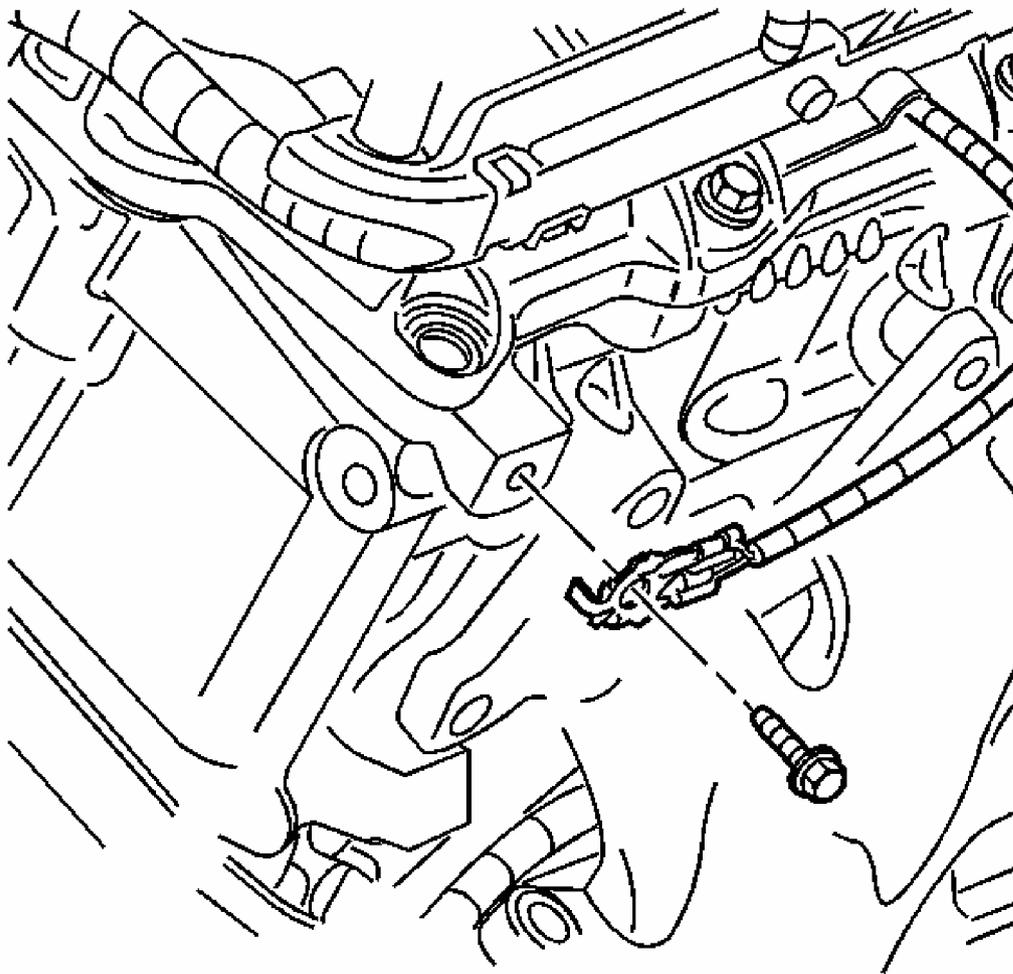


# REPAIR INSTRUCTIONS

## CYLINDER HEAD REPLACEMENT - RIGHT

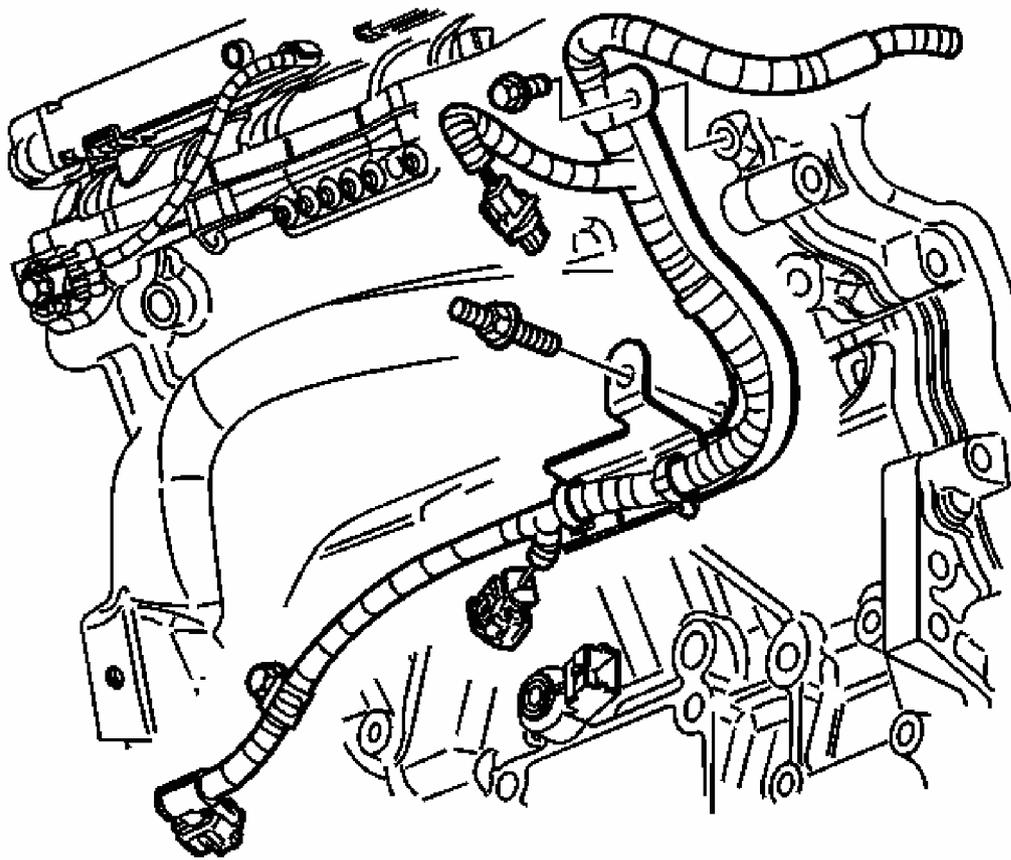
### Removal Procedure

1. Remove the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Right** .
2. Remove the coolant inlet pipe bolts and reposition the coolant inlet pipe to provide access. Refer to **Coolant Pipe Replacement - Inlet (LP1, LY7)** in Engine Cooling.
3. Remove the catalytic converter. Refer to **Catalytic Converter Replacement - Right (LP1, LY7)** or **Catalytic Converter Replacement - Right (LS6)** in Engine Exhaust.



**Fig. 1: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head**  
**Courtesy of GENERAL MOTORS CORP.**

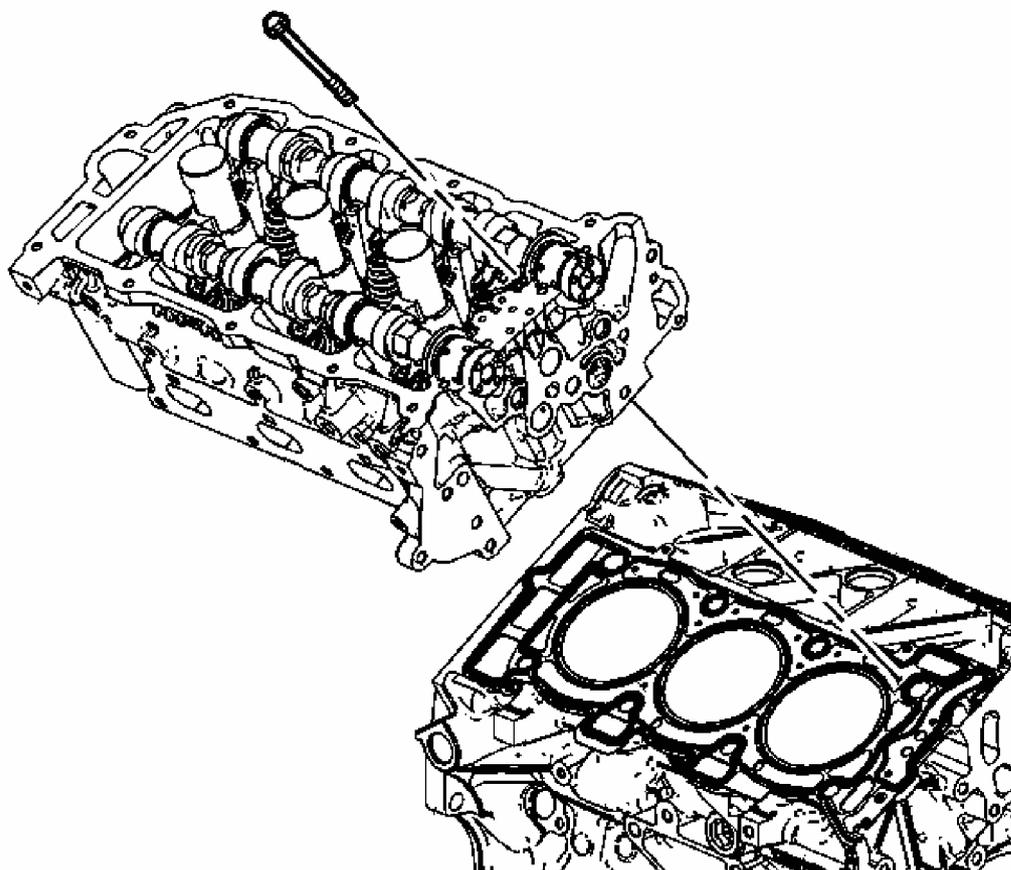
4. Remove the wiring harness ground from the side of the cylinder head.



**Fig. 2: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud**

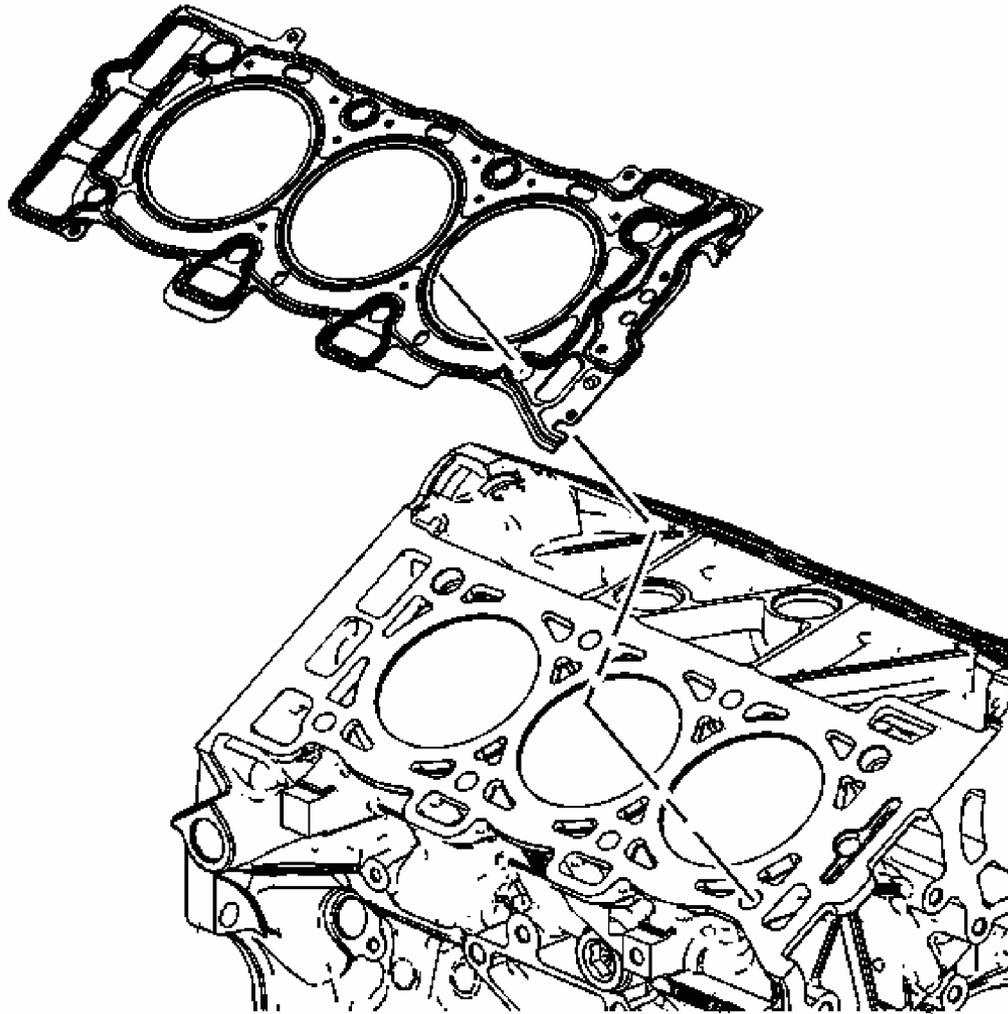
Courtesy of GENERAL MOTORS CORP.

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 (LP1, LY7)** or **Battery Negative Cable Replacement (LS6)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.



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

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

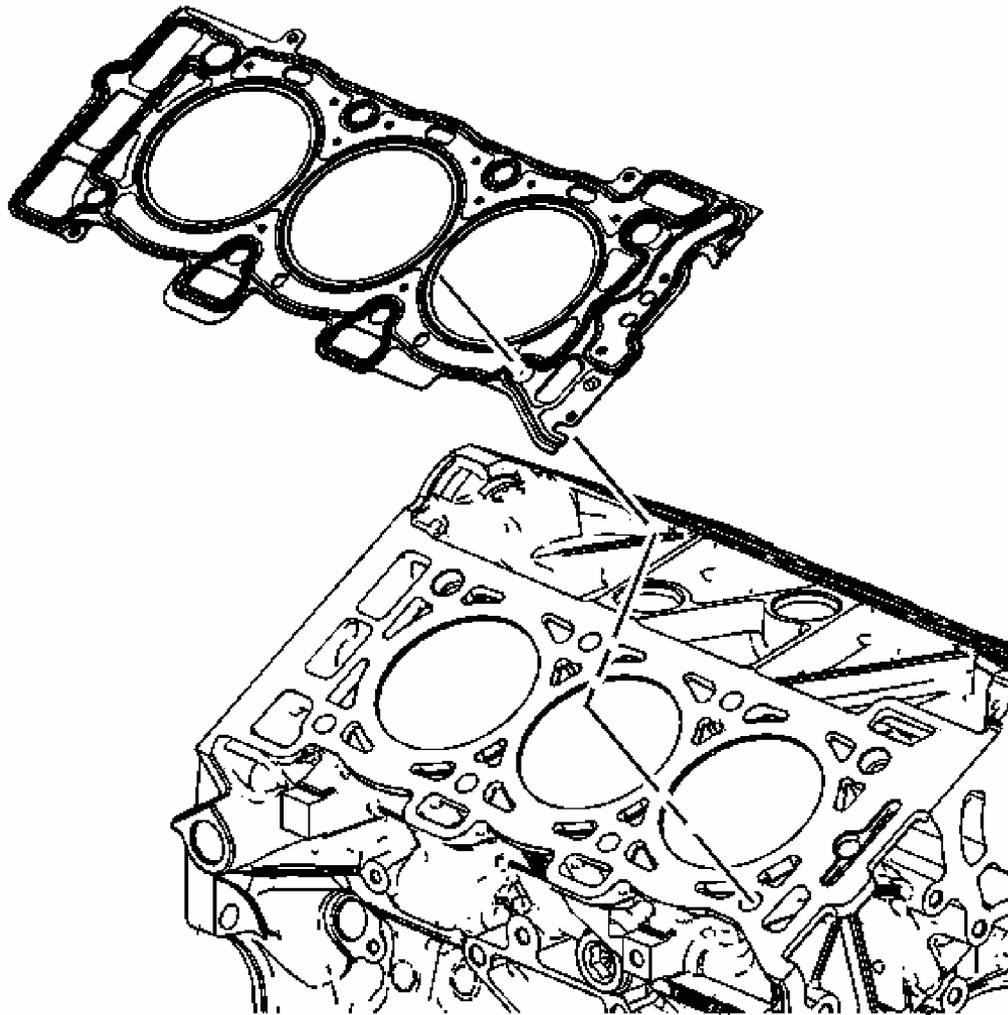


**Fig. 4: View Of Right Cylinder Head Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

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

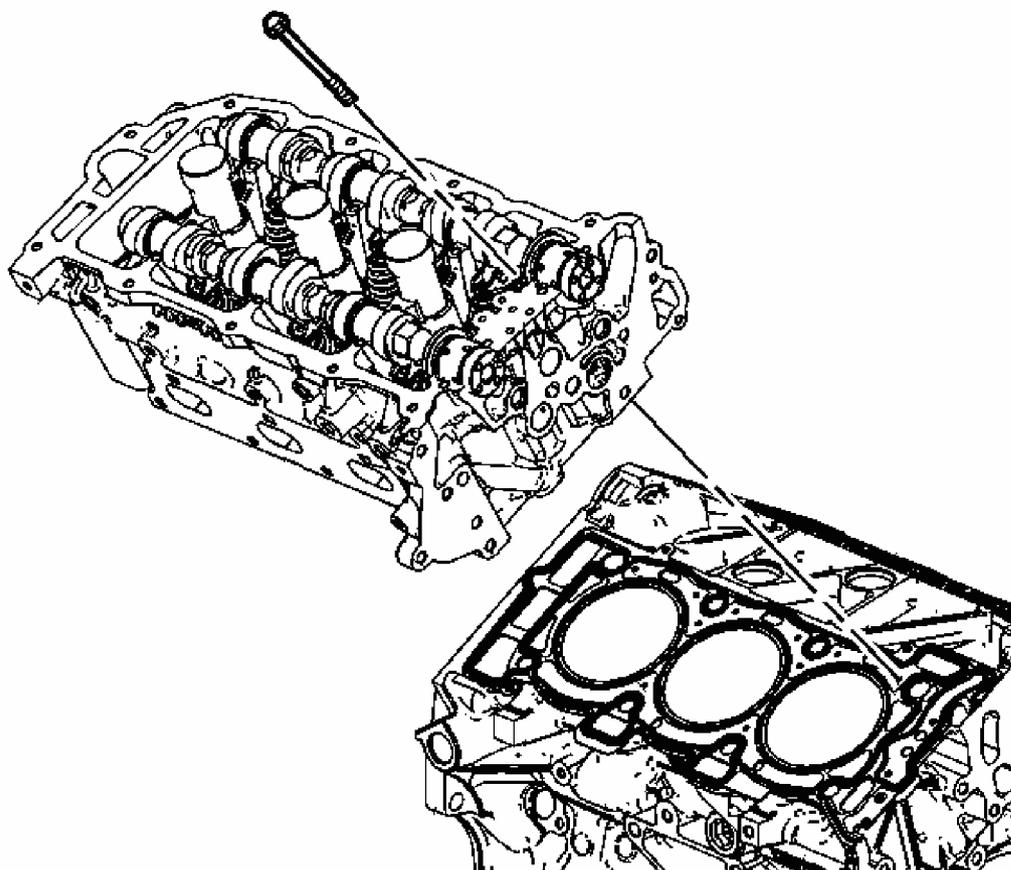
## Installation Procedure

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 - Right** .



