

Engine

Engine Mechanical - 3.0L (LFW) or 3.6L (LFX) - Repair Instructions - On Vehicle - CTS Coupe & Wagon

REPAIR INSTRUCTIONS - ON VEHICLE

DRIVE BELT REPLACEMENT

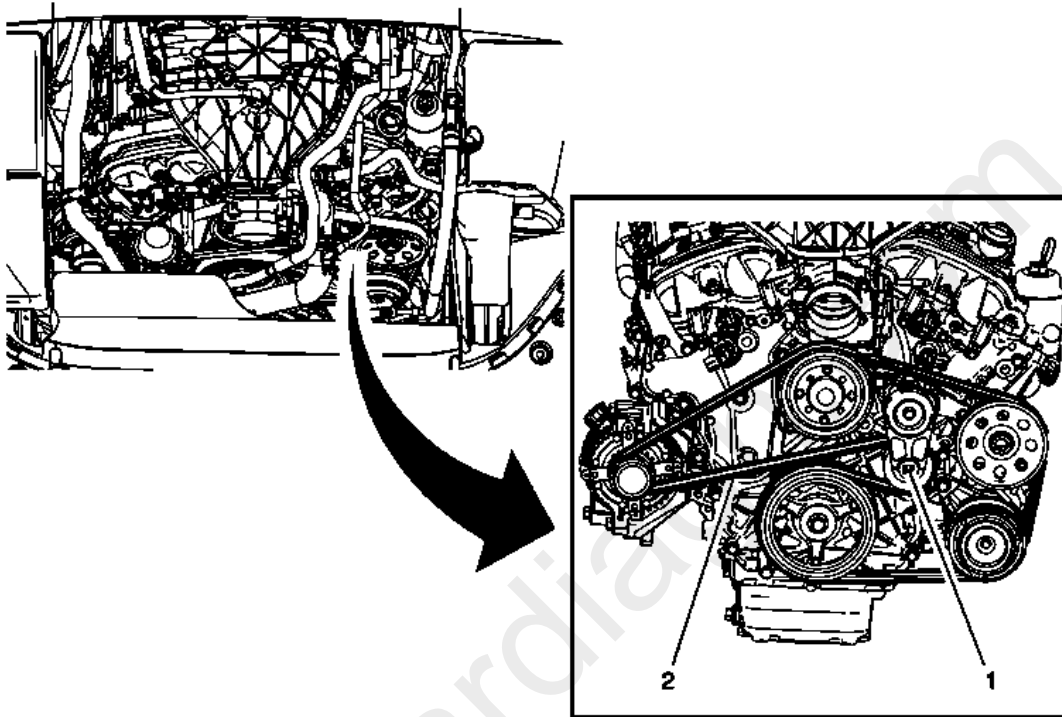


Fig. 1: Drive Belt & Tensioner And Drive Belt Routing
Courtesy of GENERAL MOTORS COMPANY

Drive Belt Replacement

Callout	Component Name
Preliminary Procedure Remove the air cleaner outlet duct. Refer to <u>Air Cleaner Outlet Duct Replacement</u> .	
1	Drive Belt Tensioner Procedure 1. Rotate the drive belt tensioner clockwise to release the drive belt tension. 2. Slide the drive belt off of the belt idler pulley. 3. Slowly release the drive belt tensioner.
2	Drive Belt

DRIVE BELT TENSIONER REPLACEMENT

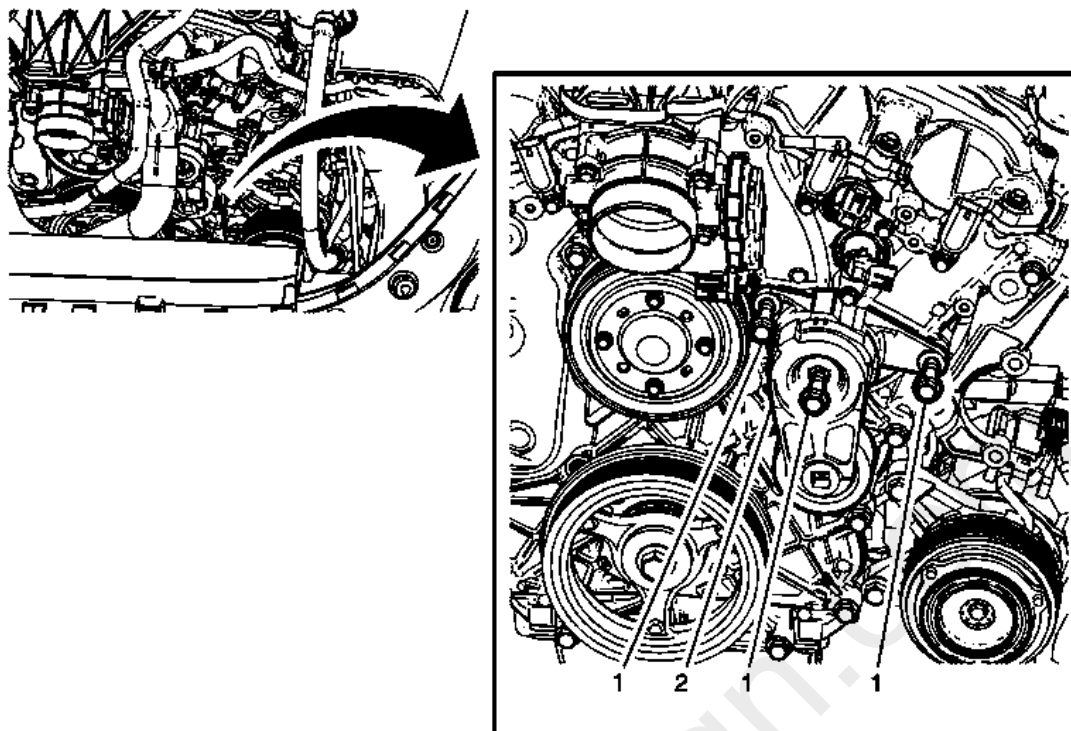


Fig. 2: Drive Belt Tensioners

Courtesy of GENERAL MOTORS COMPANY

Drive Belt Tensioner Replacement

Callout	Component Name
Preliminary Procedures Remove the power steering pump pulley. Refer to <u>Power Steering Pump Pulley Replacement (LFW, LFX)</u> .	
1	Drive Belt Tensioner (Qty; 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Drive Belt Tensioner

ENGINE SUPPORT FIXTURE

Special Tools

- J 28467-B Universal Engine Support Fixture

- **J-28467-550** Engine Support Beam Adapter
- **J 36857** Engine Lift Bracket

Installation Procedure

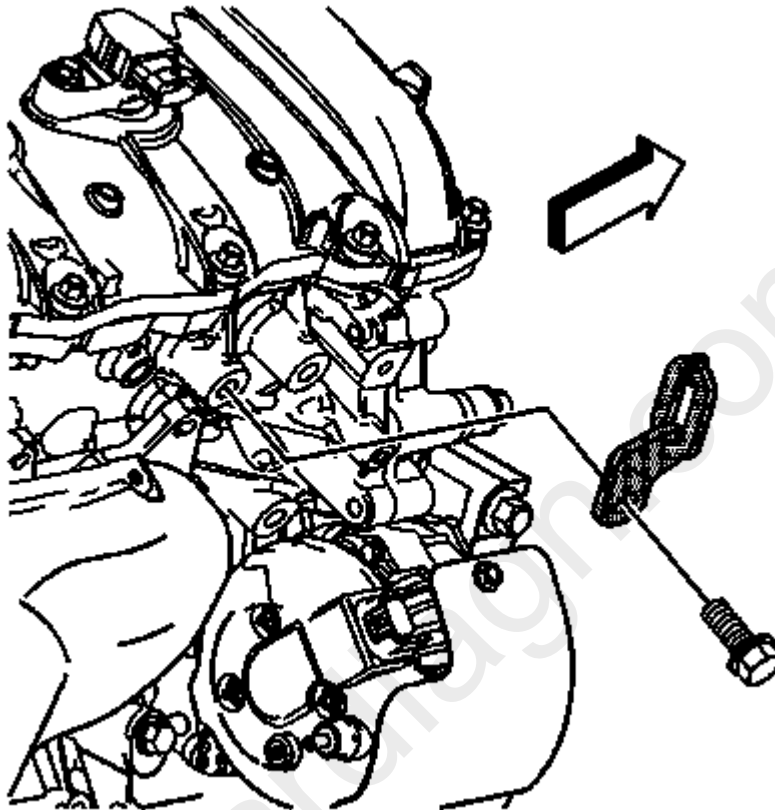


Fig. 3: View of Engine Lift Bracket Assembly
 Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine compartment sight shields. Refer to **Front Compartment Sight Shields Replacement** .
2. Remove the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
3. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

CAUTION: Refer to **Fastener Caution** .

4. Use a grade 10.9, M10 X 1.5 X 35 bolt, GM P/N 11519182, or equivalent, in order to install **J 36857** engine lift bracket , or equivalent, to the right cylinder head in the location shown. Tighten the bolt to 65 (48 lb ft).
5. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

6. Remove the vacuum pump and position aside, if equipped.

NOTE: It is not necessary to remove the hoses from the power steering reservoir.

7. Remove the power steering reservoir and position aside. Refer to **Power Steering Fluid Reservoir Replacement (LFW, LFX)**.
8. Remove the Bank 2 (Left Side) exhaust camshaft position sensor. Refer to **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust**.

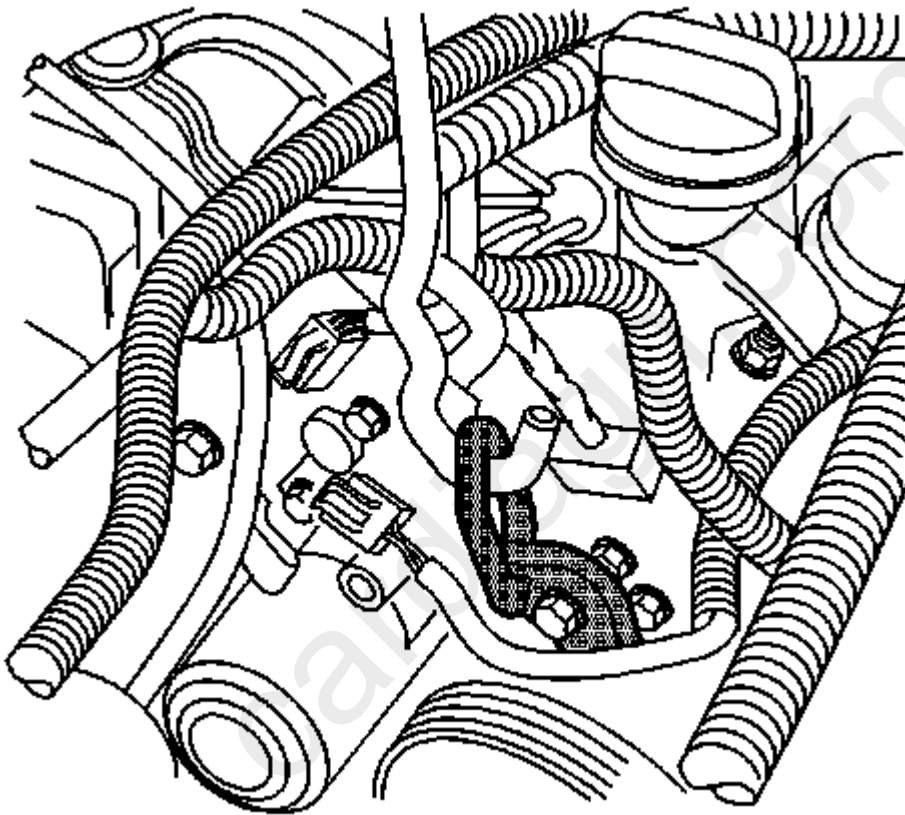


Fig. 4: Identifying Lift Hook Assembly To Left Side Engine Lift Hook Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Use a grade 10.9, M10 X 1.5 X 35 bolt, GM P/N 11519182, or equivalent, in order to install **J 36857** engine lift bracket, or equivalent, to the front of the left cylinder head in the location shown. Tighten the bolt to 65 (48 lb ft).

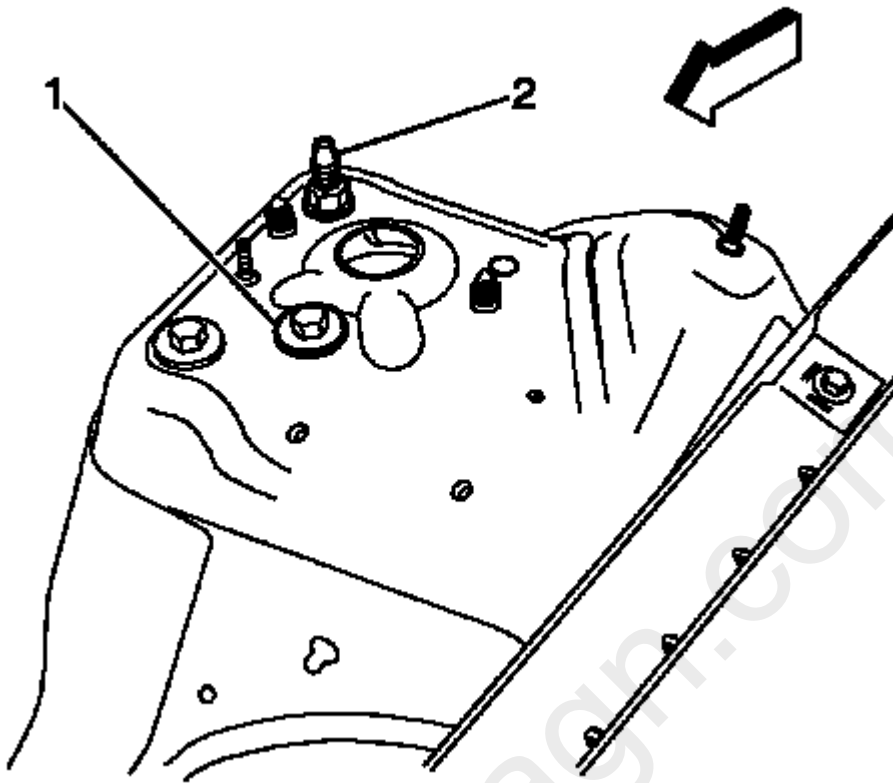


Fig. 5: Identifying Shock Module Mounting Stud & Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove the shock module mounting stud (2) and bolt (1) from the left and right shock tower.

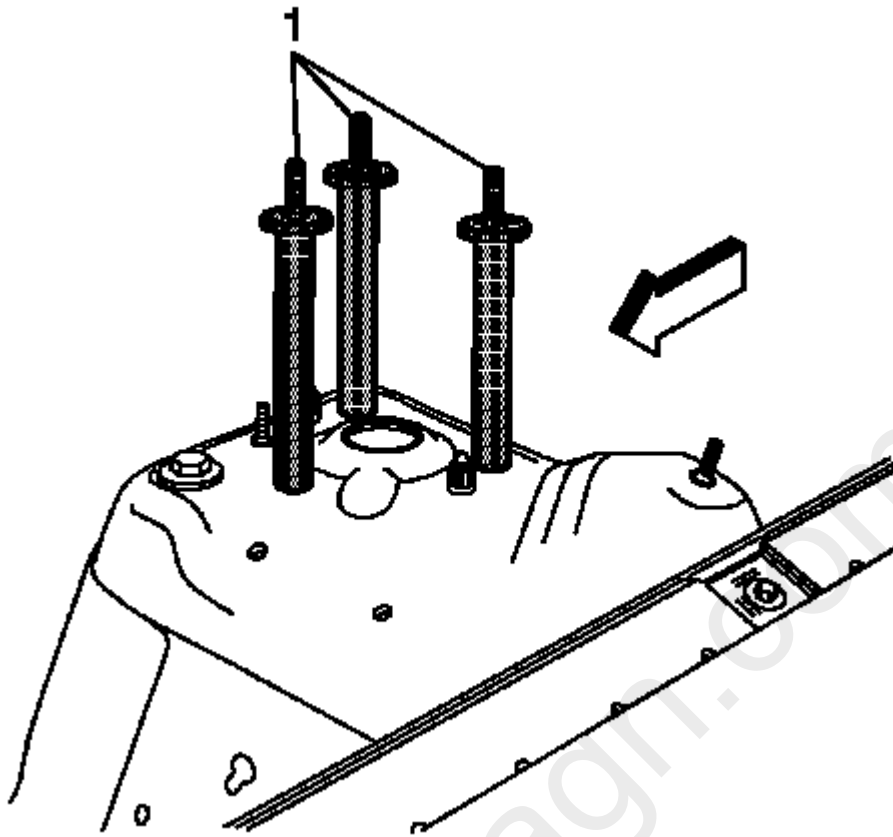


Fig. 6: Engine Support Beam Adapters
Courtesy of GENERAL MOTORS COMPANY

11. Install the J-28467-550 engine support beam adapter (1) in the location shown on the left and right shock towers.

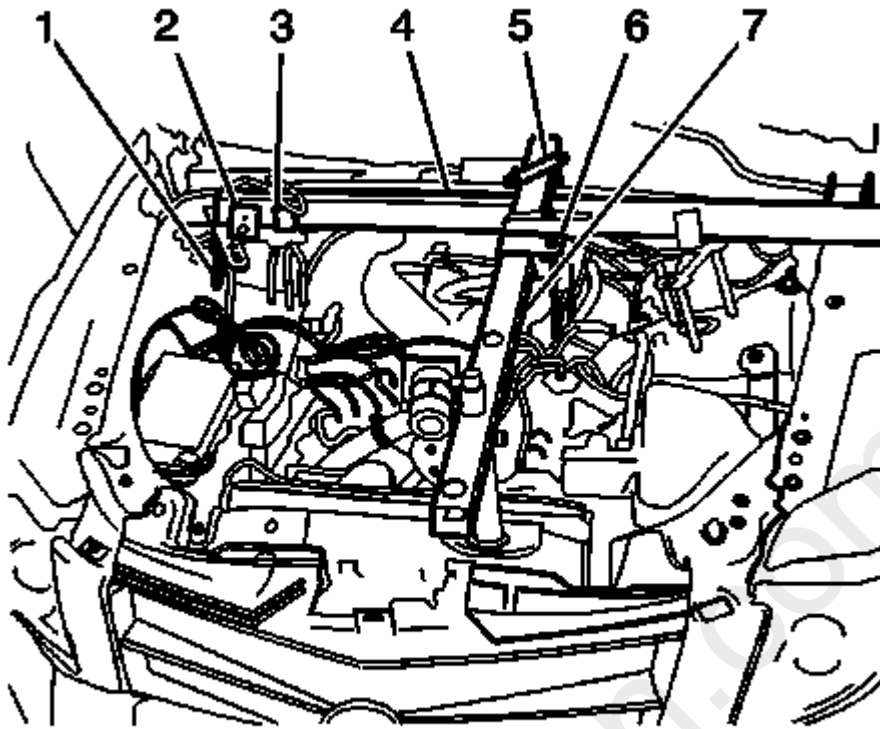


Fig. 7: Identifying Strut Tower & Engine Support Beam Adapter Components
Courtesy of GENERAL MOTORS COMPANY

12. Ensure the strut tower support assemblies (2) are secured to the engine support beam adapters (1) with wing nuts.
13. Secure the strut tower tube (4) to the strut tower support (2) with quick release pins.
14. Secure the strut tower tube (4) to the radiator shelf tube (7) with the cross bracket assembly (5).
15. Tighten the cross bracket wing nuts.

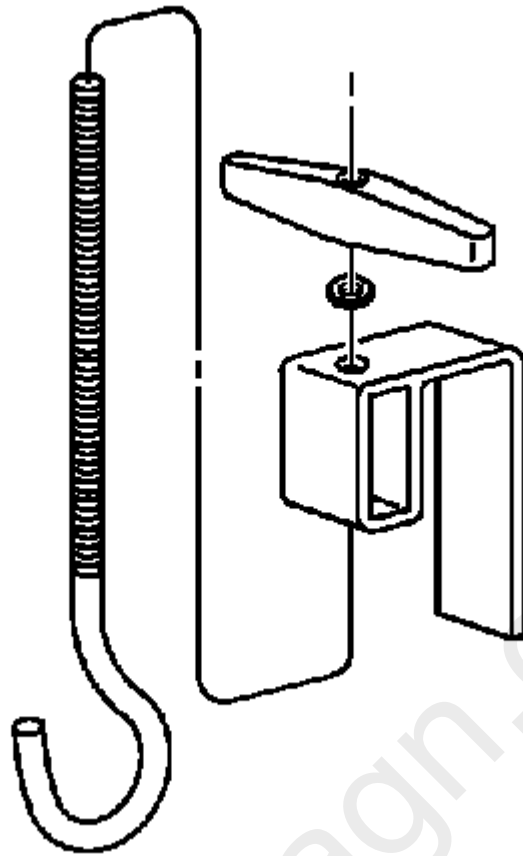


Fig. 8: View Of Lift Hook Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Assemble the lift hook wing nut and the lift hook bracket to the lift hook.

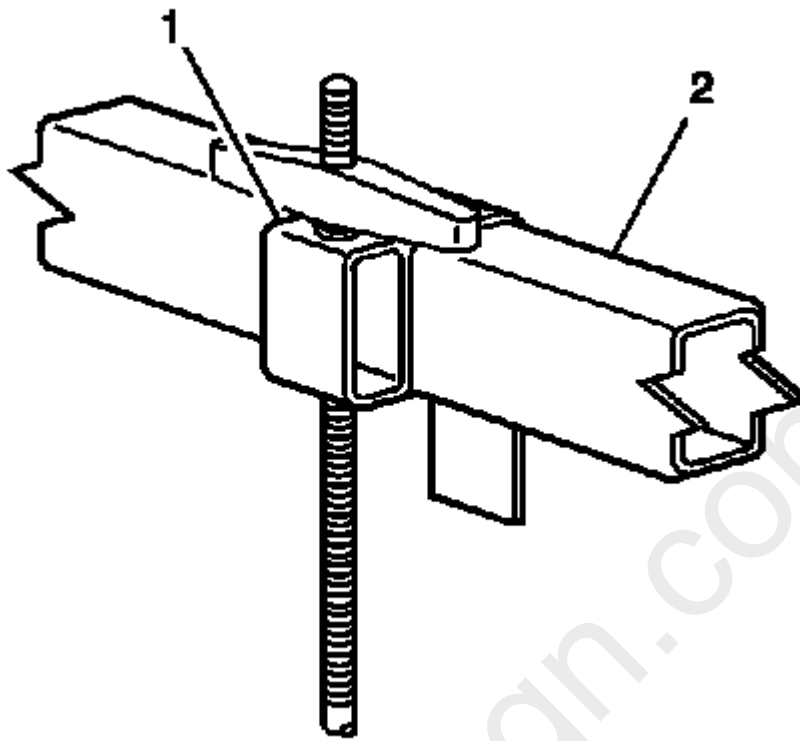


Fig. 9: View Of Lift Hook & radiator shelf tube Assembly
Courtesy of GENERAL MOTORS COMPANY

17. Install lift hook assembly (1) to the radiator shelf tube (2).

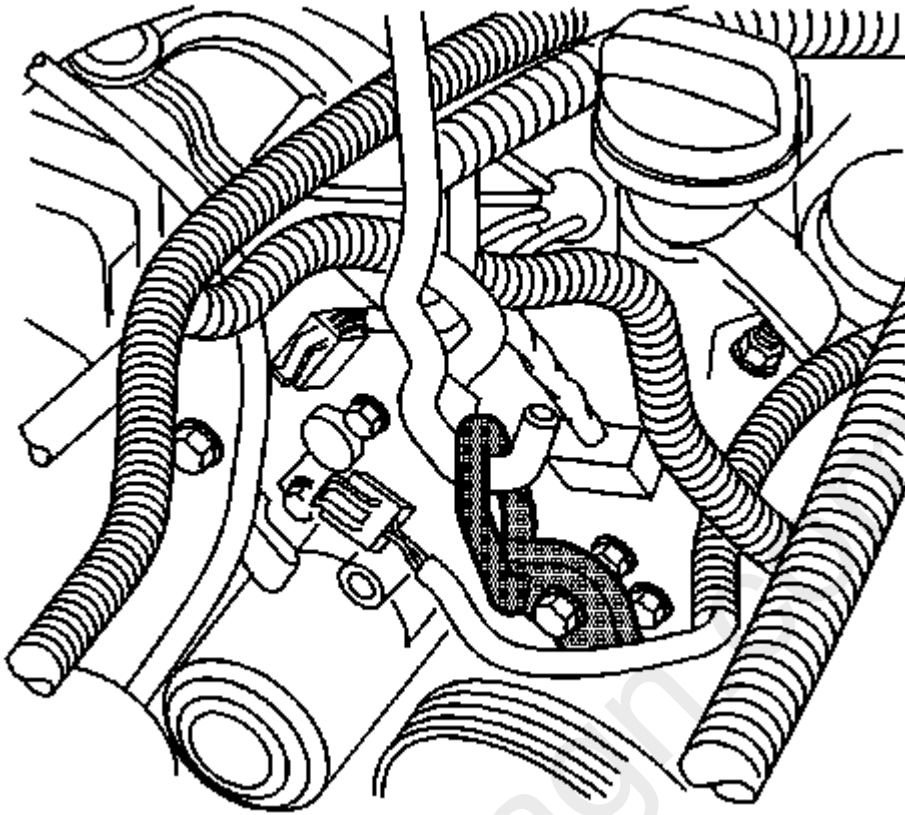


Fig. 10: Identifying Lift Hook Assembly To Left Side Engine Lift Hook Bracket
Courtesy of GENERAL MOTORS COMPANY

18. Install lift hook assembly to left side engine lift hook bracket.

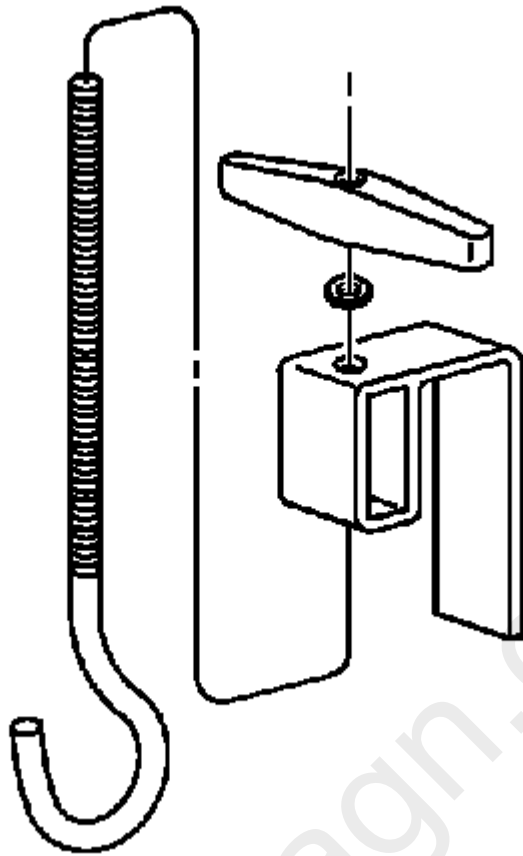


Fig. 11: View Of Lift Hook Assembly
Courtesy of GENERAL MOTORS COMPANY

19. Assemble the lift hook wing nut and the lift hook bracket to the lift hook.

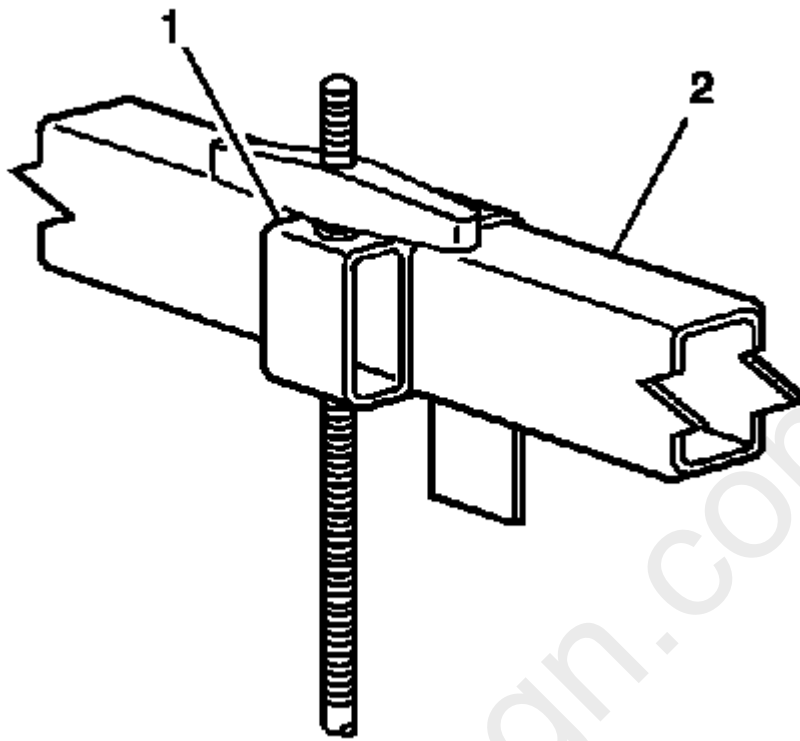


Fig. 12: View Of Lift Hook & radiator shelf tube Assembly
Courtesy of GENERAL MOTORS COMPANY

20. Install lift hook assembly (1) to the strut tower tube (2).

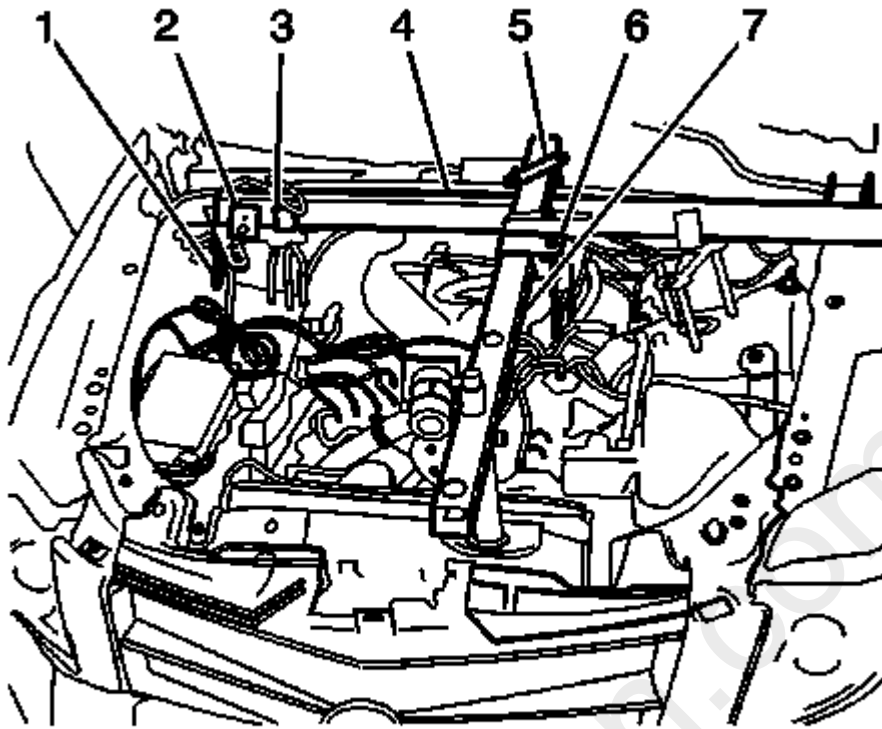


Fig. 13: Identifying Strut Tower & Engine Support Beam Adapter Components
Courtesy of GENERAL MOTORS COMPANY

21. Hand tighten the lift hooks (3, 6) in order to remove all slack from the engine support fixture.

Removal Procedure

1. Remove the **J 28467-B** universal engine support fixture.
2. Remove the **J-28467-550** engine support beam adapter.

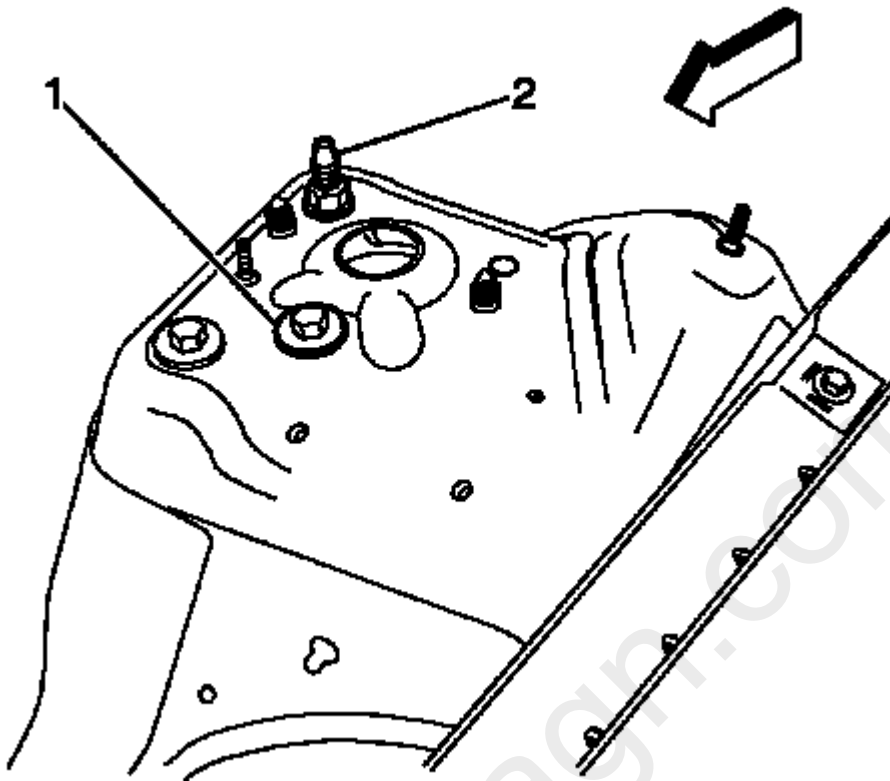


Fig. 14: Identifying Shock Module Mounting Stud & Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the shock module mounting stud (2) and bolt (1) to the left and right shock towers then tighten to 112 (83 lb ft).
4. Remove the right and left engine lift brackets from the engine.
5. Install the Bank 2 (Left Side) exhaust camshaft position sensor. Refer to Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust .
6. Install the power steering reservoir. Refer to Power Steering Fluid Reservoir Replacement (LFW, LFX) .
7. Install the vacuum pump, if equipped.
8. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement .
9. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
10. Install the cross vehicle brace. Refer to Cross Vehicle Brace Replacement .
11. Install the engine compartment sight shields. Refer to Front Compartment Sight Shields Replacement .

ENGINE MOUNT INSPECTION

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

1. Install the engine support fixture. Refer to **Engine Support Fixture**. Raising the engine removes the weight from the engine mount and creates slight tension in the rubber.
2. Observe the engine mount while raising the engine. Replace the engine mount if the engine 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 engine mount.
 - The rubber is split through the center of the engine mount.
 - The GLYCOL™ fluid is leaking from the engine mount.
3. If there is movement between the metal plate of the engine mount and its attaching points, lower the engine on the engine mount. Tighten the bolts or nuts attaching the engine mount to the frame or engine mount bracket. Refer to **Engine Mount Replacement - Left Side (RWD)**, **Engine Mount Replacement - Left Side (AWD)**, or **Engine Mount Replacement - Right Side (RWD)**, **Engine Mount Replacement - Right Side (AWD)**.

ENGINE MOUNT REPLACEMENT - LEFT SIDE (RWD)

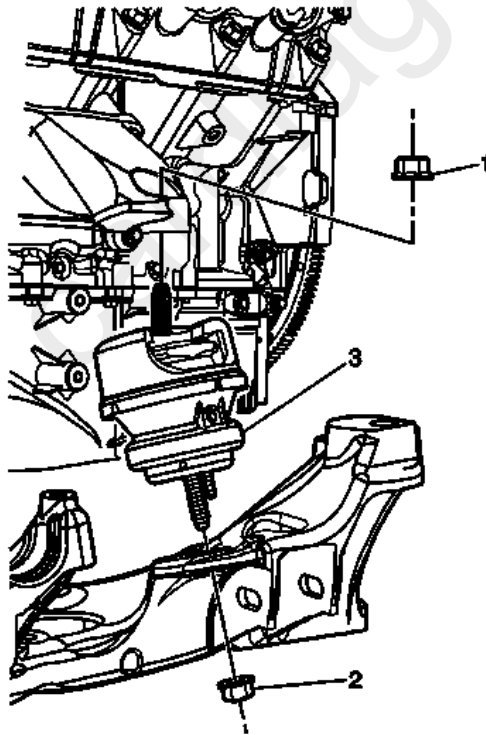


Fig. 15: Identifying Engine Mount - Left Side (RWD)
Courtesy of GENERAL MOTORS COMPANY

Engine Mount Replacement - Left Side (RWD)

Callout	Component Name
Preliminary Procedures 1. Discharge the air conditioning (A/C) system. Refer to <u>Refrigerant Recovery and Recharging (Belt Driven Compressor)</u> . 2. Remove the tower brace. Refer to <u>Cross Vehicle Brace Replacement</u> . 3. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 4. Remove the suction hose from the A/C compressor. Refer to <u>Air Conditioning Compressor Hose Replacement (LFX or LFW)</u> . 5. Position the hose aside to gain access to the engine mount top nut. 6. Lower the vehicle.	
1	Engine Mount Fastener CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure 1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Position a screw jack and a block of wood under the engine oil pan. Tighten 80 N.m (59 lb ft)
2	Engine Mount Fastener Tighten 80 N.m (59 lb ft)
3	Engine Mount Procedure 1. Using the screw jack, raise the engine enough to remove the engine mount. 2. Install the new right and left engine mount lower nut first.

ENGINE MOUNT REPLACEMENT - LEFT SIDE (AWD)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

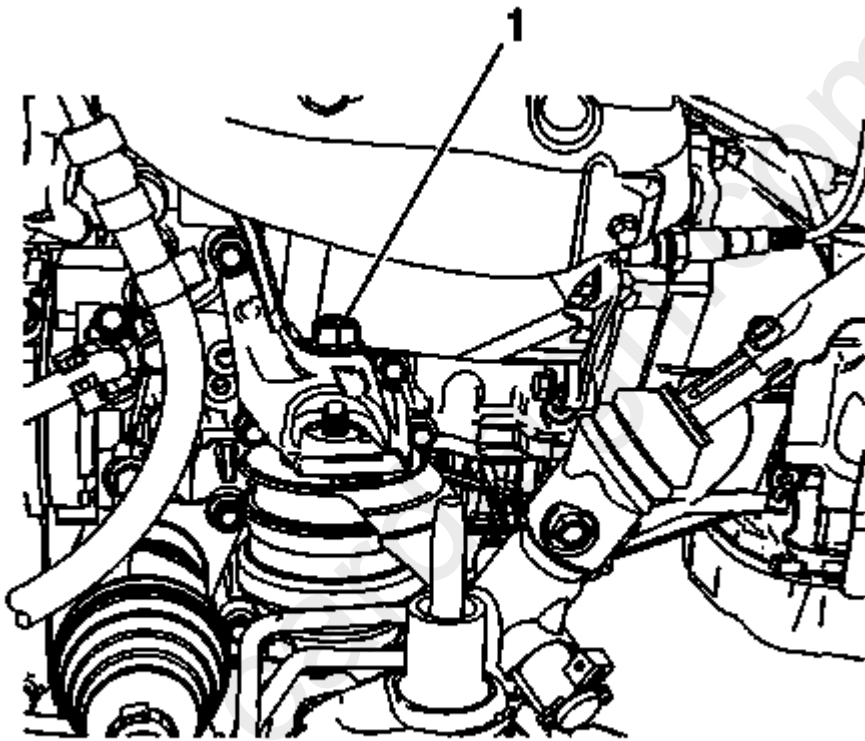


Fig. 16: Identifying Engine Mount Retaining Nut
 Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the battery ground cable. Refer to **Battery Negative Cable Disconnection and Connection (Coupe)** , **Battery Negative Cable Disconnection and Connection (Wagon)** .
2. Remove the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
3. Remove the exhaust system. Refer to **Exhaust System Replacement (Single Exhaust)** , **Exhaust System Replacement (LFX/LFW-Coupe)** , **Exhaust System Replacement (LFX/LFW-Wagon)** .
4. Remove the right and left lower engine mount retaining nuts.
5. Disconnect the lower intermediate steering shaft from the steering gear and position the shaft aside. Refer

to **Intermediate Steering Shaft Replacement** .

6. Remove the upper engine mount retaining nut (1).

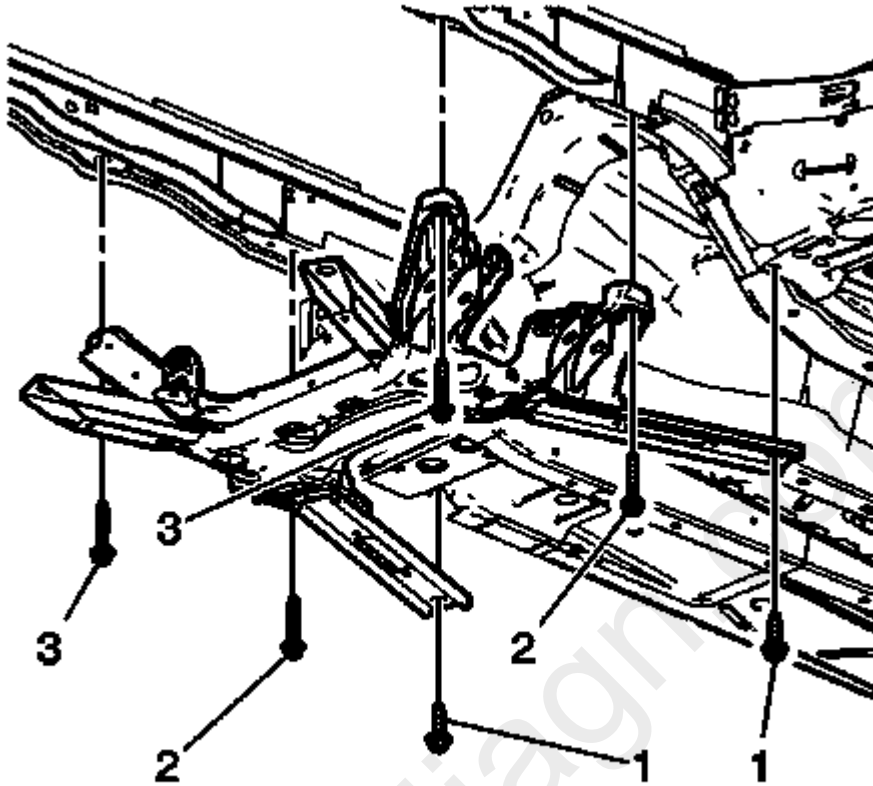


Fig. 17: View of Cross Vehicle Brace Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install a screw jack with a block of wood under the oil pan for support.
8. Support the rear of the front frame with a screw jack.
9. Remove the frame rear (1) and center (2) mounting bolts.
10. Loosen the front frame bolts (3) 12.7 mm (0.5 in) to 25.4 mm (1 in).
11. Lower the rear section of the frame.
12. Raise the engine using the screw jack until the weight is removed from the mount.
13. Lower the screw jack under the frame.

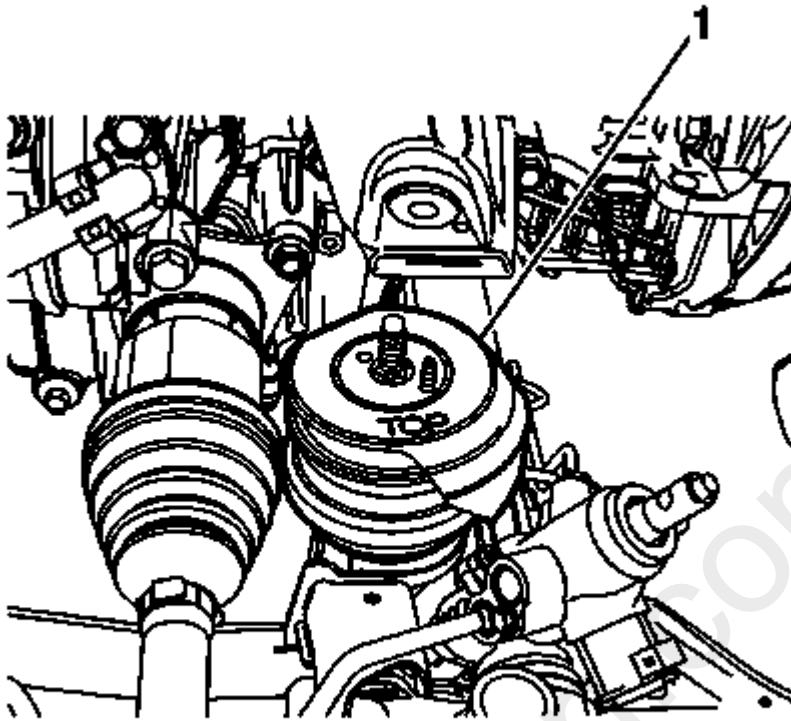


Fig. 18: Identifying Engine Mount Assembly
Courtesy of GENERAL MOTORS COMPANY

14. Remove the engine mount (1) from the vehicle.

Installation Procedure

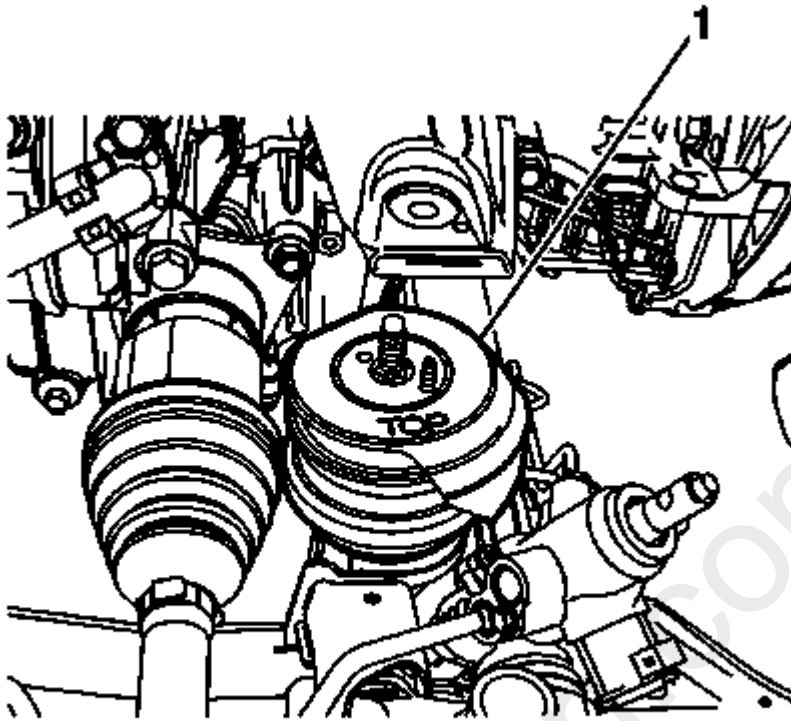


Fig. 19: Identifying Engine Mount Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the proper configuration of engine mount is being used and install the engine mount (1).
2. Raise the rear section of the frame.

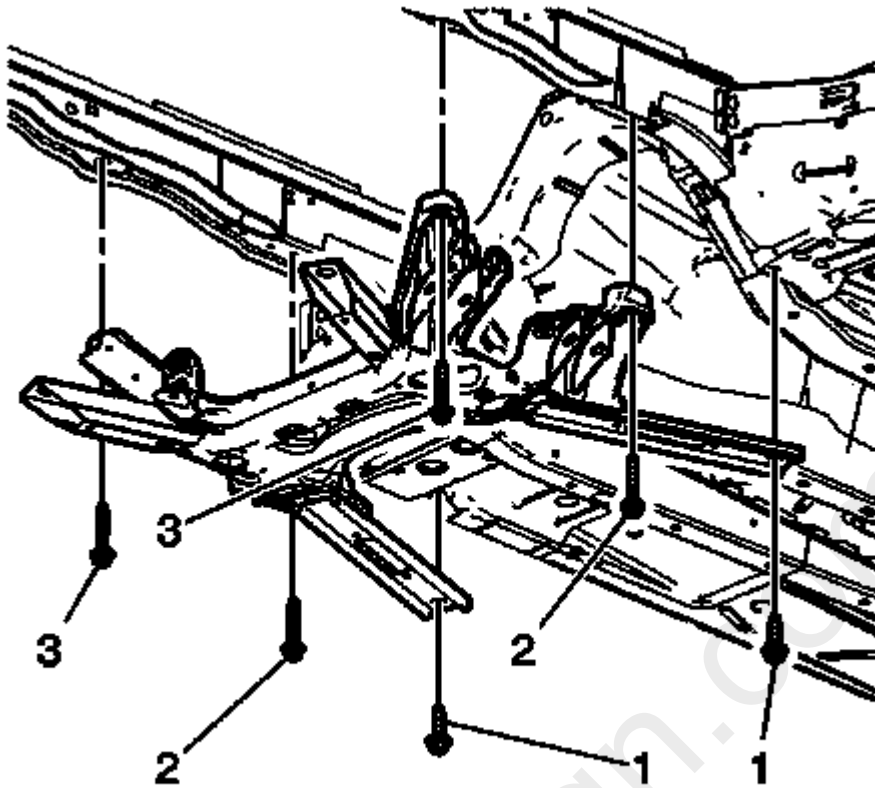


Fig. 20: View of Cross Vehicle Brace Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install but do not tighten the frame rear (1) and center (2) mounting bolts.

CAUTION: Refer to Fastener Caution .

NOTE: **Ensure to tighten the frame bolts in sequence.**

4. Tighten the frame bolts.
 1. Tighten the left front frame bolt to 191 N.m (141 lb ft).
 2. Tighten the right front frame bolt to 191 N.m (141 lb ft).
 3. Tighten the center front frame bolts to 191 N.m (141 lb ft).
 4. Tighten the rear front frame bolts to 191 N.m (141 lb ft).
5. Remove the screw jack from the rear of the front frame.
6. Remove the screw jack and block of wood from under the oil pan.

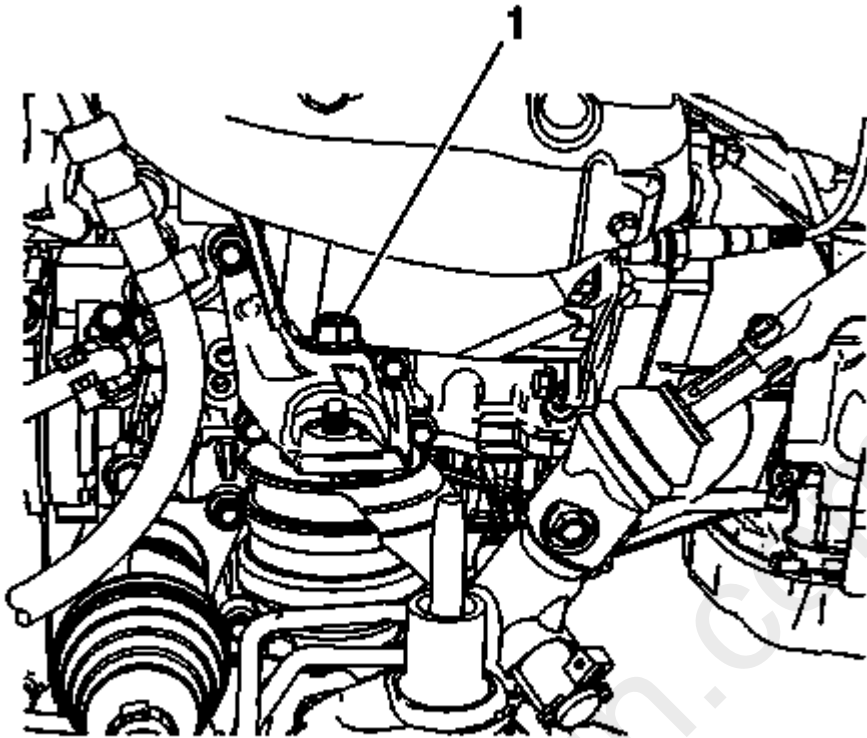


Fig. 21: Identifying Engine Mount Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install the upper engine mount retaining nut (1) and tighten to 80 N.m (59 lb ft).
8. Install the right and left lower engine mount retaining nuts and tighten to 80 N.m (59 lb ft).
9. Connect the lower intermediate steering shaft to the steering gear. Refer to **Intermediate Steering Shaft Replacement** .
10. Install the exhaust system. Refer to **Exhaust System Replacement (Single Exhaust)** , **Exhaust System Replacement (LFX/LFW-Coupe)** , **Exhaust System Replacement (LFX/LFW-Wagon)** .
11. Lower the vehicle.
12. Install the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
13. Connect the battery ground cable. Refer to **Battery Negative Cable Disconnection and Connection (Coupe)** , **Battery Negative Cable Disconnection and Connection (Wagon)** .

ENGINE MOUNT REPLACEMENT - RIGHT SIDE (RWD)

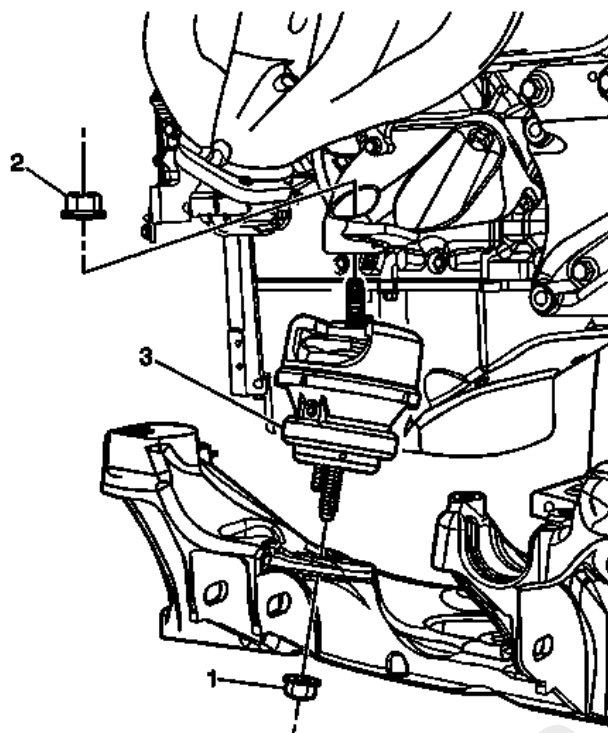


Fig. 22: Identifying Engine Mount - Right Side (RWD)

Courtesy of GENERAL MOTORS COMPANY

Engine Mount Replacement - Right Side (RWD)

Callout	Component Name
Preliminary Procedures 1. Discharge the air conditioning (A/C) system. Refer to <u>Refrigerant Recovery and Recharging (Belt Driven Compressor)</u> . 2. Remove the tower brace. Refer to <u>Cross Vehicle Brace Replacement</u> . 3. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 4. Remove the suction hose from the A/C compressor. Refer to <u>Air Conditioning Compressor Hose Replacement (LFX or LFW)</u> . 5. Position the hose aside to gain access to the engine mount top nut. 6. Lower the vehicle.	
1	Engine Mount Fastener CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure 1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Position a screw jack and a block of wood under the engine oil pan.

	Tighten 80 N.m (59 lb ft)
2	Engine Mount Fastener Tighten 80 N.m (59 lb ft)
3	Engine Mount Procedure 1. Using the screw jack, raise the engine enough to remove the engine mount. 2. Install the new right and left engine mount lower nut first.

ENGINE MOUNT REPLACEMENT - RIGHT SIDE (AWD)

Removal Procedure

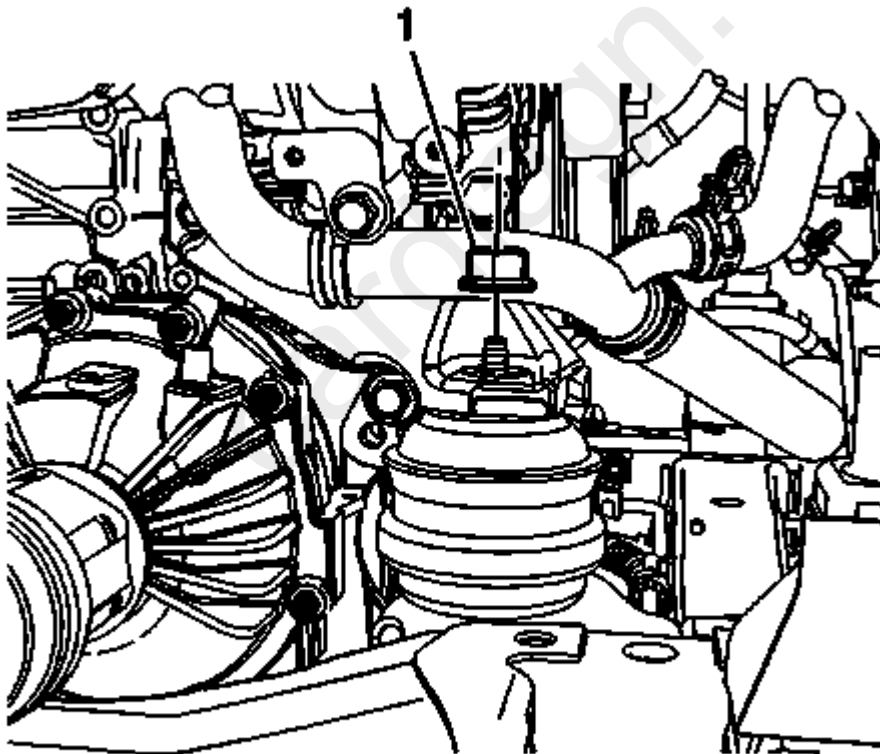


Fig. 23: Identifying Upper Engine Mount Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection (Coupe) , Battery Negative Cable Disconnection and Connection (Wagon) .
2. Remove the cross vehicle brace. Refer to Cross Vehicle Brace Replacement .
3. Remove the exhaust system. Refer to Exhaust System Replacement (Single Exhaust) , Exhaust System Replacement (LFX/LFW-Coupe) , Exhaust System Replacement (LFX/LFW-Wagon) .
4. Remove the upper engine mount retaining nut (1).

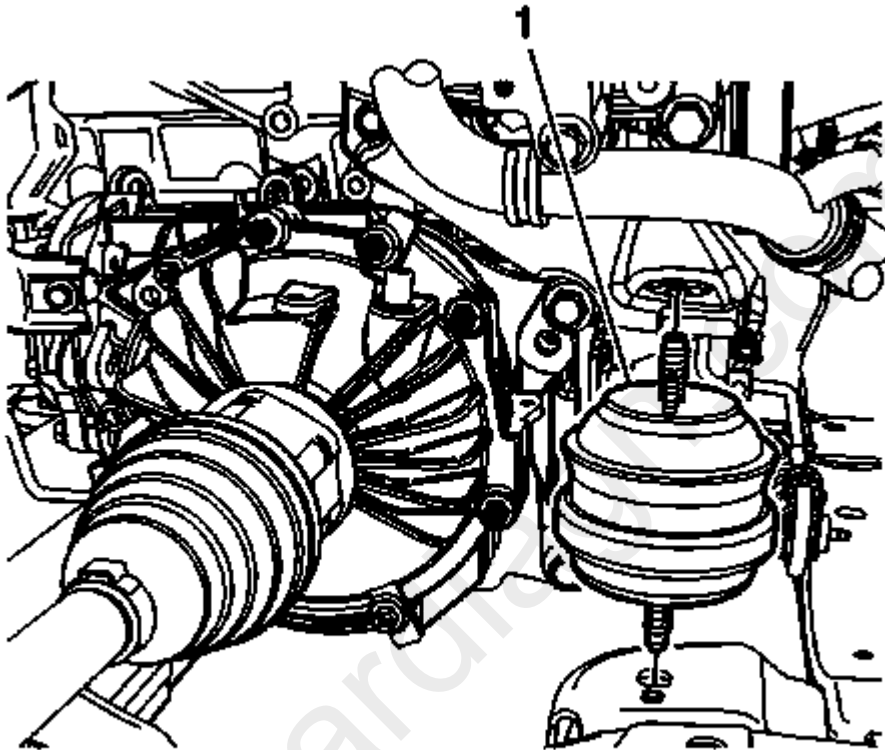


Fig. 24: Identifying Engine Mount
Courtesy of GENERAL MOTORS COMPANY

5. Remove the lower engine mount retaining nuts.
6. Install a screw jack with a block of wood under the oil pan for support.

NOTE: **Note position of the engine mount prior to removing mount.**

7. Using the screw jack, raise the engine enough to remove the engine mount.
8. Remove the engine mount (1) from the vehicle.

Installation Procedure

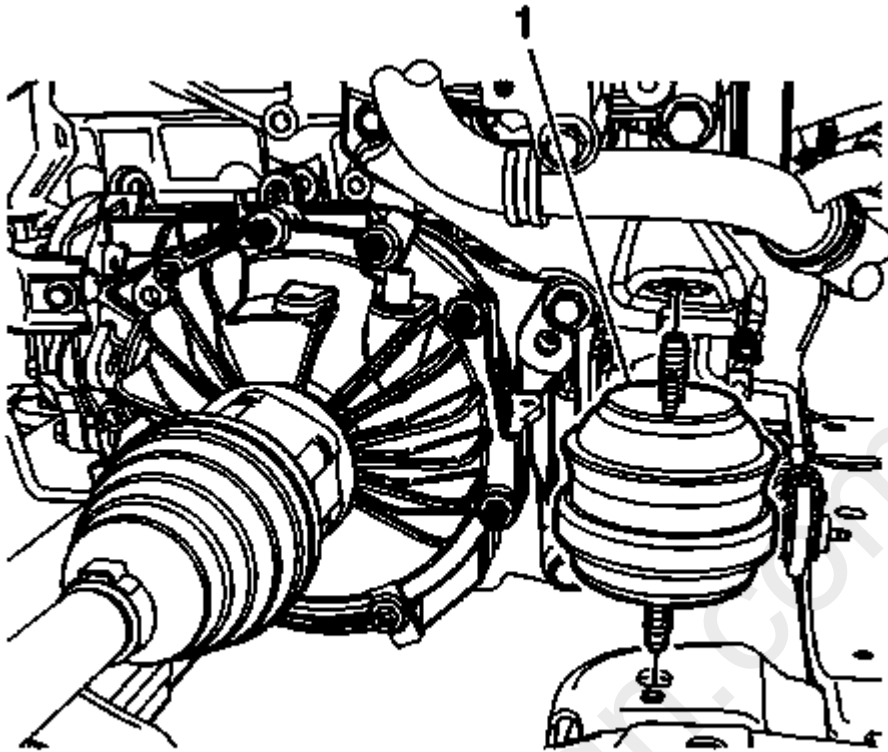


Fig. 25: Identifying Engine Mount
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the proper configuration is being used and install the engine mount (1) to the vehicle.
2. Using the screw jack, lower the engine.
3. Remove the screw jack and block of wood supporting the engine.

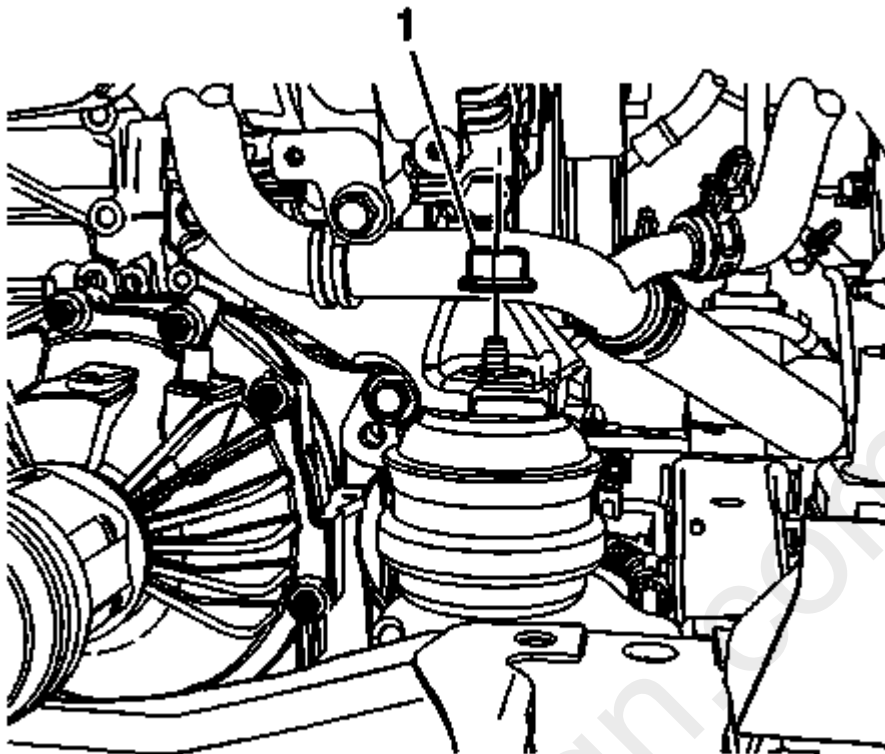


Fig. 26: Identifying Upper Engine Mount Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the upper engine mount retaining nut (1) and tighten to 80 N.m (59 lb ft).
5. Install the right and left lower engine mount retaining nuts and tighten to 80 N.m (59 lb ft).
6. Install the exhaust system. Refer to Exhaust System Replacement (Single Exhaust) , Exhaust System Replacement (LFX/LFW-Coupe) , Exhaust System Replacement (LFX/LFW-Wagon) .
7. Install the cross vehicle brace. Refer to Cross Vehicle Brace Replacement .
8. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection (Coupe) , Battery Negative Cable Disconnection and Connection (Wagon) .

ENGINE MOUNT BRACKET REPLACEMENT - LEFT SIDE (RWD)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap

to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

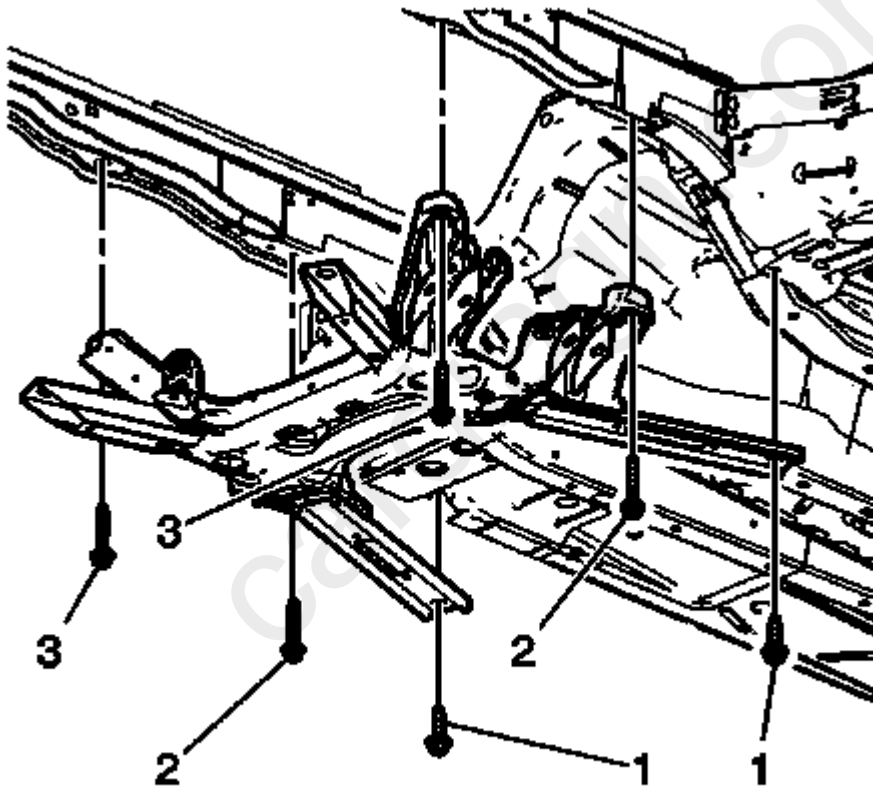


Fig. 27: View of Cross Vehicle Brace Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove the tower brace. Refer to **Cross Vehicle Brace Replacement** .
2. Secure the steering wheel in place.
3. Remove the lower section of the steering intermediate shaft. Refer to **Lower Intermediate Steering**

Shaft Replacement

4. Remove the left and right lower engine mount nuts.
5. Install a screw jack with a block of wood under the oil pan for support.
6. Support the rear of the front frame with a screw jack.
7. Remove the frame rear (1) and center (2) mounting bolts.
8. Loosen the front frame bolts (3) 12.7 mm (0.5 in) to 25.4 mm (1 in).
9. Lower the rear section of the frame.

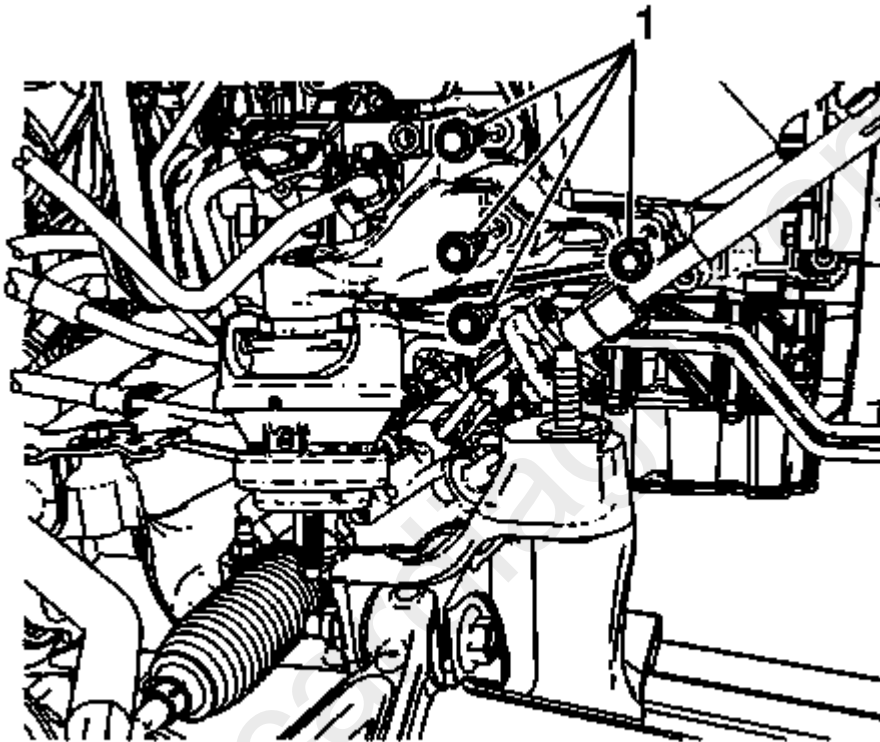


Fig. 28: Identifying Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine mount bracket bolts (1).
11. Remove the engine mount and engine mount bracket as an assembly.

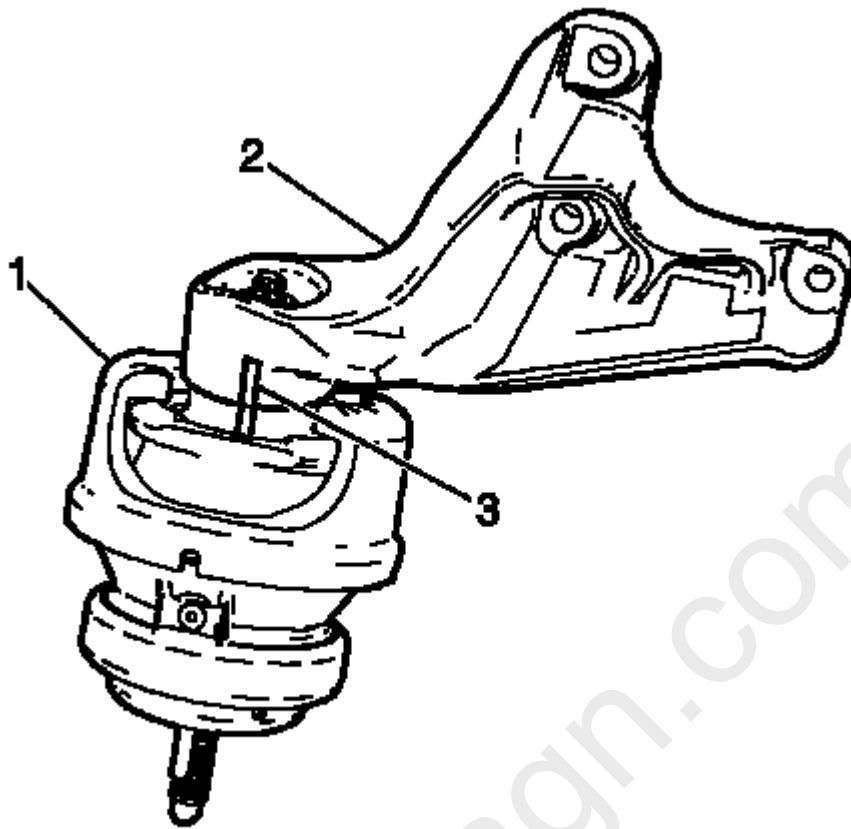


Fig. 29: View of Engine Mount, Bracket and Alignment Mark
Courtesy of GENERAL MOTORS COMPANY

12. Mark the location of the engine mount (1) to the engine mount bracket (2).

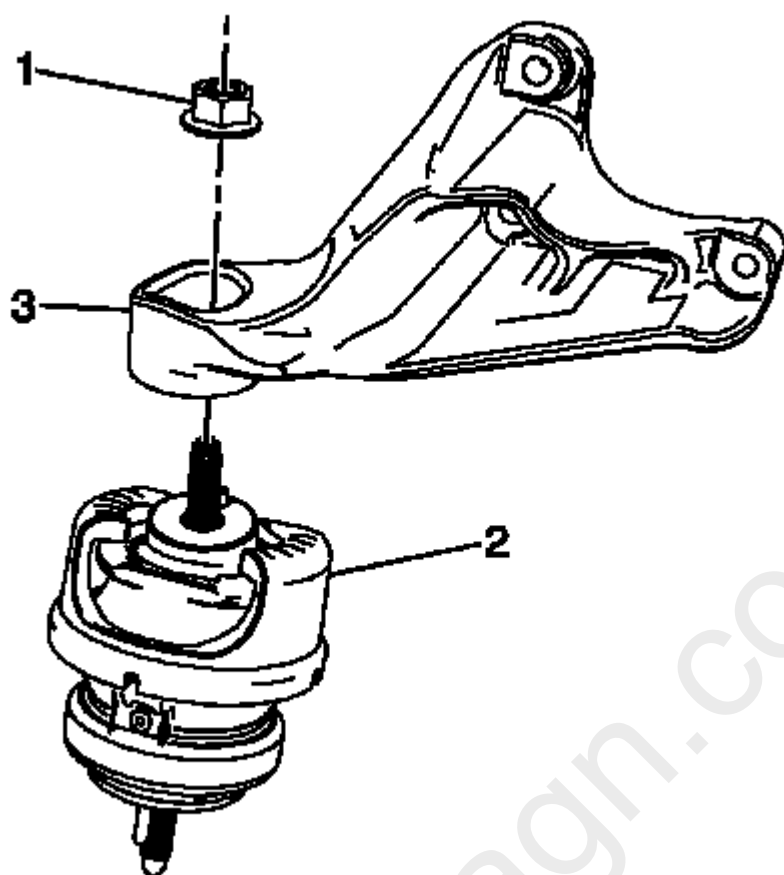


Fig. 30: View Of Left Engine Mount Bracket
Courtesy of GENERAL MOTORS COMPANY

13. Remove the upper engine mount retaining nut (1).
14. Separate the engine mount (2) from the engine mount bracket (3).

Installation Procedure

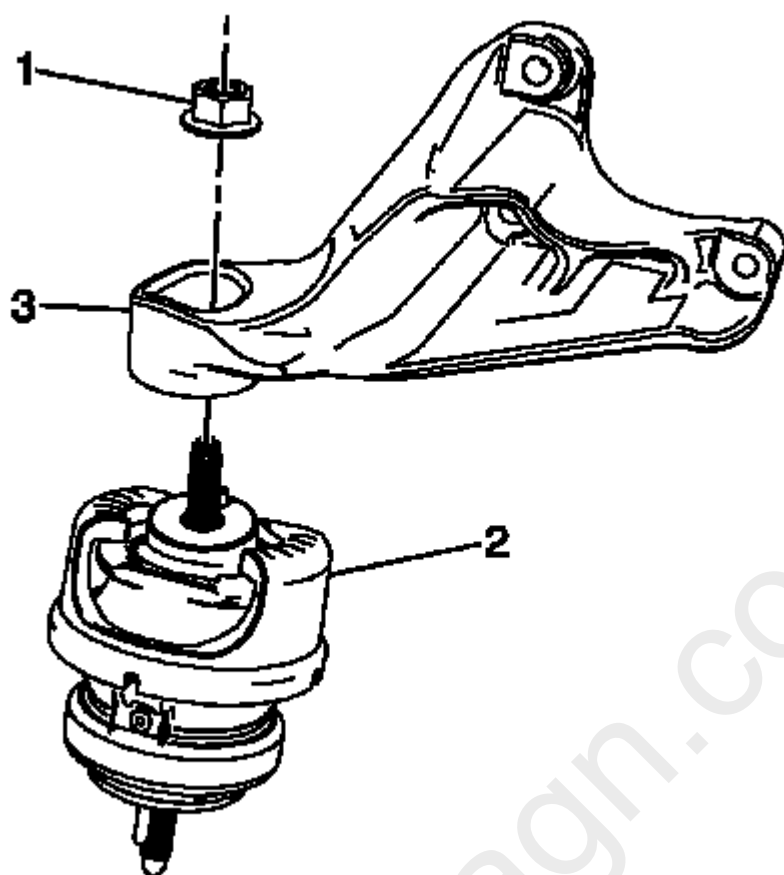


Fig. 31: View Of Left Engine Mount Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Position the engine mount bracket (3) to the engine mount (2).

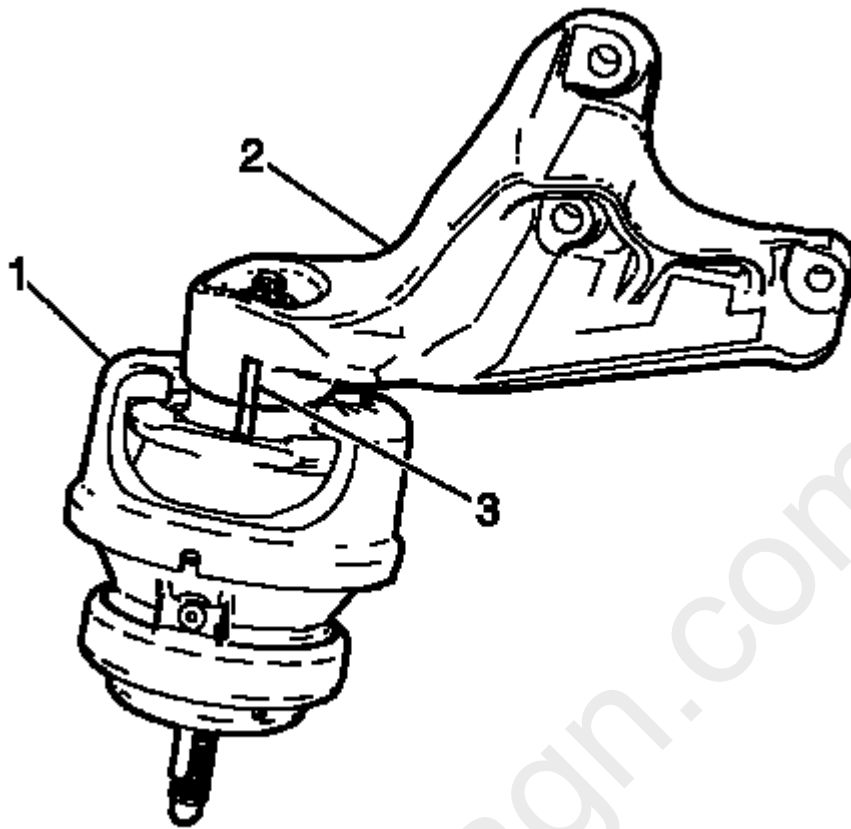


Fig. 32: View of Engine Mount, Bracket and Alignment Mark
Courtesy of GENERAL MOTORS COMPANY

2. Align the location mark (3) of the engine mount (1) to the engine mount bracket (2).

CAUTION: Refer to Fastener Caution .

3. Install the upper engine mount retaining nut and tighten to 80 N.m (59 lb ft).

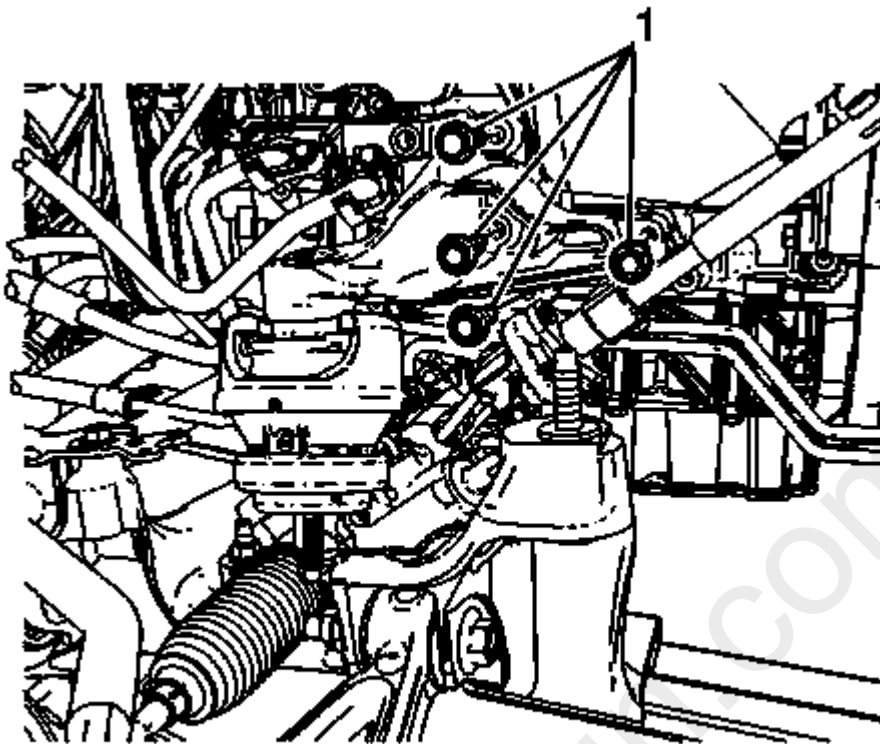


Fig. 33: Identifying Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the engine mount and engine mount bracket as an assembly.
5. Install the engine mount bracket bolts (1) and tighten to 60 N.m (44 lb ft).
6. Raise the rear section of the frame.

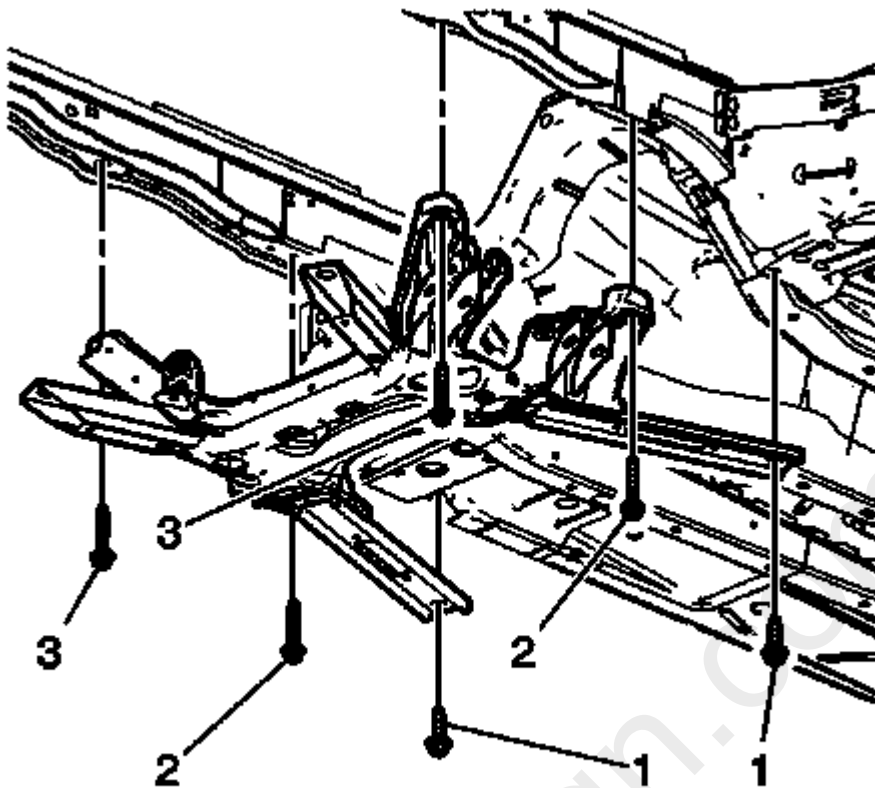


Fig. 34: View of Cross Vehicle Brace Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install but do not tighten the frame rear (1) and center (2) mounting bolts. Tighten the bolts to 191 N.m (141 lb ft).

NOTE: **Ensure to tighten the frame bolts in sequence.**

8. Tighten the frame bolts.
 1. Tighten the left front frame bolt to 191 N.m (141 lb ft).
 2. Tighten the right front frame bolt to 191 N.m (141 lb ft).
 3. Tighten the center front frame bolts to 191 N.m (141 lb ft).
 4. Tighten the rear front frame bolts to 191 N.m (141 lb ft).
9. Remove the screw jack from the rear of the front frame.
10. Remove the screw jack and block of wood from under the oil pan.
11. Install the left and right lower engine mount nuts and tighten to 80 N.m (59 lb ft).
12. Install the lower section of the steering intermediate shaft. Refer to **Lower Intermediate Steering Shaft Replacement**.
13. Unsecure the steering wheel.

14. Install the tower brace. Refer to Cross Vehicle Brace Replacement .

ENGINE MOUNT BRACKET REPLACEMENT - LEFT SIDE (AWD)

Removal Procedure

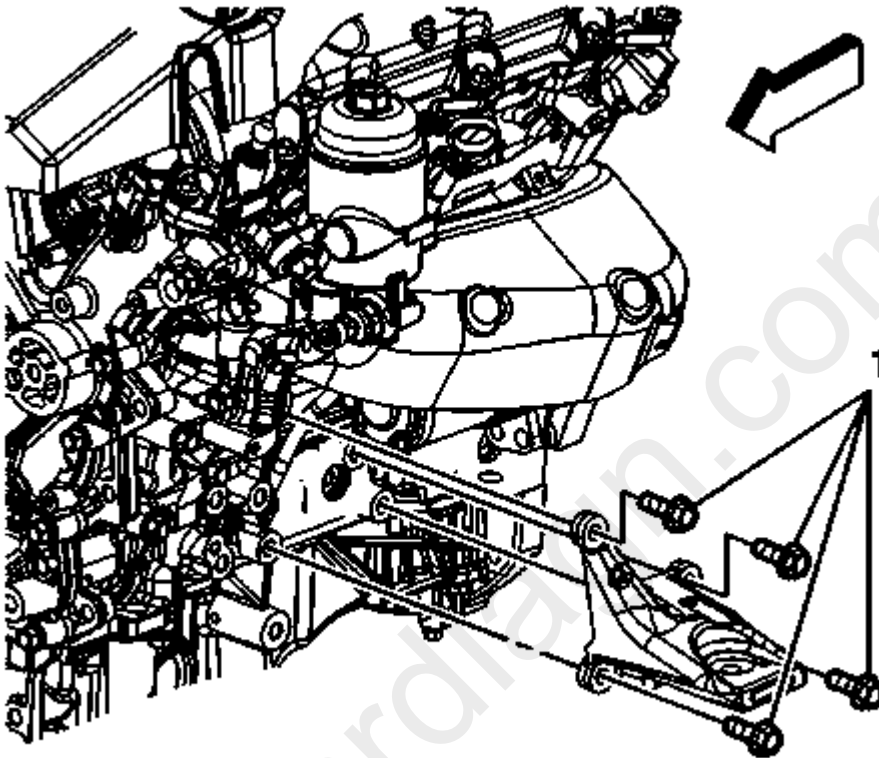


Fig. 35: View of Engine Mount

Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine mount. Refer to Engine Mount Replacement - Left Side (AWD).
2. Remove the left engine mount bracket retaining bolts (1).
3. Remove the left engine mount bracket.

Installation Procedure

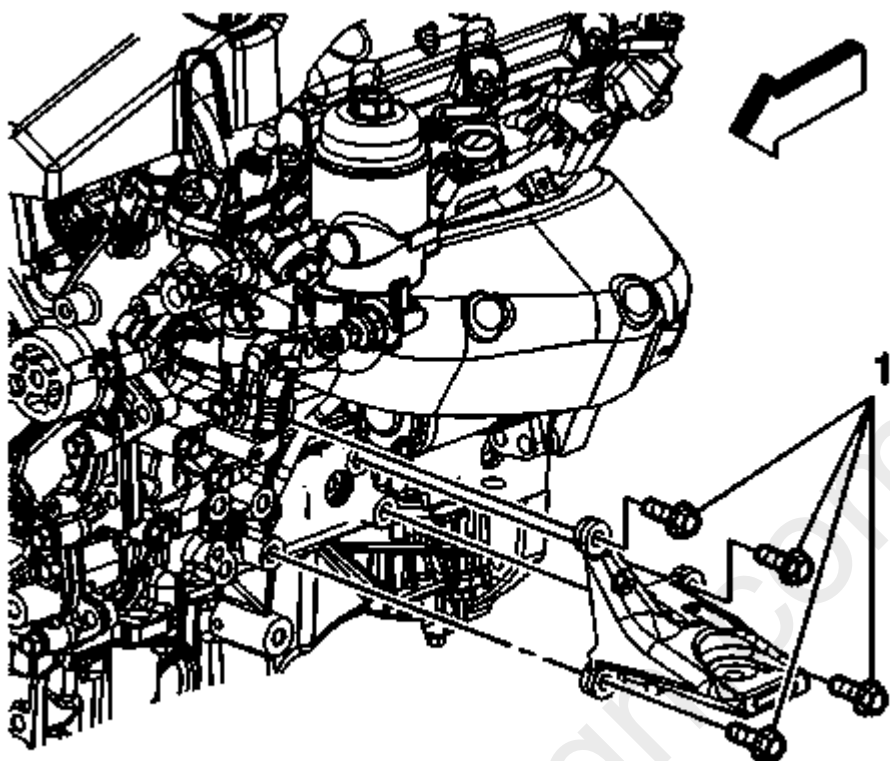


Fig. 36: View of Engine Mount

Courtesy of GENERAL MOTORS COMPANY

1. Install the left engine mount bracket assembly.

CAUTION: Refer to Fastener Caution .

2. Install the left engine mount bracket retaining bolts (1) and tighten to 60 N.m (44 lb ft).
3. Install the engine mount. Refer to Engine Mount Replacement - Left Side (AWD).

ENGINE MOUNT BRACKET REPLACEMENT - RIGHT SIDE (RWD)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

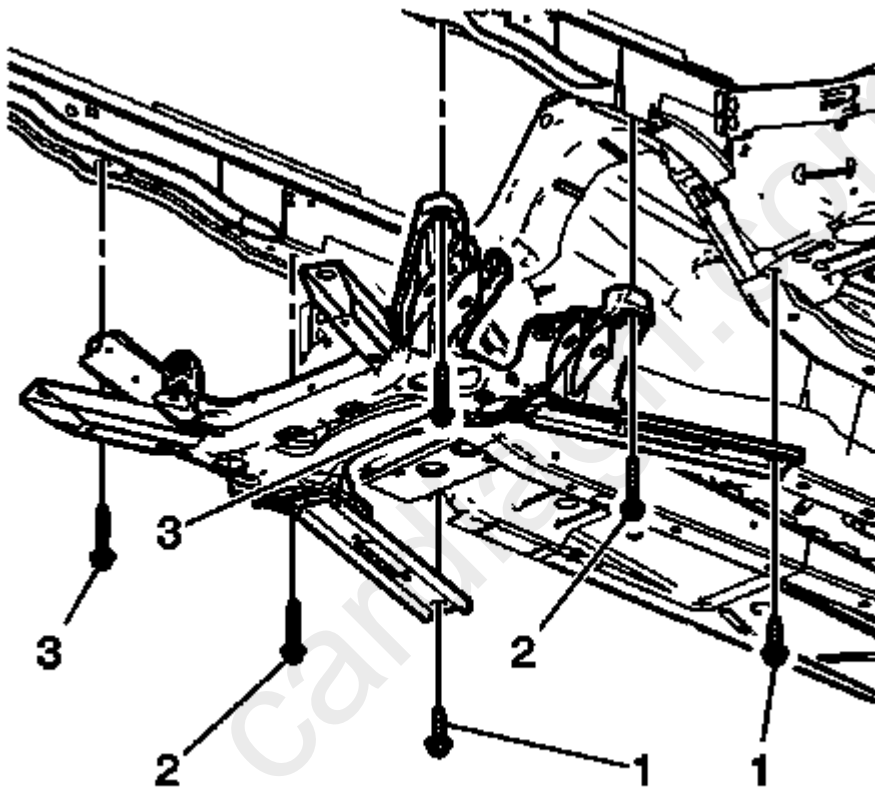


Fig. 37: View of Cross Vehicle Brace Assembly
 Courtesy of GENERAL MOTORS COMPANY

1. Remove the tower brace. Refer to **Cross Vehicle Brace Replacement** .
2. Secure the steering wheel in place.
3. Remove the lower section of the steering intermediate shaft. Refer to **Lower Intermediate Steering Shaft Replacement** .
4. Remove the left and right lower engine mount nuts.
5. Install a screw jack with a block of wood under the oil pan for support.

6. Support the rear of the front frame with a screw jack.
7. Remove the frame rear (1) and center (2) mounting bolts.
8. Loosen the front frame bolts (3) 12.7 mm (0.5 in) to 25.4 mm (1 in).
9. Lower the rear section of the frame.

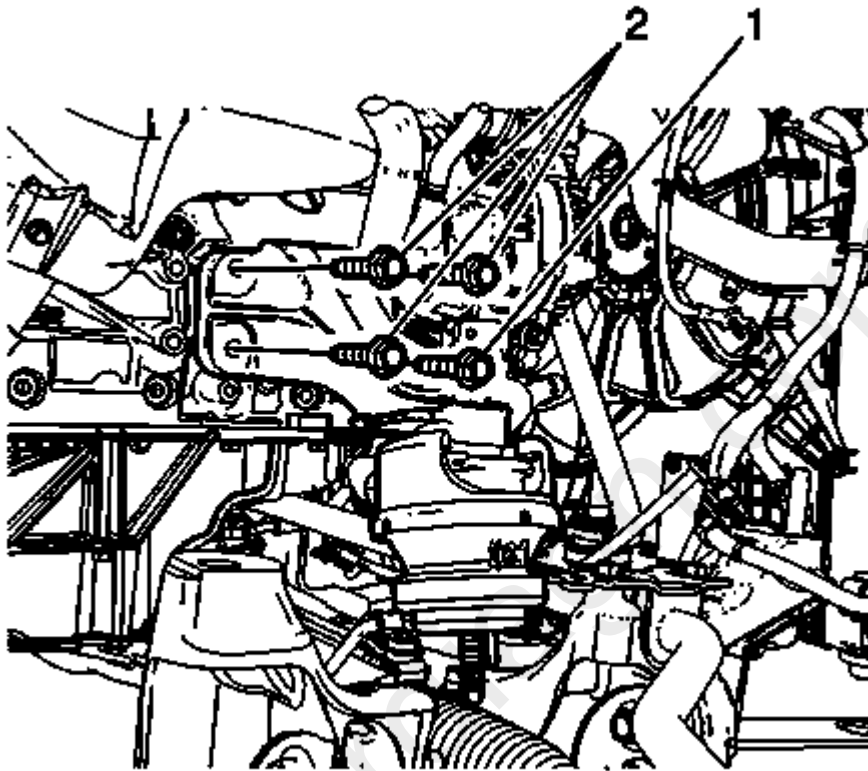


Fig. 38: Identifying Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine mount bracket bolts (1).
11. Remove the engine mount and engine mount bracket as an assembly.

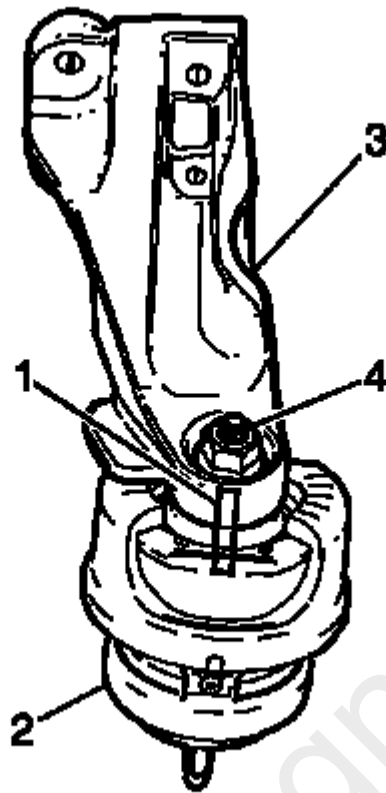


Fig. 39: View of Engine Mount and Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

12. Place a location mark (1) on the engine mount (2) and the engine mount bracket (3).
13. Remove the upper engine mount retaining nut (4).
14. Separate the engine mount (2) from the engine mount bracket (3).

Installation Procedure

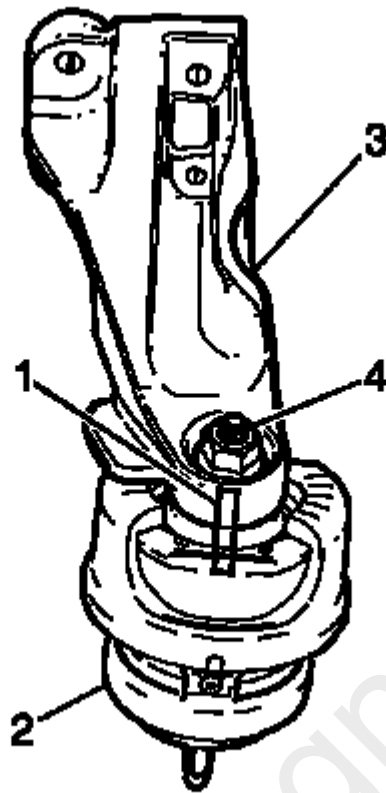


Fig. 40: View of Engine Mount and Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Position the engine mount bracket (3) to the engine mount (2).
2. Ensure to align the location mark (1) of the engine mount (2) to the engine mount bracket (3).

CAUTION: Refer to Fastener Caution .

3. Install the upper engine mount retaining nut (4) and tighten to 80 N.m (59 lb ft).
4. Position the engine mount bracket (3) to the engine mount (2).

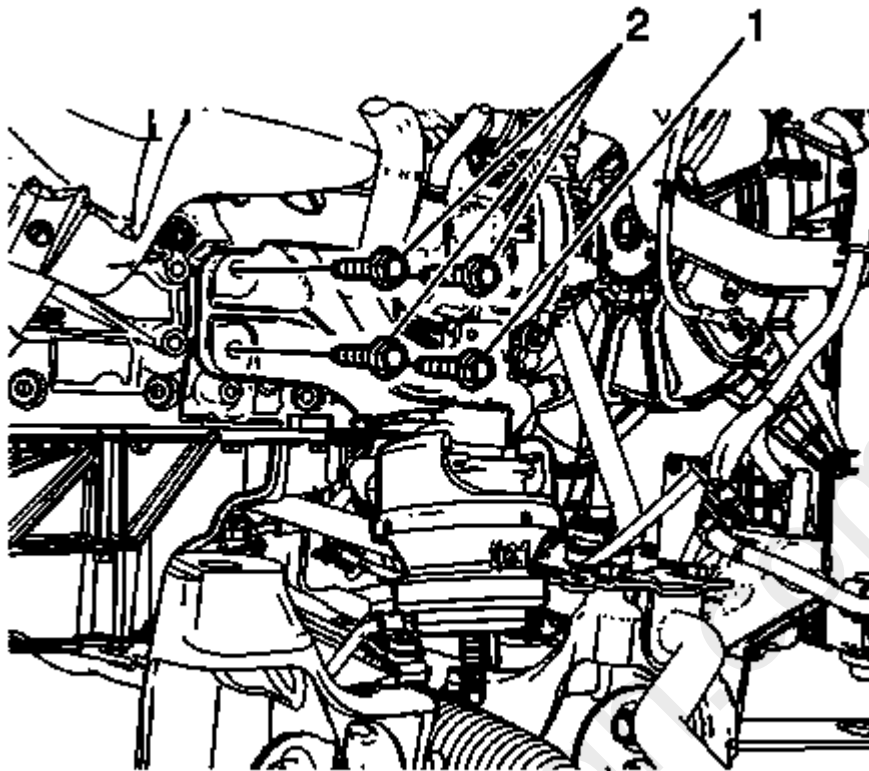


Fig. 41: Identifying Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the engine mount and engine mount bracket as an assembly.
6. Install the engine mount bracket bolts (1) and tighten to 22 N.m (16 lb ft) and tighten (2) Bolt to 60 N.m (44 lb ft)
7. Raise the rear section of the frame.

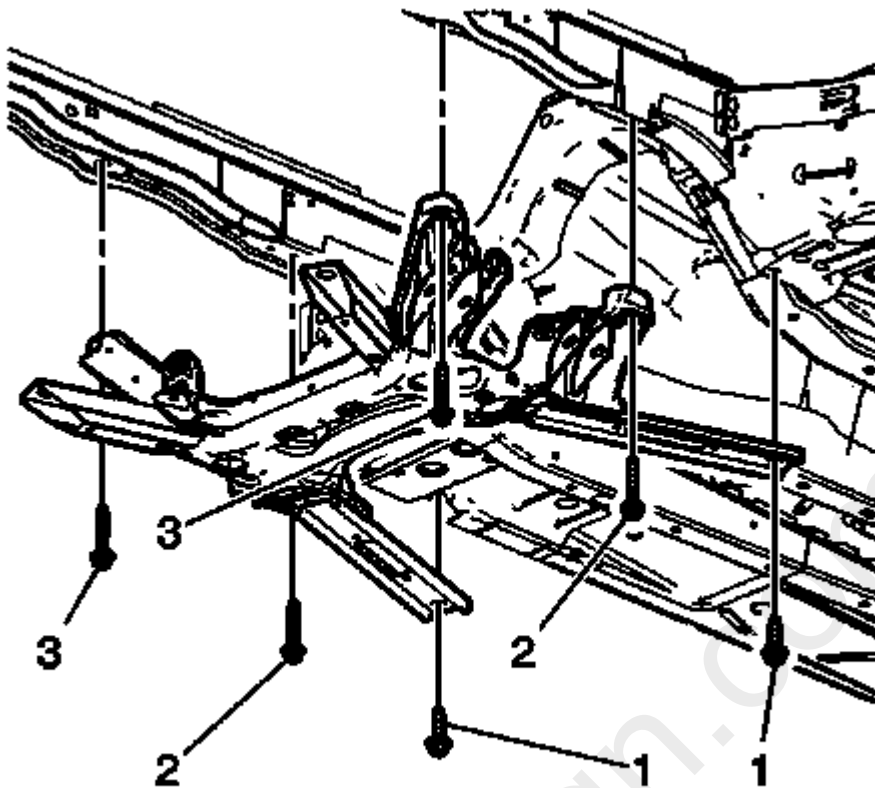


Fig. 42: View of Cross Vehicle Brace Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install but do not tighten the frame rear (1) and center (2) mounting bolts. Tighten the bolts to 191 N.m (141 lb ft).

NOTE: **Ensure to tighten the frame bolts in sequence.**

9. Tighten the frame bolts.
 1. Tighten the left front frame bolt to 191 N.m (141 lb ft).
 2. Tighten the right front frame bolt to 191 N.m (141 lb ft).
 3. Tighten the center front frame bolts to 191 N.m (141 lb ft).
 4. Tighten the rear front frame bolts to 191 N.m (141 lb ft).
10. Remove the screw jack from the rear of the front frame.
11. Remove the screw jack and block of wood from under the oil pan.
12. Install the left and right lower engine mount nuts and tighten to 80 N.m (59 lb ft).
13. Install the lower section of the steering intermediate shaft. Refer to **Lower Intermediate Steering Shaft Replacement**.
14. Unsecure the steering wheel.

15. Install the tower brace. Refer to Cross Vehicle Brace Replacement .

ENGINE MOUNT BRACKET REPLACEMENT - RIGHT SIDE (AWD)

Removal Procedure

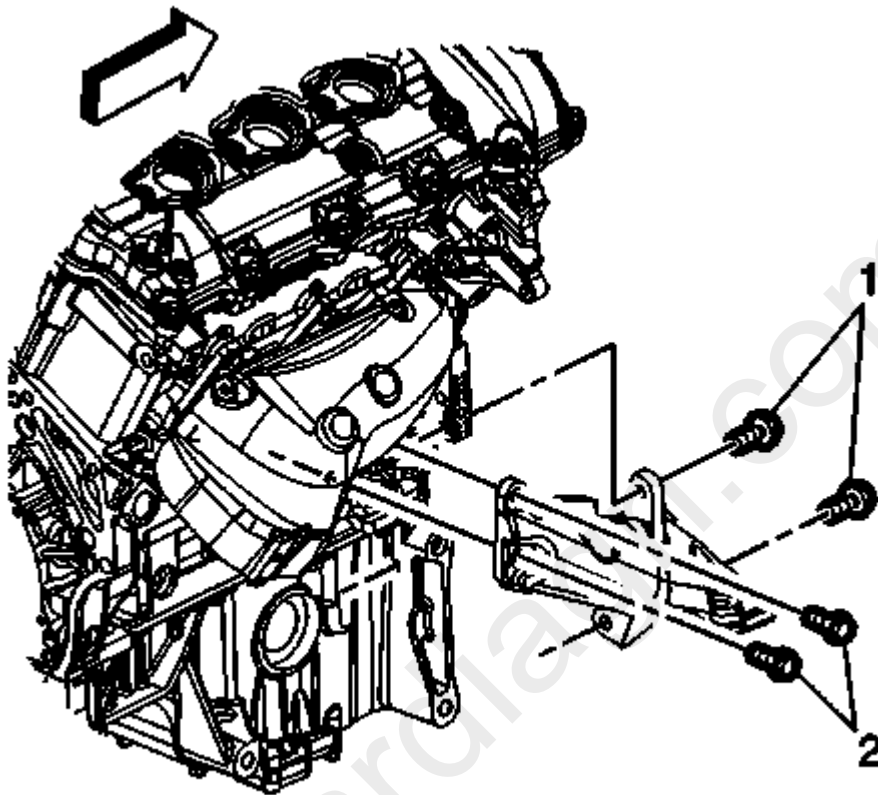


Fig. 43: Engine Mount Bracket Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Remove the right side engine mount. Refer to Engine Mount Replacement - Right Side (AWD).
2. Remove the front engine mount bracket mounting bolts (1).
3. Remove the rear engine mount bracket mounting bolts (2).

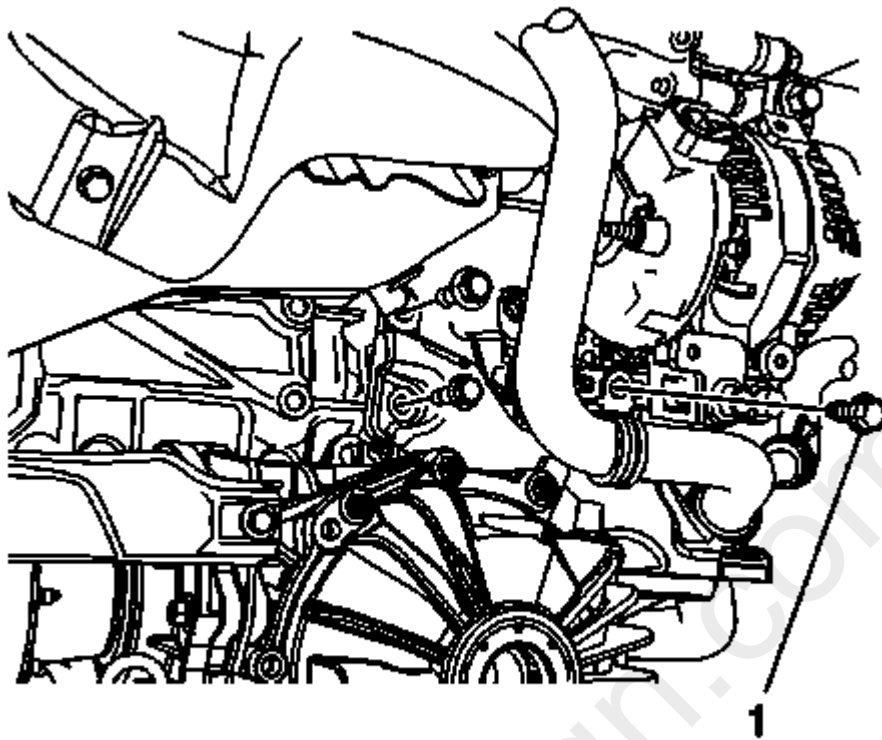


Fig. 44: Identifying Coolant Tube Retaining Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the coolant tube retaining clamp bolt (1).
5. Reposition the coolant tube aside.
6. Remove the engine mount bracket from the vehicle.

Installation Procedure

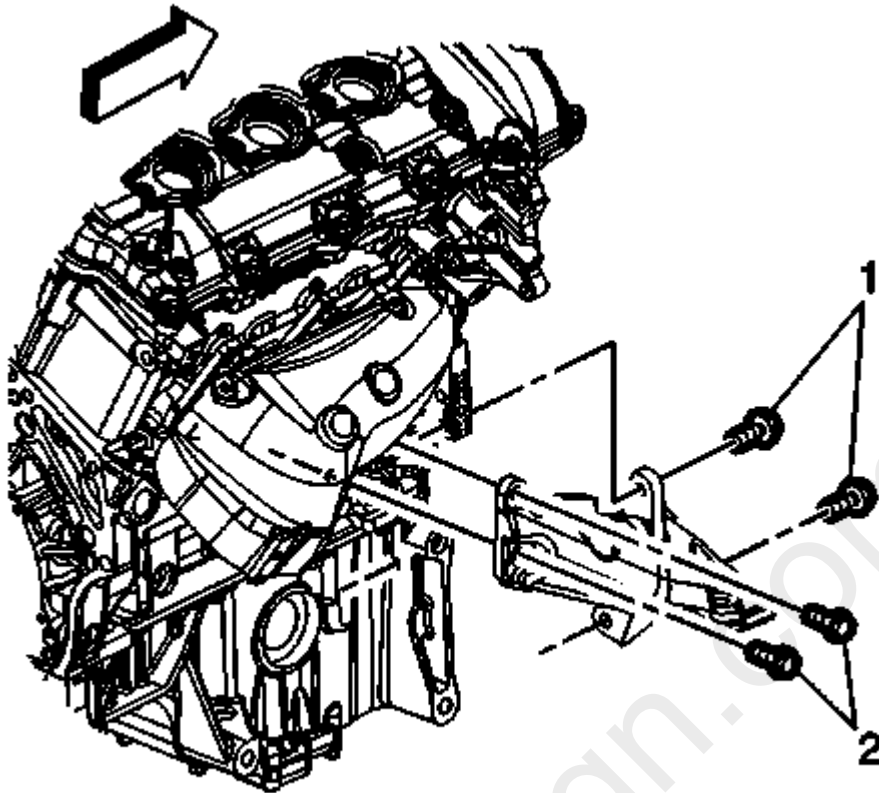


Fig. 45: Engine Mount Bracket Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the engine mount bracket to the vehicle.
2. Install but do not tighten the rear engine mount bracket retaining bolts (2).
3. Install but do not tighten the front engine mount bracket retaining bolts (1).

CAUTION: Refer to Fastener Caution .

4. Tighten the rear lower engine mount bracket retaining bolts (2) to 38 N.m (28 lb ft).
5. Tighten the front engine mount bracket retaining bolts (1) to 60 N.m (44 lb ft).

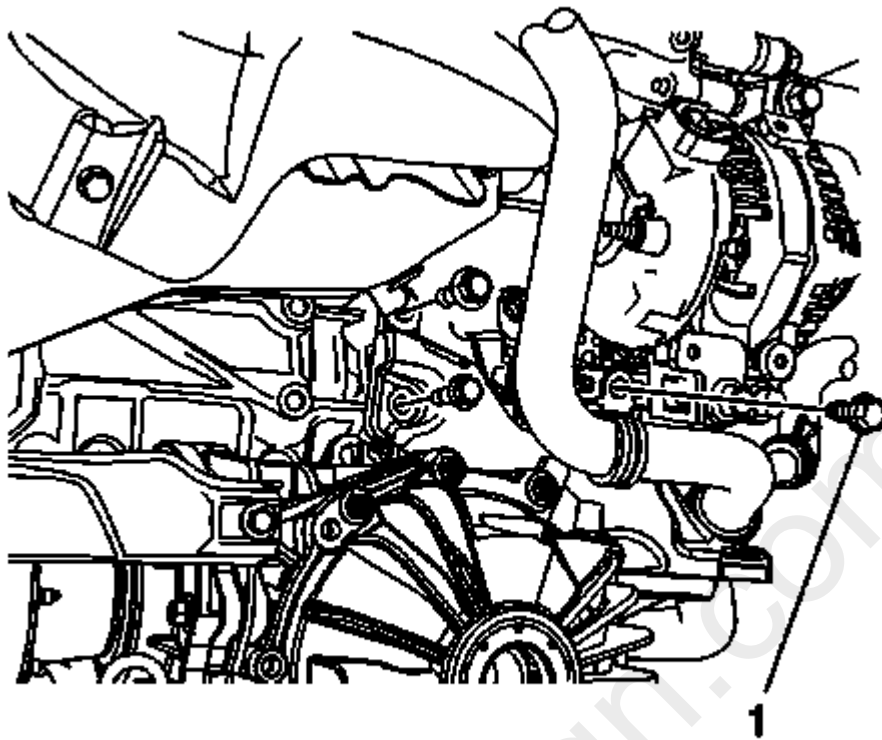


Fig. 46: Identifying Coolant Tube Retaining Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install the coolant tube retaining clamp bolt (1) and tighten to 10 N.m (87 in ft).
7. Install the right side engine mount. Refer to **Engine Mount Replacement - Right Side (AWD)**.

INTAKE MANIFOLD COVER REPLACEMENT

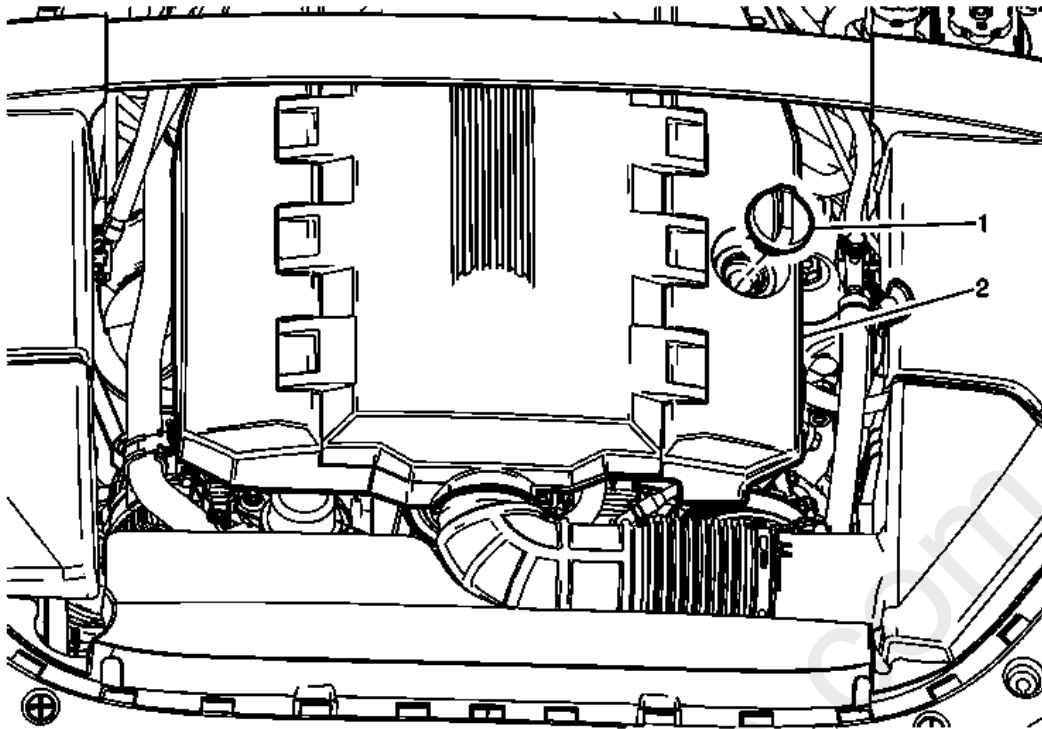


Fig. 47: Intake Manifold Cover & Oil Cap
 Courtesy of GENERAL MOTORS COMPANY

Intake Manifold Cover Replacement

Callout	Component Name
1	Oil Cap Procedure Remove the oil cap before removing the intake manifold cover.
2	Intake Manifold Cover Procedure Slide the intake manifold cover forward to remove.

INTAKE MANIFOLD INSULATOR REPLACEMENT

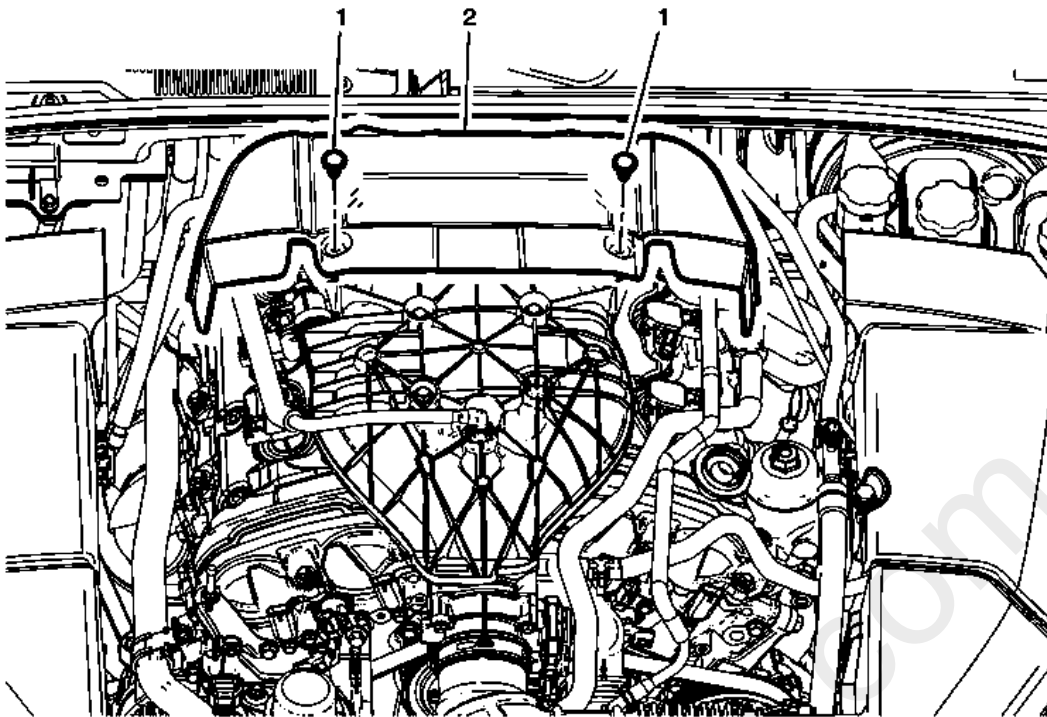


Fig. 48: Intake Manifold Insulator & Retainers
 Courtesy of GENERAL MOTORS COMPANY

Intake Manifold Insulator Replacement

Callout	Component Name
Preliminary Procedure	
Remove the intake manifold cover. Refer to <u>Intake Manifold Cover Replacement.</u>	
1	Intake Manifold Insulator Retainers (Qty;2)
2	Intake Manifold Insulator

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT

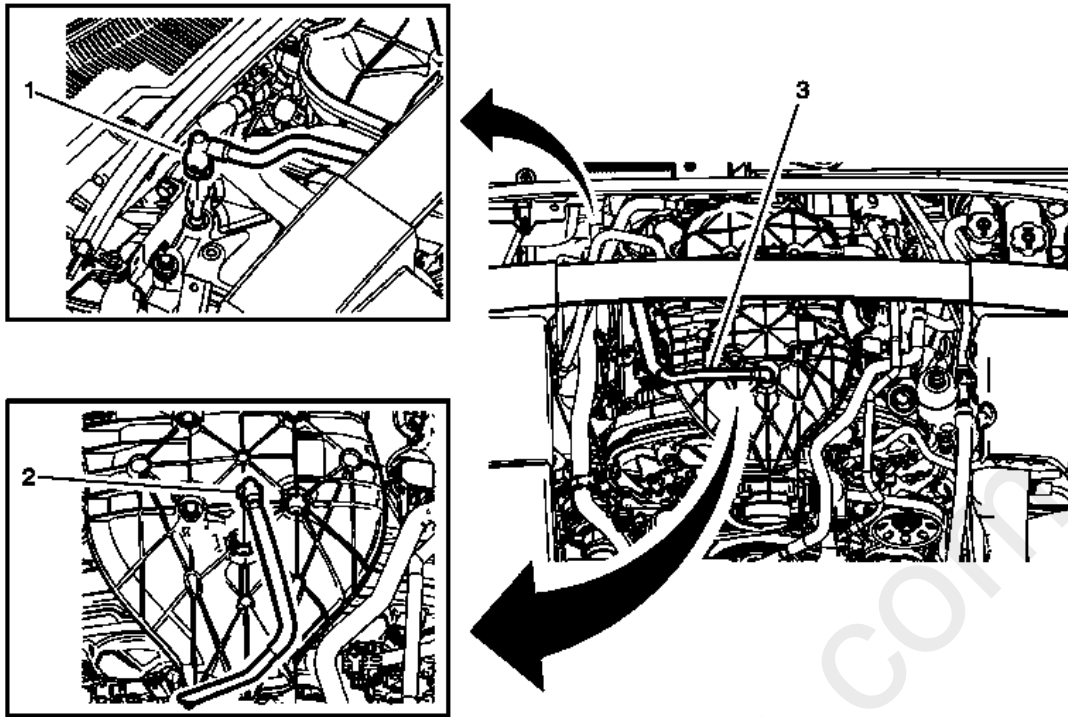


Fig. 49: PCV Pipe

Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement

Callout	Component Name
Preliminary Procedure	
Remove the intake manifold insulator. Refer to <u>Intake Manifold Insulator Replacement..</u>	
1	PCV Pipe Procedure Disconnect the pipe at right side camshaft cover.
2	PCV Pipe Procedure Turn the PCV air tube connector 90 degrees to detach the connector from the intake manifold
3	PCV Pipe

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

1. Remove the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
2. Remove the intake manifold insulator. Refer to **Intake Manifold Insulator Replacement.**
3. Remove the air outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

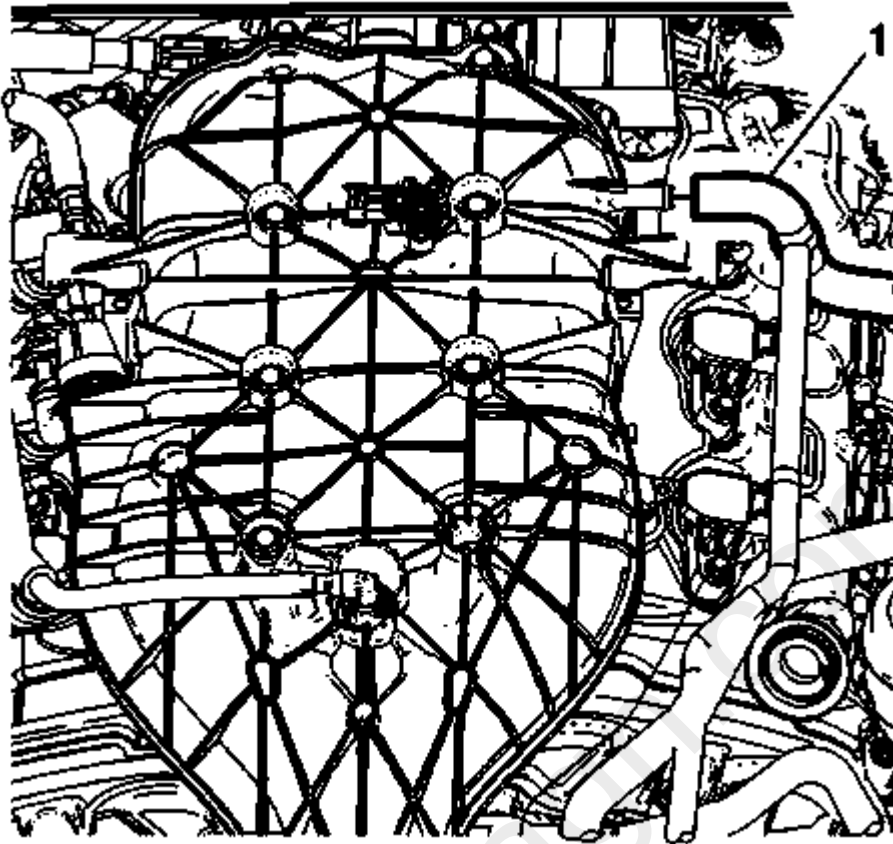


Fig. 50: Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the brake booster vacuum hose (1) from the intake manifold.

