

Engine Mechanical - 4.6L (LH2) (Repair Instructions, 2 Of 5) - SRX

Removal Procedure

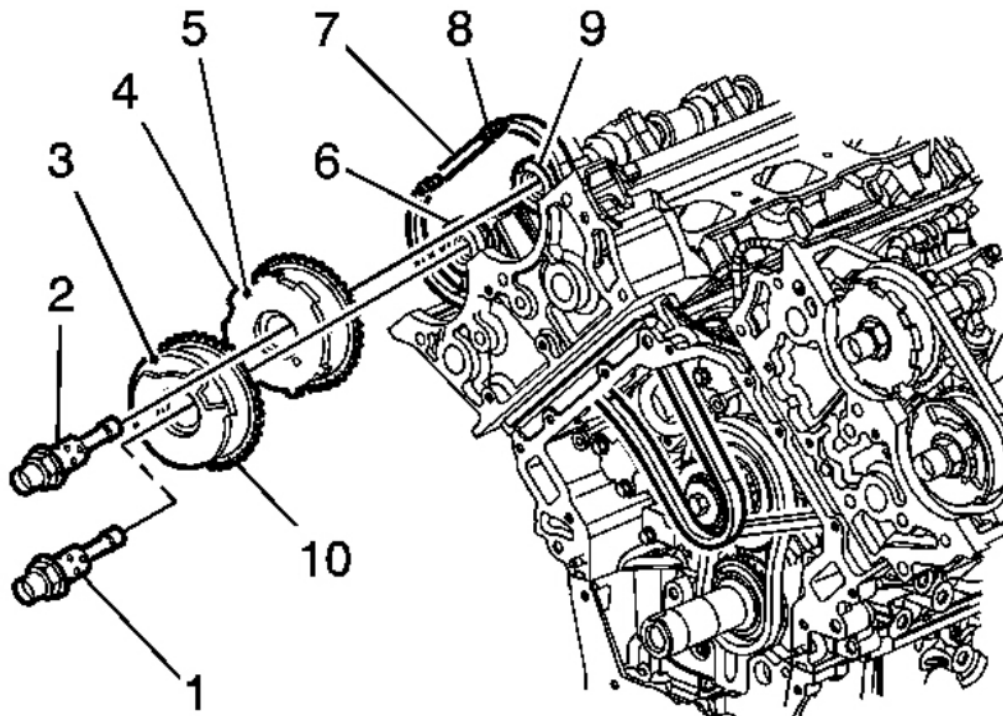


Fig. 1: Identifying Camshaft Sprockets & Related Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the right intake camshaft actuator (4). Refer to **Camshaft Position (CMP) Actuator Replacement - Bank 1 (Right) Intake** .
2. Remove the right exhaust camshaft actuator (10). Refer to **Camshaft Position (CMP) Actuator Replacement - Bank 1 (Right) Exhaust** .

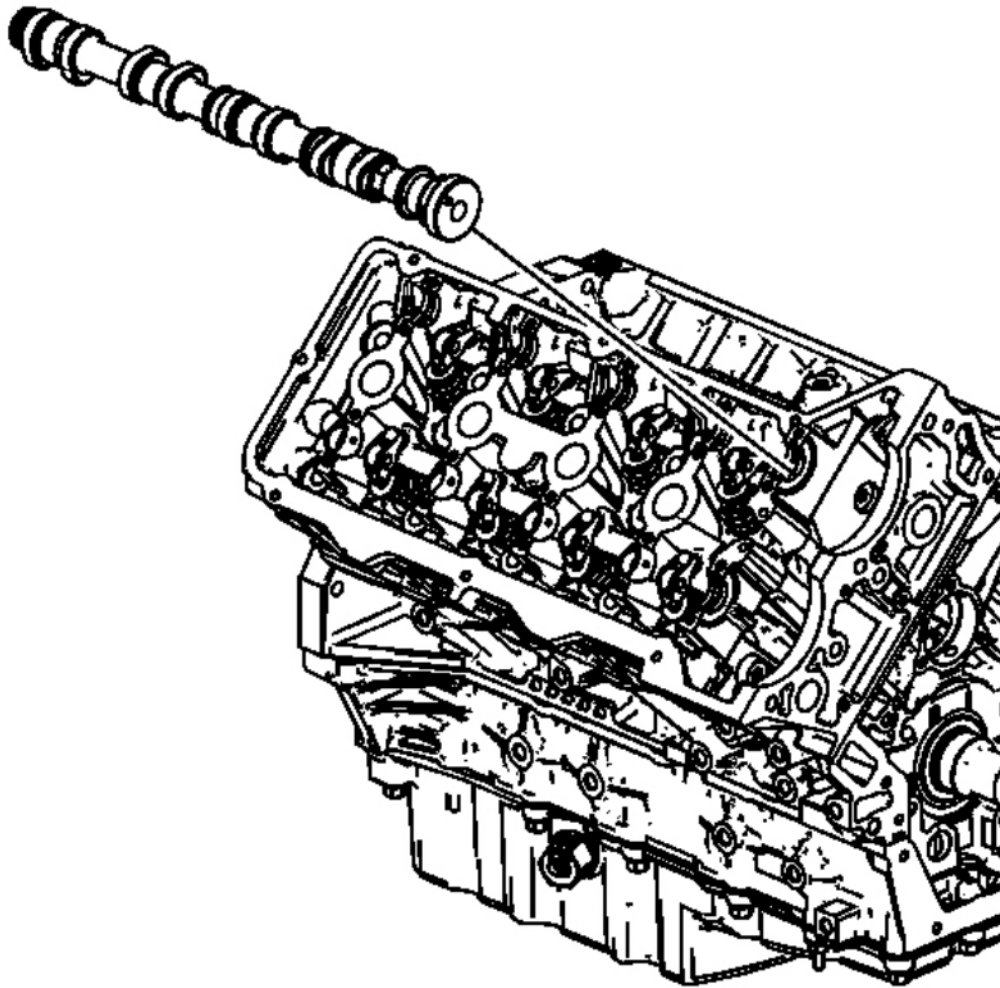


Fig. 2: View Of Right Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

3. Remove the right intake camshaft. Refer to **Camshaft Removal - Right Intake** .

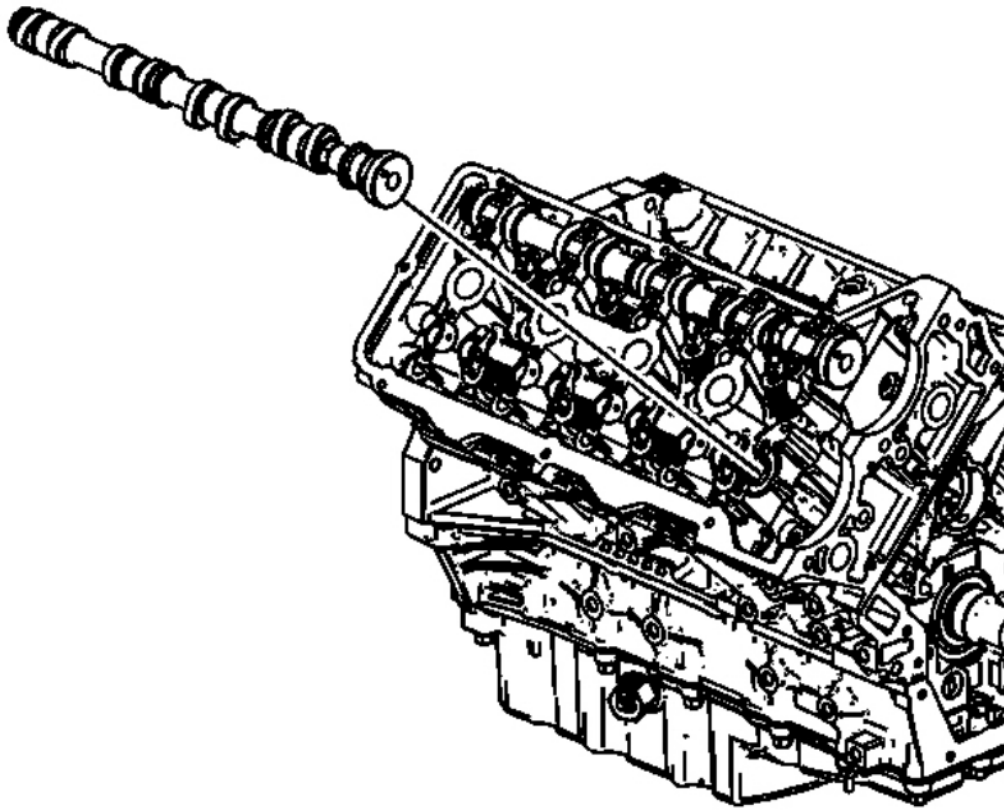


Fig. 3: View Of Right Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Remove the right exhaust camshaft. Refer to **Camshaft Removal - Right Exhaust** .
5. Clean and inspect the camshafts. Refer to **Camshaft Cleaning and Inspection** .

Installation Procedure

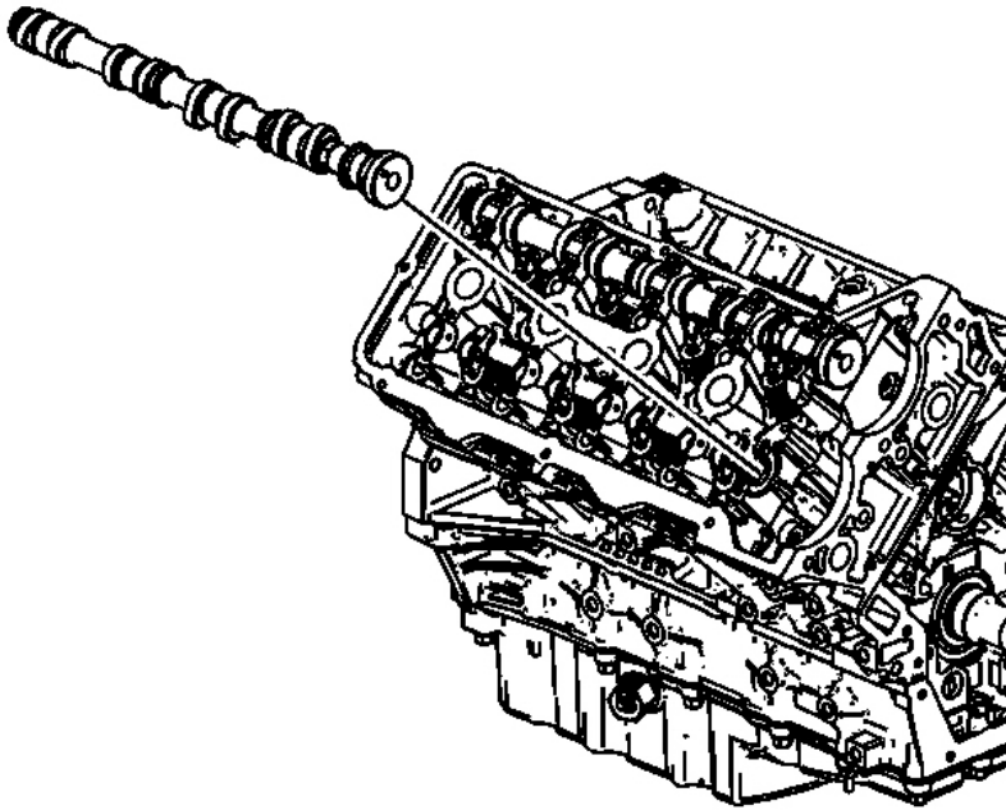


Fig. 4: View Of Right Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

1. Install the right exhaust camshaft. Refer to **Camshaft Installation - Right Exhaust** .

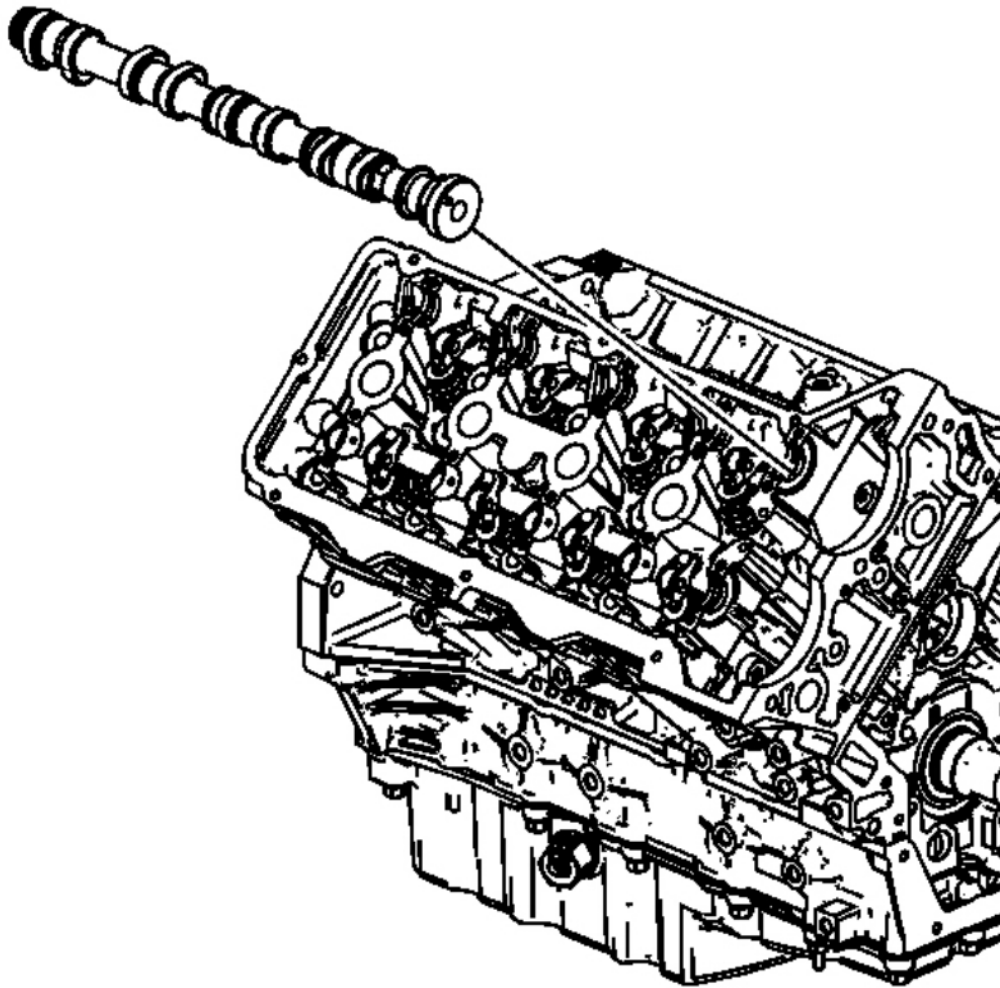


Fig. 5: View Of Right Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

2. Install the right intake camshaft. Refer to Camshaft Installation - Right Intake .

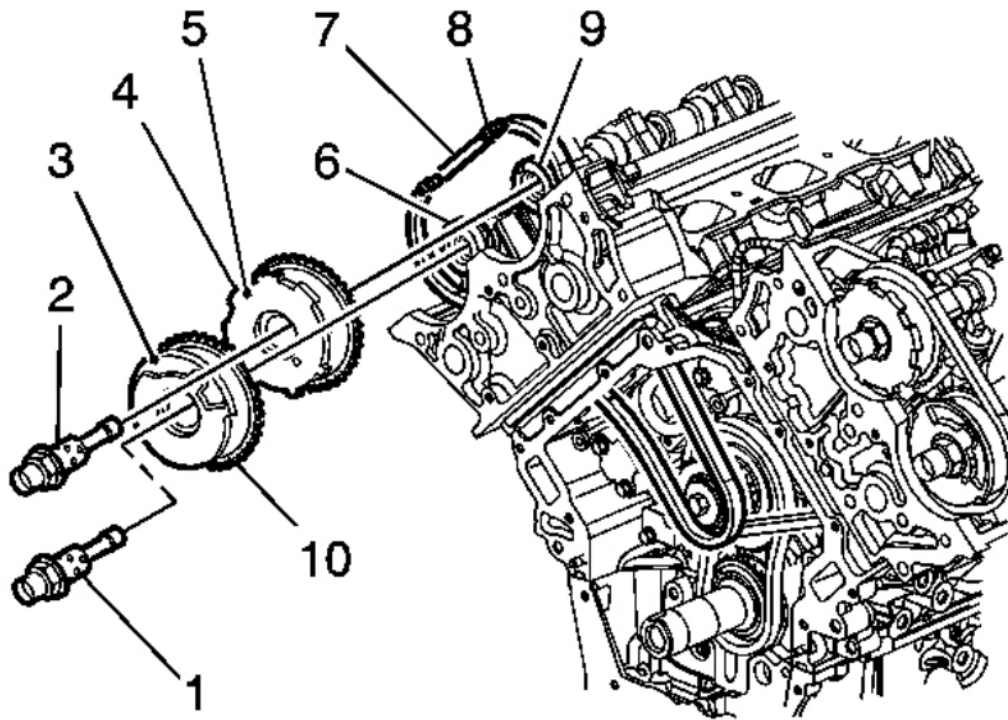


Fig. 6: Identifying Camshaft Sprockets & Related Components
Courtesy of GENERAL MOTORS CORP.

3. Install the right exhaust camshaft actuator (10). Refer to **Camshaft Position (CMP) Actuator Replacement - Bank 1 (Right) Exhaust** .
4. Install the right intake camshaft actuator (4). Refer to **Camshaft Position (CMP) Actuator Replacement - Bank 1 (Right) Intake** .

VALVE ROCKER ARM REPLACEMENT - LEFT

Removal Procedure

1. Remove the left camshafts. Refer to **Camshaft Replacement - Left** .

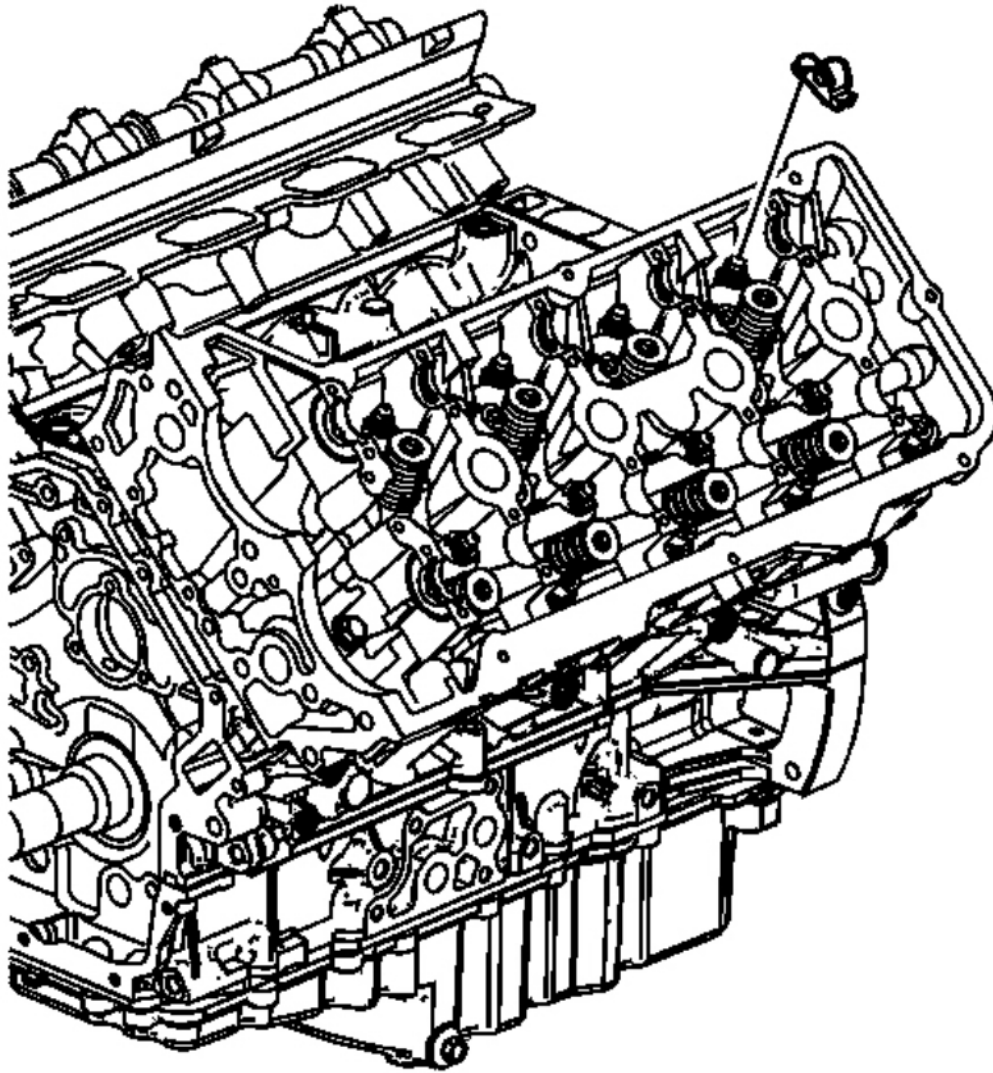


Fig. 7: View Of Left Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLAs) and original location the components were assembled in.

2. Remove the camshaft followers from the left cylinder head.

3. Clean and inspect the rocker arms. Refer to Valve Rocker Arms Cleaning and Inspection .

Installation Procedure

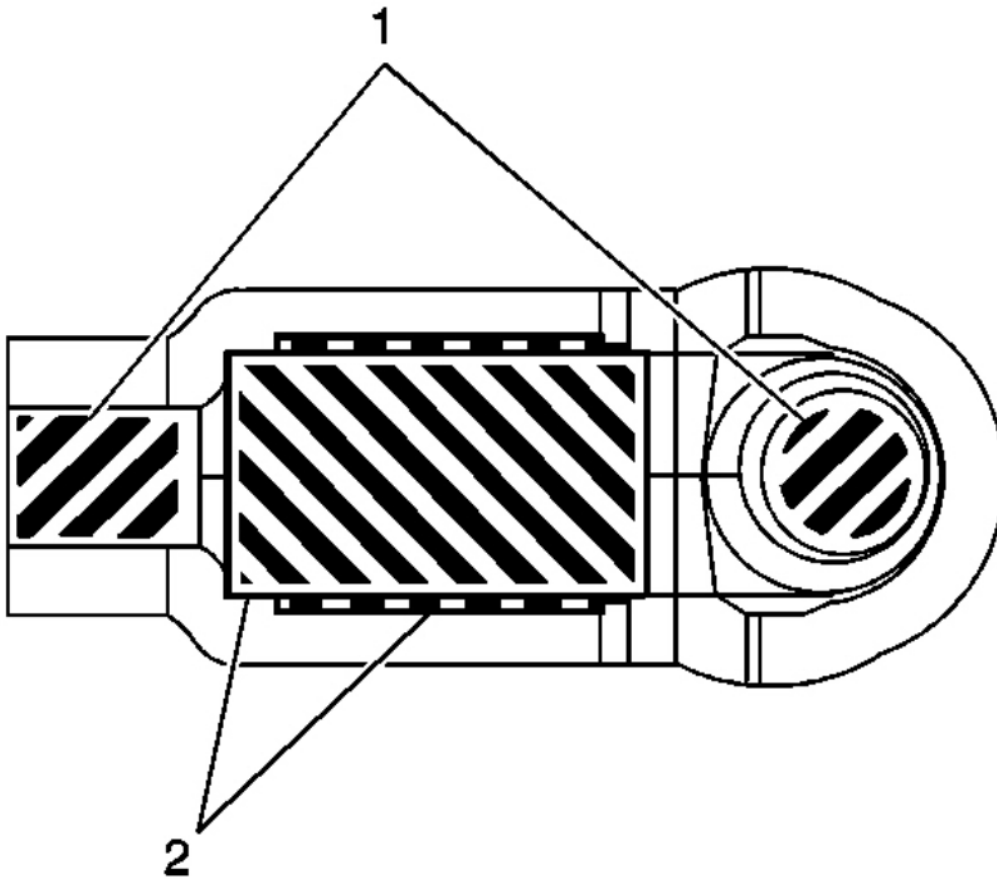


Fig. 8: Identifying Roller Pivot Pocket (2) & Valve Slot Areas (1) Of Camshaft Followers

Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the roller pivot pocket (2) and valve slot areas (1) of the camshaft followers.

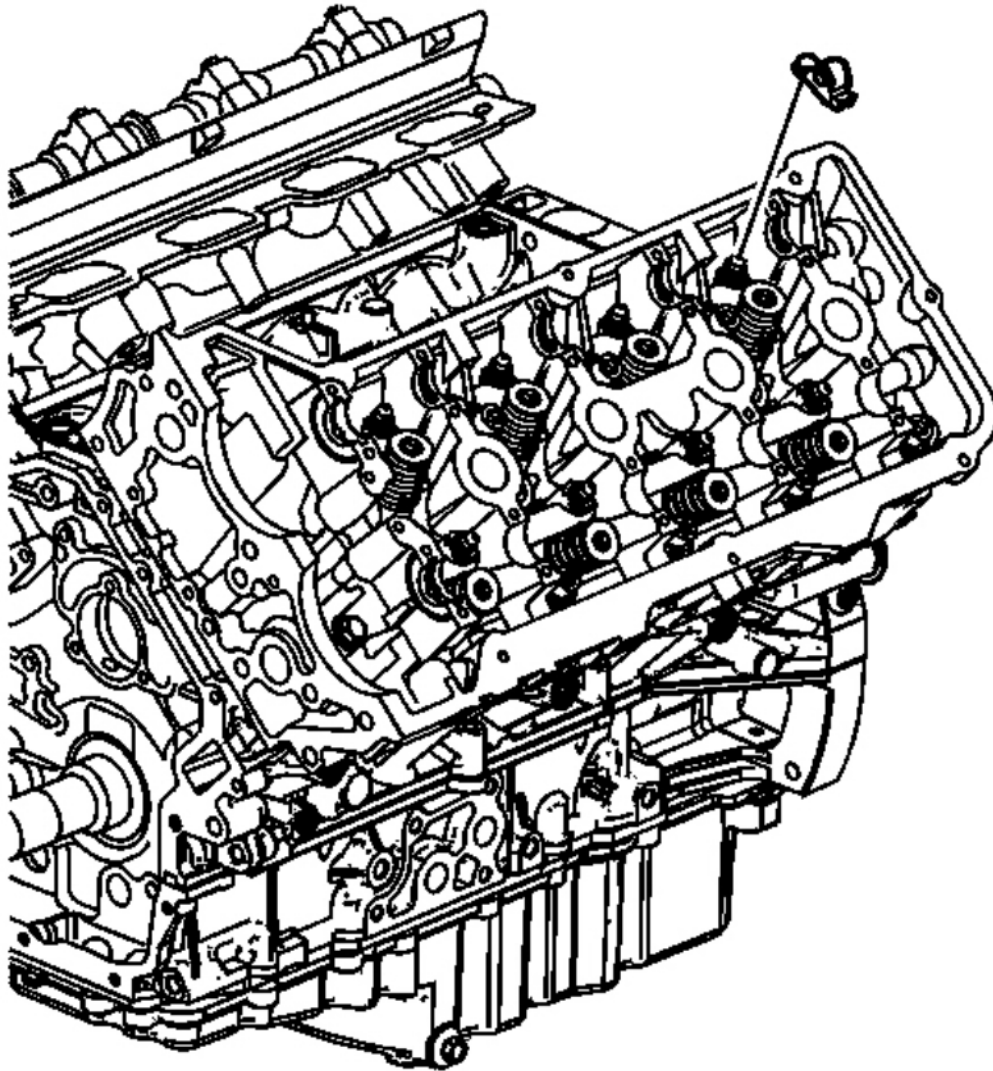


Fig. 9: View Of Left Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 2 Of 5) - SRX

2. Place the camshaft followers in position on the valve tip and the SHLA. The rounded head of the follower goes on the SHLA, while the flat end goes on the valve tip.
3. Install the left camshafts. Refer to **Camshaft Replacement - Left** .

VALVE ROCKER ARM REPLACEMENT - RIGHT

Removal Procedure

1. Remove the right camshafts. Refer to **Camshaft Replacement - Right**.

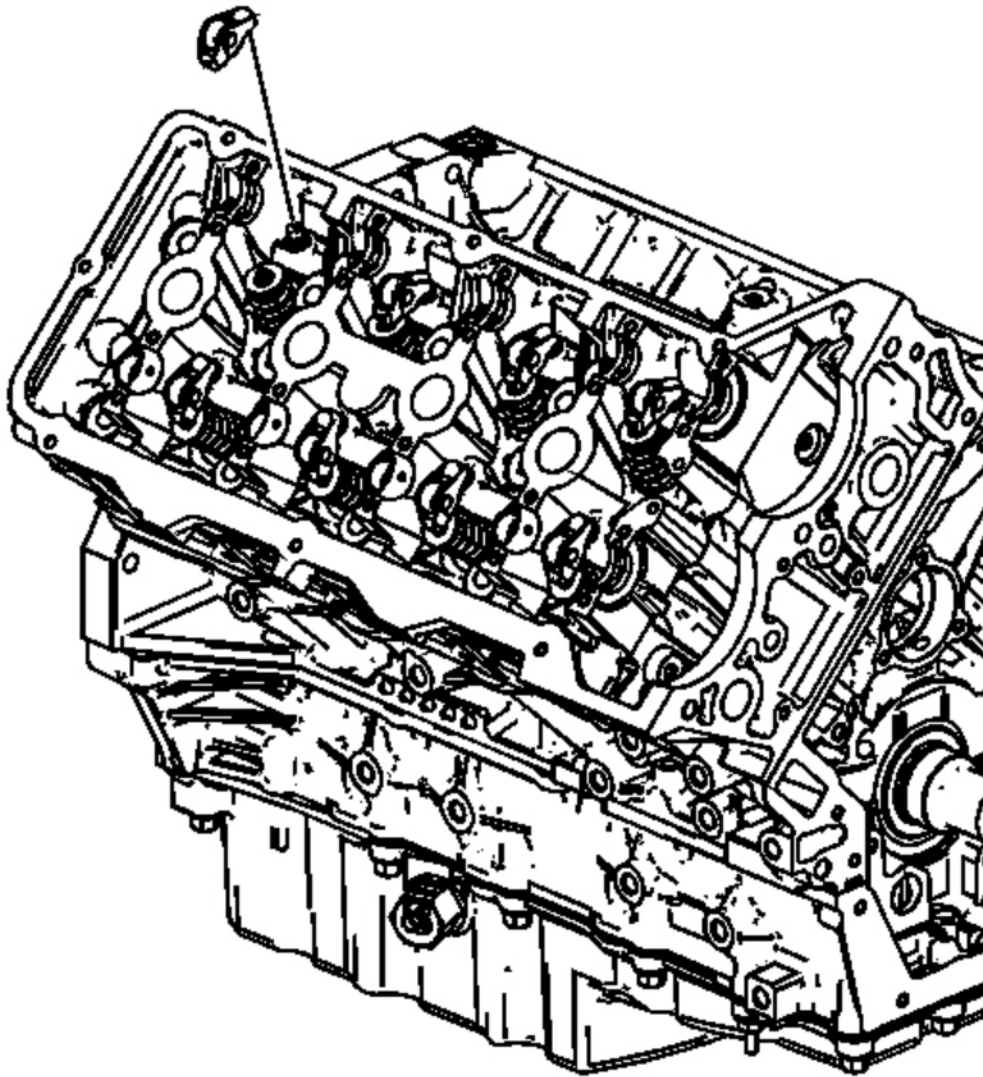


Fig. 10: View Of Right Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLAs) and original location the components were assembled in.

2. Remove the camshaft followers from the right cylinder head.

3. Clean and inspect the rocker arms. Refer to Valve Rocker Arms Cleaning and Inspection .

Installation Procedure

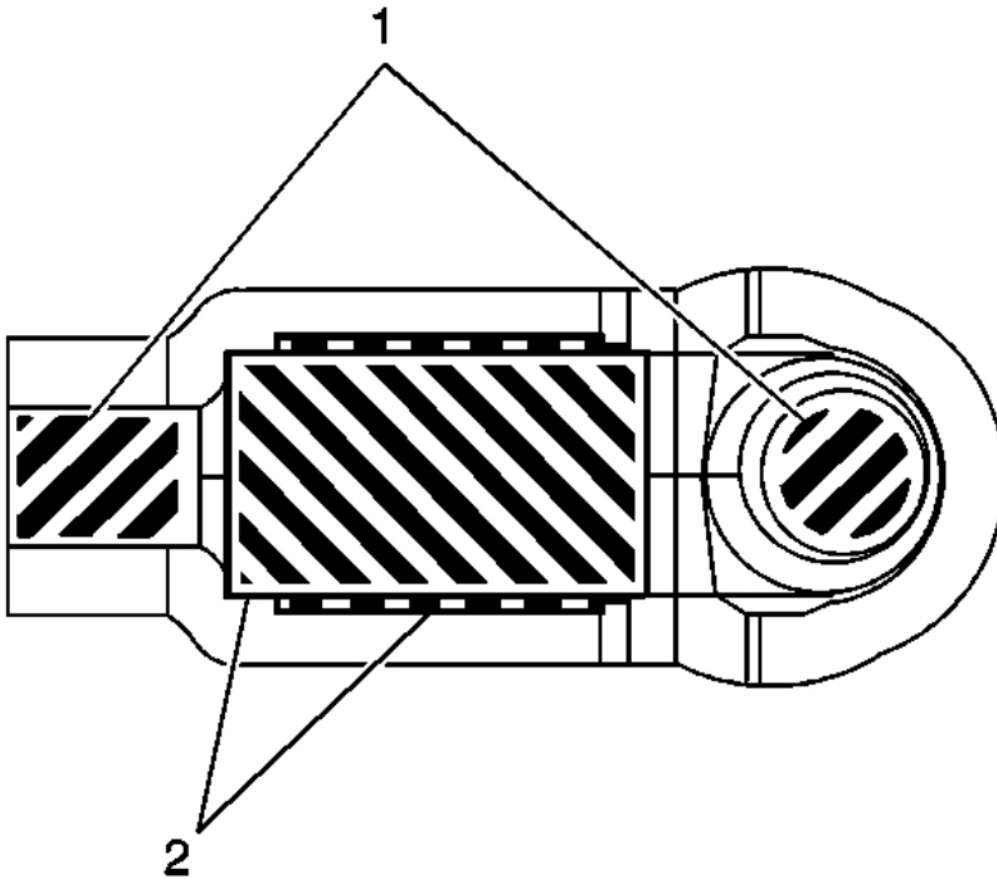


Fig. 11: Identifying Roller Pivot Pocket (2) & Valve Slot Areas (1) Of Camshaft Followers

Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the roller pivot pocket (2) and valve slot areas (1) of the camshaft followers.

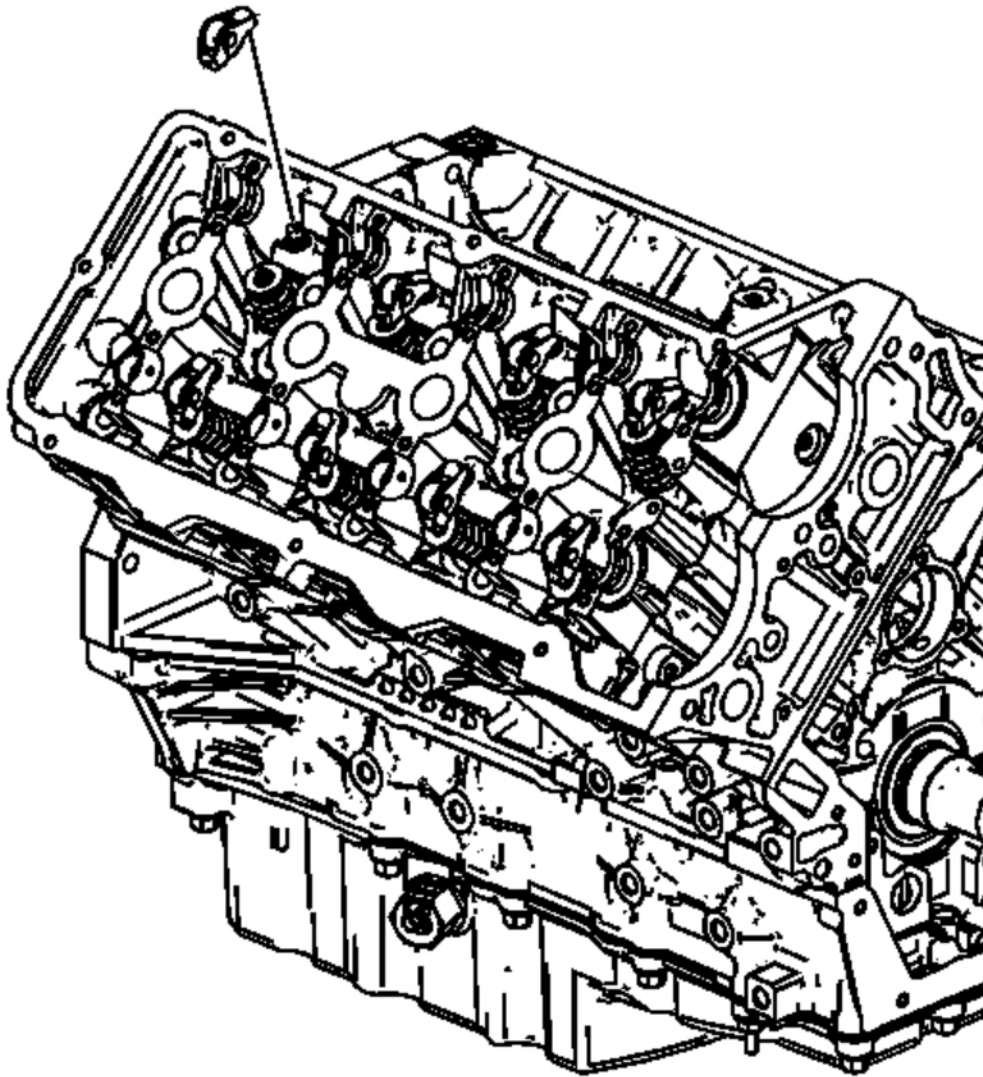


Fig. 12: View Of Right Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2. Place the camshaft followers in position on the valve tip and the SHLA. The rounded head of the follower goes on the SHLA, while the flat end goes on the valve tip.
3. Install the right camshafts. Refer to **Camshaft Replacement - Right.**

VALVE LIFTER REPLACEMENT - LEFT

Removal Procedure

1. Remove the left valve rocker arms. Refer to **Valve Rocker Arm Replacement - Left.**

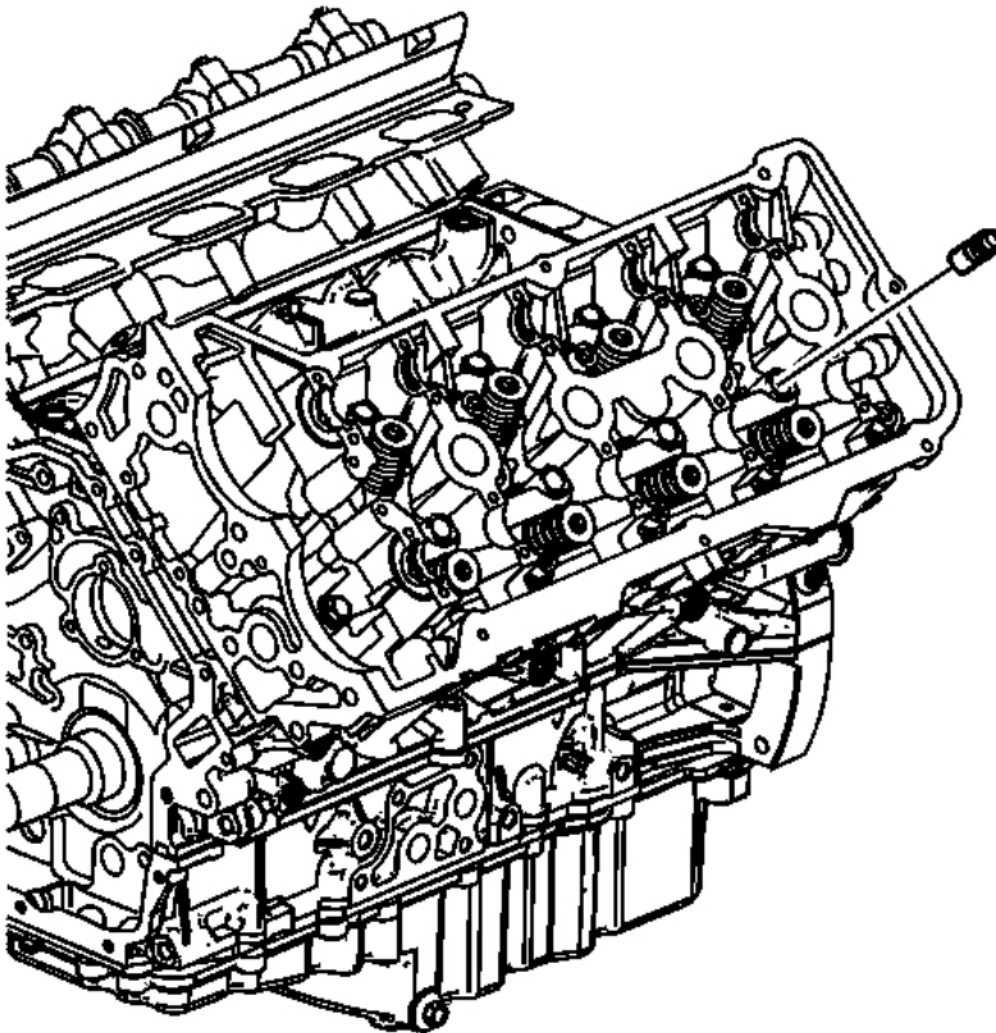


Fig. 13: View Of Left Valve Lifter

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLA) and original location the components were assembled in.

2. Remove the SHLA from the left cylinder head bores.
3. Clean and inspect the valve lifters. Refer to Valve Lifters Cleaning and Inspection .

Installation Procedure

1. Ensure the crankshaft is in the top dead center (TDC) position for the number one cylinder.

NOTE: Refer to Valve Lifter Priming Notice in Cautions and Notices.

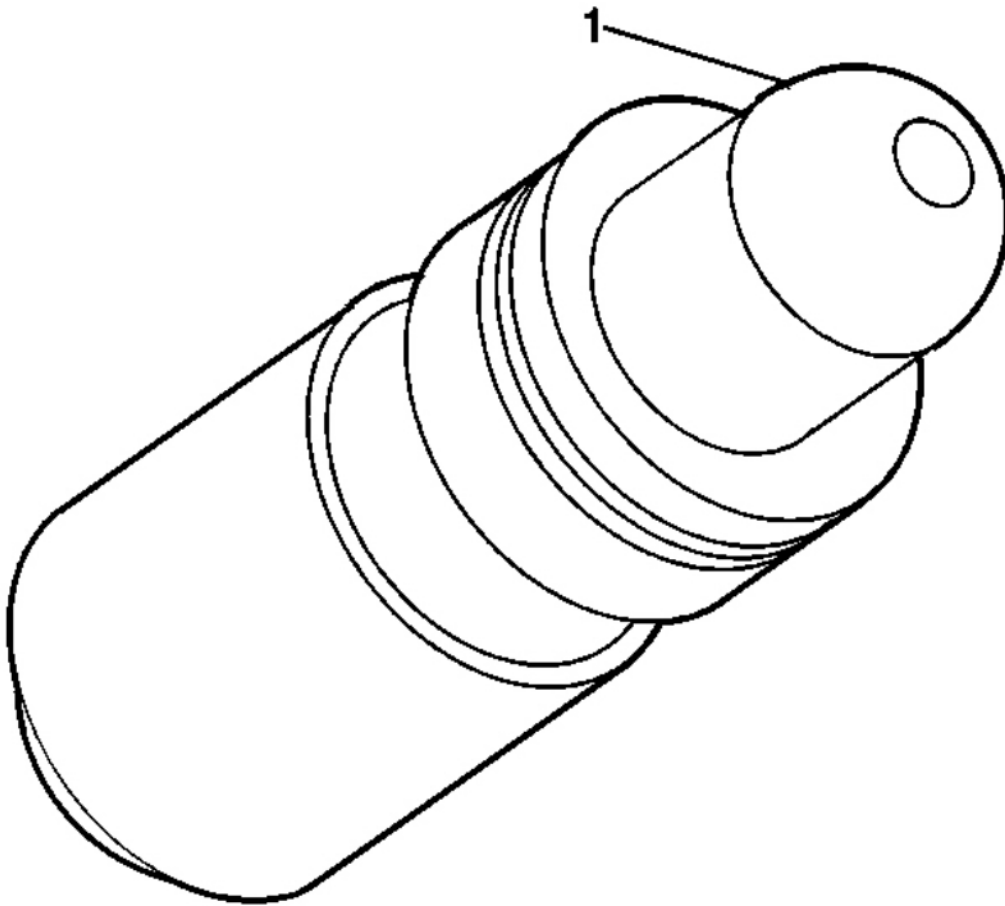


Fig. 14: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

2. Fill the SHLA with clean engine oil GM P/N 12378006 or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.

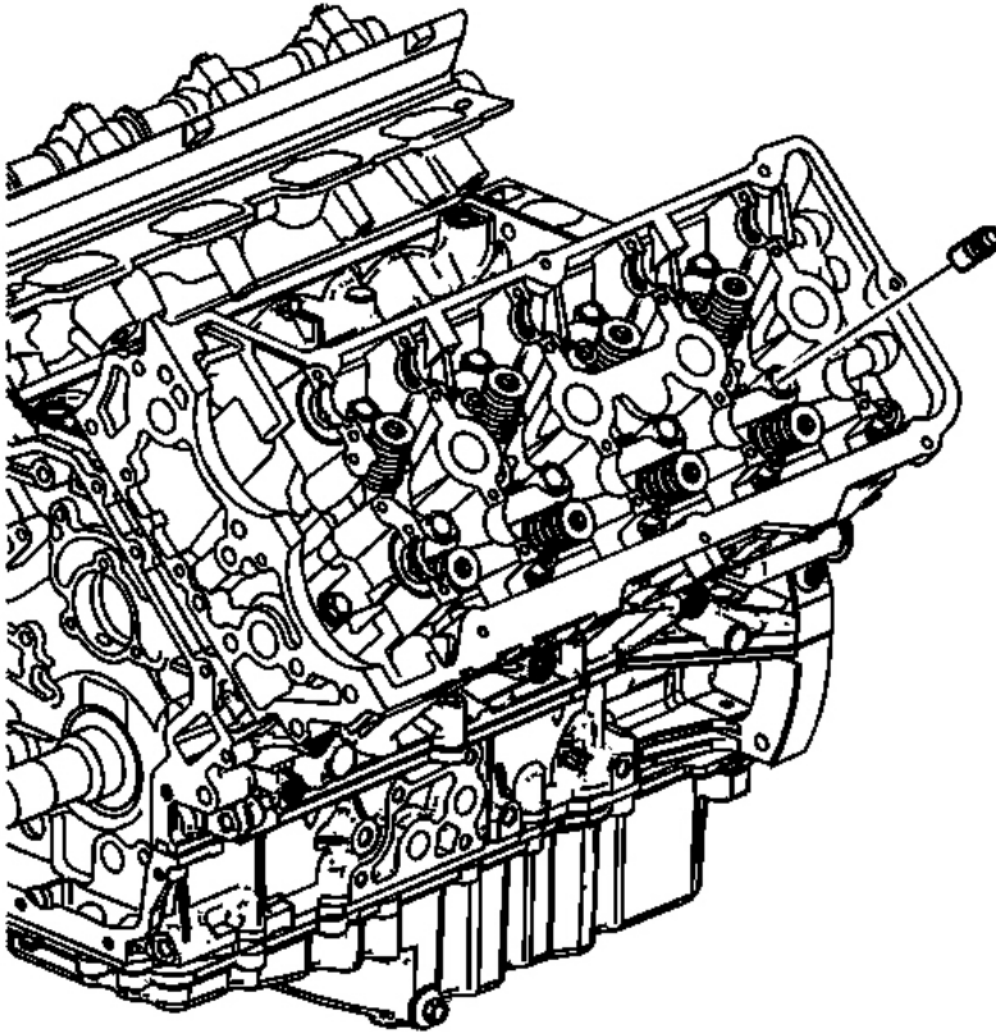


Fig. 15: View Of Left Valve Lifter
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the SHLA bores of the cylinder head with clean engine oil GM P/N 12378006 or equivalent.
4. Install the SHLA into the bores.
5. Install the left valve rocker arms. Refer to **Valve Rocker Arm Replacement - Left.**

Removal Procedure

1. Remove the right valve rocker arms. Refer to Valve Rocker Arm Replacement - Right.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLA) and original location the components were assembled in.

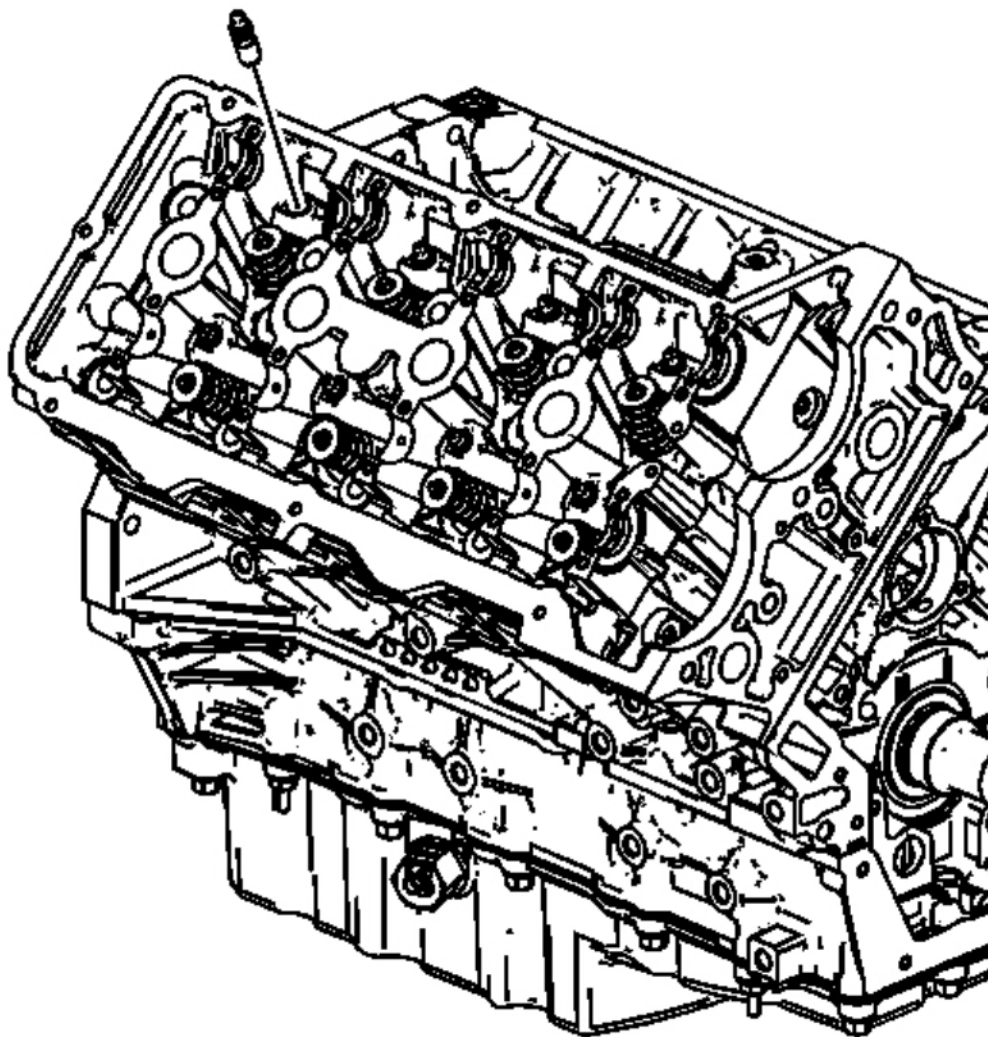


Fig. 16: View Of Right Valve Lifter

Courtesy of GENERAL MOTORS CORP.

2. Remove the SHLA from the right cylinder head bores.
3. Clean and inspect the valve lifters. Refer to Valve Lifters Cleaning and Inspection .

Installation Procedure

1. Ensure the crankshaft is in the top dead center (TDC) position for the number one cylinder.

NOTE: Refer to Valve Lifter Priming Notice in Cautions and Notices.

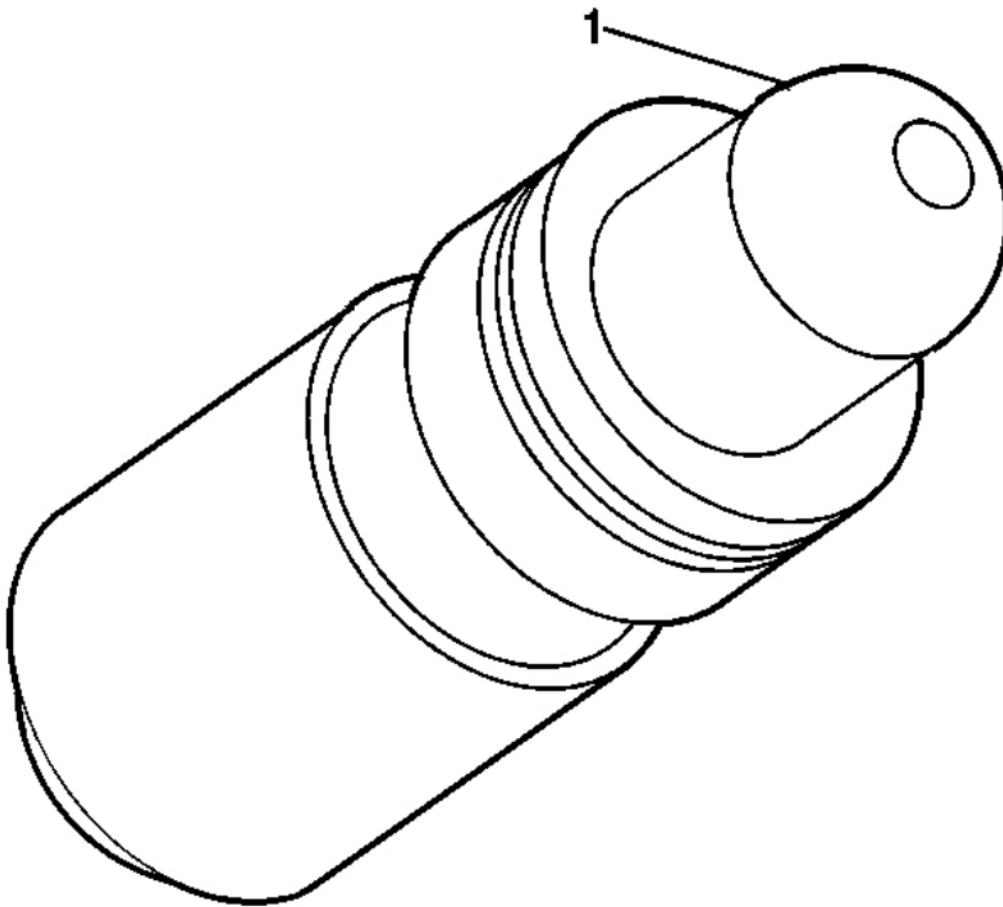


Fig. 17: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

2. Fill the SHLA with clean engine oil GM P/N 12378006 or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.

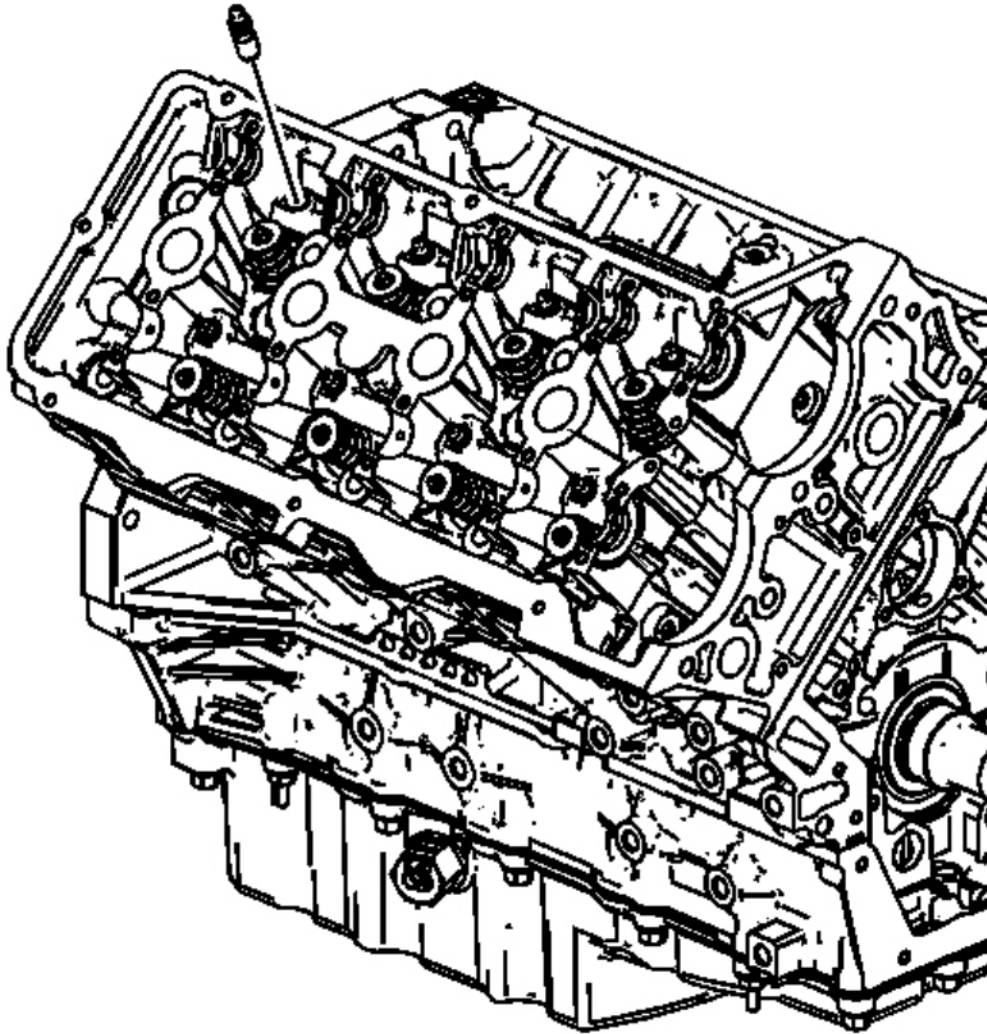


Fig. 18: View Of Right Valve Lifter
Courtesy of GENERAL MOTORS CORP.

3. Lubricate the SHLA bores of the cylinder head with clean engine oil GM P/N 12378006 or equivalent.

4. Install the SHLA into the bores.
5. Install the right valve rocker arms. Refer to **Valve Rocker Arm Replacement - Right**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - LEFT

Tools Required

- **J 38820** Valve Stem Seal Installer
- **J 39313** Spark Plug Port Adapter
- **J 44211** On-Vehicle Valve Spring Compressor
- **EN 46326** Flywheel Holder

Removal Procedure

1. Remove the left camshafts. Refer to **Camshaft Replacement - Left** .
2. Remove the starter. Refer to **Starter Motor Replacement (LH2)** or **Starter Motor Replacement (LY7)** in Engine Electrical.

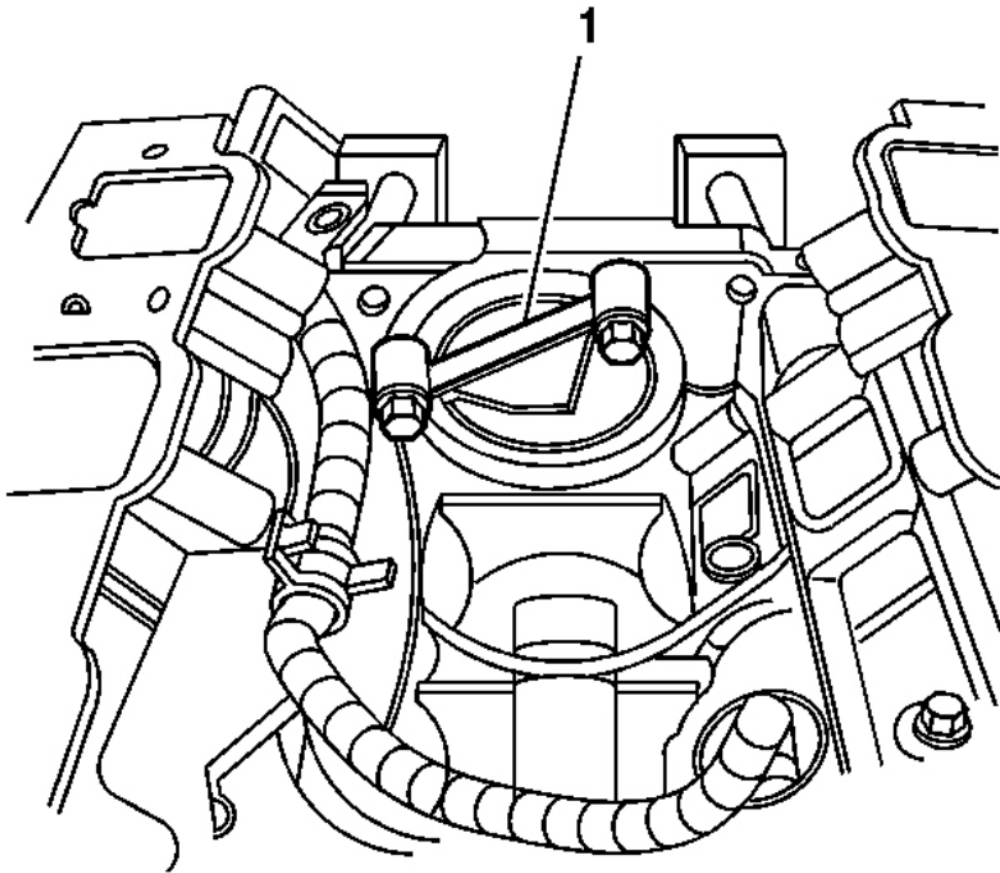


Fig. 19: View Of EN 46326 Installed To Engine Block
Courtesy of GENERAL MOTORS CORP.

3. Install the EN 46326 (1).

NOTE: Clean the spark plug recess area before removing the spark plug. Failure to do so could result in engine damage because of dirt or foreign material entering the cylinder head, or by the contamination of the cylinder head threads. The contaminated threads may prevent the proper seating of the new plug. Use a thread chaser to clean the threads of any contamination.

4. Remove the spark plug from the cylinder being worked on.

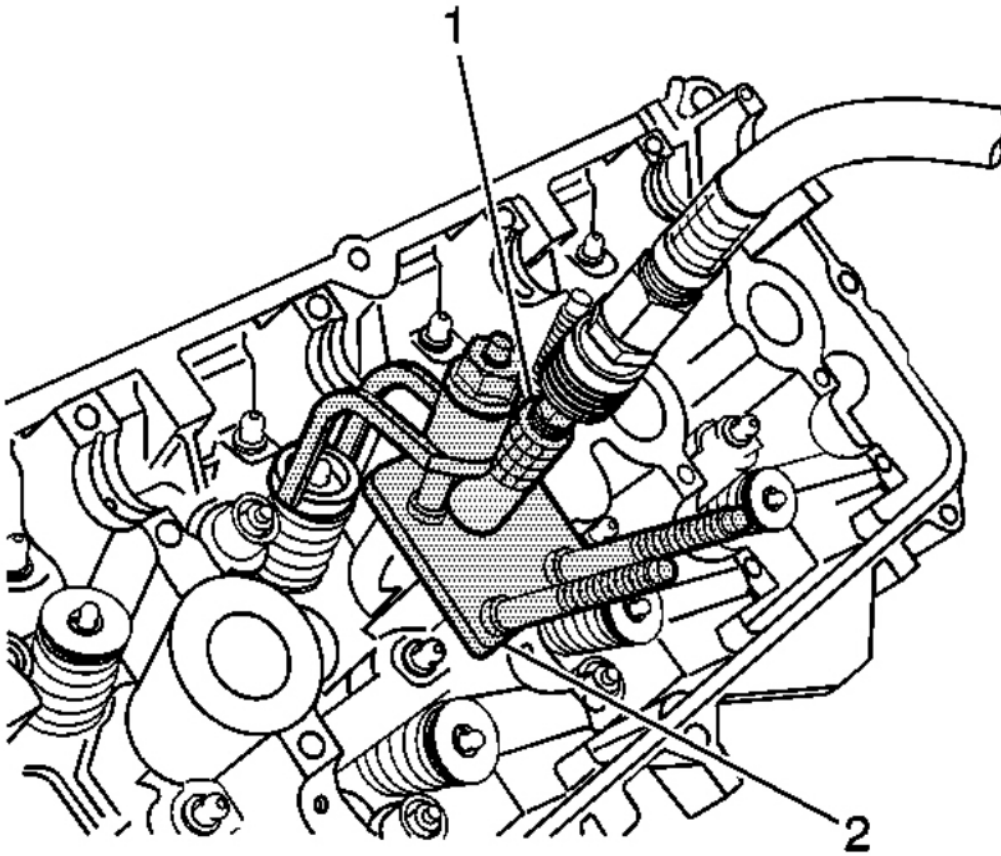


Fig. 20: View Of Base Plate Installed Over The Spark Plug Hole For Changing Valve Stem Seal

Courtesy of GENERAL MOTORS CORP.

5. Install the base plate of the **J 44211** (2) over the spark plug hole of the cylinder to be serviced.
6. Install the **J 39313** (1) in the spark plug hole.
7. Apply constant air pressure to the **J 39313** (1) in order to keep the valve closed.
8. Install the arm and swivel nut of the **J 44211** (2) over the stud corresponding to the valve to be serviced.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

9. Tighten the swivel nut of the **J 44211** (2) down only enough to allow access for removal of the valve locks.
10. Use a magnet to remove the valve locks.
11. Loosen the swivel nut of the **J 44211** (2) and swing the arm away from the valve spring retainer.
12. Remove the valve spring retainer and valve spring.

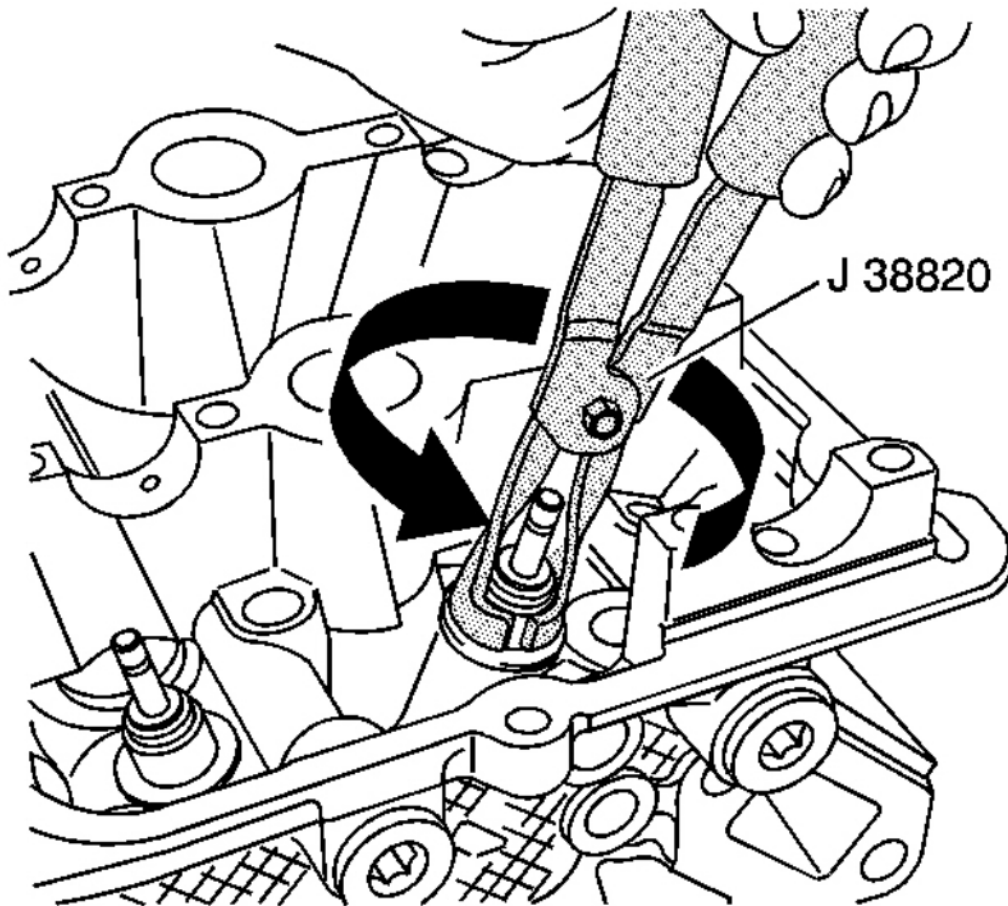


Fig. 21: Using J 38820 To Replace Valve Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The valve stem seal should not be removed unless replacement is required.

13. Use the **J 38820** in order to grip the seal. Remove the seal by exerting a twisting, pulling motion. Discard the old valve stem seal.
14. Inspect and measure the valve spring. Refer to **Valve Spring Inspection and Measurement**.

Installation Procedure

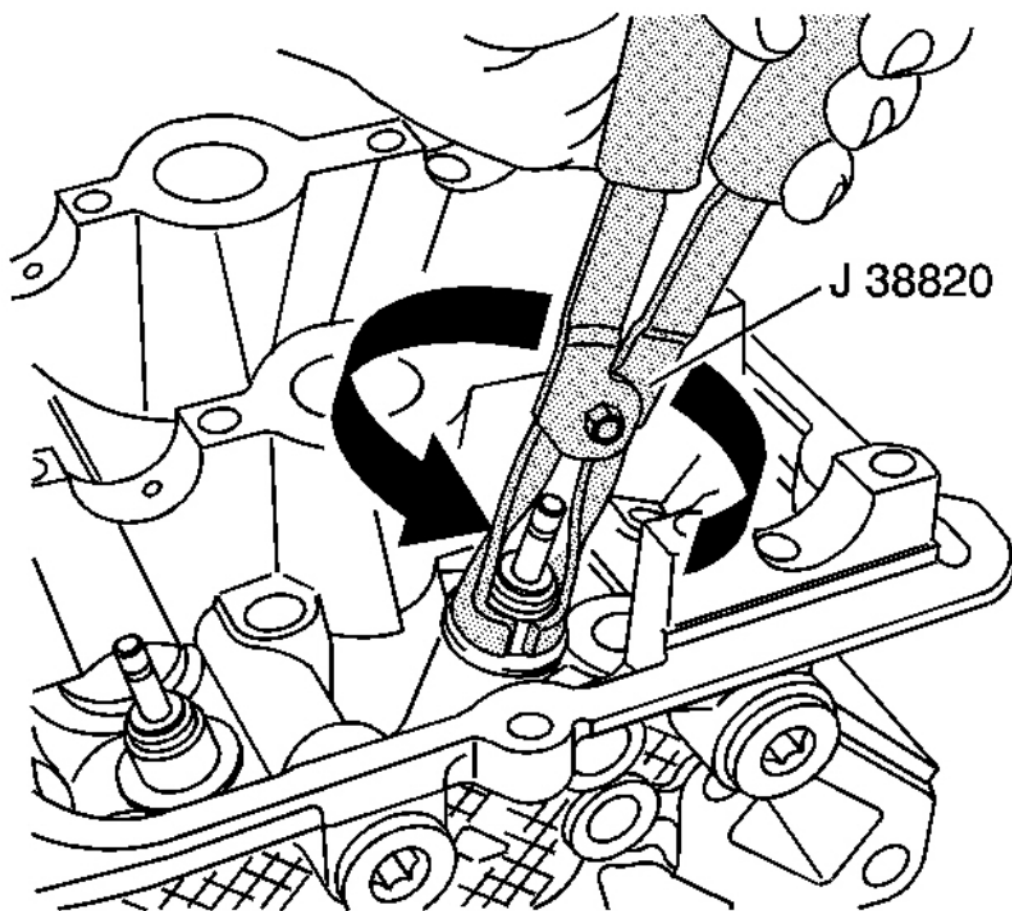


Fig. 22: Using J 38820 To Replace Valve Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve stem and the inner diameter of the new seal with clean engine oil.

IMPORTANT: Install a seal protector over the valve stem prior to installing

the valve stem seal.

2. Using a twisting pushing motion install the NEW valve stem seal using the **J 38820** .
3. Install the valve spring retainer and valve spring.

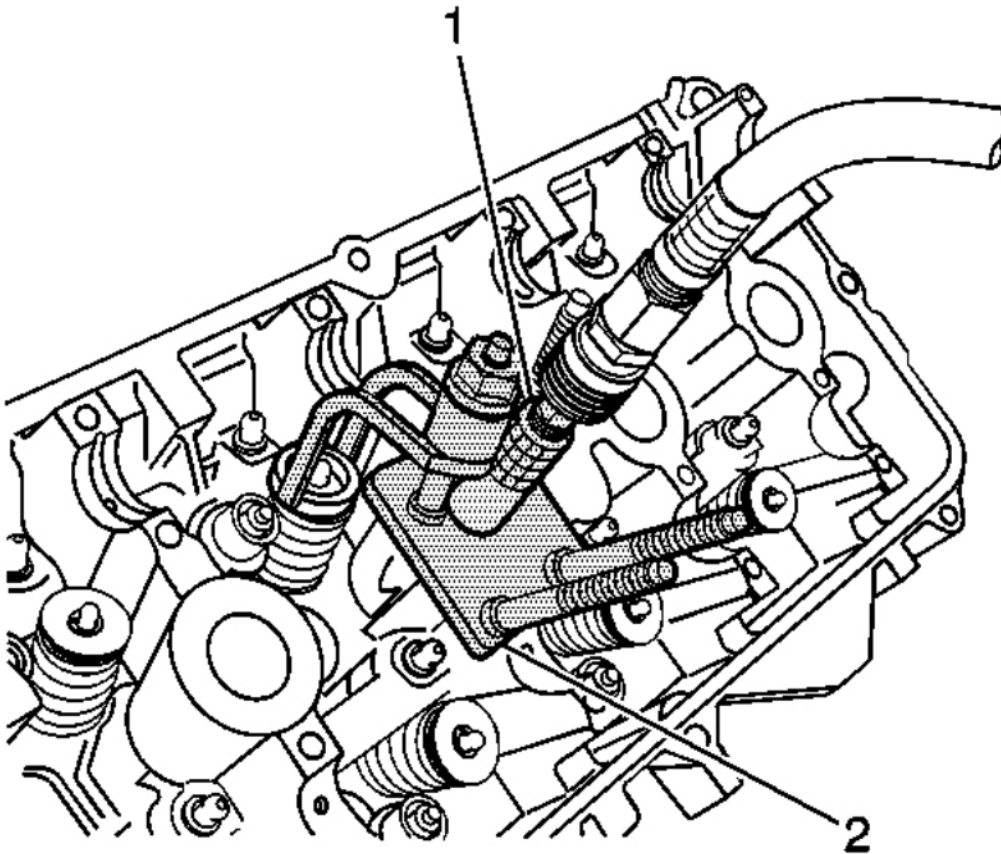


Fig. 23: View Of Base Plate Installed Over The Spark Plug Hole For Changing Valve Stem Seal

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

4. Swing the arm over the valve spring retainer and tighten the swivel nut of the **J 44211** (2)

down only enough to allow access for installation of the valve locks.

5. Using a magnet, position the valve locks to the valve stem retainer groove. Grease can be used to hold the locks in place.
6. Remove the swivel nut and arm of the **J 44211** (2).
7. Install the arm and swivel nut of the **J 44211** (2) over the stud of any other valves being serviced and repeat removal steps 12-17 and installation steps 1-7.
8. Relieve the air pressure to the cylinder being serviced.
9. Remove the **J 39313** (1) from the spark plug hole.
10. Remove the base plate of the **J 44211** (2).
11. Install the spark plug. Refer to **Spark Plug Replacement** in Engine Controls - 4.6L.
12. Repeat removal steps 7-14 and installation steps 1-11 on any other cylinders being serviced.
13. Install the left camshafts. Refer to **Camshaft Replacement - Left** .

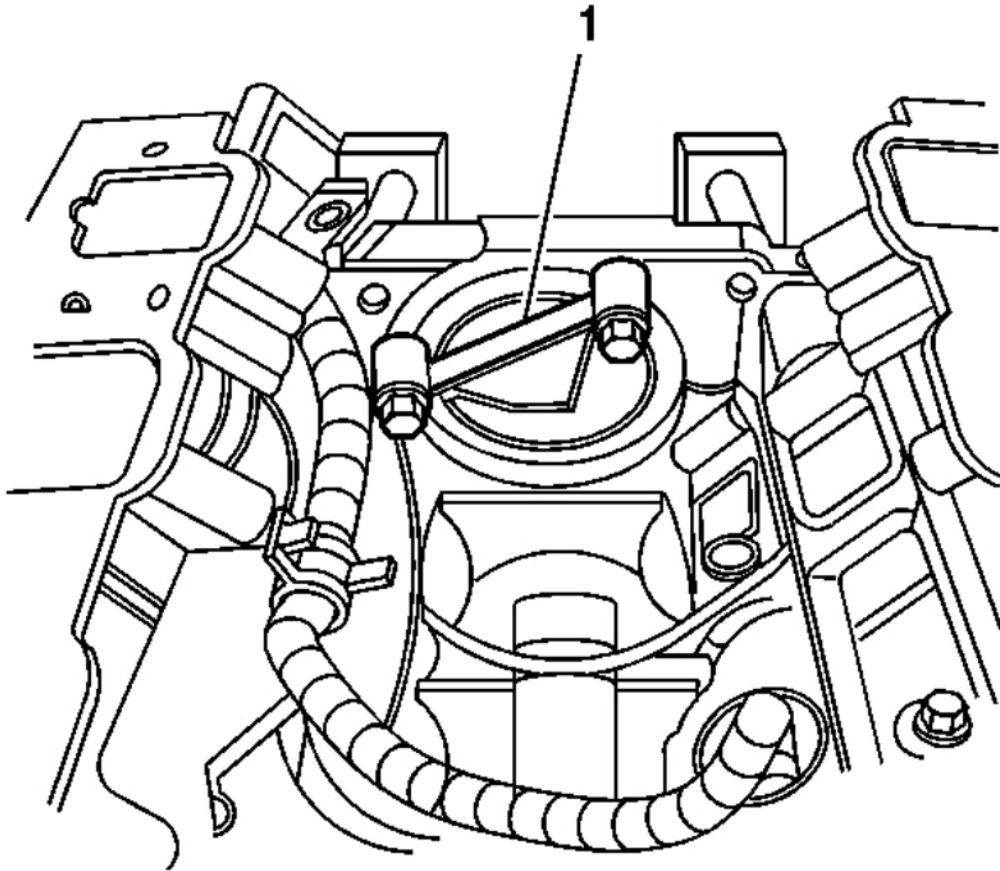


Fig. 24: View Of EN 46326 Installed To Engine Block
Courtesy of GENERAL MOTORS CORP.

14. Remove the **EN 46326** (1).
15. Install the starter. Refer to **Starter Motor Replacement (LH2)** or **Starter Motor Replacement (LY7)** in Engine Electrical.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - RIGHT

Tools Required

- **J 38820** Valve Stem Seal Installer
- **J 39313** Spark Plug Port Adapter

- **J 44211** On-Vehicle Valve Spring Compressor
- **EN 46326** Flywheel Holder

Removal Procedure

1. Remove the right camshafts. Refer to **Camshaft Replacement - Right.**
2. Remove the starter. Refer to **Starter Motor Replacement (LH2)** or **Starter Motor Replacement (LY7)** in Engine Electrical.

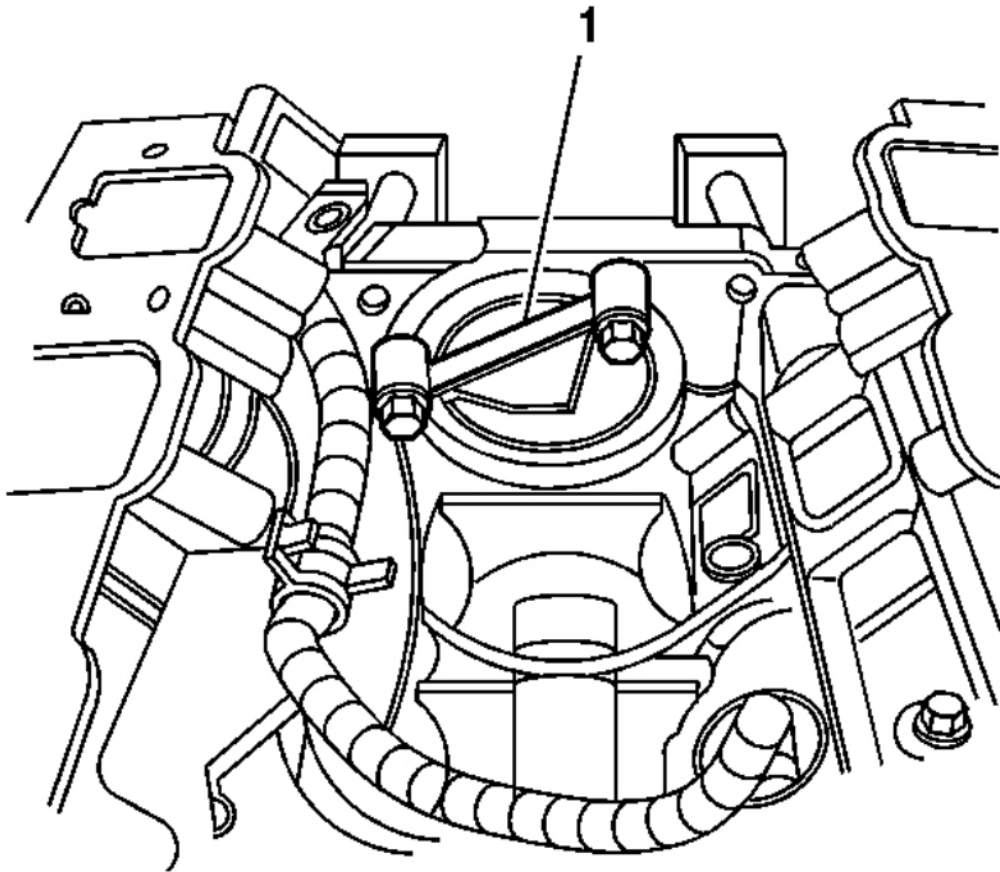


Fig. 25: View Of EN 46326 Installed To Engine Block
Courtesy of GENERAL MOTORS CORP.

