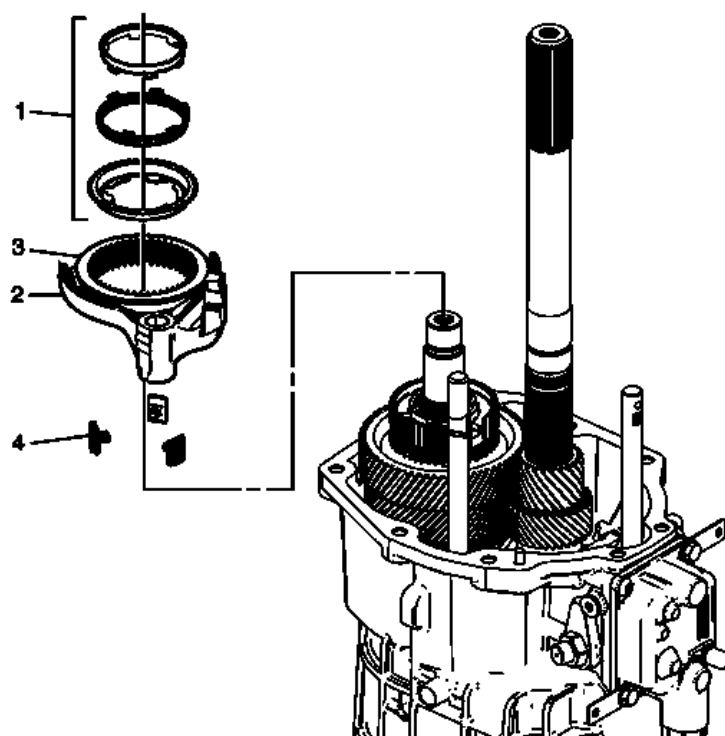


**Fig. 80: 7th & Reverse Shift Fork**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th & Reverse Shift Fork Removal

| Callout | Component Name                          |
|---------|-----------------------------------------|
| 1       | Reverse Gear Blocking Ring Assembly     |
| 2       | 7th & Reverse Shift Fork                |
| 3       | 7th & Reverse Gear Synchronizer Sleeve  |
| 4       | 7th & Reverse Gear Synchronizer Inserts |

#### 7th & Reverse Synchronizer Hub Removal

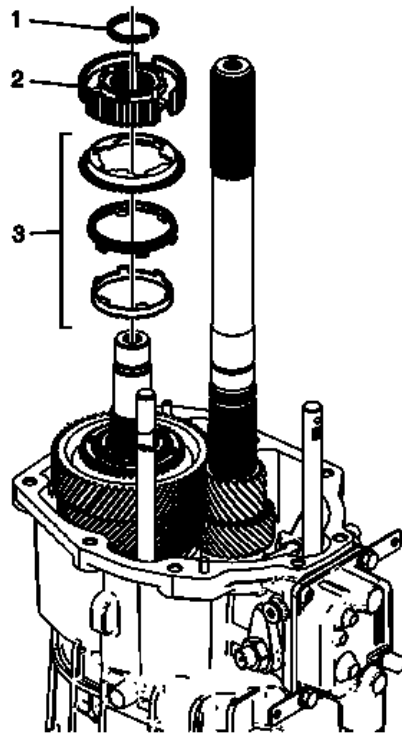


**Fig. 81: 7th & Reverse Synchronizer Hub**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th & Reverse Synchronizer Hub Removal

| Callout | Component Name                      |
|---------|-------------------------------------|
| 1       | 7th Gear Blocking Ring Retainer     |
| 2       | 7th & Reverse Gear Synchronizer Hub |
| 3       | 7th Gear Blocking Ring Assembly     |

#### 7th Drive Gear and 5th Drive Gear Removal

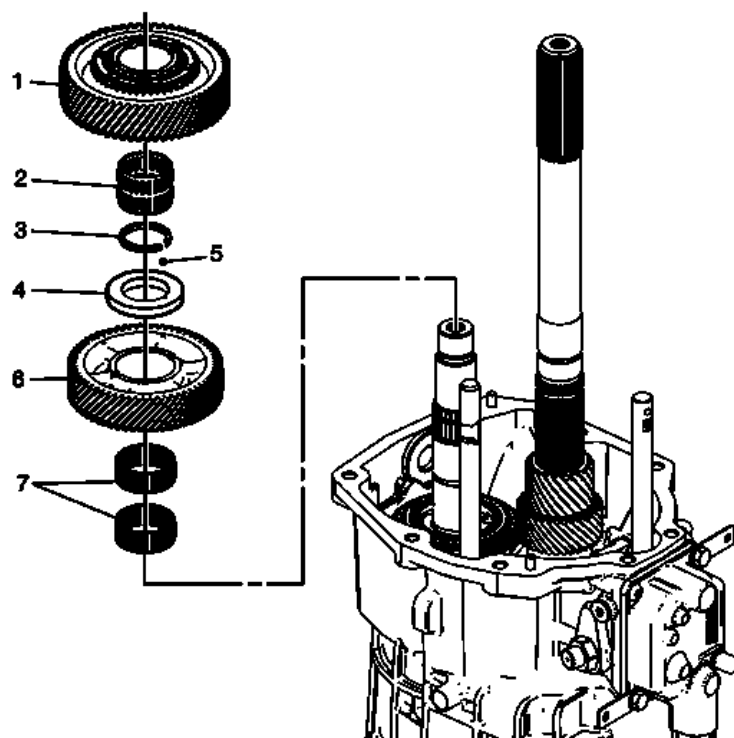


**Fig. 82: 7th Drive Gear and 5th Drive Gear**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th Drive Gear and 5th Drive Gear Removal

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | 7th Gear - Drive                     |
| 2       | 7th Gear Bearing                     |
| 3       | 5th Gear Retaining Ring              |
| 4       | 5th Gear Thrust Washer               |
| 5       | 5th Gear Thrust Washer Location Ball |
| 6       | 5th Gear - Drive                     |
| 7       | 5th Gear Bearing                     |

#### 7th Driven Gear and 5th Driven Gear Removal

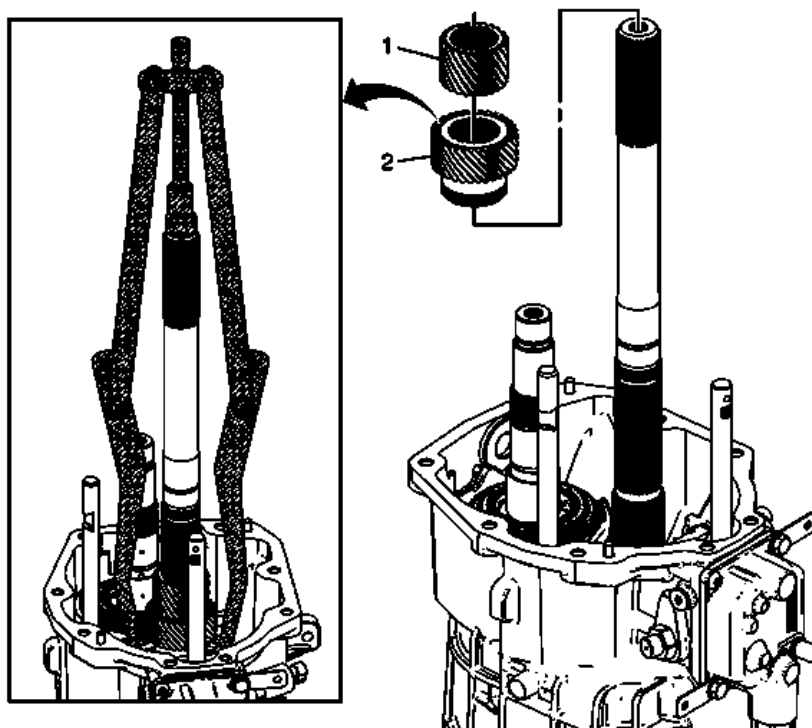


**Fig. 83: 7th Driven Gear and 5th Driven Gear**  
Courtesy of GENERAL MOTORS COMPANY

#### 7th Driven Gear and 5th Driven Gear Removal

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>7th Gear - Driven</p> <p><b>NOTE:</b><br/>This part is pressed on and removed with the 5th driven gear (2).</p>                                                                                                                                                                                                                                                                                                                                                                            |
| 2       | <p>5th Gear - Driven</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Install the <b>DT-22888-60</b> legs to the <b>DT-22888-20A</b> puller.</li> <li>2. Remove the 5th driven gear and 7th driven gear.</li> </ol> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-22888-D</b> Side Bearing Remover Kit</li> <li>• <b>DT-22888-60</b> Puller Leg Adapter Kit</li> </ul> <p>For equivalent regional tools, refer to <b>Special Tools</b>.</p> |

#### 5th & 6th Shift Fork Removal

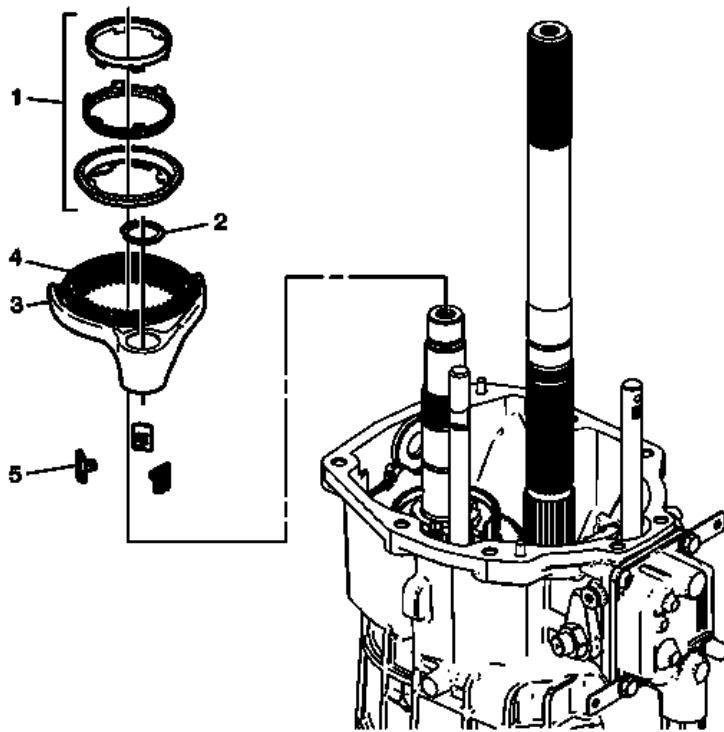


**Fig. 84: 5th & 6th Shift Fork**  
 Courtesy of GENERAL MOTORS COMPANY

#### 5th & 6th Shift Fork Removal

| Callout | Component Name                        |
|---------|---------------------------------------|
| 1       | 5th Gear Blocking Ring Assembly       |
| 2       | 5th & 6th Shift Fork Retainer         |
| 3       | 5th & 6th Shift Fork                  |
| 4       | 5th & 6th Gear Synchronizer Sleeve    |
| 5       | 5th & 6th Synchronizer Sleeve Inserts |

#### 5th & 6th Gear Synchronizer Hub & 6th Drive Gear Removal

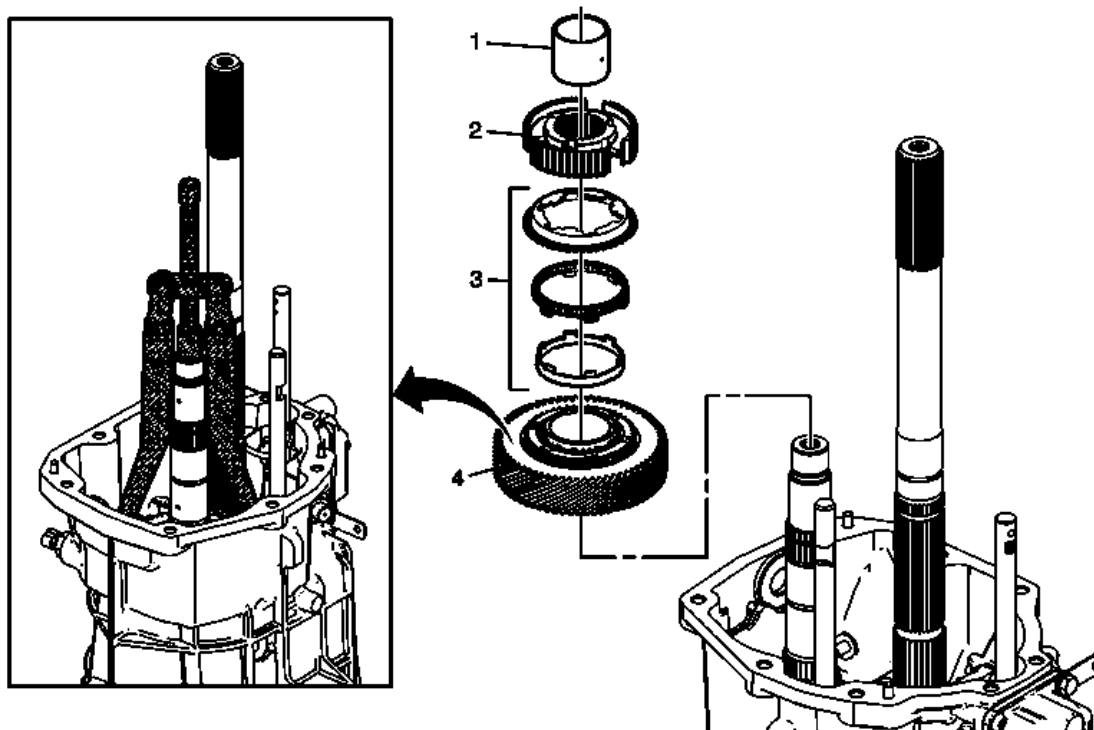


**Fig. 85: 5th & 6th Gear Synchronizer Hub & 6th Drive Gear**  
 Courtesy of GENERAL MOTORS COMPANY

#### 5th & 6th Gear Synchronizer Hub & 6th Drive Gear Removal

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                               |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 5th Gear Bearing Bushing<br><br><b>NOTE:</b><br>This part is pressed on and removed with the 6th drive gear (4).                                                                                                                                                                                                                                                                             |
| 2       | 5th & 6th Gear Synchronizer Hub                                                                                                                                                                                                                                                                                                                                                              |
| 3       | 6th Gear Blocking Ring Assembly                                                                                                                                                                                                                                                                                                                                                              |
| 4       | 6th Gear - Drive<br><br><b>Procedure</b><br><br>1. Install the <b>DT-22888-60</b> legs to the <b>DT-22888-20A</b> puller.<br>2. Remove the 6th drive gear, 6th gear blocking ring assembly, 5th & 6th gear synchronizer hub and the 5th gear bearing bushing.<br><br><b>Special Tools</b><br><br>• <b>DT-22888-D</b> Side Bearing Remover Kit<br>• <b>DT-22888-60</b> Puller Leg Adapter Kit |

For equivalent regional tools, refer to **Special Tools**.

#### 6th Drive Gear Bearing and Spacer Removal

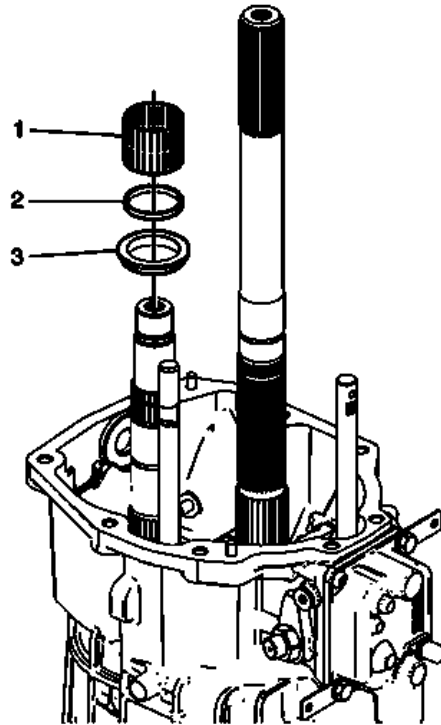


**Fig. 86: 6th Drive Gear Bearing and Spacer**  
Courtesy of GENERAL MOTORS COMPANY

#### 6th Drive Gear Bearing and Spacer Removal

| Callout | Component Name          |
|---------|-------------------------|
| 1       | 6th Drive Gear Bearing  |
| 2       | 6th Gear Bearing Spacer |
| 3       | 6th Gear Thrust Washer  |

#### Reverse Gear Blockout Solenoid and Skip Shift Solenoid Removal

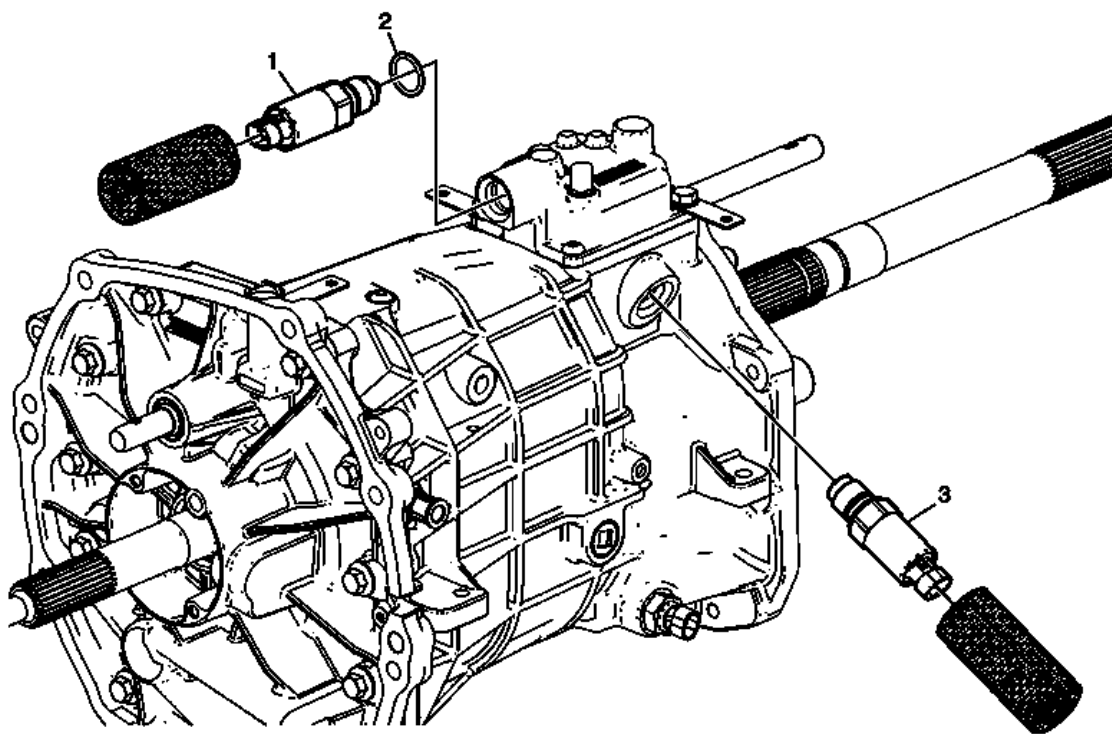


**Fig. 87: Reverse Gear Blockout Solenoid and Skip Shift Solenoid**  
 Courtesy of GENERAL MOTORS COMPANY

#### Reverse Gear Blockout Solenoid and Skip Shift Solenoid Removal

| Callout | Component Name                                                                                                                                                                                                                                                                                      |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Manual Transmission Reverse Gear Blockout Solenoid<br><br><b>NOTE:</b><br>The reverse gear blockout solenoid connector is black.<br><br><b>Special Tools</b><br><b>DT-49293</b> Gear Select/Skip Shift Solenoid Remover/Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> . |
| 2       | Manual Transmission Reverse Gear Blockout Solenoid O-ring Seal                                                                                                                                                                                                                                      |
| 3       | Skip Shift Solenoid<br><br><b>NOTE:</b><br>The skip shift solenoid connector is white.<br><br><b>Special Tools</b><br><b>DT-49293</b> Gear Select/Skip Shift Solenoid Remover/Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> .                                           |

## Reverse Gear Blockout Solenoid Housing Removal

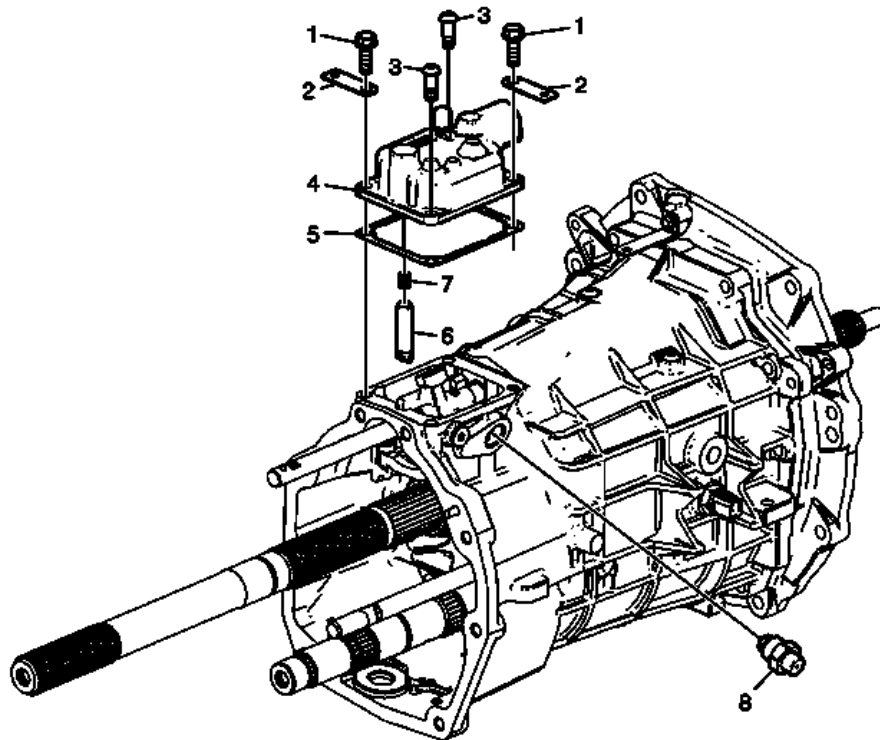


**Fig. 88: Reverse Gear Blockout Solenoid Housing**  
Courtesy of GENERAL MOTORS COMPANY

## Reverse Gear Blockout Solenoid Housing Removal

| Callout | Component Name                                                    |
|---------|-------------------------------------------------------------------|
| 1       | Reverse Lockout Solenoid Cover Hex Bolt                           |
| 2       | Wiring Harness Bracket                                            |
| 3       | Reverse Lockout Solenoid Cover Shoulder Bolt                      |
| 4       | Manual Transmission Reverse Gear Blockout Solenoid Housing        |
| 5       | Manual Transmission Reverse Gear Blockout Solenoid Housing Gasket |
| 6       | Shift Shaft Detent Roller                                         |
| 7       | Detent Roller Spring                                              |
| 8       | Shift Shaft Detent Spring                                         |

## Transmission Interlock Bolt Removal

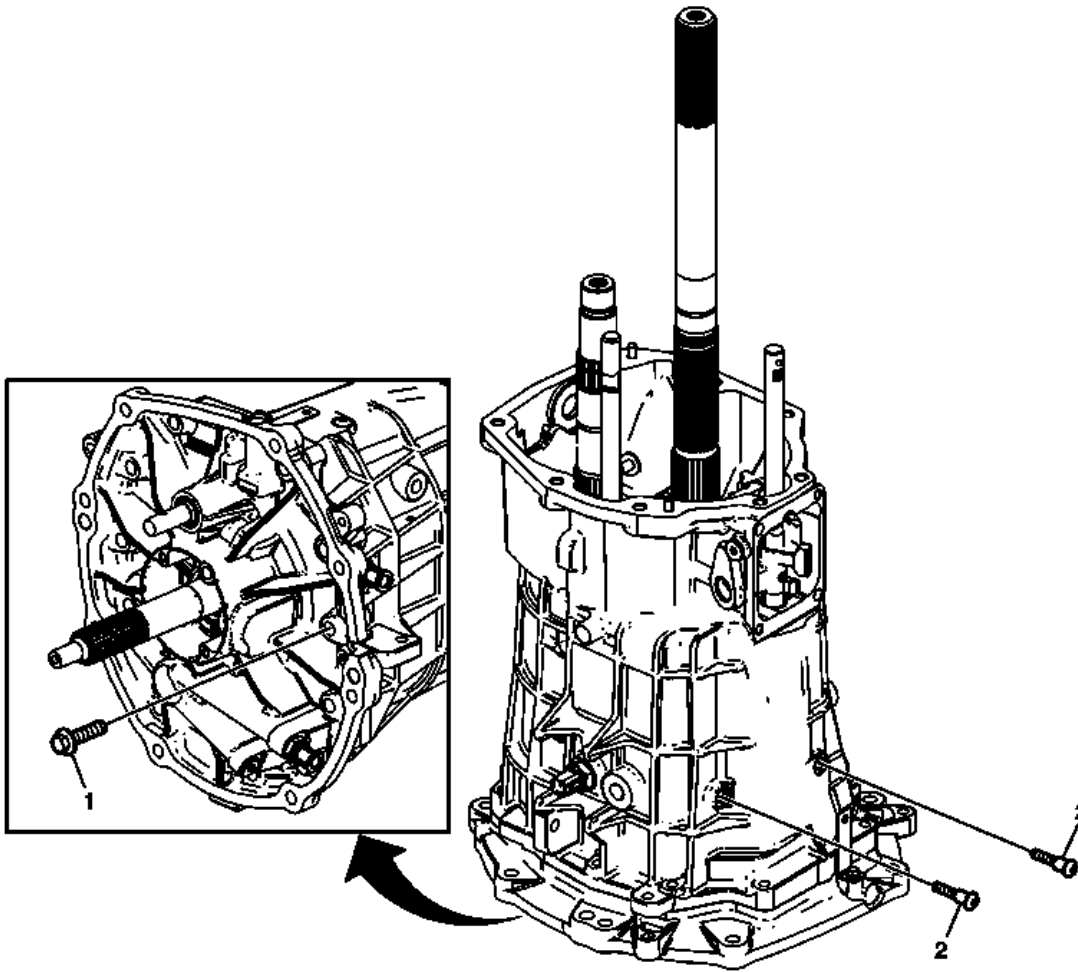


**Fig. 89: Transmission Interlock Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

#### Transmission Interlock Bolt Removal

| Callout                                                                                                                                                                            | Component Name                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 1                                                                                                                                                                                  | Transmission Adapter Bolt (Qty: 8)   |
| <b>Procedure</b> <ol style="list-style-type: none"> <li>1. Remove the 8 remaining adapter plate bolts.</li> <li>2. Rotate the transmission in to the vertical position.</li> </ol> |                                      |
| 2                                                                                                                                                                                  | Transmission Interlock Bolt (Qty: 2) |

#### Transmission Case Removal

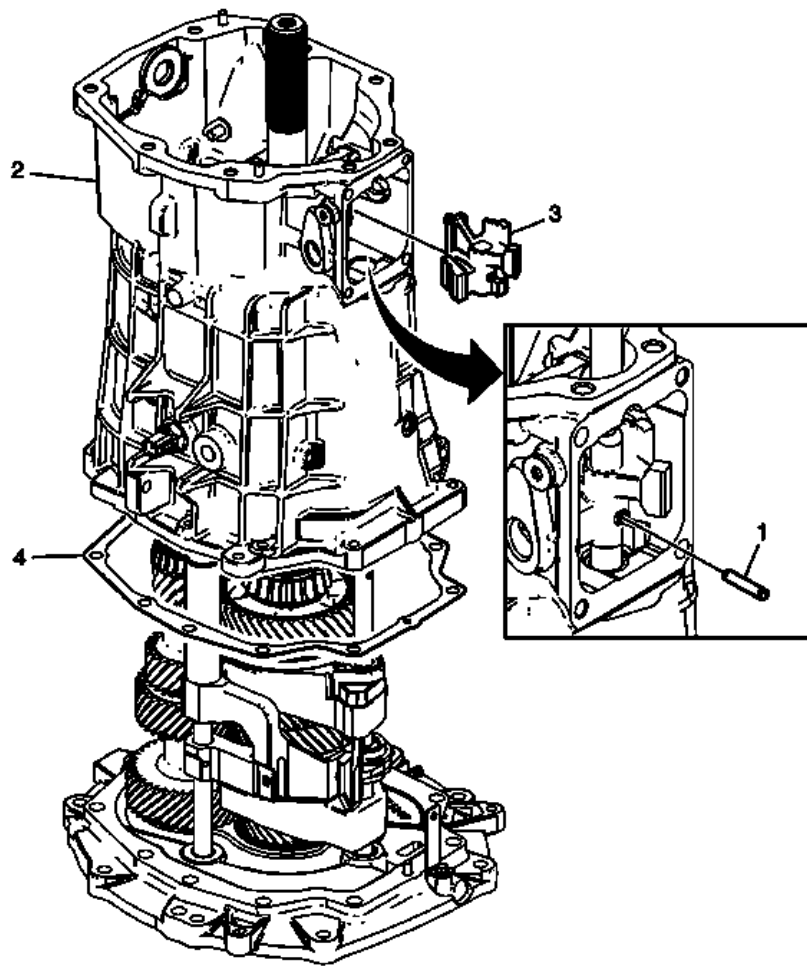


**Fig. 90: Transmission Case**  
 Courtesy of GENERAL MOTORS COMPANY

#### Transmission Case Removal

| Callout | Component Name                                                                       |
|---------|--------------------------------------------------------------------------------------|
| 1       | Roll Pin<br><b>Procedure</b><br>Use a punch to push the pin through the shift shaft. |
| 2       | Transmission Case                                                                    |
| 3       | Offset Shift Lever                                                                   |
| 4       | Transmission Case-to-Adapter Plate Gasket                                            |

#### Shift Shaft Assemblies and Gear Cluster Removal

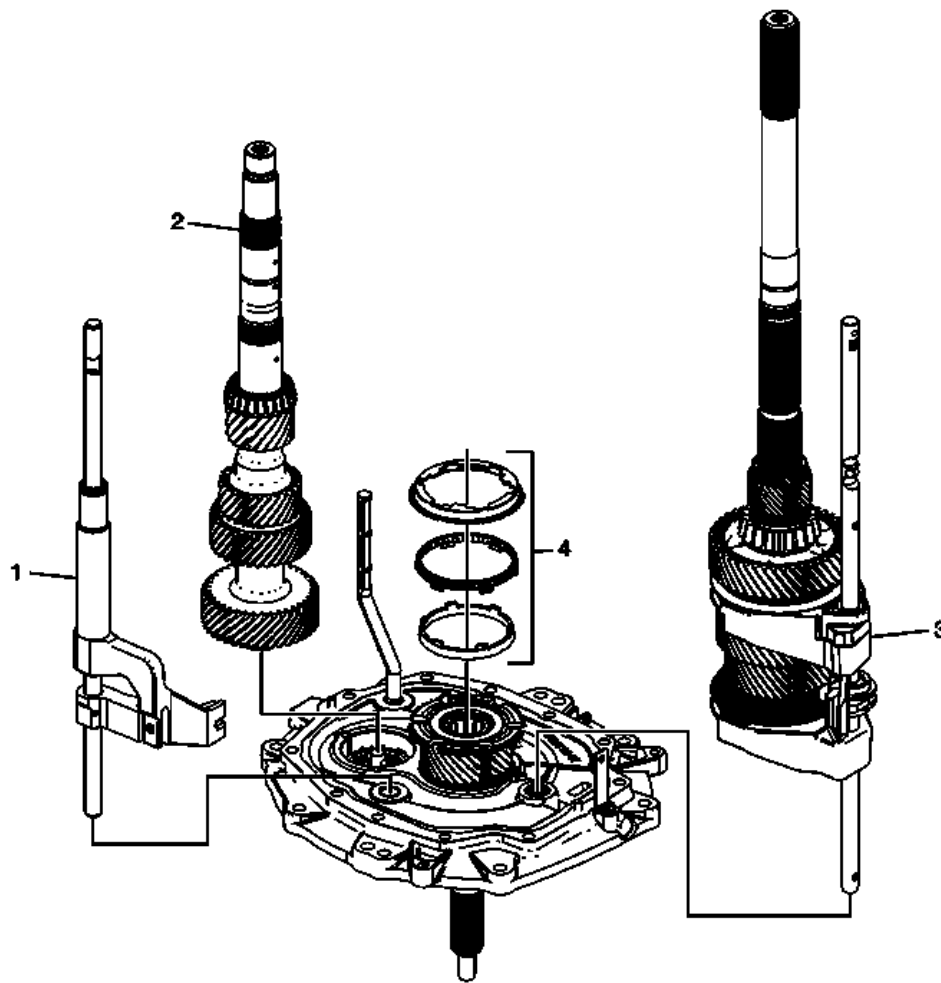


**Fig. 91: Shift Shaft Assemblies and Gear Cluster**  
 Courtesy of GENERAL MOTORS COMPANY

#### Shift Shaft Assemblies and Gear Cluster Removal

| Callout | Component Name                                                                                                                                                              |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 5th/6th & 7th/Reverse Shift Shaft Assembly<br><br><b>NOTE:</b><br>Rotate the 5th/6th & 7th/Reverse Shift Shaft Assembly off of the shift interlock plate to aid in removal. |
| 2       | Counter Gear Assembly                                                                                                                                                       |
| 3       | Main Shaft and 1st/2nd & 3rd/4th Shift Shaft Assembly                                                                                                                       |
| 4       | 4th Gear Blocking Ring Assembly                                                                                                                                             |

#### Input Shaft Removal

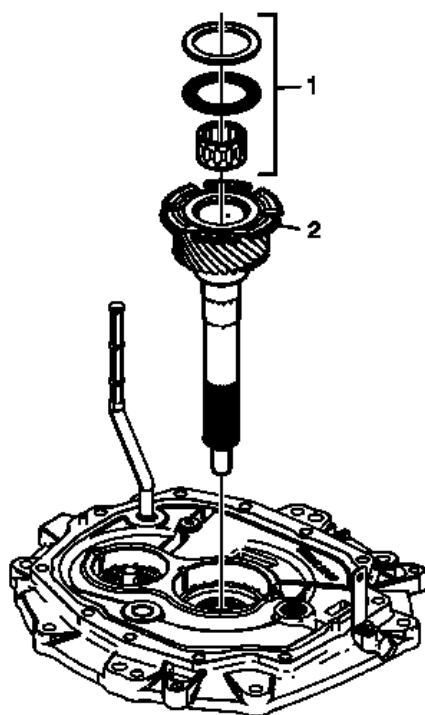


**Fig. 92: Input Shaft**

Courtesy of GENERAL MOTORS COMPANY

#### Input Shaft Removal

| Callout | Component Name              |
|---------|-----------------------------|
| 1       | Main Shaft Bearing Assembly |
| 2       | Input Shaft                 |

#### MAIN SHAFT AND INPUT SHAFT DISASSEMBLE

##### 6th Driven Gear and First Drive Gear Removal

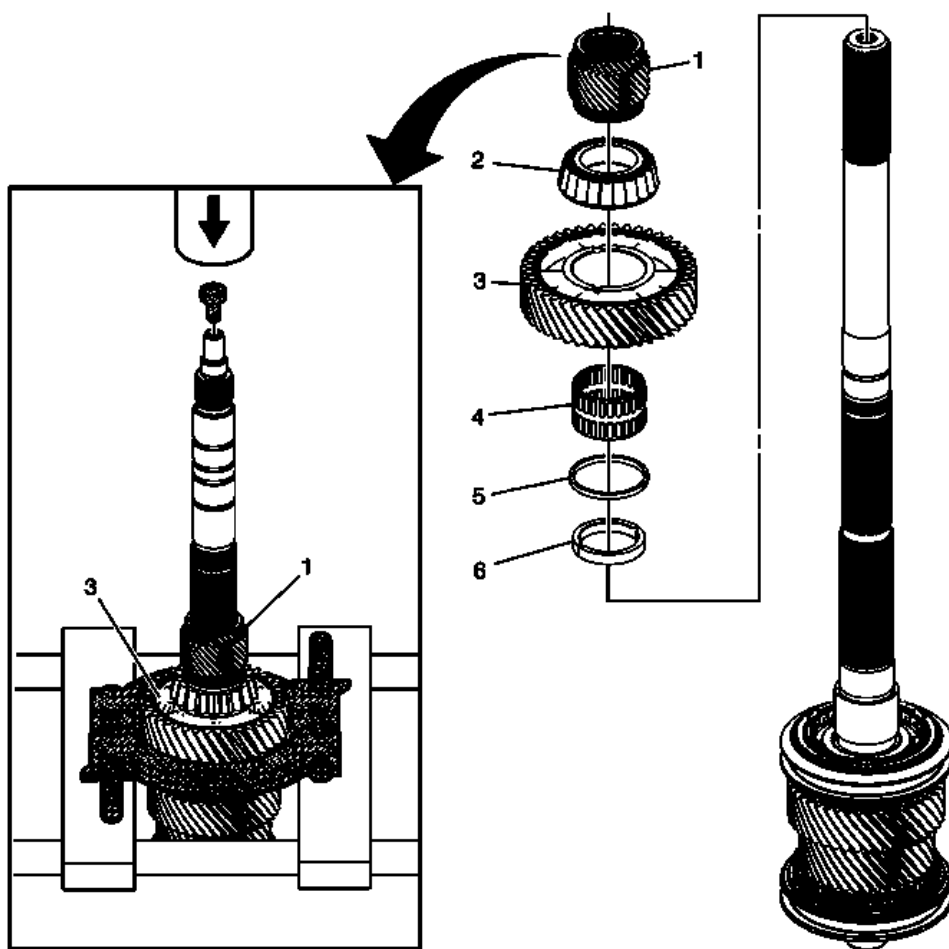


**Fig. 93: 6th Driven Gear and First Drive Gear**  
 Courtesy of GENERAL MOTORS COMPANY

#### 6th Driven Gear and First Drive Gear Removal

| Callout                                                                                                                                                                                                                                                                                                                       | Component Name    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>Preliminary Procedure</b>                                                                                                                                                                                                                                                                                                  |                   |
| <b>NOTE:</b><br>Measure the 4th speed gear synchronizer wear gap before disassembling the main shaft.                                                                                                                                                                                                                         |                   |
| 1. Install the input shaft in the adapter plate.<br>2. Install the main shaft on the input shaft.<br>3. Using a feeler gauge, measure the gap between the 4th speed gear blocking ring and the 4th speed gear.<br>4. Replace the 4th speed gear friction cone and blocking ring when the gap is less than 1.27 mm (0.050 in). |                   |
| 1                                                                                                                                                                                                                                                                                                                             | 6th Gear - Driven |

|   |                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | 1st Gear - Drive                                                                                                                                                                                                                                      |
|   | <b>NOTE:</b><br>The 6th speed driven gear, main shaft bearing and 1st drive gear are removed together using DT-36513 split plate and EN-46359 protector.                                                                                              |
| 3 | <b>Special Tools</b> <ul style="list-style-type: none"> <li>• <b>DT-36513</b> Gear and Bearing Separator Plate</li> <li>• <b>EN-46359</b> Puller End Protector</li> </ul> <p>For equivalent regional tools, refer to <b><u>Special Tools</u></b>.</p> |
| 4 | 1st Gear Bearing                                                                                                                                                                                                                                      |
| 5 | Transmission Main Shaft Washer                                                                                                                                                                                                                        |
| 6 | Transmission Main Shaft Split Washer                                                                                                                                                                                                                  |

