

Transmission

Clutch - CTS Coupe & Wagon

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator Cylinder Bolt - Tremec	13 N.m	115 lb in
Clutch Actuator Cylinder Pipe Fitting - Tremec	10 N.m	88 lb in
Clutch Pedal Assembly to Brake Pedal Assembly Nuts	20 N.m	15 lb ft
Clutch Pedal Assembly to Cowl Nut	9 N.m	80 lb in
Clutch Pedal Assembly Bolt	20 N.m	15 lb ft
Clutch Pedal Position Switch Bolt	2.5 N.m	22 lb in
Clutch Pressure Plate Bolt - CTS	30 N.m plus 20 degrees	22 lb ft plus 20 degrees
Clutch Pressure Plate Bolt - CTS-V	70 N.m	52 lb ft
Concentric Actuator Cylinder Bolt - Aisin	20 N.m	15 lb ft
Concentric Actuator Cylinder Quick Connector Bolt - Aisin	10 N.m	89 lb in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number	
		United States	Canada
Clutch Hydraulic Fluid	DOT 4 Hydraulic Brake Fluid	88958860	88901244

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - CLUTCH

Strategy Based Diagnostics

Review the system operations in order to familiarize yourself with the system functions. Refer to **Clutch System 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 clutch master cylinder reservoir for the correct fluid level.
- Inspect the hydraulic clutch lines for dents, kinks or other obvious damage that may affect the clutch system operations.
- Inspect the hydraulic lines for proper installation.
- Inspect the clutch system for contamination of dirt, oil, or other substances that may affect the clutch system operations.
- Inspect for aftermarket parts.

Intermittent

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

Symptom List

NOTE: Due to the variety of clutch options, there may be components in the mechanical diagnostic tables that are not on a particular vehicle.

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

- Clutch Drag Hard Shifting
- Clutch Slipping
- Clutch Grabbing
- Clutch Rattle
- Clutch Noisy
- Clutch Pedal Spongy Low Pedal Effort
- Clutch Pedal Hard to Push
- Clutch Vibration

CLUTCH DRAG HARD SHIFTING

Clutch Drag Hard Shifting

Cause	Action
DEFINITION: The clutch does not disengage completely to allow smooth shift operations. It may cause gear clashing while the vehicle is not moving, at idle, and shifting out of neutral, or hard shifting in and out of gears while driving the vehicle. Review the Symptoms - Clutch and perform the necessary inspections.	
Pedal blocked from full travel	1. Inspect for obstacles that will prevent the pedal from going to the floor. 2. Clear any obstacles from under the pedal area, such as floor mats or interior panels.
Too much travel between pedal and clutch	1. Inspect the pedal for worn bushings.

master cylinder	2. Replace the pedal bushings if worn. Refer to <u>Clutch Pedal Replacement</u> .
Clutch pedal mounting loose	1. Inspect the clutch pedal mounting bracket for loose or missing fasteners. 2. Replace or repair the fasteners. Refer to <u>Clutch Pedal Replacement</u> .
Linkage at pedal worn or damaged	1. Inspect the linkage at the pedal for excessive wear. 2. Repair or replace the linkage as required. Refer to <u>Clutch Pedal Replacement</u> .
Clutch master cylinder seized or binding	1. Inspect the master cylinder for the piston being able to move freely and full range of travel. 2. Repair or replace the clutch master cylinder as required. Refer to <u>Clutch Master Cylinder Replacement</u> .
Air in the clutch hydraulic system	Bleed the clutch hydraulic system. Refer to <u>Hydraulic Clutch System Bleeding</u> .
Clutch actuator cylinder seized or binding	1. Inspect the clutch actuator piston for moving freely. 2. Replace the clutch actuator cylinder if the piston is binding. Refer to <u>Clutch Concentric Actuator Cylinder Replacement</u> .
Clutch master cylinder leaking internally	1. Inspect for proper pedal reserve. 1. Let up halfway on pedal. 2. Apply the pedal a few times. 3. Inspect to ensure there is still the proper pedal reserve. 2. Replace the clutch master cylinder if it will not hold pedal reserve. Refer to <u>Clutch Master Cylinder Replacement</u> .
Damaged clutch assembly components	1. Remove the clutch assembly. 2. Inspect the following clutch assembly components for damage: • Damaged clutch disc hub splines • Bent clutch disc • Bent drive straps • Broken or warped pressure plate 3. Replace the clutch assembly if any of the above damage is found. Refer to <u>Clutch Assembly Replacement</u> .
Excessive side loading on the release bearing	

	1. Inspect the following clutch system components: • Worn or damaged pilot bearing • Excessive flywheel runout • Excessive engine to transmission misalignment 2. Repair or replace any faulty components.
Faulty pilot bearing	Replace the pilot bearing. Refer to <u>Clutch Pilot Bearing Replacement</u> .
Transmission input shaft splines worn or damaged	Replace the transmission input shaft. Refer to <u>Transmission Disassemble</u> .
Tight or contaminated clutch disc splines	1. Clean the clutch disc and input shaft splines. 2. If the clutch disc will not clean, replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u>.
Flywheel housing, engine block to clutch housing, or transmission front case excessively misaligned	1. Inspect the clutch housing or the transmission front case for being faulty. 2. Replace the clutch housing if it is faulty. Refer to <u>Transmission Disassemble</u>. 3. Replace the transmission front case half. Refer to <u>Transmission Disassemble</u>.
Grease or oil contamination on the clutch discs facing	1. Repair the oil leak. 2. Repair the grease leak. 3. Clean the clutch disc facing and the other clutch assembly components. 4. Replace the clutch assembly if it will not clean. Refer to <u>Clutch Assembly Replacement</u>.

CLUTCH SLIPPING

Clutch Slipping

Cause	Action
DEFINITION: The clutch does not engage completely after the pedal is released, after shifting gears, or the clutch slips during maximum engine loads, such as climbing hills or high vehicle speeds. Clutch slipping is identified by increase in engine RPM without increase in vehicle speed. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Incorrect clutch pedal height, not allowing the clutch master cylinder to return	Adjust the clutch pedal position switch. Refer to <u>Clutch Pedal Position Switch Replacement</u> .
The clutch pedal return spring is broken or missing	Replace the clutch pedal return spring. Refer to <u>Clutch Pedal Return Spring Replacement</u> .
The clutch pedal is binding or sticking	1. Clear away any items that may be contacting the pedal.

	- Inspect the pedal bushings for ease of movement. - Replace the clutch pedal if it is faulty. Refer to <u>Clutch Pedal Replacement</u>.
Clutch master cylinder binding or seized	Replace the clutch master cylinder. Refer to <u>Clutch Master Cylinder Replacement</u> .
Clutch actuator cylinder binding or seized	Replace the clutch actuator cylinder. Refer to <u>Clutch Concentric Actuator Cylinder Replacement</u> .
Kinked or damaged clutch hydraulic hose	- Inspect for the correct routing of the clutch hydraulic hose. - Route the hose properly. - Inspect for loose or faulty engine mounts that may allow the hydraulic hose to be kinked or pinched. - Repair or replace faulty engine mounts. Refer to the following procedures: <u>Engine Mount Replacement - Left Side</u>, and <u>Engine Mount Replacement - Right Side</u> for the 6.2L (LSA) engine - Repair or replace the clutch hydraulic hose if it is damaged. Refer to <u>Hydraulic Clutch Hose/Pipe Replacement</u>.
Grease or oil contamination of the clutch disc	- Repair the source of the oil leak. - Repair the source of the grease leak. - Clean the contamination from the clutch components. - If contaminants cannot be removed, replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u>.
Worn or damaged flywheel	Replace the engine flywheel. Refer to <u>Engine Flywheel Replacement</u> for the 6.2L (LSA) engine.
Worn clutch disc facing	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .
Burnt or glazed clutch discs	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .
Input shaft splines worn	Replace the input shaft. Refer to <u>Transmission Disassemble</u> .
Improper resurfacing of the flywheel	Replace the flywheel if it has been improperly resurfaced, allowing contact of the clutch disc hub or insufficient clamping load of the pressure plate. Refer to <u>Engine Flywheel Replacement</u> for the 6.2L (LSA) engine.

CLUTCH GRABBING

Clutch Grabbing

Cause	Action
DEFINITION: The clutch grabs, or chatters, or the clutch is unable to release without the vehicle jerking. An abrupt engagement of the clutch. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Grease or oil contamination on the clutch facings	1. Repair the cause of the oil leak or grease contamination. 2. Clean the clutch facings. 3. Replace the clutch components if they will not clean. Refer to <u>Clutch Assembly Replacement</u>.
Loose or faulty engine mounts	1. Inspect the engine mounts for being loose or faulty. Refer to <u>Engine Mount Inspection</u> for the 6.2L (LSA) engine. 2. Replace the engine mounts as required. Refer to the following procedures: • <u>Engine Mount Replacement - Left Side</u> , and <u>Engine Mount Replacement - Right Side</u> for the 6.2L (LSA) engine
Clutch pedal sticking	1. Inspect the clutch pedal for correct operation. 2. Replace the clutch pedal if it is faulty. Refer to <u>Clutch Pedal Replacement</u>.
Clutch actuator binding	1. Inspect the clutch actuator for the piston seals binding or sticking on the hub. 2. Replace the clutch actuator if it is binding. Refer to <u>Clutch Concentric Actuator Cylinder Replacement</u>.
Clutch master cylinder binding	1. Inspect the clutch master cylinder for the piston binding or sticking in the cylinder. 2. Replace the master cylinder if it is faulty. Refer to <u>Clutch Master Cylinder Replacement</u>.
Warped clutch cover	1. Inspect the clutch cover for distortion caused by improperly tightening the clutch cover bolts. 2. Replace the clutch cover if it is distorted. Refer to <u>Clutch Assembly Replacement</u>.
Improper clutch installation	1. Inspect the pressure plate for distortion caused by improperly tightening the pressure plate bolts. 2. Inspect the clutch disc for a bent hub caused by forcing the installation of the transmission. 3. Inspect for the correct clutch disc. 4. Inspect the clutch disc for being installed backwards.

	5. Replace the clutch assembly if it is damaged or the wrong components were installed. Refer to <u>Clutch Assembly Replacement</u> .
Clutch disc binding on the input shaft	1. Inspect the input shaft for rust dirt or debris. 2. Clean and lubricate the input shaft. 3. Inspect the clutch disc for a bent hub. 4. Replace the clutch assembly if the clutch disc is faulty. Refer to <u>Clutch Assembly Replacement</u>. 5. Inspect the input shaft for excessive wear on the splines, causing the clutch disc to bind. 6. Replace the transmission input shaft if it is worn. Refer to <u>Transmission Disassemble</u>.
Clutch pressure plate damaged	1. Inspect the pressure plate for bent drive straps caused by improper vehicle use. 2. Replace the clutch assembly if the clutch pressure plate is damaged. Inform the customer. Refer to <u>Clutch Assembly Replacement</u>.
Flywheel improperly machined	1. Inspect the flywheel for being machined, and causing interference with the clutch disc. 2. Replace the flywheel if it has been machined. Refer to <u>Engine Flywheel Replacement</u> for the 6.2L (LSA) engine.
Flywheel uneven	1. Inspect the flywheel surface for being warped or uneven. 2. Replace the flywheel if it is faulty. Refer to <u>Engine Flywheel Replacement</u> for the 6.2L (LSA) engine.

CLUTCH RATTLE

Clutch Rattle

Cause	Action
DEFINITION: A rattle noise coming from the clutch components with the clutch disengaged or engaged. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Idle rattle clutch engaged	Replace the engine flywheel, due to faulty dampener springs. Refer to <u>Engine Flywheel Replacement</u> for the 6.2L (LSA) engine.
Clutch is improperly installed	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .
Clutch disc splines and input shaft splines worn	1. Inspect the clutch disc hub to input shaft splines for excessive clearance. 2. Replace the clutch assembly if the clutch splines

are worn. Refer to **Clutch Assembly Replacement**.

3. Replace the input shaft. Refer to **Transmission Disassemble**.

CLUTCH NOISY

Clutch Noisy

Cause	Action
DEFINITION: A growl or whine noise is coming from the clutch when engaged or disengaged. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Pilot bearing is worn or damaged	Replace the pilot bearing. Refer to <u>Clutch Pilot Bearing Replacement</u> .
Release bearing damaged or worn	Replace the release bearing. Refer to <u>Clutch Concentric Actuator Cylinder Replacement</u> .

CLUTCH PEDAL SPONGY LOW PEDAL EFFORT

Clutch Pedal Spongy Low Pedal Effort

Cause	Action
DEFINITION: The clutch pedal may feel spongy, or it requires very little effort to operate. Review <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Air in the hydraulic system	Bleed the clutch hydraulic system. Refer to <u>Hydraulic Clutch System Bleeding</u> .
Master cylinder fluid level low	1. Inspect for leakage in the clutch master cylinder, hose connections, and the clutch actuator. 2. Repair or replace any faulty components.
Incomplete pedal return	1. Inspect the pedal for full return. 2. Clear any obstacles that may interfere with the pedal operation. 3. Replace the clutch pedal return spring. Refer to <u>Clutch Pedal Return Spring Replacement</u>. 4. Adjust the clutch pedal position switch. Refer to <u>Clutch Pedal Position Switch Replacement</u>.
Clutch incorrectly installed	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .
Clutch mounting bolts loose or broken	1. Remove the broken bolts. 2. Replace the broken or loose bolts, and tighten. Refer to <u>Clutch Assembly Replacement</u>.
Clutch pressure plate not adjusted	Adjust the clutch pressure plate. Refer to <u>Clutch Pressure Plate Adjustment</u> .

Release bearing worn or damaged	Replace the release bearing. Refer to <u>Clutch Concentric Actuator Cylinder Replacement</u> .
Contaminated hydraulic fluid	1. Inspect the clutch hydraulic fluid for contamination of moisture. 2. Inspect the reservoir cap for being faulty if moisture is present. 3. Inspect the clutch hydraulic fluid for dirt or debris. 4. Flush and bleed the clutch hydraulic system if the above conditions are found. Refer to <u>Hydraulic Clutch System Bleeding</u>.

CLUTCH PEDAL HARD TO PUSH

Clutch Pedal Hard to Push

Cause	Action
DEFINITION: The clutch pedal requires high effort to operate. Review the <u>Symptoms - Clutch</u> and perform the necessary inspections.	
Incorrect hydraulic fluid	1. Inspect for the correct fluid in the master cylinder. Refer to <u>Adhesives, Fluids, Lubricants, and Sealers</u>. 2. Flush the hydraulic system and fill with the correct fluid. 3. Replace the clutch hydraulic system if the incorrect fluid is mineral based.
Contaminated hydraulic fluid	1. Inspect the hydraulic fluid for water. 2. Inspect the hydraulic fluid for dirt or debris. 3. Flush the hydraulic system and fill with the correct fluid. Refer to <u>Adhesives, Fluids, Lubricants, and Sealers</u>.
Clutch pedal binding	1. Inspect the pedal for binding. 2. Repair or replace the pedal. Refer to <u>Clutch Pedal Replacement</u>.
Clutch pedal spring worn	Replace the clutch pedal return spring. Refer to <u>Clutch Pedal Return Spring Replacement</u> .
Kinked or damaged clutch hydraulic pipe	1. Inspect for a kinked or damaged hydraulic hose. 2. Repair or replace the clutch hydraulic hose. Refer to <u>Hydraulic Clutch Hose/Pipe Replacement</u>.
Clutch disc worn too thin	Replace the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .

CLUTCH VIBRATION

Clutch Vibration

Cause	Action
DEFINITION: Vibration from the clutch components during disengagement or engagement. Review the Symptoms - Clutch and perform the necessary inspections.	
Excessive driveline torsional activity	Review the Vibration Analysis- Driveline. Refer to Vibration Analysis - Driveline .
Clutch incorrectly installed	Remove the clutch and install it correctly. Refer to Clutch Assembly Replacement .
Pilot bearing worn or damaged- CTS-V only	1. Replace the pilot bearing. Refer to Clutch Pilot Bearing Replacement. 2. Inspect the input shaft pilot bearing journal for wear or damage. 3. Replace the input shaft if it is damaged or worn. Refer to Transmission Disassemble .
Transmission input splines worn or damaged	1. Inspect the clutch disc to input splines for wear or damage. 2. Replace the input shaft if the splines are excessively worn. Refer to Transmission Disassemble .
Clutch disc facings damaged	Replace the clutch assembly. Refer to Clutch Assembly Replacement .
Flywheel housing to clutch housing excessively misaligned	Replace the faulty clutch housing or transmission front case. Refer to Transmission Disassemble .
Clutch out of balance	Replace the clutch assembly. Refer to Clutch Assembly Replacement .