3. Install the **EN 46326** (1).

NOTE: Clean the spark plug recess area before removing the spark plug. Failure to do so could result in engine damage because of dirt or foreign material entering the cylinder head, or by the contamination of the cylinder head threads. The contaminated threads may prevent the proper seating of the new plug. Use a thread chaser to clean the threads of any contamination.

4. Remove the spark plug from the cylinder being worked on.

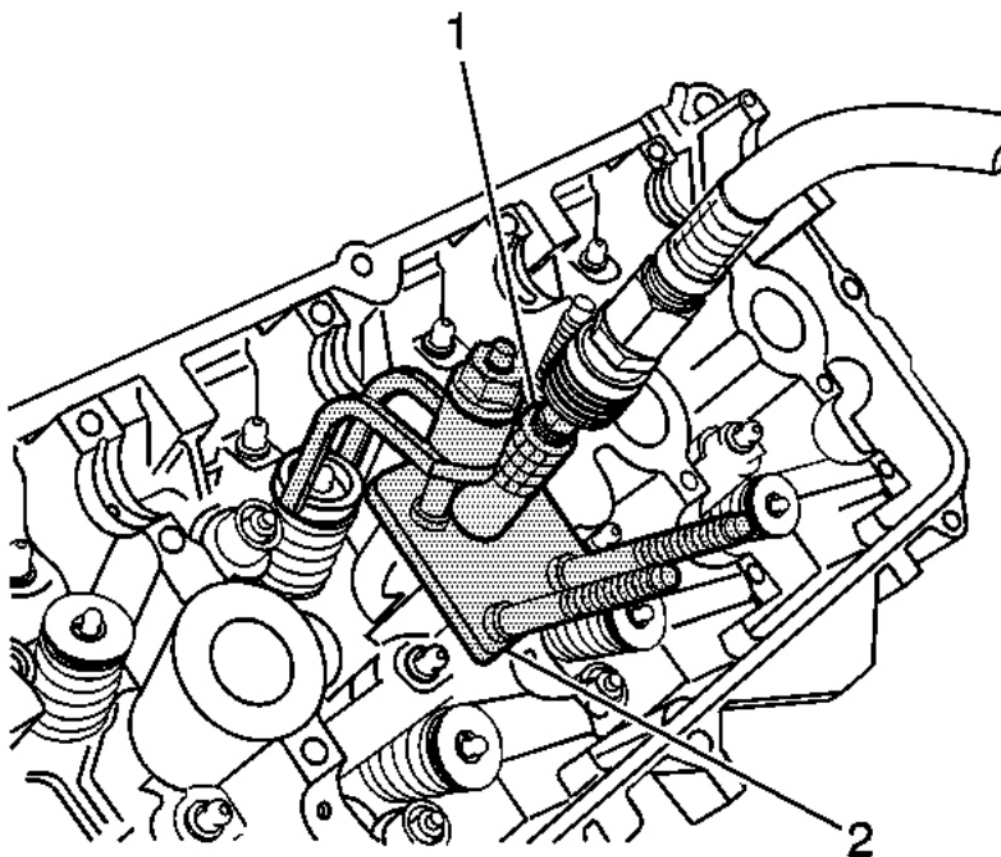


Fig. 26: View Of Base Plate Installed Over The Spark Plug Hole For Changing Valve Stem Seal

Courtesy of GENERAL MOTORS CORP.

5. Install the base plate of the J 44211 (2) over the spark plug hole of the cylinder to be

serviced.

6. Install the **J 39313** (1) in the spark plug hole.
7. Apply constant air pressure to the **J 39313** (1) in order to keep the valve closed.
8. Install the arm and swivel nut of the **J 44211** (2) over the stud corresponding to the valve to be serviced.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

9. Tighten the swivel nut of the **J 44211** (2) down only enough to allow access for removal of the valve locks.
10. Use a magnet to remove the valve stem locks.
11. Loosen the swivel nut of the **J 44211** (2) and swing the arm away from the valve spring retainer.
12. Remove the valve spring retainer and valve spring.

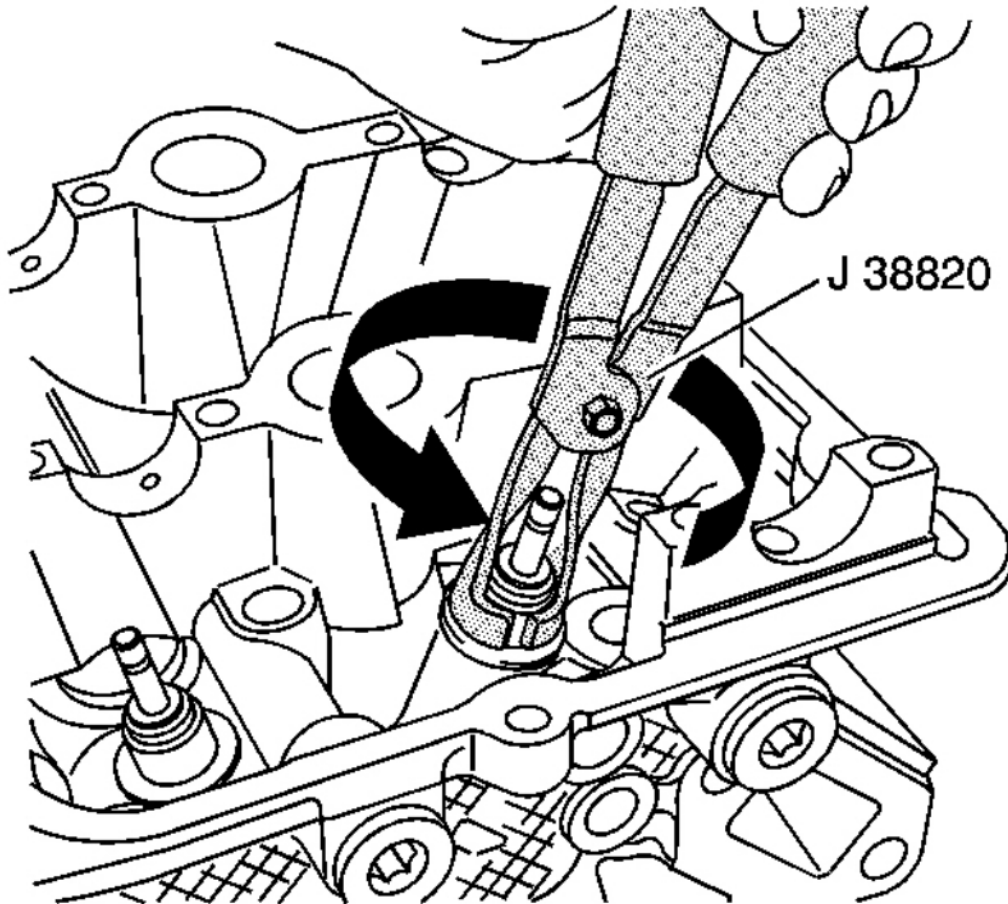


Fig. 27: Using J 38820 To Replace Valve Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The valve stem seal should not be removed unless replacement is required.

13. Use the **J 38820** in order to grip the seal. Remove the seal by exerting a twisting, pulling motion. Discard the old valve stem seal.
14. Inspect and measure the valve spring. Refer to **Valve Spring Inspection and Measurement** .

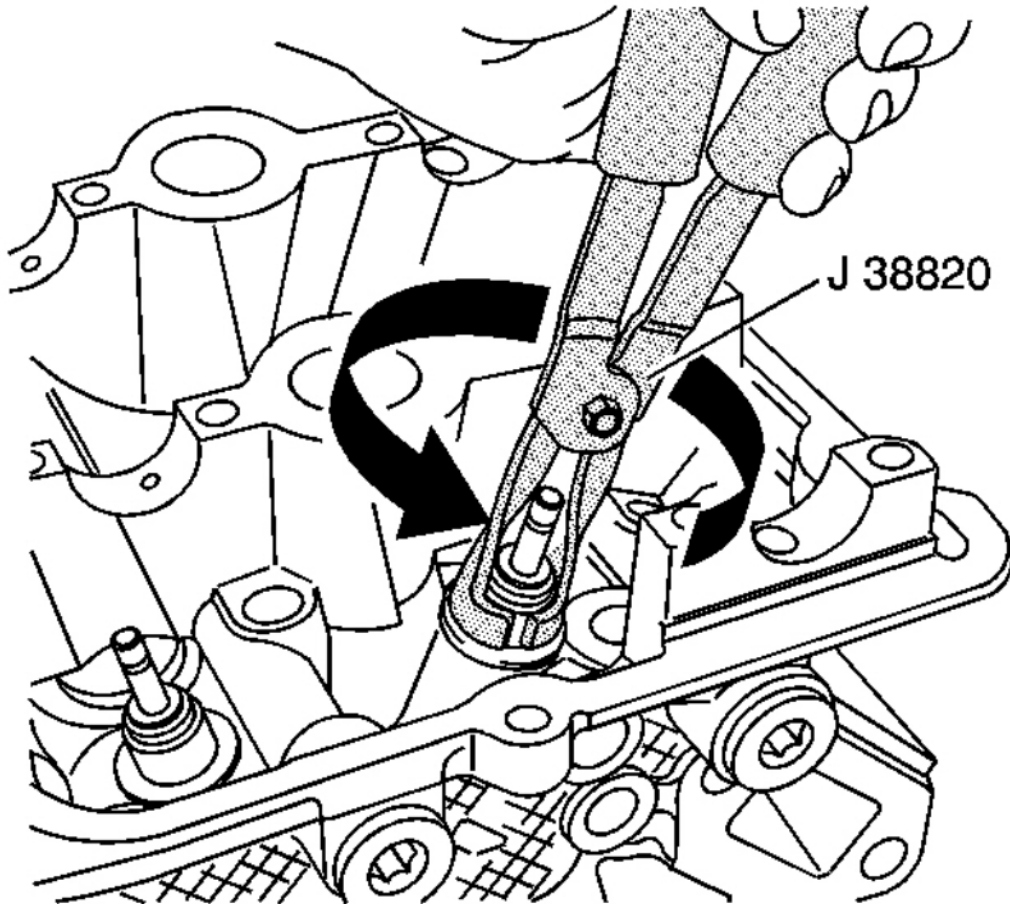


Fig. 28: Using J 38820 To Replace Valve Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve stem and the inner diameter of the new seal with clean engine oil.

IMPORTANT: Install a seal protector over the valve stem prior to installing the valve stem seal.

2. Using a twisting pushing motion install the NEW valve stem seal using the **J 38820**.
3. Install the valve spring retainer and valve spring.

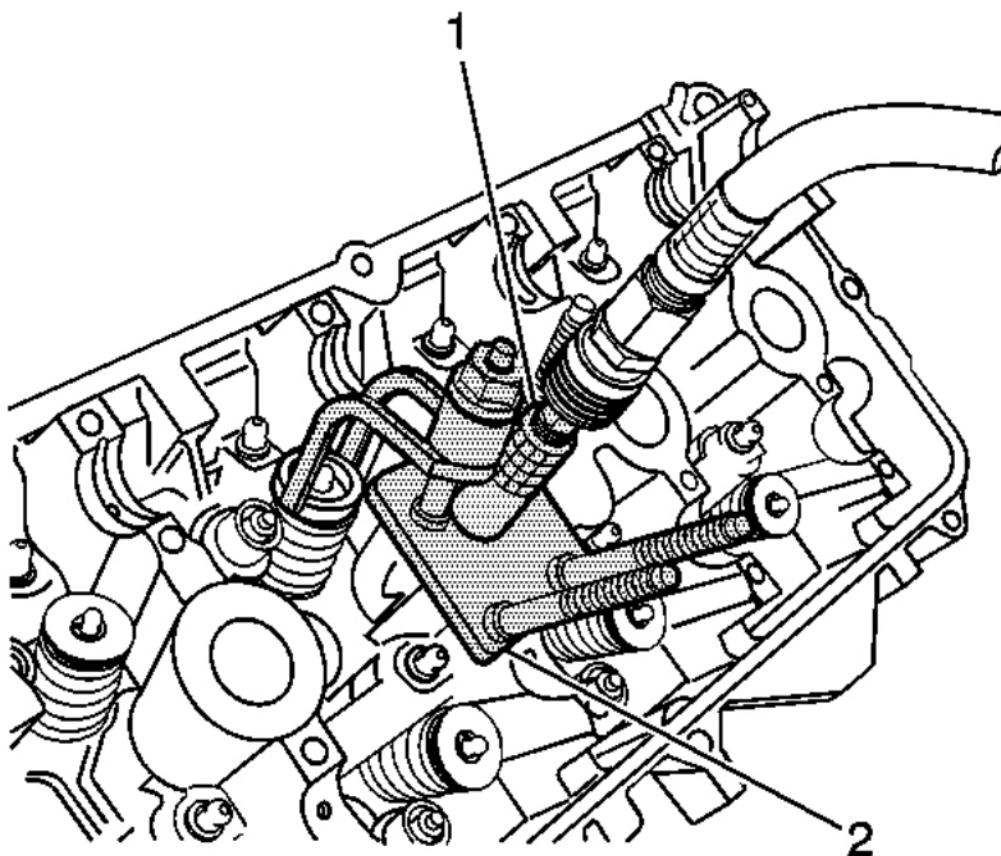


Fig. 29: View Of Base Plate Installed Over The Spark Plug Hole For Changing Valve Stem Seal

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

4. Swing the arm over the valve spring retainer and tighten the swivel nut of the **J 44211 (2)** down only enough to allow access for installation of the valve locks.
5. Using a magnet, position the valve locks to the valve stem retainer groove. Grease can be used to hold the locks in place.
6. Remove the swivel nut and arm of the **J 44211 (2)**.
7. Relieve the air pressure to the cylinder being serviced.

8. Remove the **J 39313** (1) from the spark plug hole.
9. Remove the base plate of the **J 44211** (2).
10. Install the spark plug. Refer to **Spark Plug Replacement** in Engine Controls - 4.6L.
11. Repeat removal steps 7-14 and installation steps 1-11 on any other cylinders being serviced.
12. Install the right camshafts. Refer to **Camshaft Replacement - Right**.
13. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

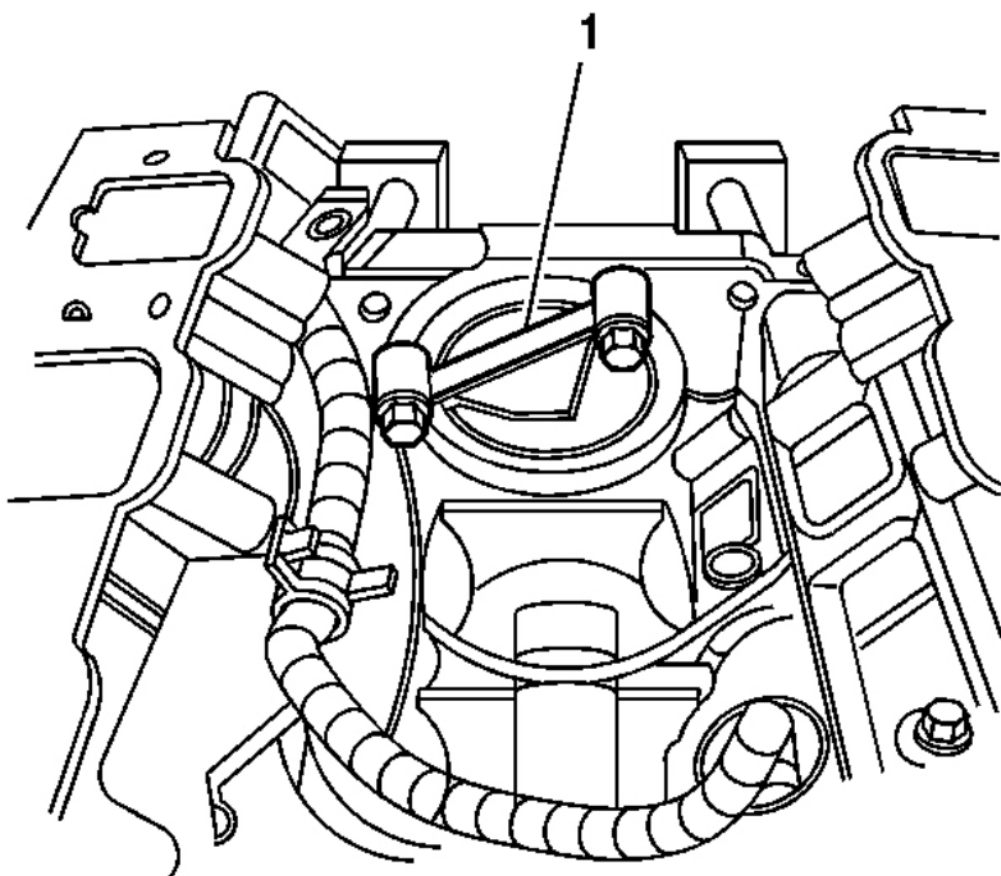


Fig. 30: View Of EN 46326 Installed To Engine Block
Courtesy of GENERAL MOTORS CORP.

14. Remove the **EN 46326** (1).

15. Install the starter. Refer to **Starter Motor Replacement (LH2)** or **Starter Motor Replacement (LY7)** in Engine Electrical.

CYLINDER HEAD REPLACEMENT - LEFT

Removal Procedure

1. Remove the following subassemblies:
 - The left exhaust manifold-Refer to **Exhaust Manifold Replacement - Left (LY7)** or **Exhaust Manifold Replacement - Left (LH2)** in Engine Exhaust.
 - The water crossover-Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LY7)** in Engine Cooling.
 - The intake manifold-Refer to **Intake Manifold Replacement** .
 - The left secondary camshaft drive chain-Refer to **Secondary Camshaft Drive Chain Replacement - Left** .
 - The left camshafts-Refer to **Camshaft Replacement - Left** .
2. Remove the power steering reservoir return hose retaining bolts from the cylinder head.

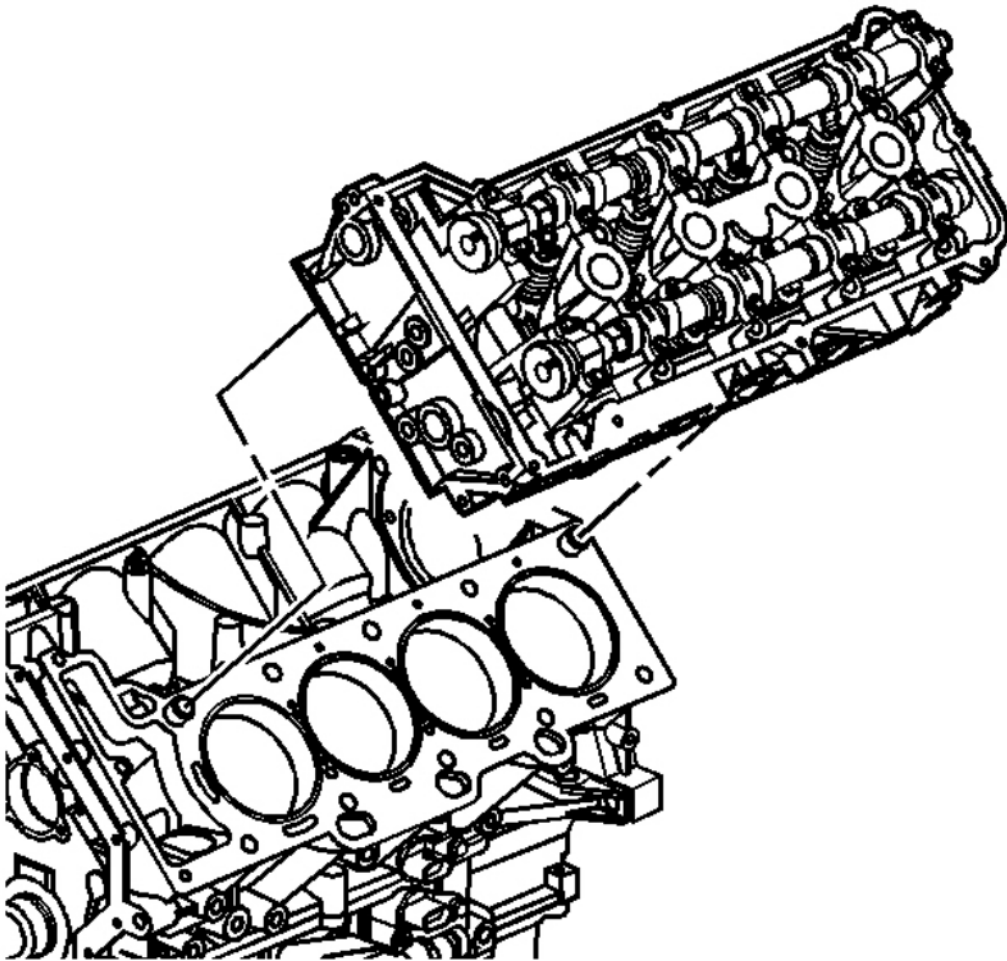


Fig. 31: View Of Cylinder Head With Alignment Dowels - Left
Courtesy of GENERAL MOTORS CORP.

3. Remove the left cylinder head. Make sure that no dowel guide pins are stuck in the cylinder head. Refer to **Cylinder Head Removal - Left** .
4. Disassemble the left cylinder head. Refer to **Cylinder Head Disassemble** .
5. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .
6. Assemble the left cylinder head. Refer to **Cylinder Head Assemble** .

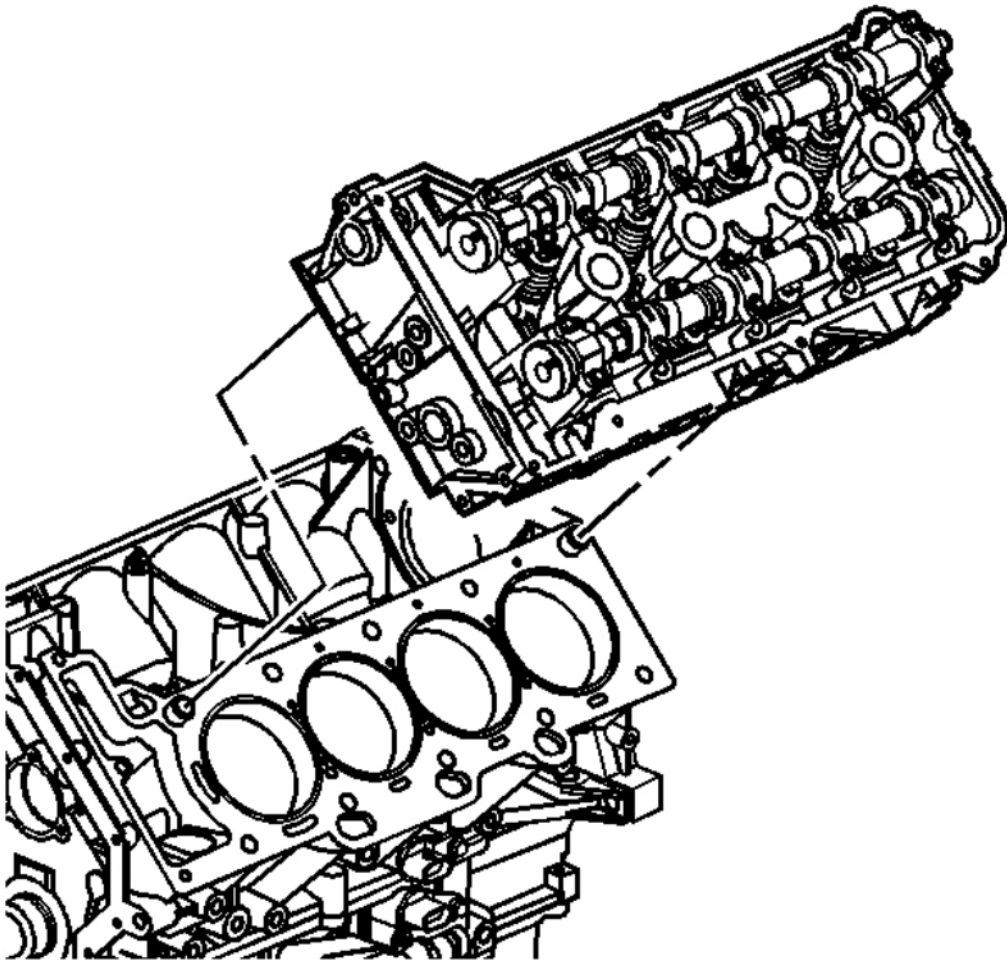


Fig. 32: View Of Cylinder Head With Alignment Dowels - Left
Courtesy of GENERAL MOTORS CORP.

1. Install the left cylinder head. Refer to Cylinder Head Installation - Left .

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the power steering reservoir and return hose retaining bolts to the cylinder head.

Tighten: Tighten the power steering reservoir and return hose retaining bolts to 50 N.m (37 lb ft).

3. Install the following subassemblies:

- The left camshafts-Refer to **Camshaft Replacement - Left** .
- The left secondary camshaft drive chain-Refer to **Secondary Camshaft Drive Chain Replacement - Left** .
- The intake manifold-Refer to **Intake Manifold Replacement** .
- The water crossover-Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LY7)** in Engine Cooling.
- The left exhaust manifold-Refer to **Exhaust Manifold Replacement - Left (LY7)** or **Exhaust Manifold Replacement - Left (LH2)** in Engine Exhaust.

CYLINDER HEAD REPLACEMENT - RIGHT

Removal Procedure

1. Remove the following subassemblies:

- The right exhaust manifold

Refer to **Exhaust Manifold Replacement - Right (LY7)** or **Exhaust Manifold Replacement - Right (LH2)** in Engine Exhaust.

- The water crossover

Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LY7)** in Engine Cooling.

- The intake manifold

Refer to **Intake Manifold Replacement** .

- The right secondary camshaft drive chain

Refer to **Secondary Camshaft Drive Chain Replacement - Right** .

- The right camshaft

Refer to **Camshaft Replacement - Right**.

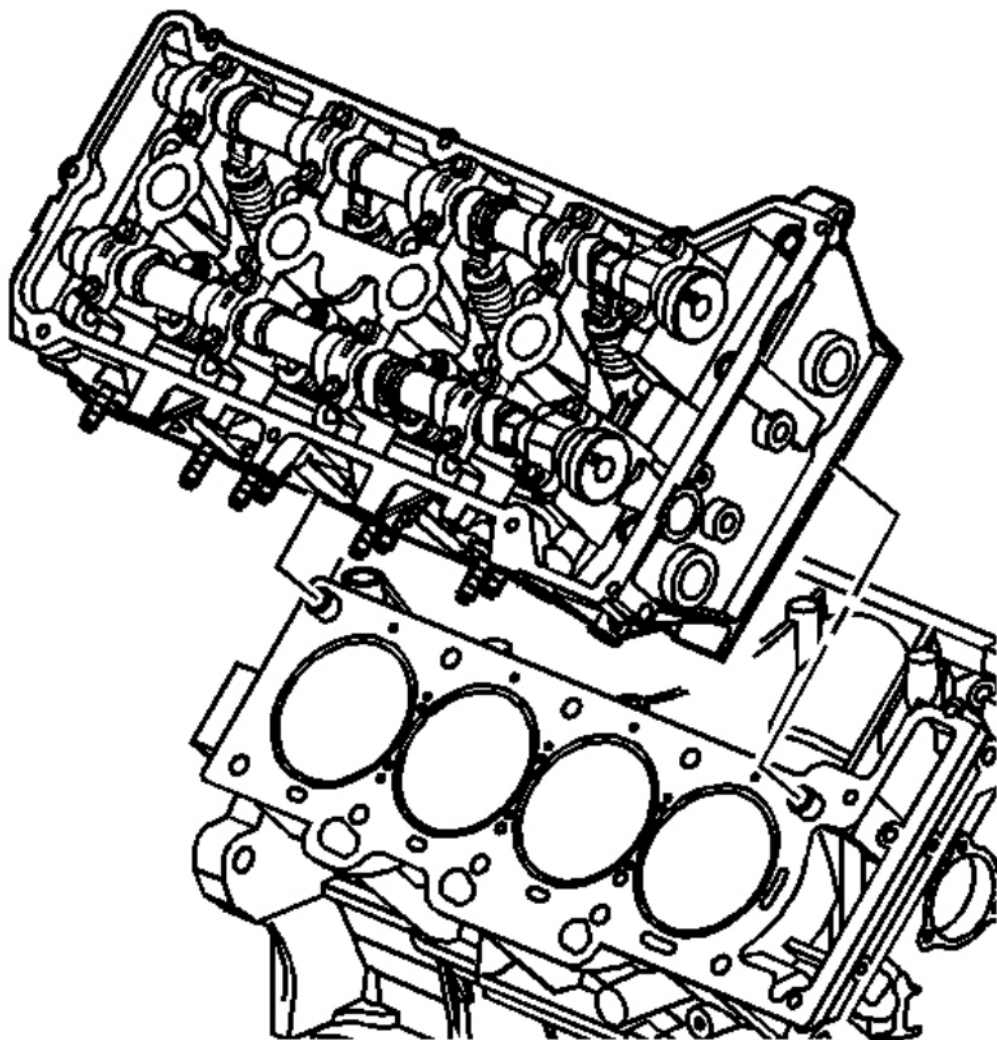


Fig. 33: View Of Cylinder Head With Alignment Dowels - Right
Courtesy of GENERAL MOTORS CORP.

2. Remove the right cylinder head. Make sure that no dowel guide pins are stuck in the cylinder head. Refer to **Cylinder Head Removal - Right** .
3. Disassemble the right cylinder head. Refer to **Cylinder Head Disassemble** .
4. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .
5. Assemble the right cylinder head. Refer to **Cylinder Head Assemble** .

Installation Procedure

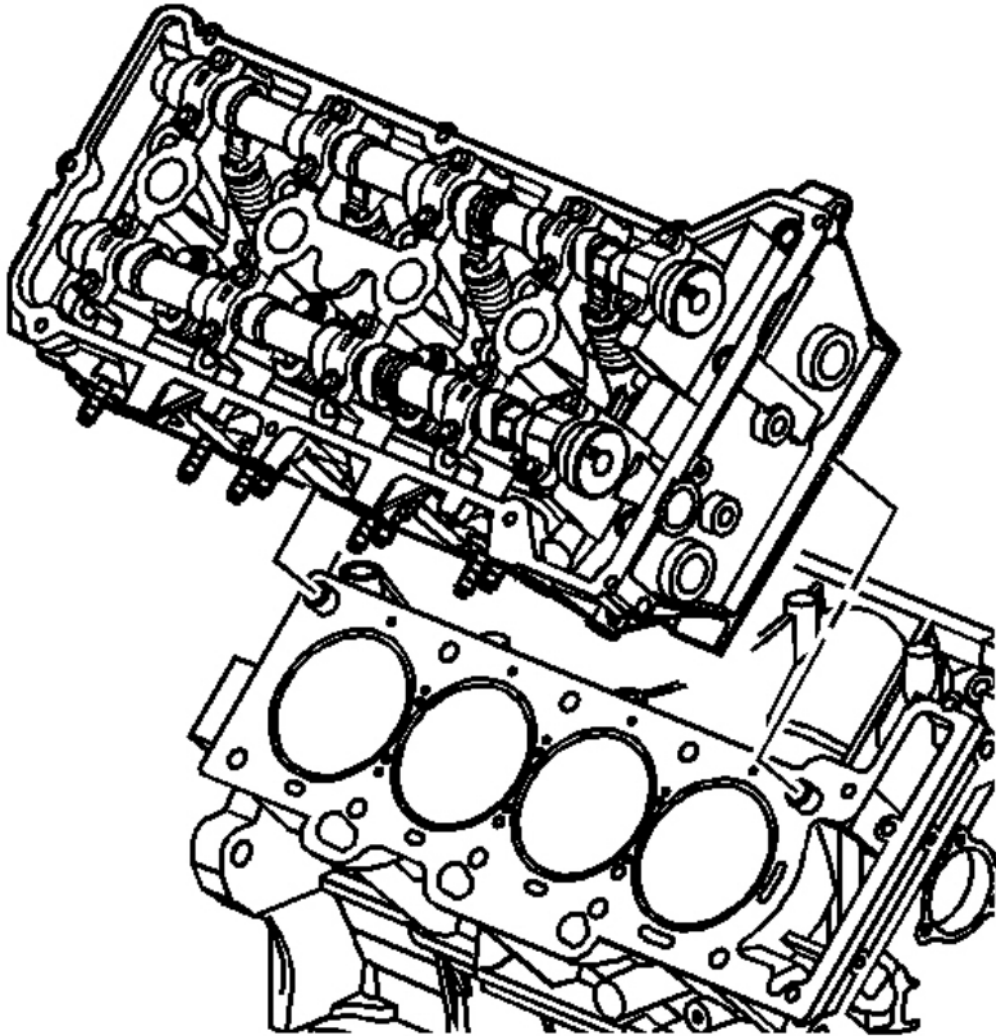


Fig. 34: View Of Cylinder Head With Alignment Dowels - Right
Courtesy of GENERAL MOTORS CORP.

1. Install the right cylinder head. Refer to **Cylinder Head Installation - Right** .
2. Install the following subassemblies:
 - The right camshaft

Refer to **Camshaft Replacement - Right.**

- The right secondary camshaft drive chain

Refer to **Secondary Camshaft Drive Chain Replacement - Right .**

- The intake manifold

Refer to **Intake Manifold Replacement .**

- The water crossover

Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LY7)** in Engine Cooling.

- The right exhaust manifold

Refer to **Exhaust Manifold Replacement - Right (LY7)** or **Exhaust Manifold Replacement - Right (LH2)** in Engine Exhaust.

ENGINE FLYWHEEL REPLACEMENT

Tools Required

J 45059 Torque Angle Meter

Removal Procedure

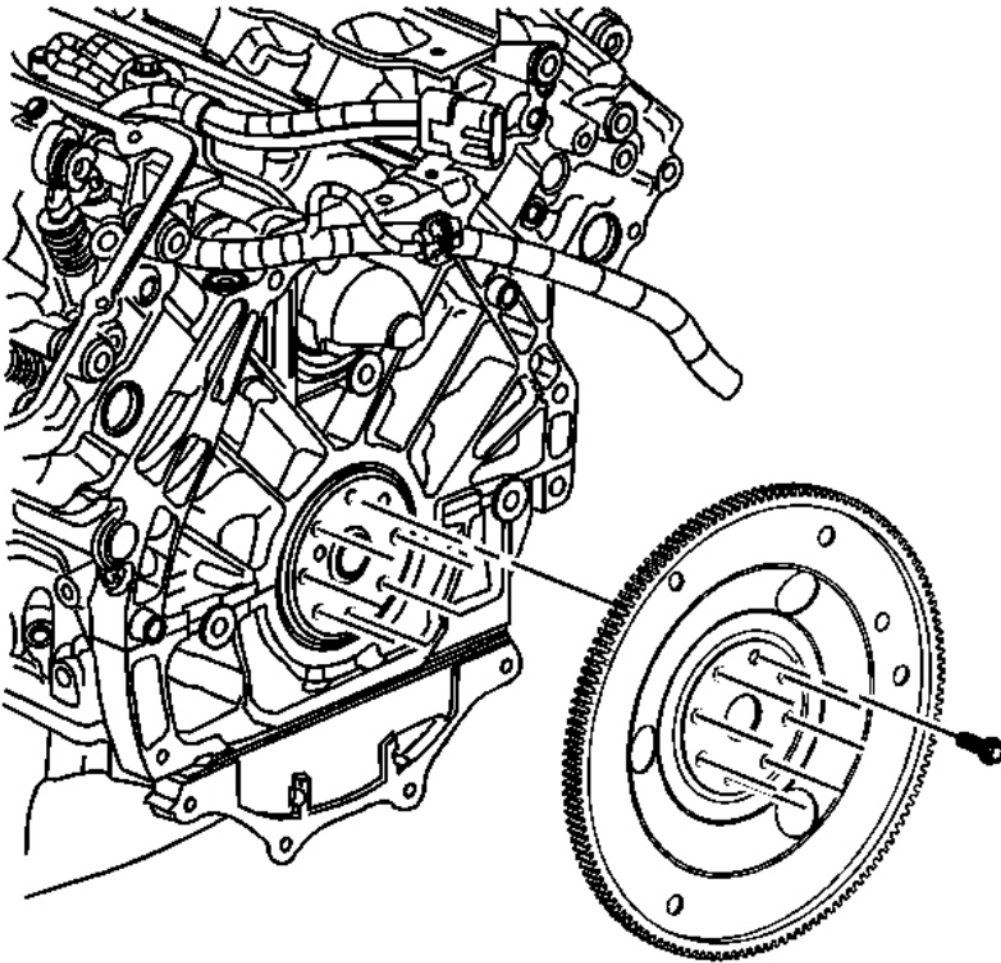


Fig. 35: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission assembly. Refer to **Transmission Replacement** in Automatic Transmission - 5L50-E.
2. Use a Snap-On™ A144A Flywheel Turner, or equivalent to prevent the engine from rotating.
3. Remove the engine flywheel bolts.
4. Clean and inspect the flywheel. Refer to **Engine Flywheel Cleaning and Inspection**

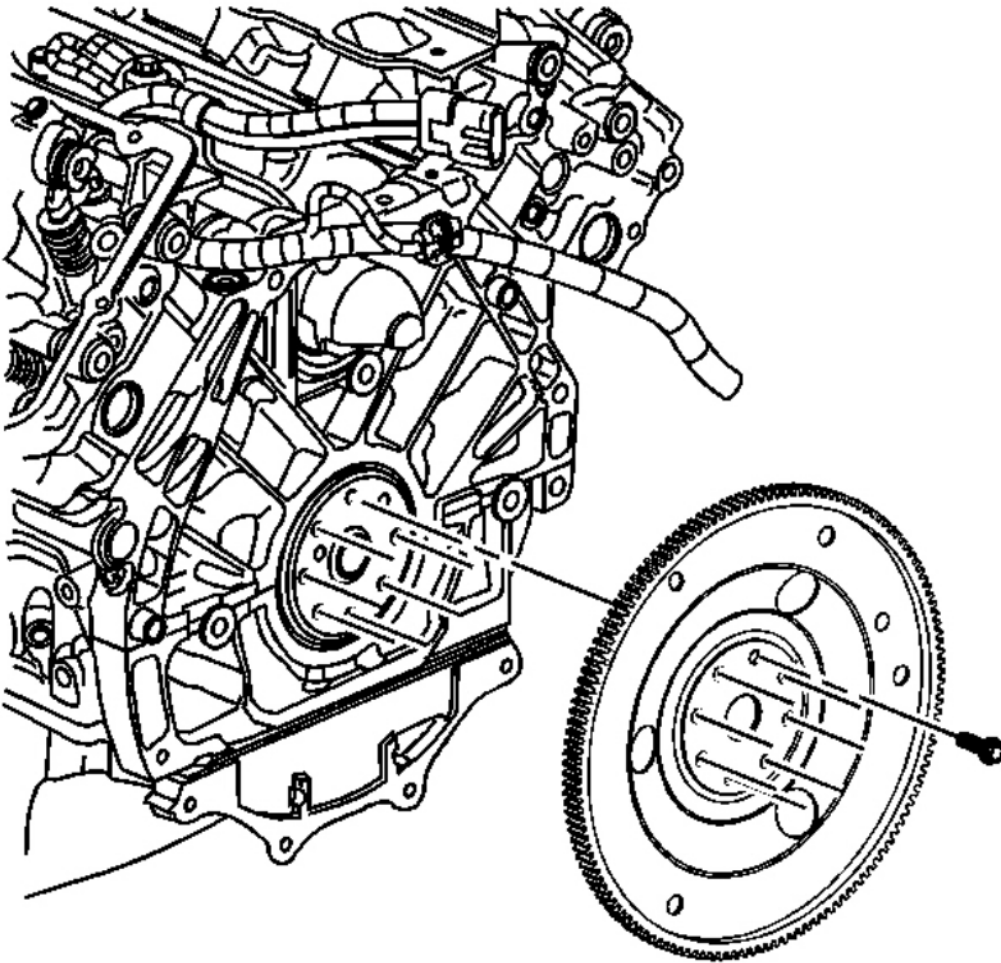


Fig. 36: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Install the engine flywheel.
2. Apply sealant, GM P/N 12346004 (Canadian P/N 10953480) or equivalent, to the engine flywheel bolts.
3. Install the engine flywheel bolts finger tight.
4. Use a Snap-On™ A144A Flywheel Turner, or equivalent to prevent the engine from rotating.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

5. Tighten the engine flywheel bolts.

Tighten:

- Tighten the flywheel bolts a first pass to 15 N.m (11 lb ft).
 - Tighten the flywheel bolts a final pass, an additional 50 degrees using the **J 45059** .
6. Install the transmission assembly. Refer to **Transmission Replacement** in Automatic Transmission - 5L50-E.

OIL PAN REPLACEMENT

Removal Procedure

1. Install the engine support fixture. Refer to **Engine Support Fixture** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Remove the front frame. Refer to **Frame Replacement - Front** in Frame and Underbody.
4. Remove the front differential carrier. Refer to **Differential Carrier Assembly Replacement** in Front Drive Axle.
5. Disconnect the electrical connector from the engine oil level sensor.

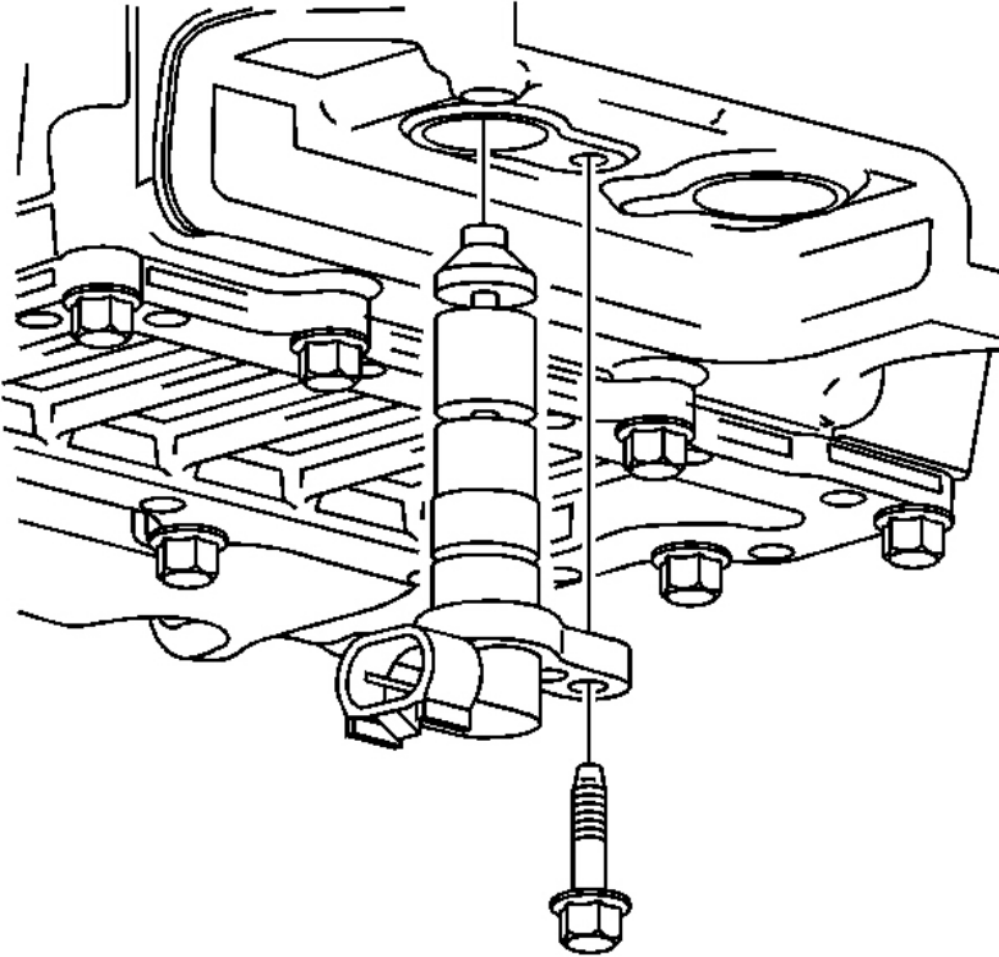


Fig. 37: Removing & Installing Oil Level Switch
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil level sensor from the oil pan.

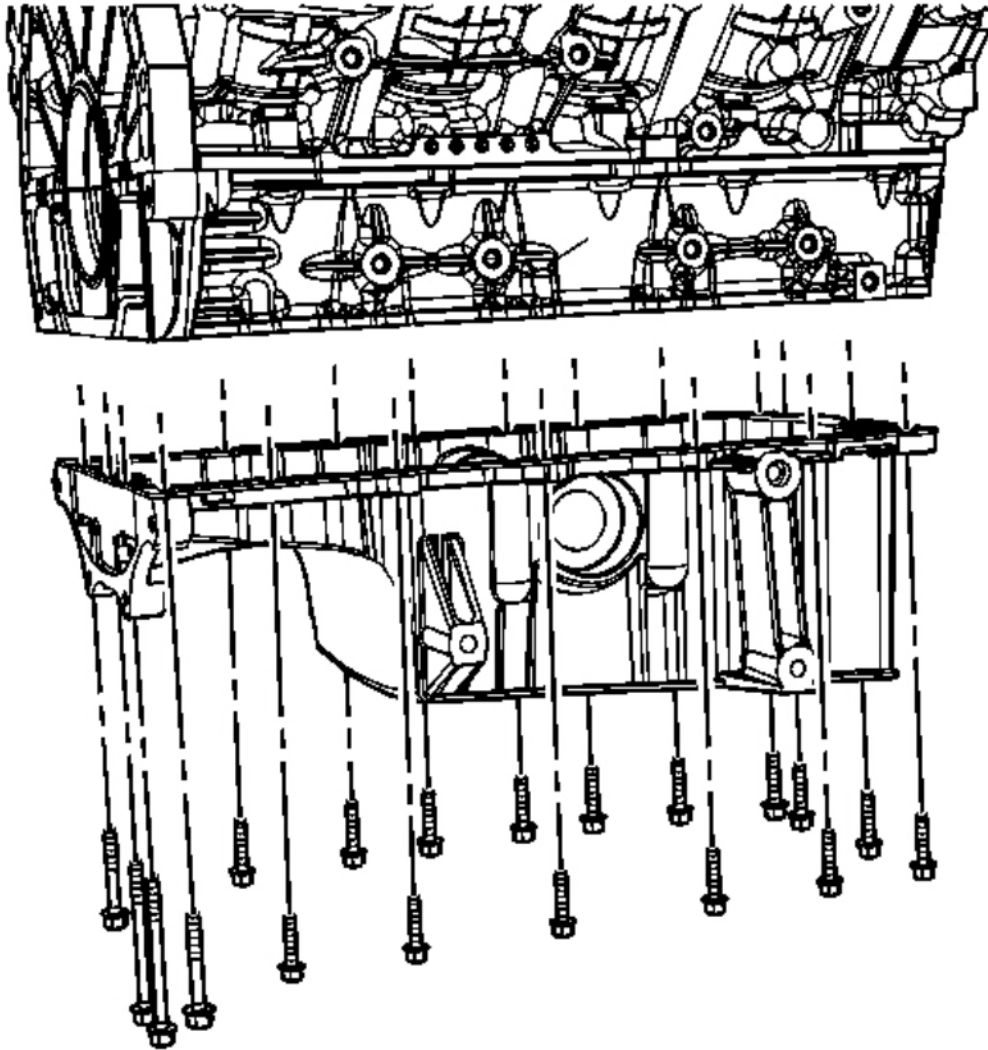


Fig. 38: View Of Oil Pan

Courtesy of GENERAL MOTORS CORP.

7. Remove the oil pan bolts.

IMPORTANT: The oil pan gasket is reusable unless damaged. Do not remove the gasket from the oil pan groove unless replacement is required.

8. Remove the oil pan.
9. Clean and inspect the oil pan. Refer to Oil Pan Cleaning and Inspection .

Installation Procedure

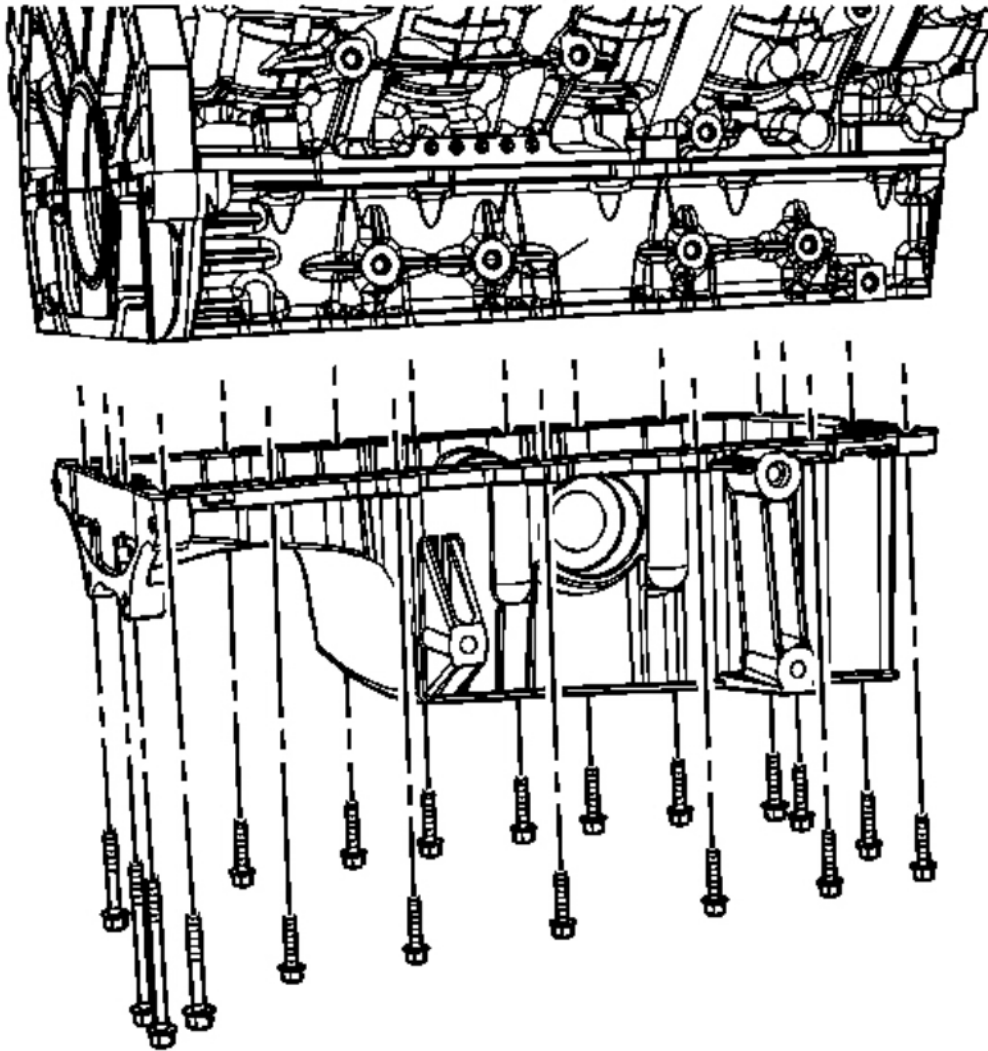


Fig. 39: View Of Oil Pan
Courtesy of GENERAL MOTORS CORP.

1. If required, install a new oil pan seal using the following procedure:

1. Clean any residual oil from the seal groove.
2. Work the seal into the pan groove in both directions around the pan.
2. Position the oil pan to the crankcase.

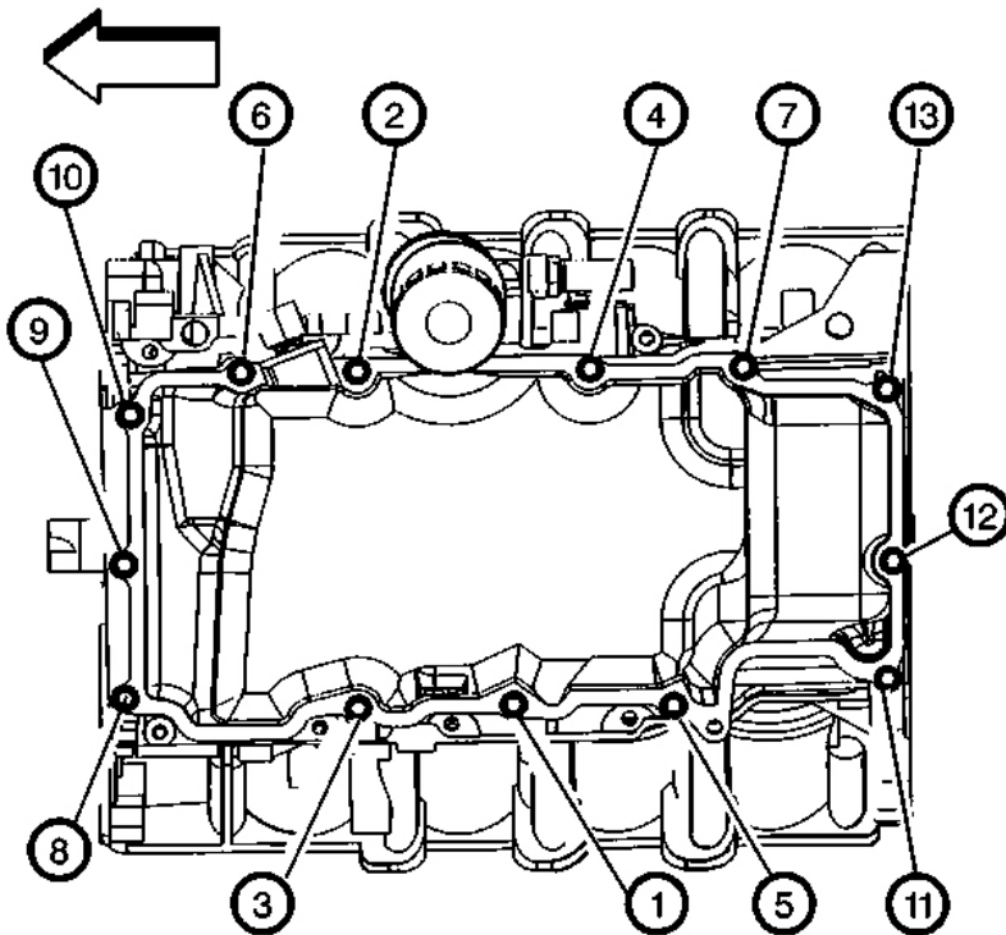


Fig. 40: Installing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil pan bolts.

Tighten: Tighten the bolts in the sequence shown to 10 N.m (89 lb in).

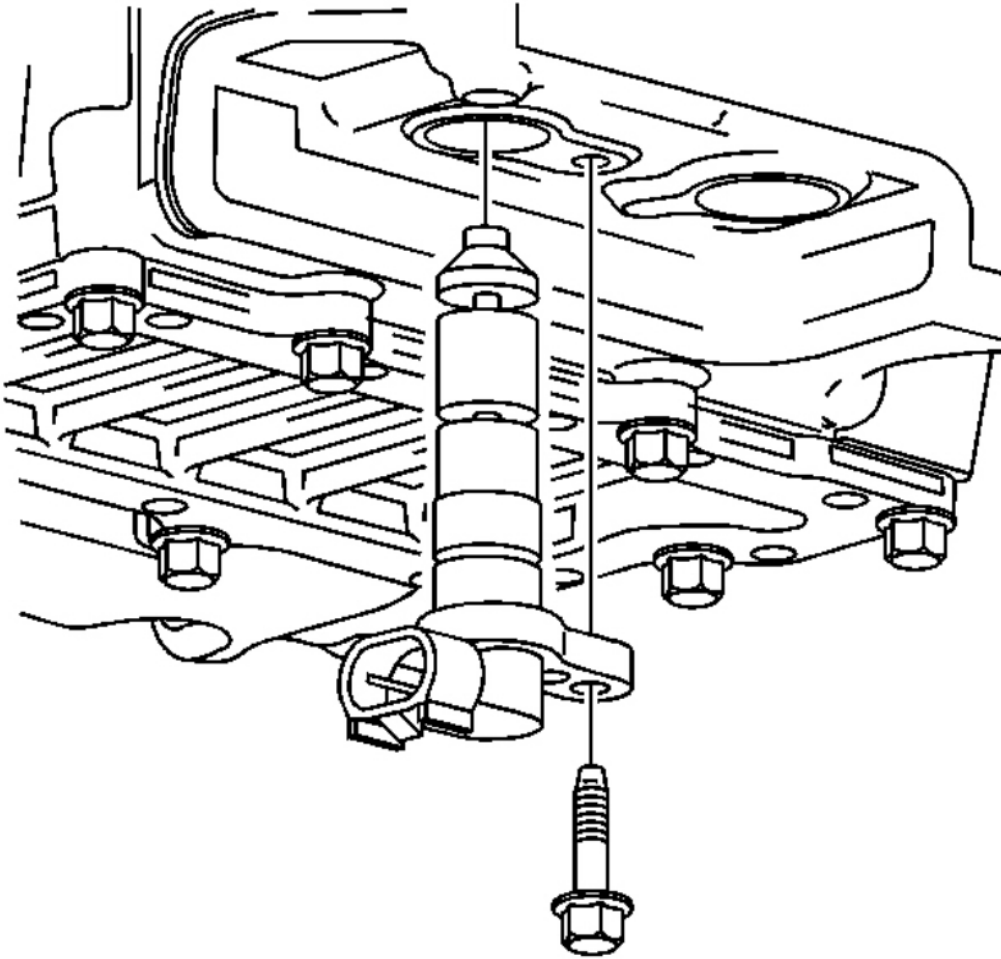


Fig. 41: Removing & Installing Oil Level Switch
Courtesy of GENERAL MOTORS CORP.

4. Install the engine oil level sensor into the oil pan.

Tighten: Tighten the sensor to 10 N.m (89 lb in).

5. Connect the electrical connector to the engine oil level sensor.
6. Install the front differential carrier. Refer to **Differential Carrier Assembly Replacement**

in Front Drive Axle.

7. Install the front frame. Refer to **Frame Replacement - Front** in Frame and Underbody.
8. Fill the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the engine support fixture. Refer to **Engine Support Fixture** .
10. Inspect for oil leaks after engine start up.

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

- **J 42841** Rear Oil Seal Remover
- **J 45930** Crankshaft Rear Oil Seal Installer

Removal Procedure

1. Remove the flywheel. Refer to **Engine Flywheel Replacement**.

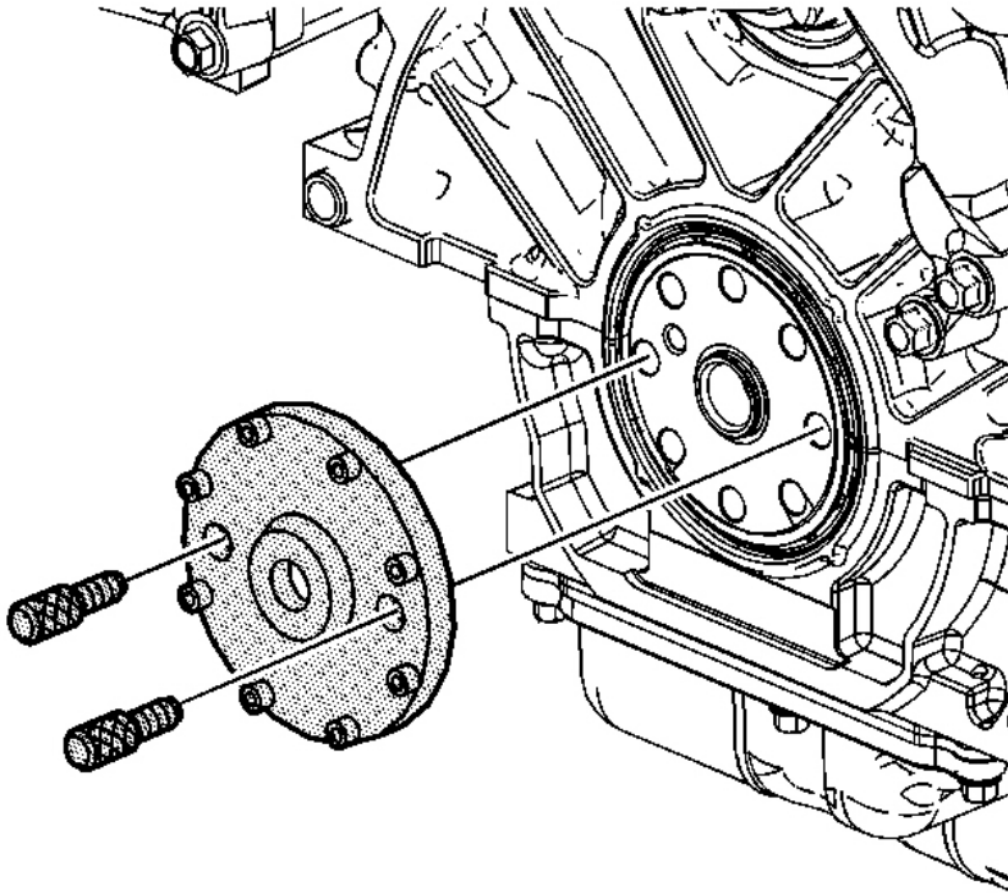


Fig. 42: View Of J 42841 Removing The Rear Crankshaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

2. Using the **J 42841** remove the rear crankshaft oil seal. Refer to **Crankshaft Rear Oil Seal Removal.**

Installation Procedure

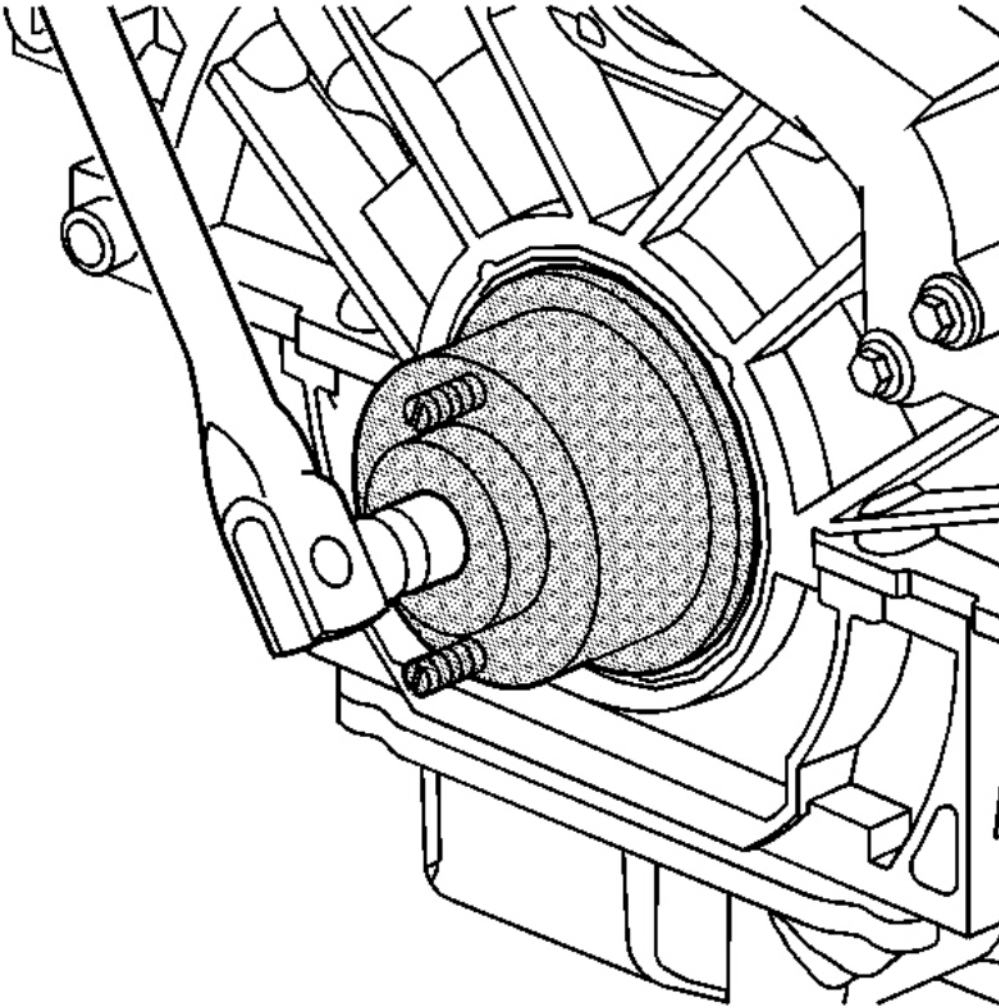


Fig. 43: Installing Rear Crankshaft Oil Seal Using The J 45930
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Make sure the drain is clear before installing the new crankshaft rear oil seal. Failure to clear the drain could cause the crankshaft rear oil seal to leak.

1. Using the **J 45930** install the rear crankshaft oil seal. Refer to **Crankshaft Rear Oil Seal Installation** .
2. Install the flywheel. Refer to **Engine Flywheel Replacement**.

ENGINE REPLACEMENT

Tools Required

- **J 28467-86** Engine Lift Bracket
- **J 28467-87** Engine Lift Bracket
- **J 42640** Steering Column Anti-Rotation Pin

Removal Procedure

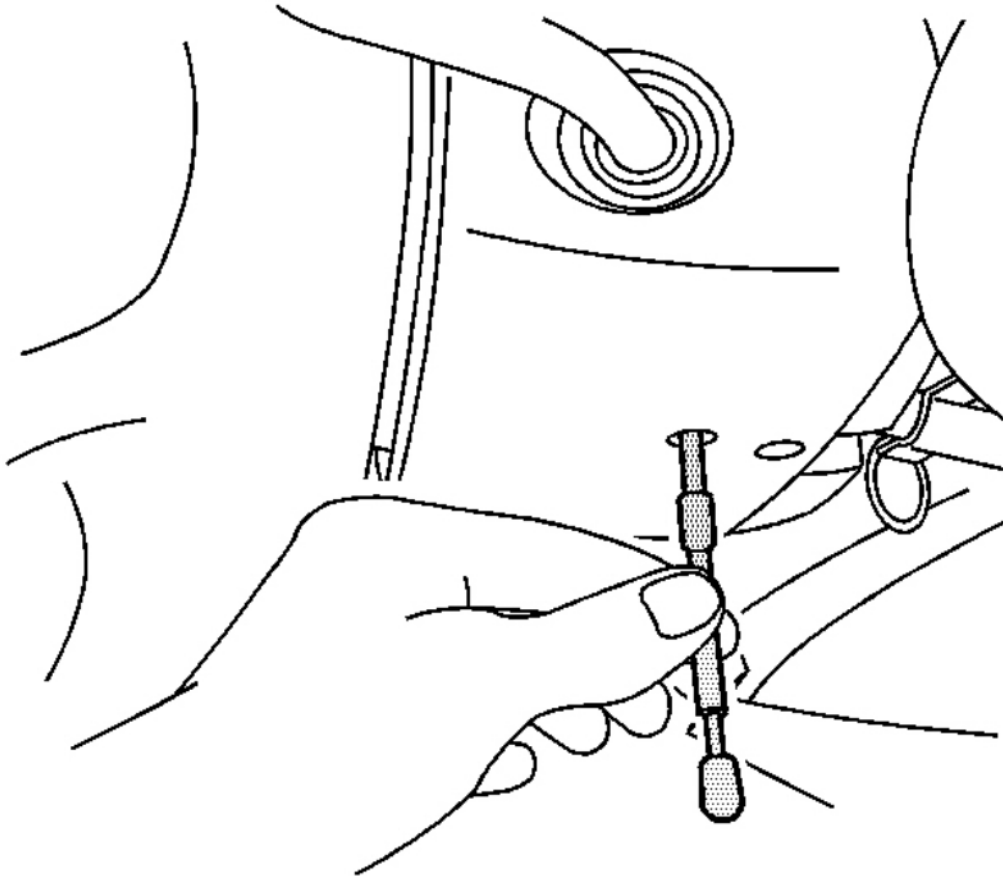


Fig. 44: Identifying J 42640

Courtesy of GENERAL MOTORS CORP.

1. Install the **J 42640** to the steering column. Refer to **Intermediate Steering Shaft**

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 2 Of 5) - SRX

Replacement - Lower in Steering Wheel and Column for the pin installation procedure.

2. Disconnect the positive and negative battery cables from the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** and to **Battery Positive Cable Replacement (LH2)** or **Battery Positive Cable Replacement (LY7)** in Engine Electrical.
3. Remove the cross vehicle brace. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.
4. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .

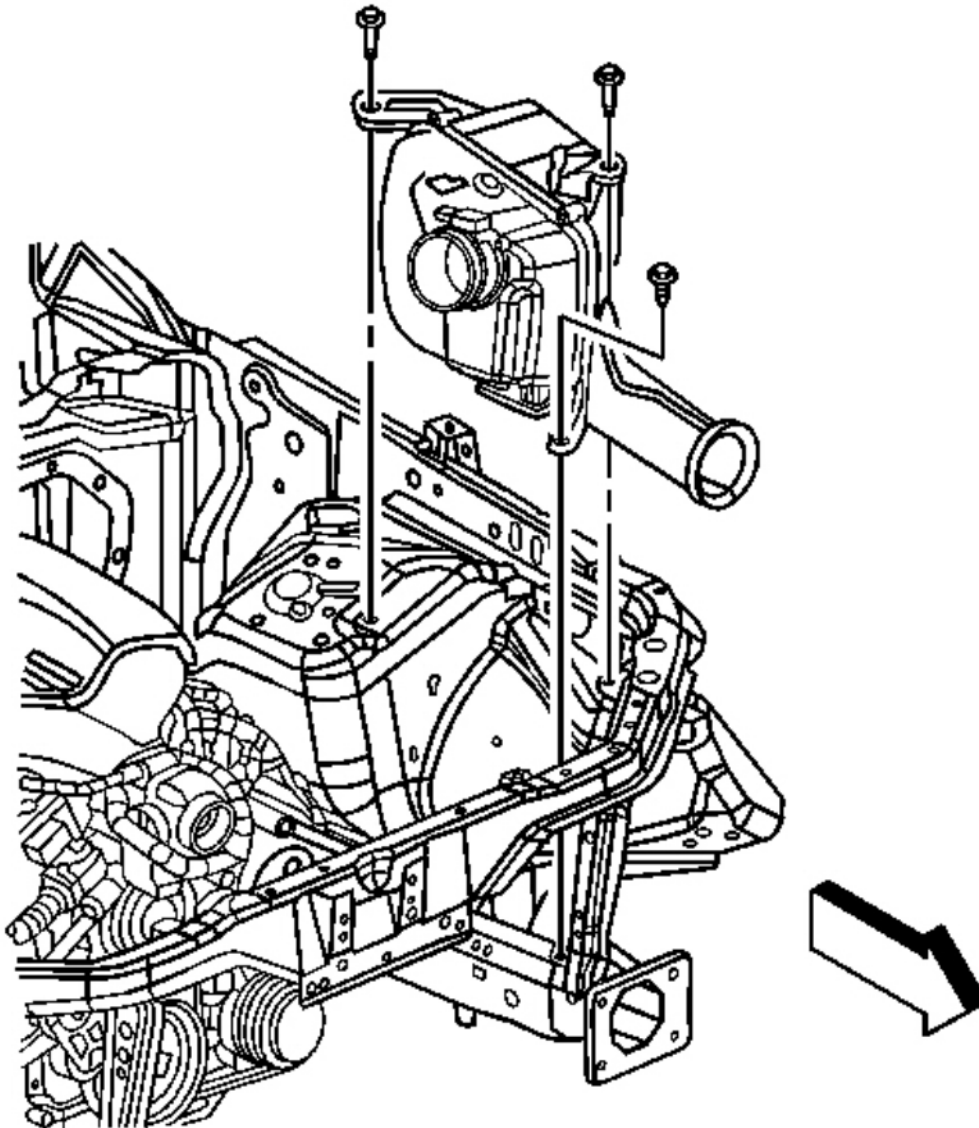


Fig. 45: View Of Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 4.6L (LH2).
6. Disconnect the surge tank inlet hose and position the hose to the engine.

7. Evacuate the air conditioning system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
8. Disconnect the air conditioning suction hose fitting at the top of the left shock tower. Refer to **Suction Hose Replacement (LH2 w/o C57)** or **Suction Hose Replacement (LH2 w/C57)** or **Suction Hose Replacement (LY7 w/o C57)** in Heating, Ventilation and Air Conditioning.
9. Remove the suction hose from the retaining feature (1). Position the line to the engine.

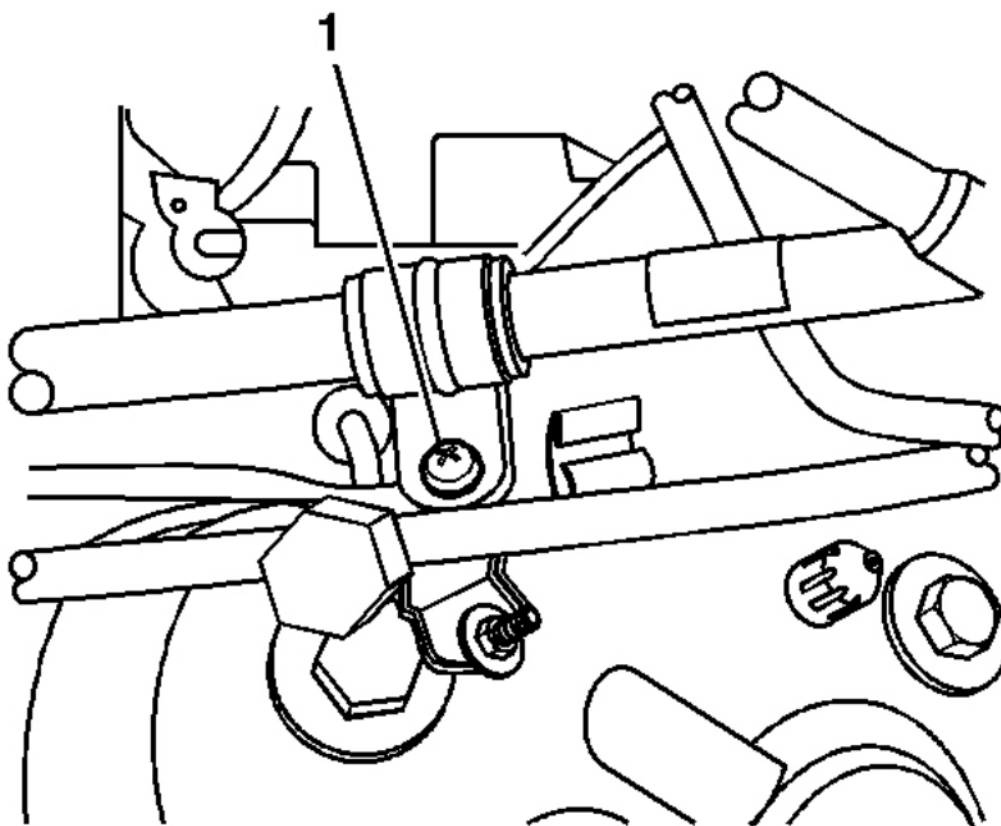


Fig. 46: View Of Suction Hose Retaining Feature
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the air conditioning liquid line from the condenser. Refer to **Liquid Line Replacement (w/o C57)** or **Liquid Line Replacement (w/C57)** in Heating, Ventilation and Air Conditioning.

11. Remove the air conditioning liquid line from the retaining feature on the fan shroud.

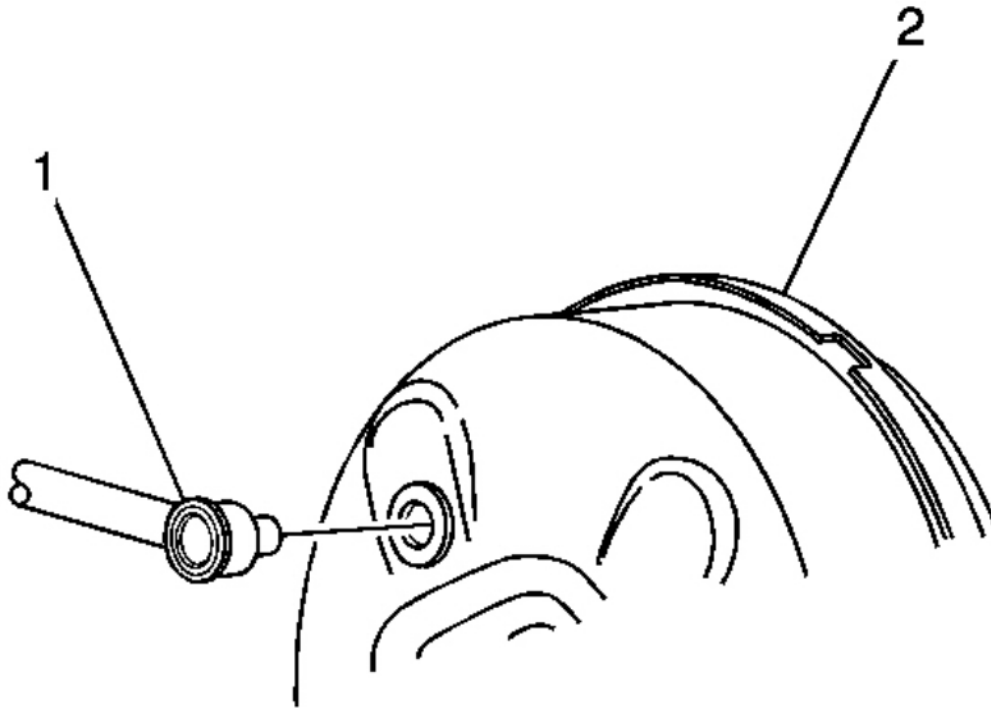


Fig. 47: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the brake booster vacuum line (1) from the brake booster (2). Position the brake booster line to the engine.
13. Disconnect the brake fluid level switch electrical connector from the master cylinder.

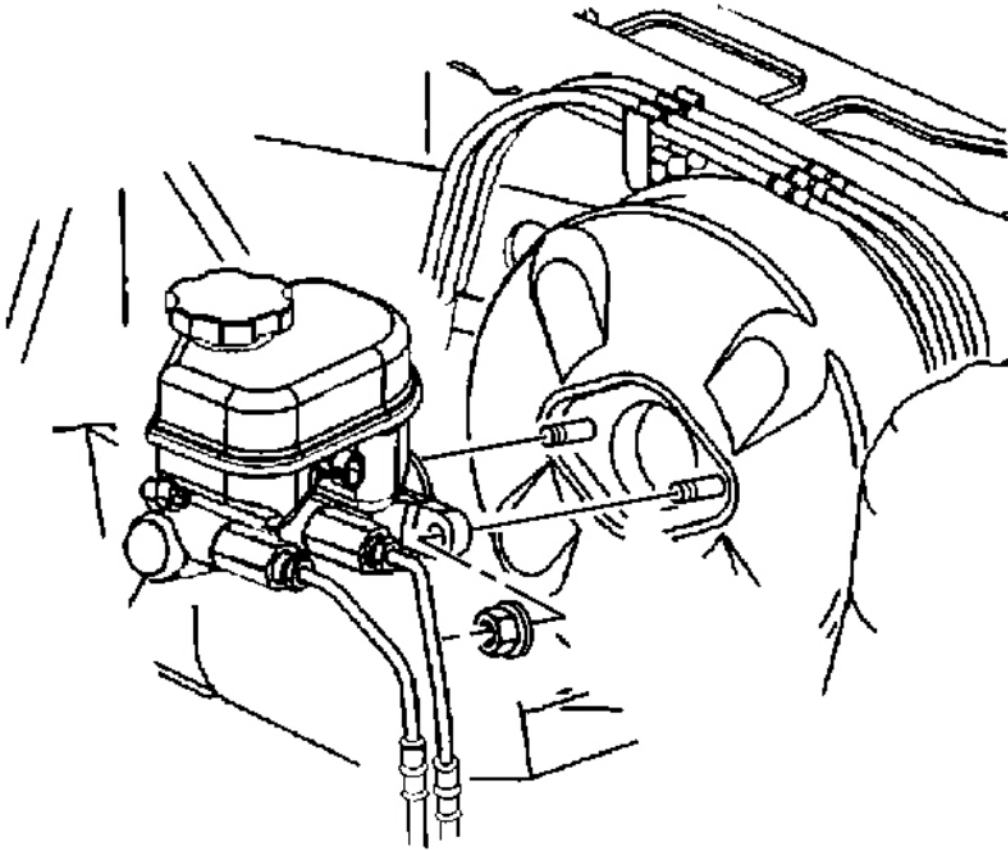


Fig. 48: Removing & Installing Master Cylinder
Courtesy of GENERAL MOTORS CORP.

14. Remove the master cylinder mounting nuts.
15. Position the master cylinder to the engine. Hold the master cylinder in position by using mechanics wire. Do not disconnect the brake lines from the master cylinder.
16. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** in Engine Controls - 4.6L (LH2).