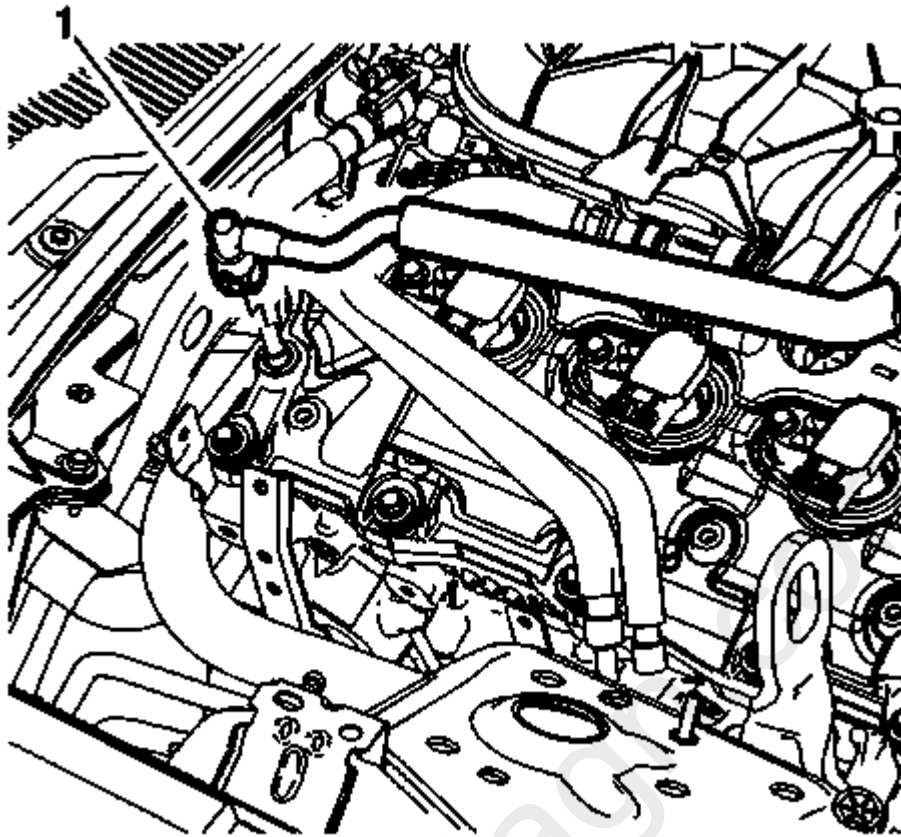


Fig. 51: PCV Hose

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the positive crankcase ventilation hose (1) from the camshaft cover.

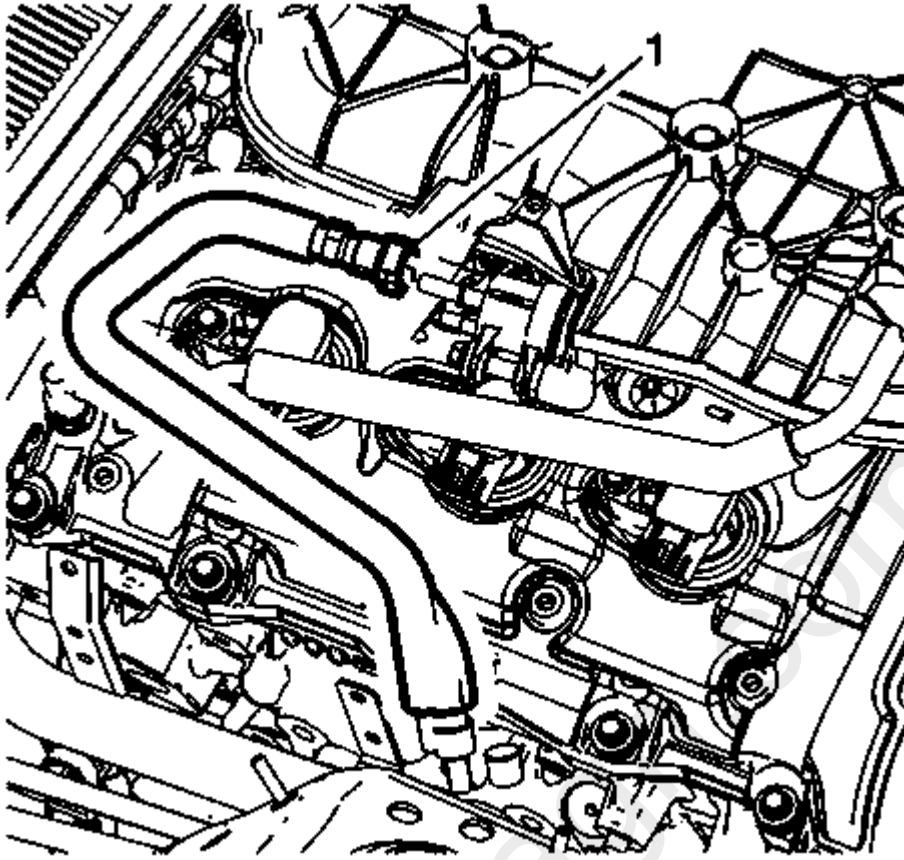


Fig. 52: Evaporative Emission Hose
Courtesy of GENERAL MOTORS COMPANY

6. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief** .
7. Disconnect the evaporative emission hose (1) from the EVAP solenoid.

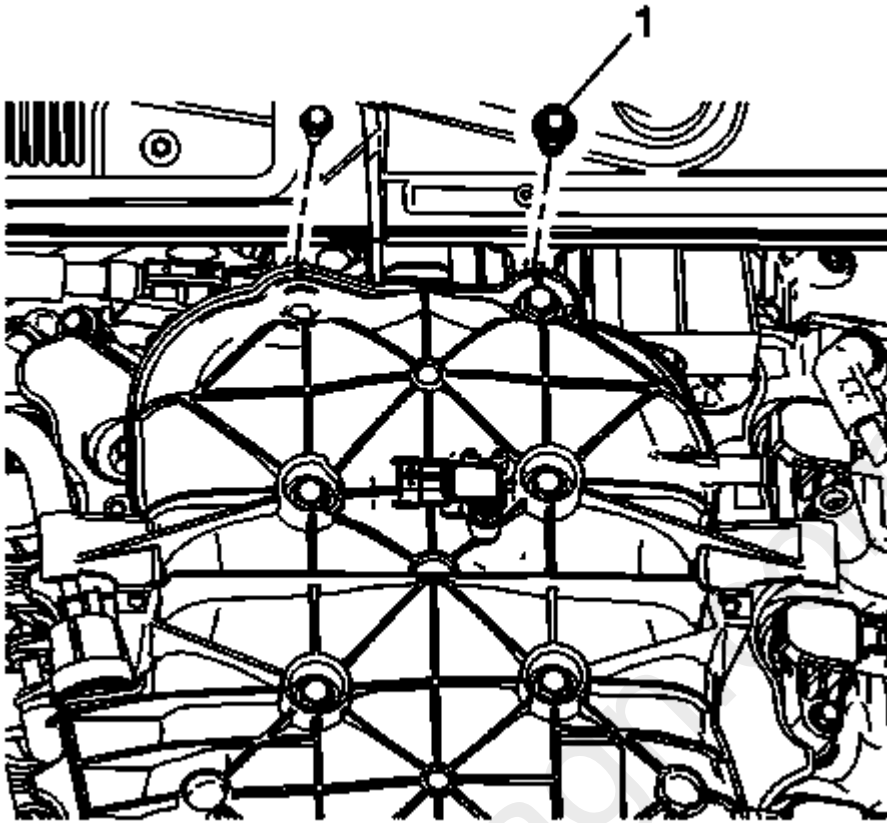


Fig. 53: Fuel Pipe Shield Fastener
Courtesy of GENERAL MOTORS COMPANY

8. Remove the fuel pipe shield fastener (1). Refer to **Fuel Pipe Shield Replacement** .
9. Disconnect electrical connector as necessary.

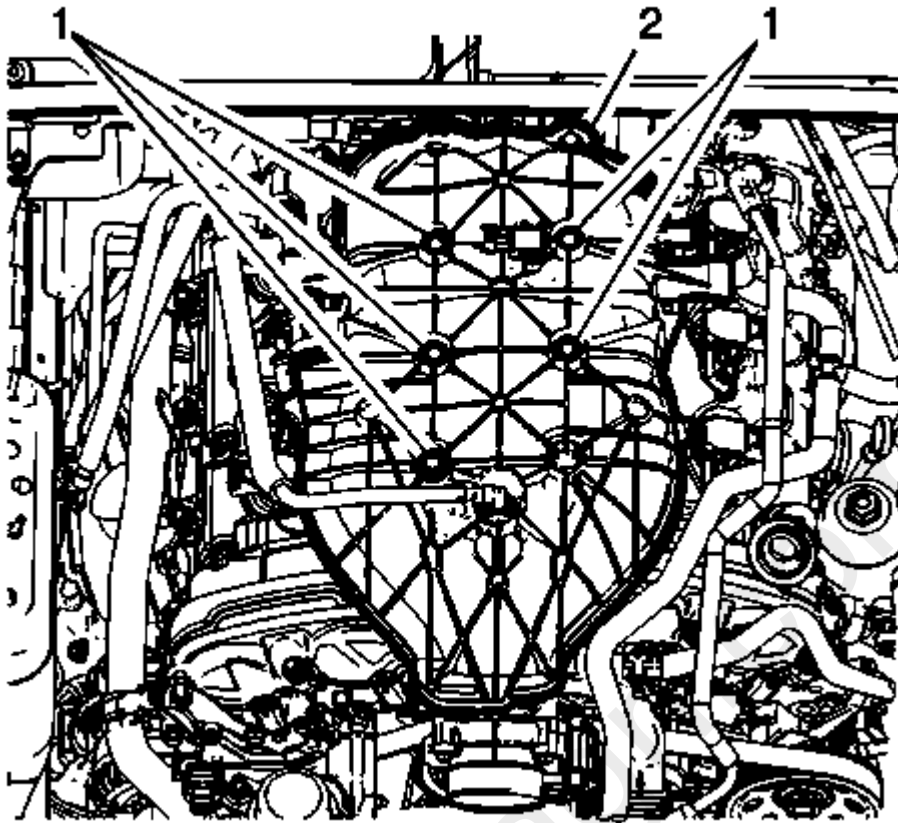


Fig. 54: Intake Manifold & Fasteners
Courtesy of GENERAL MOTORS COMPANY

10. Remove the intake manifold fastener (1).
11. Remove the intake manifold (2).

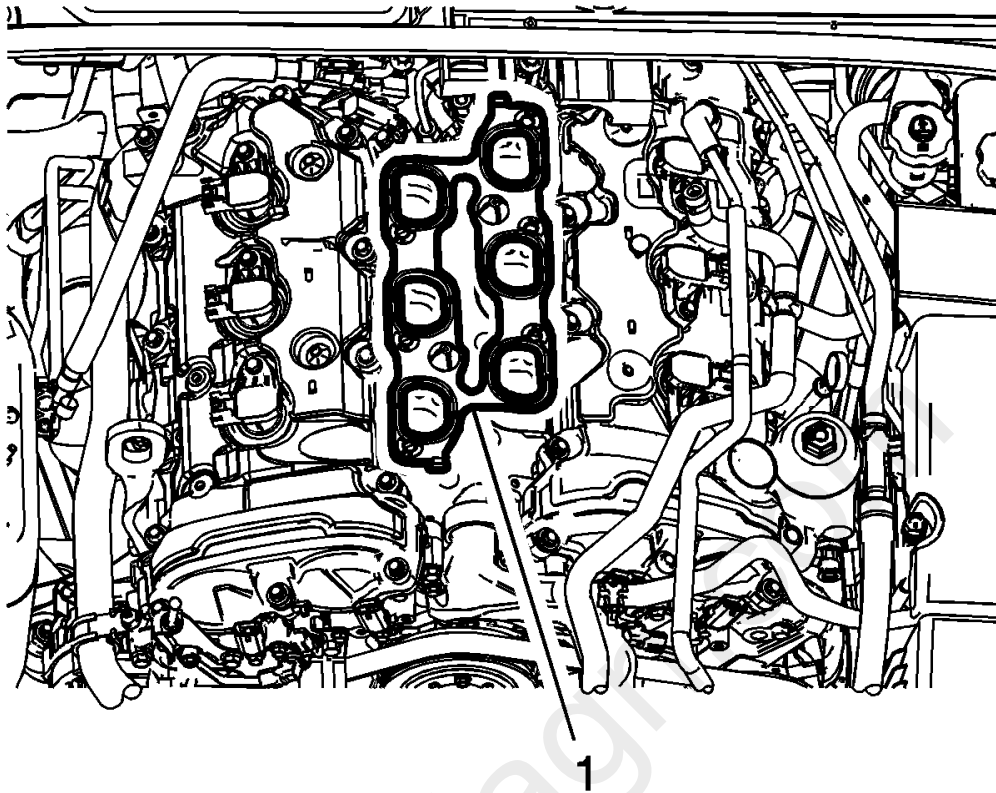


Fig. 55: Intake Manifold Gasket
Courtesy of GENERAL MOTORS COMPANY

12. Remove and discard the intake manifold gasket (1).
13. For the intake manifold cleaning and inspection. Refer to **Intake Manifold Cleaning and Inspection (LFW or LFX)** .
14. For the intake manifold disassemble. Refer to **Intake Manifold Disassemble (LFW or LFX)** .

Installation Procedure

1. For the intake manifold assemble. Refer to **Intake Manifold Assemble (LFW or LFX)** .

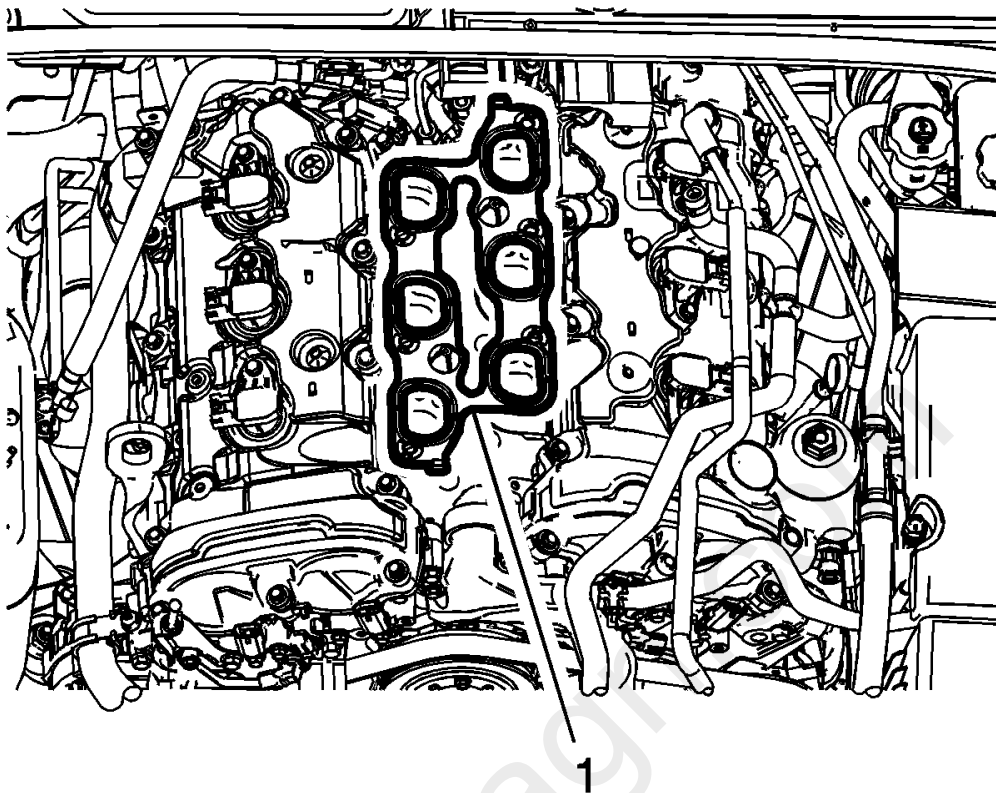


Fig. 56: Intake Manifold Gasket
Courtesy of GENERAL MOTORS COMPANY

2. Install the NEW intake manifold gasket (1).

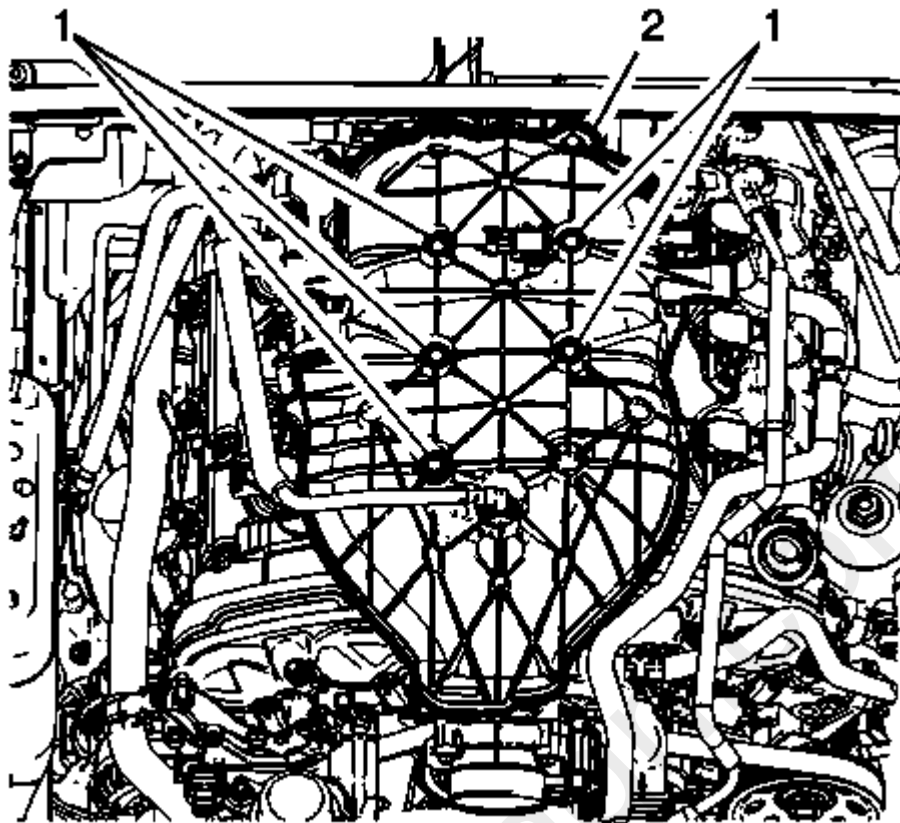


Fig. 57: Intake Manifold & Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Install the intake manifold (2)
4. install the intake manifold fastener (1) and finger tight.

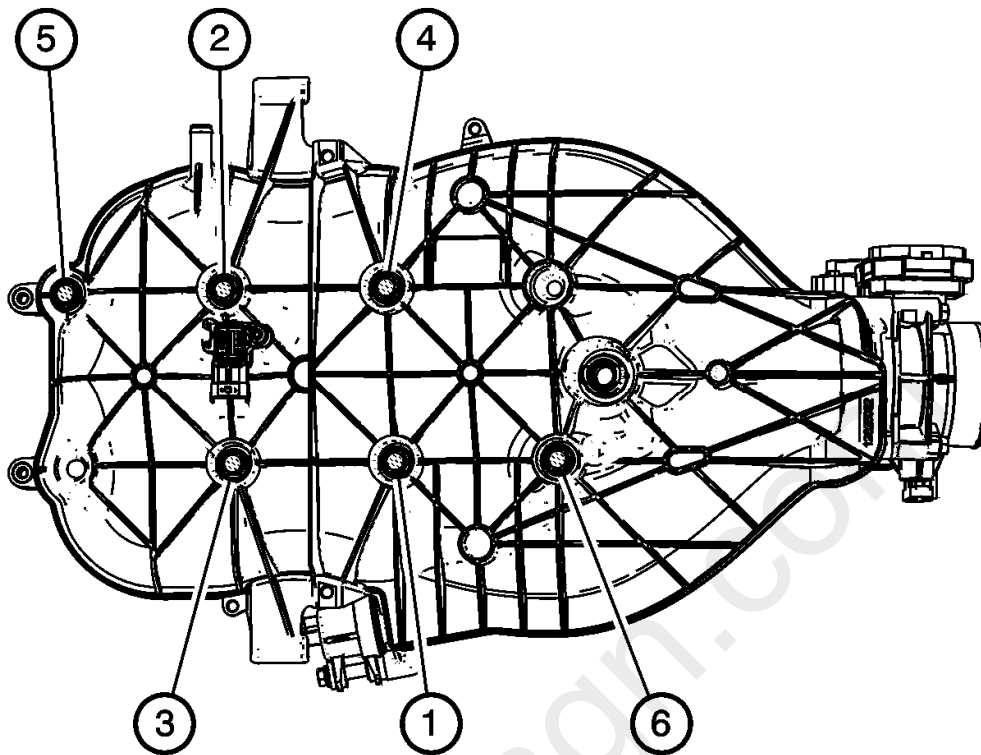


Fig. 58: Identifying Intake Manifold Bolts Tighten Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Tighten the intake manifold bolts in the sequence shown.

Tighten

- First pass tighten the intake manifold to 25 N.m (18 lb ft).
- Final pass tighten the intake manifold to 25 N.m (18 lb ft).

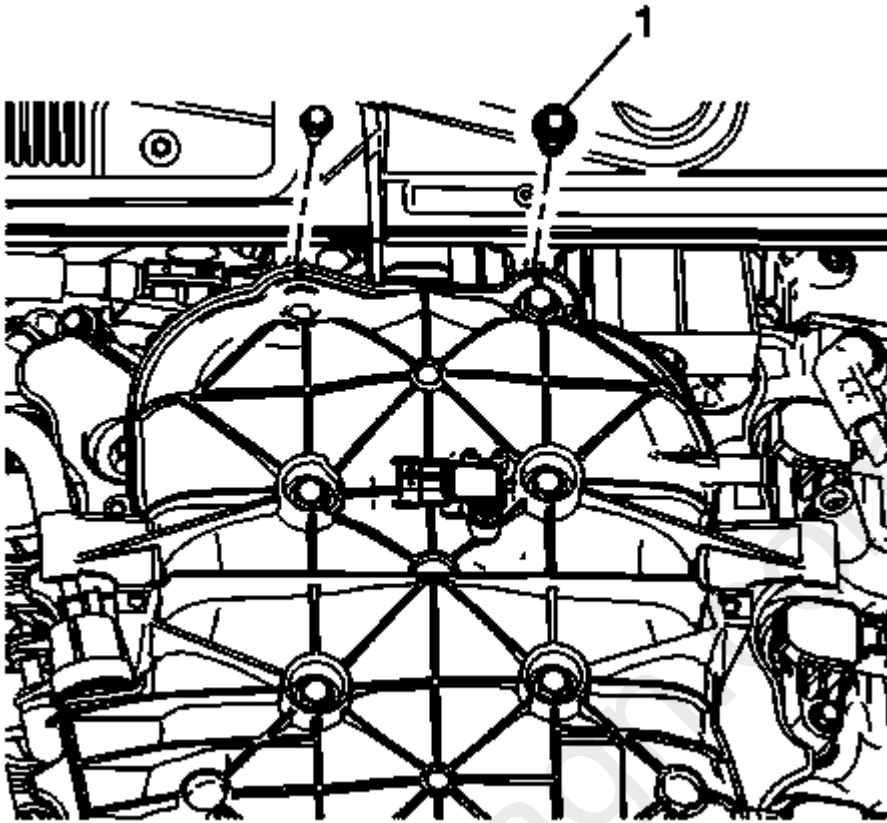


Fig. 59: Fuel Pipe Shield Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Install the fuel pump cover bolt (1) and tighten to 10 N.m (89 lb in).

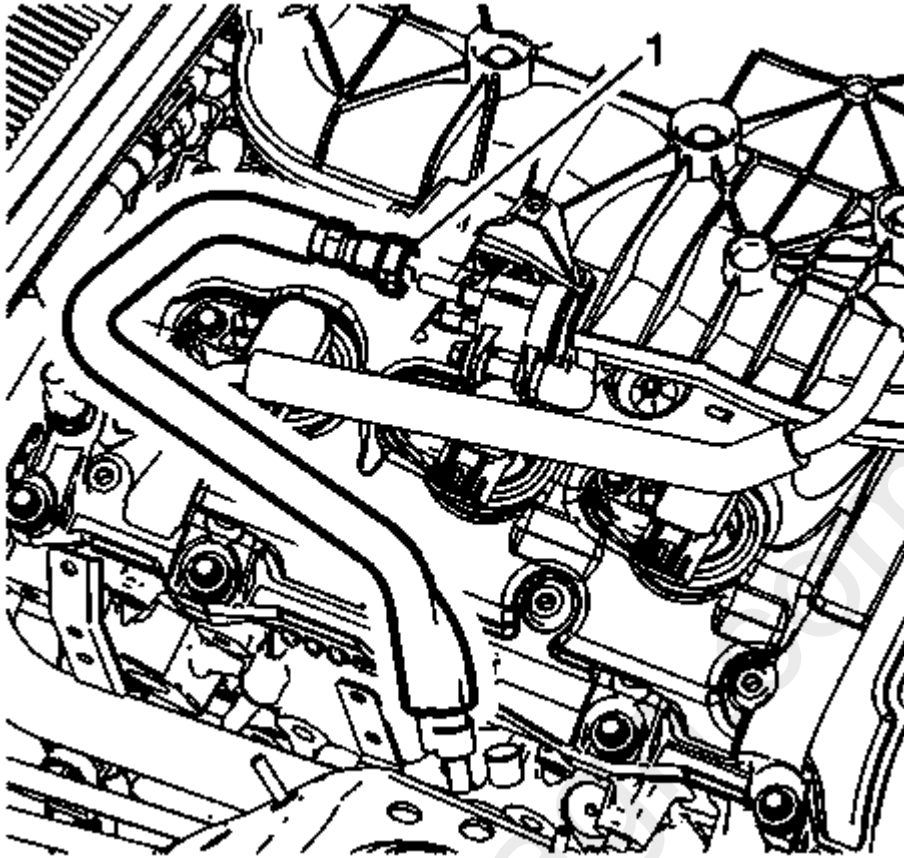


Fig. 60: Evaporative Emission Hose
Courtesy of GENERAL MOTORS COMPANY

7. Connect the evaporative (EVAP) hose (1) to the intake manifold and EVAP solenoid.

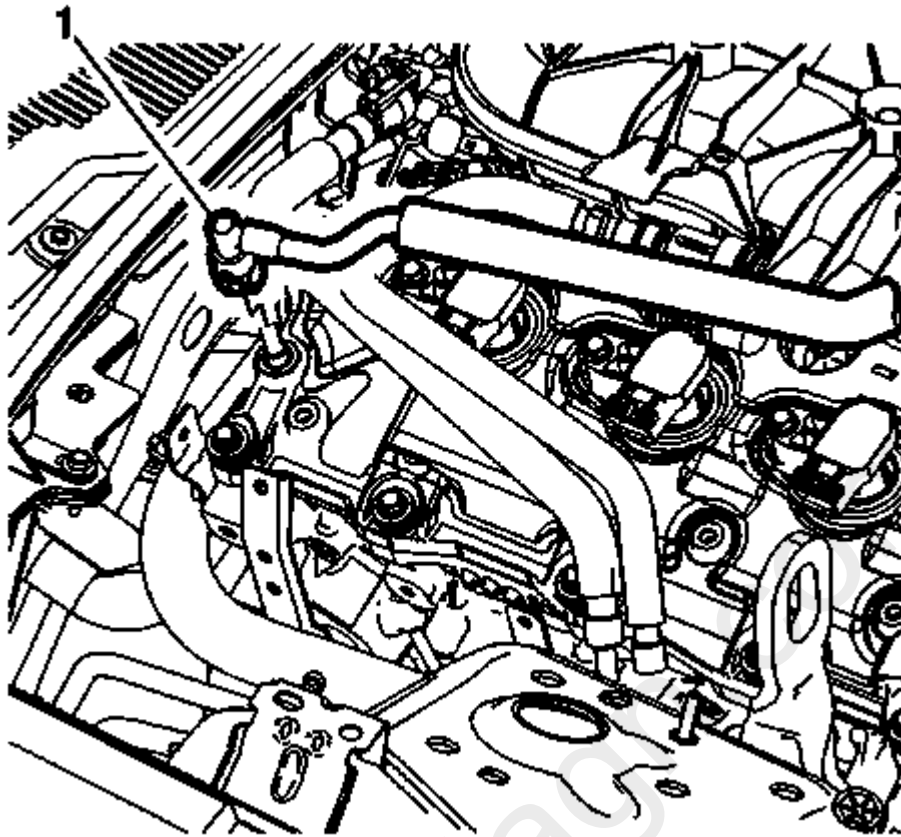


Fig. 61: PCV Hose

Courtesy of GENERAL MOTORS COMPANY

8. Connect the positive crankcase ventilation (PCV) tube assembly (1) to the intake manifold and the camshaft cover.

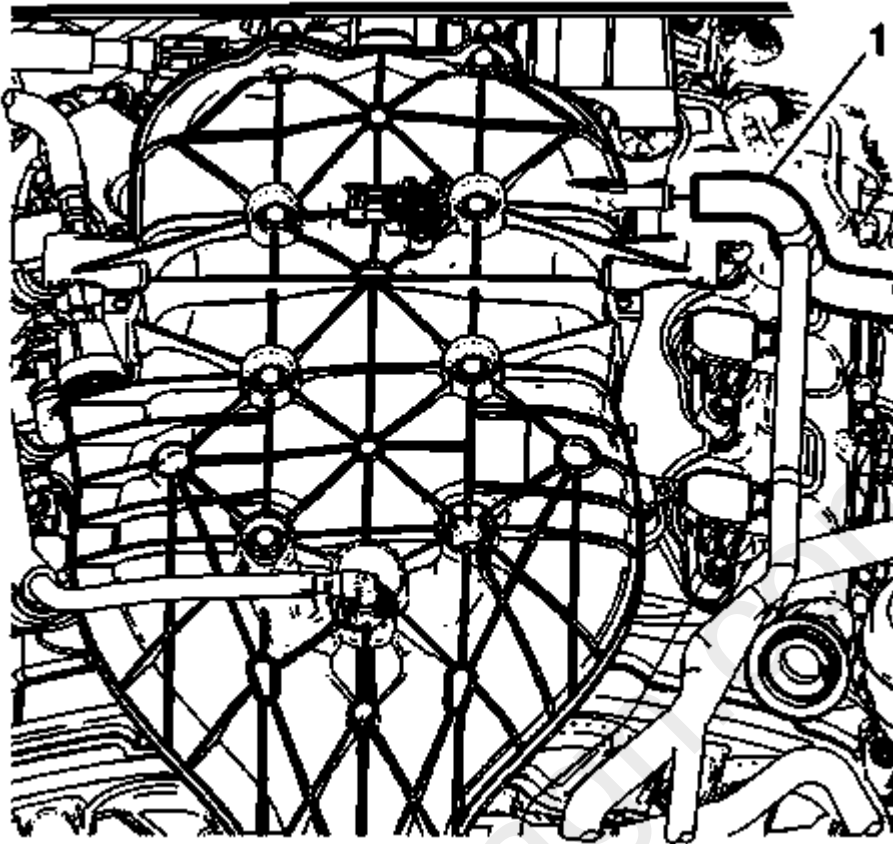


Fig. 62: Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

9. Connect the brake booster vacuum hose (1) from the intake manifold.
10. Install the air outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
11. Install the intake manifold insulator. Refer to **Intake Manifold Insulator Replacement**.
12. Install the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .

OIL LEVEL INDICATOR TUBE REPLACEMENT

Removal Procedure

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Unclip and reposition the main harness and the lower harness away from the oil level indicator tube.

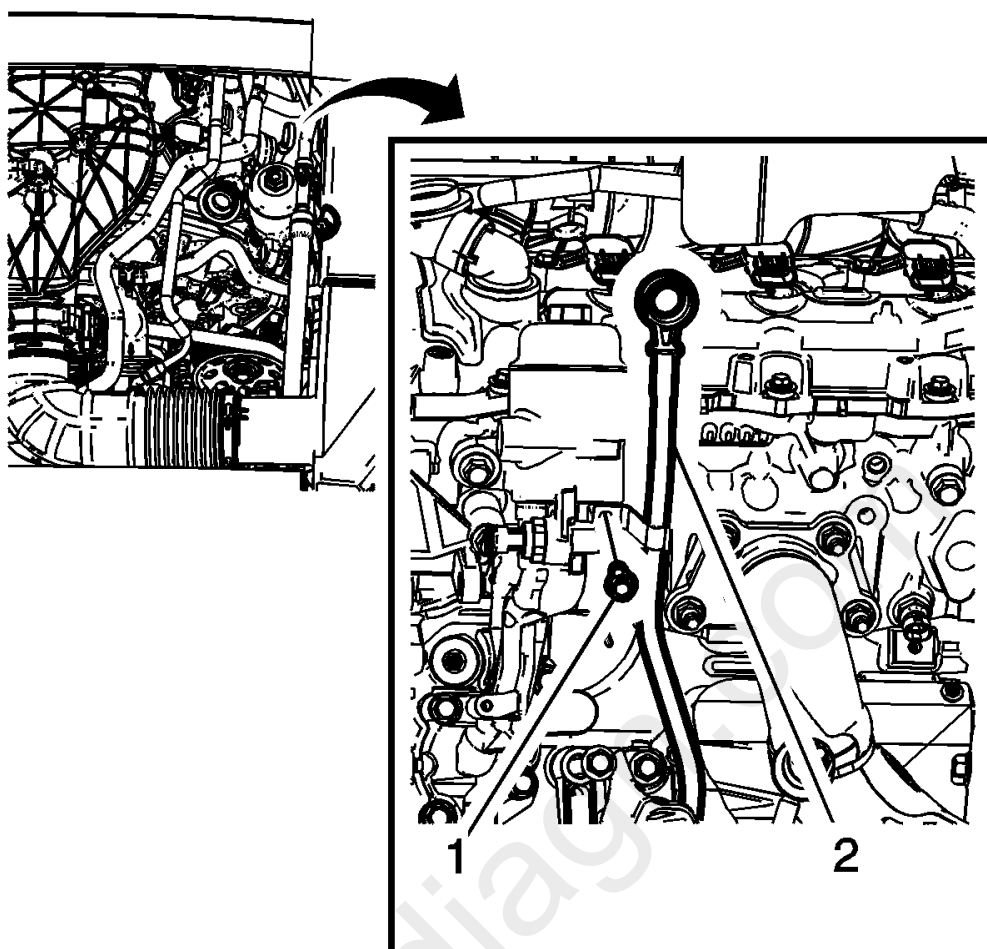


Fig. 63: Indicator Tube & Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil level indicator tube bracket bolt (1).
4. Remove the oil level indicator and tube (2) by sliding the tube out from the lower crankcase hole.

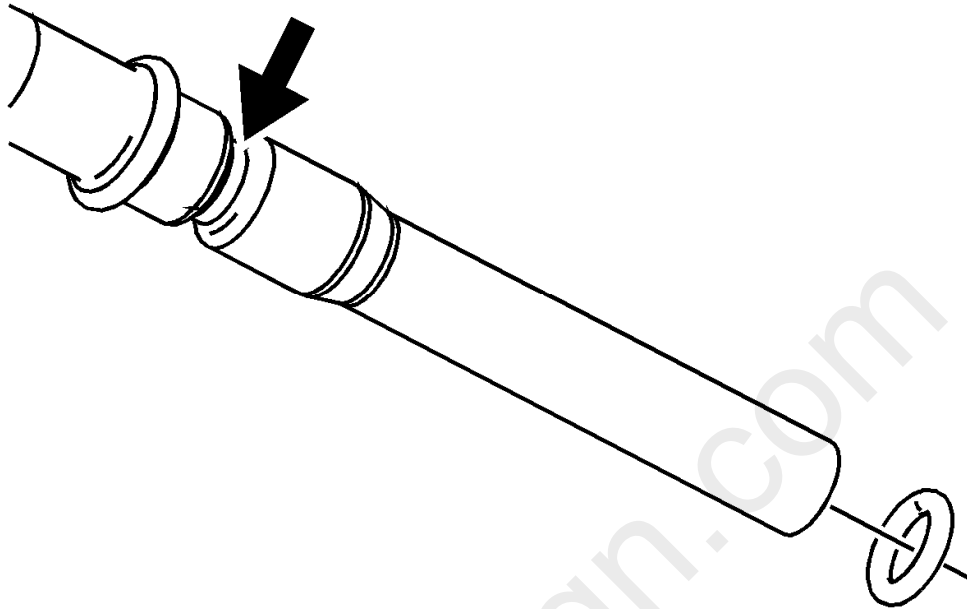


Fig. 64: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS COMPANY

5. Remove and discard the O-ring from the oil level indicator tube if damaged.

Installation Procedure

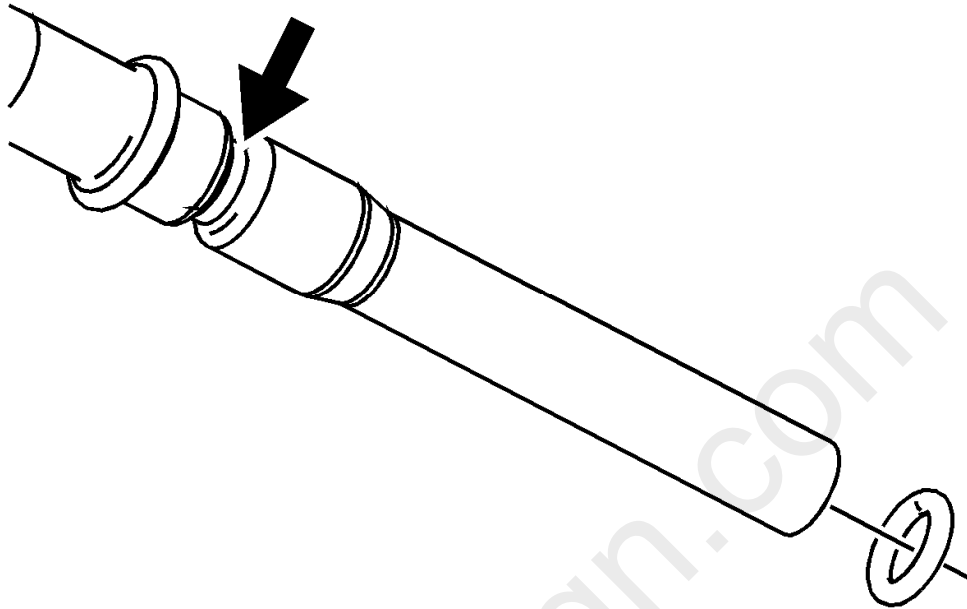


Fig. 65: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW O-ring on the oil level indicator tube

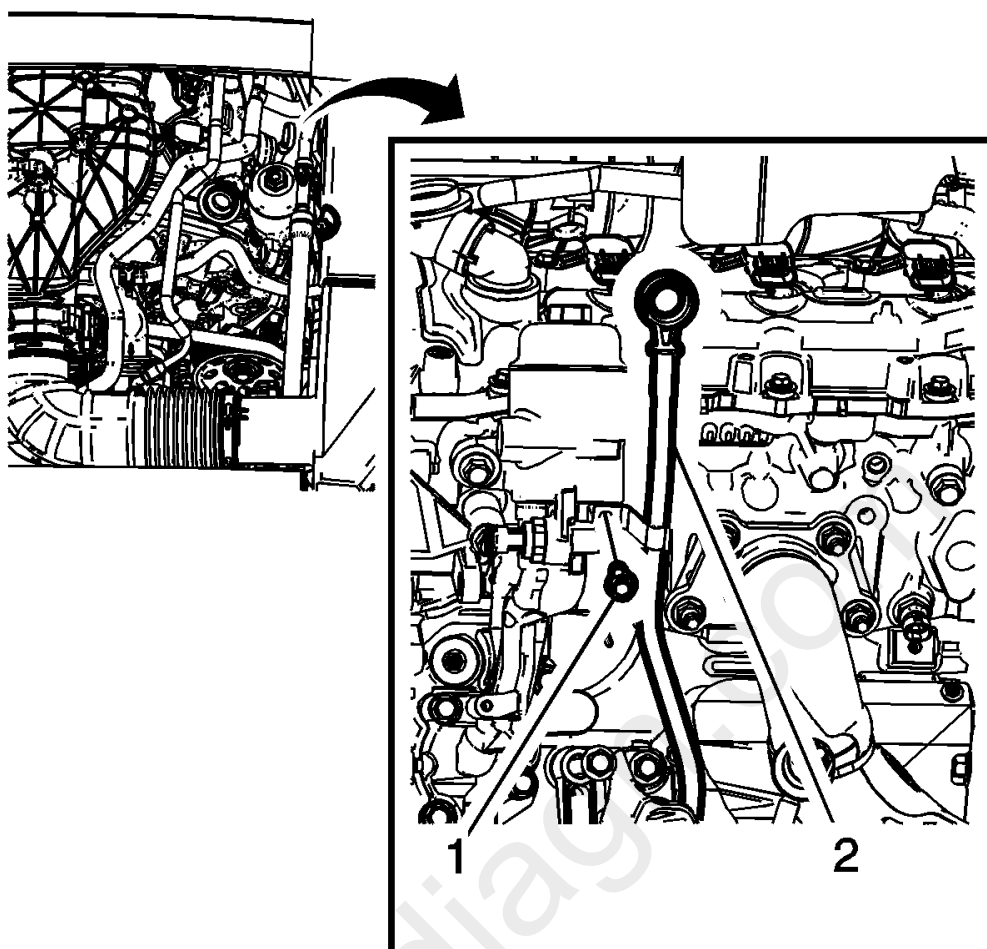


Fig. 66: Indicator Tube & Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Position the oil level indicator and tube (2) by sliding the tube down and in to the approximate location of the lower crankcase hole.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Guide the lower portion of the oil level indicator tube into the lower crankcase hole and seat the oil level indicator tube in place
5. lower the vehicle.

CAUTION: Refer to **Fastener Caution** .

6. Install the oil level indicator tube bracket bolt (1) and tighten to 10 N.m (89 lb in).
7. Position and clip the main harness and the lower harness to the oil level indicator tube.
8. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

OIL FILTER ADAPTER REPLACEMENT

Removal Procedure

1. Disconnect the battery. Refer to Battery Negative Cable Disconnection and Connection (Coupe) , Battery Negative Cable Disconnection and Connection (Wagon) .
2. Remove the front compartment lower noise shield. Refer to Front Compartment Lower Noise Shield Replacement (All Wheel Drive) , Front Compartment Lower Noise Shield Replacement (Rear Wheel Drive)

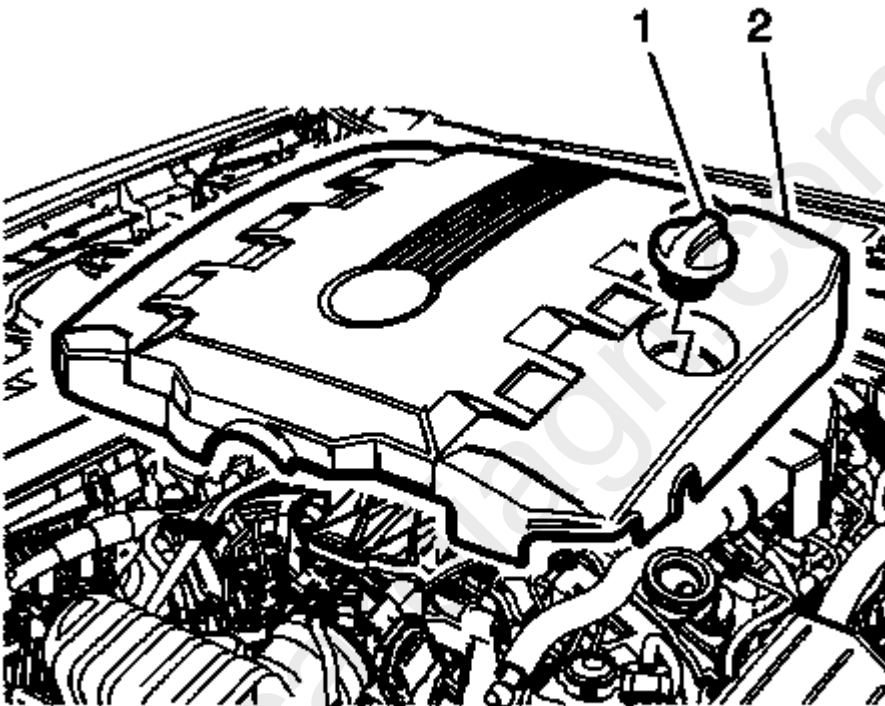


Fig. 67: Intake Manifold Cover & Cap
Courtesy of GENERAL MOTORS COMPANY

3. Remove the intake manifold cover (2). Refer to Intake Manifold Cover Replacement.
4. Remove the oil filter and allow to drain. Refer to Engine Oil and Oil Filter Replacement.
5. Install the oil filter.

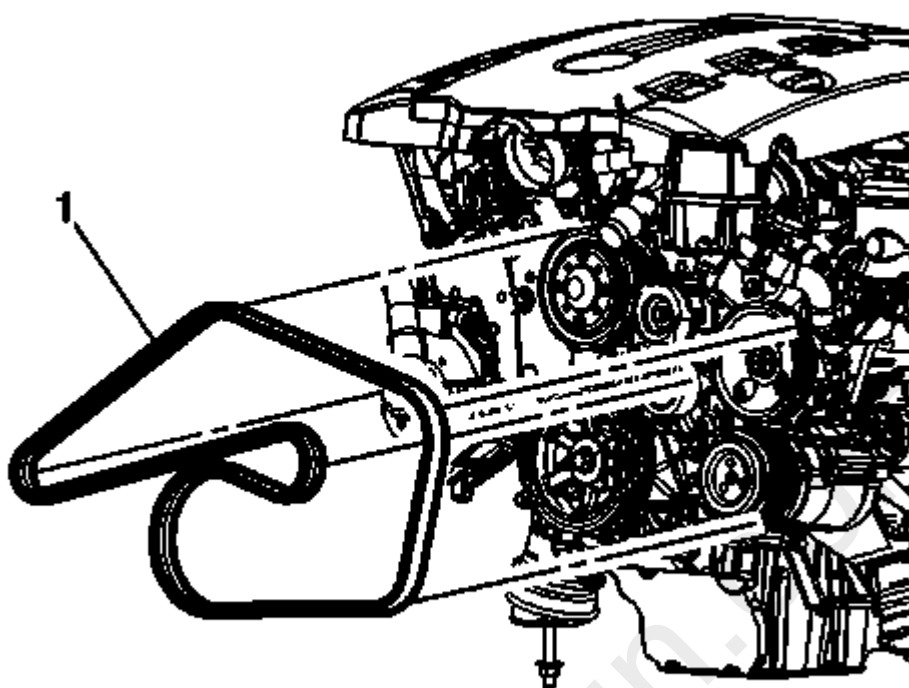


Fig. 68: Drive Belt

Courtesy of GENERAL MOTORS COMPANY

6. Remove the drive belt. Refer to **Drive Belt Replacement**.

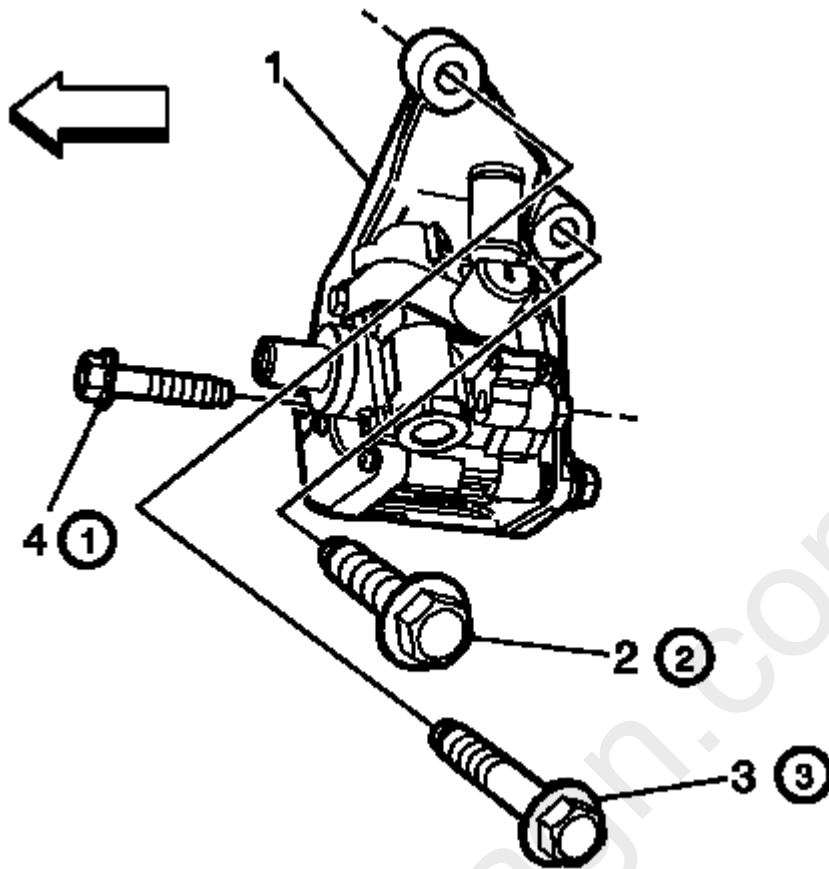


Fig. 69: Power Steering Pump Bracket & Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not disconnect the power steering lines from the power steering pump.

7. Remove the power steering pump and bracket (1). Refer to **Power Steering Pump Replacement (LFW, LFX)**.

NOTE: Do not disconnect the A/C pipes from the A/C compressor.

8. Remove the A/C compressor bolts and reposition the A/C compressor in order to gain access to the oil filter adapter fasteners. Refer to **Air Conditioning Compressor Replacement (LFW LFX)**.
9. Disconnect the oil pressure sensor electrical connector.

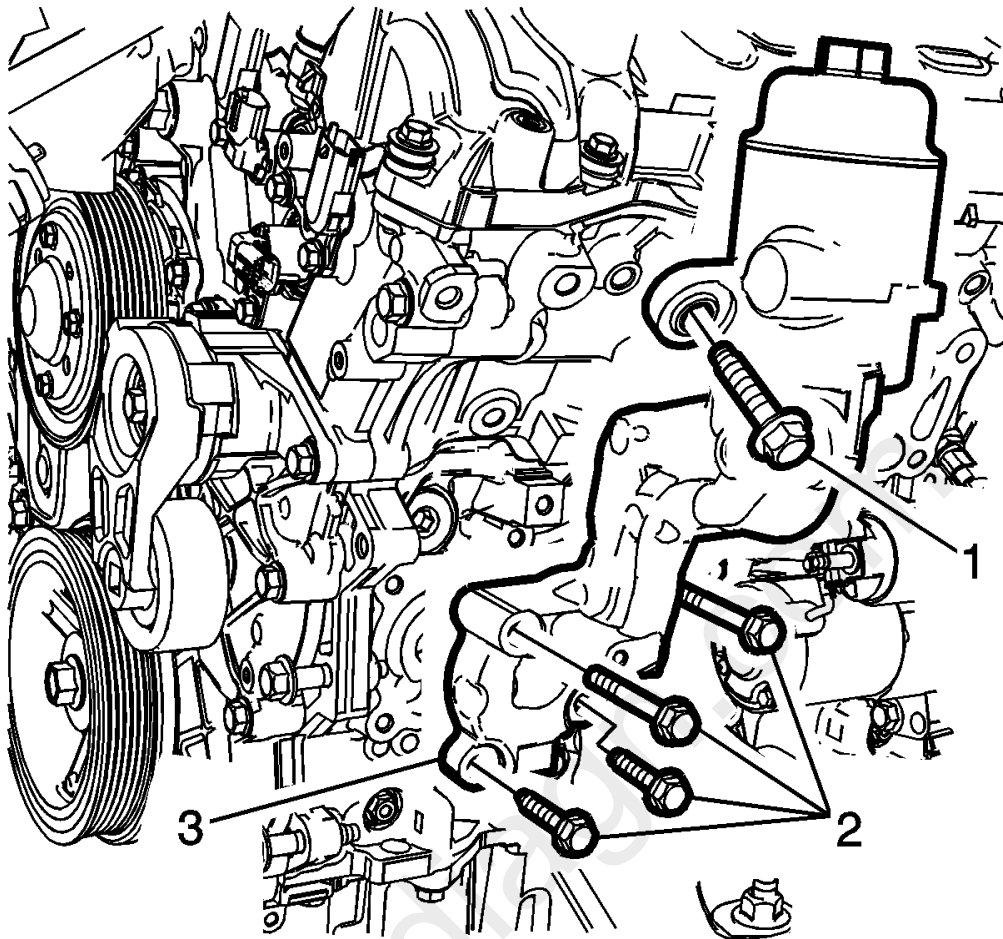


Fig. 70: Oil Filter Adapter & Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Place a drain pan under the vehicle.
11. Remove the oil filter adapter bolts (1 and 2).
12. Remove the oil filter adapter (3).
13. Remove and discard the oil filter adapter gasket.

Installation Procedure

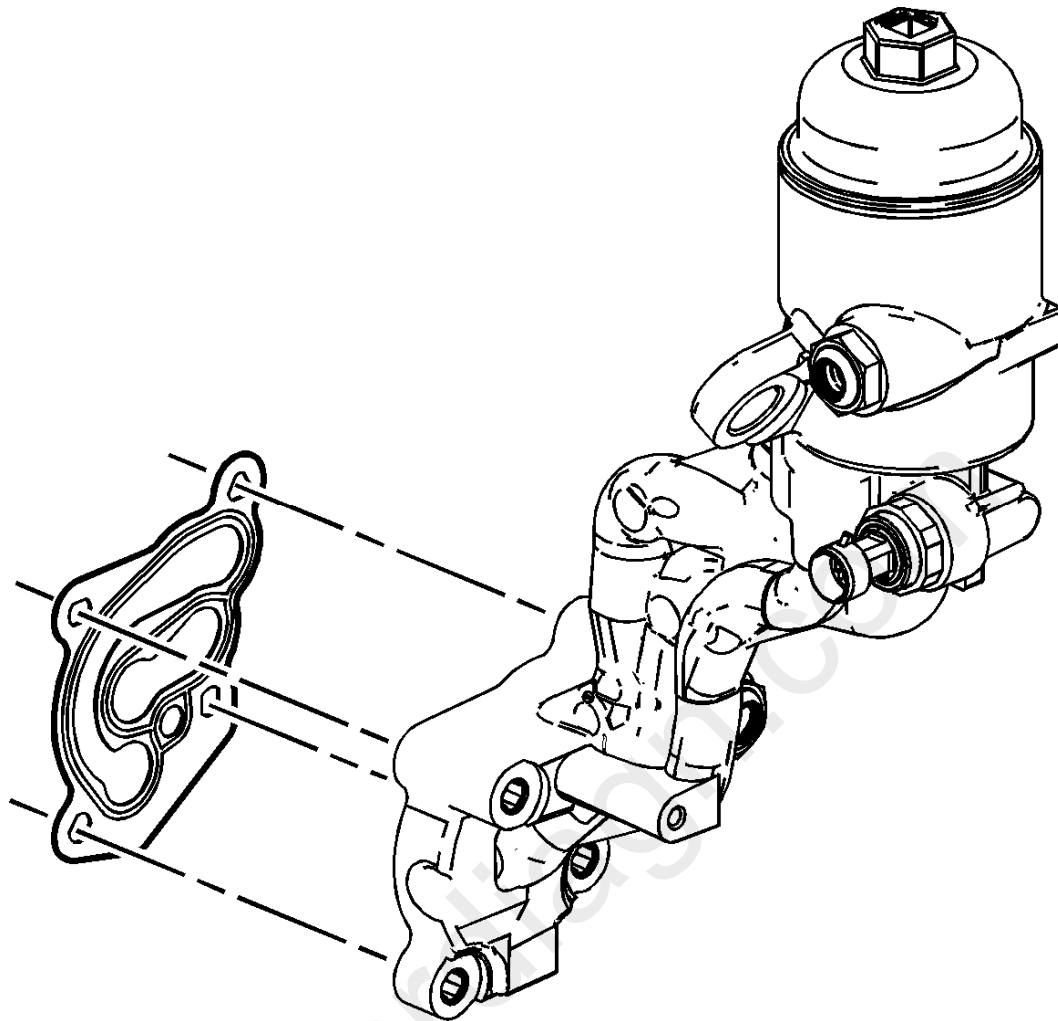


Fig. 71: View Of Oil Filter Adapter & Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Position a NEW oil filter adapter gasket onto the oil filter adapter.

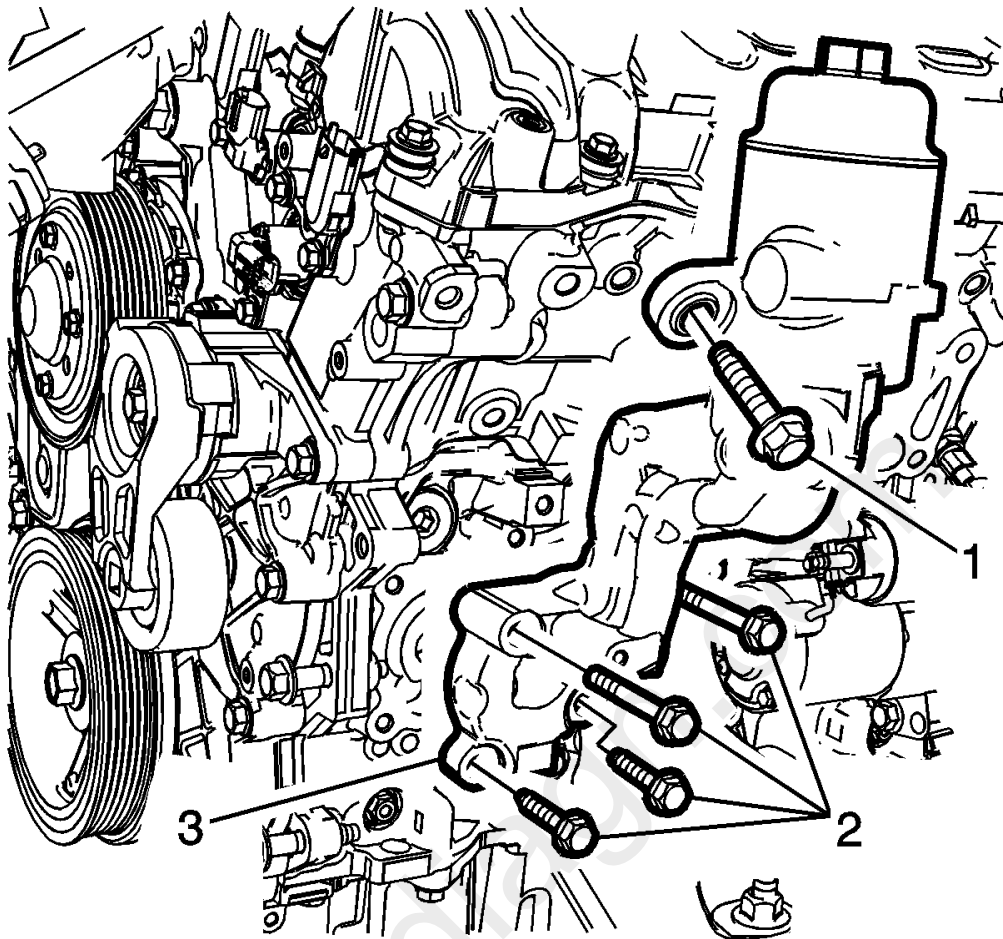


Fig. 72: Oil Filter Adapter & Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the oil filter adapter (3).
3. Install the oil filter adapter bolts (1, 2) into the oil filter adapter and hand tighten.

CAUTION: Refer to Fastener Caution .

4. Tighten the oil filter adapter bolts (2) to 25 N.m (18 lb ft).
5. Tighten the oil filter adapter bolt (1) to 58 N.m (43 lb ft).
6. Connect the oil pressure sensor electrical connector.
7. Install the A/C compressor with the A/C pipes to the engine. Refer to **Air Conditioning Compressor Replacement (LFW LFX)** .

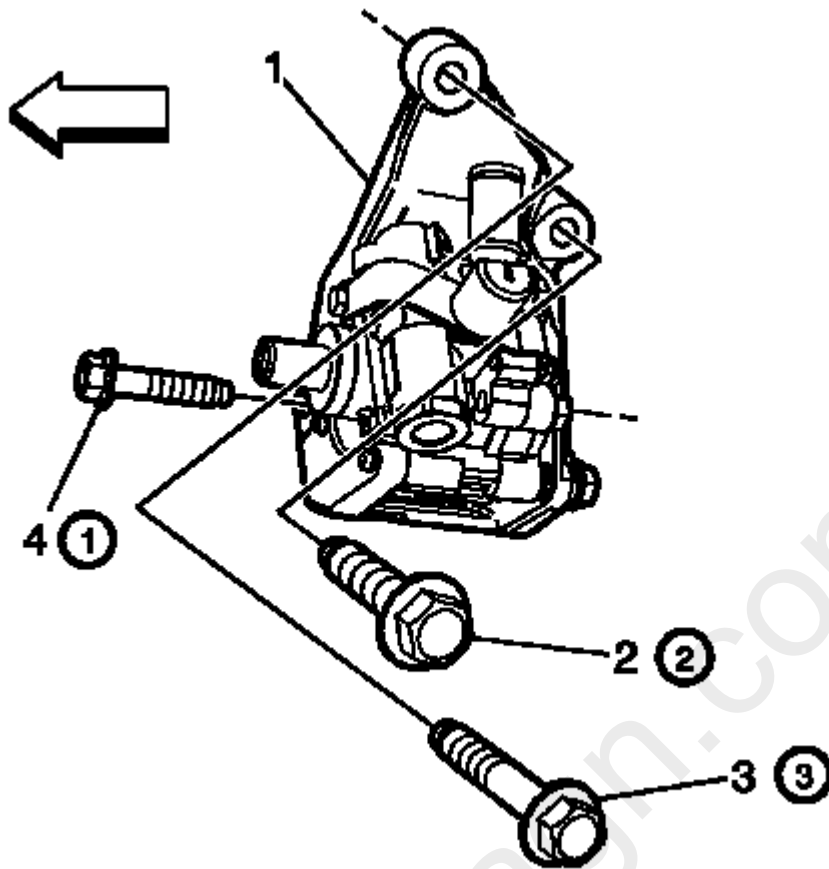


Fig. 73: Power Steering Pump Bracket & Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

8. Install the power steering pump and bracket (1). Refer to **Power Steering Pump Replacement (LFW, LFX)**.

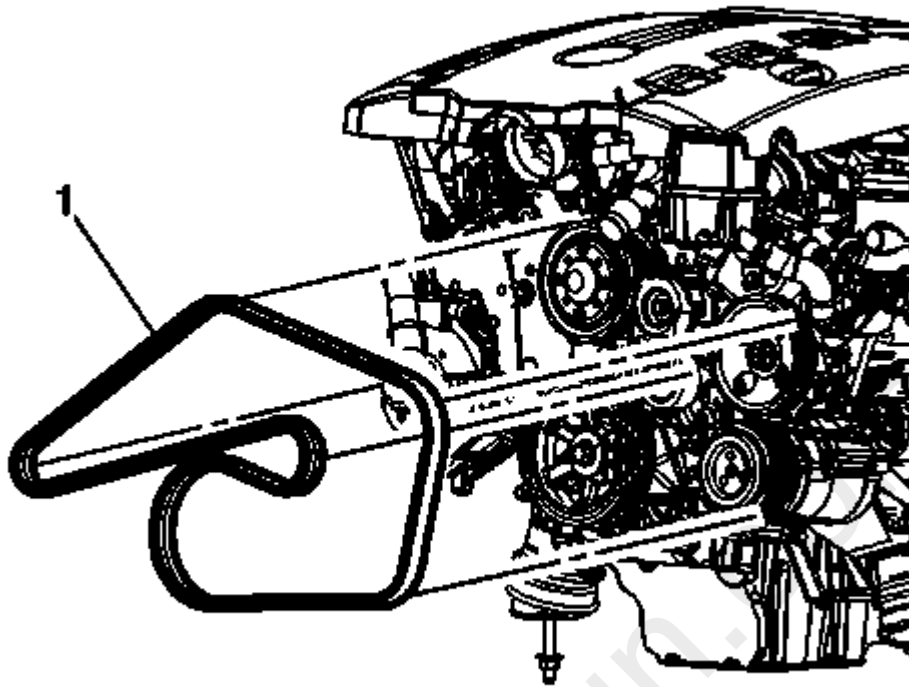


Fig. 74: Drive Belt

Courtesy of GENERAL MOTORS COMPANY

9. Install the drive belt. Refer to **Drive Belt Replacement**.

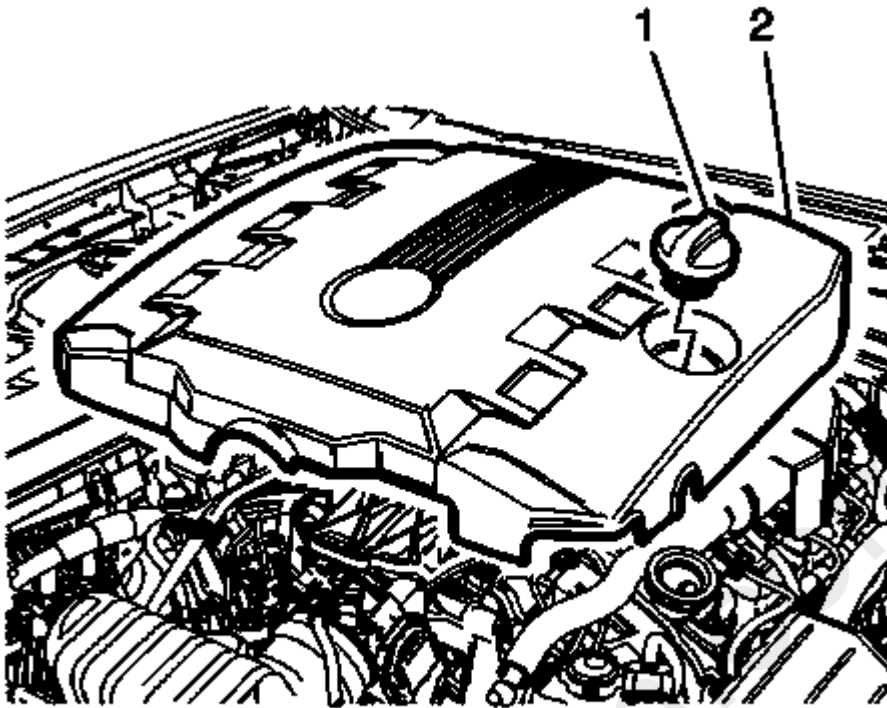


Fig. 75: Intake Manifold Cover & Cap
Courtesy of GENERAL MOTORS COMPANY

10. Install the intake manifold cover (2). Refer to **Intake Manifold Cover Replacement**.
11. Install the front compartment lower noise shield. Refer to **Front Compartment Lower Noise Shield Replacement (All Wheel Drive)** , **Front Compartment Lower Noise Shield Replacement (Rear Wheel Drive)**
12. Connect the battery. Refer to **Battery Negative Cable Disconnection and Connection (Coupe)** , **Battery Negative Cable Disconnection and Connection (Wagon)** .
13. Check and add engine oil as necessary.

CRANKSHAFT BALANCER REPLACEMENT

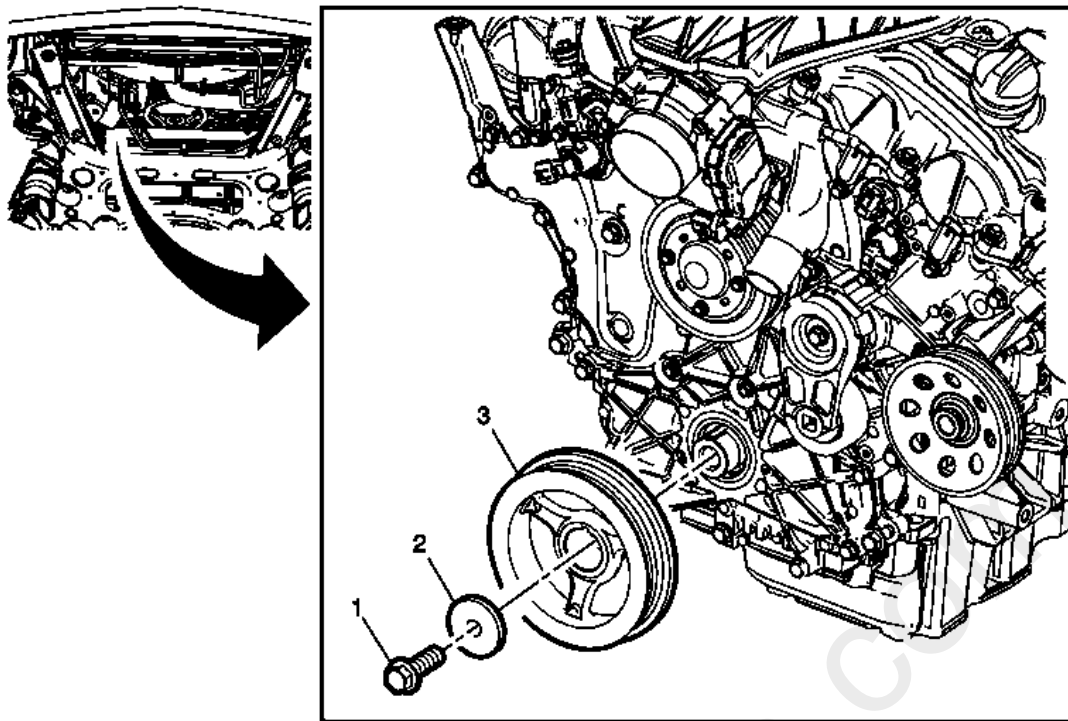


Fig. 76: Crankshaft Balancer & Components
 Courtesy of GENERAL MOTORS COMPANY

Crankshaft Balancer Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the drive belt. Refer to <u>Drive Belt Replacement</u>. 2. Remove the front air deflector. Refer to <u>Front Air Deflector Replacement</u>.	
Special Tools • EN 46106 Flywheel Holding Tool • EN 41816 Crankshaft Balancer Remover • EN 38416-2 Crankshaft Button • EN 41998-B Crankshaft Balancer Installer • EN 45059 Angle Meter	
For equivalent regional tools, refer to <u>Special Tools</u> .	
	Crankshaft Balancer Fastener CAUTION: Refer to <u>Fastener Caution</u> .

1	Procedure Remove and discard the crankshaft balancer fastener. Tighten 100 plus 150 degrees (74 lb ft plus 150 degrees)
2	Crankshaft Balancer Washer
3	Crankshaft NOTE: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tools

EN-29184 Oil Seal Installer

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

Removal Procedure

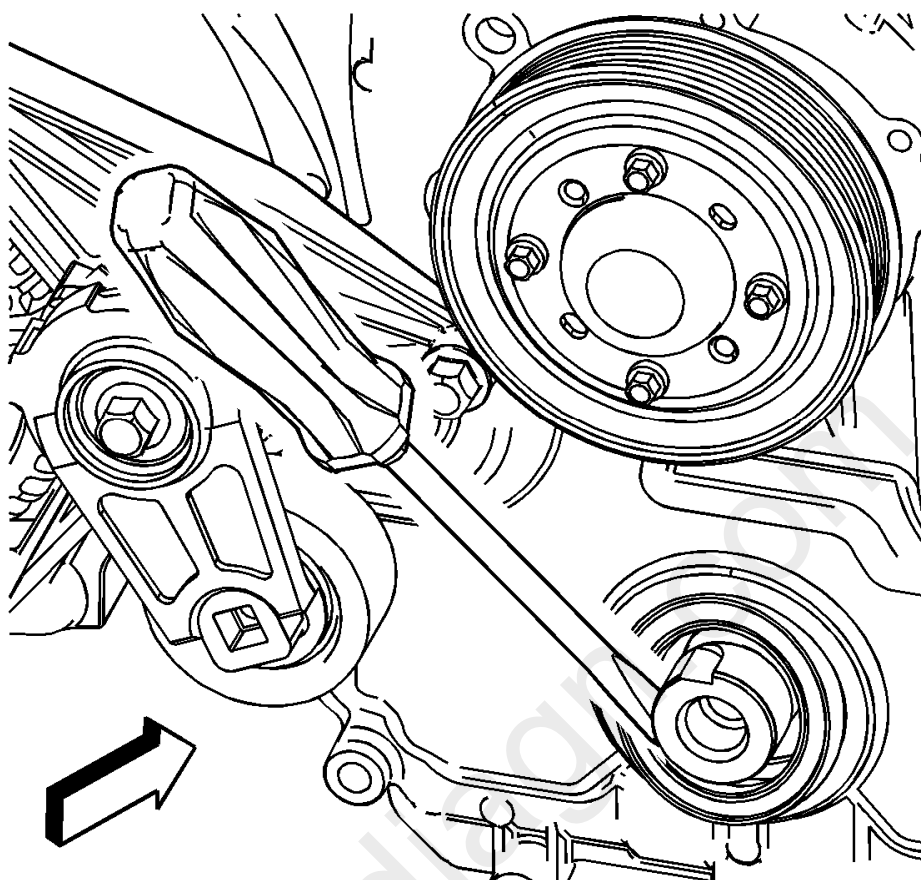


Fig. 77: Removing Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS COMPANY

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Remove the crankshaft front oil seal using a suitable flat blade tool.

Installation Procedure

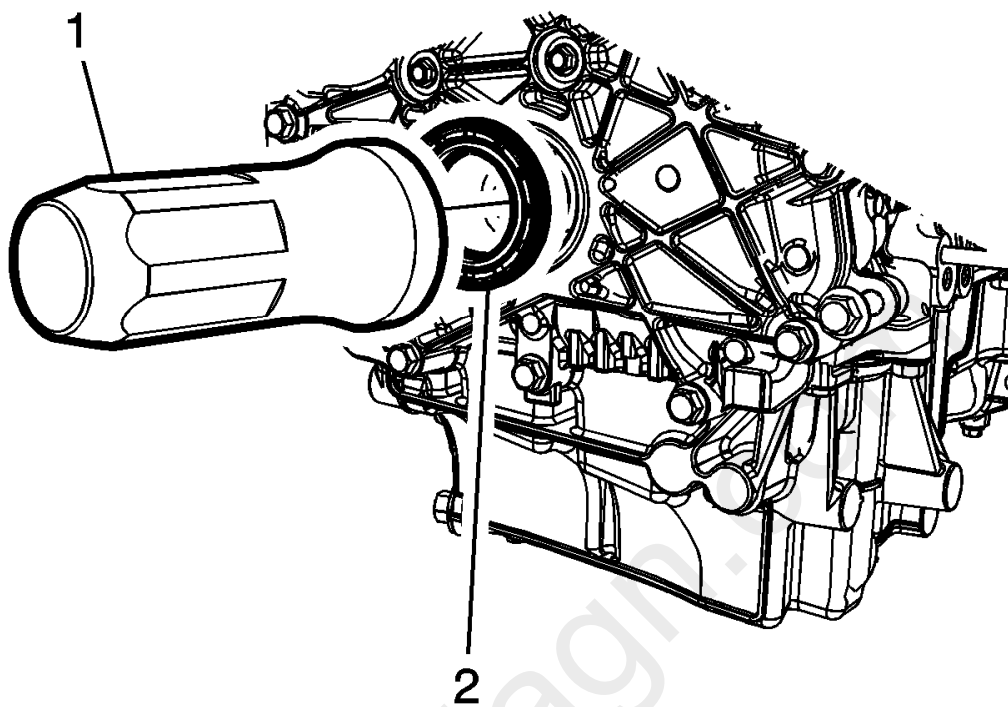


Fig. 78: Crankshaft Front Oil Seal And Installer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not lubricate the crankshaft front oil seal or the crankshaft balancer sealing surfaces.

1. Use the **EN-29184** installer (1) or equivalent to install the crankshaft front oil seal (2).
2. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

CAMSHAFT COVER REPLACEMENT - LEFT SIDE

Special Tools

EN-46101 Spark Plug Tube Seal Guide

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

Removal Procedure

1. Remove the ignition coils. Refer to **Ignition Coil Replacement - Bank 2** .
2. Disconnect and remove the engine harness from the camshaft cover.
3. Remove the intake manifold. Refer to **Intake Manifold Replacement**.

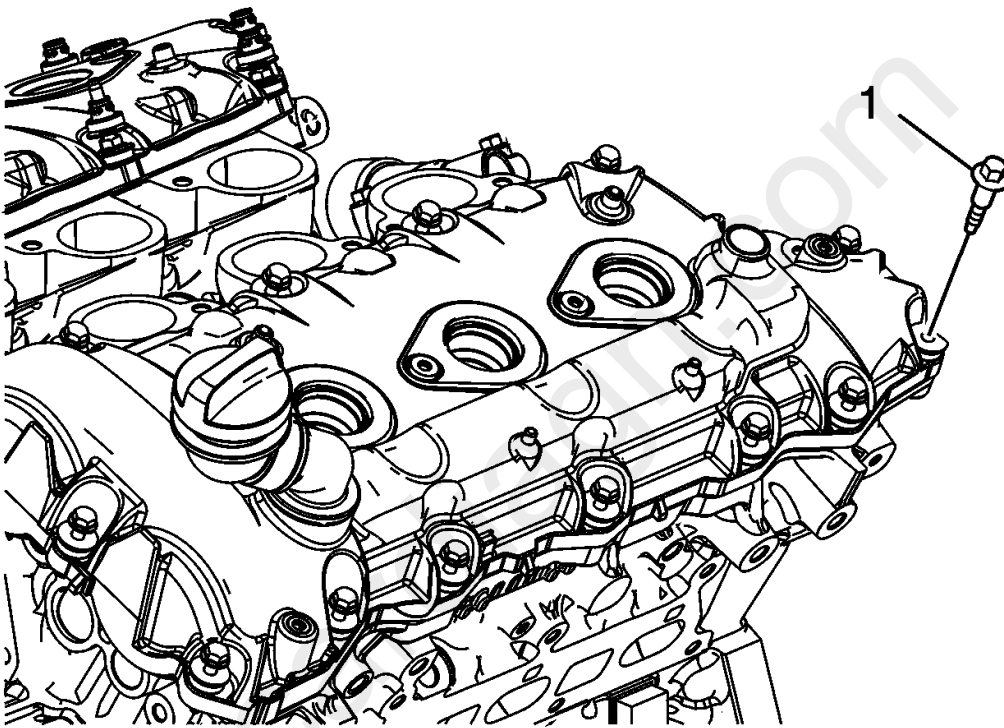


Fig. 79: View of Camshaft Cover and Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the left camshaft cover bolts.
5. Remove the left camshaft cover from the left cylinder head.
6. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **Camshaft Cover Cleaning and Inspection**

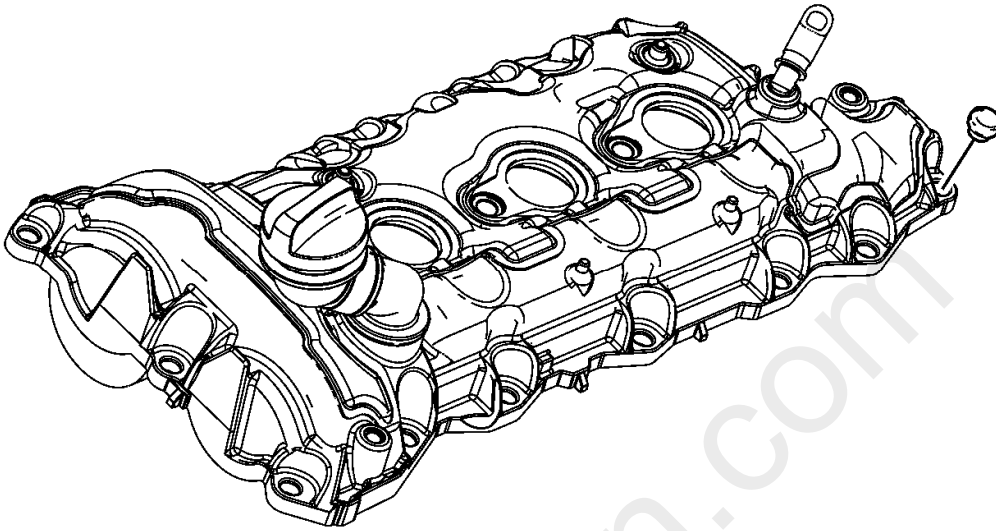


Fig. 80: View of Camshaft Cover
Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-46101** guide onto the spark plug tubes of the left cylinder head.

Installation Procedure

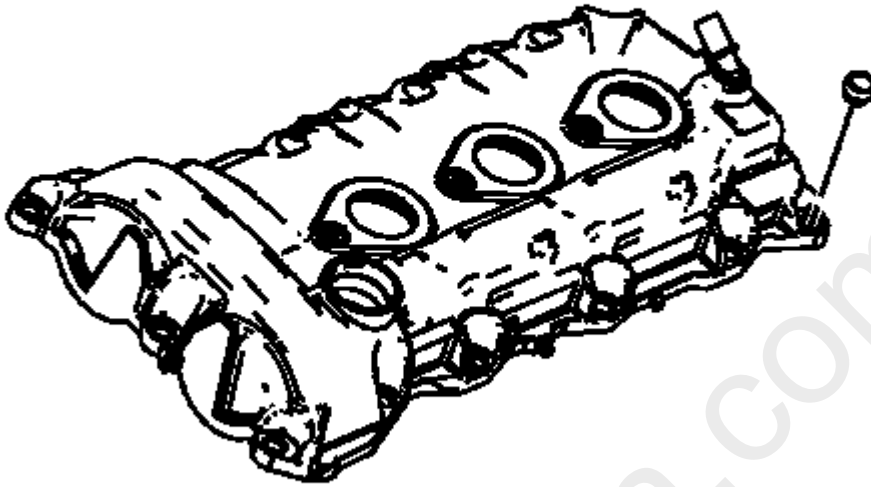


Fig. 81: Identifying Camshaft Cover Bolt Grommets
Courtesy of GENERAL MOTORS COMPANY

1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.

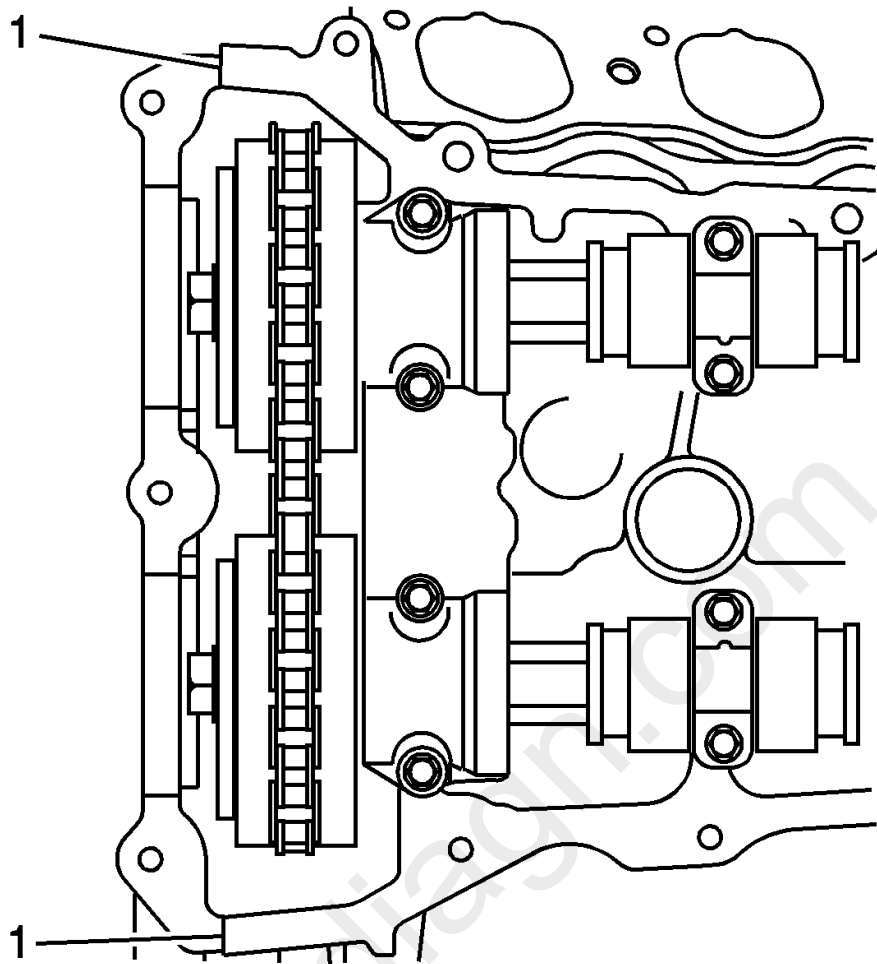


Fig. 82: Locating Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS COMPANY

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant equivalent, on the engine front cover split lines (1).

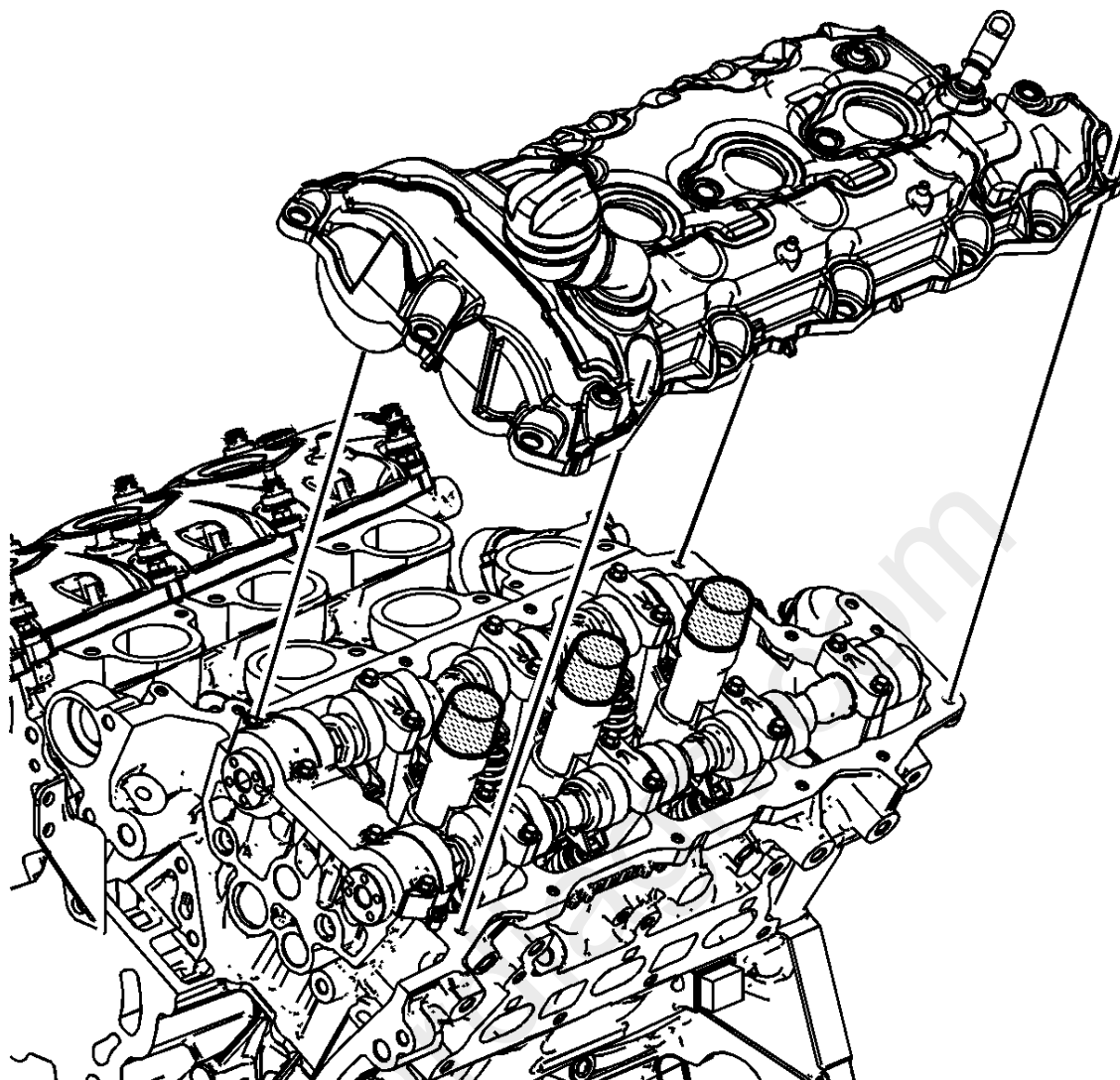


Fig. 83: View of Camshaft Cover & Cylinder Head
Courtesy of GENERAL MOTORS COMPANY

3. Place the left camshaft cover into position onto the left cylinder head.

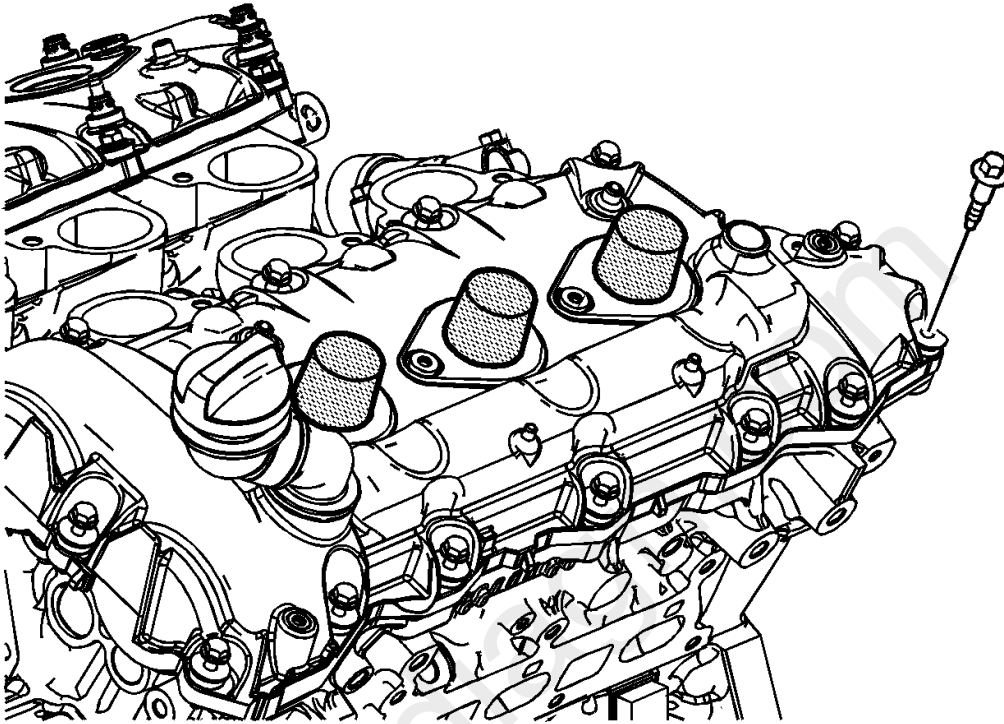


Fig. 84: View of Camshaft Cover & Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Loosely install the left camshaft cover bolts.

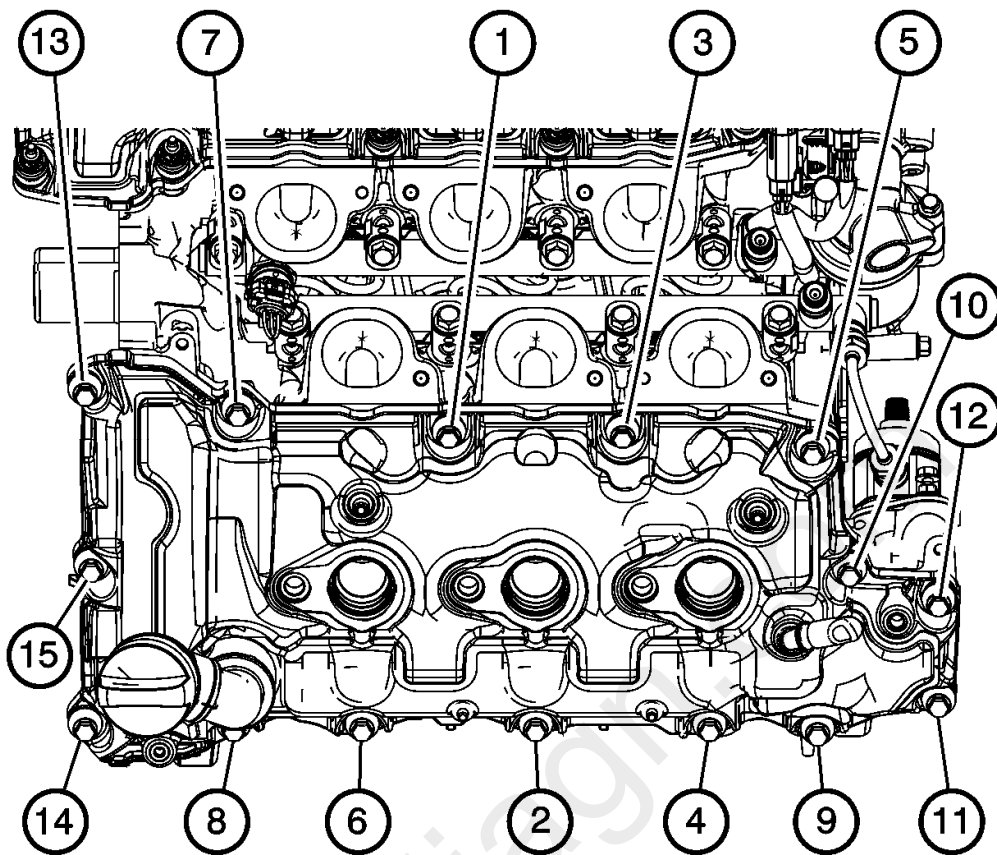


Fig. 85: Identifying Left Camshaft Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

5. Tighten the left camshaft cover bolts in the sequence shown to 10 N.m (89 lb in).
6. Connect and install the engine harness to the camshaft cover.
7. Install the intake manifold. Refer to **Intake Manifold Replacement**.

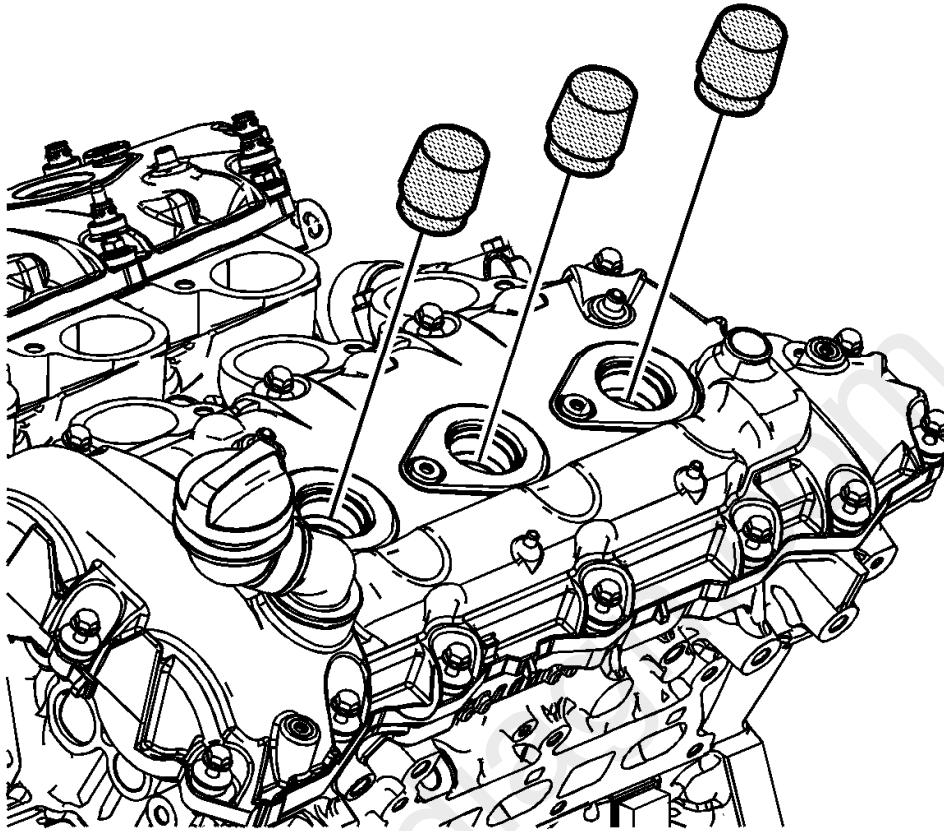


Fig. 86: View of Spark Plug Tubes & Cylinder Head
Courtesy of GENERAL MOTORS COMPANY

8. Remove the **EN-46101** guide from the spark plug tubes of the left cylinder head.
9. Install the ignition coils. Refer to **Ignition Coil Replacement - Bank 2** .

CAMSHAFT COVER REPLACEMENT - RIGHT SIDE

Special Tools

EN-46101 Spark Plug Tube Seal Guide

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

Removal Procedure

1. Remove the ignition coils. Refer to **Ignition Coil Replacement - Bank 1**
2. Disconnect and remove the engine harness from the camshaft cover.

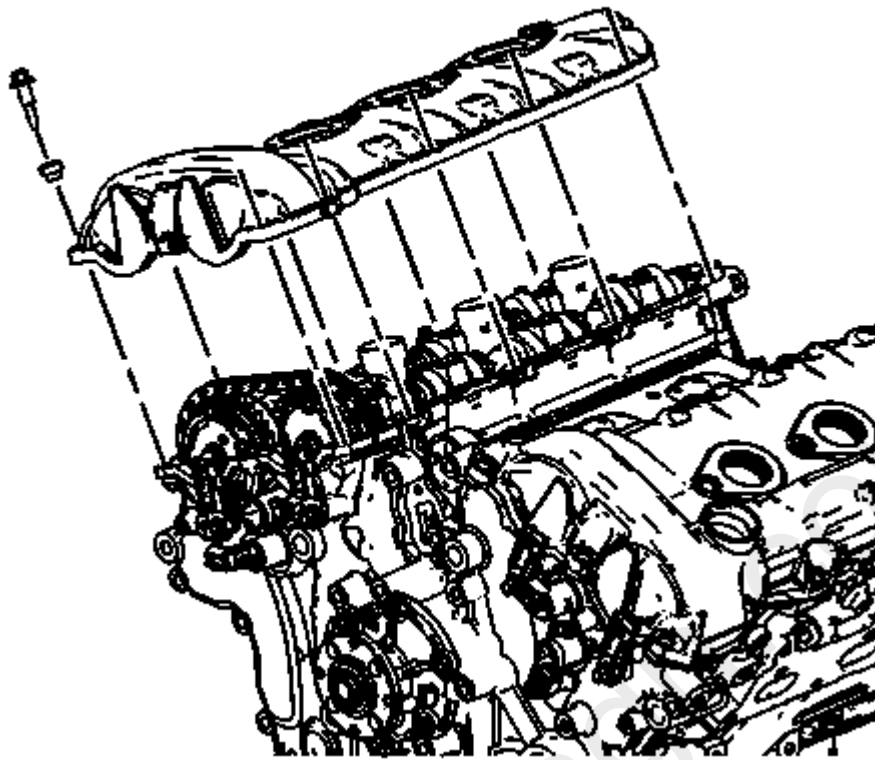


Fig. 87: View Of Camshaft Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove the right camshaft cover bolts.
4. Remove the right camshaft cover from the right cylinder head.
5. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **Camshaft Cover Cleaning and Inspection**

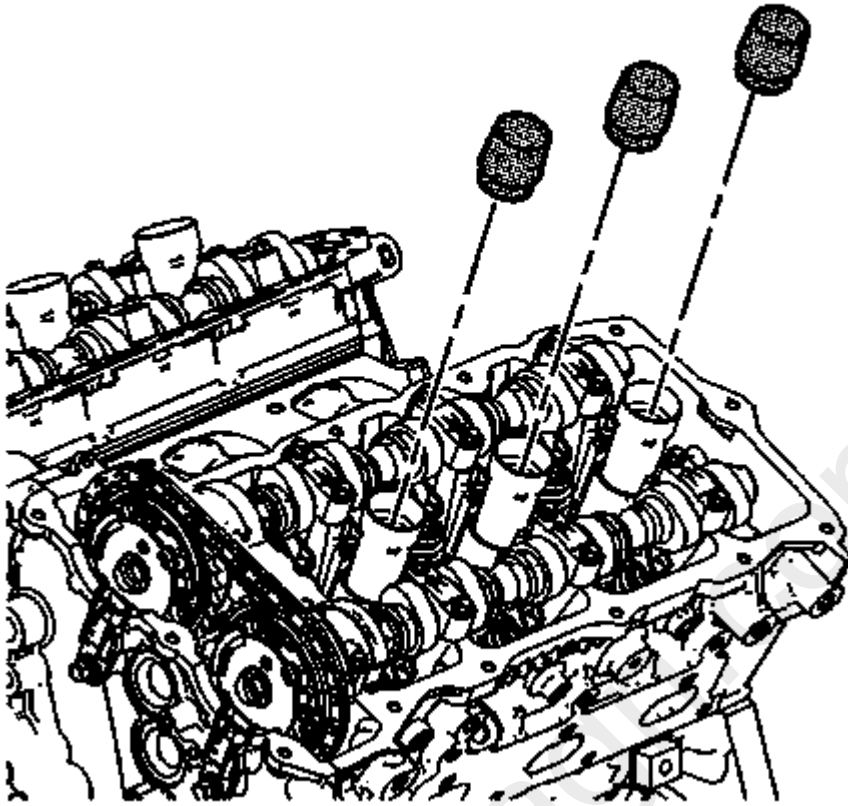


Fig. 88: Plugging Spark Plug Holes
Courtesy of GENERAL MOTORS COMPANY

6. Install the **EN-46101** guide onto the spark plug tubes of the right cylinder head.

Installation Procedure

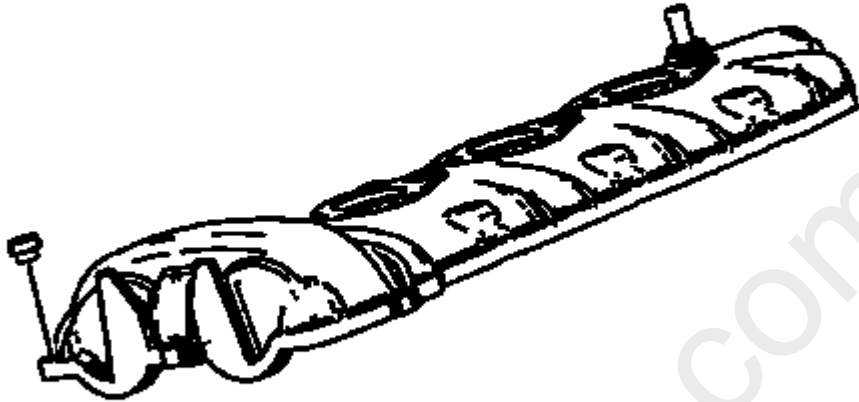


Fig. 89: Locating Camshaft Cover Bolt Grommets
Courtesy of GENERAL MOTORS COMPANY

1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.

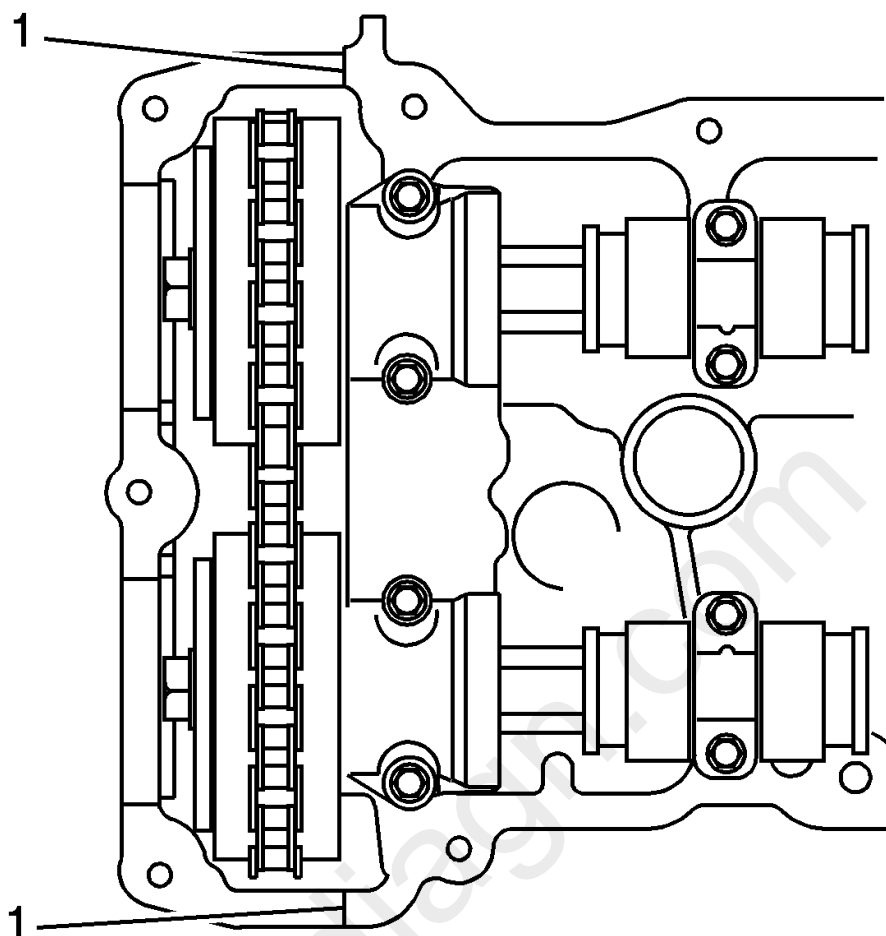


Fig. 90: Identifying Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS COMPANY

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, on the engine front cover split lines (1).

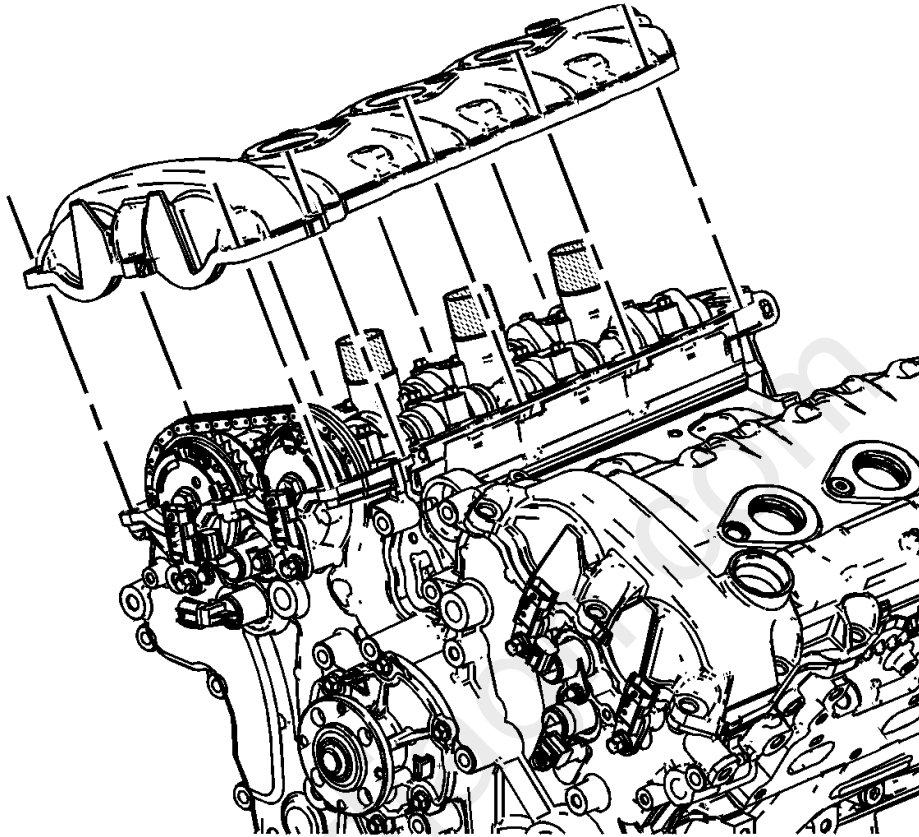


Fig. 91: View Of Right Camshaft Cover
Courtesy of GENERAL MOTORS COMPANY

3. Place the right camshaft cover into position onto the right cylinder head.

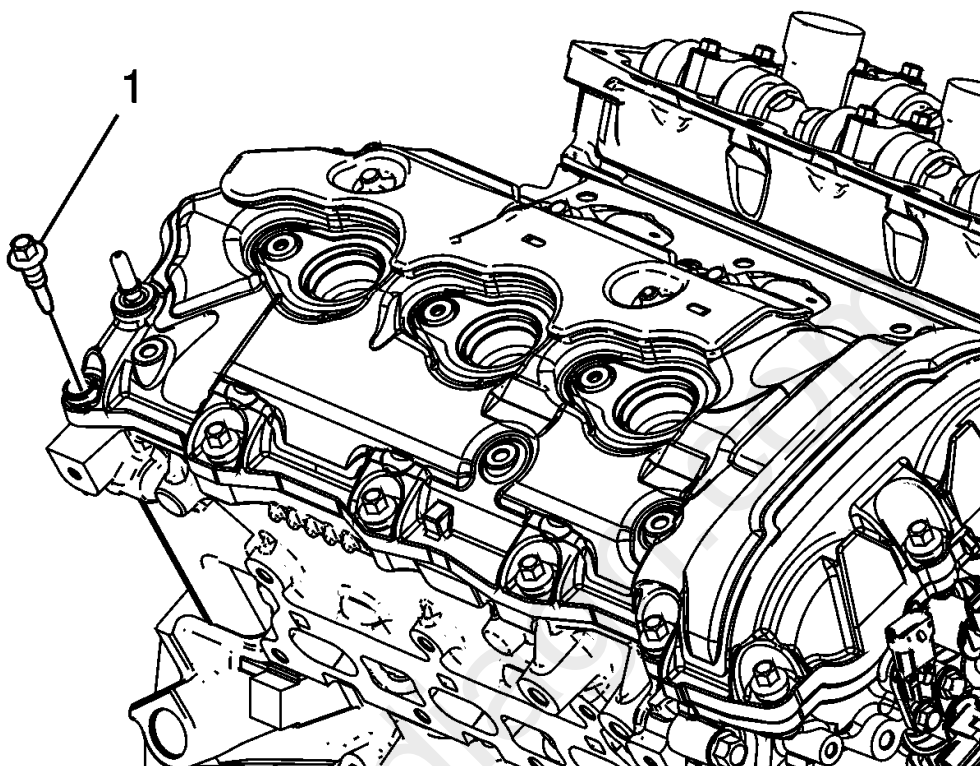


Fig. 92: View Of Camshaft Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

4. Loosely install the right camshaft cover bolts.

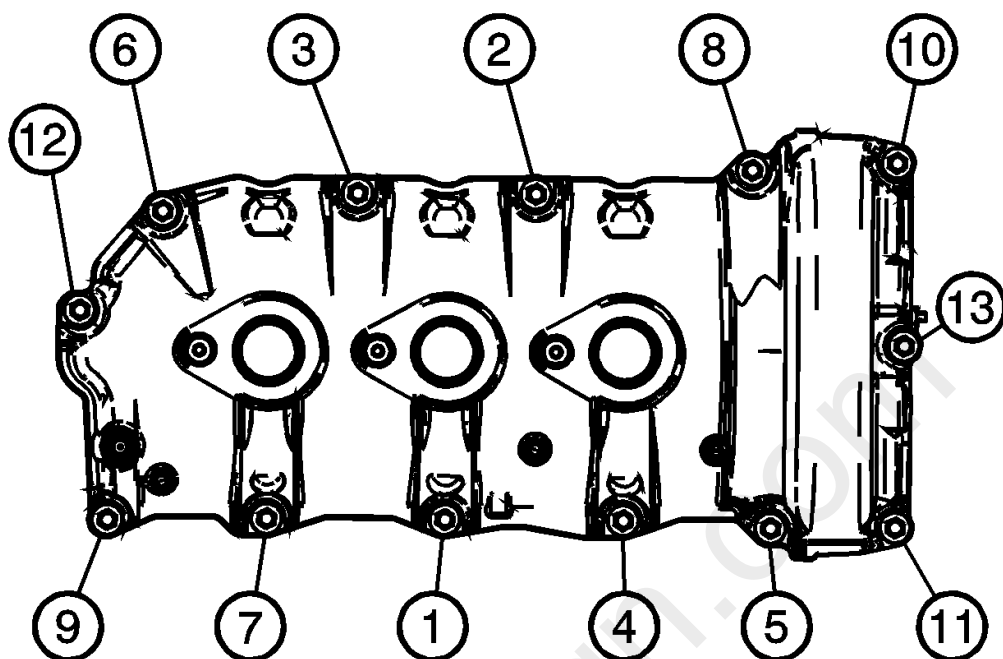


Fig. 93: Tightening Sequence for Right Camshaft Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Tighten the right camshaft cover bolts in the sequence shown to 10 N.m (89 lb in).
6. Connect and install the engine harness to the camshaft cover.

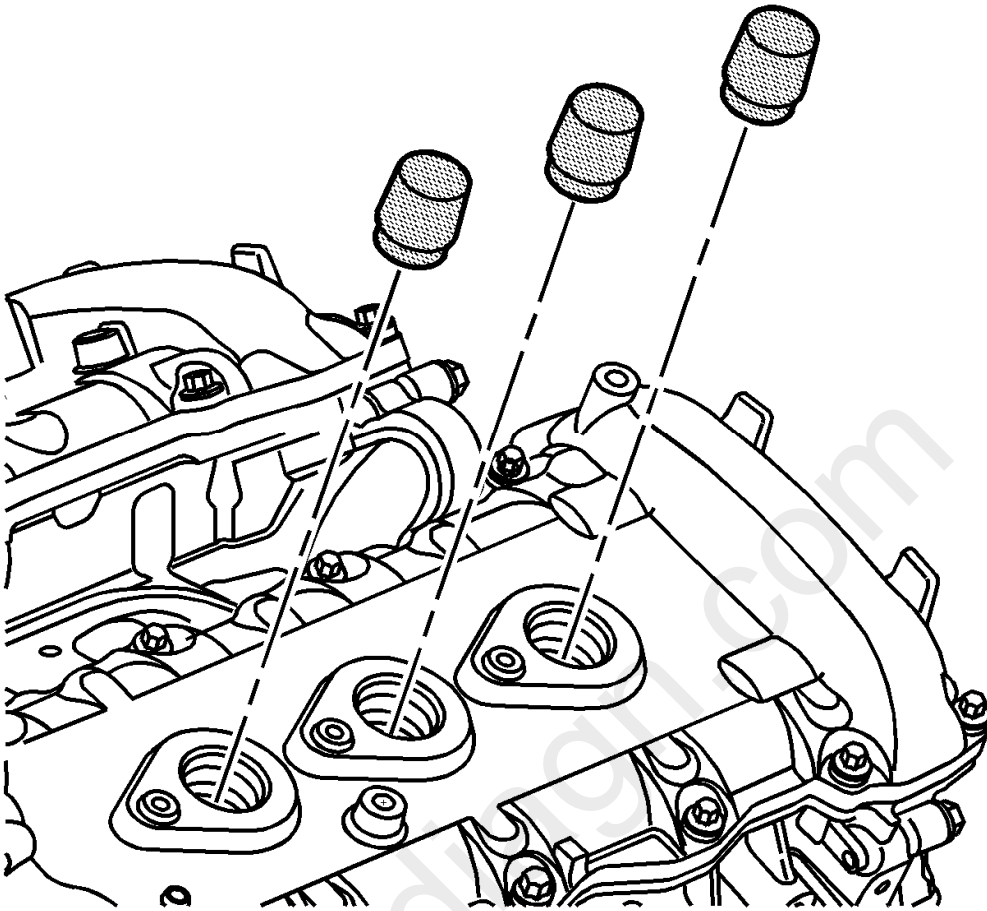


Fig. 94: Spark Plug Tube Seal Guides
Courtesy of GENERAL MOTORS COMPANY

7. Remove the **EN-46101** guide from the spark plug tubes of the right cylinder head.
8. Install the ignition coils. Refer to **Ignition Coil Replacement - Bank 1**

ENGINE FRONT COVER REPLACEMENT

Special Tools

EN-46109 Engine Front Cover Installation Guide Pins

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

Removal Procedure

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the camshaft covers. Refer to **Camshaft Cover Replacement - Left Side**, and **Camshaft Cover Replacement - Right Side**.

3. Drain the engine coolant. Refer to Cooling System Draining and Filling (Static Fill LFW or LFX) , Cooling System Draining and Filling (GE 47716 LFW or LFX) .
4. Remove the water outlet with the radiator hose and reposition aside. Refer to Water Outlet Replacement (LFW, LF1, LLT) .
5. Remove the generator. Refer to Generator Replacement (LFX) .

NOTE: Do not disconnect the power steering pipes or drain the power steering fluid.

6. Remove the power steering fluid reservoir and reposition the power steering fluid reservoir in order to provide access. Refer to Power Steering Fluid Reservoir Replacement (LFW, LFX) .
7. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
8. Remove the camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust , Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake , Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust , and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake .
9. Remove the belt tensioner. Refer to Drive Belt Tensioner Replacement
10. Remove the camshaft position actuator solenoid valves from the front cover. Refer to Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake , Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust , Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake , and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust .

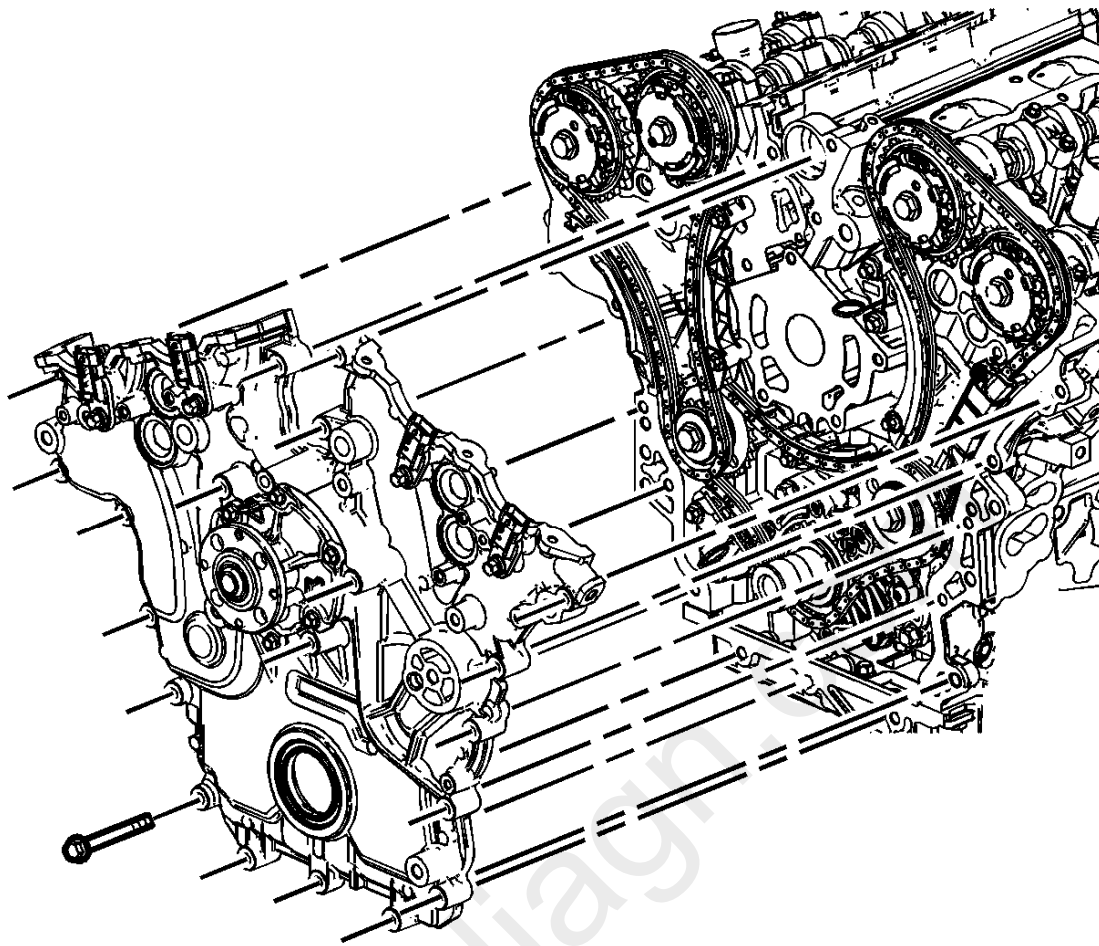


Fig. 95: Engine Front Cover

Courtesy of GENERAL MOTORS COMPANY

11. Remove the engine front cover with the water pump. Refer to **Engine Front Cover Removal** .
12. Disassemble the engine front cover. Refer to **Engine Front Cover Disassemble** .

NOTE: Do NOT use sharp and/or metal gasket scrapers in order to clean the sealing surfaces.

13. Carefully clean the engine front cover sealing surfaces. Refer to **Engine Front Cover Cleaning and Inspection** .

NOTE: Insert a piece of cardboard between the oil pan front and the oil pump in order to prevent any contaminants from falling into the oil pan.

14. Carefully clean the engine front cover sealing surfaces. Refer to **Engine Front Cover Cleaning and**

Inspection .

15. Use compressed air in order to remove any engine coolant from the engine cooling passages and from the top of the oil pan scraper (windage tray).

