

TRANSMISSION

Manual Transmission - Tremec 6-Speed (MG9) - Coupe And Wagon

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Backup Lamp Switch	27 N.m	20 lb ft
Backup Lamp Switch Bracket Bolt	9 N.m	80 lb in
Clutch Housing Assembly to Transmission Case Bolts	48 N.m	36 lb ft
Clutch Housing Pump Plug	27 N.m	20 lb ft
Concentric Slave Cylinder Bolt	12 N.m	106 lb in
Coolant Temperature Sensor	39 N.m	29 lb ft
Cooler Line Return Fitting	18 N.m	13 lb ft
Cover Plate Bolts	20 N.m	15 lb ft
Extension Housing Plug	27 N.m	20 lb ft
Extension Housing to Transmission Case Bolts	48 N.m	36 lb ft
Gear Select/Skip Shift Solenoid	40 N.m	30 lb ft
Neutral Return Cam Spring Retaining Bolt	25 N.m	18 lb ft
Propshaft Transmission Yoke Nut	136 N.m	100 lb ft
Pump Outlet Cooler Fitting	17 N.m	13 lb ft
Reverse Idler Shaft Bracket Bolts	25 N.m	18 lb ft
Reverse Lockout Assembly Bolt	18 N.m	13 lb ft
Reverse Lockout Solenoid	40 N.m	30 lb ft
Shift Control Adapter Plate Bolt	18 N.m	13 lb ft
Shift Control Adapter Plate Nut	12 N.m	106 lb in
Shift Detent Assembly	40 N.m	30 lb ft
Shift Guide Plate Bolts	22 N.m	16 lb ft
Shift Lever Guide Bolts	27 N.m	20 lb ft
Shift Shaft Detent Plug	24 N.m	18 lb ft
Transmission Bolt	48 N.m	35 lb ft
Transmission Case Drain Plug	27 N.m	20 lb ft
Transmission Case Fill Plug	27 N.m	20 lb ft
Transmission Fluid Pump Outlet Pipe Fitting	18 N.m	13 lb ft
Transmission Fluid Temperature Sensor/Drain Plug	18 N.m	13 lb ft
Transmission Mount to Transmission Case Bolts	80 N.m	59 lb ft
Transmission Mount Nut	58 N.m	43 lb ft
Transmission Mount Travel Restrictor Bolt	90 N.m	66 lb ft

Transmission Support to Body Bolt	60 N.m	44 lb ft
Vehicle Speed Sensor (VSS) Bolt	11 N.m	96 lb in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Sealers, Adhesives, and Lubricants

Application	Type Of Material	GM Part Number	
		United States	Canada
Clutch Housing Assembly Plug	Sealant	12346004	10953480
Cover Plate	Sealant	12346141	89022195
Extension Housing Bolts	Sealant	12346004	10953480
Reverse Idler Shaft Bracket Bolts	Threadlocker	12345382	10953489
Reverse Lamp Switch	Sealant	12346004	10953480
Shift Lever Guide Bolts	Sealant	12346004	10953480
Temperature Switch	Sealant	12346004	10953480
Transmission Case Drain Plug	Sealant	12346004	10953480
Transmission Case to Clutch Housing Mating Surface	Sealant	12346141	89022195
Transmission Fluid	Manual Transmission Fluid	88861800	88861801

LUBRICATION SPECIFICATIONS

Lubrication Specifications

Application	Specification	
	Metric	English
Manual Transmission Fluid GM P/N 88861800 (Canadian P/N 88861801)	3.45 liters	3.65 quarts
When filled, fluid level should be at the bottom of the fluid check plug hole.		

SHIM SIZE SPECIFICATIONS

Shim Size Specifications

Application	Specification	
	Metric	English
Countershaft Shim Preload	0.0-0.05 mm	0.0-0.002 in
Input Shaft/Mainshaft Shim Preload	0.0-0.05 mm	0.0-0.002 in

SCHEMATIC WIRING DIAGRAMS

MANUAL TRANSMISSION WIRING SCHEMATICS

Tremec (MG9)

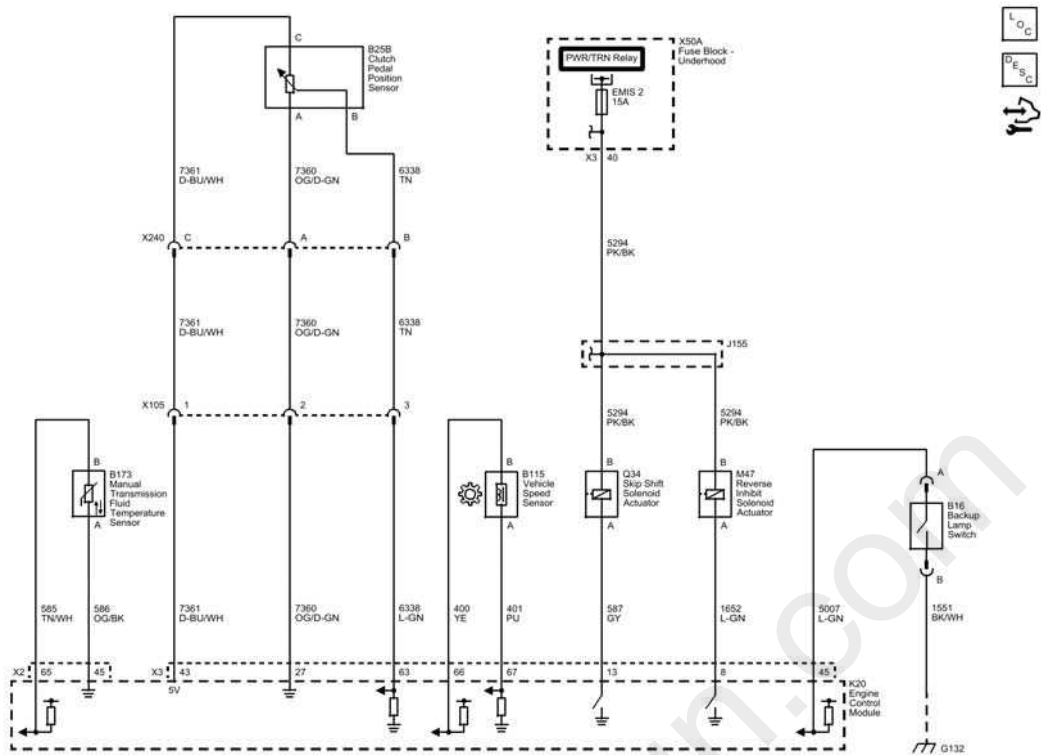


Fig. 1: Tremec (MG9)

Courtesy of GENERAL MOTORS COMPANY

VISUAL IDENTIFICATION

DISASSEMBLED VIEWS

Transmission Extension Assembly

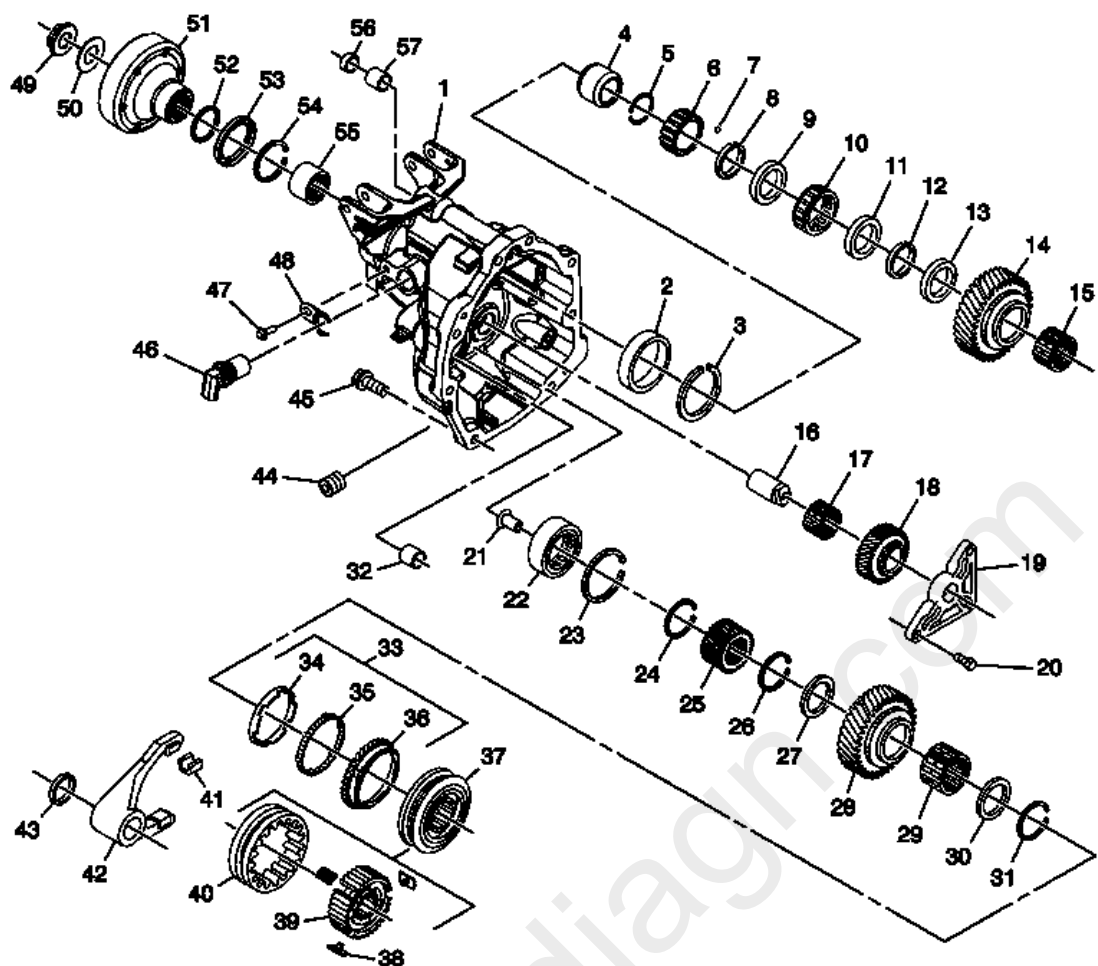


Fig. 2: Identifying Transmission Extension Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Extension Assembly
2	Mainshaft Bearing Race
3	Mainshaft Rear Bearing Race Retainer Ring
4	Extension Housing Mainshaft Bearing Race
5	Vehicle Speed Sensor Reluctor Wheel Retaining Ring
6	Vehicle Speed Sensor Reluctor Wheel
7	Vehicle Speed Sensor Reluctor Wheel Locking Ball
8	Mainshaft Rear Bearing Retainer Ring
9	Mainshaft Rear Bearing Spacer
10	Mainshaft Rear Bearing
11	Mainshaft Rear Bearing Spacer
12	Synchronizer Retainer Ring
13	Reverse Gear Thrust Washer

14	Mainshaft Reverse Speed Gear
15	Reverse Gear Bearing
16	Reverse Idler Gear Shaft
17	Reverse Idler Gear Needle Bearing
18	Reverse Idler Gear
19	Reverse Idler Bracket
20	Reverse Idler Bracket Bolt
21	Transmission Lubrication Funnel
22	Counter Gear Rear Bearing Assembly
23	Counter Gear Rear Bearing Retaining Ring
24	Reverse Counter Drive Gear Retaining Ring
25	Reverse Counter Drive Gear
26	5th Gear Retaining Ring
27	5th Gear Bearing Assembly Spacer
28	5th Speed Drive Gear
29	5th Gear Bearing Assembly
30	5th Gear Spacer
31	5th and 6th Gear Synchronizer Hub Retaining Ring
32	Reverse Rail Bushing
33	5th Gear Blocking Ring Assembly
34	5th Speed Gear Inner Cone
35	5th Speed Gear Friction Cone
36	5th Gear Synchronizer Blocking Ring
37	5th/6th Synchronizer Assembly
38	5th/6th and Reverse Synchronizer Insert
39	5th/6th Synchronizer Hub
40	5th/6th Synchronizer Sleeve
41	Shift Fork Pad
42	5th/6th Shift Fork
43	5th Gear Shift Fork Retaining Ring
44	Transmission Oil Drain Plug
45	Transmission Extension Assembly Bolt
46	Vehicle Speed Sensor
47	Vehicle Speed Sensor Bolt
48	Vehicle Speed Sensor O-Ring
49	Propshaft Transmission Yoke Nut
50	Propshaft Transmission Yoke Washer
51	Propshaft Transmission Yoke
52	Propshaft O-Ring
53	Output Shaft Seal
54	Mainshaft Rear Bearing Retaining Ring

	Mainshaft Rear Bearing Assembly
56	Shift Rail Seal
57	Shift Rail Bearing

Reverse Gear Lockout Solenoid Housing Assembly

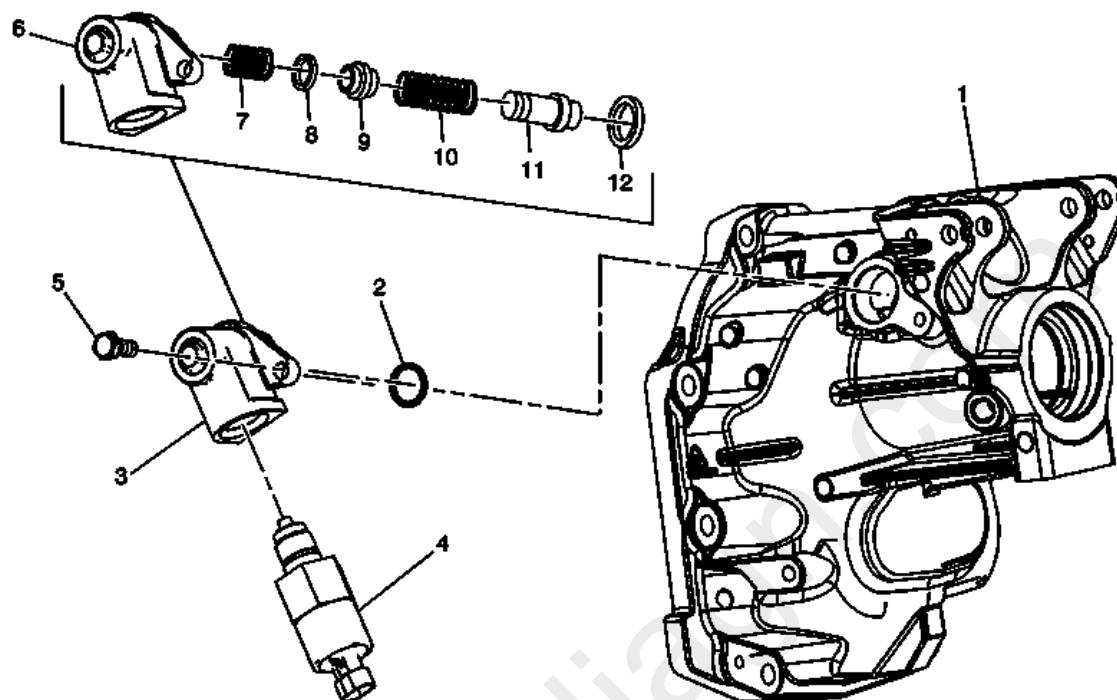


Fig. 3: Identifying Reverse Gear Lockout Solenoid Housing Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Extension Assembly
2	Reverse Gear Solenoid Housing Assembly O-Ring
3	Reverse Gear Lockout Solenoid Housing Assembly
4	Manual Transmission Reverse Gear Lockout Solenoid
5	Reverse Gear Solenoid Housing Bolt
6	Reverse Gear Solenoid Housing
7	Reverse Interlock Plunger Return Spring
8	Reverse Latch Retaining Ring
9	Reverse Latch Collar
10	Reverse Latch Plunger Spring
11	Reverse Latch Plunger
12	Reverse Shaft Blocking Retaining Ring

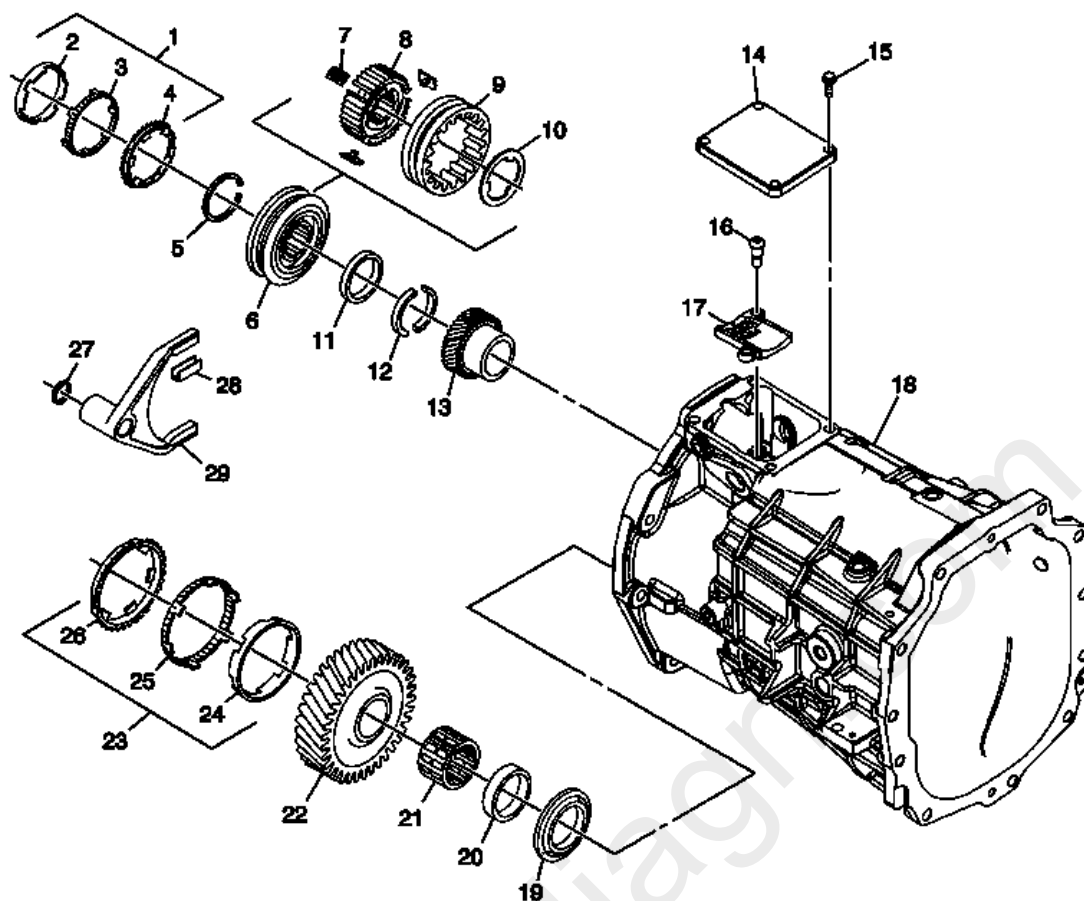


Fig. 4: Identifying Transmission Case (1 of 2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Reverse Gear Blocking Ring Assembly
2	Reverse Gear Inner Cone
3	Reverse Gear Outer Cone
4	Reverse Gear Blocker Ring
5	Reverse Synchronizer Retaining Ring
6	Reverse Synchronizer Assembly
7	Reverse Synchronizer Insert
8	Reverse Synchronizer Hub
9	Reverse Synchronizer Sleeve
10	Reverse Synchronizer Key Retainer
11	Reverse Gear Thrust Washer Locking Ring
12	Reverse Synchronizer Two Piece Washer
13	5th Speed Driven Gear

14	Shift Interlock Plate
15	Shift Interlock Plate Bolt
16	Guide Plate Bolt
17	Guide Plate
18	Transmission Case
19	Spacer
20	6th Speed Drive Gear Bearing Spacer
21	6th Speed Drive Gear Needle Bearing
22	6th Speed Drive Gear
23	6th Gear Blocking Ring Assembly
24	6th Speed Drive Gear Inner Cone
25	6th Speed Drive Gear Outer Cone
26	6th Speed Drive Gear Synchronizer Blocking Ring
27	Reverse Shift Fork Retainer Ring
28	Reverse Shift Fork Pad
29	Reverse Shift Fork

Transmission Case (2 of 2)

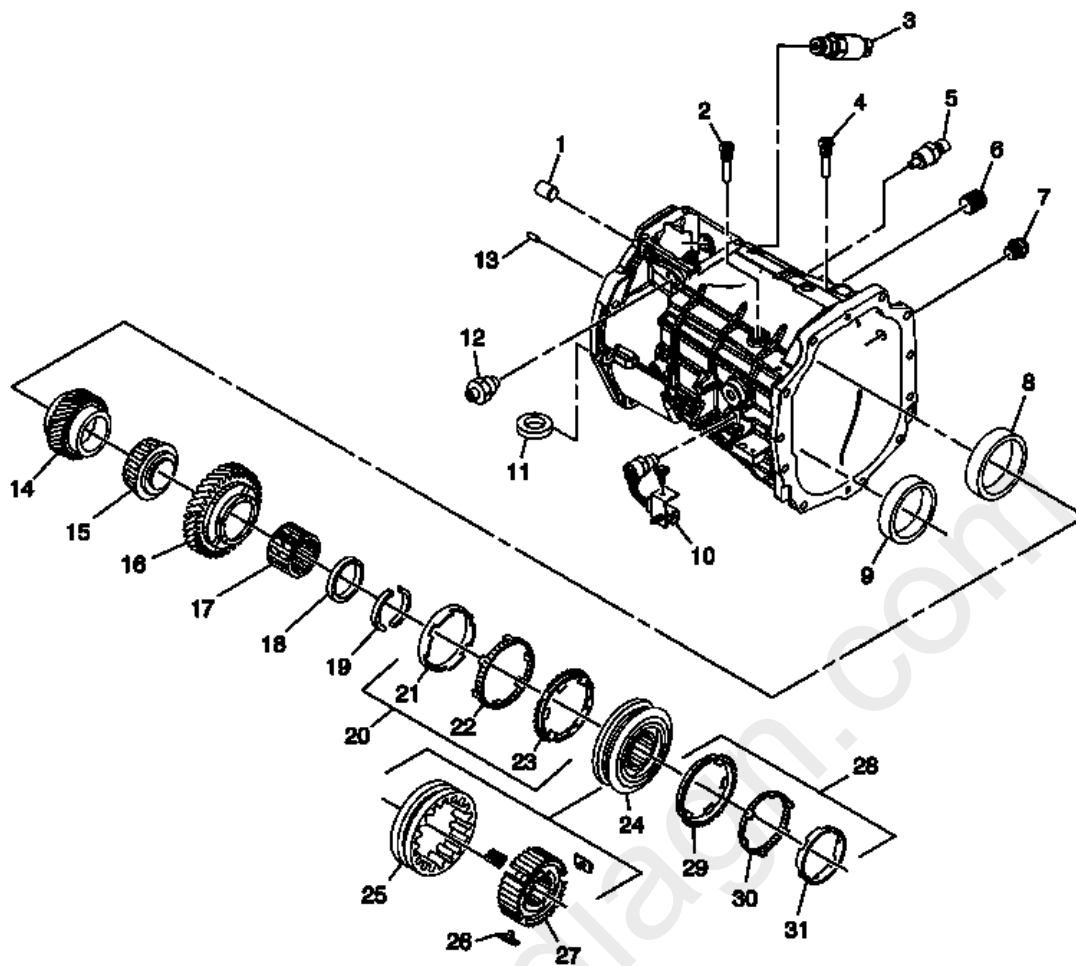


Fig. 5: Identifying Transmission Case (2 of 2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1st/2nd and 3rd/4th Shift Shaft Bearing
2	5th/6th Lever Guide Bolt
3	Skip Shift Solenoid
4	Interlock Guide Bolt
5	Coolant Temperature Sensor
6	Oil Fill Plug
7	Cooler Line Return Fitting
8	Mainshaft Center Bearing Race
9	Countershaft Bearing Race
10	Backup Lamp Switch Assembly
11	Magnet
12	Shift Detent Assembly
13	Case Rear Extension Pin

14	6th Speed Driven Gear
15	Mainshaft Center Bearing
16	1st Speed Drive Gear
17	1st Speed Drive Gear Needle Bearing
18	1st Speed Drive Gear Locking Ring
19	1st Speed Gear Two Piece Washer
20	1st Gear Blocking Ring Assembly
21	1st Speed Drive Gear Inner Cone
22	1st Speed Drive Gear Outer Cone
23	1st Gear Synchronizer Blocking Ring
24	1st/2nd Synchronizer Assembly
25	1st/2nd Synchronizer Sleeve
26	1st/2nd Synchronizer Insert
27	1st/2nd Synchronizer Hub
28	2nd Gear Blocking Ring Assembly
29	2nd Gear Synchronizer Blocking Ring
30	2nd Speed Drive Gear Outer Cone
31	2nd Speed Drive Gear Inner Cone

Clutch Housing Assembly and Gears

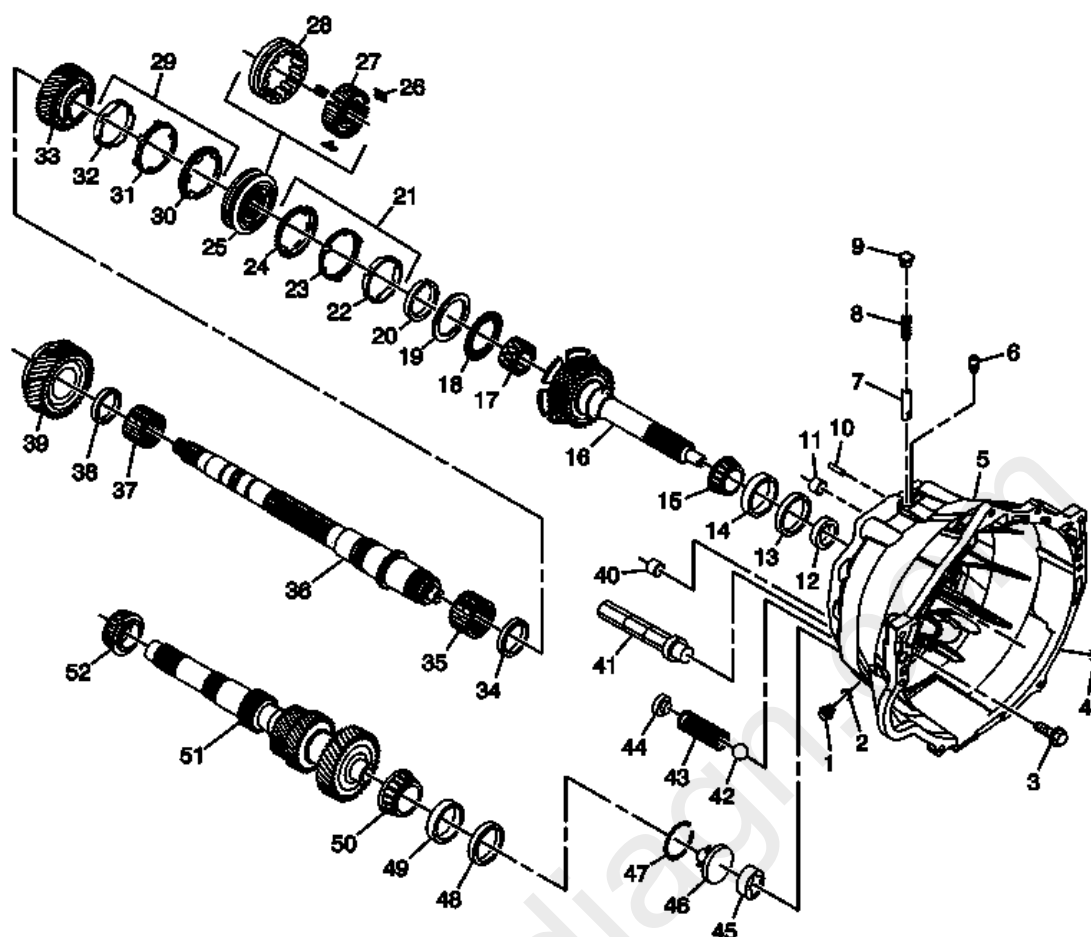


Fig. 6: Clutch Housing Assembly and Gears
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Pump Outlet Cooler Fitting
2	Pump Outlet Cooler Fitting O-ring
3	Clutch Housing Assembly to Transmission Case Bolt
4	Transmission Fluid Pump Outlet Pipe Fitting
5	Clutch Housing Assembly
6	Vent Assembly
7	Shift Shaft Detent Roller
8	Shift Shaft Detent Spring
9	Shift Shaft Detent Plug
10	Transmission Case Locating Pin
11	1st/2nd Shift Shaft Bearing
12	Input Shaft Seal
13	Input Shaft Bearing Shim

14	Input Shaft Bearing Race
15	Input Shaft Bearing
16	Input Shaft
17	Input Shaft Bearing
18	Input Shaft Thrust Bearing
19	Input Shaft Thrust Washer
20	3rd/4th Synchronizer Retaining Ring
21	4th Gear Blocking Ring Assembly
22	4th Speed Drive Gear Inner Cone
23	4th Speed Drive Gear Outer Cone
24	4th Speed Drive Gear Blocking Ring
25	3rd/4th Synchronizer Assembly
26	3rd/4th Synchronizer Insert
27	3rd/4th Synchronizer Hub
28	3rd/4th Synchronizer Sleeve
29	3rd Gear Blocking Ring Assembly
30	3rd Speed Drive Gear Synchronizer Blocking Ring
31	3rd Speed Drive Gear Friction Cone
32	3rd Speed Drive Gear Inner Cone
33	3rd Speed Drive Gear
34	3rd Speed Drive Gear Spacer
35	3rd Speed Drive Gear Bearing
36	Mainshaft
37	2nd Speed Drive Gear Needle Bearing
38	2nd Speed Drive Gear Bearing Spacer
39	2nd Speed Drive Gear
40	3rd/4th Shift Shaft Bushing
41	Oil Filter Assembly
42	Transmission Fluid Pump Check Ball
43	Transmission Fluid Pump Spring
44	Transmission Fluid Pump Spring Retaining Plug
45	Oil Pump
46	Oil Pump Cover
47	Oil Pump Cover Retainer Ring
48	Countershaft Bearing Adjust Shim
49	Countershaft Bearing Race
50	Countershaft Front Bearing
51	Counter Gear Shaft
52	Countershaft Rear Bearing

Shift Shafts

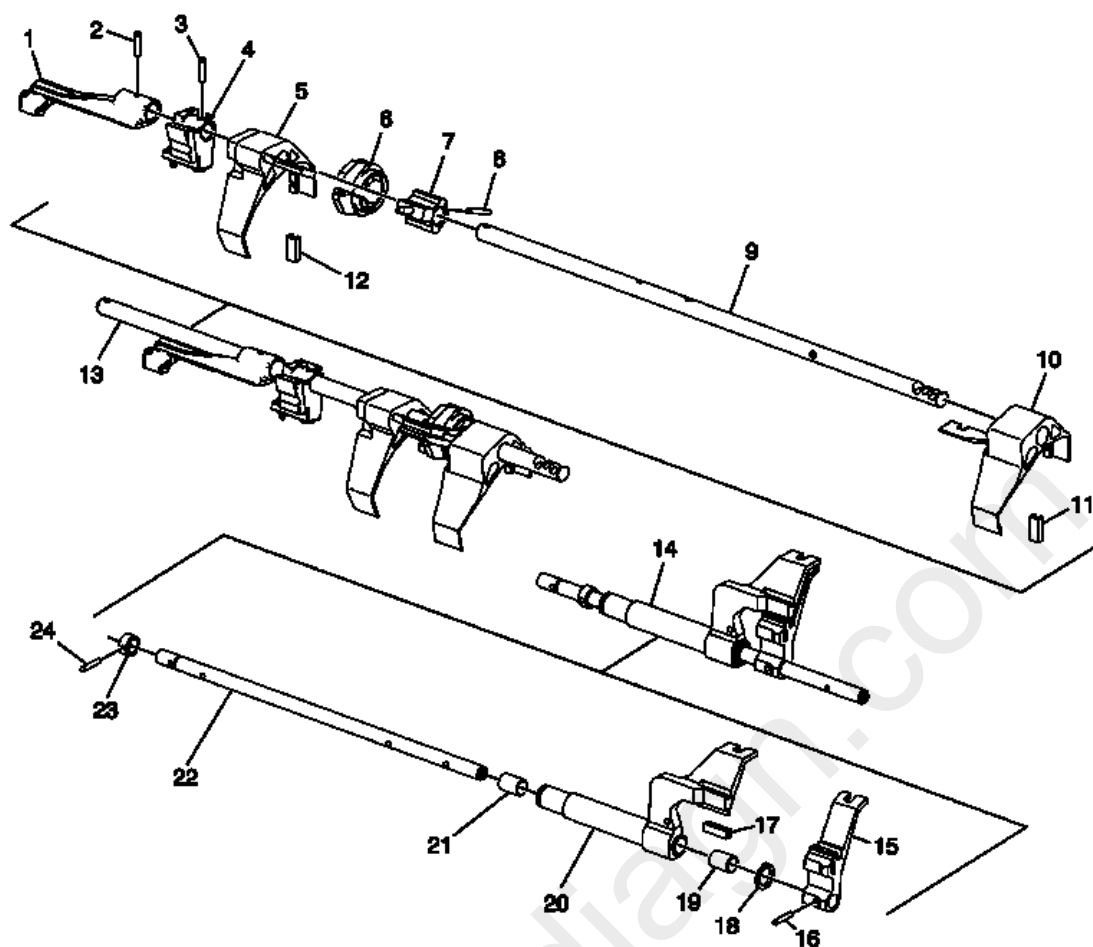


Fig. 7: Identifying Shift Shafts
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Offset Shift Lever
2	Offset Shift Lever Pin
3	Control Select Arm Pin
4	Control Select Arm
5	3rd/4th Shift Fork Assembly
6	Gear Select Interlock Plate
7	Select Control Lever Assembly
8	Select Control Lever Assembly Pin
9	1st/2nd/3rd/4th Shift Shaft
10	1st/2nd Shift Fork Assembly
11	1st/2nd Shift Fork Insert
12	3rd/4th Shift Fork Insert
13	1st/2nd/3rd/4th Shift Rail Assembly
14	Shift Control Lever Assembly
15	Shift Control Lever Assembly Pin
16	Shift Control Lever Assembly Pin
17	Shift Control Lever Assembly Pin
18	Shift Control Lever Assembly Pin
19	Shift Control Lever Assembly Pin
20	Shift Control Lever Assembly Pin
21	Shift Control Lever Assembly Pin
22	Shift Control Lever Assembly Pin
23	Shift Control Lever Assembly Pin
24	Shift Control Lever Assembly Pin

14	5th, 6th, and Reverse Shift Rail Assembly
15	Reverse Shift Lever
16	Reverse Shift Lever Pin
17	5th and Reverse Shift Fork Insert
18	5th/6th Shift Lever Retaining Ring
19	Shift Shaft Bushing
20	5th/6th Shift Lever Assembly
21	Shift Shaft Bushing
22	5th, 6th, and Reverse Shift Shaft
23	Transmission Reverse Shift Lever Collar
24	Reverse Shift Collar Pin

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0218</u>	DTC P0218 Transmission Fluid Overtemperature
<u>DTC P0502 or P0503</u>	DTC P0502 Vehicle Speed Sensor (VSS) Circuit Low Voltage DTC P0503 Vehicle Speed Sensor (VSS) Circuit Intermittent
<u>DTC P0712 or P0713</u>	DTC P0712 Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage DTC P0713 Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage
<u>DTC P0801</u>	DTC P0801 Reverse Lockout Solenoid Control Circuit
<u>DTC P0806</u>	DTC P0806 Clutch Pedal Position (CPP) Sensor Circuit Performance
<u>DTC P0807 or P0808</u>	DTC P0807 Clutch Pedal Position (CPP) Sensor Circuit Low Voltage DTC P0808 Clutch Pedal Position (CPP) Sensor Circuit High Voltage
<u>DTC P080A</u>	DTC P080A Clutch Pedal Position (CPP) Not Learned
<u>DTC P080C or P080D</u>	DTC P080C Skip Shift Solenoid Control Circuit Low Voltage DTC P080D Skip Shift Solenoid Control Circuit High Voltage

DTC P0218: TRANSMISSION FLUID OVERTEMPERATURE

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 P0218

Transmission Fluid Overtemperature

Circuit/System Description

The transmission fluid temperature (TFT) sensor is a 2 wire negative coefficient thermistor that measures the temperature of the transmission fluid. The engine control module (ECM) supplies a signal circuit and a low reference circuit to the TFT sensor. This diagnostic does not detect a malfunction of the TFT circuitry, it simply alerts the vehicle operator to a high transmission fluid temperature, which could lead to transmission damage.

Conditions for Running the DTC

- The ignition voltage is 8.6 V or greater.
- The engine speed is 1,000 RPM or greater for 7 seconds.
- The transmission fluid is between -39°C (-38°F) and 162°C (323°) for 10 seconds.

Conditions for Setting the DTC

The TFT is greater than 163°C (325°F) for 10 minutes.

Action Taken When the DTC Sets

- DTC P0218 is a Type C DTC.
- A transmission fluid hot message appears in the Driver Information Center.

Conditions for Clearing the DTC

DTC P0218 is a Type C DTC.

Reference Information

Description and Operation

Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: If DTC P0712 or P0713 is set, diagnose those DTCs first.

1. Inspect for any external transmission leakage. Refer to Transmission Fluid Leak Diagnosis.
2. Verify the transmission has the correct fluid and the fluid is at the correct level. Refer to Lubrication Specifications, and Transmission Fluid Level Inspection.
3. Inspect vehicle for modifications or aftermarket performance equipment.

4. Review with the vehicle operator their driving habits or vehicle operation.
5. After performing the above steps, then operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. If the vehicle passes the Circuit/System Verification procedure then, refer to **Testing for Intermittent Conditions and Poor Connections** .

Repair Instructions

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

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 Descriptor

DTC P0502

Vehicle Speed Sensor (VSS) Circuit Low Voltage

DTC P0503

Vehicle Speed Sensor (VSS) Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
VSS Low Signal	-	P0502, P0503	-	-
VSS High Signal	P0502, P0503	P0502, P0503	P0502, P0503	-

Circuit/System Description

The vehicle speed information is provided to the engine control module (ECM) by the vehicle speed sensor (VSS). The VSS is a permanent magnet generator that is mounted to the transmission and produces a pulsing voltage. The AC voltage amplitude and frequency increases with vehicle speed. The ECM converts the pulsing voltage into km/h (mph). The ECM supplies the VSS signal to the following components:

- The instrument panel for speedometer and odometer operation
- The cruise control module

Conditions for Running the DTC

P0502

- DTC P0120, P0220 or P0503 are not set.
- The TP sensor angle is more than 3.5 percent.
- The engine is running.
- The system voltage is 8-18V.
- TFT is more than -40°C (-40°F)
- The engine speed is 1,500-6,500 RPM.
- Vehicle speed is less than 200 km/h (124 mph).
- Engine torque is 68-8192 N.m (50-6,042 lb ft).

P0503

- The system voltage is 8-18V.
- The engine speed is 500-7,500 RPM.
- Transmission out speed change is less than 146 RPM for 2 seconds.

Conditions for Setting the DTC

P0502

The transmission output speed is 58 RPM or less for 5 seconds.

P0503

The transmission output speed drops 351 RPMs in less than 3 seconds.

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.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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

Control Module References

Special Tools

J 35616 GM-Approved Terminal Test Kit

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

Circuit/System Verification

1. Raise and support the drive wheels.

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.

2. Support the lower control arms so that the drive axles are in a horizontal position.
3. Start and idle the engine.
4. Place the transmission in second gear and release the clutch pedal.
5. Monitor VSS parameter on the scan tool. The VSS parameter should increase as the drive wheel speed increases.
6. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that are captured in the Freeze Frame/Failure Records List.

Circuit/System Testing

1. Disconnect the ECM harness connector X1.
2. Measure for 1,300-1,500 ohms at 25°C (77°F) between the VSS high signal circuit terminal 66 and the

VSS low signal circuit terminal 67.

- If the value is greater than 1,500 ohms test the VSS high signal circuit and the VSS low signal circuit for an open/high resistance. If the circuits/connections test normal, replace the vehicle speed sensor.
 - If the value is less than 1,300 ohms test the VSS high signal and the VSS low signal circuits for a shorted together condition. If the circuits/connections test normal, replace the vehicle speed sensor.
3. Measure for more than 10 ohms of resistance between the VSS high signal circuit terminal 66 and ground.
 - If the value is less than the specified range, repair the short to ground.
 4. Measure for more than 10 ohms of resistance between the VSS low signal circuit terminal 67 and ground.
 - If the value is less than the specified range, repair the short to ground.
 5. Reconnect the ECM connector. Disconnect the VSS connector.
 6. Ignition ON, test the VSS high signal circuit terminal B for a short to voltage.
 - If all circuits/connections test normal, test or replace the VSS.
 7. If all circuits test normal, replace the ECM.

Repair Instructions

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

- **Vehicle Speed Sensor Replacement**
- **Control Module References** for ECM replacement, setup and programming

DTC P0712 OR P0713: TRANSMISSION FLUID TEMPERATURE (TFT) 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 P0712

Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage

Diagnostic Fault Information

	Short to	Open/High	Short to	Signal
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Circuit	Ground	Resistance	Voltage	Performance
TFT Sensor Signal	P0712	P0713	P0713 ¹	-
Low Reference	-	P0713	P0713 ¹	-
¹ Internal ECM damage may occur if the circuit is shorted to B+.				

Circuit/System Description

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

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

TFT	TFT Resistance	TFT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

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 TFT is greater than 145°C (299°F) for more than 5 seconds.

P0713

The TFT 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 - COUPE AND WAGON

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

Control Module References

Circuit/System Verification

1. Engine running, DTC P0712 or P0713 should not set.
2. If the vehicle passes the Circuit/System Verification Test, then operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that are captured in the Freeze Frame/Failure Records List.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the TFT sensor.
2. Ignition OFF, test for less than 5 ohms of resistance between the low reference circuit terminal A and ground.
 - If greater than 5 ohms, test the low reference circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, using a scan tool verify that the TFT sensor parameter is at -40°C (-40°F).

- If greater than -40°C (-40°F), test the signal circuit terminal B for a short to ground. If the circuit tests normal, replace the ECM.

NOTE: If the signal circuit of the TFT sensor is shorted to voltage the TFT sensor may be damaged.

4. Install a 3-amp fused jumper wire between the signal circuit terminal B and the low reference circuit terminal A. Verify the TFT sensor parameter is greater than 128°C (262°F).
 - If less than 128°C (262°F), test the signal circuit of the TFT sensor for a short to voltage or an open/high resistance. If the circuit test normal, replace the ECM.
5. If all circuits test normal, test or replace the TFT sensor.

Repair Instructions

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

- **Control Module References** for ECM replacement, setup and programming.

DTC P0801: REVERSE LOCKOUT SOLENOID CONTROL CIRCUIT

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 Lockout Solenoid Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Circuit to Reverse Lockout Solenoid	P0801	P0801	-	-
Reverse Lockout Solenoid Control Circuit	P0801	P0801	P0801	-

Typical Scan Tool Data

Reverse Inhibit Solenoid

	Short to	Open/High	Short to
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Circuit	Ground	Resistance	Voltage
Operating Conditions: Engine Running. Parameter Normal Range: ON or OFF.			
Reverse Inhibit Solenoid Command	OFF	OFF	OFF

Circuit/System Description

Battery voltage (B+) is supplied directly to the reverse lockout solenoid. The engine control module (ECM) controls the reverse 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 is a Type C DTC.

Conditions for Clearing the MIL/DTC

P0801 is a Type C DTC.

Diagnostic Aids

- The battery must be fully charged and pass a battery test. Refer to **Battery Inspection/Test** .
- The reverse lockout solenoid is referred to as the reverse inhibit solenoid on the scan tool.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, command the reverse lockout solenoid ON and OFF, with a scan tool, while observing the following reverse lockout circuit status parameters.
 - Reverse lockout solenoid control Ckt. Short Gnd Test Status
 - Reverse lockout solenoid control Ckt. Open Test Status
 - Reverse lockout solenoid control Ckt. Short Volts Test Status
 - Each parameter should toggle 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 reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

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

1. Disconnect the reverse lockout solenoid harness connector.
2. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal B and ground.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the circuit fuse is open, replace the reverse lockout solenoid.
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, test the control circuit for a short to ground. If the circuit tests normal, replace the ECM.

4. Remove the test lamp.
5. Command the reverse lockout solenoid ON with a scan tool. Verify with a scan tool that the reverse lockout solenoid Ckt. Short Volts Test Status parameter is OK.
 - If not the specified value, test the control circuit for a short to voltage. If the circuit tests normal, replace the ECM.
6. Install a 3A fused jumper wire between the reverse lockout control circuit terminal A and the B+ circuit terminal B. Command the reverse lockout solenoid ON with a scan tool. Verify with a scan tool that the affected reverse lockout solenoid Ckt. Short Volts Test Status parameter is displaying Fault.
 - If not the specified value, test the control circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
7. If all the circuits test normal, test or replace the reverse lockout assembly.

Repair Instructions

- **Reverse Lockout Solenoid Replacement**
- **K20 Engine Control Module: Programming and Setup**
- **Engine Control Module Replacement**

Repair Verification

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Turn OFF the ignition for 60 seconds.
5. Engine running, command reverse lockout solenoid ON and OFF with a scan tool, while observing the reverse inhibit circuit status parameters. The circuit status parameters should change from OK to Not Run or Not Run to OK.
 - If another DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and perform the appropriate diagnostic procedure.

DTC P0806: CLUTCH PEDAL POSITION (CPP) SENSOR CIRCUIT PERFORMANCE

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 P0806

Clutch Pedal Position (CPP) Sensor Circuit Performance

Diagnostic Fault Information

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

Typical Scan Tool Information

CPP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Voltage Parameter Normal Range: 0-volts with clutch pedal applied to 5-volts when clutch pedal is released.			
CPP Sensor 5-Volt Reference	0 volts	0 volts	5 volts
CPP Sensor Signal	0 volts	0 volts	5 volts
CPP Sensor Low Reference	-	5 volts	-

CPP Sensor Percentage

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

Circuit/System Description

The clutch pedal position (CPP) sensor 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 volt when the clutch pedal is applied.

Conditions for Running the DTC

DTCs P0335, P0336, P0502, P0503, P0607, P0808, or P080A are not set.

Conditions for Setting the DTC

The CPP sensor is stuck in range.

Action Taken When the DTC Sets

P0806 is a Type A DTC.

Conditions for Clearing the MIL/DTC

P0806 is a Type A DTC.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, observe the scan tool CPP sensor percent parameter. The percentage should vary from 0 percent when the clutch pedal is released, to 100 percent when the clutch pedal is in the apply position.
2. Perform the CPP learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.
3. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Ignition ON, observe the scan tool CPP sensor voltage parameter for 0.1-volt.
 - If the voltage is below the specified value, replace the CPP sensor.
 - If the voltage is above the specified value, replace the ECM.

Component Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal A of the CPP sensor. Sweep the CPP sensor through the entire range. The resistance should vary low to high and high to low without any spikes or dropouts.
 - If the resistance is erratic with spikes or dropouts, replace the CPP sensor.

Repair Instructions

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

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

DTC P0807 OR 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 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
CPP Sensor Signal	P0807	P0807	P0808	P0806

CPP Sensor 5-Volt Reference	P0651, P0807	P0807	P0651, P0808	-
CPP Sensor Low Reference	-	P0808	P0808	-

Typical Scan Tool Information

CPP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Voltage Parameter Normal Range: 0-volts with clutch pedal applied to 5-volts when clutch pedal is released.			
CPP Sensor 5-Volt Reference	0 volts	0 volts	5 volts
CPP Sensor Signal	0 volts	0 volts	5 volts
CPP Sensor Low Reference	-	5 volts	-

CPP Sensor Percentage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. CPP Sensor Percentage Parameter Normal Range: 0% with clutch pedal released to 100% when clutch pedal is applied.			
CPP Sensor 5-Volt Reference	100%	100%	0-100%
CPP Sensor Signal	100%	100%	100%
CPP Sensor Low Reference	-	0%	-

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

P0807 and P0808

- DTCs P0641 or P0651 are not set.
- The system voltage is more than 9 volts.
- The ignition is in the RUN position.

Conditions for Setting the DTC

P0807

The CPP sensor voltage is less than 0.1 volt for more than 1 second.

P0808

The CPP sensor voltage is more than 5.2 volts for more than 1 second.

Action Taken When the DTC Sets

P0807 and P0808 are Type A DTCs.

Conditions for Clearing the MIL/DTC

P0807 and P0808 are Type A DTCs.

Reference Information

Schematic Reference

Manual Transmission Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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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

Control Module References for scan tool information

Circuit/System Verification

1. If DTC P0641 or P0651 is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition ON, observe the scan tool CPP sensor percent parameter. The percentage should vary from 0

percent when the clutch pedal is released, to 100 percent when the clutch pedal is in the apply position.

3. Perform the CPP learn procedure. Refer to **Clutch Pedal Position Sensor Learn**.
4. Operate the vehicle within the conditions for running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Ignition OFF, test for less than 1 ohm between the low reference circuit terminal A and the negative post of the battery.
 - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal C and ground.
 - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
 - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.
4. Ignition ON, verify that the scan tool CPP sensor parameter is less than 0.1 volts.
 - If greater than the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.
5. Install a 3-amp fused jumper wire between the signal circuit terminal B and the 5-volt reference circuit terminal C. Verify that the scan tool CPP sensor parameter is between 4.8-5.2 volts.
 - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
6. If all circuits test normal, test or replace the CPP sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector of the CPP sensor.
2. Measure the resistance between the signal terminal B and the low reference terminal A of the CPP sensor. Sweep the CPP sensor through the entire range. The resistance should vary low to high and high to low without any spikes or dropouts.
 - If the resistance is erratic with spikes or dropouts, replace the CPP sensor.

Repair Instructions

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

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

DTC P080A: CLUTCH PEDAL POSITION (CPP) NOT LEARNED

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 P080A

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

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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

Control Module References for scan tool information.

Circuit/System Verification

Perform the clutch pedal position sensor learn procedure.

Circuit/System Testing

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 P080C OR P080D: SKIP SHIFT SOLENOID CONTROL CIRCUIT

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 P080C

Skip Shift Solenoid Control Circuit Low Voltage

DTC P080D

Skip Shift Solenoid Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Circuit to Skip Shift Solenoid	P080C	P080C	-	-
Skip Shift Solenoid Control Circuit	P080C	P080C	P080D	-

Typical Scan Tool Data

Skip Shift Solenoid

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine Running. Parameter Normal Range: ON or OFF.			
Skip Shift Solenoid Command	OFF	OFF	OFF

Circuit/System Description

Ignition voltage is supplied directly to the skip shift solenoid. The engine control module (ECM) controls the skip shift 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 skip shift solenoid ON, the voltage on the control circuit should be low, near 0 V. When the ECM commands the control circuit to the skip shift solenoid OFF, the voltage should be high, near battery voltage.

Conditions for Running the DTC

P080C or P080D

The engine is running.

Conditions for Setting the DTC

P080C or P080D

- 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 5 seconds.

Action Taken When the DTC Sets

P080C or P080D are Type B DTCs.

Conditions for Clearing the MIL/DTC

P080C or 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

COMPONENT CONNECTOR END VIEWS - INDEX - COUPE AND WAGON

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

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, command the skip shift solenoid ON and OFF, with a scan tool, while observing the following skip shift circuit status parameters.
 - Skip shift solenoid control Ckt. Short Gnd Test Status
 - Skip shift solenoid control Ckt. Open Test Status
 - Skip shift solenoid control Ckt. Short Volts Test Status
 - Each parameter should toggle 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 reset. You

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

Circuit/System Testing

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

1. Disconnect the skip shift solenoid harness connector.
2. Ignition ON, verify that a test lamp illuminates between the voltage circuit terminal B and ground.
 - If the test lamp does not illuminate, test the voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal and the circuit fuse is open, replace the skip shift solenoid.
3. Verify that a test lamp does not illuminate between the voltage circuit terminal B and the control circuit terminal A.
 - If the test lamp illuminates, test the control circuit for a short to ground. If the circuit tests normal, replace the ECM.
4. Remove the test lamp.
5. Command the skip shift solenoid ON with a scan tool. Verify with a scan tool that the skip shift solenoid Ckt. Short Volts Test Status parameter is OK.
 - If not the specified value, test the control circuit for a short to voltage. If the circuit tests normal, replace the ECM.
6. Install a 3A fused jumper wire between the skip shift control circuit terminal A and the voltage circuit terminal B. Command the skip shift solenoid ON with a scan tool. Verify with a scan tool that the affected skip shift solenoid Ckt. Short Volts Test Status parameter is displaying Fault.
 - If not the specified value, test the control circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
7. If all the circuits test normal, replace the skip shift assembly.

Repair Instructions

- **Gear Select/Skip Shift Solenoid Replacement**
- **K20 Engine Control Module: Programming and Setup**
- **Engine Control Module Replacement**

Repair Verification

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Turn OFF the ignition for 60 seconds.
5. Engine running, command skip shift solenoid ON and OFF with a scan tool, while observing the skip shift circuit status parameters. The circuit status parameters should change from OK to Not Run or Not Run to OK.

- If another DTC is present, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and perform the appropriate diagnostic procedure.

CLUTCH PEDAL POSITION SENSOR LEARN

IMPORTANT: 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. Install a scan tool.
2. 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.
3. With a scan tool, select Clutch Pedal Position Learn under Module Setup in Manual Transmission, and perform the following instructions displayed on the scan tool screen.

IMPORTANT: The CPP sensor learn procedure cannot be performed more than once per ignition cycle. The clutch pedal needs to be fully depressed and held steady throughout this procedure in order to perform a correct learning.

4. The scan tool will display under CPP Learn Status: Not Learned, In Process, Complete, Fail - Low Volt, Fail - High Volt, or Fail Moving. The scan tool will display under CPP Learn Status Complete if the process was successful.
5. 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 - Vehicle** for the applicable DTC.
6. Turn OFF the ignition for 30 seconds after the learn procedure has successfully completed in order to store the CPP sensor variation values in ECM history.

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 after installation of a new clutch actuator. With a new clutch actuator, the annular seal may not be in the forward position and not allow full clutch release. With a self adjusting clutch, the clutch may be between adjustments and not allow full clutch release. This might be felt by a low clutch pedal load. 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 when going into a gear.

5

A dynamic shift test is performed by shifting into one 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 shifting out of a gear, you should feel the shift detent plungers operating, and the synchronizers sleeve moving freely.

The transmission uses a transmission fluid that allows proper synchronizer operation. The incorrect fluid may cause hard shifting from varnish build up, or from not enough lubrication for proper synchronizer operation. Only use the proper transmission fluid.

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 <u>Symptoms - Manual Transmission</u> operations and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	Inspect the clutch system for proper operation. Refer to <u>Clutch System Description and Operation</u> . Did you find or repair the condition?	Go to Step 11	Go to Step 3
3	1. Perform a static shift test on the transmission. 2. Test for the following conditions: • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Binding in the shift lever • Detent plungers or shift rails binding • Shift linkage binding • Shift linkage proper adjustment Are you able to shift into all gears?	Go to Step 7	Go to Step 4
4	Remove the shift control shift closeout boot and foam isolator. Refer to <u>Shift Control Shift Closeout Boot Replacement</u> . Inspect for the following: • Loose mounting • Foreign debris • Interference to foam isolator Did you find and repair the condition?	Go to Step 11	Go to Step 5
5	1. Perform a dynamic shift test on the transmission. 2. Test for the following conditions: • Detent plungers or shift rails binding • Synchronizer sleeve binding		

	• Gear clash into only one gear • Gear clash into all gears		
	Did the transmission shift hard into all gears?	Go to Step 6	Go to Step 10
6	Inspect the transmission for the correct fluid level and the correct type of transmission fluid. Refer to <u>Transmission Fluid Drain and Fill</u>, and <u>Lubrication Specifications</u>. Is the transmission at the correct level and proper fluid being used?	Go to Step 8	Go to Step 7
7	Drain and fill the transmission with the correct type fluid. Refer to <u>Transmission Fluid Drain and Fill</u>. Did you find and repair the condition?	Go to Step 11	Go to Step 8
8	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Inspect the clutch pressure plate and/or clutch driven plate. Is the clutch pressure plate and/or clutch driven plate worn or faulty?	Go to Step 9	Go to Step 10
9	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u>. Did you find and repair the condition?	Go to Step 11	Go to Step 10
10	1. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 2. Inspect the transmission for the following faulty components in the gear that is hard to shift or clashing: • Excessive synchronizers blocking ring to gear clearance • Synchronizer hub external splines worn or damaged • Excessive axial clearance in the speed gear • Mainshaft to speed gear bearing or journal worn • Shift rail and the internal shift control lever components for wear or damage 3. Replace worn or damaged components as necessary. Did you find and repair the condition?	Go to Step 10	Go to Diagnostic Aids
11	Operate the system in order to verify the repair.		

Did you correct the condition?	System OK	Go to Step 1
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TRANSMISSION GEAR CLASH WHEN SHIFTING GEARS

Diagnostic Aids

Gear clashing may be caused by shifting above 5000 RPM or not fully depressing the clutch pedal. 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 lubrication of the synchronizers.

7

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.

9

A dynamic shift test is performed by shifting into all of the gear positions with the engine operating at idle. 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. Press 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.			
	Did you review the Symptoms - Manual		Go to Symptoms -

1	<u>Transmission</u> and perform the necessary inspections?	Go to Step 2	<u>Manual Transmission</u>
2	With the engine operating at idle, 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	1. Check clutch fluid for proper level. Refer to <u>Transmission Fluid Level Inspection.</u> 2. Inspect for proper clutch operation. Refer to <u>Symptoms - Clutch .</u> Does the clutch operate properly?	Go to Step 5	Go to Step 4
4	Repair the clutch system. 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 <u>Transmission Fluid Drain and Fill.</u> 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
7	1. Perform a static shift test on the transmission. 2. Test for the following conditions: • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Binding in the shift lever • Detent plungers or shift rails binding • Shift linkage binding • Shift linkage proper adjustment Did the transmission shift smoothly into the gear that is clashing?	Go to Step 9	Go to Step 8
8	1. Remove the shift lever. 2. Inspect for damaged or worn components. Refer to <u>Shift Control Assembly Replacement.</u> Did you find and repair the condition?	Go to Step 11	Go to Step 9
	1. Perform a dynamic shift test on the transmission. 2. Test for the following conditions:		

9	• Detent plungers or shift rails binding • Synchronizer sleeve binding • Gear clashing in more than the suspected gear		
	Is the transmission hard to shift into all gears?	Go to <u>Transmission Shifts Hard</u>	Go to Step 10
10	1. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 2. Inspect the following transmission components for the suspect gear that is clashing: • Excessive synchronizer blocking ring to gear clearance • Synchronizer sleeve to hub lash or rock excessive • Excessive axial clearance in the speed gear • Mainshaft to speed gear bearing or journal worn • Shift fork worn or damaged • Internal shift control worn or damaged • Mainshaft bearing worn or damaged • Input gear bearing or pilot bearing worn		
	Did you find and repair the condition?	Go to Step 11	Go to Diagnostic Aids
11	Operate the system and verify the repair. 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 - a neutral gear rattle is heard outside the vehicle, the sound 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. Press 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 Symptoms - Manual Transmission operations and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Manual Transmission
2	Is the noise present while in neutral, with the engine operating?	Go to Diagnostic Aids	Go to Step 3
3	Is the noise present in all gears?	Go to Step 5	Go to Step 4
4	Is the noise present in just one gear?	Go to Step 15	Go to Step 5
5	Inspect the transmission fluid level. Is the fluid level correct?	Go to Step 7	Go to Step 6
6	Add transmission fluid. Refer to Transmission Fluid Drain and Fill . Did you find and repair the condition?	Go to Step 16	Go to Step 7
7	Inspect the transmission for the correct fluid type. Refer to Lubrication Specifications . Is the transmission fluid the correct type?	Go to Step 9	Go to Step 8
8	Drain and fill the transmission with the correct type of fluid. Refer to Transmission Fluid Drain and Fill . Did you find and repair the condition?	Go to Step 16	Go to Step 9
9	Inspect the shift tower boot. Is the closeout boot loose or damaged?	Go to Step 10	Go to Step 11
10	Position and tighten the shift tower boot to specifications. Refer to Transmission Control		

	<u>Lever Knob Replacement.</u> Did you find and repair the condition?	Go to Step 16	Go to Step 11
11	Inspect for loose transmission mounting bolts. Are there any loose transmission mounting bolts?	Go to Step 12	Go to Step 15
12	Replace and tighten the transmission mounting bolts. Refer to <u>Fastener Tightening Specifications.</u> Is the noise still present?	Go to Step 13	Go to Step 16
13	With the engine operating, press the clutch pedal. Is the noise still present?	Go to Step 14	Go to Step 15
14	1. Remove the clutch. Refer to <u>Clutch Assembly Replacement</u> . 2. Inspect the following components for being the cause of the noise: • The release bearing • The pilot bearing • The dual mass flywheel, if equipped • The pressure plate • The clutch disc • The input shaft bearing • The engine crankshaft end play Did you find and repair the condition?	Go to Step 16	Go to Step 15
15	1. Remove the transmission. Refer to <u>Transmission Replacement.</u> 2. Disassemble the transmission. Refer to one of the following: <u>Transmission Disassemble.</u> Use the information in the Cleaning and Inspection section to determine if any of the transmission components are faulty. Did you find and repair the condition?	Go to Step 16	-
16	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1

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 engine 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 Symptoms - Manual Transmission operations and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Manual Transmission
2	1. Perform a static shift test. 2. Test for the following conditions: • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Detent plungers engaging in the shift rails • Synchronizer pressure pieces on the		

	synchronizer sleeves • Shift linkage binding • Shift linkage proper adjustment		
	Did the transmission shift completely into all gears?	Go to Step 5	Go to Step 3
3	1. Remove the shift control shift closeout boot and foam isolator. Refer to <u>Shift Control Shift Closeout Boot Replacement</u>. 2. Inspect for the following: ○ Loose mounting ○ Foreign debris ○ Interference to foam isolator		
	Did you find and repair the condition?	Go to Step 10	Go to Step 4
4	1. Perform a dynamic shift test on the transmission. 2. Test for the following conditions: • Synchronizer sleeve engagement to the speed gear selector teeth • Detent plungers engaging in the shift rails		
	Did the transmission shift completely into all gears?	Go to Step 5	Go to Step 8
5	Inspect the engine and/or transmission mounts. Refer to <u>Transmission Mount Inspection</u>, and <u>Engine Mount Inspection</u>. Did you find and repair the condition?	Go to Step 10	Go to Step 6
6	Inspect the clutch housing for loose bolts or misalignment. Are there any loose bolts or misalignment?	Go to Step 9	Go to Step 8
7	Tighten any loose housing bolts and/or align the housing. Refer to <u>Clutch Assembly Replacement</u>. Did you find and repair the condition?	Go to Step 10	Go to Step 8
8	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Remove the clutch assembly. Refer to <u>Clutch Assembly Replacement</u>. 3. Inspect the pilot bearing for being faulty. 4. Inspect the input shaft for excessive wear at the pilot bearing.		
	Did you find and repair the condition?	Go to Step 10	Go to Step 9
	1. Disassemble the transmission. Refer to		

9	<u>Transmission Disassemble.</u> 2. Inspect the following components for wear or damage: • The shift rails • The detent plungers and springs • The shift forks • The synchronizer sleeve and speed gear selector teeth • The mainshaft to input shaft bearing and journals • The speed gear bearings and journals • The speed gear axial clearance • The mainshaft center and rear bearings • The shift guide plate		
	Did you find and repair the condition?	Go to Step 10	Go to Diagnostic Aids
10	Operate the system in order to verify the repair. Did you correct the condition?	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 into the next gear, and for the synchronizer sleeve movement.

6

A dynamic shift test is performed by shifting into all gears 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 just release from the gear, then let up on the clutch pedal. Press 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 <u>Symptoms - Manual Transmission</u> and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	Inspect the clutch system for slipping. Refer to <u>Clutch Slipping</u> . Is the clutch operating properly?	Go to Step 2	Go to <u>Clutch Assembly Replacement</u>
3	1. Perform a static shift test on the transmission. 2. Test for the following conditions: • Blockage preventing full shift lever movement • Excessive movement in the shift lever • Binding in the shift lever • Detent plungers or shift rails binding • Synchronizer sleeve moving on the hub and pressure pieces • Shift linkage binding • Shift linkage proper adjustment Were you able to shift into the gear position with the concern?	Go to Step 5	Go to Step 4
4	1. Remove the shift control shift closeout boot and foam isolator. Refer to <u>Shift Control Shift Closeout Boot Replacement</u>. 2. Inspect for the following: ○ Loose mounting ○ Foreign debris ○ Interference to foam isolator Did you find and repair the condition?	Go to Step 8	Go to Step 5
5	1. Perform a dynamic shift test on the transmission. 2. Test for the following conditions: • Detent plungers or shift rails binding • Synchronizer sleeve binding		

	• Synchronizer sleeve engaging on the speed gear selector teeth Were you able to shift into the gear position with the concern?	Go to Step 7	Go to Step 6
6	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 3. Inspect the following transmission internal components for wear or damage: • The shift forks • The internal shift control lever Did you find and repair the condition?	Go to Step 8	Go to Step 7
7	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 3. Inspect the following transmission internal components for wear or damage: • The synchronizer sleeve selector teeth • The speed gear selector teeth • The speed gear axial clearance for being excessive • The speed gear to mainshaft bearings and journals • The countershaft for being broken • The mainshaft for being broken • The countershaft gear for being stripped • The mainshaft gear for being stripped Did you find and repair the condition?	Go to Step 8	Go to Diagnostic Aids
8	Operate the system in order to verify the repair. Did you correct the condition?	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 Symptoms - Manual Transmission and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Manual Transmission
2	Inspect for the correct type of transmission fluid. Refer to Lubrication Specifications . Is the correct type of transmission fluid being used?	Go to Step 6	Go to Step 5
3	Drain and fill the transmission with the correct type of fluid. Refer to Transmission Fluid Drain and Fill . Did you find and repair the condition?	Go to Step 9	Go to Step 6
4	1. Perform a static shift test on the transmission. 2. Test for the shift lever moving to all positions. Were you able to shift into all positions?	Go to Step 6	Go to Step 5
5	1. Remove the shift lever. Refer to Shift Control Assembly Replacement . 2. Inspect for worn or faulty components. Did you find and repair the conditions?	Go to Step 9	Go to Step 6
6	1. Perform a dynamic shift test on the transmission. 2. Test for being able to shift in and out of the gear with the concern.		

	Were you able to shift the transmission correctly?	Go to Step 7	Go to Step 8
7	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Inspect the clutch system for the clutch not releasing properly. Refer to <u>Clutch System Description and Operation</u> .		
	Did you find and repair the condition?	Go to Step 9	Go to Step 8
8	1. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 2. Inspect the following transmission internal components for wear or damage: • The shift rail • The internal shift control lever • The synchronizer components for being broken or faulty • The speed gears for being seized to the mainshaft • The shift turret rail		
	Did you find and repair the conditions?	Go to Step 9	Go to Diagnostic Aids
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1

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.

Test Description

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 <u>Symptoms - Manual Transmission</u> and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Manual Transmission</u>
2	Inspect the engine mounts for being loose or damaged. Refer to <u>Engine Mount Inspection</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 3
3	Inspect the transmission mounts for being loose or damaged. Refer to <u>Transmission Mount Inspection</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 4
4	Inspect the transmission to engine fasteners for being loose or missing. Refer to <u>Fastener Tightening Specifications</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 5
5	Inspect the driveline for causing the clunk. Refer to <u>Symptoms - Propeller Shaft</u> . Did you find and repair the condition?	Go to Step 7	Go to Step 6
6	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 3. Inspect the following transmission components that maybe causing the clunk: • Faulty mainshaft bearings • Faulty counter gear shaft bearings • Worn speed gear teeth • Worn counter gear shaft gear teeth • Worn synchronizer sleeve to hub • Worn thrust washers and thrust surfaces on the speed gears or mainshaft Did you find and repair the condition?	Go to Step 7	Go to Diagnostic Aids
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1

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 Symptoms - Manual Transmission and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Manual Transmission
2	1. Inspect for the transmission fluid level higher than the recommended level. Refer to Transmission Fluid Drain and Fill. 2. Adjust the transmission level if incorrect. Was the transmission fluid level too high?	Go to Step 19	Go to Step 3
3	Inspect the transmission vent for a blockage. Is the transmission vent blocked?	Go to Step 4	Go to Step 5
4	Repair or replace the transmission vent. Did you find and repair the condition?	Go to Step 19	Go to Step 5
5	Verify the location of the leak. 1. Clean the transmission assembly. 2. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached. 3. Visual inspect or use the powder method or dye and black light method to locate the leak. Is the leak occurring at the drain or fill plug?	Go to Step 6	Go to Step 7
6	Replace the drain or fill plug. Refer to Transmission Fluid Drain and Fill . Did you find and repair the condition?	Go to Step 19	Go to Diagnostic Aids
7	Is the leak at the transmission output shaft seal?	Go to Step 8	Go to Step 9
	Remove the output shaft seal and inspect for the following. Refer to Main Shaft Rear Seal Replacement . • Damaged or worn seal • Damaged seal bore		

8	• Improper installation • Cracks in the component • Propeller shaft yoke sealing surface is scratched, nicked, damaged, or worn • Loose or worn bearing causing excessive seal wear • Yoke flange nut loose		
	Did you find and repair the condition?	Go to Step 19	Go to Diagnostic Aids
9	Is the leak at the front of the transmission?	Go to Step 10	Go to Step 12
10	1. Inspect for the leak at the input shaft seal. 2. Inspect for the following if the input shaft seal is leaking: • Damaged or worn seal • Damaged seal bore • Improper installation • Cracks in the component • Input shaft sealing surface is scratched, nicked, damaged or worn • Loose or worn bearing causing excessive seal wear 3. Replace the input shaft seal if leaking. Refer to <u>Main Shaft Rear Seal Replacement.</u>		
	Did you find and repair the condition?	Go to Step 19	Go to Step 11
11	1. Inspect the case for cracks or porosity. 2. Replace the transmission front case half if it is faulty. Refer to <u>Transmission Disassemble.</u>		
	Did you find and repair the condition?	Go to Step 19	Go to Diagnostic Aids
12	Is the leak at the backup light switch?	Go to Step 13	Go to Step 15
13	1. Remove the backup light switch. Refer to <u>Backup Lamp Switch Replacement.</u> 2. Inspect for the following: • Cross threaded or damaged threads • Insufficient sealant • Leaking switch, sensor or solenoid • Improper installation		
	Did you find and repair the condition?	Go to Step 19	Go to Step 1

14	1. Remove the shift shaft detent sleeve. Refer to the applicable procedure: • <u>Transmission Disassemble</u> • <u>Transmission Assemble</u> 2. Inspect for the following: • Cross threaded or damaged threads • Insufficient sealant • Cracked sleeve or case • Improper installation		
	Did you find and repair the condition?	Go to Step 19	Go to Step 1
15	Is the leak at the sealing flanges of the transmission case?	Go to Step 16	Go to Step 17
16	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 3. Inspect the sealing surfaces. Refer to the applicable procedure: • <u>Transmission Case and Clutch Housing Cleaning and Inspection</u> • <u>Extension Cleaning and Inspection</u>		
	Did you find and repair the condition?	Go to Step 19	Go to Step 17
17	Is the leak coming from a crack or porosity in the transmission case?	Go to Step 18	Go to Diagnostic Aids
18	1. Remove the transmission. Refer to <u>Transmission Replacement</u>. 2. Disassemble the transmission. Refer to <u>Transmission Disassemble</u>. 3. Replace the faulty case. Refer to <u>Transmission Assemble</u>		
	Did you find and repair the condition?	Go to Step 19	Go to Diagnostic Aids
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1

REPAIR INSTRUCTIONS - ON VEHICLE

TRANSMISSION FLUID LEVEL INSPECTION

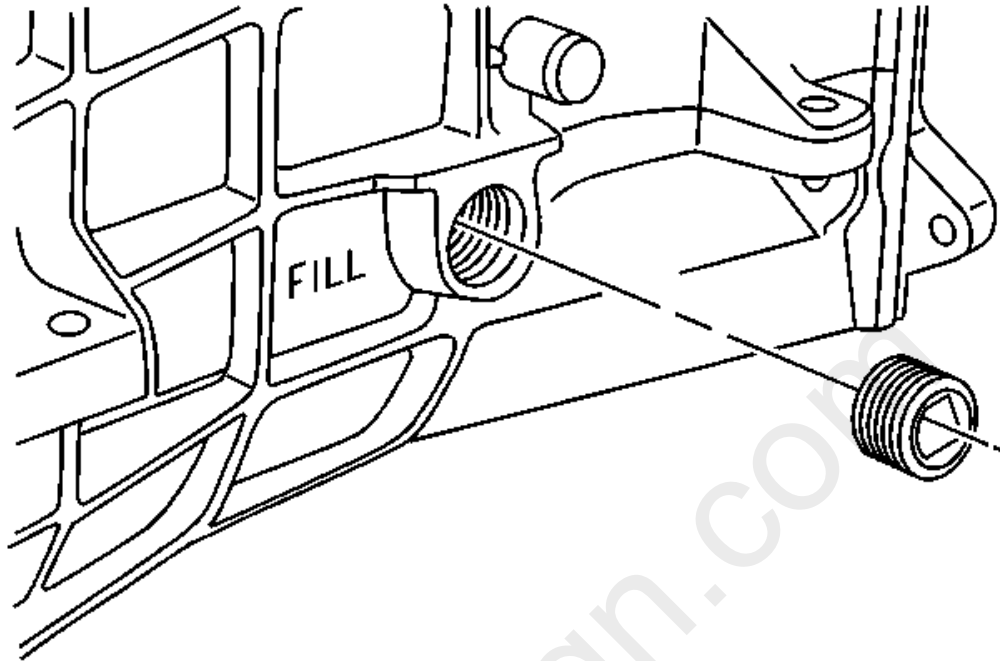


Fig. 8: Identifying Transmission Fill Plug
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Clean any dirt from around the fill plug.
3. Remove the transmission fill plug from the transmission.

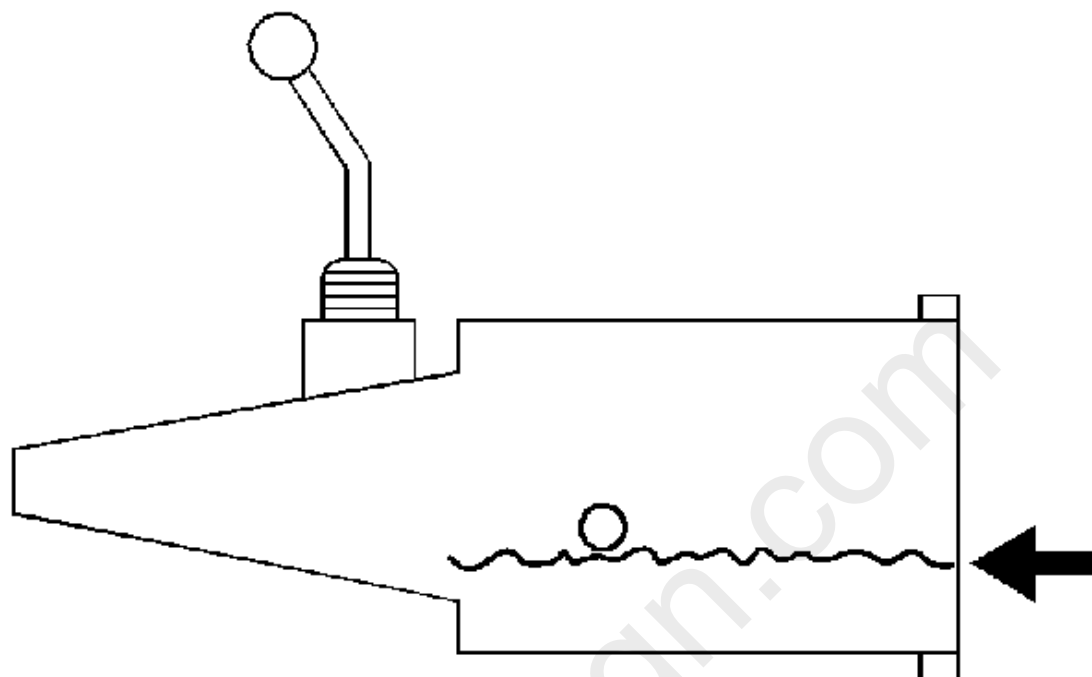


Fig. 9: Checking Transmission Fluid Level
Courtesy of GENERAL MOTORS COMPANY

4. Check that the transmission fluid level is even with the bottom of the fill plug hole.
5. Add Dexron-III transmission fluid, if necessary.

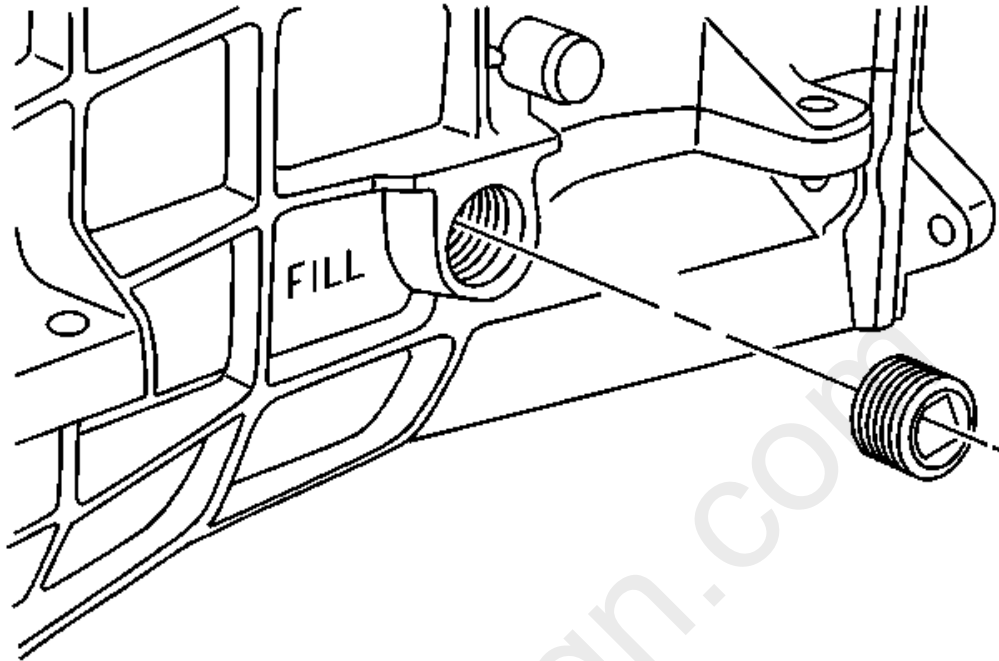


Fig. 10: Identifying Transmission Fill Plug
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

6. Install the transmission fill plug to the transmission and tighten the fill plug to 18 N.m (13 lb ft).
7. Lower the vehicle.

TRANSMISSION MOUNT INSPECTION

CAUTION: In order to avoid oil pan damage and possible engine failure, insert a block of wood that spans the width of the oil pan bottom between the oil pan and the jack support.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

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

- 2. Raise the transmission in order to remove the weight from the transmission mount and create slight tension in the rubber.
- 3. 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.
- 4. 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 mount bracket. Refer to **Transmission Mount Replacement (CTS-V)** .
- 5. Lower the vehicle.

TRANSMISSION REAR MOUNT REPLACEMENT

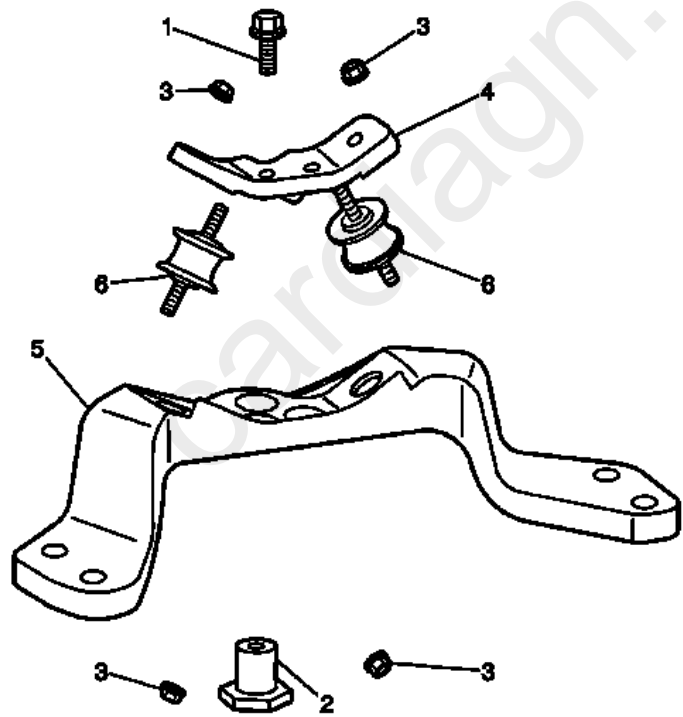


Fig. 11: Identifying Transmission Mount (CTS-V)
Courtesy of GENERAL MOTORS COMPANY

Transmission Rear Mount Replacement

Callout	Component Name
Preliminary Procedure	

Remove the transmission support. Refer to **Transmission Support Replacement (Manual CTS-V)** .

1	Transmission Mount Travel Restrictor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 90 N.m (66 lb ft)
2	Transmission Mount Travel Restrictor
3	Transmission Mount Nut (Qty: 4) Tighten 58 N.m (43 lb ft)
4	Transmission Mount Adaptor
5	Transmission Support
6	Transmission Mount (Qty: 2)

SHIFT CONTROL ASSEMBLY REPLACEMENT

Removal Procedure

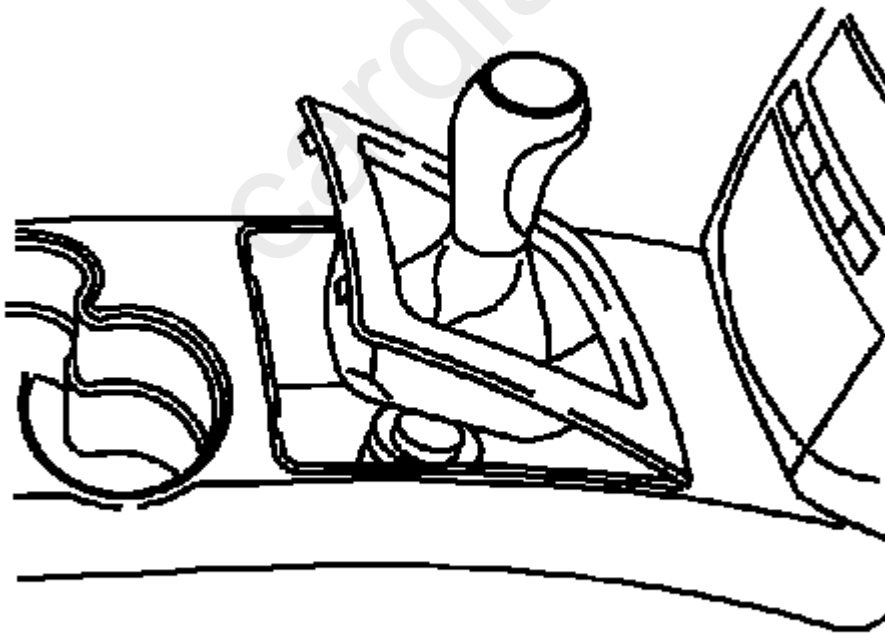


Fig. 12: Lifting Up On Rear Portion Of Shift Control Closeout Boot Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

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

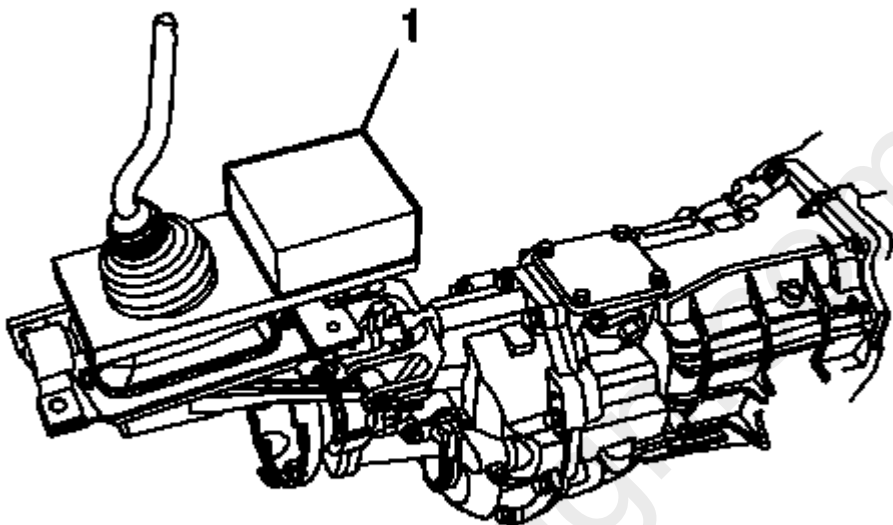


Fig. 13: Sound Insulator Foam Block
Courtesy of GENERAL MOTORS COMPANY

2. Remove the sound insulator foam block (1) from the console.
3. Remove the shifter boot from the shifter by pulling upward on the boot.
4. Place the shifter in the Neutral position.

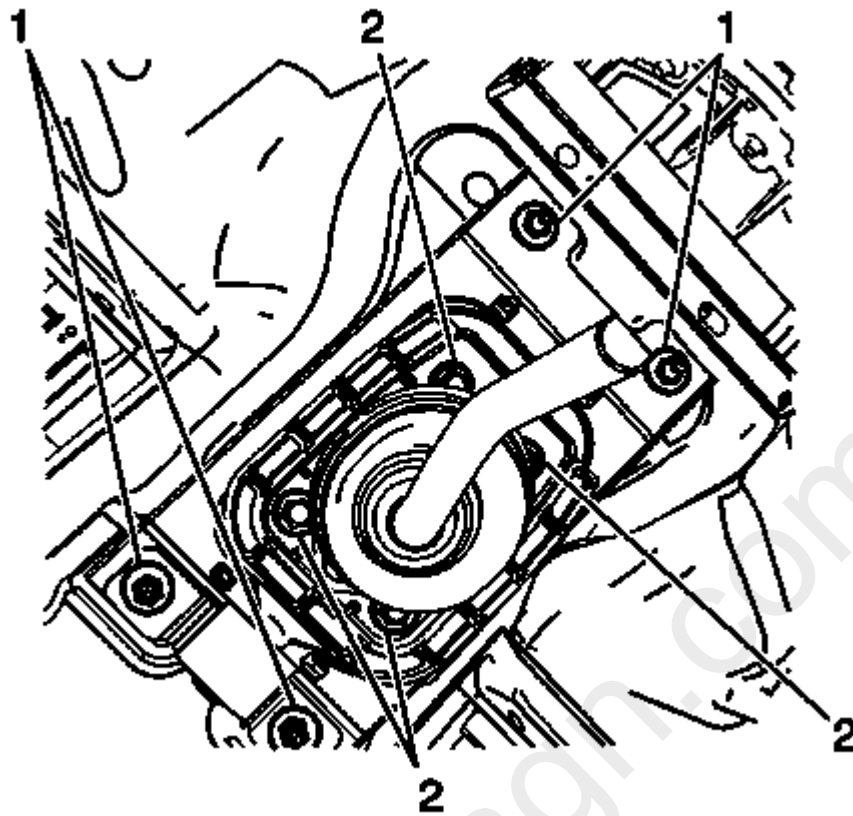


Fig. 14: Identifying Shift Control Assembly Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 4 fasteners (2) securing the shift control assembly to the shift control adapter plate.
6. Remove the 4 fasteners (2) securing the shift control adapter plate to the tunnel reinforcement.

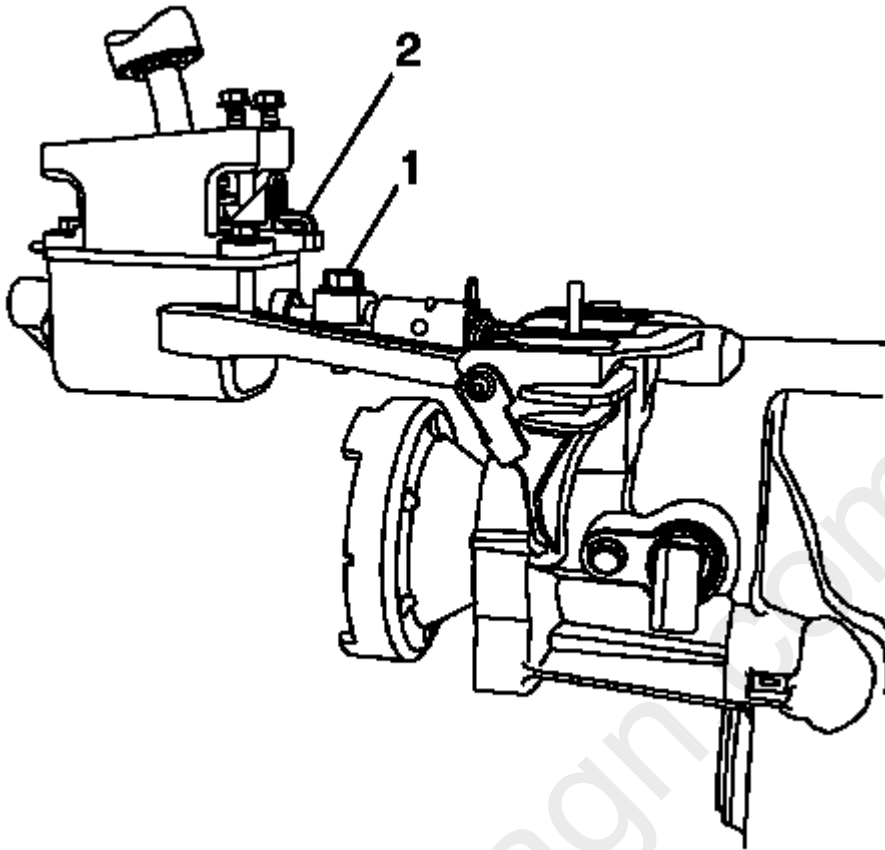


Fig. 15: Identifying Shift Assembly Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove the shift assembly clamp bolt (1).
8. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** .
9. Remove the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
10. Remove the propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
11. Support the transmission with a suitable jack.

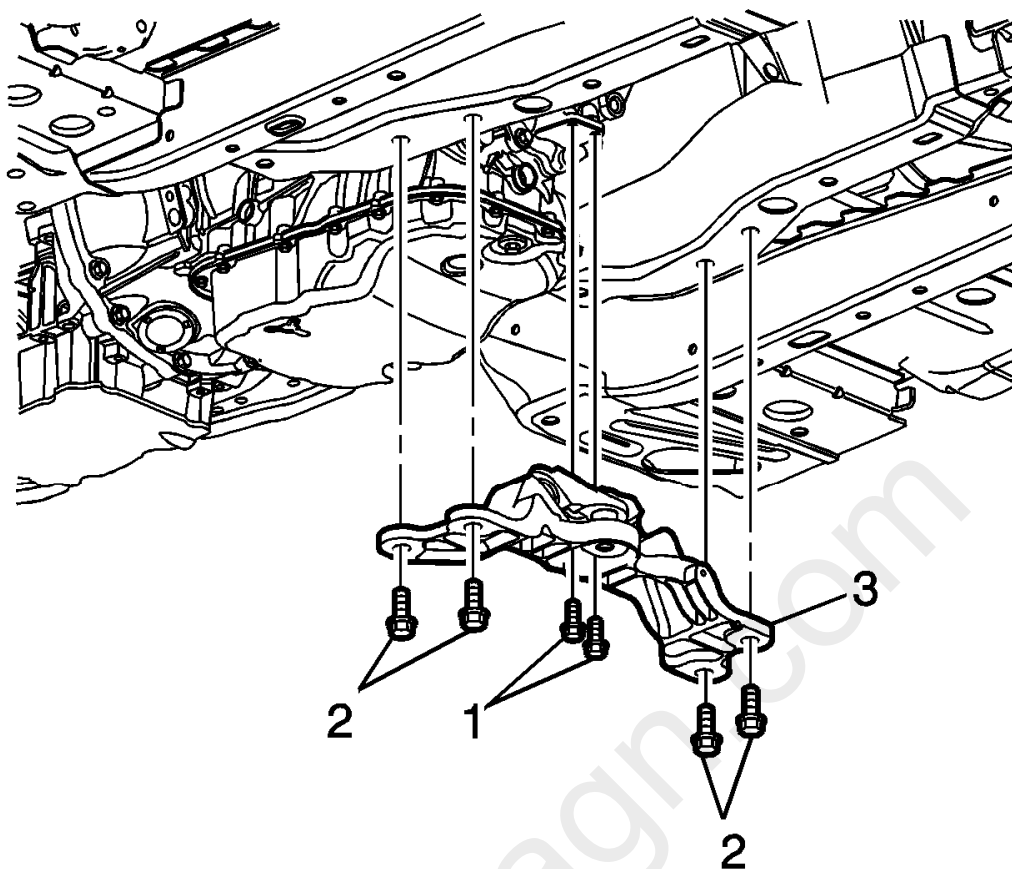


Fig. 16: Identifying Transmission Support Fasteners
Courtesy of GENERAL MOTORS COMPANY

12. Remove the 4 fasteners (2) securing the transmission support. Refer to **Transmission Support Replacement (Manual CTS-V)** .
13. Lower the transmission assembly to gain access to the top of the transmission.

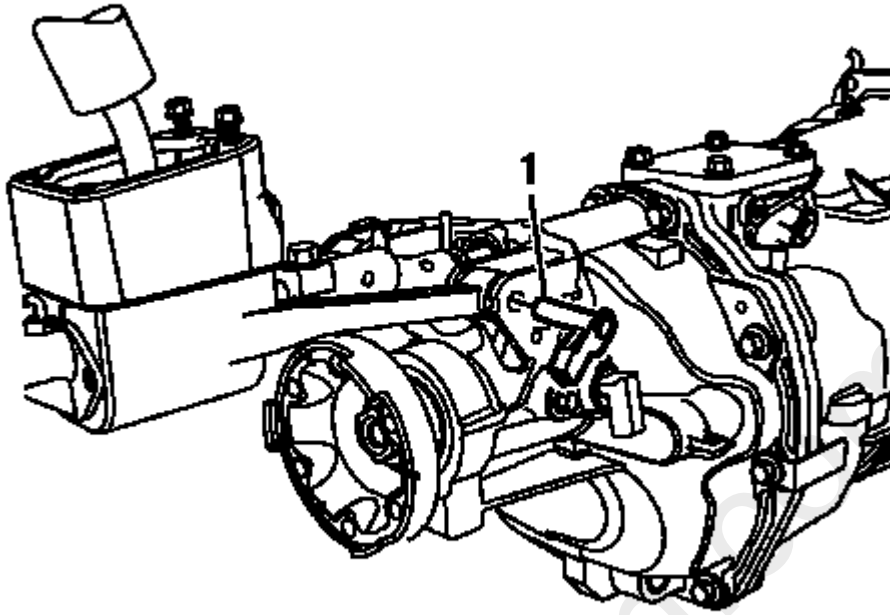


Fig. 17: Right Side Shift Control Rod Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

14. Using a flat-blade tool, release the right side shift control rod pin retainer (1), then remove the pin.

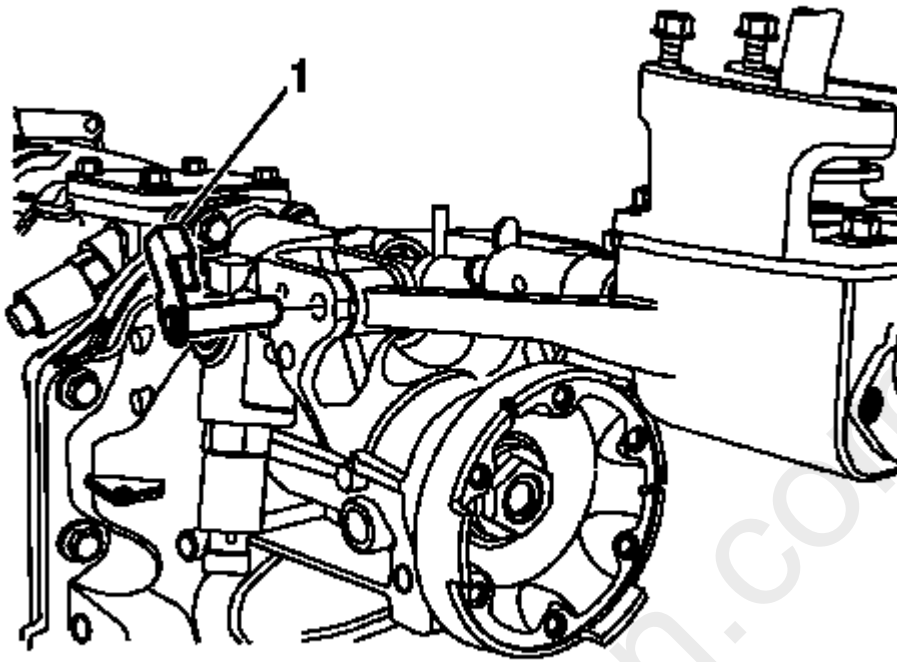


Fig. 18: Left Side Shift Control Rod Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

15. Using a flat-blade tool, release the left side shift control rod pin retainer, then remove the pin. The graphic shows the transmission removed for clarity.
16. Remove the shift control assembly from the transmission. Remove the shift control assembly from the vehicle.

Installation Procedure

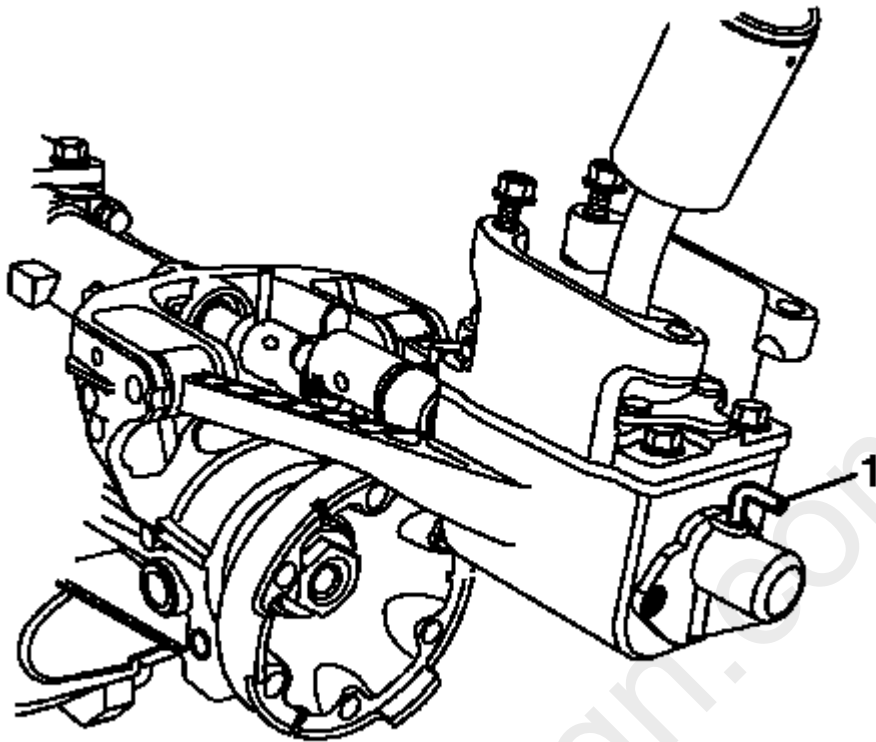


Fig. 19: View Of Alignment Pin

Courtesy of GENERAL MOTORS COMPANY

NOTE: Before installing the shifter, align shifter by installing the alignment pin (1). If a new shifter assembly is being installed, ensure the shifter is in the Neutral position and the alignment pin is fully seated

1. Install the alignment pin.

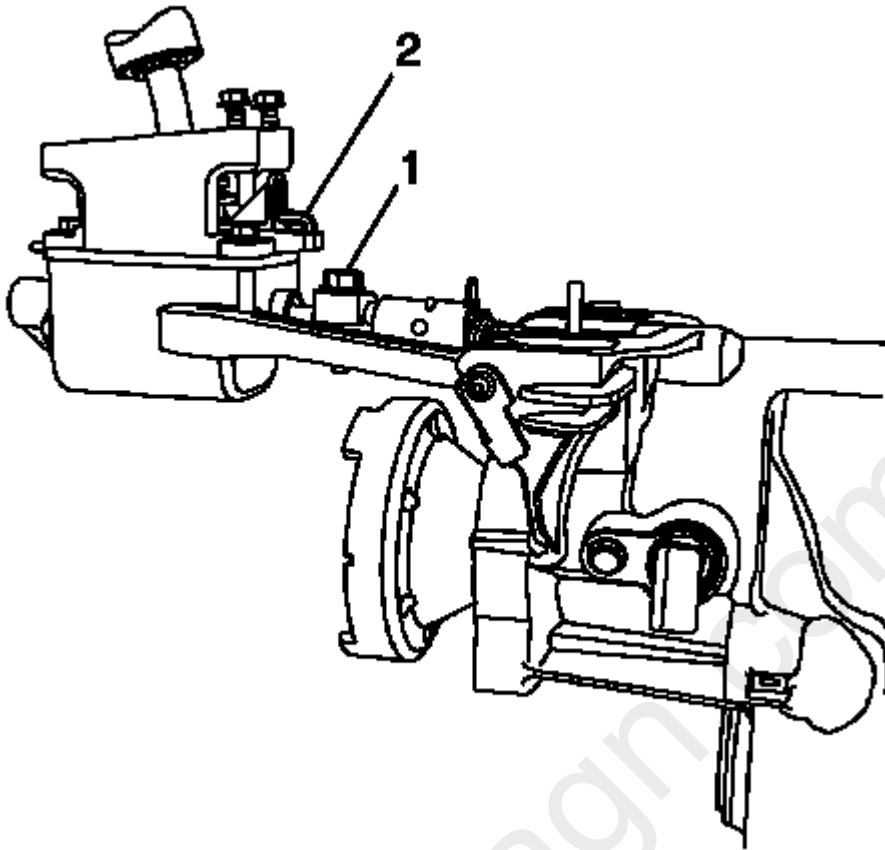


Fig. 20: Identifying Shift Assembly Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the existing shifter is being reinstalled, it will be necessary to access the service alignment pin which is located in the front of the shifter under the plastic boot (2).