REPAIR INSTRUCTIONS

CLUTCH PEDAL REPLACEMENT

Removal Procedure

1. Remove the driver side instrument panel (I/P) insulator. Refer to **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive) , Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** .
2. Remove the parking brake pedal assembly. Refer to **Parking Brake Lever Pedal Assembly Replacement** , if equipped.

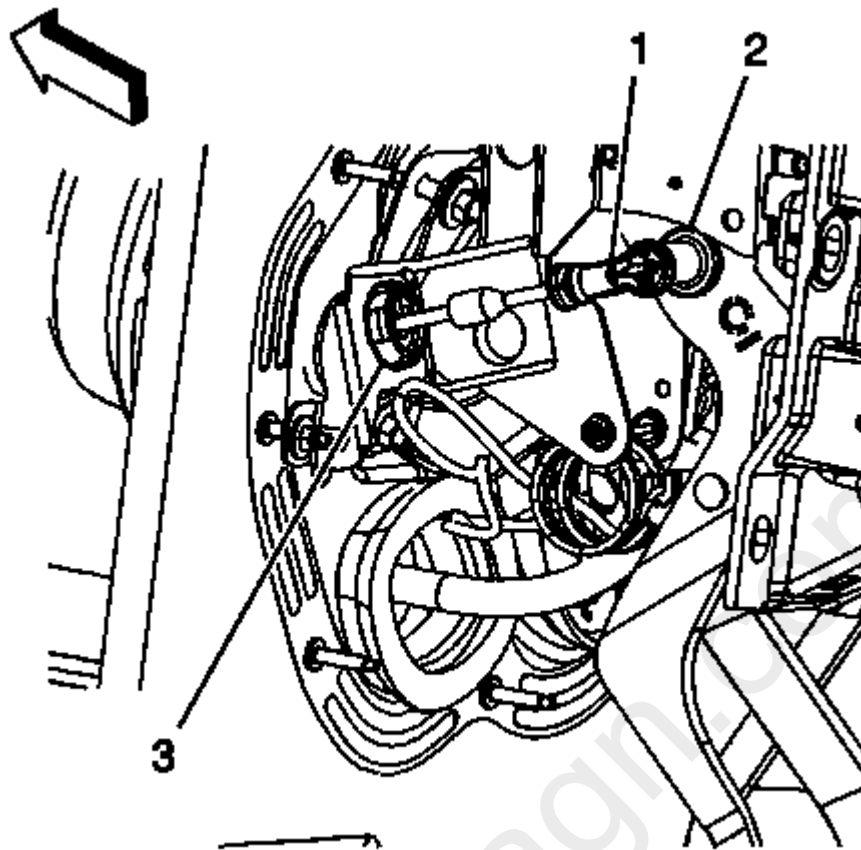


Fig. 1: View of Clutch Master Cylinder Push Rod
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the clutch master cylinder push rod (1) from the clutch pedal pin (2).

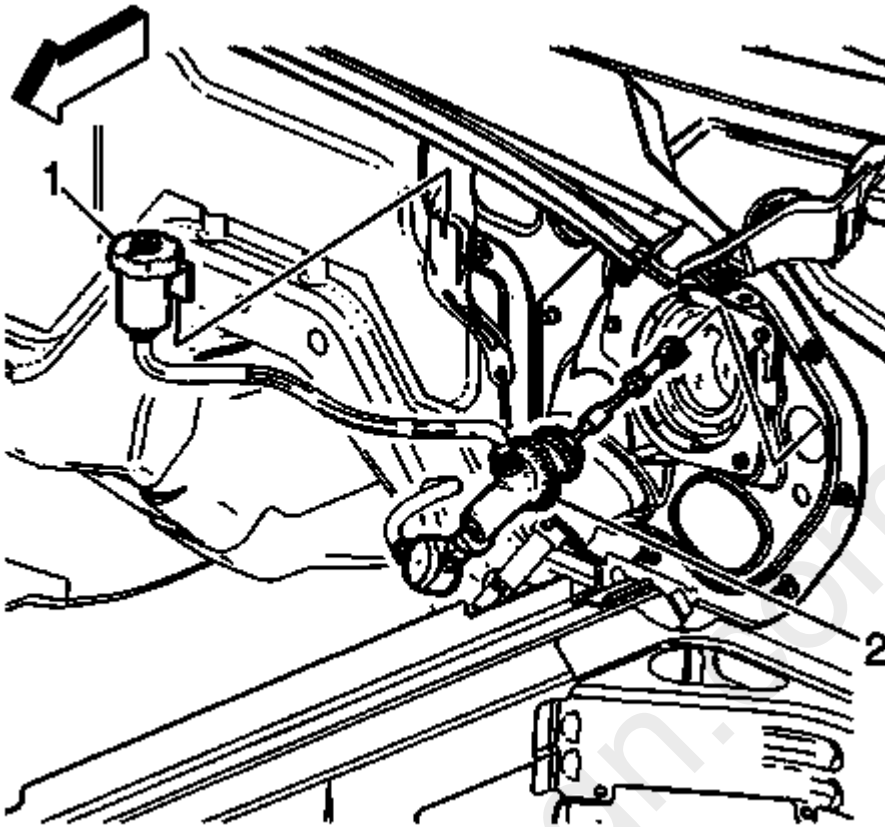


Fig. 2: Identifying Clutch Fluid Reservoir and Cowl
Courtesy of GENERAL MOTORS COMPANY

4. Remove the clutch fluid reservoir (1) from the cowl.
5. Position the clutch fluid reservoir aside.
6. Remove the vacuum brake booster. Refer to **Power Vacuum Brake Booster Replacement (RHD)** , **Power Vacuum Brake Booster Replacement (LHD)** .

NOTE: **Do NOT disconnect the hydraulic hoses from the clutch master cylinder.**

7. Rotate the clutch master cylinder (2) clockwise 1/8 turn.
8. Remove the clutch master cylinder (2) from the cowl.

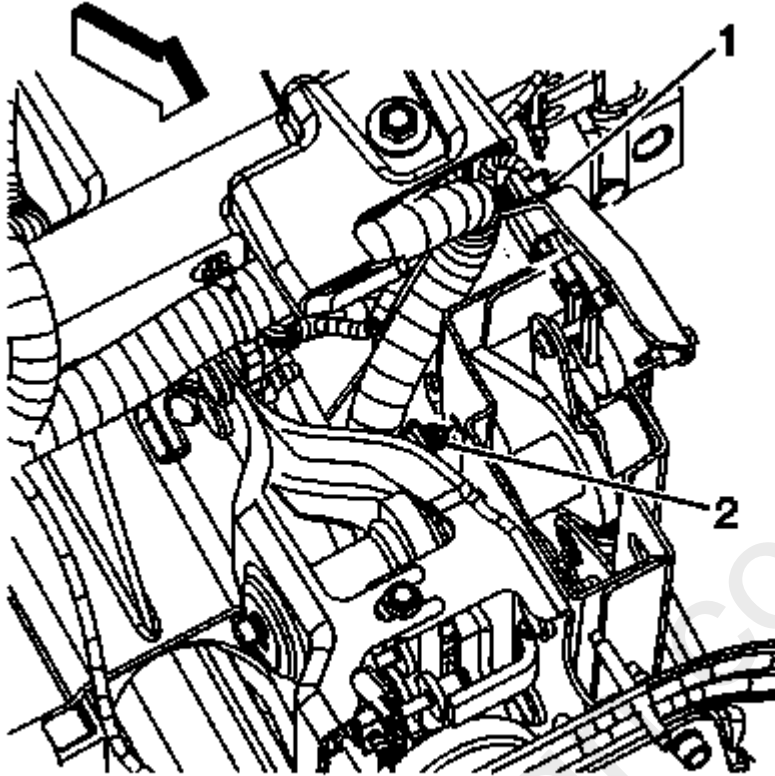


Fig. 3: Identifying Wiring Harness Retainer and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Remove the wiring harness retainer (2) from the clutch pedal assembly.

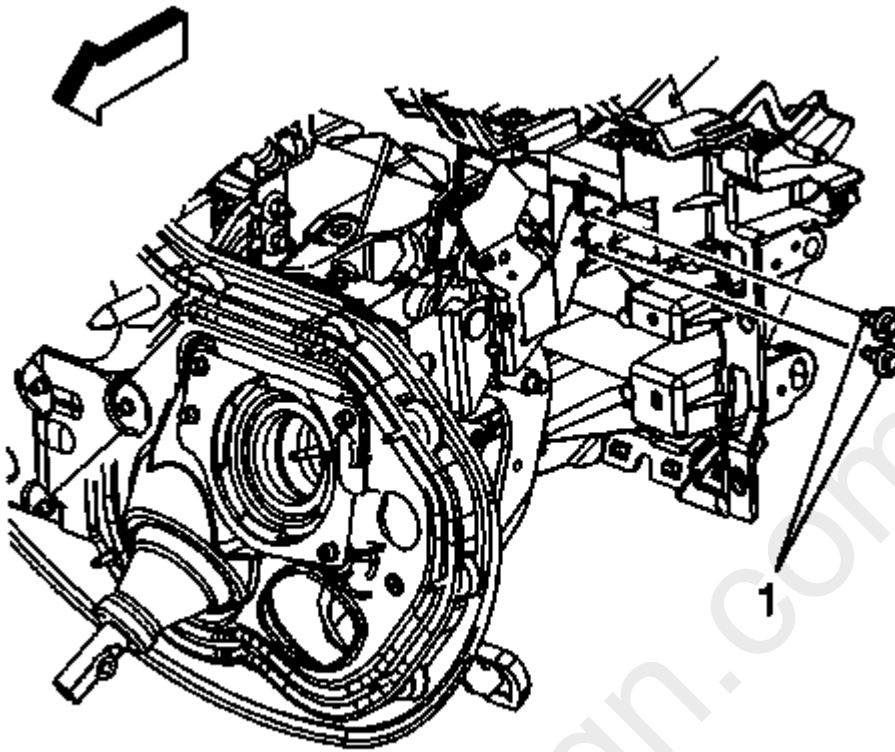


Fig. 4: Identifying 2 Bolts and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Remove the 2 bolts (1) securing the clutch pedal assembly to the I/P carrier.

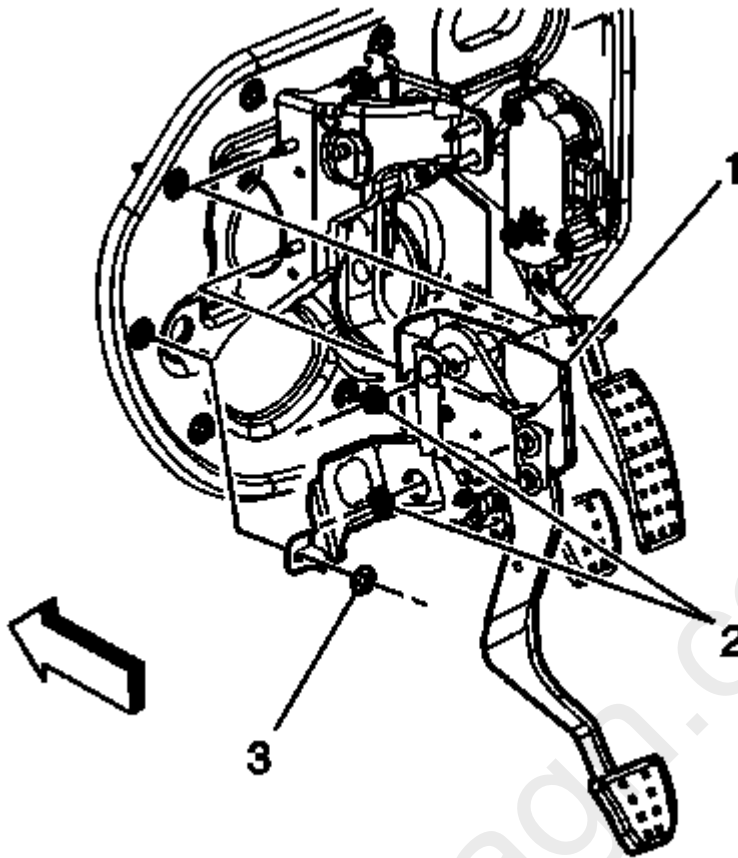


Fig. 5: View of Bolts and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 2 nuts (2) securing the clutch pedal assembly to the brake pedal assembly.
12. Remove the nut (3) securing the clutch pedal assembly to the cowl.
13. Remove the clutch pedal assembly (1) from the vehicle.
14. Remove the clutch pedal position sensor from the pedal assembly, then disconnect the clutch pedal position sensor electrical connector.

Installation Procedure

1. Install the clutch pedal position sensor the pedal assembly, then connect the clutch pedal position sensor electrical connector.

CAUTION: Refer to Fastener Caution .

2. Install the clutch pedal position sensor fastener then tighten 2.5 N.m (20 lb in)

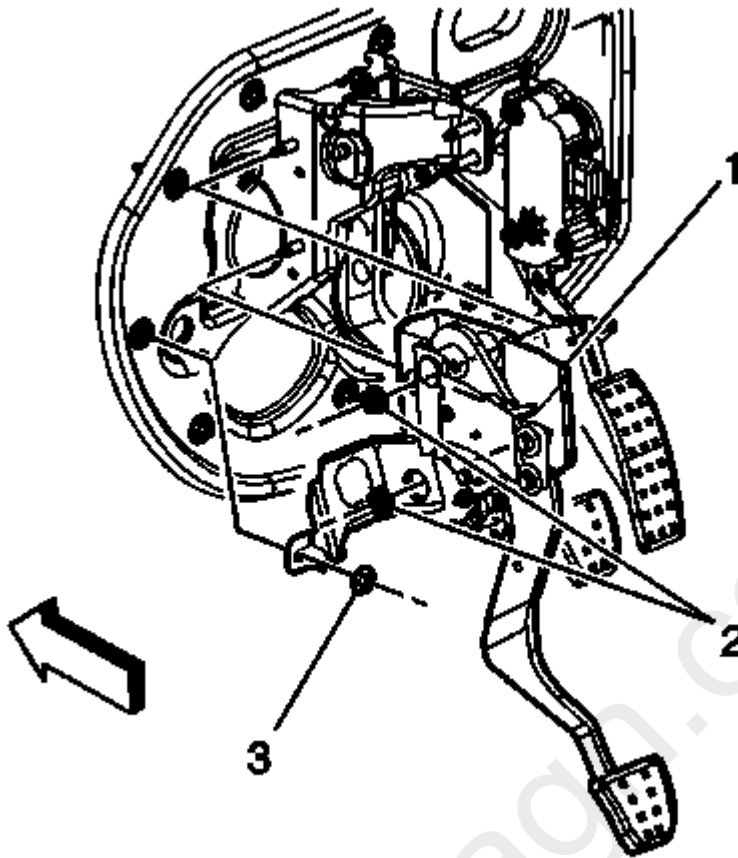


Fig. 6: View of Bolts and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install the clutch pedal assembly (1) to the vehicle.
4. Install the nuts (2) securing the clutch pedal assembly to the brake pedal assembly and tighten to 20 N.m (15 lb ft).
5. Install the nut (3) securing the clutch pedal assembly to the cowl and tighten to 9 N.m (80 lb in).

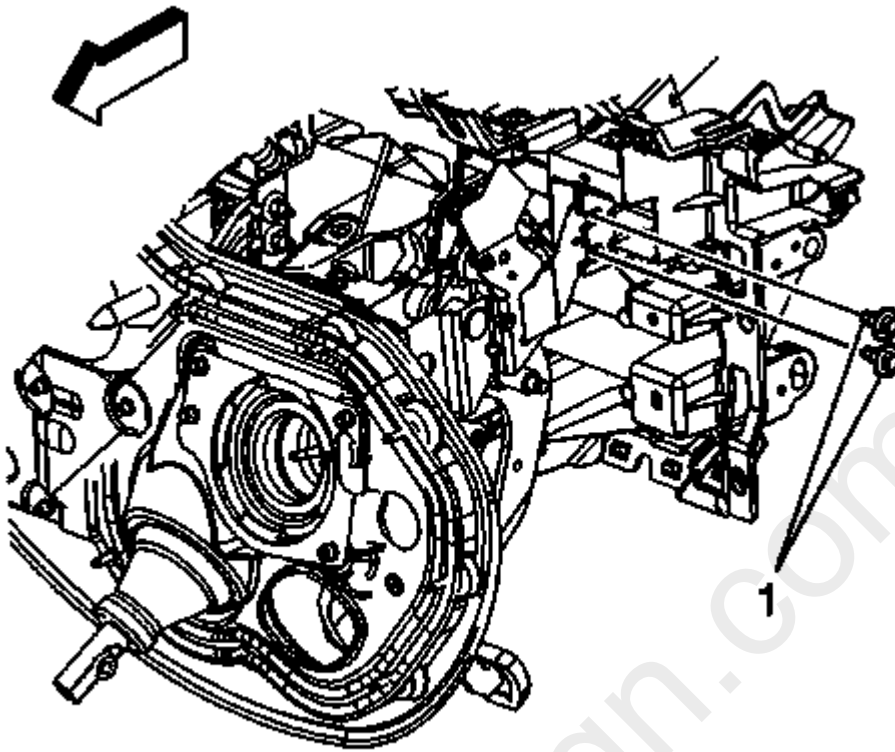


Fig. 7: Identifying 2 Bolts and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Install the 2 bolts (1) securing the clutch pedal assembly to the I/P carrier and tighten to 20 N.m (15 lb ft).