Installation Procedure

1. Assemble the engine front cover. Refer to **Engine Front Cover Assemble .**

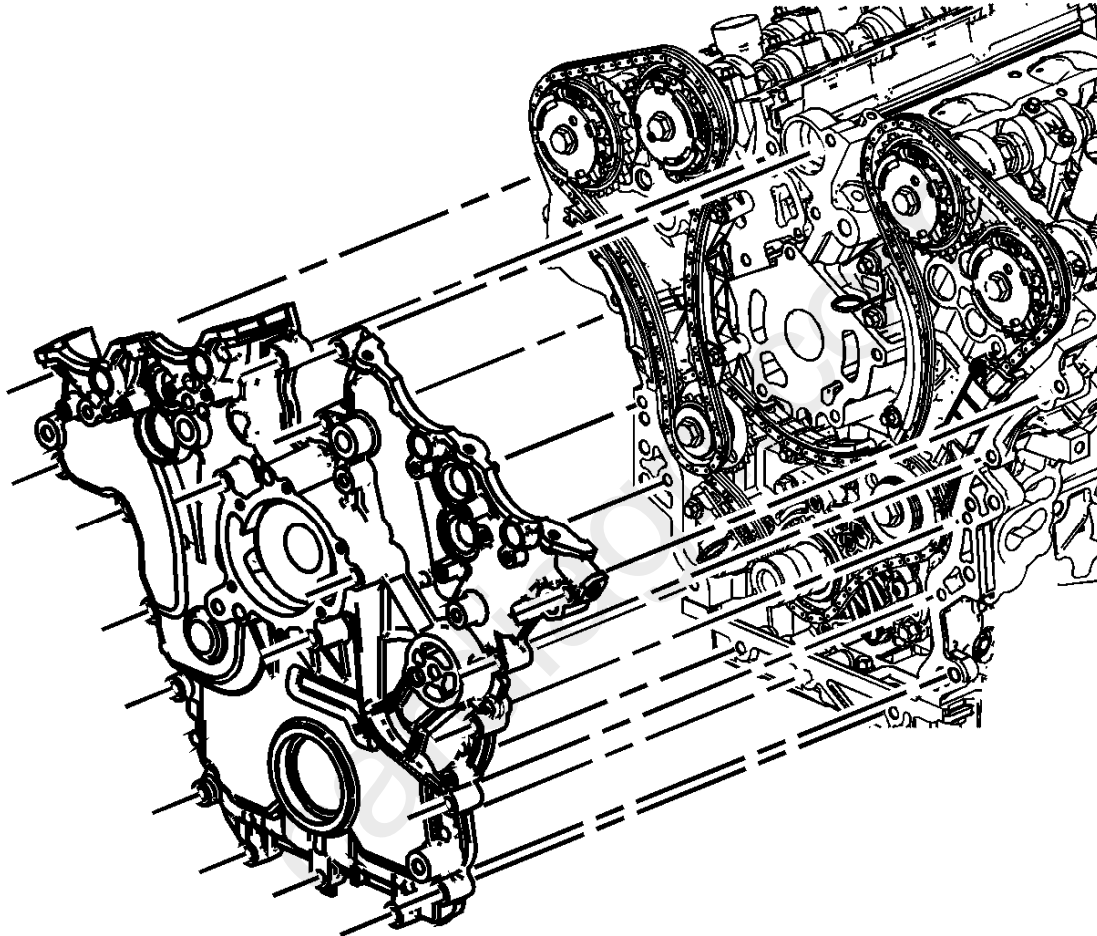


Fig. 96: View Of Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

2. Use the EN-46109 pins in order to install the engine front cover. Refer to **Engine Front Cover Installation .**
3. Install the camshaft position actuator solenoid valves to the front cover. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake** , **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust** , **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake** , and **Camshaft Position**

Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust .

4. Install the camshaft position sensors. Refer to **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust** , **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake** , **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust** , and **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake** .
5. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
6. Install the power steering pump. Refer to **Power Steering Fluid Reservoir Replacement (LFW, LFX)** .
7. Install the power steering pump pulley. Refer to **Power Steering Fluid Reservoir Replacement (LFW, LFX)** .
8. Install the power steering fluid reservoir. Refer to **Power Steering Fluid Reservoir Replacement (LFW, LFX)** .
9. Install the generator bracket with the generator and the belt tensioner. Refer to **Generator Replacement (LFX)** .
10. Install the water outlet. Refer to **Water Outlet Replacement (LFW or LFX)** .
11. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .
12. Install the camshaft covers. Refer to **Camshaft Cover Replacement - Left Side**, and **Camshaft Cover Replacement - Right Side**.
13. Install the intake manifold. Refer to **Intake Manifold Replacement**.
14. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**
15. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side** .
4. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side** .
5. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side** .
6. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal** .
7. Remove the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Removal - Upper** .
8. Remove the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain Removal** .
9. Remove the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket**

Removal - Right Side .

10. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side .**
11. Remove the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Left Side .**
12. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Left Side .**
13. Remove the left bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Removal - Left Side .**

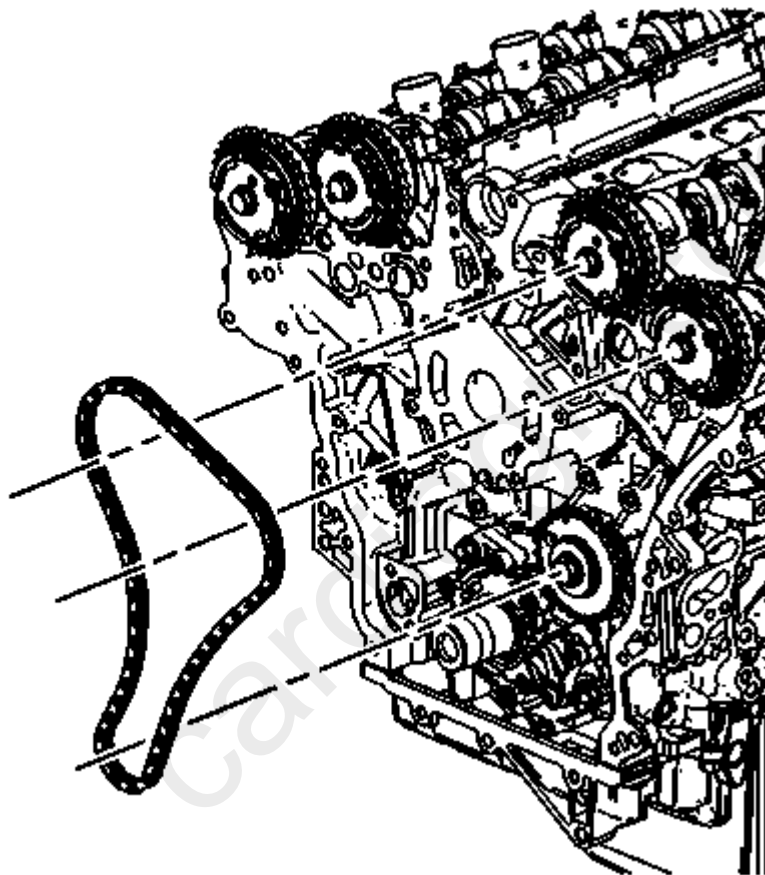


Fig. 97: View Of Left Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS COMPANY

14. Remove the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Left Side .**
15. Clean and inspect all of the camshaft timing drive components. Refer to **Camshaft Timing Drive Components Cleaning and Inspection .** Replace components as necessary.

Installation Procedure

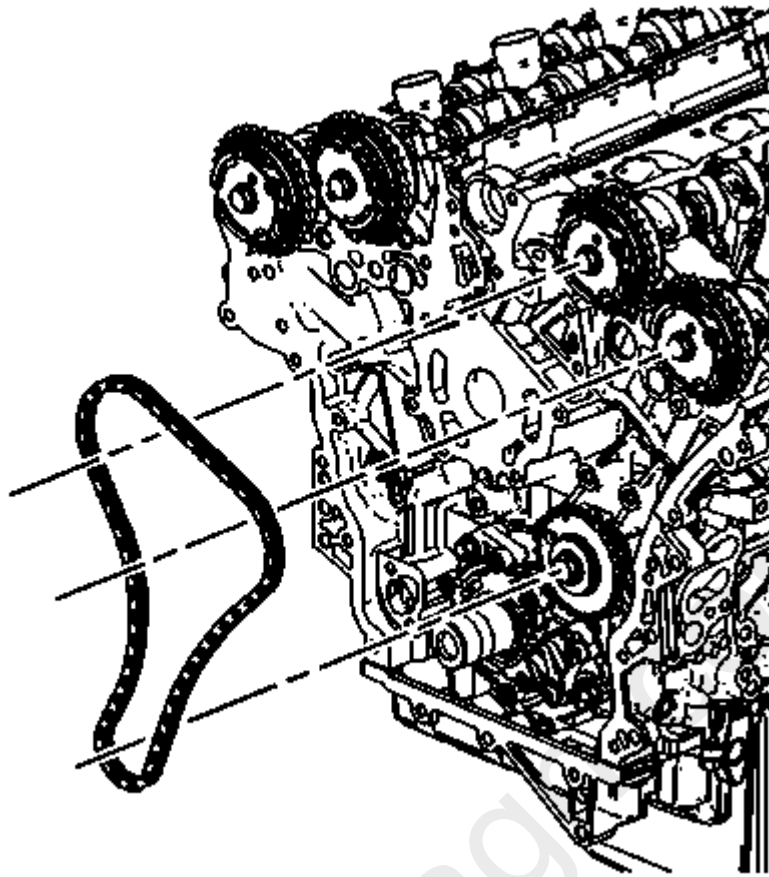


Fig. 98: View Of Left Bank Secondary Camshaft Drive Chain
 Courtesy of GENERAL MOTORS COMPANY

1. Install the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Left Side** .
2. Install the left bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Left Side** .
3. Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Left Side** .
4. Install the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Left Side** .
5. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Left Side** .
6. Install the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Right Side** .
7. Install the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain Installation** .
8. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
9. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .

10. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side** .
11. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
12. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
13. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
14. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side** .
4. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side** .

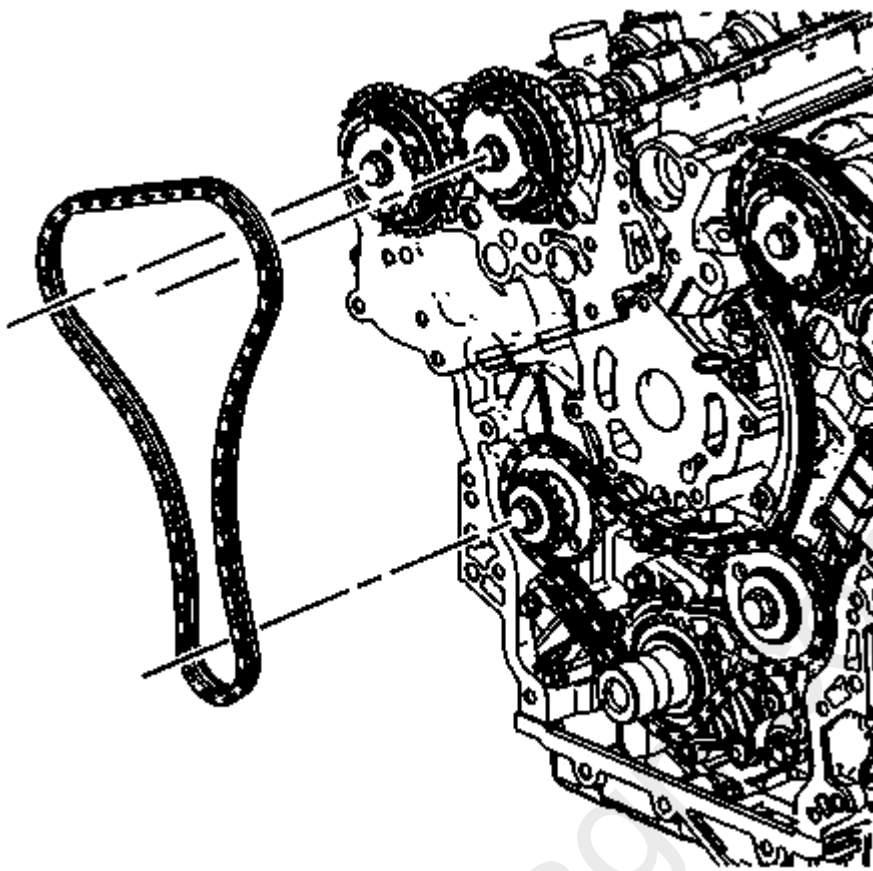


Fig. 99: View Of Right Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS COMPANY

5. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side** .

Installation Procedure

1. Ensure the stage 1 camshaft timing is correct. Refer to **Setting Camshaft Timing**.

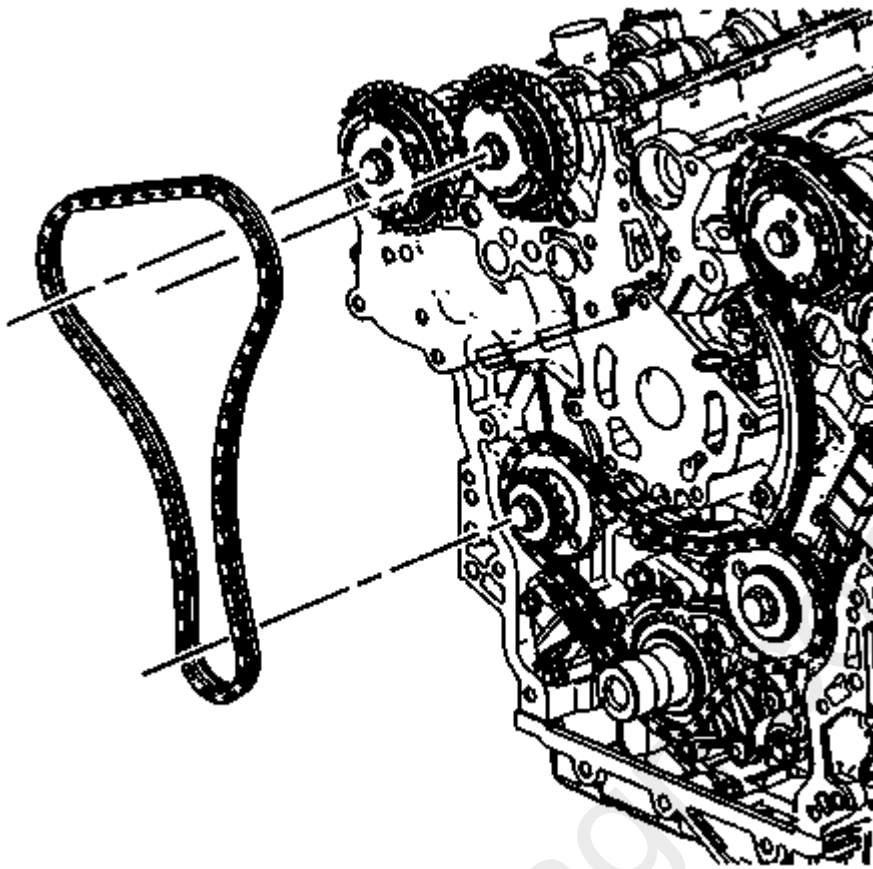


Fig. 100: View Of Right Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS COMPANY

2. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side** .
3. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
4. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
5. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
6. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.

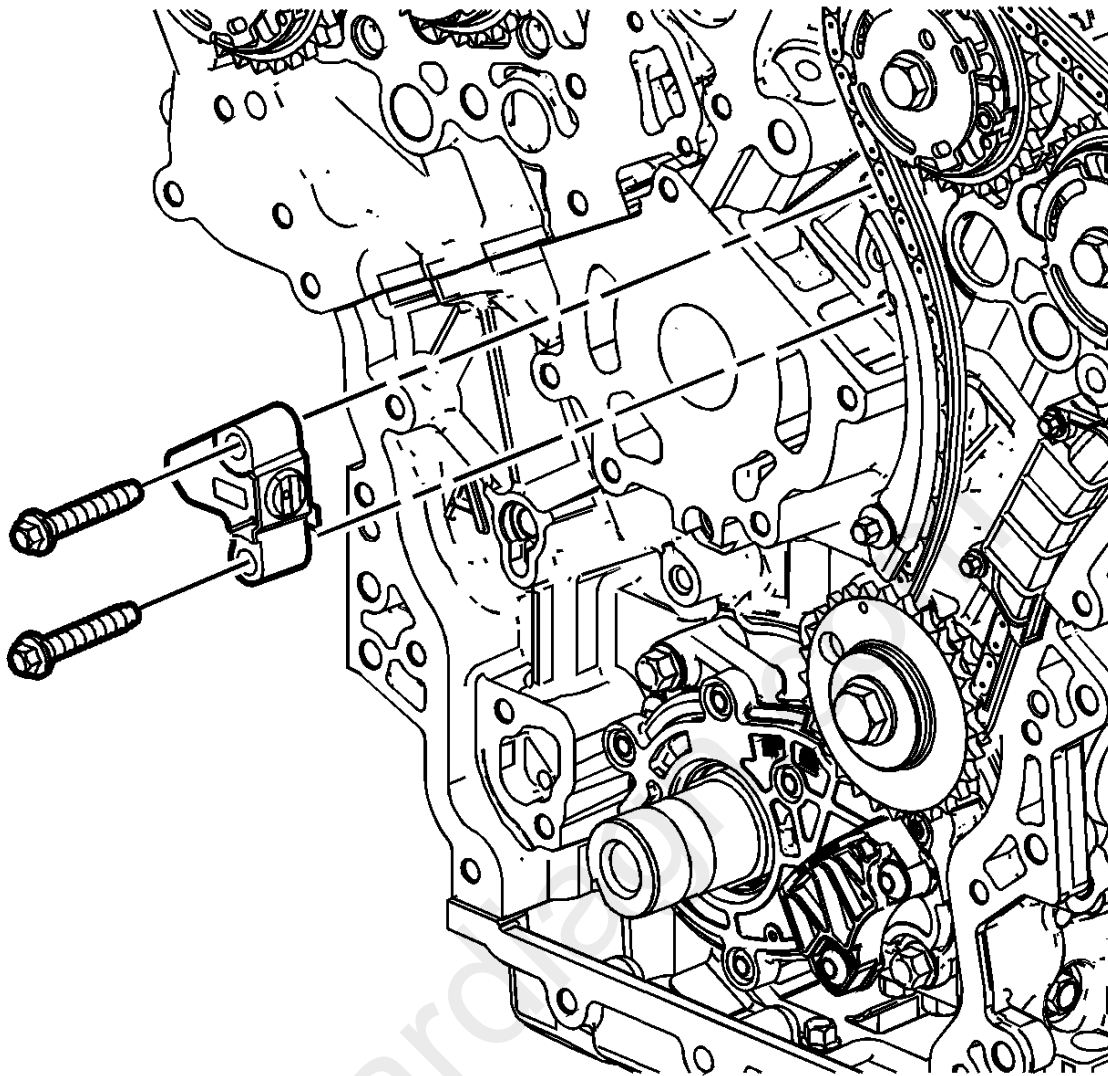


Fig. 101: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

2. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .

Installation Procedure

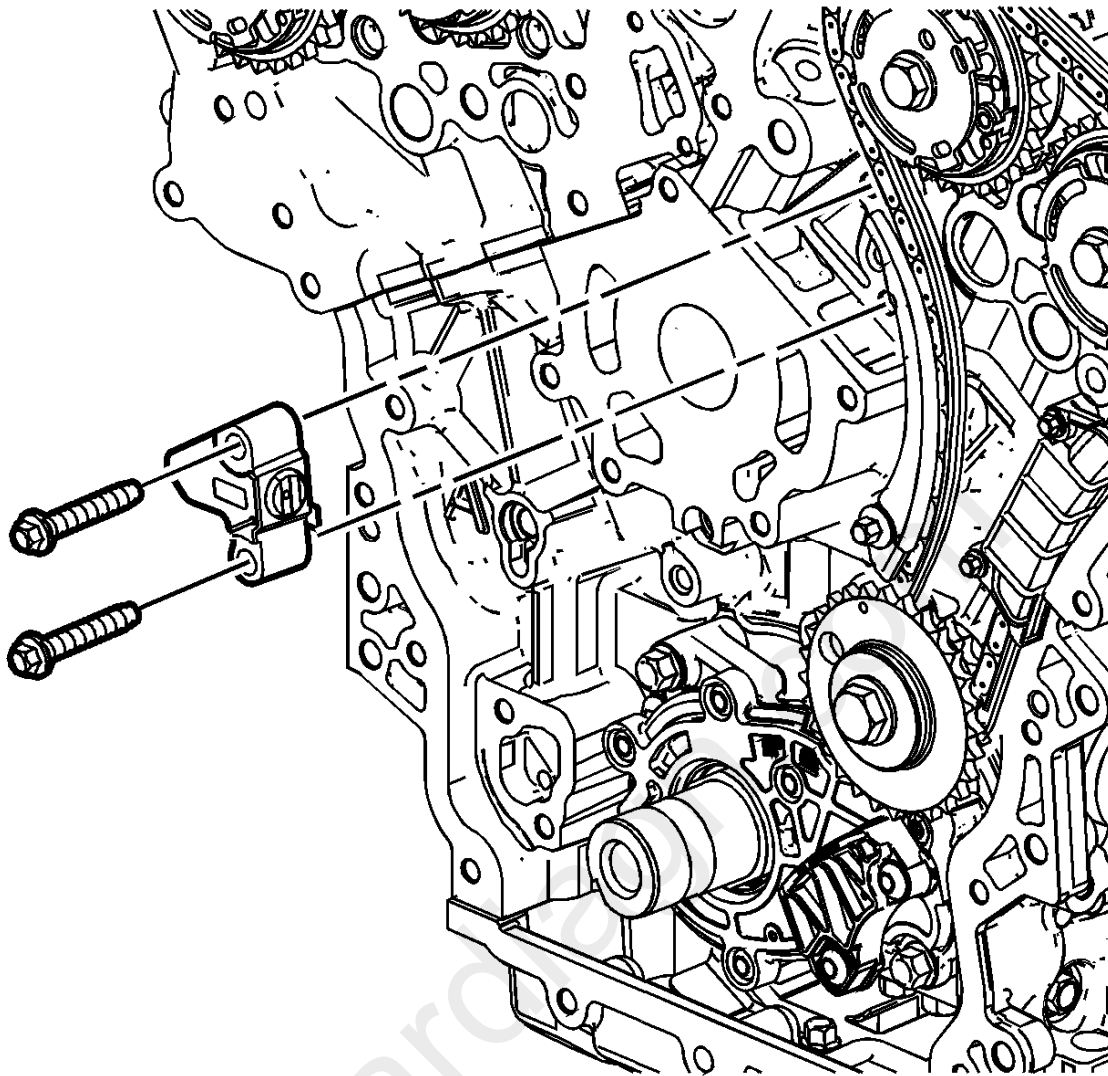


Fig. 102: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

1. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Left Side** .
2. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.

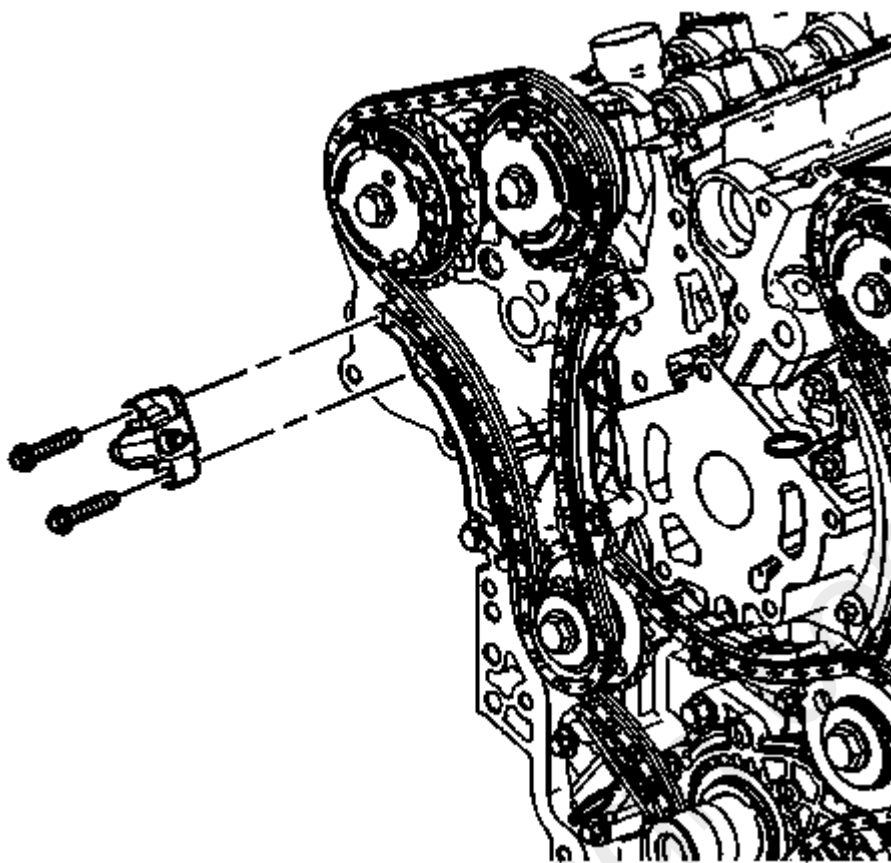


Fig. 103: View Of Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .

Installation Procedure

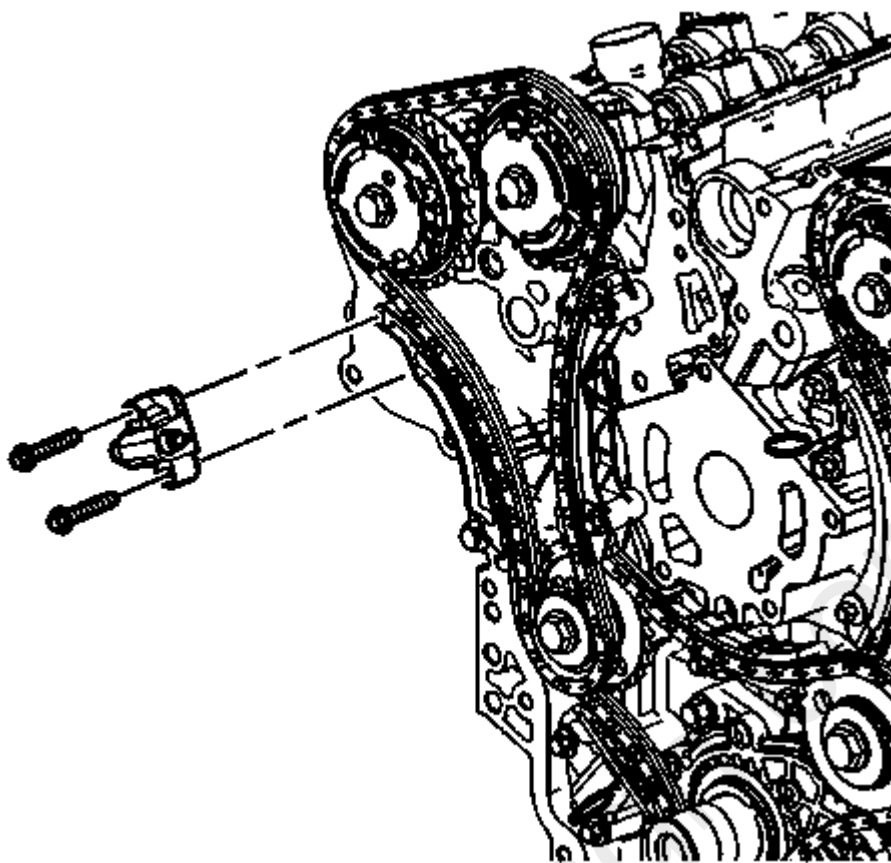


Fig. 104: View Of Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

1. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side**.
2. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY TIMING CHAIN TENSIONER SHOE REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.

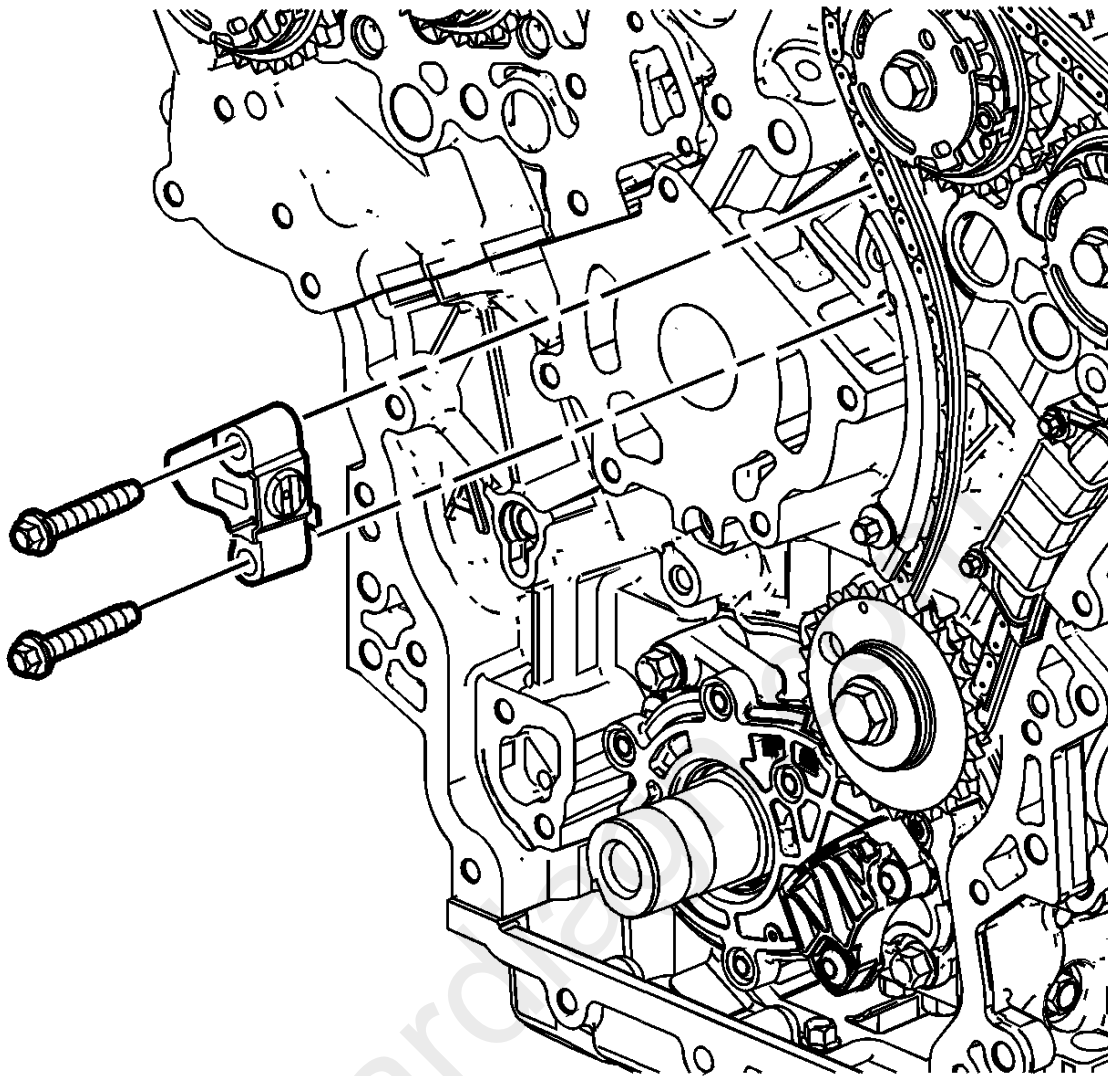


Fig. 105: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

2. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .

Installation Procedure

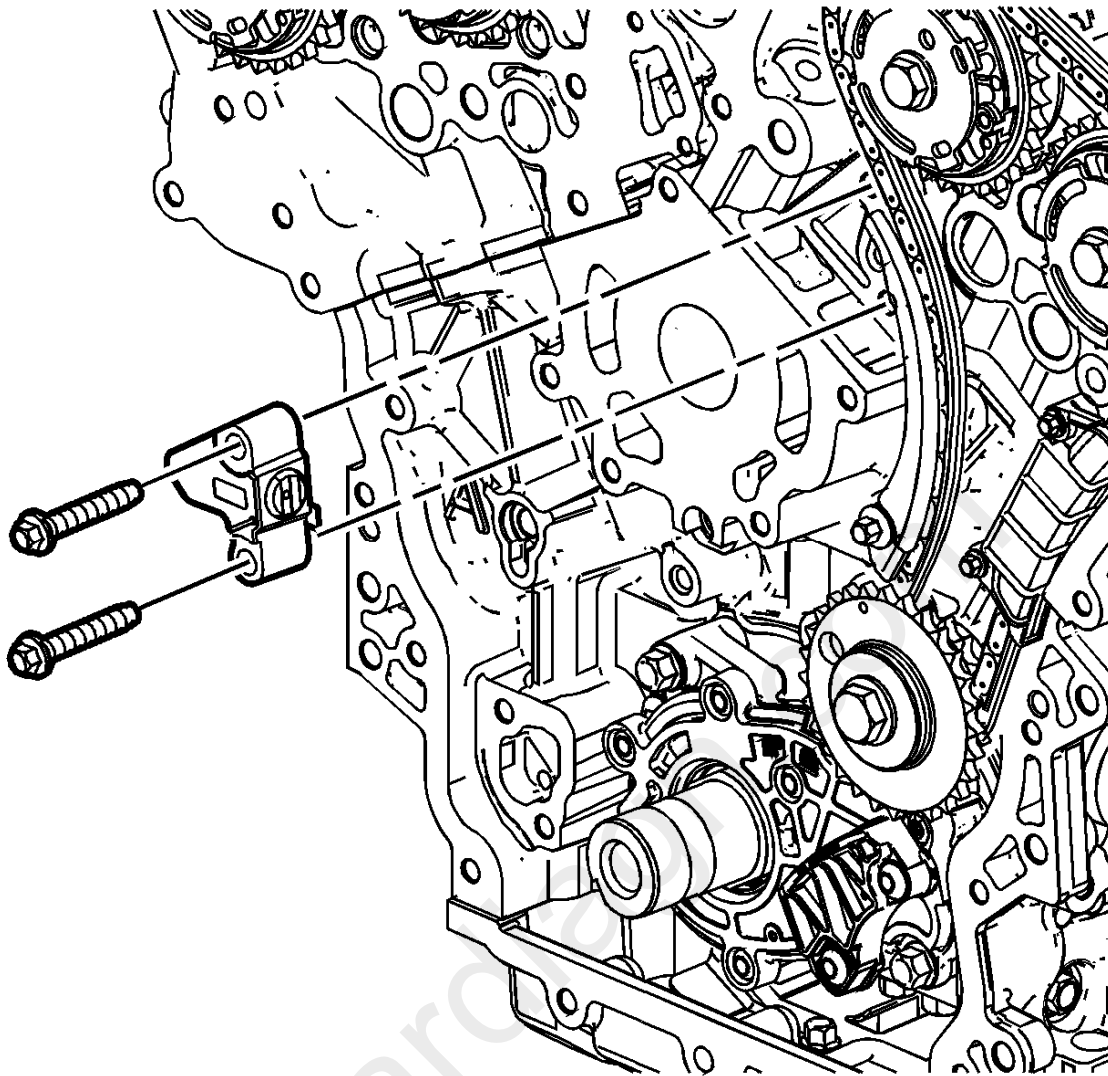


Fig. 106: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

1. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Left Side** .
2. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY TIMING CHAIN TENSIONER SHOE REPLACEMENT - RIGHT SIDE

Removal Procedure

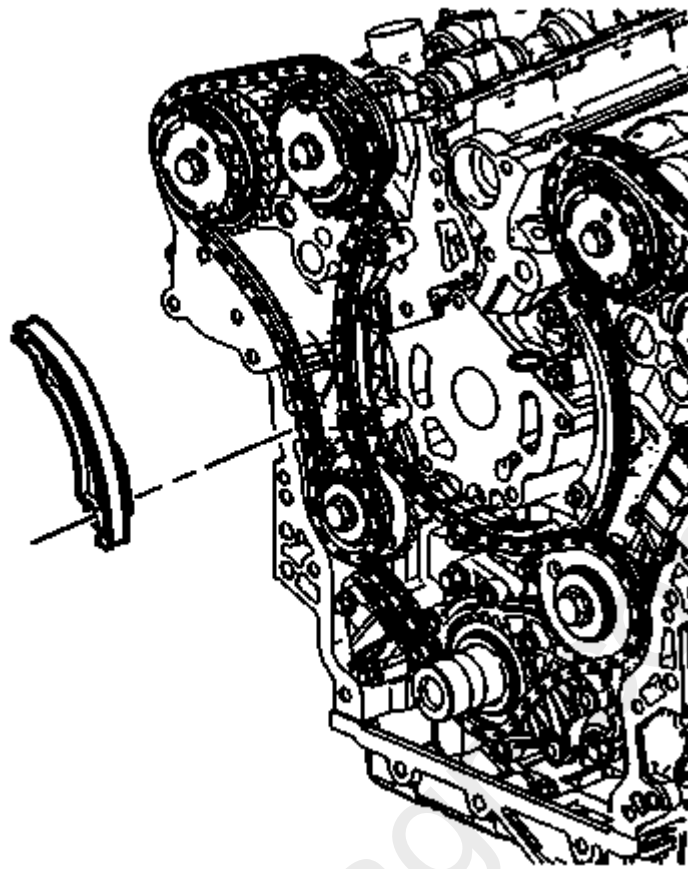


Fig. 107: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side**.
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side**.

Installation Procedure

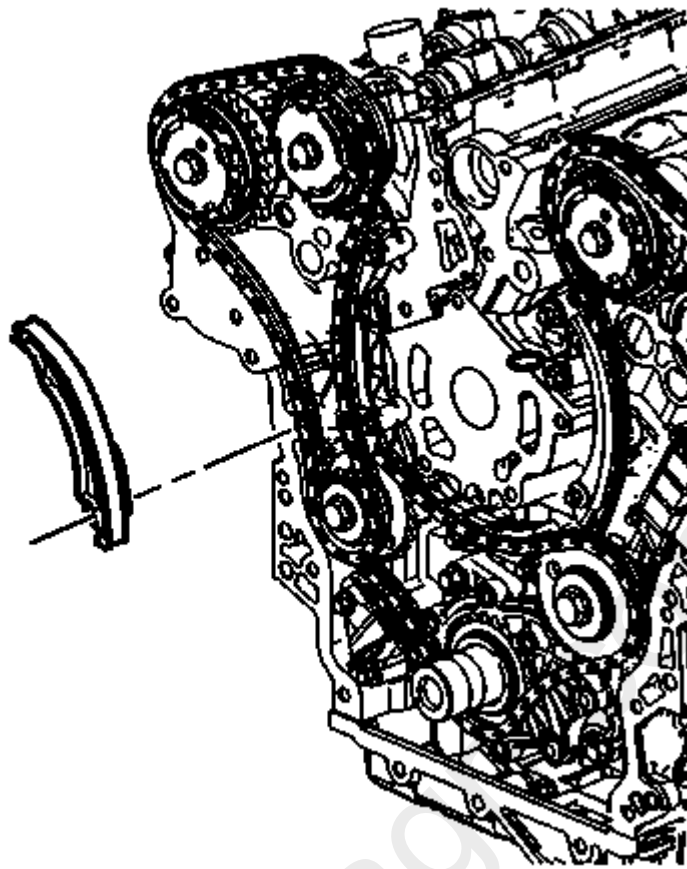


Fig. 108: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS COMPANY

1. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY TIMING CHAIN GUIDE REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .

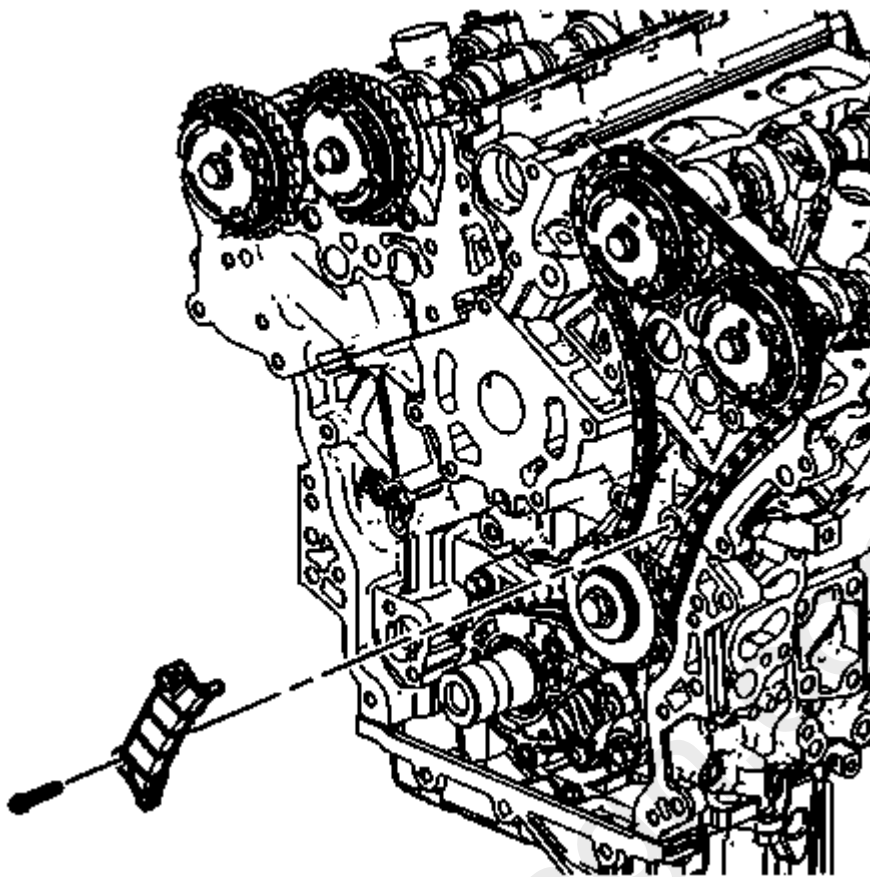


Fig. 109: View Of Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS COMPANY

3. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Left Side** .

Installation Procedure

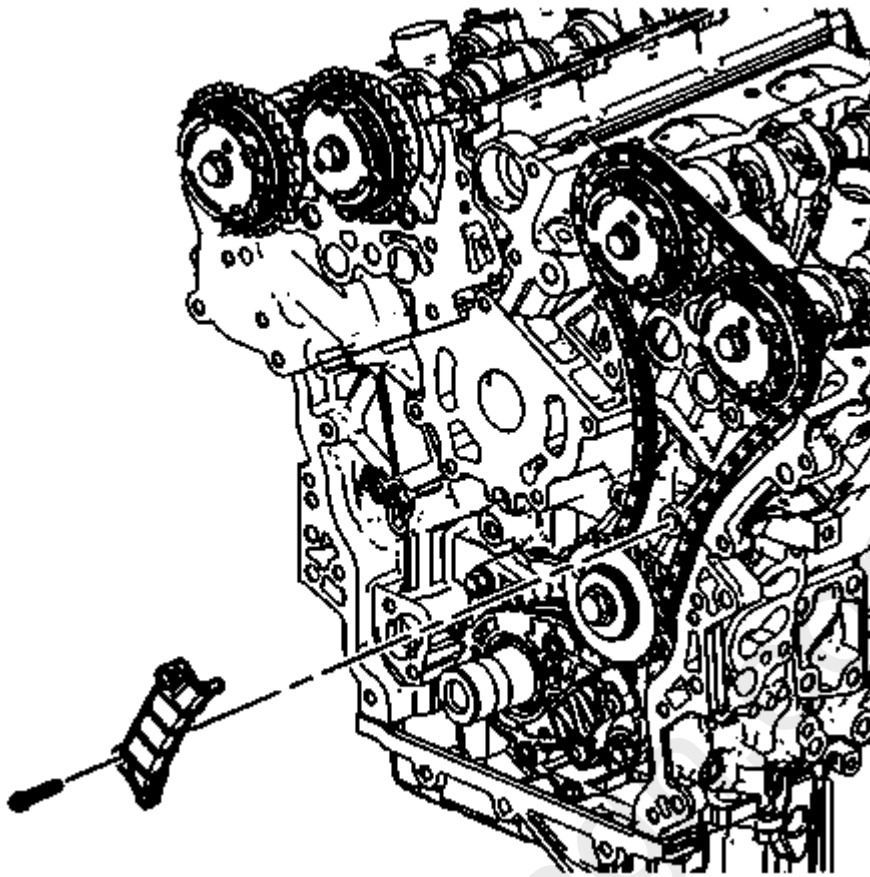


Fig. 110: View Of Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS COMPANY

1. Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Left Side** .
2. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Left Side** .
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY TIMING CHAIN GUIDE REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .

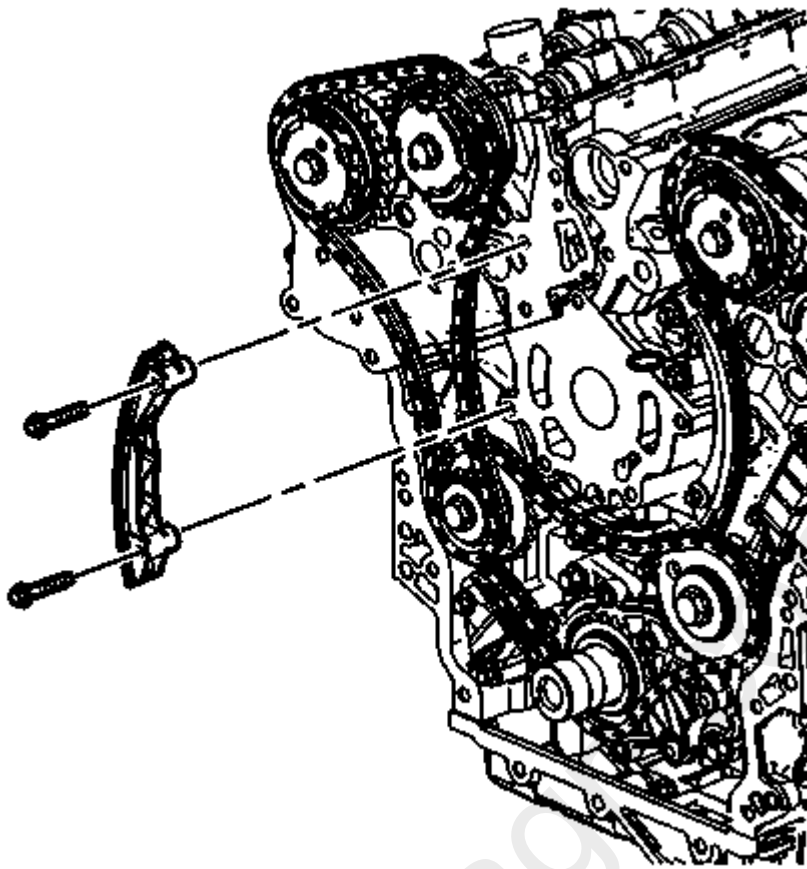


Fig. 111: View Of Right Secondary Camshaft Drive Chain Guide & Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side** .

Installation Procedure

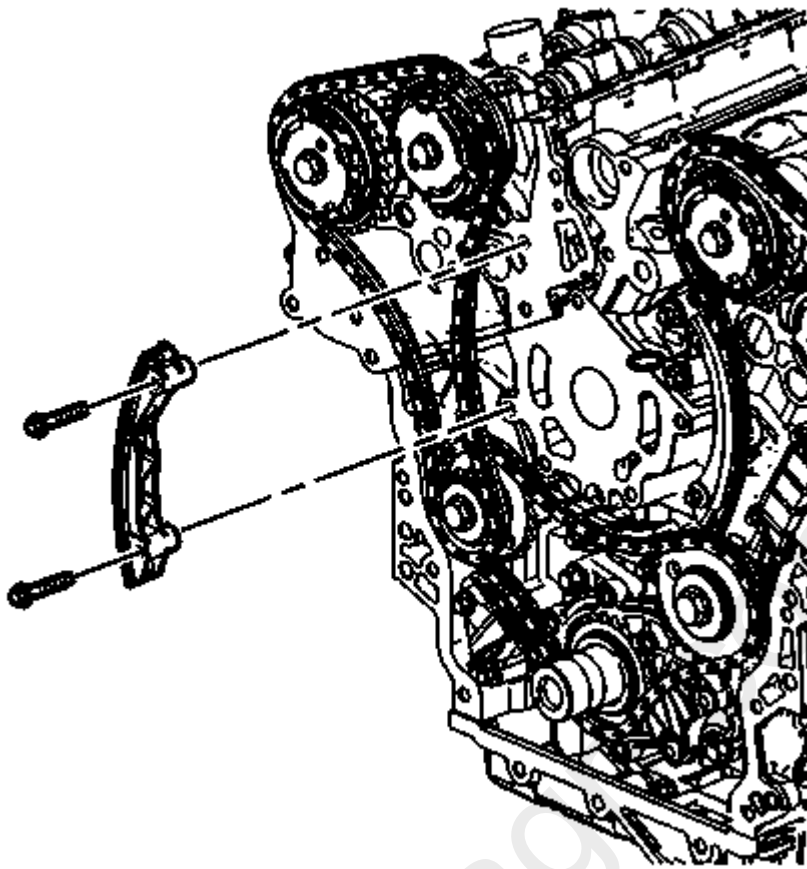


Fig. 112: View Of Right Secondary Camshaft Drive Chain Guide & Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
3. Install the engine front cover. Refer to **Engine Front Cover Replacement** .

PRIMARY CAMSHAFT DRIVE CHAIN AND SPROCKETS REPLACEMENT

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement** .
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side** .
4. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side** .
5. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side** .

6. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal** .
7. Remove the primary camshaft drive chain upper guide. **Primary Timing Chain Guide Removal - Upper** .

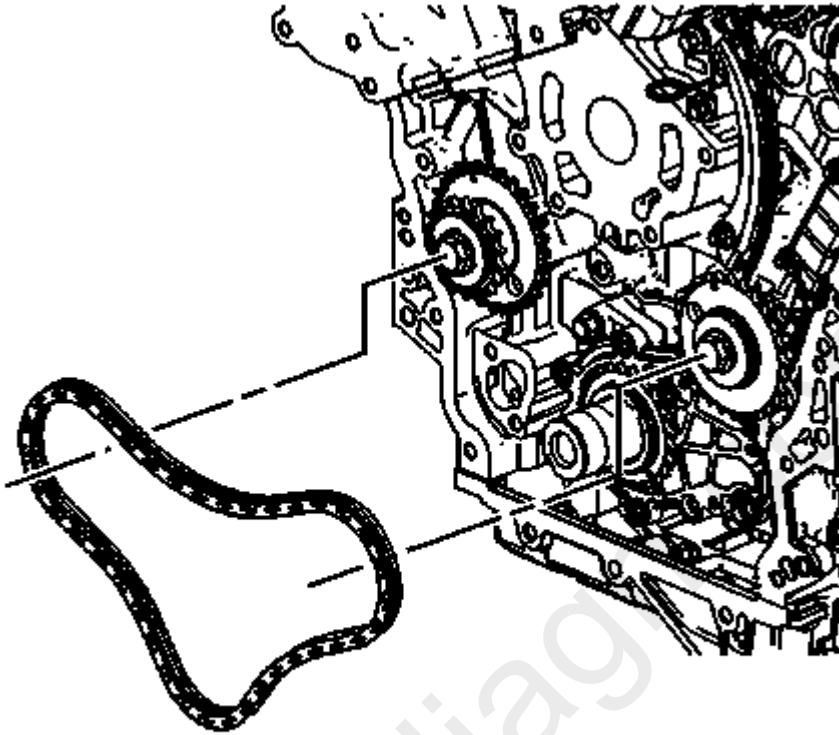


Fig. 113: View Of Primary Camshaft Timing Chain
Courtesy of GENERAL MOTORS COMPANY

8. Remove the primary camshaft timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side** .

Installation Procedure

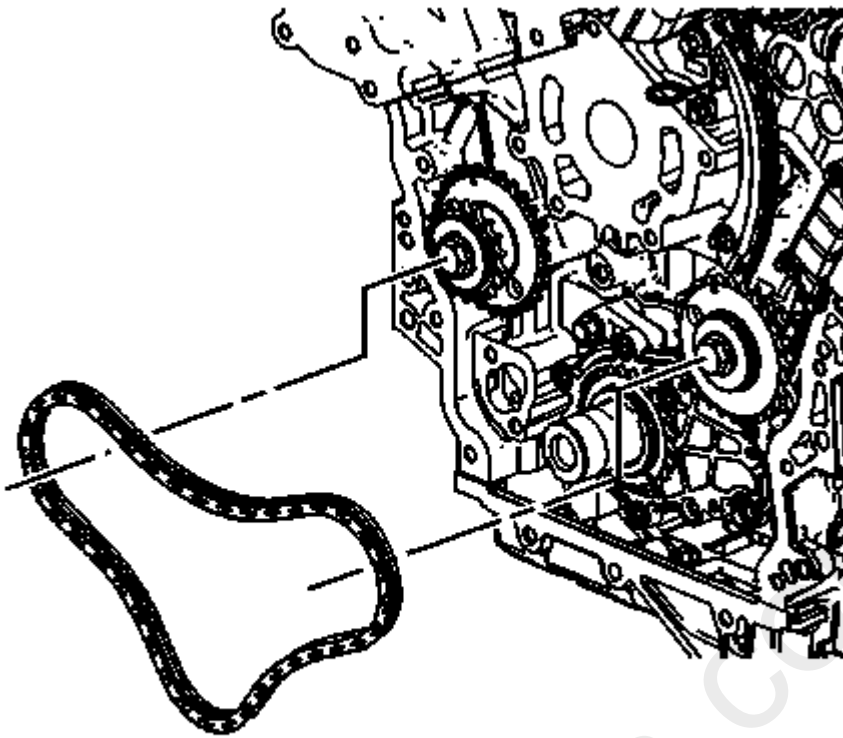


Fig. 114: View Of Primary Camshaft Timing Chain
 Courtesy of GENERAL MOTORS COMPANY

1. Install the primary camshaft timing chain. Refer to **Primary Camshaft Intermediate Drive Chain Installation** .
2. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
3. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
4. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side** .
5. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
6. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
7. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
8. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

TIMING CHAIN IDLER SPROCKET REPLACEMENT - LEFT SIDE

Removal Procedure

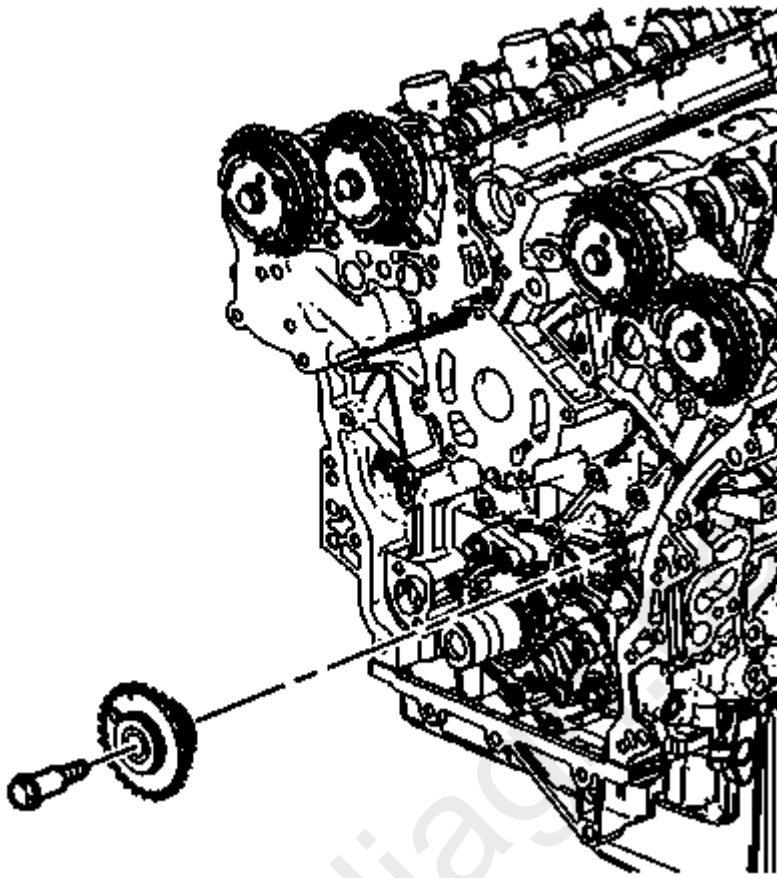


Fig. 115: View Of Left Camshaft Intermediate Drive Chain Idler Sprocket
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side**.
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side**.
4. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side**.
5. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side**.
6. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal**.
7. Remove the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Removal - Upper**.
8. Remove the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain Removal**.
9. Remove the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket**

Removal - Right Side .

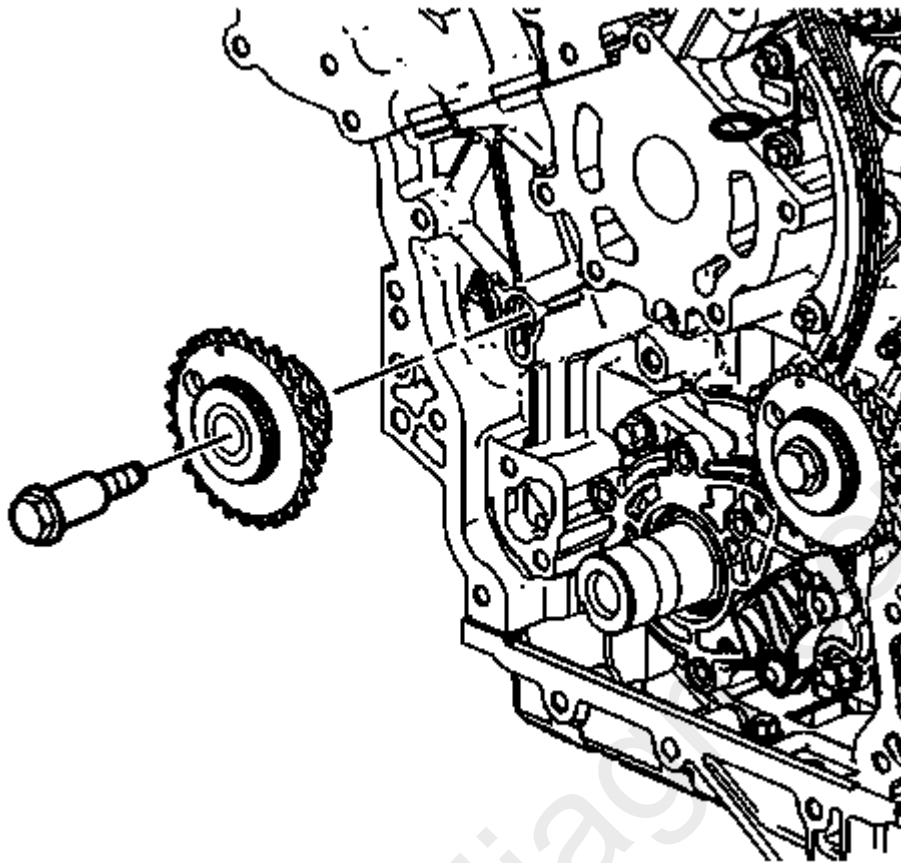


Fig. 116: View Of Right & Left Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS COMPANY

10. If you are servicing the left bank camshaft intermediate drive chain idler, perform the following steps:
 1. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .
 2. Remove the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Left Side** .
 3. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Left Side** .
 4. Remove the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Left Side** .
 5. Remove the left bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Removal - Left Side** .

Installation Procedure

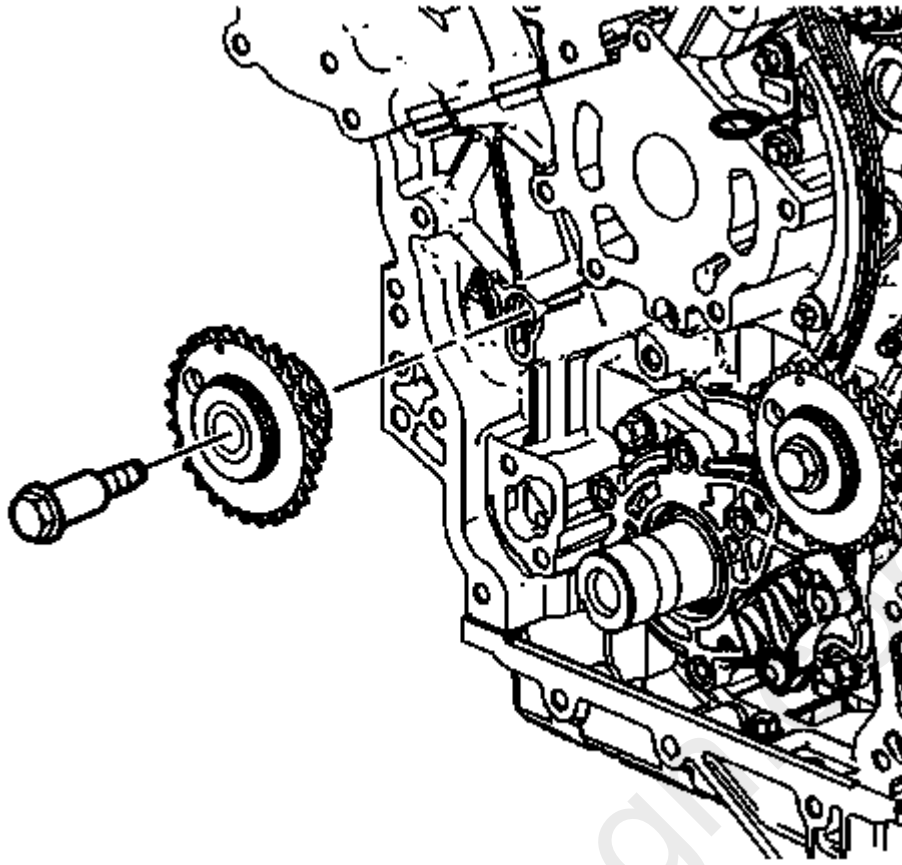


Fig. 117: View Of Right & Left Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS COMPANY

1. If you are servicing the left bank idler sprocket, perform the following steps:
 1. Install the left bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Left Side** .
 2. Install the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Left Side** .
 3. Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Left Side** .
 4. Install the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Left Side** .
 5. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Left Side** .

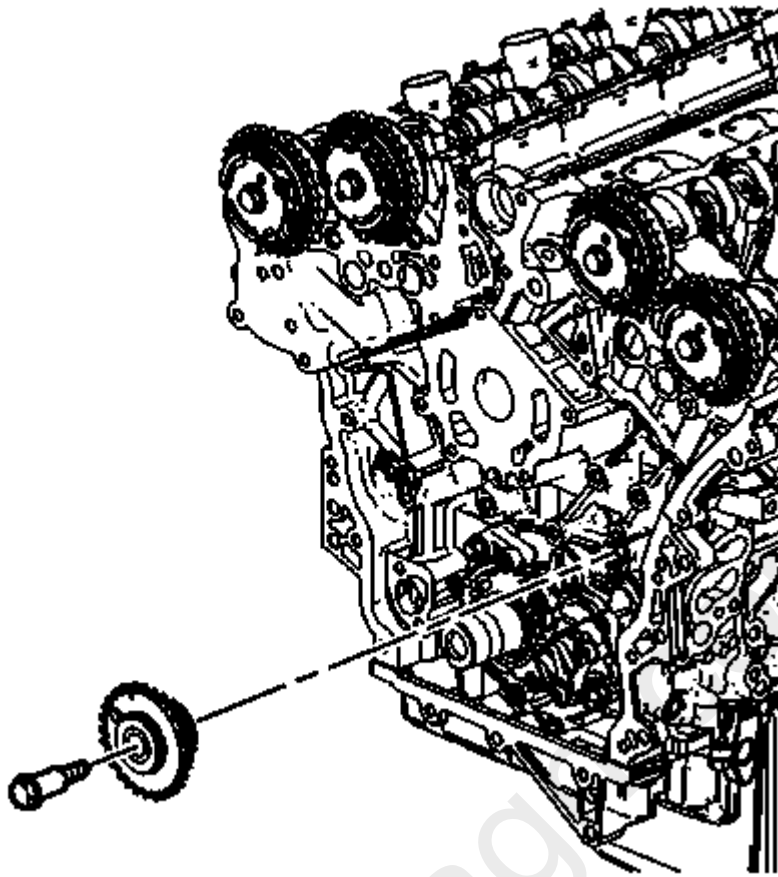


Fig. 118: View Of Left Camshaft Intermediate Drive Chain Idler Sprocket
Courtesy of GENERAL MOTORS COMPANY

2. Install the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Right Side** .
3. Install the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain Installation** .
4. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
5. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
6. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side** .
7. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
8. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
9. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .
10. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

TIMING CHAIN IDLER SPROCKET REPLACEMENT - RIGHT SIDE

Removal Procedure

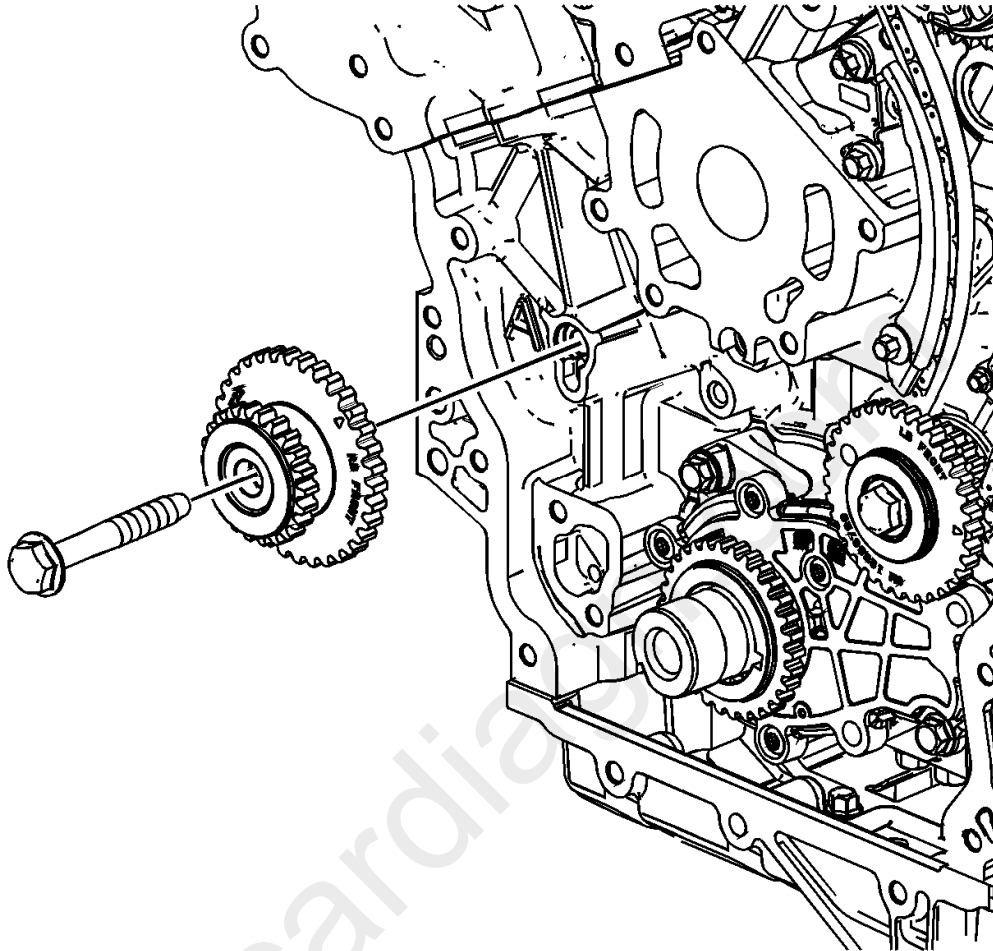


Fig. 119: Identifying Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement**.
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side**.
5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side**.
6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side**.
7. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive**

Chain Tensioner Removal .

8. Remove the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Removal - Upper** .
9. Remove the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain Removal** .
10. Remove the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Removal - Right Side** .

Installation Procedure

1. Ensure stage 1 camshaft timing is correct. Refer to **Setting Camshaft Timing**.

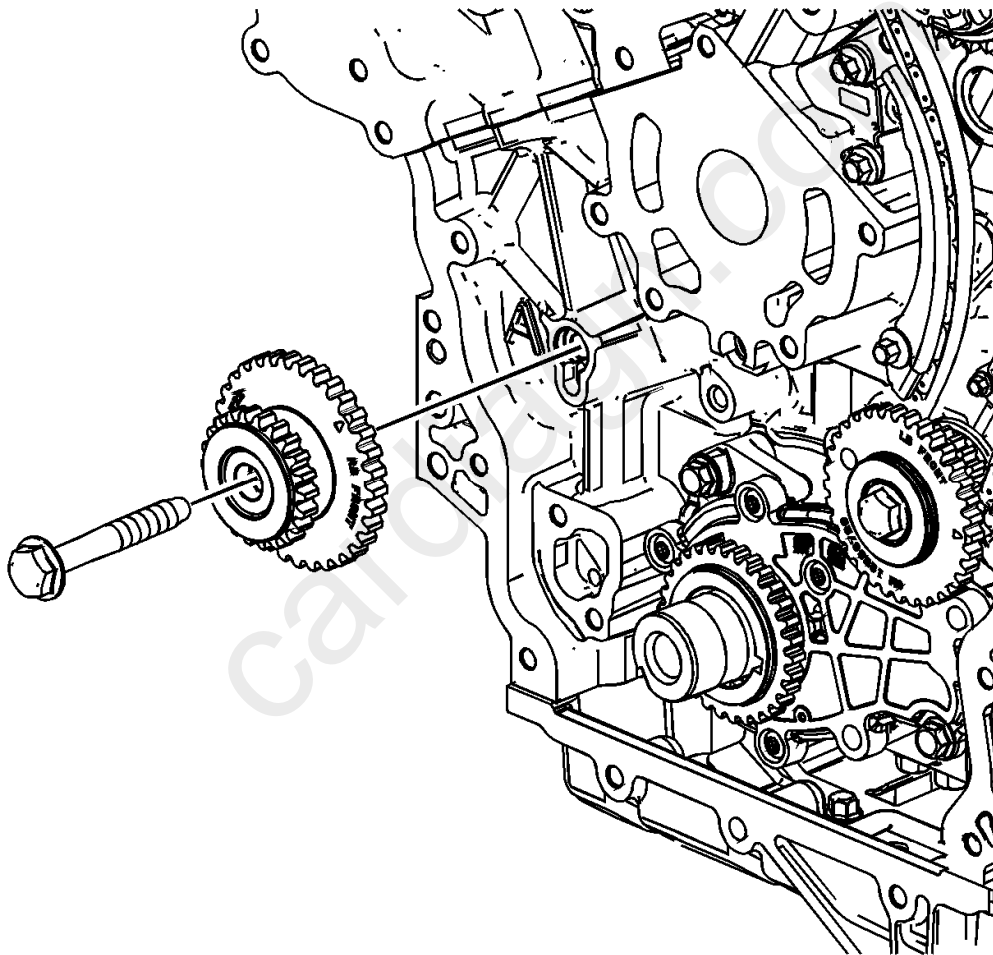


Fig. 120: Identifying Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install the right bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Right Side** .
3. Install the primary camshaft drive chain. Refer to **Primary Camshaft Intermediate Drive Chain**

Installation .

4. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper .**
5. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation .**
6. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side .**
7. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side .**
8. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side .**
9. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side .**
10. Install the spark plugs. Refer to **Spark Plug Replacement .**
11. Install the engine front cover. Refer to **Engine Front Cover Replacement.**

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT

Removal Procedure

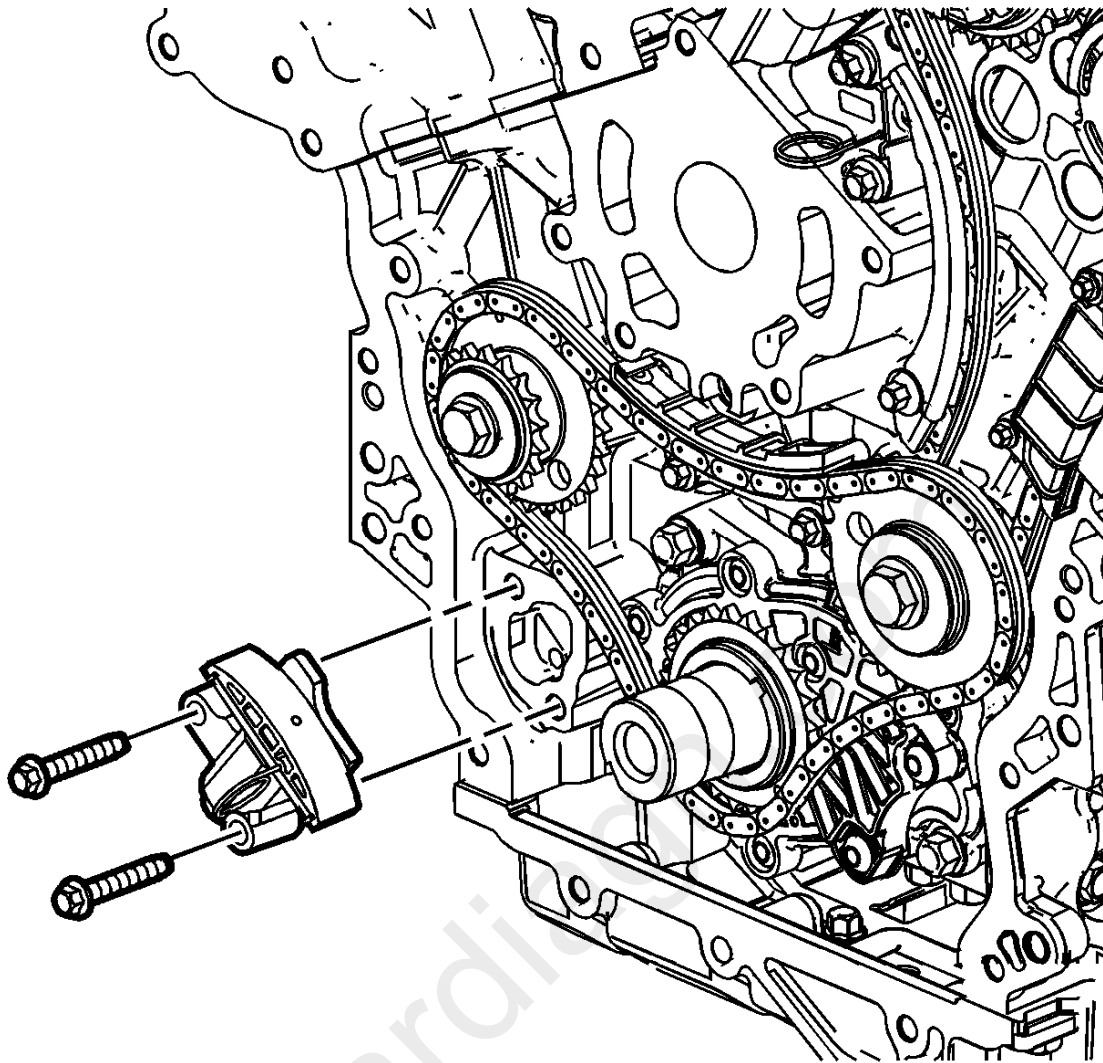


Fig. 121: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.

IMPORTANT: If the entire camshaft timing system is not in Stage 2, **Timing Chain Alignment Diagram** , mark the timing chain and sprockets in order to ensure proper reassembly.

2. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal** .

Installation Procedure

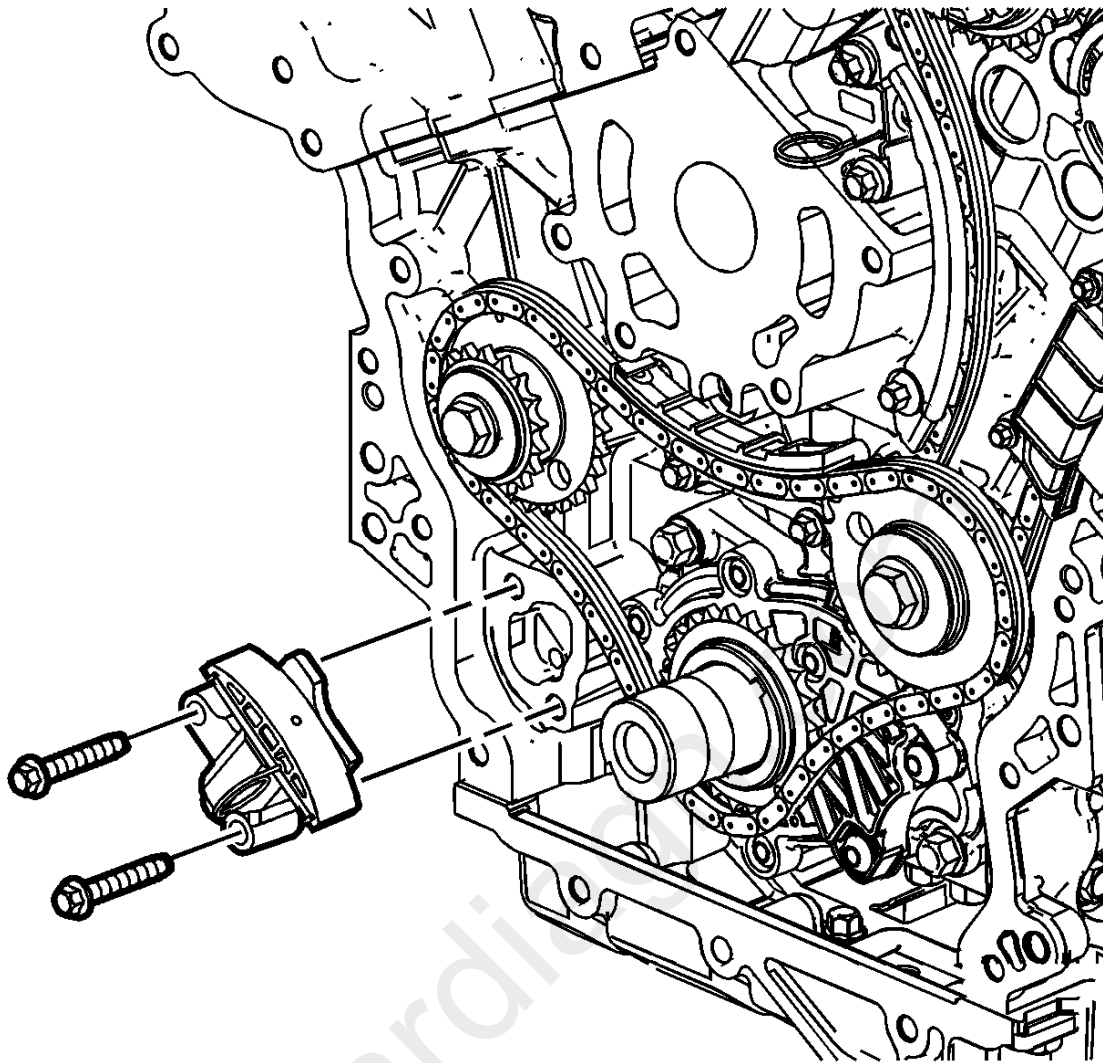


Fig. 122: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

1. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
2. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

PRIMARY TIMING CHAIN GUIDE REPLACEMENT - LOWER

Removal Procedure

1. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Replacement**.

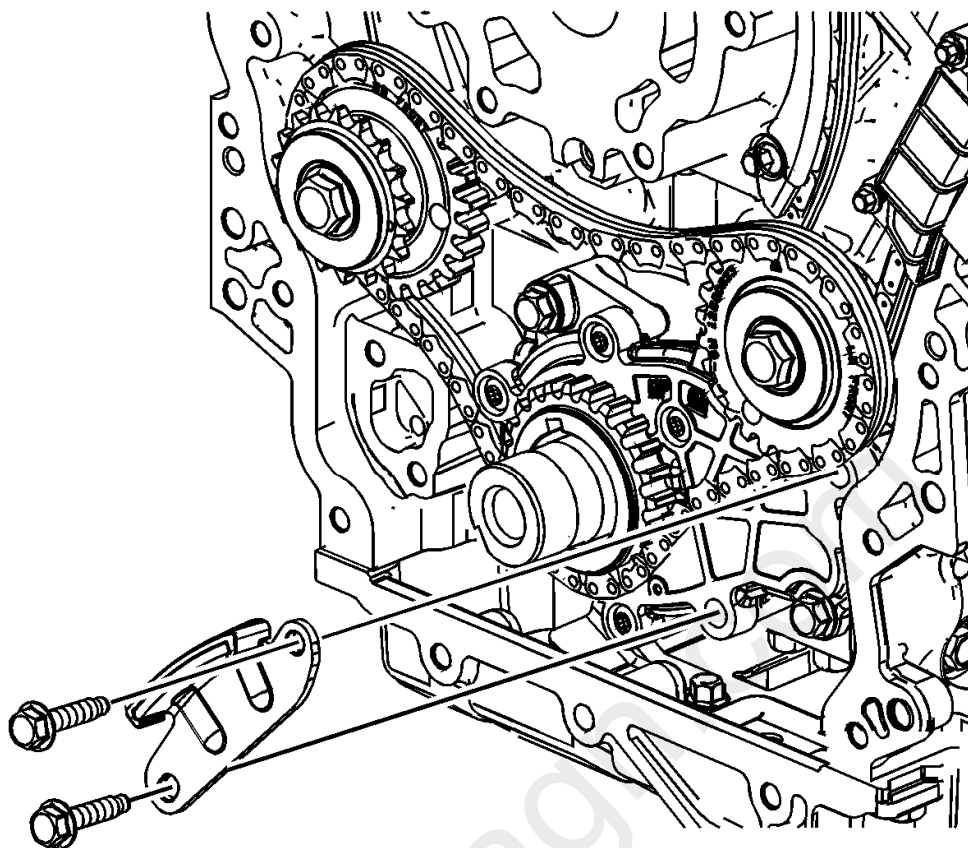


Fig. 123: View Of Primary Camshaft Drive Chain Lower Guide Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the primary camshaft drive chain lower guide bolts.
3. Remove the primary camshaft drive chain lower guide.

Installation Procedure

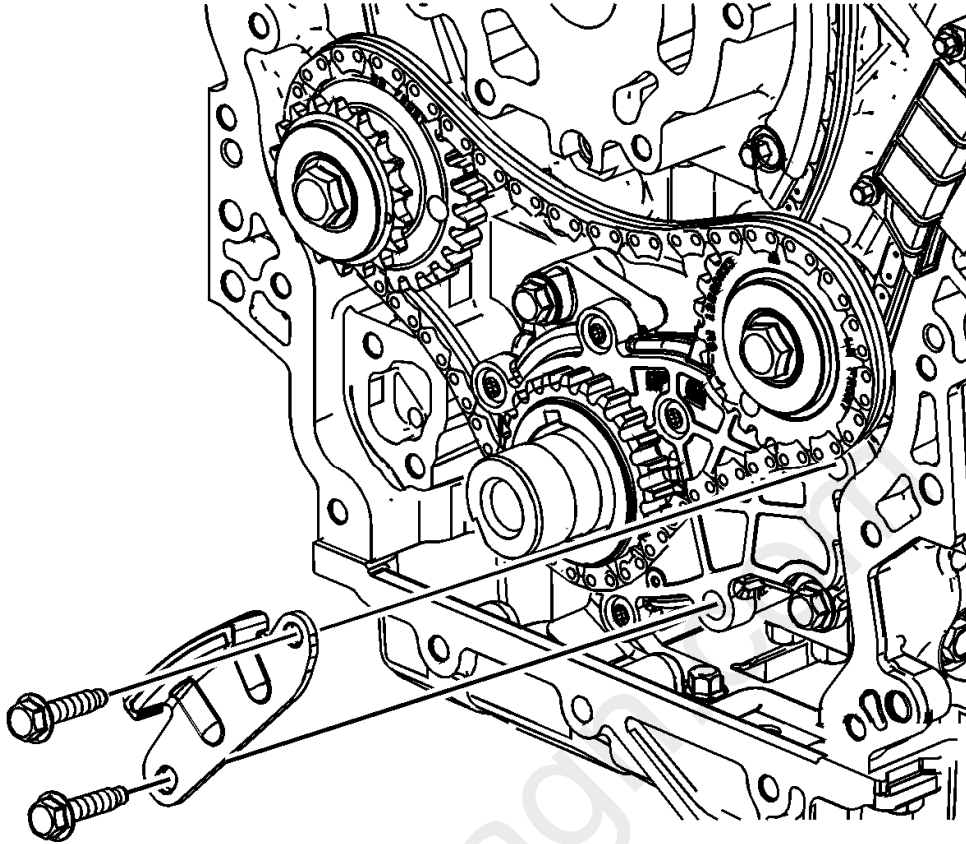


Fig. 124: View Of Primary Camshaft Drive Chain Lower Guide Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the primary camshaft drive chain lower guide to the oil pump.

CAUTION: Refer to Fastener Caution .

2. Install the primary camshaft drive chain lower guide bolts and tighten to 23 N.m (17 lb ft).
3. Install the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Replacement.

PRIMARY TIMING CHAIN GUIDE REPLACEMENT - UPPER

Removal Procedure

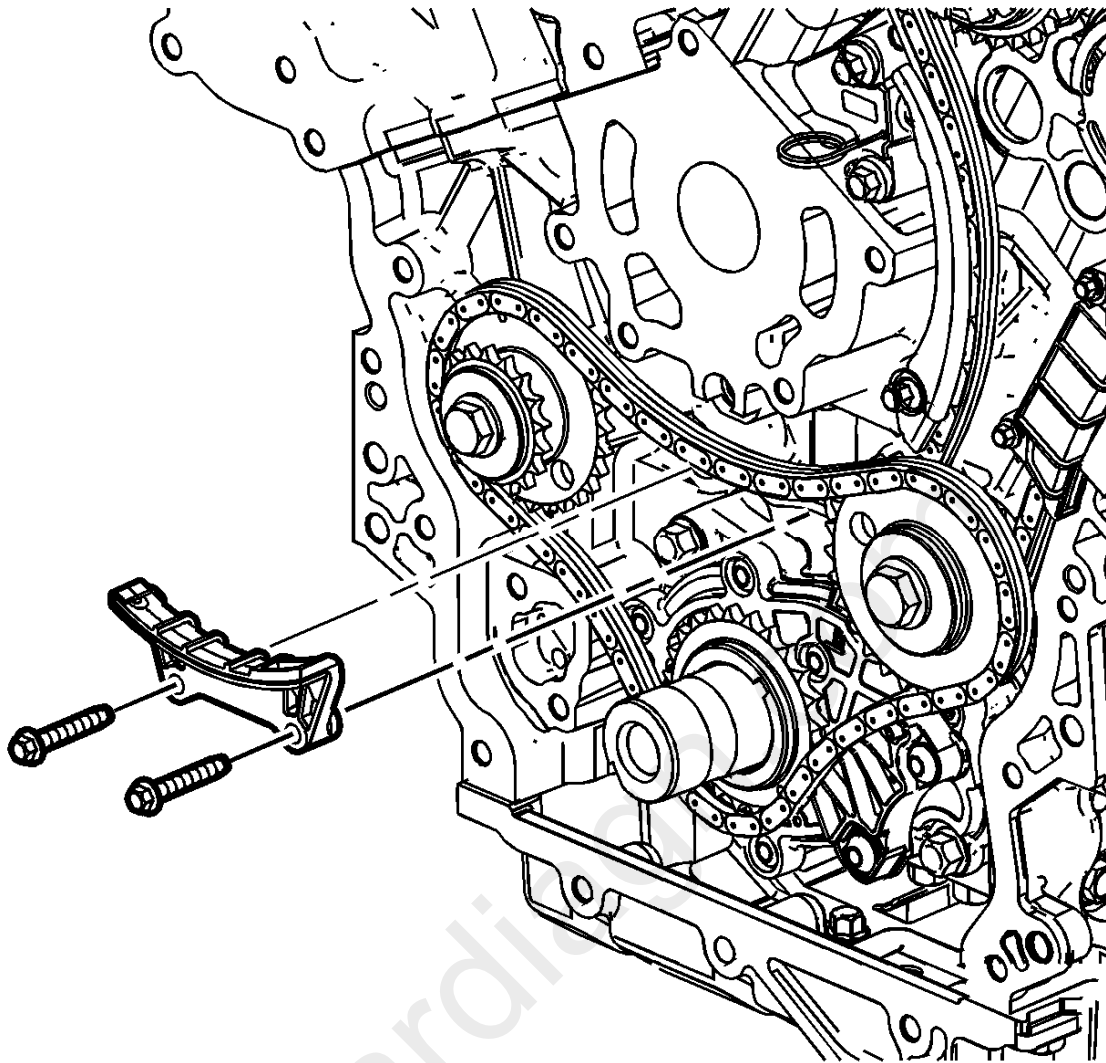


Fig. 125: View Of Upper Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal**.
3. Remove the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Removal - Upper**.

Installation Procedure

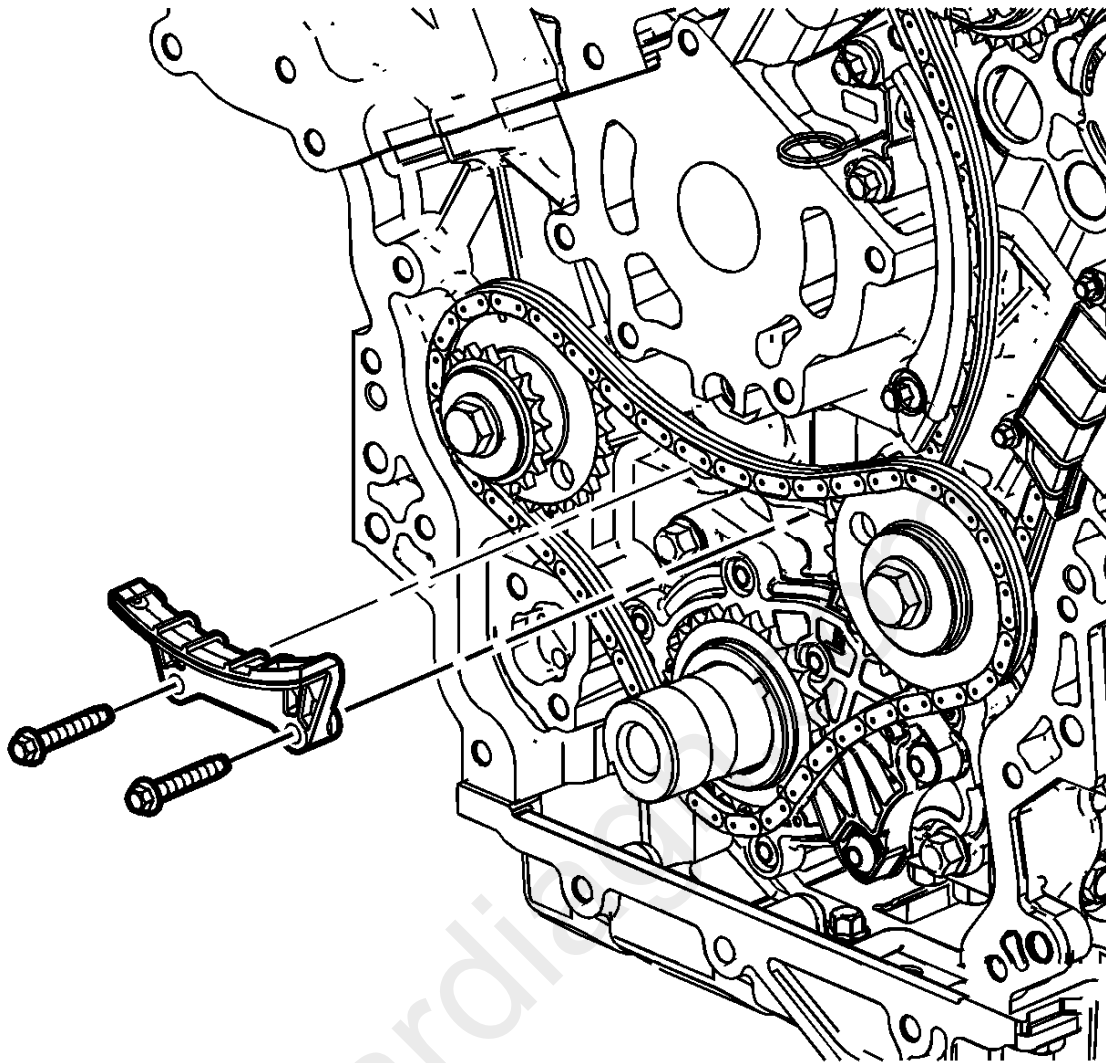


Fig. 126: View Of Upper Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS COMPANY

1. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
2. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1

Special Tools

- EN49982-1 Timing Chain Retainer
- EN49982-2 Timing Chain Retainer

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

Removal Procedure

1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement - Right Side.**
2. Remove the camshaft position actuator solenoid valve solenoid - intake. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake .**
3. Remove the intake camshaft position sensor. Refer to **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake .**
4. Remove the exhaust camshaft position sensor. Refer to **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust .**
5. Remove the camshaft position actuator solenoid valve solenoid - exhaust. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust .**
6. Rotate engine clockwise using crankshaft dampener retaining bolt until the flats at the rear ends of the camshafts are pointing up. This puts the camshafts on "base circle" and will reduce their tendency to rotate from valve spring pressure when the camshaft position actuators/drive chains are removed.

NOTE: **Do NOT remove or back out the camshaft position actuator bolt(s) significantly, simply break them loose from their fully-torqued position. The position actuators must stay firmly attached until the retaining tools are in place, but they should be broken loose while the chain is still tight and in position.**

7. Loosen intake and/or exhaust camshaft position actuator retaining bolts, depending on which camshaft position actuator and/or camshaft you will be servicing. If servicing both camshaft position actuators and/or camshafts, loosen both bolts.

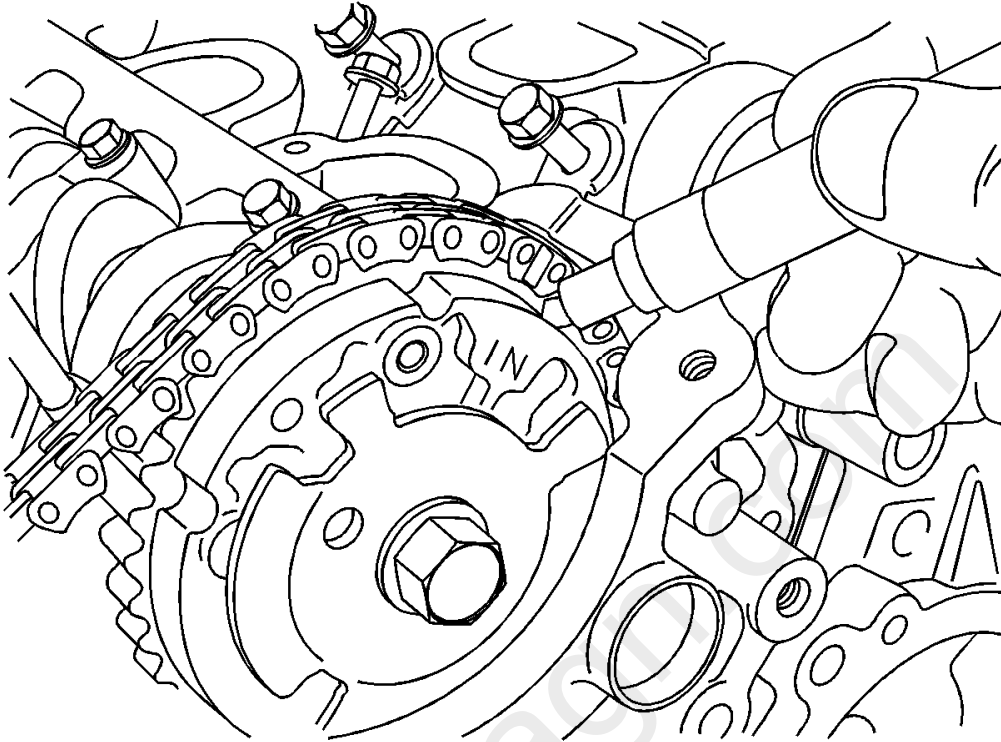


Fig. 127: Marking Position Of Chain To Camshaft Position Actuator - Intake
Courtesy of GENERAL MOTORS COMPANY

NOTE: Be certain to clearly mark the position of the chain to the camshaft position actuator(s). Though the engine does not need to be set to a specific timing mark before starting the procedure, the relationship of the chain to the actuator(s) is critical and must be reestablished on assembly.

8. Mark the position of the chain to the camshaft position actuator - intake.

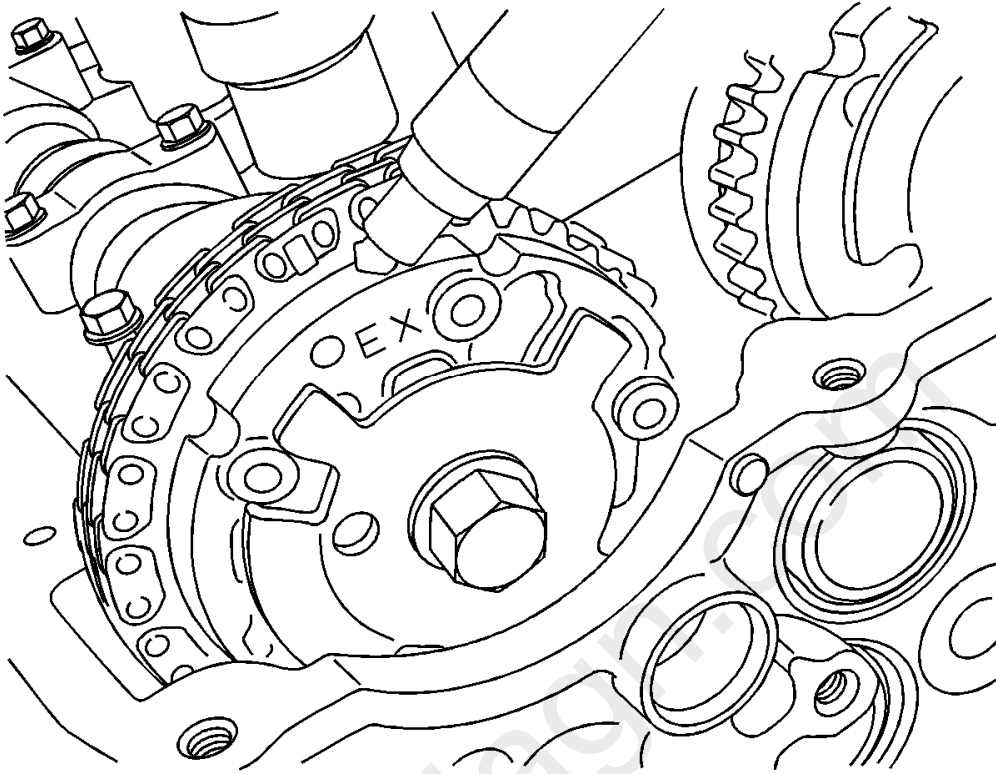


Fig. 128: Marking Position Of Chain To Camshaft Position Actuator - Exhaust
Courtesy of GENERAL MOTORS COMPANY

9. Mark the position of the chain to the camshaft position actuator - exhaust.

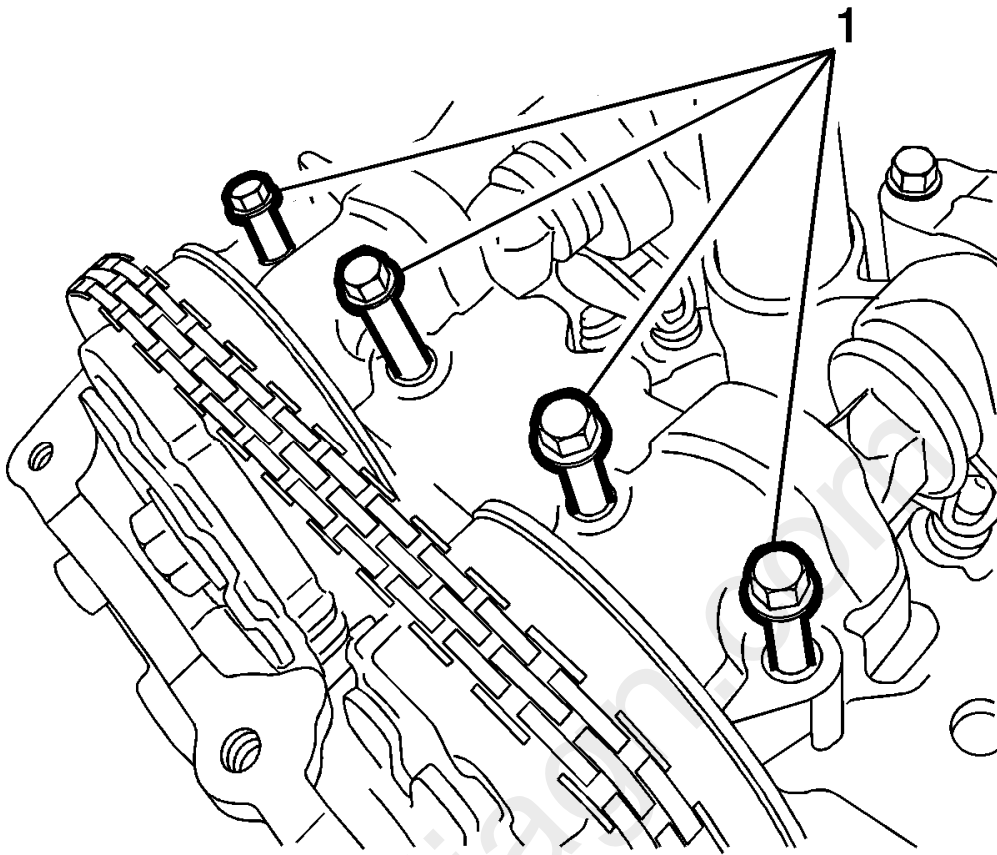


Fig. 129: Identifying Camshaft Front Cap & Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove camshaft front cap bolts (1).

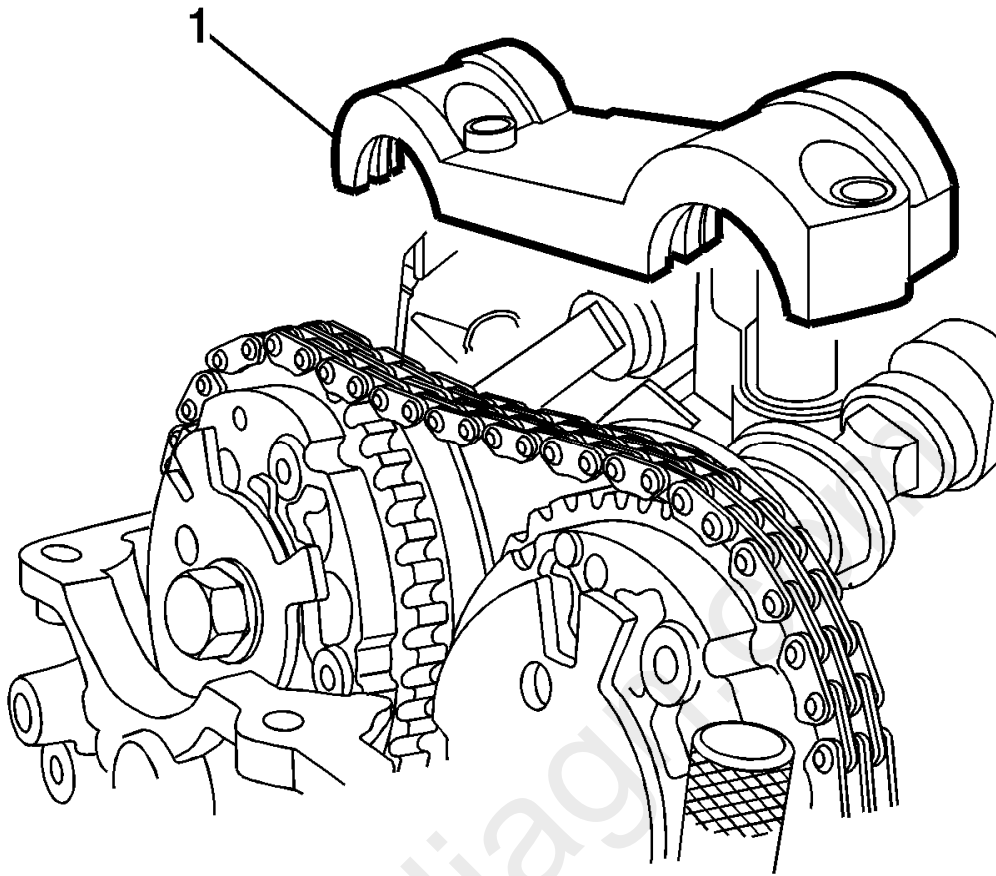


Fig. 130: View Of Camshaft Front Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT remove or loosen any other camshaft bearing caps at this time, even if you intend to eventually remove the camshaft.

11. Remove the camshaft front cap (1).

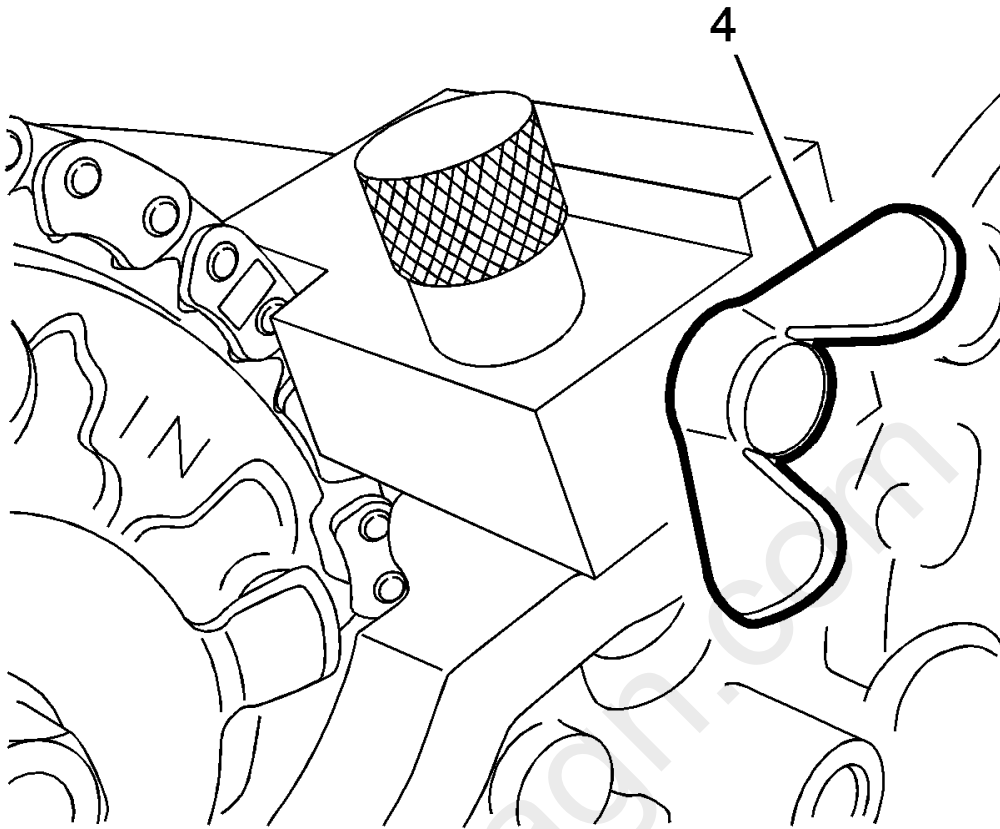


Fig. 131: Retainer Wingnut
Courtesy of GENERAL MOTORS COMPANY

12. Loosen wingnut (4) to open the clamping area of EN49982-1 retainer.

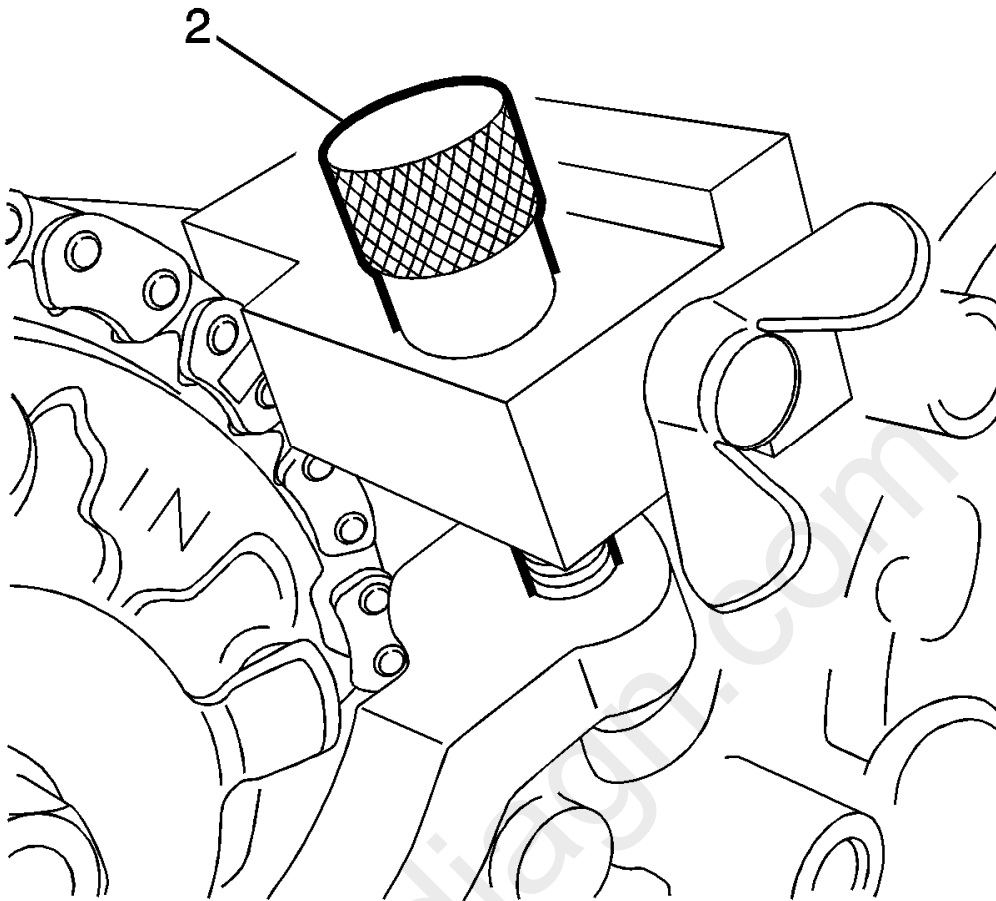


Fig. 132: View Of Retainer Thumbscrew
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT overtighten the thumbscrew. The EN49982-1 retainer should be able to slide slightly via the slot the screw goes through. This fore/aft movement will allow easier removal and installation of the chain later.

13. Install EN49982-1 retainer intake side chain holder onto front cover by screwing in the thumbscrew (2) on the EN49982-1 retainer finger-tight.

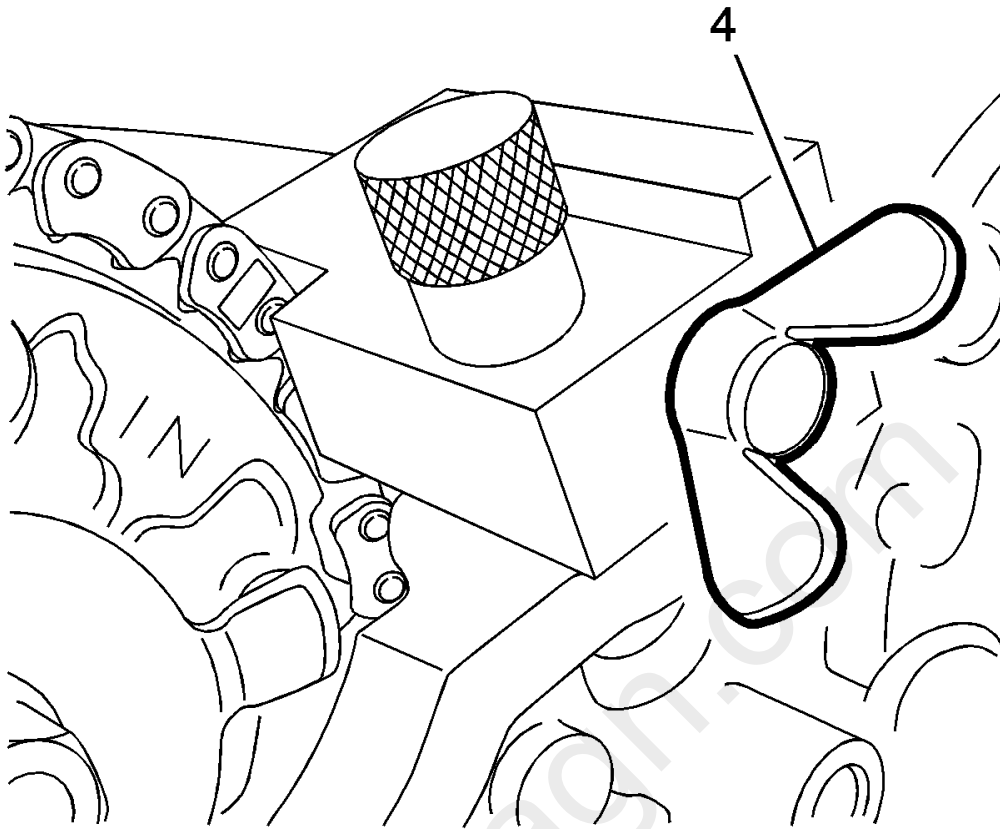


Fig. 133: Retainer Wingnut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten the wingnut with a tool of any kind. Firm finger-tightening is sufficient.

14. Tighten wingnut (4) so **EN49982-1** retainer closes over and firmly grasps timing chain.

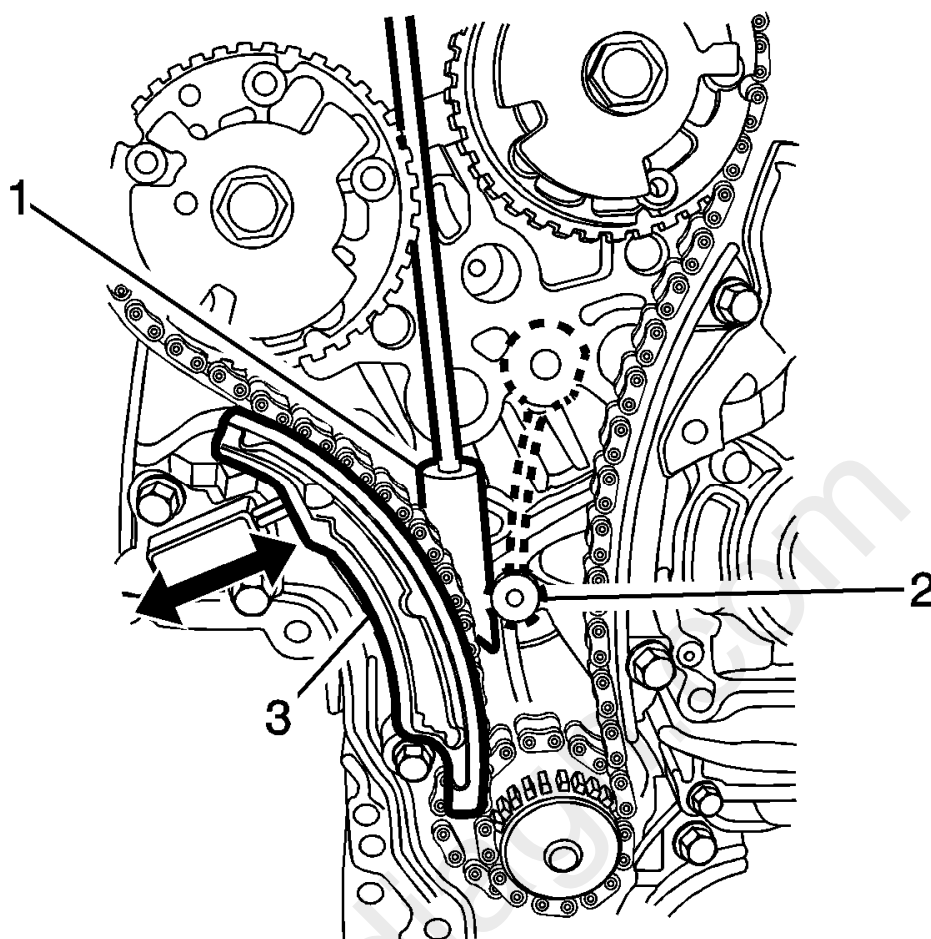


Fig. 134: Retainer Wedge

Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine front cover is removed for clarity in the following graphics, but is NOT required to be removed to perform the procedure.

15. **EN49982-2** retainer (1) will be installed in the following steps such that it wedges between an internal rib (2) that is cast into the inside of the front cover (shown in dotted line above) and the timing chain and spring-loaded tensioner shoe (3), holding the chain in position. The wedge will be left in place during the cam position actuator and/or camshaft service.

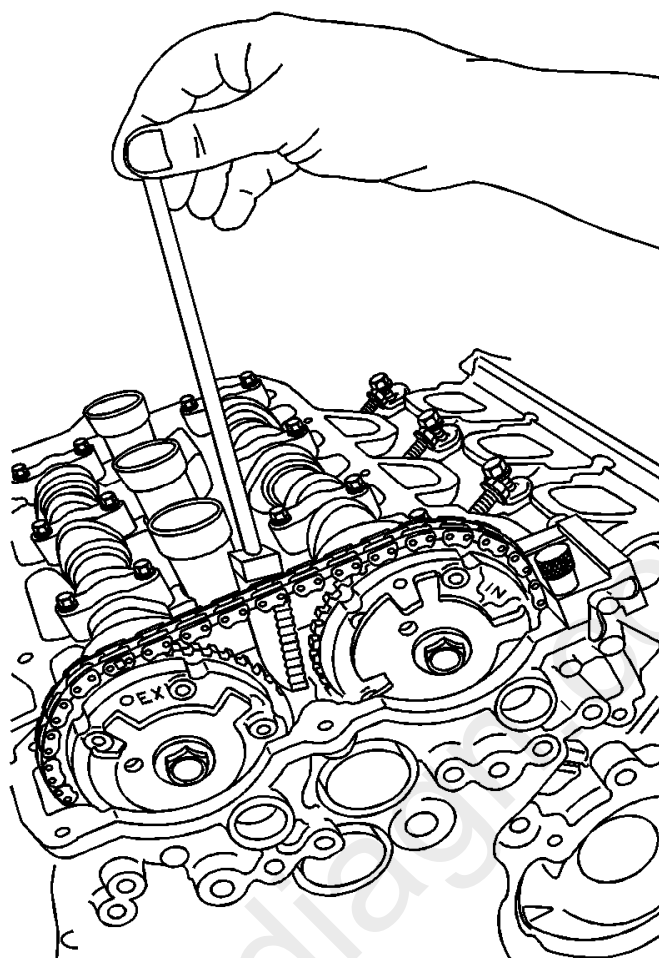


Fig. 135: Inserting Retainer

Courtesy of GENERAL MOTORS COMPANY

16. Insert the **EN49982-2** retainer between the two camshaft position actuators with the "teeth" on the **EN49982-2** retainer facing toward the front cover.

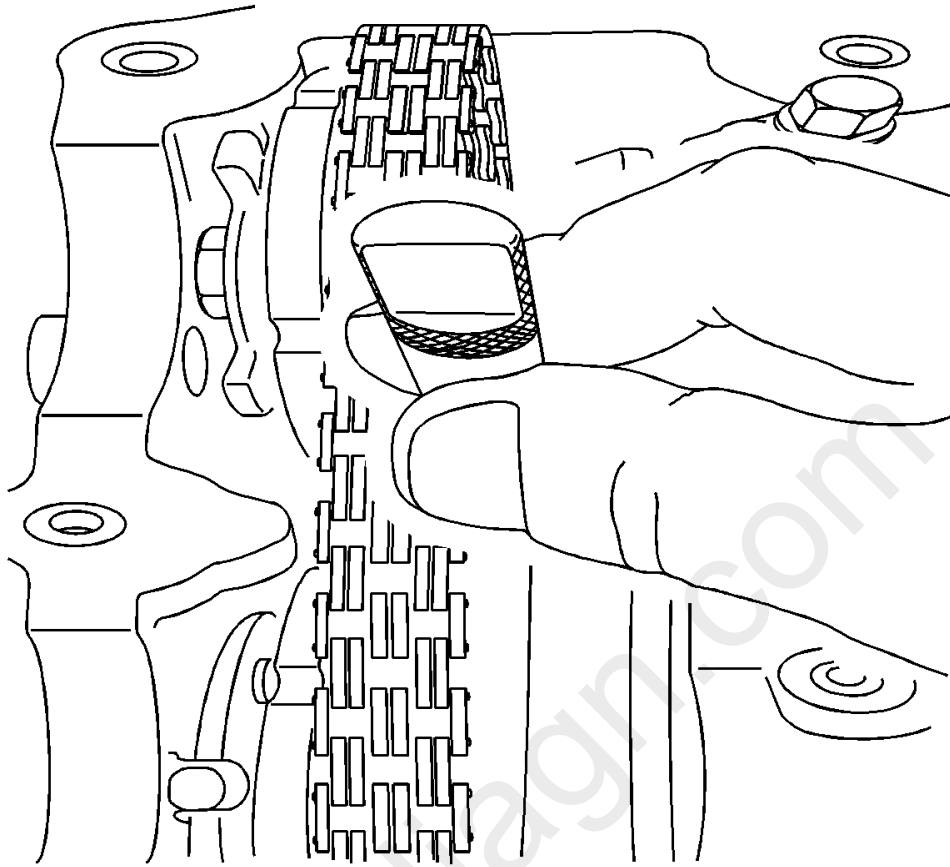


Fig. 136: Orienting Retainer Teeth
Courtesy of GENERAL MOTORS COMPANY

17. Once the wedge portion of **EN49982-2** retainer is below the camshaft position actuators, rotate the **EN49982-2** retainer until the flat in the handle faces toward the intake camshaft position actuator. This orients the "teeth" toward the chain.

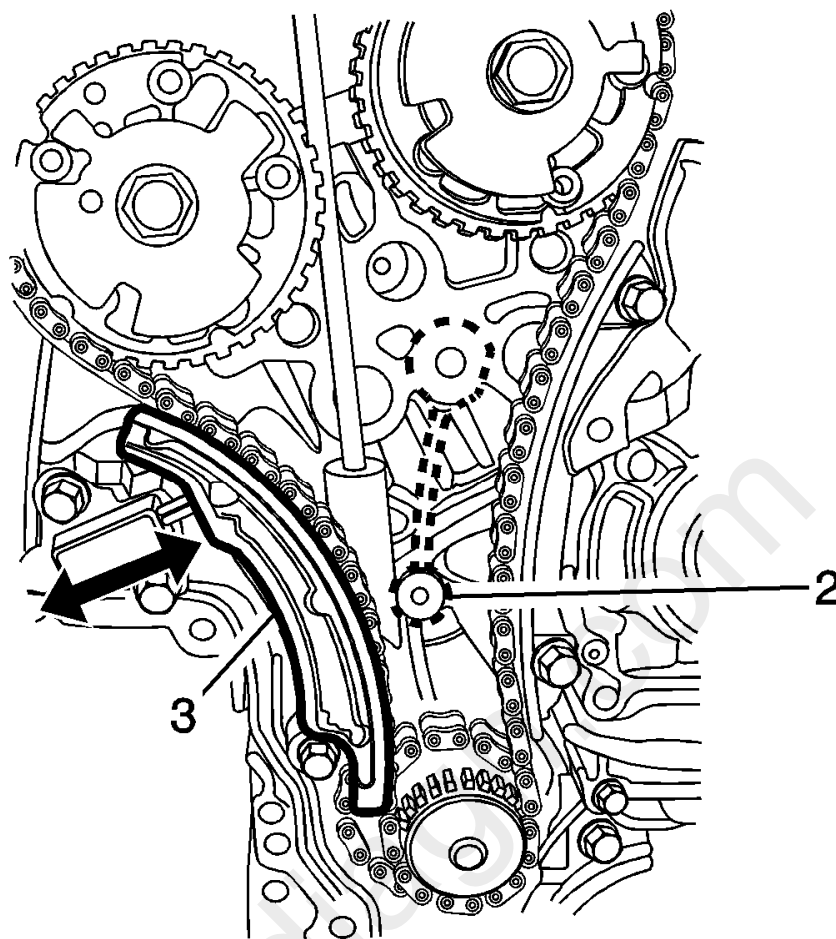


Fig. 137: Wedge, Timing Chain And Belt Casting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not try to force the wedge into position, simply ensure it is loosely engaged in the timing chain and in the correct overall position.

