

2008 Buick LaCrosse CX
2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

2008 ENGINE

Engine Mechanical - 3.6L - LaCrosse

ON-VEHICLE REPAIR INSTRUCTIONS (CONT.)

CYLINDER HEAD REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the left bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Left Side** .
2. Remove the oil level indicator. Refer to **Oil Level Indicator and Tube Replacement** .

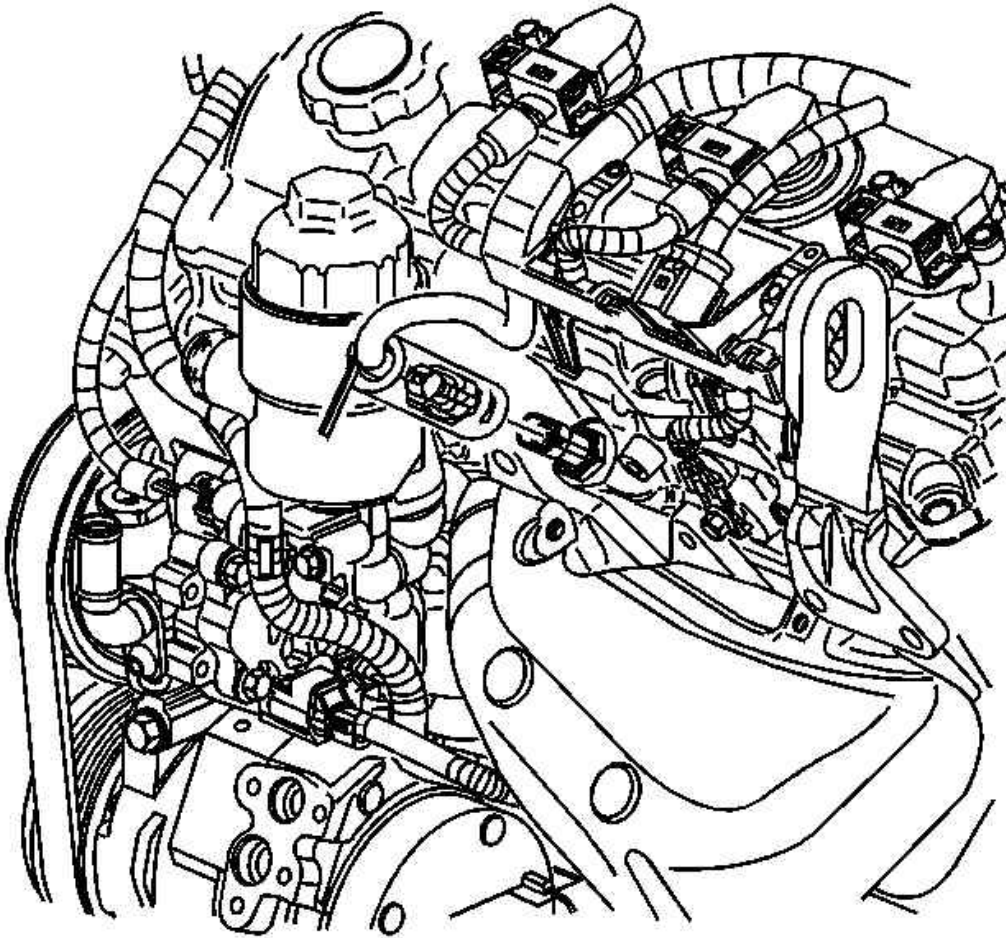


Fig. 1: View Of Coolant Temperature Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Remove the heat shield from the coolant temperature sensor and disconnect the coolant temperature sensor electrical connector.

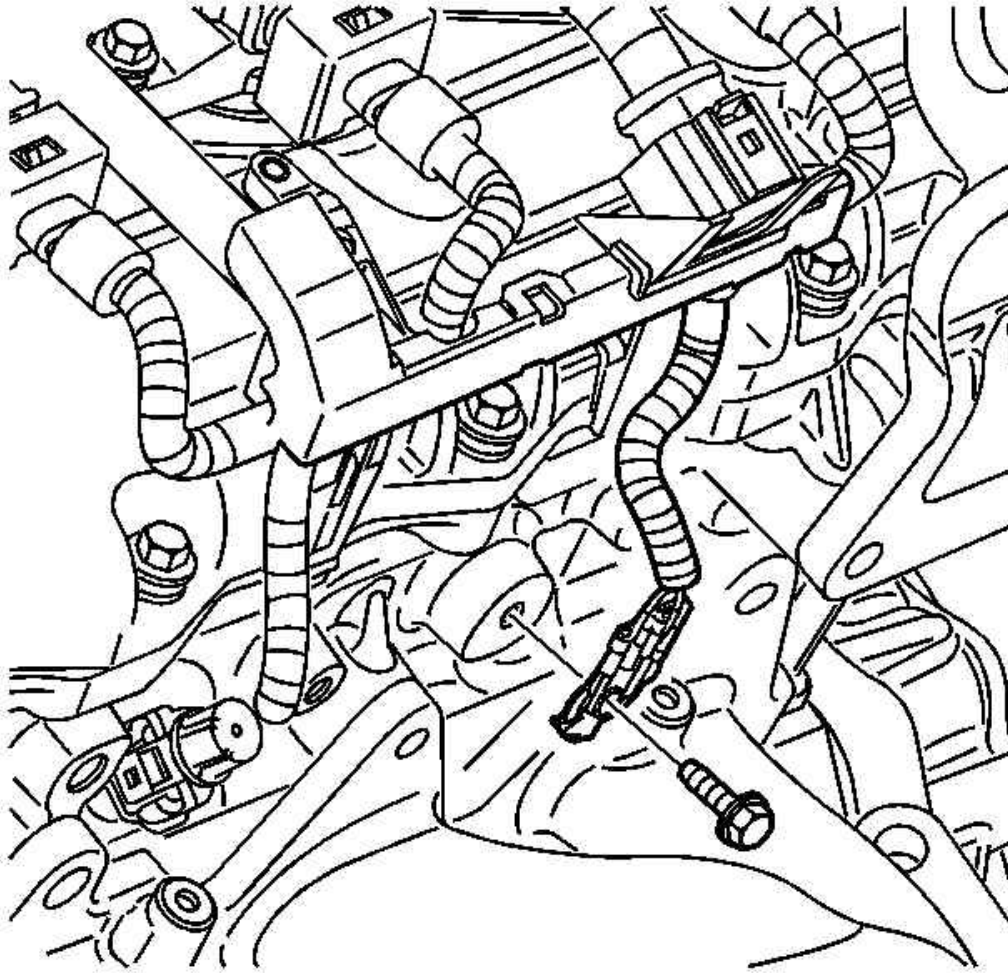


Fig. 2: View Of Left Cylinder Head Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness ground from the cylinder head.
5. Disconnect the wiring harness electrical connector located at the side of the cylinder head.
6. Remove the wiring harness connector bracket from the side of the cylinder head.

IMPORTANT: DO NOT disconnect the power steering pipes and/or

hoses.

7. Remove the power steering pump bolts.
8. Remove the surge tank hose from the bracket at the rear of the cylinder head.
9. Remove the wiring harness bracket from the rear of the cylinder head.
10. Remove the catalytic converter. Refer to **Catalytic Converter Replacement** .

IMPORTANT: Do not remove the oil filter adapter.

11. Remove the oil filter adapter upper bolt.
12. Remove the secondary timing chain. Refer to **Secondary Camshaft Drive Chain Removal - Left Side (Fourth Design)**.

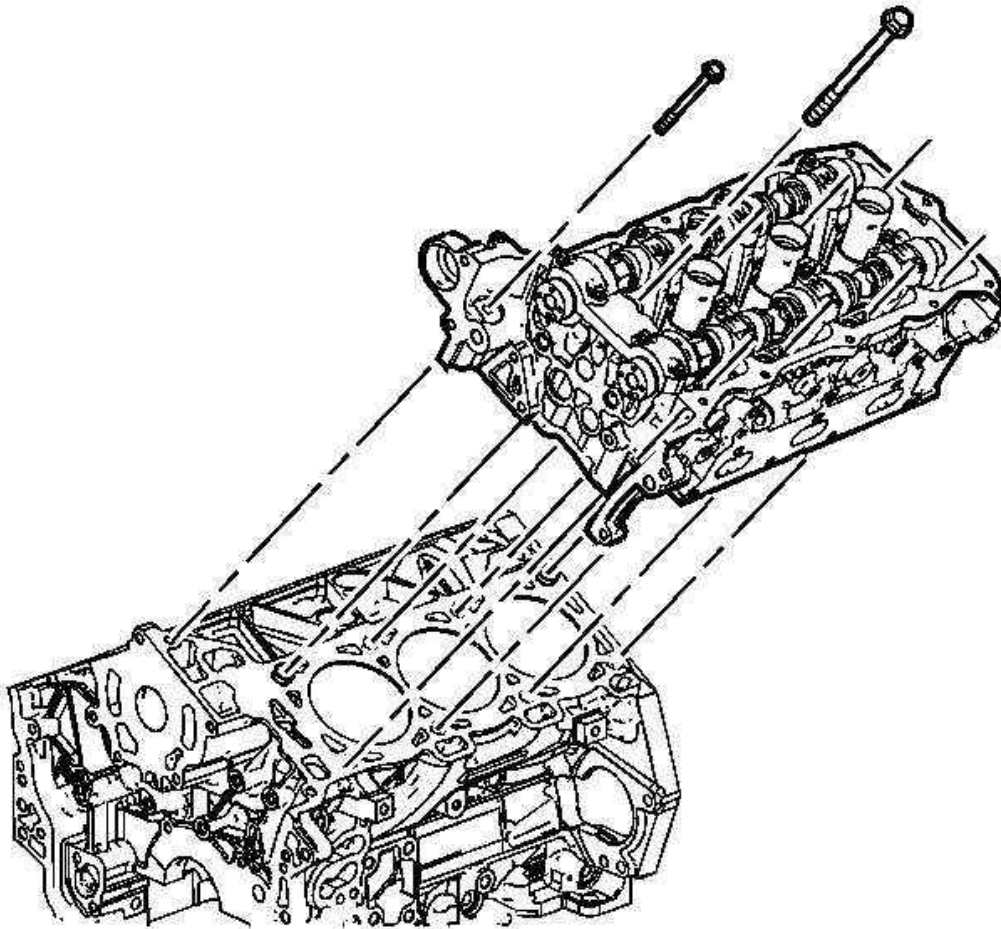


Fig. 3: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

13. Remove the cylinder head with the exhaust manifold. Refer to **Cylinder Head Removal - Left Side**.

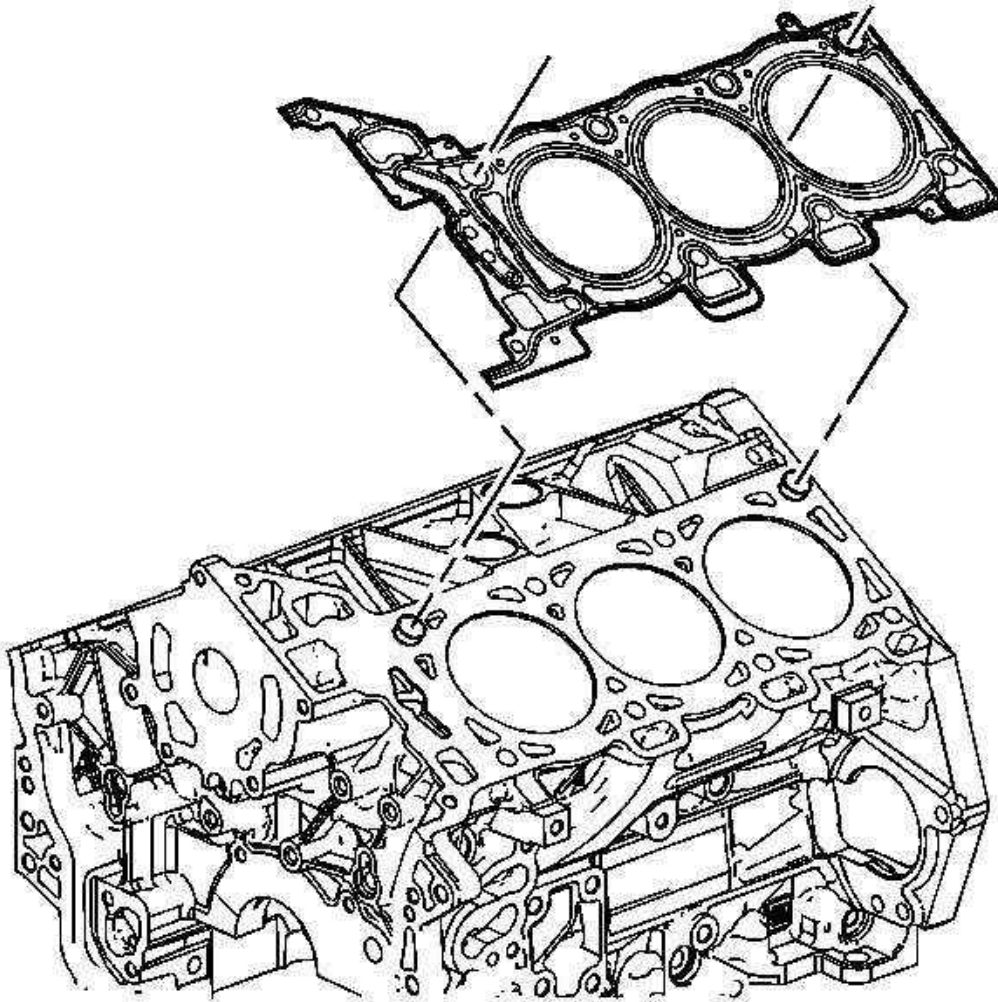


Fig. 4: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** and **Engine Block Cleaning and Inspection** .
16. If necessary, perform the following steps:

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- Remove the exhaust manifold from the cylinder head. Refer to **Exhaust Manifold Removal - Left Side**.
- Disassemble the cylinder head. Refer to **Cylinder Head Disassemble** .

Installation Procedure

1. If necessary, perform the following steps:
 - Assemble the cylinder head. Refer to **Cylinder Head Assemble** .
 - Install the exhaust manifold to the cylinder head. Refer to **Exhaust Manifold Installation - Left Side** .

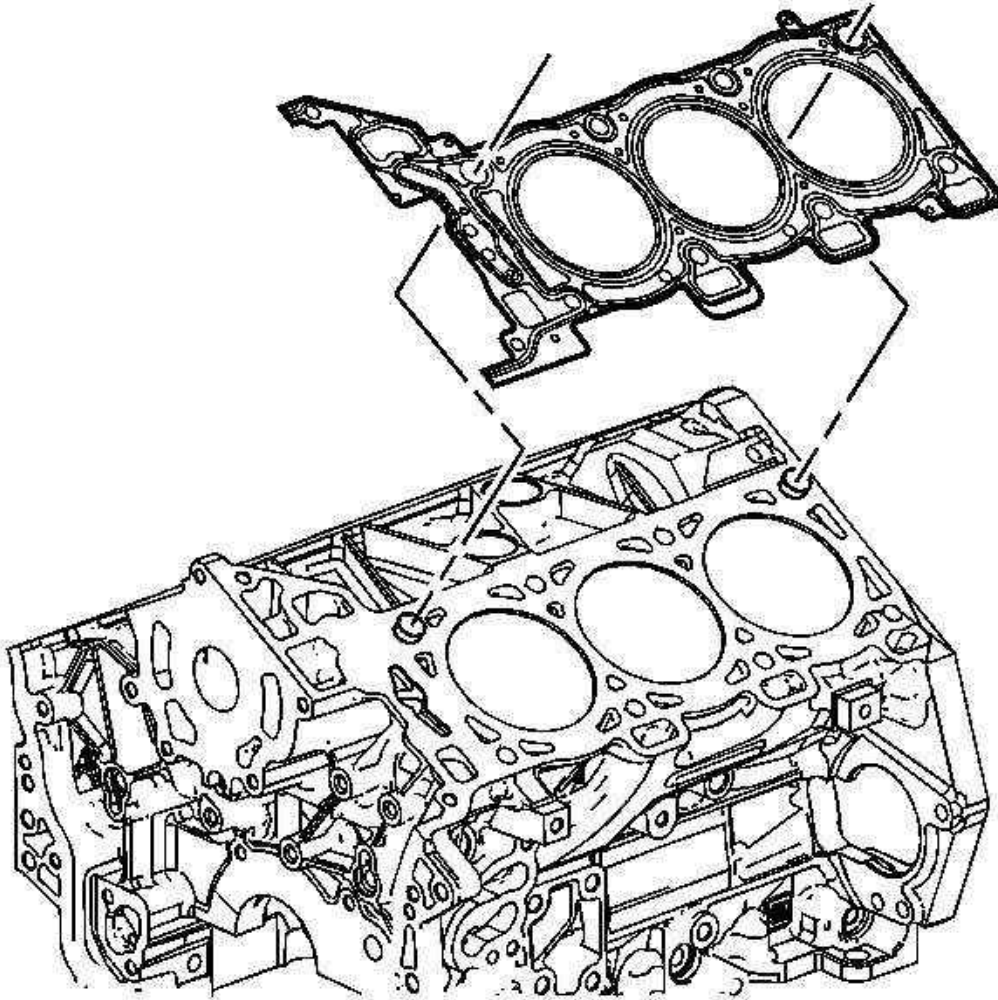


Fig. 5: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW cylinder head gasket.

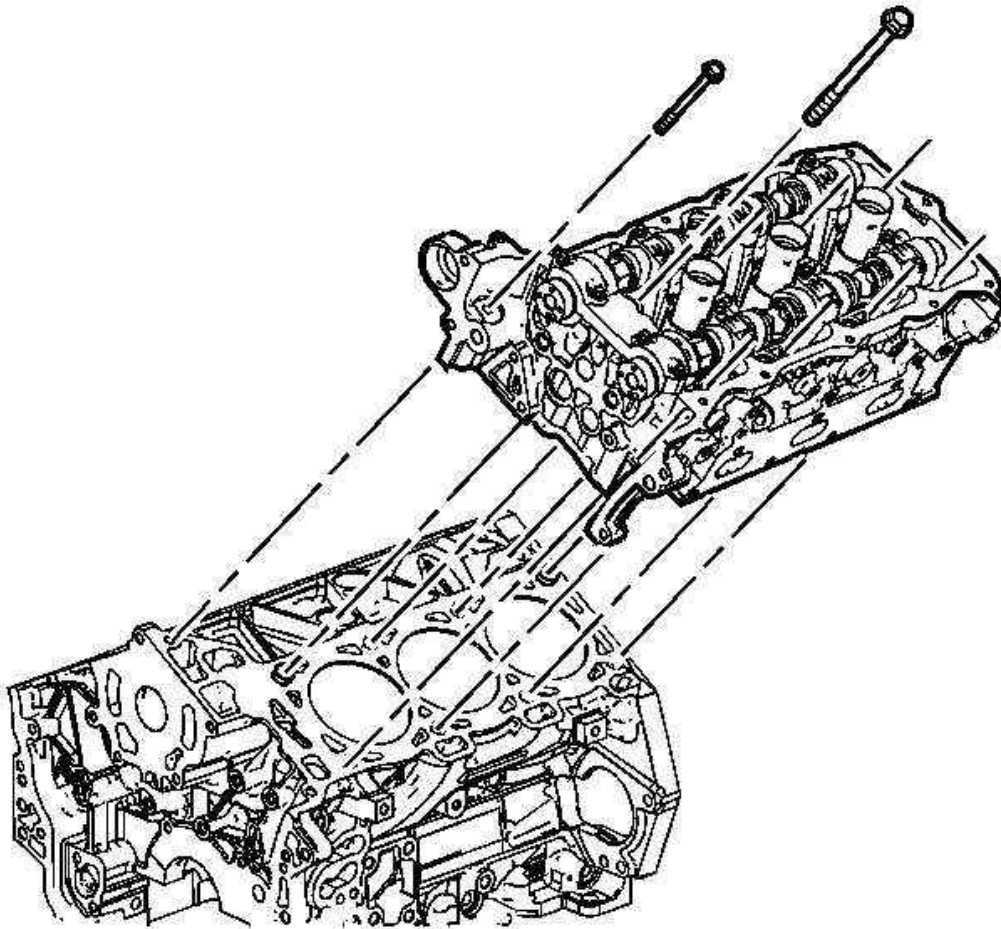


Fig. 6: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Carefully install the cylinder head with the exhaust manifold to the engine. Refer to **Cylinder Head Installation - Left Side** .
4. Install the secondary timing chain. Refer to **Secondary Camshaft Drive Chain Installation - Left Side (Fourth Design)** .

NOTE: Refer to **Fastener Notice** .

5. Install the oil filter adapter upper bolt.

Tighten: Tighten the oil filter housing adapter bolt to 23 N.m (17 lb ft).

6. Install the oil level indicator. Refer to **Oil Level Indicator and Tube Replacement** .
7. Install the catalytic converter to the exhaust manifold. Refer to **Catalytic Converter Replacement** .
8. Install the wiring harness bracket to the rear of the cylinder head.
9. Install the surge tank hose to the bracket at the rear of the cylinder head.
10. Install the power steering pump bolts. Refer to **Power Steering Pump Replacement (LY7)** .
11. Install the wiring harness connector bracket to the side of the cylinder head.
12. Connect the wiring harness electrical connector located at the side of the cylinder head.

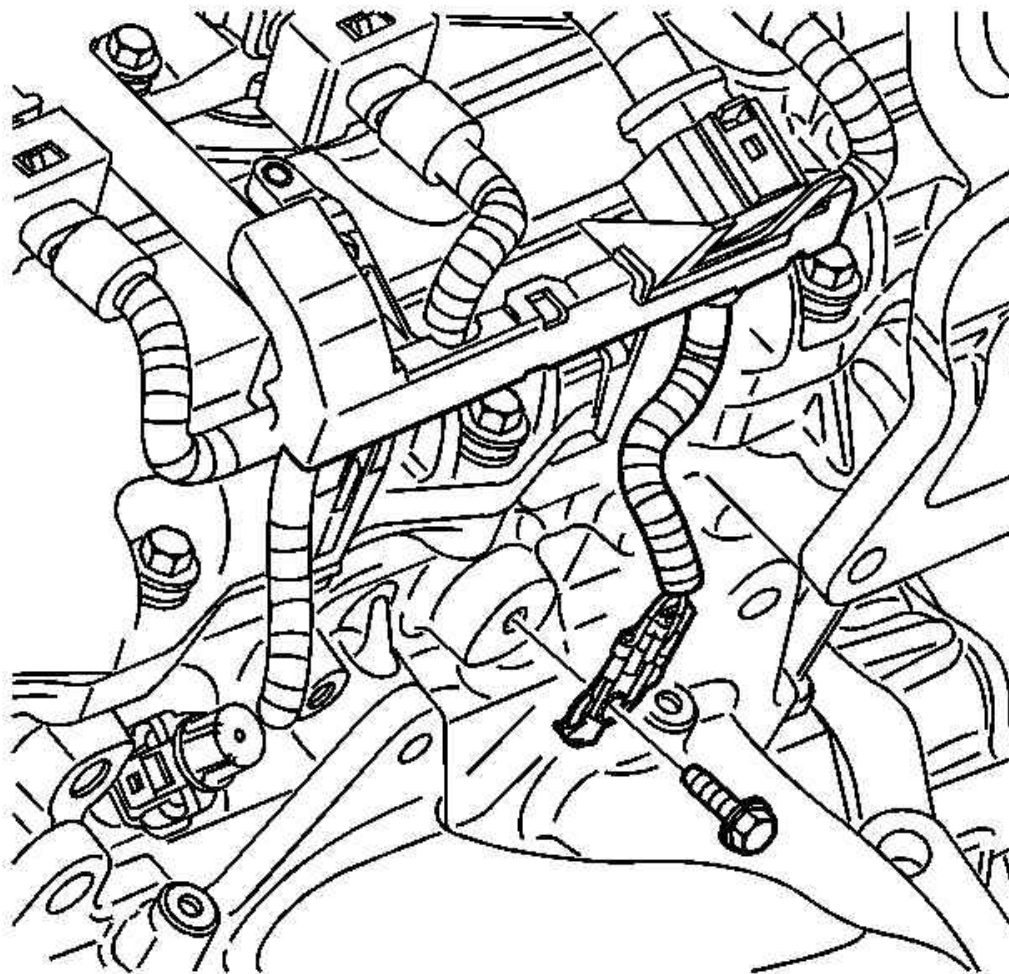


Fig. 7: View Of Left Cylinder Head Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the wiring harness ground to the cylinder head.

Tighten: Tighten the wiring harness ground bolt to 10 N.m (89 lb in).

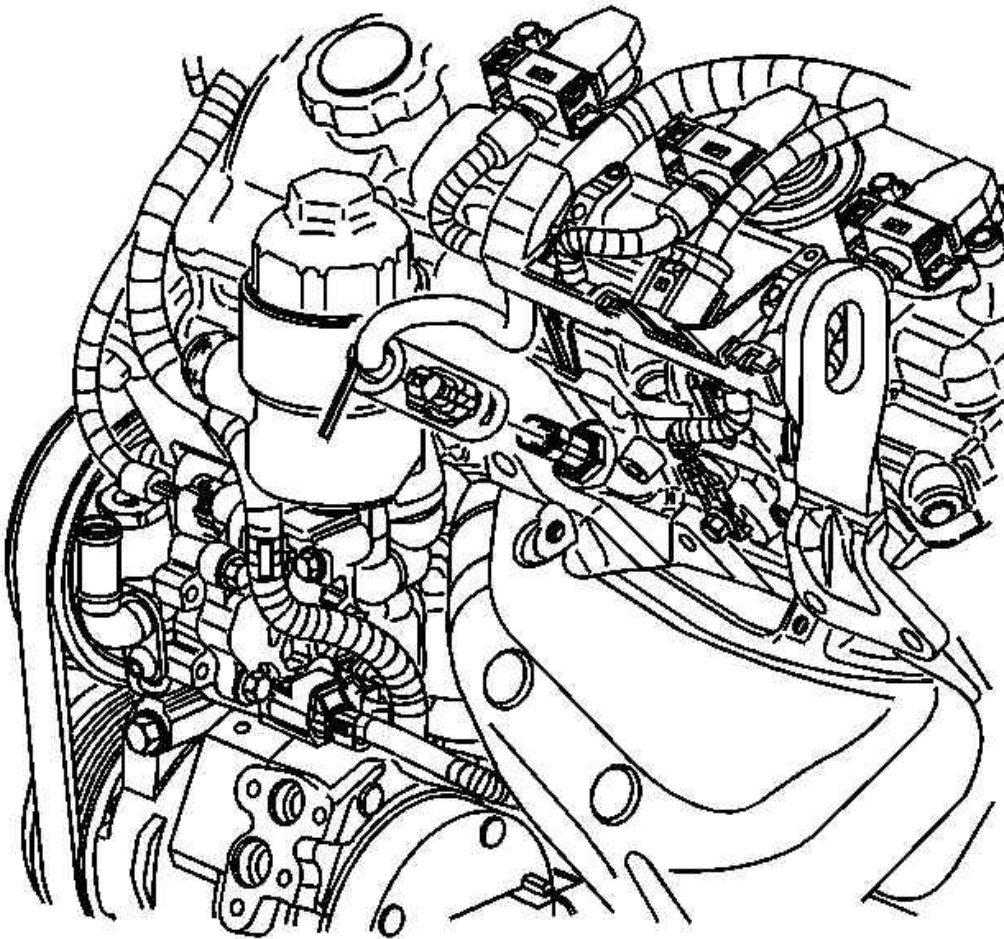


Fig. 8: View Of Coolant Temperature Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Connect the coolant temperature sensor electrical connector and heat shield.
15. Install the oil level indicator. Refer to **Oil Level Indicator and Tube Replacement** .
16. Install the left bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Left Side** .

Removal Procedure

1. Remove the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Right Side** .
2. Remove the coolant inlet pipe bolts and reposition the coolant inlet pipe to provide access.
3. Remove the catalytic converter. Refer to **Catalytic Converter Replacement** .

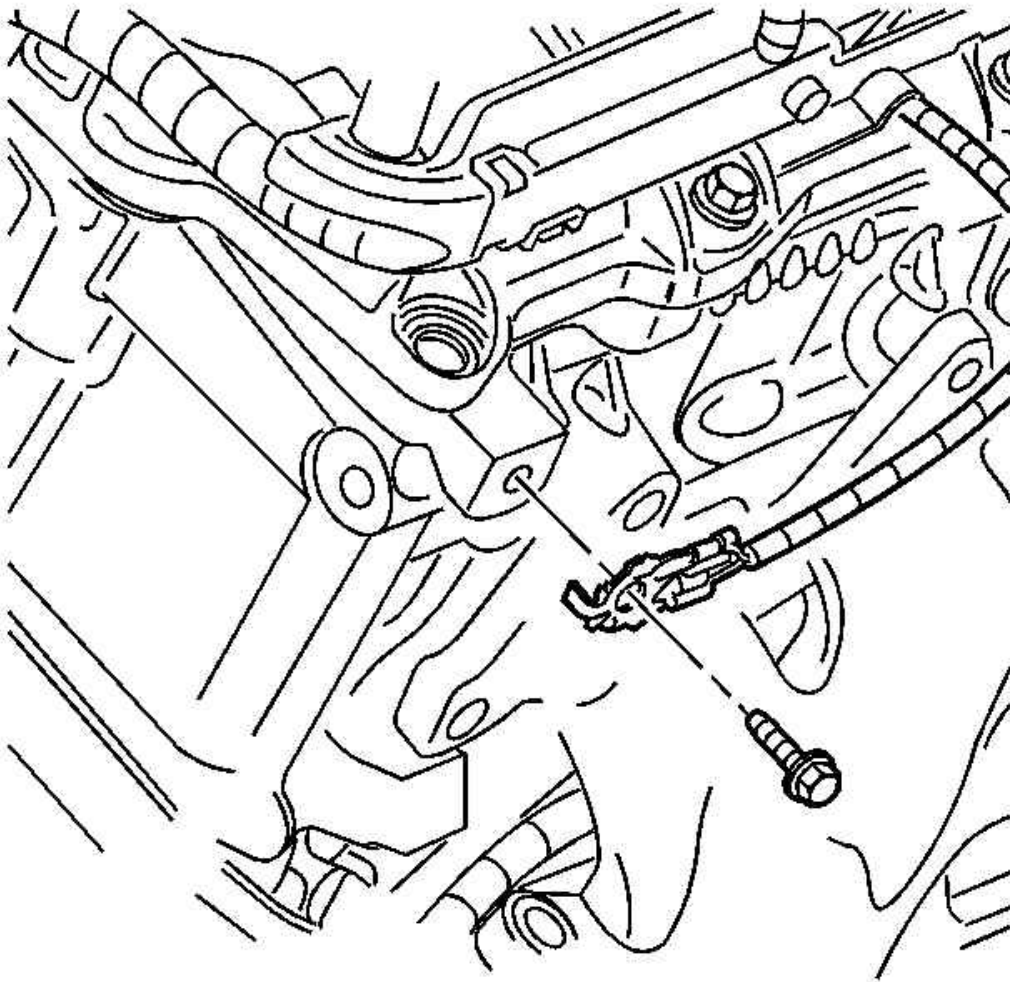


Fig. 9: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head

Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness ground from the side of the cylinder head.

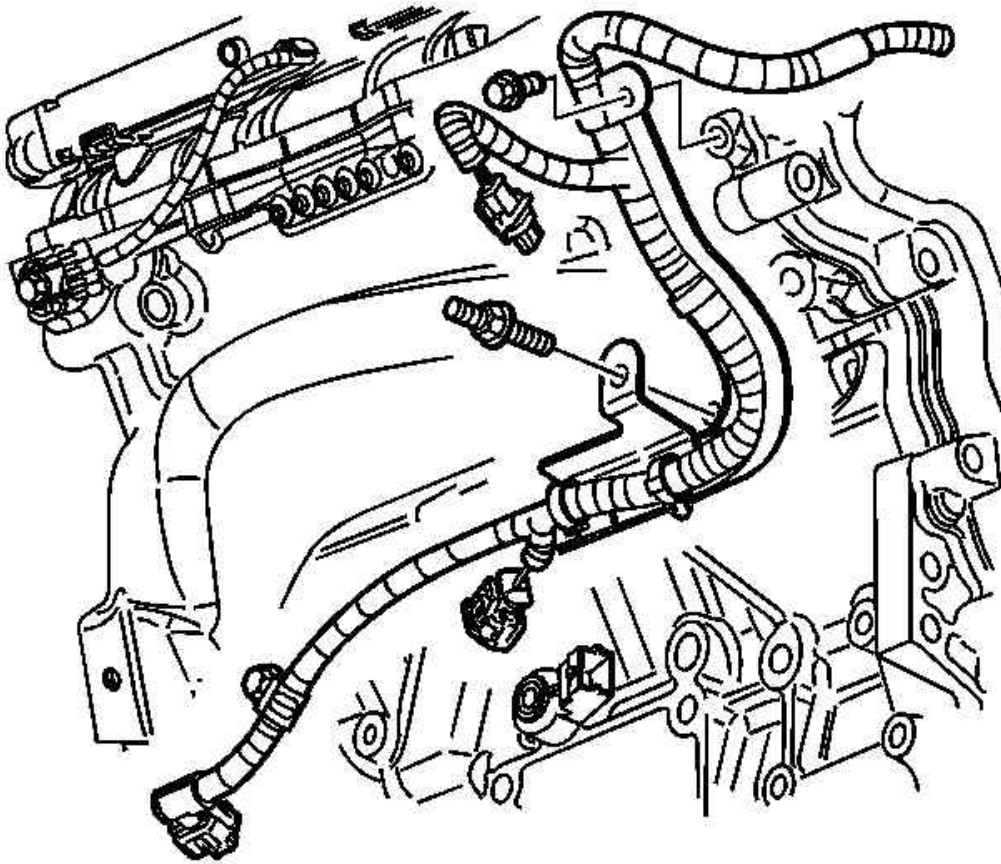


Fig. 10: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud

Courtesy of GENERAL MOTORS CORP.

5. Remove the wiring harness conduit upper bolt from the cylinder head and reposition the conduit to provide access.
6. Remove the battery cable from the cylinder head. Refer to **Battery Negative Cable Replacement (LY7)** .

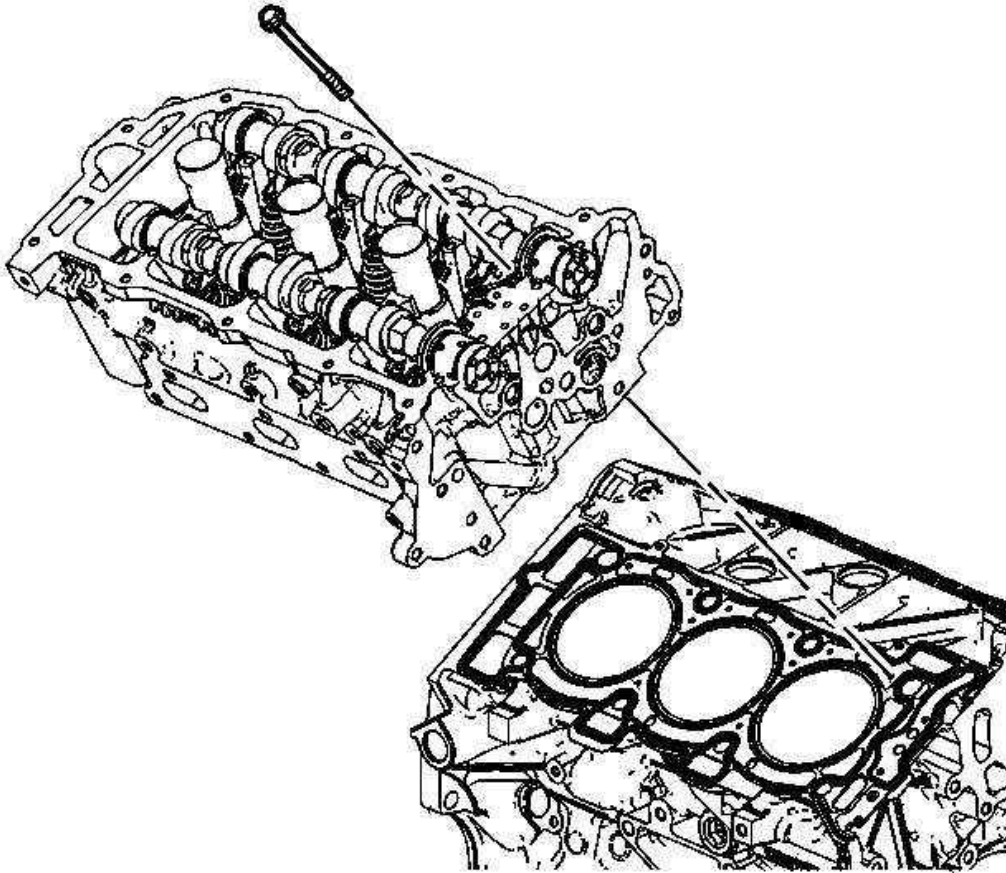


Fig. 11: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

7. Remove the cylinder head with the exhaust manifold. Refer to **Cylinder Head Removal - Left Side**.

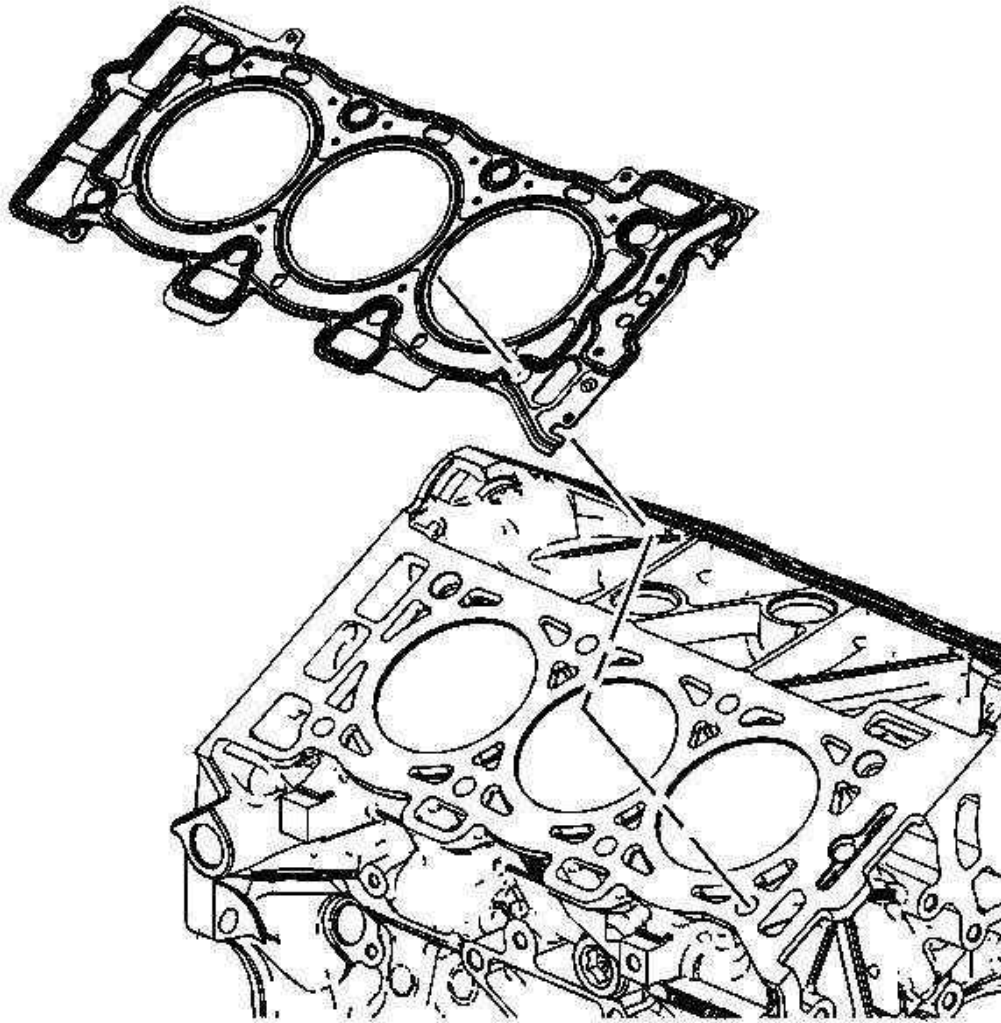


Fig. 12: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

8. Remove and discard the cylinder head gasket.
9. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** and **Engine Block Cleaning and Inspection** .
10. If necessary, perform the following steps:

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- Remove the exhaust manifold from the cylinder head. Refer to **Exhaust Manifold Removal - Left Side**.
- Disassemble the cylinder head. Refer to **Cylinder Head Disassemble** .

Installation Procedure

1. If necessary, perform the following steps:
 - Assemble the cylinder head. Refer to **Cylinder Head Assemble** .
 - Install the exhaust manifold to the cylinder head. Refer to **Exhaust Manifold Installation - Left Side** .

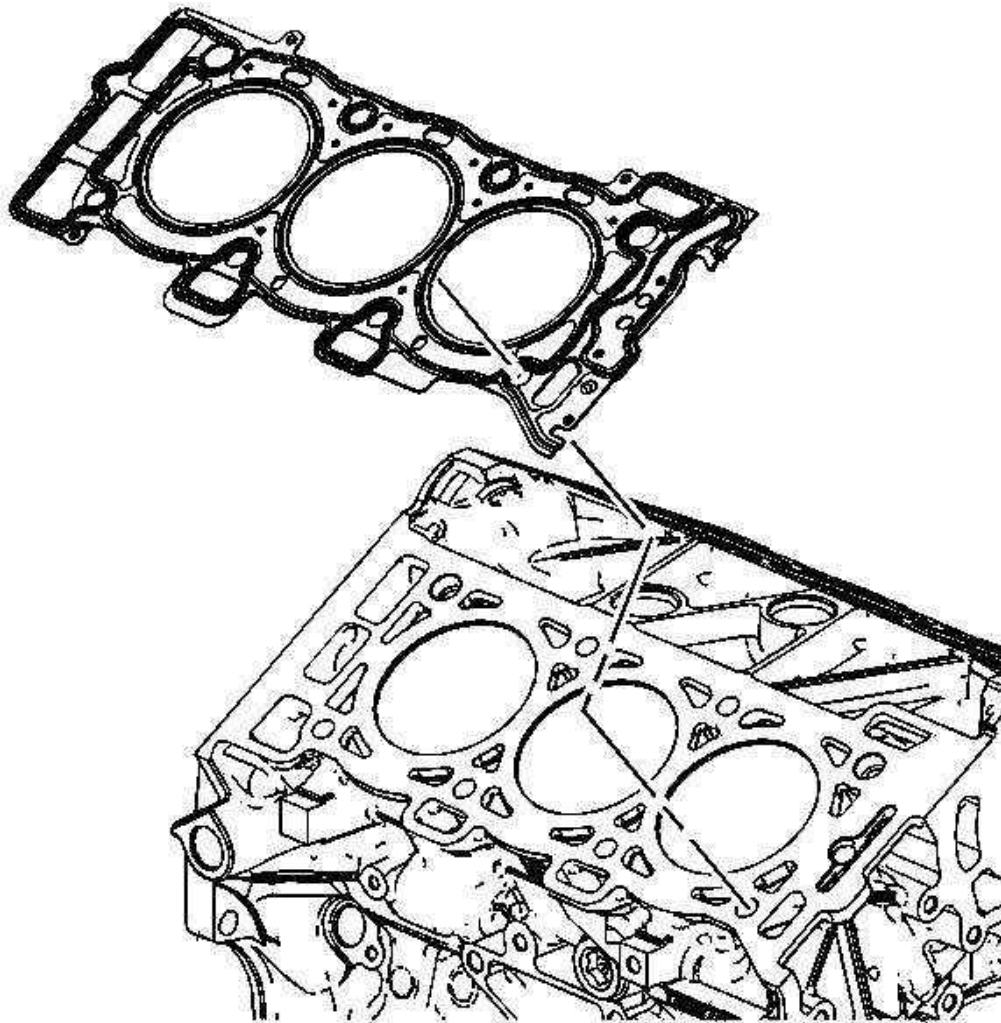


Fig. 13: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW cylinder head gasket.

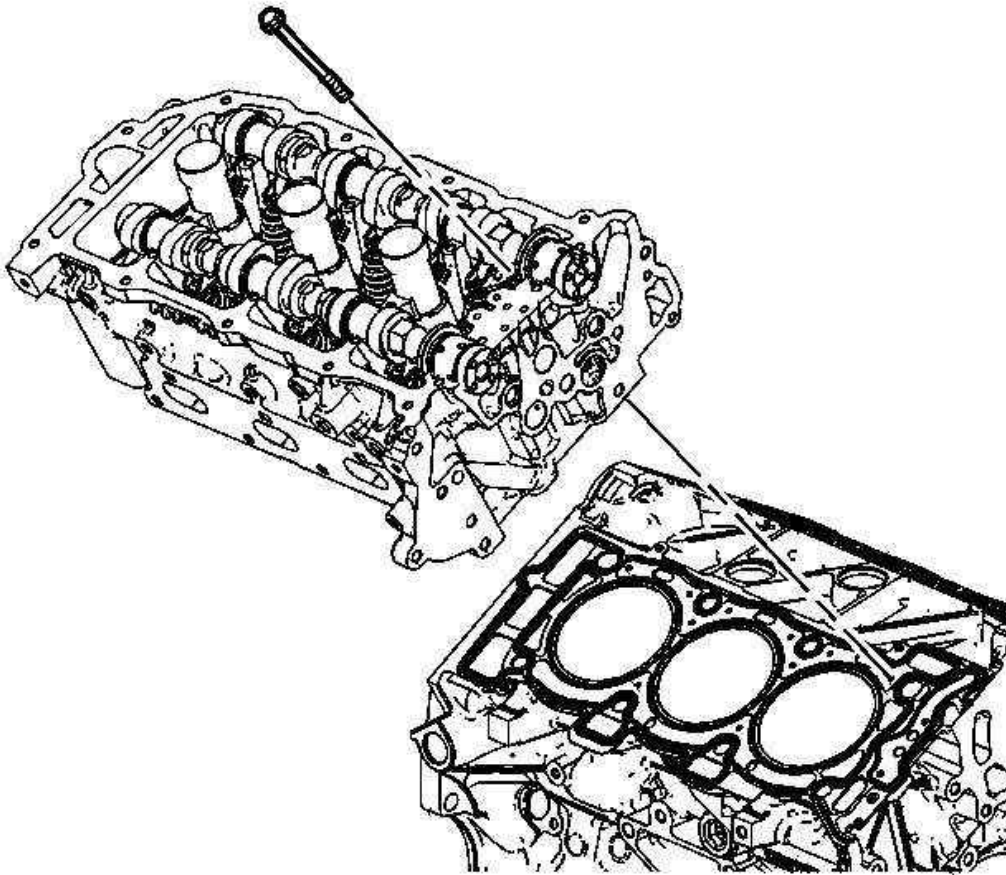


Fig. 14: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Carefully install the cylinder head with the exhaust manifold to the engine. Refer to **Cylinder Head Installation - Left Side** .
4. Connect the catalytic converter to the exhaust manifold.
5. Install the battery negative cable to the cylinder head. Refer to **Battery Negative Cable Replacement (LY7)** .

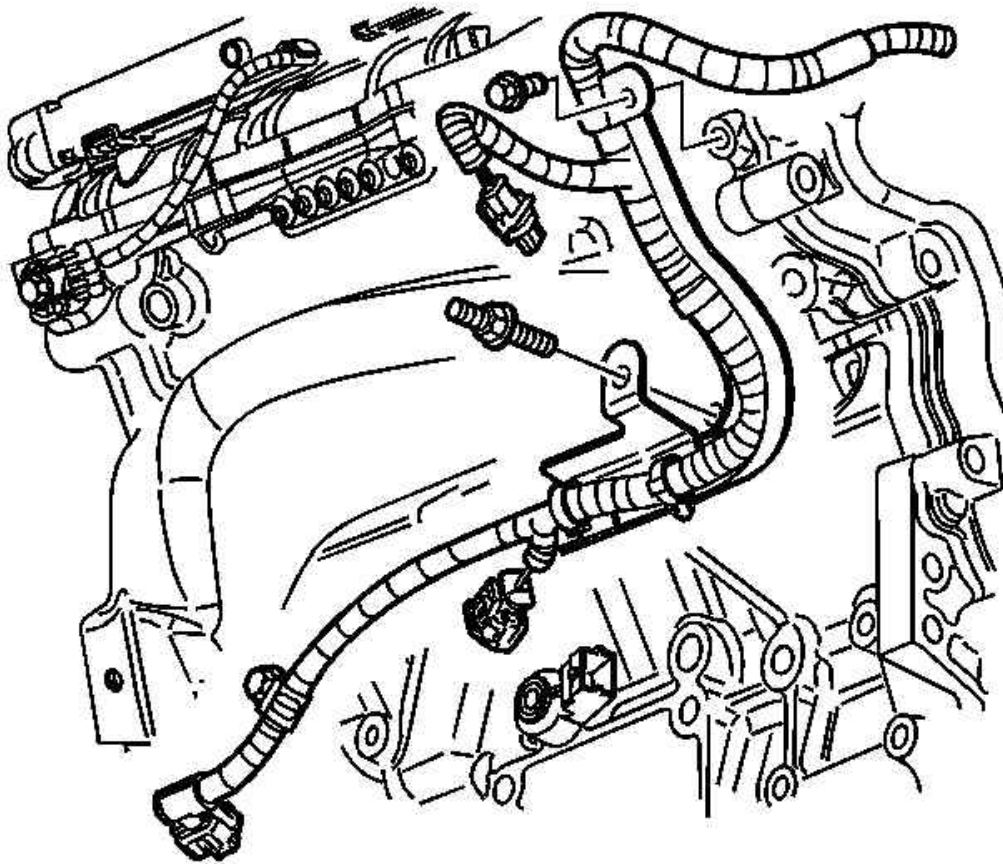


Fig. 15: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

6. Install the wiring harness conduit to the cylinder head.

Tighten: Tighten the wiring harness upper bolt to 10 N.m (89 lb in).

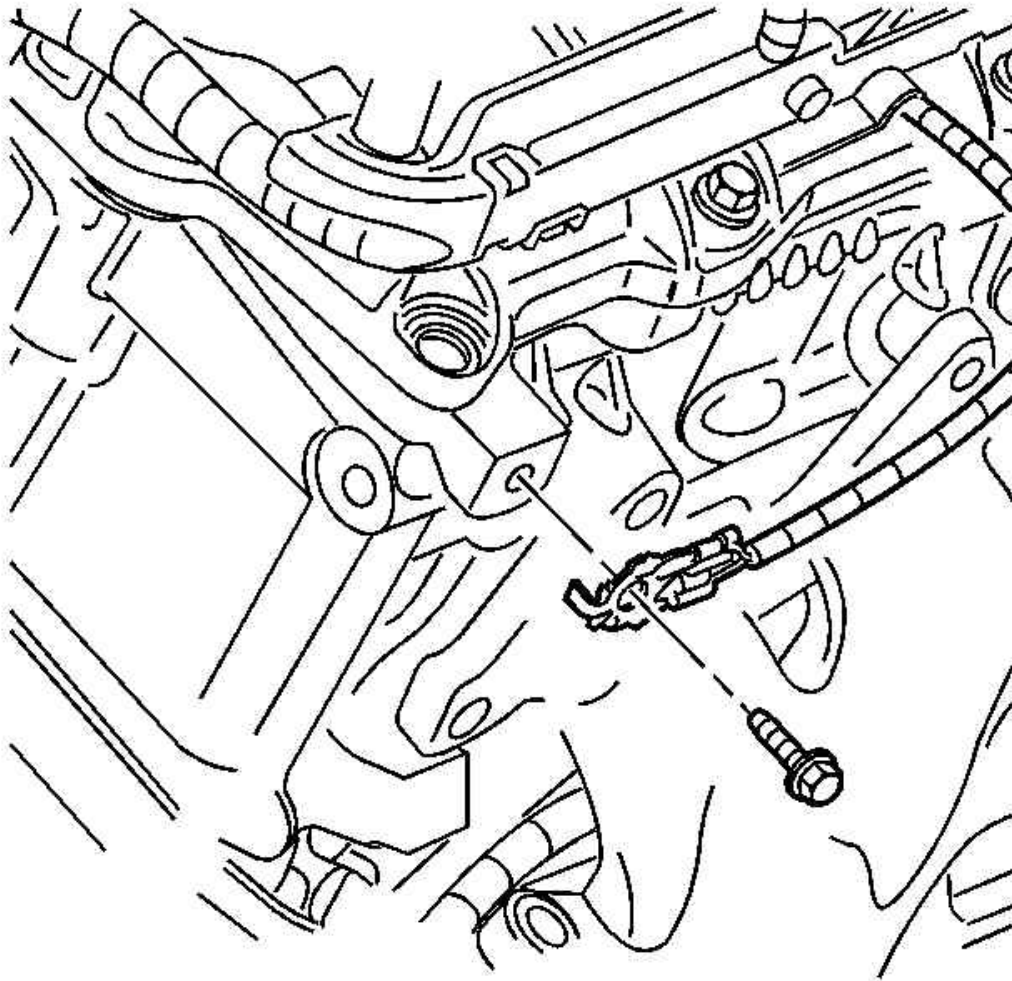


Fig. 16: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head

Courtesy of GENERAL MOTORS CORP.

7. Install the wiring harness ground to the side of the cylinder head.

Tighten: Tighten the wiring harness ground bolt to 10 N.m (89 lb in).

8. Install the catalytic converter. Refer to **Catalytic Converter Replacement** .
9. Install the coolant inlet pipe.

Tighten:

- Tighten the coolant inlet pipe-to-cylinder head bolt to 50 N.m (37 lb ft).
- Tighten the coolant inlet pipe-to-thermostat housing bolt to 10 N.m (89 lb in).

10. Install the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Right Side** .

ENGINE FLYWHEEL REPLACEMENT

Removal Procedure

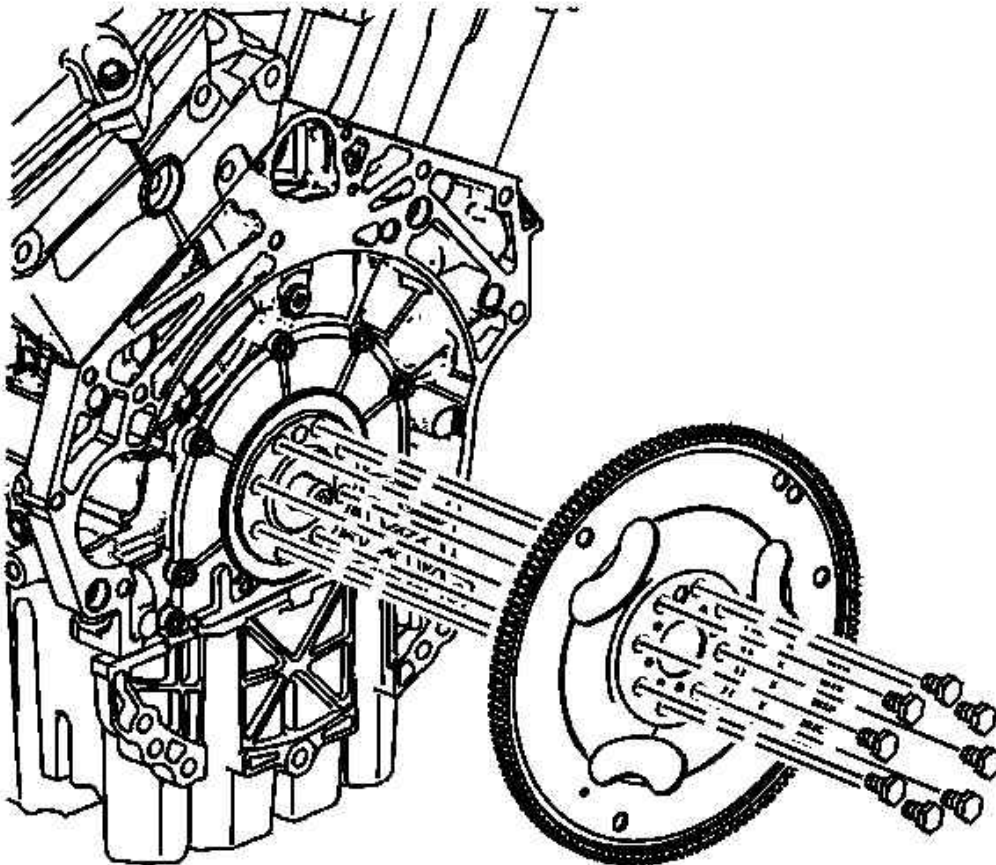


Fig. 17: View Of Engine Flywheel

Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission. Refer to **Transmission Replacement** .
2. Remove the engine flywheel bolts and the flywheel. Refer to **Engine Flywheel Removal**.
3. Clean and inspect the flywheel. Refer to **Engine Flywheel Cleaning and Inspection** . If the flywheel teeth are damaged, inspect the starter for proper operation. Replace the starter if there is excessive wear or damage to the starter drive. Refer to **Starter Motor Replacement (LY7)** .

Installation Procedure

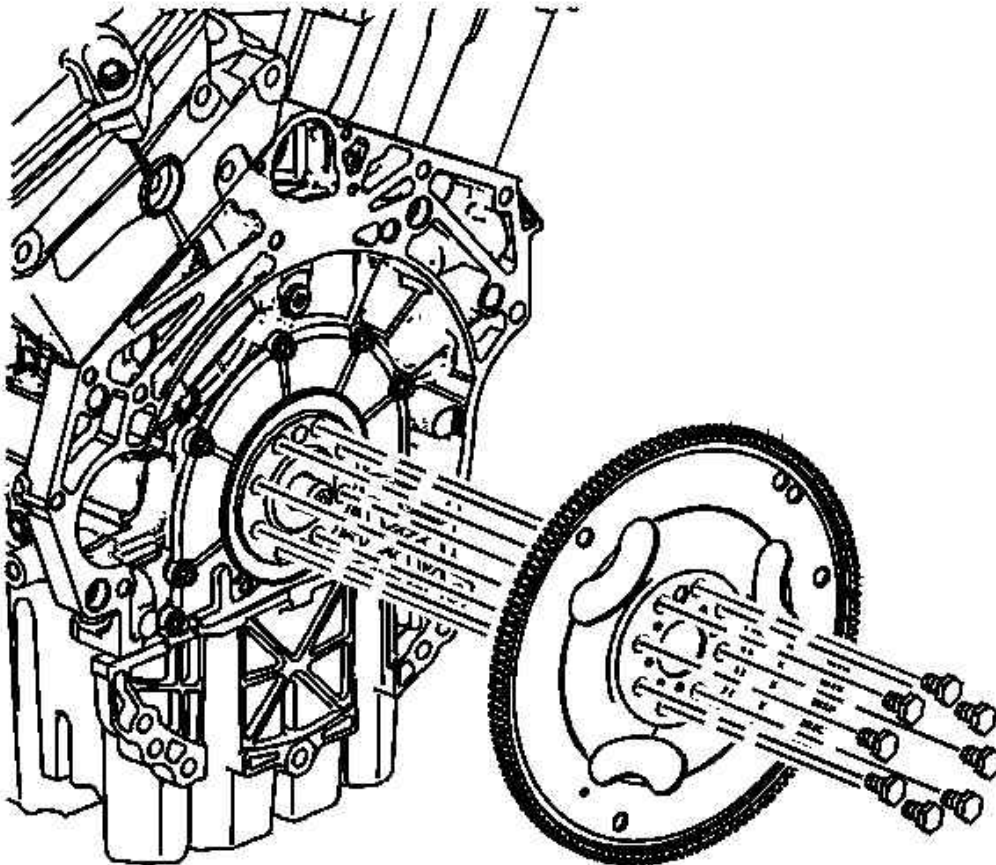


Fig. 18: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Install the engine flywheel. Refer to **Engine Flywheel Installation** .
2. Install the transmission. Refer to **Transmission Replacement** .

CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

Removal Procedure

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove the oil pan. Refer to **Oil Pan Replacement**.