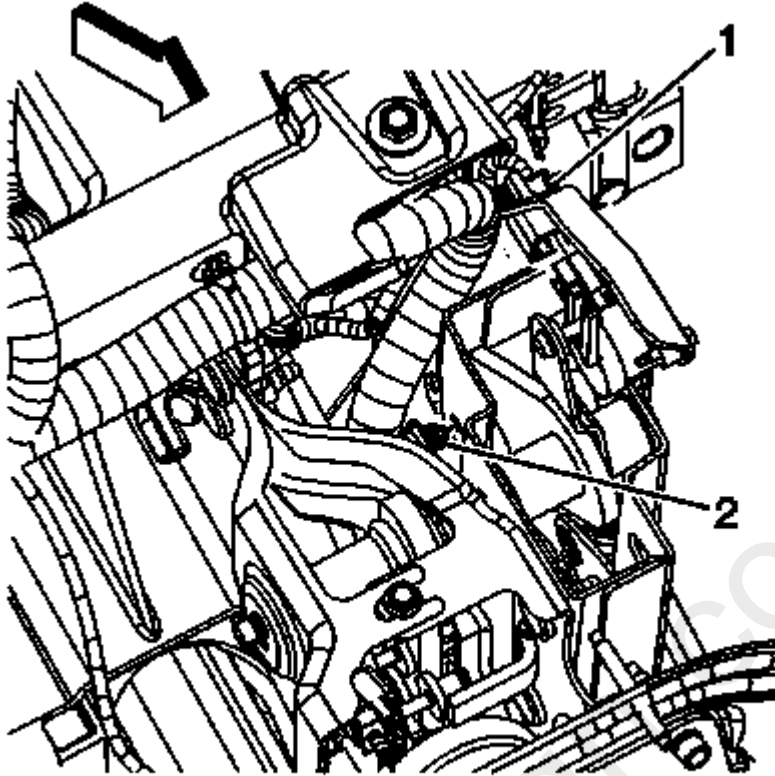


Fig. 8: Identifying Wiring Harness Retainer and Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the wiring harness retainer (2) to the clutch pedal assembly.
8. Install the wiring harness connector (1) to the clutch pedal position sensor.
9. Install the park brake pedal assembly. Refer to **Parking Brake Lever Pedal Assembly Replacement** .

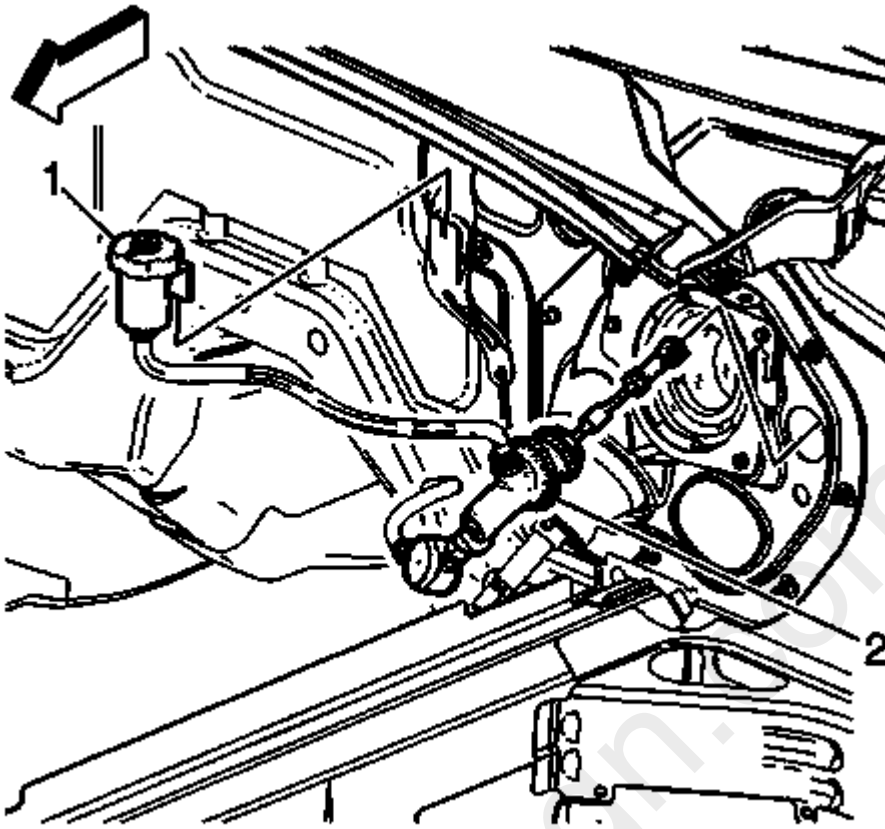


Fig. 9: Identifying Clutch Fluid Reservoir and Cowl
Courtesy of GENERAL MOTORS COMPANY

10. With the clutch fluid reservoir connection at 2 o'clock position. Insert the clutch master cylinder (2) into the cowl.
11. Align the keys of the clutch master cylinder housing with the tabs on the clutch pedal bracket.
12. Rotate the clutch master cylinder (2) counter clockwise approximately 1/8 turn until fully seated. The clutch fluid reservoir hose connection will be at vertical 12 o'clock position when the clutch master cylinder is properly installed.
13. Install the vacuum brake booster. Refer to **Power Vacuum Brake Booster Replacement (RHD)** , **Power Vacuum Brake Booster Replacement (LHD)** .
14. Install the clutch fluid reservoir (1) to the cowl.

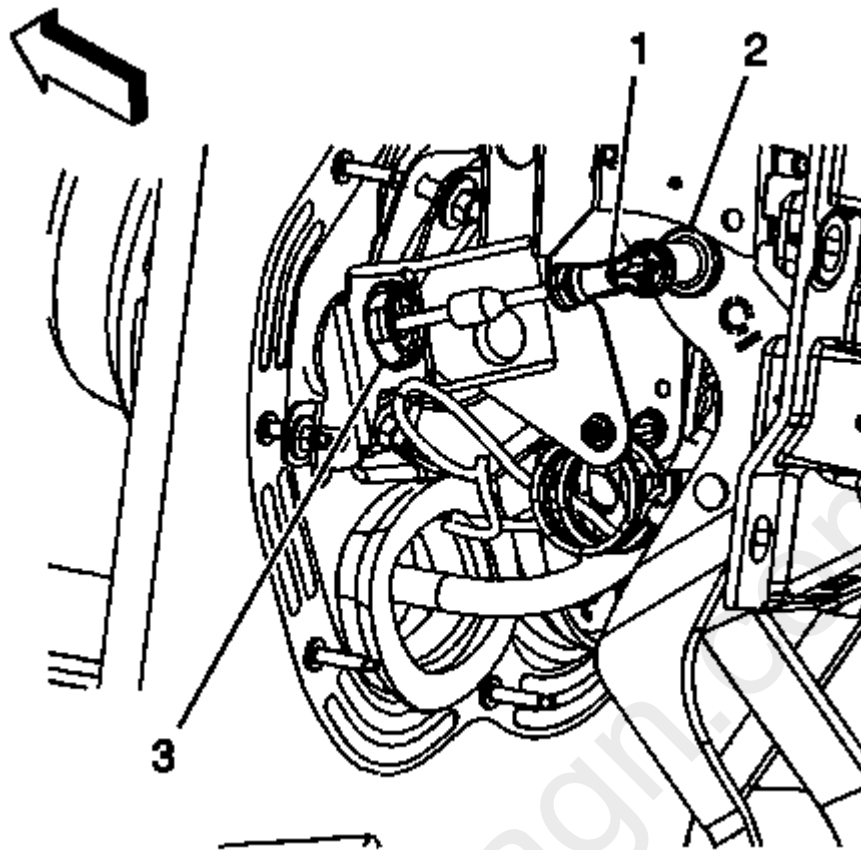


Fig. 10: View of Clutch Master Cylinder Push Rod
 Courtesy of GENERAL MOTORS COMPANY

15. Position the clutch master cylinder push rod (1) to the clutch pedal pin (2).
16. Push the clutch master cylinder push rod (1) onto the clutch pedal pin (2) to secure.
17. Check for proper clutch pedal movement and operation.
18. Install the parking brake pedal assembly. Refer to **Parking Brake Lever Pedal Assembly Replacement** .
19. Install the driver side I/P insulator. Refer to **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** , **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** .

WARNING: Replacement or reprogramming of the ECM, or replacement of the clutch pedal position sensor (CPPS) or clutch pedal requires that a CPPS learn procedure be performed. Failure to perform the CPPS learn procedure may result in personal injury or damage to the vehicle or its components if the vehicle is in gear and the starter motor is accidentally engaged.

20. Perform the clutch pedal position sensor learn procedure. Refer to **Clutch Pedal Position Sensor Learn** .

CLUTCH PEDAL RETURN SPRING REPLACEMENT

Removal Procedure

1. Remove the closeout/insulator panel. Refer to Instrument Panel Insulator Replacement - Left Side (Right Hand Drive) , Instrument Panel Insulator Replacement - Left Side (Left Hand Drive) .

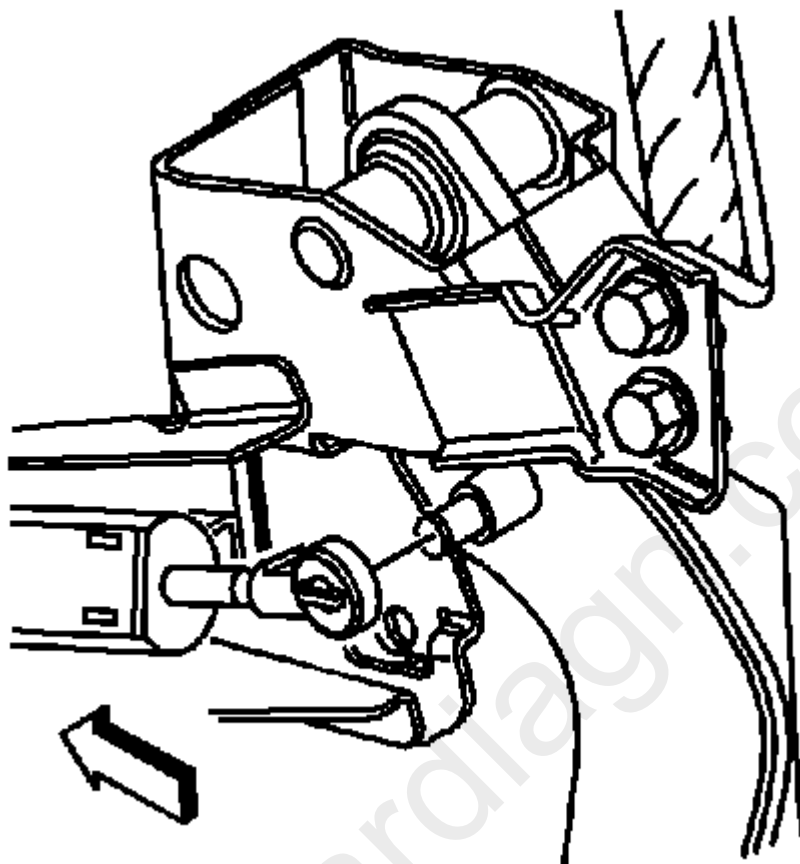


Fig. 11: Identifying Clutch Master Cylinder Push Rod & Clutch Pedal Pin
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the clutch master cylinder push rod from the clutch pedal pin.

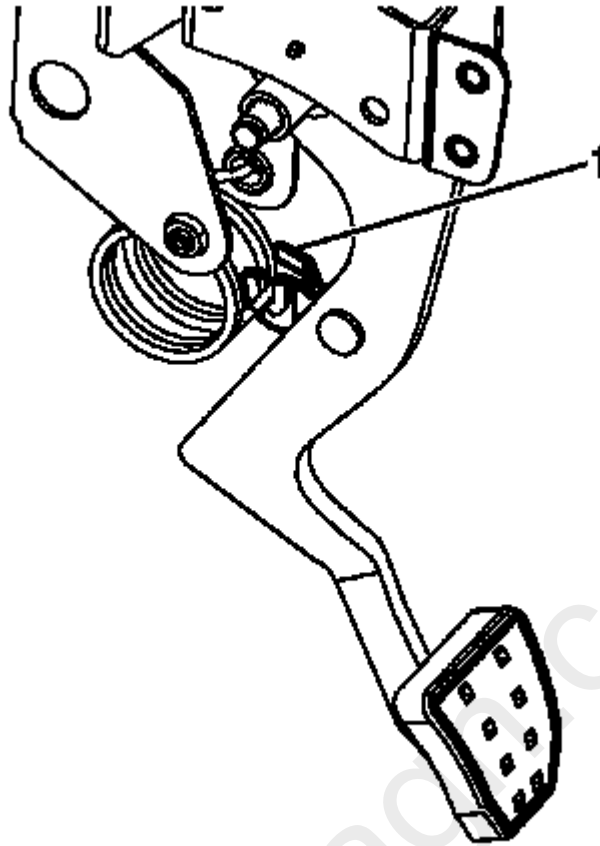


Fig. 12: Locating Clutch Spring Retaining Tab
Courtesy of GENERAL MOTORS COMPANY

3. Carefully bend the clutch spring retaining tab (1) to the side only far enough to provide clearance for clutch spring removal.

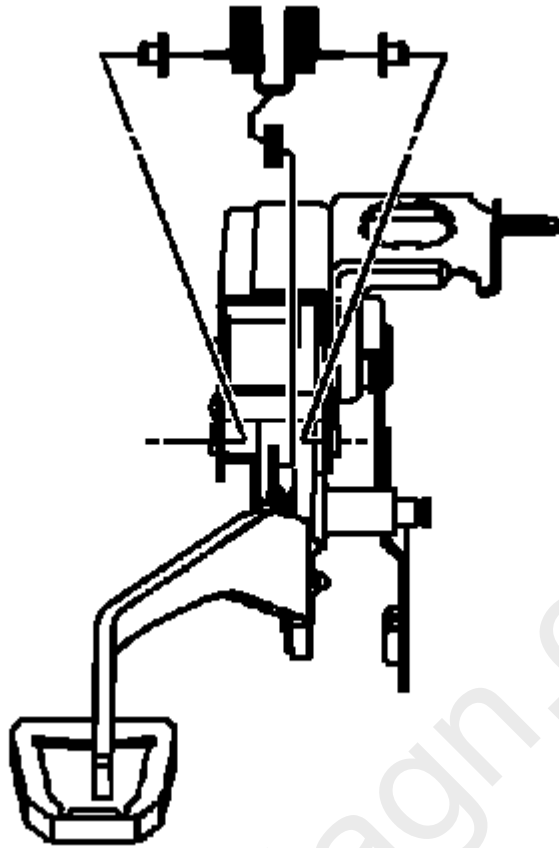


Fig. 13: View of Clutch Pedal Return Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove the clutch pedal return spring from the clutch pedal assembly as follows:
 1. Remove the center of the spring from the center spring bushing.
 2. Remove the outer ears of the spring from the outer spring bushings.
5. Remove the clutch pedal return spring bushings from the clutch pedal assembly.