#### 1st Gear Blocking Ring Assembly Removal

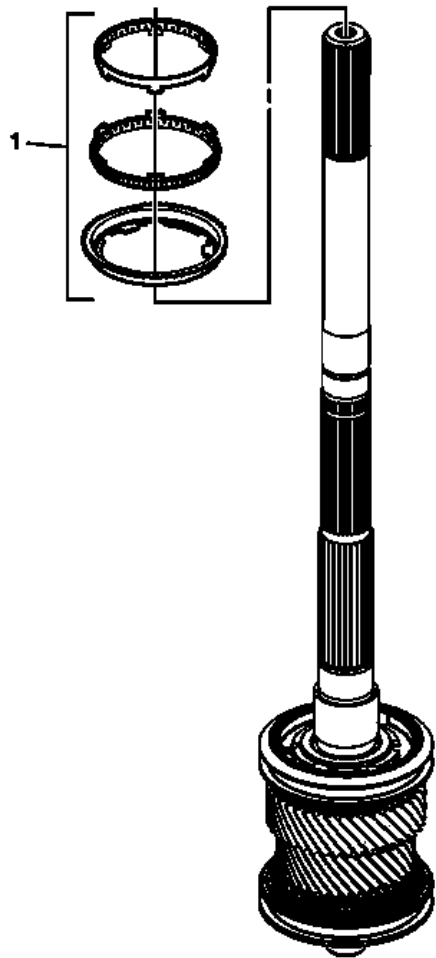


**Fig. 94: 1st Gear Blocking Ring Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

**1st Gear Blocking Ring Assembly Removal**

| Callout | Component Name                  |
|---------|---------------------------------|
| 1       | 1st Gear Blocking Ring Assembly |

**2nd Drive Gear and 1st & 2nd Synchronizer Assembly Removal**

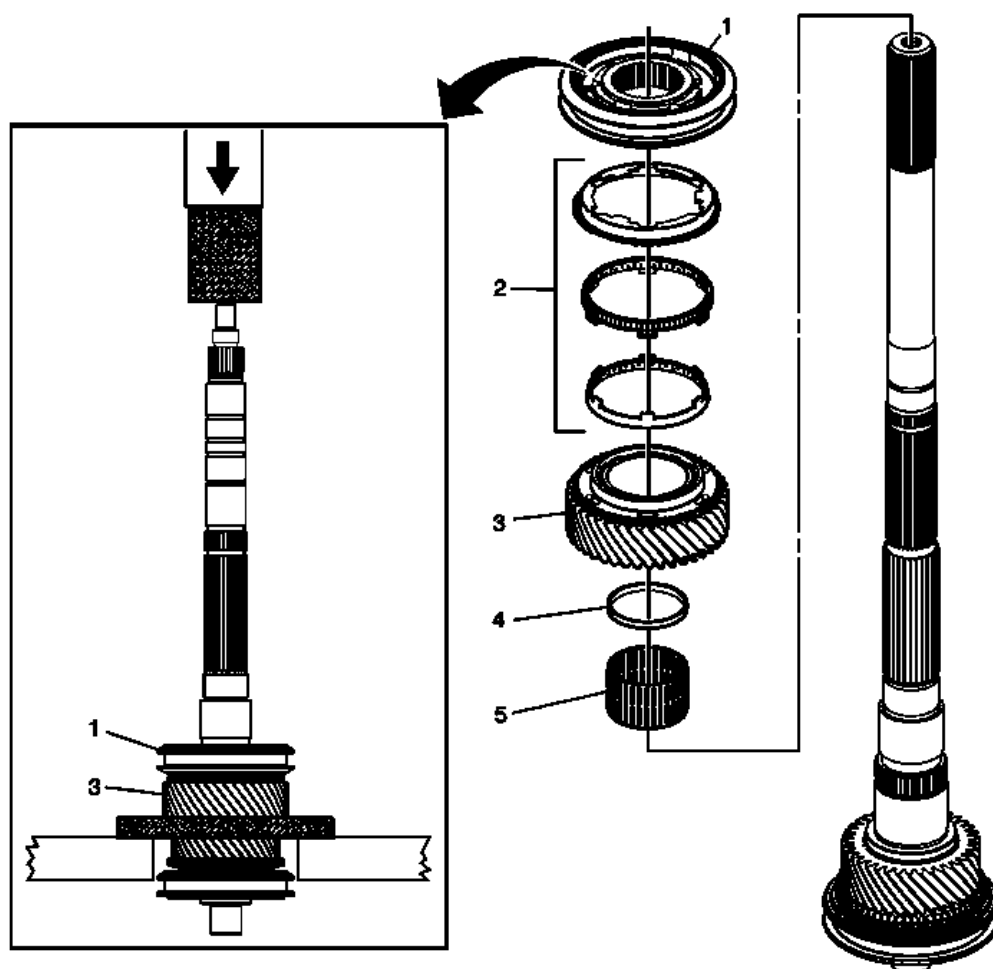


**Fig. 95: 2nd Drive Gear and 1st & 2nd Synchronizer Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

#### 2nd Drive Gear and 1st & 2nd Synchronizer Assembly Removal

| Callout | Component Name                                                                                                                                                                                                                                                                         |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 1st & 2nd Synchronizer Assembly                                                                                                                                                                                                                                                        |
| 2       | 2nd Gear Blocking Ring Assembly                                                                                                                                                                                                                                                        |
| 3       | 2nd Gear - Drive<br><br><b>Special Tools</b> <ul style="list-style-type: none"> <li>• <b>DT-36513</b> Gear and Bearing Separator Plate</li> <li>• <b>DT-39442</b> Main Shaft and Counter Shaft Press Adapter</li> </ul> For equivalent regional tools, refer to <b>Special Tools</b> . |
| 4       | 2nd Gear Bearing Spacer                                                                                                                                                                                                                                                                |
| 5       | 2nd Gear Bearing                                                                                                                                                                                                                                                                       |

3rd Drive Gear and 3rd Gear Synchronizer Assembly Removal

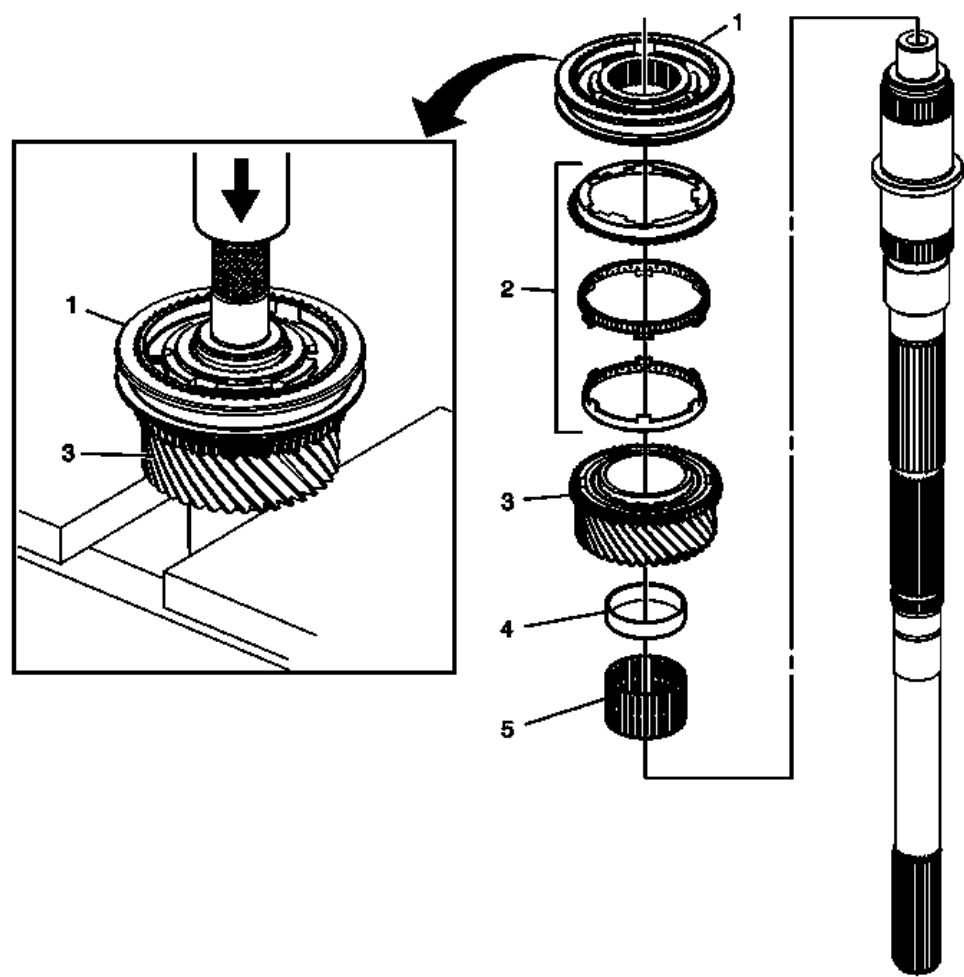


Fig. 96: 3rd Drive Gear and 3rd Gear Synchronizer Assembly  
Courtesy of GENERAL MOTORS COMPANY

3rd Drive Gear and 3rd Gear Synchronizer Assembly Removal

| Callout | Component Name                                                                                                                                             |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 3rd Gear Synchronizer Assembly                                                                                                                             |
| 2       | 3rd Gear Blocking Ring Assembly                                                                                                                            |
| 3       | 3rd Gear - Drive<br><b>Special Tools</b><br><b>DT-39473</b> Main Shaft Bearing Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> . |
| 4       | 3rd Gear Bearing Spacer                                                                                                                                    |
| 5       | 3rd Gear Bearing                                                                                                                                           |

Input Shaft Bearing Removal

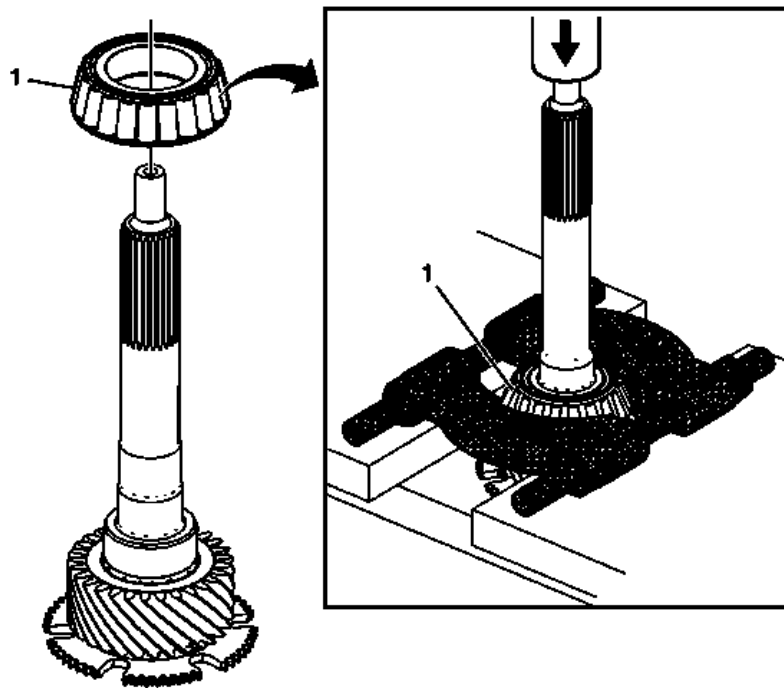


**Fig. 97: Input Shaft Bearing**  
 Courtesy of GENERAL MOTORS COMPANY

#### Input Shaft Bearing Removal

| Callout | Component Name                                                                                                                                                                                                                                                            |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Input Shaft Bearing<br><br><b>NOTE:</b><br>Do NOT replace the tapered bearing unless inspection shows that the bearing is damaged.<br><br><b>Special Tools</b><br>DT-22912-B Split Plate Bearing Puller<br>For equivalent regional tools, refer to <b>Special Tools</b> . |

#### COUNTER GEAR SHAFT DISASSEMBLE

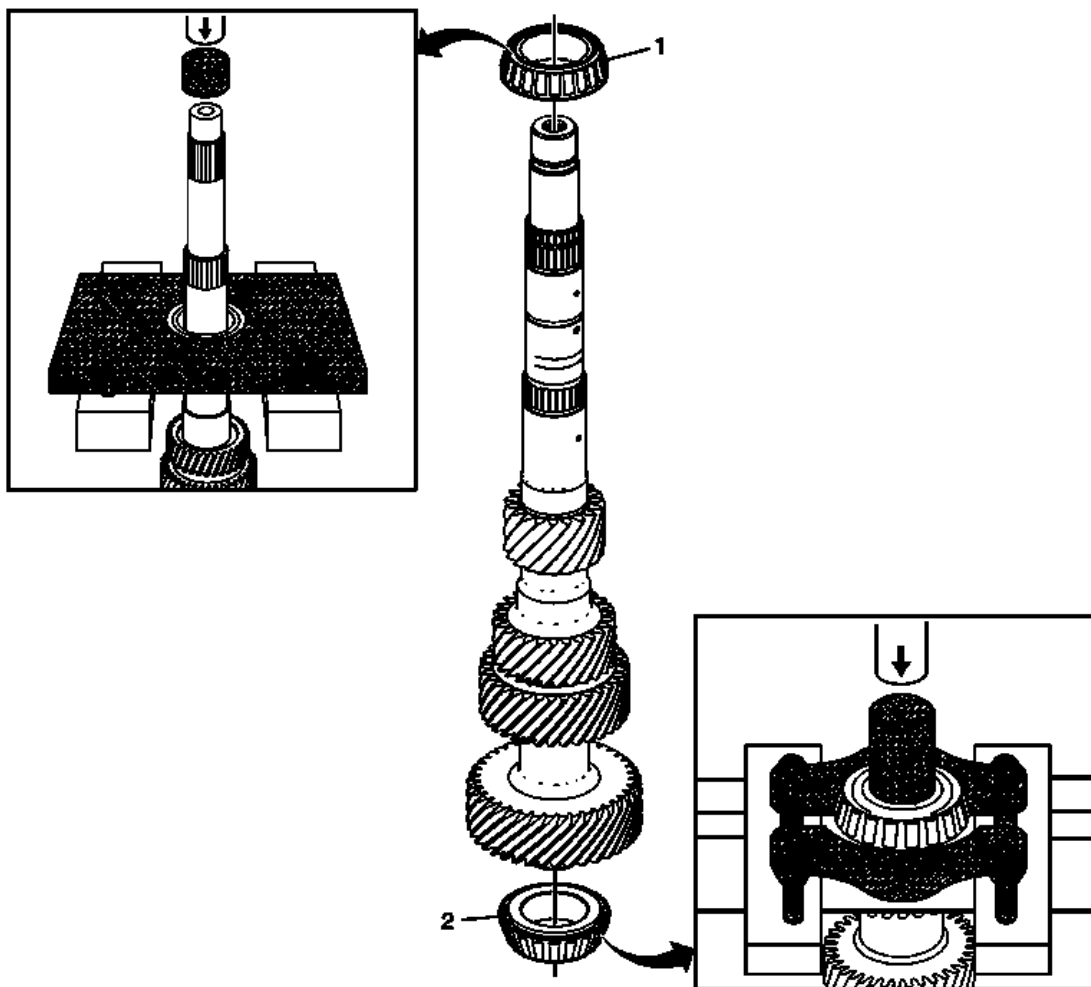


**Fig. 98: Counter Gear Shaft**  
 Courtesy of GENERAL MOTORS COMPANY

#### Counter Gear Shaft Disassemble

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                        |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>Counter Gear Bearing</p> <p><b>NOTE:</b><br/>           Do NOT replace the bearing unless inspection shows the bearing is damaged.</p> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-39511</b> Counter Shaft Bearing Installer</li> <li>• <b>DT-39547</b> Counter Shaft Press Adapter</li> </ul> <p>For equivalent regional tools, refer to <b>Special Tools</b>.</p> |

|   |                                                                                                                                                                                                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | <p><b>NOTE:</b><br/>Do NOT replace the bearing unless inspection shows the bearing is damaged.</p> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-22912-B</b> Split Plate Bearing Puller</li> <li>• <b>DT-39473</b> Main Shaft Bearing Installer</li> </ul> <p>For equivalent regional tools, refer to <b><u>Special Tools</u></b>.</p> |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## SYNCHRONIZERS DISASSEMBLE

If you are servicing this transmission for a shifting concern such as clash, hop out of gear or block-out in a particular gear, the following hardware must be replaced as a set for the gear in question. Adjoining gears do not need to be serviced unless necessary:

- Main gear in question - for example 2nd, 3rd
- Synchronizer assembly, slider sleeve assembly
- Blocker ring assembly
- Shift fork inserts, pads

**IMPORTANT:** Synchronizer components are not interchangeable. Keep all the synchronizer components separate. The synchronizer hubs and the sliding sleeves are a selected assembly. Keep the hubs and the sliding sleeves together as originally assembled.

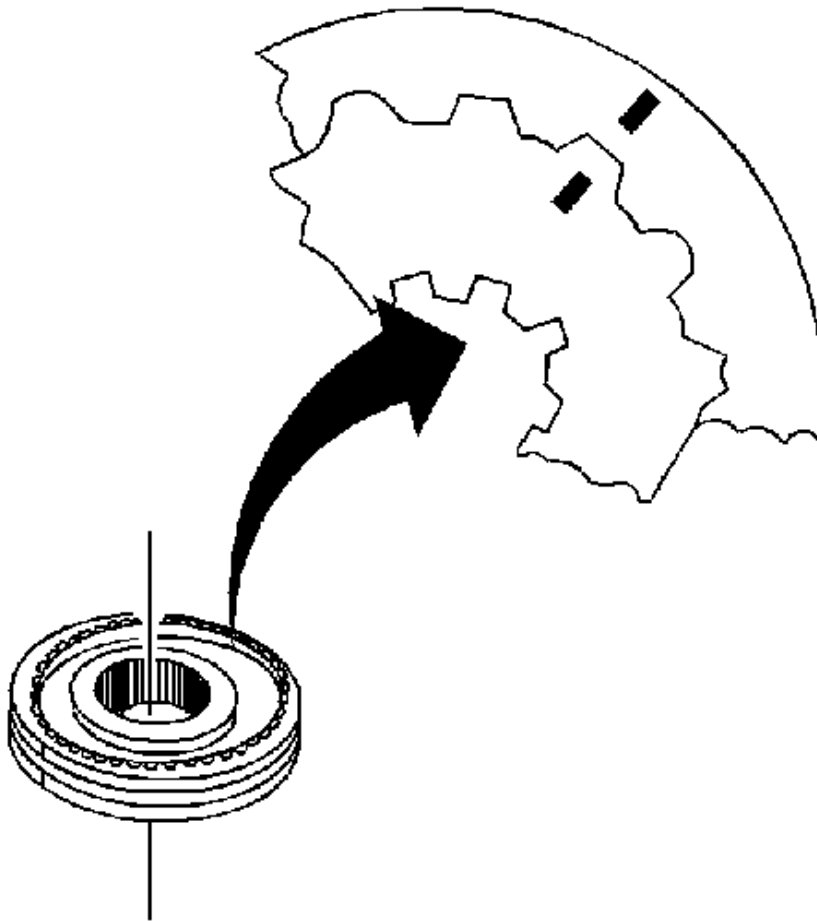


**Fig. 99: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Scribe a mark on the synchronizer hub and on the sleeve. This will help you to reinstall the parts in the same position.

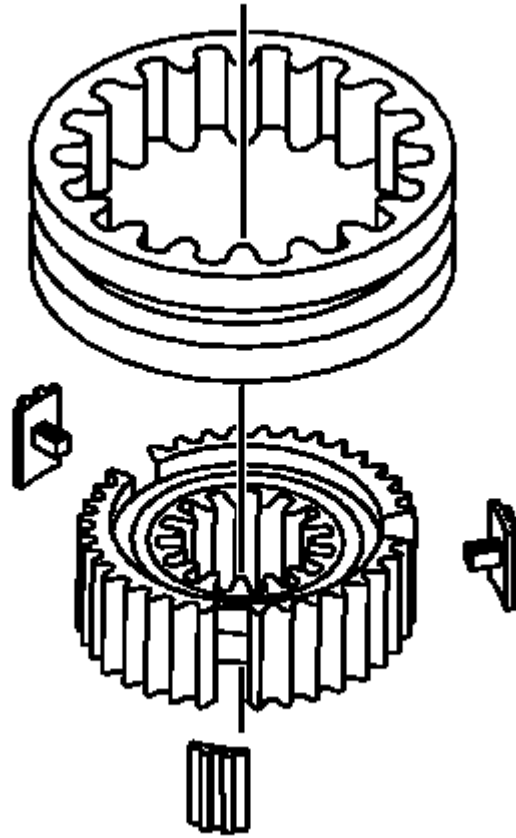


**Fig. 100: Identifying Synchronizer Inserts**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the synchronizer inserts from the hub.

### **SYNCHRONIZERS CLEANING AND INSPECTION**

If you are servicing this transmission for a shifting concern such as clash, hop out of gear or block-out in a particular gear, the following hardware must be replaced as a set for the gear in question. Adjoining gears do not need to be serviced unless necessary:

- Main gear in question - for example 2nd, 3rd
  - Synchronizer assembly, slider sleeve assembly
  - Blocker ring assembly
  - Shift fork inserts, pads
1. Clean all the synchronizer parts in a suitable solvent. Air dry all the synchronizer parts.
  2. Inspect the synchronizer parts for the following conditions:
    - Burrs
    - Cracks

- Hicks
  - Chamfer for excessive wear
  - Free movement of the clutching sleeves on their hubs
  - Worn or damaged clutch teeth
  - Distorted springs
3. Replace synchronizer parts that are worn or damaged.

Replace a burred or nicked part that cannot be reconditioned by hand. Use a soft stone or a crocus cloth.

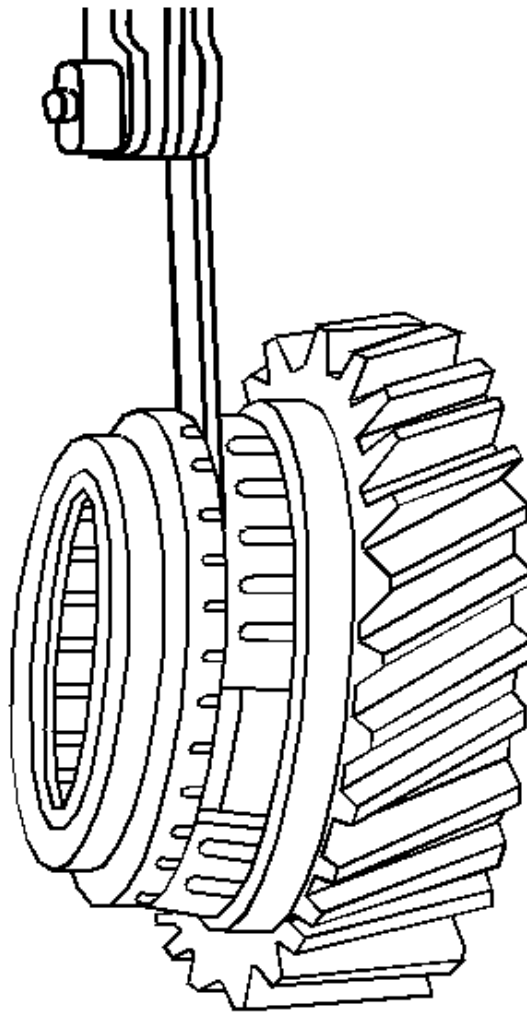


**Fig. 101: Measuring Gap Between Blocking Ring & Speed Gear**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Measure the gap without the wave washer in between the blocking ring

**and the reverse gear.**

4. Measure the gap between the vertical faces of the blocking ring teeth and the speed gear as follows:
  1. Assemble the correct blocking ring with the correct speed gear.
  2. The blocking ring must be fully seated on the gear.
  3. Use a feeler gauge to measure the forward gear gap.
  4. Use a feeler gauge to measure the reverse gear gap.

The nominal gap is 0.93-1.98 mm (0.037-0.078 in) for the 1st and 2nd gear.

The nominal gap is 0.89-2.03 mm (0.035-0.080 in) for the 3rd gear.

The nominal gap is 0.91-2.03 mm (0.036-0.080 in) for the 4th gear.

The nominal gap is 0.76-1.88 mm (0.030-0.074 in) for the 5th, 6th, 7th and Reverse gear.

Replace the friction cones and blocker rings when the gap is less than specified.

## **SYNCHRONIZERS ASSEMBLE**

If you are servicing this transmission for a shifting concern such as clash, hop out of gear or block-out in a particular gear, the following hardware must be replaced as a set for the gear in question. Adjoining gears do not need to be serviced unless necessary:

- Main gear in question - for example 2nd, 3rd
- Synchronizer assembly, slider sleeve assembly
- Blocker ring assembly
- Shift fork inserts, pads

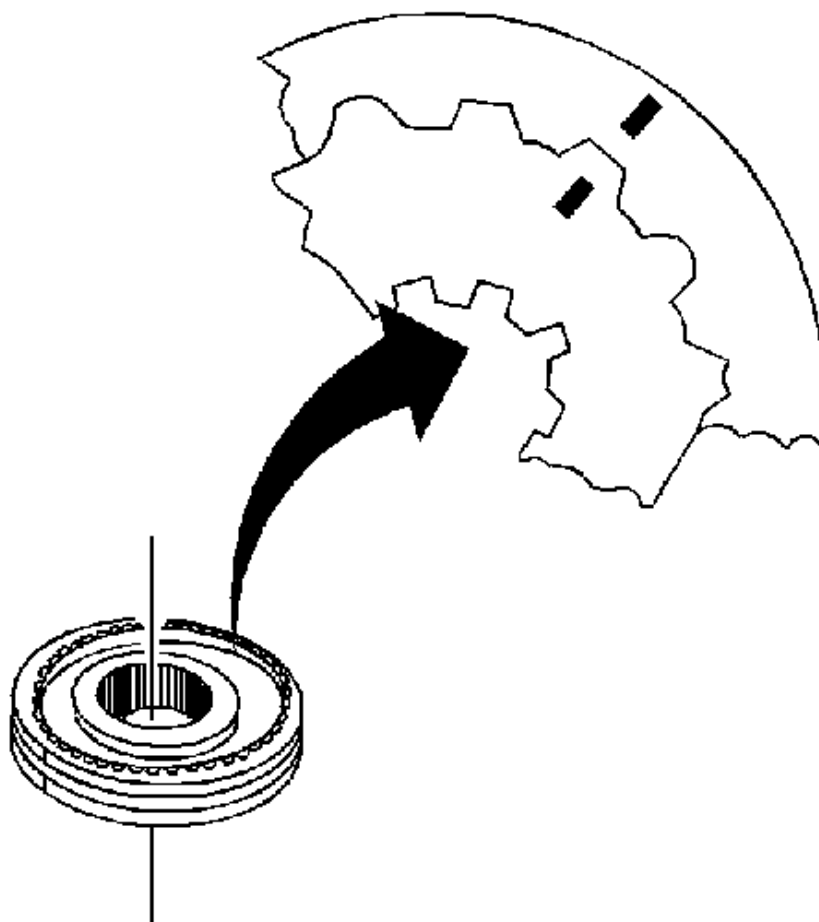


**Fig. 102: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Check the synchronizer assembly scribe marks for correct positions.

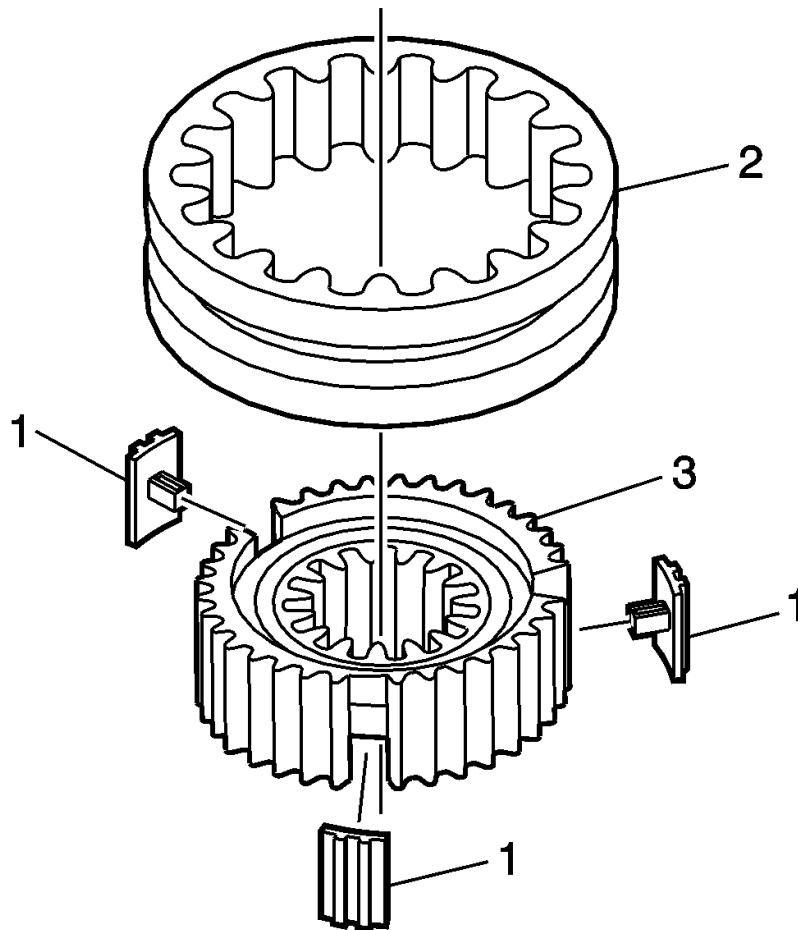


**Fig. 103: Assembling 1st/2nd Synchronizer**  
Courtesy of GENERAL MOTORS COMPANY

2. Install the synchronizer sleeve (2) to the hub (3) (align the insert openings in the hub with the cuts in the synchronizer sleeve).
3. Install the inserts (1) with the slots facing the hub.

## SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE

### 1st/2nd & 3rd/4th Shift Shaft Assembly Disassemble

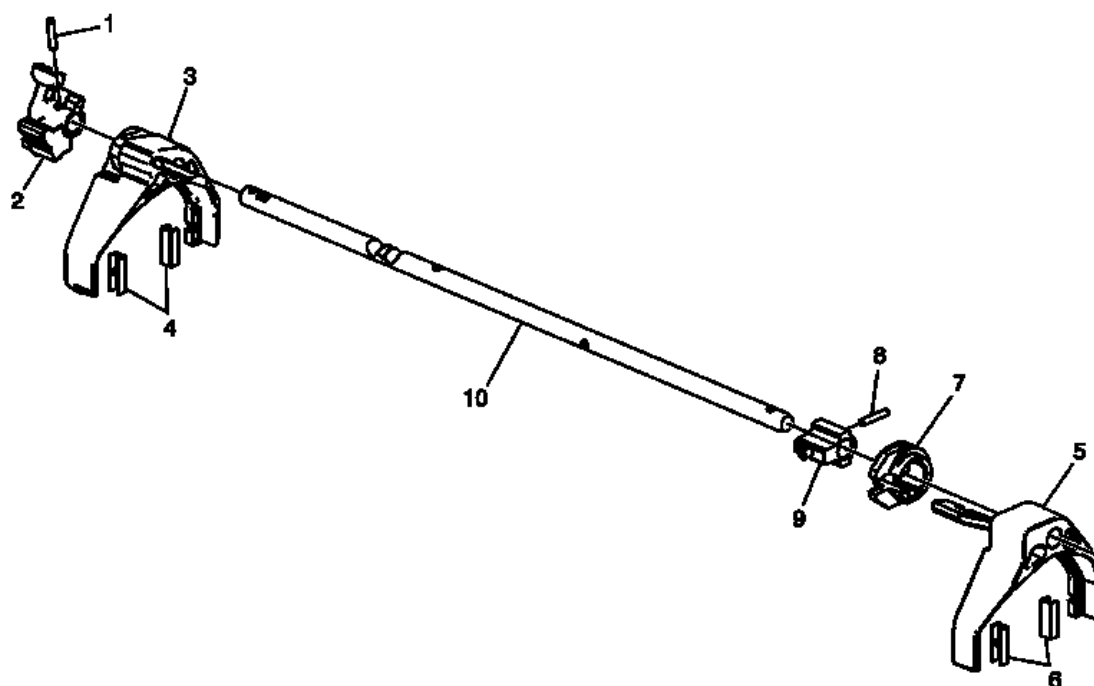


**Fig. 104: 1st/2nd & 3rd/4th Shift Shaft Assembly Disassemble**  
 Courtesy of GENERAL MOTORS COMPANY

**1st/2nd & 3rd/4th Shift Shaft Assembly Disassemble**

| Callout | Component Name                                    |
|---------|---------------------------------------------------|
| 1       | Roll Pin                                          |
| 2       | Offset Shift Lever                                |
| 3       | 1st & 2nd Shift Fork                              |
| 4       | 1st & 2nd Shift Fork Insert                       |
| 5       | 3rd & 4th Shift Fork                              |
| 6       | 3rd & 4th Shift Fork Insert                       |
| 7       | Manual Transmission Shift Lever Interlock Bracket |
| 8       | Roll Pin                                          |
| 9       | Shift Control Lever                               |
| 10      | 1st/2nd & 3rd/4th Shift Shaft                     |

**5th/6th & 7th/Reverse Shift Shaft Assembly Disassemble**

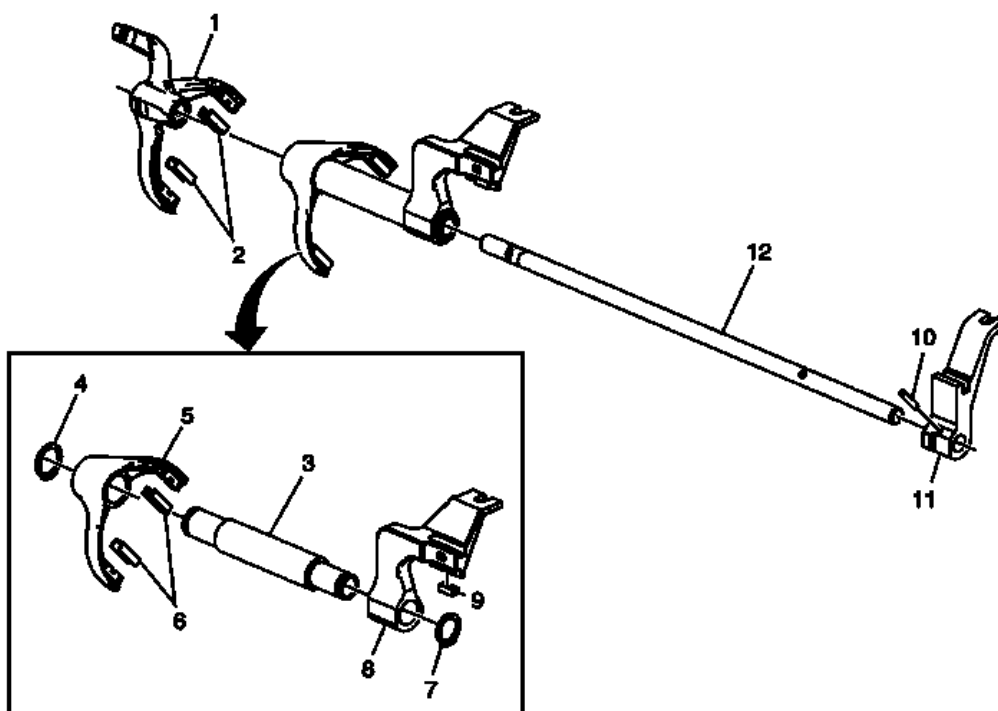


**Fig. 105: 5th/6th & 7th/Reverse Shift Shaft Assembly Disassemble**  
 Courtesy of GENERAL MOTORS COMPANY

**5th/6th & 7th/Reverse Shift Shaft Assembly Disassemble**

| Callout | Component Name                    |
|---------|-----------------------------------|
| 1       | 7th & Reverse Shift Fork          |
| 2       | 7th & Reverse Shift Fork Insert   |
| 3       | 5th & 6th Shift Shaft             |
| 4       | 5th & 6th Shift Fork Retainer     |
| 5       | 5th & 6th Shift Fork              |
| 6       | 5th & 6th Shift Fork Insert       |
| 7       | 5th & 6th Shift Lever Retainer    |
| 8       | 5th & 6th Shift Lever             |
| 9       | 5th & 6th Shift Lever Insert      |
| 10      | Roll Pin                          |
| 11      | Reverse Shift Lever               |
| 12      | 5th/6th & 7th/Reverse Shift Shaft |