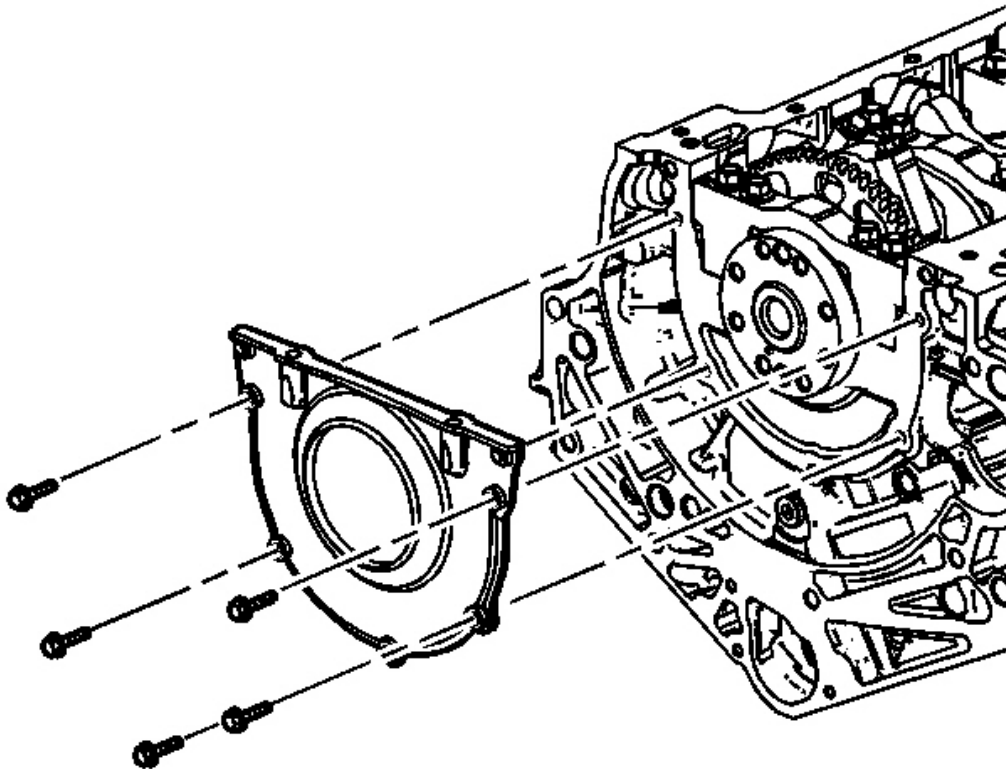


Fig. 19: View Of Crankshaft Rear Oil Seal And Housing
Courtesy of GENERAL MOTORS CORP.

3. Remove the crankshaft rear oil seal and housing. Refer to **Crankshaft Rear Oil Seal and Housing Removal** .

Installation Procedure

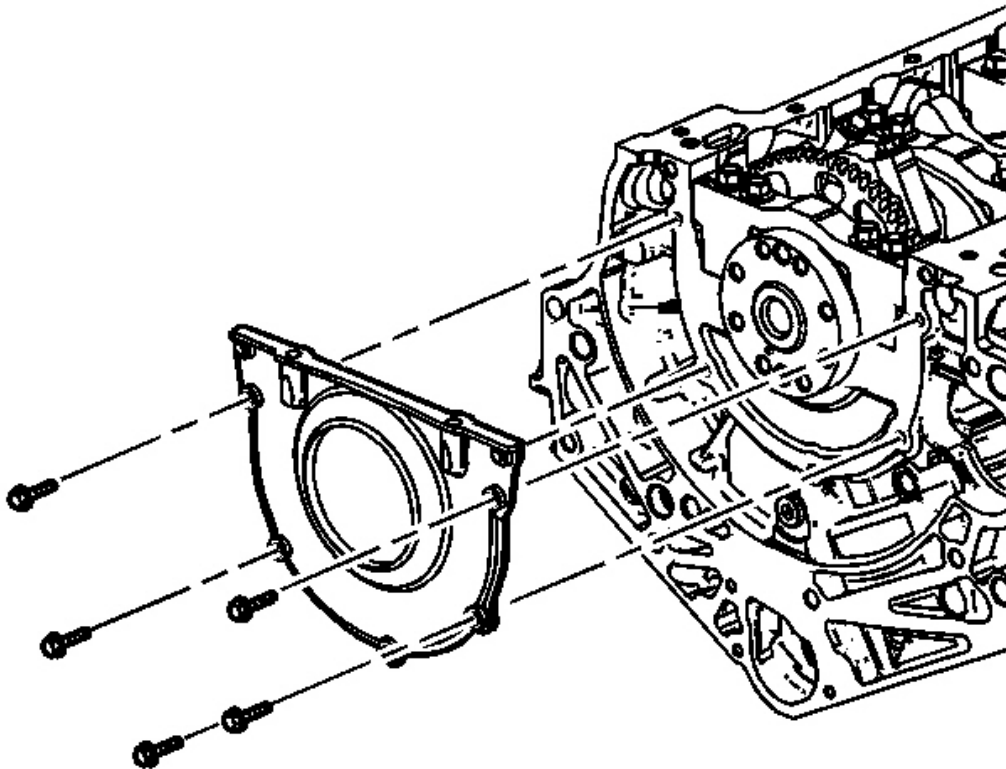


Fig. 20: View Of Crankshaft Rear Oil Seal And Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft rear oil seal and housing. Refer to **Crankshaft Rear Oil Seal and Housing Installation** .
2. Install the oil pan. Refer to **Oil Pan Replacement**.
3. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

OIL PUMP REPLACEMENT

Removal Procedure

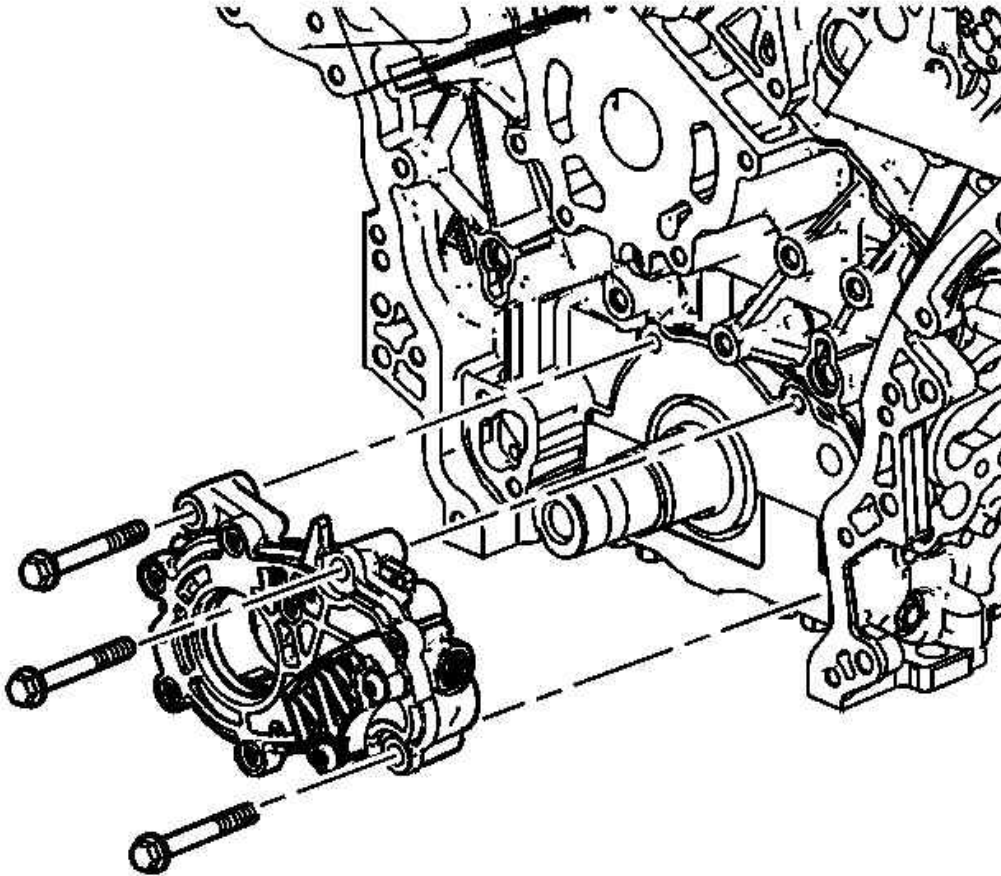


Fig. 21: View Of Oil Pump & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the left bank idler sprocket.

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

Installation Procedure

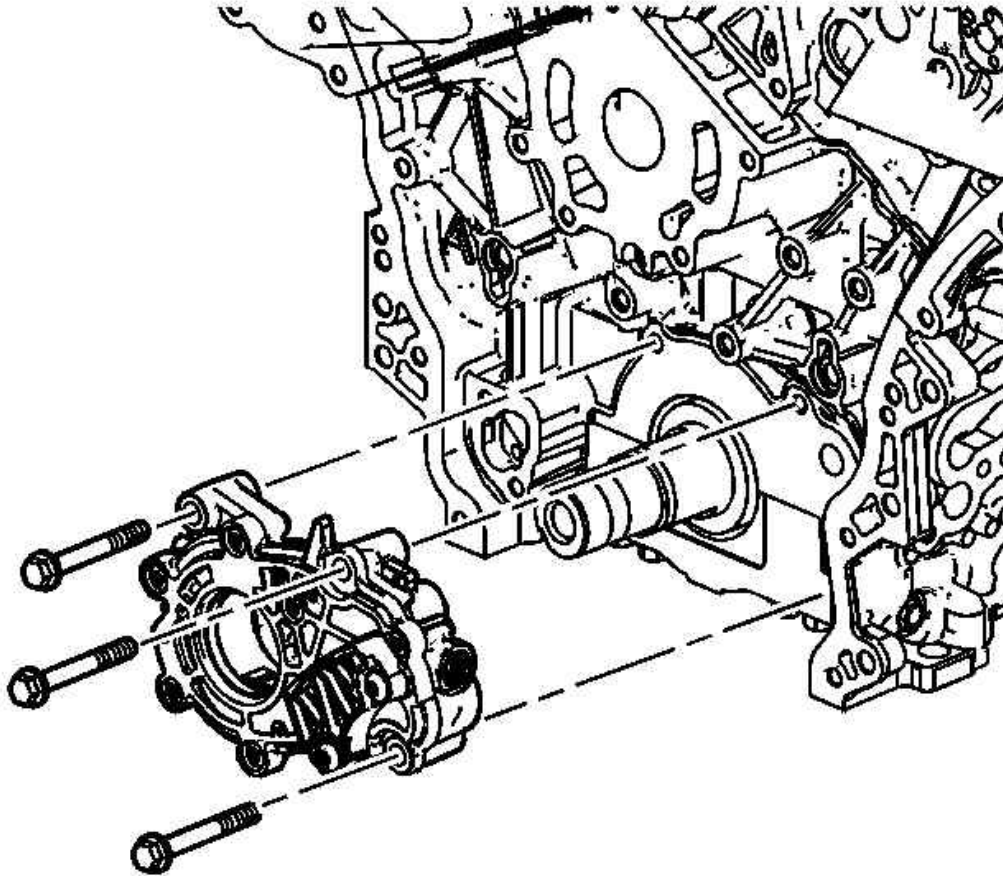


Fig. 22: View Of Oil Pump & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

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

Removal Procedure

1. Remove the tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
2. Remove the oil level indicator.
3. Remove the engine splash shields. Refer to **Engine Splash Shield Replacement** .
4. Drain the engine of oil.

IMPORTANT: In the following service procedure, **DO NOT** remove the brake calipers. Relocate them to the side and properly support them.

5. Remove the brake calipers and relocate to the side. Refer to **Front Brake Caliper Replacement** .

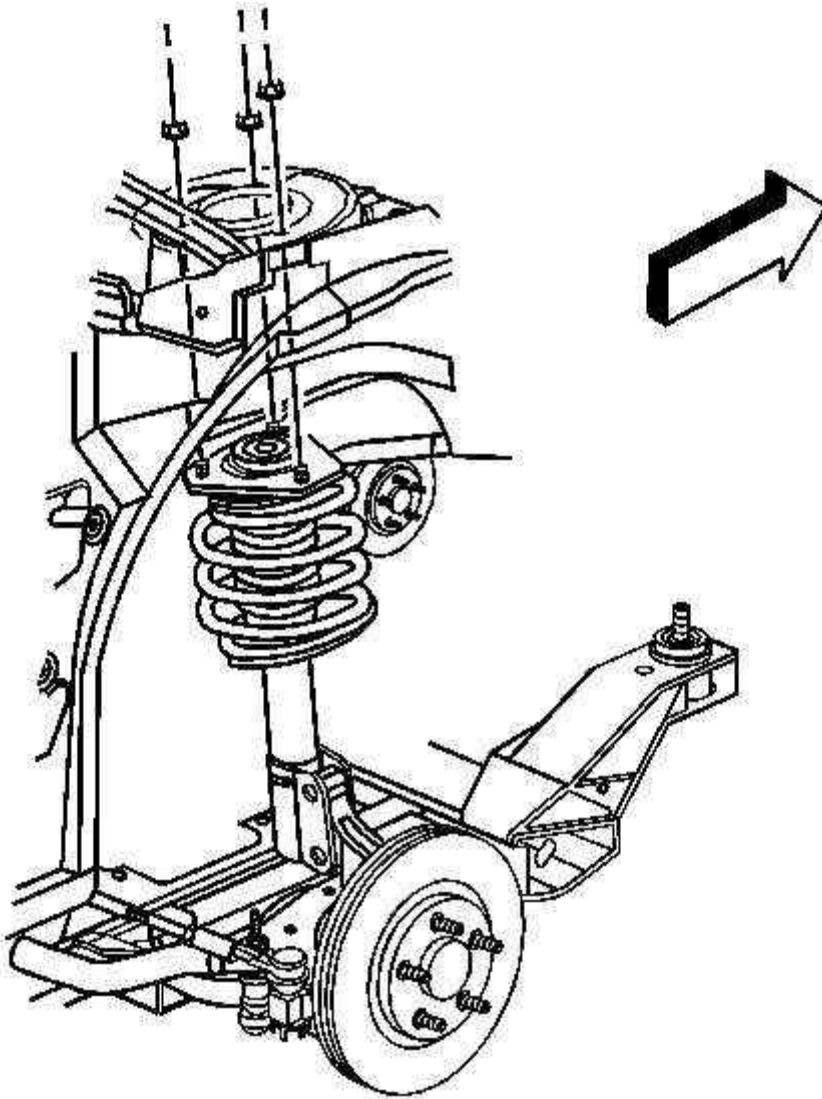


Fig. 23: Identifying Strut Upper Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the retaining bolts for the struts.

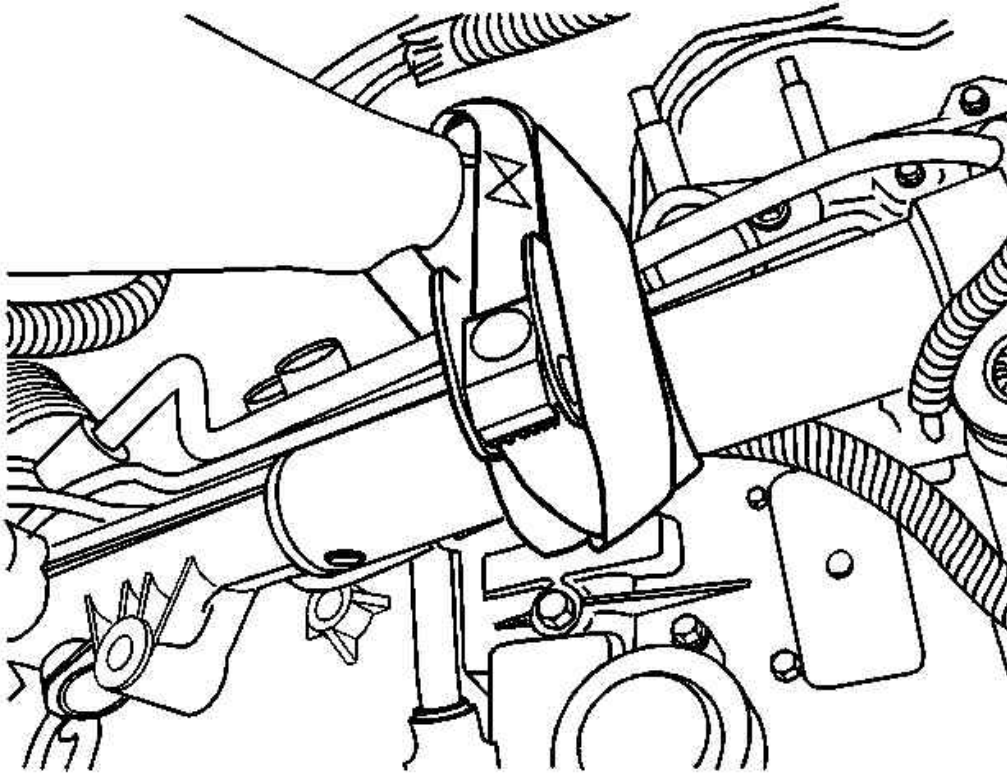


Fig. 24: Securing Power Steering Gear To Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: In the following service procedure, **DO NOT** remove the steering rack from the vehicle. Relocate the steering rack and support the steering rack.

7. Remove the steering rack from the frame. Refer to **Steering Gear Replacement** .
8. Remove the tie rods from the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .
9. Remove the power steering cooler lines from the retainers on the frame.
10. Remove the transmission cooler lines from the retainers on the frame.

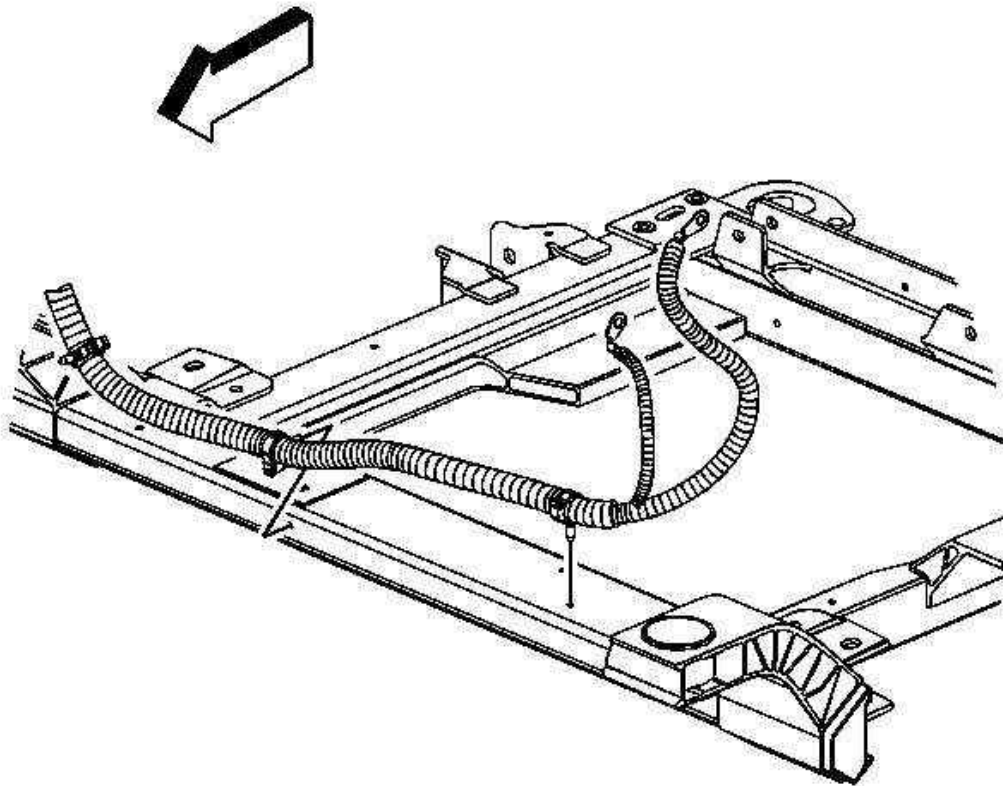


Fig. 25: View Of Wiring Harness, Retainers and Cradle
Courtesy of GENERAL MOTORS CORP.

11. Remove the battery cable wiring harness from the retainers on the frame.

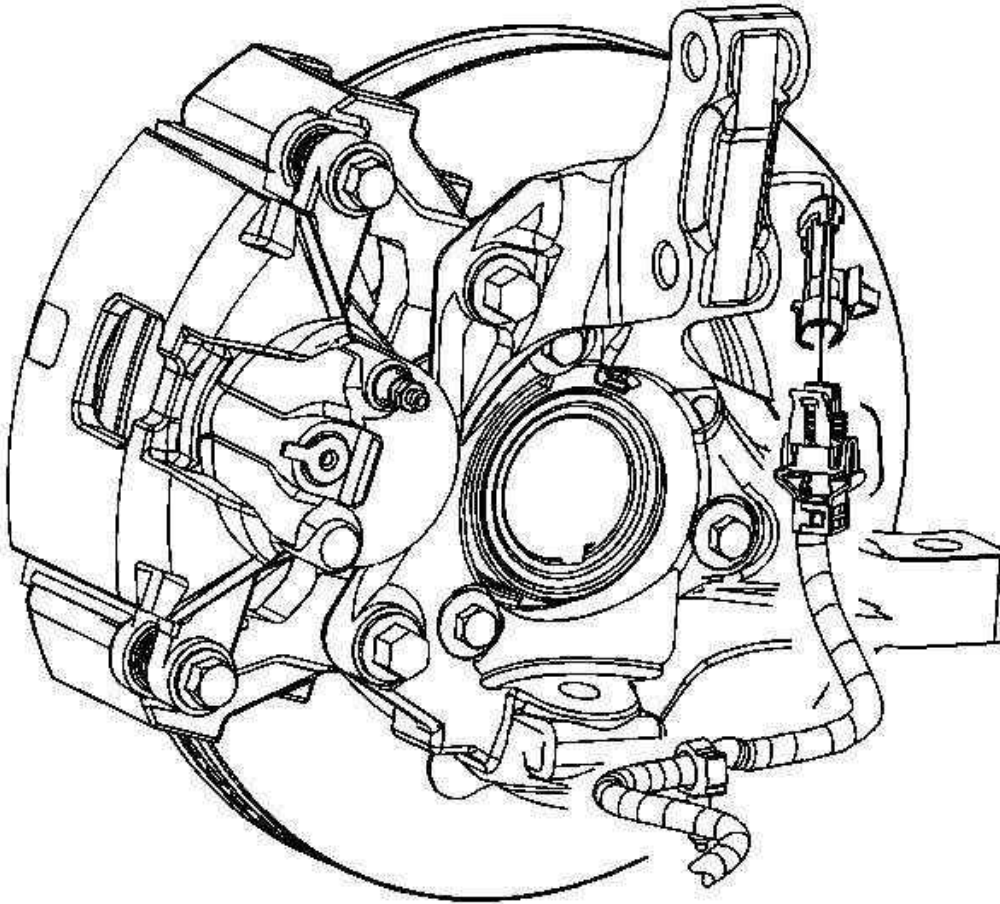


Fig. 26: Locating Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the speed sensor electrical connectors.

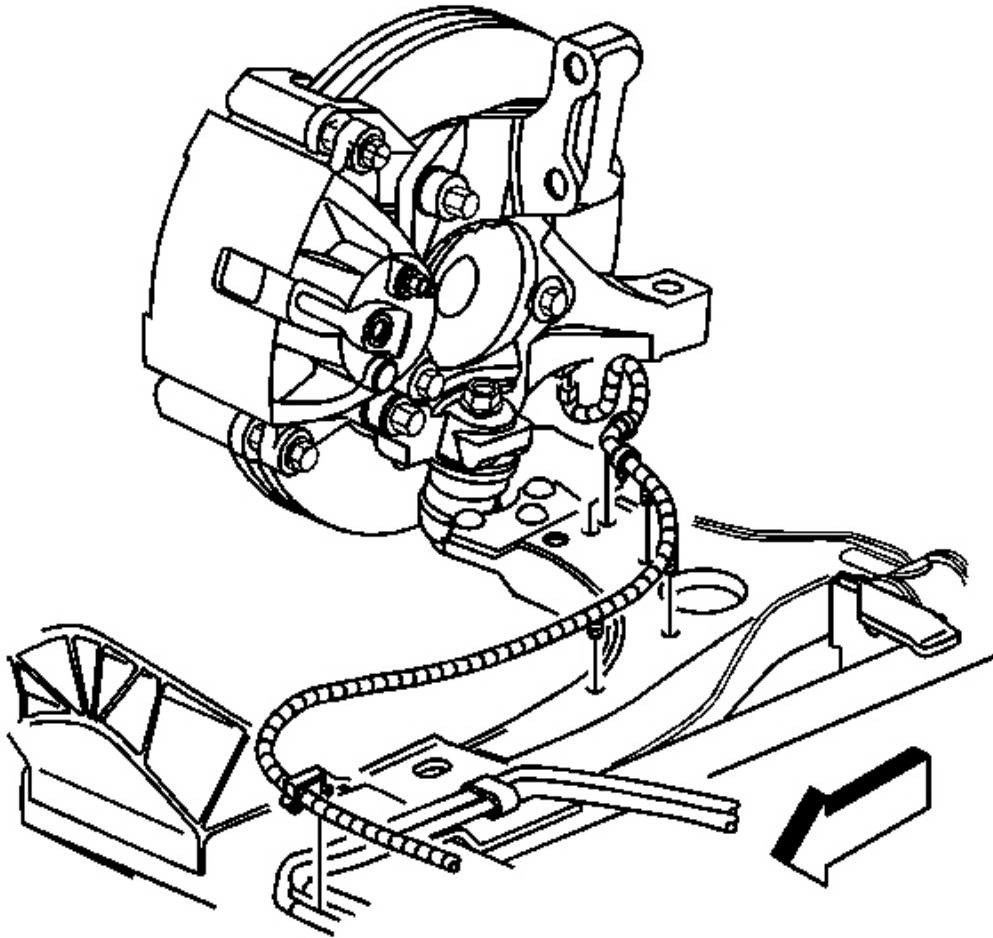


Fig. 27: View Of Front Wheel Speed Sensor Harness Connectors
Courtesy of GENERAL MOTORS CORP.

13. Remove the speed sensor wiring harness from the retainers on the frame.

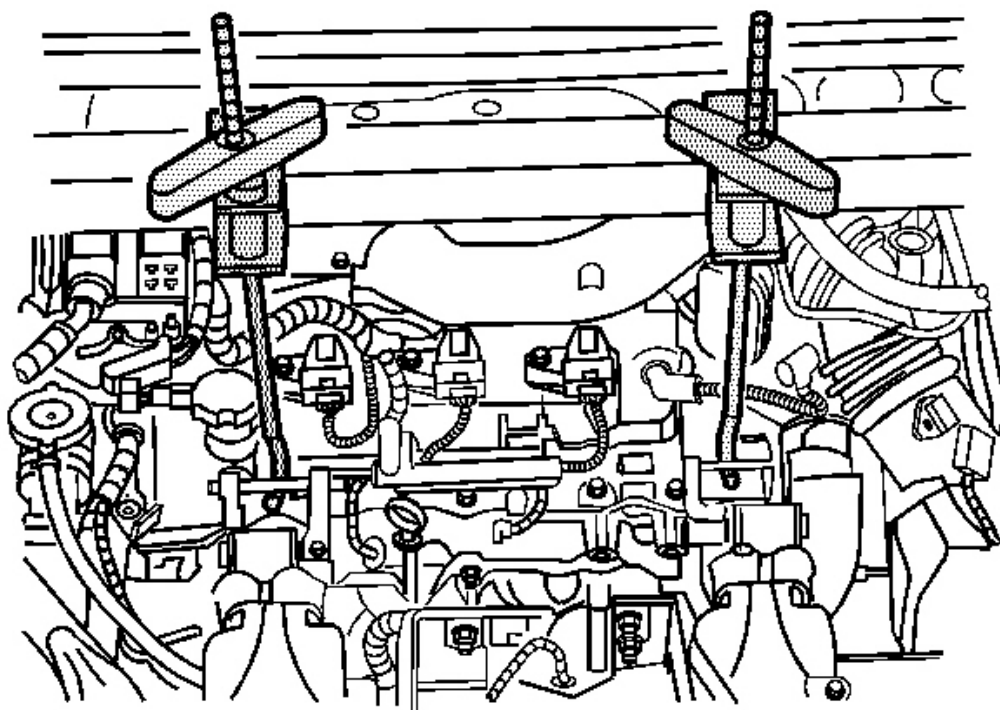


Fig. 28: Identifying J 28467-34

Courtesy of GENERAL MOTORS CORP.

14. Install the engine support fixture. Refer to **Engine Support Fixture** .

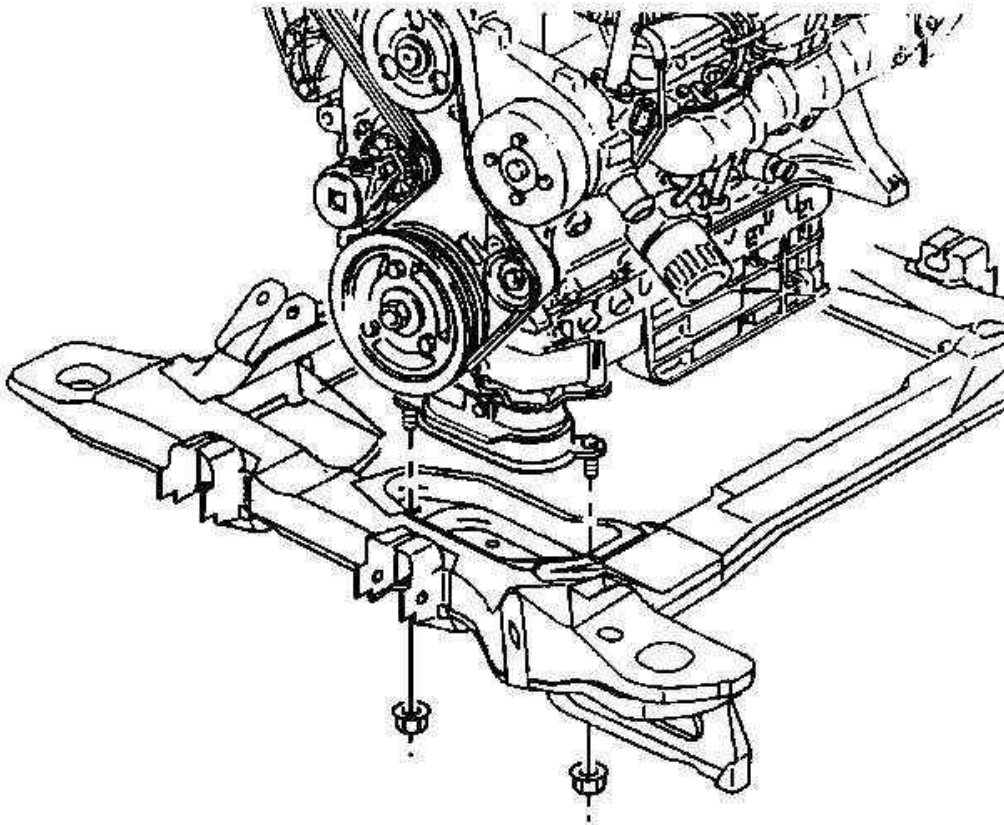


Fig. 29: Identifying Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

15. Remove the right engine mount nuts.
16. Remove the transmission mount bolts.
17. Remove the engine mount struts. Refer to the following procedures:
 - **Engine Mount Strut Replacement - Left Side**
 - **Engine Mount Strut Replacement - Right Side**

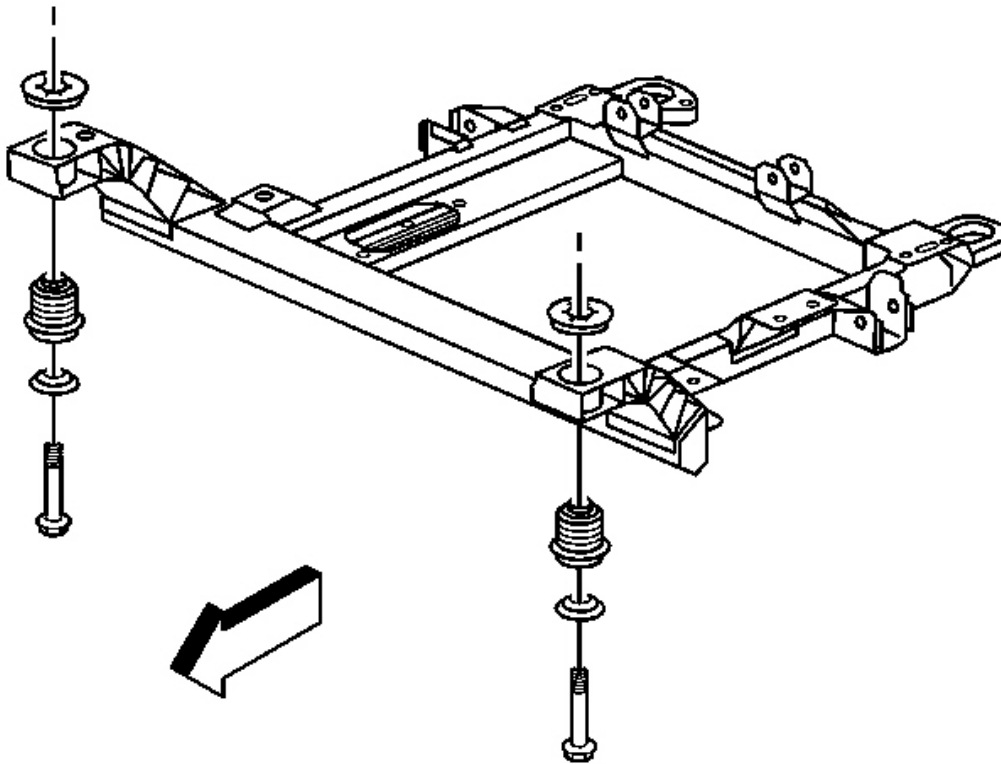


Fig. 30: View Of Bolts From Front Frame Of Body
Courtesy of GENERAL MOTORS CORP.

18. Remove the frame mounting bolts. Front shown, rear similar.

IMPORTANT: Before lowering the frame, make sure that all transmission lines, power steering lines, and electrical harness have been disconnected and relocated to ensure that nothing will be damaged while lowering the frame.
Lower the frame enough to remove the oil pan assembly.

19. Lower the frame. Refer to **Frame Replacement** .

20. Disconnect the oil level sensor electrical connector.

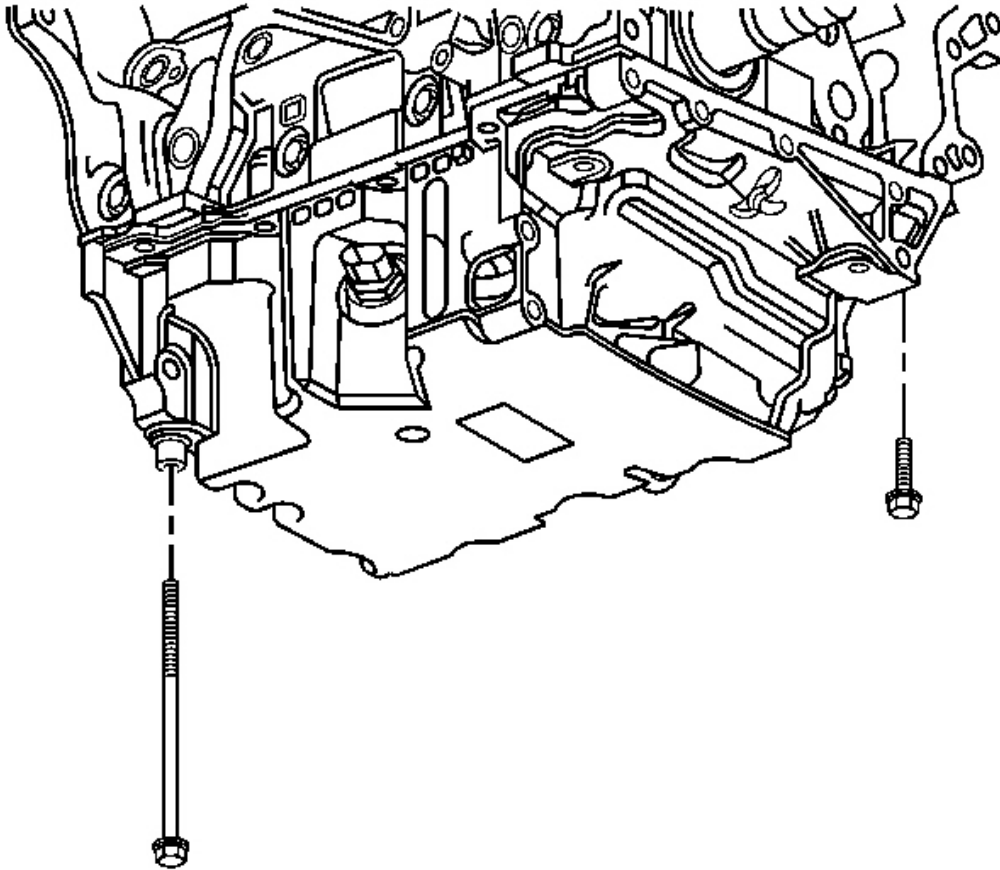


Fig. 31: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

21. Remove the oil pan bolts.

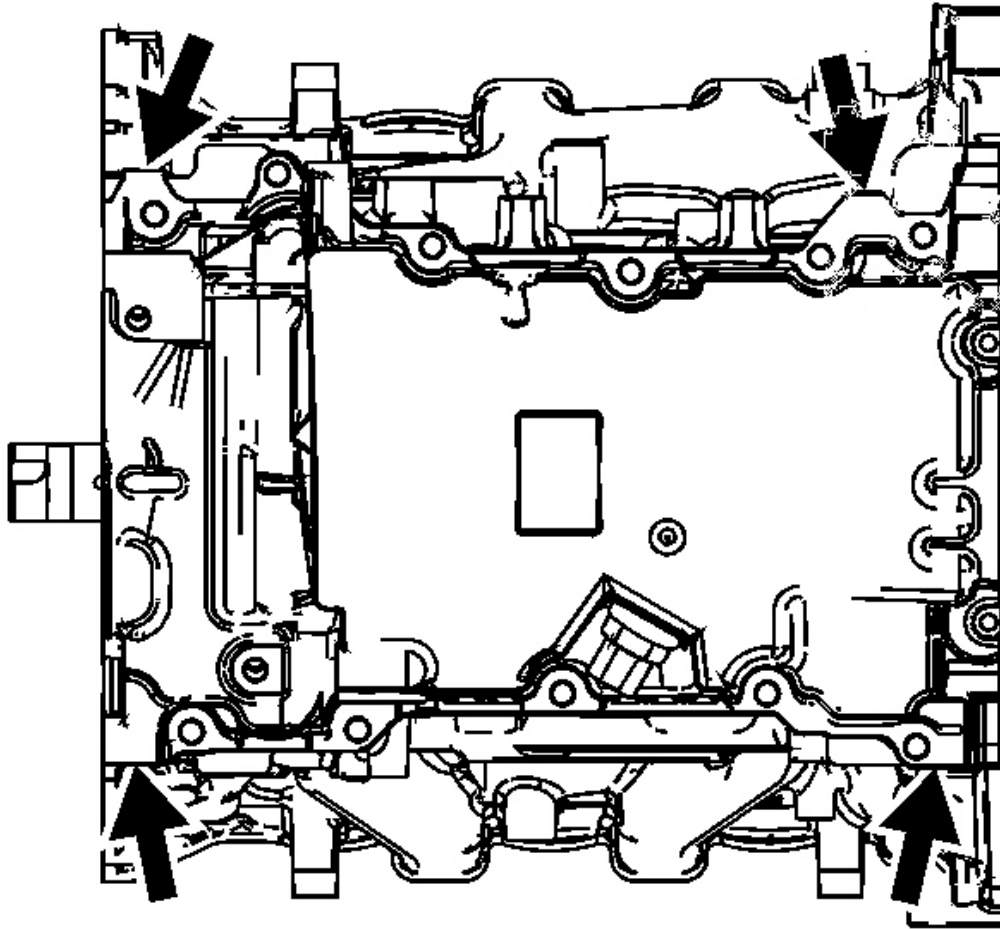


Fig. 32: Identifying Pry Points On Edge Of Oil Pan
Courtesy of GENERAL MOTORS CORP.

22. Using the pry points on the oil pan, separate the oil pan from the engine block.

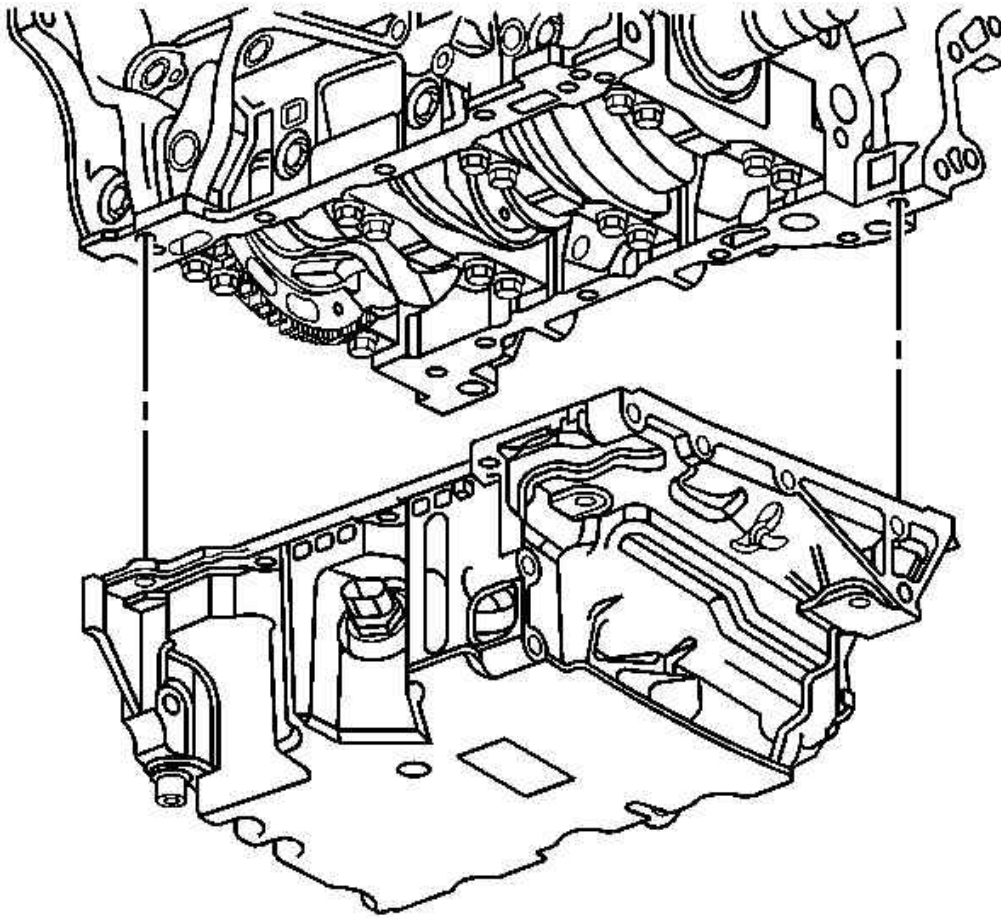


Fig. 33: View Of Oil Pan

Courtesy of GENERAL MOTORS CORP.

23. Remove the oil pan from the vehicle.
24. Disassemble the oil pan. Refer to **Oil Pan Disassemble** .

Installation Procedure

1. Assemble the oil pan. Refer to **Oil Pan Assemble** .

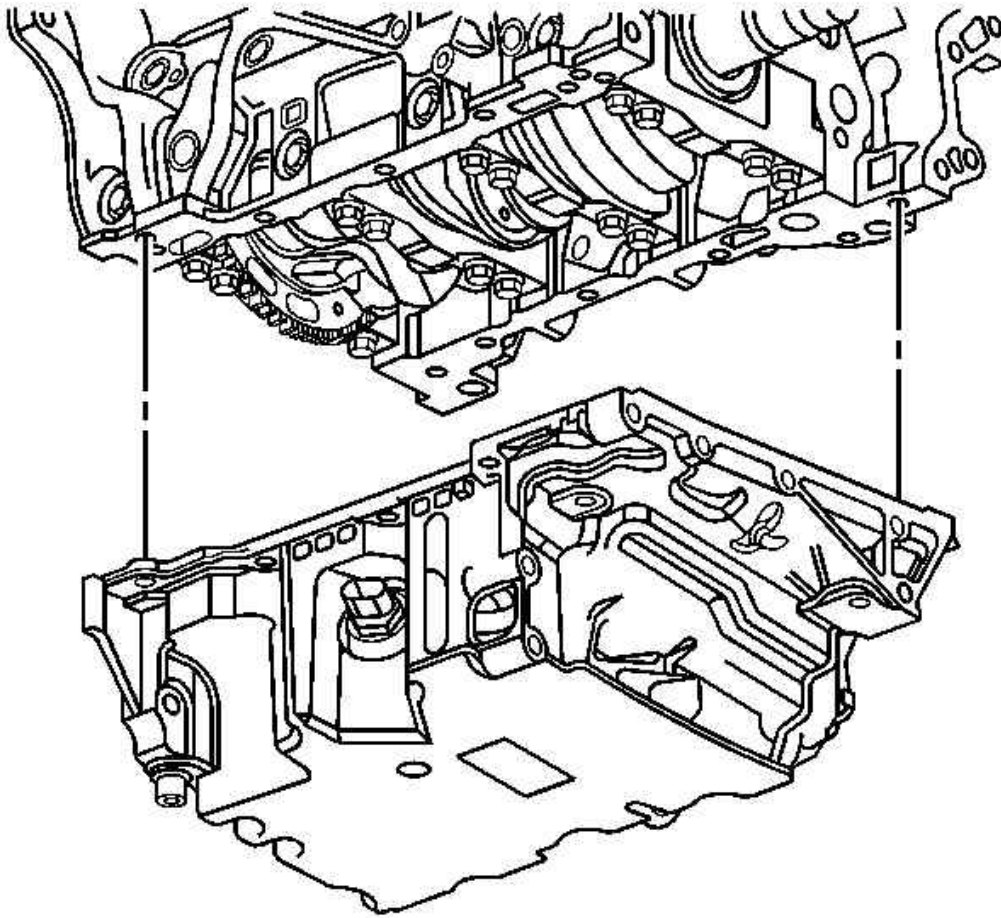


Fig. 34: View Of Oil Pan

Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan. Refer to **Oil Pan Installation** .
3. Connect the oil level sensor electrical connector.
4. Raise the frame. Refer to **Frame Replacement** .

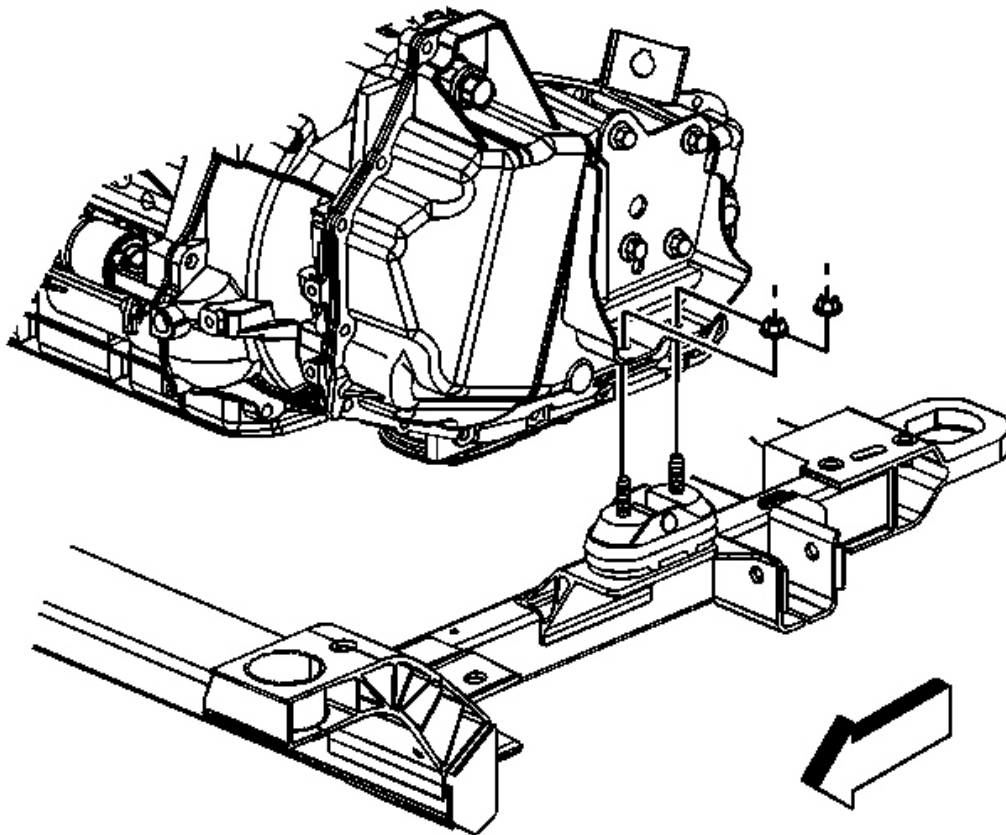


Fig. 35: View Of Transmission/Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

5. Install the transmission mount bolts. Refer to **Transmission Mount Replacement - Left Side** .
6. Install the engine mount struts. Refer to the following procedures:
 - **Engine Mount Strut Replacement - Left Side**
 - **Engine Mount Strut Replacement - Right Side**

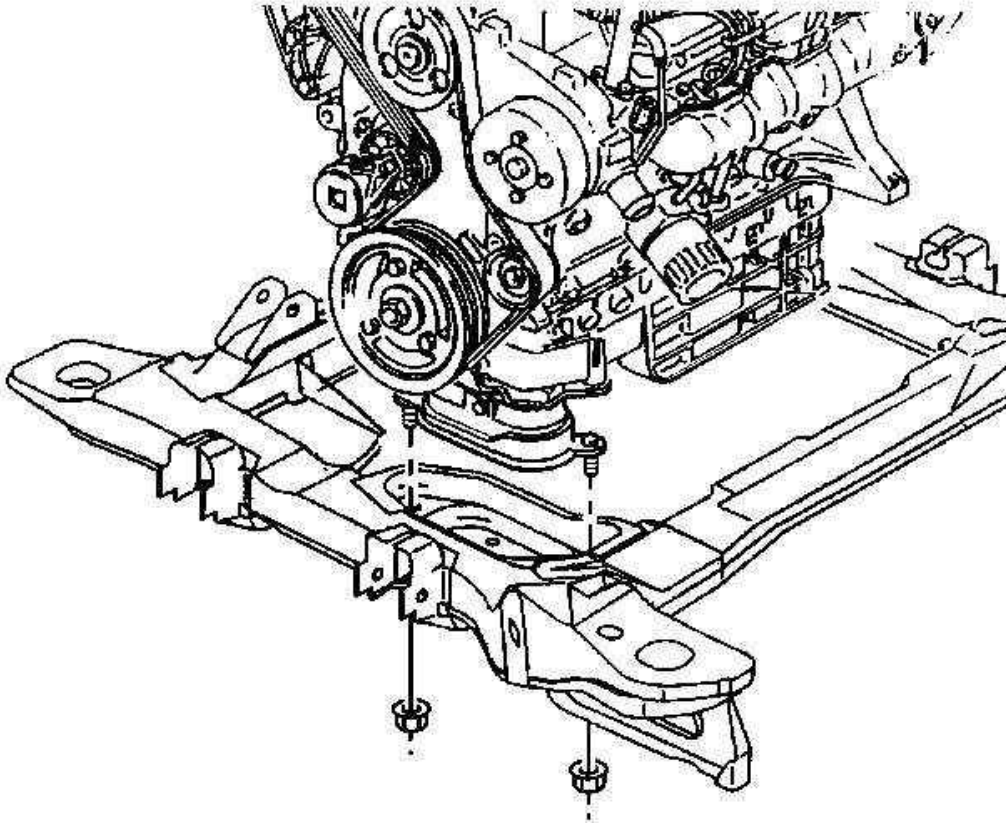


Fig. 36: Identifying Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

7. Install the right engine mount nuts. Refer to **Engine Mount Inspection** .

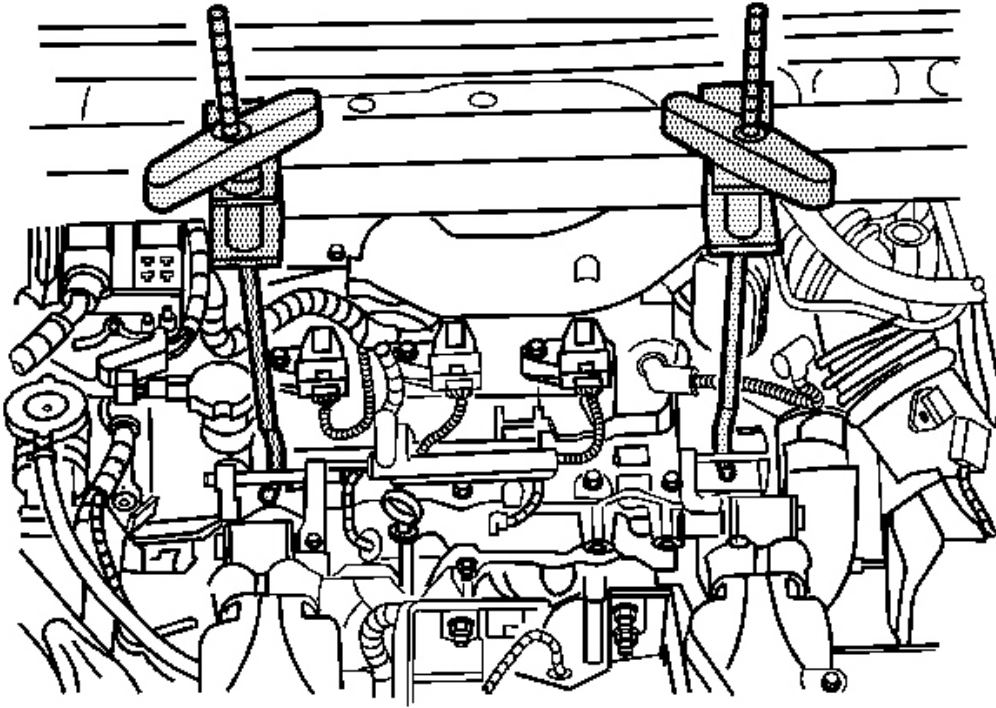


Fig. 37: Identifying J 28467-34

Courtesy of GENERAL MOTORS CORP.

8. Remove the engine support fixture. Refer to **Engine Support Fixture** .

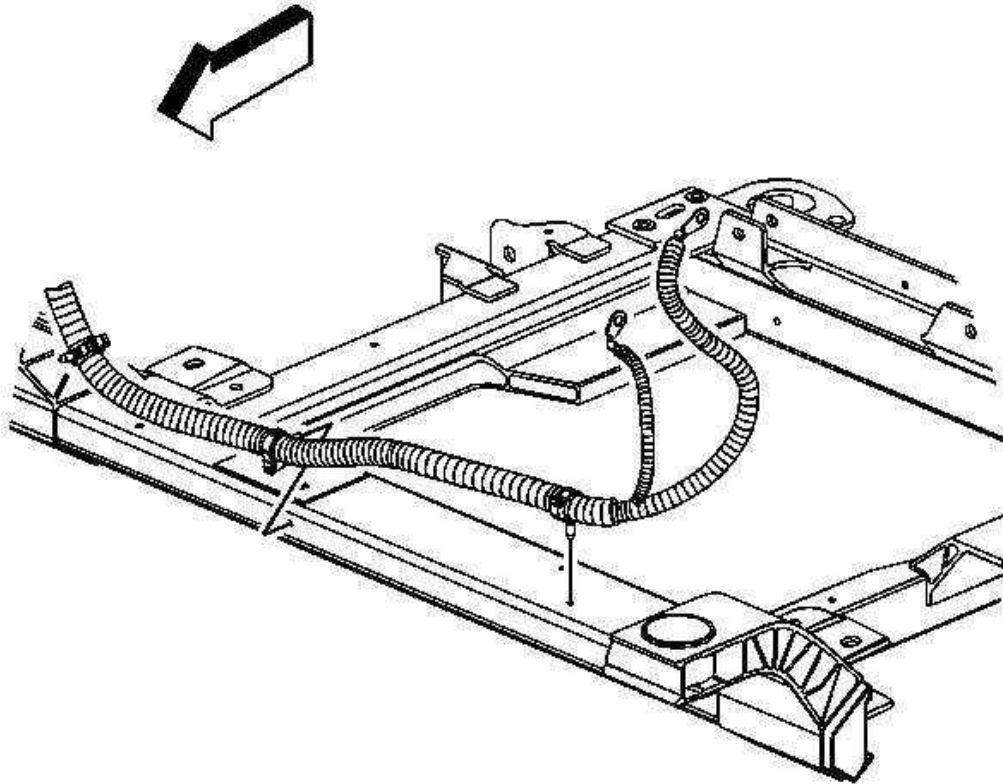


Fig. 38: View Of Wiring Harness, Retainers and Cradle
Courtesy of GENERAL MOTORS CORP.

9. Install the battery cable wiring harness in the retainers on the frame.

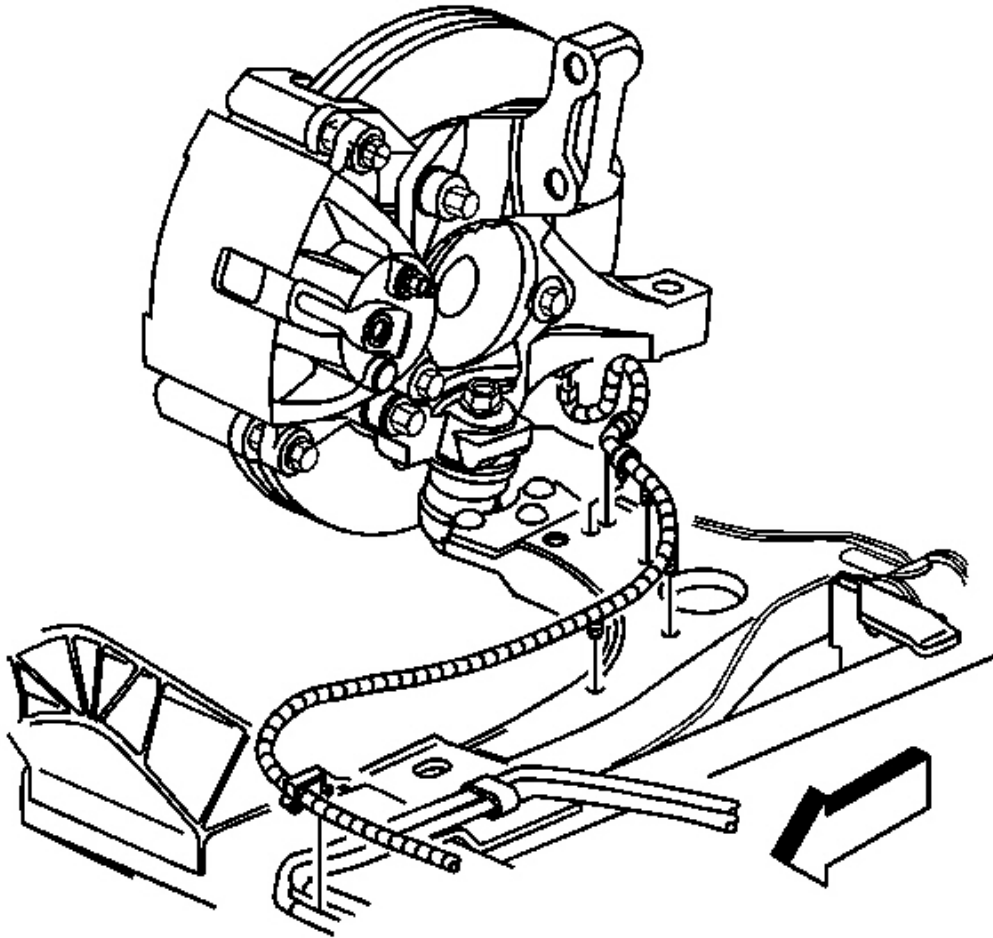


Fig. 39: View Of Front Wheel Speed Sensor Harness Connectors
Courtesy of GENERAL MOTORS CORP.

10. Install the speed sensor wiring harness in the retainers on the frame.

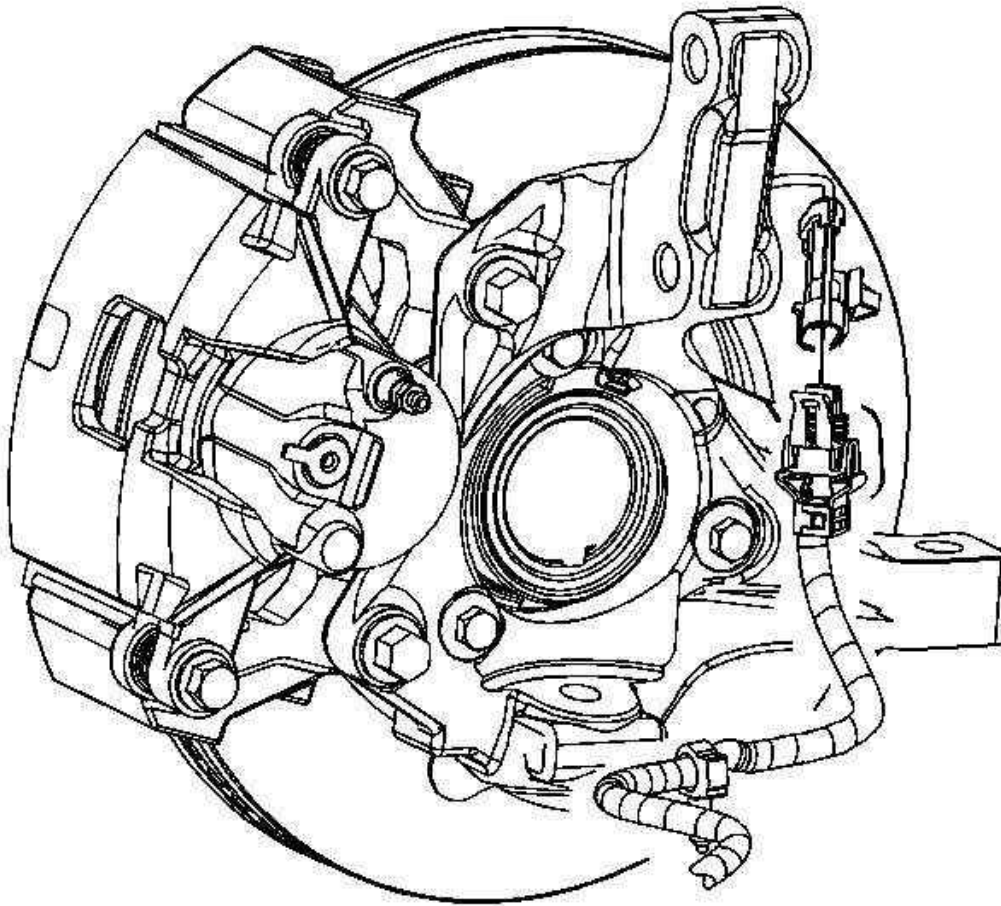


Fig. 40: Locating Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Connect the speed sensor electrical connectors.
12. Install the transmission cooler lines in the retainers on the frame.
13. Install the power steering lines in the retainers on the frame.