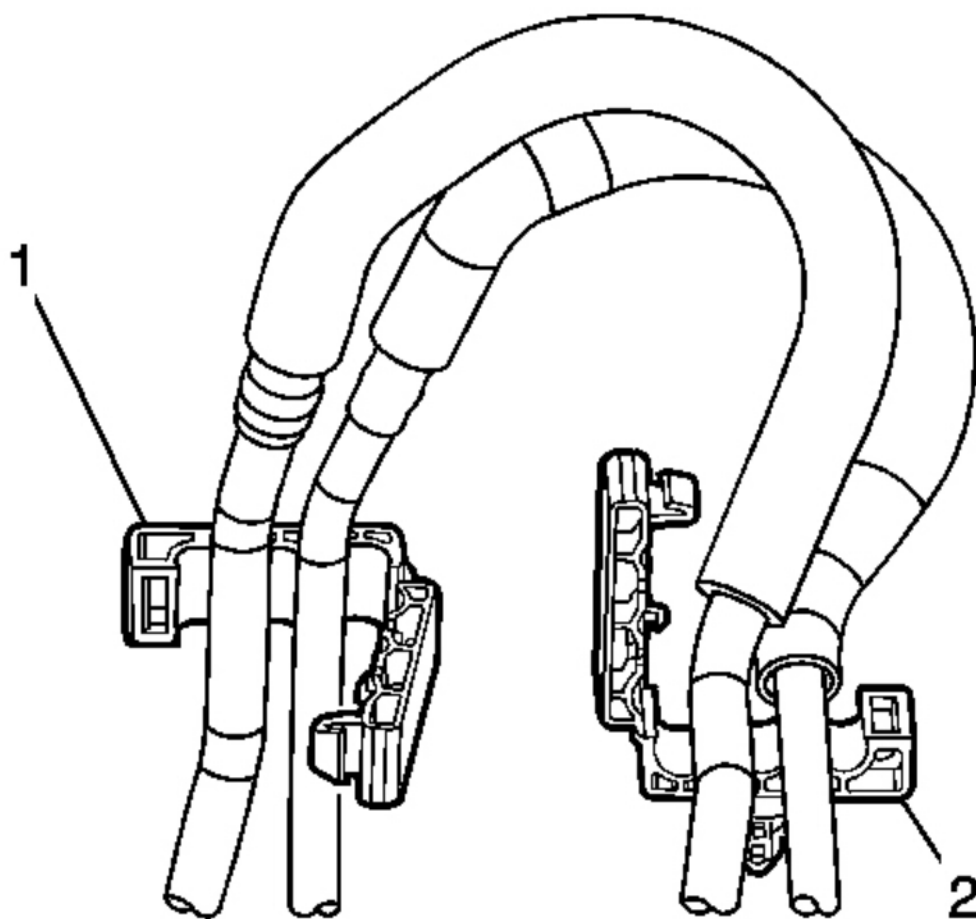


Fig. 49: View Of Hose Retainers
Courtesy of GENERAL MOTORS CORP.

17. Remove the fuel line retainer (1) from the vehicle. The retainer is located on the bracket attached to the heater lines on the front of the dash.
18. Disconnect the engine wiring harness connector C102 at the front of the dash. Refer to **Harness Routing Views** in Wiring Systems.
19. Disconnect the underhood fuse block connector C5 located between the right shock tower and the cam cover. Refer to **Harness Routing Views** in Wiring Systems.
20. Remove the underhood electrical center cover.

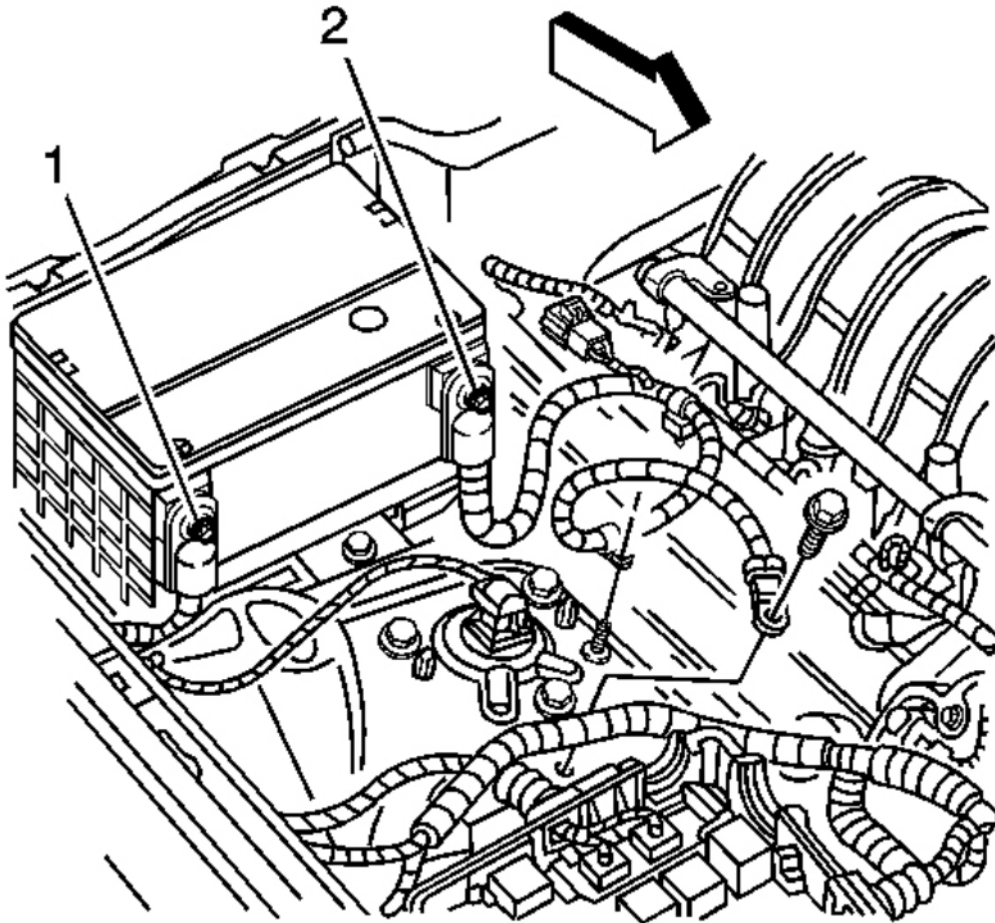


Fig. 50: View Of Battery Cables

Courtesy of GENERAL MOTORS CORP.

21. Remove the negative battery cable (2) bolt from the right shock tower. Remove the cable retainer from the stud on the right shock tower and position the cable to the engine.

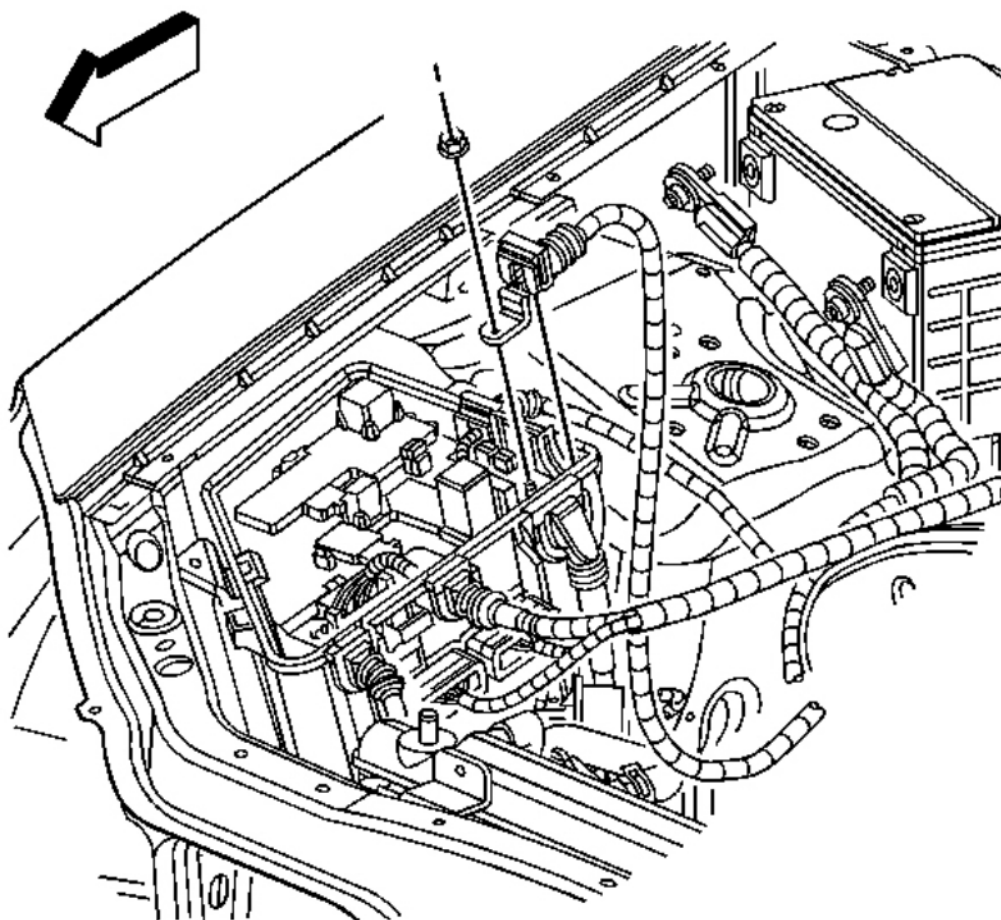


Fig. 51: View Of Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

22. Remove the positive battery cable nut from inside the underhood electrical center. Remove the cable from the electrical center and position the cable to the engine.
23. Disconnect the chassis electrical connector at the top of the right shock tower. Position the wire to the engine.
24. Disconnect the transmission control module electrical connector and position the wiring harness to the engine. Refer to **Transmission Control Module (TCM) Replacement** in Automatic Transmission - 5L50-E.
25. Disconnect the engine wiring harness C5 connector from the inside of the underhood

electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.

26. Disconnect the electrical connector C113 at the right frame rail. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
27. Remove the engine cooling fan(s). Refer to the appropriate procedure:
 - **Fan Replacement** in Engine Cooling
 - **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)** in Engine Cooling
28. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
29. Remove the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

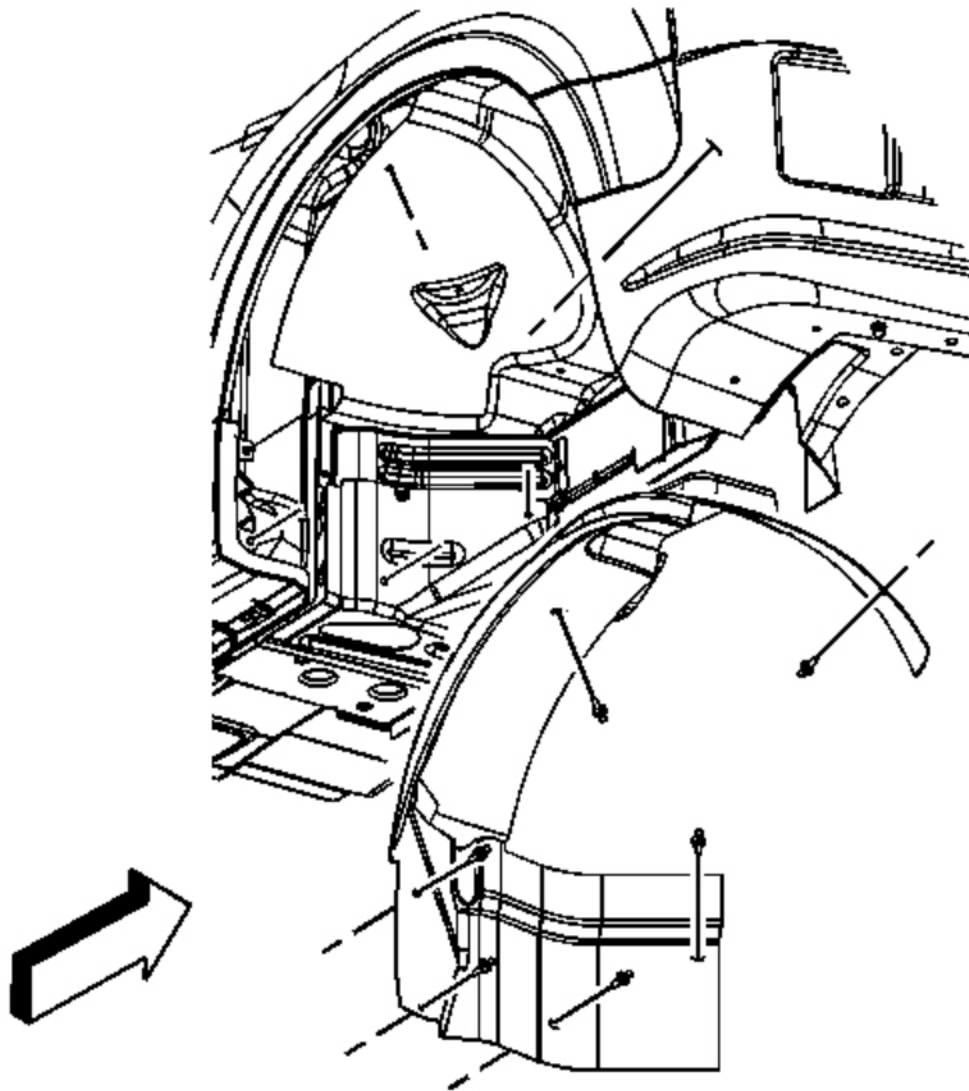


Fig. 52: View Of Wheelhouse Liners
Courtesy of GENERAL MOTORS CORP.

30. Remove the right and left wheelhouse splash shields. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
31. Remove the right and left wheelhouse liners. Refer to **Wheelhouse Liner Replacement - Front** in Body Front End.

32. Working through the right wheelhouse, remove the windshield washer reservoir to front frame brace.
33. Place a suitable drain pan under the vehicle.
34. Working through the left wheelhouse, disconnect the transmission oil cooler lines located near the air conditioning compressor.

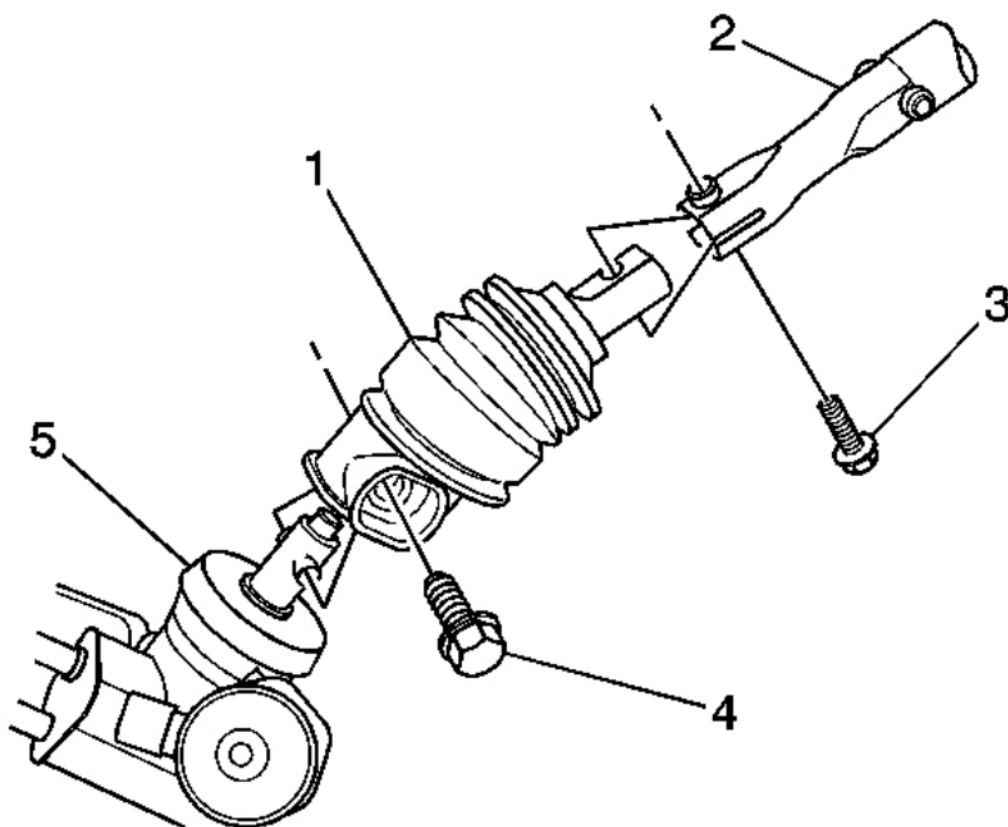


Fig. 53: View Of Steering Column Intermediate Shafts
Courtesy of GENERAL MOTORS CORP.

35. Remove the center intermediate shaft to the lower intermediate shaft bolt (3).
36. Separate the center intermediate shaft from the lower intermediate shaft.
37. Drain the cooling system. Refer to **Draining and Filling Cooling System** in Engine Cooling.

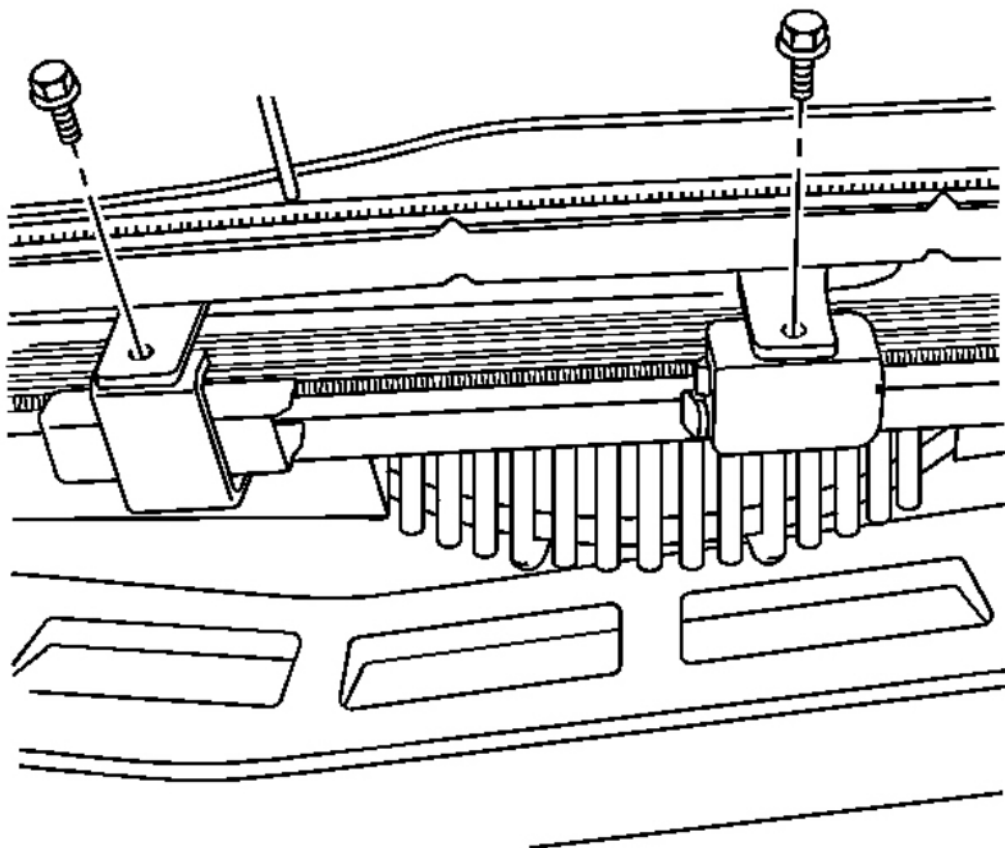


Fig. 54: View Of Power Steering Cooler Line Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

38. Remove the bolt securing the power steering cooler lines to the radiator assembly.
39. Lower the vehicle.
40. Remove the radiator, condenser, and transmission oil cooler as an assembly. Refer to **Radiator Replacement (LH2 - Standard Cooling)** or **Radiator Replacement (LH2 - Heavy Duty Cooling)** or **Radiator Replacement (LY7 - Standard Cooling)** in Engine Cooling and **Condenser Replacement (Heavy Duty Cooling)** or **Condenser Replacement (Standard Cooling)** in Heating, Ventilation and Air Conditioning.
41. Raise the vehicle.
42. Remove the power steering oil cooler bolts from the power steering oil cooler mounting bracket. Refer to **Power Steering Cooler Replacement (LY7 W/O V92)** or **Power**

Steering Cooler Replacement (LH2 or LY7 with V92) in Power Steering System.

Position the power steering oil cooler to the engine. Secure the cooler to the engine with mechanics wire.

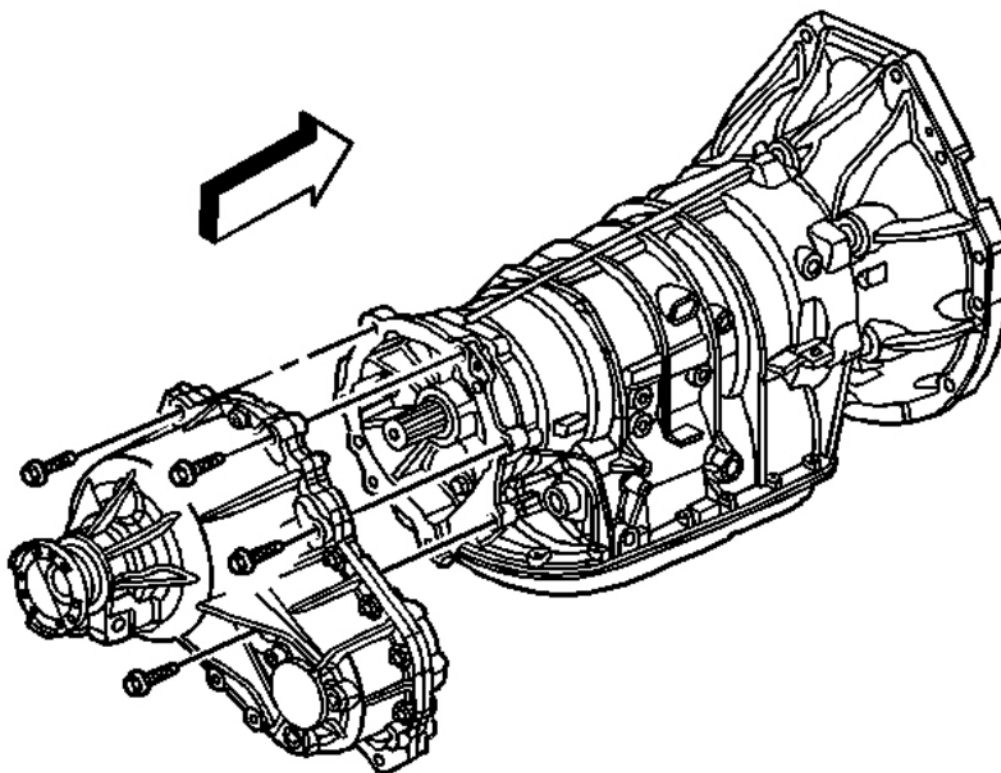


Fig. 55: View Of Transfer Case
Courtesy of GENERAL MOTORS CORP.

43. Remove the transfer case, if equipped. Refer to **Transfer Case Assembly Replacement** in Transfer Case - BW 4476.
44. Remove the transmission assembly. Refer to **Transmission Replacement** in Automatic Transmission - 5L40-E or **Transmission Replacement** in Automatic Transmission - 5L50-E
45. Remove the brake bundle clips from the right and left frame rails. Do not remove the clips from the brake lines.
46. Disconnect the fuel line from the fuel filter. Refer to **Fuel Hose/Pipes Replacement** -

Chassis in Engine Controls - 4.6L (LH2).

47. Disconnect the evaporative emission (EVAP) hose connection at the rear of the fuel filter. Refer to **Evaporative Emission (EVAP) Hoses/Pipes Replacement - Chassis/Canister** in Engine Controls - 4.6L (LH2).
48. Disconnect the rear brake lines from the bracket above the rear axle assembly. Refer to **Brake Pipe Replacement** in Hydraulic Brakes.
49. Remove the fuel and brake line bundle retainers from the frame rail the length of the vehicle. Do not remove the retainers from the lines. Refer to **Fuel Hose/Pipes Replacement - Chassis** in Engine Controls - 4.6L (LH2).
50. Remove the fuel filter bracket to provide a removal path for the fuel and brake line bundle assembly.
51. Remove the fuel and brake line bundle bracket from the right side wheelhouse.
52. Lower the vehicle.
53. Disconnect the heater outlet hose from the heater outlet pipe at the right frame rail. Position the hose to the engine.
54. Disconnect the heater inlet hose from the water housing and position the hose to the vehicle.
55. If the vehicle is equipped with Magnaride, disconnect the electrical connectors from the top of the right and left shock modules.
56. Remove the right and left shock module upper mounting bolts.
57. Secure the shock modules to the front frame with mechanics wire to avoid stretching the front brake hoses.
58. Raise the vehicle enough to place a suitable lift table under the engine, front frame, and front suspension assembly.

CAUTION: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed.

59. Support the rear of the vehicle with suitable jack stands.
60. Raise the lift table and/or lower the vehicle to preload the weight of the engine, front frame, and front suspension assembly.
61. Remove the front frame bolts.
62. With the aid of an assistant, lower the table and/or raise the vehicle to remove the engine, front frame, fuel/brake bundle and front suspension assembly from the vehicle.

63. Ensure that all the hoses, wires, pipes and shock modules clear the vehicle during the removal process.

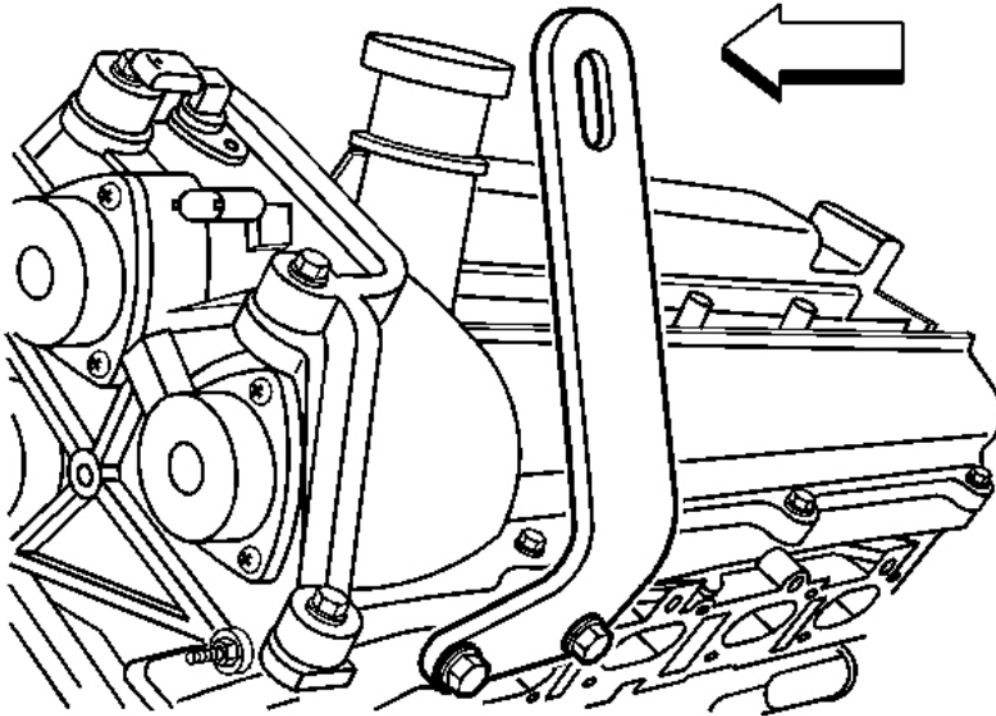


Fig. 56: View Of J 28467-86 Installed To Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

64. Install the **J 28467-86** to the left cylinder head. Refer to **Engine Support Fixture** .

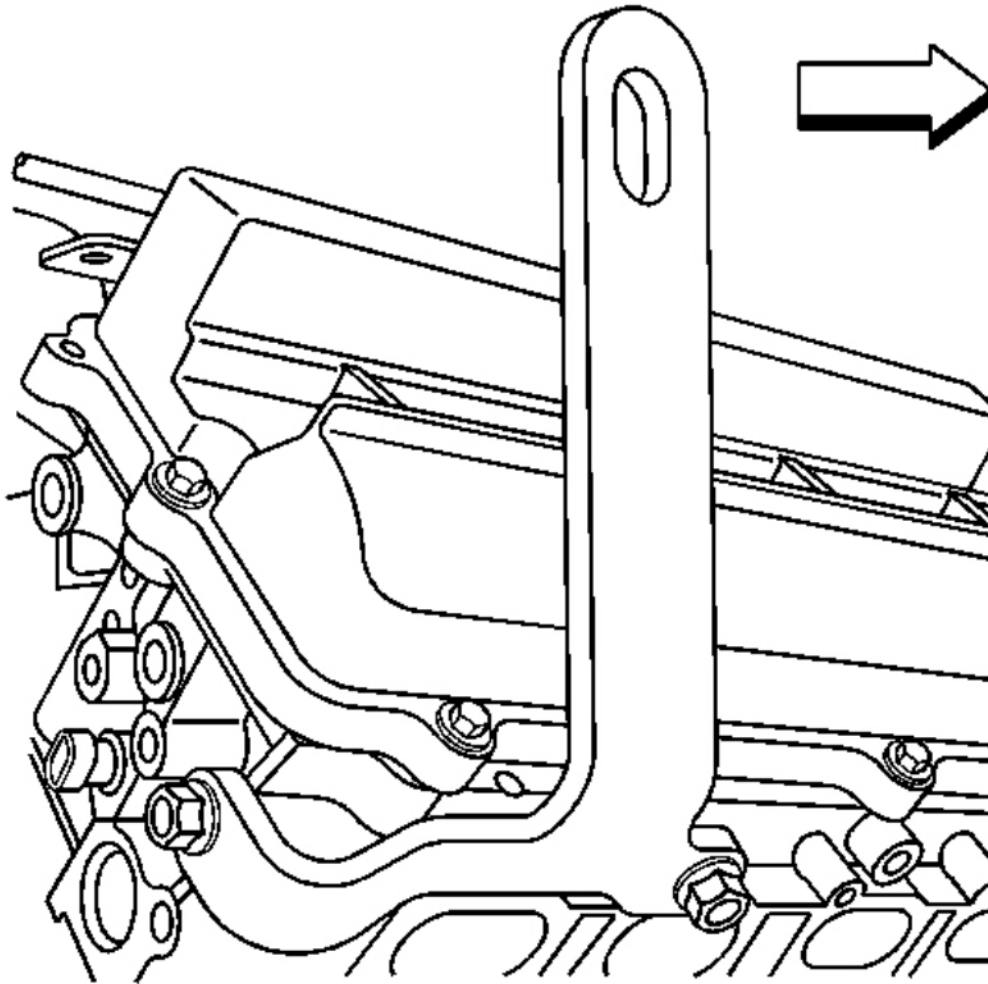


Fig. 57: View Of J 28467-87 Installed To Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

65. Install the **J 28467-87** to the right cylinder head. Refer to **Engine Support Fixture** .
66. Using a suitable engine lift, remove the engine from the front frame assembly.

Installation Procedure

1. Install the engine to the front frame.
2. Ensure that all the hoses, wires, pipes and shock modules are positioned out of the way to

avoid contact during engine installation.

3. With the aid of an assistant, raise the table and/or lower the vehicle to install the engine, front frame, fuel/brake bundle and front suspension.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the frame bolts.

Tighten: Tighten the frame bolts to 191 N.m (141 lb ft)

5. Install the right and left upper shock modules bolts.

Tighten: Tighten the bolts to 112 N.m (83 lb ft)

6. Connect the shock module electrical connectors, if equipped with Magnaride.
7. Connect the heater inlet hose to the water housing.
8. Connect the heater outlet hose to the outlet pipe.
9. Raise the vehicle.
10. Install the fuel and brake line bundle bracket bolt to the right side wheelhouse.

Tighten: Tighten the fuel and brake line bundle bracket bolt to 9 N.m (80 lb in)

11. Install the fuel filter bracket bolt.

Tighten: Tighten the fuel filter bracket bolt to 9 N.m (80 lb in)

12. Install the fuel and brake line to the bundle brackets, the length of the vehicle.
13. Install the rear brake line to the bracket bolt above the rear axle assembly.

Tighten: Tighten the rear brake line to the bracket bolt to 9 N.m (80 lb in)

14. Connect the evaporative emission hose to the rear of the fuel filter.
15. Connect the fuel line to the fuel filter.
16. Install the brake lines to the bundle clips on the right and left frame rails.
17. Install the transmission assembly. Refer to Transmission Replacement in Automatic Transmission 5L40-E.
18. Install the transfer case, if equipped. Refer to Transfer Case Assembly Replacement in Transfer Case - BW 4476.

19. Install the power steering oil cooler to the mounting bracket. Refer to **Power Steering Cooler Replacement (LY7 W/O V92)** or **Power Steering Cooler Replacement (LH2 or LY7 with V92)** in Power Steering System.
20. Lower the vehicle.
21. Install the radiator, condenser and transmission oil cooler as an assembly. Refer to **Radiator Replacement (LH2 - Standard Cooling)** or **Radiator Replacement (LH2 - Heavy Duty Cooling)** or **Radiator Replacement (LY7 - Standard Cooling)** in Engine Cooling and **Condenser Replacement (Heavy Duty Cooling)** or **Condenser Replacement (Standard Cooling)** in Heating, Ventilation and Air Conditioning.
22. Raise the vehicle.
23. Install the power steering to the radiator retaining bolt.

Tighten: Tighten the power steering to the radiator retaining bolt to 9 N.m (80 lb in)

24. Connect the center intermediate shaft to the lower intermediate shaft.

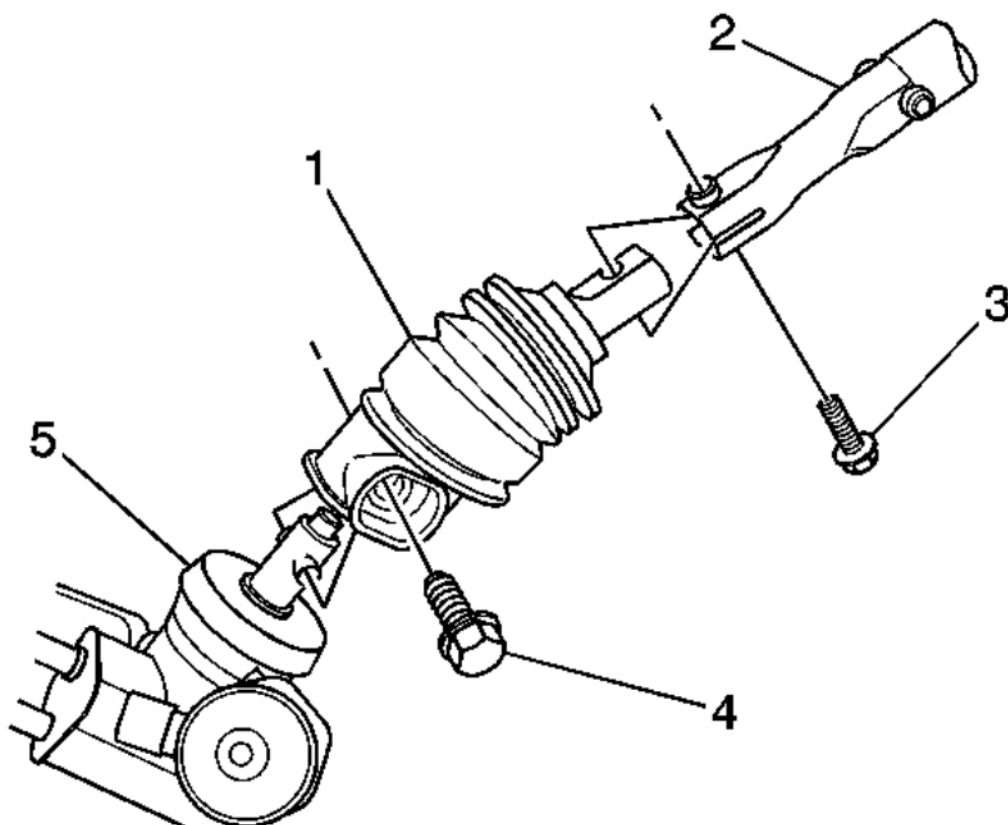


Fig. 58: View Of Steering Column Intermediate Shafts
 Courtesy of GENERAL MOTORS CORP.

25. Install the center intermediate to lower intermediate shaft attaching bolt.

Tighten: Tighten the intermediate shaft attaching bolt to 30 N.m (23 lb ft)

26. Working through the left wheelhouse, connect the transmission oil cooler lines (near the air conditioning compressor).
27. Working through the right hand wheelhouse, install the washer fluid reservoir to the front frame brace bolt.

Tighten: Tighten the washer fluid reservoir to the front frame brace bolt to 6 N.m (53 lb in)

28. Install the right and left front wheelhouse liners. Refer to **Wheelhouse Liner Replacement**

- **Front** in Body Front End.

29. Install the right and left wheelhouse splash shields. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
30. Install the right and left front tire assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
31. Lower the vehicle.
32. Install the cooling fan(s). Refer to the appropriate procedure:
 - **Fan Replacement** in Engine Cooling
 - **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)** in Engine Cooling
33. Connect the electrical connector C113 at the right hand frame rail. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
34. Connect the electrical connector C5 to the underhood bussed electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
35. Connect the transmission control module. Refer to **Transmission Control Module (TCM) Replacement** in Automatic Transmission - 5L40-E
36. Connect the chassis electrical connector located at the top of the right hand shock tower.
37. Install the positive battery cable toe underhood bussed electrical center.

Tighten: Tighten the battery cable nut to 15 N.m (11 lb ft).

38. Install the negative battery cable retainer and bolt to the right hand shock tower.

Tighten: Tighten the retainer bolt to 36 N.m (27 lb ft).

39. Install the underhood electrical center cover.
40. Connect the underhood fuse block connector C5.
41. Connect the front of the dash electrical connector C102. Refer to **Harness Routing Views** in Wiring Systems.
42. Install the fuel line retainer located on the bracket attached to the heater lines on the front of the dash.
43. Install the brake master cylinder.

Tighten: Tighten the master cylinder retaining nuts to 25 N.m (18 lb ft).

44. Connect the brake fluid level switch.

45. Connect the brake booster vacuum line to the brake booster.
46. Install the air conditioning liquid line to the condenser. Refer to **Liquid Line Replacement (w/o C57)** or **Liquid Line Replacement (w/C57)** in Heating, Ventilation, and Air Conditioning.

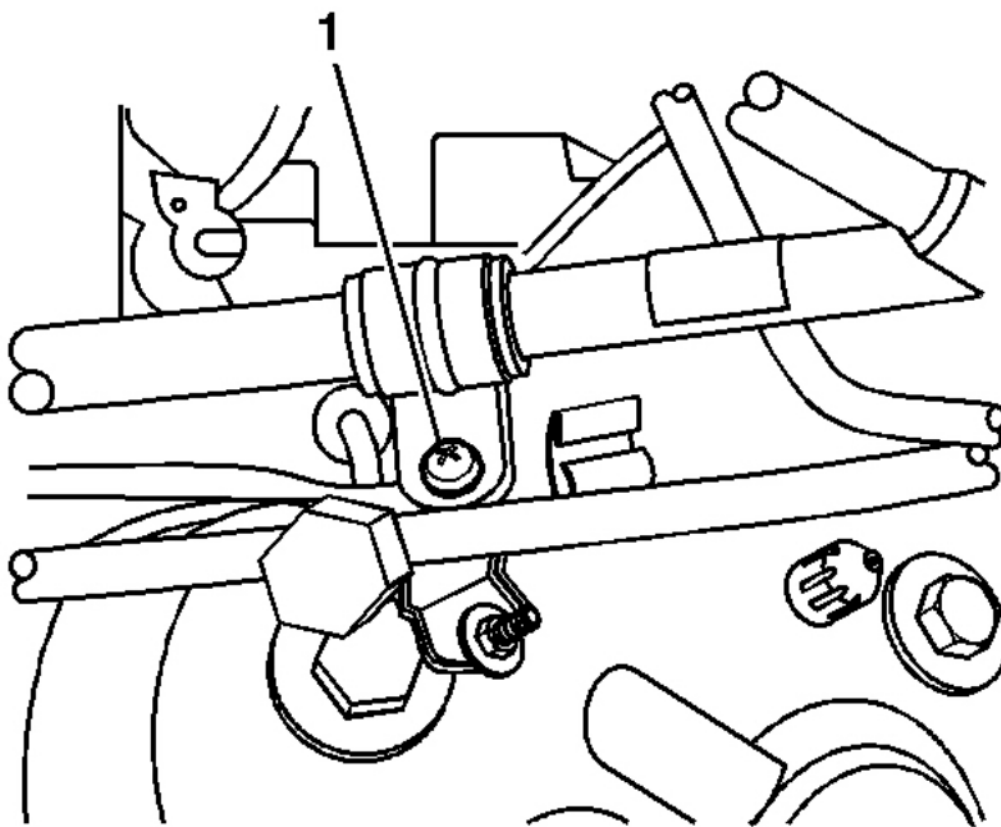


Fig. 59: View Of Suction Hose Retaining Feature
Courtesy of GENERAL MOTORS CORP.

47. Install the air conditioning suction hose located at the top of the left hand shock tower. Refer to **Suction Hose Replacement (LH2 w/o C57)** or **Suction Hose Replacement (LH2 w/C57)** or **Suction Hose Replacement (LY7 w/o C57)** in Heating, Ventilation, and Air Conditioning.
48. Install the air conditioning liquid and suction lines in place to the retaining feature on the fan shroud.

49. Connect the coolant surge tank hose to the radiator.

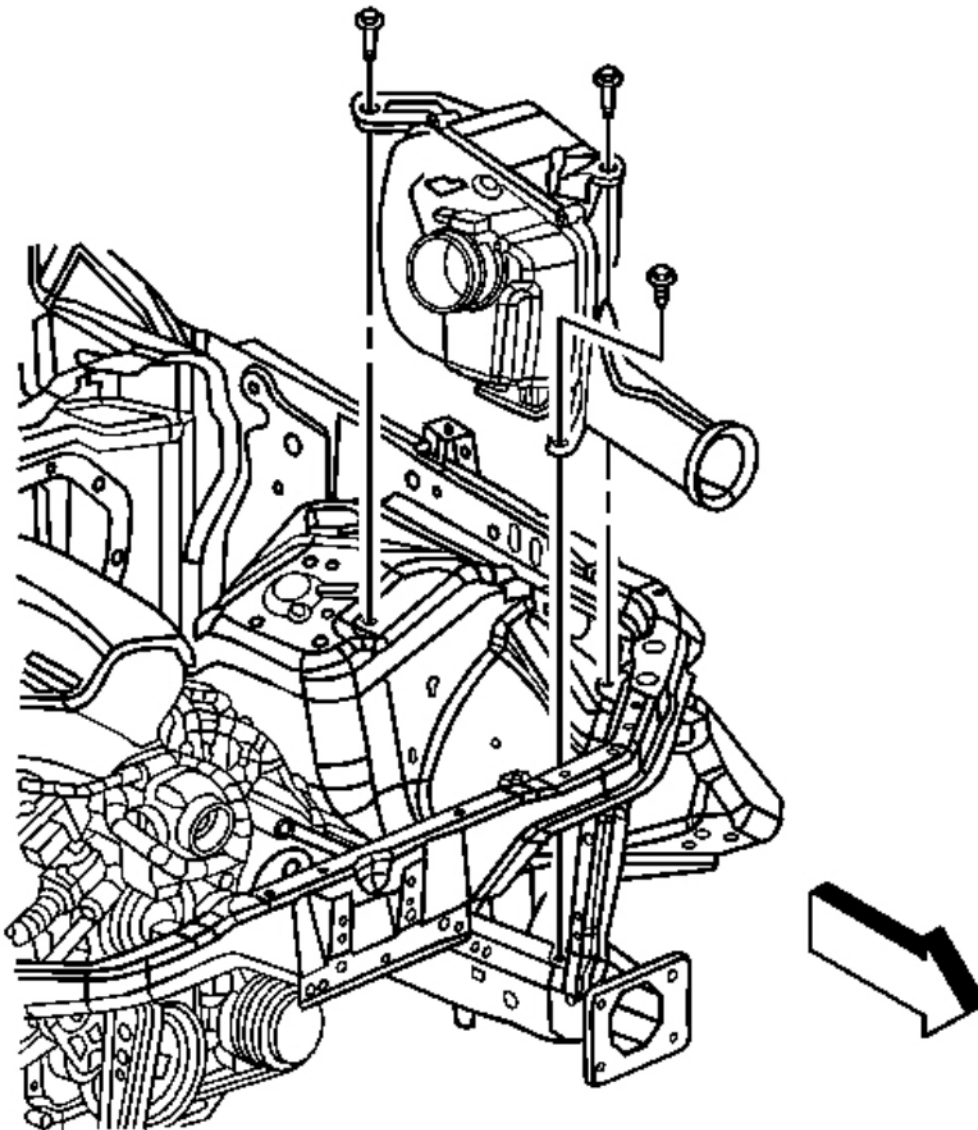


Fig. 60: View Of Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

50. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine

Controls - 4.6L (LH2).

51. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .
52. Install the cross vehicle brace. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.
53. Install the positive battery cable. Refer to **Battery Positive Cable Replacement (LH2)** or **Battery Positive Cable Replacement (LY7)** in Engine Electrical.
54. Install the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.
55. Remove the **J 42640** . Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column.
56. Fill the engine with engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
57. Fill the cooling system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation, and Air Conditioning.
58. Recharge the air conditioning system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation, and Air Conditioning.
59. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brake System.

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Position the oil drain pan under the engine oil drain plug.

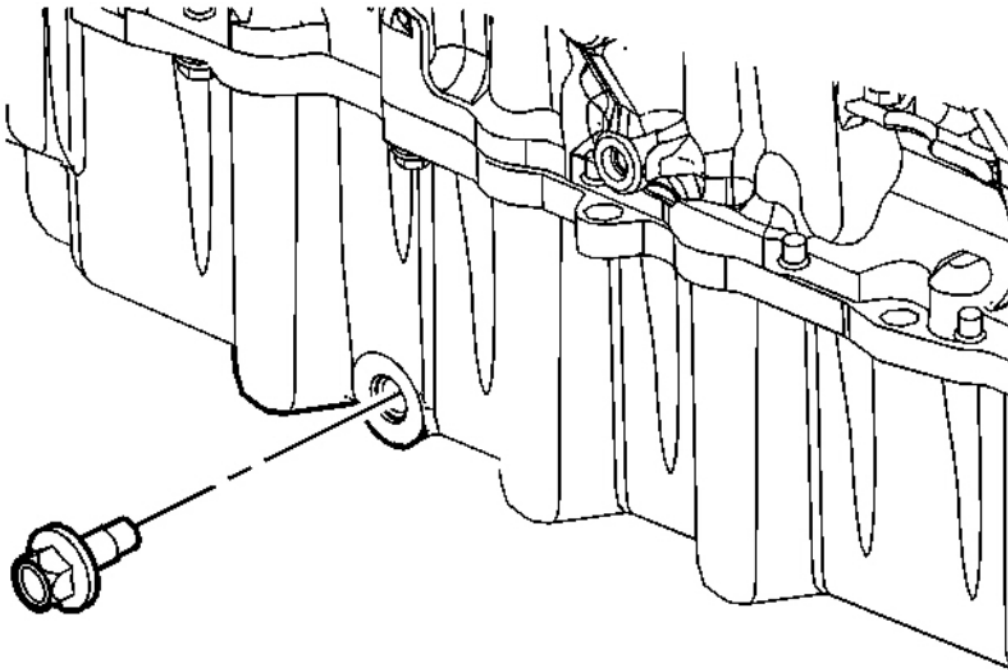


Fig. 61: View Of Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine oil drain plug.
4. Clean and inspect the engine oil drain plug, replace if necessary.
5. Clean and inspect the engine oil drain plug sealing surface on the oil pan, repair or replace oil pan if necessary.

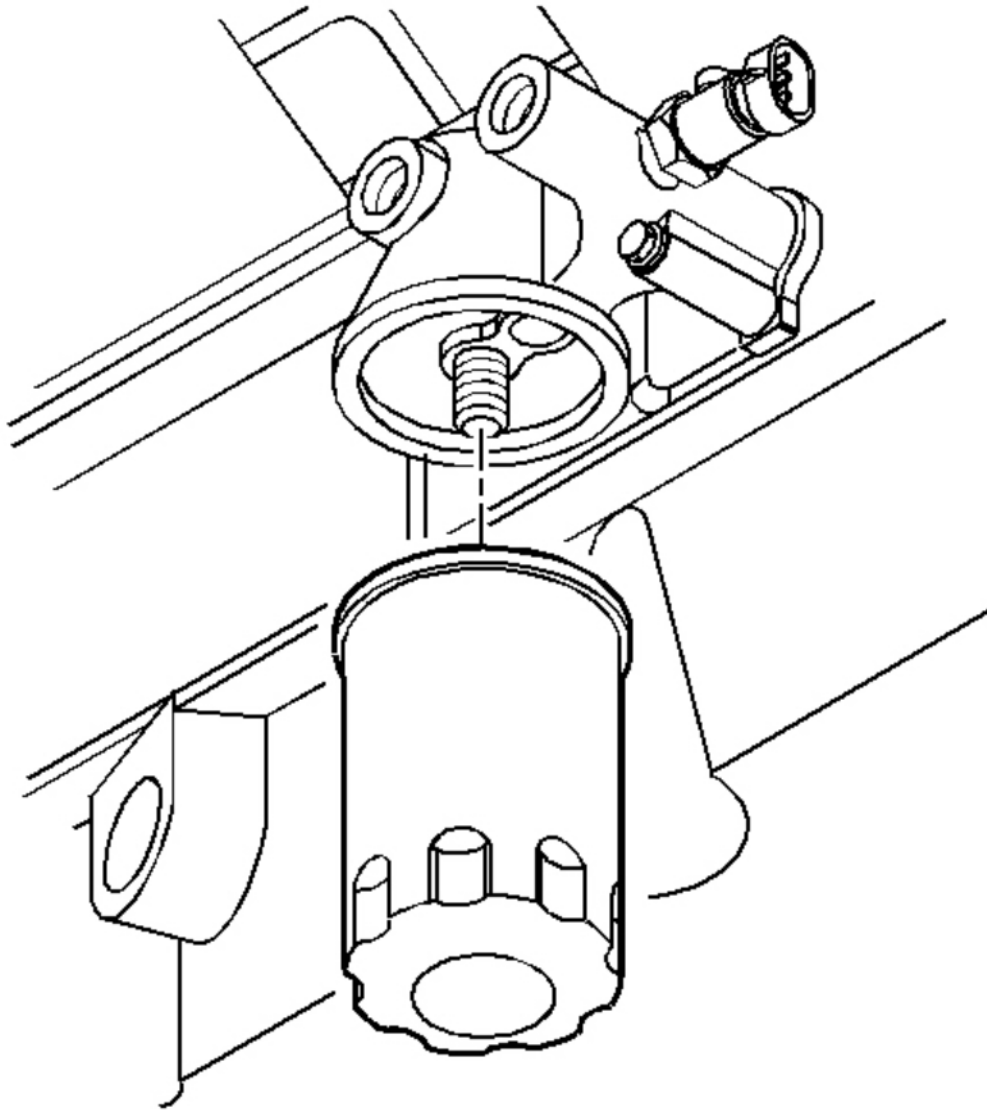


Fig. 62: Locating Oil Filter Adapter & Filter
Courtesy of GENERAL MOTORS CORP.

6. Remove the oil filter.
7. Clean and inspect the oil filter sealing area on the oil filter adapter, repair or replace if necessary.

Installation Procedure

1. Fill the oil filter with oil.
2. Lightly oil the replacement oil filter gasket with clean oil.

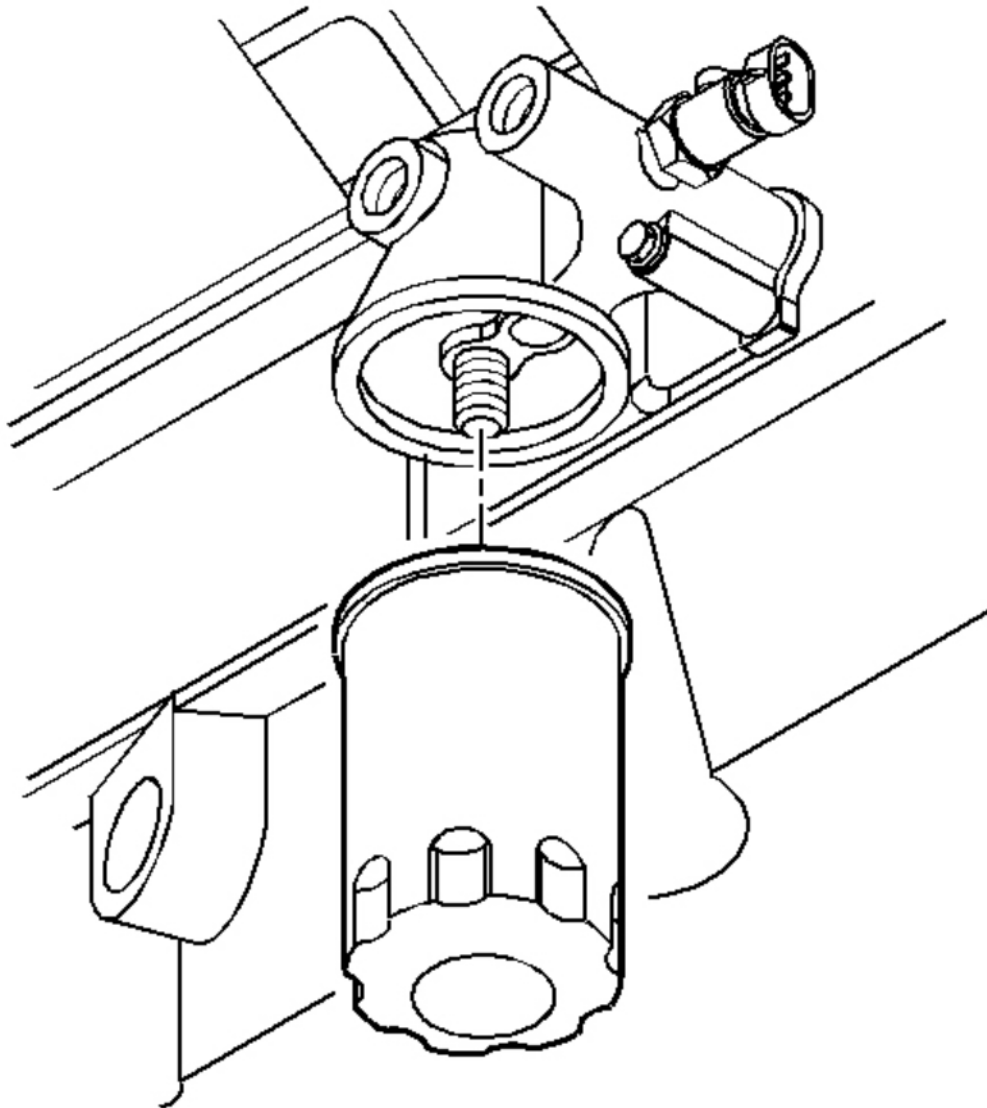


Fig. 63: Locating Oil Filter Adapter & Filter
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the new oil filter.

Tighten: Tighten the new oil filter to 3/4 to 1 full turn, after the oil filter gasket contacts the oil filter mounting surface.

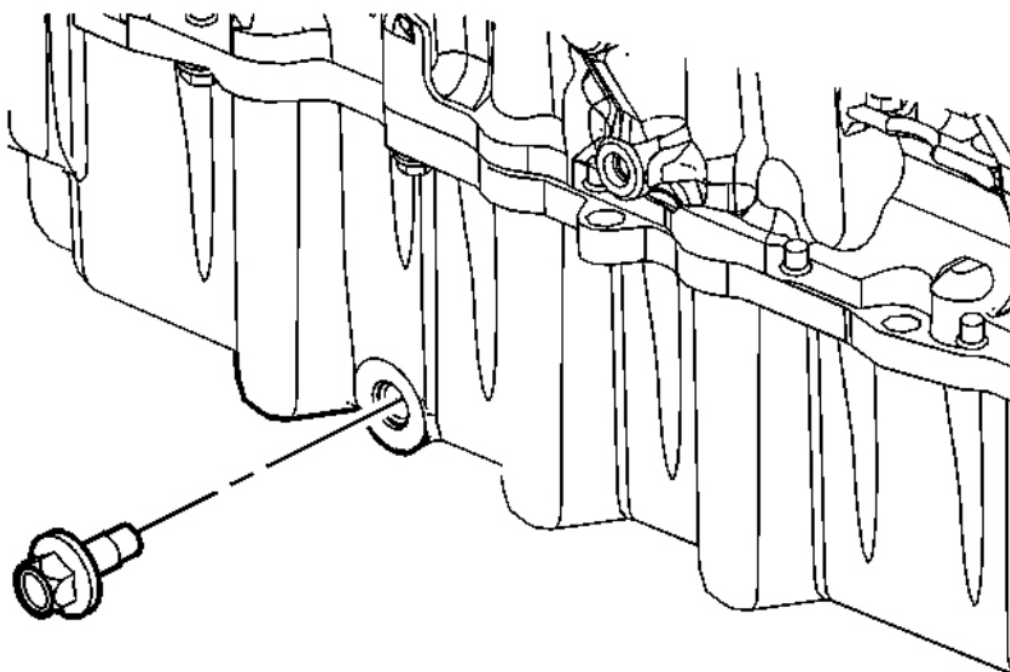


Fig. 64: View Of Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

4. Install the engine oil drain plug.

Tighten: Tighten the engine oil drain plug to 20 N.m (15 lb ft).

5. Lower the vehicle.
6. Fill the engine with new engine oil. Refer to **Fluid and Lubricant Recommendations** and **Capacities - Approximate Fluid** in Maintenance and Lubrication.
7. Inspect for oil leaks after engine start up.

8. Reset the oil life monitor. Refer to **GM Oil Life System - Resetting (1)** in Maintenance and Lubrication.

ENGINE WIRING HARNESS ASSEMBLY REMOVAL

Left Side Harness Connections

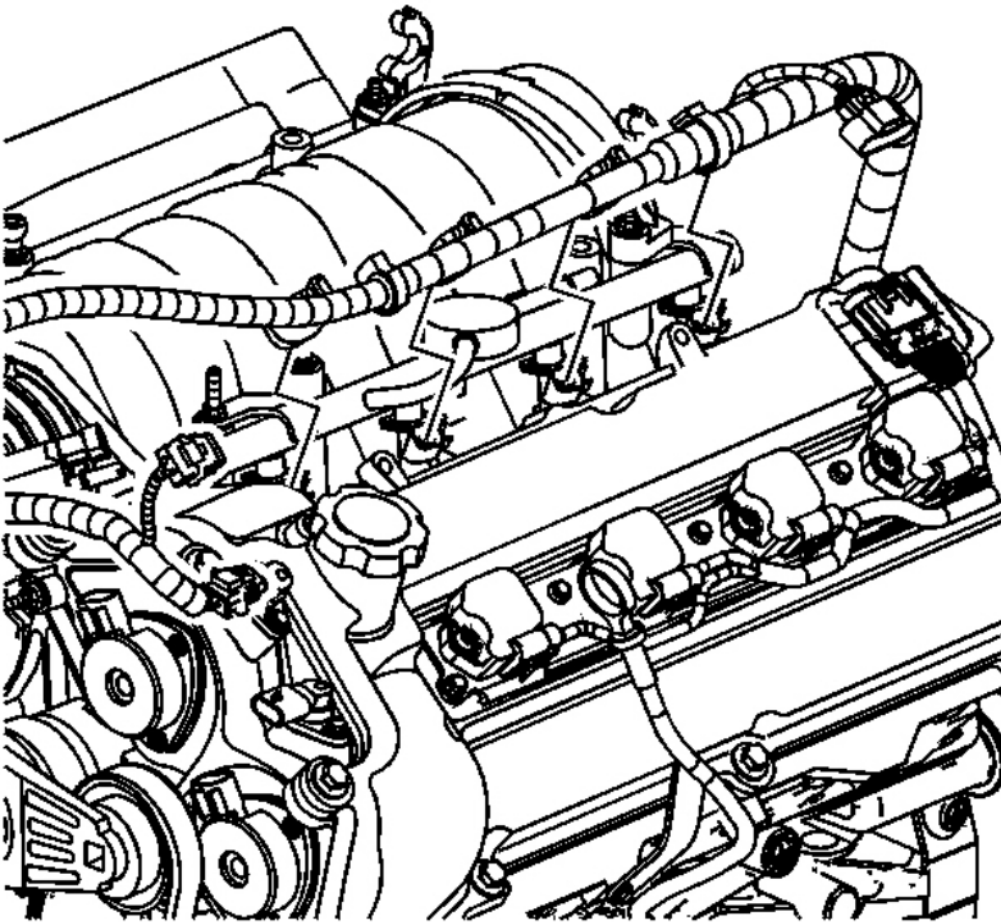


Fig. 65: View Of Left Side Fuel Injectors Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine wiring harness from the left side fuel injectors.

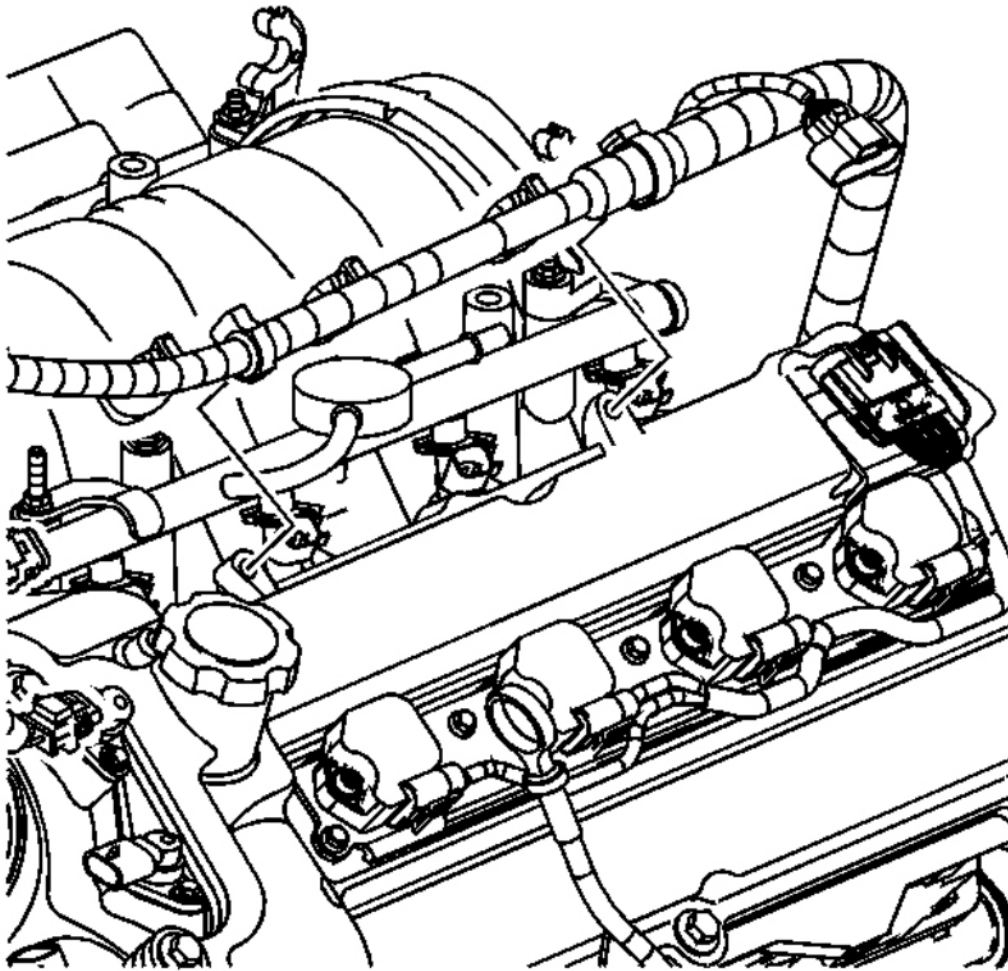


Fig. 66: View Of Left Camshaft Cover Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the engine wiring harness from the left camshaft cover.

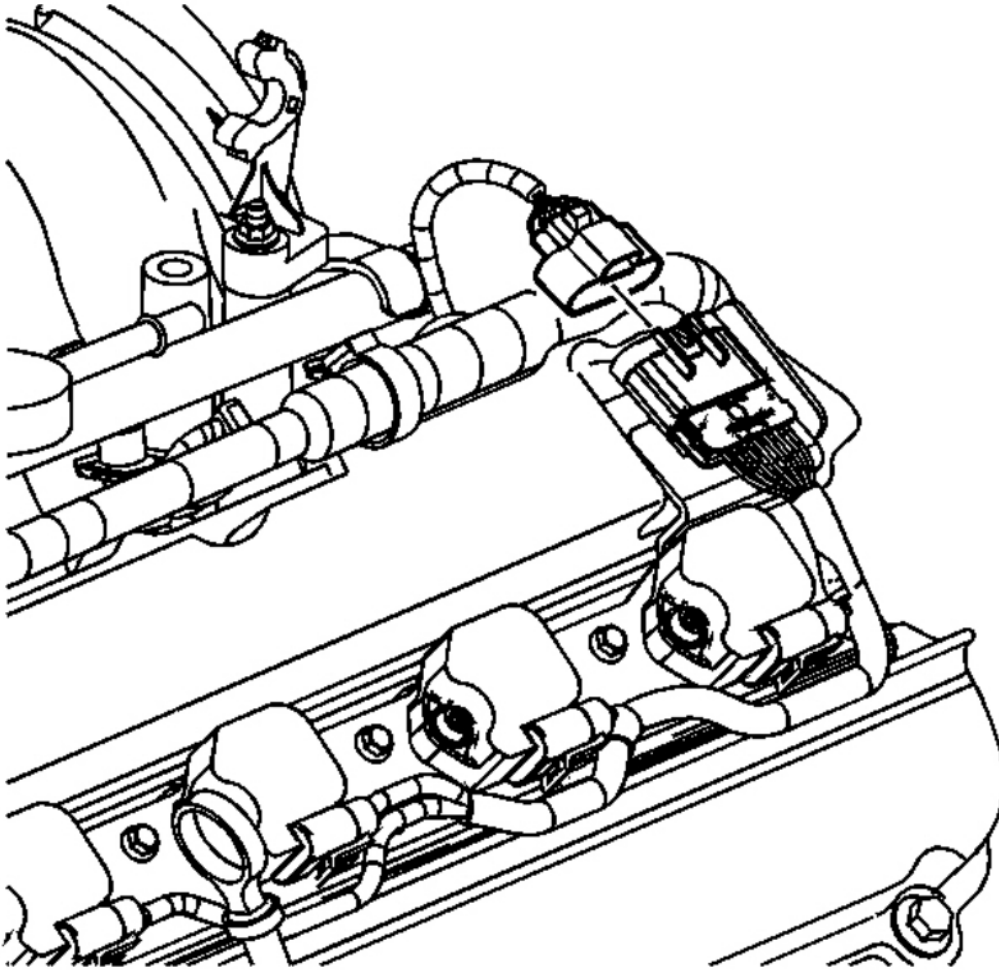


Fig. 67: View Of Left Coil Assembly Harness Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the engine wiring harness from the left coil assembly harness.

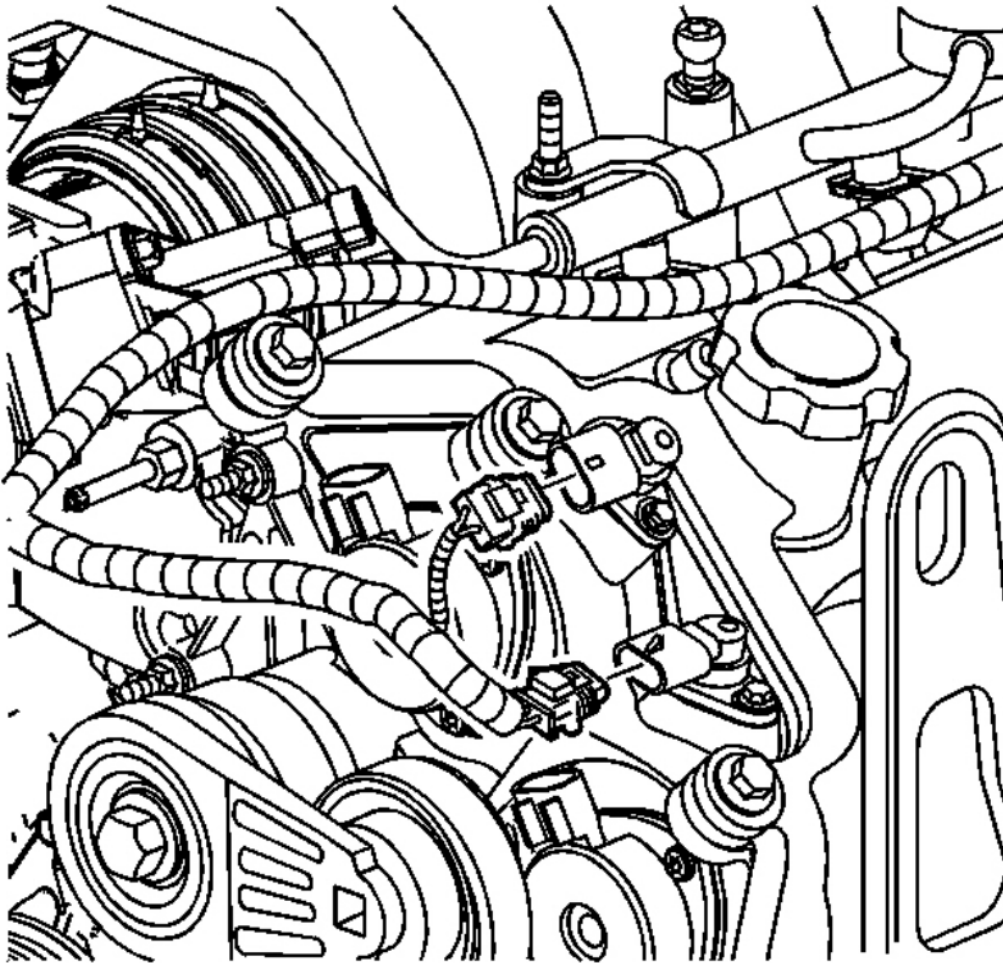


Fig. 68: View Of Left Camshaft Position Sensors Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the engine wiring harness from the left camshaft position sensors.

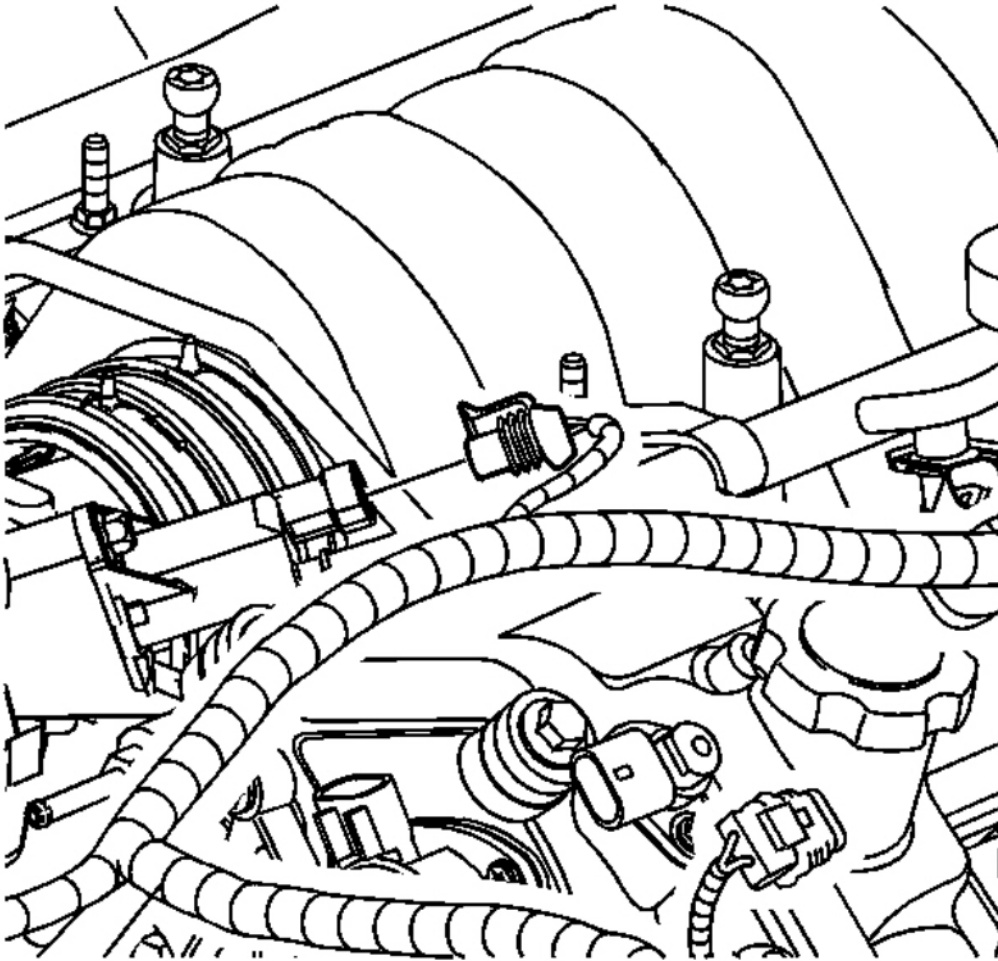


Fig. 69: View Of EVAP Purge Solenoid Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine wiring harness from the EVAP purge solenoid.

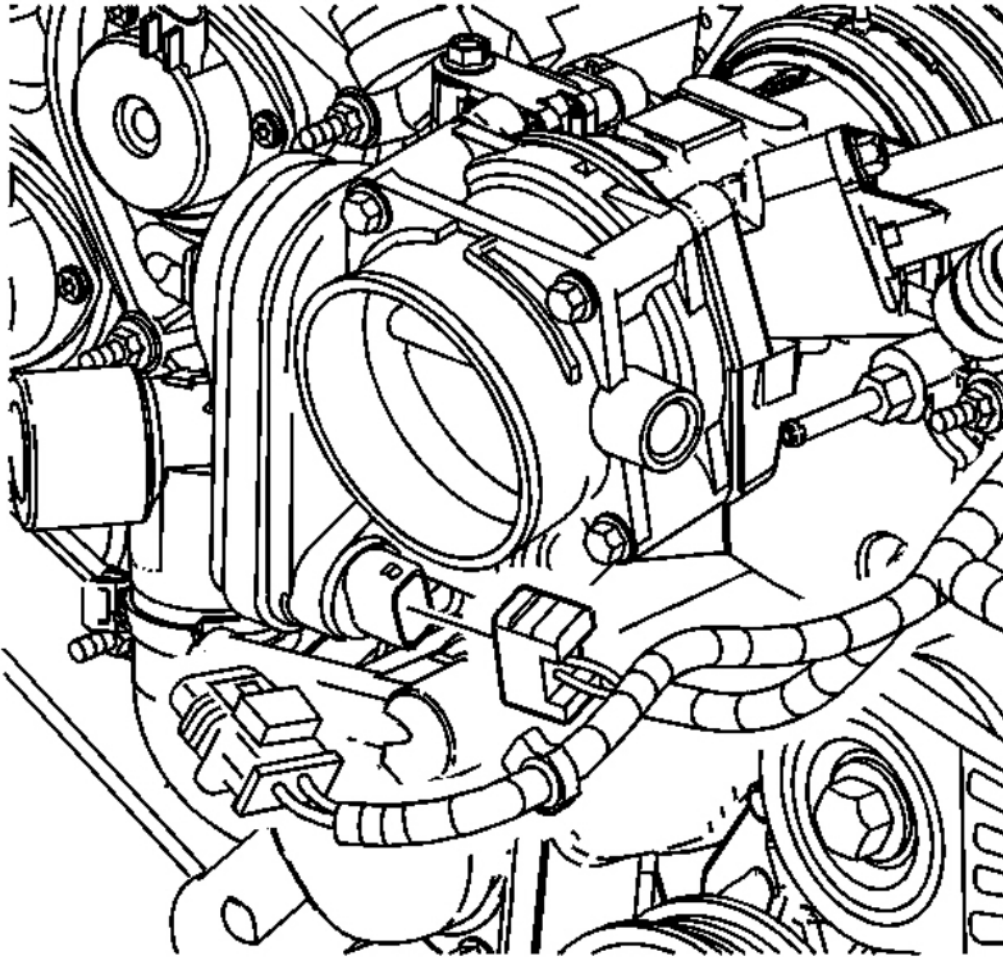


Fig. 70: View Of Throttle Position Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the engine wiring harness from the throttle position sensor on the throttle body.

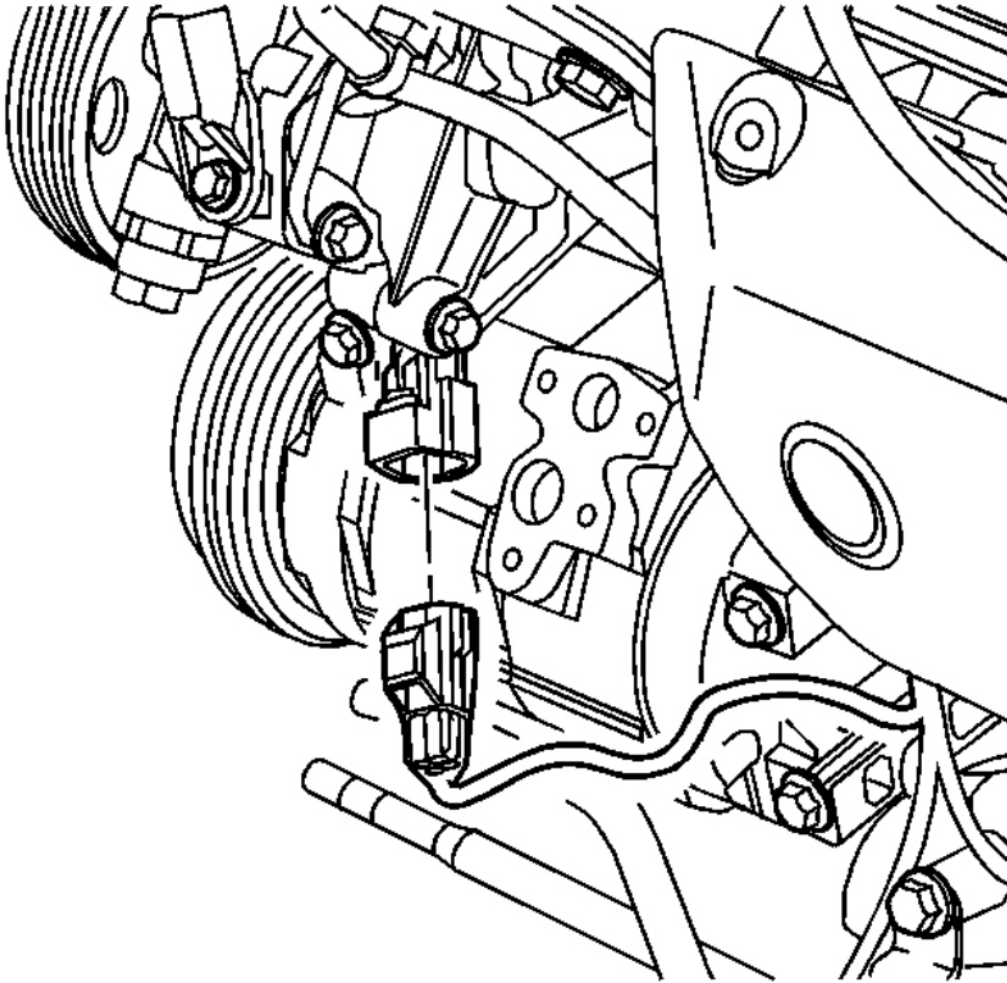


Fig. 71: View Of A/C Compressor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the engine wiring harness from the air conditioner compressor.

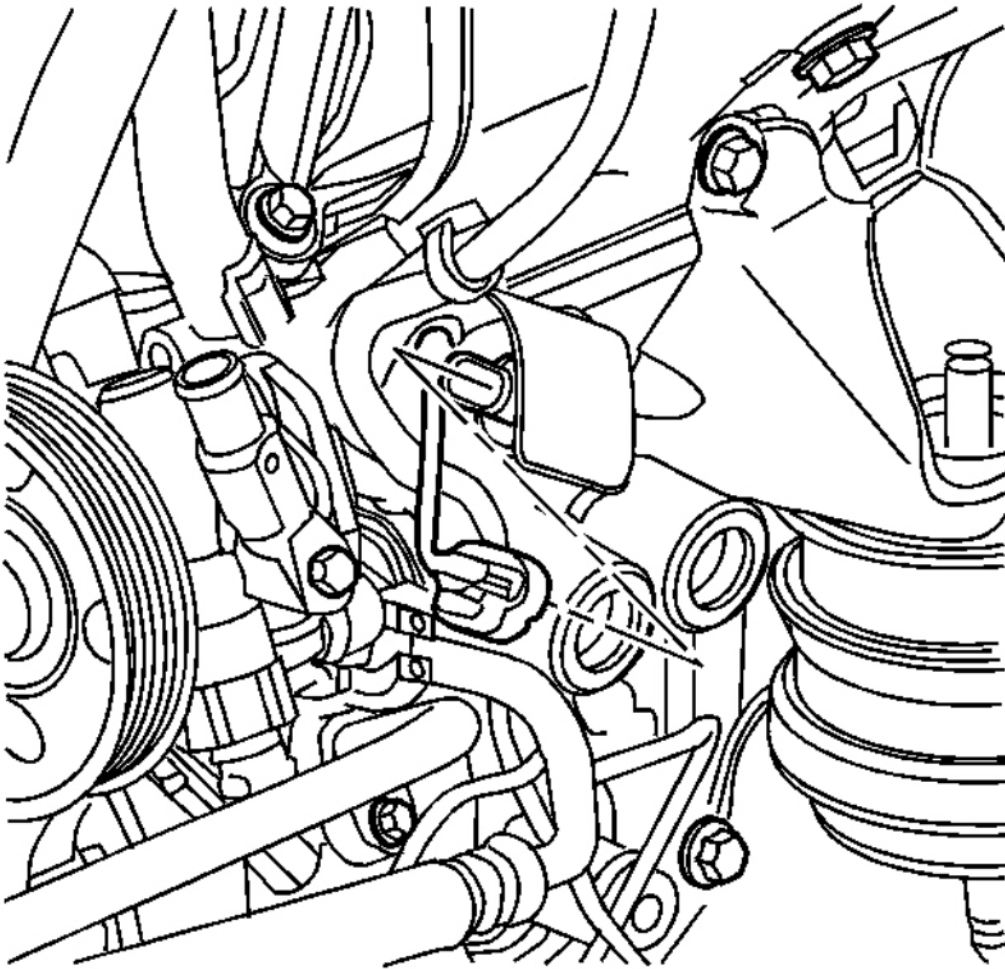


Fig. 72: View Of Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the engine wiring harness from the oil pressure sensor.