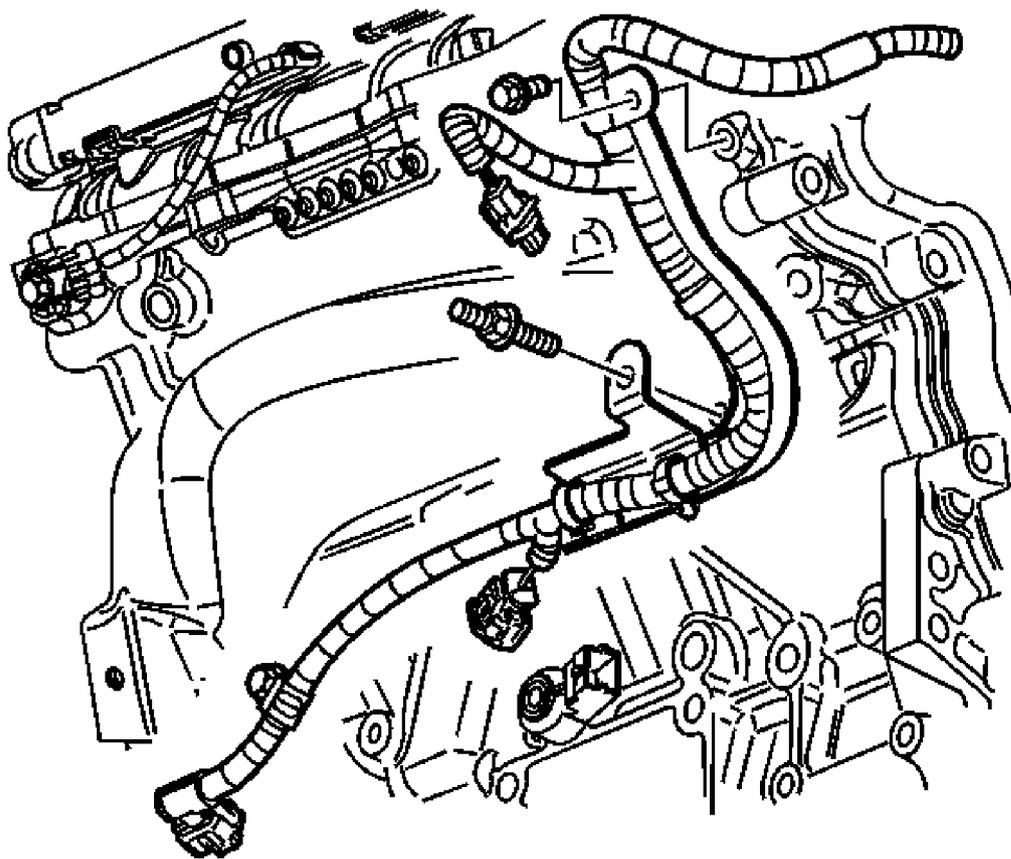
**Fig. 5: View Of Right Cylinder Head Gasket**  
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW cylinder head gasket.



**Fig. 6: 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 - Right**.
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 (LP1, LY7)** or **Battery Negative Cable Replacement (LS6)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.



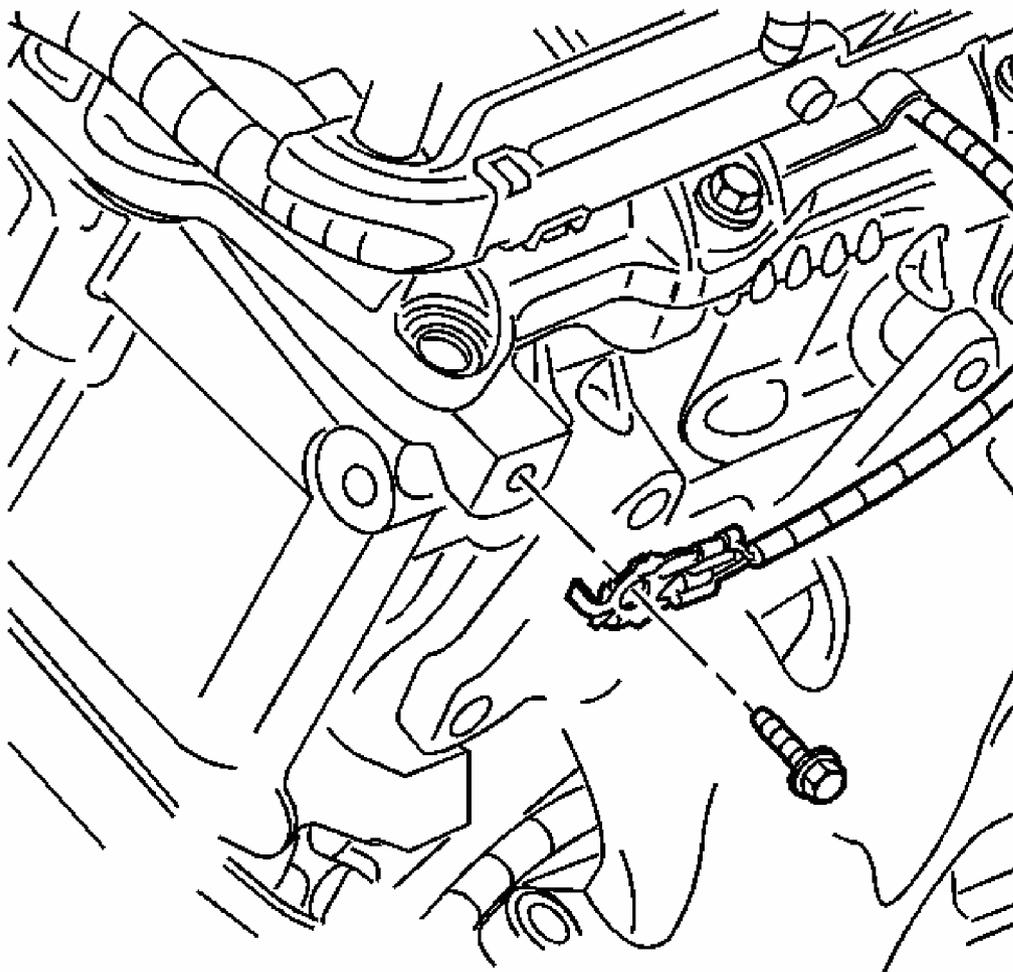
**Fig. 7: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud**

Courtesy of GENERAL MOTORS CORP.

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

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. 8: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head**  
Courtesy of GENERAL MOTORS CORP.

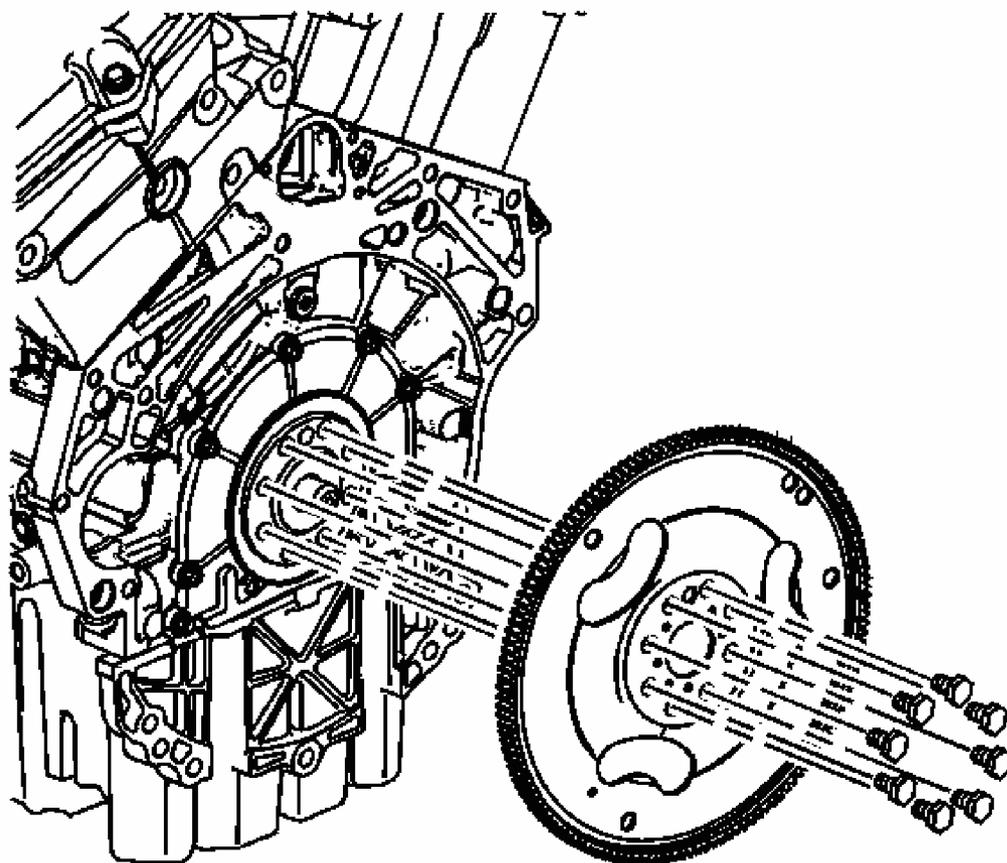
7. Install the wiring harness ground to the side of the cylinder head.

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

8. Install the catalytic converter. Refer to **Catalytic Converter Replacement - Right (LP1, LY7)** or **Catalytic Converter Replacement - Right (LS6)** in Engine Exhaust.
9. Install the coolant inlet pipe. Refer to **Coolant Pipe Replacement - Inlet (LP1, LY7)** in Engine Cooling.
10. Install the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Right**.

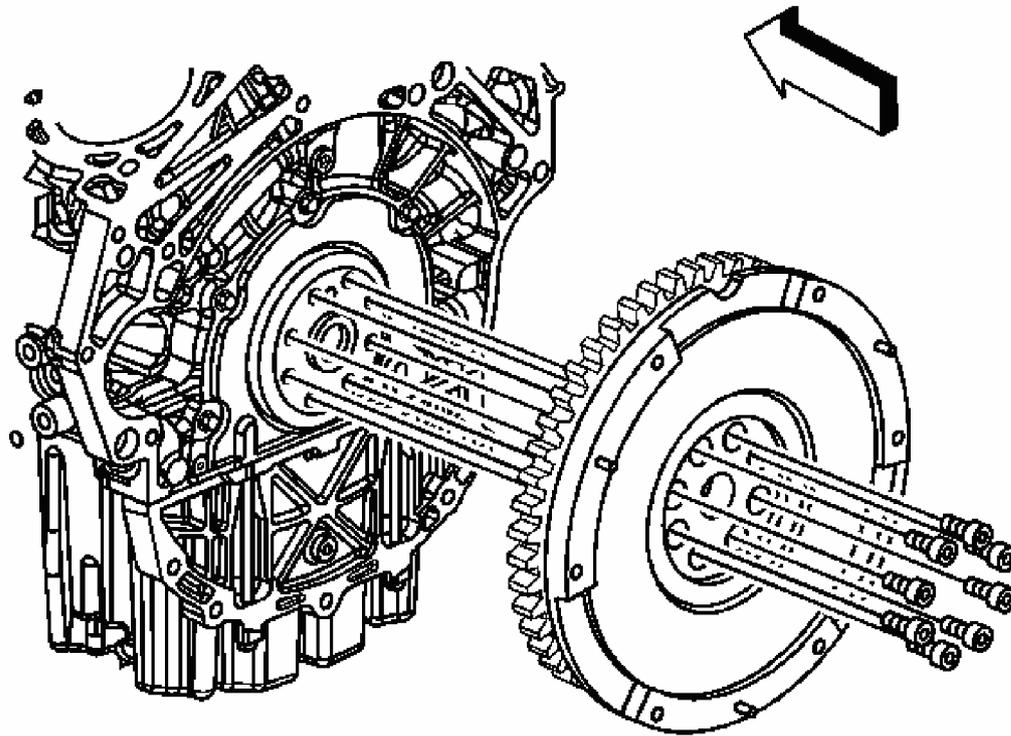
# ENGINE FLYWHEEL REPLACEMENT

## Removal Procedure



**Fig. 9: View Of Engine Flywheel**  
Courtesy of GENERAL MOTORS CORP.

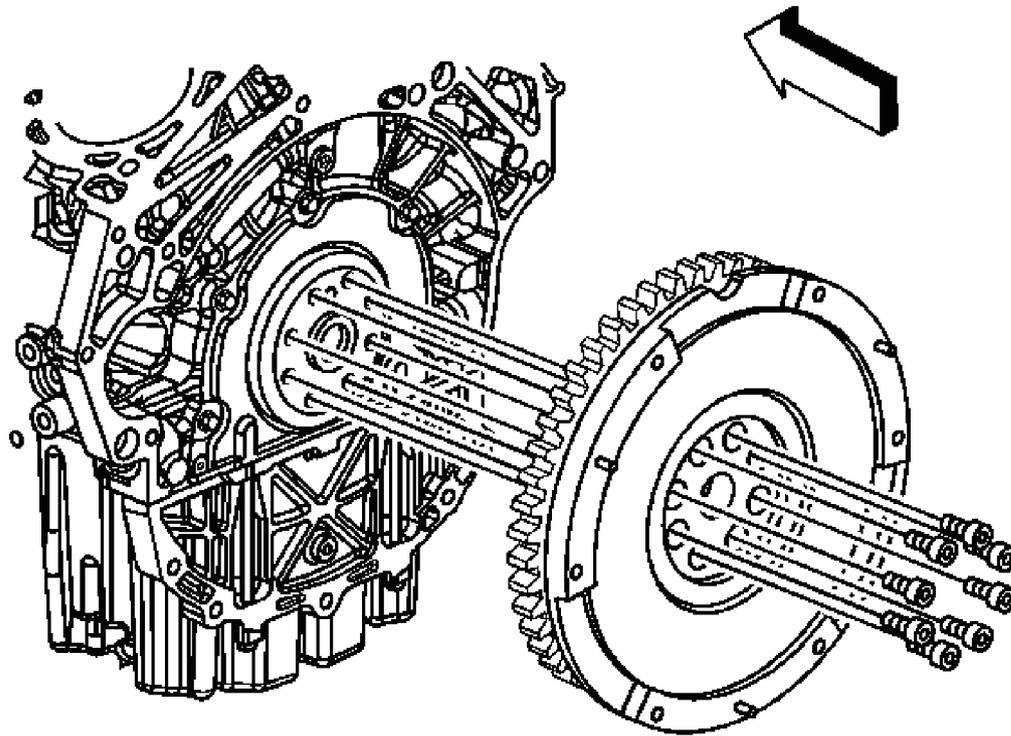
1. Remove the automatic transmission, if equipped. Refer to **Transmission Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.
2. Remove the engine flywheel bolts and flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)**.



**Fig. 10: View Of Flywheel & Flywheel Bolts**  
Courtesy of GENERAL MOTORS CORP.

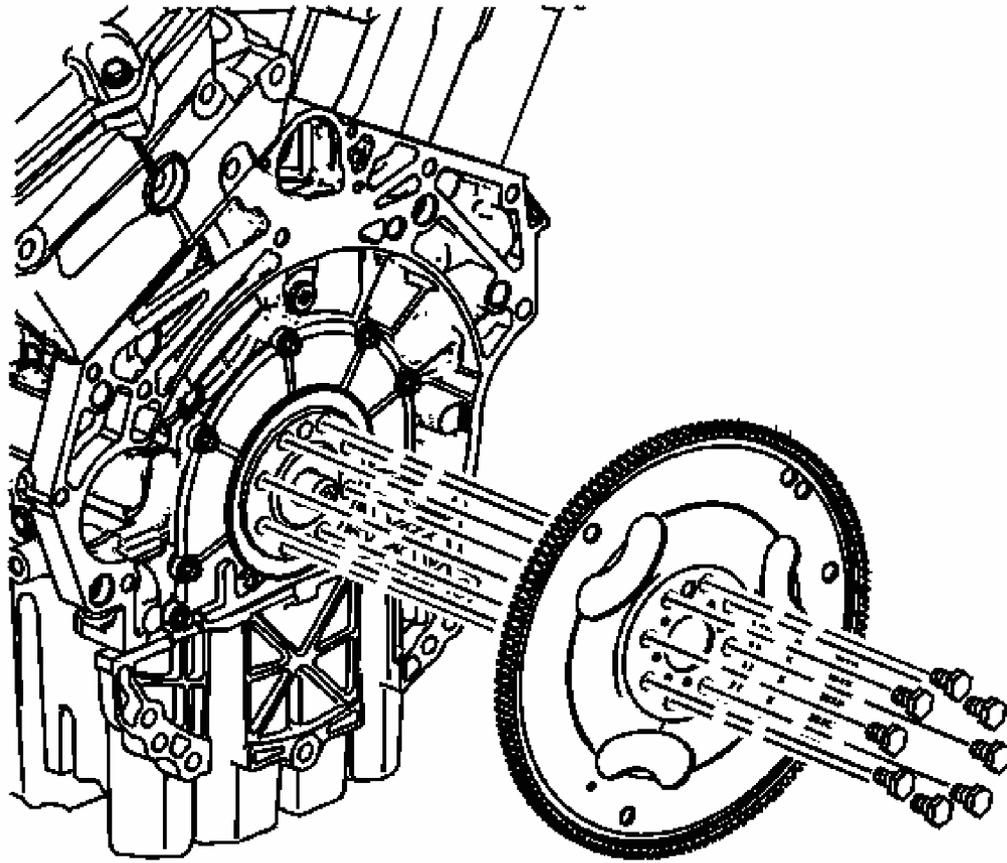
3. Remove the manual transmission, if equipped. Refer to **Transmission Replacement** in Manual Transmission - Aisin M6-D173.
4. Remove the engine flywheel bolts and flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)**.
5. Clean and inspect the flywheel. Refer to **Engine Flywheel Cleaning and Inspection (Automatic Transmission)** or **Engine Flywheel Cleaning and Inspection (Manual Transmission)**. If the flywheel teeth are damaged, inspect the starter for proper operation. Replace the starter if you find excessive wear or damage to the starter drive. Refer to **Starter Motor Replacement (LP1, LY7)** or **Starter Motor Replacement (LS6)** in Engine Electrical.

#### Installation Procedure



**Fig. 11: View Of Flywheel & Flywheel Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the engine flywheel and bolts. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)** .
2. Install the manual transmission, if equipped. Refer to **Transmission Replacement** in Manual Transmission - Aisin M6-D173.