18. Drop the wedge down until it begins to engage the timing chain and the belt casting (2).

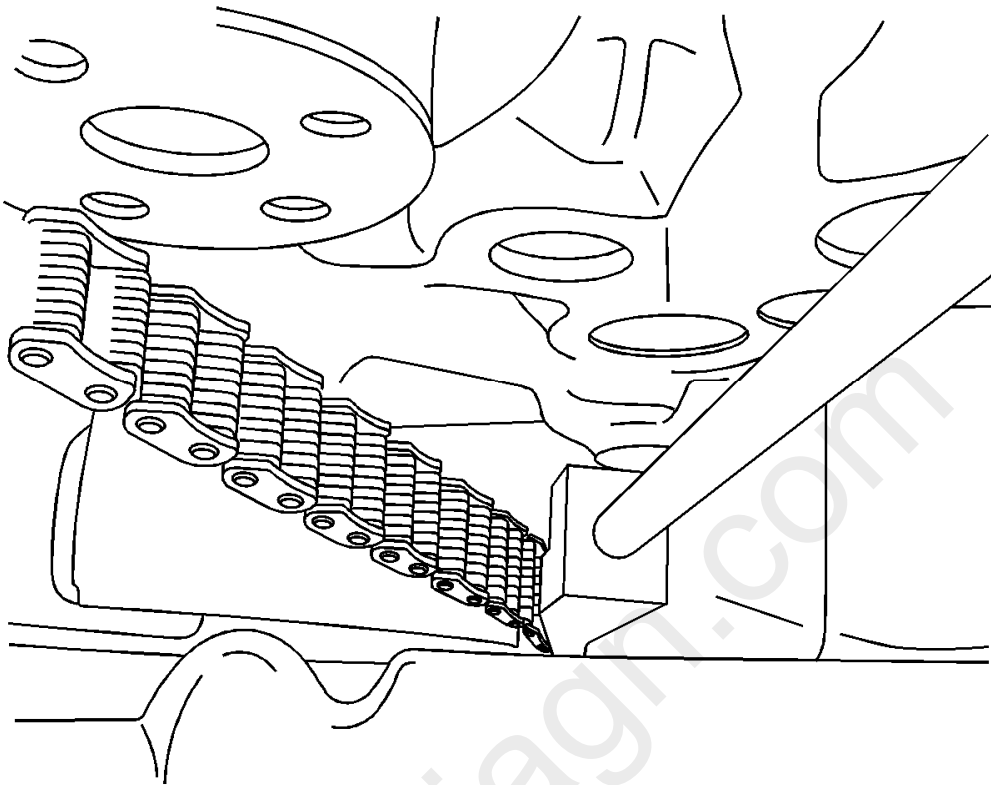


Fig. 138: Positioning Wedge

Courtesy of GENERAL MOTORS COMPANY

19. If possible shine a strong light down from above, between the camshaft position actuators, and see the wedge in overall position as shown in the above graphic.

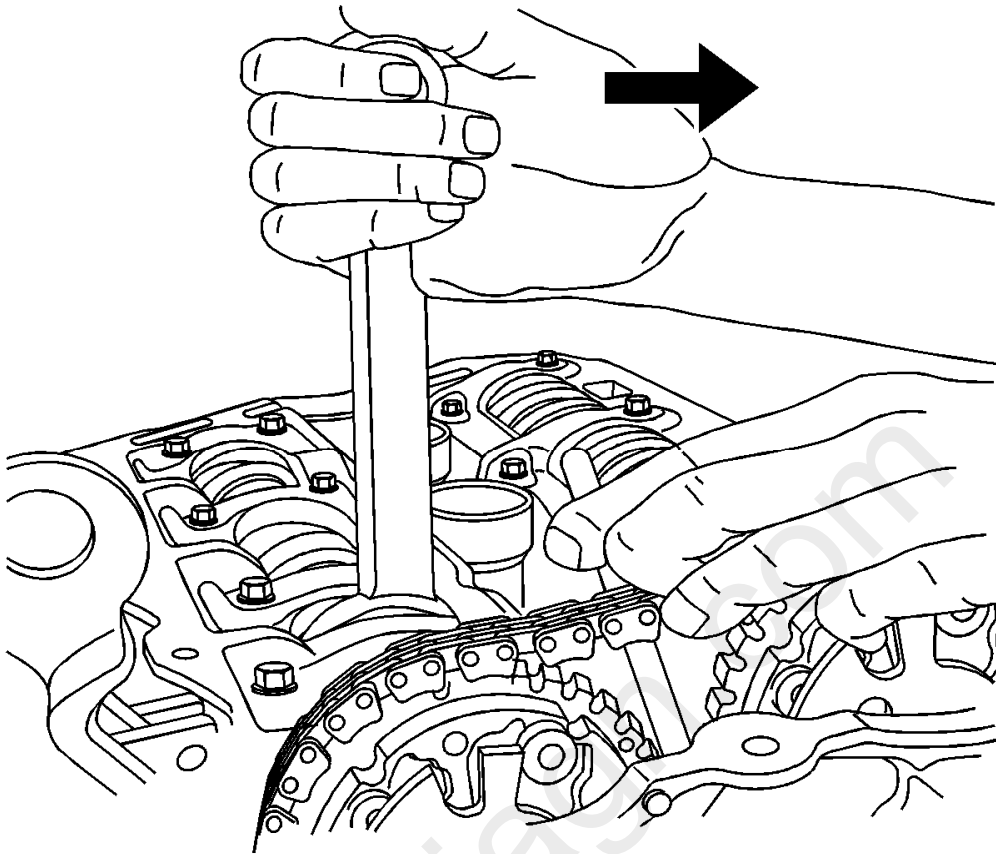


Fig. 139: Rotating Camshaft
Courtesy of GENERAL MOTORS COMPANY

20. Using a 20 mm wrench on the cast hexagonal portion of the exhaust camshaft, rotate the camshaft toward the intake camshaft while pushing down on the handle of the **EN49982-2** retainer.

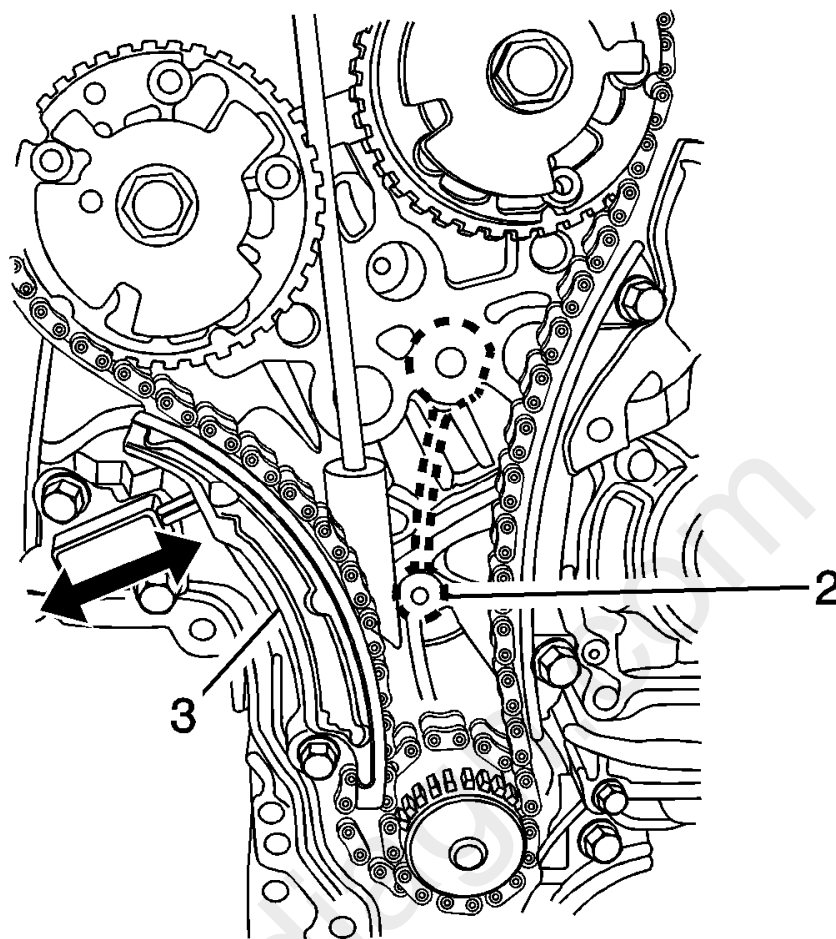


Fig. 140: Opening Gap Between Chain & Internal Rib In Front Cover
Courtesy of GENERAL MOTORS COMPANY

21. This rotation of the camshaft will compress the tensioner shoe (3) against the spring force of the tensioner, opening up a gap between the chain and the internal rib in the front cover. The wedge will then drop into this gap. You will feel a distinct click as the teeth engage the chain.

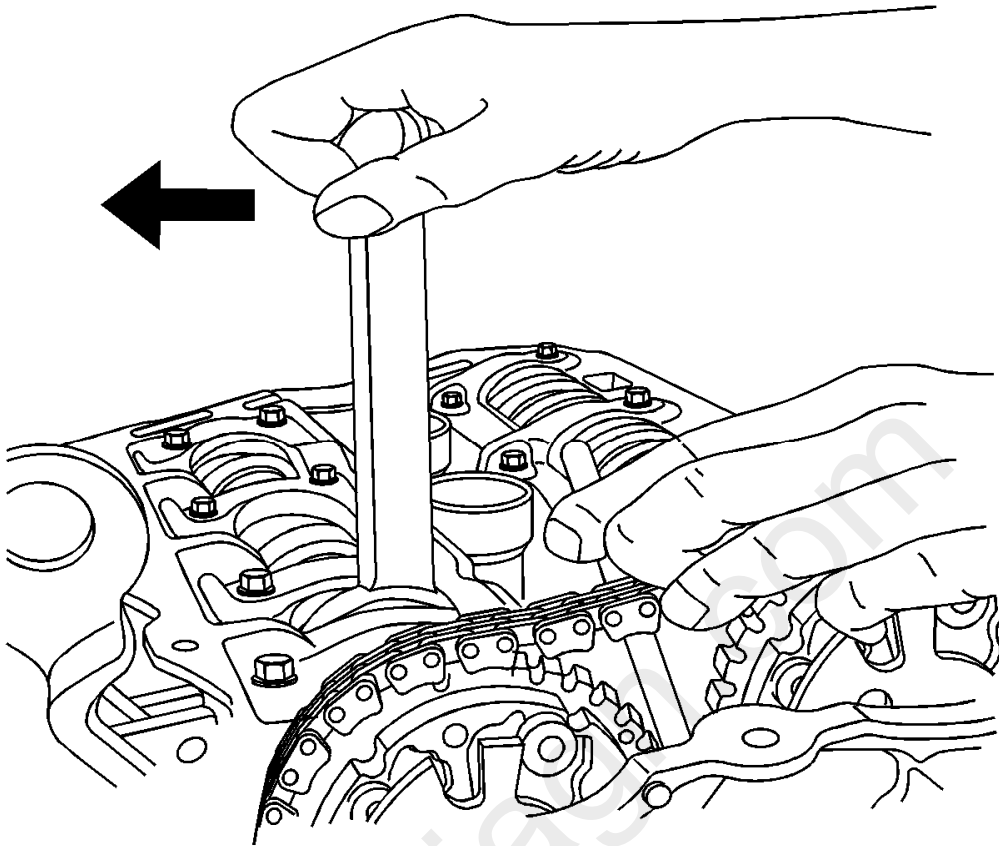


Fig. 141: Releasing Force On Wrench
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Be sure the EN49982-2 is captured firmly as described before continuing. This is critical to ensuring the camshaft drive chains stay properly timed.

22. Release the force on the wrench, allowing the spring tension to close the tensioner shoe against the wedge portion of EN49982-2 retainer. You should be able to lightly tug on the EN49982-2 retainer and it should stay in position. Repeat Steps 20 and 21 if necessary to re-insert the EN49982-2 retainer until you are certain it is in position and will stay in position.

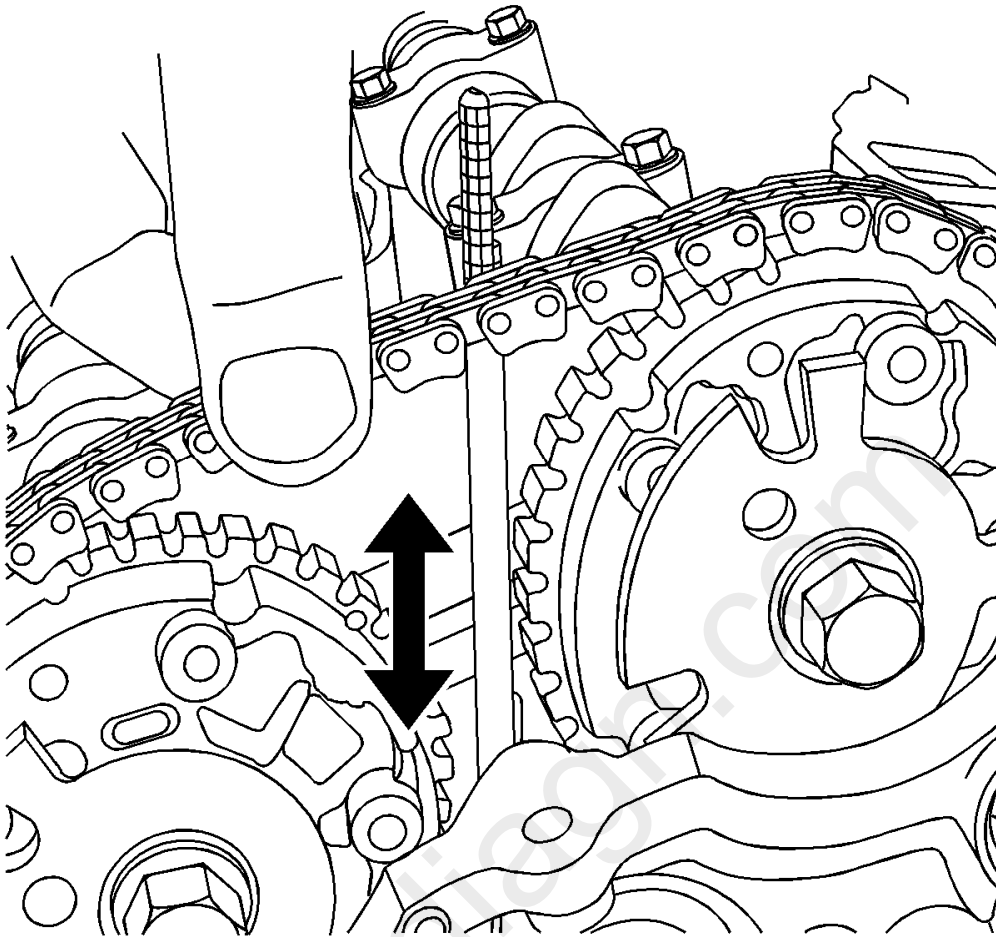


Fig. 142: Slack In Timing Drive Chain
Courtesy of GENERAL MOTORS COMPANY

23. With **EN49982-2** retainer in position and with the 20 mm wrench removed, there should now be some slack in the timing drive chain as indicated in the graphics shown.

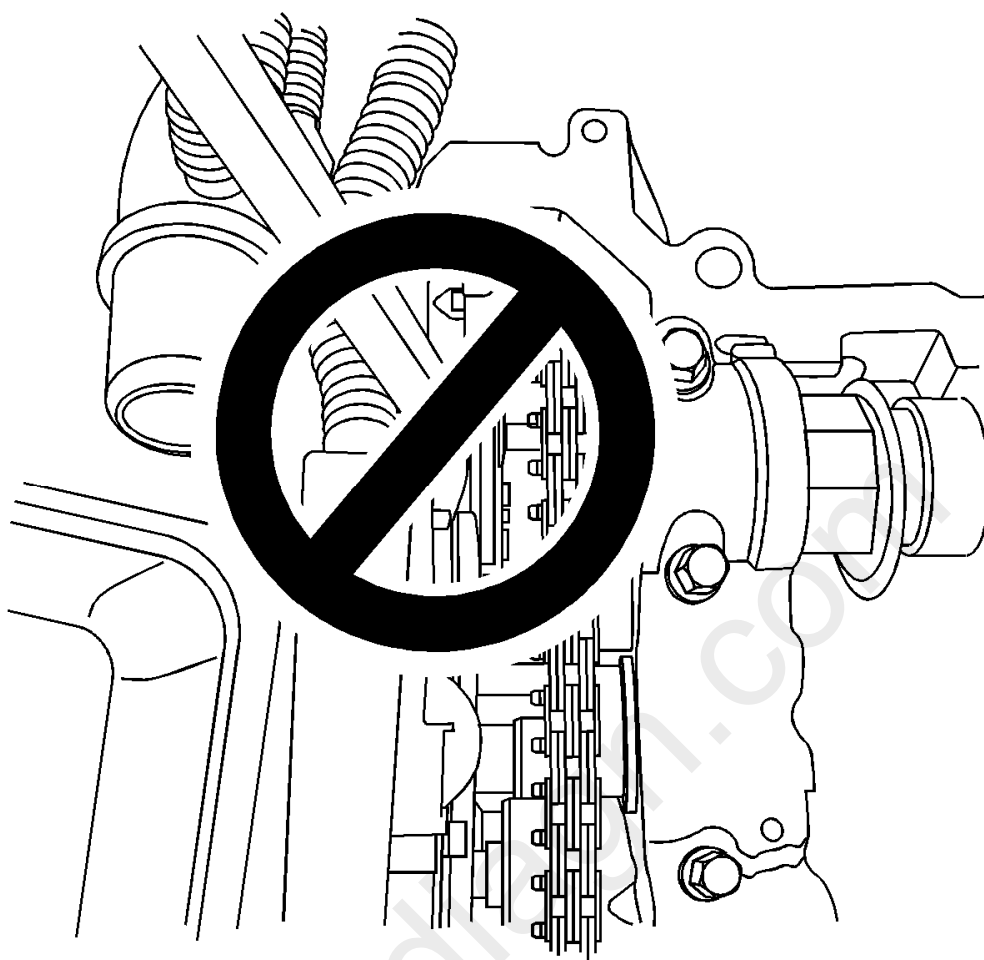


Fig. 143: Do Not Pry Warning
Courtesy of GENERAL MOTORS COMPANY

24. Do not pry against the face of the camshaft position actuators or the position actuator retaining bolt.

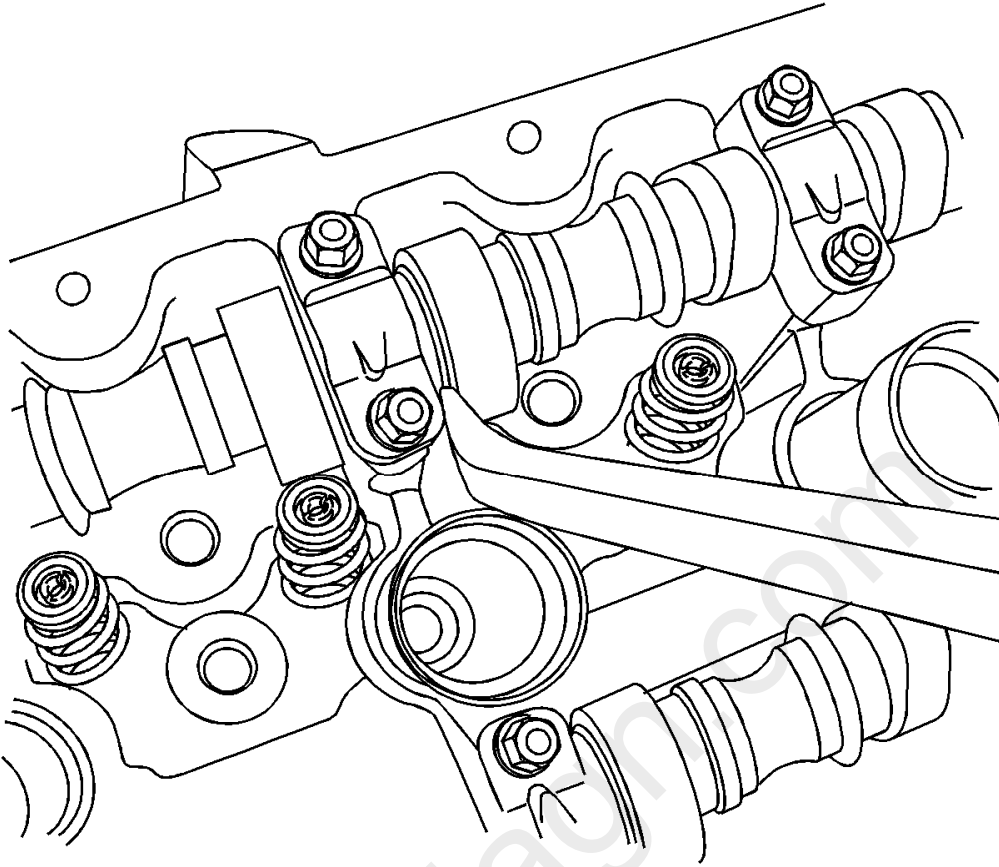


Fig. 144: Prying Camshaft Forward
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not pry against the face of the camshaft position actuators or the position actuator retaining bolts as the position actuators will be damaged.

25. Position a screwdriver or small pry bar between a camshaft cap and camshaft lobe. Carefully move/pry the camshafts as far as possible toward the rear/flywheel end of the engine.

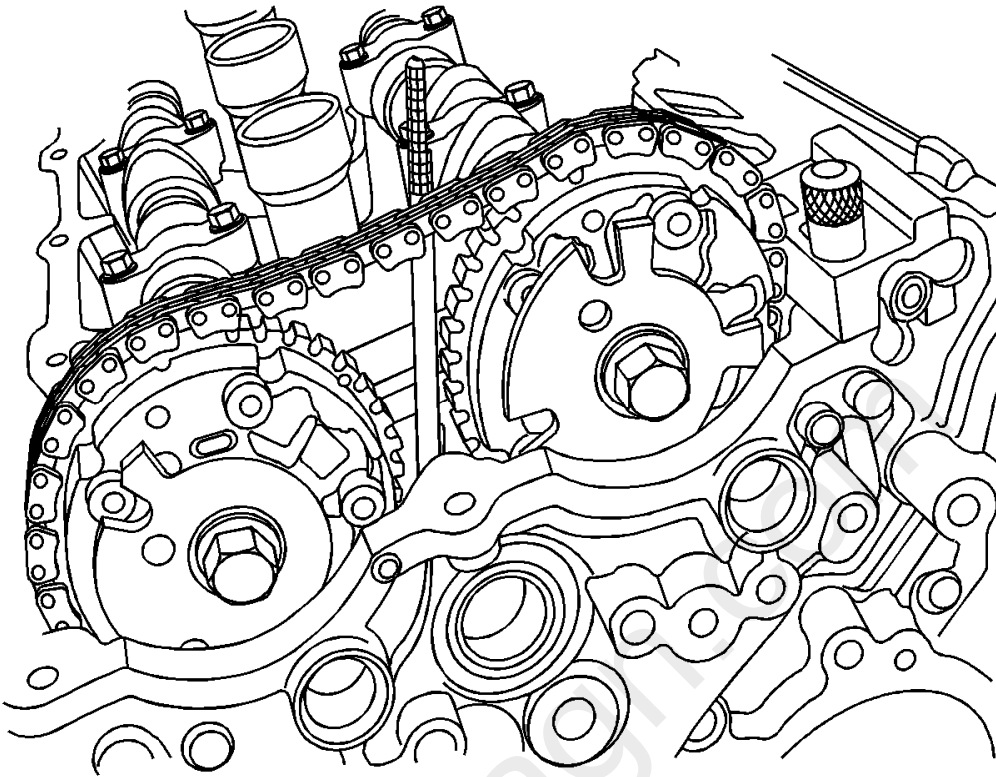


Fig. 145: Retainer Position

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not move or disturb the EN49982 retainer components after their installation or the timing chains may be lost inside the front cover.

26. The EN49982-1 retainer and EN49982-2 retainer should be in position as shown, they must be left in position during the servicing of the camshaft position actuator(s) and/or camshaft(s).

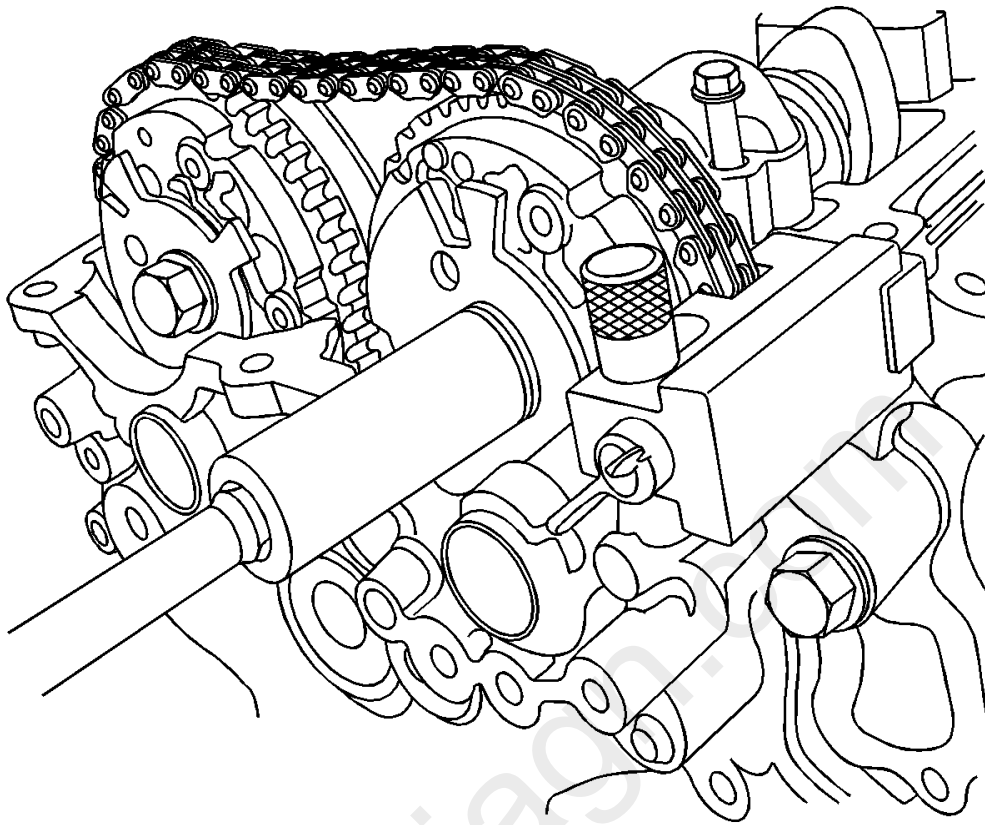


Fig. 146: View Of Intake Camshaft Position Actuator
Courtesy of GENERAL MOTORS COMPANY

27. To remove the intake camshaft position actuator, remove the loosened retaining bolt. To remove only the exhaust camshaft position actuator, skip the steps for removing the intake camshaft position actuator. However, the **EN49982-1** retainer **MUST** be installed as discussed even if the intake side will not be serviced or the timing of the camshaft chains will be lost.

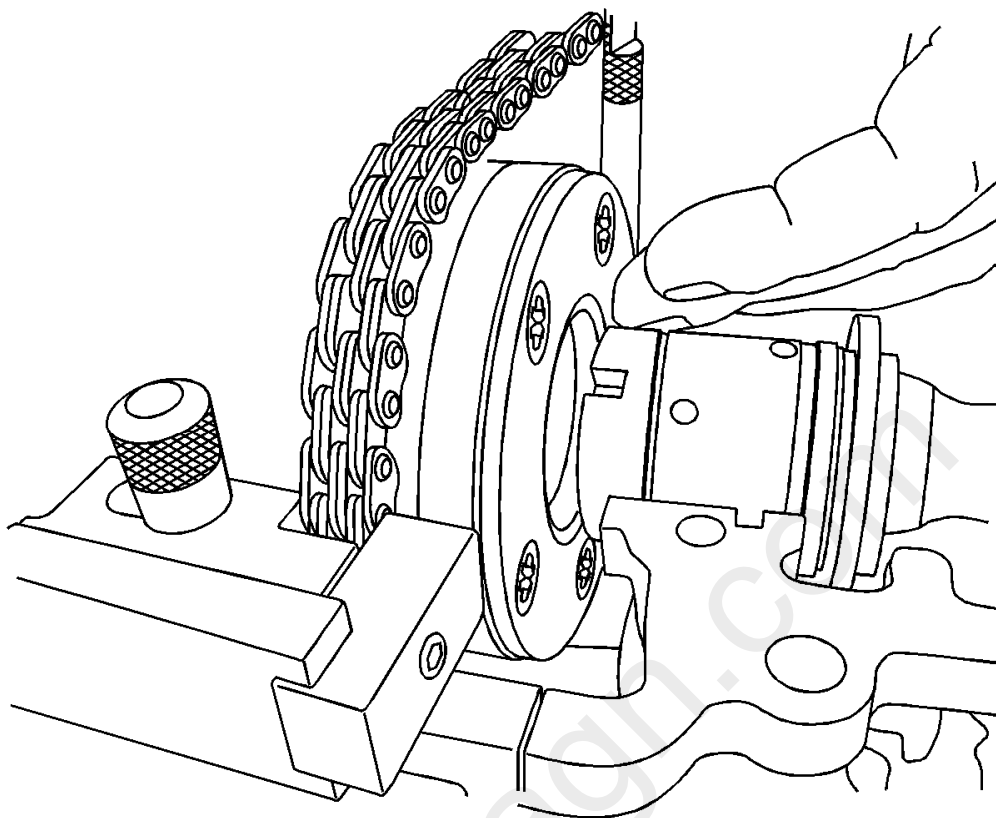


Fig. 147: Sliding Camshaft Position Actuator Off End Of Intake Camshaft
Courtesy of GENERAL MOTORS COMPANY

28. Slide the camshaft position actuator forward and off the end of the intake camshaft. The slot in the **EN49982-1** retainer will allow the tool to move forward enough to disengage the camshaft position actuator from the front of the camshaft. Remove the plastic thrust washer when removing the camshaft position actuator from the end of the camshaft.

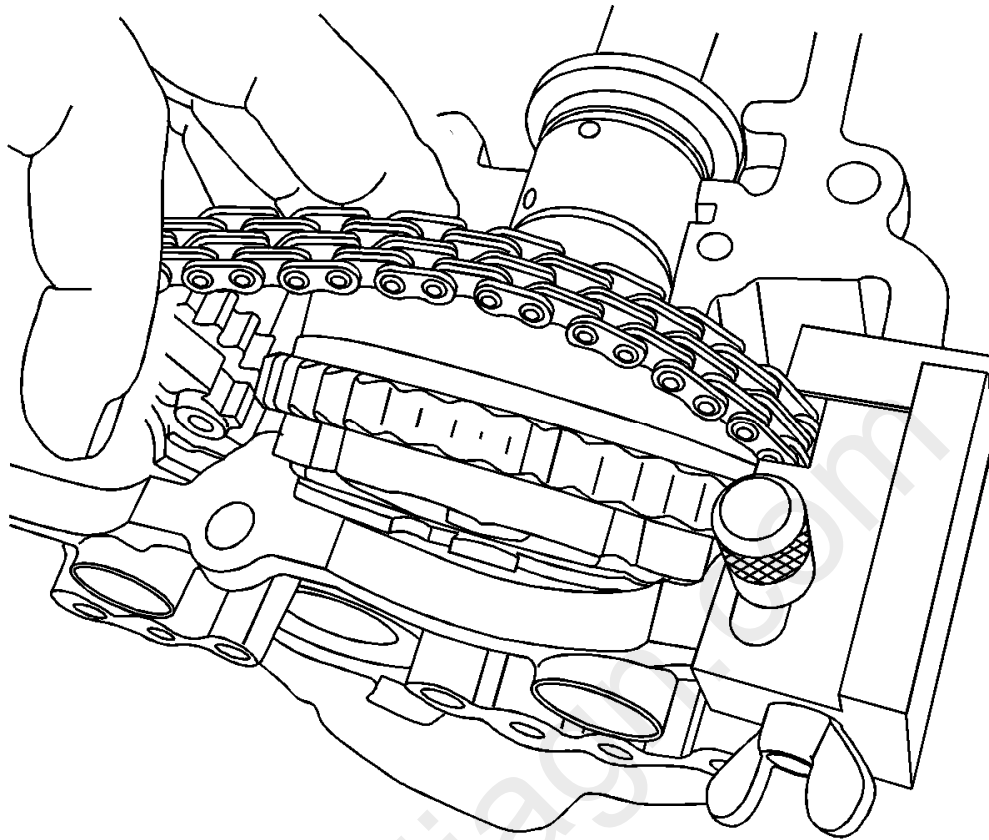


Fig. 148: Tilting Camshaft Position Actuator Forward
Courtesy of GENERAL MOTORS COMPANY

29. Tilt the camshaft position actuator forward and out/away from the engine.

NOTE: **DO NOT** remove the EN49982 retainers. They are holding the cam chains to maintain their properly-timed positions.

30. Allow the chain to rest on the **EN49982-1** retainer and **EN49982-2** retainer in position during service.

Installation Procedure

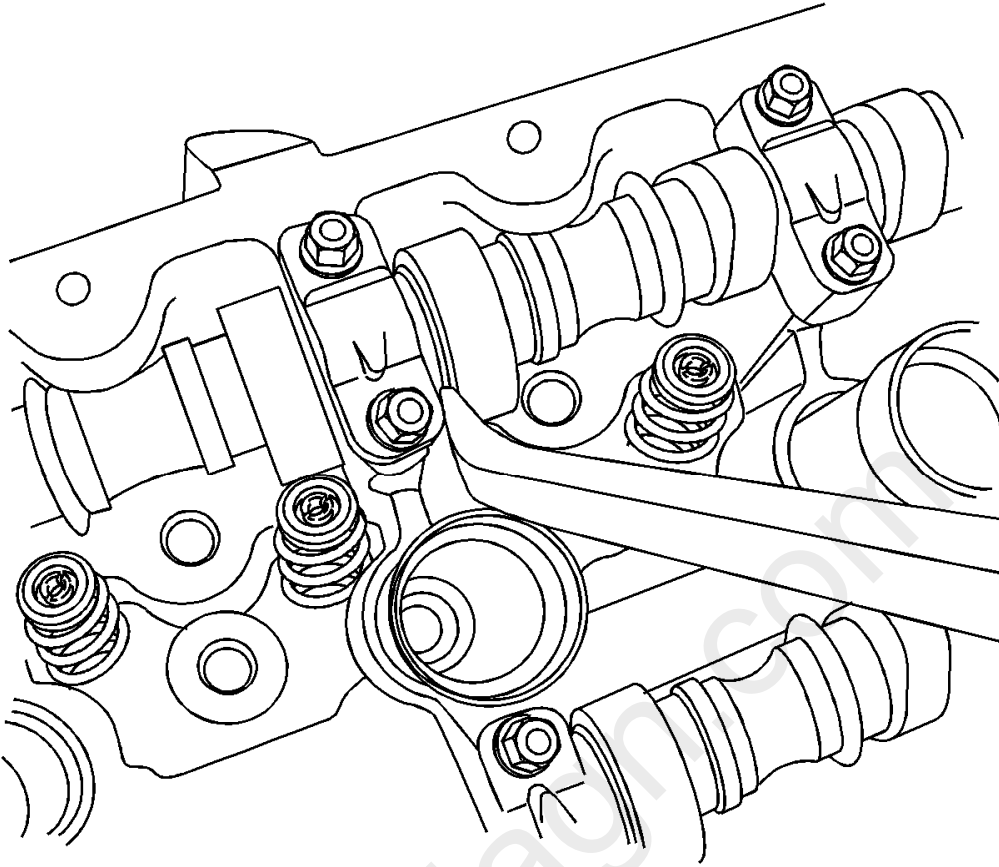


Fig. 149: Prying Camshaft Forward
Courtesy of GENERAL MOTORS COMPANY

1. It may help to carefully pry the camshaft forward and to move the **EN49982-1** retainer backward via the slot to reengage the position actuator to the camshaft. The dowel pin on the camshaft position actuator must be aligned with the slot in the camshaft nose for reassembly.

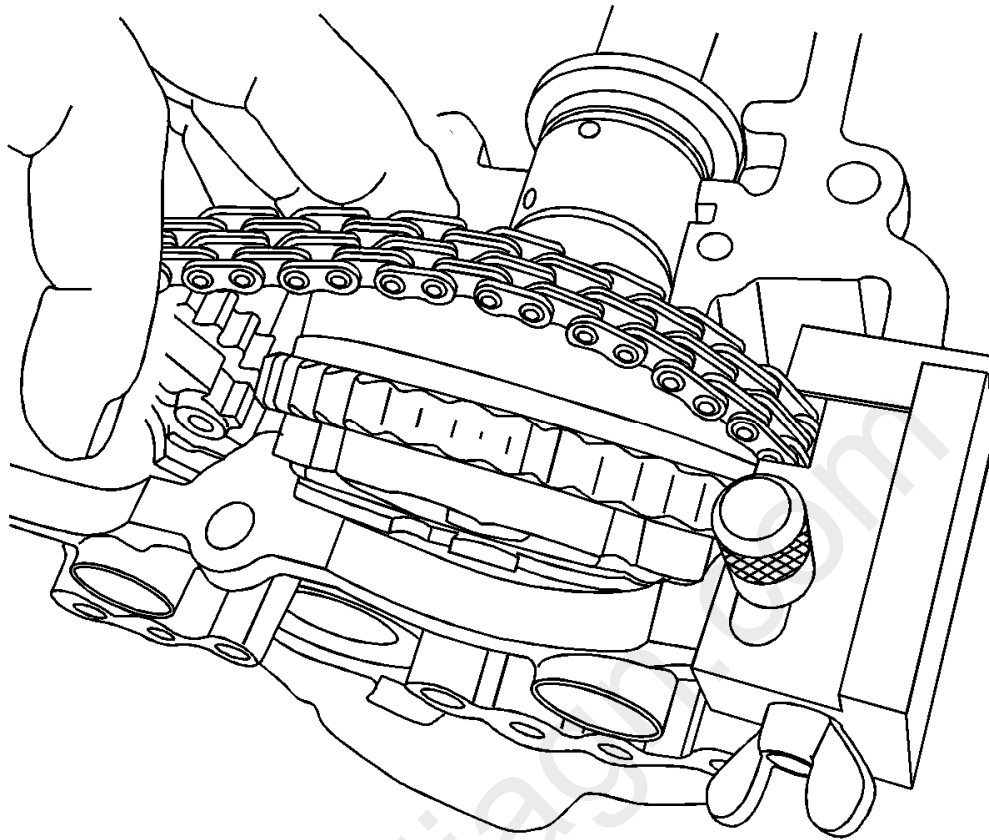


Fig. 150: Tilting Camshaft Position Actuator Forward
Courtesy of GENERAL MOTORS COMPANY

2. Install the intake camshaft position actuator first by inserting the actuator between the timing chain and front cover. Tilt the actuator in and engage the chain while aligning the marks you made on the chain and position actuator.

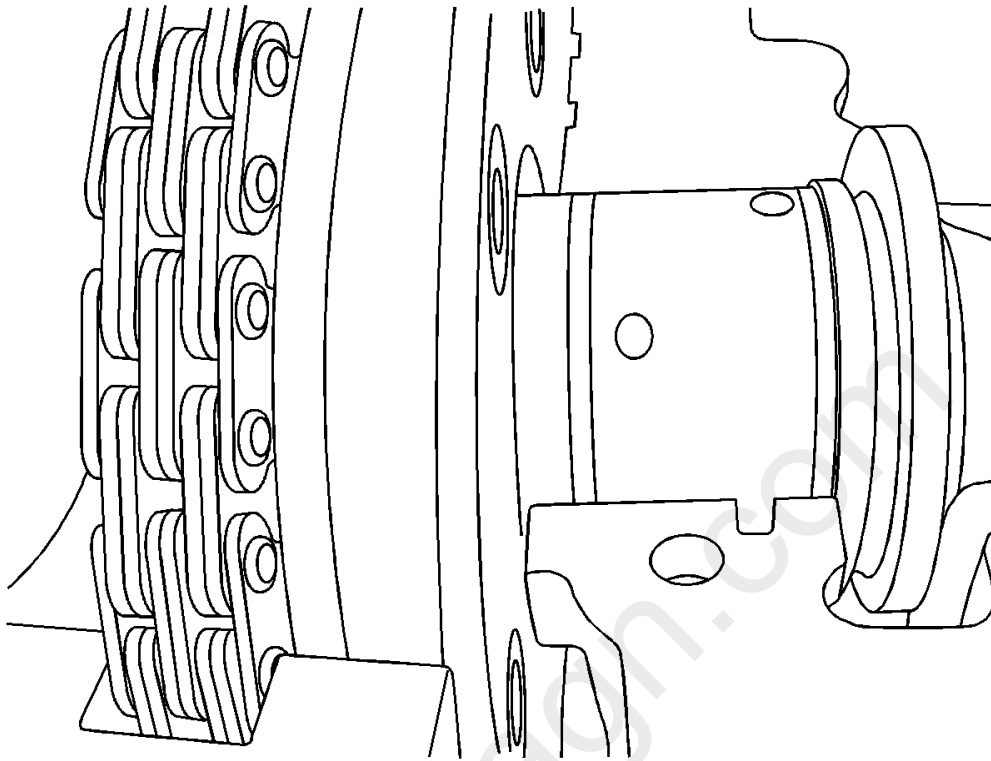


Fig. 151: Fitting Camshaft Position Actuator
Courtesy of GENERAL MOTORS COMPANY

3. Ensure the camshaft position actuator fits snugly to the end of the camshaft.

CAUTION: Refer to Fastener Caution .

4. Install the intake camshaft position actuator retaining bolt, and lightly tighten the bolt to hold the camshaft actuator in place. DO NOT torque at this time.
5. Install the exhaust camshaft position actuator retaining bolt, and lightly tighten the bolt to hold the camshaft actuator in place. DO NOT torque at this time.
6. Double-check that the marks on both the intake and exhaust camshaft position actuators to ensure that they are aligned with their respective paint marks on the chain.

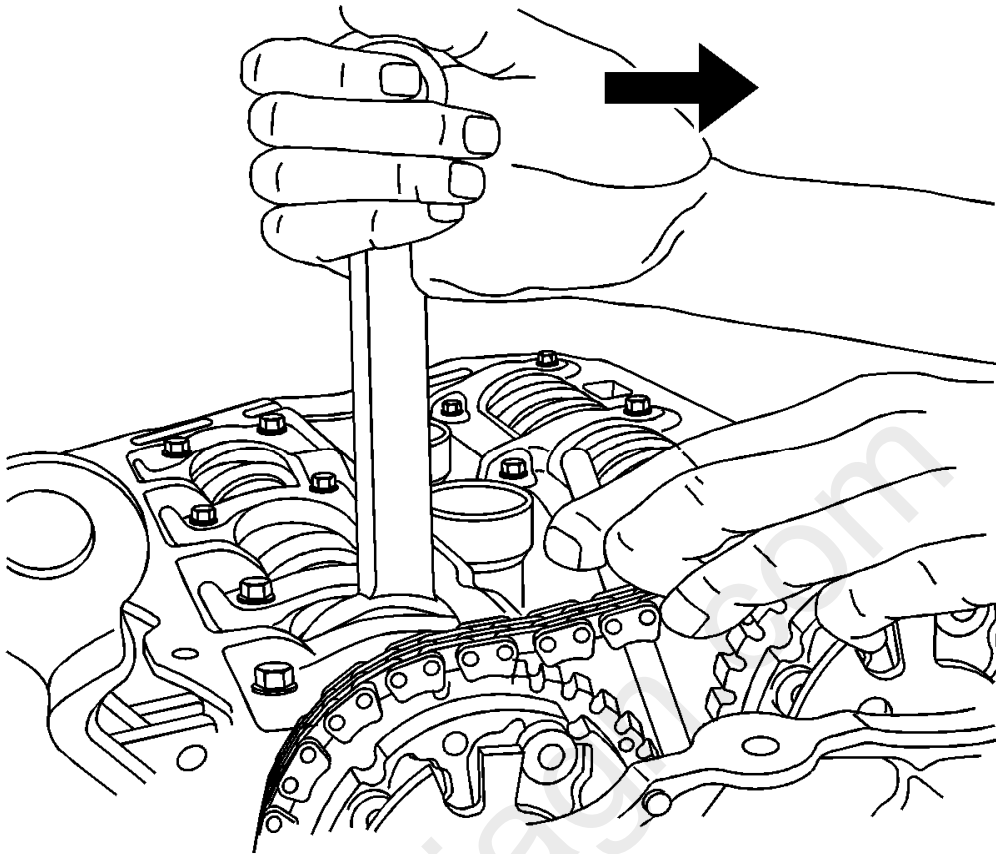


Fig. 152: Rotating Camshaft

Courtesy of GENERAL MOTORS COMPANY

7. Using a 20 mm wrench on the cast hexagonal portion of the exhaust camshaft, rotate the camshaft clockwise while pulling up on the handle of the **EN49982-2** retainer.
8. Remove EN49982-2 retainer.
9. Release the pressure on the wrench. The timing chain should now be tight and should lose the slack the wedge was providing.

NOTE: **Double-check the marks on the camshaft position actuators and chains to ensure they are correct.**

10. Torque one or both camshaft position actuator retaining bolts to 58 N.m (43 lb ft).

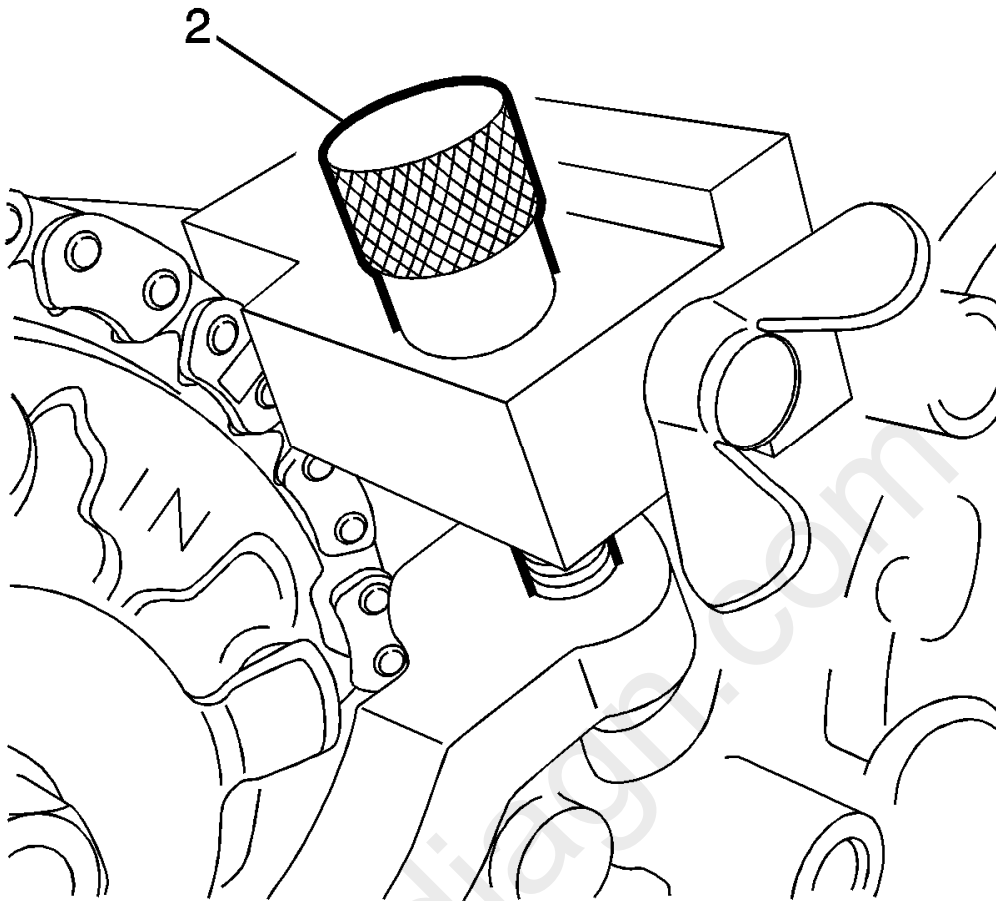


Fig. 153: View Of Retainer Thumbscrew
Courtesy of GENERAL MOTORS COMPANY

11. Unscrew the wingnut on **EN49982-1** retainer to release timing chain, and then remove **EN49982-1** retainer from the front cover by unscrewing the thumbscrew (2).

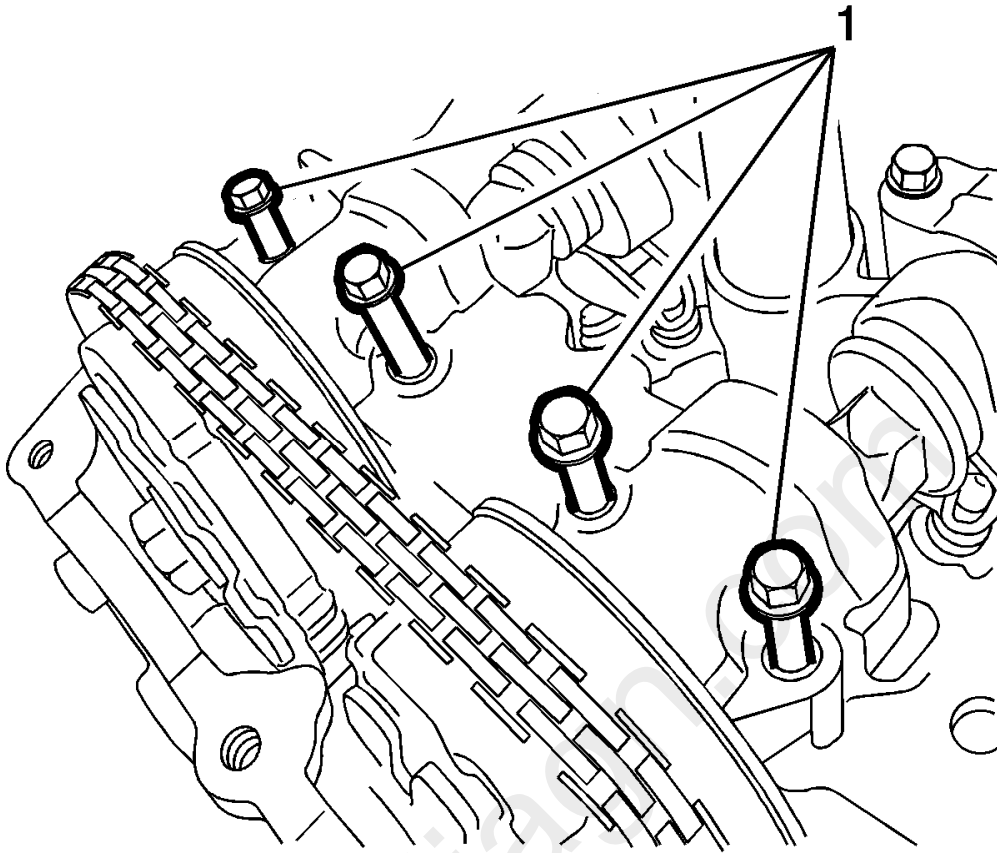


Fig. 154: Identifying Camshaft Front Cap & Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Install camshaft front cap and bolts (1).
13. Tighten the camshaft front cap outer bolts to 10 N.m (89 lb in).
14. Tighten the camshaft front cap inner bolts to 10 N.m (89 lb in).
15. Install the camshaft position actuator solenoid valve solenoid - exhaust. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust** .
16. Install the camshaft position actuator solenoid valve solenoid-intake. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake** .
17. Install the intake camshaft position sensors. Refer to **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake** .
18. Install the exhaust camshaft position sensor. Refer to **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust** .
19. Install the camshaft cover. Refer to **Camshaft Cover Replacement - Right Side**.

CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2

Special Tools

EN-48313 Timing Chain Retention Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

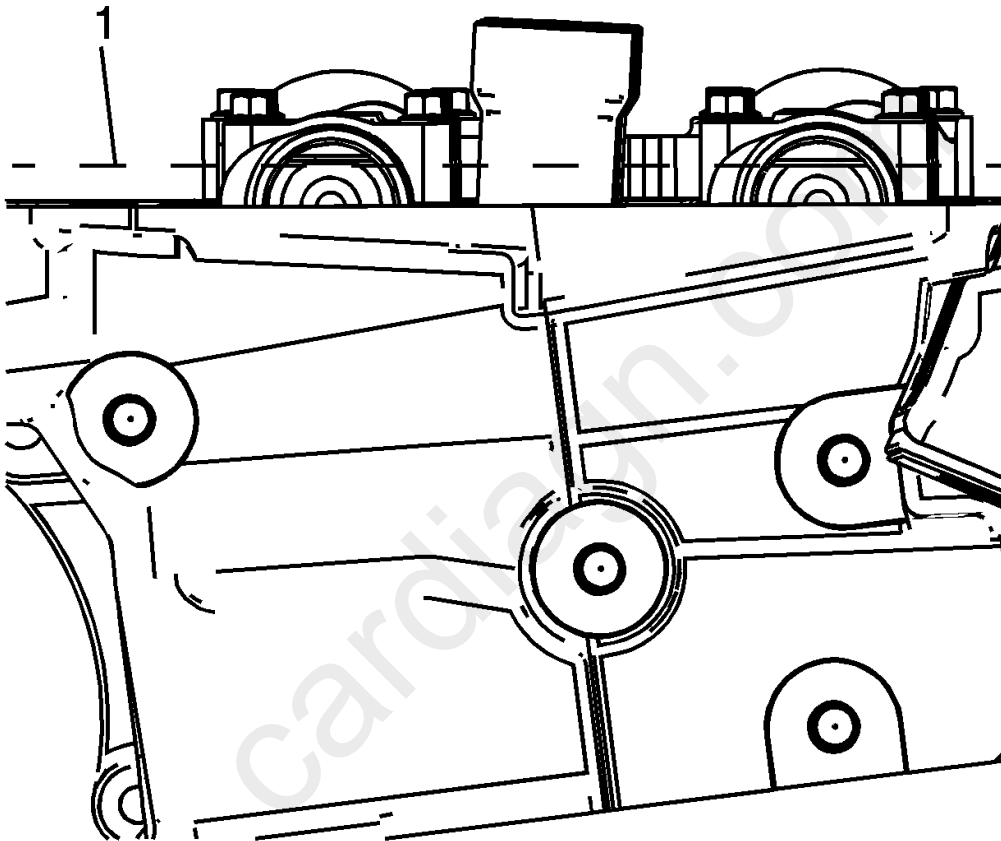


Fig. 155: View Of Camshaft Flats Parallel With Camshaft Cover Rail
Courtesy of GENERAL MOTORS COMPANY

1. Remove the left camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
2. Remove the left intake and exhaust camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake , and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust .
3. Remove the left intake and exhaust camshaft position actuator solenoids. Refer to Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake , and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust .

NOTE: Rotate the crankshaft balancer bolt in a clockwise direction **ONLY**.

4. Rotate the crankshaft balancer using the balancer bolt until the camshafts are in a neutral (low tension) position. The camshafts will be parallel with the camshaft cover rail (1).

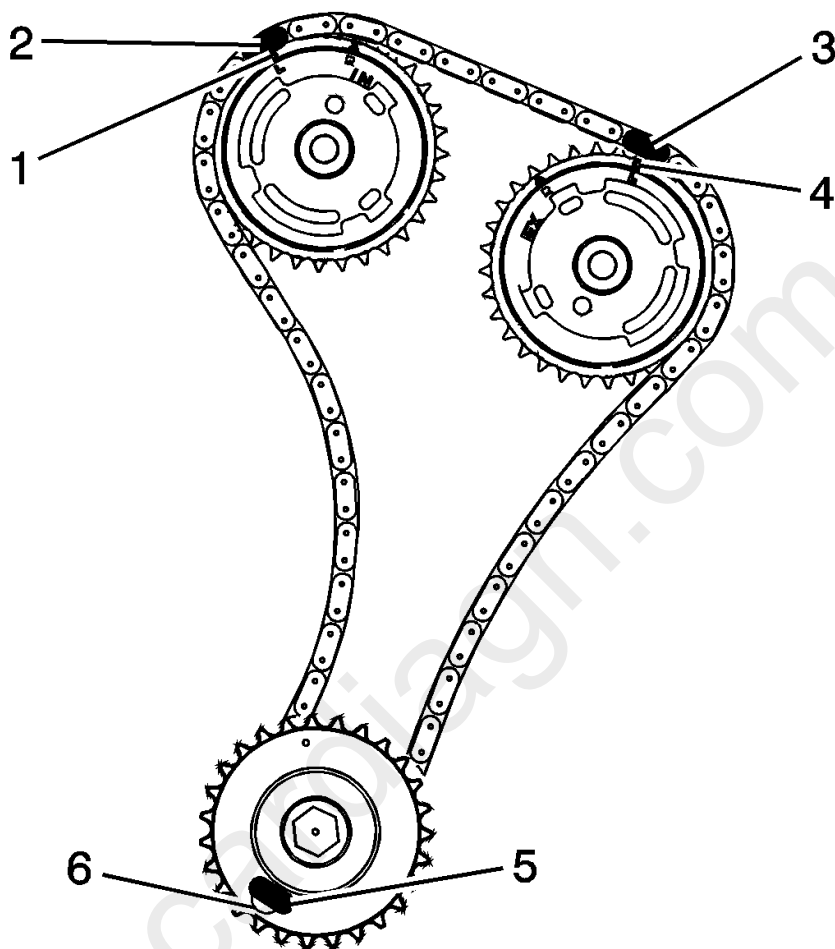


Fig. 156: Locating Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

5. Use a paint stick to create an alignment mark on one of the timing chain links (2) and the adjacent tooth on the exhaust camshaft position actuator (1).
6. Use a paint stick to create an alignment mark on one of the timing chain links (3) and the adjacent tooth on the intake camshaft position actuator (4).

CAUTION: Refer to Torque Reaction Against Timing Drive Chain Caution .

7. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

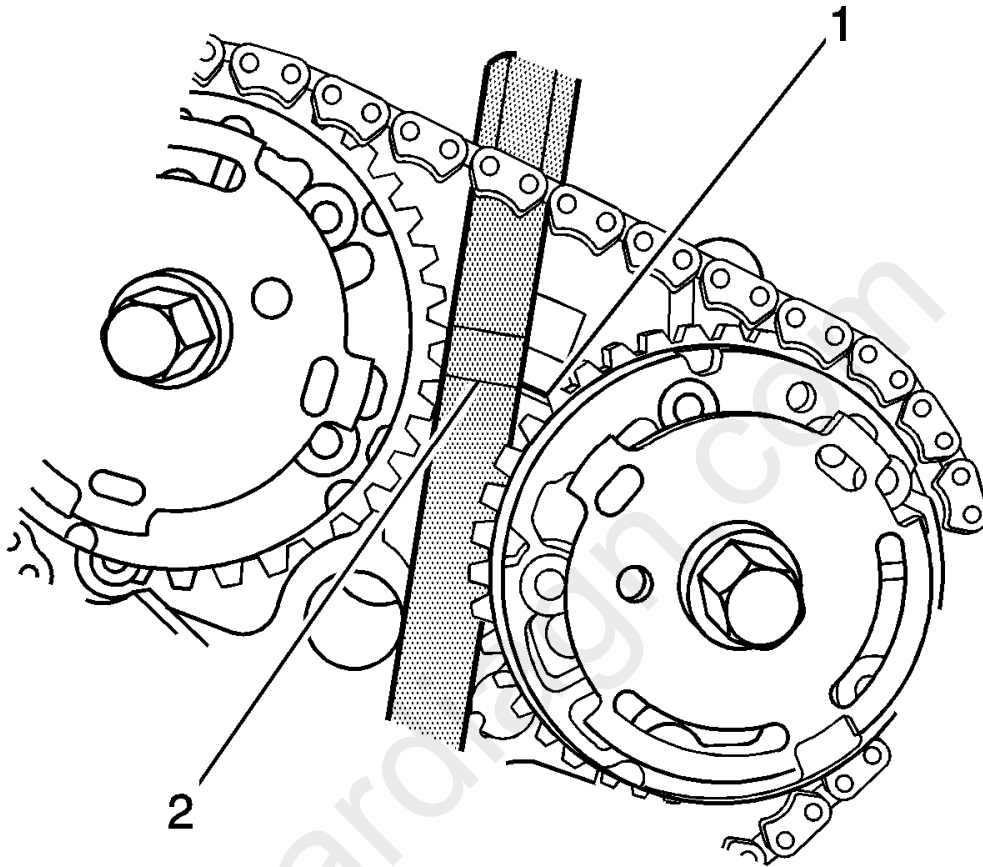


Fig. 157: Inserting Timing Chain Retention Tool

Courtesy of GENERAL MOTORS COMPANY

8. Unscrew the **EN-48313** tool so that the legs of the tool are retracted.
9. Insert the **EN-48313** tool between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This is the approximate installed position.

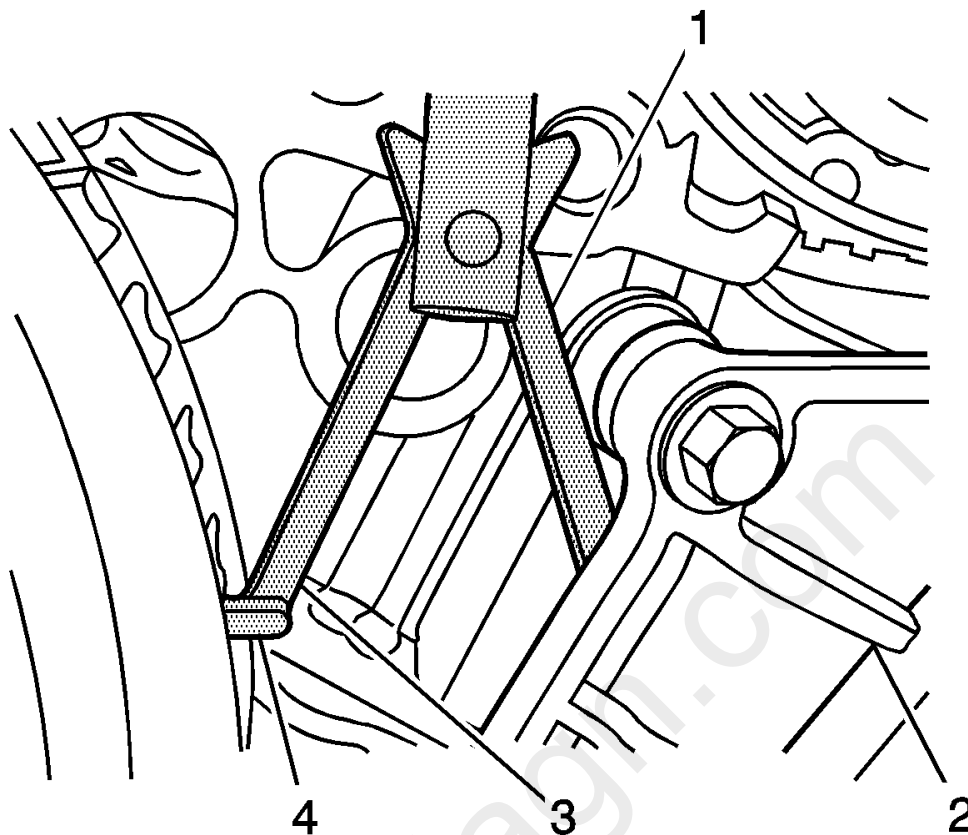


Fig. 158: View Of Feet, Legs & Timing Chain Guide
Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine front cover is removed for clarity in the following graphics, but NOT required to perform the procedure.

10. Ensure that the feet (4) on the legs of the tool are facing the front of the engine.
11. Partially expand the legs (1, 3) of the **EN-48313** tool by turning the T-shaped handle clockwise.
12. Insert the leg of the tool (1) behind the timing chain guide (2).
13. Continue expanding the **EN-48313** tool until the legs (1, 3) contact the timing chain. Do not tighten at this time.

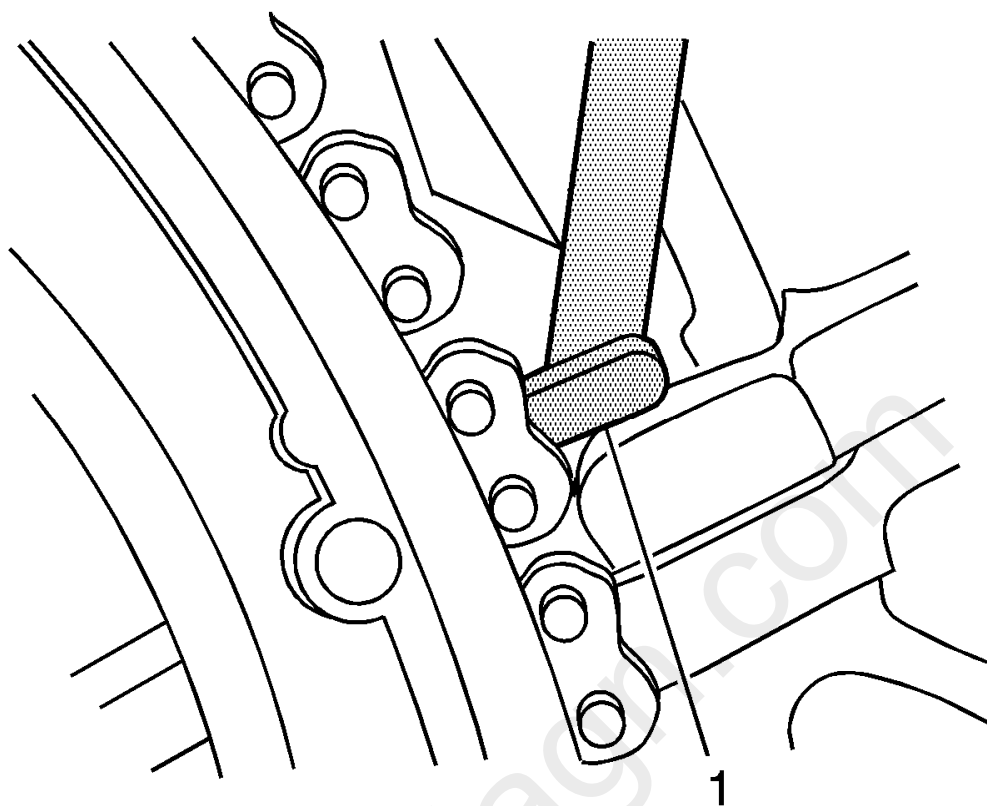


Fig. 159: Foot Of Timing Chain Retention Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the foot (1) of the EN-48313 tool is engaged into one of the link pockets to prevent tool slippage during tightening of the EN-48313 tool.

14. Hand tighten the **EN-48313** tool.
15. Use an open end wrench on the hex cast into the left intake and exhaust camshafts and rotate the camshafts toward each other in order to create slack in the chain between the actuators.

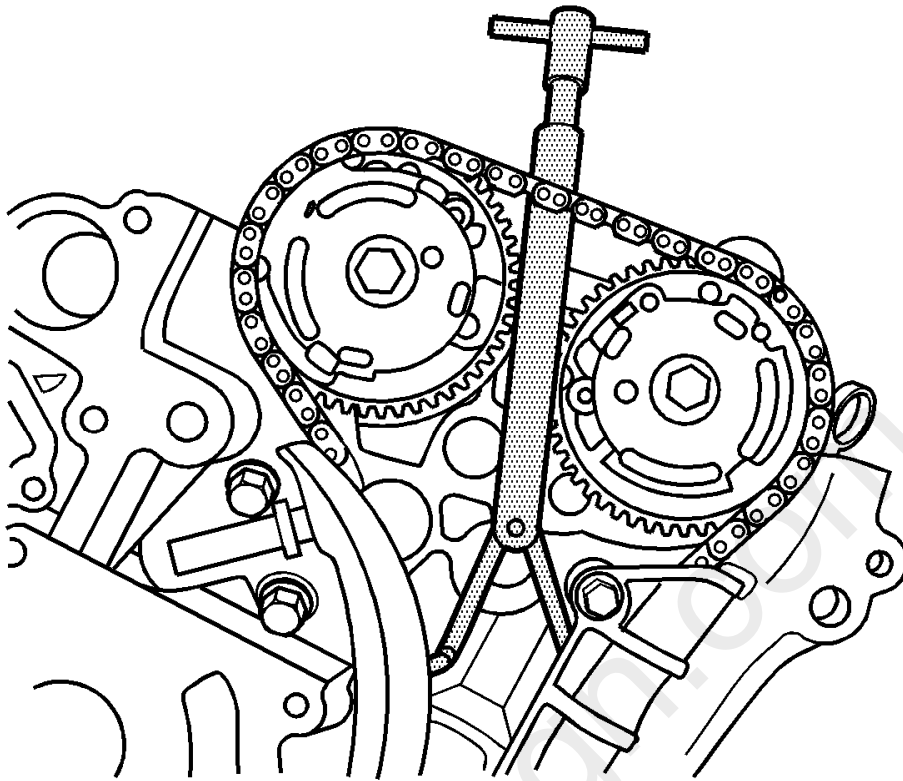


Fig. 160: Timing Chain Retention Tool
Courtesy of GENERAL MOTORS COMPANY

16. The EN-48313 tool is now properly installed to hold the timing chain in position.

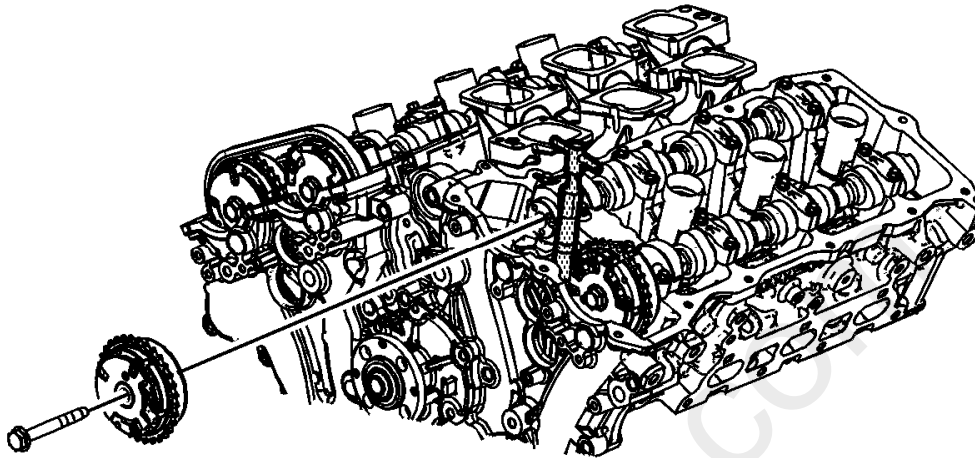


Fig. 161: View Of Exhaust Camshaft Position Actuator Bolt
Courtesy of GENERAL MOTORS COMPANY

17. Use an open end wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
18. If replacing the exhaust camshaft position actuator, then remove the bolt and the actuator.
19. If replacing the intake camshaft position actuator, then remove the bolt and the actuator.
20. If removing both the exhaust and intake camshaft actuators, the timing chain can be draped over the **EN-48313** tool once the actuators have been removed.
21. Rotate the actuator in order to align the opening in the actuator reluctor wheel with the cam sensor boss in the front cover, to allow actuator removal.
22. Remove the camshaft thrust washer.

Installation Procedure

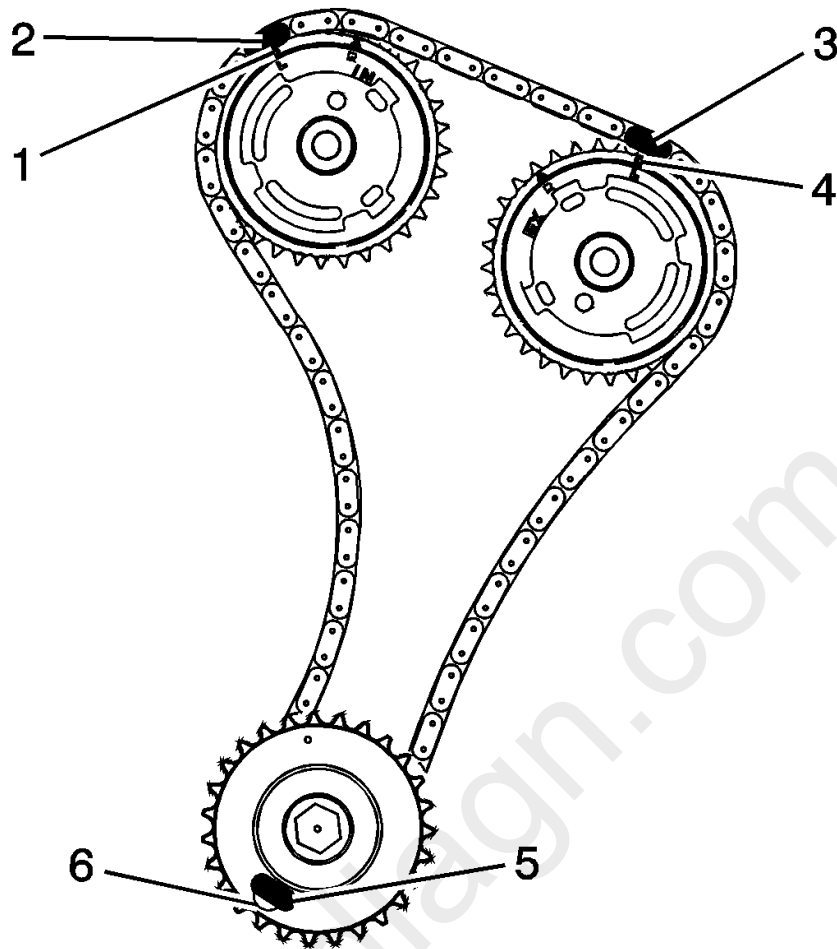


Fig. 162: Locating Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

1. Align the exhaust camshaft actuator alignment mark (1) to the timing chain alignment mark (2) made during disassembly.
2. Ensure that the intake camshaft actuator alignment mark (4) and the timing chain alignment mark (3) are also aligned.
3. Position the exhaust camshaft actuator to the camshaft and install the actuator bolt hand tight.
4. Remove the **EN-48313** tool.

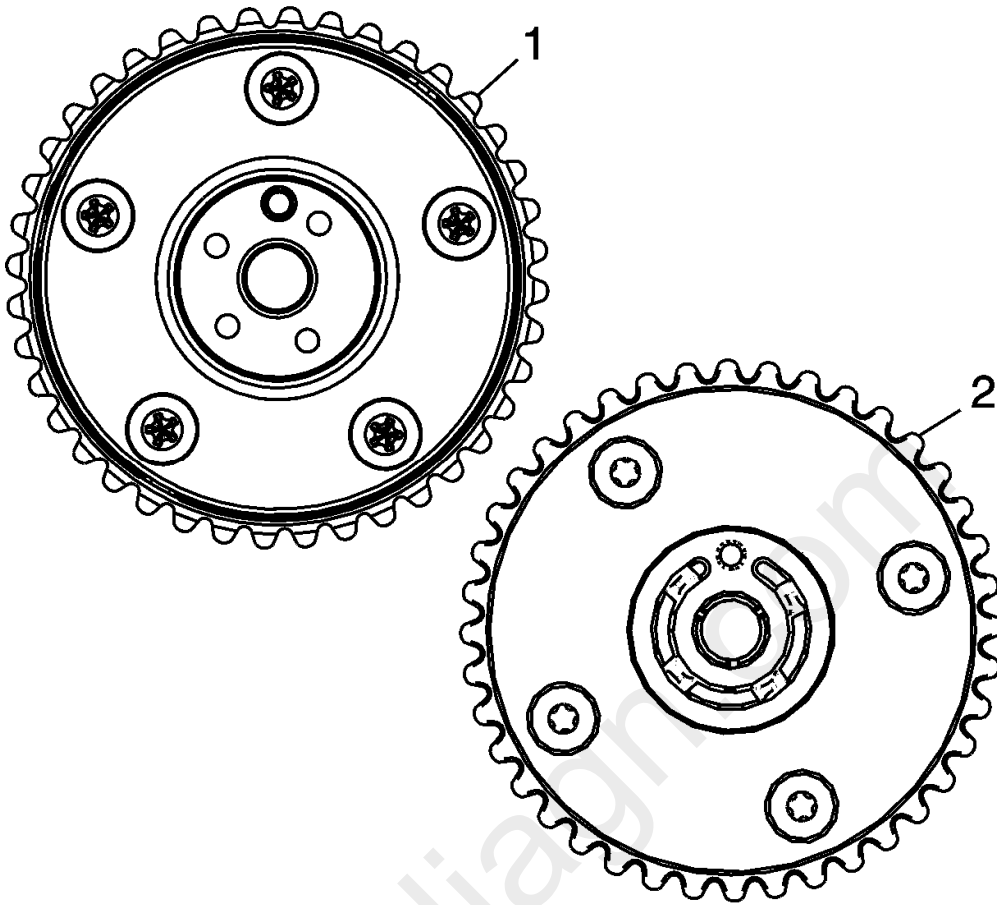


Fig. 163: Identifying Camshaft Position Actuators
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- The camshaft position actuator will vary depending on application.
- Camshaft thrust washers must only be installed on applications that had thrust washers present during removal of the camshaft position actuators. Do not install washers on applications if they are not already present.

5. If equipped, ensure the proper camshaft thrust washer is used. Use a 1.6 mm (0.063 in) thrust washer on applications that have 5 attaching screws on the back side of the camshaft position actuator (1). Use a 1.1 mm (0.043 in) thick thrust washer with yellow speckles on applications that have 4 attaching screws on the back side of the camshaft position actuator (2).
6. Install the thrust washer, if applicable.

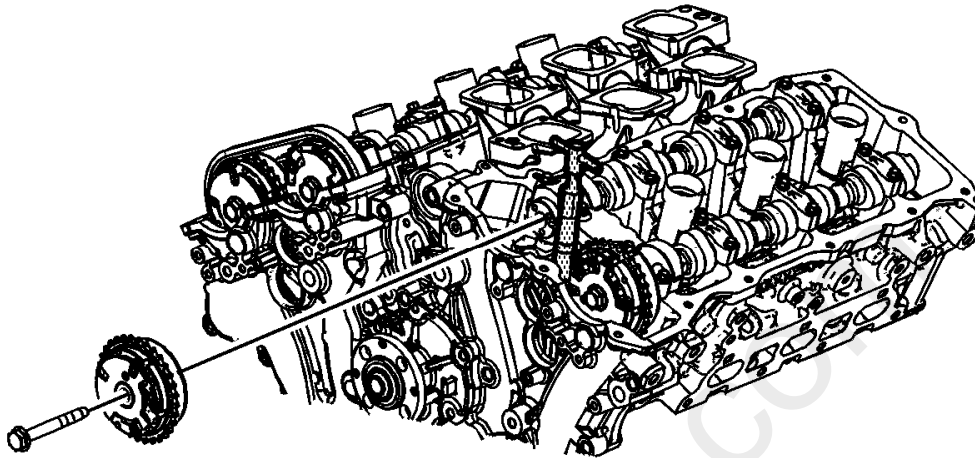


Fig. 164: View Of Exhaust Camshaft Position Actuator Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

7. If the exhaust camshaft position actuator has been replaced, then tighten the bolt to 58 N.m (43 lb ft).
8. If the intake camshaft position actuator has been replaced, then tighten the bolt to 58 N.m (43 lb ft).
9. If both the exhaust and intake has been replaced, then tighten bolt to 58 N.m (43 lb ft).
10. Install the left intake and exhaust camshaft position actuator solenoids. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake** , and **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust** .
11. Install the left intake and exhaust camshaft position sensors. Refer to **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake** , and **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust** .
12. Install the left camshaft cover. Refer to **Camshaft Cover Replacement - Left Side**.
13. Install the intake manifold. Refer to **Intake Manifold Replacement**.

SETTING CAMSHAFT TIMING

IMPORTANT: Setting the camshaft timing is necessary whenever the camshaft drive system has been disturbed such that the relationship between any chain and sprocket has been lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.

Follow the left bank secondary camshaft drive chain replacement procedures to reset the camshaft timing. Refer to Secondary Camshaft Intermediate Drive Chain Replacement - Left Side.

CAMSHAFT REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the fuel pump. Refer to Fuel Pump Replacement .
2. Remove the camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 2.

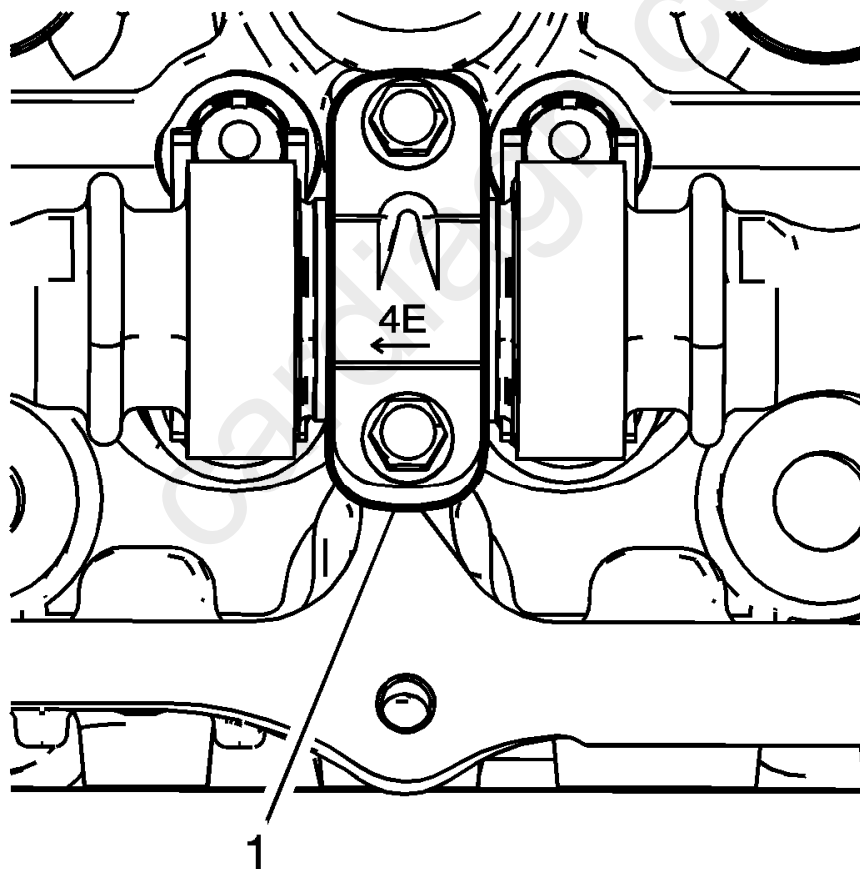


Fig. 165: Bearing Caps

Courtesy of GENERAL MOTORS COMPANY

3. Observe the markings on the bearing caps (1). Each bearing cap is marked in order to identify its location. The markings have the following meanings:
- The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the engine.

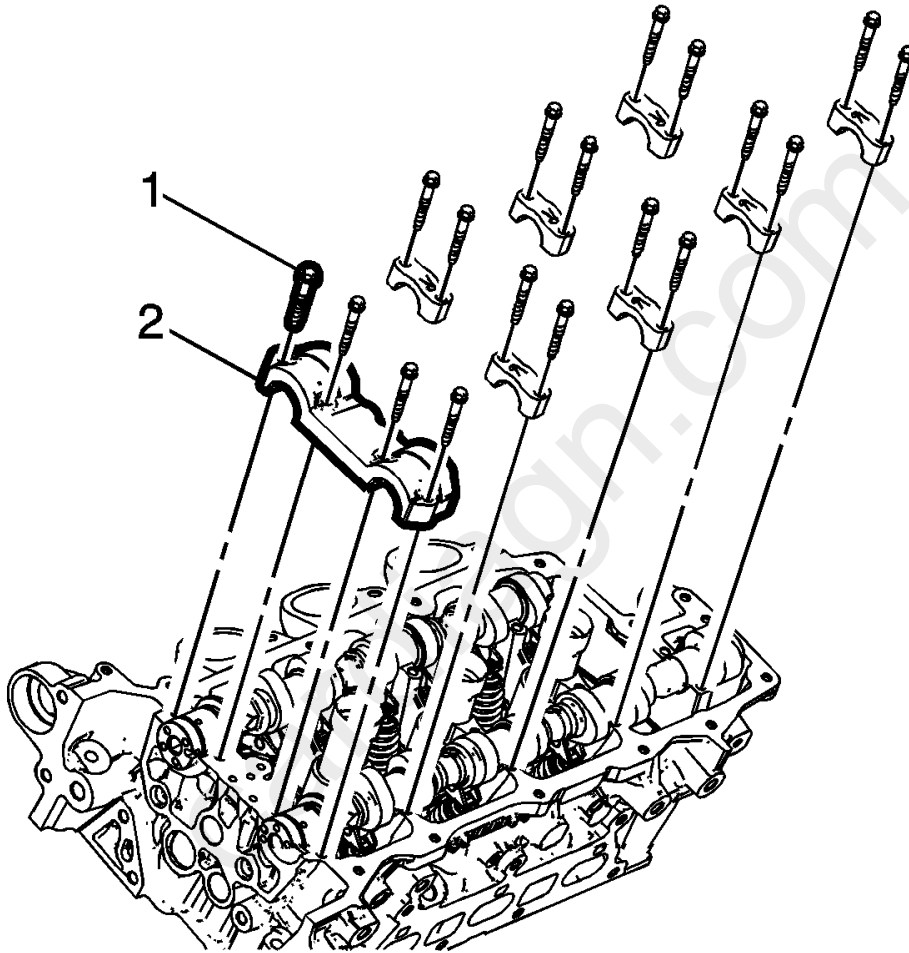


Fig. 166: Bearing Cap Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the camshaft bearing cap bolts (1).
5. Remove the camshaft bearing caps (2).

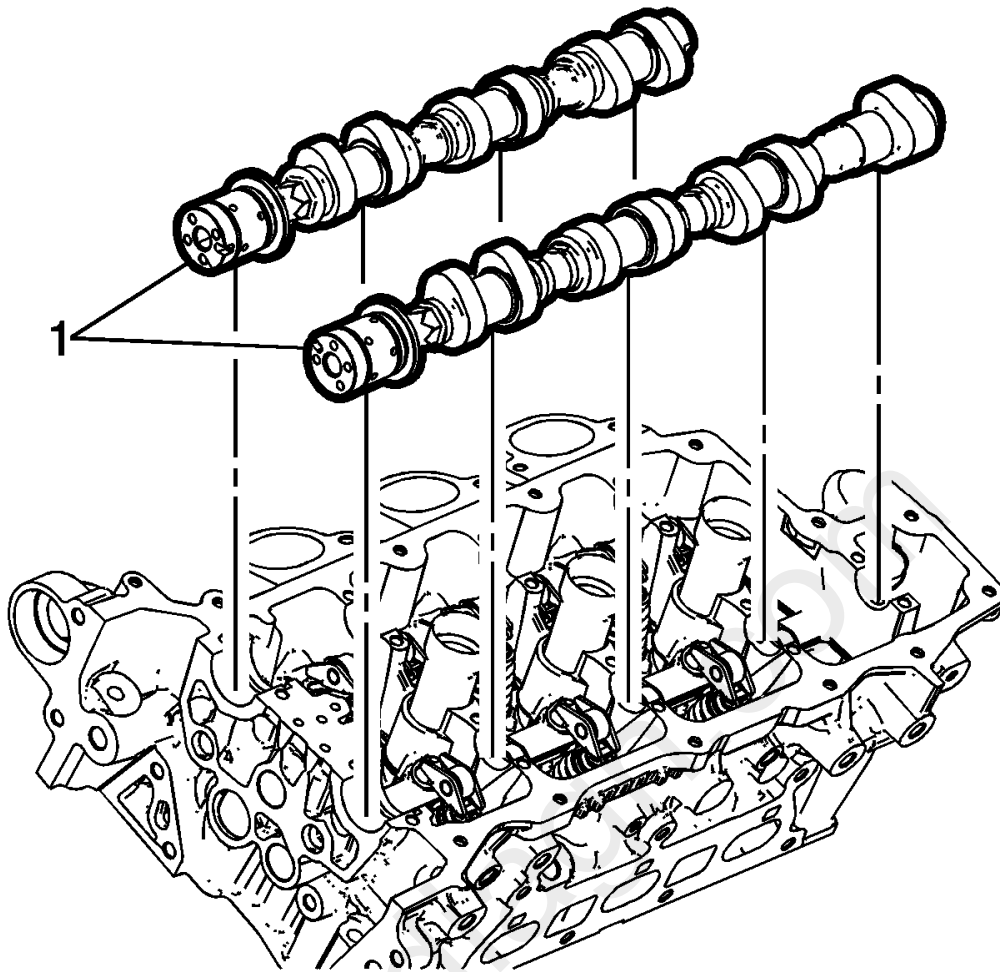


Fig. 167: Camshafts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mark the camshafts upon removal to ensure installation is in the correct position.

6. Remove the camshafts (1).

Installation Procedure

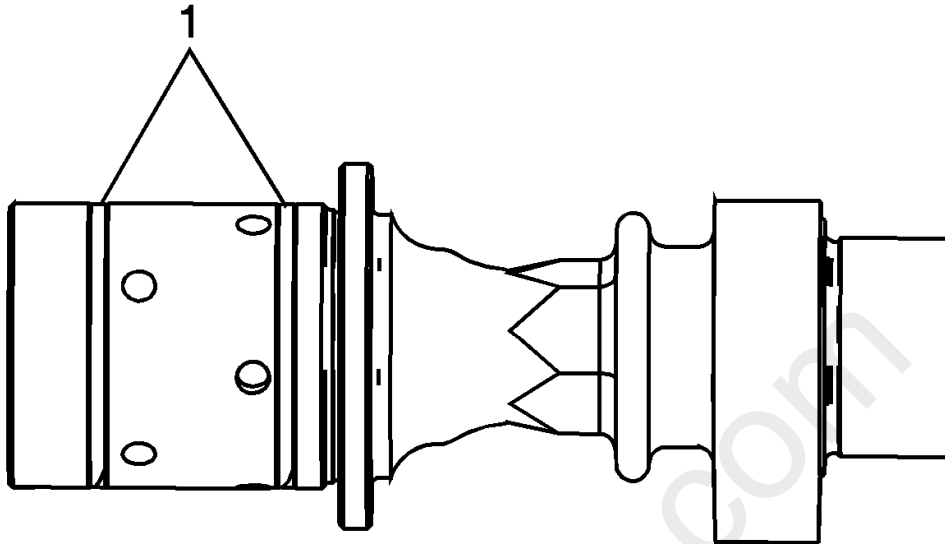


Fig. 168: Locating Camshaft Sealing Rings In Camshaft Grooves
Courtesy of GENERAL MOTORS COMPANY

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the cylinder head and the camshaft caps.

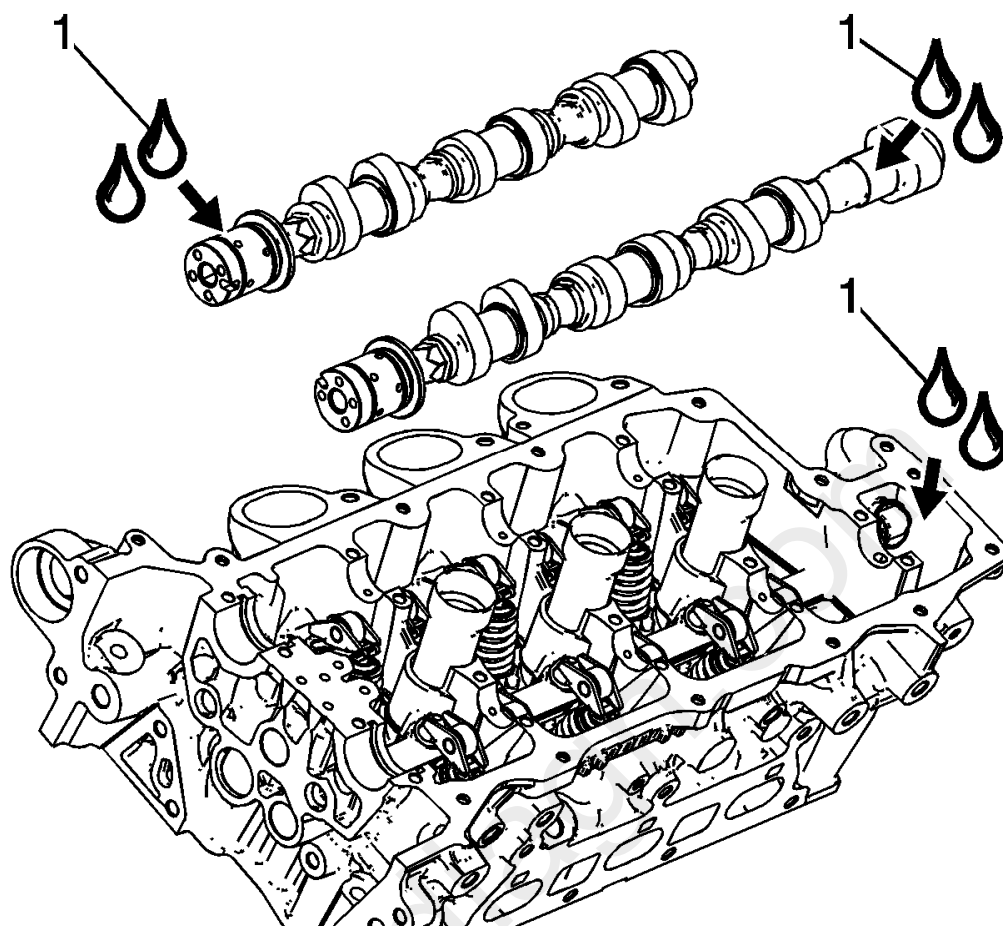


Fig. 169: Camshaft Journal Lubrication Points
Courtesy of GENERAL MOTORS COMPANY

2. Apply a liberal amount of lubricant (1) to the camshaft journals and the left cylinder head camshaft carriers. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

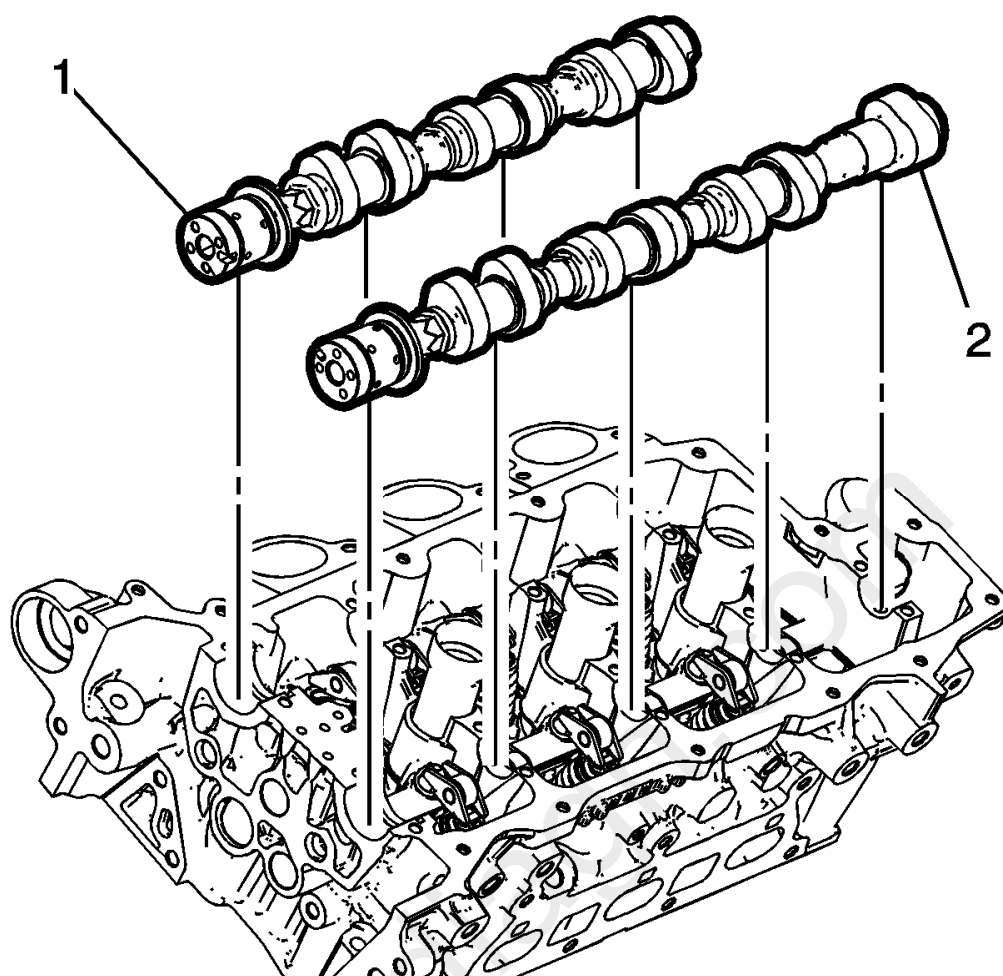


Fig. 170: Camshaft Intake And Exhaust Positioning Points
Courtesy of GENERAL MOTORS COMPANY

3. Place the left intake (1) and left exhaust (2) camshafts in position in the left cylinder head.

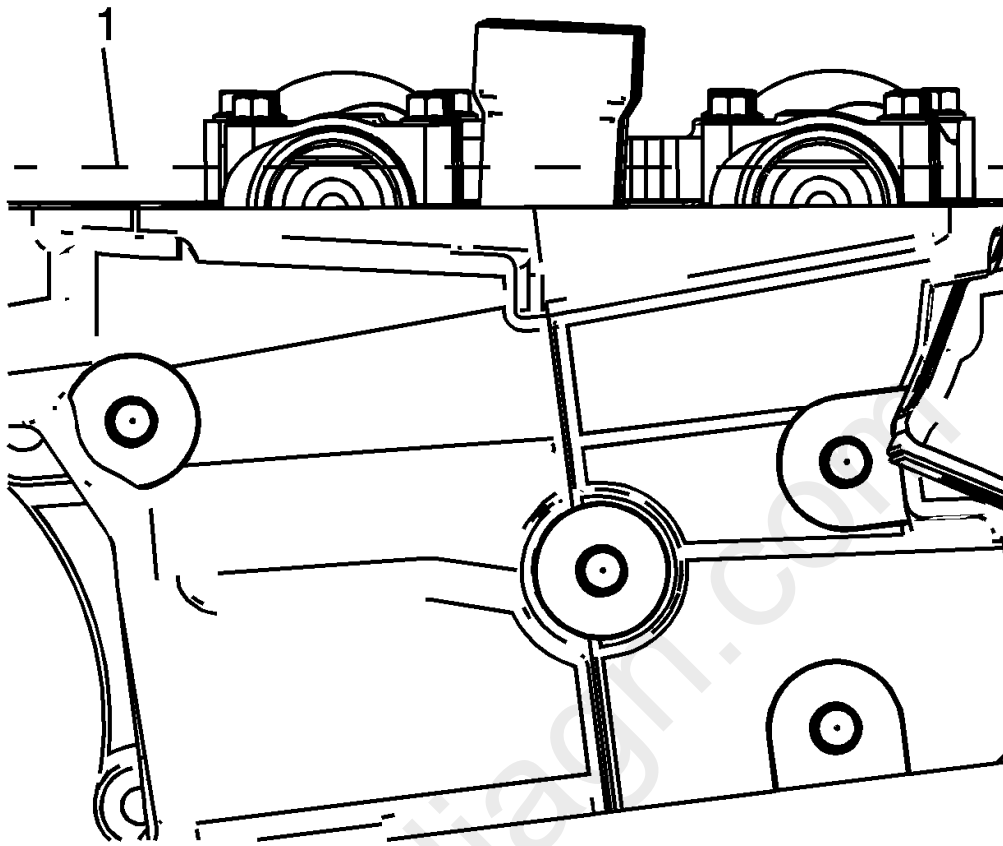


Fig. 171: View Of Camshaft Flats Parallel With Camshaft Cover Rail
Courtesy of GENERAL MOTORS COMPANY

4. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the left cylinder head camshaft cover rail.

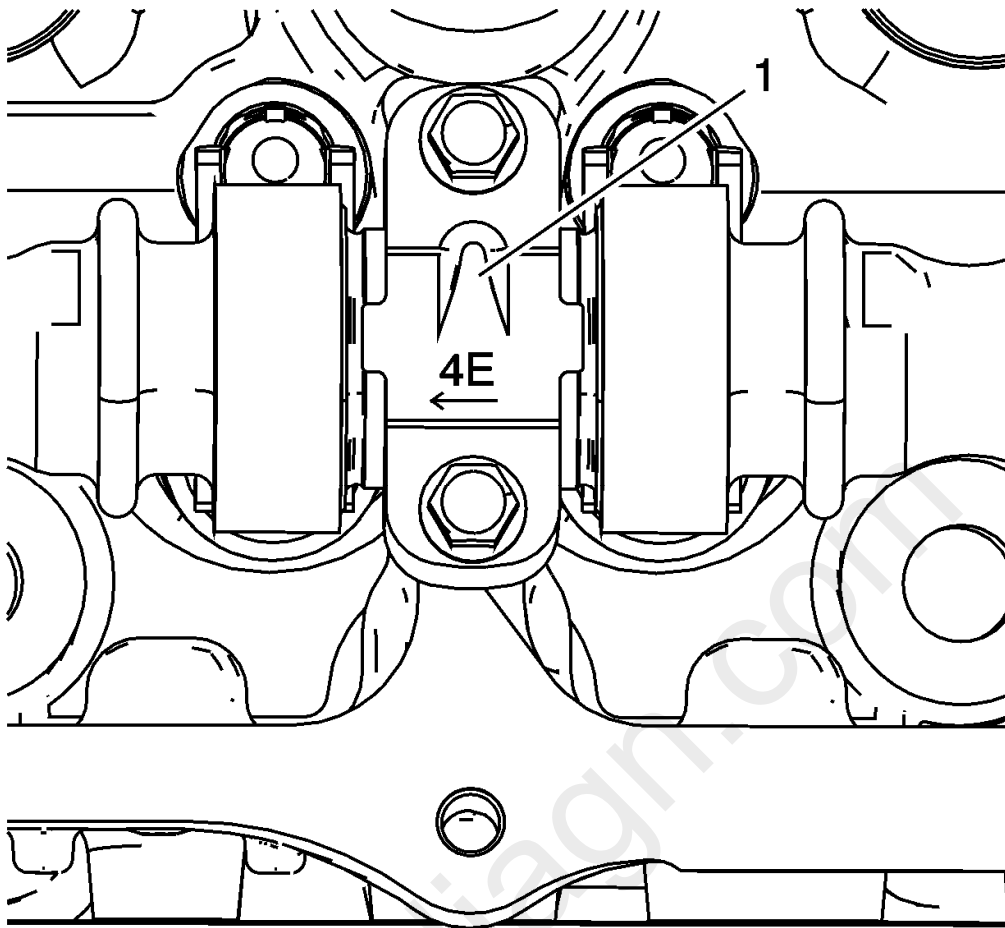


Fig. 172: Left Cylinder Head Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS COMPANY

5. Observe the markings on the left cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature (1) must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number 2, 4, 6 indicates the cylinder position from the front of the engine.
6. Apply a liberal amount of lubricant to the camshaft bearing caps. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

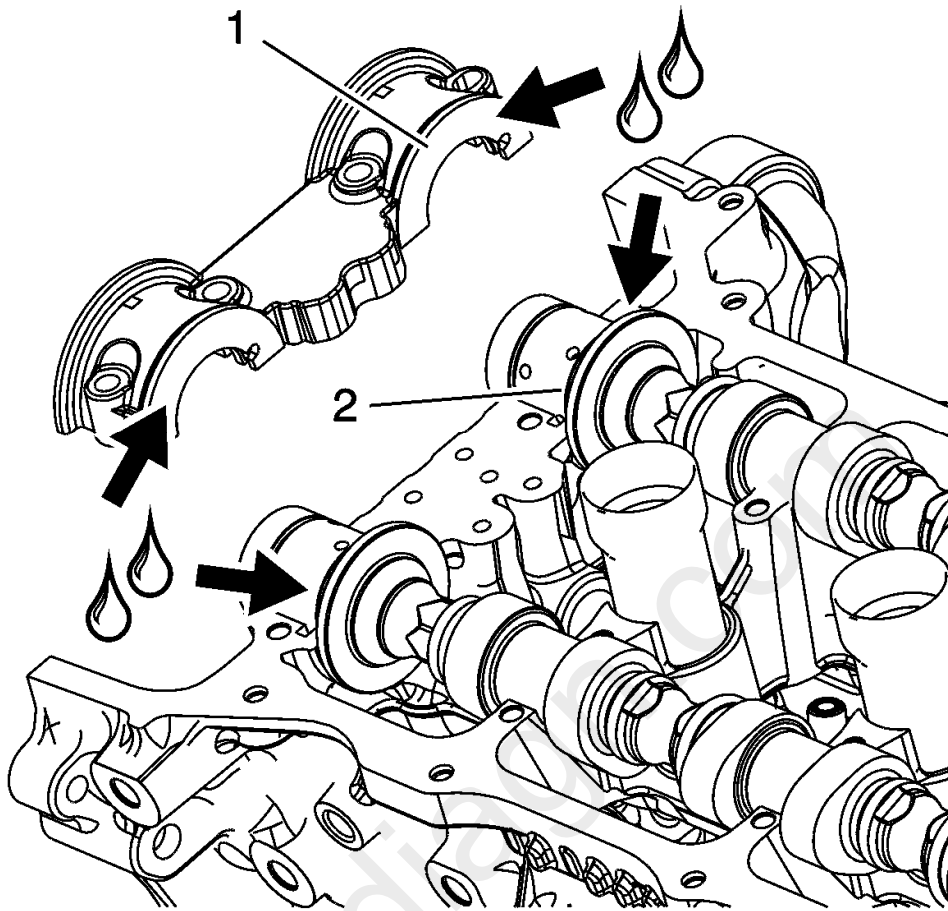


Fig. 173: Camshaft Bearing Cap And Camshaft Thrust Surface
Courtesy of GENERAL MOTORS COMPANY

7. Apply a liberal amount of lubricant to the camshaft bearing cap (1) and camshaft thrust surface (2). Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

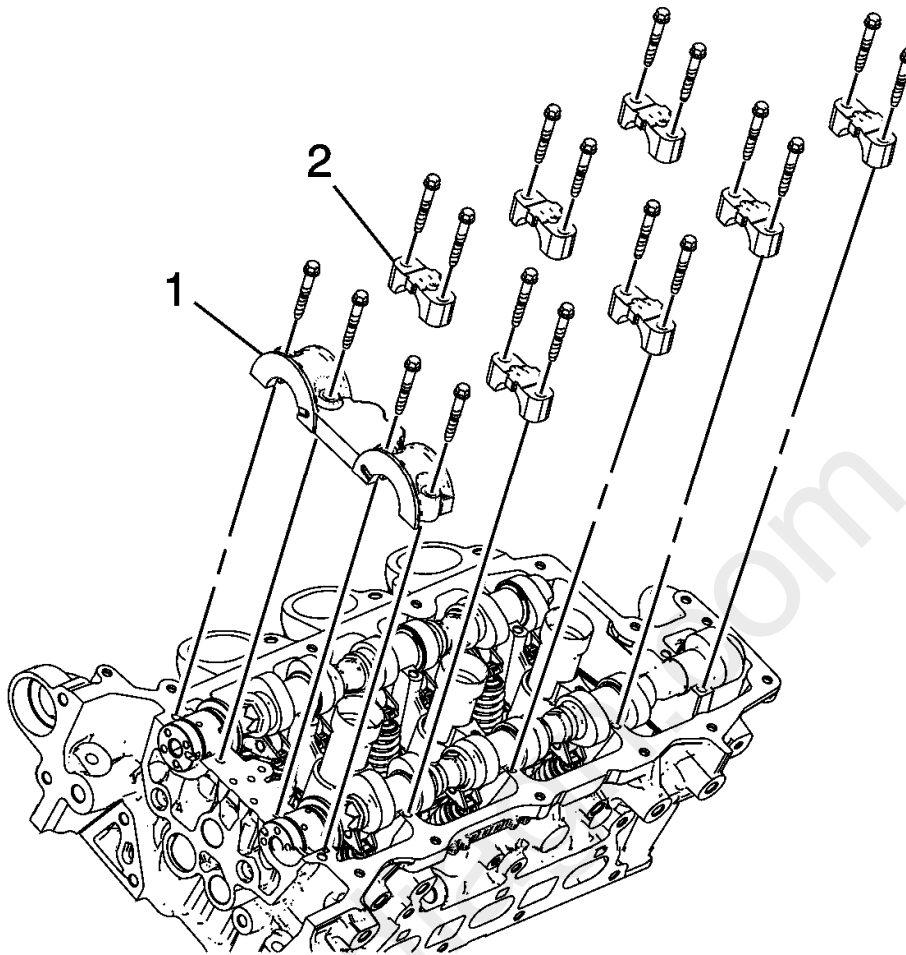


Fig. 174: Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the camshaft bearing thrust cap (1) in the first journal of the left cylinder head.
9. Install the remaining bearing caps (2) with their orientation mark toward the center of the cylinder head.
10. Hand start all the camshaft bearing cap bolts.

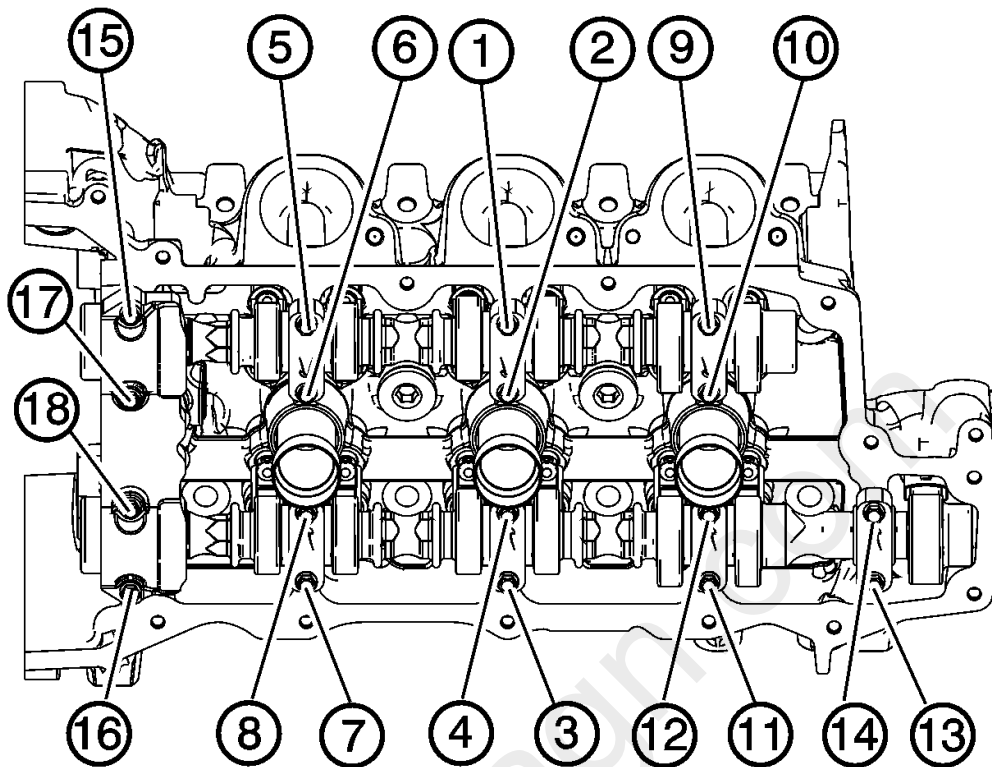


Fig. 175: Identifying Camshaft Bearing Cap Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

11. Tighten the camshaft bearing cap bolts in the sequence shown and tighten to 10 N.m (89 lb in).
12. Loosen the center intake camshaft bearing cap bolts 1, 2 and the center exhaust camshaft bearing cap bolts 3, 4.
13. Retighten the center camshaft bearing cap bolts 1, 2, 3, 4 and retighten the camshaft bearing cap bolts to 10 N.m (89 lb in).
14. Install the camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 2.
15. Install the fuel pump. Refer to Fuel Pump Replacement .

CAMSHAFT REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 1 .

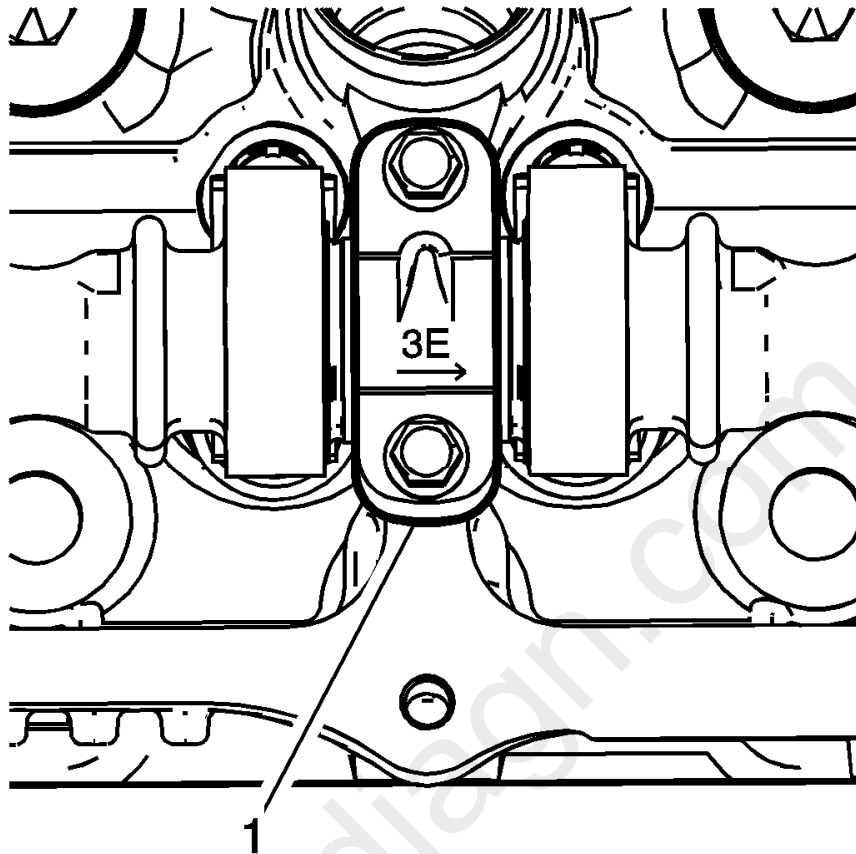


Fig. 176: Bearing Cap Markings

Courtesy of GENERAL MOTORS COMPANY

2. Observe the markings on the bearing caps (1). Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the engine.

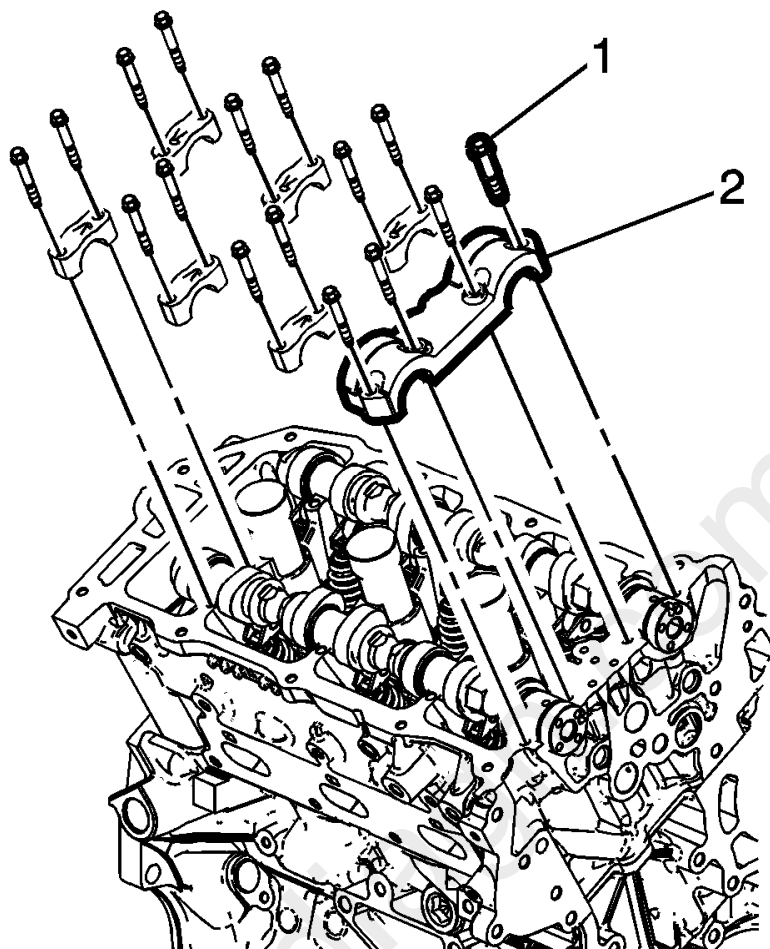


Fig. 177: Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the camshaft bearing cap bolts (1).
4. Remove the camshaft bearing caps (2).

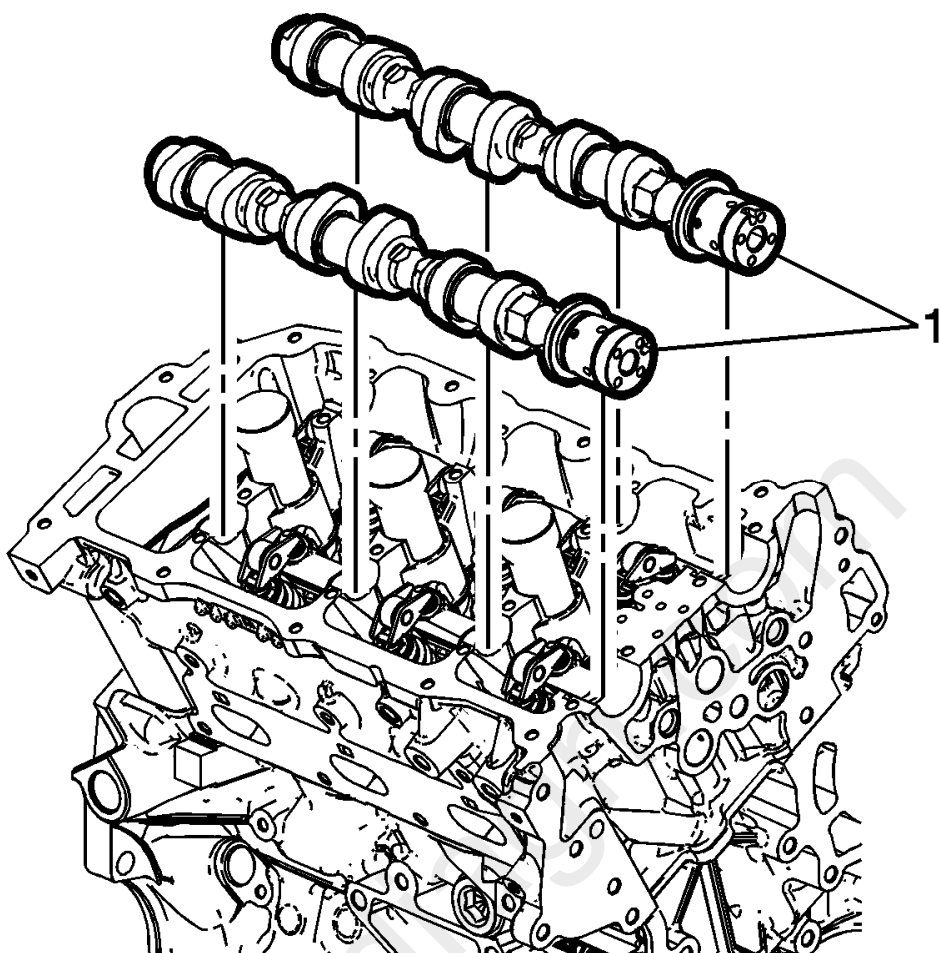


Fig. 178: Camshafts
Courtesy of GENERAL MOTORS COMPANY

IMPORTANT: Mark the camshafts upon removal to ensure installation is in the correct position.

5. Remove the camshafts (1).

Installation Procedure

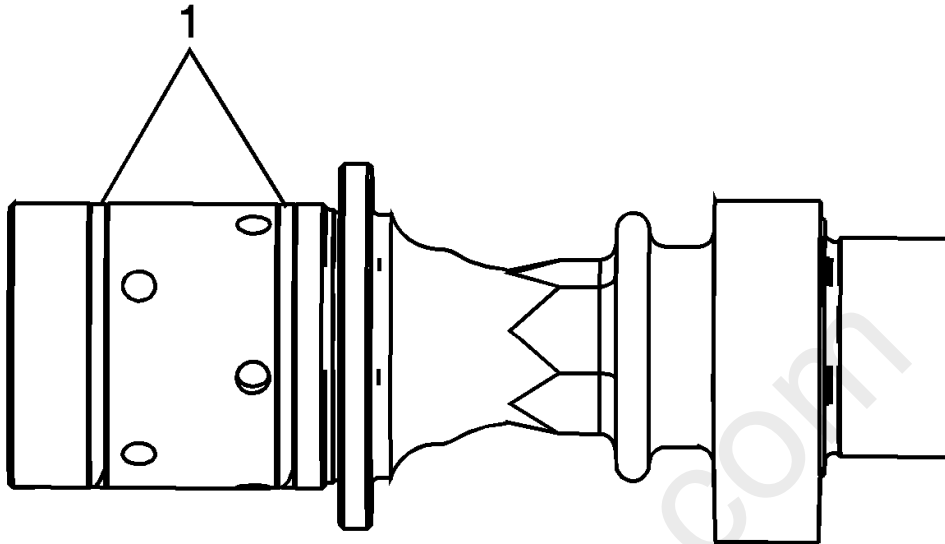


Fig. 179: Locating Camshaft Sealing Rings In Camshaft Grooves
Courtesy of GENERAL MOTORS COMPANY

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the cylinder head and the camshaft caps.