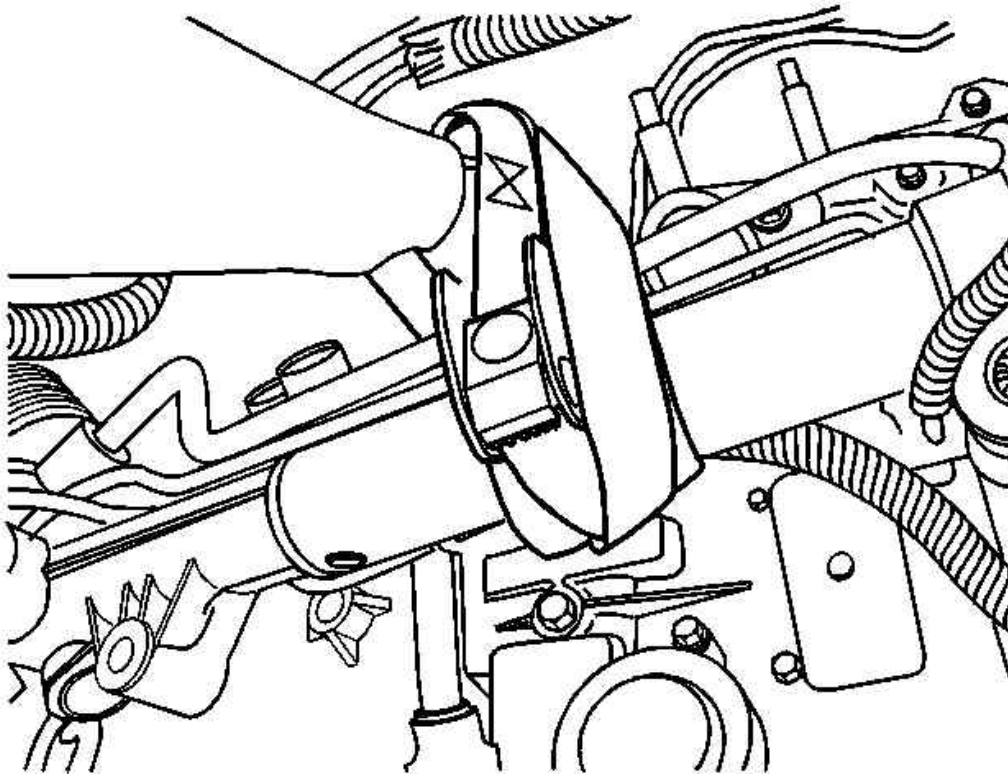


Fig. 41: Securing Power Steering Gear To Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

14. Install the steering rack on the frame. Refer to **Steering Gear Replacement** .
15. Install the tie rods in the steering knuckle. Refer to **Rack and Pinion Outer Tie Rod End Replacement** .

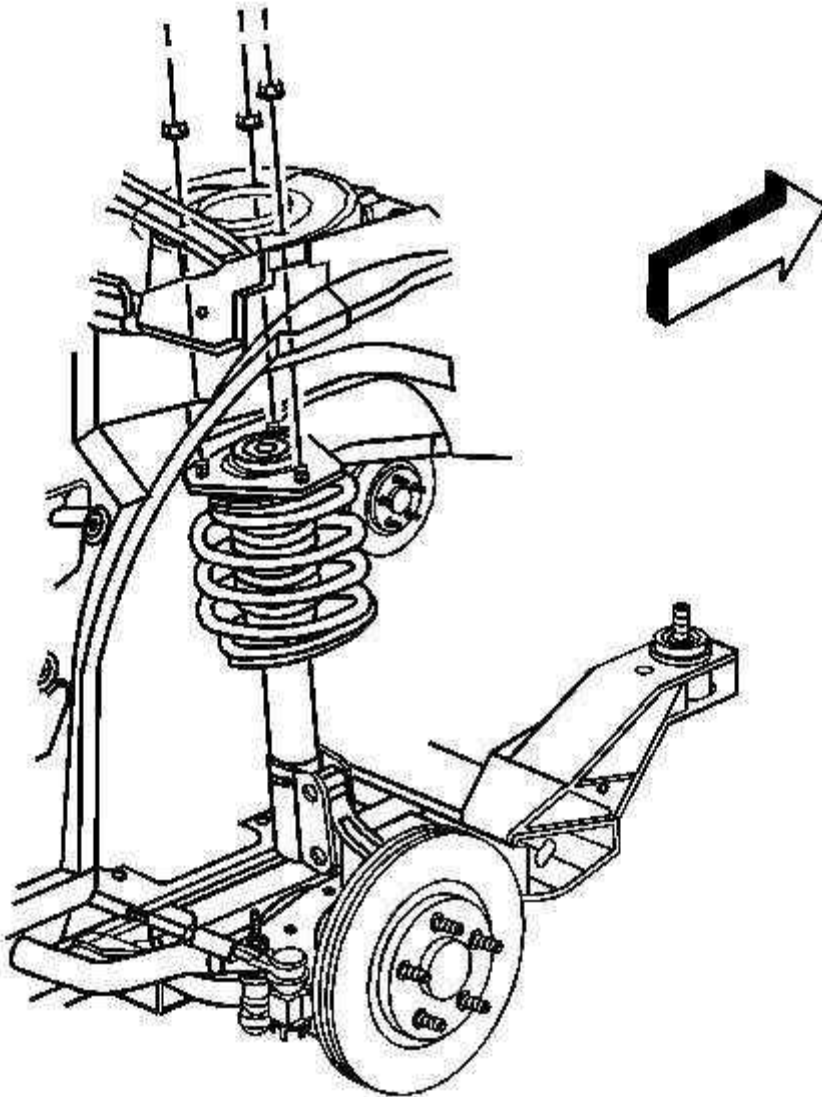


Fig. 42: Identifying Strut Upper Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

16. Install the retaining bolts for the struts. Refer to **Strut Assembly Replacement** .
17. Install the brakes calipers. Refer to **Front Brake Caliper Replacement** .

18. Install the engine splash shields. Refer to **Engine Splash Shield Replacement** .
19. Install the oil level indicate.
20. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
21. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

1. Turn the ignition OFF.

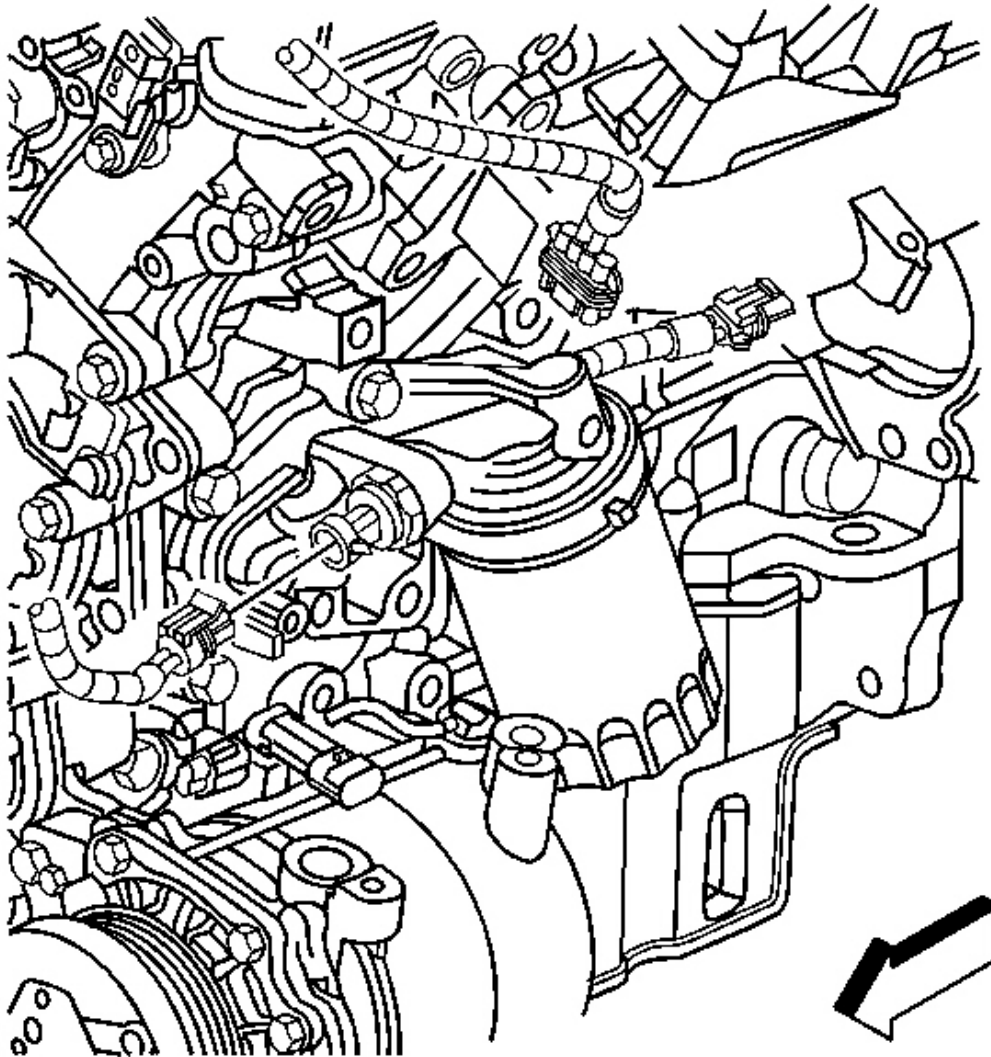


Fig. 43: Identifying Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the oil pressure sensor electrical connector.

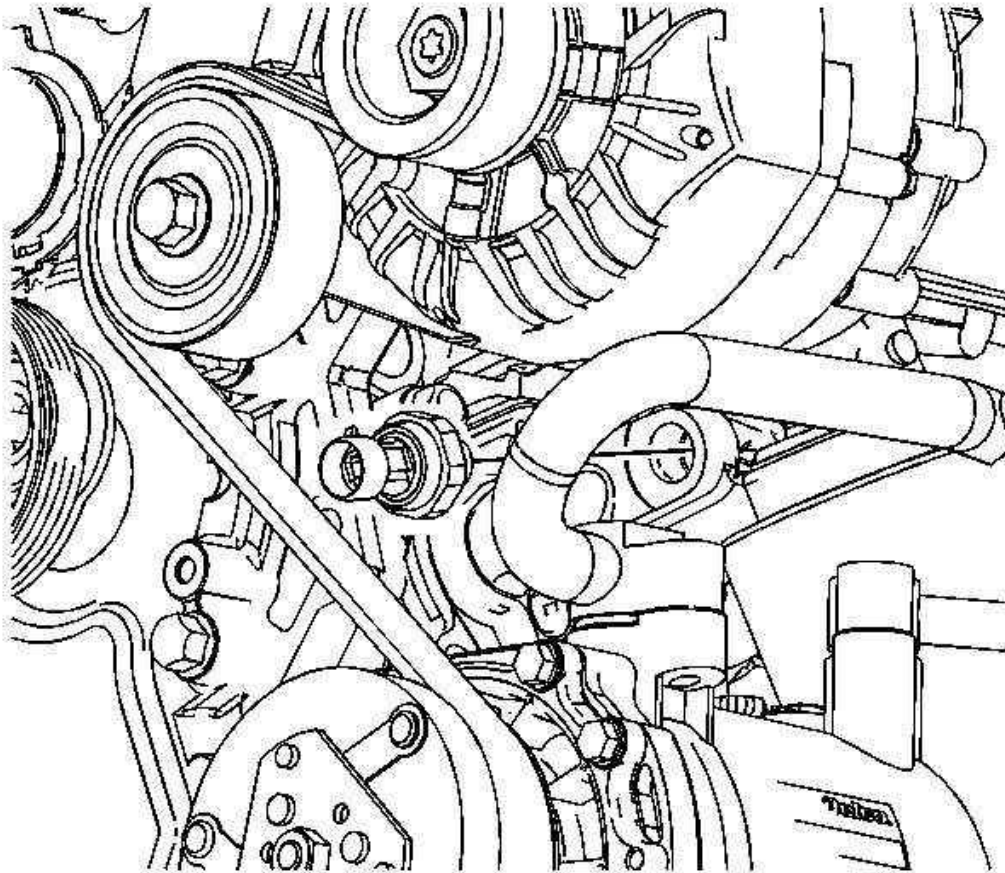


Fig. 44: Identifying Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pressure sensor.

Installation Procedure

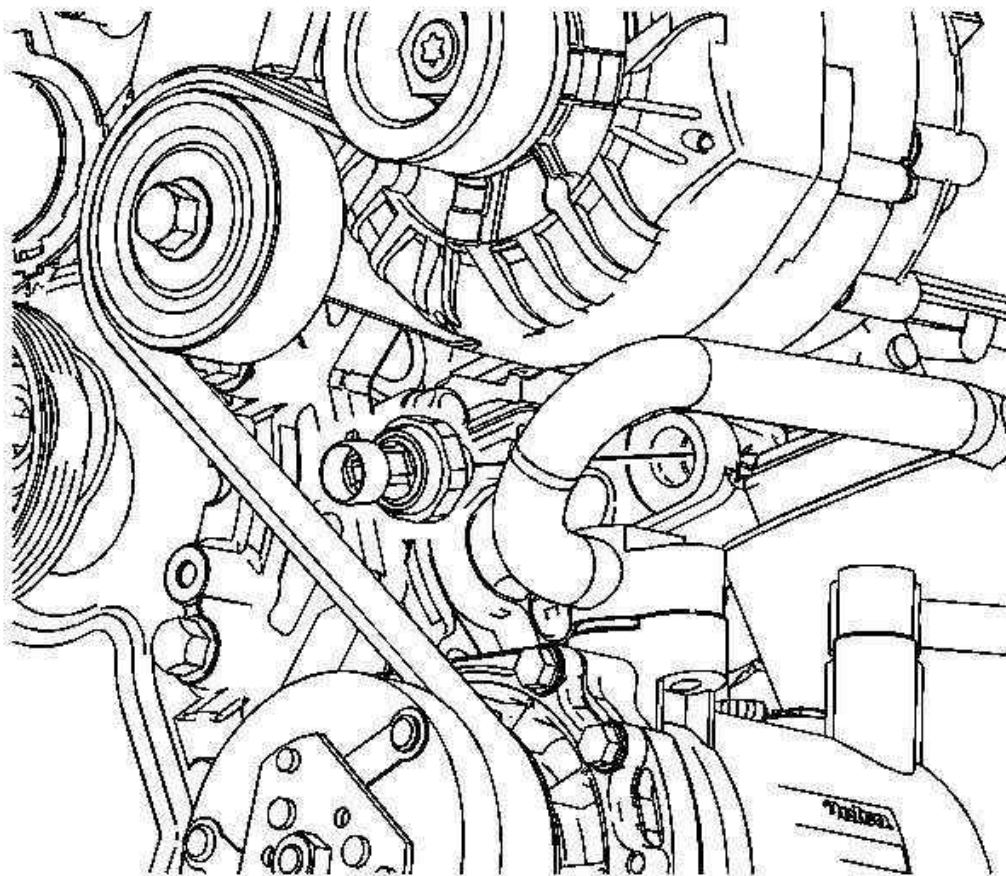


Fig. 45: Identifying Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

1. Install the oil pressure sensor.

Tighten: Tighten the oil pressure sensor to 20 N.m (15 lb ft).

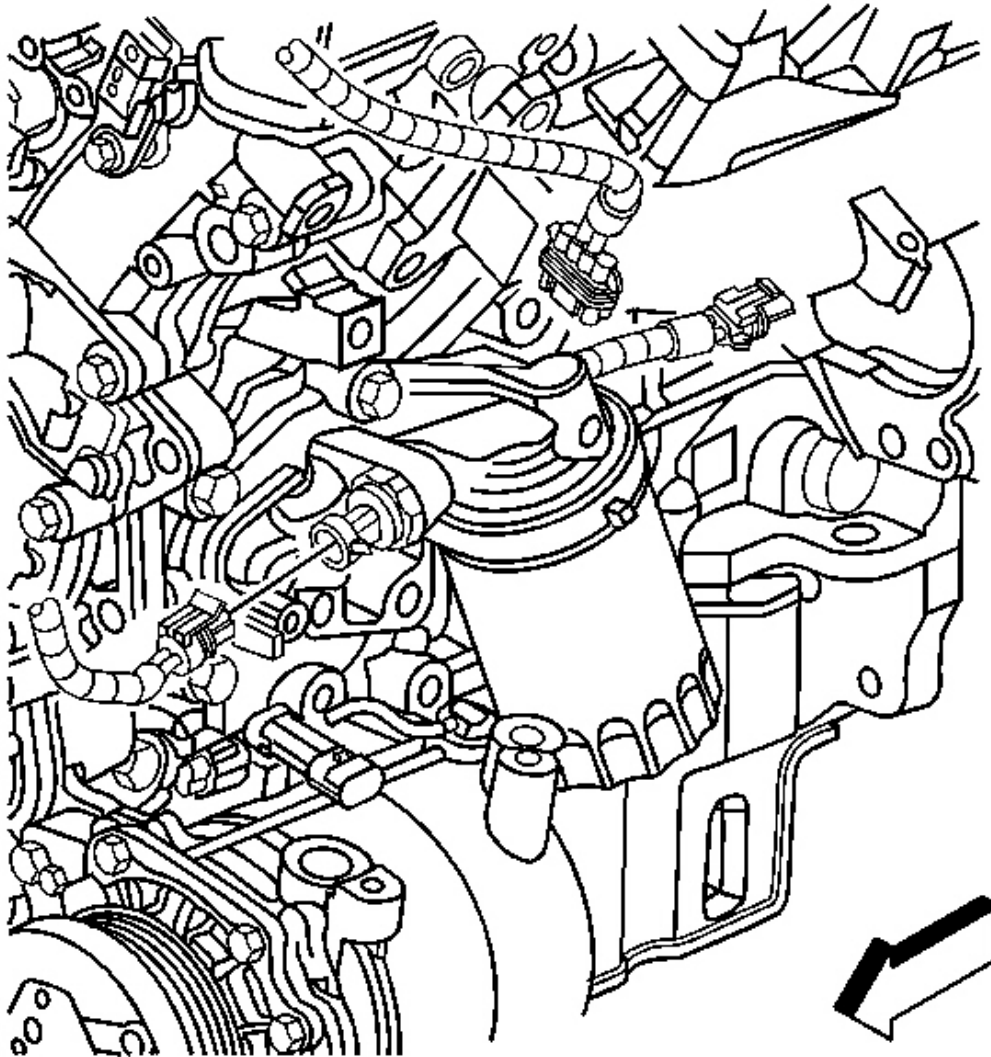


Fig. 46: Identifying Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the oil pressure sensor electrical connector.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

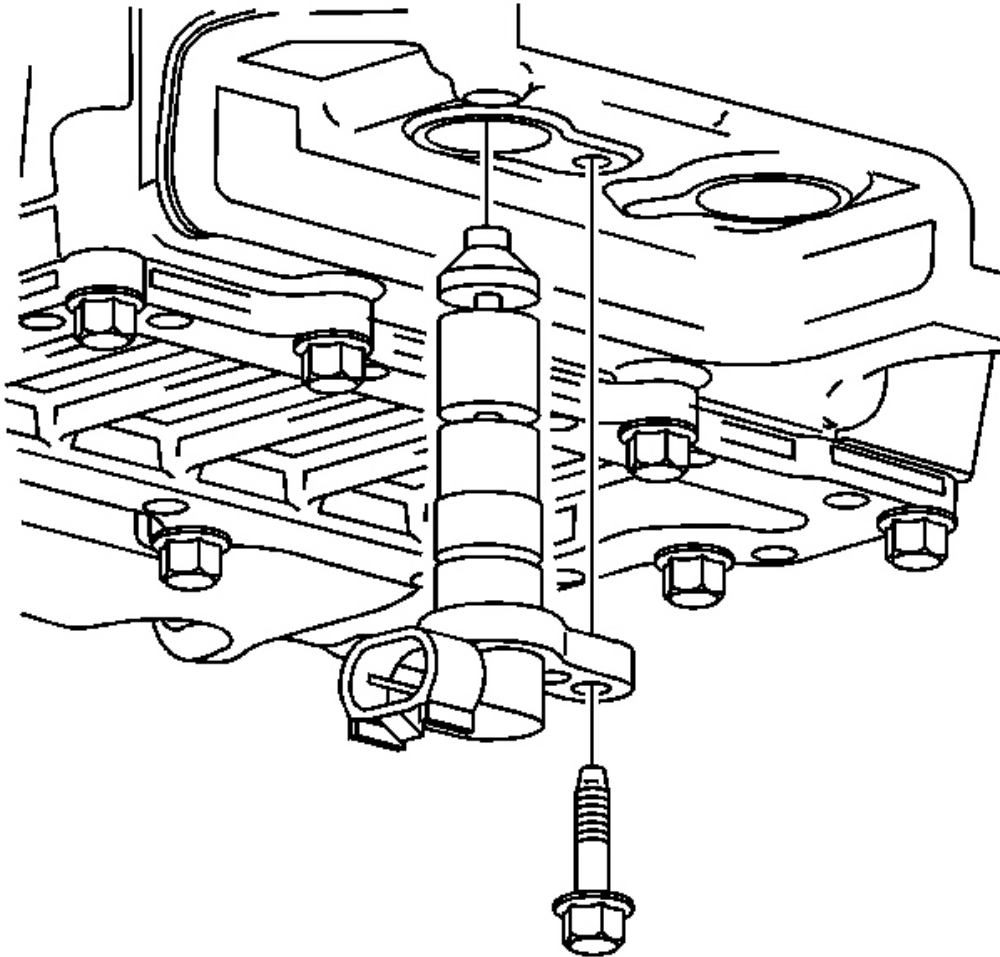


Fig. 47: View Of Oil Level Switch
Courtesy of GENERAL MOTORS CORP.

1. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
2. Disconnect the electrical connector from engine oil level switch.
3. Remove the engine oil level switch from the oil pan.

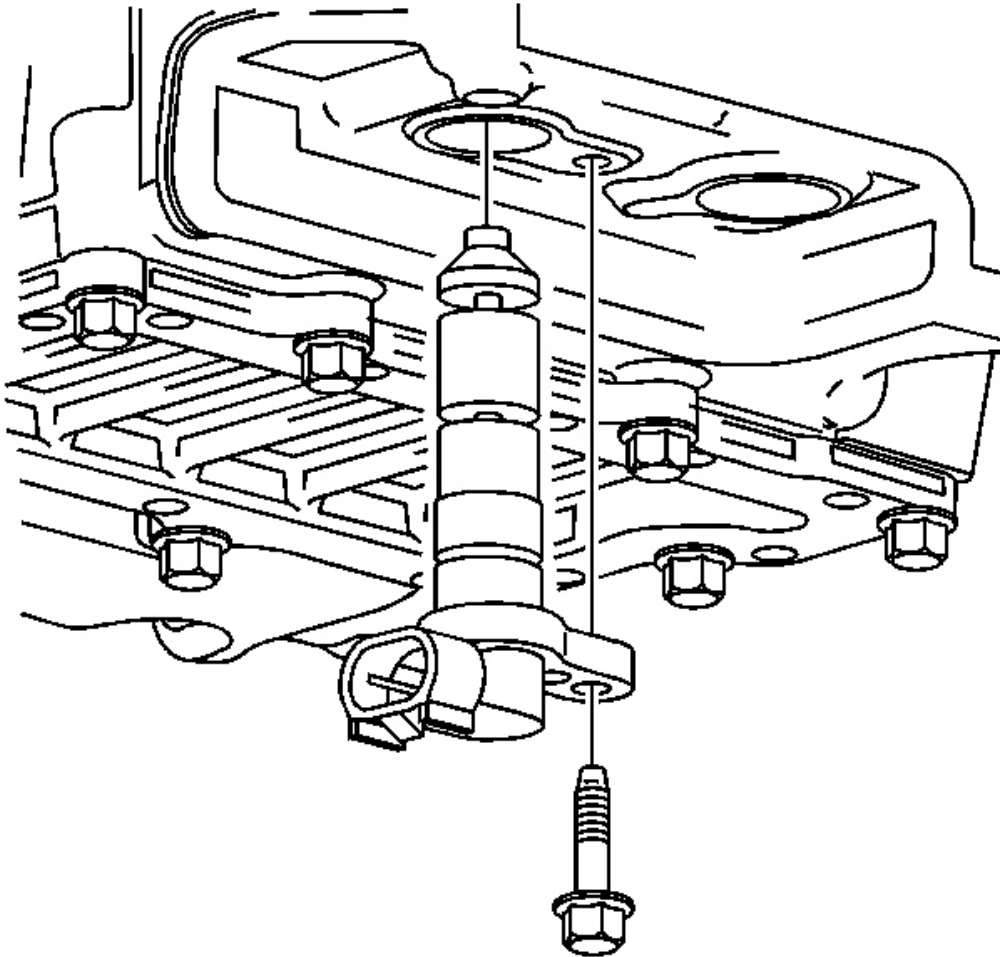


Fig. 48: View Of Oil Level Switch
Courtesy of GENERAL MOTORS CORP.

1. Install the engine oil level switch to the oil pan.

NOTE: Refer to Fastener Notice .

2. Install the engine oil level switch bolt.

Tighten: Tighten the engine oil level switch bolt to 10 N.m (89 lb in).

3. Connect the electrical connector to engine oil level switch.
4. Fill the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
5. Inspect for oil leaks after engine start up.

OIL PUMP SUCTION PIPE AND SCREEN ASSEMBLY REPLACEMENT

Removal Procedure

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

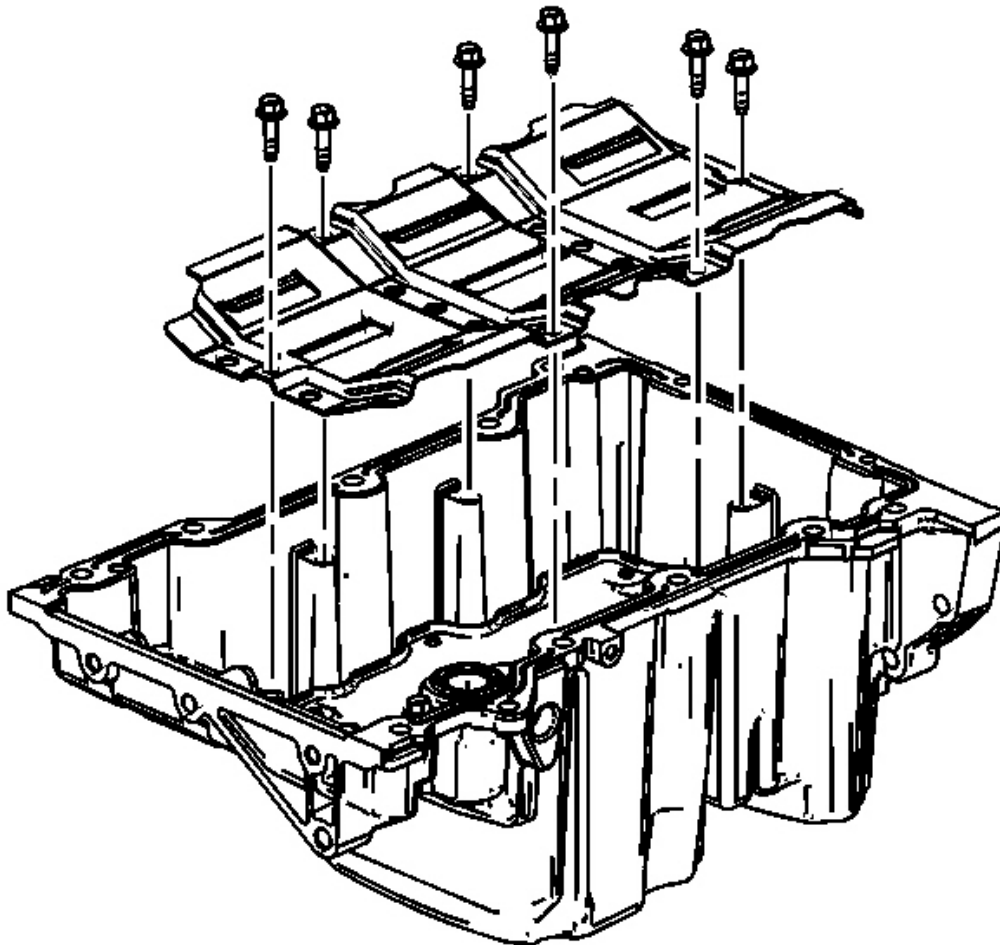


Fig. 49: View Of Oil Pan Scraper And Bolts

Courtesy of GENERAL MOTORS CORP.

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

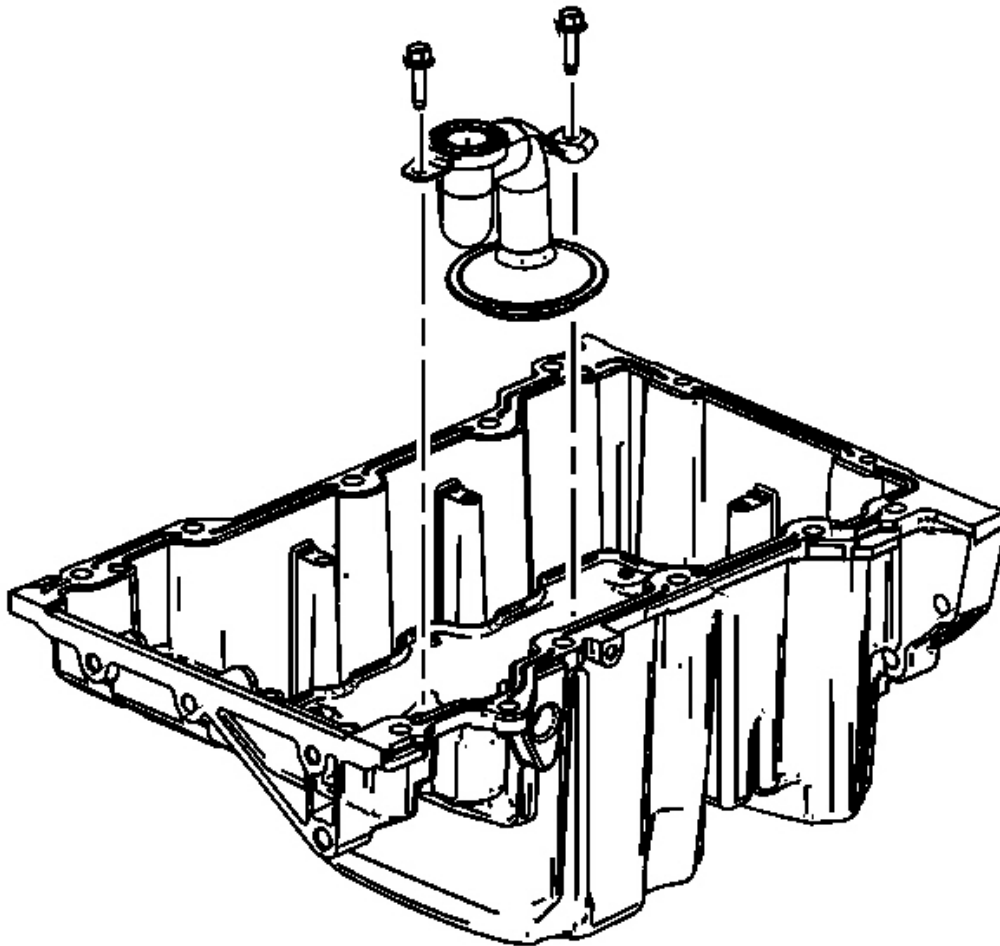


Fig. 50: View Of Oil Suction Pipe
Courtesy of GENERAL MOTORS CORP.

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

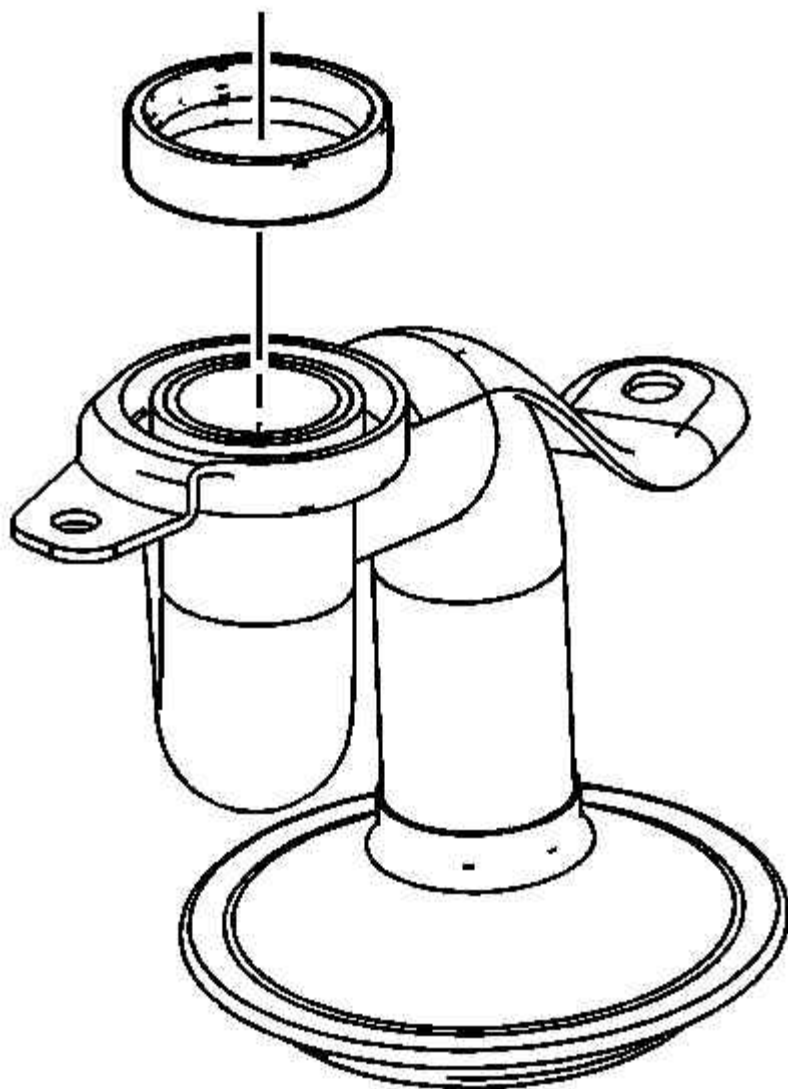


Fig. 51: View Of Oil Suction Tube Seal & Oil Suction Tube
Courtesy of GENERAL MOTORS CORP.

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

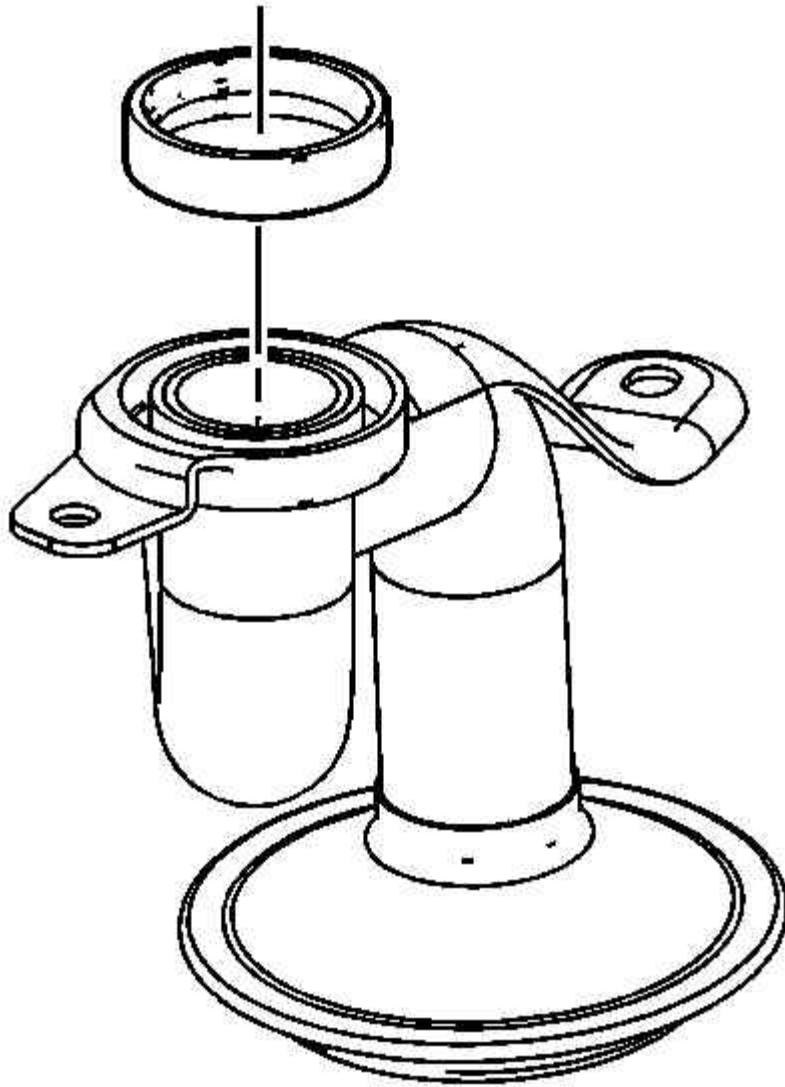


Fig. 52: View Of Oil Suction Tube Seal & Oil Suction Tube
Courtesy of GENERAL MOTORS CORP.

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

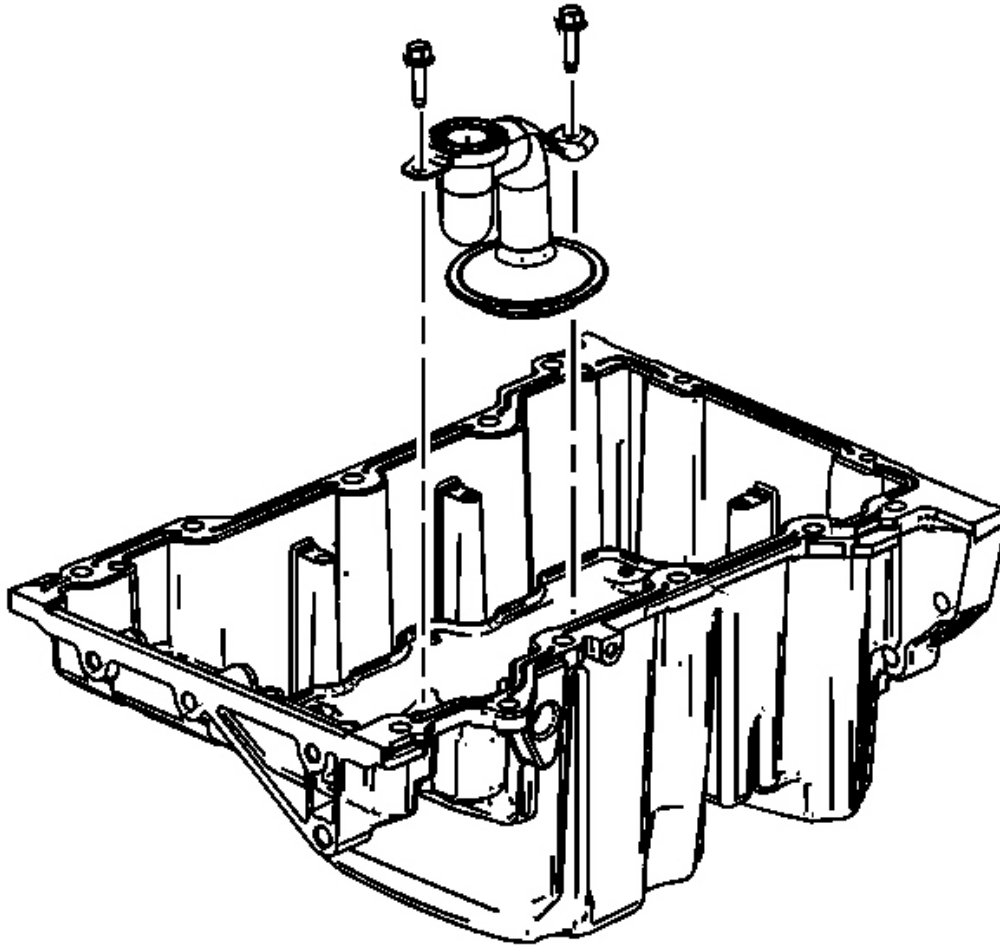


Fig. 53: View Of Oil Suction Pipe
Courtesy of GENERAL MOTORS CORP.

2. Install the oil suction pipe.

NOTE: Refer to Fastener Notice .

3. Install the oil suction pipe bolts.

Tighten: Tighten the oil suction pipe bolts to 10 N.m (89 lb in).

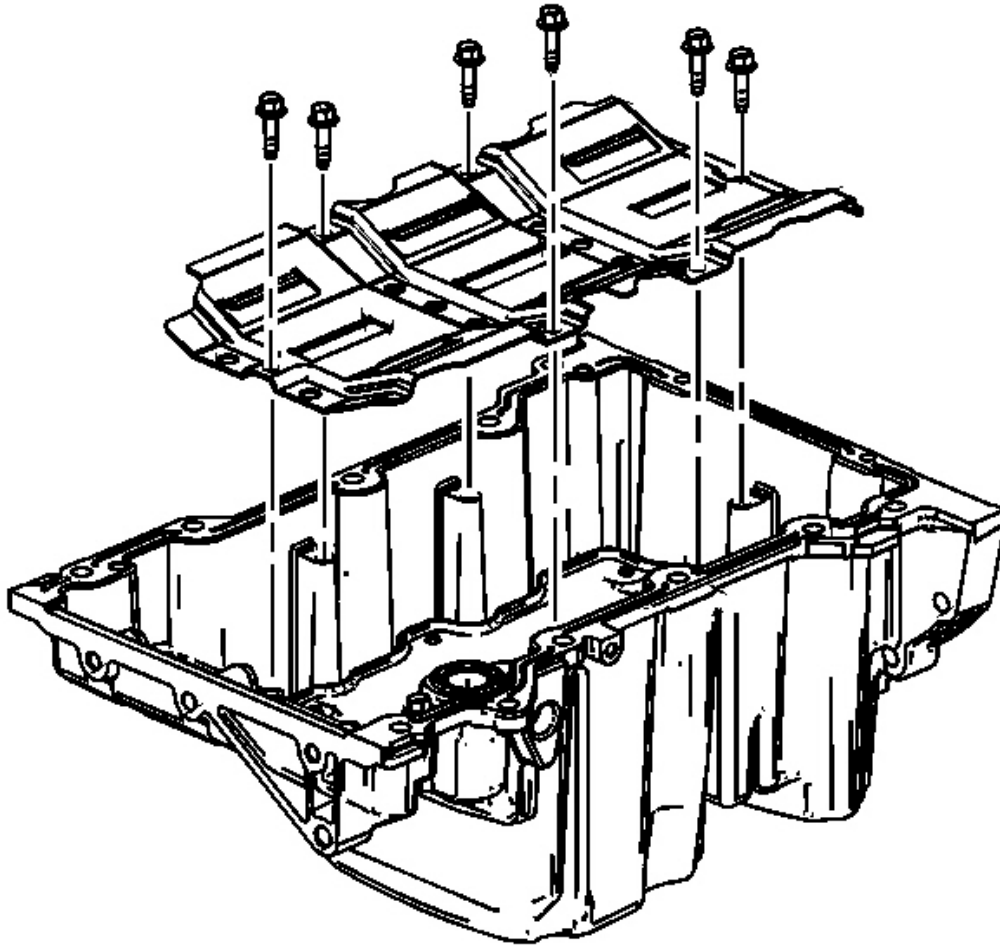


Fig. 54: View Of Oil Pan Scraper And Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the oil pan scraper.
5. Install the oil pan scraper bolts.

Tighten: Tighten the oil pan scraper bolts to 10 N.m (89 lb in).

6. Install the oil pan. Refer to **Oil Pan Replacement**.

Special Tools

- **EN 46114** Engine Lift Brackets. See **Special Tools** .
- **J 42640** Steering Column Anti-Rotation Pin. See **Special Tools** .

Removal Procedure

1. Center the steering wheel.
2. Turn the ignition OFF.

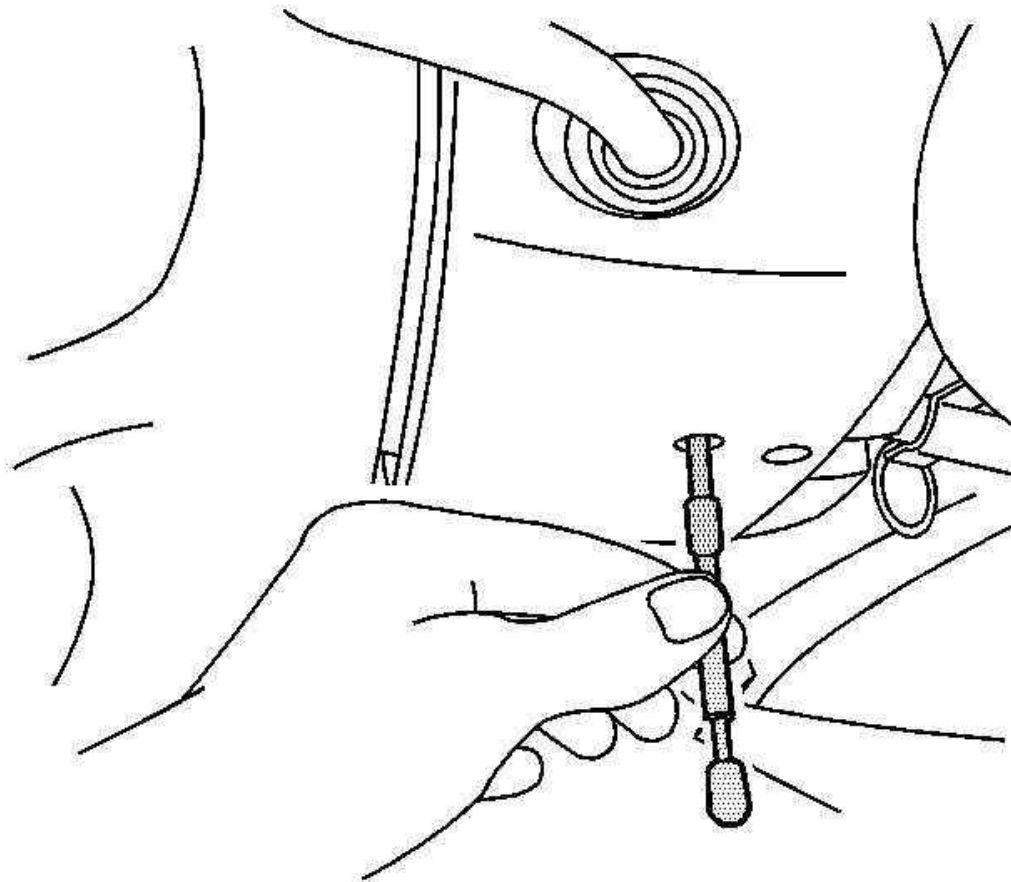


Fig. 55: Identifying J 42640
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 42640** to the steering column. See **Special Tools** .

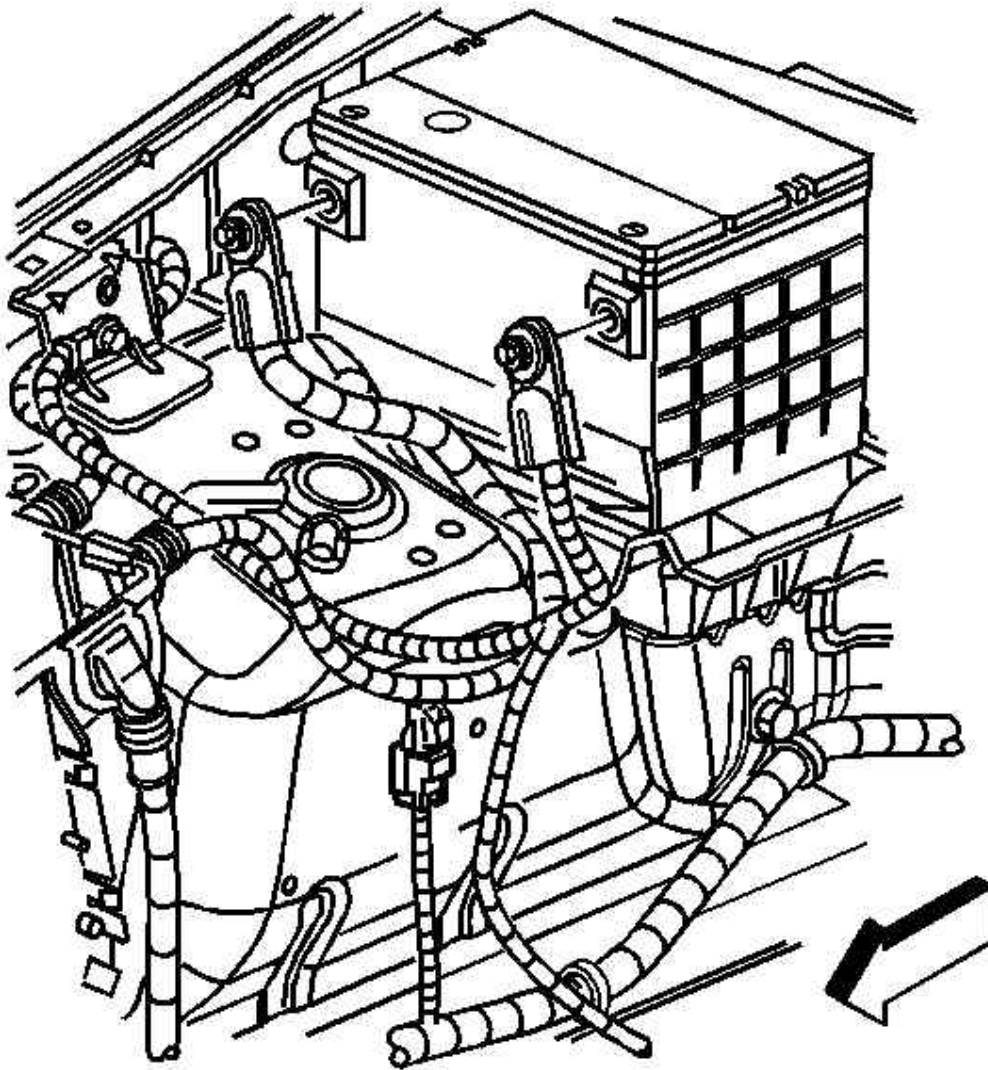


Fig. 56: View Of Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the battery negative cable from the battery and the body. Refer to **Battery Positive Cable Replacement (LY7)** .

5. Disconnect the battery positive cable from the battery and the underhood electrical center. Refer to **Battery Positive Cable Replacement (LY7)** .
6. Position and secure the battery cables to the engine.
7. Remove the battery. Refer to **Battery Replacement (LY7)** .
8. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .
9. Remove the air cleaner duct. Refer to **Air Cleaner Inlet Duct Replacement** .
10. Drain the cooling system. Refer to **Cooling System Draining and Filling (L26, LY7 GE 47716 Fill)** .
11. Disconnect the overflow hose.
12. Position and secure the overflow hose to the engine.

Position and secure the overflow hose to the vehicle.

13. Disconnect the heater hoses from the heater core. Refer to **Heater Inlet Hose Replacement (LY7)** and **Heater Outlet Hose Replacement (LY7)** .

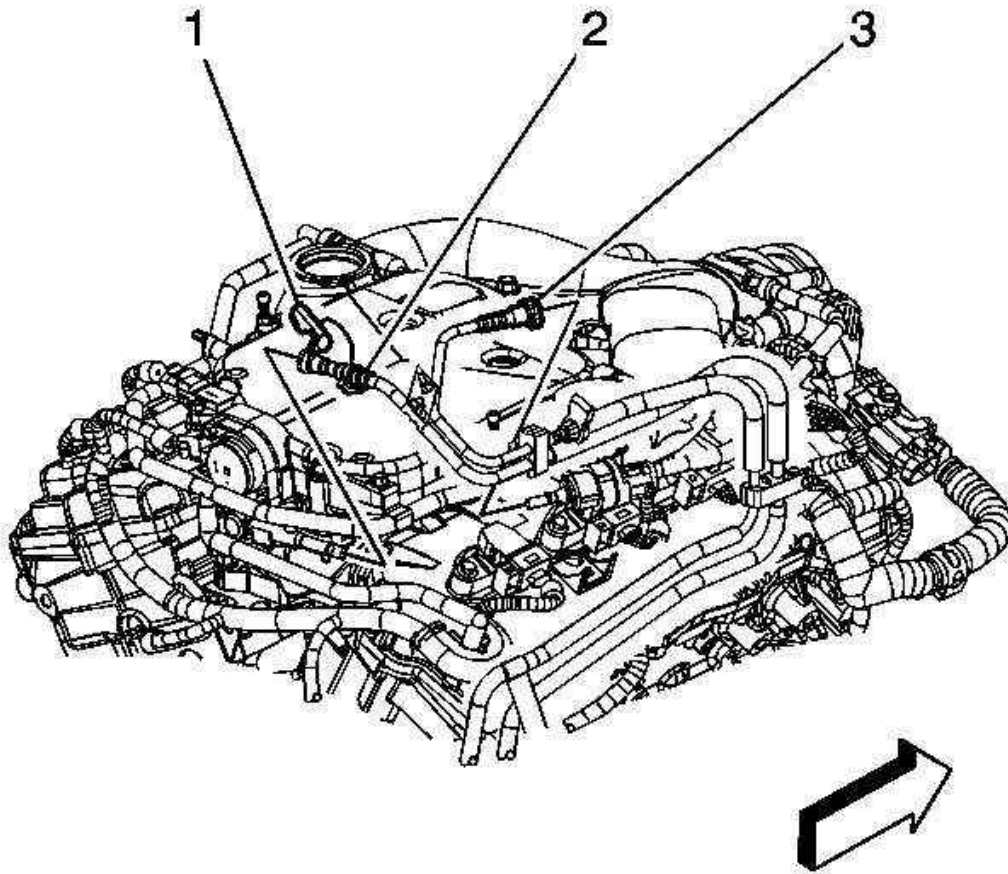


Fig. 57: Identifying Fuel Feed Pipe & Fuel Rail
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the purge line (3) from the purge solenoid.

IMPORTANT: Plug the fuel pipe and cap the fuel rail to prevent fuel loss and/or contamination.

15. Disconnect the fuel pipe (2) from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
16. Evacuate the air conditioning system. Refer to **Refrigerant Recovery and Recharging** .

17. Remove the A/C lines from the A/C compressor. Refer to **Compressor Hose Assembly Replacement (LY7)** .

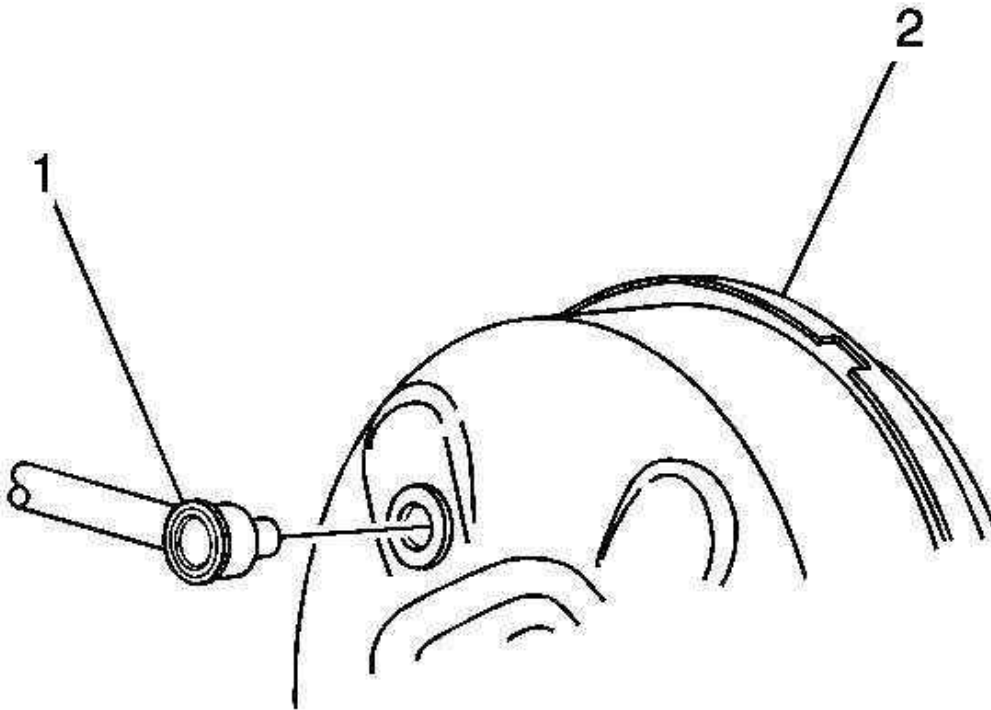


Fig. 58: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS CORP.

18. Disconnect the brake booster check valve and vacuum hose (1) from the brake booster (2).

Position and secure the brake booster hose to the engine.

19. Disconnect the brake fluid level switch electrical connector from the master cylinder.
20. Disconnect the mass air flow sensor electrical connector.
21. Unlock and disconnect the instrument panel (I/P) electrical connector from the

engine.

Position and secure the I/P harness to the vehicle.

22. Disconnect the engine module wiring harness connectors.
23. Disconnect the wiring harness from the transmission control module (TCM). Refer to **Transmission Control Module Replacement (3.8L)** or **Transmission Control Module Replacement (3.6L)** .

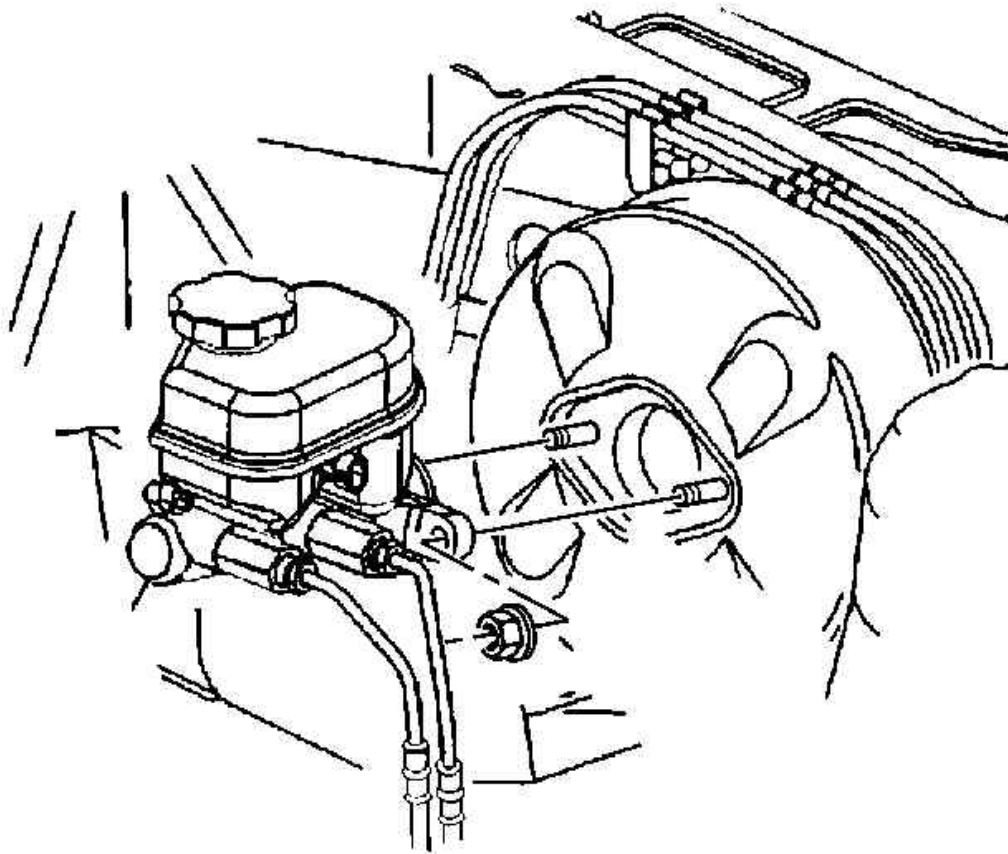


Fig. 59: Identifying Master Cylinder Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do NOT disconnect the brake pipes from the master

cylinder.