2. Remove the pin from the front of the shifter and place it in the rear alignment hole.

NOTE: Before installing the shifter, ensure that the shift shaft it is clean of dirt or lubricants.

3. Install the shift control assembly to the transmission.

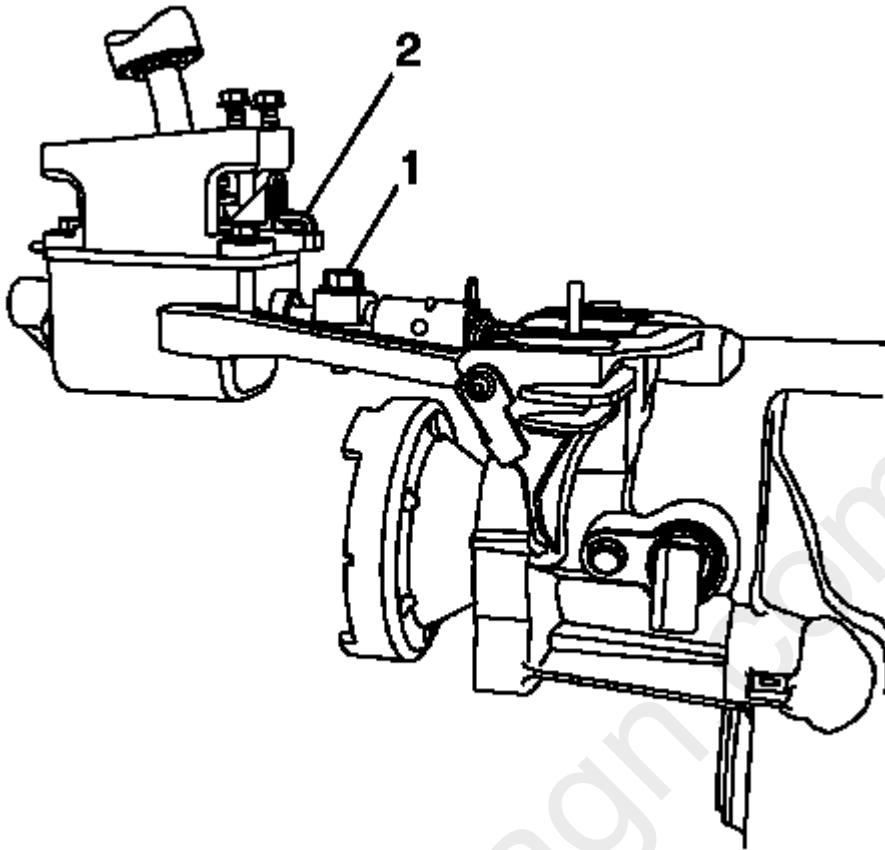


Fig. 21: Identifying Shift Assembly Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Align shift assembly clamp with shift rod, then install retaining bolt finger tight, Do Not tighten at this time.

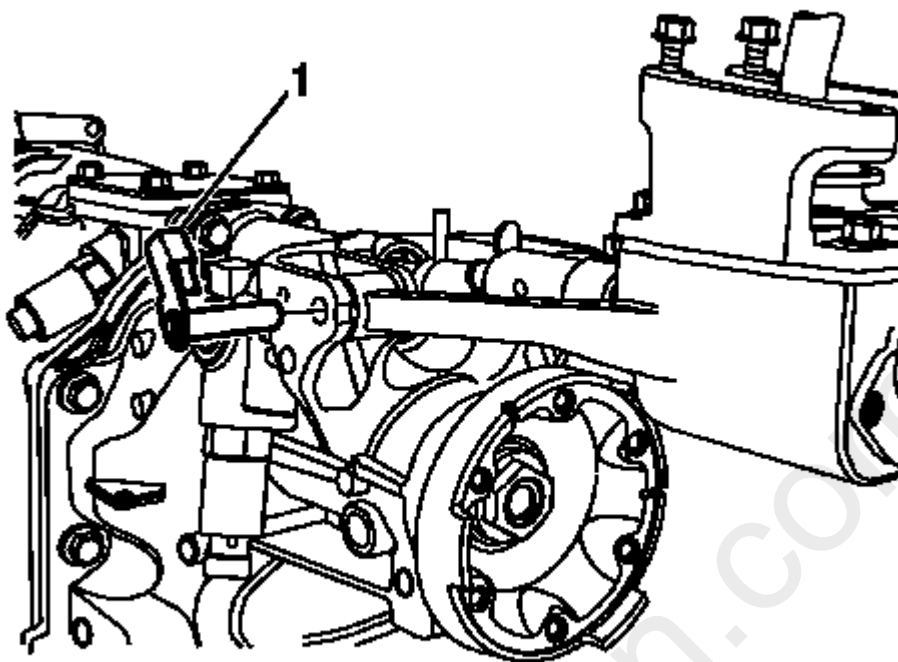


Fig. 22: Left Side Shift Control Rod Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Install the left side shift control rod pin. Rotate the pin in order to lock the retainer into place on the transmission.

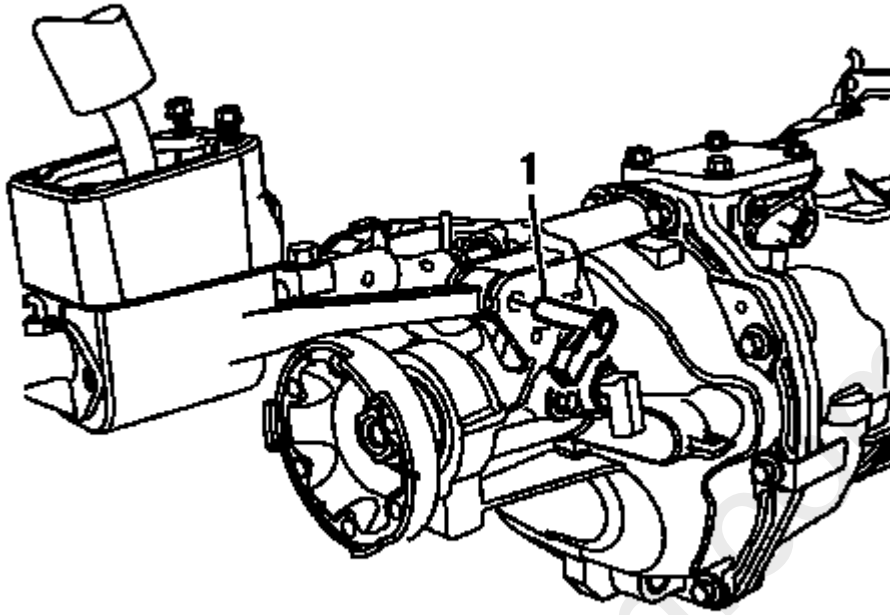


Fig. 23: Right Side Shift Control Rod Pin Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Install the right side shift control rod pin. Rotate the pin in order to lock the retainer into place on the transmission.

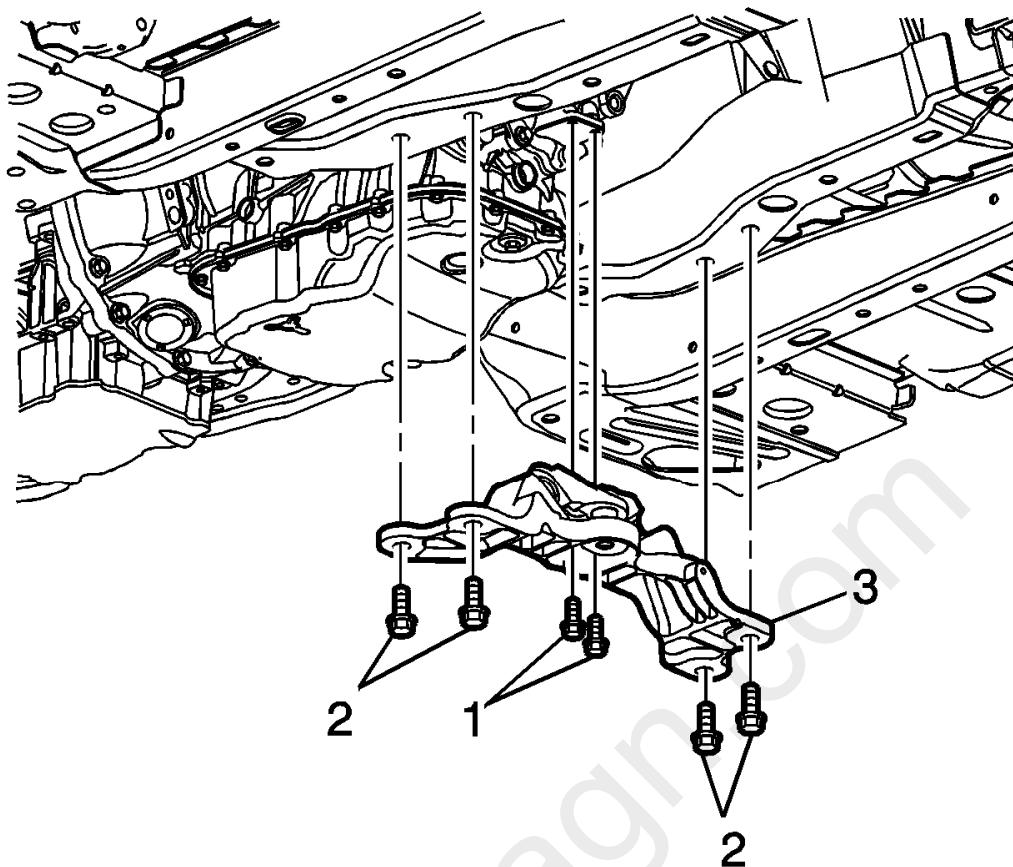


Fig. 24: Identifying Transmission Support Fasteners
 Courtesy of GENERAL MOTORS COMPANY

7. Raise the transmission .

CAUTION: Refer to Fastener Caution .

8. Install the 4 transmission support fasteners (2) ,then tighten to 60 N.m (44 lb ft).
9. Remove the jack supporting the transmission.
10. Install the propeller shaft (6). Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
11. Install the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
12. Lower the vehicle.

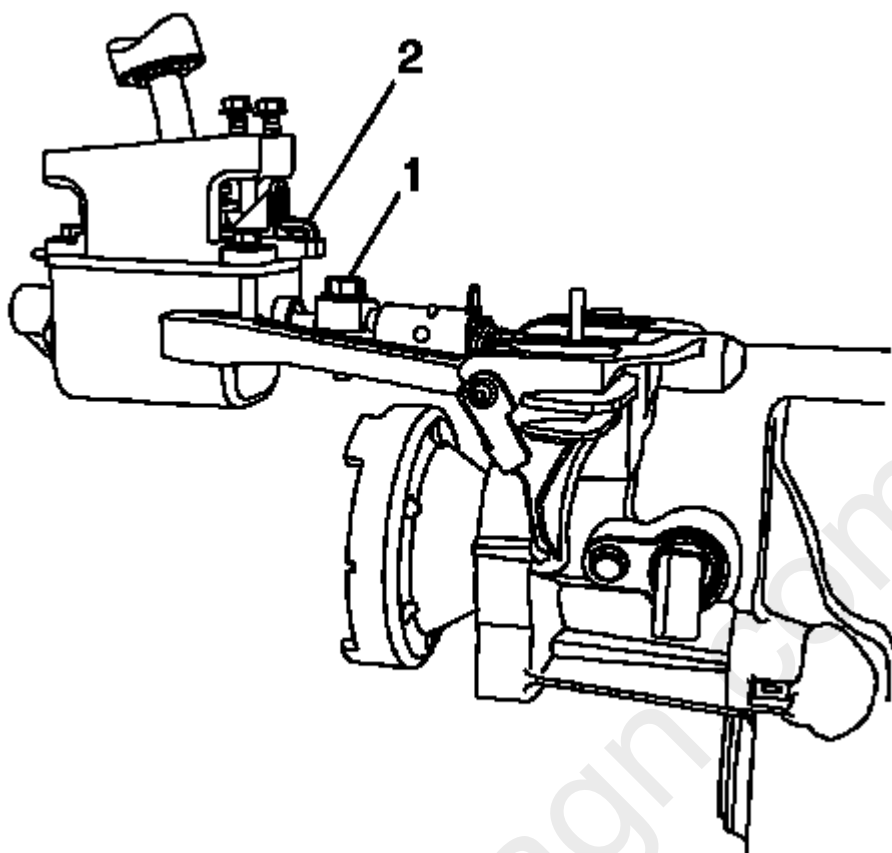


Fig. 25: Identifying Shift Assembly Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Tighten the shift assembly clamp bolt (1) to 30 N.m (22 lb ft)

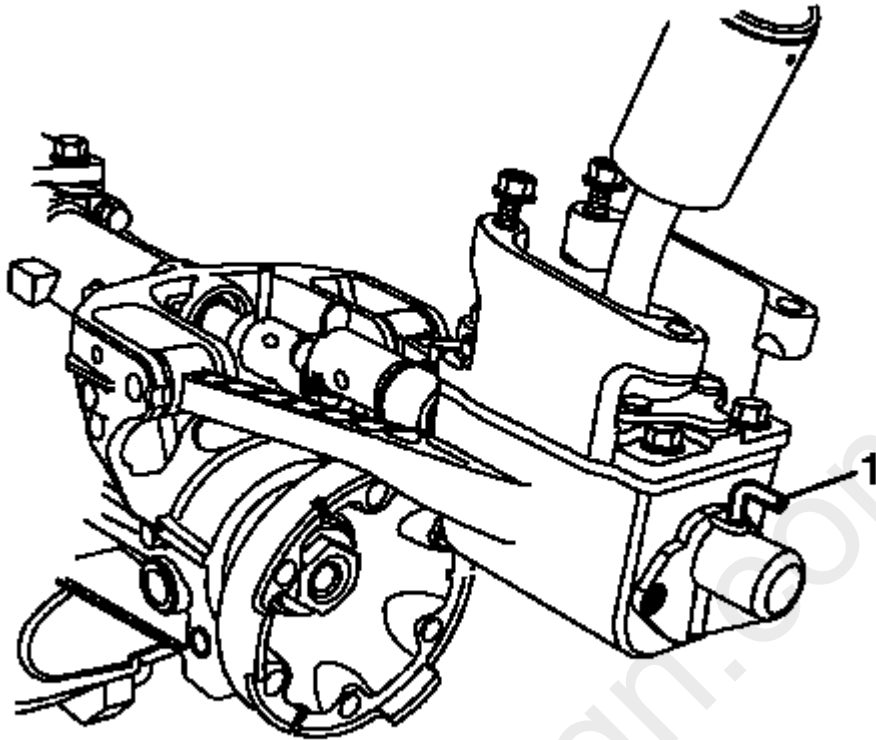


Fig. 26: View Of Alignment Pin
Courtesy of GENERAL MOTORS COMPANY

14. Remove the alignment pin (1) from the rear of the shifter assembly, then install in service storage position.
15. Install rubber grommet covering alignment hole.

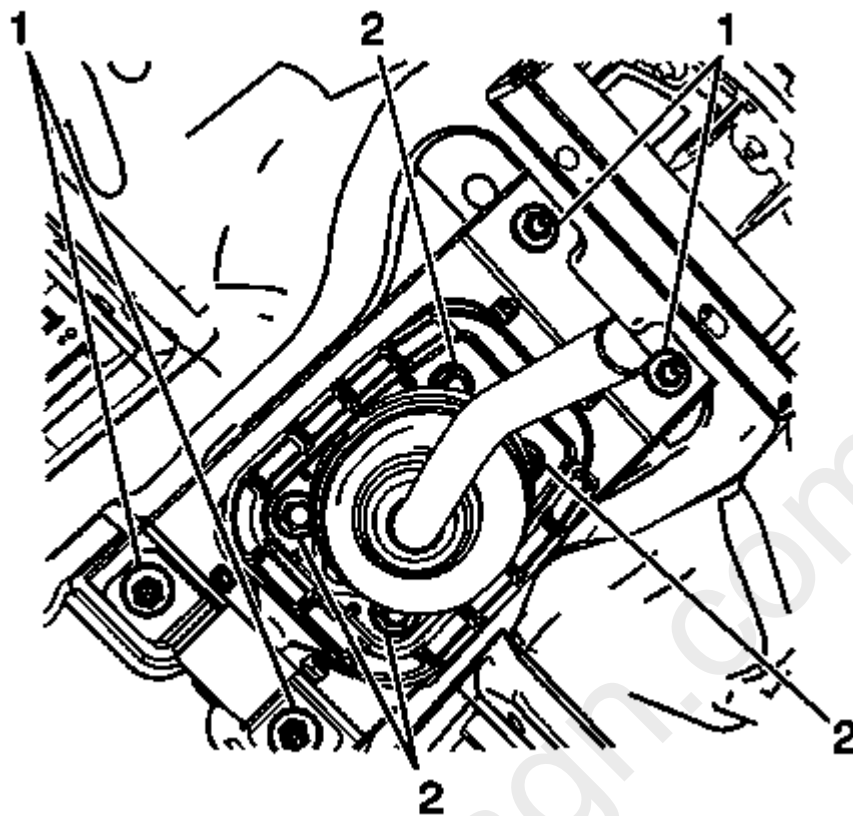


Fig. 27: Identifying Shift Control Assembly Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Install the 4 fasteners (1) securing the shift control adapter plate to the tunnel reinforcements, then tighten the bolts to 12 N.m (106 lb in).
17. Install the 4 fasteners (2) securing the shift control assembly to the shift control adapter plate, then tighten the fasteners to 18 N.m (13 lb ft)

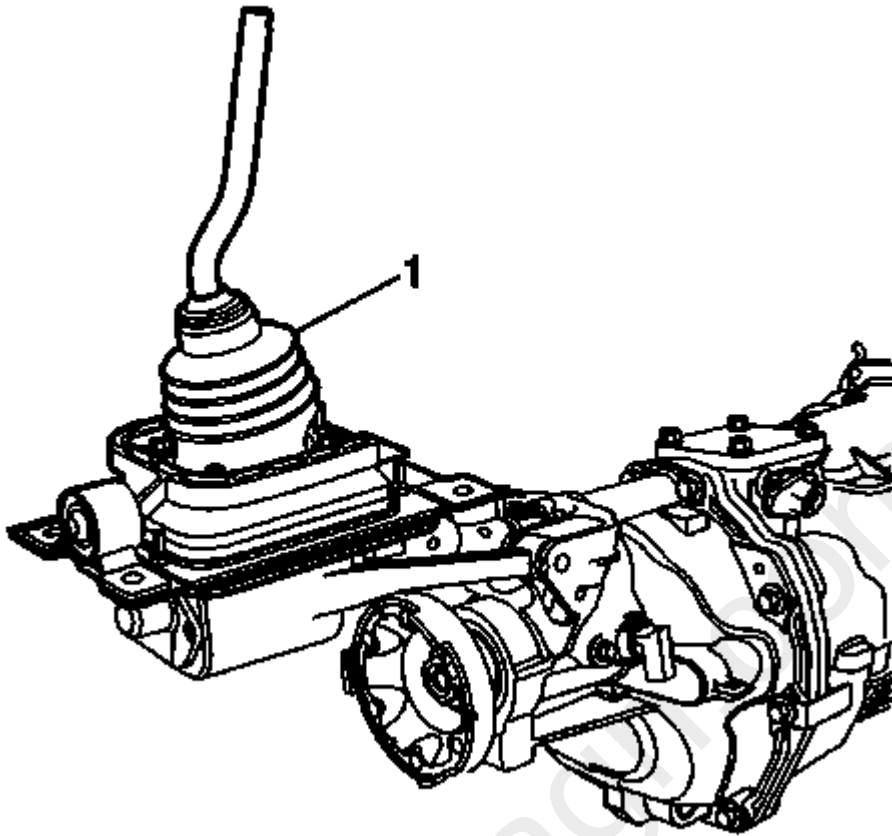


Fig. 28: Identifying Shifter Boot
Courtesy of GENERAL MOTORS COMPANY

18. Install the shifter boot to the shift rod by pushing down on the boot, ensure the boot is seated in the groove (1).

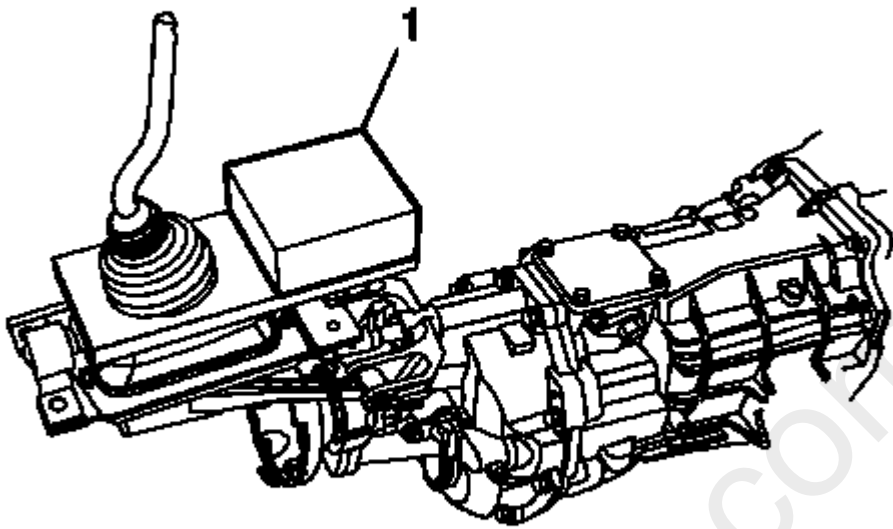


Fig. 29: Sound Insulator Foam Block
Courtesy of GENERAL MOTORS COMPANY

19. Install the sound insulator foam block into the console.

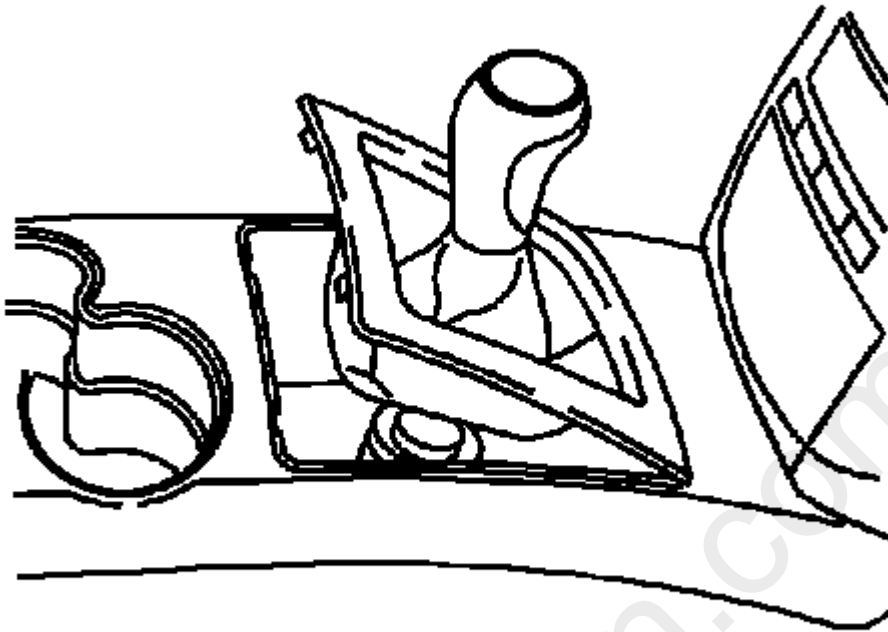


Fig. 30: Lifting Up On Rear Portion Of Shift Control Closeout Boot Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

20. Install the shift control knob. Refer to **Transmission Control Lever Knob Replacement**.

SHIFT CONTROL SHIFT CLOSEOUT BOOT REPLACEMENT

Removal Procedure

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

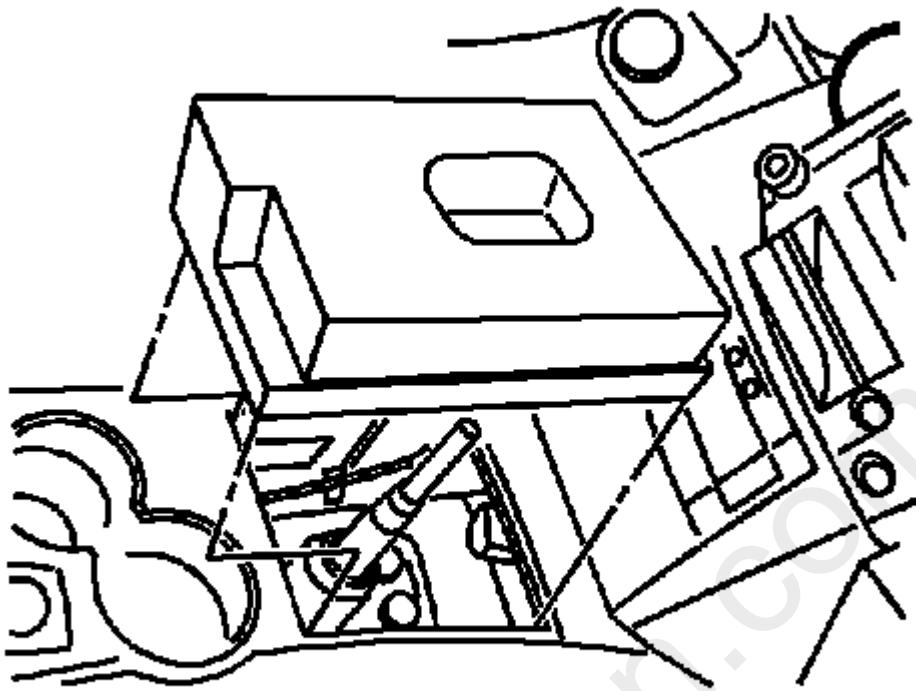


Fig. 31: Removing Sound Insulator Foam Block From Console
Courtesy of GENERAL MOTORS COMPANY

2. Remove the sound insulator foam block from the console.

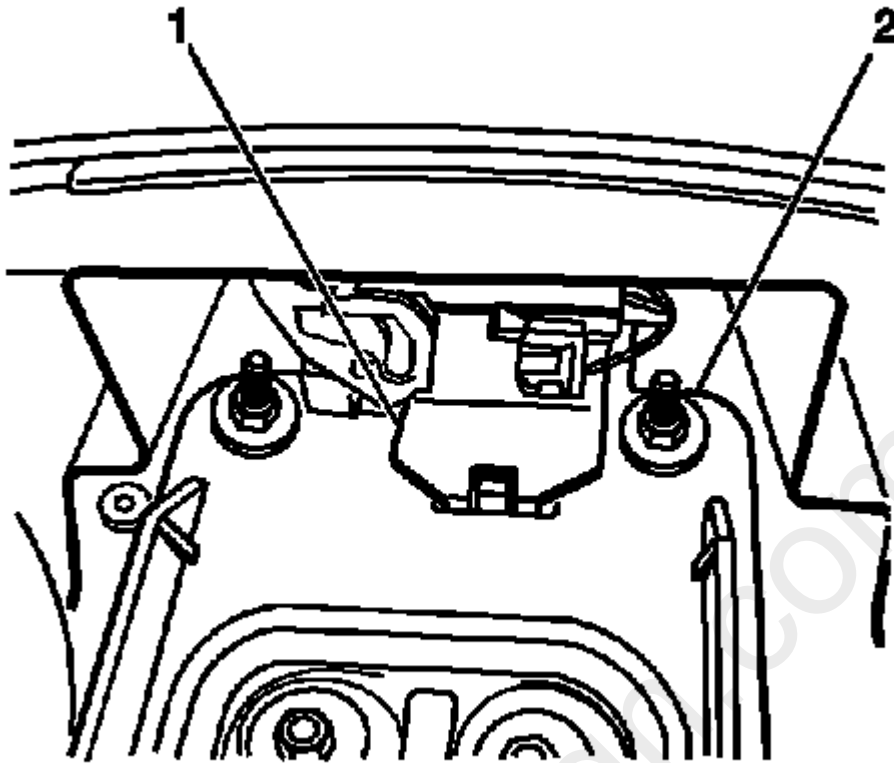


Fig. 32: Removing Electrical Connector From Shift Control Adaptor Plate
Courtesy of GENERAL MOTORS COMPANY

3. Remove the electrical connector (1) from the shift control adaptor plate (2).
4. Position the electrical connector (1) out of the way.

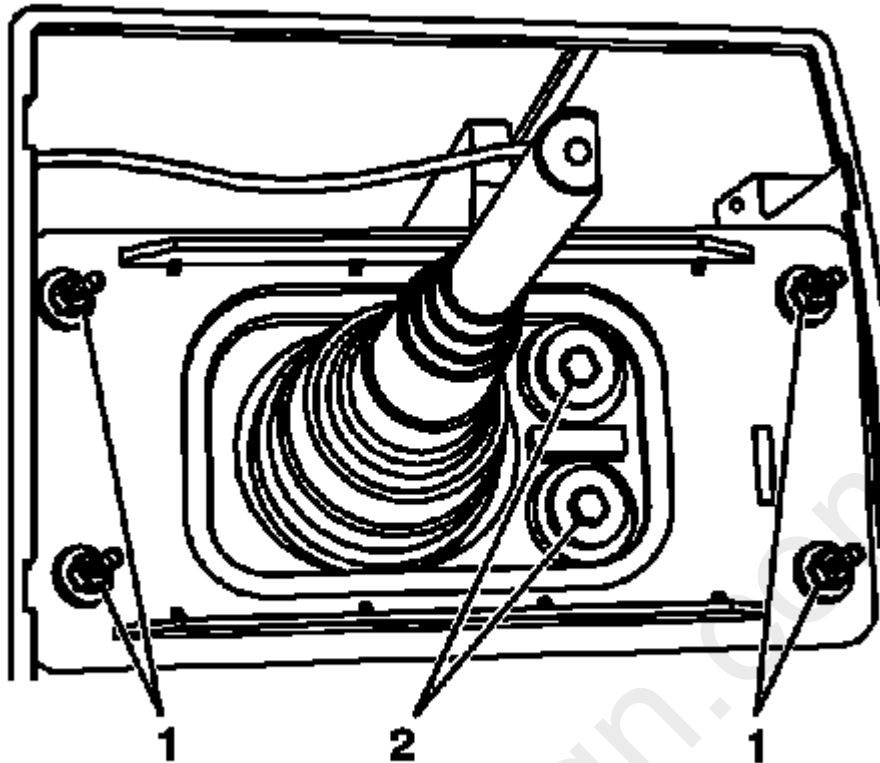


Fig. 33: View Of Shifter Assembly Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 bolts (2) attaching the shift control assembly to the shift control adaptor plate.
6. Remove the 4 nuts (1) securing the shift control adaptor plate to the tunnel reinforcement.

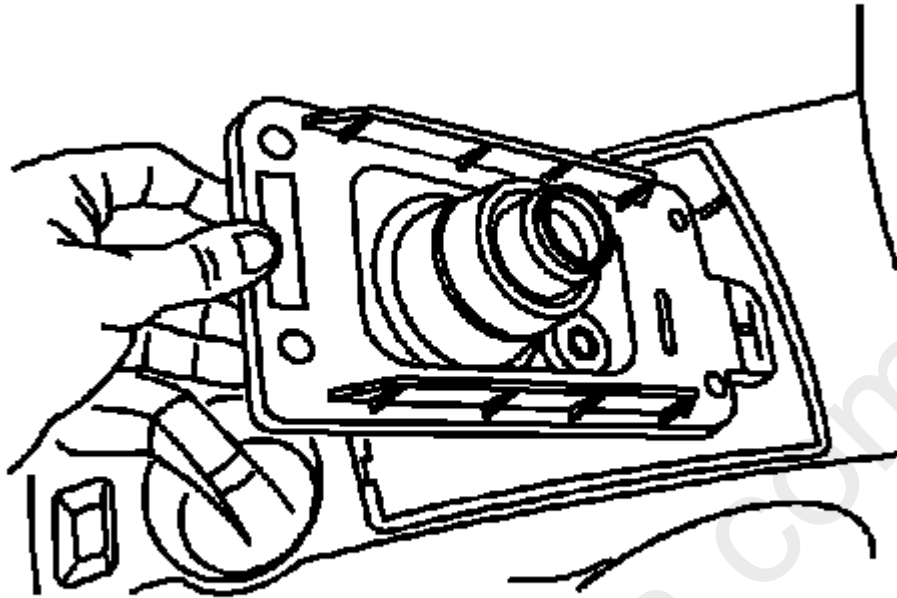


Fig. 34: Removing Shift Control Boot
Courtesy of GENERAL MOTORS COMPANY

7. Remove the shift control boot and adaptor plate assembly from the vehicle.

Installation Procedure

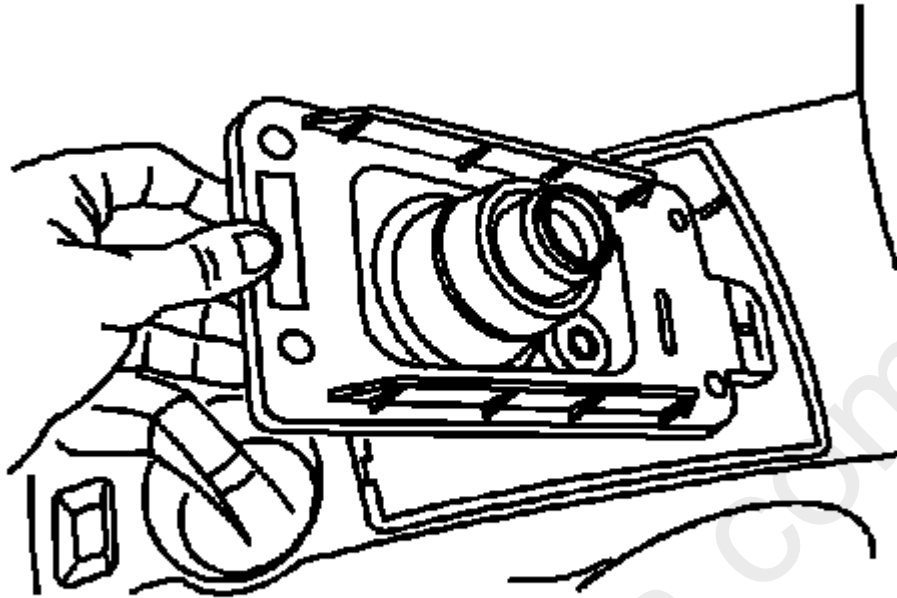


Fig. 35: Removing Shift Control Boot
Courtesy of GENERAL MOTORS COMPANY

1. Install the shift control boot and adaptor plate assembly to the vehicle.

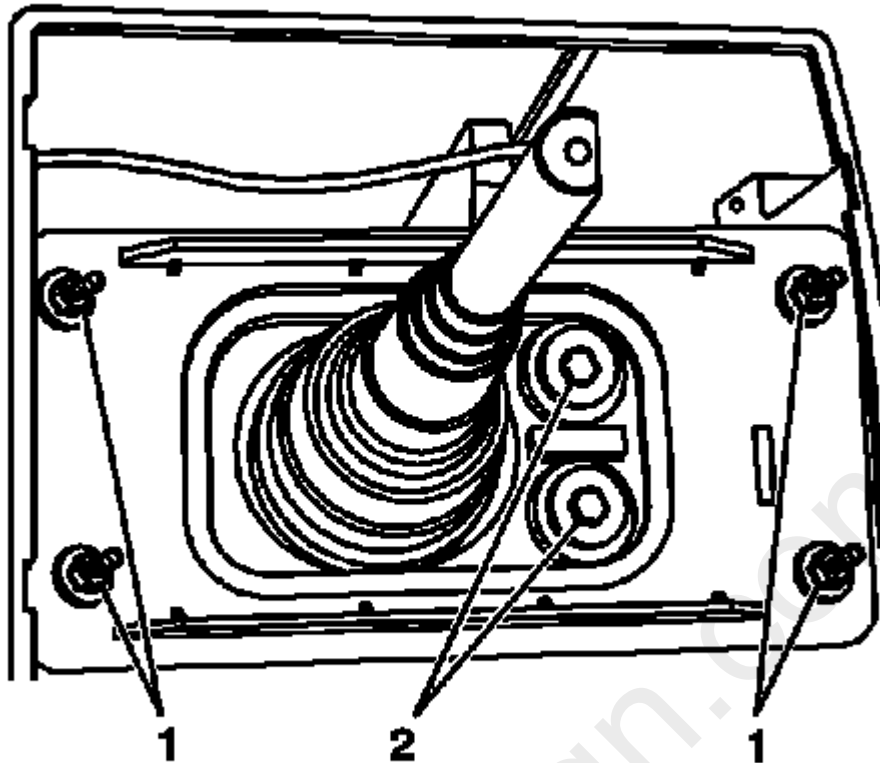


Fig. 36: View Of Shifter Assembly Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install the 4 nuts (1) securing the shift control adaptor plate to the tunnel reinforcement and tighten the nuts to 12 N.m (106 lb in).
3. Lift up on the shift control lever to bring the shift control assembly in contact with the shift control adaptor plate.
4. Install the 2 bolts (2) securing the shift control assembly to the shift control adaptor plate and tighten the bolts to 18 N.m (13 lb ft).

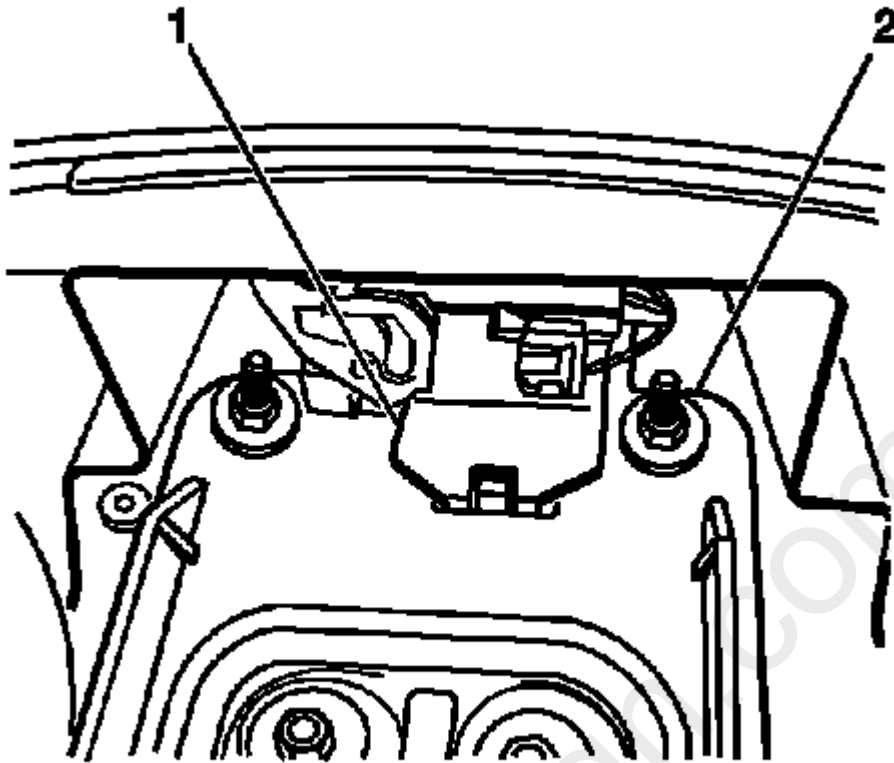


Fig. 37: Removing Electrical Connector From Shift Control Adaptor Plate
Courtesy of GENERAL MOTORS COMPANY

5. Install the electrical connector (1) to the shift control adaptor plate (2).

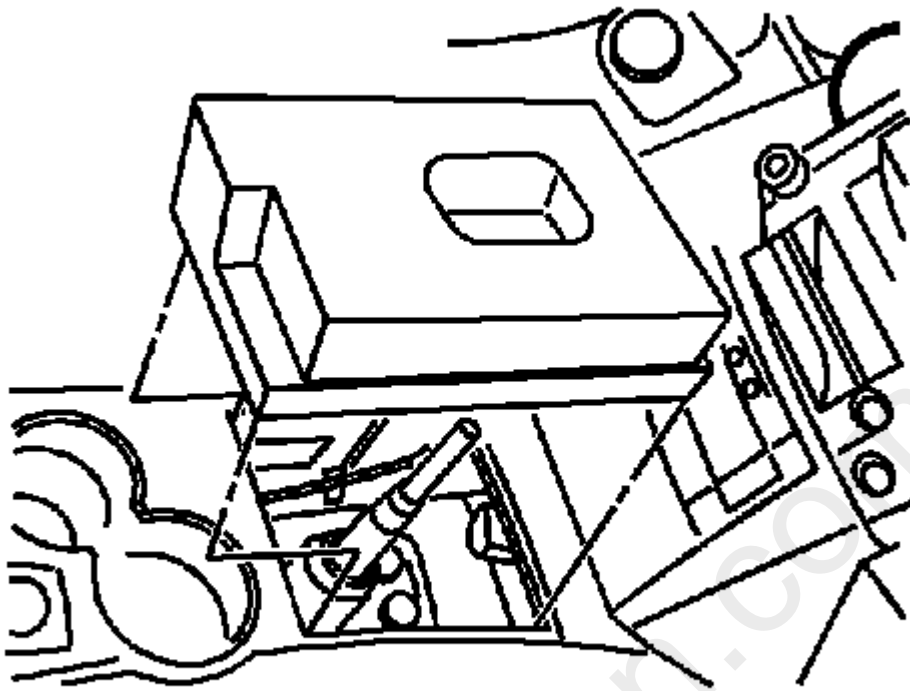


Fig. 38: Removing Sound Insulator Foam Block From Console
Courtesy of GENERAL MOTORS COMPANY

6. Install the sound insulator foam block into the console.
7. Install the shift control knob/ boot assembly. Refer to **Transmission Control Lever Knob Replacement**.

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

Removal Procedure

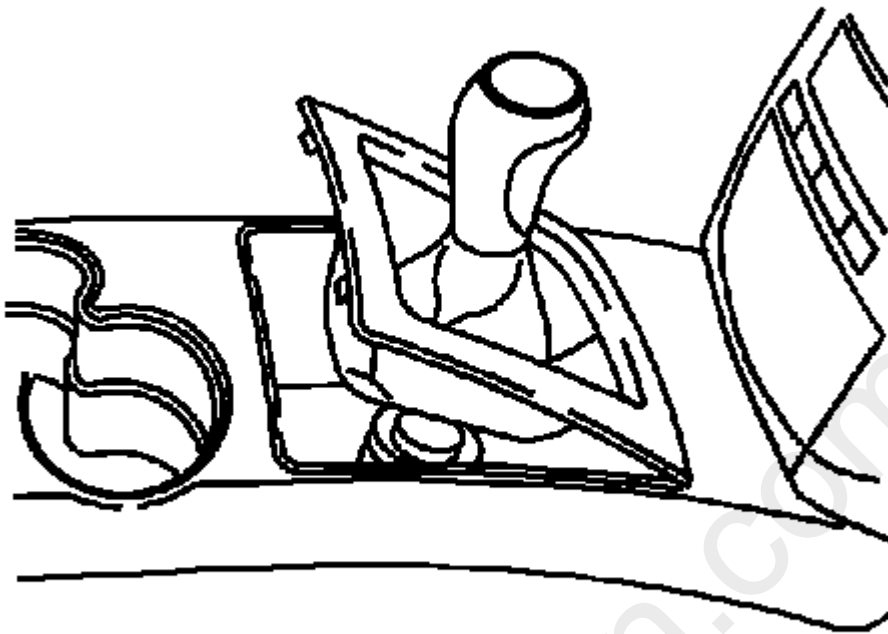


Fig. 39: Lifting Up On Rear Portion Of Shift Control Closeout Boot Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

1. Lift up on the rear portion of the shift control closeout boot retaining ring and detach the retaining ring from the console.

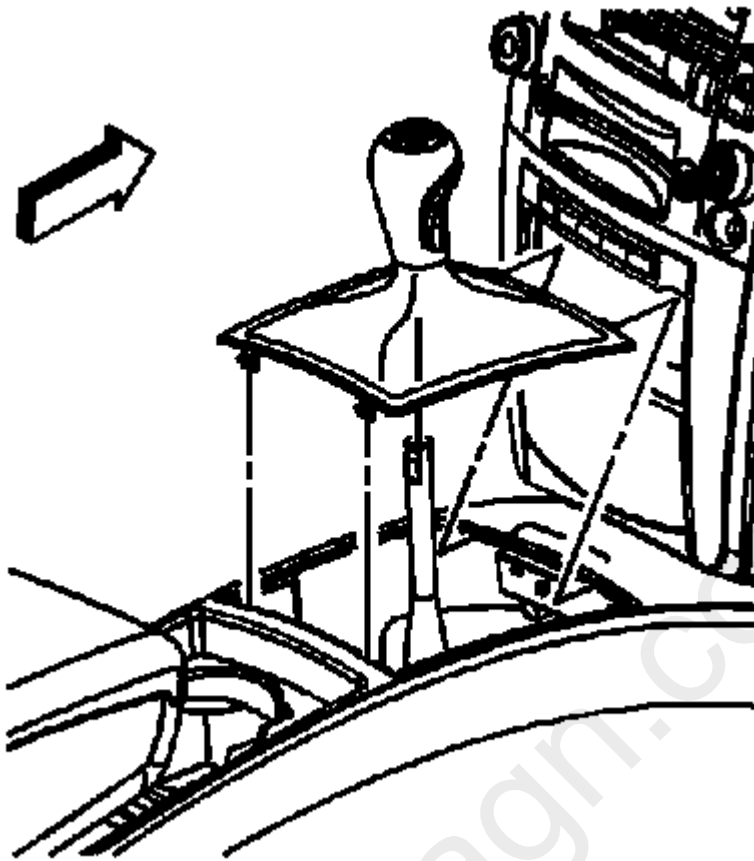


Fig. 40: Removing Shift Control Closeout Boot And Knob Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Detaching the shift control knob from the shift lever may require a large amount of physical effort.

2. Firmly grasp the shift control knob and pull straight up to detach the shift control knob from the shift lever.
3. Remove the shift control closeout boot and knob assembly.

Installation Procedure

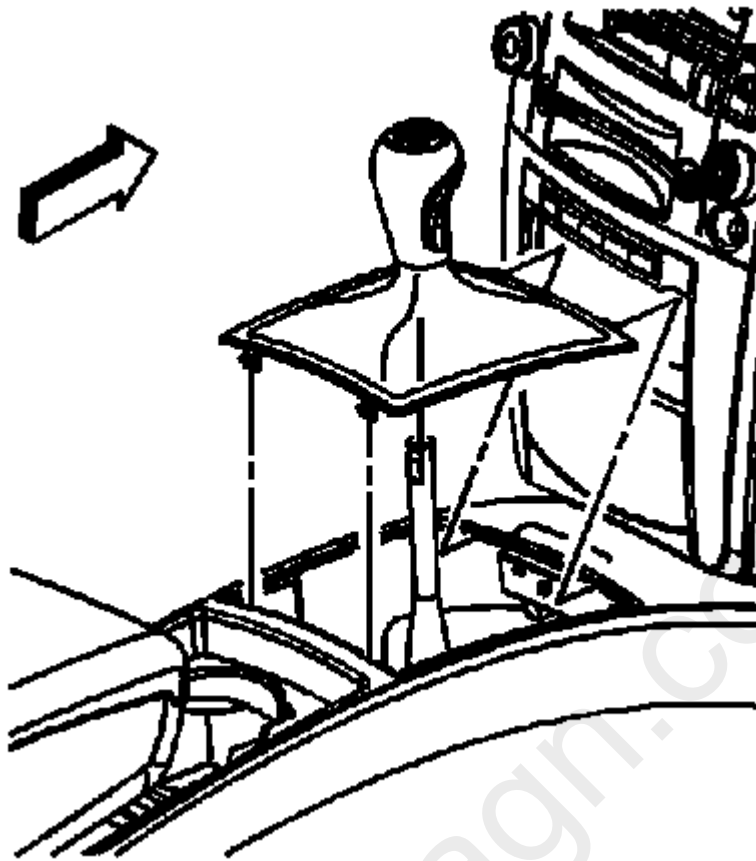


Fig. 41: Removing Shift Control Closeout Boot And Knob Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the shift control closeout boot and knob assembly to the shift lever.
2. Firmly press down on the shift control knob in order to attach the shift control knob to the shift lever.

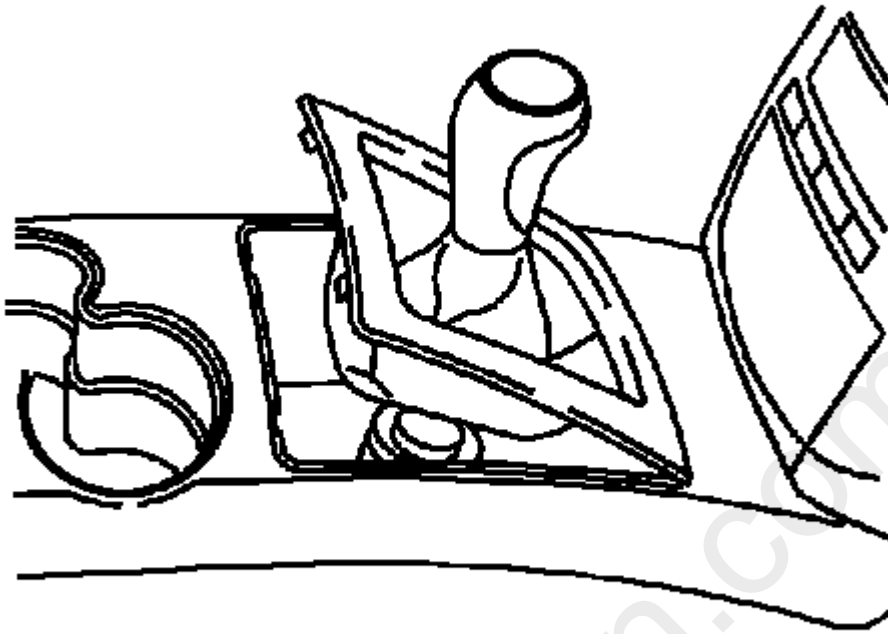


Fig. 42: Lifting Up On Rear Portion Of Shift Control Closeout Boot Retaining Ring
Courtesy of GENERAL MOTORS COMPANY

3. Insert the front tabs of the shift control closeout boot retaining ring to the console.
4. Press the rear portion of the shift control closeout boot retaining ring down into the console.
5. Tug lightly to insure the shift control closeout boot retaining ring is securely attached to the console.

SHIFT ROD REPLACEMENT

Removal Procedure

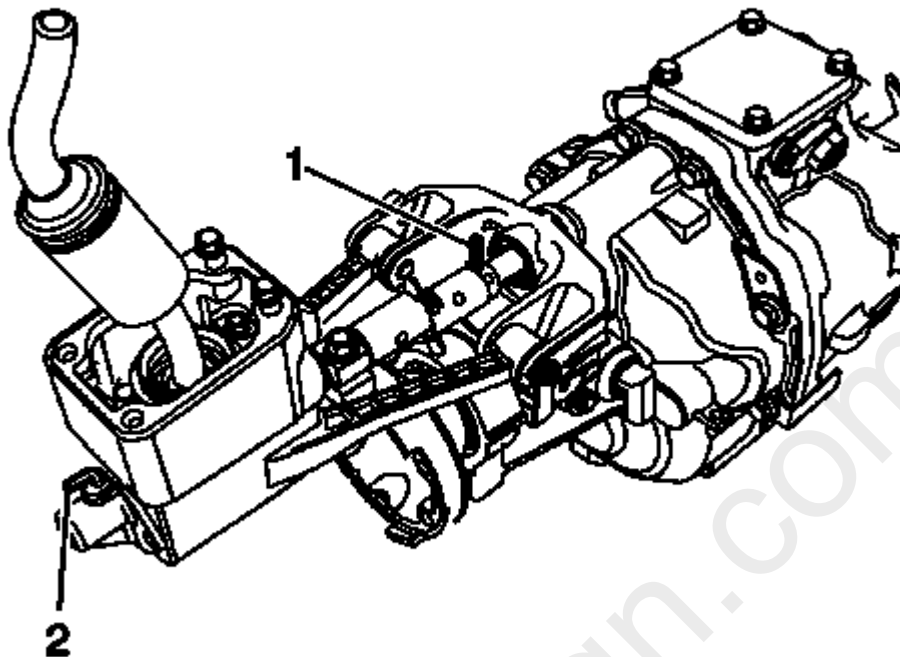


Fig. 43: View Of Roll Pin And Alignment Pin
Courtesy of GENERAL MOTORS COMPANY

1. Remove the shift control assembly, refer to Shift Control Assembly Replacement.

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

2. Slide the transmission shift rod toward the transmission until the transmission shift shaft seats in the rear most detent position.
3. Using a drift or punch, remove the roll pin (1).
4. Remove the shift rod from the transmission.

Installation Procedure

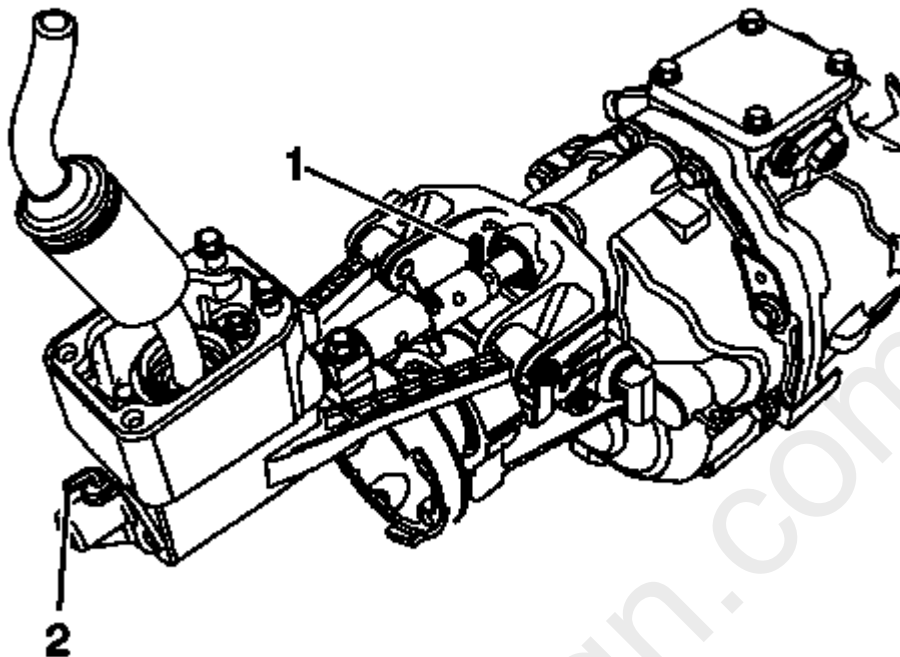


Fig. 44: View Of Roll Pin And Alignment Pin
Courtesy of GENERAL MOTORS COMPANY

1. Install the shift rod to the transmission.
2. Using a drift or punch, install a new roll pin (1).
3. Pull the transmission shift rod away from the transmission to the middle detent position (Neutral).
4. Install the shift control assembly. Refer to **Shift Control Assembly Replacement**.

MAIN SHAFT REAR SEAL REPLACEMENT

Special Tools

- J 6125-1B Slide Hammer
- J 23129 Universal Seal Remover
- J 29873 Injector Nozzle Socket 30 mm
- J 44765 Seal Installer
- J 45012 Holding Fixture
- J 45019 Flange and Pinion Gauge Remover

Removal Procedure

1. Place the transmission in neutral.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Remove the propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
4. Install the **J 45012** holding fixture to the drive flange.
5. While holding the **J 45012** holding fixture , remove the flange nut using the **J 29873** injector nozzle socket 30 mm.
6. Remove the **J 45012** holding fixture.

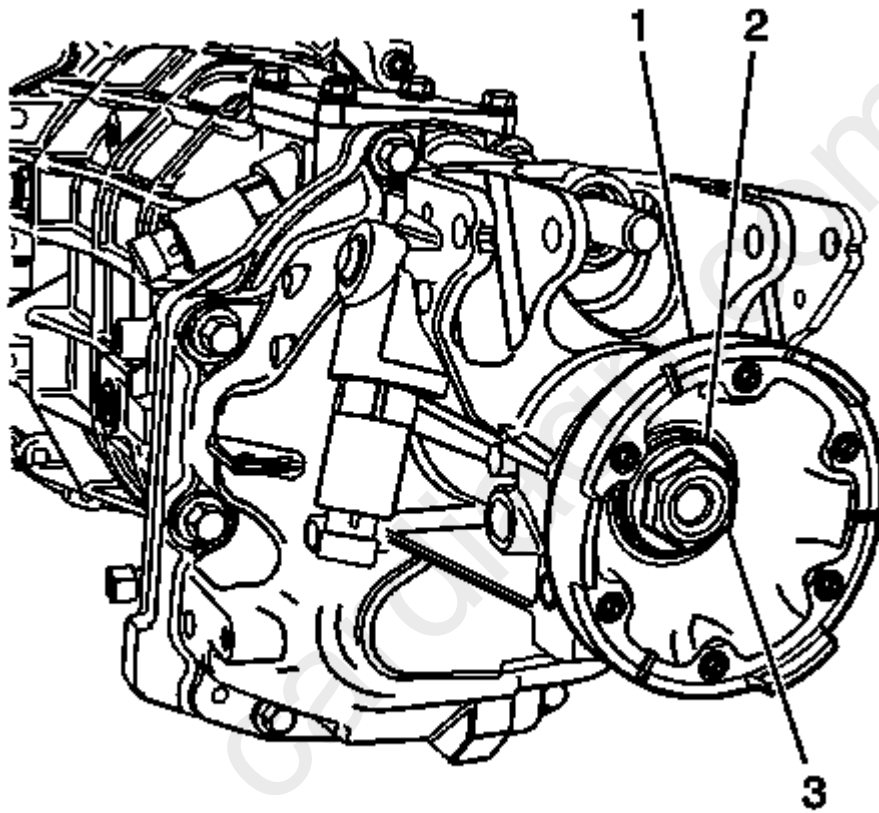


Fig. 45: View Of Drive Flange And Thrust Washer
Courtesy of GENERAL MOTORS COMPANY

7. Remove the drive flange thrust washer (2).
8. Remove the drive flange using the **J 45019** flange and pinion gauge remover.

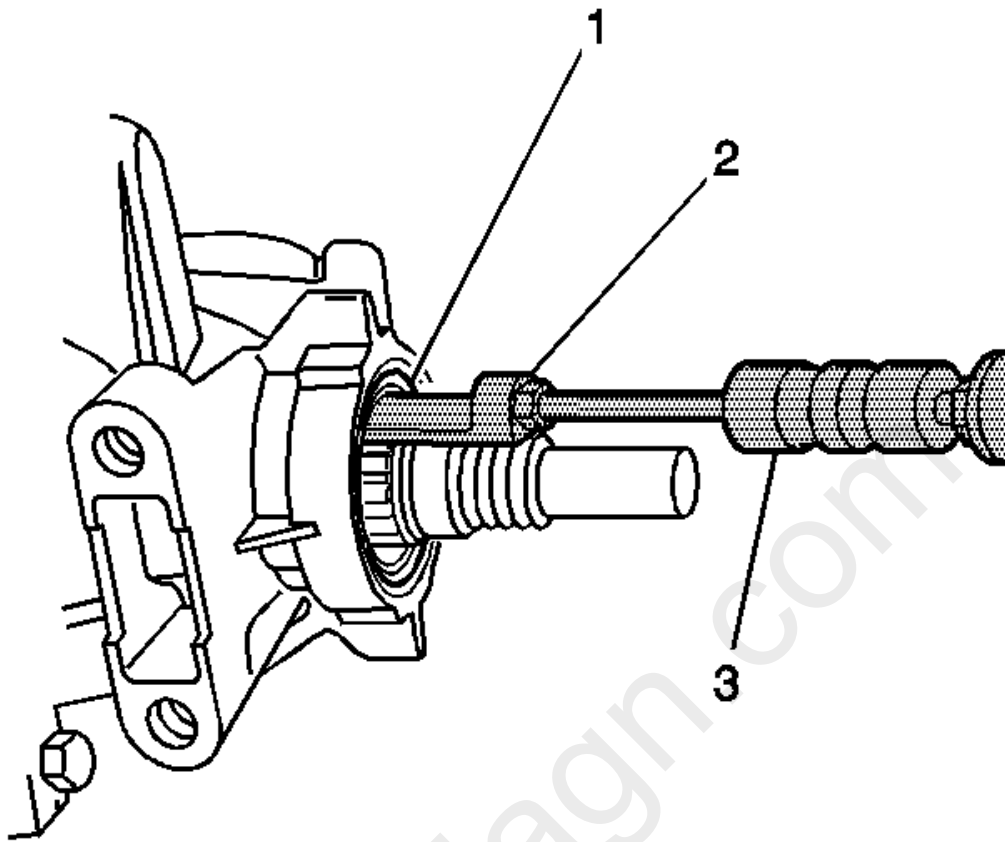


Fig. 46: Removing Transmission Case Extension Seal
Courtesy of GENERAL MOTORS COMPANY

9. Use the **J 6125-1B** slide hammer and **J 23129** universal seal remover to remove the transmission case extension seal (1).

Installation Procedure

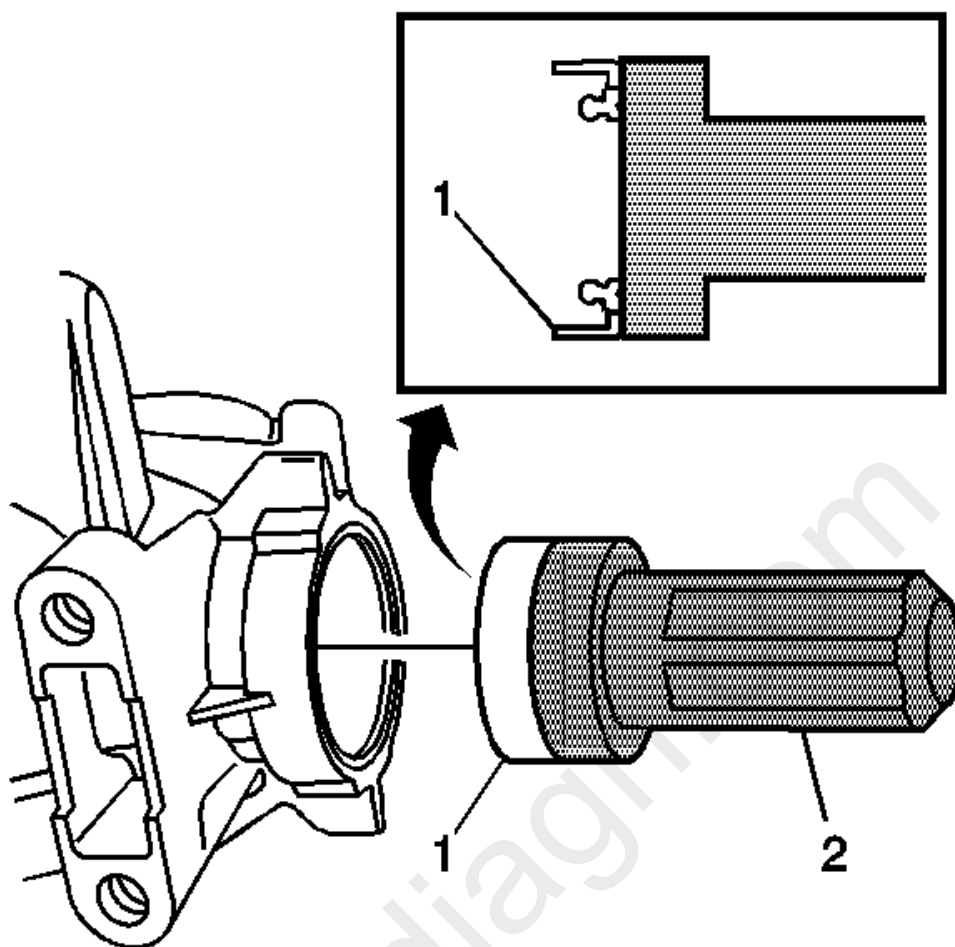


Fig. 47: Installing Transmission Case Extension Seal
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install the seal onto the tool before installing into the case to prevent damage to the seal.

1. Using J 44765 seal installer install the new transmission case extension seal (1).

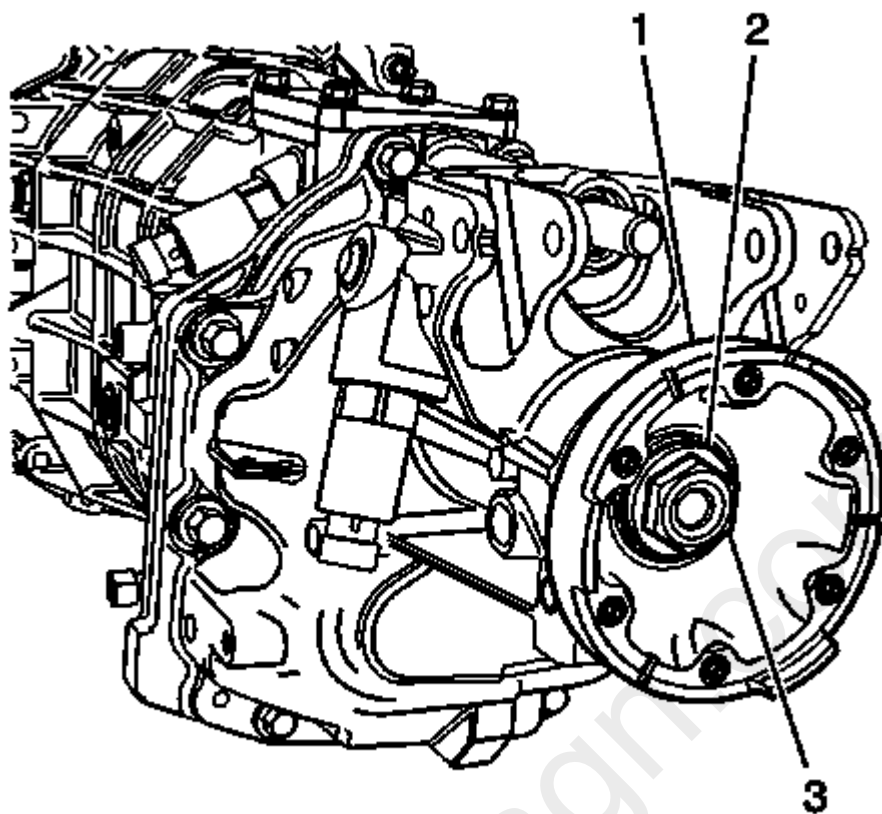


Fig. 48: View Of Drive Flange And Thrust Washer
Courtesy of GENERAL MOTORS COMPANY

2. Install the drive flange to the transmission output shaft.
3. Install a NEW drive flange thrust washer (2).

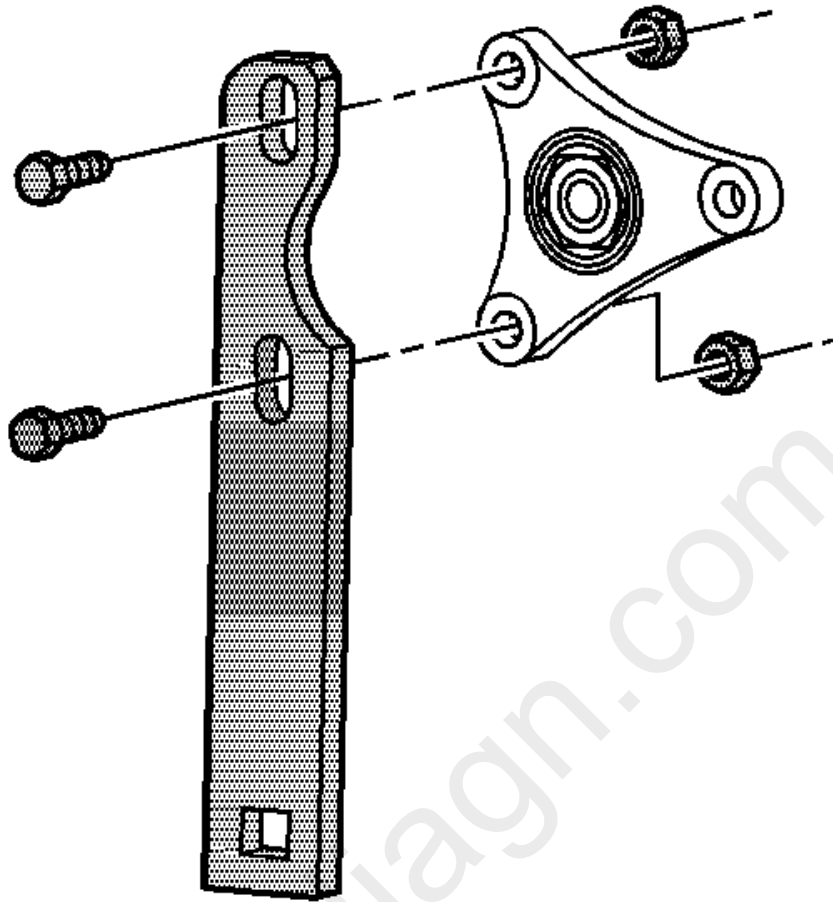


Fig. 49: View Of Flange Tool
Courtesy of GENERAL MOTORS COMPANY

4. Install the **J 45012** holding fixture to the drive flange.

CAUTION: Refer to **Fastener Caution** .

5. While holding **J 45012** holding fixture , install a NEW drive flange nut using **J 29873** injector nozzle socket 30 mm.

Tighten the drive flange nut to 57 N.m (42 lb ft).

6. Remove the **J 45012** holding fixture from the drive flange.
7. Install the propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
8. Lower the vehicle.

BACKUP LAMP SWITCH REPLACEMENT

Removal Procedure

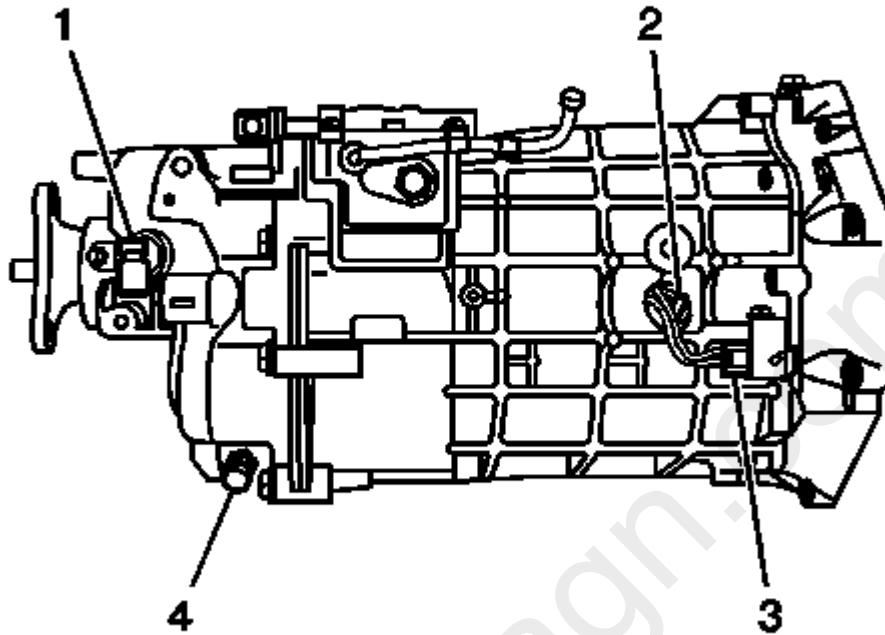


Fig. 50: Locating Backup Lamp Switch, Transmission Fluid Temperature (TFT) Sensor, Vehicle Speed Sensor (VSS) & Reverse Lockout Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the backup lamp switch electrical connector (3).
3. Remove the backup lamp switch wire harness from the bracket.
4. Using a 22 mm angle head open end wrench, or equivalent, remove the backup lamp switch (2).

Installation Procedure

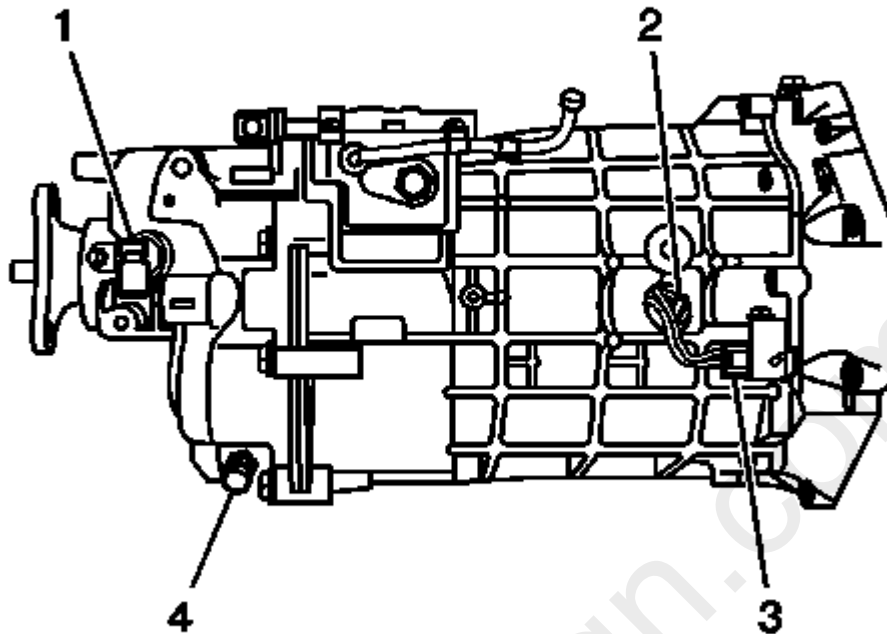


Fig. 51: Locating Backup Lamp Switch, Transmission Fluid Temperature (TFT) Sensor, Vehicle Speed Sensor (VSS) & Reverse Lockout Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Apply sealant to the threads of the backup lamp switch. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the recommended sealant material.

CAUTION: Refer to **Fastener Caution** .

2. Install the backup lamp switch (2) and tighten the switch to 27 N.m (20 lb ft).
3. Install the backup lamp switch wire harness to the bracket.
4. Connect the backup lamp switch electrical connector (3).
5. Lower the vehicle.

VEHICLE SPEED SENSOR REPLACEMENT

Removal Procedure

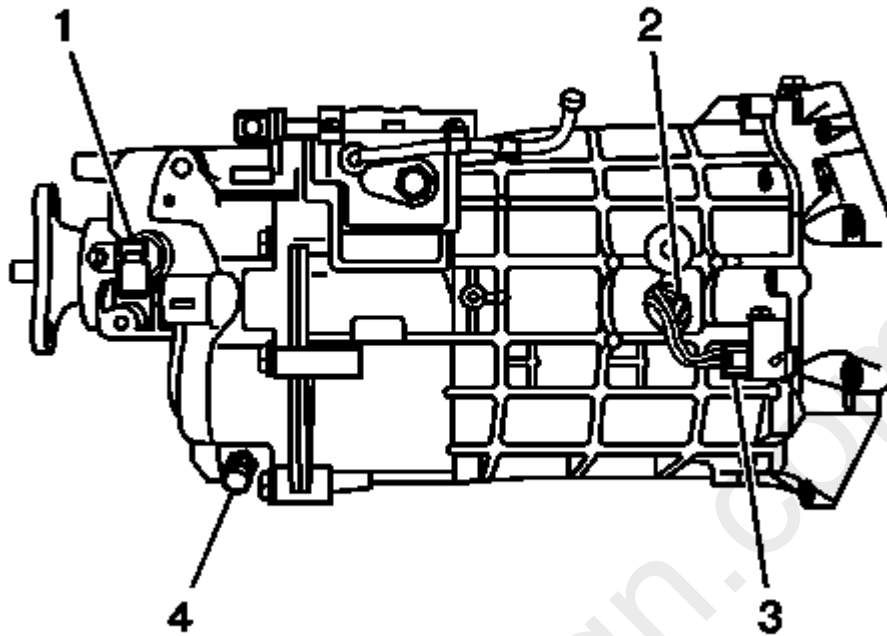


Fig. 52: Locating Backup Lamp Switch, Transmission Fluid Temperature (TFT) Sensor, Vehicle Speed Sensor (VSS) & Reverse Lockout Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the vehicle speed sensor electrical connector.
3. Remove the attaching bolt and the vehicle speed sensor.
4. Remove the vehicle speed sensor (1).

Installation Procedure

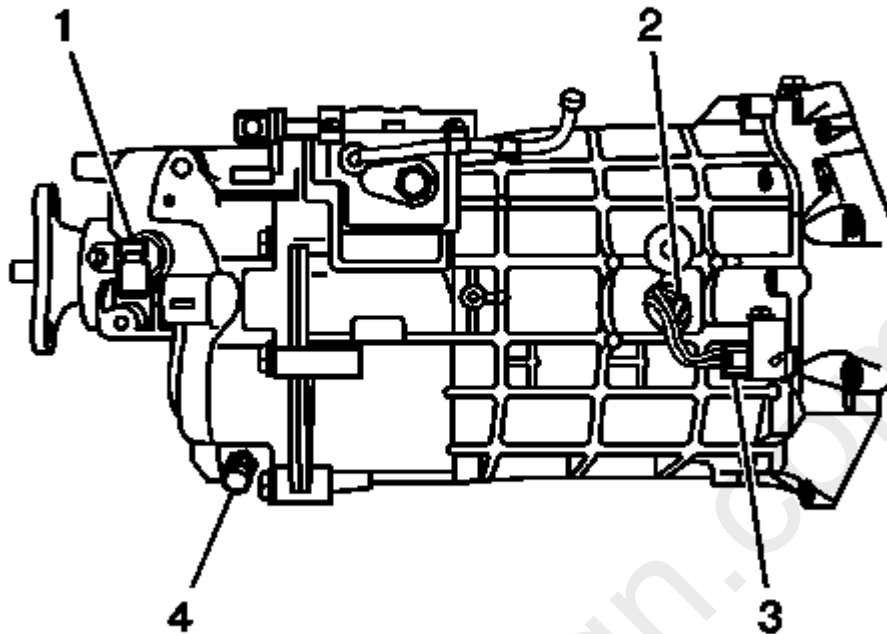


Fig. 53: Locating Backup Lamp Switch, Transmission Fluid Temperature (TFT) Sensor, Vehicle Speed Sensor (VSS) & Reverse Lockout Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Install the vehicle speed sensor (1).

CAUTION: Refer to Fastener Caution .

2. Install the vehicle speed sensor bolt and tighten to 10 N.m (89 lb in).
3. Connect the vehicle speed sensor electrical connector.
4. Lower the vehicle.

REVERSE LOCKOUT SOLENOID REPLACEMENT

Removal Procedure

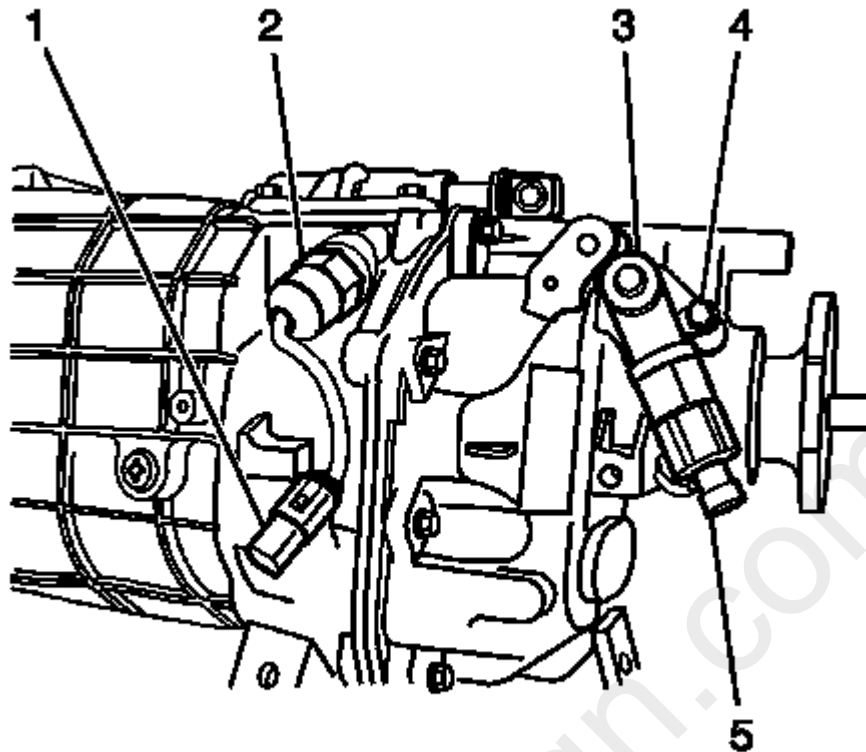


Fig. 54: Locating Reverse Lockout Solenoid & Skip Shift Solenoid Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** ,.
3. Support the transmission with a suitable jack.
4. Remove the transmission support. Refer to **Transmission Support Replacement (Manual CTS-V)** .
5. Remove the transmission mount. Refer to **Transmission Rear Mount Replacement**.
6. Disconnect the reverse lockout solenoid electrical connector (5).

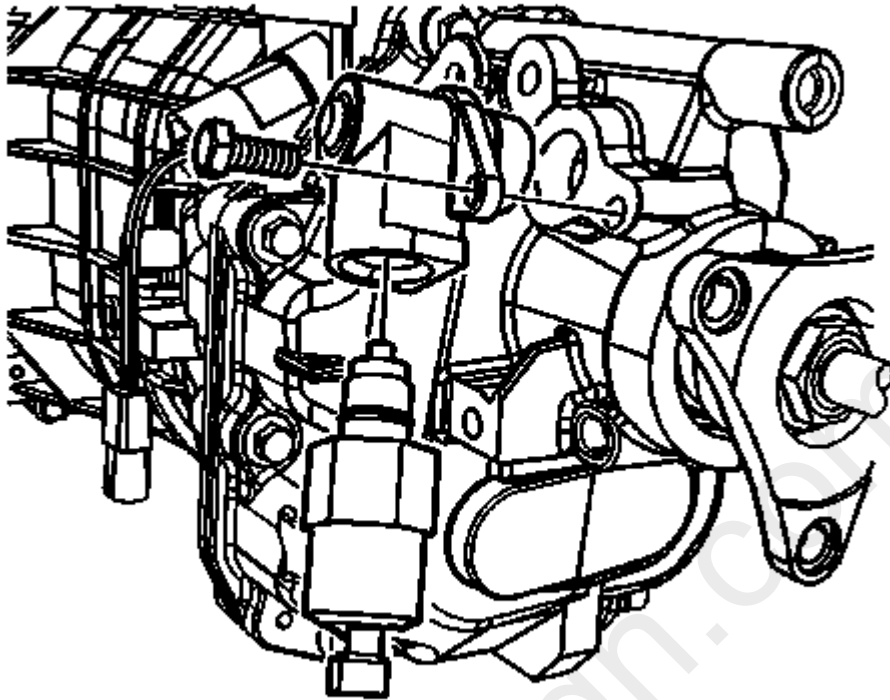


Fig. 55: Removing Bolt And Reverse Lockout Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove the reverse lockout solenoid.
8. Remove the bolt and the reverse lockout assembly , if necessary.

Installation Procedure

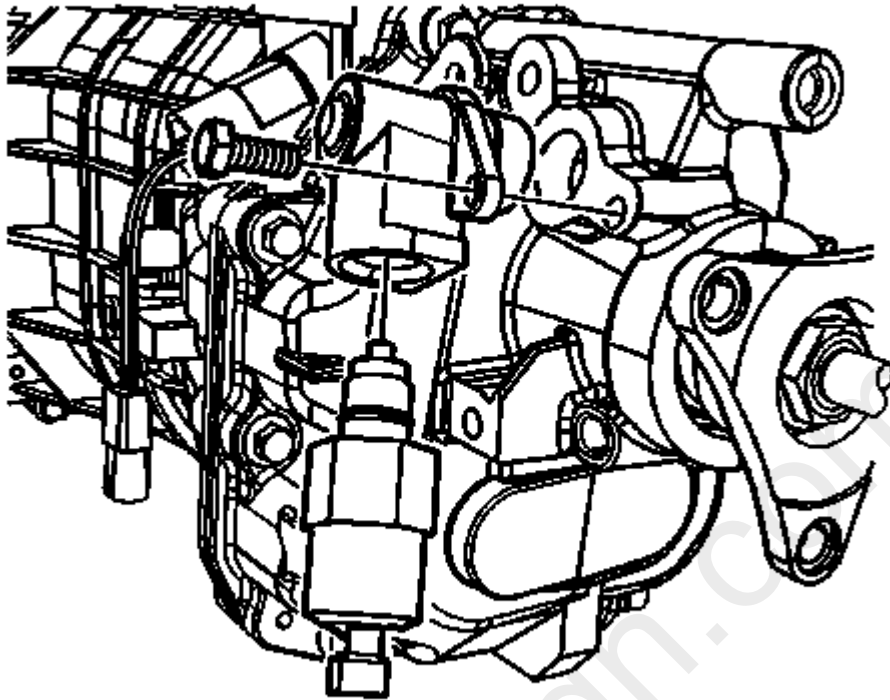


Fig. 56: Removing Bolt And Reverse Lockout Assembly
Courtesy of GENERAL MOTORS COMPANY

1. If removed, inspect the reverse lockout assembly O-ring. Replace the reverse lockout assembly O-ring if necessary.

CAUTION: Refer to Fastener Caution .

2. Install the reverse lockout assembly and bolt and tighten to 18 N.m (13 lb ft).
3. Install the reverse lockout solenoid .

Tighten the reverse lockout solenoid to 40 N.m (30 lb ft).

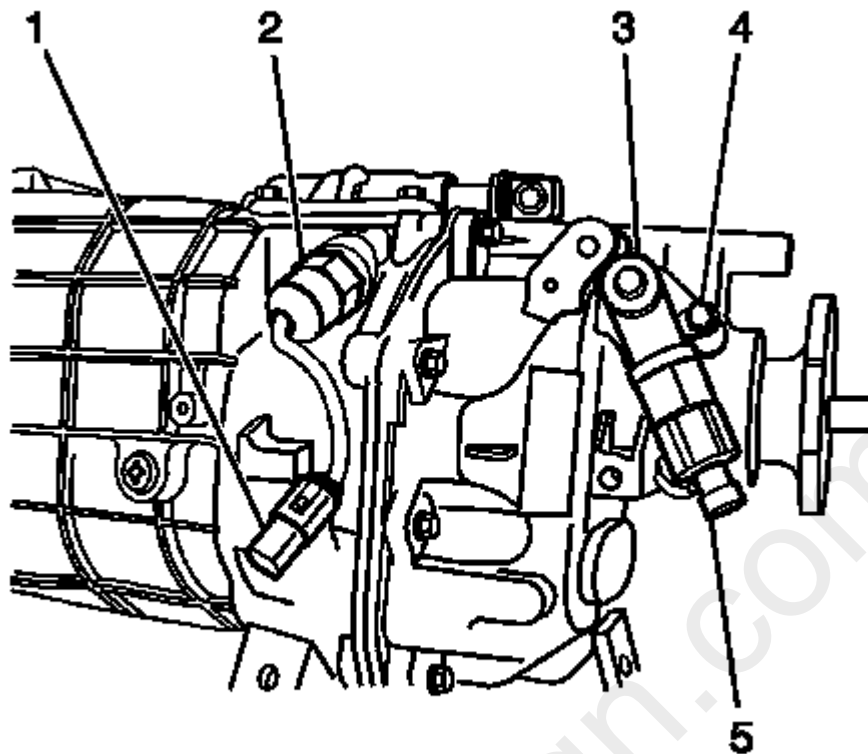


Fig. 57: Locating Reverse Lockout Solenoid & Skip Shift Solenoid Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

4. Connect the reverse lockout solenoid electrical connector (5).
5. Install the transmission mount. Refer to **Transmission Rear Mount Replacement**.
6. Install the transmission support. Refer to **Transmission Support Replacement (Manual CTS-V)**.
7. Remove the transmission jack.
8. Install the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
9. Lower the vehicle.

GEAR SELECT/SKIP SHIFT SOLENOID REPLACEMENT

Special Tools

DT-49293 Gear Select/Skip Shift Solenoid Remover/Installer

Removal Procedure

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

2. Remove the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
3. Remove the propeller shaft Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
4. Support the transmission with a suitable jack.
5. Remove the transmission support retaining fasteners from the vehicle body. Refer to **Transmission Support Replacement (Manual CTS-V)** .
6. Slightly lower the transmission to gain access to the solenoid. Refer to **Transmission Rear Mount Replacement**.

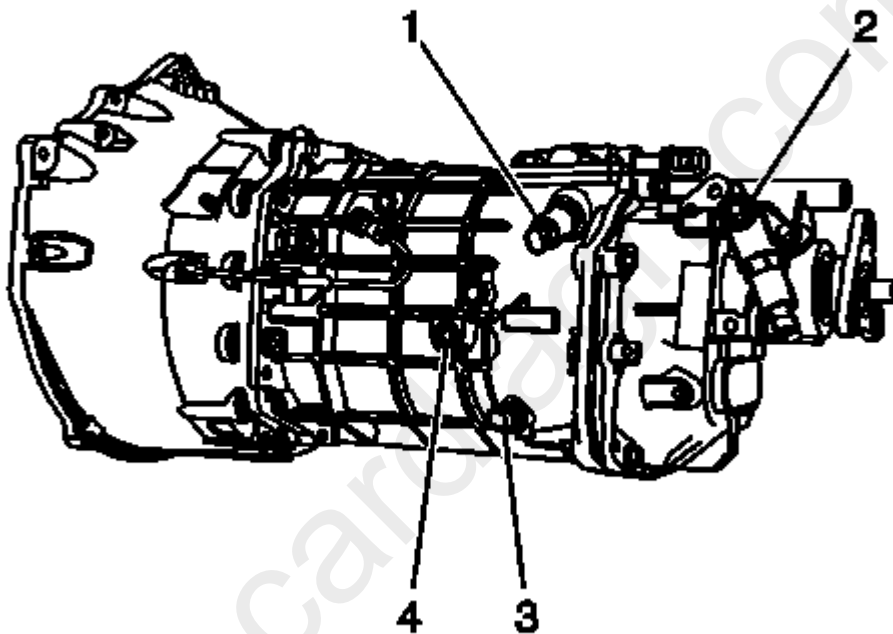


Fig. 58: TFT Sensor, Reverse Lockout Solenoid & Transmission Fluid Fill Plug
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the solenoid electrical connector (1).
8. Using the **DT-49293** gear select/skip shift solenoid remover/installer or equivalent, loosen the retaining bolt, then remove the bolt and the solenoid.

Installation Procedure

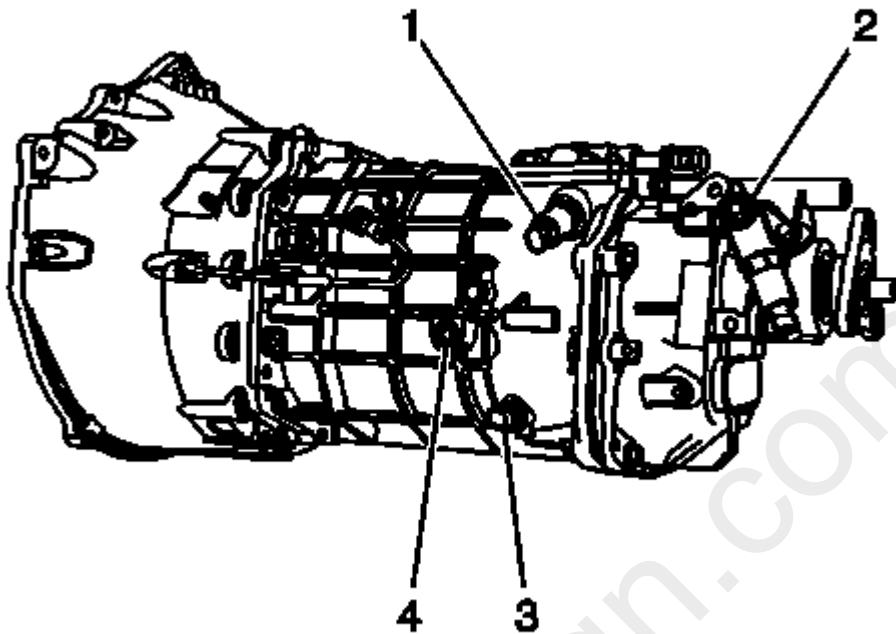


Fig. 59: TFT Sensor, Reverse Lockout Solenoid & Transmission Fluid Fill Plug
Courtesy of GENERAL MOTORS COMPANY

1. If removed, inspect the solenoid O-ring. Replace the O-ring if necessary.

CAUTION: Refer to Fastener Caution .

2. Install the solenoid, then tighten the solenoid to 40 N.m (30 lb ft).
3. Connect the solenoid electrical connector (1).
4. Install the transmission support to body retaining bolts. Refer to **Transmission Support Replacement (Manual CTS-V)** .
5. Remove the transmission jack.
6. Install the propeller shaft . Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
7. Install the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
8. Lower the vehicle.

TRANSMISSION FLUID DRAIN AND FILL

Draining Procedure

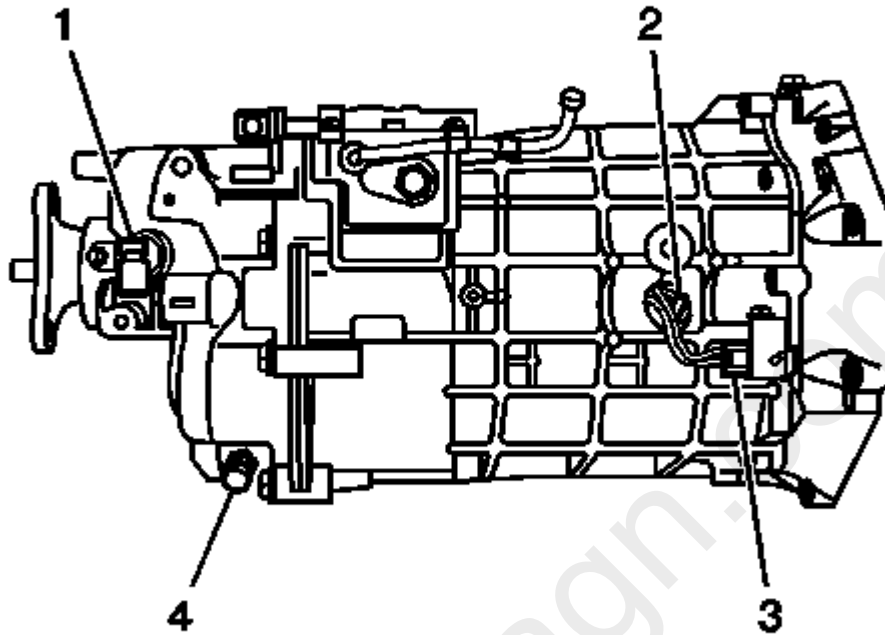


Fig. 60: Locating Backup Lamp Switch, Transmission Fluid Temperature (TFT) Sensor, Vehicle Speed Sensor (VSS) & Reverse Lockout Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Clean away all dirt and debris from the transmission fluid temperature sensor/drain plug area.
3. Place a suitable drain pan under the transmission.
4. Disconnect the electrical connector from the transmission fluid temperature sensor/drain plug.
5. Remove the fluid temperature sensor/drain plug (4).
6. Allow the system to drain.

CAUTION: Refer to Fastener Caution .

7. Install the transmission fluid temperature sensor/drain plug (4) and tighten to 27 N.m (20 lb ft).
8. Connect the electrical connector to the transmission fluid temperature sensor/drain plug.

Filling Procedure

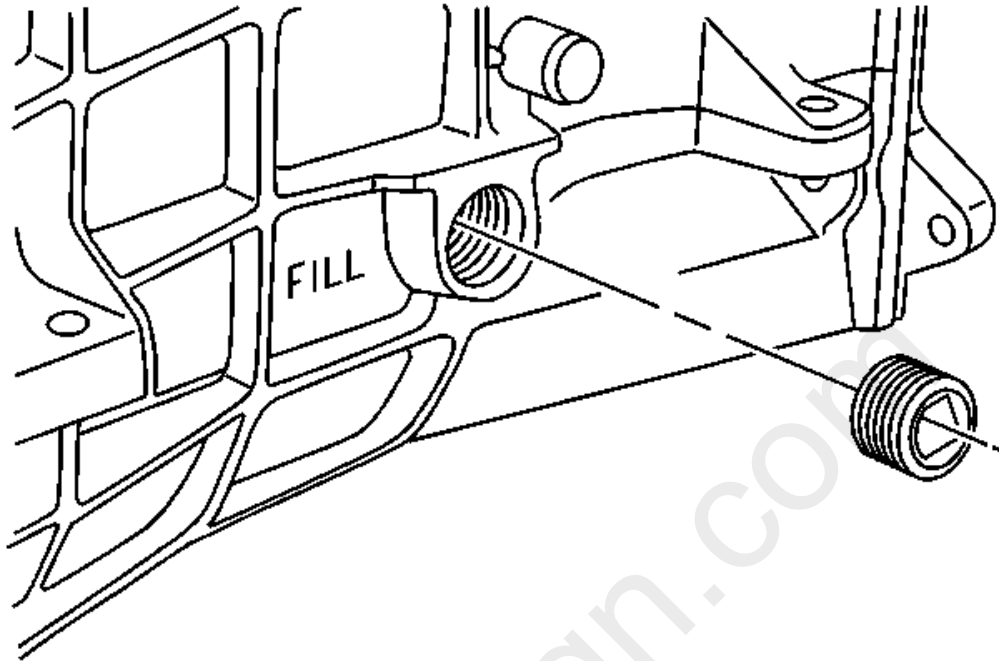


Fig. 61: Identifying Transmission Fill Plug
Courtesy of GENERAL MOTORS COMPANY

1. Clean away all dirt and debris from the transmission fluid fill plug area.
2. Remove the transmission fluid fill plug.
3. Fill the transmission with DEXRON®-III transmission fluid, until even with the bottom of the fill plug hole.
4. Install the transmission fluid fill plug and tighten to 27 N.m (20 lb ft).
5. Remove the drain pan.
6. Lower the vehicle.

TRANSMISSION REPLACEMENT

Removal Procedure

1. Remove the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .

2. Remove the propeller shaft from the vehicle. Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
3. Support the transmission with a suitable jack.
4. Remove the transmission mount. Refer to **Transmission Rear Mount Replacement**.
5. Lower the transmission assembly to gain access to the top of the transmission.
6. Disconnect the shift control assembly from the transmission. Refer to **Shift Control Assembly Replacement**.
7. Disconnect the following electrical connectors:
 - Transmission fluid temperature (TFT) sensor
 - Backup lamp switch
 - Vehicle speed sensor (VSS)
 - Reverse lockout solenoid
 - Gear select/skip shift solenoid
8. Disconnect the clutch hydraulic hose.

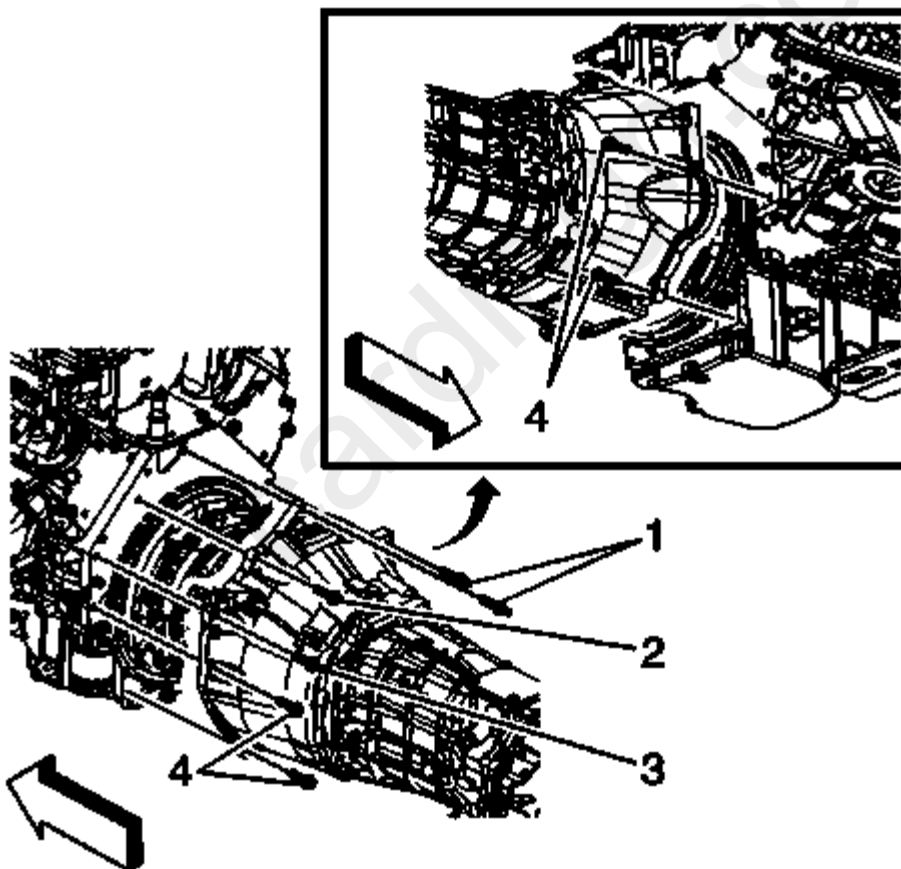


Fig. 62: Identifying Transmission Clutch Housing To Engine Bolts & Studs
Courtesy of GENERAL MOTORS COMPANY

9. Remove the transmission clutch housing to engine fasteners (1-4).

10. Remove the transmission from the vehicle.
11. Flush and flow test the oil cooler lines. Refer to Transmission Fluid Cooler Flushing and Flow Test .

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.