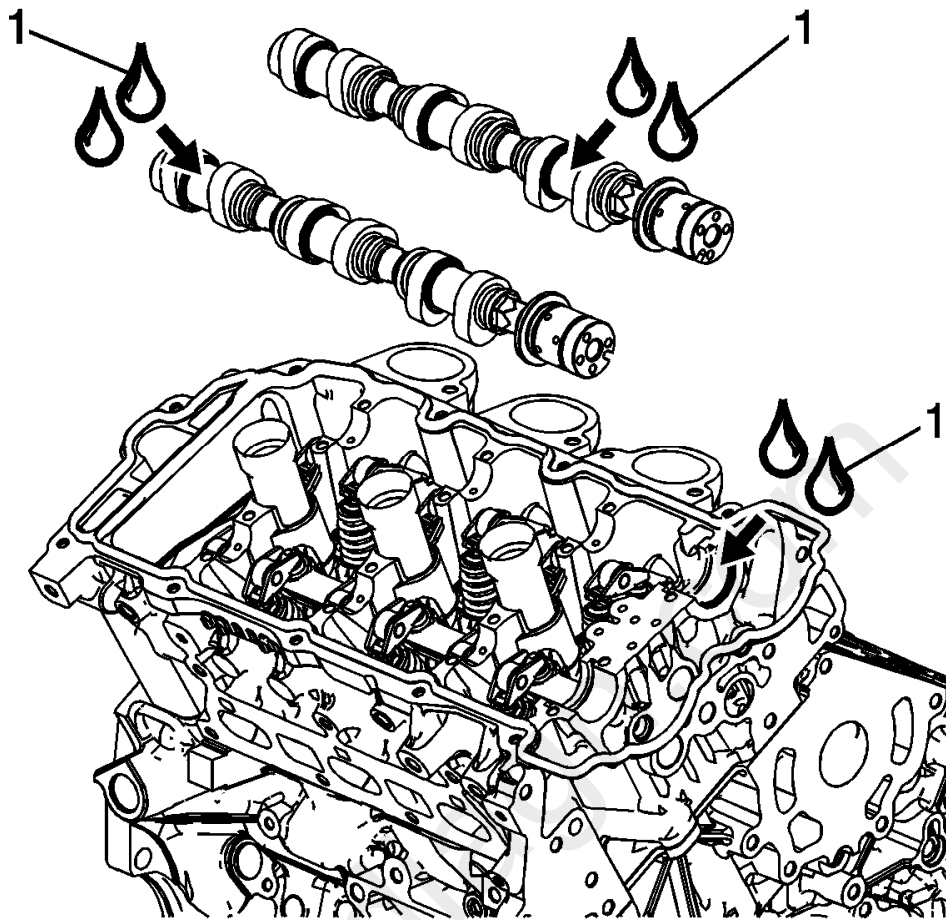


Fig. 180: Right Cylinder Head Camshaft Lubrication Points
Courtesy of GENERAL MOTORS COMPANY

2. Apply a liberal amount of lubricant (1) to the camshaft journals and the right cylinder head camshaft carriers. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

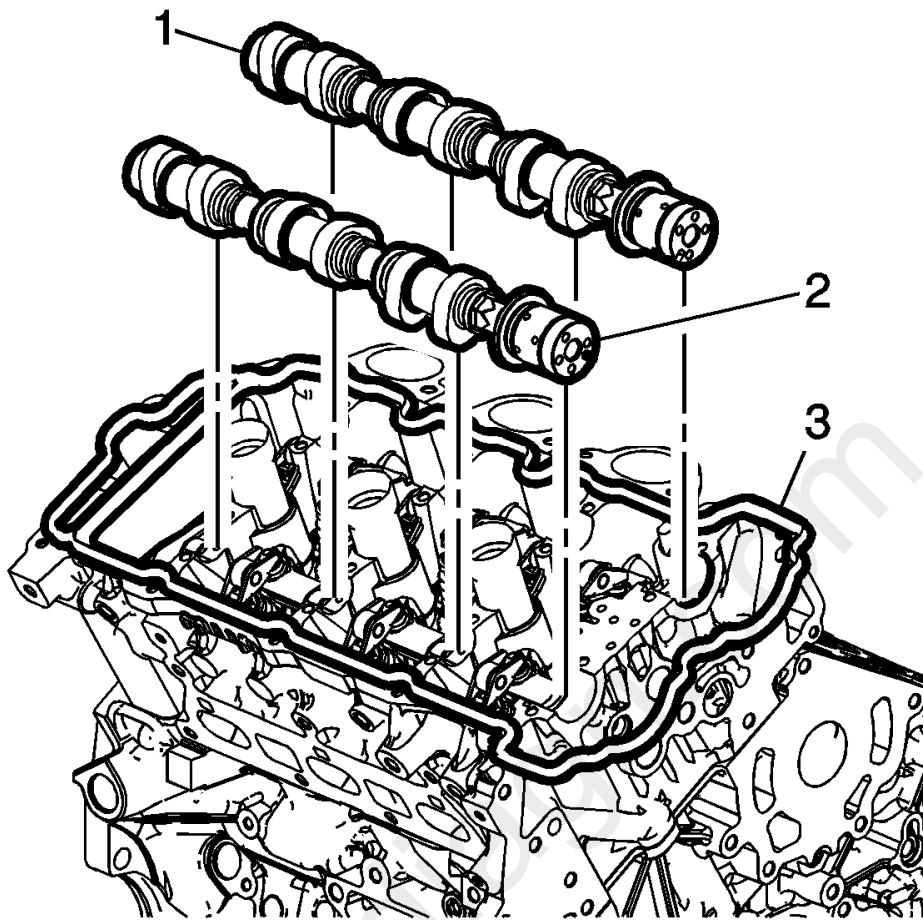


Fig. 181: Right Cylinder Head Camshaft Intake And Exhaust Positioning Points
Courtesy of GENERAL MOTORS COMPANY

3. Place the right intake (1) and right exhaust (2) camshafts in position in the right cylinder head (3).

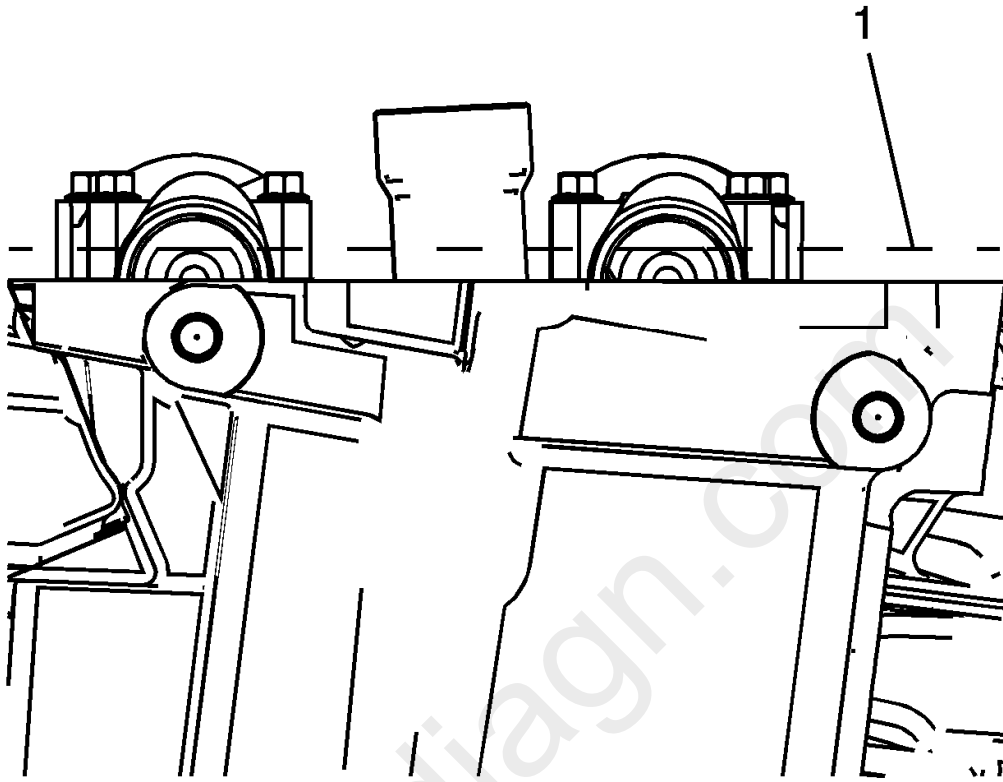


Fig. 182: Identifying Camshaft Neutral (Low Tension) Position
Courtesy of GENERAL MOTORS COMPANY

4. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the right cylinder head camshaft cover rail.

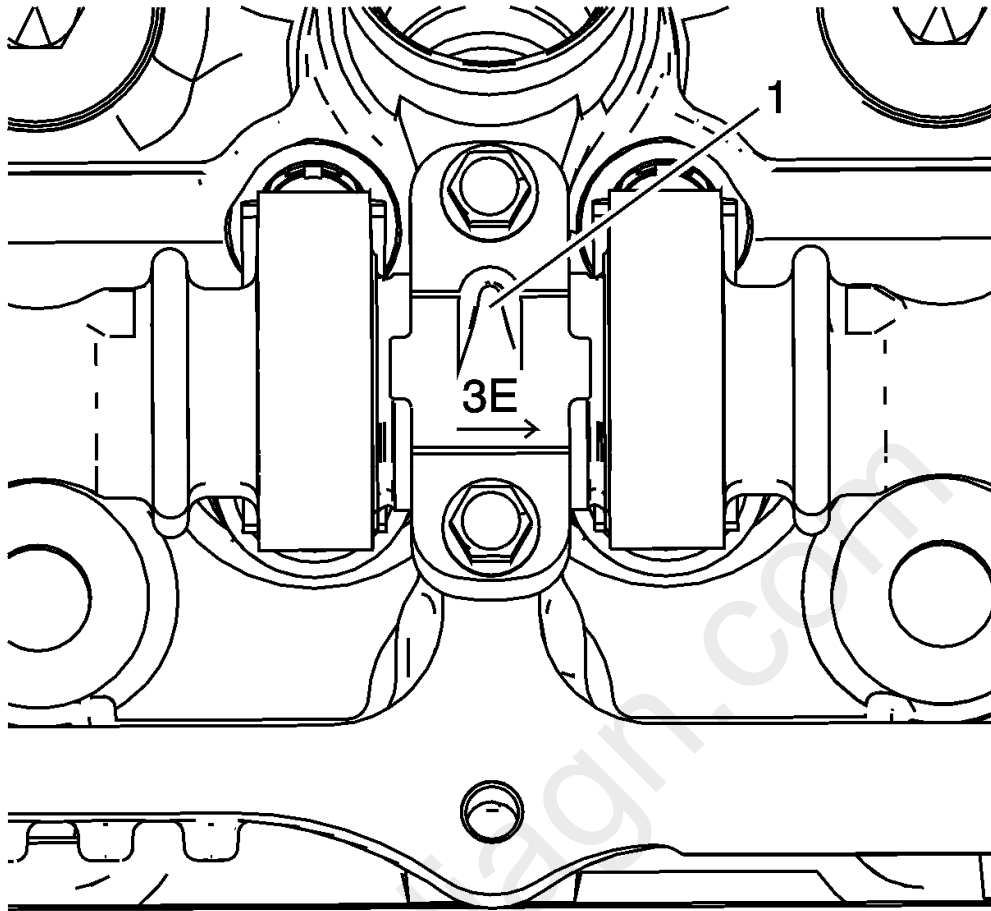


Fig. 183: Right Cylinder Head Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS COMPANY

5. Observe the markings on the right cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature (1) must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number 1, 3, 5 indicates the cylinder position from the front of the engine.
6. Apply a liberal amount of lubricant to the camshaft bearing caps. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

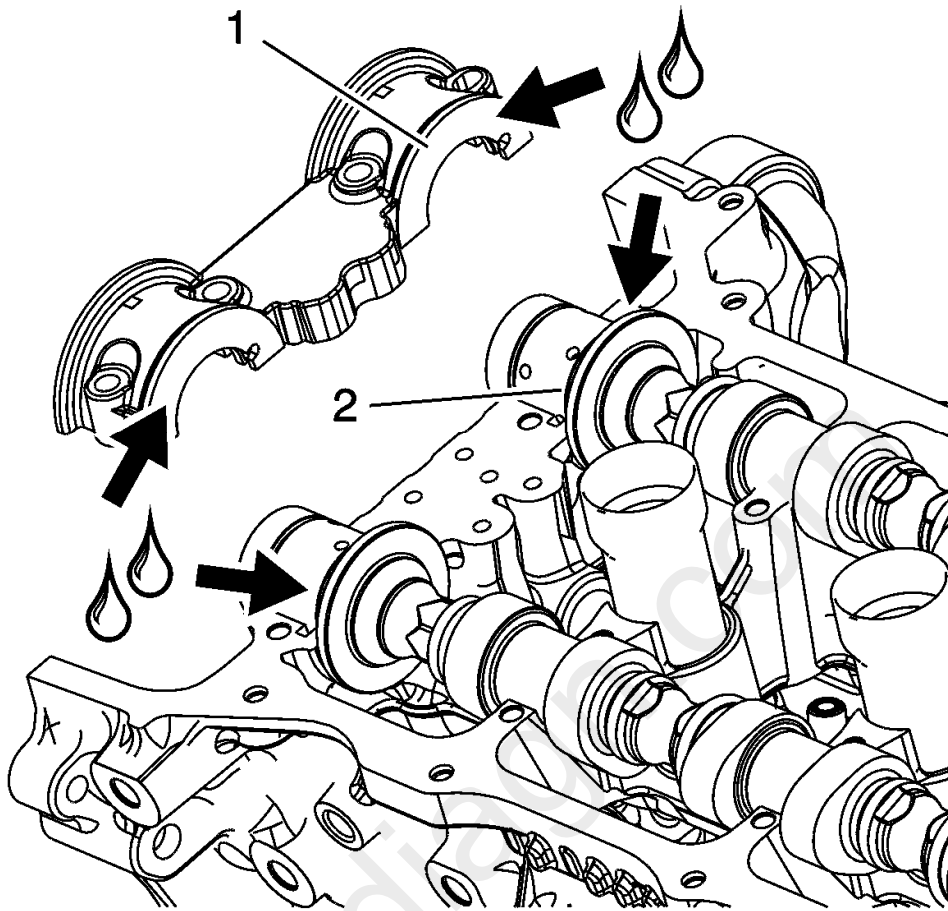


Fig. 184: Camshaft Bearing Cap And Camshaft Thrust Surface
Courtesy of GENERAL MOTORS COMPANY

7. Apply a liberal amount of lubricant to the camshaft bearing cap (1) and camshaft thrust surface (2). Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended lubricant.

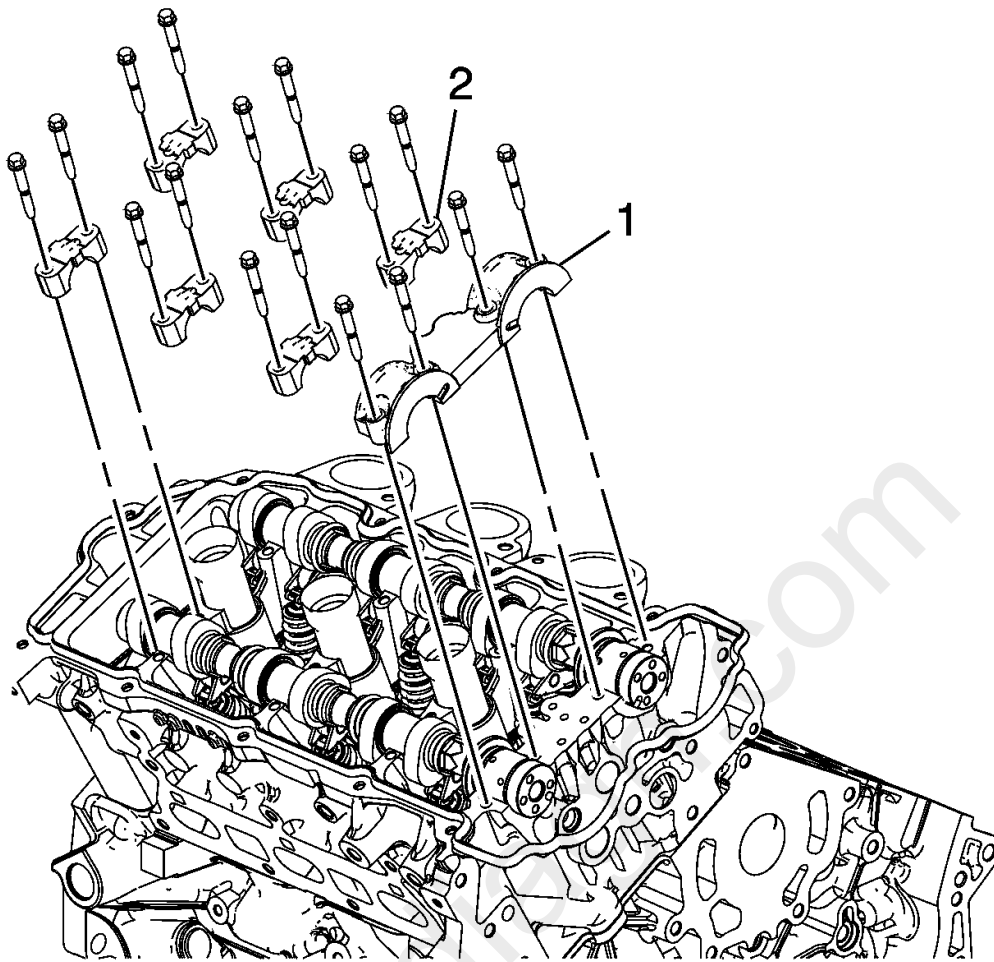


Fig. 185: Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the camshaft bearing thrust caps (1) in the first journal of the right cylinder head.
9. Install the remaining bearing caps (2) with their orientation mark toward the center of the cylinder head.
10. Hand start all the camshaft bearing cap bolts.

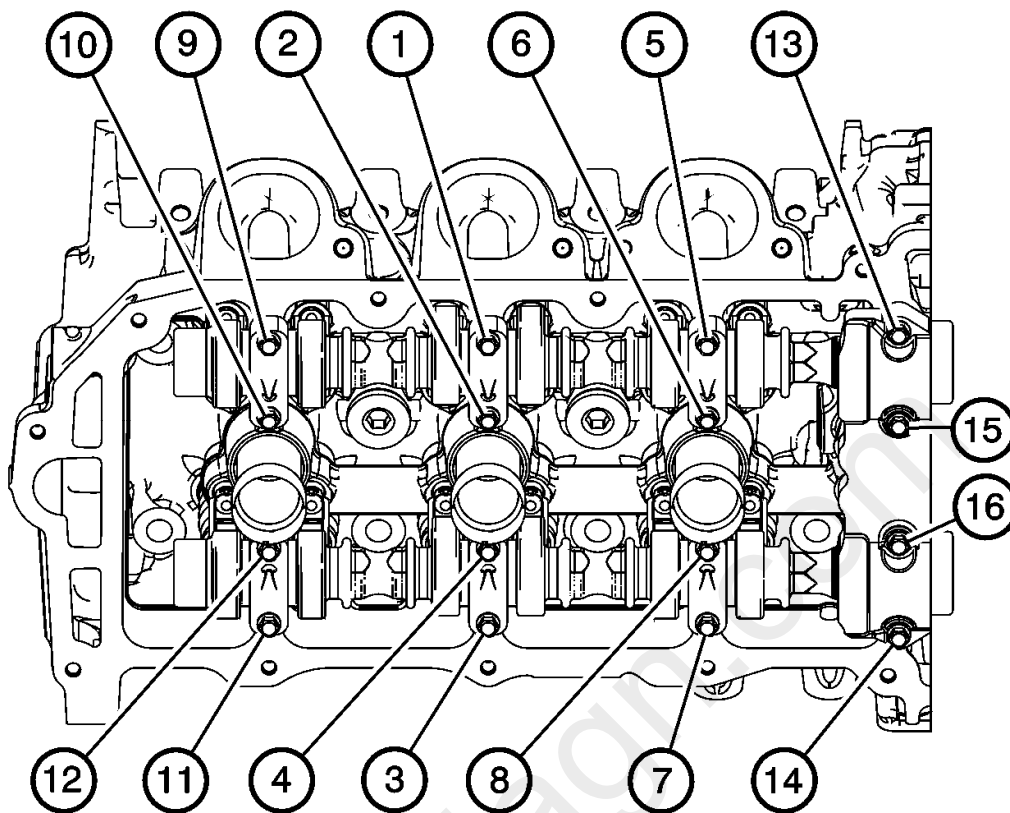


Fig. 186: Camshaft Bearing Cap Bolts Tighten Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

11. Tighten the camshaft bearing cap bolts in the sequence shown and tighten to 10 N.m (89 lb in).
12. Loosen the center intake camshaft bearing cap bolts (1, 2) and the center exhaust camshaft bearing cap bolts (3, 4).
13. Retighten the center camshaft bearing cap bolts (1, 2, 3, 4) and retighten the camshaft bearing cap bolts to 10 N.m (89 lb in).
14. Install the camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 1 .

VALVE ROCKER ARM REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.

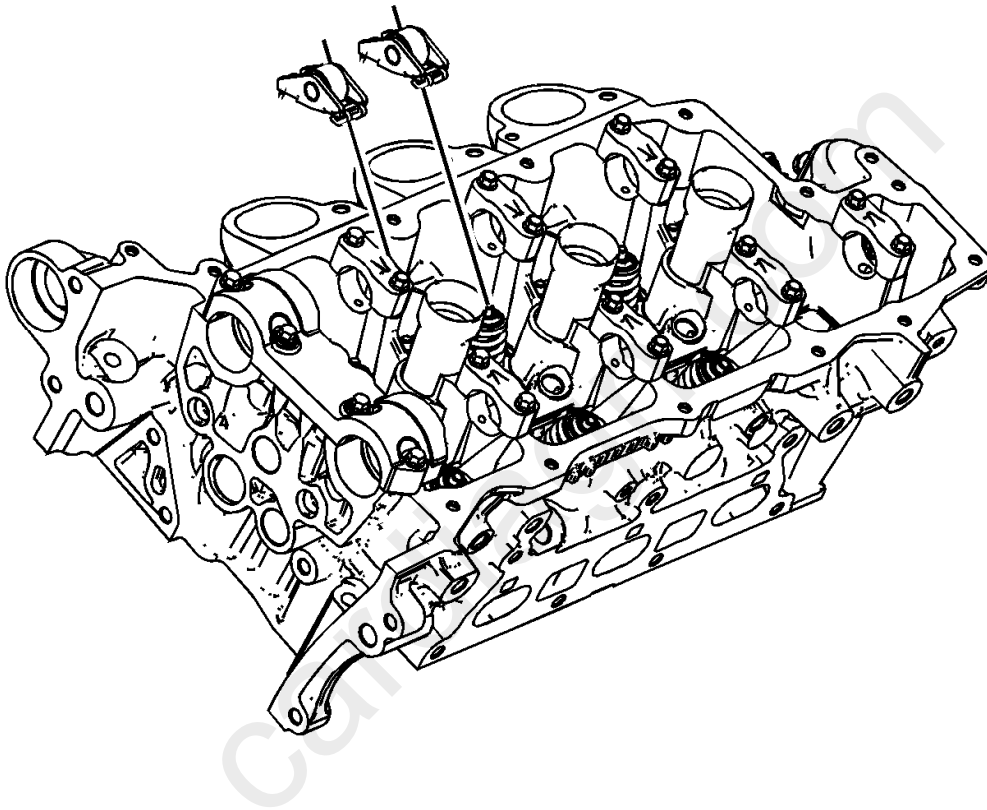


Fig. 187: View Of Valve Rocker Arm - Left Side
Courtesy of GENERAL MOTORS COMPANY

2. Remove the rocker arms.
3. Clean and inspect the camshaft(s) and the rocker arm(s). Replace as necessary. Refer to Camshaft Cleaning and Inspection , and Valve Rocker Arm Cleaning and Inspection .
4. Clean and inspect the valve lifters and replace as necessary. Refer to Valve Lifter Cleaning and Inspection

Installation Procedure

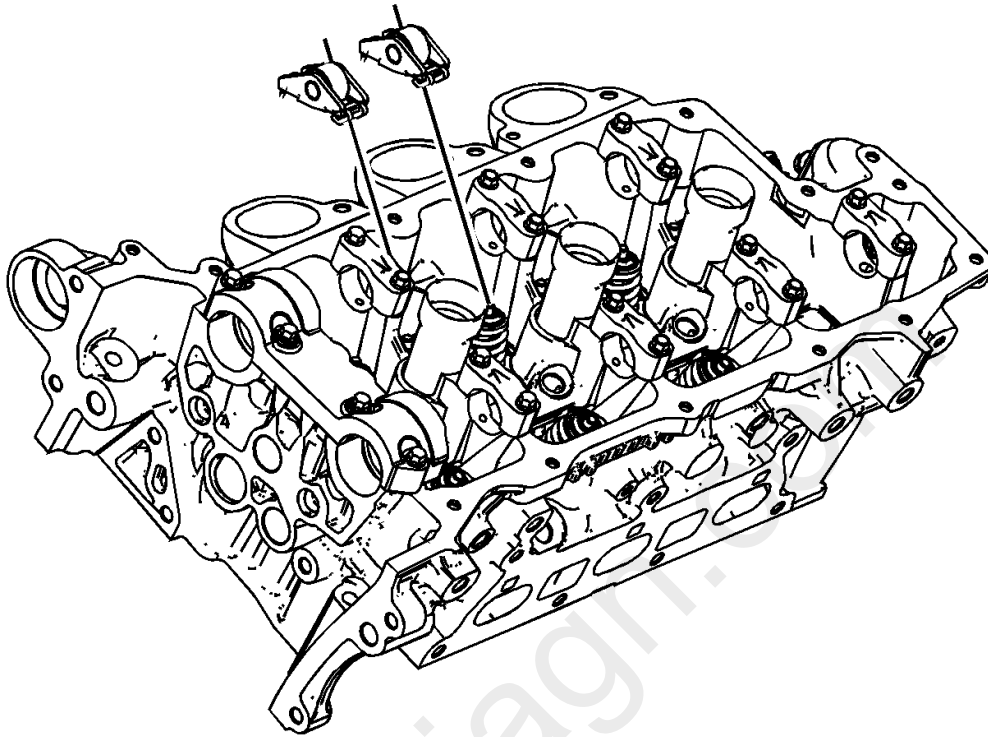


Fig. 188: View Of Valve Rocker Arm - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Install the rocker arms. Refer to **Valve Rocker Arm Installation - Left Side** .
2. Install the camshaft(s). Refer to **Camshaft Replacement - Left Side**.

VALVE ROCKER ARM REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **Camshaft Replacement - Right Side**.

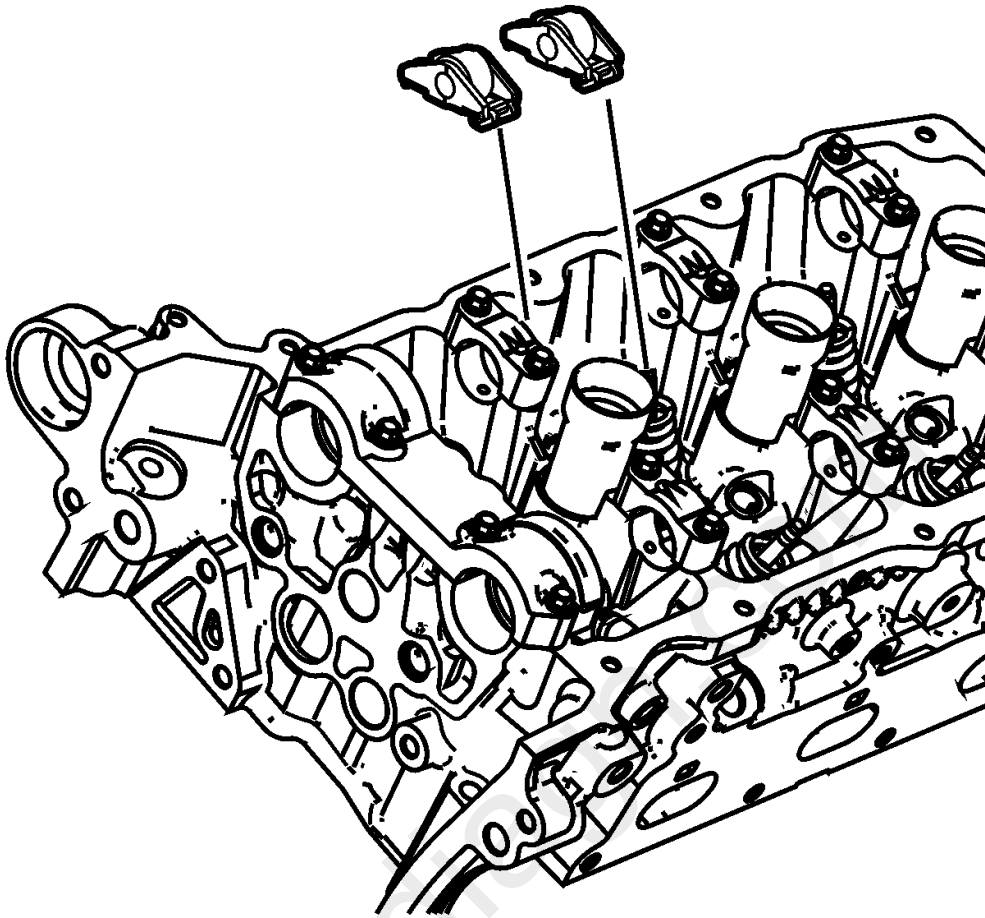


Fig. 189: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

2. Remove the rocker arms.
3. Clean and inspect the camshaft(s) and the rocker arm(s). Replace as necessary. Refer to **Camshaft Cleaning and Inspection** , and **Valve Rocker Arm Cleaning and Inspection** .
4. Clean and inspect the valve lifters and replace as necessary. Refer to **Valve Lifter Cleaning and Inspection**

Installation Procedure

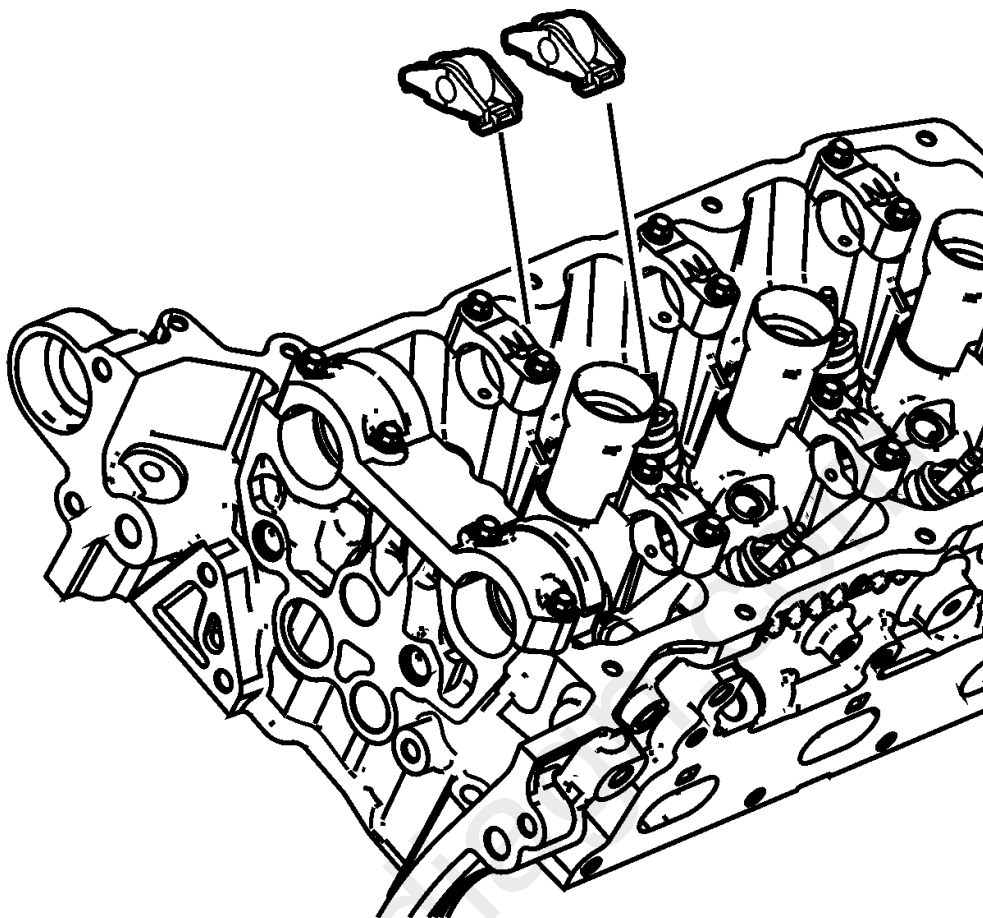


Fig. 190: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

1. Install the rocker arms. Refer to **Valve Rocker Arm Installation - Right Side** .
2. Install the camshaft(s). Refer to **Camshaft Replacement - Right Side**.

VALVE LIFTER REPLACEMENT - LEFT SIDE

Removal Procedure

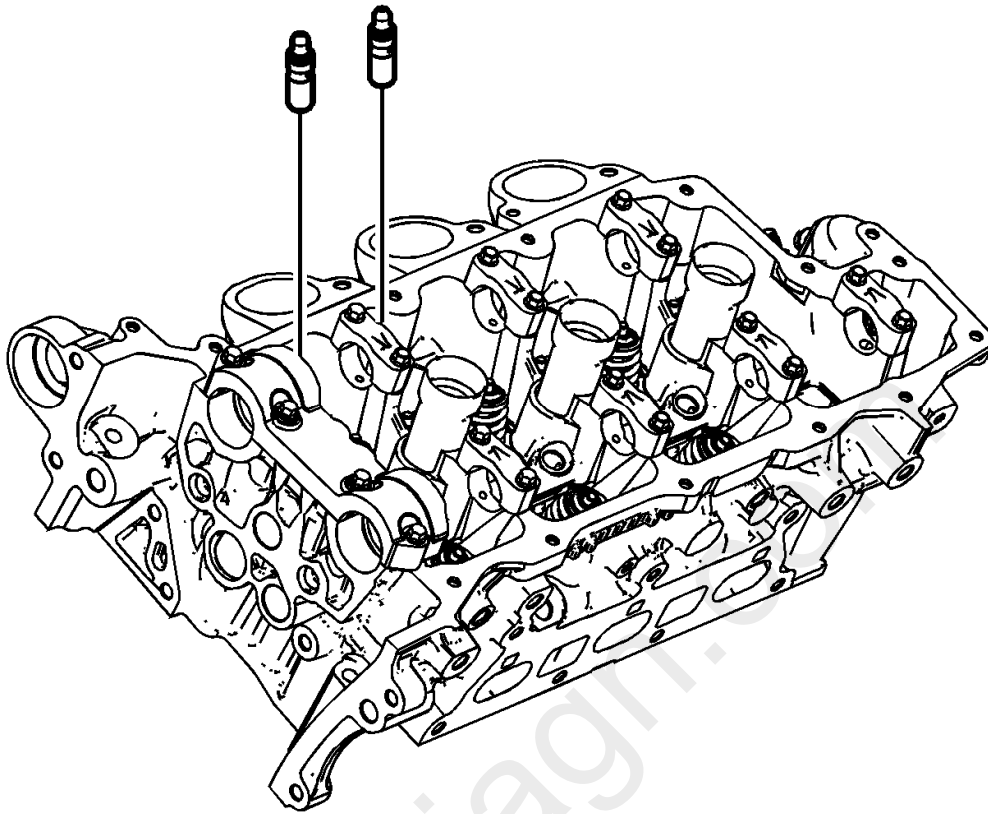


Fig. 191: Valve Lifter Removal - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Remove the applicable camshafts. Refer to **Camshaft Replacement - Left Side**.
2. Remove the rocker arms. Refer to **Valve Rocker Arm Replacement - Left Side**.
3. Remove the lifters. Refer to **Valve Lifter Removal - Left Side**
4. Clean and inspect the camshafts, rocker arms and lifters. Repair or replace as necessary. Refer to **Camshaft Cleaning and Inspection** , and **Valve Lifter Cleaning and Inspection** .
5. Clean and inspect the rocker arm. Refer to **Valve Rocker Arm Cleaning and Inspection**

Installation Procedure

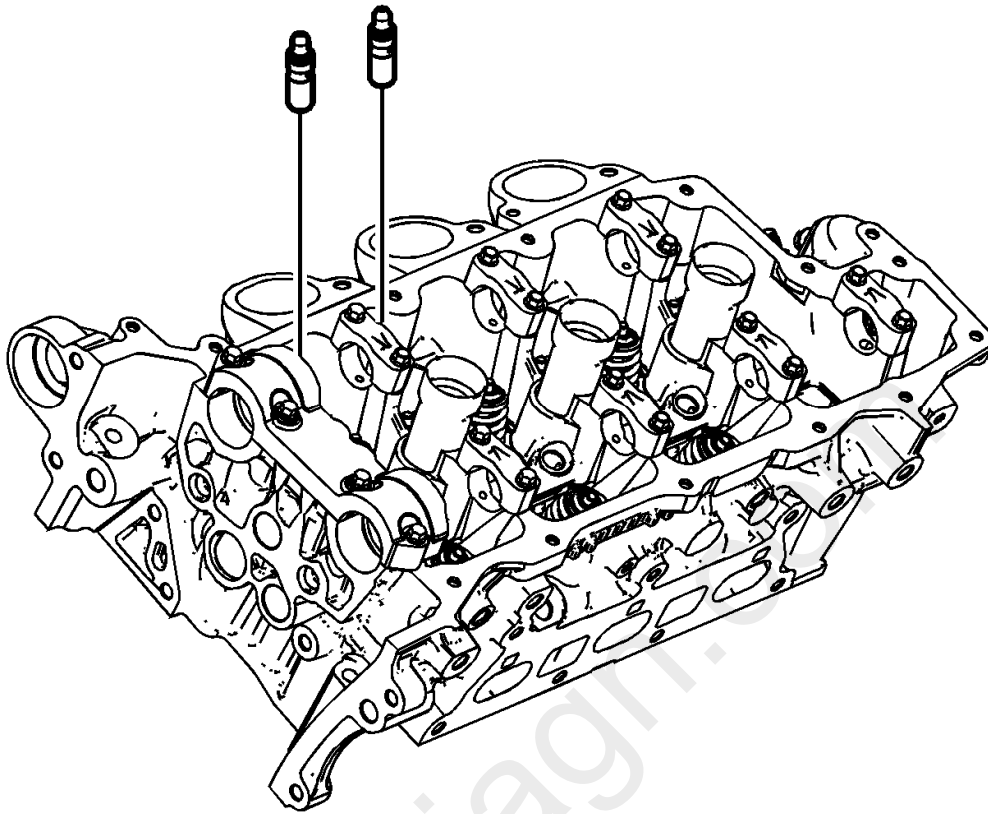


Fig. 192: Valve Lifter Removal - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Install the lifters.
2. Install the rocker arms. Refer to **Valve Rocker Arm Replacement - Left Side**.
3. Install the camshafts. Refer to **Camshaft Replacement - Left Side**.

VALVE LIFTER REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the applicable camshaft(s). Refer to **Camshaft Replacement - Right Side**.
2. Remove the rocker arms. Refer to **Valve Rocker Arm Removal - Right Side**.

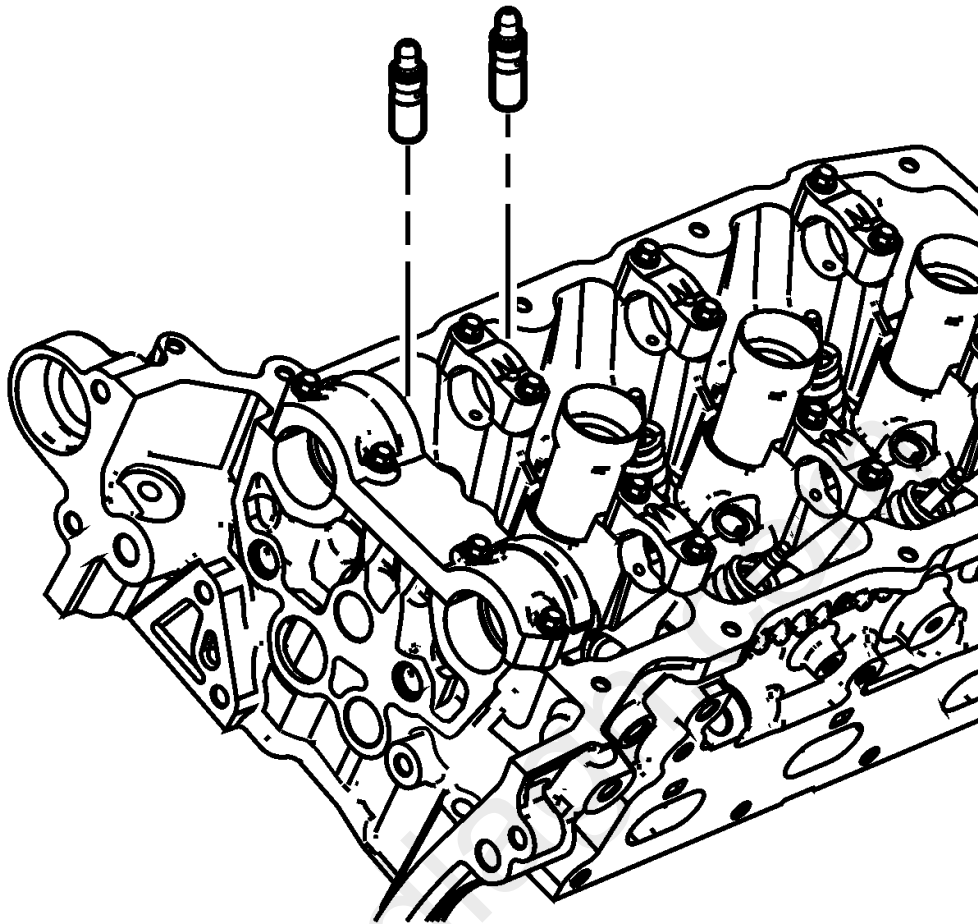


Fig. 193: View Of Stationary Hydraulic Lash Adjuster (SHLAs)
Courtesy of GENERAL MOTORS COMPANY

3. Remove the lifters. Refer to **Valve Lifter Removal - Right Side** .
4. Clean and inspect the camshaft(s) and the rocker arm(s) and lifter. Repair or replace as necessary. Refer to **Camshaft Cleaning and Inspection** , **Valve Lifter Cleaning and Inspection** , and **Valve Rocker Arm Cleaning and Inspection** .

Installation Procedure

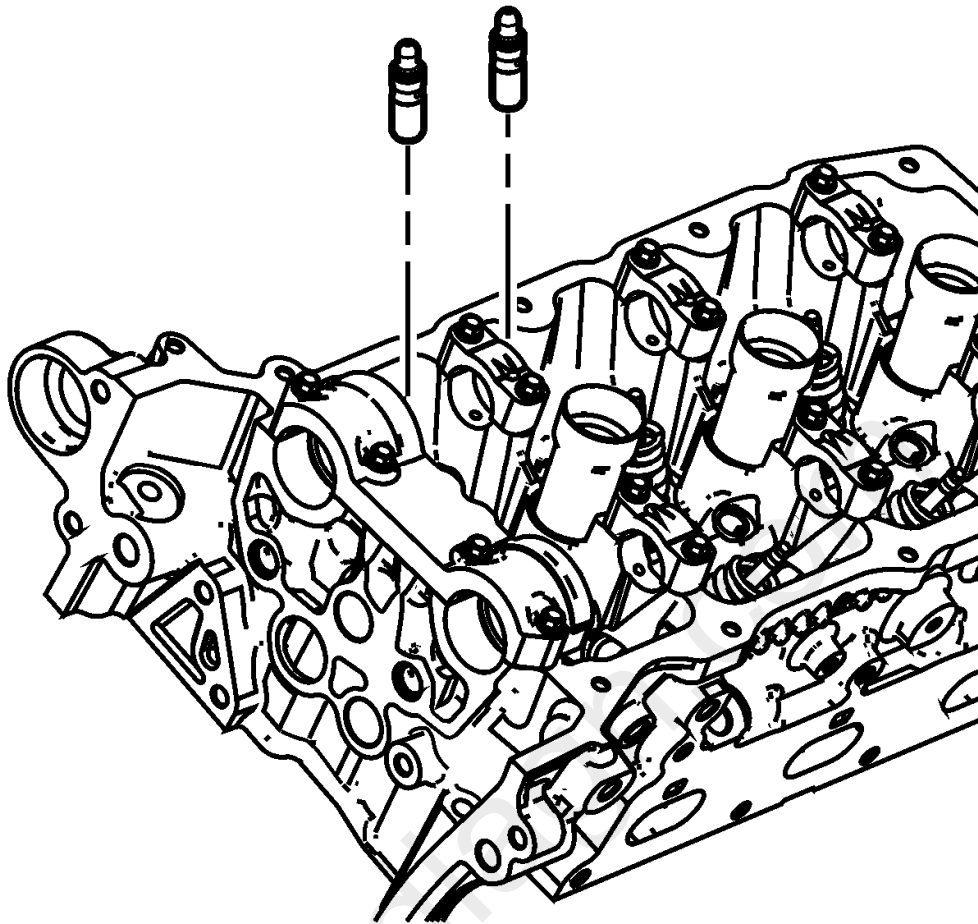


Fig. 194: View Of Stationary Hydraulic Lash Adjuster (SHLAs)
Courtesy of GENERAL MOTORS COMPANY

1. Install the lifters. Refer to **Valve Lifter Installation - Right Side** .
2. Install the rocker arms. Refer to **Valve Rocker Arm Installation - Right Side** .
3. Install the applicable camshaft(s). Refer to **Camshaft Replacement - Right Side**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - LEFT SIDE

Special Tools

- **EN-39313** Spark Plug Port Adapter
- **EN-46106** Flywheel Holding Tool
- **EN-46110** On-Vehicle Valve Spring Compressor
- **EN-46116** Valve Stem Seal Remover/Installer

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

Removal Procedure

NOTE: This procedure is not used in Brazil.

1. Remove the rocker arms. Refer to **Valve Rocker Arm Replacement - Left Side**.
2. Remove the starter motor. Refer to **Starter Replacement (LF1/LLT)** .

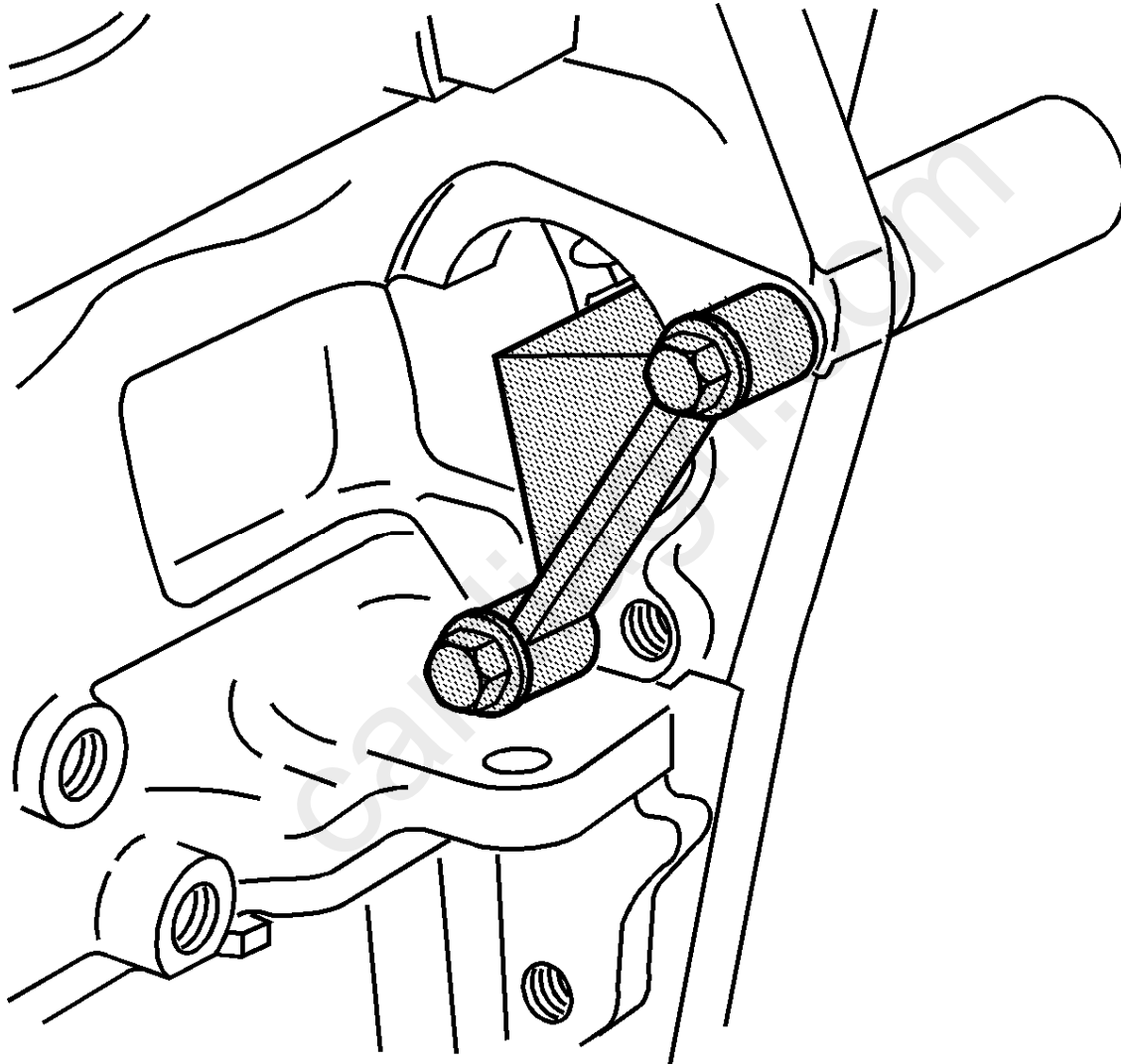


Fig. 195: Flywheel Holding Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the EN-46106 tool is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

3. Install the **EN-46106** tool in order to prevent crankshaft rotation.

4. Remove the spark plug from the applicable cylinder. Refer to **Spark Plug Replacement** .
5. Install the **EN-39313** adapter to the applicable cylinder.
6. Connect the **EN-39313** adapter to a compressed air source.

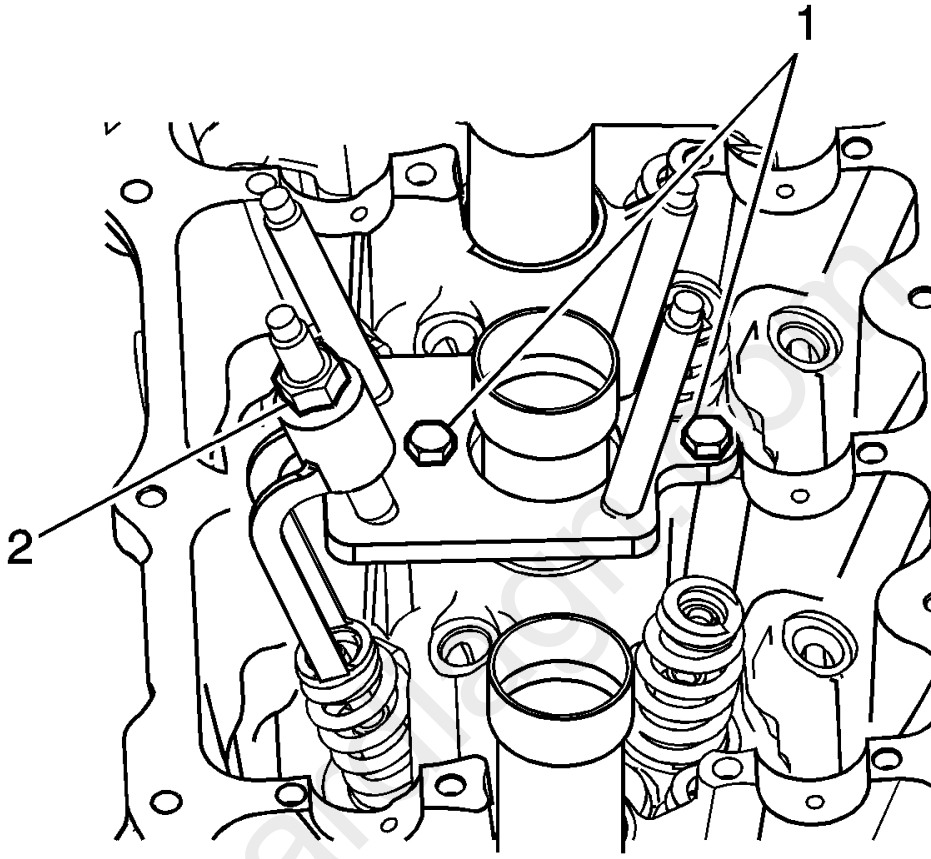


Fig. 196: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-46110** compressor above the applicable cylinder as shown.
8. Tighten the **EN-46110** compressor nut (2).

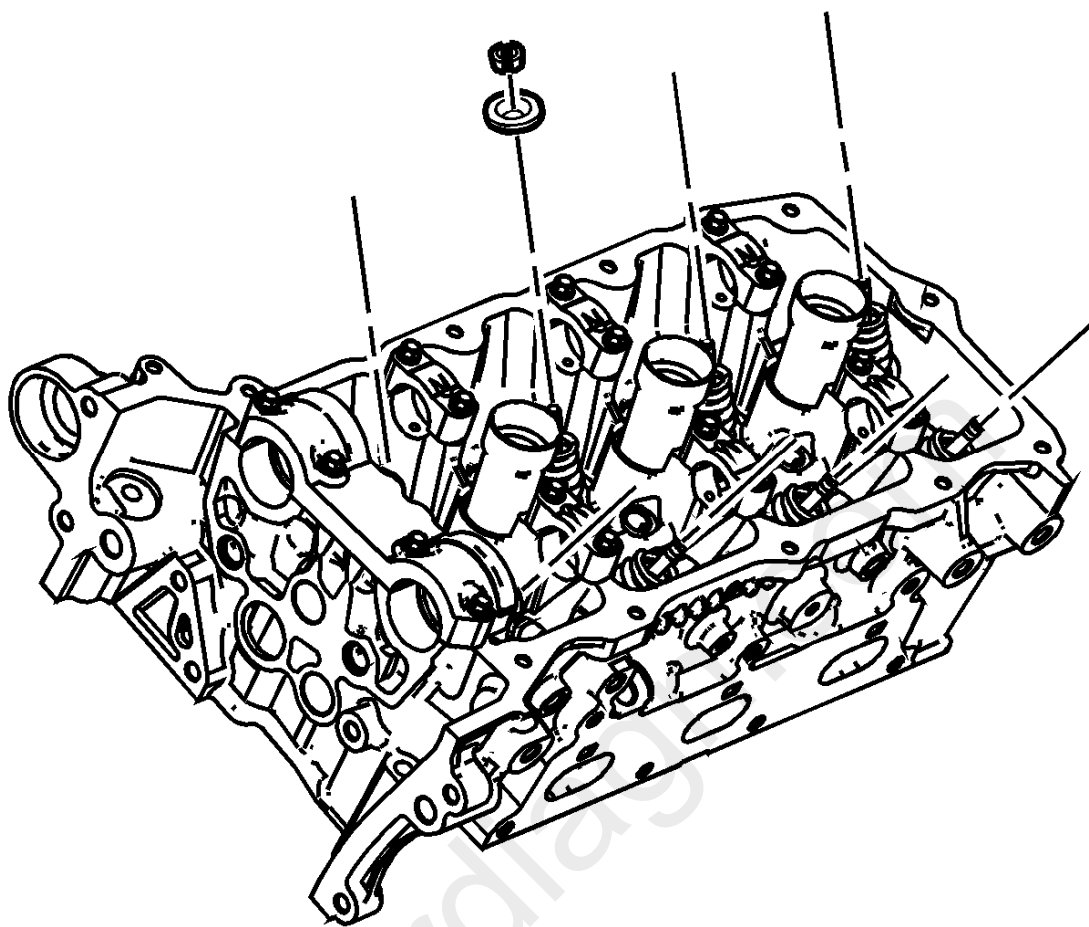


Fig. 197: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS COMPANY

9. Remove the valve keepers.
10. Loosen the **EN-46110** compressor nut.
11. Remove the valve spring retainer.

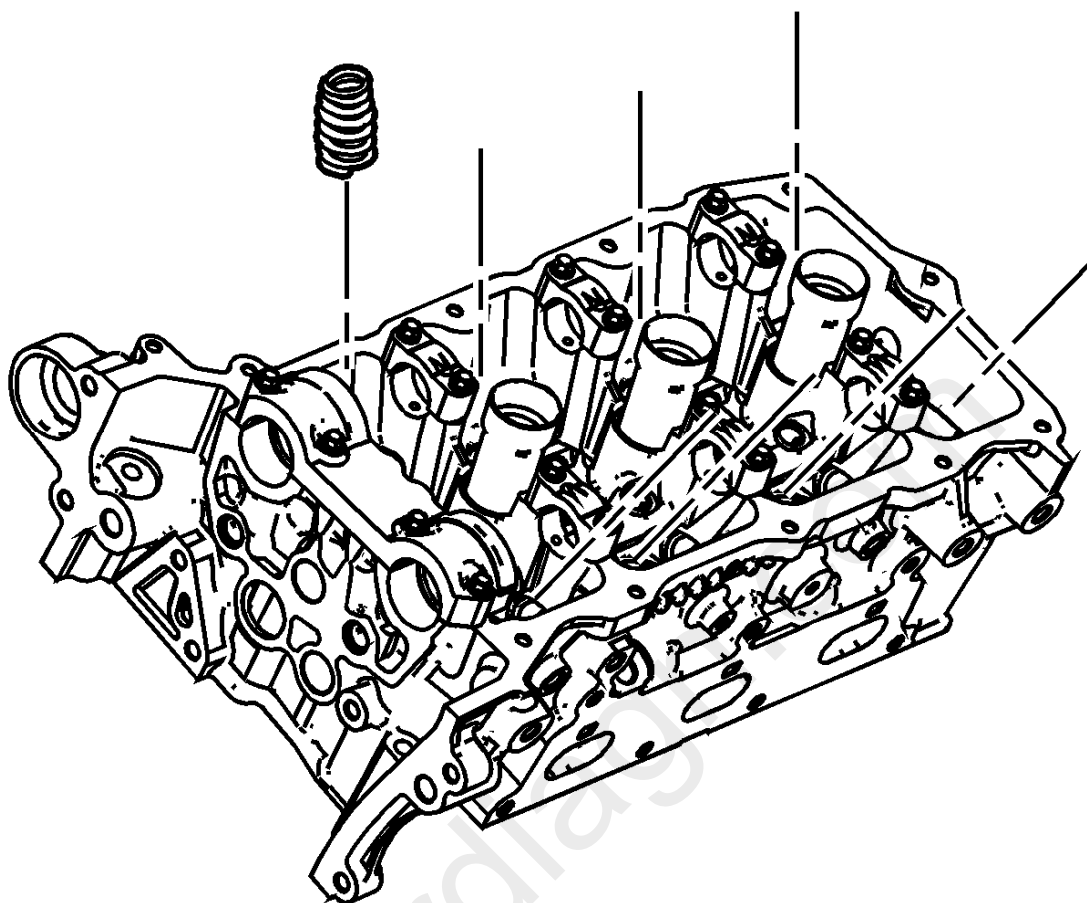


Fig. 198: View Of Valve Spring
Courtesy of GENERAL MOTORS COMPANY

12. Remove the valve spring.

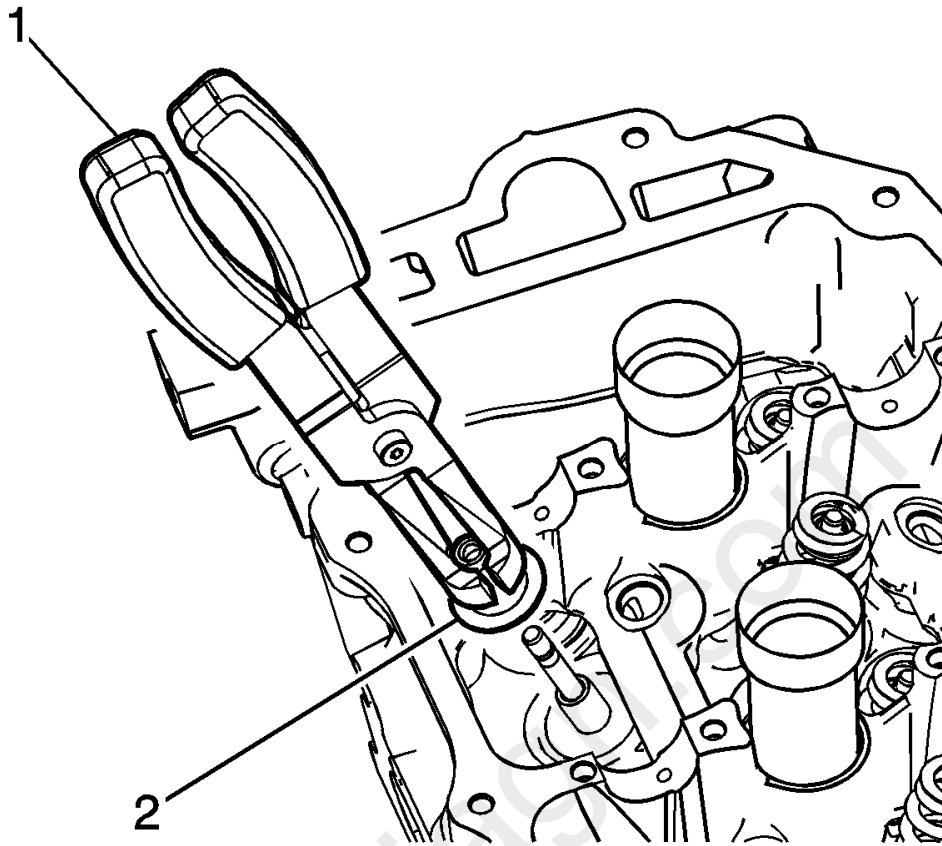


Fig. 199: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

13. Use the **EN-46116** remover/installer (1) in order to remove the valve stem seal (2).

Installation Procedure

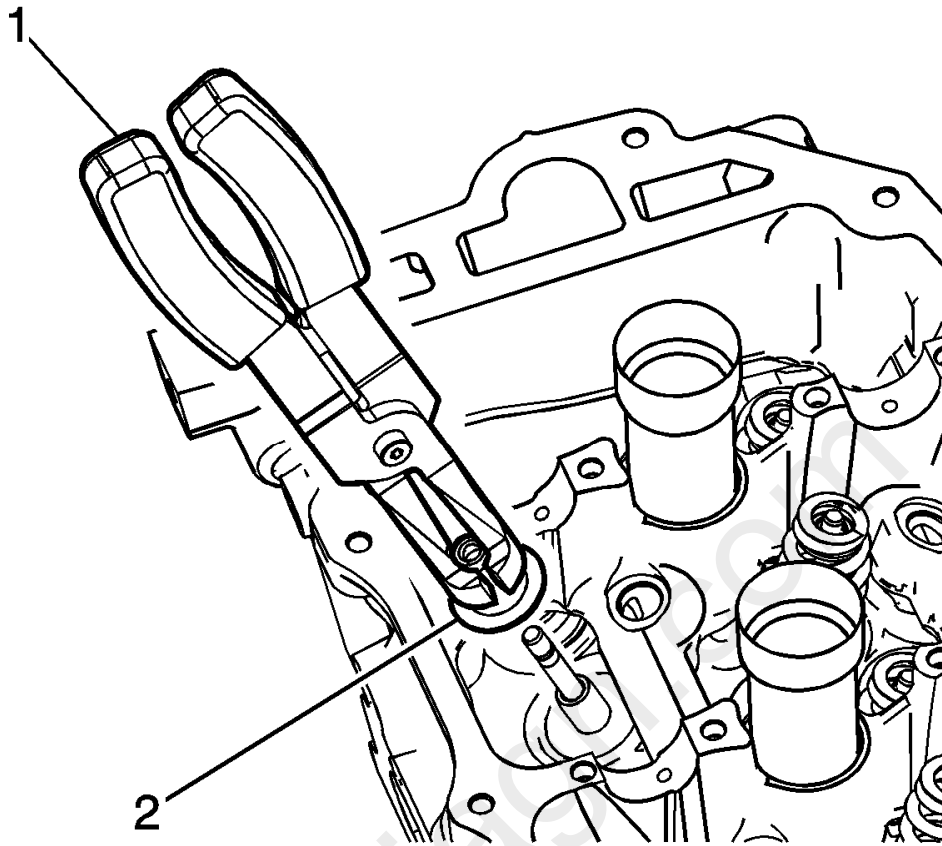


Fig. 200: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

1. Use the **EN-46116** remover/installer (1) in order to install the valve stem seal (2).

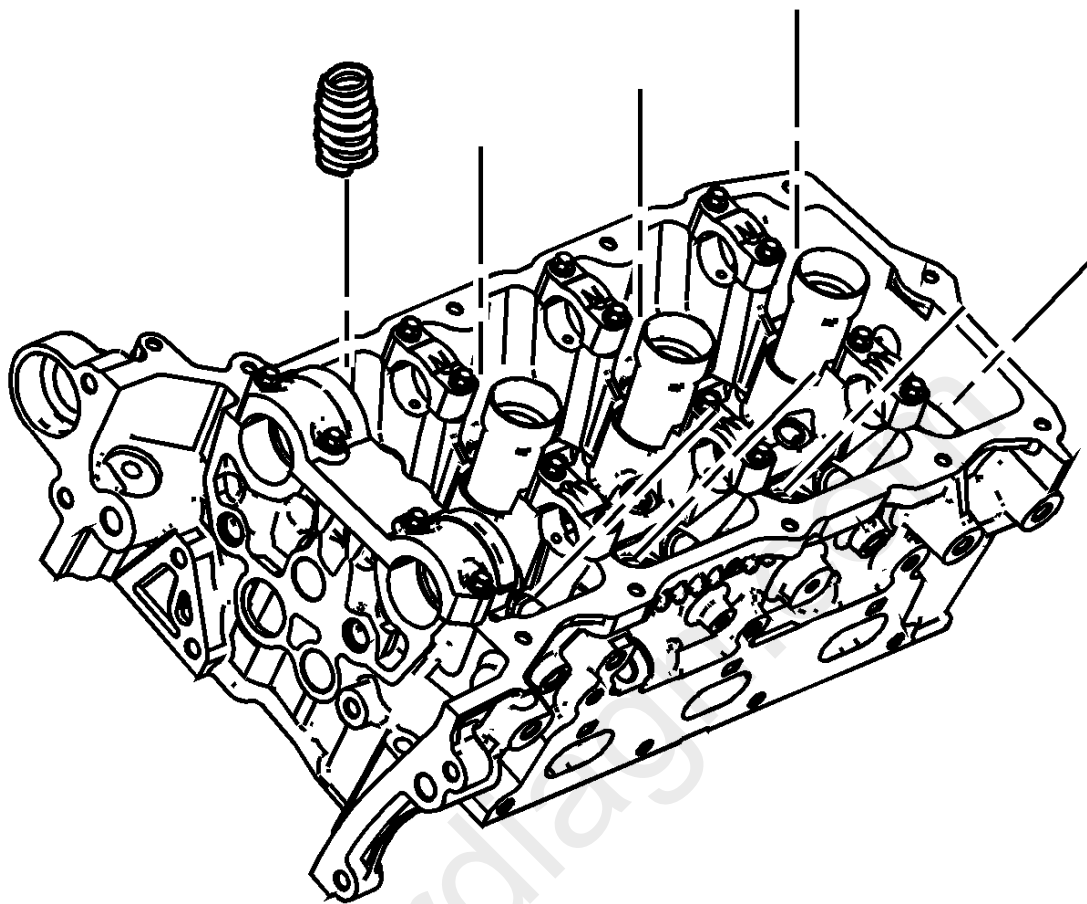


Fig. 201: View Of Valve Spring
Courtesy of GENERAL MOTORS COMPANY

2. Install the valve spring.
3. Install the valve spring retainer.

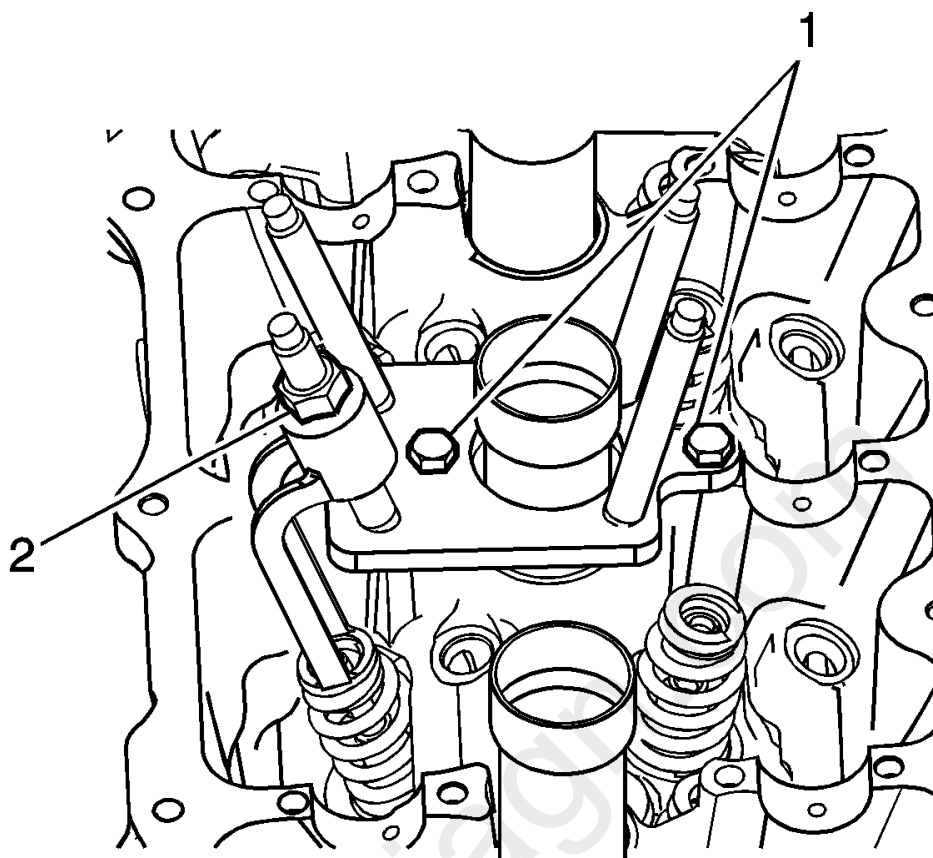


Fig. 202: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-46110** compressor above the applicable valve spring as shown.
Tighten the **EN-46110** compressor nut (2).

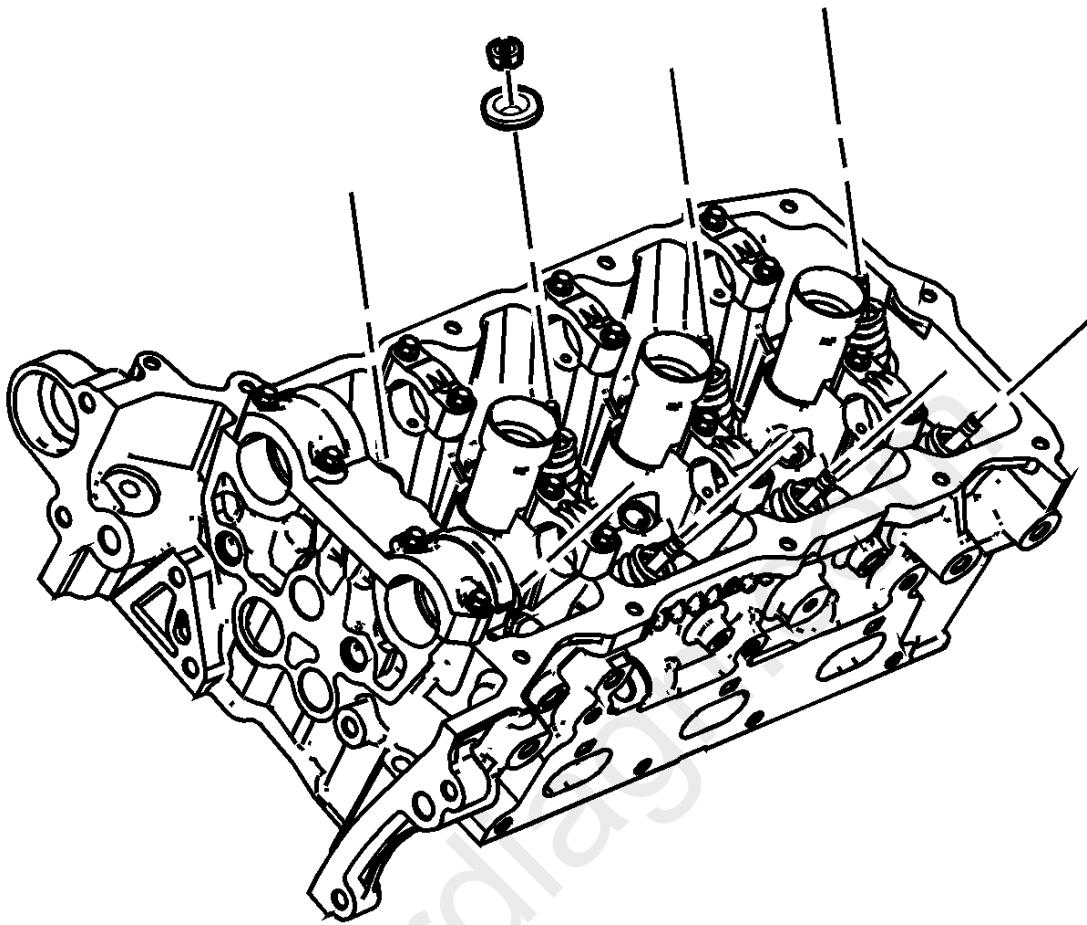


Fig. 203: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS COMPANY

5. Install the valve spring keepers.
6. Remove the **EN-46110** compressor.
7. Disconnect the **EN-39313** adapter from the compressed air source.
8. Remove the **EN-39313** adapter.
9. Install the spark plugs. Refer to **Spark Plug Replacement** .
10. Install the rocker arms. Refer to **Valve Rocker Arm Replacement - Left Side**.
11. Remove the **EN-46106** tool in order to prevent crankshaft rotation.
12. Install the starter motor. Refer to **Starter Replacement** .

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - RIGHT SIDE

Special Tools

- **EN-39313** Spark Plug Port Adapter
- **EN-46106** Flywheel Holding Tool
- **EN-46110** On-Vehicle Valve Spring Compressor
- **EN-46116** Valve Stem Seal Remover/Installer

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

Removal Procedure

NOTE: **This procedure is not used in Brazil.**

1. Remove the rocker arms. Refer to **Valve Rocker Arm Replacement - Right Side**.
2. Remove the starter motor. Refer to **Starter Replacement** .

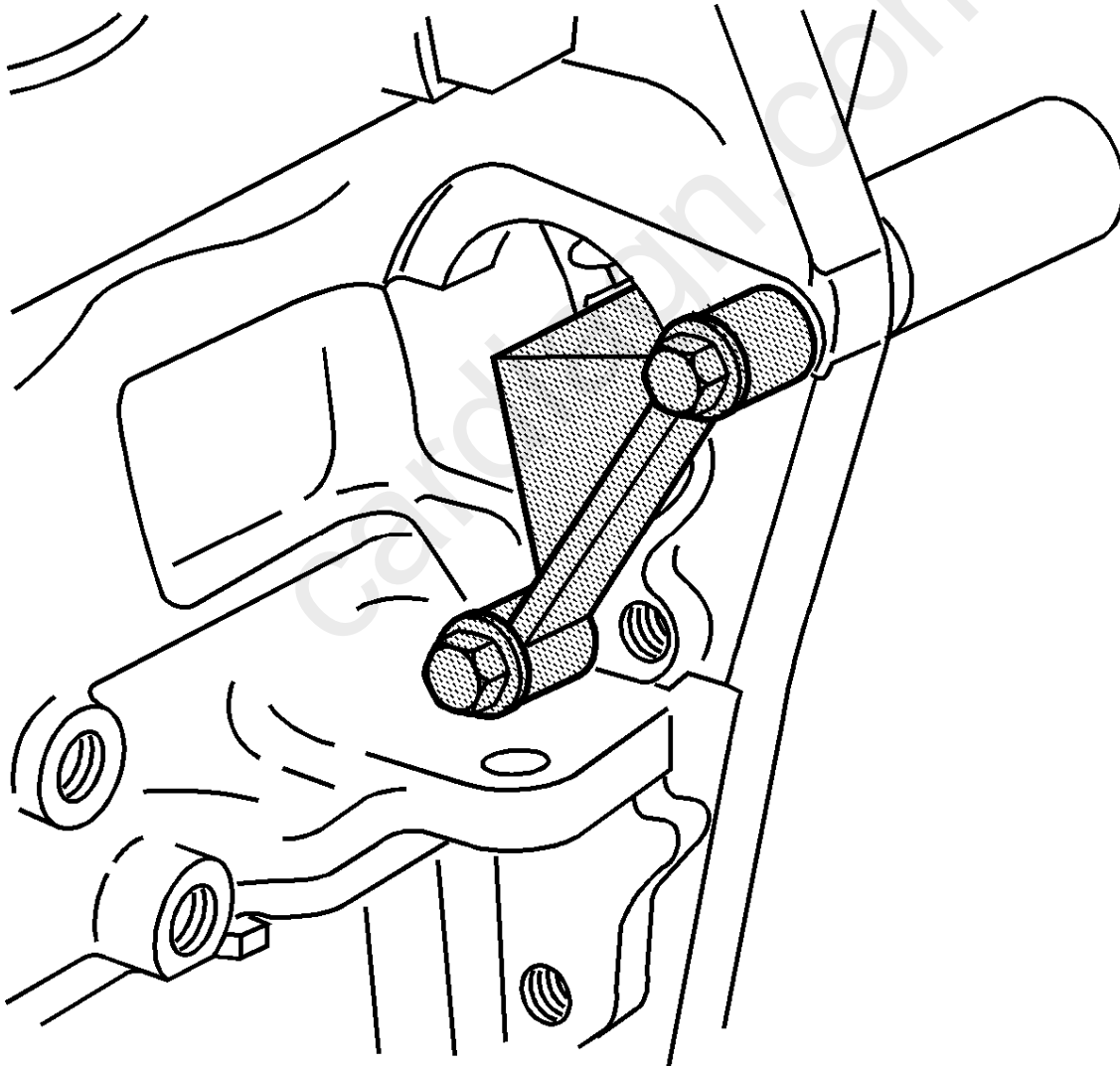


Fig. 204: Flywheel Holding Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the EN-46106 tool is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

3. Install the **EN-46106** tool in order to prevent crankshaft rotation.
4. Remove the spark plug from the applicable cylinder. Refer to **Spark Plug Replacement** .
5. Install the **EN-39313** adapter to the applicable cylinder.
6. Connect the **EN-39313** adapter to a compressed air source.

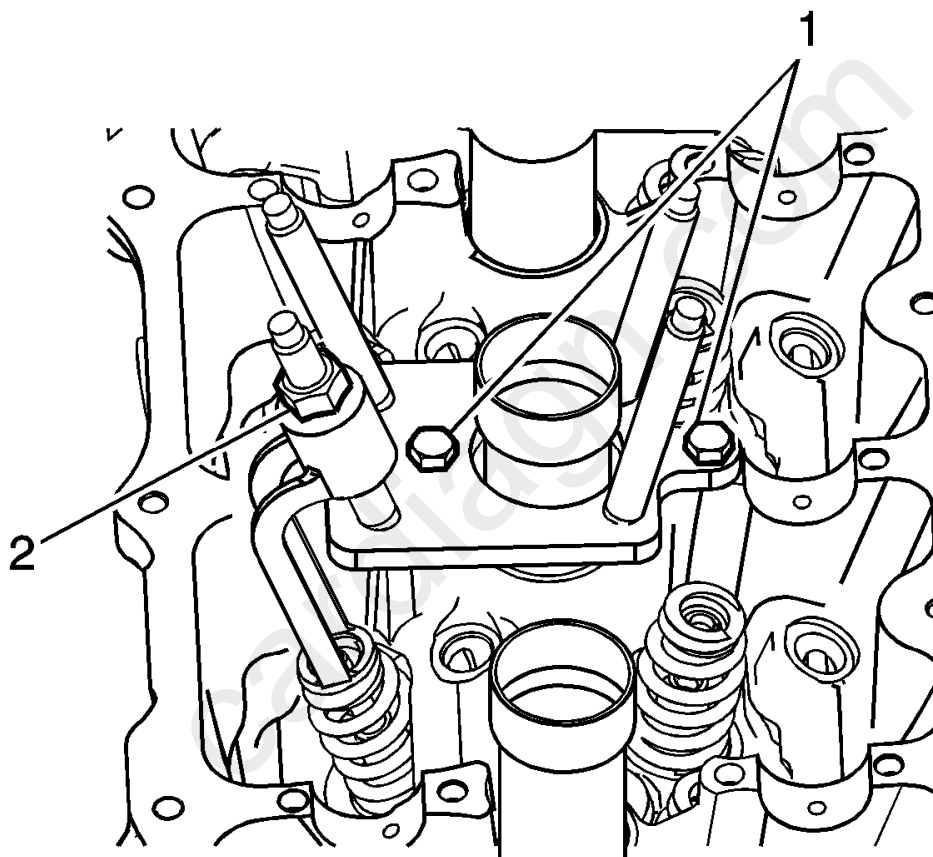


Fig. 205: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-46110** compressor above the applicable cylinder as shown.
8. Tighten the **EN-46110** compressor nut (2).

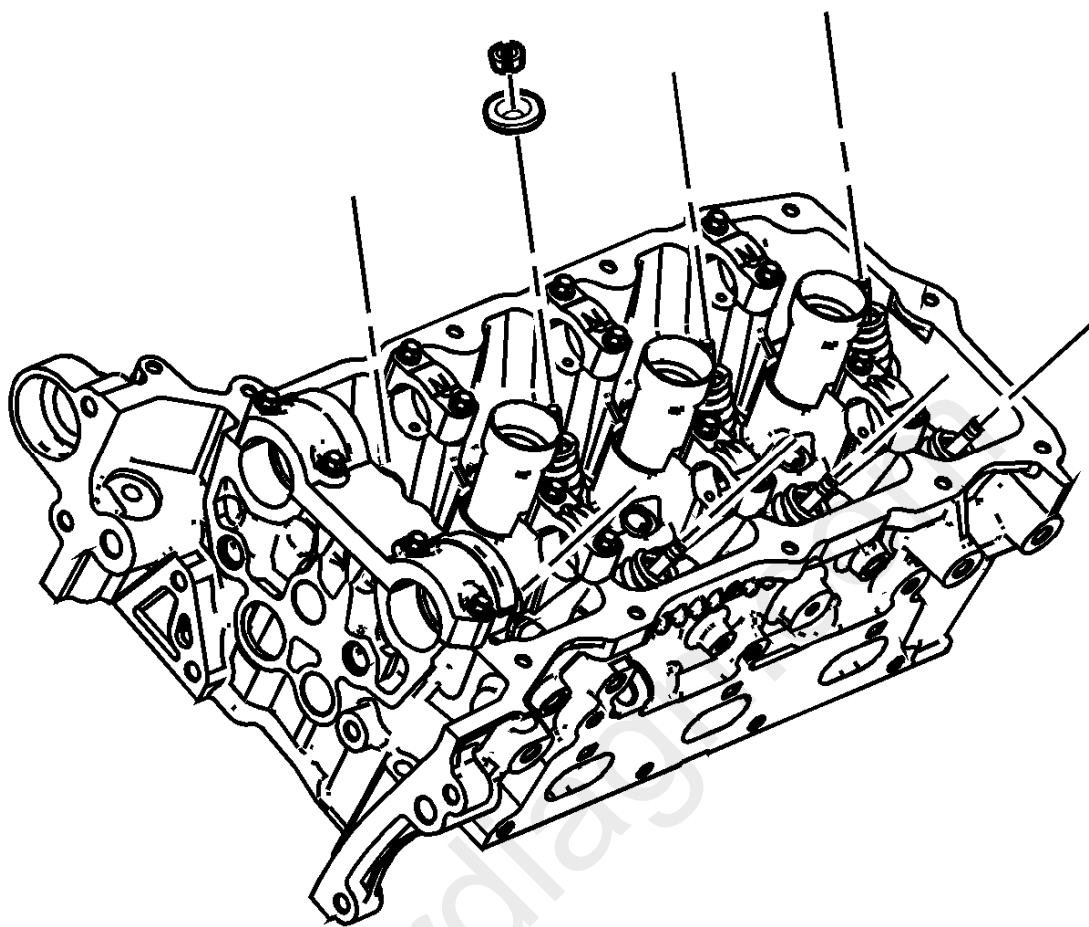


Fig. 206: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS COMPANY

9. Remove the valve keepers.
10. Loosen the **EN-46110** compressor nut.
11. Remove the valve spring retainer.

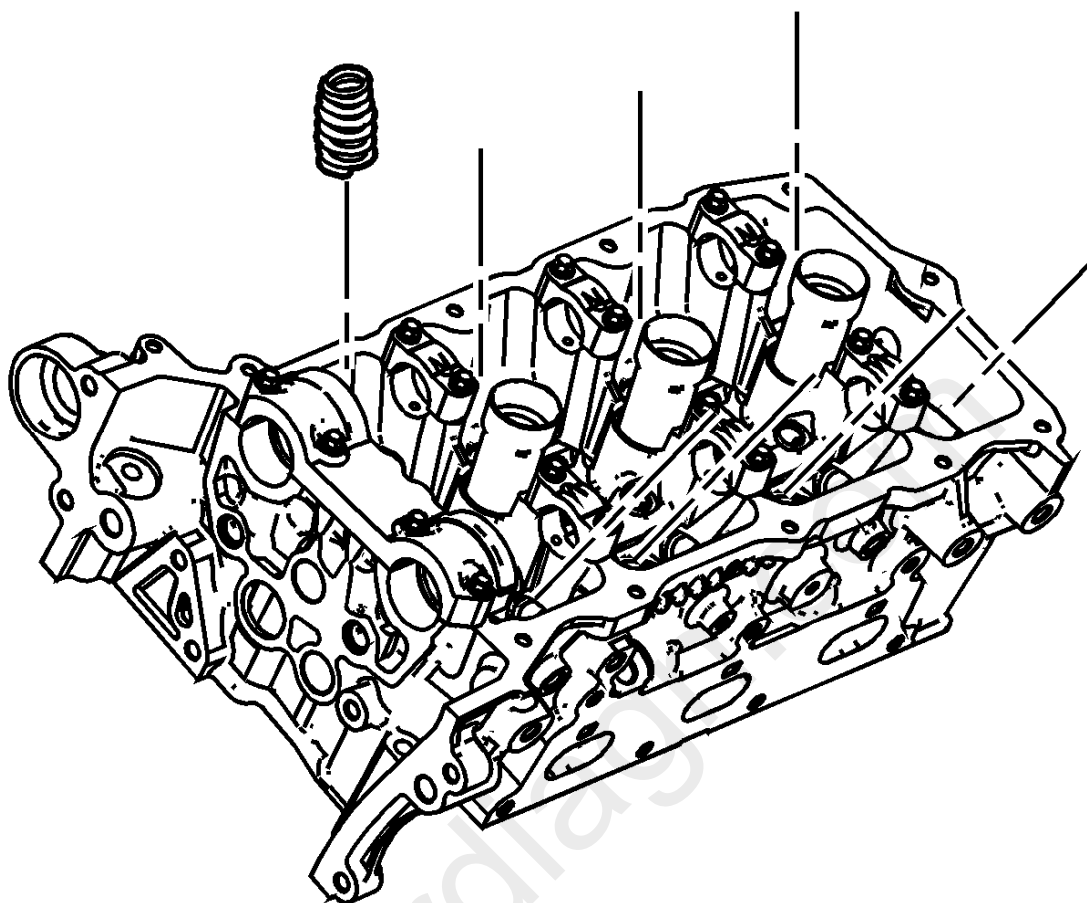


Fig. 207: View Of Valve Spring
Courtesy of GENERAL MOTORS COMPANY

12. Remove the valve spring.

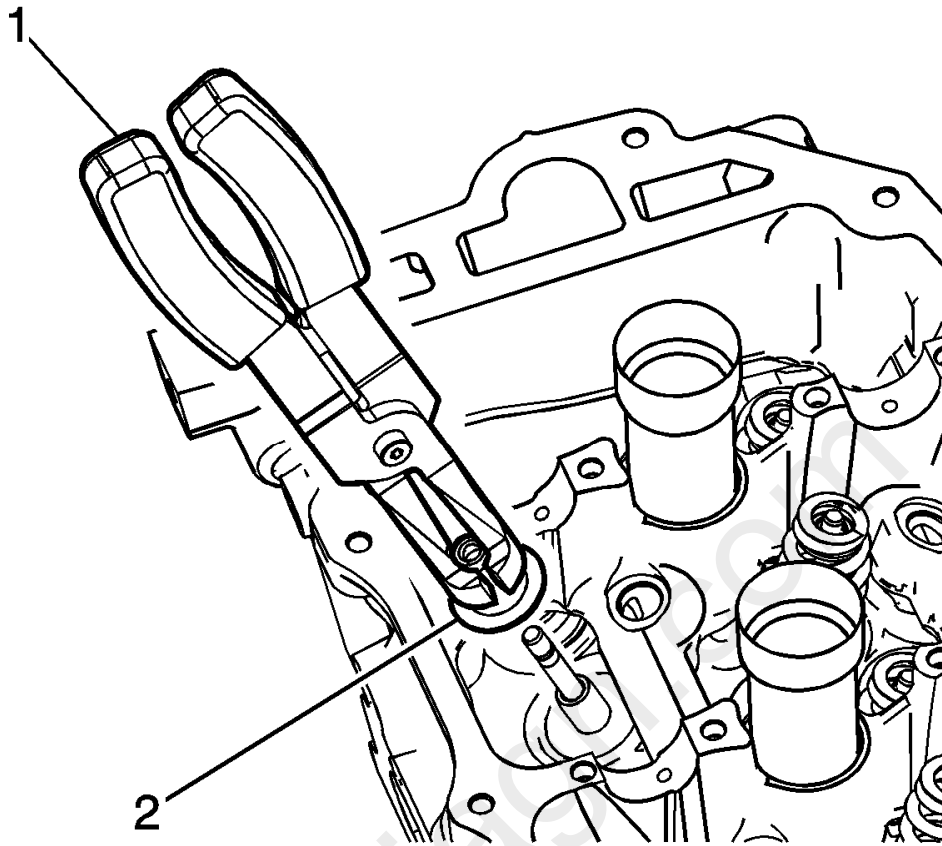


Fig. 208: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

13. Use the **EN-46116** remover/installer (1) in order to remove the valve stem seal (2).

Installation Procedure

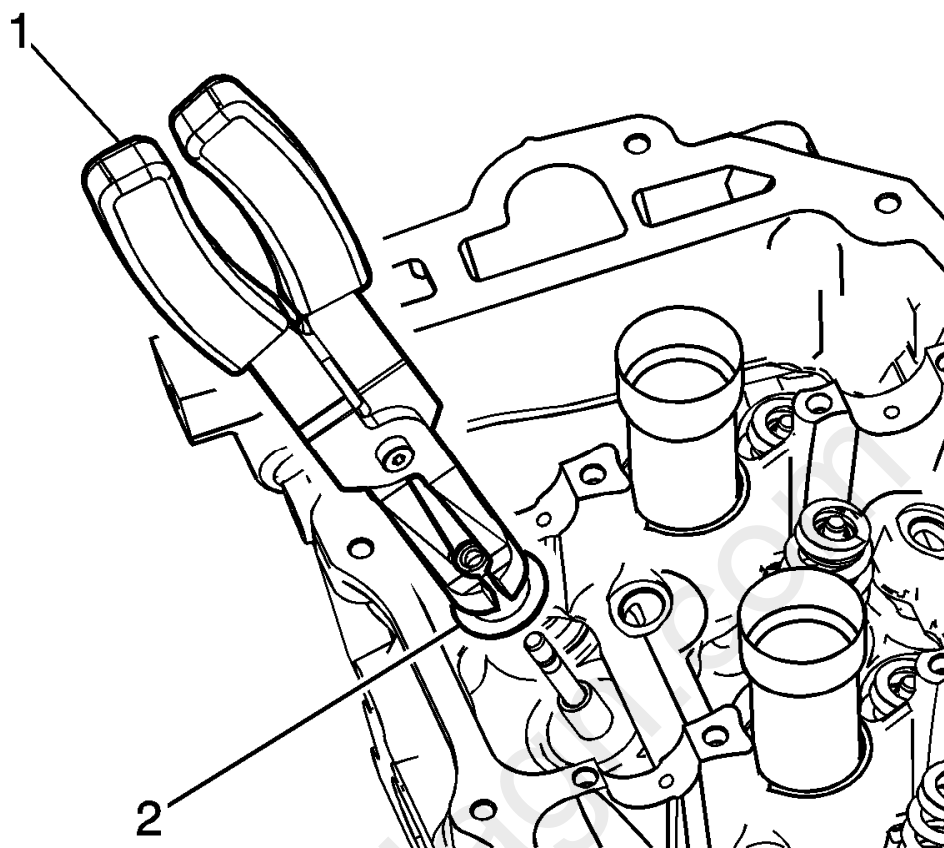


Fig. 209: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS COMPANY

1. Use the **EN-46116** remover/installer (1) in order to install the valve stem seals (2).

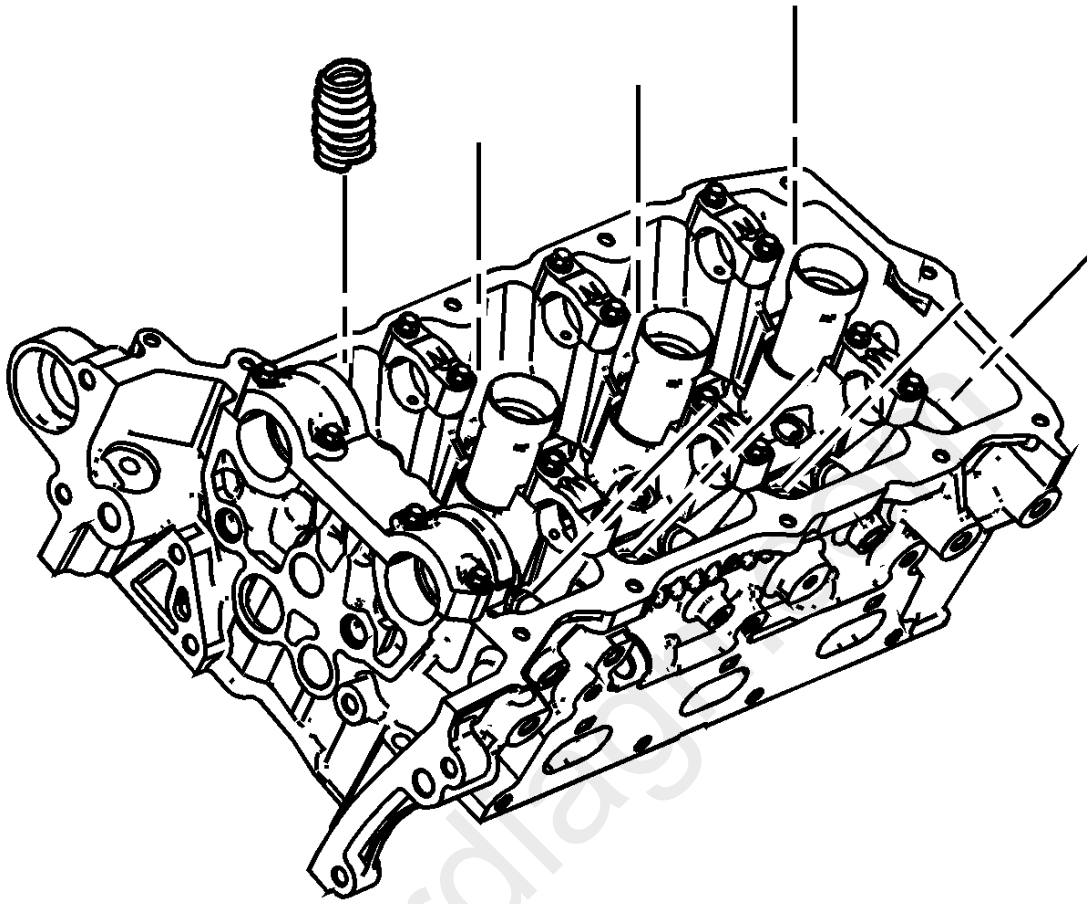


Fig. 210: View Of Valve Spring
Courtesy of GENERAL MOTORS COMPANY

2. Install the valve spring.
3. Install the valve spring retainer.

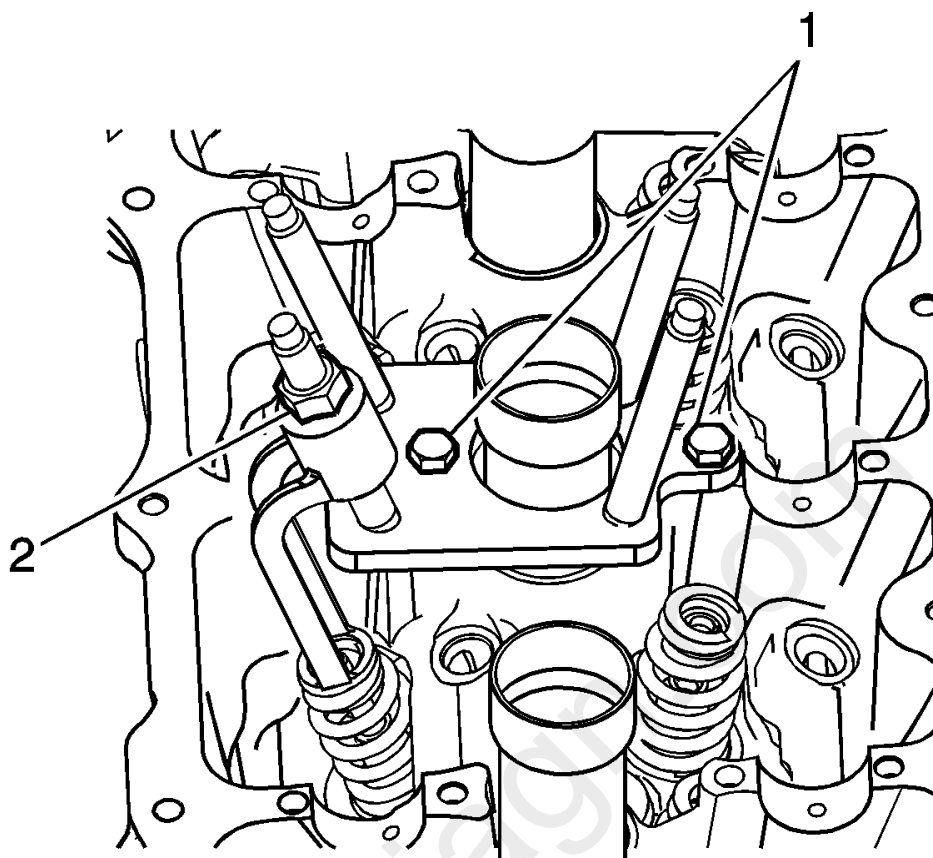


Fig. 211: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-46110** compressor above the applicable valve spring as shown.
Tighten the **EN-46110** compressor nut (2).

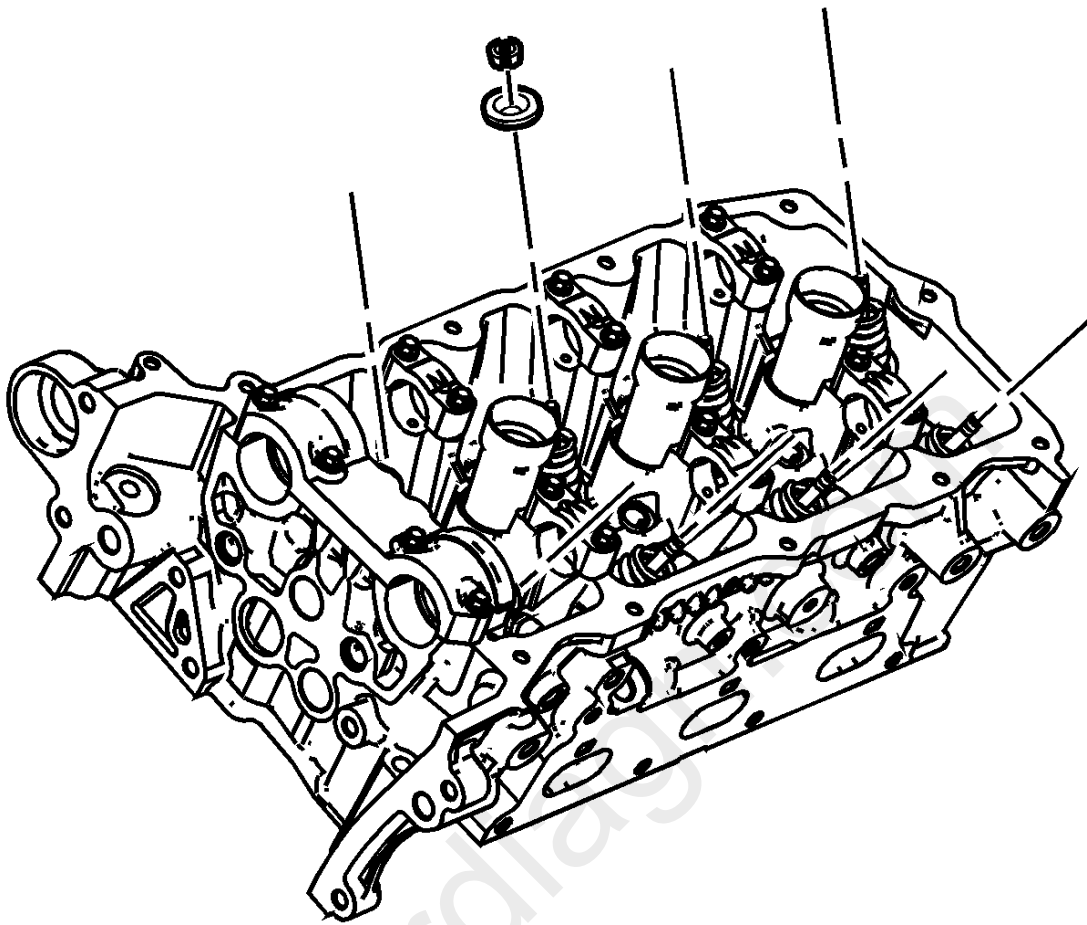


Fig. 212: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS COMPANY

5. Install the valve spring keepers.
6. Remove the **EN-46110** compressor.
7. Disconnect the **EN-39313** adapter from the compressed air source.
8. Remove the **EN-39313** adapter.
9. Install the spark plugs. Refer to **Spark Plug Replacement** .
10. Install the rocker arms . Refer to **Valve Rocker Arm Replacement - Right Side**.
11. Remove the **EN-46106** tool.
12. Install the starter motor. Refer to **Starter Replacement (3.0L, 3.6L)** .

CYLINDER HEAD REPLACEMENT - LEFT SIDE (LFW, OR LFX)

Special Tools

EN-45059 Angle Meter

For equivalent regional tools, refer to Special Tools .

Removal Procedure

1. Remove the left bank secondary timing chain. Refer to Secondary Camshaft Intermediate Drive Chain Replacement - Left Side.
2. Remove the fuel pump. Refer to Fuel Pump Replacement .
3. Remove the Catalytic Converter. Refer to Catalytic Converter Replacement - Left Side (LFW,LFX) .
4. Remove the oil level indicator tube. Refer to Oil Level Indicator Tube Replacement.

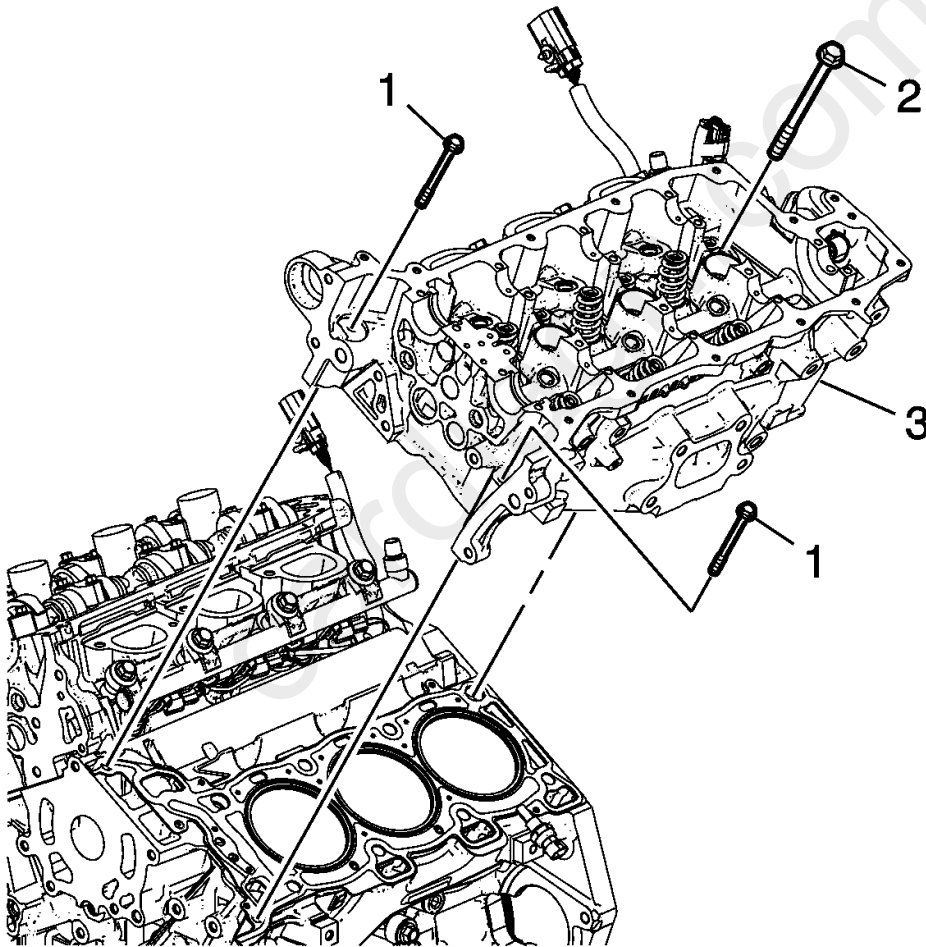


Fig. 213: View Of Left Cylinder Head & Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 front M8 left cylinder head bolts (1).
6. Remove the left cylinder head bolts (2).
7. Remove the left cylinder head (3).

8. Remove the ground wire bolt and ground wire.
9. Disconnect and reposition harness as necessary.

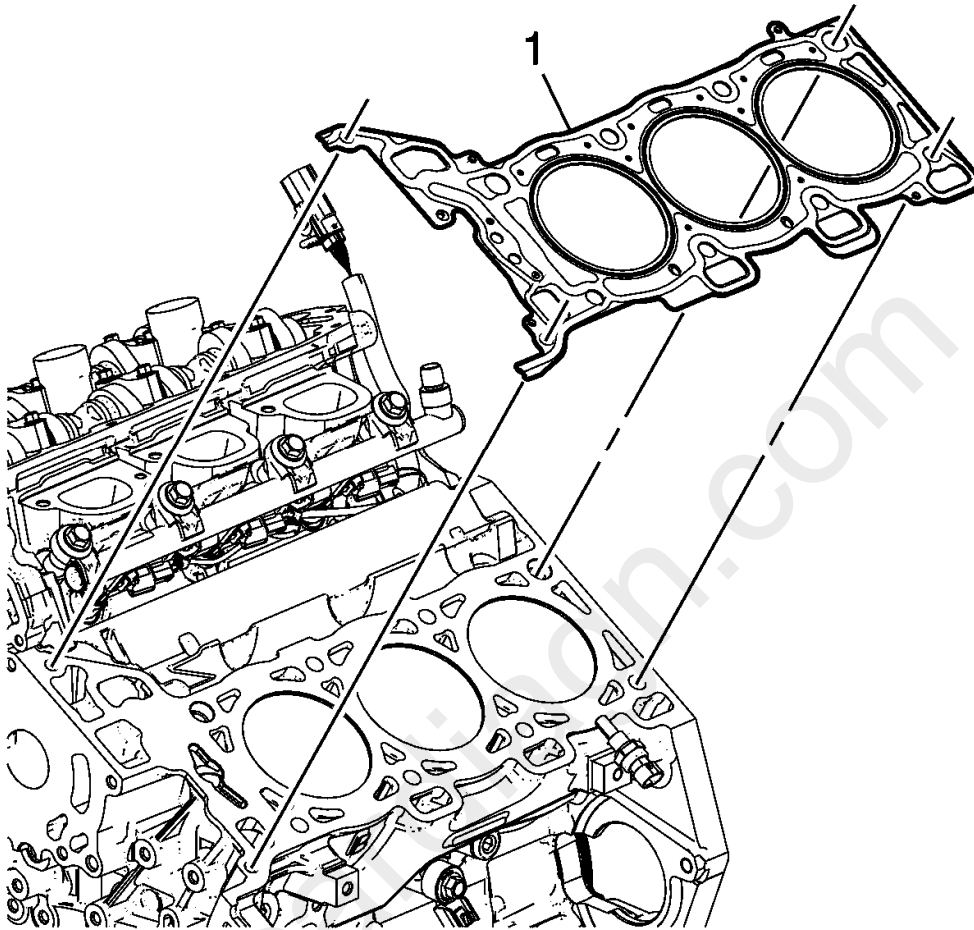


Fig. 214: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS COMPANY

10. Remove and discard the left cylinder head gasket (1).
11. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to Cylinder Head Cleaning and Inspection , and Engine Block Cleaning and Inspection .
12. Transfer parts as needed. Refer to Cylinder Head Disassemble (LFW or LFX) , and Cylinder Head Assemble (LFW or LFX) .

Installation Procedure

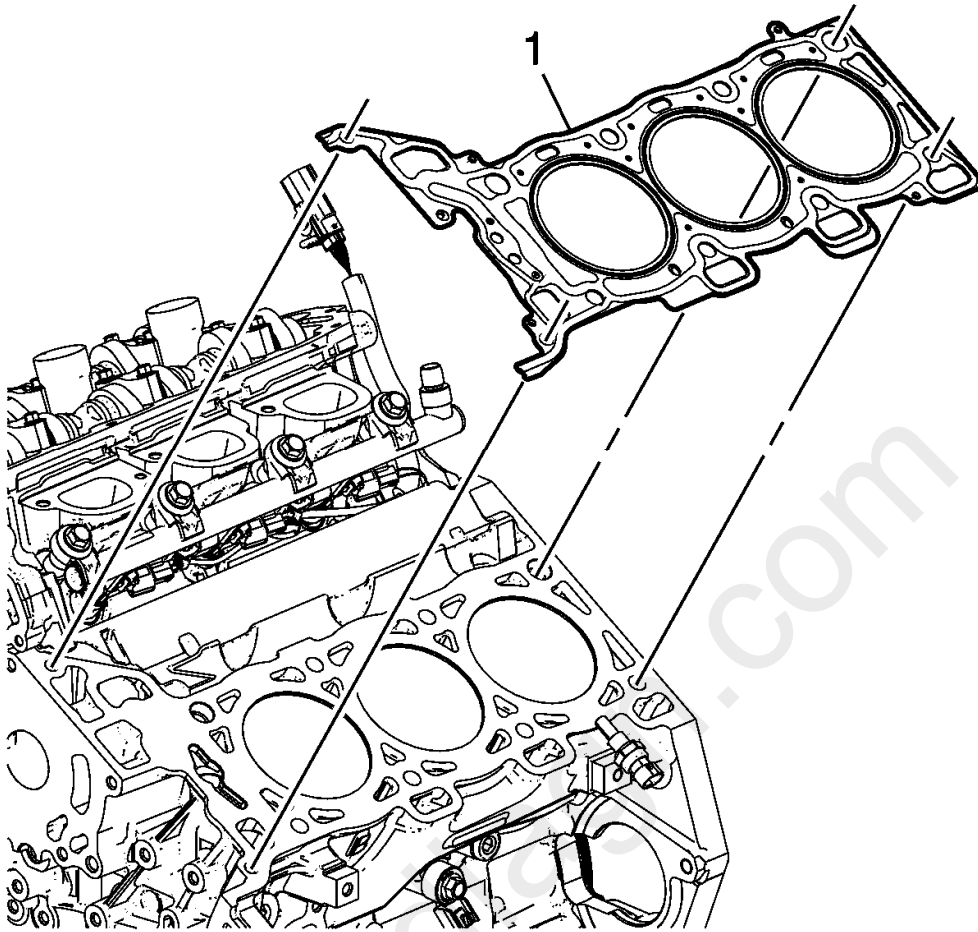


Fig. 215: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.
2. Install a NEW left cylinder head gasket (1) using the deck face locating pins for retention.

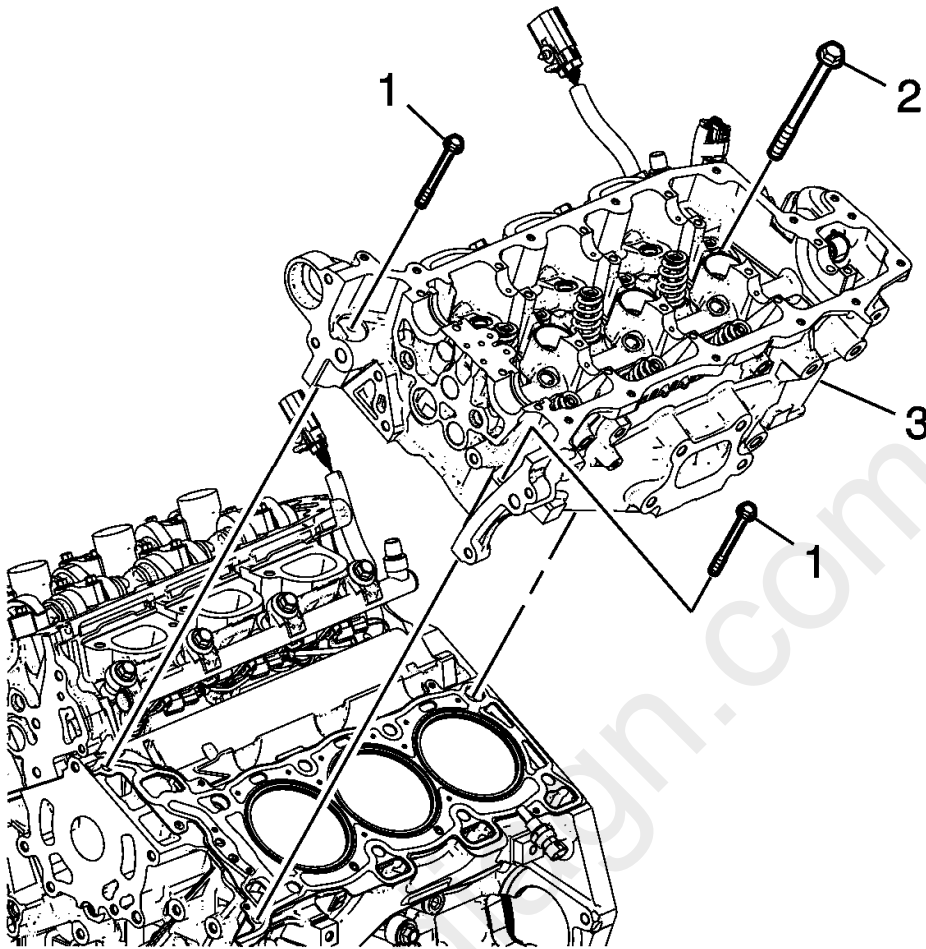


Fig. 216: View Of Left Cylinder Head & Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Align the left cylinder head (3) with the deck face locating pins.
4. Place the left cylinder head in position on the deck face.

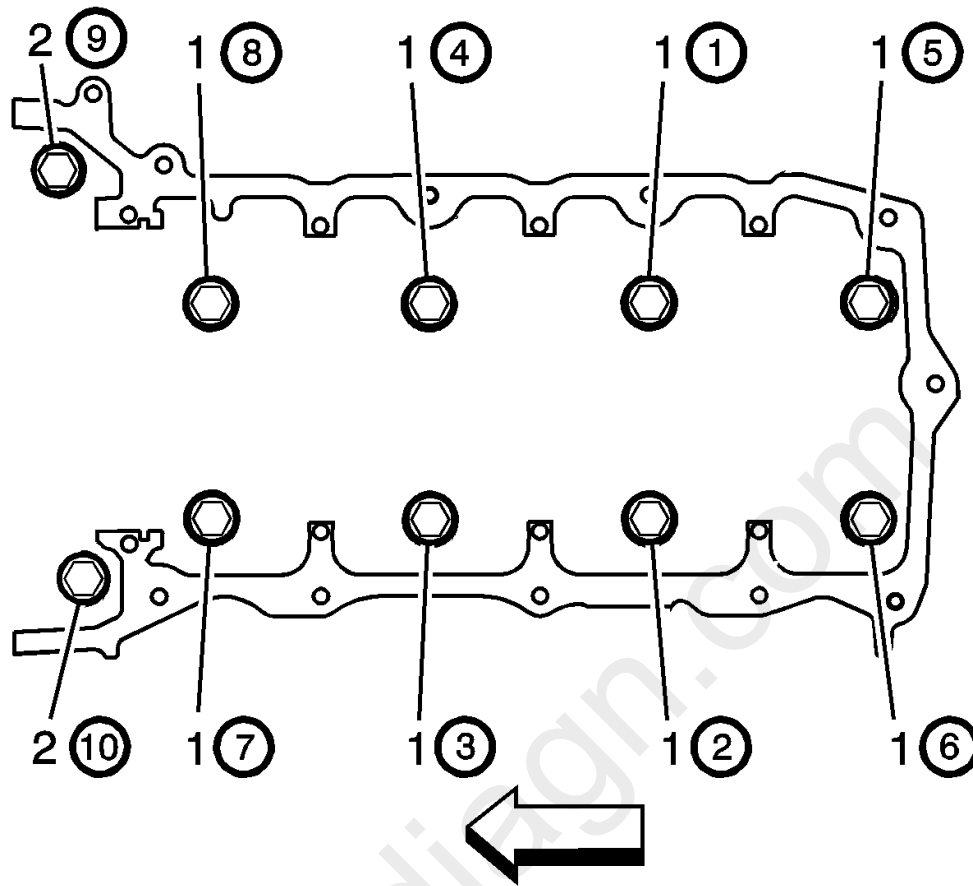


Fig. 217: Identifying M11 Cylinder Head Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE:

- **DO NOT** allow oil on the cylinder head bolt bosses.
- **DO NOT** reuse the old cylinder head bolts.

5. Install the NEW M11 cylinder head bolts (1).
 1. Tighten the M11 cylinder head bolts a first pass in sequence to 30 N.m (22 lb ft).
 2. Tighten the M11 cylinder head bolts a second pass in sequence an additional 150 degrees using the **EN-45059** meter.
6. Install the 2 NEW front M8 left cylinder head bolts (2).
 1. Tighten the M8 cylinder head bolts a first pass to 15 N.m (11 lb ft).
 2. Tighten the M8 cylinder head bolts a second pass in sequence an additional 75 degrees using the

EN-45059 meter.

7. Install the left bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Left Side.**
8. Install the camshaft cover. Refer to **Camshaft Cover Replacement - Left Side.**
9. Install the fuel pump. Refer to **Fuel Pump Replacement** .
10. Install the generator. Refer to **Generator Replacement (LFX)** .
11. Install the exhaust manifold. Refer to **Catalytic Converter Replacement - Left Side (LFW,LFX)** .
12. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement.**

CYLINDER HEAD REPLACEMENT - RIGHT SIDE (LFW, OR LFX)

Special Tools

EN-45059 Angle Meter

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

Removal Procedure

1. Remove the right bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Right Side.**
2. Remove the power brake booster pump aside.
3. Remove the catalytic converter . Refer to **Catalytic Converter Replacement - Right Side (LFW,LFX)** .

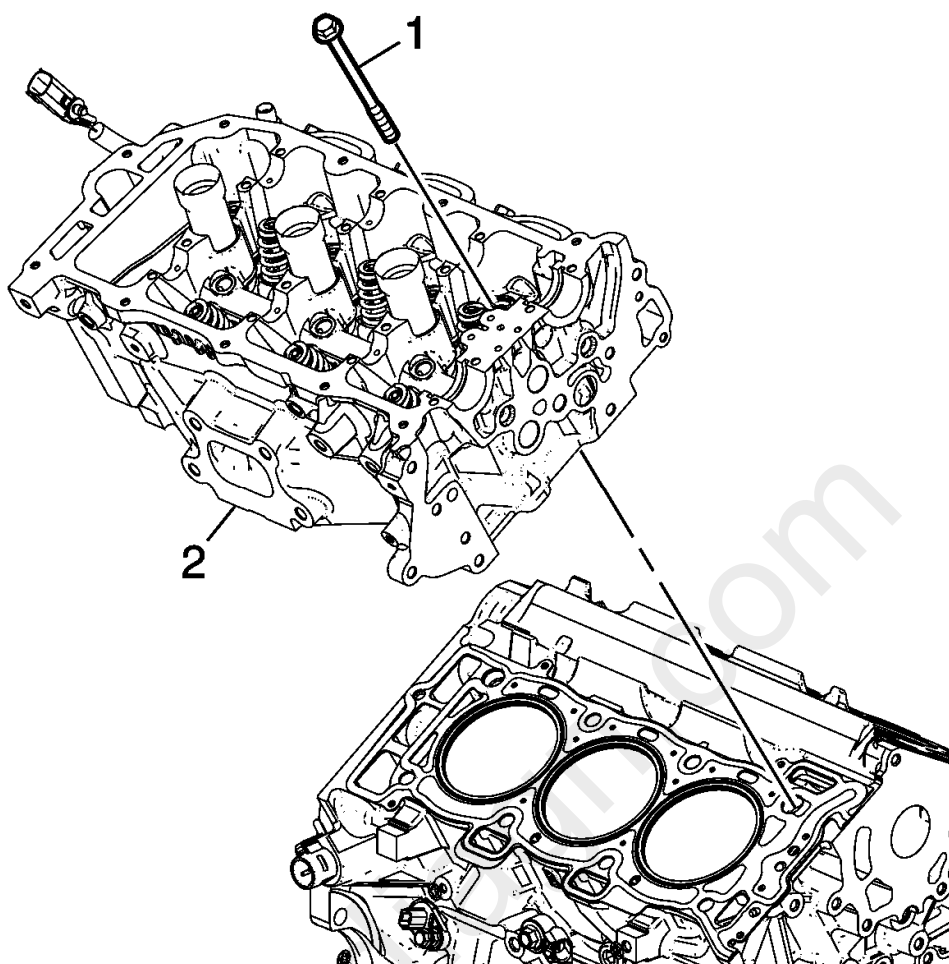


Fig. 218: View Of Right Cylinder Head & Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the right cylinder head bolts (1).
5. Remove the right cylinder head (2).
6. Remove Ground wire and harness and position aside.