24. Remove the master cylinder and reposition and secure the master cylinder to the engine.
25. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief (With CH 48027)** or **Fuel Pressure Relief (Without CH 48027)** .
26. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
27. Remove the catalytic converter. Refer to **Catalytic Converter Replacement** .
28. Remove the air deflector.
29. Disconnect the left front brake pipe retainer with the brake pipe.
30. Remove the right front brake pipe from the brake pipe.

IMPORTANT: Cap and/or plug the brake pipes and the brake pressure modulator valve (BPMV) in order to minimize brake fluid loss.

31. Disconnect the rear brake pipes (two center pipes) from the BPMV. Refer to **Electronic Brake Control Module Replacement** .
32. Remove the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
33. Remove the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** .
34. Disconnect the transmission shift linkage from the transmission. Refer to **Range Selector Lever Cable Replacement** .

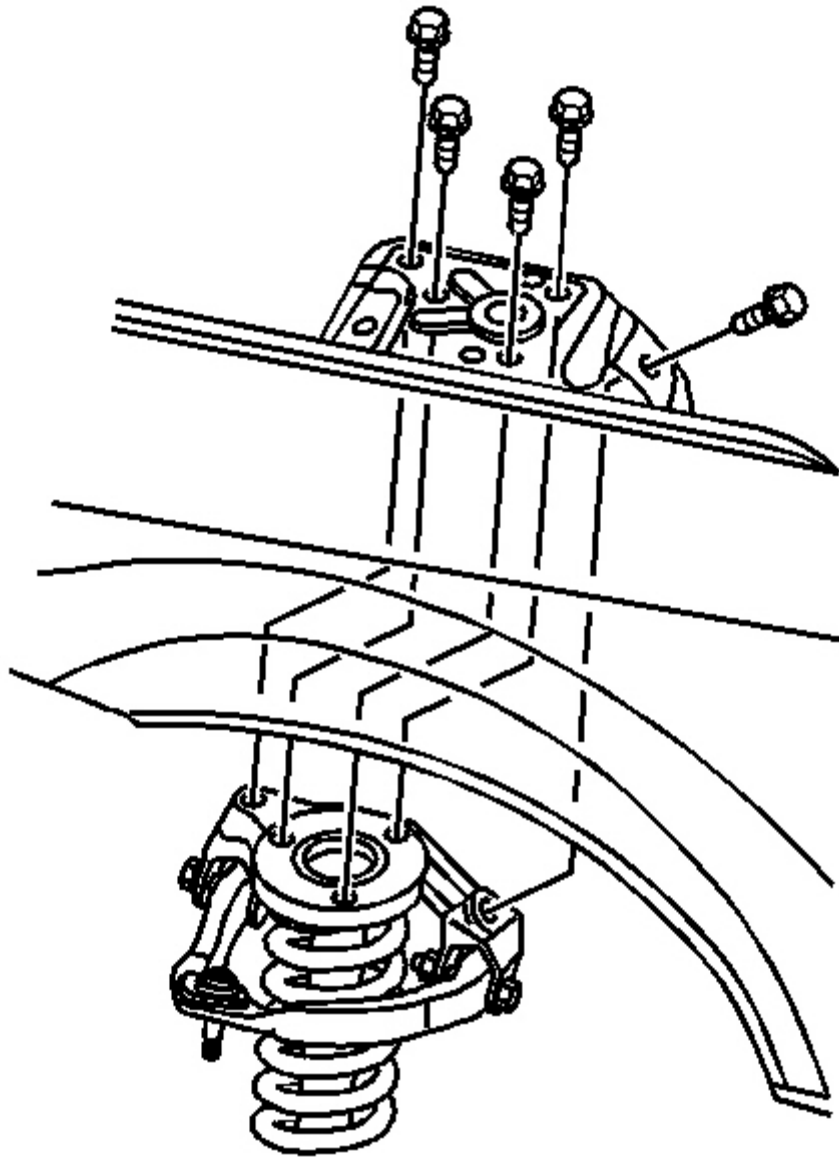


Fig. 60: View Of Shock Module & Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Secure the shock modules to the lower control arms with a suitable strap in order to prevent damage to

the front brake hoses.

35. Remove the right and left shock module upper mounting bolts. Refer to **Strut Assembly Replacement** .
36. Raise the vehicle enough to place a suitable lift table under the engine, transmission, front frame and front suspension assembly.
37. Position a suitable powertrain and/or engine lift table below the frame, engine and transmission.
38. Raise the lift table and/or lower the vehicle to support the frame, engine and transmission.
39. Remove the transmission brace to underbody bolts. Refer to **Transmission Brace Replacement** .
40. Remove the front frame bolts.

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

41. With the aid of an assistant, lower the table and/or raise the vehicle to remove the engine, transmission, front frame and front suspension assembly from the vehicle.
42. Disconnect the engine control module (ECM) electrical connector. Refer to **Engine Control Module Replacement** .
43. Remove the thermostat housing with the heater pipes, heater hoses and surge tank outlet hose. Refer to **Engine Coolant Thermostat Housing Replacement (LY7)** .
44. Remove the starter motor. Refer to **Starter Motor Replacement (LY7)** .
45. Remove the heated oxygen sensor (HO2S) connectors.
46. Disconnect the transmission oil cooler (TOC) pipes from the engine, radiator and the transmission. Refer to **Automatic Transmission Oil Cooler Hose Replacement** .
47. Disconnect the radiator hoses from the water outlet housing and the coolant inlet pipe.

48. Cap and plug the power steering hoses and pipes in order to prevent fluid loss and contamination.
49. Remove the radiator hoses. Refer to **Radiator Inlet Hose Replacement (LY7)** or **Radiator Outlet Hose Replacement (LY7)** .
50. Install the **EN 46114** to the engine. See **Special Tools** .
51. Connect a floor crane to the engine lift brackets and raise the floor crane to partially support the engine.
52. Position a second powertrain lift table below the transmission.
53. Remove the transmission. Refer to **Transmission Replacement** .
54. Remove the drive belts. Refer to **Drive Belt Replacement** .
55. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Removal**.
56. Remove the idler pulley. Refer to **Drive Belt Idler Pulley Removal**.
57. Remove the generator. Refer to **Generator Replacement (LY7)** .
58. Remove the A/C compressor. Refer to **Compressor Replacement (LY7)** .
59. Remove the power steering pump. Refer to **Power Steering Pump Replacement (LY7)** .
60. Remove the oil level indicator. Refer to **Oil Level Indicator and Tube Removal**.
61. Remove the left exhaust manifold. Refer to **Exhaust Manifold Removal - Left Side**.
62. Remove the oil filter adapter. Refer to **Oil Filter Adapter Removal**.
63. Remove the right exhaust manifold. Refer to **Exhaust Manifold Removal - Right Side**.
64. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal**.
65. Remove the flywheel. Refer to **Engine Flywheel Removal**.
66. Remove the intake manifold. Refer to **Intake Manifold Removal**.
67. Remove the water outlet. Refer to **Water Outlet Removal**.
68. Remove the block heater. Refer to **Coolant Heater Replacement (LY7)** .
69. Remove the ECM with the ECM bracket. Refer to **Engine Control Module Replacement** .
70. Use a floor crane in order to remove the engine from the frame.

71. Remove the engine mount brackets with the engine mounts.

Installation Procedure

1. Install the engine mount brackets with the engine mounts.
2. Use a floor crane in order to install the engine to the frame.
3. Install the ECM with the ECM bracket. Refer to **Engine Control Module Replacement** .
4. Install the water outlet. Refer to **Water Outlet Removal**.
5. Install the block heater. Refer to **Coolant Heater Replacement (LY7)** .
6. Install the flywheel. Refer to **Engine Flywheel Installation** .
7. Install the intake manifold. Refer to **Intake Manifold Installation** .
8. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation** .
9. Install the right exhaust manifold. Refer to **Exhaust Manifold Installation - Right Side** .
10. Install the oil filter adapter. Refer to **Oil Filter Adapter Installation** .
11. Install the left exhaust manifold. Refer to **Exhaust Manifold Installation - Left Side** .
12. Install the oil level indicator. Refer to **Oil Level Indicator and Tube Installation** .
13. Install the generator and the generator bracket. Refer to **Generator Replacement (LY7)** .
14. Install the power steering pump. Refer to **Power Steering Pump Replacement (LY7)** .
15. Install the A/C compressor. Refer to **Compressor Replacement (LY7)** .
16. Install the idler pulley. Refer to **Drive Belt Idler Pulley Installation** .
17. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Installation** and **Drive Belt Replacement** .
18. Install the drive belts. Refer to **Drive Belt Replacement** .
19. Install the transmission-to-engine and flywheel-to-torque convertor bolts. Refer to **Transmission Replacement** .
20. Install the starter motor. Refer to **Starter Motor Replacement (LY7)** .

21. Remove the **EN 46114** from the engine. See **Special Tools** .
22. Connect the radiator hoses to the water outlet housing and the coolant inlet pipe. Refer to **Radiator Inlet Hose Replacement (LY7)** and **Radiator Outlet Hose Replacement (LY7)** .
23. Install the TOC pipes to the engine, radiator and the transmission. Refer to **Automatic Transmission Oil Cooler Hose Replacement** .
24. Install the engine wiring harness and related components.
25. Install the HO2S connectors.
26. Install the thermostat housing with the heater pipes, heater hoses and surge tank outlet hose. Refer to **Engine Coolant Thermostat Housing Replacement (LY7)** .
27. Install the catalytic converters with the oxygen sensors. Refer to **Catalytic Converter Replacement** .

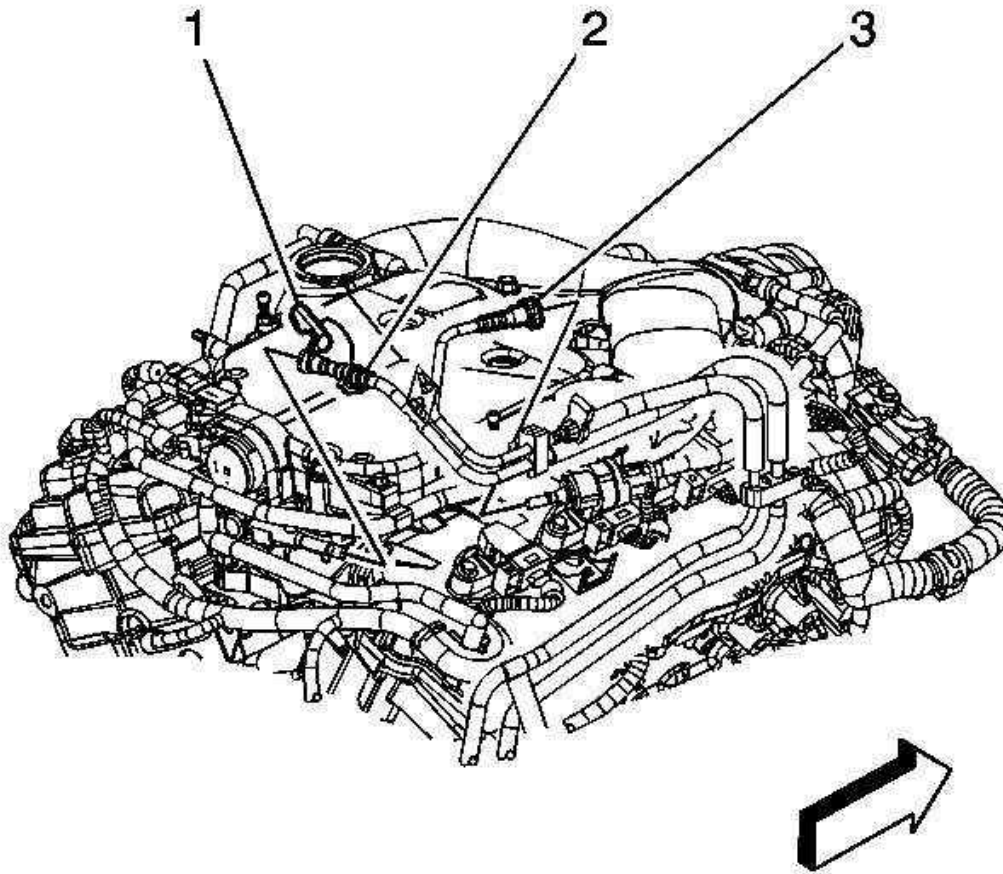


Fig. 61: Identifying Fuel Feed Pipe & Fuel Rail
Courtesy of GENERAL MOTORS CORP.

28. Remove the cap or plug from the fuel line.
29. Install the fuel lines to the fuel rail and the EVAP purge solenoid. Refer to **Metal Collar Quick Connect Fitting Service** .
30. Install the purge line (3) to the purge solenoid.
31. Connect the ECM electrical connector. Refer to **Engine Control Module Replacement** .

IMPORTANT: Ensure that all the hoses, wires, pipes and shock

modules clear the vehicle during the installation process.

32. With the aid of an assistant, raise the table and/or lift the vehicle to install the engine, transmission, front frame and front suspension assembly to the vehicle.

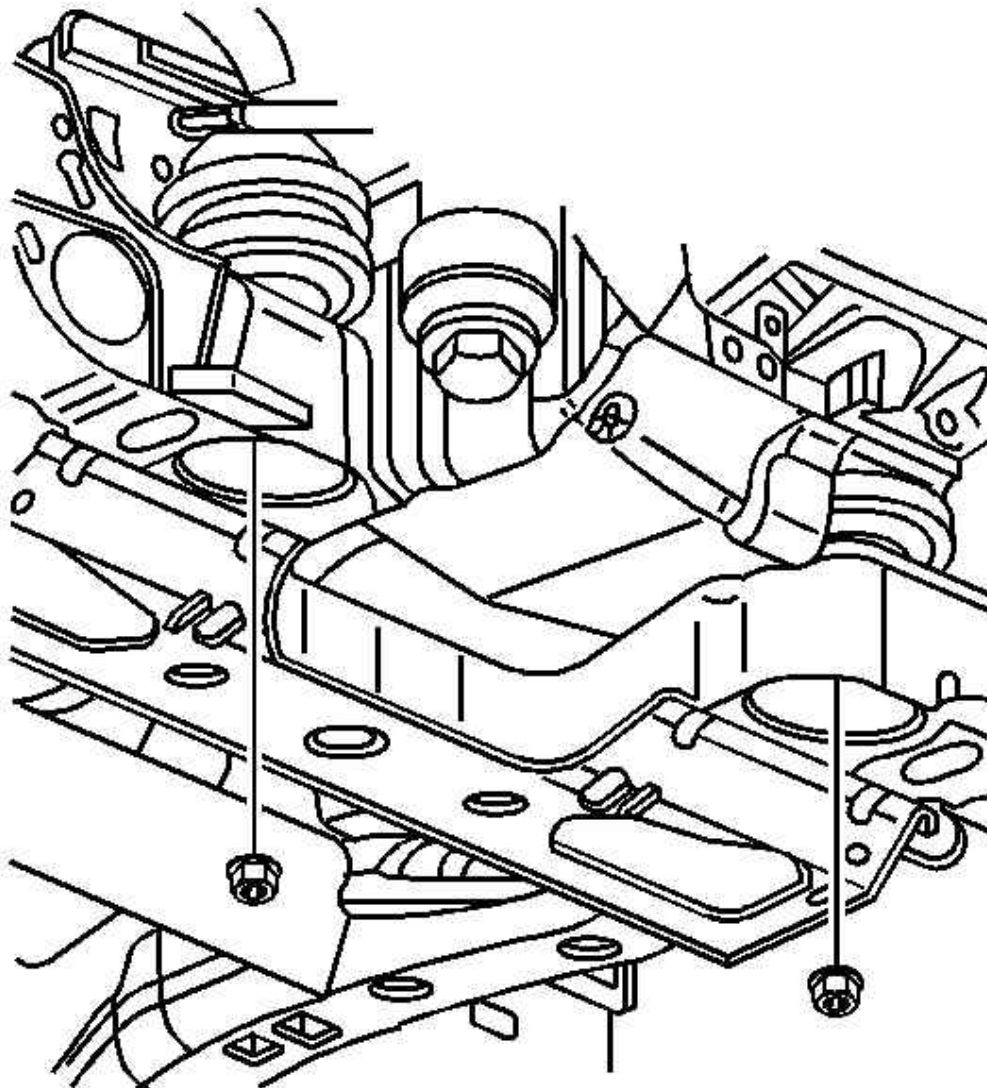


Fig. 62: Identifying Frame Mounting Nuts

Courtesy of GENERAL MOTORS CORP.

33. Install the front frame bolts.
34. Install the transmission support to underbody bolts. Refer to **Transmission Brace Replacement** .
35. Remove the powertrain lift/support table.

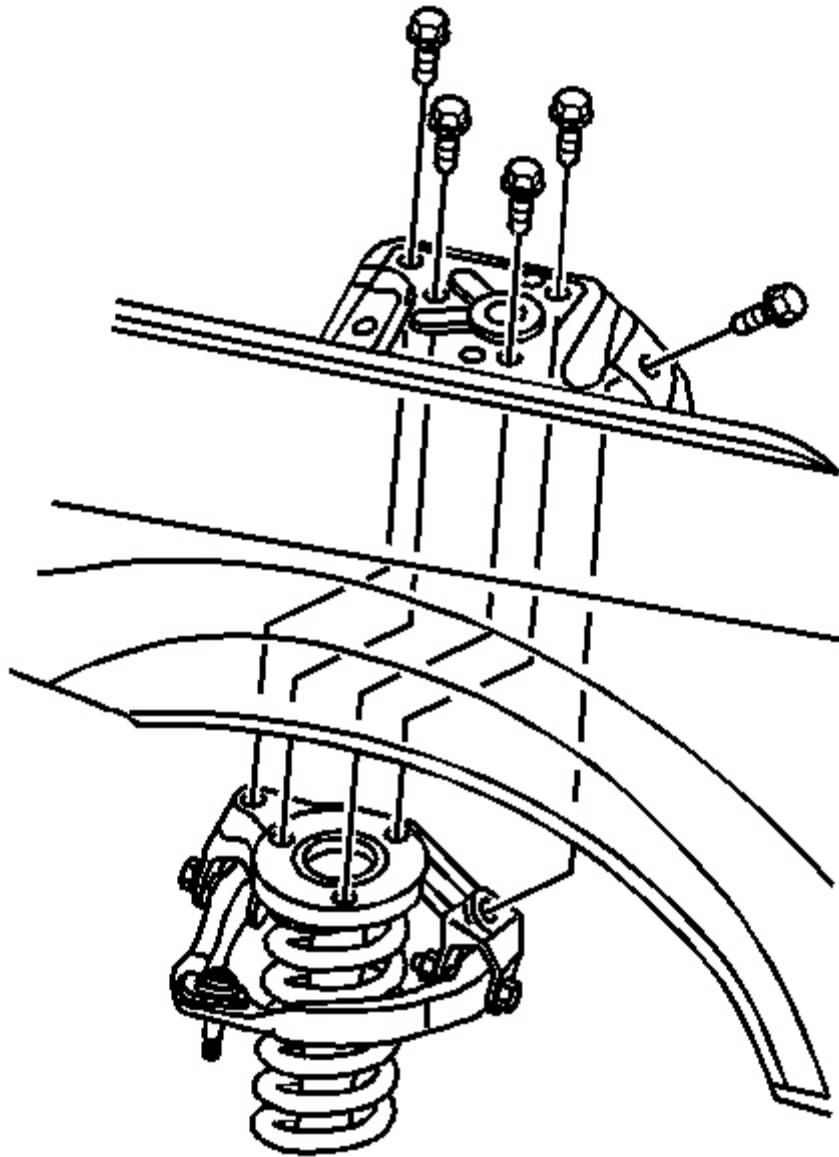


Fig. 63: View Of Shock Module & Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

36. Install the right and left shock module upper mounting bolts. Refer to **Strut Assembly Replacement** .

37. Connect the transmission shift linkage to the transmission. Refer to **Range Selector Lever Cable Replacement** .
38. Install the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** .
39. Install the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
40. Install the front brake pipes and retainers to the underbody.
41. Connect the rear brake pipes (two center pipes) to the BPMV. Refer to **Electronic Brake Control Module Replacement** .
42. Connect the radiator side air baffles to the radiator.
43. Install the air deflector.

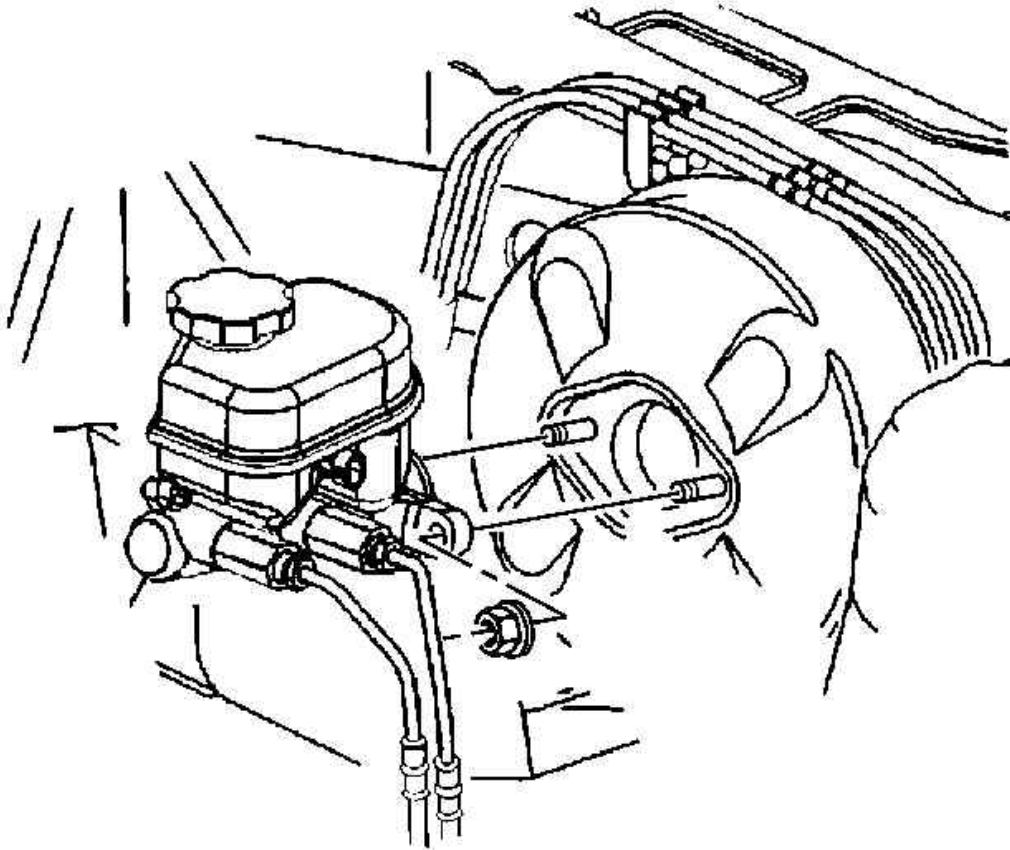


Fig. 64: Identifying Master Cylinder Assembly
Courtesy of GENERAL MOTORS CORP.

44. Install the master cylinder.
45. Connect the engine harness electrical connector at the frame.

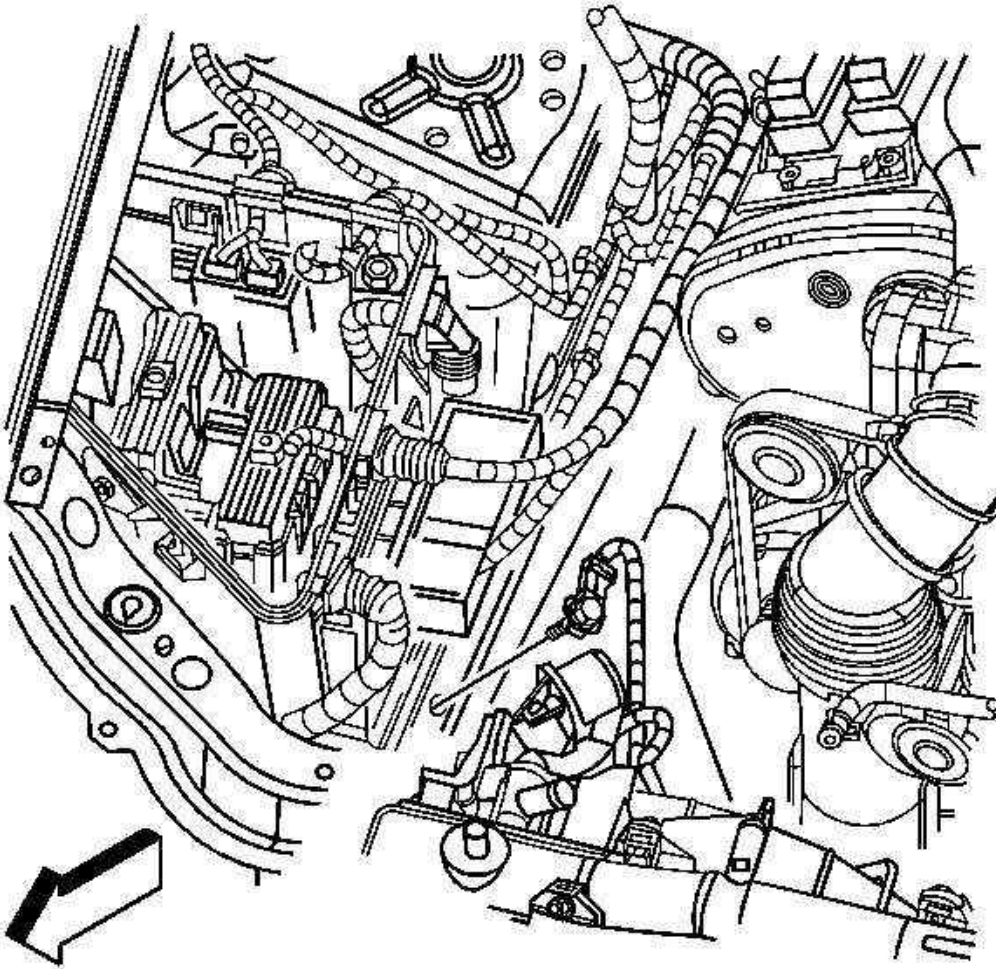


Fig. 65: View Of Ground Bolt & Wire
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

46. Install the ground wire and bolt to the frame.

Tighten: Tighten the engine harness ground wire to longitudinal rail bolt to 10 N.m (89 lb in).

47. Connect the wiring harness to the TCM. Refer to **Transmission Control Module Replacement (3.8L)** or **Transmission Control Module Replacement (3.6L)** .
48. Connect the engine module wiring harness connectors.
49. Connect and lock the I/P electrical connector.
50. Connect the mass air flow sensor electrical connector.
51. Connect the brake fluid level switch electrical connector from the master cylinder.

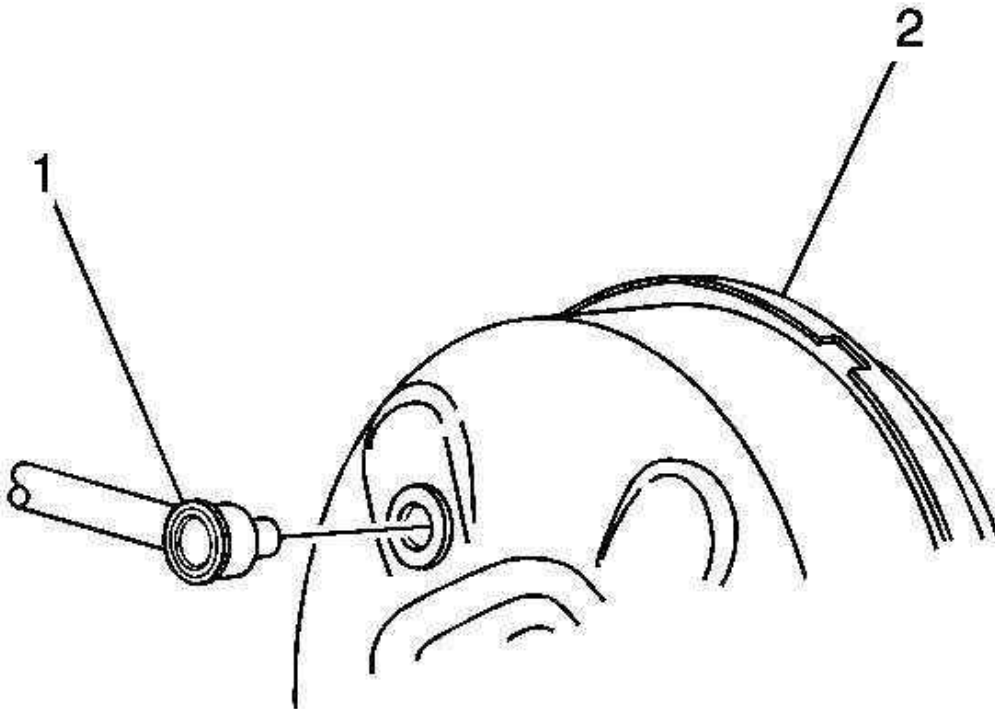


Fig. 66: View Of Vacuum Check Valve & Brake Booster
Courtesy of GENERAL MOTORS CORP.

52. Connect the brake booster vacuum hose (1) to the brake booster (2).

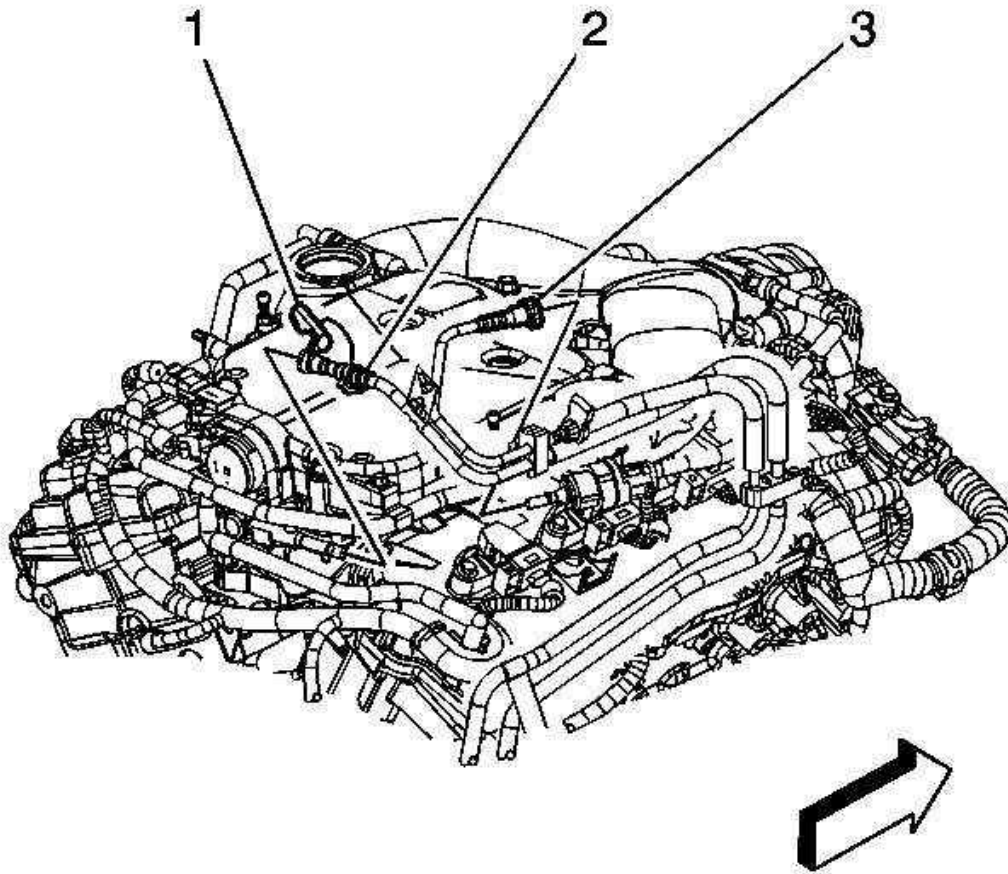


Fig. 67: Identifying Fuel Feed Pipe & Fuel Rail
Courtesy of GENERAL MOTORS CORP.

53. Connect the purge line (3) to the purge solenoid.
54. Connect the fuel pipe (2) to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
55. Connect the heater hoses to the heater core. Refer to **Heater Inlet Hose Replacement (LY7)** and **Heater Outlet Hose Replacement (LY7)** .
56. Connect the overflow hose to the coolant overflow tank.
57. Connect the air conditioning pressure switch electrical connector and the liquid line to the evaporator.

58. Connect the air conditioning suction hose to the evaporator and install the suction hose bracket to the shock tower.
59. Install the air cleaner duct. Refer to **Air Cleaner Inlet Duct Replacement** .
60. Install the battery. Refer to **Battery Replacement (LY7)** .
61. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .

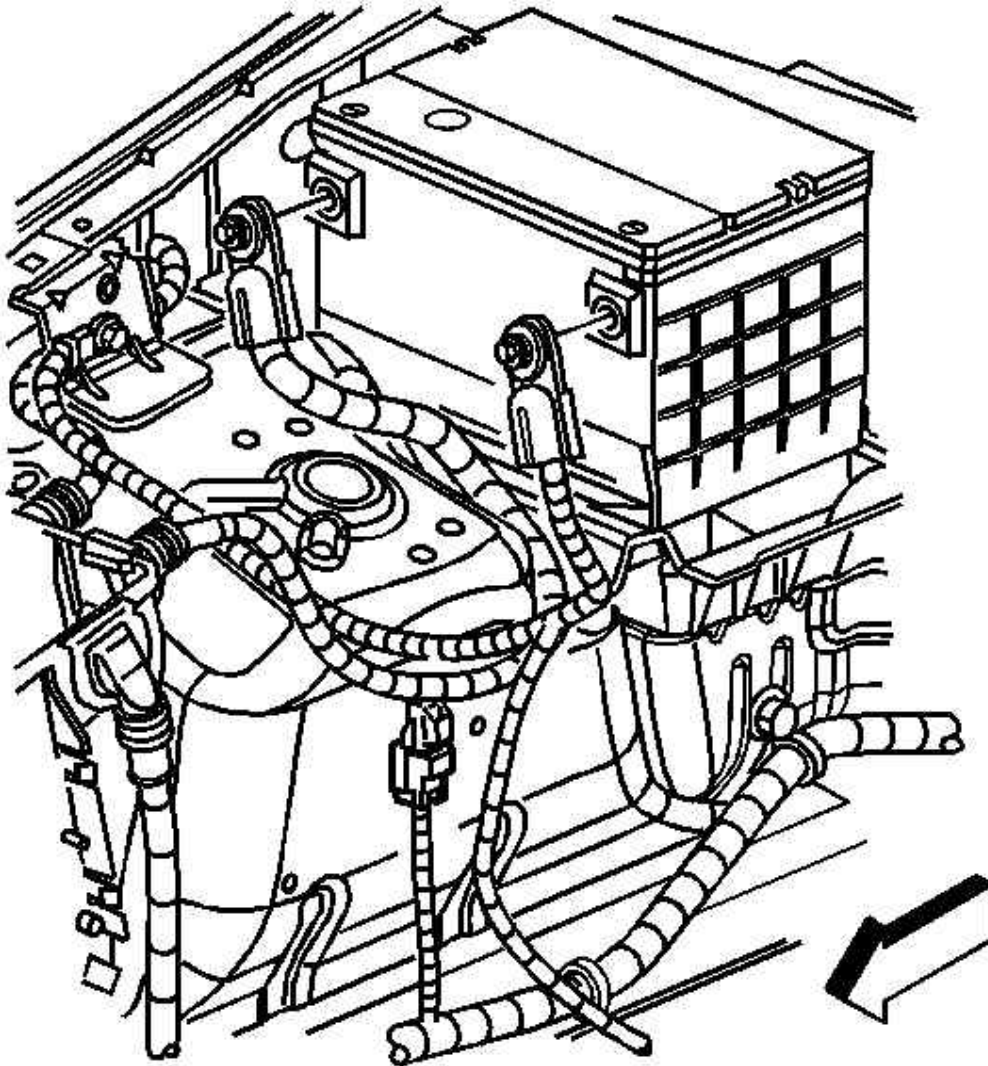


Fig. 68: View Of Battery Positive & Negative Cables
Courtesy of GENERAL MOTORS CORP.

62. Connect the battery positive cable to the battery and the underhood electrical center. Refer to **Battery Positive Cable Replacement (LY7)** .
63. Connect the battery negative cable from the battery and the body. Refer to **Battery Negative Cable Replacement (LY7)** .

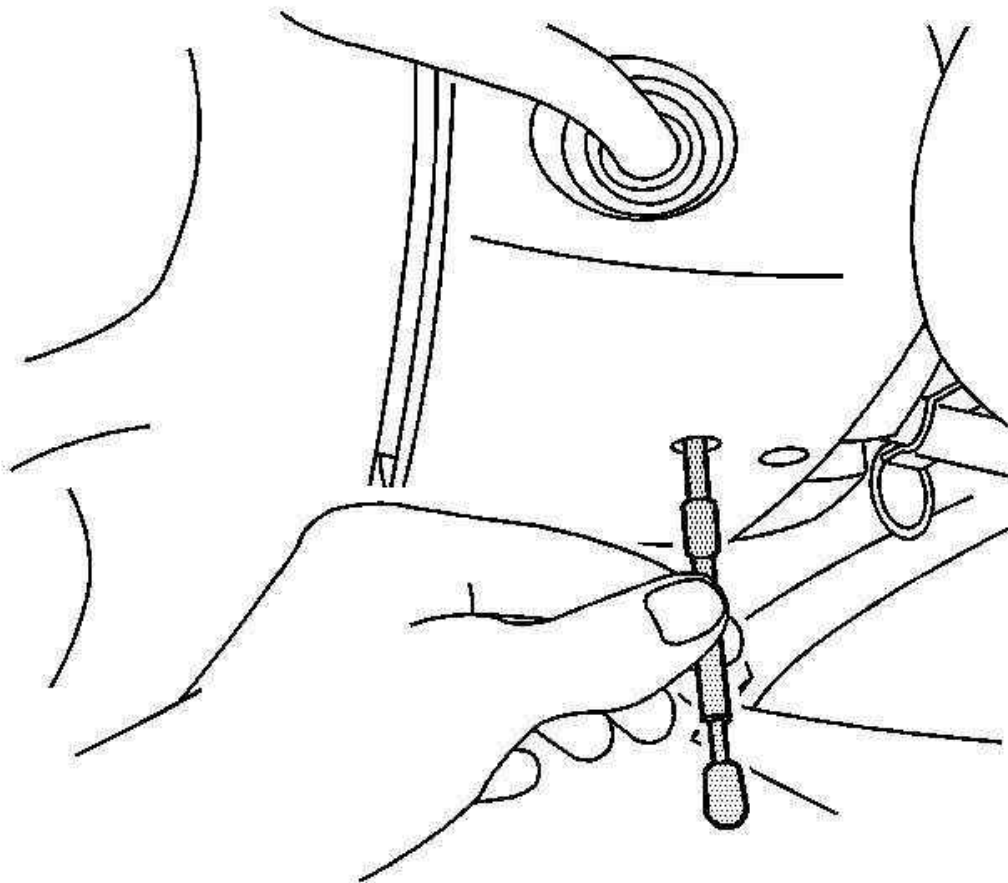


Fig. 69: Identifying J 42640
Courtesy of GENERAL MOTORS CORP.

64. Remove the **J 42640** from the steering column. See **Special Tools** .

65. Fill the cooling system. Refer to **Cooling System Draining and Filling (L26, LY7 GE 47716 Fill)** or **Cooling System Draining and Filling (LY7 Static Fill)** .
66. Charge the air conditioning system. Refer to **Refrigerant Recovery and Recharging** .
67. Bleed the brake system. Refer to **Antilock Brake System Automated Bleed Procedure** .

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

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

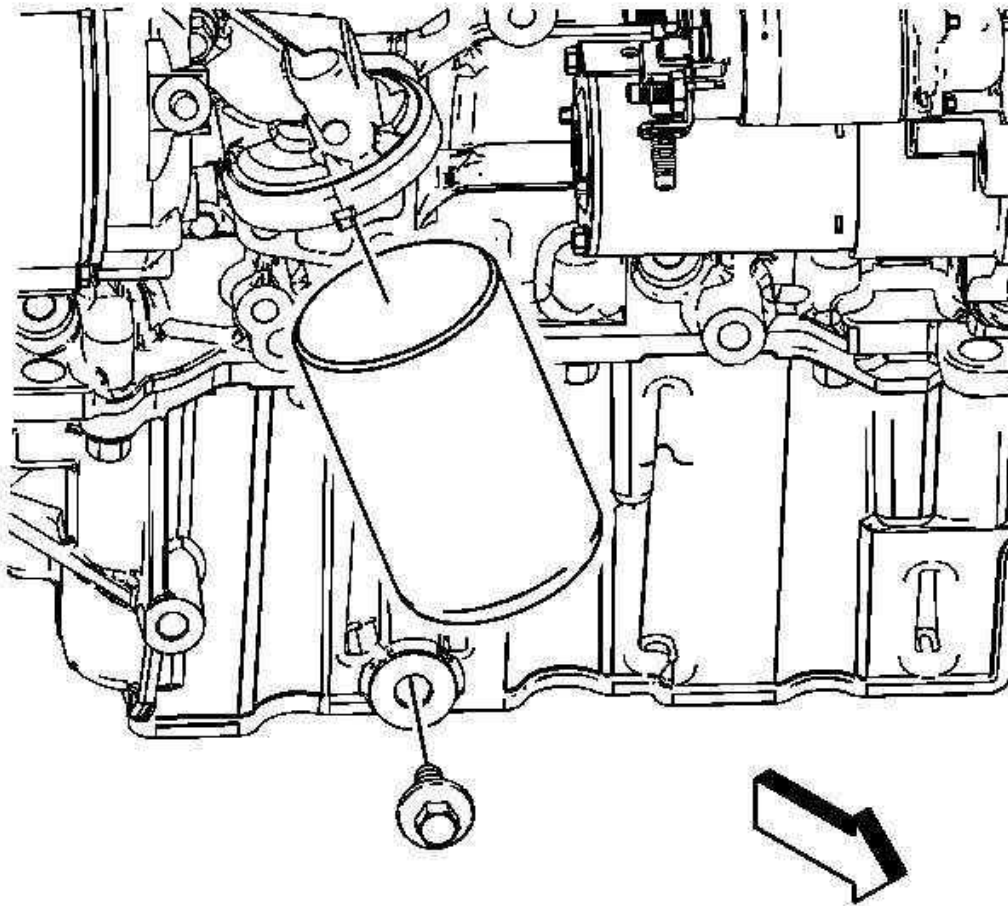


Fig. 70: View Of Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine oil drain plug.
4. Clean and inspect the engine oil drain plug, repair or 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.
6. Remove the oil filter.

1. Lightly oil the replacement oil filter gasket with clean oil and install the new oil filter.

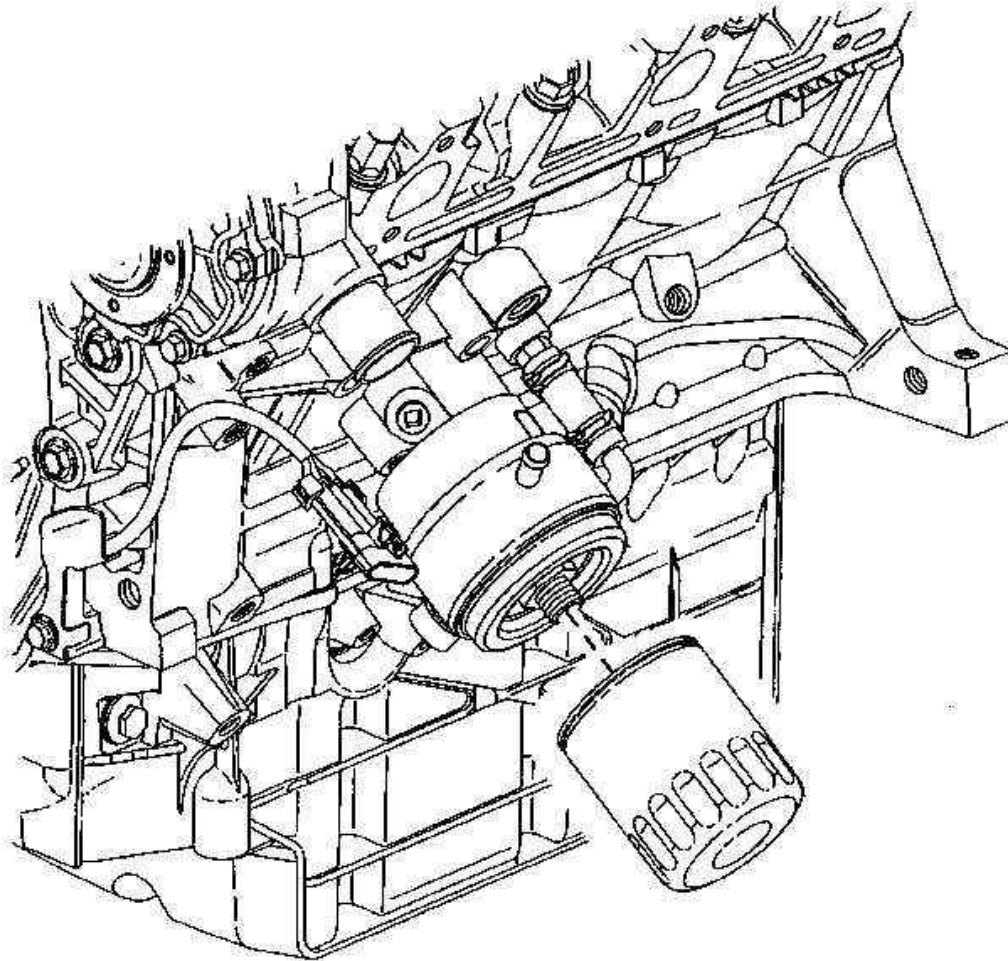


Fig. 71: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2. Install the new oil filter. Refer to Maintenance Items .

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

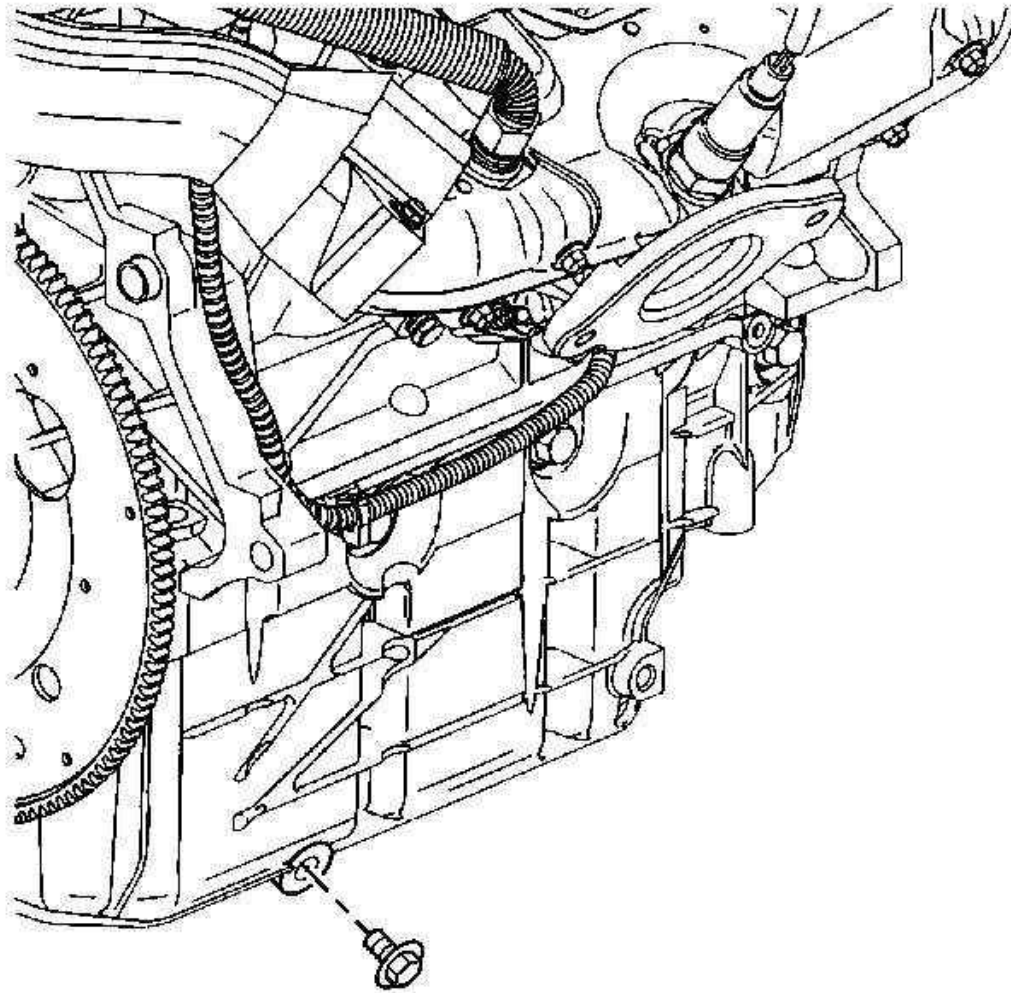


Fig. 72: View Of Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

3. Install the engine oil drain plug.

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

4. Remove the oil drain pan.
5. Lower the vehicle.
6. Fill the engine with new engine oil. Refer to the following information:
 - **Approximate Fluid Capacities**
 - **Fluid and Lubricant Recommendations**

OFF-VEHICLE REPAIR INSTRUCTIONS

DRIVE BELT TENSIONER REMOVAL

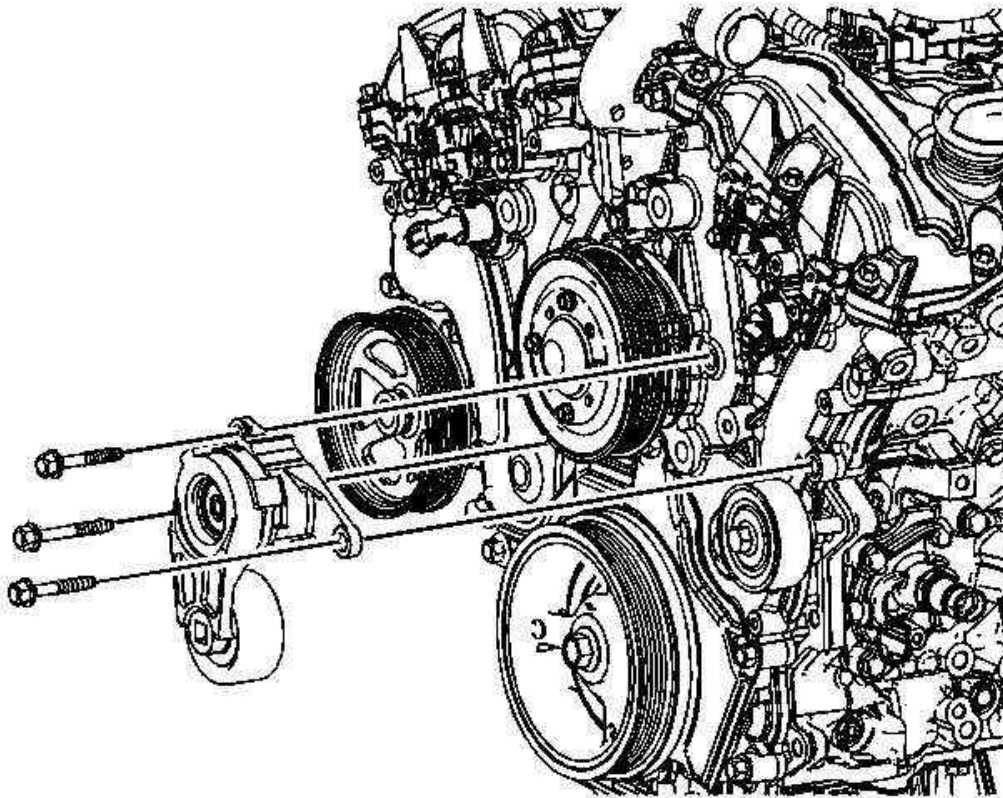


Fig. 73: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt tensioner bracket bolts.

2. Remove the drive belt tensioner assembly.

DRIVE BELT IDLER PULLEY REMOVAL

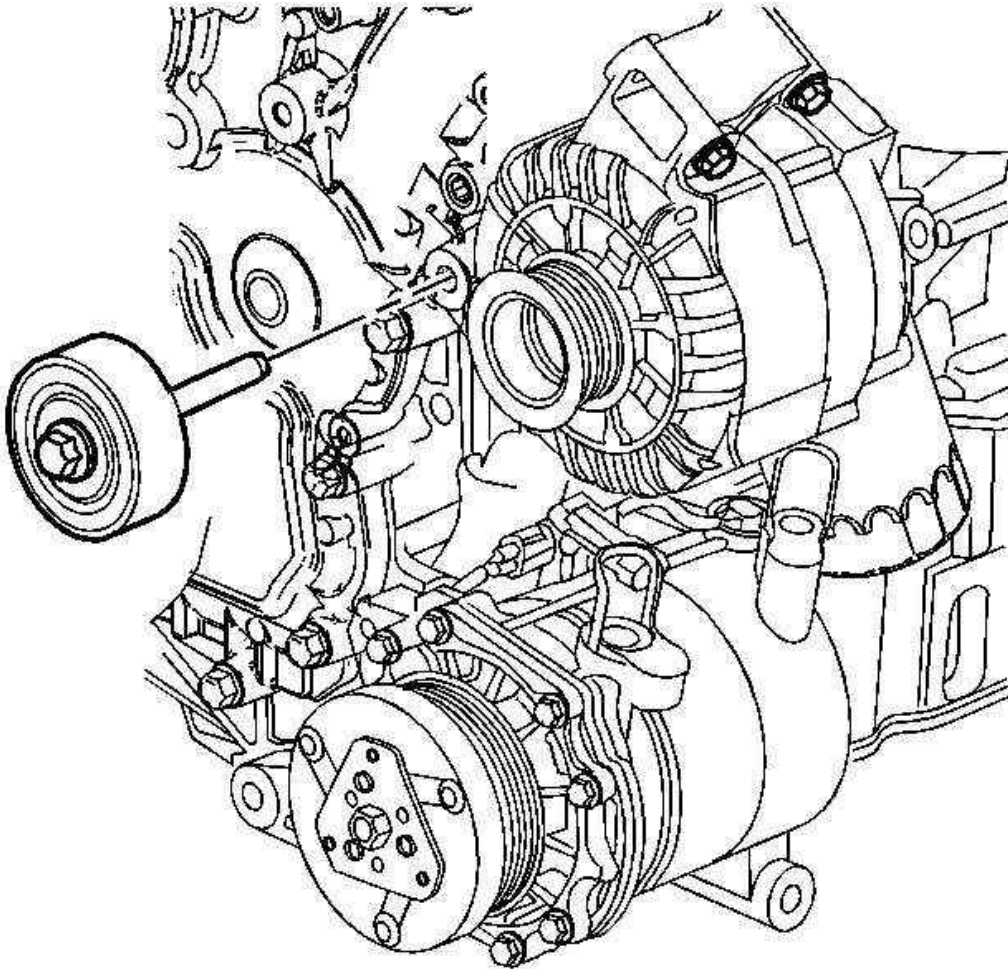


Fig. 74: Identifying Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

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

OIL LEVEL INDICATOR AND TUBE REMOVAL

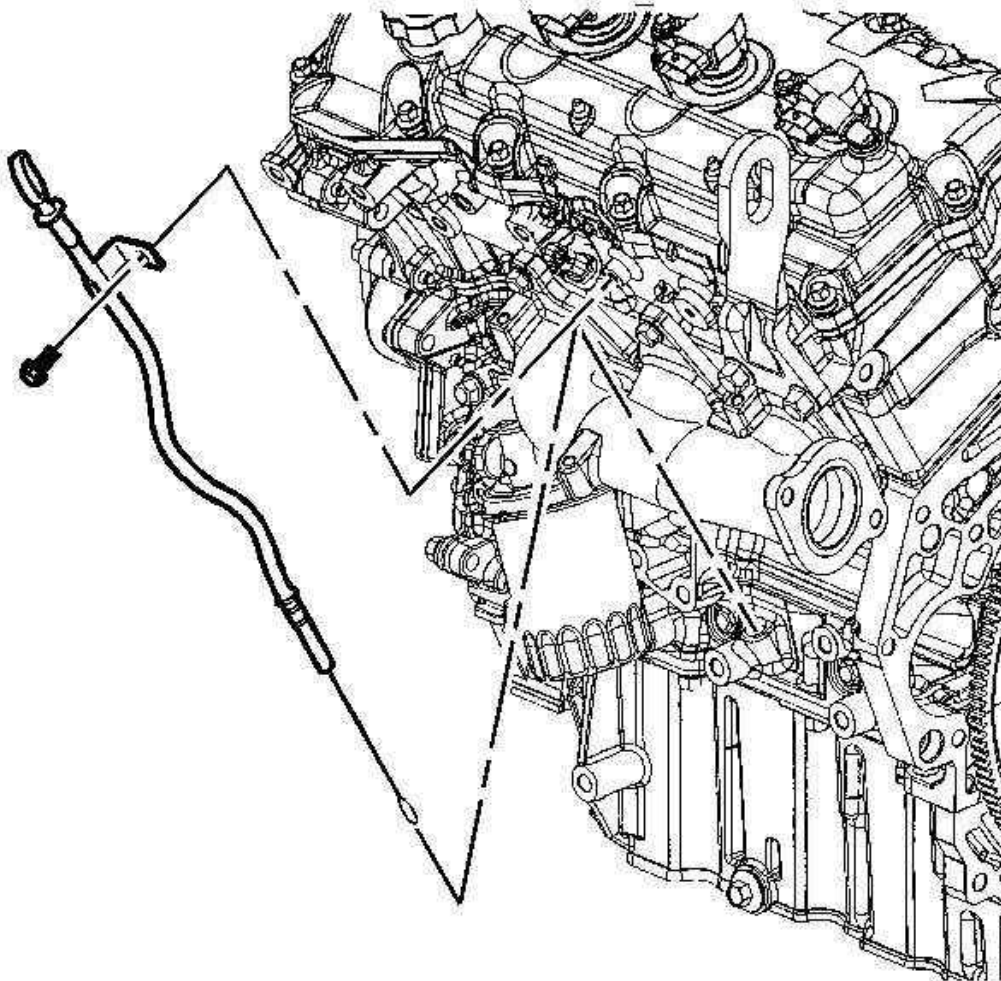


Fig. 75: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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

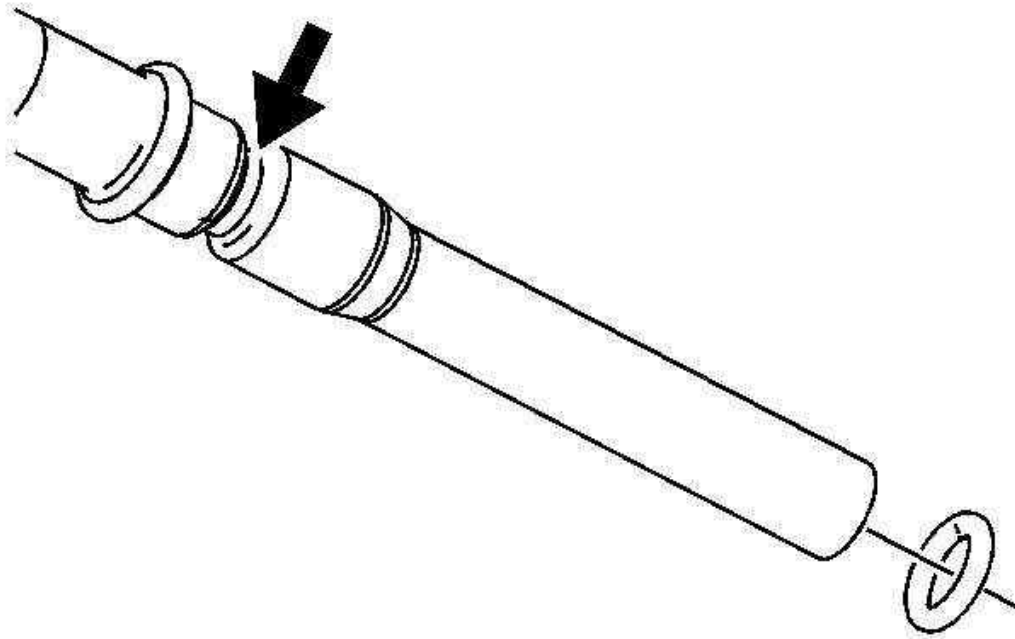


Fig. 76: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

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

EXHAUST MANIFOLD REMOVAL - LEFT SIDE

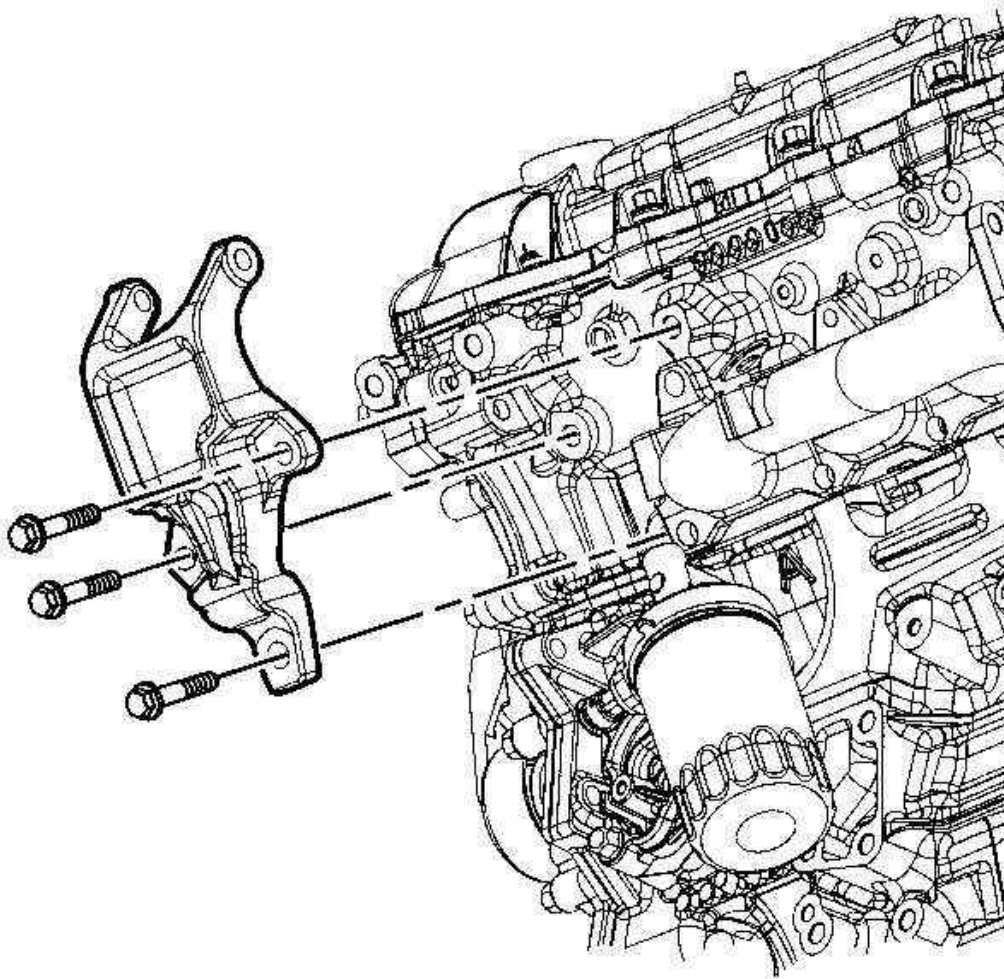


Fig. 77: View Of Left Torque Strut Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the left torque strut bracket bolts.
2. Remove the left torque strut bracket.