Installation Procedure

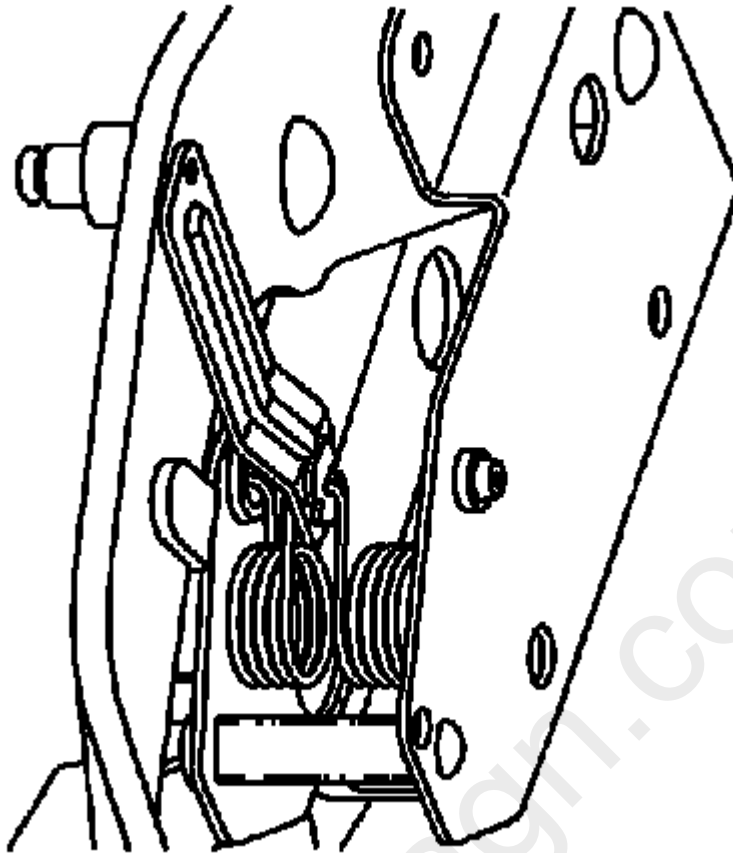


Fig. 14: View of Clutch Pedal Return Spring Bushings To Clutch Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the clutch pedal return spring bushings to the clutch pedal assembly.

IMPORTANT: Correct spring orientation is critical for proper clutch pedal operation.

2. Install the clutch pedal return spring to the clutch pedal assembly as follows:
 1. Insert the outer ears of the spring into the outer spring bushings.
 2. While holding the clutch pedal fully depressed to the floor place the center of the spring into the center spring bushing.
3. Move the clutch pedal through the full range of motion to check for proper clutch pedal spring operation.

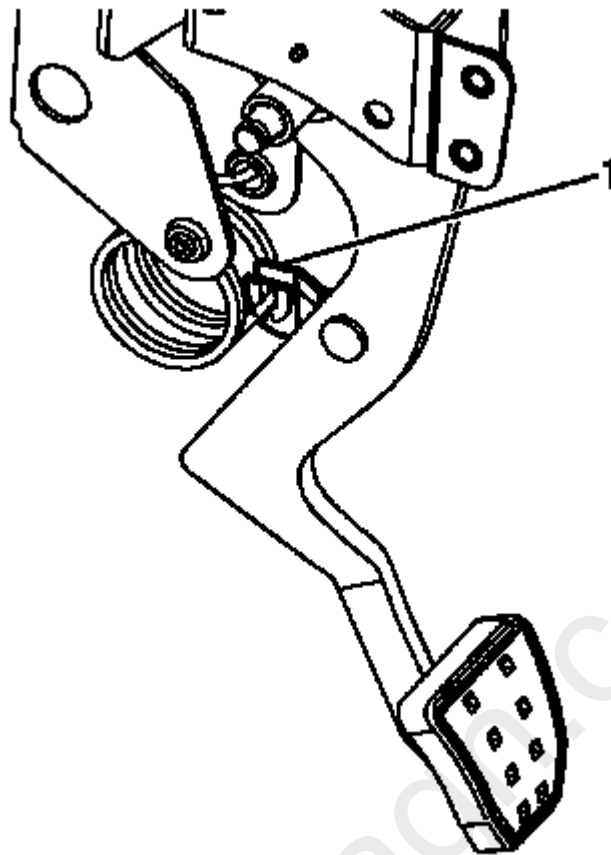


Fig. 15: Locating Clutch Spring Retaining Tab
Courtesy of GENERAL MOTORS COMPANY

4. Carefully bend the clutch spring retaining tab (1) back to the original position in order to retain the clutch spring.

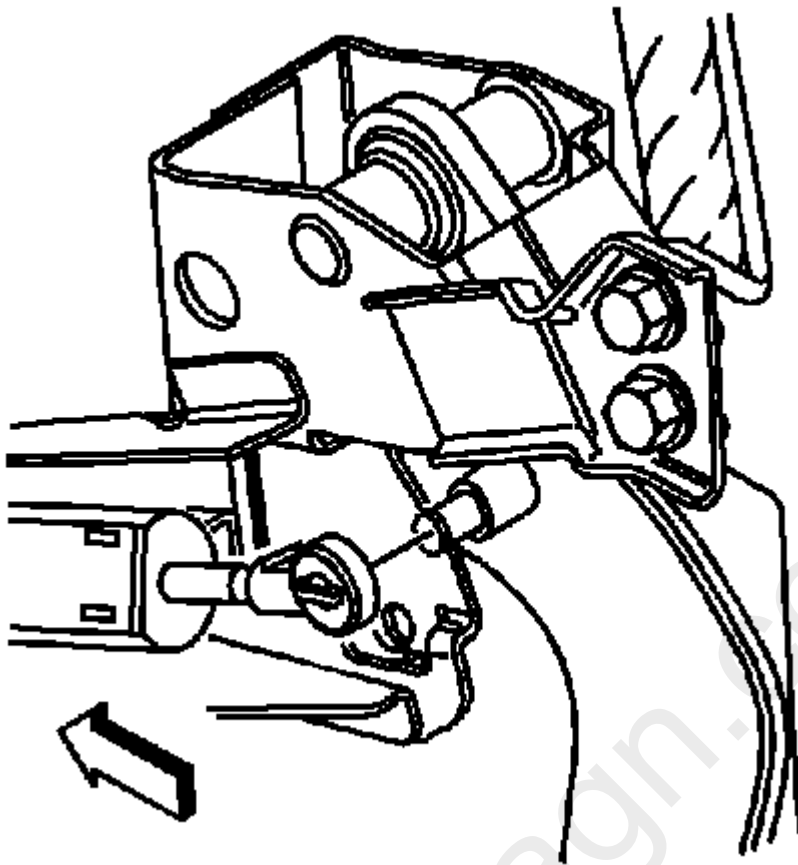


Fig. 16: Identifying Clutch Master Cylinder Push Rod & Clutch Pedal Pin
Courtesy of GENERAL MOTORS COMPANY

5. Connect the clutch master cylinder push rod to the clutch pedal pin.
6. Install the closeout/insulator panel. Refer to **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** , **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** .

CLUTCH MASTER CYLINDER REPLACEMENT

Removal Procedure

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

1. Remove the driver side instrument panel insulator. Refer to **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** , **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** .
2. Disconnect the clutch pedal position switch electrical connector.

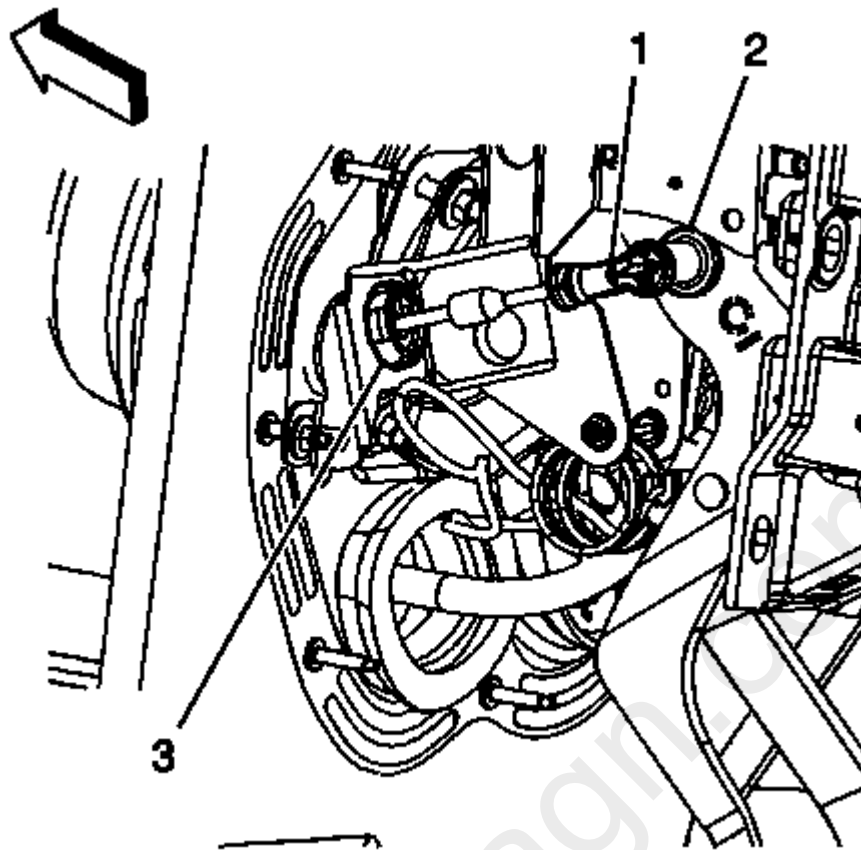


Fig. 17: View of Clutch Master Cylinder Push Rod
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the clutch master cylinder push rod (1) from the clutch pedal pin (2).

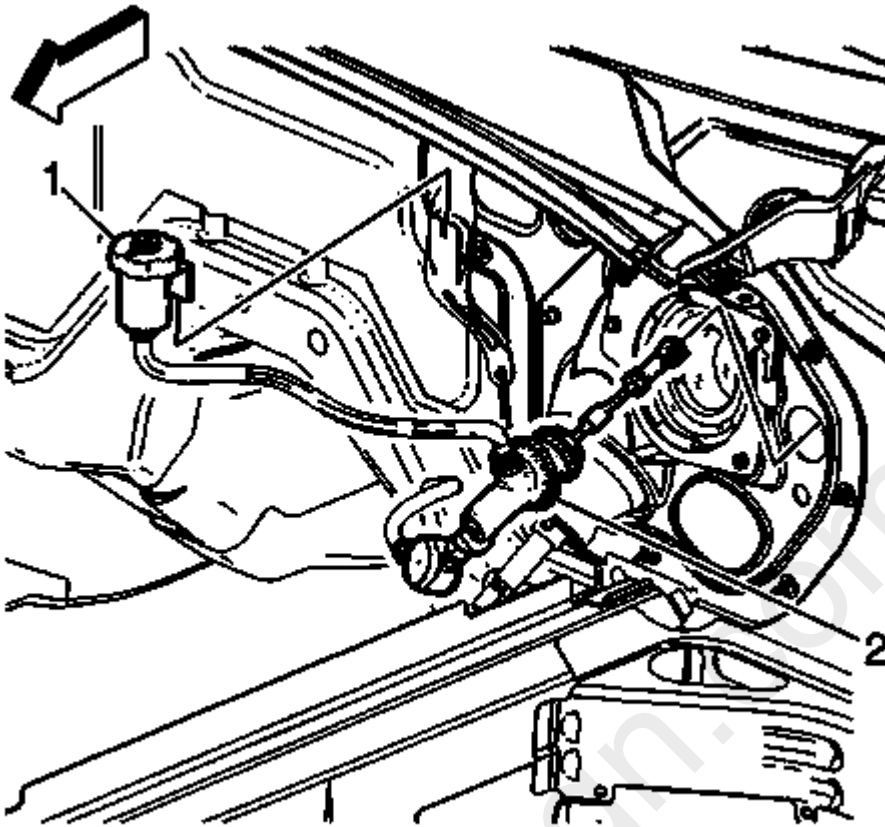


Fig. 18: Identifying Clutch Fluid Reservoir and Cowl
Courtesy of GENERAL MOTORS COMPANY

4. Remove the clutch fluid reservoir (1) from the cowl.
5. Position the clutch fluid reservoir aside.
6. Remove the vacuum brake booster. Refer to **Power Vacuum Brake Booster Replacement (RHD)** , **Power Vacuum Brake Booster Replacement (LHD)** .

NOTE: **Do NOT disconnect the hydraulic hoses from the clutch master cylinder.**

7. Rotate the clutch master cylinder (2) clockwise 1/8 turn.
8. Remove the clutch master cylinder (2) from the cowl.
9. Remove the park brake pedal assembly from the instrument panel and position aside. Refer to **Parking Brake Lever Pedal Assembly Replacement** .

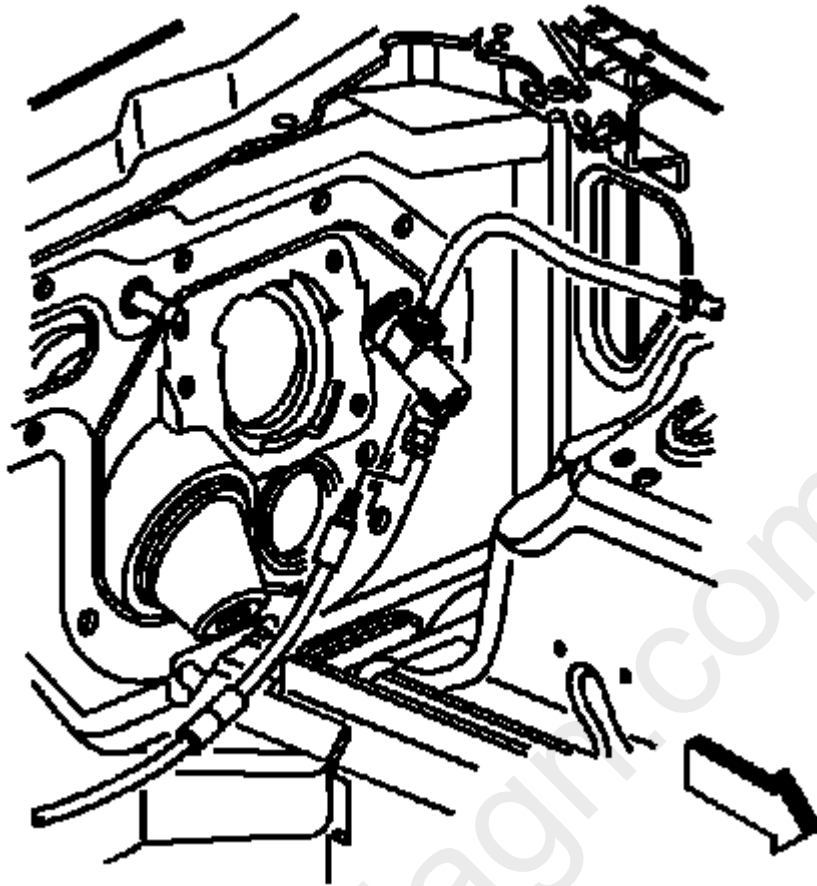


Fig. 19: View Of Clutch Hydraulic Hose & Clutch Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a rubber cap over the exposed hose fitting in order to prevent fluid loss and contamination.