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

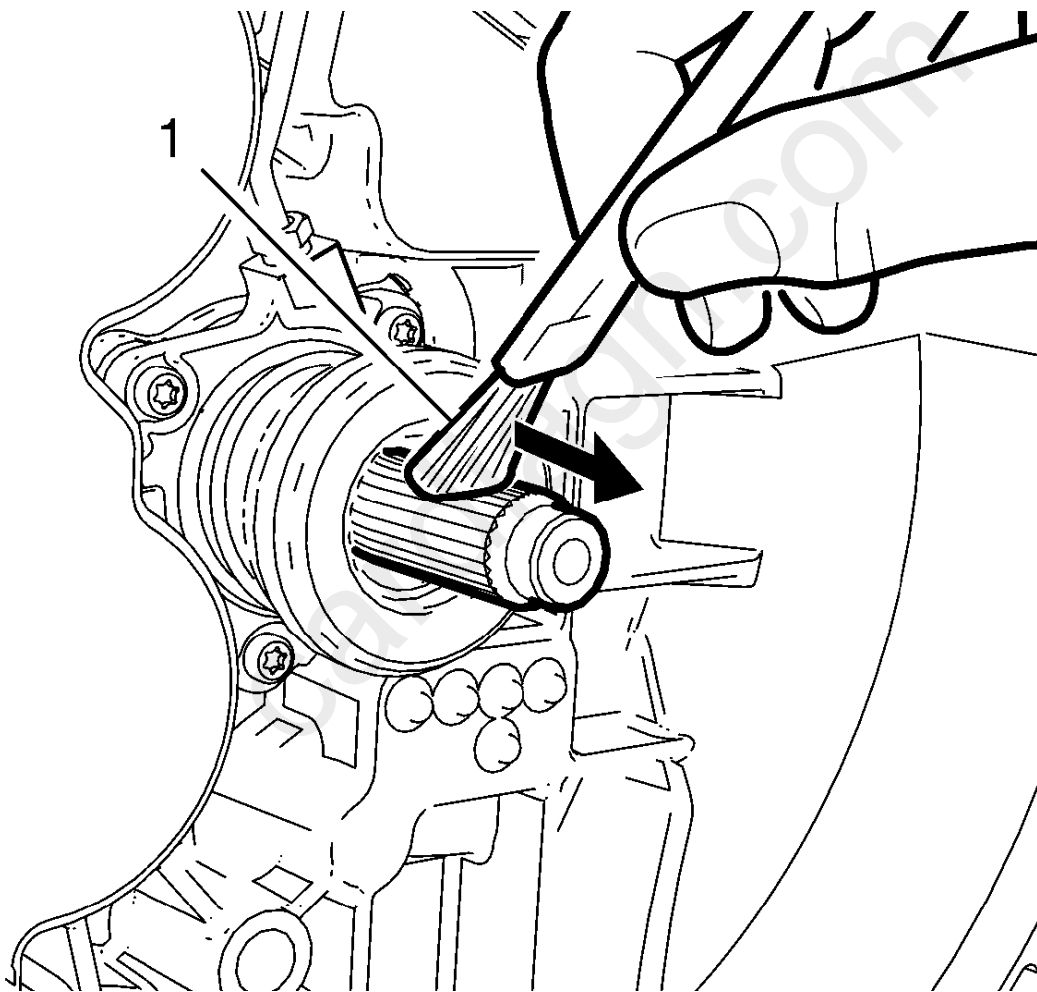


Fig. 63: Using Flat Brush To Apply Light Coating Of Multi-Purpose Grease
Courtesy of GENERAL MOTORS COMPANY

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.

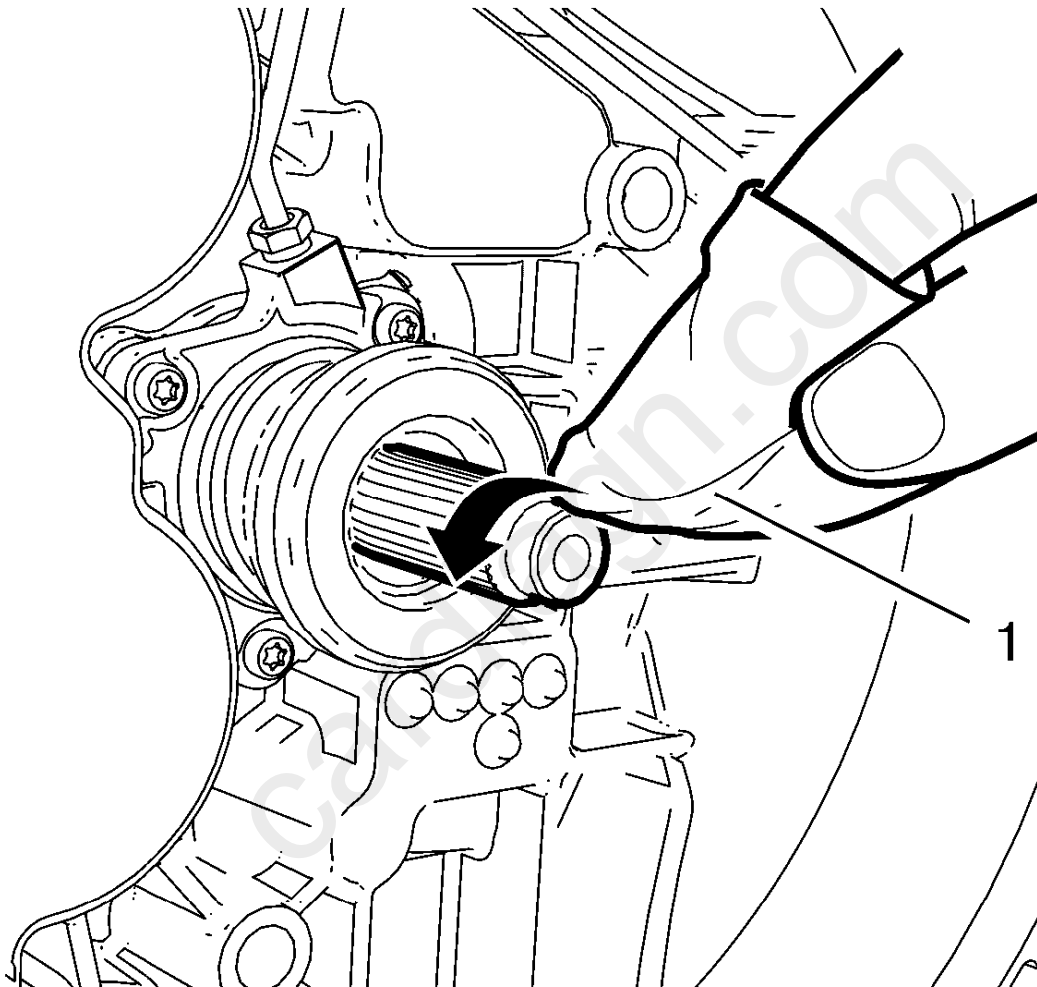


Fig. 64: Lint Free Towel

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).
4. Install the transmission to the vehicle.

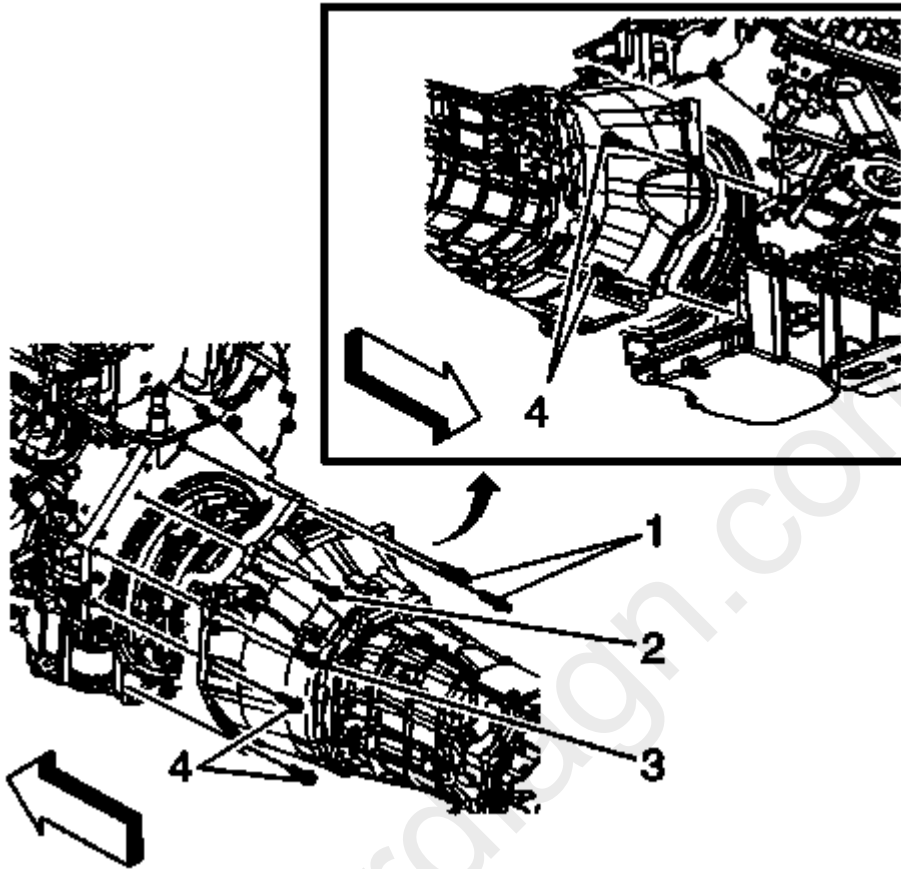


Fig. 65: Identifying Transmission Clutch Housing To Engine Bolts & Studs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the transmission clutch housing to engine bolts and studs (1-4) and tighten to 50 (37 lb ft).
6. Connect the clutch hydraulic hose to the transmission.
7. Raise the transmission back into place.
8. Connect the shift control assembly to the transmission. Refer to Shift Control Assembly Replacement.
9. Connect the following electrical connectors:
 - TFT sensor
 - Backup lamp switch
 - Vehicle Speed Sensor
 - Reverse lockout solenoid

- Gear select/skip shift solenoid
- 10. Raise the transmission assembly.
- 11. Install the transmission mount. Refer to **Transmission Rear Mount Replacement**.
- 12. Remove the transmission jack.
- 13. Install the propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LSA)** .
- 14. Check the transmission fluid and fill as necessary.
- 15. Install the exhaust system. Refer to **Exhaust System Replacement (LSA-Coupe)** , **Exhaust System Replacement (LSA-Wagon)** .
- 16. Lower the vehicle.

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION DISASSEMBLE

Special Tools

- **DT 47678** Transmission Holding Flange
- **DT 47678-10** Transmission Holding Flange Adapter
- **DT 49139** Hub Remover Tool
- **DT 49293** Gear Select/Skip Shift Solenoid Socket
- **J 6125-1B** Slider Hammer
- **J 8433** Universal Bridge Puller
- **J 08614-A** Pinion Flange Holder and Remover
- **J 08614-20** Forcing Screw
- **J 3289-20** Holding Fixture
- **J 22888-20A** Puller
- **J 23907** Slide Hammer
- **J 36017** Valve Seal Remover
- **J 39431** 5th/6th Driven Gear Puller
- **J 39431-3** 5th Gear Puller Adapter Bolts
- **J 44873-3** Mounting Bolts

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

Extension Housing Removal

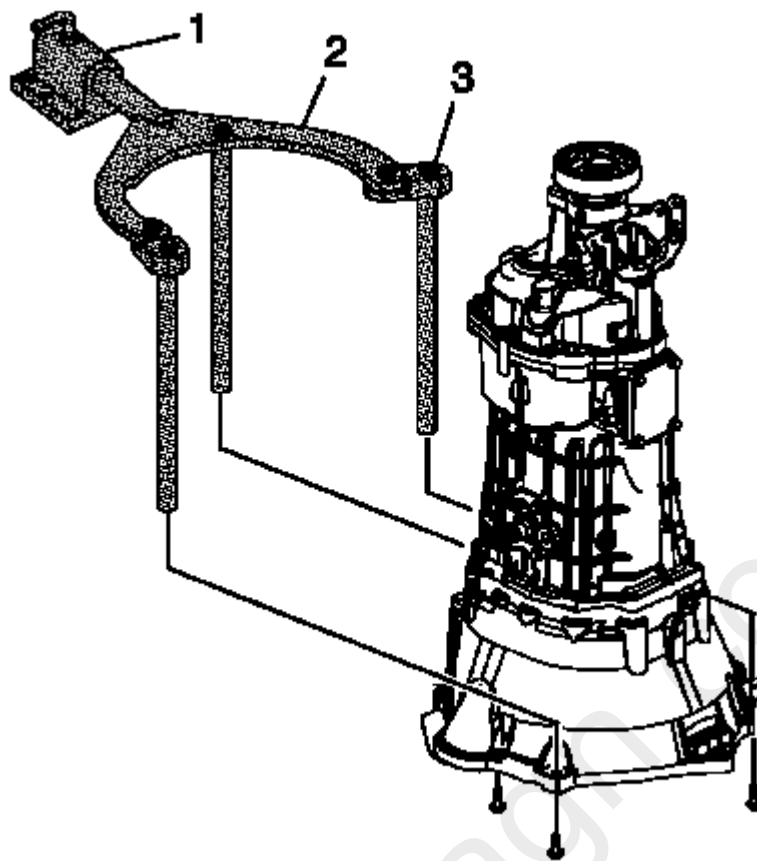


Fig. 66: Identifying Special Tool Flange & Flange Adapter
Courtesy of GENERAL MOTORS COMPANY

1. Install the **DT 47678** flange (2) and the **DT 47678-10** flange adapter (3).
2. Mount the transmission on a workbench using the **J 3289-20** holding fixture (1).
3. Rotate the transmission into a horizontal position.
4. Remove the transmission drain plug and drain the transmission fluid.
5. Shift the transmission into NEUTRAL (N).

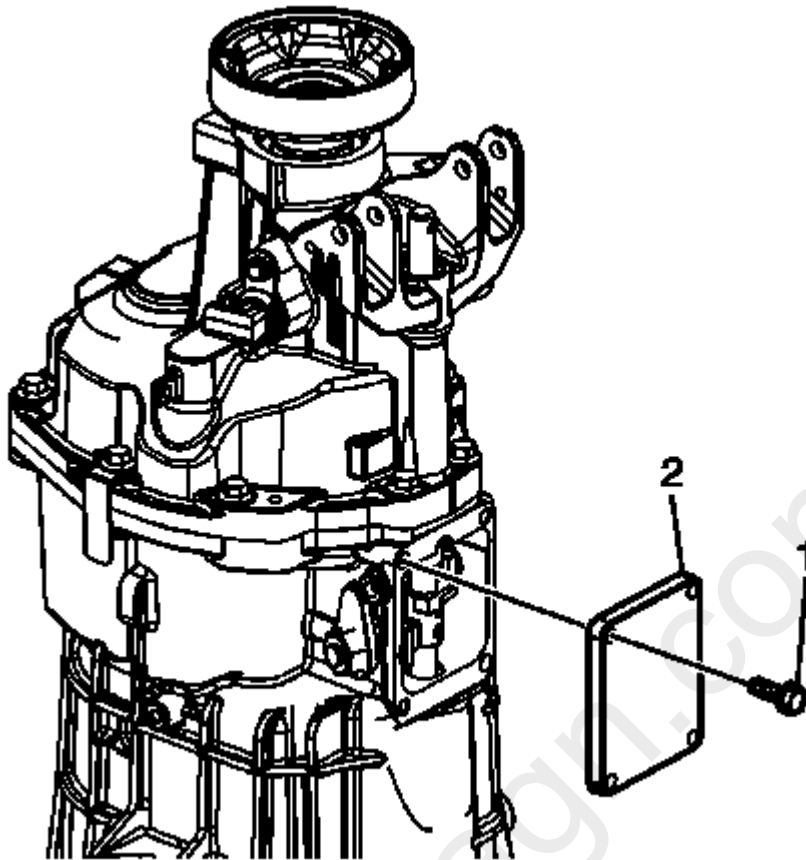


Fig. 67: Identifying Shifter Cover Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the shifter cover plate bolts (1).
7. Remove the shifter cover plate (2).

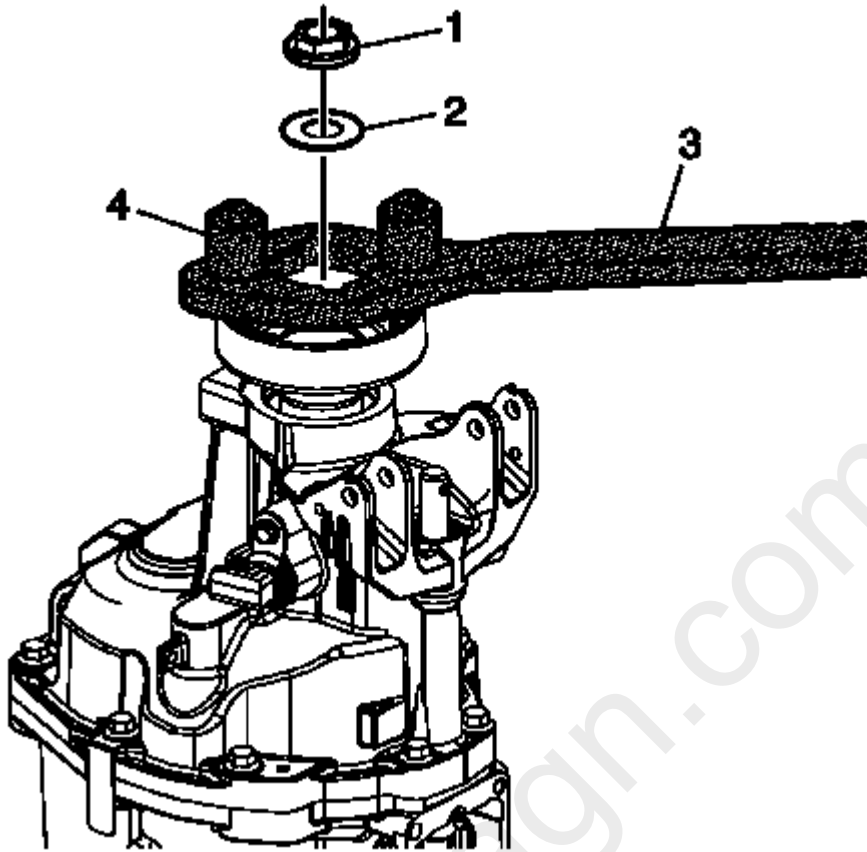


Fig. 68: Identifying Propshaft Transmission Yoke Nut & Washer
Courtesy of GENERAL MOTORS COMPANY

8. Install the **J 08614-A** holder (3) with the **J 08614-20** mounting bolts (4) to the propshaft transmission yoke.
9. Using a socket wrench, remove the propshaft transmission yoke nut (1).
10. Remove the propshaft transmission yoke washer (2).

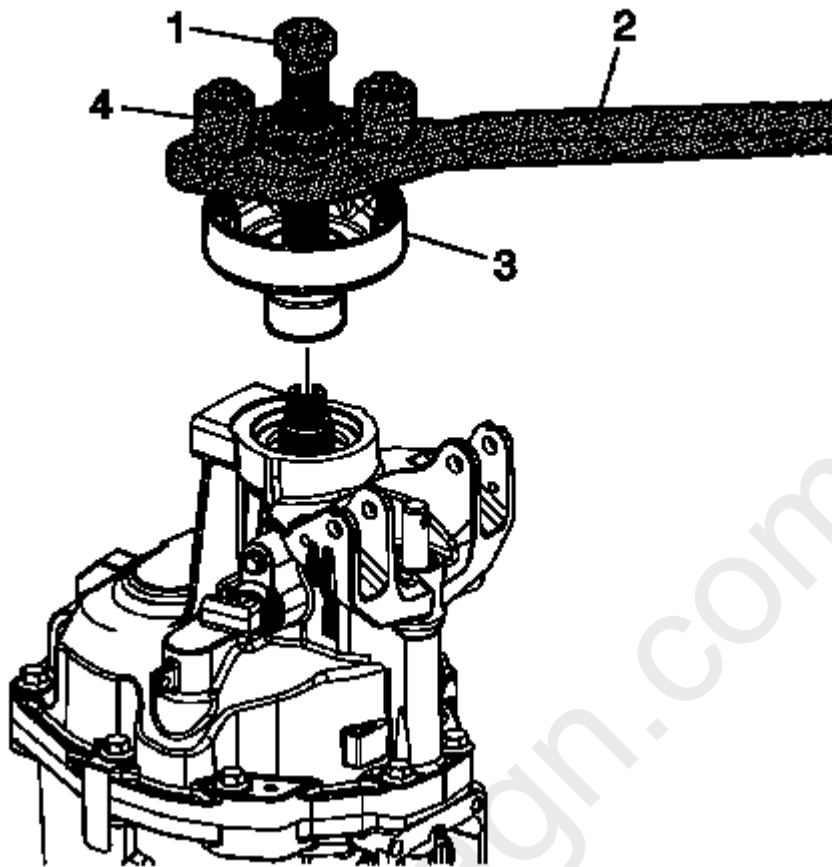


Fig. 69: Removing Propshaft Transmission Yoke
Courtesy of GENERAL MOTORS COMPANY

11. Using J 08614-A holder (2), J 08614-20 mounting bolts (4), and J 08614-A forcing screw (1), remove the propshaft transmission yoke (3).

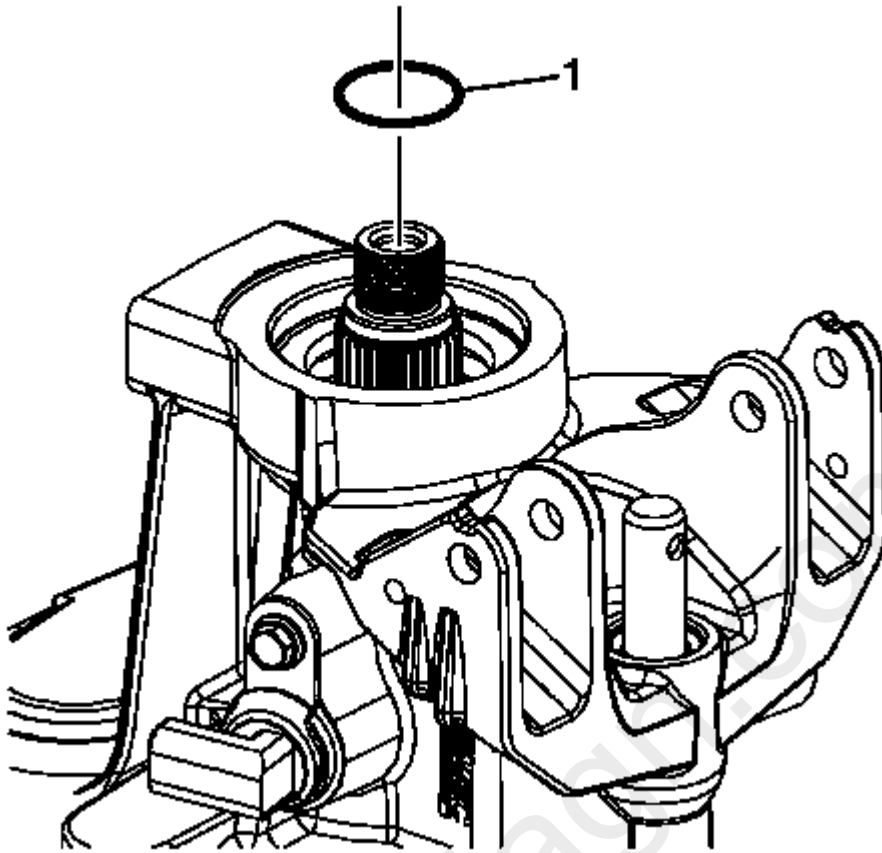


Fig. 70: Identifying Propshaft O-Ring
Courtesy of GENERAL MOTORS COMPANY

12. Remove the O-ring (1) from propshaft or propshaft transmission yoke.

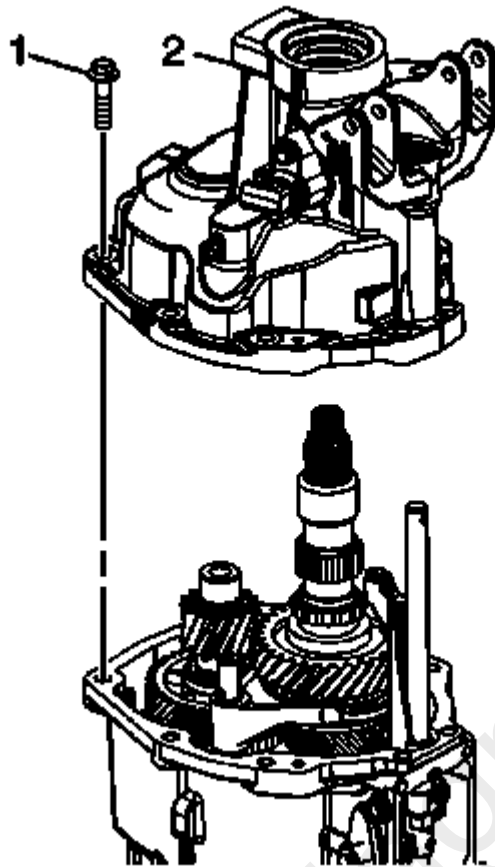


Fig. 71: Identifying Rear Extension Housing & Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the rear extension housing bolts (1) and the rear extension housing (2).

Reverse Speed Gear Removal

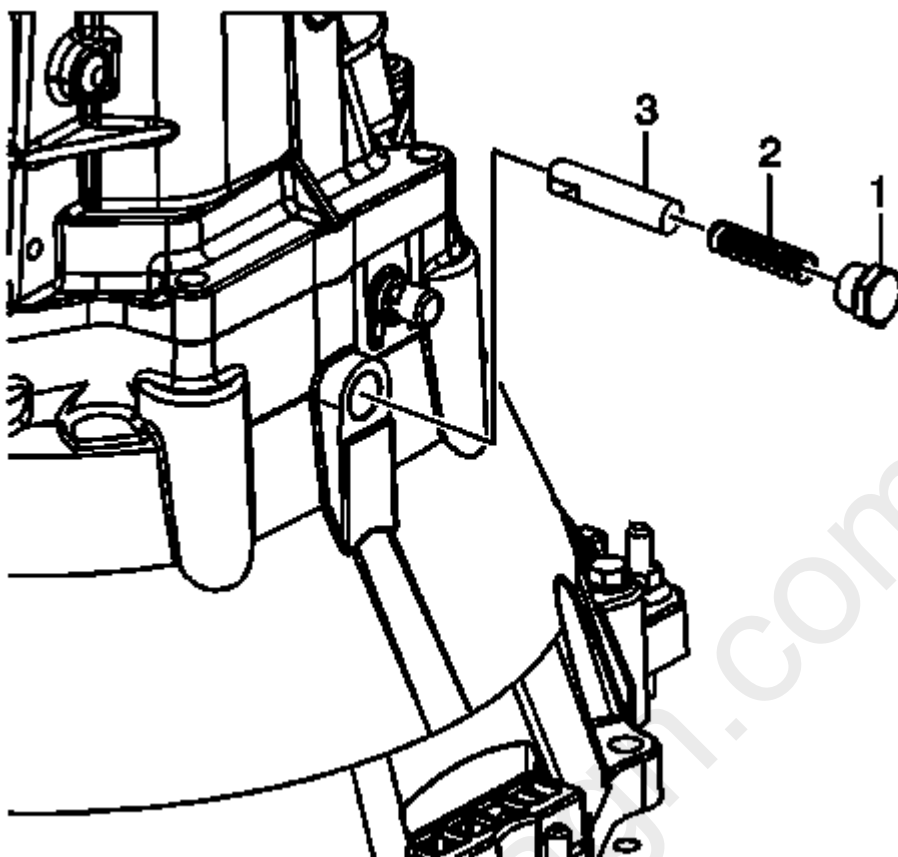


Fig. 72: Identifying Plug, Spring & Shift Detent Roller
Courtesy of GENERAL MOTORS COMPANY

1. Remove the plug (1), spring (2), and shift detent roller (3).

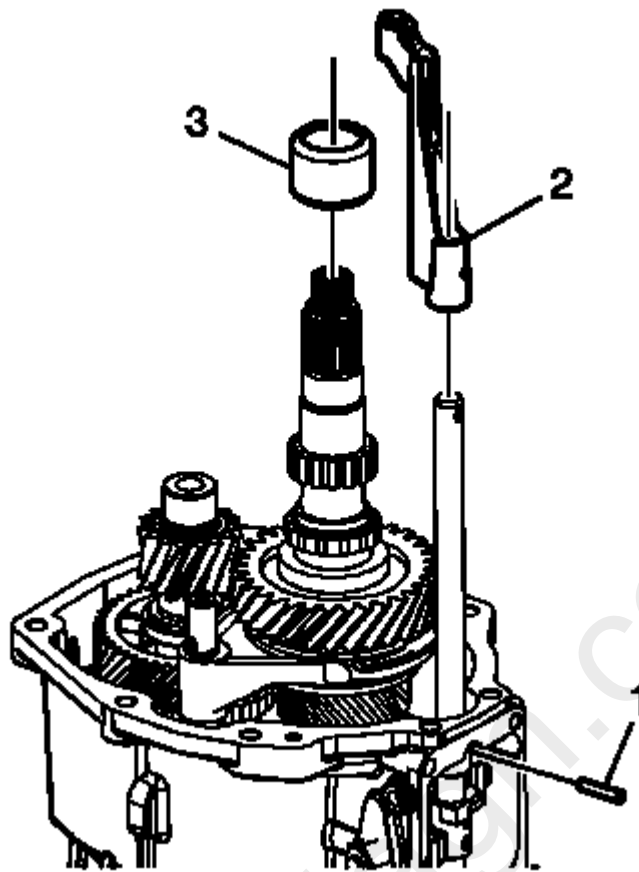


Fig. 73: Identifying Shift Guide Rollpin, Shift Shaft Extension & Extension Housing Main Shaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

2. Remove the shift guide rollpin (1).
3. Remove the shift shaft extension (2).
4. Remove the extension housing main shaft bearing race (3).

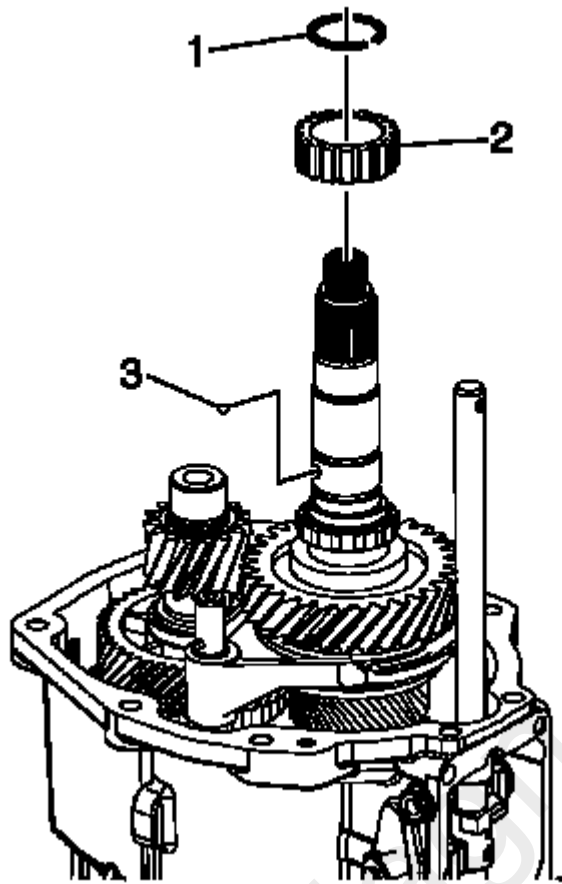


Fig. 74: Identifying Snap Ring, Speed Sensor Rotor & Locking Ball
Courtesy of GENERAL MOTORS COMPANY

5. Remove the following parts in order:
- The snap ring (1)
 - The speed sensor rotor (2)
 - The locking ball (3)

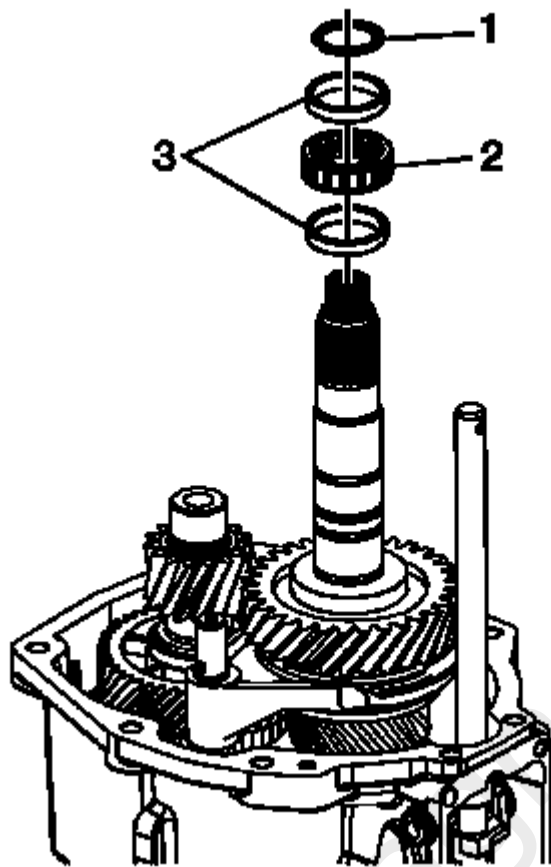


Fig. 75: Identifying Rear Bearing Retainer Ring, Spacers & Mainshaft Rear Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

6. Remove the rear bearing retainer ring (1).
7. Remove the spacer (3).
8. Remove the mainshaft rear roller bearing (2).
9. Remove the spacer (3).

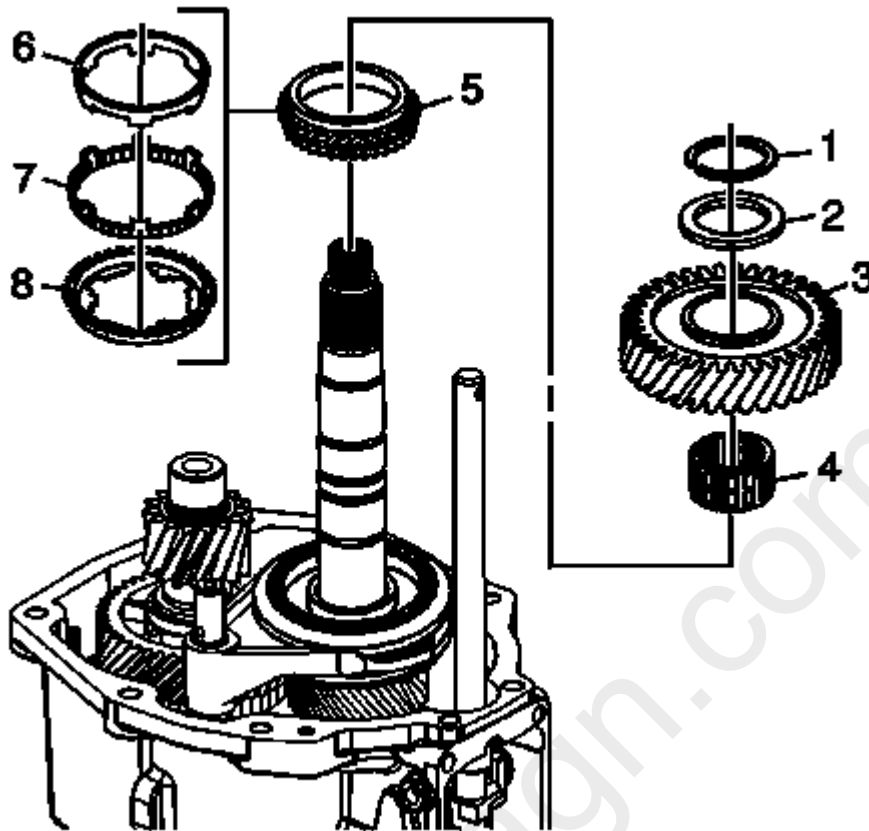


Fig. 76: Identifying Reverse Gear Components
Courtesy of GENERAL MOTORS COMPANY

10. Remove the retainer ring (1).
11. Remove the reverse gear thrust washer (2).
12. Remove the reverse gear (3).
13. Remove the reverse gear caged needle bearing (4).
14. Remove the reverse gear blocking ring assembly (5), which includes the following components:
 1. Reverse drive gear inner cone (6)
 2. Reverse drive gear outer cone (7)
 3. Reverse gear blocking ring (8)

Reverse Shift Fork Removal

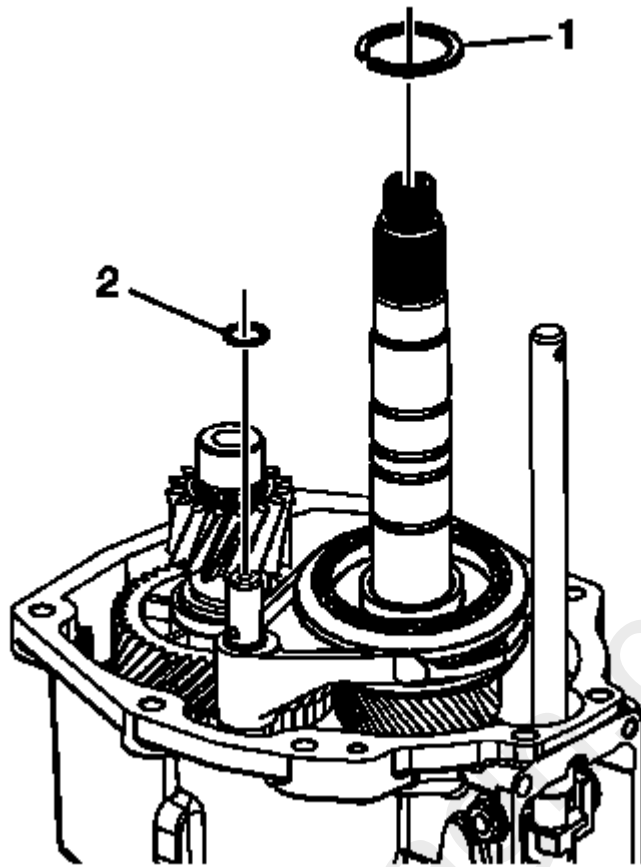


Fig. 77: Identifying Reverse Retainer Rings
Courtesy of GENERAL MOTORS COMPANY

1. Remove the reverse synchronizer retainer ring (1).
2. Remove and discard the reverse shift fork retainer ring (2).

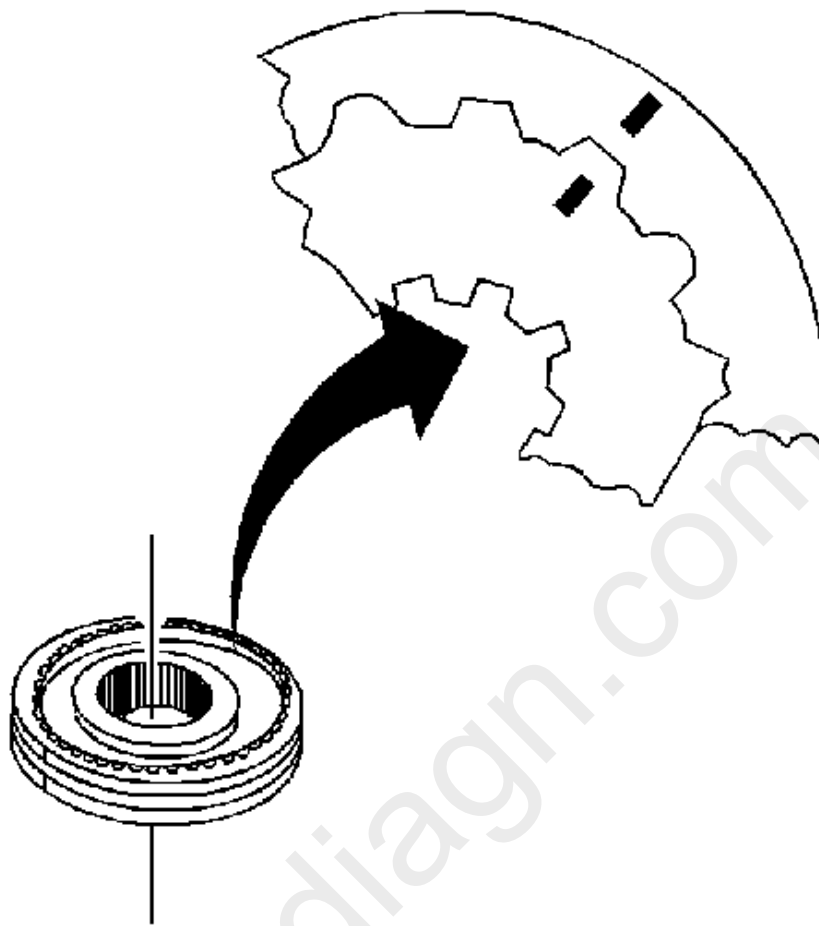


Fig. 78: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

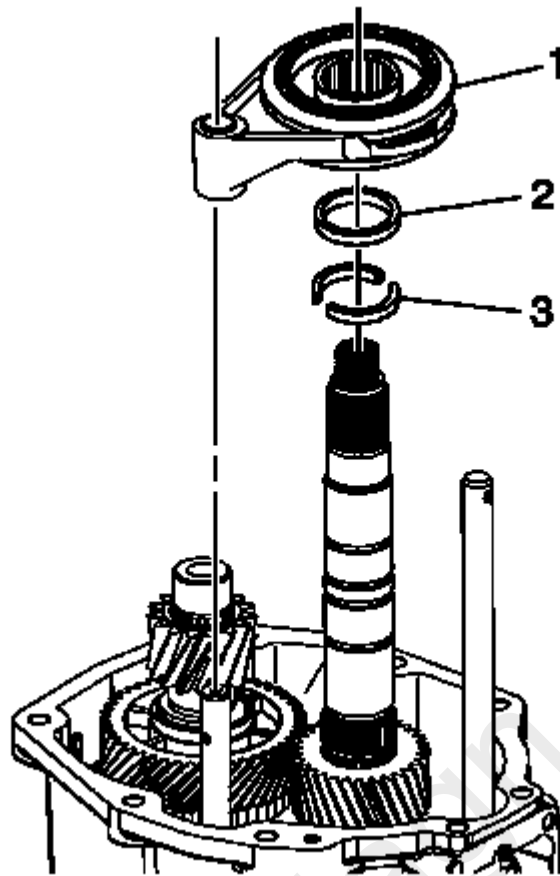


Fig. 79: Identifying Reverse Synchronizer Components
Courtesy of GENERAL MOTORS COMPANY

4. Remove the reverse shift fork and synchronizer (1) and inserts.
5. Pry to remove the reverse synchronizer hub.
6. Remove the locking ring (2).
7. Remove the two piece thrust washer (3).

Countershaft Gear Removal

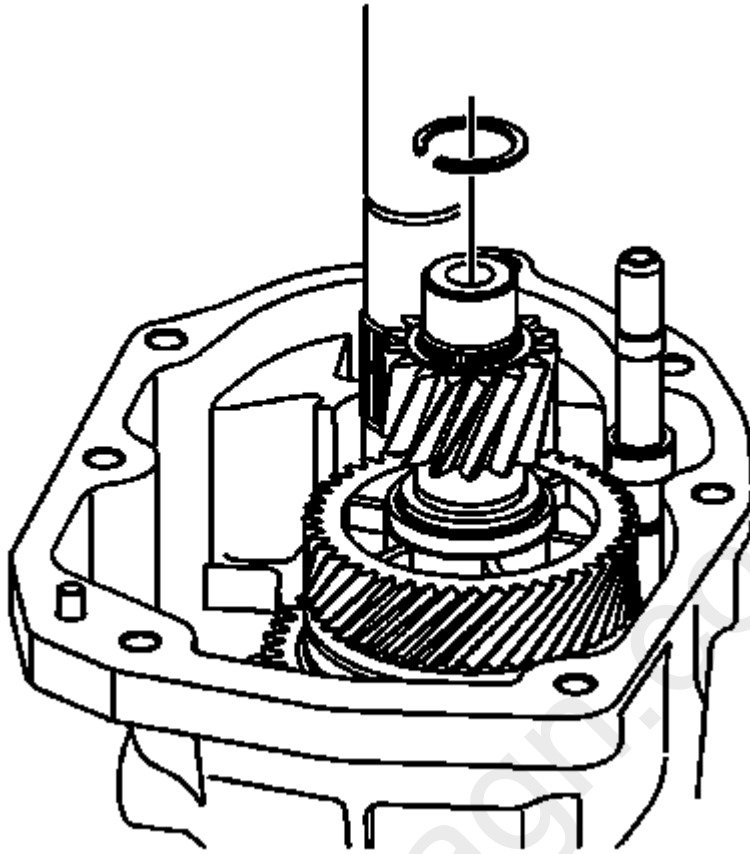


Fig. 80: View Of Countershaft Retainer Clip
Courtesy of GENERAL MOTORS COMPANY

1. Remove the counter shaft retainer ring.

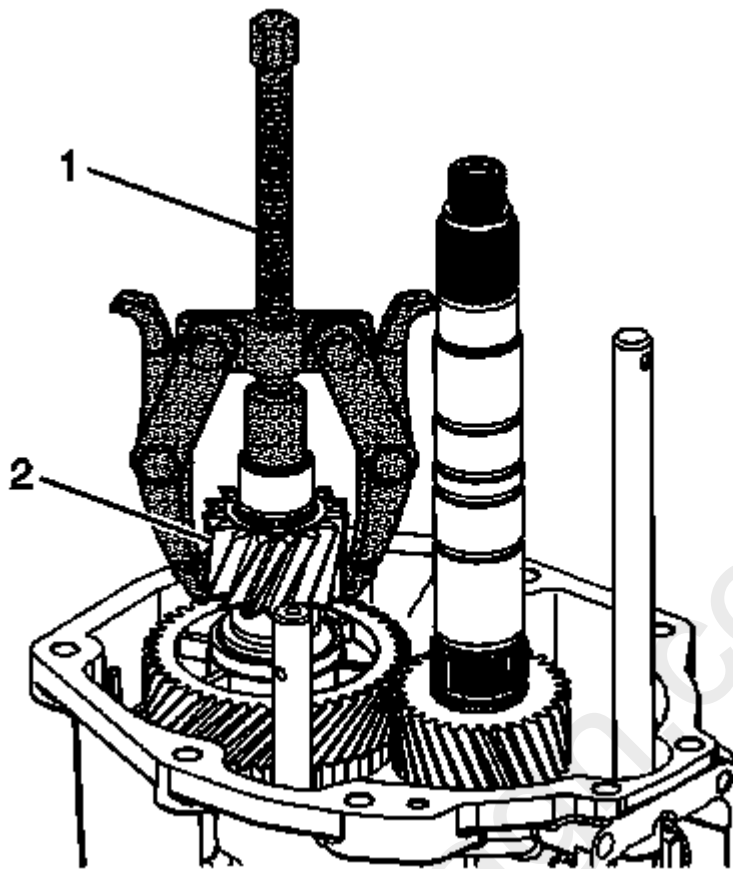


Fig. 81: View Of Countershaft Gear Puller
Courtesy of GENERAL MOTORS COMPANY

2. Remove the countershaft gear (2) using J 22888-20A puller (1).

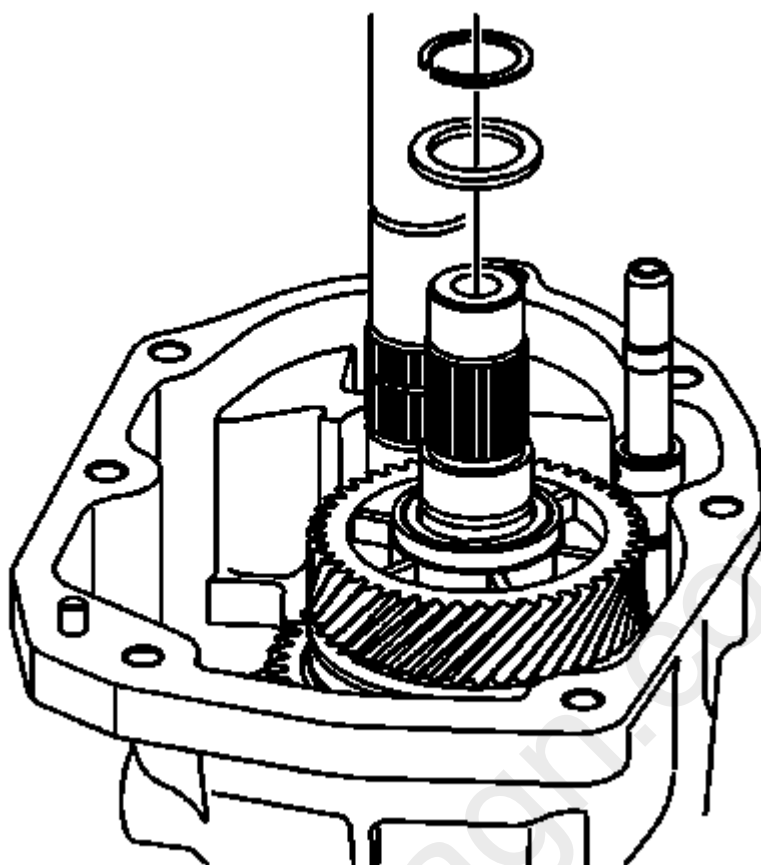


Fig. 82: View Of Countershaft Retainer And Spacer
Courtesy of GENERAL MOTORS COMPANY

3. Remove the countershaft retainer and spacer.

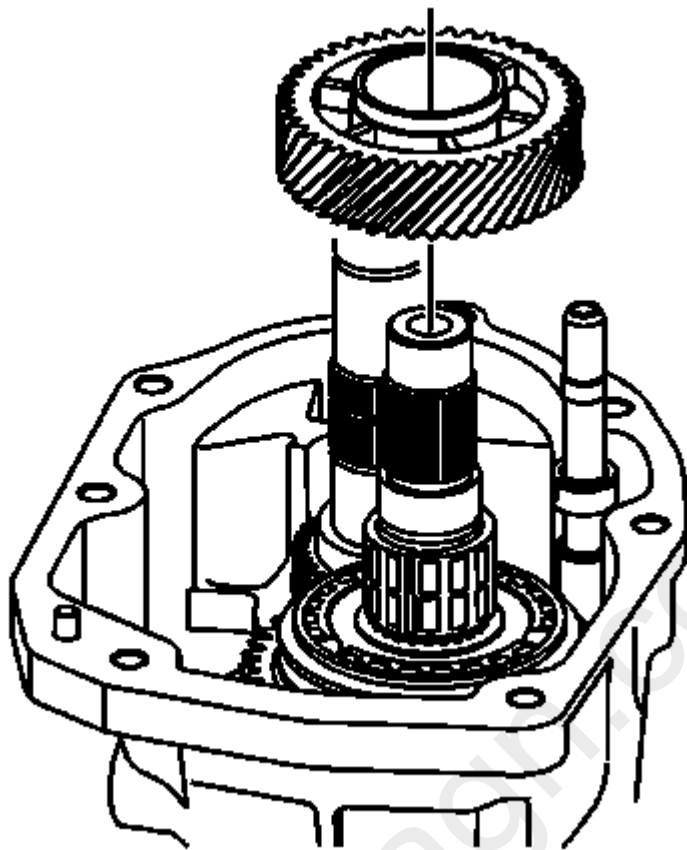


Fig. 83: View Of Gear & Countershaft
Courtesy of GENERAL MOTORS COMPANY

4. Remove the gear from the countershaft.

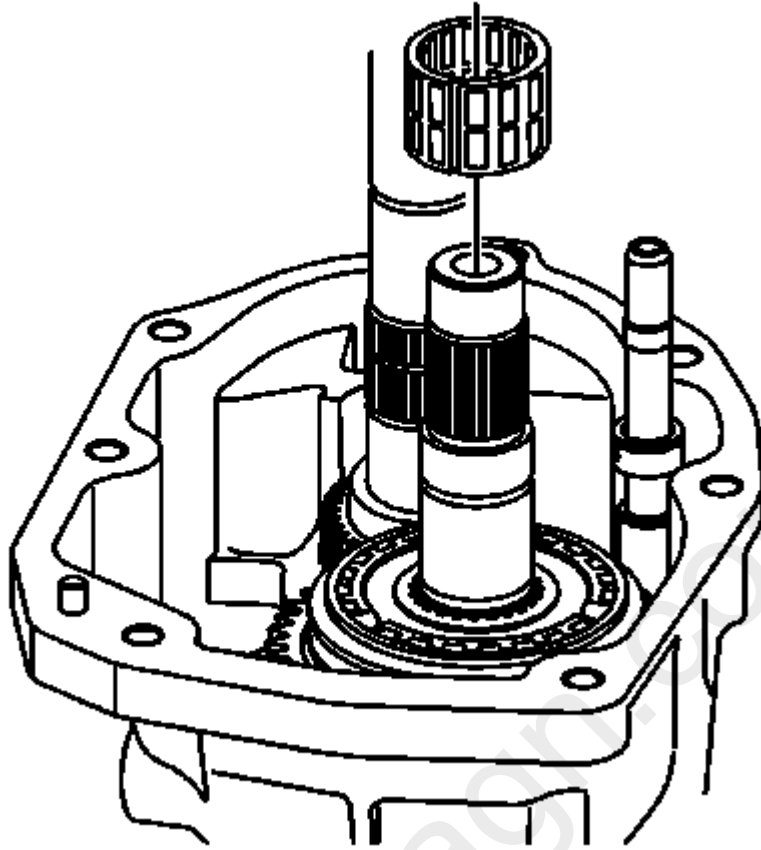


Fig. 84: View of Needle Bearing & Countershaft
Courtesy of GENERAL MOTORS COMPANY

5. Remove the needle bearing from the countershaft.

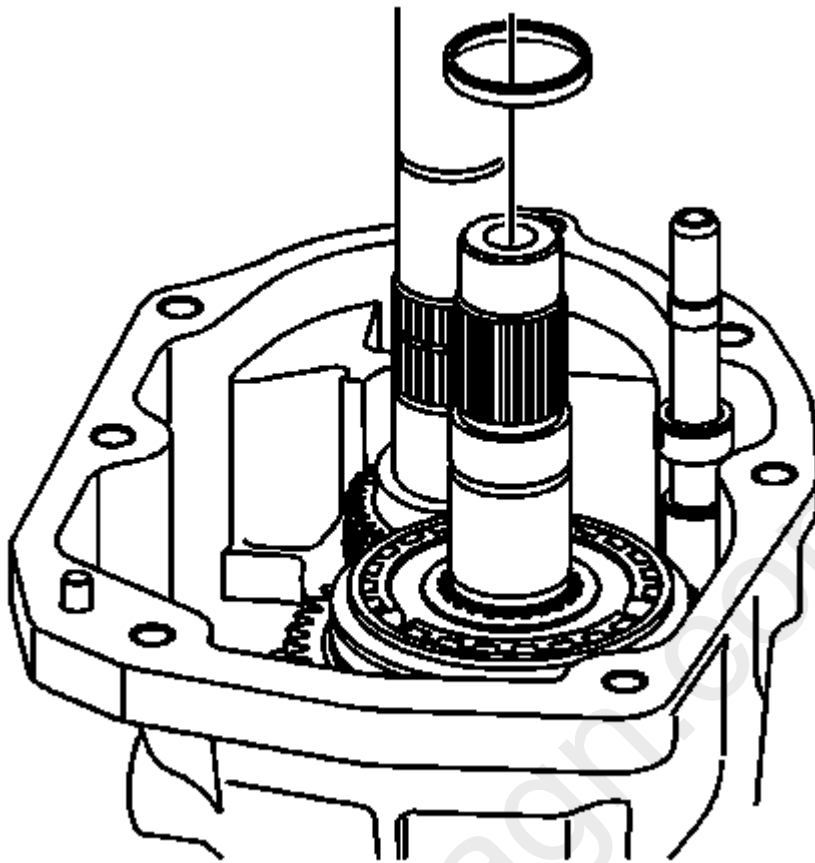


Fig. 85: View of Spacer & Countershaft
Courtesy of GENERAL MOTORS COMPANY

6. Remove the spacer from the countershaft.

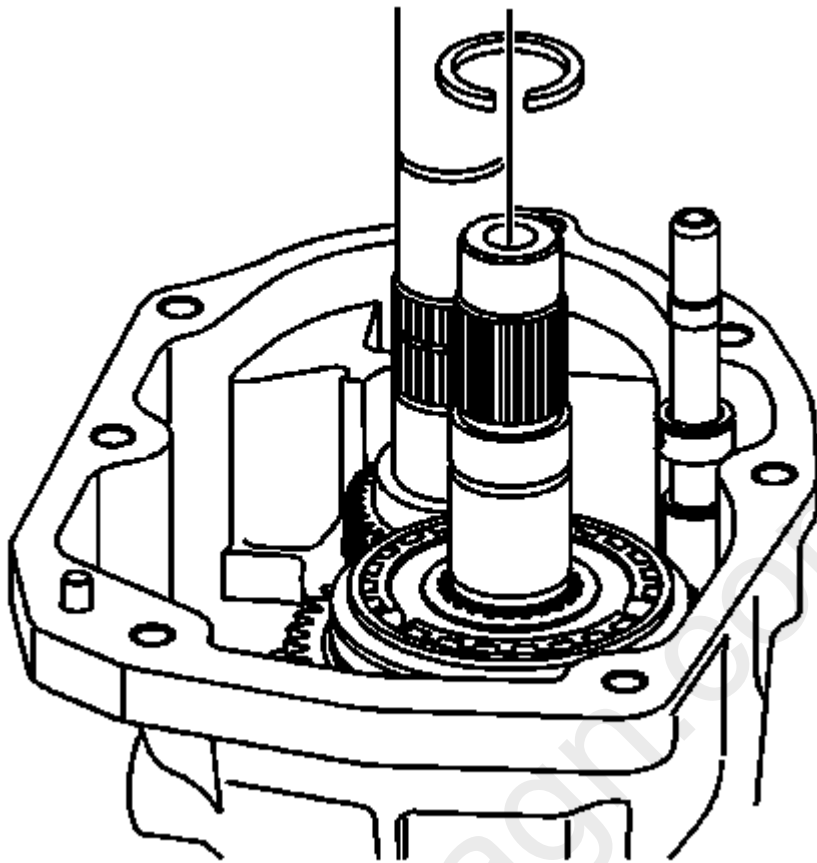


Fig. 86: View Of Retainer Clip & Countershaft
Courtesy of GENERAL MOTORS COMPANY

7. Remove the retainer clip from the countershaft.

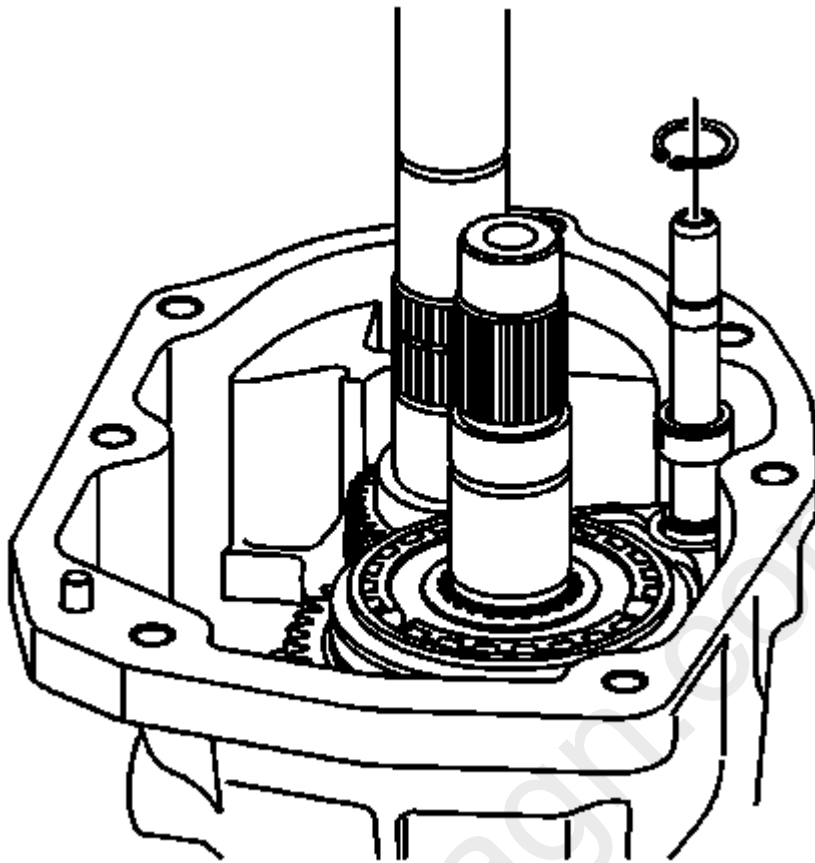


Fig. 87: View Of 5th/6th Speed Shift Fork Retainer Ring
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 5th/6th speed shift fork retainer ring.

5th/6th Speed Driven Gear Removal

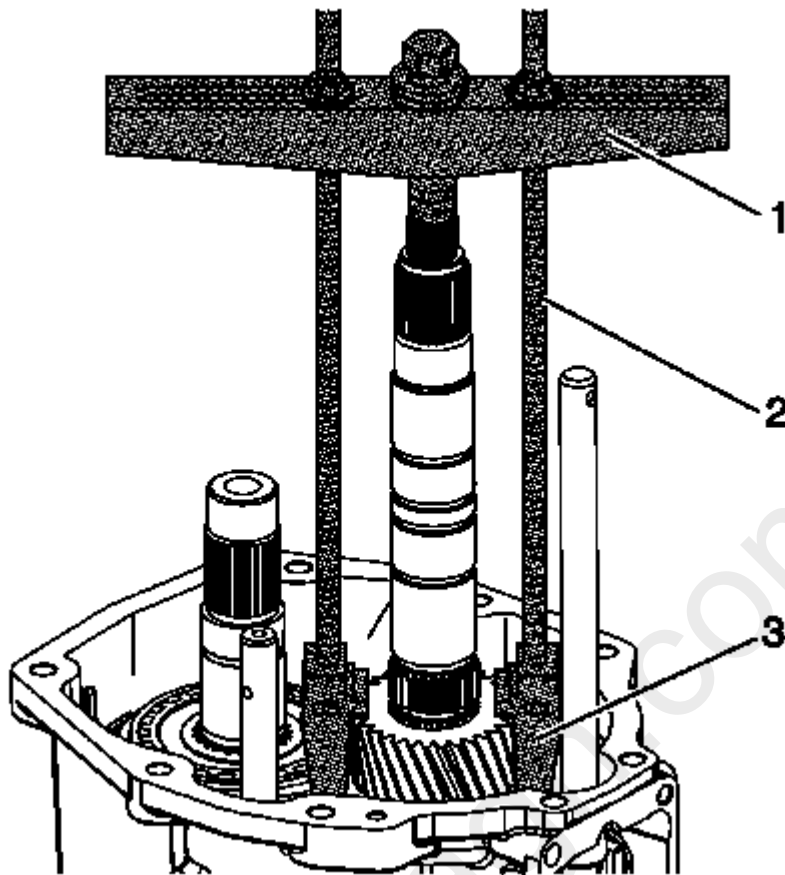


Fig. 88: Removing 5th/6th Speed Driven Gear
Courtesy of GENERAL MOTORS COMPANY

1. Using the **J 8433** puller (1), **J 39431** gear remover (3), and the **J 39431-3** adapter bolts (2), remove the 5th/6th speed driven gear.

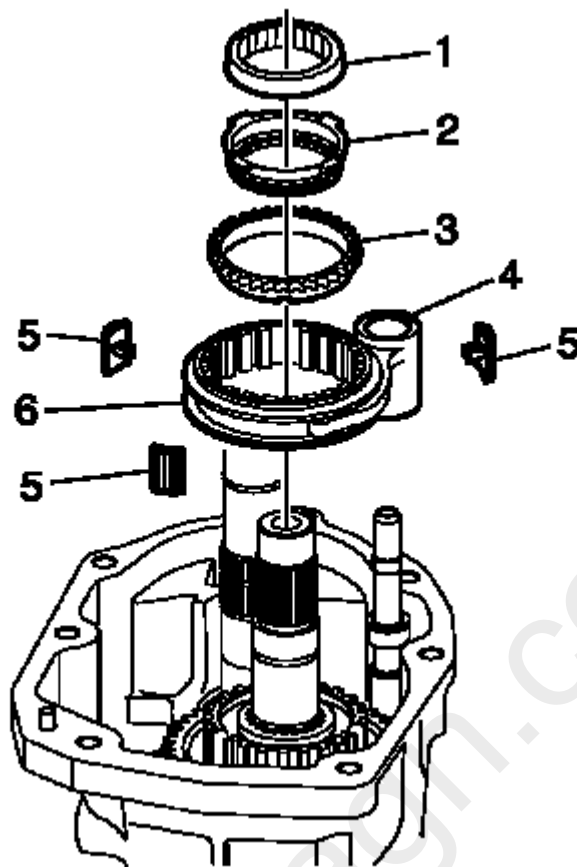


Fig. 89: View Of 5th/6th Shift Fork, Synchronizer Sleeve, Synchronizer Inserts, Speed Drive Gear Synchronizer Blocking Ring, Friction Cone and Inner Cone
Courtesy of GENERAL MOTORS COMPANY

2. Remove the following components:
 1. The 5th/6th shift fork
 2. The synchronizer sleeve
 3. The synchronizer inserts
 4. The speed drive gear synchronizer blocking ring
 5. The speed drive gear friction cone
 6. The speed drive gear inner cone

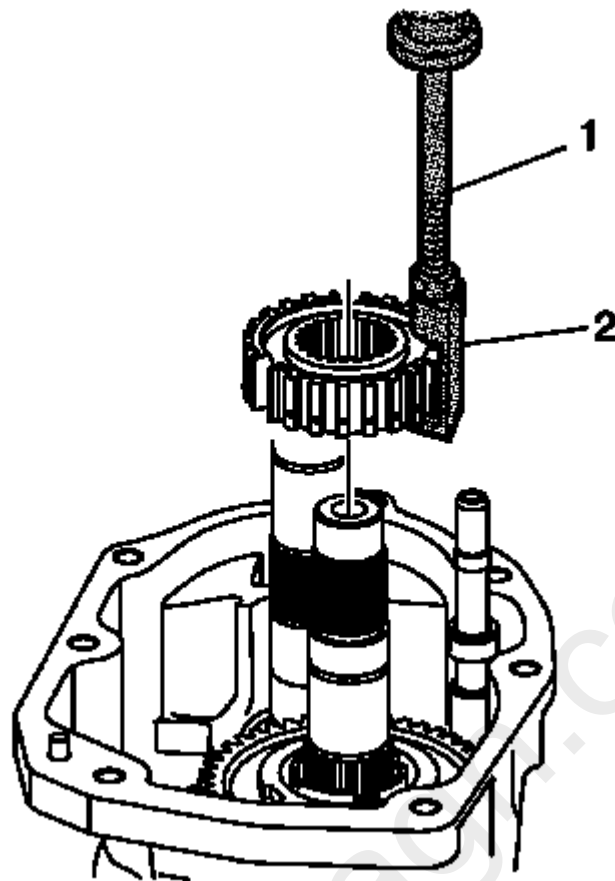


Fig. 90: Removing Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install the **DT 49139** remover (2) between the synchronizer hub assembly and synchronizer blocking ring.
4. Remove the synchronizer hub assembly with **J 6125-1B** slide hammer (1).

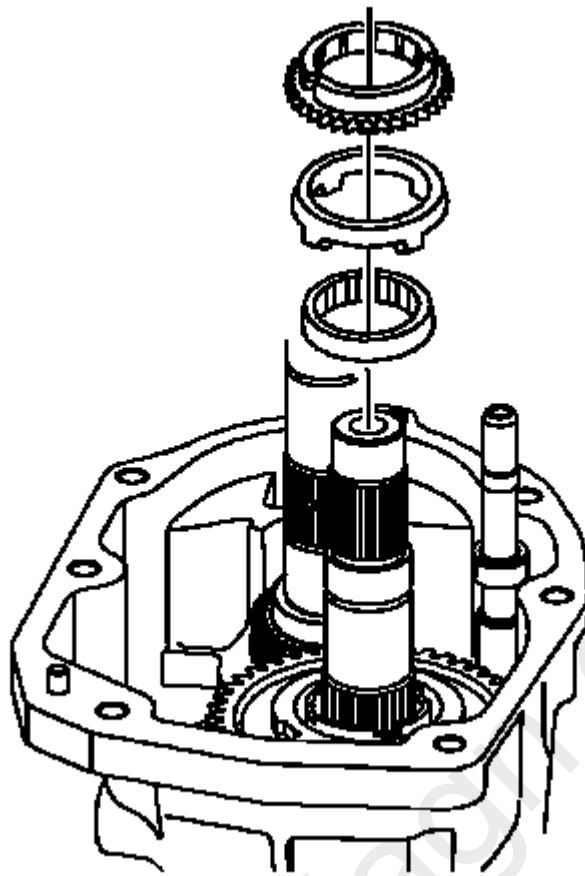


Fig. 91: View Of Speed Drive Gear Synchronizer Blocking Ring, Gear Friction Cone And Gear Inner Cone

Courtesy of GENERAL MOTORS COMPANY

5. Remove the following components:
 1. The speed drive gear synchronizer blocking ring
 2. The speed drive gear friction cone
 3. The speed drive gear inner cone

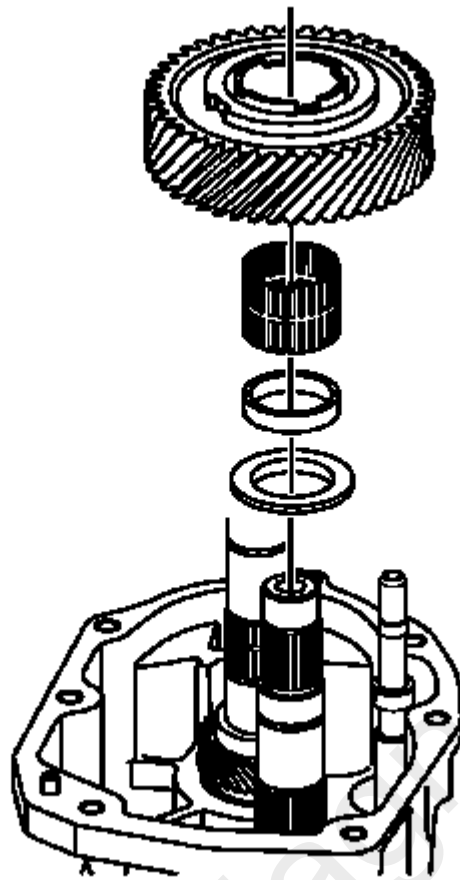


Fig. 92: View Of 6th Driven Gear, Caged Needle Bearing, And Spacer
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 6th driven gear, caged needle bearing, and 2 spacers.

Transmission Case Removal

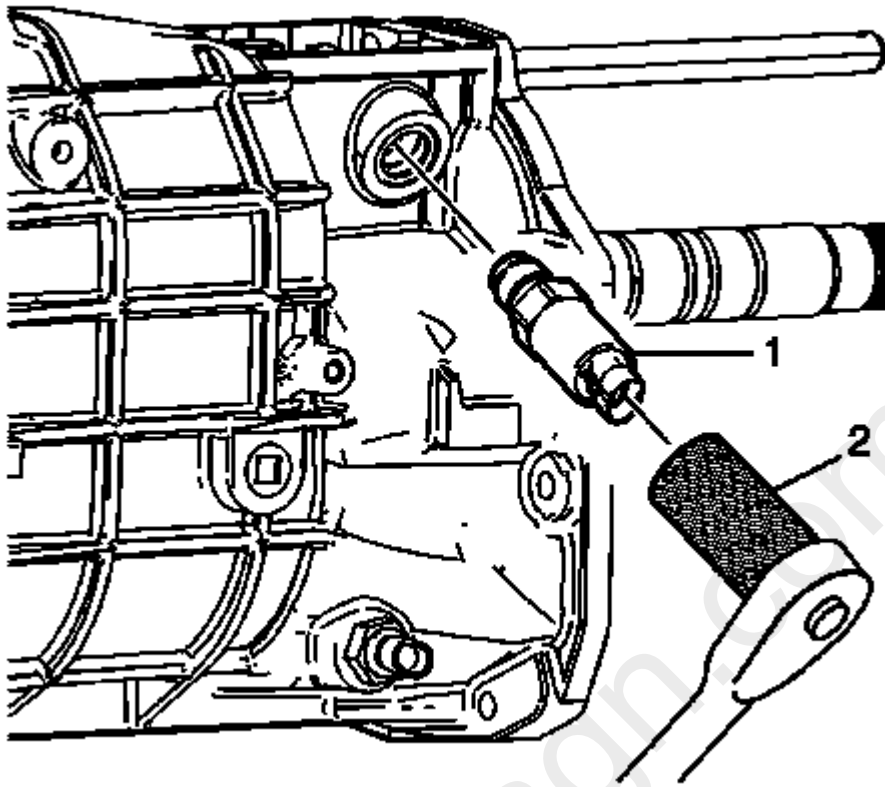


Fig. 93: Removing/Installing Gear Select/Skip Shift Solenoid
Courtesy of GENERAL MOTORS COMPANY

1. Remove the gear select/skip shift solenoid (1) using **DT 49293** socket (2).

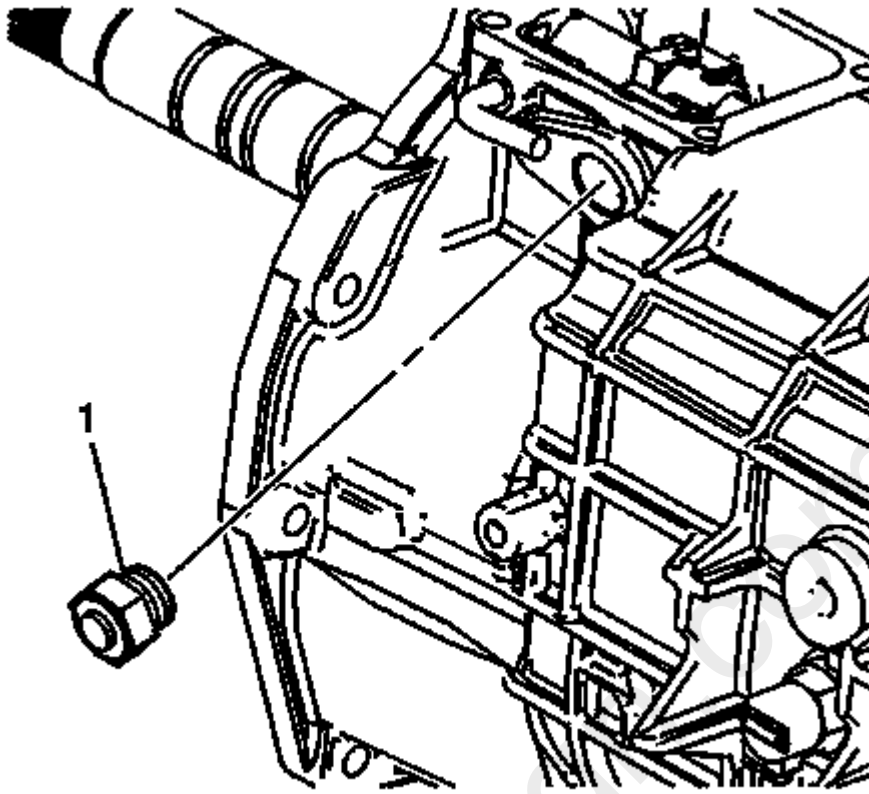


Fig. 94: Identifying Shift Detent Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Remove the shift detent assembly (1).

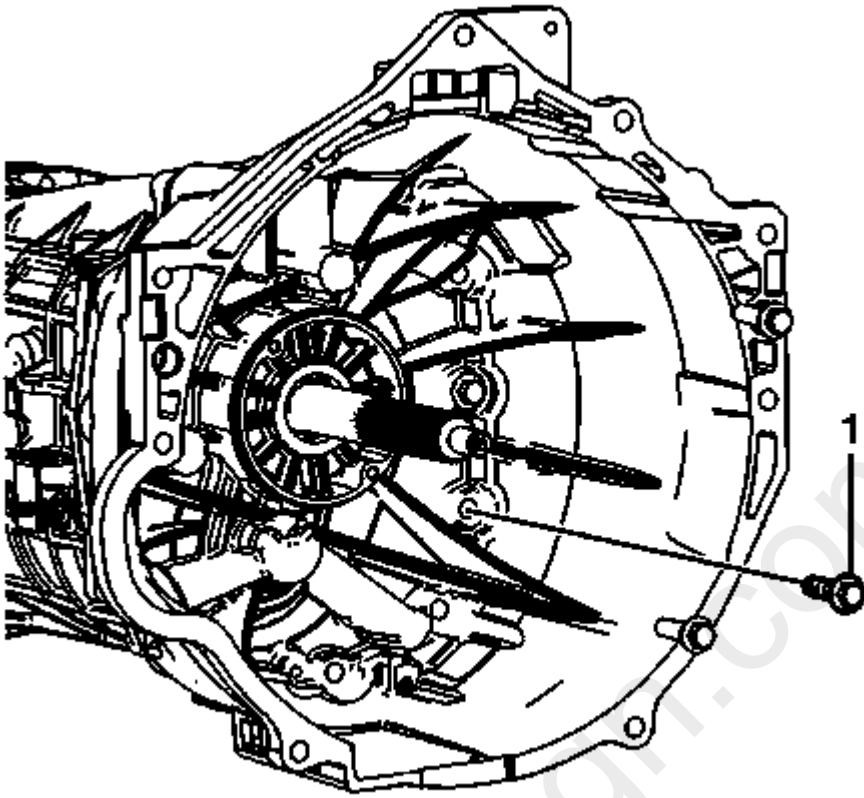


Fig. 95: Identifying Clutch Housing To Transmission Case Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove 9 of the 11 clutch housing to transmission case bolts (1).
4. Rotate the transmission into the vertical position.

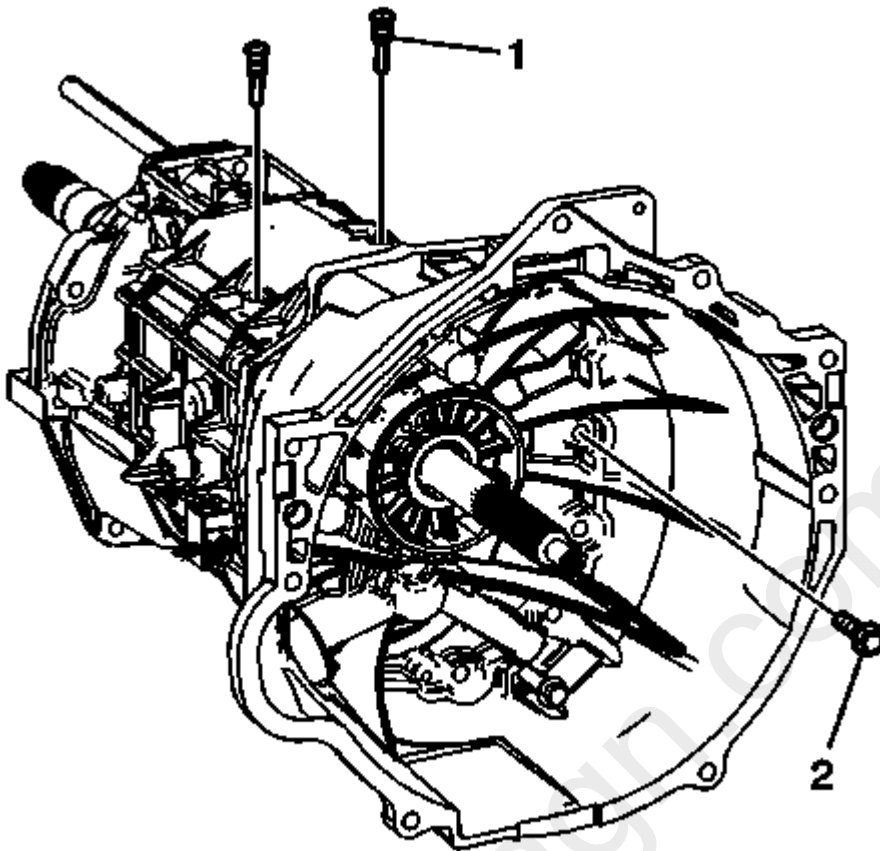


Fig. 96: Identifying Last Clutch Housing To Transmission Case & Shift Lever Guide Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the last 2 clutch housing to transmission case bolts (2).
6. Remove the shift lever guide bolts (1).

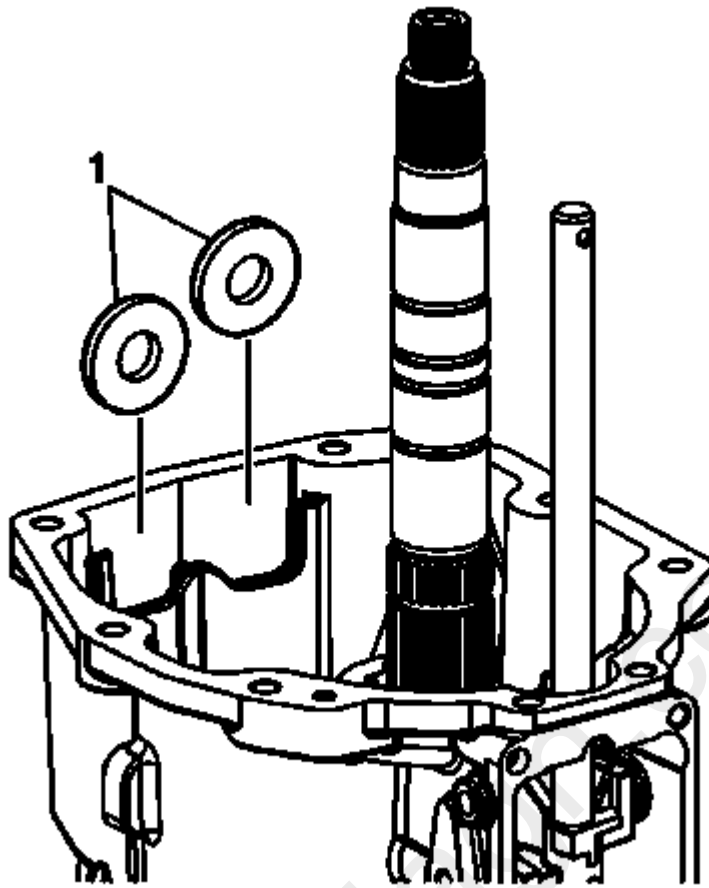


Fig. 97: Identifying Transmission Case Magnets
Courtesy of GENERAL MOTORS COMPANY

7. Remove the magnets (1) from the transmission case.

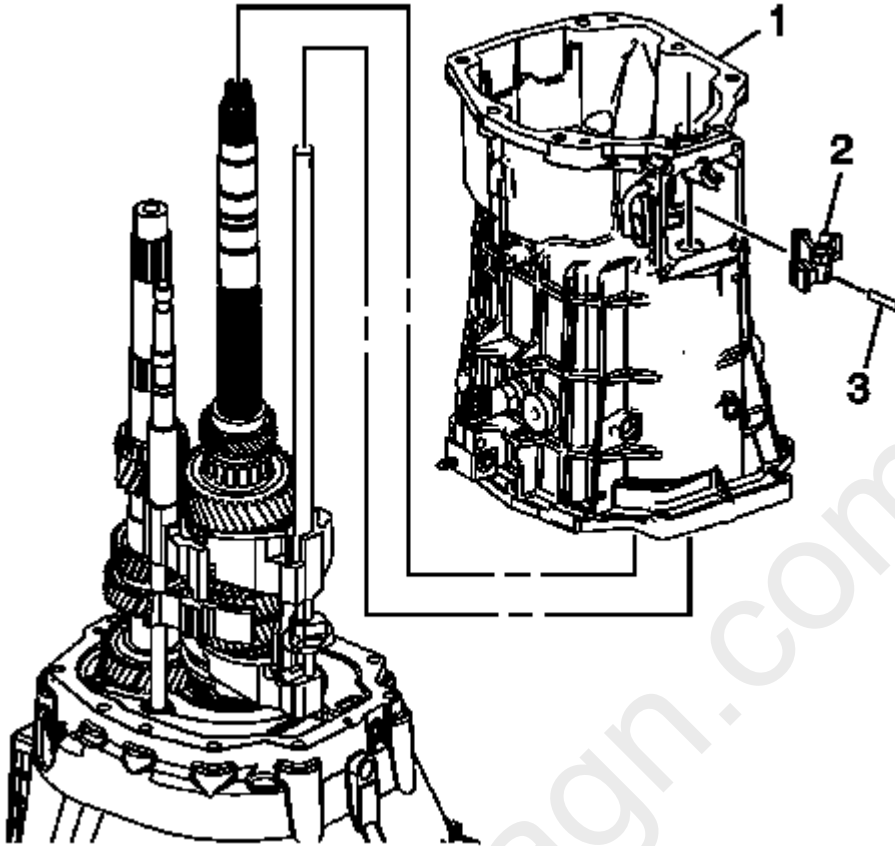


Fig. 98: Identifying Transmission Case & Select Control Lever Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove the transmission case (1) and the select control lever assembly (2) together as follows:
 1. Remove the select control lever assembly pin.
 2. Slide the transmission case up and off of the gear clusters and the shift shaft components.
 3. Hold the select control lever assembly against the guide plate in order to prevent the release of the detent ball and the spring.
 4. Remove the select control lever assembly from the transmission case.

Oil Filter Removal

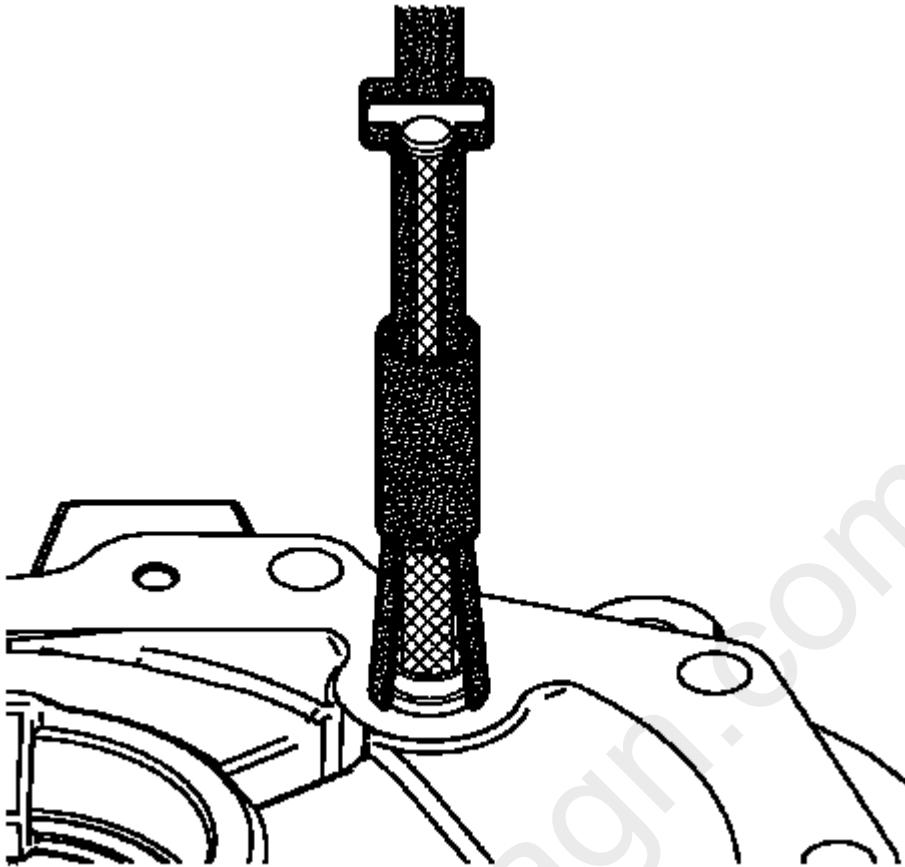


Fig. 99: View Of Special Tool On Oil Filter
Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove the oil filter before removing the shift shaft assemblies and gear clusters.

1. Attach **J 36017** tool over oil filter. Ensure that the tool grasps the oil filter where it contacts the adapter housing.
2. Slide the collar of **J 36017** tool down to secure the oil filter.

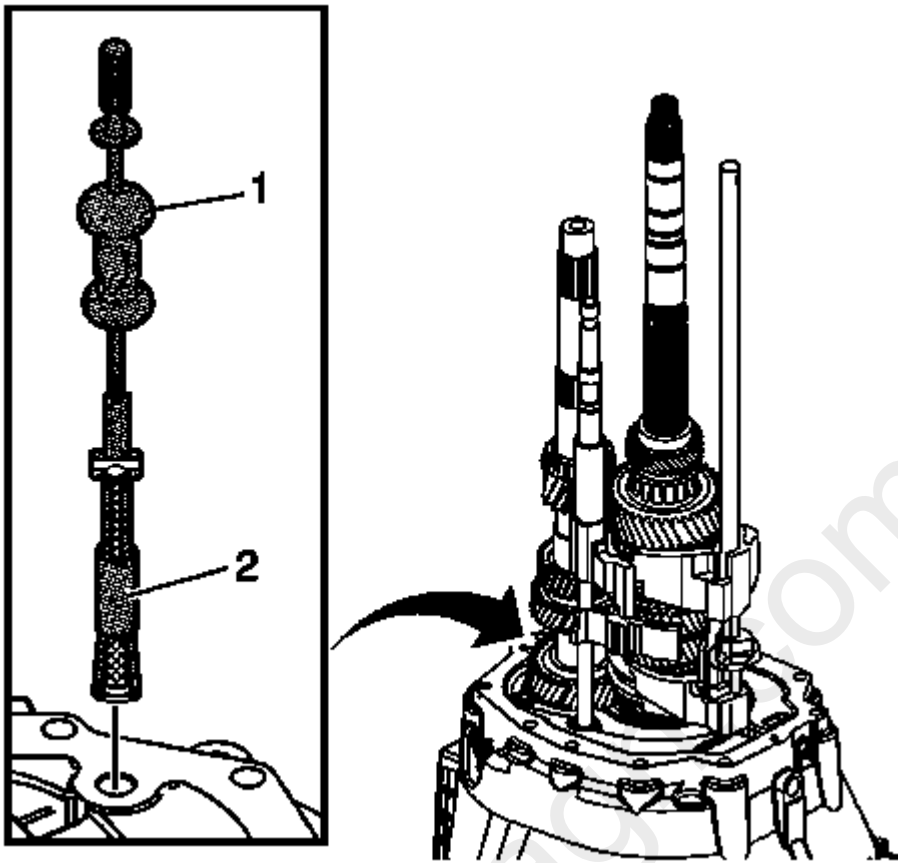


Fig. 100: Slide Hammer, Remover & Oil Filter
Courtesy of GENERAL MOTORS COMPANY

3. Using J 23907 slide hammer (1) and J 36017 remover (2), remove the oil filter.

Shift Shaft Assemblies and Gear Cluster Removal

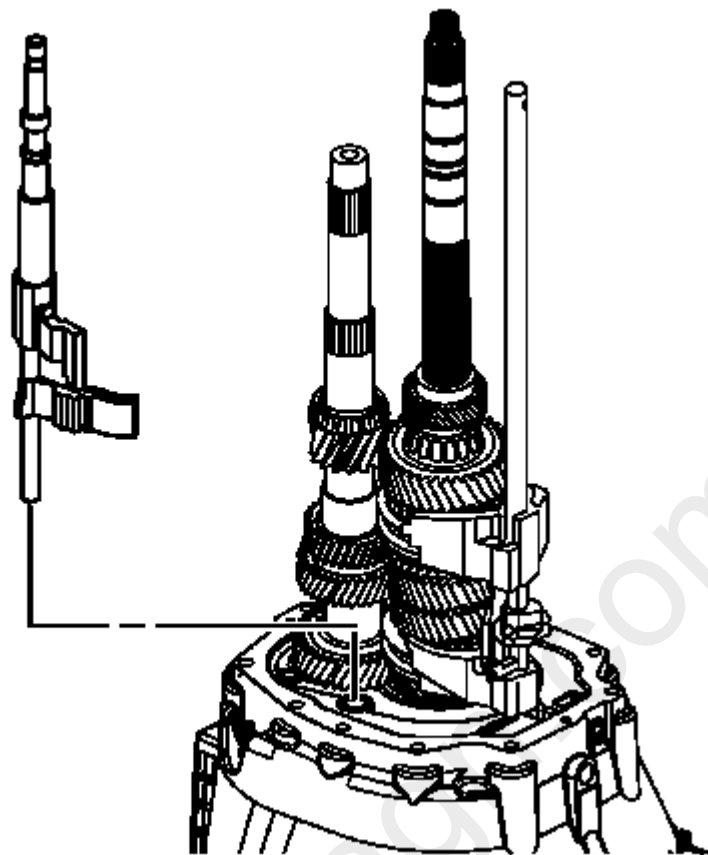


Fig. 101: View Of 5th/6th & Reverse Shift Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Rotate the 5th/6th and the reverse shift shaft levers off the shift interlock plate.
2. Remove the 5th/6th and the reverse shift shaft assembly.

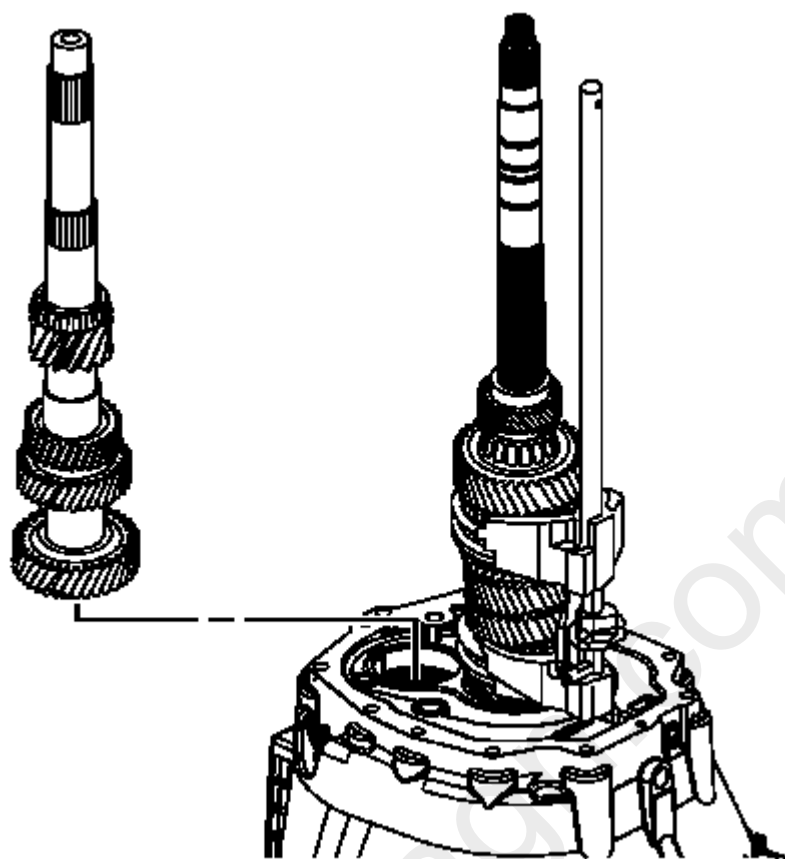


Fig. 102: View Of Countershaft

Courtesy of GENERAL MOTORS COMPANY

3. Remove the countershaft. Lift up the mainshaft enough in order to remove the countershaft.

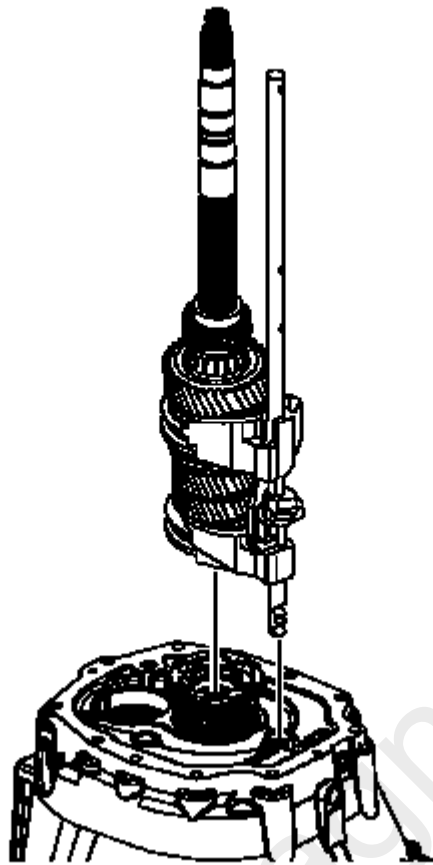


Fig. 103: View Of Mainshaft & Shift Shaft Components
Courtesy of GENERAL MOTORS COMPANY

4. Remove the mainshaft and the shift shaft components as an assembly.
5. Remove the shift shaft assembly from the mainshaft.

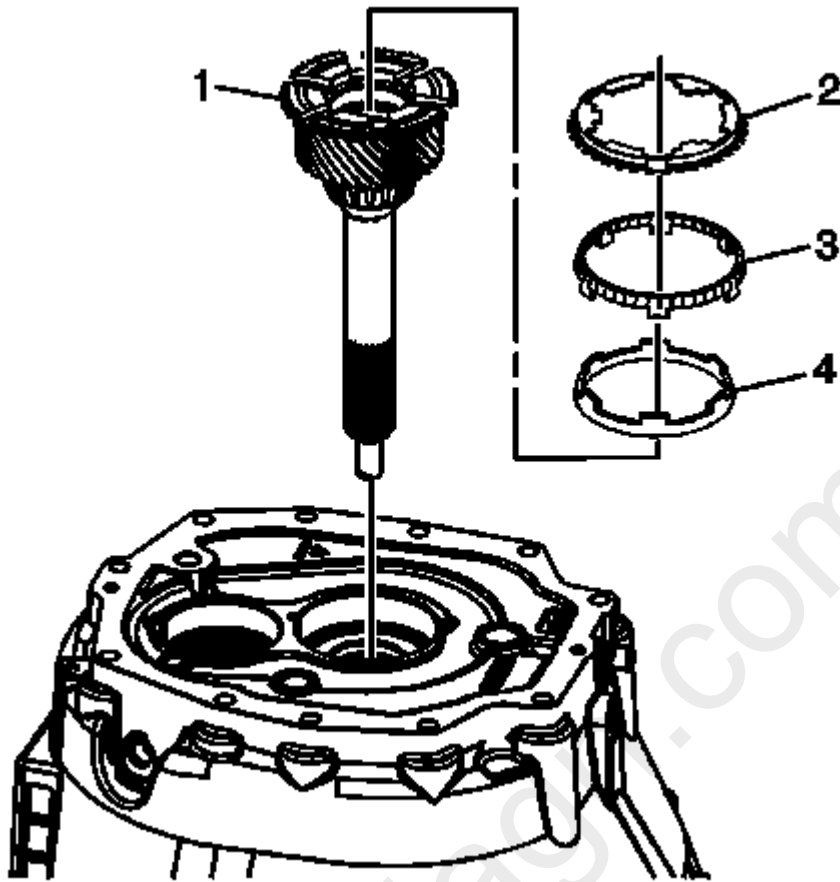


Fig. 104: Identifying 4th Gear Blocking Ring Assembly Components
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 4th gear blocking ring assembly, which includes the following components:
 1. 4th speed drive gear blocking ring (2)
 2. 4th speed drive gear outer cone (3)
 3. 4th speed drive gear inner cone (4)
7. Remove the input shaft (1).