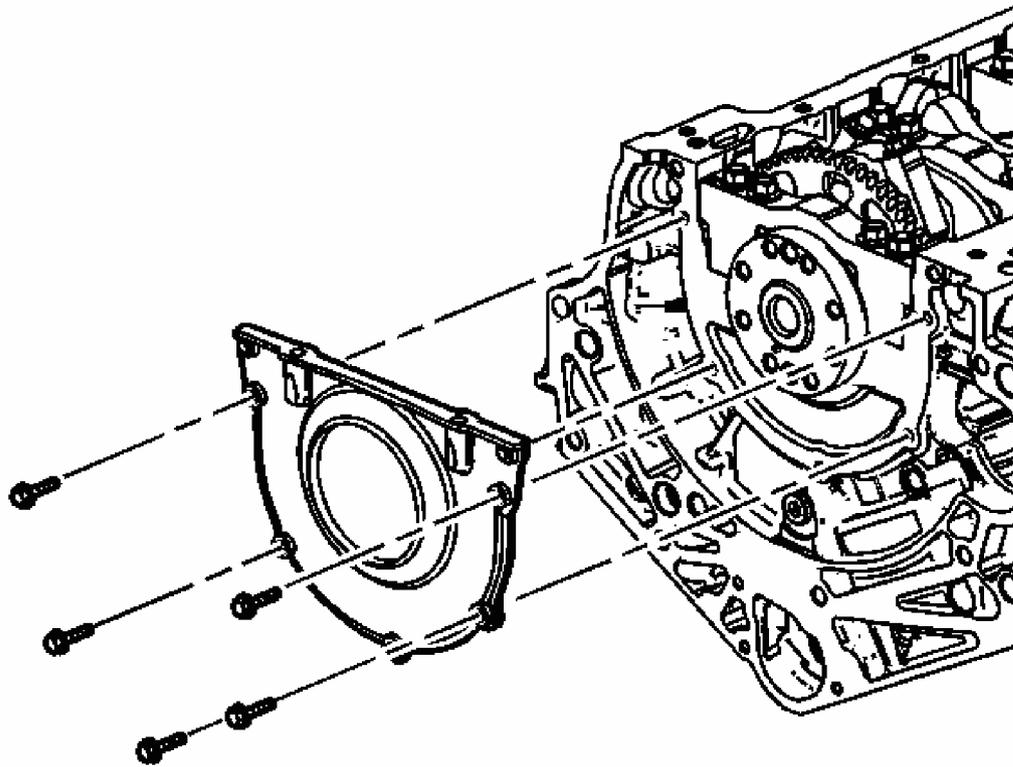
**Fig. 12: View Of Engine Flywheel**  
Courtesy of GENERAL MOTORS CORP.

3. Install the engine flywheel and bolts. Refer to **Engine Flywheel Installation (Automatic Transmission)** or **Engine Flywheel Installation (Manual Transmission)** .
4. Install the automatic transmission, if equipped. Refer to **Transmission Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.

#### **CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT**

##### **Removal Procedure**

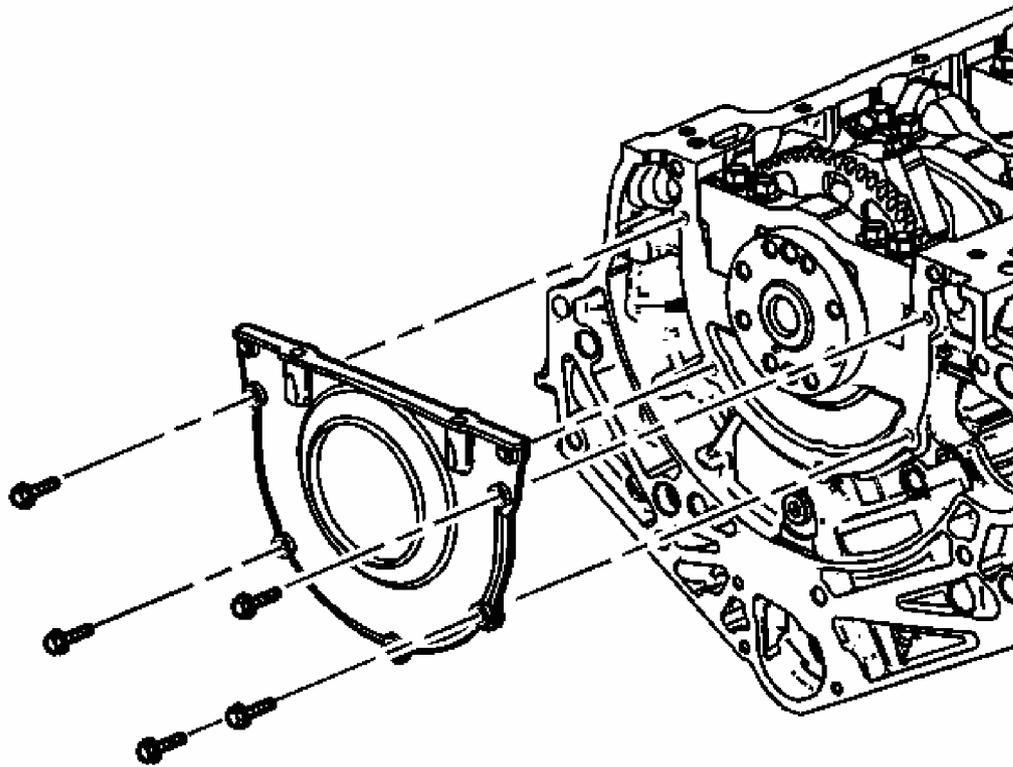
1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove the oil pan. Refer to **Oil Pan Replacement**.



**Fig. 13: 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**

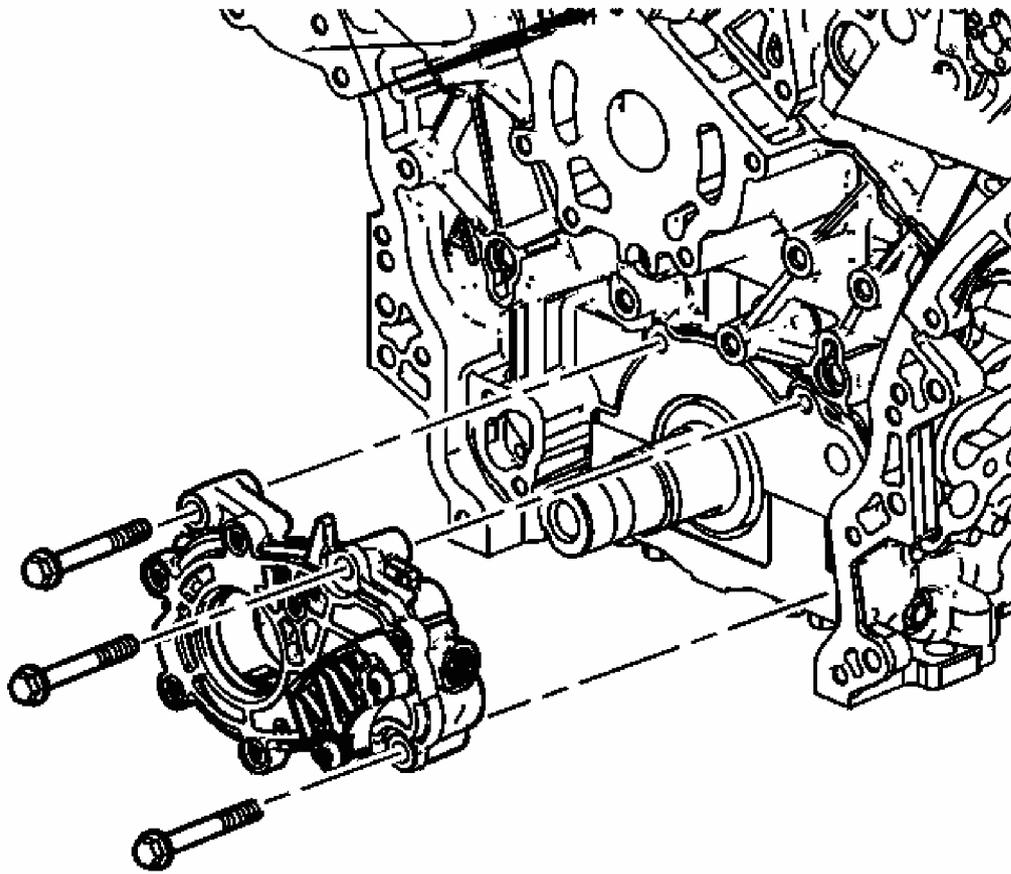


**Fig. 14: View Of Crankshaft Rear Oil Seal And Housing**  
**Courtesy of GENERAL MOTORS CORP.**

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**



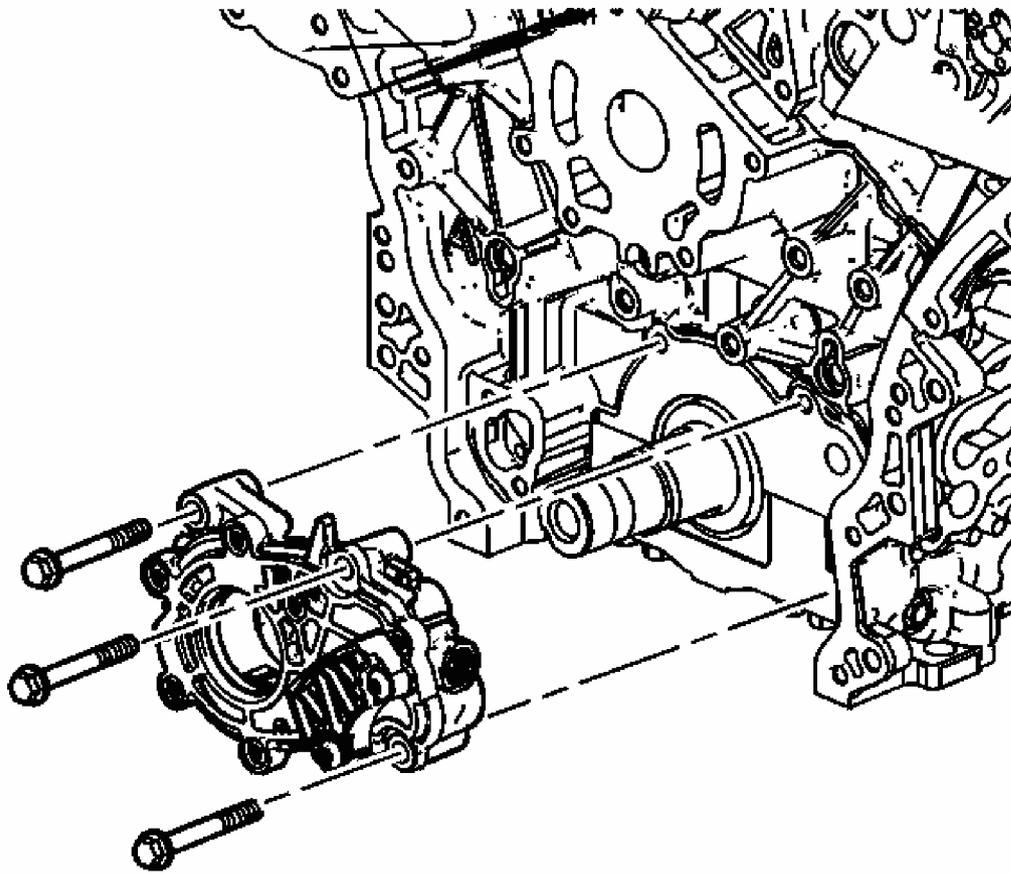
**Fig. 15: View Of Oil Pump & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

**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 .
3. Remove the oil pump bolts and the oil pump. Refer to Oil Pump Removal .
4. Perform the following steps as necessary:
  - Disassemble the oil pump. Refer to Oil Pump Disassemble .
  - Clean and inspect the oil pump. Refer to Oil Pump Cleaning and Inspection .

#### **Installation Procedure**

1. Assemble the oil pump as necessary. Refer to Oil Pump Assemble .



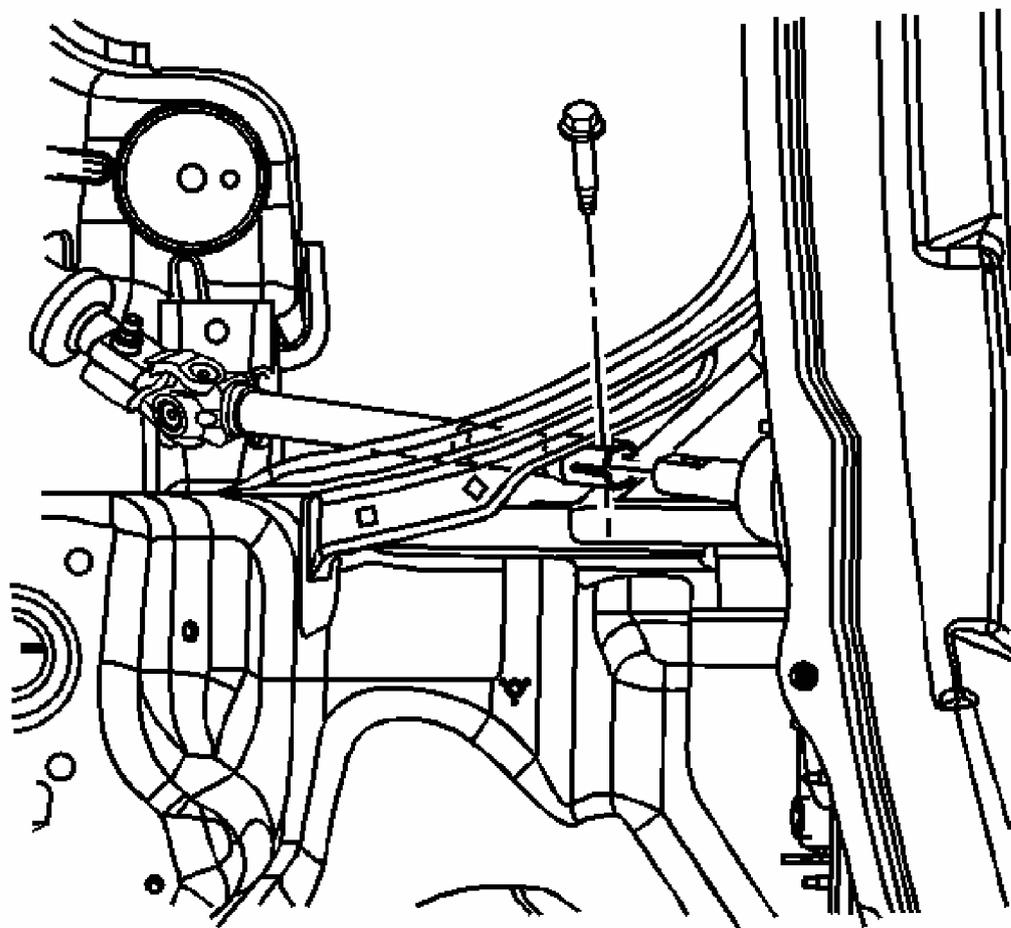
**Fig. 16: View Of Oil Pump & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

## **OIL PAN REPLACEMENT**

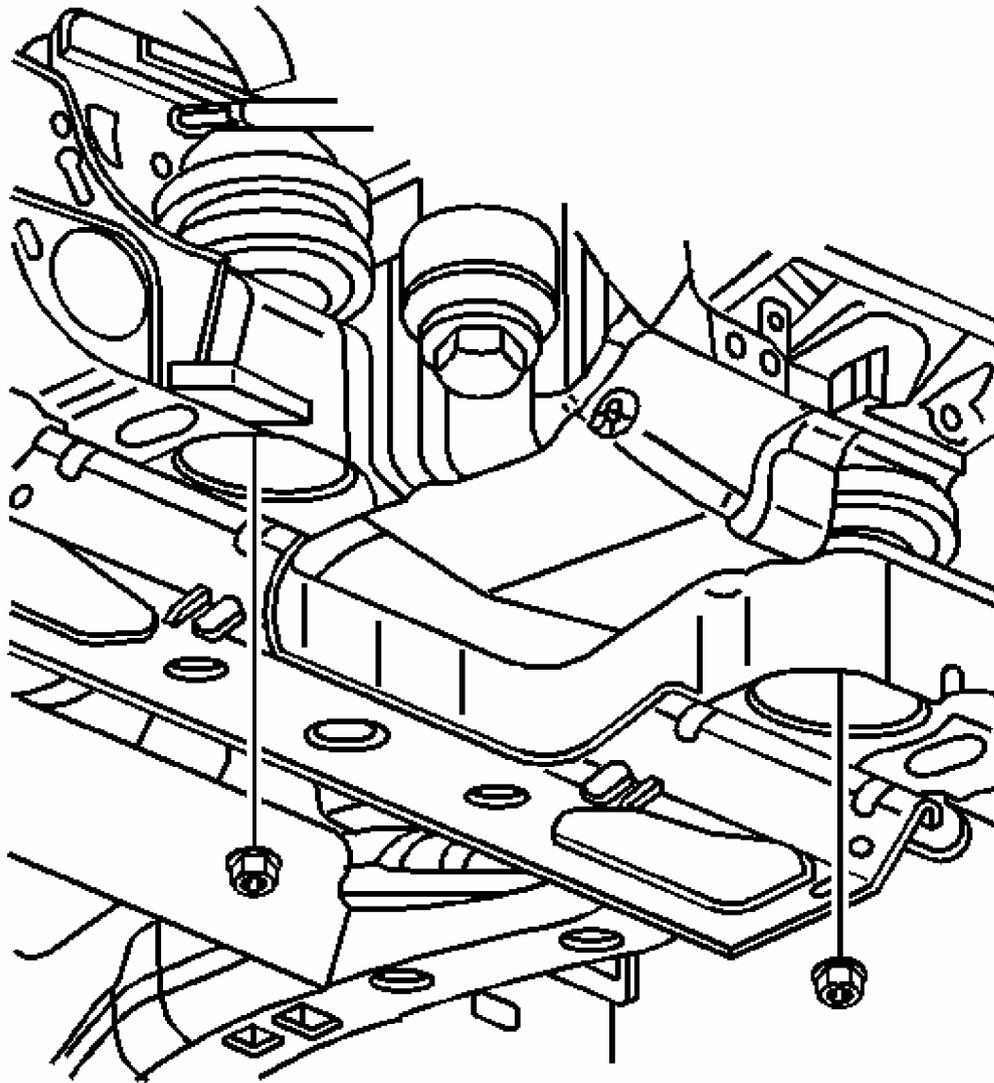
### **Removal Procedure**

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement** .
2. Remove the power steering hose retainer from the A/C compressor bracket.