**SHIFT SHAFT AND FORK ASSEMBLIES CLEANING AND INSPECTION**

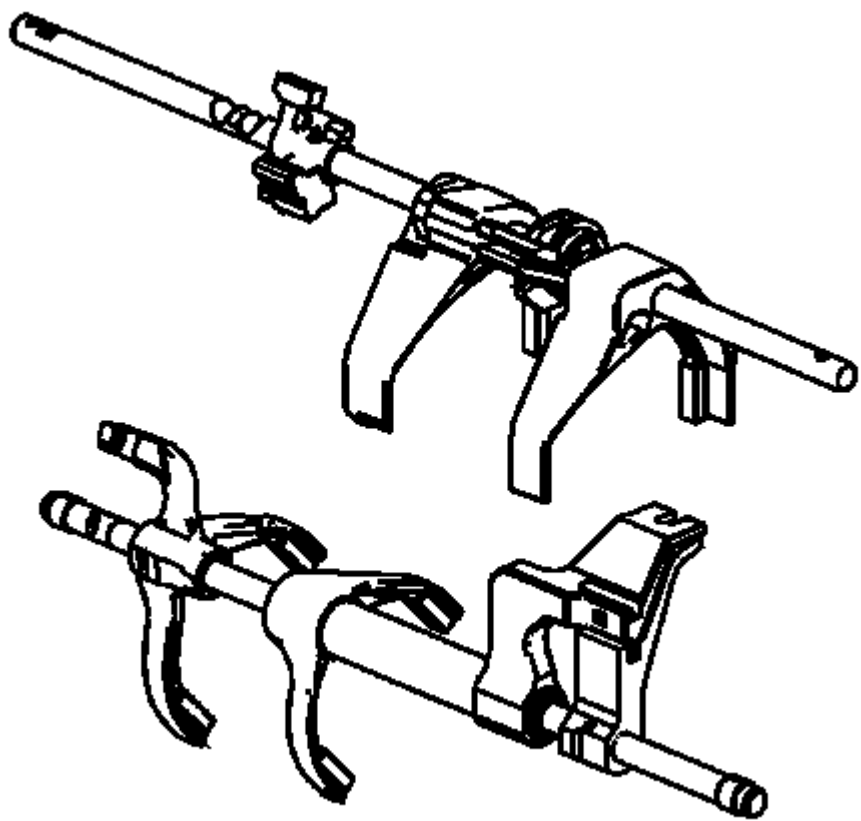


**Fig. 106: Shift Shaft And Fork Assembly Parts**  
Courtesy of GENERAL MOTORS COMPANY

1. Clean the shift shaft and fork assembly parts with a suitable solvent. Air dry all the parts.

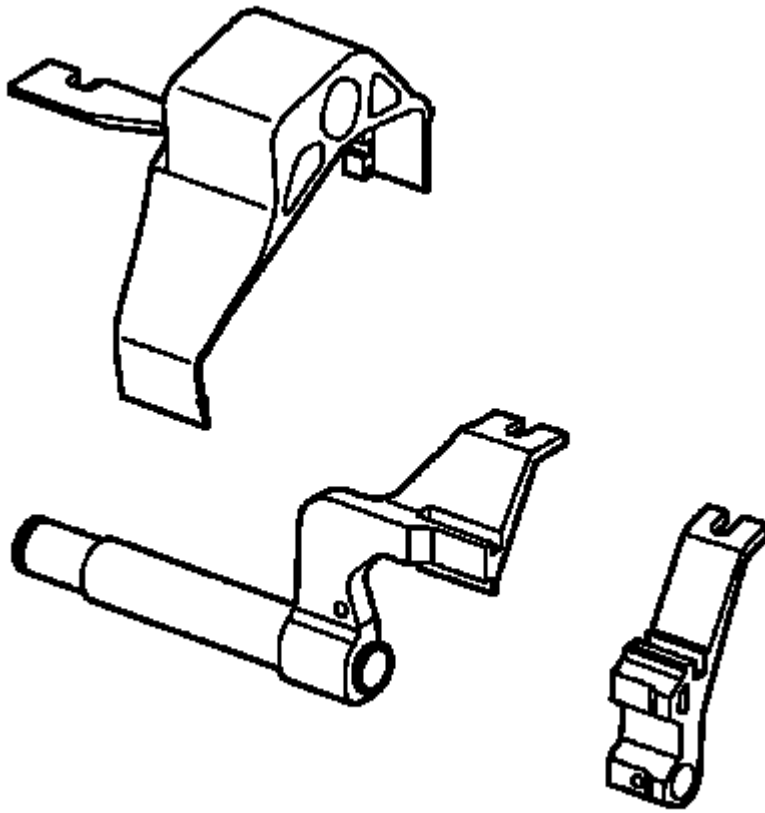


**Fig. 107: View Of Shift Forks And Shift Links**  
**Courtesy of GENERAL MOTORS COMPANY**

2. Inspect the shift forks and the shift links for excessive wear, fractures or distortion.

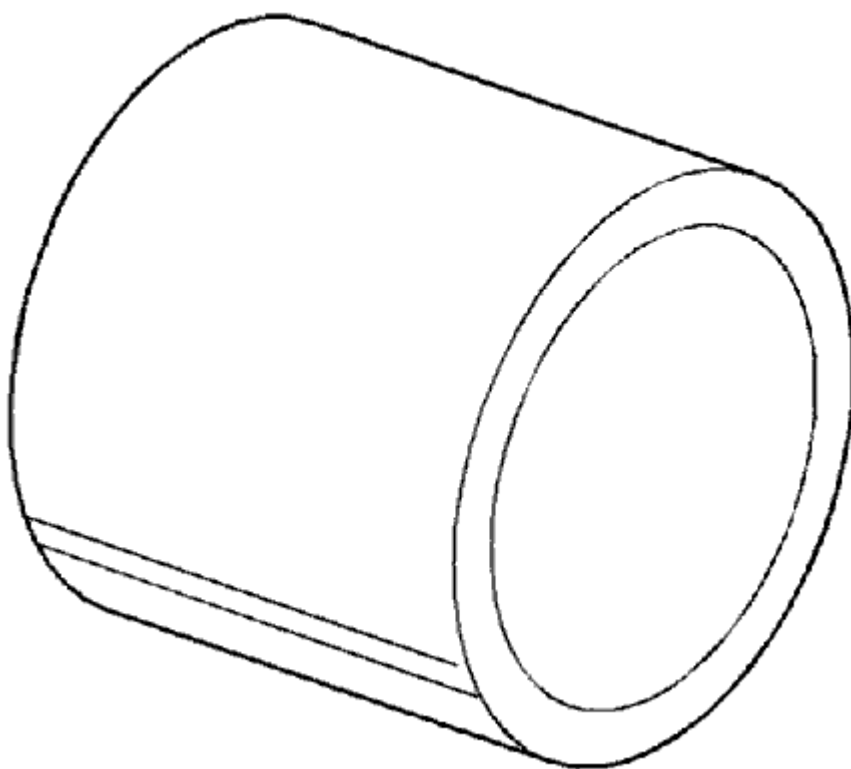


**Fig. 108: View Of Shift Shaft Lever Bushing**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Inspect the shift shaft lever bushings for excessive wear.

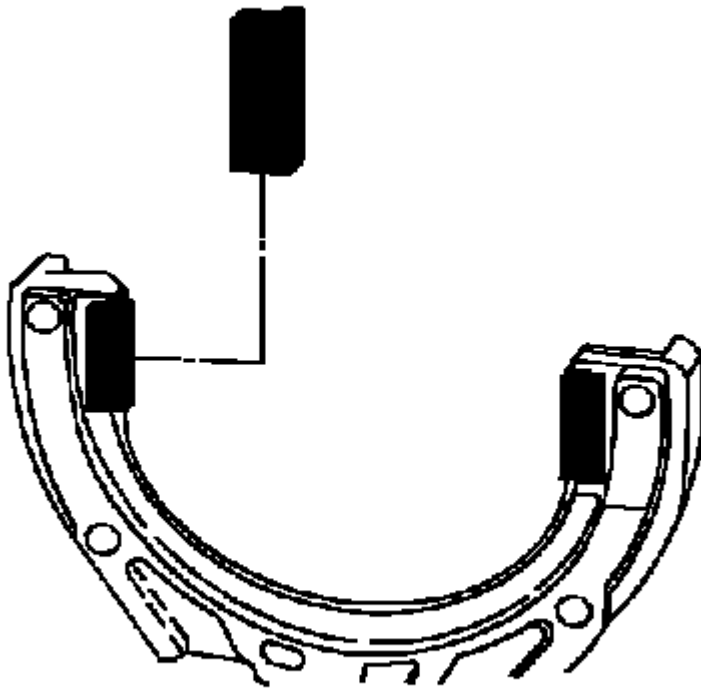


**Fig. 109: Identifying Inspection Areas On Shift Fork Nylon Inserts**  
**Courtesy of GENERAL MOTORS COMPANY**

4. Inspect the shift fork nylon inserts for wear.
5. Replace parts that are fractured, excessively worn or distorted.
6. Replace an excessively worn or burred shift shaft.

#### **SHIFT SHAFT AND FORK ASSEMBLIES ASSEMBLE**

**1st/2nd & 3rd/4th Shift Shaft Assembly Assemble**

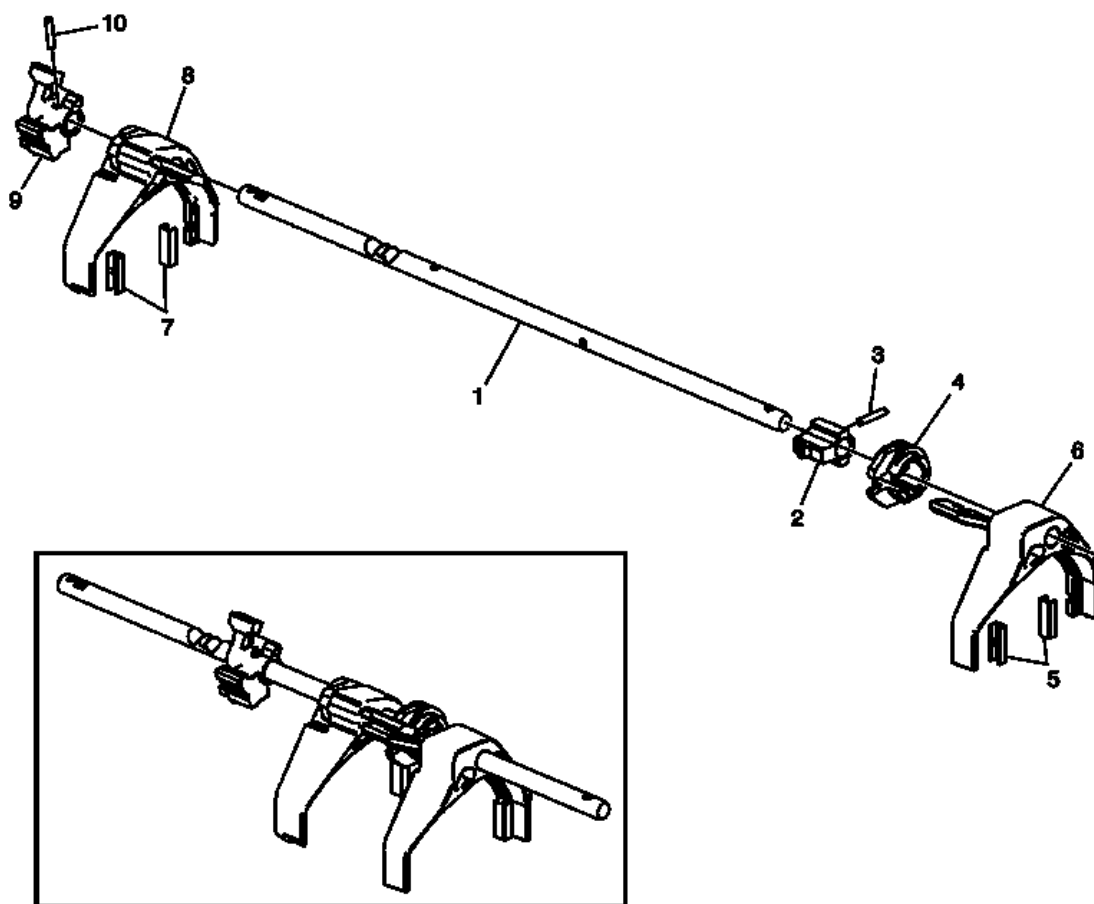


**Fig. 110: 1st/2nd & 3rd/4th Shift Shaft Assembly Assemble**  
 Courtesy of GENERAL MOTORS COMPANY

**1st/2nd & 3rd/4th Shift Shaft Assembly Assemble**

| Callout | Component Name                                                                                                                                                                                                    |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 1st/2nd & 3rd/4th Shift Shaft                                                                                                                                                                                     |
| 2       | Shift Control Lever                                                                                                                                                                                               |
| 3       | Roll Pin                                                                                                                                                                                                          |
| 4       | Manual Transmission Shift Lever Interlock Bracket<br><br><b>NOTE:</b><br>The interlock bracket fits loosely on the shift shaft and control lever. Use Transjel lubricant or similar to hold the bracket in place. |
| 5       | 3rd & 4th Shift Fork Insert                                                                                                                                                                                       |
| 6       | 3rd & 4th Shift Fork                                                                                                                                                                                              |
| 7       | 1st & 2nd Shift Fork Insert                                                                                                                                                                                       |
|         | 1st & 2nd Shift Fork                                                                                                                                                                                              |

|    |                                                                                                    |
|----|----------------------------------------------------------------------------------------------------|
| 8  | <b>NOTE:</b><br>The 1st & 2nd shift fork lever should be on top of the 3rd & 4th shift fork lever. |
| 9  | Offset Shift Lever                                                                                 |
| 10 | Roll Pin                                                                                           |

5th/6th & 7th/Reverse Shift Shaft Assembly Assemble

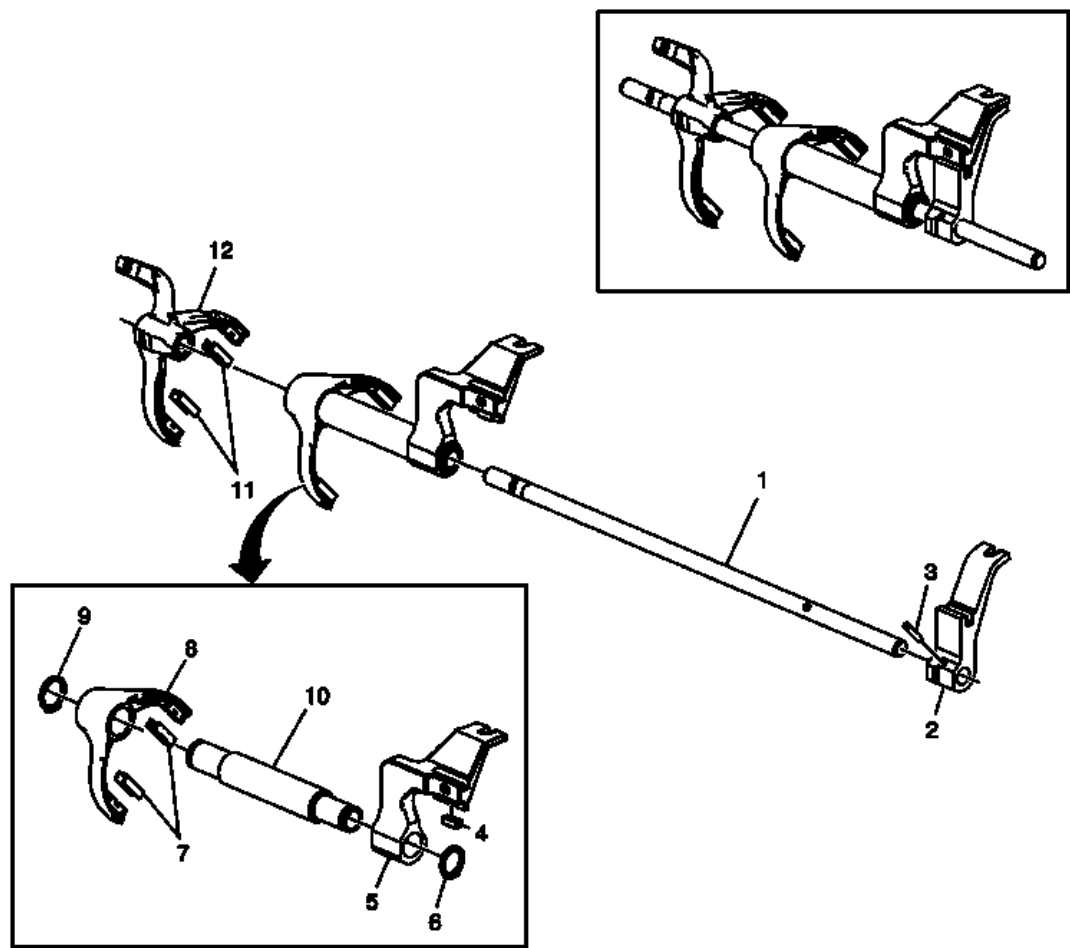


**Fig. 111: 5th/6th & 7th/Reverse Shift Shaft Assembly Assemble**  
 Courtesy of GENERAL MOTORS COMPANY

5th/6th & 7th/Reverse Shift Shaft Assembly Assemble

| Callout | Component Name                    |
|---------|-----------------------------------|
| 1       | 5th/6th & 7th/Reverse Shift Shaft |
| 2       | Reverse Shift Lever               |
| 3       | Roll Pin                          |
| 4       | 5th & 6th Shift Lever Insert      |
| 5       | 5th & 6th Shift Lever             |

|    |                                 |
|----|---------------------------------|
| 6  | 5th & 6th Shift Lever Retainer  |
| 7  | 5th & 6th Shift Fork Insert     |
| 8  | 5th & 6th Shift Fork            |
| 9  | 5th & 6th Shift Fork Retainer   |
| 10 | 5th & 6th Shift Shaft           |
| 11 | 7th & Reverse Shift Fork Insert |
| 12 | 7th & Reverse Shift Fork        |

## TRANSMISSION CASE AND ADAPTER DISASSEMBLE

### Shift Detent Guide Plate and Temperature Sensor Removal

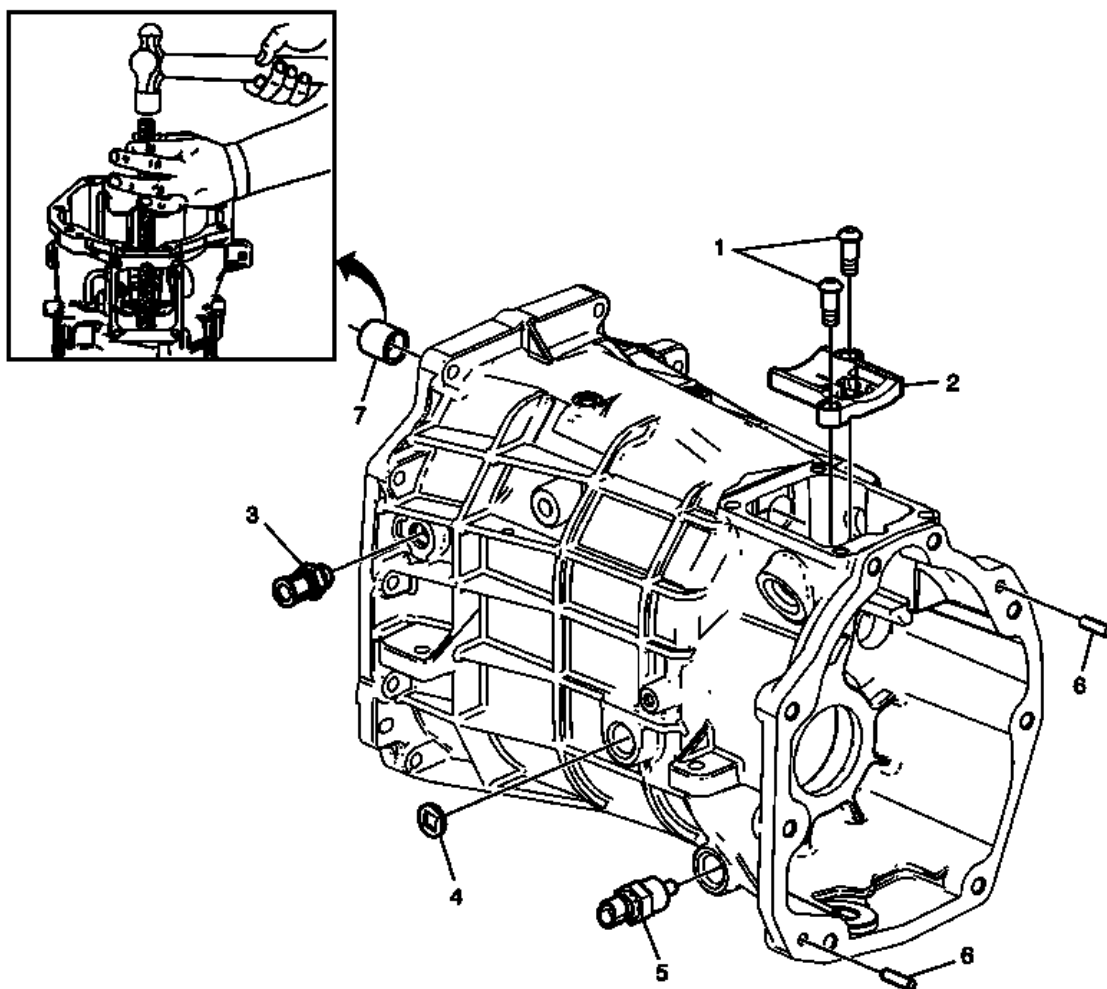


**Fig. 112: Shift Detent Guide Plate and Temperature Sensor Removal**  
Courtesy of GENERAL MOTORS COMPANY

### Shift Detent Guide Plate and Temperature Sensor Removal

| Callout | Component Name                |
|---------|-------------------------------|
| 1       | Shift Detent Guide Plate Bolt |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Shift Detent Guide Plate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3 | Transmission Fluid Cooler Pipe Quick Connect Fitting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4 | Transmission Oil Fill Plug                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 5 | Manual Transmission Fluid Temperature Sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 6 | Transmission Case Locating Pin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 7 | <p>Shift Shaft Bearing</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Insert the <b>DT-39439-3</b> shift rail remover and the <b>GE-36190</b> universal driver handle into the bearing journal.</li> <li>2. Use a hammer to tap downward and remove the shift shaft bearing.</li> </ol> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-39439</b> Shift Rail Remover</li> <li>• <b>GE-36190</b> Universal Driver Handle</li> </ul> <p>For equivalent regional tools, refer to <b>Special Tools</b>.</p> |

#### Backup Lamp Switch and Detent Spring Cover Bolt Removal

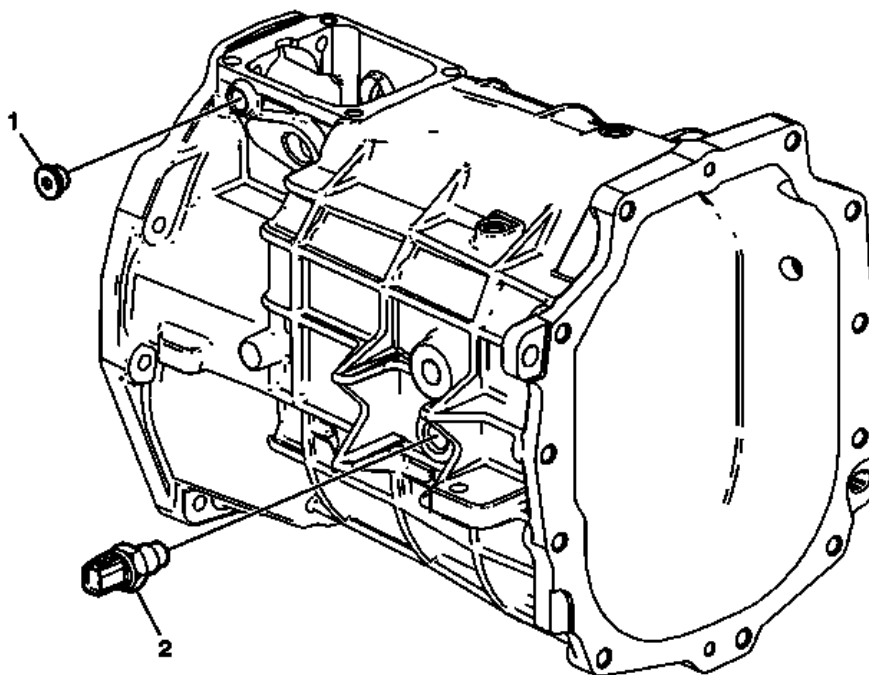


**Fig. 113: Backup Lamp Switch and Detent Spring Cover Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

### Backup Lamp Switch and Detent Spring Cover Bolt Removal

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | Shift Shaft Detent Spring Cover Bolt |
| 2       | Backup Lamp Switch                   |

### Fluid Pump Inlet Tube and Wiring Harness Bracket Removal

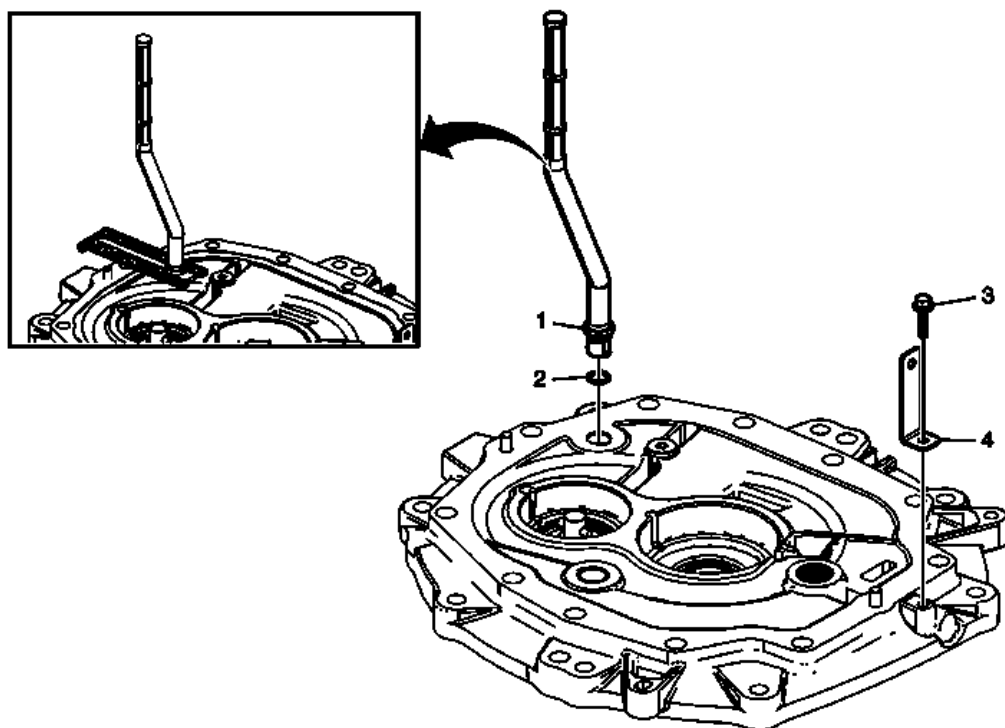


**Fig. 114: Fluid Pump Inlet Tube and Wiring Harness Bracket**  
Courtesy of GENERAL MOTORS COMPANY

### Fluid Pump Inlet Tube and Wiring Harness Bracket Removal

| Callout | Component Name                                                                                                                                                           |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Transmission Fluid Pump Inlet Tube<br><b>Special Tools</b><br>DT-36221 Hydraulic Clutch Line Separator<br>For equivalent regional tools, refer to <b>Special Tools</b> . |
| 2       | Transmission Fluid Pump Inlet Tube Seal                                                                                                                                  |
| 3       | Wiring Harness Bracket Bolt                                                                                                                                              |
| 4       | Wiring Harness Bracket                                                                                                                                                   |

### Fluid Pump Assembly Removal

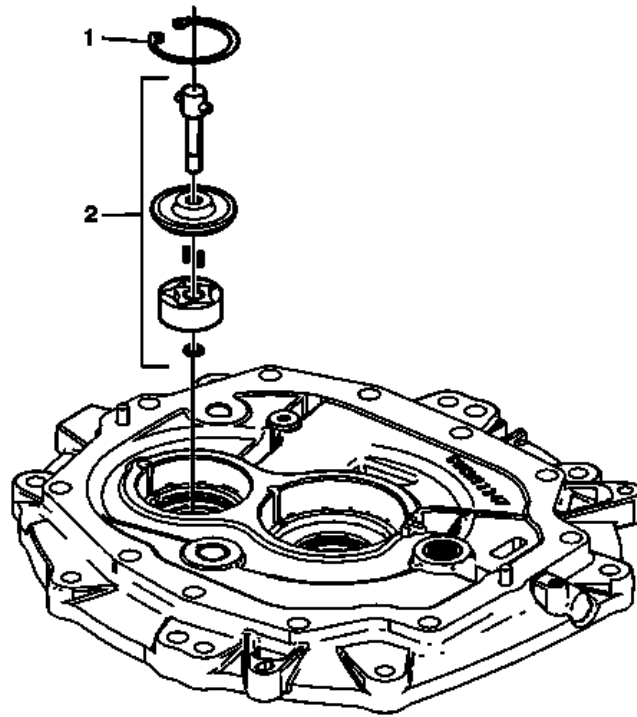


**Fig. 115: Fluid Pump Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

#### Fluid Pump Assembly Removal

| Callout | Component Name                         |
|---------|----------------------------------------|
| 1       | Transmission Fluid Pump Retaining Ring |
| 2       | Transmission Fluid Pump Assembly       |

#### Detent and Locating Pin Removal

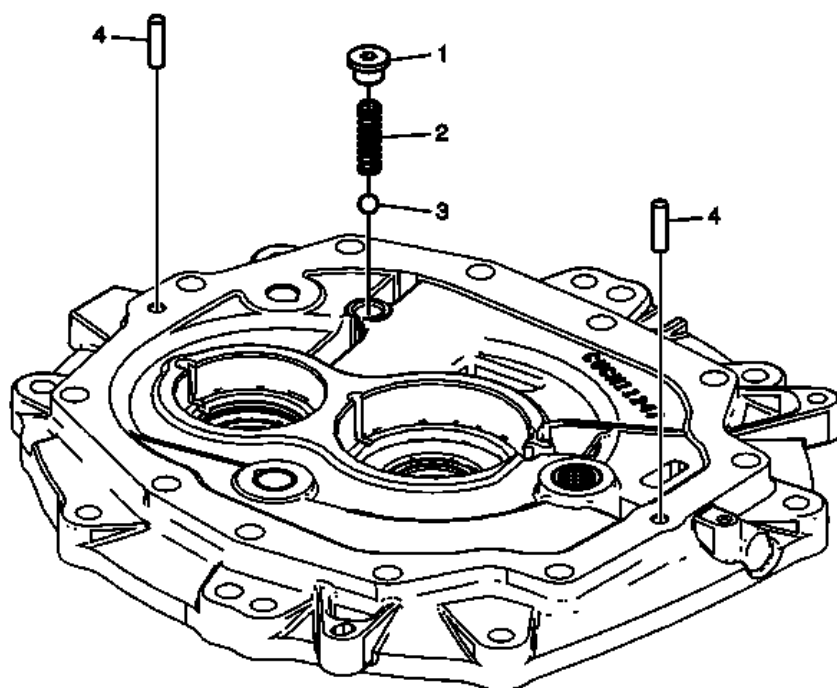


**Fig. 116: Detent and Locating Pin**  
 Courtesy of GENERAL MOTORS COMPANY

#### Detent and Locating Pin Removal

| Callout | Component Name                 |
|---------|--------------------------------|
| 1       | Shift Shaft Detent Plug        |
| 2       | Shift Detent Ball Spring       |
| 3       | Transmission Detent Ball       |
| 4       | Transmission Case Locating Pin |

#### Input Shaft Seal and Shift Shaft Seal Removal

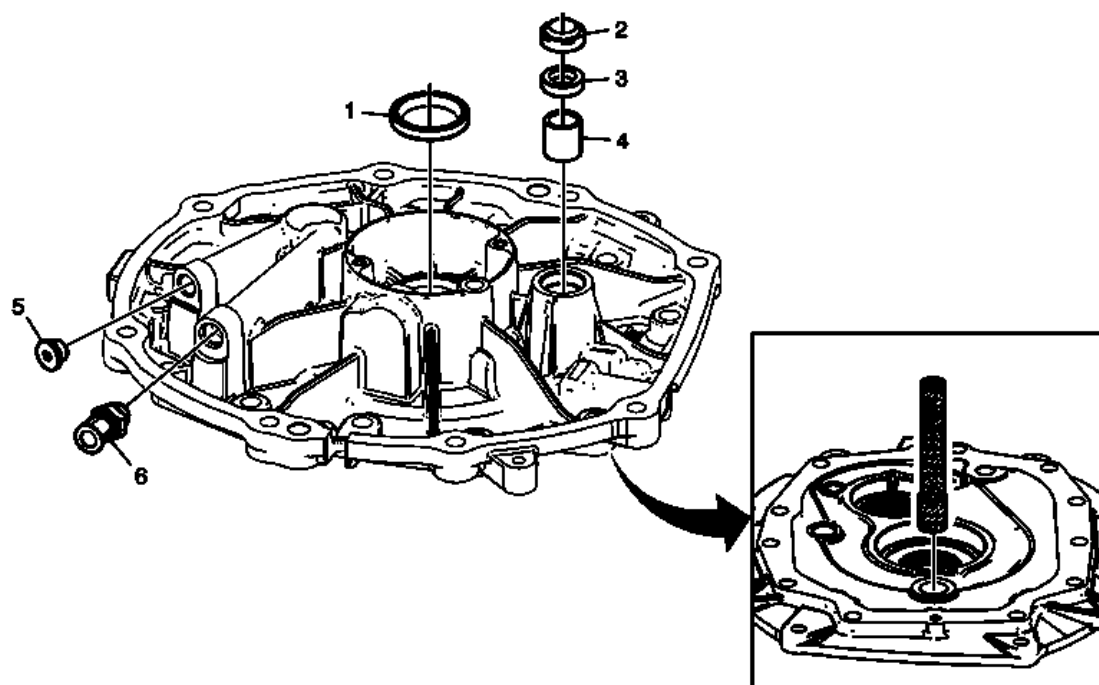


**Fig. 117: Input Shaft Seal and Shift Shaft Seal**  
 Courtesy of GENERAL MOTORS COMPANY

#### Input Shaft Seal and Shift Shaft Seal Removal

| Callout                                                                                                                                                                                                                                                                      | Component Name                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 1                                                                                                                                                                                                                                                                            | Input Shaft Seal                                     |
| 2                                                                                                                                                                                                                                                                            | Shift Shaft Inner Seal                               |
| 3                                                                                                                                                                                                                                                                            | Shift Control Shaft Cover Outer Seal                 |
| 4                                                                                                                                                                                                                                                                            | Shift Shaft Bearing                                  |
| <b>Procedure</b> <ol style="list-style-type: none"> <li>1. Insert the <b>DT-39439-3</b> shift rail remover and the <b>GE-36190</b> universal driver handle into the bearing journal.</li> <li>2. Use a hammer to tap downward and remove the shift shaft bearing.</li> </ol> |                                                      |
| <b>Special Tools</b> <ul style="list-style-type: none"> <li>• <b>DT-39439</b> Shift Rail Remover</li> <li>• <b>GE-36190</b> Universal Driver Handle</li> </ul>                                                                                                               |                                                      |
| For equivalent regional tools, refer to <b>Special Tools</b> .                                                                                                                                                                                                               |                                                      |
| 5                                                                                                                                                                                                                                                                            | Shift Control Shaft Detent Plug                      |
| 6                                                                                                                                                                                                                                                                            | Transmission Fluid Cooler Pipe Quick Connect Fitting |

## Input Shaft and Counter Gear Bearing Race Removal

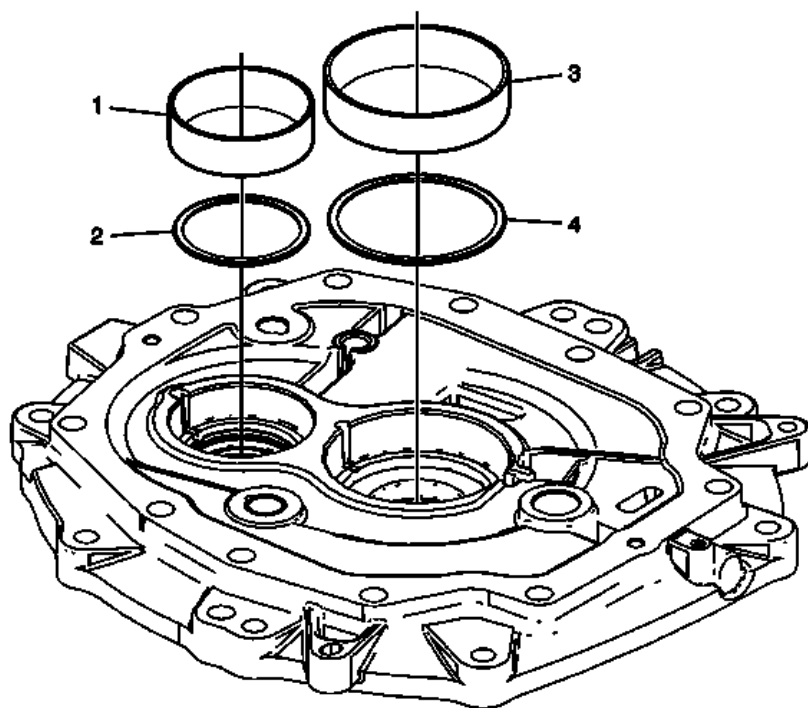


**Fig. 118: Input Shaft and Counter Gear Bearing Race**  
Courtesy of GENERAL MOTORS COMPANY

### Input Shaft and Counter Gear Bearing Race Removal

| Callout | Component Name                  |
|---------|---------------------------------|
| 1       | Counter Gear Front Bearing Race |
| 2       | Counter Gear Front Bearing Shim |
| 3       | Input Shaft Bearing Race        |
| 4       | Input Shaft Bearing Shim        |

## TRANSMISSION CASE AND ADAPTER CLEANING AND INSPECTION

### Transmission Case

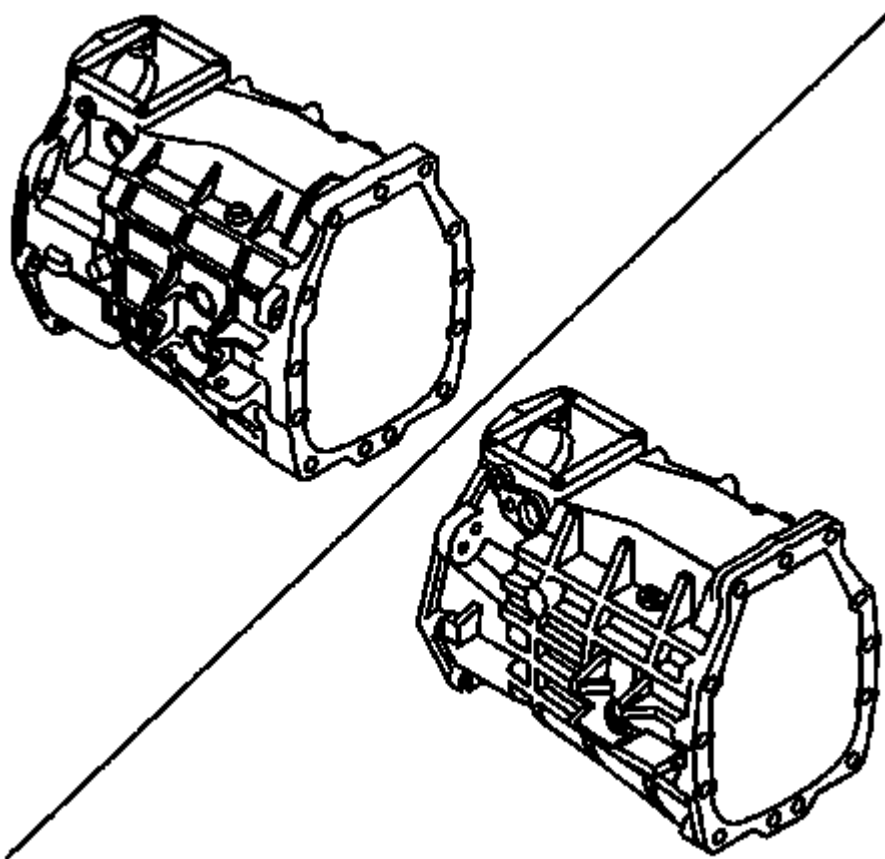


**Fig. 119: View Of Transmission Case**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Clean the transmission case in a suitable solvent. Air dry the transmission case.
2. Clean all sealant material from retainer bolt threads.
3. Inspect the transmission case for the following conditions:
  - Cracks
  - Scratches
  - Damaged threads
  - Burrs
  - Nicked mounting surfaces
  - Damaged sealing surfaces
  - Damaged front or rear bearing bores
4. Inspect the machined mating surfaces for flatness with a straight edge.
5. Inspect the bearing races and bores for wear, scratches or grooves.
6. Inspect the bushing for excessive wear.
7. Use a fine mill file to dress minor scratches or burrs.
8. If scratches or grooves or scoring cannot be removed by hand with a soft stone or crocus cloth,

replace the component.