MAIN SHAFT AND INPUT SHAFT DISASSEMBLE

6th Speed Driven and 1st Speed Drive Gear Removal

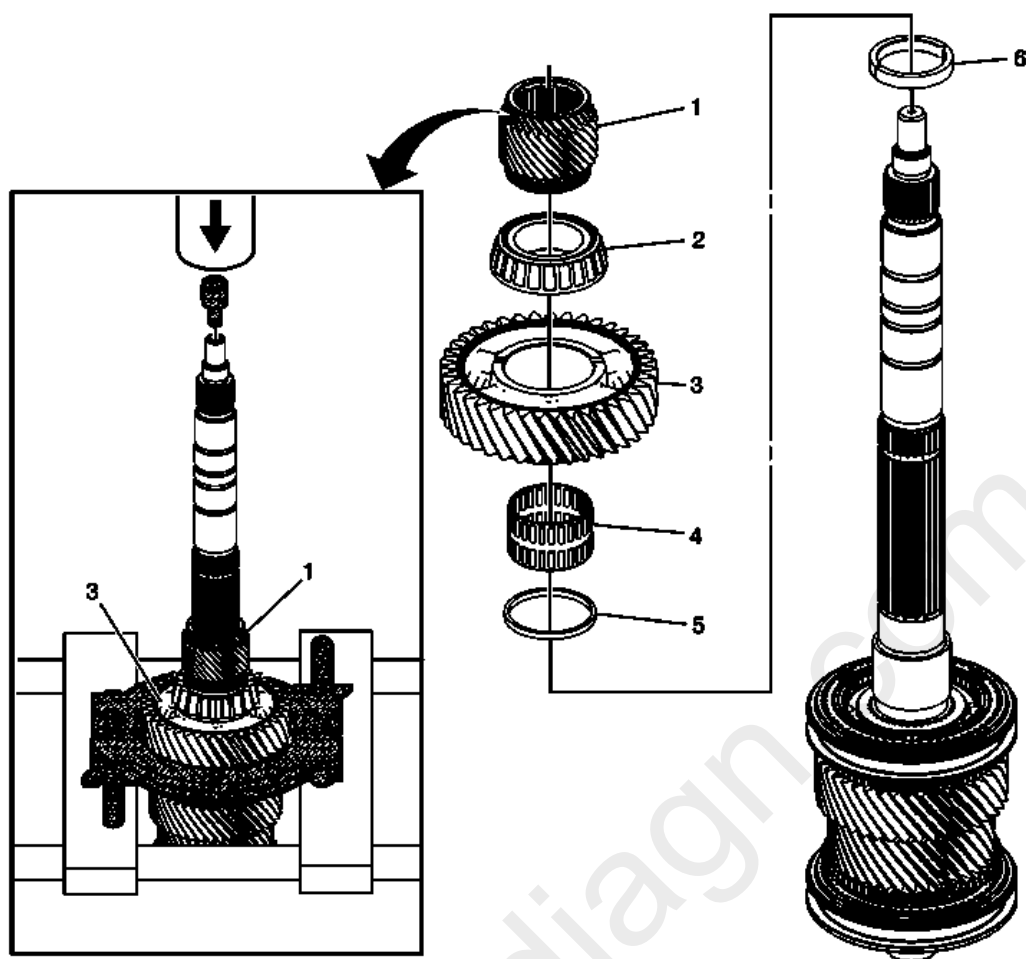


Fig. 105: 6th Speed Driven and 1st Speed Drive Gear Components
 Courtesy of GENERAL MOTORS COMPANY

6th Speed Driven and 1st Speed Drive Gear Removal

Callout	Component Name
NOTE: Measure the 4th speed gear synchronizer wear gap before disassembling the main shaft.	
Preliminary Procedure	
1. Install the input shaft in the clutch housing. 2. Install the main shaft on the input shaft. 3. Using a feeler gauge, measure the gap between the 4th speed gear blocking ring and the 4th speed gear. 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 Speed Driven Gear
2	Main Shaft Bearing

	1st Speed Drive Gear
	CAUTION: Do not overtighten the J 36513 split plate past the gear teeth or damage to gear may occur.
3	Special Tools • J-36513 Split Plate • J-39442 Press Adapter For equivalent regional tools, refer to Special Tools.
4	1st Speed Drive Gear Needle Bearing
5	1st Speed Drive Gear Locking Ring
6	1st Speed Drive Gear Two Piece Washer

1st Speed Drive Gear Blocking Ring Assembly Removal

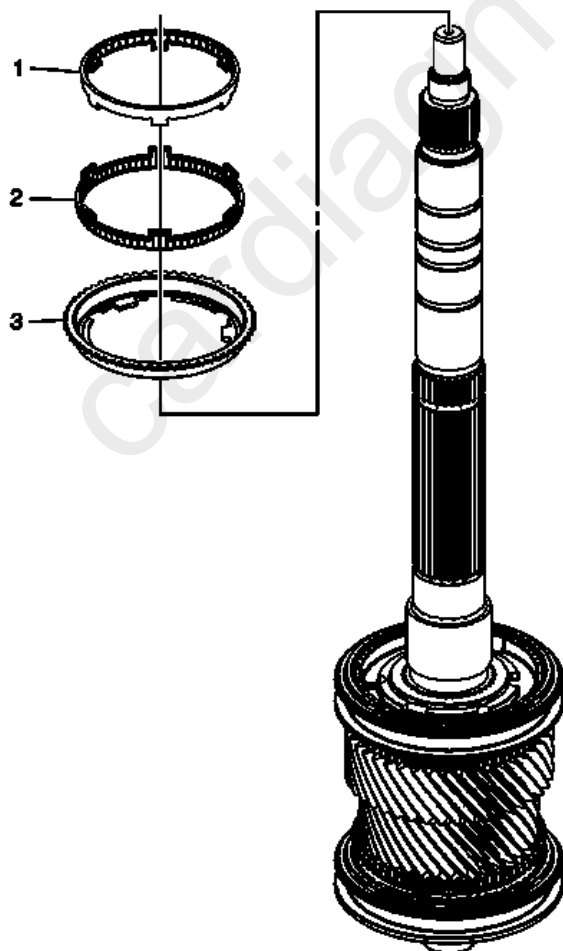


Fig. 106: 1st Speed Drive Gear Blocking Ring Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

1st Speed Drive Gear Blocking Ring Assembly Removal

Callout	Component Name
1	1st Speed Drive Gear Inner Cone
2	1st Speed Drive Gear Friction Cone
3	1st Speed Drive Gear Synchronizer Blocking Ring

2nd Speed Drive Gear Removal

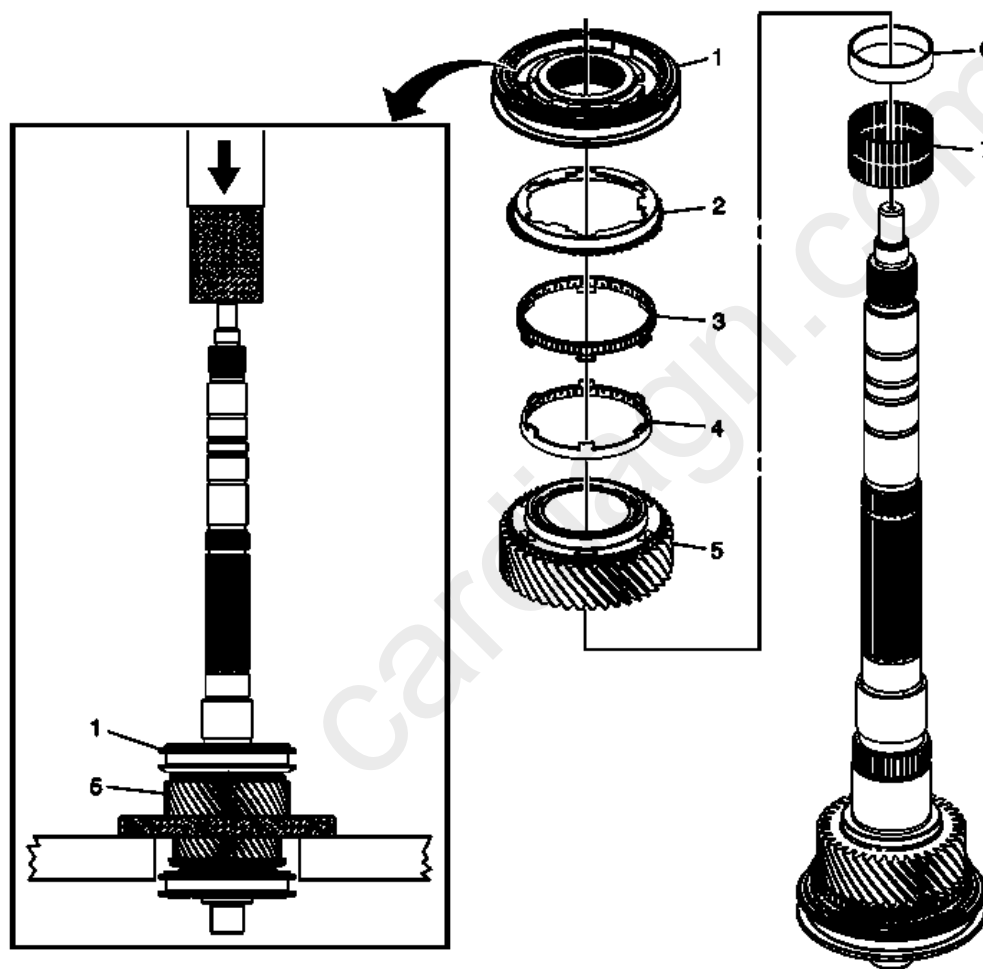


Fig. 107: 2nd Speed Drive Gear Components
 Courtesy of GENERAL MOTORS COMPANY

2nd Speed Drive Gear Removal

Callout	Component Name
1	1st/2nd Synchronizer Assembly
2	2nd Speed Drive Gear Synchronizer Blocking Ring

3	2nd Speed Drive Gear Friction Cone
4	2nd Speed Drive Gear Inner Cone
5	2nd Speed Drive Gear Special Tools • J-36513 Split Plate • J-39442 Press Adapter For equivalent regional tools, refer to Special Tools .
6	2nd Speed Drive Gear Bearing Spacer
7	2nd Speed Drive Gear Needle Bearing

3rd Speed Drive Gear Removal

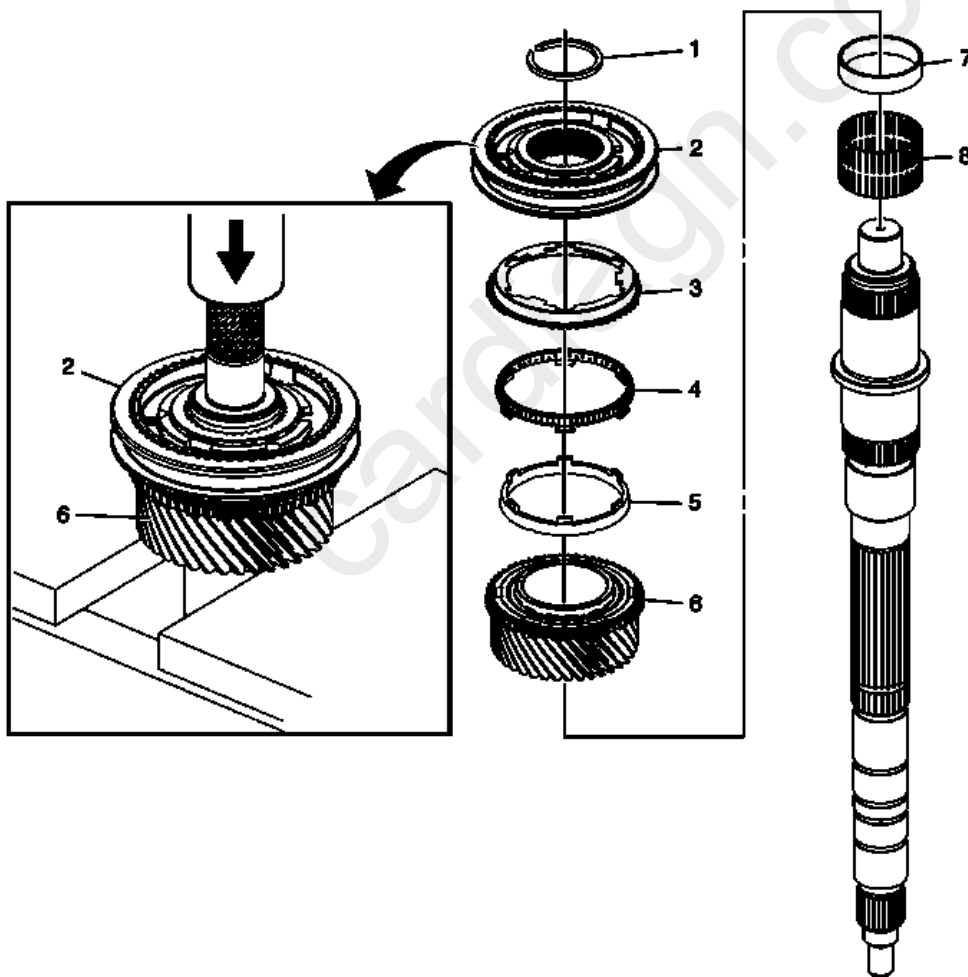


Fig. 108: 3rd Speed Drive Gear Components
Courtesy of GENERAL MOTORS COMPANY

3rd Speed Drive Gear Removal

Callout	Component Name
1	3rd/4th Synchronizer Retaining Ring
2	3rd/4th Synchronizer Assembly
3	3rd Speed Drive Gear Synchronizer Blocking Ring
4	3rd Speed Drive Gear Friction Cone
5	3rd Speed Drive Gear Inner Cone
6	3rd Speed Drive Gear Special Tools J-39473 Main Shaft Bearing Installer For equivalent regional tools, refer to Special Tools .
7	3rd Speed Drive Gear Bearing Spacer
8	3rd Speed Drive Gear Needle Bearing

Input Shaft Pocket Bearing Removal

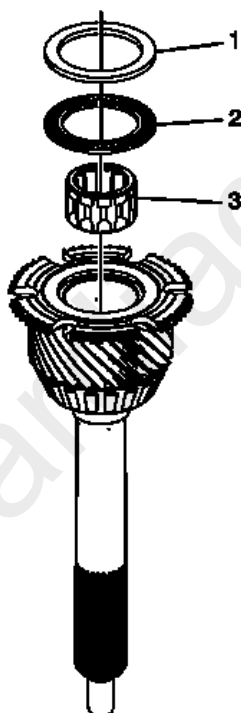


Fig. 109: Input Shaft Pocket Bearing Components

Courtesy of GENERAL MOTORS COMPANY

Input Shaft Pocket Bearing Removal

Callout	Component Name
1	Input Shaft Thrust Washer
2	Input Shaft Thrust Bearing
3	Input Shaft Bearing

Input Shaft Bearing Removal

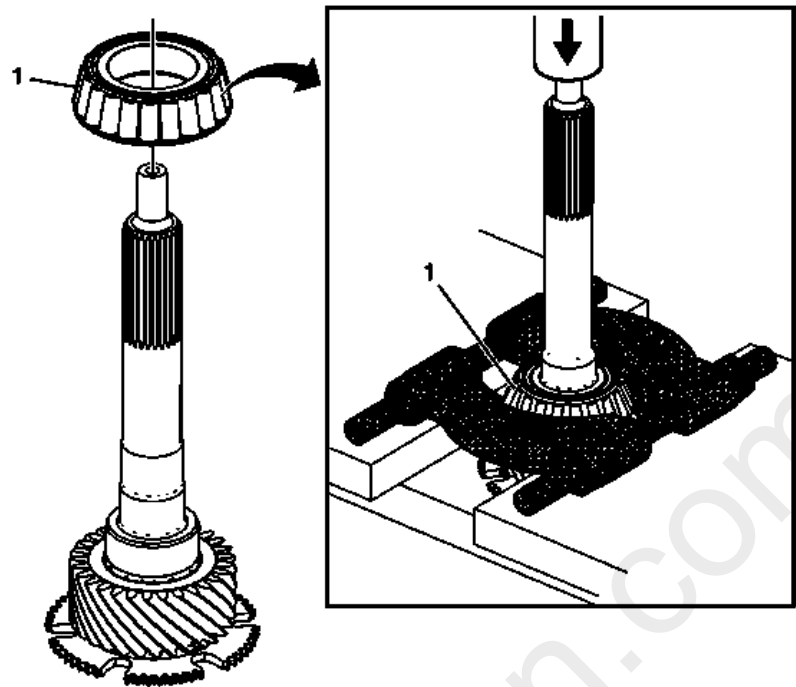


Fig. 110: Input Shaft Bearing
Courtesy of GENERAL MOTORS COMPANY

Input Shaft Bearing Removal

Callout	Component Name
1	Input Shaft Bearing NOTE: DO NOT replace the tapered bearing unless inspection shows that the bearing is damaged. Special Tools J-22912-B Rear Pinion and Axle Bearing Remover For equivalent regional tools, refer to Special Tools.

COUNTER GEAR SHAFT DISASSEMBLE

Special Tools

- J 22912-B Rear Pinion and Axle Bearing Remover
- J 39473 Mainshaft Bearing Installer
- J 39511 Split Plate

- **J 39547** Press Adapter

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

NOTE: Do not replace tapered bearings unless inspection shows bearing damage.

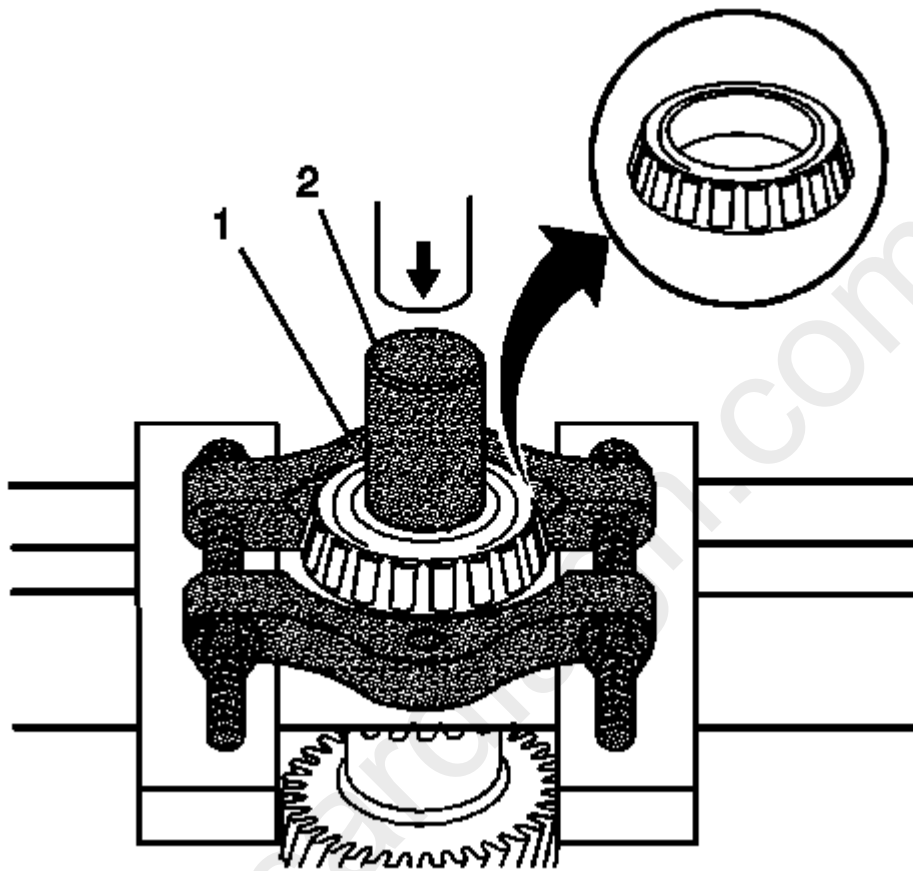


Fig. 111: Rear Pinion & Axle Bearing Remover & Mainshaft Bearing Installer
Courtesy of GENERAL MOTORS COMPANY

1. Remove the countershaft front bearing, using the **J 22912-B** remover (1) with the **J 39473** installer (2) and a hydraulic press.
2. Discard the countershaft front bearing.

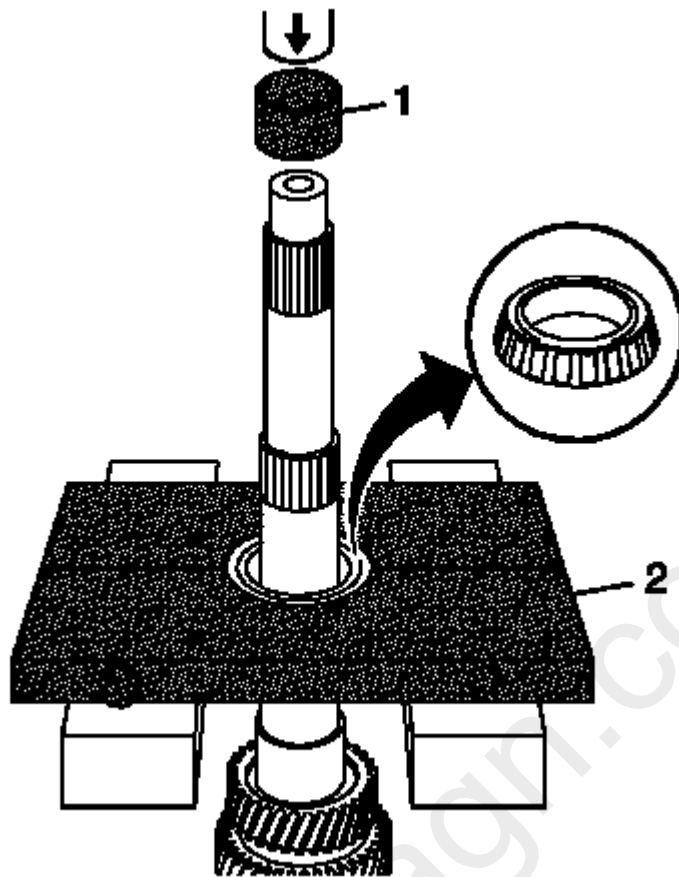


Fig. 112: View Of Tapered Bearing, Split Plate and Press Adapter
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the countershaft rear bearing, using the J 39511 plate (2), the J 39547 adapter (1) and a hydraulic press.
4. Discard the countershaft rear bearing.

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

1st/2nd, 3rd/4th, 5th/6th Synchronizers

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.

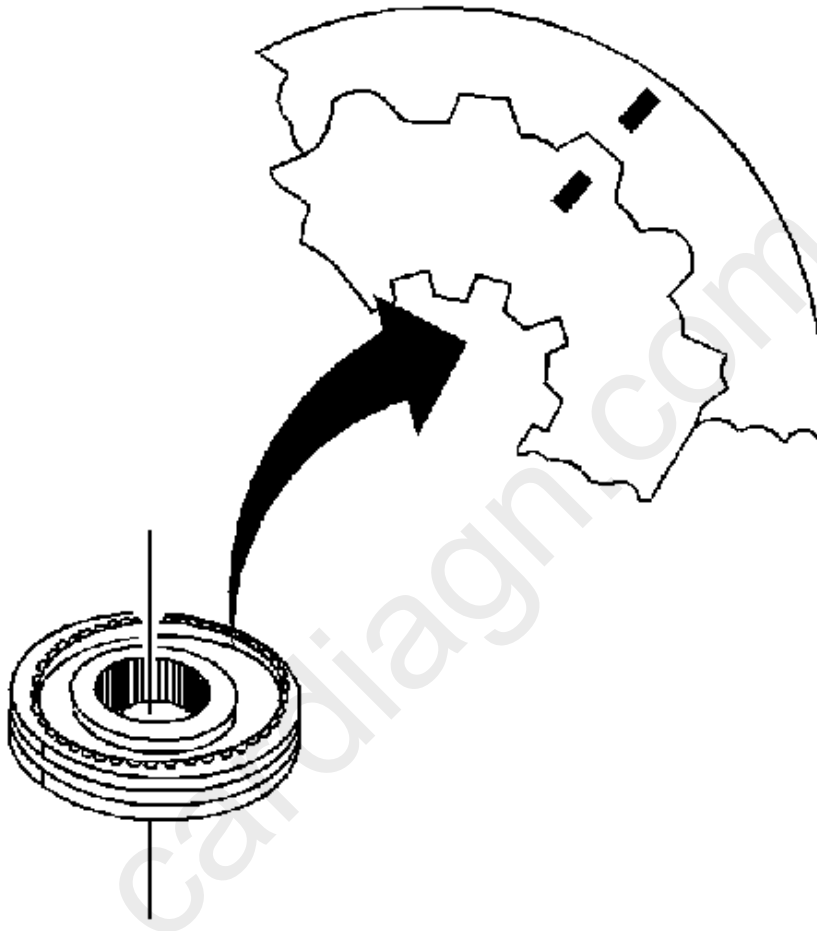


Fig. 113: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

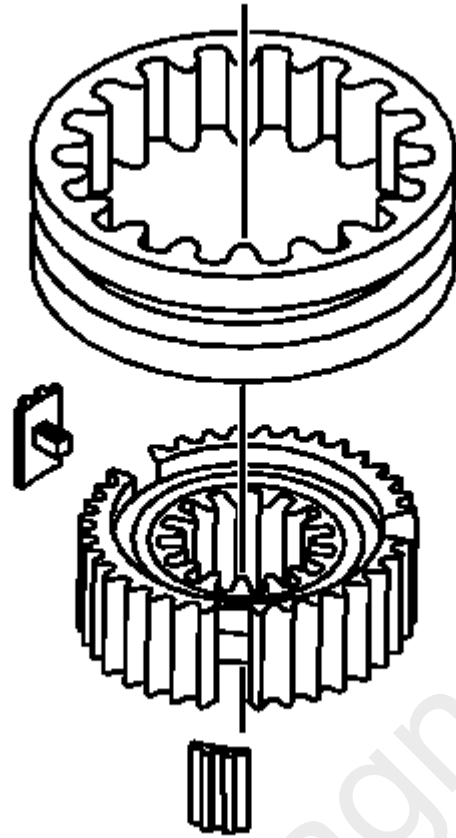


Fig. 114: Identifying Synchronizer Inserts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the synchronizer inserts from the hub.

Reverse Synchronizer

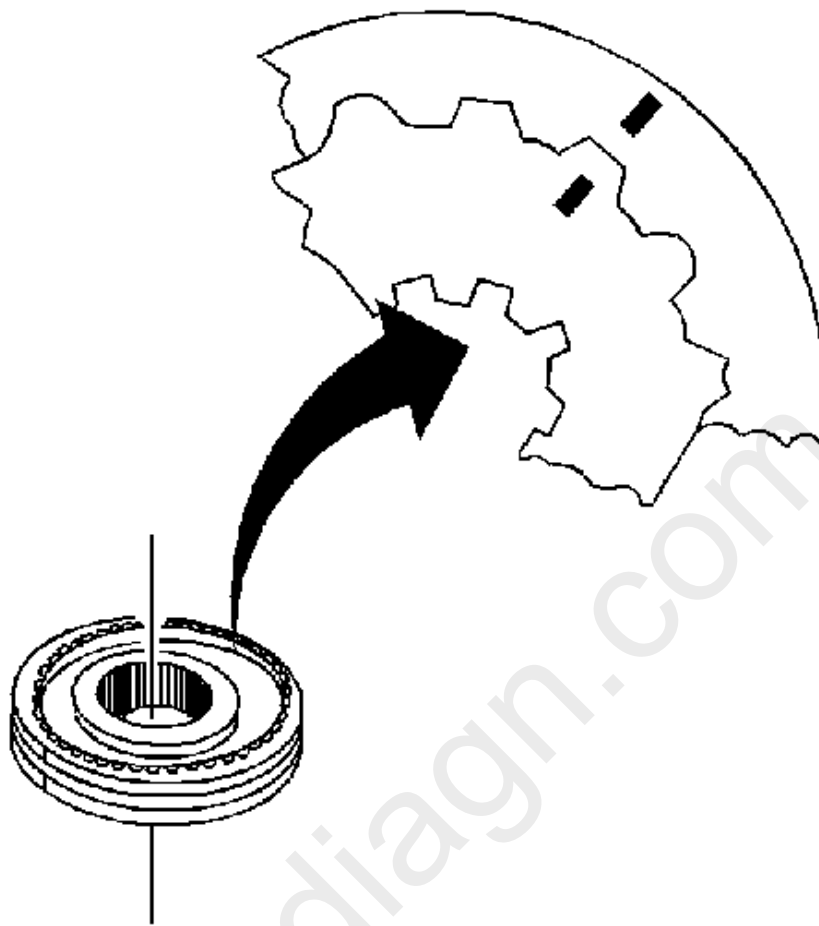


Fig. 115: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

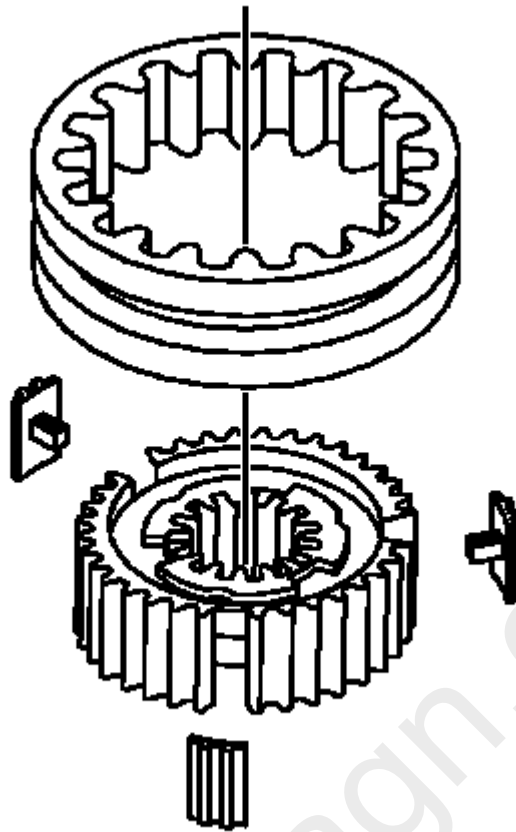


Fig. 116: Synchronizer Sleeve & Hub
Courtesy of GENERAL MOTORS COMPANY

2. Remove the synchronizer sleeve from the hub. Press against the inner hub.
3. Turn the hub over. The inserts will slide out from the hub.

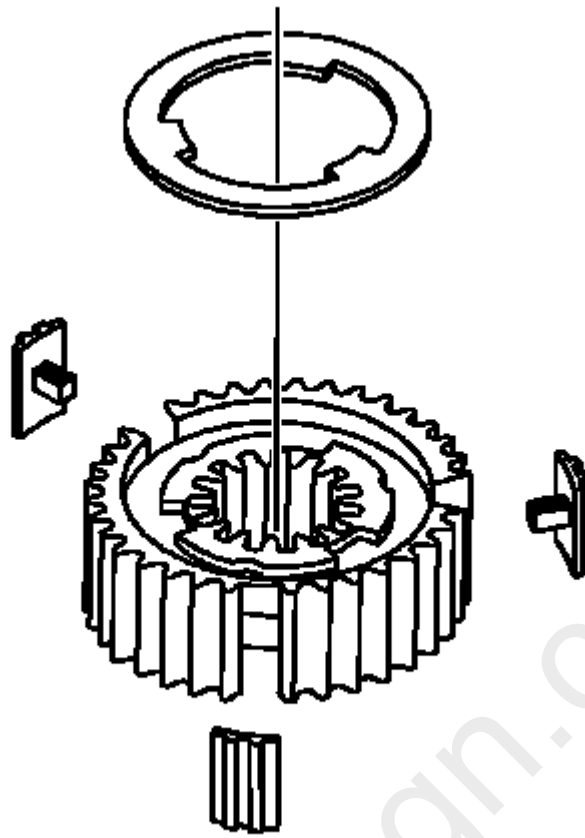


Fig. 117: View Of Synchronizer Key Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Using a small-blade screwdriver, remove the synchronizer key retainer, and discard.

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.

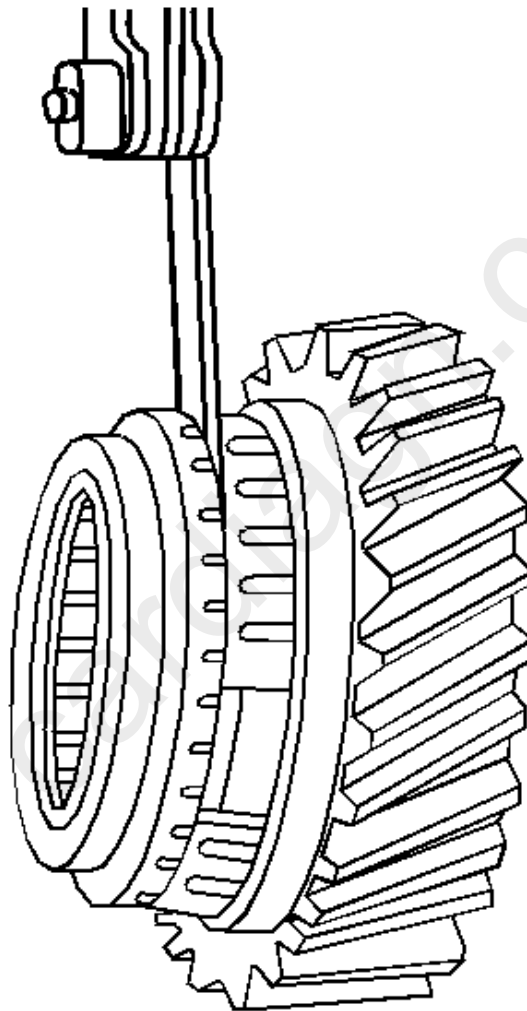


Fig. 118: Measuring Gap Between Blocking Ring & Speed Gear
Courtesy of GENERAL MOTORS COMPANY

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 1.27-2.16 mm (0.050-0.085 in) for the 1st and 2nd gear.

The nominal gap is 1.27-2.03 mm (0.050-0.080 in) for the 3rd, 4th, 5th and 6th 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

1st/2nd Synchronizer

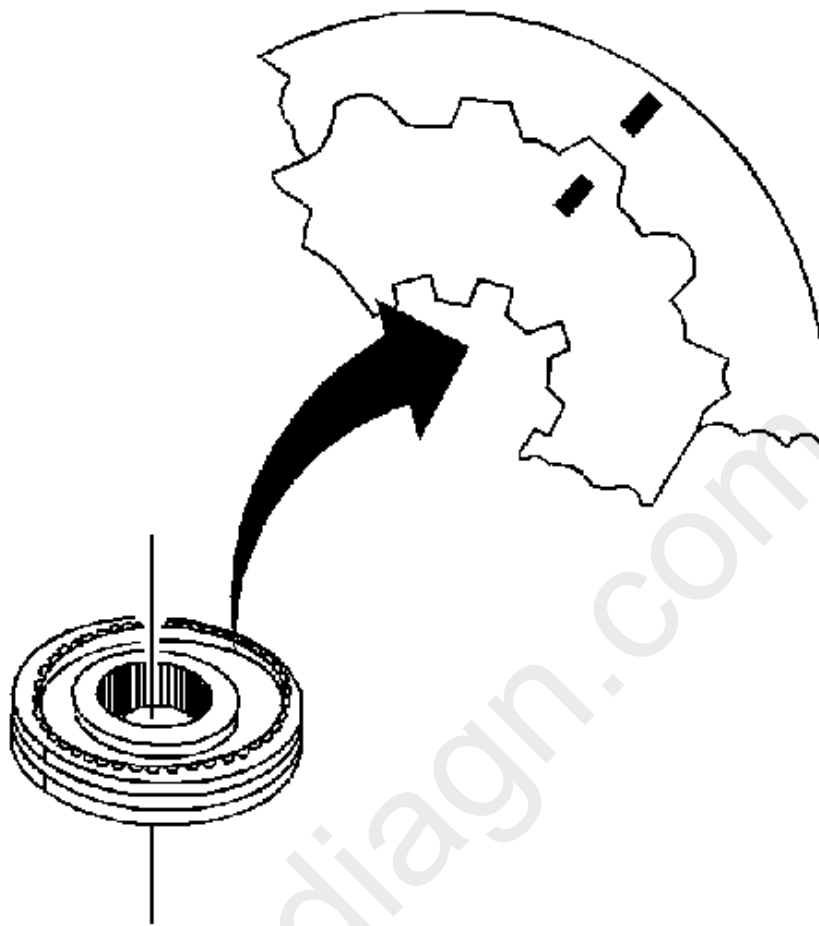


Fig. 119: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

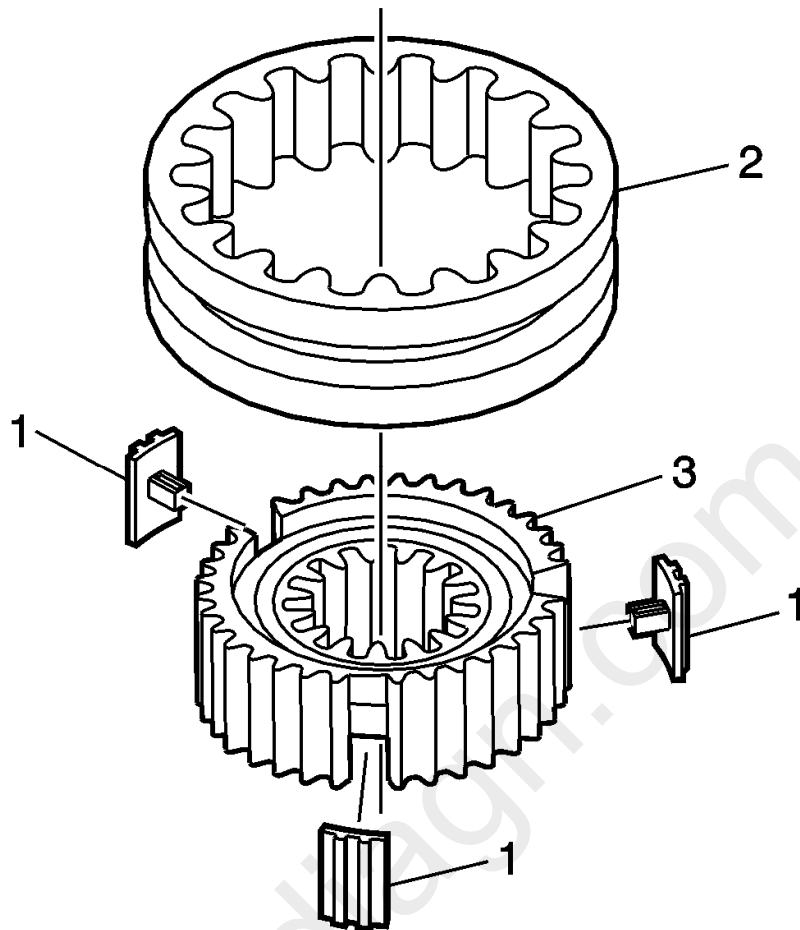


Fig. 120: Assembling 1st/2nd Synchronizer
Courtesy of GENERAL MOTORS COMPANY

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.

3rd/4th, 5th/6th Synchronizers

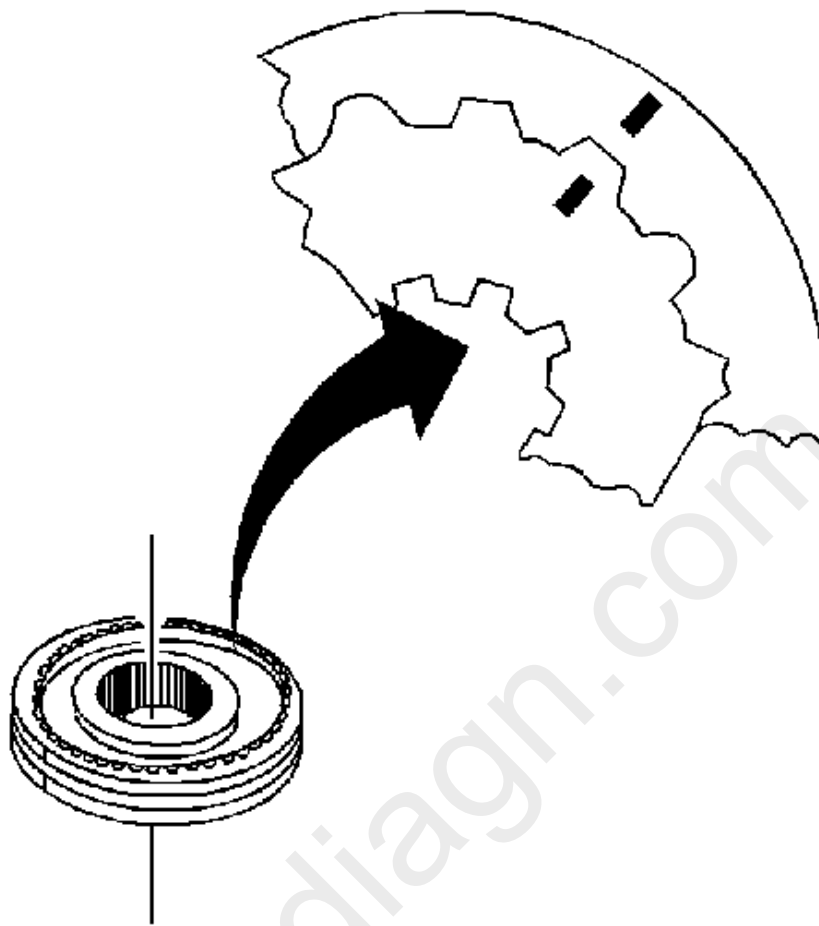


Fig. 121: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

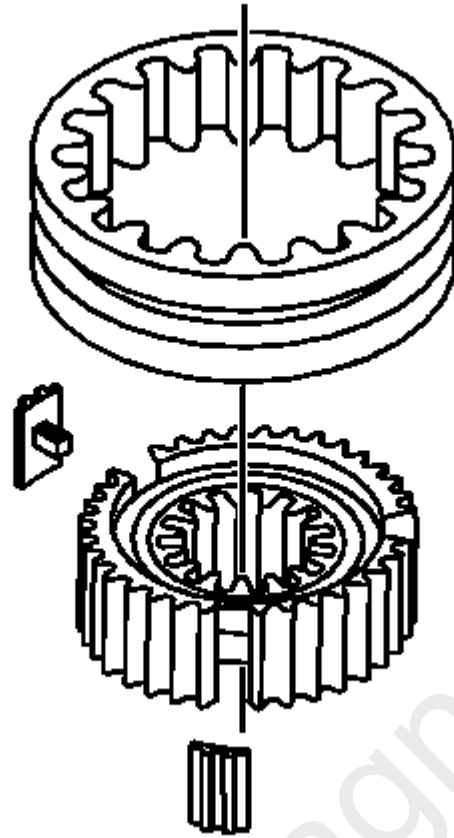


Fig. 122: Identifying Synchronizer Inserts
Courtesy of GENERAL MOTORS COMPANY

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

Reverse Synchronizer

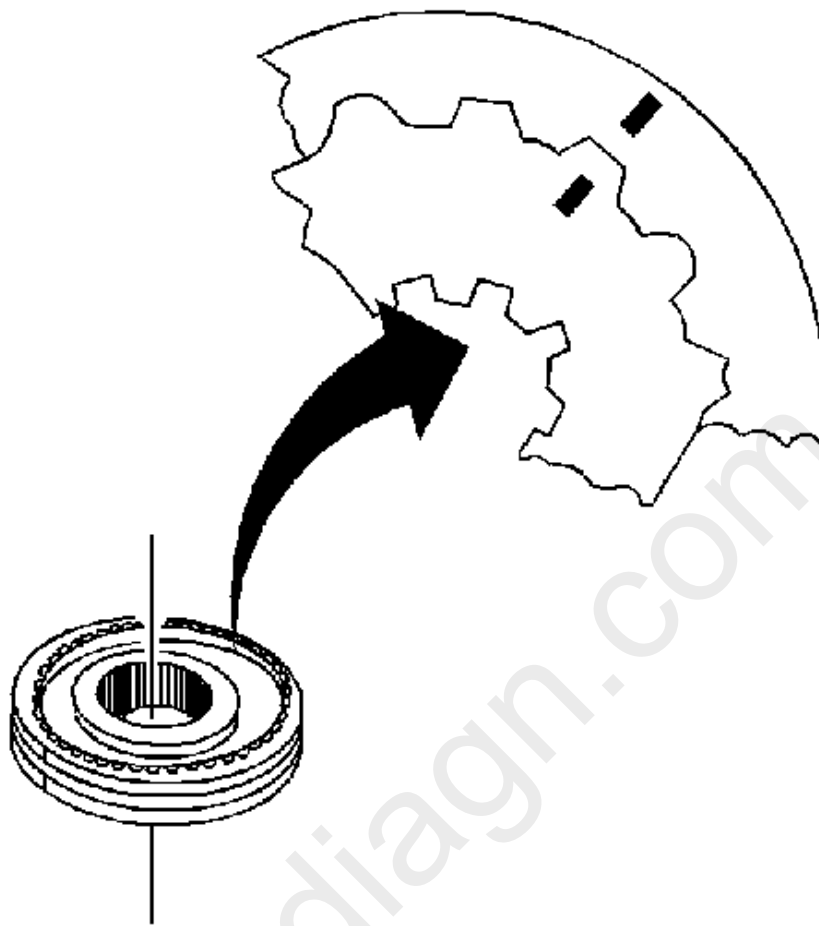


Fig. 123: View Of Alignment Marks On Synchronizer Hub & Synchronizer Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

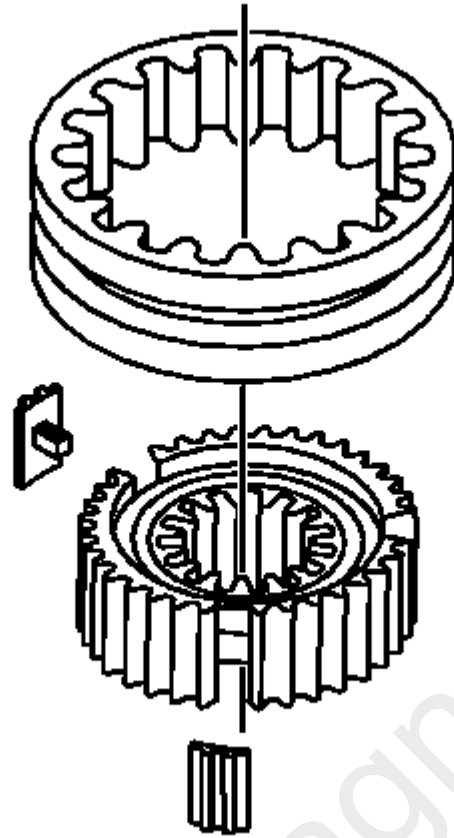


Fig. 124: Identifying Synchronizer Inserts
Courtesy of GENERAL MOTORS COMPANY

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

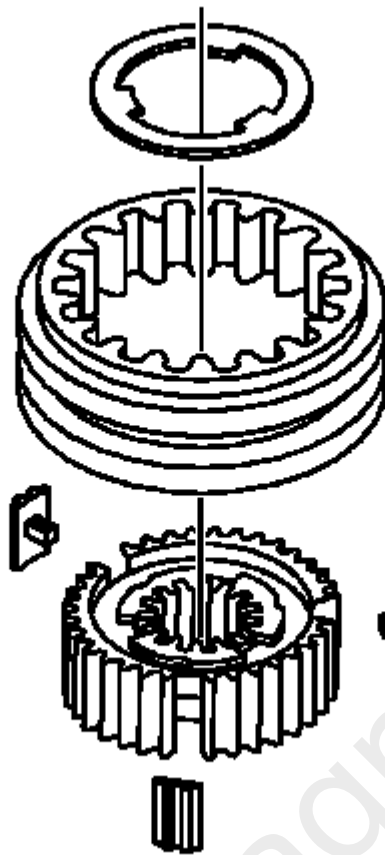


Fig. 125: View Of New Synchronizer Insert Retainer & Key Retainer Tangs
Courtesy of GENERAL MOTORS COMPANY

4. Install a new synchronizer insert retainer with the key retainer tangs over the synchronizer inserts.

SHIFT SHAFT AND FORK ASSEMBLIES DISASSEMBLE

Special Tools

- J 23907 Slide Hammer
- J 39439-2 Bushing Remover

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

1st/2nd, 3rd/4th Shift Rail Assembly

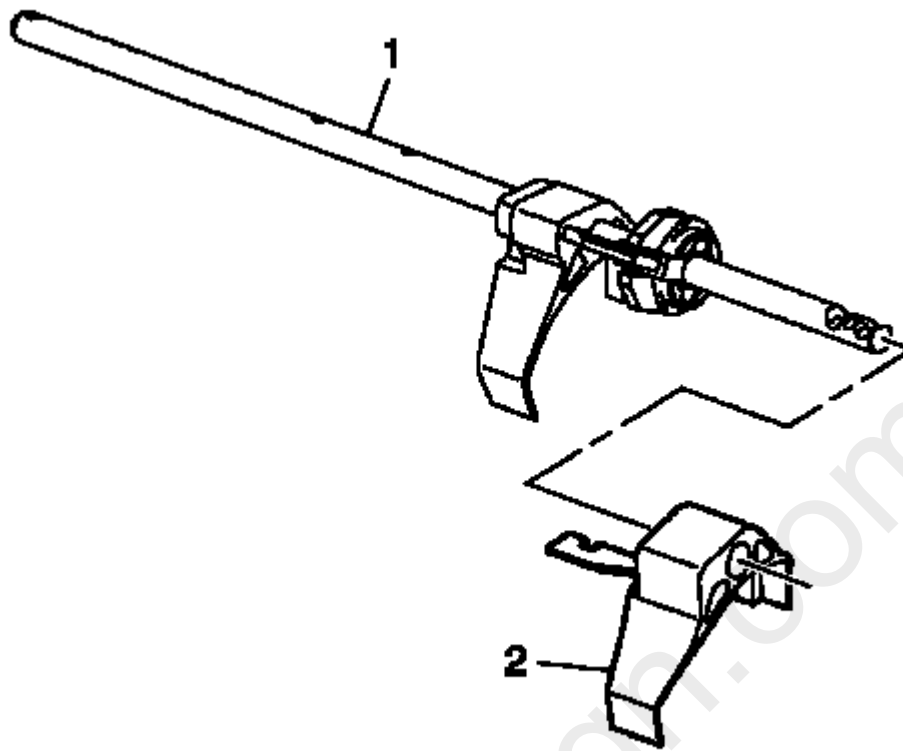


Fig. 126: Identifying 1st/2nd Shift Fork & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Remove the 1st/2nd shift fork (2) from the shift shaft (1).

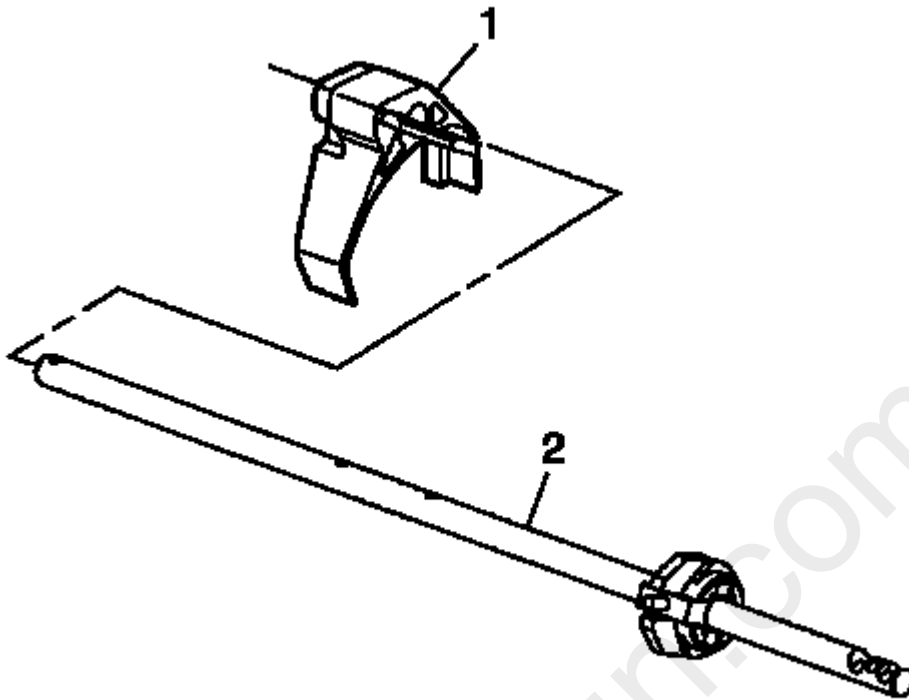


Fig. 127: Identifying 3rd/4th Shift Fork & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 3rd/4th shift fork (1) from the shift shaft (2).

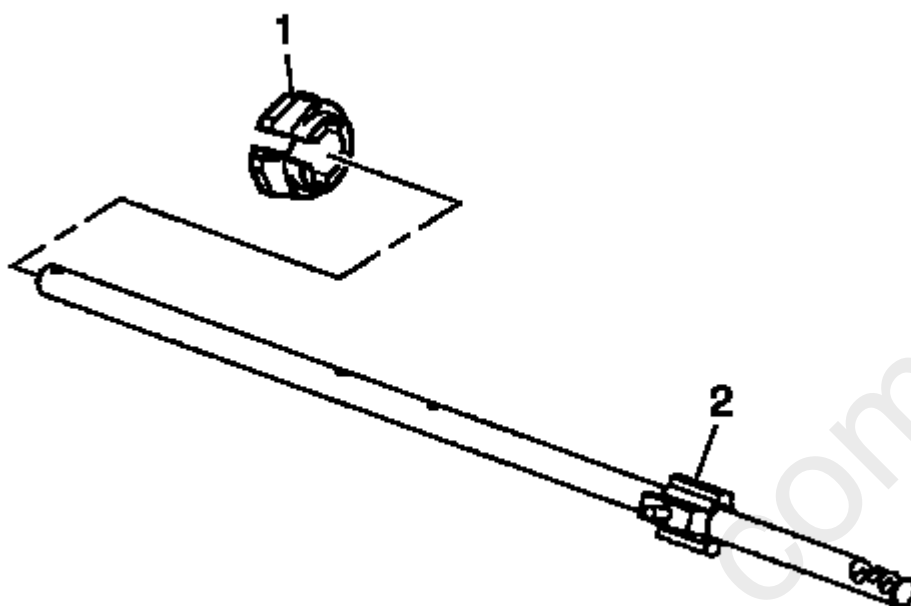


Fig. 128: Identifying Interlock Plate & Selector Pin
Courtesy of GENERAL MOTORS COMPANY

3. Remove the interlock plate (1) from the selector pin (2).

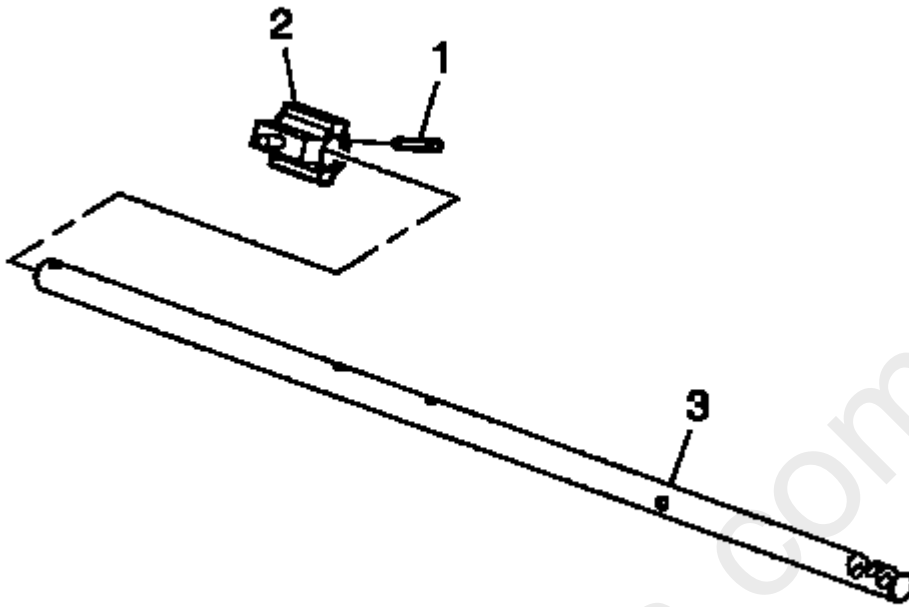


Fig. 129: Identifying Selector Roll Pin, Selector Pin & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

4. Remove the selector roll pin (1).
5. Remove the selector pin (2) from the shift shaft (3).

5th/6th, Reverse Shift Rail Assembly

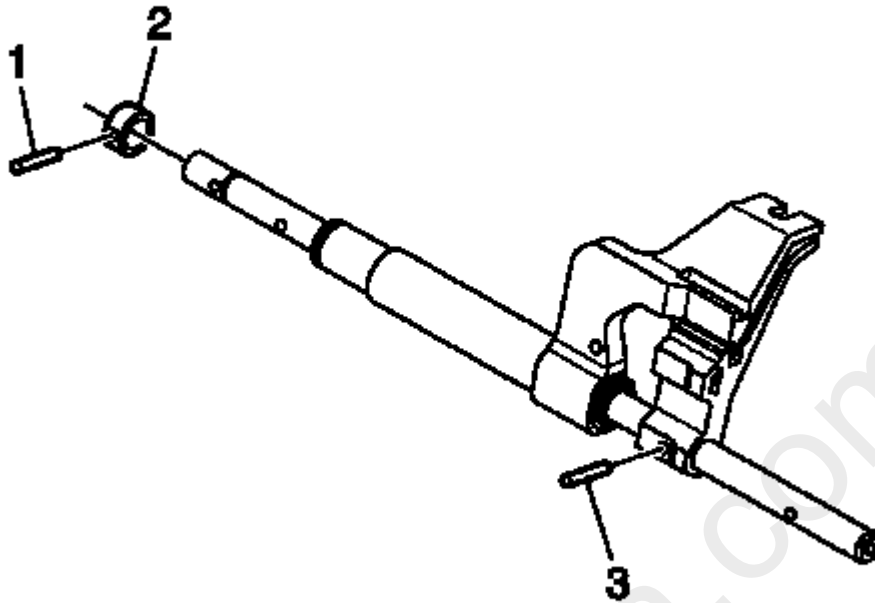


Fig. 130: View Of Reverse Lever Roll Pin
Courtesy of GENERAL MOTORS COMPANY

1. Remove the reverse shift collar pin (1).
2. Remove the reverse shift lever collar (2).
3. Remove the reverse shift lever pin (3).

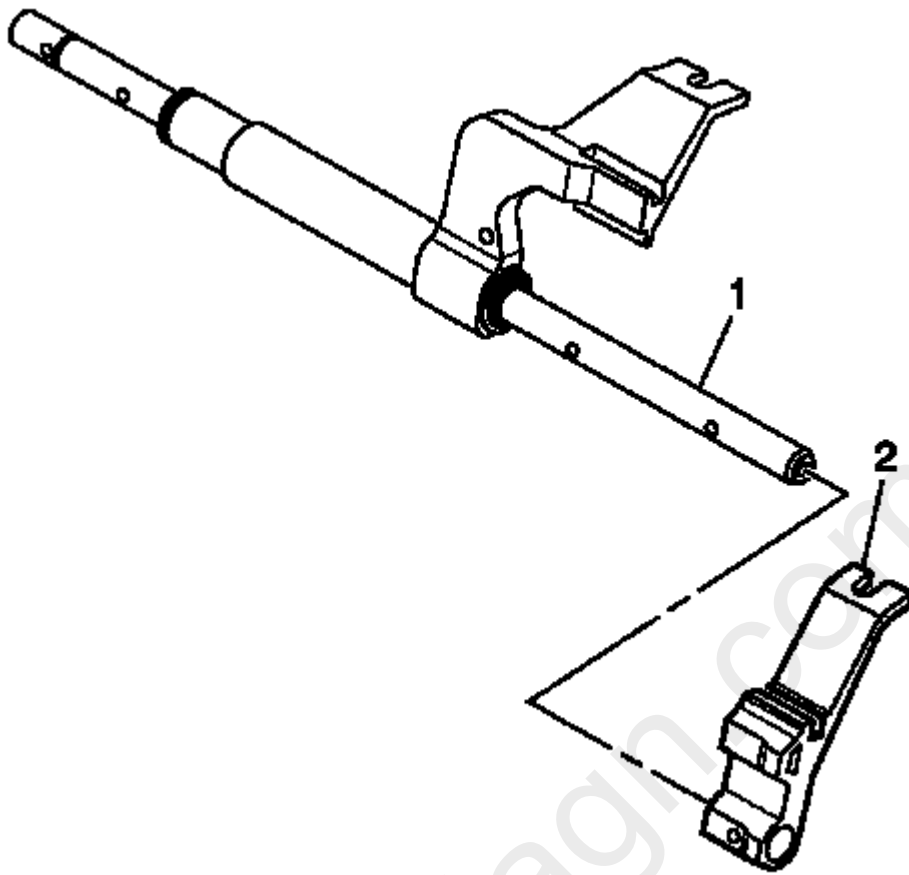


Fig. 131: View Of Reverse Shift Lever On The Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

4. Remove the reverse shift lever (2) from the shift shaft (1).

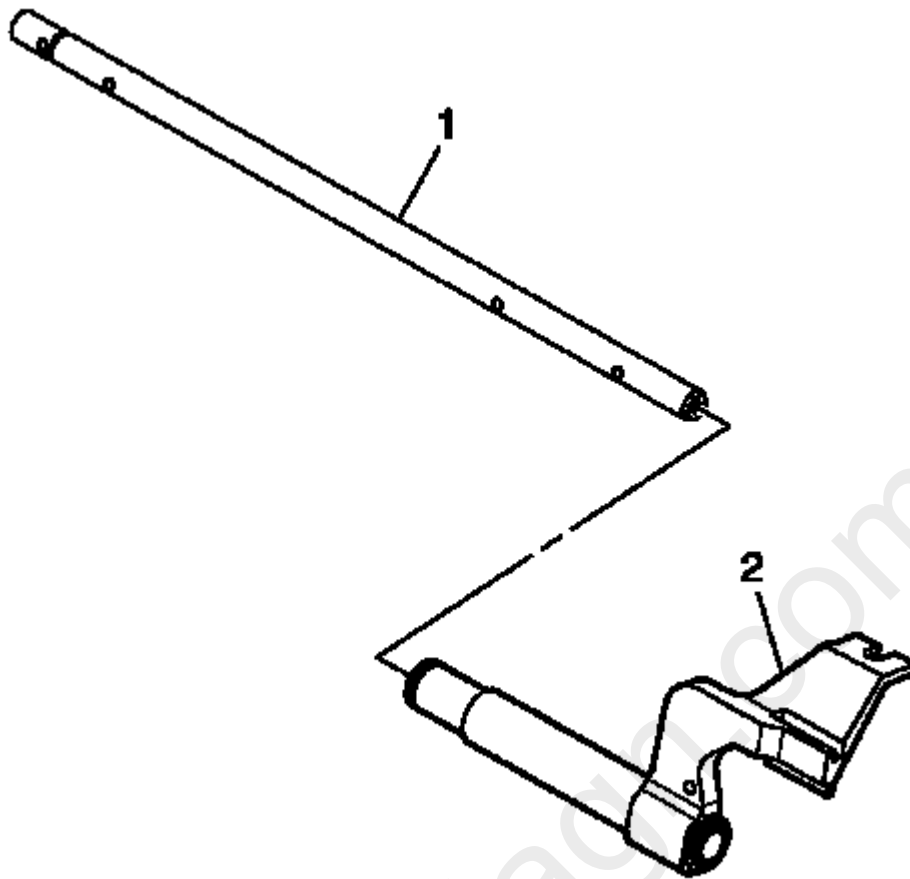


Fig. 132: View Of 5th/6th Shift Lever & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 5th/6th shift lever (2) from the shift shaft (1).

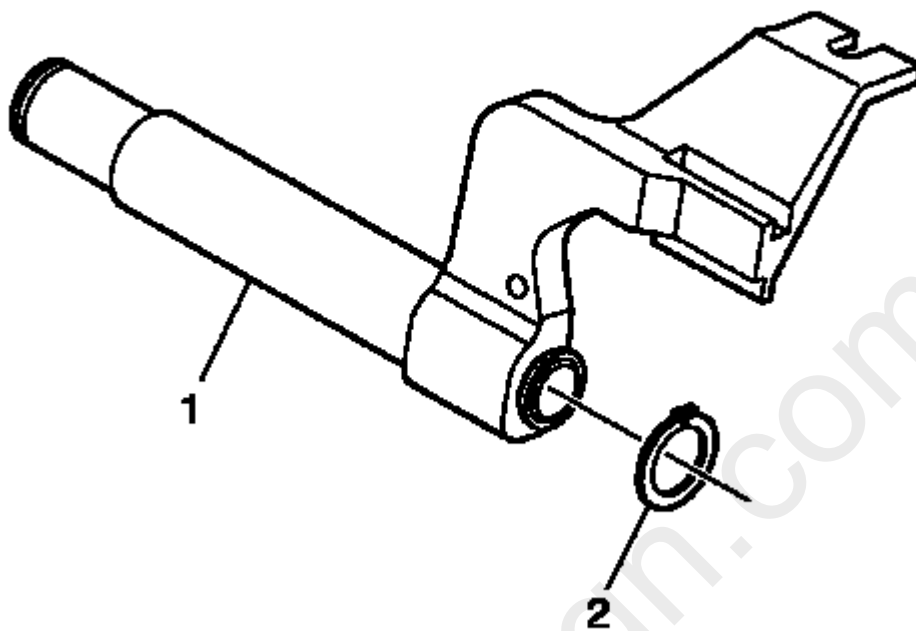


Fig. 133: View Of Retainer Ring & 5th/6th Shift Lever
Courtesy of GENERAL MOTORS COMPANY

6. Remove the snap ring (2) from the 5th/6th shift lever (1).

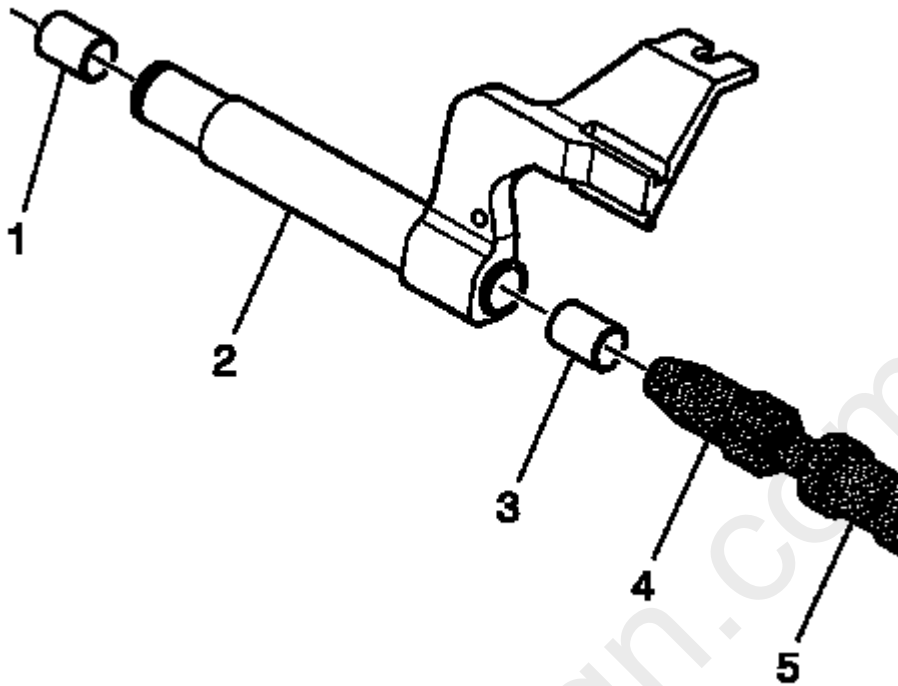


Fig. 134: View Of 5th/6th Shift Shaft Lever Bushings Slide Hammer & Remover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not replace the bushings unless inspection shows bushing damage.

7. Remove the shift shaft bushings (1, 3) from the 5th/6th and reverse shift lever (2) using the J 23907 slide hammer (5) and the J 39439-2 remover (4).

SHIFT SHAFT AND FORK ASSEMBLIES CLEANING AND INSPECTION

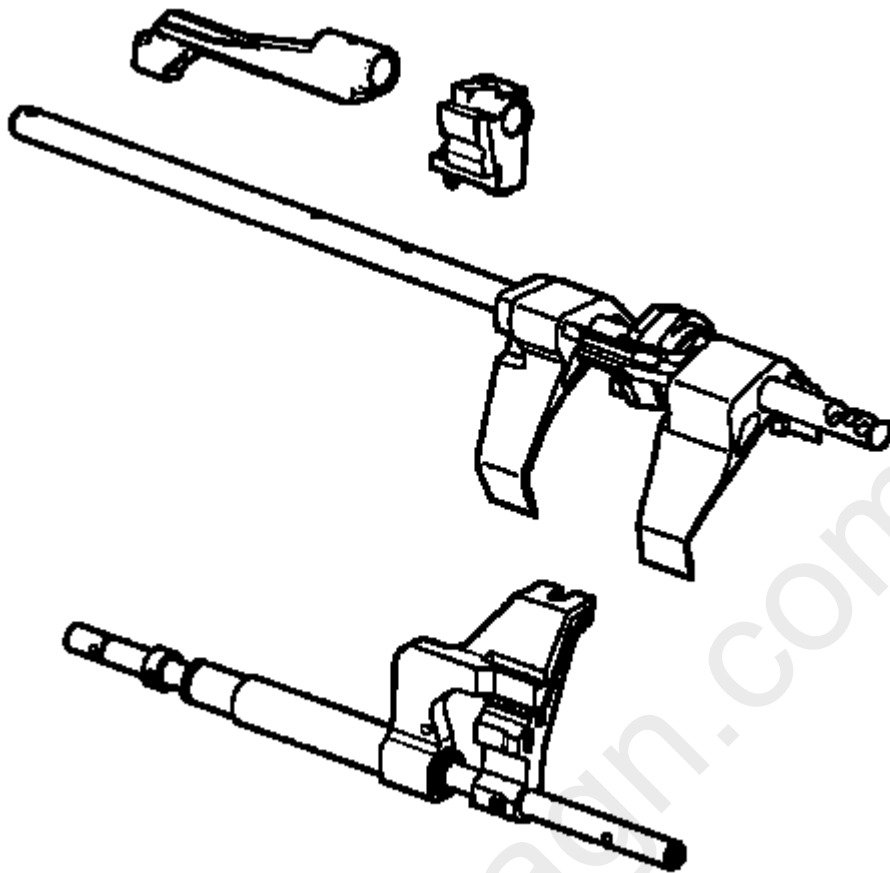


Fig. 135: View Of Shift Shaft & Fork Assembly Parts
Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses to avoid injury when using compressed air or any cleaning solvent. Bodily injury may occur if fumes are inhaled or if skin is exposed to chemicals.

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

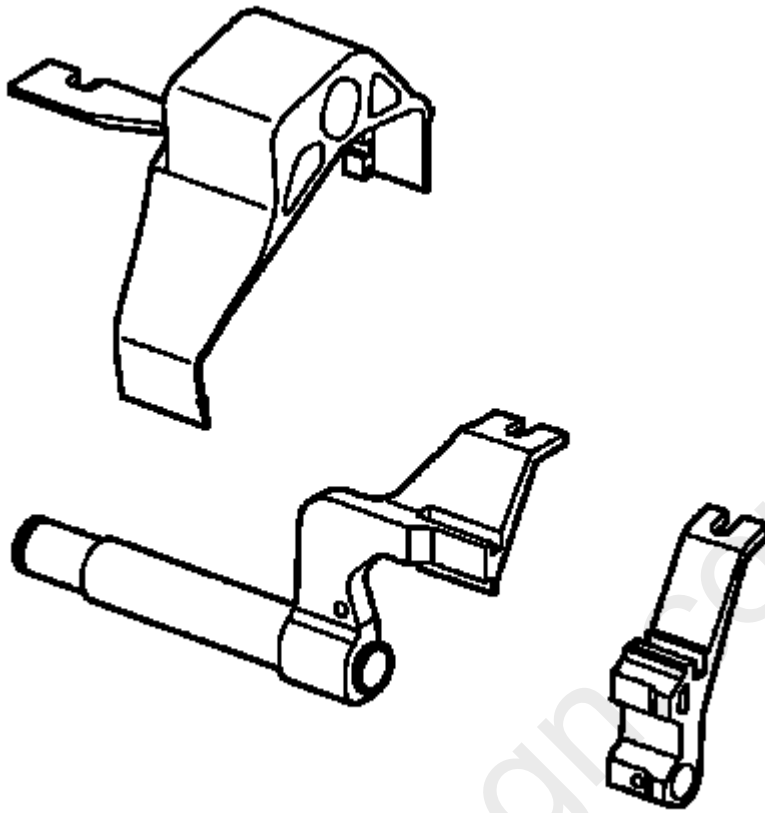


Fig. 136: View Of Shift Forks And Shift Links
Courtesy of GENERAL MOTORS COMPANY

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

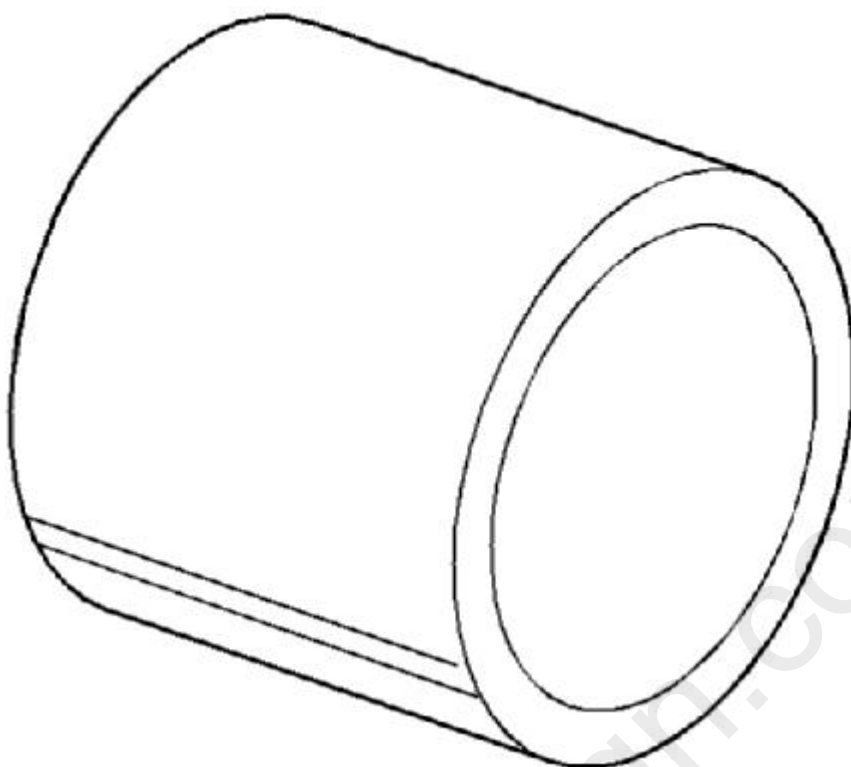


Fig. 137: View Of Shift Shaft Lever Bushing
Courtesy of GENERAL MOTORS COMPANY

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

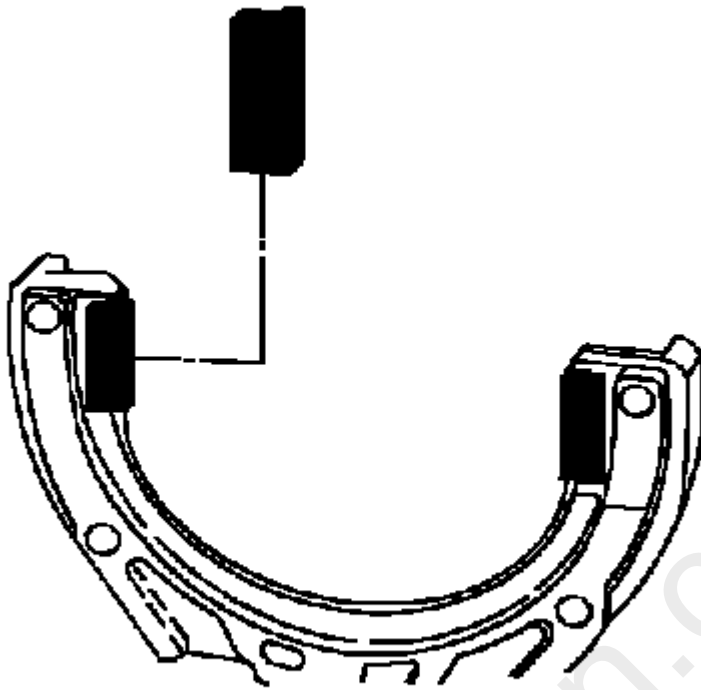


Fig. 138: Identifying Inspection Areas On Shift Fork Nylon Inserts
Courtesy of GENERAL MOTORS COMPANY

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

Special Tools

- **J 36850** Transjel Lubricant
- **J 39437** Bushing Installer

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

1st/2nd, 3rd/4th Shift Rail Assembly

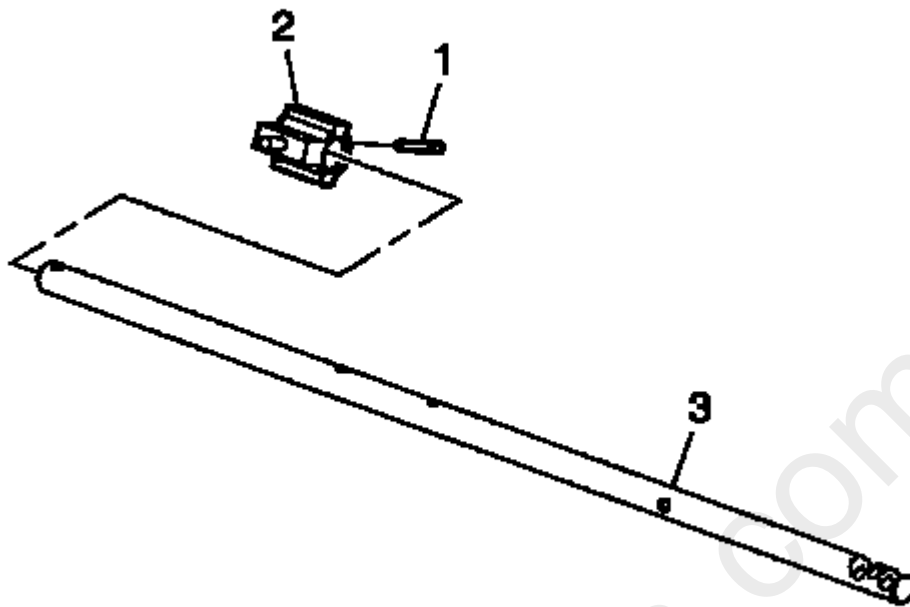


Fig. 139: Identifying Selector Roll Pin, Selector Pin & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Install the selector pin (2) on the shift shaft (3).
2. Align the roll pin hole on the selector pin with the roll pin hole on the shift shaft.
3. Install the roll pin (1) through the selector pin (2) and the shift shaft (3).

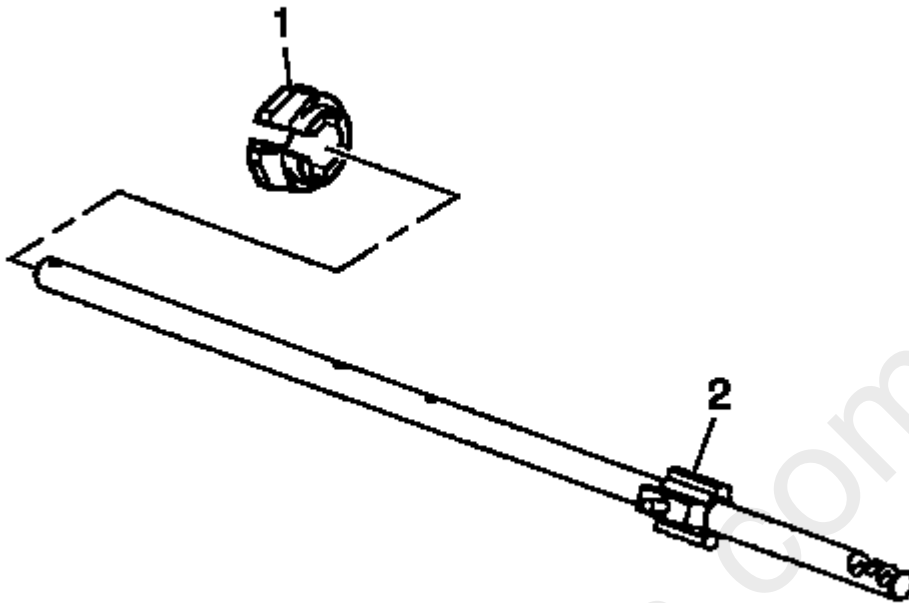


Fig. 140: Identifying Interlock Plate & Selector Pin
Courtesy of GENERAL MOTORS COMPANY

NOTE: The interlock plate fits loosely on the shift shaft and selector pin assembly. Use the J 36850 transjel lubricant to hold the neutral return cam pin in place.

4. Install the interlock plate (1) on the selector pin (2).

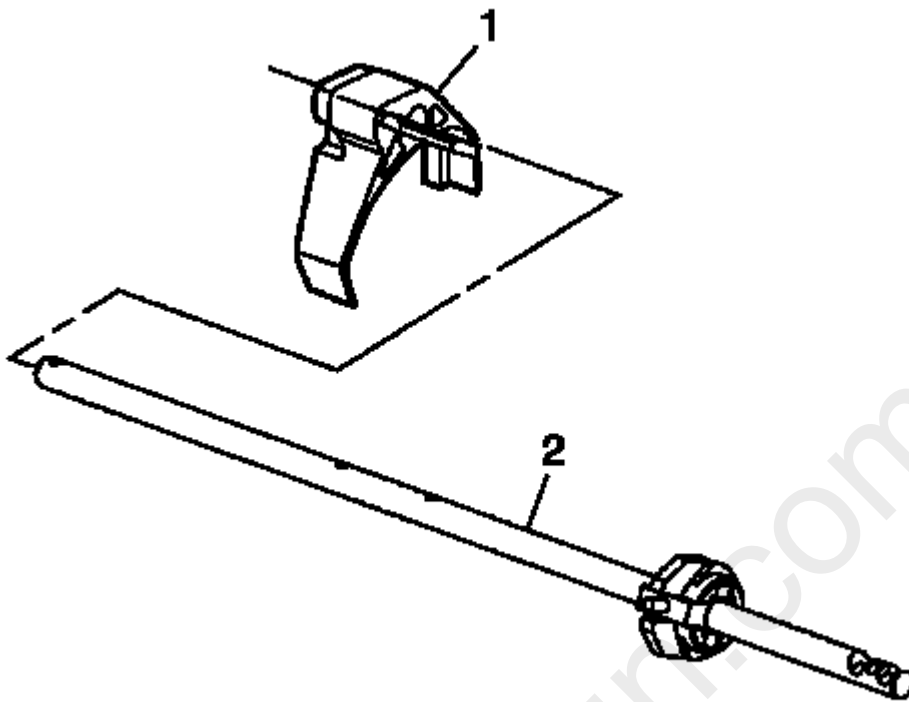


Fig. 141: Identifying 3rd/4th Shift Fork & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

5. Install the 3rd/4th shift fork (1) on the shift shaft (2).

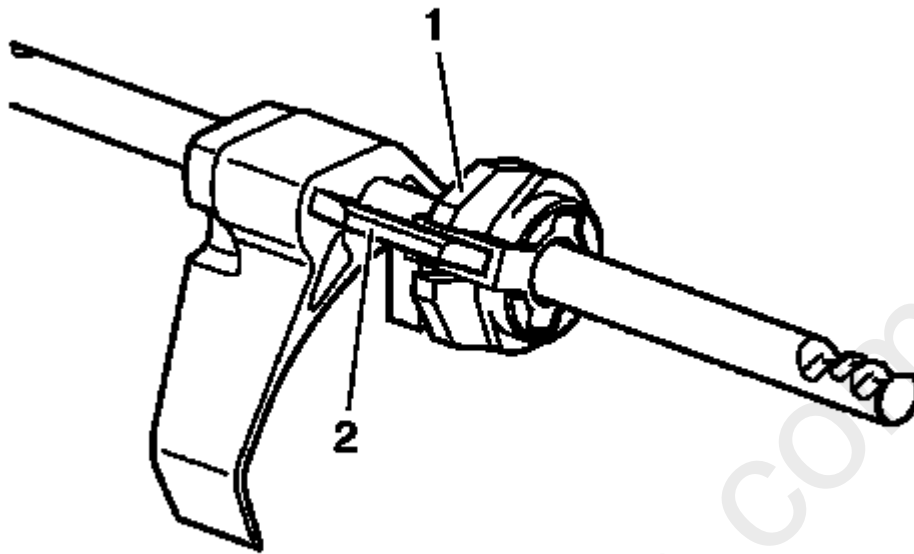


Fig. 142: Aligning Notch On Shift Link With Shift Interlock Plate
Courtesy of GENERAL MOTORS COMPANY

6. Align the notch on the shift link (2) with the shift interlock plate (1).

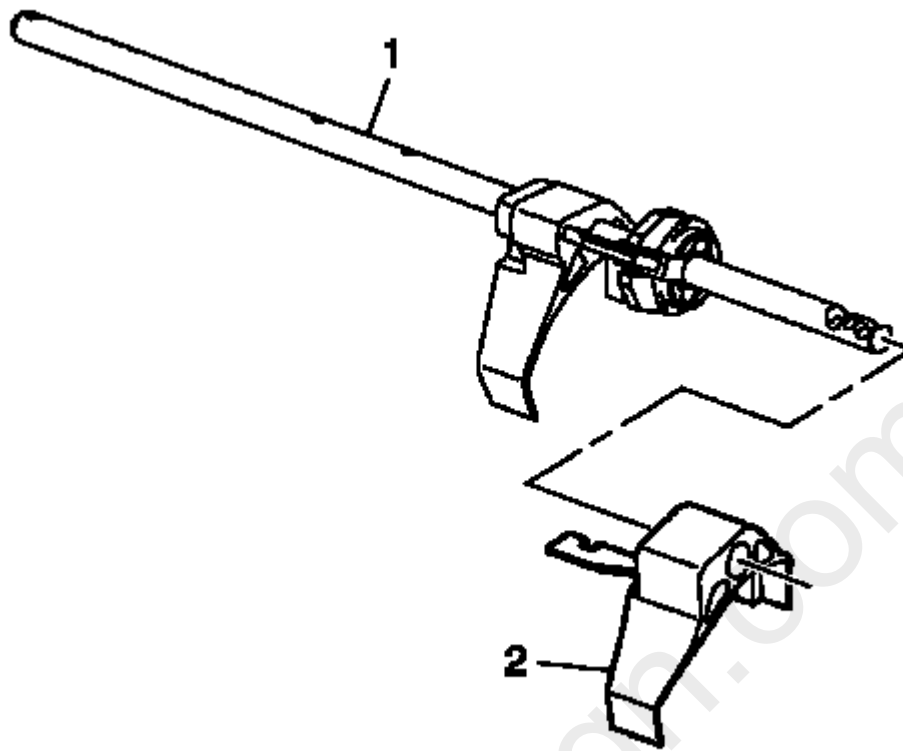


Fig. 143: Identifying 1st/2nd Shift Fork & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

7. Install the 1st/2nd shift fork (2) on the shift shaft (1).

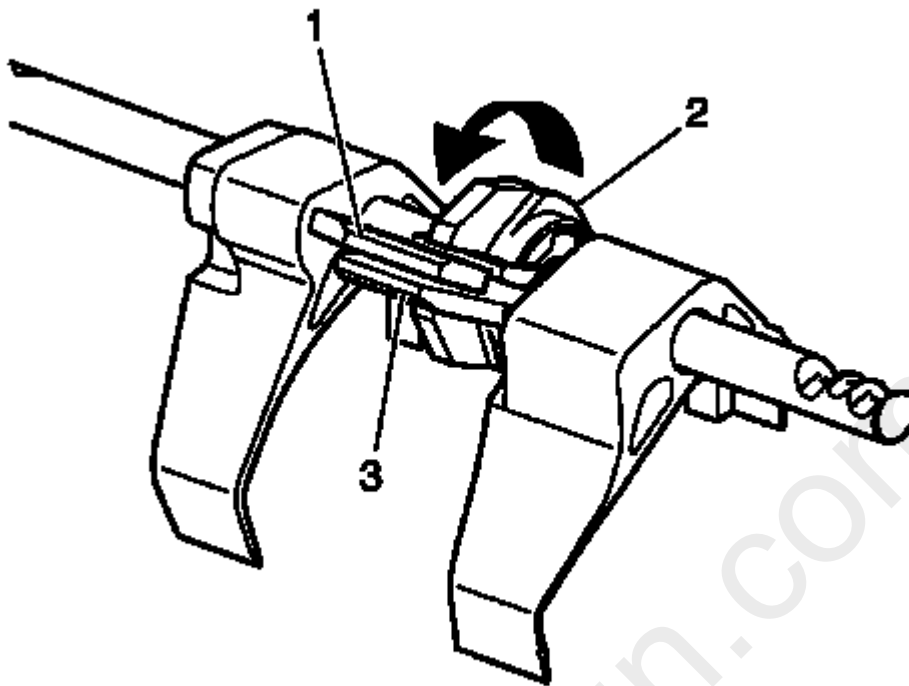


Fig. 144: Installing 1st/2nd Shift Shaft Link
Courtesy of GENERAL MOTORS COMPANY

8. Install the 1st/2nd shift shaft link (3) beneath the 3rd/4th shift shaft link (1) on the interlock plate and the selector roll pin assembly (2).

5th/6th, Reverse Shift Rail Assembly

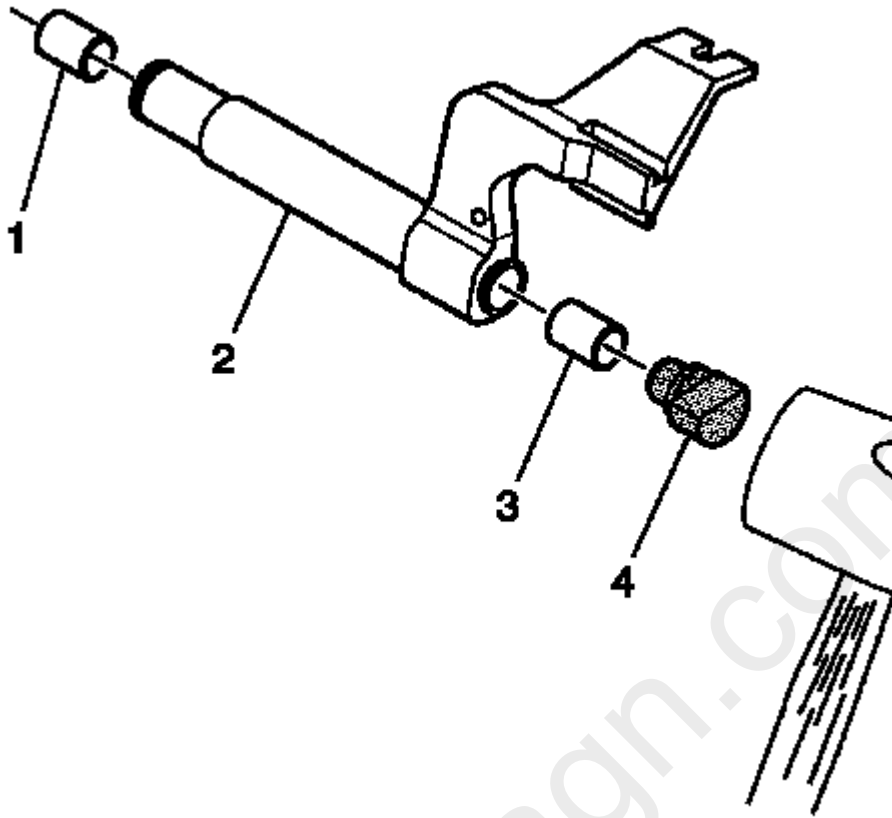


Fig. 145: View of 5th/6th Shift Shaft Lever Bushings, Lever & Bushing Installer
Courtesy of GENERAL MOTORS COMPANY

1. Install the 5th/6th shift shaft lever bushings (1) and (3) in the 5th/6th shift lever (2) using the J 39437 bushing installer (4) and a hammer.

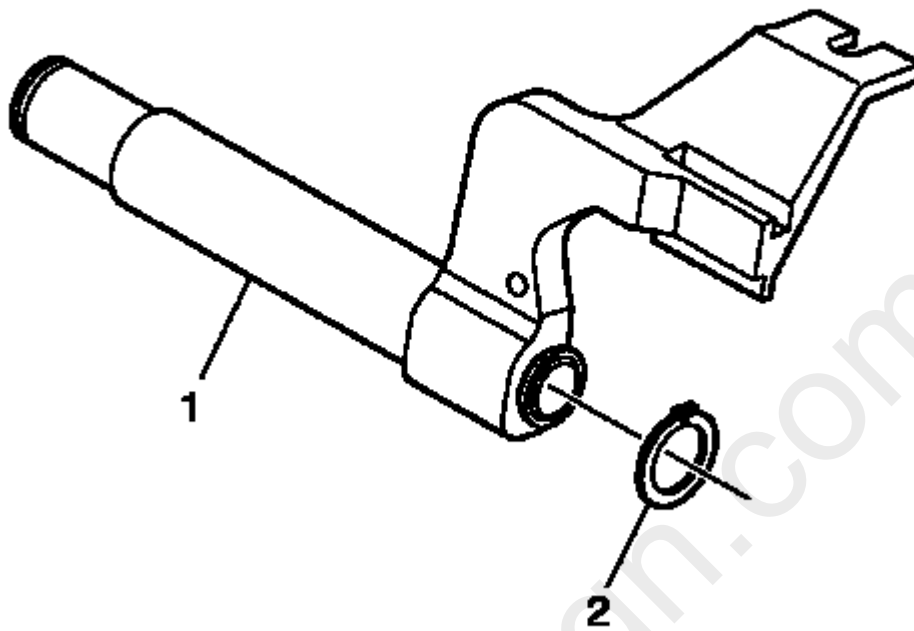


Fig. 146: View Of Retainer Ring & 5th/6th Shift Lever
Courtesy of GENERAL MOTORS COMPANY

2. Install the retainer ring (2) on the 5th/6th shift lever (1).

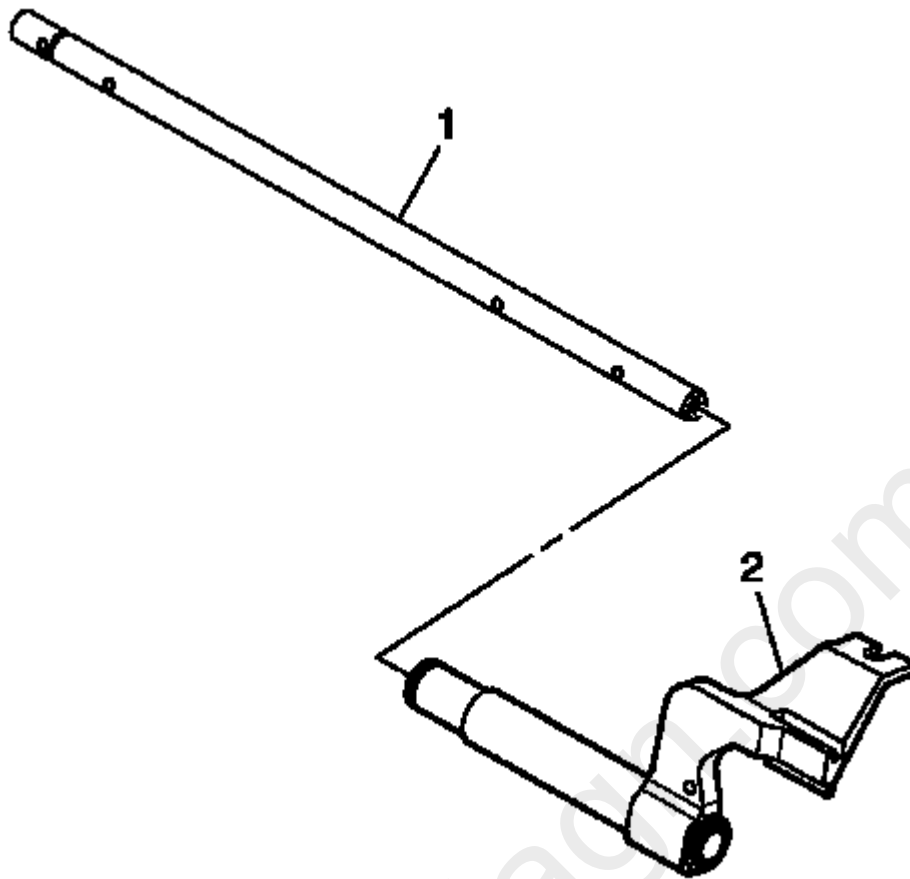


Fig. 147: View Of 5th/6th Shift Lever & Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Install the 5th/6th shift lever (2) on the shift shaft (1).

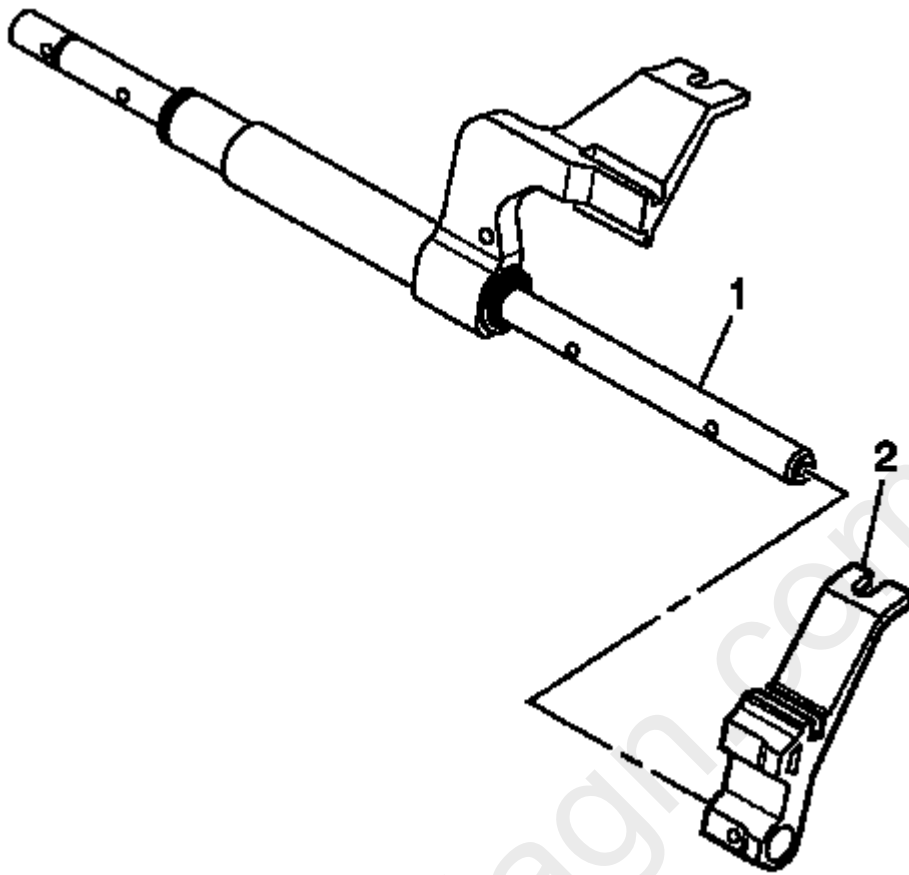


Fig. 148: View Of Reverse Shift Lever On The Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

4. Install the reverse shift lever (2) on the shift shaft (1).

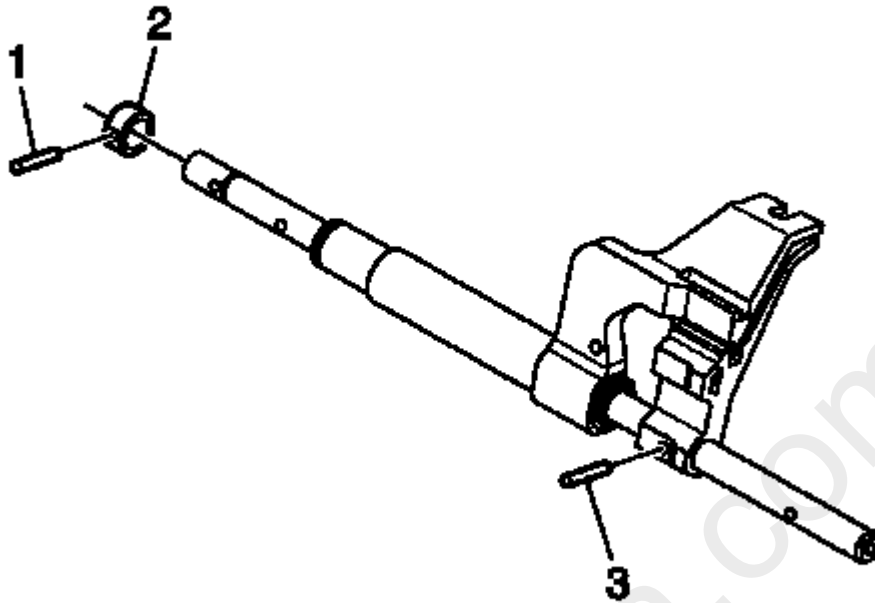


Fig. 149: View Of Reverse Lever Roll Pin
Courtesy of GENERAL MOTORS COMPANY

5. Install the reverse lever roll pin (3).
6. Install the reverse collar (2).
7. Install the reverse collar roll pin (1).

TRANSMISSION CASE AND CLUTCH HOUSING DISASSEMBLE

Special Tools

- DT 49216 Bushing Remover
- J 8092 Drive Handle
- J 36190 Driver Handle
- J 39439-2 Bushing Remover
- J 39790-A Mainshaft Bearing Race Remover
- J 44384 Shift Fork Bearing Installer
- J 45124 Removal Bridge

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

Guide Plate Removal

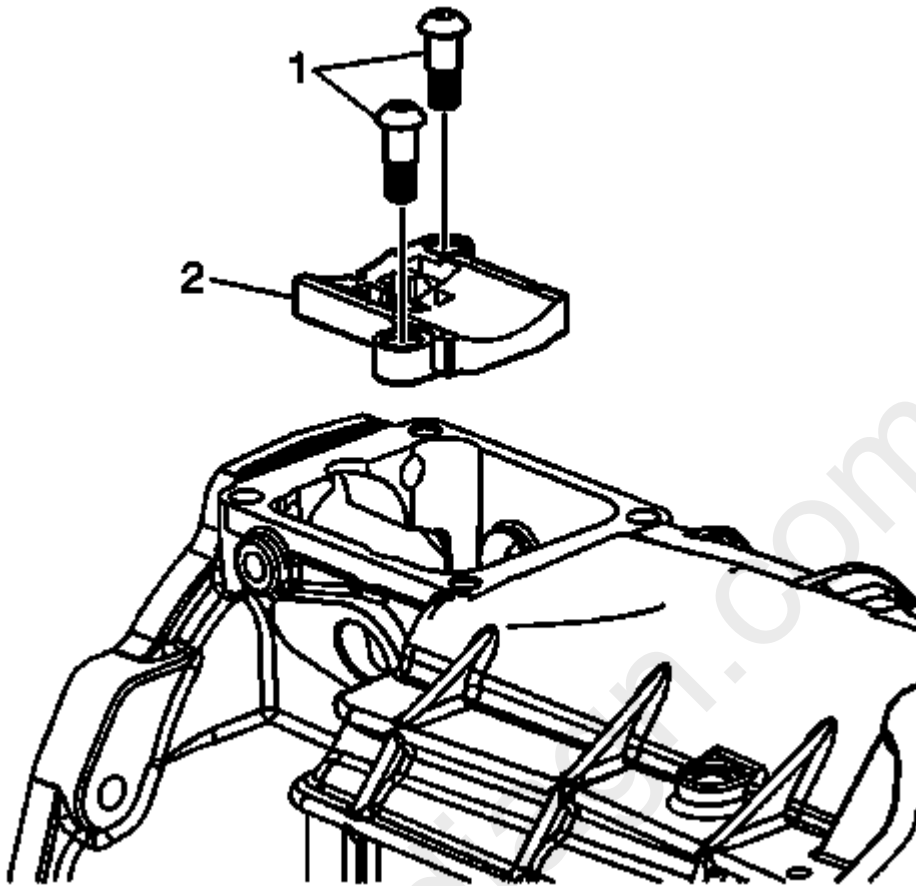


Fig. 150: Identifying Detent Guide Plate & Attaching Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the detent guide plate attaching bolts (1).
2. Remove the detent guide plate (2).

Transmission Case

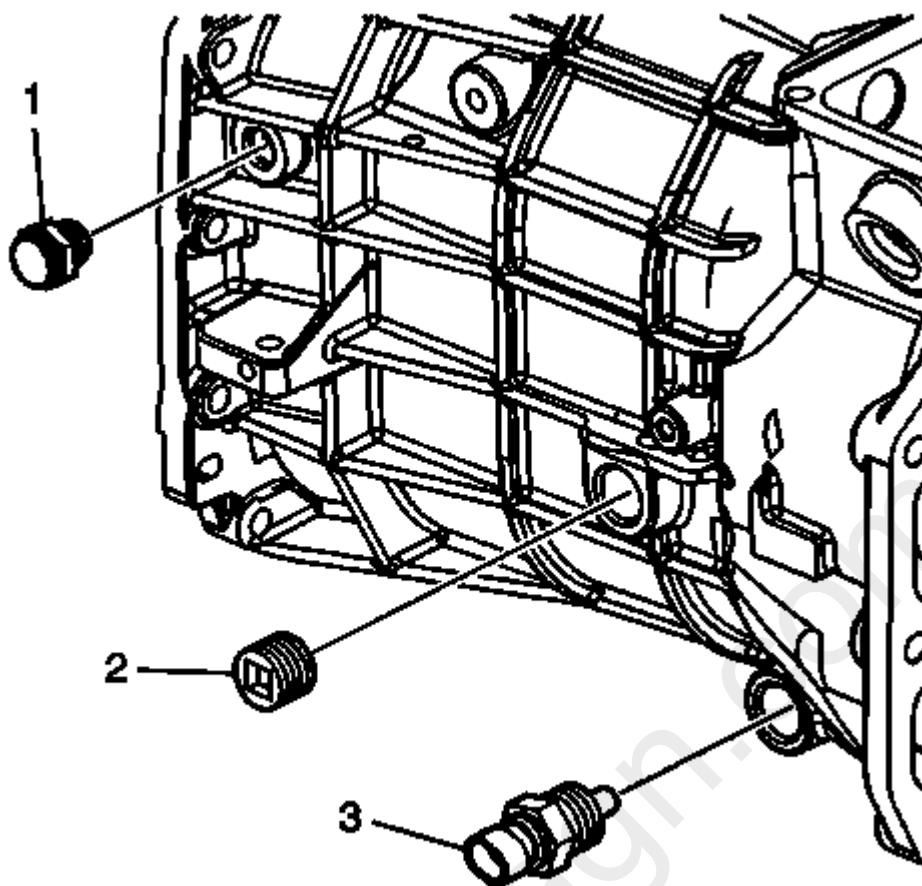


Fig. 151: Identifying Cooler Line Return Fitting, Fill Plug & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

1. Remove the cooler line return fitting (1).
2. Remove the transmission case fill plug (2).
3. Remove the coolant temperature sensor (3).