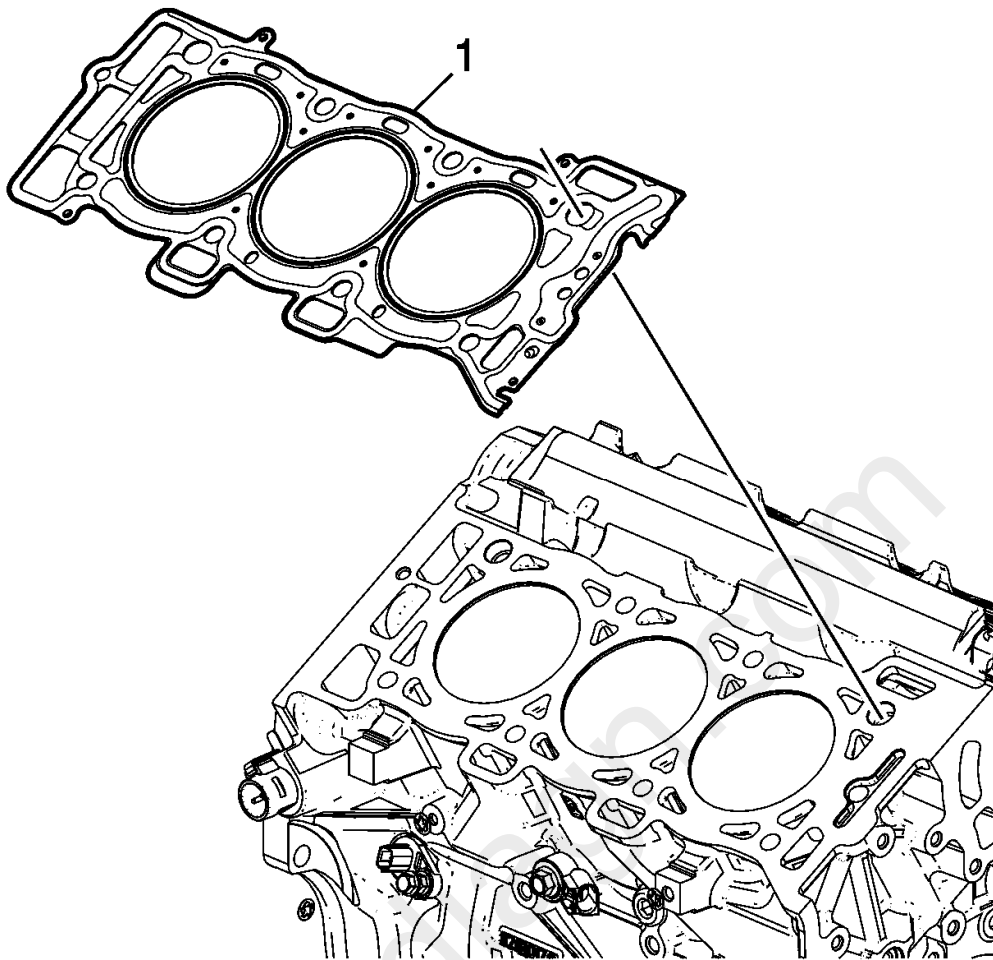


Fig. 219: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS COMPANY

7. Remove and discard the cylinder head gasket (1).
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** , and **Engine Block Cleaning and Inspection** .
9. Transfer parts as needed. Refer to **Cylinder Head Disassemble (LFW or LFX)** , and **Cylinder Head Assemble (LFW or LFX)** .

Installation Procedure

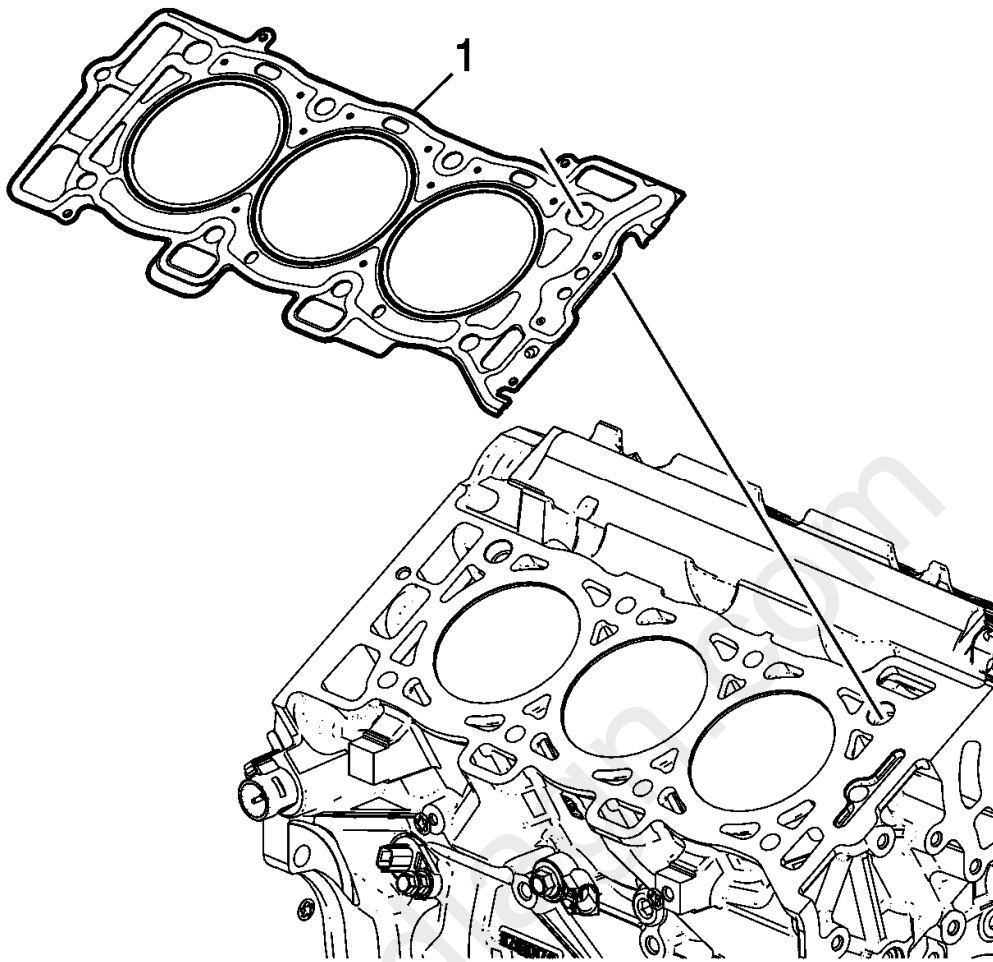


Fig. 220: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.
2. Install a NEW right cylinder head gasket (1) using the deck face locating pins for retention.

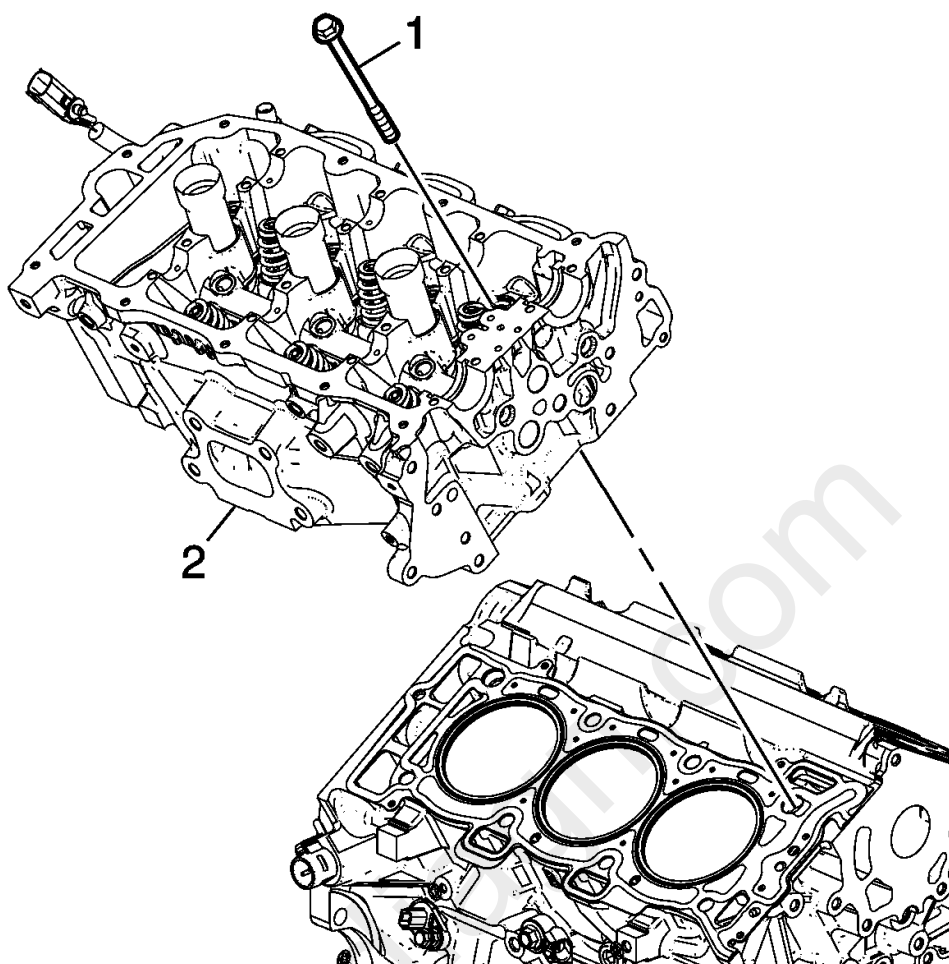


Fig. 221: View Of Right Cylinder Head & Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Align the right cylinder head (2) with the deck face locating pins.
4. Place the right cylinder head in position on the deck face.

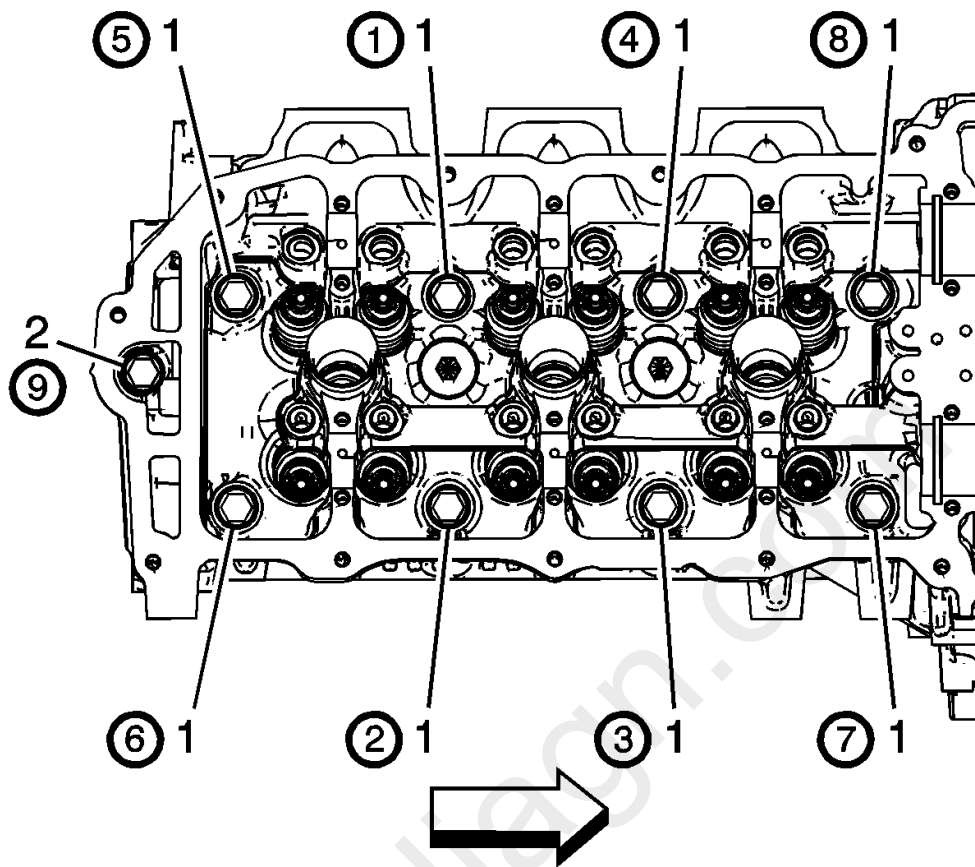


Fig. 222: Identifying M11 Cylinder Head Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE:

- DO NOT allow oil on the cylinder head bolt bosses.
- DO NOT reuse the old cylinder head bolts.

5. Install the NEW M11 cylinder head bolts (1).
 1. Tighten the M11 cylinder head bolts a first pass in sequence to 30 N.m (22 lb ft).
 2. Tighten the M11 cylinder head bolts a second pass in sequence an additional 150 degrees using the **EN-45059** meter.
6. Install the NEW M8 cylinder head bolt (2).
 1. Tighten the M8 cylinder head bolt a first pass to 15 N.m (11 lb ft).
 2. Tighten the M8 cylinder head bolt a second pass an additional 75 degrees using the **EN-45059**

meter.

7. Install the right bank secondary timing chain. Refer to Secondary Camshaft Intermediate Drive Chain Replacement - Right Side.
8. Install the exhaust manifold. Refer to Catalytic Converter Replacement - Right Side (LFW,LFX) .
9. Install the camshaft cover. Refer to Camshaft Cover Replacement - Right Side.

ENGINE FLYWHEEL REPLACEMENT

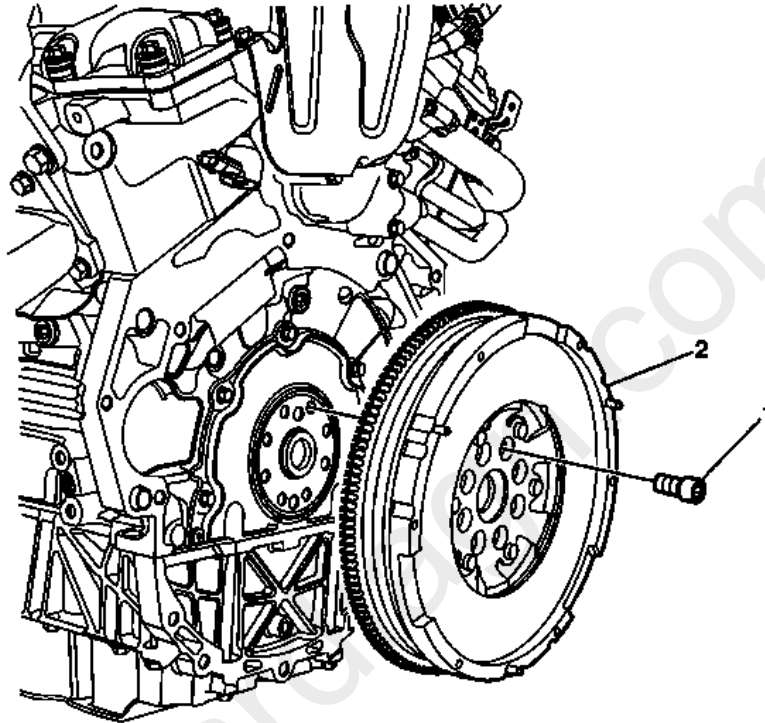


Fig. 223: Engine Flywheel (Manual)

Courtesy of GENERAL MOTORS COMPANY

Engine Flywheel Replacement

Callout	Component Name
Preliminary Procedure Remove the clutch assembly. Refer to <u>Clutch Assembly Replacement</u> .	
1	Flywheel Fastener (Qty: 8) CAUTION: Refer to <u>Fastener Caution</u> . Procedure New bolts must be used whenever removing the flywheel. Tighten

	67 (49 lb ft)
2	Flywheel Procedure Transfer parts as needed.

AUTOMATIC TRANSMISSION FLEX PLATE REPLACEMENT

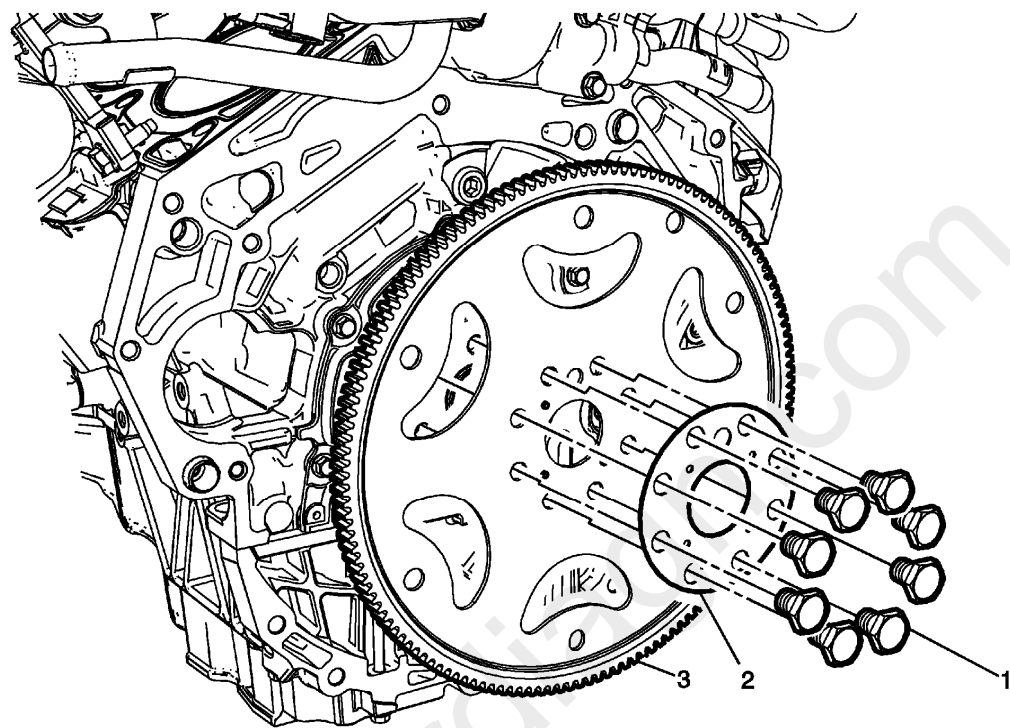


Fig. 224: Automatic Transmission Flex Plate & Components
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Flex Plate Replacement

Callout	Component Name
Preliminary Procedure Remove the transmission. Refer to <u>Transmission Replacement (All Wheel Drive)</u> , <u>Transmission Replacement (Rear Wheel Drive)</u> .	
Special Tools • EN 45059 Angle Meter • EN 46106 Flywheel Holding Tool	
For equivalent regional tools. Refer to Special Tools .	
	Automatic Transmission Flex Plate Fastener (Qty: 8)

	CAUTION: Refer to <u>Fastener Caution</u> .
1	Procedure New bolts must be used whenever removing the automatic transmission flex plate. Tighten 30 N.m (22 lb ft) plus 45 degrees
2	Automatic Transmission Flex Spacer Plate
3	Automatic Transmission Flex Plate Procedure 1. For cleaning and inspection . Refer to <u>Engine Flywheel Cleaning and Inspection</u> . 2. Transfer parts as necessary.

CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

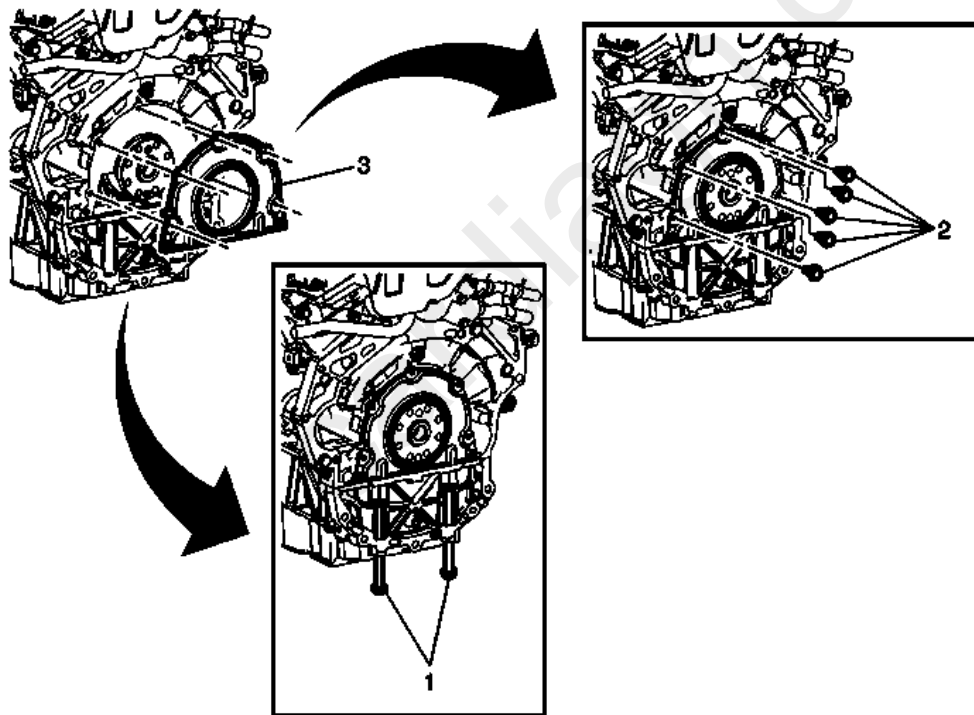


Fig. 225: Crankshaft Rear Oil Seal and Housing Components
Courtesy of GENERAL MOTORS COMPANY

Crankshaft Rear Oil Seal and Housing Replacement

Callout	Component Name
Preliminary Procedures	

1. If equipped with automatic transmission. Refer to **Automatic Transmission Flex Plate Replacement**.
2. If equipped with manual transmission. Refer to **Engine Flywheel Replacement**.

1	Oil Pan Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Crankshaft Rear Oil Seal and Housing Fastener (Qty: 5) Tighten 10 N.m (89 lb in)
3	Crankshaft Rear Oil Seal and Housing Procedure For special tool usage. Refer to <u>Crankshaft Rear Oil Seal and Housing Installation</u> .

OIL PUMP REPLACEMENT

Removal Procedure

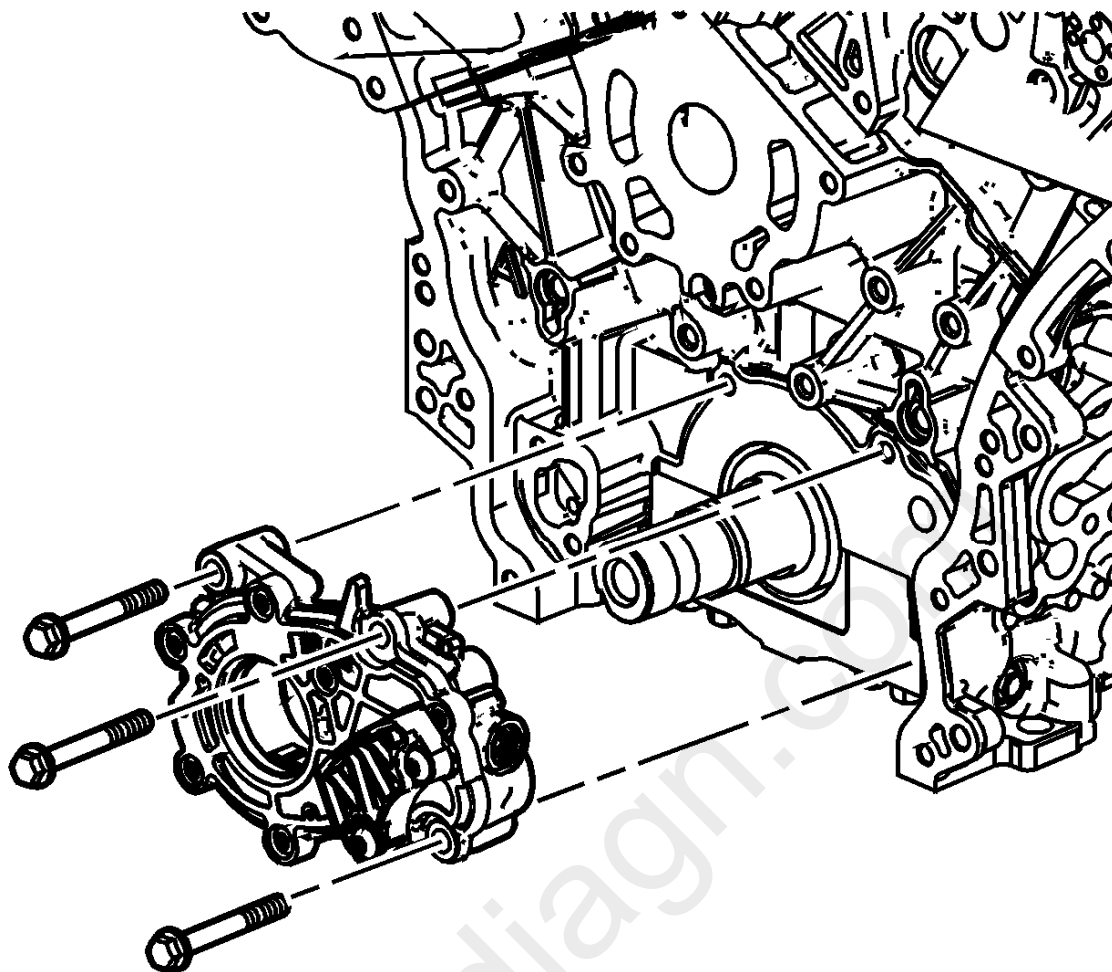


Fig. 226: View Of Oil Pump & Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not remove the left bank idler sprocket.

1. Remove the primary timing chain. Refer to **Primary Camshaft Drive Chain and Sprockets Replacement**.
2. Remove the crankshaft sprocket. Refer to **Crankshaft Sprocket Removal** .
3. Remove the oil pump bolts and the oil pump.

Installation Procedure

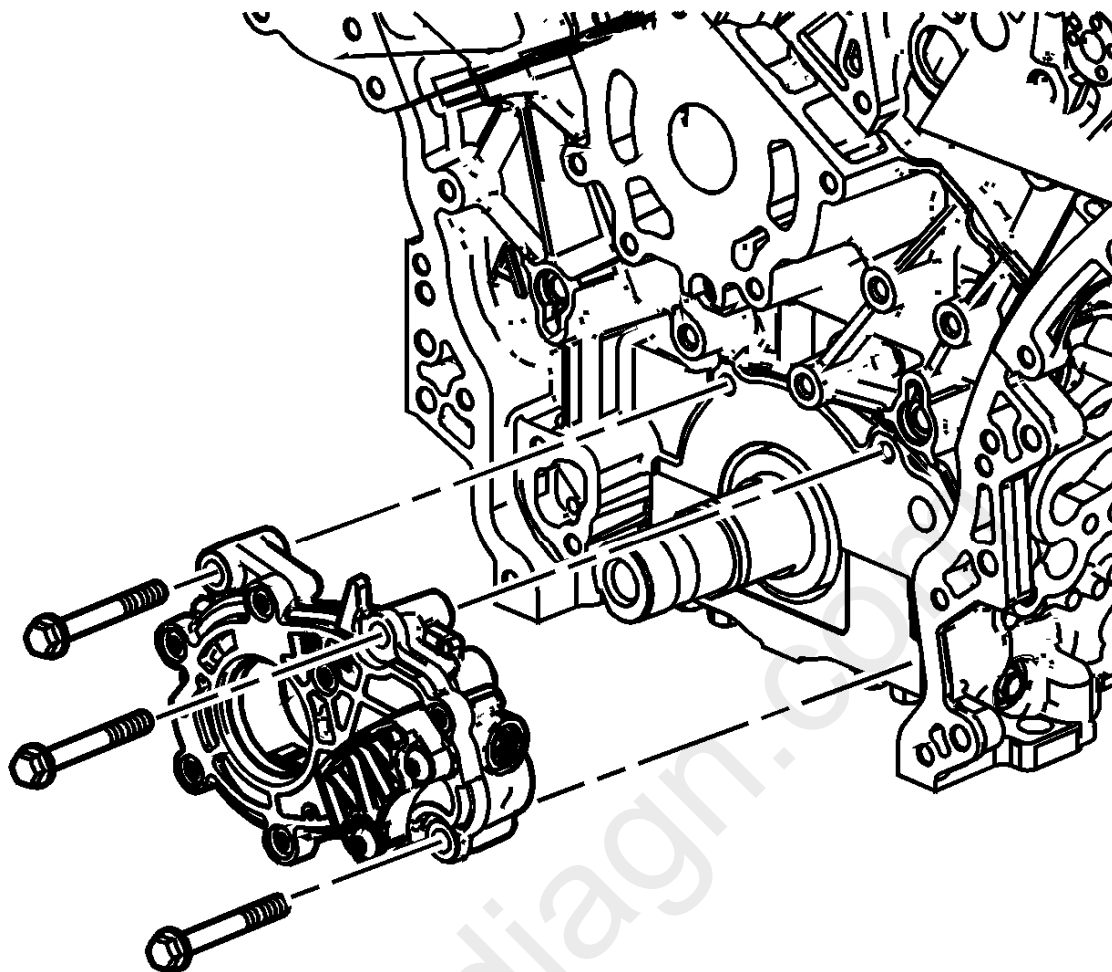


Fig. 227: View Of Oil Pump & Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the oil pump and bolts. Refer to **Oil Pump Installation**
2. Install the crankshaft sprocket. Refer to **Crankshaft Sprocket Installation** .
3. Install the primary timing chain. Refer to **Primary Camshaft Drive Chain and Sprockets Replacement**.

OIL PAN REPLACEMENT

Special Tools

EN 46109 Guide Pin Set

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

Removal Procedure

1. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
2. Remove the drivetrain and front suspension frame. Refer to **Drivetrain and Front Suspension Frame Replacement (All Wheel Drive)** , **Drivetrain and Front Suspension Frame Replacement (Rear Wheel Drive)** .
3. If equipped with AWD, remove the front differential carrier. Refer to **Differential Carrier Assembly Replacement** .

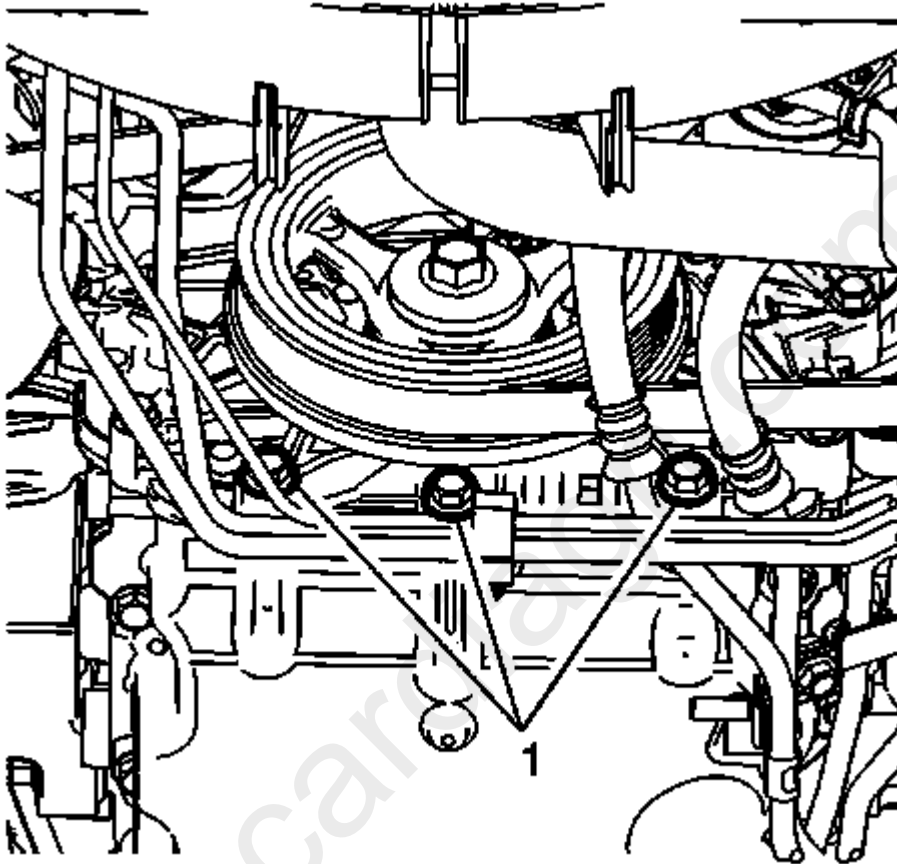


Fig. 228: Oil Pan Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the front cover bolts (1).

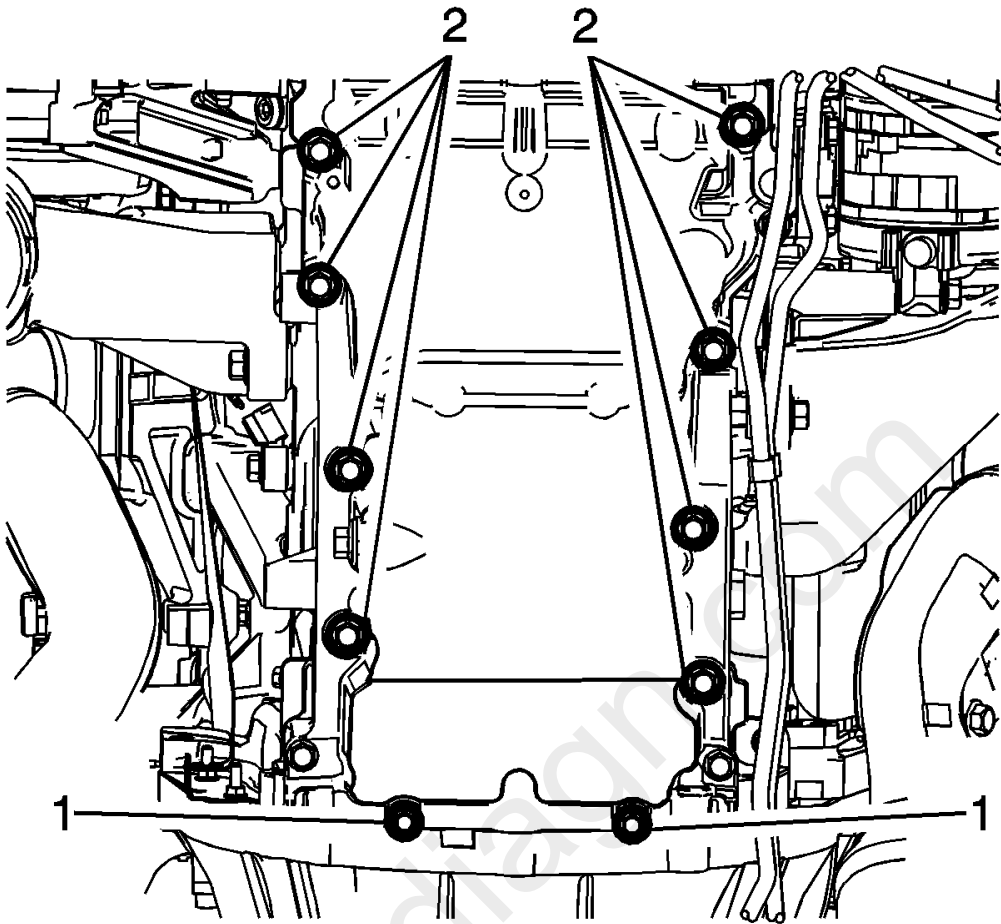


Fig. 229: Oil Pan Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil pan bolts (1) and (2).

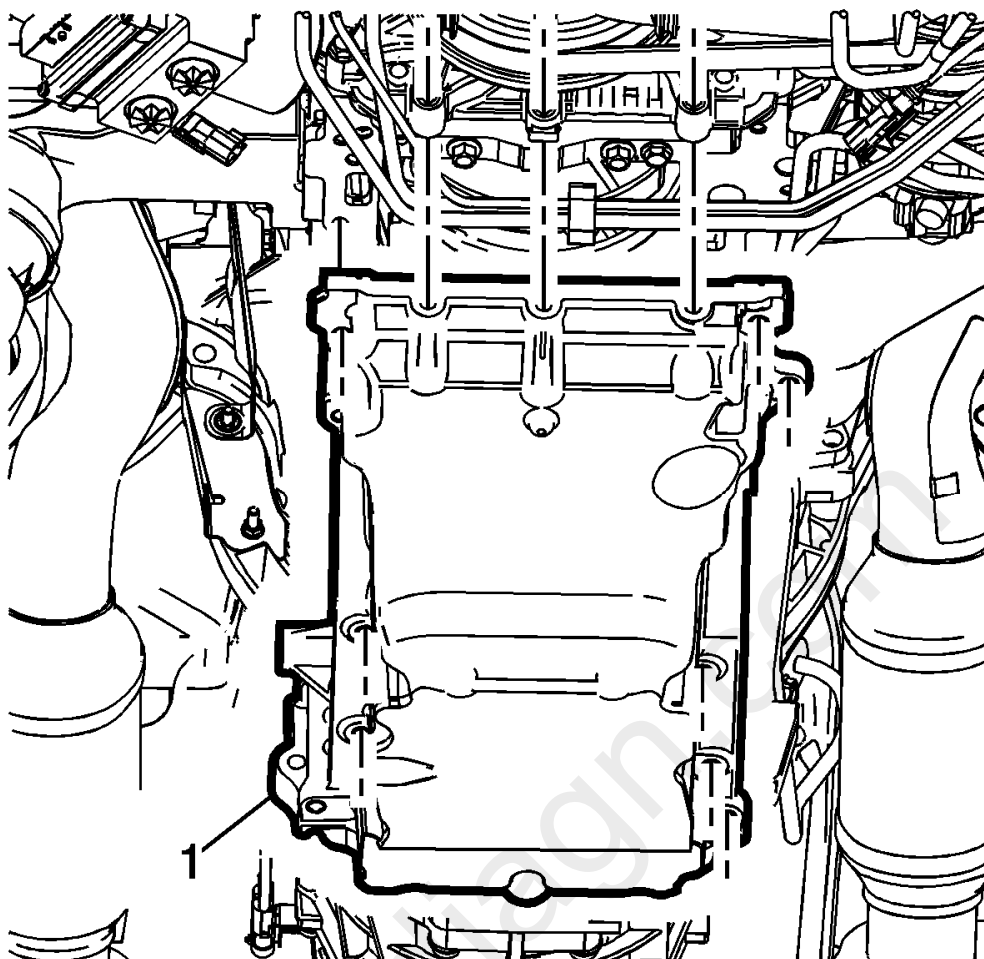


Fig. 230: Oil Pan

Courtesy of GENERAL MOTORS COMPANY

6. Remove the oil pan (1).
7. For oil pan cleaning and inspection. Refer to **Oil Pan Cleaning and Inspection (AWD)** , **Oil Pan Cleaning and Inspection (RWD)** .
8. For oil pan disassemble. Refer to **Oil Pan Disassemble (AWD)** , **Oil Pan Disassemble (RWD)** .

Installation Procedure

1. For oil pan assemble. Refer to **Oil Pan Assemble (RWD)** , **Oil Pan Assemble (AWD)** .

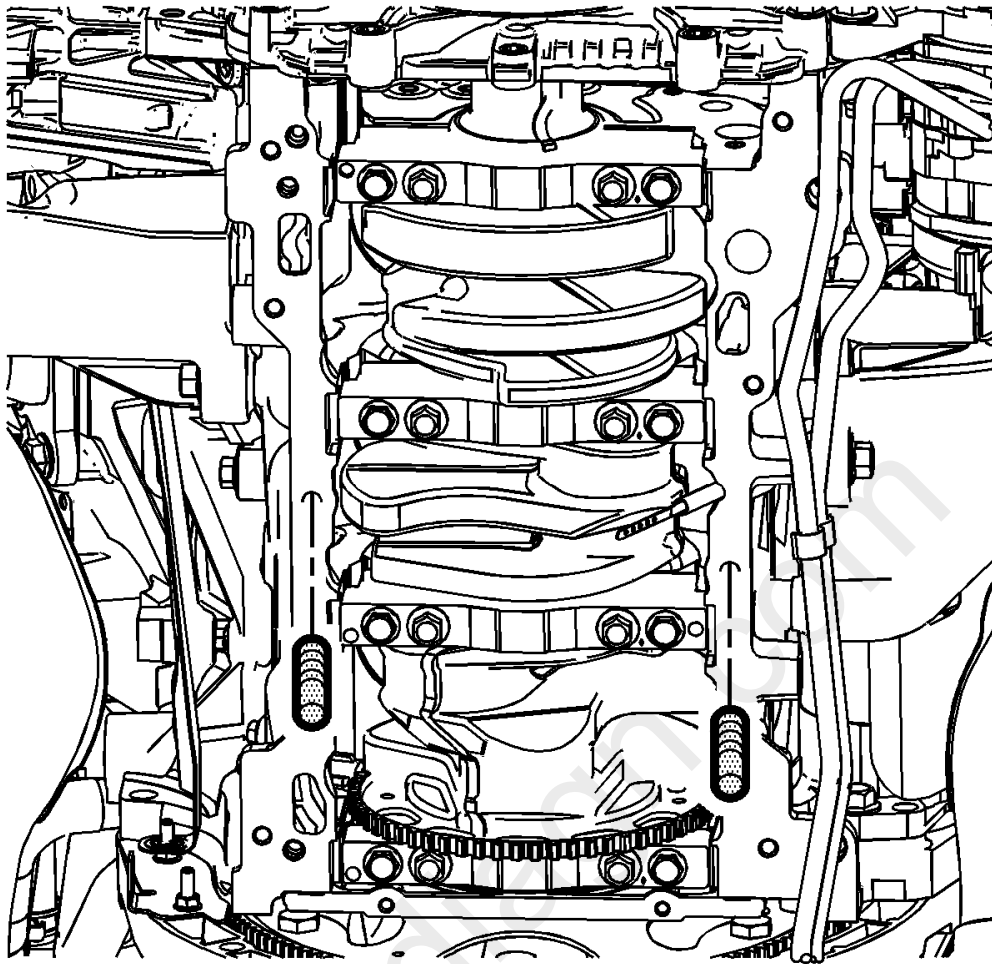


Fig. 231: 8mm Guides
Courtesy of GENERAL MOTORS COMPANY

2. Install the 8 mm (0.315 in) guides from the EN 46109 set into the center oil pan rail bolt hole on each side of the engine block.

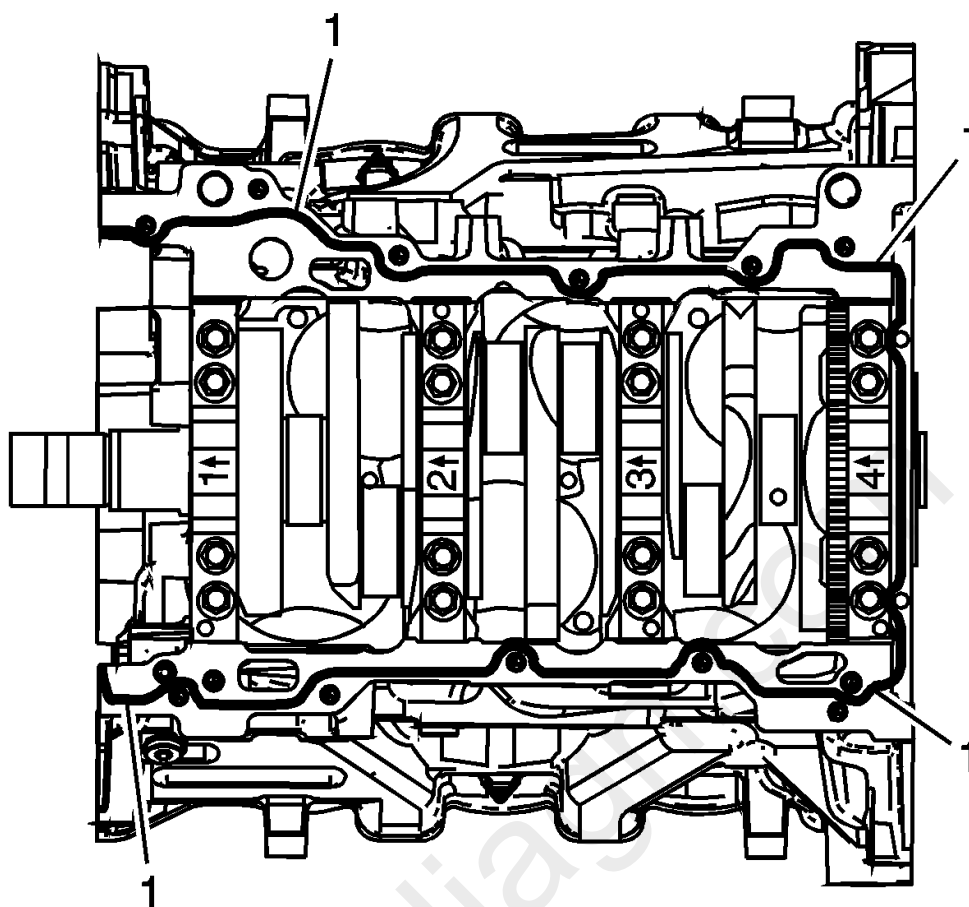


Fig. 232: Identifying Sealant Application Locations On Block Pan Rail & Crankshaft Rear Oil Seal Housing

Courtesy of GENERAL MOTORS COMPANY

3. Place a 3 mm (0.118 in) bead of RTV sealant, on the block pan rail and the crankshaft rear oil seal housing (1).

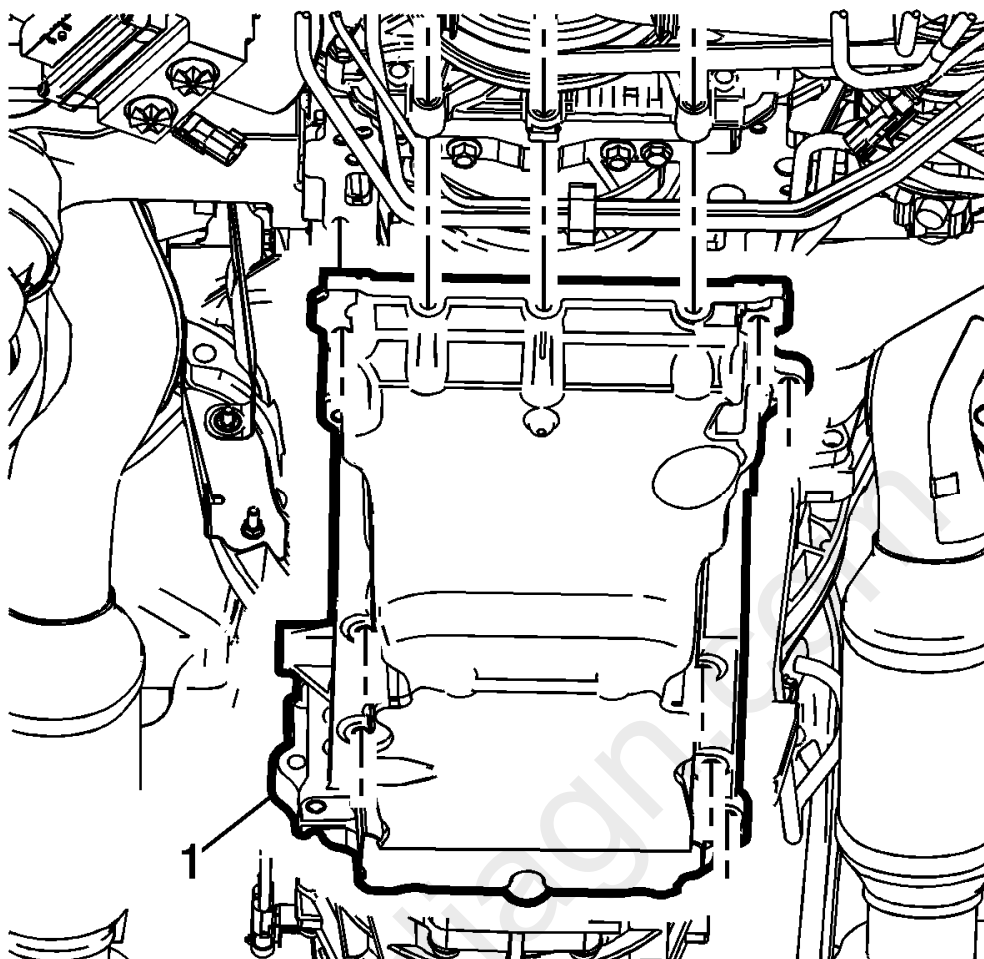


Fig. 233: Oil Pan

Courtesy of GENERAL MOTORS COMPANY

4. Install oil pan (1)
5. Remove the EN 46109 set 8 mm (0.315 in) guides from the engine block.

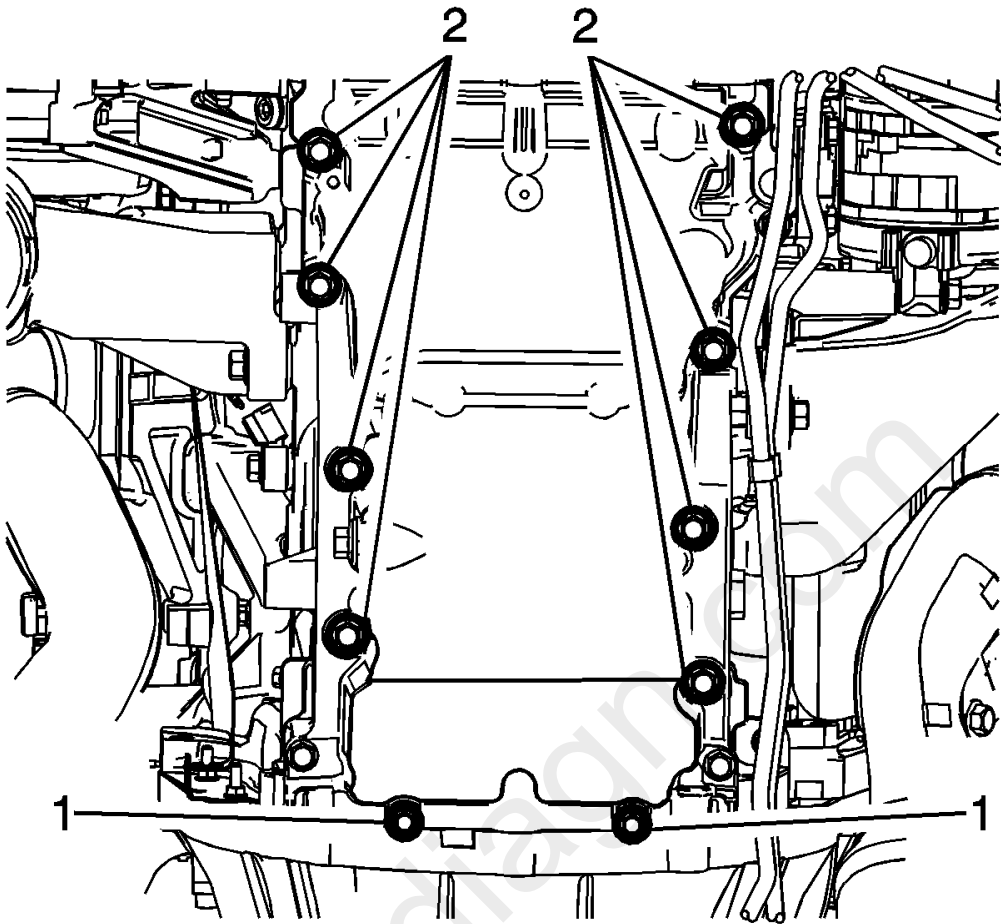


Fig. 234: Oil Pan Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Loosely install the oil pan bolts (1) and (2).

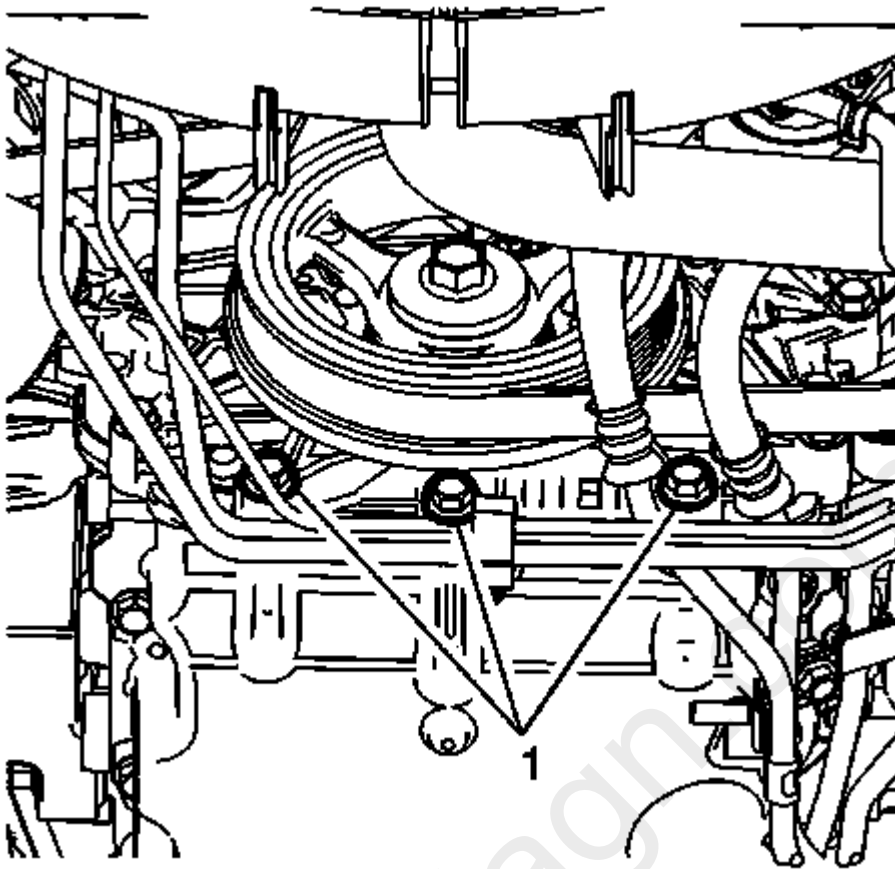


Fig. 235: Oil Pan Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install the front cover NEW bolts (1) and tighten the bolts to 20 (14 lb ft) plus 60°.

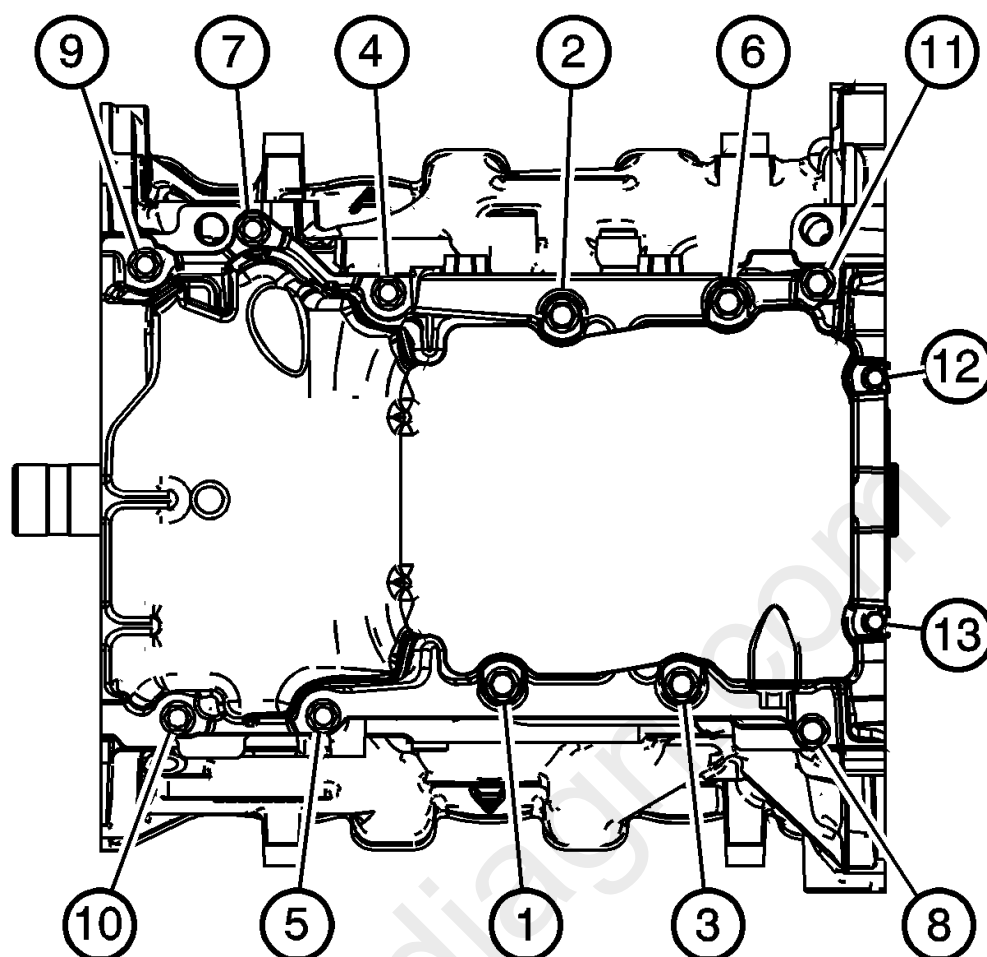


Fig. 236: View Of Oil Pan Bolts Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

8. Tighten the oil pan bolts in sequence shown.
 - Tighten the 8 mm bolts (1-11) to 25 (18 lb ft).
 - Tighten the 6 mm bolts (12, 13) to 10 (89 lb in).
9. If equipped with AWD, install the front differential carrier. Refer to **Differential Carrier Assembly Replacement**.
10. Install the drivetrain and front suspension frame. Refer to **Drivetrain and Front Suspension Frame Replacement (All Wheel Drive)**, **Drivetrain and Front Suspension Frame Replacement (Rear Wheel Drive)**.
11. Fill the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

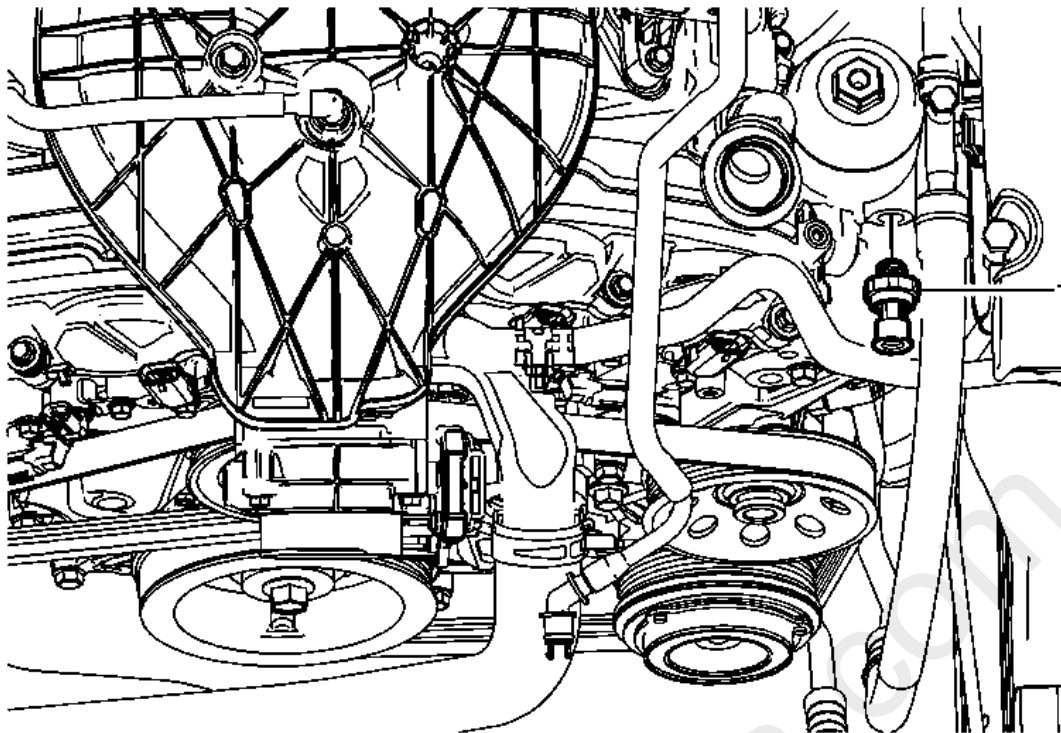


Fig. 237: Engine Oil Pressure Sensor and/or Switch
 Courtesy of GENERAL MOTORS COMPANY

Engine Oil Pressure Sensor and/or Switch Replacement

Callout	Component Name
Preliminary Procedure	
Remove the intake manifold cover. Refer to <u>Intake Manifold Cover Replacement</u>	
1	Engine Oil pressure Sensor and / or Switch CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure Disconnect electrical connector. Tighten 20 N.m (15 lb ft)

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT (RWD)

Removal Procedure

1. Remove the oil pan. Refer to Oil Pan Replacement.

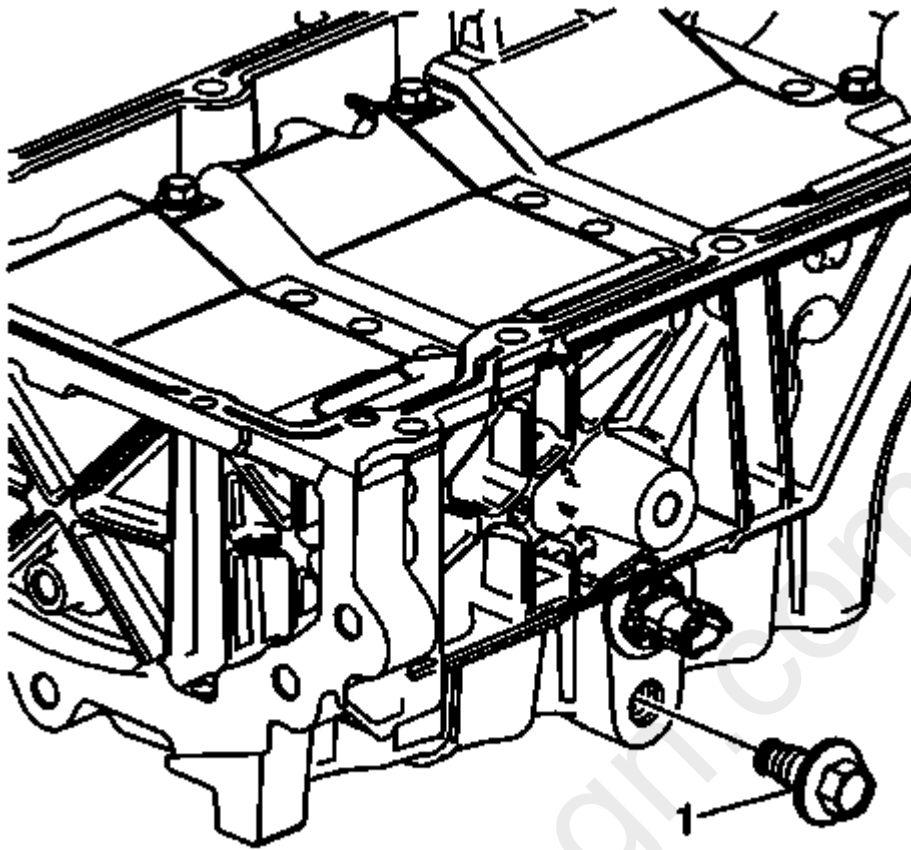


Fig. 238: Oil Drain Plug

Courtesy of GENERAL MOTORS COMPANY

2. Remove the oil pan drain plug (1)

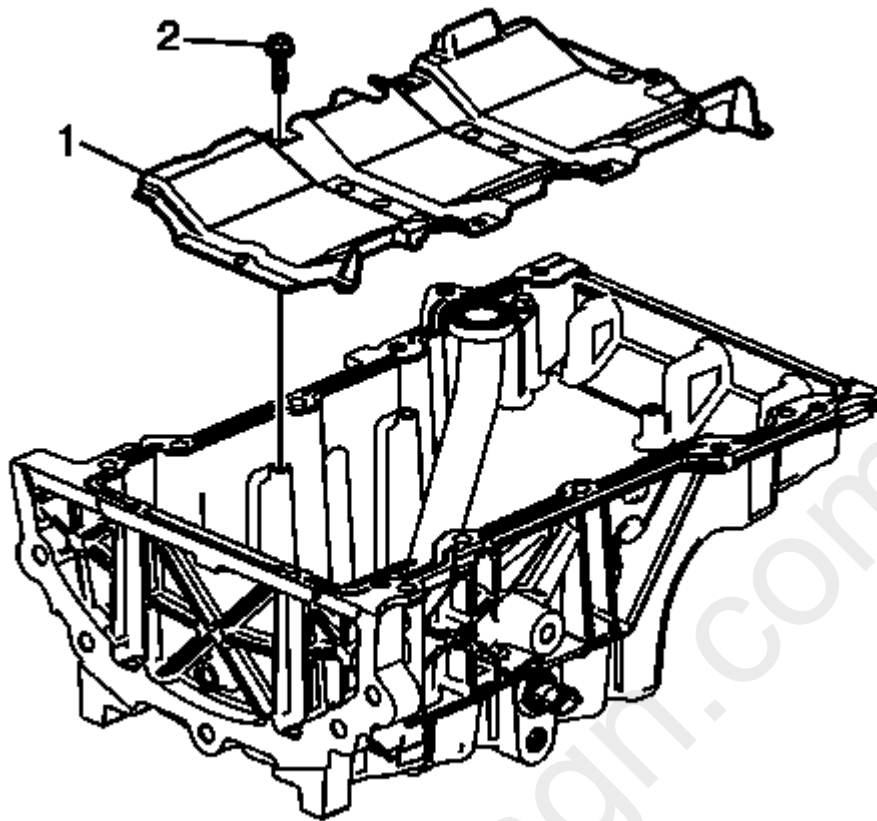


Fig. 239: Oil Pan Scraper & Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil pan scraper bolts (2).
4. Remove the oil pan scraper (1).

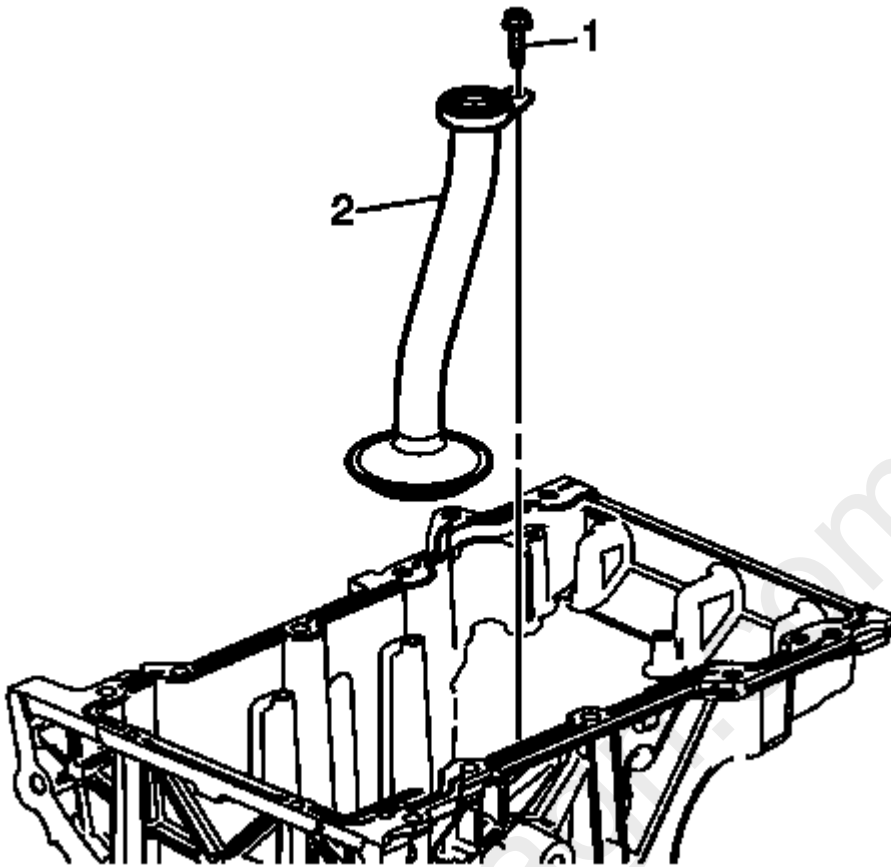


Fig. 240: Oil Suction Pipe & Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil suction pipe bolts (1).
6. Remove the oil suction pipe (2).

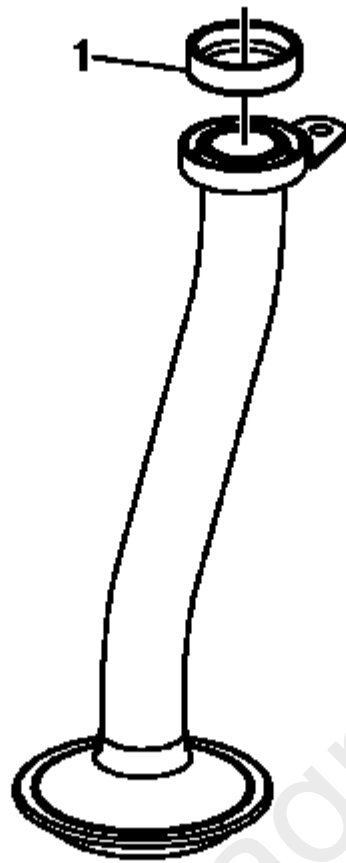


Fig. 241: Oil Suction Pipe Seal

Courtesy of GENERAL MOTORS COMPANY

7. Remove and discard the oil suction pipe seal (1).

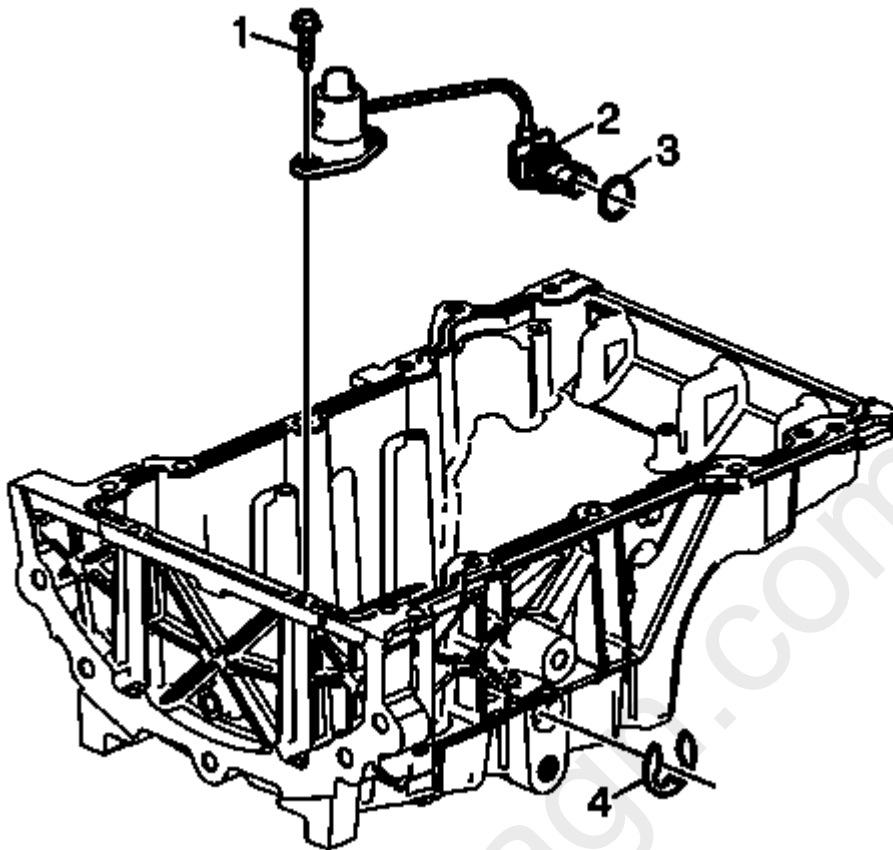


Fig. 242: Engine Oil Level Switch & Components
Courtesy of GENERAL MOTORS COMPANY

8. Remove the engine oil level switch clip (4).
9. Remove the engine oil level switch bolts (1).
10. Remove the engine oil level switch (2).
11. Remove and discard the engine oil level switch seal (3).

Installation Procedure

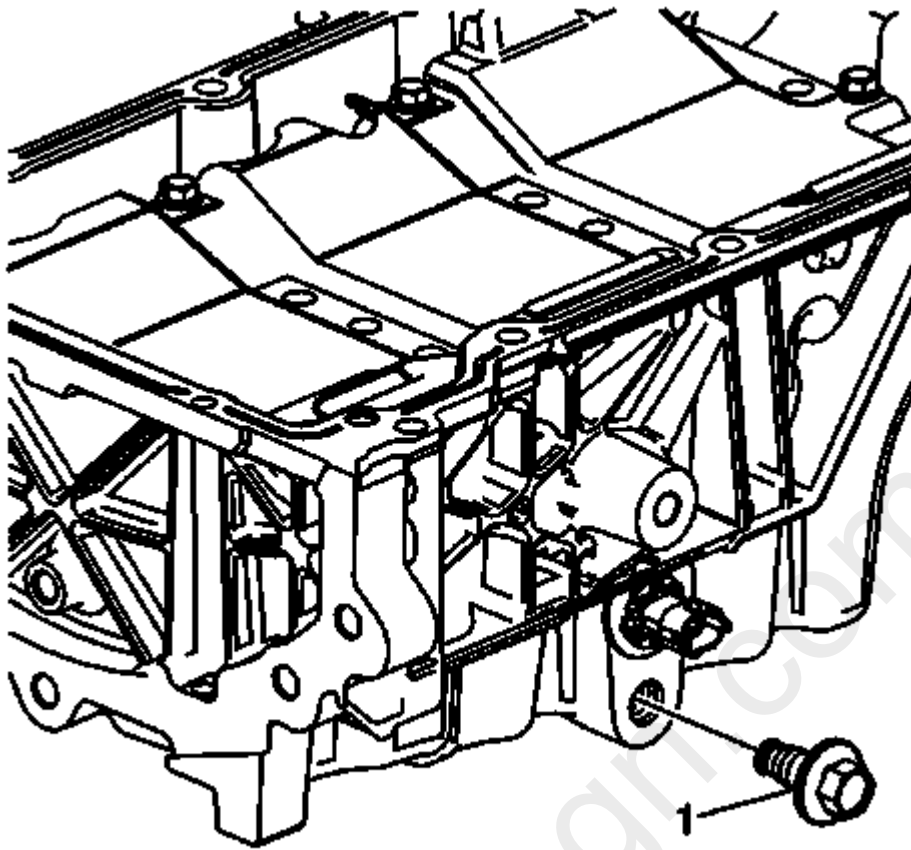


Fig. 243: Oil Drain Plug

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the oil pan drain plug (1) and tighten the oil pan drain plug to 25 N.m (18 lb ft).

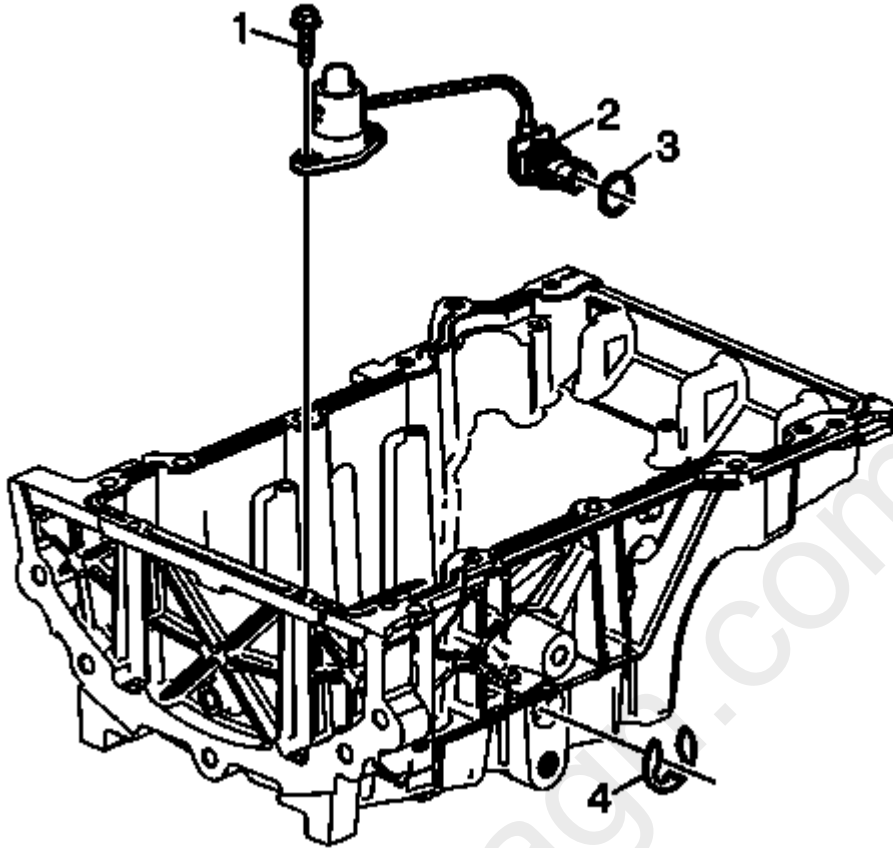


Fig. 244: Engine Oil Level Switch & Components
Courtesy of GENERAL MOTORS COMPANY

2. Install the NEW engine oil level switch seal (3).
3. Install the engine oil level switch (2).
4. Install the engine oil level switch bolts (1) and tighten to 10 N.m (89 lb in).
5. Install NEW engine oil level switch clip (4).

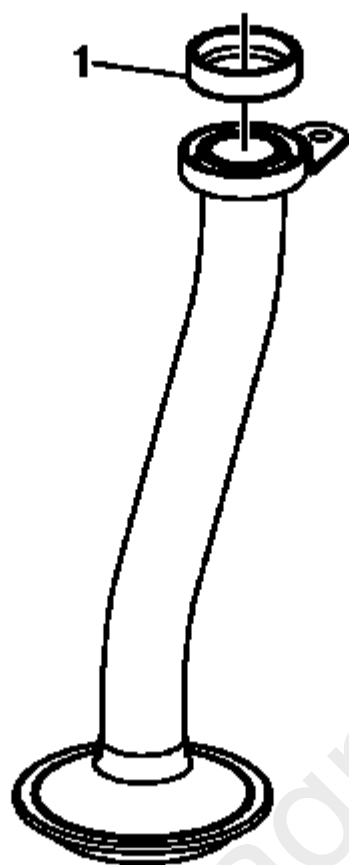


Fig. 245: Oil Suction Pipe Seal

Courtesy of GENERAL MOTORS COMPANY

6. Install the NEW oil suction pipe seal (1).

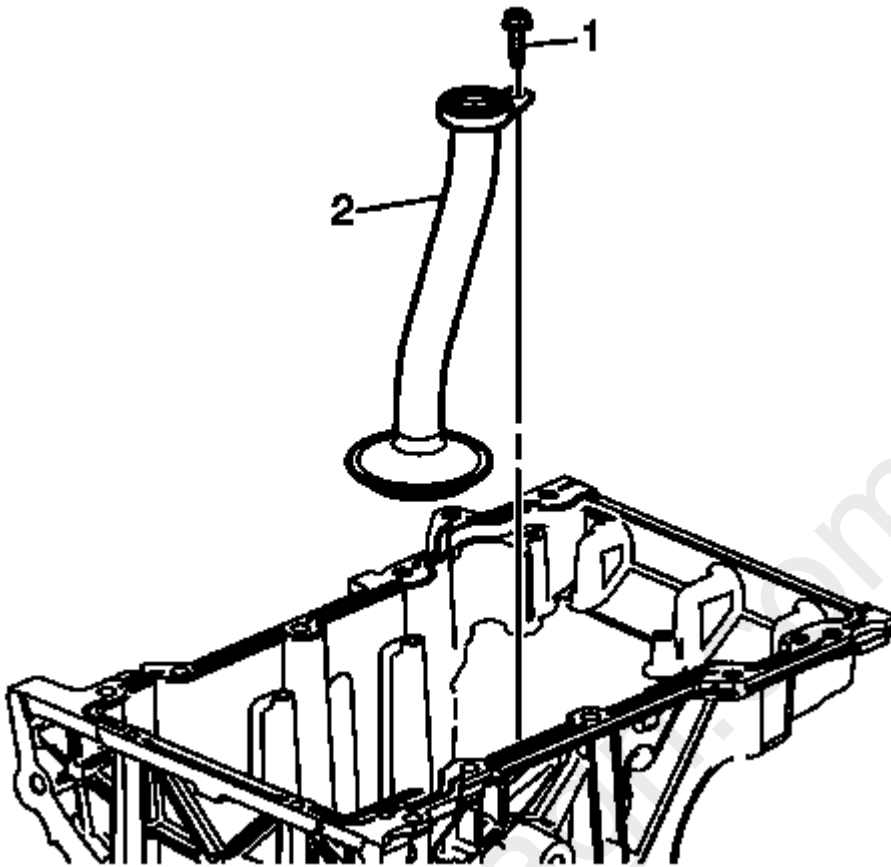


Fig. 246: Oil Suction Pipe & Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install the oil suction pipe (2).
8. Install the oil suction pipe bolts (1) and tighten to 10 N.m (89 lb in).

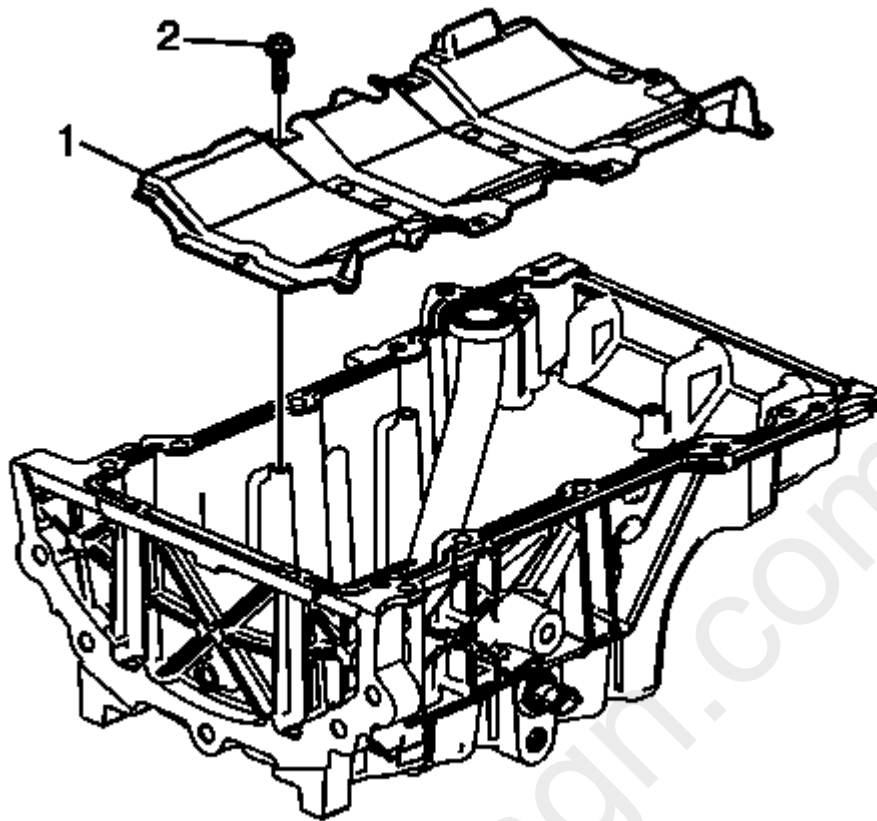


Fig. 247: Oil Pan Scraper & Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Install the oil pan scraper (1).
10. Install the oil pan scraper bolts (2) and tighten to 10 N.m (89 lb in).
11. Install the oil pan. Refer to **Oil Pan Replacement**.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT (AWD)

Removal Procedure

1. Remove the oil pan. Refer to **Oil Pan Replacement**.

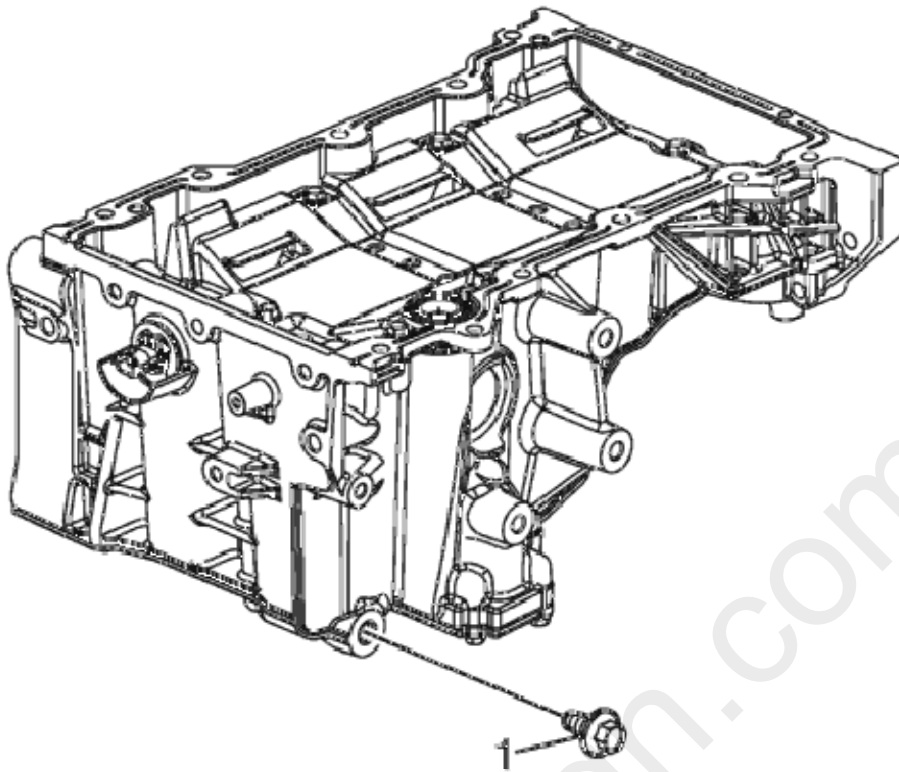


Fig. 248: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS COMPANY

2. Remove the oil pan drain plug (1).

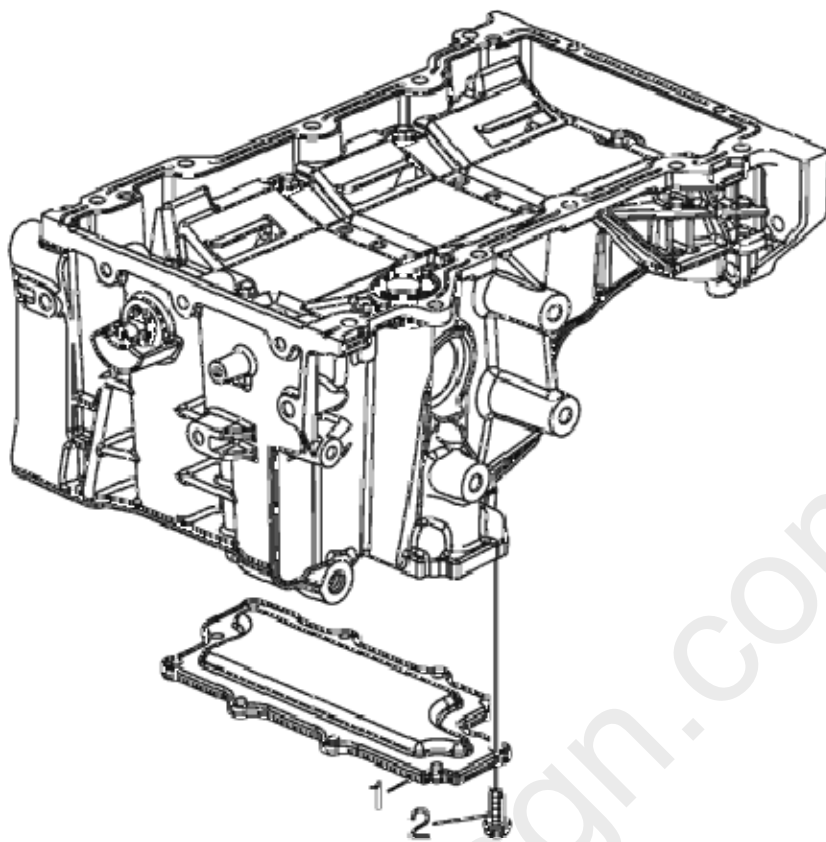


Fig. 249: Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil pan skid plate bolts (2).
4. Remove the oil pan skid plate (1).

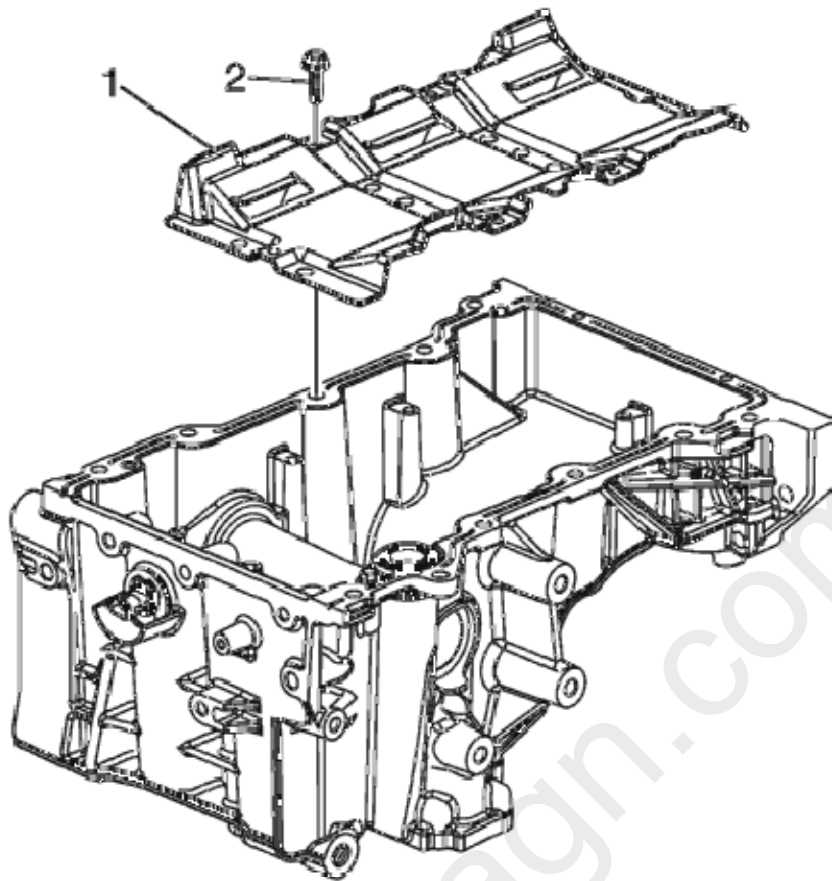


Fig. 250: Oil Pan Scraper & Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil pan scraper bolts (2).
6. Remove the oil pan scraper (1).

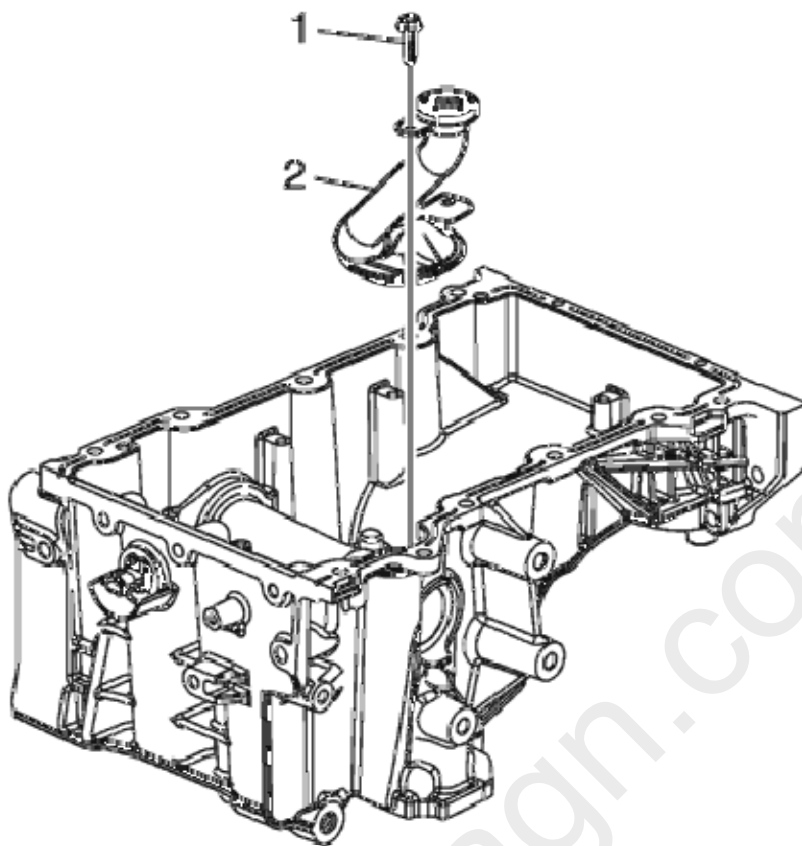


Fig. 251: Oil Suction Pipe & Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the oil suction pipe bolts (1).
8. Remove the oil suction pipe (2).

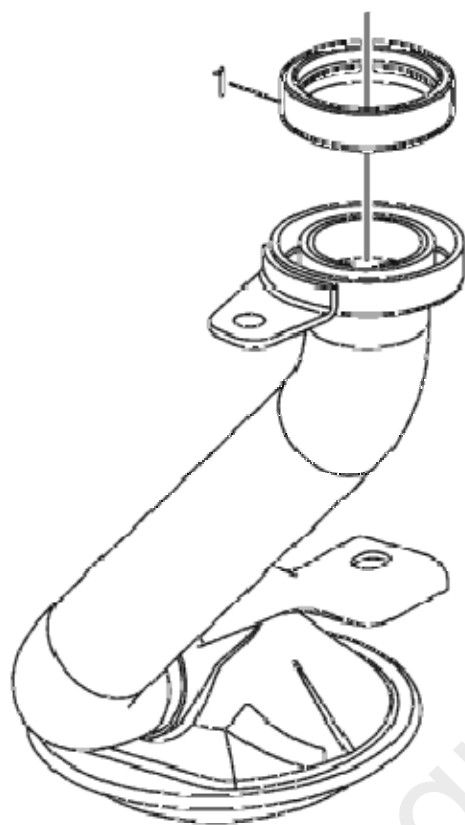


Fig. 252: Oil Suction Pipe Seal
Courtesy of GENERAL MOTORS COMPANY

9. Remove the oil suction pipe seal (1).

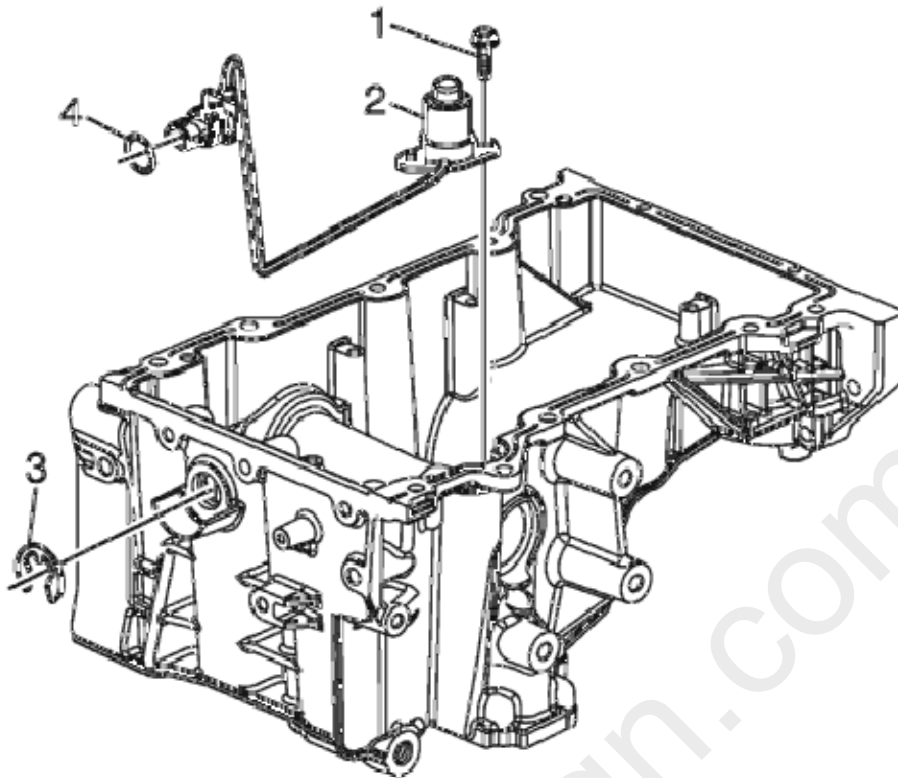


Fig. 253: Engine Oil Level Switch & Components
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine oil level switch clip (3)
11. Remove the engine oil level switch bolt (1).
12. Remove the engine oil level switch (2).
13. Remove the engine oil level switch seal (4).

Installation Procedure

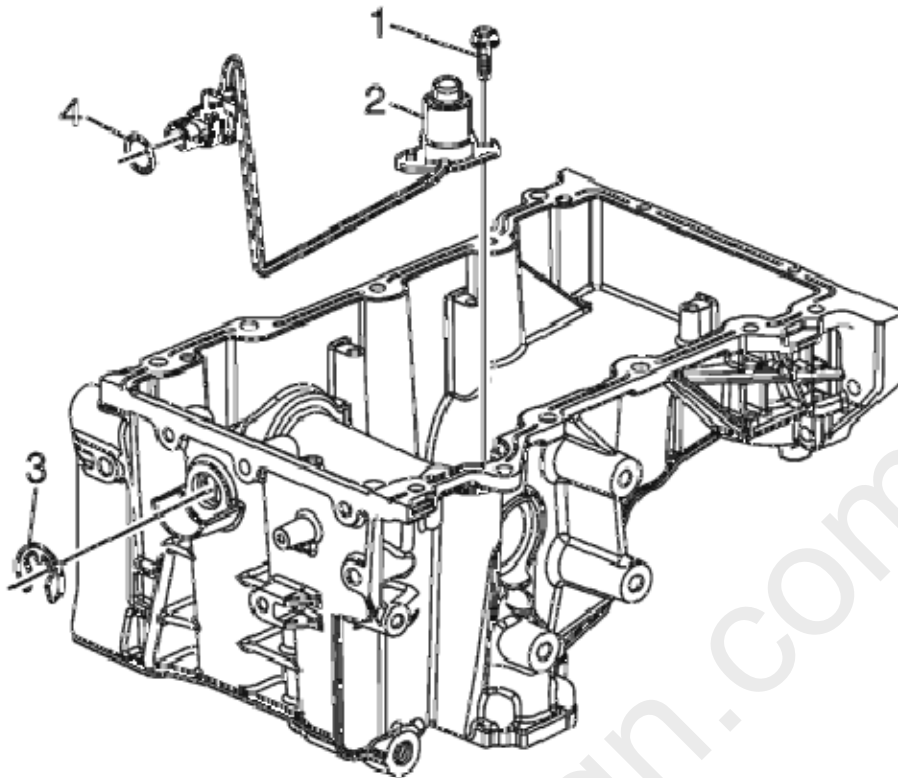


Fig. 254: Engine Oil Level Switch & Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW engine oil level switch seal (4).
2. Install the engine oil level switch (2).

CAUTION: Refer to Fastener Caution .

3. Install the engine oil level switch bolts (1) and tighten to 10 N.m (89 lb in).
4. Install NEW engine oil level switch clip (3).

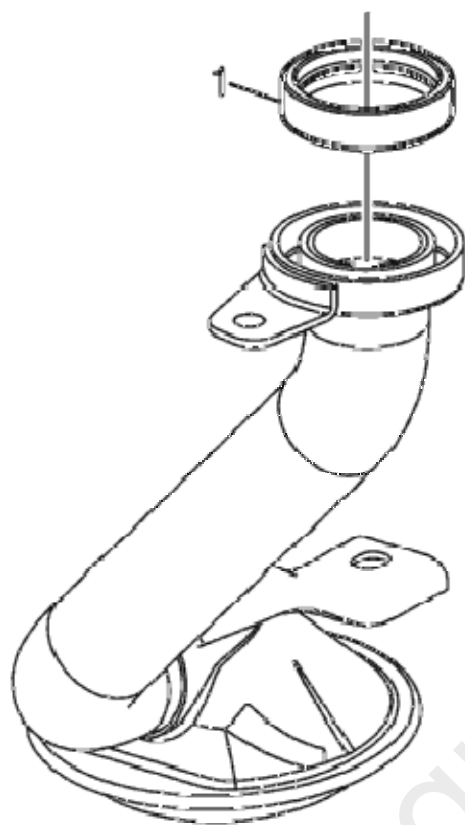


Fig. 255: Oil Suction Pipe Seal

Courtesy of GENERAL MOTORS COMPANY

5. Install the NEW oil suction pipe seal (1).

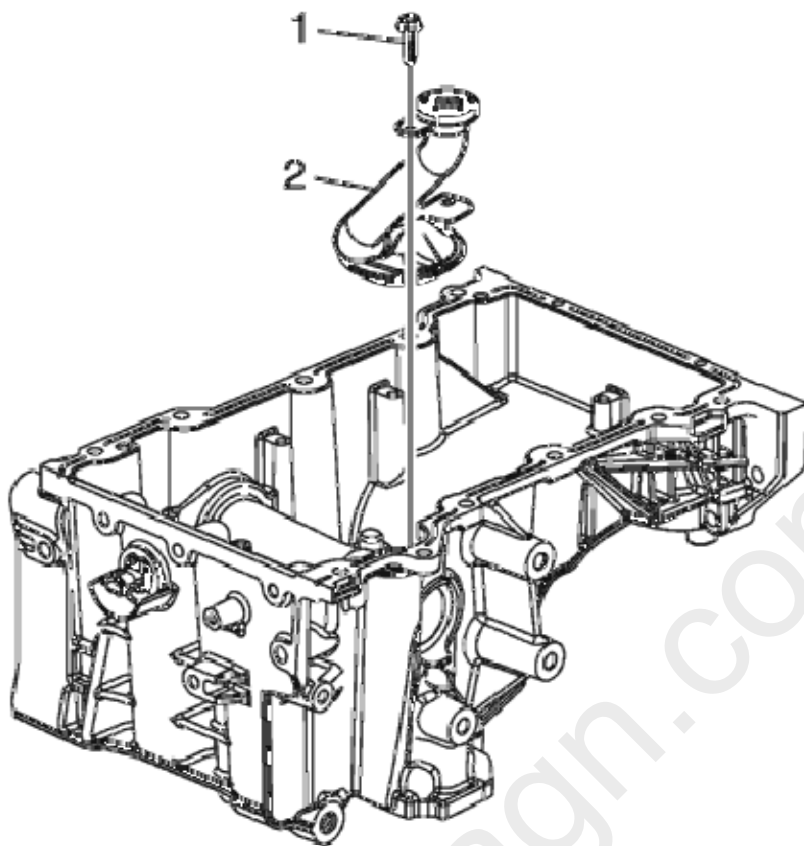


Fig. 256: Oil Suction Pipe & Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the oil suction pipe (2).
7. Install the oil suction pipe bolts (1) and tighten to 10 N.m (89 lb in).

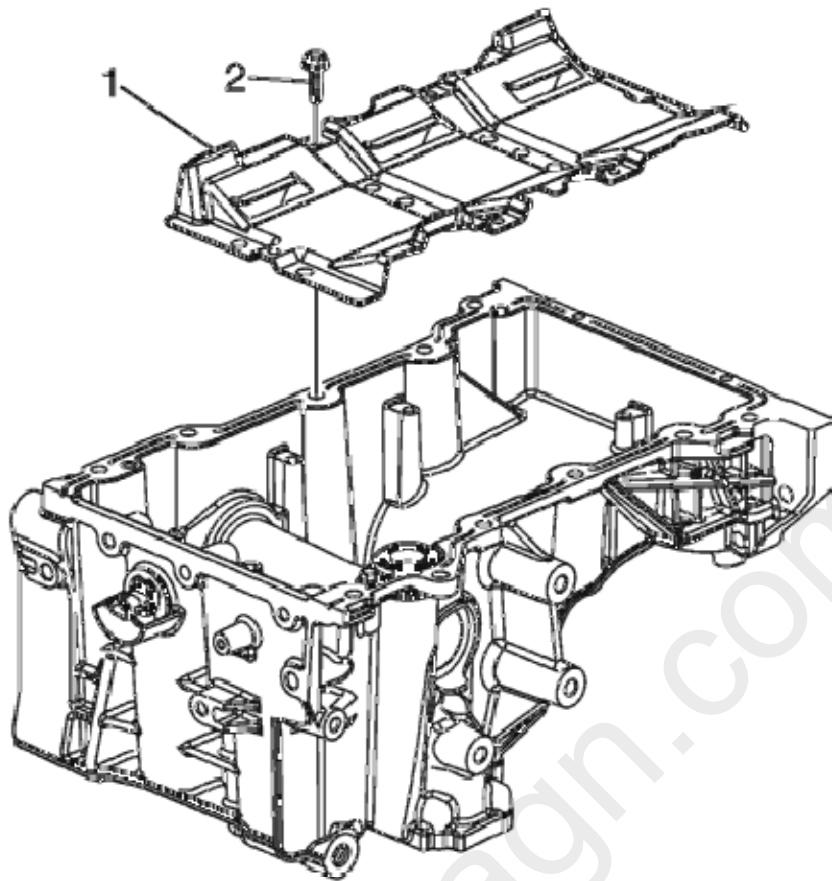


Fig. 257: Oil Pan Scraper & Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Install the oil pan scraper (1).
9. Install the oil pan scraper bolts (2) and tighten to 10 N.m (89 lb in).

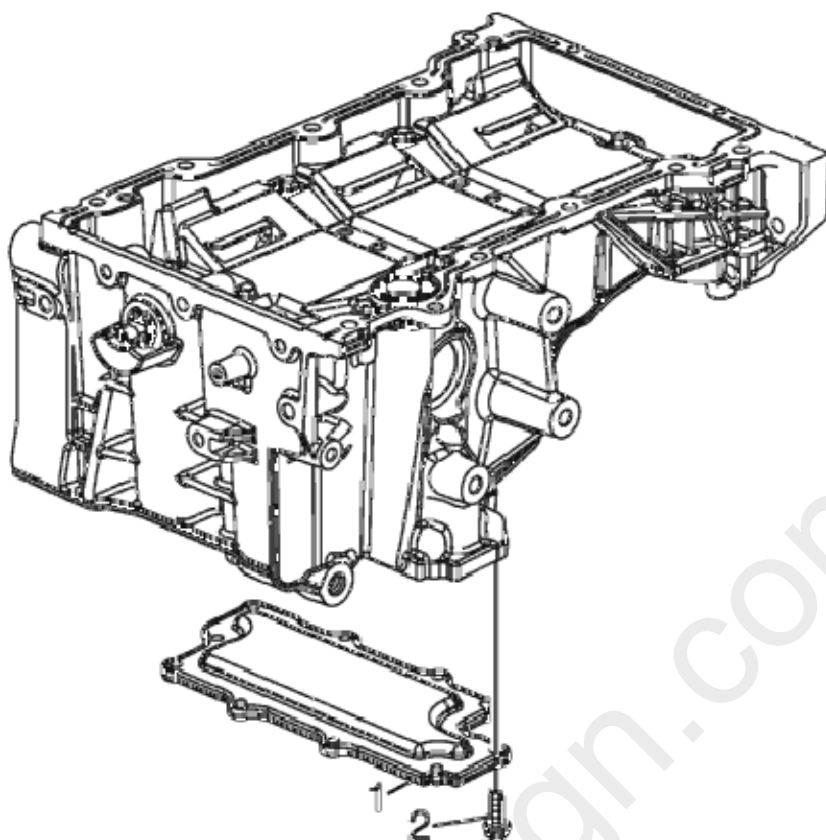


Fig. 258: Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Install the oil pan skid plate (1).
11. Install the oil pan skid bolt (2).

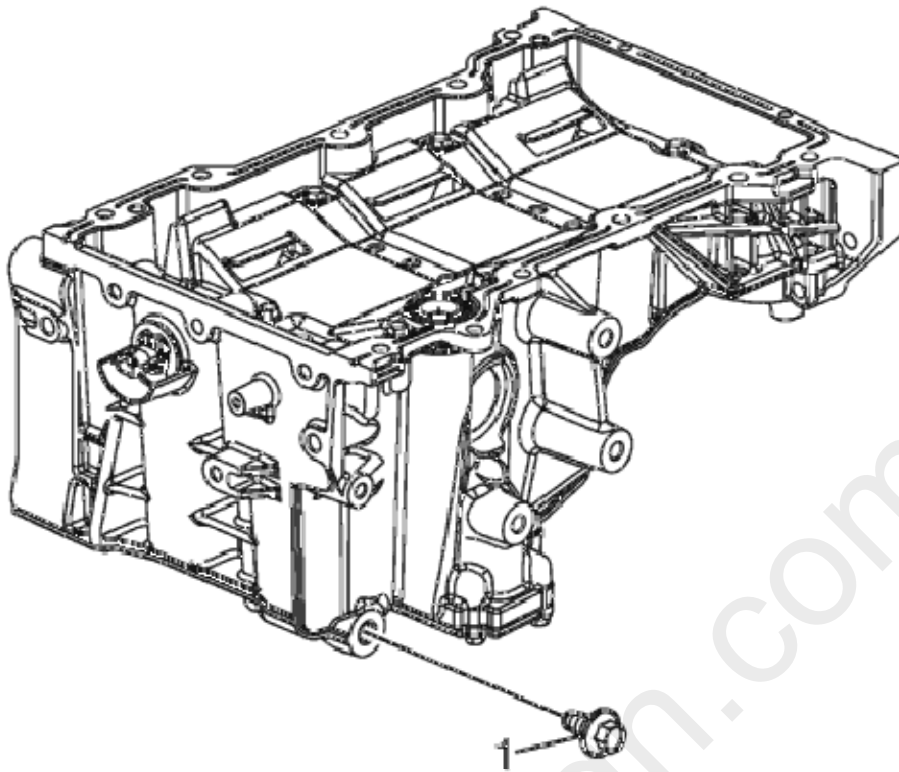


Fig. 259: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS COMPANY

12. Install the oil pan drain plug (1) and tighten to 25 N.m (18 lb ft).
13. Install the oil pan. Refer to **Oil Pan Replacement**.

OIL PUMP SUCTION PIPE AND SCREEN ASSEMBLY REPLACEMENT

Removal Procedure

1. Remove the oil pan. Refer to **Oil Pan Replacement**.

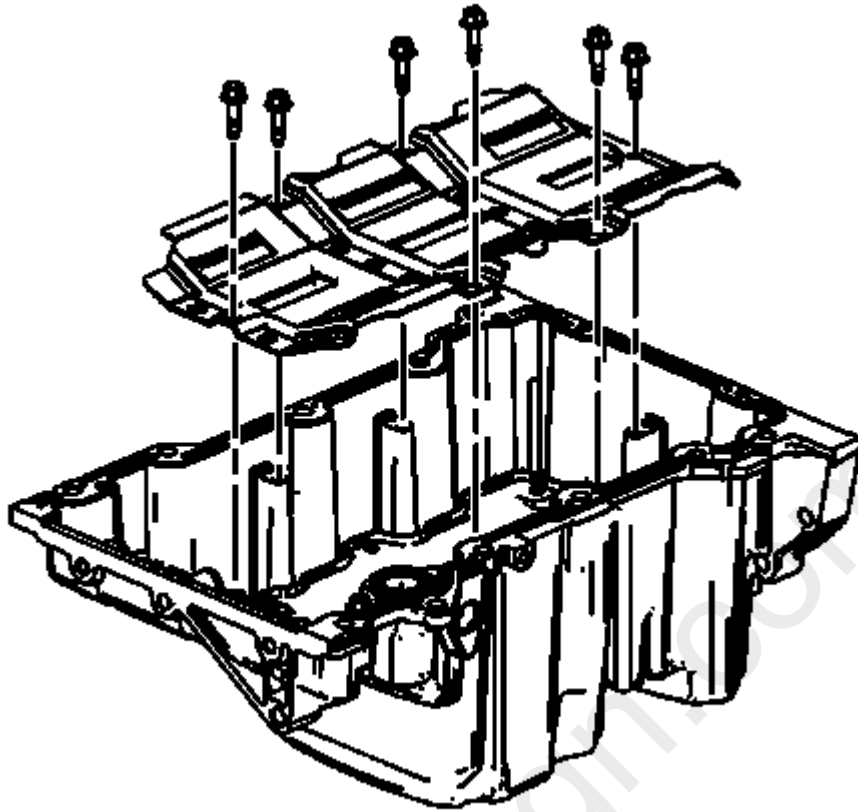


Fig. 260: View Of Oil Pan Scraper And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the oil pan scraper bolts.
3. Remove the oil pan scraper.

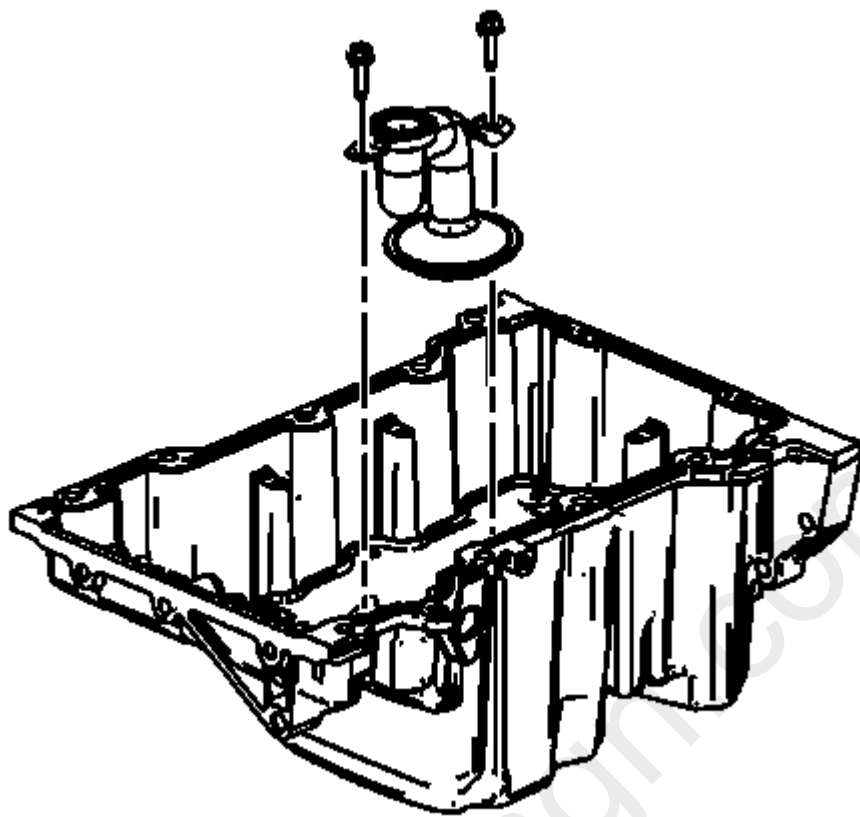


Fig. 261: View Of Oil Suction Pipe
Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil suction pipe bolts.
5. Remove the oil suction pipe.

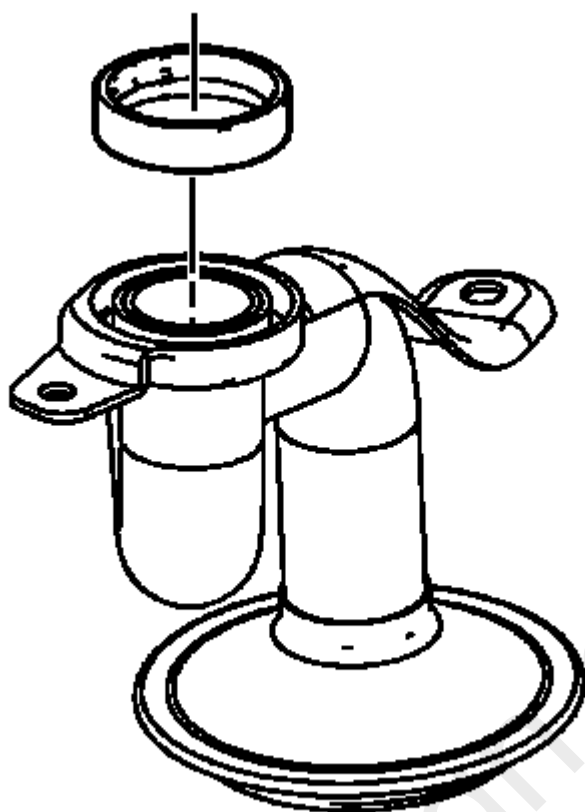


Fig. 262: View Of Oil Suction Tube Seal & Oil Suction Tube
Courtesy of GENERAL MOTORS COMPANY

6. Remove the oil suction tube seal from the oil suction tube. Discard the oil suction tube seal.

Installation Procedure

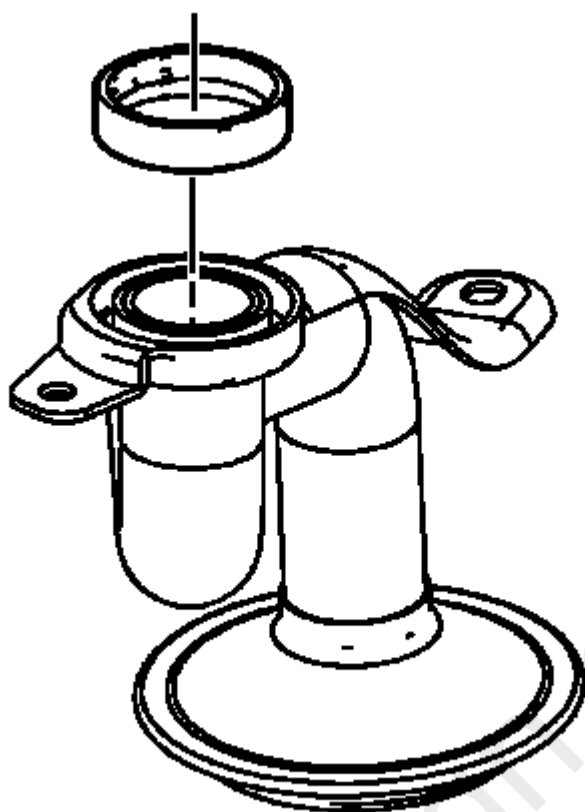


Fig. 263: View Of Oil Suction Tube Seal & Oil Suction Tube
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW oil suction tube seal onto the oil suction tube. DO NOT reuse the old oil suction tube seal.

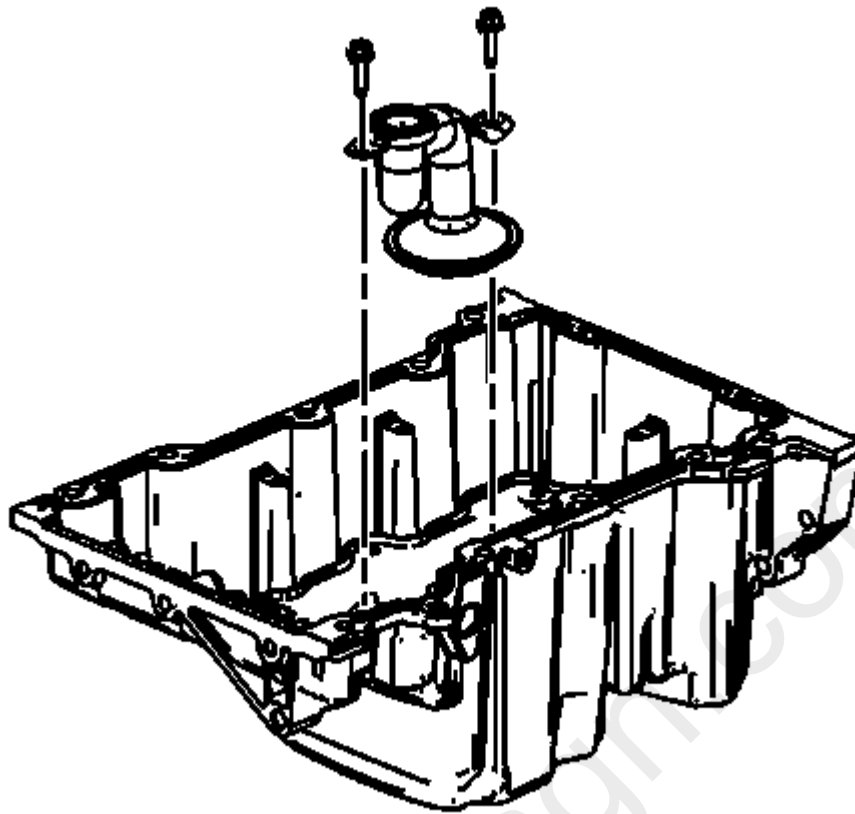


Fig. 264: View Of Oil Suction Pipe
Courtesy of GENERAL MOTORS COMPANY

2. Install the oil suction pipe.

CAUTION: Refer to Fastener Caution .

3. Install the oil suction pipe bolts and tighten to 10 N.m (89 lb in).

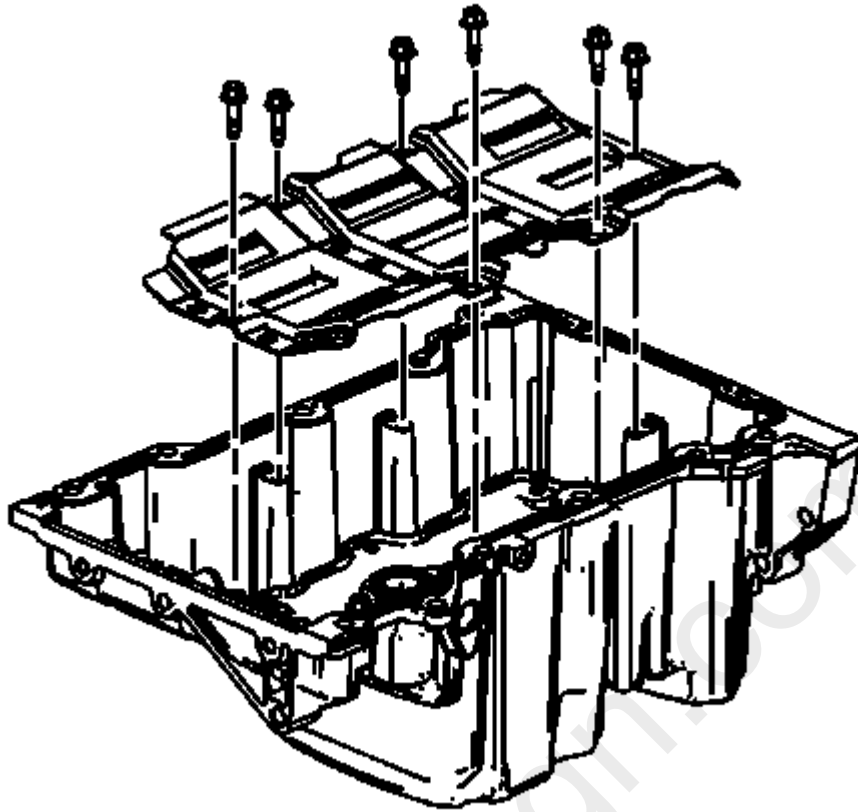


Fig. 265: View Of Oil Pan Scraper And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the oil pan scraper.
5. Install the oil pan scraper bolts and tighten to 10 N.m (89 lb in).
6. Install the oil pan. Refer to **Oil Pan Replacement**.

ENGINE REPLACEMENT (AWD)

Special Tools

EN 46114 Engine Lift Bracket

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (Coupe)** , **Battery Negative Cable Disconnection and Connection (Wagon)** .
2. Remove the front compartment side sight shields. Refer to **Front Compartment Side Sight Shield Replacement** .
3. Remove the Front Compartment sight shields. Refer to **Front Compartment Sight Shields Replacement** .

4. Remove the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
5. Remove the intake manifold insulator. Refer to **Intake Manifold Insulator Replacement**.