9. Clean up damaged threads with the correct size tap.
10. Replace a cracked housing.
11. Replace worn bushings.

#### Adapter Plate

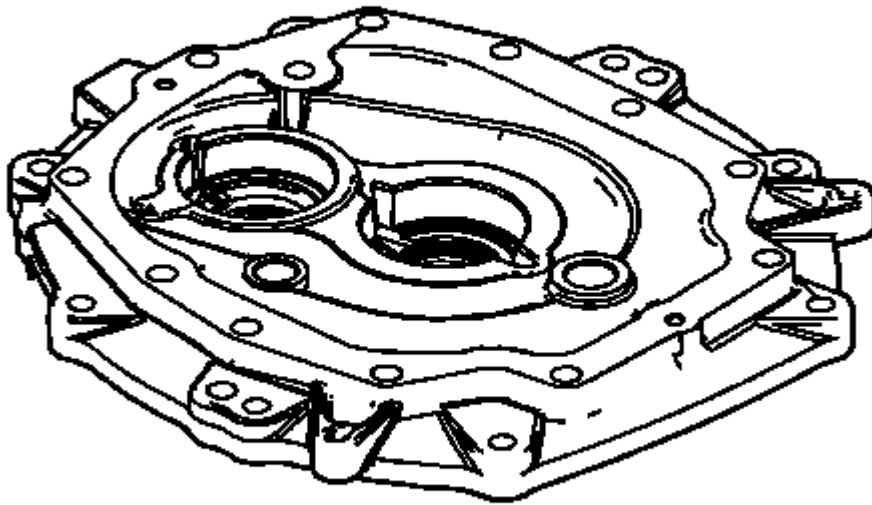


**Fig. 120: View of Adapter Plate Parts**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Clean the adapter plate parts with a suitable solvent. Air dry all the parts.
2. Inspect the adapter plate parts for the following conditions:

- Cracks

Replace the adapter plate parts if cracks are found.

- Scratches
- Burrs
- Nicked mounting surfaces

- Damaged front or rear bearing bores
3. Inspect the machined mating surfaces for flatness. Check the mating surfaces with a straight edge.
  4. Inspect the bearing races and bores for wear, scratches or grooves.
  5. Inspect the bushing for excessive wear. Replace worn bushings.
  6. Use a fine mill file to dress minor scratches or burrs.
  7. If scratches or grooves or scoring cannot be removed by hand with a soft stone or crocus cloth, replace the component.

## TRANSMISSION CASE AND ADAPTER ASSEMBLE

### Input Shaft and Counter Gear Bearing Race Installation

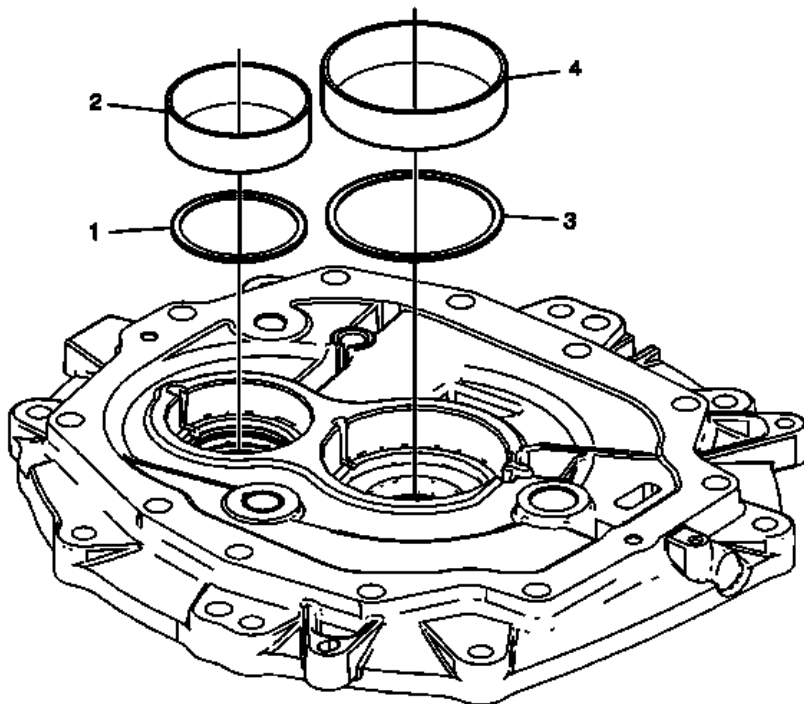


**Fig. 121: Input Shaft and Counter Gear Bearing Race**  
 Courtesy of GENERAL MOTORS COMPANY

### Input Shaft and Counter Gear Bearing Race Installation

| Callout | Component Name                  |
|---------|---------------------------------|
| 1       | Counter Gear Front Bearing Shim |
| 2       | Counter Gear Front Bearing Race |
| 3       | Input Shaft Bearing Shim        |
| 4       | Input Shaft Bearing Race        |

### Input Shaft Seal and Shift Shaft Seal Installation

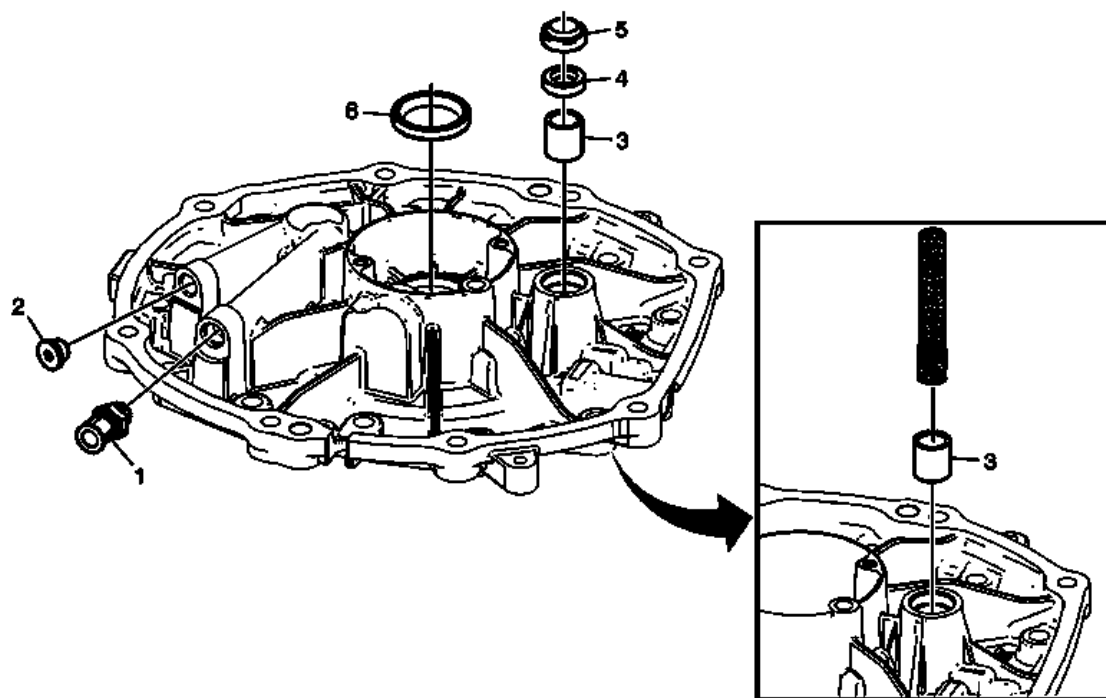


**Fig. 122: Input Shaft Seal and Shift Shaft Seal**  
 Courtesy of GENERAL MOTORS COMPANY

#### Input Shaft Seal and Shift Shaft Seal Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Transmission Fluid Cooler Pipe Quick Connect Fitting<br><b>Tighten</b><br>22 N.m (16 lb ft)                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2       | Shift Control Shaft Detent Plug<br><b>Tighten</b><br>27 N.m (20 lb ft)                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3       | <p>Shift Shaft Bearing</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Insert the shift shaft bearing into the journal.</li> <li>2. Insert the <b>DT-39439-3</b> shift rail remover and the <b>GE-36190</b> universal driver handle into the bearing journal.</li> <li>3. Use a hammer to tap downward and install the shift shaft bearing.</li> </ol> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-39439</b> Shift Rail Remover</li> </ul> |

|   |                                                                |
|---|----------------------------------------------------------------|
|   | For equivalent regional tools, refer to <b>Special Tools</b> . |
| 4 | Shift Control Shaft Cover Outer Seal                           |
| 5 | Shift Shaft Inner Seal                                         |
| 6 | Input Shaft Seal                                               |

Detent and Locating Pin Installation

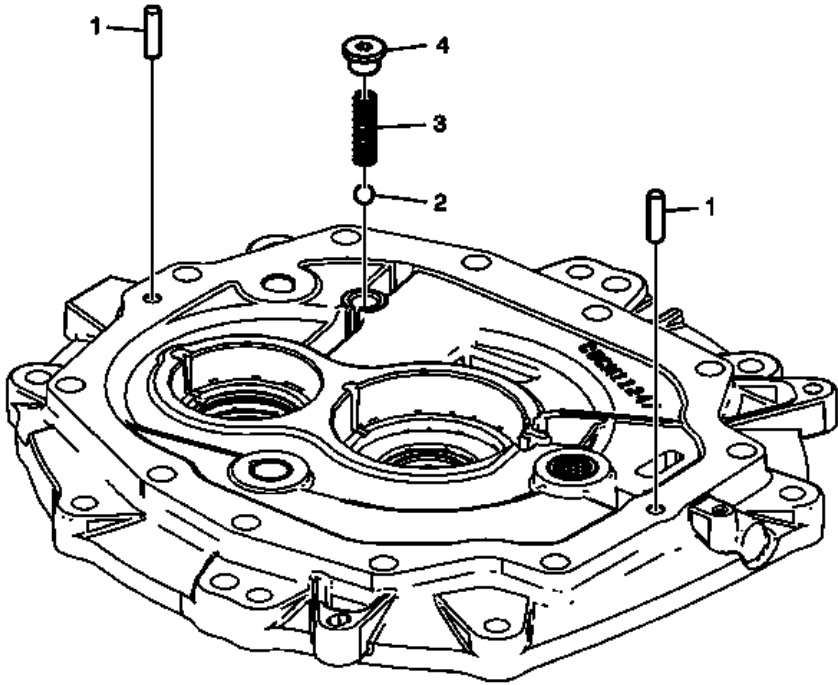


Fig. 123: Detent and Locating Pin  
Courtesy of GENERAL MOTORS COMPANY

Detent and Locating Pin Installation

| Callout | Component Name                                                 |
|---------|----------------------------------------------------------------|
| 1       | Transmission Case Locating Pin                                 |
| 2       | Transmission Detent Ball                                       |
| 3       | Shift Detent Ball Spring                                       |
| 4       | Shift Shaft Detent Plug<br><b>Tighten</b><br>27 N.m (20 lb ft) |

Fluid Pump Assembly Installation

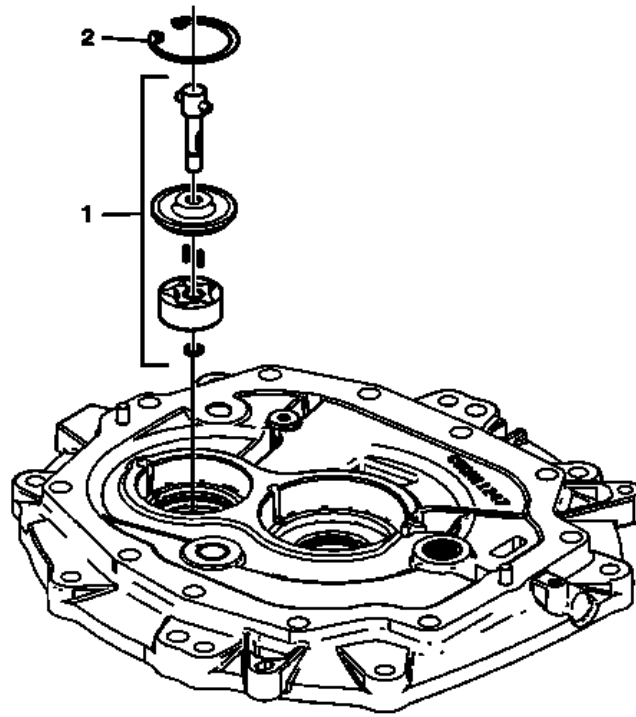


**Fig. 124: Fluid Pump Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

#### Fluid Pump Assembly Installation

| Callout | Component Name                         |
|---------|----------------------------------------|
| 1       | Transmission Fluid Pump Assembly       |
| 2       | Transmission Fluid Pump Retaining Ring |

#### Fluid Pump Inlet Tube and Wiring Harness Bracket Installation

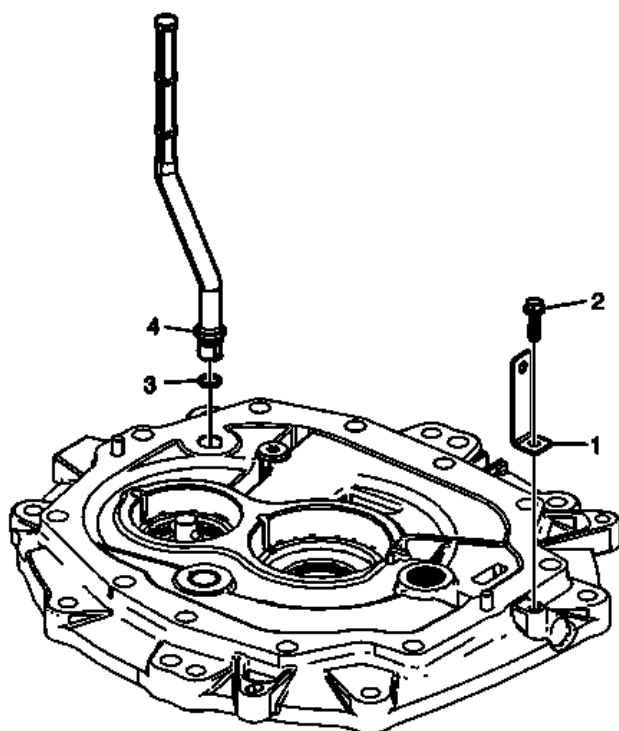


**Fig. 125: Fluid Pump Inlet Tube and Wiring Harness Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

#### Fluid Pump Inlet Tube and Wiring Harness Bracket Installation

| Callout | Component Name                                                                                                                     |
|---------|------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Wiring Harness Bracket                                                                                                             |
| 2       | Wiring Harness Bracket Bolt<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>8 N.m (71 lb in) |
| 3       | Transmission Fluid Pump Inlet Tube Seal                                                                                            |
| 4       | Transmission Fluid Pump Inlet Tube                                                                                                 |

#### Backup Lamp Switch and Detent Spring Cover Bolt Installation

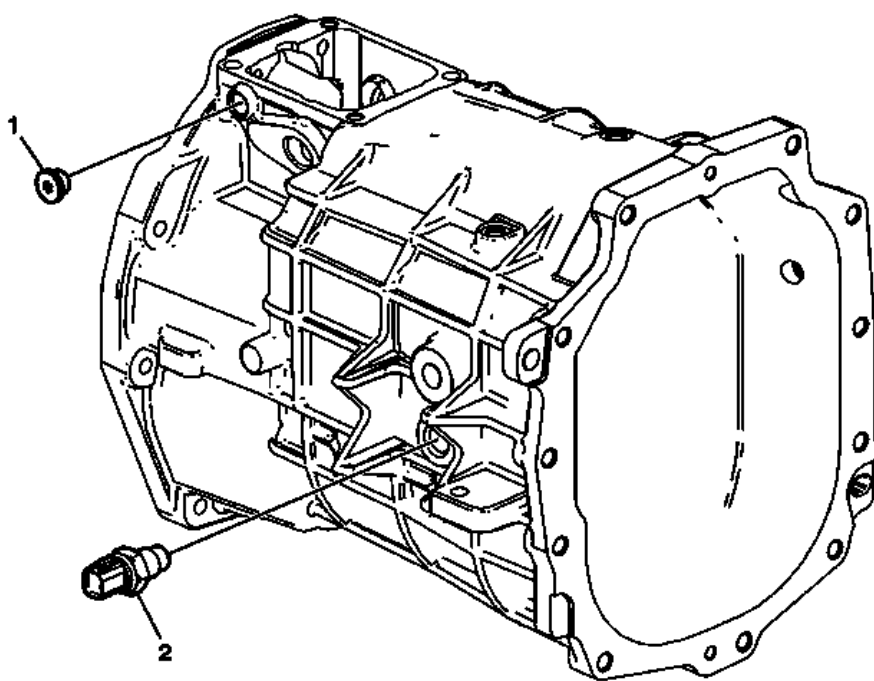


**Fig. 126: Backup Lamp Switch and Detent Spring Cover Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

**Backup Lamp Switch and Detent Spring Cover Bolt Installation**

| Callout | Component Name                                                              |
|---------|-----------------------------------------------------------------------------|
| 1       | Shift Shaft Detent Spring Cover Bolt<br><b>Tighten</b><br>27 N.m (20 lb ft) |
| 2       | Backup Lamp Switch<br><b>Tighten</b><br>27 N.m (20 lb ft)                   |

**Shift Detent Guide Plate and Temperature Sensor Installation**

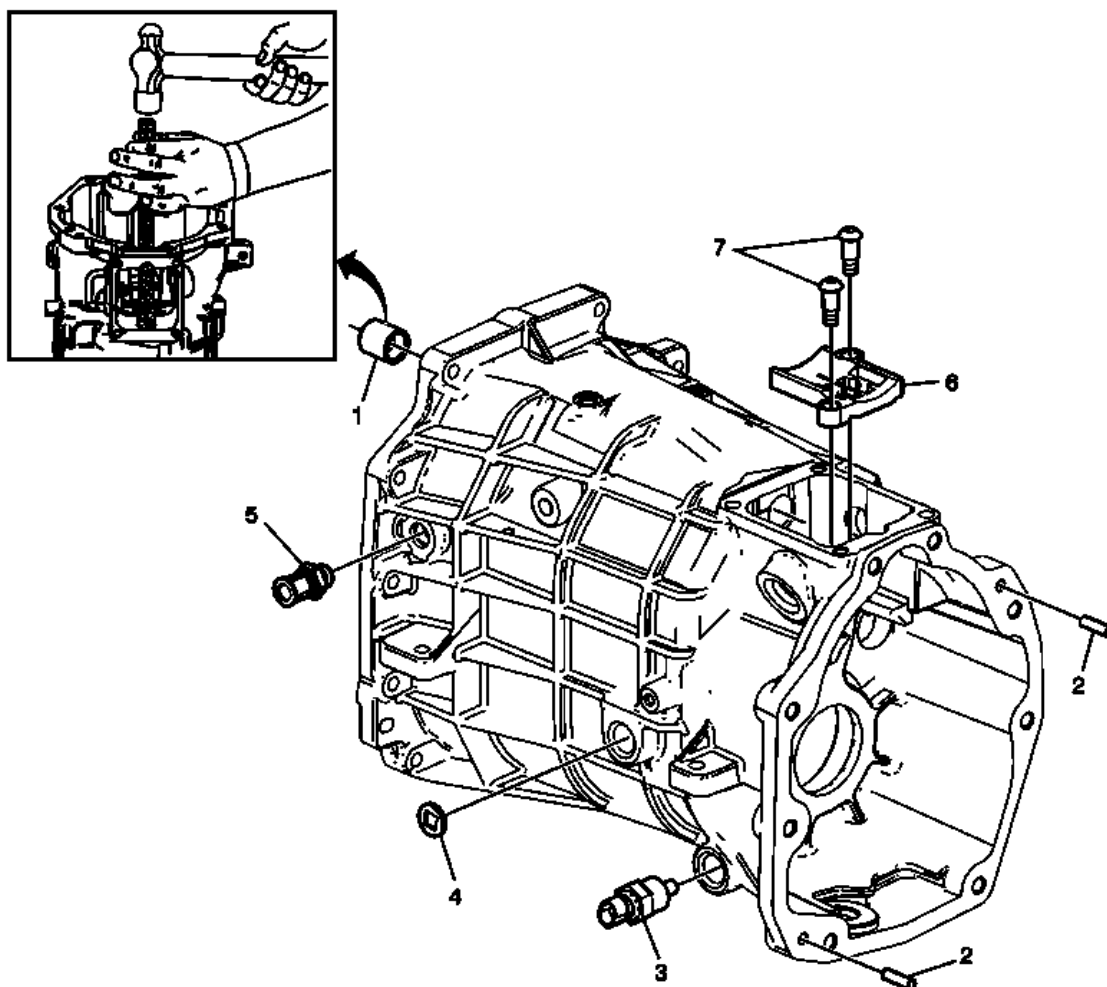


**Fig. 127: Shift Detent Guide Plate and Temperature Sensor**  
 Courtesy of GENERAL MOTORS COMPANY

#### Shift Detent Guide Plate and Temperature Sensor Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>Shift Shaft Bearing</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Insert the shift shaft bearing into the journal.</li> <li>2. Insert the <b>DT-44384</b> installer and the <b>GE-36190</b> driver handle into the bearing journal.</li> <li>3. Use a hammer to tap downward and install the shift shaft bearing.</li> </ol> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-44384</b> Shifter Fork Bearing Installer</li> </ul> |

|   |                                                                                             |
|---|---------------------------------------------------------------------------------------------|
|   | For equivalent regional tools, refer to <b>Special Tools</b> .                              |
| 2 | Transmission Case Locating Pin                                                              |
| 3 | Manual Transmission Fluid Temperature Sensor<br><b>Tighten</b><br>41 N.m (30 lb ft)         |
| 4 | Transmission Oil Fill Plug<br><b>Tighten</b><br>27 N.m (20 lb ft)                           |
| 5 | Transmission Fluid Cooler Pipe Quick Connect Fitting<br><b>Tighten</b><br>22 N.m (16 lb ft) |
| 6 | Shift Detent Guide Plate                                                                    |
| 7 | Shift Detent Guide Plate Bolt (Qty: 2)<br><b>Tighten</b><br>22 N.m (16 lb ft)               |

## EXTENSION DISASSEMBLE

### Main Shaft Rear Seal and Output Speed Sensor Removal

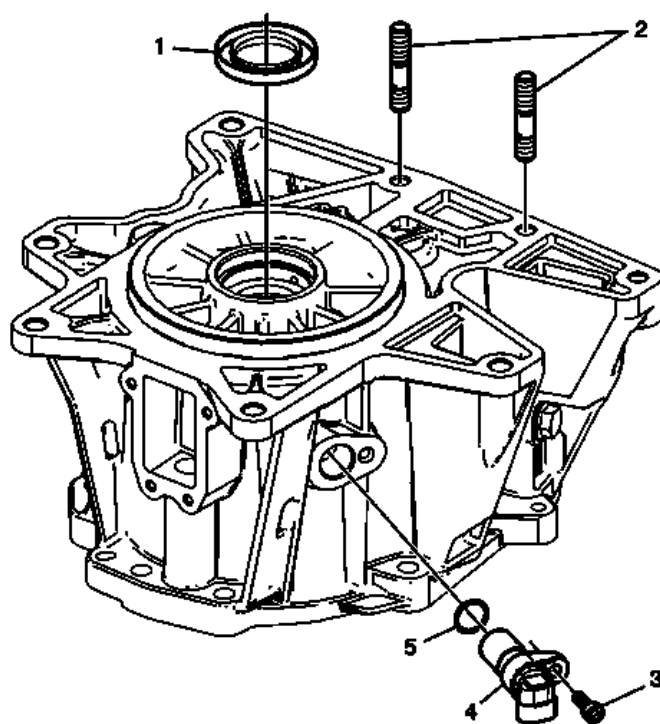


**Fig. 128: Main Shaft Rear Seal and Output Speed Sensor**  
Courtesy of GENERAL MOTORS COMPANY

### Main Shaft Rear Seal and Output Speed Sensor Removal

| Callout | Component Name                          |
|---------|-----------------------------------------|
| 1       | Main Shaft Rear Outer Seal              |
| 2       | Transmission Extension Stud             |
| 3       | Transmission Speed Sensor Bolt          |
| 4       | Manual Transmission Output Speed Sensor |
| 5       | Vehicle Speed Sensor O-ring Seal        |

#### Oil Drain Plug Removal

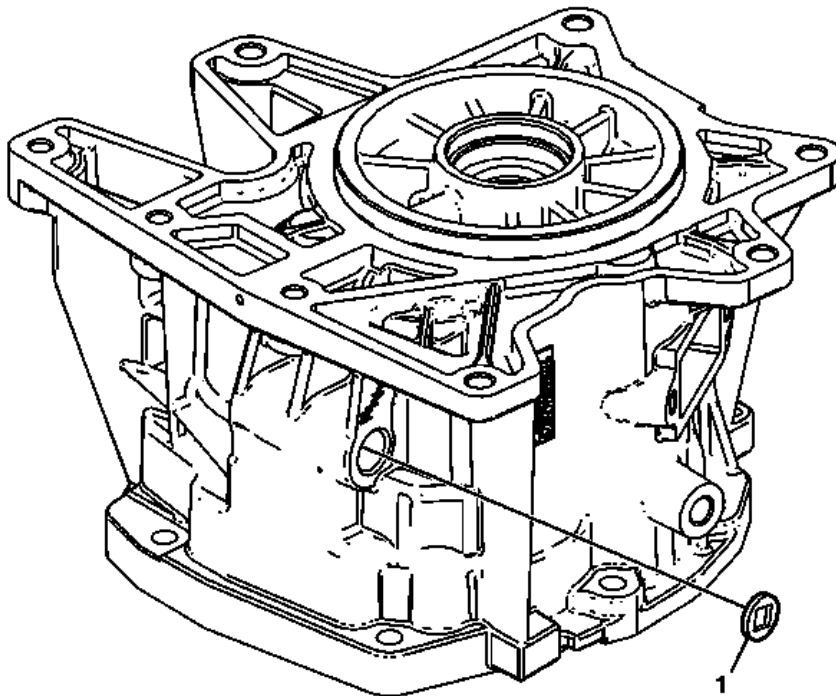


**Fig. 129: Oil Drain Plug**  
 Courtesy of GENERAL MOTORS COMPANY

#### Oil Drain Plug Removal

| Callout | Component Name              |
|---------|-----------------------------|
| 1       | Transmission Oil Drain Plug |

#### Counter Gear Rear Bearing and Main Shaft Rear Bearing Removal

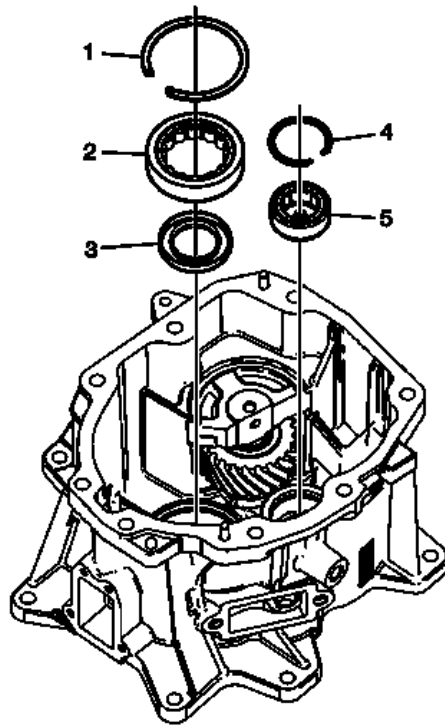


**Fig. 130: Counter Gear Rear Bearing and Main Shaft Rear Bearing**  
 Courtesy of GENERAL MOTORS COMPANY

#### Counter Gear Rear Bearing and Main Shaft Rear Bearing Removal

| Callout | Component Name                     |
|---------|------------------------------------|
| 1       | Main Shaft Rear Bearing Retainer   |
| 2       | Main Shaft Rear Bearing            |
| 3       | Main Shaft Rear Inner Seal         |
| 4       | Counter Gear Rear Bearing Retainer |
| 5       | Counter Gear Rear Bearing          |

#### EXTENSION CLEANING AND INSPECTION

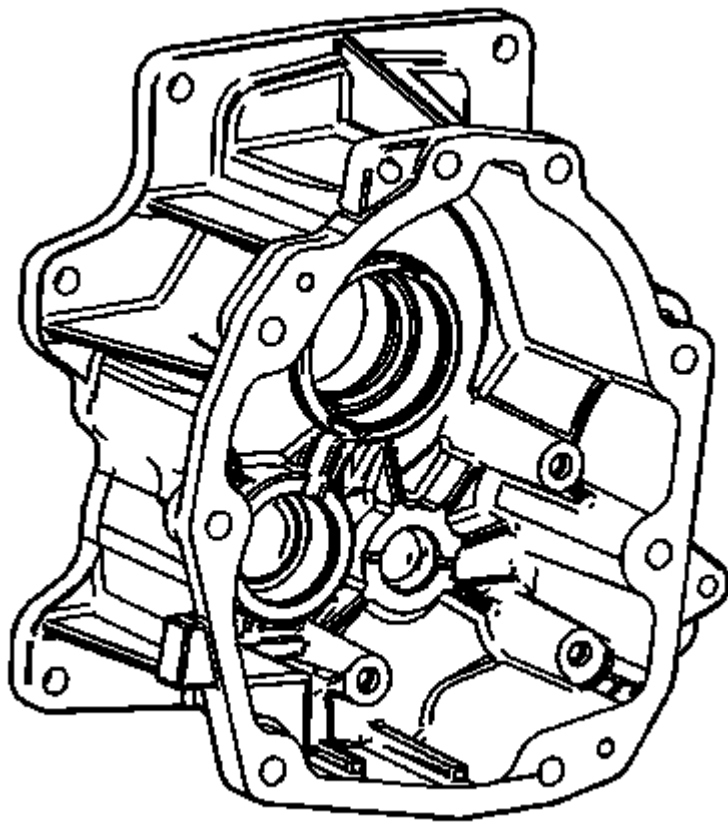


**Fig. 131: View Of Rear Extension Housing**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Clean the rear extension housing in a suitable solvent. Air dry the housing.
2. Inspect the extension housing for the following:
  - Cracks
  - Scratches
  - Damaged threads
  - Burrs
  - Nicked mounting surfaces
  - Damaged sealing surfaces
  - Damaged front or rear bearing bores
3. Replace a cracked housing.
4. Clean up damaged threads with the correct size thread tap.
5. Inspect the machined mating surfaces for flatness (Check the mating surfaces with a straight edge).
6. Use a fine mill file to dress minor scratches or burrs.

### Counter Gear Rear Bearing and Main Shaft Rear Bearing Installation

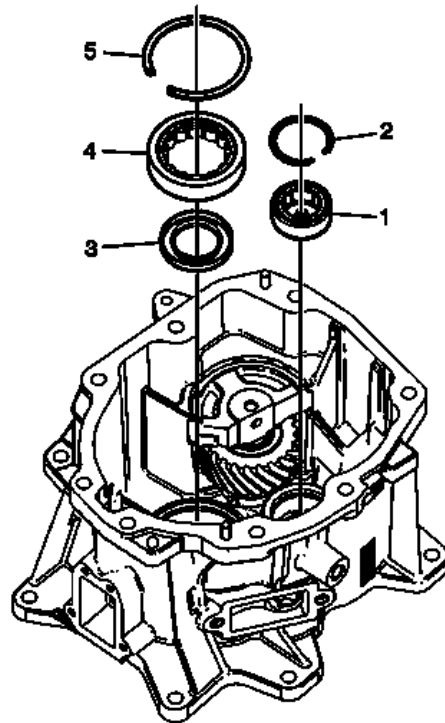


**Fig. 132: Counter Gear Rear Bearing and Main Shaft Rear Bearing**  
Courtesy of GENERAL MOTORS COMPANY

### Counter Gear Rear Bearing and Main Shaft Rear Bearing Installation

| Callout | Component Name                     |
|---------|------------------------------------|
| 1       | Counter Gear Rear Bearing          |
| 2       | Counter Gear Rear Bearing Retainer |
| 3       | Main Shaft Rear Inner Seal         |
| 4       | Main Shaft Rear Bearing            |
| 5       | Main Shaft Rear Bearing Retainer   |

### Oil Drain Plug Installation

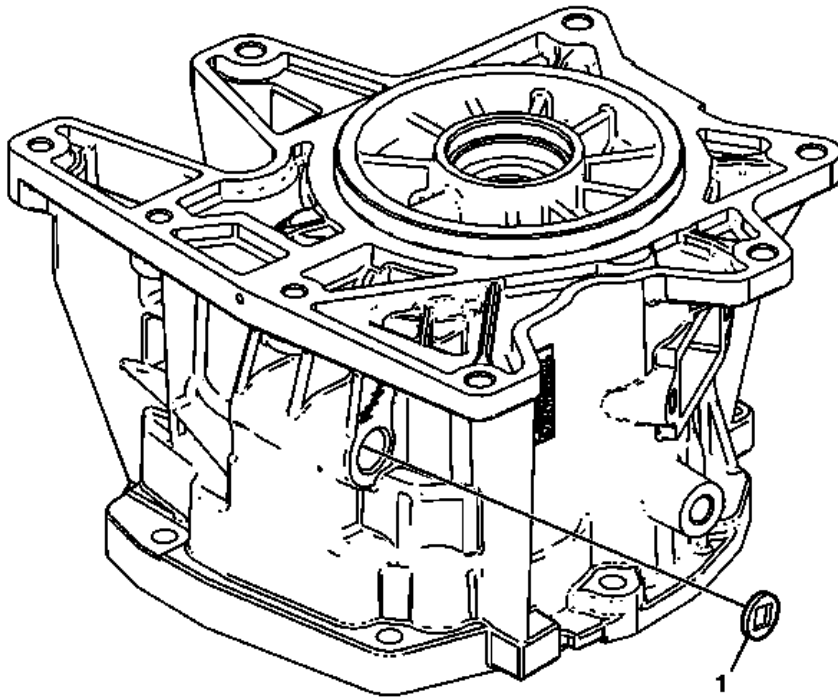


**Fig. 133: Oil Drain Plug**  
Courtesy of GENERAL MOTORS COMPANY

#### Oil Drain Plug Installation

| Callout | Component Name                                                     |
|---------|--------------------------------------------------------------------|
| 1       | Transmission Oil Drain Plug<br><b>Tighten</b><br>27 N.m (20 lb ft) |

#### Main Shaft Rear Seal and Output Speed Sensor Installation

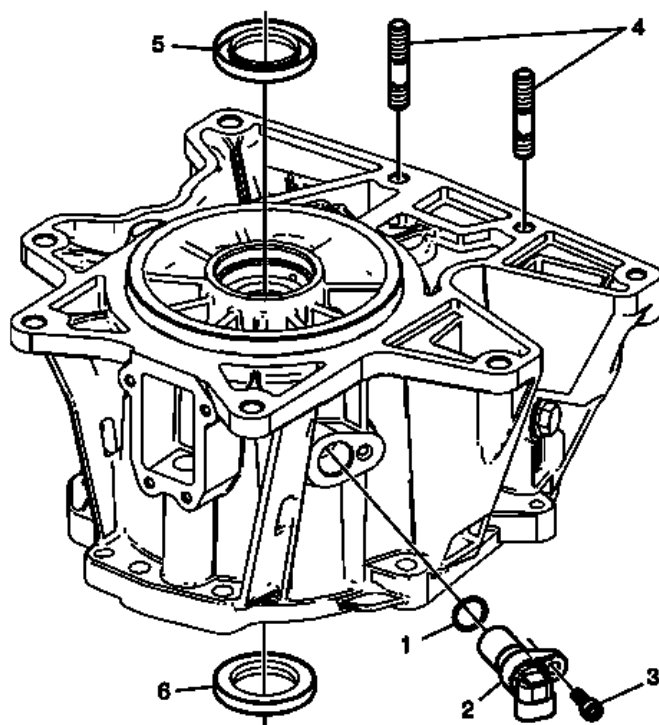


**Fig. 134: Main Shaft Rear Seal and Output Speed Sensor**  
 Courtesy of GENERAL MOTORS COMPANY

#### Main Shaft Rear Seal and Output Speed Sensor Installation

| Callout | Component Name                                                                                                                                                            |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Vehicle Speed Sensor O-ring Seal                                                                                                                                          |
| 2       | Manual Transmission Output Speed Sensor                                                                                                                                   |
| 3       | Transmission Speed Sensor Bolt<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten</b><br>9 N.m (80 lb in)                              |
| 4       | Transmission Extension Stud<br><b>Tighten</b><br>34 N.m (25 lb ft)                                                                                                        |
| 5       | Main Shaft Rear Outer Seal<br><b>Special Tools</b><br><b>DT-44731</b> Input Shaft Seal Installer<br>For equivalent regional tools, refer to <b><u>Special Tools</u></b> . |
| 6       | Main Shaft Rear Inner Seal<br><b>Special Tools</b>                                                                                                                        |

For equivalent regional tools, refer to **Special Tools**.