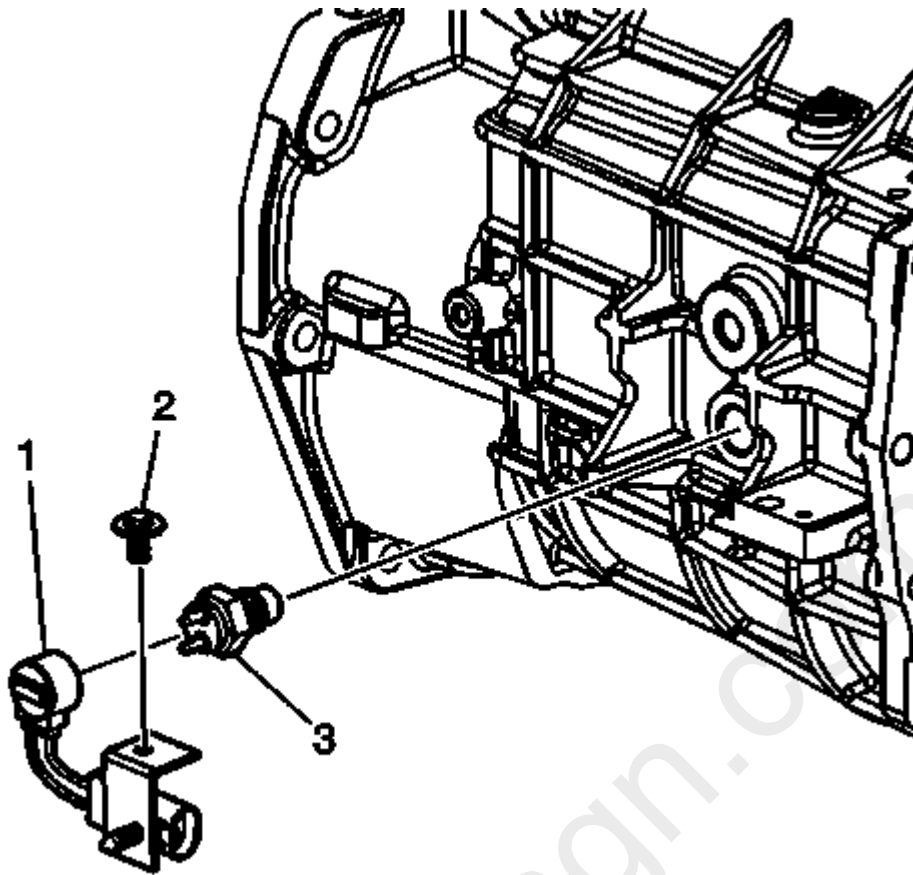


Fig. 152: Identifying Backup Lamp Switch Components
Courtesy of GENERAL MOTORS COMPANY

4. Remove the backup lamp switch connector harness bolt (2).
5. Remove the backup lamp switch connector harness (1).
6. Remove the backup lamp switch (3).

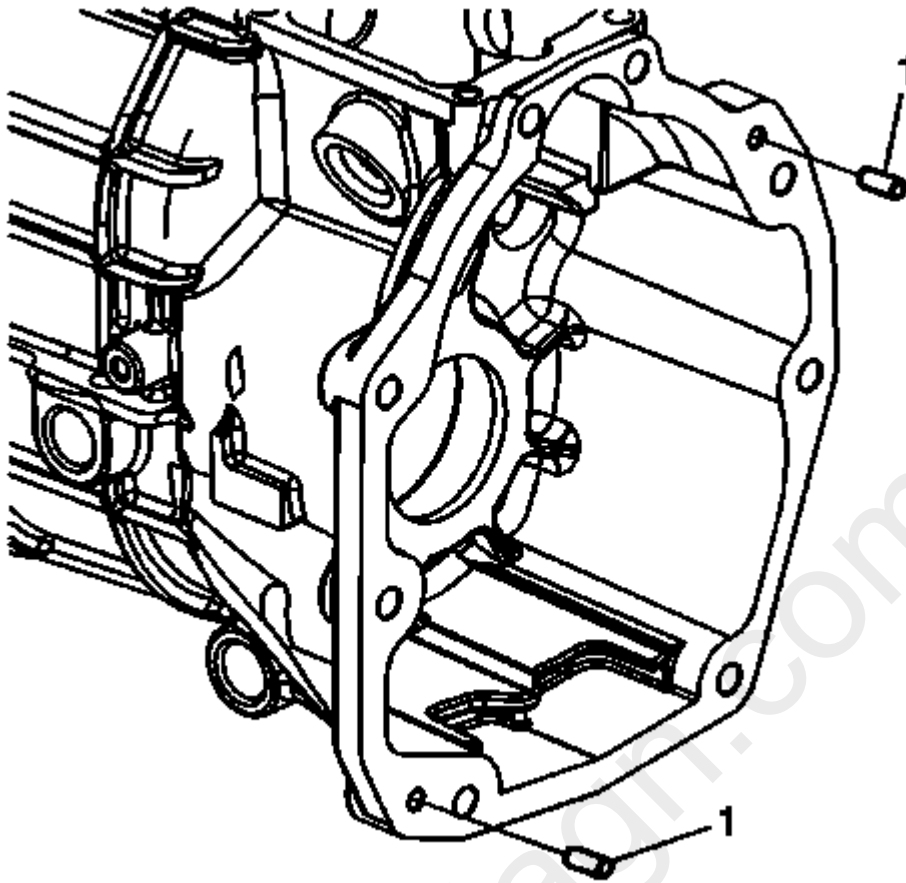


Fig. 153: Locating Dowel Pins

Courtesy of GENERAL MOTORS COMPANY

7. Remove the dowel pins (1).

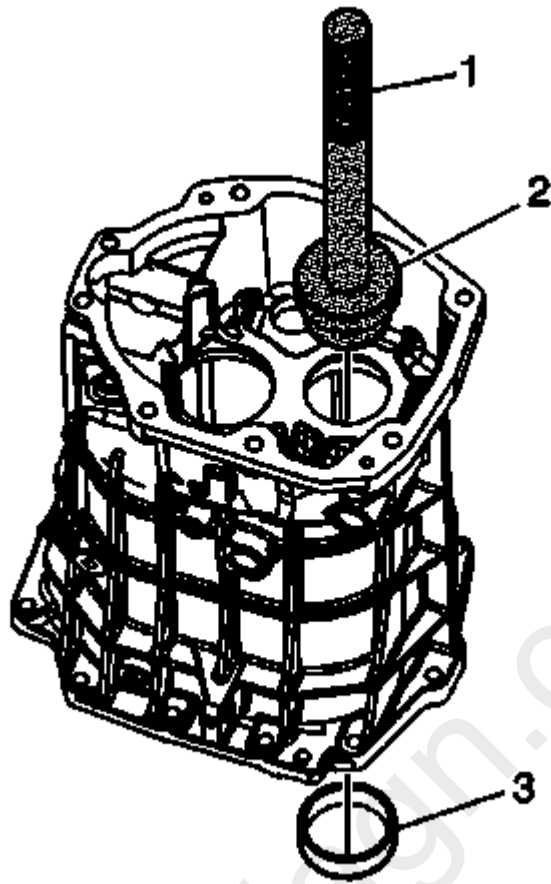


Fig. 154: Removing Countershaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not replace the bearing race unless inspection shows bearing race damage.

8. Remove the countershaft bearing race (3), using the **J 8092** drive handle (1) and the **J 39790-A** race remover (2).

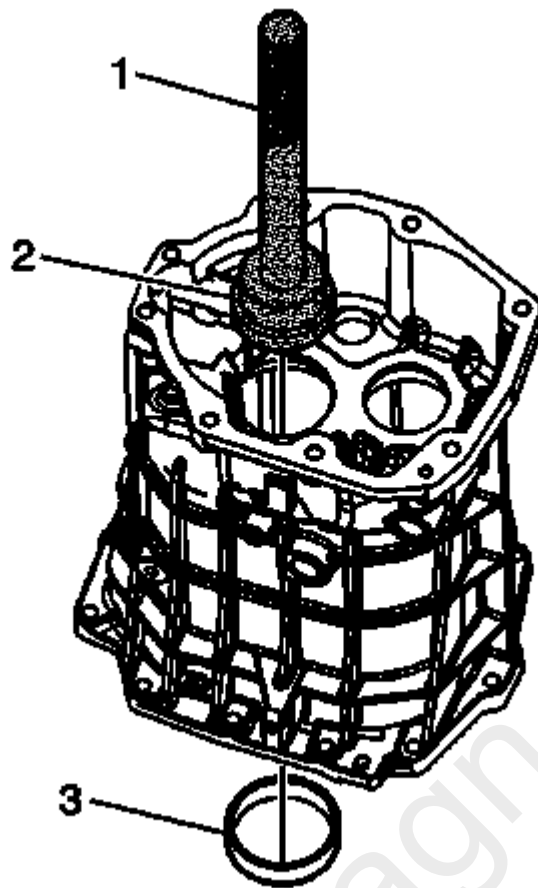


Fig. 155: Removing Mainshaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not replace the bearing race unless inspection shows bearing race damage.

9. Remove the mainshaft bearing race (3), using the **J 8092** drive handle (1) and the **J 39790-A** race remover (2) .

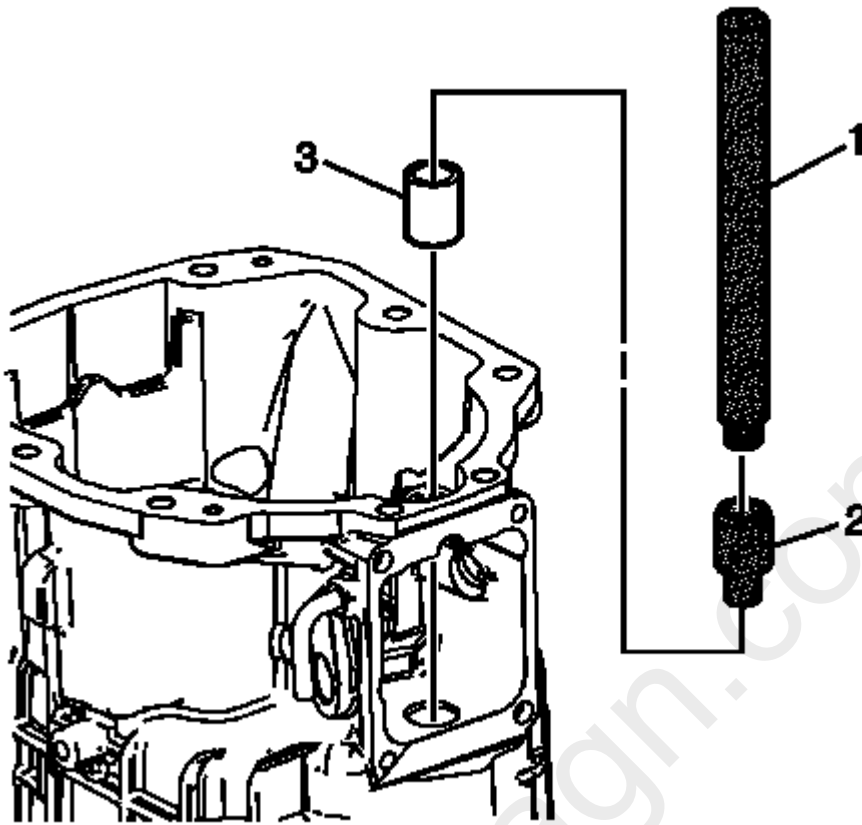


Fig. 156: Removing 1st/2nd & 3rd/4th Shift Shaft Bearing
Courtesy of GENERAL MOTORS COMPANY

10. Remove the 1st/2nd and the 3rd/4th shift shaft bearing (3), using the J 36190 driver handle (1) and the J 44384 remover (2).

Clutch Housing

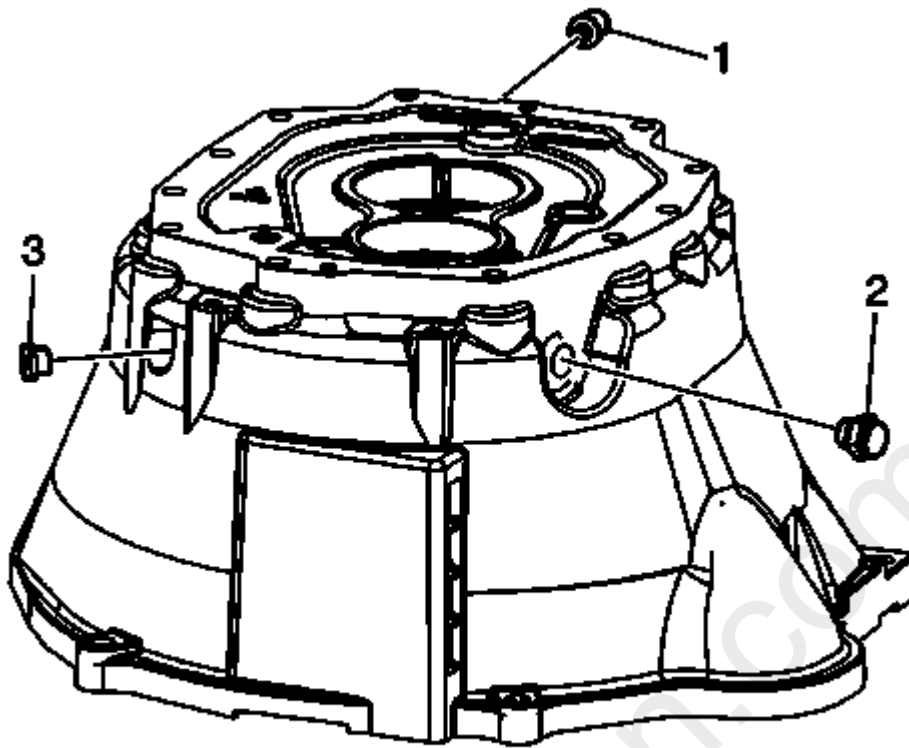


Fig. 157: Identifying Vent Assembly, Pump Outlet Cooler Fitting With O-Ring & Transmission Fluid Pump Outlet Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

1. Remove the vent assembly (1).
2. Remove the pump outlet cooler fitting with o-ring (2).
3. Remove the transmission fluid pump outlet pipe fitting (3).

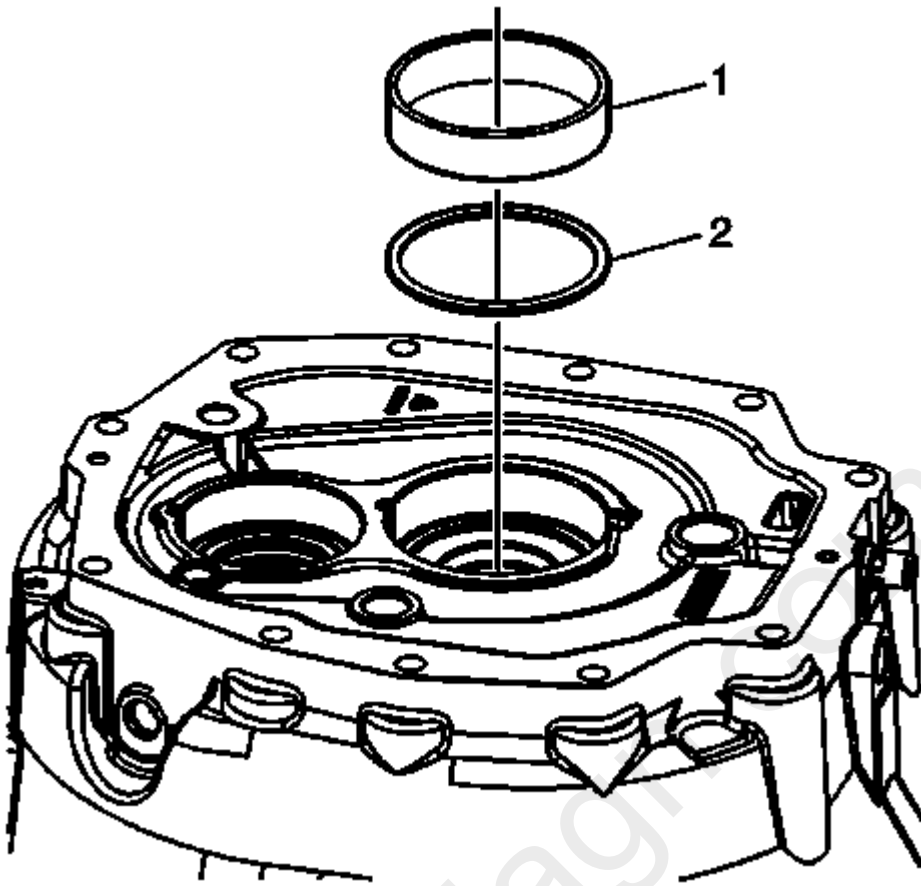


Fig. 158: Identifying Input Shaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

NOTE: There may be one or more shims.

4. Remove the input shaft bearing race (1) and one or more shims (2).

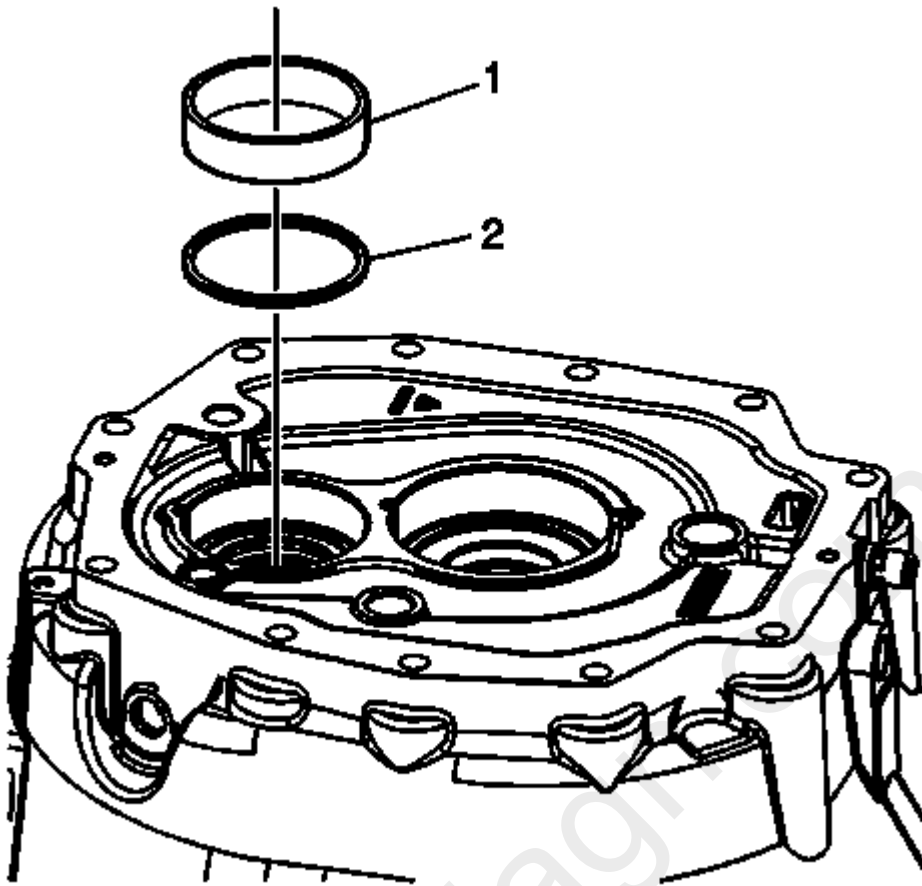


Fig. 159: Identifying Countershaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

5. Remove the countershaft bearing race (1) and one or more the shims (2).

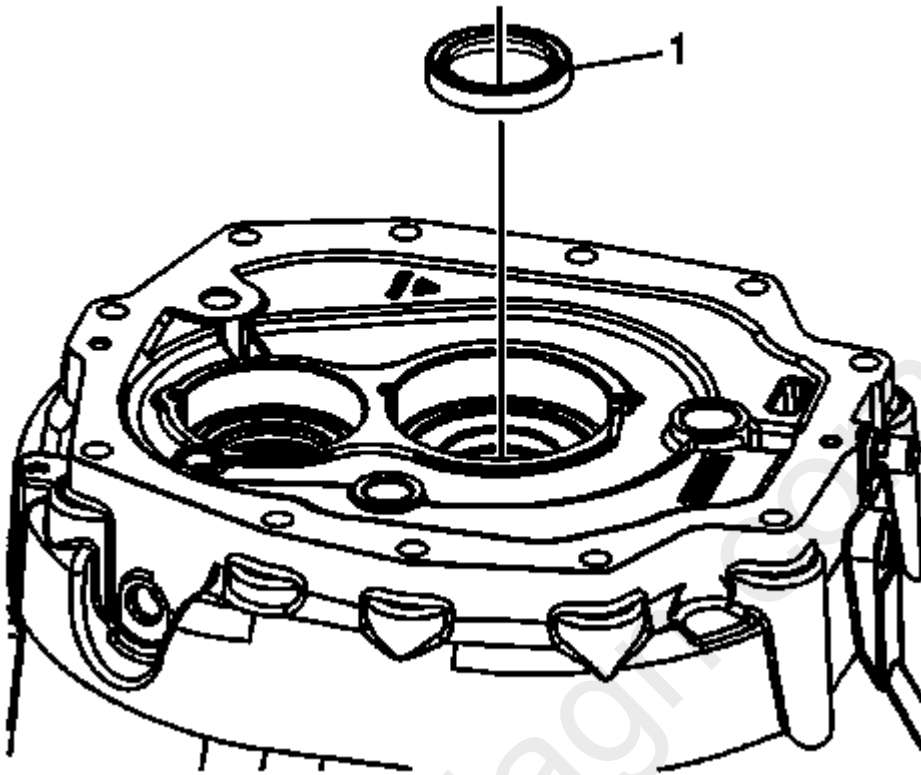


Fig. 160: Identifying Input Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

6. Remove and discard the input shaft seal (1).

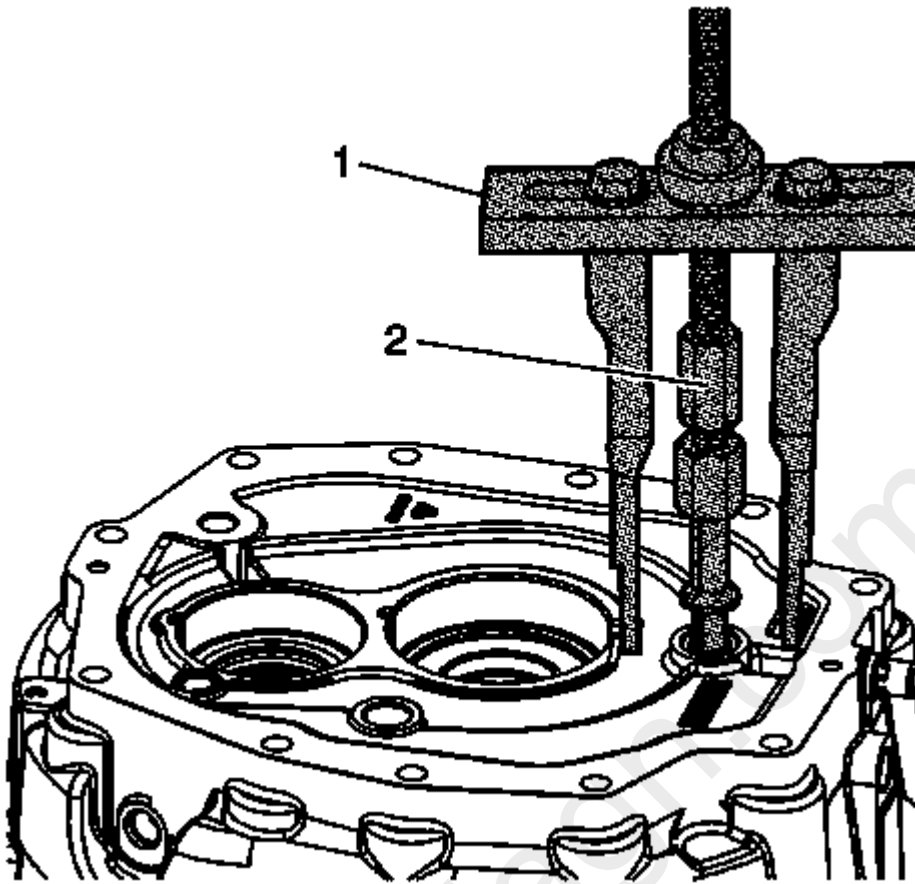


Fig. 161: Removing 1st/2nd Shift Shaft Bearing
Courtesy of GENERAL MOTORS COMPANY

7. Remove the 1st/2nd shift shaft bearing, using the **J 45124** removal bridge (1) with the **DT 49216** bushing remover (2) and a wrench.

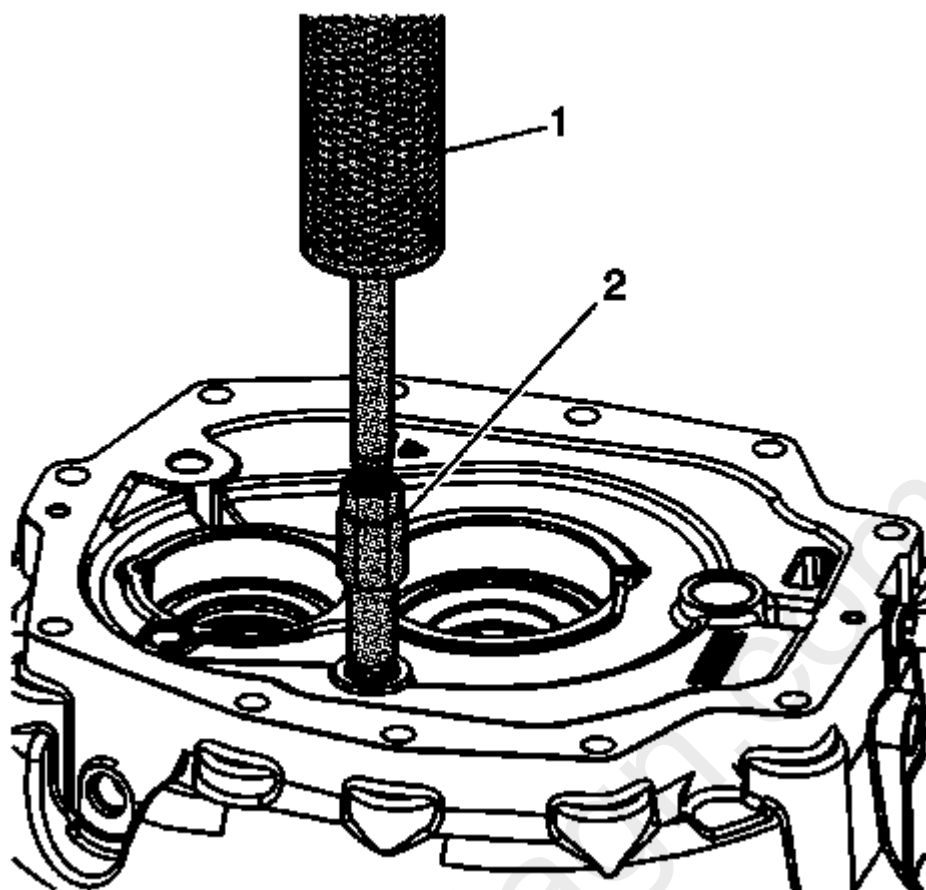


Fig. 162: Removing 3rd/4th Shift Shaft Bushing
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 3rd/4th shift shaft bushing, using the J 23907-1 slide hammer (1) with the J 39439-2 bushing remover (2).

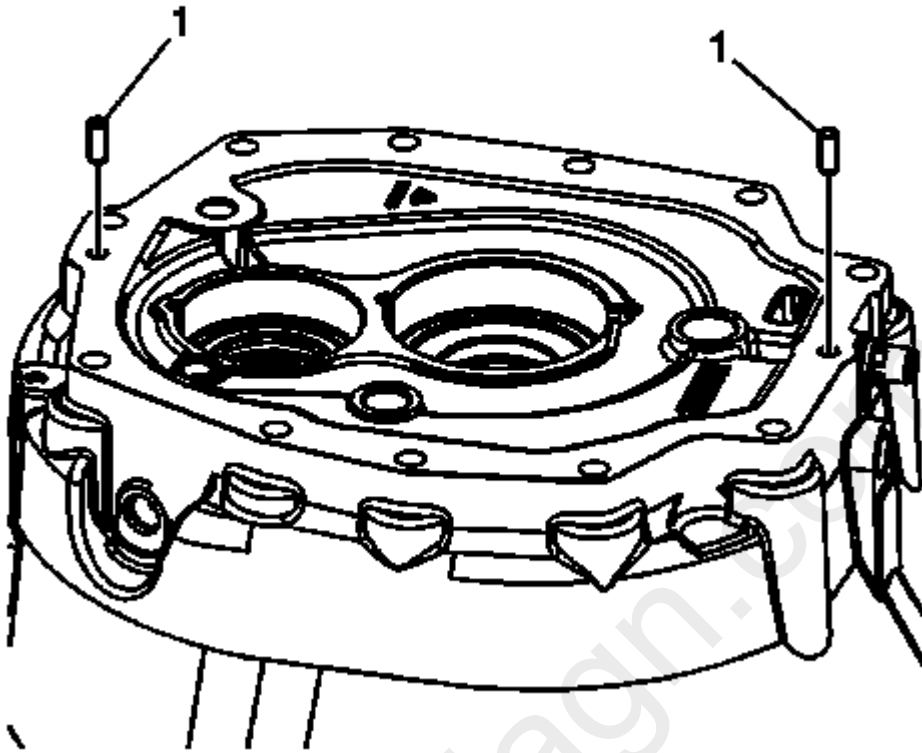


Fig. 163: Identifying Dowel Pins

Courtesy of GENERAL MOTORS COMPANY

9. Remove the dowel pins (1).

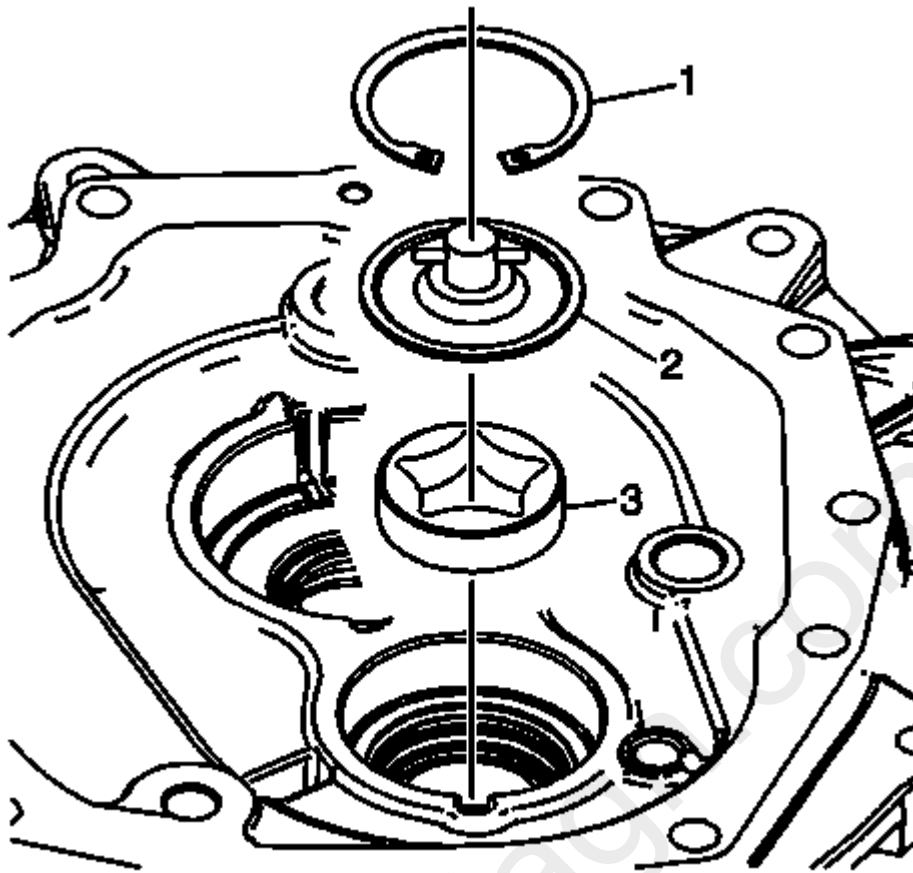


Fig. 164: Identifying Oil Pump & Oil Pump Cover Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Remove the retainer ring (1).
11. Remove the oil pump cover assembly (2).
12. Remove the oil pump (3).

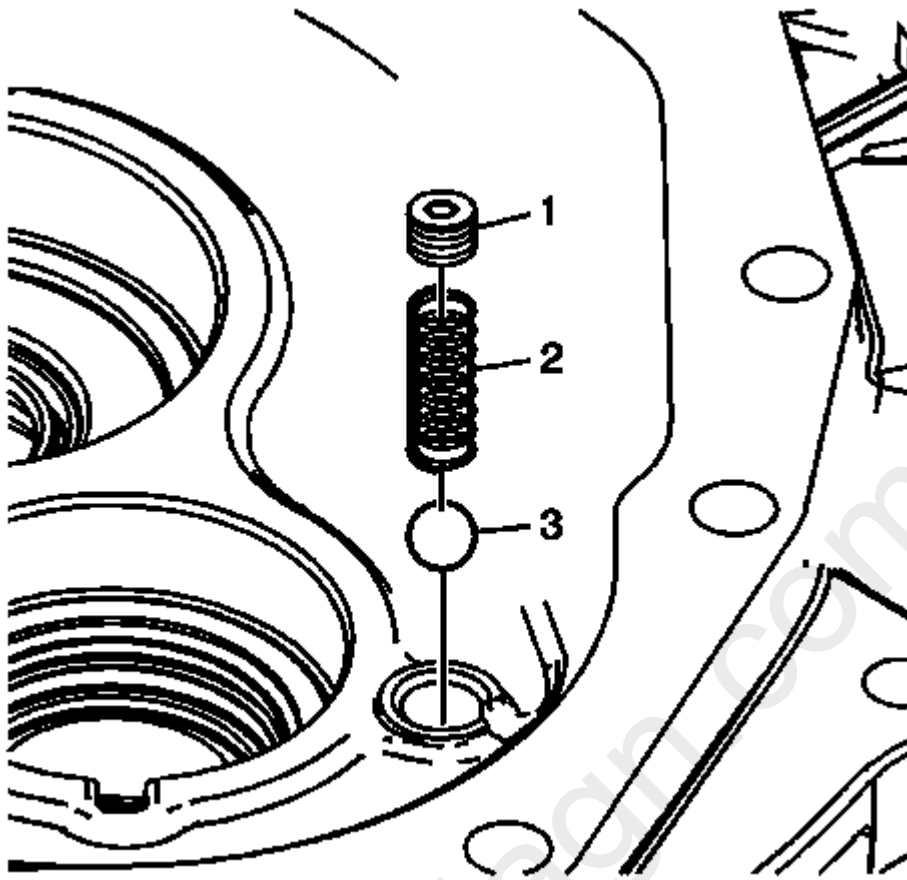


Fig. 165: Identifying Plug & Spring
Courtesy of GENERAL MOTORS COMPANY

13. Remove the transmission fluid pump spring retaining plug (1).
14. Remove the transmission fluid pump spring (2).
15. Remove the transmission fluid pump check ball (3).

TRANSMISSION CASE AND CLUTCH HOUSING CLEANING AND INSPECTION

Transmission Case

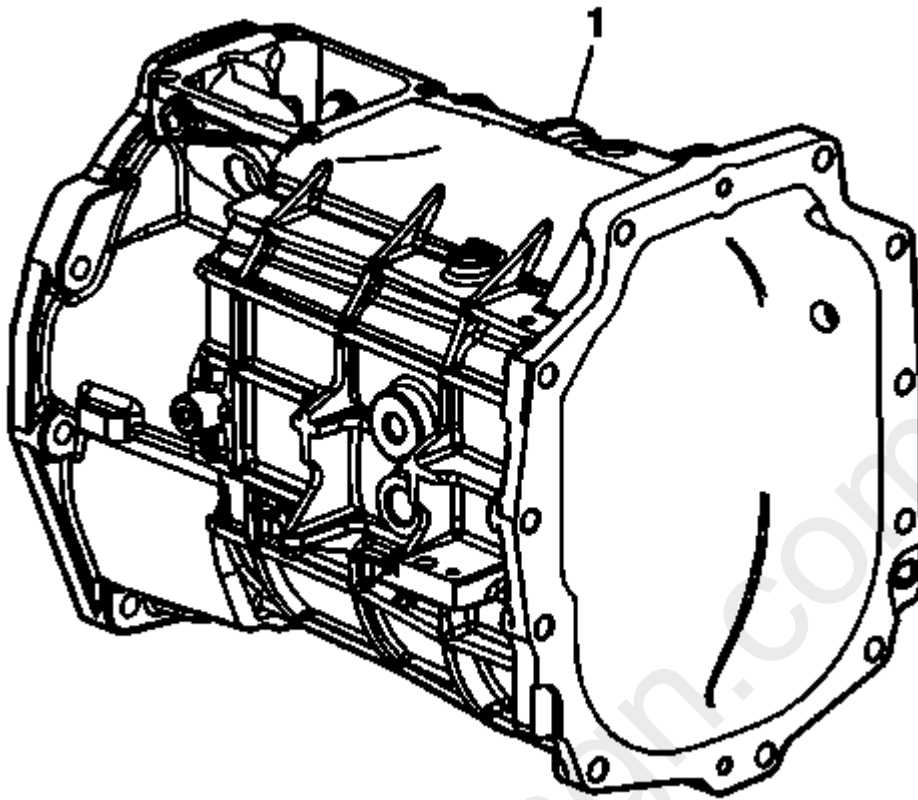


Fig. 166: Identifying Transmission Case
Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses to avoid injury when using compressed air or any cleaning solvent. Bodily injury may occur if fumes are inhaled or if skin is exposed to chemicals.

1. Clean the transmission case (1) 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.

Clutch Housing Assembly

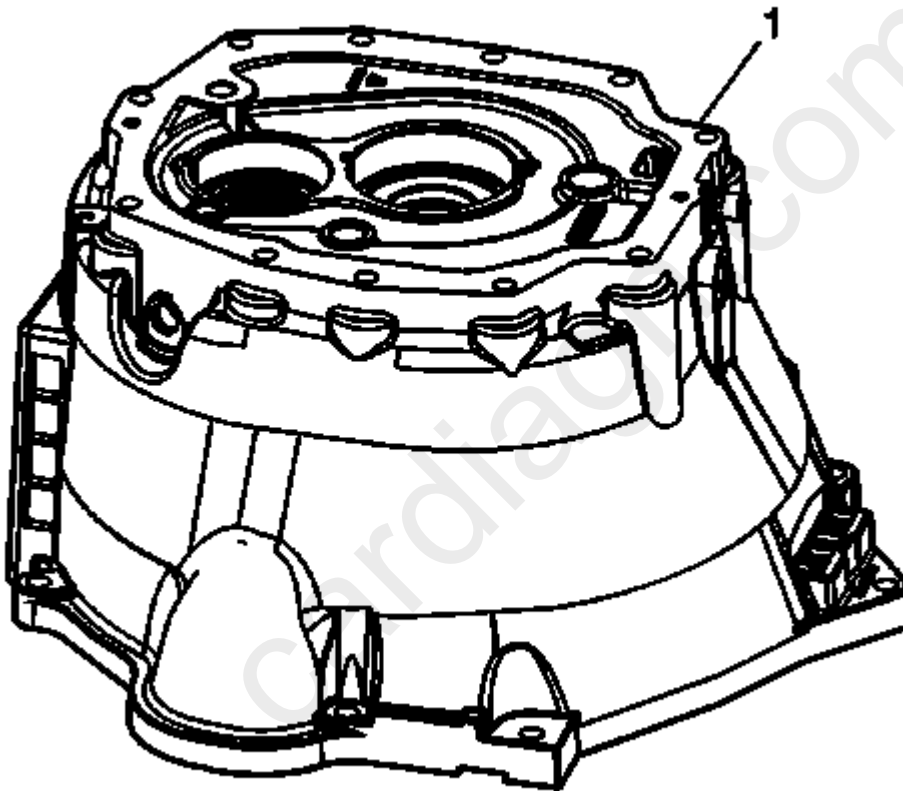


Fig. 167: Identifying Clutch Housing Assembly
Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses to avoid injury when using compressed air or any cleaning solvent. Bodily injury may occur if fumes are inhaled or if skin is exposed to chemicals.

1. Clean the clutch housing (1) parts with a suitable solvent. Air dry all the parts.
2. Inspect the clutch housing parts for the following conditions:

- Cracks

Replace the clutch housing part if cracks are found.

- Scratches
 - Burrs
 - Nicked mounting surfaces
 - Damaged sealing 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 CLUTCH HOUSING ASSEMBLE

Special Tools

- **J 8092** Universal Driver Handle
- **J 23907-1** Slide Hammer
- **J 36017** Valve Seal Remover
- **J 36190** Universal Driver Handle
- **J 39433** Input Shaft Seal Installer
- **J 39435** Bearing Race Installer
- **J 39439-3** Bushing Installer
- **J 39439-1** Shift Rail Bushing Removal/Installer
- **J 39442** Mainshaft and Countershaft Press Adapter
- **J 42464** Shift Shaft Seal Installer
- **J 44384** Bearing Installer

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

Transmission Case

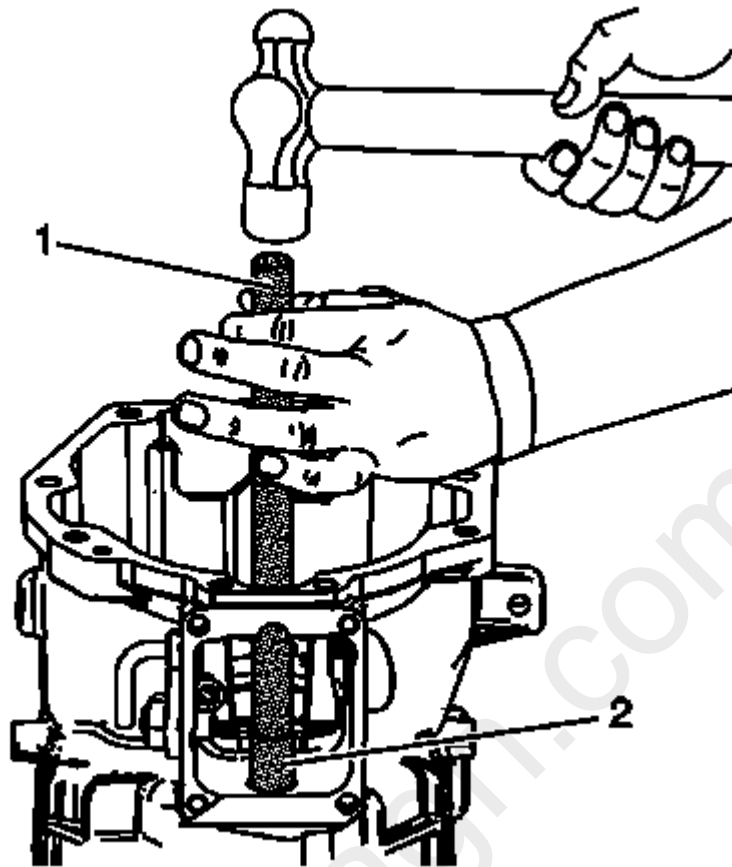


Fig. 168: 1st/2nd, 3rd/4th Shift Shaft Bushings
Courtesy of GENERAL MOTORS COMPANY

NOTE: The end of the bearing that has numbers stamped on it must face the J 44384 bearing installer , so that the numbers are visible when the bearing is installed.

1. Install the 1st/2nd and the 3rd/4th shift shaft bearing. Use the J 36190 driver handle (1) and the J 44384 bearing installer (2).

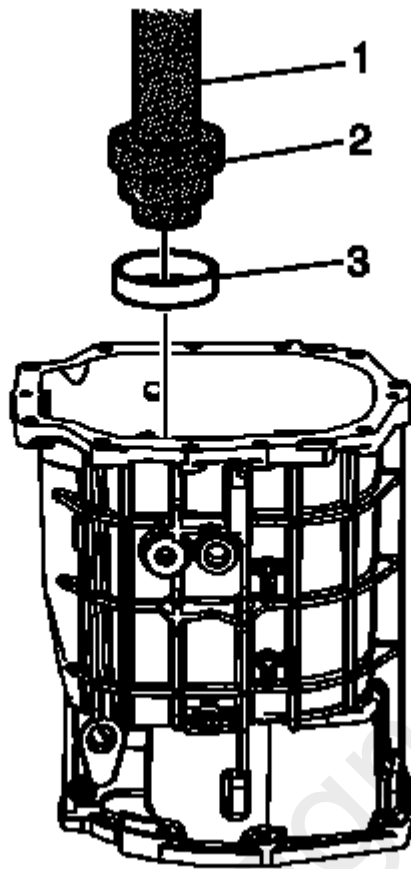


Fig. 169: Installing Mainshaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: Bearings and Races are replaced as sets.

2. Install the mainshaft bearing race (3), using the **J 8092** driver handle (1) and the **J 39435** installer (2).

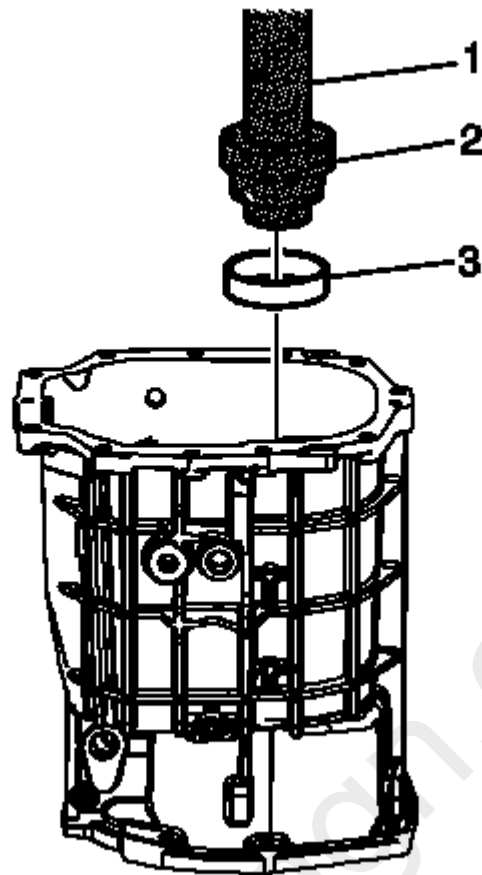


Fig. 170: Installing Countershaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

3. Install the countershaft bearing race (3), using the J 8092 driver handle (1) and the J 39435 installer (2).

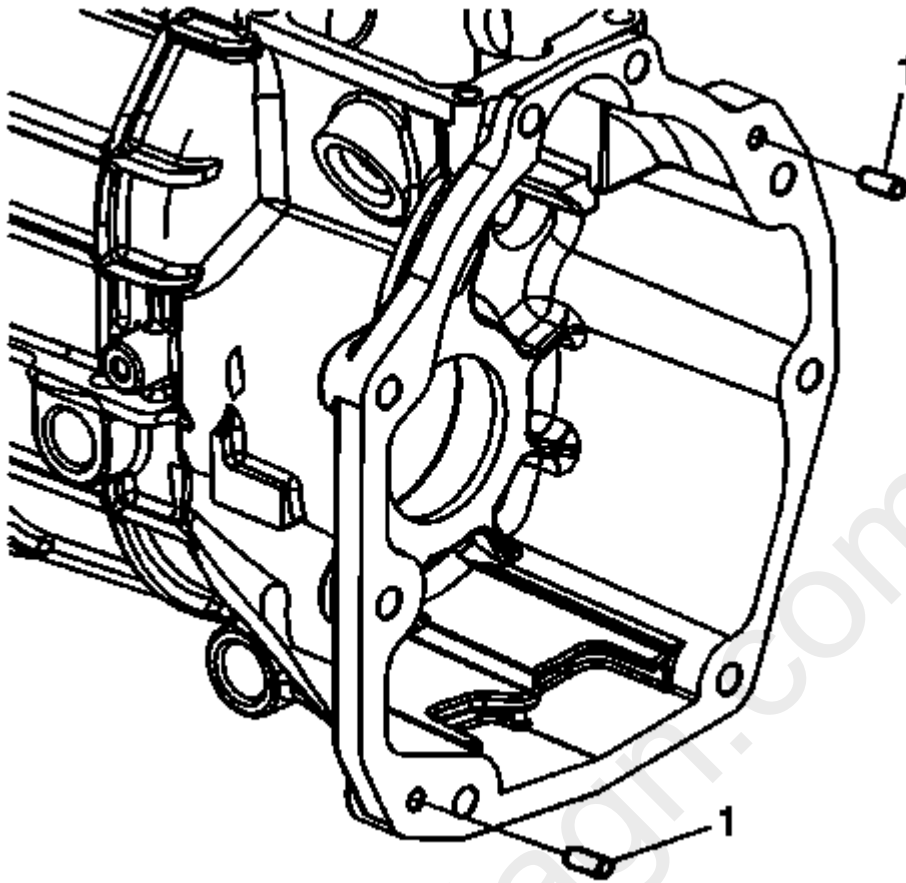


Fig. 171: Locating Dowel Pins

Courtesy of GENERAL MOTORS COMPANY

4. Install the dowel pins (1).

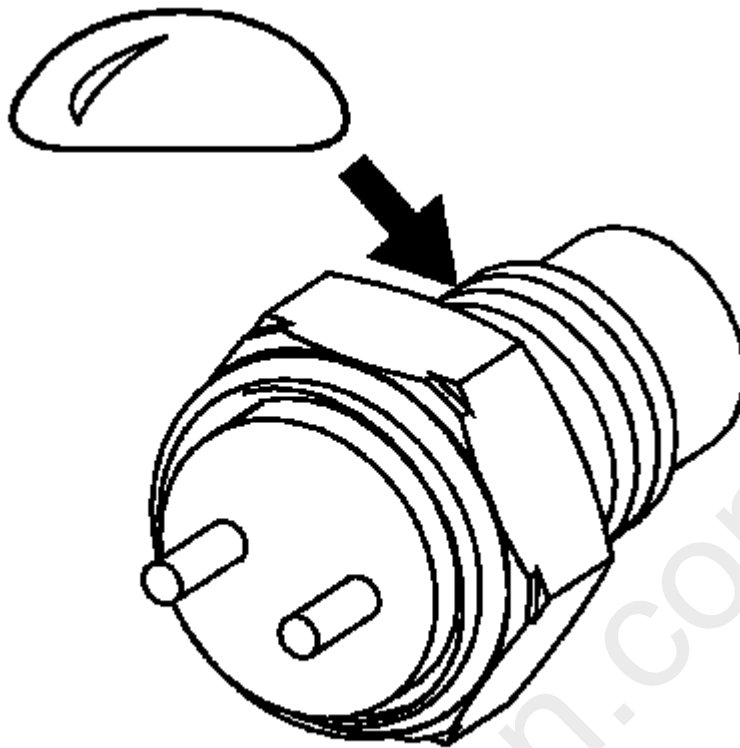


Fig. 172: Applying Sealant To Threads Of Backup Lamp Switch
Courtesy of GENERAL MOTORS COMPANY

5. Apply sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the threads of the backup lamp switch.

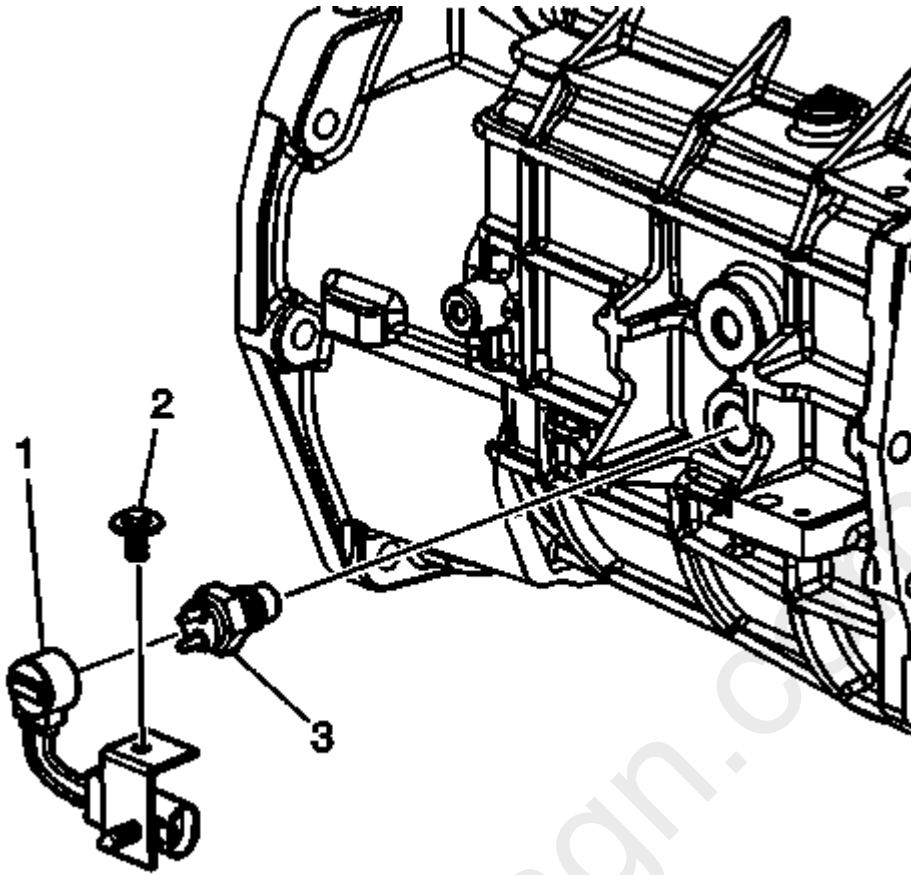


Fig. 173: Identifying Backup Lamp Switch Components
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

6. Install the backup lamp switch (3) and tighten to 27 N.m (20 lb ft).
7. Connect the backup lamp switch connector harness (1) to the backup lamp switch.
8. Install the backup switch bracket and bolt with washer (2). Tighten the bracket bolt to 9 N.m (80 lb in).

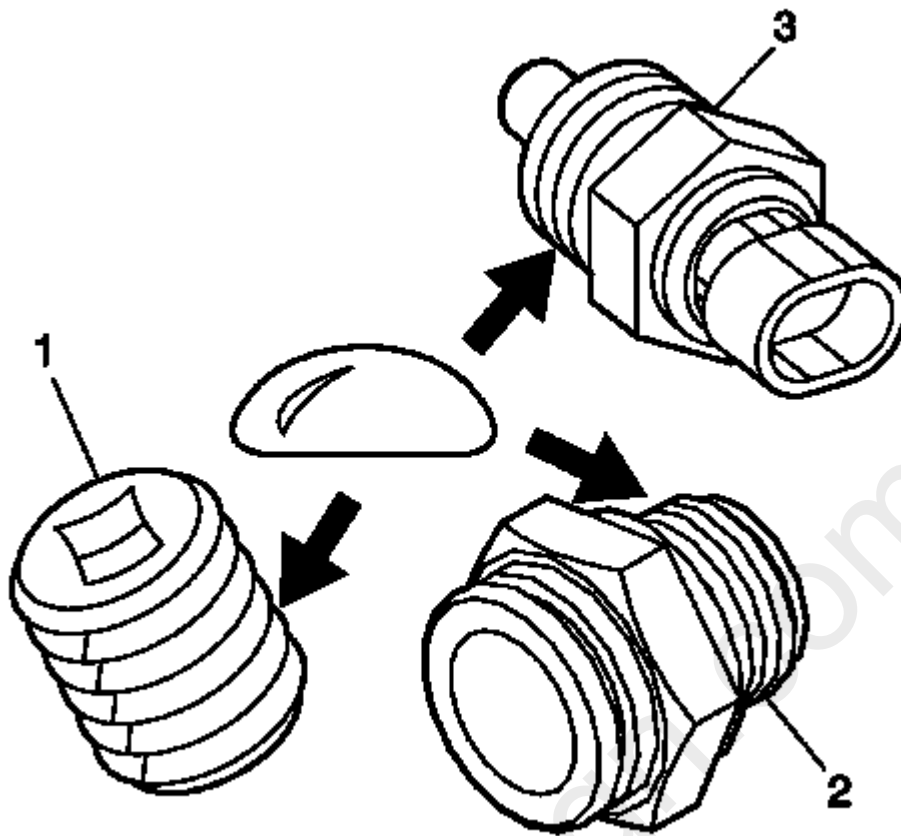


Fig. 174: Applying Sealant To Threads Of Transmission Case Fill Plug, Temperature Sensor & Cooler Line Return Fitting
Courtesy of GENERAL MOTORS COMPANY

9. Apply sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the threads of the transmission case fill plug (1), the temperature sensor (3) and the cooler line return fitting (2).

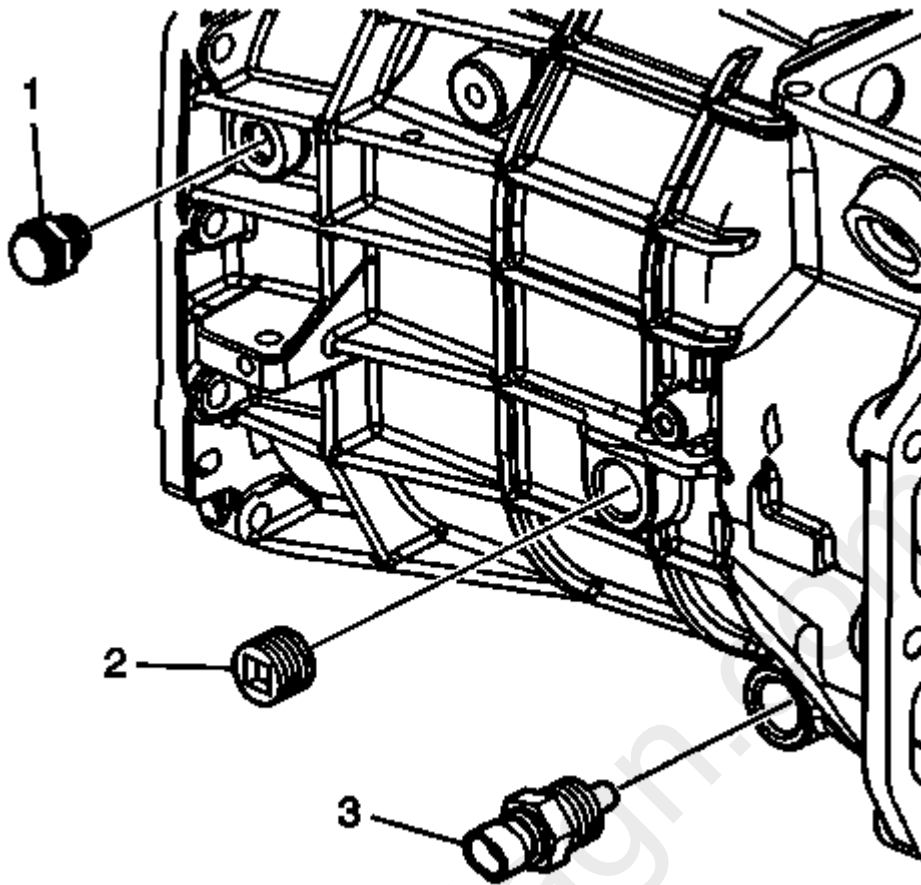


Fig. 175: Identifying Cooler Line Return Fitting, Fill Plug & Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

10. Install the transmission case cooler line return fitting (1) and tighten to 18 N.m (13 lb ft).
11. Install the transmission case fill plug (2) and tighten to 27 N.m (20 lb ft).
12. Install the coolant temperature sensor (3) and tighten to 39 N.m (29 lb ft).

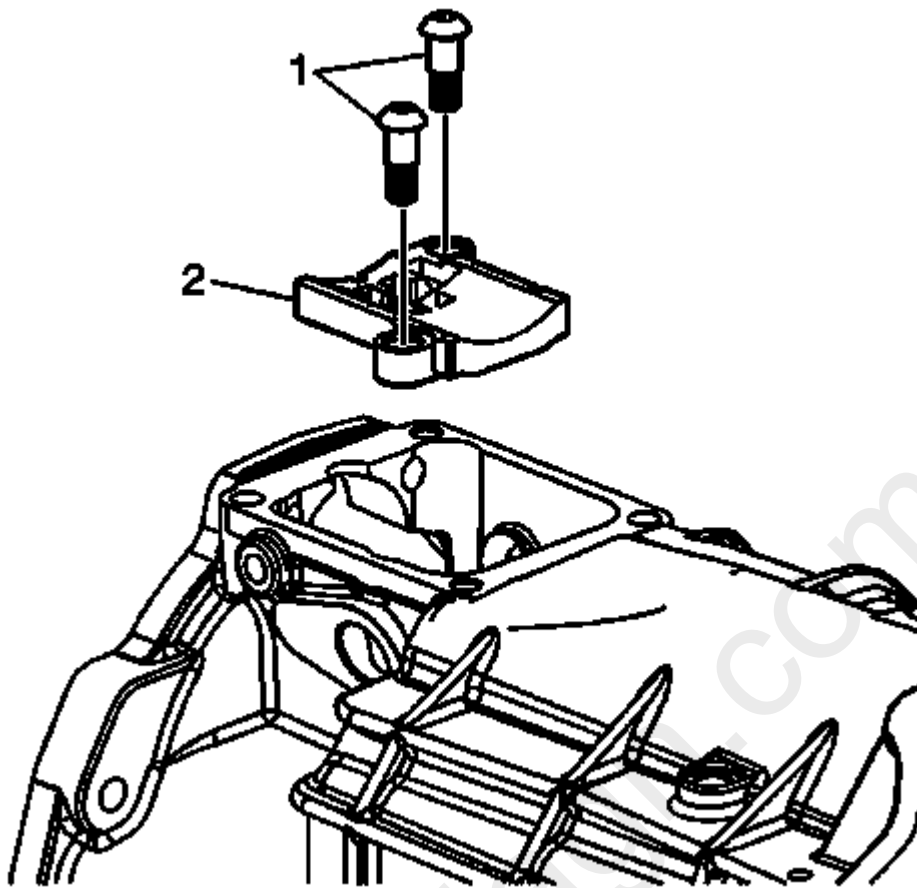


Fig. 176: Identifying Detent Guide Plate & Attaching Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: The H-pattern on the guide plate must face the extension housing. If the guide plate is installed incorrectly, then damage will occur.

13. Install the guide plate (2) and the guide plate bolts (1) and tighten to 22 N.m (16 lb ft).

Clutch Housing Assembly

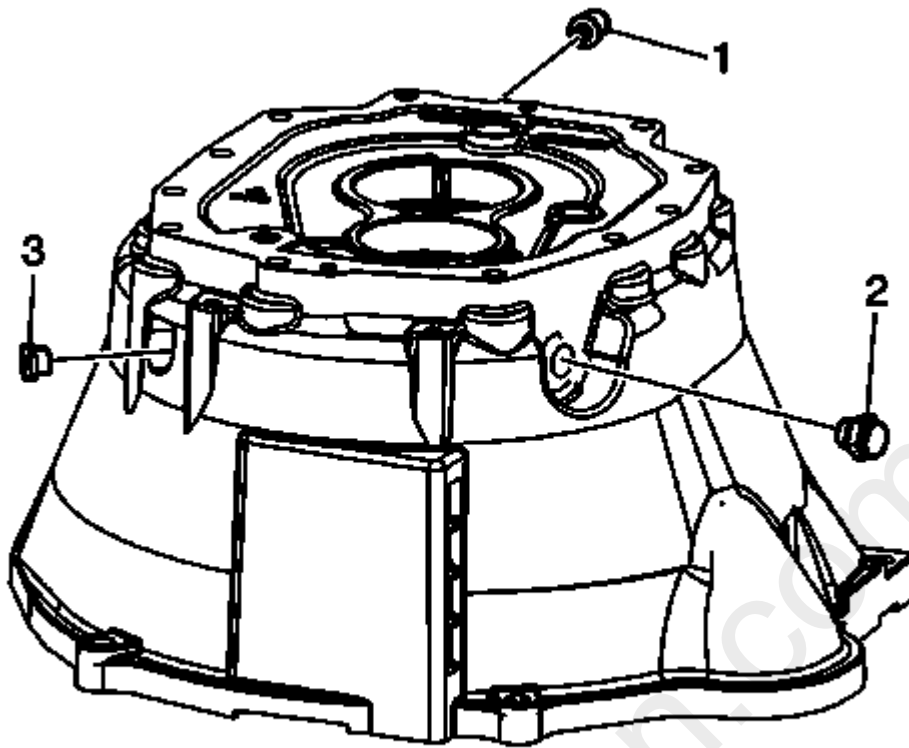


Fig. 177: Identifying Vent Assembly, Pump Outlet Cooler Fitting With O-Ring & Transmission Fluid Pump Outlet Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

1. Install the transmission fluid pump outlet pipe fitting (3) and tighten to 27 N.m (20 lb ft).
2. Install the pump outlet cooler fitting (2), and tighten to 18 N.m (13 lb ft).
3. Install the vent assembly (1).

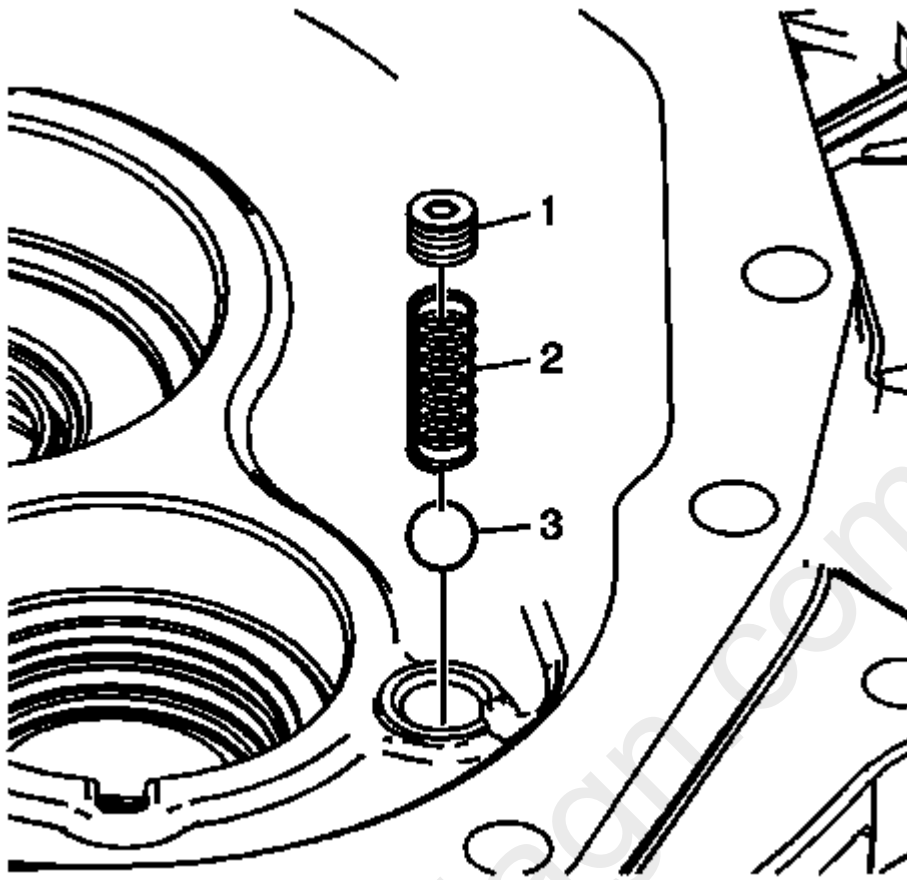


Fig. 178: Identifying Plug & Spring
Courtesy of GENERAL MOTORS COMPANY

4. Install the transmission fluid pump check ball (3).
5. Install the transmission fluid pump spring (2).
6. Install the transmission fluid pump spring retaining plug (1). Tighten the plug to 27 N.m (20 lb ft).

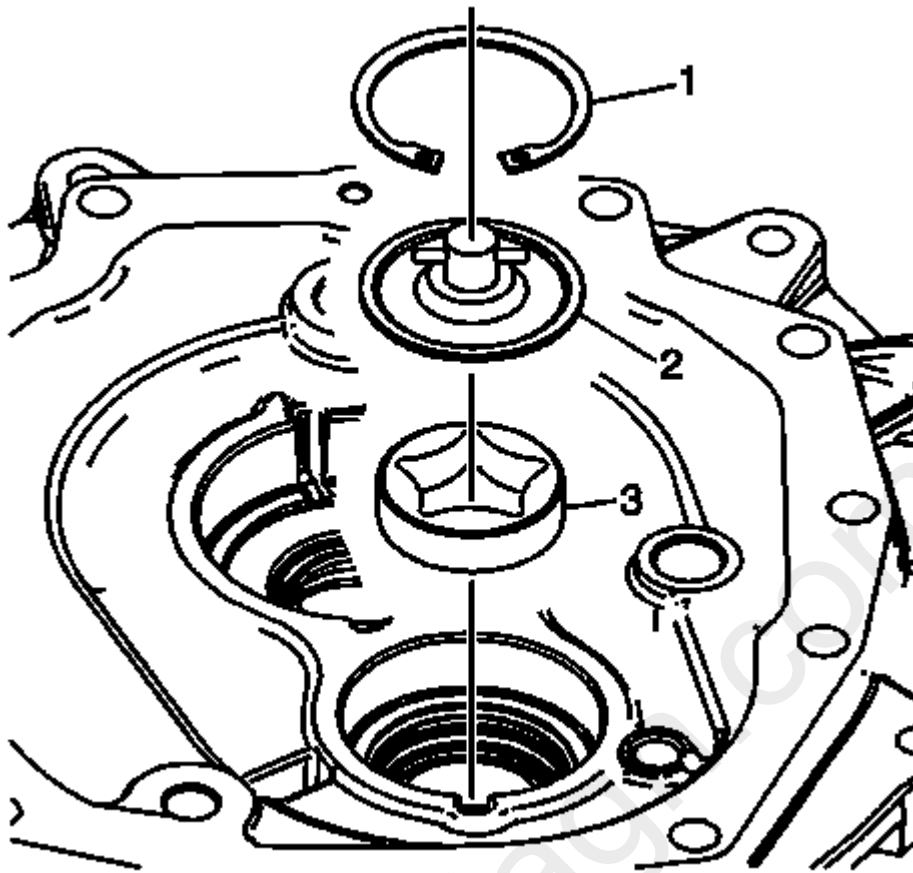


Fig. 179: Identifying Oil Pump & Oil Pump Cover Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the oil pump (3).
8. Install the oil pump cover assembly (2).
9. Install the retainer ring (1).

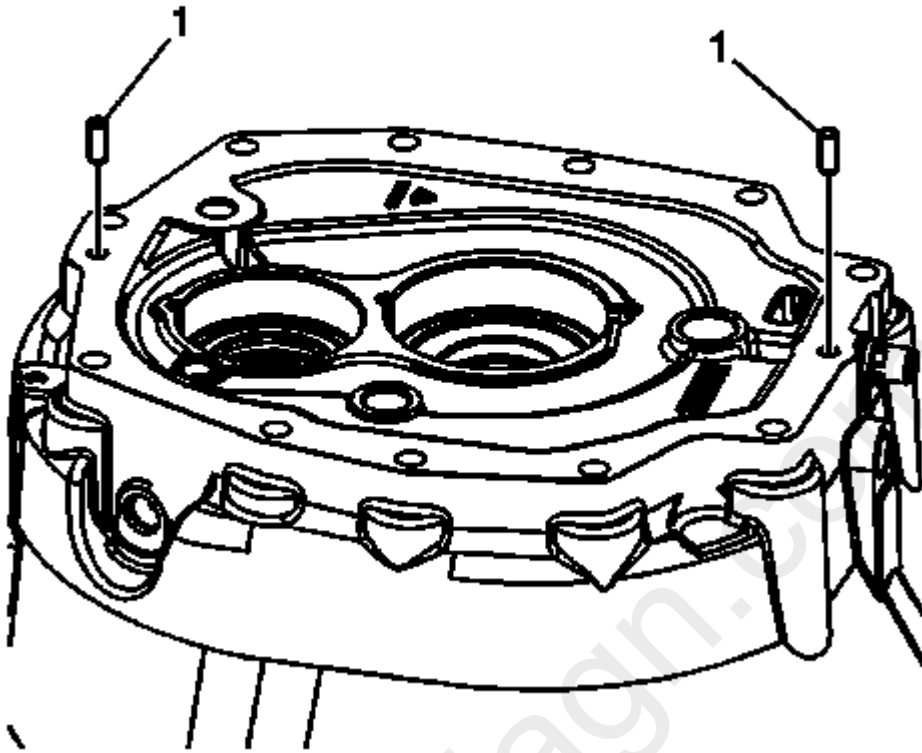


Fig. 180: Identifying Dowel Pins
Courtesy of GENERAL MOTORS COMPANY

10. Install the dowel pins (1).

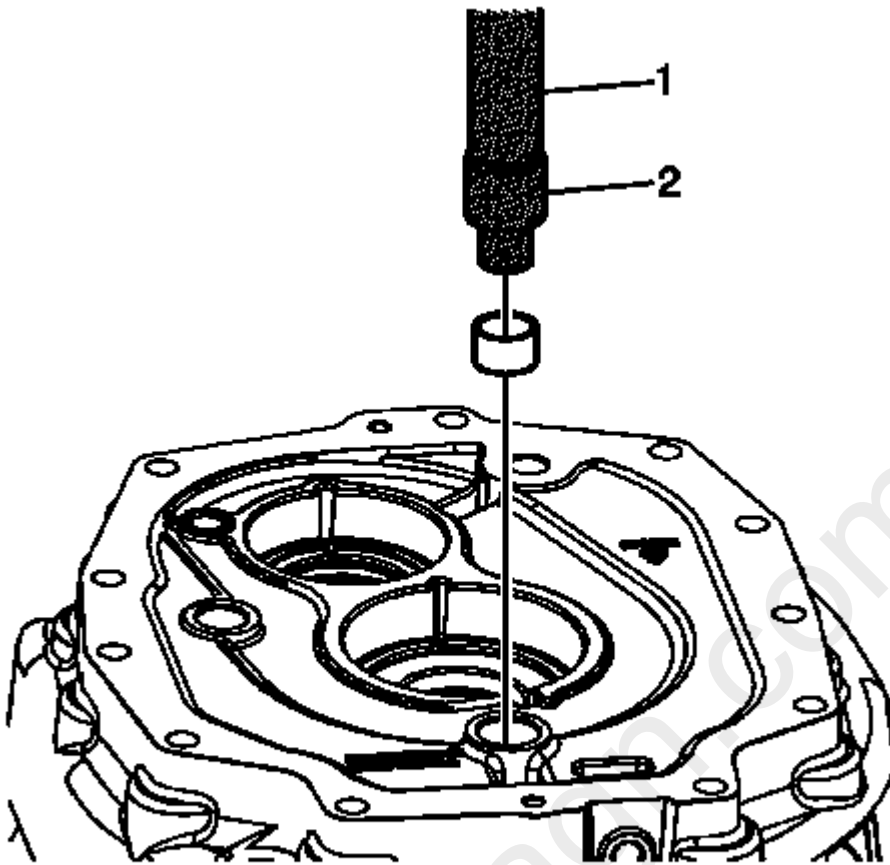


Fig. 181: Installing 1st/2nd Speed Shift Shaft Bearing
Courtesy of GENERAL MOTORS COMPANY

CAUTION: If the 1st/2nd speed shift shaft bearing is installed incorrectly it will interfere with the inner shift rail seal causing a leak.

11. Install the 1st/2nd speed shift shaft bearing flush with the clutch housing, using the **J 36190** driver handle (1) with the **J 44384** bearing installer (2).

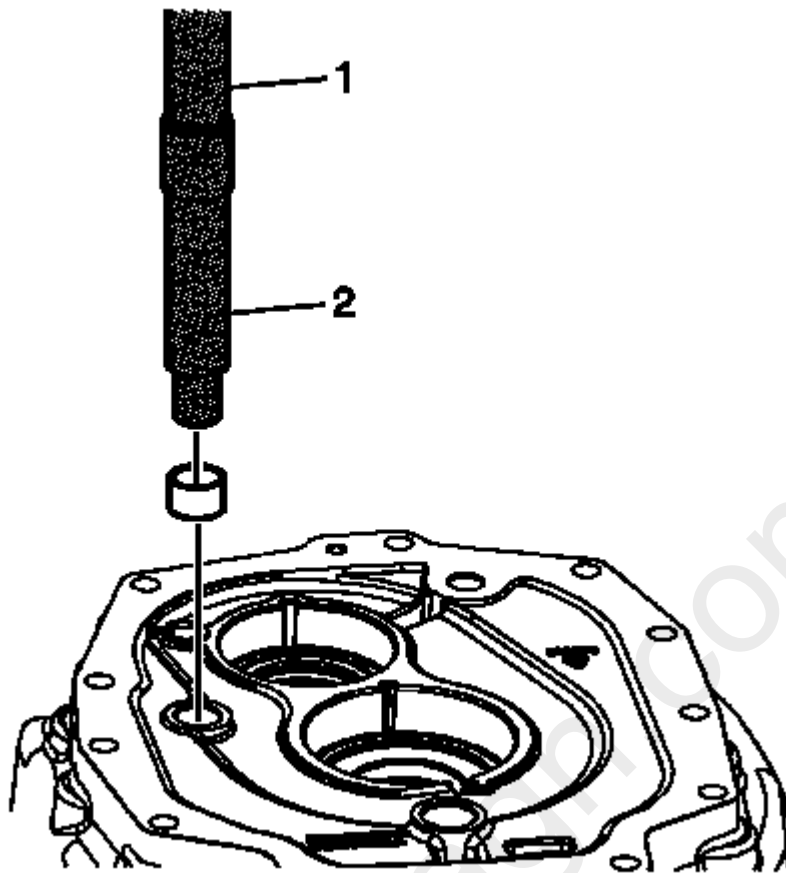


Fig. 182: Installing 3rd/4th Speed Shift Shaft Bushing
Courtesy of GENERAL MOTORS COMPANY

12. Install the 3rd/4th speed shift shaft bushing flush with the clutch housing, using the **J 36190** driver handle (1) with the **J 39439-1** bushing removal/installer (2).

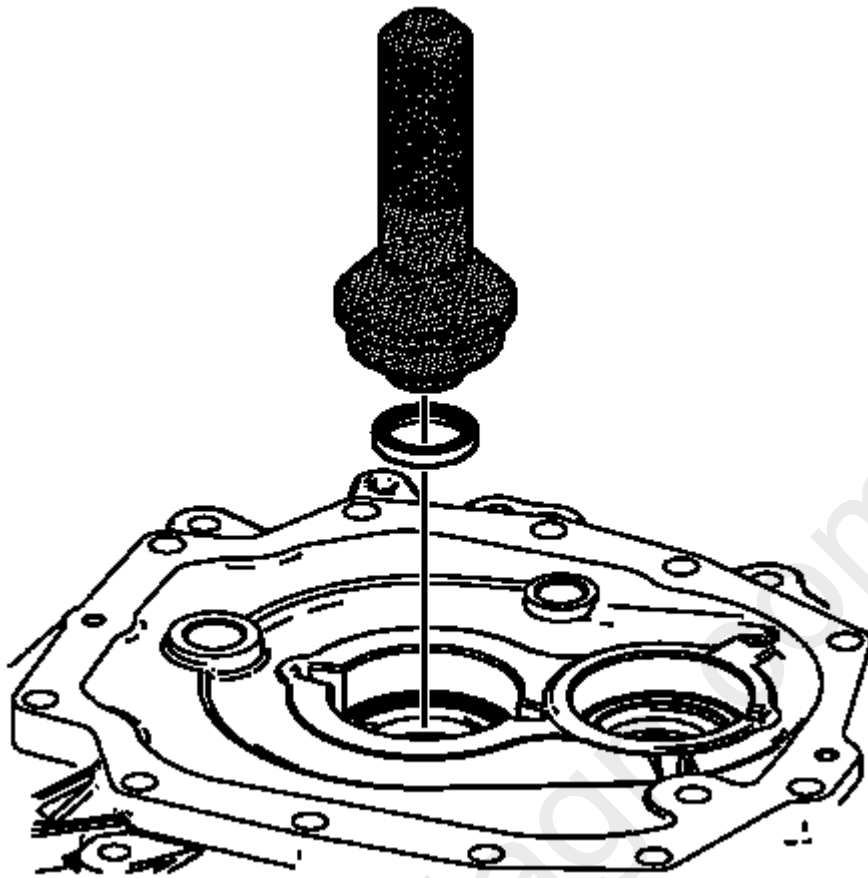


Fig. 183: Installing Input Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

13. Install the input shaft seal, using the J 39433 input installer.

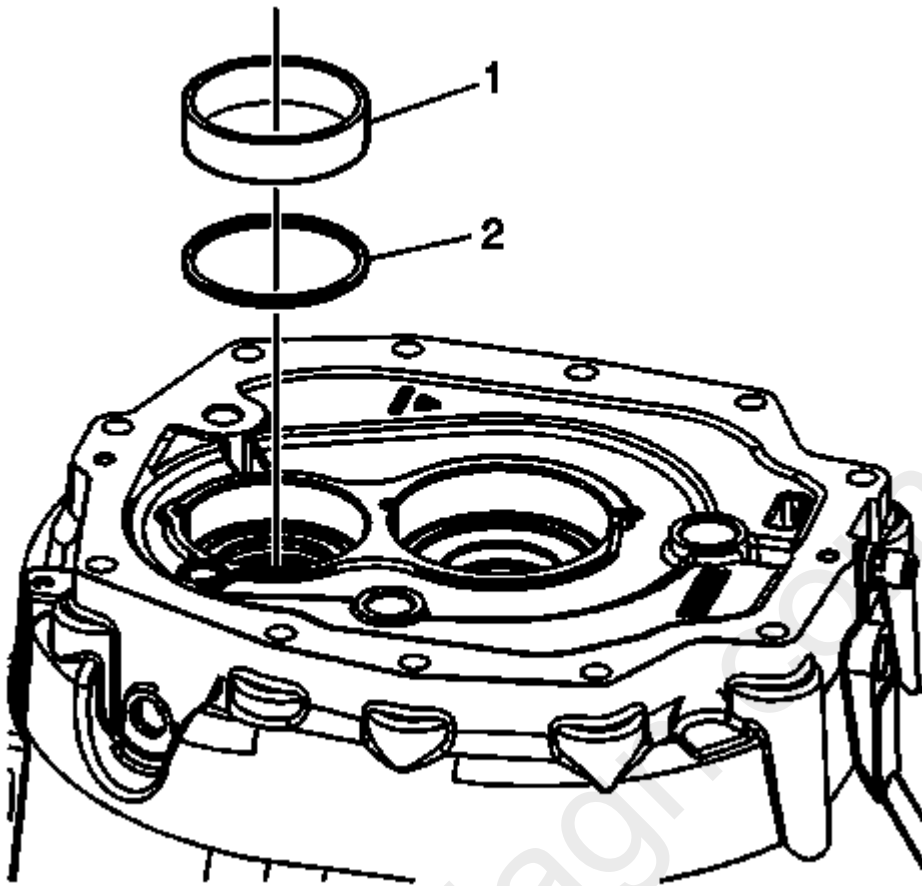


Fig. 184: Identifying Countershaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

NOTE: One or more shims may be used.

14. Install one or more countershaft bearing shims (2) and the bearing race (1). Refer to Input Shaft, Mainshaft and Countershaft in **Shimming Procedures**.

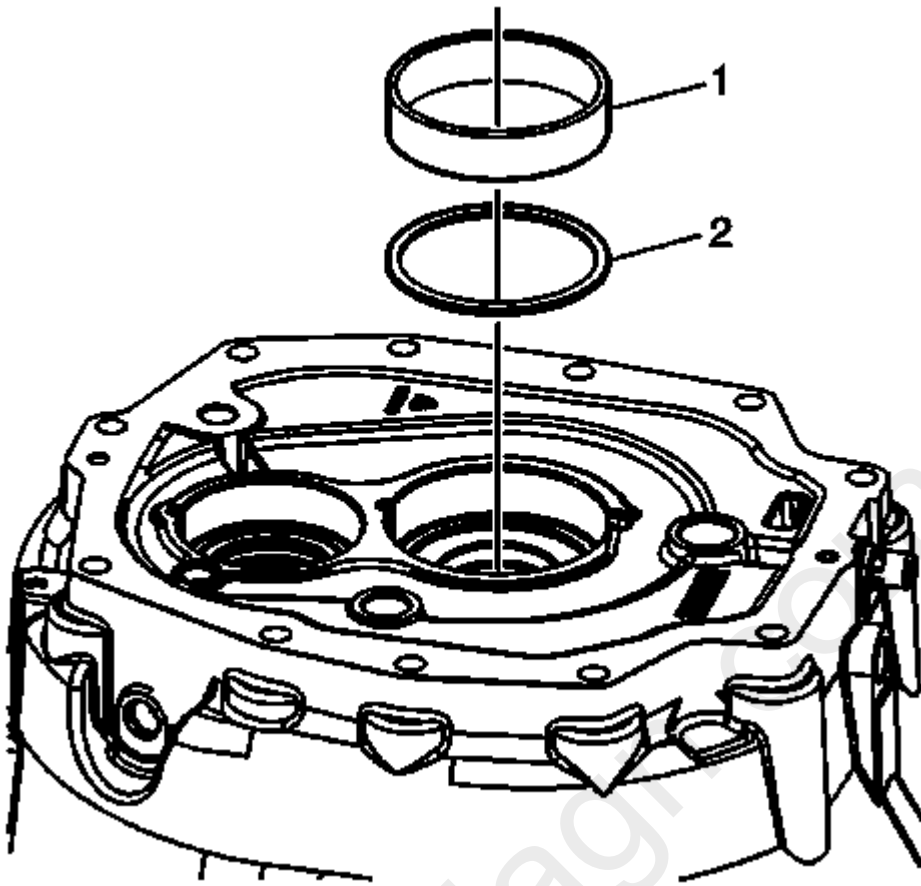


Fig. 185: Identifying Input Shaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

15. Install one or more input shaft bearing shims 2) and the bearing race (1). Refer to Input Shaft, Mainshaft and Countershaft in Shimming Procedures.

EXTENSION DISASSEMBLE

Special Tools

- DT 49216 Shift Rail Bearing Remover
- J 23907 Slide Hammer with Bearing Adapter
- J 26941 Bearing Race Remover
- J 29369-2 Bushing and Bearing Remover - 2-3 in
- J 36190 Universal Driver Handle
- J 39431 Fifth/Sixth Driven Gear Puller
- J 39439-1 Bushing Installer
- J 39439-2 Shift Rail Bushing Remover
- J 39439-3 Bushing Installer

- J 45124 Removal Bridge
- J 45124-9 Puller Leg

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

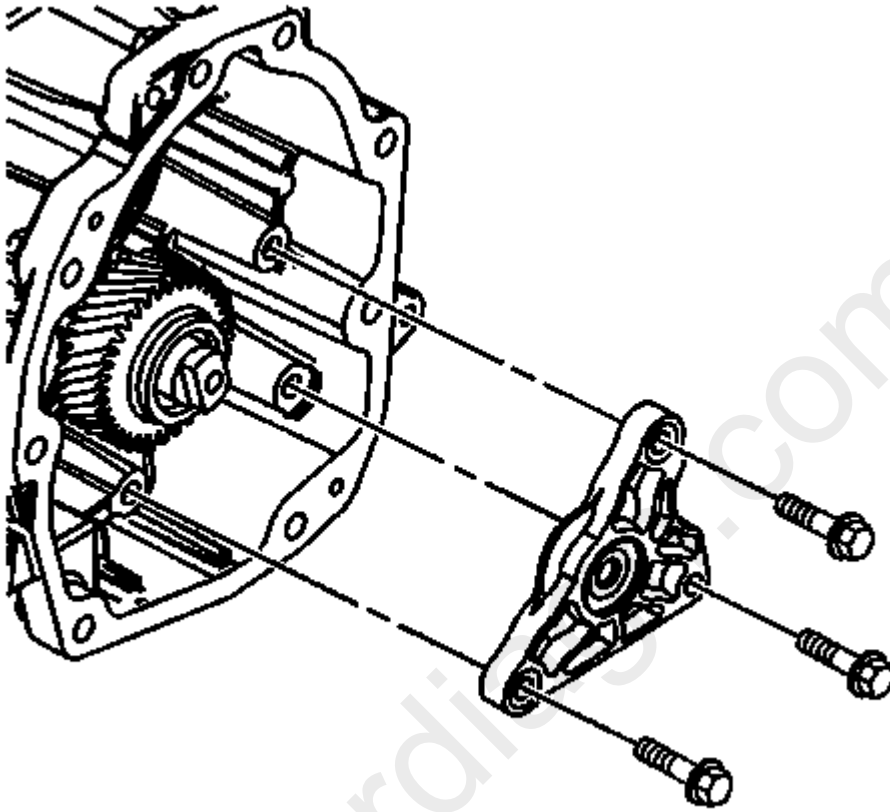


Fig. 186: View Of Reverse Idler Shaft Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the reverse idler shaft bracket bolts and bracket.

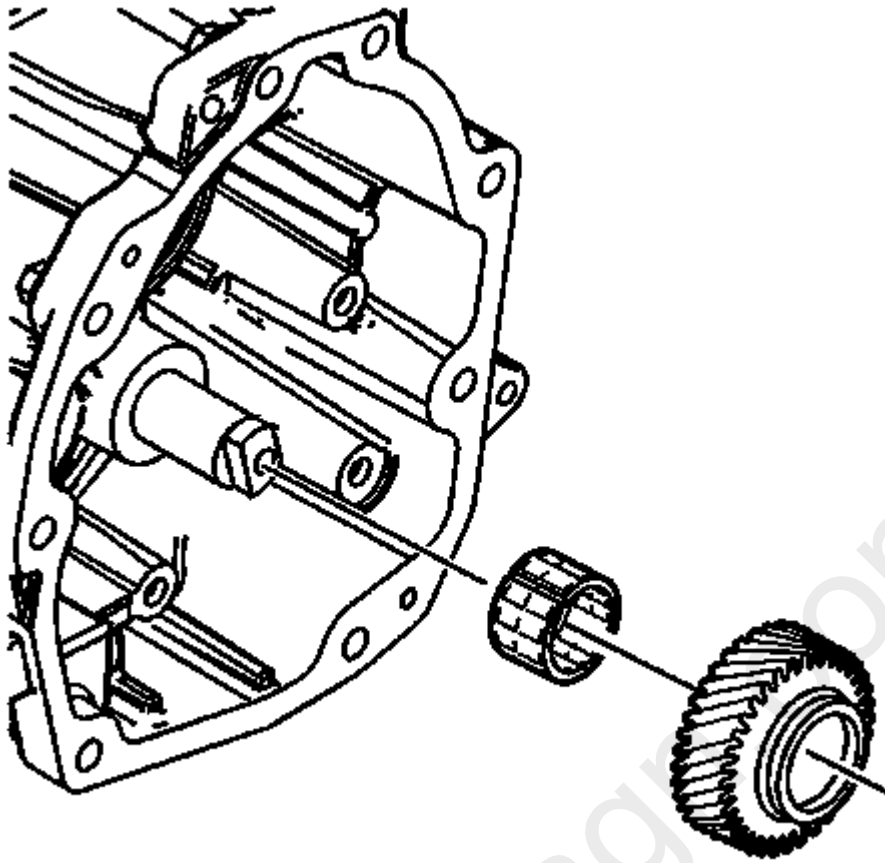


Fig. 187: View Of Reverse Idler Gear And The Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

2. Remove the reverse idler gear and the roller bearing.

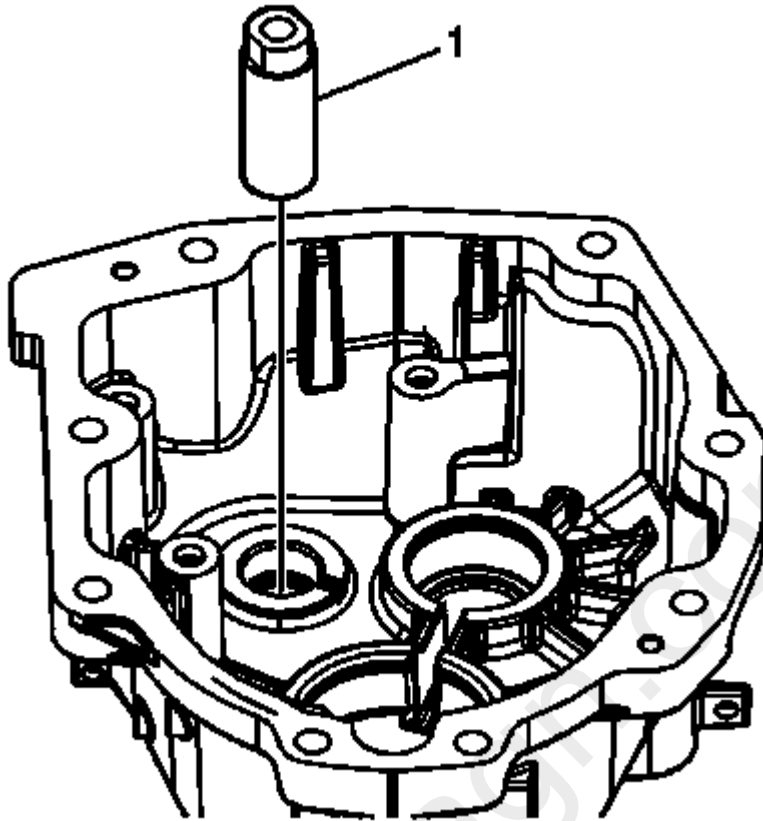


Fig. 188: Identifying Reverse Idler Gear Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Remove the reverse idler gear shaft (1).

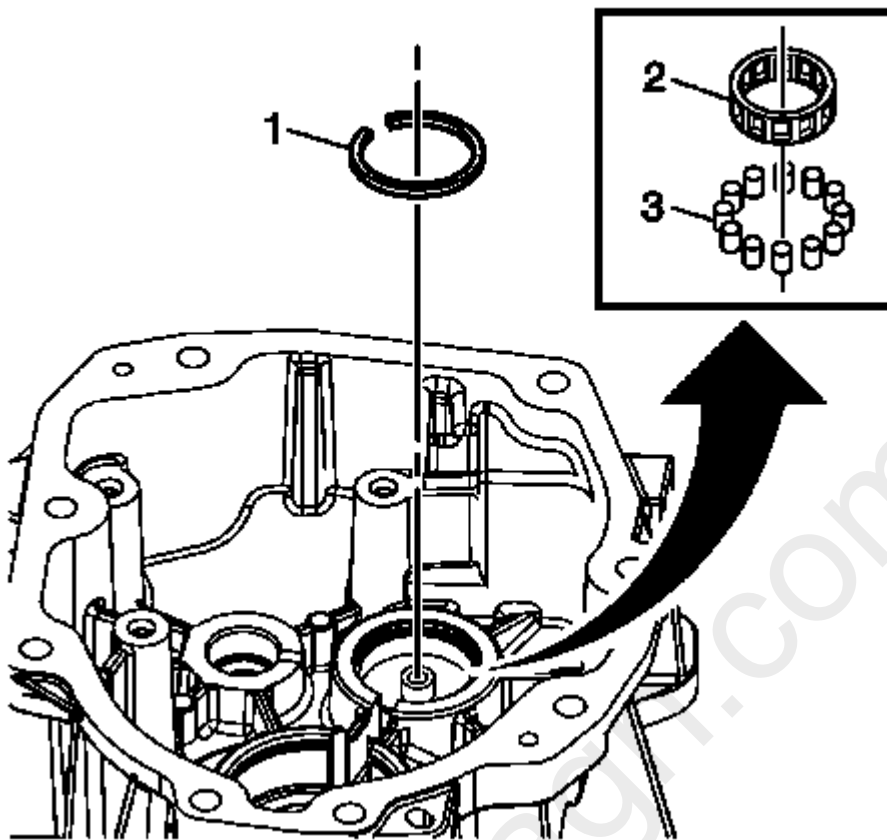


Fig. 189: View Of Countershaft Rear Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Remove the countershaft rear bearing retainer (1).

NOTE: The plastic roller bearing cage (2) and bearings are part of the countershaft bearing assembly. Always use a new countershaft bearing assembly.

5. Cut away the plastic roller bearing cage (2) from the countershaft bearing assembly.
6. Remove the bearings (3). Discard the cage and bearings.

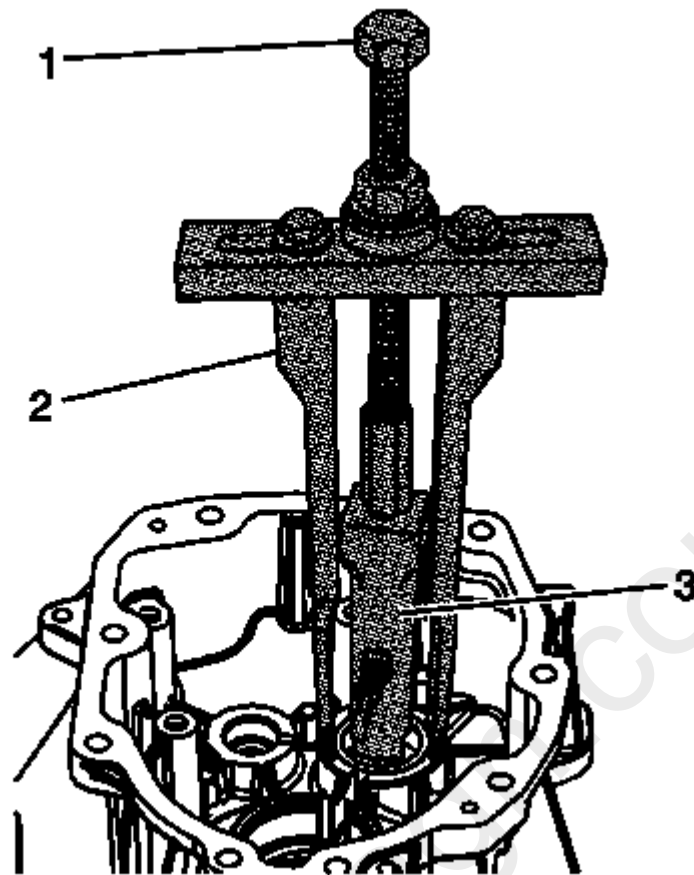


Fig. 190: View of Special Tools, Extension Bearing Race & Extension Housing
Courtesy of GENERAL MOTORS COMPANY

7. Install J 45124-1 removal bridge (1), J 45124-9 puller leg (2), and J 29369-2 remover (3) in the race from the countershaft bearing assembly in the extension housing.
8. Remove the race.

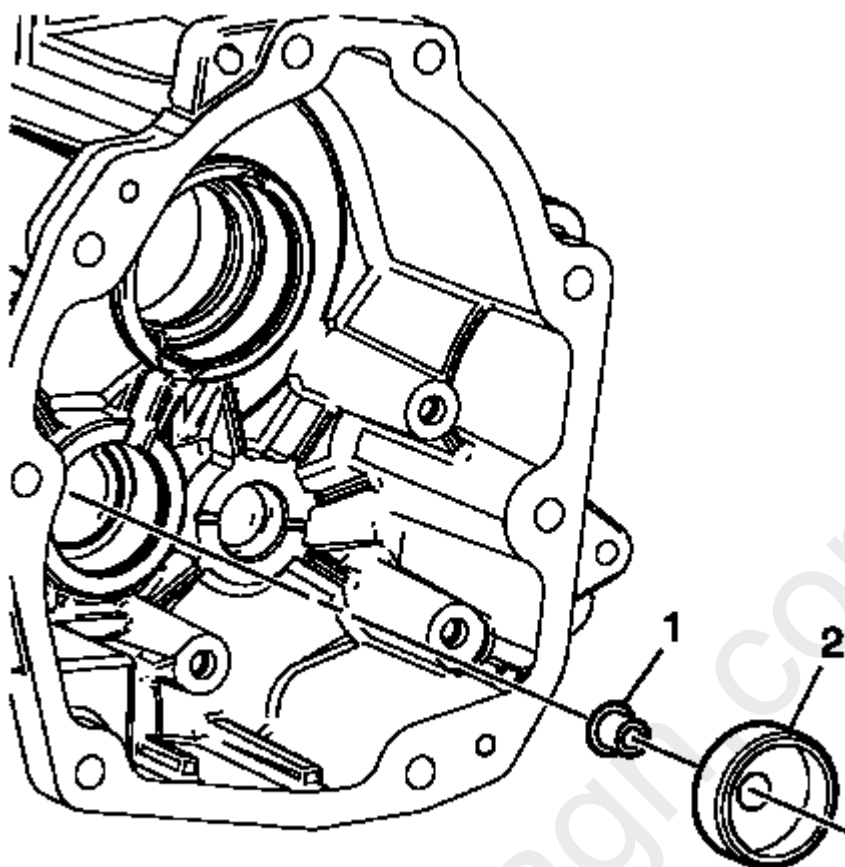


Fig. 191: View Of Oil Funnel & Bearing Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: The bearing race is part of the countershaft bearing assembly. Always use a new countershaft bearing assembly.