10. Disconnect the clutch hydraulic hose. Refer to **Hydraulic Clutch Hose/Pipe Replacement**.

Installation Procedure

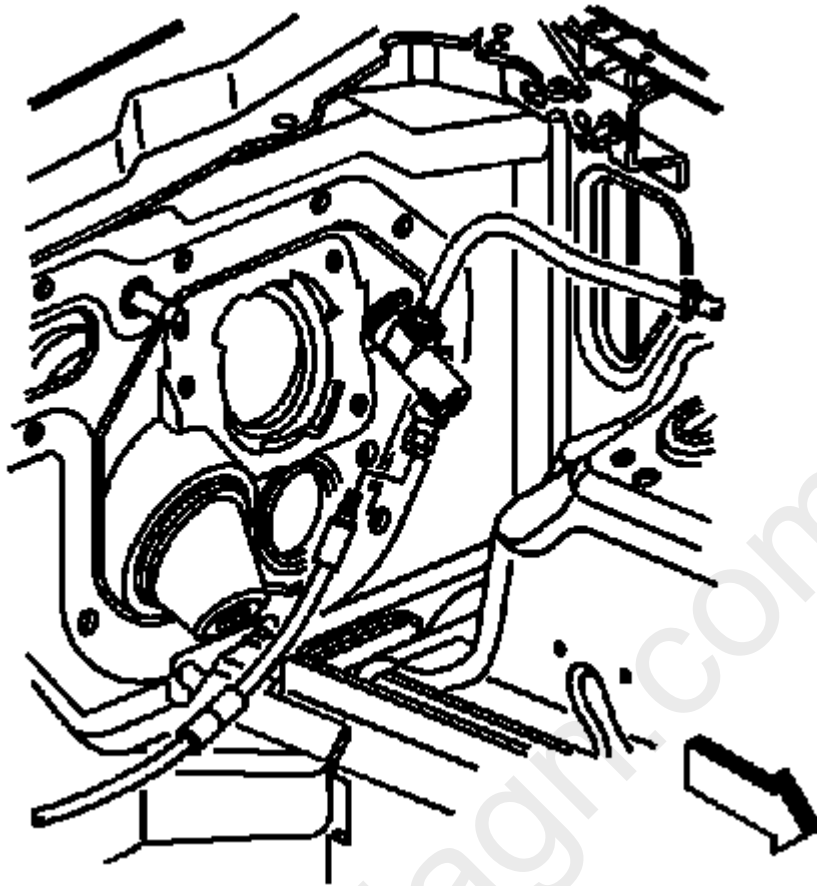


Fig. 20: View Of Clutch Hydraulic Hose & Clutch Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

1. Connect the clutch hydraulic hose. Refer to **Hydraulic Clutch Hose/Pipe Replacement**.

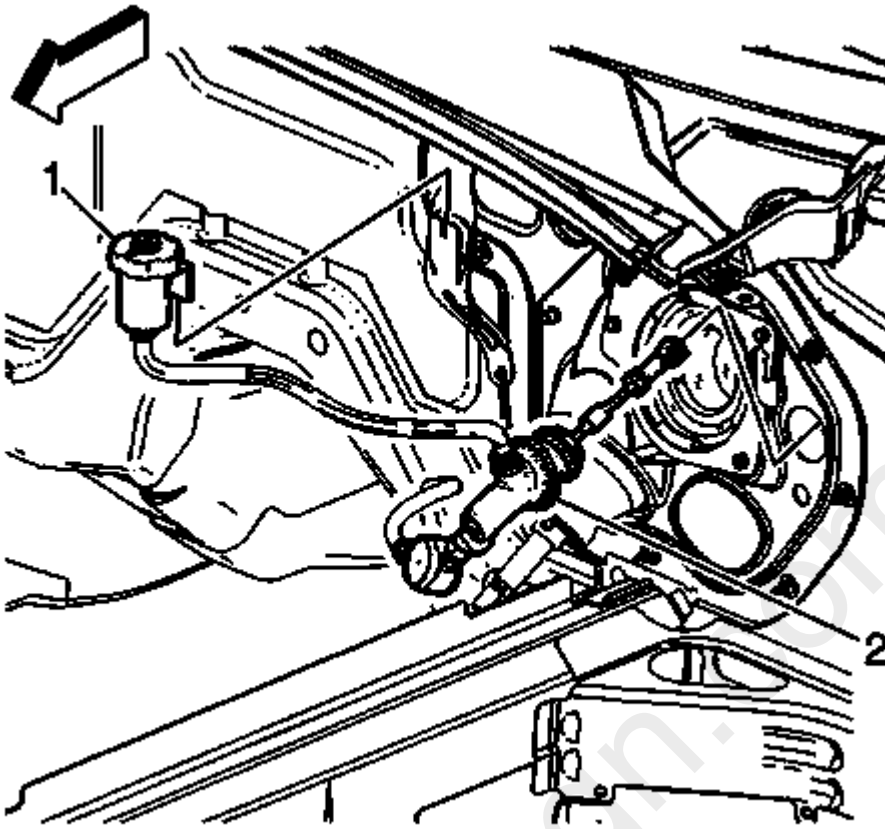


Fig. 21: Identifying Clutch Fluid Reservoir and Cowl
Courtesy of GENERAL MOTORS COMPANY

2. With the clutch fluid reservoir connection at 2 o'clock position. Insert the clutch master cylinder (2) into the cowl.
3. Align the keys of the clutch master cylinder housing with the tabs on the clutch pedal bracket.
4. Rotate the clutch master cylinder (2) counter clockwise approximately 1/8 turn until fully seated. The clutch fluid reservoir hose connection will be at vertical 12 o'clock position when the clutch master cylinder is properly installed.
5. Install the vacuum brake booster. Refer to **Power Vacuum Brake Booster Replacement (RHD)** , **Power Vacuum Brake Booster Replacement (LHD)** .
6. Install the clutch fluid reservoir (1) to the cowl.

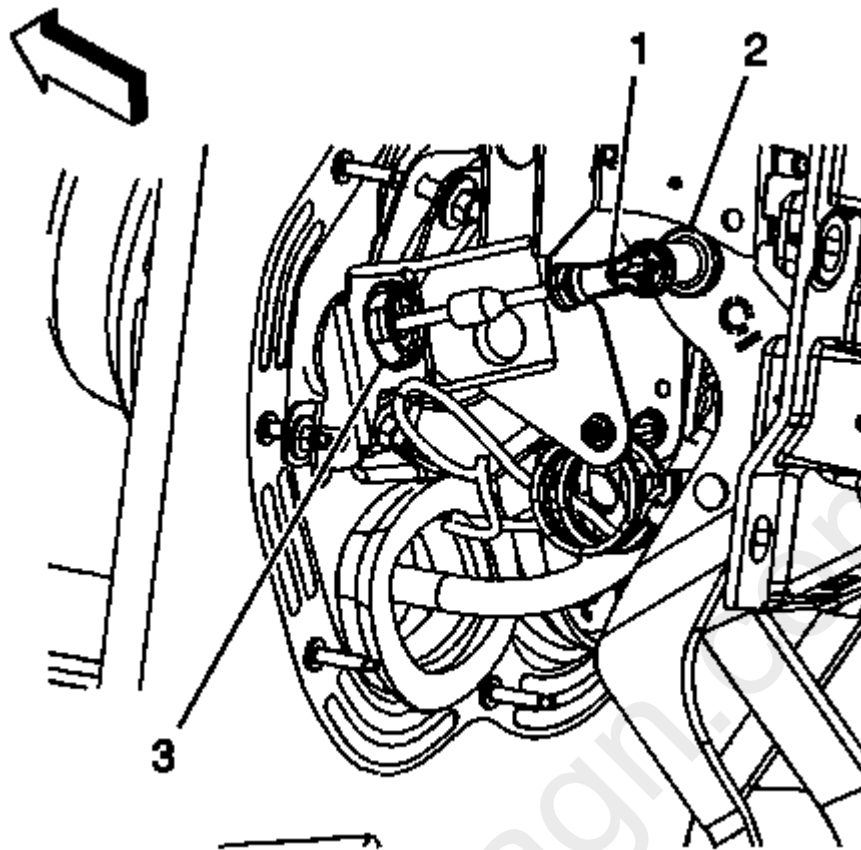


Fig. 22: View of Clutch Master Cylinder Push Rod
Courtesy of GENERAL MOTORS COMPANY

7. Position the clutch master cylinder push rod (1) to the clutch pedal pin (2).
8. Push the clutch master cylinder push rod (1) onto the clutch pedal pin (2) to secure.
9. Check for proper clutch pedal movement and operation.
10. Install the driver side instrument panel insulator. Refer to **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** , **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** .
11. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch System Bleeding**.

HYDRAULIC CLUTCH HOSE/PIPE REPLACEMENT

Removal Procedure

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

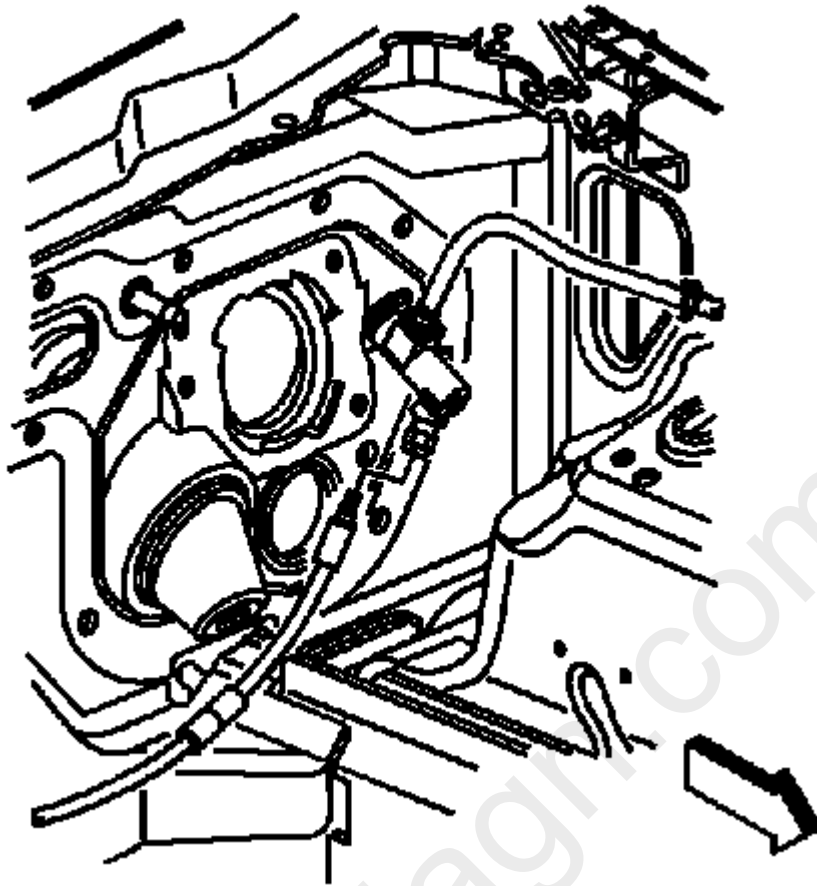


Fig. 23: View Of Clutch Hydraulic Hose & Clutch Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: It is not necessary to drain the coolant or disconnect the coolant lines from the coolant surge tank.

1. Remove the surge tank bolts and position the tank out of the way. Refer to **Radiator Surge Tank Replacement** .
2. Remove the clutch hydraulic hose retaining clip from the clutch master cylinder.

NOTE: Install a cap or plug to the exposed hose and clutch master cylinder fittings in order to prevent fluid loss and contamination.

3. Disconnect the clutch hydraulic hose from the clutch master cylinder.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

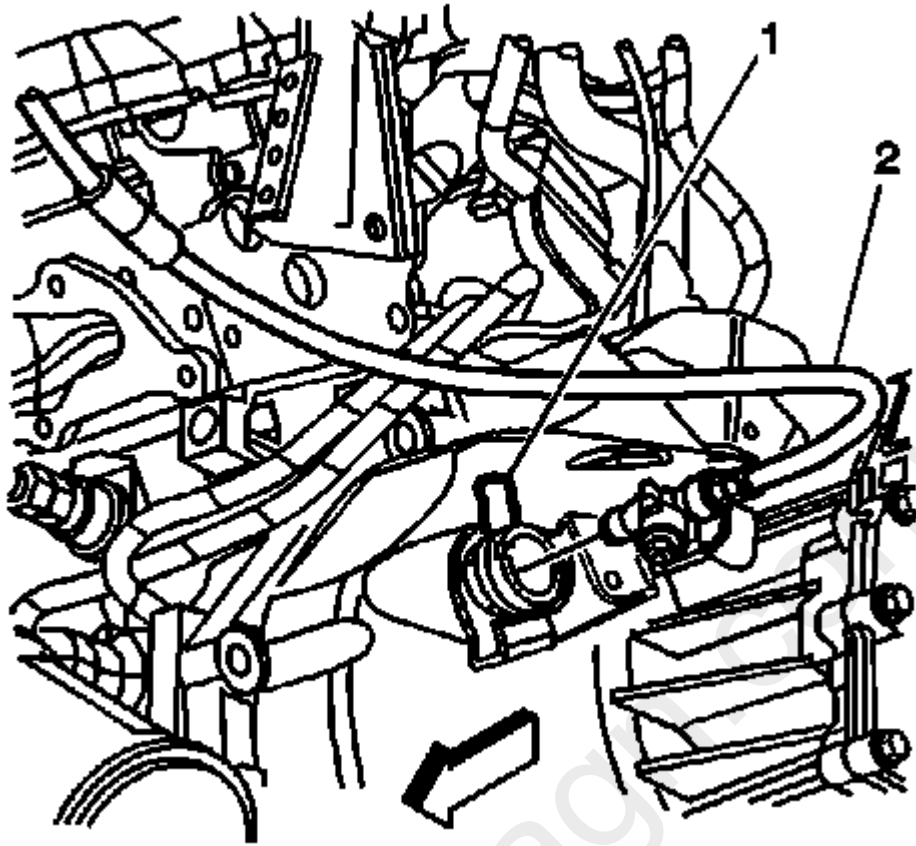


Fig. 24: Identifying Clutch Retaining Hose Retaining Clip & Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS COMPANY

5. Remove the clutch hydraulic hose retaining clip (1) from the clutch slave cylinder.
6. Disconnect the clutch hydraulic hose (2) from the clutch slave cylinder. It is not necessary to plug the lower hose end or slave cylinder fitting as they are equipped with check valves. Only minimal fluid loss may be experienced.

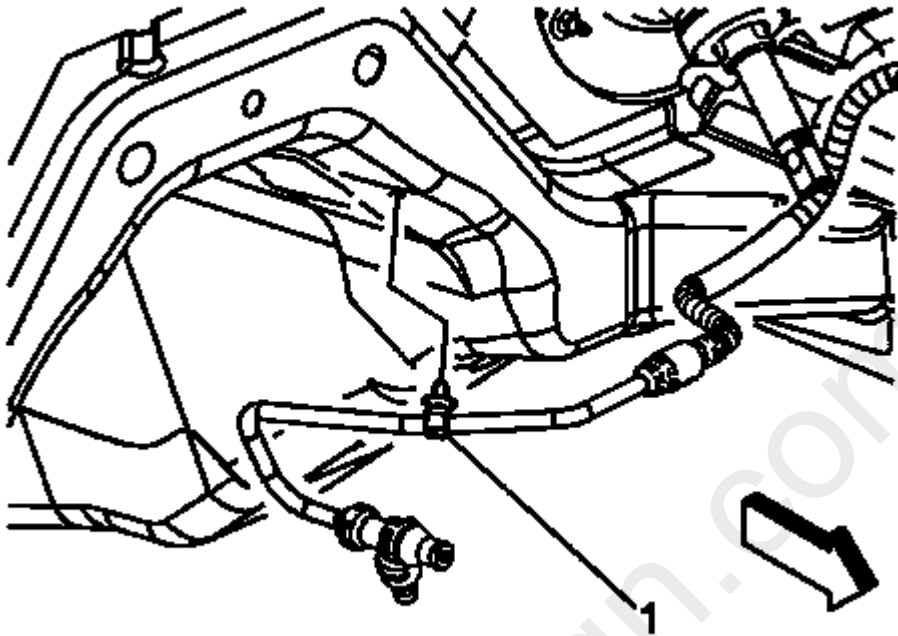


Fig. 25: View of Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove the clutch hydraulic hose retainer (1).
8. Remove the clutch hydraulic hose from the vehicle.