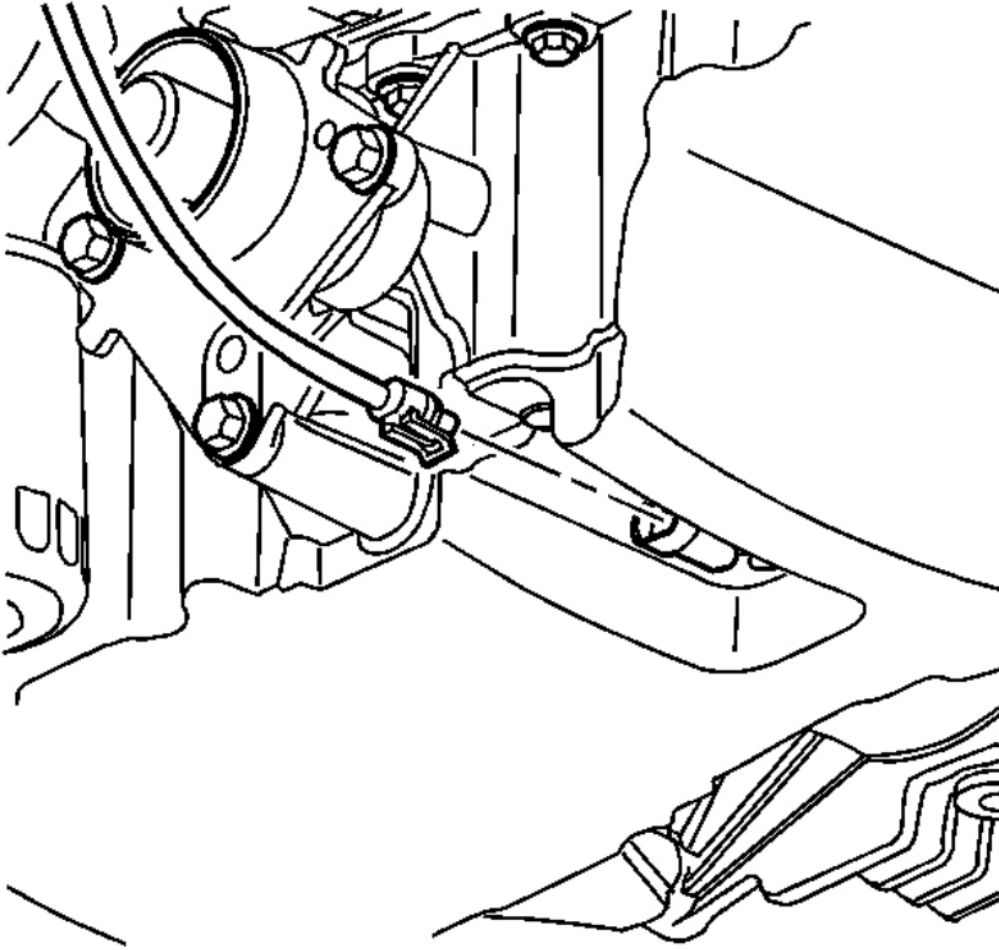


Fig. 73: View Of Oil Level Oil Switch Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the engine wiring harness from the oil level oil switch.

Right Side Harness Connections

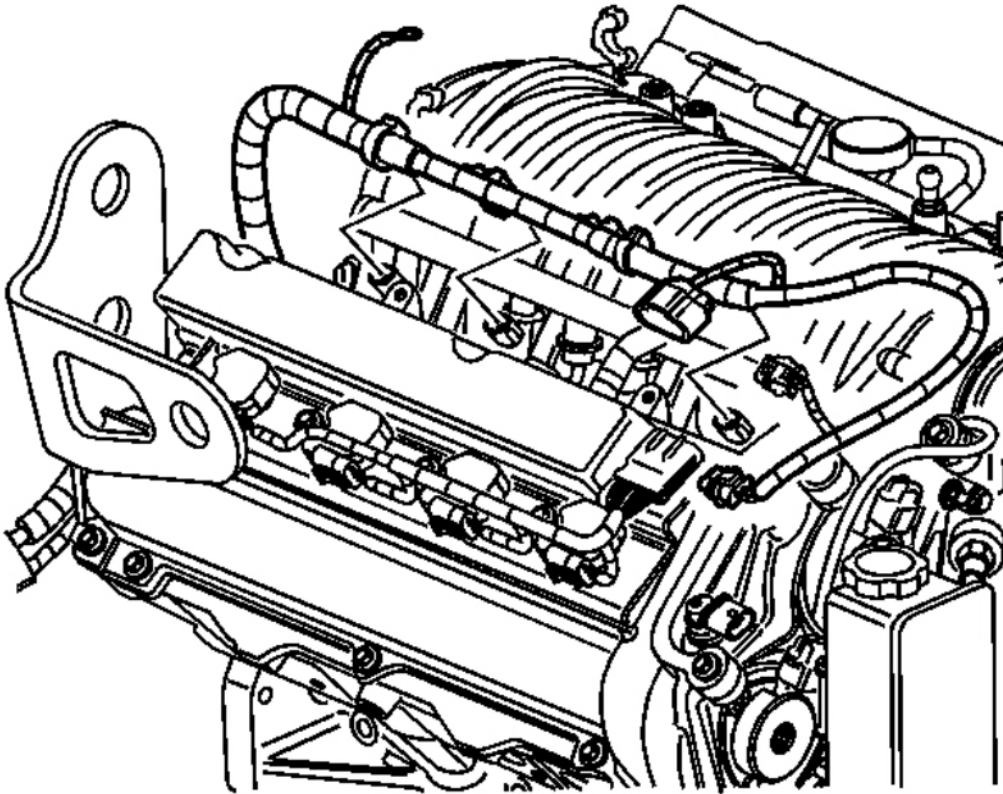


Fig. 74: View Of Right Side Fuel Injectors Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine wiring harness from the right side fuel injectors.

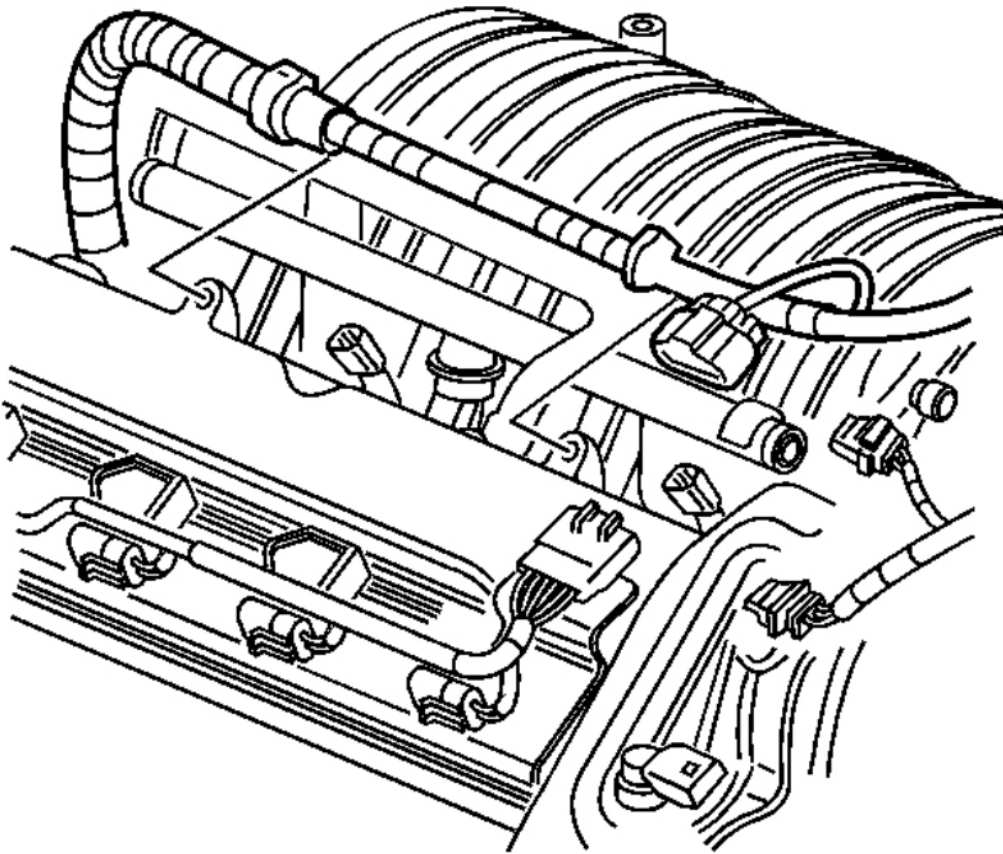


Fig. 75: View Of Right Camshaft Cover Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the engine wiring harness from the right camshaft cover.

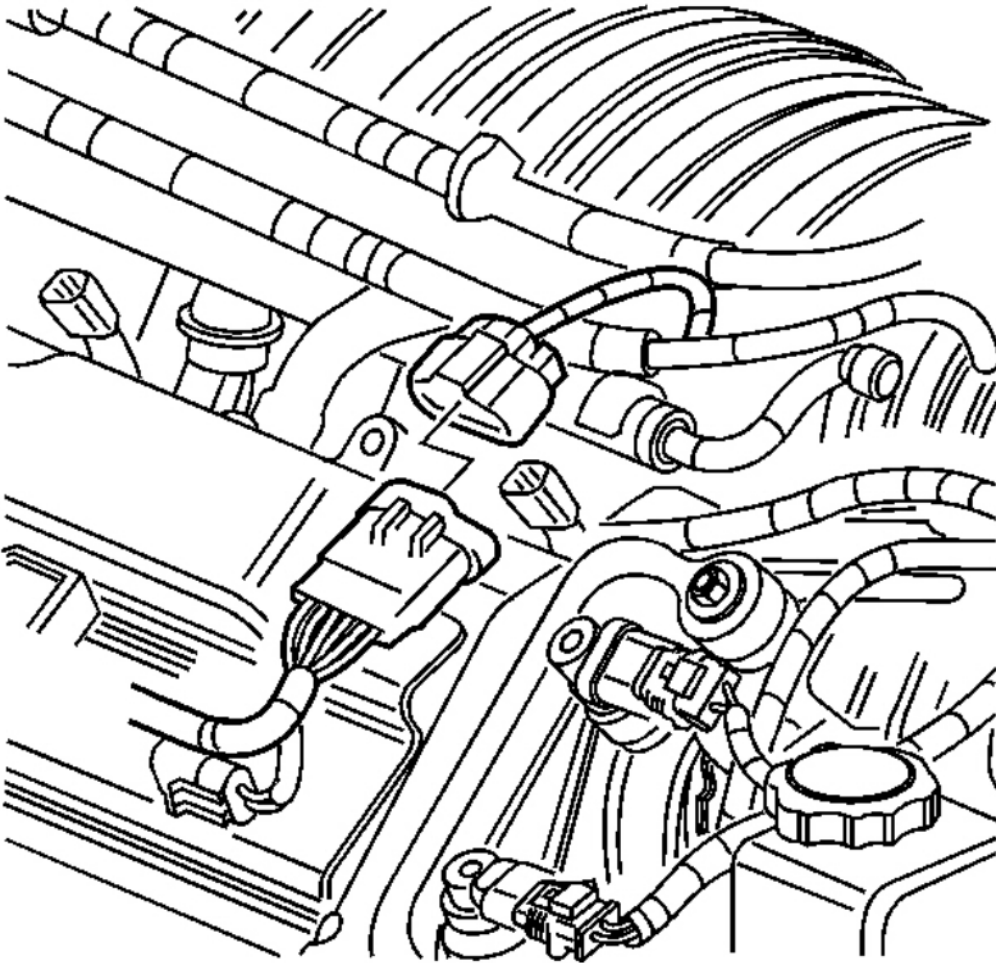


Fig. 76: View Of Engine Wiring Harness & Right Ignition Coil Harness
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the engine wiring harness from right coil assembly harness.

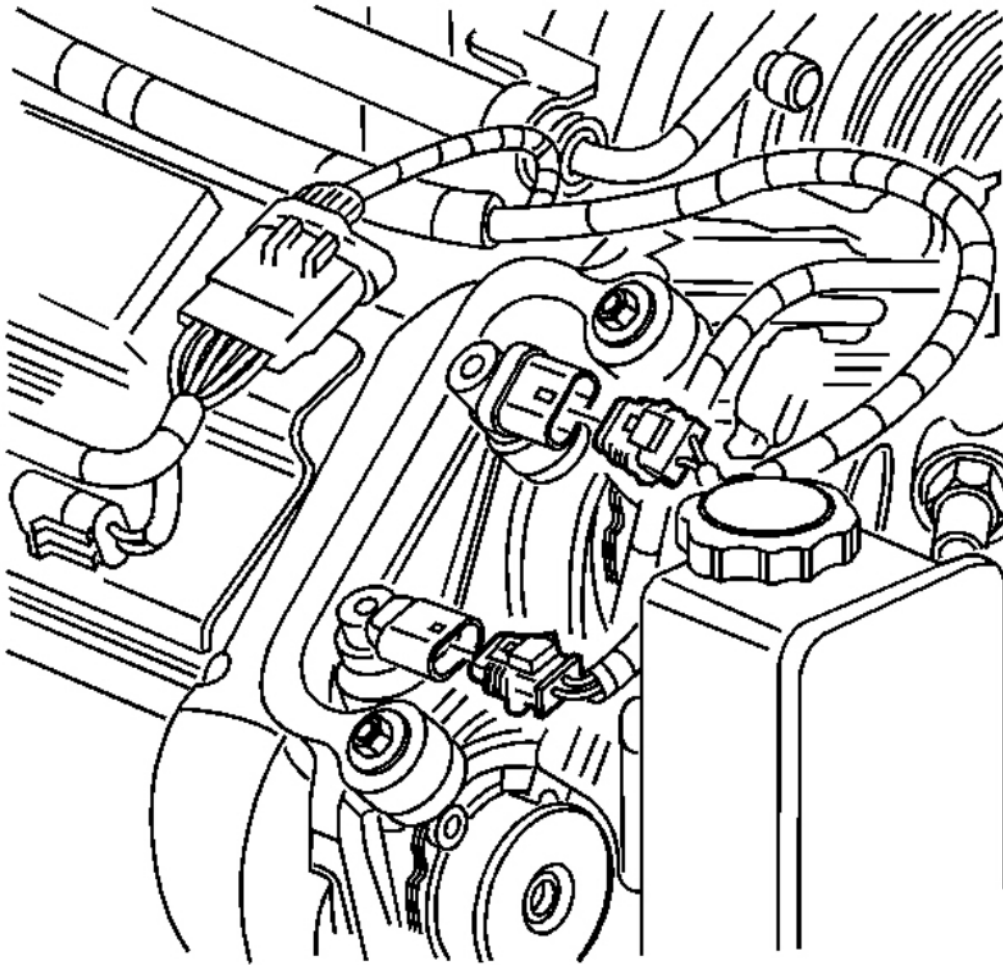


Fig. 77: View Of Right Camshaft Position Sensors Engine Wiring Harness Connectors

Courtesy of GENERAL MOTORS CORP.

4. Disconnect the engine wiring harness from right camshaft position sensors.

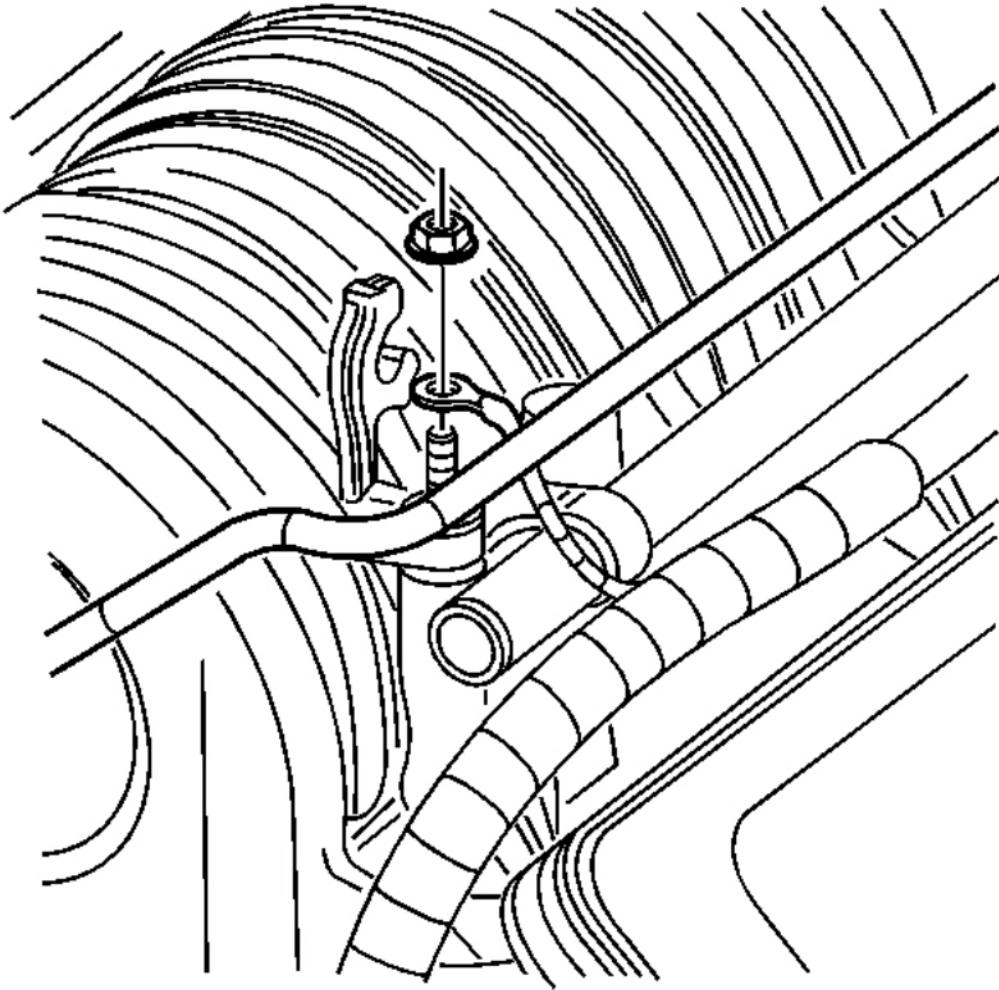


Fig. 78: View Of Intake Manifold Stud Engine Wiring Harness Ground
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine wiring harness ground from the intake manifold stud.

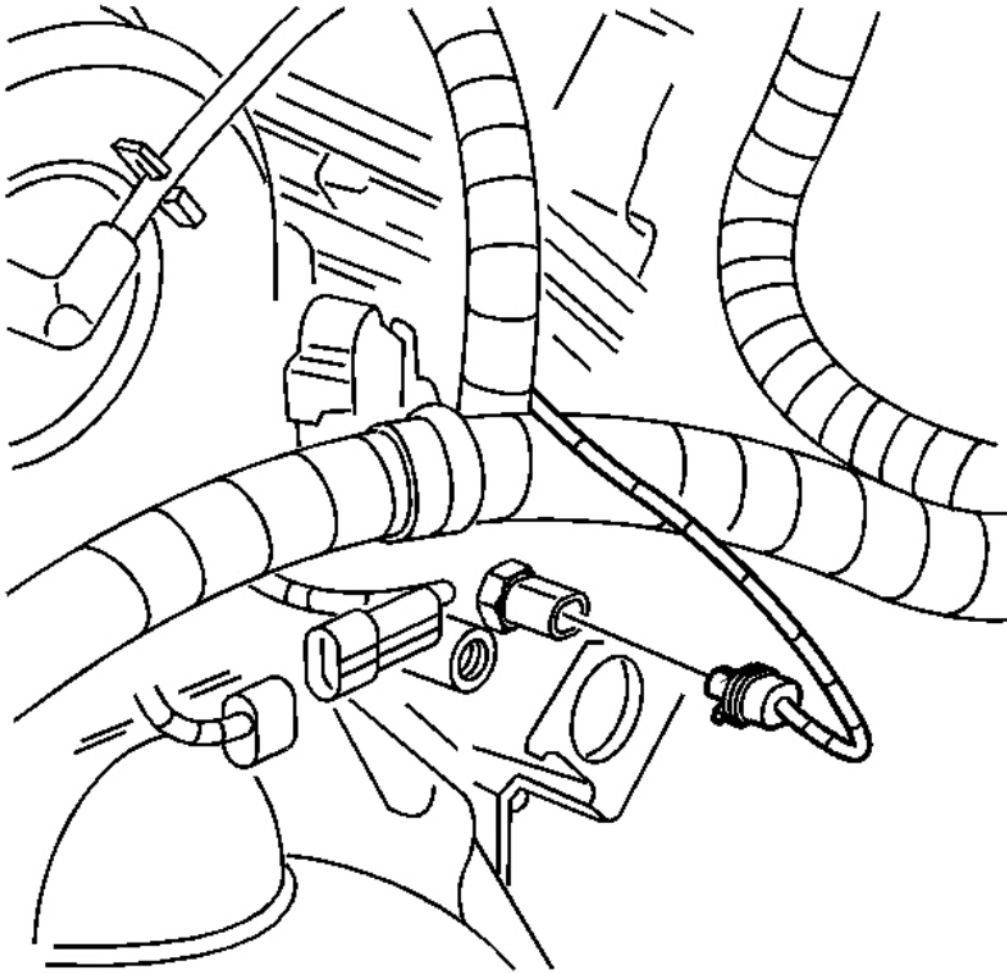


Fig. 79: View Of ECT Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the engine wiring harness from the ECT sensor at the rear of the right cylinder head.

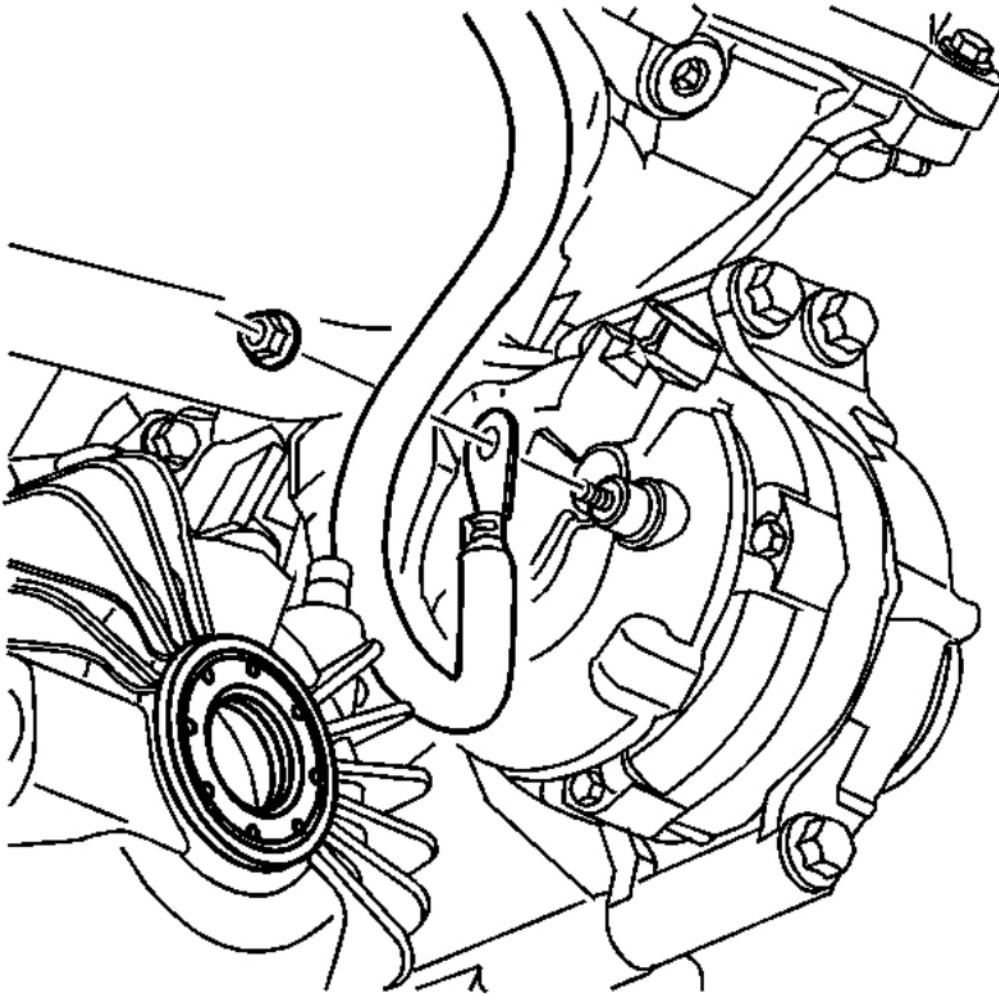


Fig. 80: View Of Generator Starter Motor Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the starter motor wiring harness from the generator.

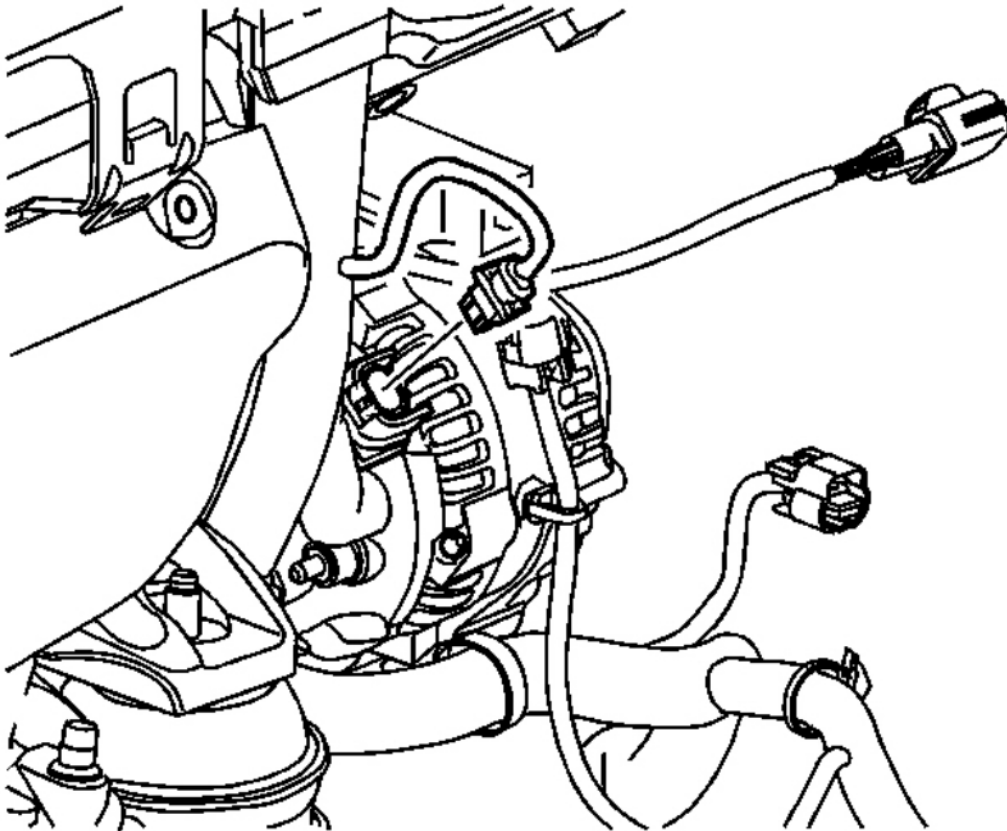


Fig. 81: View Of Generator Engine Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the engine wiring harness from the generator.

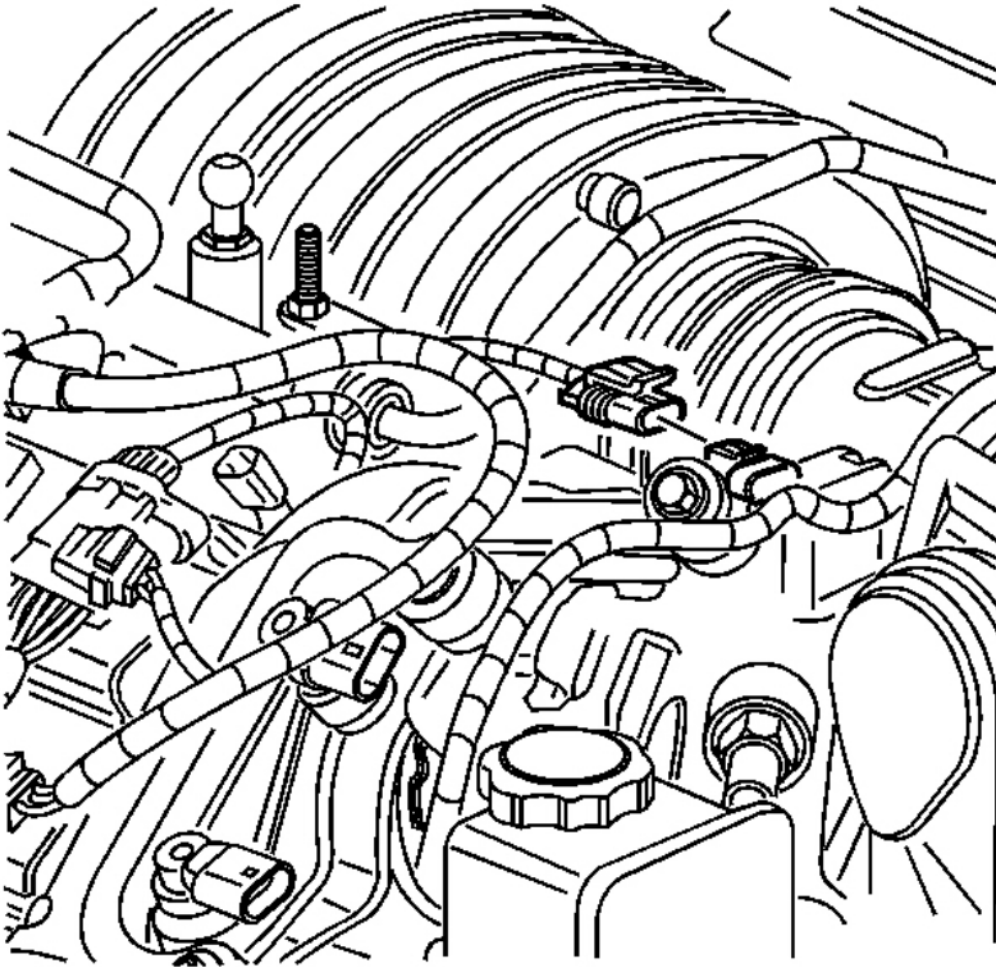


Fig. 82: View Of MAP Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the engine wiring harness from the MAP sensor.

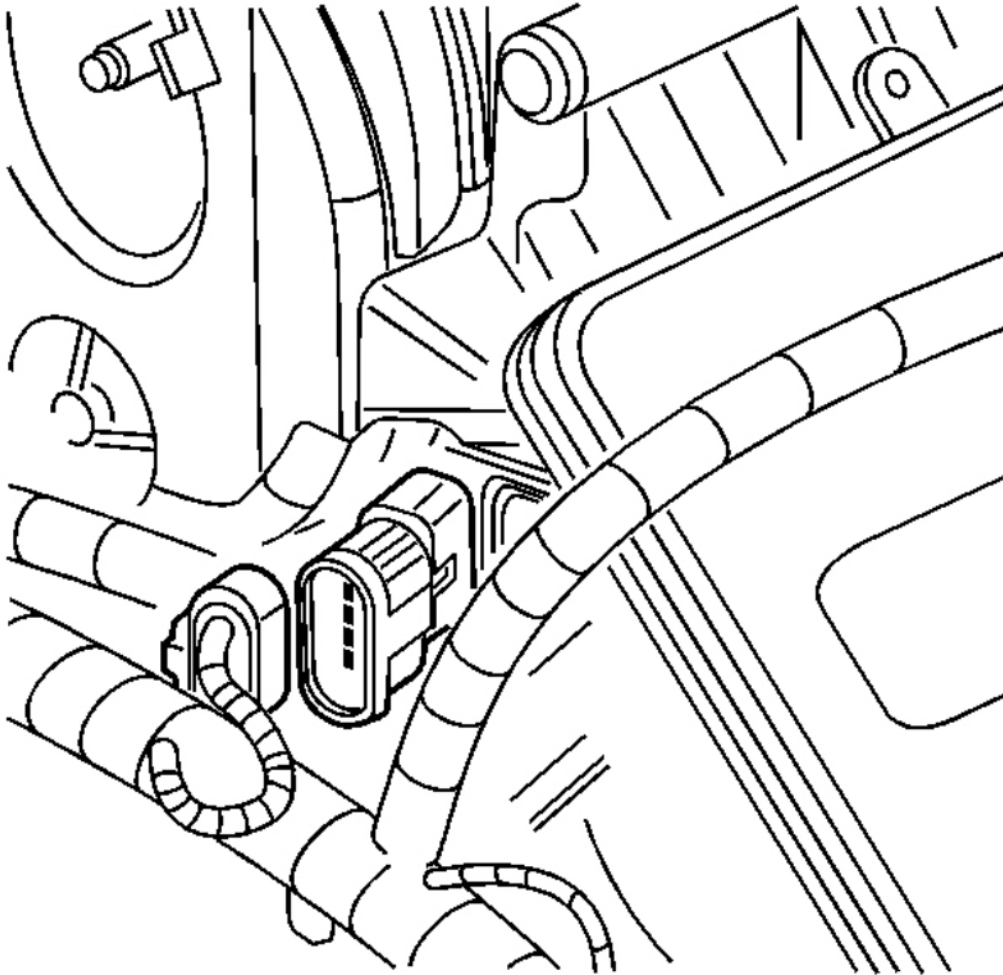


Fig. 83: View Of Knock & Crankshaft Position Sensor Wiring Harness Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the engine wiring harness from the knock and crankshaft position sensor wiring harness.

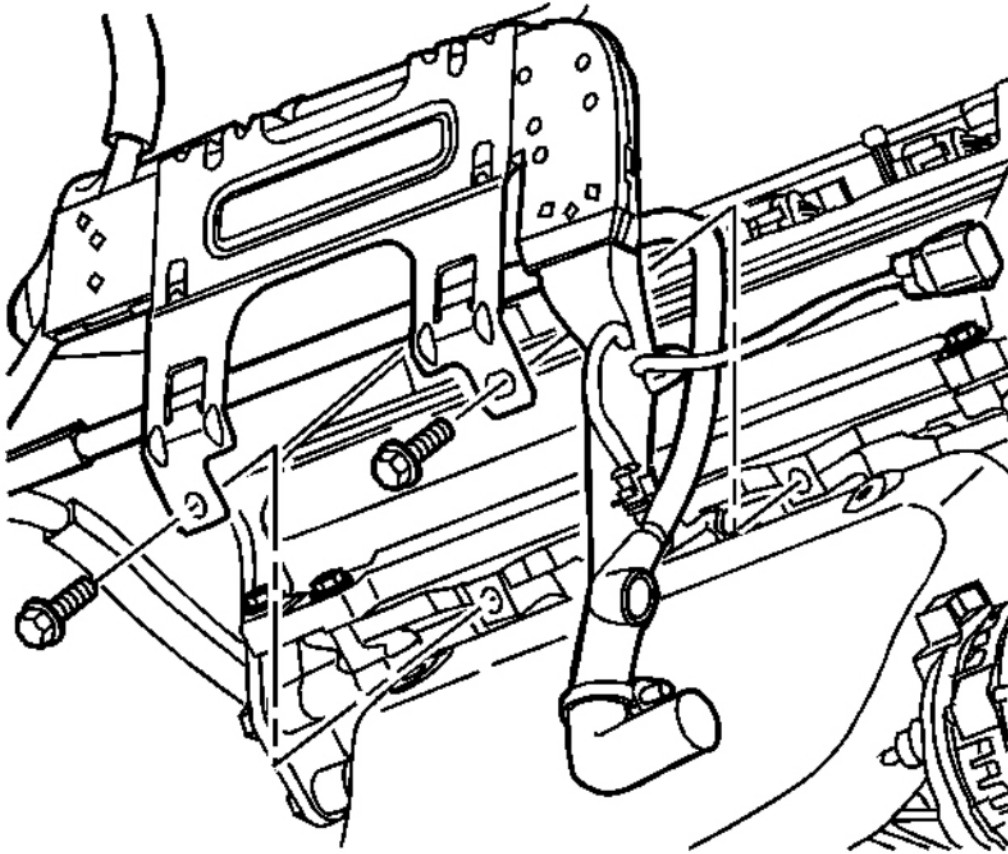


Fig. 84: View Of Engine Block Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

11. Remove the engine wiring harness bracket from the engine block.

EXHAUST MANIFOLD REMOVAL - LEFT

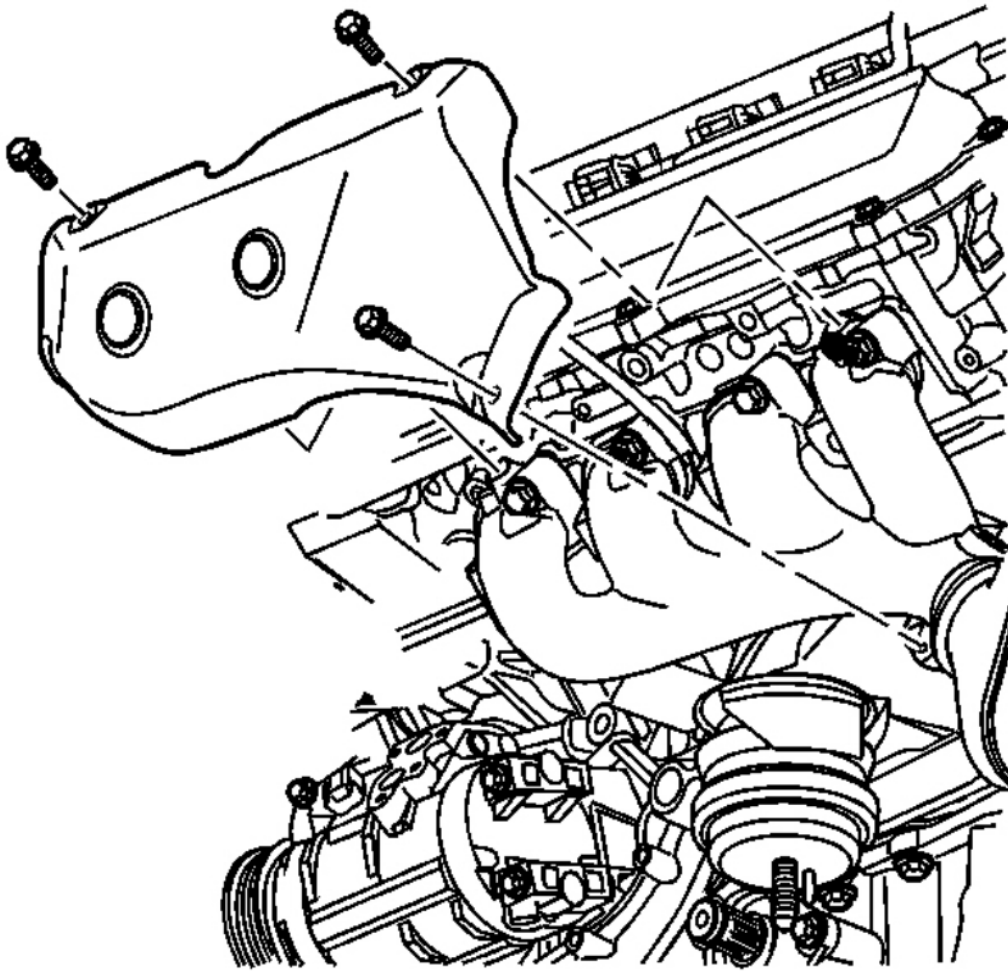


Fig. 85: View Of Left Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the left exhaust manifold heat shield bolts.
2. Remove the left exhaust manifold heat shield.

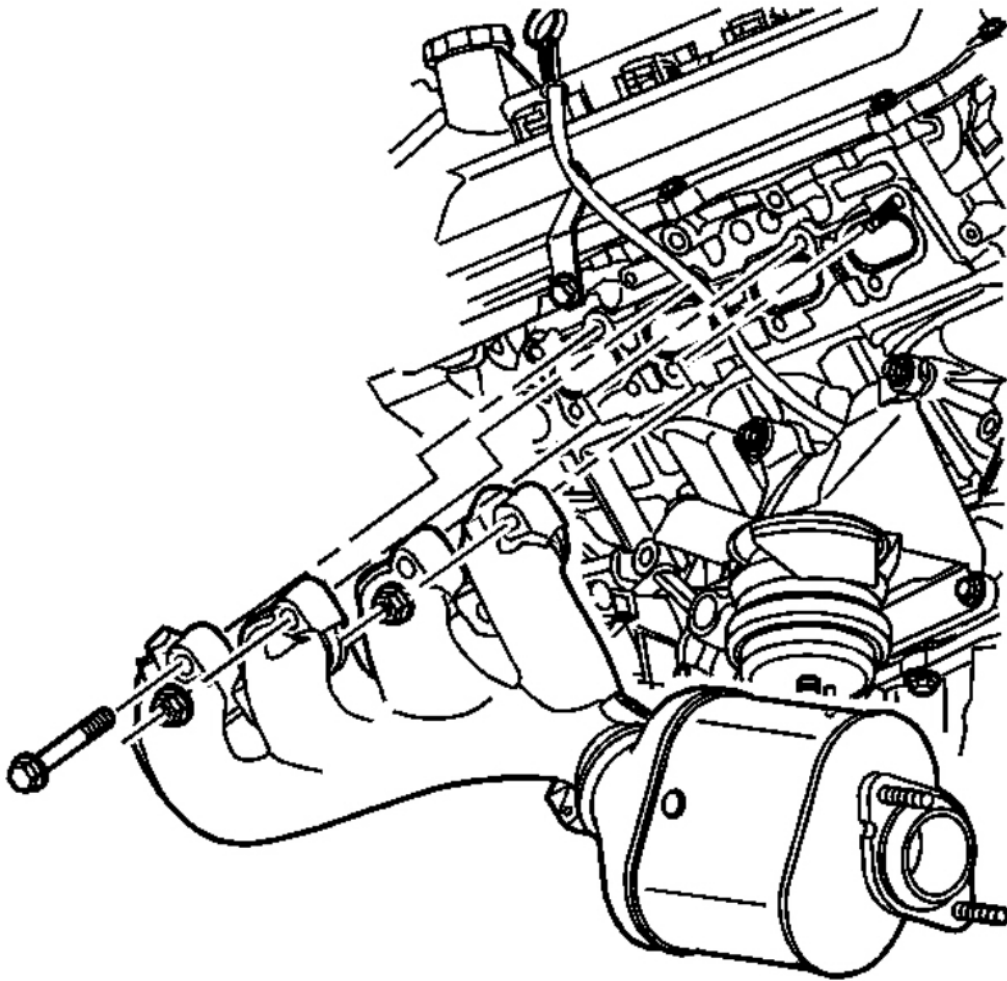


Fig. 86: View Of Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

3. Remove the left exhaust manifold bolts and nuts from the left cylinder head.
4. Remove the left exhaust manifold.

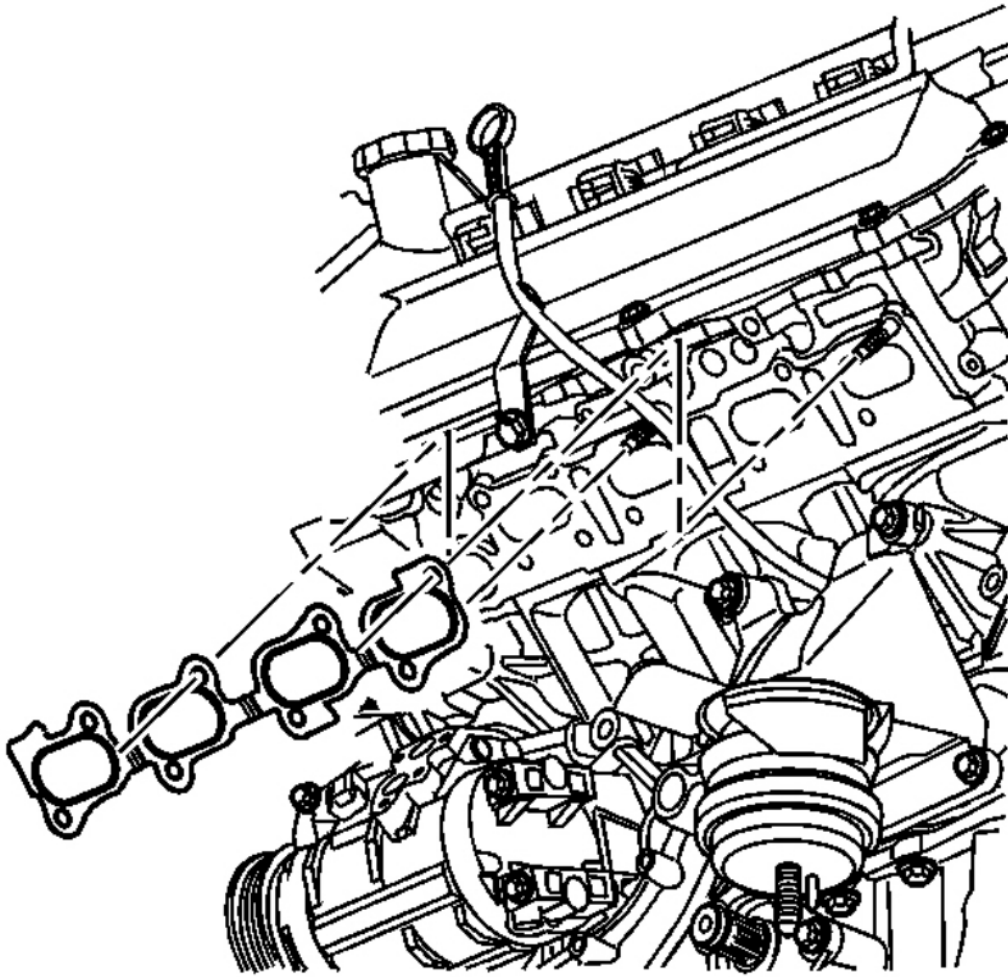


Fig. 87: View Of Left Exhaust Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the left exhaust manifold gasket.

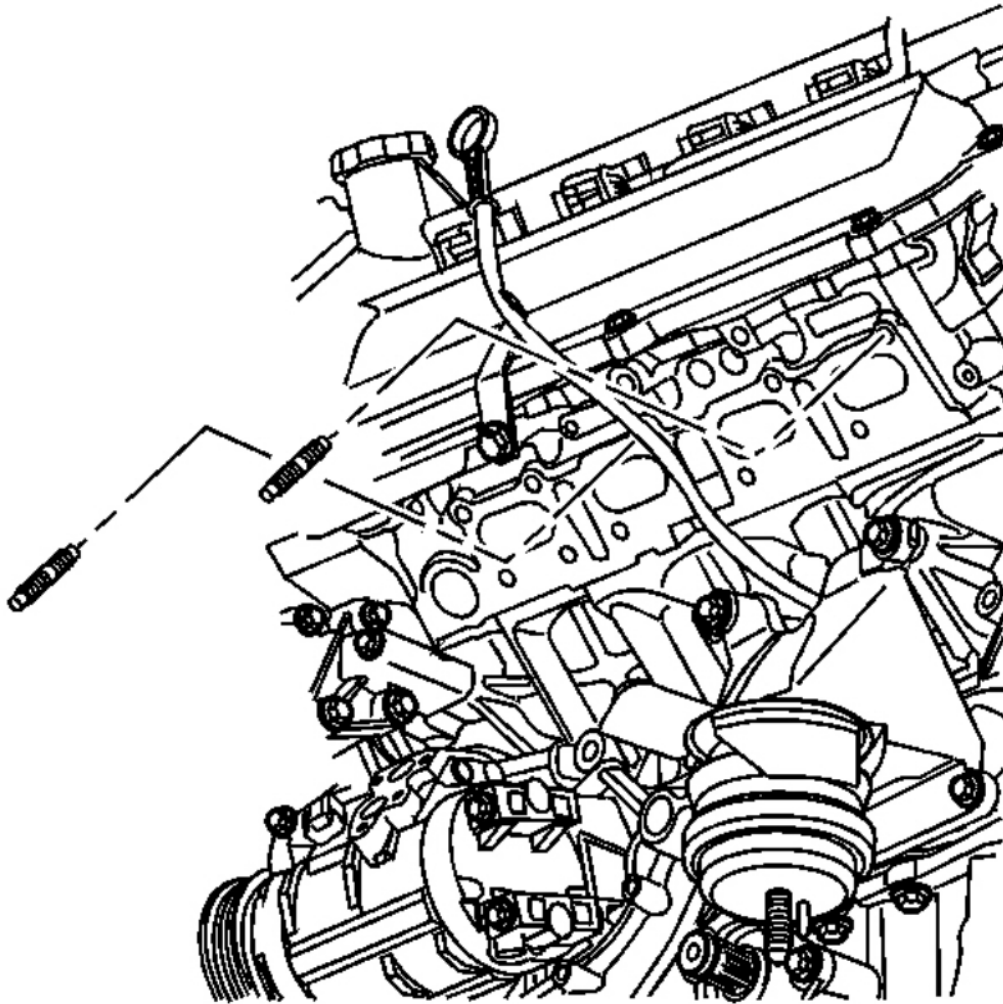


Fig. 88: View Of Left Exhaust Manifold Studs
Courtesy of GENERAL MOTORS CORP.

6. Remove the left exhaust manifold studs from the left cylinder head.

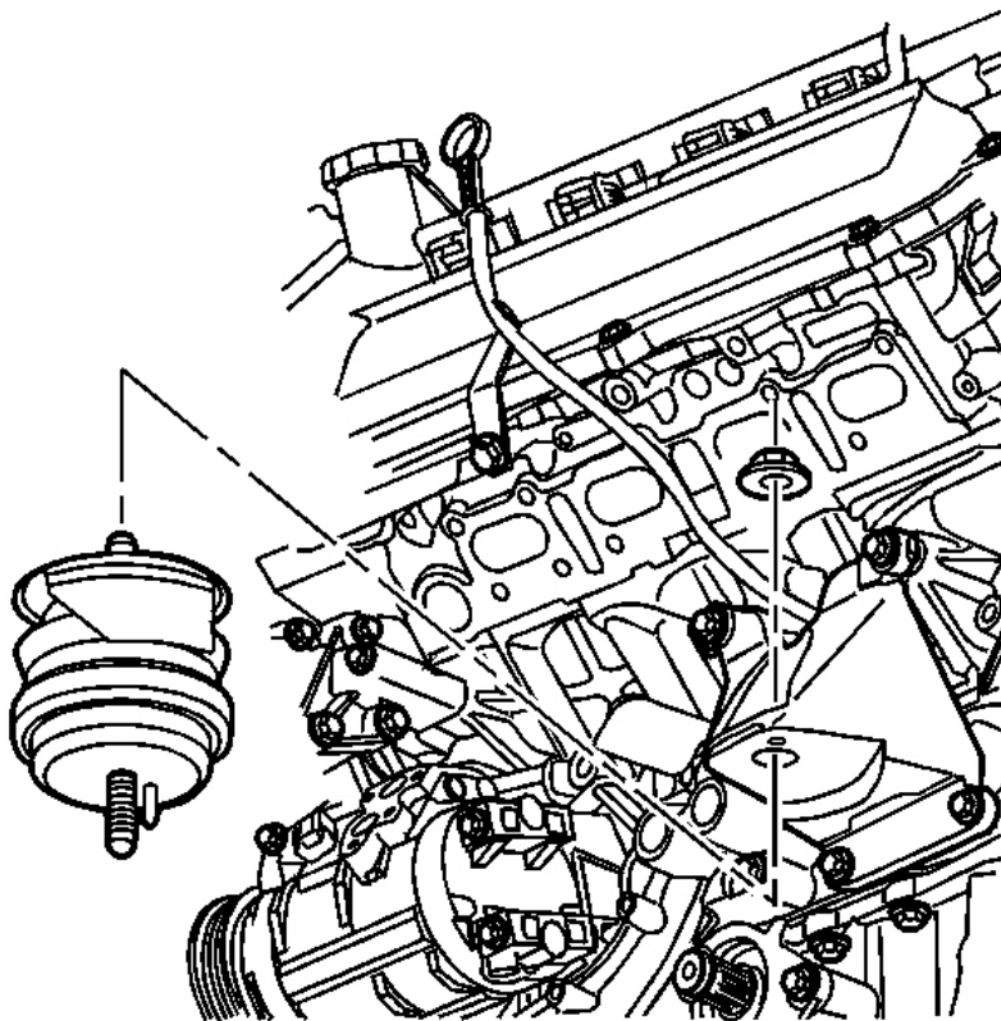


Fig. 89: View Of Left Engine Mount
Courtesy of GENERAL MOTORS CORP.

7. Remove the left engine mount upper nut.
8. Remove the left engine mount.

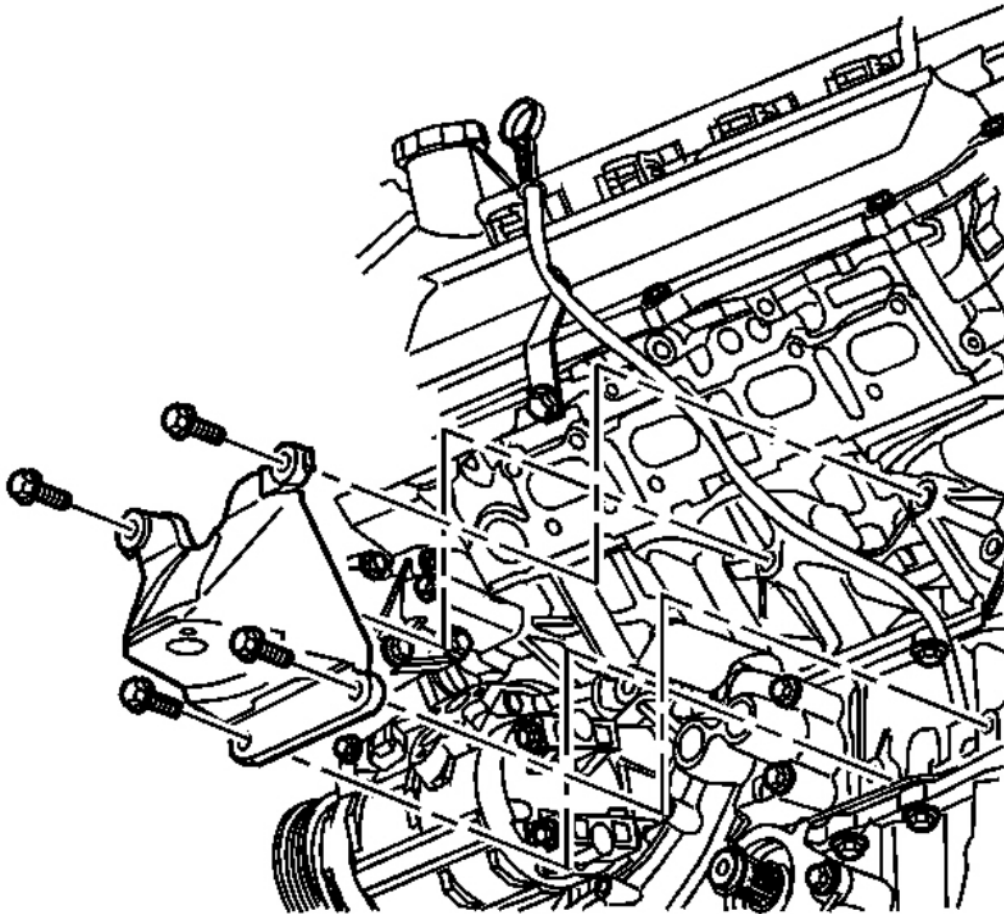


Fig. 90: View Of Left Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

9. Remove the left engine mount bracket bolts.
10. Remove the left engine mount bracket.

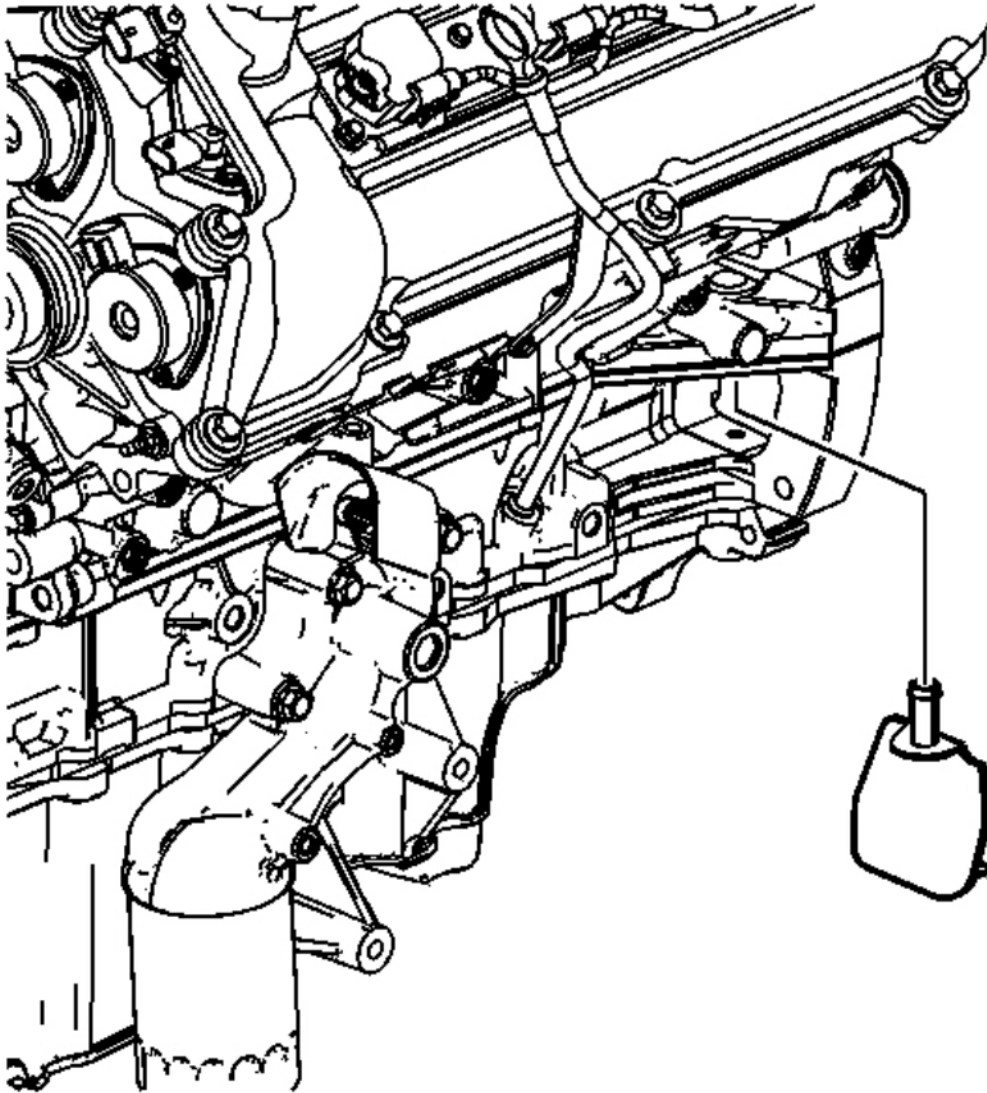


Fig. 91: View Of Engine Flywheel Housing Left Cover
Courtesy of GENERAL MOTORS CORP.

11. Remove the engine flywheel housing left cover.

EXHAUST MANIFOLD REMOVAL - RIGHT (RWD)

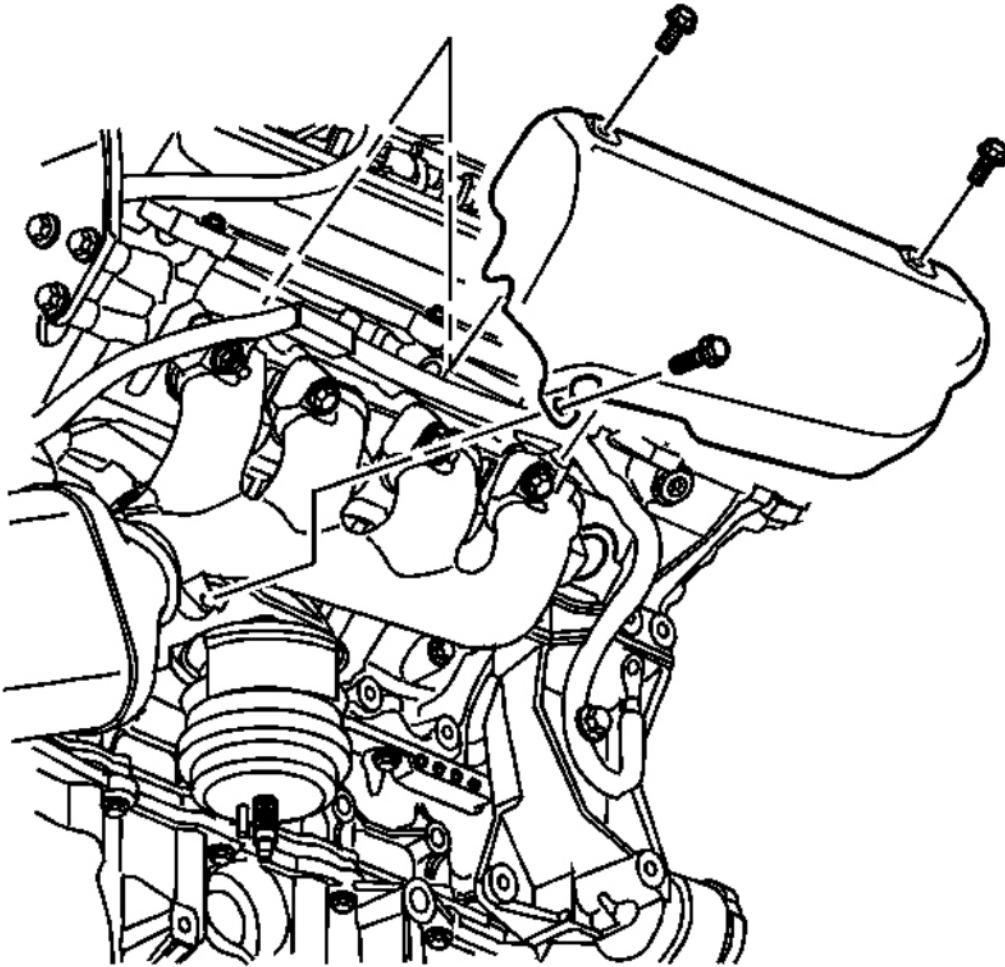


Fig. 92: View Of Right Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the right exhaust manifold heat shield bolts.
2. Remove the right exhaust manifold heat shield.

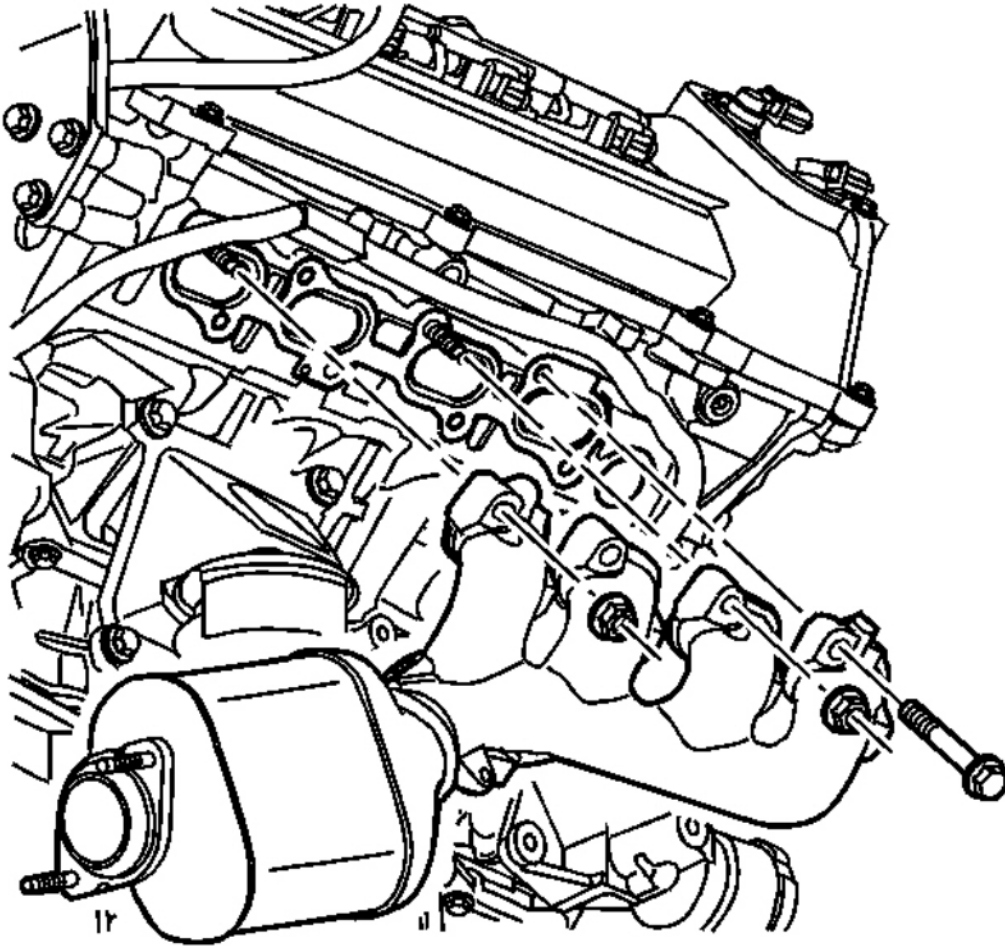


Fig. 93: View Of Right Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

3. Remove the right exhaust manifold bolts and nuts from the right cylinder head.
4. Remove the right exhaust manifold.

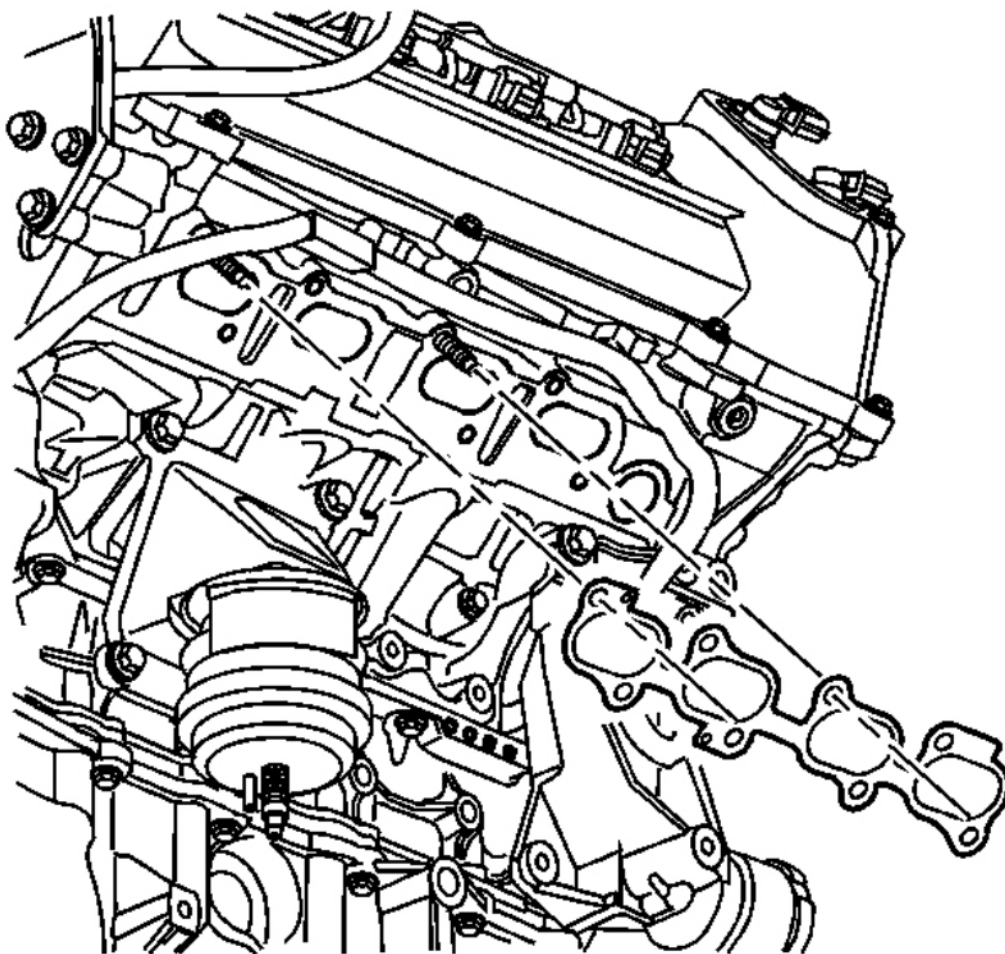


Fig. 94: View Of Right Exhaust Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the right exhaust manifold gasket.

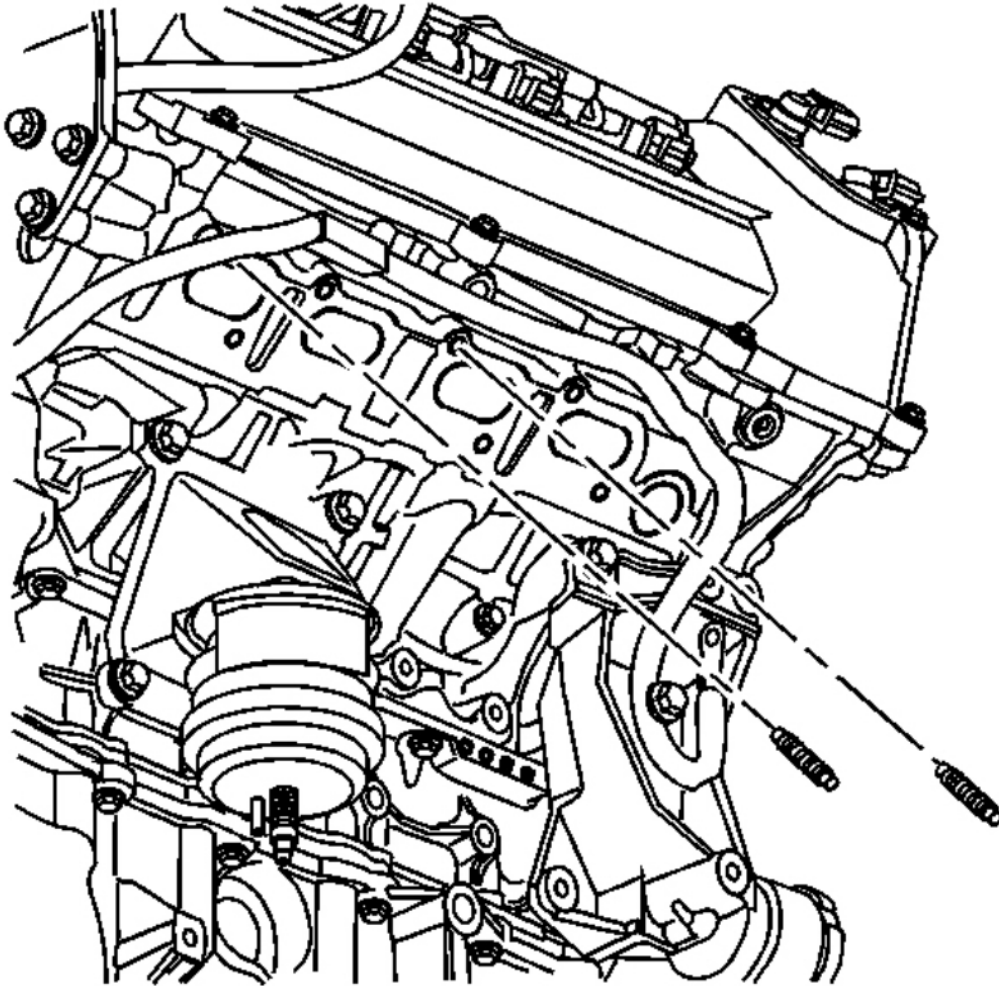


Fig. 95: View Of Right Exhaust Manifold Studs
Courtesy of GENERAL MOTORS CORP.

6. Remove the right exhaust manifold studs from the right cylinder head.

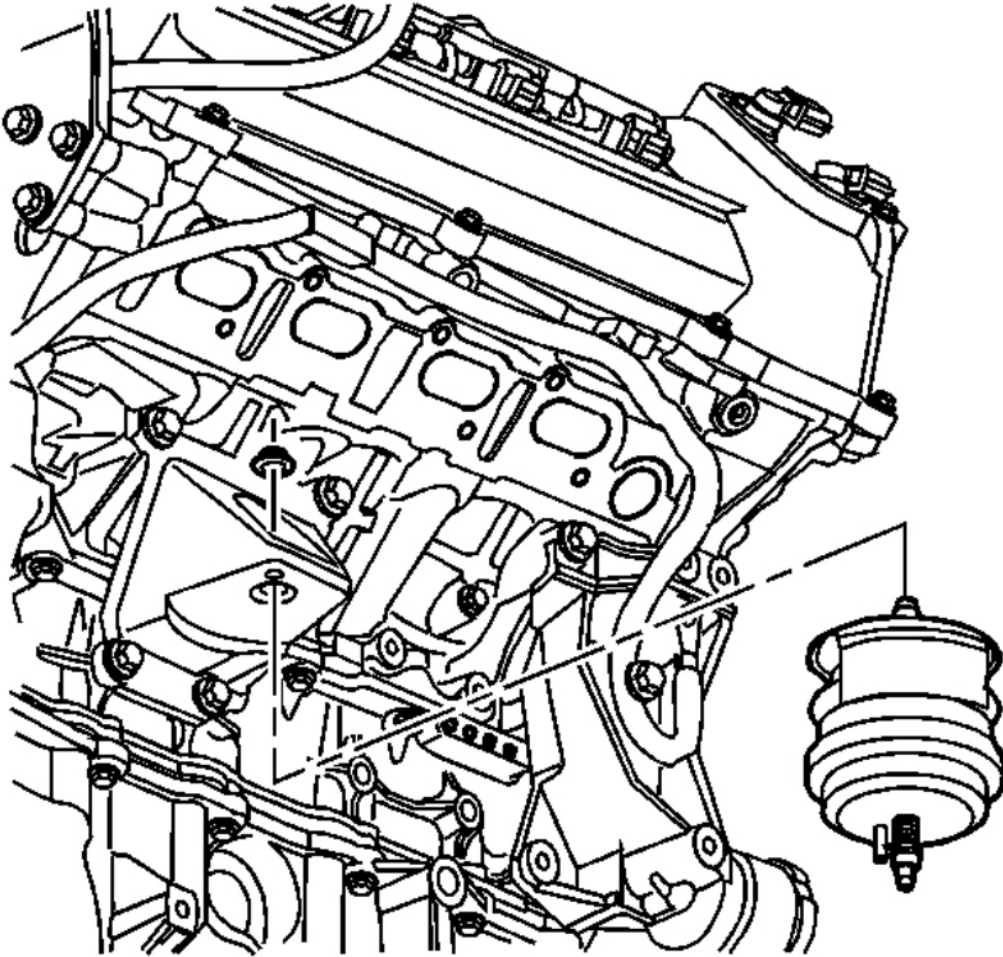


Fig. 96: View Of Right Engine Mount - RWD
Courtesy of GENERAL MOTORS CORP.

7. Remove the right engine mount upper nut.
8. Remove the right engine mount.

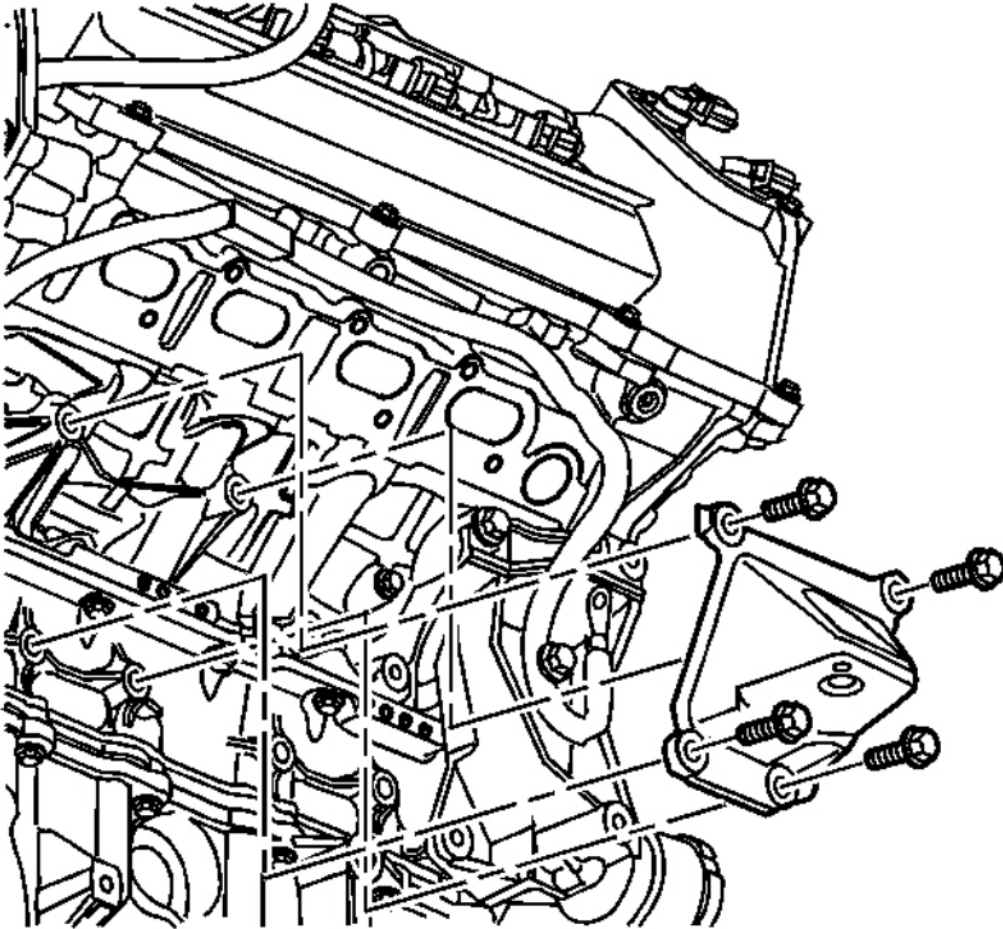


Fig. 97: View Of Right Engine Mount Bracket - RWD
Courtesy of GENERAL MOTORS CORP.

9. Remove the right engine mount bracket bolts.
10. Remove the right engine mount bracket.

EXHAUST MANIFOLD REMOVAL - RIGHT (AWD)

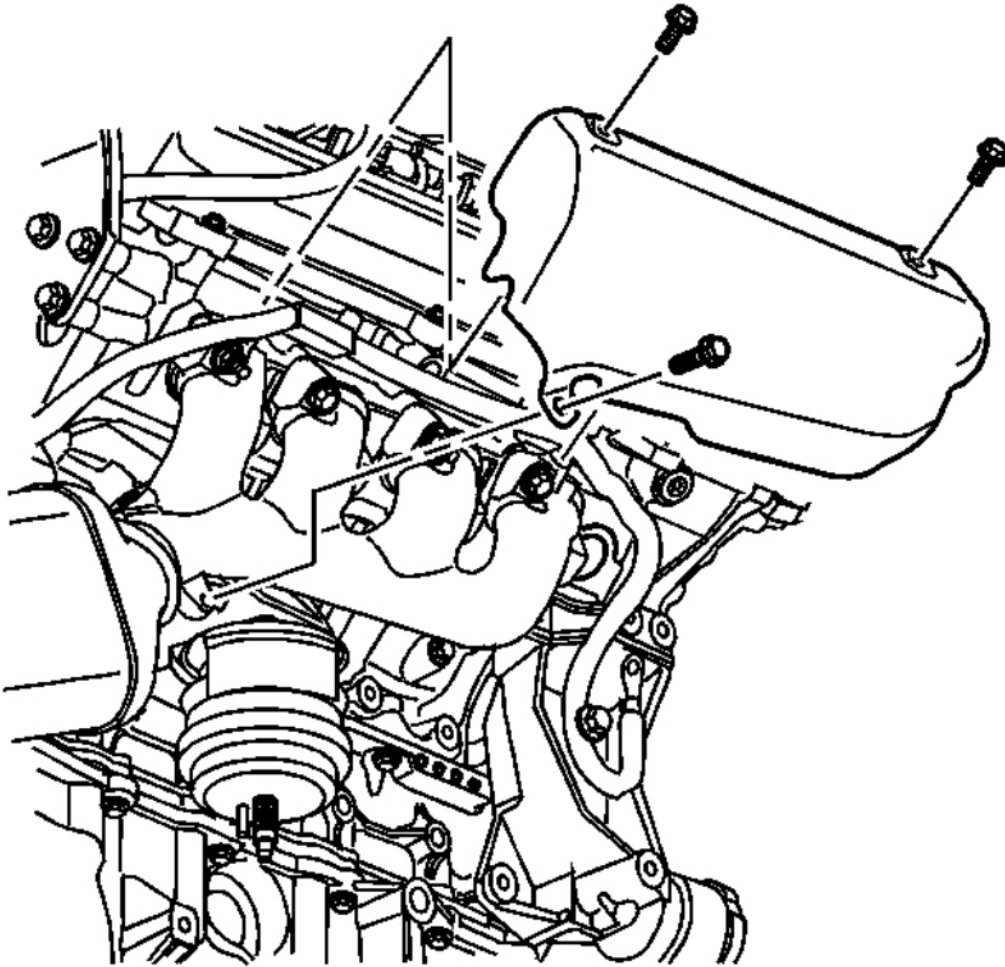


Fig. 98: View Of Right Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the right exhaust manifold heat shield bolts.
2. Remove the right exhaust manifold heat shield.