9. Remove the oil funnel (1) from the bearing race (2). Discard the bearing race.

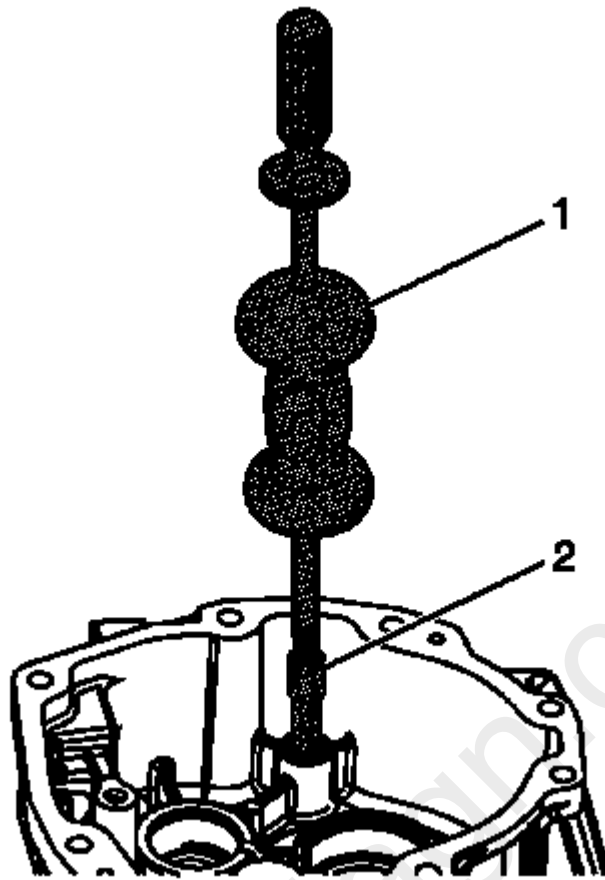


Fig. 192: Removing Reverse Rail Bushing
Courtesy of GENERAL MOTORS COMPANY

10. Using J 39439-2 remover (2) and J 23907 slide hammer (1), remove the bushing.

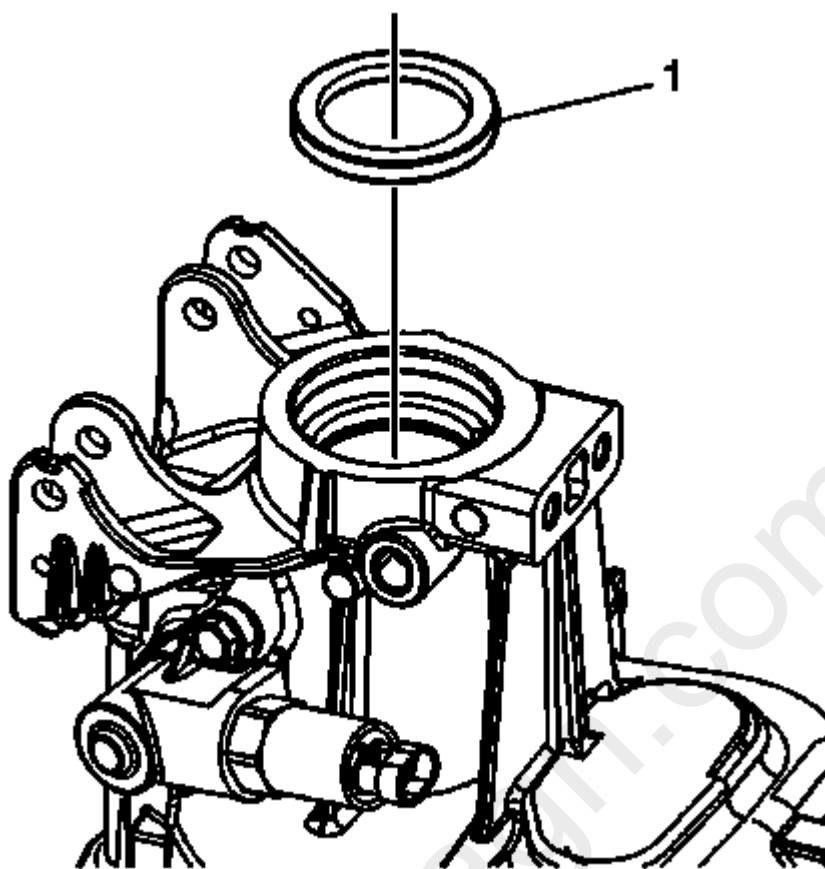


Fig. 193: Identifying Output Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

11. Remove the output shaft seal (1).

Pry out the seal with a suitable tool.

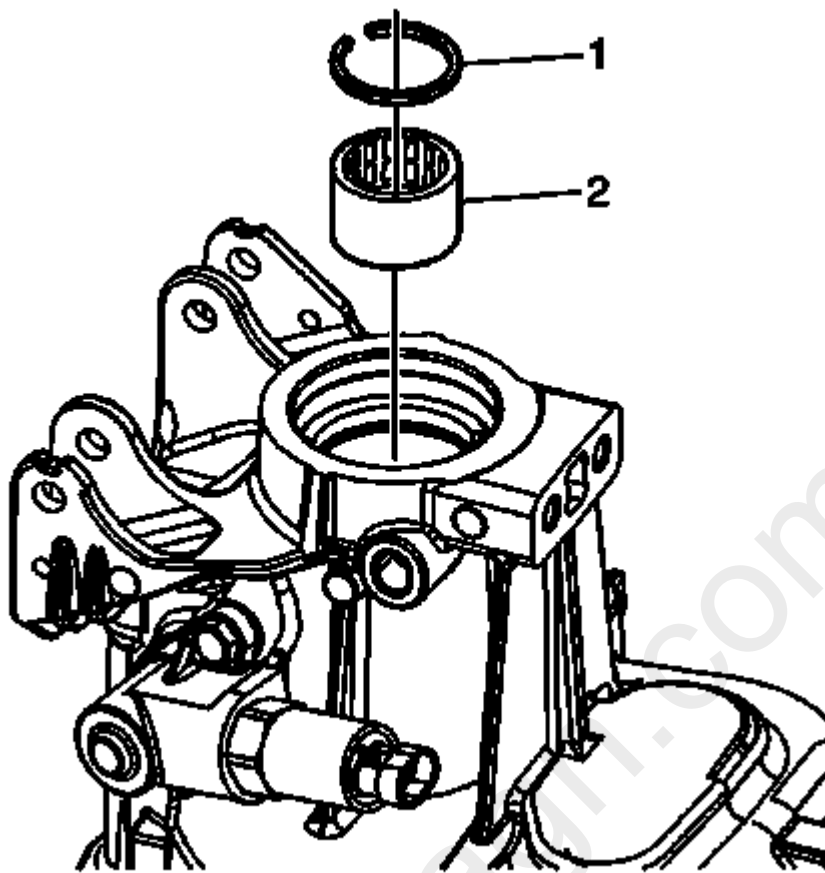


Fig. 194: Identifying Roller Bearing & Snap Ring
Courtesy of GENERAL MOTORS COMPANY

12. Remove the snap ring (1) and the roller bearing (2).

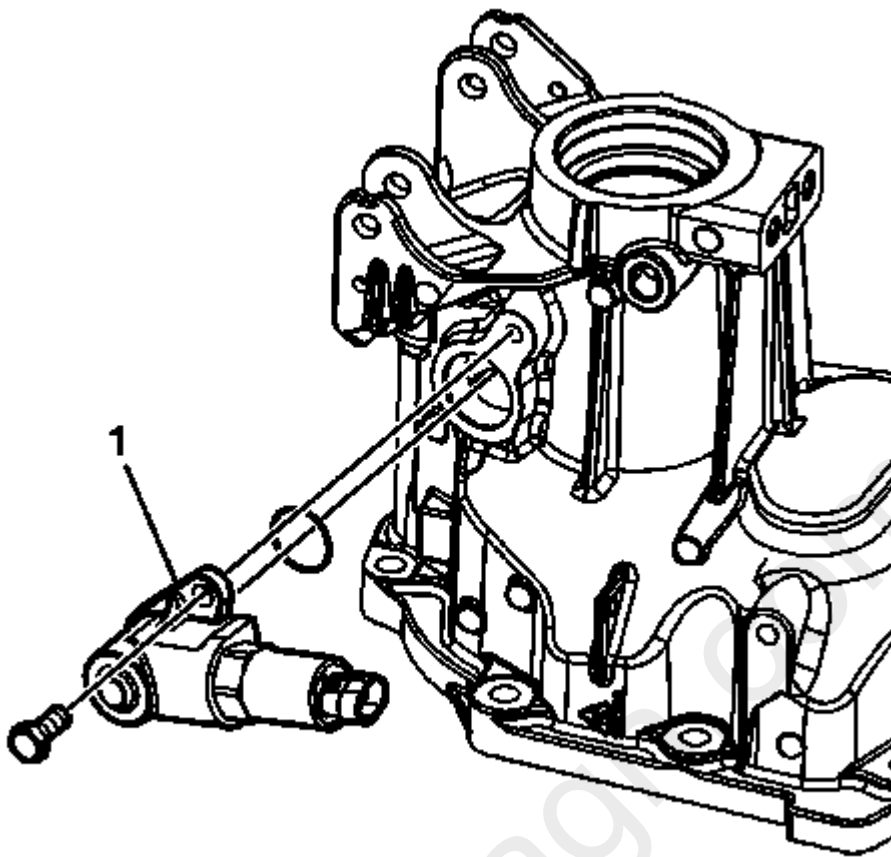


Fig. 195: Identifying Reverse Lockout Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Remove the mounting bolt, the reverse lockout assembly (1) and the O-ring.

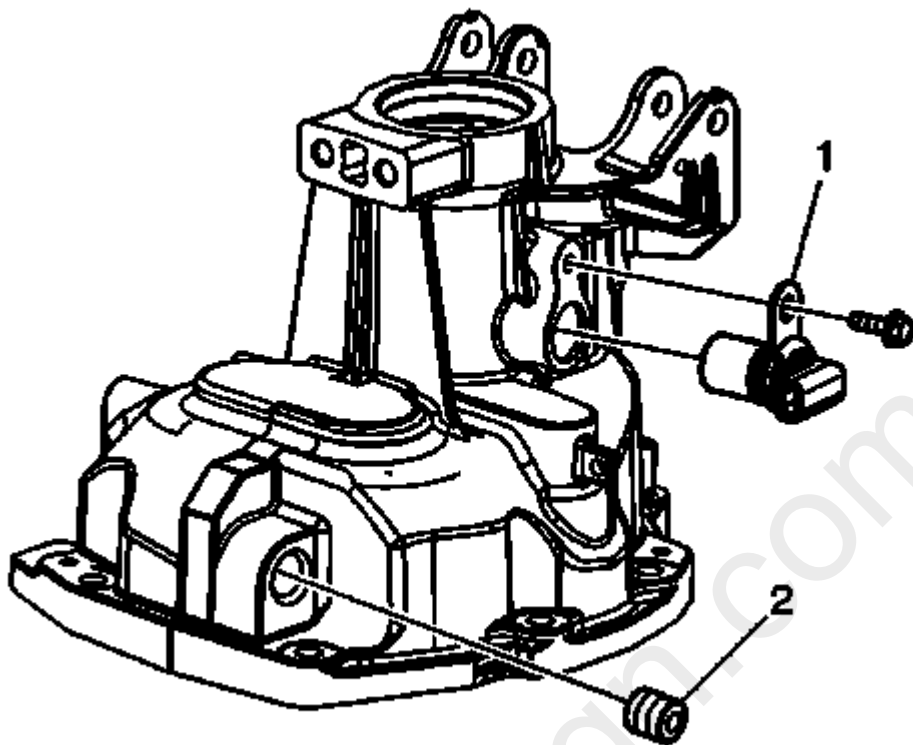


Fig. 196: Identifying Transmission Case Drain Plug & Vehicle Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

14. Remove the bolt and the vehicle speed sensor (1).
15. Remove the plug (2).

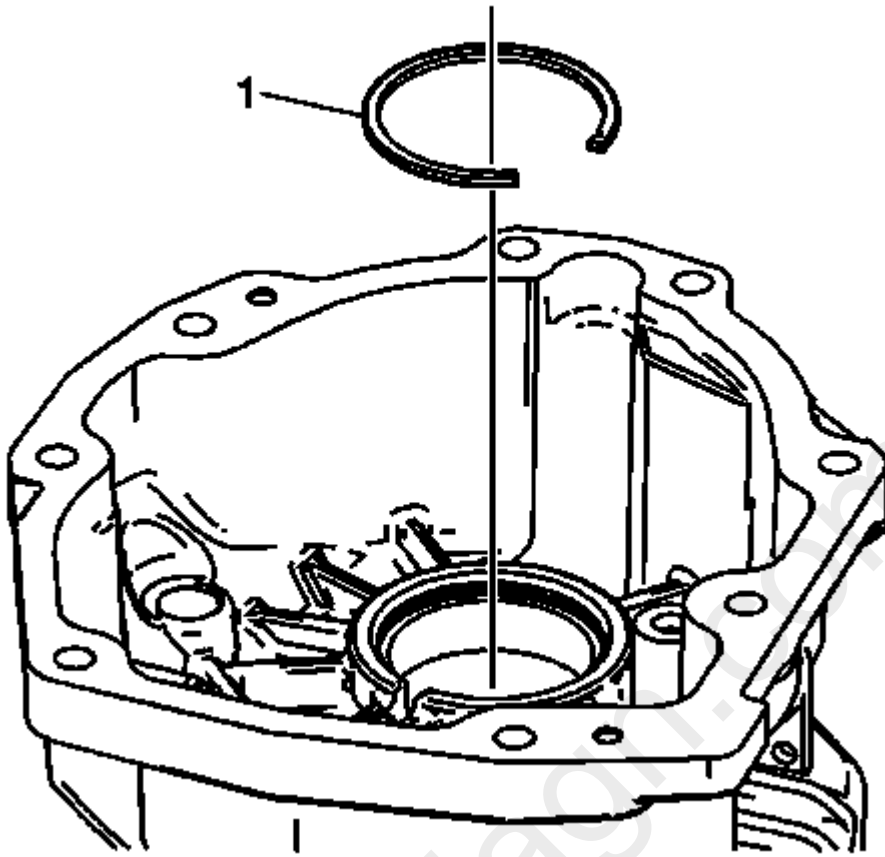


Fig. 197: Identifying Mainshaft Bearing Race Retainer Ring
Courtesy of GENERAL MOTORS COMPANY

16. Remove the mainshaft bearing race retainer ring (1).

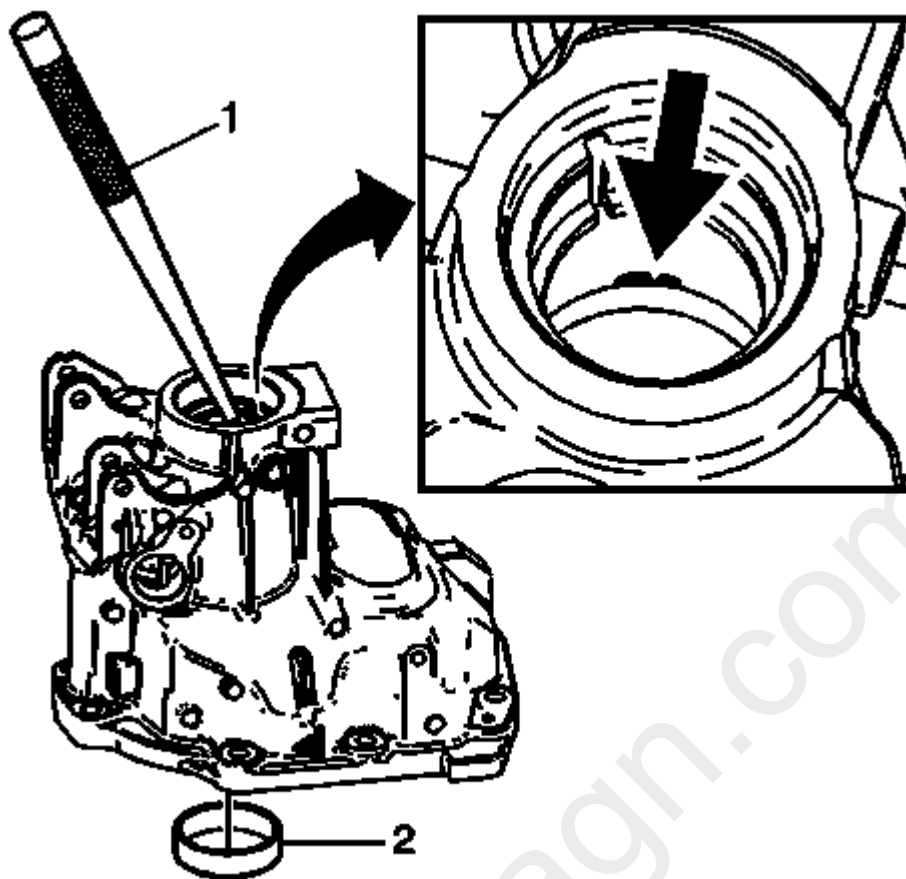


Fig. 198: Removing Mainshaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not replace the bearing race unless inspection shows bearing race damage.

17. Place the extension housing on a flat work surface. Locate the oil clearance gap between the housing and the main shaft bearing race.
18. Insert a brass drift (1) through the mainshaft opening of the extension housing, into the oil clearance gap. Using a mallet, tap down on the drift to remove the mainshaft bearing race (2).

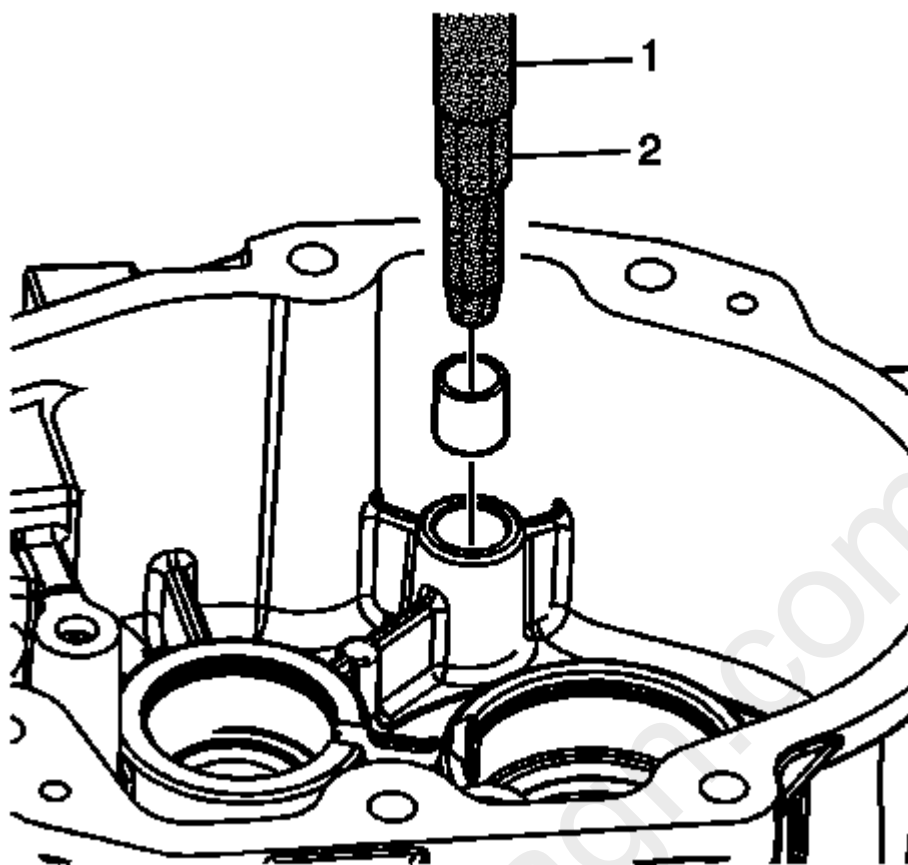


Fig. 199: Removing Reverse Rail Bushing
Courtesy of GENERAL MOTORS COMPANY

19. Remove the reverse rail bushing using the J 36190 handle (1) and J 39439-2 installer (2).

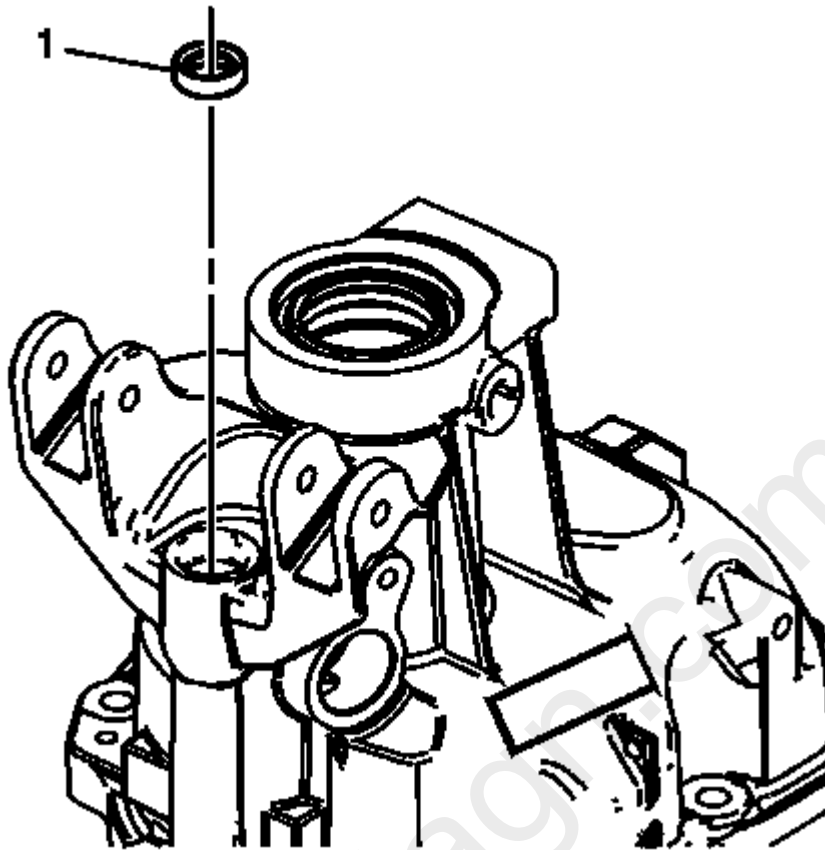


Fig. 200: Identifying Rear Housing Shift Rail Seal
Courtesy of GENERAL MOTORS COMPANY

20. Remove the rear housing shift rail seal (1).

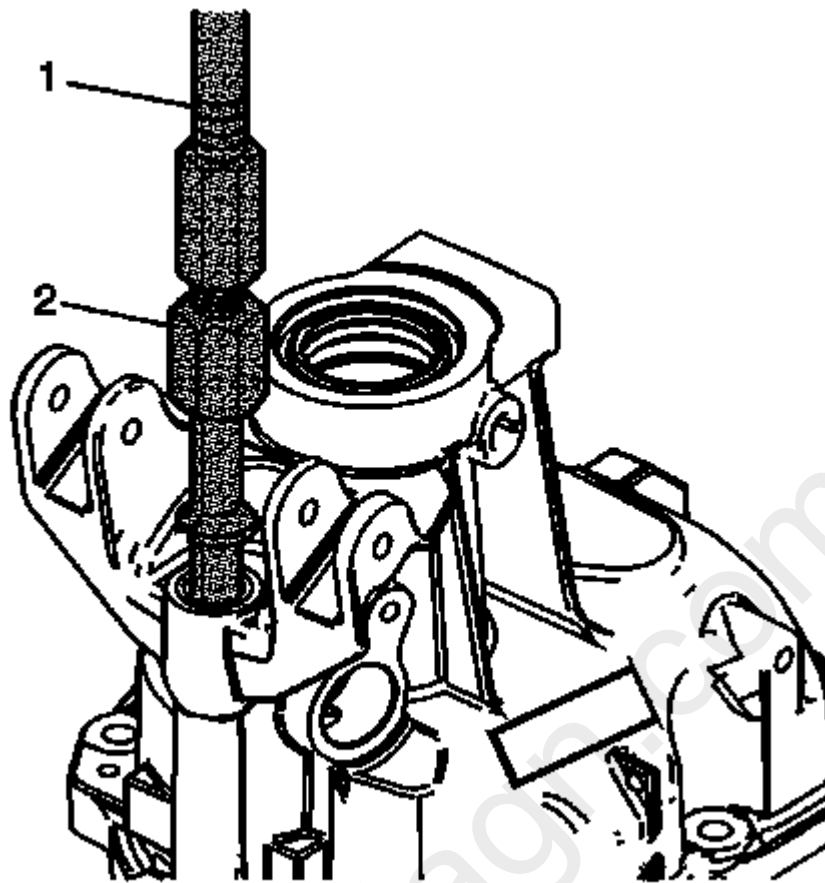


Fig. 201: Removing Shift Rail Bearing
Courtesy of GENERAL MOTORS COMPANY

21. Remove the shift rail bearing using the J 23907 slide hammer (1) and DT 49216 remover (2).

EXTENSION CLEANING AND INSPECTION

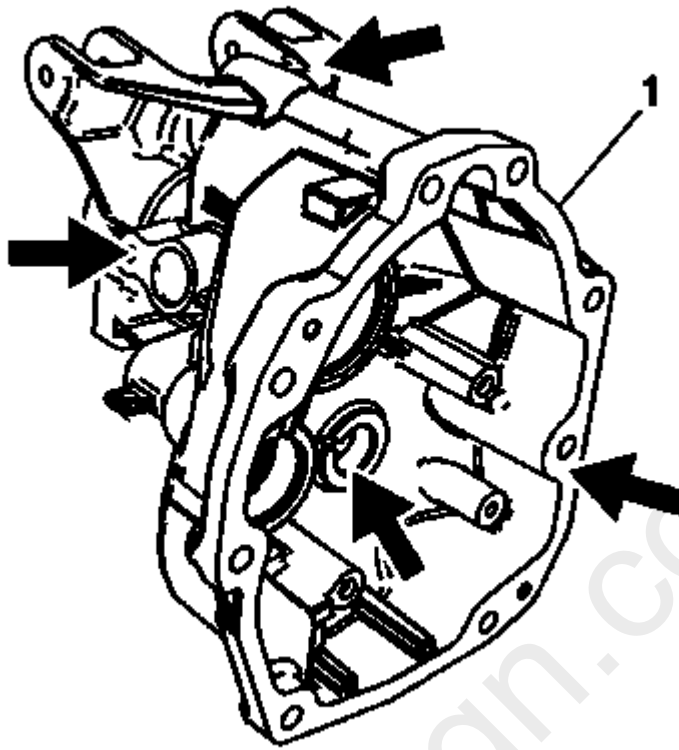


Fig. 202: Identifying Extension Housing
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Safety Glasses and Compressed Air Warning .

1. Clean the rear extension housing (1) 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.

EXTENSION ASSEMBLY

Special Tools

- **DT 48074** Input and Output Shaft Seal Installer
- **DT 48802** Bearing Installer
- **J 8092** Drive Handle
- **J 21426** Outer Output Shaft Seal Installer
- **J 36190** Universal Driver Handle
- **J 39437** Bushing Installer
- **J 39439-3** Rear Case Bushing Installer
- **J 39546** Bearing Race Installer
- **J 44384** Shifter Fork Bearing Installer

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

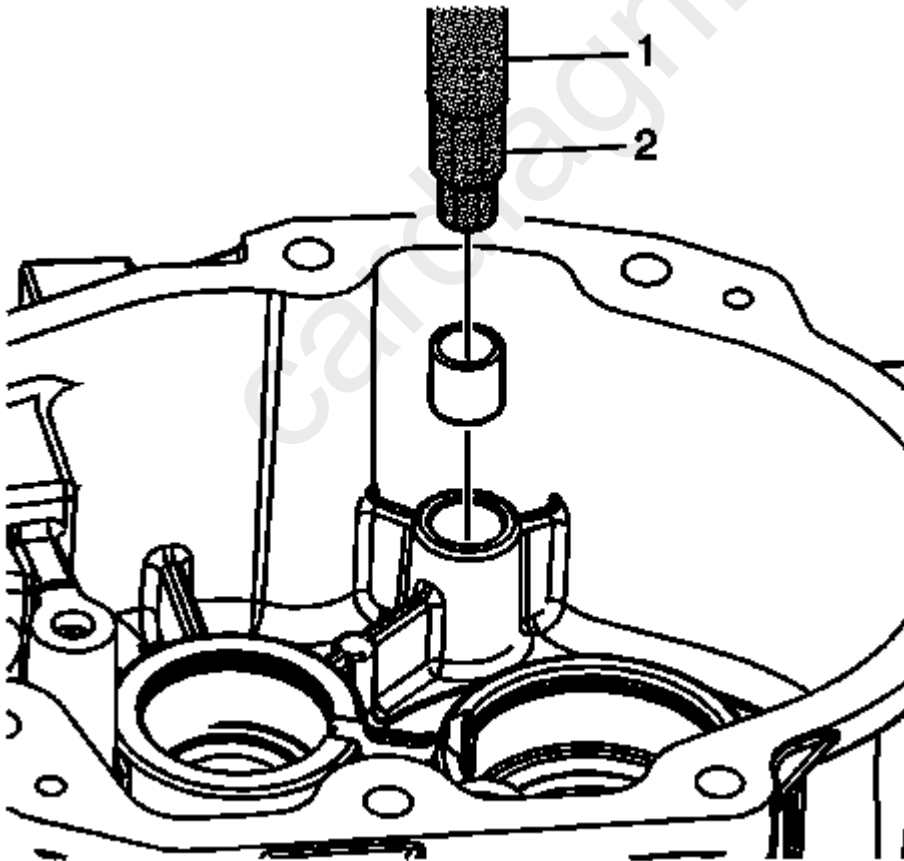


Fig. 203: Installing Reverse Rail Bushing

Courtesy of GENERAL MOTORS COMPANY

1. Using **J 36190** handle (1) and **J 39439-3** installer (2), install the reverse rail bushing.

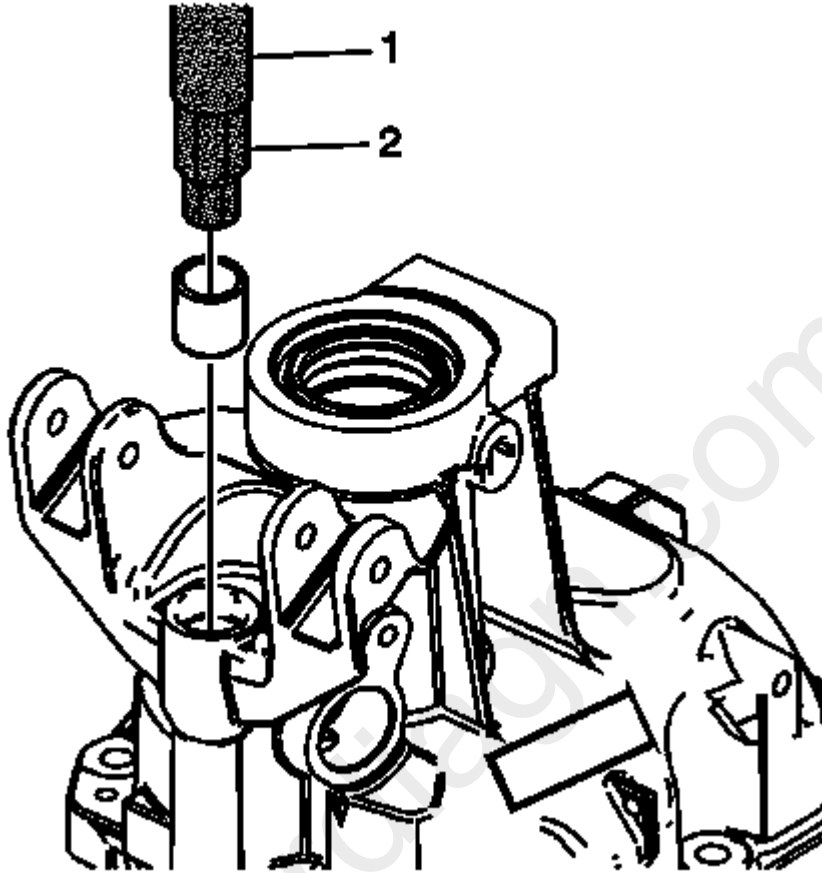


Fig. 204: Installing Shift Rail Bearing

Courtesy of GENERAL MOTORS COMPANY

2. Install the shift rail bearing using the **J 36190** handle (1) and the **J 44384** installer (2) .

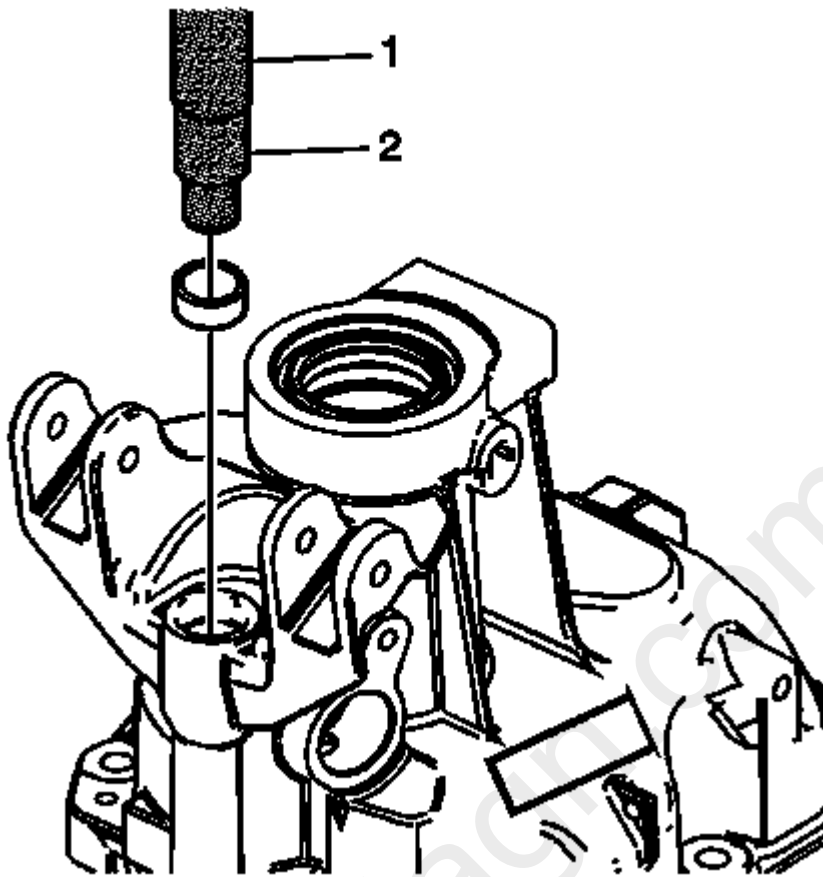


Fig. 205: Installing Seal

Courtesy of GENERAL MOTORS COMPANY

3. Install the seal using the J 36190 handle (1) and J 44384 installer (2).

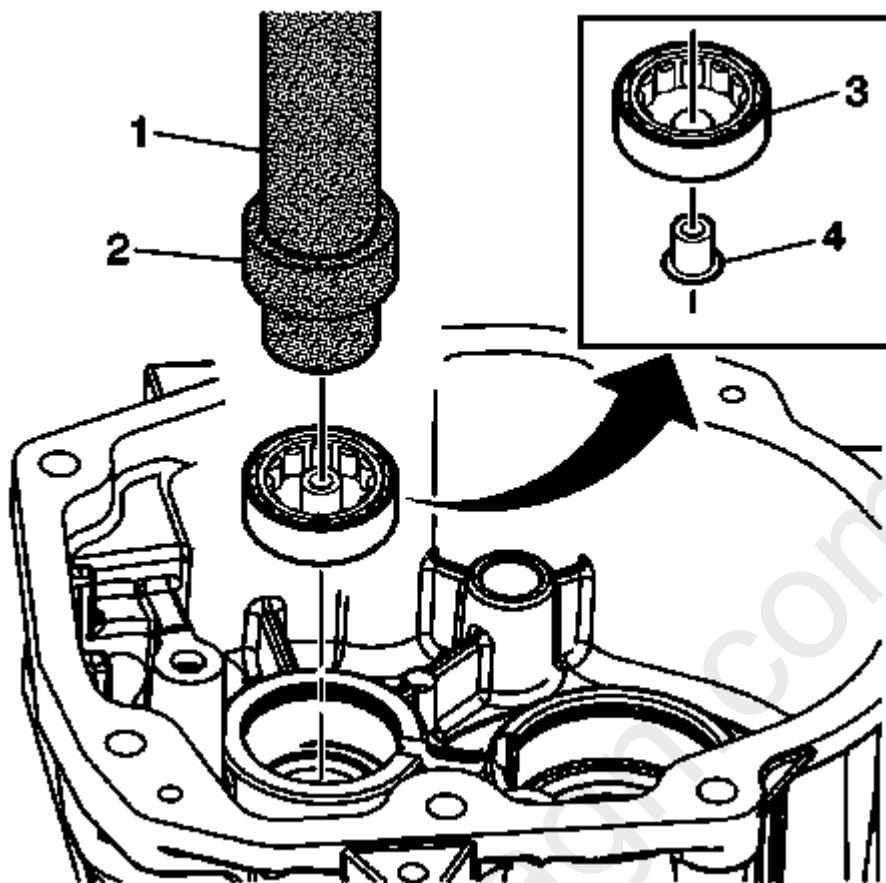


Fig. 206: View Of Oil Funnel Into The Extension Housing Countershaft Bearing
Courtesy of GENERAL MOTORS COMPANY

4. Snap the oil funnel into a NEW extension housing countershaft bearing assembly.
5. Using the J 36190 handle (1) and DT 48802 installer (2), install the countershaft bearing.

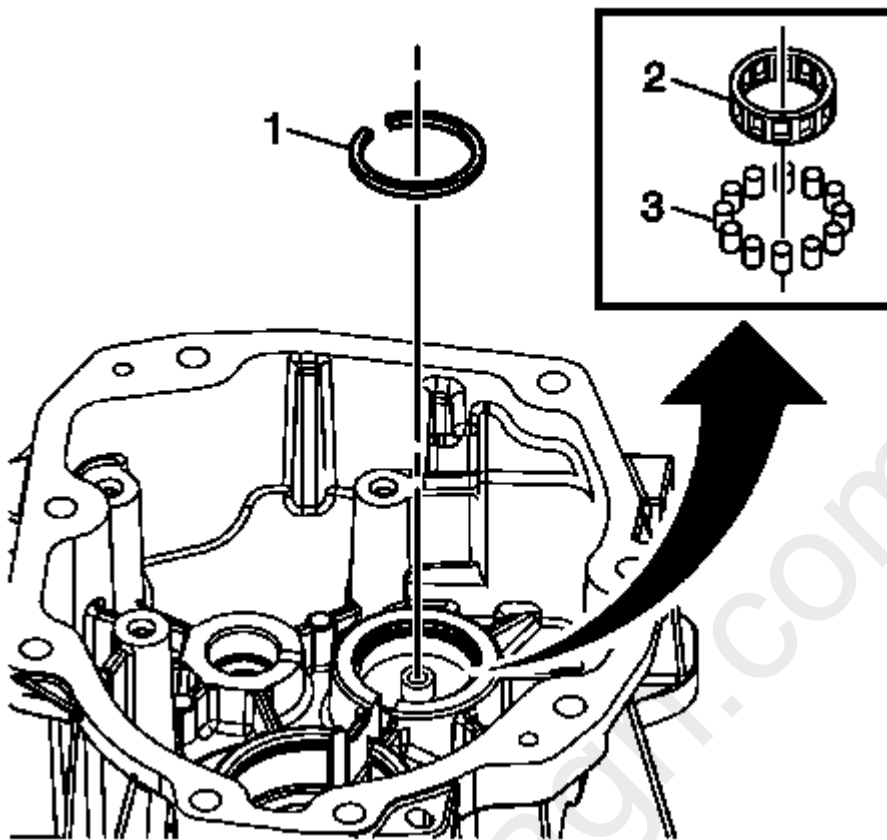


Fig. 207: View Of Countershaft Rear Bearing Retainer
Courtesy of GENERAL MOTORS COMPANY

NOTE: The plastic roller bearing cage (2) and bearings (3) are part of the countershaft bearing assembly.

6. Install the countershaft rear bearing retainer (1).

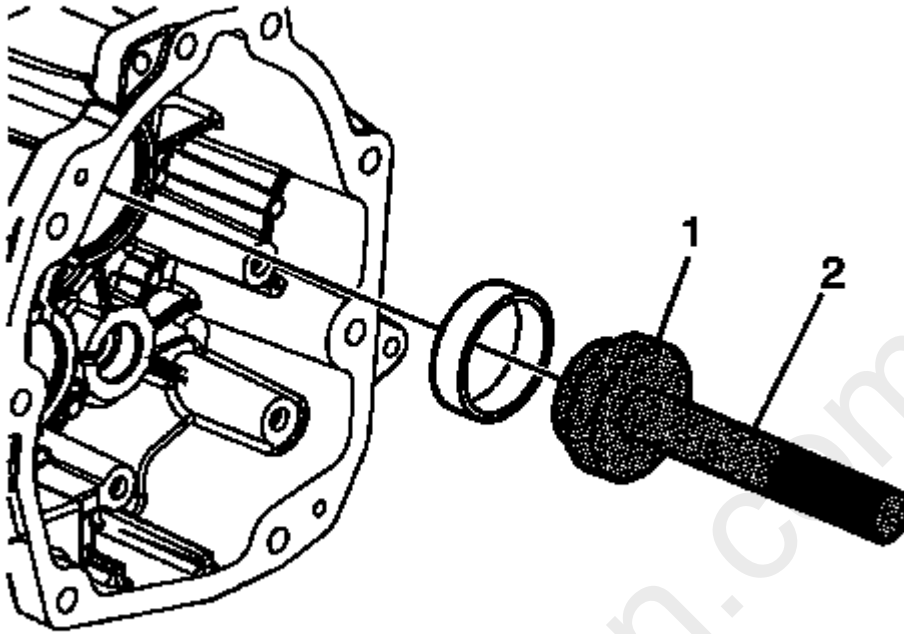


Fig. 208: Installing Mainshaft Bearing Race
Courtesy of GENERAL MOTORS COMPANY

7. Install the mainshaft bearing race, using the **J 39546** installer (1) and the **J 8092** drive handle (2).

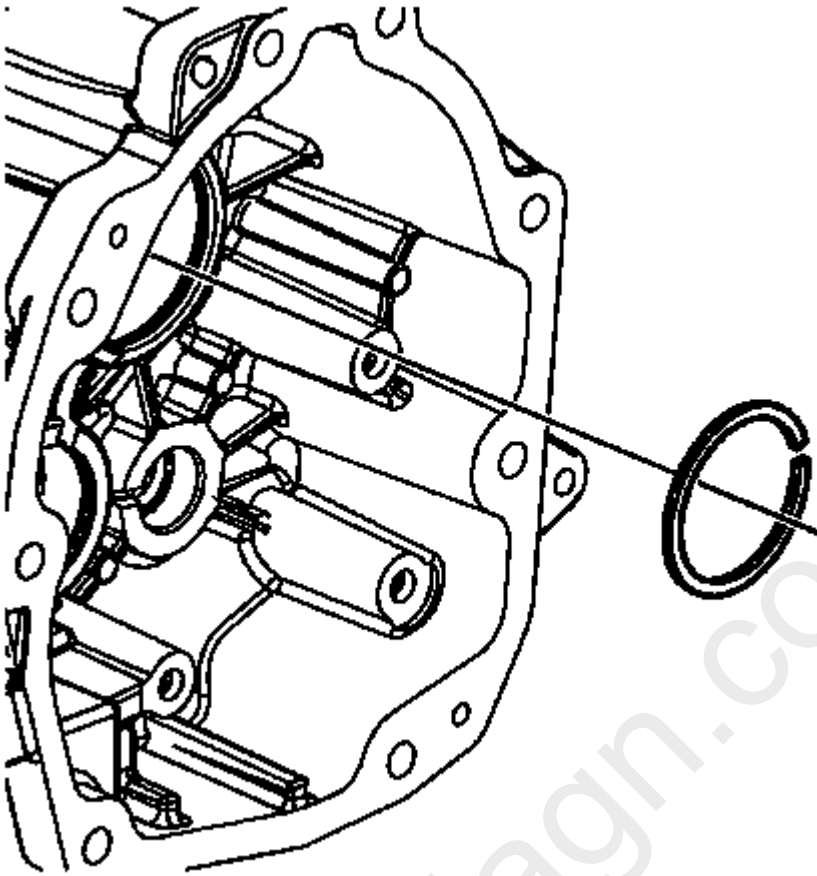


Fig. 209: View Of Mainshaft Bearing Race Retainer Ring
Courtesy of GENERAL MOTORS COMPANY

8. Install the mainshaft bearing race retainer ring.

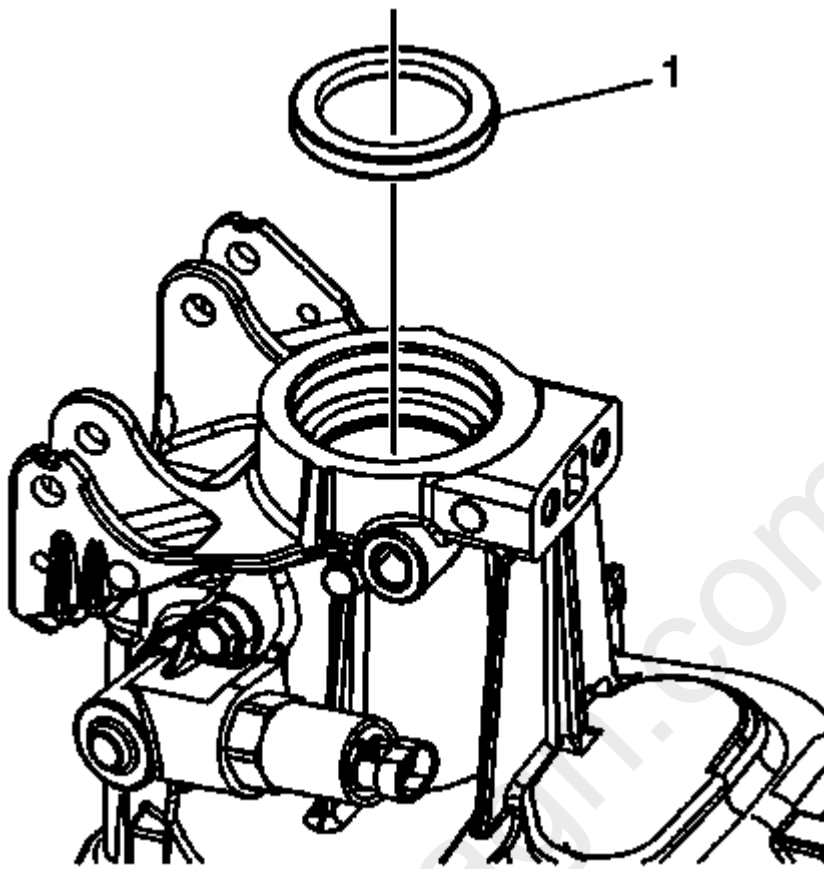


Fig. 210: Identifying Output Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

9. Install the NEW output shaft seal (1) using the **J 8092** drive handle and the **DT 48074** input/output Shaft installer.

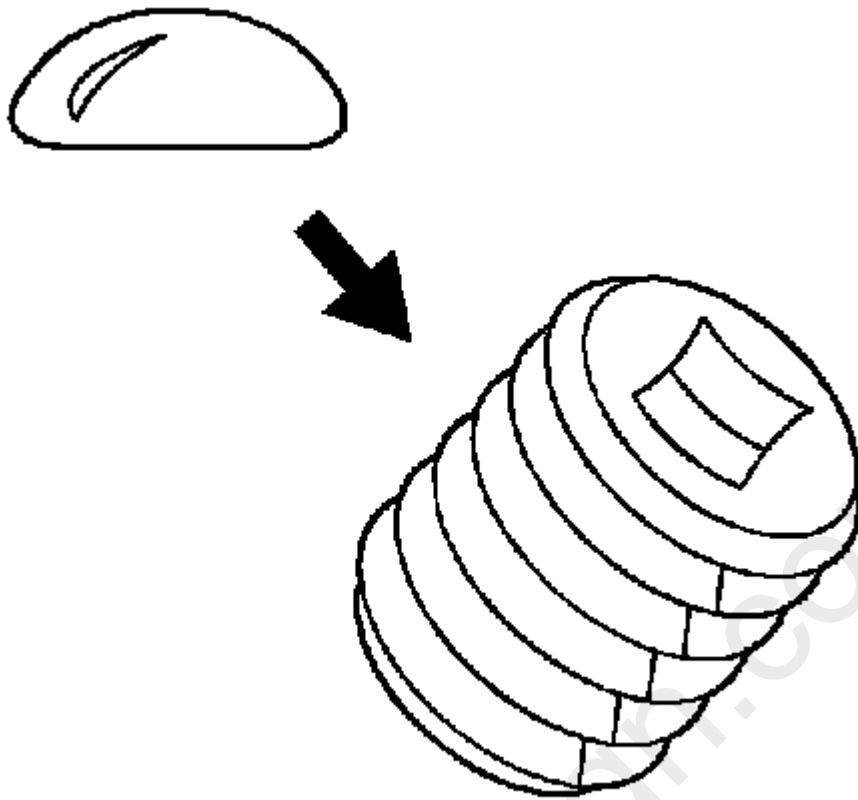


Fig. 211: Applying Sealant To Adapter Plate Plug Threads
Courtesy of GENERAL MOTORS COMPANY

10. Apply sealer GM P/N 12346004 (Canadian P/N 10953480) or equivalent to the transmission case drain plug.

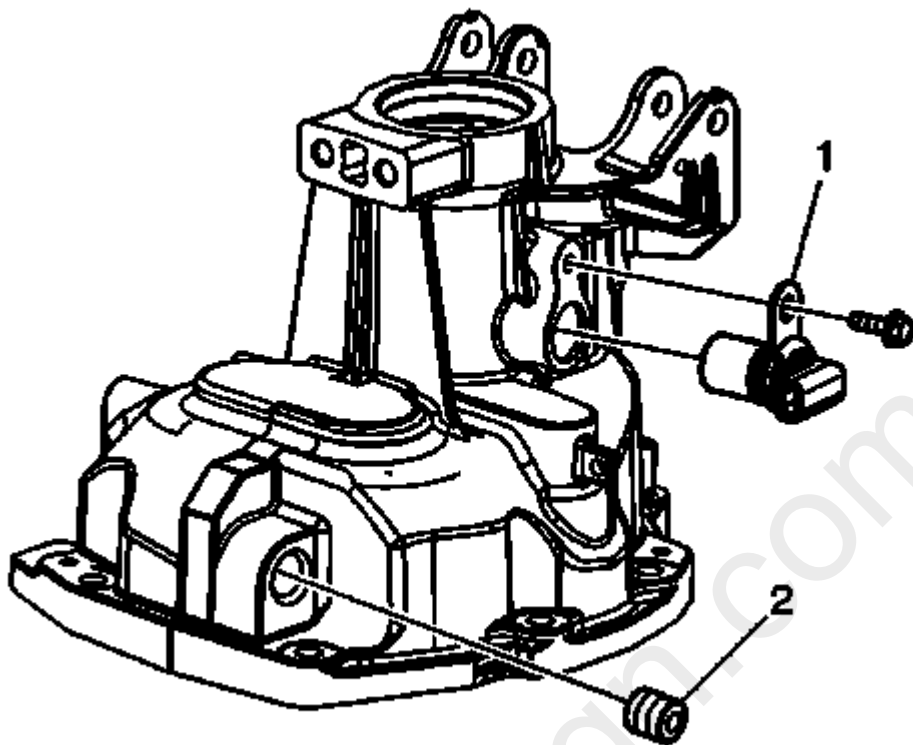


Fig. 212: Identifying Transmission Case Drain Plug & Vehicle Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

11. Install the transmission case drain plug (2) and tighten to 27 N.m (20 lb ft).
12. Install the vehicle speed sensor (1).
13. Install the vehicle speed sensor bolt and tighten to 11 N.m (96 lb in).

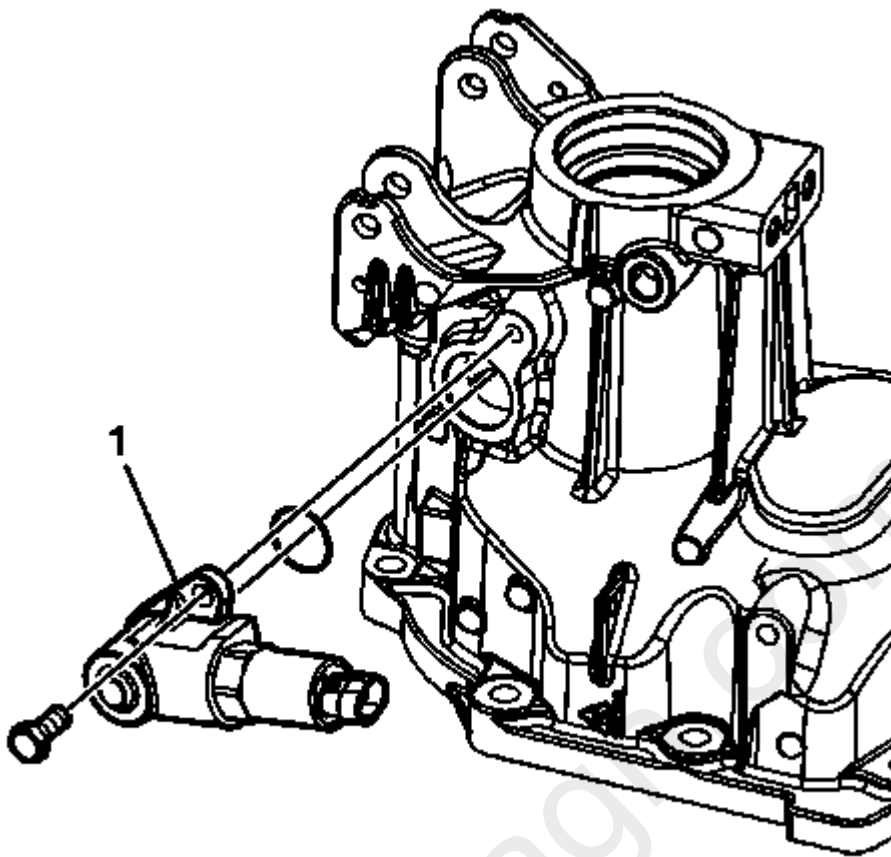


Fig. 213: Identifying Reverse Lockout Assembly
Courtesy of GENERAL MOTORS COMPANY

14. Install a NEW O-ring onto the reverse lockout assembly (1).
15. Install the reverse lockout assembly into the extension housing.
16. Install the reverse lockout assembly bolt and tighten to 18 N.m (13 lb ft).

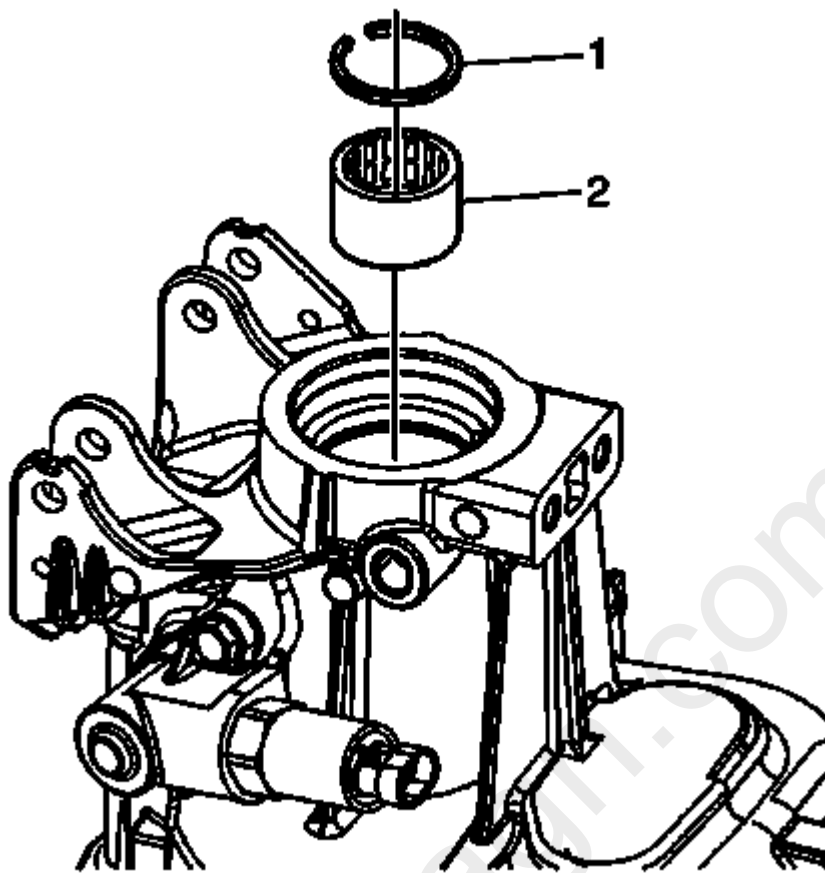


Fig. 214: Identifying Roller Bearing & Snap Ring
Courtesy of GENERAL MOTORS COMPANY

17. Install the roller bearing (2).
18. Install the snap ring (1).

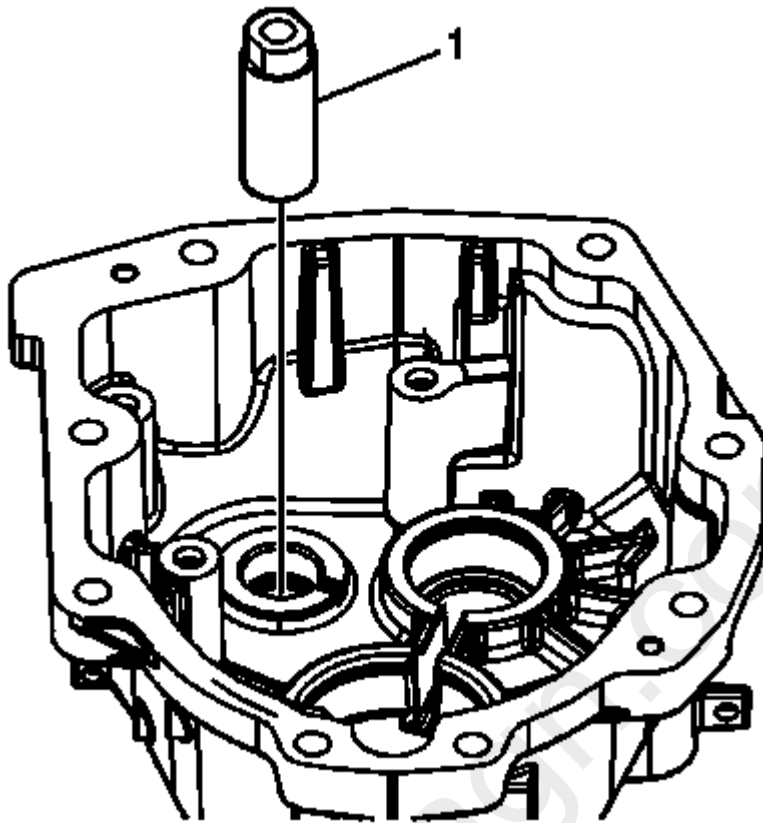


Fig. 215: Identifying Reverse Idler Gear Shaft
Courtesy of GENERAL MOTORS COMPANY

19. Install the reverse idler gear shaft (1).

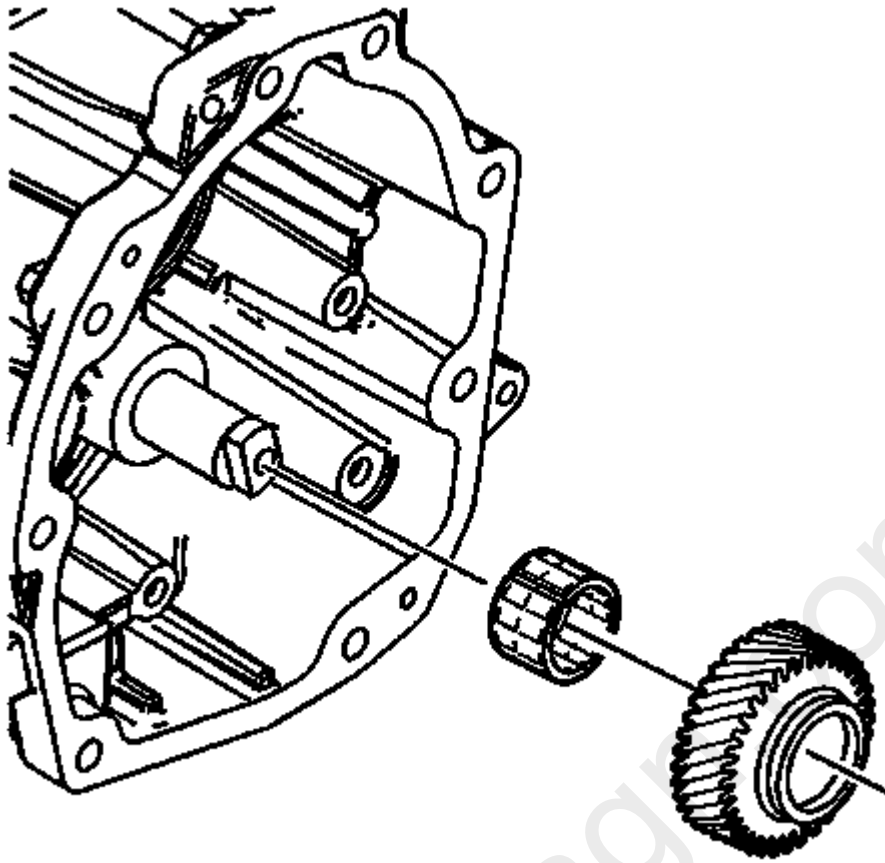


Fig. 216: View Of Reverse Idler Gear And The Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

20. Install the roller bearing and reverse idler gear.

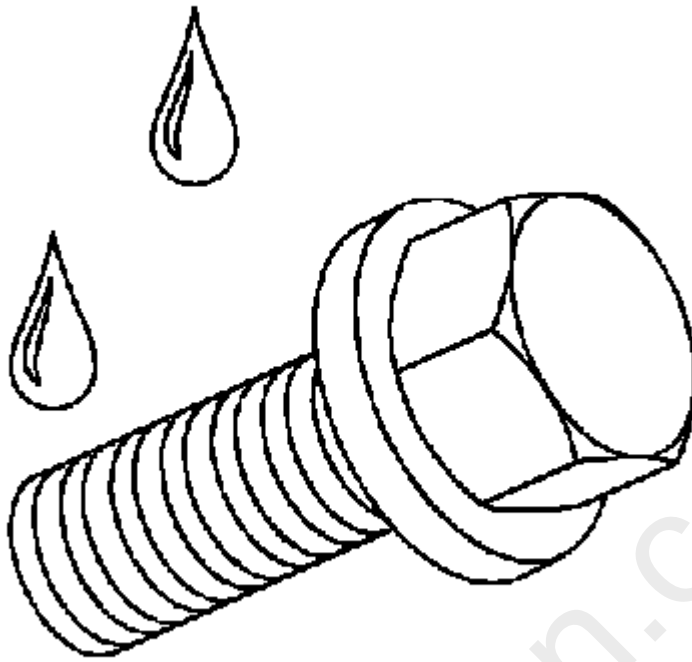


Fig. 217: Applying Sealant To Reverse Idler Shaft Brackets Bolt Threads
Courtesy of GENERAL MOTORS COMPANY

21. Apply GM P/N 12345382, (Canadian P/N 10953489) or equivalent to the reverse idler shaft bracket bolt threads.

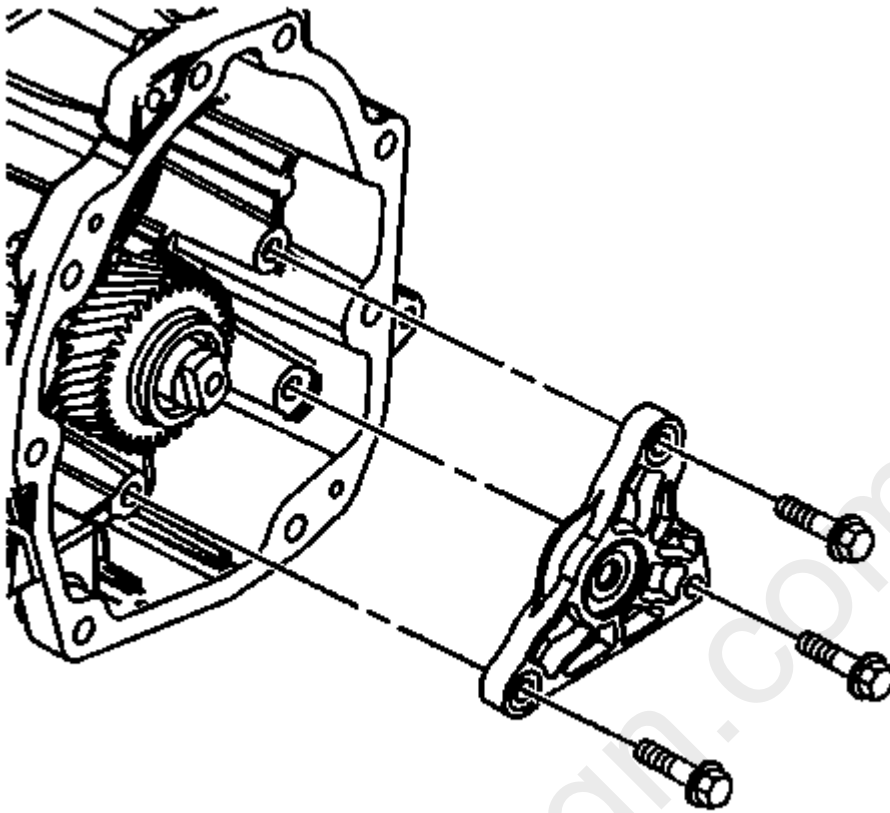


Fig. 218: View Of Reverse Idler Shaft Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

22. Install the reverse idler shaft bracket and bolts. Tighten the bolts to 25 N.m (18 lb ft).

BEARINGS AND SPACERS CLEANING AND INSPECTION

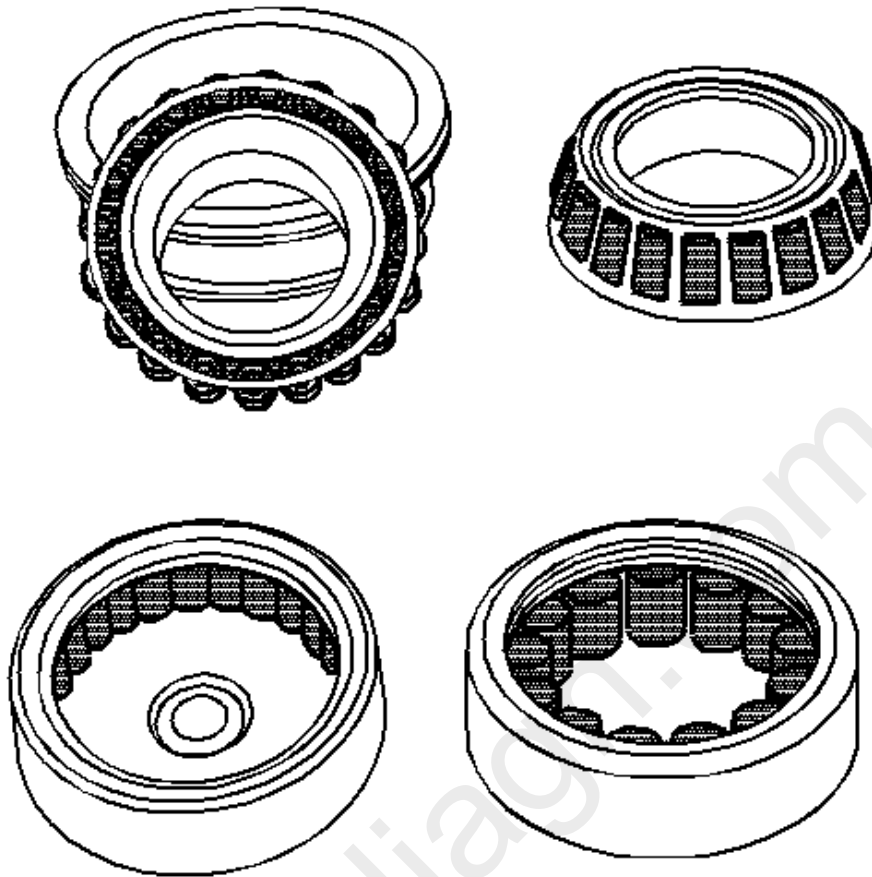


Fig. 219: View of Bearings & Spacers
Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses to avoid injury when using compressed air or any cleaning solvent. Bodily injury may occur if fumes are inhaled or if skin is exposed to chemicals.

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

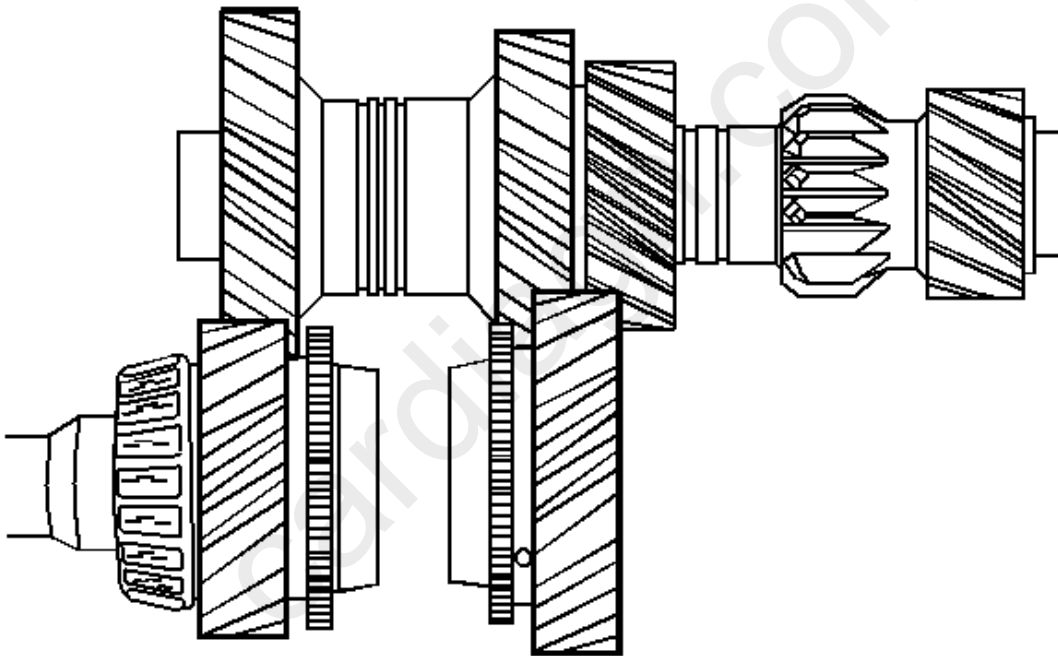


Fig. 220: View Of Gears

Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses to avoid injury when using compressed air or any cleaning solvent. Bodily injury may occur if fumes are inhaled or

if skin is exposed to chemicals.

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 surfaces
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

Special Tools

J 38205-1 Press Tube

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

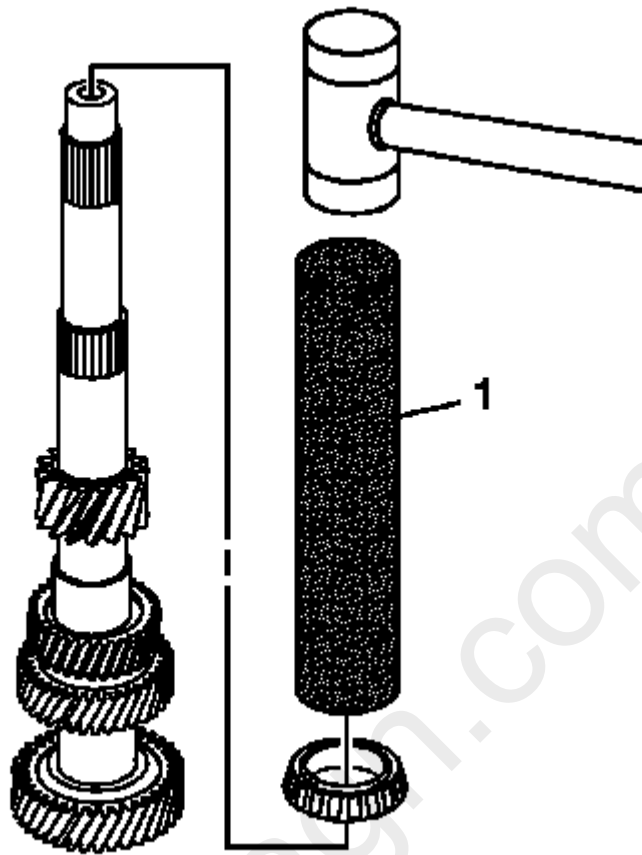


Fig. 221: Installing Large Tapered Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW countershaft rear bearing, using the J 38205-1 press tube (1) and a rubber mallet.

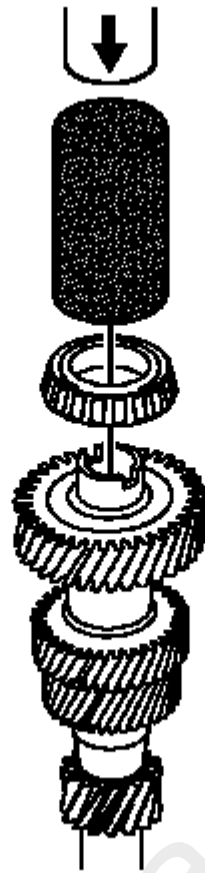


Fig. 222: View Of Small Tapered Bearing & Special Tool
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW countershaft front bearing, using the **J 38205-1** press tube and a hydraulic press.

MAIN SHAFT AND INPUT SHAFT ASSEMBLE

3rd Speed Drive Gear Installation

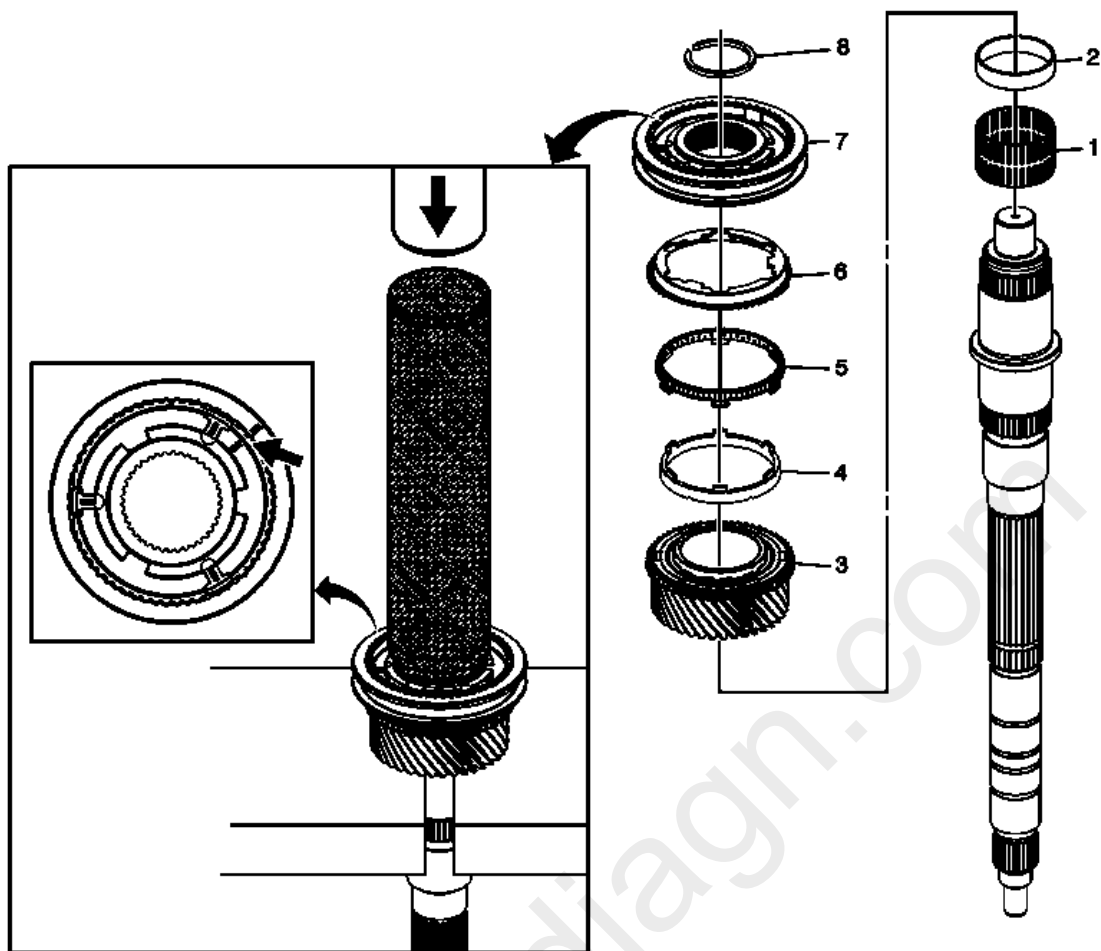


Fig. 223: 3rd Speed Drive Gear Components
 Courtesy of GENERAL MOTORS COMPANY

3rd Speed Drive Gear Installation

Callout	Component Name
1	3rd Speed Drive Gear Needle Bearing
2	3rd Speed Drive Gear Bearing Spacer
3	3rd Speed Drive Gear
4	3rd Speed Drive Gear Inner Cone
5	3rd Speed Gear Friction Cone
6	3rd Speed Drive Gear Synchronizer Blocking Ring
	NOTE: Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub.
	3rd/4th Synchronizer Assembly
	NOTE:

7	The groove on the sleeve faces the 3rd speed gear. Procedure 1. Check the 3rd/4th speed 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 speed gear in order to engage the keys with the blocking ring. 5. Continue pressing until the synchronizer is seated. Special Tools • J-36183 Press Tube • J-36184 Press Tube Adapter For equivalent regional tools, refer to <u>Special Tools</u>.
8	3rd/4th Synchronizer Retaining Ring

2nd Speed Drive Gear Installation

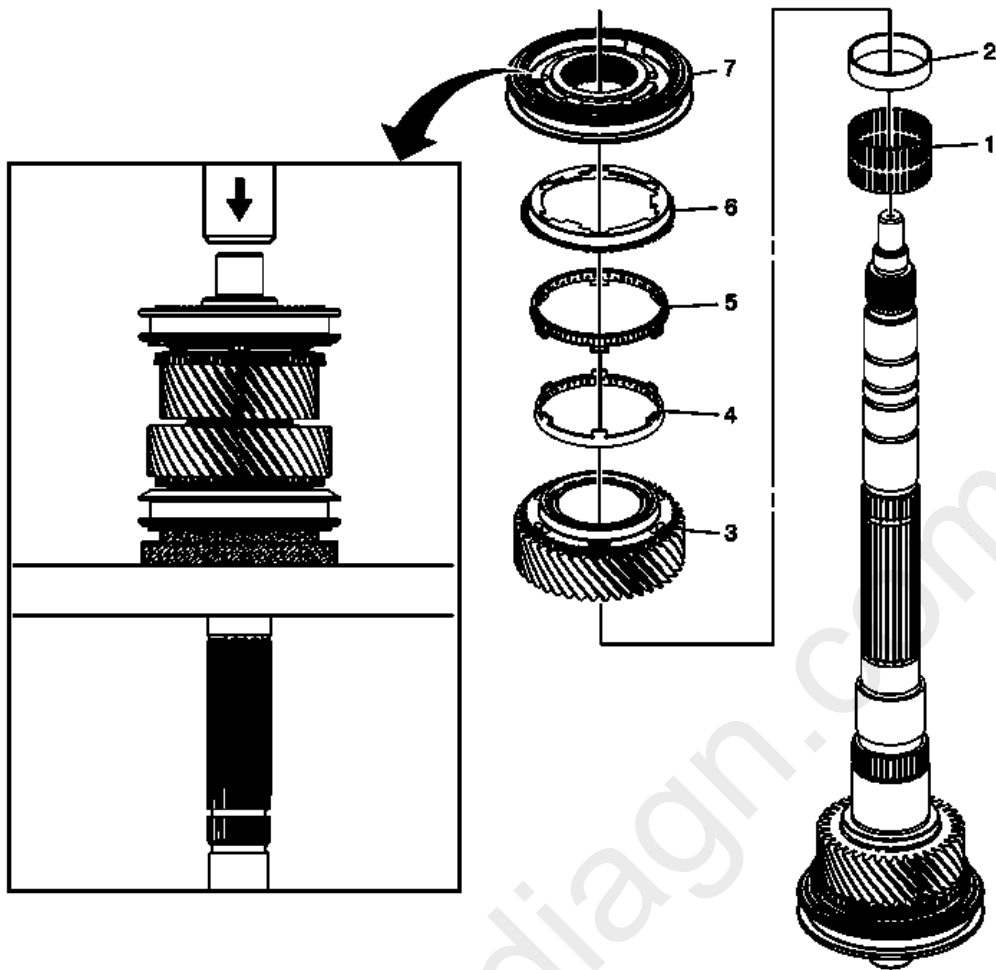


Fig. 224: 2nd Speed Drive Gear Components
 Courtesy of GENERAL MOTORS COMPANY

2nd Speed Drive Gear Installation

Callout	Component Name
1	2nd Speed Drive Gear Needle Bearing
2	2nd Speed Drive Gear Bearing Spacer
3	2nd Speed Drive Gear
4	2nd Speed Drive Gear Inner Cone
5	2nd Speed Drive Gear Friction Cone
6	2nd Speed Drive Gear Synchronizer Blocking Ring
	NOTE: Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub.
	1st/2nd Synchronizer Assembly
	NOTE:

The ID groove on the sleeve faces the 2nd speed gear.

Procedure

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

Special Tools

J-39371 1st/2nd Synchronizer Installer

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

1st Speed Drive Gear Installation

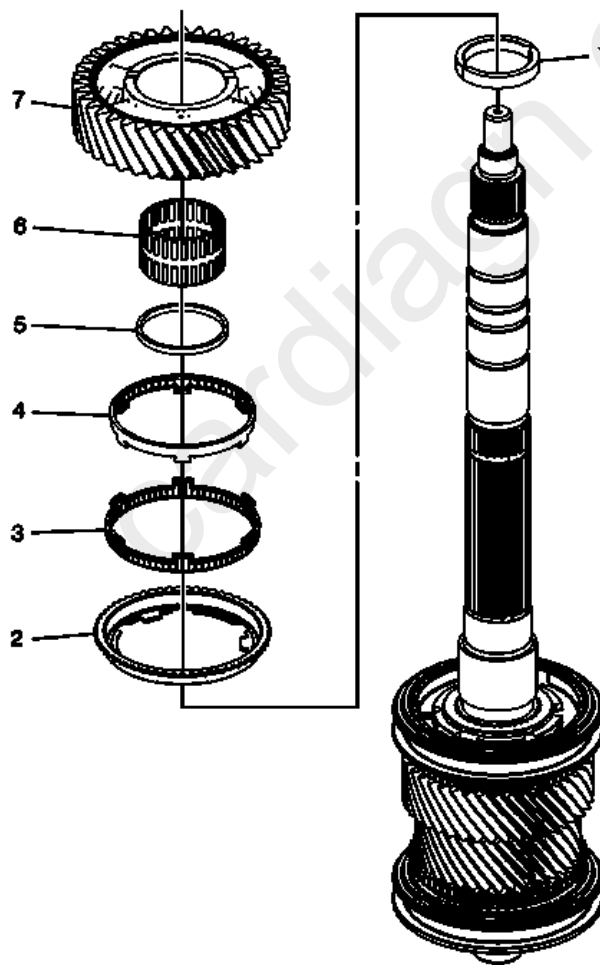


Fig. 225: 1st Speed Drive Gear Components
Courtesy of GENERAL MOTORS COMPANY

1st Speed Drive Gear Installation

Callout	Component Name
1	1st Speed Drive Gear Two Piece Washer
2	1st Speed Drive Gear Synchronizer Blocking Ring NOTE: Ensure the tabs on the blocking ring align with the corresponding pockets in the synchronizer hub.
3	1st Speed Drive Gear Friction Cone
4	1st Speed Drive Gear Inner Cone
5	1st Speed Drive Gear Locking Ring
6	1st Speed Drive Gear Needle Bearing
7	1st Speed Drive Gear

6th Speed Driven Gear Installation

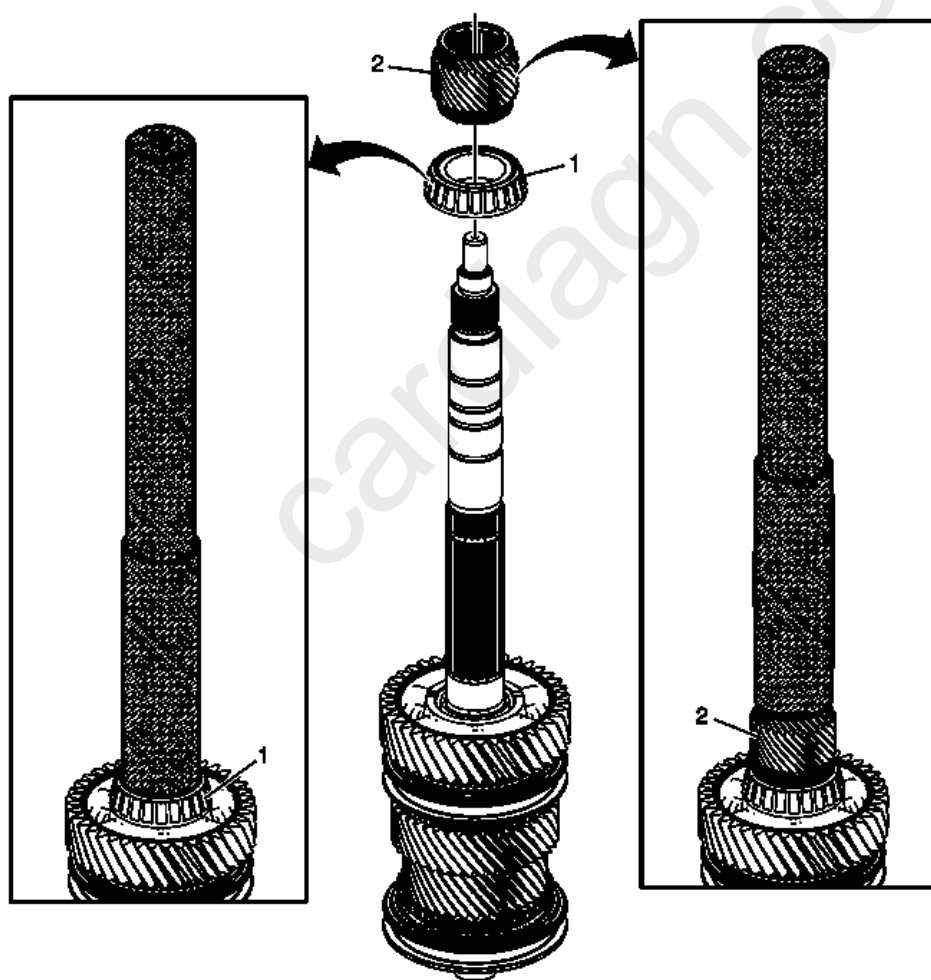


Fig. 226: 6th Speed Driven Gear Components
Courtesy of GENERAL MOTORS COMPANY

6th Speed Driven Gear Installation

Callout	Component Name
1	Main Shaft Bearing Special Tools • J-39441 5th/6th Driven Gear Installer • J-39441-20 5th Gear Installer Adapter
2	6th Speed Driven Gear Special Tools • J-39441 5th/6th Driven Gear Installer • J-39441-10 5th Gear Installer Adapter

Input Shaft Bearing Installation

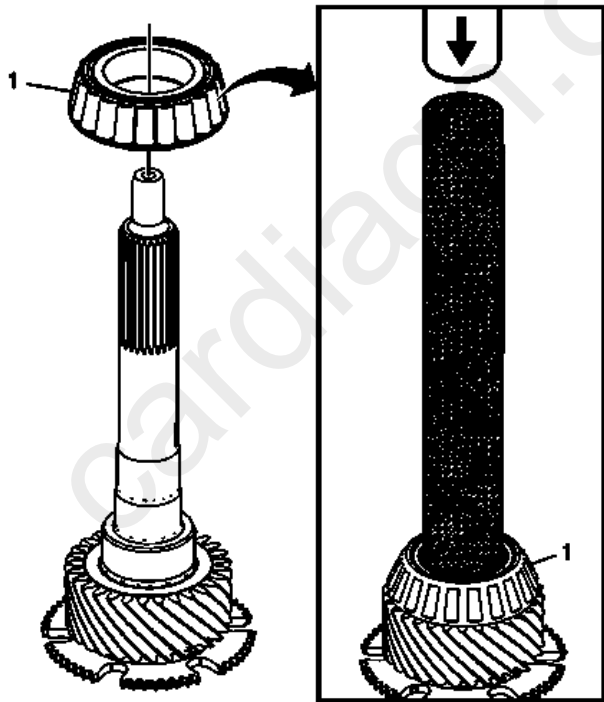


Fig. 227: Input Shaft Bearing
Courtesy of GENERAL MOTORS COMPANY

Input Shaft Bearing Installation

Callout	Component Name
1	Input Shaft Bearing Special Tools J-44735 Installation Tube

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

Input Shaft Pocket Bearing Installation

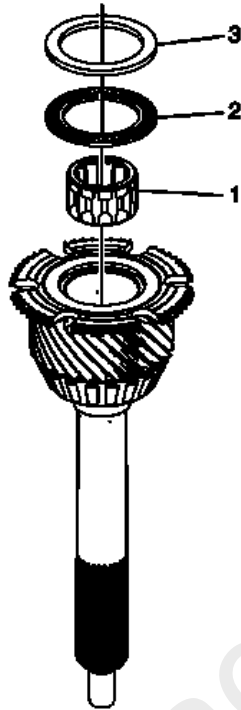


Fig. 228: Input Shaft Pocket Bearing Components
Courtesy of GENERAL MOTORS COMPANY

Input Shaft Pocket Bearing Installation

Callout	Component Name
1	Input Shaft Bearing
2	Input Shaft Thrust Bearing
3	Input Shaft Thrust Washer

TRANSMISSION ASSEMBLE

Special Tools

- **DT 47678** Transmission Holding Flange
- **DT 47678-10** Transmission Holding Flange Adapter
- **DT 49293** Gear Select/Skip Shift Solenoid Socket
- **J 08614A** Pinion Flange Holder and Remover
- **J 3289-20** Holding Fixture
- **J 36017** Valve Seal Remover
- **J 36850** Transjel® Lubricant Assembly Lube

- **J 38205-1** Press Tube
- **J 39441-20** Fifth Gear Installer Adapter
- **J 39441-30** 5th/6th Driven Gear Installer
- **J 39442** Mainshaft and Countershaft Press Adapter
- **J 44395** Transmission Holding Fixture

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

Shift Shaft Assemblies and Gear Clusters Installation

1. Lubricate all components as assembly progresses, using **J 36850** transjel® lubricant.

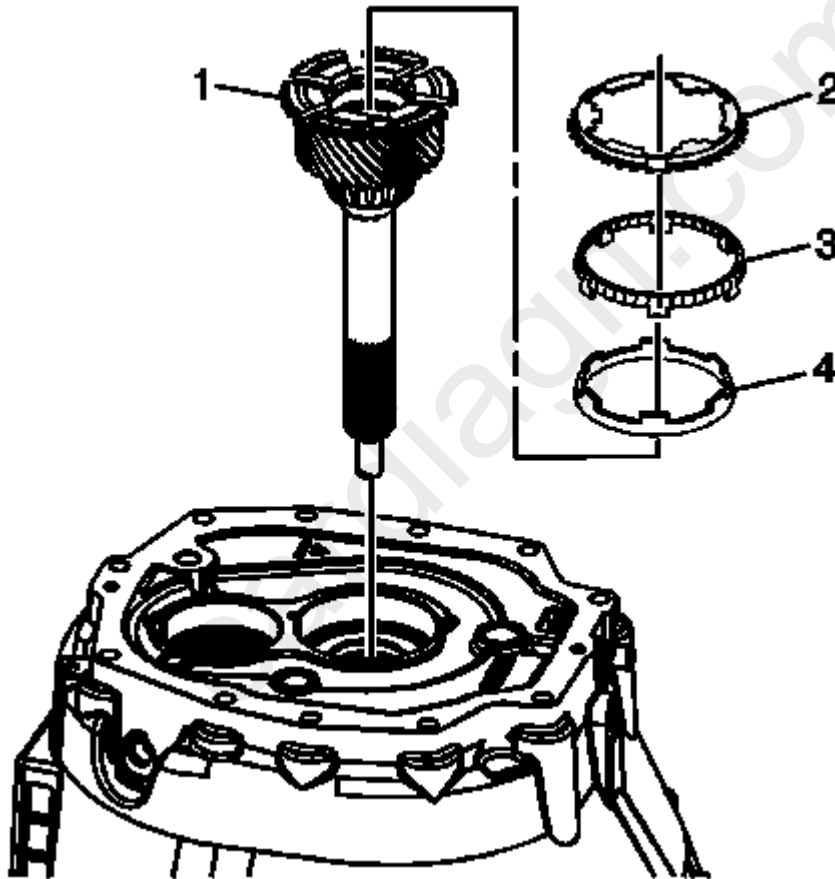


Fig. 229: Identifying 4th Gear Blocking Ring Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

2. Install the input shaft (1) in the clutch housing.
3. Install the 4th gear blocking assembly:
 1. Install the 4th speed drive gear inner cone (4).
 2. Install the 4th speed drive gear outer cone (3).
 3. Install the 4th speed drive gear blocking ring (2).

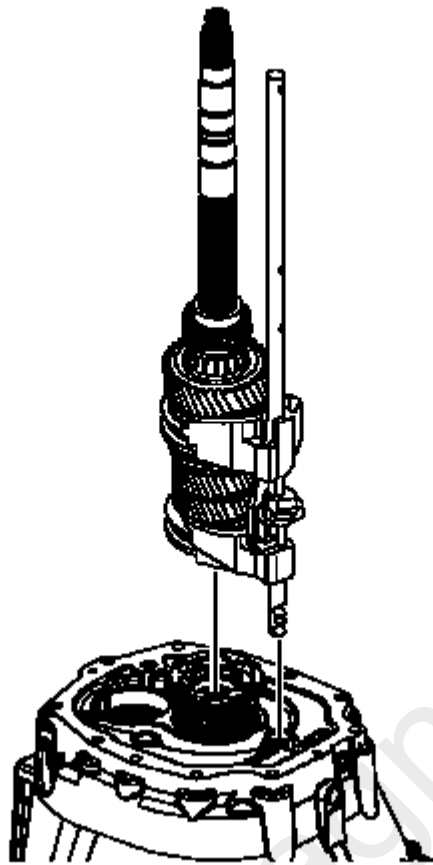


Fig. 230: View Of Mainshaft & Shift Shaft Components
Courtesy of GENERAL MOTORS COMPANY

NOTE: In order for the shift forks to properly line up with the synchronizers, the shift shaft assembly must be assembled correctly. Refer to Shift Shaft and Fork Assemblies Assemble.

4. Assemble the shift shaft to the mainshaft.
5. Install the mainshaft and the shift shaft assembly into the clutch housing.

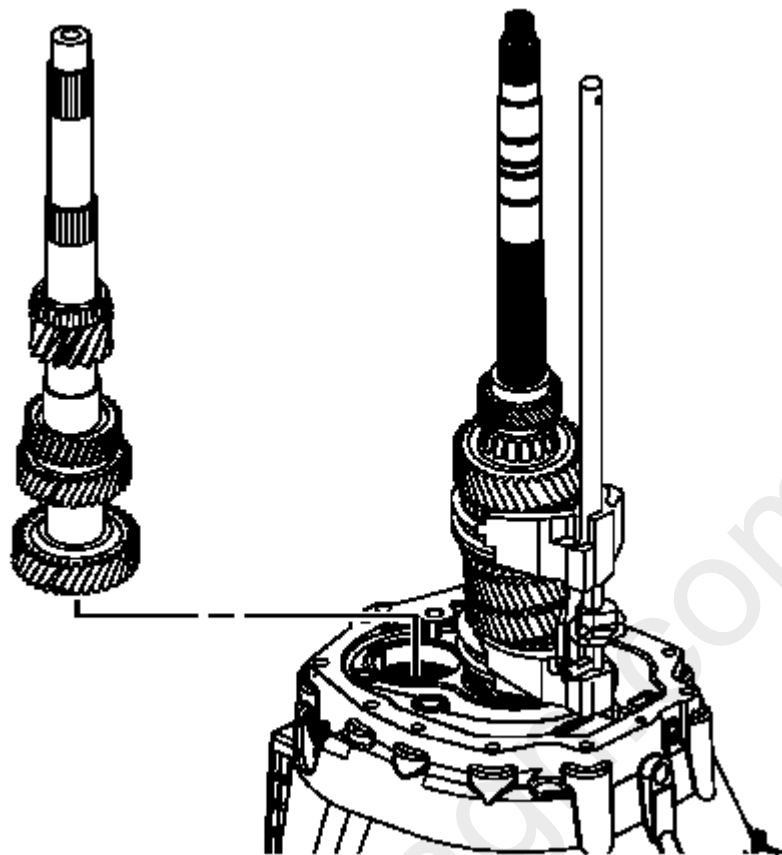


Fig. 231: View Of Countershaft
Courtesy of GENERAL MOTORS COMPANY

6. Install the countershaft assembly using the following sequence:
 1. Lift up the mainshaft assembly enough in order to install the countershaft assembly.
 2. Install the countershaft assembly.
 3. Lift the mainshaft assembly enough in order to rotate the input shaft to engage the synchronizer keys with 4th gear blocking ring.

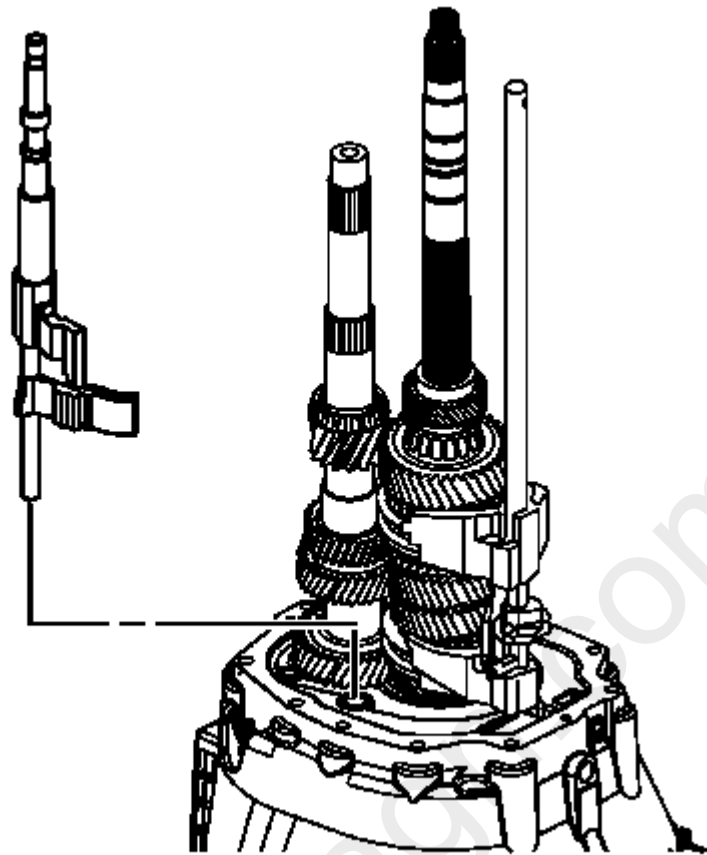


Fig. 232: View Of 5th/6th & Reverse Shift Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the 5th/6th and the reverse shift shaft.

Align the slots of the shift shaft levers with the interlock plate.

Oil Filter Installation

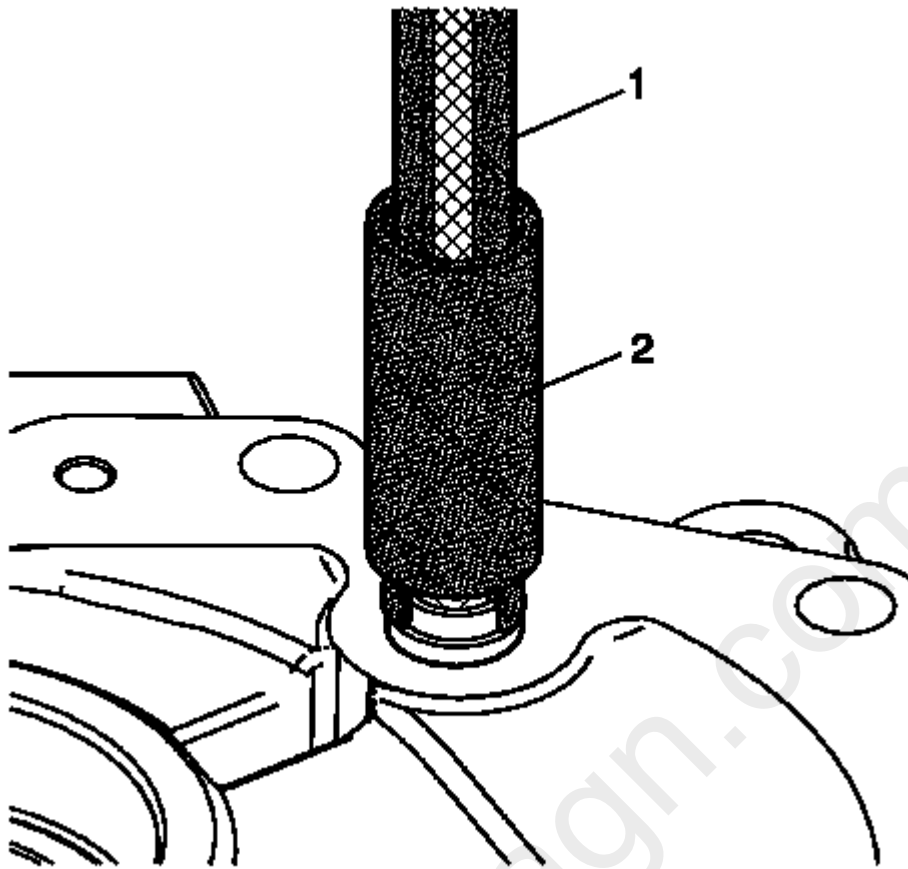


Fig. 233: Grasping Oil Filter Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Attach the **J 36017** remover (1) within the groove at the base of the oil filter assembly. Slide the collar (2) of the tool down to grasp the oil filter assembly.