Installation Procedure

1. Install the clutch hydraulic hose to the vehicle.

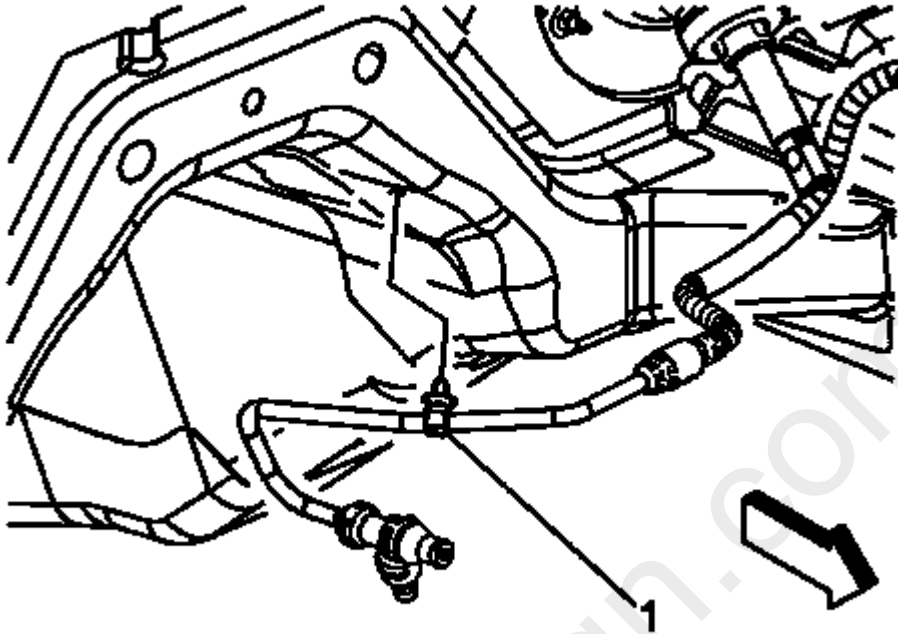


Fig. 26: View of Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS COMPANY

2. Attach the clutch hydraulic hose retainer (1).

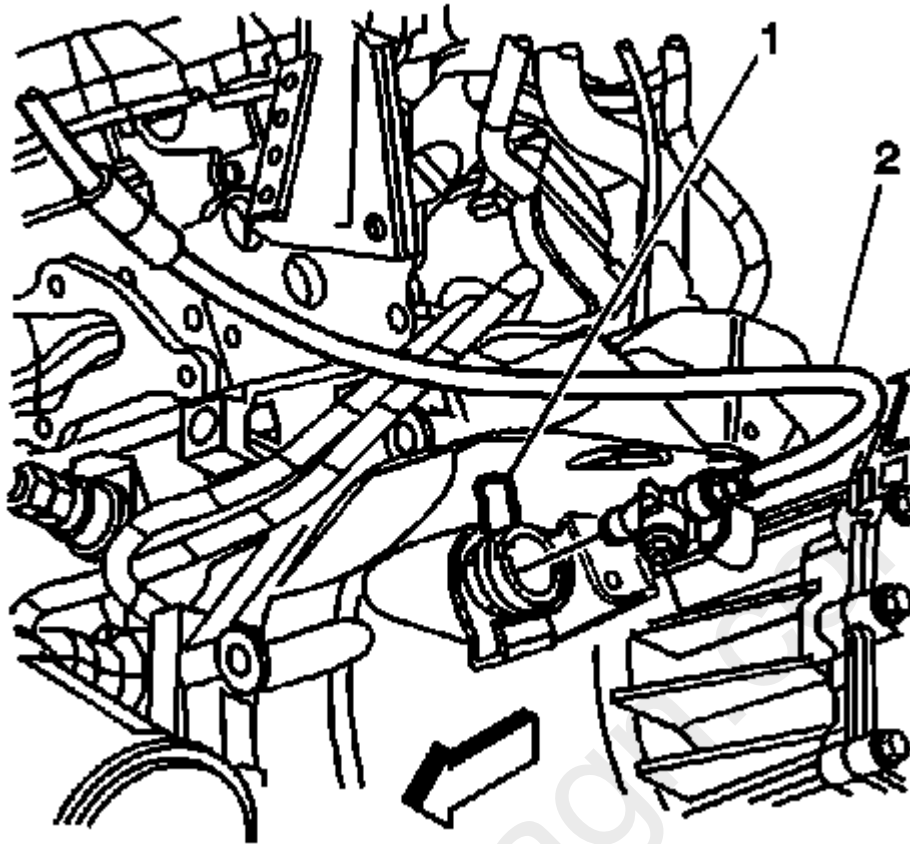


Fig. 27: Identifying Clutch Retaining Hose Retaining Clip & Clutch Hydraulic Hose
Courtesy of GENERAL MOTORS COMPANY

3. Install the clutch hydraulic hose retaining clip (1) to the clutch slave cylinder.

NOTE: Ensure the clutch hydraulic hose is routed in an upward direction above the clutch slave cylinder with no sharp bends, kinks, or downward loops. Ensure the clutch hydraulic hose does not come in contact with any sharp or potentially hot surfaces.

4. Install the clutch hydraulic hose (2) to the vehicle.
5. Align the clutch hydraulic hose locating tab with the notch in the slave cylinder hose fitting.
6. Push the clutch hydraulic hose into the clutch slave cylinder until a "click" is heard.
7. Tug gently on the clutch hydraulic hose to ensure proper retention to the clutch slave cylinder.
8. Lower the vehicle.

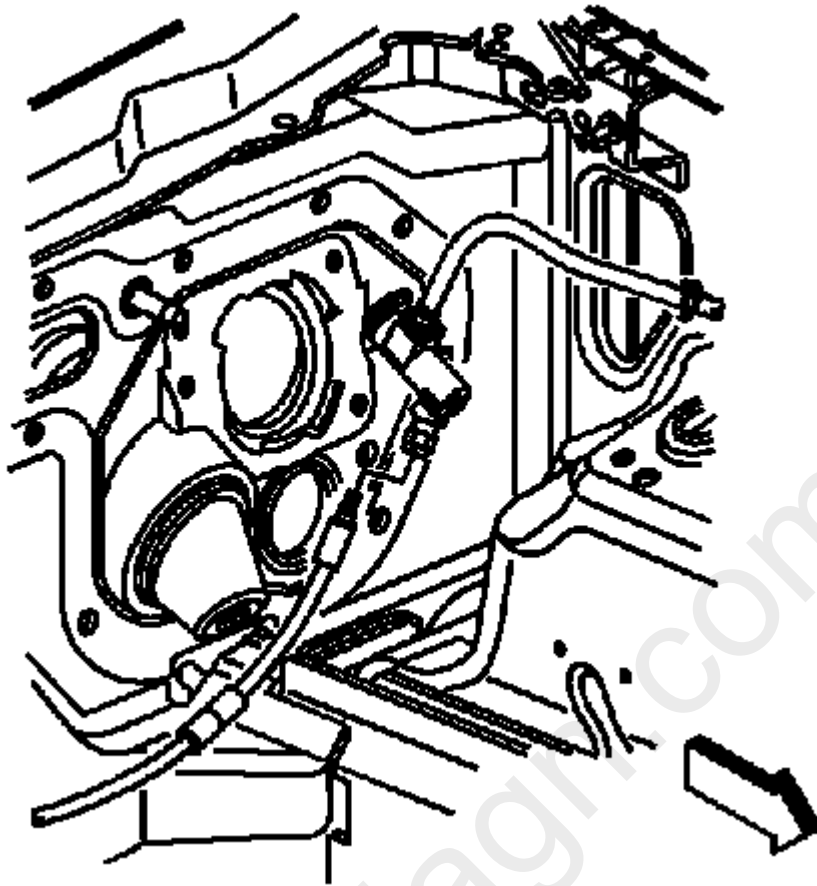


Fig. 28: View Of Clutch Hydraulic Hose & Clutch Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

9. Install the clutch hydraulic hose retaining clip to the clutch master cylinder.
10. Connect the clutch hydraulic hose to the clutch master cylinder.
11. Push the clutch hydraulic hose into the clutch master cylinder until a "click" is heard.
12. Tug gently on the clutch hydraulic hose to ensure proper retention to the clutch master cylinder.
13. Bleed the clutch hydraulic system. Refer to **Hydraulic Clutch System Bleeding**.
14. Position the coolant surge tank in the proper location and install the surge tank bolts. Refer to **Radiator Surge Tank Replacement**.

HYDRAULIC CLUTCH SYSTEM BLEEDING

Special Tools

- J-35555 Metal Mityvac
- J 43485 Power Steering Bleeder Adapter

1. Verify that all the lines and fittings are dry and secure.
2. Clean the dirt and grease from the reservoir cap in order to ensure that no foreign substances enter the

system.

3. Remove the reservoir cap.
4. Fill the reservoir to the proper level with the required fluid.

Some manual transmission equipped vehicles have a combined brake and clutch fluid reservoir.

5. Attach the **J 43485** power steering bleeder adapter to the **J-35555** Metal Mityvac , or equivalent.

NOTE: **Brake fluid will deteriorate the rubber on the J 43485 power steering bleeder adapter. Use a clean shop cloth to wipe away the fluid after each use.**

6. Place and hold the adapter on the reservoir filler neck to ensure a tight fit. In some cases, the adapter will fit into the reservoir opening.
7. Apply a vacuum of 51-68 kPa (15-20 hg) and remove the adapter.
8. Refill the reservoir to the proper level.
9. Repeat steps 6 and 7.
10. If needed, refill the reservoir and continue to pull a vacuum until no more bubbles can be seen in the reservoir or until the fluid level no longer drops.

WARNING: The vehicle will move if started in gear before the Actuator Cylinder is refilled and operational. Start the vehicle the first time in neutral to help prevent personal injury from vehicle movement and see if the transmission will shift easily into gear.

11. Pump the clutch pedal until firm (to refill actuator cylinder).
12. Add additional fluid if needed.
13. Test drive the vehicle to ensure proper operation.

CLUTCH PEDAL POSITION SWITCH REPLACEMENT

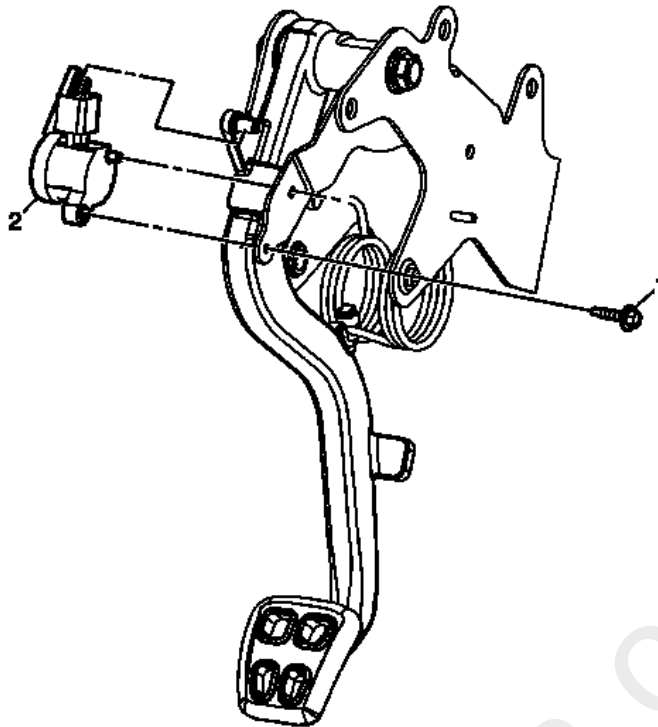


Fig. 29: Clutch Pedal Position Switch
 Courtesy of GENERAL MOTORS COMPANY

Clutch Pedal Position Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the left insulator panel. Refer to <u>Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)</u> , <u>Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)</u>	
1	Clutch Pedal Position Switch Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Clutch Pedal Position Switch WARNING: Replacement or reprogramming of the ECM, or replacement of the clutch pedal position sensor (CPPS) or clutch pedal requires that a CPPS learn procedure be performed. Failure to perform the CPPS learn procedure may result in personal injury or damage to the vehicle or its components if the vehicle is in gear and the starter motor is accidentally engaged.

Procedure

1. Disconnect the clutch pedal position switch electrical connector.
2. Perform the clutch pedal position sensor learn procedure. Refer to **Clutch Pedal Position Sensor Learn** .

CLUTCH PILOT BEARING REPLACEMENT

Special Tools

- J 2619-01 Slide Hammer
- J 23907 Slide Hammer with Bearing Adapter
- J 38836 Pilot Bushing Installer/Clutch

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

Removal Procedure

1. Remove the clutch assembly. Refer to **Clutch Assembly Replacement**.

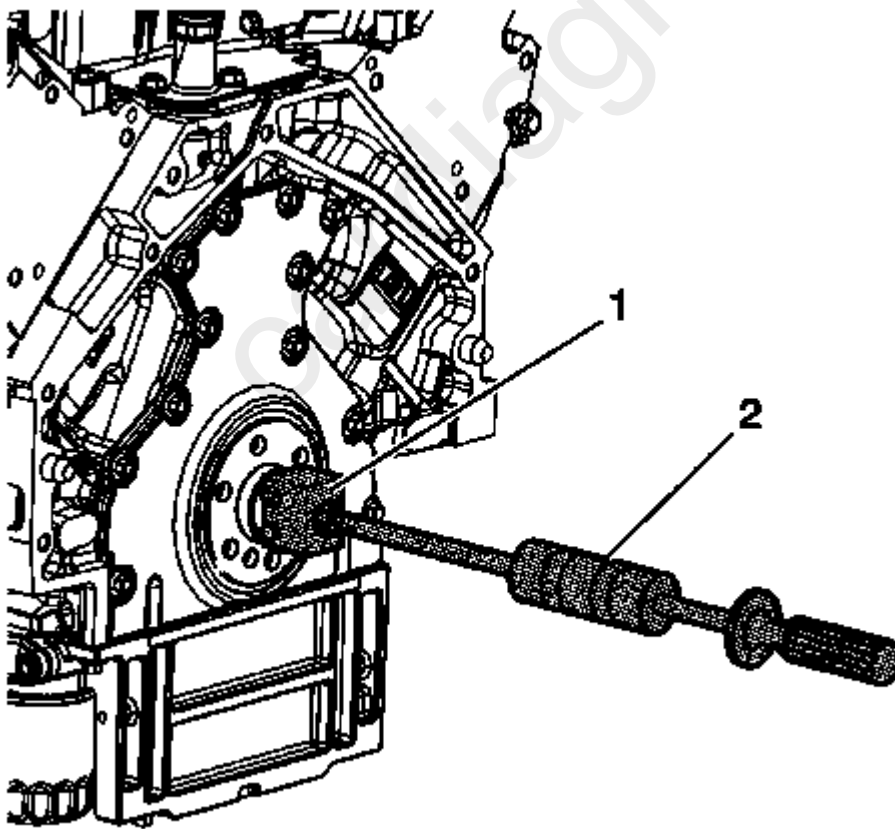


Fig. 30: Removing Clutch Pilot Bearing

Courtesy of GENERAL MOTORS COMPANY

2. Remove the clutch pilot bearing using the **J 23907** slide hammer with bearing adapter (1) and **J 2619-01** slide hammer (2).
 1. Install the legs of the **J 23907** slide hammer with bearing adapter (1) into the clutch pilot bearing.
 2. Rotate the shaft of the tool until the legs of the tool are snug and contacting the I.D. surface of the bearing.
 3. Install the **J 2619-01** slide hammer (2) to the **J 23907** slide hammer with bearing adapter (1).
 4. Remove the bearing from the rear of the crankshaft.
 5. Remove the **J 23907** slide hammer with bearing adapter (1) and **J 2619-01** slide hammer (2) from the bearing.