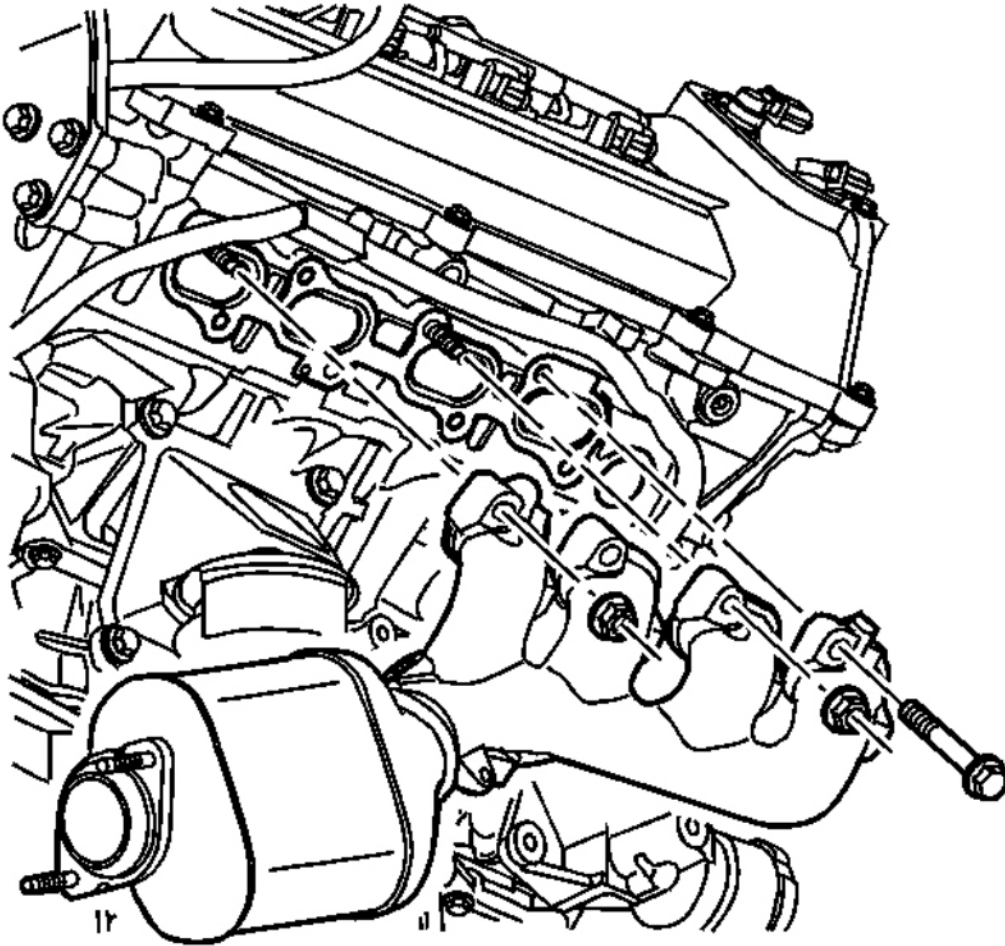


Fig. 99: View Of Right Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

3. Remove the right exhaust manifold bolts from the right cylinder head and bell housing.
4. Remove the right exhaust manifold.

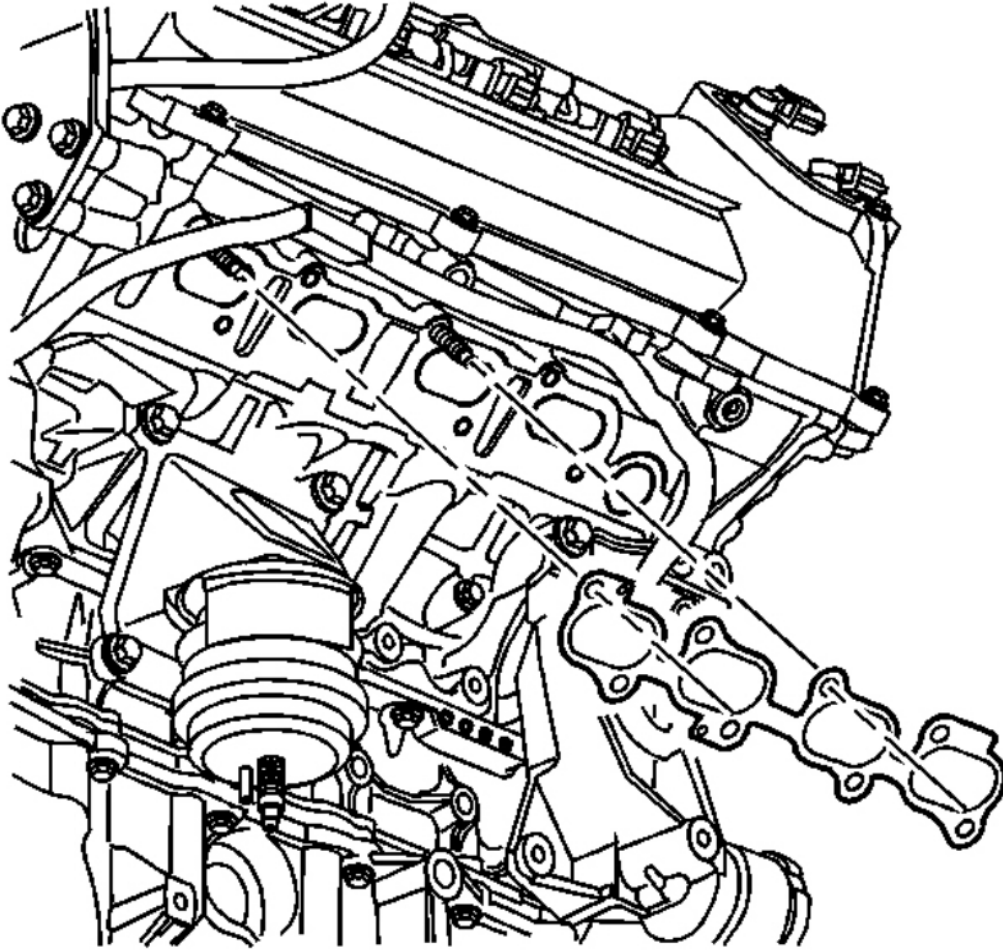


Fig. 100: View Of Right Exhaust Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the right exhaust manifold gasket.

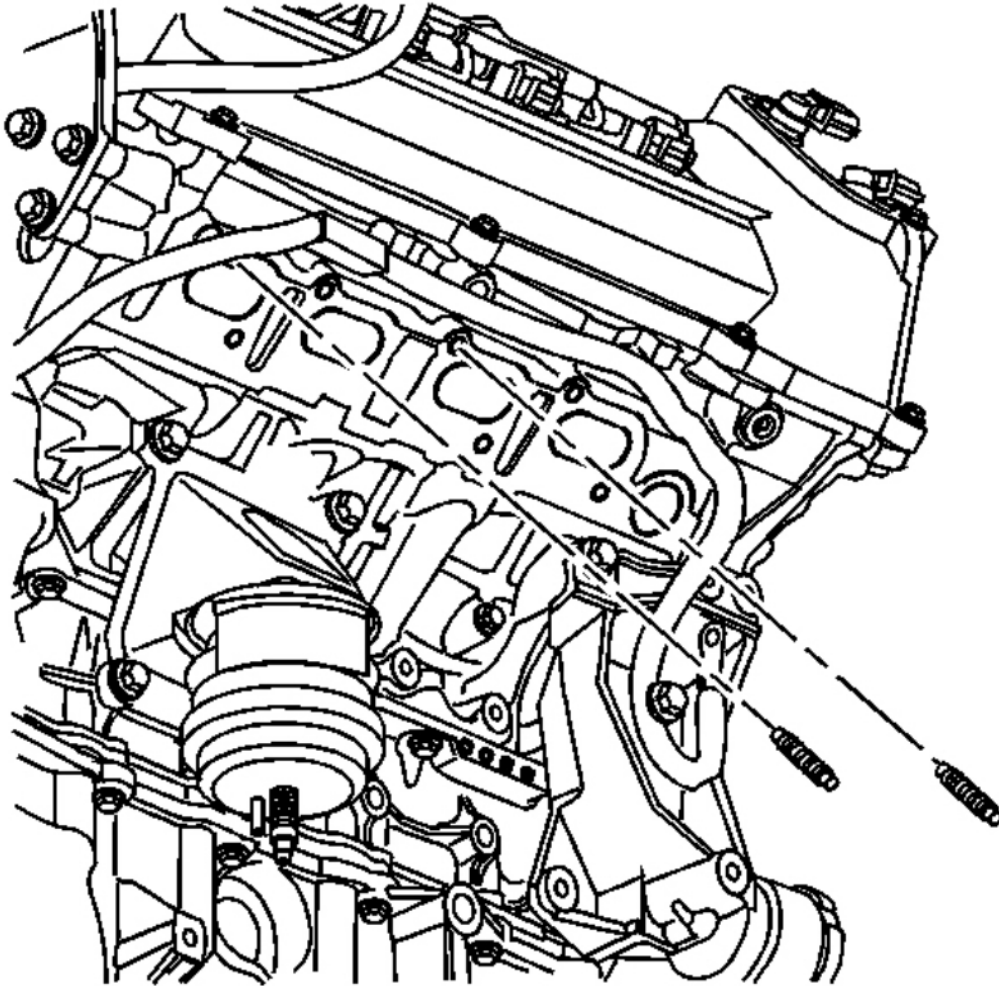


Fig. 101: View Of Right Exhaust Manifold Studs
Courtesy of GENERAL MOTORS CORP.

6. Remove the right exhaust manifold studs from the right cylinder head.

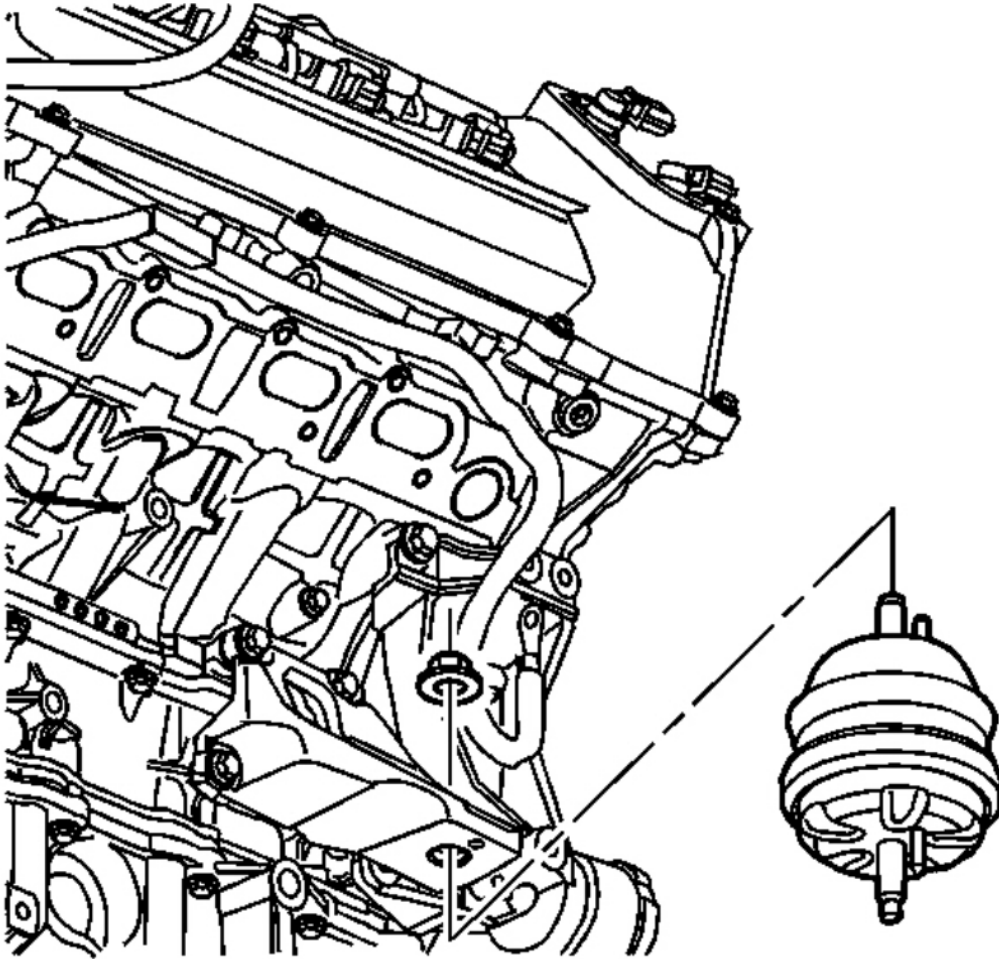


Fig. 102: View Of Right Engine Mount - AWD
Courtesy of GENERAL MOTORS CORP.

7. Remove the right engine mount upper nut.
8. Remove the right engine mount.

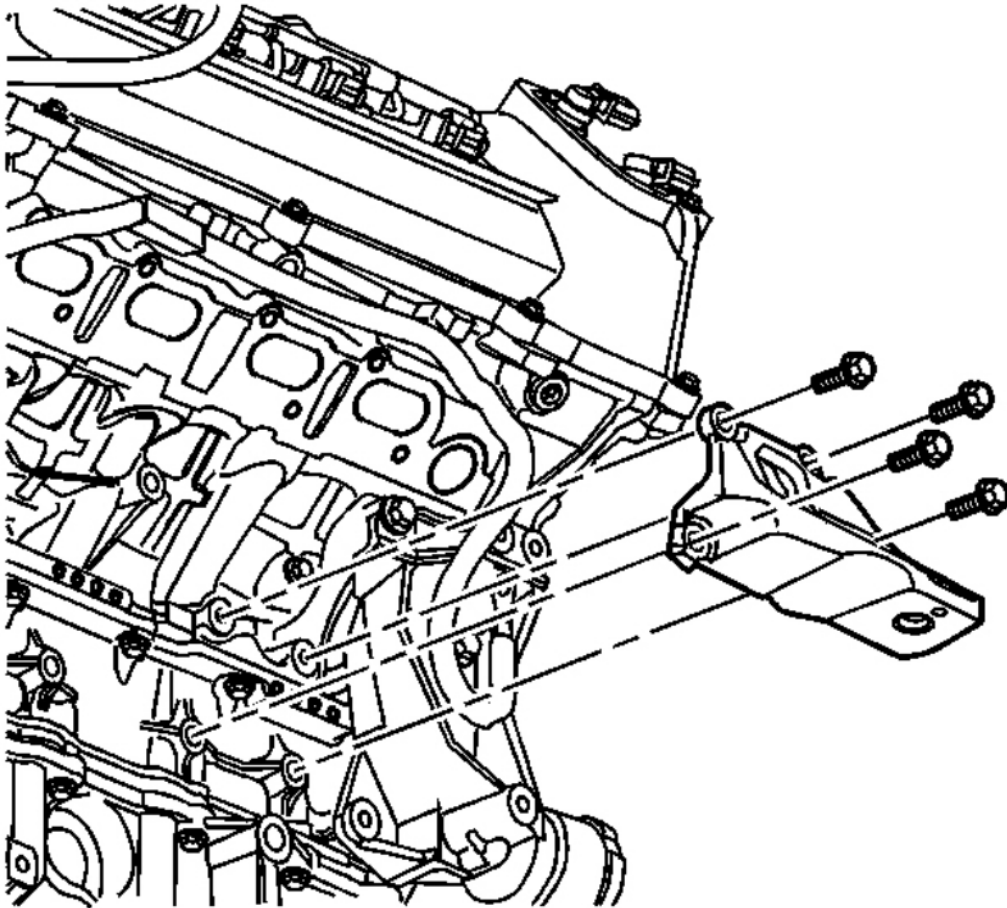


Fig. 103: View Of Right Engine Mount Bracket - AWD
Courtesy of GENERAL MOTORS CORP.

9. Remove the right engine mount bracket bolts.
10. Remove the right engine mount bracket.

DRIVE BELT REMOVAL

Outer Drive Belt

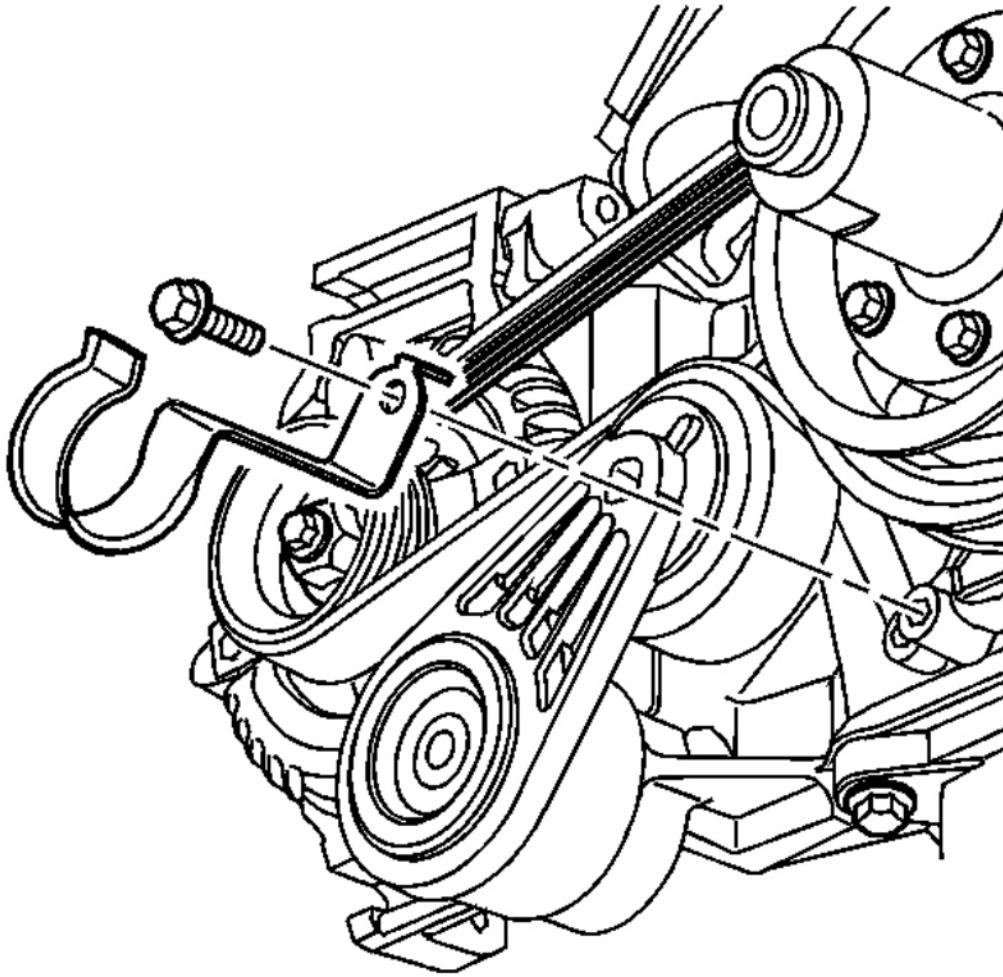


Fig. 104: View Of Radiator Hose Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the radiator hose bracket bolt.
2. Remove the radiator hose bracket.

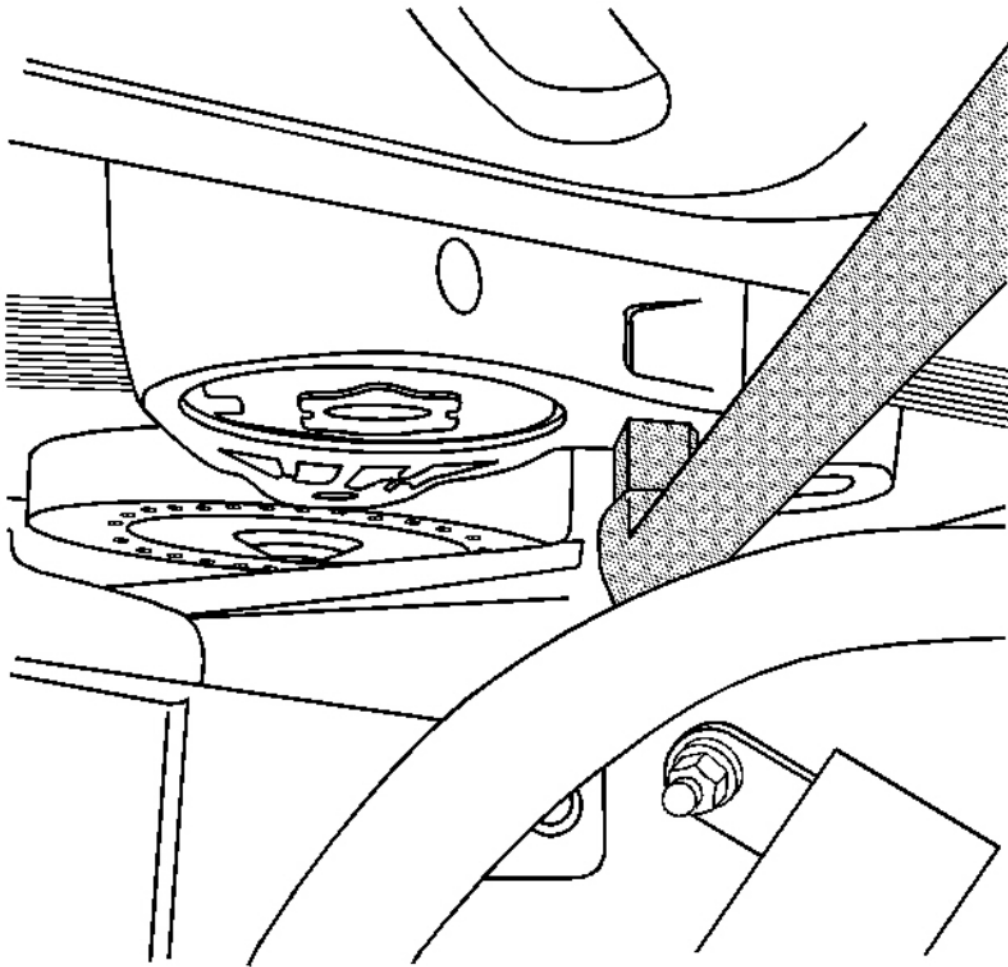


Fig. 105: View Of Drive Belt Tensioner & Pulleys
Courtesy of GENERAL MOTORS CORP.

3. Insert a 1/2-inch drive extension into the drive belt tensioner.
4. Push down on the extension to release tension.
5. Remove the drive belt from the power steering pump.
6. Slowly return the drive belt tensioner to the original position.

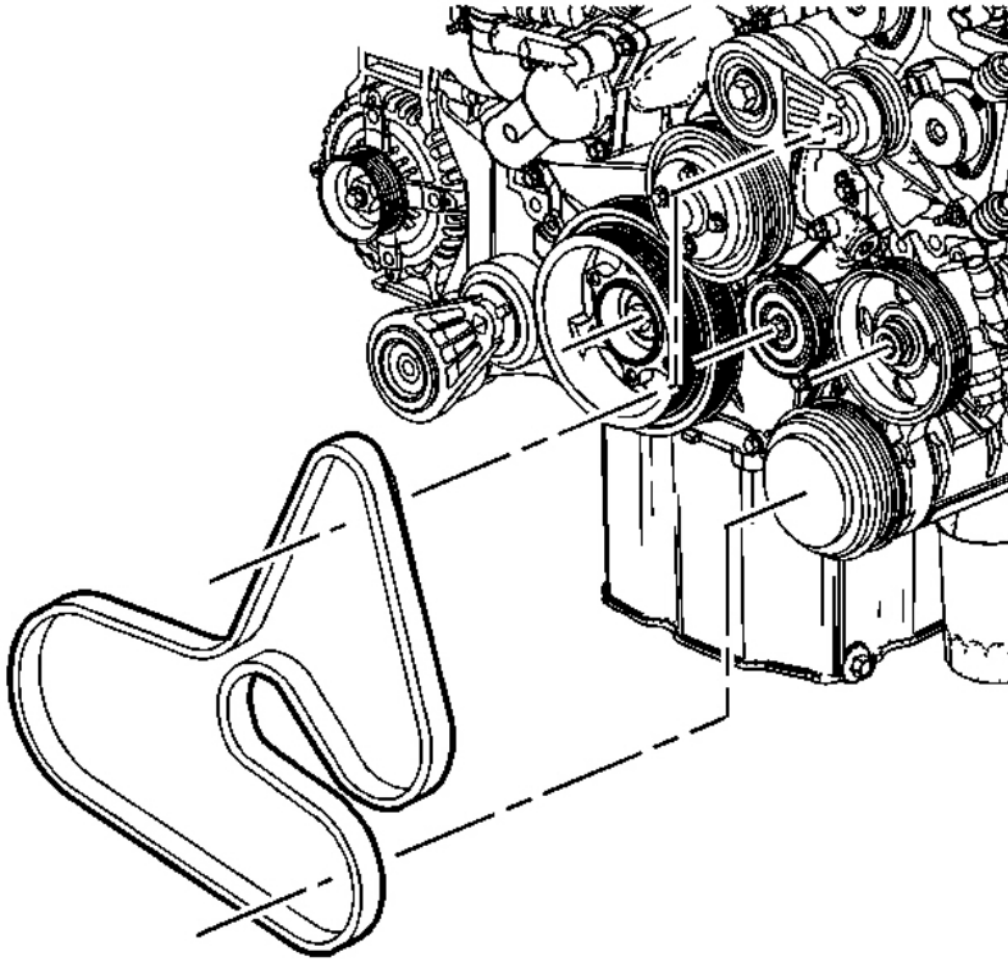


Fig. 106: View Of Outer Drive Belt
Courtesy of GENERAL MOTORS CORP.

7. Remove the outer drive belt.

Inner Drive Belt

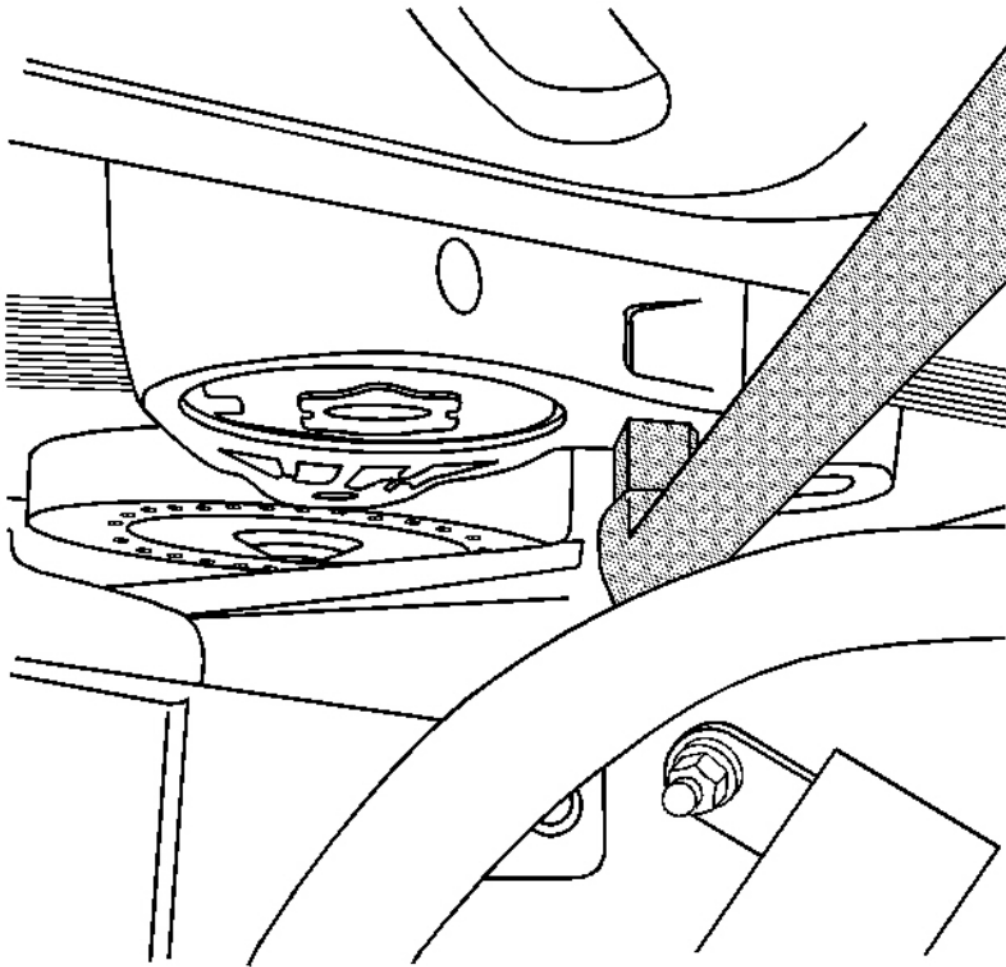


Fig. 107: View Of Drive Belt Tensioner & Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Insert a 1/2-inch drive extension into the drive belt tensioner.
2. Push down on the extension to release tension.
3. Remove the drive belt from the generator.
4. Slowly return the drive belt tensioner to the original position.

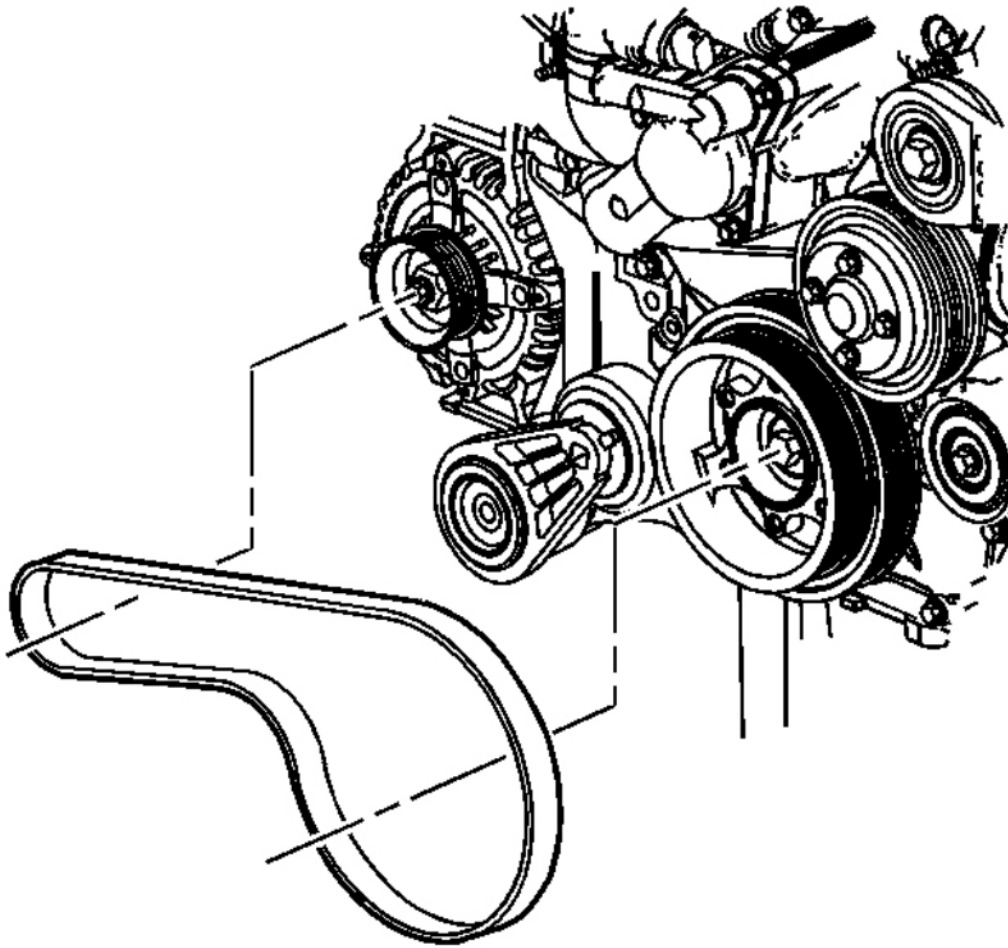


Fig. 108: View Of Inner Drive Belt
Courtesy of GENERAL MOTORS CORP.

5. Remove the inner drive belt.

POWER STEERING PUMP REMOVAL

Tools Required:

J 25034-C Pulley Remover

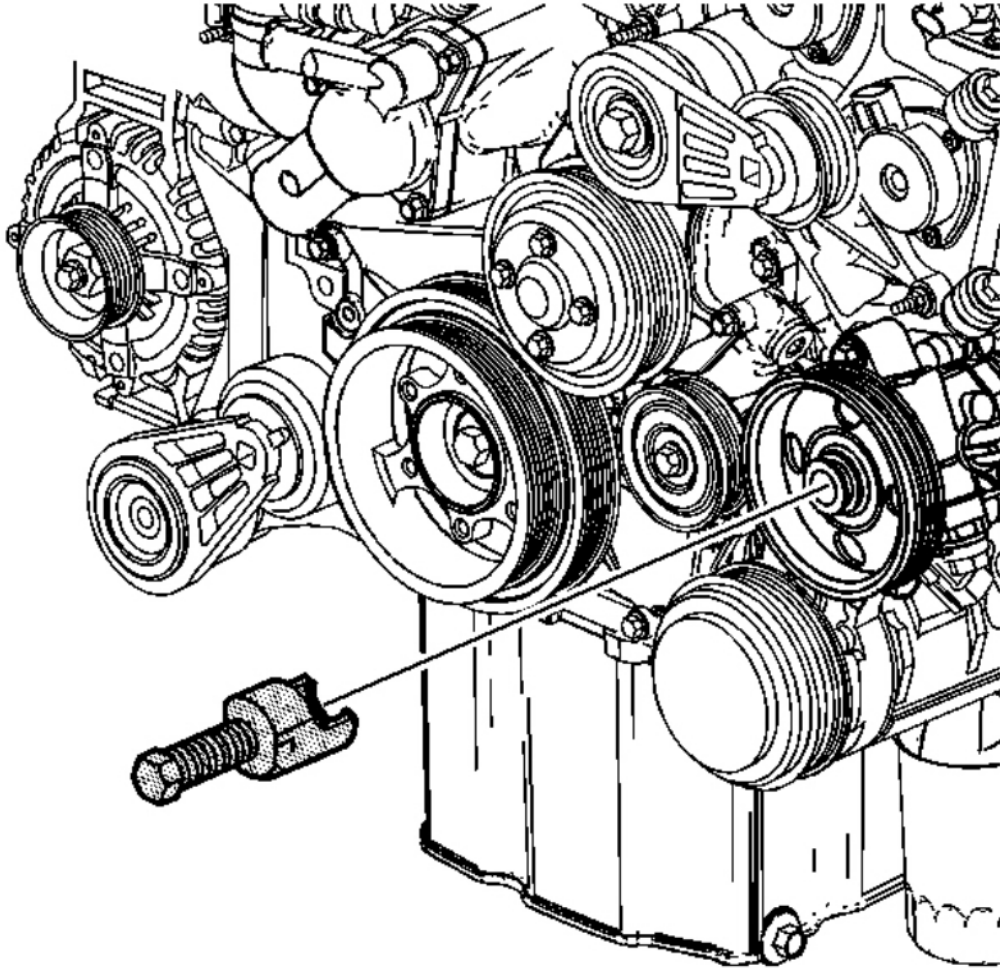


Fig. 109: Removing The Power Steering Pump Pulley Using J 25034-C
Courtesy of GENERAL MOTORS CORP.

1. If necessary, using the **J 25034-C** , remove the power steering pump pulley in order to access the power steering pump mounting bolts.

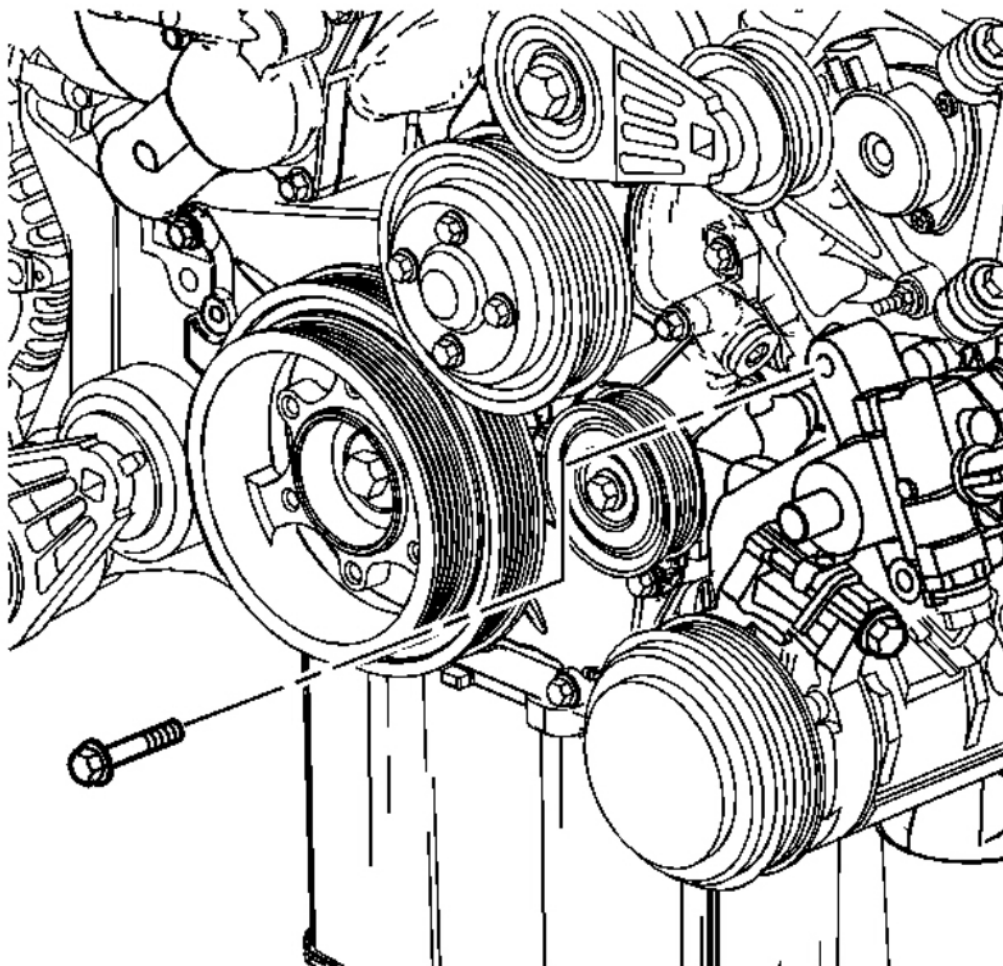


Fig. 110: View Of Power Steering Pump Front Mounting Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the power steering pump front mounting bolt.

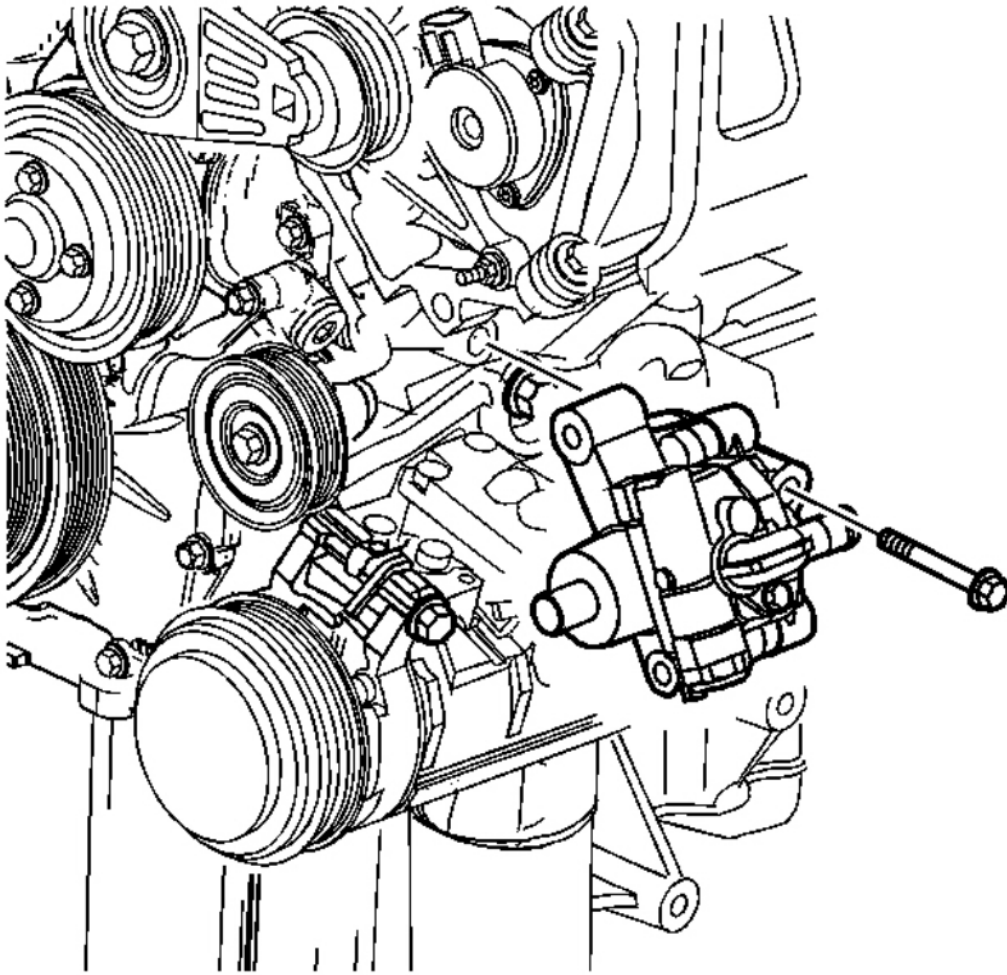


Fig. 111: View Of Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

3. Remove the power steering pump side mounting bolt.
4. Remove the power steering pump.

DRIVE BELT IDLER PULLEY REMOVAL

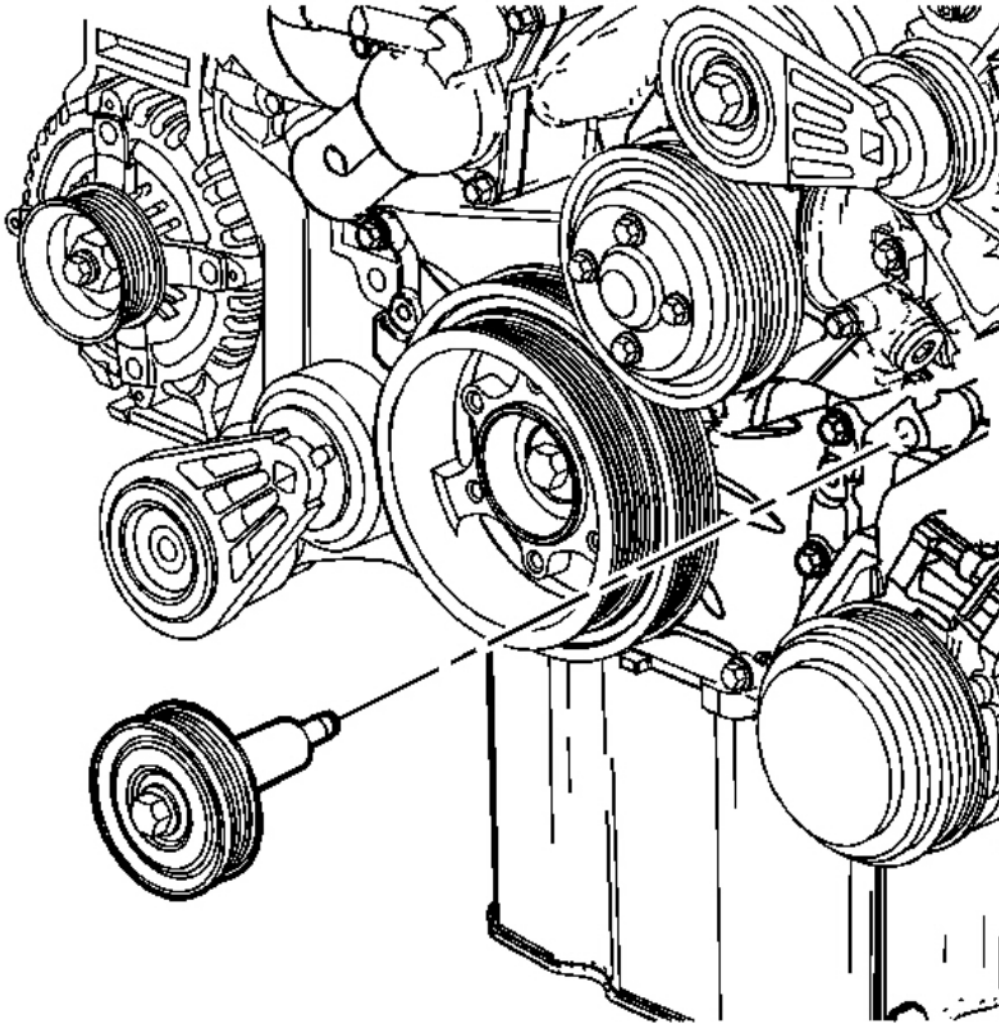


Fig. 112: View Of Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

1. Loosen the drive belt idler pulley bolt.
2. Remove the drive belt idler pulley.

GENERATOR REMOVAL

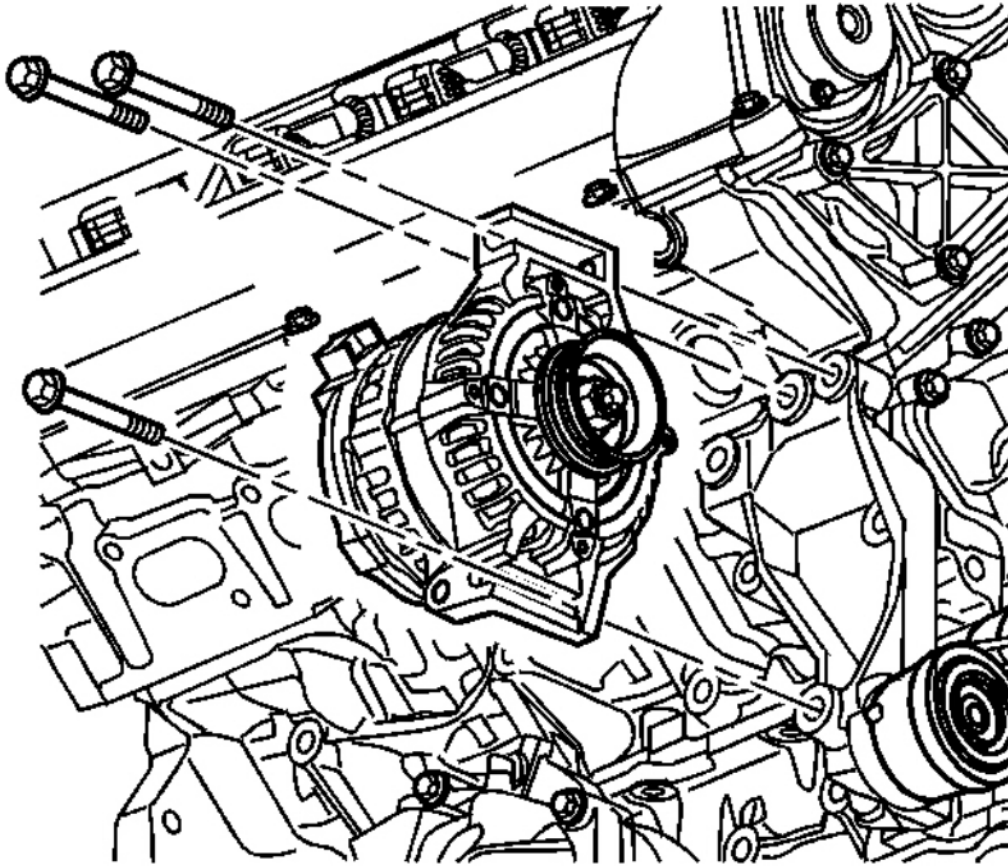


Fig. 113: View Of Generator
Courtesy of GENERAL MOTORS CORP.

1. Remove the front upper generator bolt.
2. Remove the lower generator bolt.
3. Remove the rear upper generator bolt.
4. Remove the generator.

AIR CONDITIONING (A/C) COMPRESSOR REMOVAL

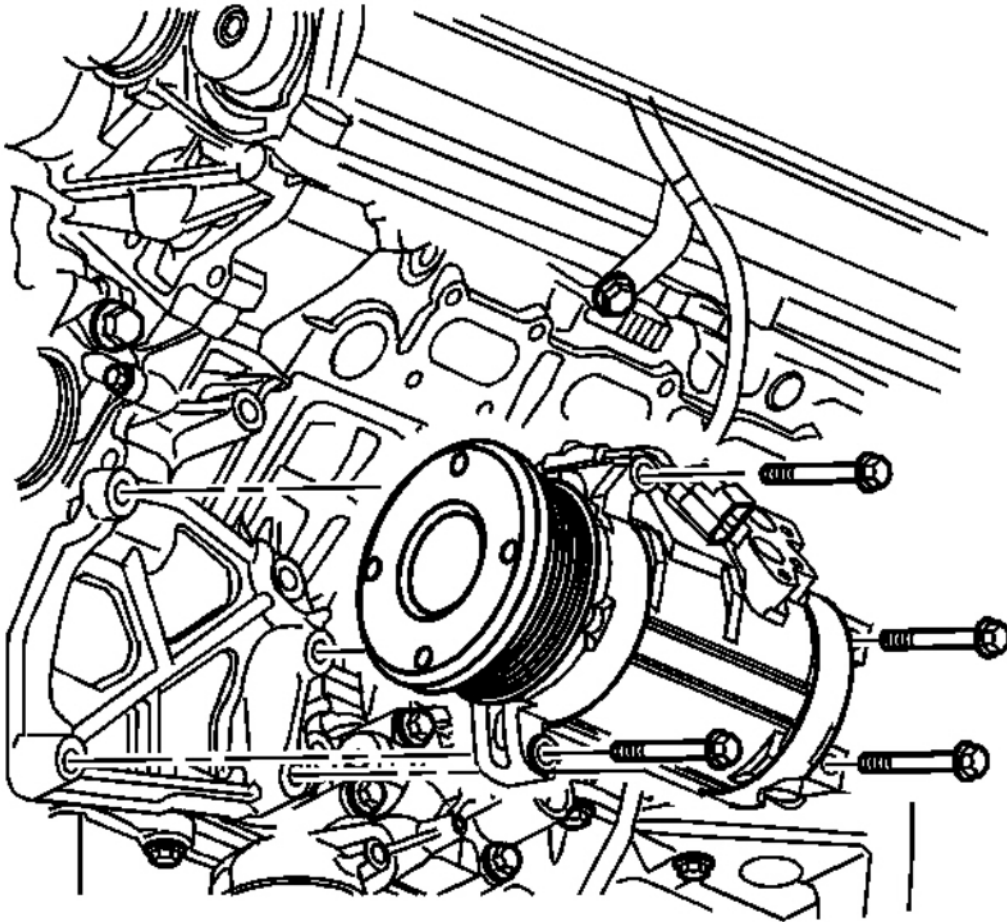


Fig. 114: View Of A/C Compressor
Courtesy of GENERAL MOTORS CORP.

1. Remove the A/C compressor bolts.
2. Remove the A/C compressor.

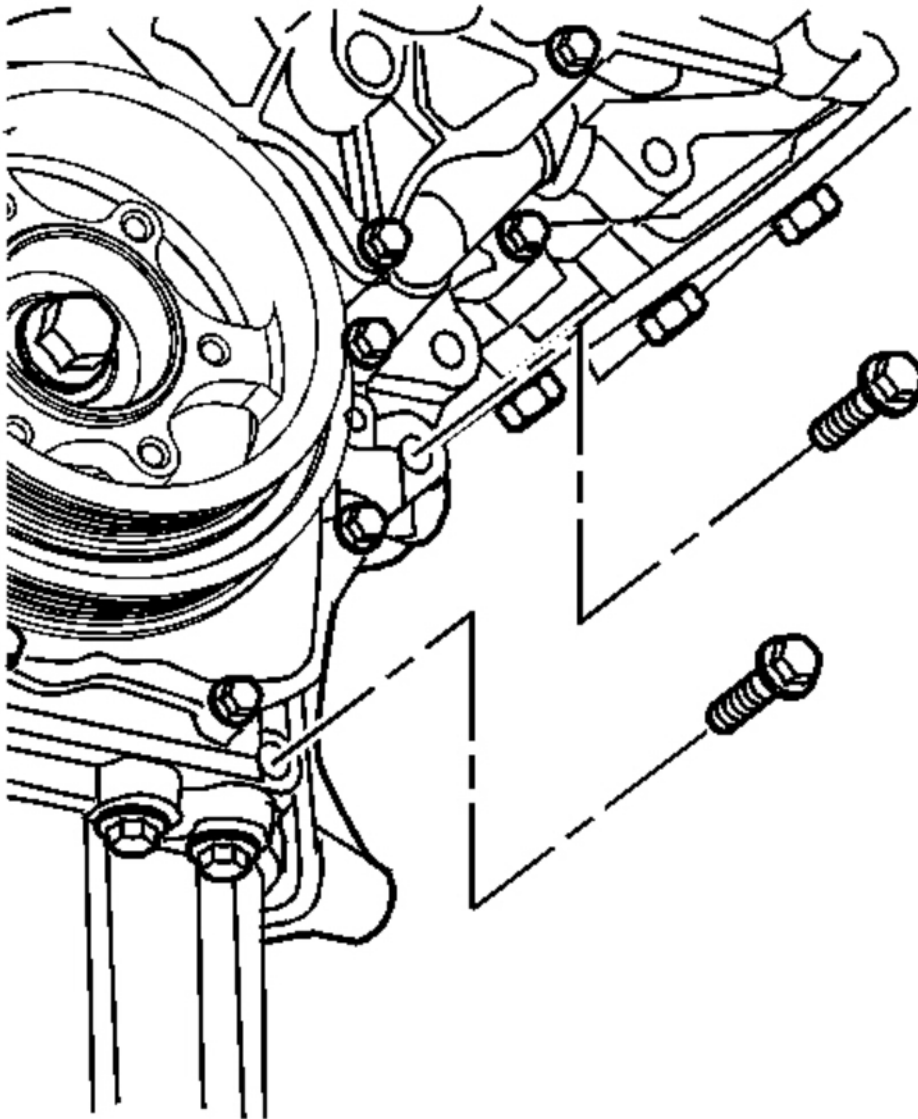


Fig. 115: View Of P/S Pump & A/C Compressor Bracket Front Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the P/S pump and A/C compressor bracket front bolts.

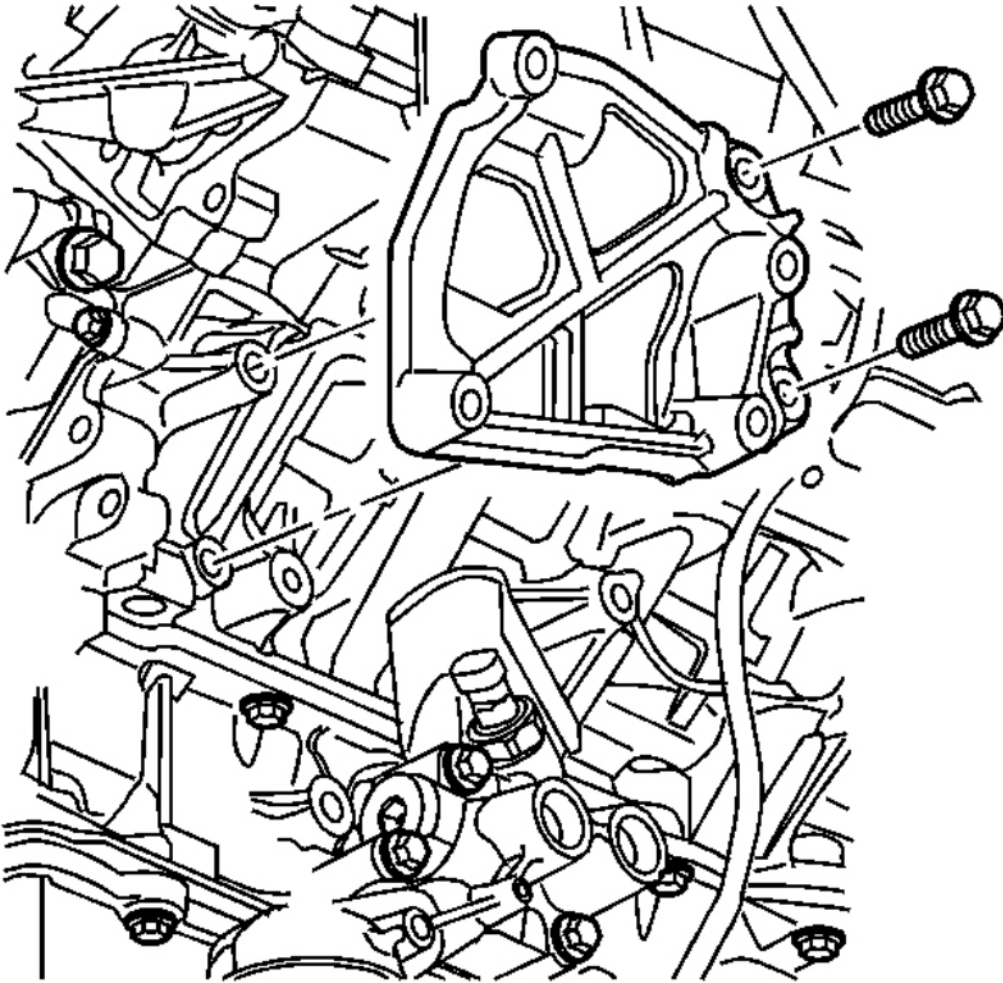


Fig. 116: View Of P/S Pump & A/C Compressor Bracket
Courtesy of GENERAL MOTORS CORP.

4. Remove the P/S pump and A/C compressor bracket side bolts.
5. Remove the P/S pump and A/C compressor bracket.

DRIVE BELT TENSIONER REMOVAL

Generator Drive Belt Tensioner

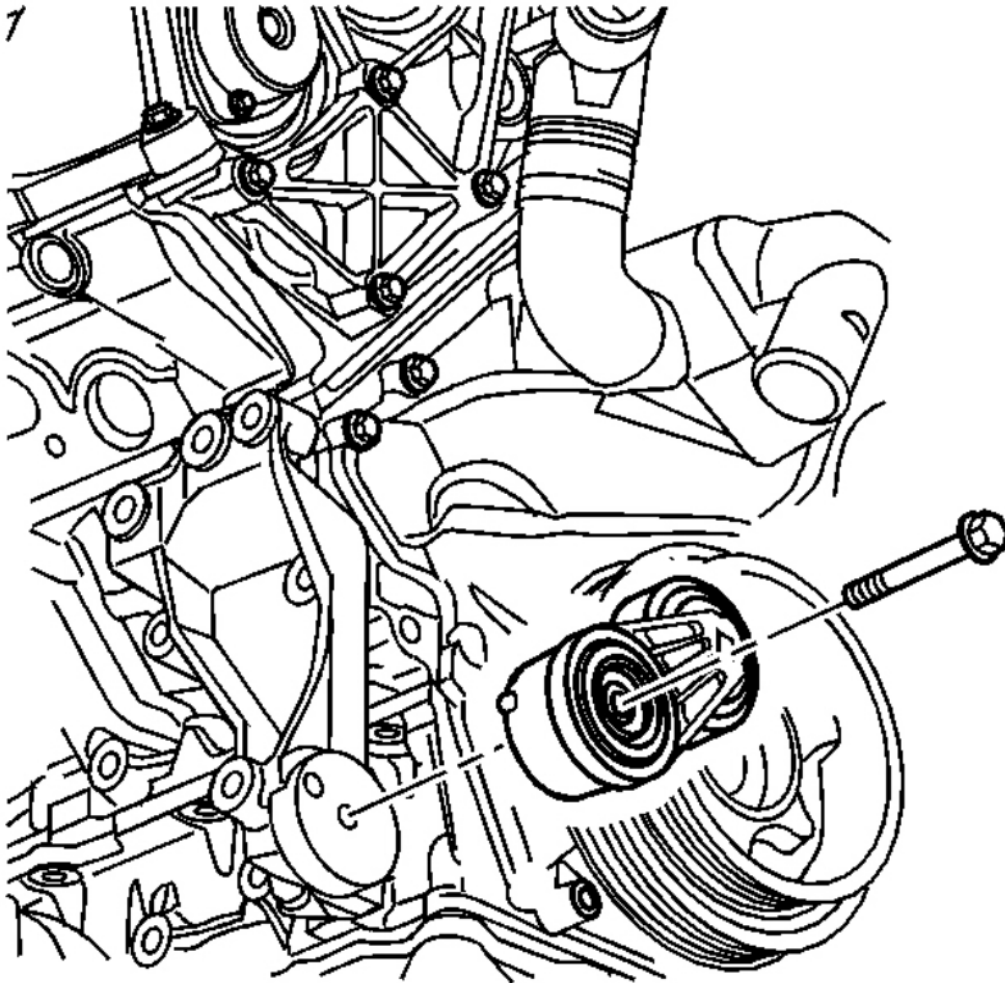


Fig. 117: View Of Generator Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator drive belt tensioner bolt.
2. Remove the generator drive belt tensioner.

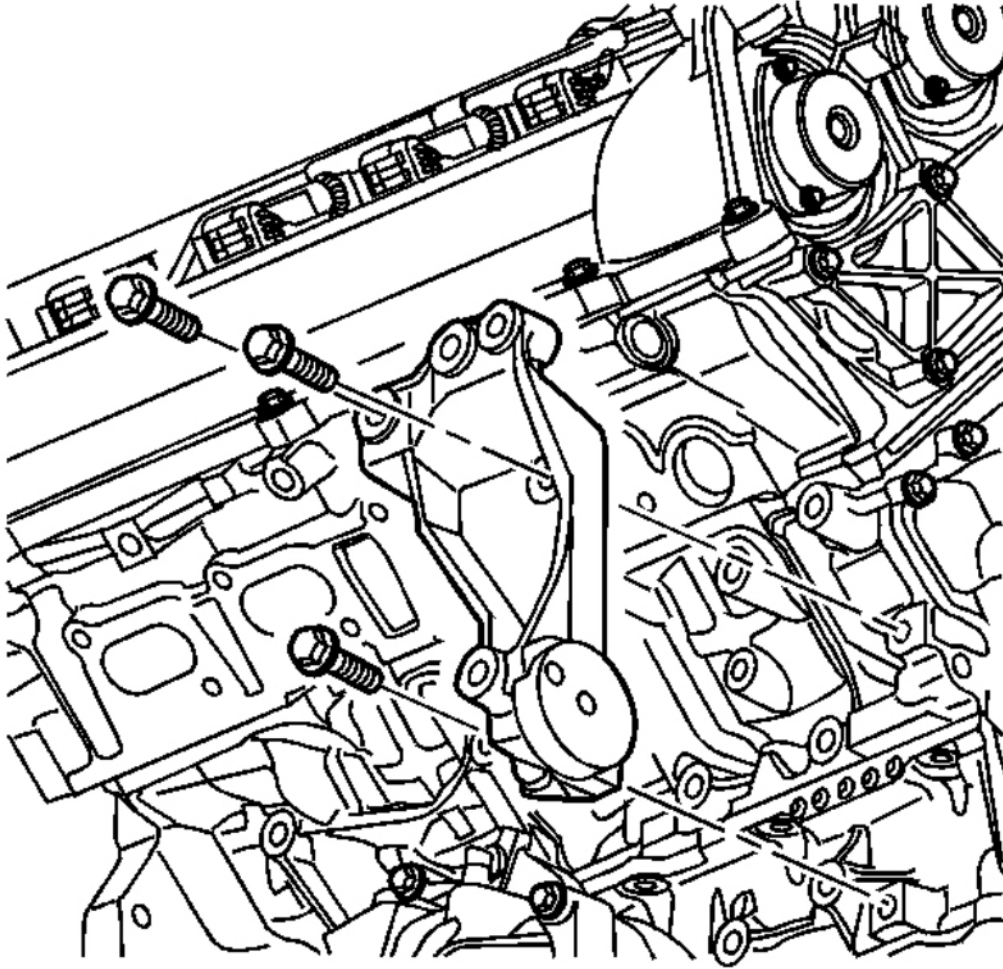


Fig. 118: View Of Generator Bracket
Courtesy of GENERAL MOTORS CORP.

3. Remove the generator bracket bolts.
4. Remove the generator bracket.

P/S Pump and A/C Compressor Drive Belt Tensioner

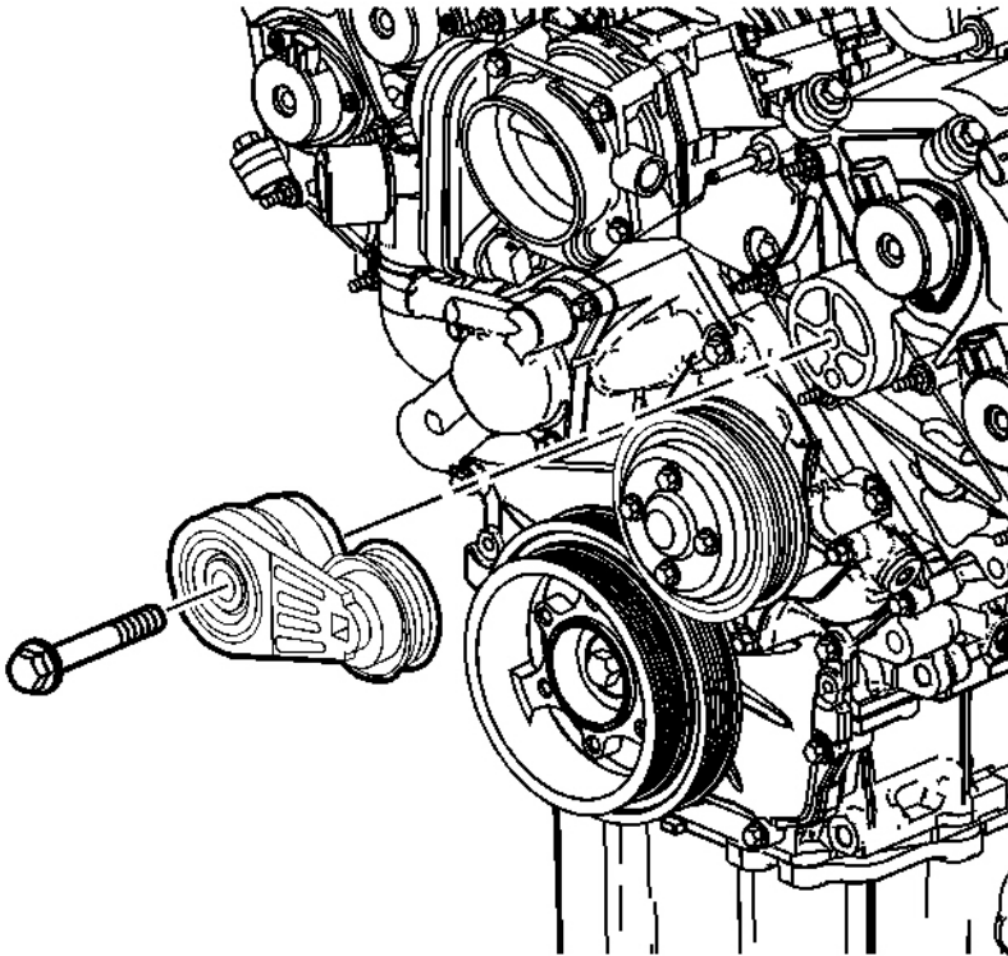


Fig. 119: View Of P/S Pump & A/C Compressor Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the P/S pump and A/C compressor drive belt tensioner bolt.
2. Remove the P/S pump and A/C compressor drive belt tensioner.

WATER OUTLET HOUSING REMOVAL

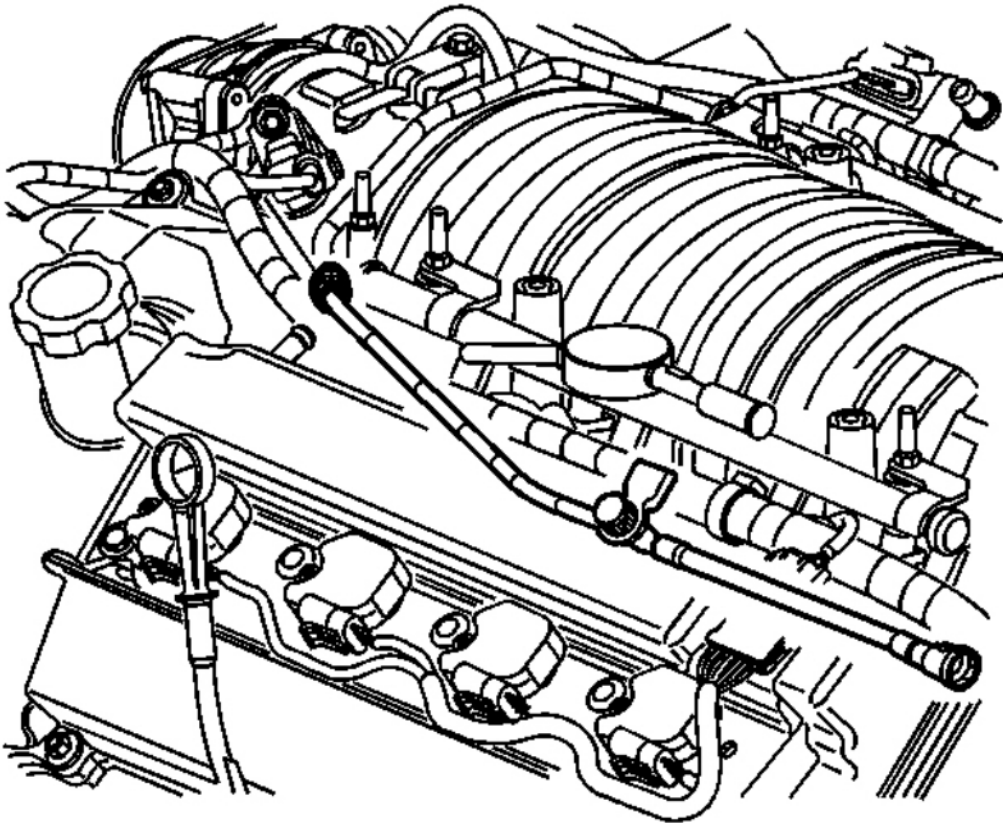


Fig. 120: View Of EVAP Purge Valve Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the EVAP purge valve tube from the EVAP purge valve.

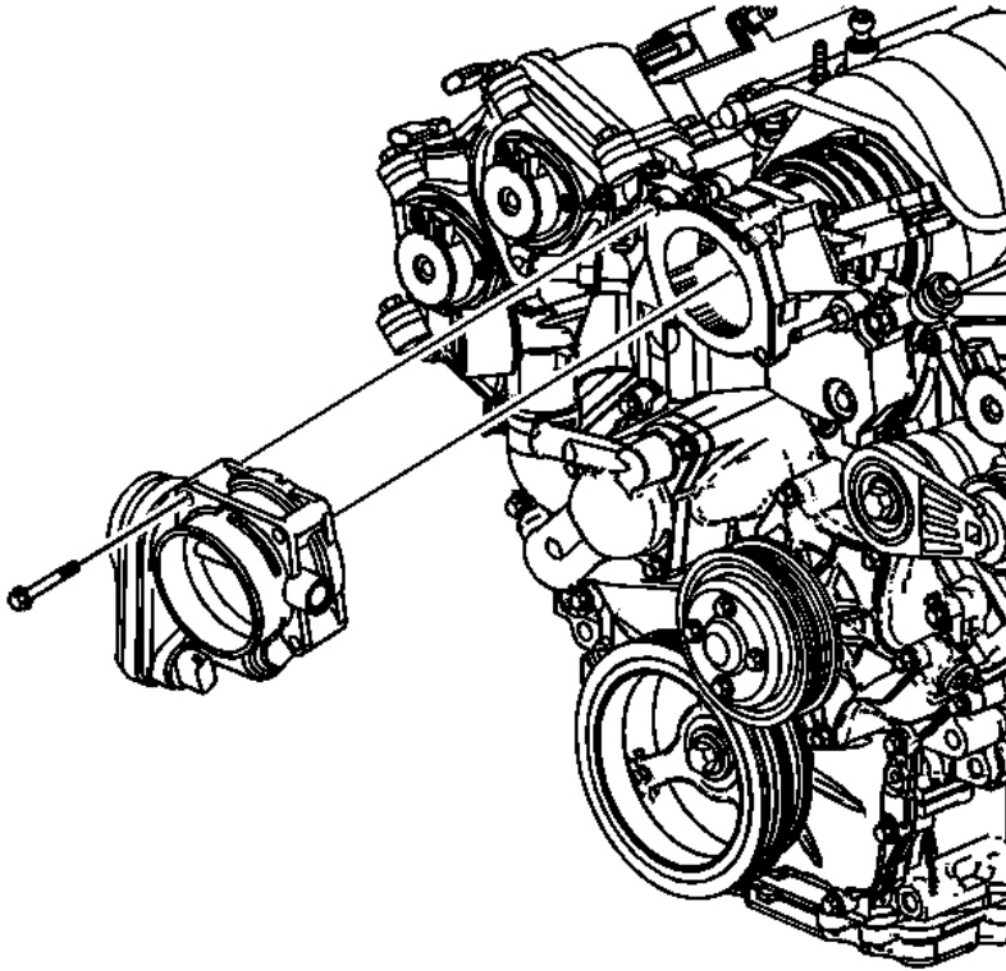


Fig. 121: View Of Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

2. Remove the throttle body bolts.
3. Remove the throttle body from the water outlet.

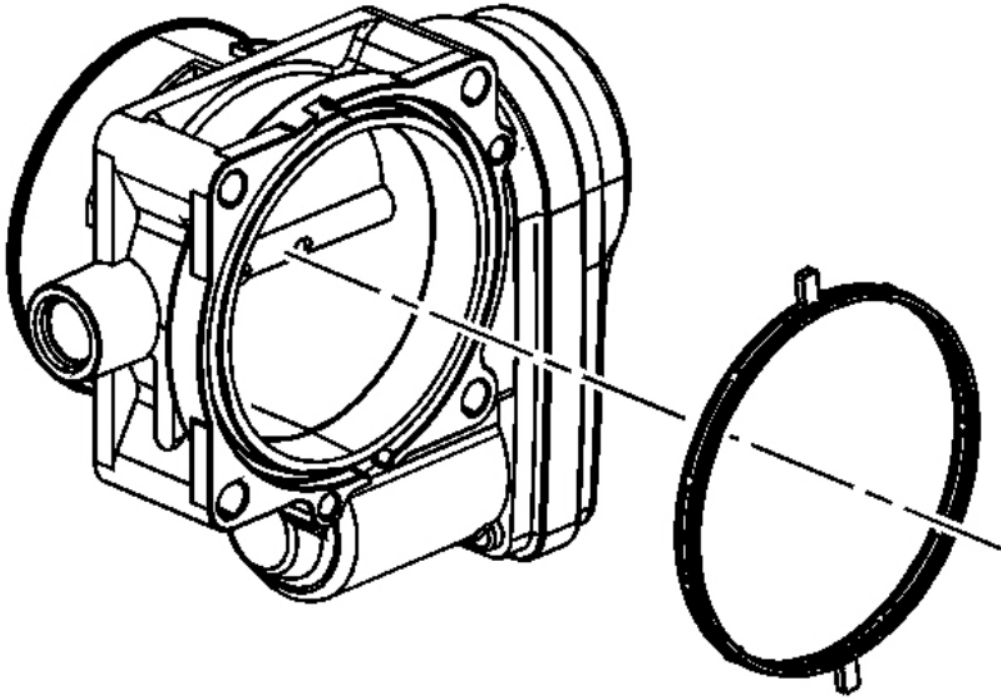


Fig. 122: View Of Throttle Body Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the throttle body gasket.

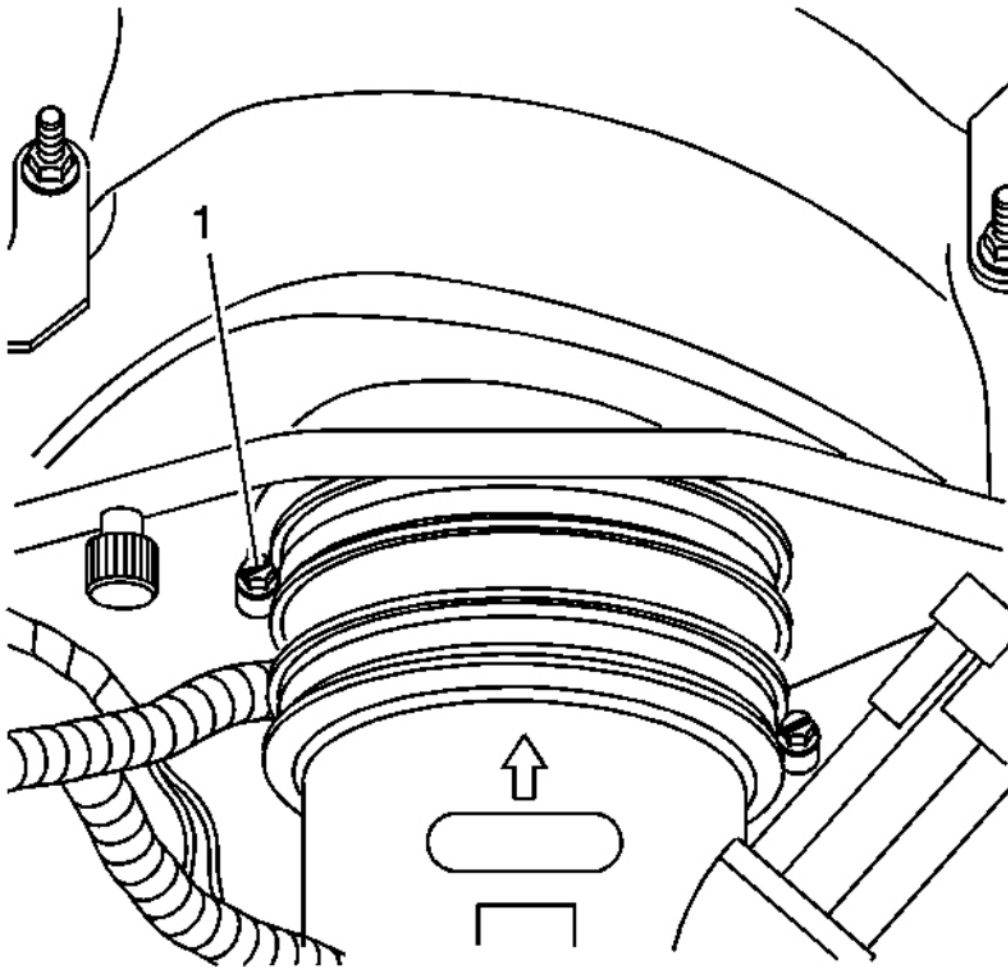


Fig. 123: Locating Intake Manifold Plenum Duct Clamp
Courtesy of GENERAL MOTORS CORP.

5. Loosen the clamp (1) on the intake manifold plenum duct.

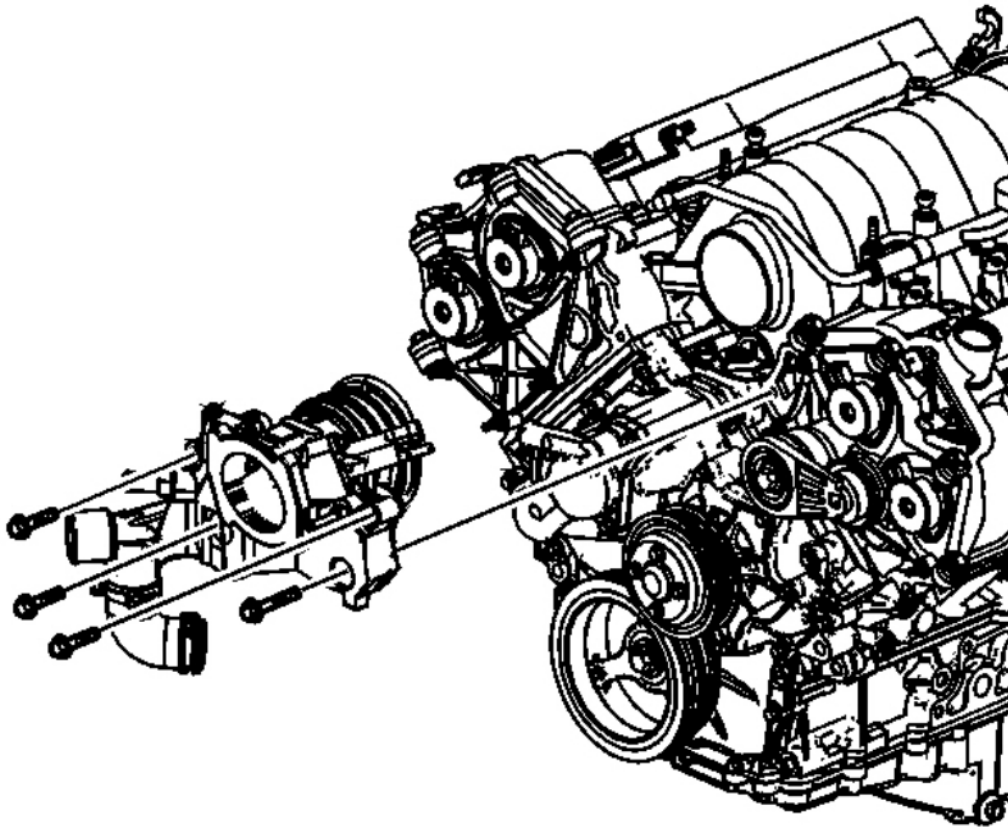


Fig. 124: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

6. Remove the water outlet housing bolts.
7. Remove the water outlet housing.

INTAKE MANIFOLD REMOVAL

1. Disconnect the PCV dirty air tube from the camshaft cover.

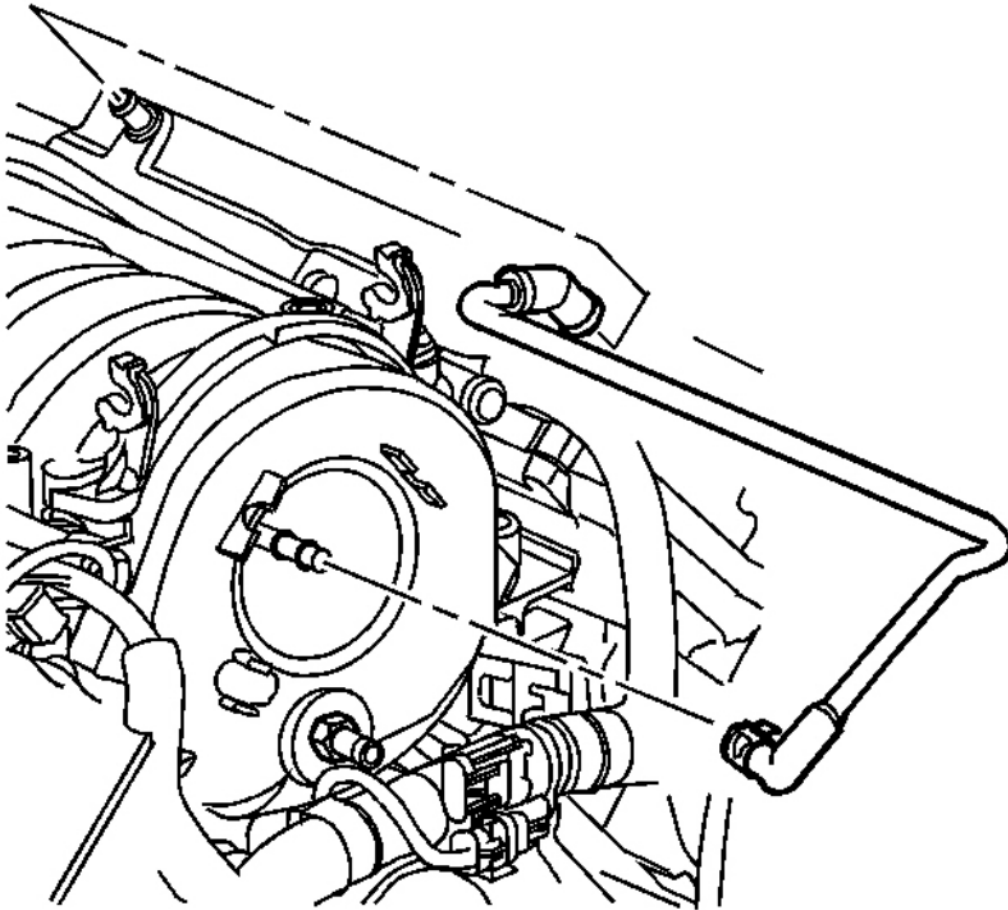


Fig. 125: View Of PCV Dirty Air Breather Tube
Courtesy of GENERAL MOTORS CORP.