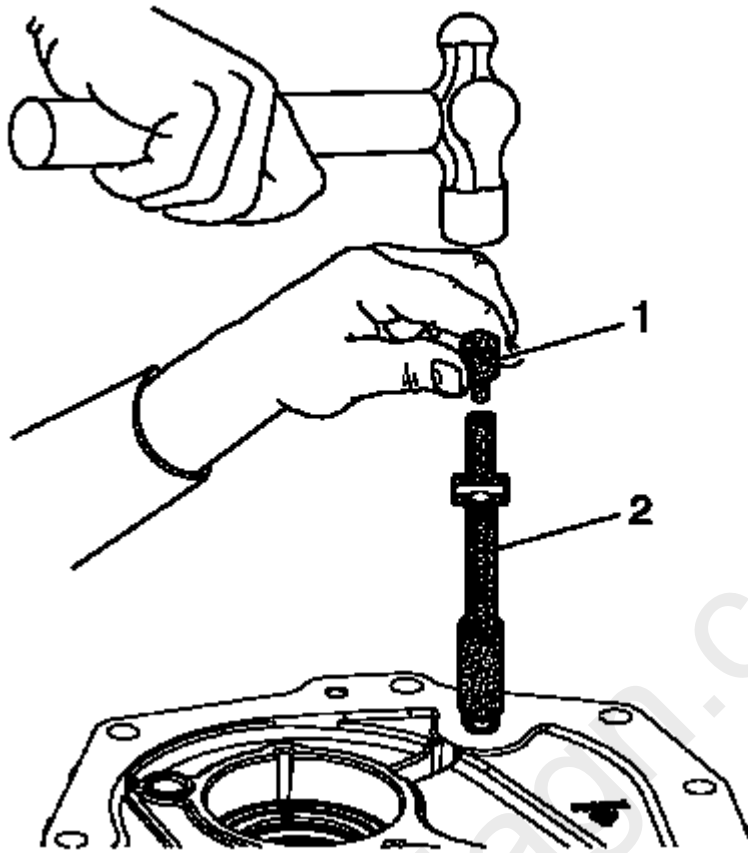


Fig. 234: Installing Oil Filter Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Place the oil filter assembly with J 36017 remover (2) attached onto the clutch housing.
3. Using the J 39442 adapter (1), tap the oil filter assembly into place with a hammer. Remove the J 36017 remover.

Transmission Case Installation

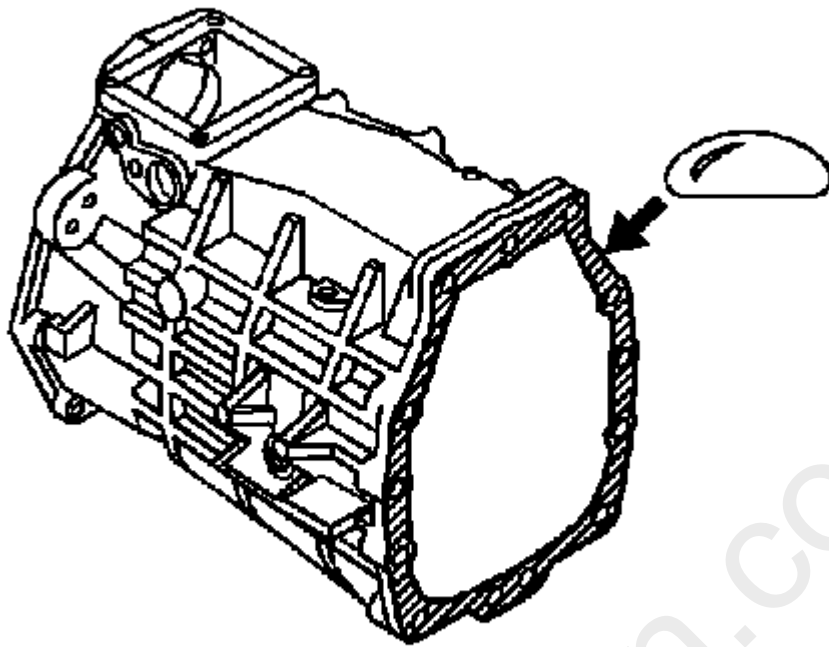


Fig. 235: Apply Sealer To Transmission Case To Adapter Plate Mating Surface
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate all components as the assembly progresses. Use J 36850 transjel® lubricant or the equivalent.

1. Apply sealant GM P/N 12345739, (Canadian P/N 10953472) or equivalent to the transmission case to adapter plate mating surface.

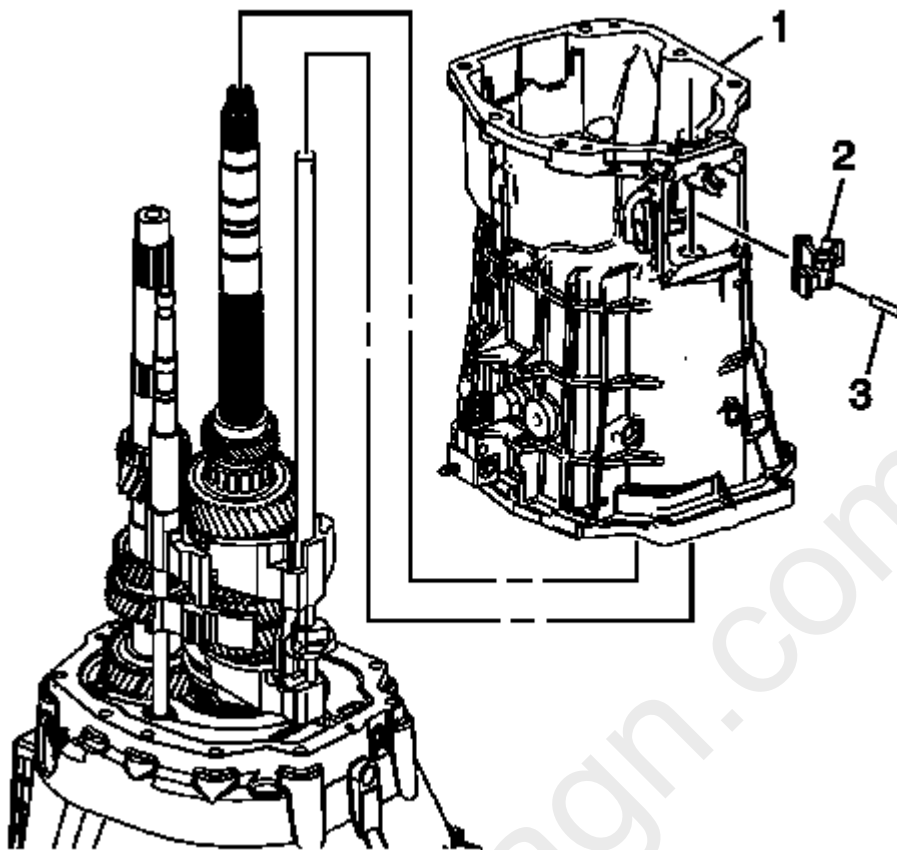


Fig. 236: Identifying Transmission Case & Select Control Lever Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Do the following in order to install the transmission case and the select control lever assembly:
 1. Shift the transmission into NEUTRAL in order to keep the 3rd/4th shift shaft from engaging.
 2. Install the select control lever assembly (2), through the transmission case opening, while sliding the transmission case (1) onto the gear clusters and the shift rail components.
 3. Install the select control lever assembly pin (3).

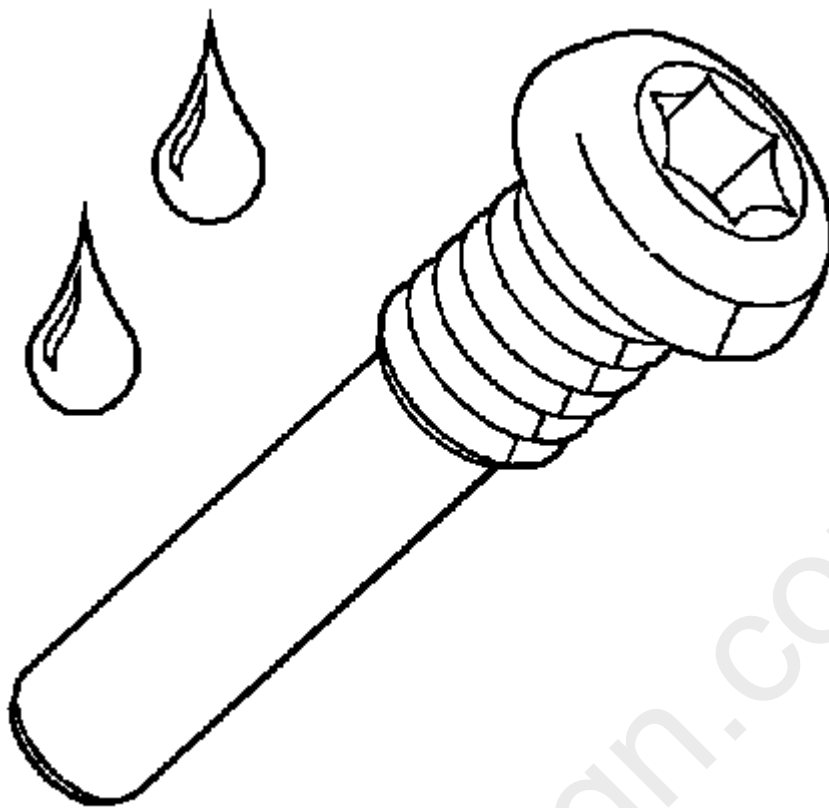


Fig. 237: Applying Sealer To Shift Lever Guide Bolts Threads
Courtesy of GENERAL MOTORS COMPANY

3. Apply threadlock GM P/N 12346004, (Canadian P/N 10953480) or equivalent to the threads of the shift lever guide bolts.

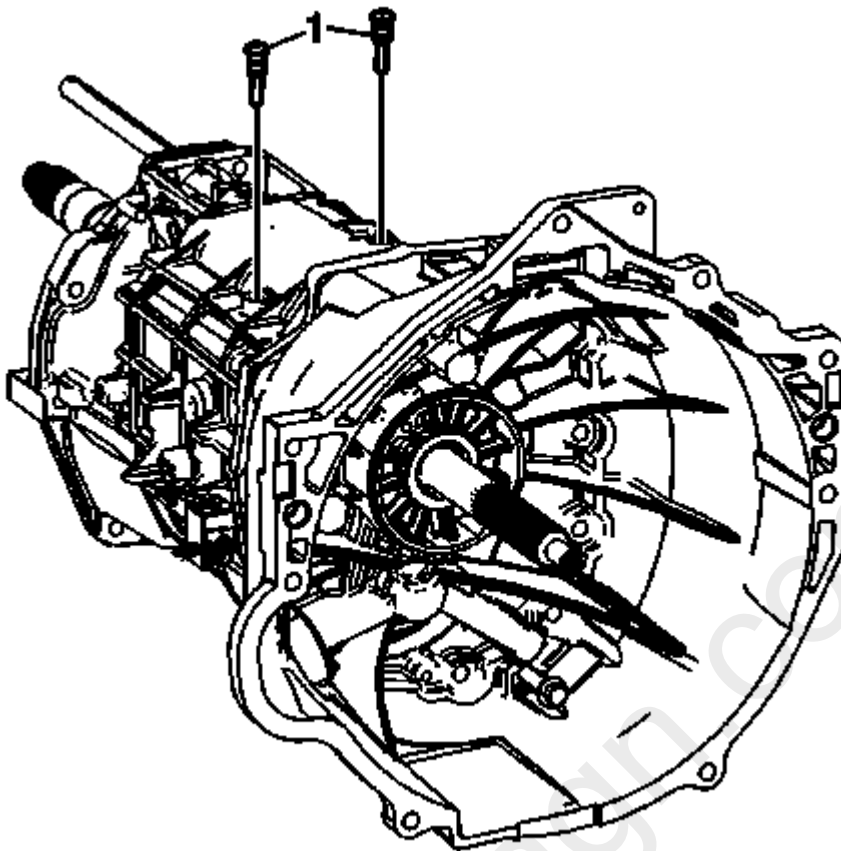


Fig. 238: Identifying Shift Lever Guide Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: In order to align the shift interlock plate slot with the shift lever guide bolt holes, pull up on the 5th/6th and reverse shift rail assembly while installing the shift lever guide bolts.

4. Install the shift lever guide bolts (1) while pulling up on 5th/6th and reverse shift rail assembly. Tighten the bolts to 27 N.m (20 lb ft).

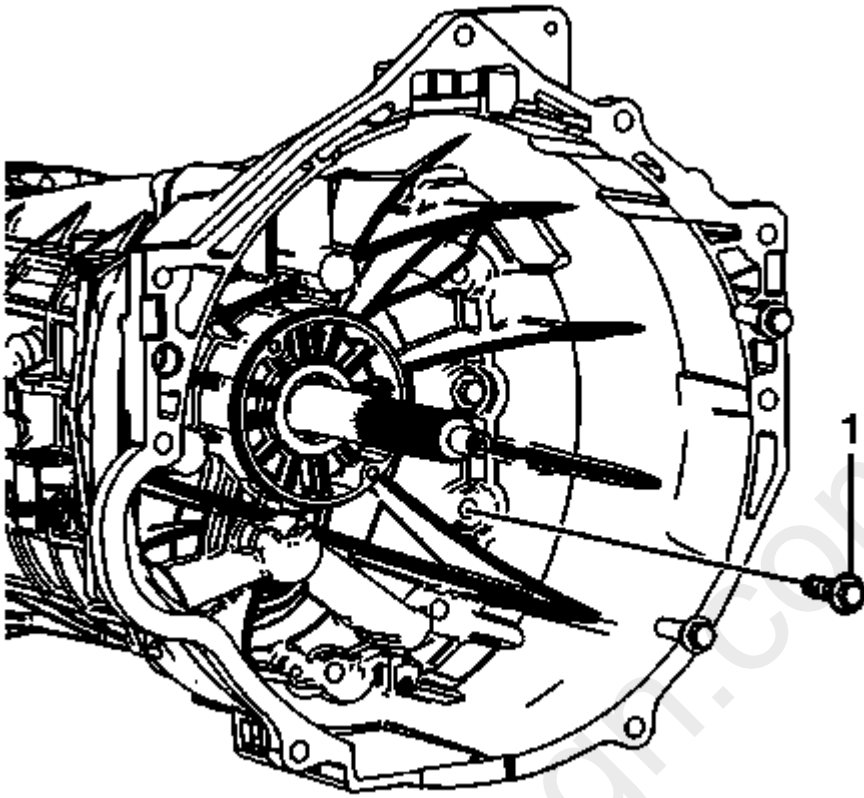


Fig. 239: Identifying Clutch Housing To Transmission Case Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the clutch housing to transmission case bolts (1) and tighten to 48 N.m (36 lb ft).

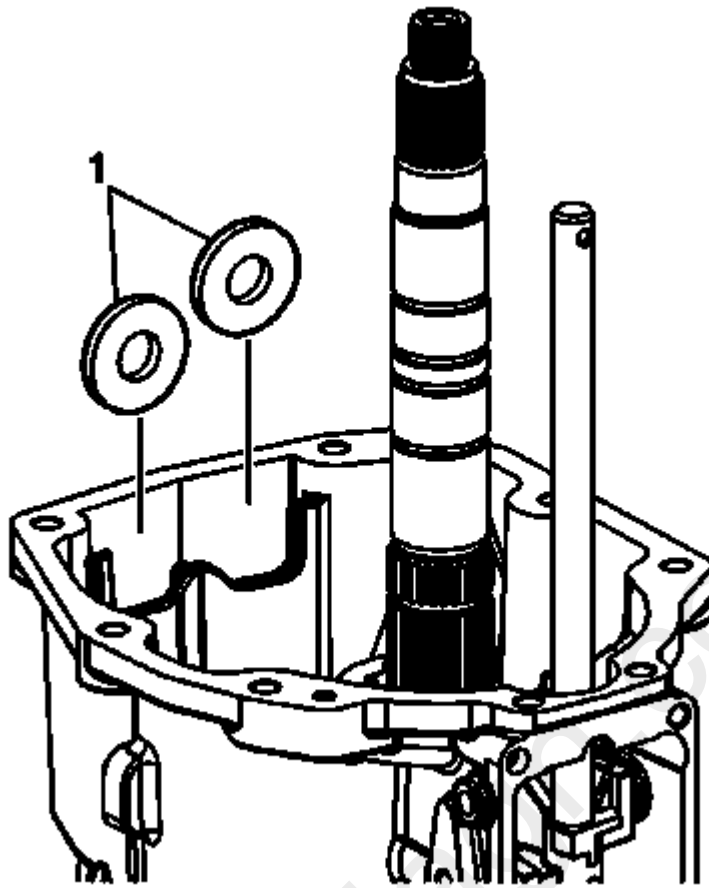


Fig. 240: Identifying Transmission Case Magnets
Courtesy of GENERAL MOTORS COMPANY

6. Install the magnets (1) into the transmission case.

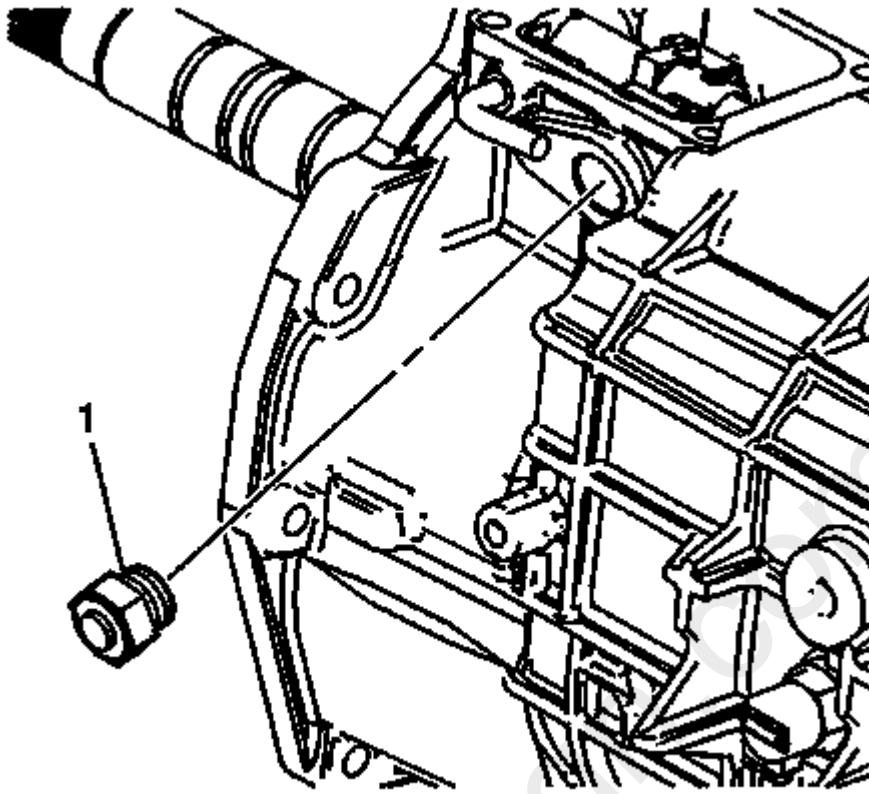


Fig. 241: Identifying Shift Detent Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the shift detent assembly (1) and tighten to 40 N.m (30 lb ft).

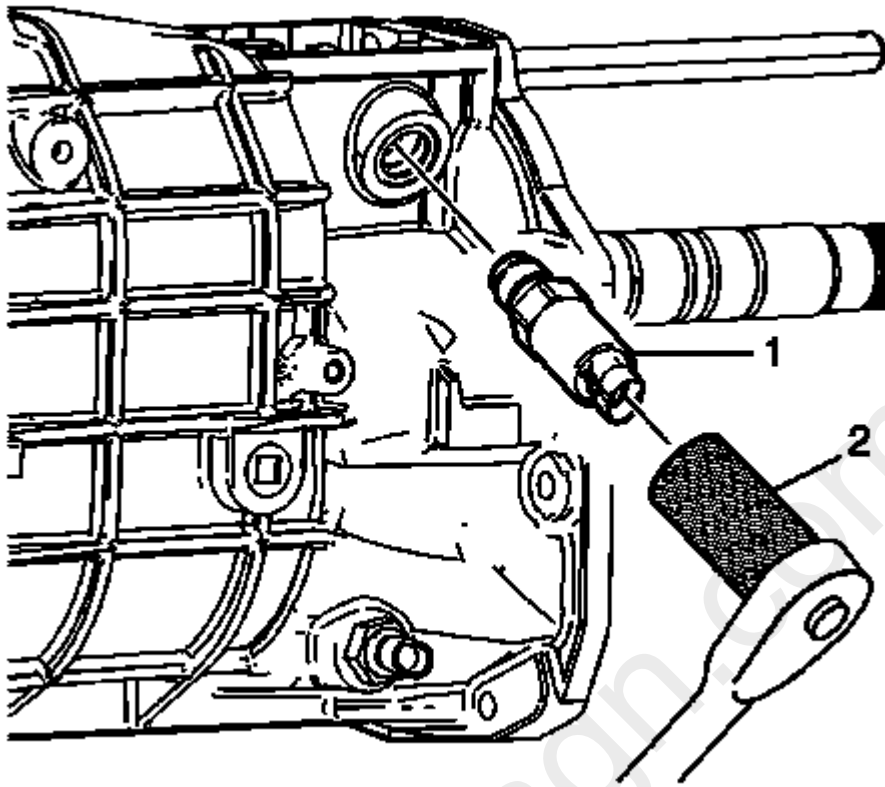


Fig. 242: Removing/Installing Gear Select/Skip Shift Solenoid
Courtesy of GENERAL MOTORS COMPANY

8. Using **DT 49293** socket (2), install the gear select/skip shift solenoid (1) and tighten to 40 N.m (30 lb ft).

5th/6th Speed Driven Gear Installation

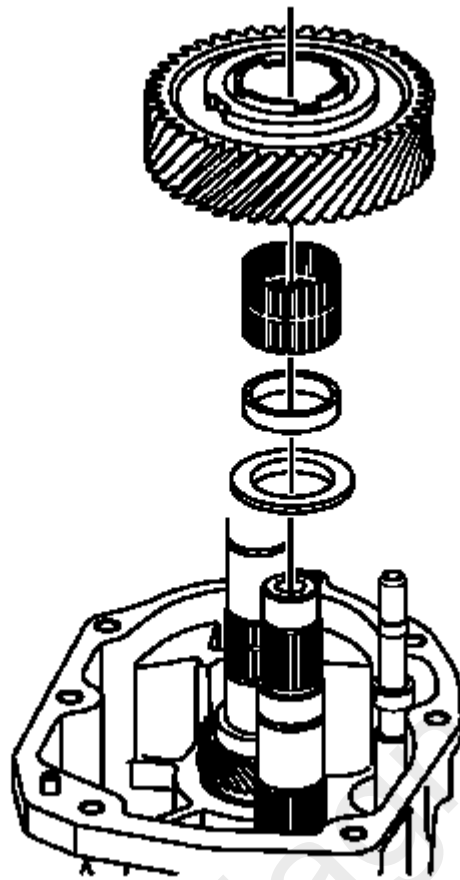


Fig. 243: View Of 6th Driven Gear, Caged Needle Bearing, And Spacer
Courtesy of GENERAL MOTORS COMPANY

1. Install two spacers, caged needle bearing, and 6th driven gear.

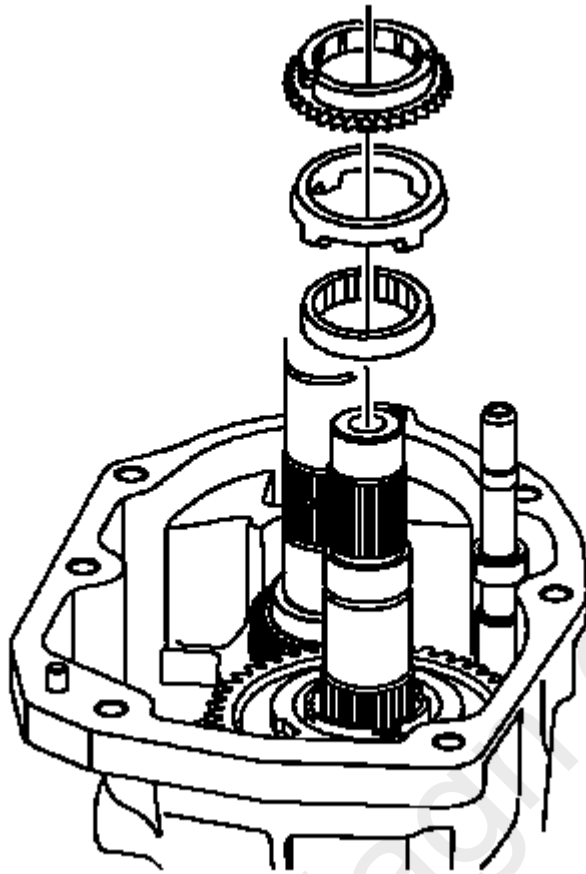


Fig. 244: View Of Speed Drive Gear Synchronizer Blocking Ring, Gear Friction Cone And Gear Inner Cone

Courtesy of GENERAL MOTORS COMPANY

2. Install the speed drive gear inner cone, speed drive gear friction cone, and synchronizer blocking ring.

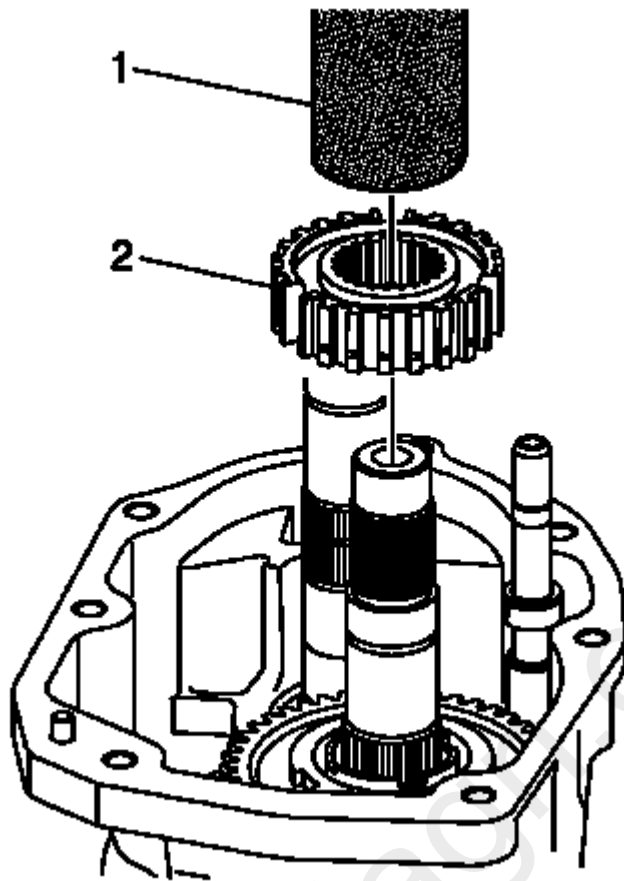


Fig. 245: Identifying Synchronizer Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install the synchronizer hub assembly (2) using J 38205-1 tube (1).

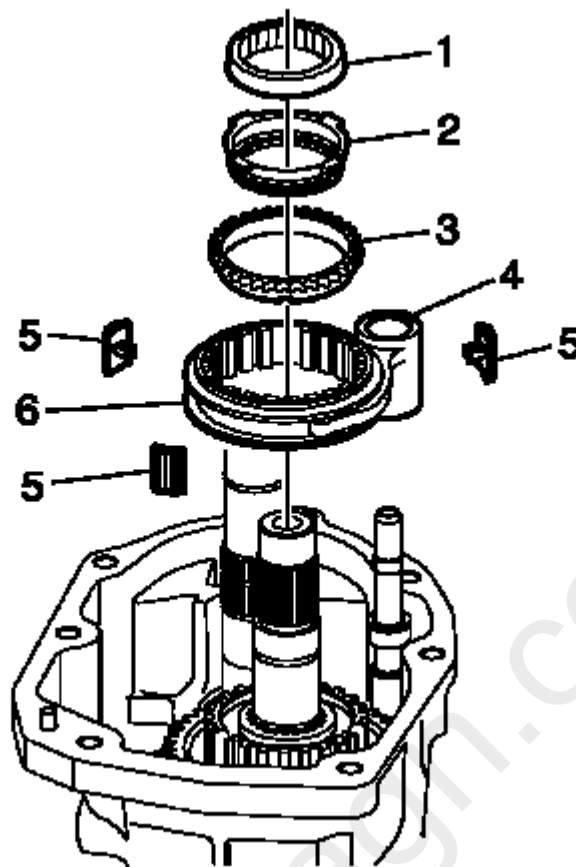


Fig. 246: View Of 5th/6th Shift Fork, Synchronizer Sleeve, Synchronizer Inserts, Speed Drive Gear Synchronizer Blocking Ring, Friction Cone and Inner Cone
Courtesy of GENERAL MOTORS COMPANY

4. Install the following components:
- Drive gear inner cone
 - Drive gear friction cone
 - Synchronizer blocking ring
 - Synchronizer inserts
 - Synchronizer sleeve
 - 5th/6th shift fork

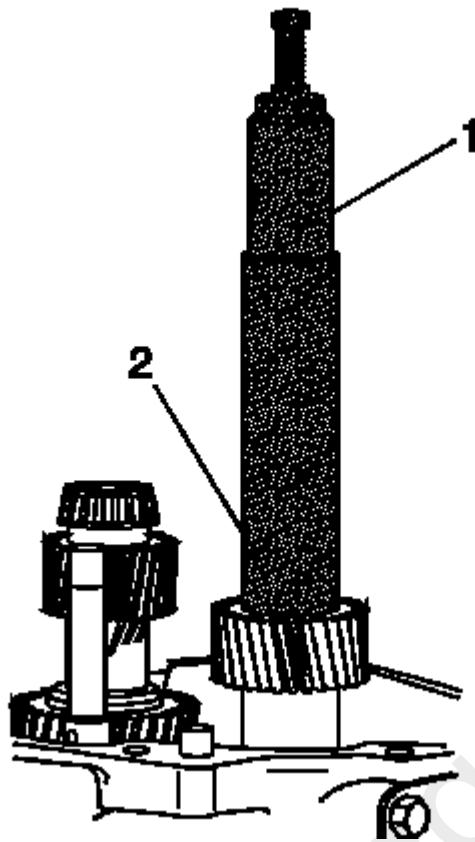


Fig. 247: Installing 5th/6th Speed Driven Gear
Courtesy of GENERAL MOTORS COMPANY

5. Install the 5th/6th speed driven gear using the **J 39441-30** installer (2) and **J 39441-20** adapter (1). The smaller outside diameter (OD) of the gear faces down.

Reverse Shift Fork Installation

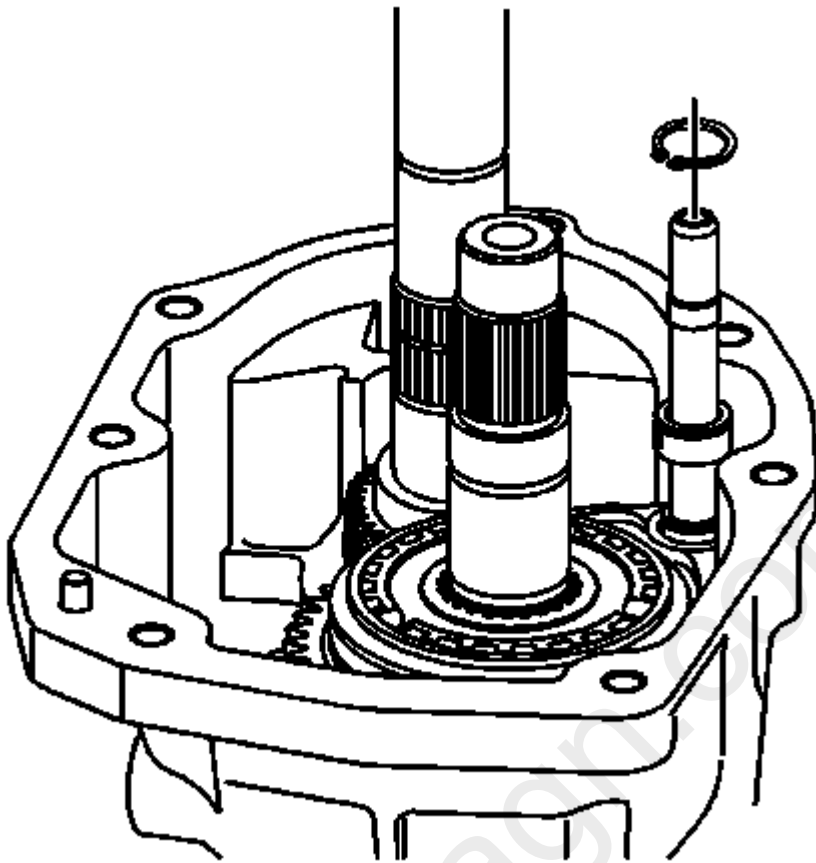


Fig. 248: View Of 5th/6th Speed Shift Fork Retainer Ring
Courtesy of GENERAL MOTORS COMPANY

1. Install the 5th/6th speed shift fork retainer ring.

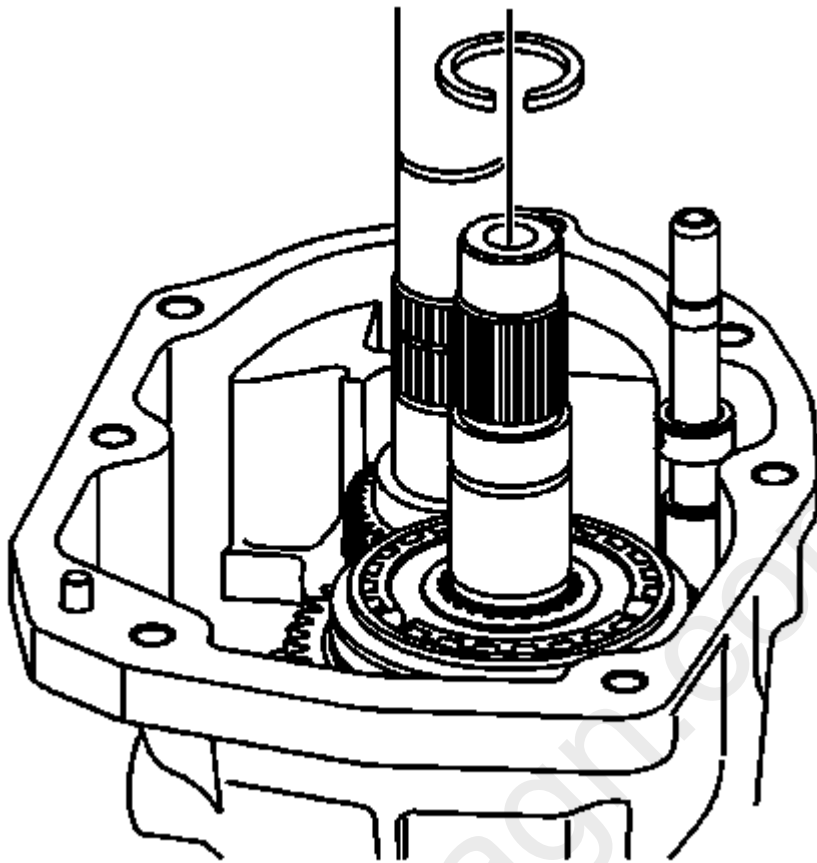


Fig. 249: View Of Retainer Clip & Countershaft
Courtesy of GENERAL MOTORS COMPANY

2. Install the retainer clip to the countershaft.

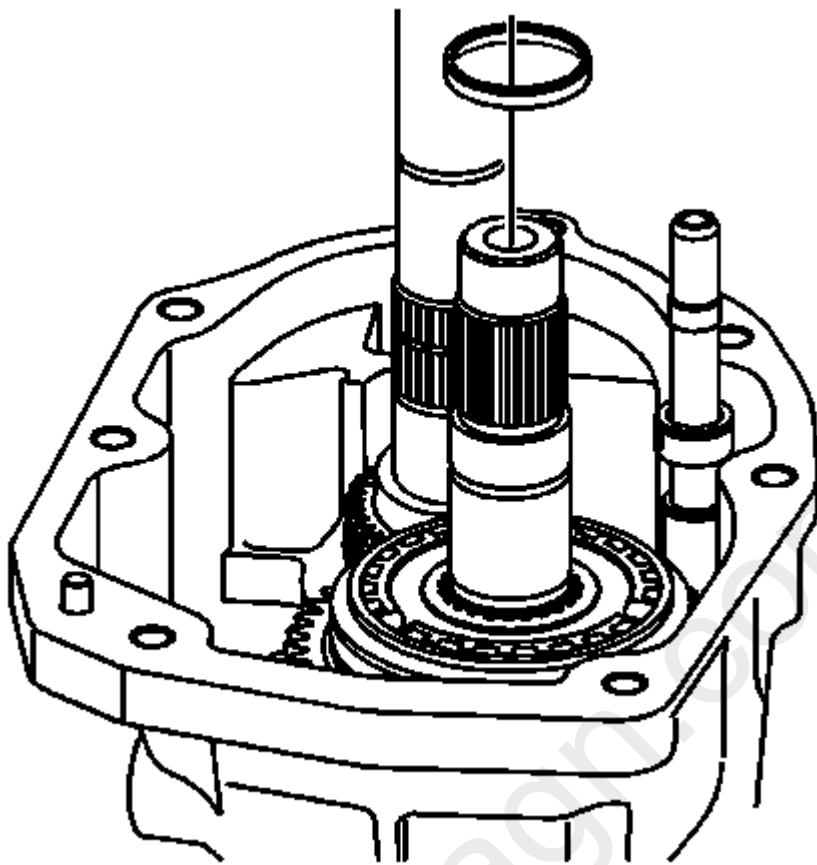


Fig. 250: View of Spacer & Countershaft
Courtesy of GENERAL MOTORS COMPANY

3. Install the spacer to the countershaft.

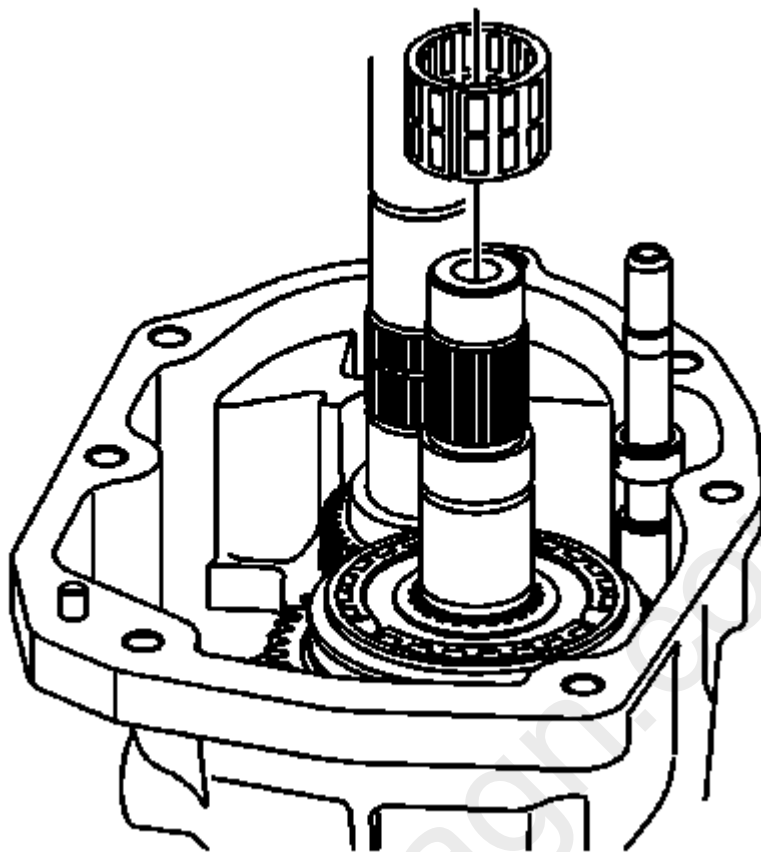


Fig. 251: View of Needle Bearing & Countershaft
Courtesy of GENERAL MOTORS COMPANY

4. Install the needle bearing to the countershaft.

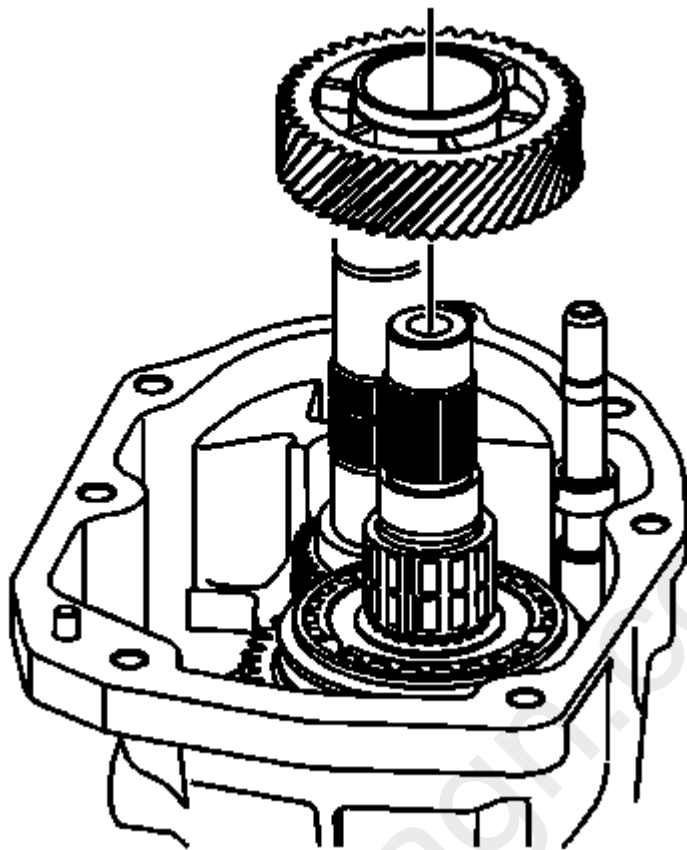


Fig. 252: View Of Gear & Countershaft
Courtesy of GENERAL MOTORS COMPANY

5. Install the gear to the countershaft.

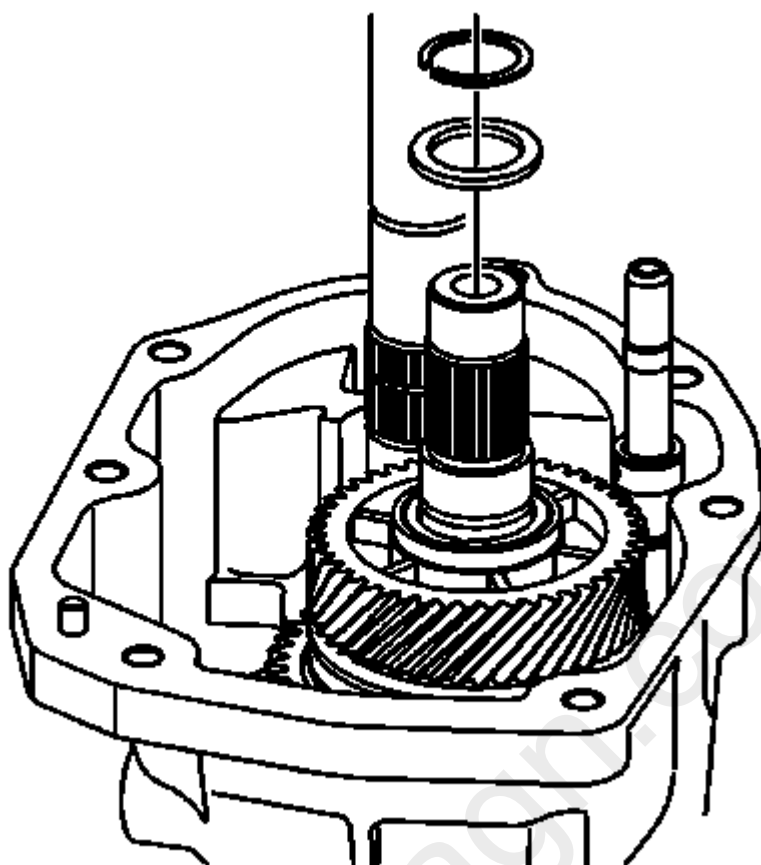


Fig. 253: View Of Countershaft Retainer And Spacer
Courtesy of GENERAL MOTORS COMPANY

6. Install the countershaft retainer and spacer.

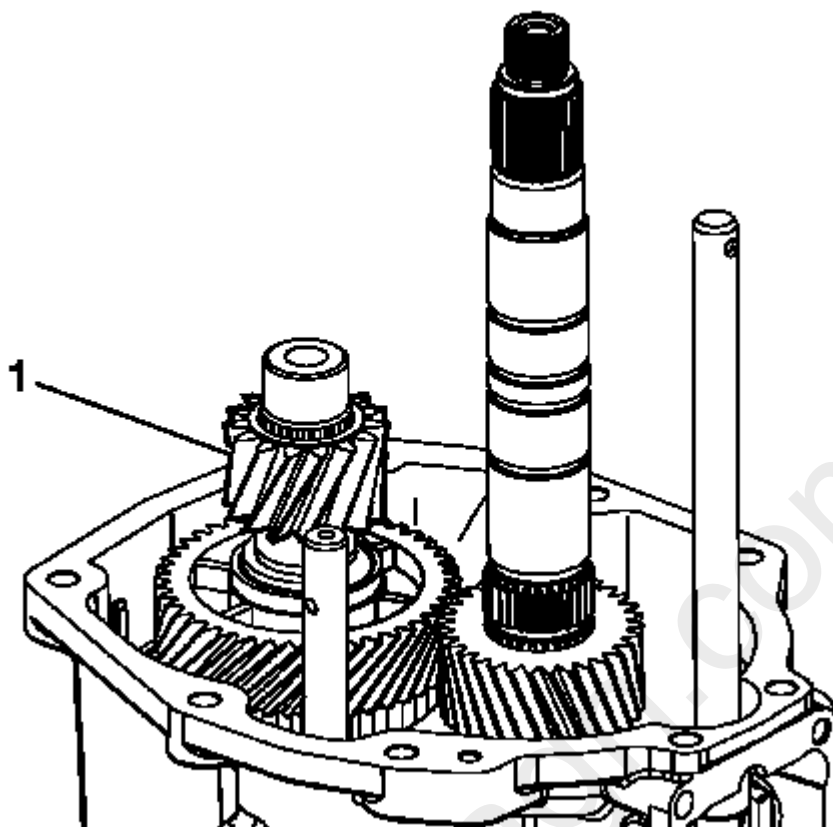


Fig. 254: Identifying Countershaft Gear
Courtesy of GENERAL MOTORS COMPANY

7. Install the countershaft gear (1).

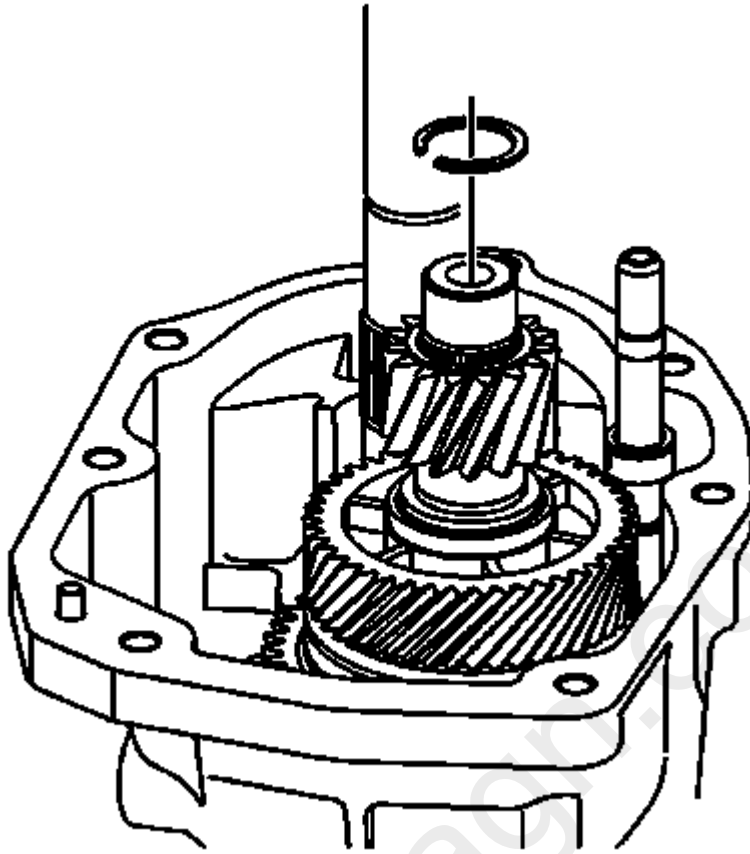


Fig. 255: View Of Countershaft Retainer Clip
Courtesy of GENERAL MOTORS COMPANY

8. Install the countershaft retainer ring.

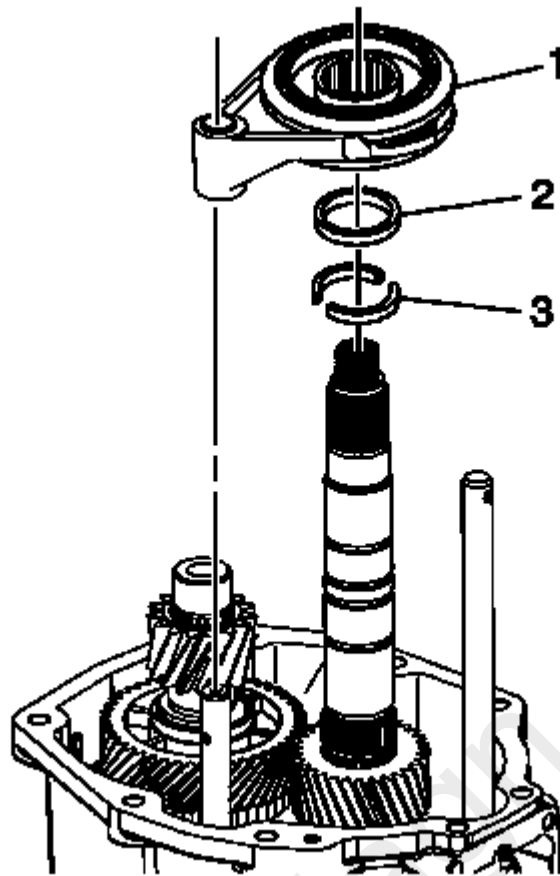


Fig. 256: Identifying Reverse Synchronizer Components
Courtesy of GENERAL MOTORS COMPANY

9. Install the two piece thrust washer (3).
10. Install the locking ring (2).
11. Install the reverse shift fork and the synchronizer (1).

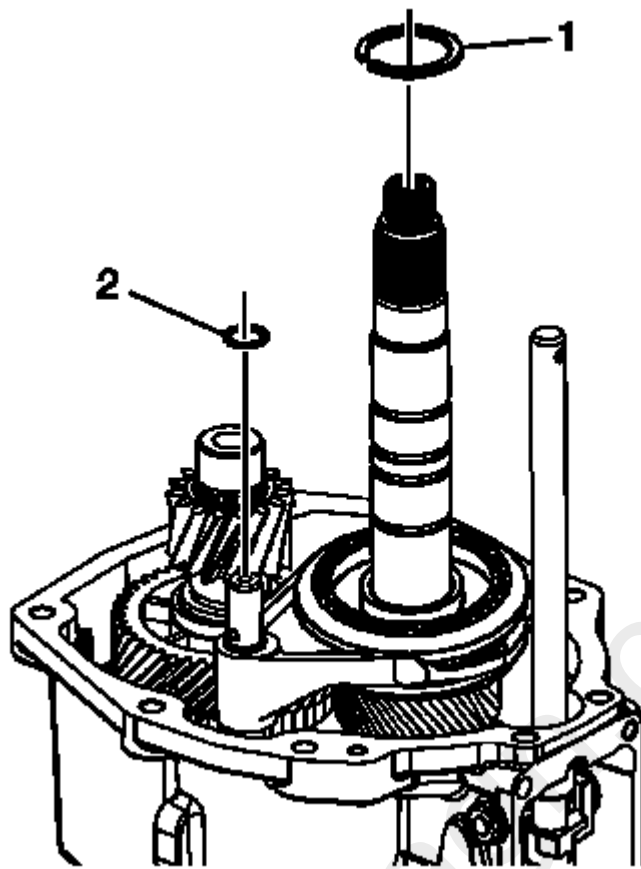


Fig. 257: Identifying Reverse Retainer Rings
Courtesy of GENERAL MOTORS COMPANY

12. Install a NEW shift fork retainer ring (2).
13. Install the reverse synchronizer retainer ring (1).

Reverse Speed Gear Installation

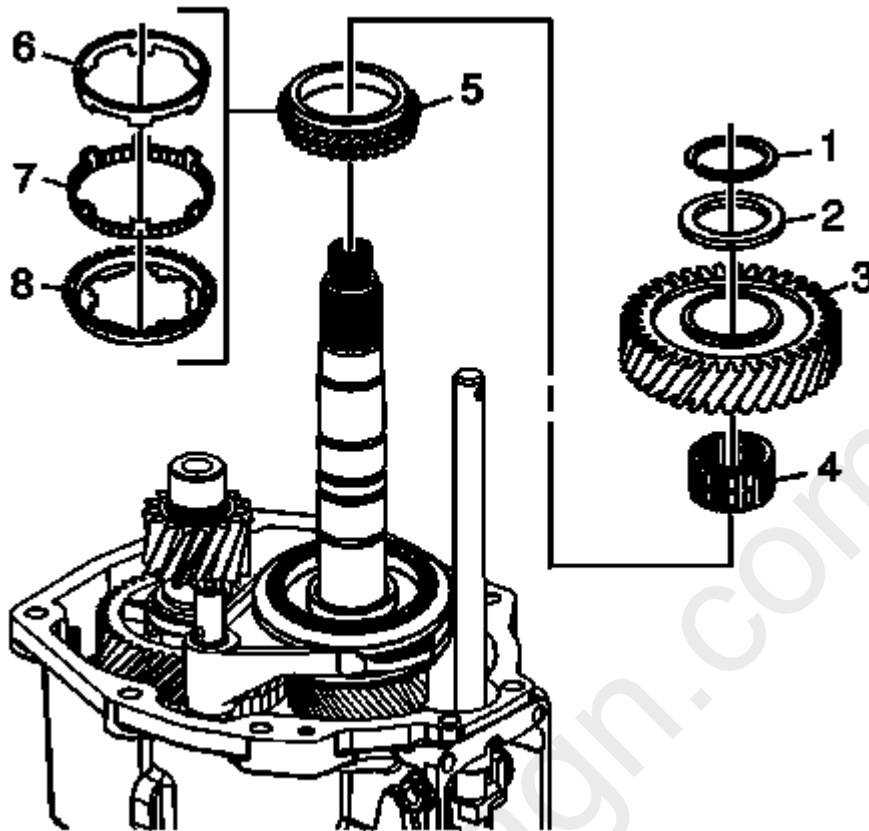


Fig. 258: Identifying Reverse Gear Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the following parts in order:
 1. The reverse gear blocking ring assembly (5), including the following components:
 - Reverse gear inner ring (6)
 - Reverse gear outer ring (7)
 - Reverse gear blocking ring (8)
 2. The caged needle bearing (4)
 3. The reverse speed gear (3)
 4. The thrust washer (2)
 5. The retainer ring (1)

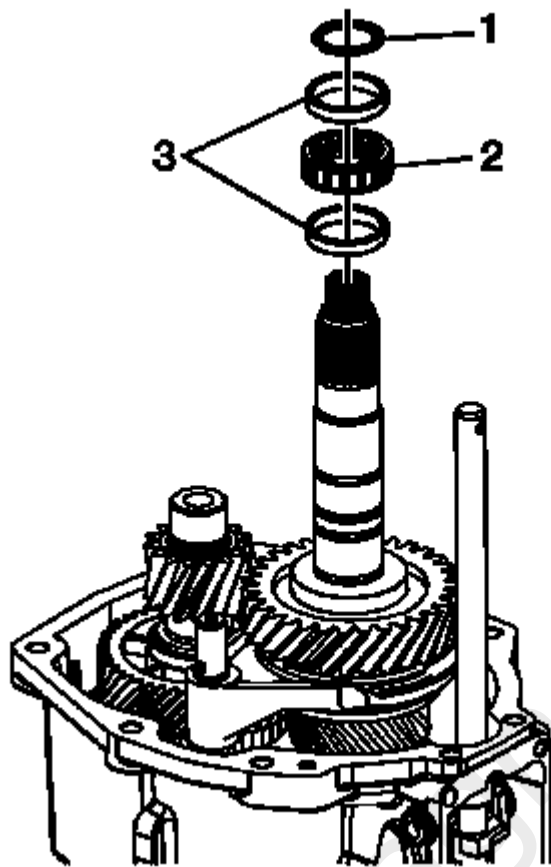


Fig. 259: Identifying Rear Bearing Retainer Ring, Spacers & Mainshaft Rear Roller Bearing
Courtesy of GENERAL MOTORS COMPANY

2. Install the following parts in order:
 1. The spacer (3)
 2. The roller bearing (2)
 3. The spacer (3)
 4. The roller bearing retainer ring (1)

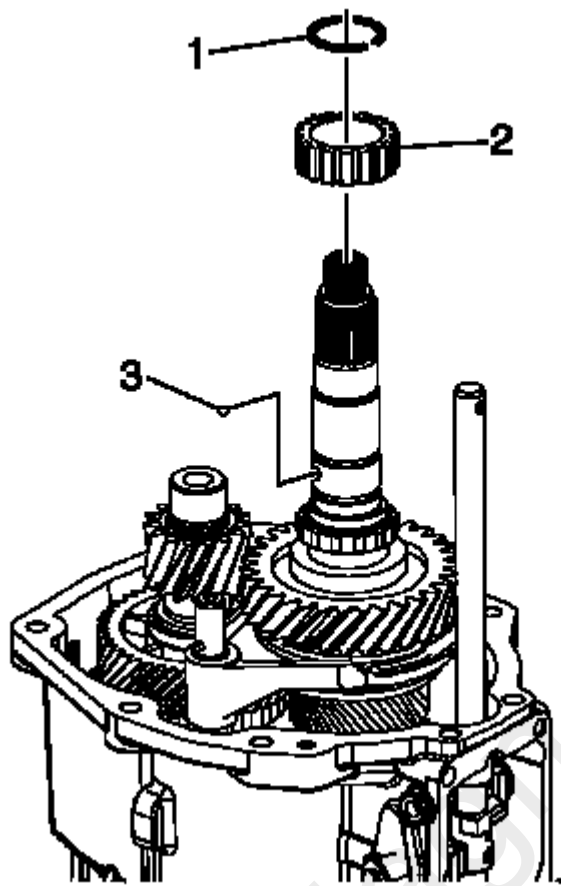


Fig. 260: Identifying Snap Ring, Speed Sensor Rotor & Locking Ball
Courtesy of GENERAL MOTORS COMPANY

3. Install the following parts in order:
- The locking ball (3)
 - The speed sensor rotor (2)
 - The snap ring (1)

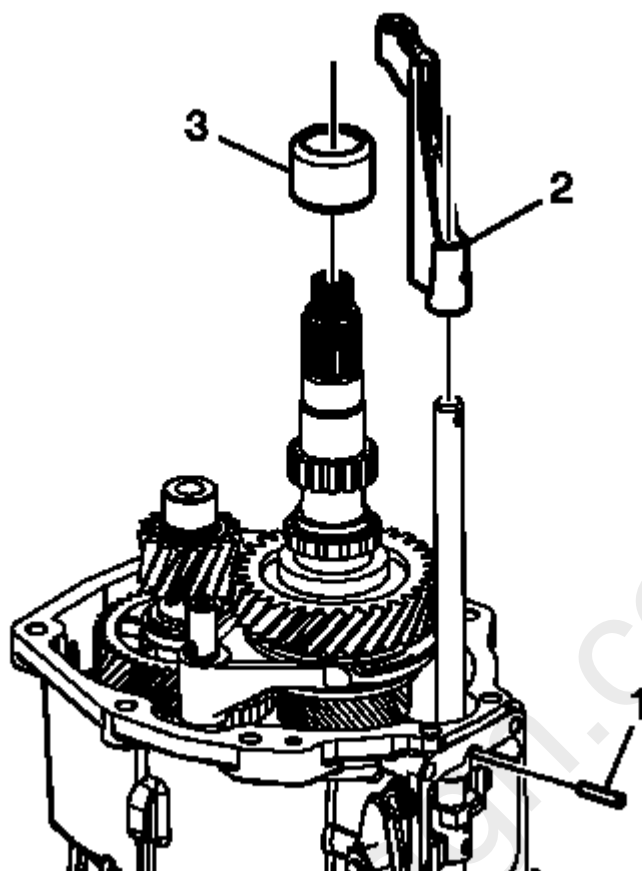


Fig. 261: Identifying Shift Guide Rollpin, Shift Shaft Extension & Extension Housing Main Shaft Bearing Race

Courtesy of GENERAL MOTORS COMPANY

4. Install the extension housing main shaft bearing race (3).
5. Install the shift shaft extension (2).
6. Install NEW shift guide roll pin (1).

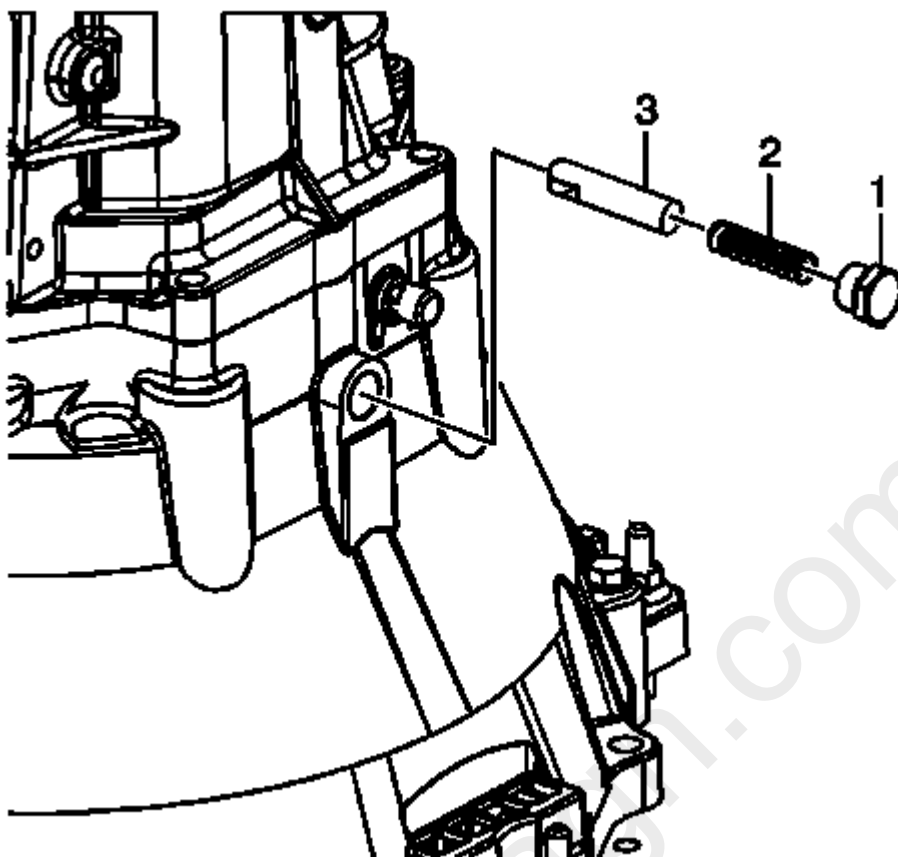


Fig. 262: Identifying Plug, Spring & Shift Detent Roller
Courtesy of GENERAL MOTORS COMPANY

7. Lift up on the shift shaft extension while installing the shift detent roller (3), spring (2) and plug (1). Tighten the plug to 24 N.m (18 lb in).

Extension Housing Assembly Installation

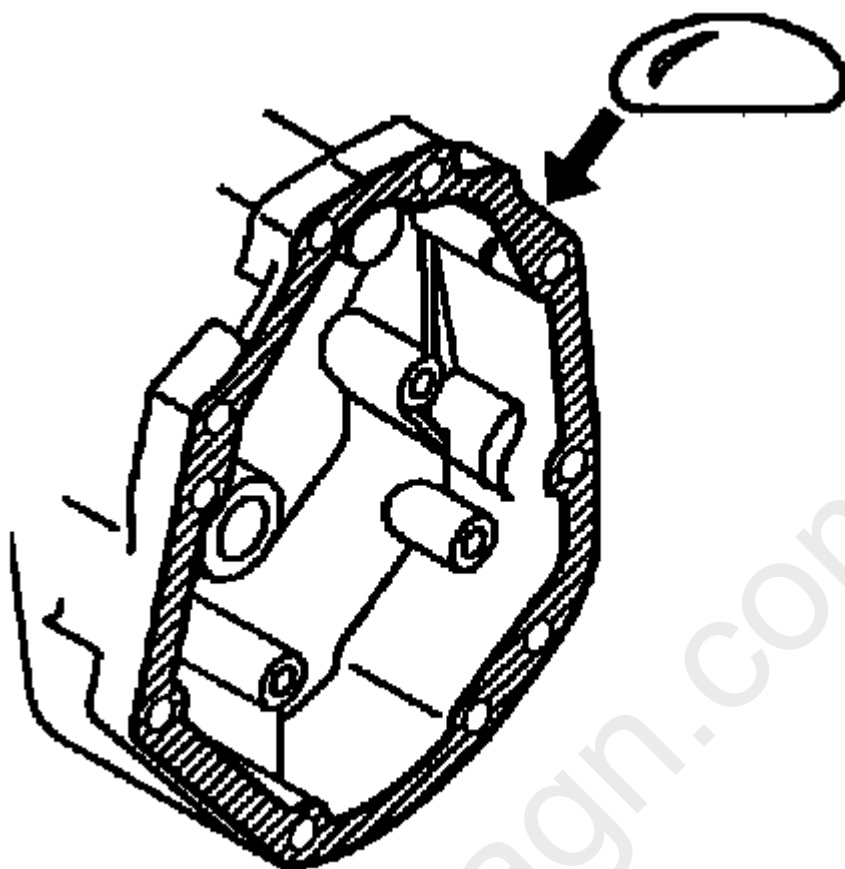


Fig. 263: Applying Sealant To Extension Housing To Transmission Case Mating Surface
Courtesy of GENERAL MOTORS COMPANY

1. Apply sealant GM P/N 12345739, (Canadian P/N 10953472) or equivalent to the extension housing to the transmission case mating surface.

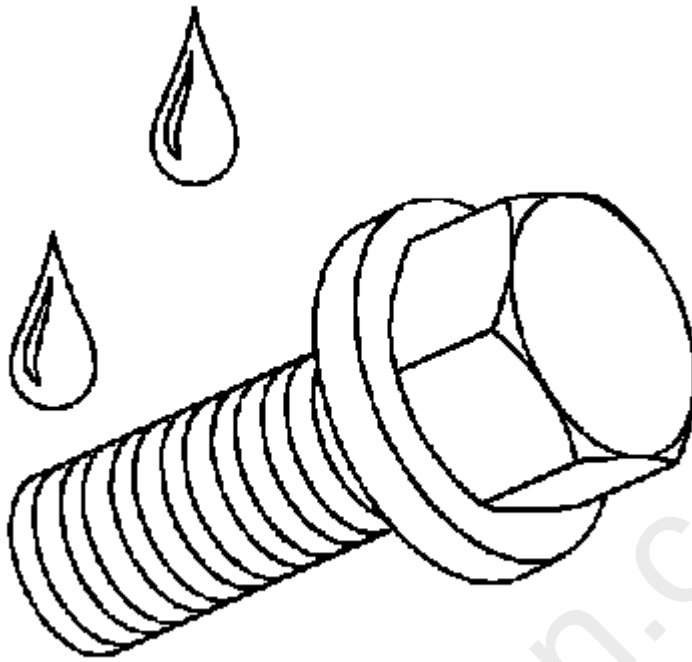


Fig. 264: Applying Sealant To Reverse Idler Shaft Brackets Bolt Threads
Courtesy of GENERAL MOTORS COMPANY

2. Apply thread sealer GM P/N 12346004, (Canadian P/N 10953480) or equivalent to the top 2 extension housing bolts.

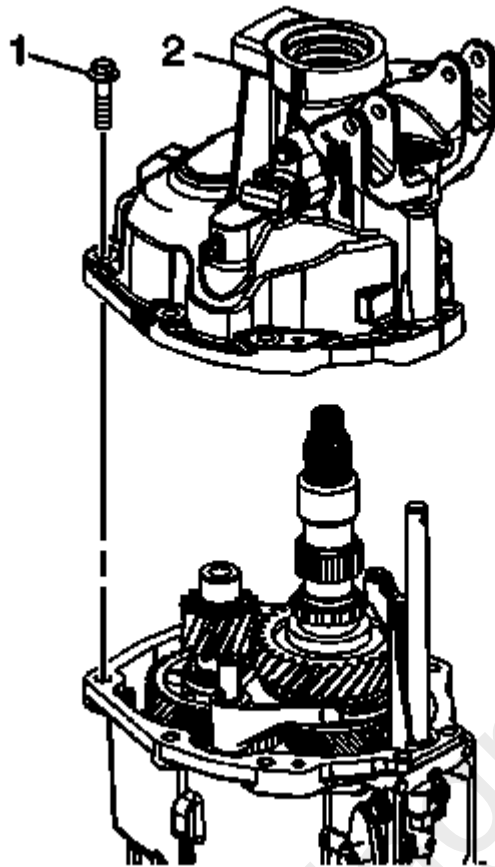


Fig. 265: Identifying Rear Extension Housing & Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Align the 5th/6th shift shaft to the extension housing bore in order to install the extension housing.

3. Install the extension housing (2).
4. Install the extension housing bolts (1) and tighten to 48 N.m (36 lb ft).

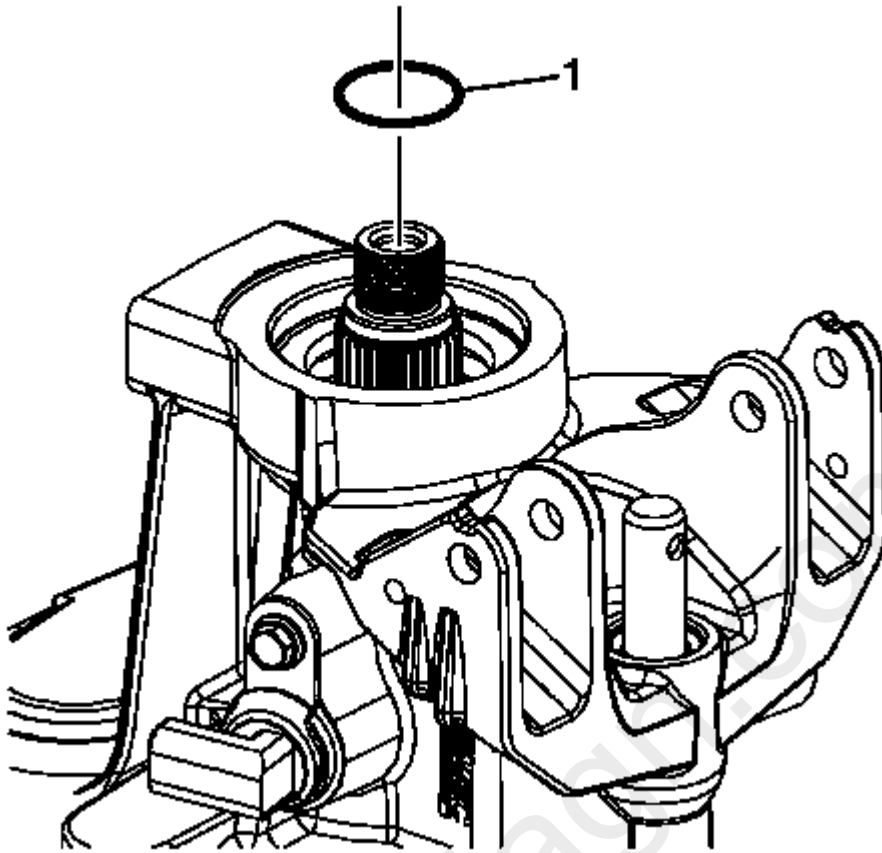


Fig. 266: Identifying Propshaft O-Ring
Courtesy of GENERAL MOTORS COMPANY

5. Install the propshaft O-ring (1).

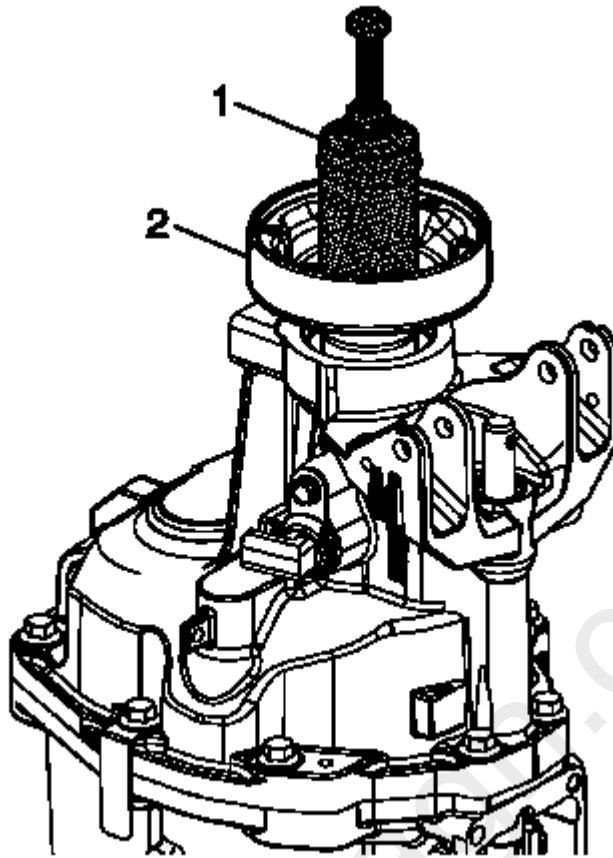


Fig. 267: Identifying Propshaft Transmission Yoke
Courtesy of GENERAL MOTORS COMPANY

6. Install the propshaft transmission yoke (2). Install J 39441-30 installer (1) onto the transmission yoke. Turn the bolt to install the transmission yoke into the mainshaft.

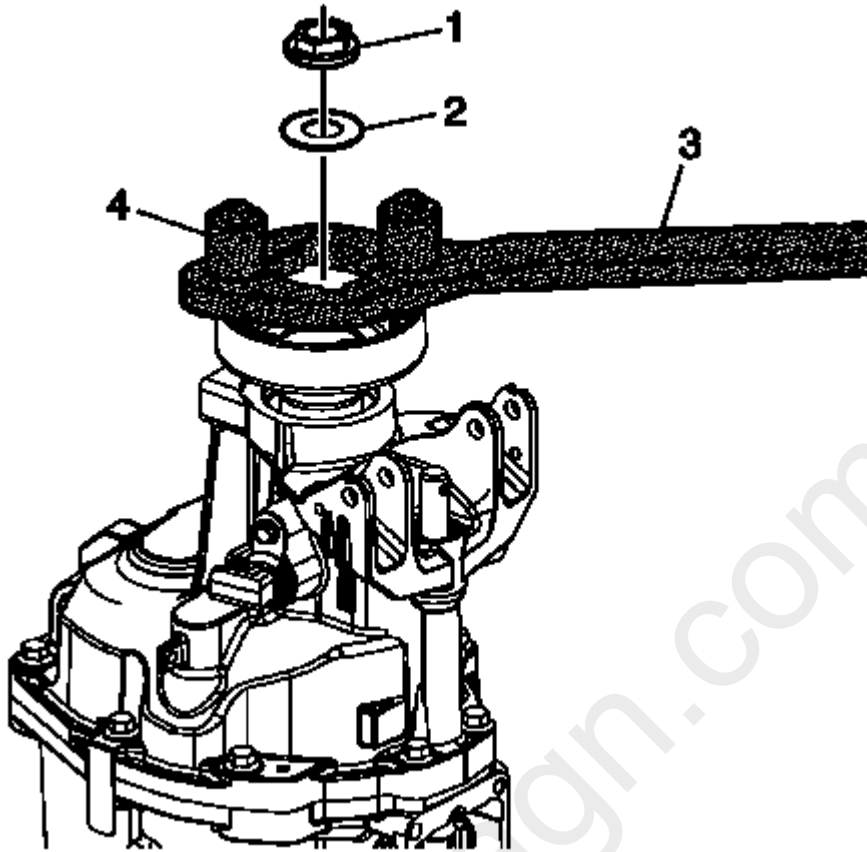


Fig. 268: Identifying Propshaft Transmission Yoke Nut & Washer
Courtesy of GENERAL MOTORS COMPANY

7. Install the propshaft washer (2) and nut (1).
8. Use the **J 08614A** holder (3) and **J 08614-20** bolts (4) to hold the propshaft transmission yoke. Tighten the nut (1) to 136 N.m (100 lb ft)

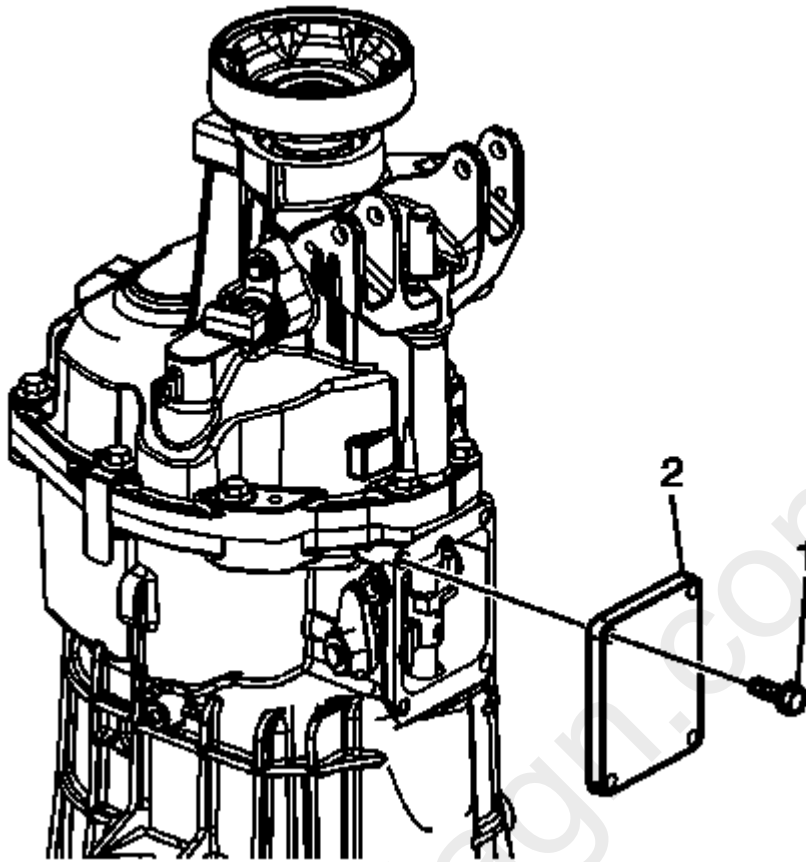


Fig. 269: Identifying Shifter Cover Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Install the shifter cover plate (2).
10. Install the shifter cover plate bolts (1) and tighten to 20 N.m (15 lb ft).

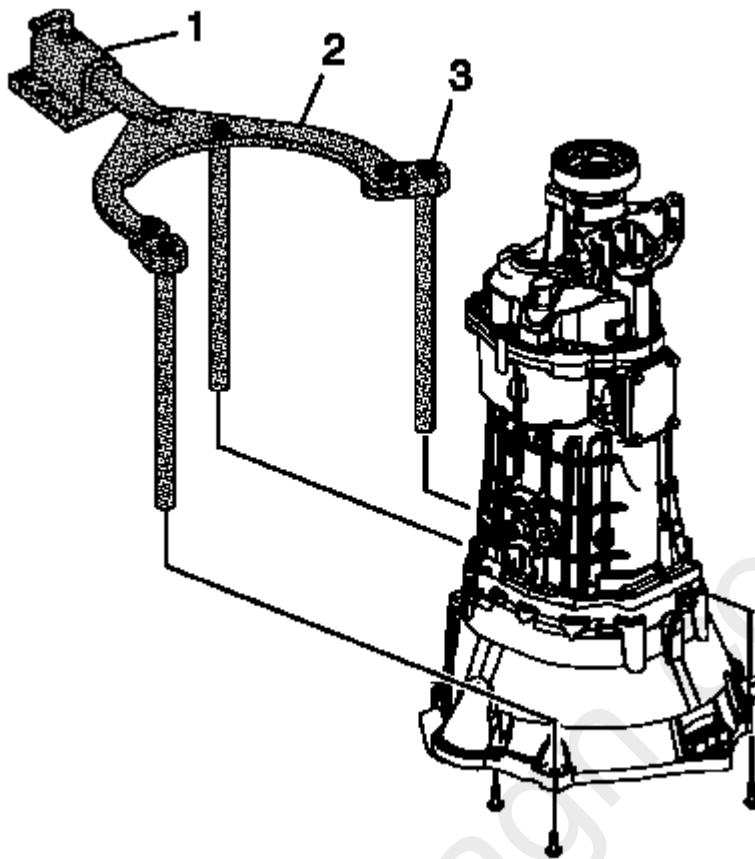


Fig. 270: Identifying Special Tool Flange & Flange Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Remove the **DT 47678** flange (2) and **DT 47678-10** adapter.
12. Remove the **DT 47678** flange and **DT 47678-10** adapter from **J 3289-20** fixture (1).

SHIMMING PROCEDURES

Special Tools

J 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, Mainshaft, and Countershaft

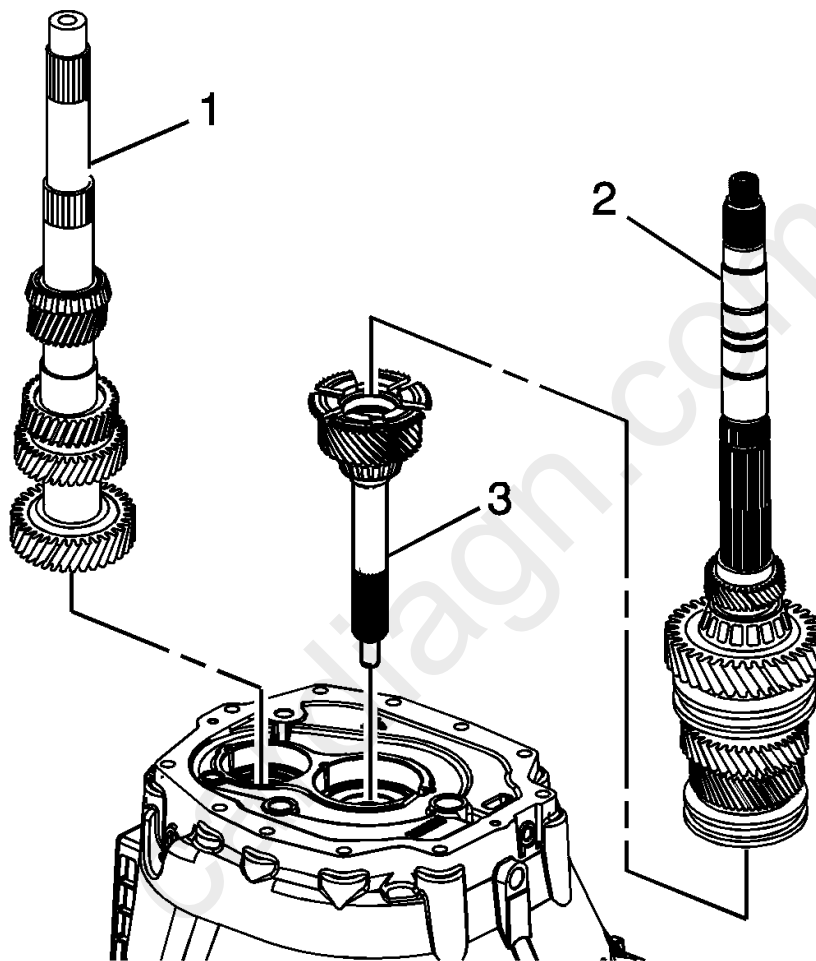


Fig. 271: Identifying Input Shaft, Mainshaft, and Countershaft
 Courtesy of GENERAL MOTORS COMPANY

1. Rotate the clutch housing to the vertical position.
2. Install the following assemblies in order:
 1. The input shaft (3)
 2. Align the 4th speed gear blocking ring to the input shaft.
 3. The mainshaft assembly (2)
 4. The countershaft (1), lifting up the mainshaft enough to install the countershaft.

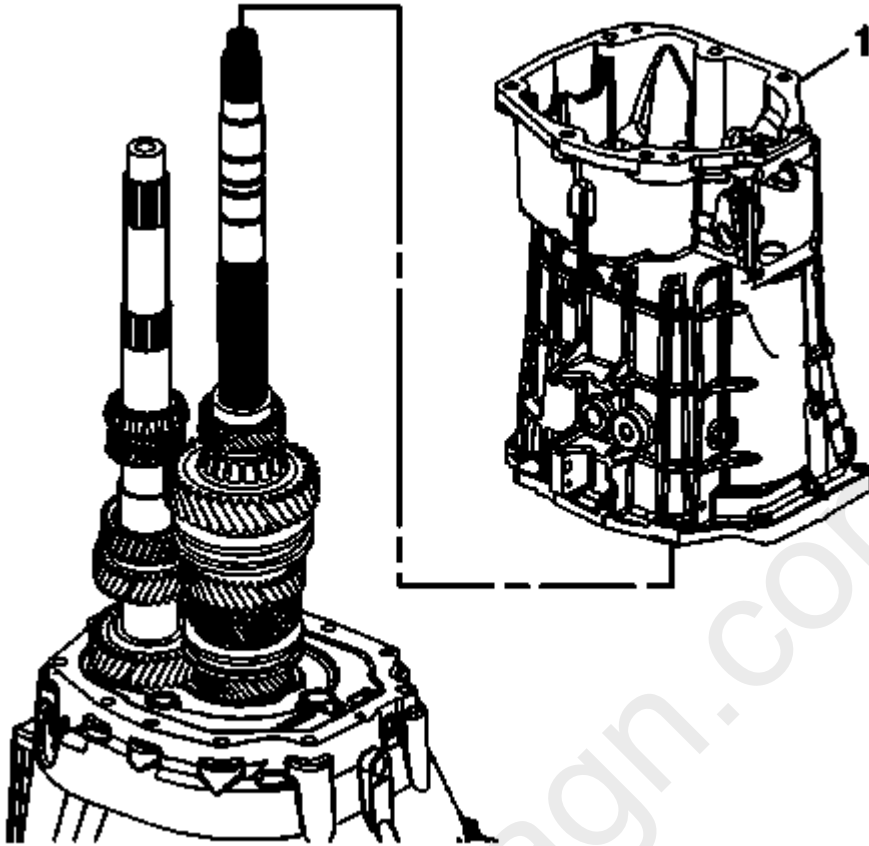


Fig. 272: Identifying Transmission Case
Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission case (1).

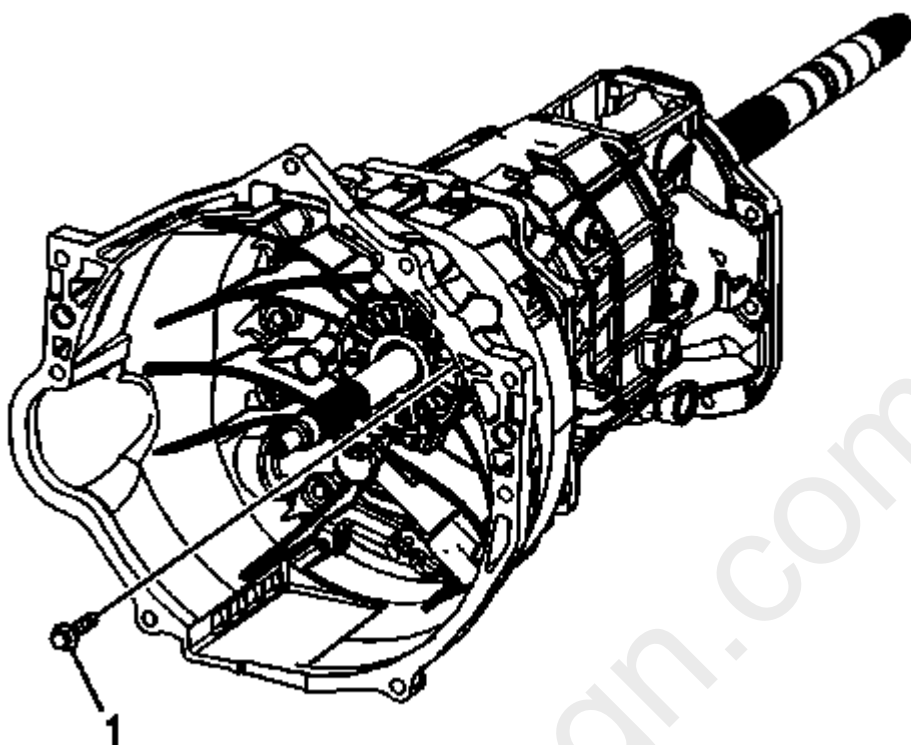


Fig. 273: Identifying Clutch Housing To Transmission Case Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the clutch housing to transmission case bolts (1) and tighten to 36 N.m (27 lb ft).

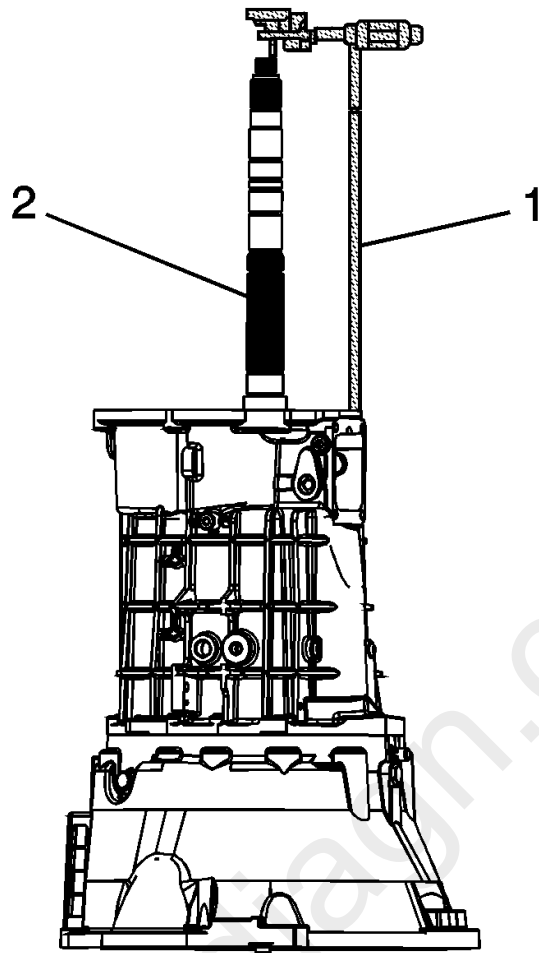


Fig. 274: Measuring Input Shaft/Mainshaft End Play
Courtesy of GENERAL MOTORS COMPANY

5. Measure the input shaft/mainshaft end play using the following procedure:
 1. Place the tip of the **J 8001** indicator set (1) on the end of the mainshaft.
 2. Move the main shaft up and down.
 3. Record the measurement.
6. Select a shim to achieve 0.0127-0.0889 mm (0.00049-0.00349 in) end play.
7. Remove the **J 8001** indicator set.

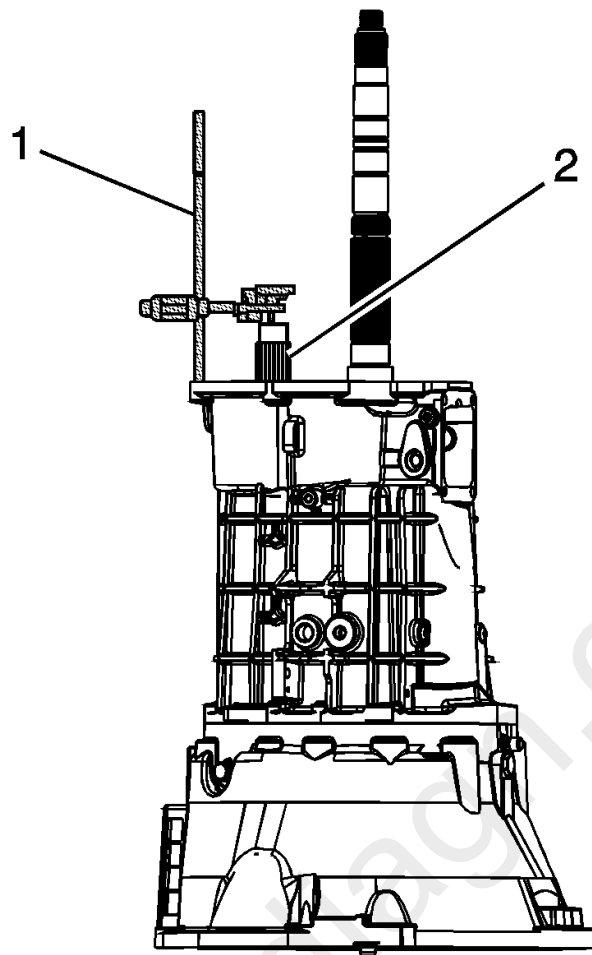


Fig. 275: Measuring Countershaft End Play
Courtesy of GENERAL MOTORS COMPANY

8. Measure the countershaft end play using the following procedure:
 1. Place the tip of the **J 8001** indicator set (1) on the end of the countershaft.
 2. Move the countershaft up and down.
 3. Record the measurement.
9. Select a shim to achieve 0.0127-0.0889 mm (0.00049-0.00349 in) end play.
10. Remove the **J 8001** indicator set.

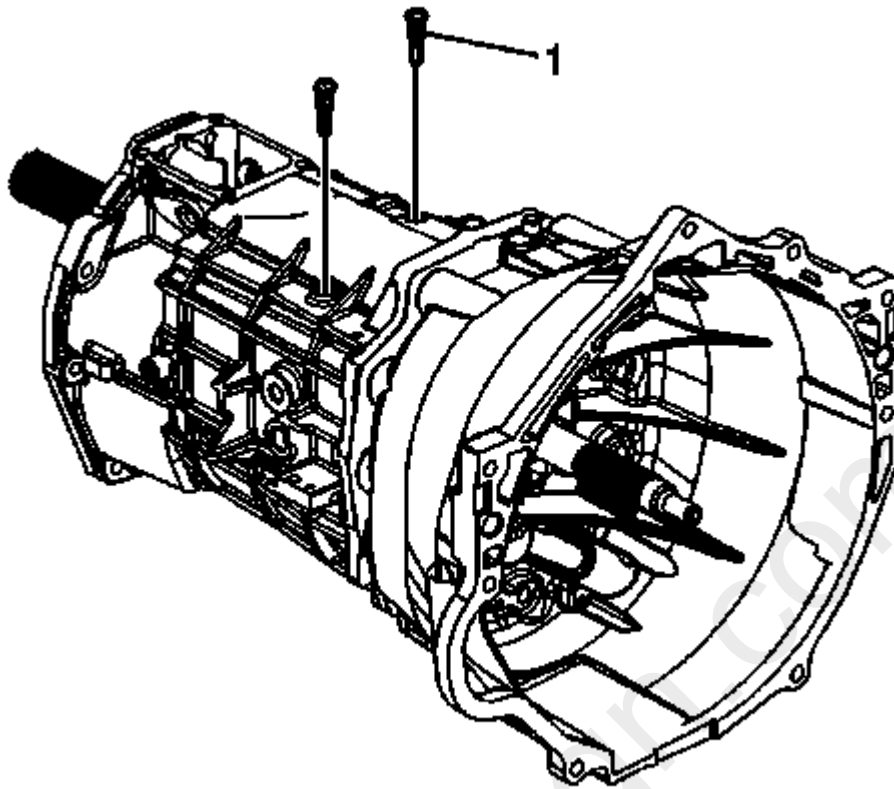


Fig. 276: Identifying Shift Lever Guide Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the shift lever guide bolts (1).

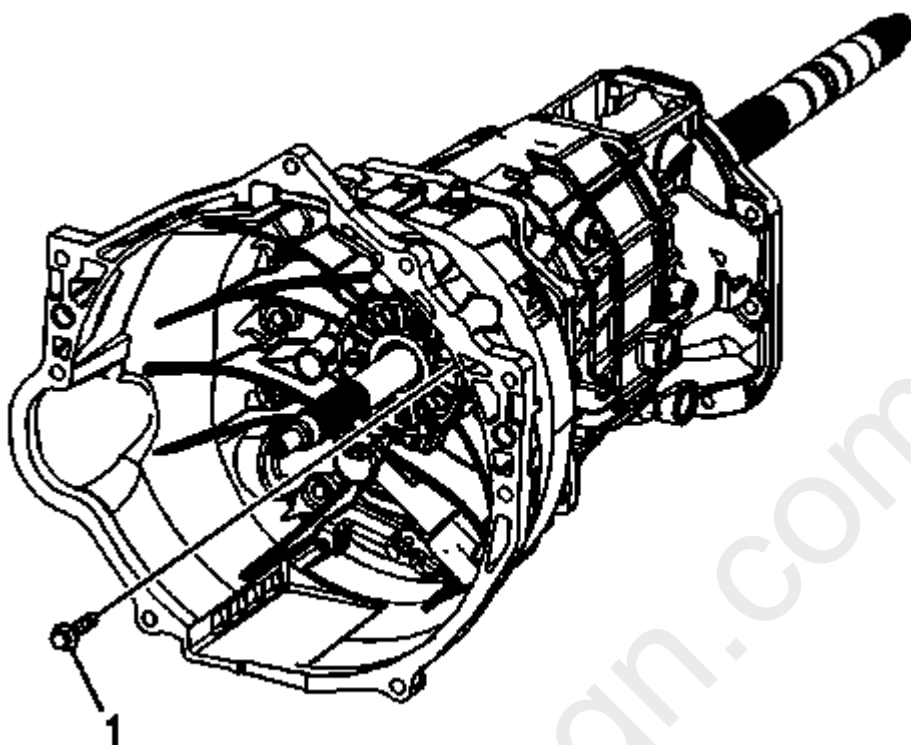


Fig. 277: Identifying Clutch Housing To Transmission Case Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the clutch housing to the transmission case bolts (1).