## BEARINGS AND SPACERS CLEANING AND INSPECTION

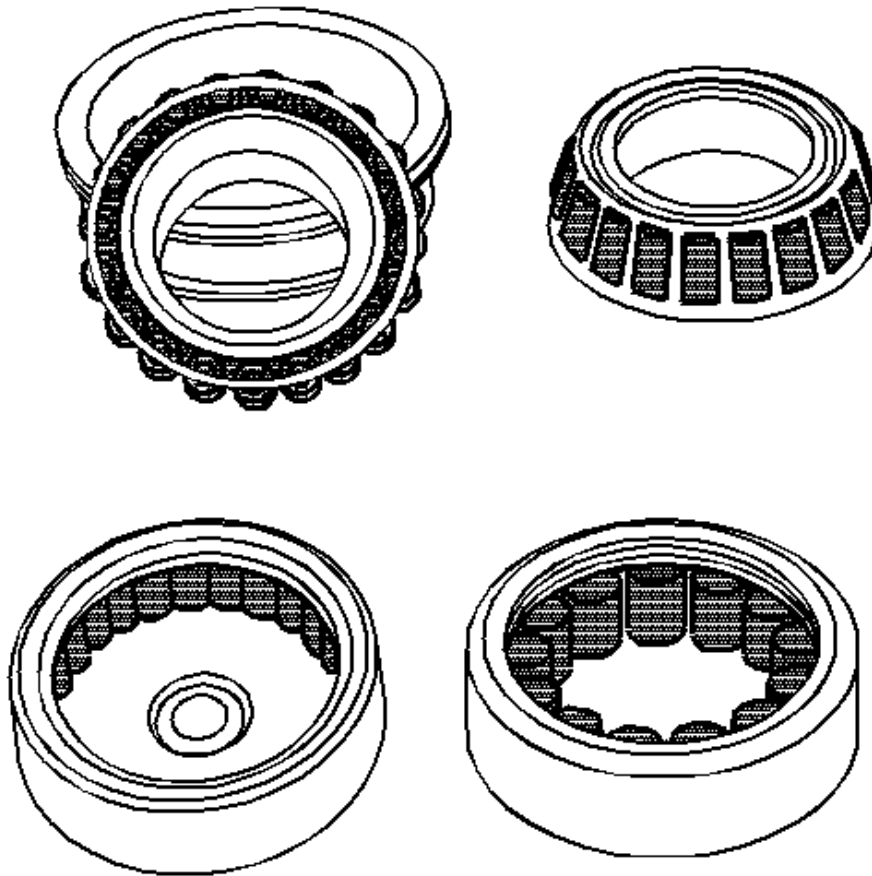


**Fig. 135: View of Bearings & Spacers**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Do not allow the bearings to spin. Turn them slowly by hand.  
Spinning the bearings may damage the race and the rollers.

1. Clean all the bearing parts in a suitable solvent. Air dry all the parts.
2. Lubricate the bearings. Refer to **Lubrication Specifications** for the proper transmission lubricant.
3. Inspect the bearings and journals for roughness and unusual wear or damage.

4. Inspect the mainshaft bearing journals for wear.
5. Inspect the mainshaft speed gear bearings for wear.
6. Inspect the main drive gear pilot bearing rollers for wear.
7. Replace parts which show signs of excessive wear.
8. Do not file surfaces which have been hardened and precision ground.
9. Replace worn or damaged bearings.
10. Replace mated bearing parts when only one part is damaged.

#### **GEARS CLEANING AND INSPECTION**

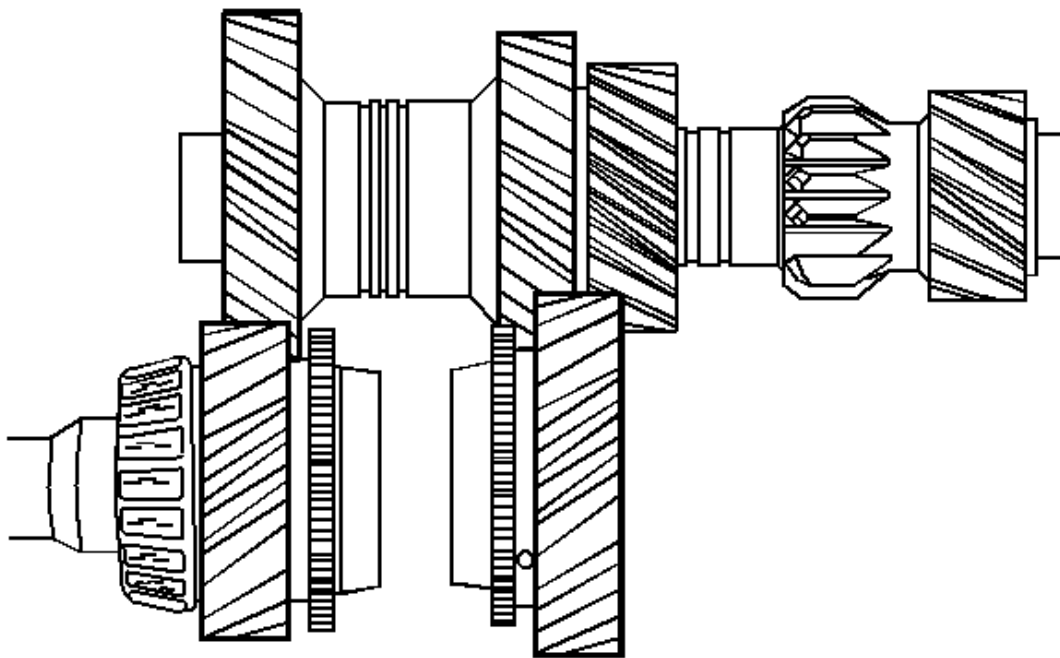


**Fig. 136: View Of Gears**

**Courtesy of GENERAL MOTORS COMPANY**

1. Clean all the parts in a suitable solvent. Air dry all the parts.

2. Inspect the gear tooth surfaces on all the gear sets for the following conditions:
  - Cracks
  - Pitting
  - Nicks
  - Chipped gear teeth
  - High spots (Small-shiny spots on the gear teeth mating surface) that could cause gear noise
3. Inspect for damaged splines on the input shaft, mainshaft and the countershaft extension.
4. Remove nicks and burrs with a soft stone or a crocus cloth.
5. Replace a burred or nicked part that cannot be reconditioned by hand.
6. Replace gears and gear assemblies that are worn or damaged.

### COUNTER GEAR SHAFT ASSEMBLE

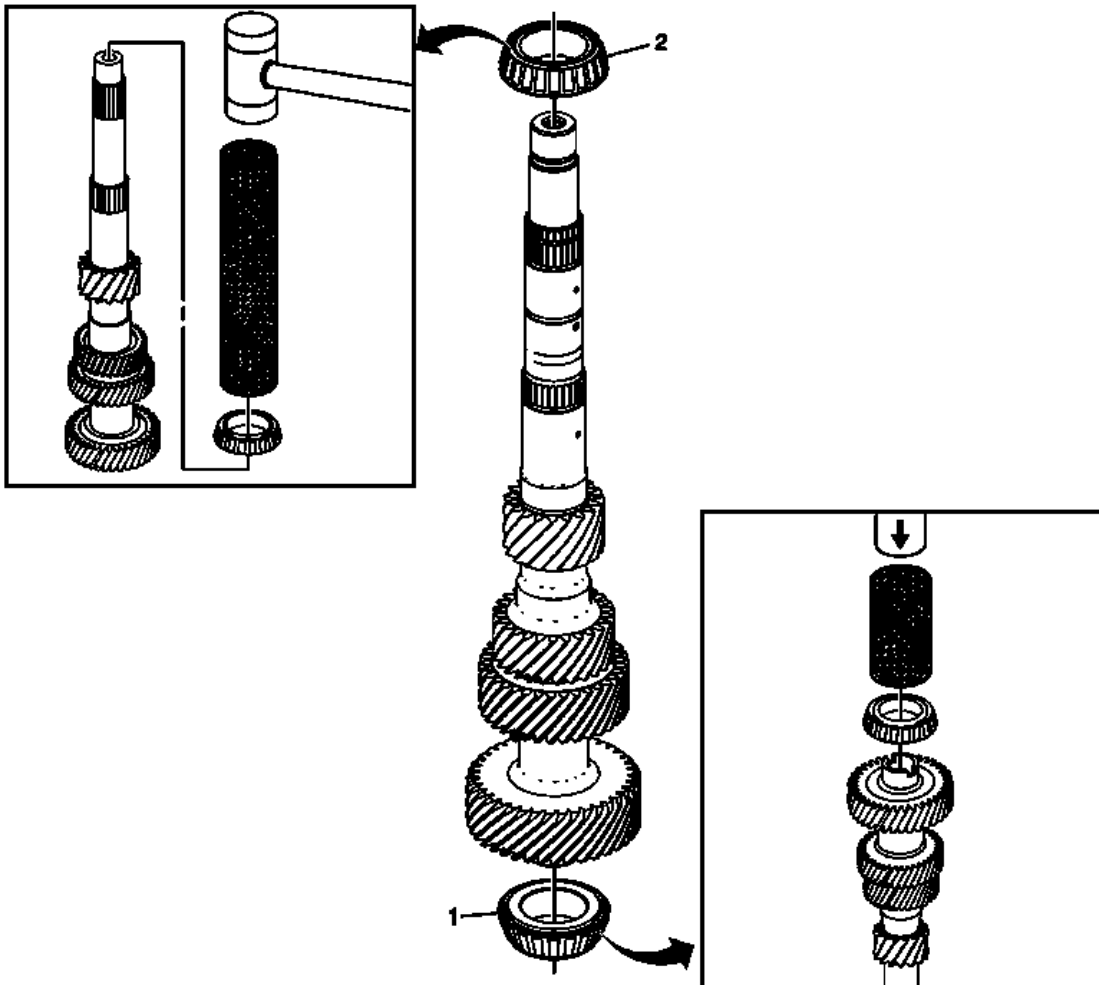


**Fig. 137: Counter Gear Shaft Assemble**  
Courtesy of GENERAL MOTORS COMPANY

Counter Gear Shaft Assemble

| Callout | Component Name                                                                                                                                                                                                                                                    |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Counter Gear Bearing<br><b>Procedure</b><br>Use the <b>DT-51076</b> installer and a mallet to install the bearing.<br><b>Special Tools</b><br><b>DT-51076</b> Bearing and Gear Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> .        |
| 2       | Counter Gear Front Bearing<br><b>Procedure</b><br>Use the <b>DT-5590</b> driver and a hydraulic press to install the bearing.<br><b>Special Tools</b><br><b>DT-5590</b> Bearing and Seal Driver<br>For equivalent regional tools, refer to <b>Special Tools</b> . |

MAIN SHAFT AND INPUT SHAFT ASSEMBLE

Input Shaft Bearing Installation

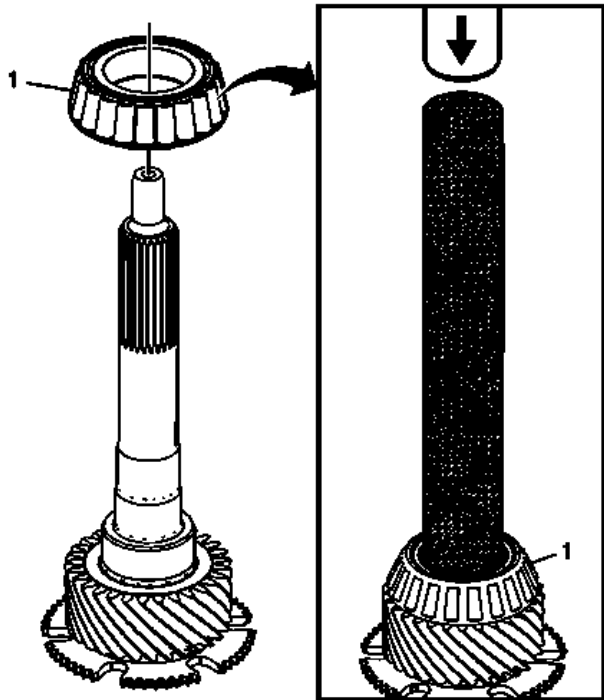


Fig. 138: Input Shaft Bearing  
Courtesy of GENERAL MOTORS COMPANY

Input Shaft Bearing Installation

| Callout | Component Name      |
|---------|---------------------|
|         | Input Shaft Bearing |

1

**DT-25234** Gear and Bearing Installer  
For equivalent regional tools, refer to **Special Tools**.

### 3rd Drive Gear and 3rd Gear Synchronizer Assembly Installation

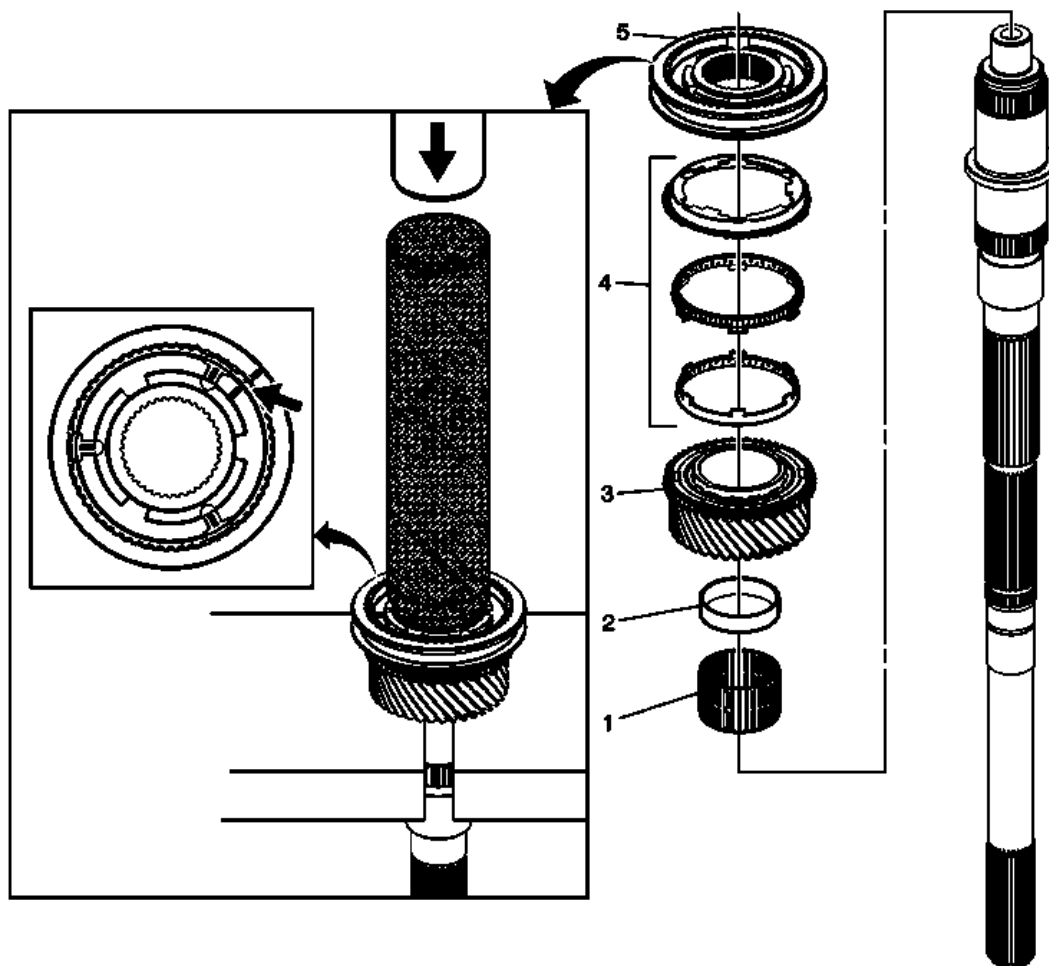


**Fig. 139: 3rd Drive Gear and 3rd Gear Synchronizer Assembly**  
Courtesy of GENERAL MOTORS COMPANY

### 3rd Drive Gear and 3rd Gear Synchronizer Assembly Installation

| Callout | Component Name                                                                                                     |
|---------|--------------------------------------------------------------------------------------------------------------------|
| 1       | 3rd Gear Bearing                                                                                                   |
| 2       | 3rd Gear Bearing Spacer                                                                                            |
| 3       | 3rd Gear - Drive                                                                                                   |
| 4       | 3rd Gear Blocking Ring Assembly                                                                                    |
|         | <b>NOTE:</b><br>Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub. |

### 3rd Gear Synchronizer Assembly

**NOTE:**

The groove on the sleeve faces the 3rd drive gear.

**Procedure**

5

1. Check the 3rd gear synchronizer assembly scribe marks for correct position.
2. Start the hydraulic press operation.
3. STOP pressing before the keys engage the blocking ring slots.
4. Lift and rotate the 3rd gear in order to engage the keys with the blocking ring.
5. Continue pressing until the synchronizer is seated.

**Special Tools**

- **DT-36183** Press Tube
- **DT-36184** Press Tube Reducer

For equivalent regional tools, refer to **Special Tools**.

### 2nd Drive Gear and 1st & 2nd Synchronizer Assembly Installation

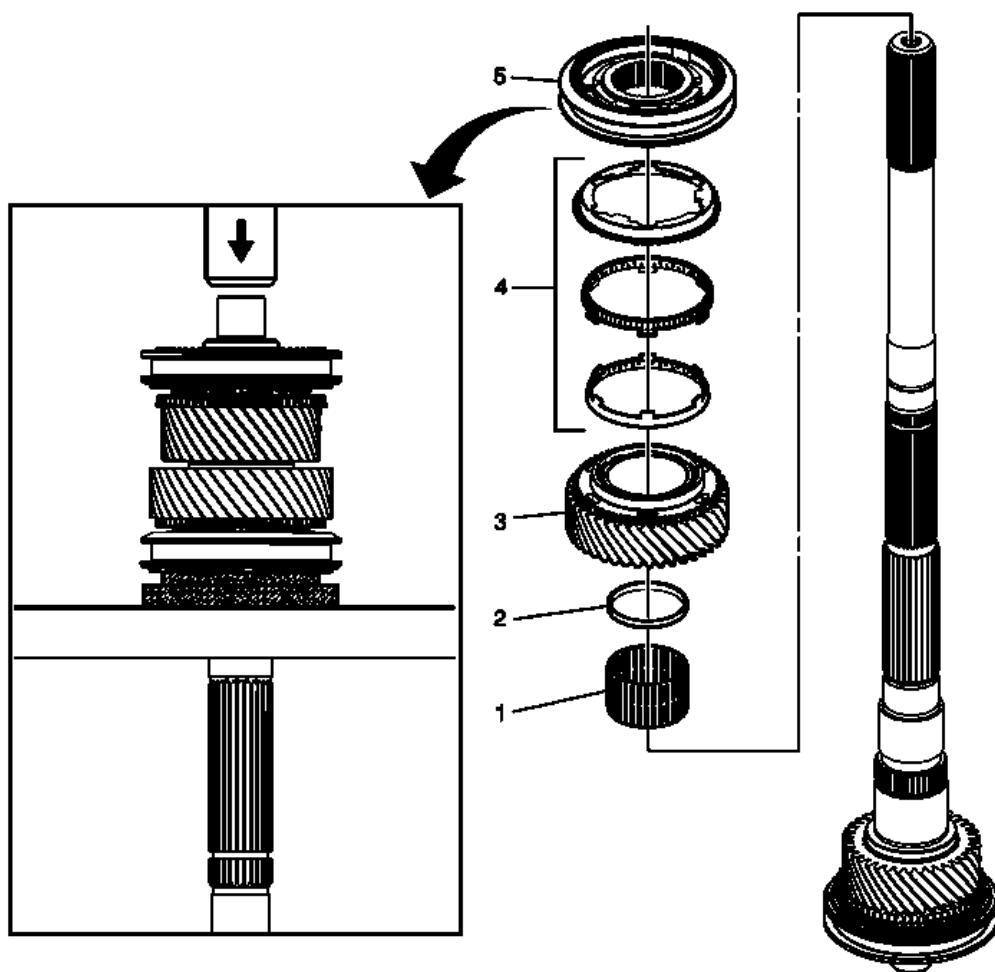


**Fig. 140: 2nd Drive Gear and 1st & 2nd Synchronizer Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

#### 2nd Drive Gear and 1st & 2nd Synchronizer Assembly Installation

| Callout | Component Name                                                                                                                                            |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 2nd Gear Bearing                                                                                                                                          |
| 2       | 2nd Gear Bearing Spacer                                                                                                                                   |
| 3       | 2nd Gear - Drive                                                                                                                                          |
| 4       | 2nd Gear Blocking Ring Assembly<br><br><b>NOTE:</b><br>Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub. |
|         | 1st & 2nd Synchronizer Assembly<br><br><b>NOTE:</b>                                                                                                       |

5

# **Procedure**

1. Start the hydraulic press operation.
2. STOP pressing before the keys engage the blocking ring slots.
3. Lift and rotate the 2nd gear in order to engage the keys with the blocking ring.
4. Continue pressing until the synchronizer is seated.

## **Special Tools**

**DT-39371** 1st/2nd Synchronizer Installer

For equivalent regional tools, refer to **Special Tools**.

## **1st Gear Blocking Ring Assembly Installation**

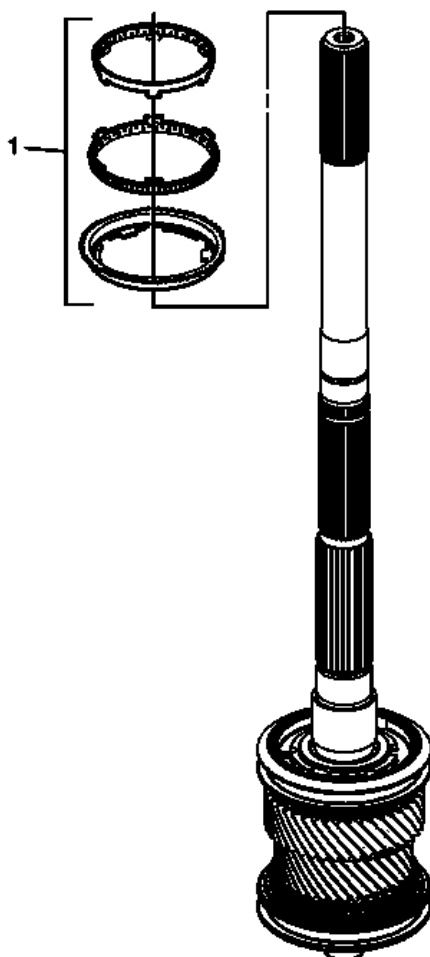


**Fig. 141: 1st Gear Blocking Ring Assembly**  
 Courtesy of GENERAL MOTORS COMPANY

## **1st Gear Blocking Ring Assembly Installation**

| Callout | Component Name                                                                                                                                            |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 1st Gear Blocking Ring Assembly<br><br><b>NOTE:</b><br>Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub. |

First Drive Gear Installation

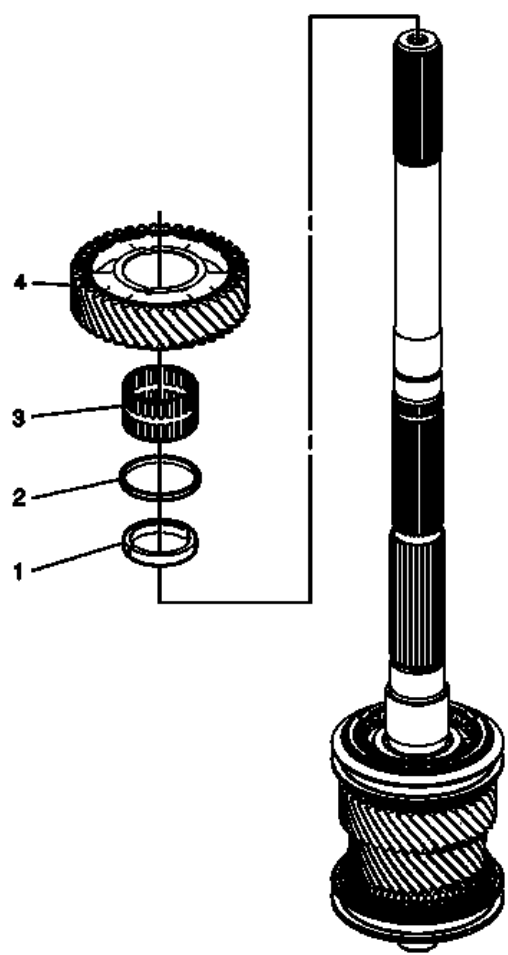


Fig. 142: First Drive Gear  
Courtesy of GENERAL MOTORS COMPANY

First Drive Gear Installation

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | Transmission Main Shaft Split Washer |
| 2       | Transmission Main Shaft Washer       |
| 3       | 1st Gear Bearing                     |
| 4       | 1st Gear - Drive                     |

Main Shaft Bearing and 6th Driven Gear Installation

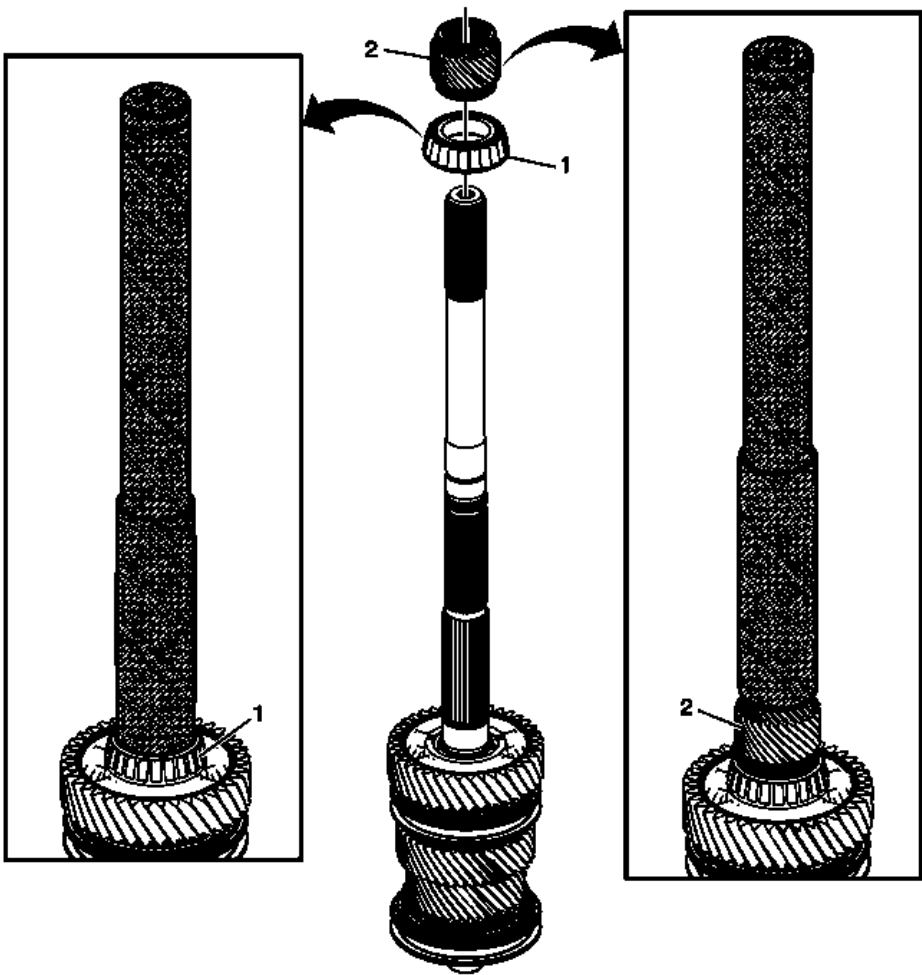


Fig. 143: Main Shaft Bearing and 6th Driven Gear  
Courtesy of GENERAL MOTORS COMPANY

Main Shaft Bearing and 6th Driven Gear Installation

| Callout | Component Name                                                                                                                                         |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Main Shaft Bearing                                                                                                                                     |
|         | <b>Special Tools</b> <ul style="list-style-type: none"><li>• DT-51076 Bearing and Gear Installer</li><li>• DT-51076-10 Installer Adapter Set</li></ul> |
|         | For equivalent regional tools, refer to <b>Special Tools</b> .                                                                                         |
|         | 6th Gear - Driven                                                                                                                                      |

2

- **DT-51076** Bearing and Gear Installer
- **DT-51076-10** Installer Adapter Set

For equivalent regional tools, refer to **Special Tools**.

## TRANSMISSION ASSEMBLE

### Input Shaft Installation

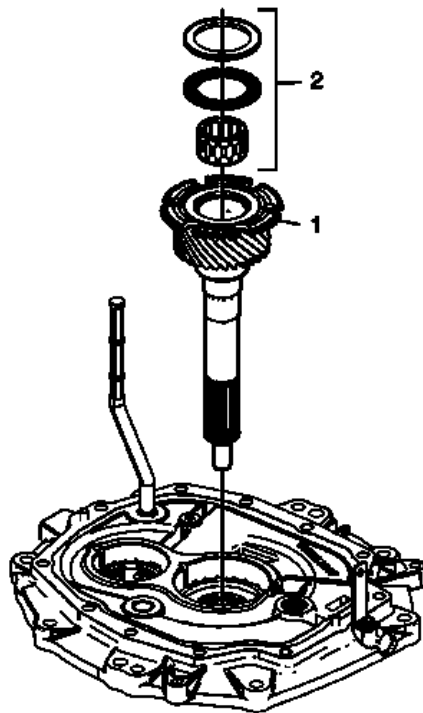


**Fig. 144: Input Shaft**

Courtesy of GENERAL MOTORS COMPANY

### Input Shaft Installation

| Callout | Component Name              |
|---------|-----------------------------|
| 1       | Input Shaft                 |
| 2       | Main Shaft Bearing Assembly |

### Shift Shaft Assemblies and Gear Cluster Installation

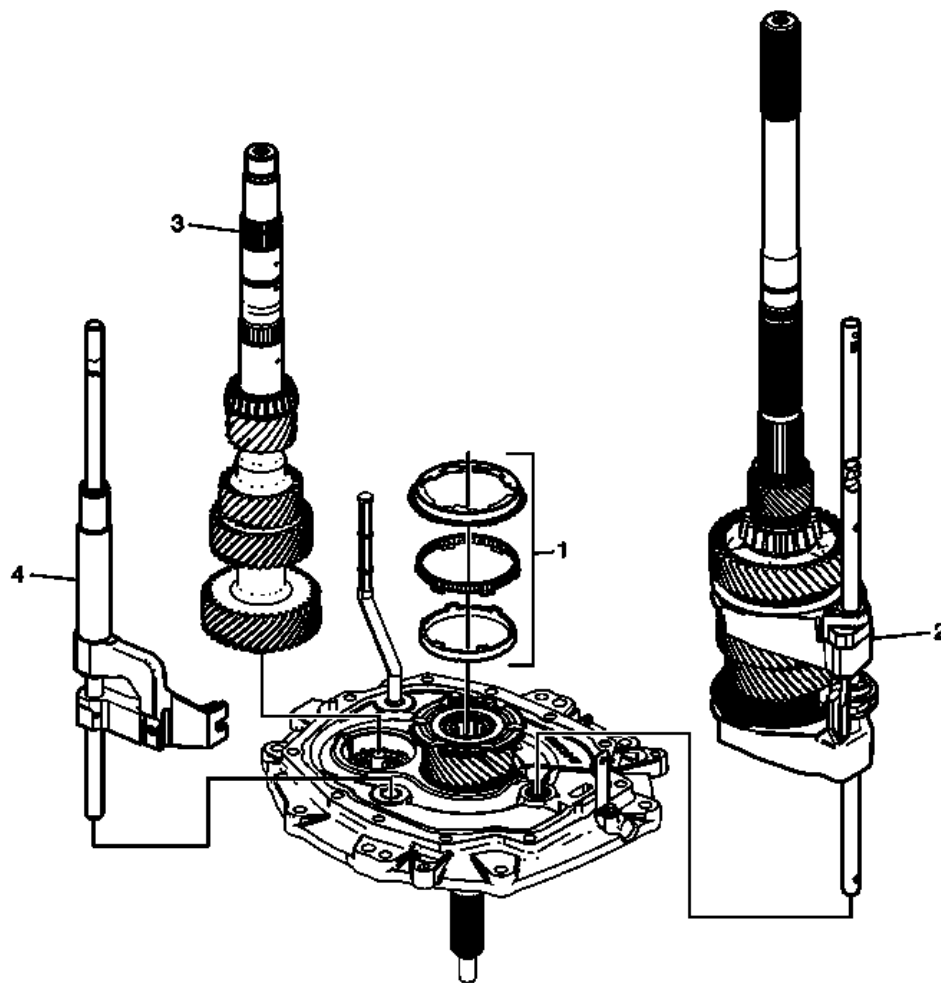


**Fig. 145: Shift Shaft Assemblies and Gear Cluster**  
 Courtesy of GENERAL MOTORS COMPANY

#### Shift Shaft Assemblies and Gear Cluster Installation

| Callout | Component Name                                                                                                              |
|---------|-----------------------------------------------------------------------------------------------------------------------------|
| 1       | 4th Gear Blocking Ring Assembly                                                                                             |
| 2       | Main Shaft and 1st/2nd & 3rd/4th Shift Shaft Assembly                                                                       |
| 3       | Counter Gear Assembly                                                                                                       |
| 4       | 5th/6th & 7th/Reverse Shift Shaft Assembly                                                                                  |
|         | <b>NOTE:</b><br>Rotate the 5th/6th & 7th/Reverse Shift Shaft Assembly off the shift interlock plate to aid in installation. |

#### Transmission Case Installation

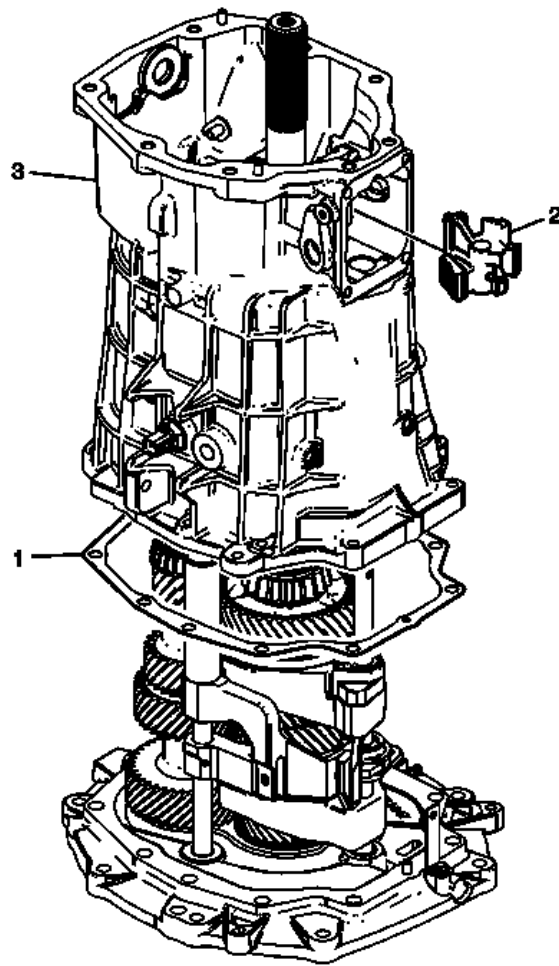


**Fig. 146: Transmission Case**  
 Courtesy of GENERAL MOTORS COMPANY

#### Transmission Case Installation

| Callout | Component Name                            |
|---------|-------------------------------------------|
| 1       | Transmission Case-to-Adapter Plate Gasket |
| 2       | Offset Shift Lever                        |
| 3       | Transmission Case                         |

#### Transmission Interlock Bolt Installation

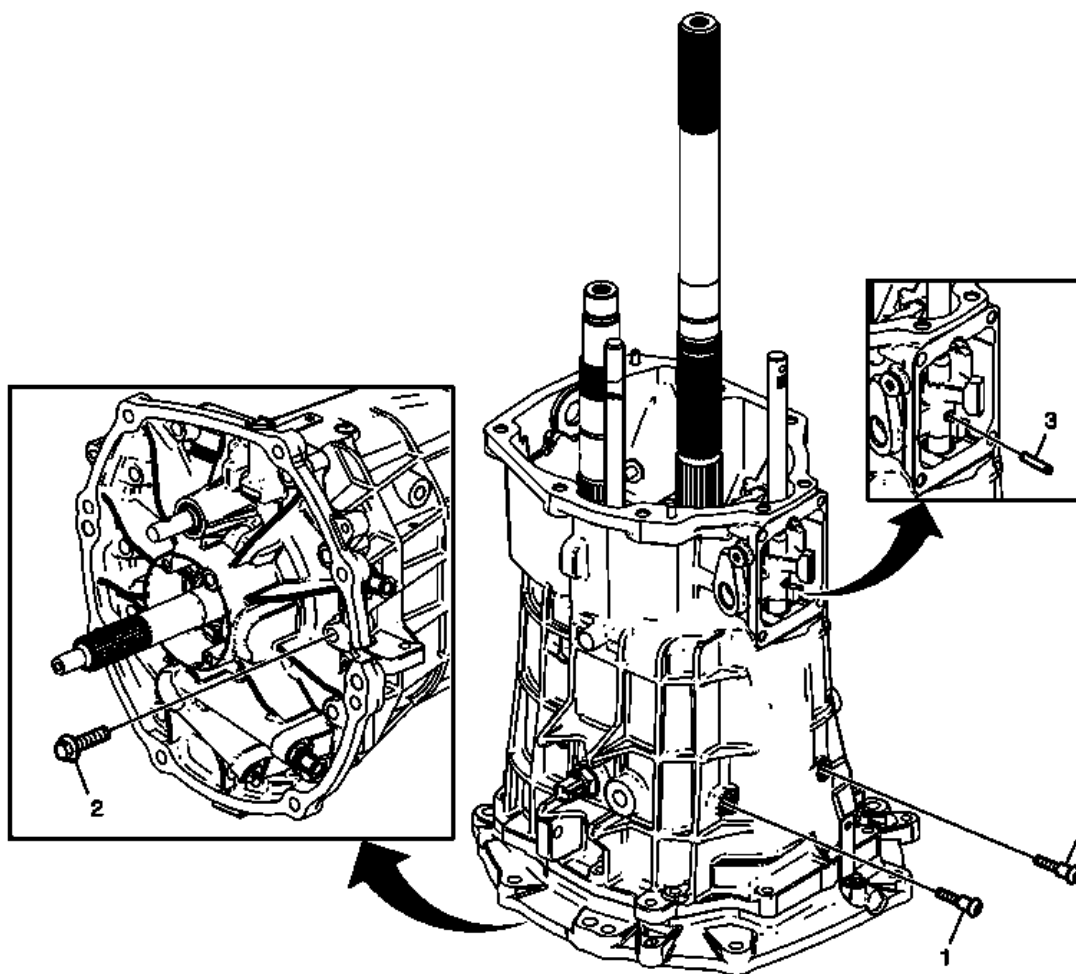


**Fig. 147: Transmission Interlock Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

#### Transmission Interlock Bolt Installation

| Callout | Component Name                                                                                                                               |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Transmission Interlock Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>27 N.m (20 lb ft) |
|         | Transmission Adapter Bolt (Qty: 8)<br><br><b>Procedure</b>                                                                                   |