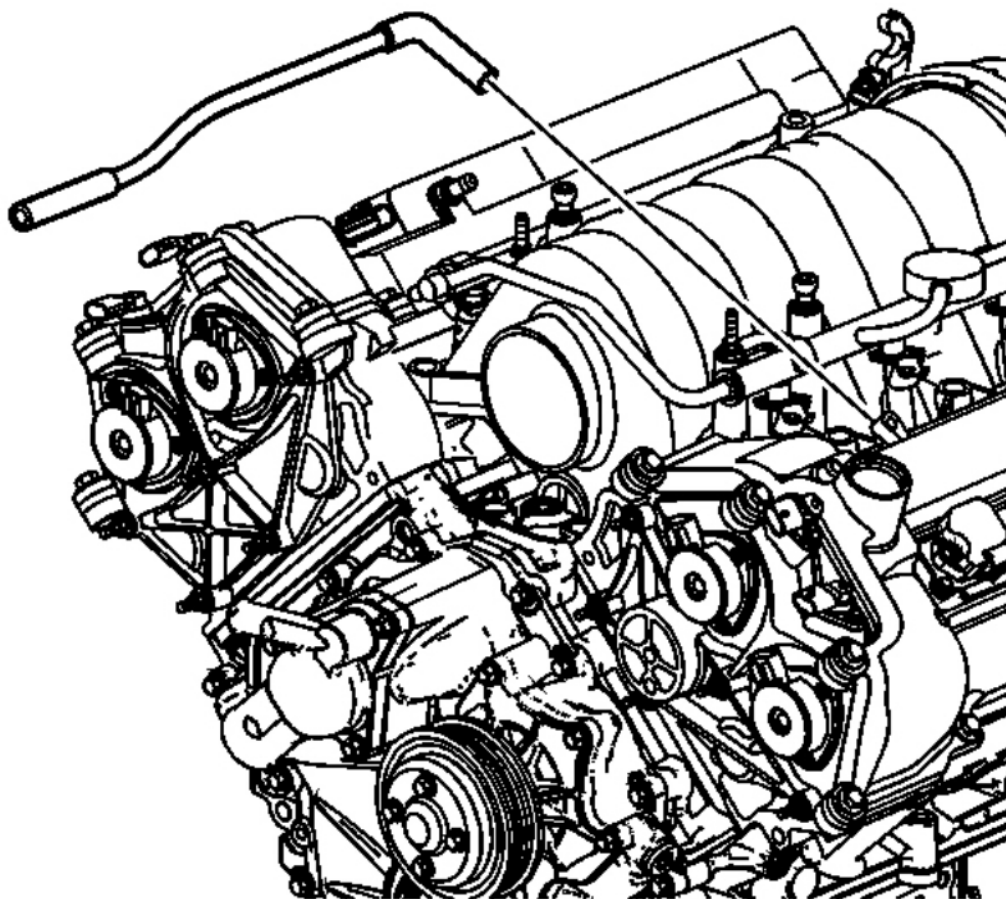


Fig. 126: View Of PCV Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the PCV fresh air tube from the camshaft cover.

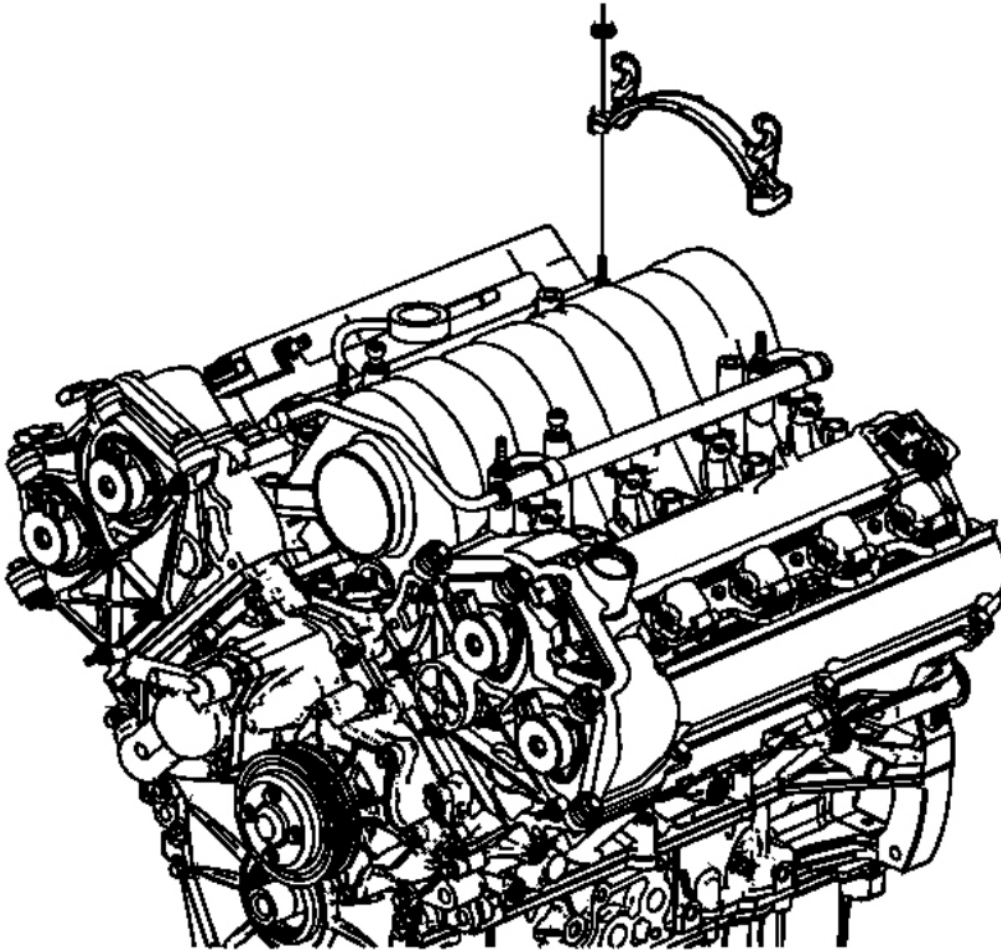


Fig. 127: View Of Sight Shield Bracket
Courtesy of GENERAL MOTORS CORP.

3. Remove the sight shield bracket nuts.
4. Remove the sight shield bracket.

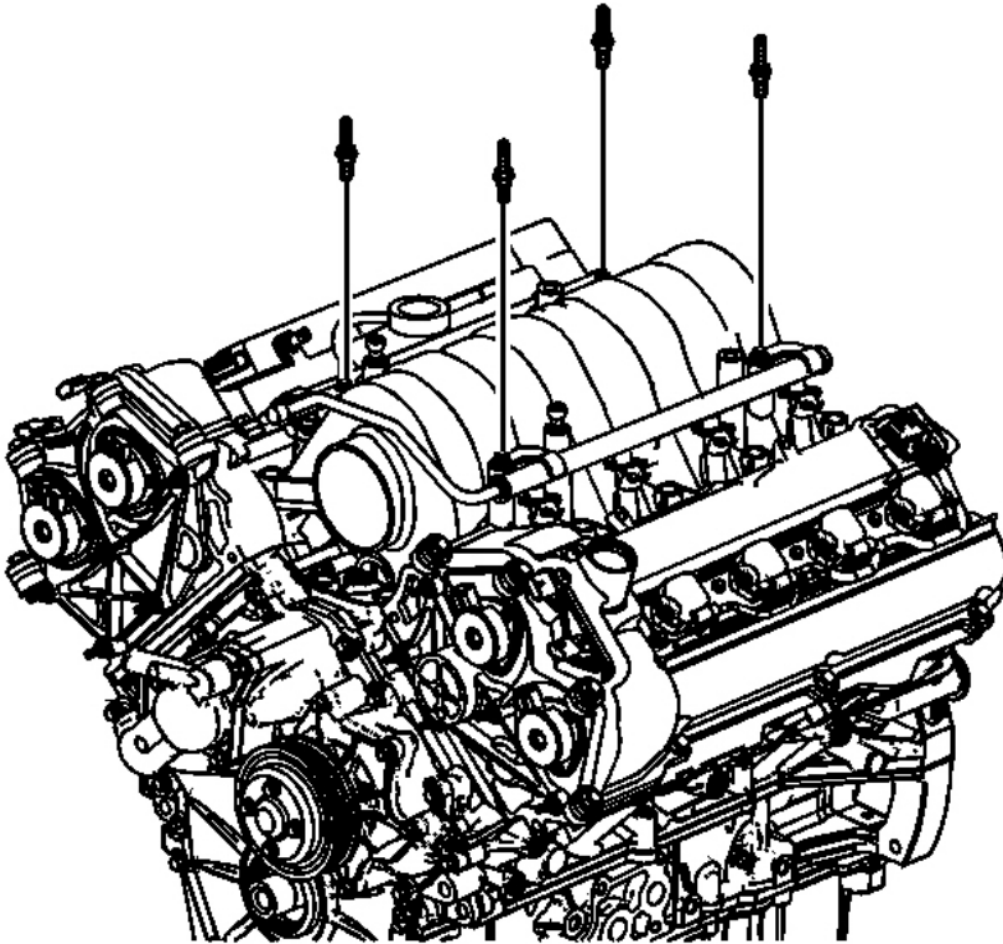


Fig. 128: View Of Fuel Rail-To-Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the bolts attaching the fuel rail to the intake manifold.

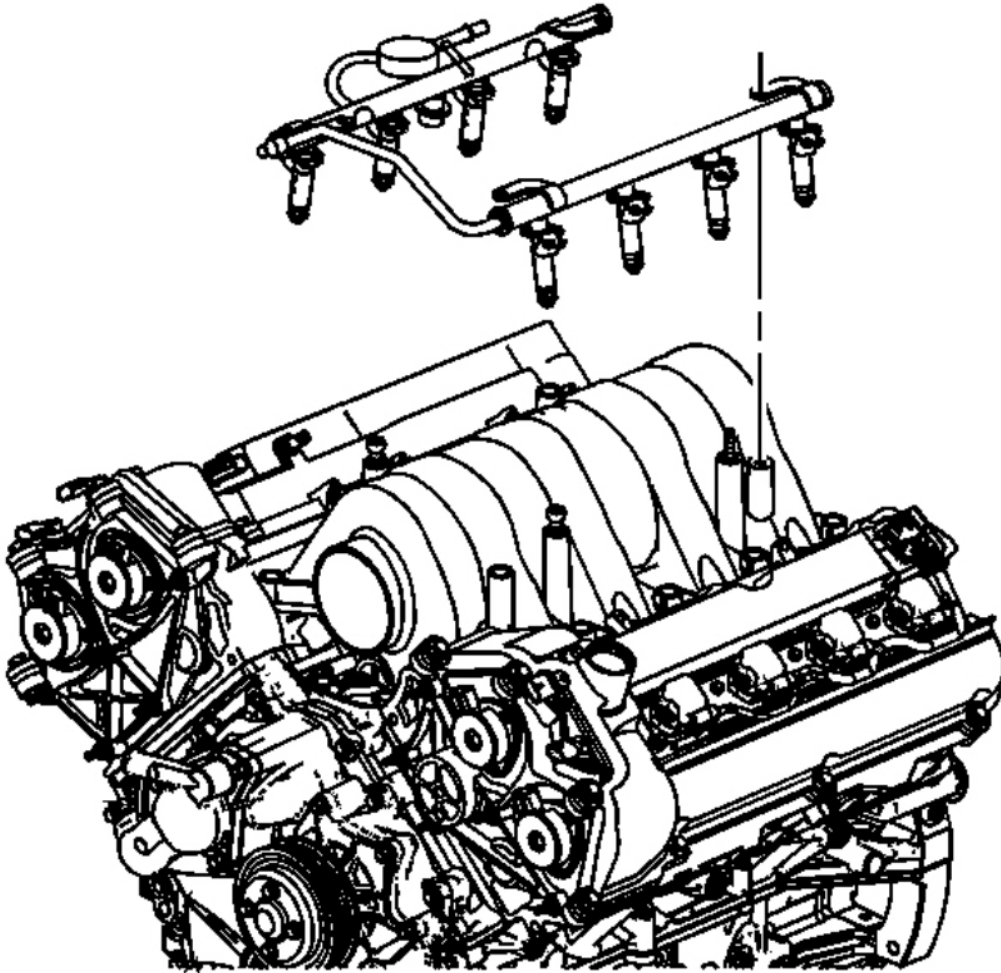


Fig. 129: View Of Fuel Rail & Injector Assembly
Courtesy of GENERAL MOTORS CORP.

6. Lift the entire fuel rail and injector assembly from the intake manifold.

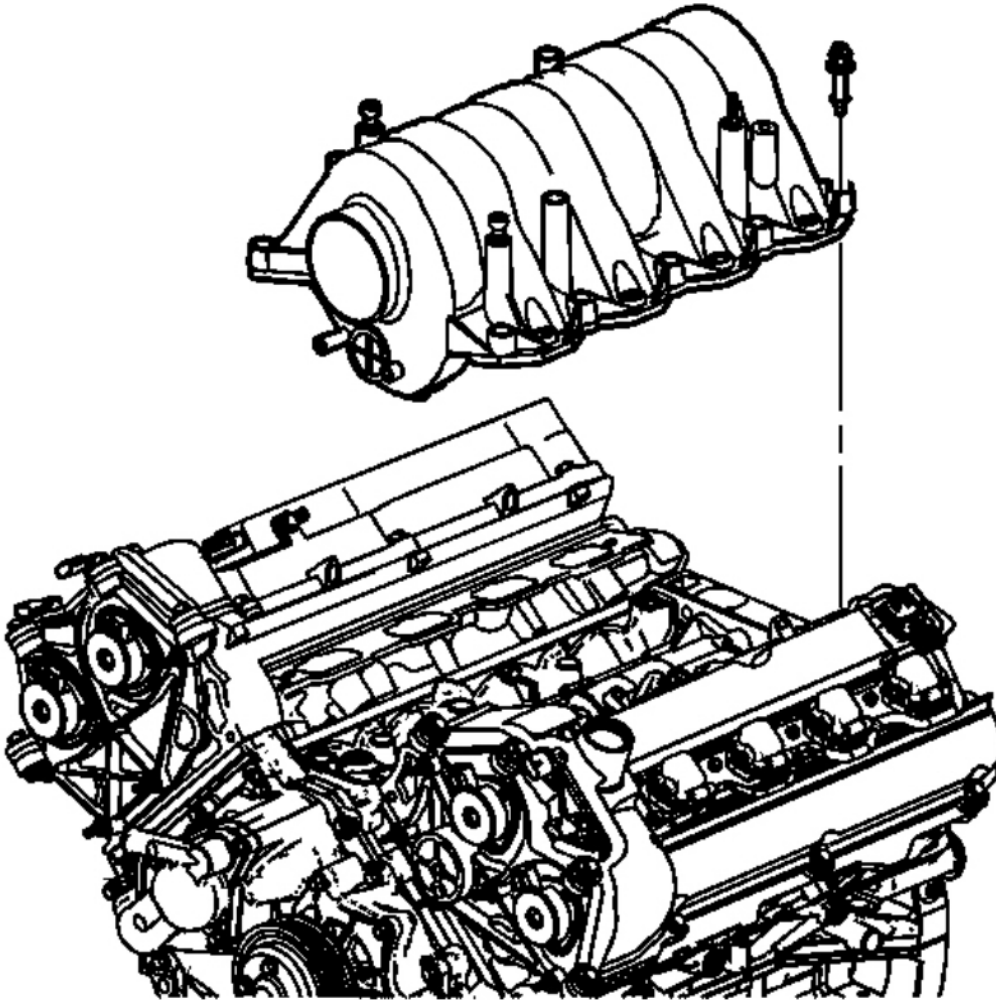


Fig. 130: View Of Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosen the bolts attaching the intake manifold to the cylinder heads.
8. Remove the intake manifold by using an upward lifting motion at the rear of the manifold assembly.

STARTER MOTOR REMOVAL

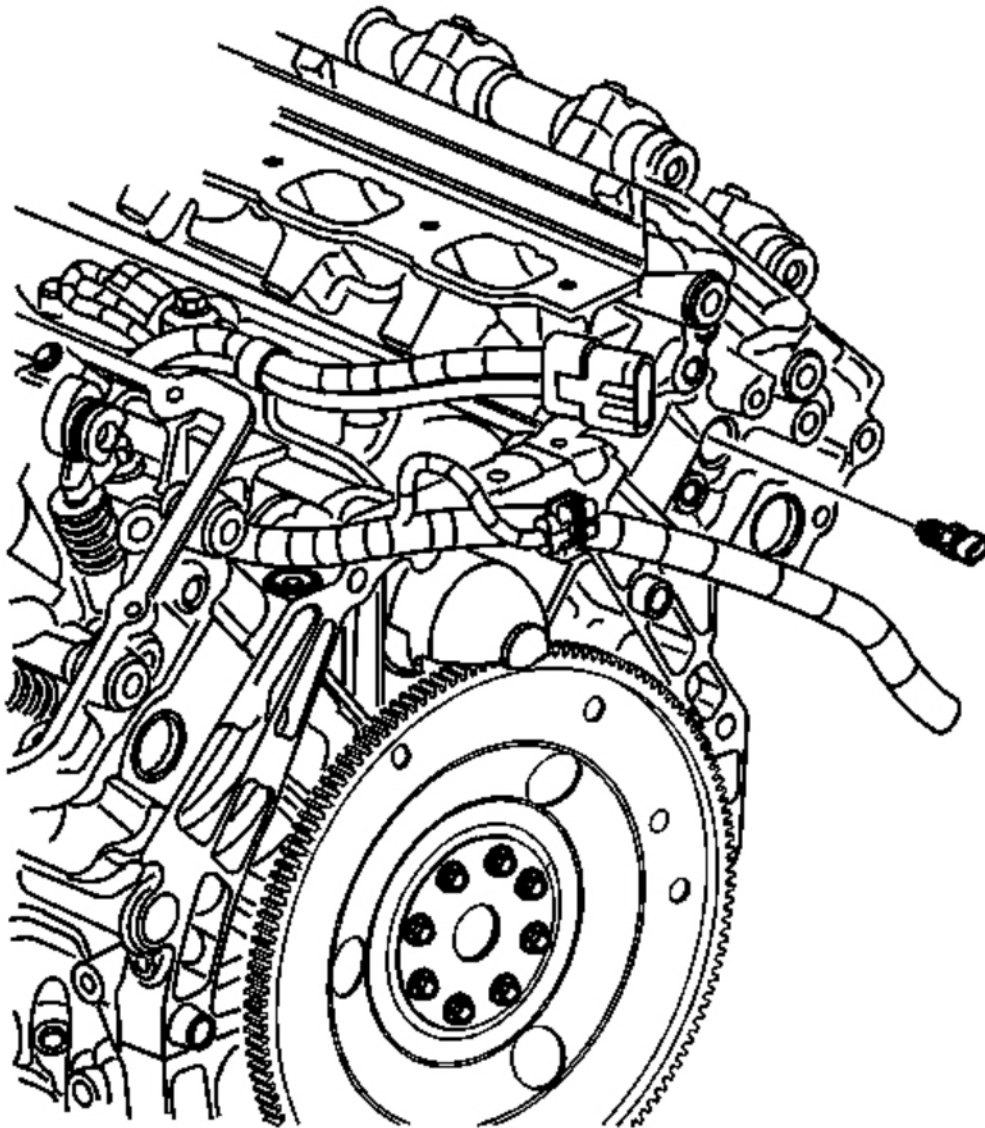


Fig. 131: View Of ECT Sensor

Courtesy of GENERAL MOTORS CORP.

1. Remove the engine coolant temperature (ECT) sensor from the rear of the right cylinder head.

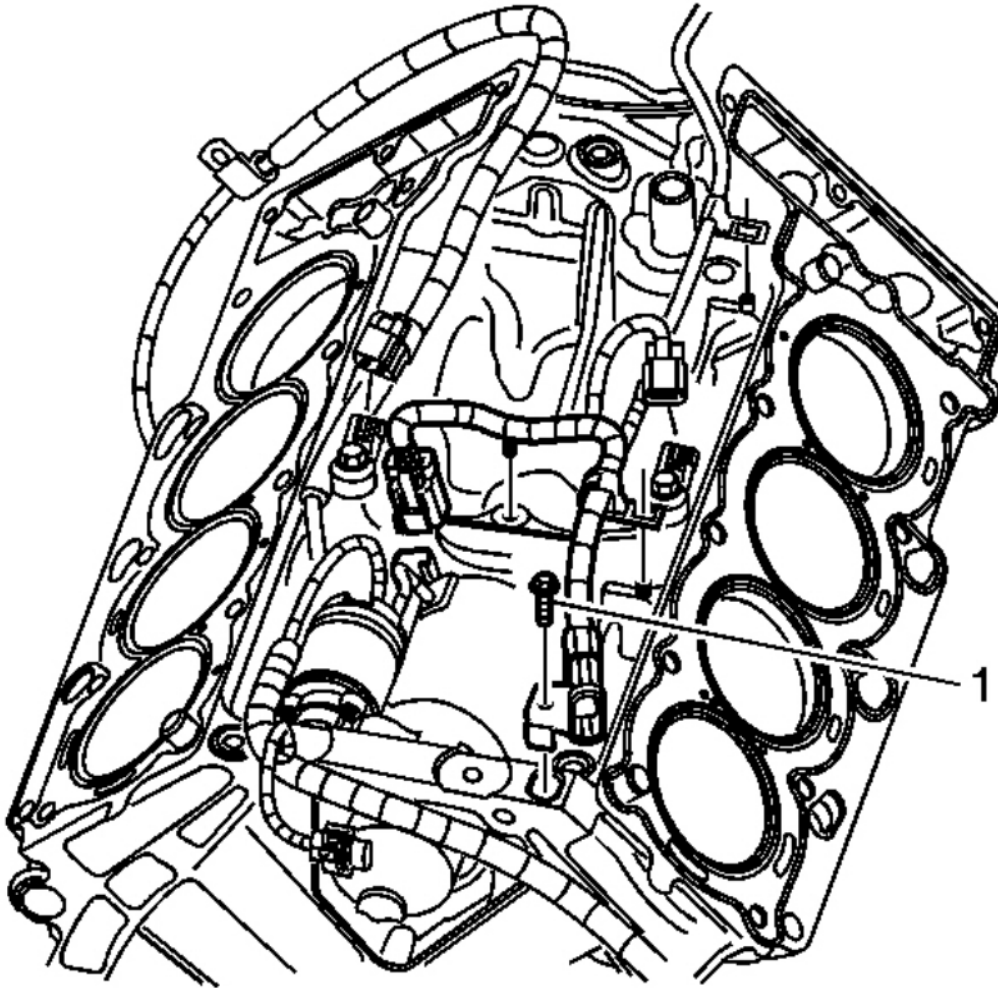


Fig. 132: Locating Knock & Crankshaft Position Sensor Wiring Harness Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the knock and crankshaft position sensor wiring harness bolt (1).
3. Disconnect the knock and crankshaft position sensor wiring harness connectors from the knock sensors and the crankshaft position sensor.
4. Disconnect the knock and crankshaft position sensor wiring harness from the attaching points in the center, back and front of block valley.

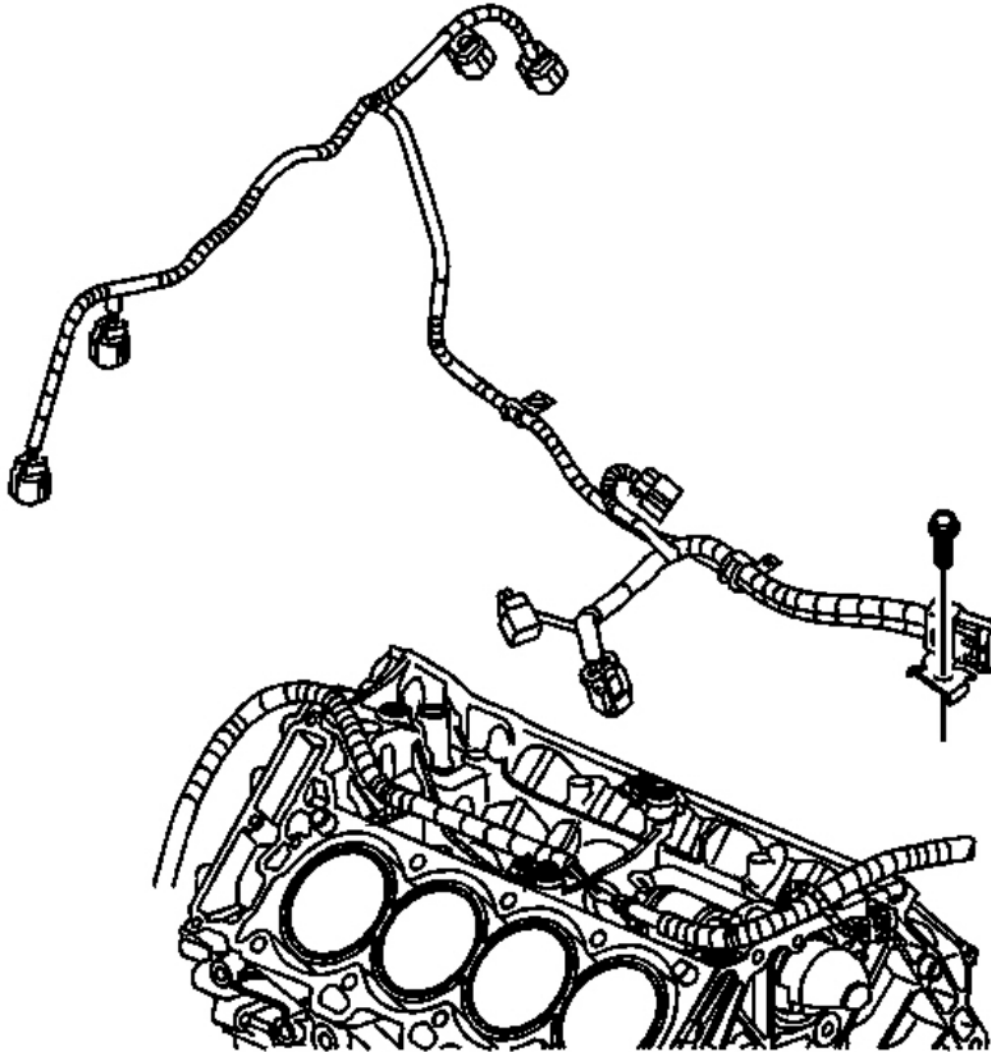


Fig. 133: View Of Knock & Crankshaft Position Sensor Wiring Harness
Courtesy of GENERAL MOTORS CORP.

5. Remove the knock and crankshaft position sensor wiring harness.

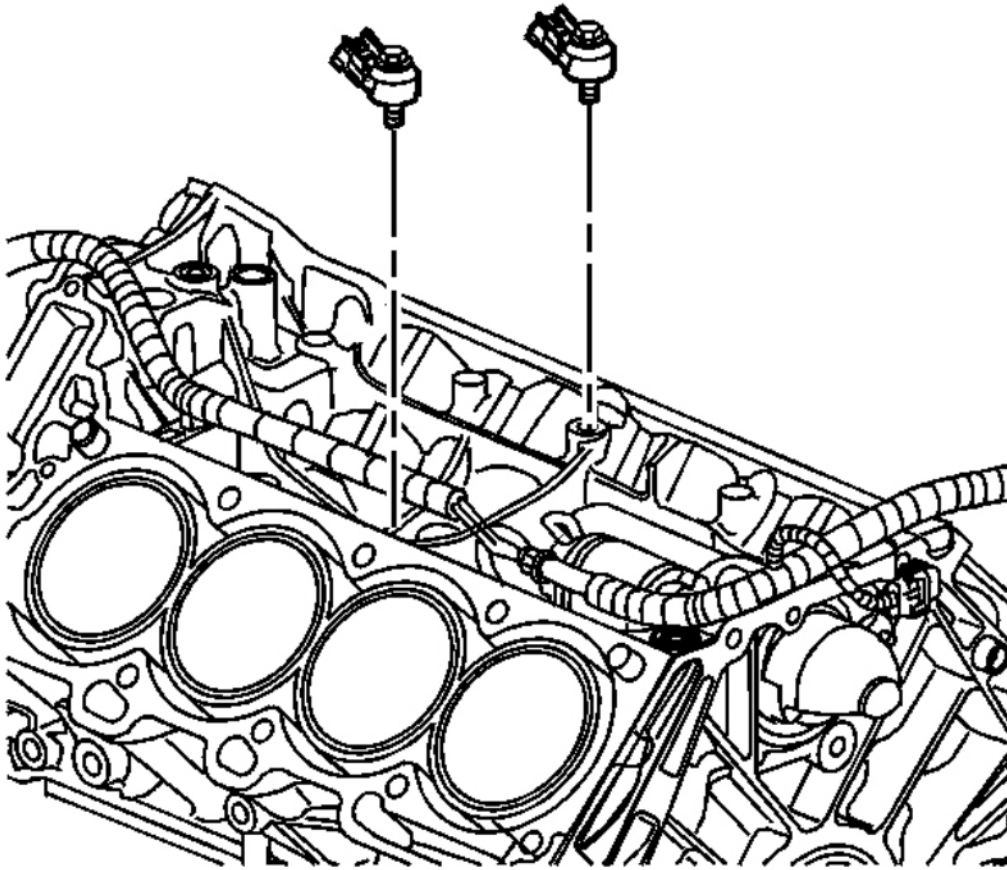


Fig. 134: View Of Knock Sensors
Courtesy of GENERAL MOTORS CORP.

6. Loosen the knock sensor bolts.
7. Remove the knock sensors.

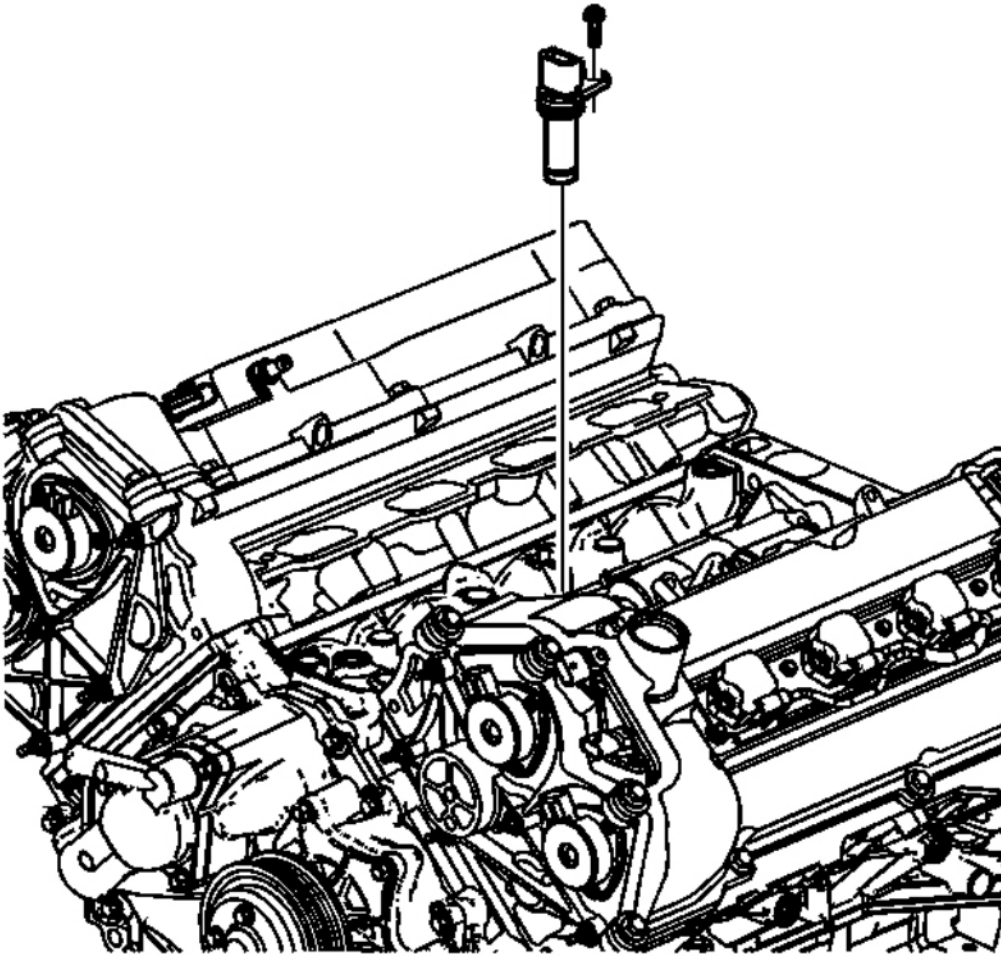


Fig. 135: View Of Crankshaft Position Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Remove the crankshaft position sensor bolt.
9. Remove the crankshaft position sensor.

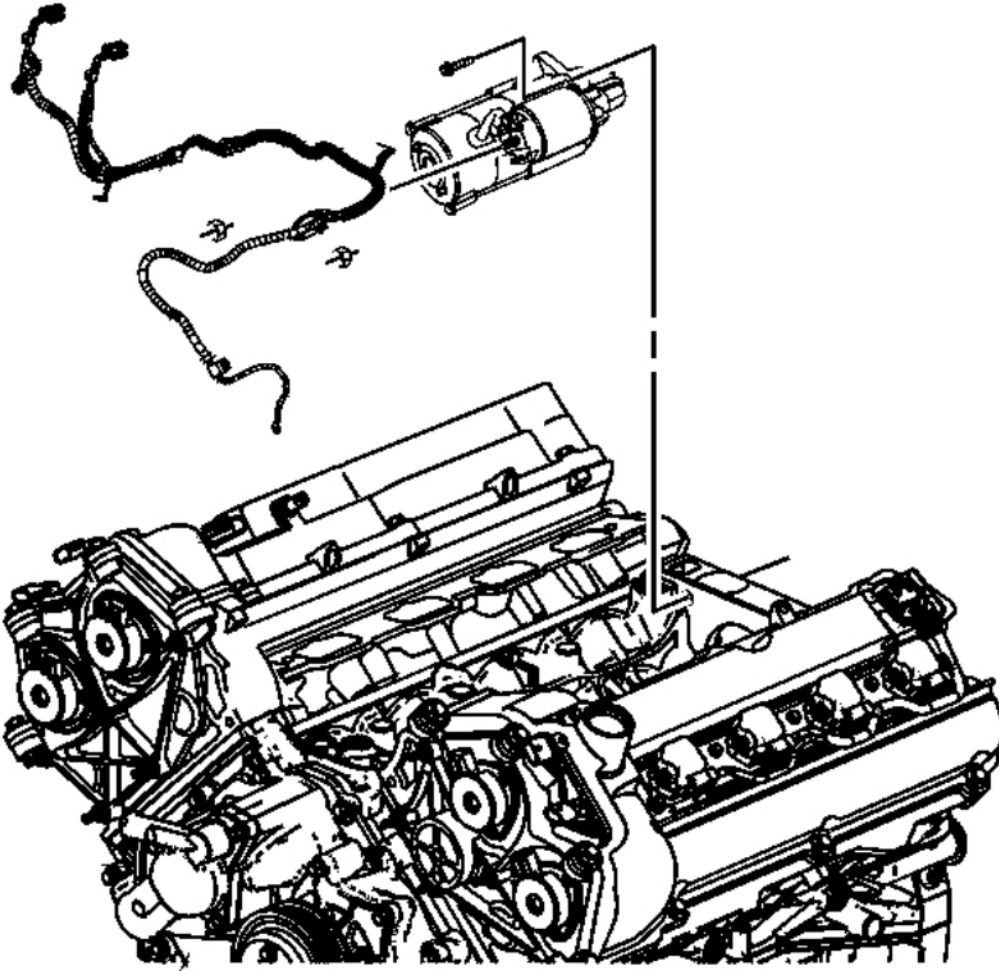


Fig. 136: View Of Starter Motor
Courtesy of GENERAL MOTORS CORP.

10. Remove the starter motor bolts.
11. Remove the starter motor and starter motor wiring harness.

CRANKSHAFT BALANCER REMOVAL

Tools Required

- **EN 46326** Flywheel Holding Tool

- **J 24420-C** Harmonic Balancer Puller
- **J 38416-2** Crankshaft Button

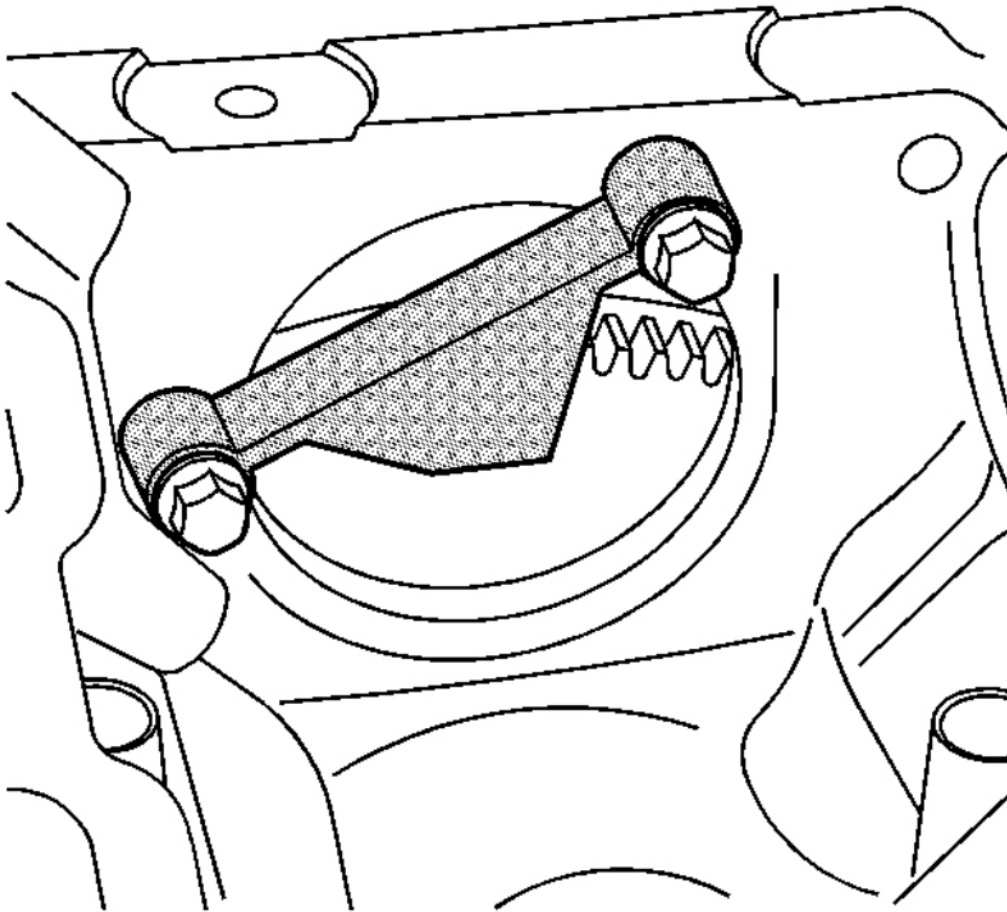


Fig. 137: View Of Flywheel Holder
Courtesy of GENERAL MOTORS CORP.

1. Install the **EN 46326** .

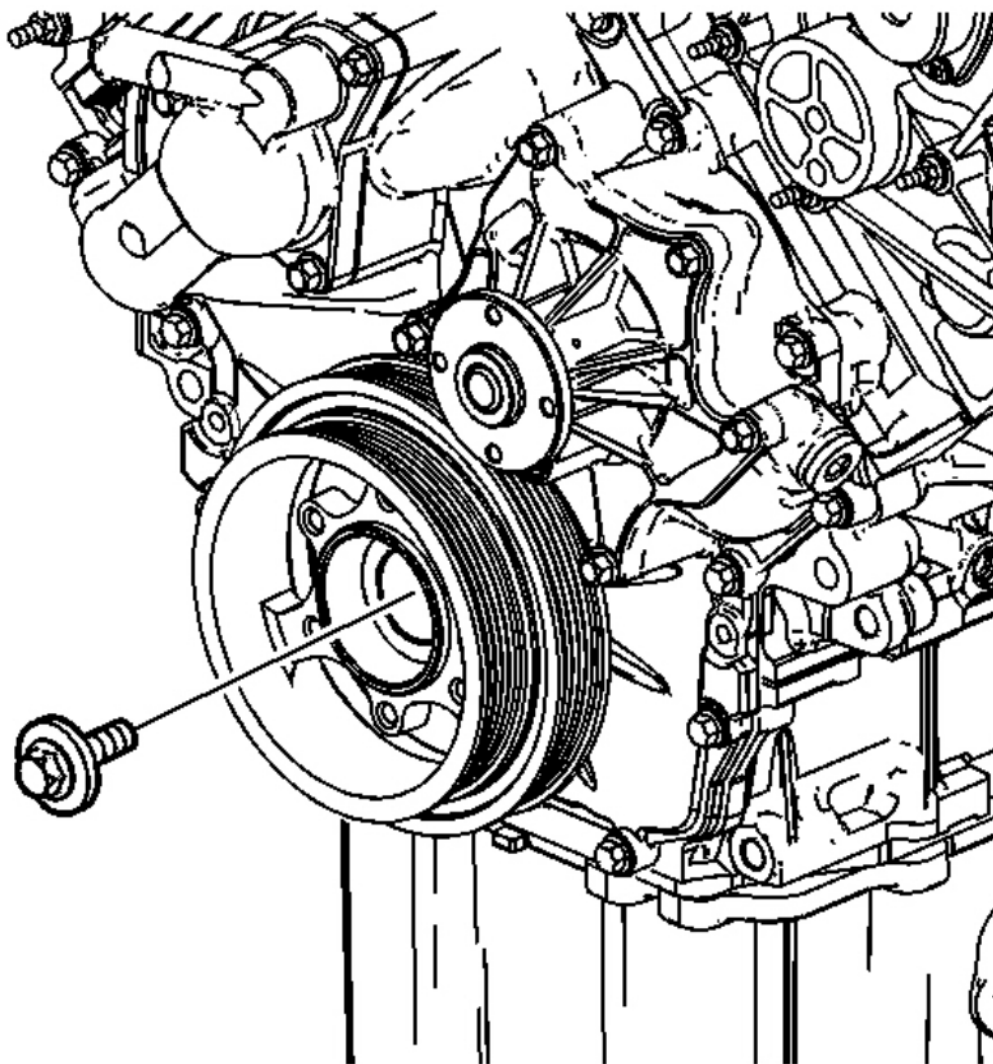


Fig. 138: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the crankshaft balancer bolt.

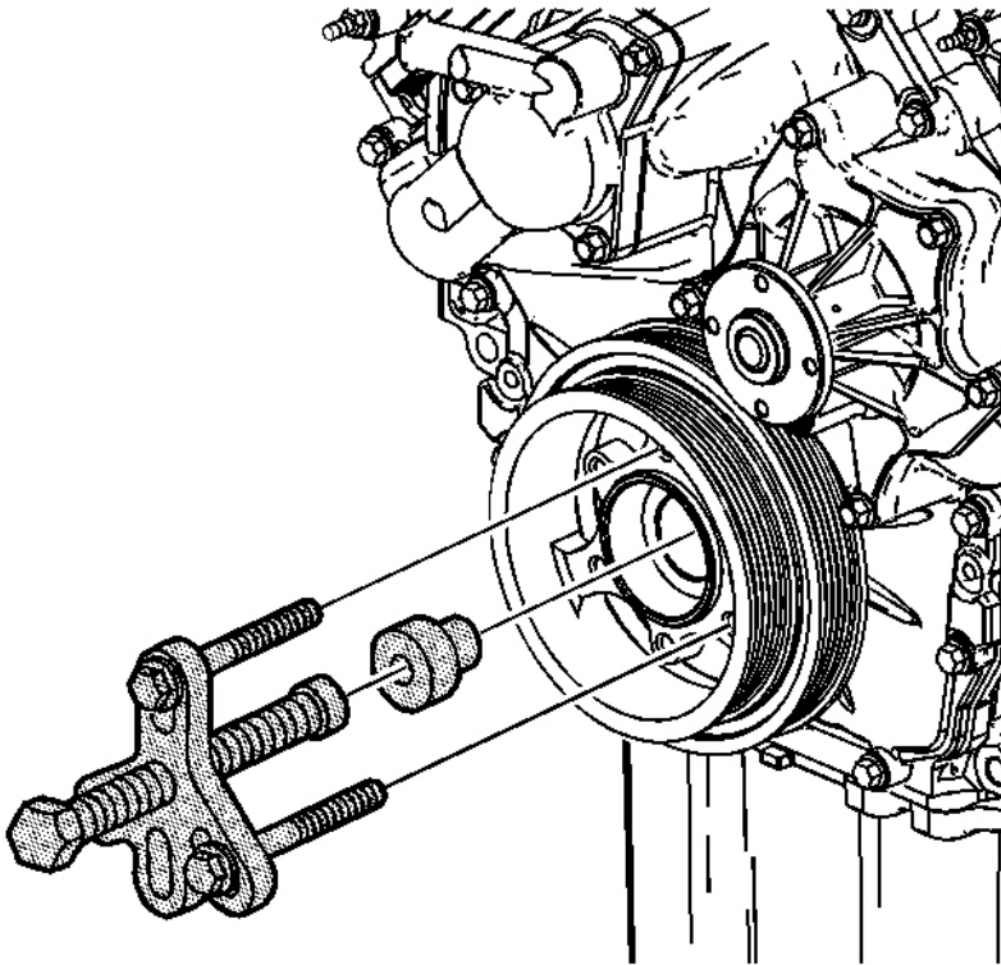


Fig. 139: View Of J 38416-2 & J 24420-C Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

3. Place the **J 38416-2** into the end of the crankshaft.
4. Install the **J 24420-C** on the crankshaft balancer.

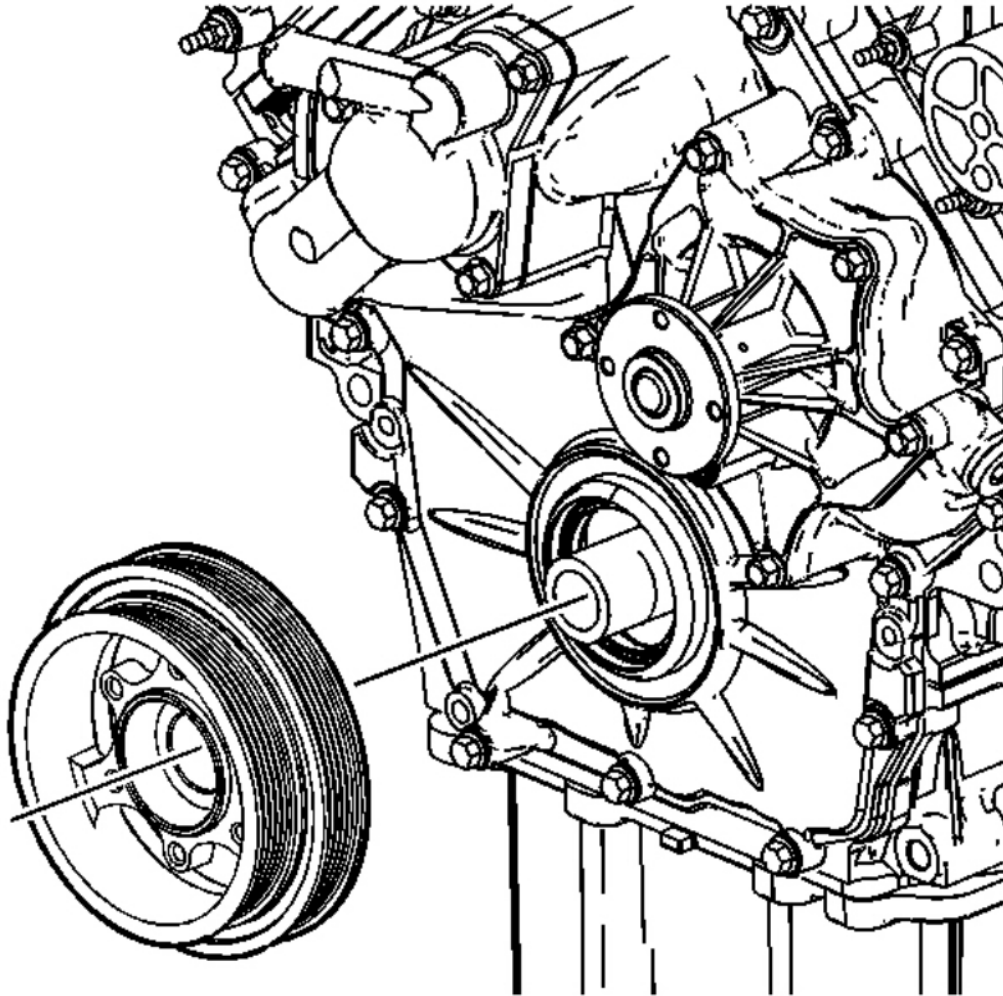


Fig. 140: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft balancer using the J 24420-C .

ENGINE FLYWHEEL REMOVAL

Tools Required:

EN 46326 Flywheel Holding Tool

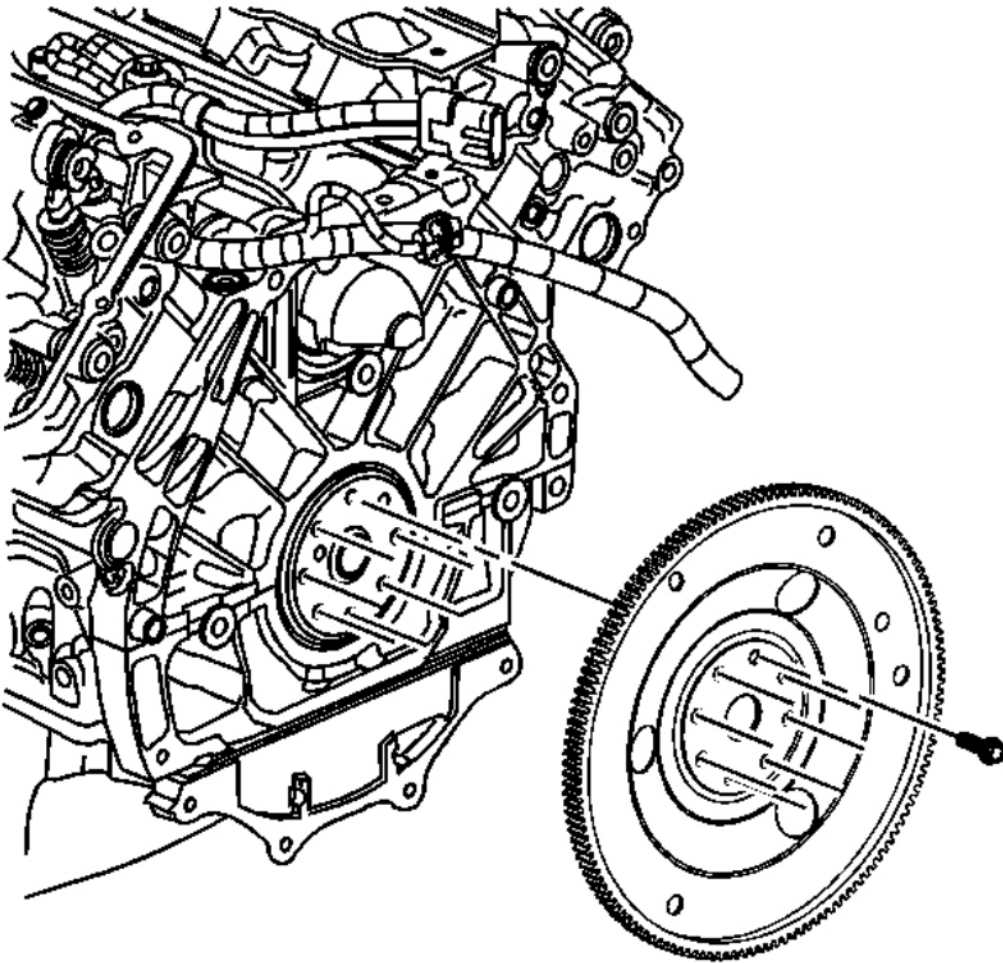


Fig. 141: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel bolts.
2. Remove the engine flywheel.

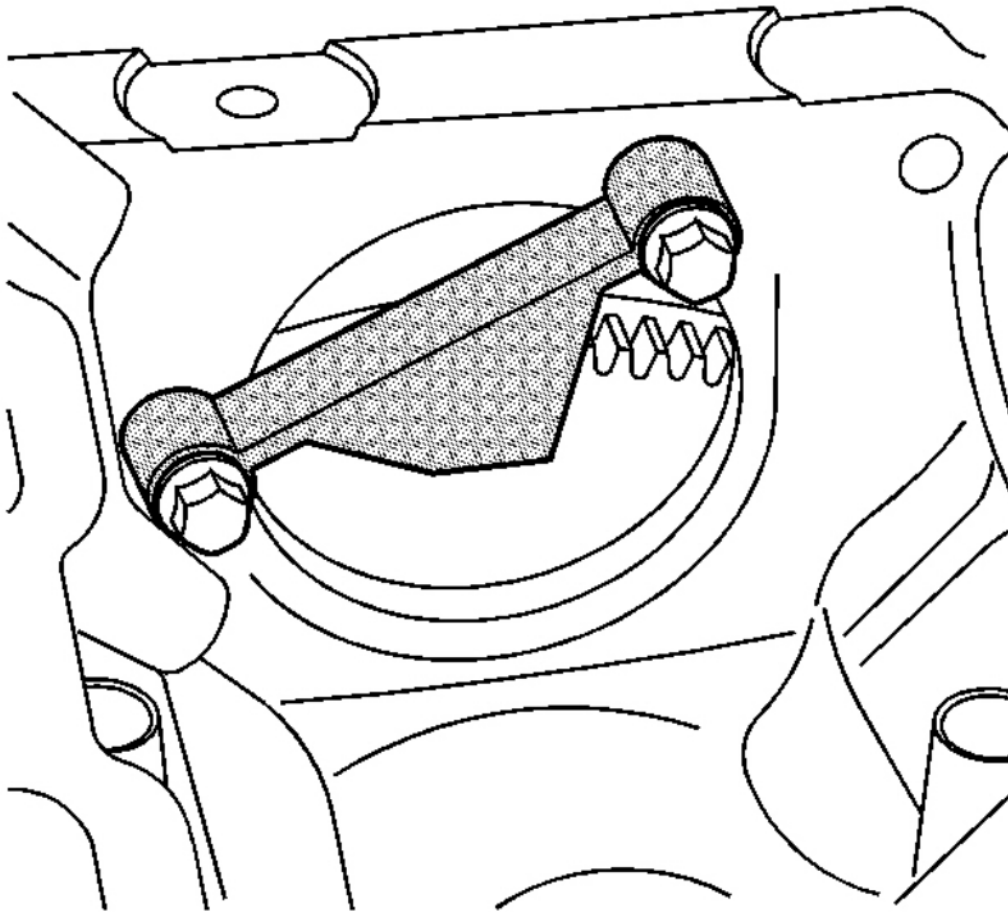


Fig. 142: View Of Flywheel Holder
Courtesy of GENERAL MOTORS CORP.

3. Remove the EN 46326 .

CRANKSHAFT REAR OIL SEAL REMOVAL

Tools Required:

J 42841 Rear Oil Seal Remover

IMPORTANT: Crankshaft rear oil seal removal requires adequate space for removal. Mount the engine on a suitable engine stand which

will properly space the engine in order to use the J 42841 to remove the crankshaft rear oil seal. If necessary remove the crankshaft rear oil seal with the engine properly supported on the floor or on a bench.

IMPORTANT: Rear crankshaft seal removal cannot be performed on an engine stand. If the engine is out of the vehicle, properly support the engine on a bench or on the floor. If the engine is in the vehicle the seal can be removed after the transaxle and engine flywheel are removed.

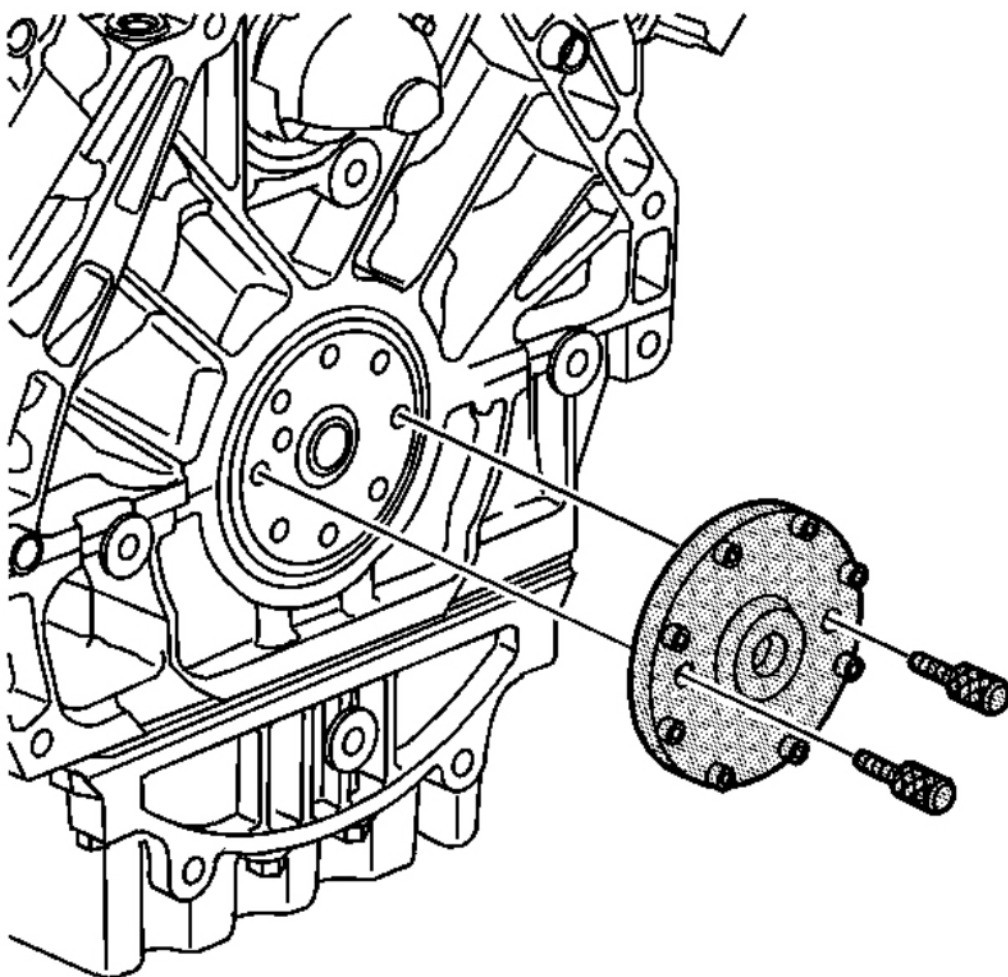


Fig. 143: View Of J 42841

Courtesy of GENERAL MOTORS CORP.

1. Place the **J 42841** onto the crankshaft.
2. Install the **J 42841** retaining bolt that match the threads in the crankshaft flange.

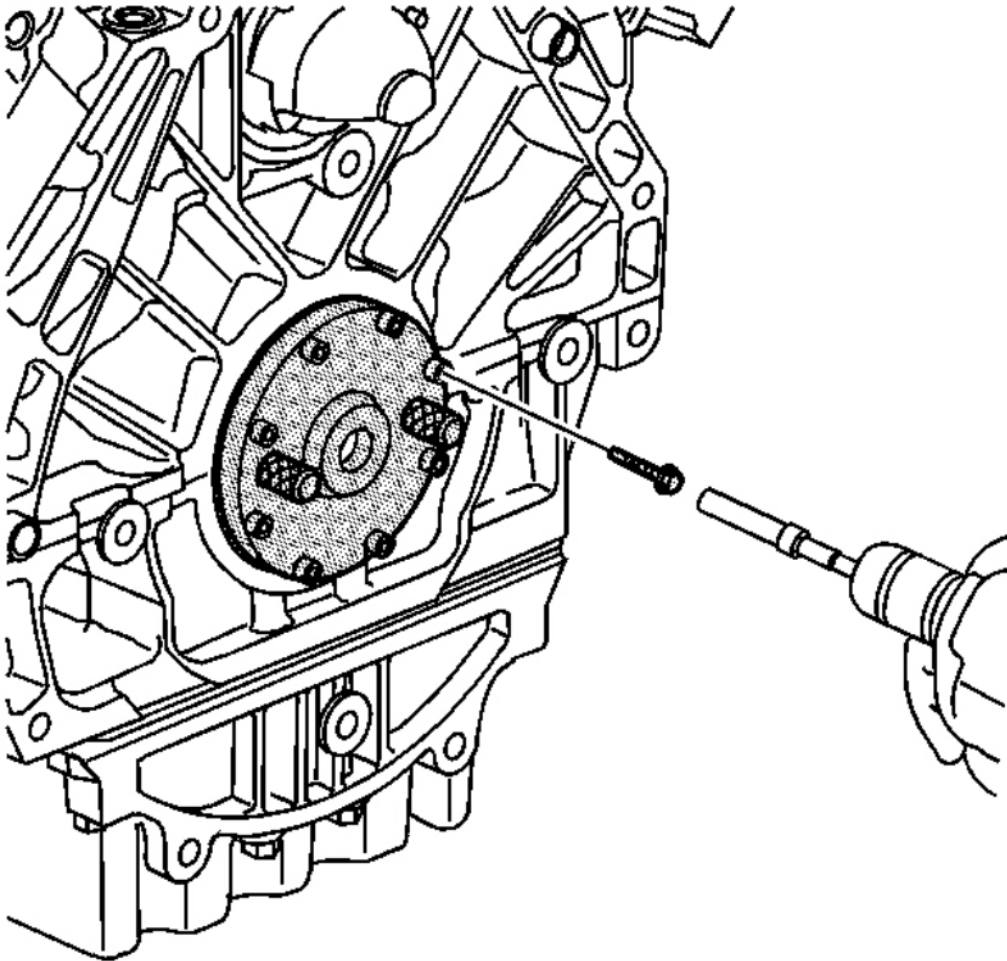


Fig. 144: Installing Self-Drilling Screws Into Seal

Courtesy of GENERAL MOTORS CORP.

3. Using a drill motor, variable speed preferred, with a socket adapter, install eight 25 mm (1.0 in) self-drilling screws into the seal using the guide holes in the removal tool. When drilling,

make sure you reduce the drill speed when the screw begins threading into the seal.

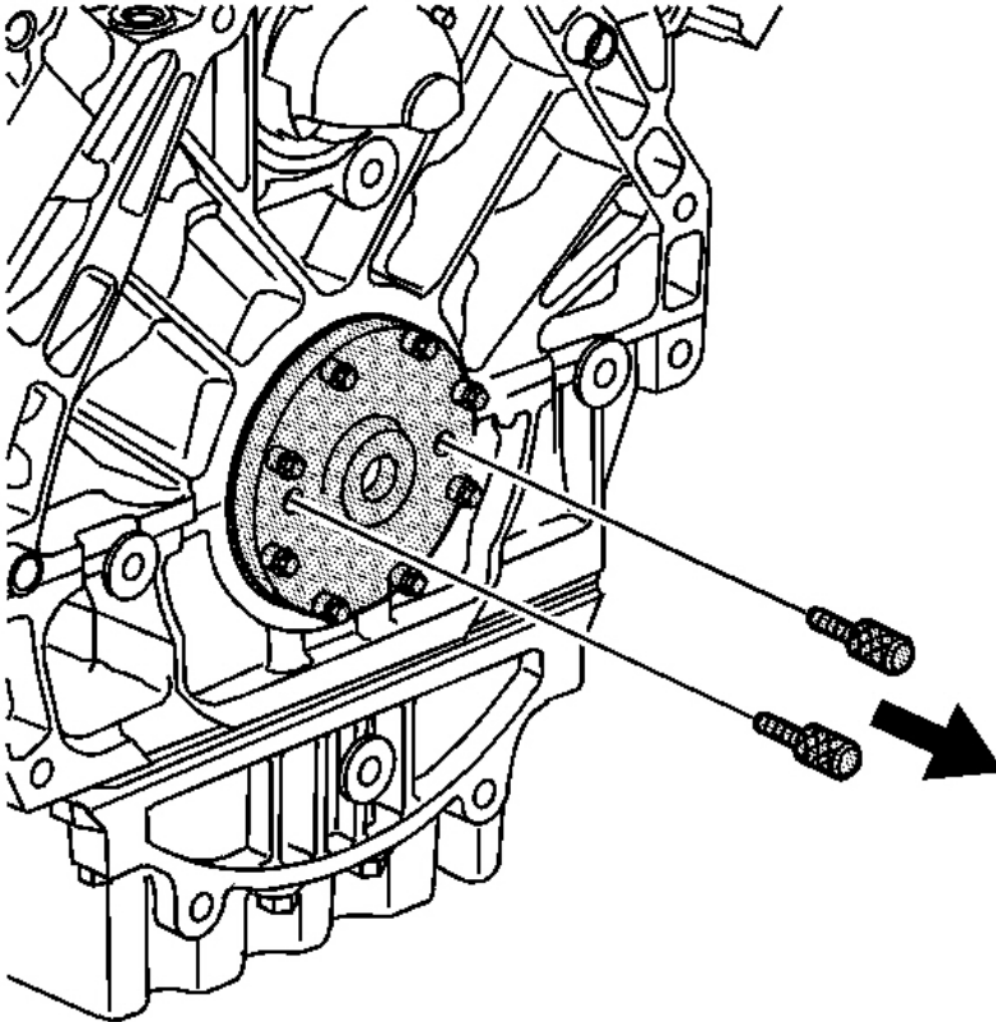


Fig. 145: Removing J 42841 Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

4. With all 8 removal screws installed, remove the **J 42841** retaining bolts.

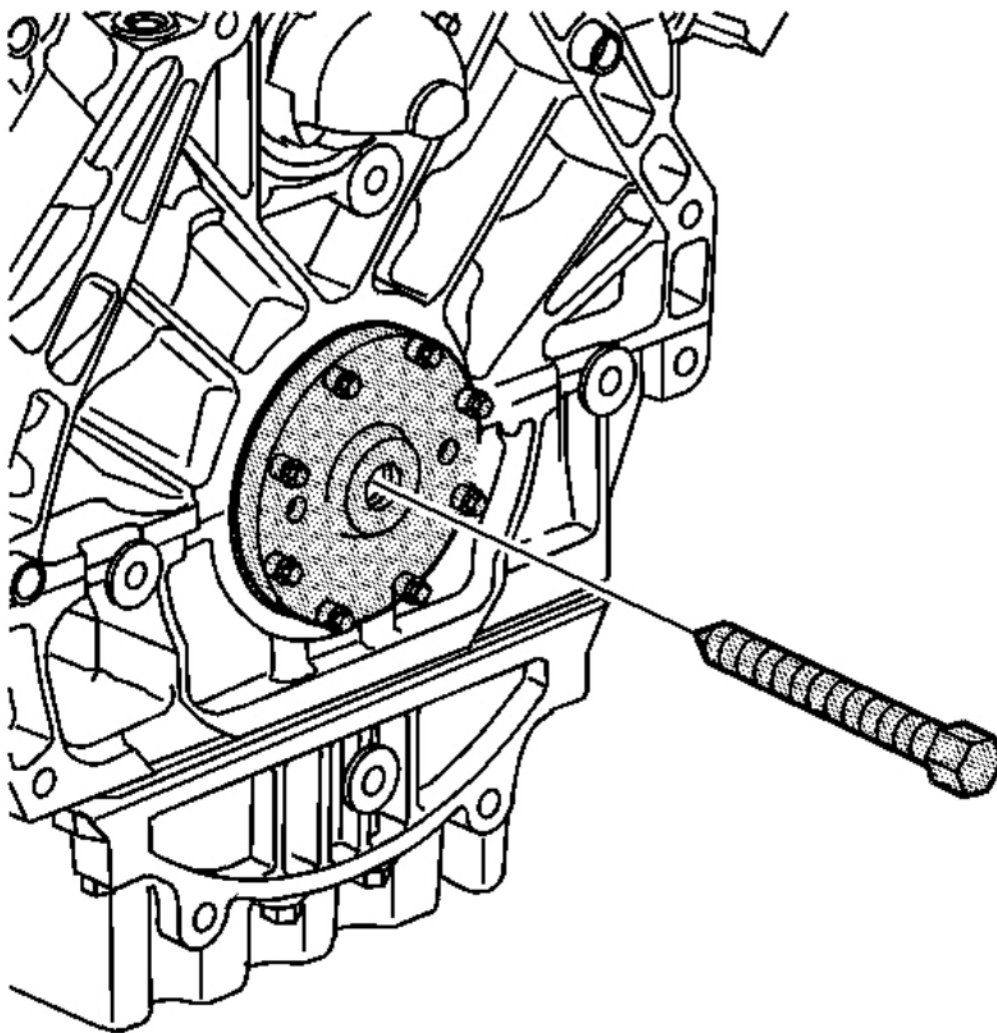


Fig. 146: View Of Center Forcing Screw
Courtesy of GENERAL MOTORS CORP.

5. Install the center forcing screw.

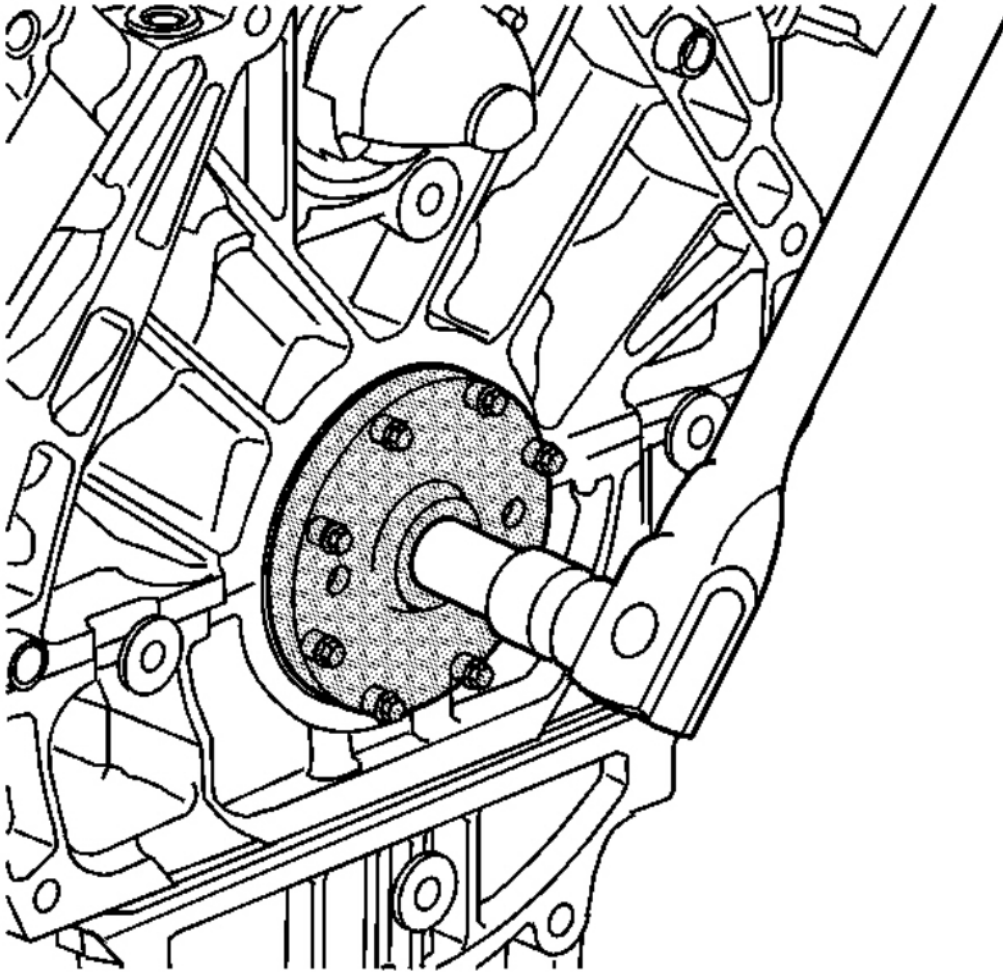


Fig. 147: Removing Crankshaft Rear Oil Seal Assembly
Courtesy of GENERAL MOTORS CORP.

6. Tighten the center screw on the removal tool to pull the seal assembly off the end of the crankshaft.

OIL LEVEL INDICATOR AND TUBE REMOVAL

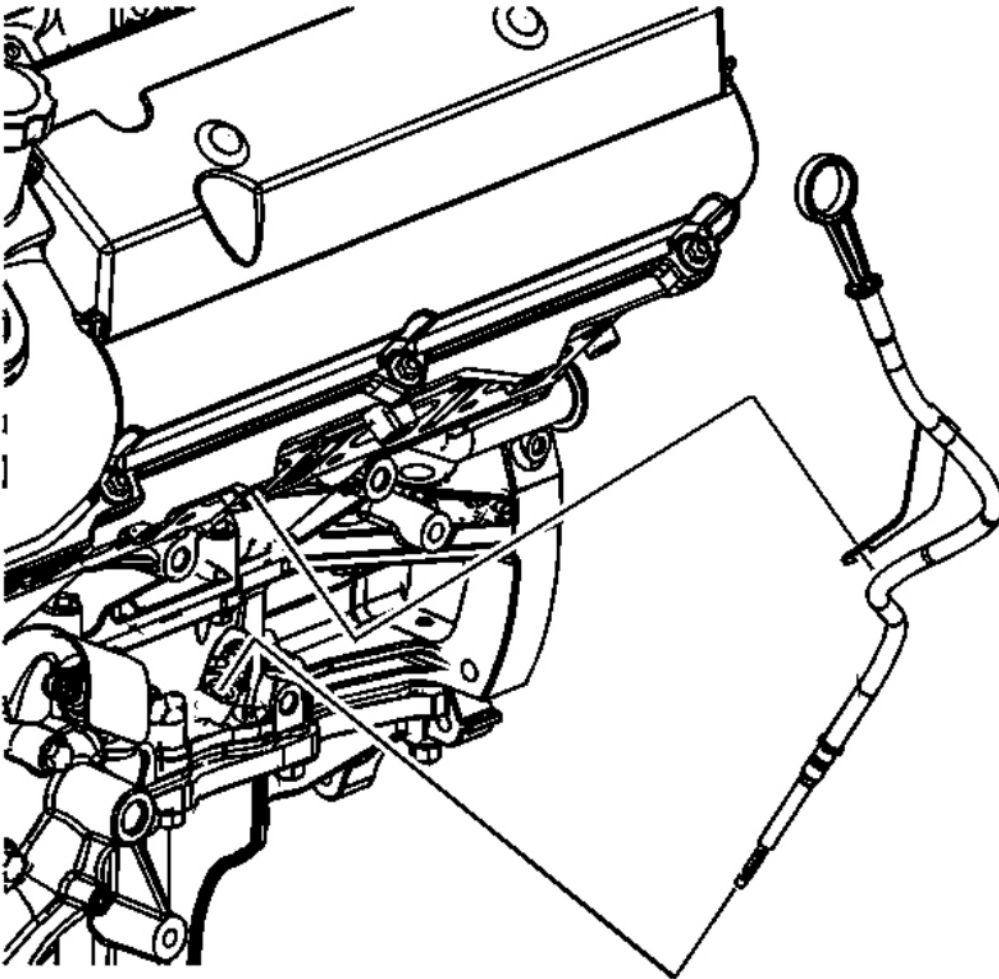


Fig. 148: View Of Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator bolt.
2. Remove the oil level indicator tube.

OIL FILTER ADAPTER REMOVAL (WITHOUT OIL COOLER)

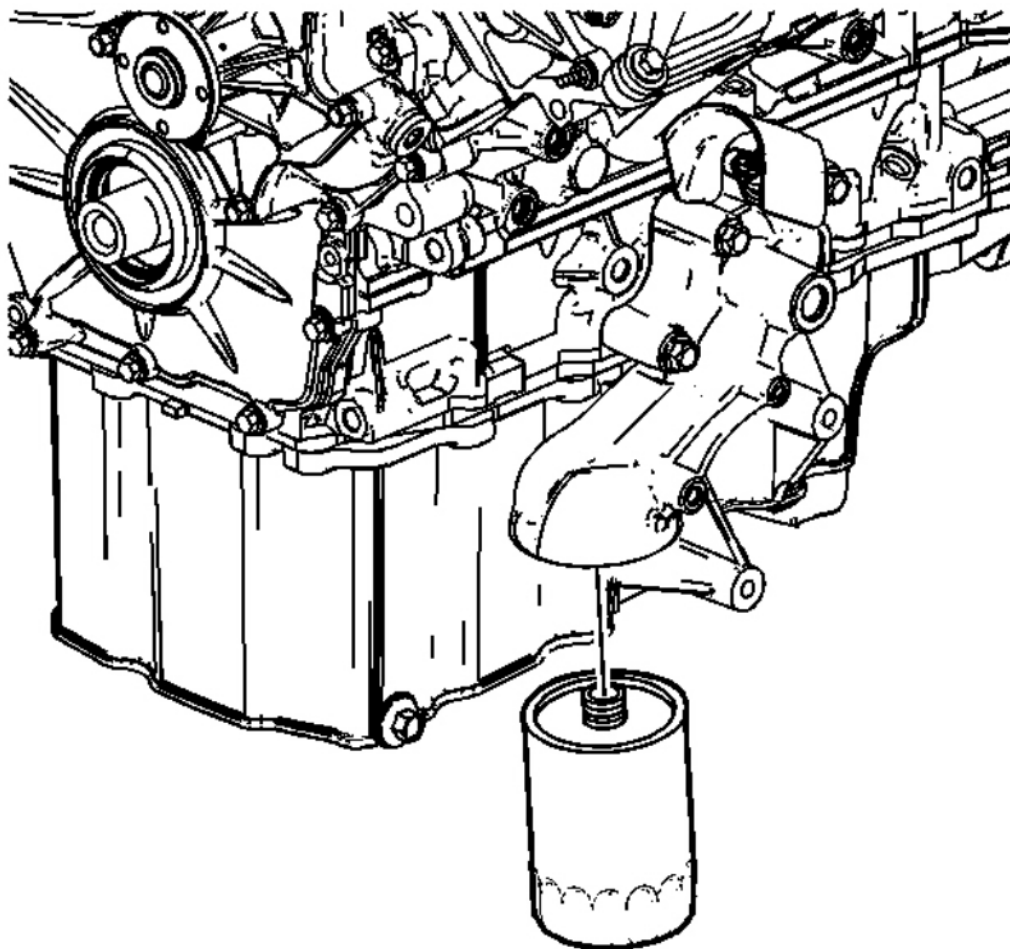


Fig. 149: View Of Oil Filter - w/o Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter.

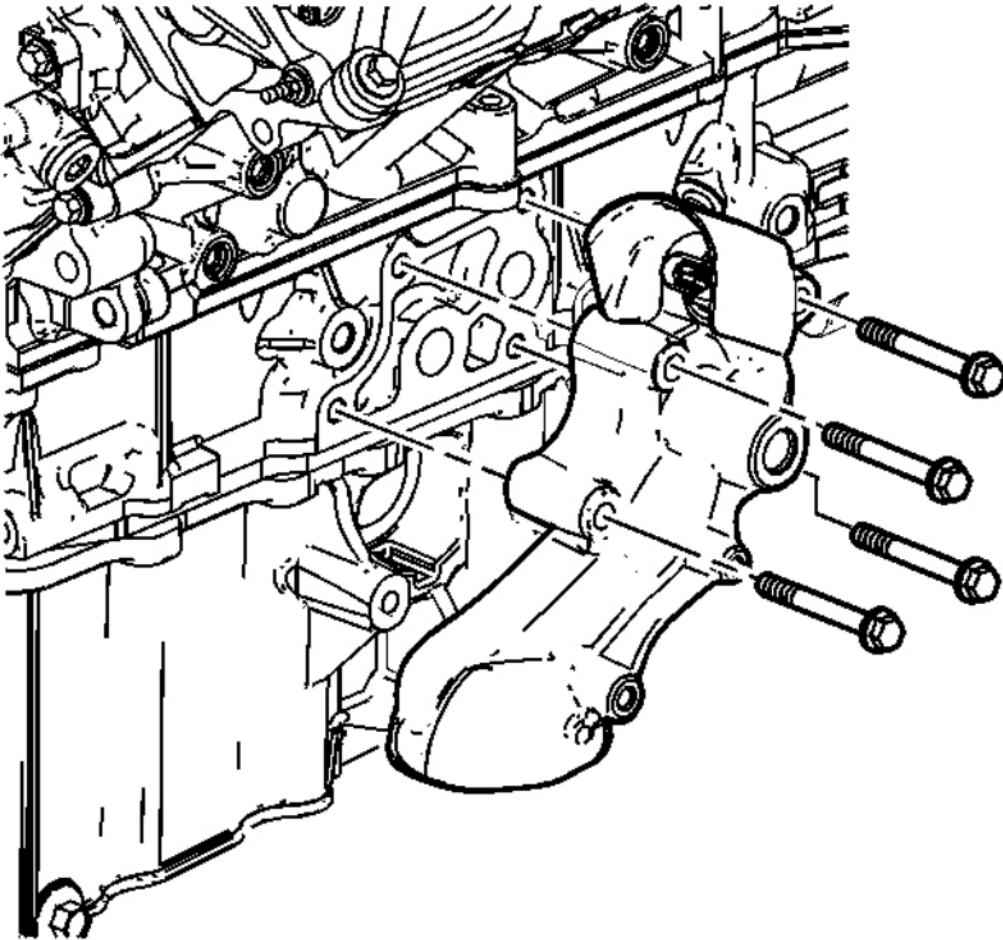


Fig. 150: View Of Oil Filter Adapter - w/o Oil Cooler
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filter adapter bolts.
3. Remove the oil filter adapter.
4. Remove and discard the oil filter adapter gasket.