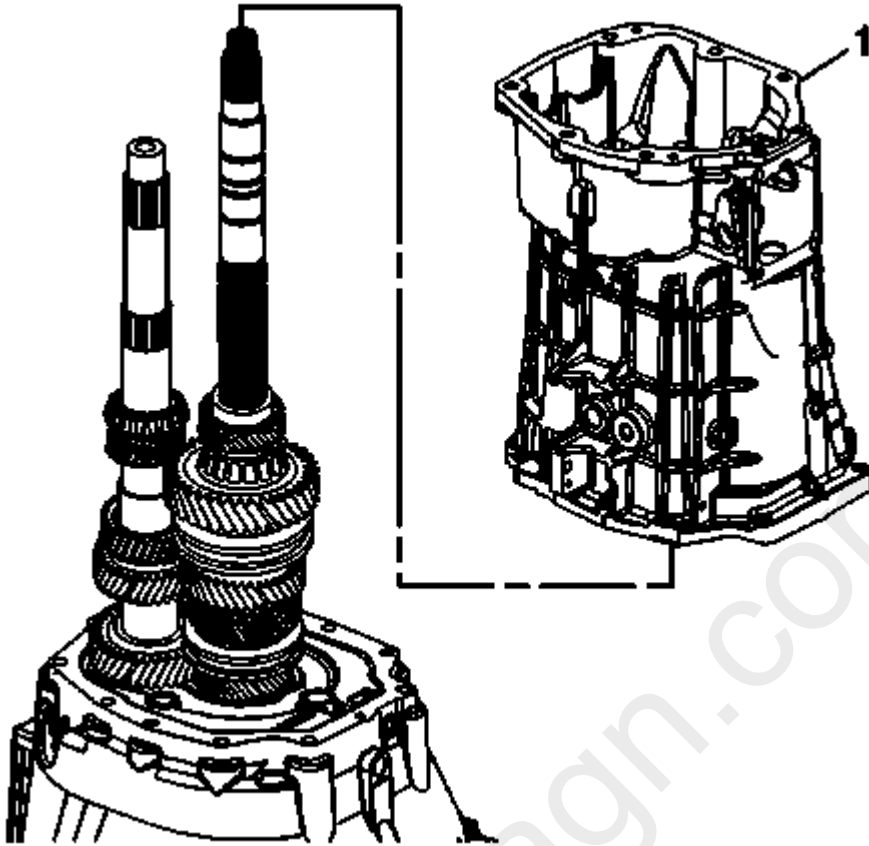


Fig. 278: Identifying Transmission Case
Courtesy of GENERAL MOTORS COMPANY

13. Remove the transmission case (1).

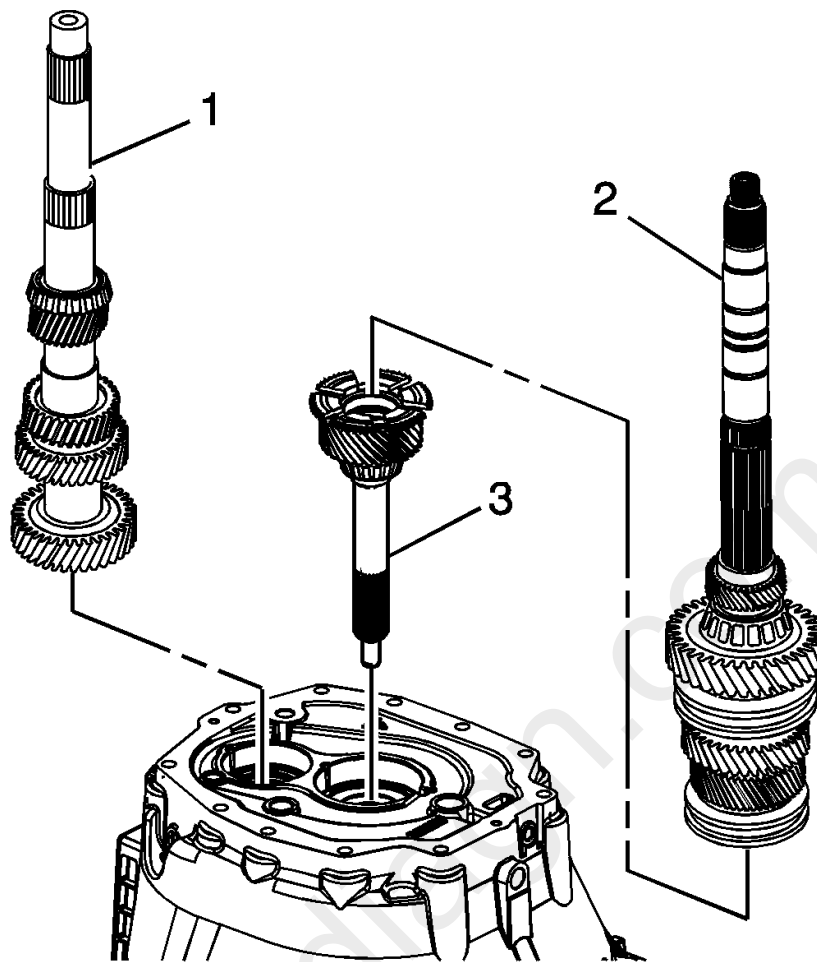


Fig. 279: Identifying Input Shaft, Mainshaft, and Countershaft
Courtesy of GENERAL MOTORS COMPANY

14. Remove the following parts in order:
 1. The countershaft (1), lifting up the mainshaft (2) enough to remove the countershaft.
 2. The mainshaft assembly (2)
 3. The input shaft (3)

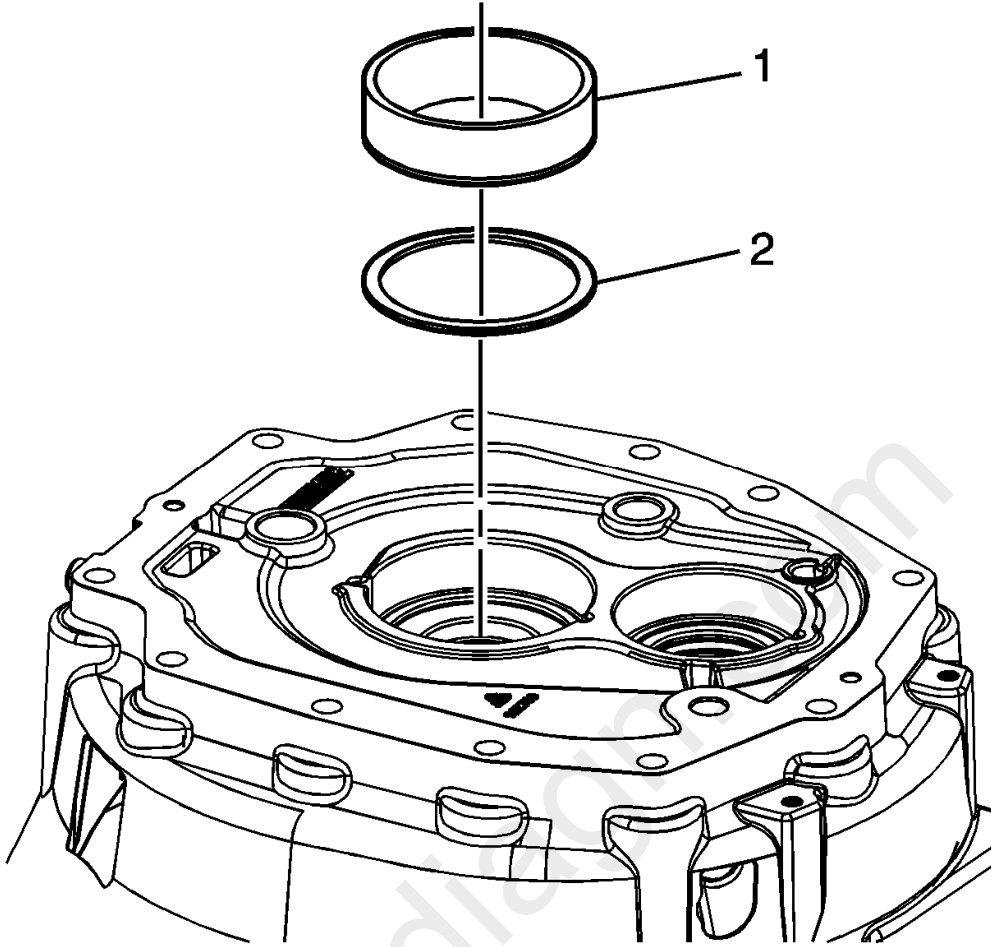


Fig. 280: Identifying Input Shaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

15. Remove the input shaft bearing race (1).
16. Remove the input shaft bearing shim (2) and discard.
17. Install the new input shaft bearing shim, and the original bearing race.

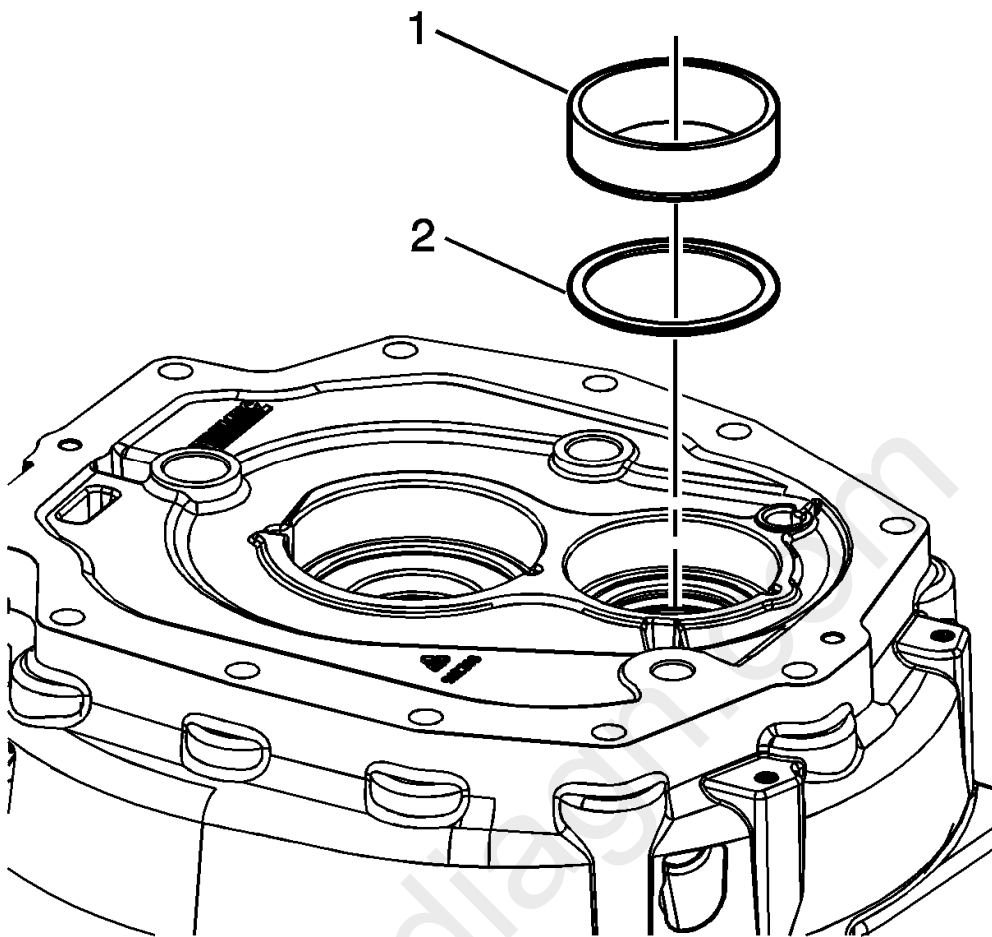


Fig. 281: Identifying Countershaft Bearing Race & Shim
Courtesy of GENERAL MOTORS COMPANY

18. Remove the countershaft bearing race (1).
19. Remove the countershaft bearing shim (2) and discard.
20. Install the new input shaft bearing shim, and the original bearing race.

DESCRIPTION AND OPERATION

TRANSMISSION IDENTIFICATION INFORMATION

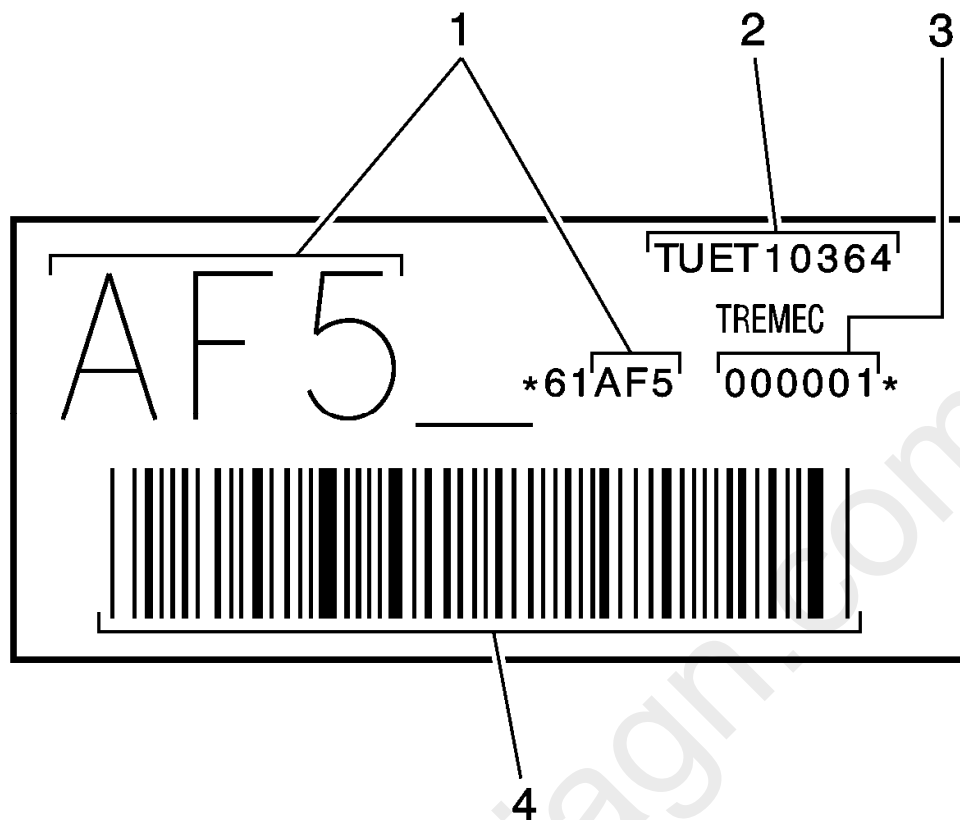


Fig. 282: Transmission Identification Plate
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Broadcast Code
2	Transmission Assembly Number
3	Serial Number
4	Bar Code

MANUAL TRANSMISSION DESCRIPTION AND OPERATION

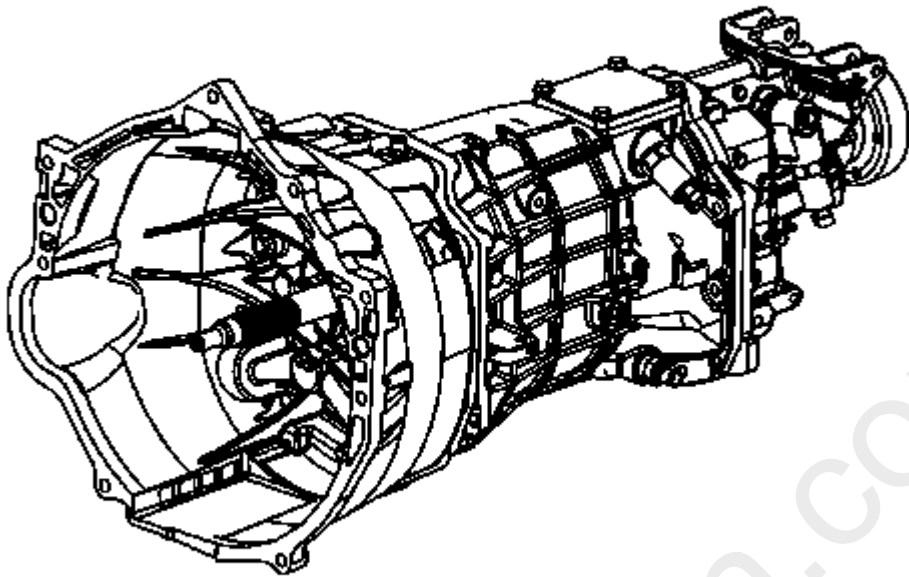


Fig. 283: View Of Manual Transmission
Courtesy of GENERAL MOTORS COMPANY

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 6-speed manual transmission RPO: MG9 incorporates the following features:

- An aluminum case
- Fully synchronized gearing with an enhanced synchronizer cone arrangement:
 - Triple-cone: FIRST, SECOND
 - Double-cone: THIRD, FOURTH, FIFTH, SIXTH, REVERSE
- An internal shift rail mechanism
- A remote transmission shift control mounted forward of the transmission
- An external transmission shift rod enabling the rearward mount location of the transmission shift control
- 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

These features combine to yield a rugged, reliable system capable of handling input torques of 766 N.m (565 lb ft).

The gear ratios are as follows:

Gear	MG9 Ratio (:1)
FIRST	2.66
SECOND	1.78
THIRD	1.30
FOURTH	1.00
FIFTH	0.80
SIXTH	0.63
REVERSE	2.90

Shift Control and Shift Rod

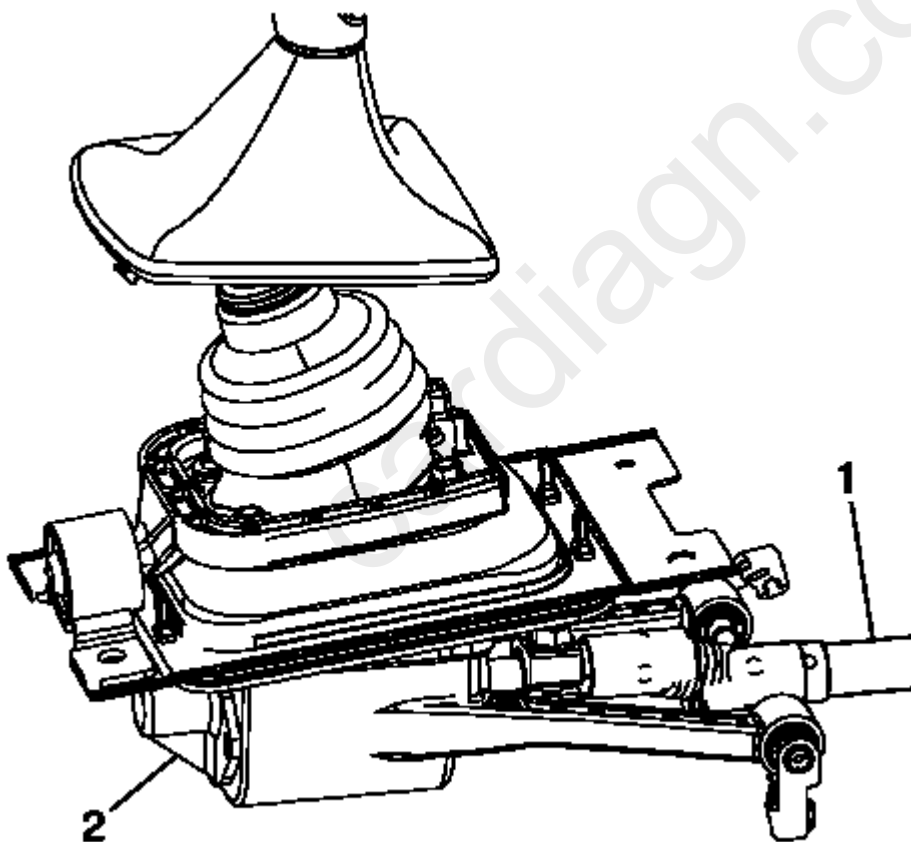


Fig. 284: Identifying Shift Control & Shift Rod
Courtesy of GENERAL MOTORS COMPANY

The shift shaft is connected to a transmission shift rod (1) which contains two sealed universal-style joints, enabling the range of motion necessary in order to shift gears. The shift rod (1) is connected to the transmission

shift control (2) which is a lubricated and sealed unit, mounted to the driveline support assembly. The mounting system utilized for the shift control (2) 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 77°C (171°F).
- Vehicle speed is 24-30 km/h (15-19 mph).
- Throttle is opened 13 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.

Temperature Sensor

The temperature sensor is a safety feature that provides a warning in the event the manual transmission is operating in temperatures above 163°C (325°F).

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 24-30 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 13 percent.

When the conditions are met the powertrain control module (PCM) grounds the skip shift solenoid control circuit. This energizes the skip shift solenoid and mechanically blocks the gear shift lever from 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.

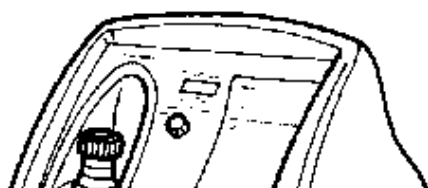
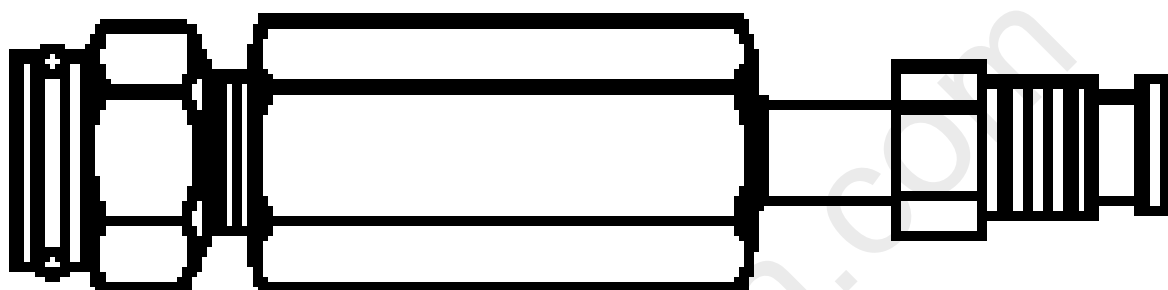
When the conditions for skip shift engagement are no longer met the powertrain control module (PCM) disables the skip shift solenoid, allowing the driver to use second and third gears.

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

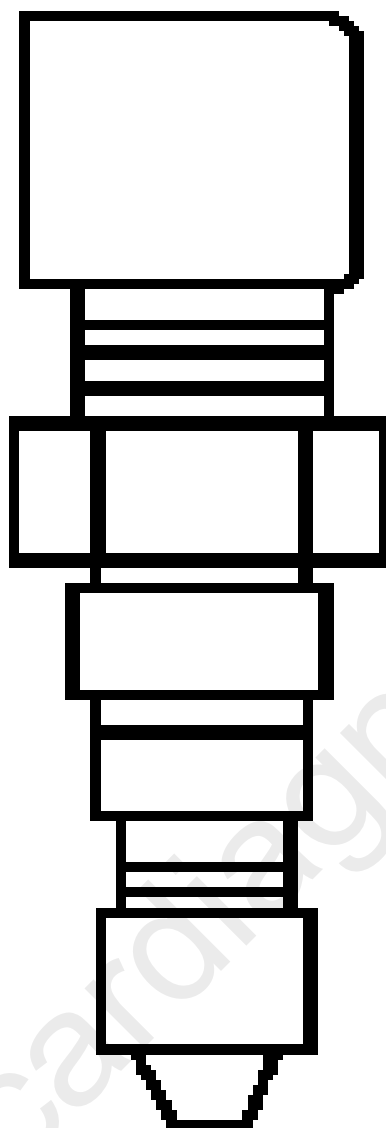
SPECIAL TOOLS

Illustration	Tool Number/ Description
	DT 35944-200A Cooler Flushing Adapter



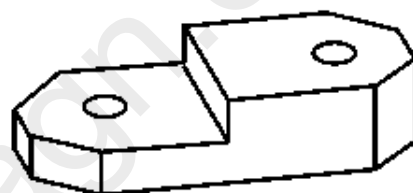
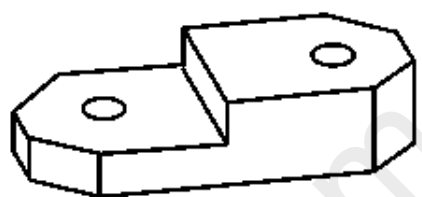
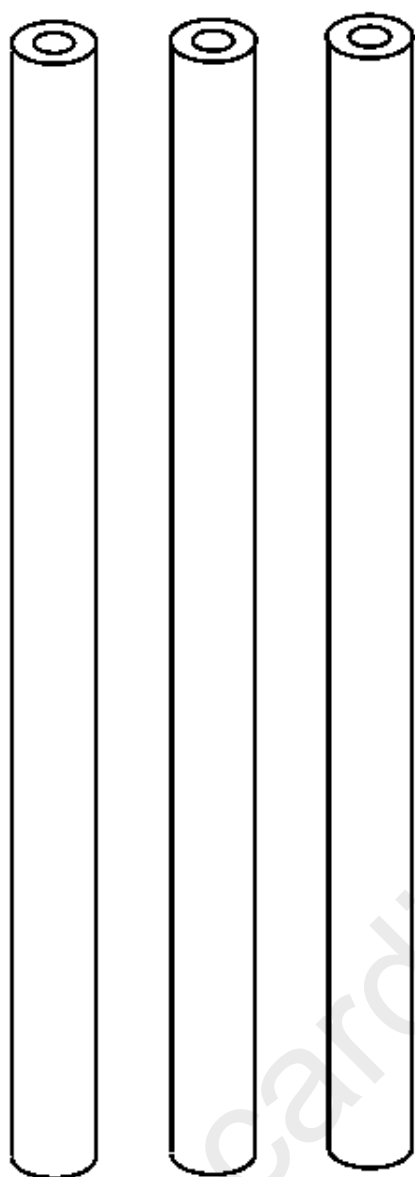
DT 45096
Transmission Oil
Cooling System
Flush and Flow
Test Tool

DT 45096-21
Cooler Flushing
Adapter



DT 47678
Transmission
Holding Flange

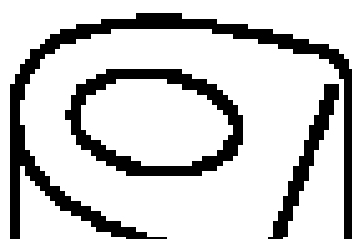
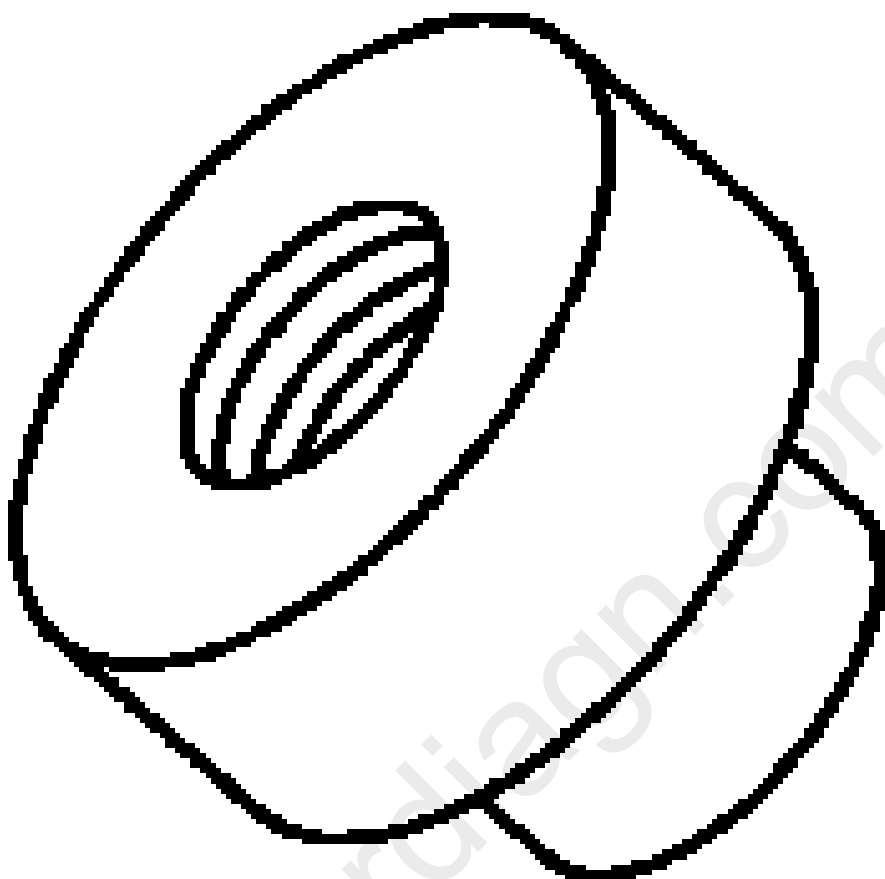
DT 47678-10
Transmission
Holding Flange
Adapter



DT 48074
Input and Output
Shaft Seal
Installer

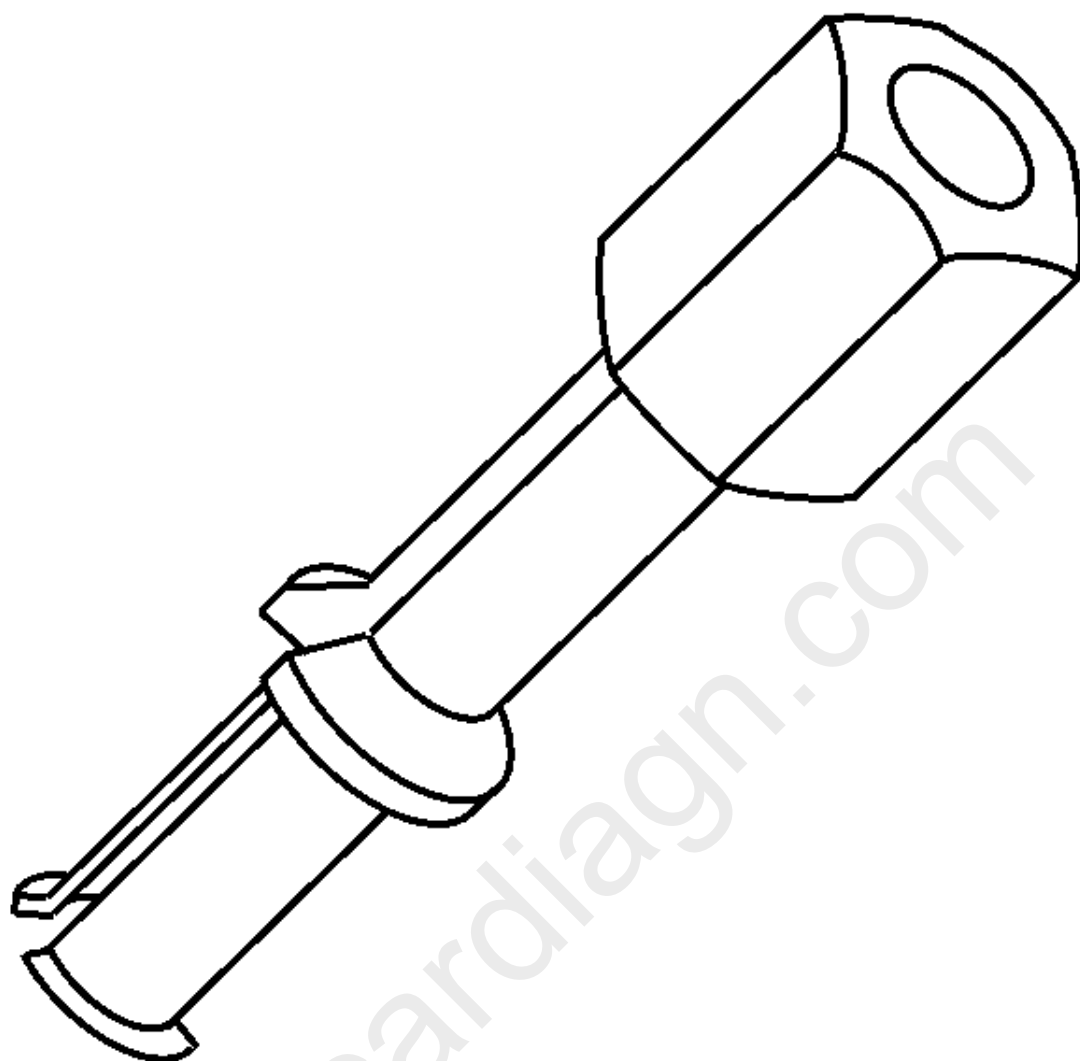
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DT 48802
Bearing Installer



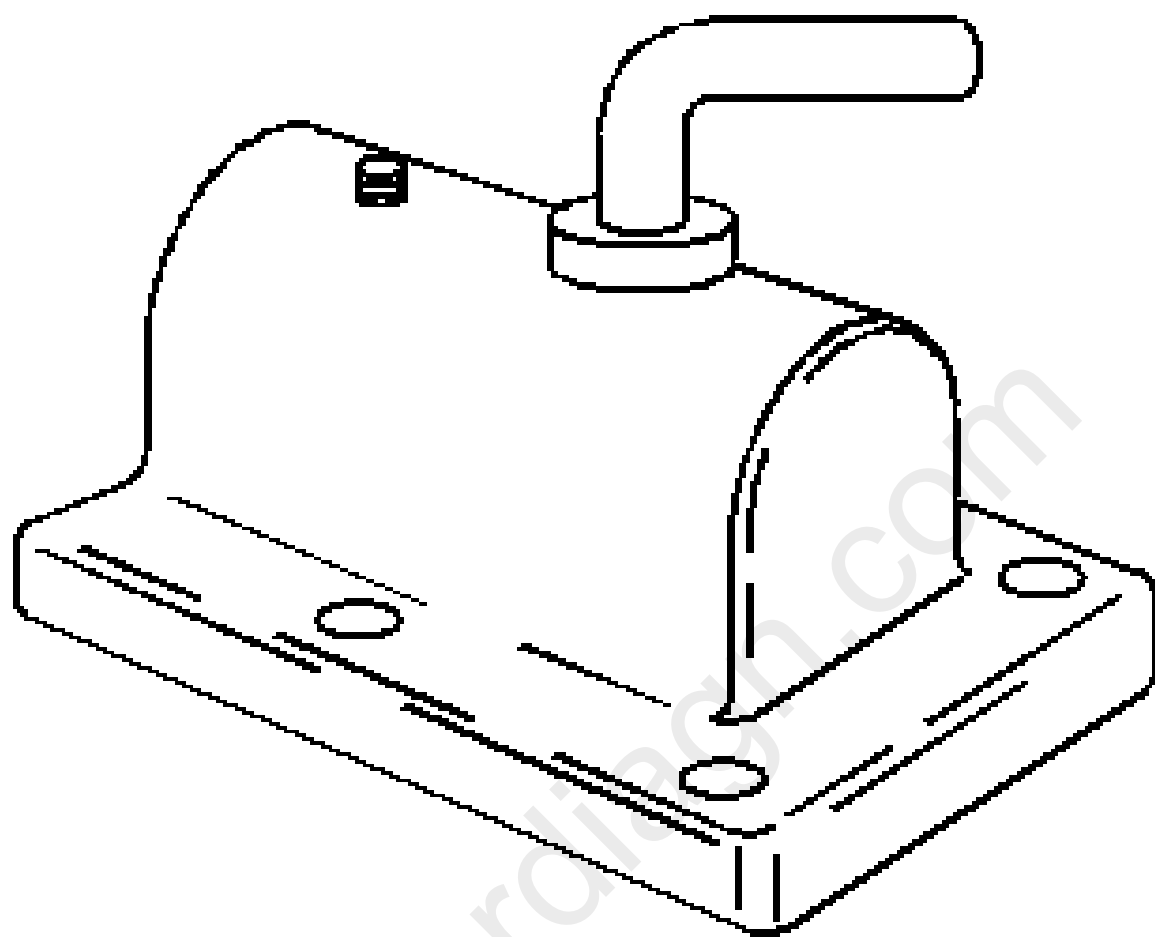
DT 49139
Hub Remover
Tool

DT 49216
Bushing
Remover



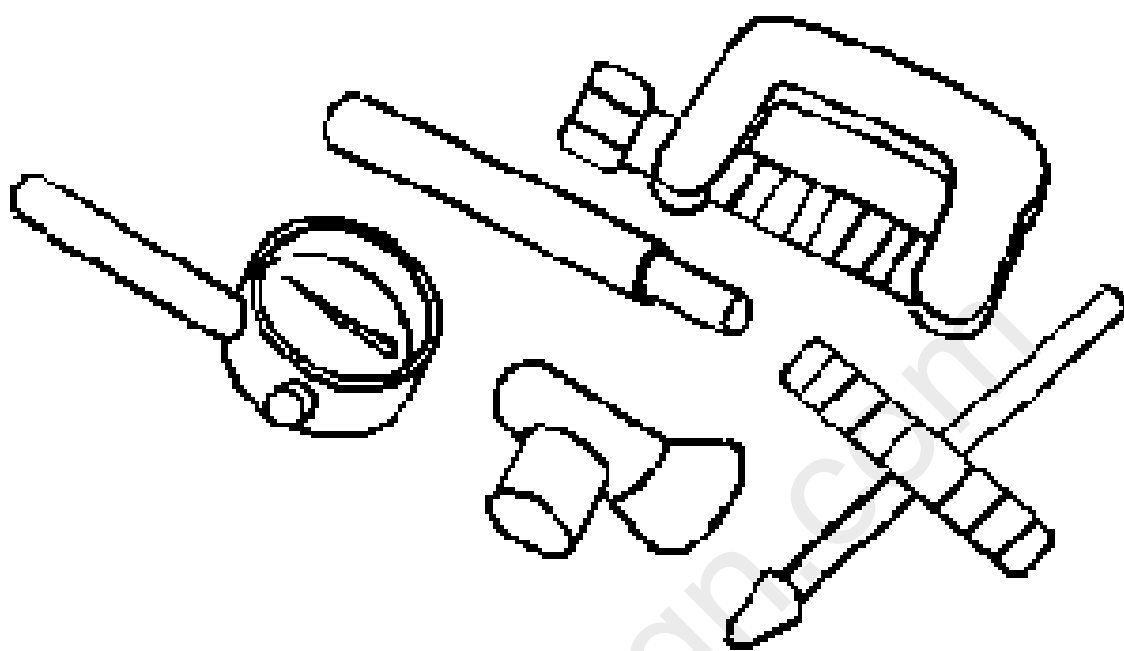
DT 49293
Gear Select/Skip
Shift Solenoid
Socket

J 3289-20
Holding Fixture



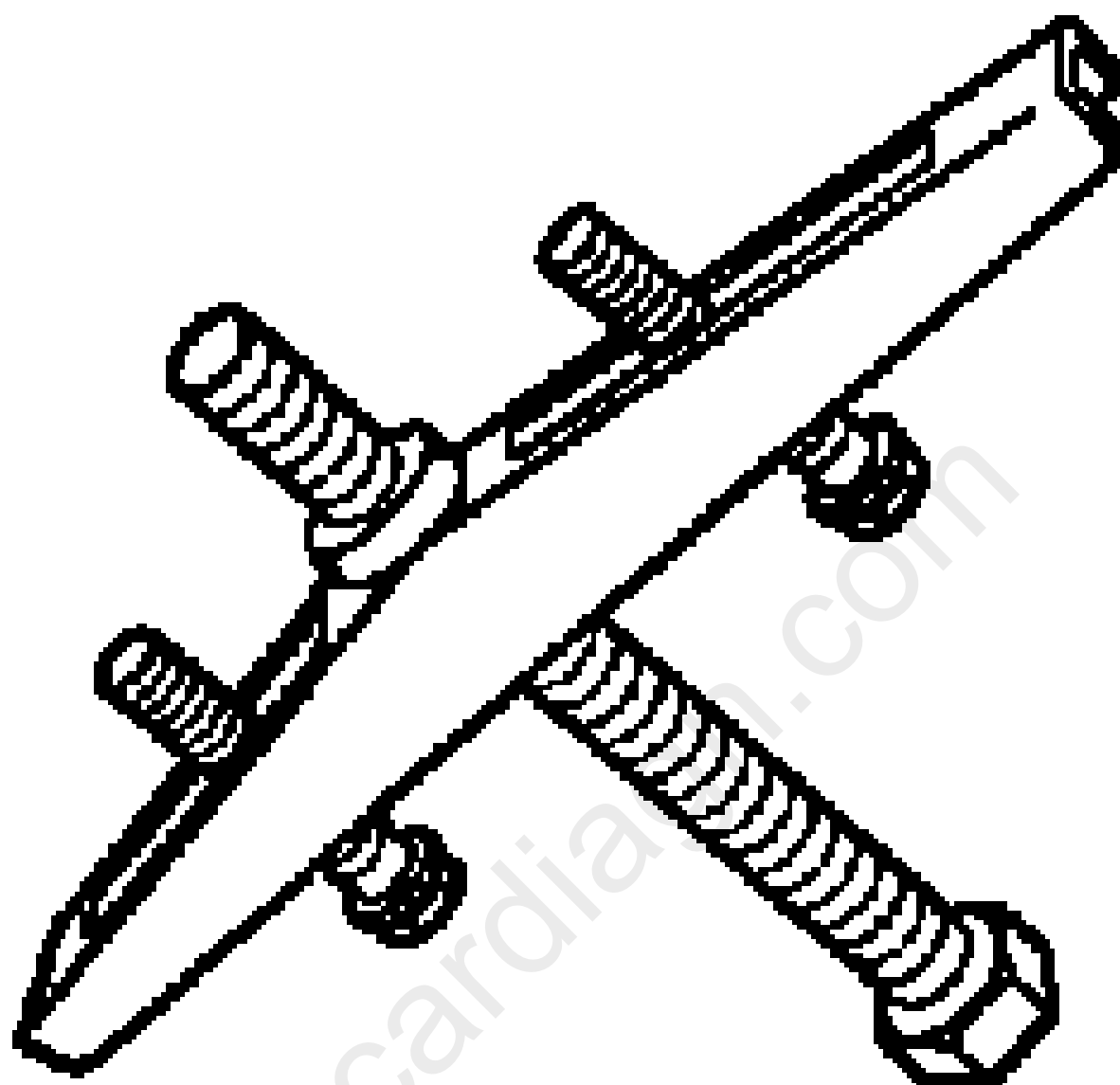
J 6125-1B
Slide Hammer
with Adapter

J 8001
Dial Indicator Set



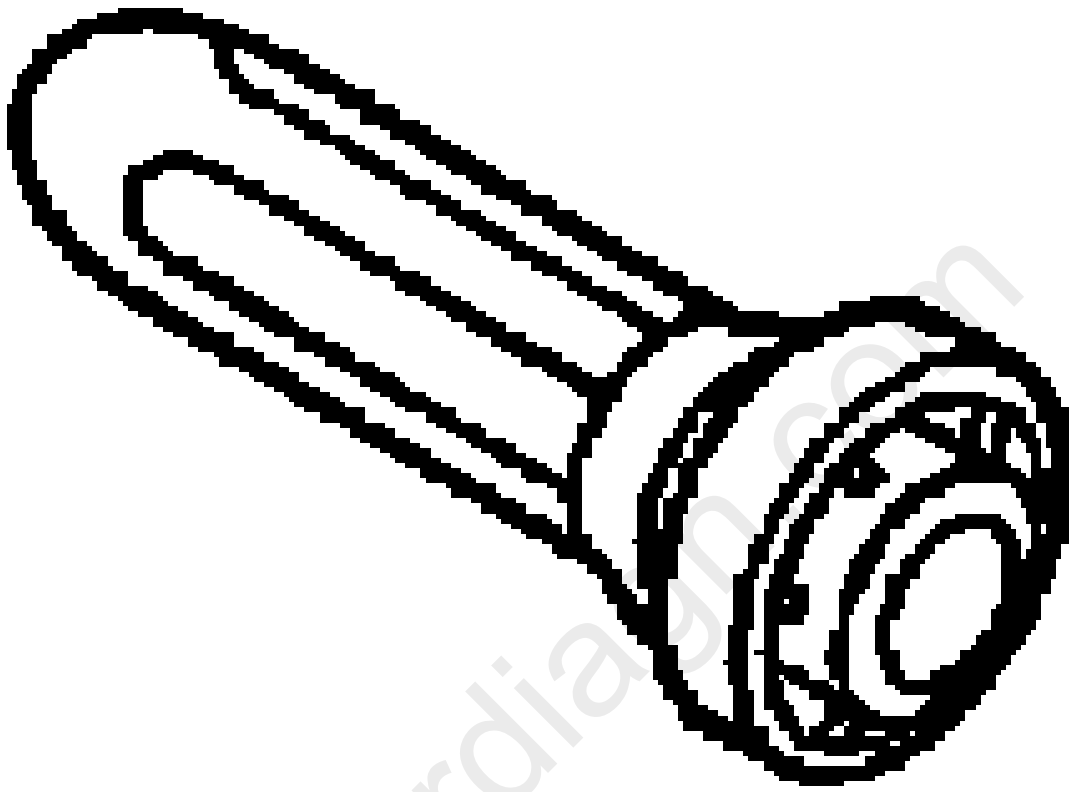
J 8092
Universal Driver
Handle

J 8433
Universal Bridge
Puller



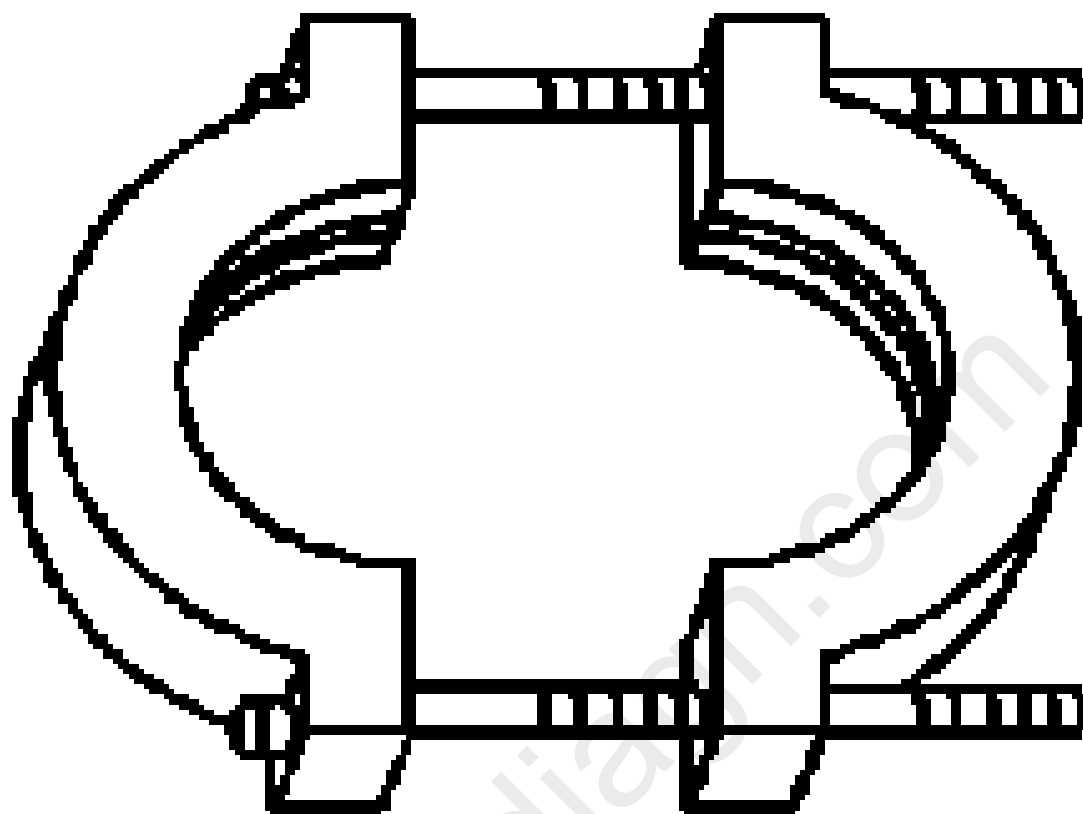
J 08614-A
Pinion Flange
Holder and
Remover

J 21426
Extension
Housing Seal
Installer



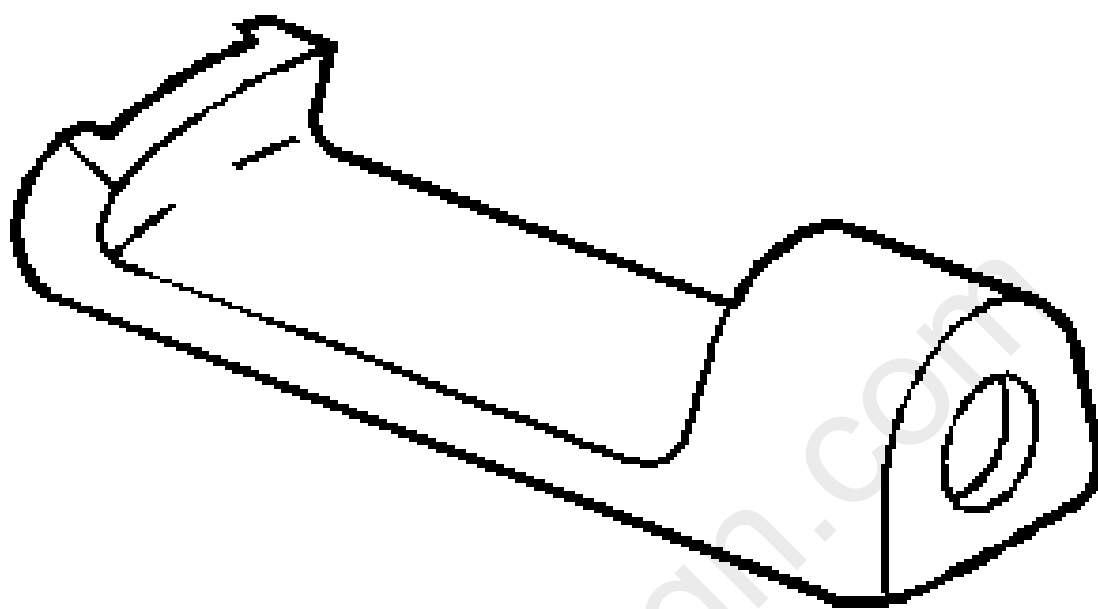
J 22888-20A
Universal Two
Jaw Puller

J 22910-01
Split Plate



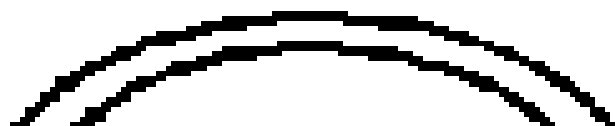
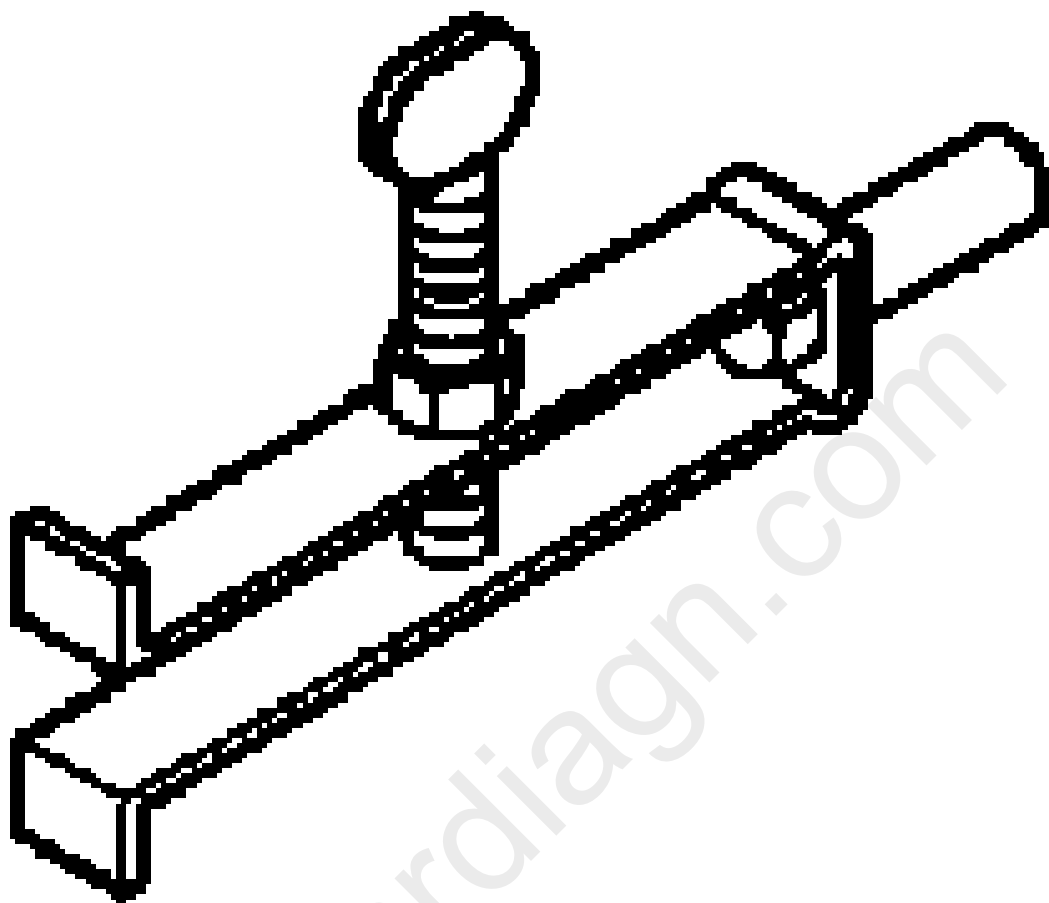
J 22912-B
Rear Pinion and
Axle Bearing
Remover

J 23129
Universal Seal
Remover



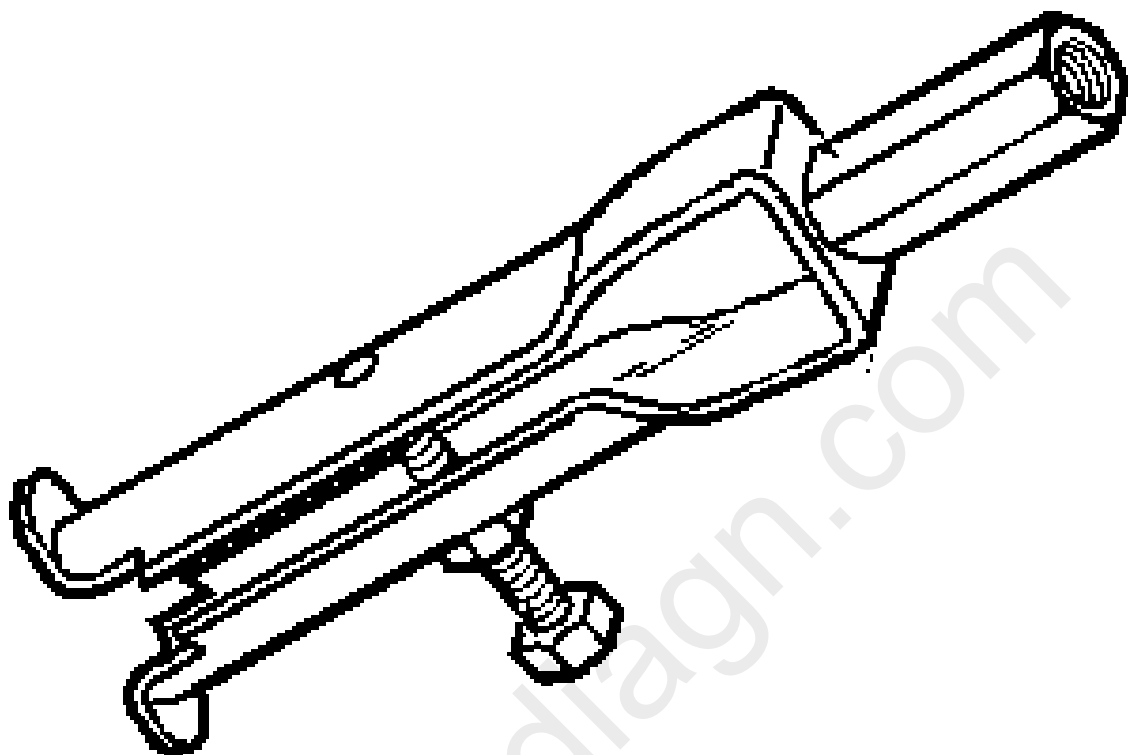
J 23907
Slide Hammer

J 26941
Bearing Race
Remover



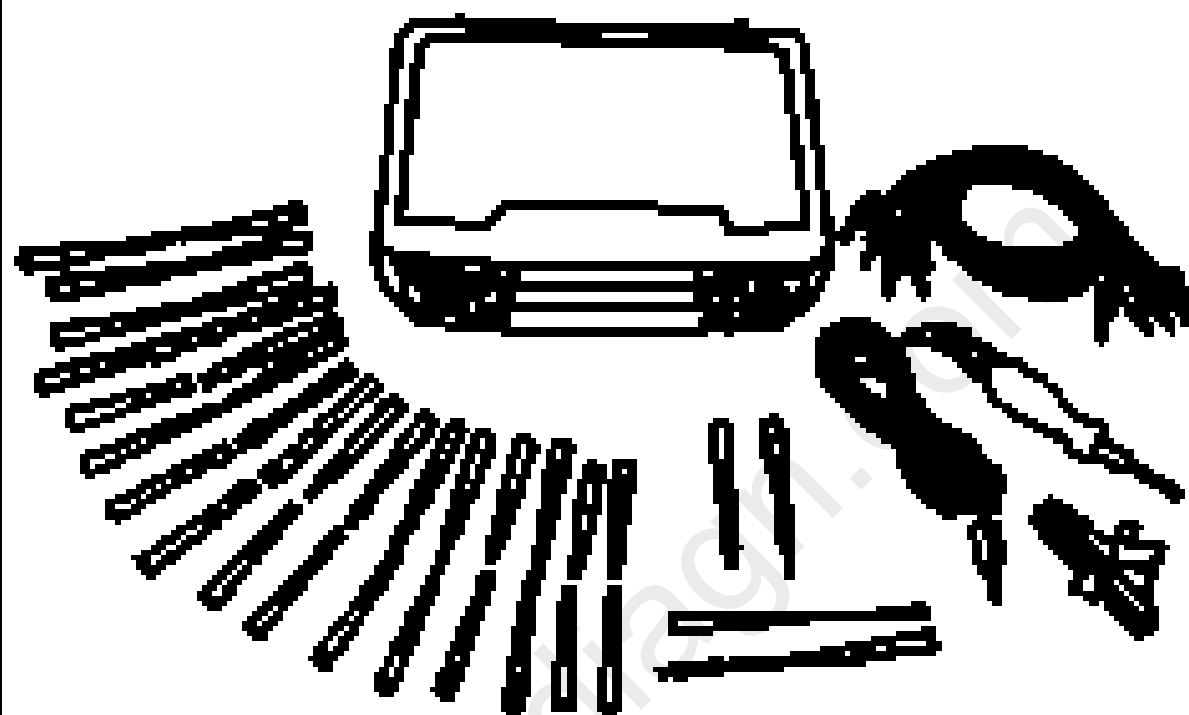
J 28537-17
Bearing Race
Installer

J 29369-2
Bushing and
Bearing Remover
- 2-3 in



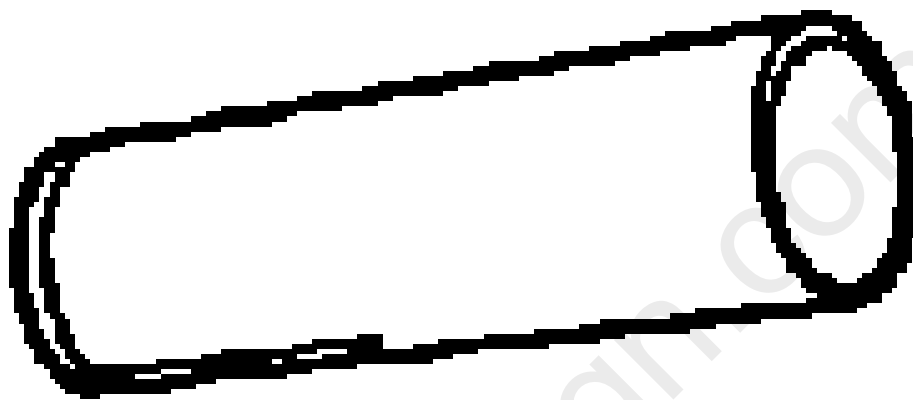
J 29873
Injector Nozzle
Socket 30 mm

J 35616
GM Terminal
Test Kit



J 36017
Valve Seal
Remover

J 36183
Press Tube



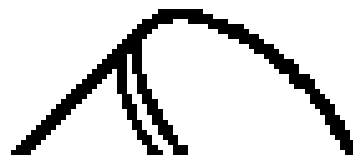
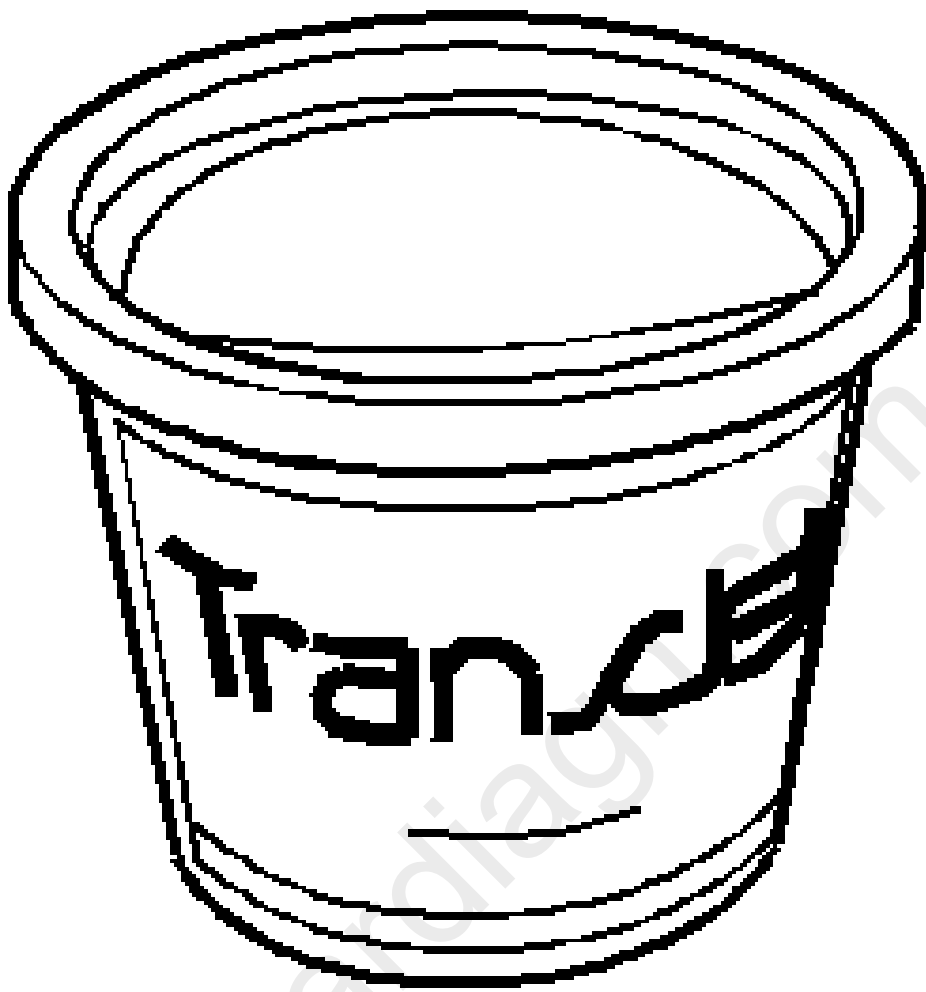
J 36184
Press Tube
Adapter

J 36190
Universal Driver
Handle



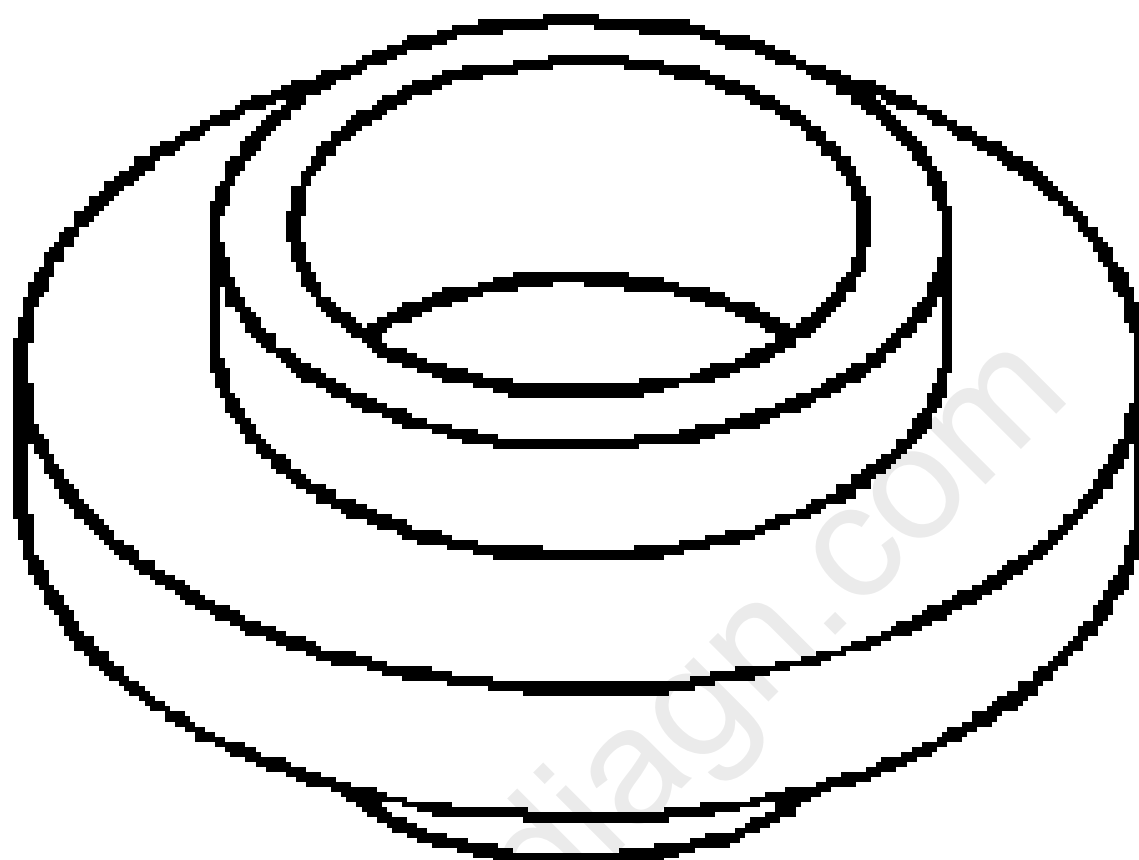
J 36513
Split Plate

J 36850
Transjel®
Lubricant



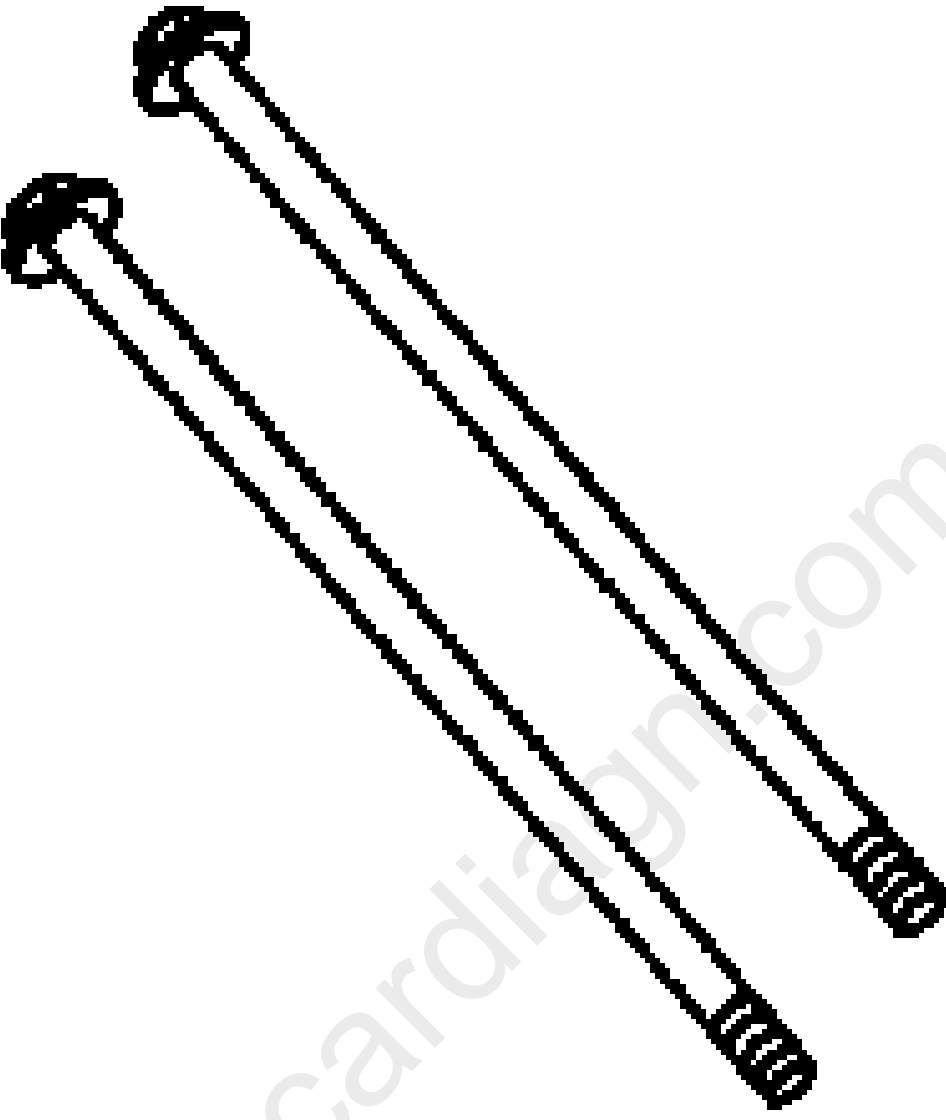
J 38205-1
Press Tube

J 39371
1st/2nd
Synchronizer
Installer



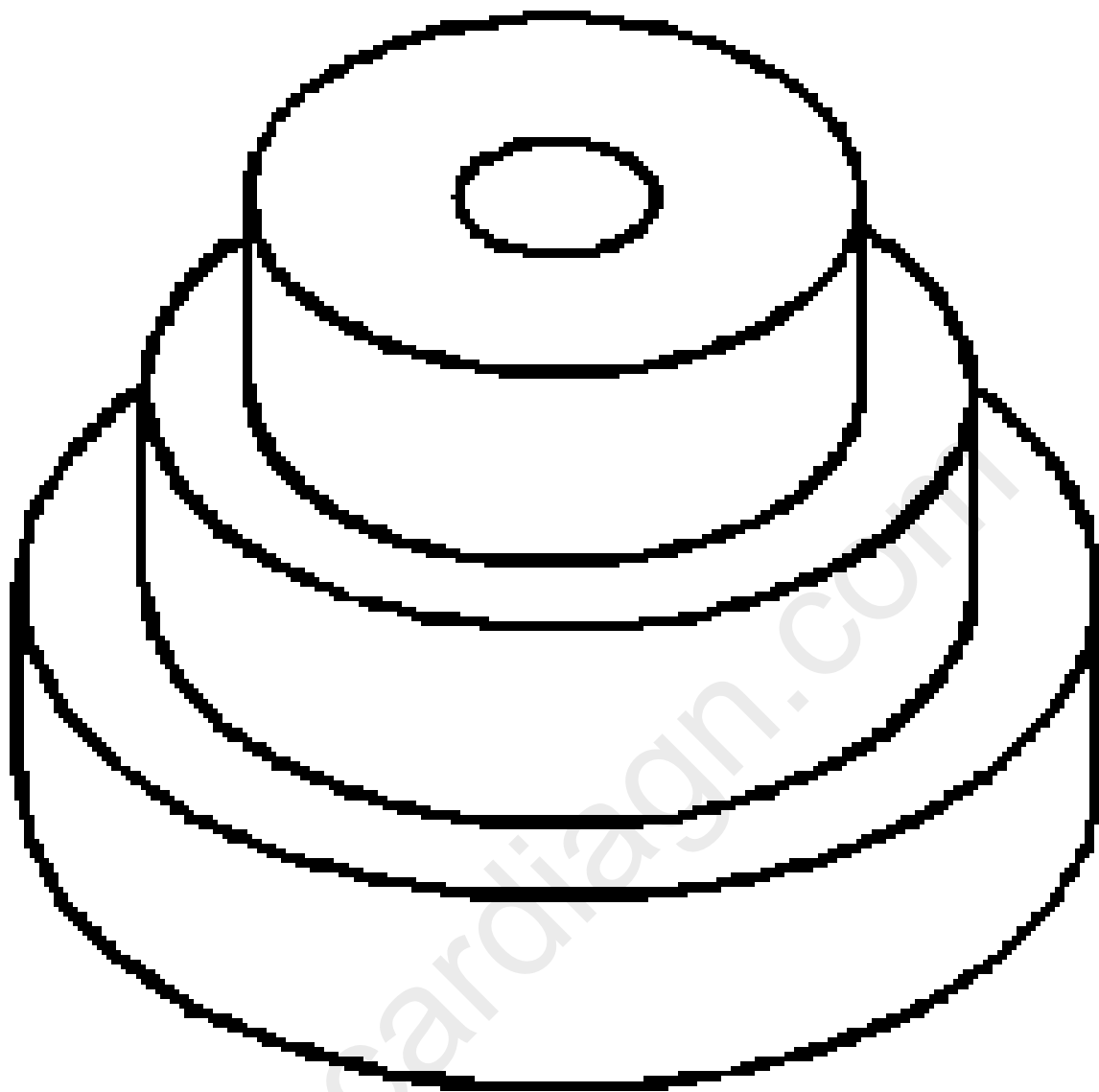
J 39431
5th/6th Driven
Gear Puller

J 39431-3
5th Gear Puller
Adapter Bolts



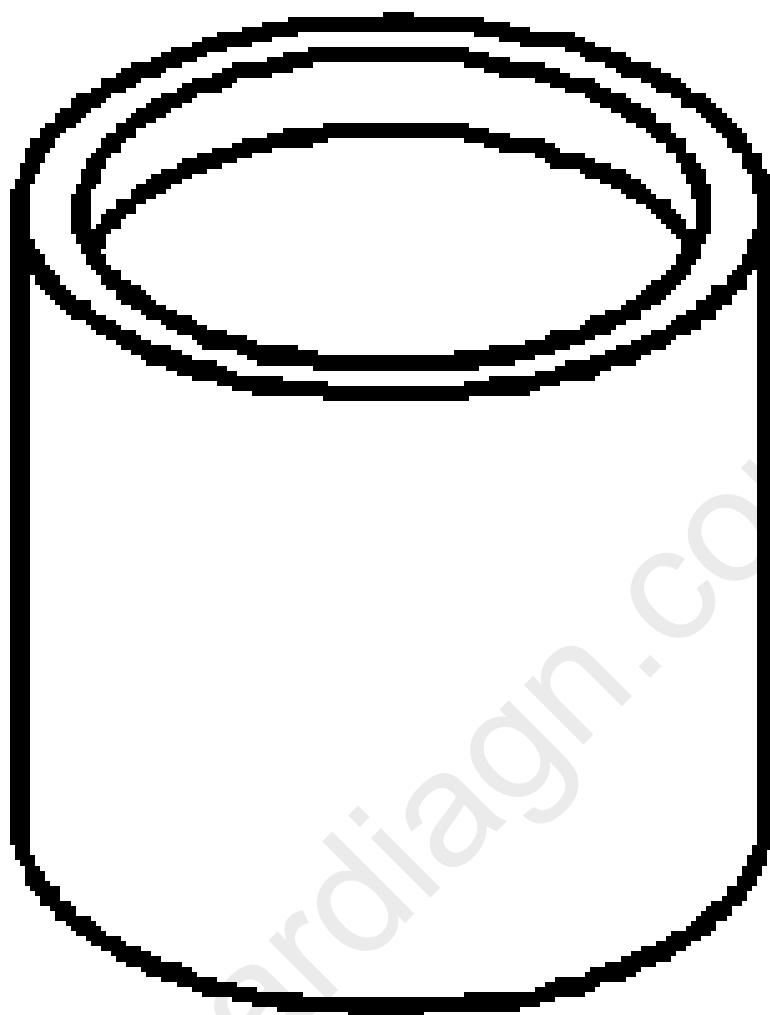
J 39433
Input Shaft Seal
Installer

J 39435
Bearing Race
Installer



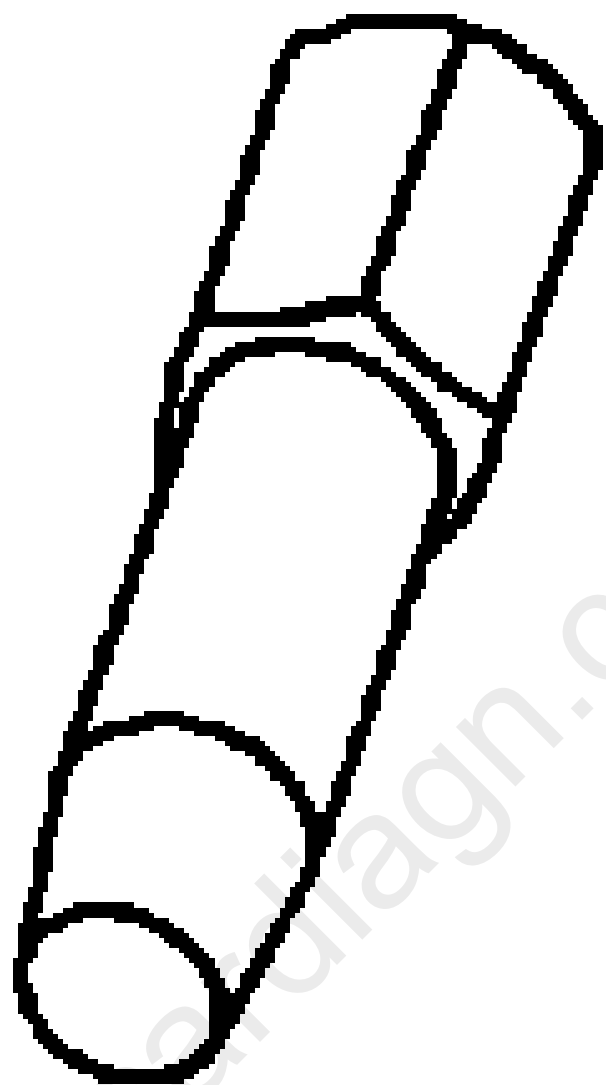
J 39437
Bushings Installer

J 39438
Bearing Installer



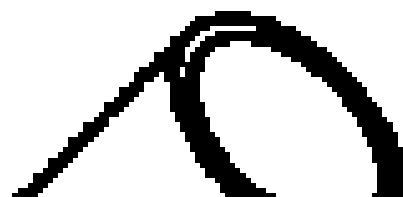
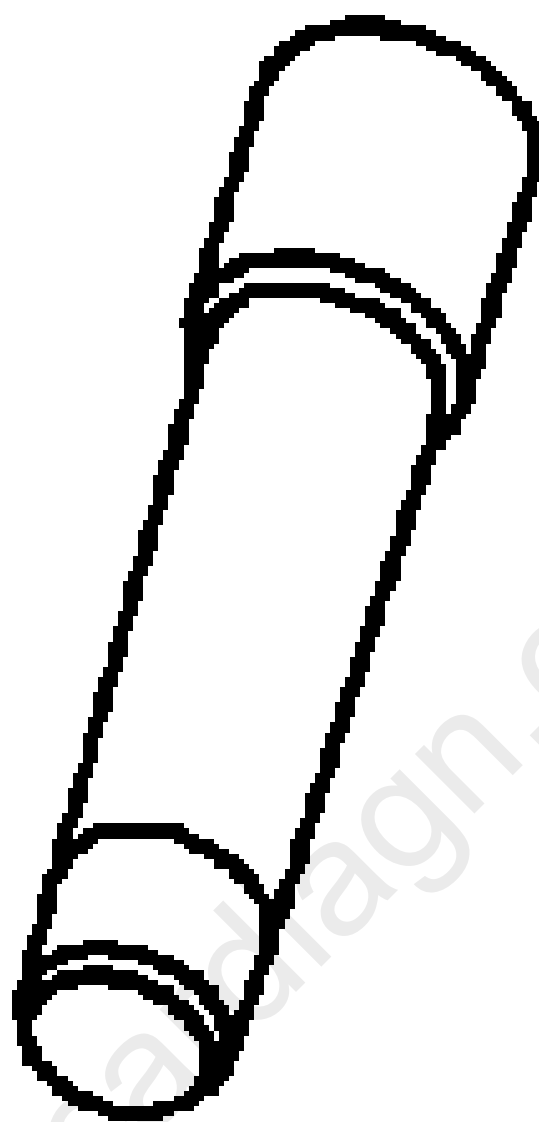
J 39439-1
Shift Rail
Bushing
Remover/Installer

J 39439-2
Bushing
Remover



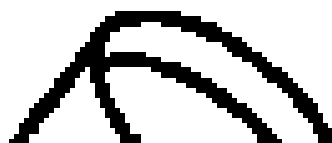
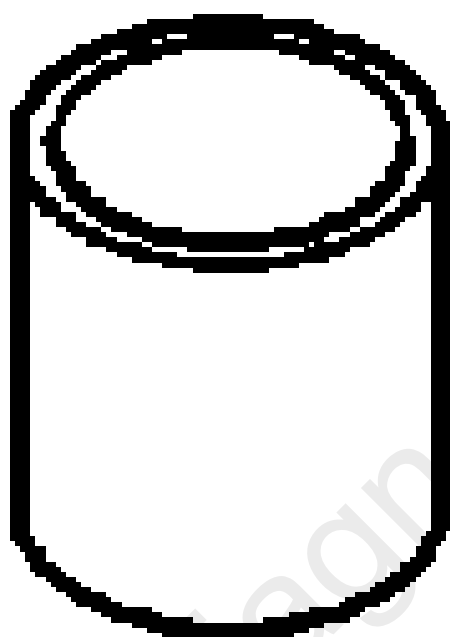
J 39439-3
Bushing Installer

J 39439-4
Bushing Installer



J 39441
5th/6th Driven
Gear Installer

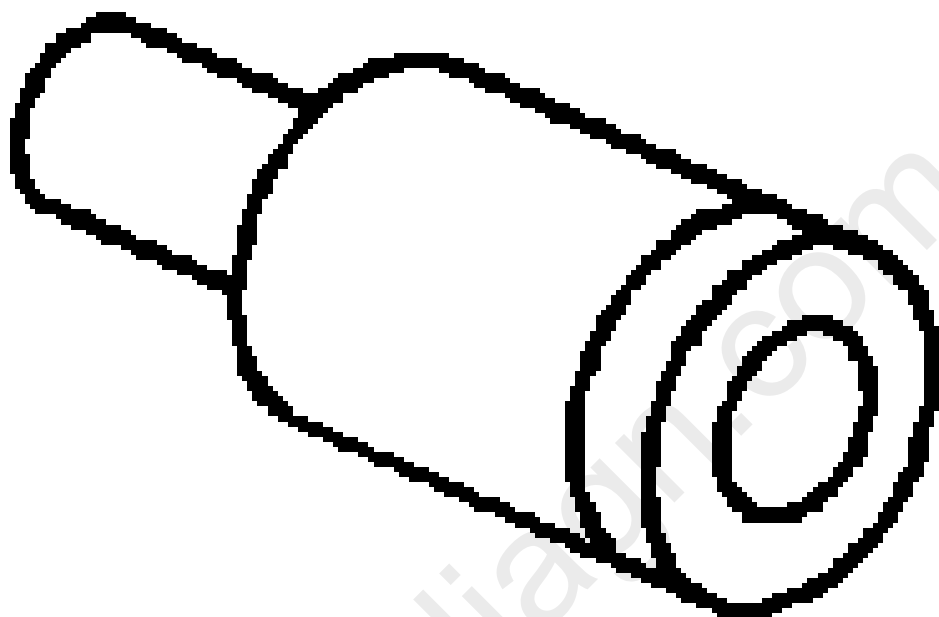
J 39441-10
5th Gear Installer
Adapter



J 39441-20
5th Gear Installer
Adapter

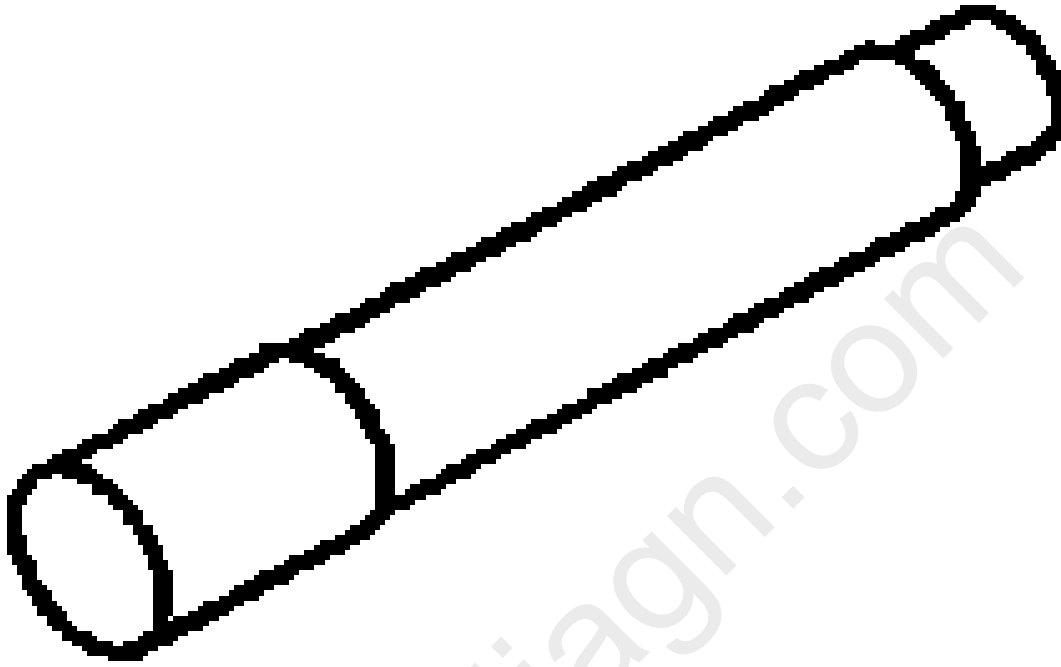
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J 39442
Press Adapter



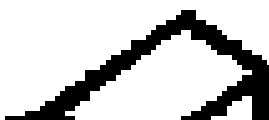
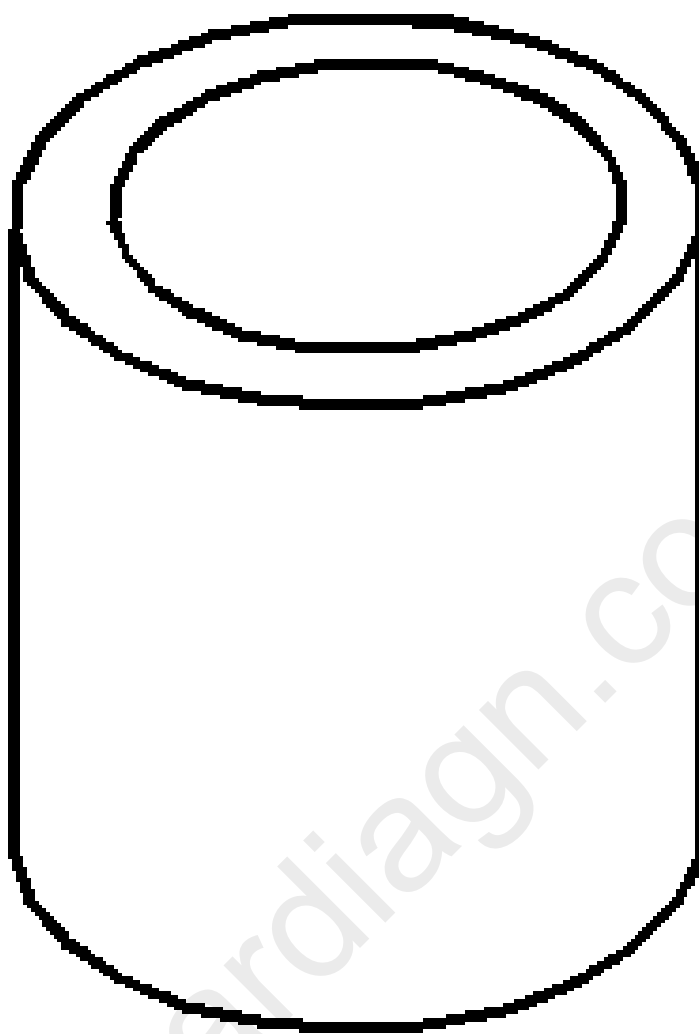
J 39443
Split Plate

J 39444-1
Countershaft End
Play Rod



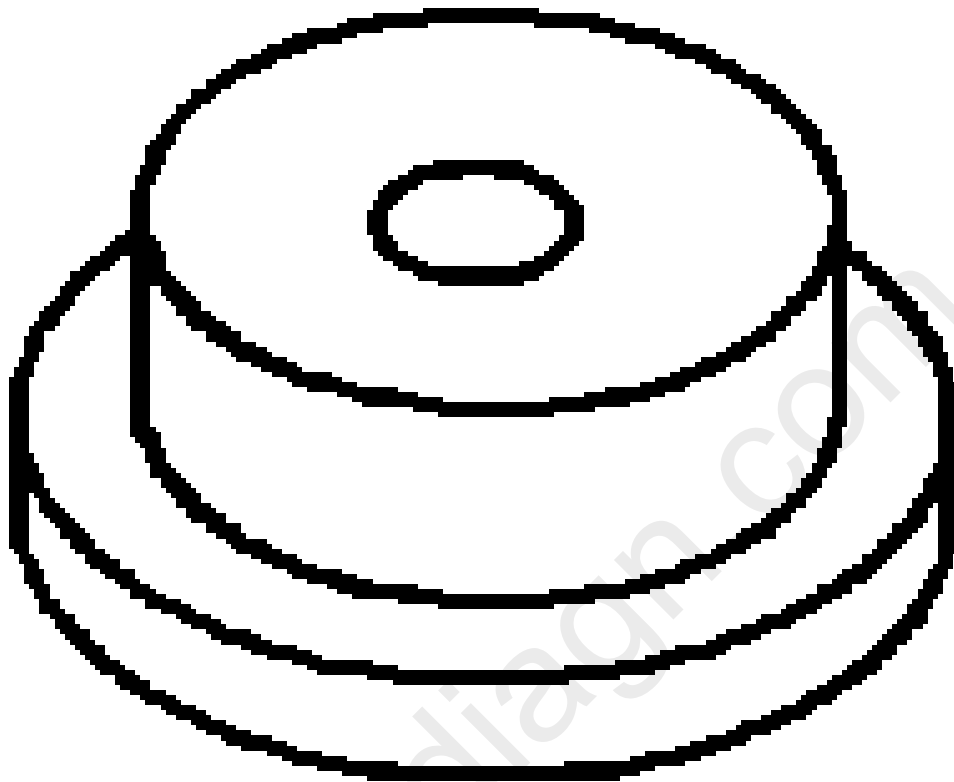
J 39444-2
Countershaft
Extension End
Play Rod

J 39473
Mainshaft
Bearing
Installer/Adapter



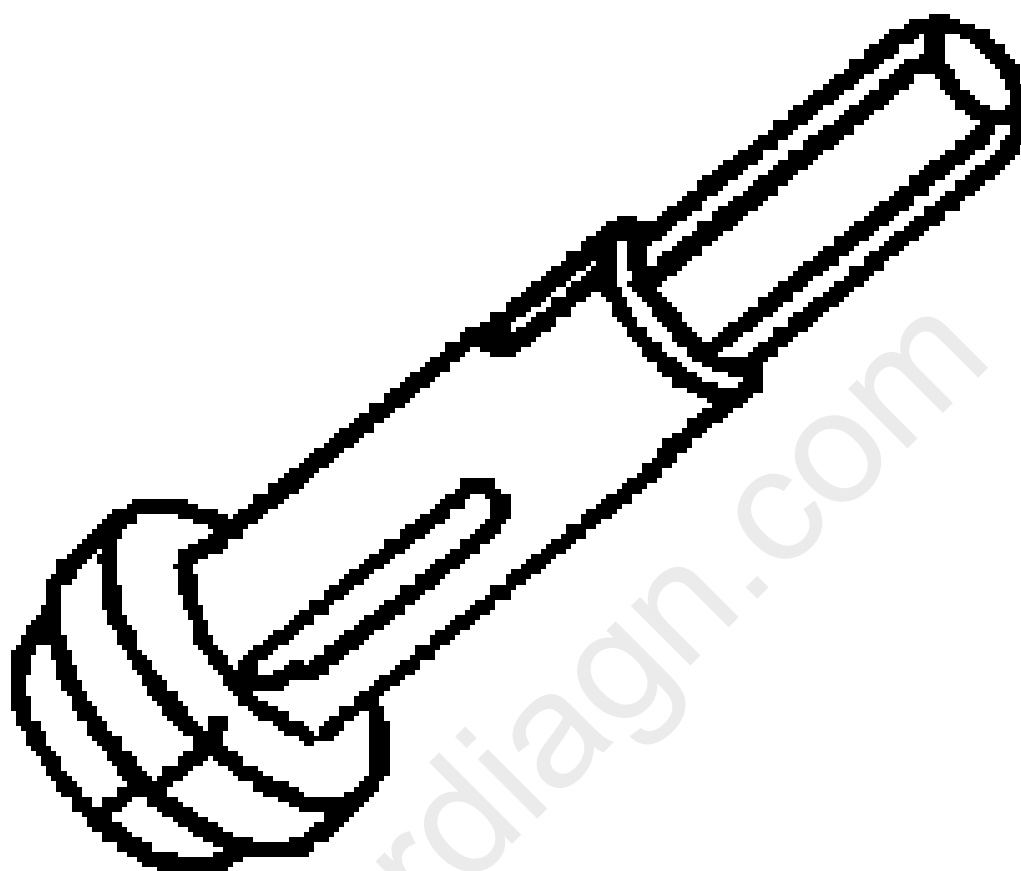
J 39511
Split Plate

J 39546
Bearing Race
Installer



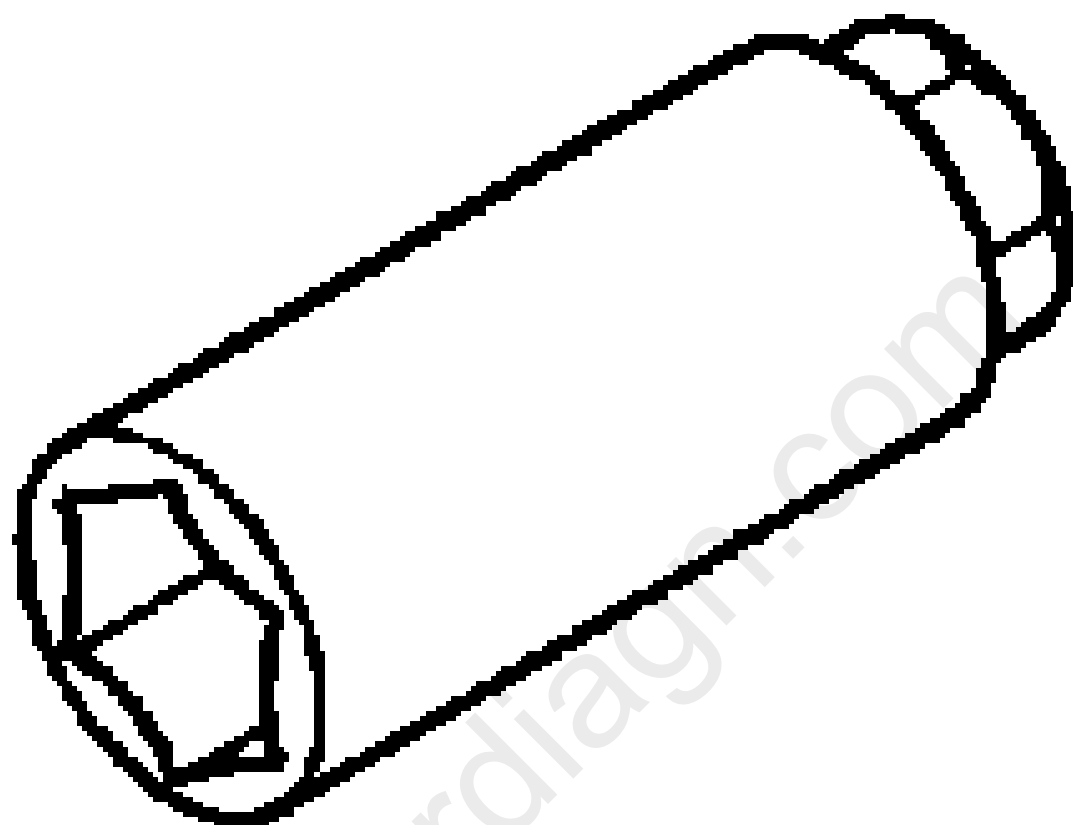
J 39547
Press Adapter

J 39594
Bearing Race
Remover



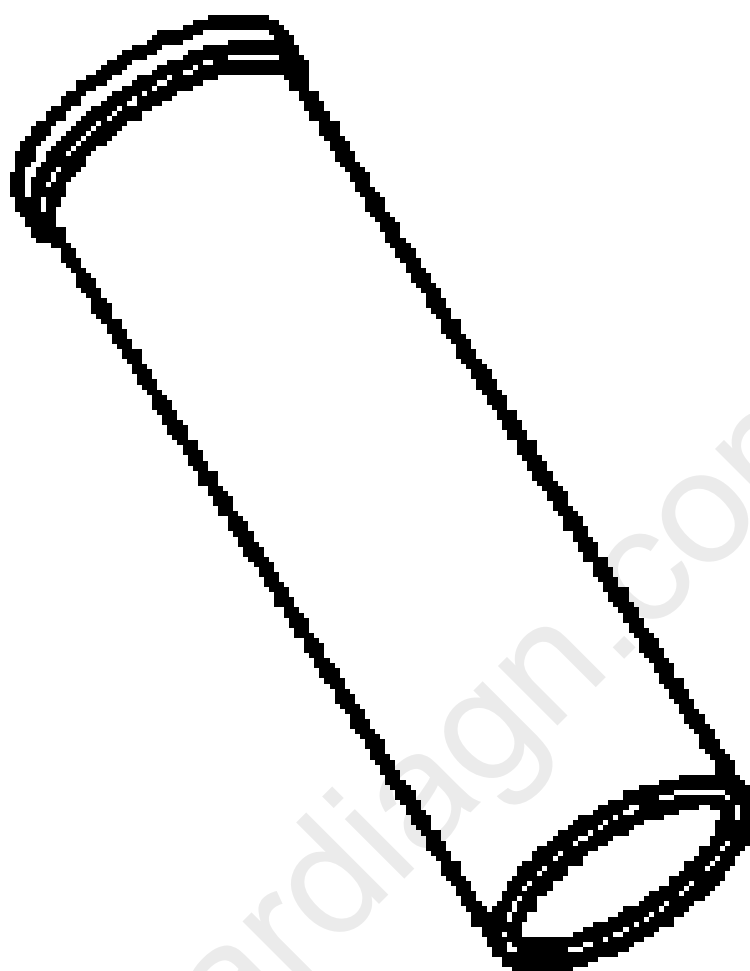
J 39790
Mainshaft
Bearing Race
Remover

J 41099
Skip Shift Sensor
Remover/Installer



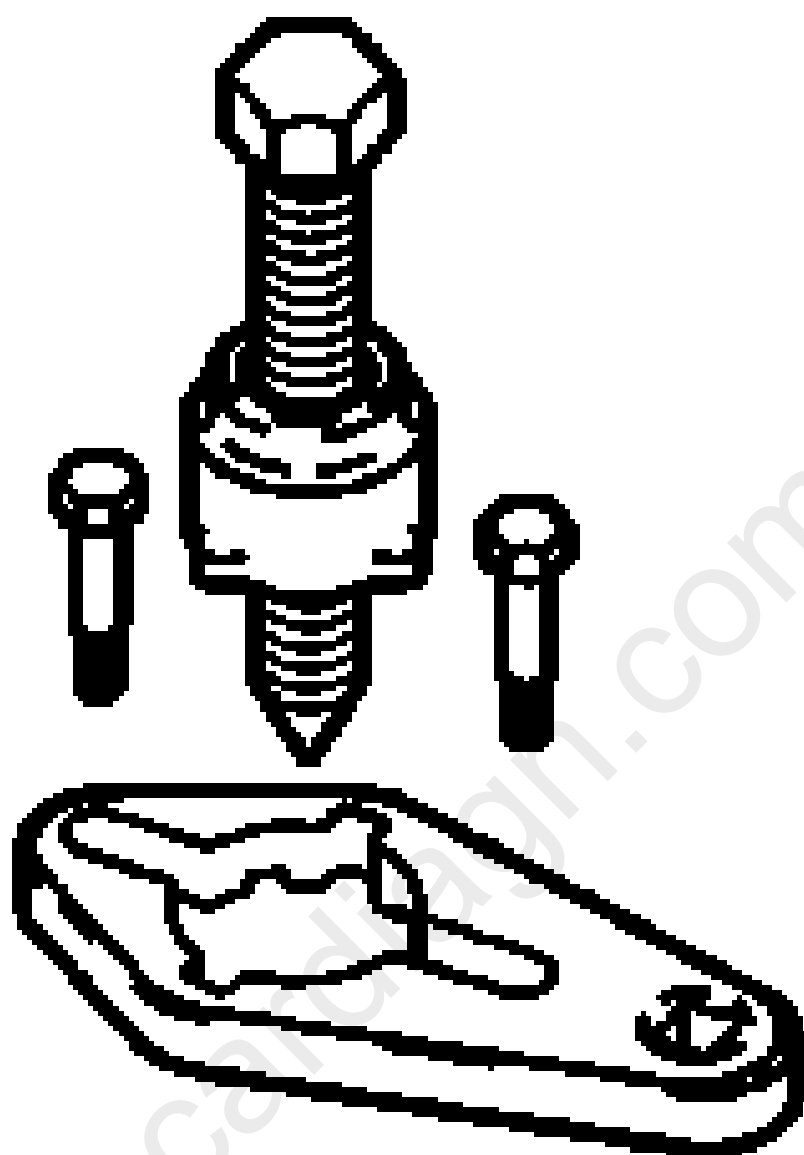
J 44384
Shift Fork
Bearing Installer

J 44735
Installation Tube



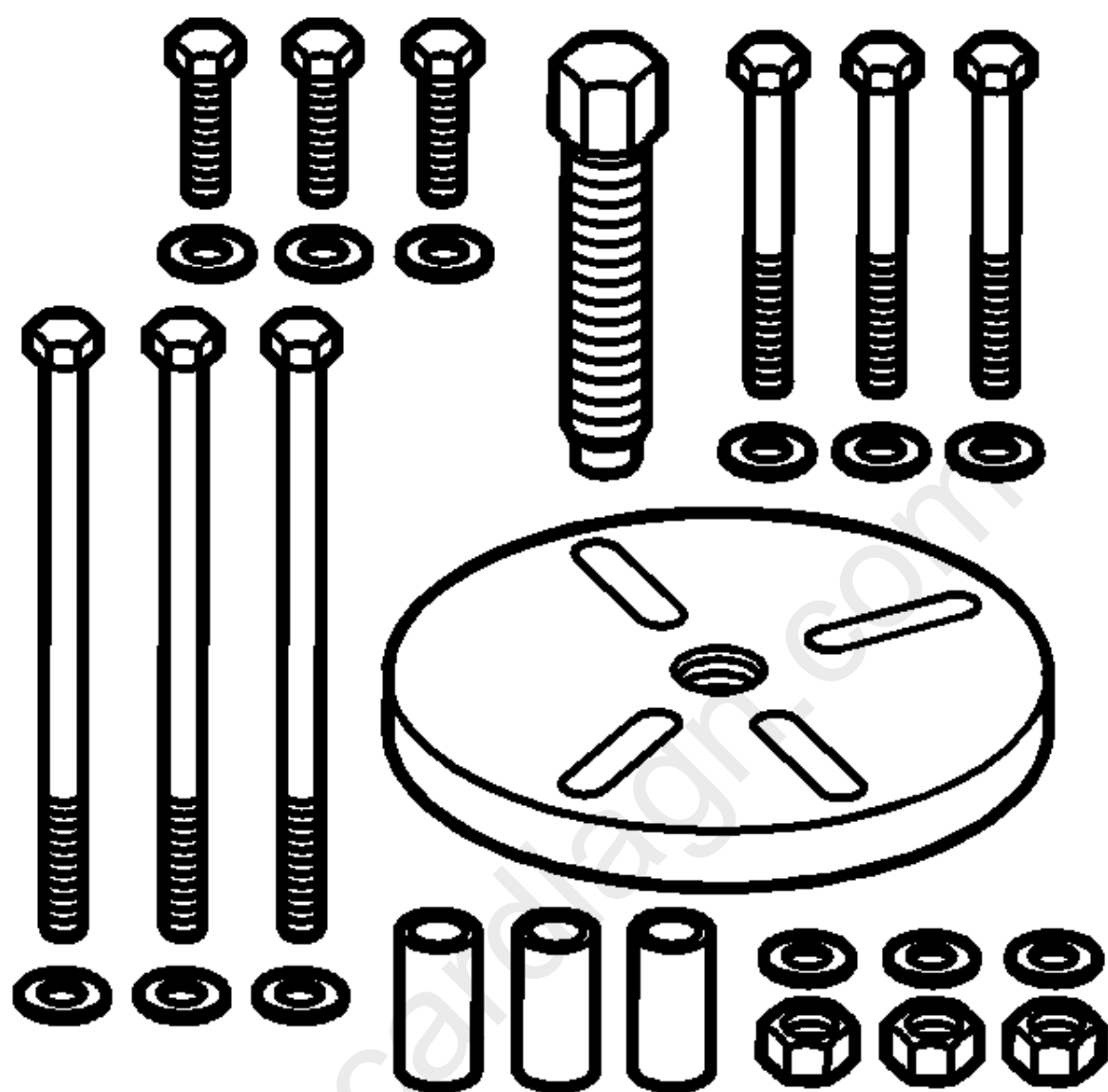
J 44765
Seal Installer

J 44873
Shoulder Bolts



J 45012
Holding Fixture

J 45019
Flange and
Pinion Gauge
Remover



J 45124
Removal Bridge

J 45124-9
Puller Leg