**Fig. 17: View Of Intermediate Steering Shaft**  
**Courtesy of GENERAL MOTORS CORP.**

3. Disconnect the intermediate steering shaft.



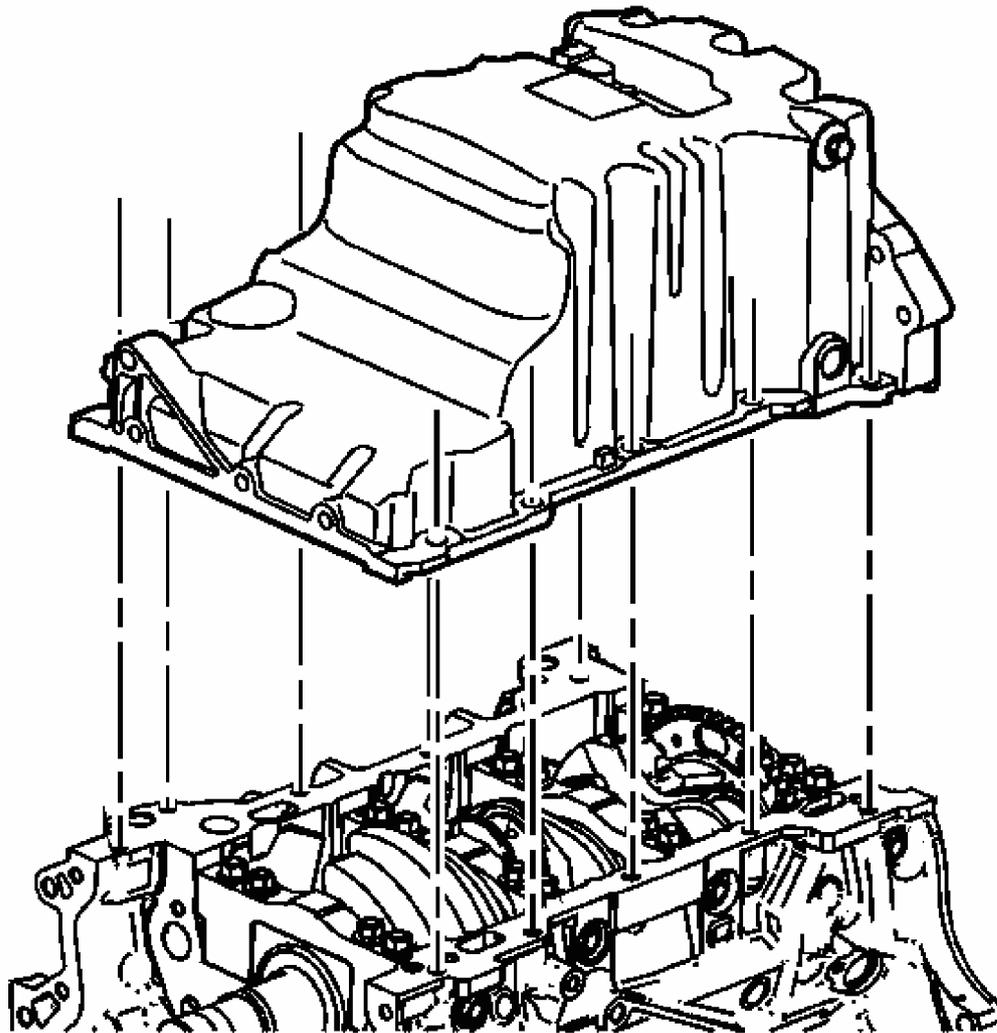
**Fig. 18: Identifying Frame Mounting Nuts**  
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine mount lower nuts.

**IMPORTANT: Do NOT disconnect the A/C pipes and/or hoses.**

5. Remove the A/C compressor bracket bolts and reposition aside. Refer to [Air Conditioning \(A/C\) Compressor Removal](#) .
6. Drain the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#).

7. Remove the transmission oil cooler pipe retainer from the engine right side.
8. Install the engine support fixture. Refer to **Engine Support Fixture** .
9. Tighten the support fixture wing nuts in order to provide clearance for the oil pan.

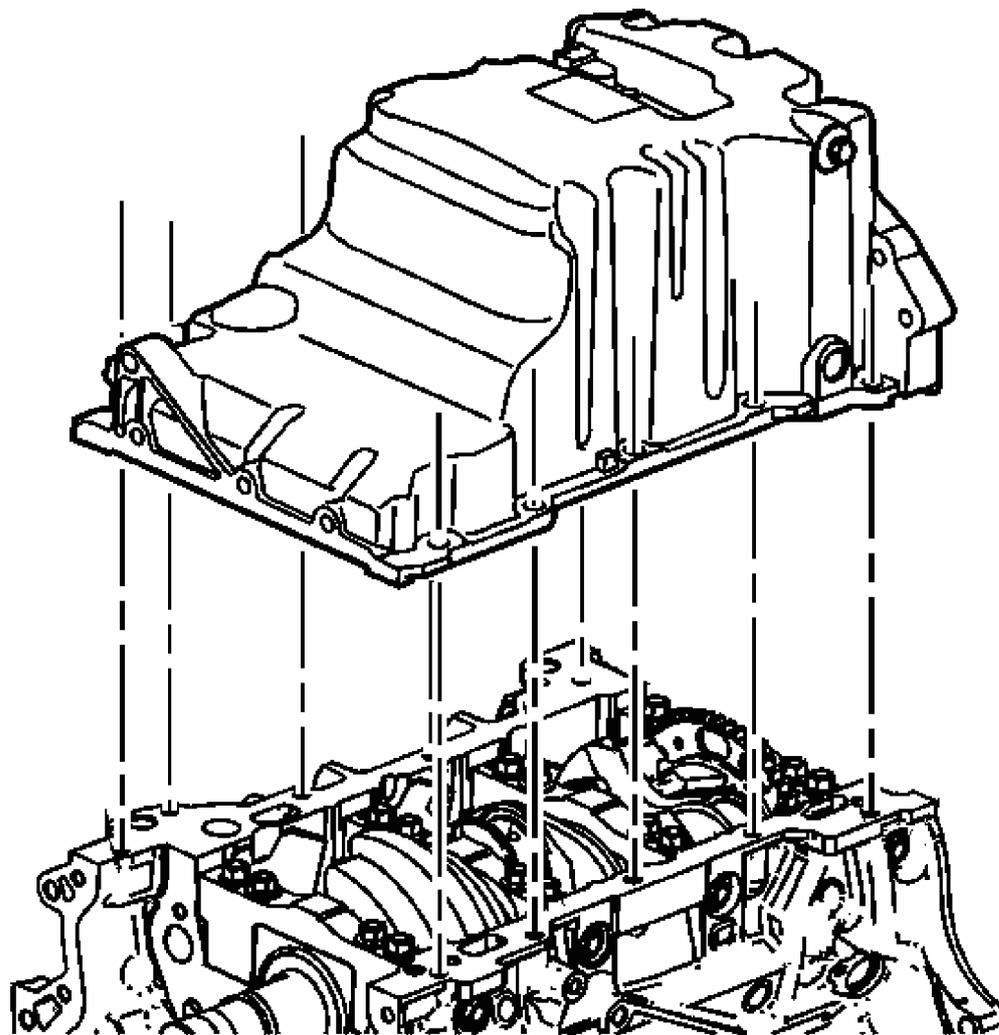


**Fig. 19: Removing & Installing Oil Pan**  
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil pan. Refer to **Oil Pan Removal** .
11. Perform the following steps as necessary.
  - Disassemble the oil pan. Refer to **Oil Pan Disassemble**
  - Clean and inspect the oil pan. Refer to **Oil Pan Cleaning and Inspection** .

## Installation Procedure

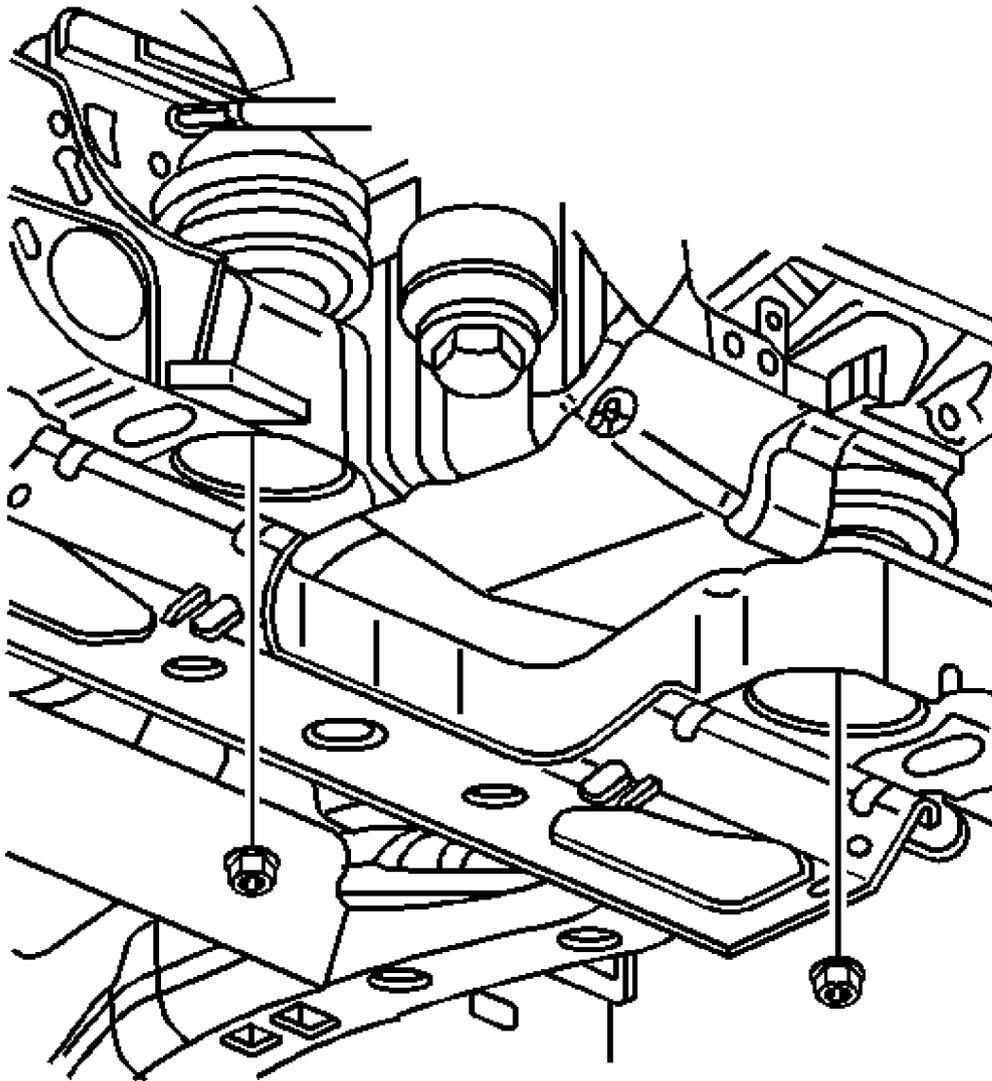
1. Assemble the oil pan as necessary. Refer to **Oil Pan Assemble** .



**Fig. 20: Removing & Installing Oil Pan**  
Courtesy of GENERAL MOTORS CORP.

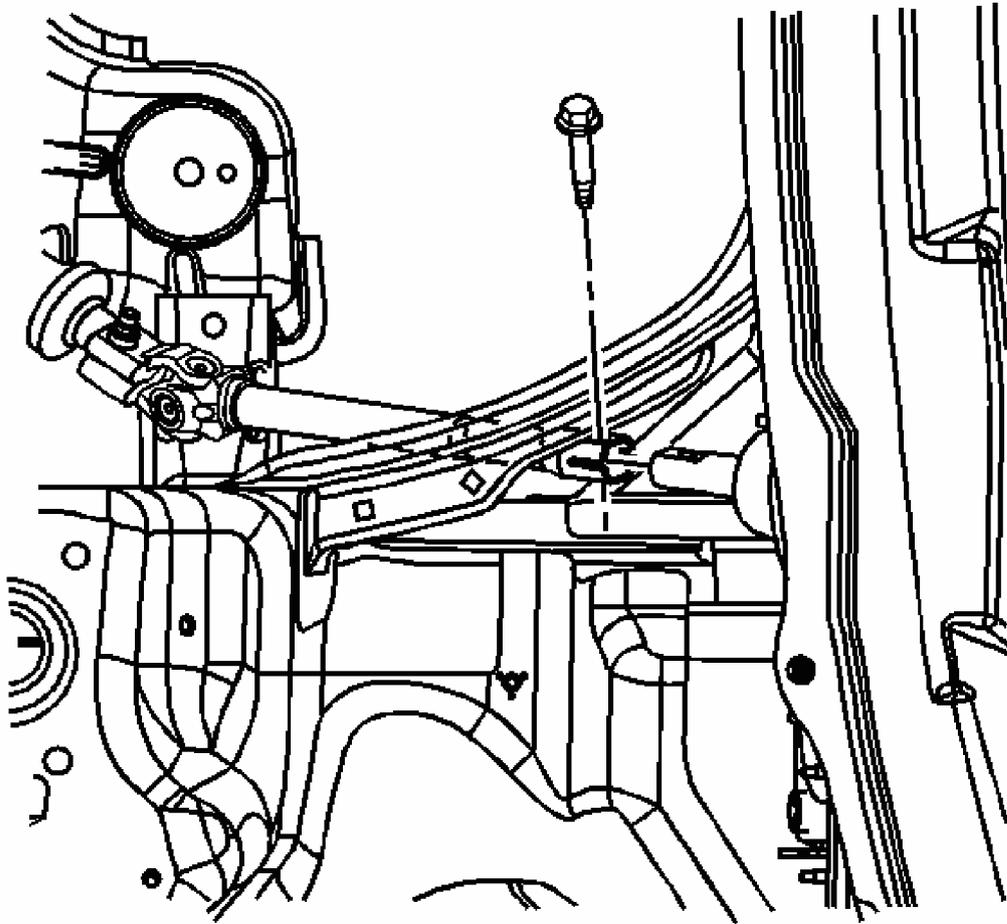
2. Install the oil pan. Refer to **Oil Pan Installation** .
3. Loosen the engine support fixture wing nuts in order to lower the engine and engage the engine mounts to the frame.
4. Remove the engine support fixture. Refer to **Engine Support Fixture** .
5. Remove the transmission oil cooler pipe retainer from the engine right side.

6. Fill the engine with new engine oil. Refer to **Engine Oil and Oil Filter Replacement.**
7. Install the A/C compressor bracket with the A/C compressor. Refer to **Air Conditioning (A/C) Compressor Installation .**



**Fig. 21: Identifying Frame Mounting Nuts**  
Courtesy of GENERAL MOTORS CORP.

8. Install the engine mount lower nuts. Refer to **Engine Mount Replacement - Left** and **Engine Mount Replacement - Right .**



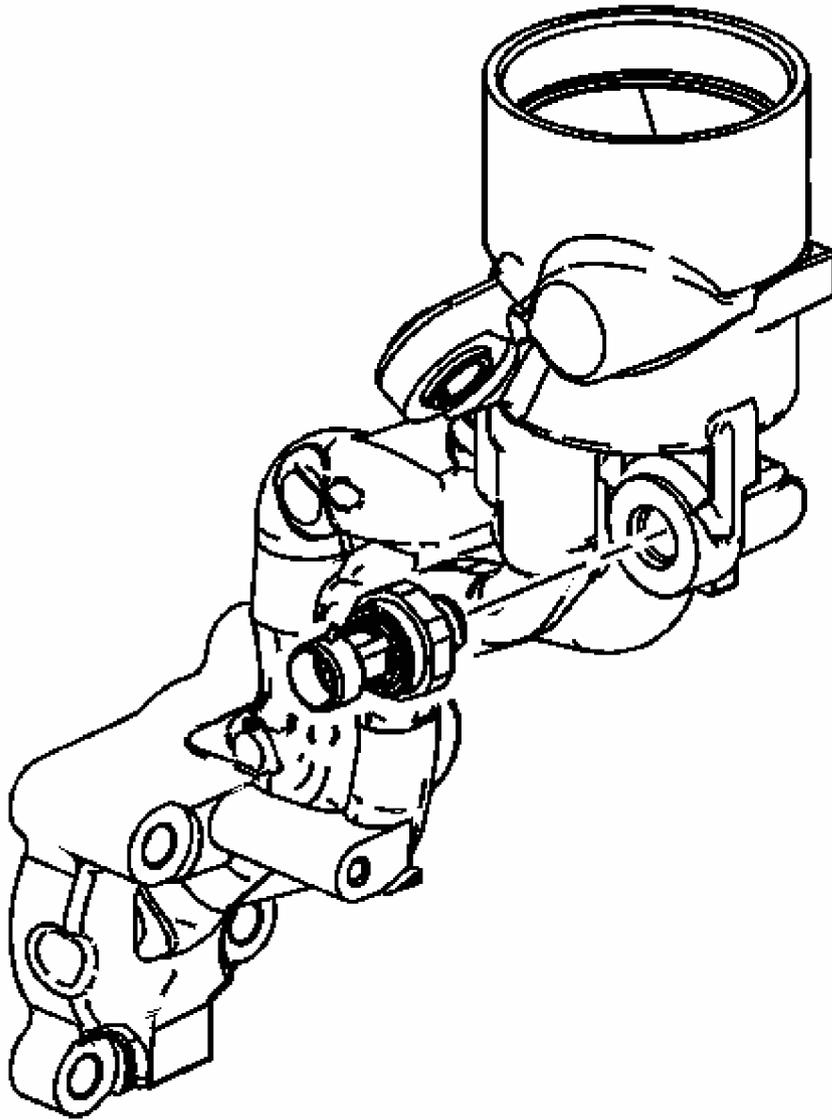
**Fig. 22: View Of Intermediate Steering Shaft**  
Courtesy of GENERAL MOTORS CORP.

9. Connect the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement - Upper** in Steering Wheel and Column.
10. Install the power steering hose retainer to the A/C compressor bracket.
11. Install the engine front cover. Refer to **Engine Front Cover Replacement** .

#### **ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT**

##### **Removal Procedure**

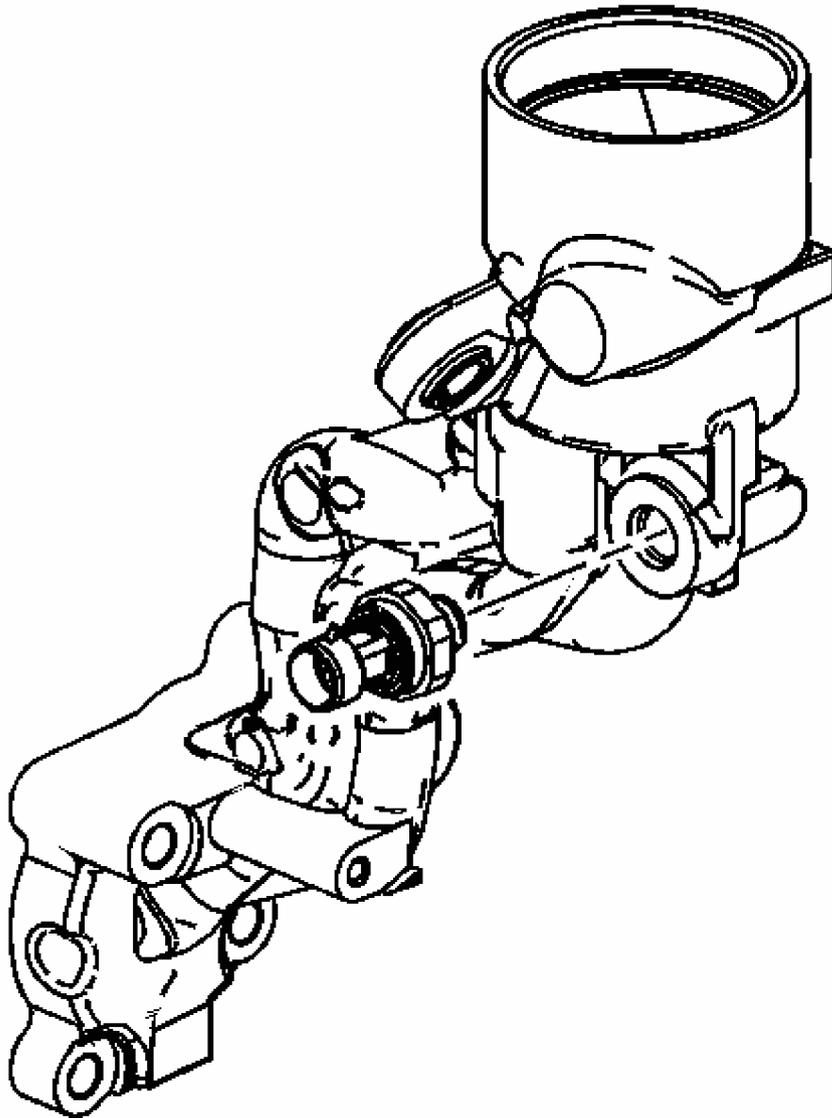
1. Turn the ignition OFF.
2. Disconnect the oil pressure sensor electrical connector.