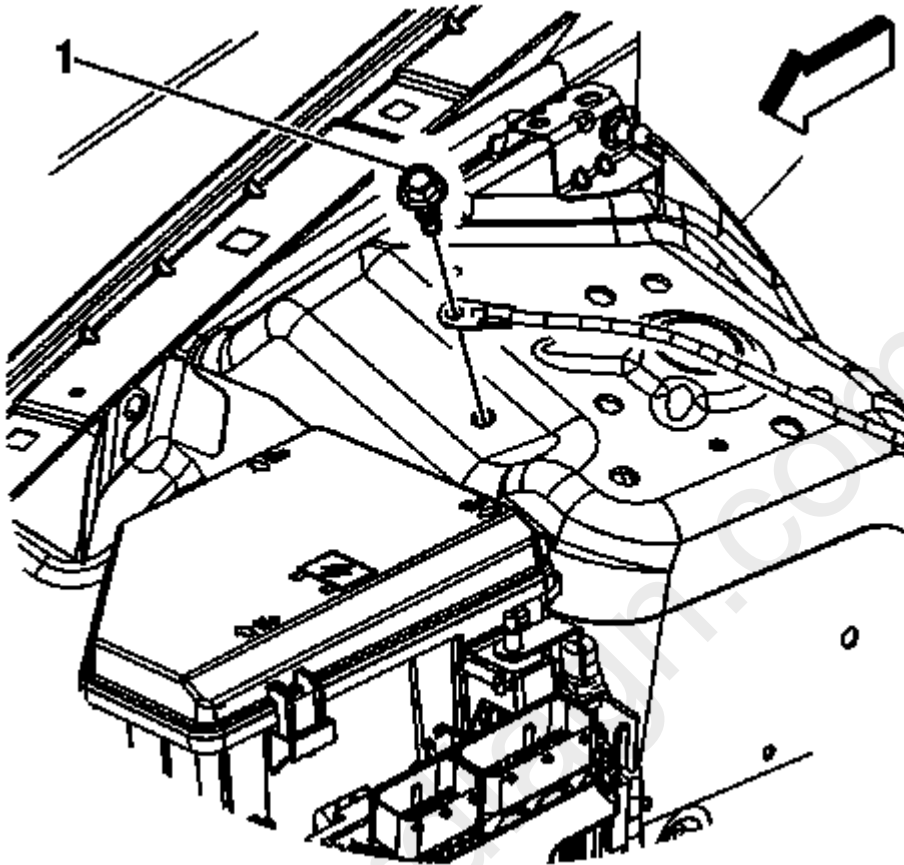


Fig. 266: Identifying Battery Negative Cable Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the bolt (1) retaining the battery negative cable extension cable to the right strut tower.
7. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Remove the wiper module. Refer to **Windshield Wiper Transmission Replacement** .
9. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .

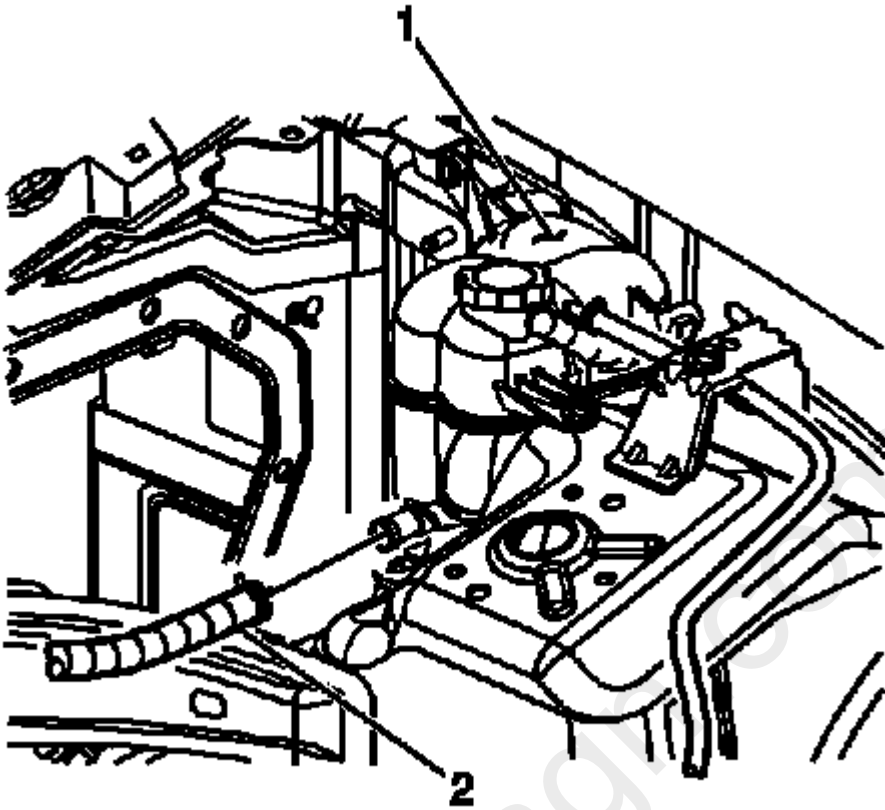


Fig. 267: Locating Surge Tank & Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the surge tank outlet hose (2) from the surge tank (1). Secure the hose to the engine.
11. Disconnect the surge tank inlet hose from the water outlet only and secure to the vehicle.

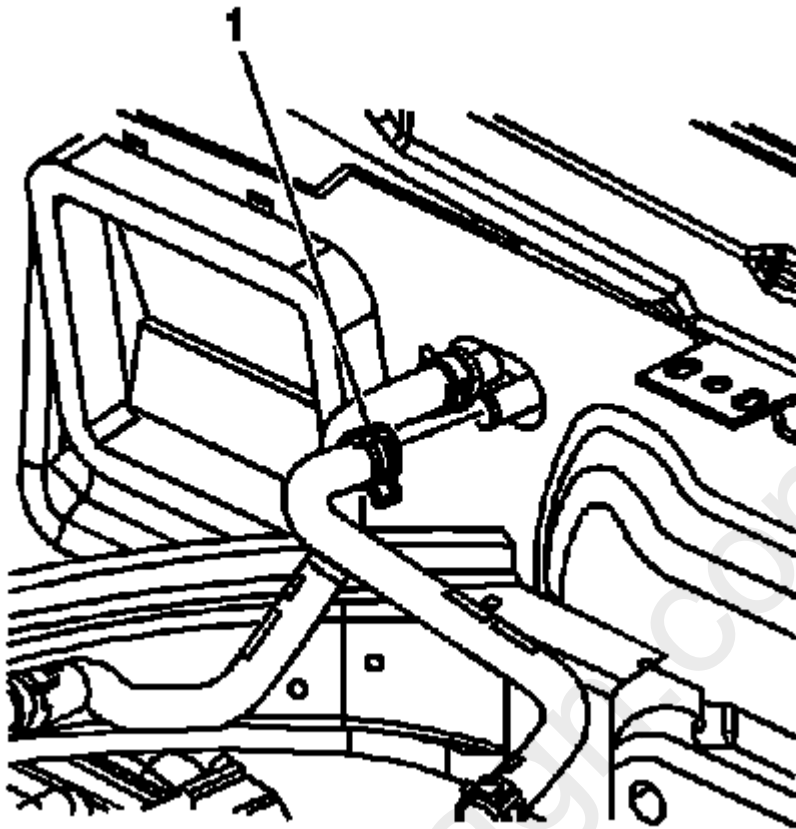


Fig. 268: Identifying Inlet Heater Hose
Courtesy of GENERAL MOTORS COMPANY

12. Disconnect the heater inlet heater hose (1) from the heater core.

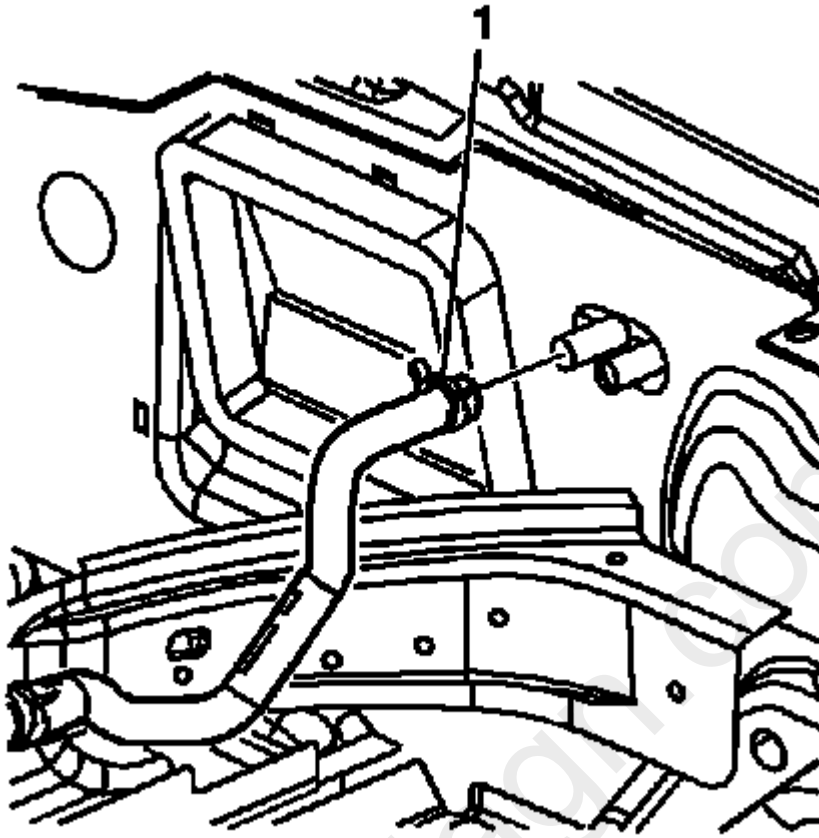


Fig. 269: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the heater outlet heater hose (1) from the heater core.
14. Remove the radiator inlet and outlet hose. Refer to **Radiator Inlet Hose Replacement (LFW or LFX)** , and **Radiator Outlet Hose Replacement (LFX or LFW)** .
15. Tie the radiator and condenser as an assembly to the upper radiator support brackets.

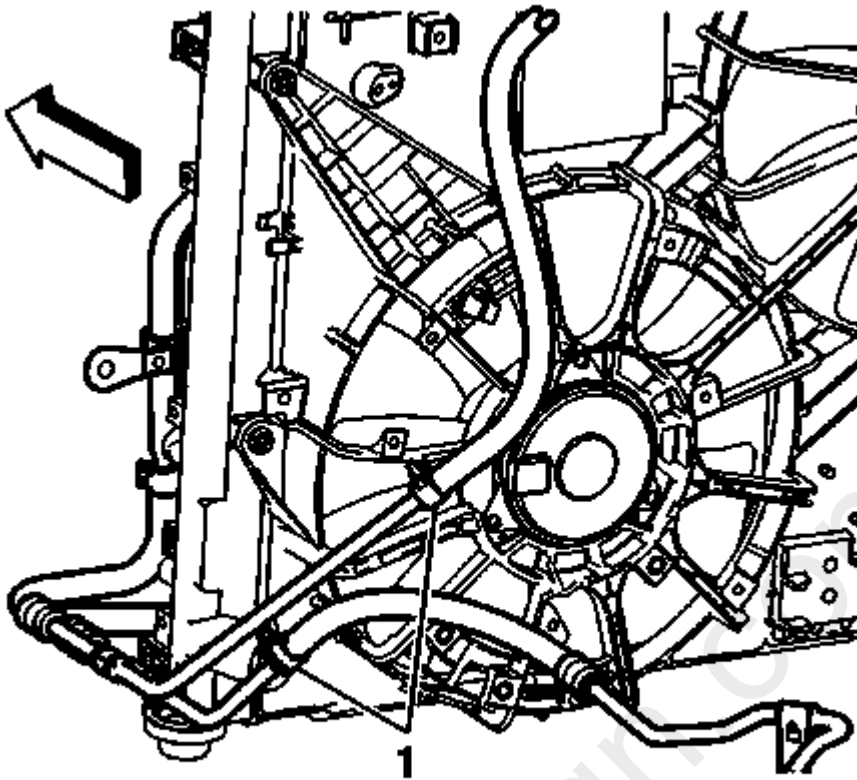


Fig. 270: Identifying Power Steering Hoses
Courtesy of GENERAL MOTORS COMPANY

16. Place a pan under the vehicle in order to capture as much power steering fluid as possible.
17. Disconnect the power steering cooler hoses (1) from the condenser radiator and fan module (CRFM).
18. Plug the power steering hoses and pipes in order to prevent fluid loss and contamination.
19. Disconnect the purge pipe from the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .
20. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief** .
21. Disconnect the fuel pipe (2) from the fuel feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
22. Plug the fuel pipe and cap the fuel rail to prevent fuel loss or contamination.
23. Evacuate the air conditioning system. Refer to **Refrigerant Recovery and Recharging (Belt Driven Compressor)** .
24. Disconnect the air conditioning suction hose from the evaporator and shock tower bracket and secure to the engine.
25. Disconnect the air conditioning pressure switch harness connector.
26. Disconnect the air conditioning evaporator tube at the condenser.

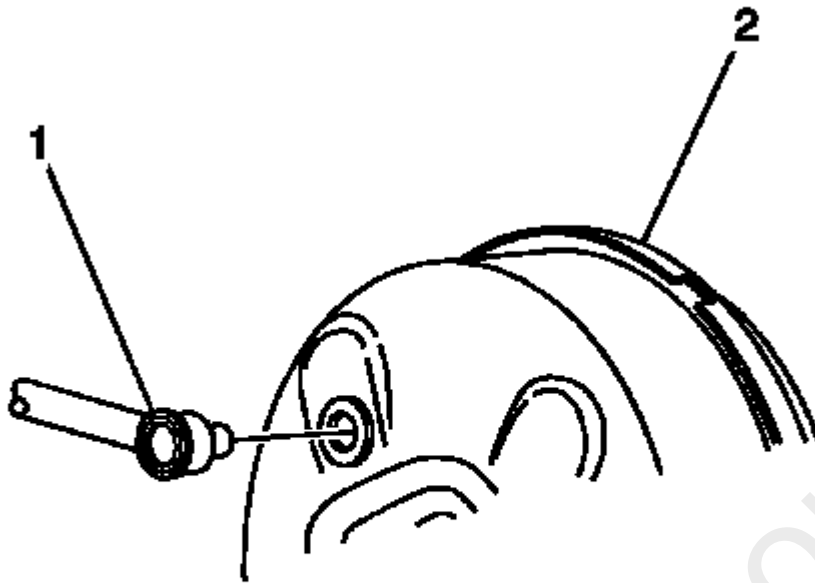


Fig. 271: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS COMPANY

27. Disconnect the brake booster check valve and vacuum hose (1) from the brake booster (2). Secure the hose to the engine.
28. Disconnect all engine harness electrical connectors. Refer to **Powertrain Component Views** , and **Harness Routing Views** .
29. Remove the right side engine harness to valve cover retaining clips.
30. Remove the left side engine harness to valve cover retaining clips.
31. Remove the transmission. Refer to **Transmission Replacement (All Wheel Drive)** .
32. Remove the left front wheel driveshaft and front wheel drive intermediate shaft bearing. Refer to **Front Wheel Drive Intermediate Shaft Bearing Replacement** .
33. Remove the right front wheel Drive Shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .

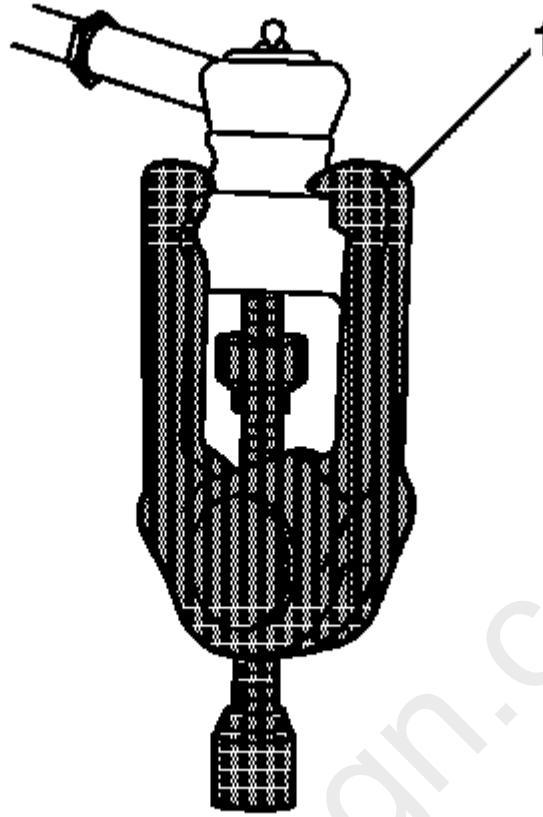


Fig. 272: Removing Outer Tie Rod Assembly From Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

34. Remove the outer tie rod nut and disconnect the steering linkage outer tie rod from the steering knuckle using a steering linkage and tie rod puller (1).
35. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .
36. Remove the windshield washer solvent container. Refer to **Windshield Washer Solvent Container Replacement (Without CE4)** , **Windshield Washer Solvent Container Replacement (With CE4)** .
37. Remove the windshield washer solvent container bracket.

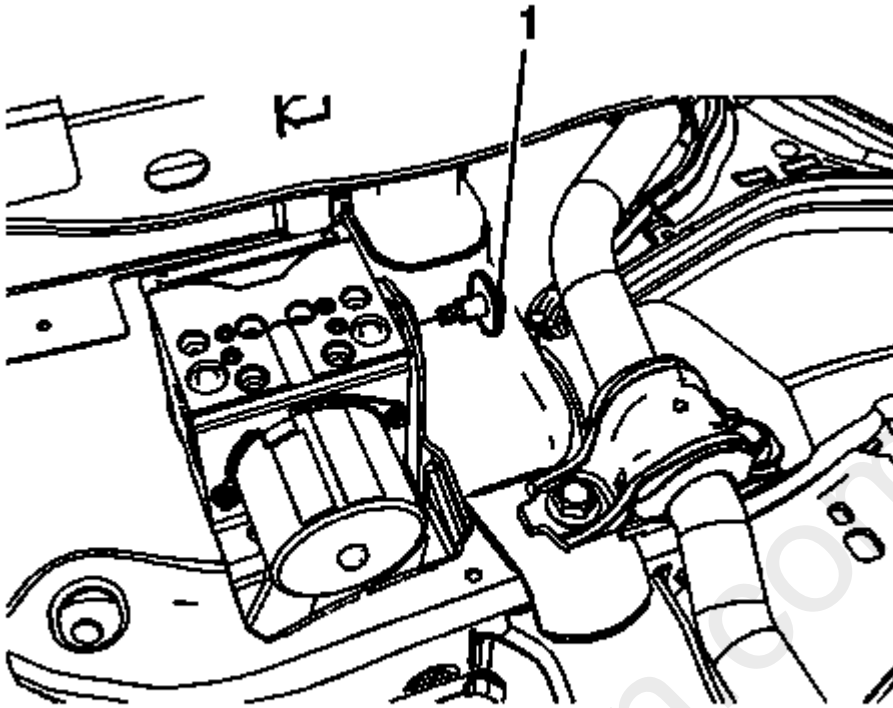


Fig. 273: Identifying BPMV Bolt
Courtesy of GENERAL MOTORS COMPANY

38. Remove the brake pressure modulator valve (BPMV) bolt (1) in order to disengage the valve from the bracket.

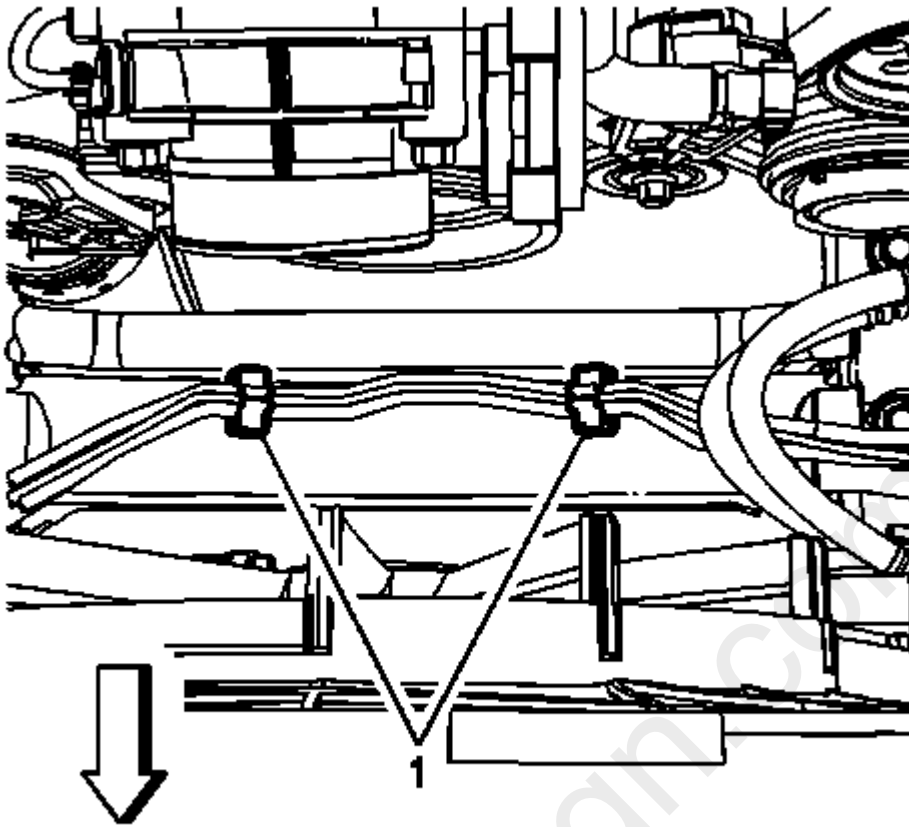


Fig. 274: Front Cross Brake Line Frame Clips
Courtesy of GENERAL MOTORS COMPANY

39. Disengage the front cross brake lines from the frame clips (1).

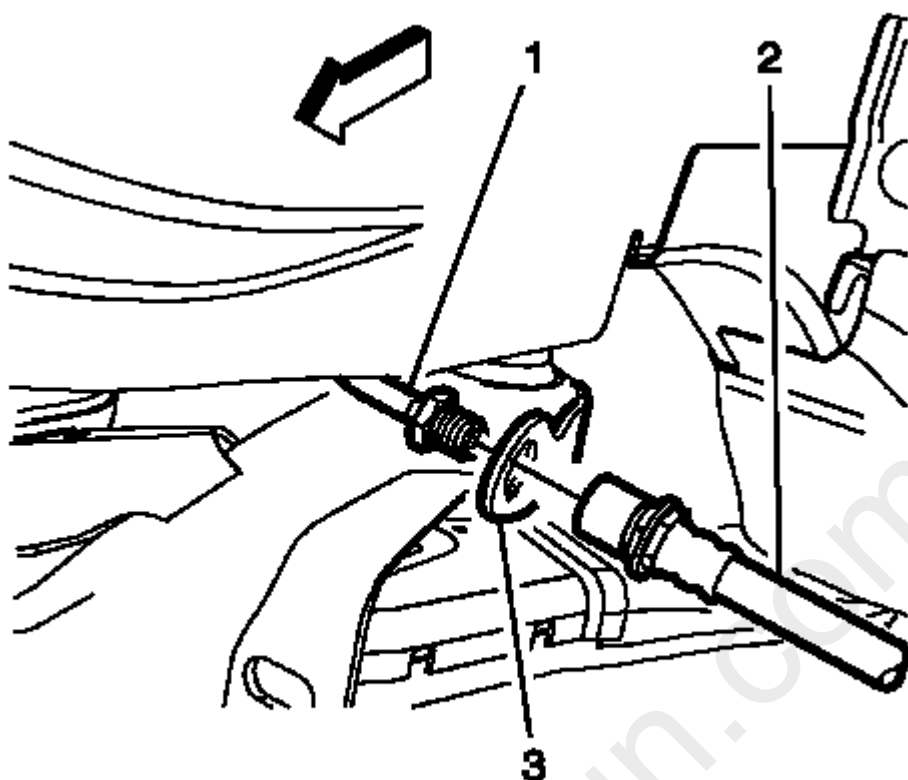


Fig. 275: Front Brake Hoses, Pipes & Brackets
Courtesy of GENERAL MOTORS COMPANY

40. Disconnect the front brake hoses (2) from the front brake pipes (1) and brackets (2). Cap the lines and hoses to prevent contamination.

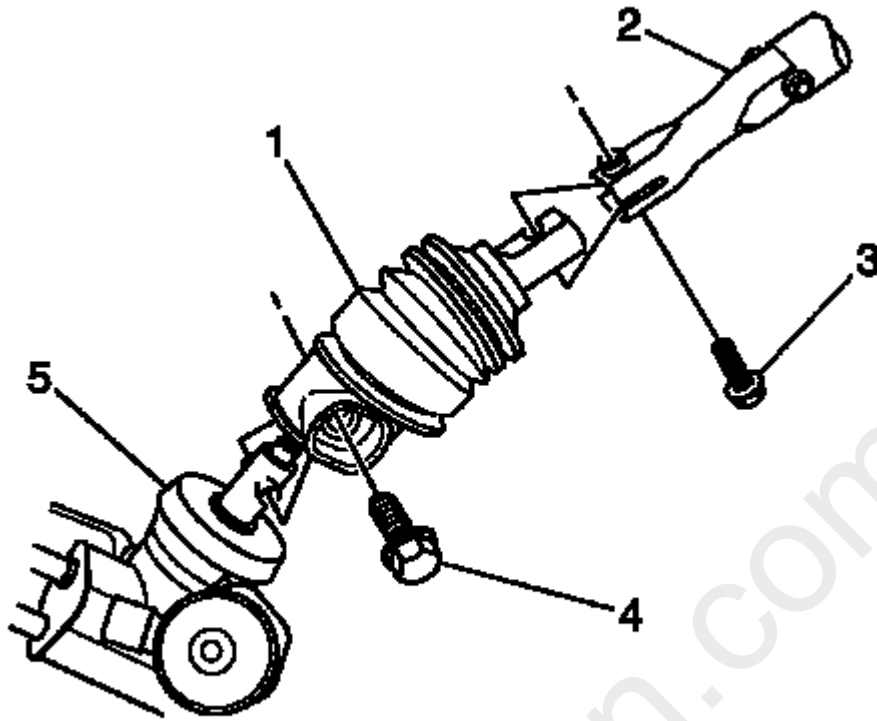


Fig. 276: View Of Steering Column Intermediate Shafts
Courtesy of GENERAL MOTORS COMPANY

41. Remove lower intermediate steering shaft bolt (4) and separate the intermediate steering shaft from the steering gear.
42. Remove the headlamp leveling sensors. Refer to **Headlamp Leveling Front Suspension Height Sensor Replacement** .
43. Position a suitable powertrain table or engine lift table below the frame and engine.
44. Raise the lift table or lower the vehicle to support the frame and engine.

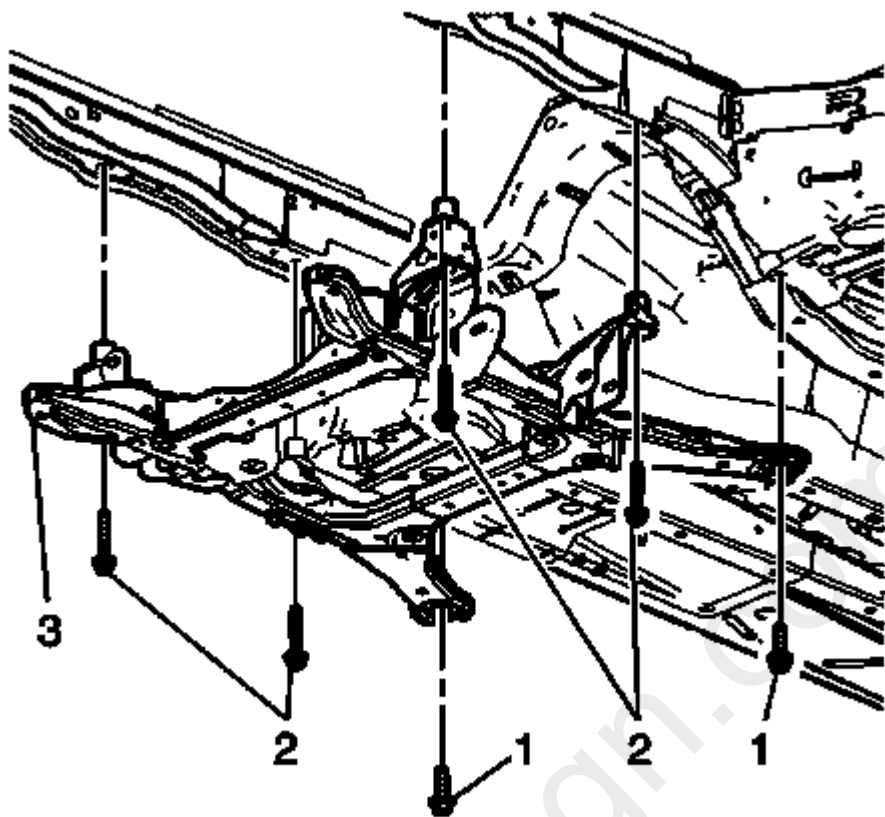


Fig. 277: Front Frame Bolts

Courtesy of GENERAL MOTORS COMPANY

45. Remove the front frame bolts (1, 2)

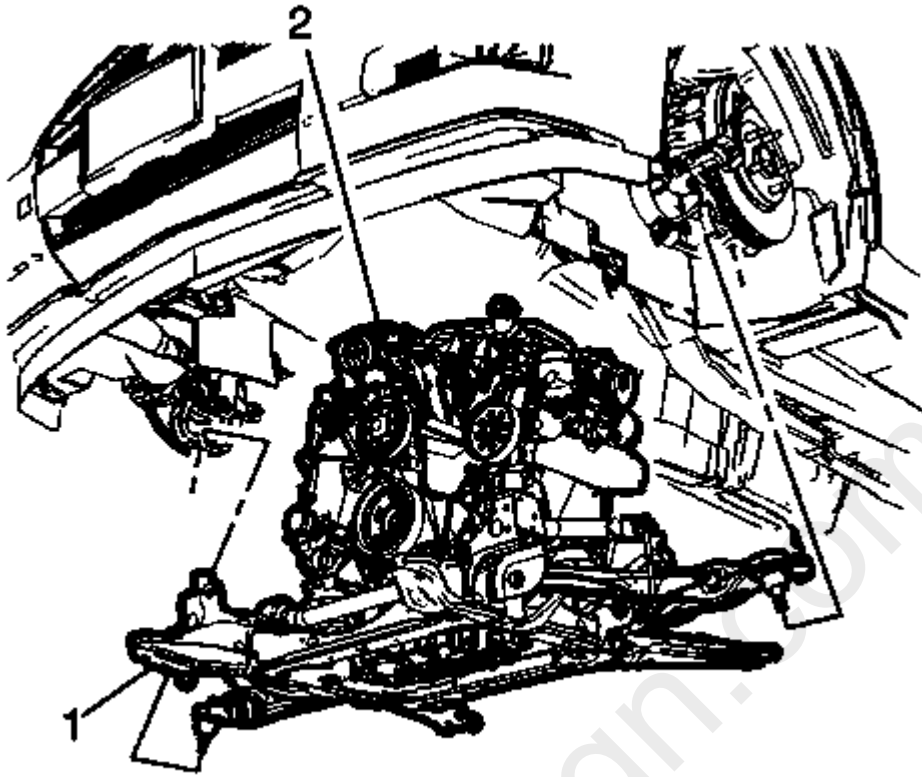


Fig. 278: Front Suspension Frame & Engine
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that all the remaining hoses, wires, and pipes clear the vehicle during the removal process.

46. With the aid of an assistant, lower the table or raise the vehicle to remove the engine (2), front drive axle and front suspension frame (1) from the vehicle.

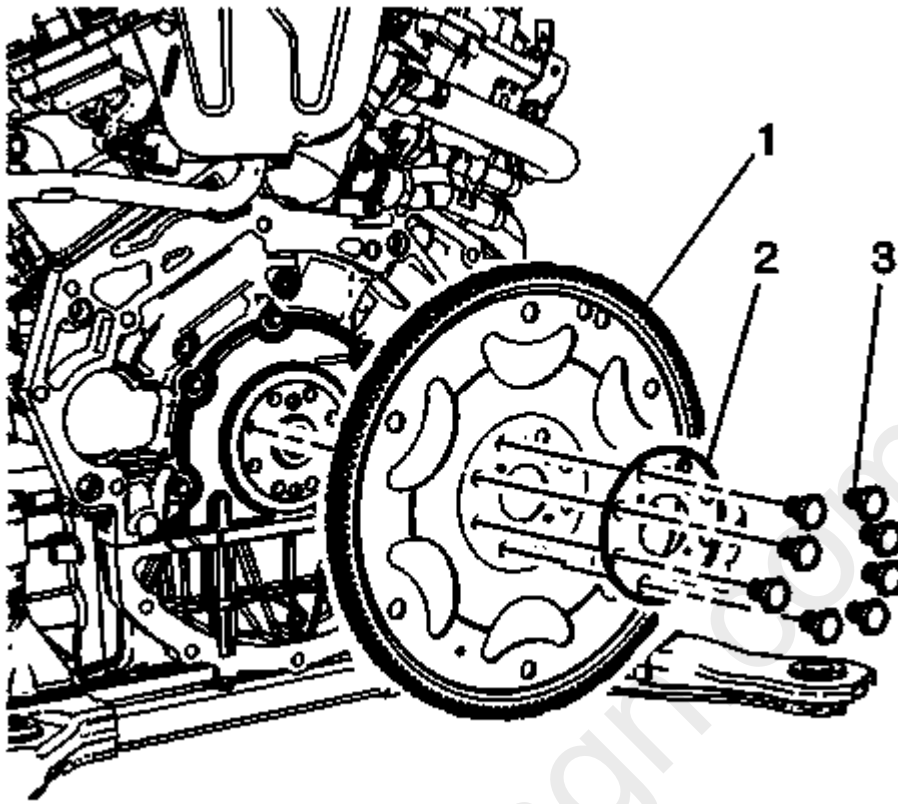


Fig. 279: Flex Plate & Bolts

Courtesy of GENERAL MOTORS COMPANY

47. Remove the flex plate bolts (3) and remove the automatic transmission flex plate (1, 2) from the engine.

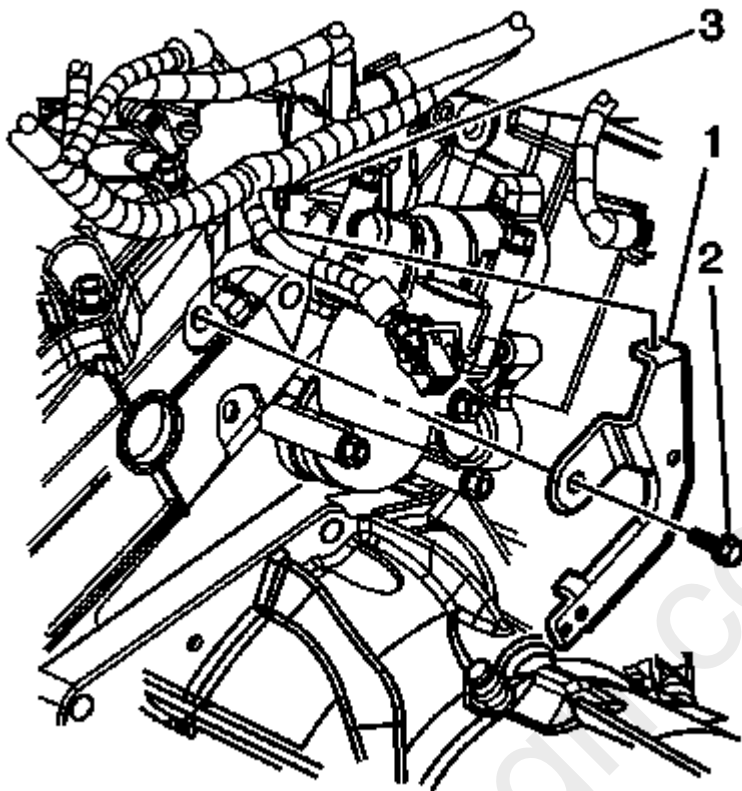


Fig. 280: View Of HO2S Connector Bracket
Courtesy of GENERAL MOTORS COMPANY

48. Remove the heated oxygen sensor connector bracket (1) from the left cylinder head.
49. Remove the engine wiring harness and related components.

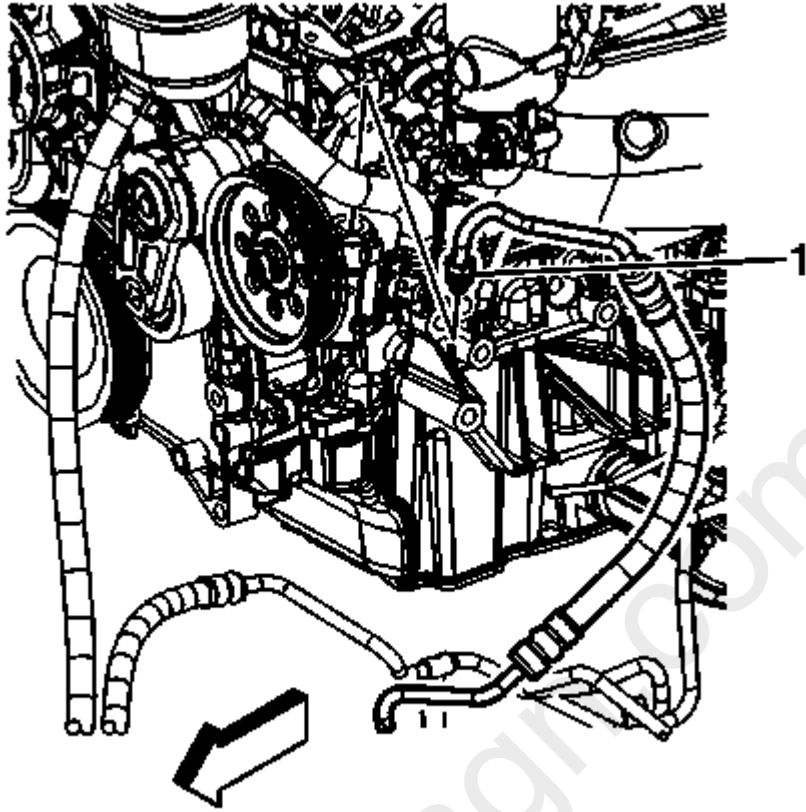


Fig. 281: Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

50. Disconnect the power steering gear inlet hose (1) from the power steering pump.

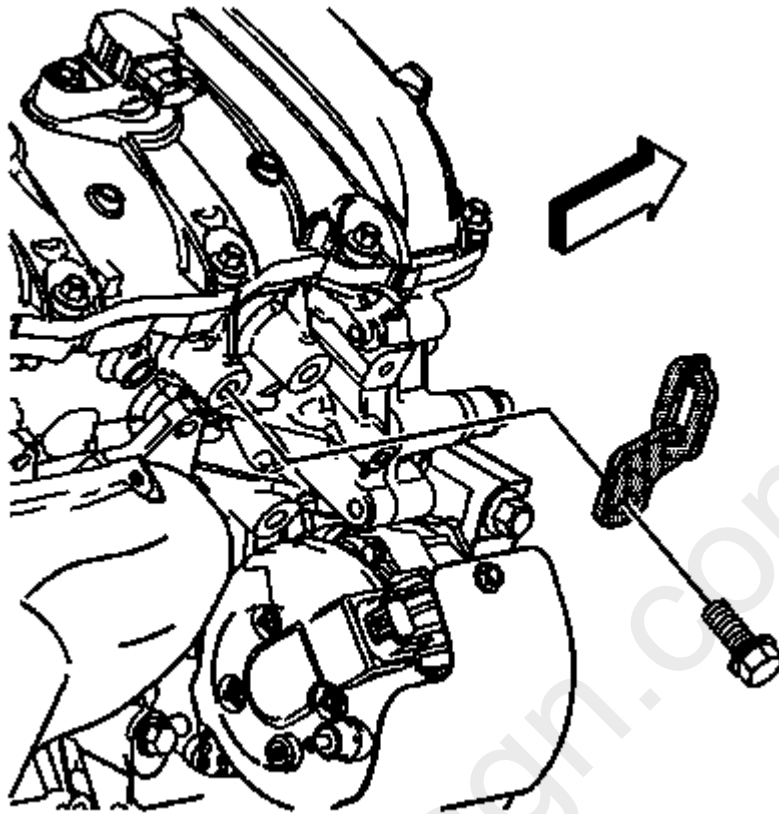


Fig. 282: View of Engine Lift Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

51. Install EN 46114 engine lift bracket to the engine and tighten the bolts to 65 N.m (48 lb ft).
52. Connect a engine hoist and lift chain to the engine lift brackets.
53. Raise the engine hoist enough to support the engine.

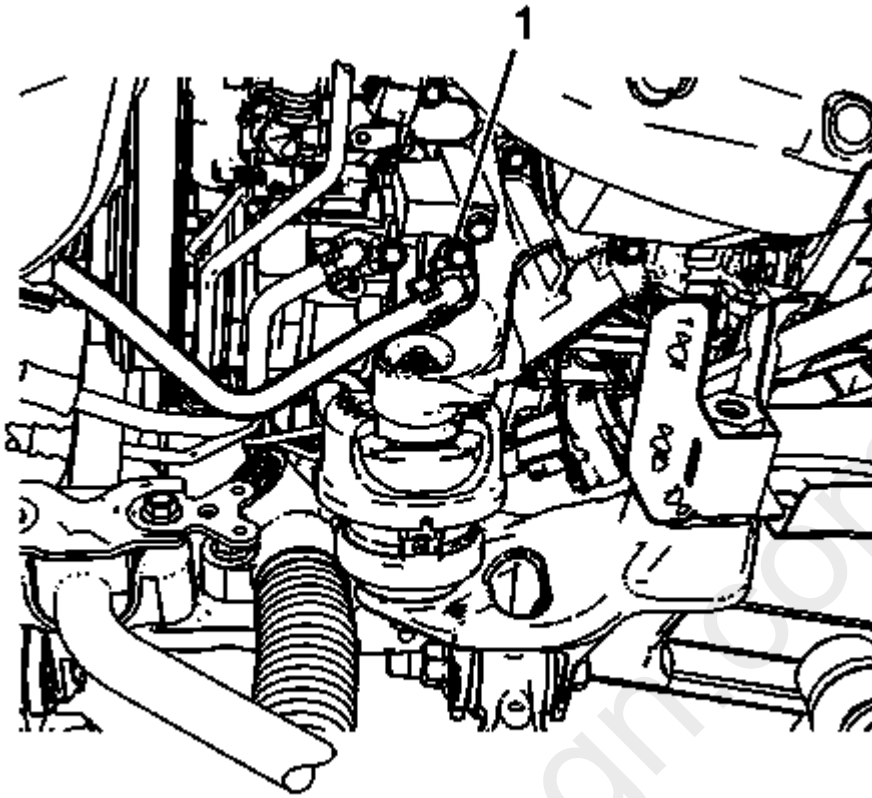


Fig. 283: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

54. Remove the engine mount to engine mount bracket nuts (1).
55. Use the engine hoist to raise the engine enough to clear the frame assembly.
56. Mount the engine to an engine stand.

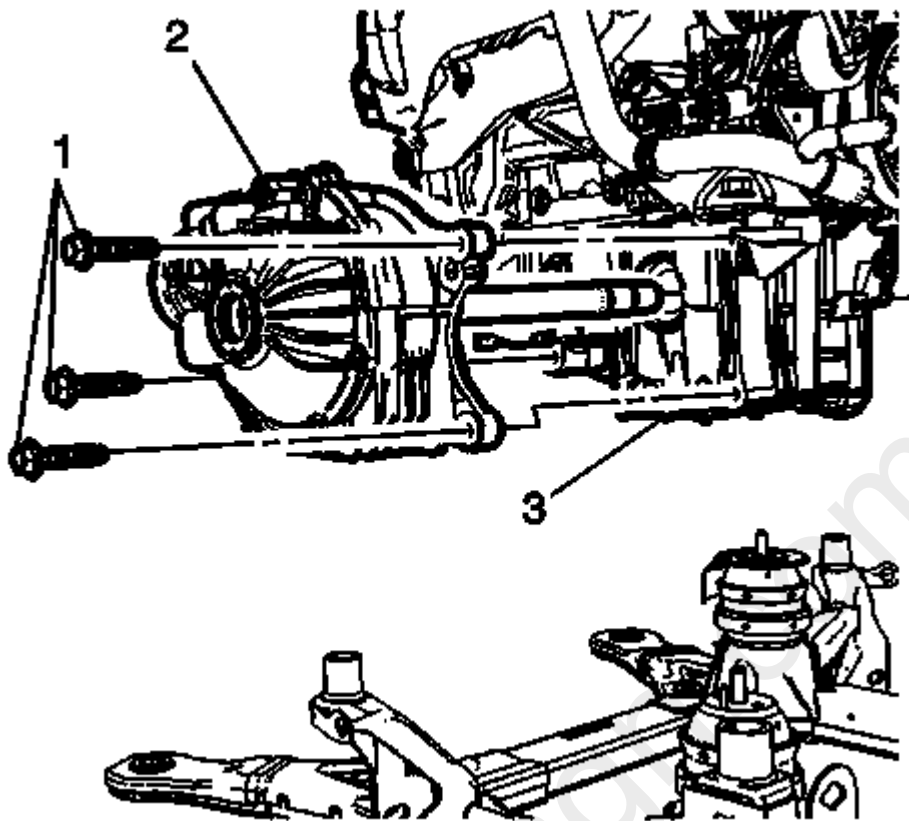


Fig. 284: Front Differential & Fasteners
Courtesy of GENERAL MOTORS COMPANY

57. Remove the three fasteners (1) in order to remove front differential (2) from the engine (3).
58. Remove the drive belts.

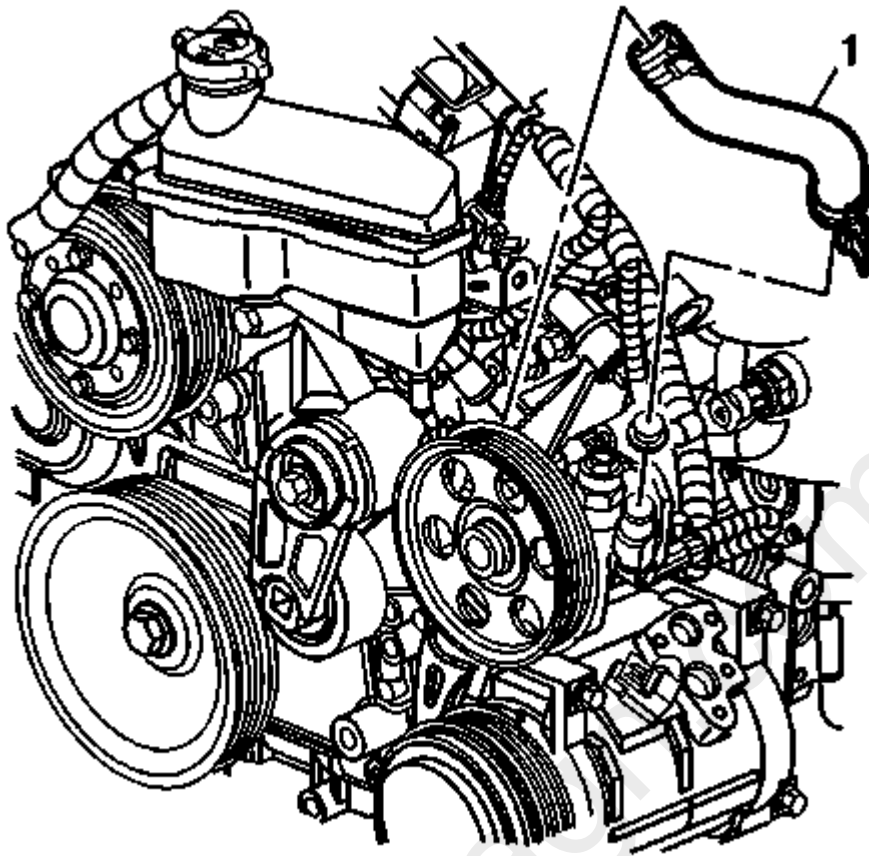


Fig. 285: Pump Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

59. Remove the steering reservoir to Pump outlet hose (1).

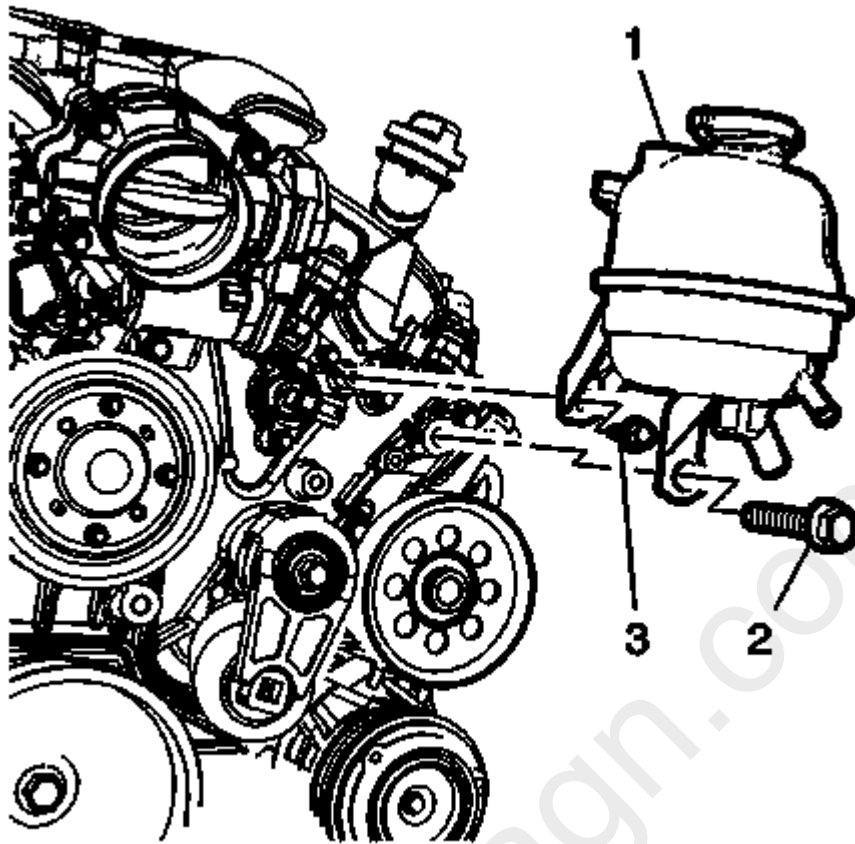


Fig. 286: Power Steering Reservoir & Fasteners
Courtesy of GENERAL MOTORS COMPANY

60. Remove the fasteners (2, 3) and the power steering reservoir (1) from the engine.

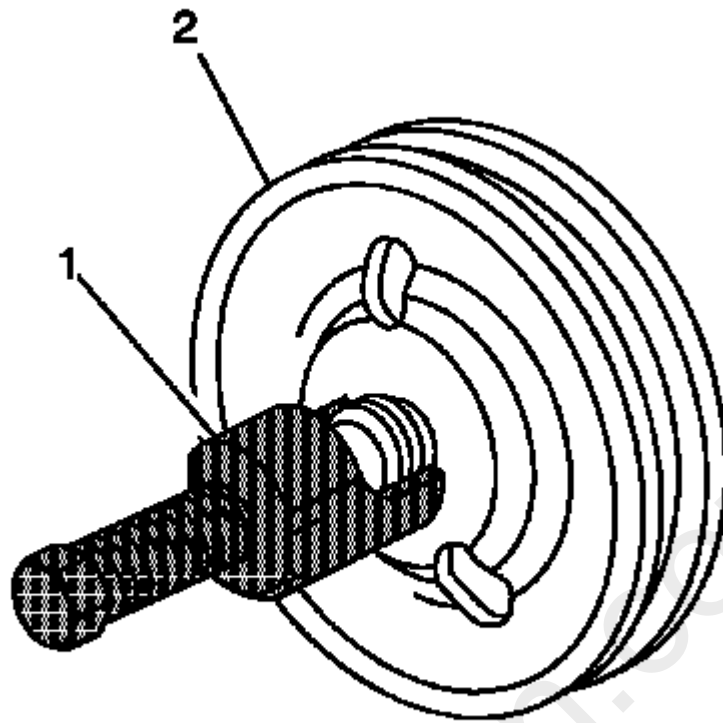


Fig. 287: View Of Power Steering Pump Pulley Remover
Courtesy of GENERAL MOTORS COMPANY

61. Remove the power steering pump pulley (2) using a power steering pulley remover (1).

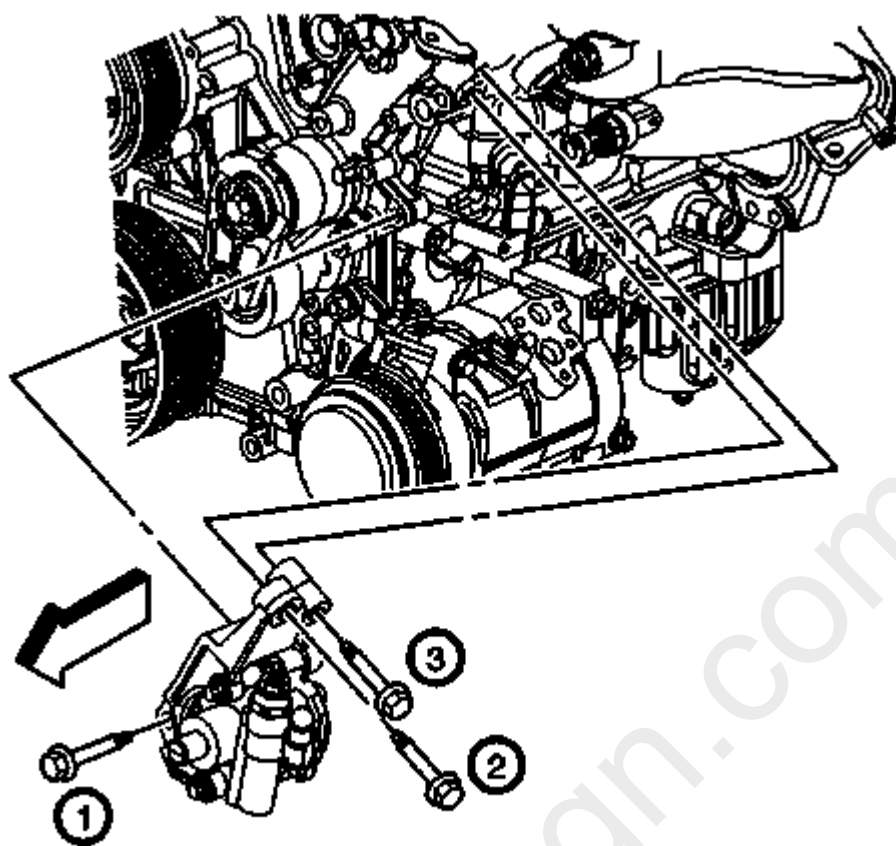


Fig. 288: View Of Power Steering Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

62. Remove the power steering pump fasteners (1, 2 and 3) and power steering pump.

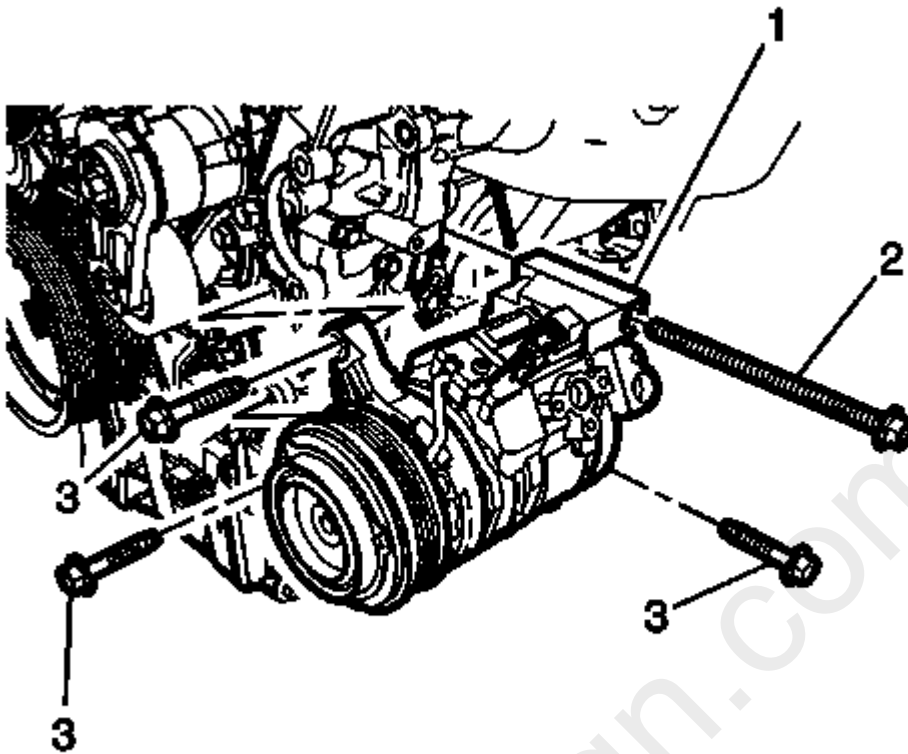


Fig. 289: A/C Compressor & Fasteners
Courtesy of GENERAL MOTORS COMPANY

63. Remove fasteners (2, 3) and the A/C compressor (1) from the engine.

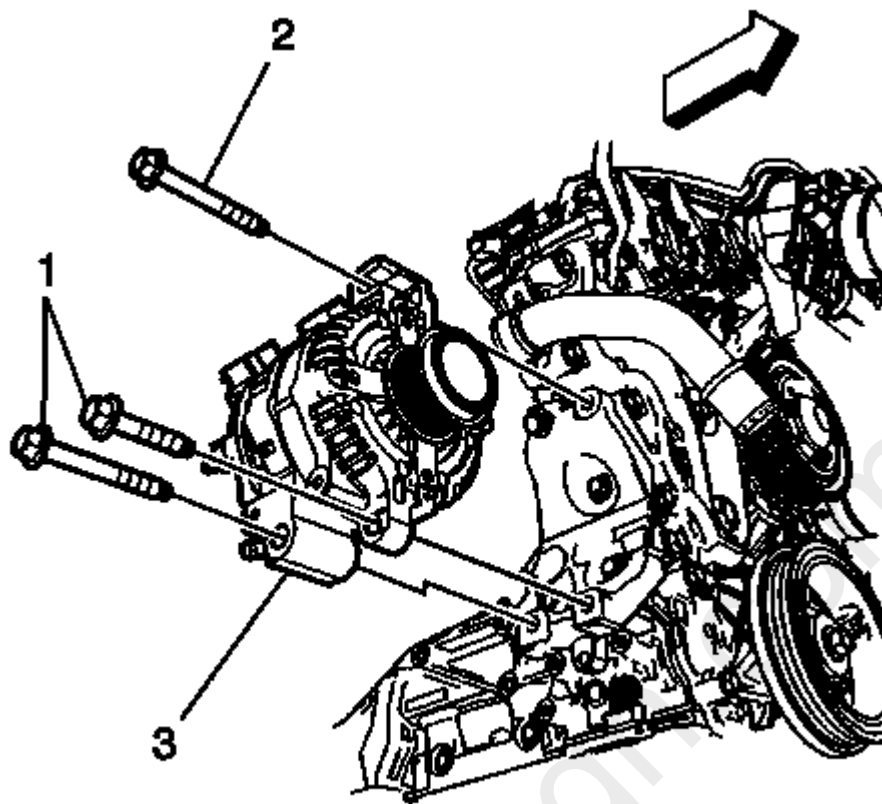


Fig. 290: Generator Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

64. Disconnect the electrical harness connectors from the generator.
65. Remove the bolts (1, 2) and remove the generator from the engine
66. Transfer any additional parts as necessary.

Installation Procedure

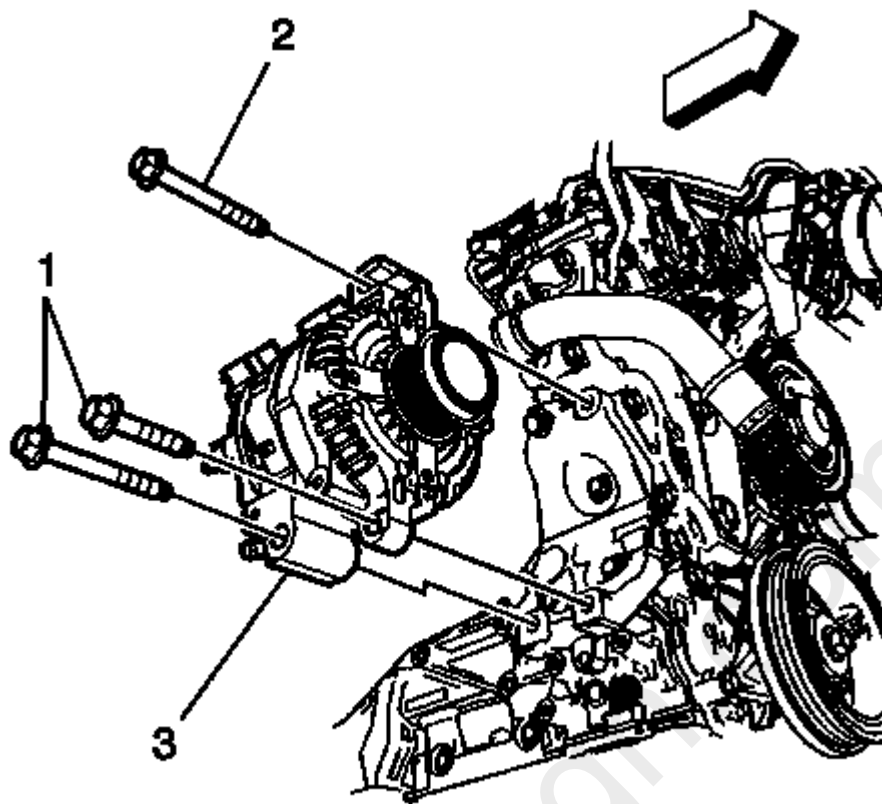


Fig. 291: Generator Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fasteners .

1. Install the generator to the engine. Refer to Fastener Tightening Specifications
2. Connect the electrical harness connectors to the generator.

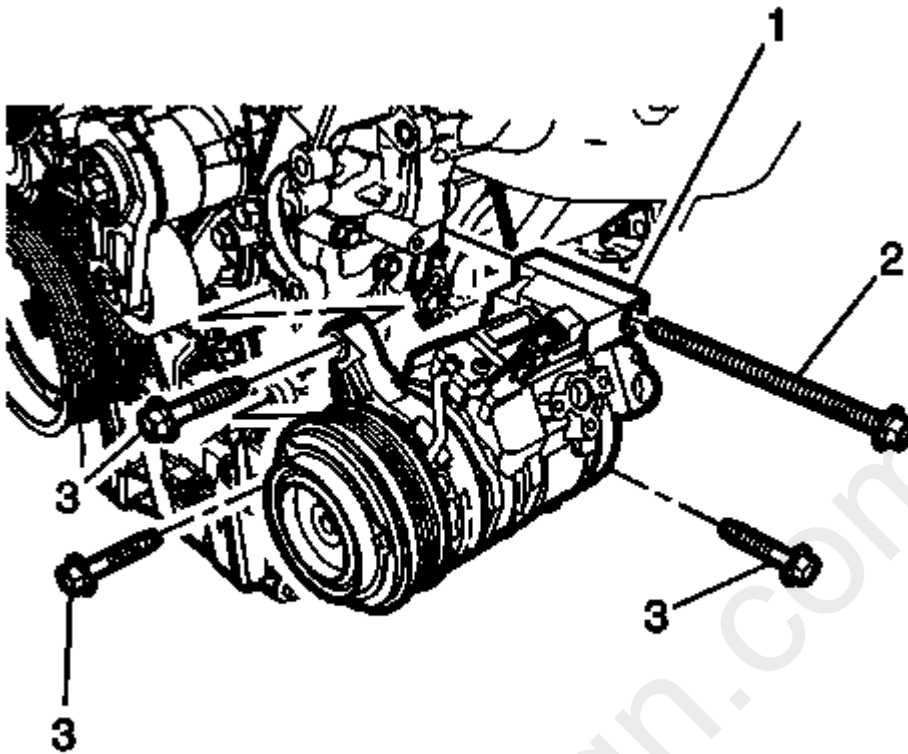


Fig. 292: A/C Compressor & Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Install the air conditioning compressor (1). Refer to **Fastener Tightening Specifications**

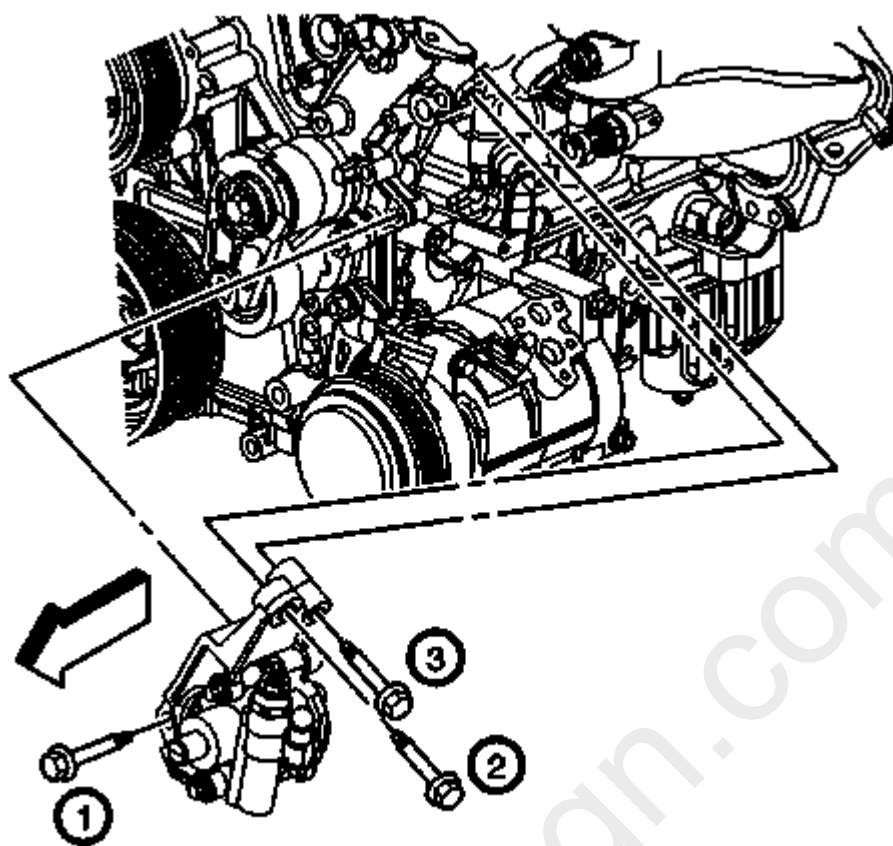


Fig. 293: View Of Power Steering Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the power steering pump to the engine using the torquing sequence shown. Refer to **Fastener Tightening Specifications**

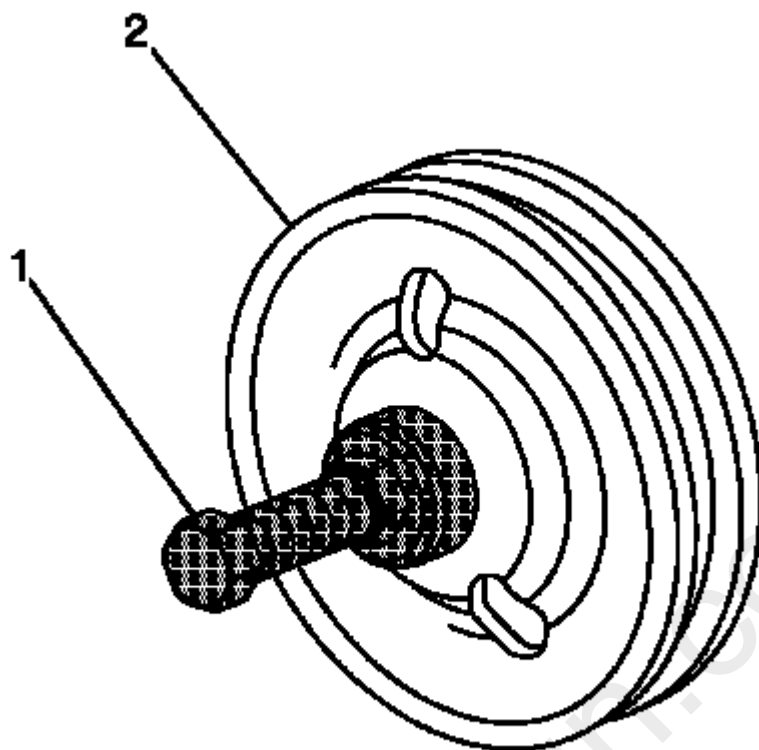


Fig. 294: View Of Power Steering Pump Pulley Installer
Courtesy of GENERAL MOTORS COMPANY

5. Install the power steering pump pulley (2) using a power steering pulley installer (1).

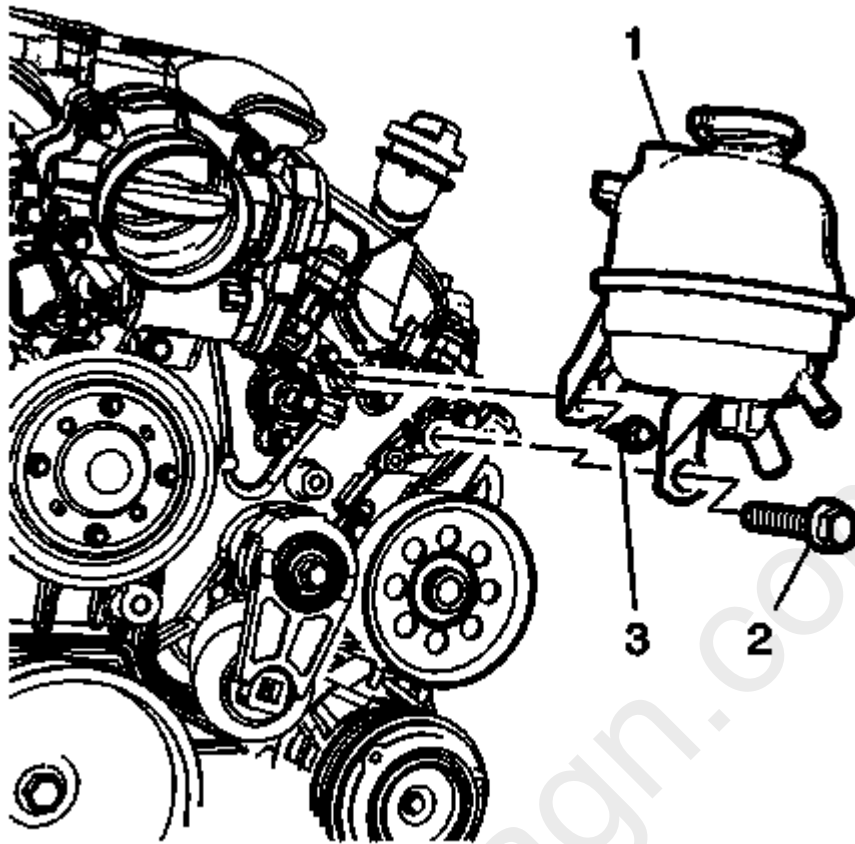


Fig. 295: Power Steering Reservoir & Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Install the power steering reservoir (1). Refer to **Fastener Tightening Specifications**

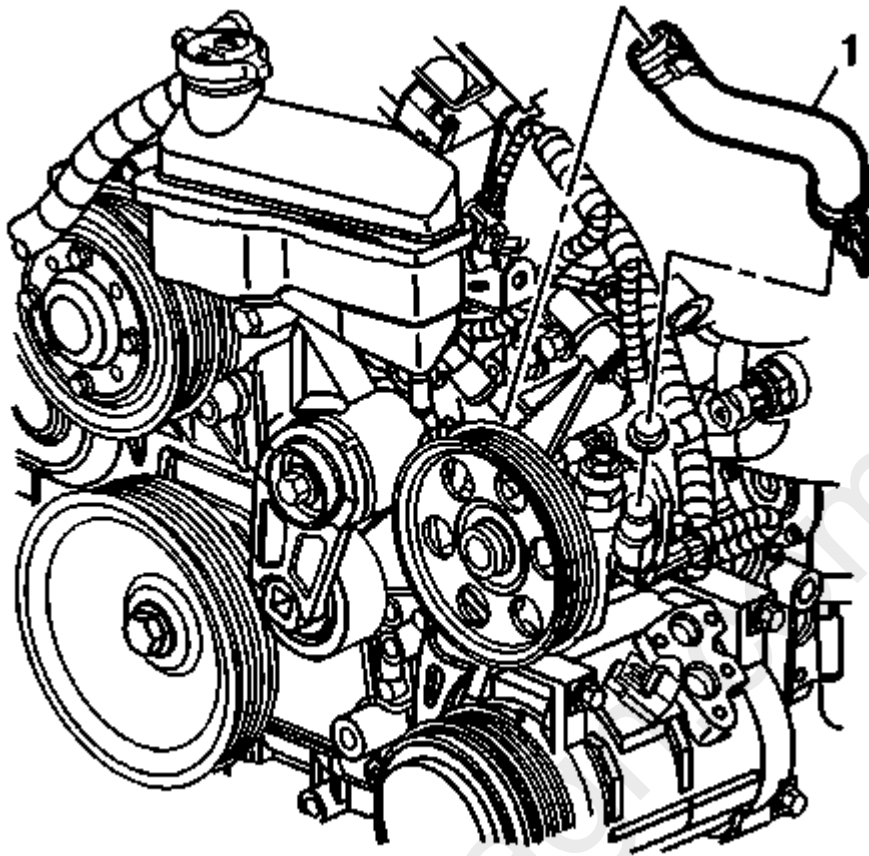


Fig. 296: Pump Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install the power steering reservoir to power steering pump hose (1).
8. Install the drive belts.

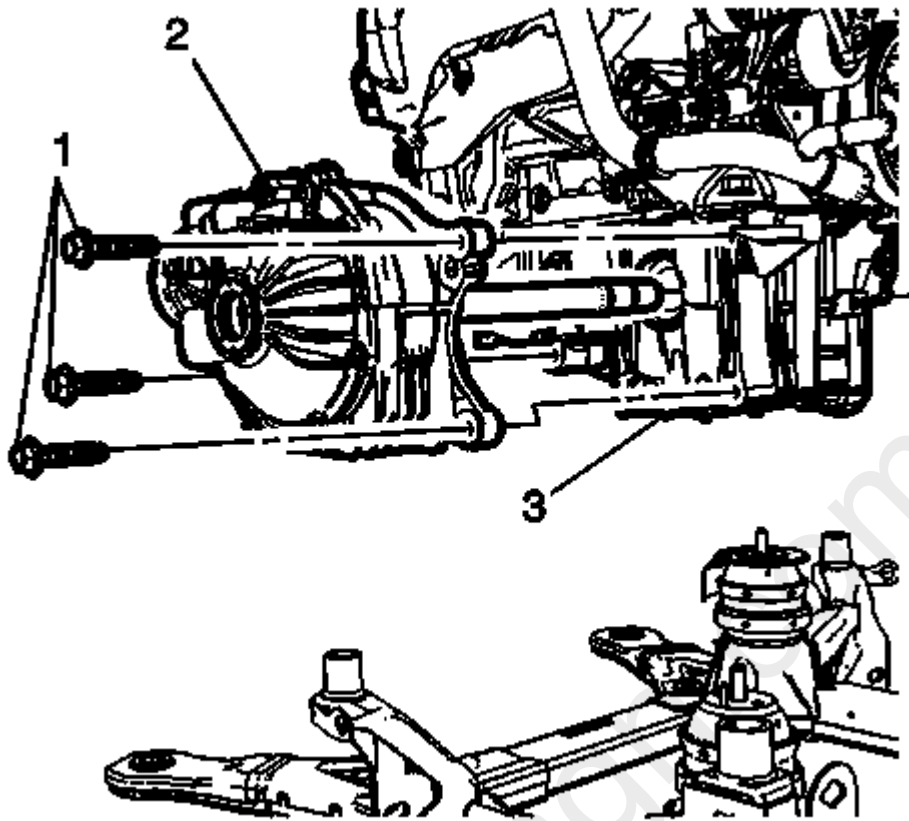


Fig. 297: Front Differential & Fasteners
Courtesy of GENERAL MOTORS COMPANY

9. Install the differential carrier assembly (2) to the engine (3). Refer to **Fastener Tightening Specifications**
10. Use an engine hoist to remove the engine from the engine stand.

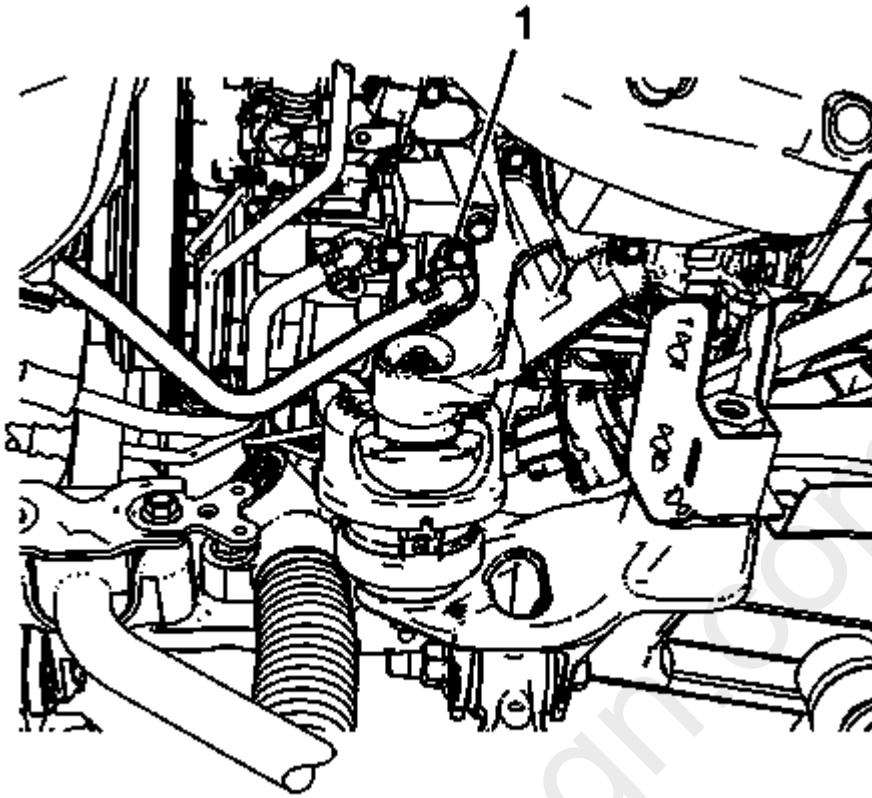


Fig. 298: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Position the engine to the front and rear engine mounts on the front suspension frame and tighten the engine mount bracket nuts to 80 N.m (59 lb ft).

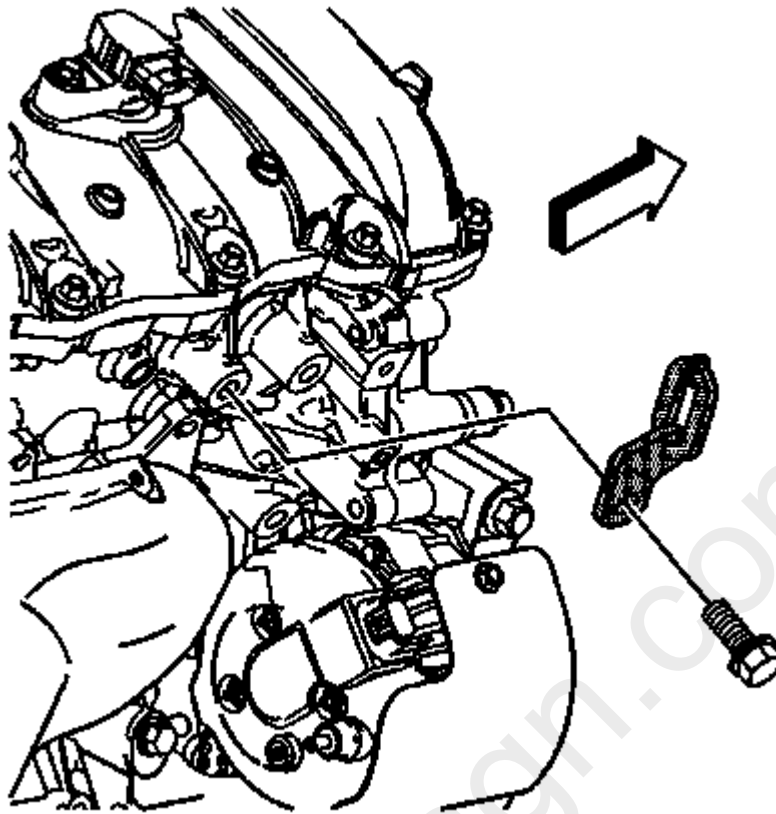


Fig. 299: View of Engine Lift Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

12. Remove the engine hoist and the EN 46114 engine lift bracket from the engine.

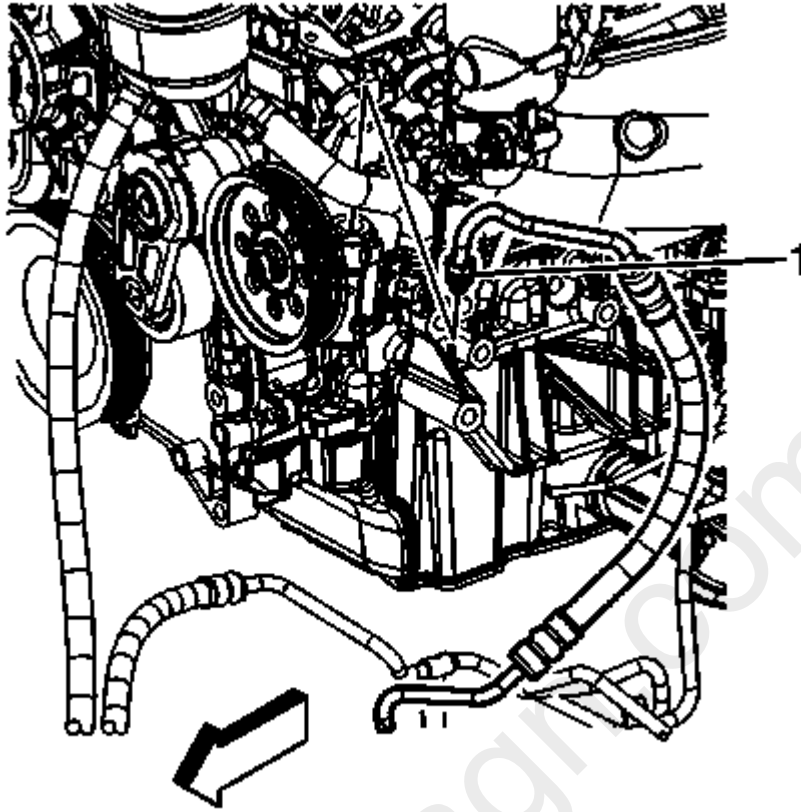


Fig. 300: Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Connect the power steering gear inlet hose (1) to the power steering pump. Refer to **Fastener Tightening Specifications**
14. Connect the engine wiring harness to related components.

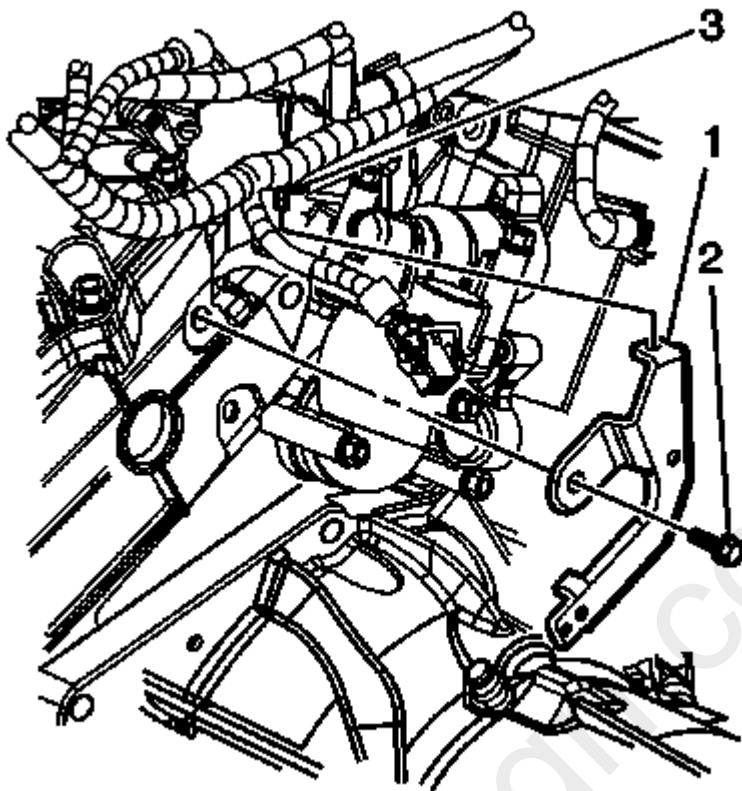


Fig. 301: View Of HO2S Connector Bracket
Courtesy of GENERAL MOTORS COMPANY

15. Install the heated oxygen sensor (HO2S) connector bracket (1) to the left cylinder.

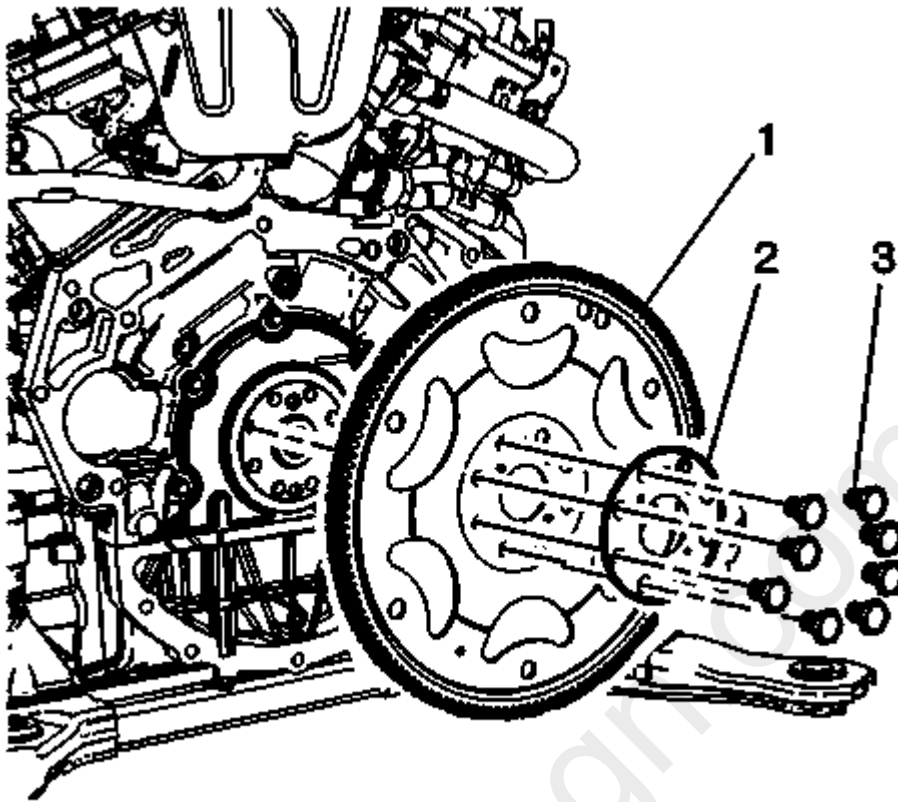


Fig. 302: Flex Plate & Bolts

Courtesy of GENERAL MOTORS COMPANY

16. Install the automatic transmission flex plate (1) spacer (2) to the engine and tighten the bolts (3) to 30 N.m (22 lb ft) plus 45 degrees.

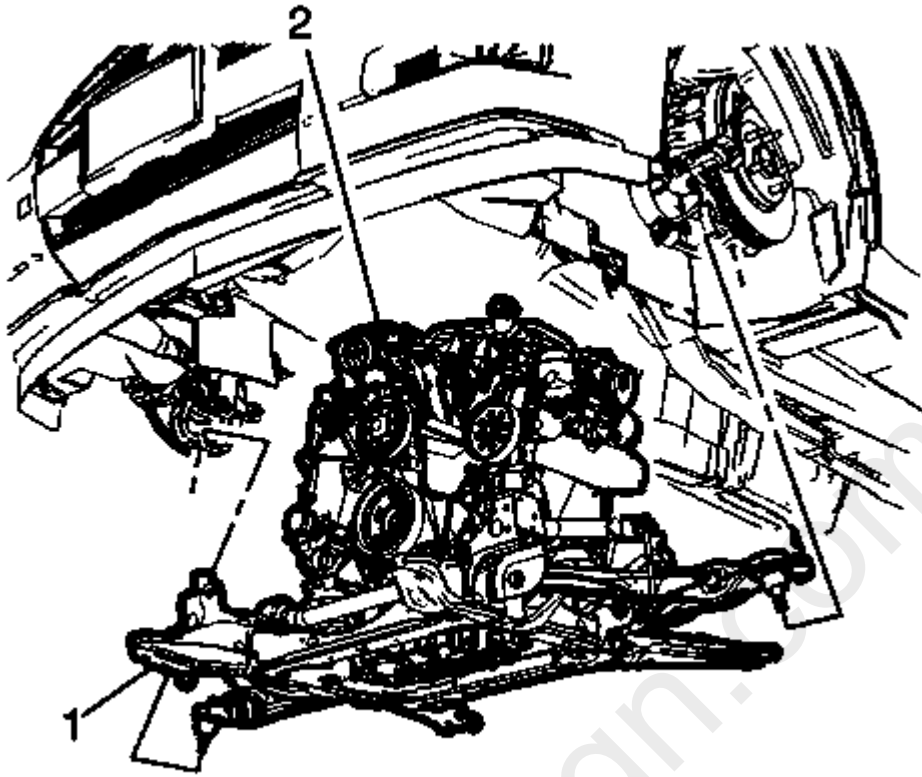


Fig. 303: Front Suspension Frame & Engine
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that all the hoses, wires, and pipes clear the vehicle during the installation process.

17. With the aid of an assistant, raise the table or lower the vehicle to position the engine (2), front drive axle and front suspension frame (1) into the vehicle.

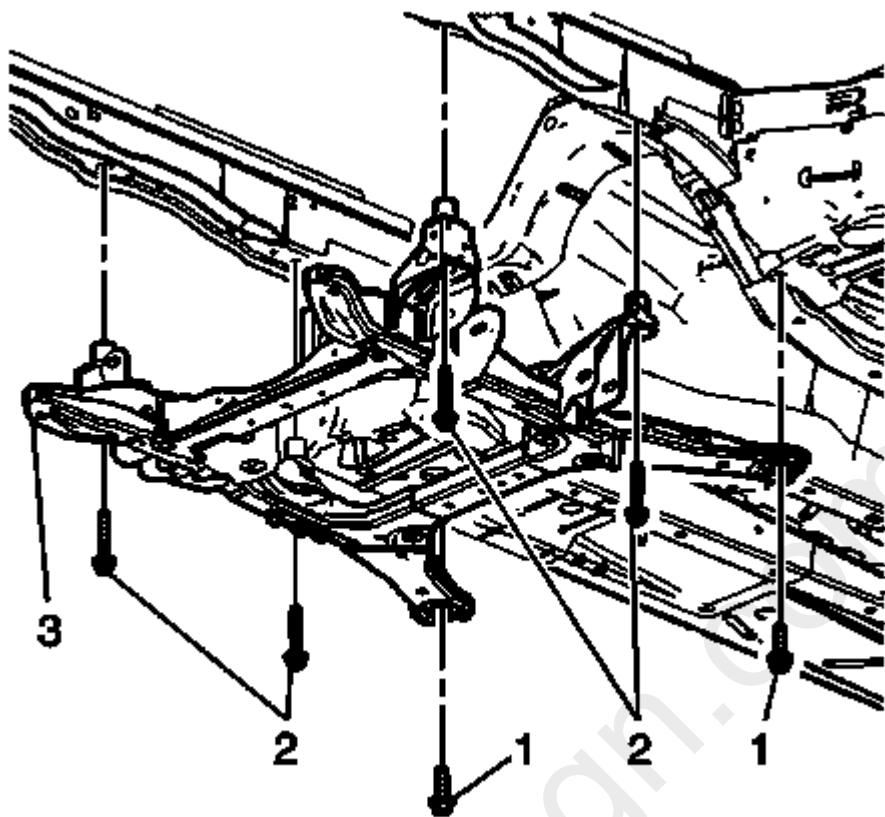


Fig. 304: Front Frame Bolts

Courtesy of GENERAL MOTORS COMPANY

18. Install the front frame bolts (1, 2). Refer to **Fastener Tightening Specifications**
19. Remove the powertrain table or engine lift table.
20. Install the headlamp leveling sensors. Refer to **Headlamp Leveling Front Suspension Height Sensor Replacement** .

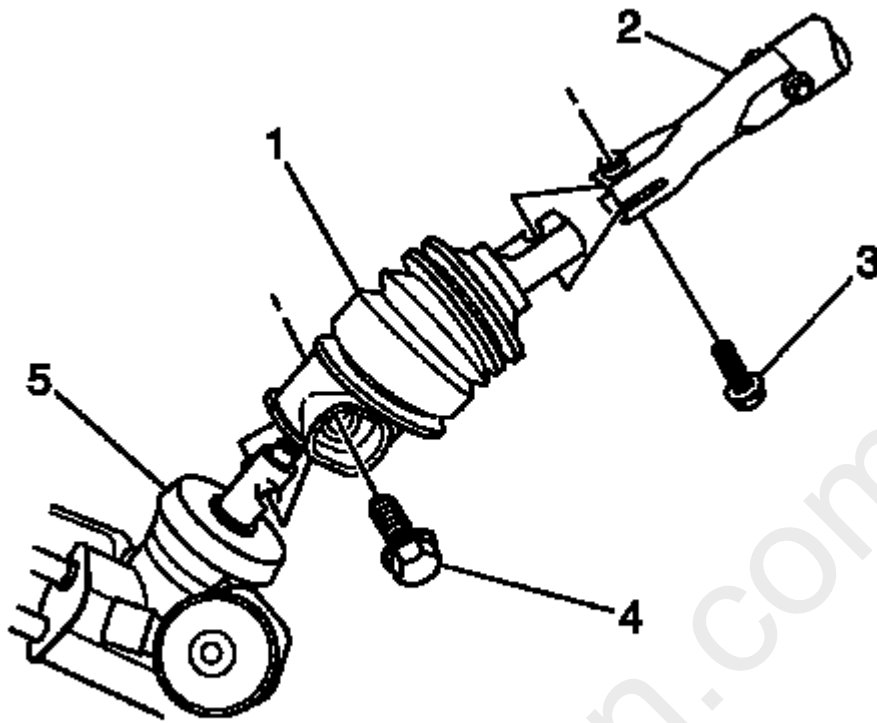


Fig. 305: View Of Steering Column Intermediate Shafts
Courtesy of GENERAL MOTORS COMPANY

21. Connect the intermediate steering shaft (1) to the steering gear (5). Refer to **Fastener Tightening Specifications**

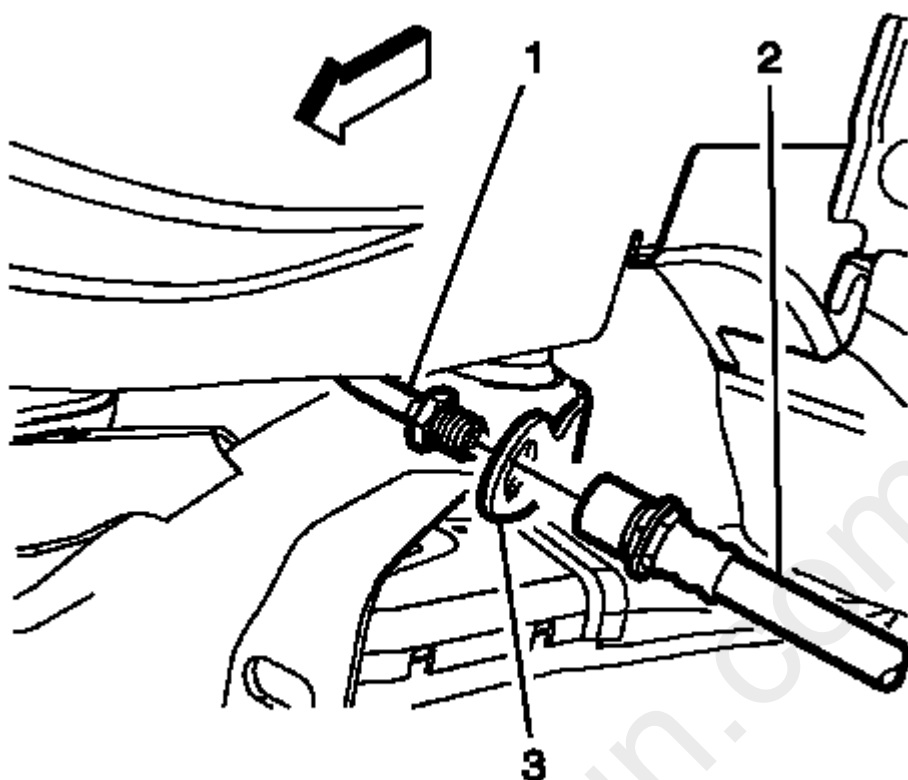


Fig. 306: Front Brake Hoses, Pipes & Brackets
Courtesy of GENERAL MOTORS COMPANY

22. Connect the front brake hoses (2) to the front brake pipes (1) and brackets (3).

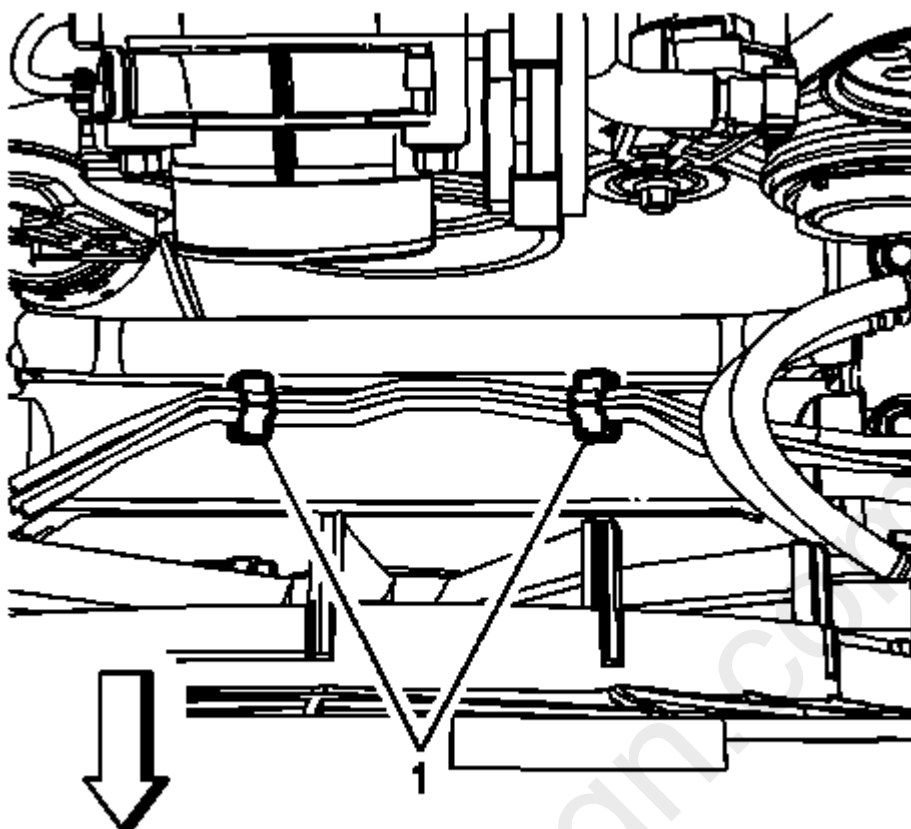


Fig. 307: Front Cross Brake Line Frame Clips
Courtesy of GENERAL MOTORS COMPANY

23. Connect the front cross brake lines to the frame.

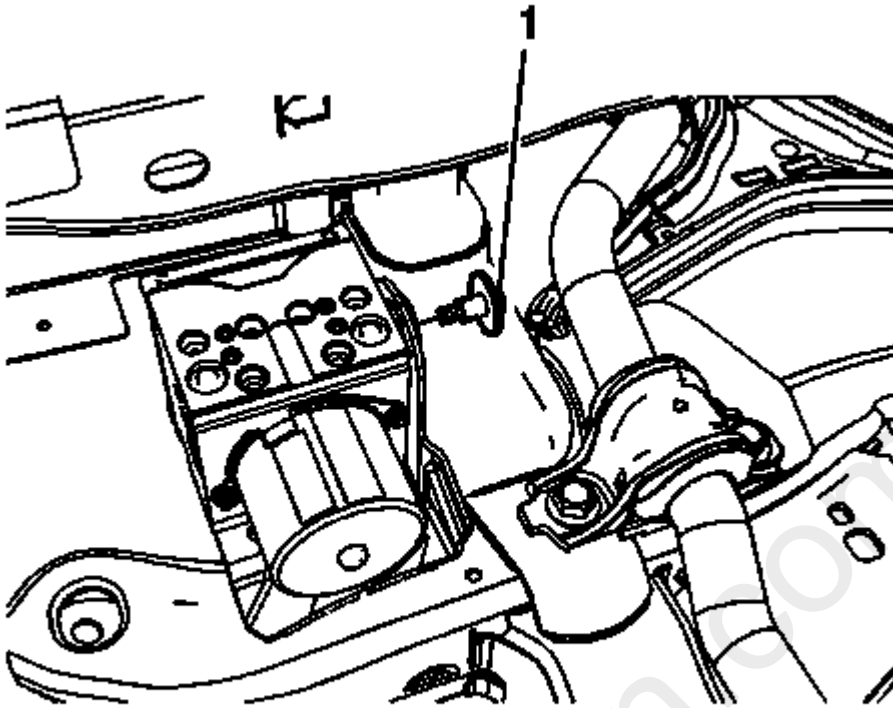


Fig. 308: Identifying BPMV Bolt
Courtesy of GENERAL MOTORS COMPANY

24. Install the bolt (1) retaining the brake pressure modulator valve (BPMV) to the bracket. For torque specifications refer to **Fastener Tightening Specifications**
25. Connect the front brake hoses to the front brake pipes and brackets.
26. Install the windshield washer solvent container and bracket. Refer to **Windshield Washer Solvent Container Replacement (Without CE4)** , **Windshield Washer Solvent Container Replacement (With CE4)** .
27. Install the front air deflector. Refer to **Front Air Deflector Replacement** .

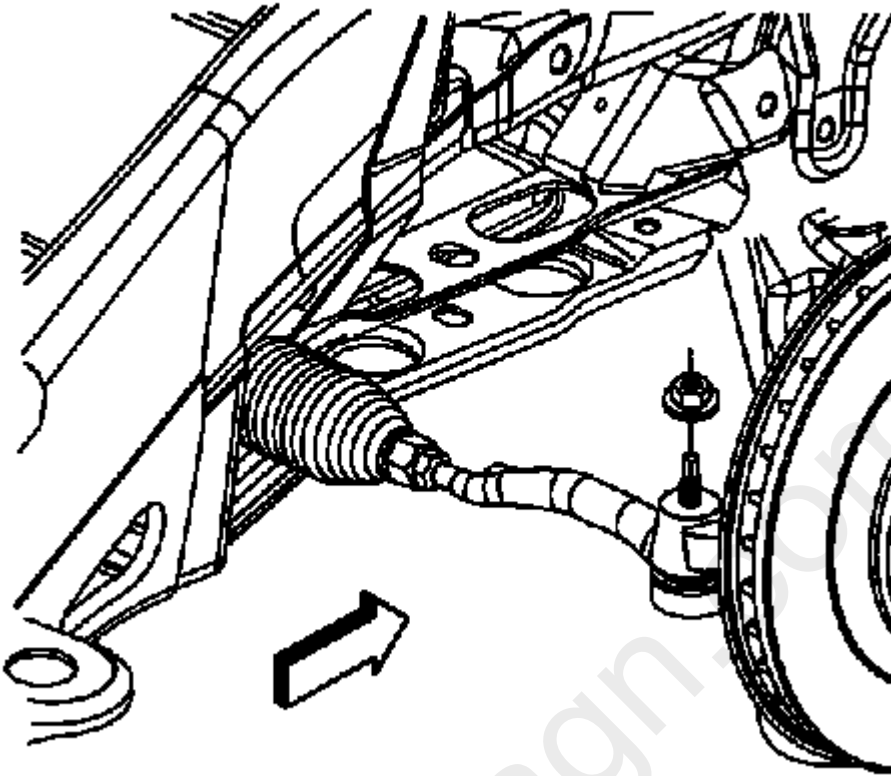


Fig. 309: View Of Tie Rod Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

28. Install the steering linkage outer tie rods to the steering knuckles. Refer to **Fastener Tightening Specifications**
29. Install the left front wheel driveshaft and front wheel drive intermediate shaft bearing. Refer to **Front Wheel Drive Intermediate Shaft Bearing Replacement** .
30. Install the right front wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .
31. Install the transmission. Refer to **Transmission Replacement (All Wheel Drive)** .

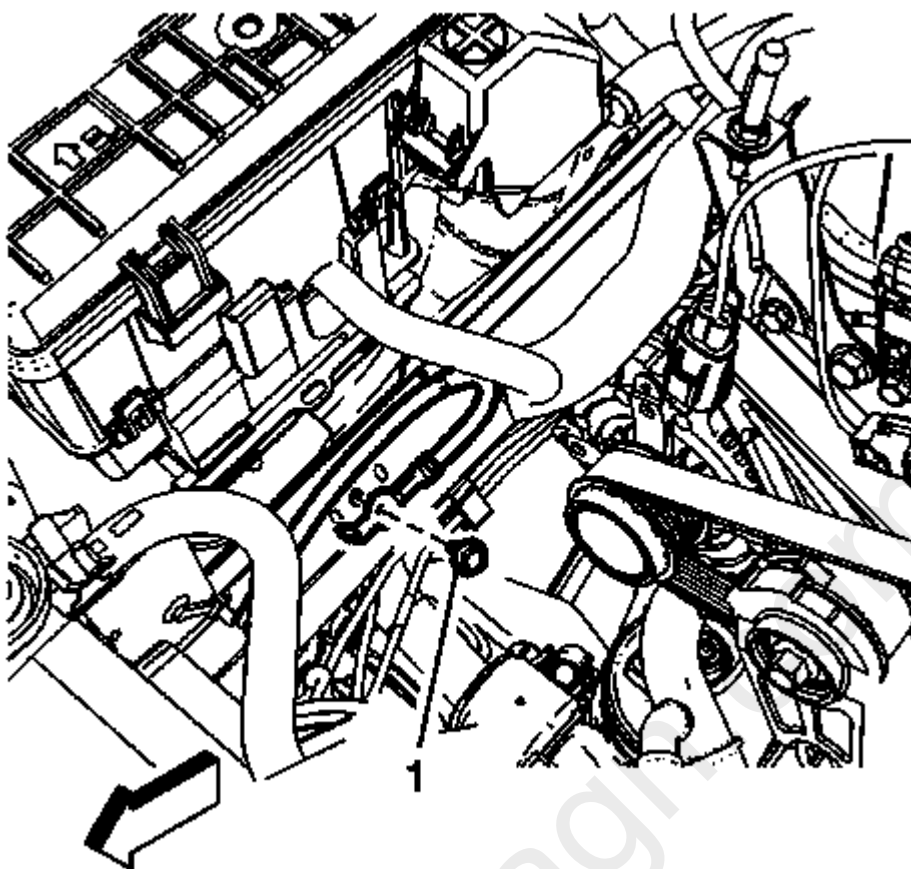


Fig. 310: Longitudinal Rail Bolt
Courtesy of GENERAL MOTORS COMPANY

32. Connect the ground wire to the longitudinal rail and tighten the bolt (1) to 10 N.m (89 lb in).
33. Install the right side engine harness to valve cover retaining clips.
34. Install the left side engine harness to valve cover retaining clips.

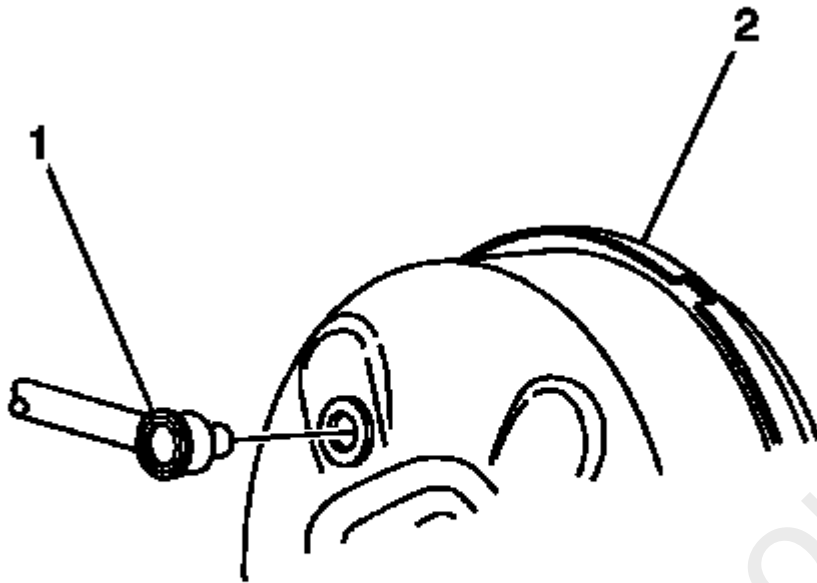


Fig. 311: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS COMPANY

35. Connect the brake booster check valve and vacuum hose (1) to the brake booster (2).
36. Connect all engine harness electrical connectors. Refer to **Powertrain Component Views** , and **Harness Routing Views** .
37. Connect the air conditioning evaporator tube at the condenser.
38. Connect the air conditioning pressure switch harness connector.
39. Connect the air conditioning suction hose to the evaporator and shock tower bracket.

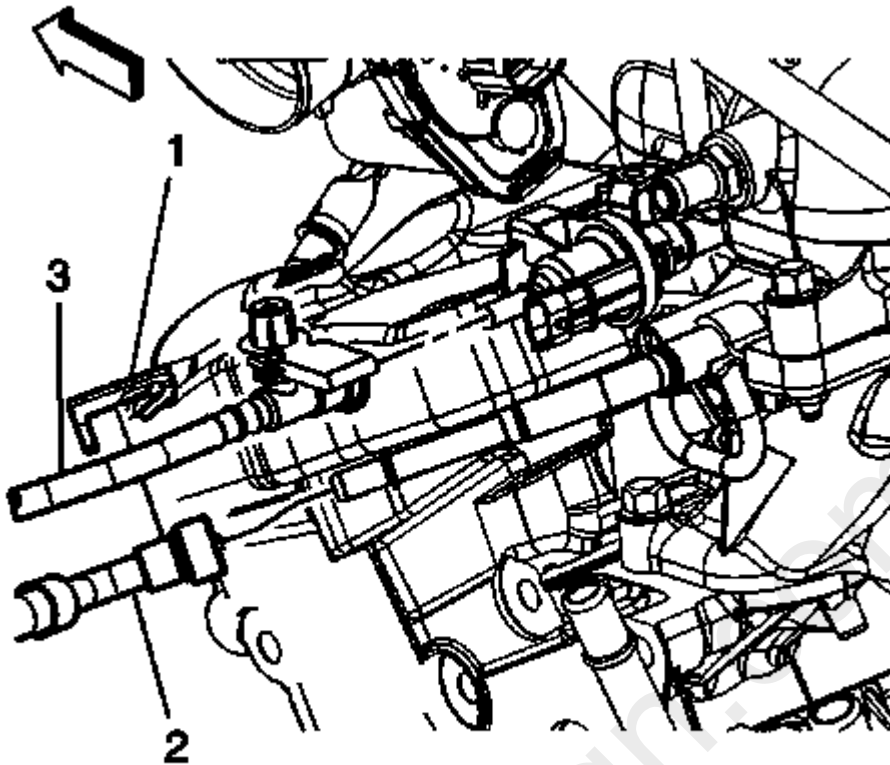


Fig. 312: View Of EVAP Pipe

Courtesy of GENERAL MOTORS COMPANY

40. Connect the fuel pipe (2) to the fuel feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
41. Connect the purge pipe to the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .

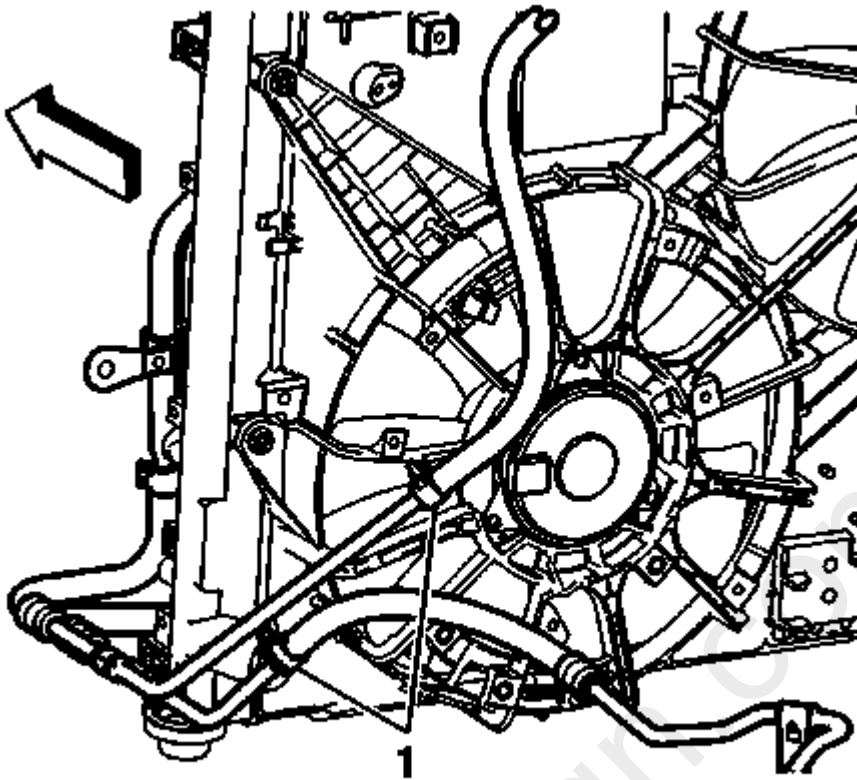


Fig. 313: Identifying Power Steering Hoses
Courtesy of GENERAL MOTORS COMPANY

42. Connect the power steering cooler hoses (1) to the power steering cooler at the condenser radiator and fan module (CRFM).

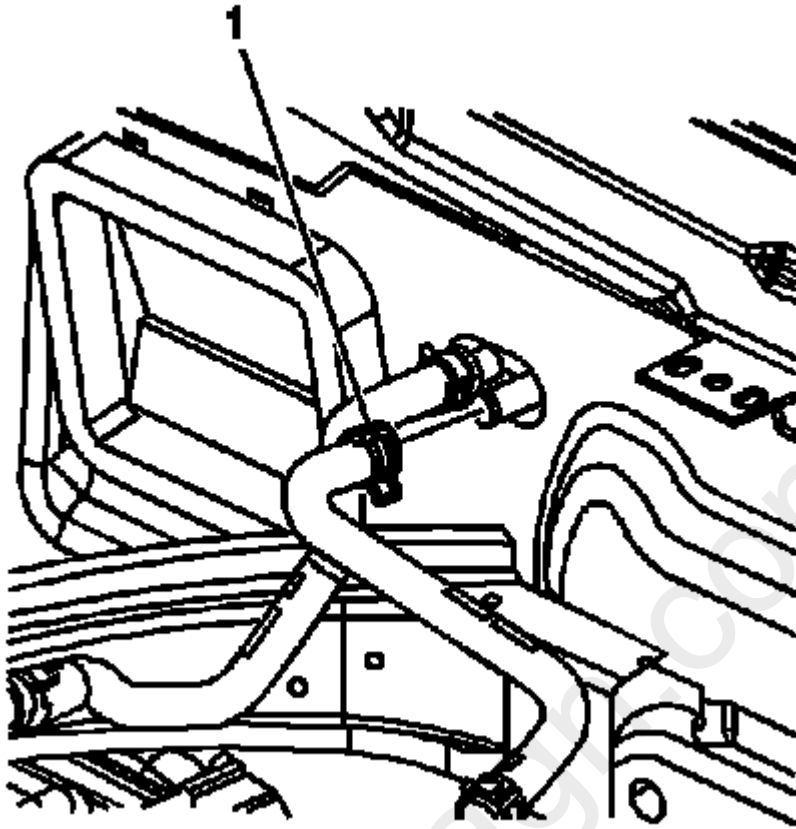


Fig. 314: Identifying Inlet Heater Hose
Courtesy of GENERAL MOTORS COMPANY

43. Connect the heater inlet heater hose (1) to the heater core.

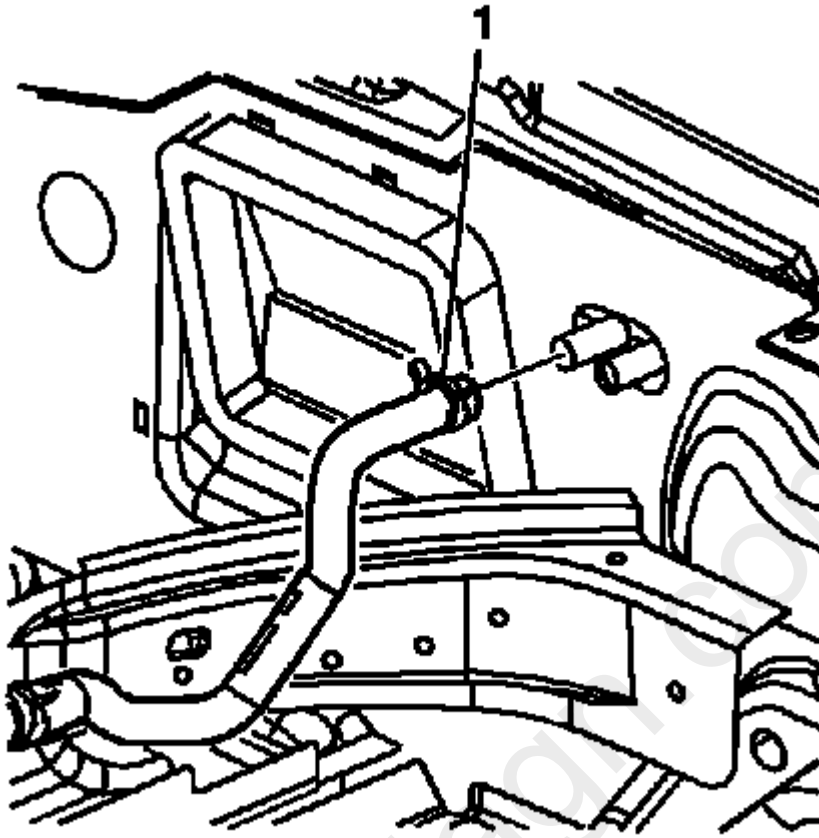


Fig. 315: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

44. Connect the heater outlet heater hose (1) to the heater core.
45. Install the radiator inlet and outlet hose. Refer to **Radiator Inlet Hose Replacement (LFW or LFX)** , and **Radiator Outlet Hose Replacement (LFX or LFW)** .

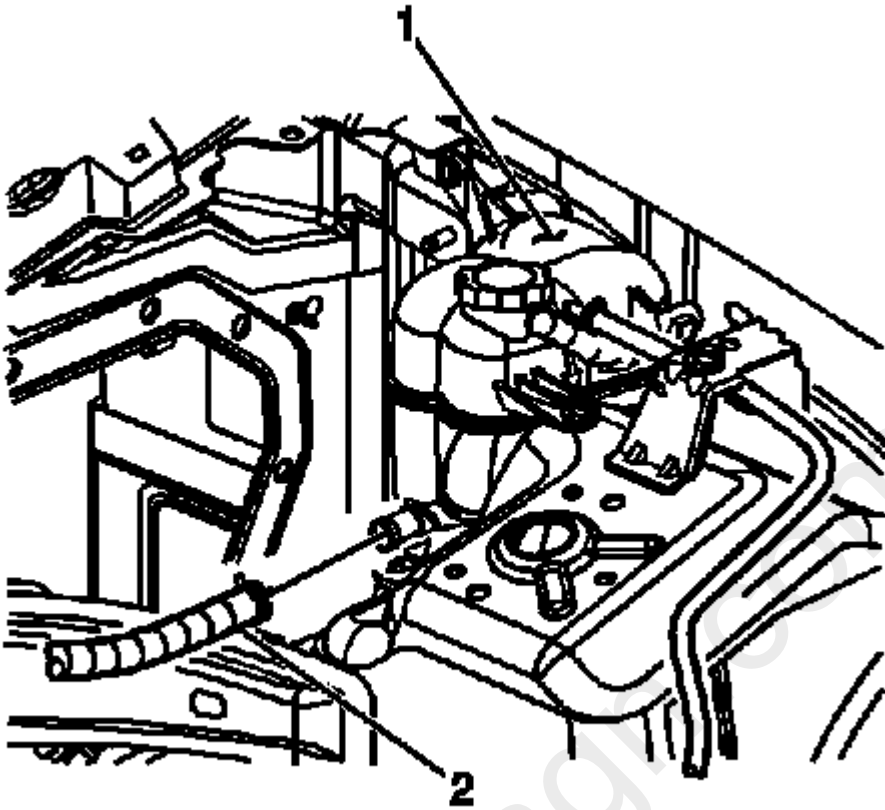


Fig. 316: Locating Surge Tank & Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

46. Connect the surge tank outlet hose (2) to the surge tank (1).
47. Connect the surge tank inlet hose to the water outlet.
48. Install the wiper module. Refer to **Windshield Wiper Transmission Replacement** .
49. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

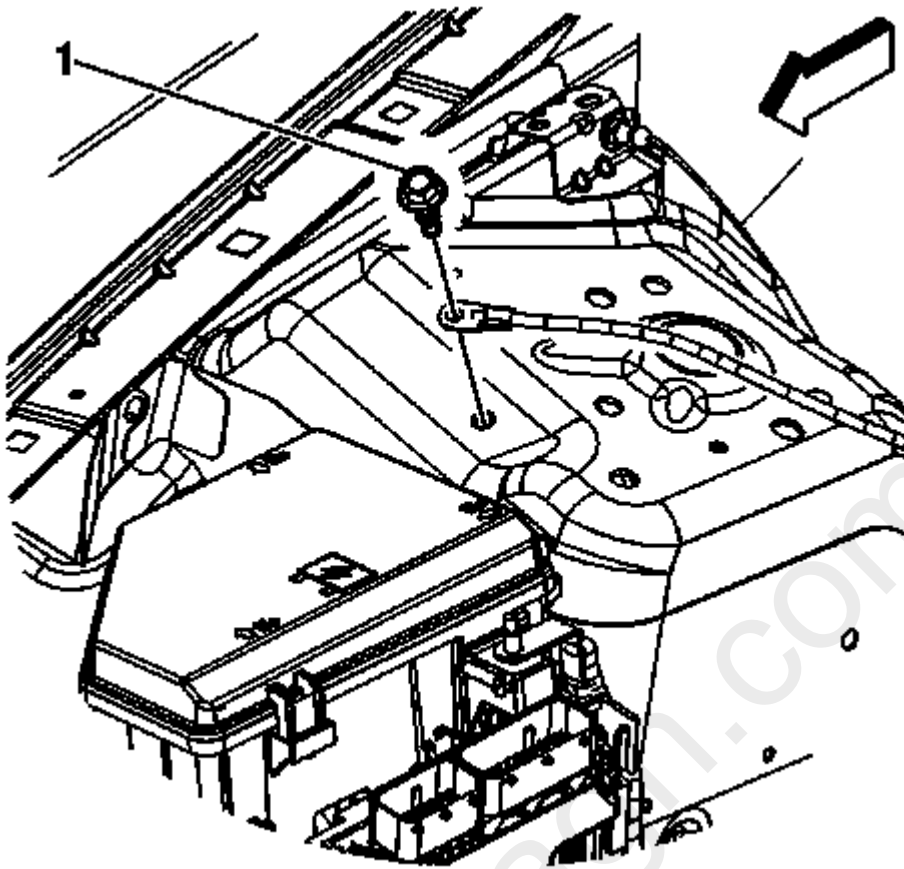


Fig. 317: Identifying Battery Negative Cable Ground Bolt
 Courtesy of GENERAL MOTORS COMPANY

50. Install the bolt (1) retaining the battery negative cable extension cable to the right strut tower. Refer to , **Battery Negative Cable Extension Cable Replacement (3.0L,3.6L)** .
51. Install the intake manifold in insulator. Refer to **Intake Manifold Insulator Replacement** .
52. Install the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
53. Install the front compartment sight shields. Refer to **Front Compartment Sight Shields Replacement** .
54. Install the front compartment side sight shields. Refer to **Front Compartment Side Sight Shield Replacement** .
55. Connect the negative cable from the battery and the body at the top of the right strut tower. Refer to **Battery Negative Cable Replacement** .
56. Perform the following steps with the engine OFF:
 1. Check the oil level and fill as necessary.
 2. Fill the cooling system. Refer to Cooling System Draining and Filling. **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .
 3. Fill and Bleed the power steering system. Refer to **Power Steering System Bleeding** .
 4. Charge the air conditioning system. Refer to **Refrigerant Recovery and Recharging (Belt Driven**

Compressor .