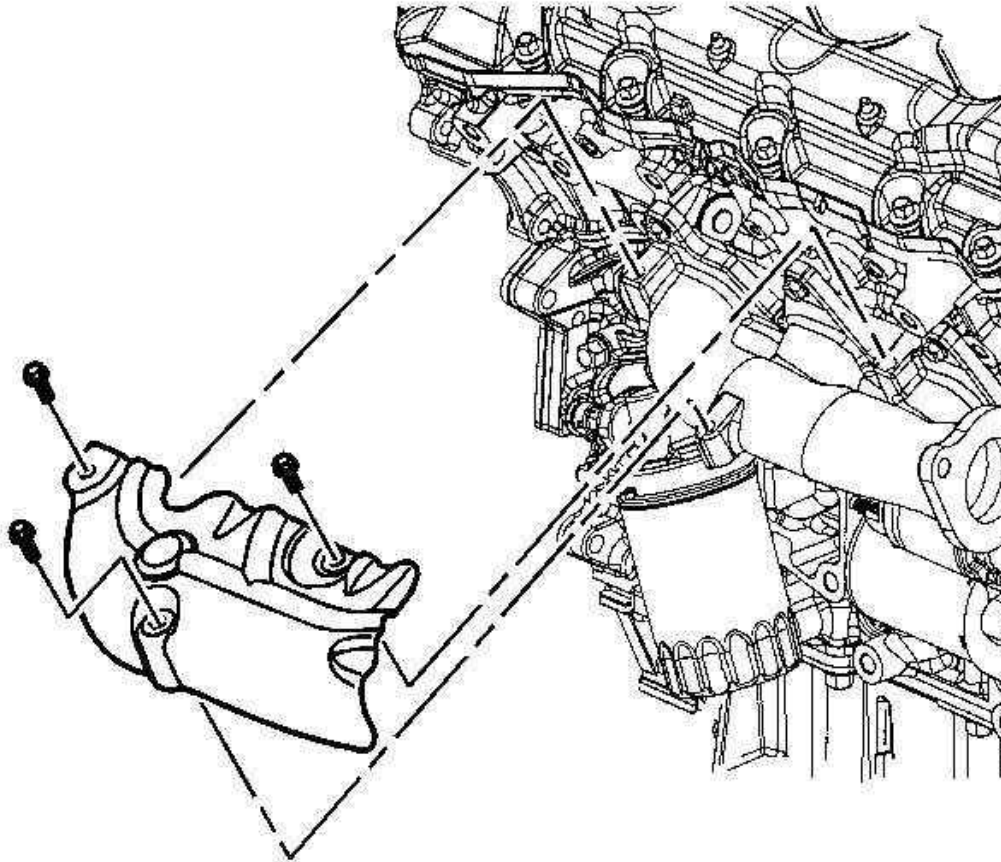


Fig. 78: Identifying Left Exhaust Manifold Heat Shield Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the left exhaust manifold heat shield bolts.
4. Remove the left exhaust manifold heat shield.

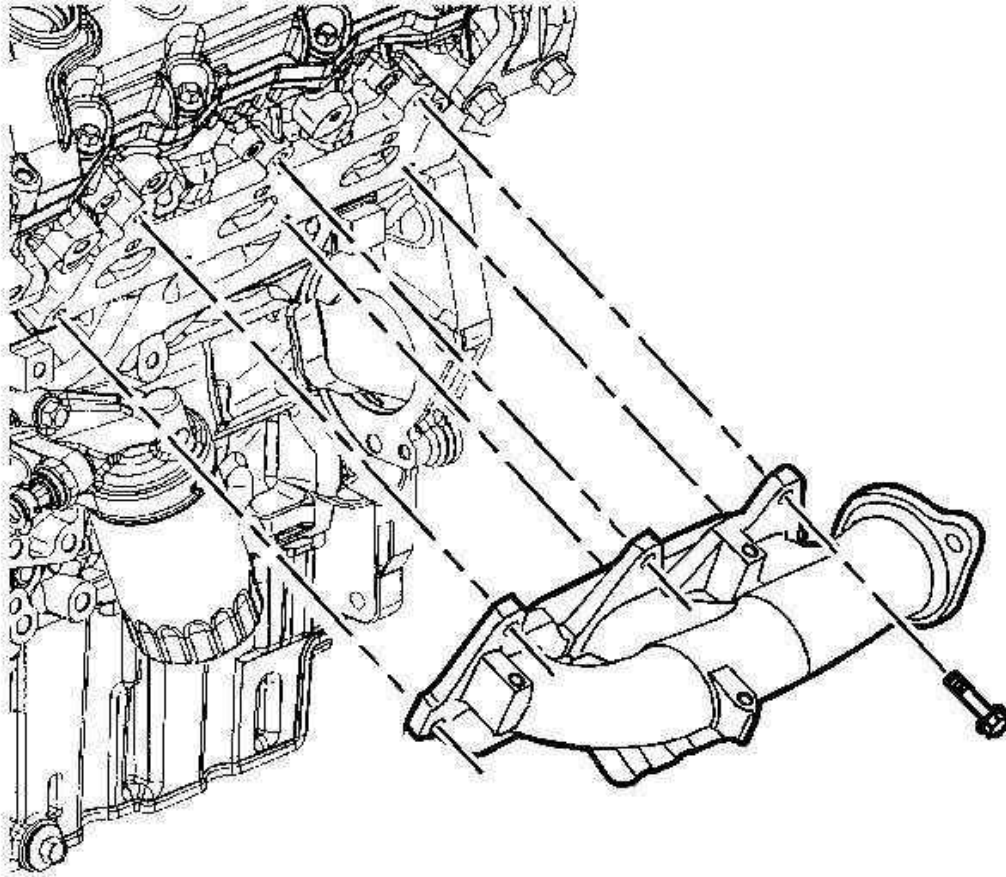


Fig. 79: View Of Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

5. Remove the exhaust manifold bolts from the left cylinder head.
6. Remove the left exhaust manifold.
7. Remove and discard the exhaust manifold gasket.

OIL FILTER ADAPTER REMOVAL

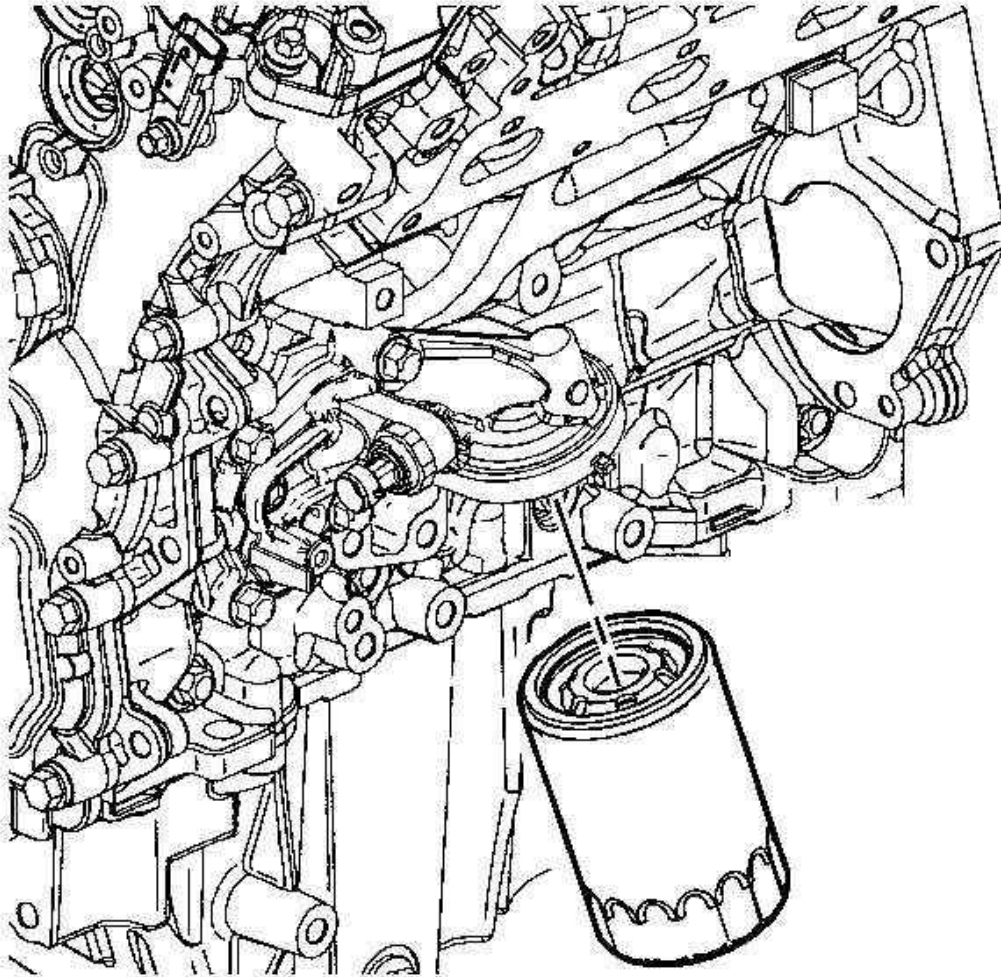


Fig. 80: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

1. Remove and properly dispose of the oil filter.

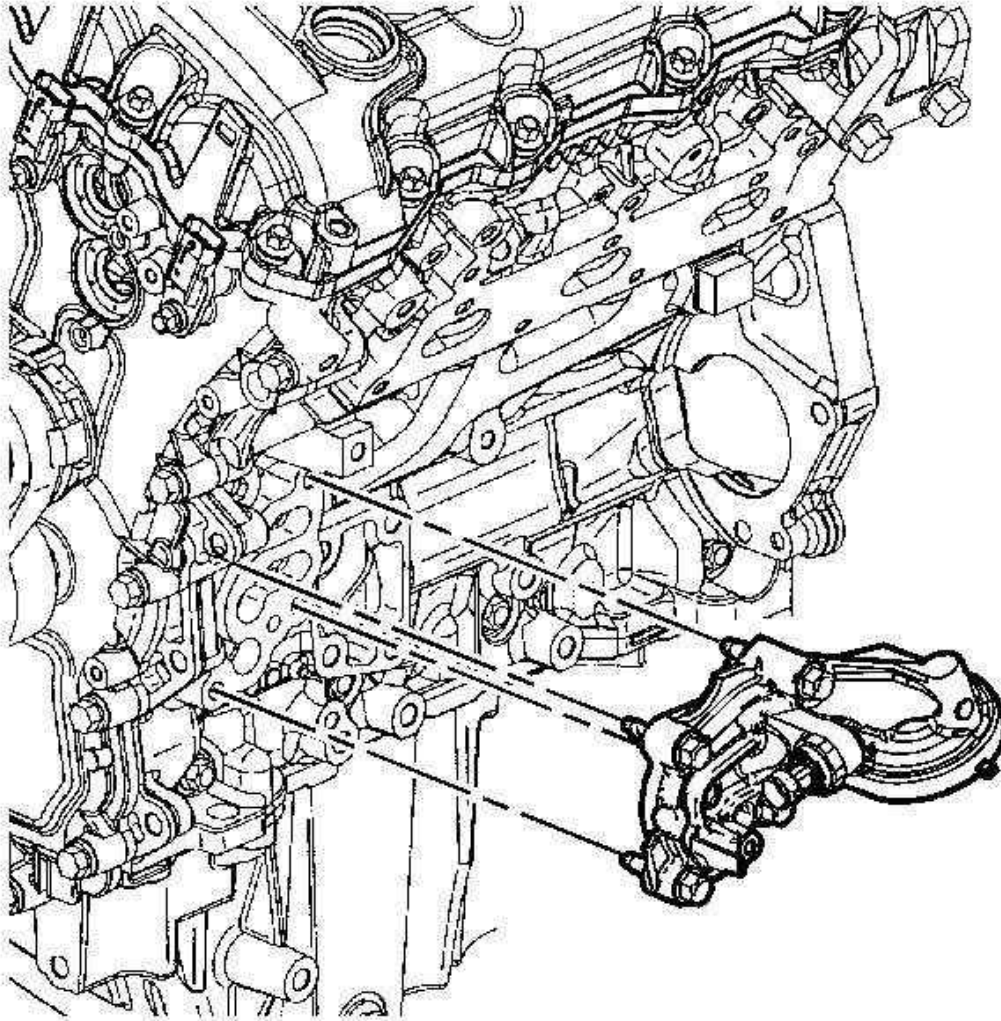


Fig. 81: Identifying Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filter adapter bolts from the engine block.
3. Remove the oil filter adapter.

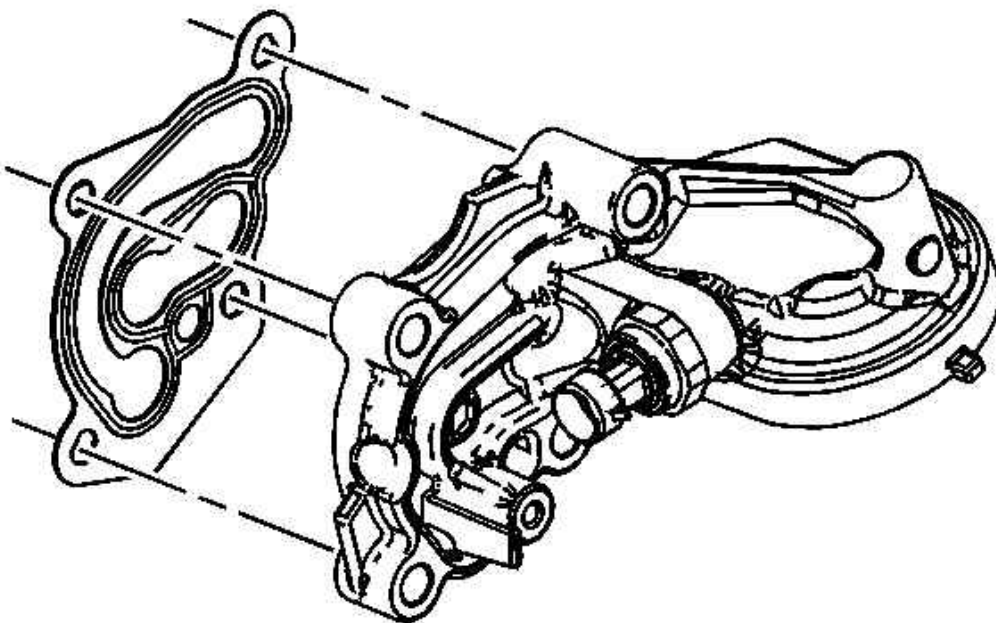


Fig. 82: View Of Oil Filter Adapter Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the oil filter adapter gasket.

EXHAUST MANIFOLD REMOVAL - RIGHT SIDE

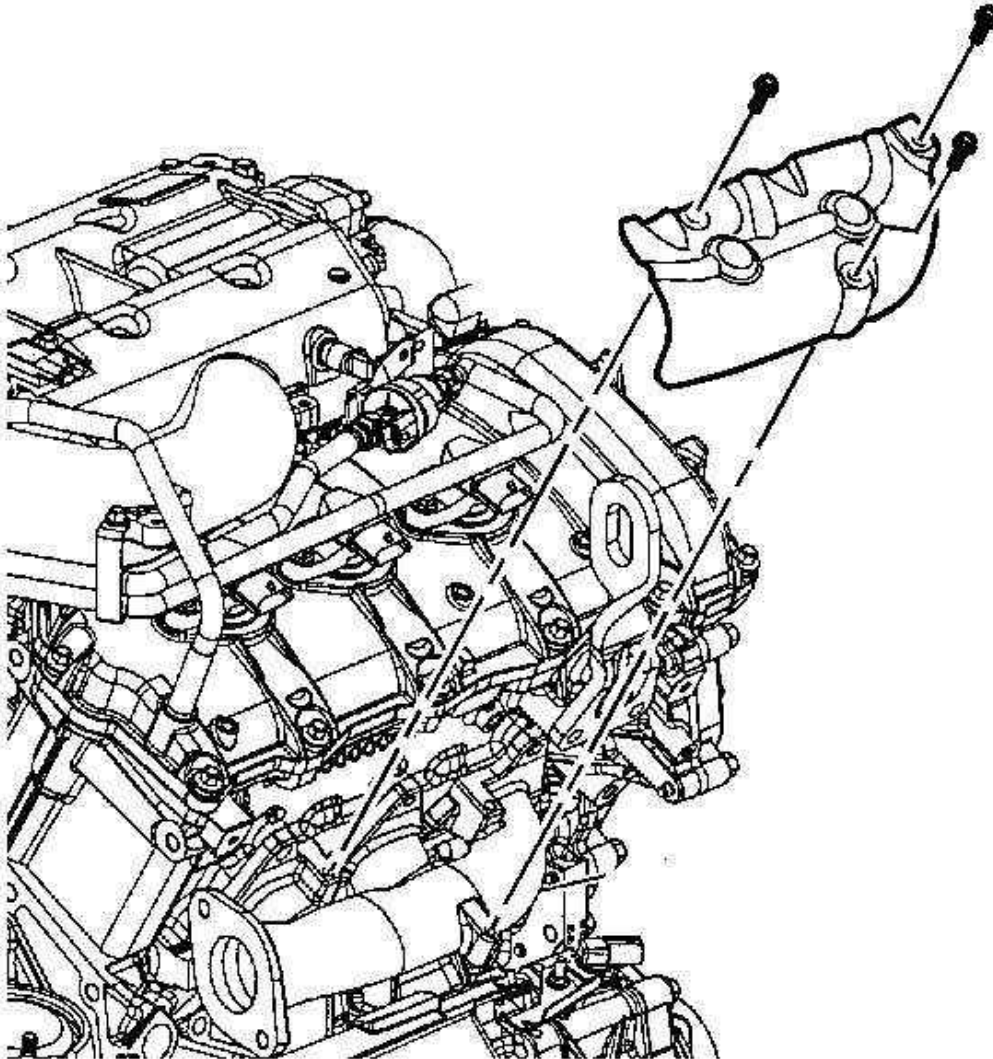


Fig. 83: View Of Right Exhaust Manifold Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

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

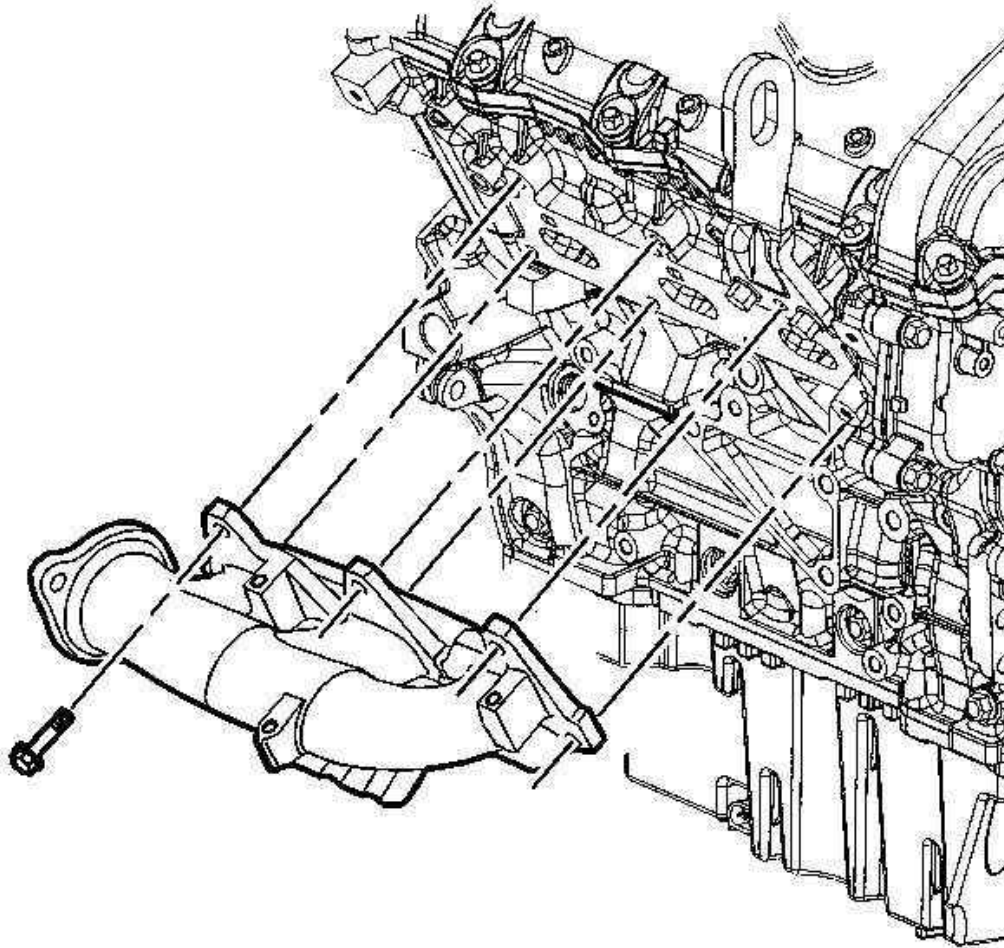


Fig. 84: Identifying Exhaust Manifold Bolts To Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Remove the exhaust manifold bolts from the right cylinder head.
4. Remove the right exhaust manifold.
5. Remove and discard the exhaust manifold gasket.

WATER OUTLET REMOVAL

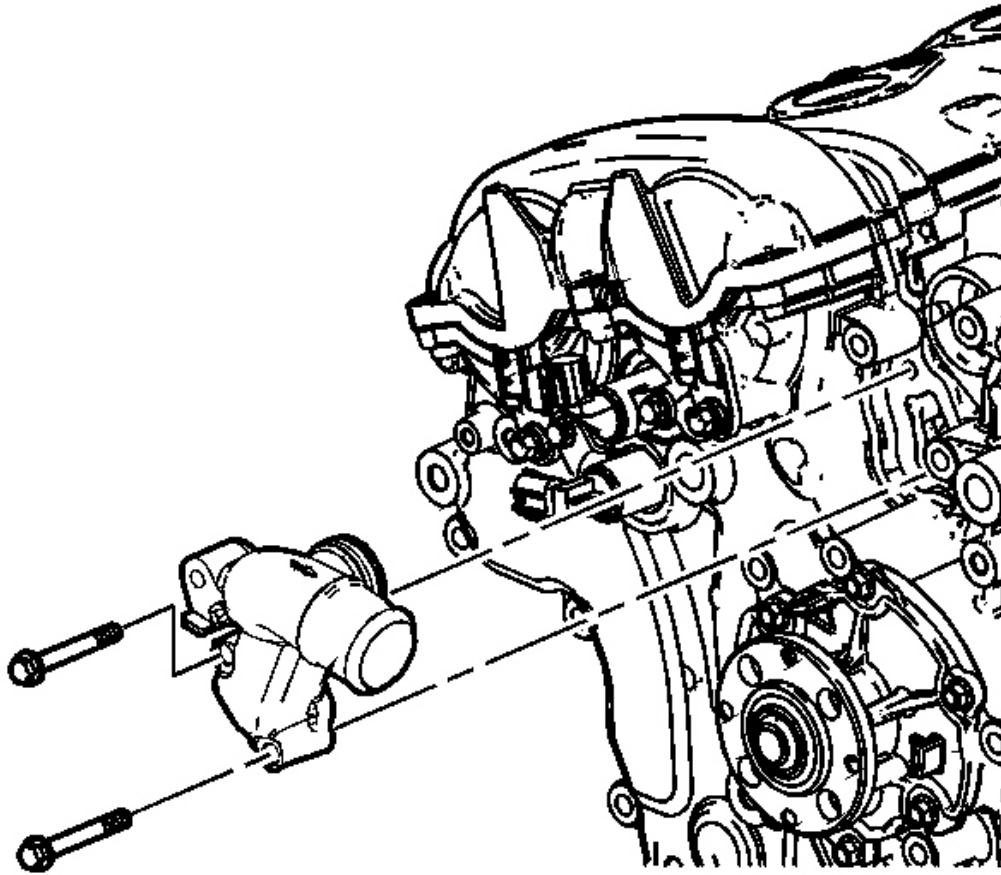


Fig. 85: Locating Water Outlet Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the water outlet bolts.
2. Remove the water outlet.

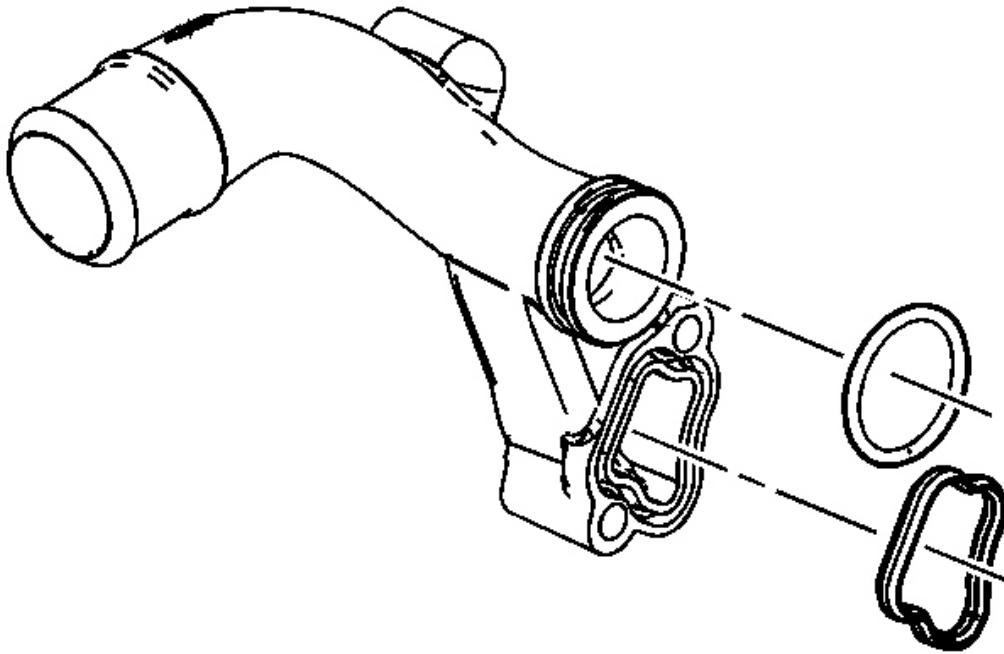


Fig. 86: Identifying Water Outlet Gasket & O-Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the water outlet gasket and O-ring.

ENGINE COOLANT THERMOSTAT HOUSING REMOVAL

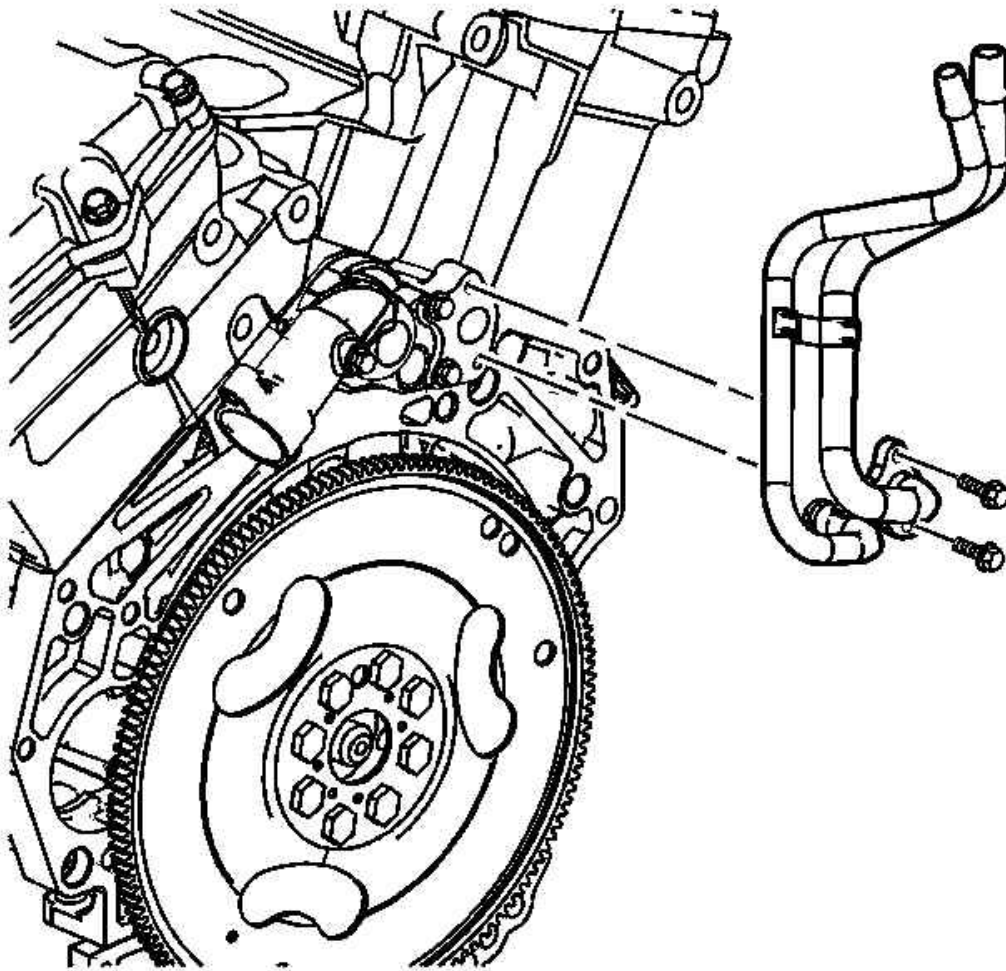


Fig. 87: View Of Heater Inlet/Outlet Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the heater inlet/outlet pipe assembly bolts.
2. Remove the heater inlet/outlet pipe assembly.

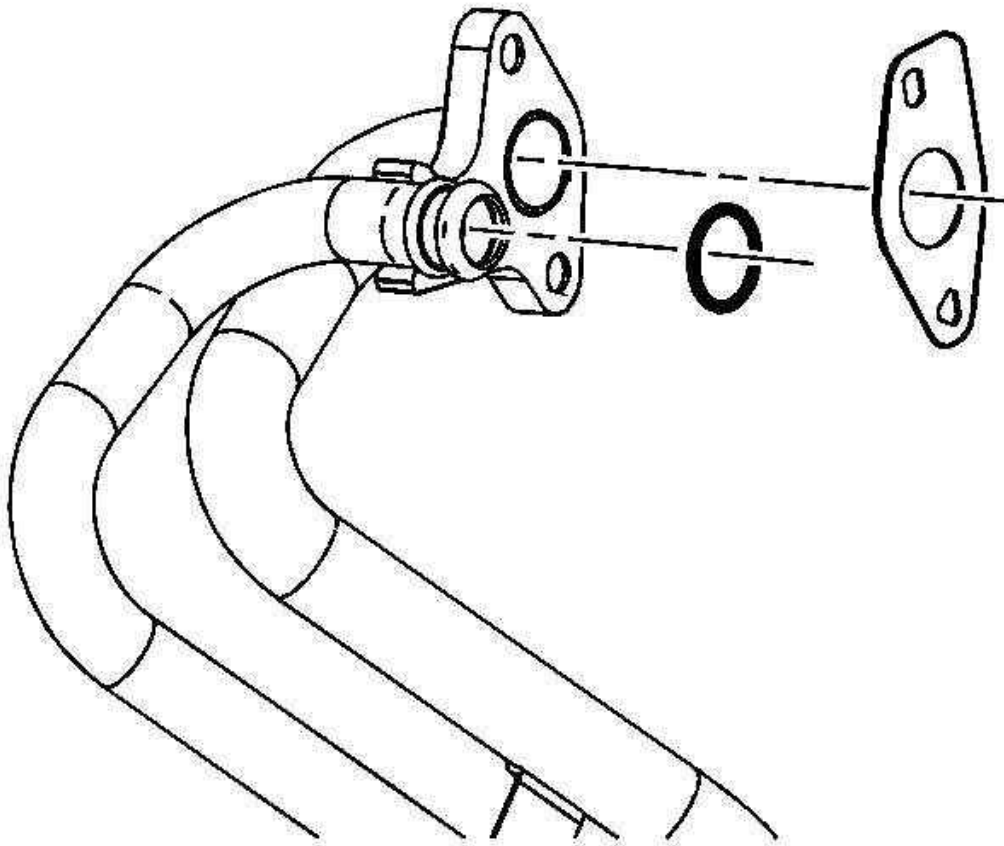


Fig. 88: Identifying Heater Inlet/Outlet Pipe Gasket & O-Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the heater inlet/outlet pipe gasket and O-ring.

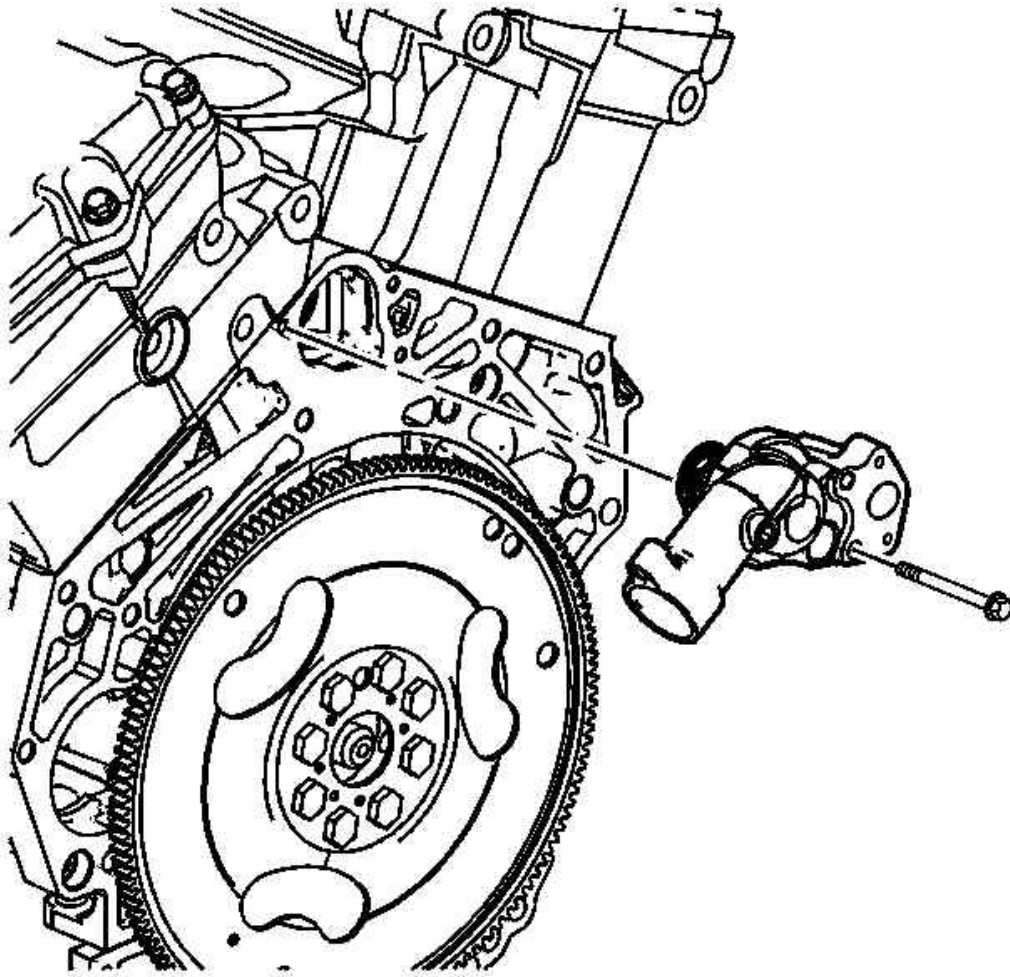


Fig. 89: View Of Thermostat Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the thermostat housing bolts.
5. Remove the thermostat housing.

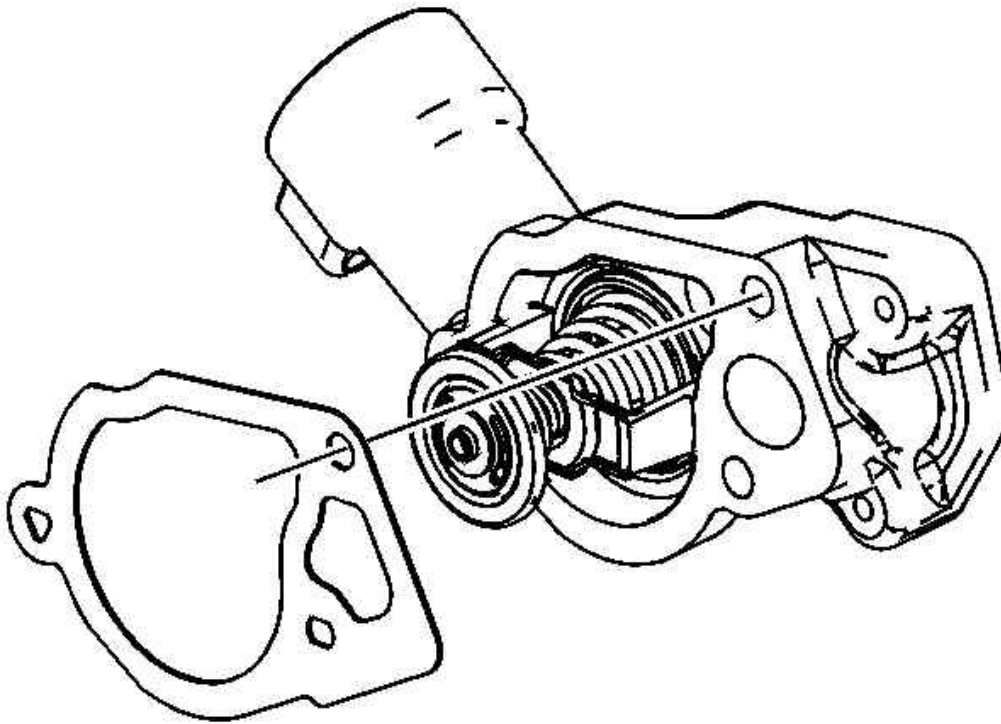


Fig. 90: View Of Thermostat Housing Gasket
Courtesy of GENERAL MOTORS CORP.

6. Remove and discard the thermostat housing gasket.

CRANKSHAFT BALANCER REMOVAL

Tools Required

- **EN 46106** Flywheel Holding Tool. See **Special Tools** .
- **J 38416-2** Crankshaft Button. See **Special Tools** .
- **J 41816** Crankshaft Balancer Remover

Removal Procedure

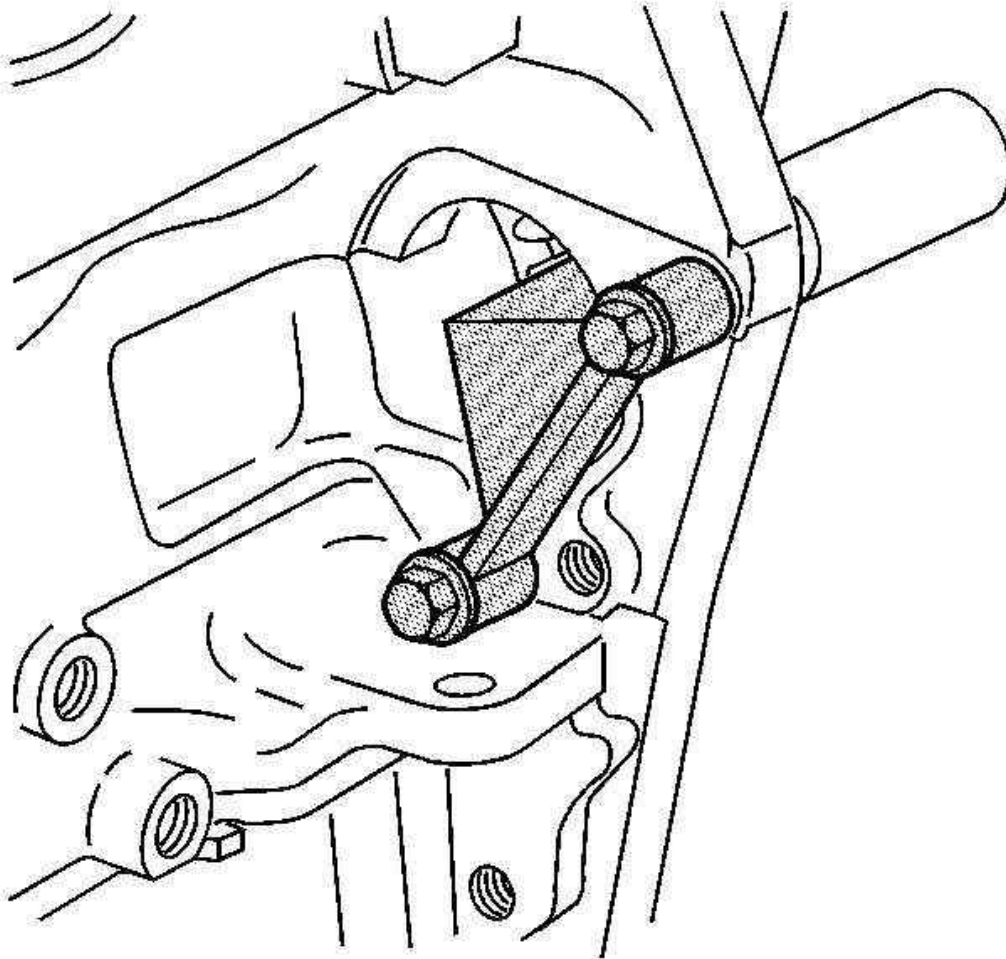


Fig. 91: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

1. Install the **EN 46106** through the starter mounting hole. See **Special Tools** .

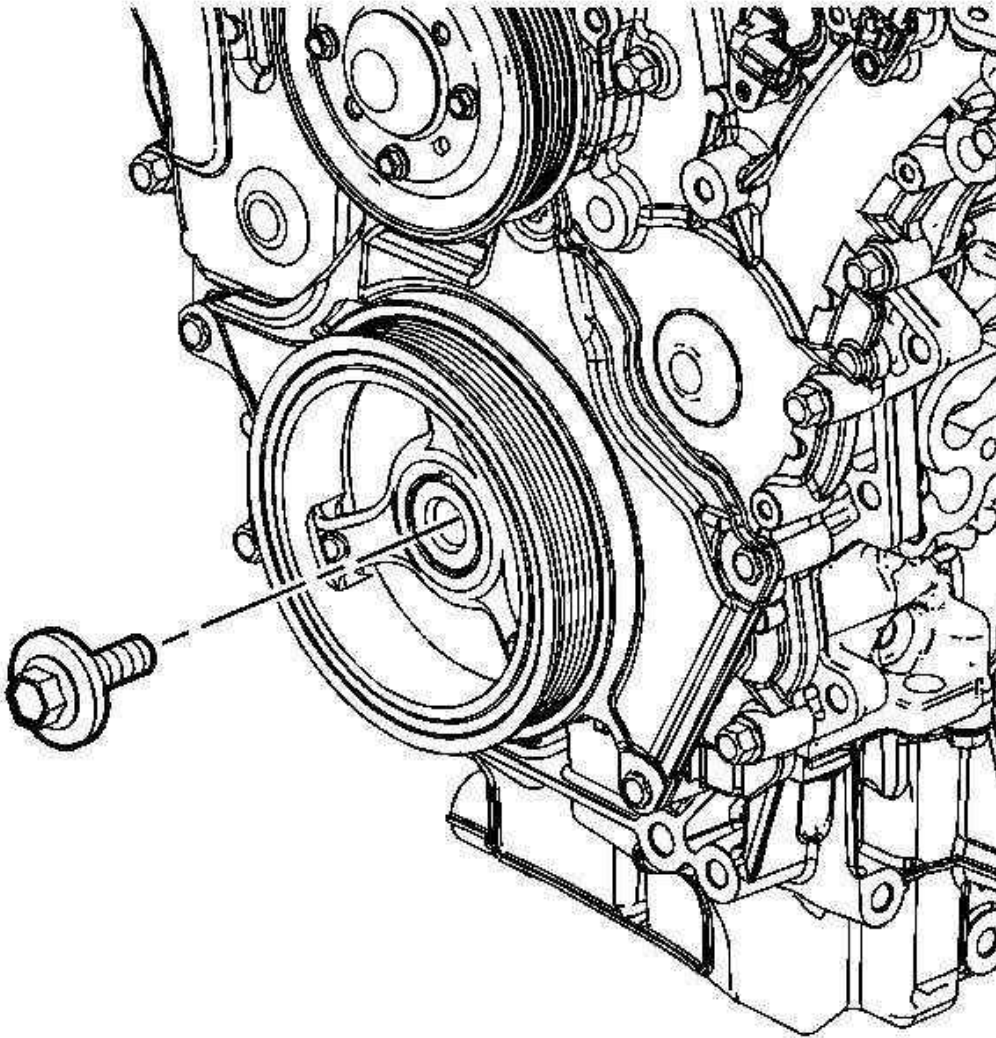


Fig. 92: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the crankshaft balancer bolt.

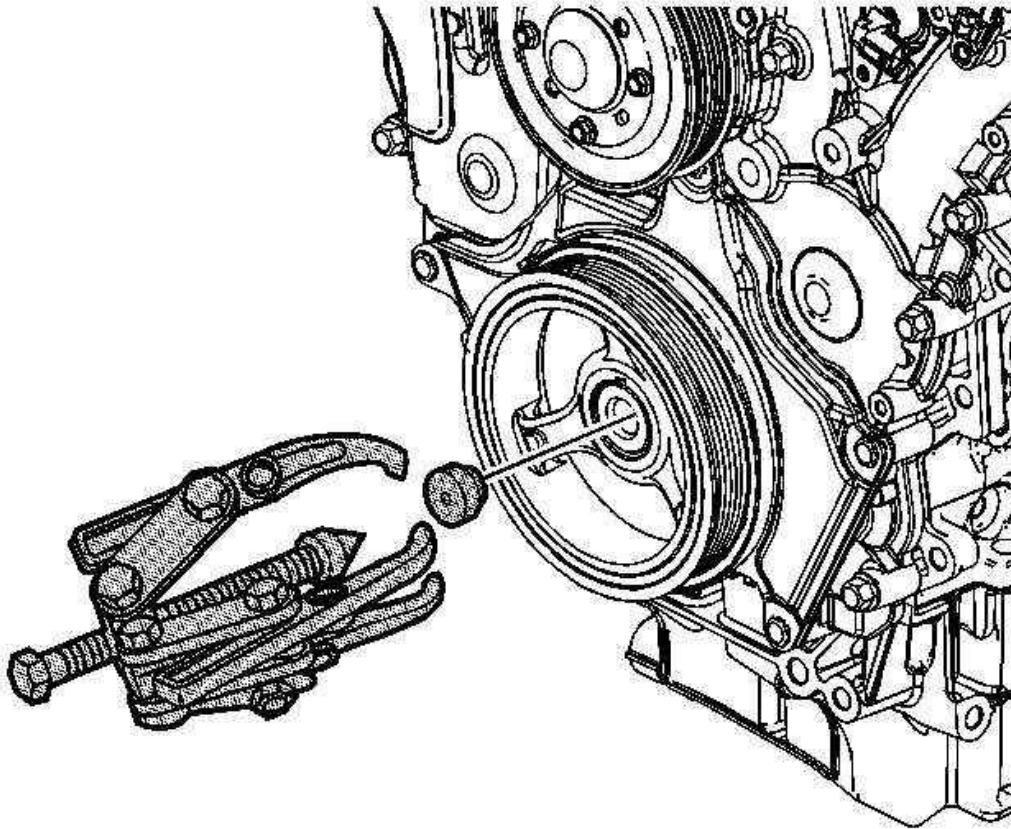


Fig. 93: Identifying Crankshaft Balancer Remover
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 38416-2** in the nose of the crankshaft. See **Special Tools** .
4. Install the **J 41816** in order to remove the crankshaft balancer.
5. Tighten the center bolt of the **J 41816** in order to pull the crankshaft balancer off of the crankshaft.
6. Remove the **J 41816** from the crankshaft balancer.

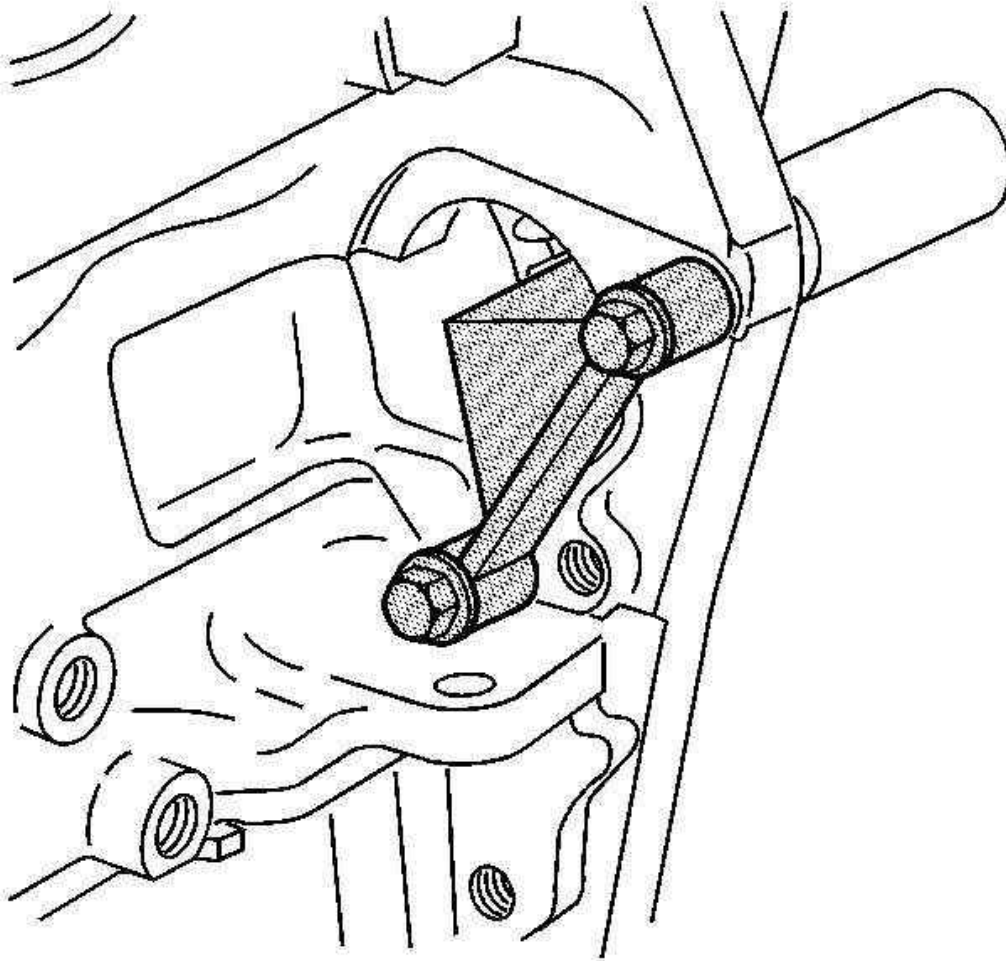


Fig. 94: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

7. Remove the **EN 46106** . See **Special Tools** .

ENGINE FLYWHEEL REMOVAL

Tools Required

EN 46106 Flywheel Holding Tool. See **Special Tools** .

Removal Procedure

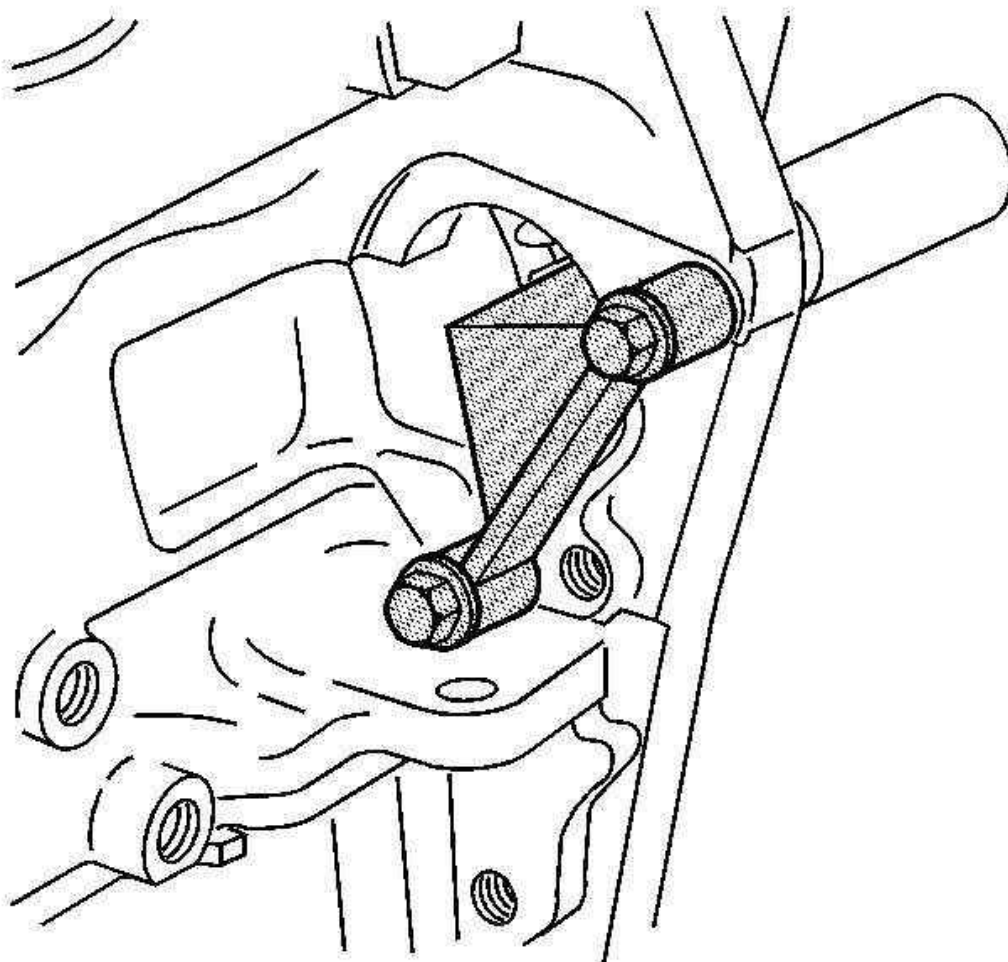


Fig. 95: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

1. Install the **EN 46106** through the starter mounting hole. See **Special Tools** .

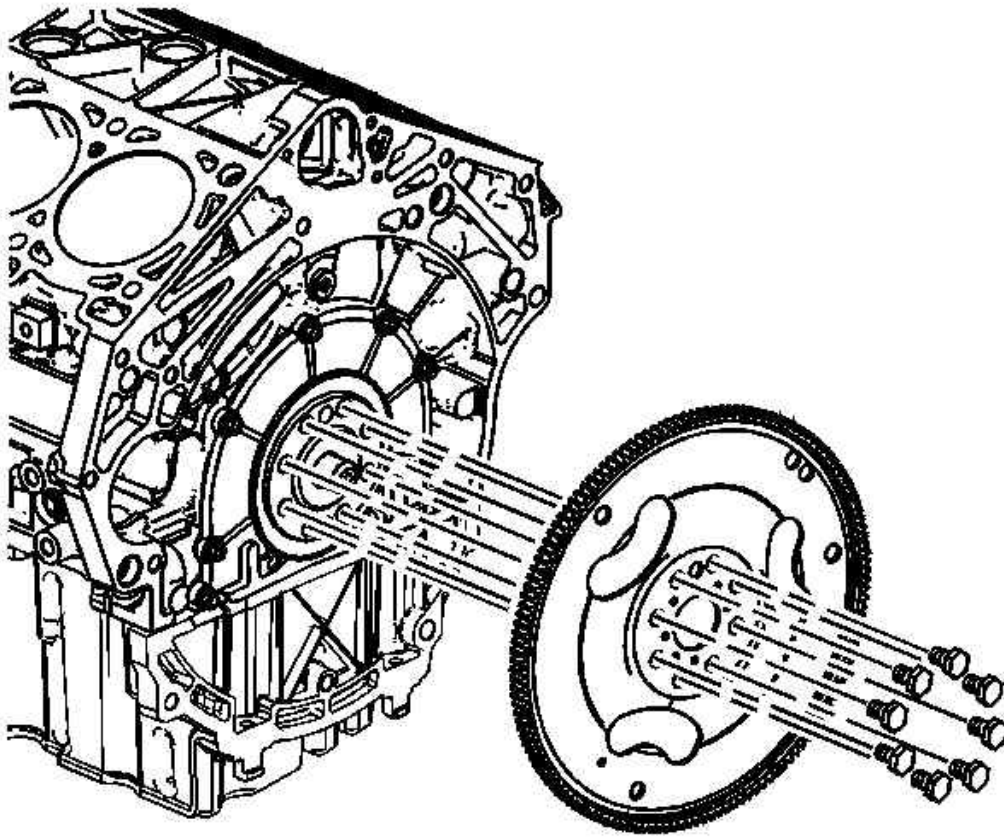


Fig. 96: Identifying Engine Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine flywheel bolts and discard.
3. Remove the engine flywheel from the crankshaft.