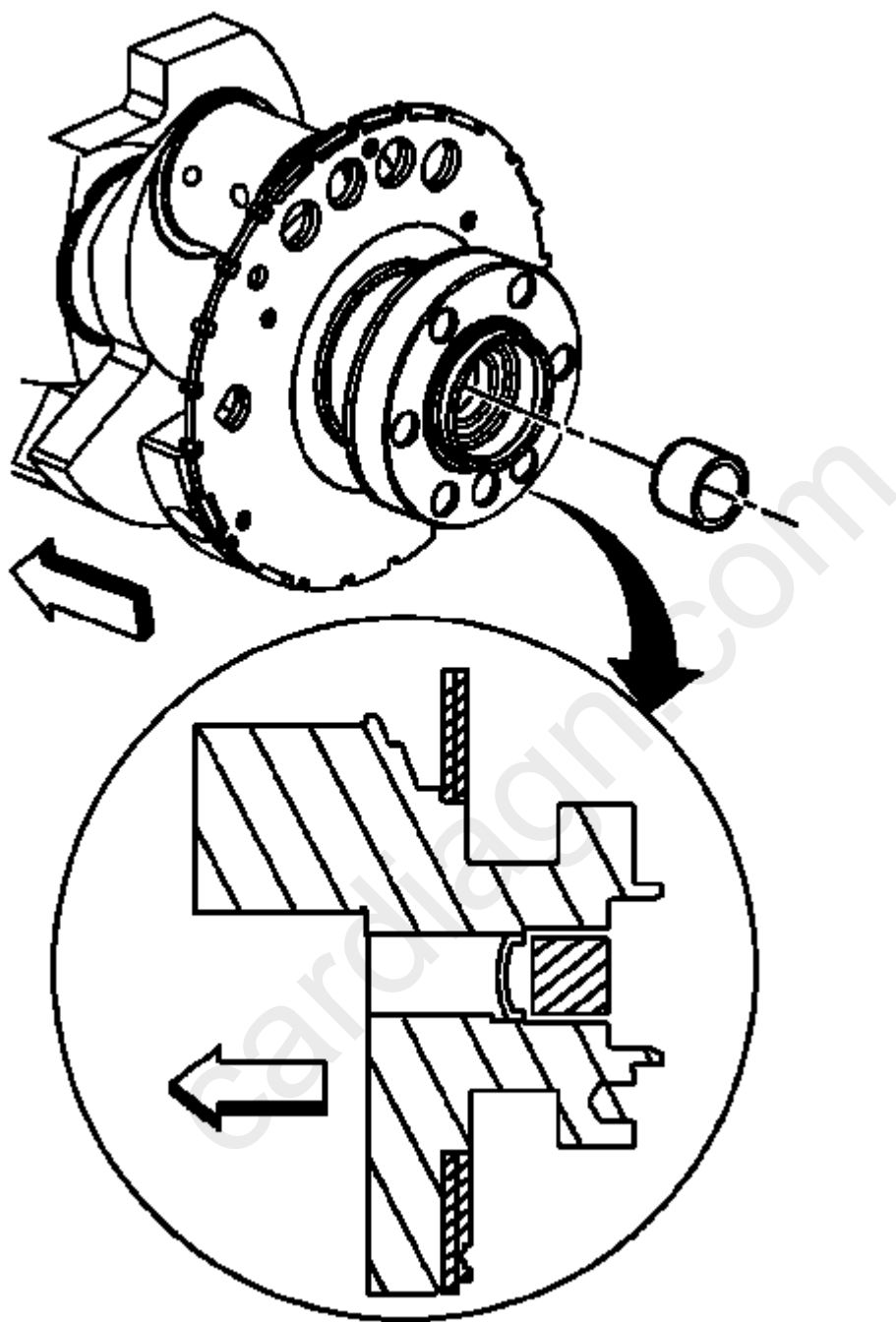


Fig. 31: Locating Clutch Pilot Bearing
Courtesy of GENERAL MOTORS COMPANY

3. Discard the bearing.

Installation Procedure

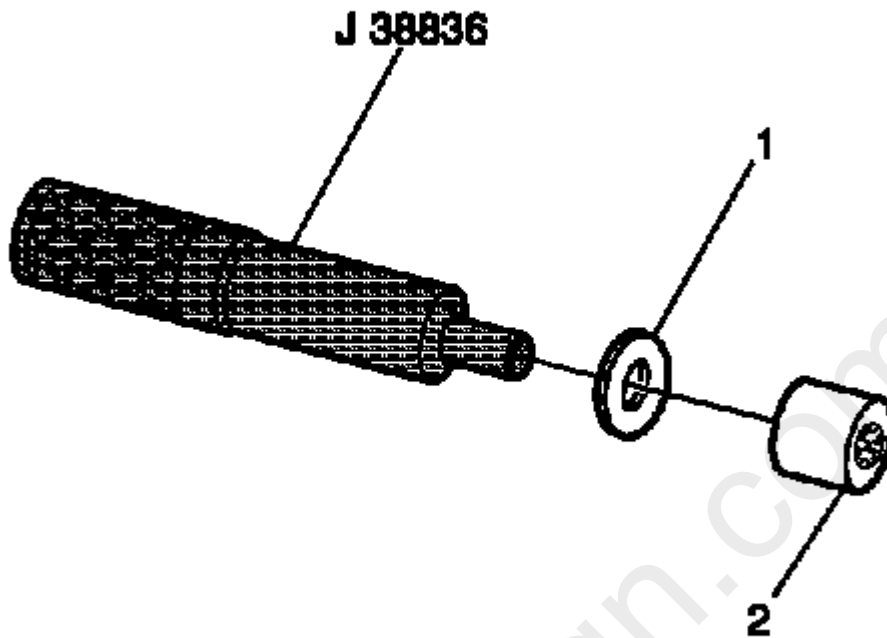


Fig. 32: Pilot Bushing Installer/Clutch Tool, Washer & Pilot Bearing
Courtesy of GENERAL MOTORS COMPANY

1. Install a 5/8 inch washer (1) onto the **J 38836** pilot bushing installer/clutch or equivalent. The washer serves as a stop against the crankshaft face and will assist in installing the bearing to the proper depth.
2. Install the new pilot bearing (2) onto the tool.

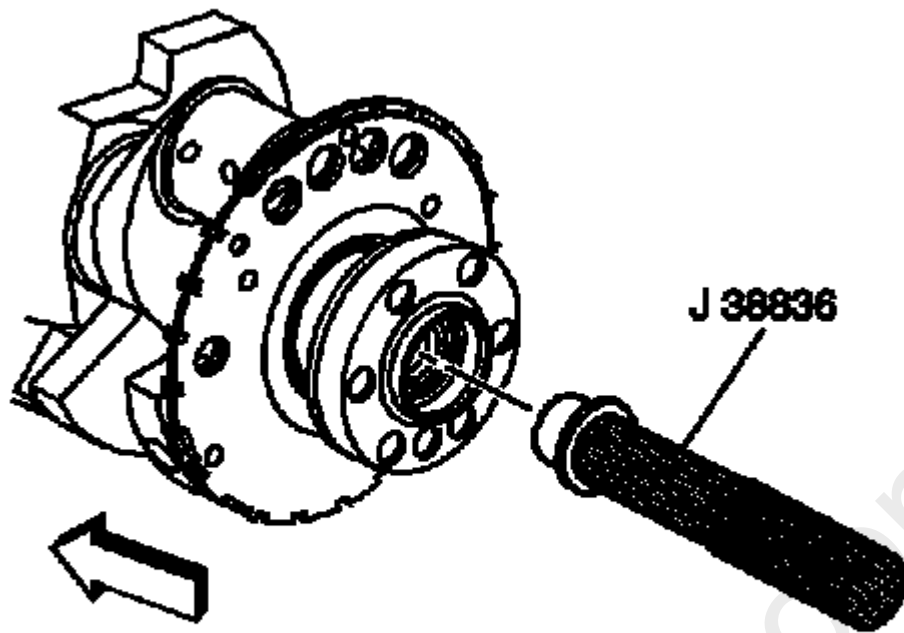


Fig. 33: Installing New Pilot Bearing Into Crankshaft
Courtesy of GENERAL MOTORS COMPANY

3. Install a new pilot bearing into the crankshaft using the **J 38836** pilot bushing installer/clutch.
4. Inspect the clutch pilot bearing for proper installation. A properly installed clutch pilot bearing will be installed until flush to the rear of the crankshaft.
5. Install the clutch assembly. Refer to **Clutch Assembly Replacement**

CLUTCH ASSEMBLY REPLACEMENT

Special Tools

- **DT-49267** Dual Clutch Alignment Tool
- **J 42386-A** Flywheel Holding Tool

Removal Procedure

1. Remove the transmission. Refer to **Transmission Replacement**
2. If reusing the pressure plate assembly, place an alignment mark on the pressure plate and flywheel for proper alignment during installation.

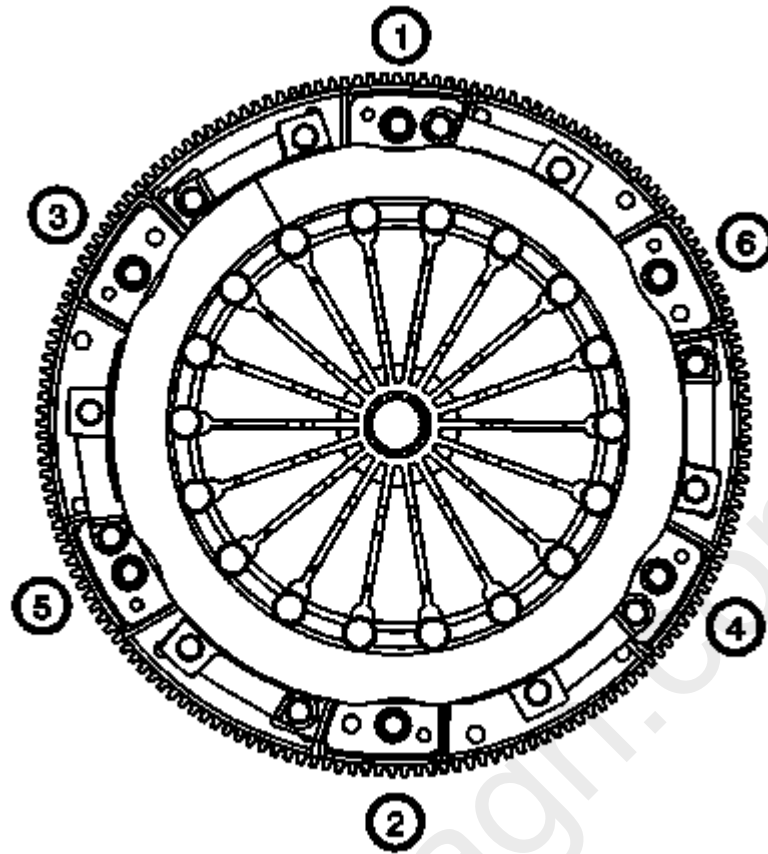


Fig. 34: Identifying Clutch Pressure Plate Bolt Loosening & Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do Not use air tools to remove the clutch pressure plate bolts.

3. Loosen the clutch pressure plate bolts using the following sequence:
 1. Loosen bolts 1 and 2 one full turn, then stop.
 2. Loosen bolts 3 and 4 one full turn, then stop.
 3. Loosen bolts 5 and 6 one full turn, then stop.
 4. Repeat steps 5.1 through 5.3 until all the bolts are loose.
4. Remove the clutch pressure plate bolts from the flywheel.
5. Remove the clutch pressure plate and the clutch driven plates.

Installation Procedure

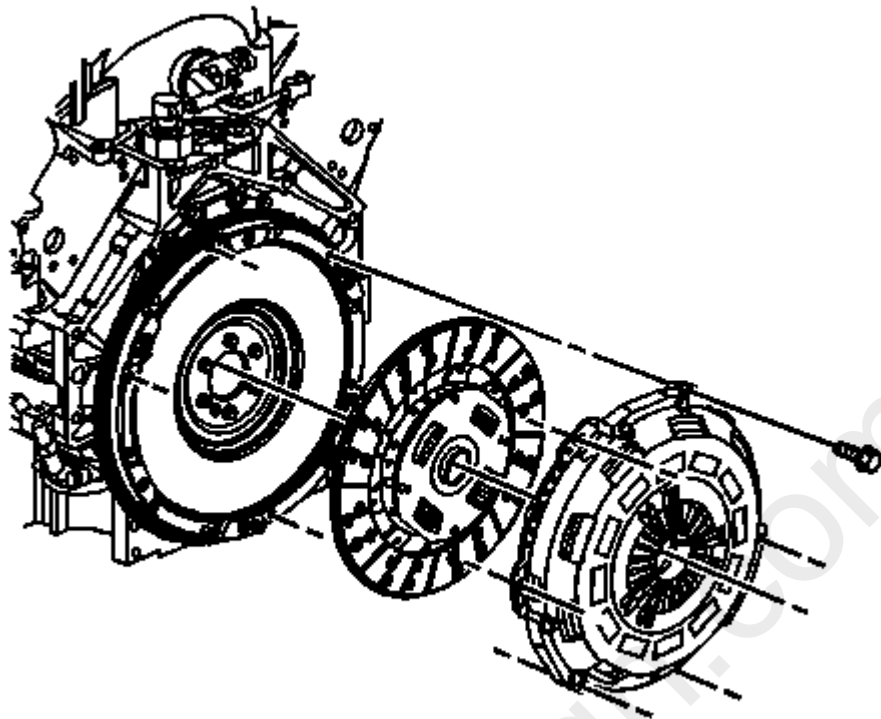


Fig. 35: View Of Flywheel, Clutch Pressure Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the clutch pressure plates and the clutch driven plate for wear or damage. Repair or replace as necessary.
2. Inspect the engine flywheel. Refer to **Engine Flywheel Replacement** .
3. Using the **DT-49267** tool , align the two clutch driven plates .

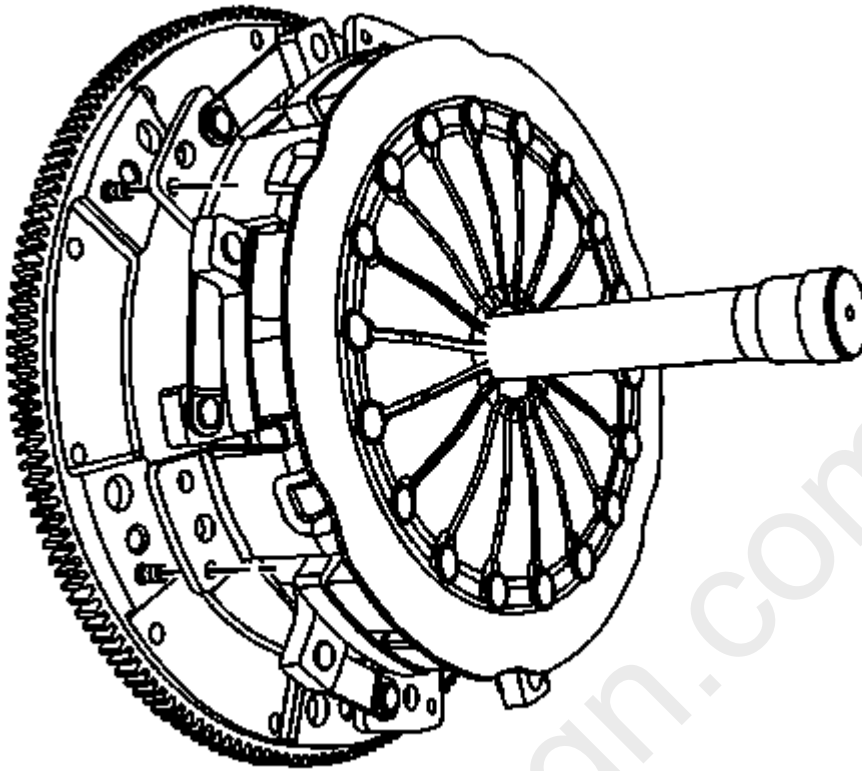


Fig. 36: Installing Clutch Driven Plate & Clutch Pressure Plate
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Use NEW clutch pressure plate bolts in order to maintain proper torque. Apply red LOCTITE 242 to the threads to make certain the bolts do not come loose.
- Do Not use air tools to install the clutch pressure plate bolts.

4. Install the clutch driven plate and clutch pressure plate to the engine flywheel with the clutch alignment tool still installed in the clutch assembly.
5. If reusing the clutch pressure plate, align the previously created mark on the flywheel with the alignment mark on the pressure plate.
6. Install the NEW clutch pressure plate bolts finger tight.

CAUTION: Refer to Fastener Caution .

7. Install **J 42386-A** tool and bolts. Use one M10 1.5 X 25 mm and one M10 1.5 X 45 mm bolt for proper tool operation.

Tighten the **J 42386-A** tool bolts to 50 N.m (37 lb ft).

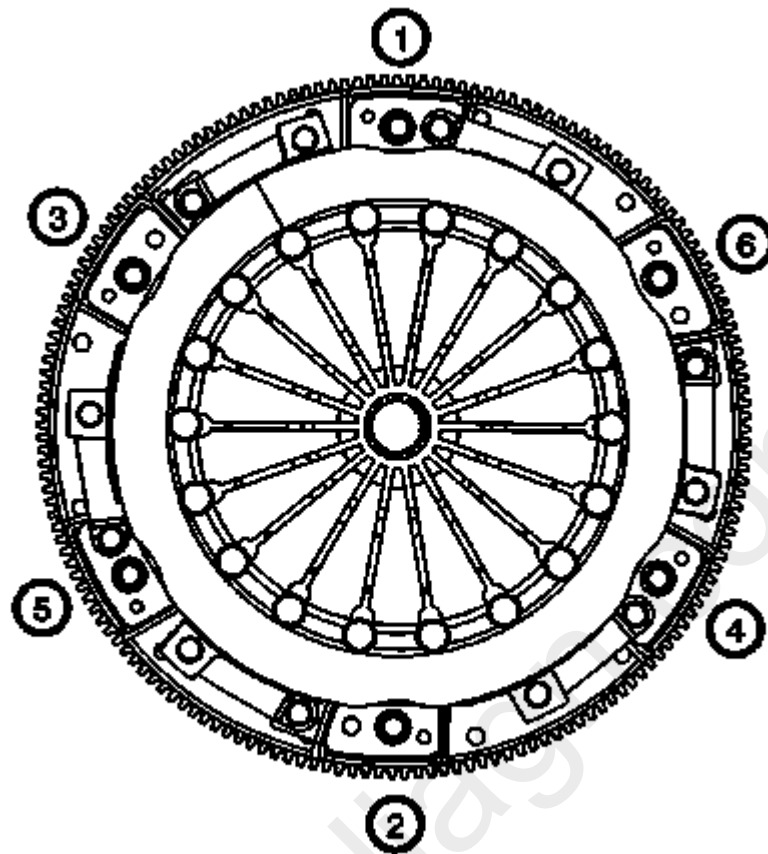


Fig. 37: Identifying Clutch Pressure Plate Bolt Loosening & Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

8. Tighten the clutch pressure plate bolts using the following sequence:
 1. Finger tighten bolts 1 and 2.
 2. Using a socket wrench, turn bolts 1 and 2 360 degrees.
 3. Finger tighten bolts 3 and 4.
 4. Using a socket wrench, turn bolts 3 and 4 360 degrees.
 5. Finger tighten bolts 5 and 6.
 6. Using a socket wrench, turn bolts 5 and 6 360 degrees.
 7. Return to bolts 1 and 2 and rotate 360 degrees.
 8. Return to bolts 3 and 4 and rotate 360 degrees.
 9. Return to bolts 5 and 6 and rotate 360 degrees.
10. Repeat steps 7.7-7.9 until the clutch pressure plate is flat against the flywheel
11. Remove the clutch alignment tool.
12. Torque the bolts to 70 N.m (52 lb ft) in the numbered sequence shown.