5. Bleed the Hydraulic Brake System. Refer to . **Hydraulic Brake System Bleeding (Manual)** , **Hydraulic Brake System Bleeding (Pressure)** .
6. Recheck all fluid levels.

ENGINE REPLACEMENT (RWD)

Special Tools

EN 46114 Engine Lift Bracket

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (Coupe)** , **Battery Negative Cable Disconnection and Connection (Wagon)** .
2. Remove the front compartment side sight shields. Refer to **Front Compartment Side Sight Shield Replacement** .
3. Remove the Front Compartment sight shields. Refer to **Front Compartment Sight Shields Replacement** .
4. Remove the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
5. Remove the intake manifold insulator. Refer to **Intake Manifold Insulator Replacement**.

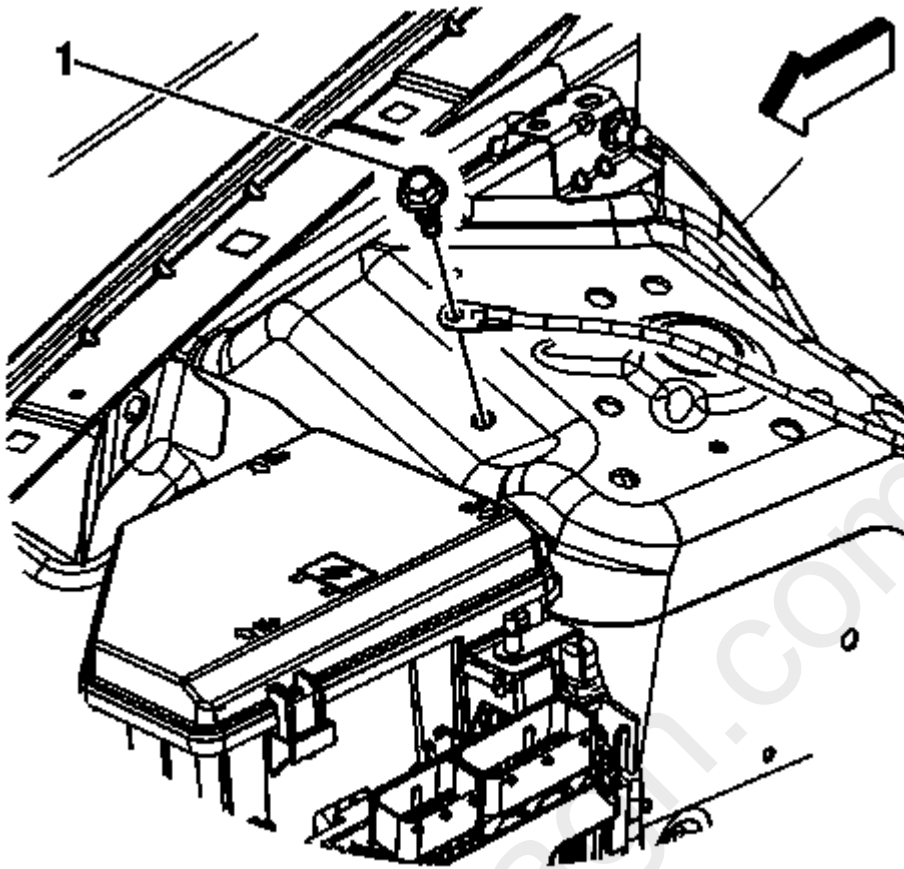


Fig. 318: Identifying Battery Negative Cable Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the bolt (1) retaining the battery negative cable extension cable to the right strut tower.
7. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Remove the wiper module. Refer to **Windshield Wiper Transmission Replacement** .
9. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .

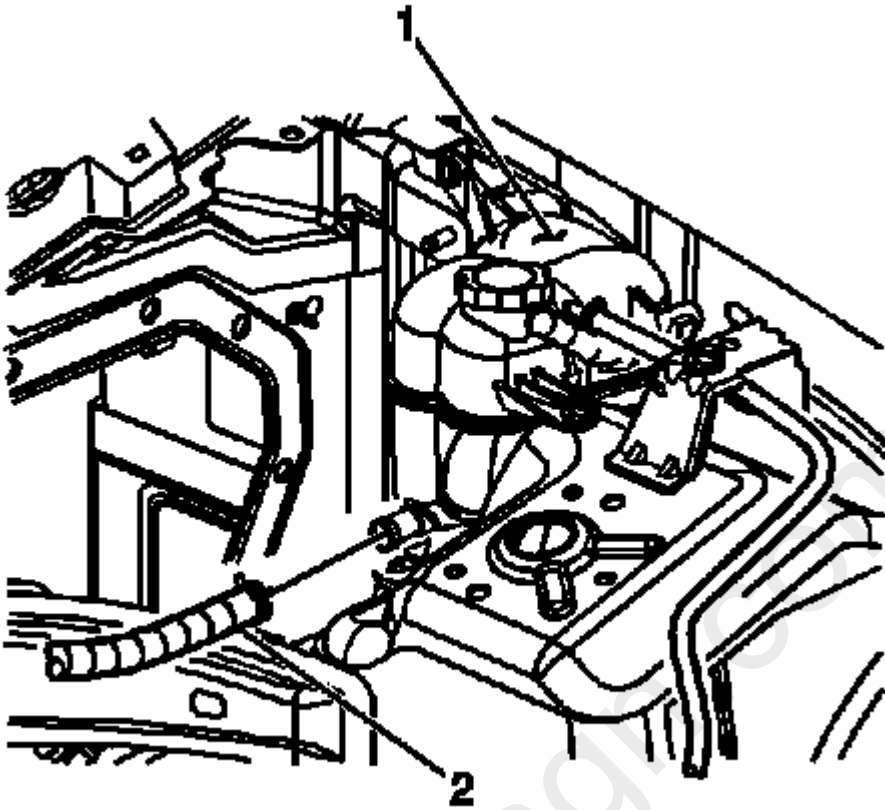


Fig. 319: Locating Surge Tank & Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the surge tank outlet hose (2) from the surge tank (1). Secure the hose to the engine.
11. Disconnect the surge tank inlet hose from the water outlet only and secure to the vehicle.

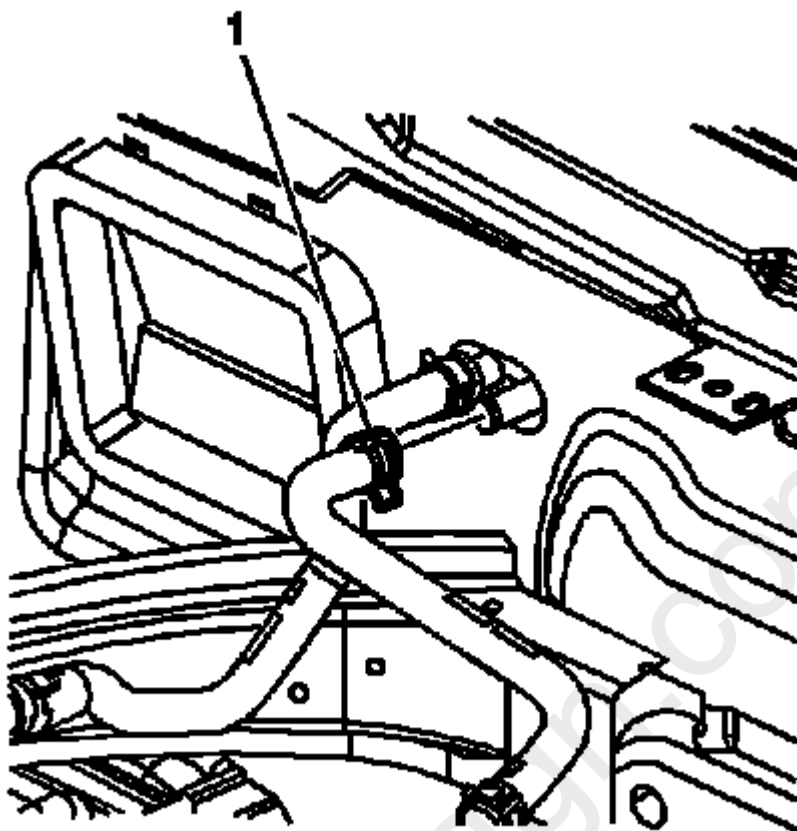


Fig. 320: Identifying Inlet Heater Hose
Courtesy of GENERAL MOTORS COMPANY

12. Disconnect the heater inlet heater hose (1) from the heater core.

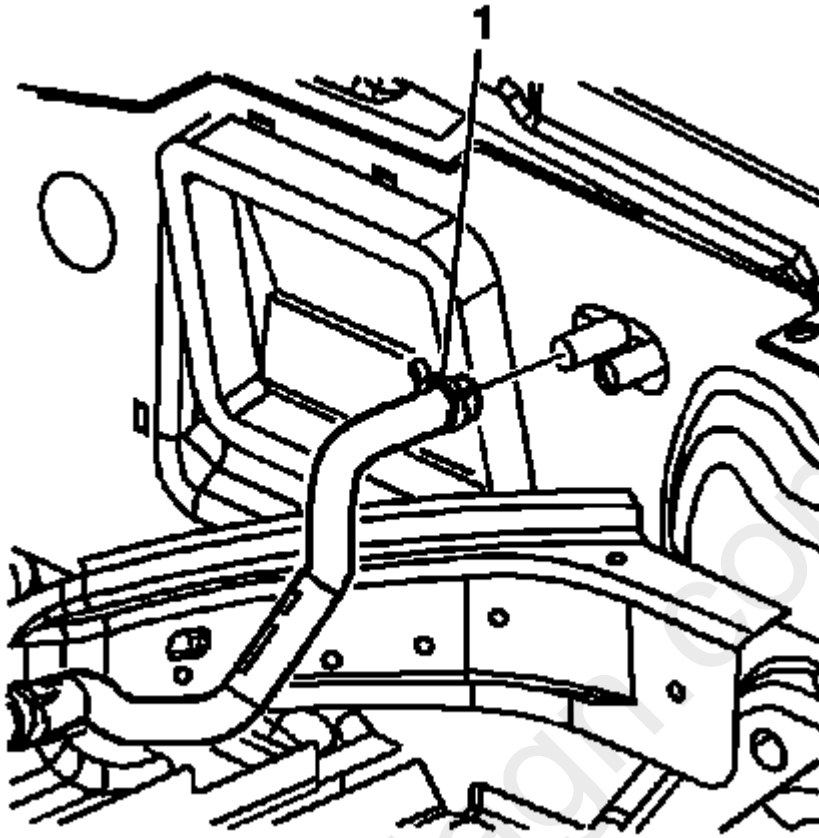


Fig. 321: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the heater outlet heater hose (1) from the heater core.
14. Remove the radiator inlet and outlet hose. Refer to **Radiator Inlet Hose Replacement (LFW or LFX)** , and **Radiator Outlet Hose Replacement (LFX or LFW)** .
15. Tie the radiator and condenser as an assembly to the upper radiator support brackets.

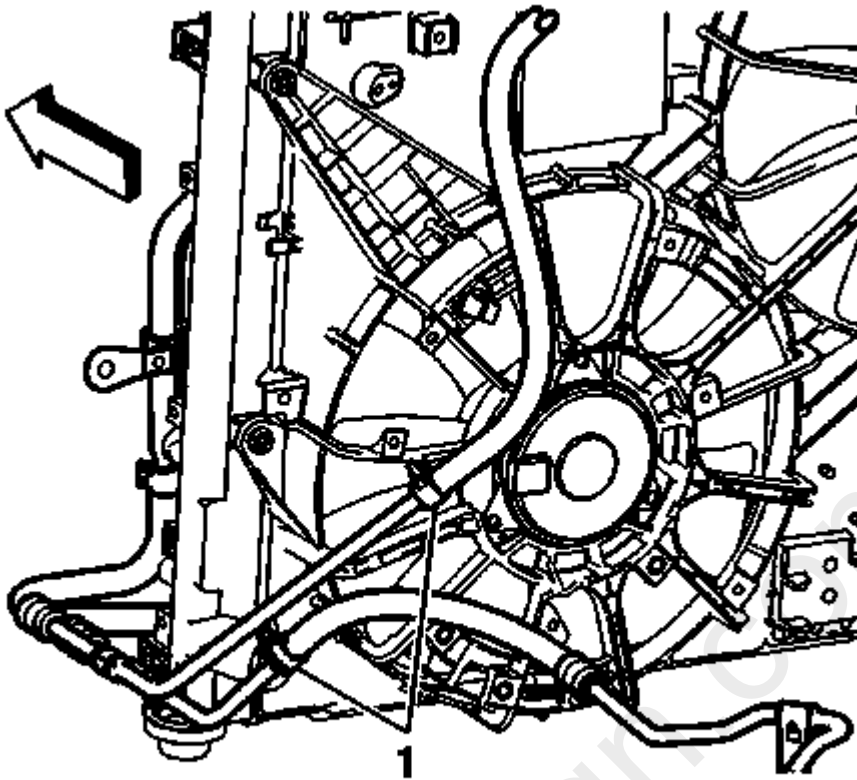


Fig. 322: Identifying Power Steering Hoses
Courtesy of GENERAL MOTORS COMPANY

16. Place a pan under the vehicle in order to capture as much power steering fluid as possible.
17. Disconnect the power steering cooler hoses (1) from the condenser radiator and fan module (CRFM).
18. Plug the power steering hoses and pipes in order to prevent fluid loss and contamination.
19. Disconnect the purge pipe from the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .
20. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief** .
21. Disconnect the fuel pipe (2) from the fuel feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
22. Plug the fuel pipe and cap the fuel rail to prevent fuel loss or contamination.
23. Evacuate the air conditioning system. Refer to **Refrigerant Recovery and Recharging (Belt Driven Compressor)** .
24. Disconnect the air conditioning suction hose from the evaporator and shock tower bracket and secure to the engine.
25. Disconnect the air conditioning pressure switch harness connector.
26. Disconnect the air conditioning evaporator tube at the condenser.

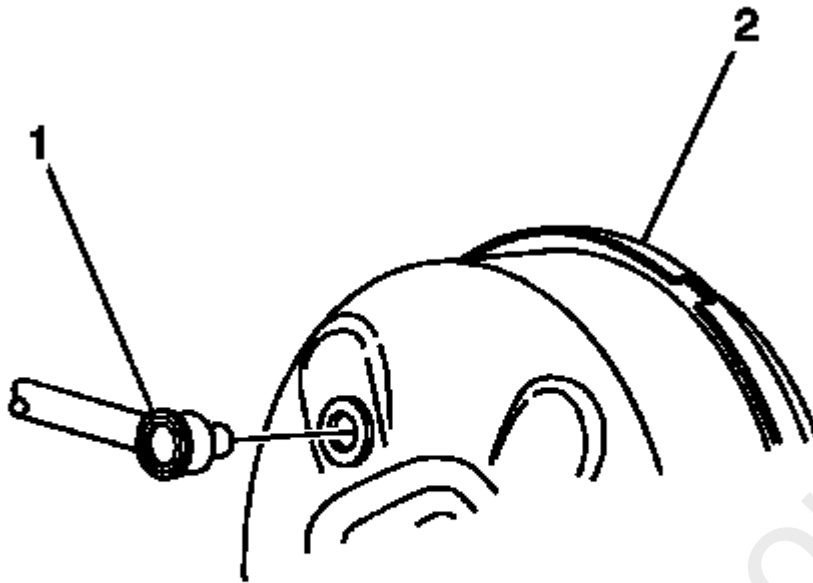


Fig. 323: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS COMPANY

27. Disconnect the brake booster check valve and vacuum hose (1) from the brake booster (2). Secure the hose to the engine.
28. Disconnect all engine harness electrical connectors. Refer to **Powertrain Component Views** , and **Harness Routing Views** .
29. Remove the right side engine harness to valve cover retaining clips.
30. Remove the left side engine harness to valve cover retaining clips.
31. Remove the transmission. Refer to **Transmission Replacement (Rear Wheel Drive)** .
32. Remove the left front wheel driveshaft and front wheel drive intermediate shaft bearing. Refer to **Front Wheel Drive Intermediate Shaft Bearing Replacement** .
33. Remove the right front wheel Drive Shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .

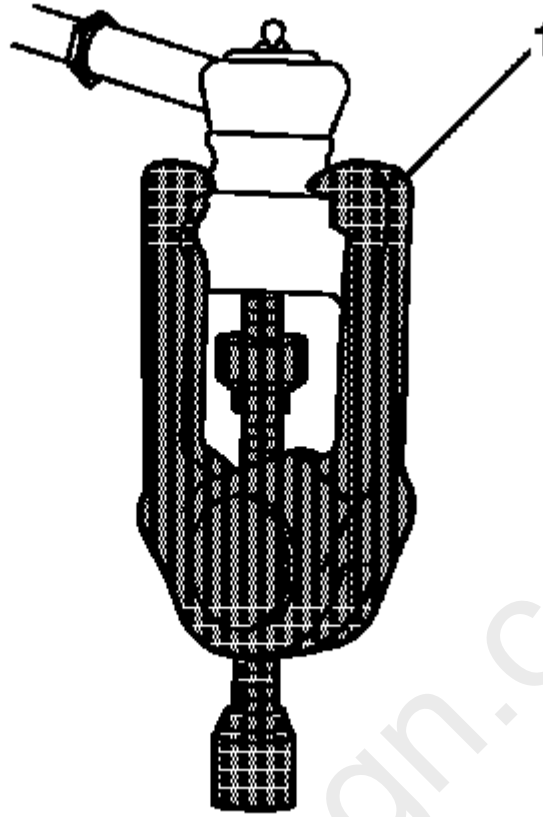


Fig. 324: Removing Outer Tie Rod Assembly From Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

34. Remove the outer tie rod nut and disconnect the steering linkage outer tie rod from the steering knuckle using a steering linkage and tie rod puller (1).
35. Remove the front air deflector. Refer to **Front Air Deflector Replacement** .
36. Remove the windshield washer solvent container. Refer to **Windshield Washer Solvent Container Replacement (Without CE4)** , **Windshield Washer Solvent Container Replacement (With CE4)** .
37. Remove the windshield washer solvent container bracket.

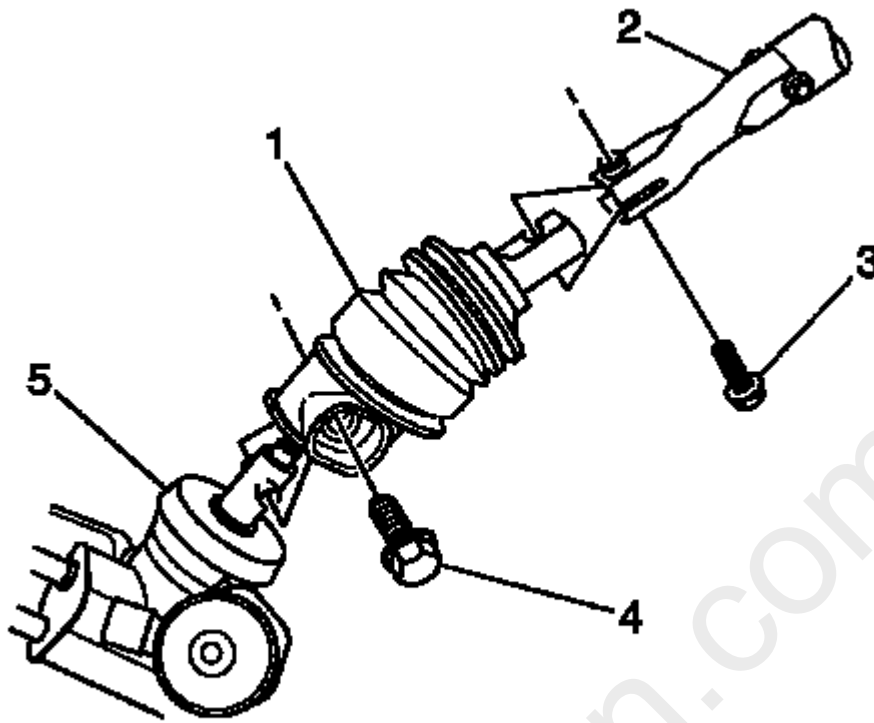


Fig. 325: View Of Steering Column Intermediate Shafts
Courtesy of GENERAL MOTORS COMPANY

38. Remove lower intermediate steering shaft bolt (4) and separate the intermediate steering shaft from the steering gear.
39. Remove the headlamp leveling sensors. Refer to **Headlamp Leveling Front Suspension Height Sensor Replacement**.
40. Position a suitable powertrain table or engine lift table below the frame and engine.
41. Raise the lift table or lower the vehicle to support the frame and engine.

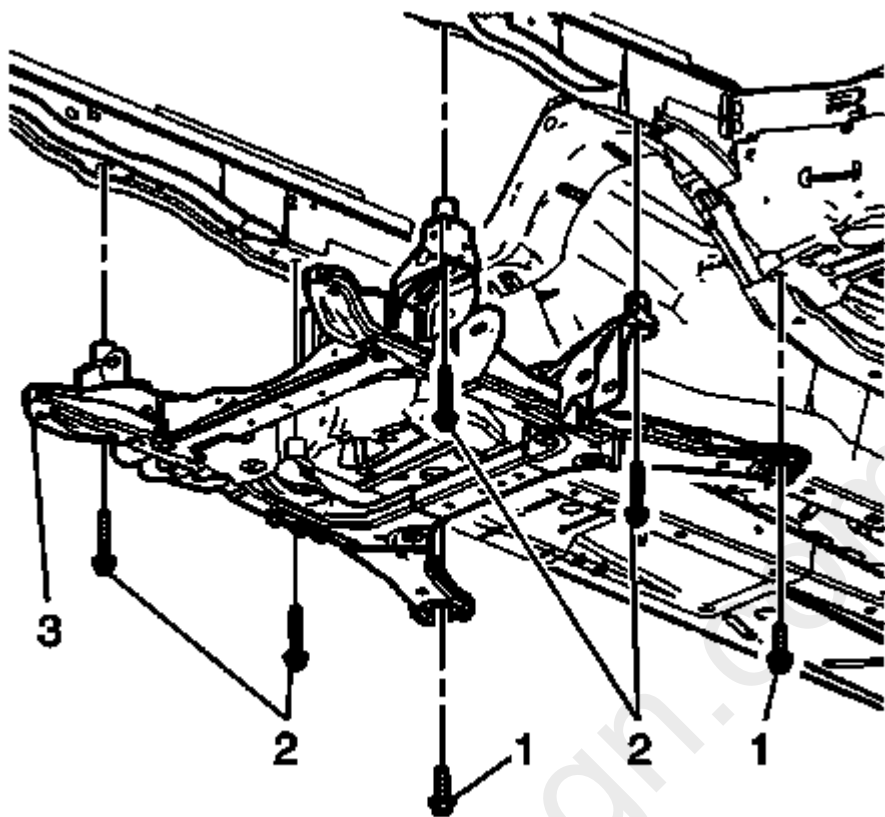


Fig. 326: Front Frame Bolts

Courtesy of GENERAL MOTORS COMPANY

42. Remove the front frame bolts (1, 2)

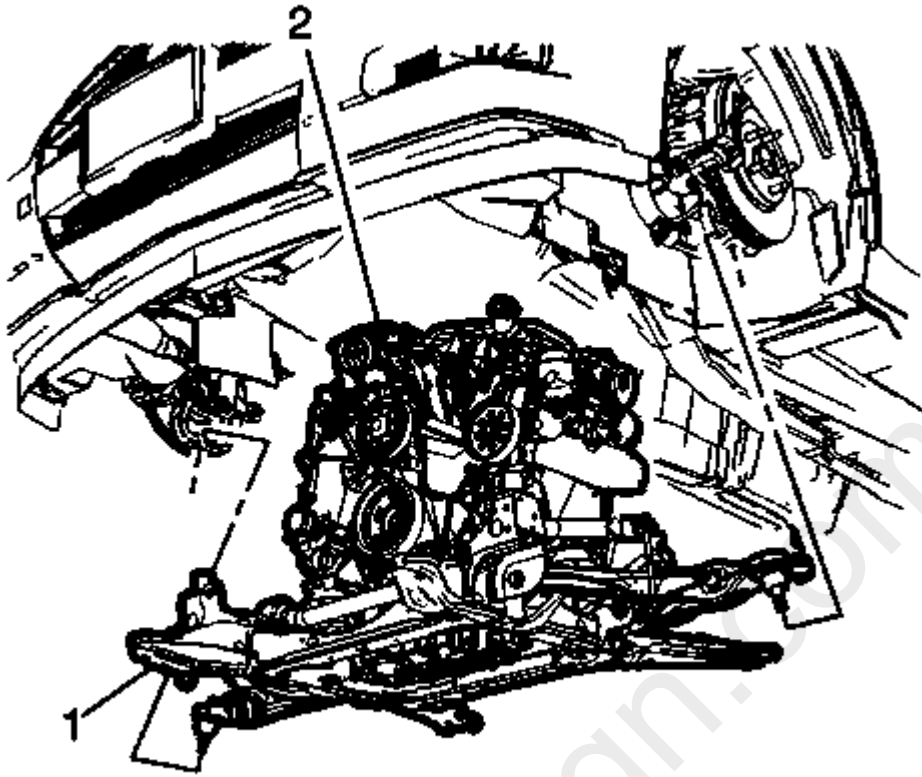


Fig. 327: Front Suspension Frame & Engine
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that all the remaining hoses, wires, and pipes clear the vehicle during the removal process.

43. With the aid of an assistant, lower the table or raise the vehicle to remove the engine (2), front drive axle and front suspension frame (1) from the vehicle.

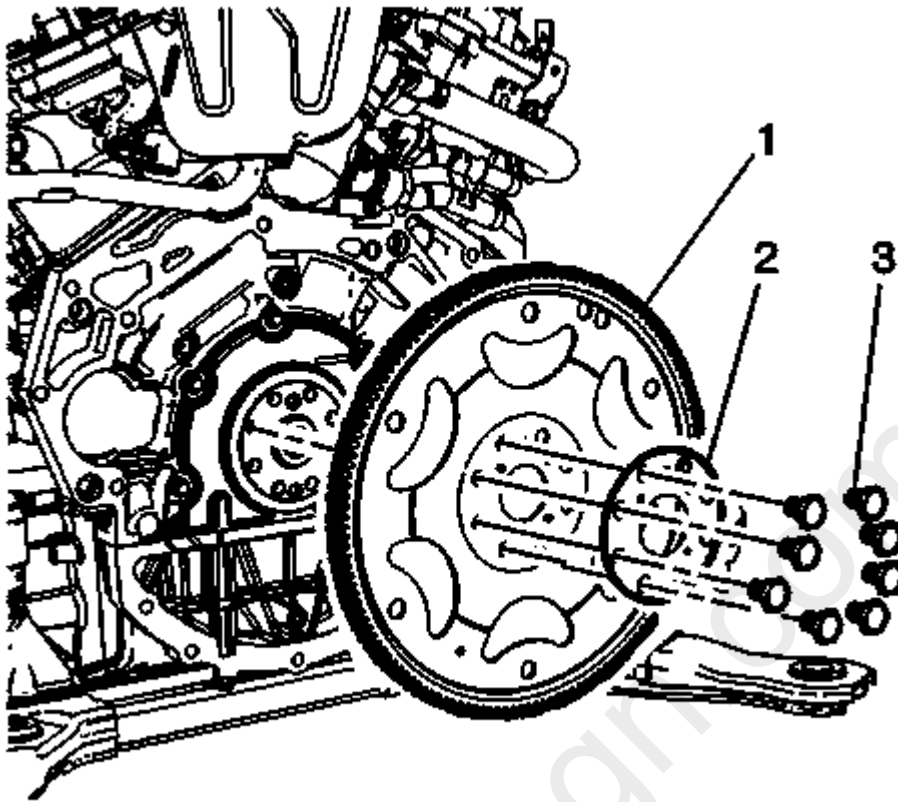


Fig. 328: Flex Plate & Bolts

Courtesy of GENERAL MOTORS COMPANY

44. Remove the flex plate bolts (3) and remove the automatic transmission flex plate (1, 2) from the engine.

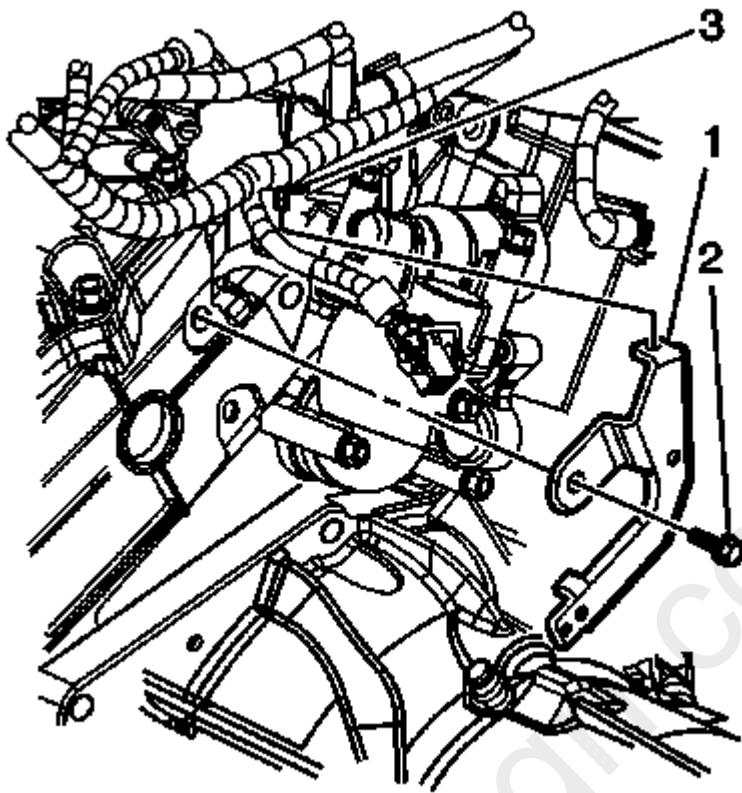


Fig. 329: View Of HO2S Connector Bracket
Courtesy of GENERAL MOTORS COMPANY

45. Remove the heated oxygen sensor connector bracket (1) from the left cylinder head.
46. Remove the engine wiring harness and related components.

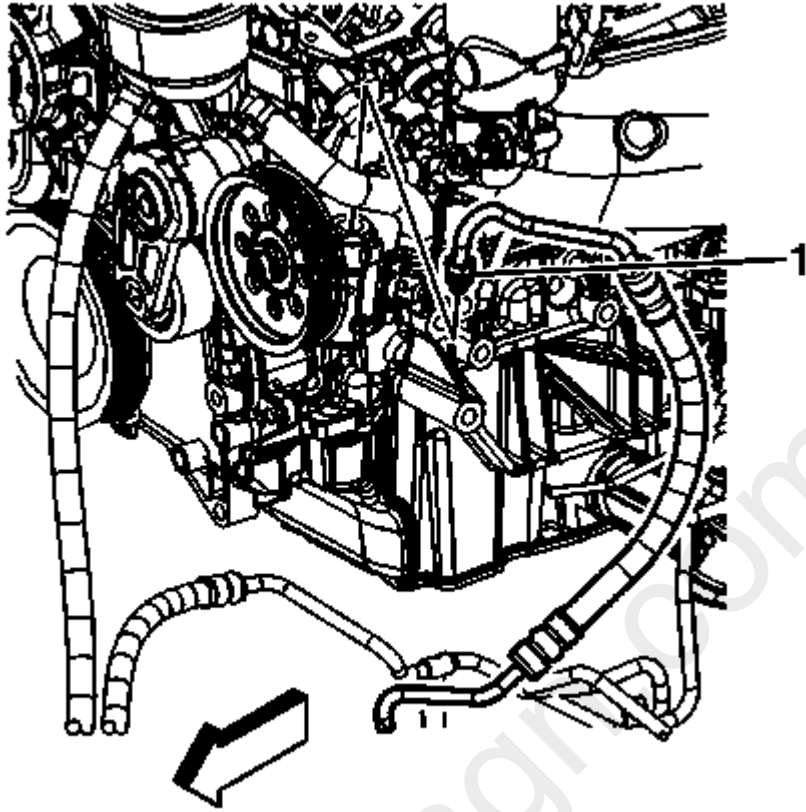


Fig. 330: Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

47. Disconnect the power steering gear inlet hose (1) from the power steering pump.

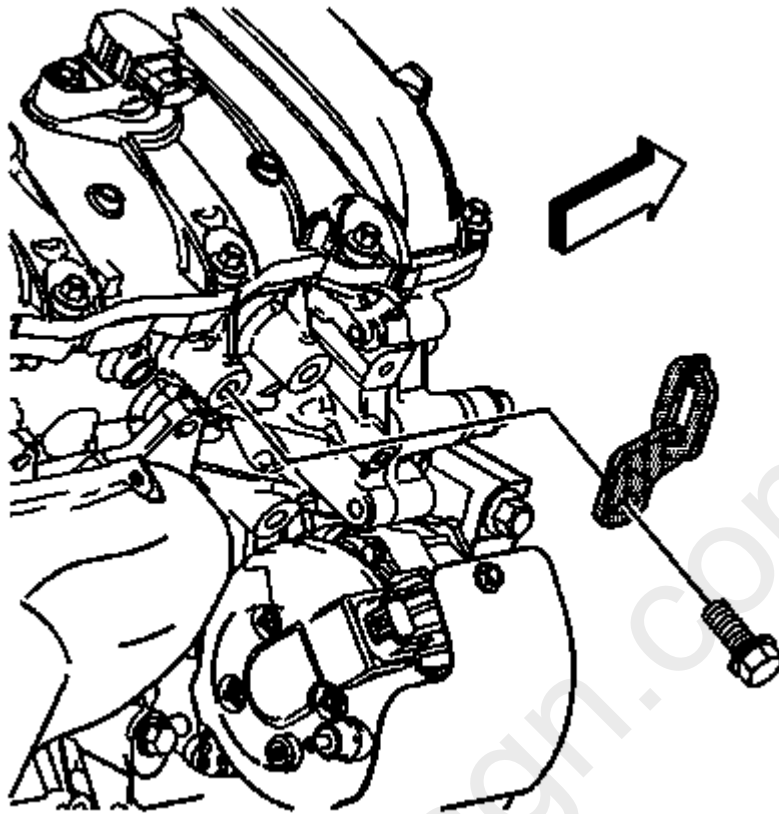


Fig. 331: View of Engine Lift Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

48. Install EN 46114 engine lift bracket to the engine and tighten the bolts to 65 N.m (48 lb ft).
49. Connect a engine hoist and lift chain to the engine lift brackets.
50. Raise the engine hoist enough to support the engine.

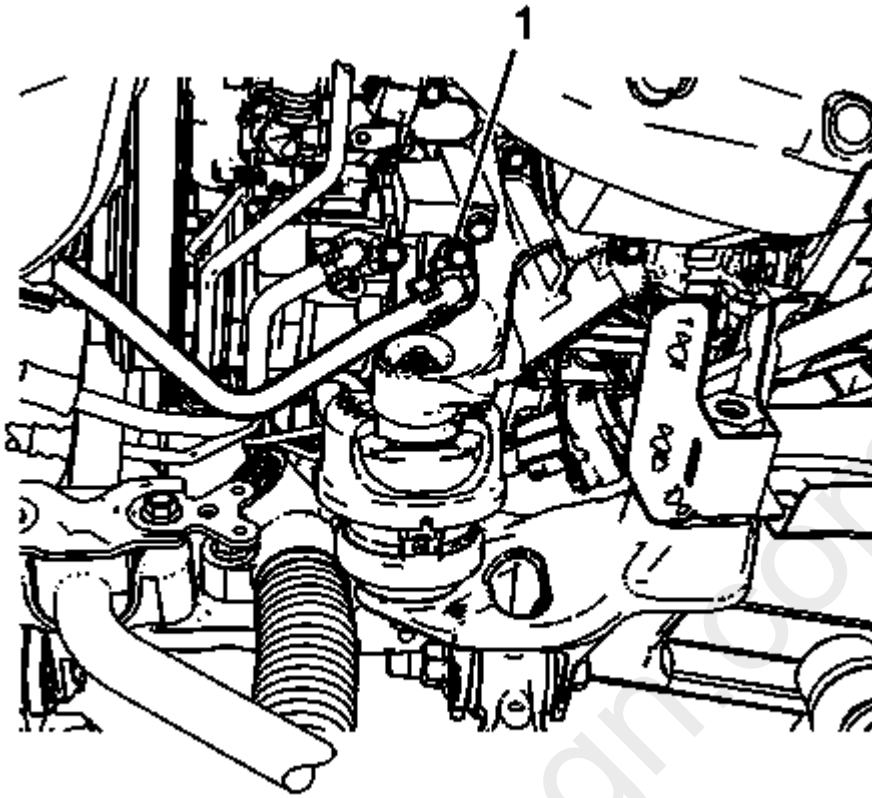


Fig. 332: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

51. Remove the engine mount to engine mount bracket nuts (1).
52. Use the engine hoist to raise the engine enough to clear the frame assembly.
53. Mount the engine to an engine stand.

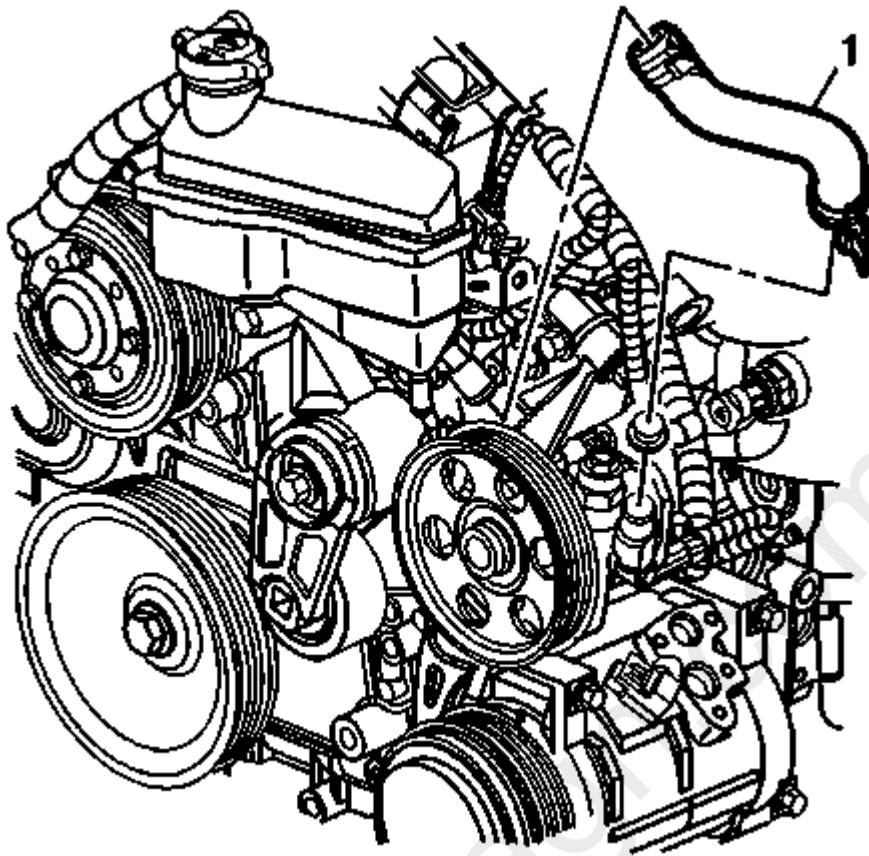


Fig. 333: Pump Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

54. Remove the steering reservoir to Pump outlet hose (1).

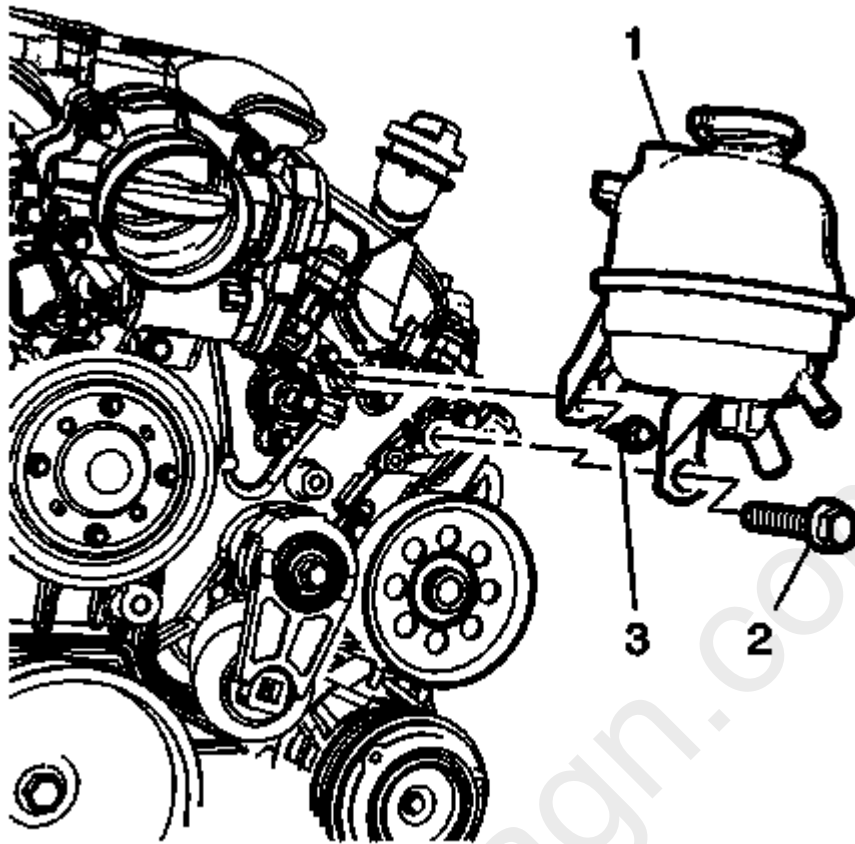


Fig. 334: Power Steering Reservoir & Fasteners
Courtesy of GENERAL MOTORS COMPANY

55. Remove the fasteners (2, 3) and the power steering reservoir (1) from the engine.

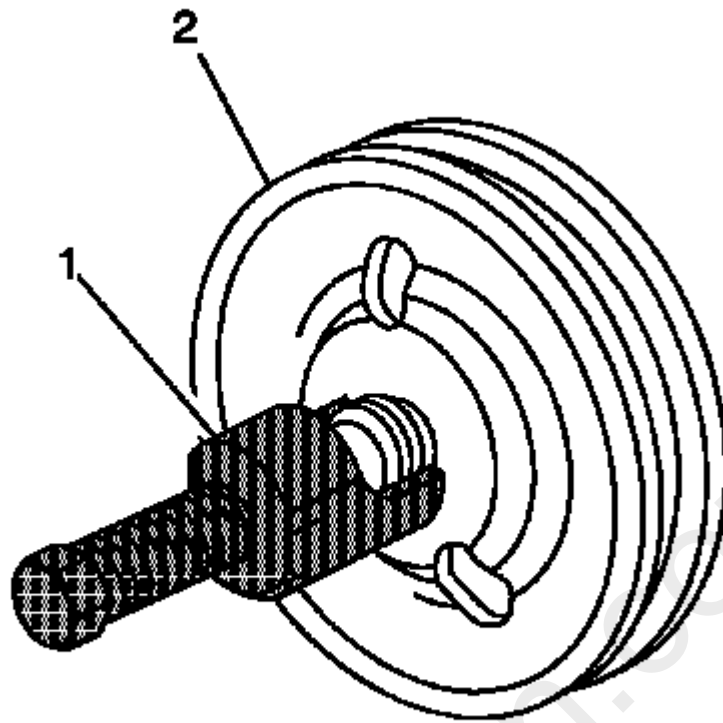


Fig. 335: View Of Power Steering Pump Pulley Remover
Courtesy of GENERAL MOTORS COMPANY

56. Remove the power steering pump pulley (2) using a power steering pulley remover (1).

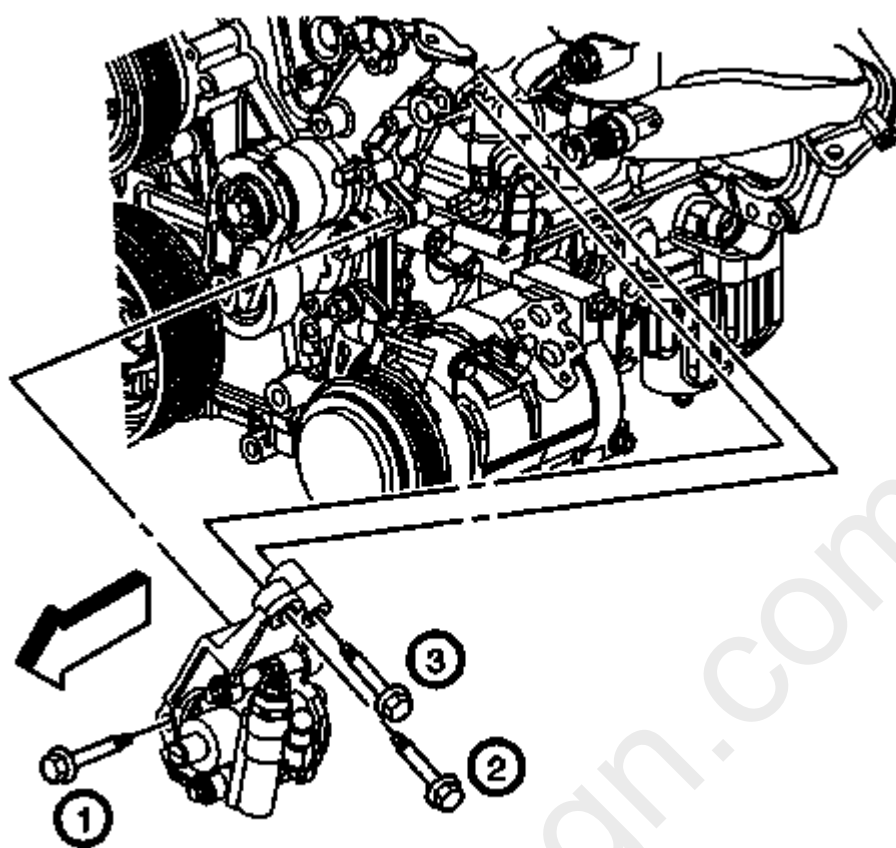


Fig. 336: View Of Power Steering Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

57. Remove the power steering pump fasteners (1, 2 and 3) and power steering pump.

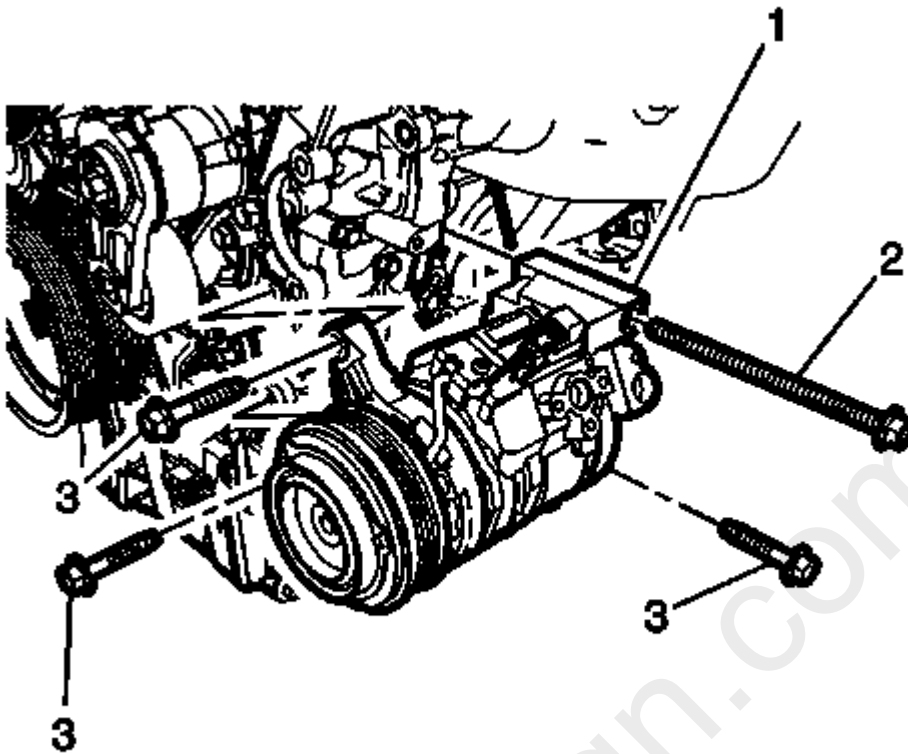


Fig. 337: A/C Compressor & Fasteners
Courtesy of GENERAL MOTORS COMPANY

58. Remove fasteners (2, 3) and the A/C compressor (1) from the engine.

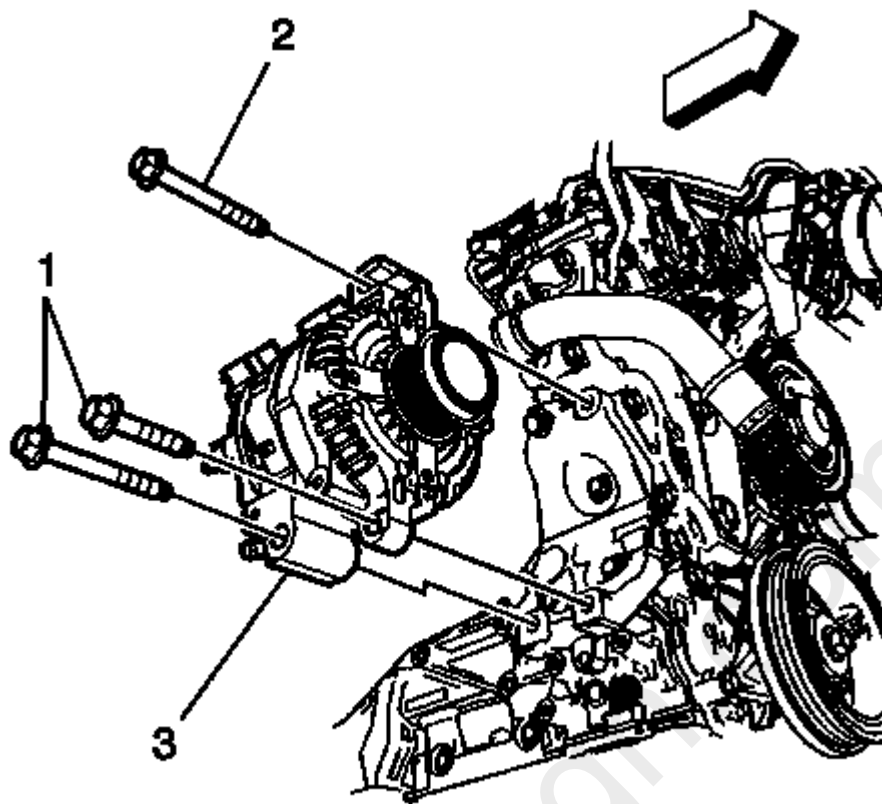


Fig. 338: Generator Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

59. Disconnect the electrical harness connectors from the generator.
60. Remove the bolts (1, 2) and remove the generator from the engine
61. Transfer any additional parts as necessary.

Installation Procedure

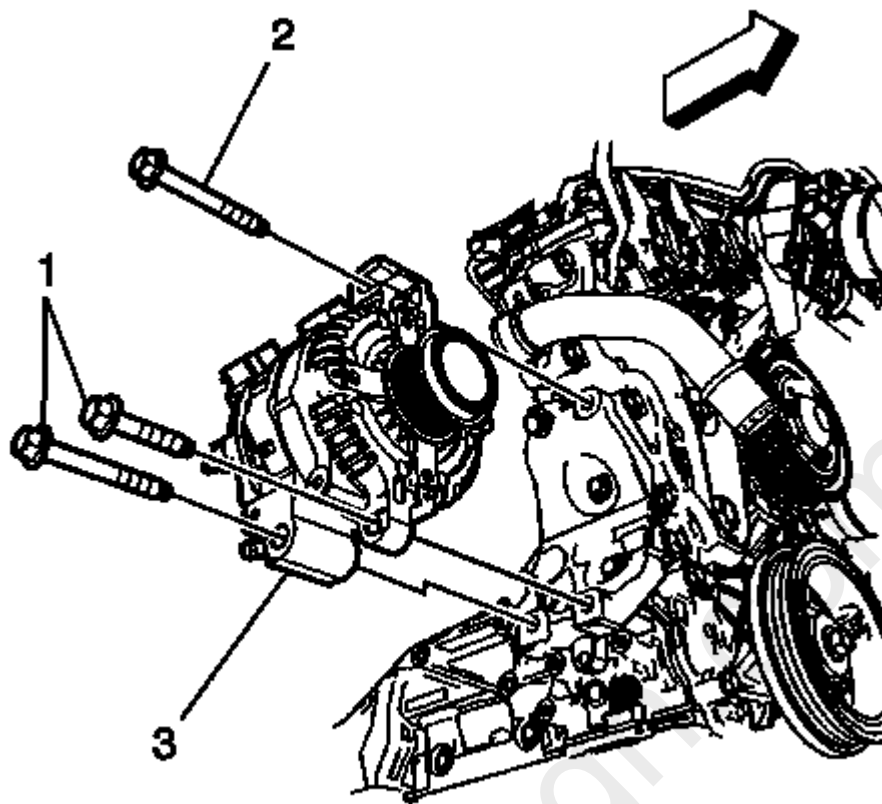


Fig. 339: Generator Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fasteners .

1. Install the generator to the engine. Refer to Fastener Tightening Specifications
2. Connect the electrical harness connectors to the generator.

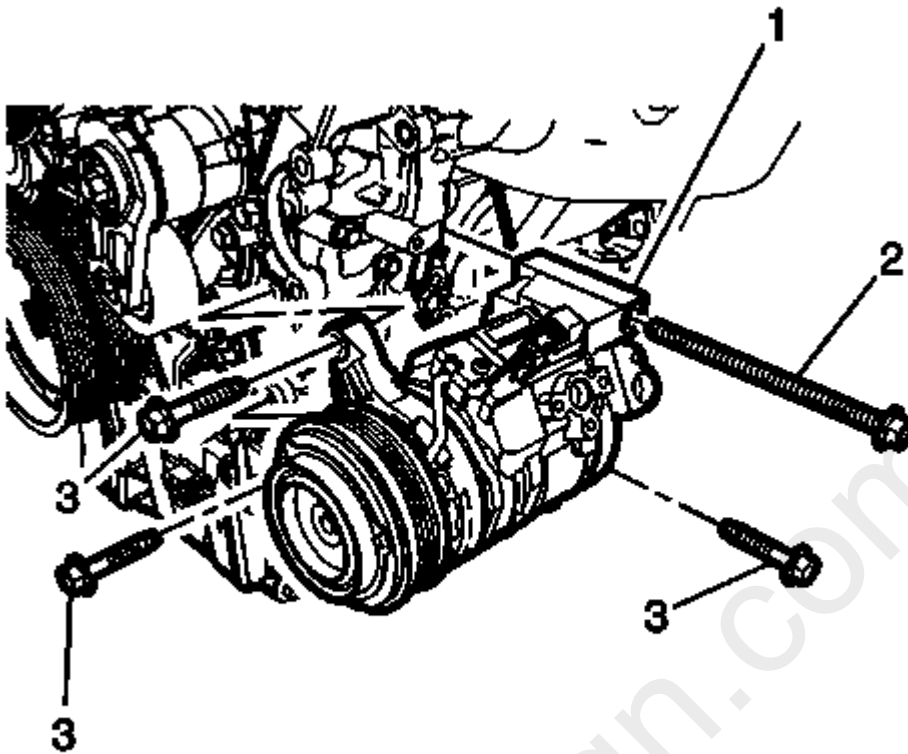


Fig. 340: A/C Compressor & Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Install the air conditioning compressor (1). Refer to **Fastener Tightening Specifications**

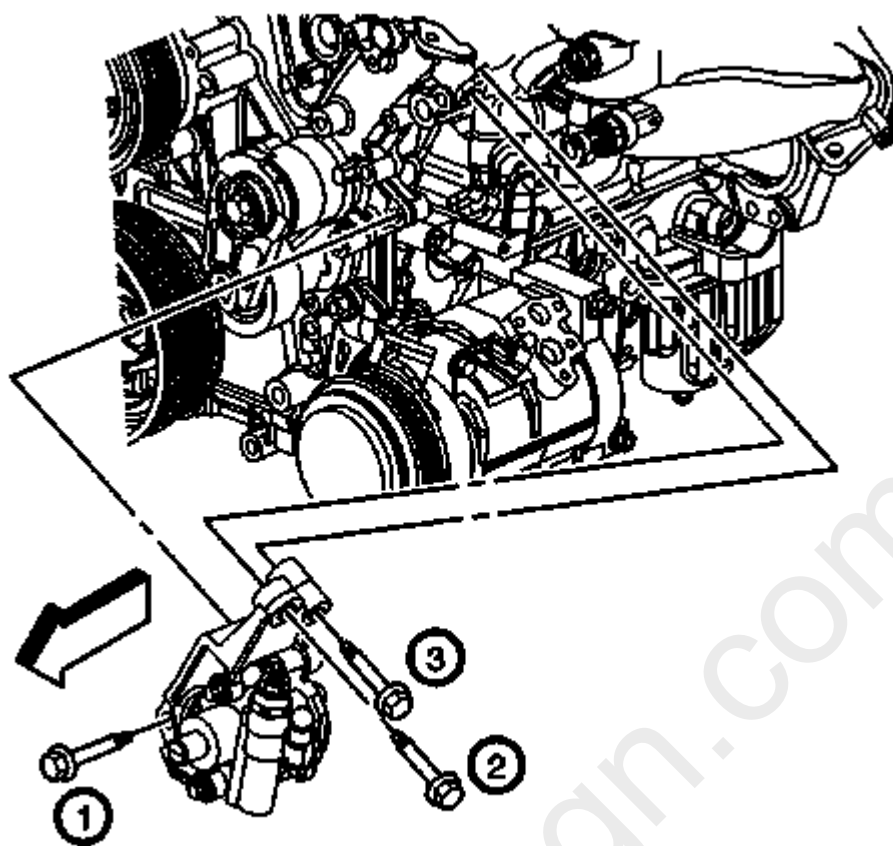


Fig. 341: View Of Power Steering Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the power steering pump to the engine using the torquing sequence shown. Refer to **Fastener Tightening Specifications**

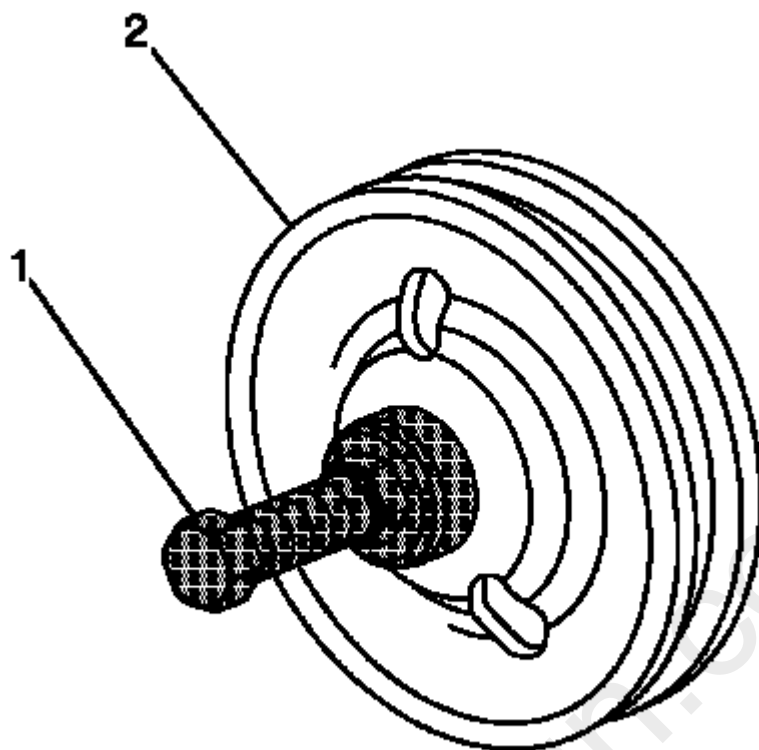


Fig. 342: View Of Power Steering Pump Pulley Installer
Courtesy of GENERAL MOTORS COMPANY

5. Install the power steering pump pulley (2) using a power steering pulley installer (1).

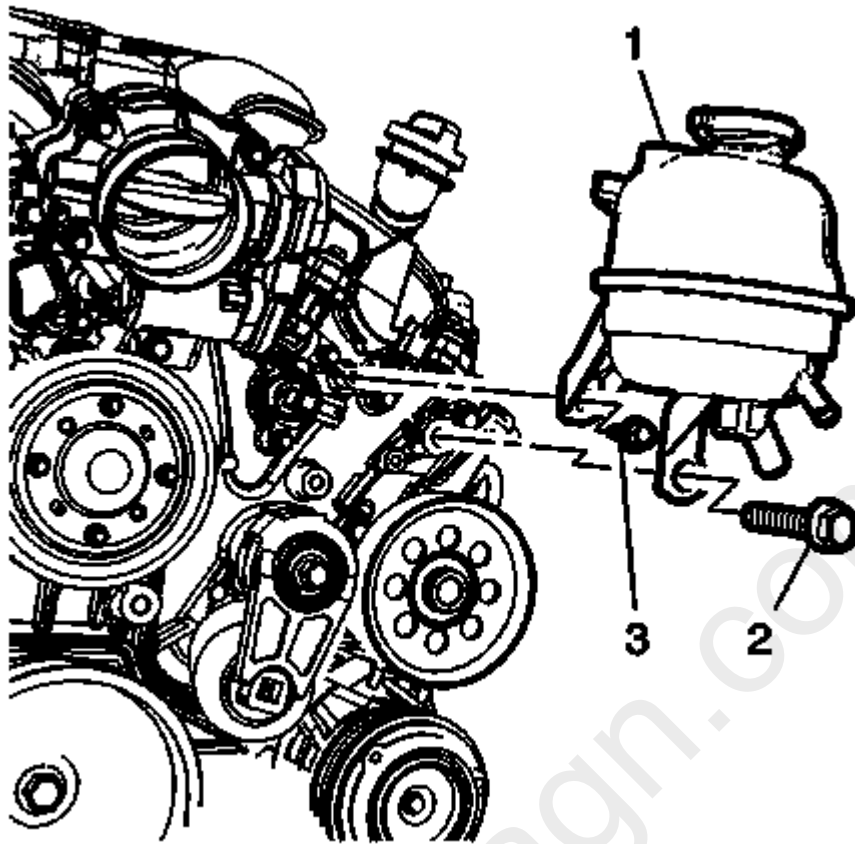


Fig. 343: Power Steering Reservoir & Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Install the power steering reservoir (1). Refer to **Fastener Tightening Specifications**

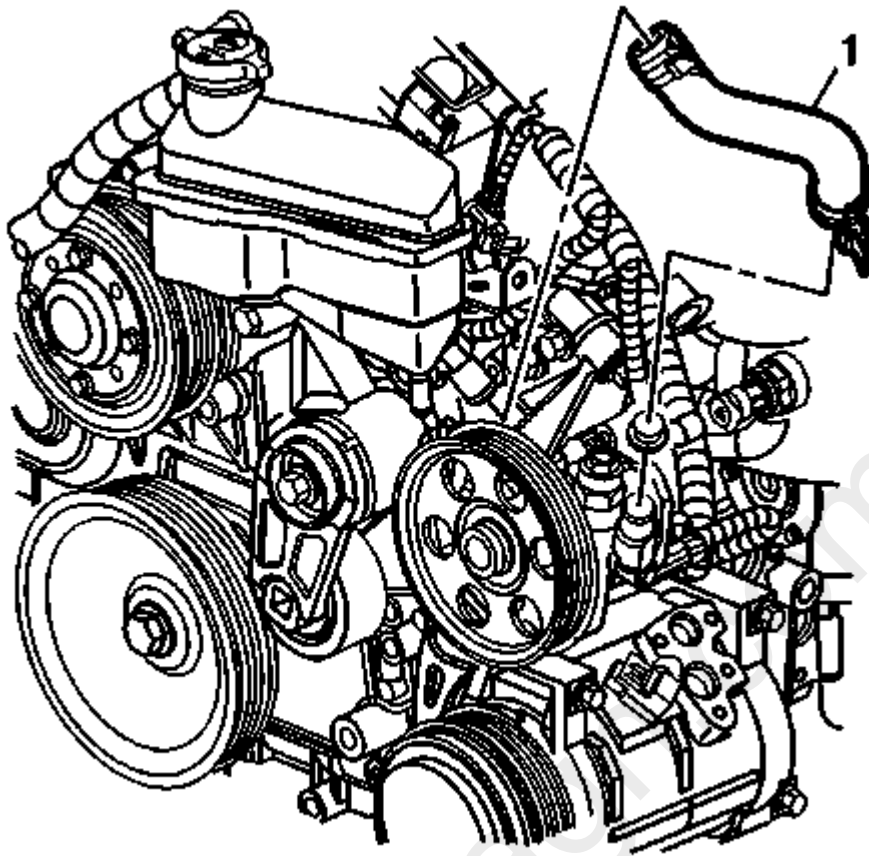


Fig. 344: Pump Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install the power steering reservoir to power steering pump hose (1).
8. Install the drive belts.
9. Use an engine hoist to remove the engine from the engine stand.

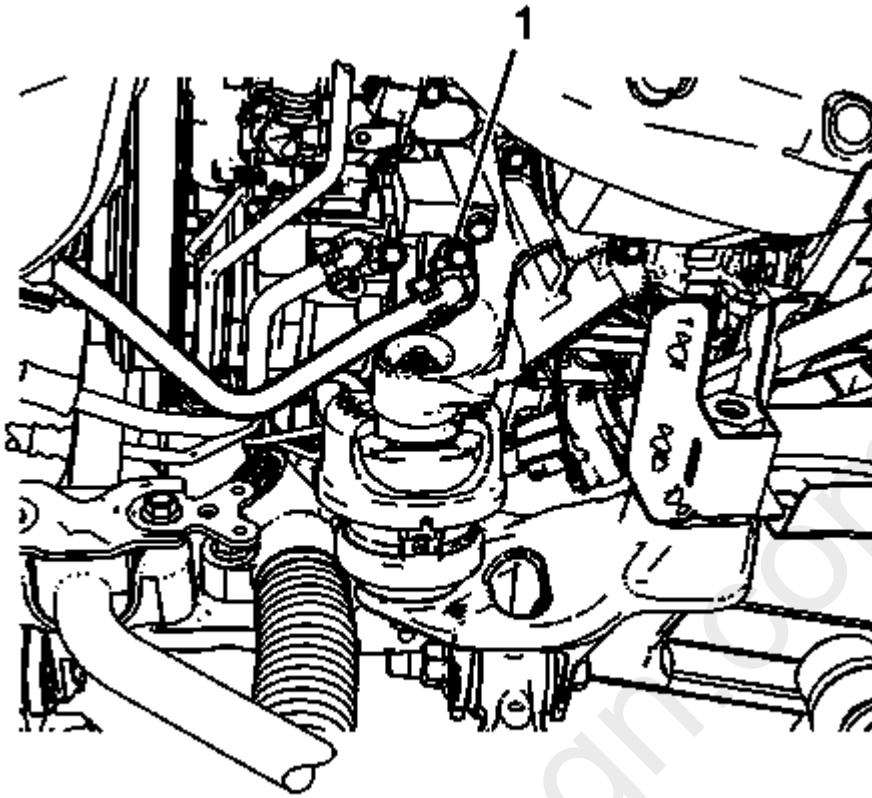


Fig. 345: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Position the engine to the front and rear engine mounts on the front suspension frame and tighten the engine mount bracket nuts to 80 N.m (59 lb ft).

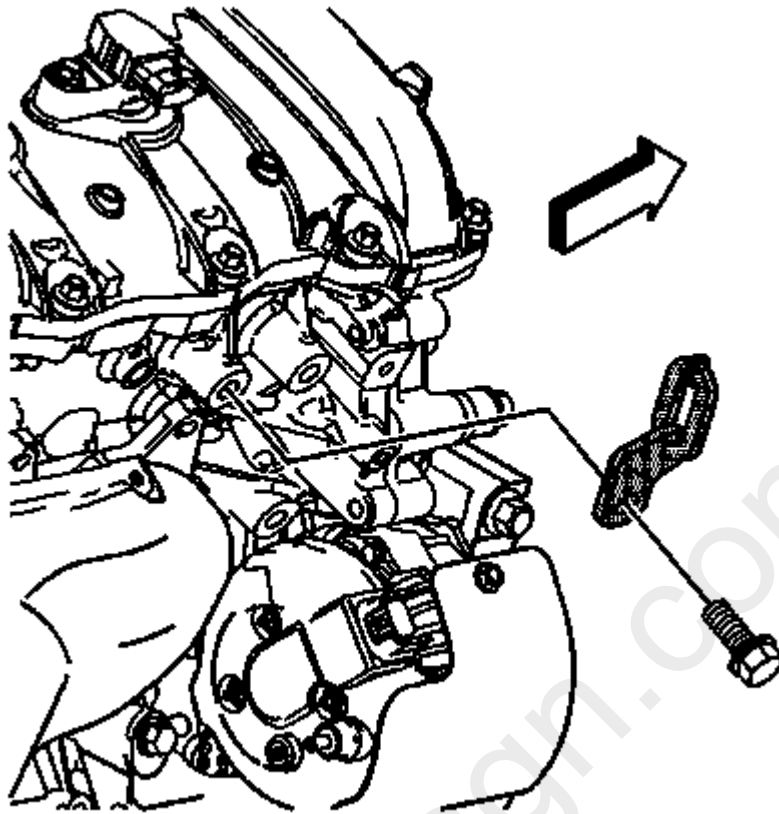


Fig. 346: View of Engine Lift Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Remove the engine hoist and the EN 46114 engine lift bracket from the engine.

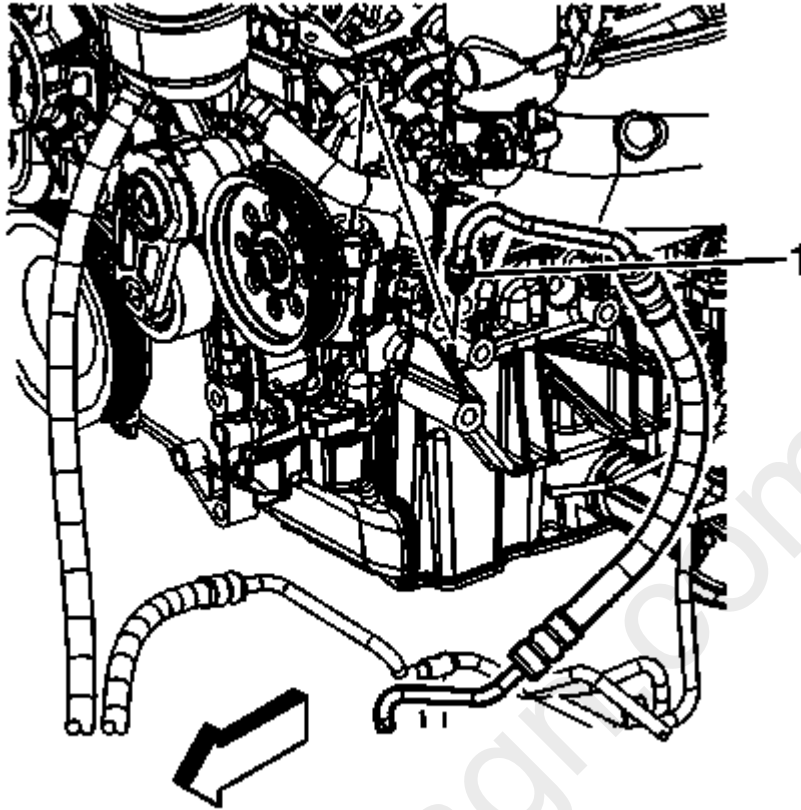


Fig. 347: Power Steering Gear Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

12. Connect the power steering gear inlet hose (1) to the power steering pump. Refer to **Fastener Tightening Specifications**
13. Connect the engine wiring harness to related components.

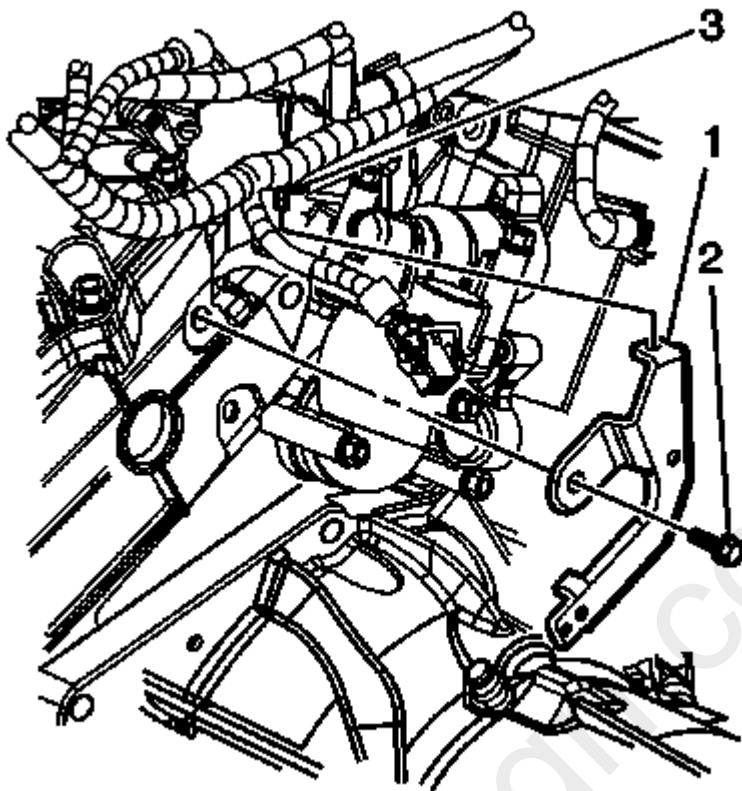


Fig. 348: View Of HO2S Connector Bracket
Courtesy of GENERAL MOTORS COMPANY

14. Install the heated oxygen sensor (HO2S) connector bracket (1) to the left cylinder.

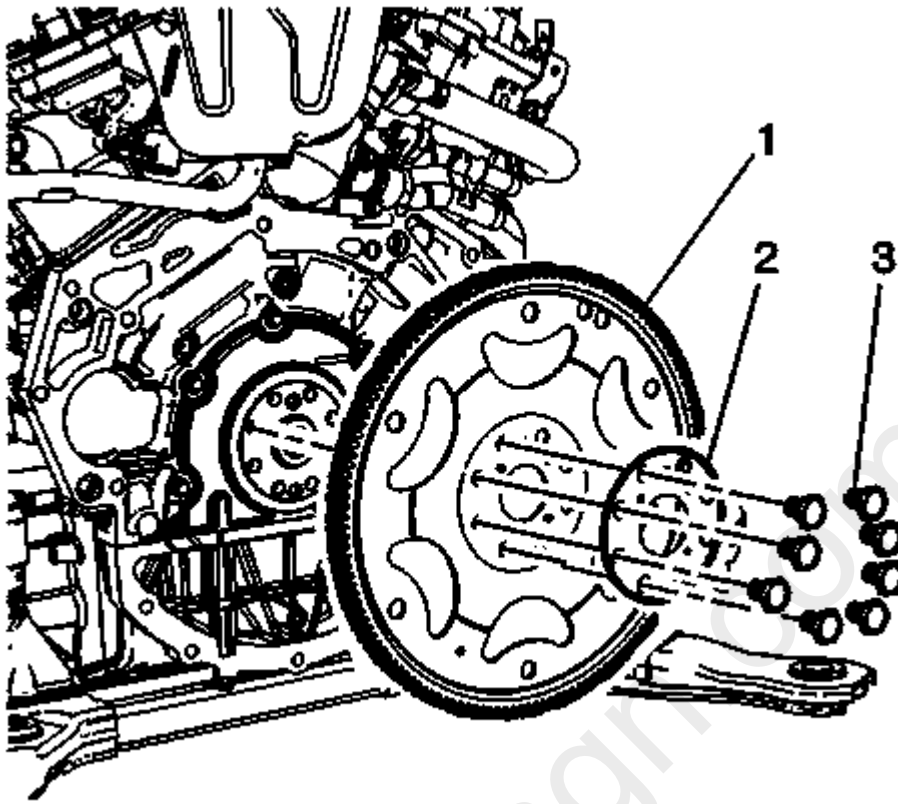


Fig. 349: Flex Plate & Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Install the automatic transmission flex plate (1) spacer (2) to the engine and tighten the bolts (3) to 30 N.m (22 lb ft) plus 45 degrees.

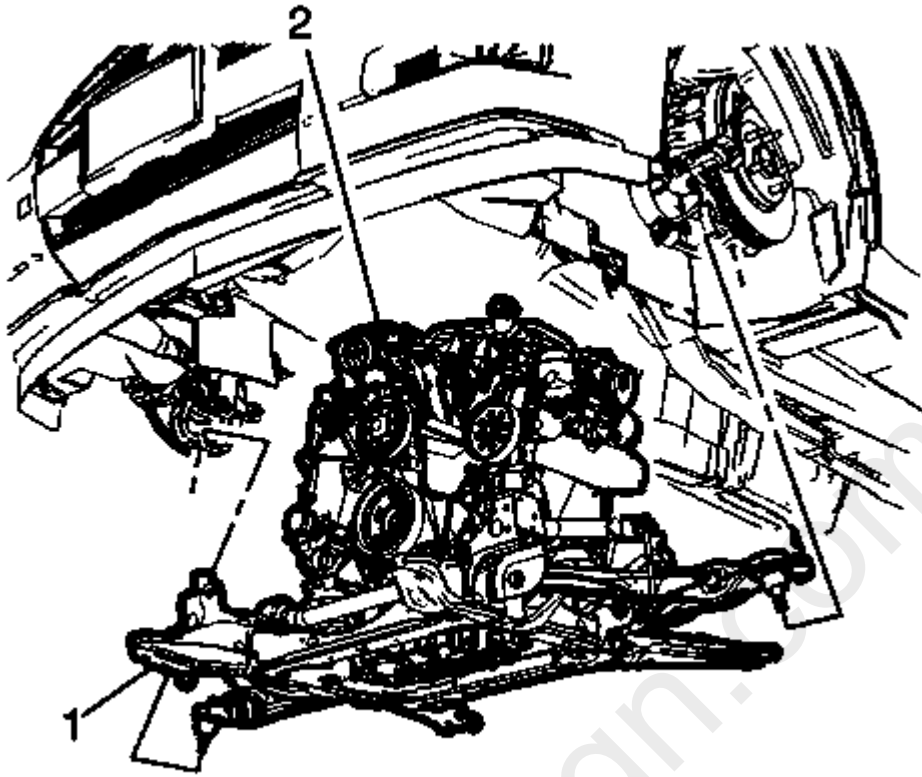


Fig. 350: Front Suspension Frame & Engine
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that all the hoses, wires, and pipes clear the vehicle during the installation process.

16. With the aid of an assistant, raise the table or lower the vehicle to position the engine (2), front drive axle and front suspension frame (1) into the vehicle.

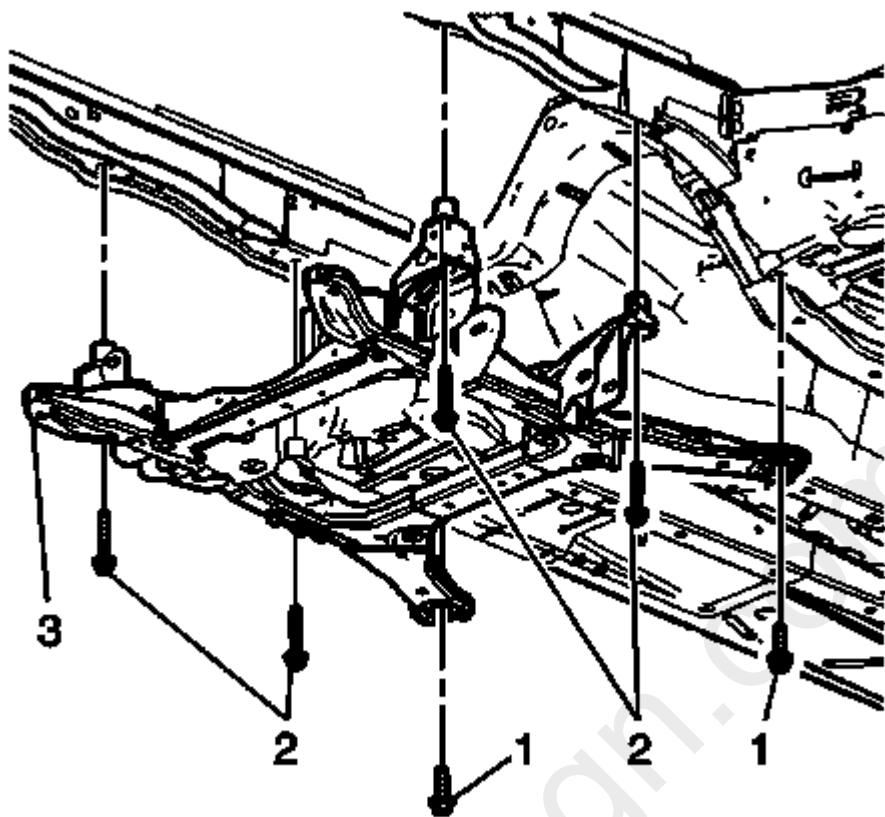


Fig. 351: Front Frame Bolts

Courtesy of GENERAL MOTORS COMPANY

17. Install the front frame bolts (1, 2). Refer to **Fastener Tightening Specifications**
18. Remove the powertrain table or engine lift table.
19. Install the headlamp leveling sensors. Refer to **Headlamp Leveling Front Suspension Height Sensor Replacement** .

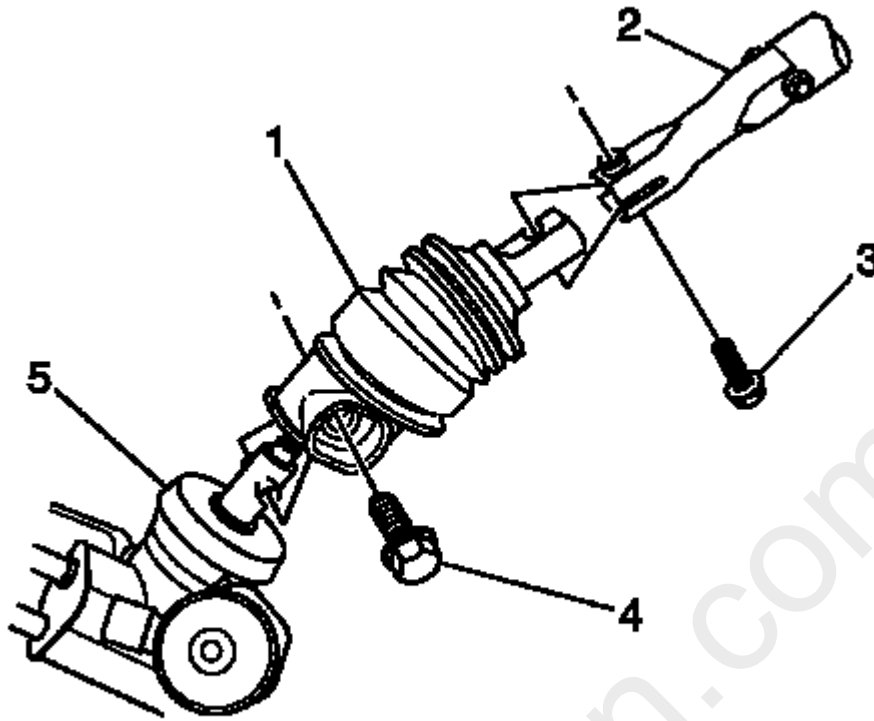


Fig. 352: View Of Steering Column Intermediate Shafts
Courtesy of GENERAL MOTORS COMPANY

20. Connect the intermediate steering shaft (1) to the steering gear (5). Refer to **Fastener Tightening Specifications**
21. Connect the front brake hoses to the front brake pipes and brackets.
22. Install the windshield washer solvent container and bracket. Refer to **Windshield Washer Solvent Container Replacement (Without CE4)** , **Windshield Washer Solvent Container Replacement (With CE4)** .
23. Install the front air deflector. Refer to **Front Air Deflector Replacement** .

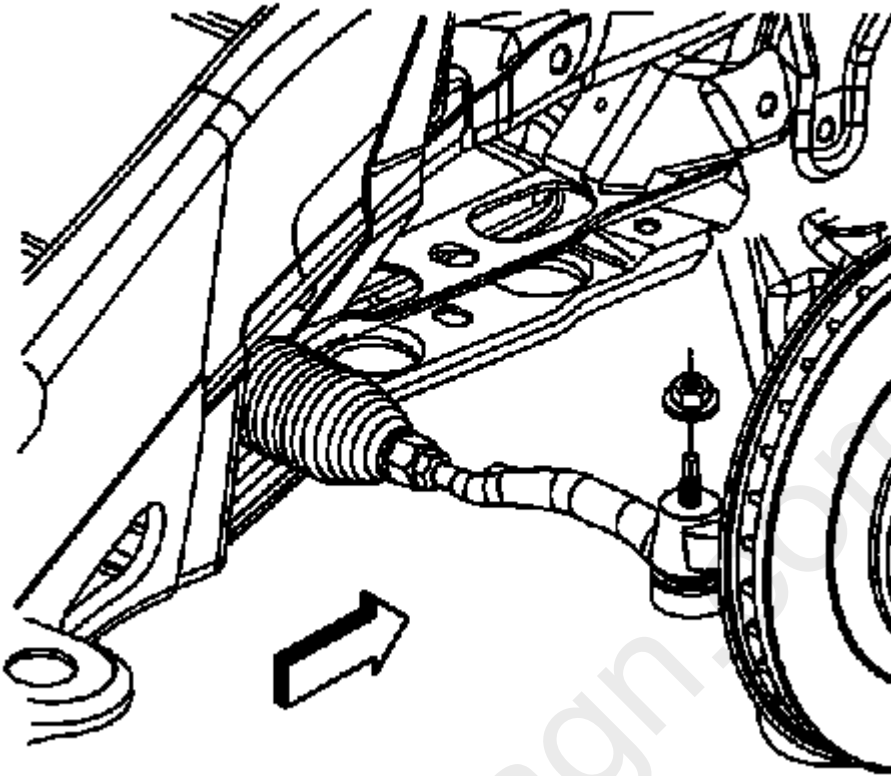


Fig. 353: View Of Tie Rod Retaining Nut
Courtesy of GENERAL MOTORS COMPANY

24. Install the steering linkage outer tie rods to the steering knuckles. Refer to **Fastener Tightening Specifications**
25. Install the left front wheel driveshaft and front wheel drive intermediate shaft bearing. Refer to **Front Wheel Drive Intermediate Shaft Bearing Replacement** .
26. Install the right front wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .
27. Install the transmission. Refer to **Transmission Replacement (Rear Wheel Drive)** .

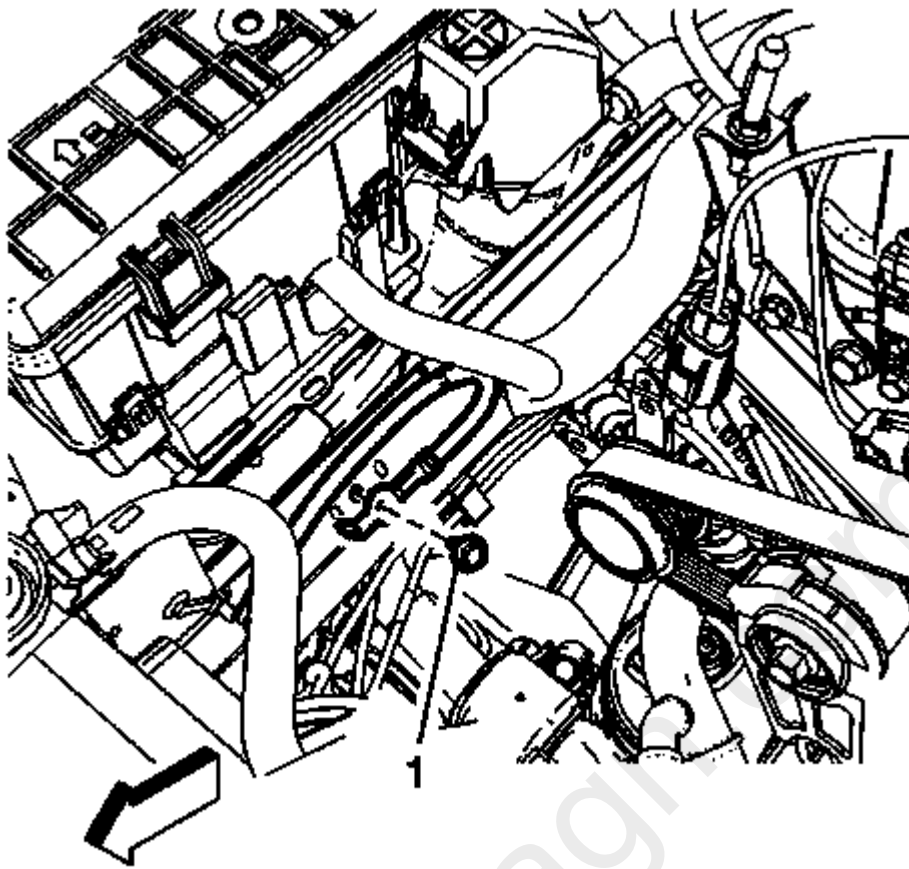


Fig. 354: Longitudinal Rail Bolt
Courtesy of GENERAL MOTORS COMPANY

28. Connect the ground wire to the longitudinal rail and tighten the bolt (1) to 10 N.m (89 lb in).
29. Install the right side engine harness to valve cover retaining clips.
30. Install the left side engine harness to valve cover retaining clips.

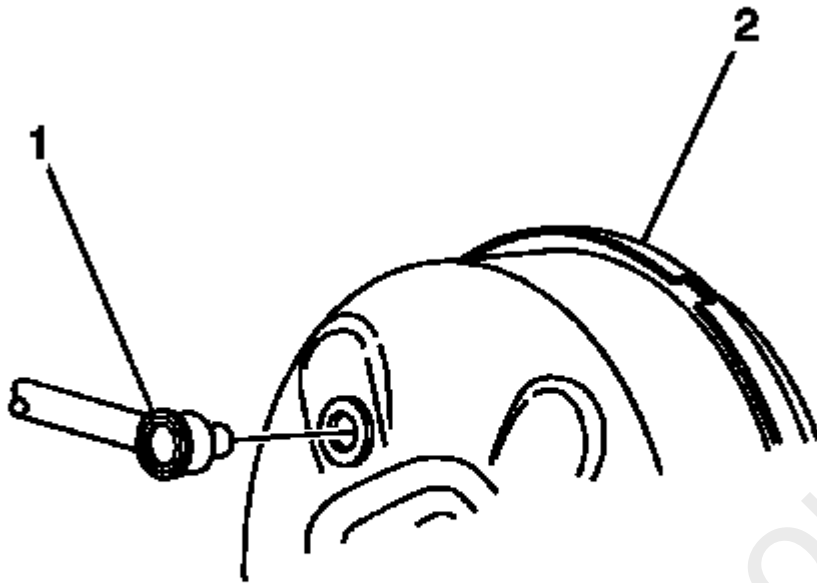


Fig. 355: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS COMPANY

31. Connect the brake booster check valve and vacuum hose (1) to the brake booster (2).
32. Connect all engine harness electrical connectors. Refer to **Powertrain Component Views** , and **Harness Routing Views** .
33. Connect the air conditioning evaporator tube at the condenser.
34. Connect the air conditioning pressure switch harness connector.
35. Connect the air conditioning suction hose to the evaporator and shock tower bracket.

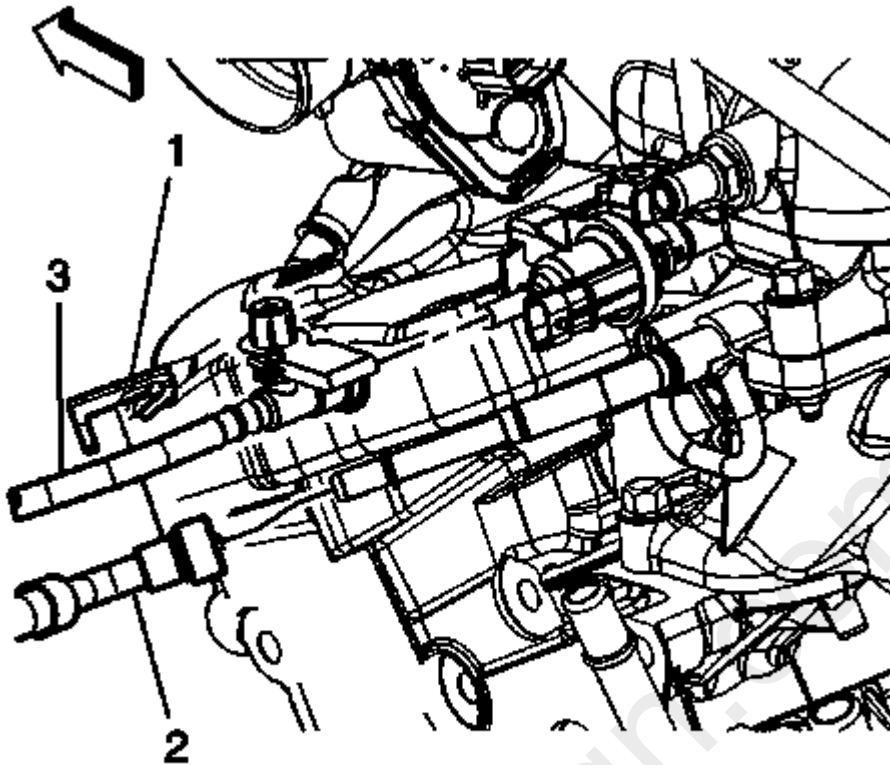


Fig. 356: View Of EVAP Pipe

Courtesy of GENERAL MOTORS COMPANY

36. Connect the fuel pipe (2) to the fuel feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
37. Connect the purge pipe to the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .

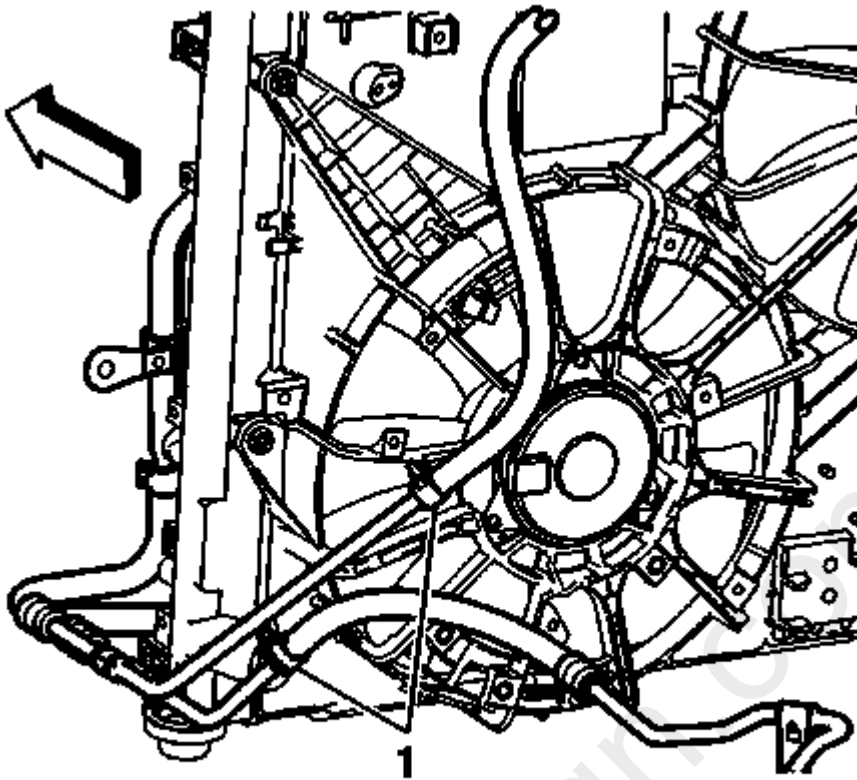


Fig. 357: Identifying Power Steering Hoses
Courtesy of GENERAL MOTORS COMPANY

38. Connect the power steering cooler hoses (1) to the power steering cooler at the condenser radiator and fan module (CRFM).

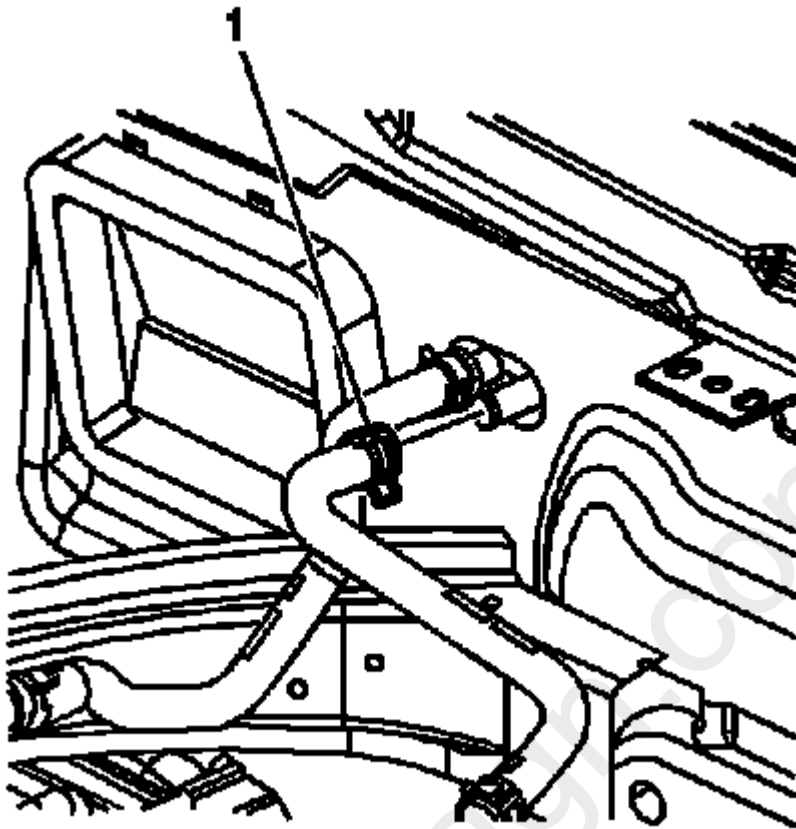


Fig. 358: Identifying Inlet Heater Hose
Courtesy of GENERAL MOTORS COMPANY

39. Connect the heater inlet heater hose (1) to the heater core.

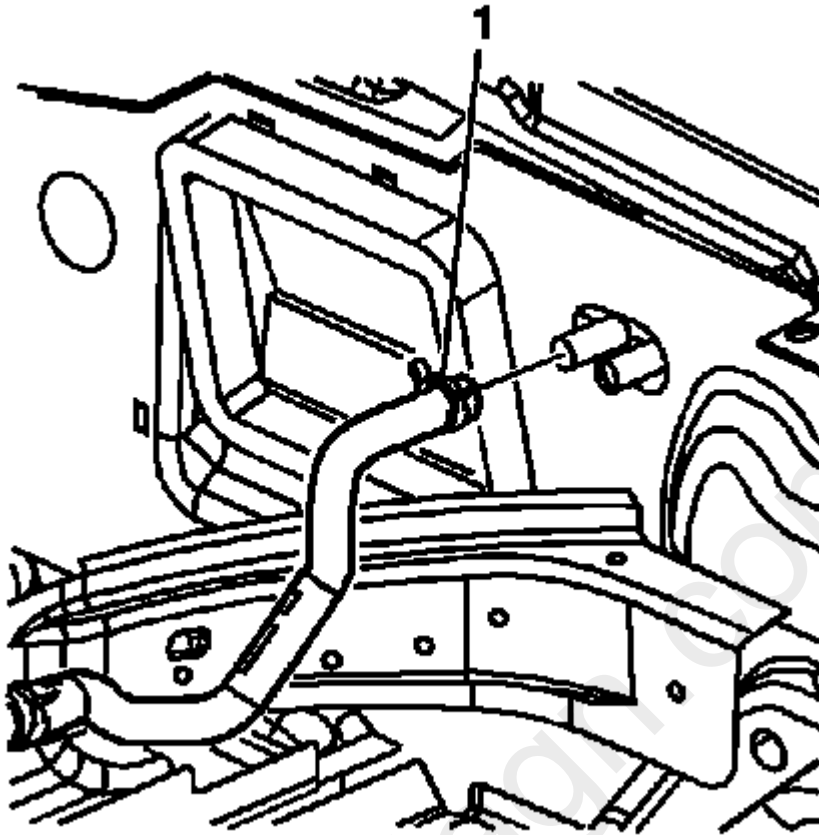


Fig. 359: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

40. Connect the heater outlet heater hose (1) to the heater core.
41. Install the radiator inlet and outlet hose. Refer to **Radiator Inlet Hose Replacement (LFW or LFX)** , and **Radiator Outlet Hose Replacement (LFX or LFW)** .

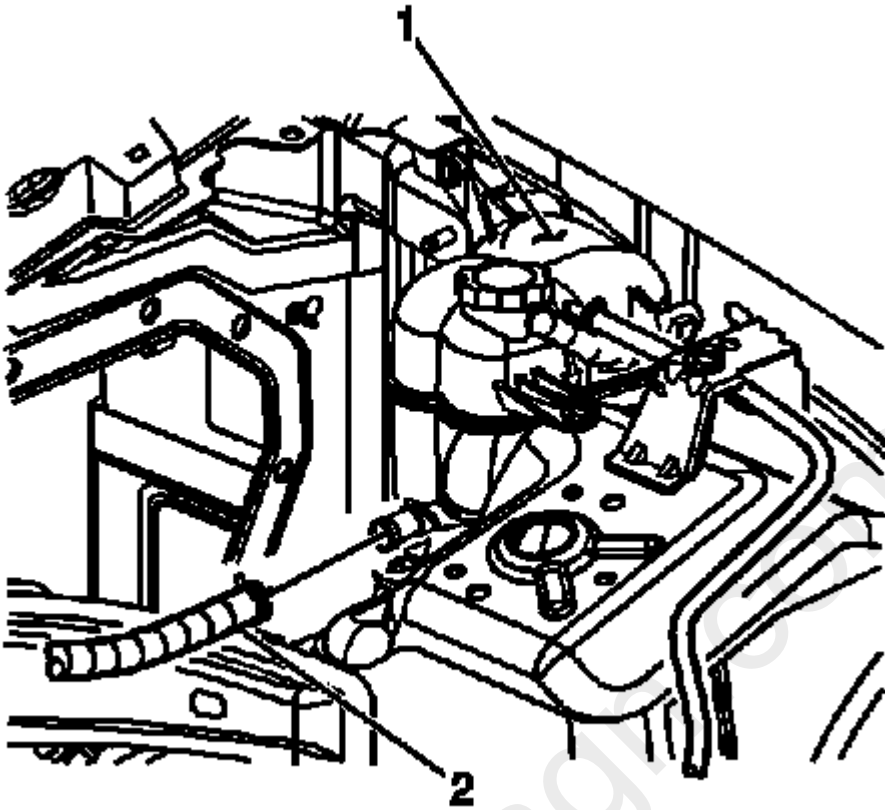


Fig. 360: Locating Surge Tank & Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

42. Connect the surge tank outlet hose (2) to the surge tank (1).
43. Connect the surge tank inlet hose to the water outlet.
44. Install the wiper module. Refer to **Windshield Wiper Transmission Replacement** .
45. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

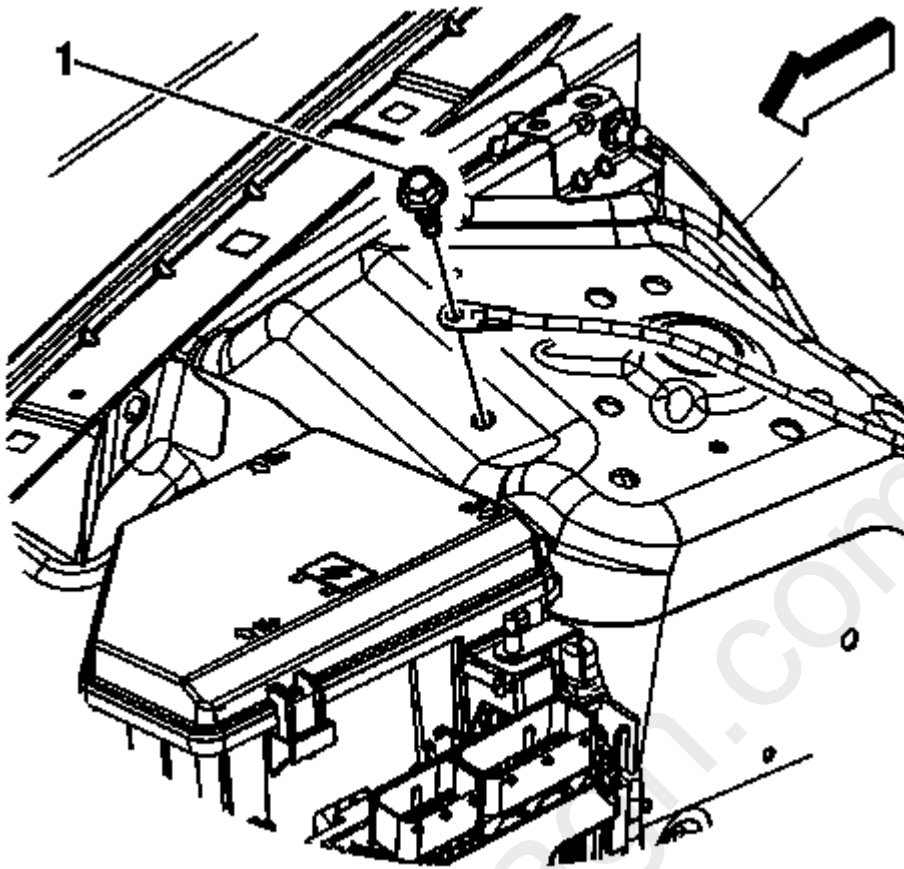


Fig. 361: Identifying Battery Negative Cable Ground Bolt
 Courtesy of GENERAL MOTORS COMPANY

46. Install the bolt (1) retaining the battery negative cable extension cable to the right strut tower. Refer to **Battery Negative Cable Extension Cable Replacement (3.0L,3.6L)** .
47. Install the intake manifold in insulator. Refer to **Intake Manifold Insulator Replacement** .
48. Install the cross vehicle brace. Refer to **Cross Vehicle Brace Replacement** .
49. Install the front compartment sight shields. Refer to **Front Compartment Sight Shields Replacement** .
50. Install the front compartment side sight shields. Refer to **Front Compartment Side Sight Shield Replacement** .
51. Connect the negative cable from the battery and the body at the top of the right strut tower. Refer to **Battery Negative Cable Replacement** .
52. Perform the following steps with the engine OFF:
 1. Check the oil level and fill as necessary.
 2. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill LFW or LFX)** , **Cooling System Draining and Filling (GE 47716 LFW or LFX)** .
 3. Fill and Bleed the power steering system. Refer to **Power Steering System Bleeding** .
 4. Charge the air conditioning system. Refer to **Refrigerant Recovery and Recharging (Belt Driven Compressor)** .

5. Bleed the Hydraulic Brake System. Refer to . Hydraulic Brake System Bleeding (Manual) , Hydraulic Brake System Bleeding (Pressure) .
6. Recheck all fluid levels.

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
2. Place a collecting pan underneath the oil filter.

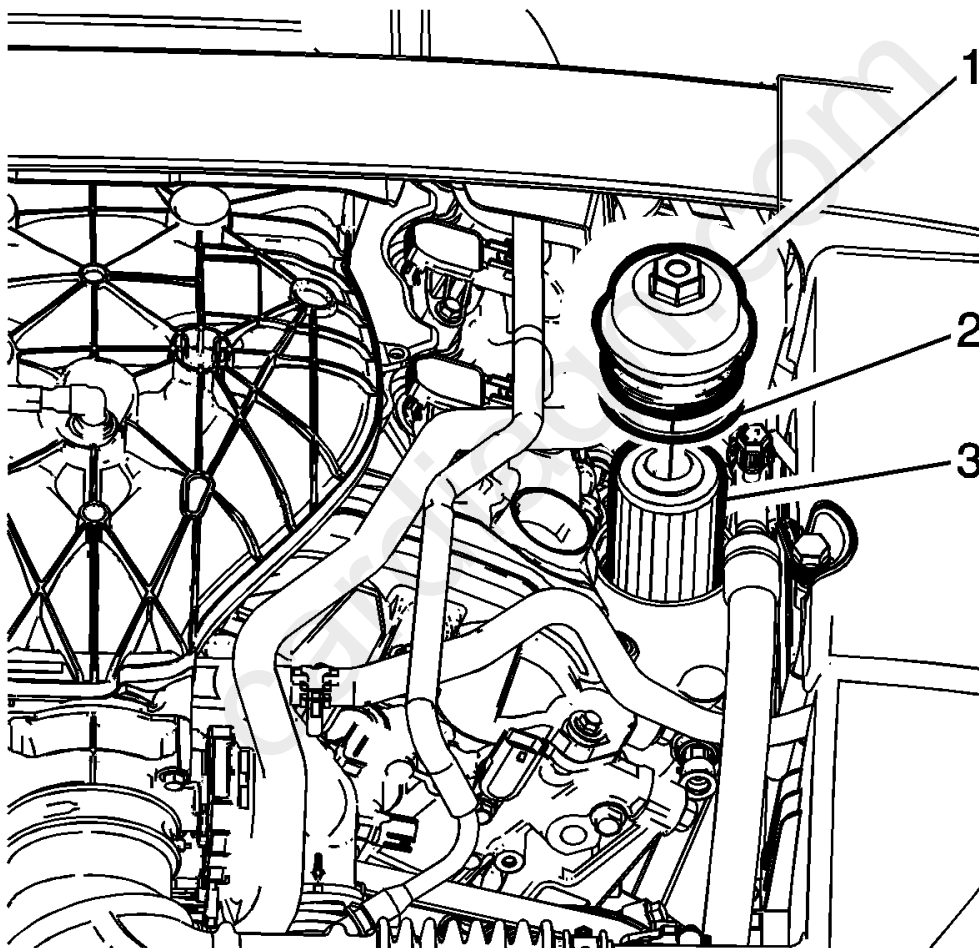


Fig. 362: Oil Cap & Seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil cap (1) and seal (2).
4. Remove and properly dispose of the oil filter insert (3).
5. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
6. Remove the front compartment lower noise shield. Refer to Front Compartment Lower Noise Shield

Replacement (All Wheel Drive) , Front Compartment Lower Noise Shield Replacement (Rear Wheel Drive) .

7. Place a suitable drain below the oil pan drain plug.

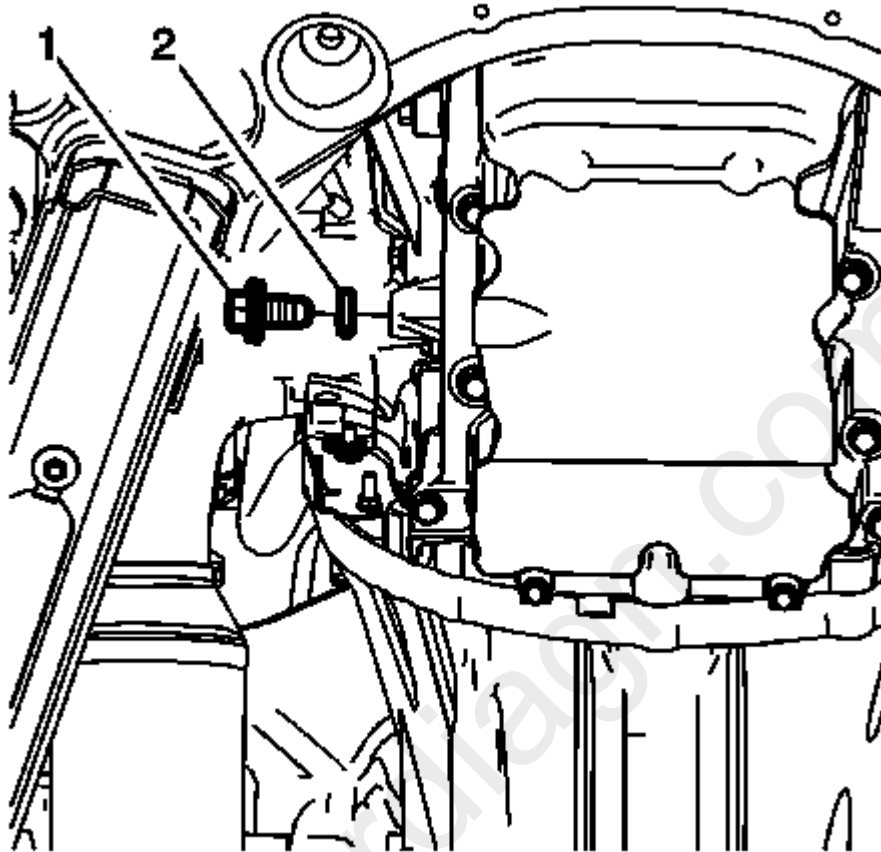


Fig. 363: Oil Drain Plug & Seal
Courtesy of GENERAL MOTORS COMPANY

8. Remove the oil pan drain plug (1) and seal (2).
9. Allow the oil to drain completely.

Installation Procedure

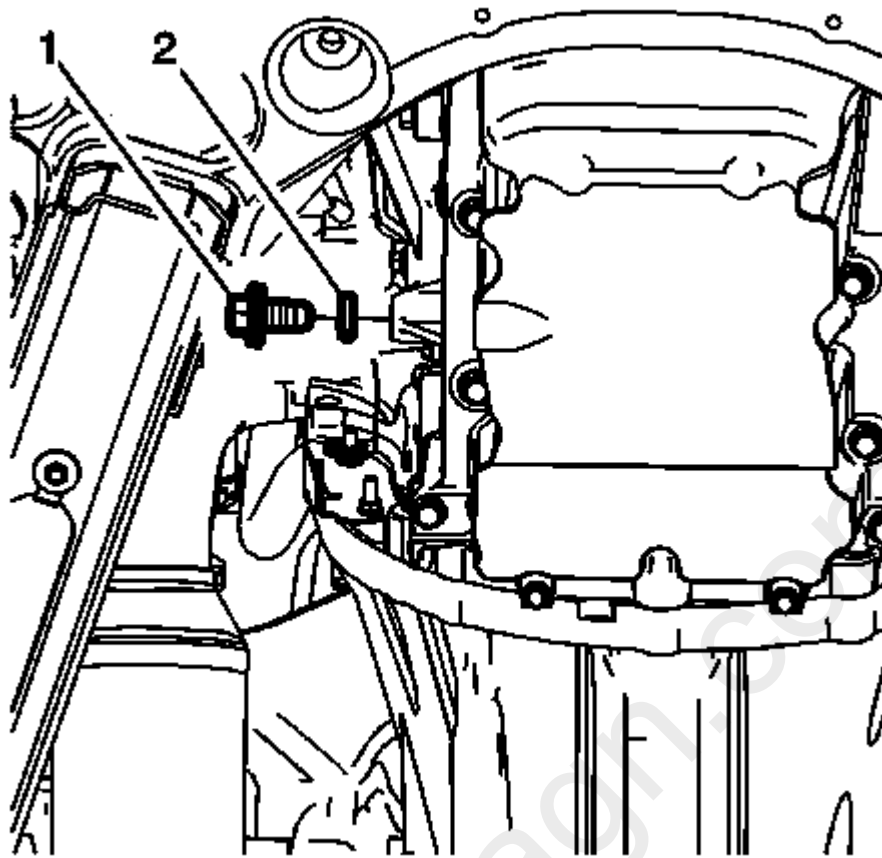


Fig. 364: Oil Drain Plug & Seal

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW seal (2) and oil pan drain plug (1) and tighten to 25 N.m (18 lb ft).
2. Remove the drain pan out of the way.
3. Install the front compartment lower noise shield. Refer to **Front Compartment Lower Noise Shield Replacement (All Wheel Drive)** , **Front Compartment Lower Noise Shield Replacement (Rear Wheel Drive)** .
4. Lower the vehicle.

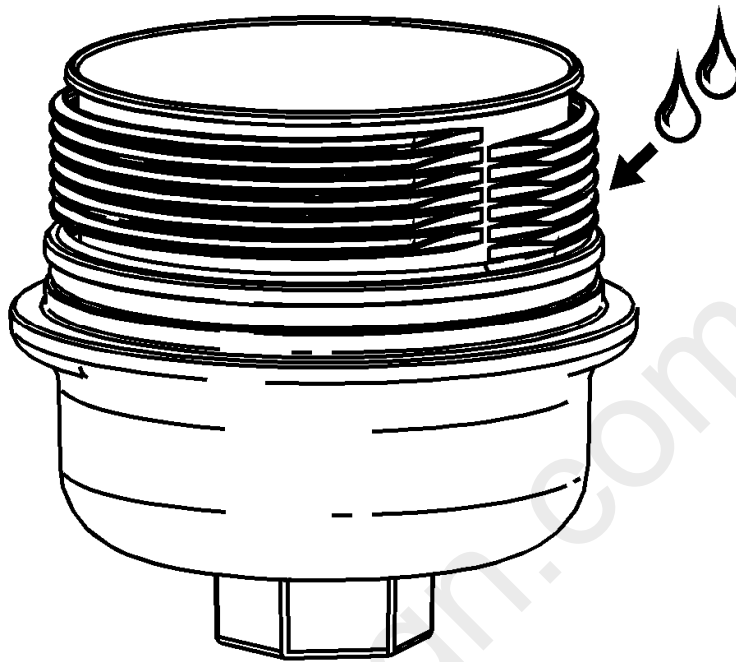


Fig. 365: Lubricating Threads Of Oil Filter Cap
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Lubrication must be applied to the threads of the oil filter cap prior to installation. Failure to lubricate the oil filter cap threads can hinder later removal and cause possible oil filter cap damage.

5. Lubricate the oil filter cap threads with clean engine oil.

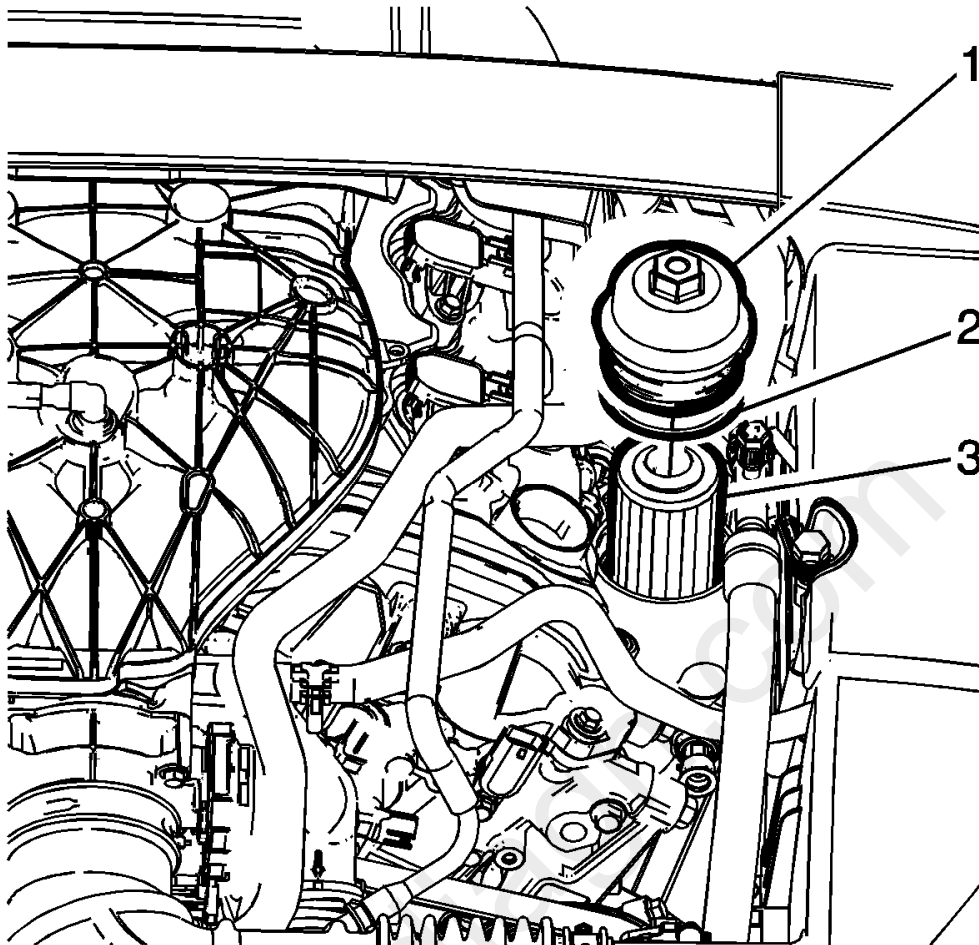


Fig. 366: Oil Cap & Seal

Courtesy of GENERAL MOTORS COMPANY

6. Install a NEW oil filter (3)

CAUTION: Proper oil filter cap tightening is mandatory. Failure to tighten the oil filter cap to the proper specification can hinder later removal and cause possible oil filter cap damage.

7. Install a NEW seal (2) and tighten the oil cap (1) to 25 N.m (18 lb ft).
8. Fill the engine with the appropriate oil type and quantity. Refer to **Fluid and Lubricant Recommendations (USA and Canada)**
9. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement.**
10. Reset the oil life.