OIL FILTER ADAPTER REMOVAL (WITH OIL COOLER)

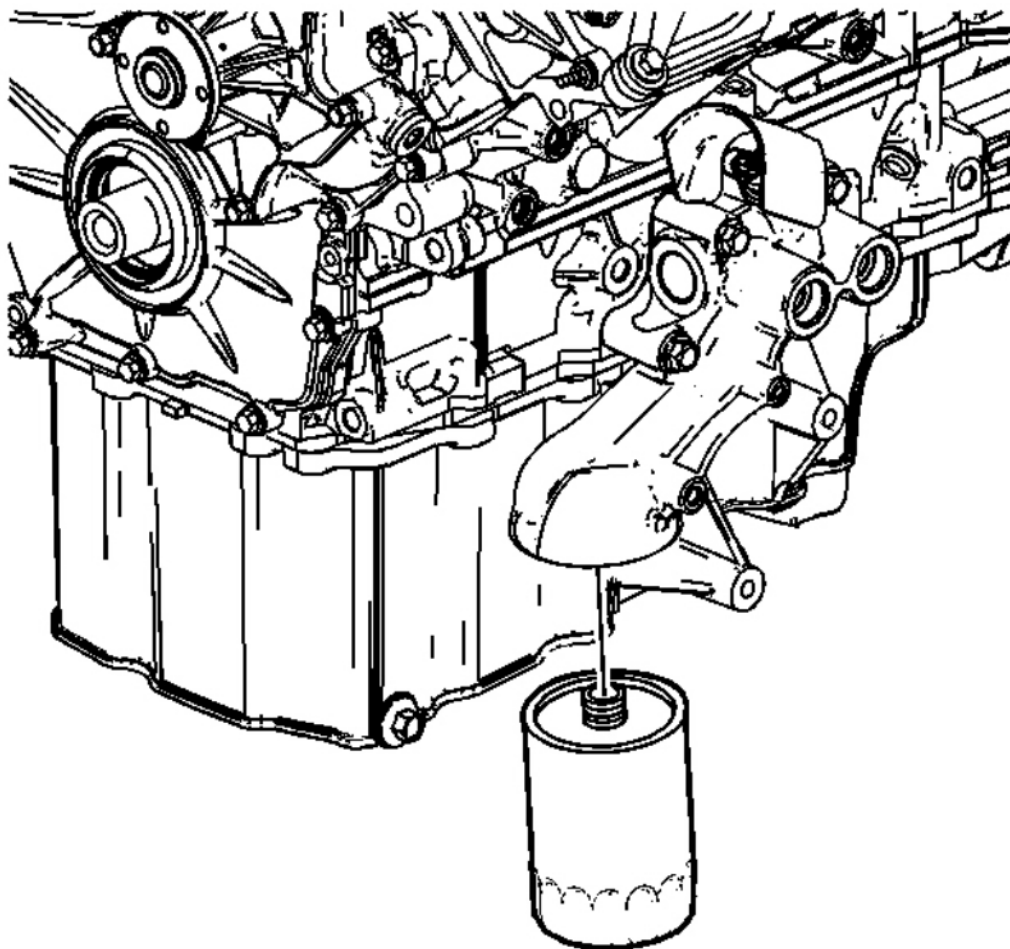


Fig. 151: View Of Oil Filter - Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter.

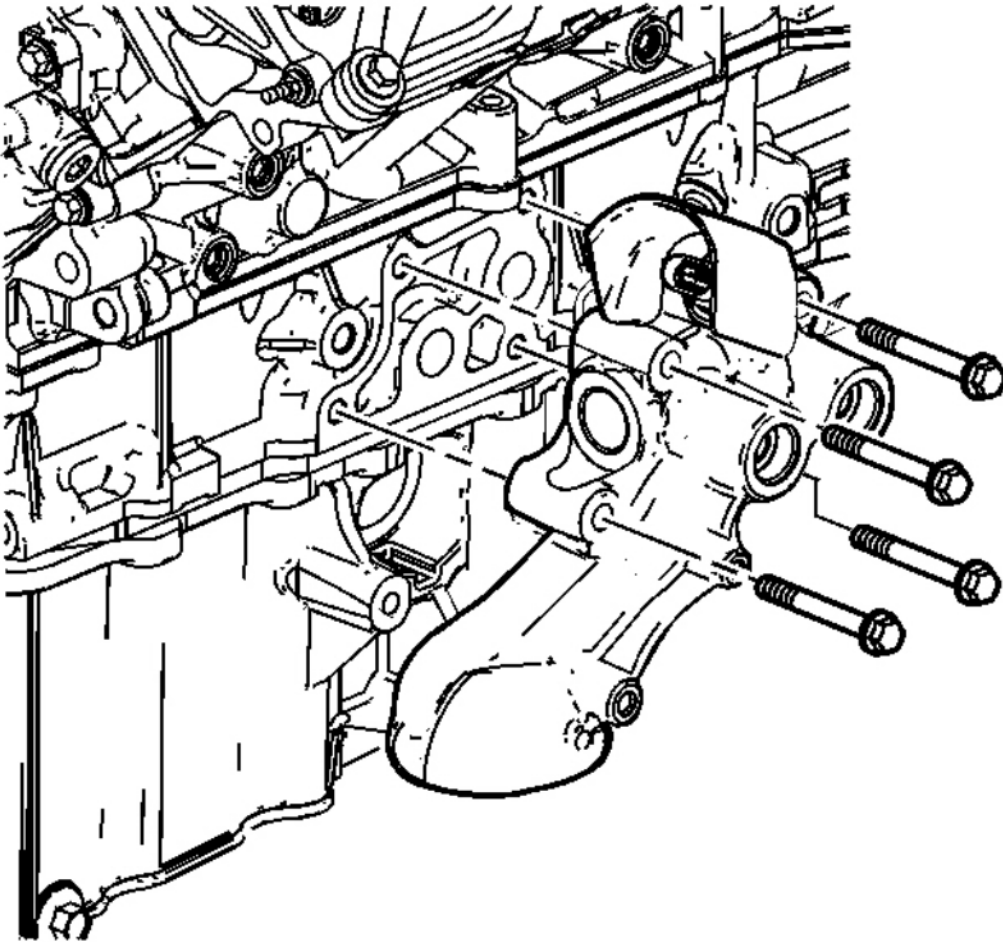


Fig. 152: View Of Oil Filter Adapter - Oil Cooler
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filter adapter bolts.
3. Remove the oil filter adapter.
4. Remove and discard the oil filter adapter gasket.

IGNITION MODULE REMOVAL - LEFT

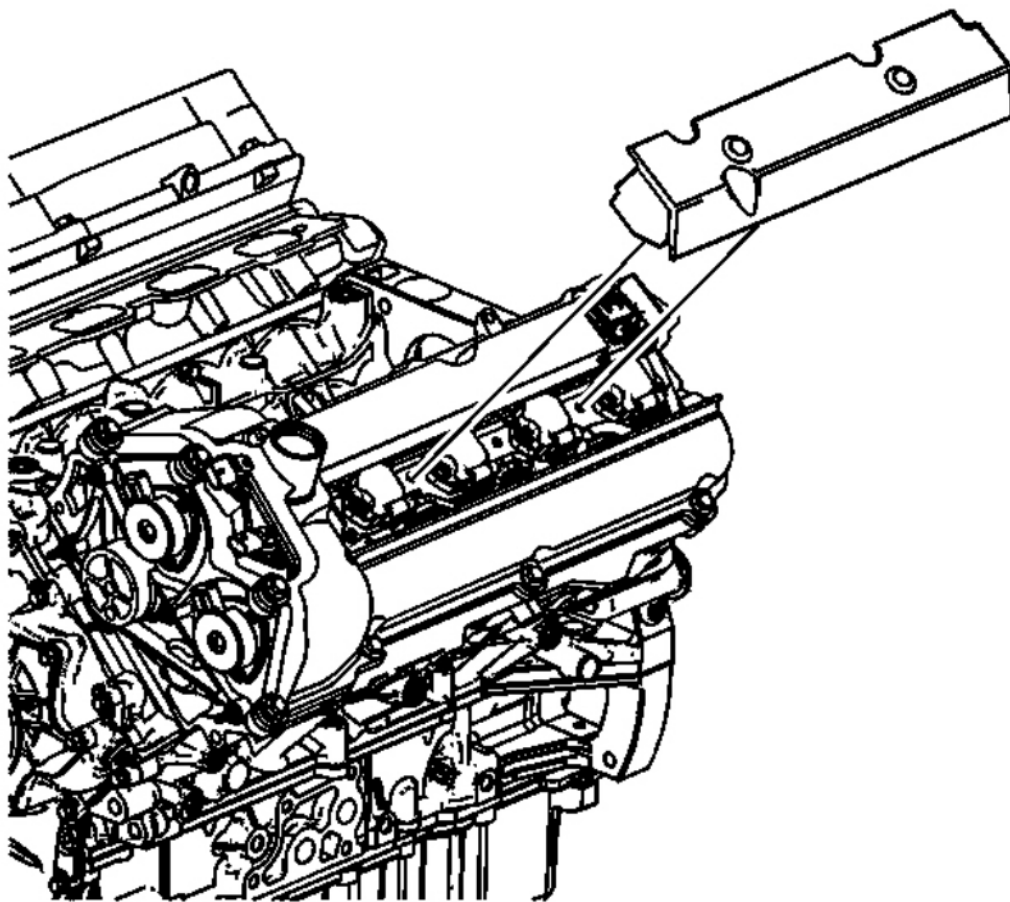


Fig. 153: View Of Left Ignition Coil Assembly Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the ignition coil assembly cover.

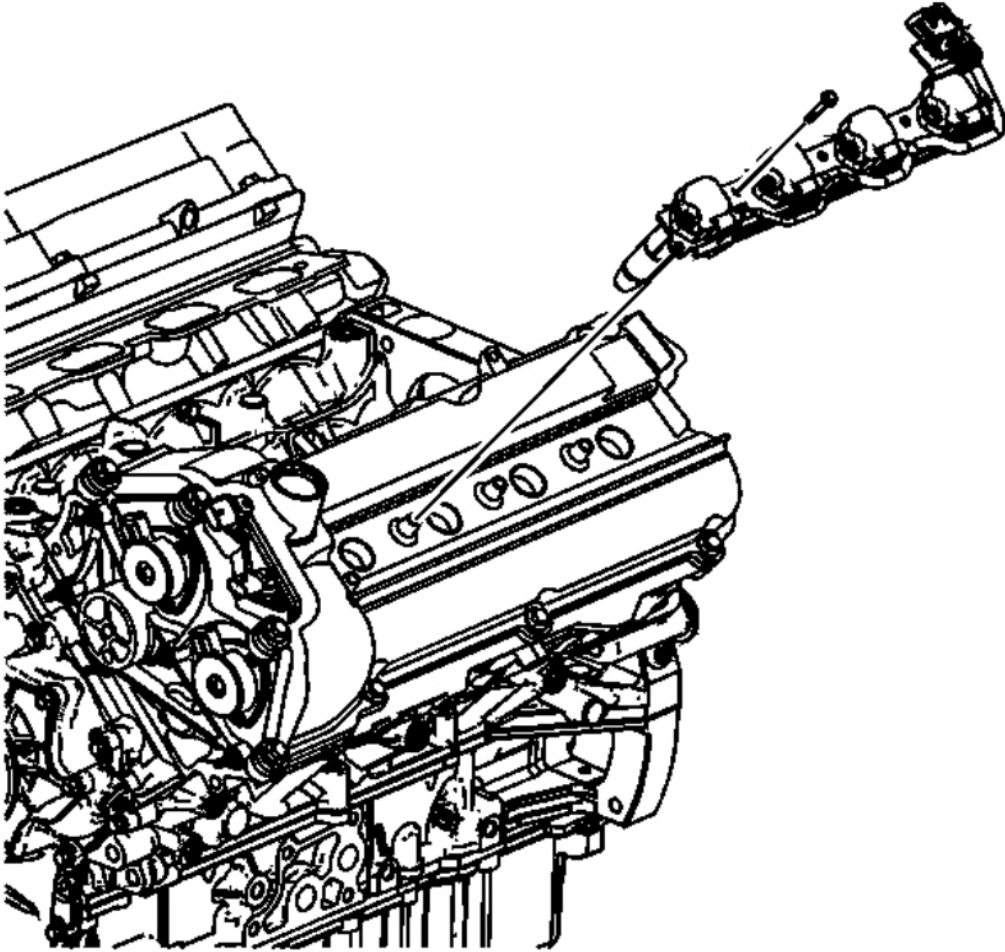


Fig. 154: View Of Left Ignition Coil Assembly, Bolts & Ball Studs
Courtesy of GENERAL MOTORS CORP.

2. Remove the ignition coil assembly bolts and ball studs.
3. Carefully, remove the ignition coil assembly.

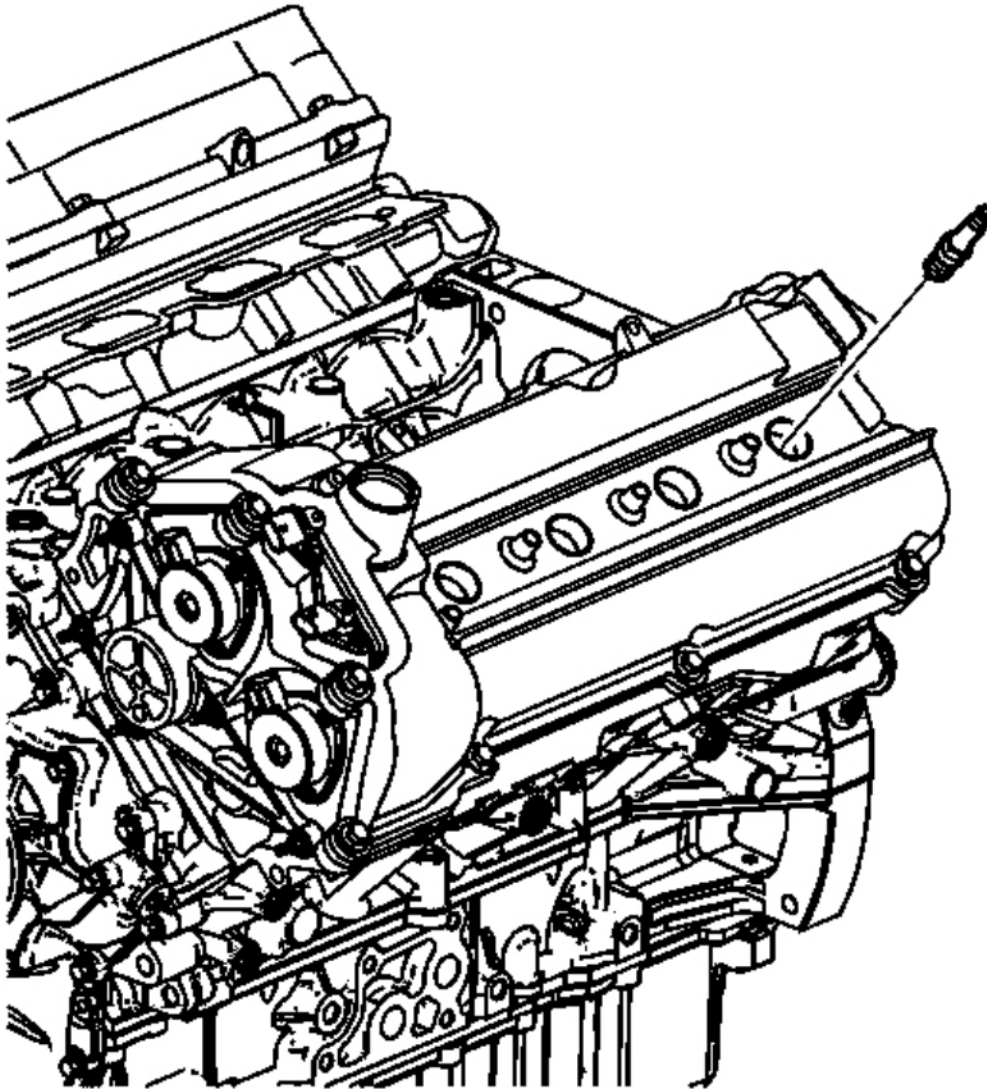


Fig. 155: View Of Left Spark Plugs
Courtesy of GENERAL MOTORS CORP.

4. Remove the spark plugs.

CAMSHAFT COVER REMOVAL - LEFT

Tools Required

- **J 39946** Crankshaft Socket - 4.0L and 4.6L
- **EN 46328** Camshaft Holding Tool

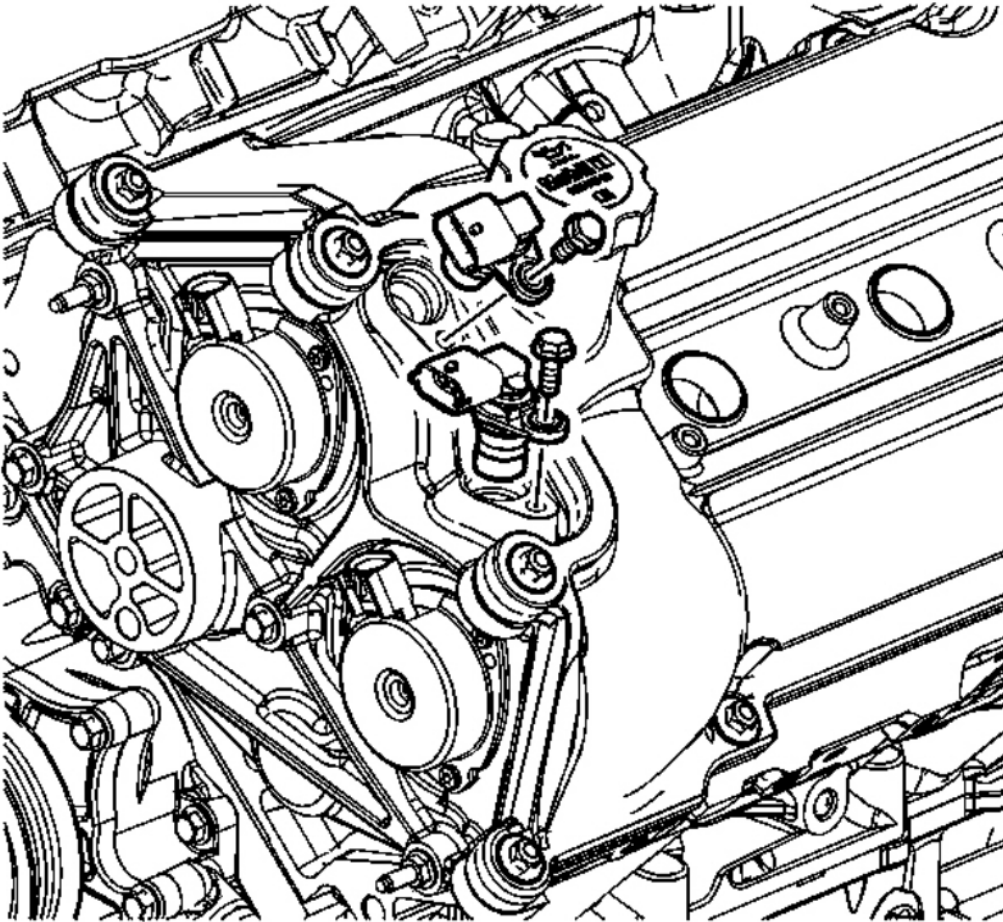


Fig. 156: View Of Left Intake Camshaft Sensor & Left Exhaust Camshaft Sensor
Courtesy of GENERAL MOTORS CORP.

1. Loosen the left camshaft position sensor bolts.
2. Remove the left camshaft position sensors.

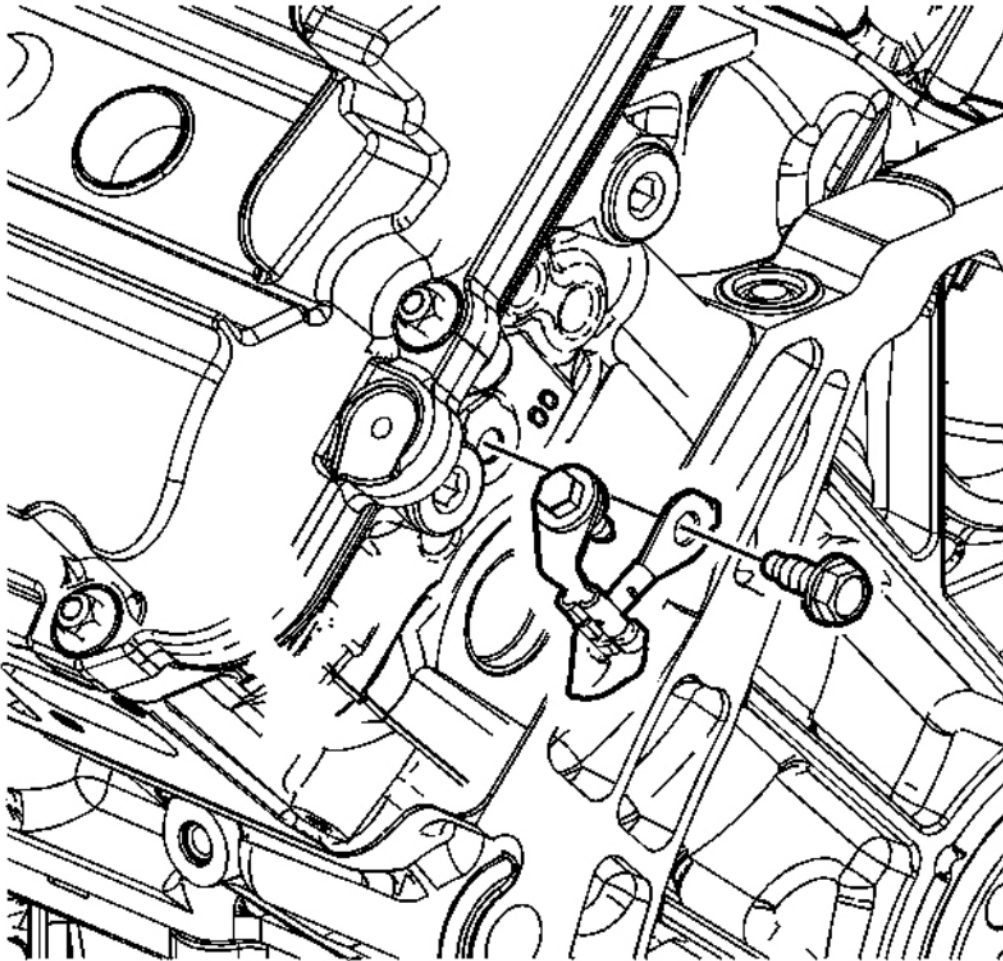


Fig. 157: View Of Left Camshaft Cover Ground Strap & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts connecting the left camshaft cover ground strap to the left cylinder head and to the left camshaft cover.
4. Remove the left camshaft cover ground strap.

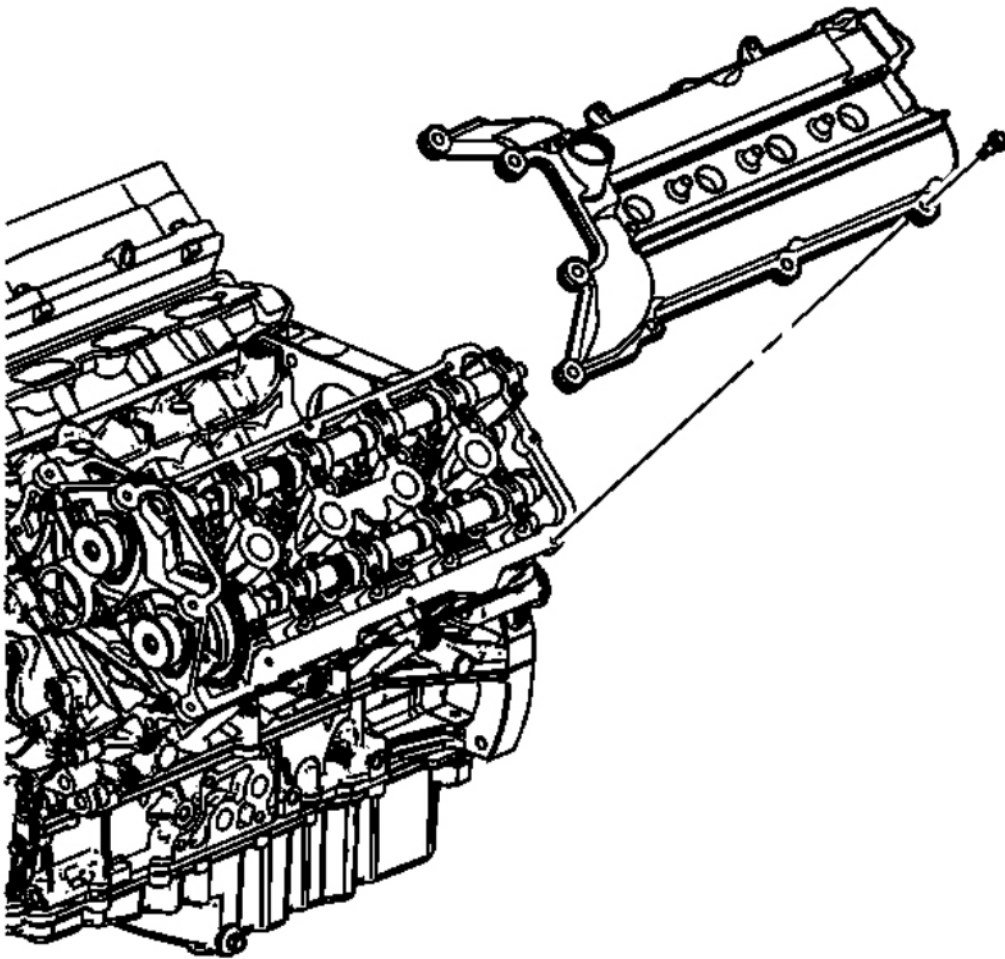


Fig. 158: View Of Left Camshaft Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Loosen the left camshaft cover bolts.
6. Remove the left camshaft cover.
7. Use the **J 39946** on the nose of the crankshaft in order to align and install the **EN 46328** on the rear of the left cylinder head camshafts.

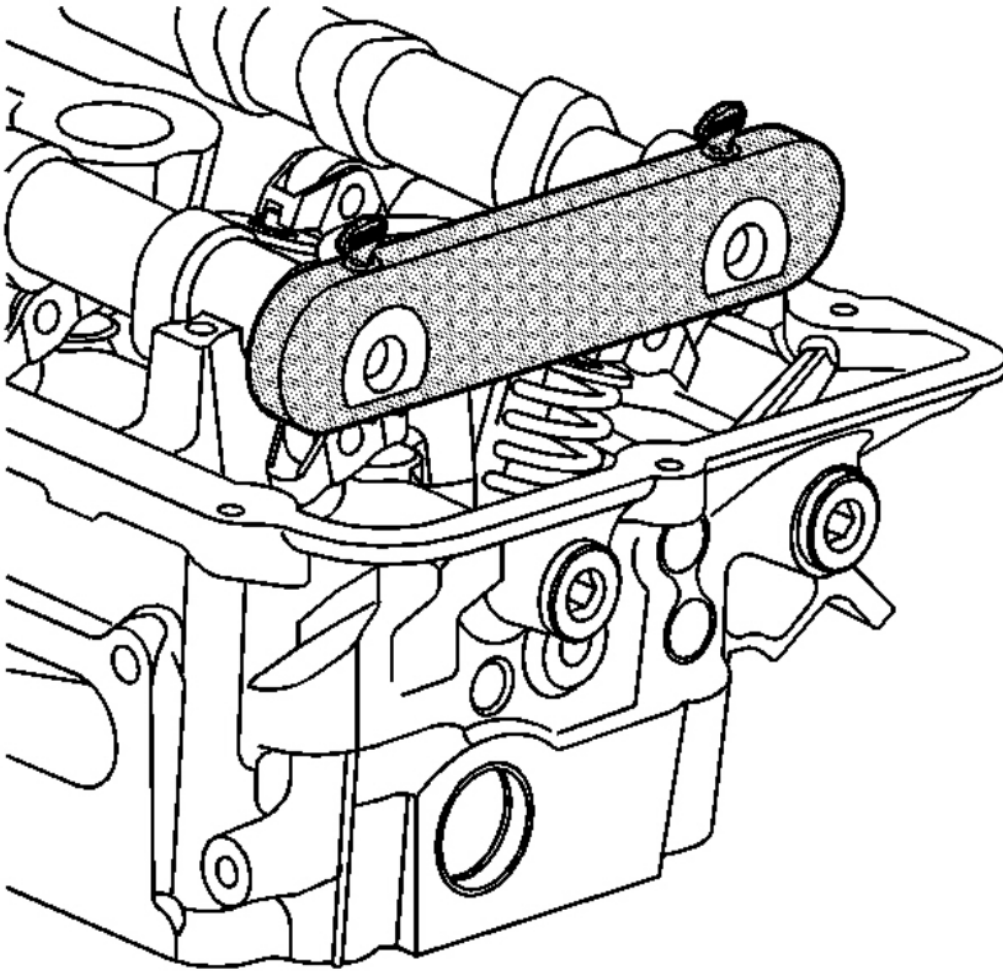


Fig. 159: Installing EN 46328 On Left Cylinder Head Camshafts
Courtesy of GENERAL MOTORS CORP.

CAUTION: The camshaft holding tools must be installed on the camshafts to prevent camshaft rotation. When performing service to the valve train and/or timing components, valve spring pressure can cause the camshafts to rotate unexpectedly and can cause personal injury.

8. Install the **EN 46328** on the left cylinder head camshafts.

CAMSHAFT POSITION (CMP) ACTUATOR HOUSING REMOVAL - LEFT

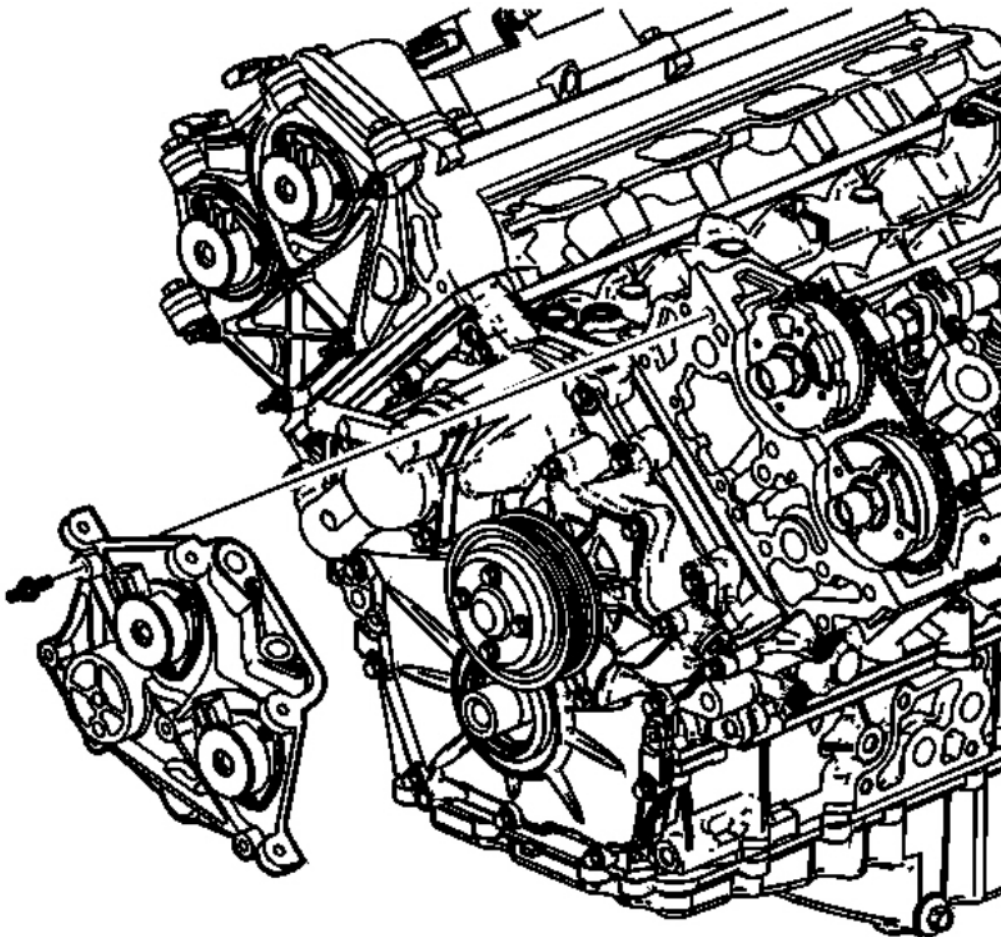


Fig. 160: View Of Left CMP Actuator Housing Removal
Courtesy of GENERAL MOTORS CORP.

NOTE: DO NOT remove the camshaft position actuator magnet unless it needs to be replaced. The camshaft position actuator magnet is precisely aligned to the camshaft position actuator oil control valve on the end of the camshaft during engine assembly. If the camshaft position actuator magnet is removed and/or needs to be replaced, it will be necessary to realign the

camshaft position actuator magnet to the camshaft position actuator oil control valve after the camshaft position actuator housing is installed to the cylinder head. Failure to realign the camshaft position actuator magnet to the camshaft position actuator oil control valve can lead to poor engine performance and engine component damage.

1. Remove the left camshaft position actuator housing bolts.
2. Remove the left camshaft position actuator housing.

IGNITION MODULE REMOVAL - RIGHT

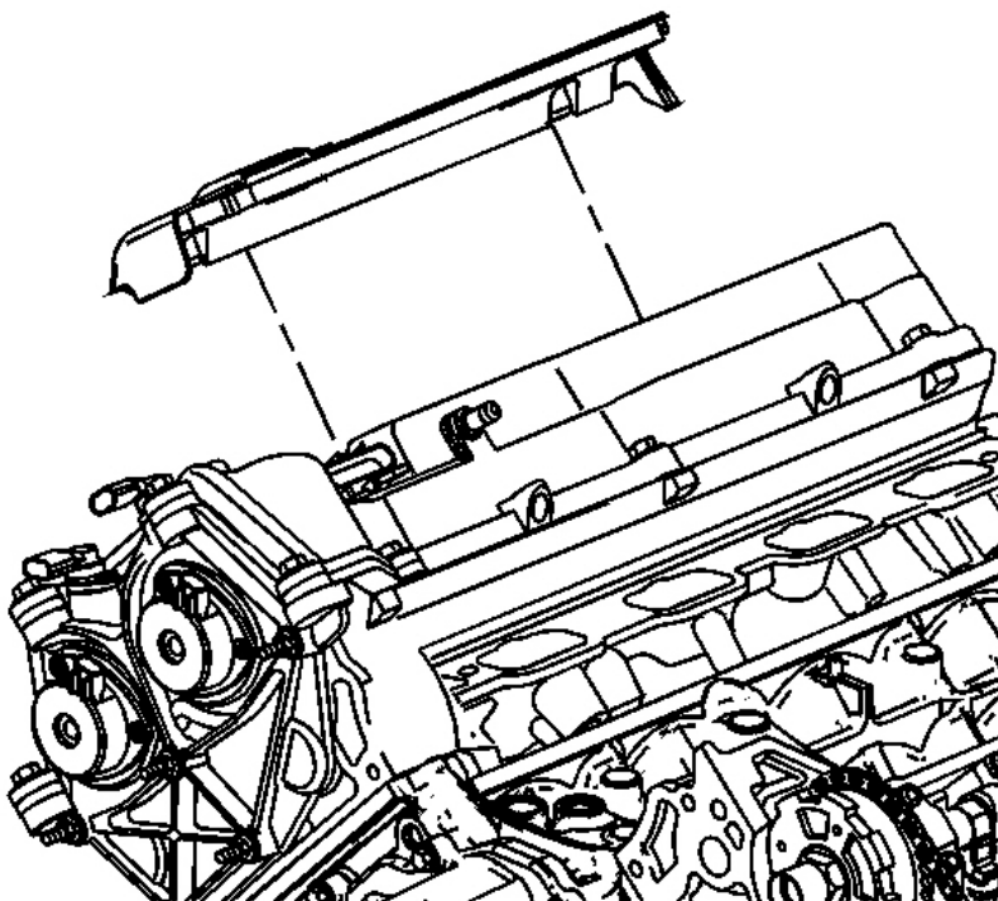


Fig. 161: View Of Ignition Coil Assembly Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the ignition coil assembly cover.

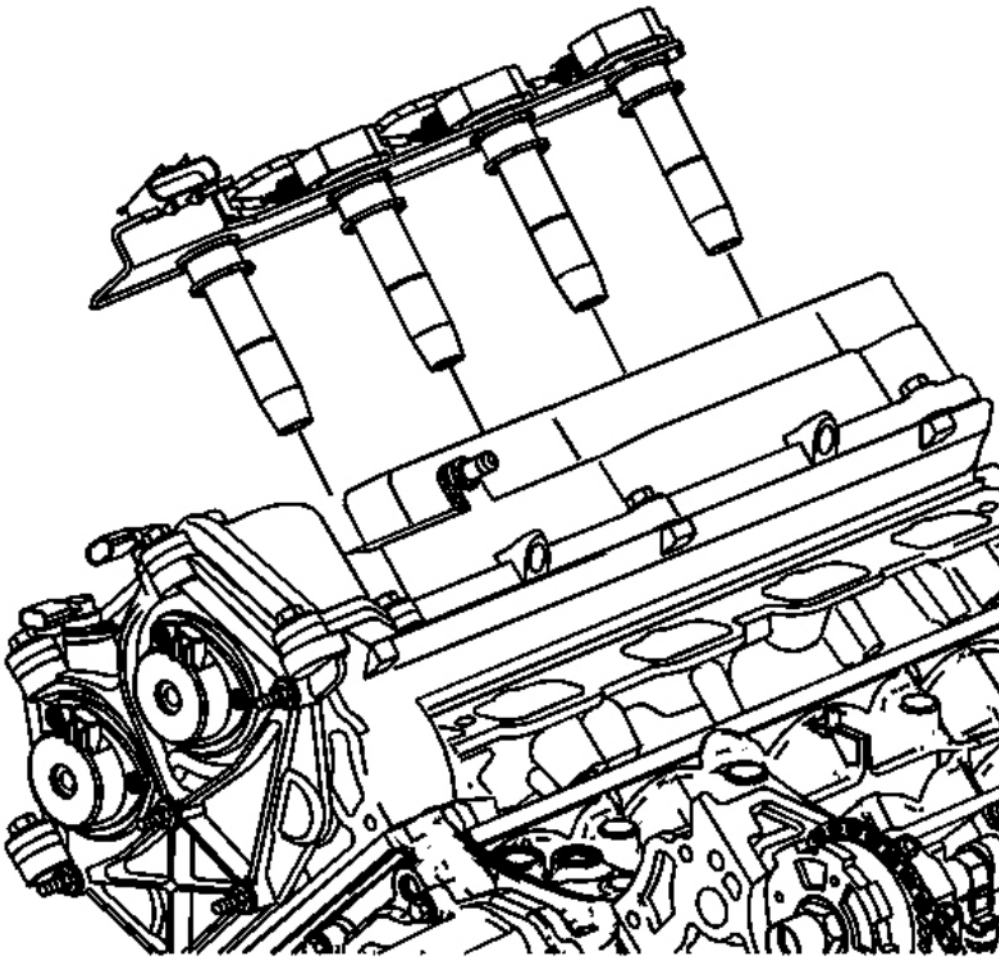


Fig. 162: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

2. Remove the ignition coil assembly bolts and ball studs.
3. Carefully, remove the ignition coil assembly.

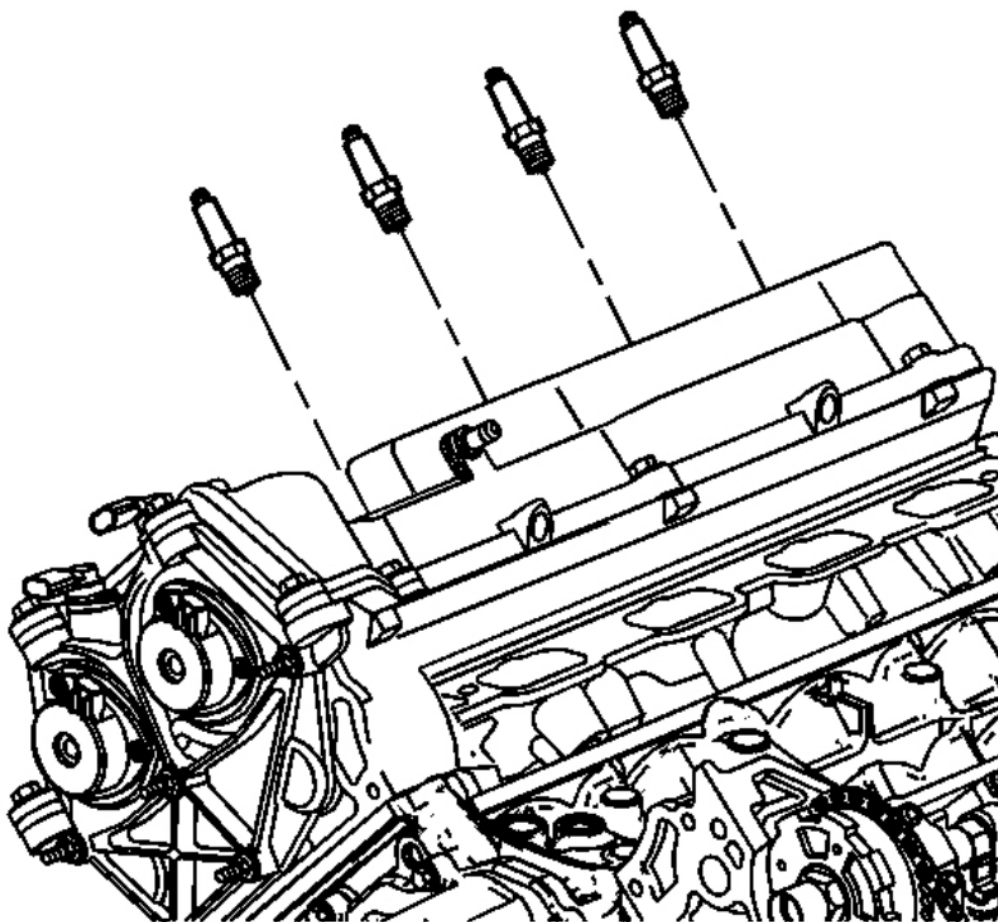


Fig. 163: View Of Right Spark Plugs
Courtesy of GENERAL MOTORS CORP.

4. Remove the spark plugs.

CAMSHAFT COVER REMOVAL - RIGHT

Tools Required:

EN 46328 Camshaft Holding Tool

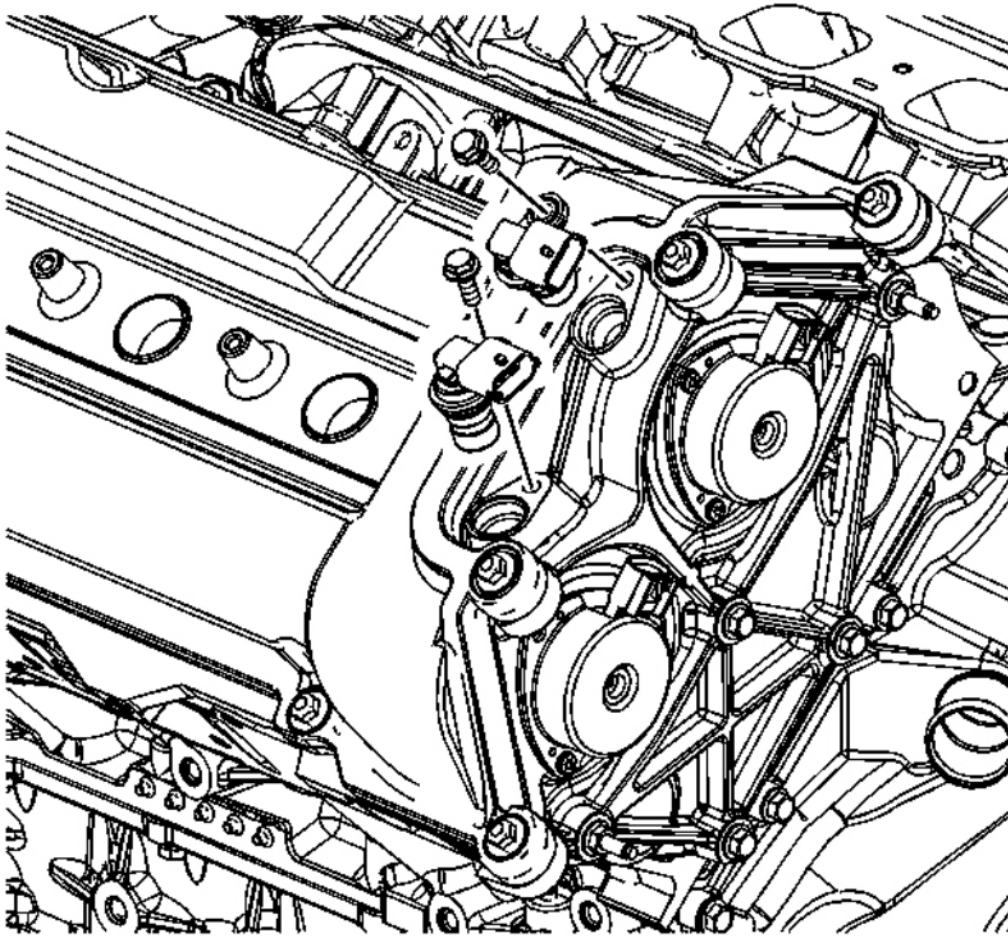


Fig. 164: View Of Right Intake Camshaft Sensor & Right Exhaust Camshaft Sensor
Courtesy of GENERAL MOTORS CORP.

1. Loosen the right camshaft position sensor bolts.
2. Remove the right camshaft position sensors.

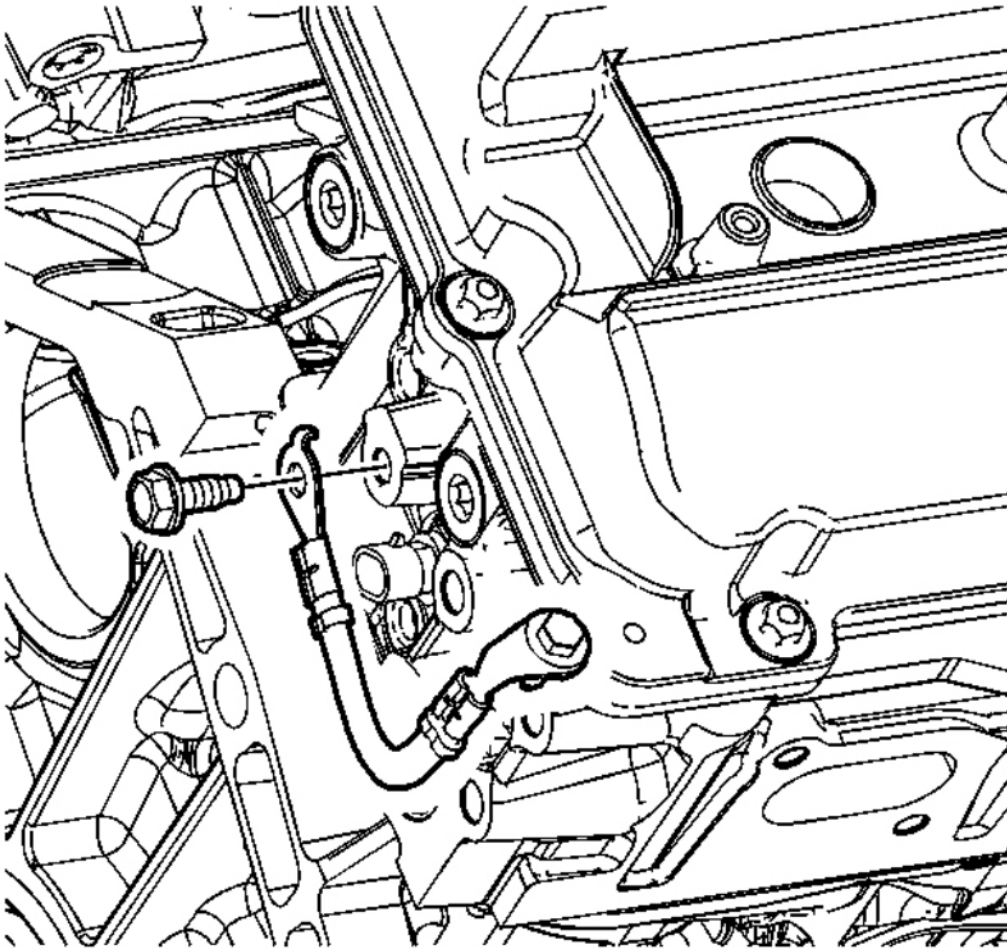


Fig. 165: View Of Ground Strap, Right Camshaft Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts connecting the right camshaft cover ground strap to the right cylinder head and to the right camshaft cover.
4. Remove the right camshaft cover ground strap.

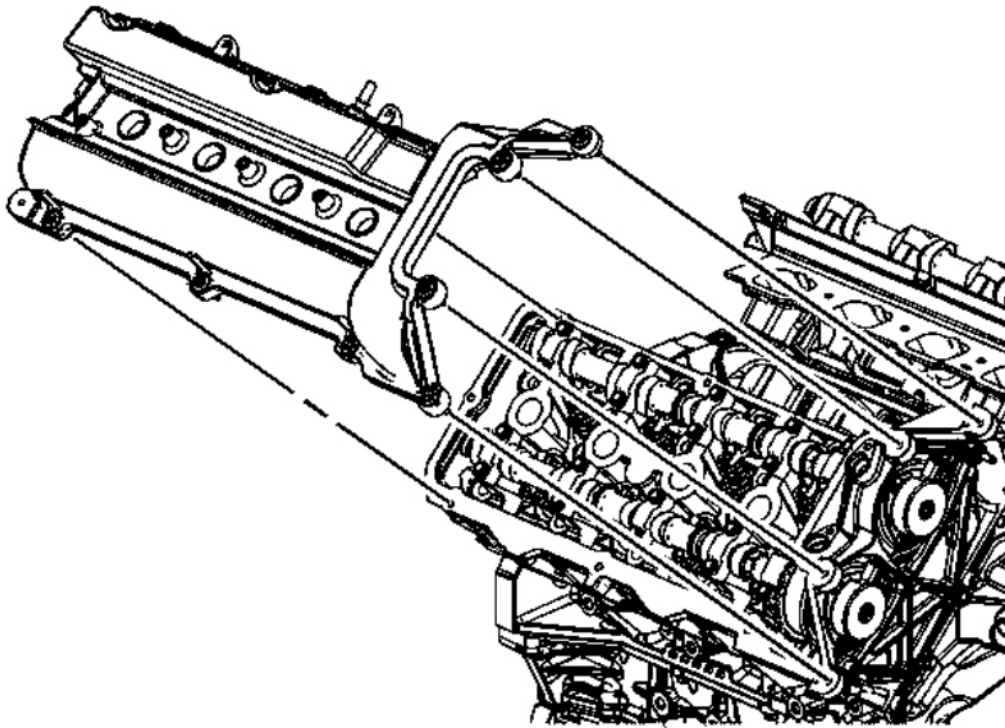


Fig. 166: View Of Right Camshaft Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Loosen the right camshaft cover bolts.
6. Remove the right camshaft cover.

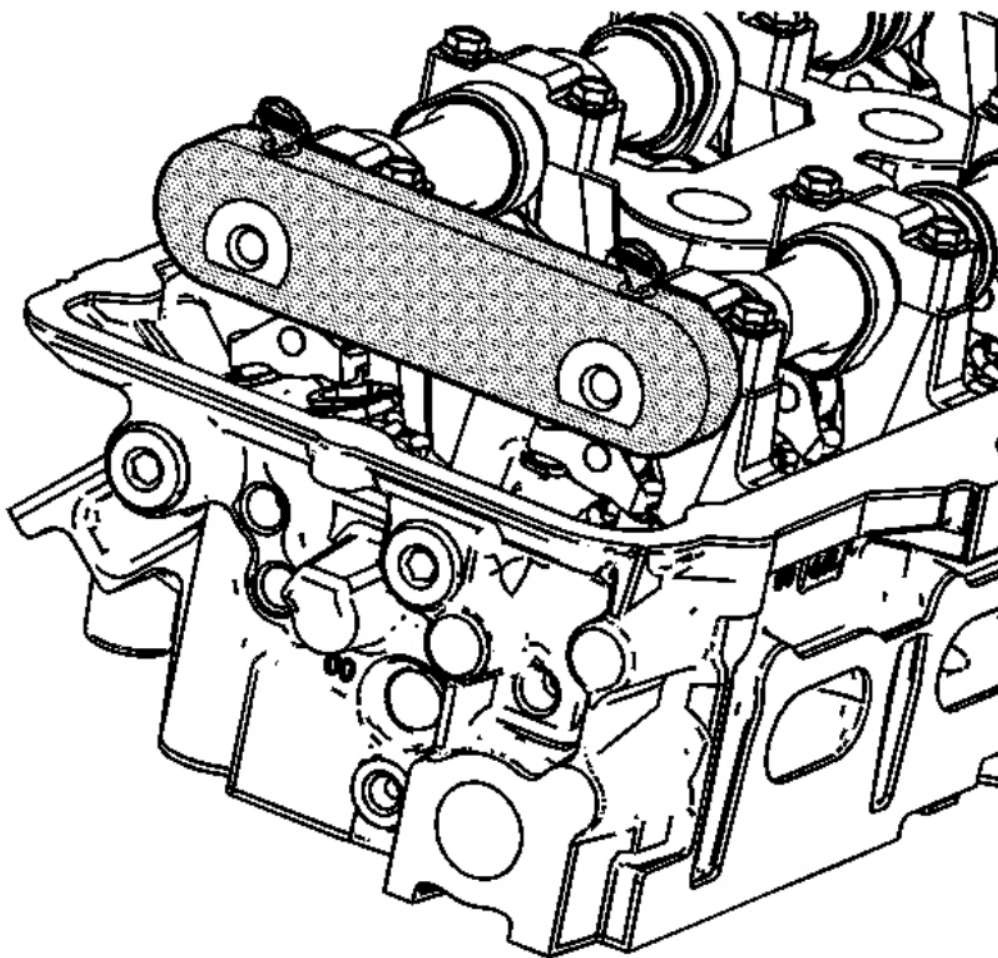


Fig. 167: Installing EN 46328 On Right Cylinder Head Camshafts
Courtesy of GENERAL MOTORS CORP.

CAUTION: The camshaft holding tools must be installed on the camshafts to prevent camshaft rotation. When performing service to the valve train and/or timing components, valve spring pressure can cause the camshafts to rotate unexpectedly and can cause personal injury.

7. Install the **EN 46328** on the right cylinder head camshafts.

CAMSHAFT POSITION (CMP) ACTUATOR HOUSING REMOVAL - RIGHT

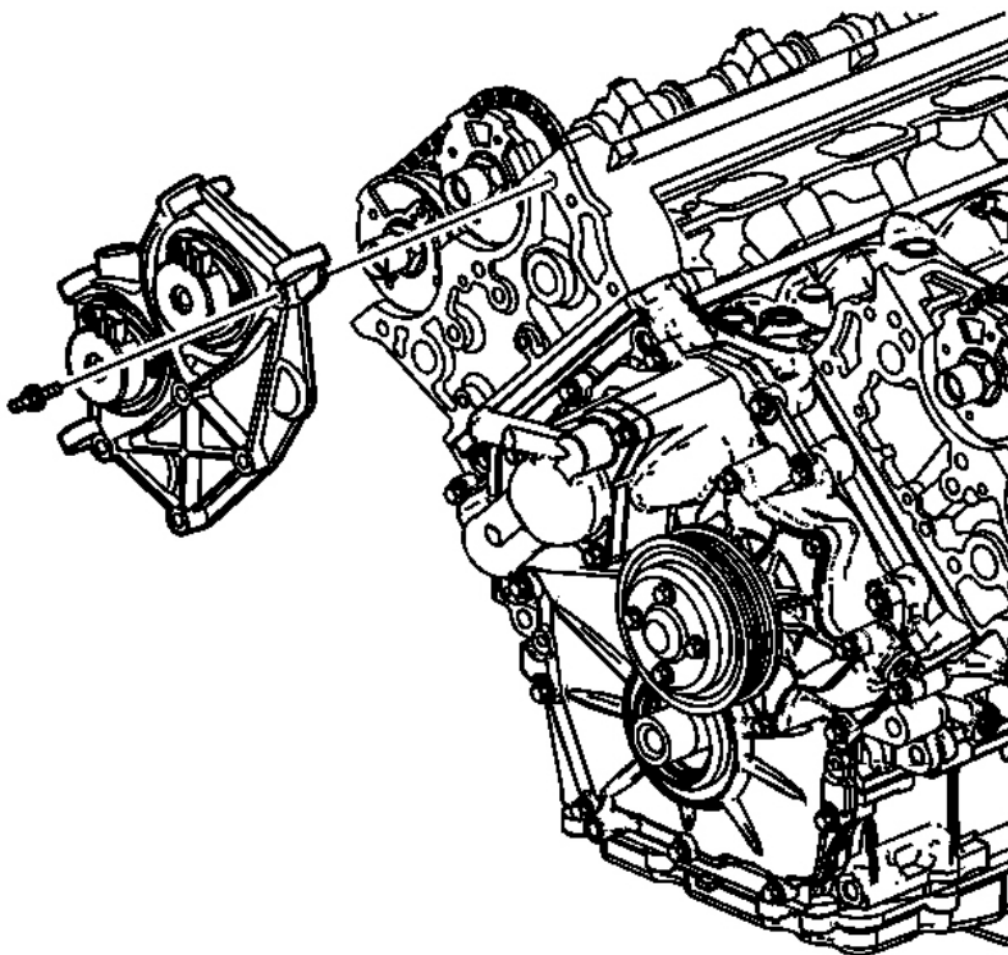


Fig. 168: View Of Right Camshaft Position Actuator Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: DO NOT remove the camshaft position actuator magnet unless it needs to be replaced. The camshaft position actuator magnet is precisely aligned to the camshaft position actuator oil control valve on the end of the camshaft during engine assembly. If the camshaft position actuator magnet is removed and/or needs to be replaced, it will be necessary to realign the

camshaft position actuator magnet to the camshaft position actuator oil control valve after the camshaft position actuator housing is installed to the cylinder head. Failure to realign the camshaft position actuator magnet to the camshaft position actuator oil control valve can lead to poor engine performance and engine component damage.

1. Remove the right camshaft position actuator housing bolts.
2. Remove the right camshaft position actuator housing.

ENGINE FRONT COVER REMOVAL

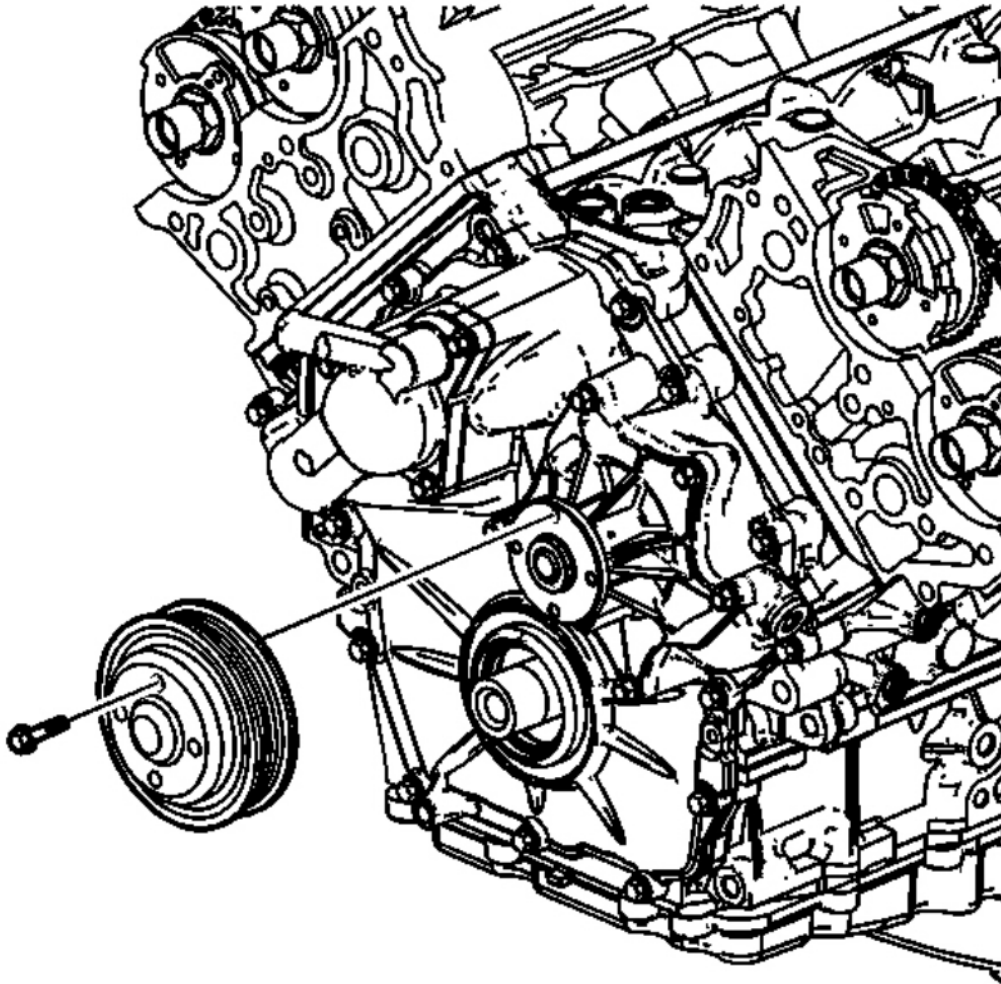


Fig. 169: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

1. Remove the water pump pulley.

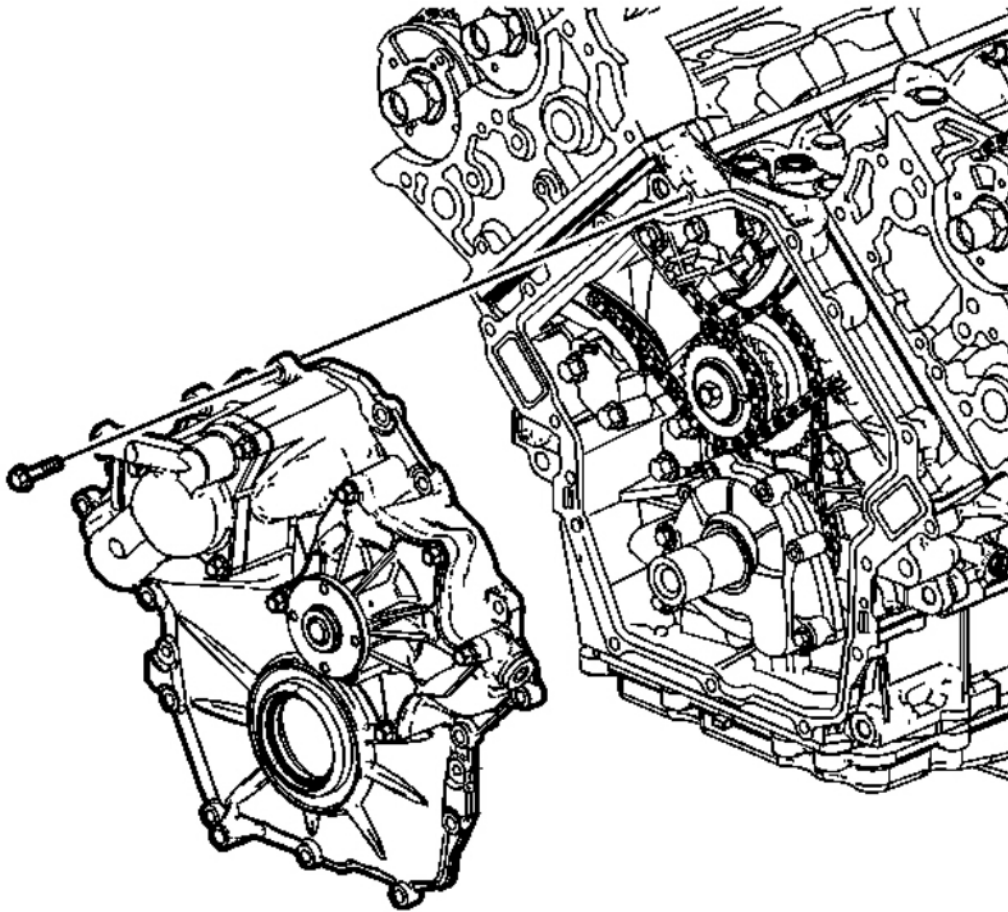


Fig. 170: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine front cover bolts.
3. Remove the engine front cover.

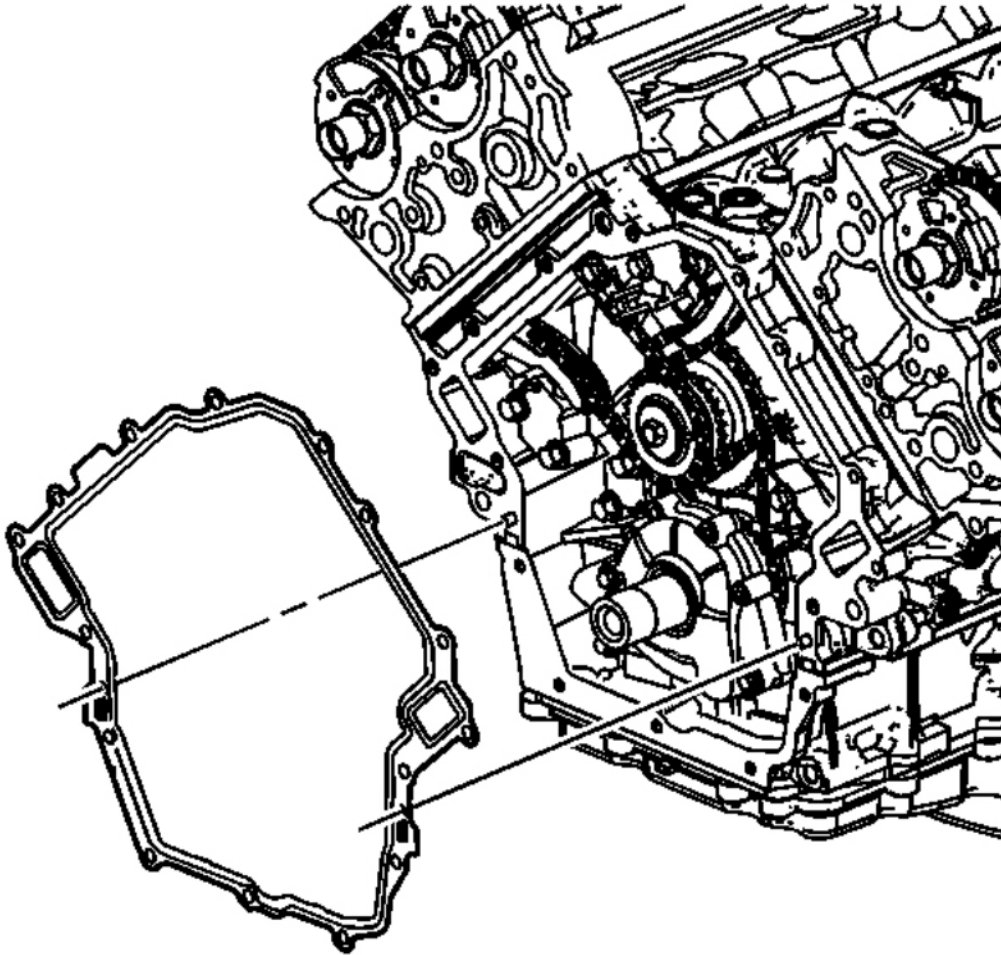


Fig. 171: View Of Engine Front Cover Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the engine front cover gasket.

OIL PUMP REMOVAL

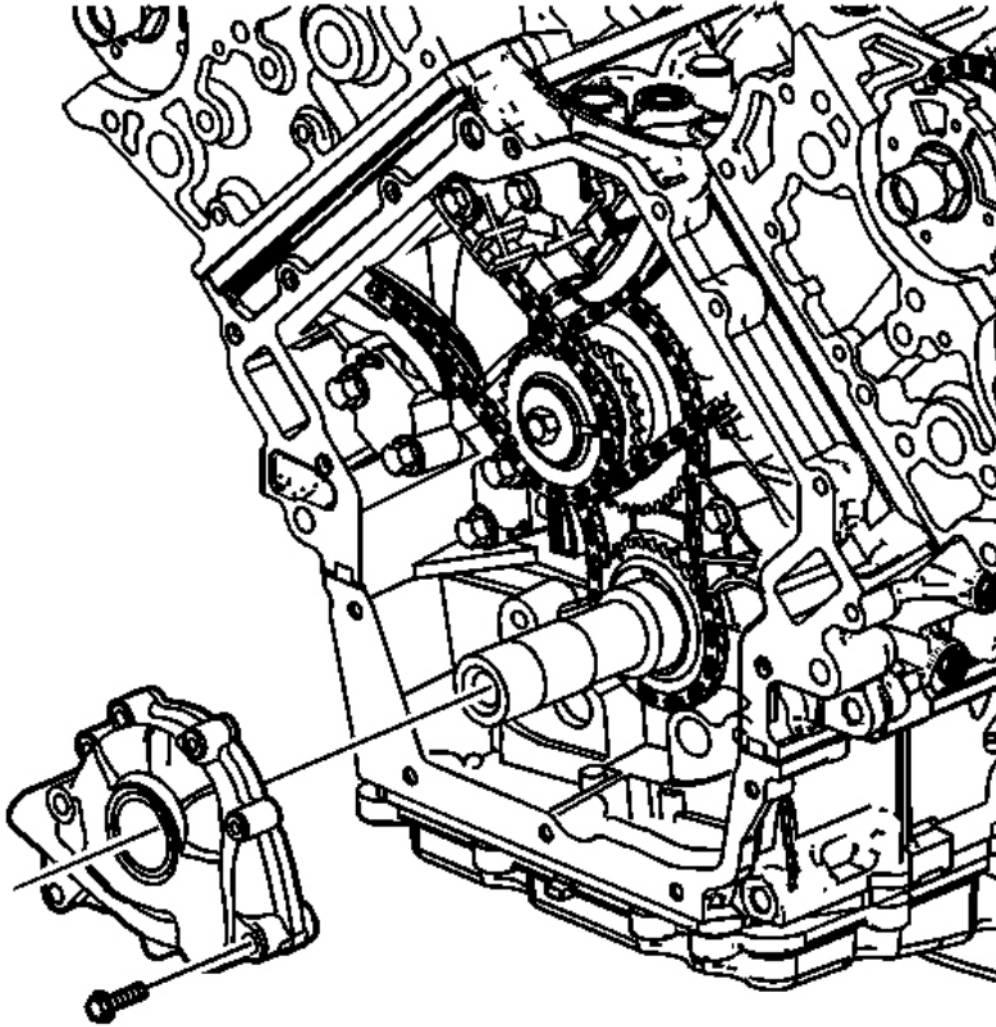


Fig. 172: View Of Oil Pump

Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump bolts.
2. Remove the oil pump.

SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT

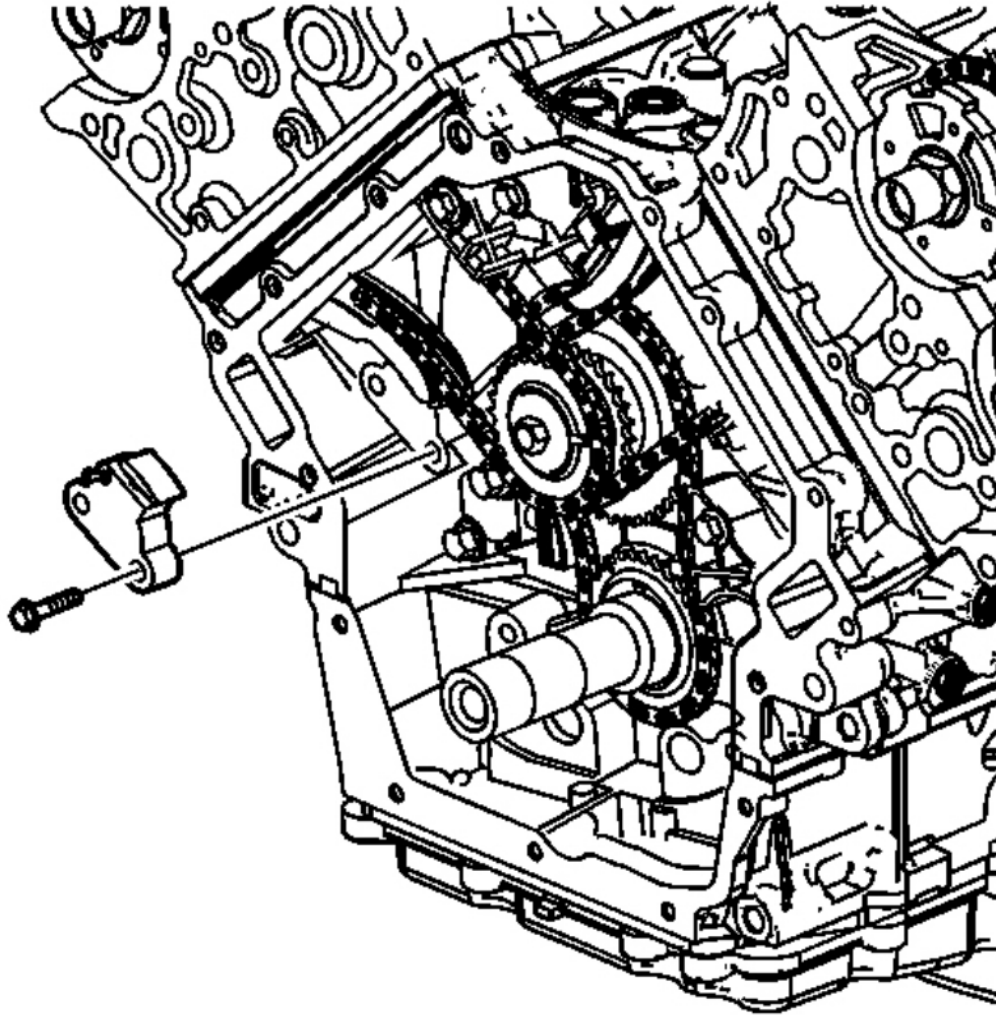


Fig. 173: View Of Right Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the right secondary camshaft drive chain tensioner.

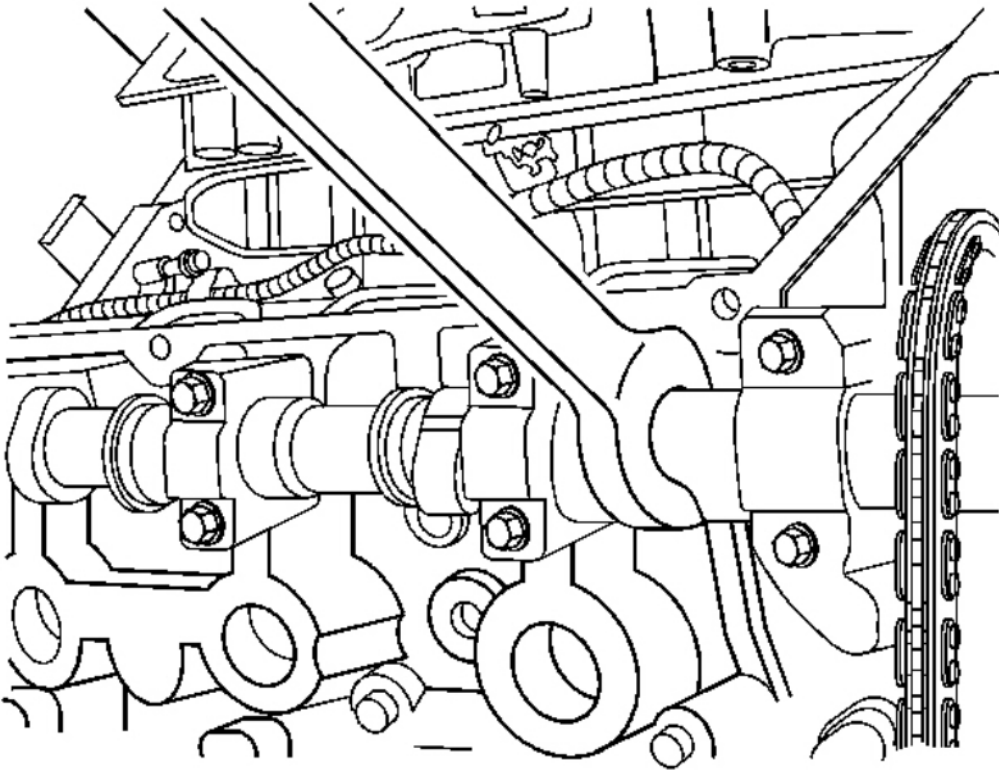


Fig. 174: Holding Camshaft In Position
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

2. Use an open end wrench on the hex cast into the right intake camshaft, in order to prevent the camshaft from rotating, when loosening the camshaft position actuator oil control valve on the right intake camshaft.

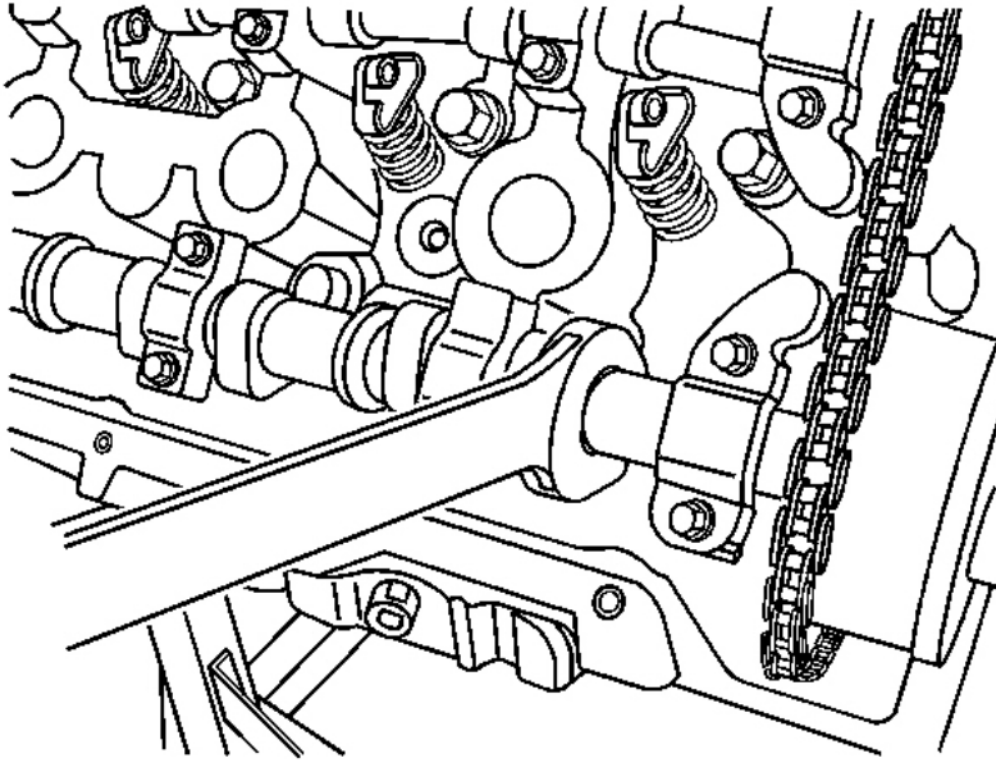


Fig. 175: Preventing Camshaft Rotation
Courtesy of GENERAL MOTORS CORP.

3. Use an open end wrench on the hex cast into the right exhaust camshaft, in order to prevent the camshaft from rotating, when loosening the camshaft position actuator oil control valve on the right exhaust camshaft.

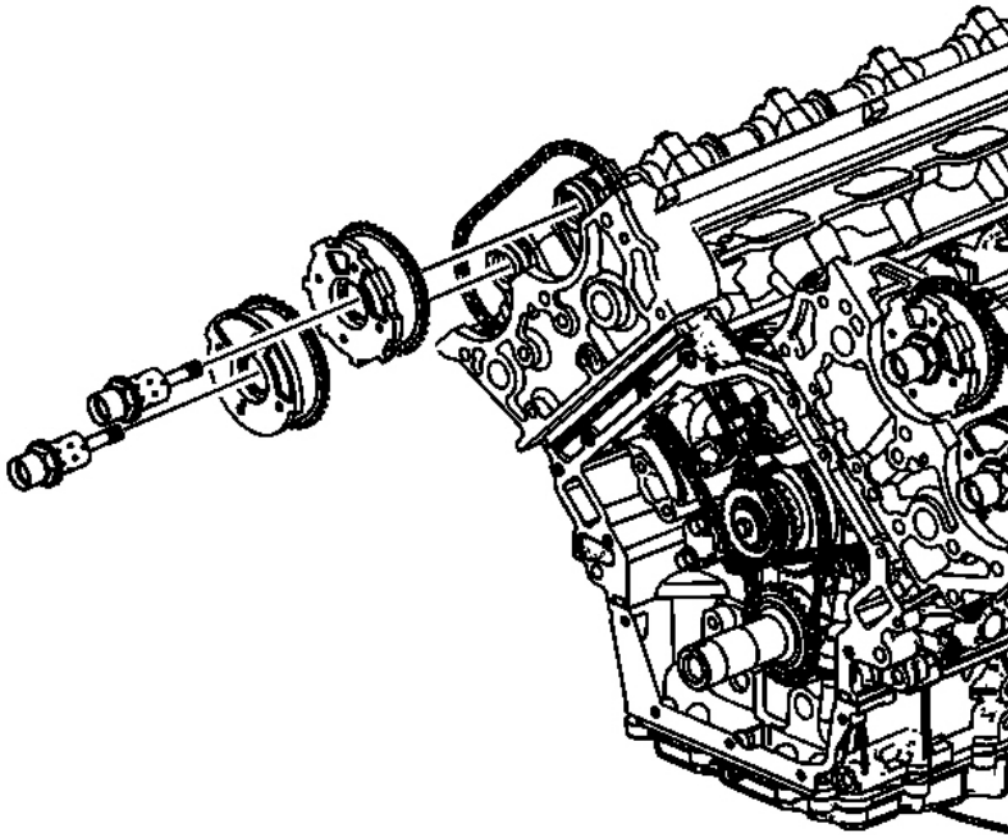


Fig. 176: View Of Right Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

4. Remove the right camshaft position actuator oil control valves from the right side camshafts.
5. Slide the right camshaft position actuators off the right side camshafts.