9. Install the transmission. Refer to Transmission Replacement .

CLUTCH CONCENTRIC ACTUATOR CYLINDER REPLACEMENT

Removal Procedure

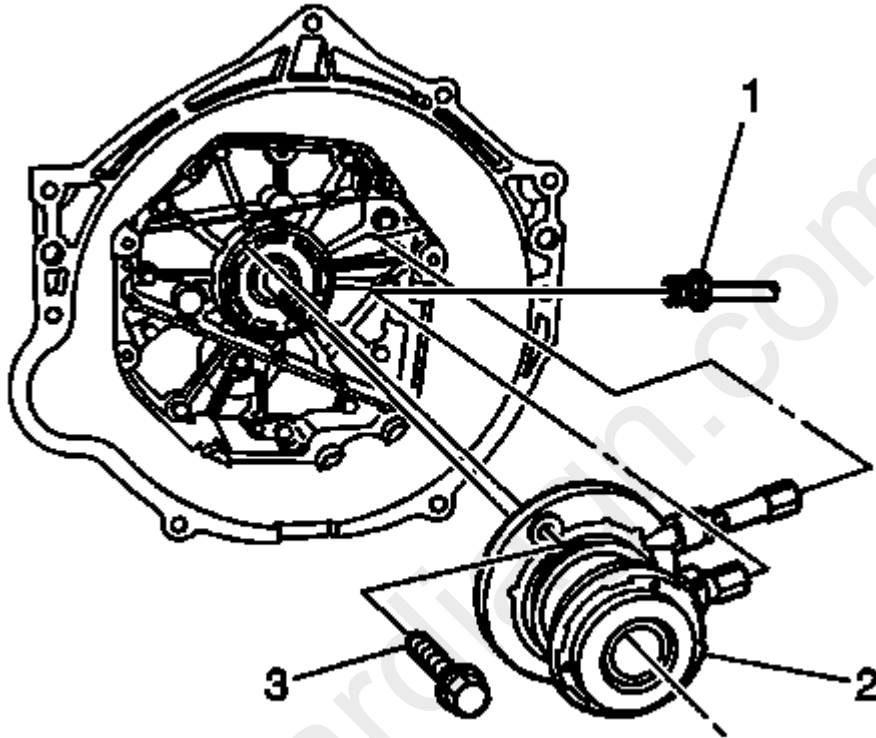


Fig. 38: View Of Pipe Fitting & Clutch Slave Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Remove the manual transmission from the vehicle. Refer to Transmission Replacement .
2. Disconnect the pipe fitting (1) from the clutch slave cylinder.
3. Remove the clutch slave cylinder bolts (3).

Installation Procedure

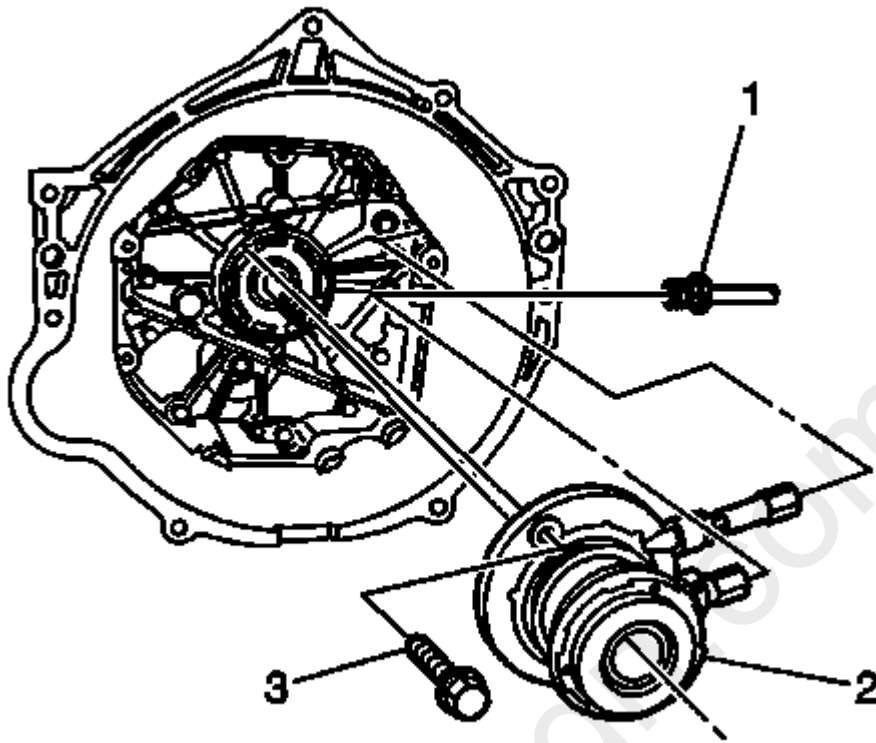


Fig. 39: View Of Pipe Fitting & Clutch Slave Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the clutch slave cylinder and bolts (3) and tighten to 13 N.m (115 lb in).
2. Connect the pipe fitting (1) to the clutch slave cylinder. Tighten the pipe fitting (1) to 10 N.m (88 lb in).
3. Install the manual transmission to the vehicle. Refer to Transmission Replacement .

CLUTCH PRESSURE PLATE ADJUSTMENT

NOTE: If clutch adjustment is required, do not adjust the clutch. Order a new clutch and replace. Refer to Clutch Assembly Replacement.

DESCRIPTION AND OPERATION

CLUTCH SYSTEM DESCRIPTION AND OPERATION

Tremec 6-Speed

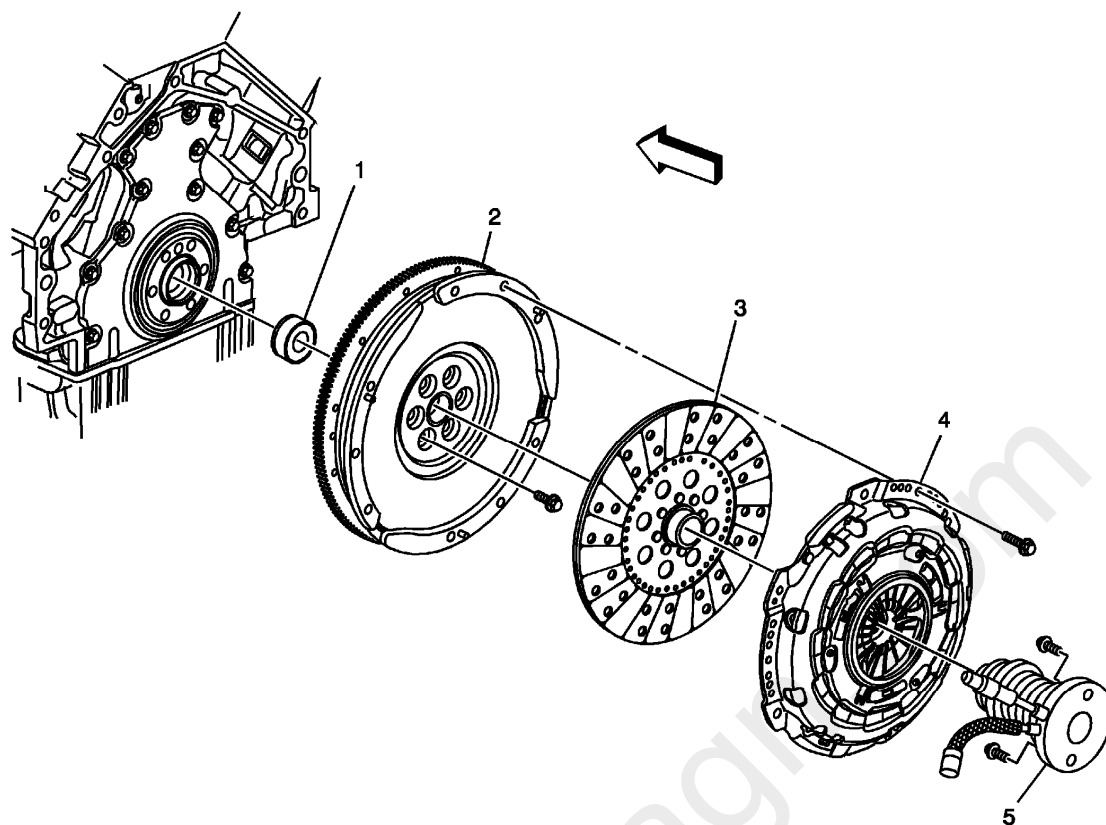


Fig. 40: Tremec 6-Speed
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Clutch Pilot Bearing
2	Engine Flywheel
3	Clutch Driven Plate
4	Clutch Pressure Plate
5	Clutch Actuator Cylinder

The following are the principal components of the clutch system:

- The driving members attached to the engine and turning with the engine
- The driven member attached to the driveline and transmission and turning with the driveline and transmission
- The operating members including the spring, the clutch hydraulic system, and the clutch pedal linkages, required to apply and release the pressure, which holds the driving and driven members in contact with each other

Clutch Driving Members

The clutch driving members consist of 2, flat surface, iron plates. One of these surfaces is a heavy flat ring, with one side machined, known as the clutch plate and the other is the rear face of the engine flywheel. This is a dual mass flywheel that is designed to absorb engine vibrations before they are transmitted to the driveline, where they can create gear rattle. This is achieved by splitting the conventional flywheel into 2 sections: a primary section, which bolts to the crankshaft, and a secondary section, onto which the clutch is bolted. The primary section of the flywheel contains springs to isolate the engine vibrations. A small amount of fore aft looseness between the primary and secondary sections is normal. It is also normal for the secondary section to have a rotating travel of 25-50 mm (1-2 in) measured near the flywheel ring, while the primary section stays stationary.

Clutch Driven Members

The driven member, clutch disc, has a splined hub that freely slides lengthwise along the splines of the input shaft, which also drives the shaft through these same splines. Suitable friction facings are attached to each side of the plate by rivets.

In order to make the clutch engagement as smooth as possible and eliminate chatter, the steel segments driving the splined hub are slightly waved, which causes the contact pressure on the facings to rise gradually as the waved springs flatten out.

Clutch Operating Members

The driving member and the driven member are held in contact by spring pressure. This pressure is exerted by a 1-piece conical or diaphragm spring.

A diaphragm spring is a conical piece of spring steel that has been specially stamped to give it greater flexibility. The diaphragm is positioned between the cover and the pressure plate so that the diaphragm spring is nearly flat when the clutch is in the engaged position. The action of this type of spring is similar to that of an ordinary oil can.

The pressure of the inner rim of the spring on the pressure plate decreases as the flat position is passed. The inner rim of the diaphragm bears on the pressure plate and is pivoted on a ring on the outer edge of the pressure plate. The application of a pulling load on the inner section of the pressure plate will cause the inner rim to move away from the flywheel and allow the pressure plate to move away from the clutch disc, thereby releasing or disengaging the clutch. When the pressure is released from the inner section, the OIL CAN action of the diaphragm causes the inner section to move in, and the movement of the inner rim forces the pressure plate against the clutch disc, thus engaging the clutch.

The clutch release bearing is moved by the actuator assembly to move the release levers which move the pressure plate to the rear, thus separating the clutch disc from the flywheel when the clutch pedal is depressed by the driver. A piston return spring in the actuator cylinder preloads the clutch linkage and assures a small load on the release bearing with the actuator assembly at all times. As the clutch disc wears, the diaphragm spring fingers move forward forcing the release bearing, actuator assembly, and pushrod to move. This movement forces the actuator cylinder piston to move forward in its bore, consuming hydraulic fluid from the master cylinder reservoir, thereby providing the SELF-ADJUSTING feature of the hydraulic clutch linkage system.

Hydraulic Clutch Description

The clutch hydraulic system consists of a master cylinder and an actuator cylinder. When pressure is applied to the clutch pedal, pedal depressed, the pushrod contacts the plunger and pushes it down the bore of the master cylinder. In the first 0.8 mm (0.031 in) of movement, the compensation port closes the port to the fluid reservoir tank, and as the plunger continues to move down the bore of the cylinder, the fluid is forced through the outlet line to the actuator cylinder mounted to the driveline support assembly. As fluid is pushed down the pipe from the master cylinder, this in turn forces the piston in the actuator cylinder outward. As the actuator cylinder piston moves forward, it forces the release bearing to disengage the clutch pressure plate from the clutch disc. On the return stroke, pedal released, the plunger moves back as a result of the return pressure of the clutch. Fluid returns to the master cylinder and the final movement of the plunger opens the port to the fluid reservoir, allowing an unrestricted flow of fluid between system and reservoir. Some systems may have a clutch pedal hold down assist spring. Its purpose is to keep the clutch pedal depressed. This reduces driver fatigue during stop and go traffic.

SPECIAL TOOLS AND EQUIPMENT

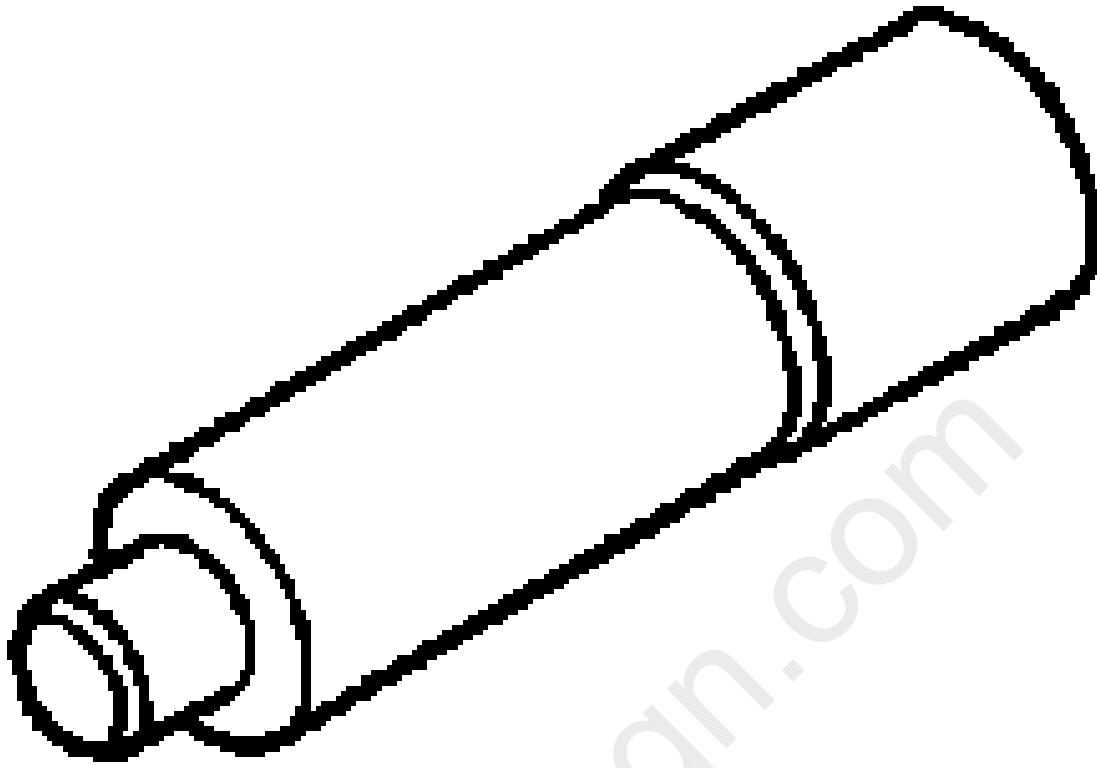
SPECIAL TOOLS

Illustration	Tool Number / Description
	DT-49267 Dual Clutch Alignment Tool (CTS- V)



DT-50194
Dual Clutch
Alignment
Tool (CTS)

J-38836
Bushings
Installer
and Clutch
Arbor



J-43276
Clutch Pilot
Bearing
Remover