**Fig. 23: View Of Oil Pressure Sender**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the oil pressure sensor.

**Installation Procedure**



**Fig. 24: View Of Oil Pressure Sender**  
Courtesy of GENERAL MOTORS CORP.

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

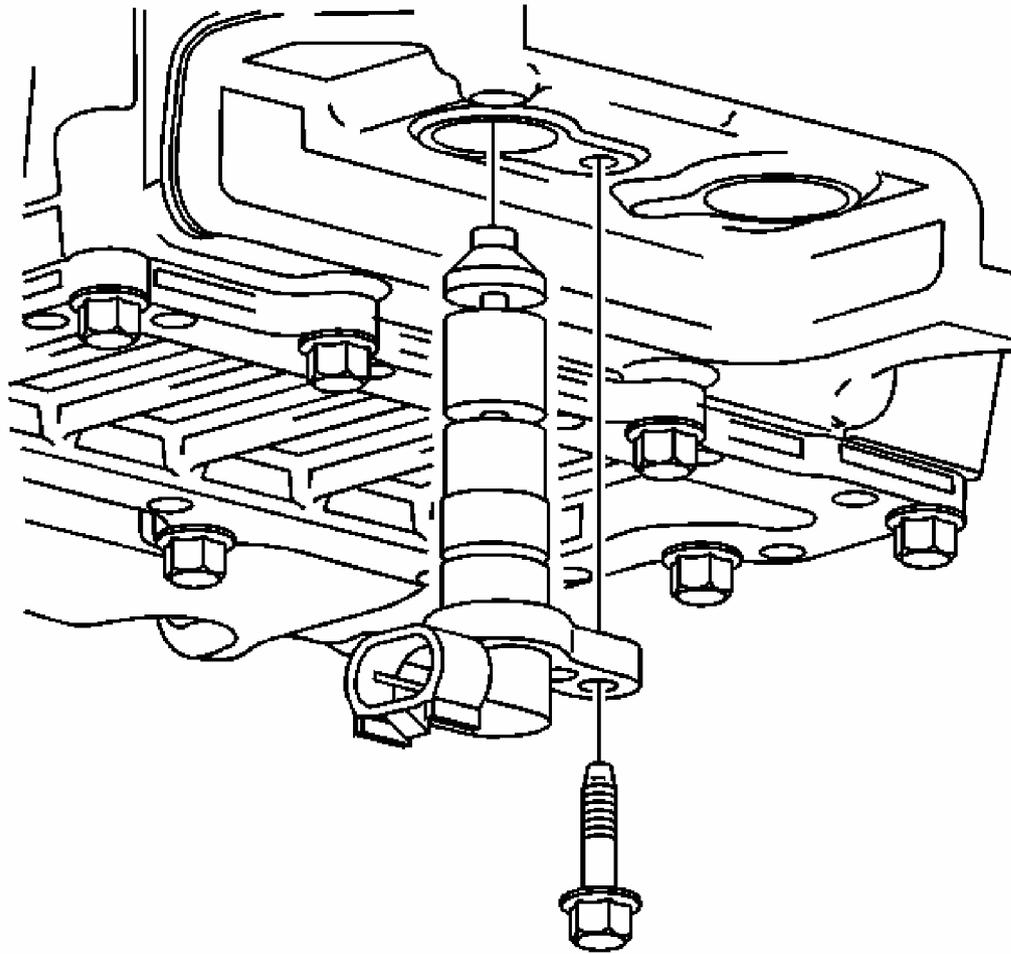
1. Install the oil pressure sensor.

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

2. Connect the oil pressure sensor electrical connector.

## ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

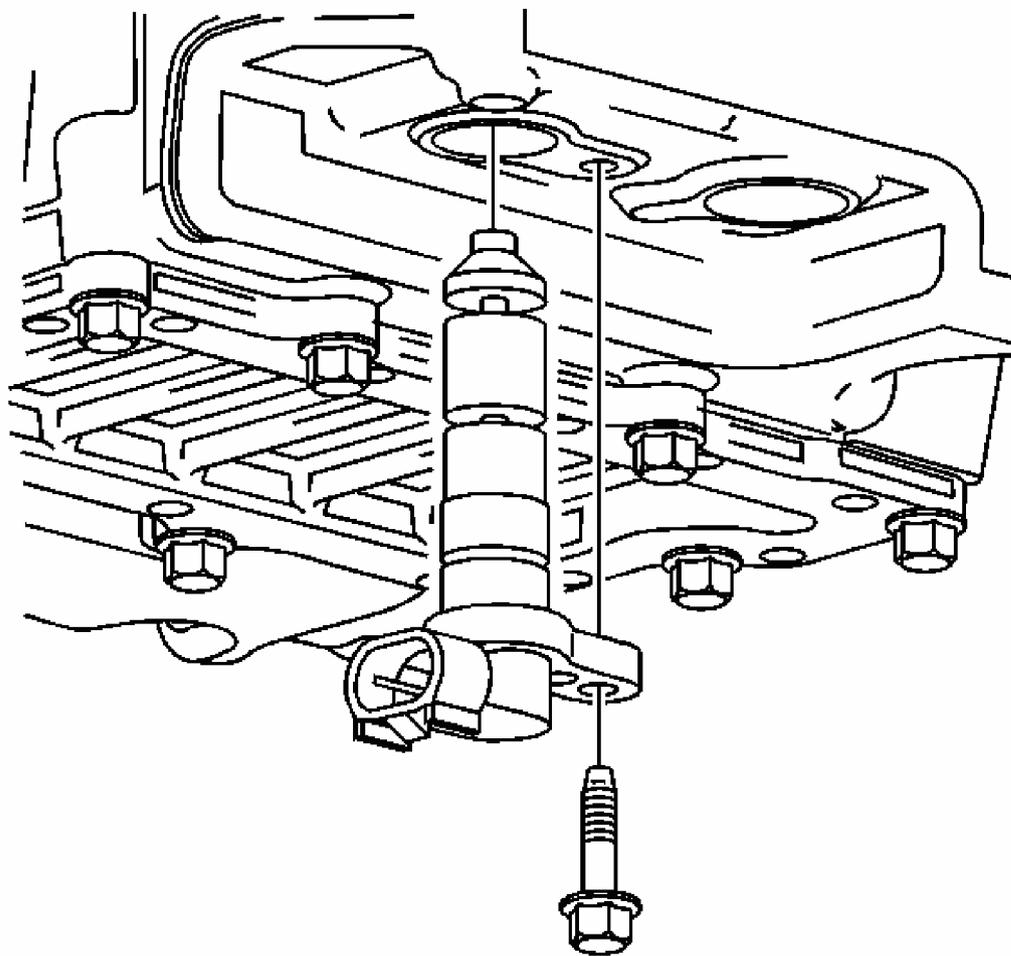
### Removal Procedure



**Fig. 25: Removing & Installing 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.

### Installation Procedure



**Fig. 26: Removing & Installing Oil Level Switch**  
Courtesy of GENERAL MOTORS CORP.

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

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

2. Install the engine oil level switch bolt.

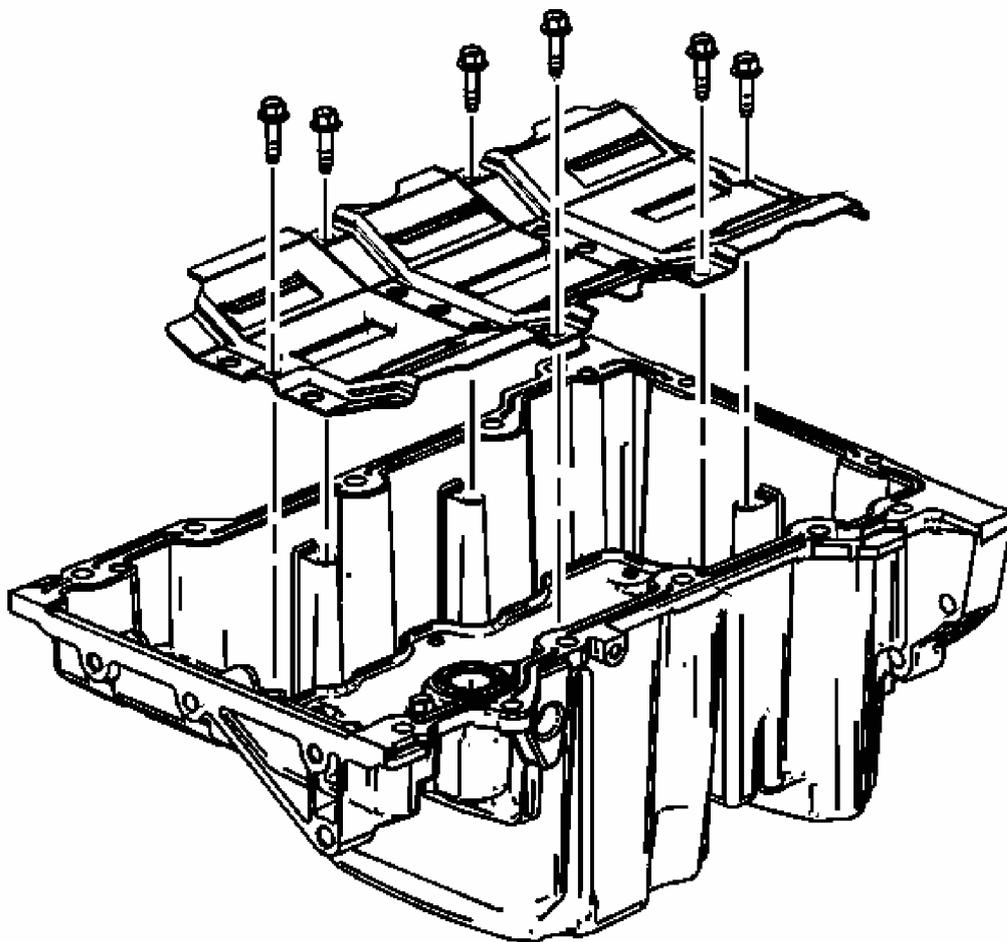
**Tighten:** Tighten the engine oil level switch bolt to 10 N.m (89 lb in).

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 PIPE AND SCREEN ASSEMBLY REPLACEMENT

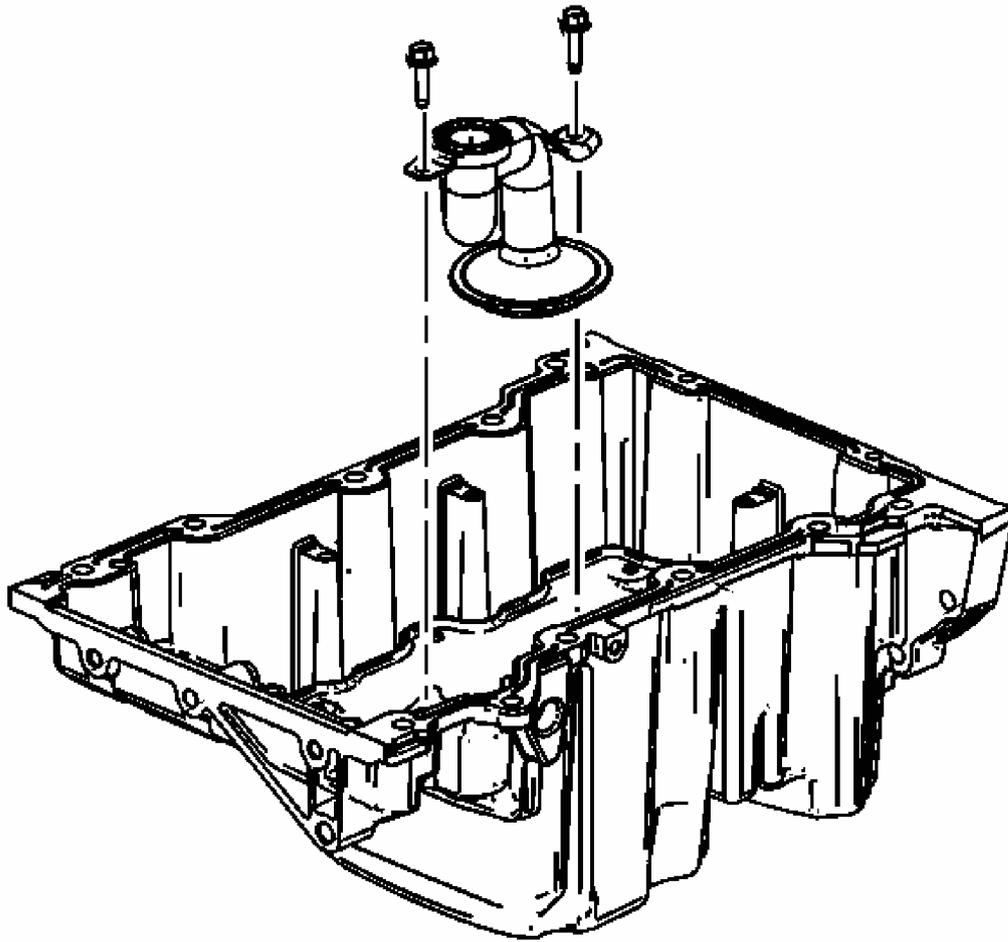
### Removal Procedure

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



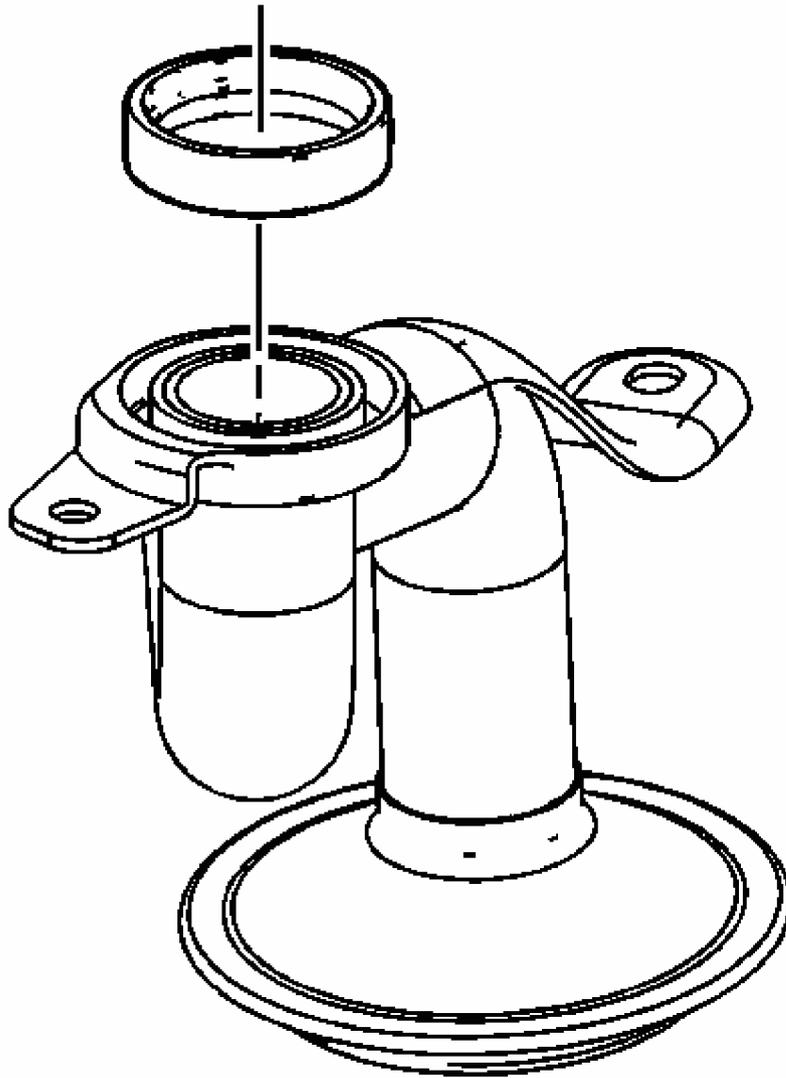
**Fig. 27: View Of Oil Pan Scraper And Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 28: View Of Oil Suction Pipe**  
**Courtesy of GENERAL MOTORS CORP.**

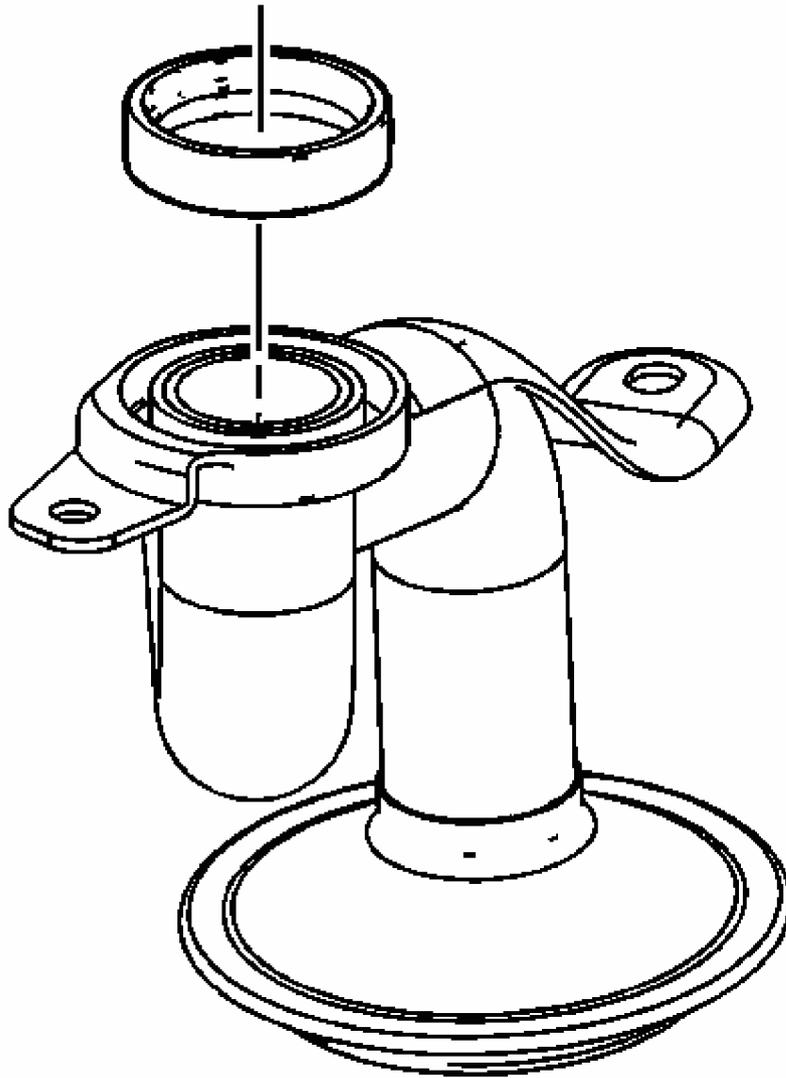
4. Remove the oil suction pipe bolts.
5. Remove the oil suction pipe.