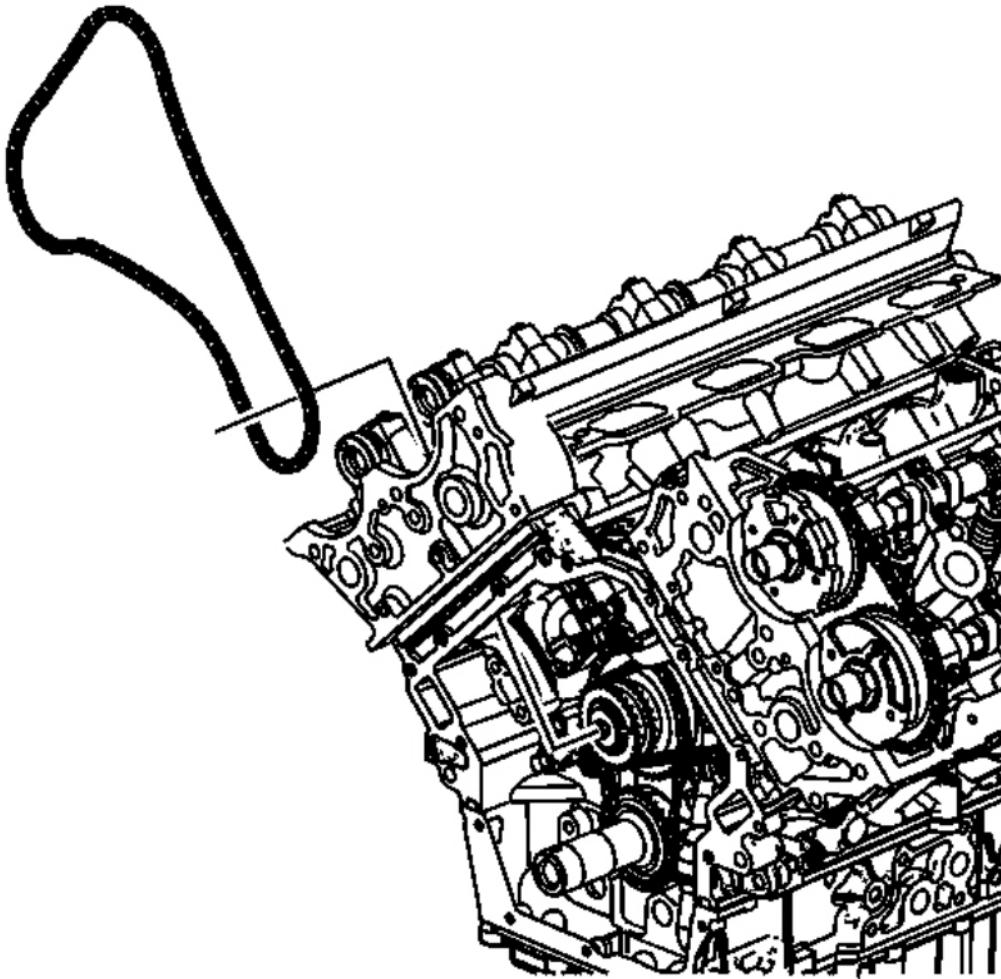


Fig. 177: View Of Right Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

6. Remove the right secondary camshaft drive chain from the outer camshaft intermediate drive shaft sprocket teeth.
7. Remove the right secondary camshaft drive chain from the engine.

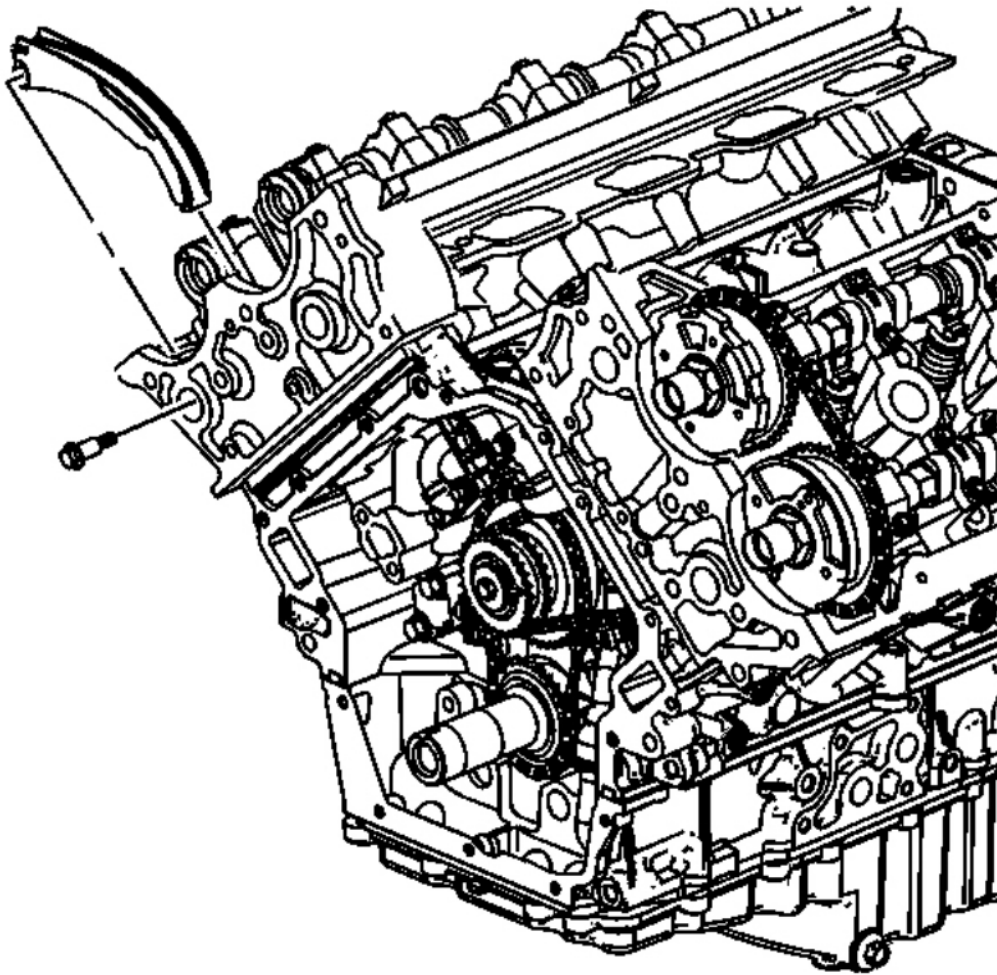


Fig. 178: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

8. Remove the right secondary camshaft drive chain shoe bolt.
9. Remove the right secondary camshaft drive chain shoe.

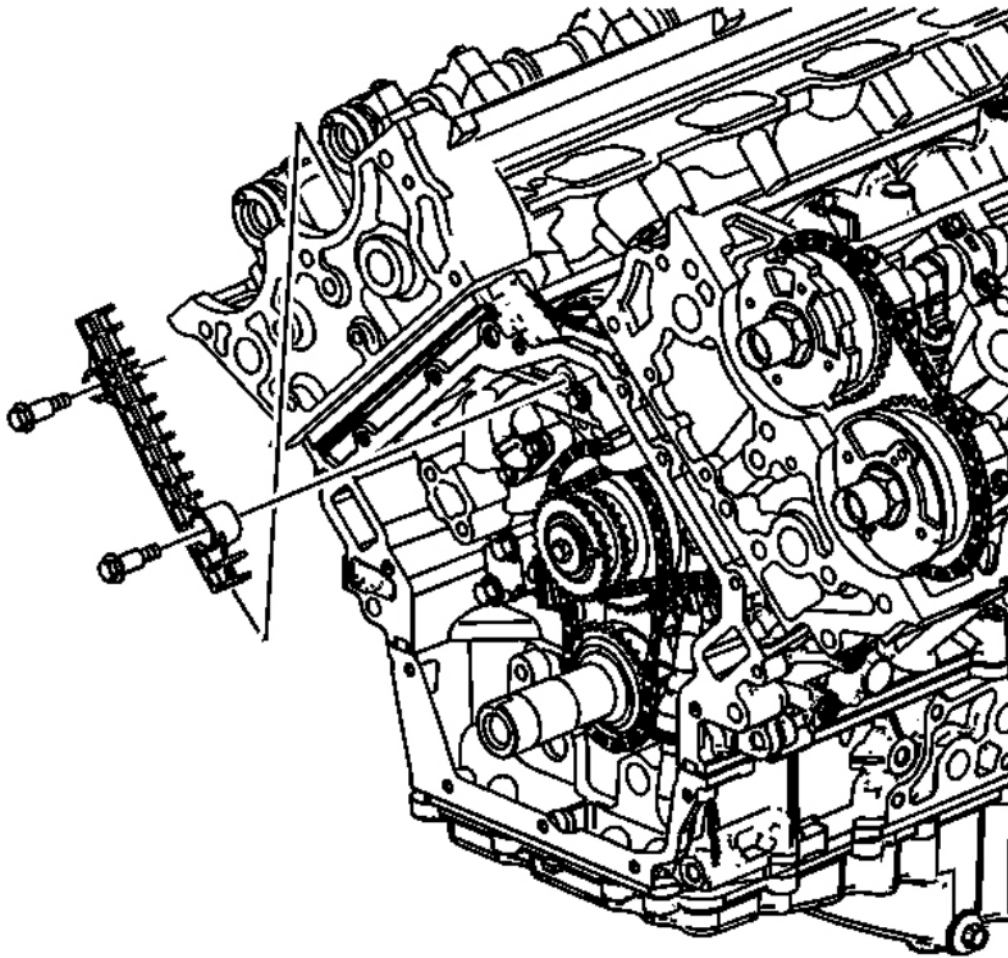


Fig. 179: View Of Right Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

10. Remove the right secondary camshaft drive chain guide bolt.
11. Remove the right secondary camshaft drive chain guide.

SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT

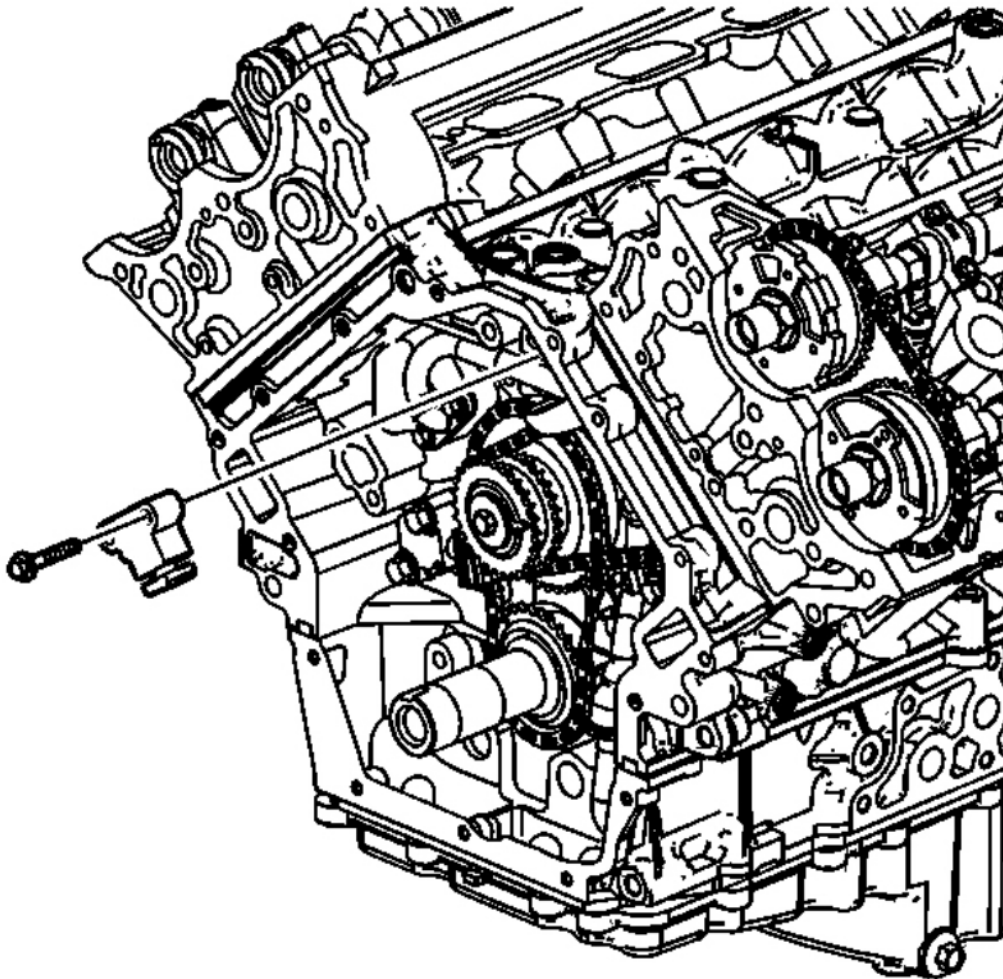


Fig. 180: View Of Left Secondary Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the left secondary camshaft drive chain tensioner.

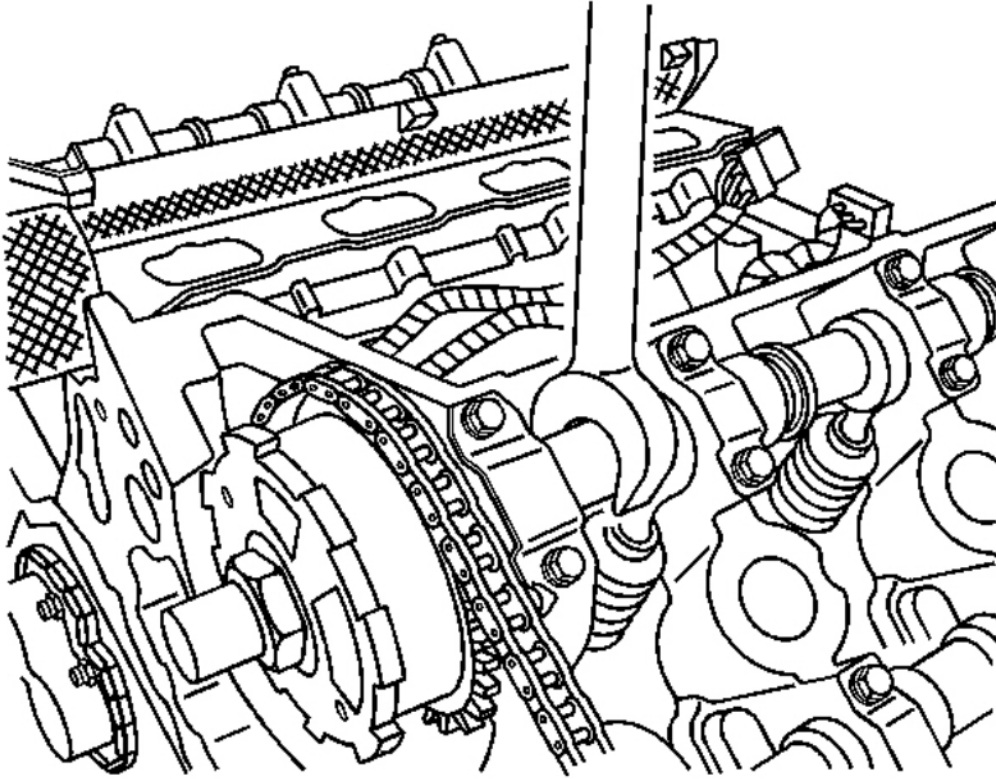


Fig. 181: Holding Camshaft
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

2. Use an open end wrench on the hex cast into the left intake camshaft, in order to prevent the camshaft from rotating, when loosening the camshaft position actuator oil control valve on the left intake camshaft.

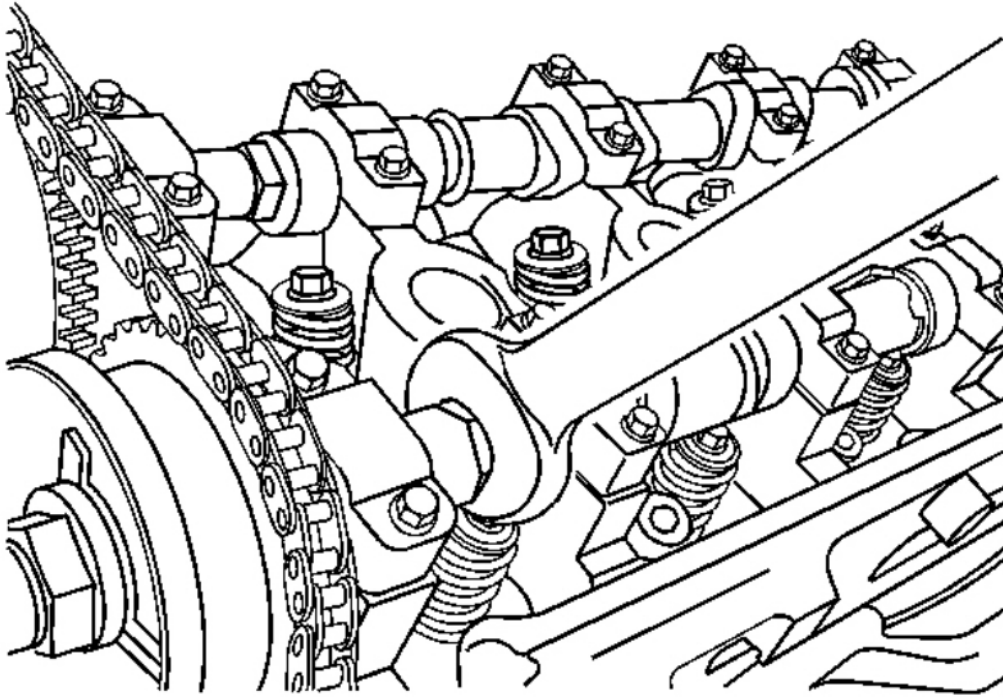


Fig. 182: Holding Camshaft In Position
Courtesy of GENERAL MOTORS CORP.

3. Use an open end wrench on the hex cast into the left exhaust camshaft, in order to prevent the camshaft from rotating, when loosening the camshaft position oil actuator control valve on the left exhaust camshaft.

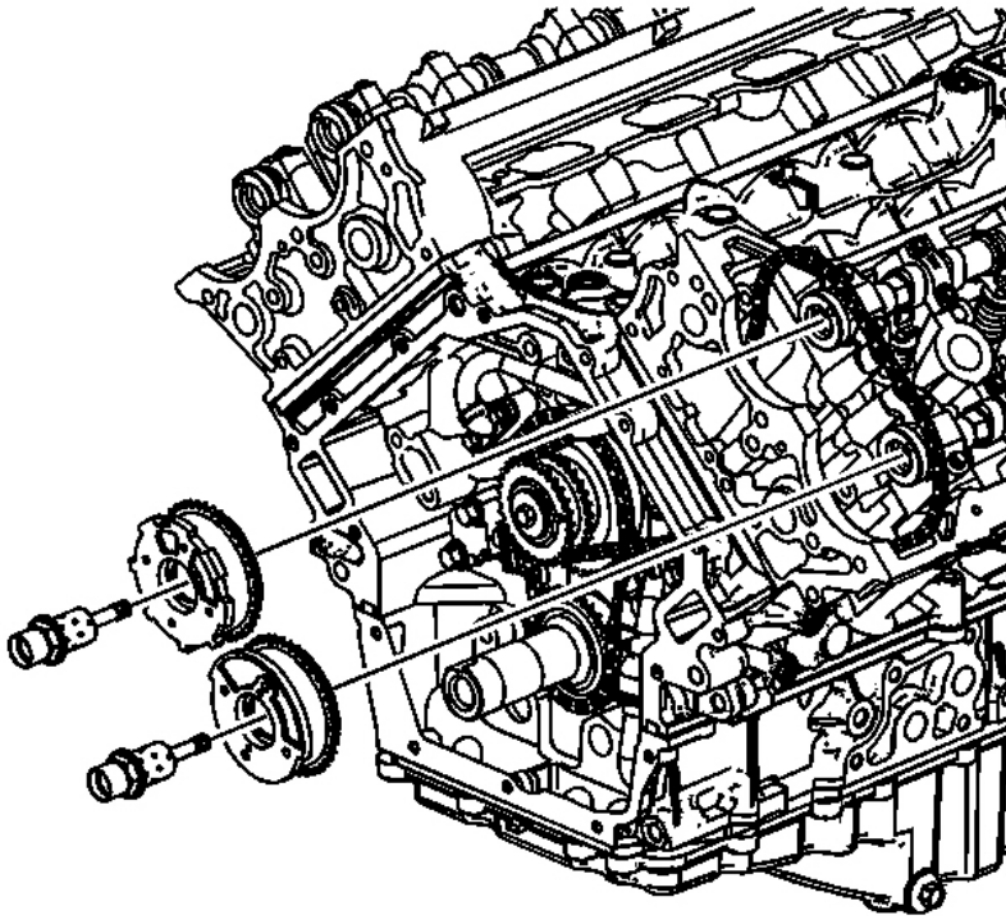


Fig. 183: View Of Left Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

4. Remove the left camshaft position actuator oil control valves from the left side camshafts.
5. Slide the left camshaft position actuators off the left side camshafts.

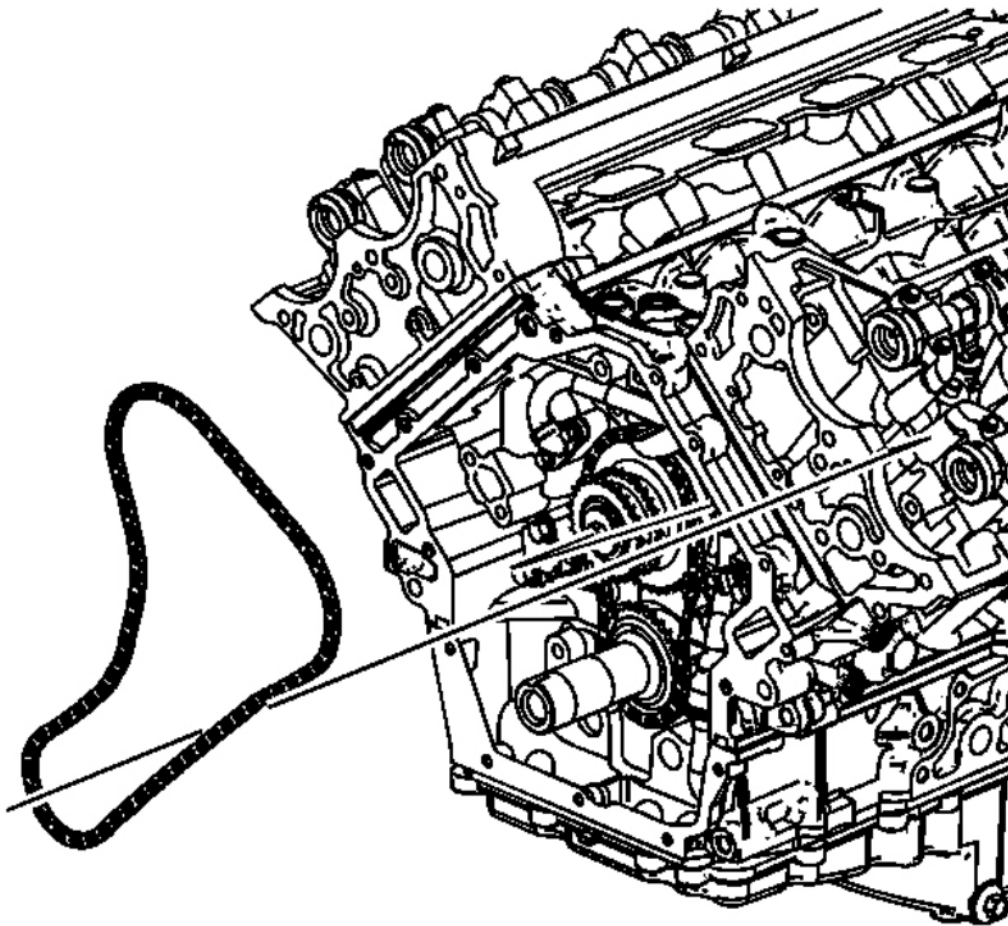


Fig. 184: View Of Left Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

6. Remove the left secondary camshaft drive chain from the inner camshaft intermediate drive shaft sprocket teeth.
7. Remove the left secondary camshaft drive chain from the engine.

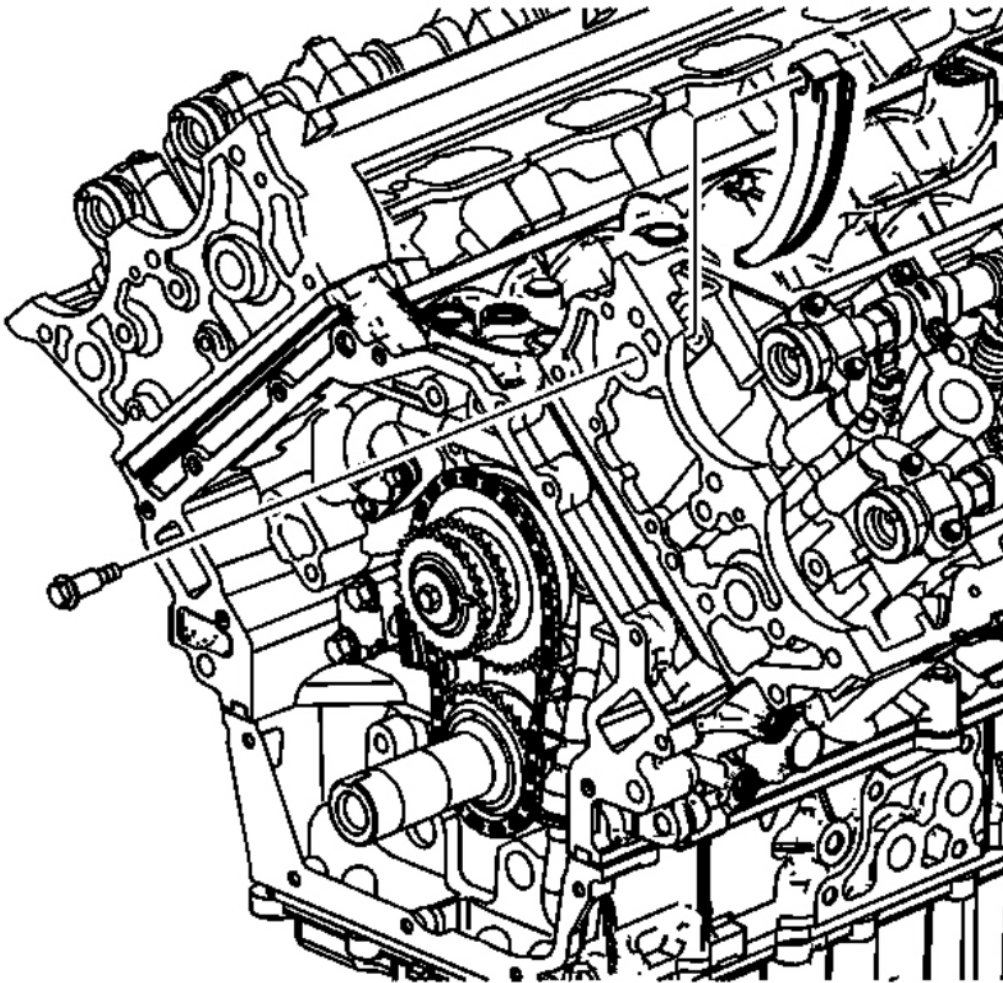


Fig. 185: View Of Left Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

8. Remove the left secondary camshaft drive chain shoe bolt.
9. Remove the left secondary camshaft drive chain shoe.

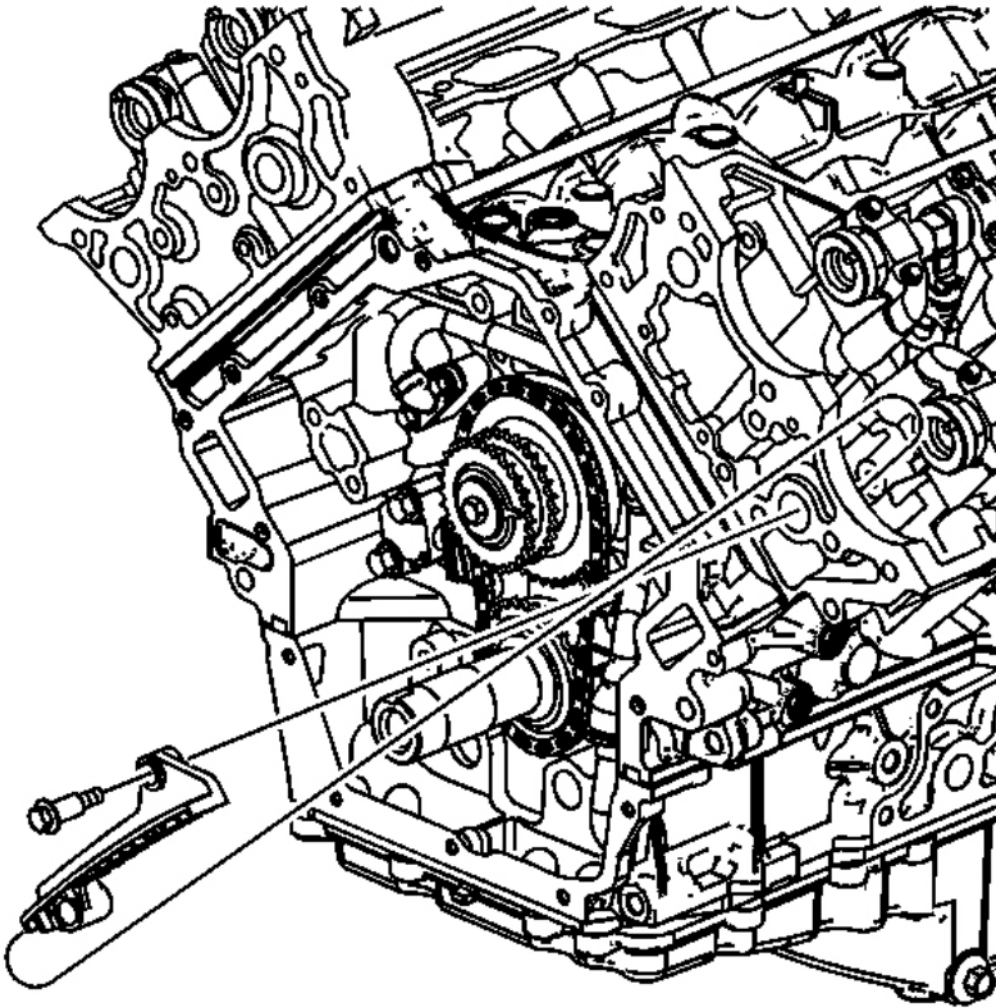


Fig. 186: View Of Left Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

10. Remove the left secondary camshaft drive chain guide bolt.
11. Remove the left secondary camshaft drive chain guide.

OIL OUTLET TUBE REMOVAL

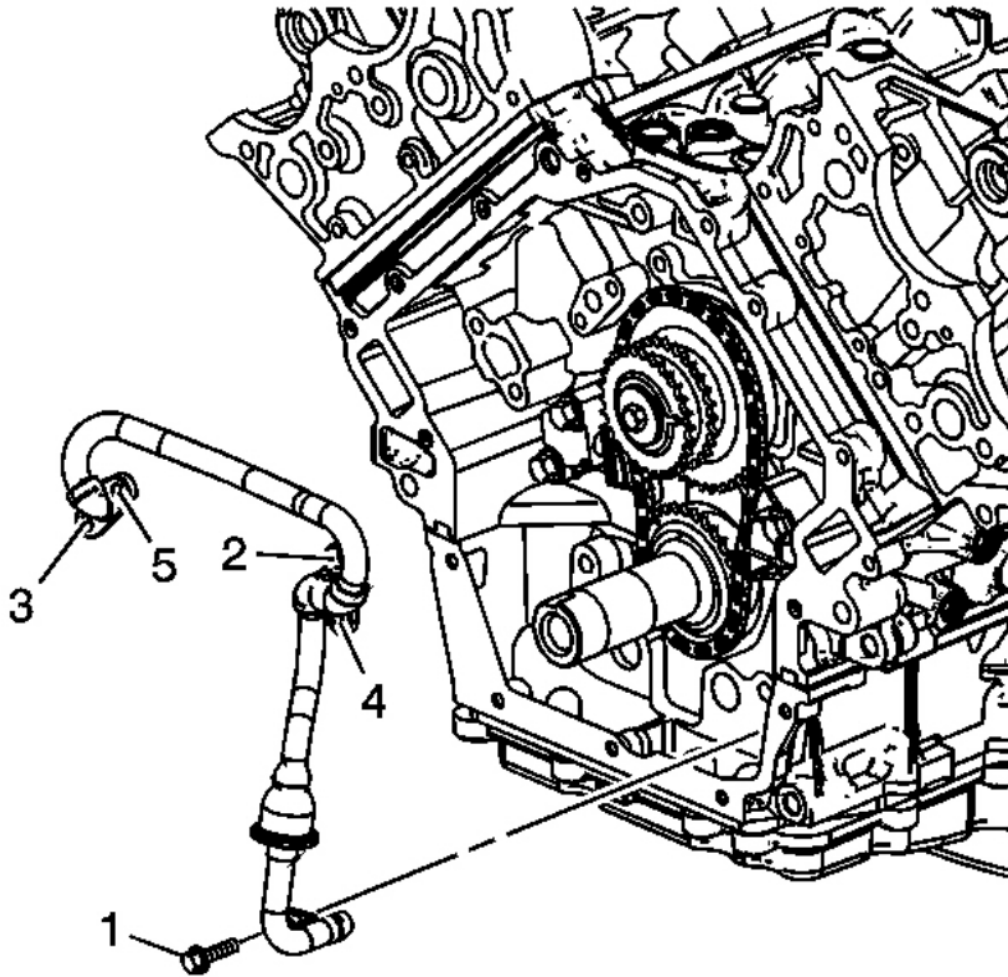


Fig. 187: View Of Oil Outlet Tube Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil outlet tube bolts (1-5).
2. Remove the oil outlet tube.

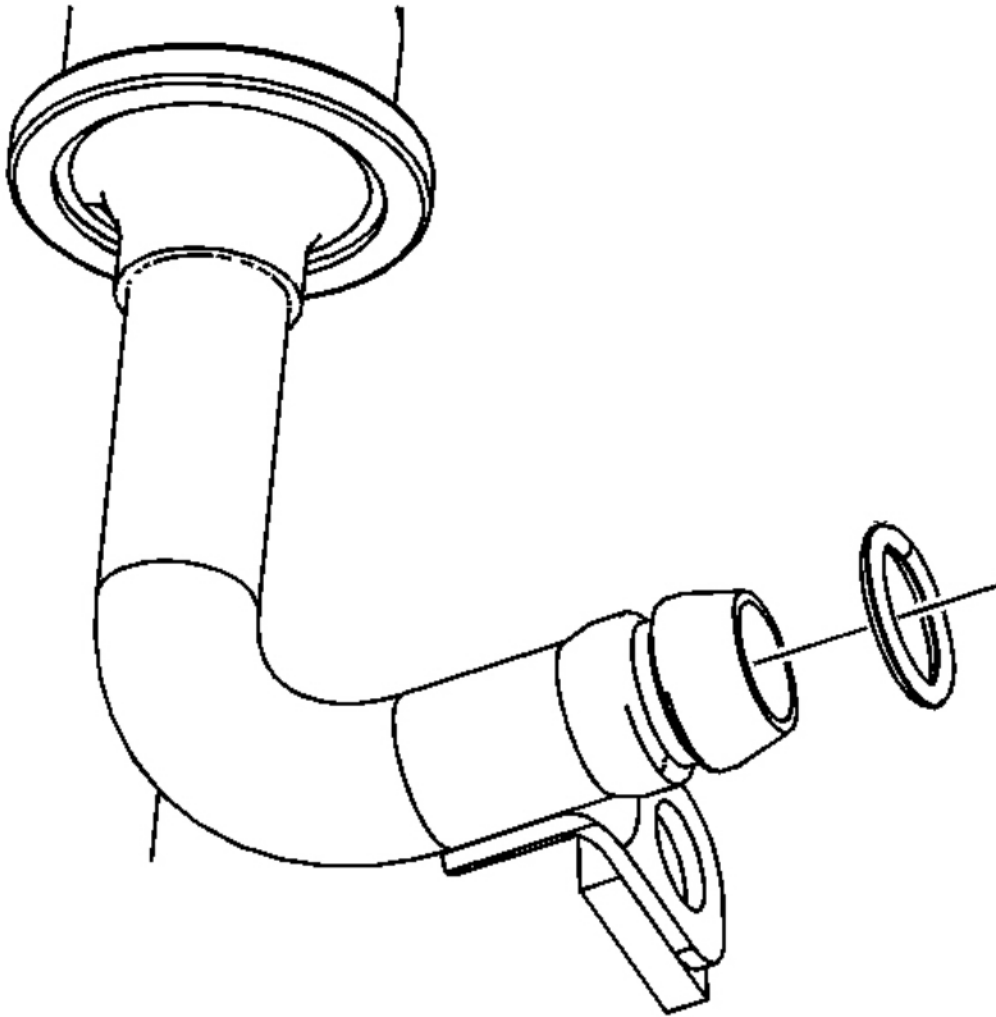


Fig. 188: View Of Oil Outlet Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the oil outlet tube O-ring.

PRIMARY CAMSHAFT DRIVE CHAIN REMOVAL

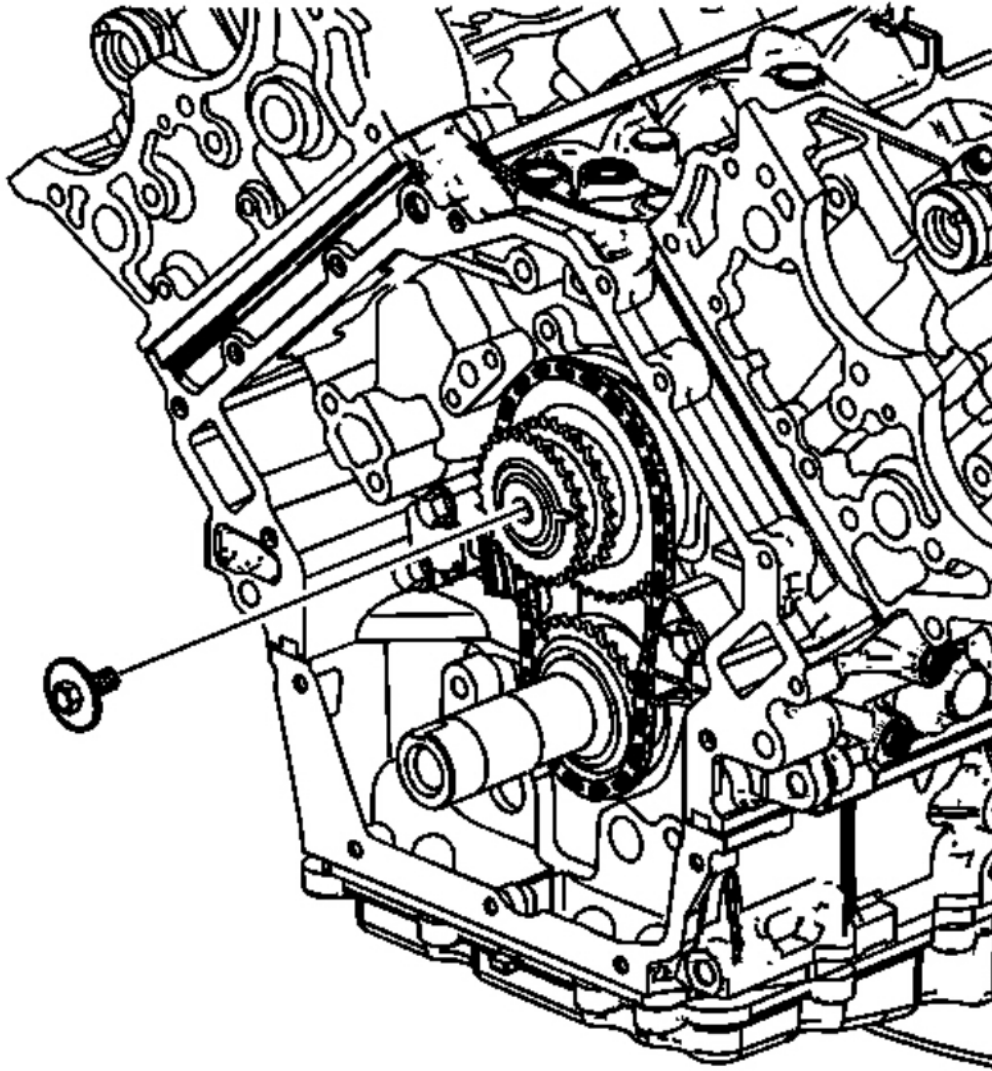


Fig. 189: View Of Camshaft Intermediate Sprocket Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft intermediate drive shaft sprocket bolt.

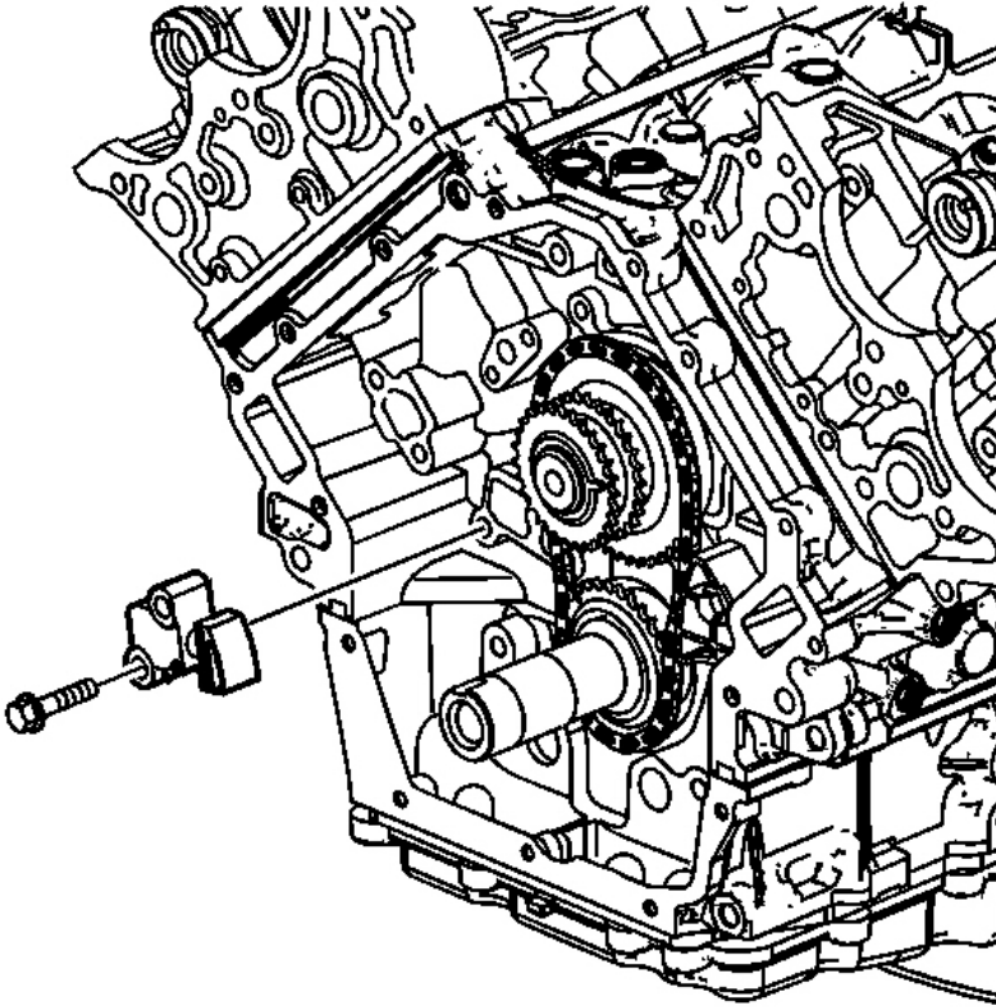


Fig. 190: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

2. Remove the primary camshaft drive chain tensioner bolts.
3. Remove the primary camshaft drive chain tensioner.

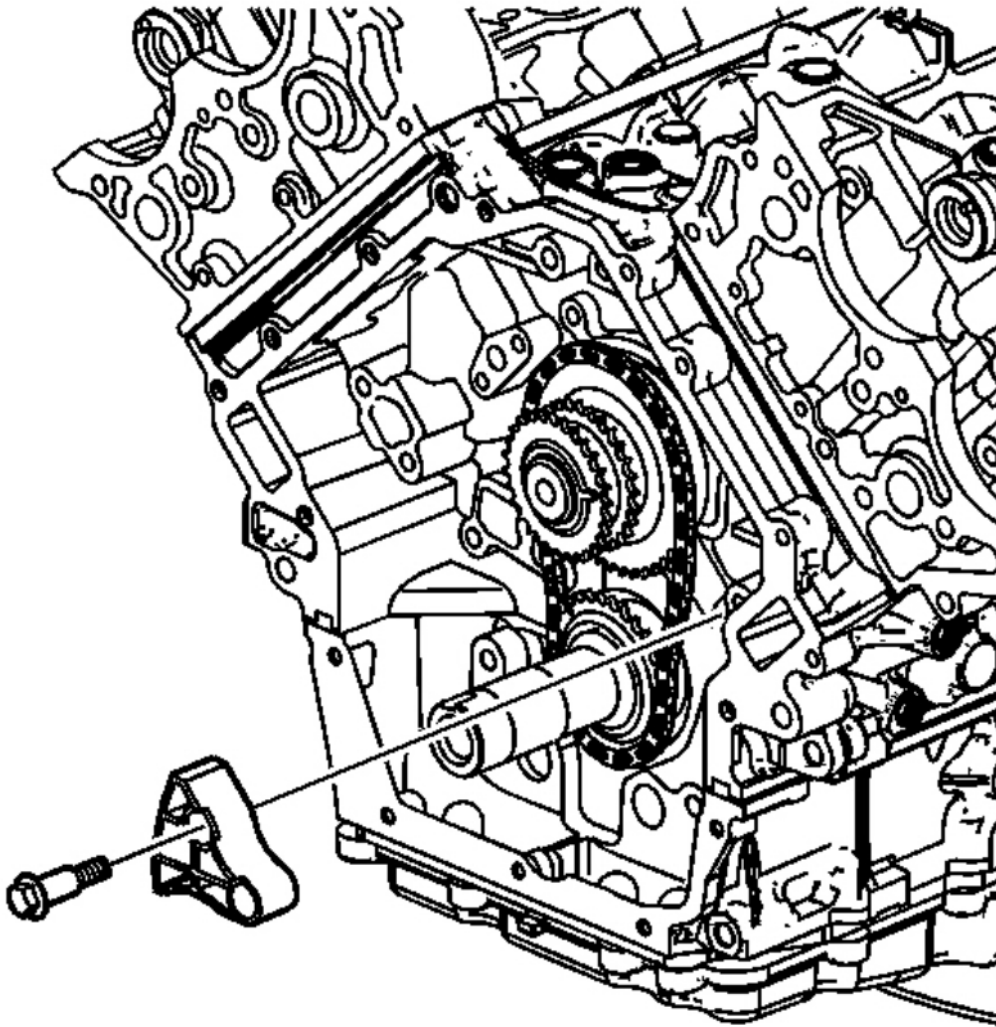


Fig. 191: View Of Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

4. Remove the primary camshaft drive chain guide bolts.
5. Remove the primary camshaft drive chain guide.

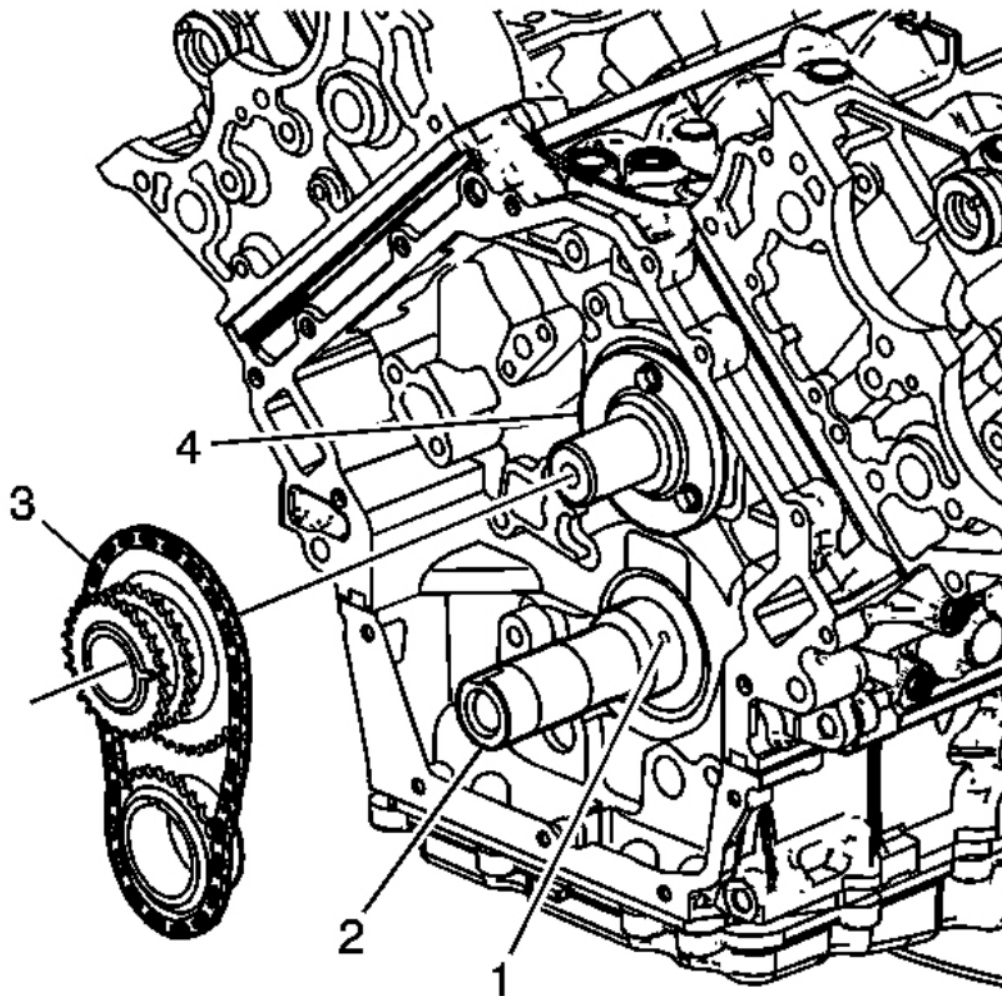


Fig. 192: View Of Primary Camshaft Drive Chain, Intermediate Drive Shaft Sprocket & Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

6. Remove the camshaft intermediate drive shaft sprocket, primary camshaft drive chain and crankshaft sprocket (3) as an assembly.

CAMSHAFT INTERMEDIATE DRIVE SHAFT REMOVAL

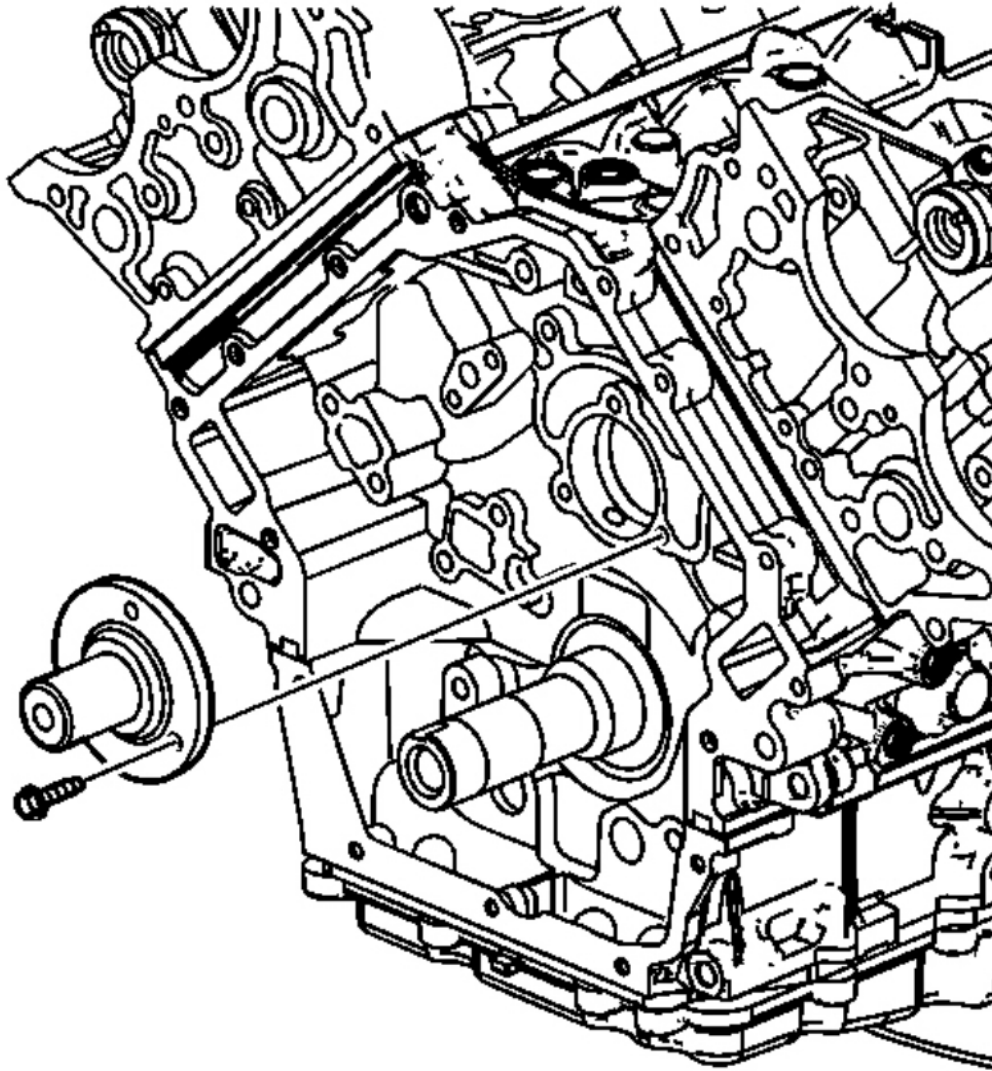


Fig. 193: View Of Intermediate Sprocket Shaft & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the intermediate sprocket shaft retaining bolts.
2. Remove the intermediate sprocket shaft.

CAMSHAFT REMOVAL - LEFT EXHAUST

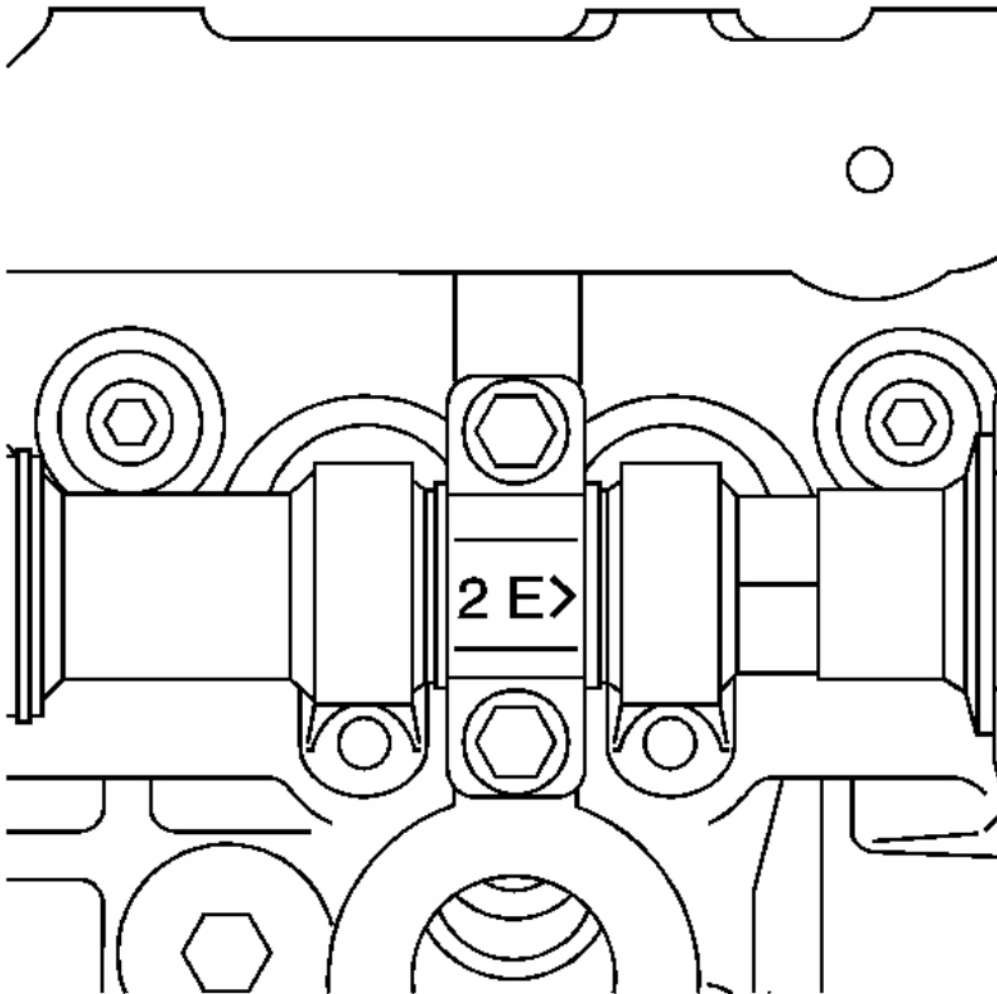


Fig. 194: View Of Exhaust Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Bearing caps must remain with their original cylinder head and in their original location. Do not mix bearing caps.

1. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow points toward the front of the engine.
 - The "E" indicates the exhaust camshaft.

- The number indicates the journal position from the front of the engine.

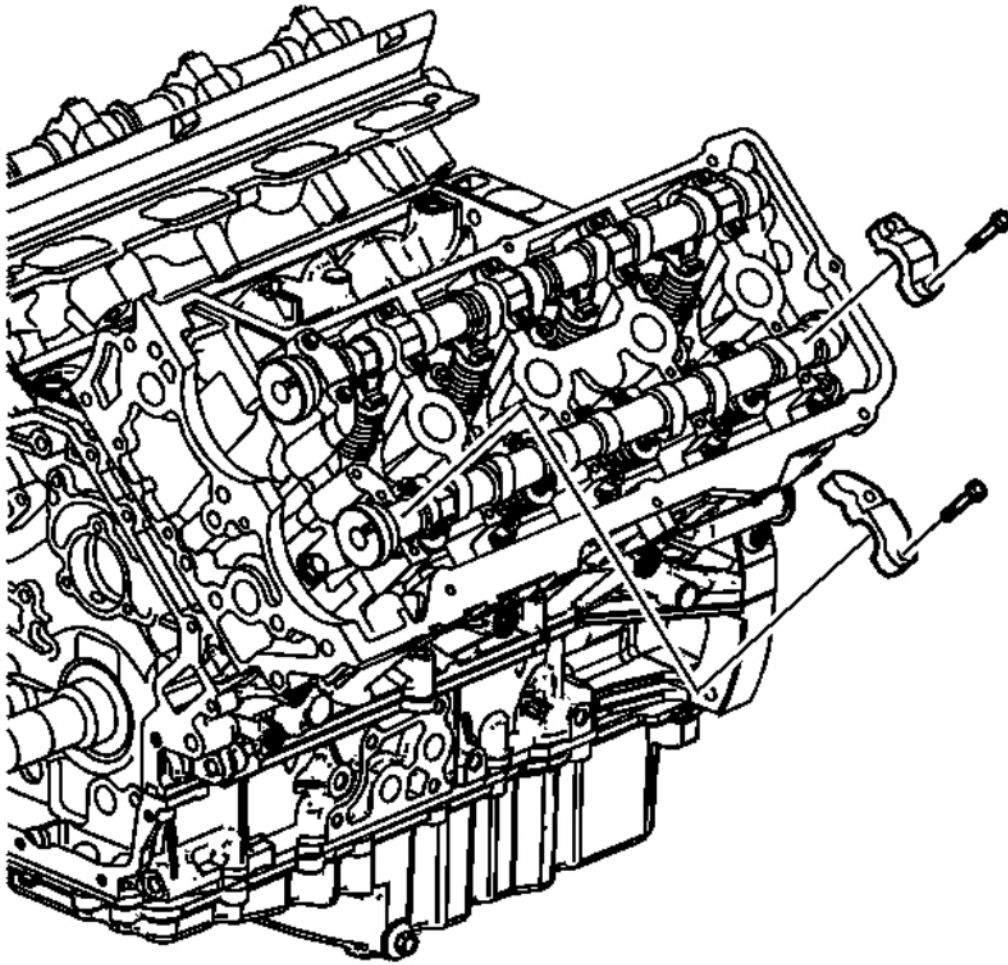


Fig. 195: View Of Left Exhaust Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the left exhaust camshaft bearing cap bolts.
3. Remove the left exhaust camshaft bearing caps. Store the bearing caps in a clean shop towel.

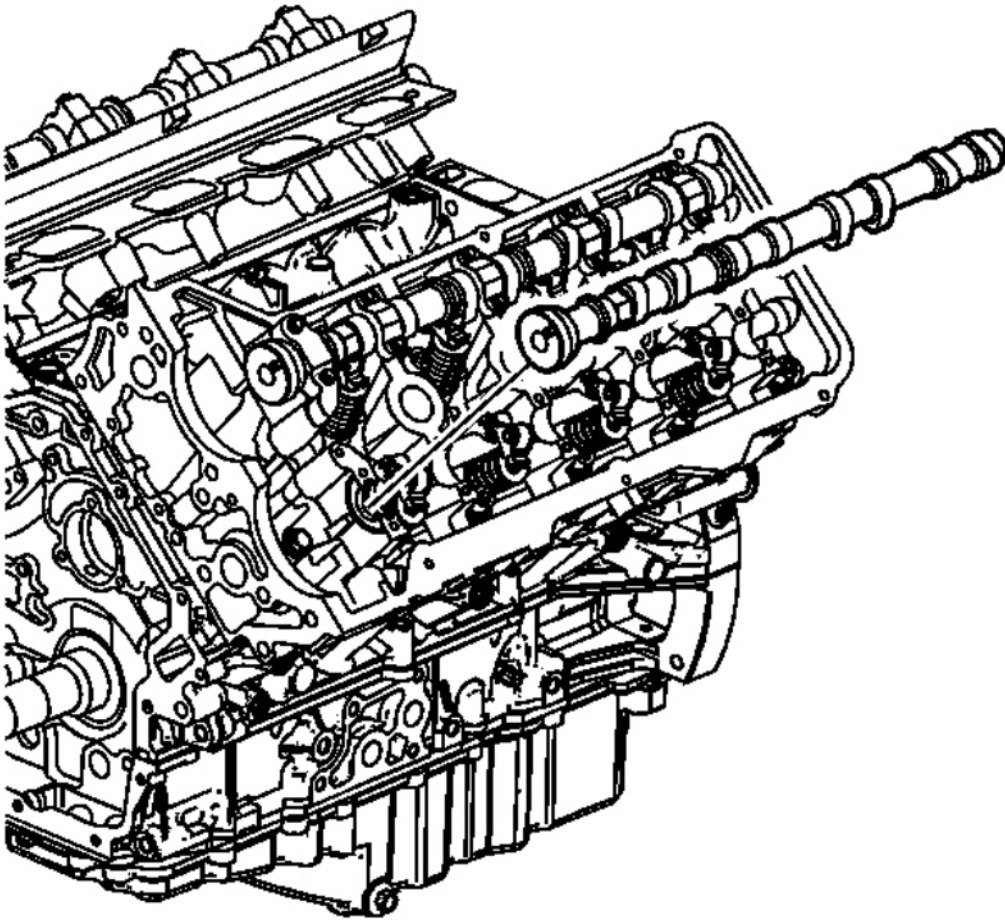


Fig. 196: View Of Left Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Remove the left exhaust camshaft. Place the camshaft in a secure location.
5. Cover the camshaft with an oil soaked towel in order to prevent corrosion.

CAMSHAFT REMOVAL - LEFT INTAKE

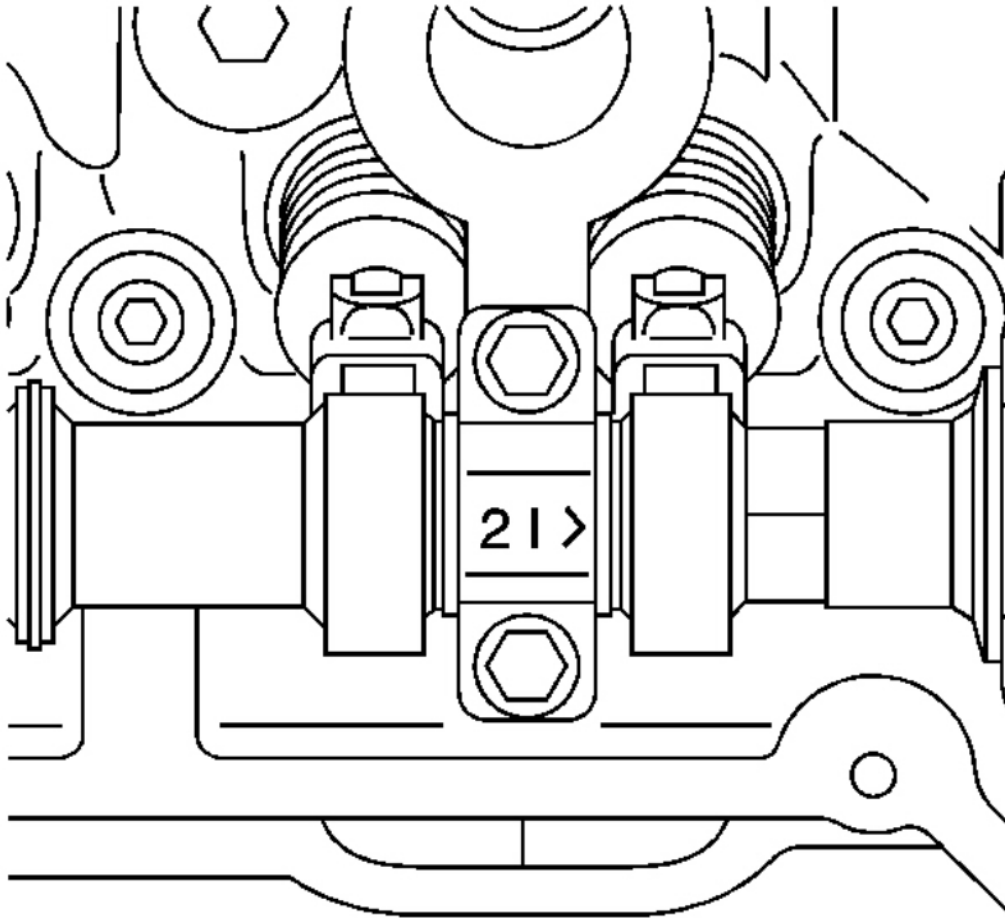


Fig. 197: View Of Intake Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Bearing caps must remain with their original cylinder head and in their original location. Do not mix bearing caps.

1. Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow points toward the front of the engine.
 - The "I" indicates the intake camshaft.
 - The number indicates the journal position from the front of the engine.

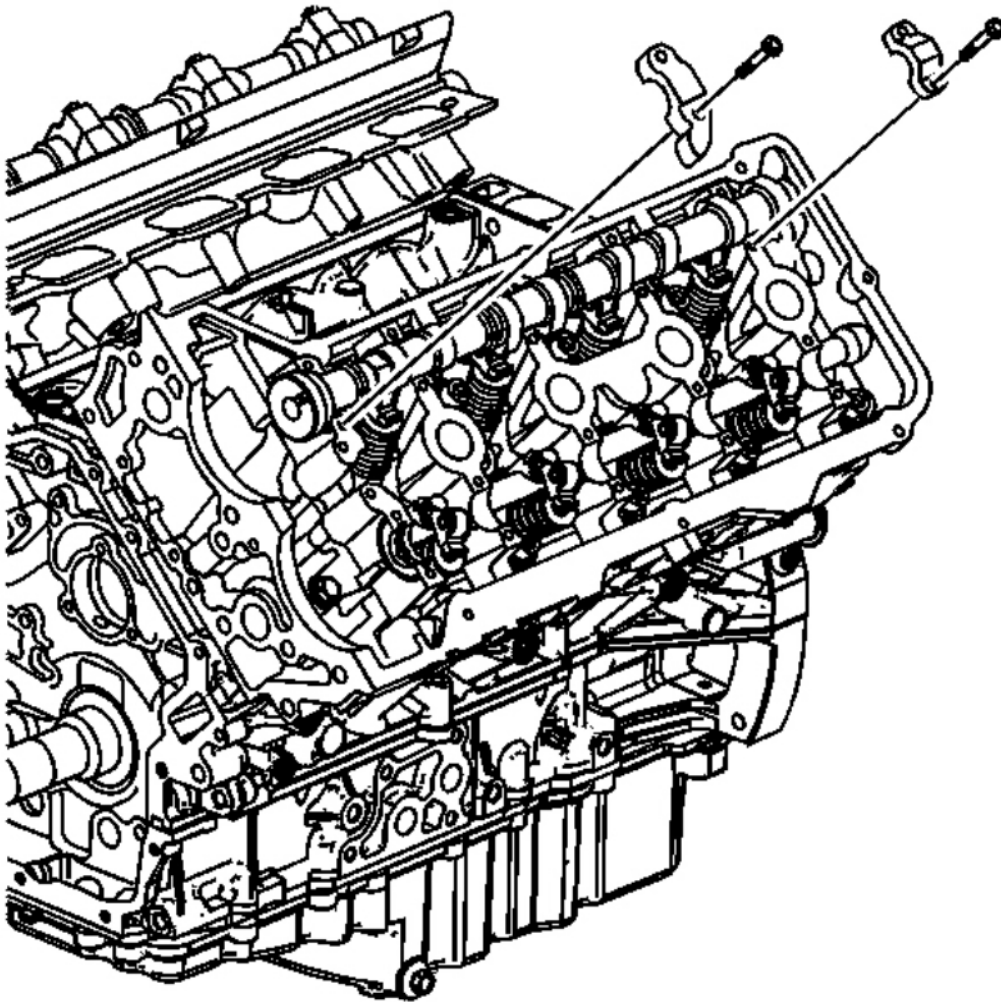


Fig. 198: View Of Left Intake Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

2. Remove the left intake camshaft bearing cap bolts.
3. Remove the left intake camshaft bearing caps. Store the bearing caps in a clean shop towel.

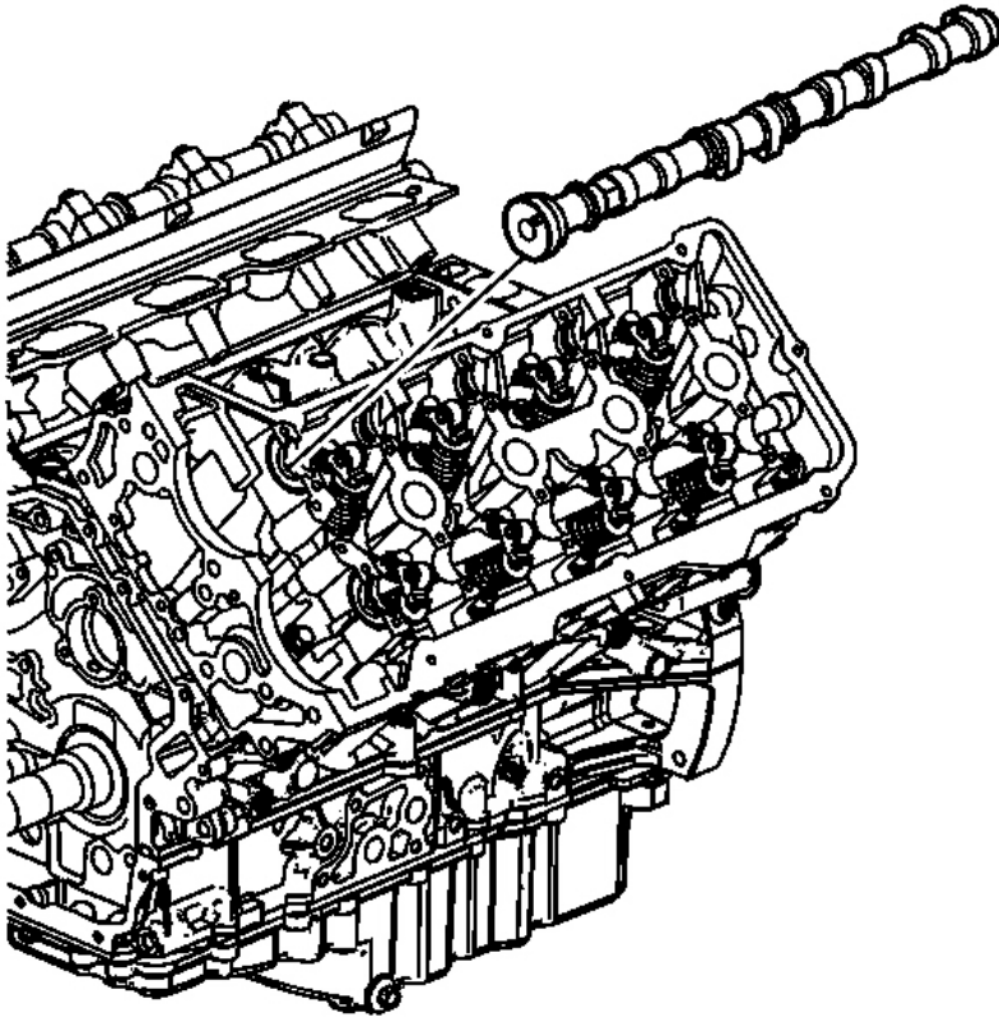


Fig. 199: View Of Left Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Remove the left intake camshaft. Place the camshaft in a secure location.
5. Cover the camshaft with an oil soaked towel in order to prevent corrosion.

VALVE ROCKER ARM REMOVAL - LEFT

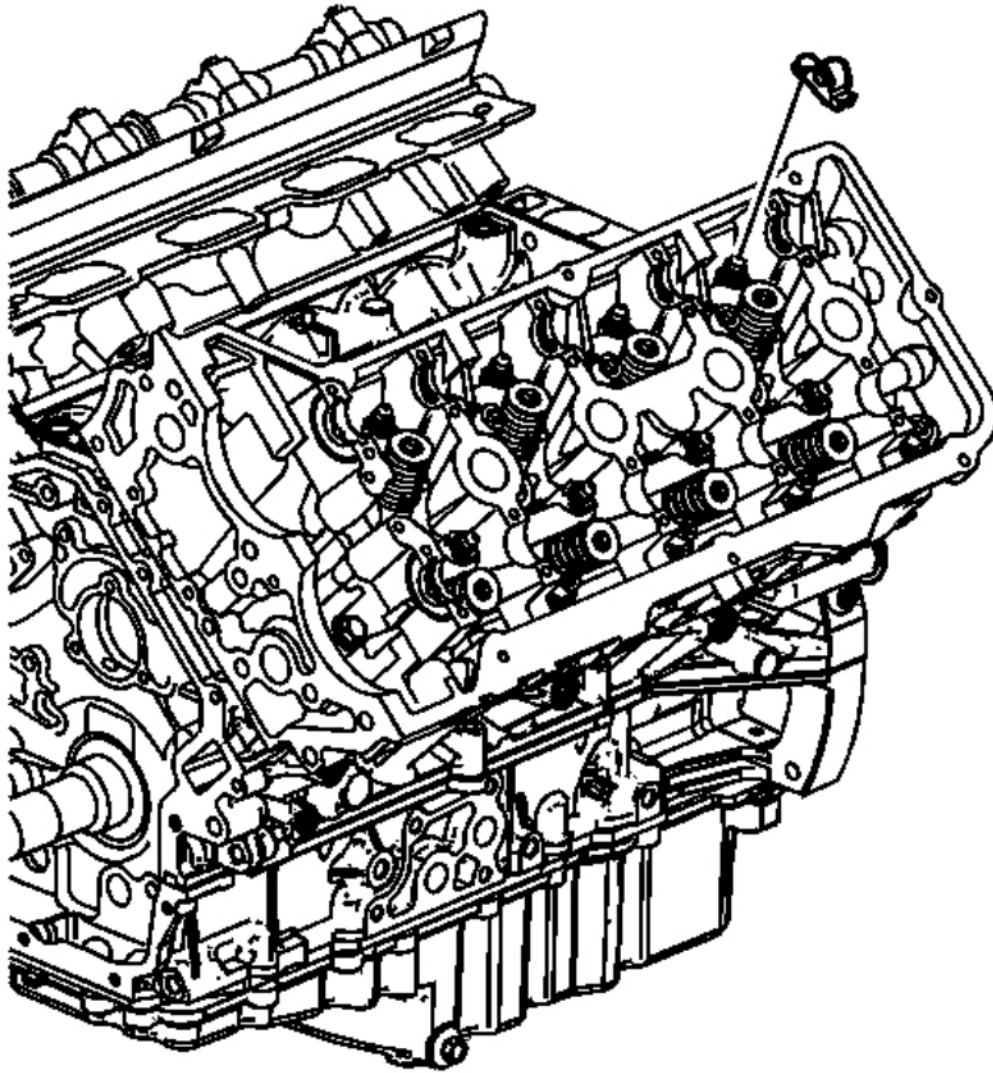


Fig. 200: View Of Left Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLAs) and original location the components were assembled in.

1. Remove the camshaft followers from the left cylinder head.

2. Store the camshafts, followers and SHLAs in a clean, secure location.

VALVE LIFTER REMOVAL - LEFT

NOTE: Refer to Valve Lifter Priming Notice in Cautions and Notices.

IMPORTANT: Ensure each camshaft follower remains matched to the original stationary hydraulic lash adjuster (SHLAs) and original location the components were assembled in.

1. Remove the stationary hydraulic lash adjuster (SHLAs) from the left cylinder head lifter bores.

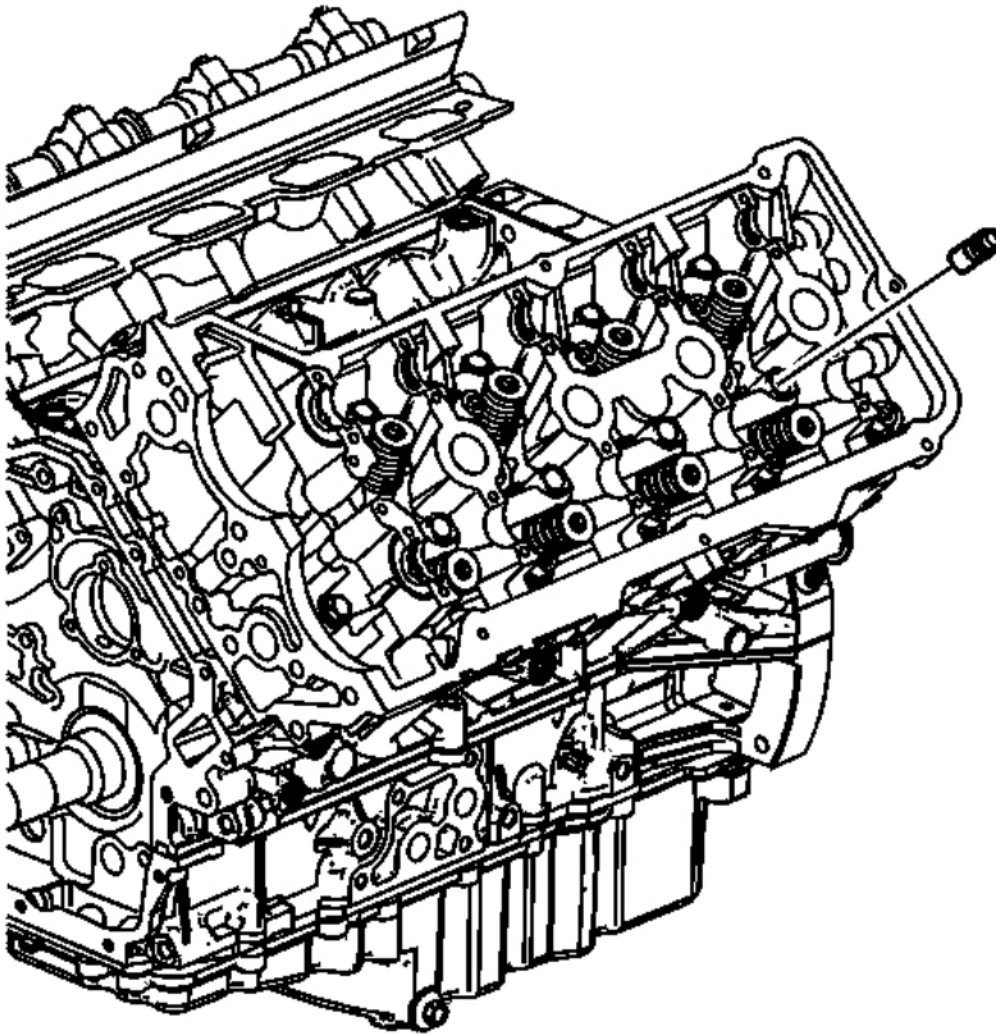


Fig. 201: View Of Left Valve Lifter
Courtesy of GENERAL MOTORS CORP.

2. Store the camshafts, followers and SHLAs in a clean, secure location.