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | <p>2. Install the 8 adapter plate bolts that can be accessed with the transmission in the holding fixture.</p> <p><b>Tighten</b><br/>49 N.m (36 lb ft)</p> |
| 3 | <p>Roll Pin</p> <p><b>Procedure</b><br/>Use a punch to install the pin into the shift shaft.</p>                                                           |

Reverse Blockout Solenoid Housing Installation

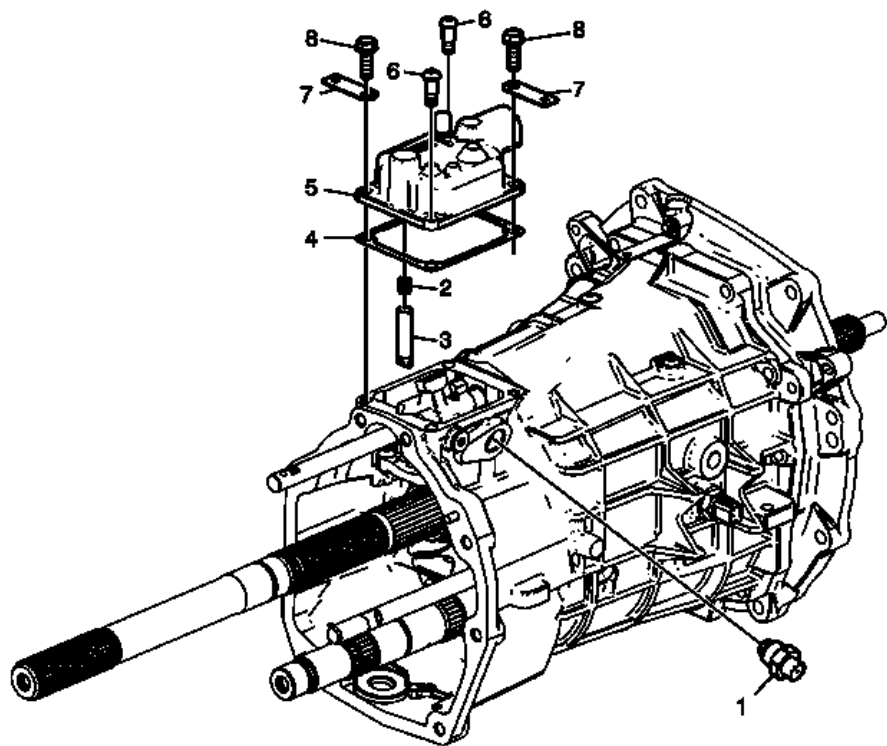


Fig. 148: Reverse Blockout Solenoid Housing  
Courtesy of GENERAL MOTORS COMPANY

Reverse Blockout Solenoid Housing Installation

| Callout | Component Name                                                              |
|---------|-----------------------------------------------------------------------------|
| 1       | Shift Shaft Detent Spring Cover Bolt<br><b>Tighten</b><br>27 N.m (20 lb ft) |
| 2       | Detent Roller Spring                                                        |
| 3       | Shift Shaft Detent Roller                                                   |
| 4       | Manual Transmission Reverse Gear Blockout Solenoid Housing Gasket           |
| 5       | Manual Transmission Reverse Gear Blockout Solenoid Housing                  |

|   |                                                                                         |
|---|-----------------------------------------------------------------------------------------|
| 6 | <b>Tighten</b><br>22 N.m (16 lb ft)                                                     |
| 7 | Wiring Harness Bracket                                                                  |
| 8 | Reverse Lockout Solenoid Cover Hex Bolt (Qty: 2)<br><b>Tighten</b><br>31 N.m (23 lb ft) |

#### Reverse Gear Blockout Solenoid and Skip Shift Solenoid Installation

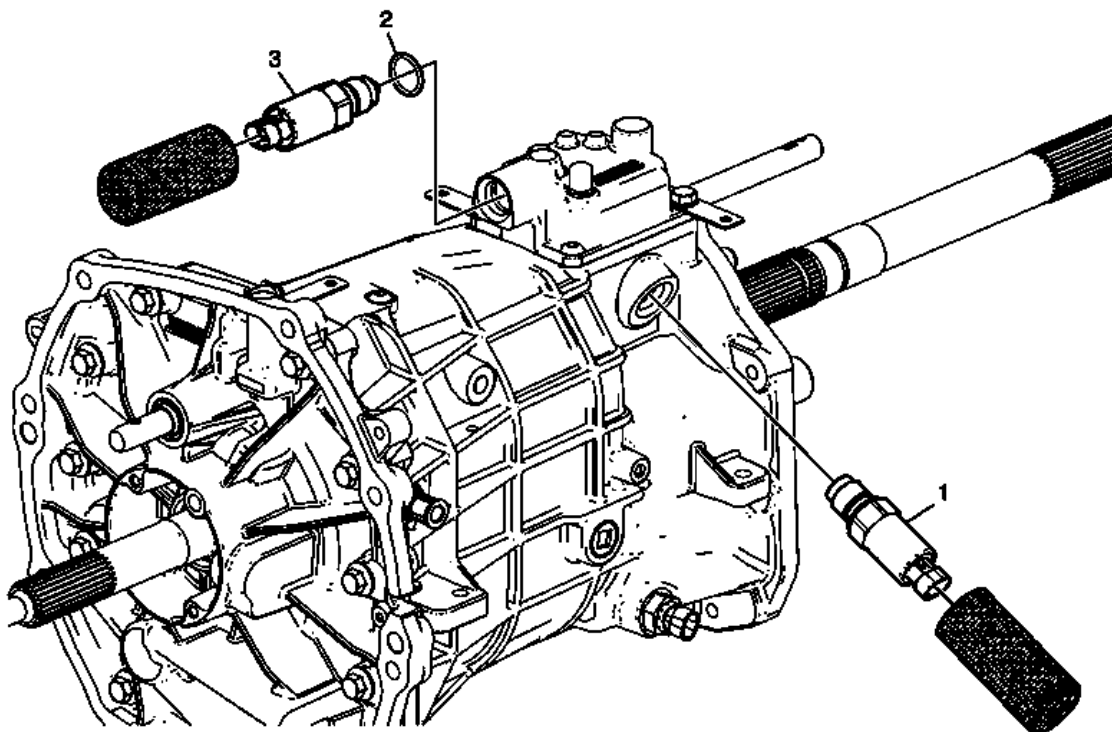


**Fig. 149: Reverse Gear Blockout Solenoid and Skip Shift Solenoid**  
Courtesy of GENERAL MOTORS COMPANY

#### Reverse Gear Blockout Solenoid and Skip Shift Solenoid Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>Skip Shift Solenoid</p> <p><b>NOTE:</b><br/>The skip ship solenoid connector is white.</p> <p><b>Tighten</b><br/>41 N.m (30 lb ft)</p> <p><b>Special Tools</b><br/><b>DT-49293</b> Gear Select/Skip Shift Solenoid Remover/Installer<br/>For equivalent regional tools, refer to <b>Special Tools</b>.</p> |

|   |                                                                                                                                                                                                                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Manual Transmission Reverse Gear Blockout Solenoid O-ring Seal                                                                                                                                                                                                                                                                             |
| 3 | Manual Transmission Reverse Gear Blockout Solenoid<br><br><b>NOTE:</b><br>The reverse gear blockout solenoid connector is black.<br><br><b>Tighten</b><br>41 N.m (30 lb ft)<br><b>Special Tools</b><br><b>DT-49293</b> Gear Select/Skip Shift Solenoid Remover/Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> . |

### 6th Gear Bearing and Spacer Installation

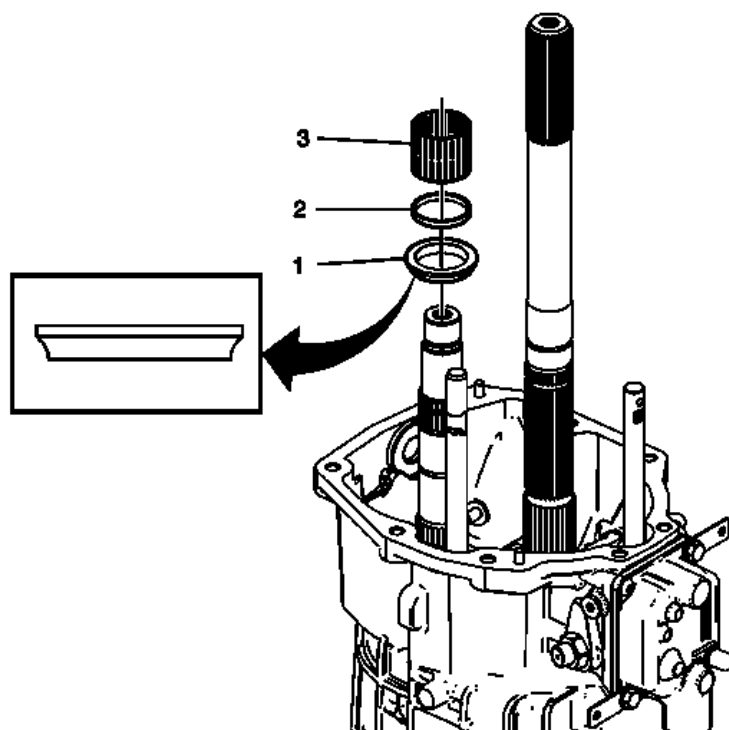


**Fig. 150: 6th Gear Bearing and Spacer**  
Courtesy of GENERAL MOTORS COMPANY

### 6th Gear Bearing and Spacer Installation

| Callout | Component Name                                                                                      |
|---------|-----------------------------------------------------------------------------------------------------|
| 1       | 6th Gear Thrust Washer<br><br><b>NOTE:</b><br>Install the thrust washer in the correct orientation. |
| 2       | 6th Gear Bearing Spacer                                                                             |

## 5th &amp; 6th Gear Synchronizer Hub &amp; 6th Drive Gear Installation

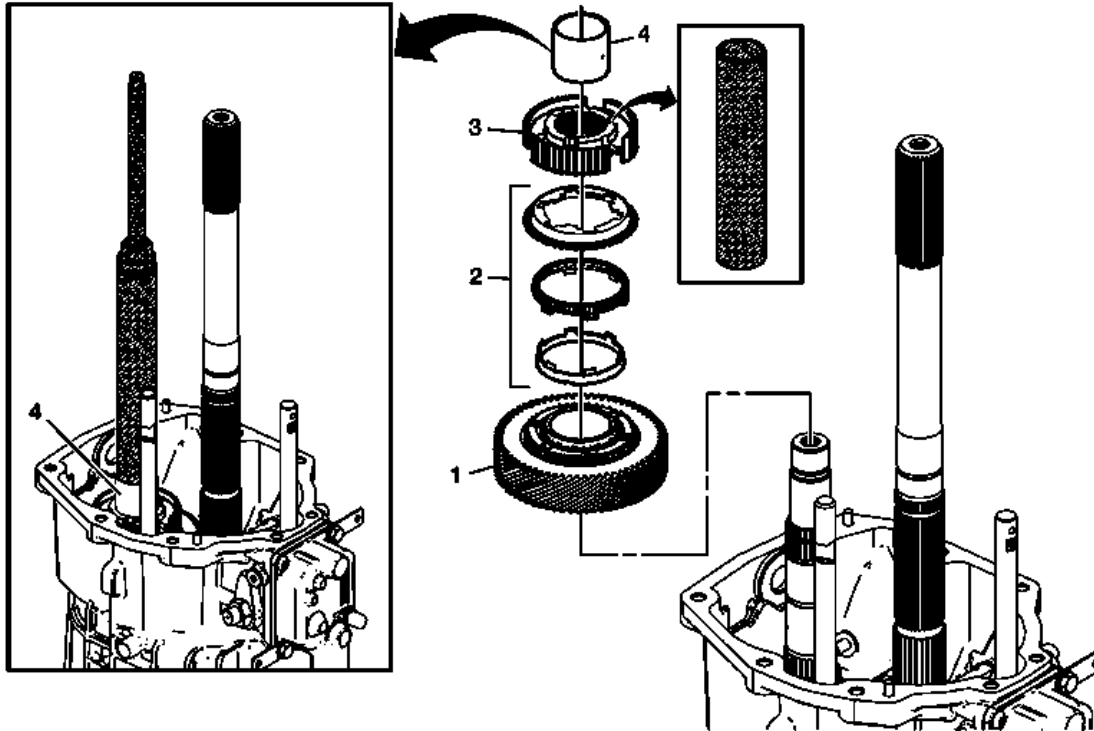


**Fig. 151: 5th & 6th Gear Synchronizer Hub & 6th Drive Gear**  
 Courtesy of GENERAL MOTORS COMPANY

## 5th &amp; 6th Gear Synchronizer Hub &amp; 6th Drive Gear Installation

| Callout | Component Name                                                                                                                                                                                                                                                                       |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 6th Gear - Drive                                                                                                                                                                                                                                                                     |
| 2       | 6th Gear Blocking Ring Assembly                                                                                                                                                                                                                                                      |
| 3       | 5th & 6th Gear Synchronizer Hub<br><b>Procedure</b><br>Use the <b>DT-25234</b> installer and a mallet to install the 5th & 6th Gear Synchronizer Hub.<br><b>Special Tools</b><br><b>DT-25234</b> Bearing Installer<br>For equivalent regional tools, refer to <b>Special Tools</b> . |
| 4       | 5th Gear Bearing Bushing<br><b>Procedure</b><br>Use the <b>DT-51076</b> installer and the <b>DT-51076-11</b> and <b>DT-51076-14</b> adapters to install the 5th gear bushing.                                                                                                        |

- **DT-51076** Bearing and Gear Installer
- **DT-51076-10** Installer Adapter Set

For equivalent regional tools, refer to **Special Tools**.

#### 5th & 6th Shift Fork Installation

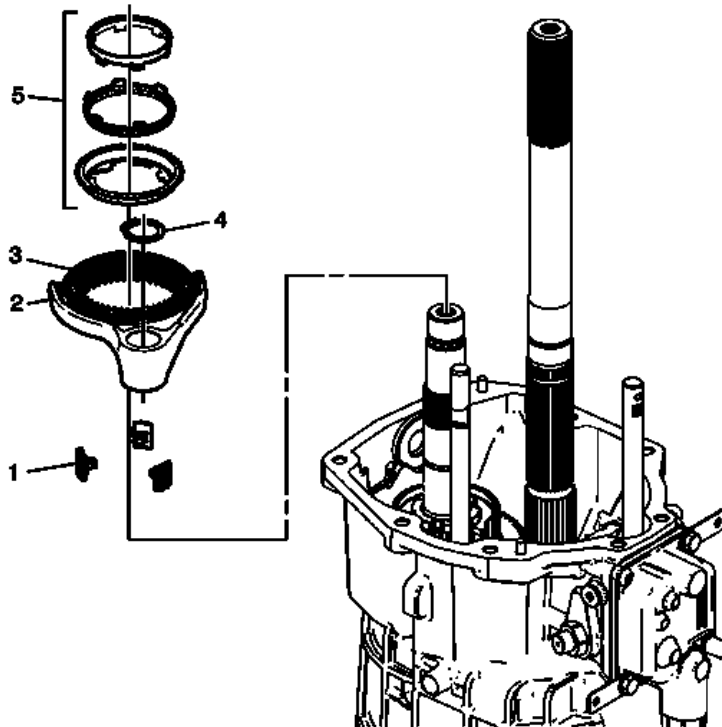


**Fig. 152: 5th & 6th Shift Fork**  
Courtesy of GENERAL MOTORS COMPANY

#### 5th & 6th Shift Fork Installation

| Callout | Component Name                        |
|---------|---------------------------------------|
| 1       | 5th & 6th Synchronizer Sleeve Inserts |
| 2       | 5th & 6th Shift Fork                  |
| 3       | 5th & 6th Synchronizer Sleeve         |
| 4       | 5th & 6th Shift Fork Retainer         |
| 5       | 5th Gear Blocking Ring Assembly       |

#### 7th Driven Gear and 5th Driven Gear Installation

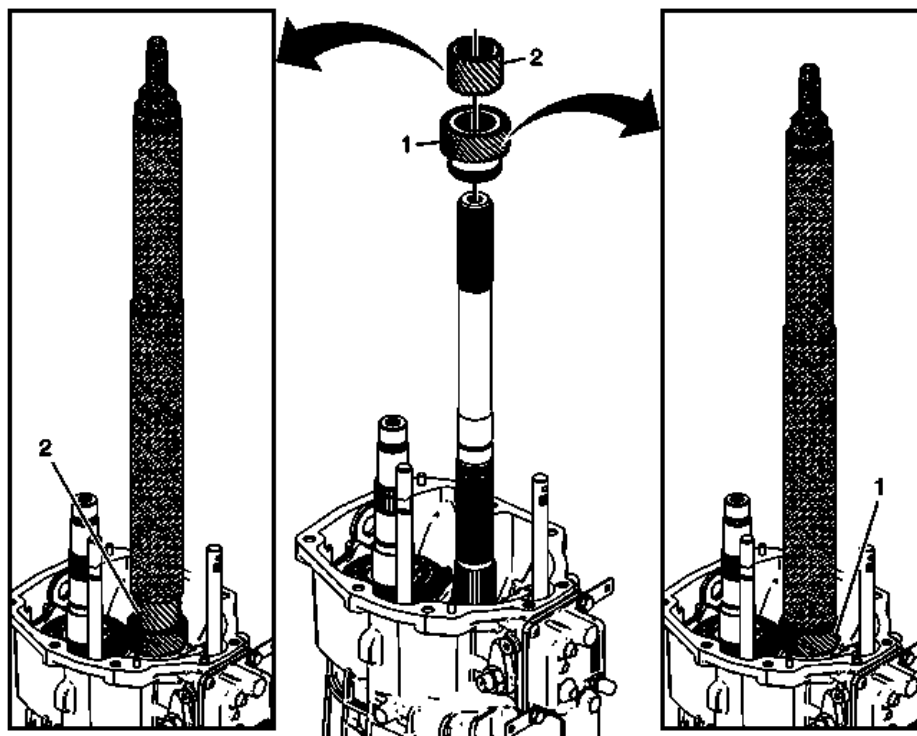


**Fig. 153: 7th Driven Gear and 5th Driven Gear**  
Courtesy of GENERAL MOTORS COMPANY

#### 7th Driven Gear and 5th Driven Gear Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>5th Gear - Driven</p> <p><b>Procedure</b><br/>Use the <b>DT-51076</b> installer and the <b>DT-51076-11</b>, <b>DT-51076-12</b> and <b>DT-51076-14</b> adapters to install the 5th speed driven gear.</p> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-51076</b> Bearing and Gear Installer</li> <li>• <b>DT-51076-10</b> Installer Adapter Set</li> </ul> <p>For equivalent regional tools, refer to <b>Special Tools</b>.</p> |
| 2       | <p>7th Gear - Driven</p> <p><b>Procedure</b><br/>Use the <b>DT-51076</b> installer and the <b>DT-51076-13</b> and <b>DT-51076-14</b> adapters to install the 5th speed driven gear.</p> <p><b>Special Tools</b></p>                                                                                                                                                                                                                                             |

- **DT-51076-10** Installer Adapter Set

For equivalent regional tools, refer to **Special Tools**.

#### 7th Drive Gear and 5th Drive Gear Installation

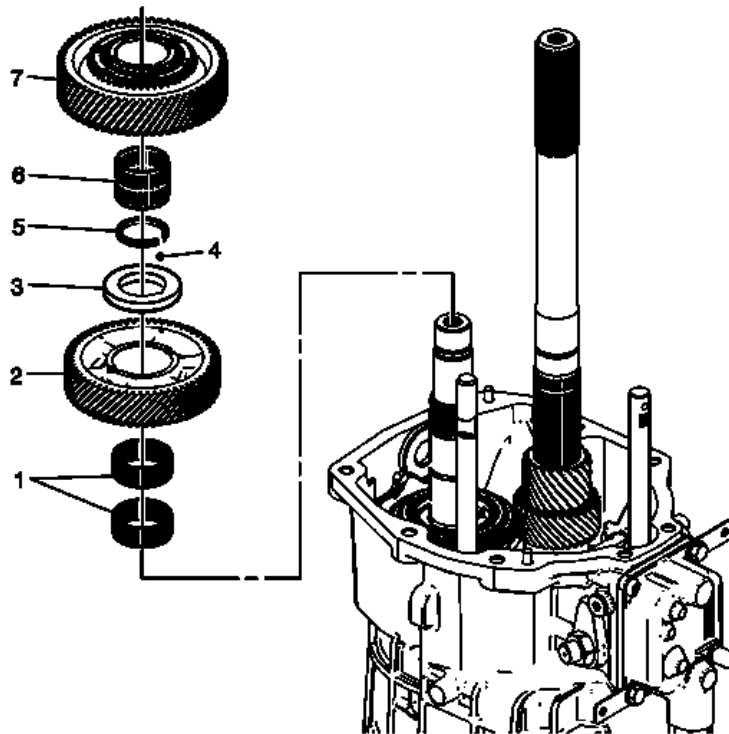


**Fig. 154: 7th Drive Gear and 5th Drive Gear**  
Courtesy of GENERAL MOTORS COMPANY

#### 7th Drive Gear and 5th Drive Gear Installation

| Callout | Component Name                       |
|---------|--------------------------------------|
| 1       | 5th Gear Bearing                     |
| 2       | 5th Gear - Drive                     |
| 3       | 5th Gear Thrust Washer               |
| 4       | 5th Gear Thrust Washer Location Ball |
| 5       | 5th Gear Retaining Ring              |
| 6       | 7th Gear Bearing                     |
| 7       | 7th Gear - Drive                     |

#### 7th & Reverse Synchronizer Hub Installation

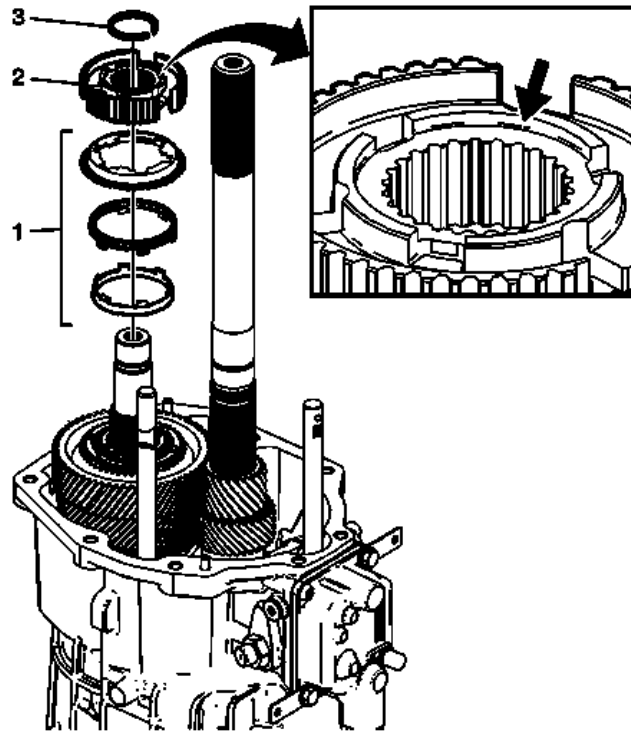


**Fig. 155: 7th & Reverse Synchronizer Hub**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th & Reverse Synchronizer Hub Installation

| Callout | Component Name                                                                                                                                           |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | 7th Gear Blocking Ring Assembly                                                                                                                          |
| 2       | 7th and Reverse Gear Synchronizer Hub<br><br><b>NOTE:</b><br>Install the hub in the correct orientation. The recess for the snap ring faces up as shown. |
| 3       | 7th Gear Blocking Ring Retainer                                                                                                                          |

#### 7th & Reverse Shift Fork Installation

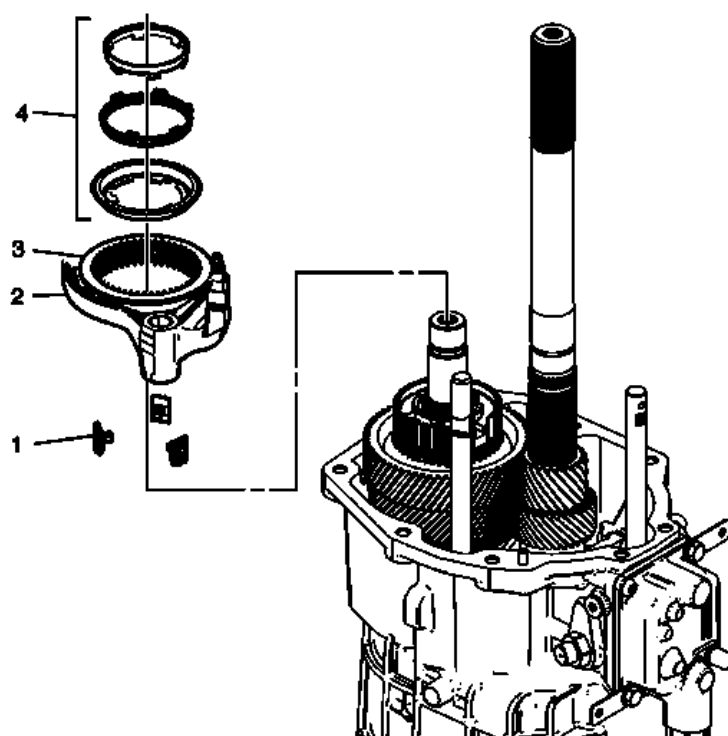


**Fig. 156: 7th & Reverse Shift Fork**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th & Reverse Shift Fork Installation

| Callout | Component Name                          |
|---------|-----------------------------------------|
| 1       | 7th & Reverse Gear Synchronizer Inserts |
| 2       | 7th & Reverse Shift Fork                |
| 3       | 7th & Reverse Gear Synchronizer Sleeve  |
| 4       | Reverse Gear Blocking Ring Assembly     |

#### Reverse Drive Gear Installation

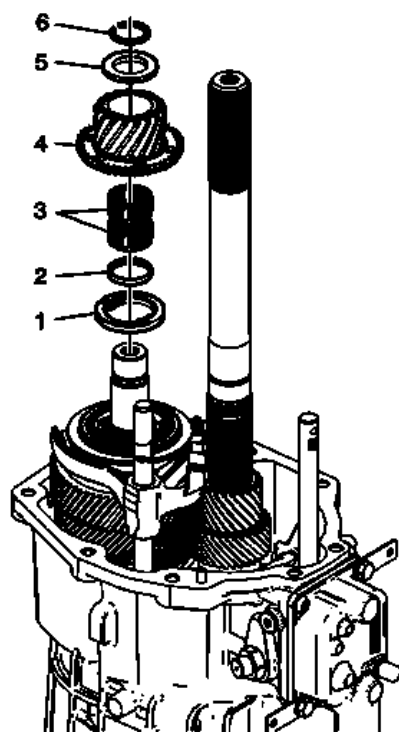


**Fig. 157: Reverse Drive Gear**  
 Courtesy of GENERAL MOTORS COMPANY

#### Reverse Drive Gear Installation

| Callout | Component Name              |
|---------|-----------------------------|
| 1       | 7th Gear Bearing Spacer     |
| 2       | Reverse Gear Spacer         |
| 3       | Reverse Gear Bearing        |
| 4       | Reverse Gear - Drive        |
| 5       | Reverse Gear Thrust Washer  |
| 6       | Reverse Gear Retaining Ring |

#### Reverse Driven Gear Installation

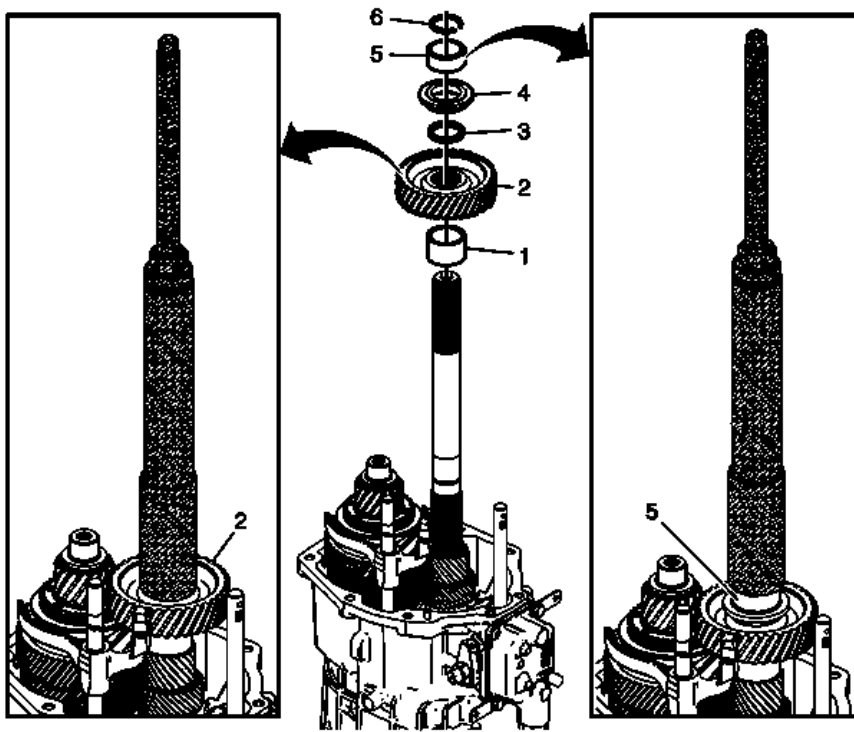


**Fig. 158: Reverse Driven Gear**  
 Courtesy of GENERAL MOTORS COMPANY

#### Reverse Driven Gear Installation

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Reverse Driven Gear Spacer                                                                                                                                                                                                                                                                                                                                                                                   |
| 2       | Reverse Gear - Driven<br><b>Procedure</b><br>Use the <b>DT-51076</b> installer and the <b>DT-51076-13</b> and <b>DT-51076-14</b> adapters to install the gear.<br><br><b>Special Tools</b> <ul style="list-style-type: none"> <li>• <b>DT-51076</b> Bearing and Gear Installer</li> <li>• <b>DT-51076-10</b> Installer Adapter Set</li> </ul> For equivalent regional tools, refer to <b>Special Tools</b> . |
| 3       | Reverse Gear Split Washer                                                                                                                                                                                                                                                                                                                                                                                    |
| 4       | Transmission Main Shaft Split Washer                                                                                                                                                                                                                                                                                                                                                                         |
|         | Main Shaft Bushing<br><b>Procedure</b><br>Use the <b>DT-51076</b> installer and the <b>DT-51076-13</b> and <b>DT-51076-14</b> adapters to                                                                                                                                                                                                                                                                    |

|   |                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | <b>Special Tools</b> <ul style="list-style-type: none"> <li>• <b>DT-51076</b> Bearing and Gear Installer</li> <li>• <b>DT-51076-10</b> Installer Adapter Set</li> </ul> |
|   | For equivalent regional tools, refer to <b>Special Tools</b> .                                                                                                          |
| 6 | Reverse Gear Retaining Ring                                                                                                                                             |

Extension Housing Installation

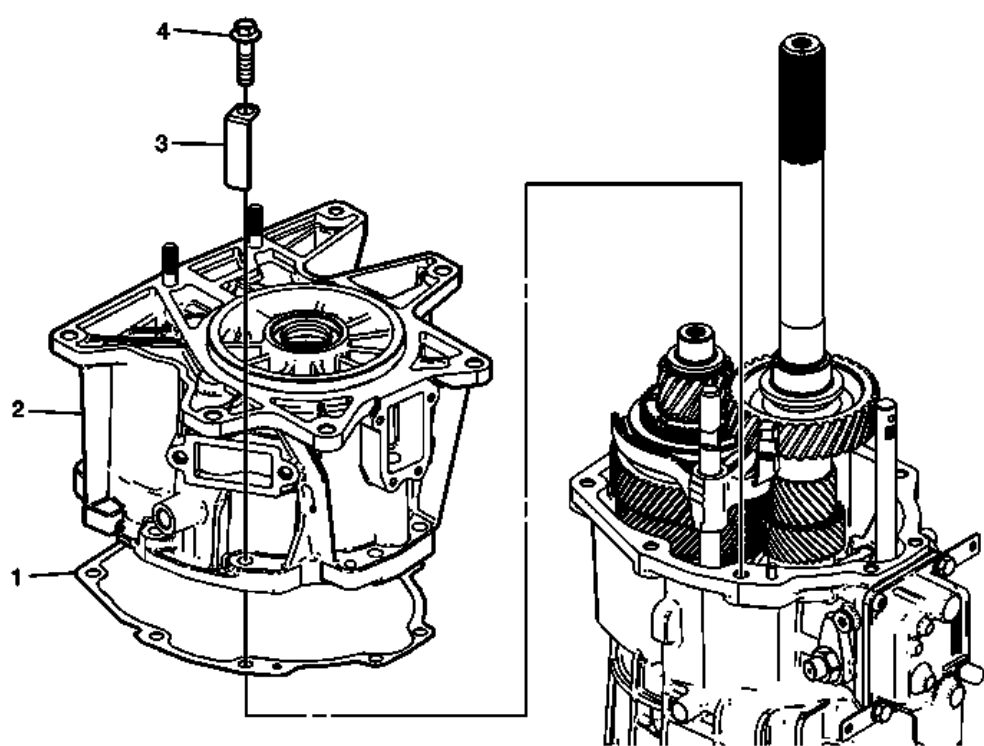


**Fig. 159: Extension Housing**  
Courtesy of GENERAL MOTORS COMPANY

Extension Housing Installation

| Callout | Component Name                                                              |
|---------|-----------------------------------------------------------------------------|
| 1       | Transmission Extension Gasket                                               |
| 2       | Extension Housing                                                           |
| 3       | Transmission Identification Tag                                             |
| 4       | Transmission Extension Bolt (Qty: 8)<br><b>Tighten</b><br>62 N.m (46 lb ft) |

7th/Reverse Inverter Link Cover and Gear Position Sensor Installation

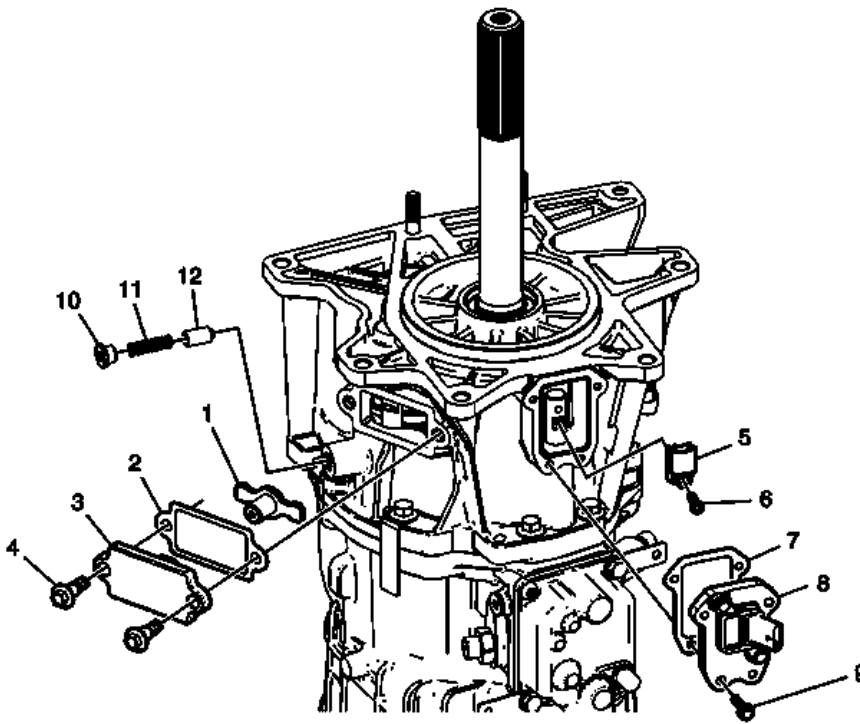


**Fig. 160: 7th/Reverse Inverter Link Cover and Gear Position Sensor**  
 Courtesy of GENERAL MOTORS COMPANY

#### 7th/Reverse Inverter Link Cover and Gear Position Sensor Installation

| Callout | Component Name                                                                                                         |
|---------|------------------------------------------------------------------------------------------------------------------------|
| 1       | Manual Transmission Selector Lever Pivot Pin                                                                           |
| 2       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Gasket                                               |
| 3       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover                                                      |
| 4       | Manual Transmission Control Lever 7th/Reverse Inverter Link Cover Bolt (Qty: 2)<br><b>Tighten</b><br>24 N.m (18 lb ft) |
| 5       | Transmission Gap Magnet                                                                                                |
| 6       | Transmission Gap Magnet Bolt (Qty: 1)                                                                                  |
| 7       | Manual Transmission Gear Position Sensor Gasket                                                                        |
| 8       | Manual Transmission Gear Position Sensor                                                                               |
| 9       | Manual Transmission Gear Position Sensor Bolt (Qty: 4)<br><b>Tighten</b><br>8 N.m (71 lb ft)                           |
| 10      | Shift Shaft Detent Plug<br><b>Tighten</b><br>27 N.m (20 lb ft)                                                         |
| 11      | Shift Detent Ball Spring                                                                                               |
| 12      | Transmission Detent Ball                                                                                               |

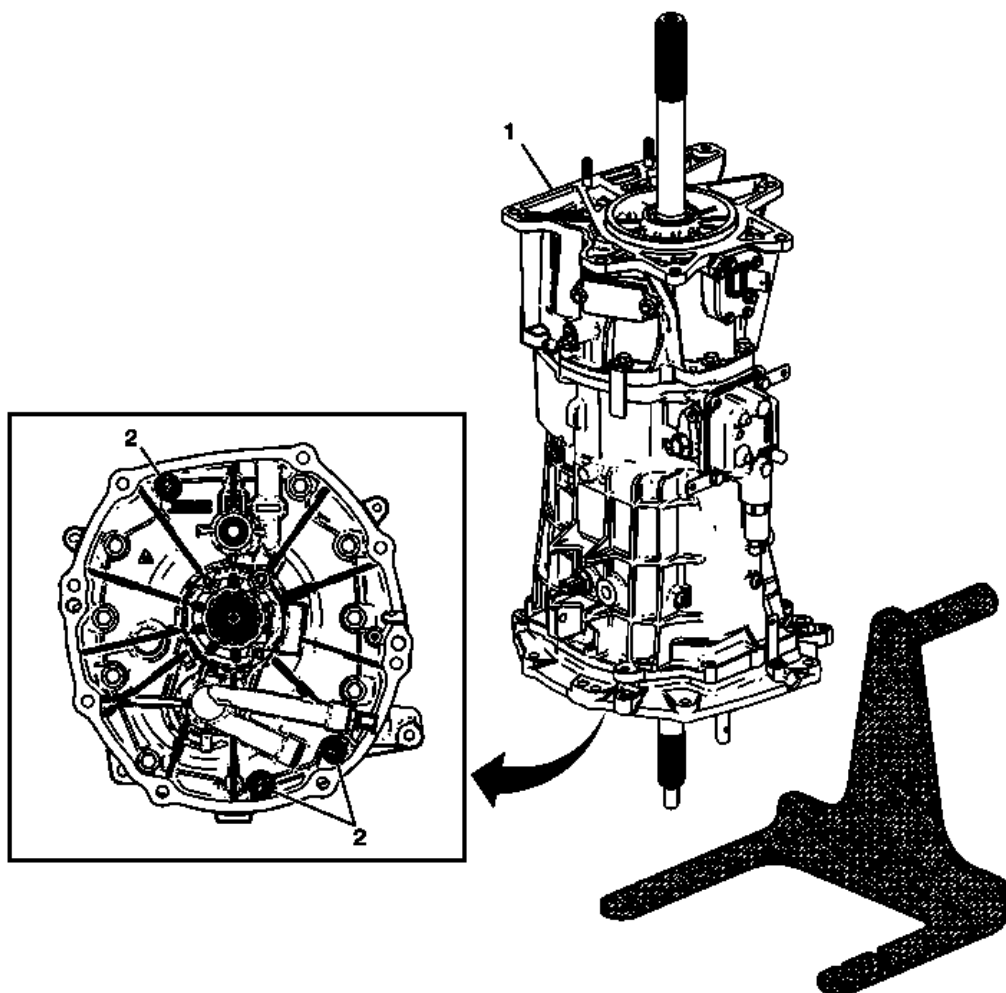


**Fig. 161: Holding Fixture**  
 Courtesy of GENERAL MOTORS COMPANY

#### Holding Fixture Removal

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <p>Transmission Assembly</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove the transmission from the <b>DT-3289-20</b> fixture.</li> <li>2. Remove the <b>DT-44395-B</b> holding fixture from the transmission assembly.</li> </ol> <p><b>Special Tools</b></p> <ul style="list-style-type: none"> <li>• <b>DT-44395-B</b> Transmission Holding Fixture</li> <li>• <b>DT-3289-20</b> Holding Fixture</li> </ul> |

|   |                                                                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | For equivalent regional tools, refer to <b><u>Special Tools</u></b> .                                                                                                                      |
| 2 | Transmission Adapter Bolt (Qty: 3)<br><b>Procedure</b><br>Install the three remaining adapter plate bolts shown after removing the holding fixture.<br><b>Tighten</b><br>49 N.m (36 lb ft) |

## SHIMMING PROCEDURES

### Special Tools

**DT-8001** Dial Indicator Set

For equivalent regional tools, refer to **Special Tools**.