**Fig. 29: View Of Oil Suction Tube Seal & Oil Suction Tube**  
Courtesy of GENERAL MOTORS CORP.

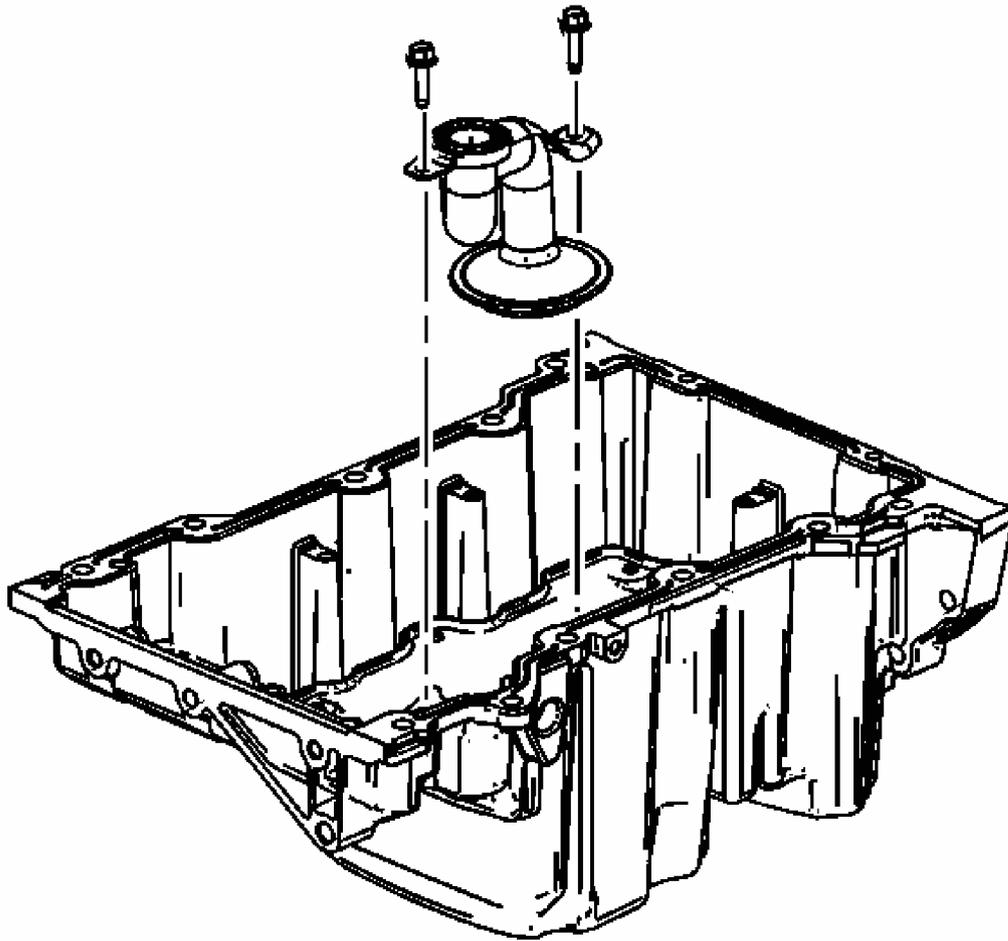
6. Remove the oil suction tube seal from the oil suction tube. Discard the oil suction tube seal.

**Installation Procedure**



**Fig. 30: 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.



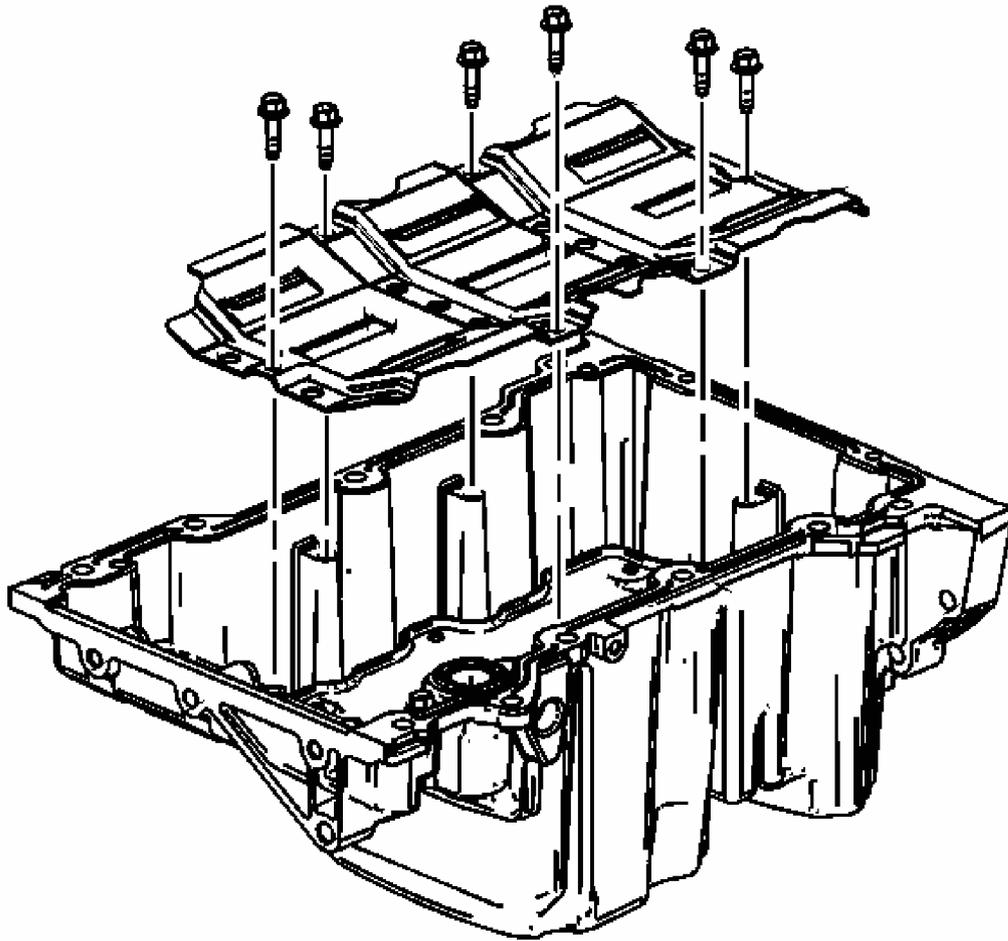
**Fig. 31: View Of Oil Suction Pipe**  
Courtesy of GENERAL MOTORS CORP.

2. Install the oil suction pipe.

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

3. Install the oil suction pipe bolts.

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



**Fig. 32: 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**.

## ENGINE REPLACEMENT

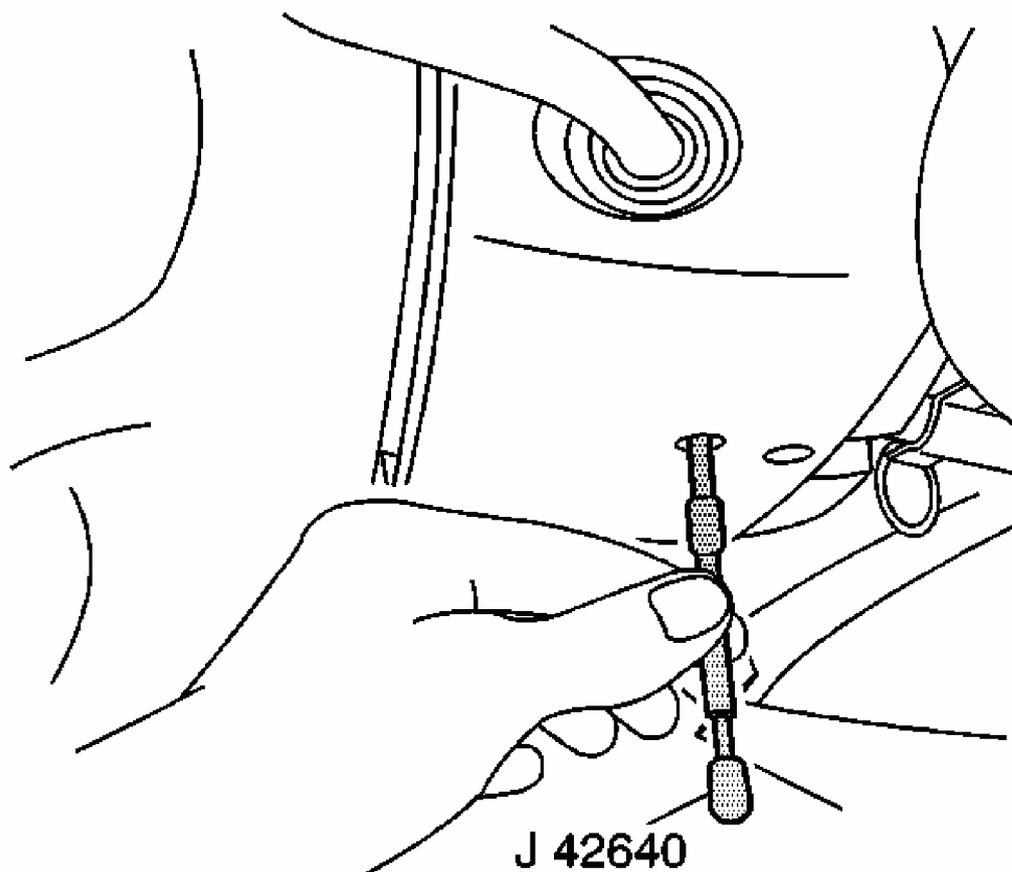
### Tools Required

- J 42640 Steering Column Anti-Rotation Pin

- EN 46114 Engine Lift Brackets

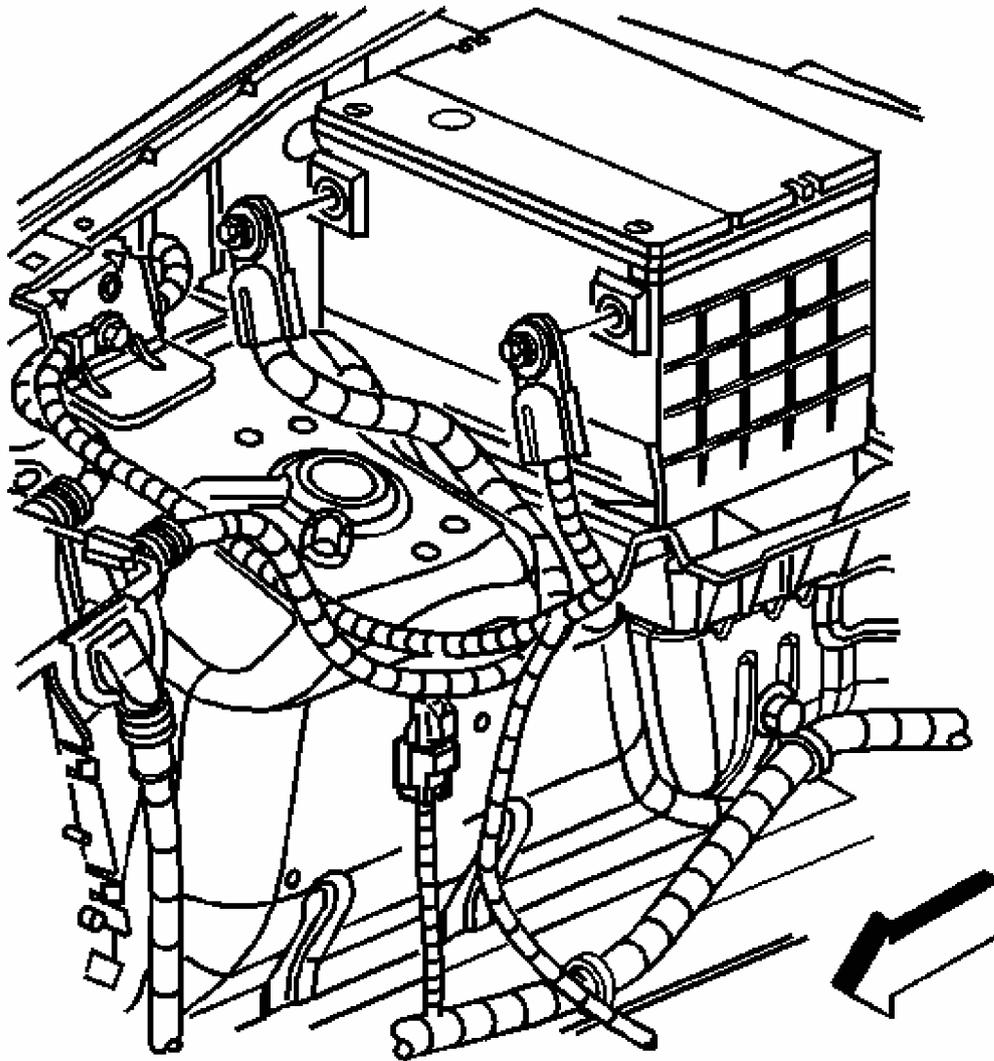
### Removal Procedure

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



**Fig. 33: Identifying J 42640**  
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 42640** to the steering column. Refer to **Intermediate Steering Shaft Replacement - Lower** in Steering Wheel and Column for more information.



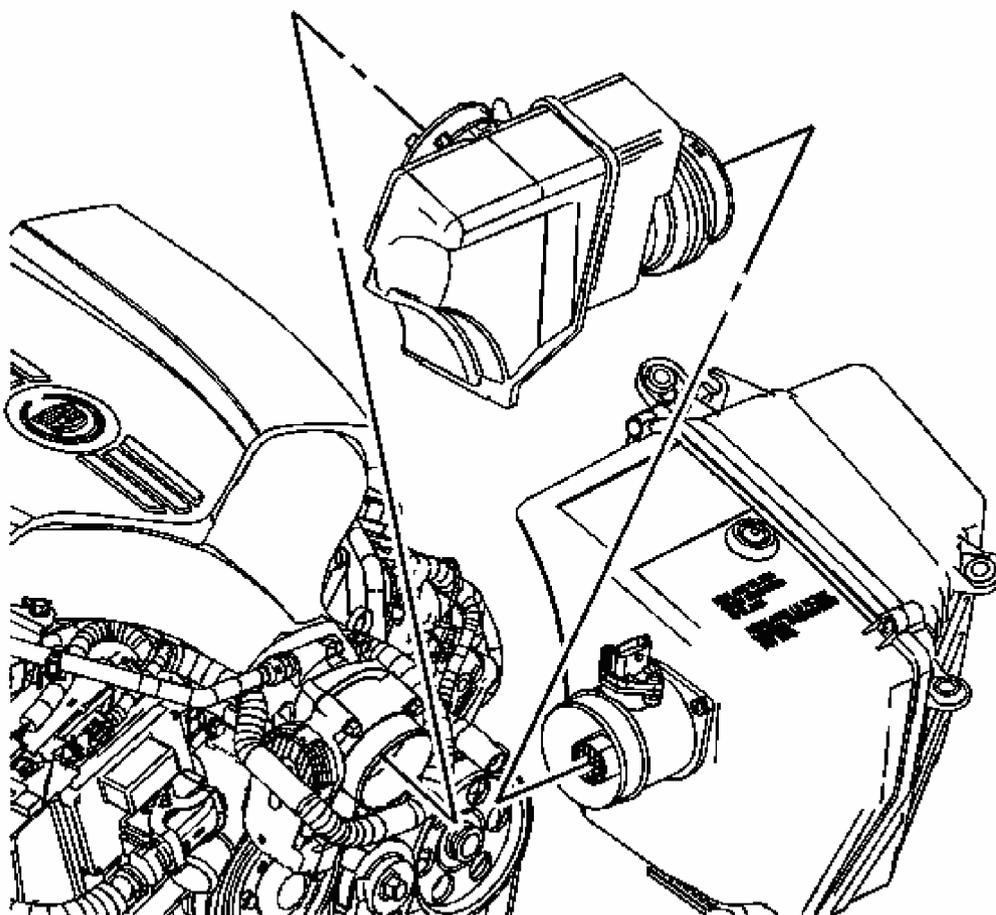
**Fig. 34: View Of Battery Positive & Negative Cables**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Do NOT disconnect the battery cable from the engine.**

4. Disconnect the battery negative cable from the battery and the body. Refer to **Battery Negative Cable Replacement (LP1, LY7)** or **Battery Negative Cable Replacement (LS6)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.

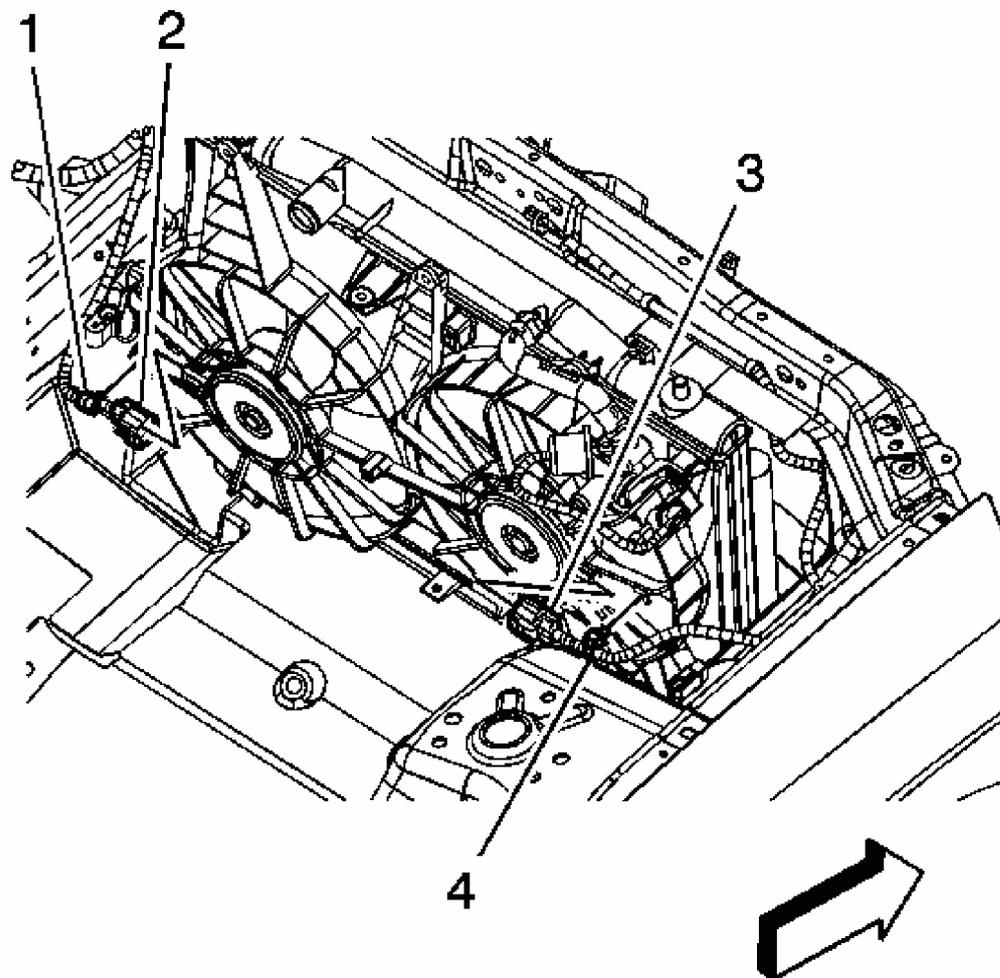
**IMPORTANT: Do NOT disconnect the battery cable from the engine.**

5. Disconnect the battery positive cable from the battery and the underhood electrical center. Refer to **Battery Positive Cable Replacement (LP1, LY7)** or **Battery Positive Cable Replacement (LS6)** or **Battery Positive Cable Replacement (RHD)** in Engine Electrical.
6. Position and secure the battery cables to the engine.
7. Remove the battery. Refer to **Battery Replacement (LHD)** or **Battery Replacement (RHD)** in Engine Electrical.
8. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .