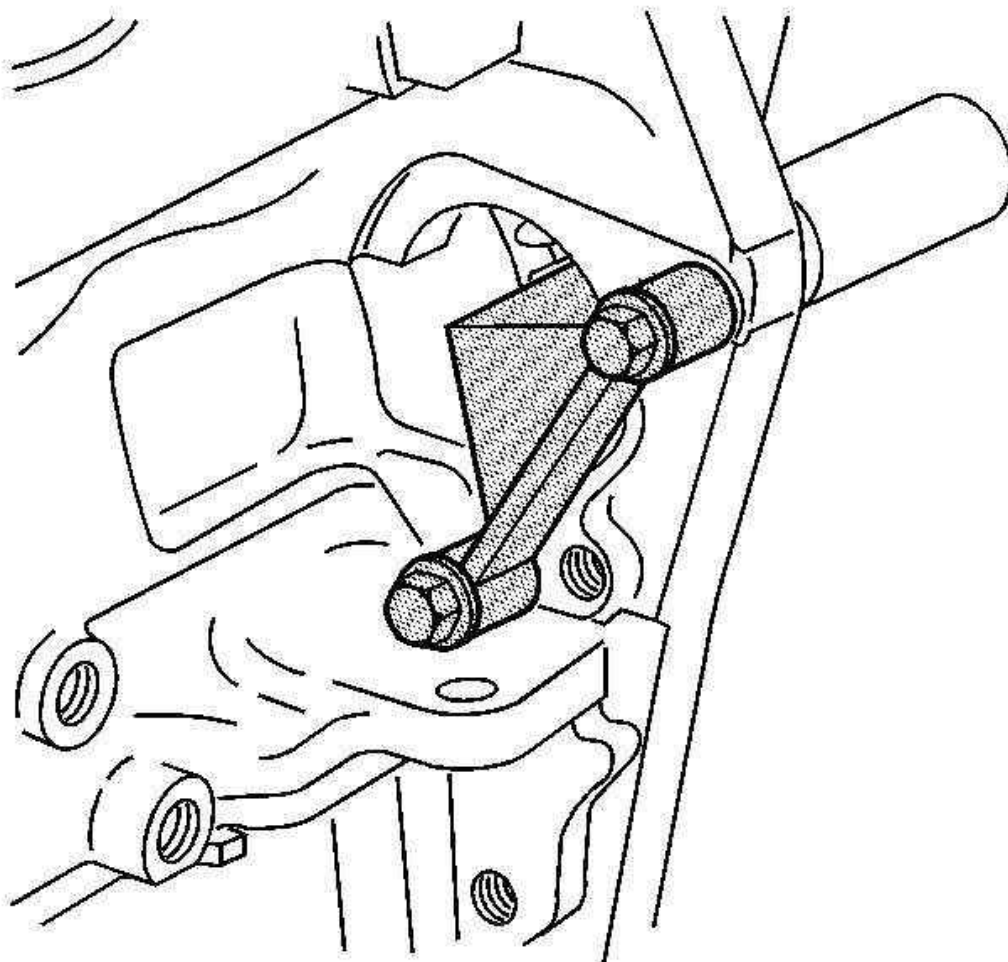


Fig. 97: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

4. Remove the **EN 46106** . See **Special Tools** .

INTAKE MANIFOLD REMOVAL

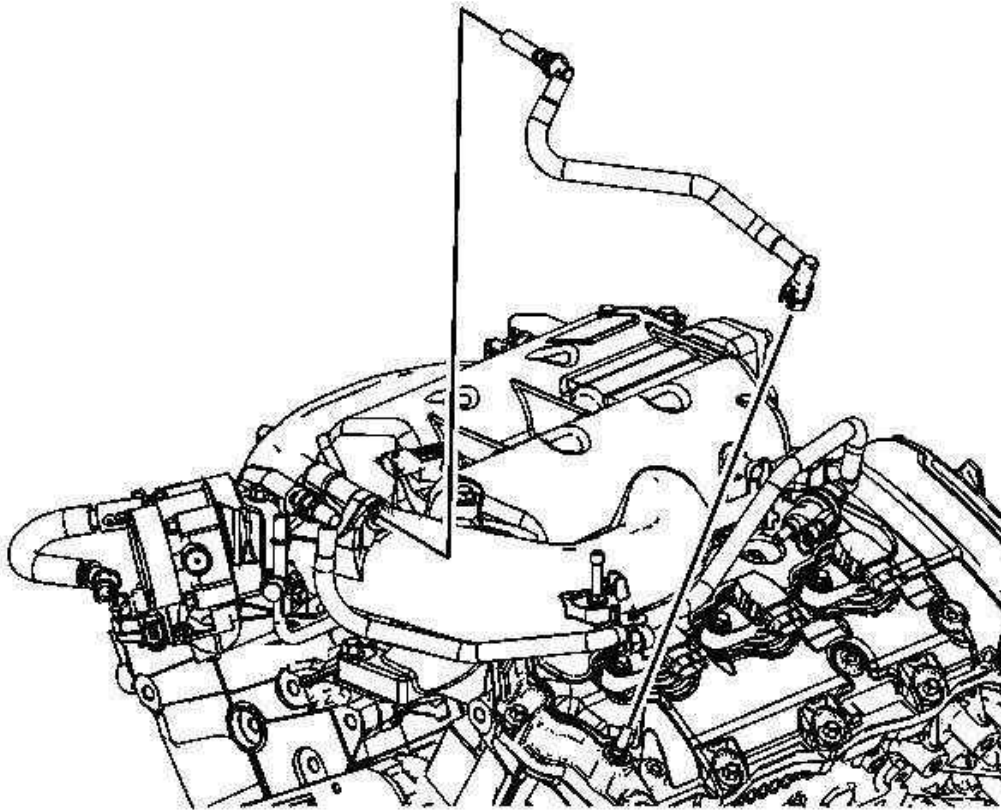


Fig. 98: Identifying Dirty Air Positive Crankcase Ventilation (PCV) Hose
Courtesy of GENERAL MOTORS CORP.

1. Disconnect and remove the dirty air positive crankcase ventilation (PCV) hose from the intake manifold and the right camshaft cover fitting.

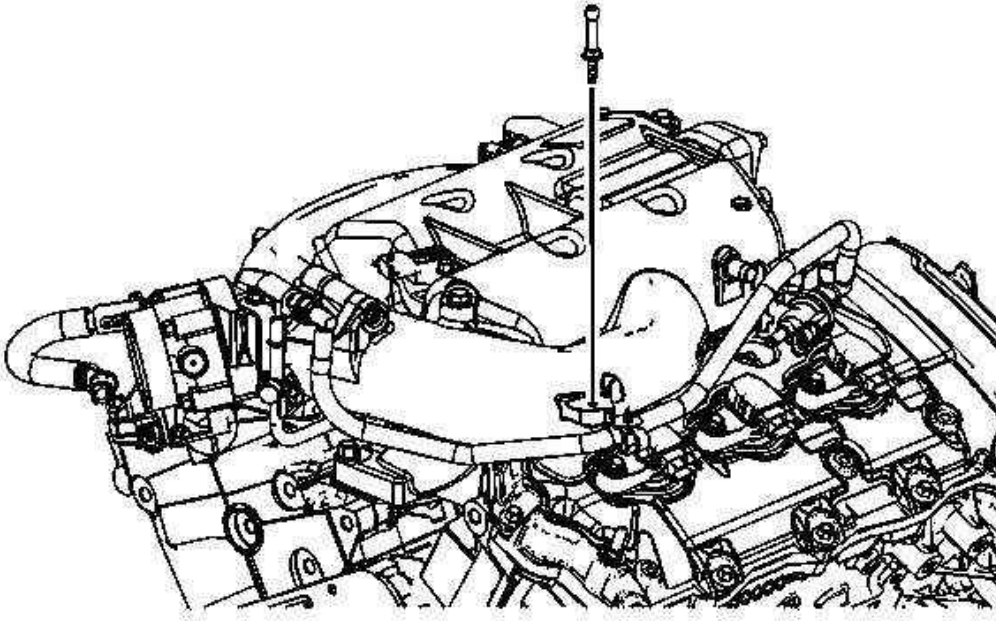


Fig. 99: Identifying Intake Manifold-To-Solenoid EVAP Hose Bracket Ballstud Bolt

Courtesy of GENERAL MOTORS CORP.

2. Remove the intake manifold-to-solenoid evaporative emissions (EVAP) hose bracket ballstud bolt from the intake manifold.

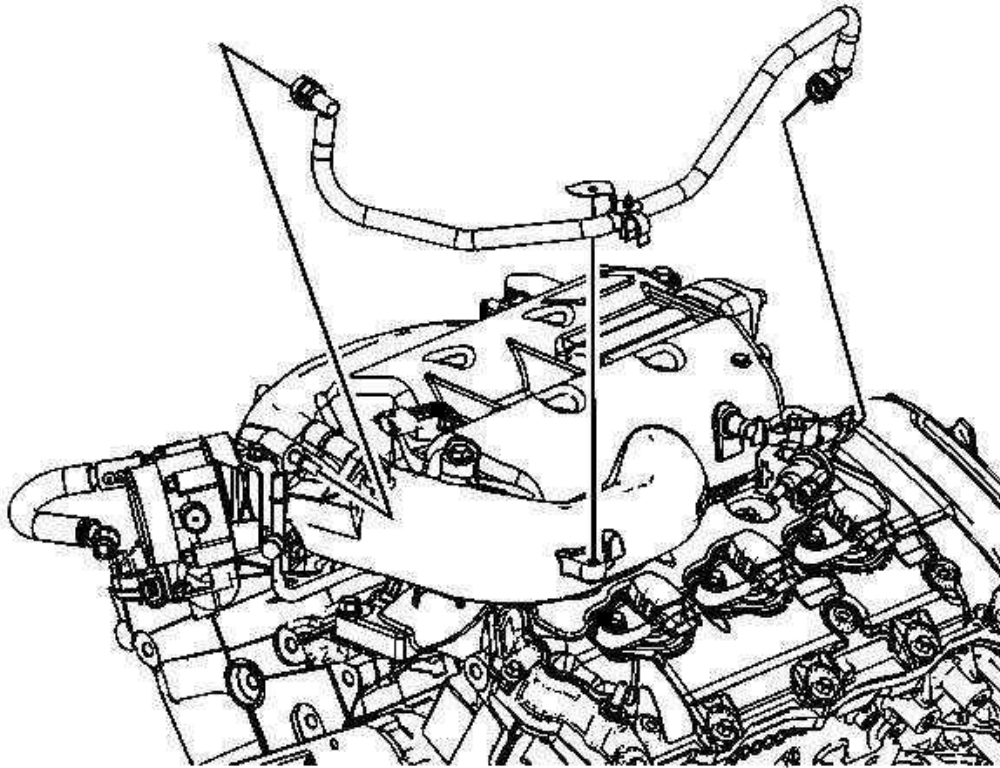


Fig. 100: Identifying Intake Manifold-To-Solenoid EVAP Hose
Courtesy of GENERAL MOTORS CORP.

3. Disconnect and remove the intake manifold-to-solenoid EVAP hose from the intake manifold and from the EVAP solenoid.

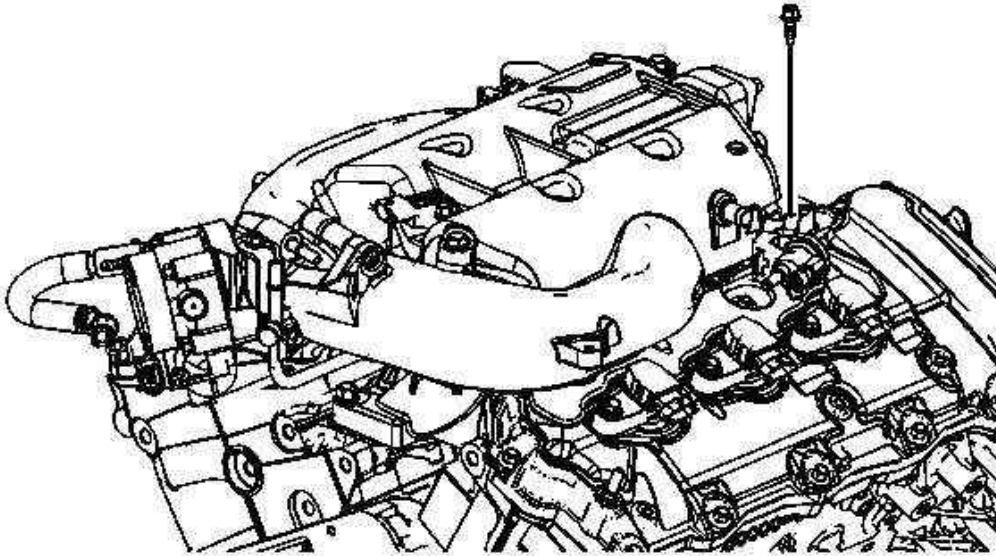


Fig. 101: Identifying EVAP Solenoid Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the EVAP solenoid bolt.

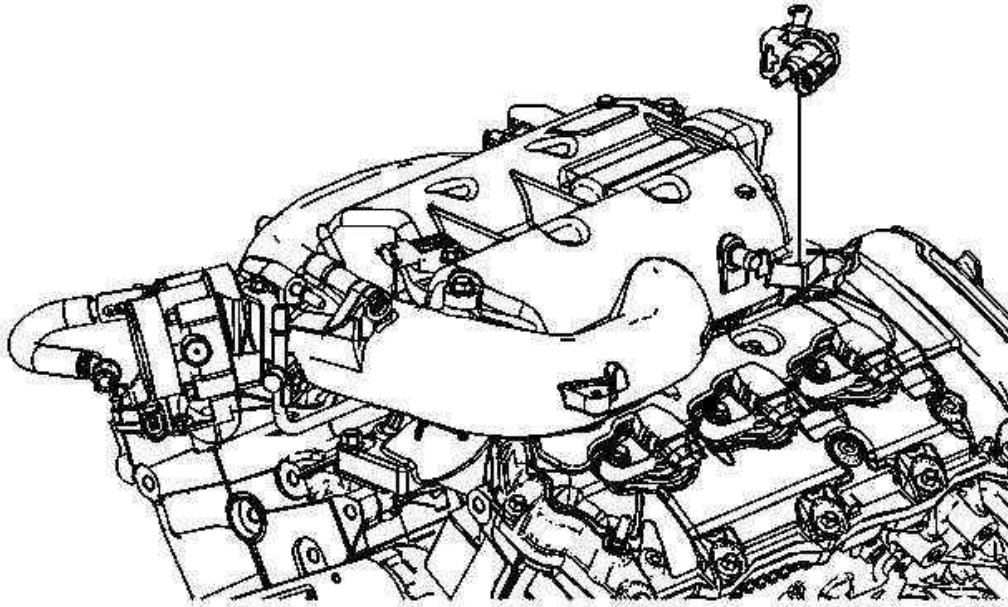


Fig. 102: View Of EVAP Solenoid
Courtesy of GENERAL MOTORS CORP.

5. Remove the EVAP solenoid.

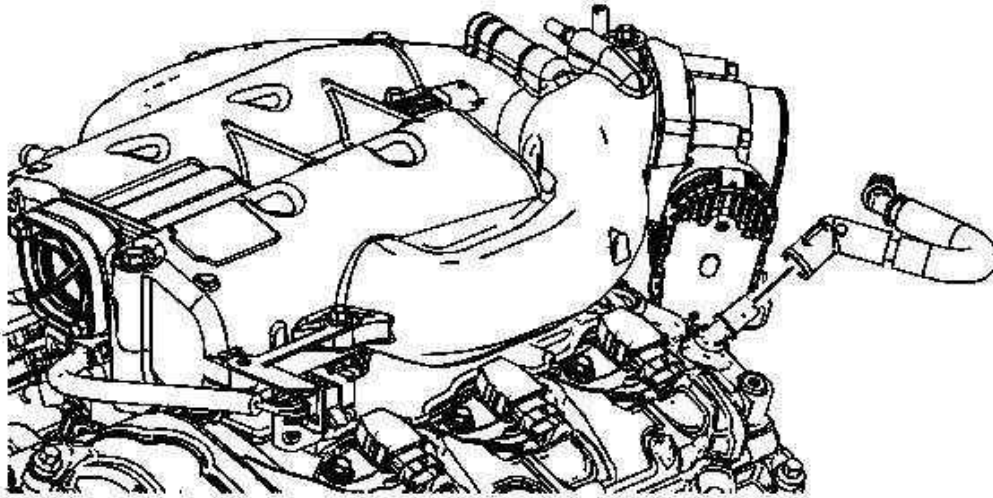


Fig. 103: Identifying Fresh Air PCV Hose
Courtesy of GENERAL MOTORS CORP.

6. Disconnect and remove the fresh air PCV hose from the left camshaft cover fitting.

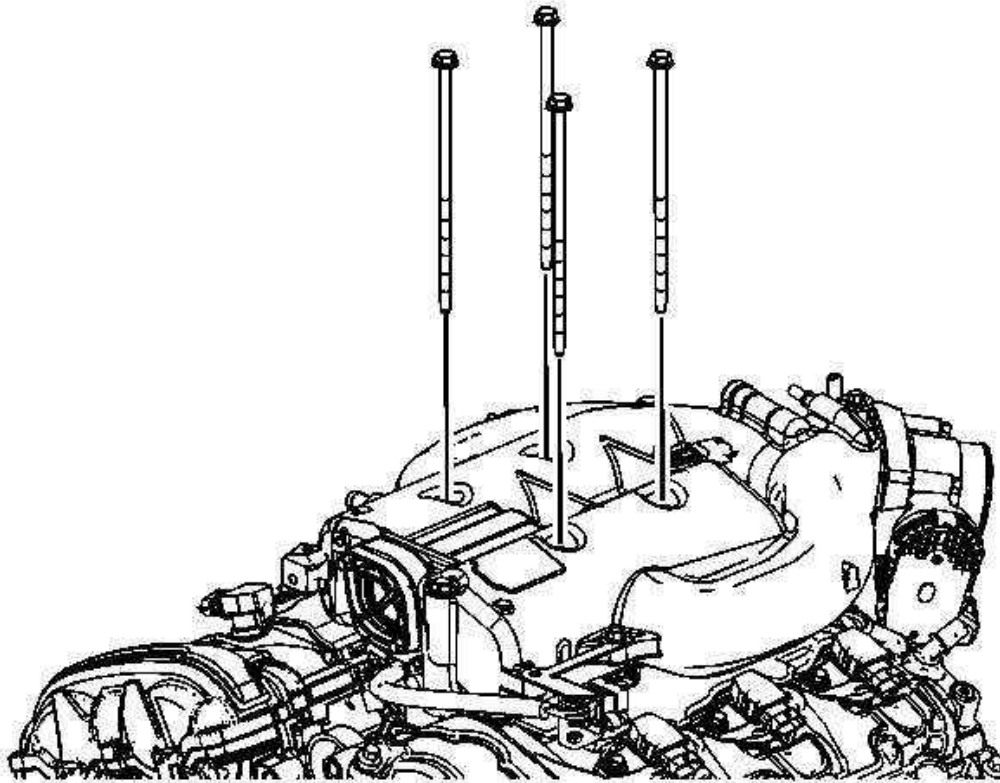


Fig. 104: Identifying Intake Manifold Long Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the intake manifold long bolts.

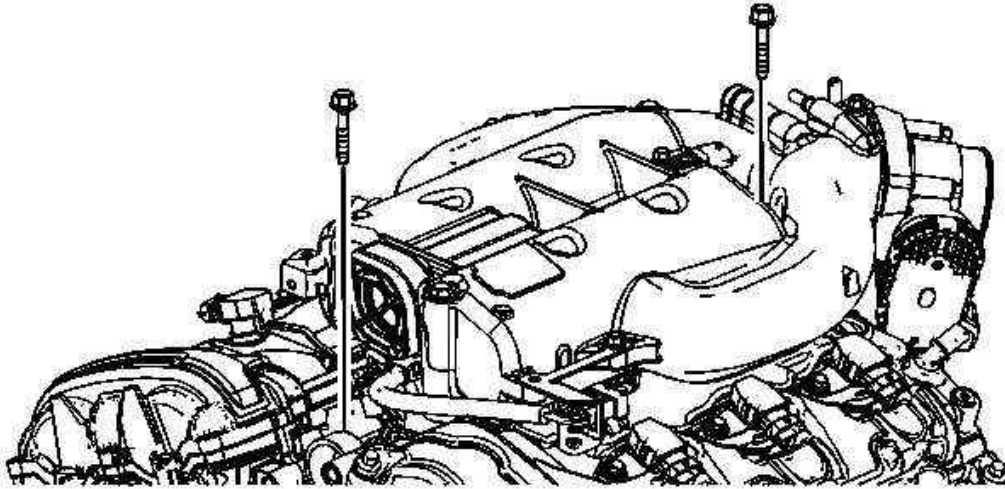


Fig. 105: Identifying Intake Manifold Short Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the intake manifold short bolts.

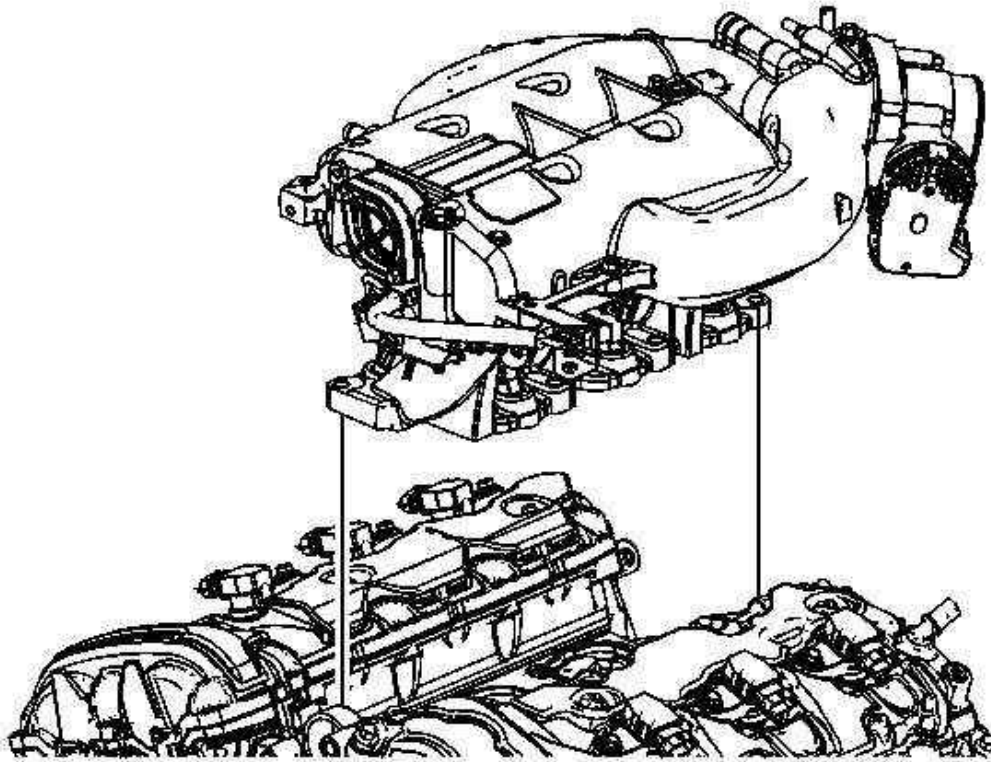


Fig. 106: View Of Intake Manifold
Courtesy of GENERAL MOTORS CORP.

9. Remove the intake manifold assembly.

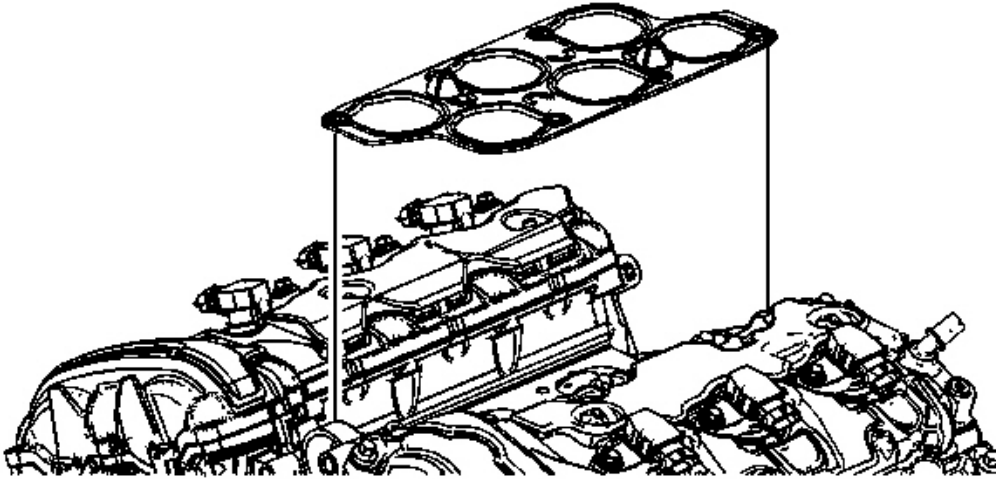


Fig. 107: View Of Lower Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the lower intake manifold gasket.

CAMSHAFT COVER REMOVAL - LEFT SIDE

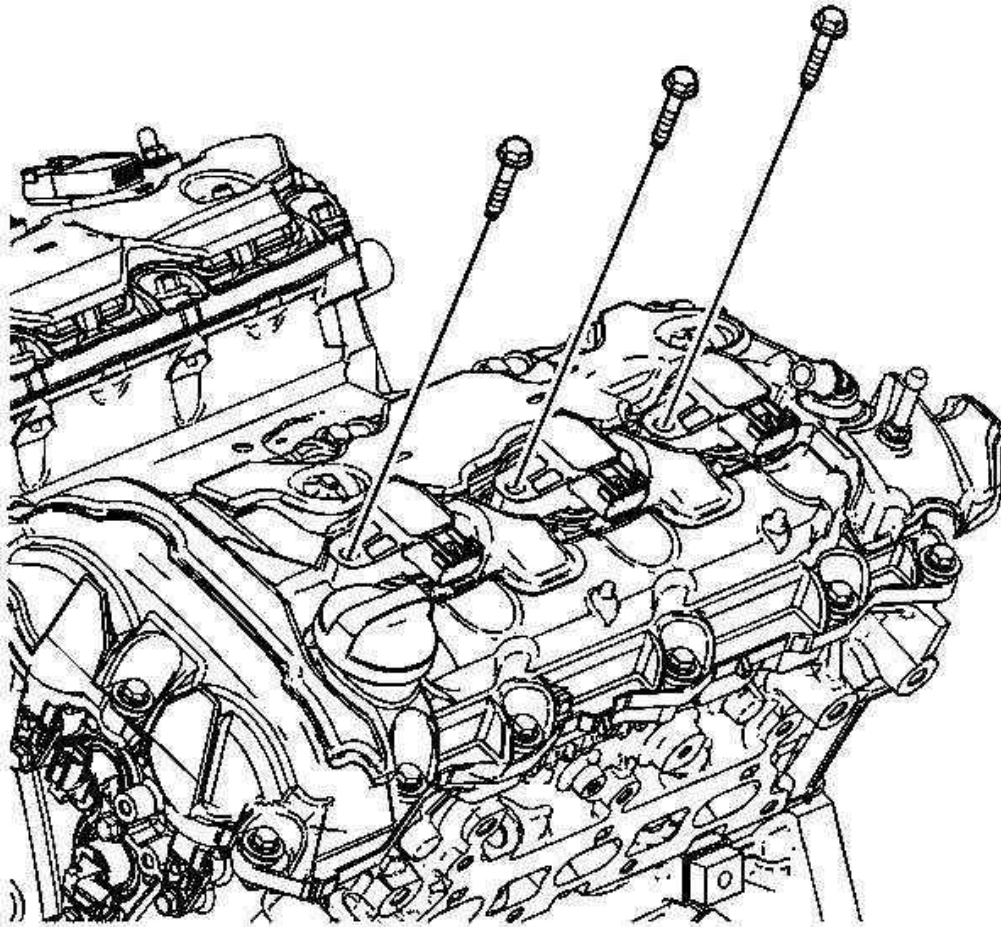


Fig. 108: Identifying Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the ignition coil bolts.

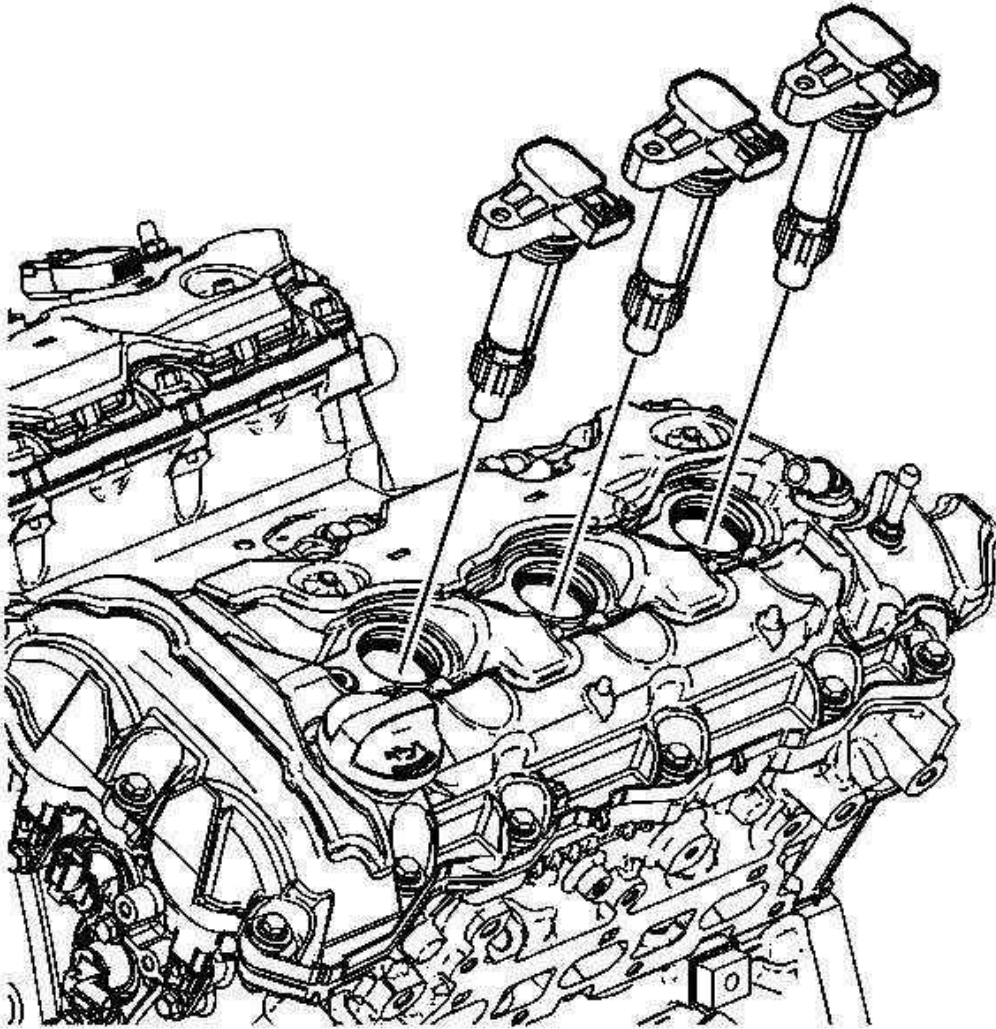


Fig. 109: Identifying Ignition Coils
Courtesy of GENERAL MOTORS CORP.

2. Remove the ignition coils.

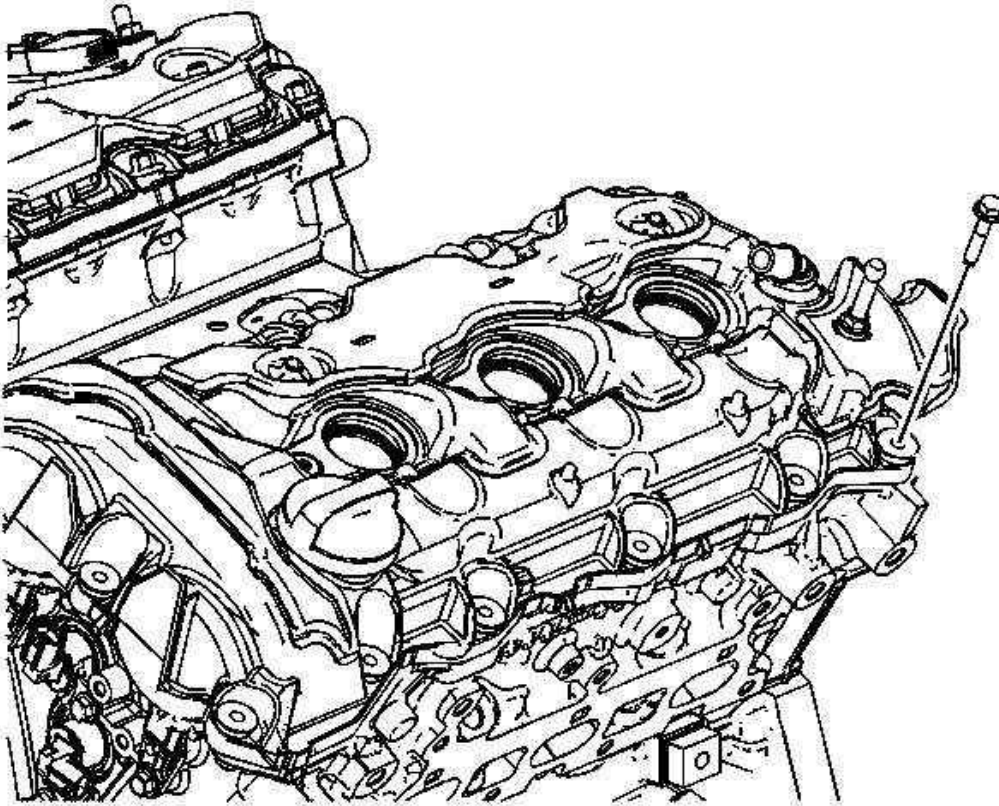


Fig. 110: Locating Left Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the left camshaft cover bolts.

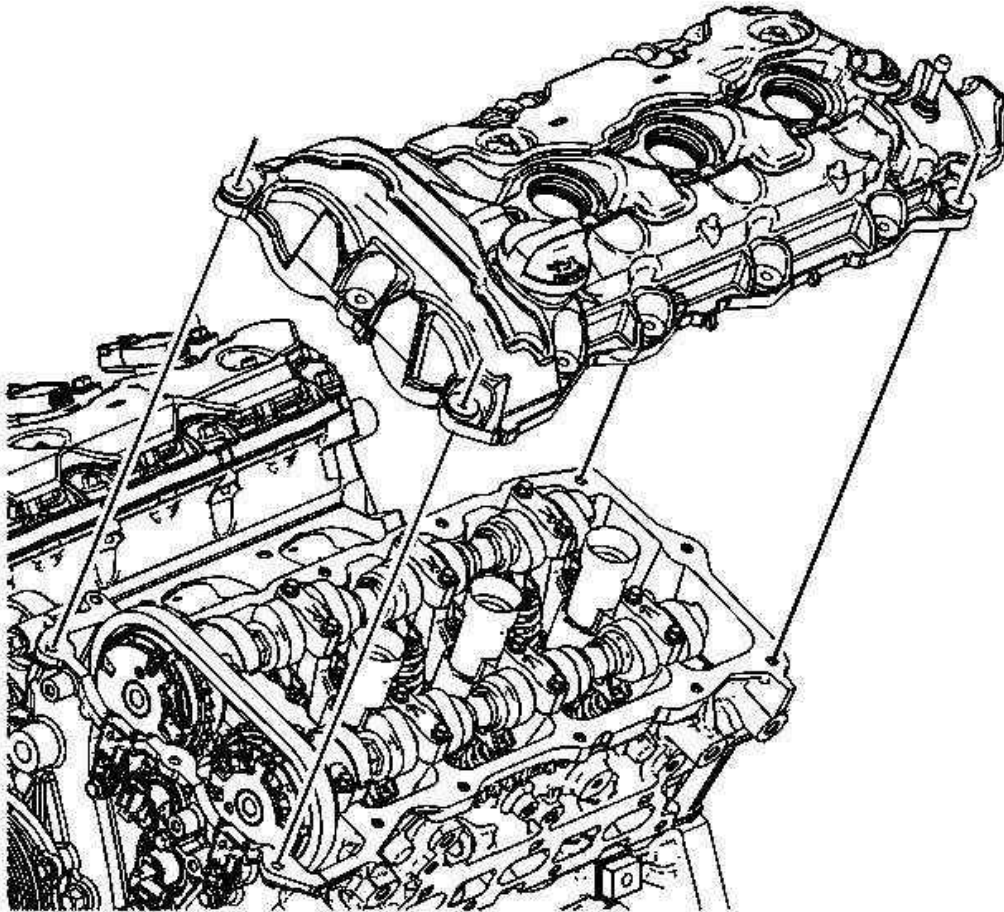


Fig. 111: View Of Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the left camshaft cover from the left cylinder head.

CAMSHAFT COVER REMOVAL - RIGHT SIDE

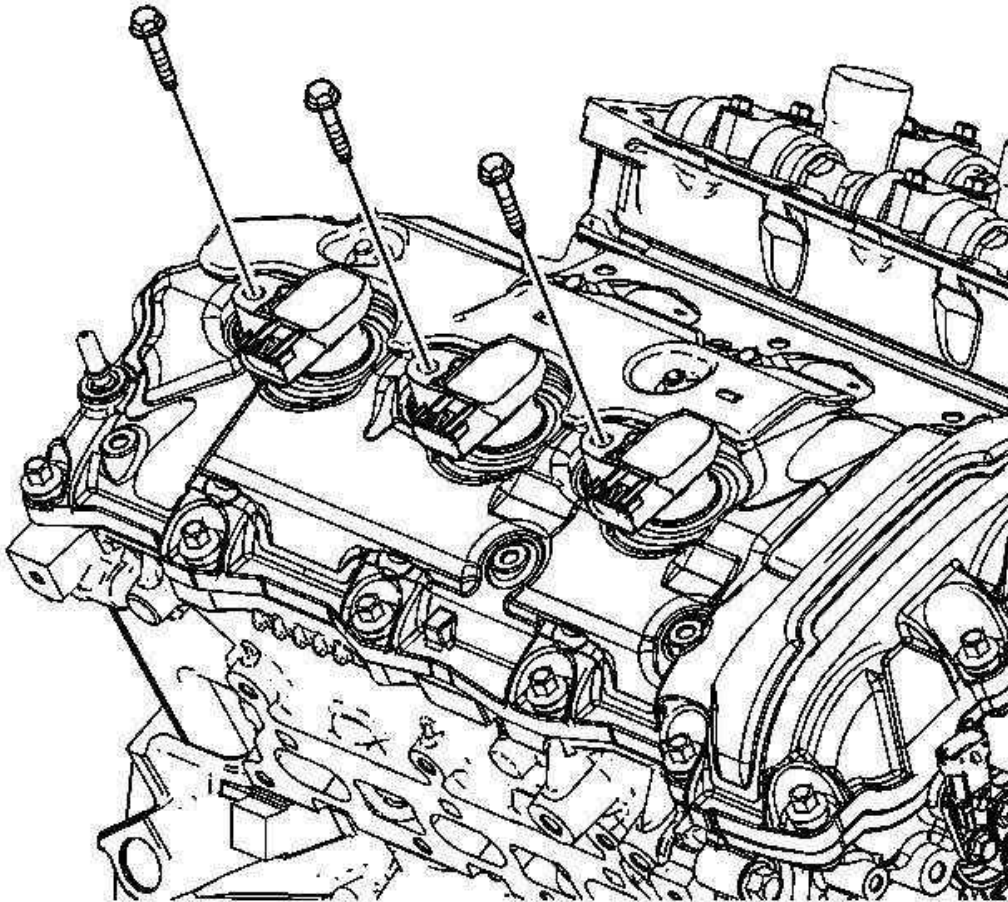


Fig. 112: Identifying Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the ignition coil bolts.

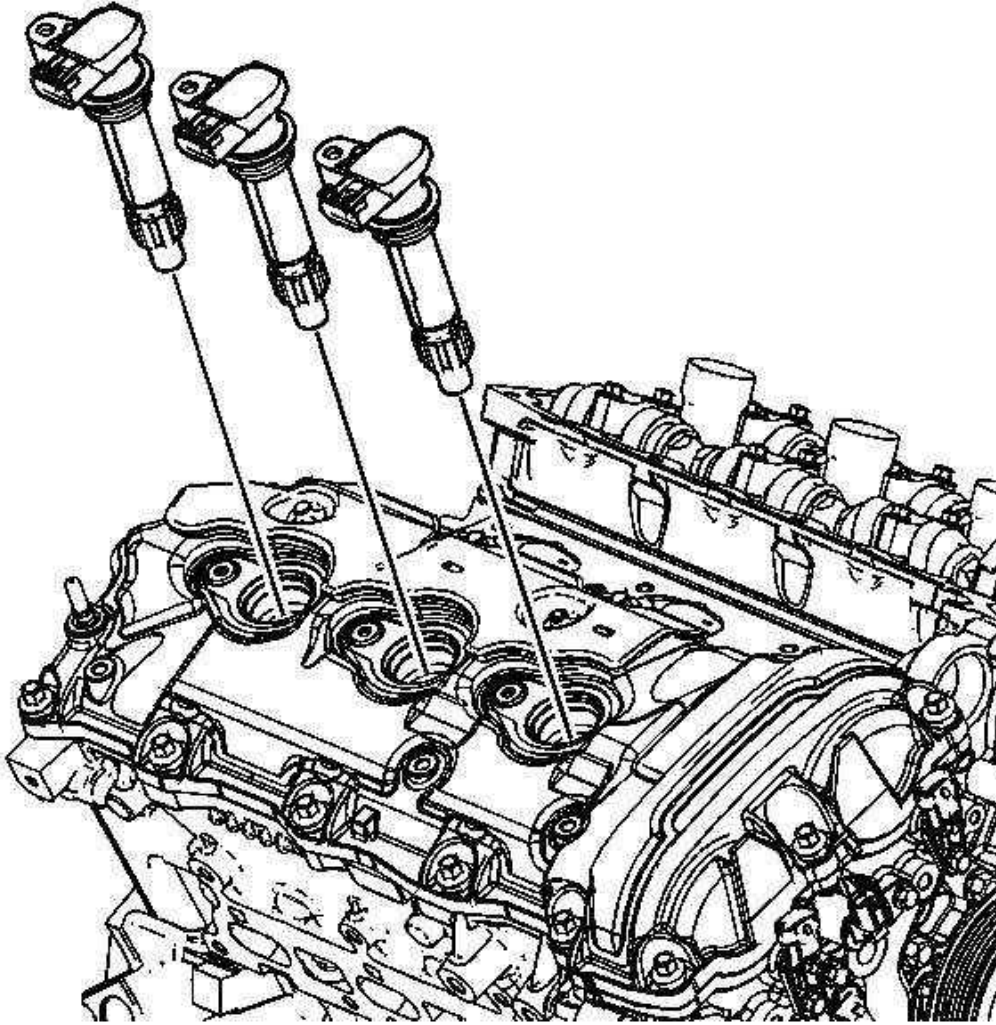


Fig. 113: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

2. Remove the ignition coils.

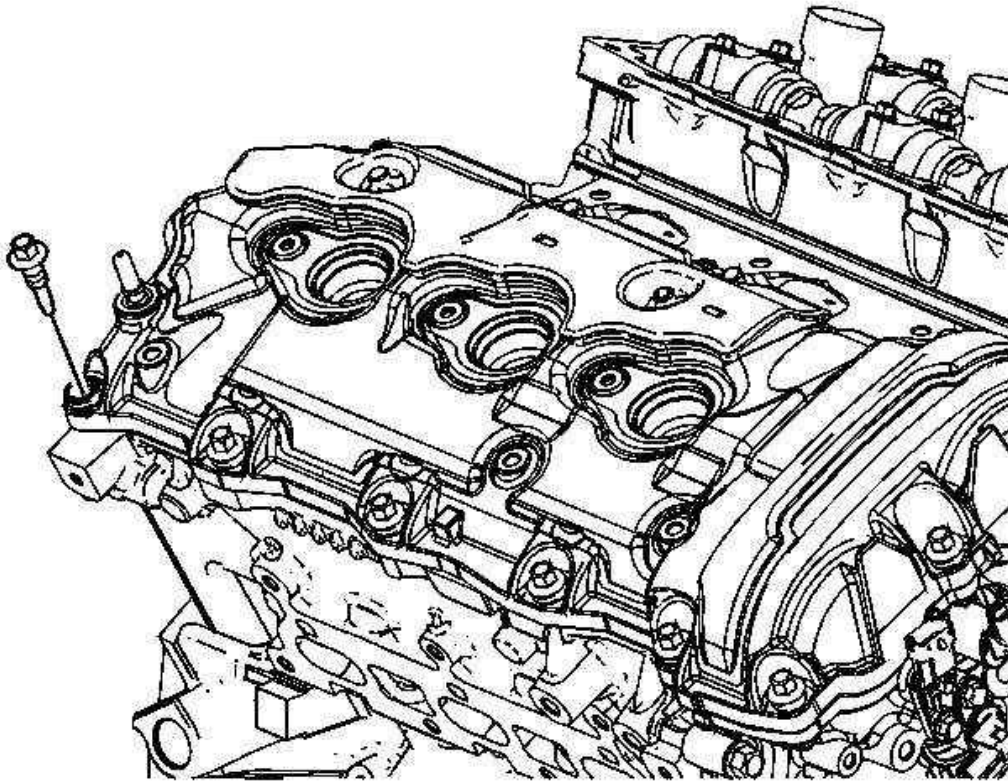


Fig. 114: View Of Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the right camshaft cover bolts.

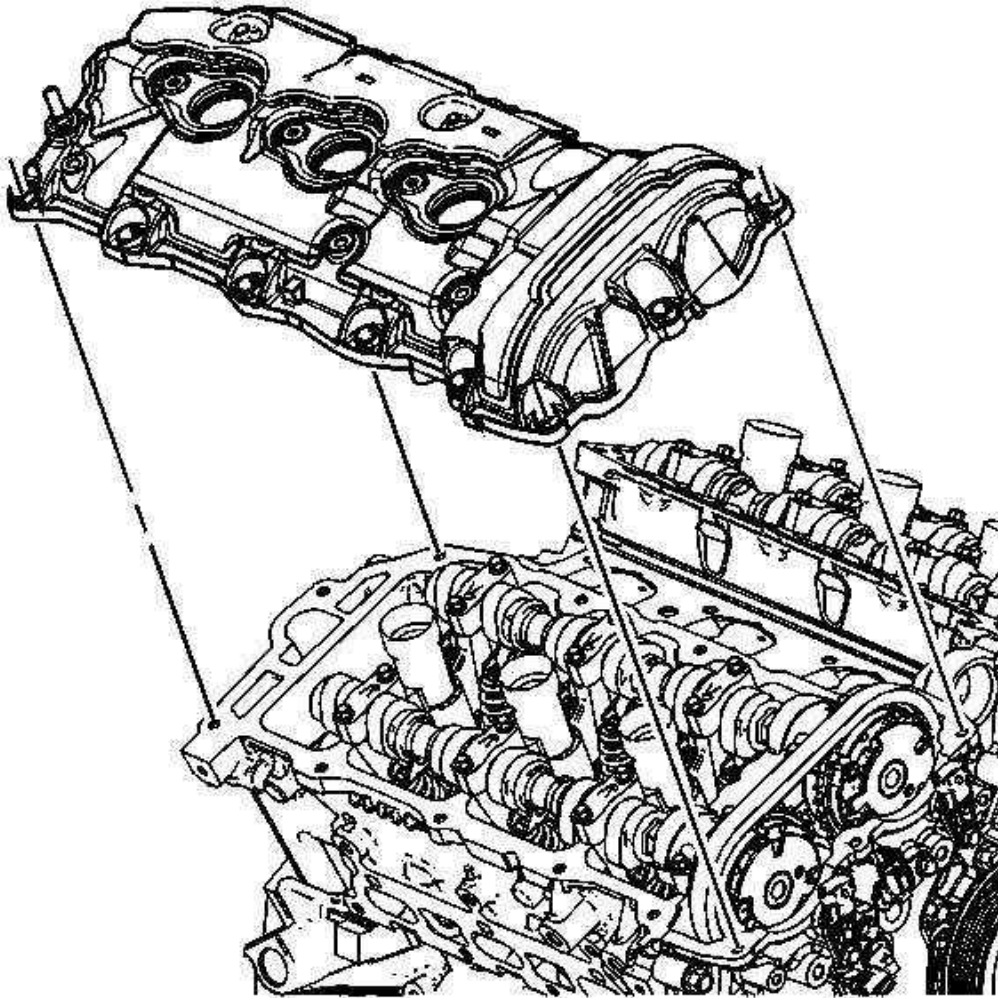


Fig. 115: View Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the right camshaft cover from the right cylinder head.

WATER PUMP REMOVAL

Tools Required

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

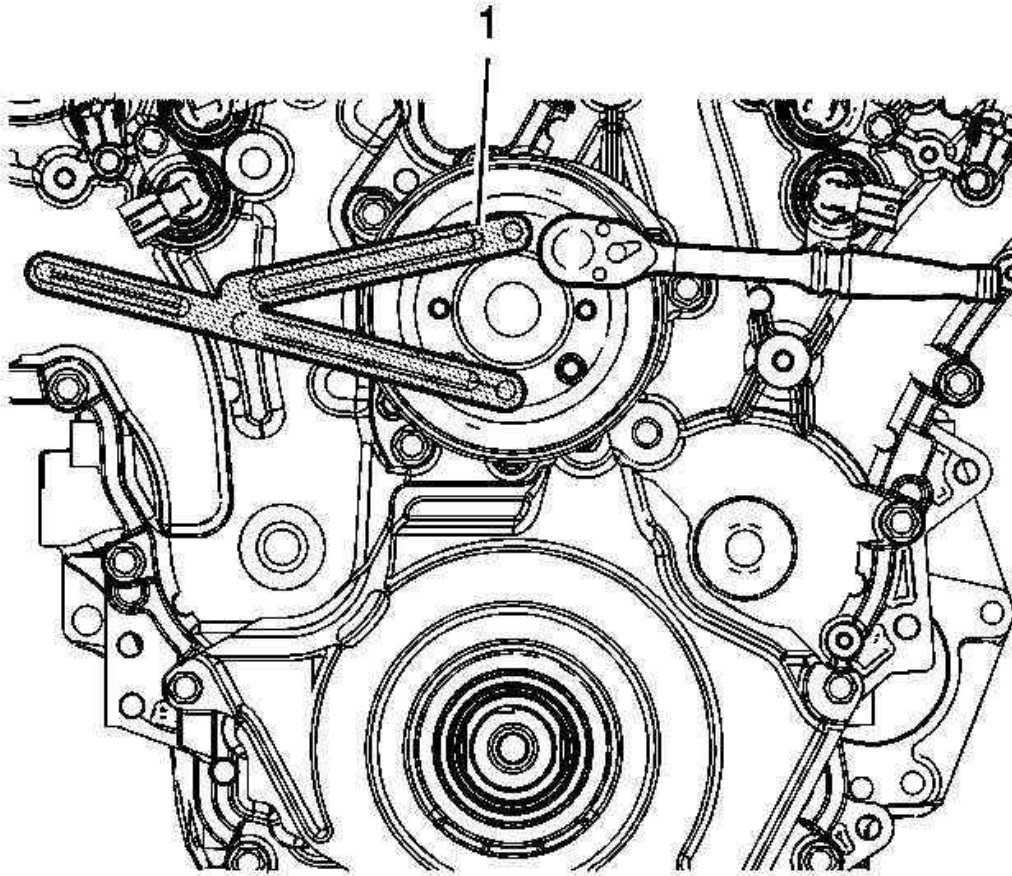


Fig. 116: Identifying Special Tool - EN 46104
Courtesy of GENERAL MOTORS CORP.

1. Install the **EN 46104** (1) onto the water pump pulley.

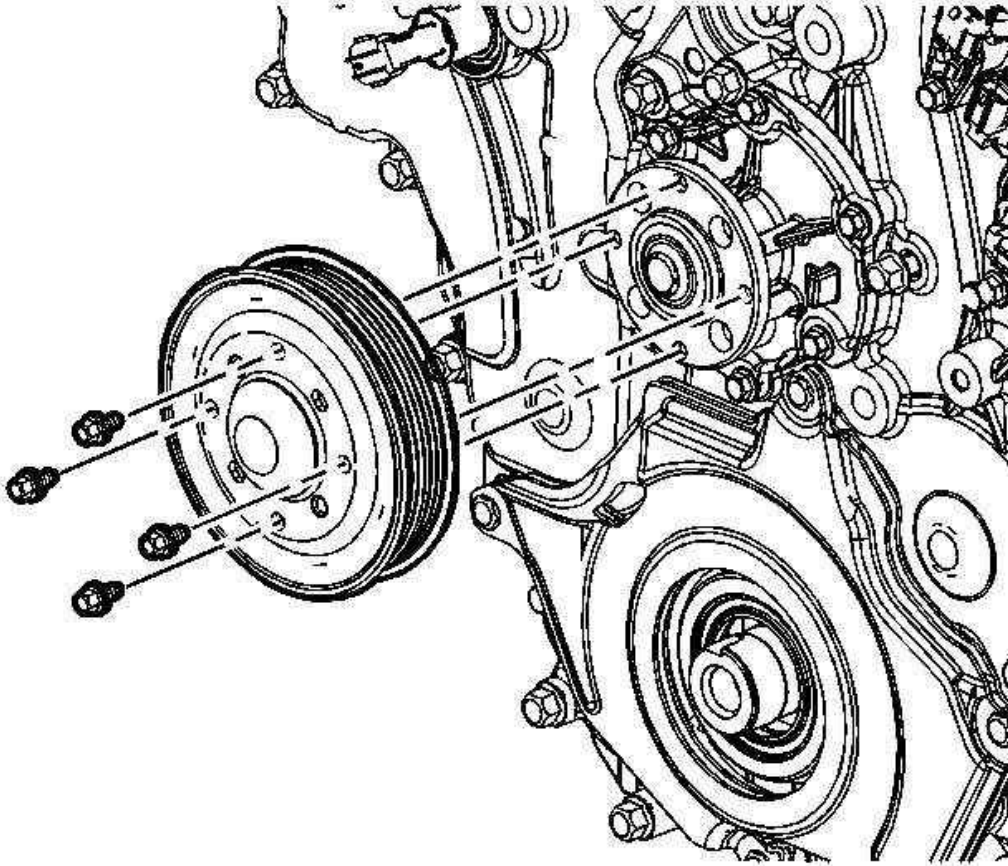


Fig. 117: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the water pump pulley bolts.
3. Remove the water pump pulley.

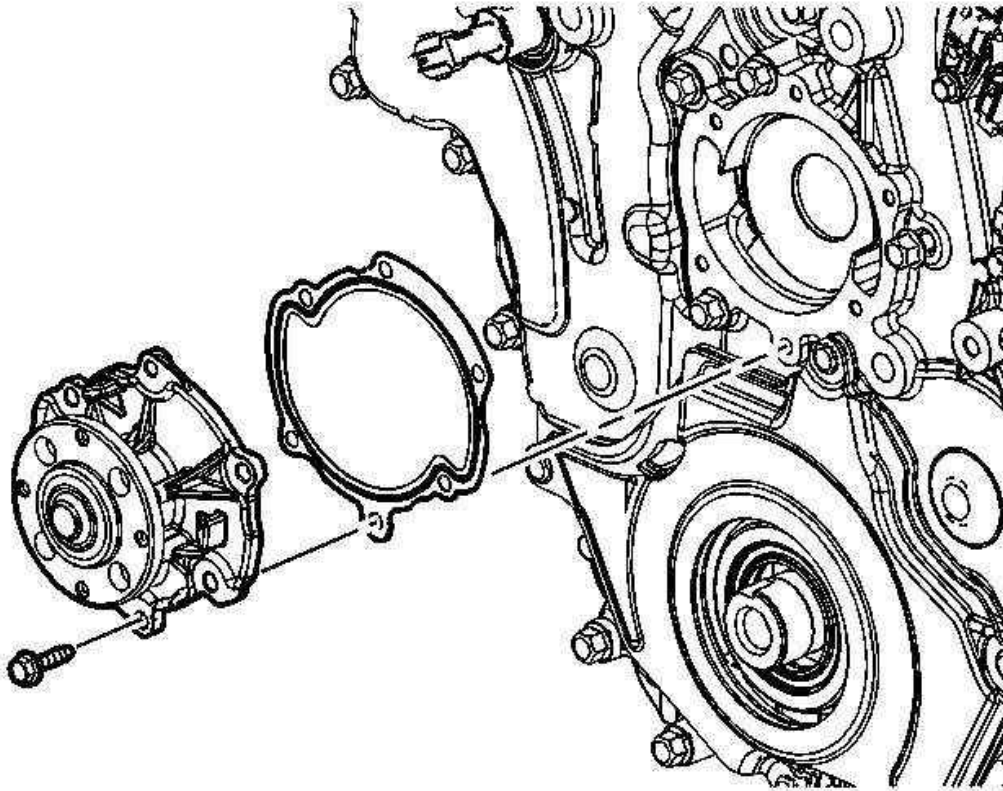


Fig. 118: View Of Water Pump, Gasket & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the water pump bolts.
5. Remove the water pump from the front cover.
6. Remove the water pump gasket.

ENGINE FRONT COVER REMOVAL

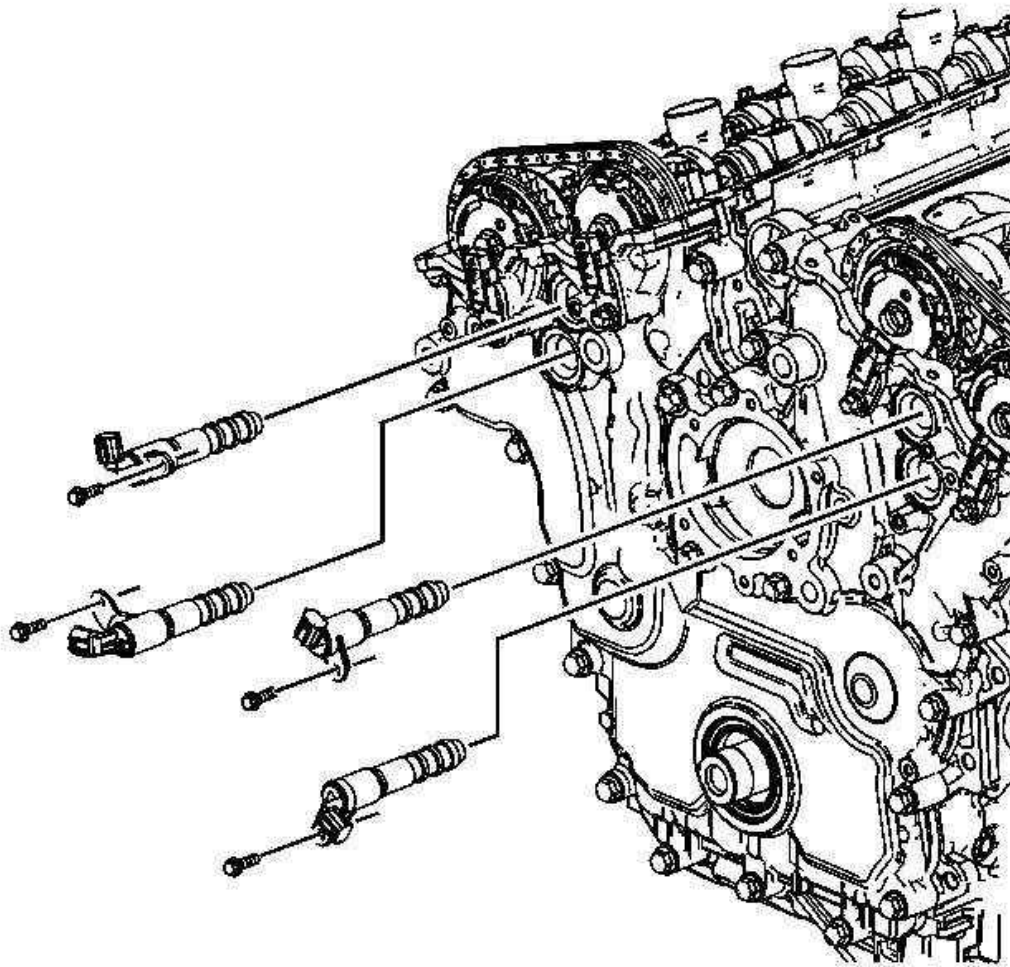


Fig. 119: View Of Camshaft Position Actuator Valves
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft position actuator valve bolts.
2. Remove the camshaft position actuator valves from the front cover.