**NOTE:** The shimming procedure is required to be performed during service only when the following parts are replaced:

- The input shaft
- The counter shaft
- The main shaft
- The adapter plate
- The main housing
- The extension housing

**Input Shaft, Main Shaft and Counter Shaft**

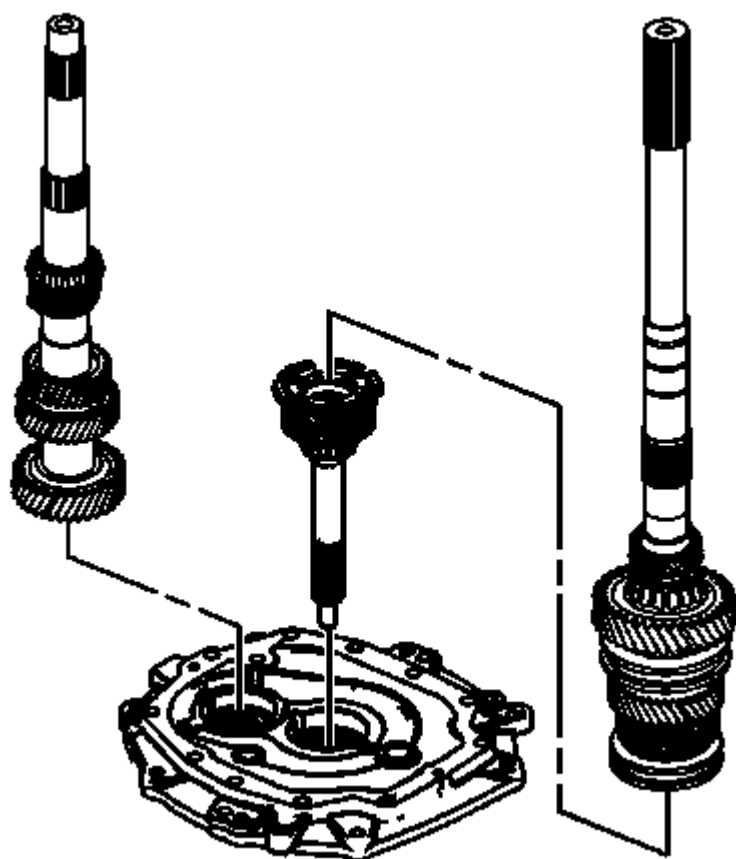


**Fig. 162: View Of Countershaft, Mainshaft Assembly, Input Shaft & Adapter Plate**  
Courtesy of GENERAL MOTORS COMPANY

1. Rotate the transmission adapter plate to the vertical position.
2. Install the following assemblies in order:
  1. The input shaft to the adapter plate (With its corresponding bearing cone previously assembled).
  2. Install the pocket bearing in the input shaft.
  3. Align the 4th speed gear blocking ring to the input shaft.
  4. The main shaft assembly (With its corresponding bearing cone previously assembled).

**NOTE:** Lift up the main shaft enough to install the counter shaft.

5. The counter shaft (With its corresponding bearing cone previously assembled).
6. Install the corresponding transmission case-to-adapter plate gasket.

**NOTE:** Adapter plate and main case bearing races must be previously assembled.

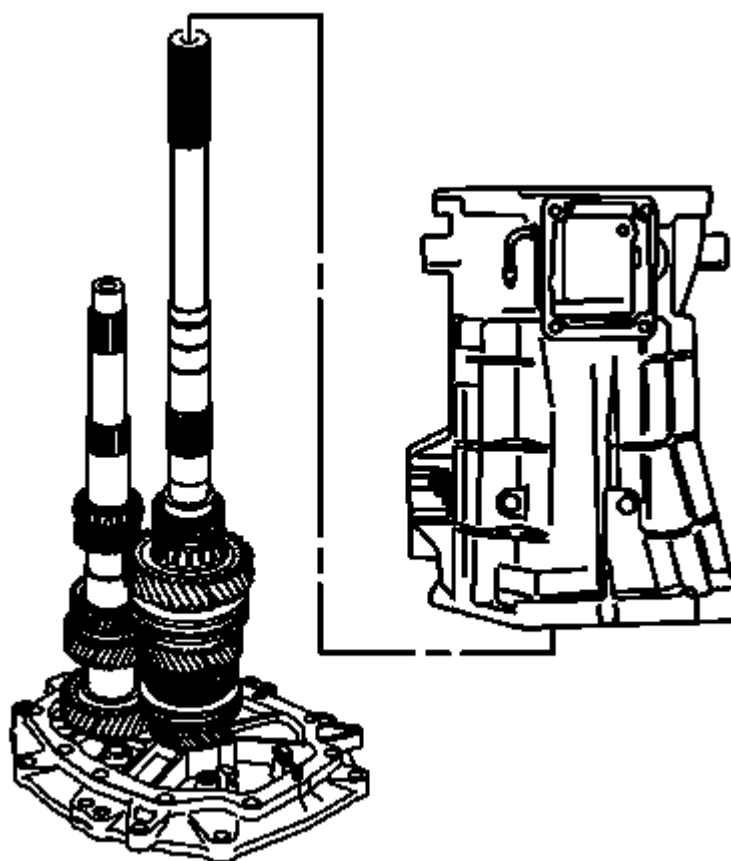


**Fig. 163: View Of Transmission Case**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Install the transmission case.

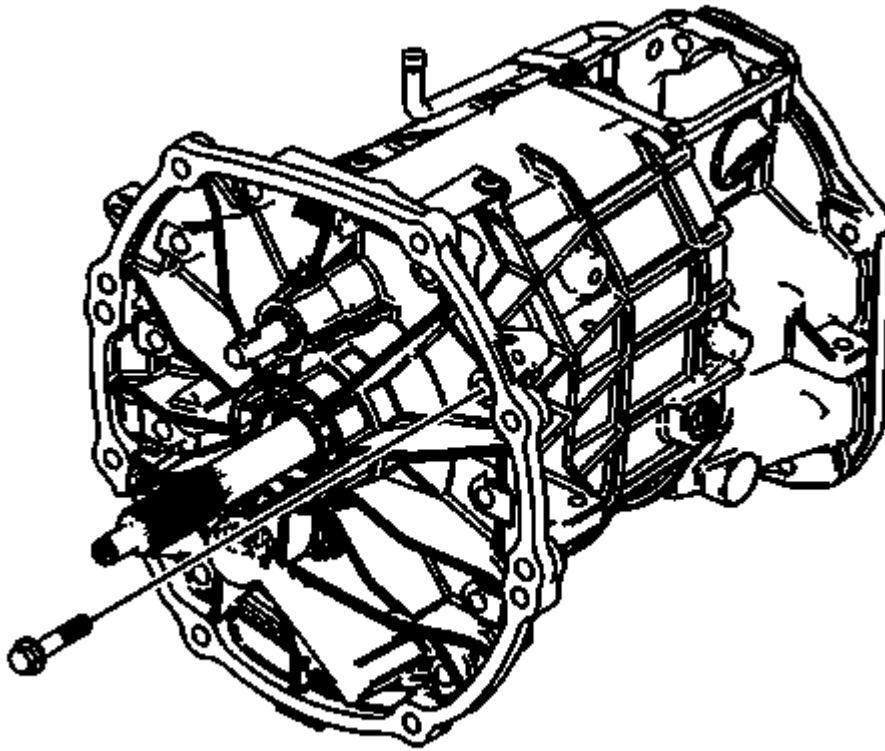


**Fig. 164: View Of Adapter Plate & Transmission Case Bolts**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

4. Install the adapter plate to transmission case bolts and tighten to 36 N.m (27 lb ft).

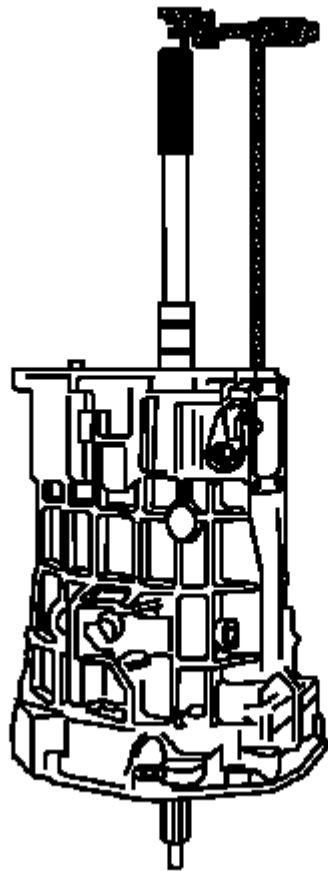


**Fig. 165: Input Shaft/Mainshaft End Play & J 8001**  
**Courtesy of GENERAL MOTORS COMPANY**

5. Measure the input shaft/main shaft end play using the following procedure:
  1. Place the tip of the **DT-8001-3** indicator set on the end of the main shaft.
  2. Move the main shaft up and down.
  3. Record the measurement.
6. Select a shim to achieve 0.038 - 0.1143 mm (0.0015 - 0.0045 in) preload.
7. Remove the **DT-8001-3** indicator set.

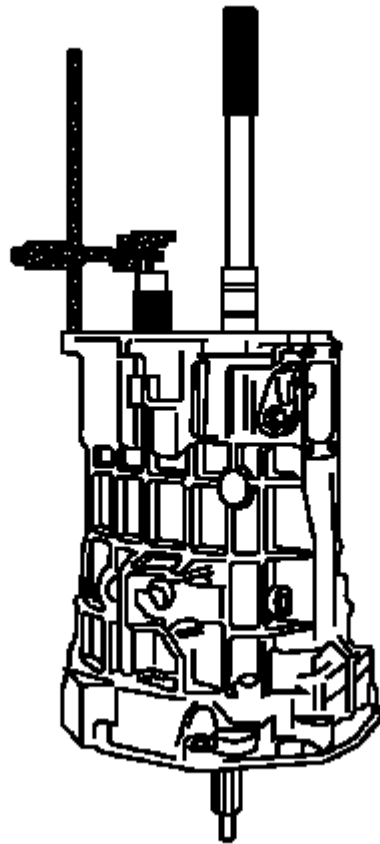


**Fig. 166: View Of Special Tool On End Of Countershaft**  
**Courtesy of GENERAL MOTORS COMPANY**

8. Measure the counter shaft end play using the following procedure:
  1. Place the tip of the **DT-8001-3** indicator set on the end of the counter shaft.
  2. Move the counter shaft up and down.
  3. Record the measurement.
9. Select a shim to achieve 0.025 - 0.1016 mm (0.001 - 0.004 in) preload.
10. Remove the **DT-8001-3** indicator set.

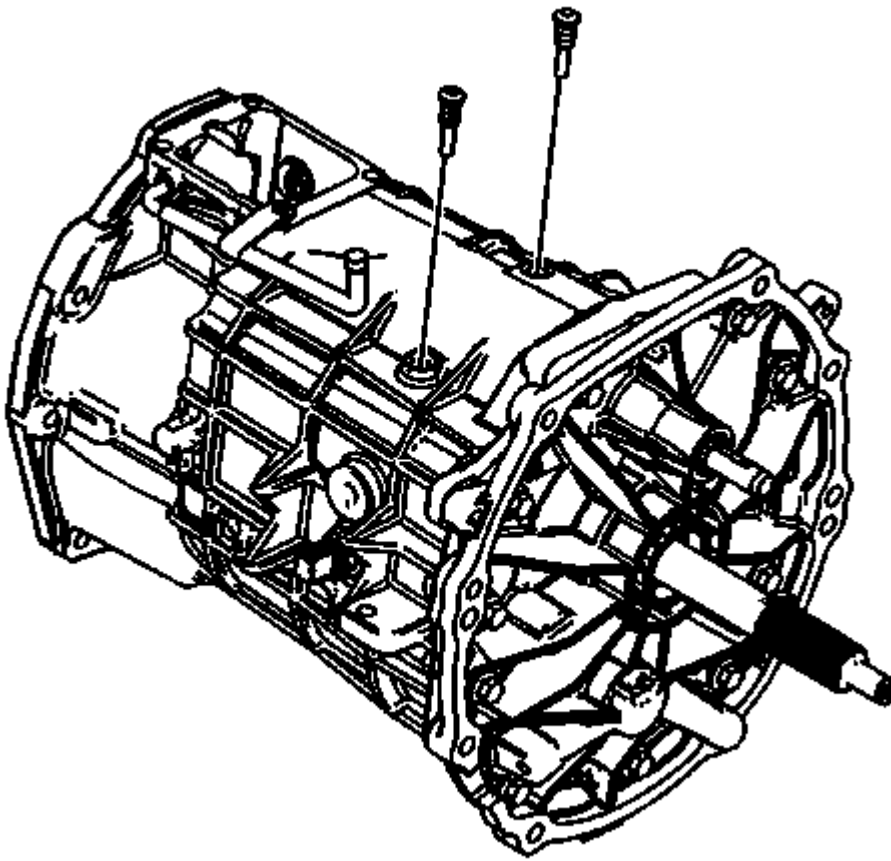


**Fig. 167: View Of Shift Lever Guide Bolts**  
Courtesy of GENERAL MOTORS COMPANY

11. Remove the shift lever guide bolts.

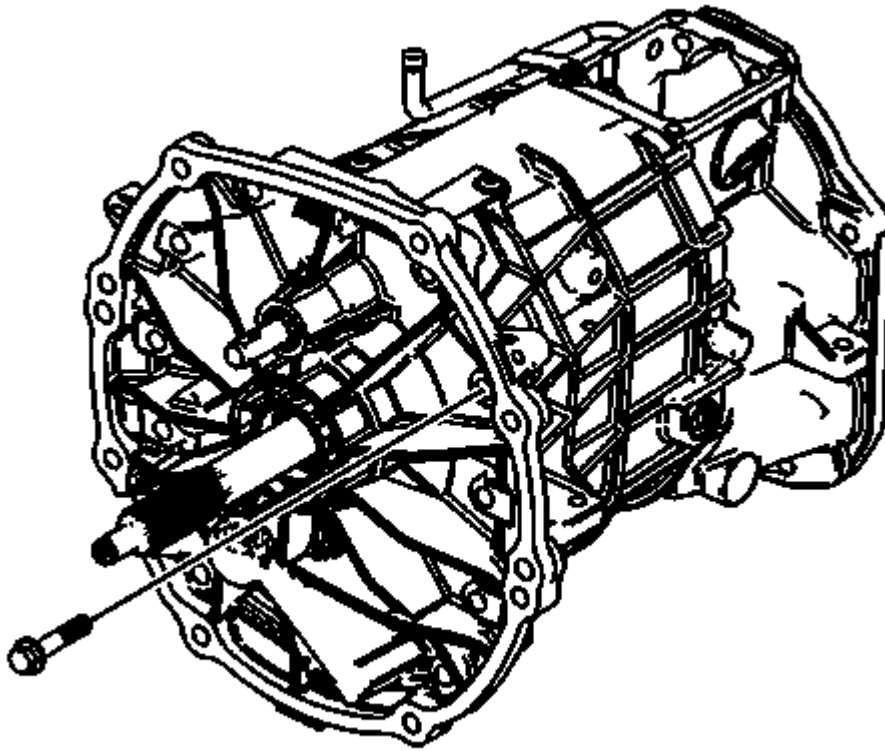


**Fig. 168: View Of Adapter Plate & Transmission Case Bolts**  
Courtesy of GENERAL MOTORS COMPANY

12. Remove the adapter plate to the transmission case bolts.

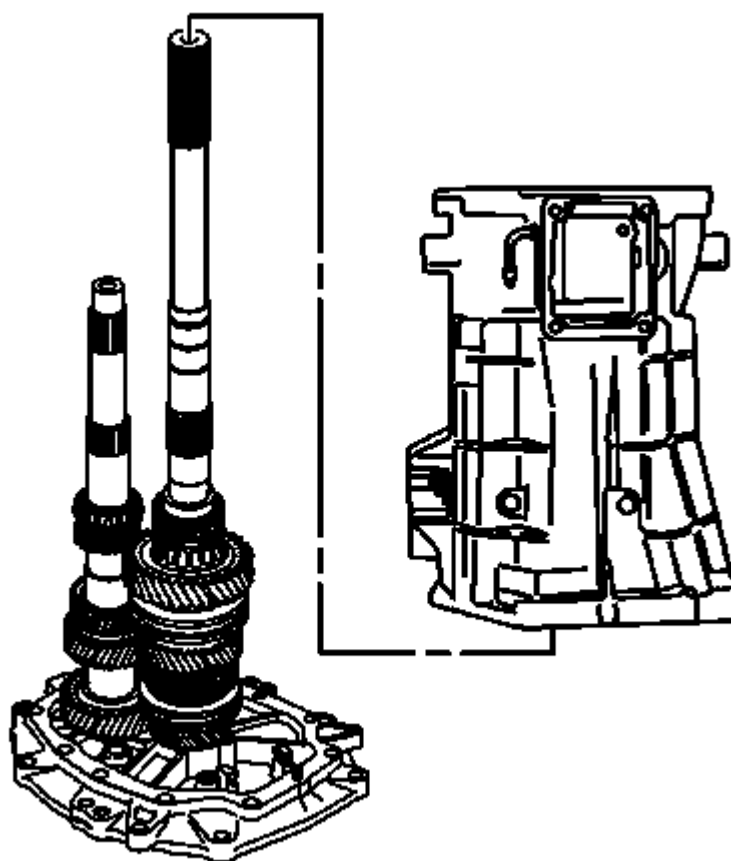


**Fig. 169: View Of Transmission Case**  
**Courtesy of GENERAL MOTORS COMPANY**

13. Remove the transmission case.

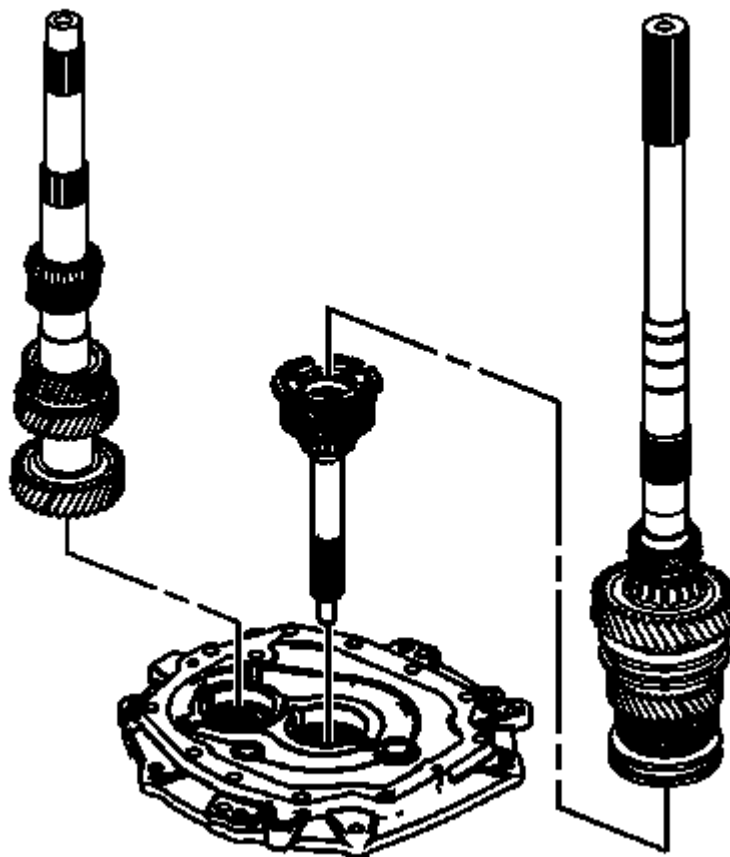


**Fig. 170: View Of Countershaft, Mainshaft Assembly, Input Shaft & Adapter Plate**  
**Courtesy of GENERAL MOTORS COMPANY**

14. Remove the following parts in order:

**NOTE:** Lift up the main shaft enough to remove the counter shaft.

1. The counter shaft
2. The main shaft assembly
3. The input shaft from the adapter plate

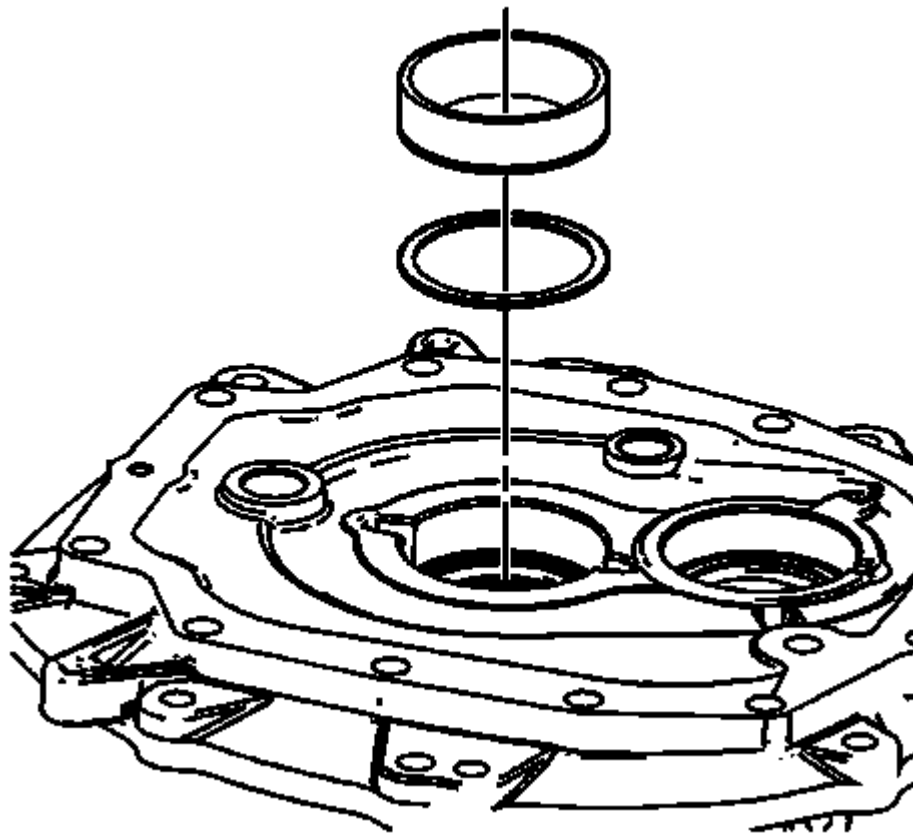


**Fig. 171: View Of Input Shaft Bearing Race**  
**Courtesy of GENERAL MOTORS COMPANY**

15. Remove the input shaft bearing race.
16. Remove the input shaft bearing shim and discard.
17. Install the new input shaft bearing shim and the original bearing race.

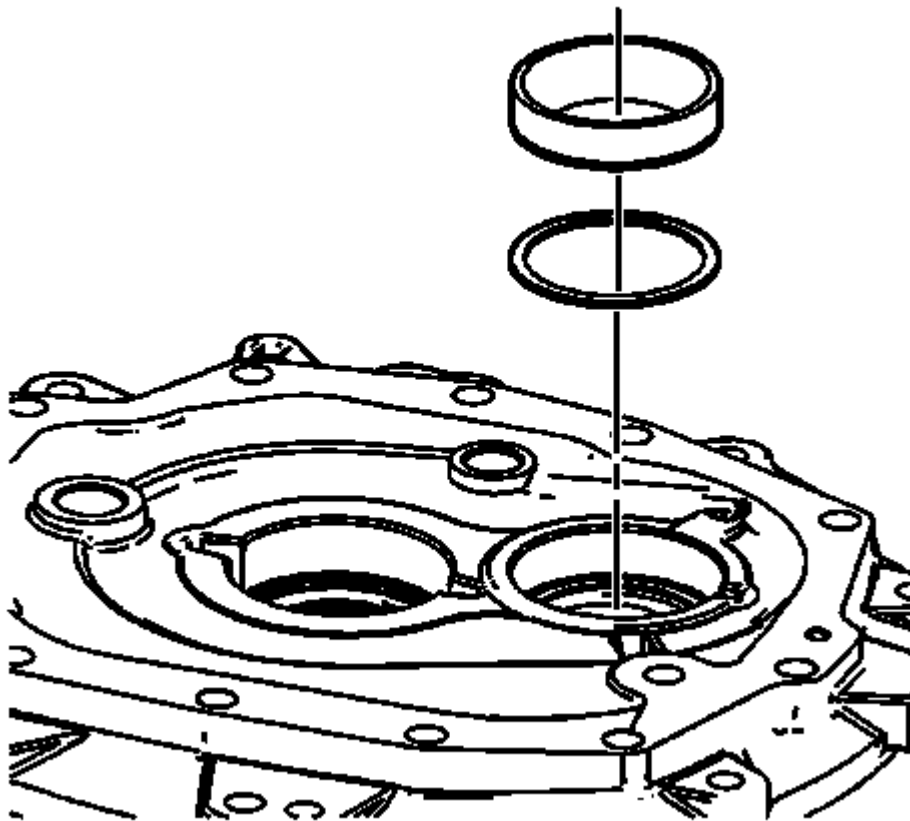


**Fig. 172: View Of Countershaft Bearing Race**  
Courtesy of GENERAL MOTORS COMPANY

18. Remove the counter shaft bearing race.
19. Remove the counter shaft bearing shim and discard.
20. Install the new input shaft bearing shim and the original bearing race.
21. Refer to **Transmission Assemble**.

## **DESCRIPTION AND OPERATION**

### **TRANSMISSION IDENTIFICATION INFORMATION**

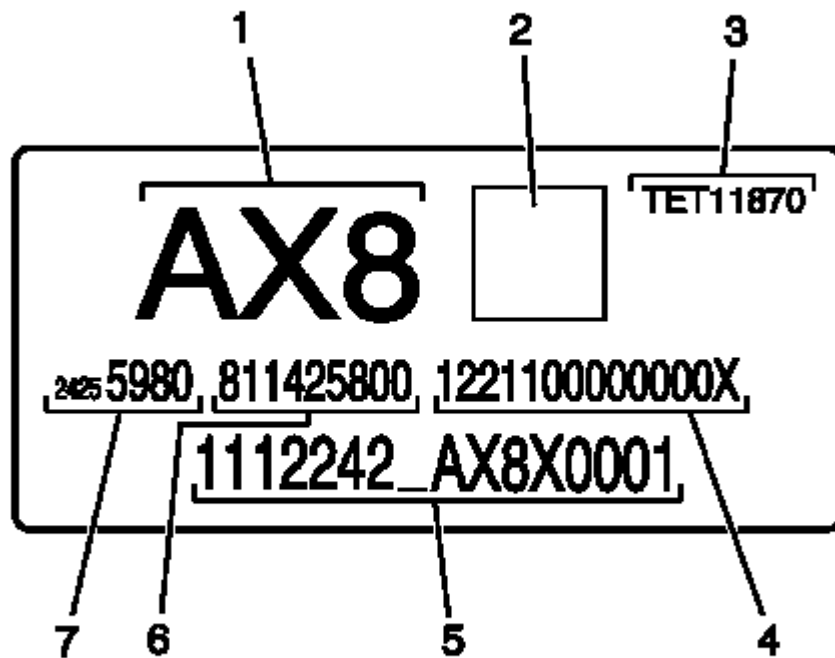


**Fig. 173: Transmission Identification**

Courtesy of GENERAL MOTORS COMPANY

1. Broadcast Code
2. 2D Machine Readable Matrix
3. Transmission Assembly Number
4. Vehicle Partitioning and Product Structure Code (VPPS)
5. GM Traceability Code
6. Manufacturing or Assembly Site Data Universal Numbering System (DUNS)
7. GM Part Number

## MANUAL TRANSMISSION DESCRIPTION AND OPERATION

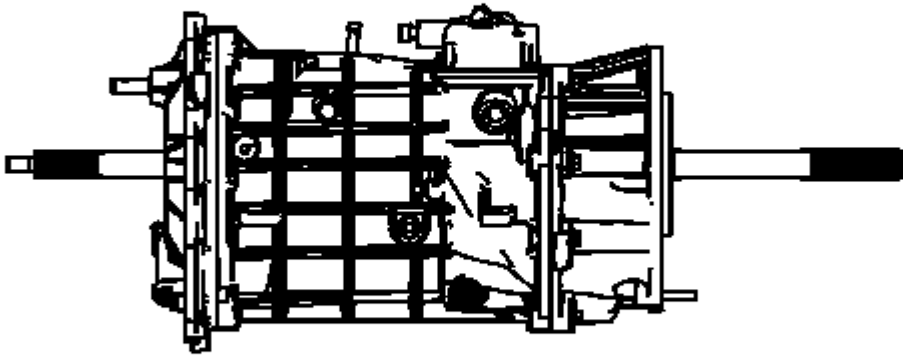


**Fig. 174: Manual Transmission Description and Operation**  
**Courtesy of GENERAL MOTORS COMPANY**

Manual transmissions are identified by the number of forward gears and the measured distance between the centerline of the output shaft and the counter gear.

The 7-speed manual transmission (RPO MEP/MEL) incorporates the following features:

- An aluminum case
- Fully synchronized gearing with an enhanced synchronizer cone arrangement:
  - Triple-cone hybrid rings: FIRST, SECOND
  - Double-cone hybrid rings: THIRD, FOURTH, FIFTH, SIXTH, SEVENTH
  - Double-cone sintered bronze ring: REVERSE
- An internal shift rail mechanism
- A remote transmission shift control mounted forward of the transmission
- An external transmission shift rod enabling the forward mount location of the transmission shift control
- An extended-length transmission output shaft mating directly to the rear axle drive pinion, in the rear of the differential housing

- Tapered roller bearings supporting the mainshaft and countershaft
- Caged roller bearings under all speed gears
- Solenoid inhibit of SECOND and THIRD gears
- Solenoid inhibit of REVERSE gear during predefined forward motion
- Mechanical inhibit of REVERSE gear during 7th to 6th shift

The gear ratios are as follows:

| <b>Gear</b> | <b>MEP Ratio (:1)</b> | <b>MEL Ratio (:1)</b> |
|-------------|-----------------------|-----------------------|
| FIRST       | 2.66                  | 2.97                  |
| SECOND      | 1.78                  | 2.06                  |
| THIRD       | 1.30                  | 1.43                  |
| FOURTH      | 1.00                  | 1.00                  |
| FIFTH       | 0.74                  | 0.71                  |
| SIXTH       | 0.50                  | 0.57                  |
| SEVENTH     | 0.42                  | 0.48                  |
| REVERSE     | 2.53                  | 2.85                  |

#### Shift Control and Shift Rod

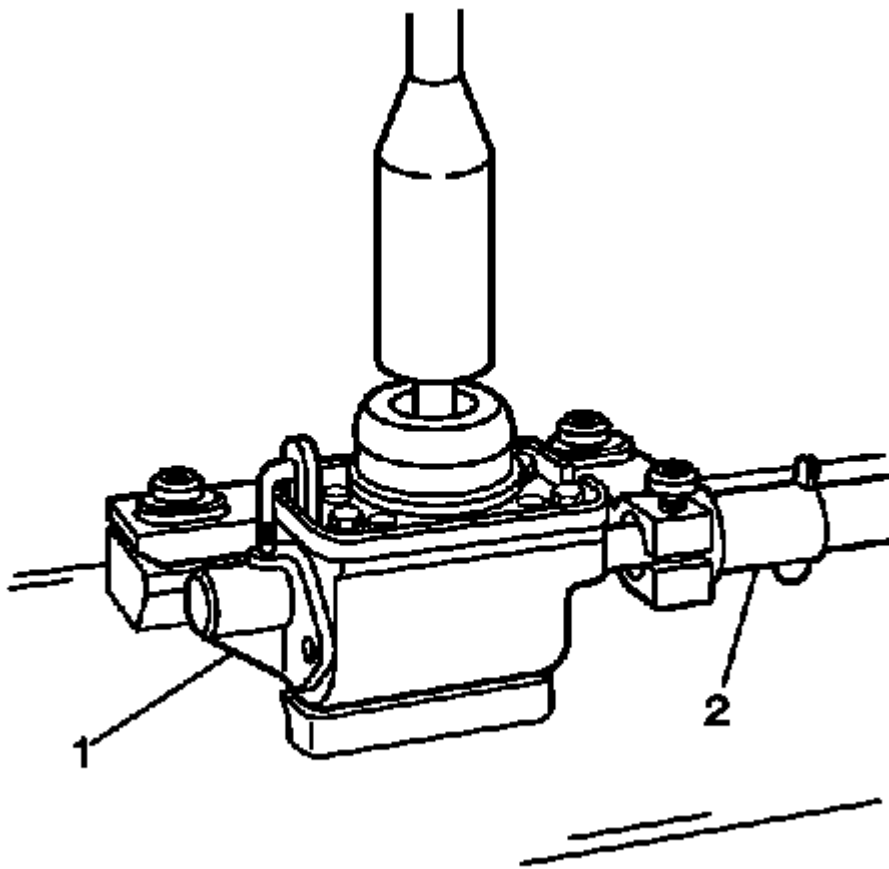


**Fig. 175: Shift Control and Shift Rod**  
Courtesy of GENERAL MOTORS COMPANY

To allow the rear-of-vehicle transmission location, the transmission shift shaft has been relocated to the front of the transmission. The shift shaft is connected to a transmission shift rod (2) which contains two sealed universal-style joints, enabling the range of motion necessary in order to shift gears. The shift rod (2) is connected to the transmission shift control (1) which is a lubricated and sealed unit, mounted to the driveline support assembly. The mounting system utilized for the shift control (1) incorporates rubber insulators. The cockpit of the vehicle is isolated from the driveline through the use of a shift control closeout boot which seals off the shift control and the driveline tunnel shift control opening.

#### **Gear Select - Skip Shift**

To ensure good fuel economy and compliance with federal fuel economy standards, SECOND and THIRD gears are inhibited when shifting out of FIRST gear under the following conditions:

- Coolant temperature is above 76°C (169°F).
- Vehicle speed is 24-31 km/h (15-19 mph).
- Throttle is opened 21 percent or less.

## **Reverse Lockout**

A reverse lockout system, consisting of a reverse lockout solenoid which operates a reverse lockout mechanism, is utilized to prevent shifting into REVERSE gear when the vehicle is moving forward at a speed of 5 km/h (3 mph) or more.

A reverse lockout mechanical system is utilized to prevent shifting into REVERSE gear during a downshift from 7th to 6th speed.

## **REVERSE INHIBIT DESCRIPTION AND OPERATION**

The reverse inhibit solenoid is a safety feature which prevents an inadvertent shift into reverse at speeds above 5 km/h (3 mph). The system consist of the following components:

- The powertrain control module (PCM).
- The reverse inhibit solenoid.

With the ignition ON, battery voltage is supplied directly to the reverse inhibit solenoid. At forward speeds above 5 km/h (3 mph) the PCM opens the control circuit of the reverse inhibit solenoid. This de-energizes the solenoid and mechanically blocks the shift lever from going into the REVERSE position.

## **SKIP SHIFT DESCRIPTION AND OPERATION**

The skip shift solenoid is a performance feature which forces the driver to shift from first gear to fourth gear during light acceleration and low engine load conditions. This feature is used to ensure good fuel economy and compliance with federal economy standards. The skip shift system consist of the following components:

- The powertrain control module (PCM).
- The skip shift solenoid.
- The skip shift lamp.