**Fig. 35: View Of Air Inlet Duct**  
Courtesy of GENERAL MOTORS CORP.

9. Remove the air cleaner duct. Refer to **Air Cleaner Intake Duct Replacement** in

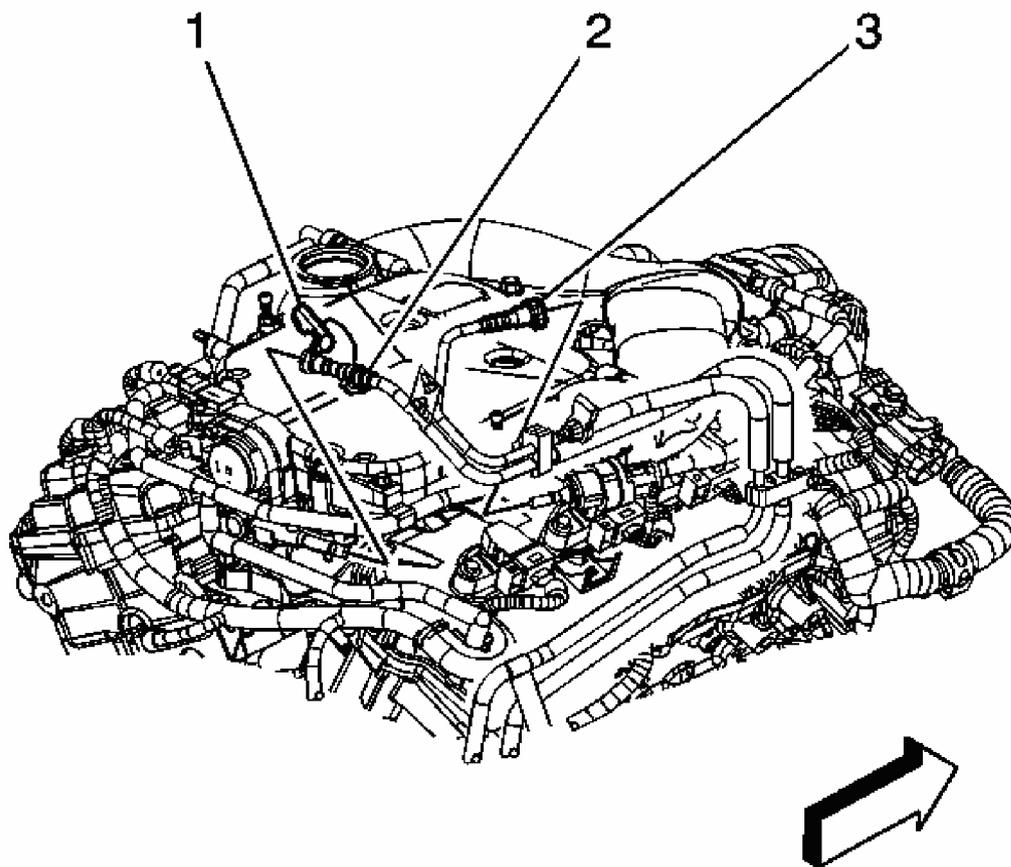


**Fig. 36: View Of Cooling Fan Wiring Harness & Electrical Connectors**  
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the cooling fan electrical connectors (2 and 3).
11. Remove the cooling fan wiring harnesses (1 and 4) from the fan shroud.
12. Secure the wiring harnesses to the vehicle.
13. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7)** or **Draining and Filling Cooling System (LS6)** in Engine Cooling.

**IMPORTANT: Do NOT disconnect the surge hoses from the engine or the radiator.**

14. Disconnect the surge tank outlet hose from the surge tank. Refer to **Surge Tank Hose/Pipe Replacement - Inlet (LP1, LY7)** or **Surge Tank Hose/Pipe Replacement - Inlet (LS6)** in Engine Cooling.
15. Position and secure the surge hose to the engine.
16. Disconnect the surge tank inlet (vent) hose from the water outlet housing and the radiator. Refer to **Surge Tank Hose/Pipe Replacement - Outlet (LP1, LY7)** or **Surge Tank Hose/Pipe Replacement - Outlet (LS6)** in Engine Cooling.
17. Position and secure the surge tank inlet (vent) hose to the vehicle.
18. Disconnect the heater hoses from the heater core. Refer to **Heater Hose Replacement - Inlet (LY7)** and **Heater Hose Replacement - Outlet (LY7)** in Heating, Ventilation and Air Conditioning.



**Fig. 37: Top Of Engine View**  
Courtesy of GENERAL MOTORS CORP.

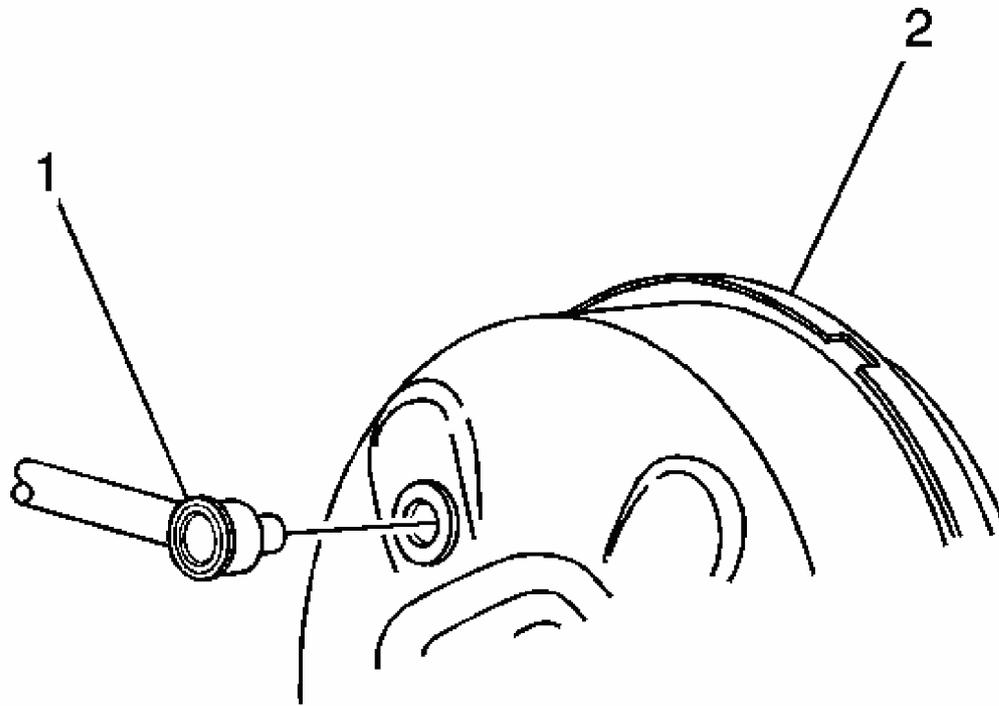
19. Disconnect the purge line (3) from the purge solenoid.
20. Disconnect the fuel pipe (2) from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** in Engine Controls - 3.6L (LY7).
21. Plug the fuel pipe and cap the fuel rail to prevent fuel loss and/or contamination.
22. Evacuate the air conditioning system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
23. Remove the wiper module. Refer to **Wiper Motor Module Replacement (LHD)** or **Wiper Motor Module Replacement (RHD)** .

**IMPORTANT: Do NOT disconnect the suction hose from the A/C compressor.**

24. Disconnect the air conditioning suction hose from the evaporator and remove the suction hose bracket from the shock tower. Refer to in **Suction Hose Replacement (2.8L (LP1))** or **Suction Hose Replacement (3.6L (LY7))** or **Suction Hose Replacement (5.7L (LS6))** Heating, Ventilation and Air Conditioning.
25. Position and secure suction hose to the engine.

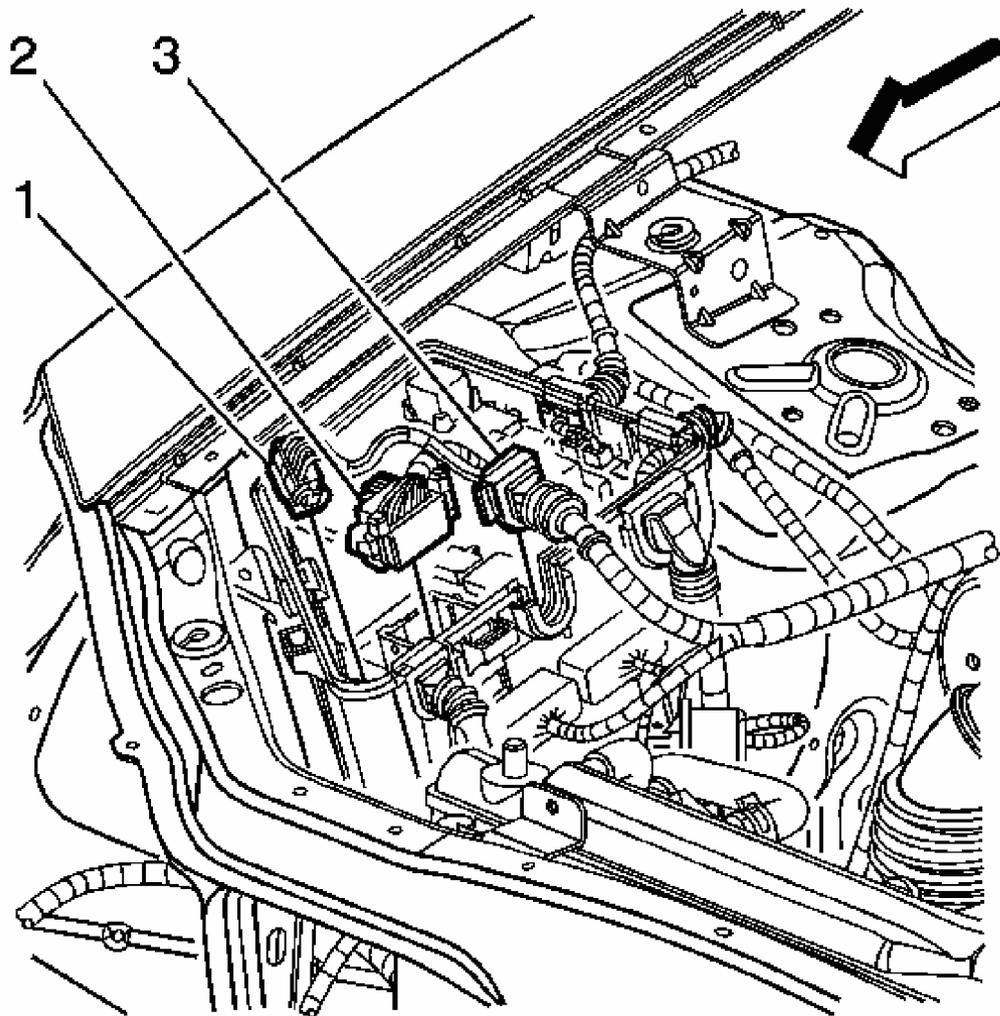
**IMPORTANT: Do NOT disconnect the liquid line from the condenser.**

26. Disconnect the air conditioning pressure switch electrical connector and remove the liquid line. Refer to **Liquid Line Replacement (2.8L (LP1))** or **Liquid Line Replacement (3.6L (LY7))** or **Liquid Line Replacement (5.7L (LS6))** in Heating, Ventilation and Air Conditioning.
27. Remove the radiator support brackets. Refer to **Radiator Support Bracket Replacement (LP1, LY7)** or **Radiator Support Bracket Replacement (LS6)** in Engine Cooling.



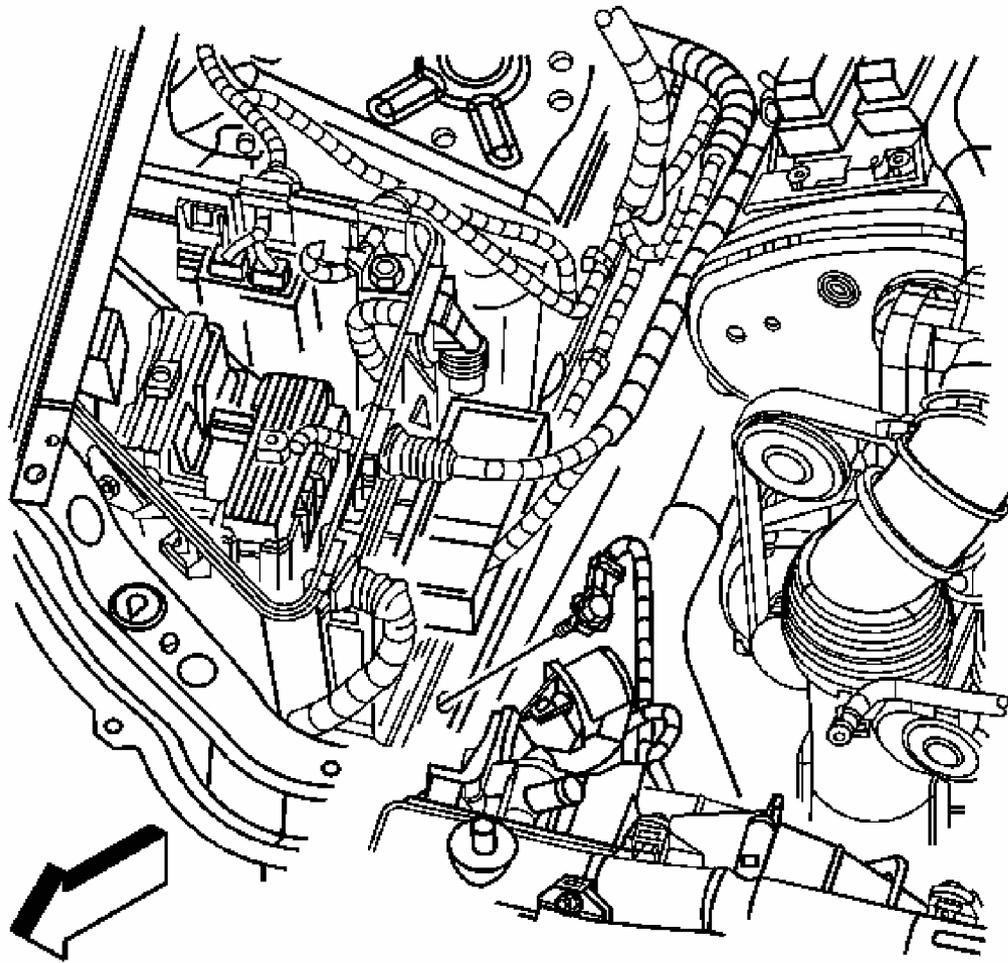
**Fig. 38: View Of Vacuum Check Valve & Brake Booster**  
**Courtesy of GENERAL MOTORS CORP.**

28. Disconnect the brake booster check valve and vacuum hose (1) from the brake booster (2).
29. Position and secure the brake booster hose to the engine.
30. Disconnect the brake fluid level switch electrical connector from the master cylinder.
31. Disconnect the mass air flow sensor electrical connector.
32. Unlock and disconnect the instrument panel (I/P) electrical connector from the engine located at the rear of the left (Bank 2) cylinder head.
33. Position and secure the I/P harness to the vehicle.



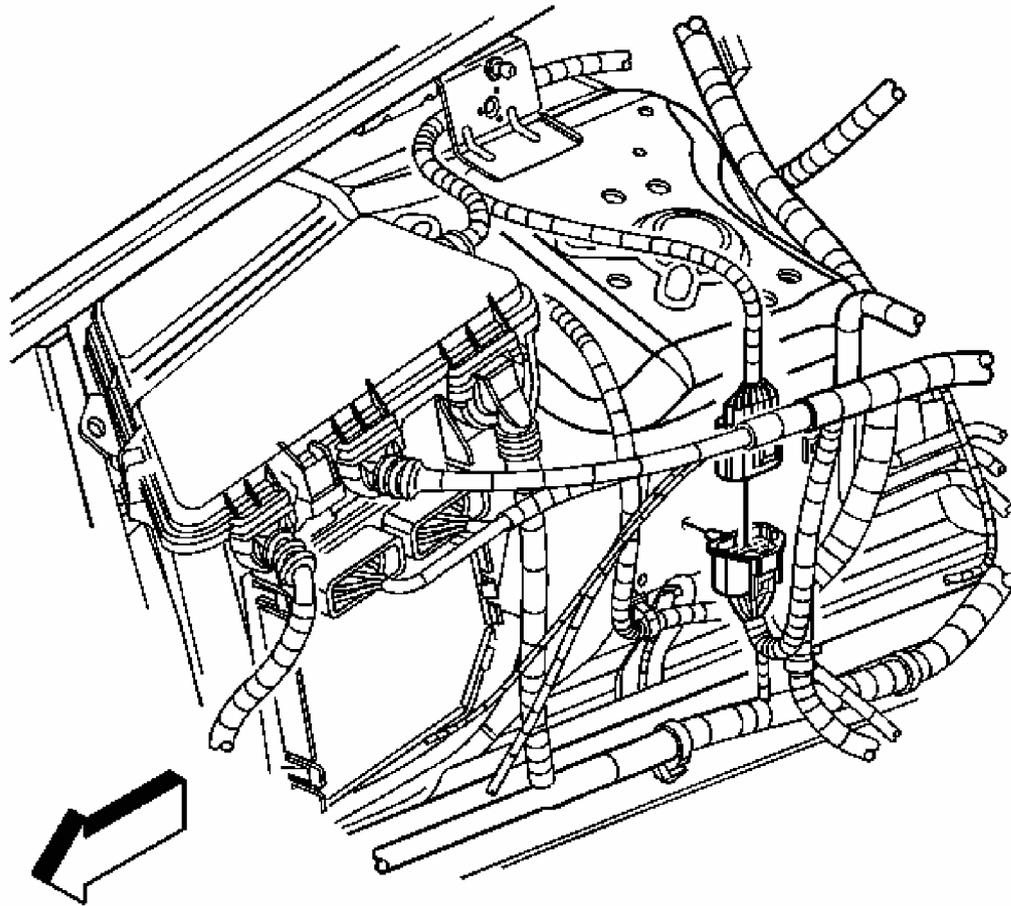
**Fig. 39: View Of Engine Module Wiring Harness Connectors**  
Courtesy of GENERAL MOTORS CORP.