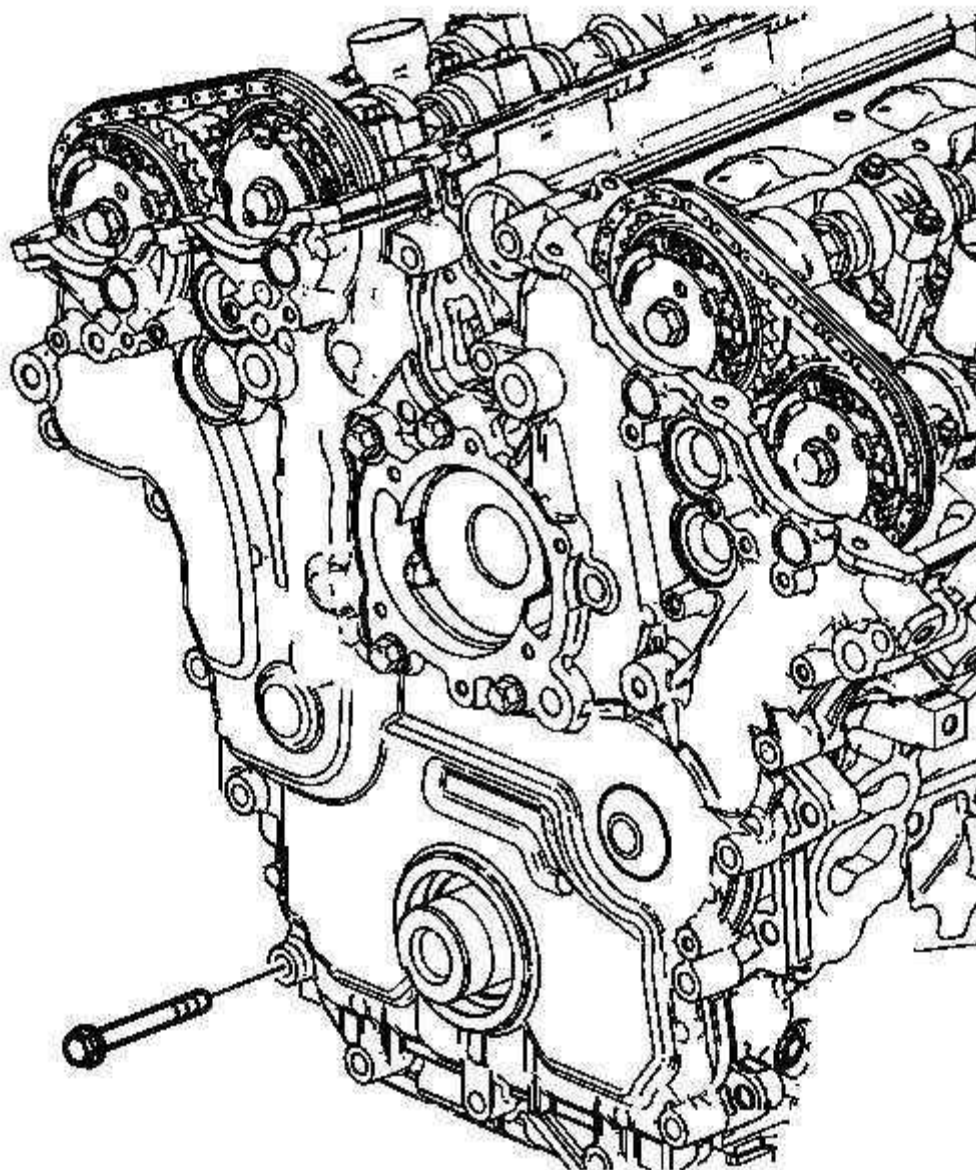


Fig. 120: Locating Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine front cover bolts.

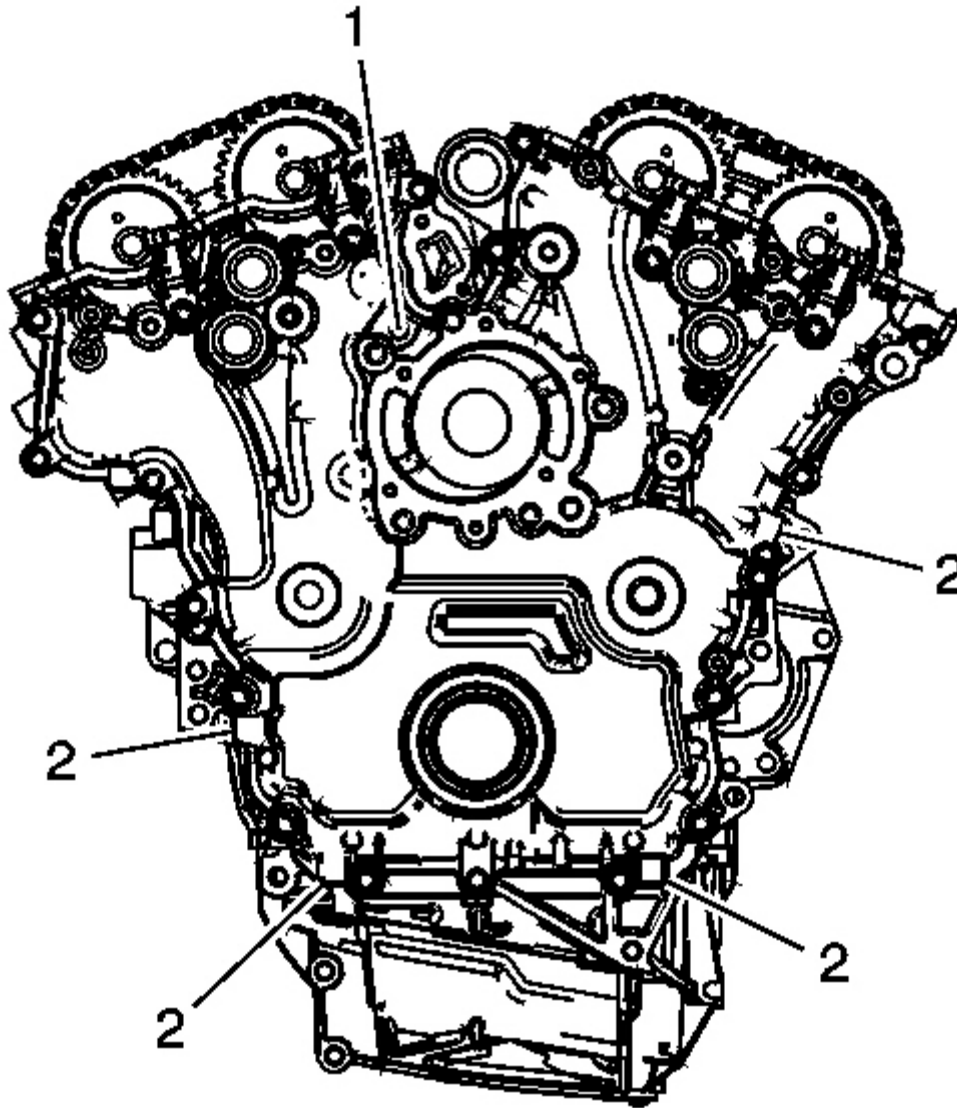


Fig. 121: Identifying Pry Points

Courtesy of GENERAL MOTORS CORP.

NOTE: Do not pry between the engine front cover and the camshaft position sensors or the camshaft position actuators in order to separate the RTV. Use the pry

points and a bolt in the jackscrew hole in order to remove the engine front cover. Damage to the camshaft position sensors or the camshaft position actuators may occur if the camshaft position sensors or the camshaft position actuators are used to pry against in order to remove the engine front cover.

4. Loosely install a 10 x 1.5 mm bolt in the jackscrew hole (1).
5. Using the pry points (2) located at the edge of the front cover and the jackscrew, shear the room temperature vulcanizing (RTV) sealant.

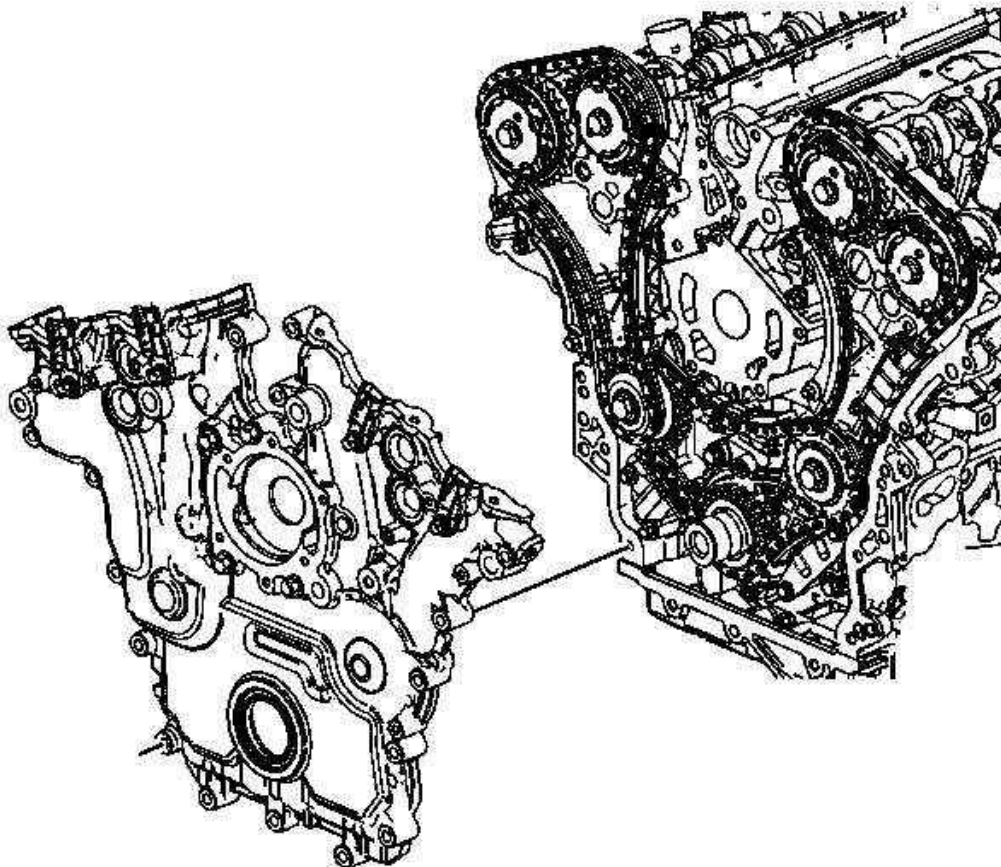


Fig. 122: View Of Engine Front Cover

Courtesy of GENERAL MOTORS CORP.

6. Remove the engine front cover.

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT SIDE (FOURTH DESIGN)

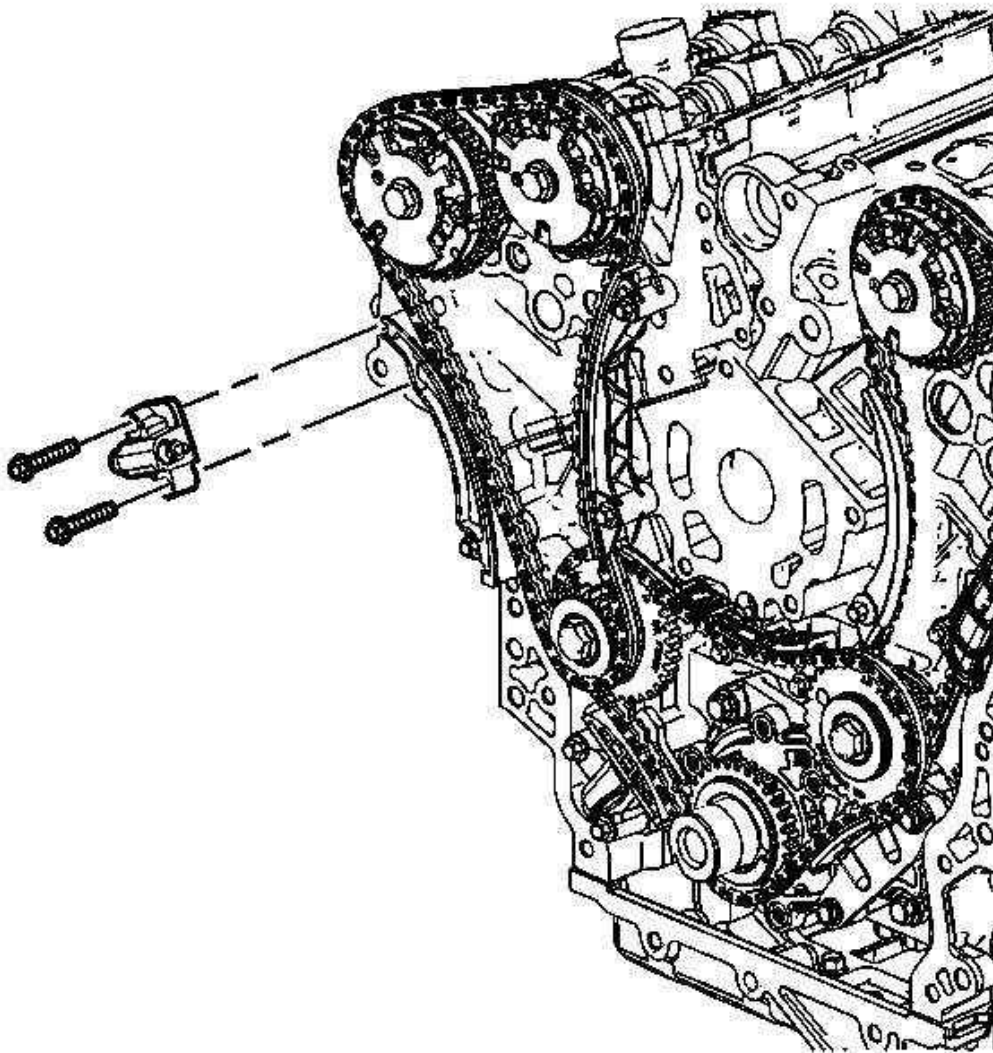


Fig. 123: View Of Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the right secondary camshaft drive chain tensioner bolts.
2. Remove the right secondary camshaft drive chain tensioner.

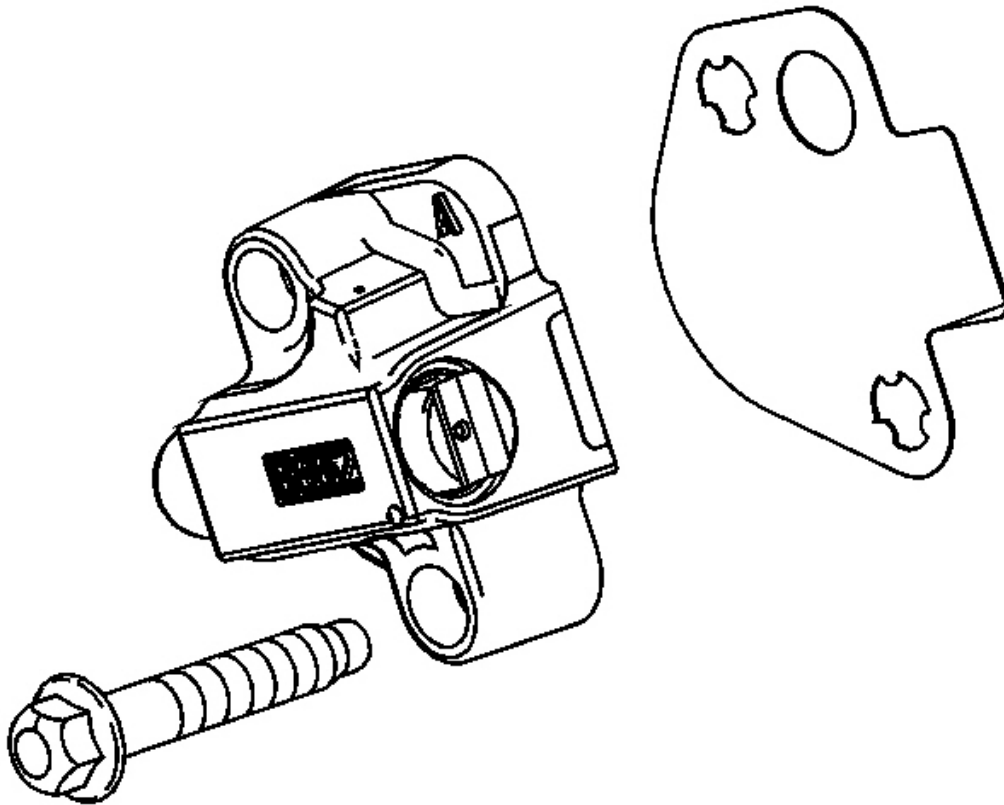


Fig. 124: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket

Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the right secondary camshaft drive chain tensioner gasket.
4. Inspect the right secondary camshaft drive chain tensioner mounting surface on the right cylinder head for burrs or any defects that would degrade the sealing of the NEW right secondary camshaft drive chain tensioner gasket.

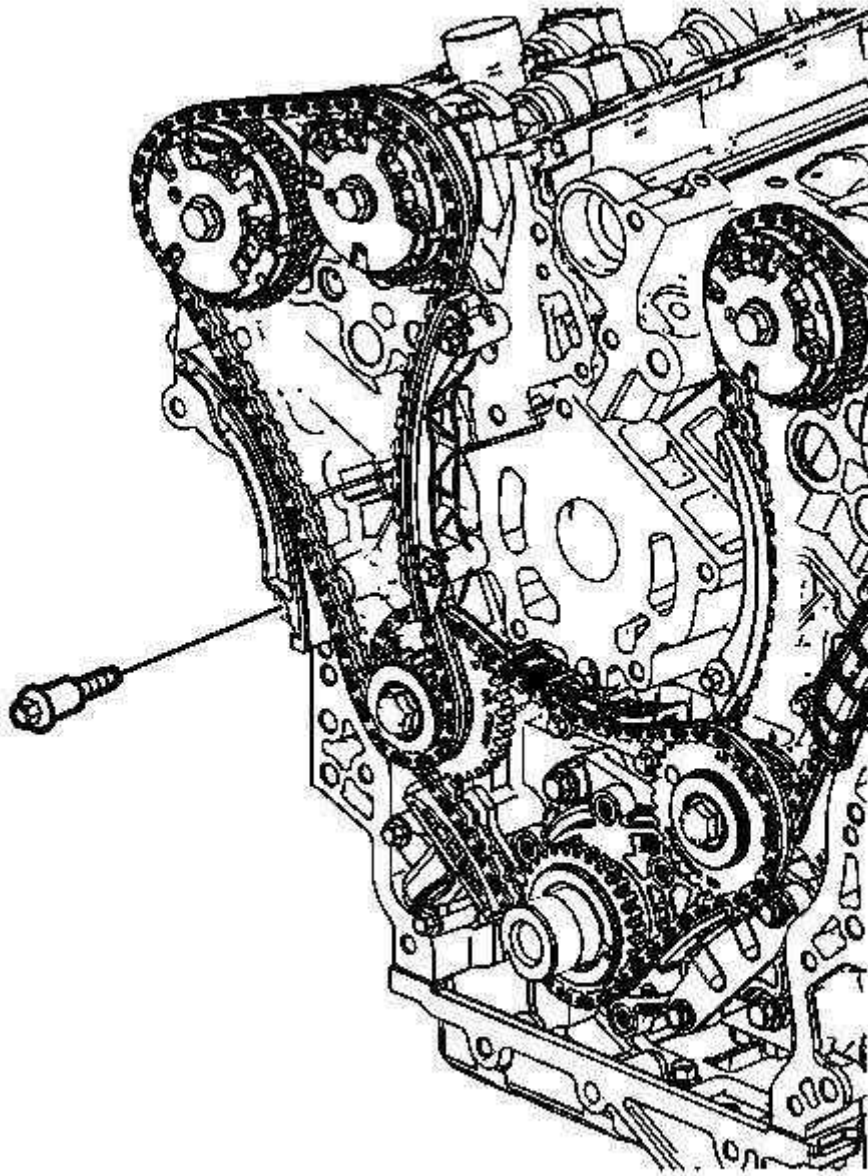


Fig. 125: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

1. Remove the right secondary camshaft drive chain shoe bolt.

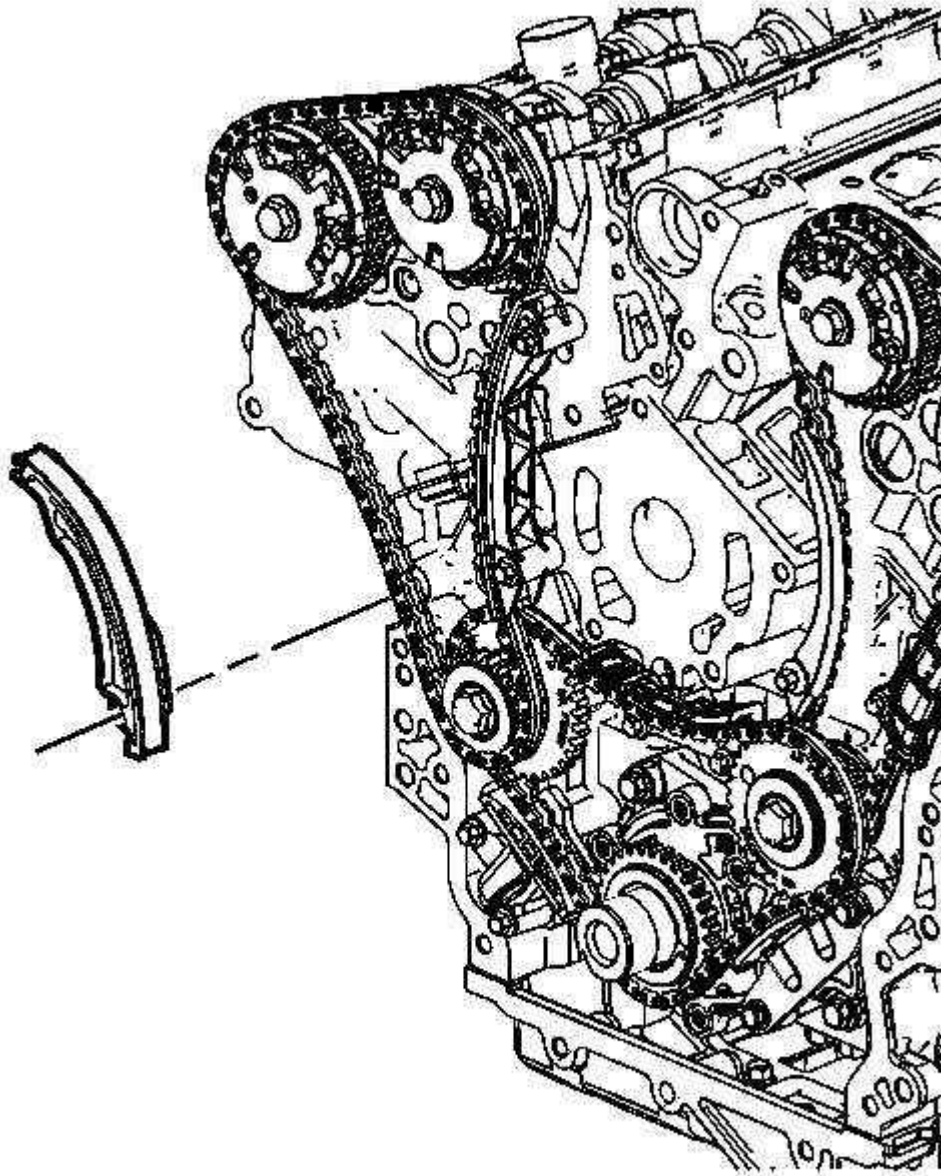


Fig. 126: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Remove the right secondary camshaft drive chain shoe.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT SIDE (FOURTH DESIGN)

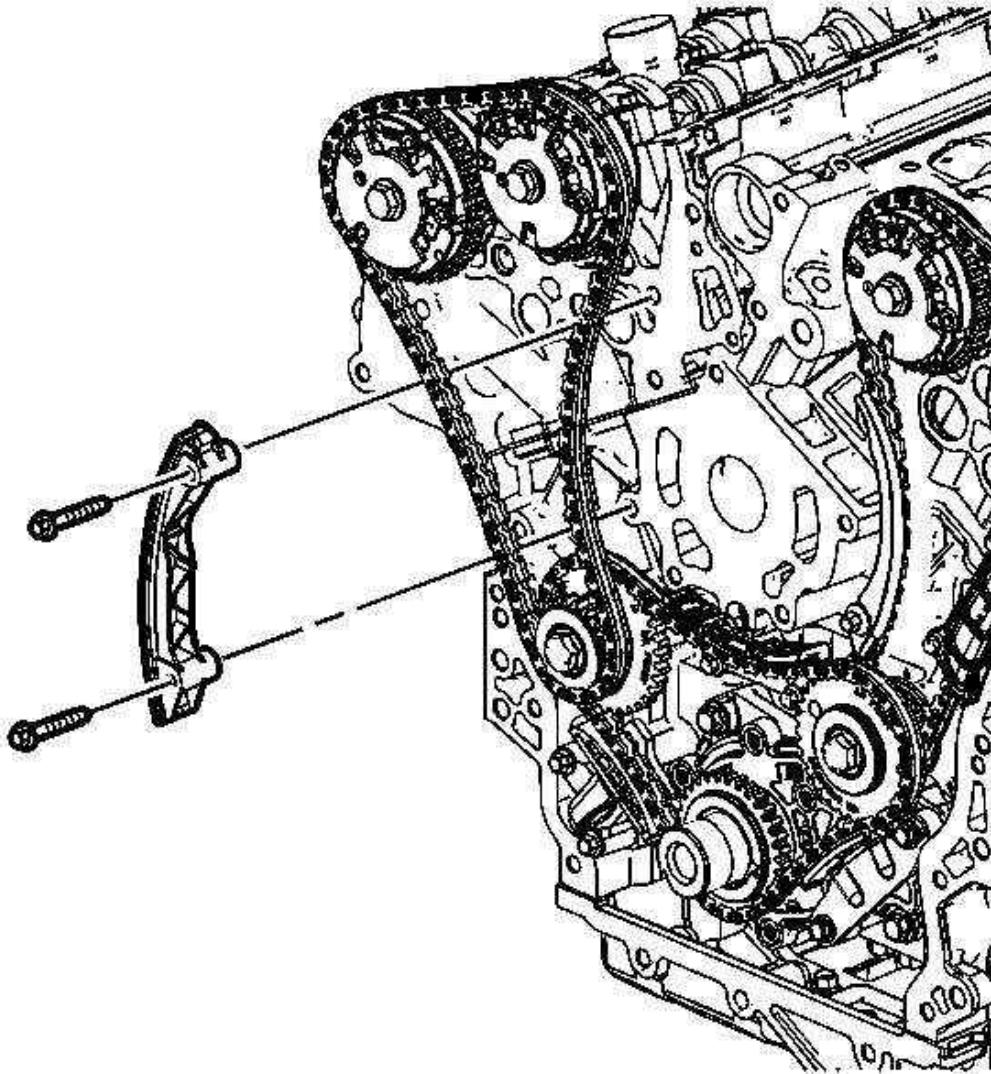


Fig. 127: Identifying Secondary Camshaft Drive Chain Guide And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the right secondary camshaft drive chain guide bolts.
2. Remove the right secondary camshaft drive chain guide.

SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT SIDE (FOURTH DESIGN)

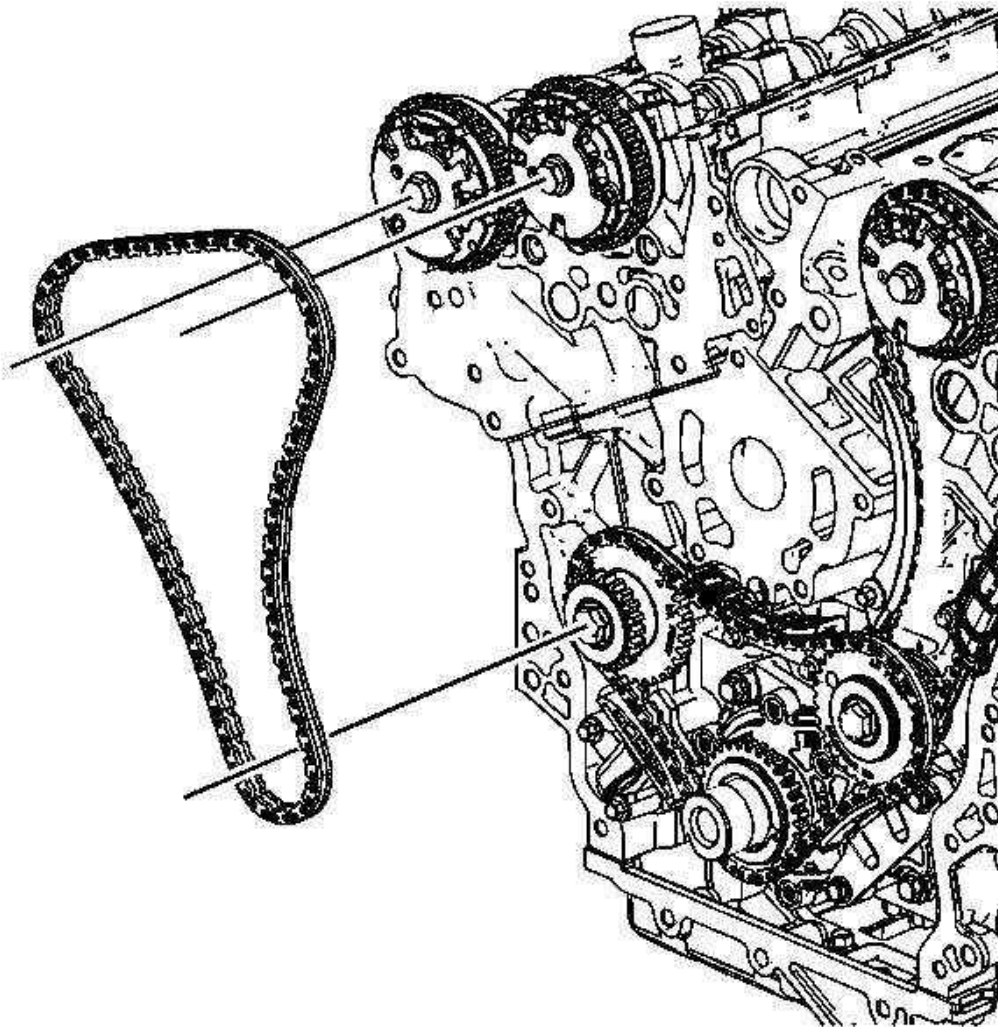


Fig. 128: View Of Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

Remove the right secondary camshaft drive chain from the right camshaft position actuators and the right camshaft intermediate drive chain idler sprocket.

PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL (FOURTH DESIGN)

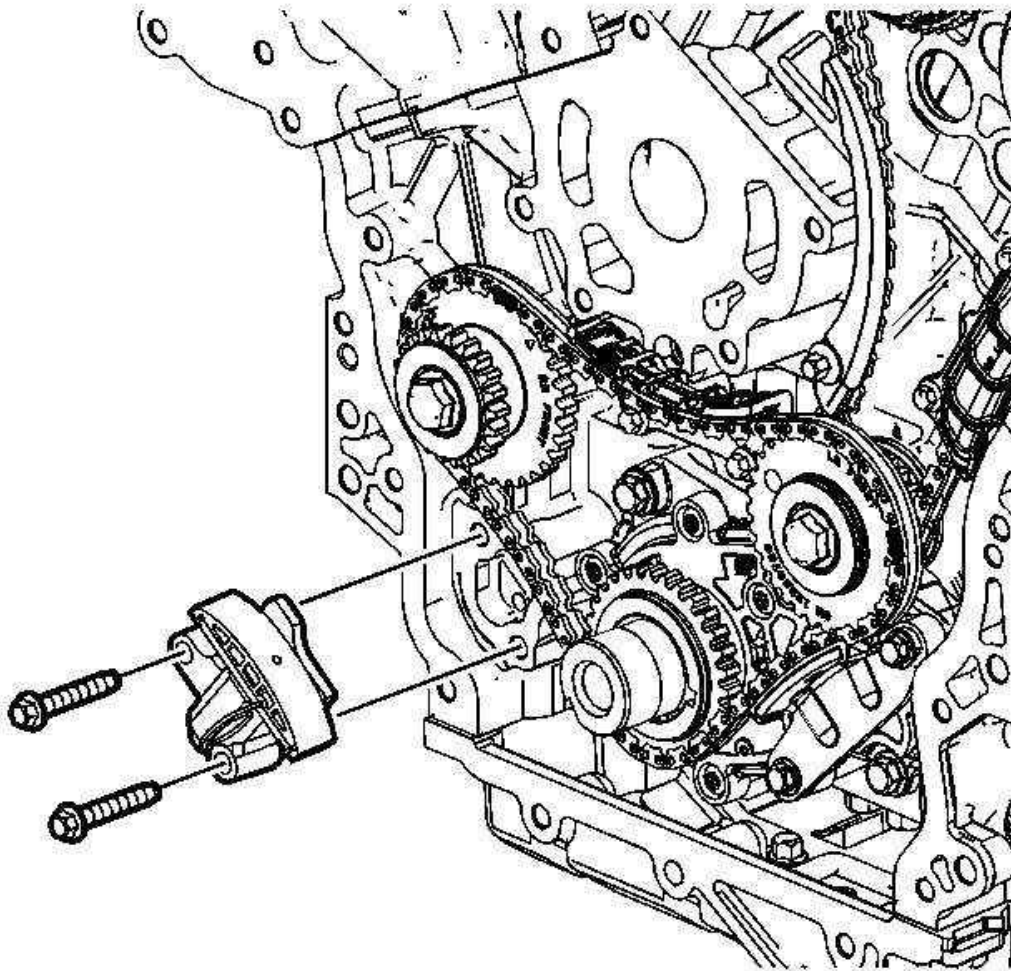


Fig. 129: View Of Primary Camshaft Drive Chain Tensioner And Bolts
Courtesy of GENERAL MOTORS CORP.

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

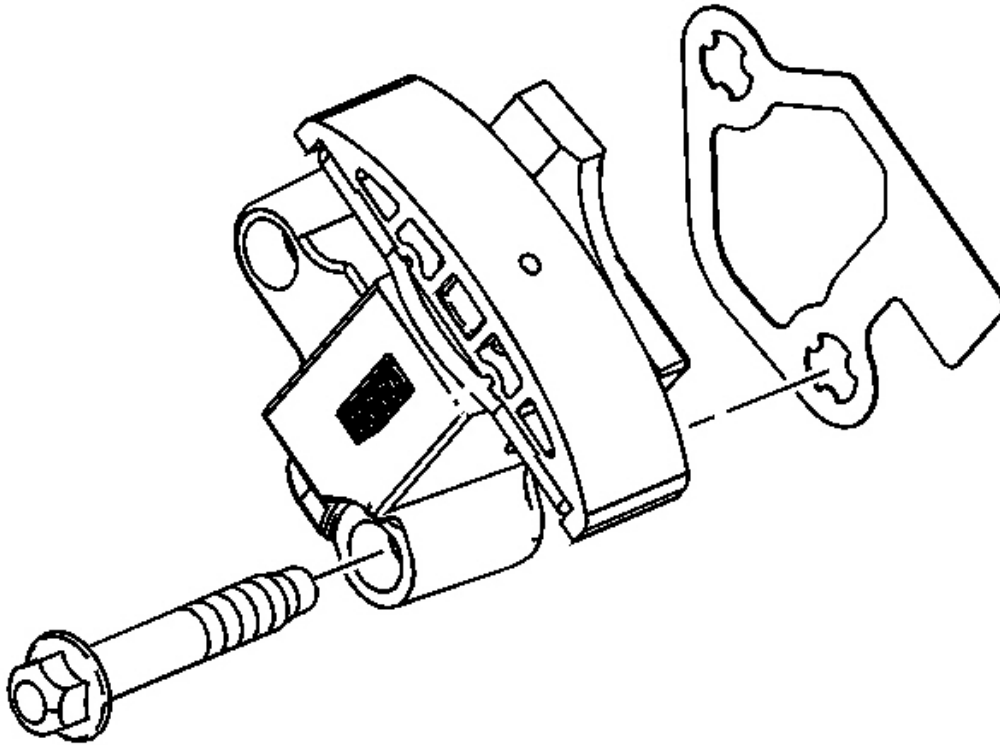


Fig. 130: Identifying Primary Camshaft Drive Chain Tensioner Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the primary camshaft drive chain tensioner gasket.
4. Inspect the primary camshaft drive chain tensioner mounting surface on the engine block for burrs or any defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - UPPER (FOURTH DESIGN)

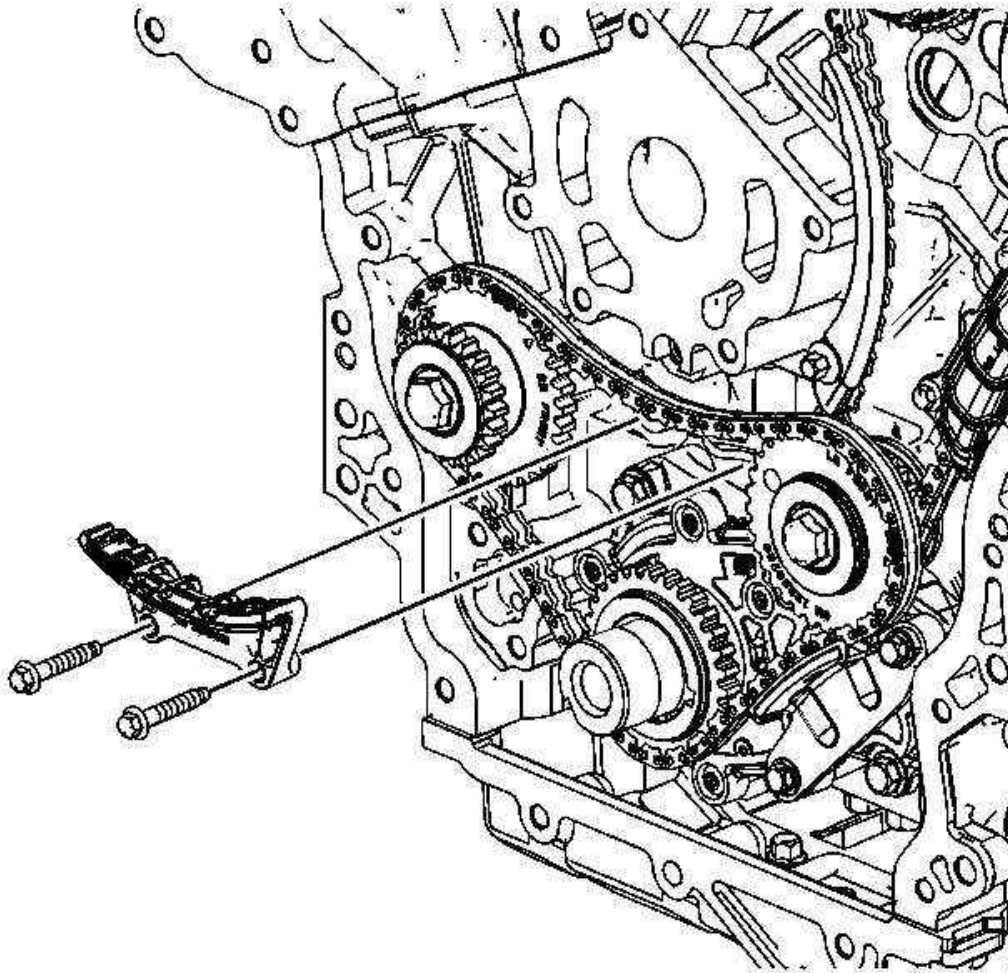


Fig. 131: Identifying Primary Camshaft Drive Chain Upper Guide And Bolts

Courtesy of GENERAL MOTORS CORP.

1. Remove the primary camshaft drive chain upper guide bolts.
2. Remove the primary camshaft drive chain upper guides.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LOWER (FOURTH DESIGN)

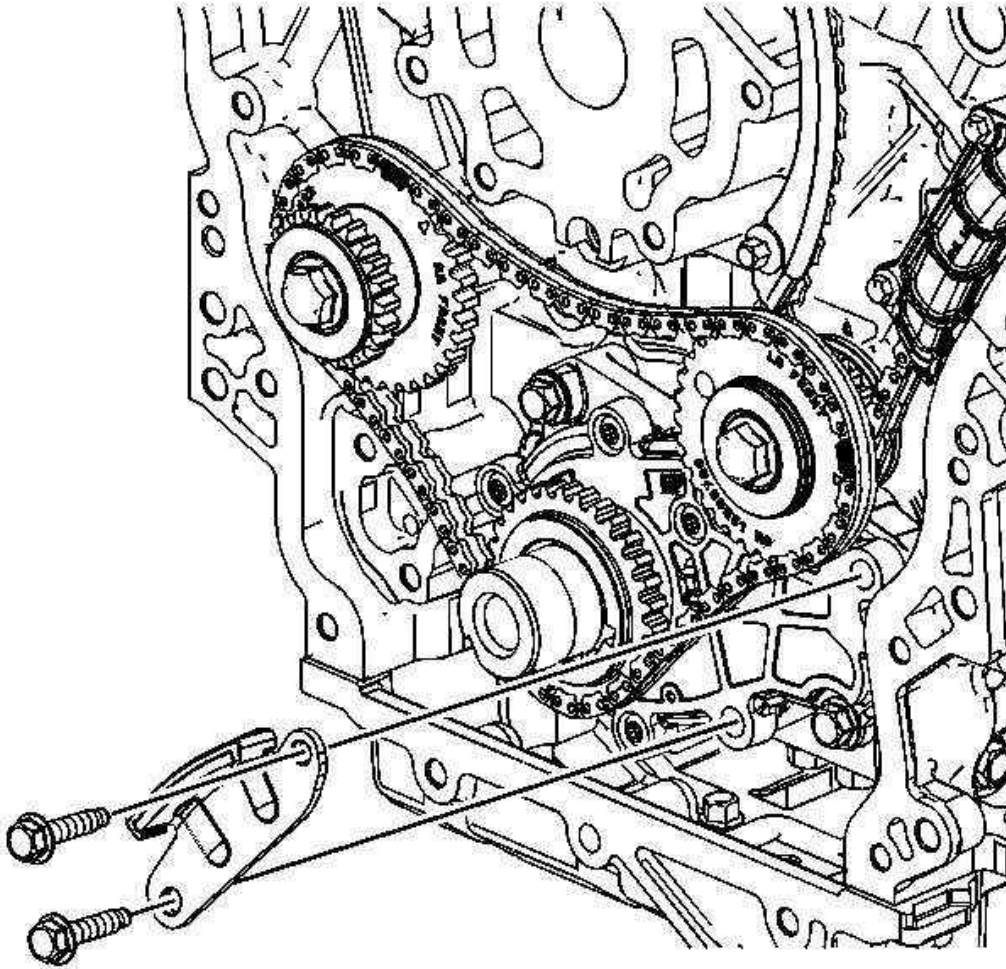


Fig. 132: View Of Primary Camshaft Drive Chain Lower Guide Bolts
Courtesy of GENERAL MOTORS CORP.

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

PRIMARY CAMSHAFT DRIVE CHAIN REMOVAL (FOURTH DESIGN)

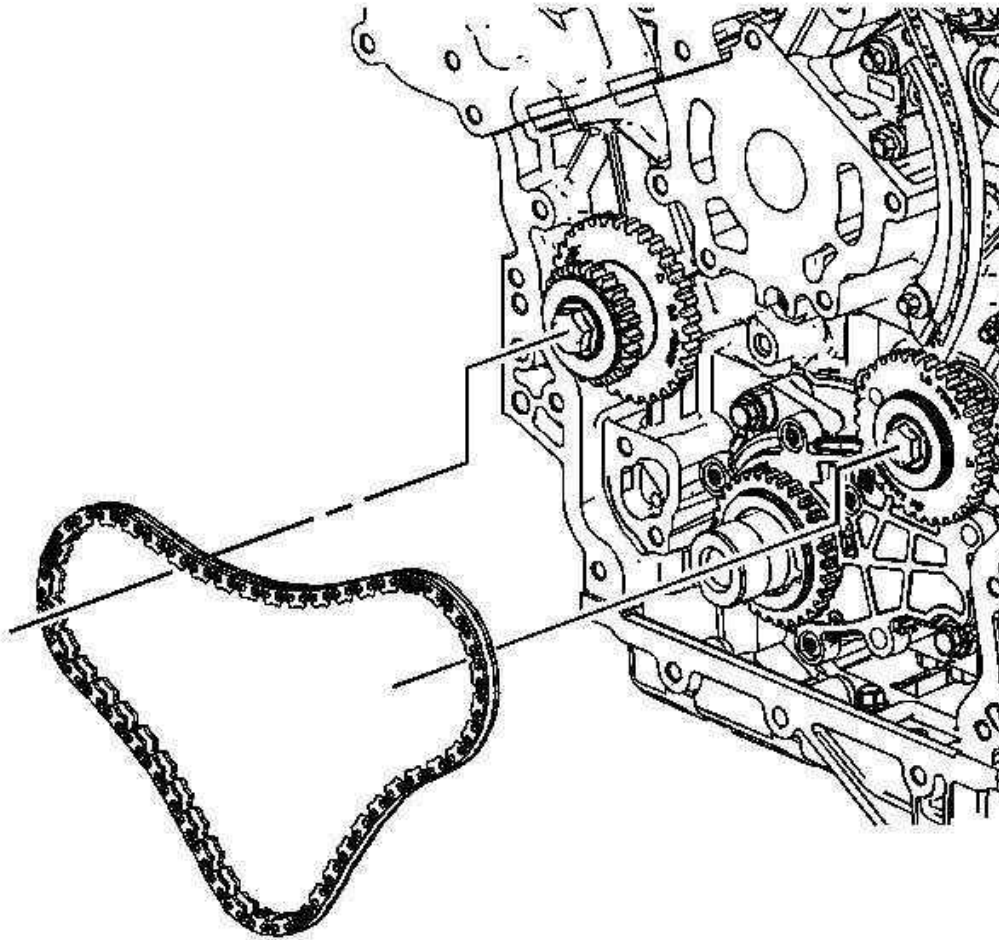


Fig. 133: Identifying Primary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

Remove the primary camshaft drive chain.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT SIDE (FOURTH DESIGN)

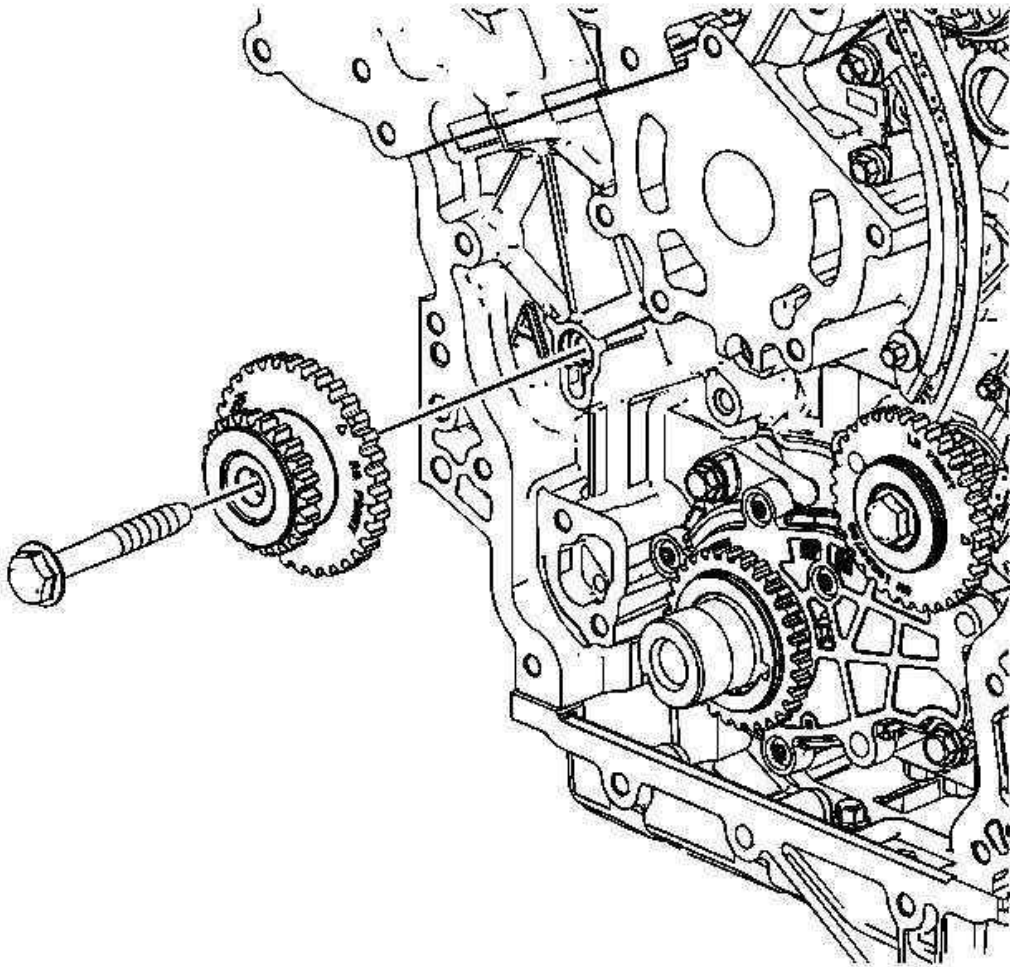


Fig. 134: Identifying Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the right camshaft intermediate drive chain idler bolt.
2. Remove the right camshaft intermediate drive chain idler.

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT SIDE (FOURTH DESIGN)

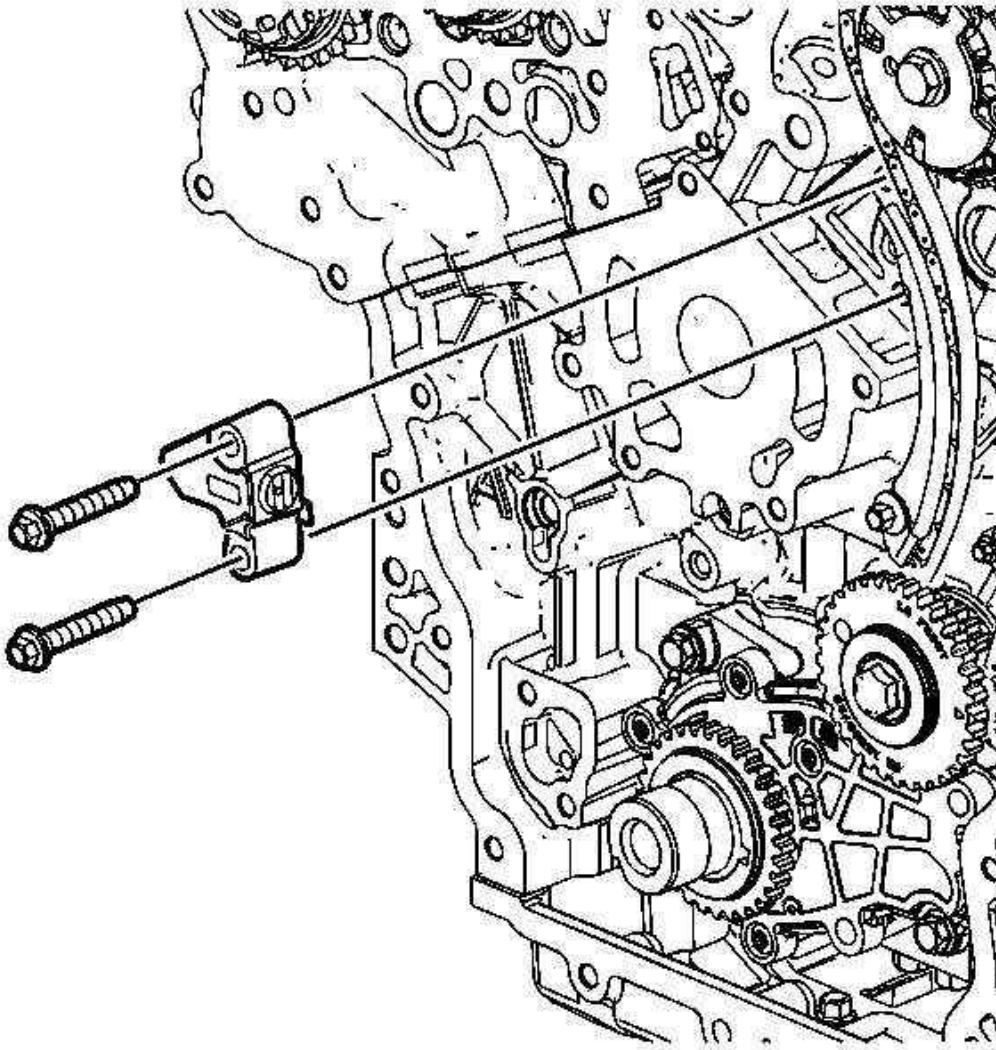


Fig. 135: View Of Secondary Camshaft Drive Chain Tensioner And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the left secondary camshaft drive chain tensioner bolts.
2. Remove the left secondary camshaft drive chain tensioner.

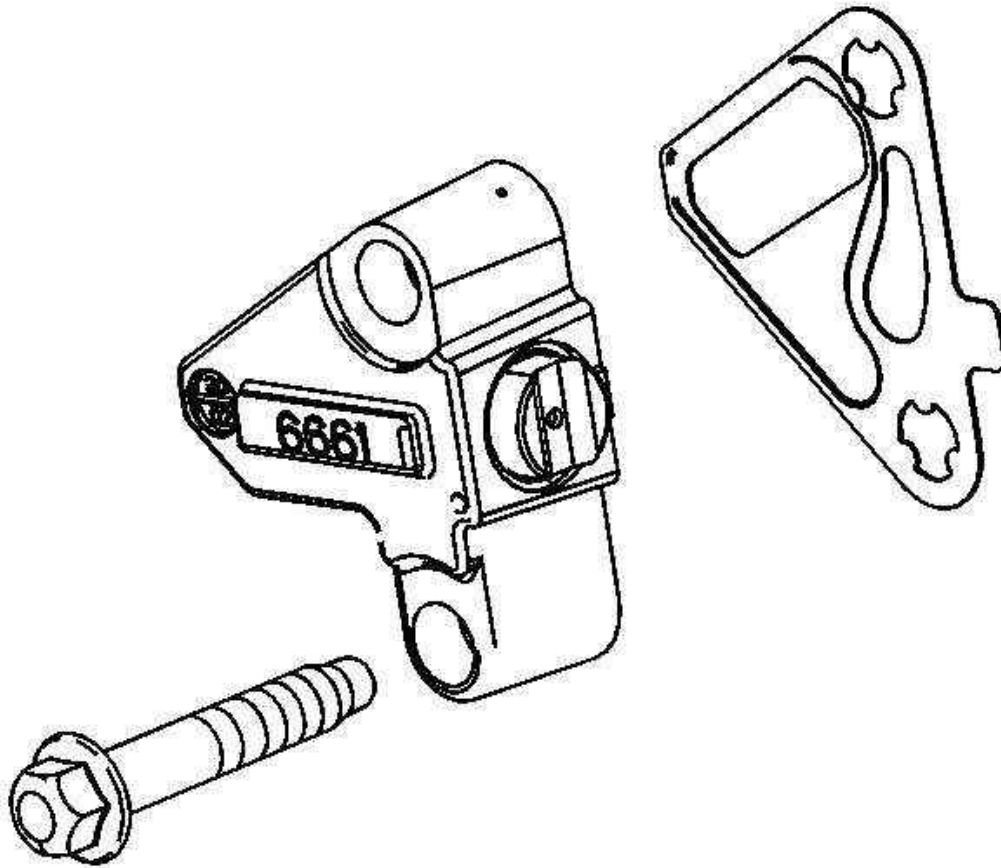


Fig. 136: Identifying Left Secondary Camshaft Drive Chain Tensioner Gasket

Courtesy of GENERAL MOTORS CORP.

3. Remove and discard the left secondary camshaft drive chain tensioner gasket.
4. Inspect the left secondary camshaft drive chain tensioner mounting surface on the left cylinder head for burrs or any defects that would degrade the sealing of the NEW left secondary camshaft drive chain tensioner gasket.

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT SIDE (FOURTH DESIGN)

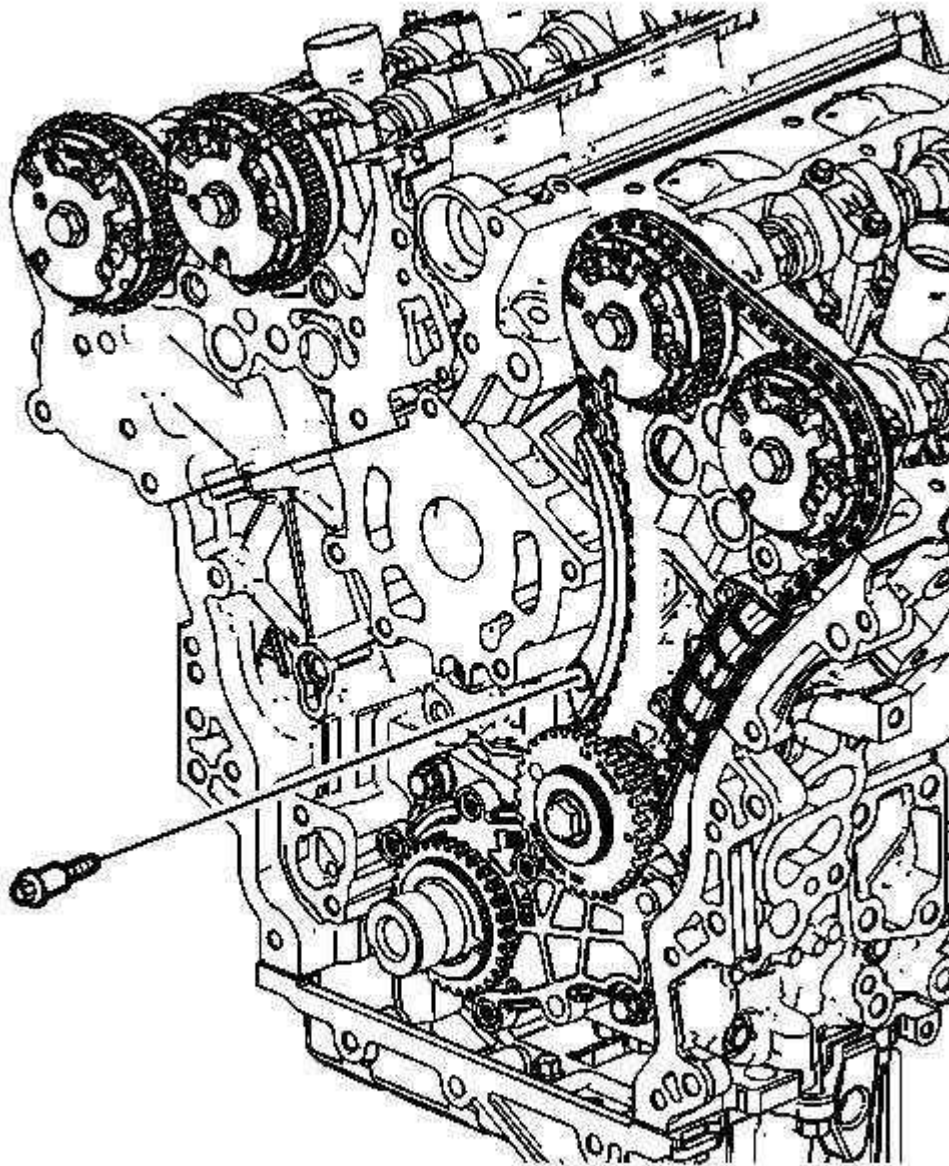


Fig. 137: Identifying Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the left secondary camshaft drive chain shoe bolt.