With the ignition ON, battery voltage is supplied directly to the skip shift solenoid. The powertrain control module (PCM) controls the solenoid by grounding the control circuit. When the skip shift system is active the PCM also grounds the control circuit of the skip shift lamp. The lamp illuminates to inform the driver that the 1-4 skip shift is engaged. The PCM determines when the skip shift system is active when the following parameters are met:

- The vehicle speed is between 24-31 km/h (15-19 mph).
- The engine coolant temperature (ECT) is greater than 77°C (171°F).
- The BARO is greater than 76 kPa.
- The accelerator pedal position (APP) is less than 21 percent.

When the conditions are met the powertrain control module (PCM) grounds the skip shift solenoid

going into the second or third gear positions. When the drivers pulls back on the shift lever with the system enabled the transmission will go into fourth gear.

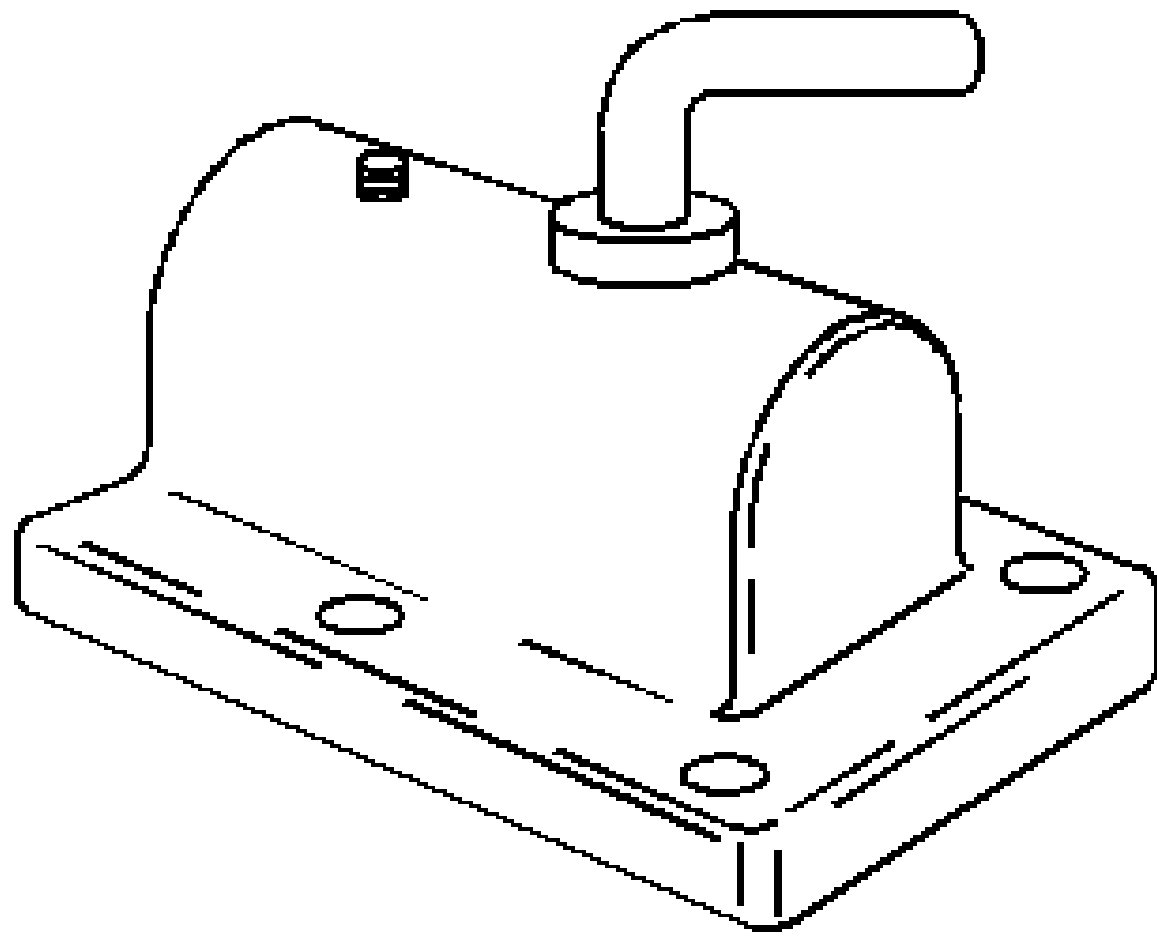
When the conditions for skip shift engagement are no longer met the powertrain control module (PCM) disables the skip shift solenoid, allowing the driver to use second and third gears.

Once the skip shift solenoid is enabled the system will not be re-enabled until the vehicle speed returns to 0 km/h (0 mph) and the conditions for enabling skip shift solenoid are met.

**SPECIAL TOOLS AND EQUIPMENT**

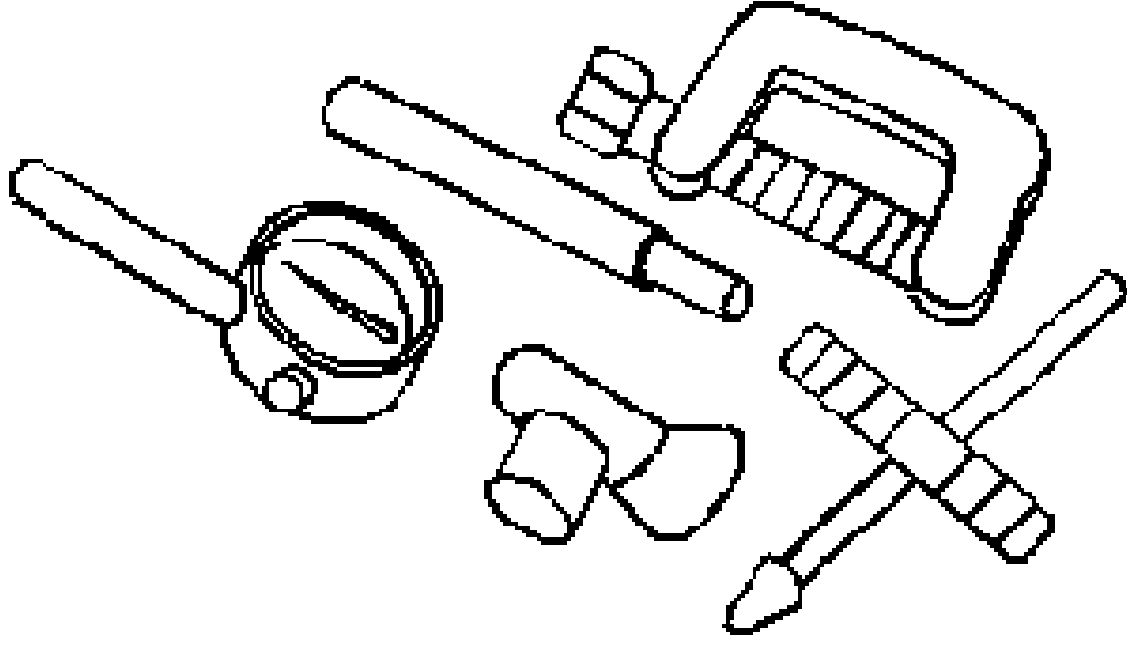
**SPECIAL TOOLS**

| Illustration | Tool Number/<br>Description                |
|--------------|--------------------------------------------|
|              | DT-3289-20<br>J-3289-20<br>Holding Fixture |



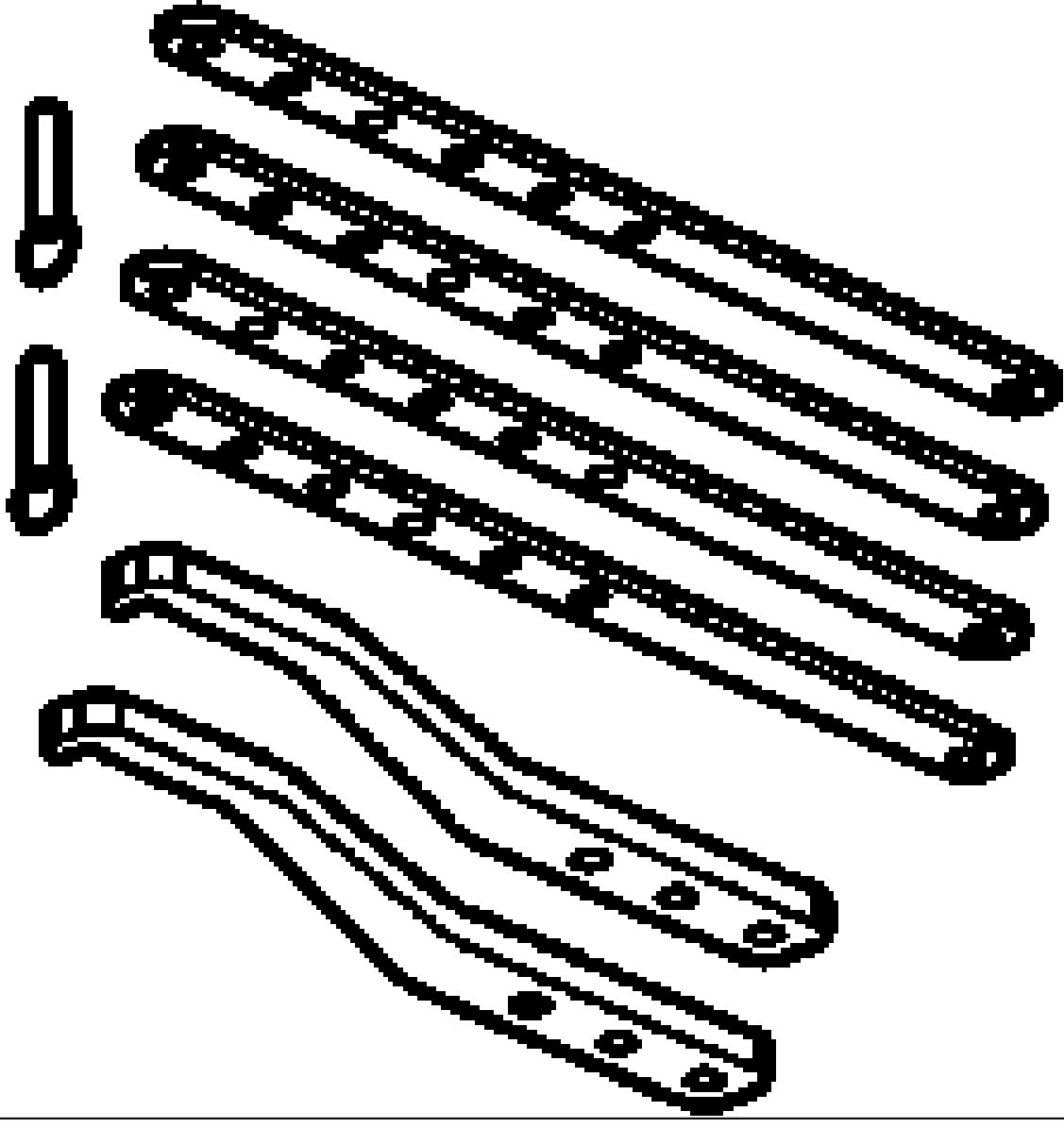
DT-5590  
J-5590  
Bearing Installer

DT-8001  
J-8001  
Dial Indicator  
Set



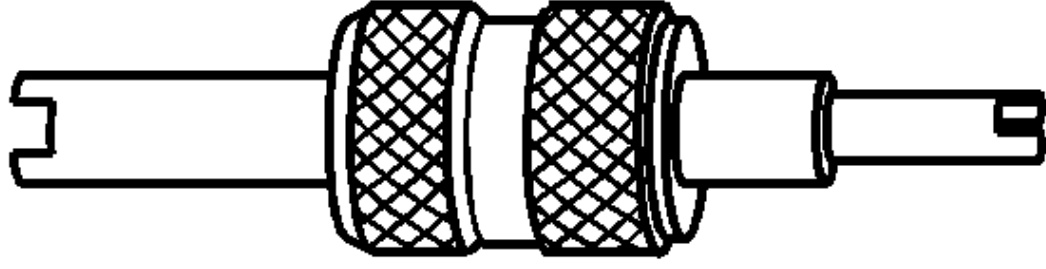
DT-22888-D  
J-22888-D  
Side Bearing  
Remover Kit

DT-22888-60  
Puller Leg  
Adapter Set



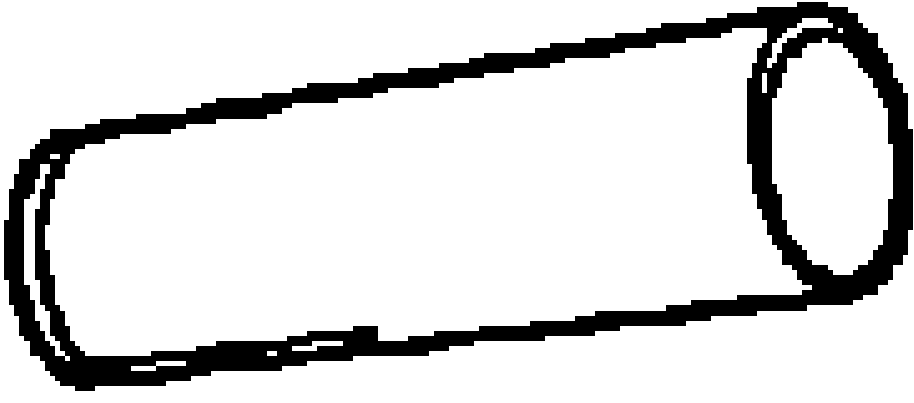
DT-22912-B  
J-22912-B  
Rear Pinion and  
Axle Bearing  
Remover

DT-25234  
J-25234  
Press Tube



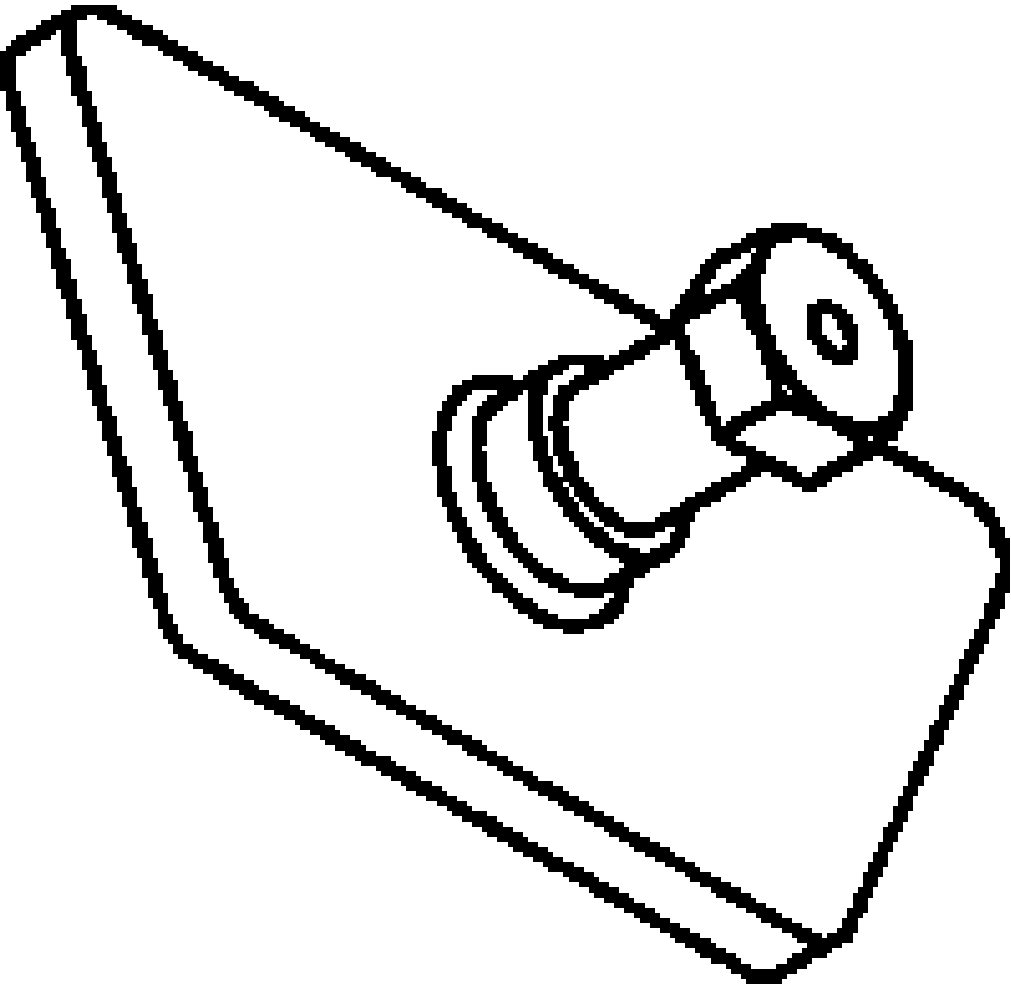
DT-35944-200A  
Cooler Flushing  
Adapter

DT-36183  
J-36183  
Press Tube



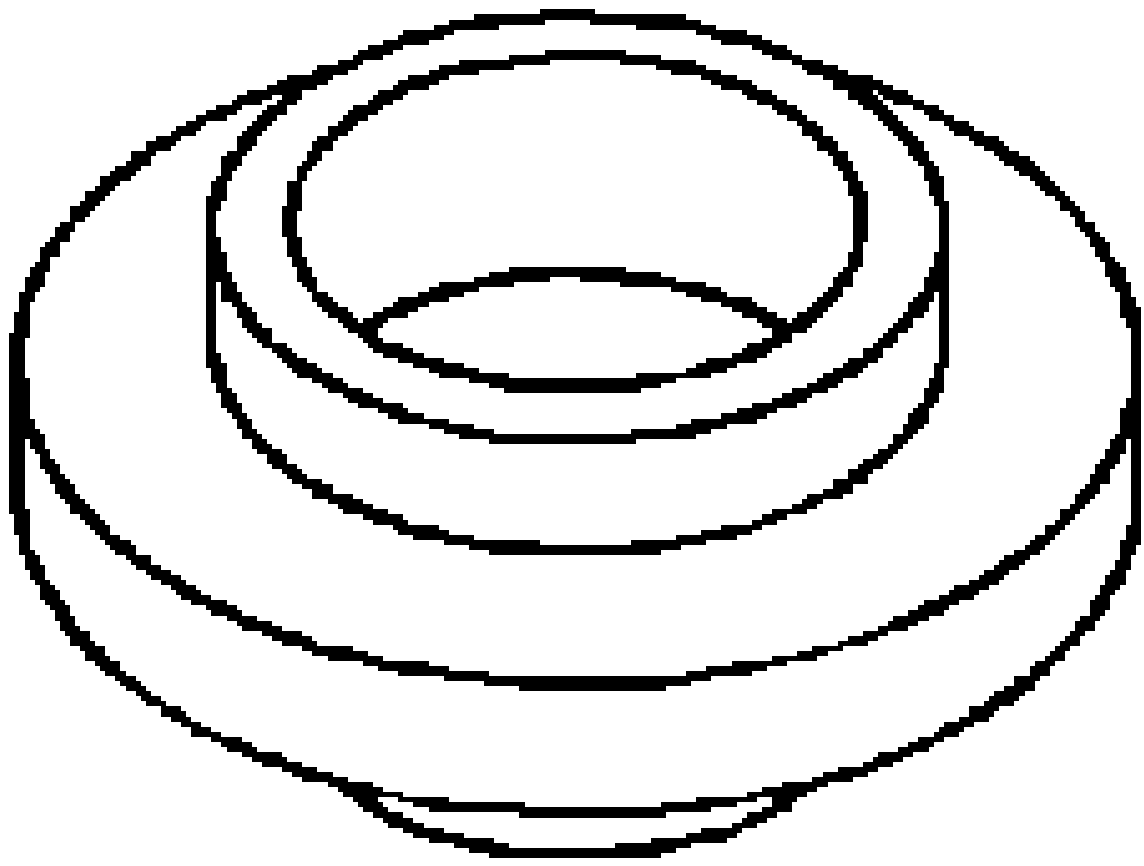
DT-36184  
J-36184  
Press Tube  
Reducer

DT-36221  
J-36221  
Hydraulic Clutch  
Line Separator



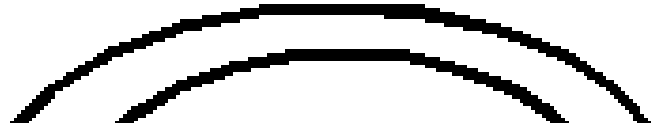
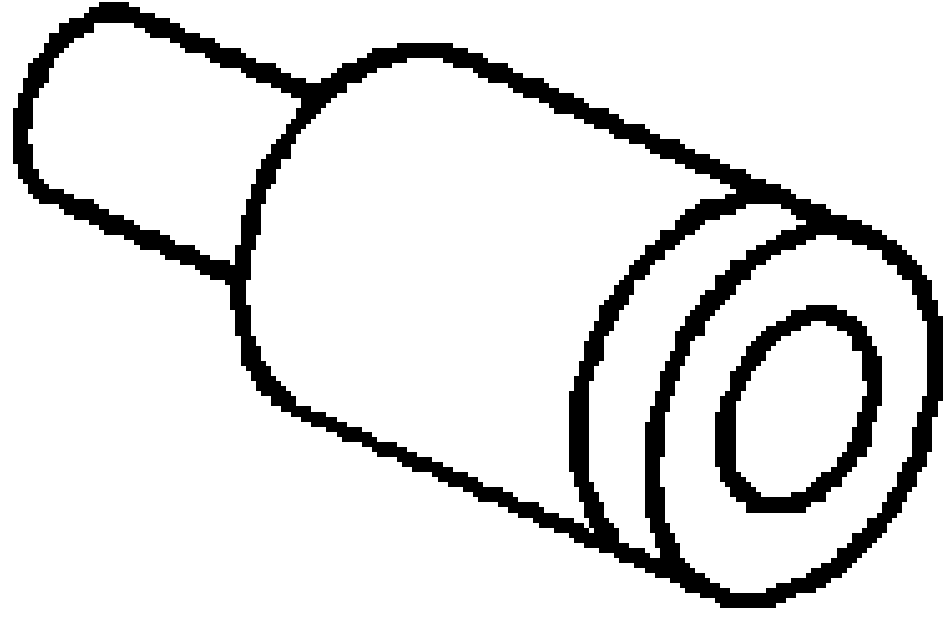
DT-36513  
J-36513  
Gear and  
Bearing  
Separator Plate

DT-39371  
J-39371  
1st/2nd  
Synchronizer  
Installer



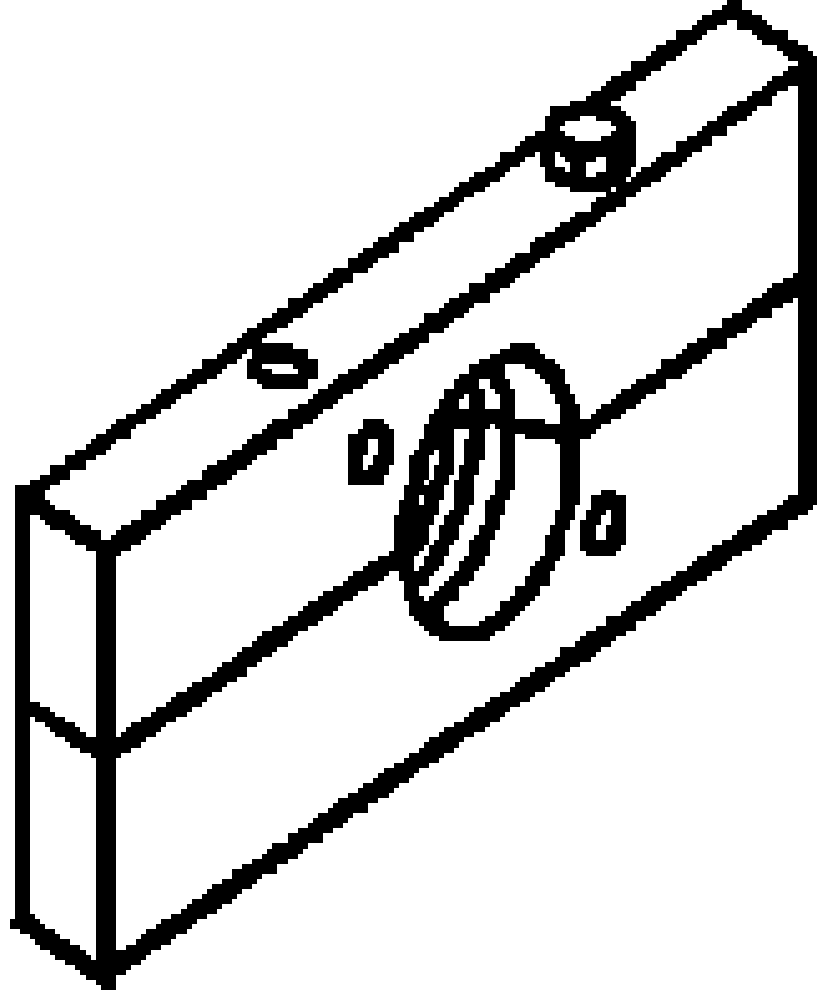
DT-39439  
J-39439  
Shift Rail  
Bushing  
Replacer

DT-39442  
J-39442  
Main Shaft and  
Counter Shaft  
Press Adapter



DT-39473  
J-39473  
Main Shaft  
Bearing Installer

DT-39511  
J-39511  
Counter Shaft  
Bearing Installer



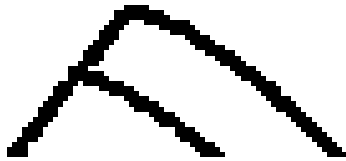
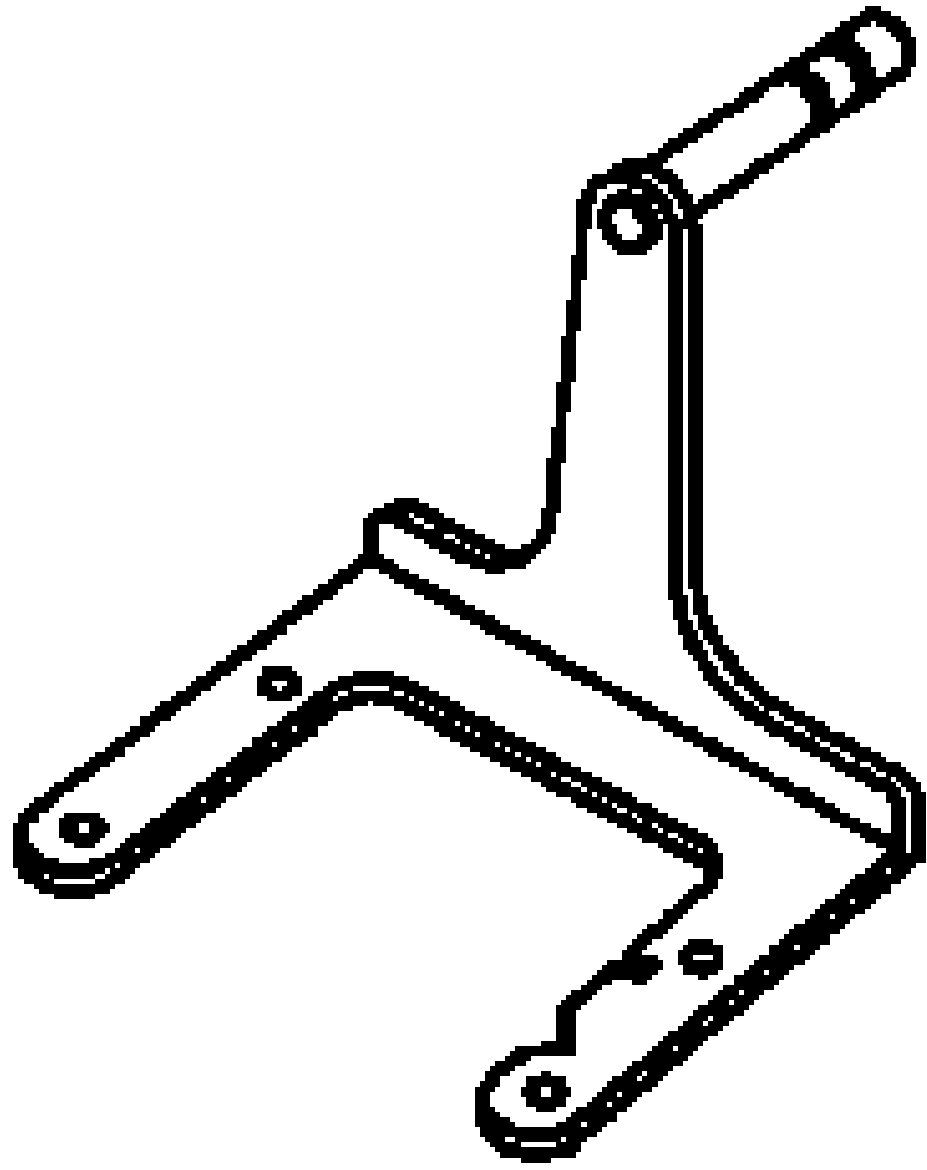
DT-39547  
J-39547  
Counter Shaft  
Press Adapter

DT-42055  
Drivetrain  
Support Fixture



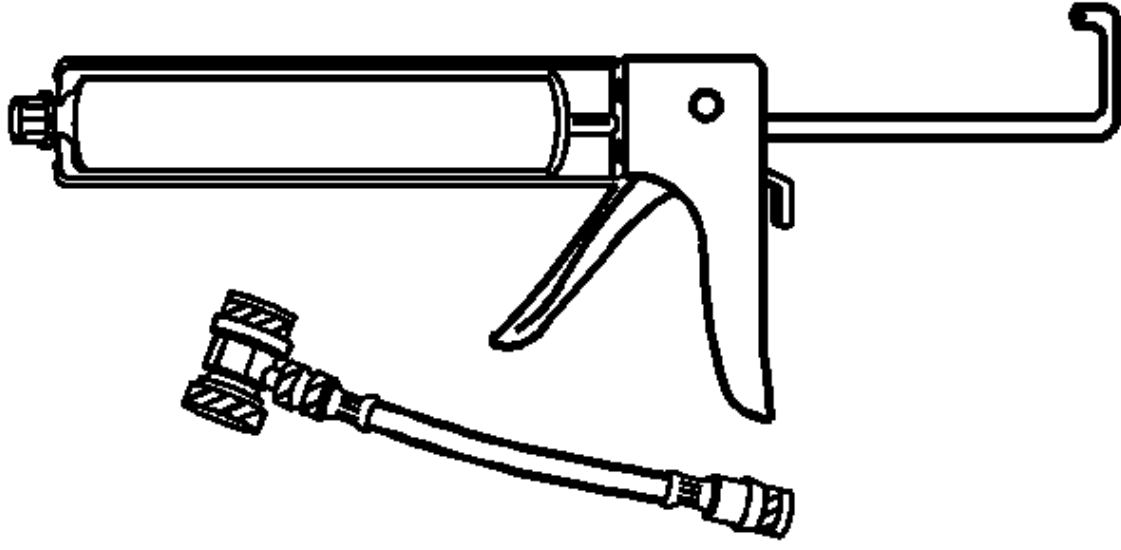
DT-44384  
J-44384  
Shift Fork  
Bearing Installer

DT-44395-B  
Transmission  
Holding Fixture



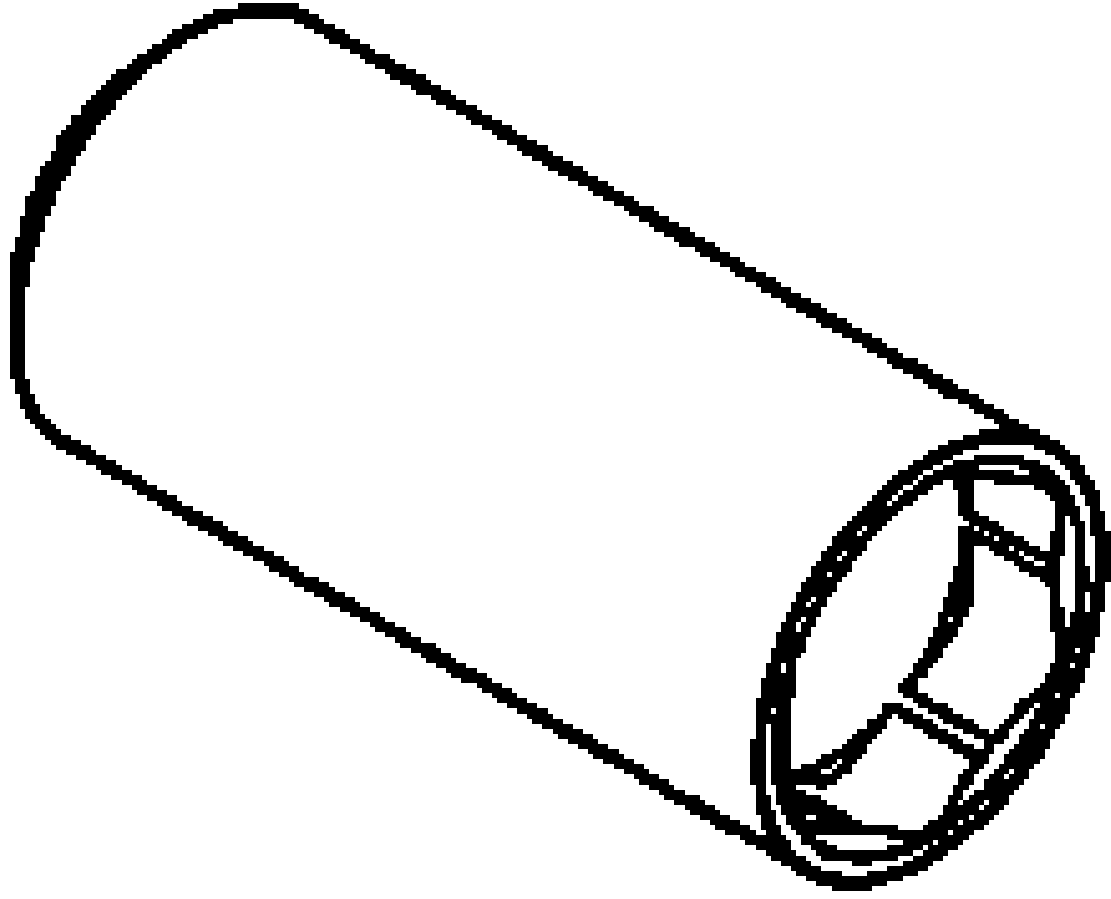
DT-44731  
J-44731  
Input Shaft Seal  
Installer

DT-45096  
Transmission Oil  
Cooling System  
Flush and Flow  
Test Tool



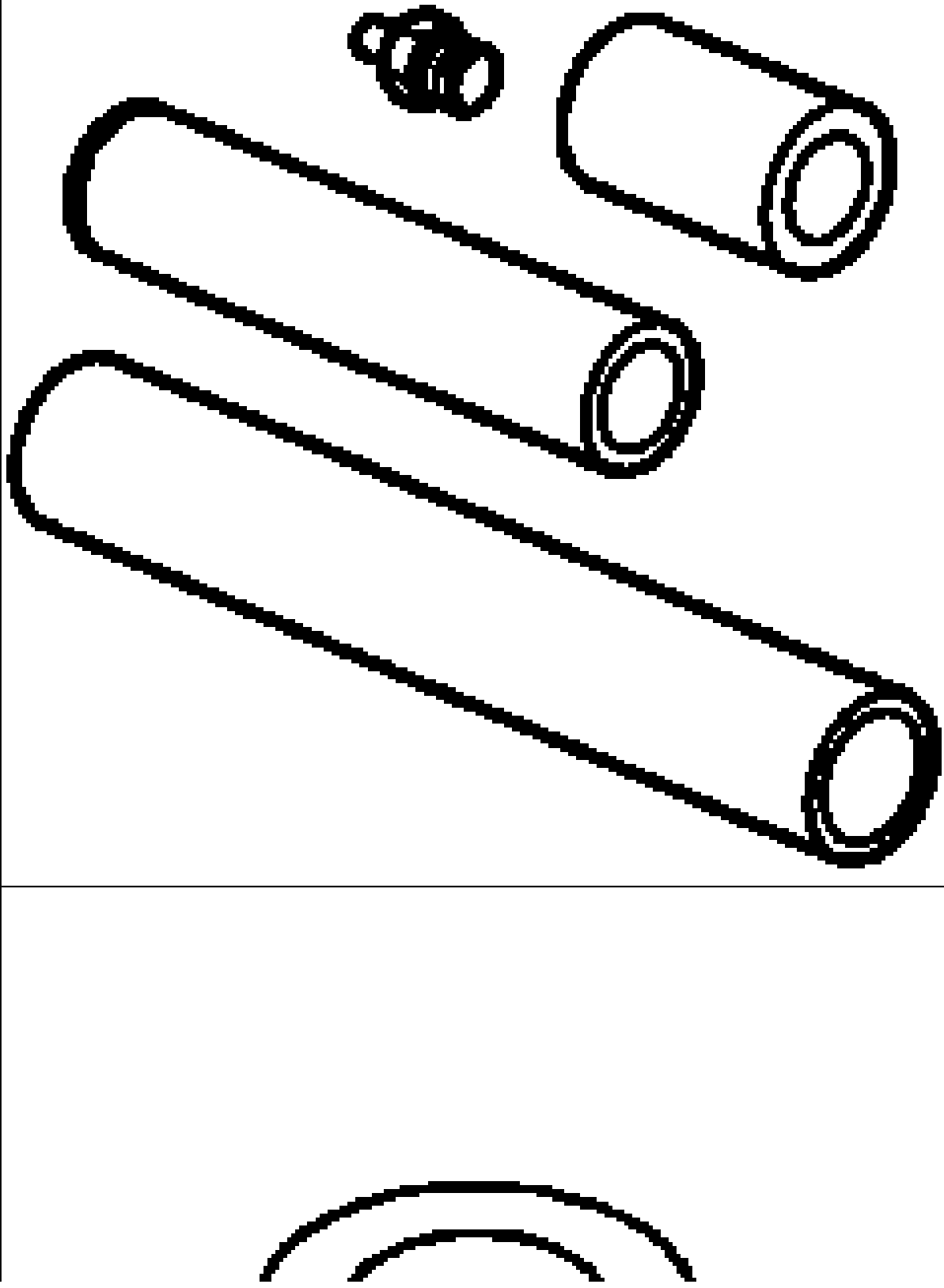
DT-45096-21  
Cooler Flushing  
Adapter

DT-49293  
Gear Select/Skip  
Shift Solenoid  
Remove/Install



DT-51076  
Bearing and  
Gear Installer

DT-51076-10  
Bearing and  
Gear Installer  
Adapter Set



EN-46359  
Puller End  
Protector

GE-36190  
J-36190  
Universal Driver  
Handle