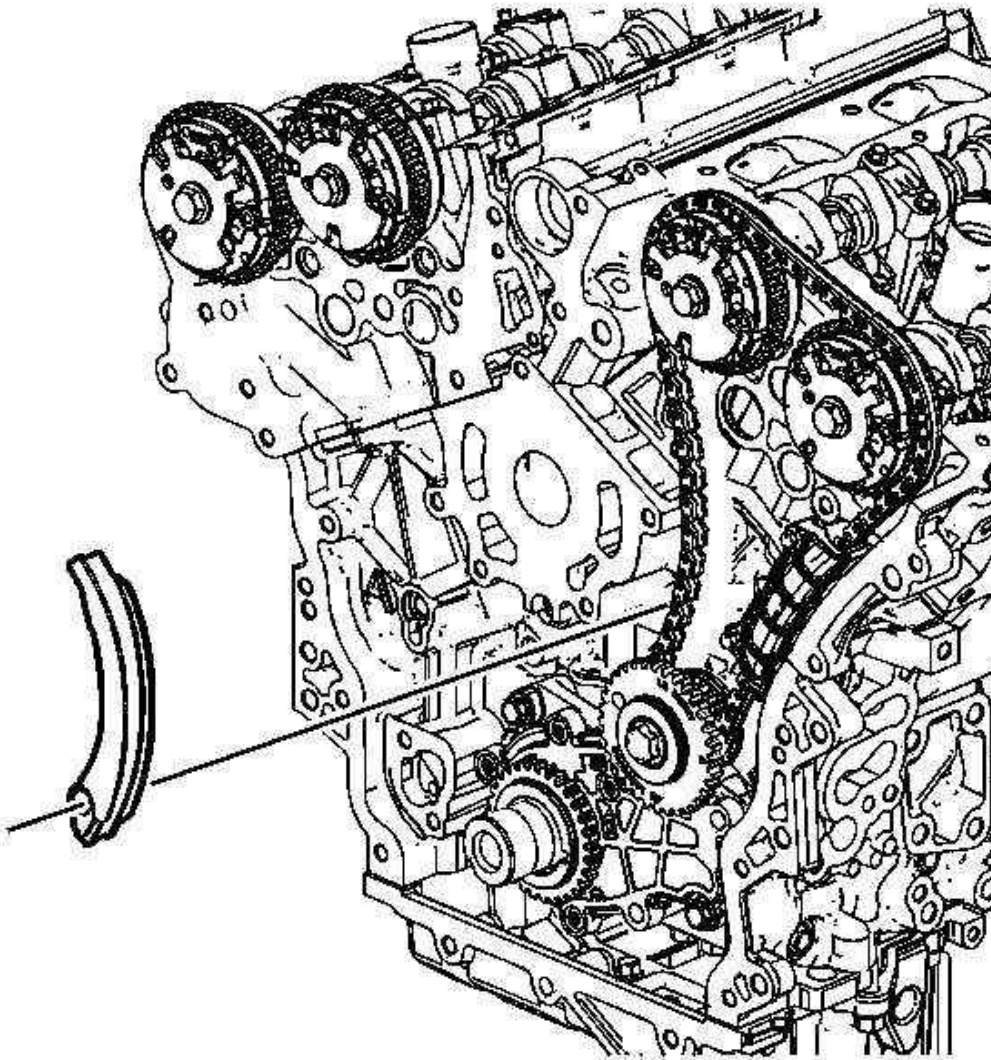


Fig. 138: View Of Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Remove the left secondary camshaft drive chain shoe.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT SIDE (FOURTH DESIGN)

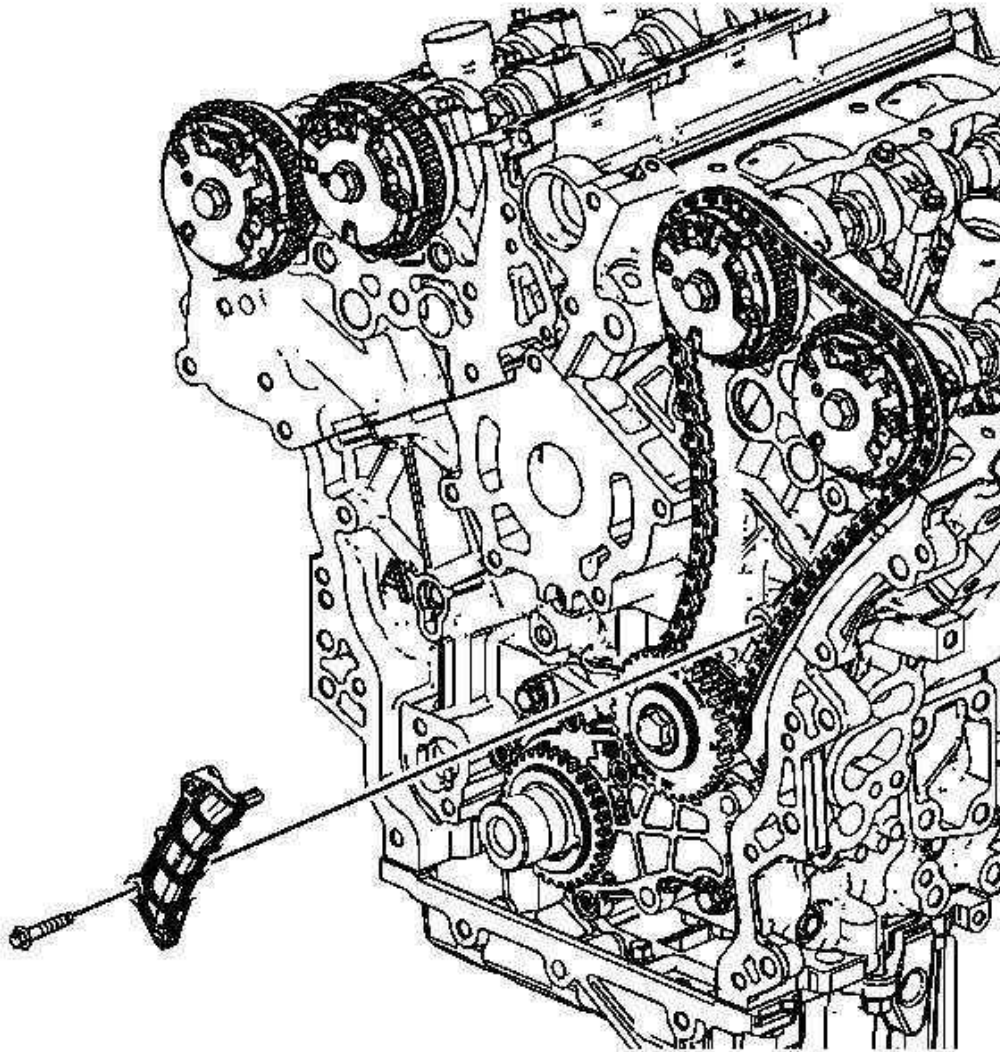


Fig. 139: View Of Secondary Camshaft Drive Chain Guide Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the left secondary camshaft drive chain guide bolts.
2. Remove the left secondary camshaft drive chain guide.

SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT SIDE (FOURTH DESIGN)

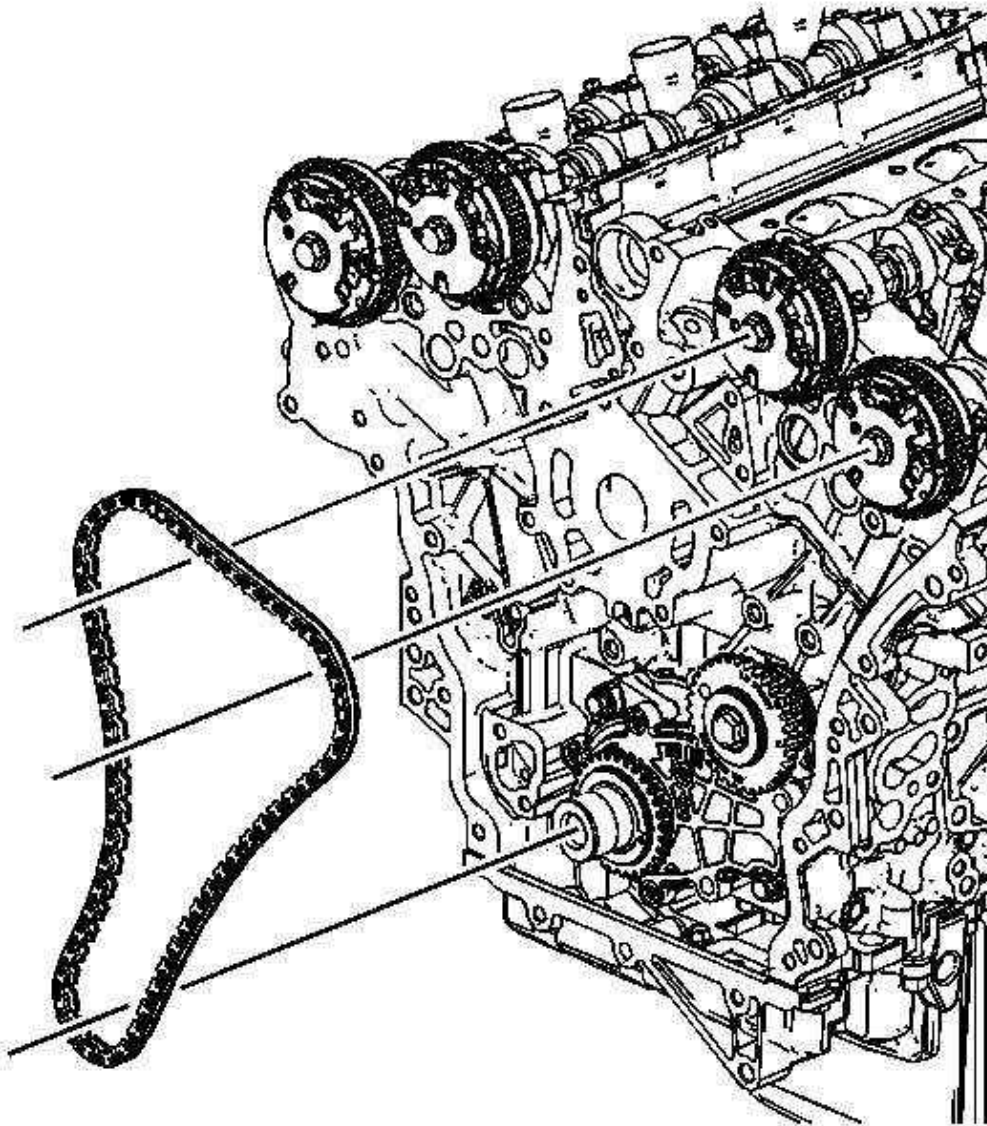


Fig. 140: Identifying Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

Remove the left secondary camshaft drive chain from the left camshaft position actuators and the left camshaft intermediate drive chain idler sprocket.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT SIDE (FOURTH DESIGN)

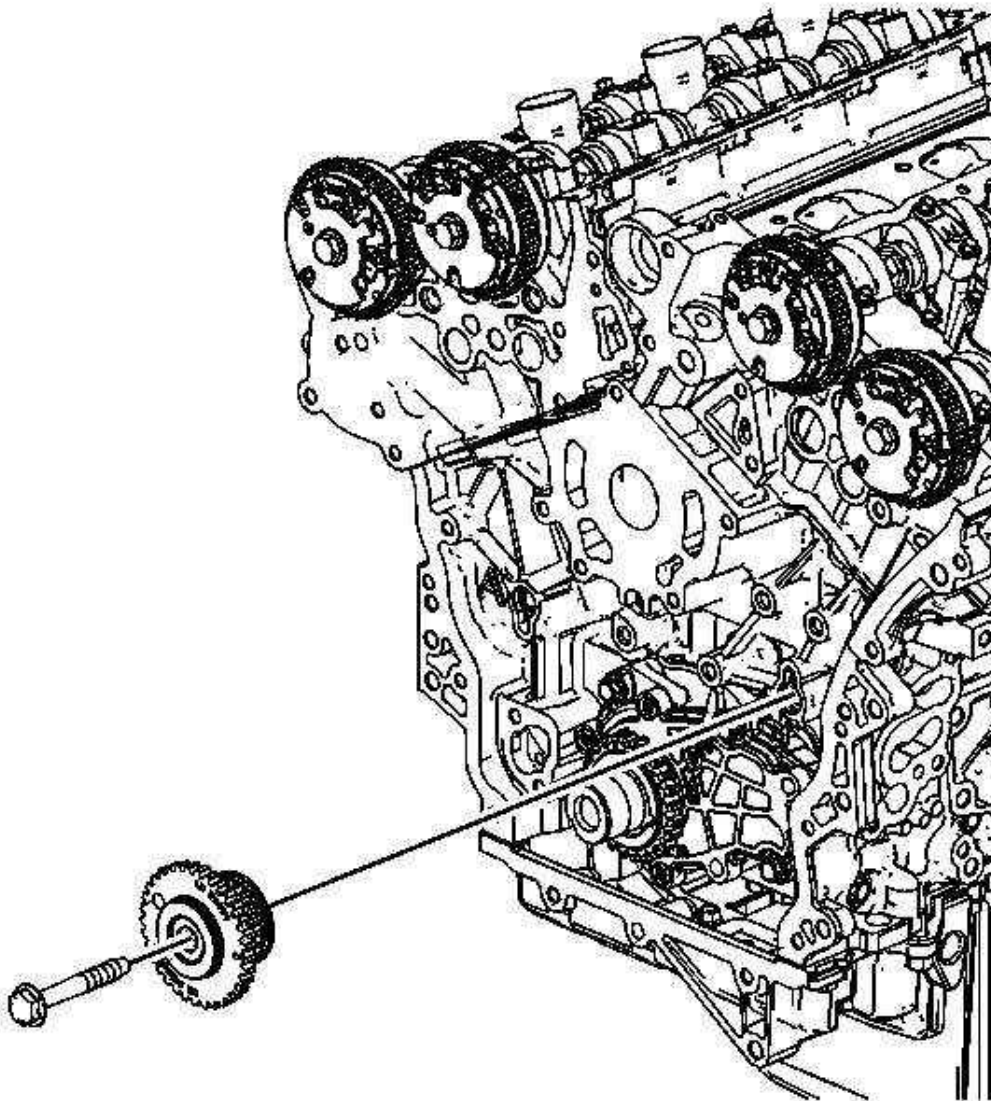


Fig. 141: View Of Camshaft Intermediate Drive Chain Idler And Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the left camshaft intermediate drive chain idler bolt.

2. Remove the left camshaft intermediate drive chain idler.

CRANKSHAFT SPROCKET REMOVAL (FOURTH DESIGN)

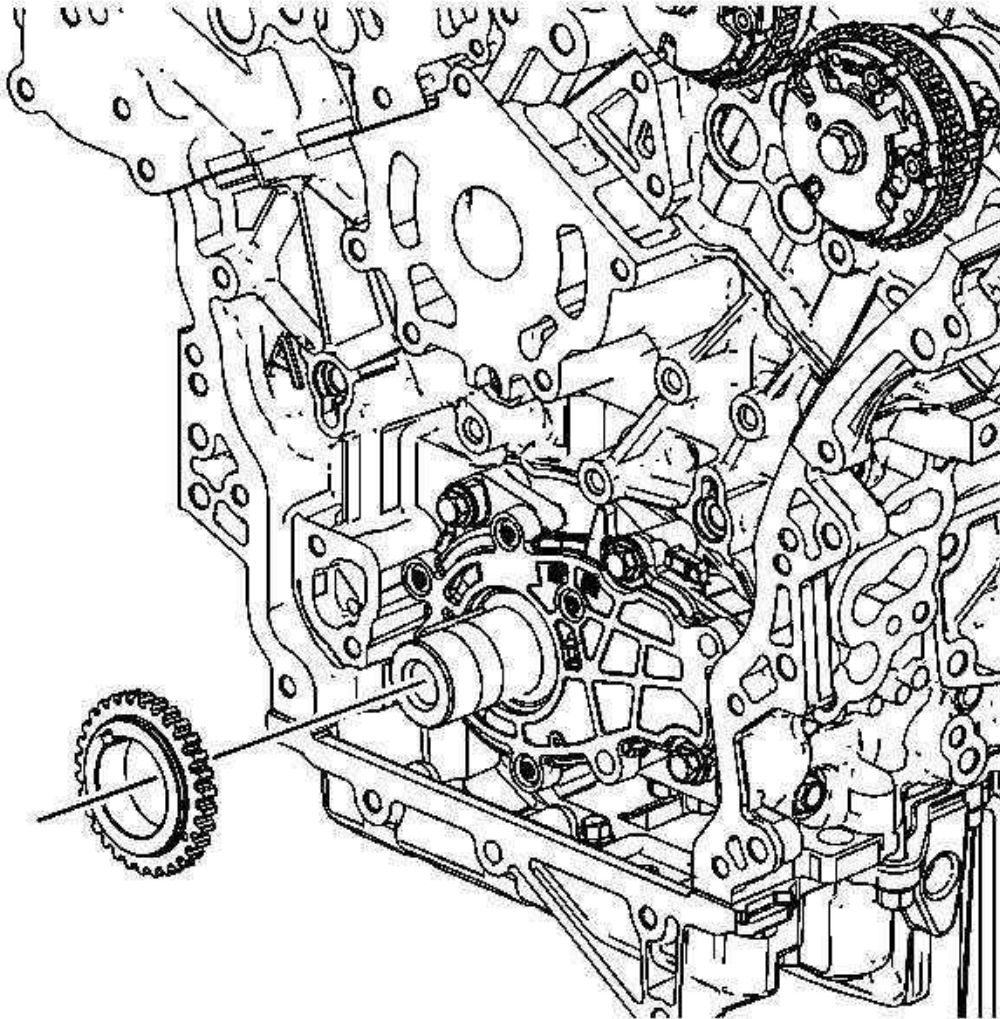


Fig. 142: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

Remove the crankshaft sprocket from the nose of the crankshaft.

CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE EXHAUST (FOURTH DESIGN)

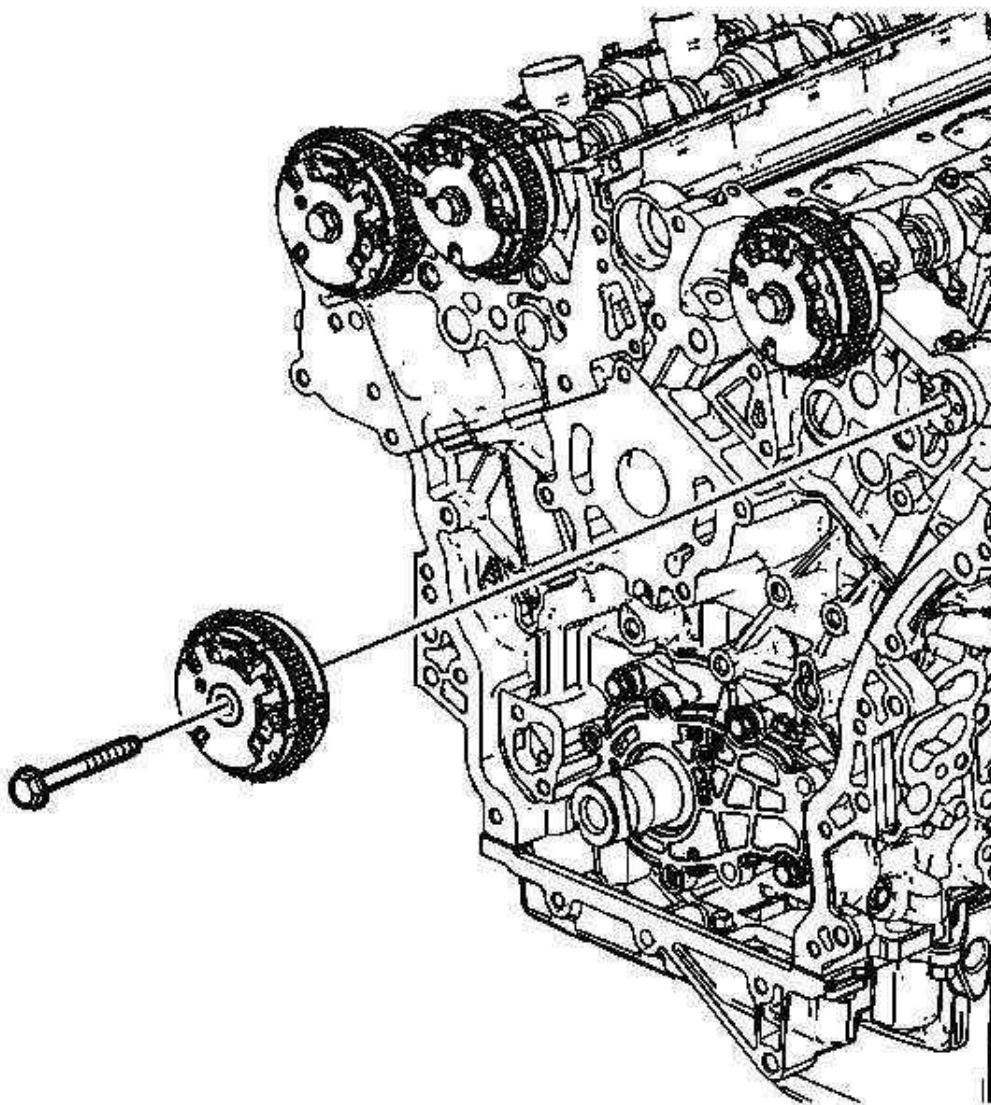


Fig. 143: Locating Exhaust Camshaft Position Actuator And Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice .

1. Use an open wrench on the hex cast into the camshaft in order to prevent

engine rotation when loosening the camshaft position actuator bolt.

2. Remove the left exhaust camshaft position actuator bolt.
3. Remove the left exhaust camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - LEFT SIDE INTAKE (FOURTH DESIGN)

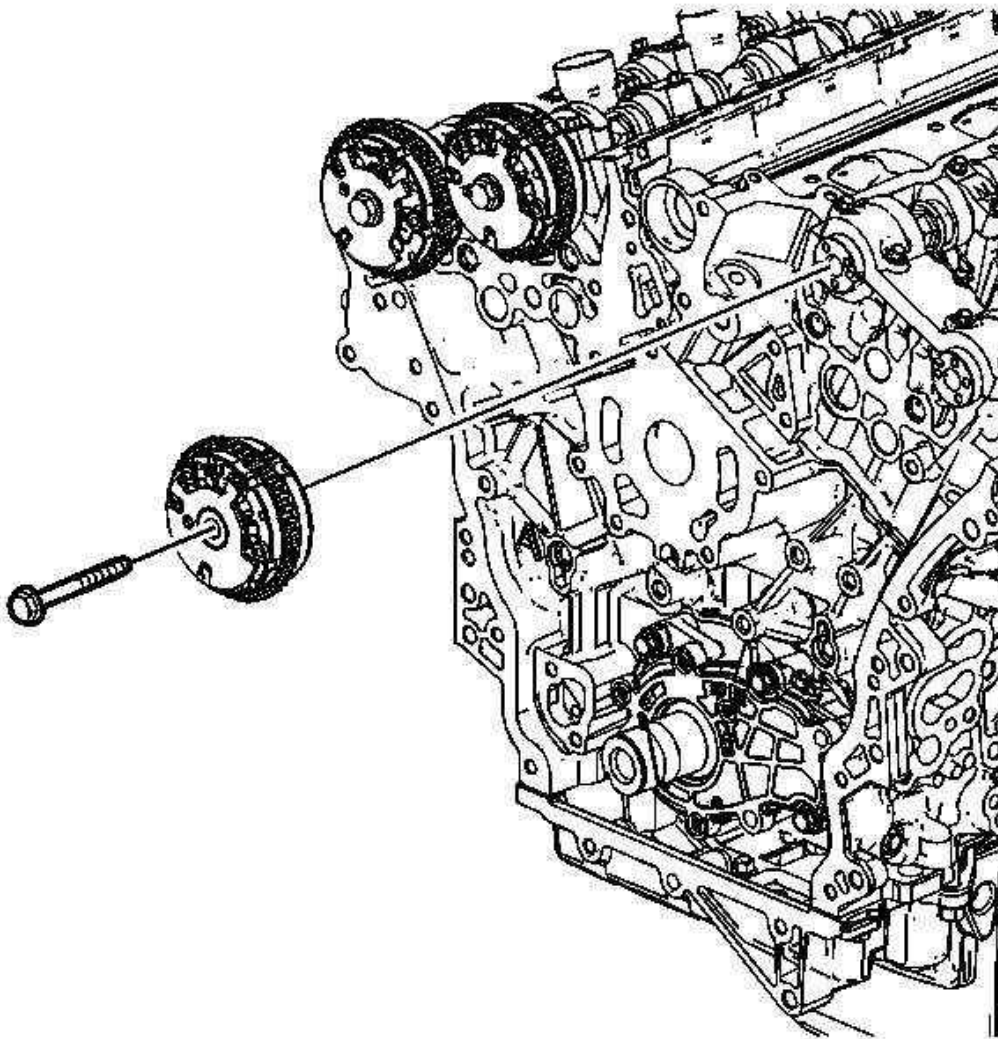


Fig. 144: View Of Camshaft Position Actuator Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice .

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the left intake camshaft position actuator bolt.
3. Remove the left intake camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE EXHAUST (FOURTH DESIGN)

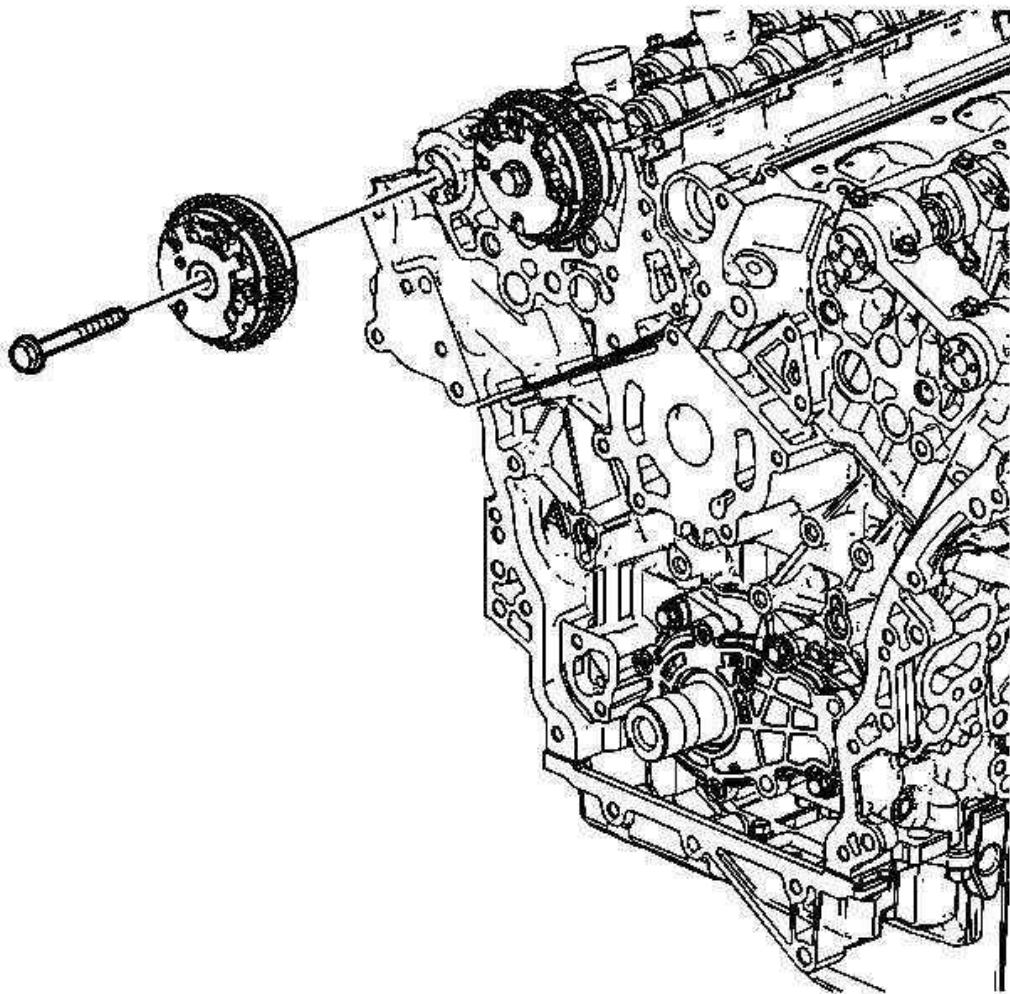


Fig. 145: Identifying Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Torque Reaction Against Timing Drive Chain Notice .**

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the right exhaust camshaft position actuator bolt.
3. Remove the right exhaust camshaft position actuator.

CAMSHAFT POSITION ACTUATOR REMOVAL - RIGHT SIDE INTAKE (FOURTH DESIGN)

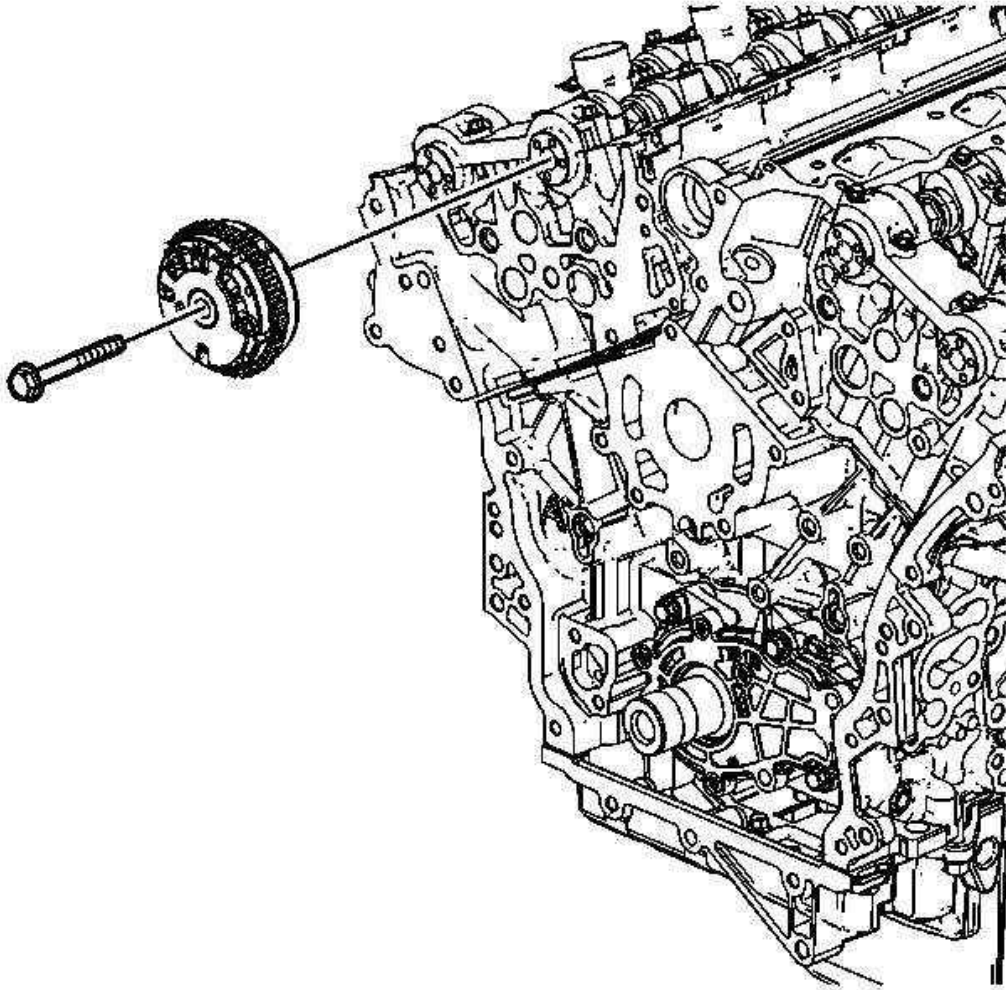


Fig. 146: Identifying Intake Camshaft Position Actuator And Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice .

1. Use an open wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
2. Remove the right intake camshaft position actuator bolt.

3. Remove the right intake camshaft position actuator.

CAMSHAFT REMOVAL - LEFT SIDE

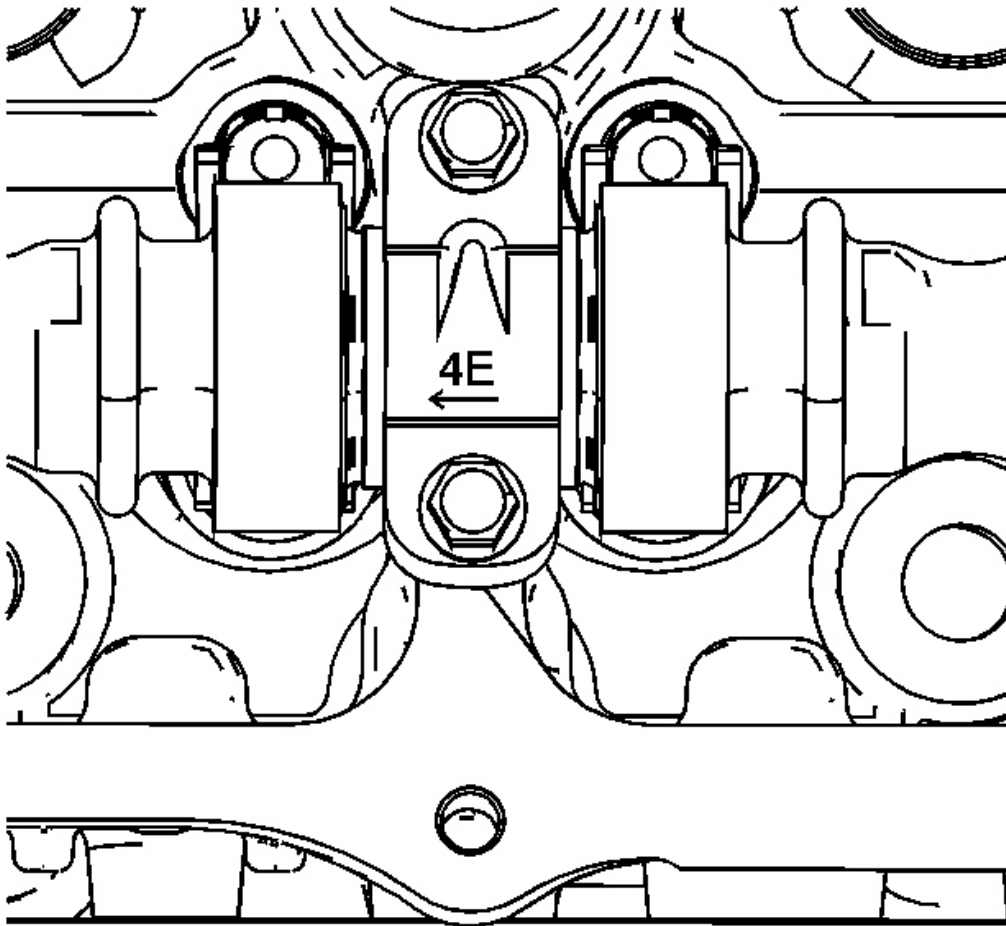


Fig. 147: Identifying Markings On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

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 raised feature must always be oriented toward the center of the cylinder head.

- The I indicates the intake camshaft.
- The E indicates the exhaust camshaft.
- The number indicates the journal position from the front of the engine.

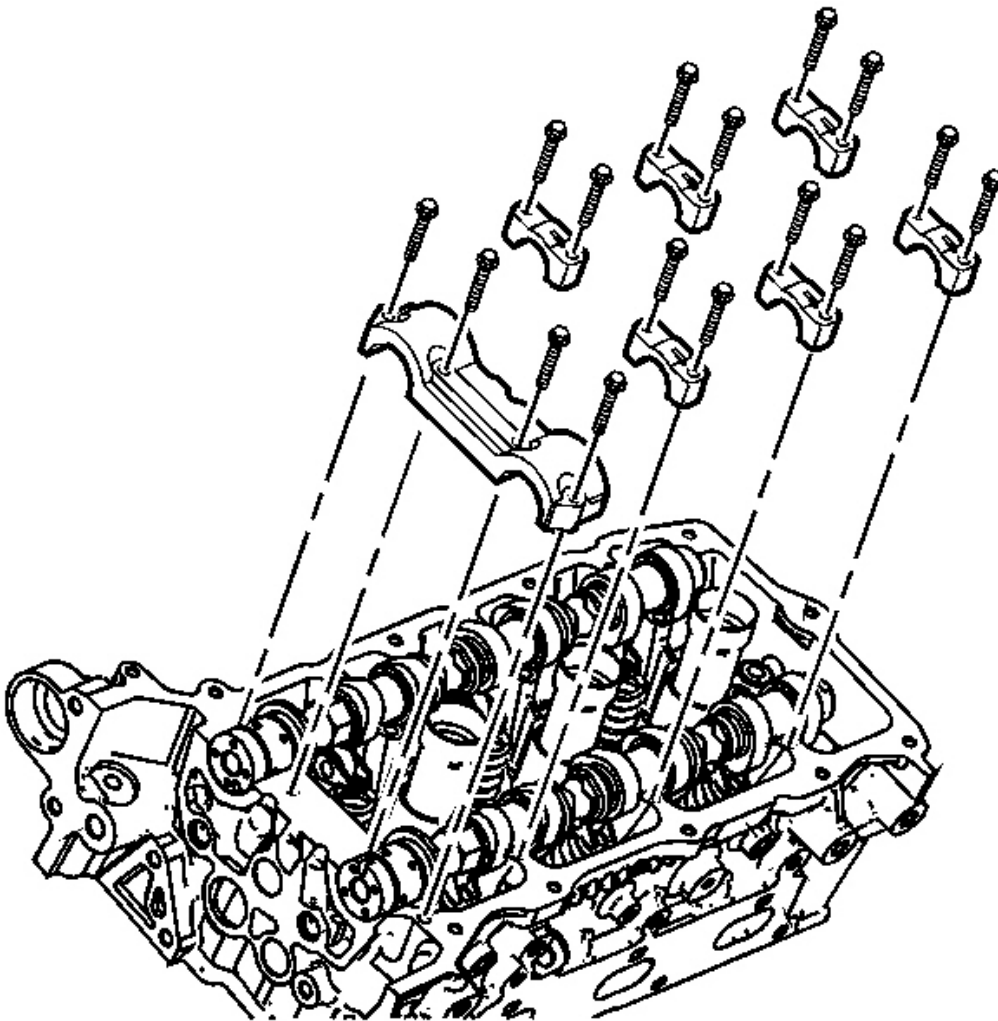


Fig. 148: Locating Camshaft Bearing Cap & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the camshaft bearing cap bolts.

3. Remove the camshaft bearing caps.

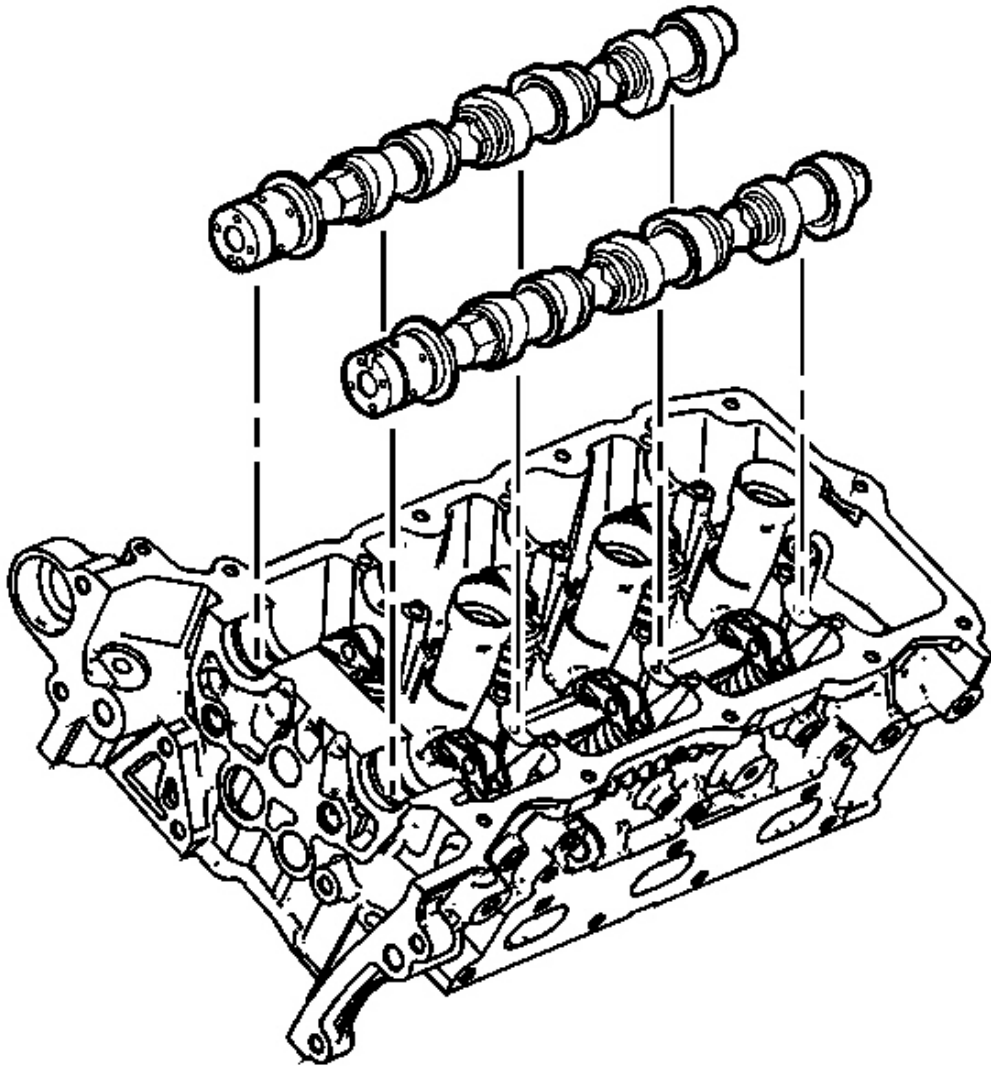


Fig. 149: View Of Camshafts
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshafts.
5. Replace the camshaft bearing caps and bolts.

VALVE ROCKER ARM REMOVAL - LEFT SIDE

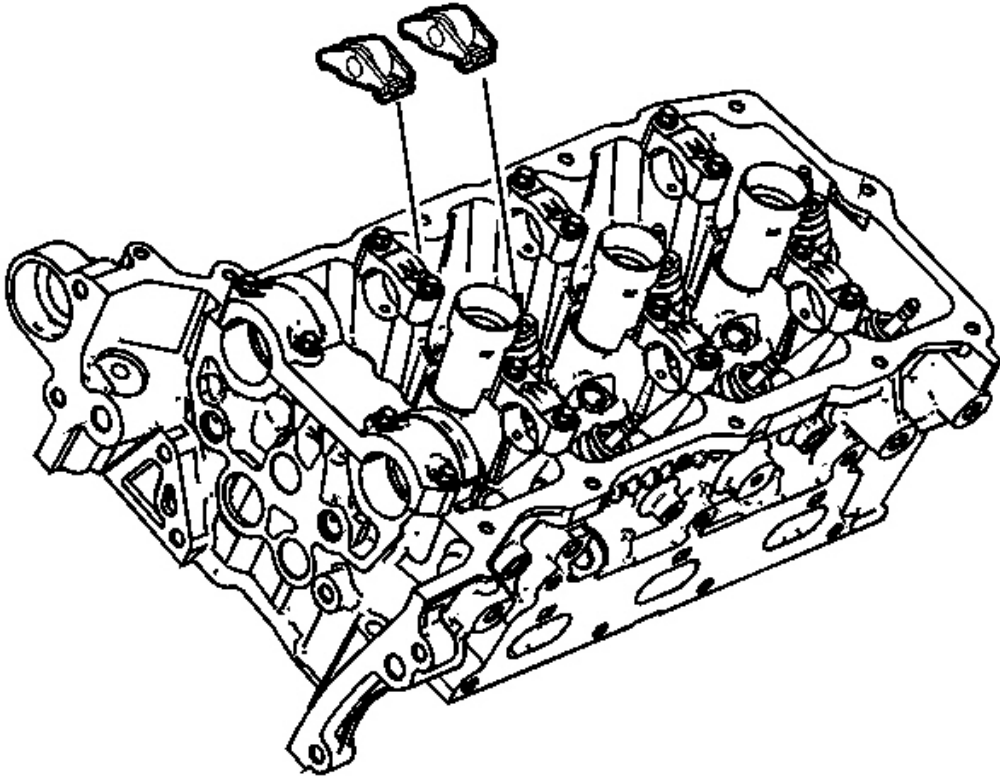


Fig. 150: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

Remove the valve rocker arms, camshaft followers, from the left cylinder head.

VALVE LIFTER REMOVAL - LEFT SIDE

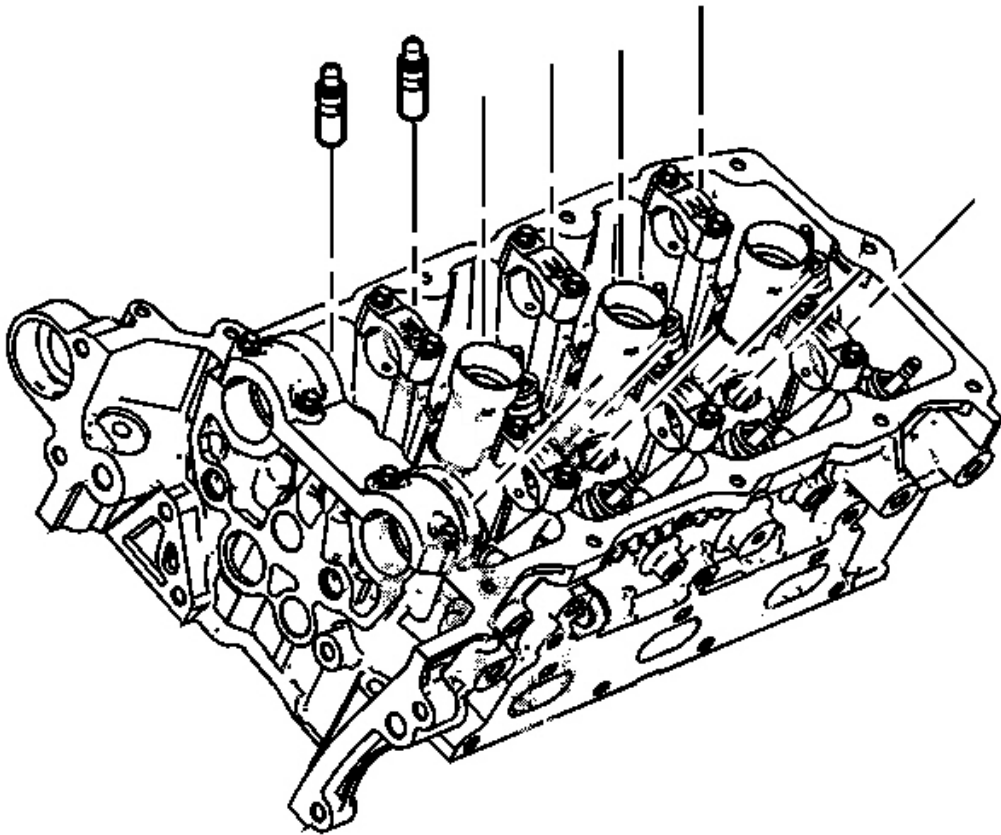


Fig. 151: View Of Stationary Hydraulic Lash Adjuster (SHLA)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.
- Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.

Remove the valve lifters, stationary hydraulic lash adjuster, (SHLAs) from the left cylinder head.

CYLINDER HEAD REMOVAL - LEFT SIDE

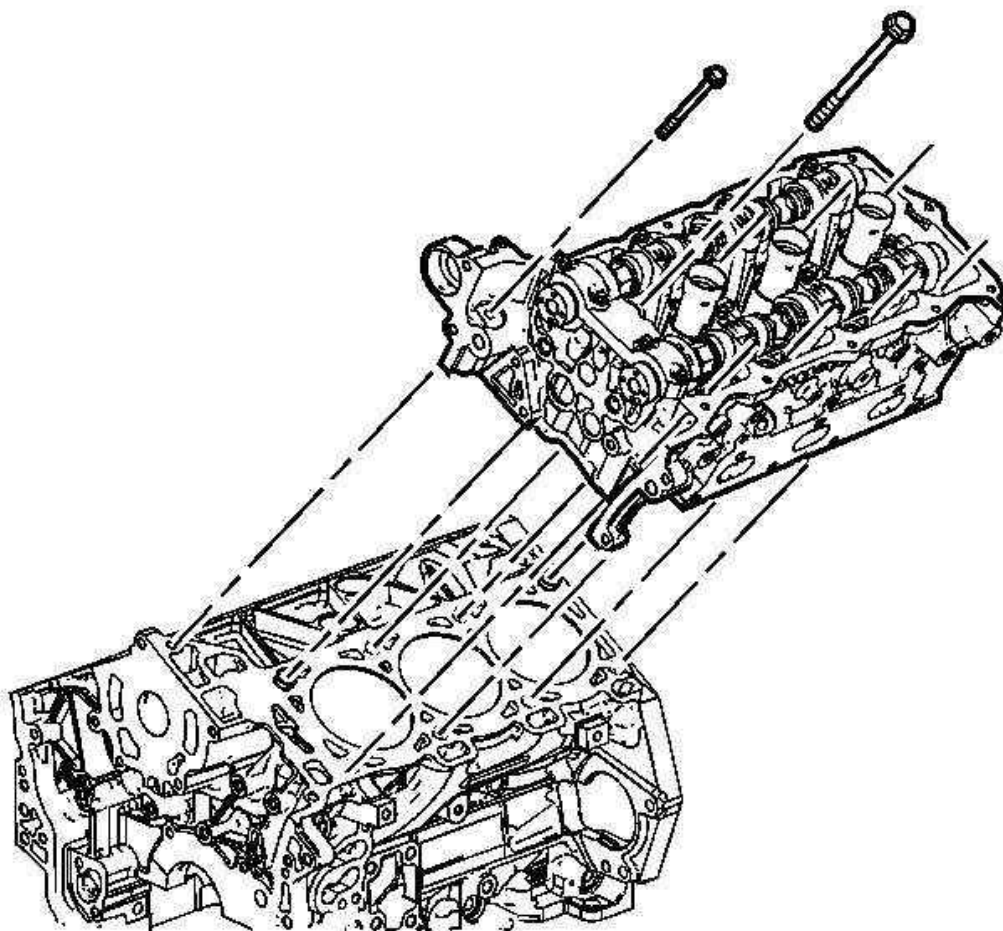


Fig. 152: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Remove the two front M8 left cylinder head bolts.
2. Remove the left cylinder head bolts.
3. Remove the left cylinder head.

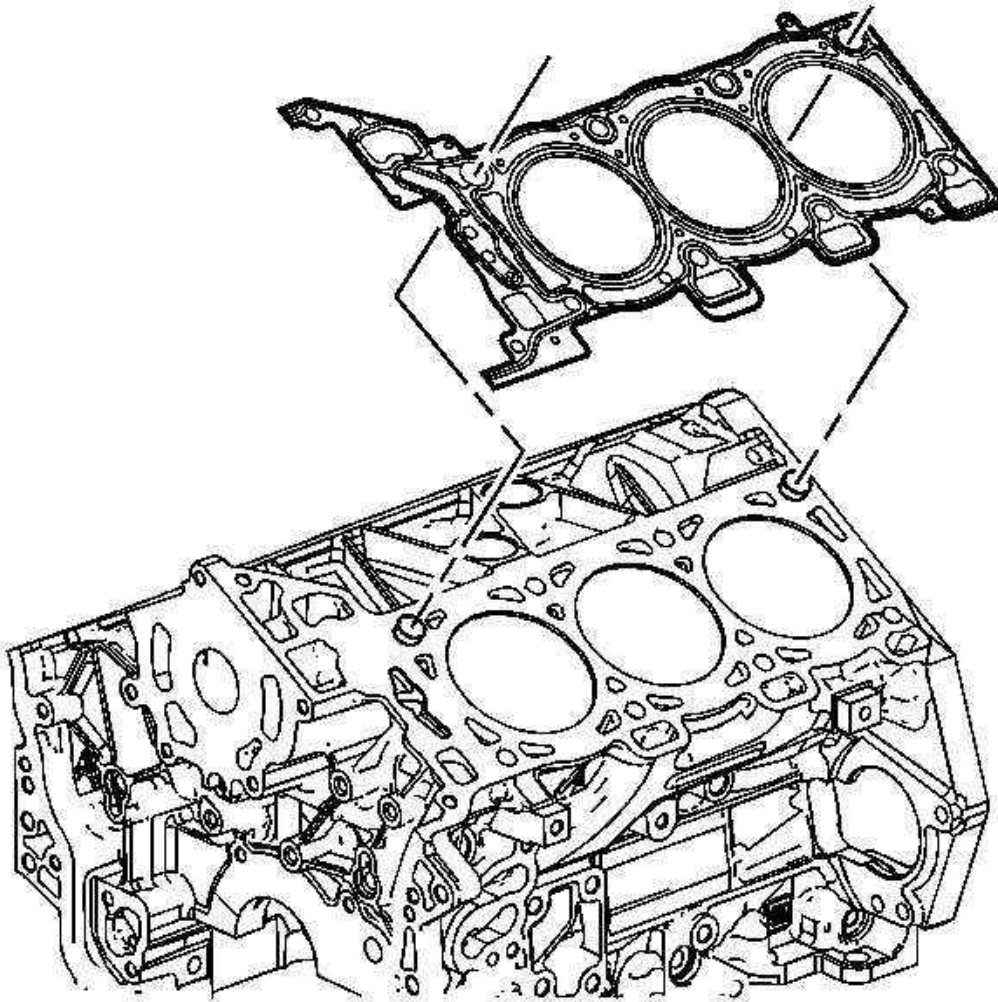


Fig. 153: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the left cylinder head gasket.

CAMSHAFT REMOVAL - RIGHT SIDE

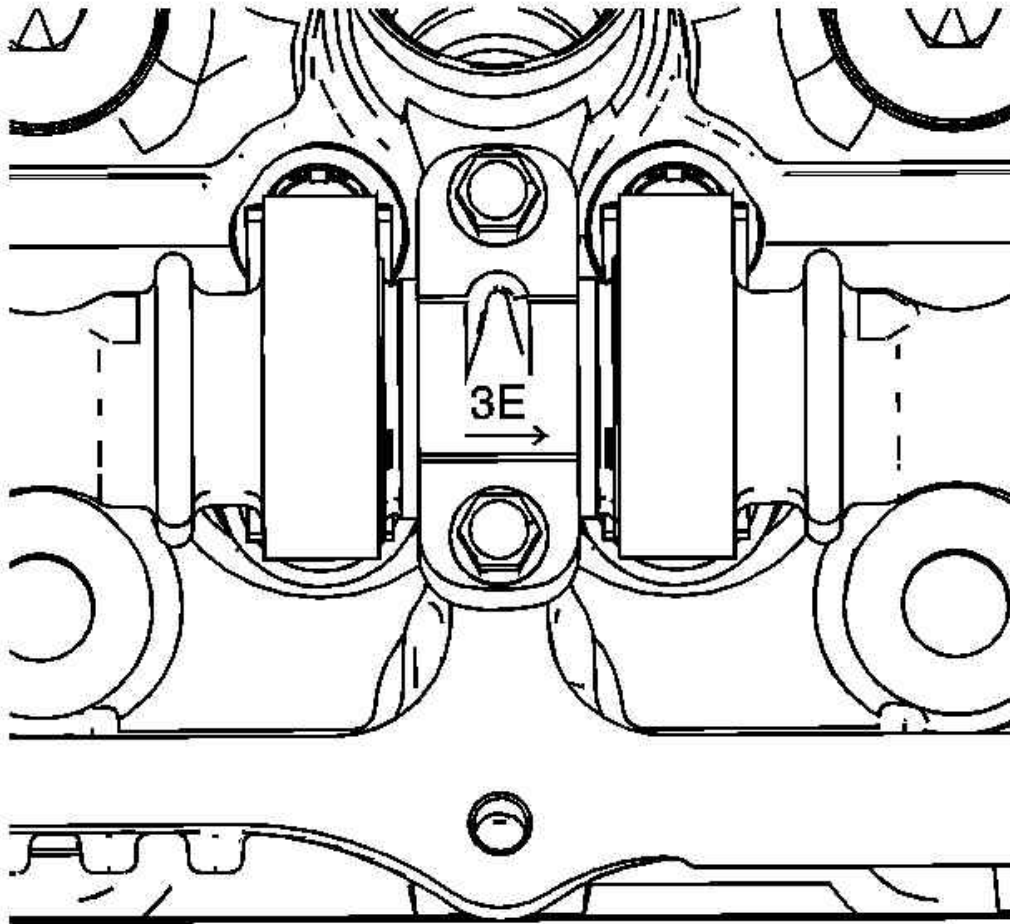


Fig. 154: Identifying Markings On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

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 raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number indicates the journal position from the front of the engine.

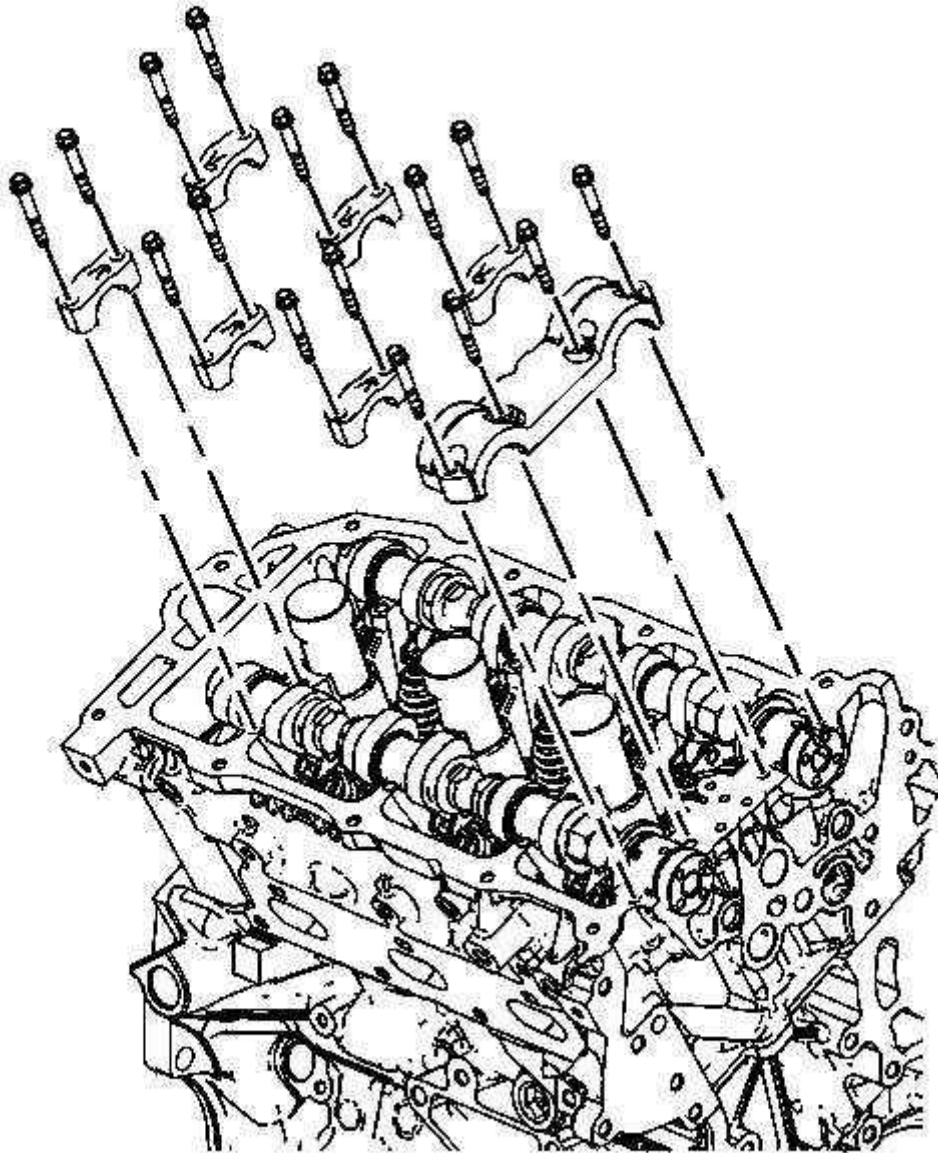


Fig. 155: View Of Camshaft Bearing Caps & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the camshaft bearing cap bolts.
3. Remove the camshaft bearing caps.

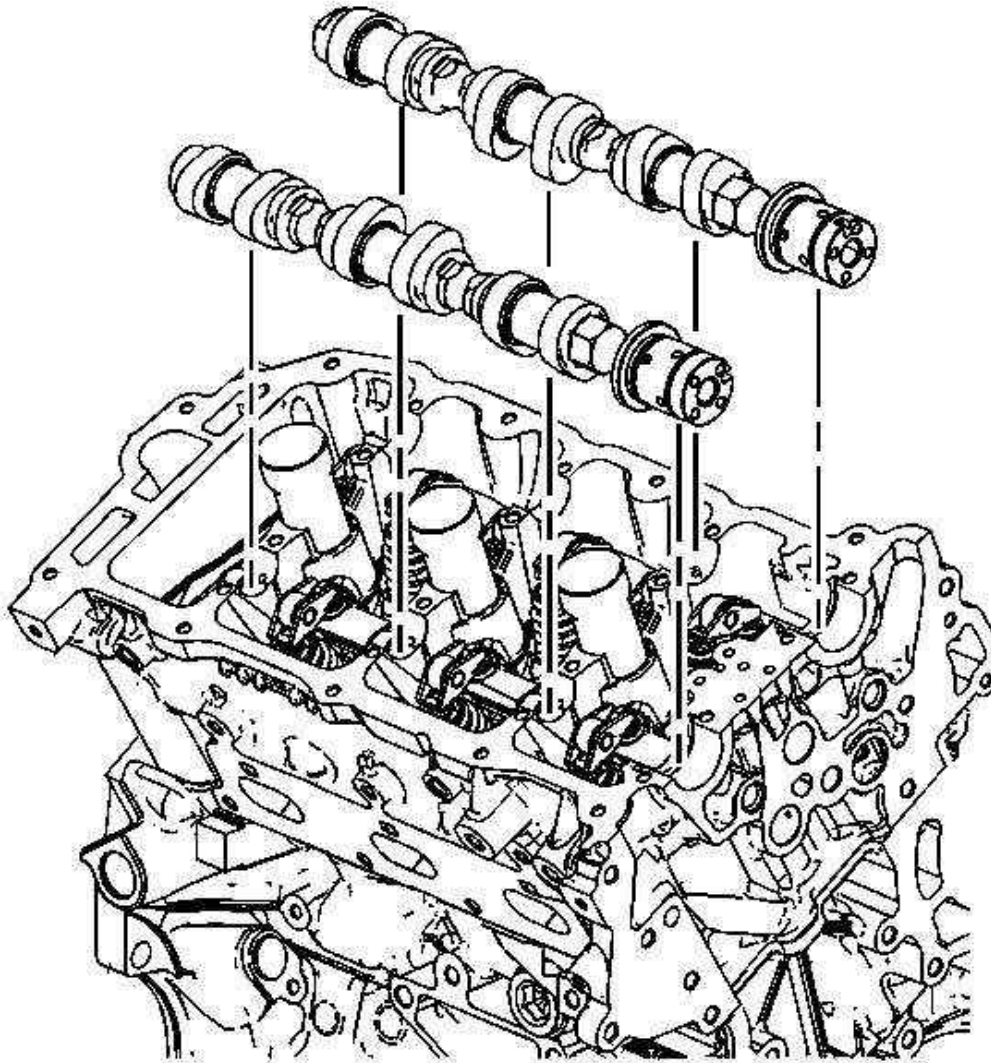


Fig. 156: Locating Camshafts
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshafts.
5. Replace the camshaft bearing caps and bolts.