34. Disconnect the engine module wiring harness connectors (1-3) from the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
35. Disconnect the wiring harness from the transmission control module (TCM). Refer to **Torque Converter Replacement** in Automatic Transmission - 5L40-E/5L50-E.



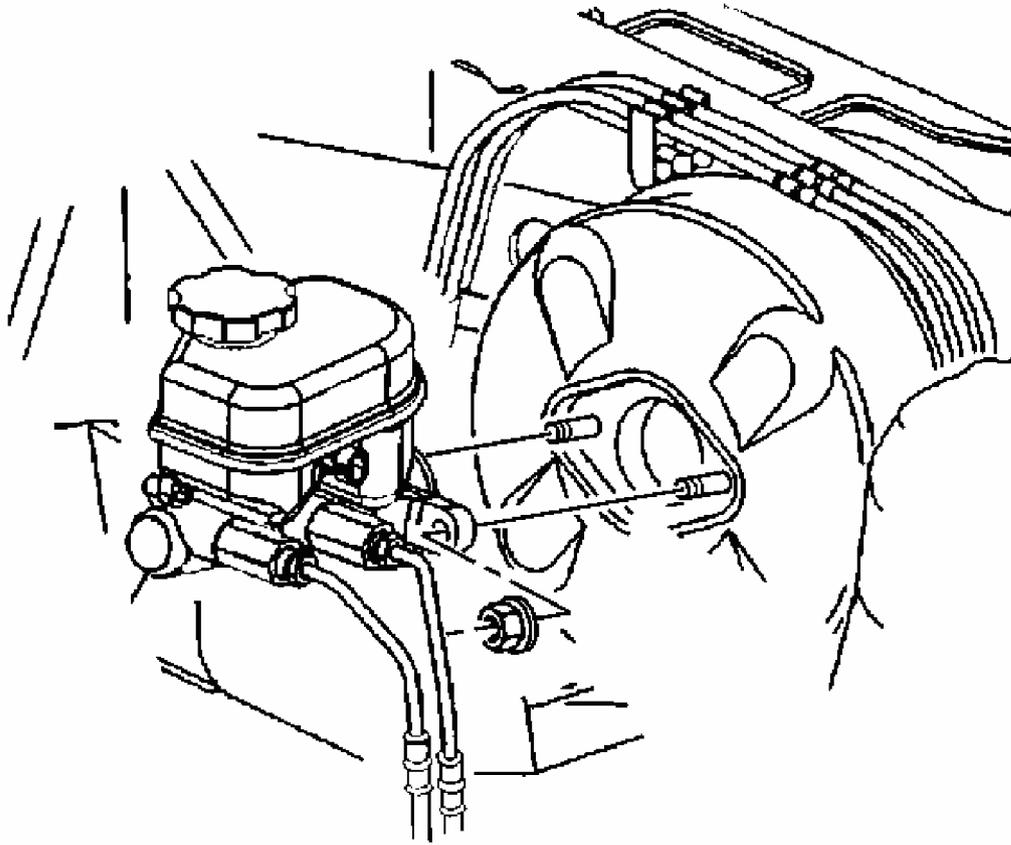
**Fig. 40: View Of Ground Bolt & Wire At Longitudinal Rail**  
**Courtesy of GENERAL MOTORS CORP.**

36. Remove the ground bolt and wire from the longitudinal rail.



**Fig. 41: View Of Longitudinal Rail Engine Harness Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

37. Disconnect the engine harness electrical connector at the longitudinal rail.
38. Position and secure the ground wire, engine harness and TCM harness to the engine.



**Fig. 42: Removing & Installing Master Cylinder**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Do NOT disconnect the brake pipes from the master cylinder.**

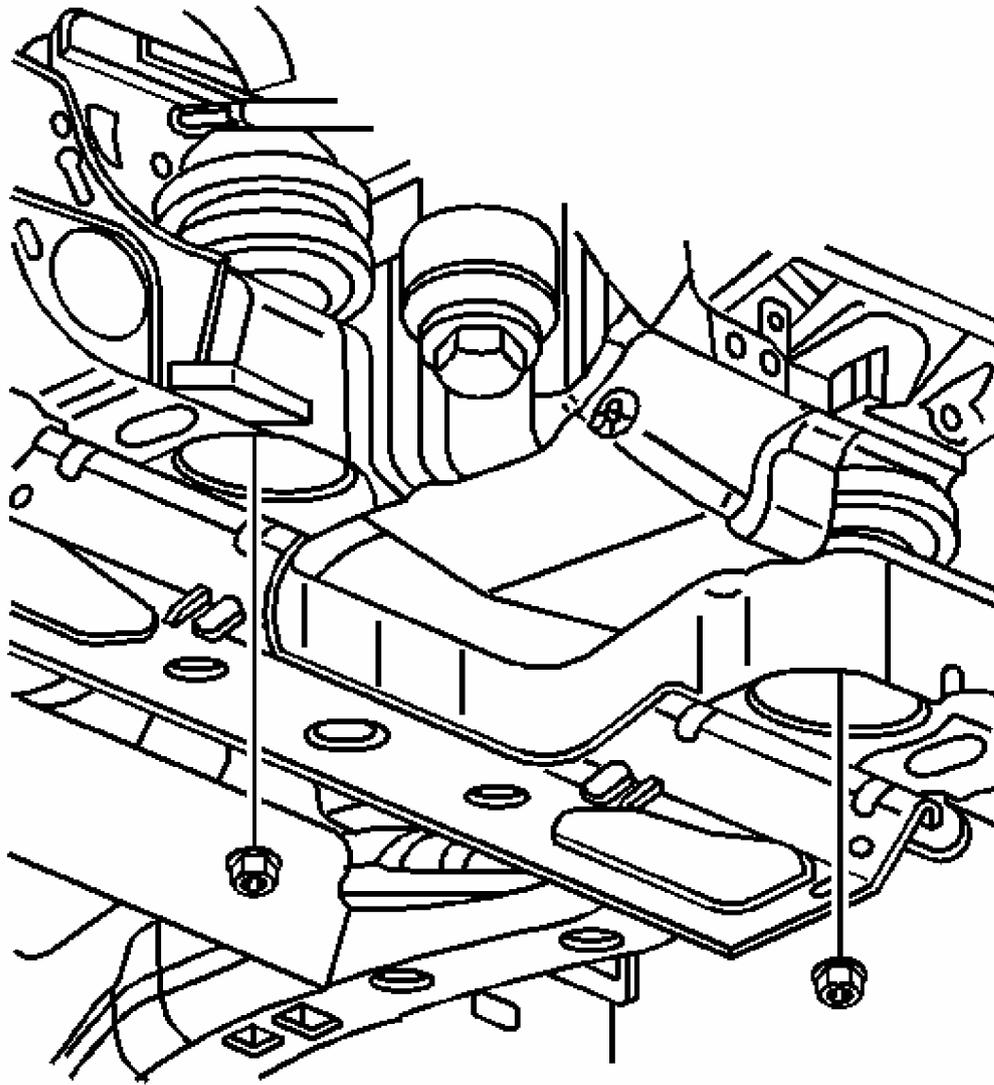
39. Remove the master cylinder nuts.
40. Reposition and secure the master cylinder to the engine.
41. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** in Engine Controls - 3.6L (LY7).
42. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
43. Remove the muffler assembly. Refer to **Exhaust System Replacement (LP1)** or **Exhaust System Replacement (LY7)** or **Exhaust System Replacement (LS6)** in Engine Exhaust.
44. Remove the propeller shaft. Refer to **Propeller Shaft Replacement (Automatic**

**Transmission**) or **Propeller Shaft Replacement (Manual Transmission)** or **Propeller Shaft Replacement (CTS-V)** in Propeller Shaft.

45. Remove the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.

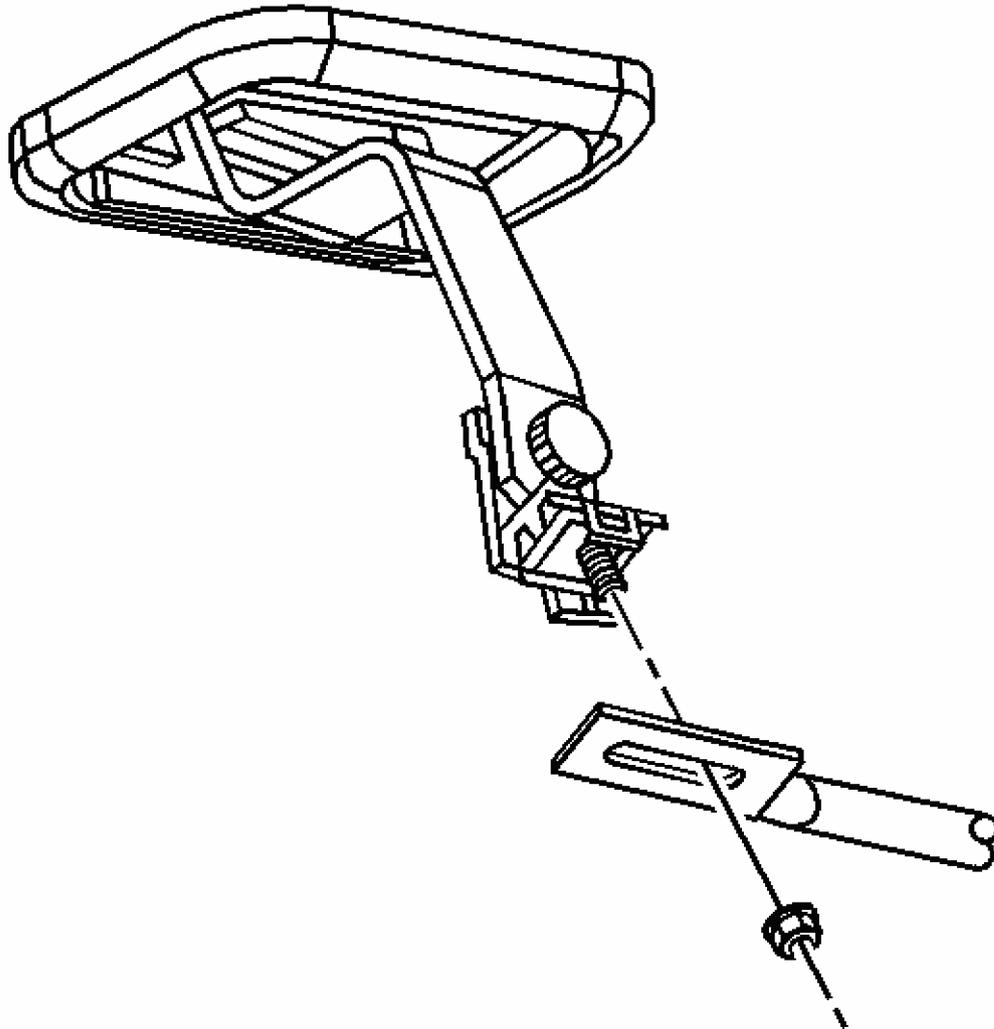
**IMPORTANT: DO NOT remove the water bottle.**

46. Remove the washer bottle bracket. Refer to **Washer Solvent Container Replacement (w/o CE4)** in Wipers/Washer Systems.
47. Disconnect the radiator side air baffles from the radiator.
48. Disconnect the left front brake pipe retainer with the brake pipe from the longitudinal rail.
49. Remove the right front brake pipe from the brake pipe bundle retainer.
50. Disconnect the rear brake pipes (two center pipes) from the brake pressure modulator valve (BPVM). Refer to **Brake Pressure Modulator Valve (BPMV) Replacement (CTS)** or **Brake Pressure Modulator Valve (BPMV) Replacement (CTS-V)** in Antilock Brake System.
51. Cap and/or plug the brake pipes and the BPMV in order to minimize brake fluid loss.
52. Remove the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
53. Remove the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement - Center** in Steering Wheel and Column.



**Fig. 43: Identifying Frame Mounting Nuts**  
Courtesy of GENERAL MOTORS CORP.

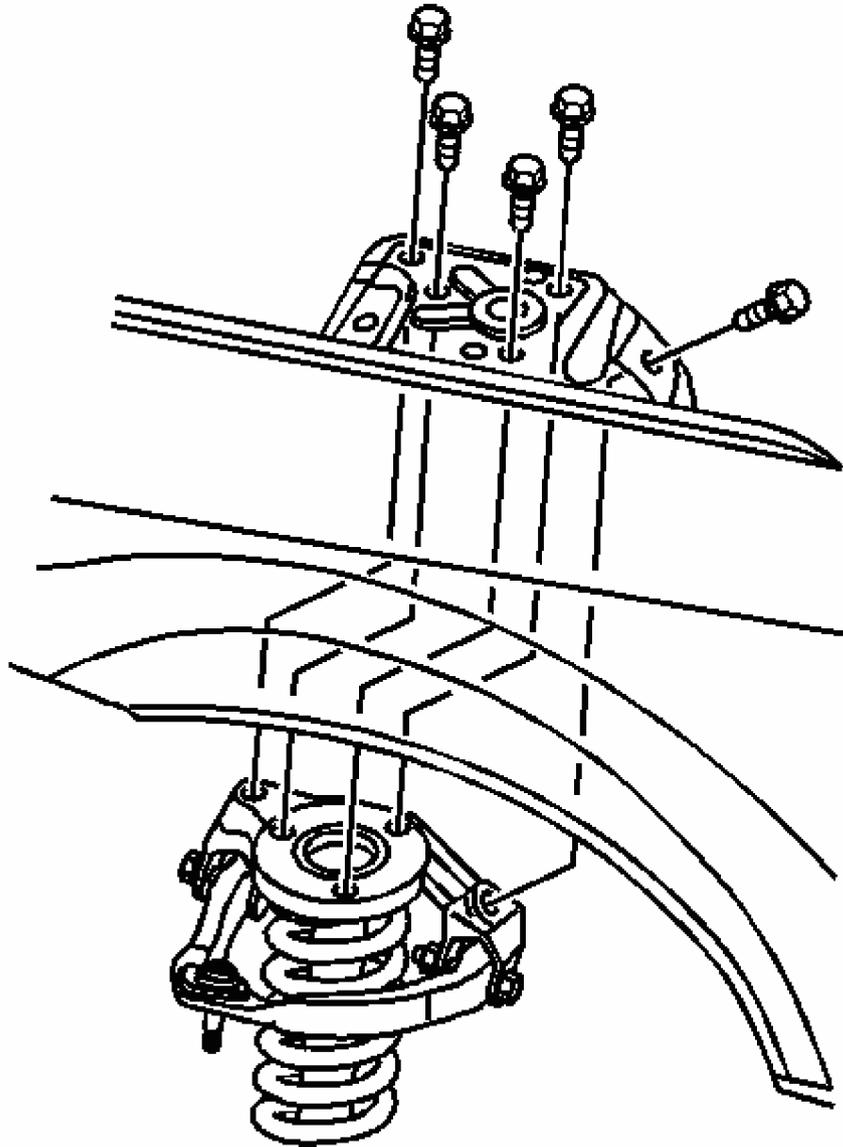
54. Remove the lower engine mount nuts. Refer to [Engine Mount Replacement - Left](#) and [Engine Mount Replacement - Right](#) .



**Fig. 44: View Of Transmission Shift Linkage**  
Courtesy of GENERAL MOTORS CORP.

55. Disconnect the transmission shift linkage from the transmission. Refer to **Shift Control Linkage Replacement** Automatic Transmission - 5L40-E/5L50-E.
56. Disconnect the low oil level sensor electrical connector.
57. Secure the low oil level sensor electrical connector and harness to the engine mount bracket.
58. Remove the headlamp leveling sensors. Refer to **Headlamp Leveling Sensor Replacement - Front** in Lighting Systems.
59. Secure the shock modules to the lower control arms with a suitable strap in order to

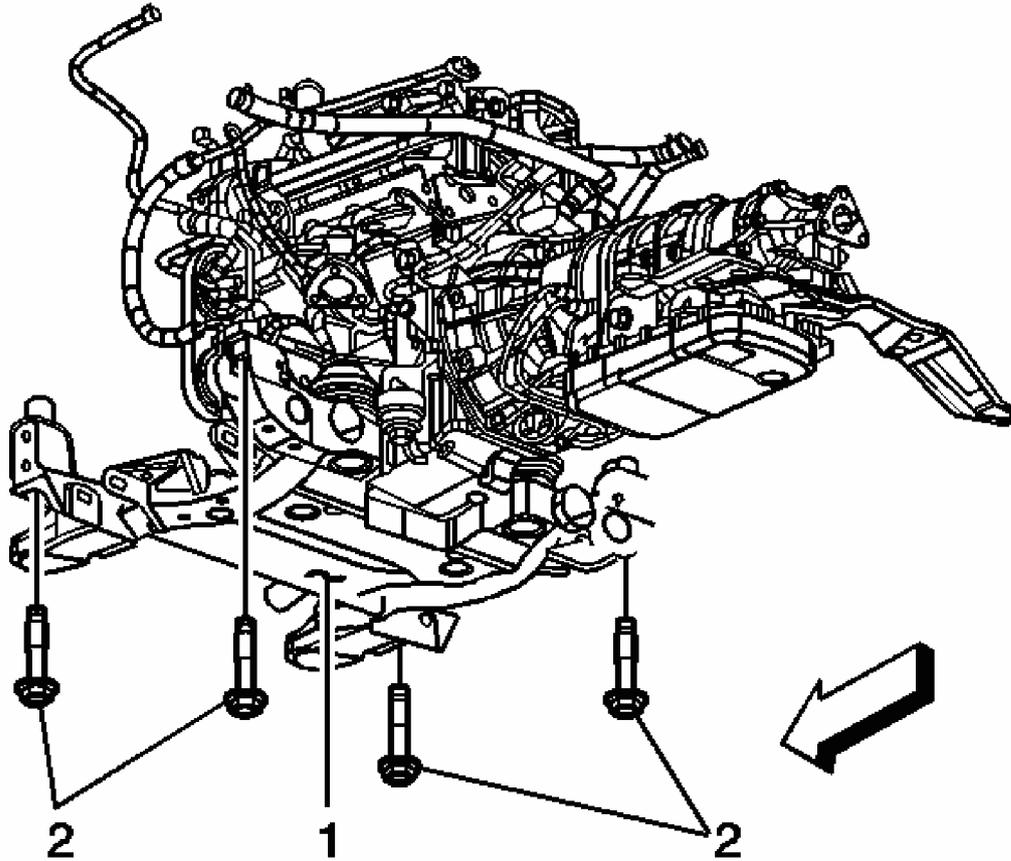
prevent damage to the front brake hoses.



**Fig. 45: View Of Shock Module & Upper Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

60. Remove the right and left shock module upper mounting bolts. Refer to **Shock Module Replacement** in Front Suspension.
61. Raise the vehicle enough to place a suitable lift table under the engine, transmission, front frame and front suspension assembly.

62. Position a suitable powertrain and/or engine lift table below the frame, engine and transmission.
63. Raise the lift table and/or lower the vehicle to support the frame, engine and transmission.
64. Remove the transmission brace to underbody bolts. Refer to **Transmission Support Replacement** in Frame and Underbody.



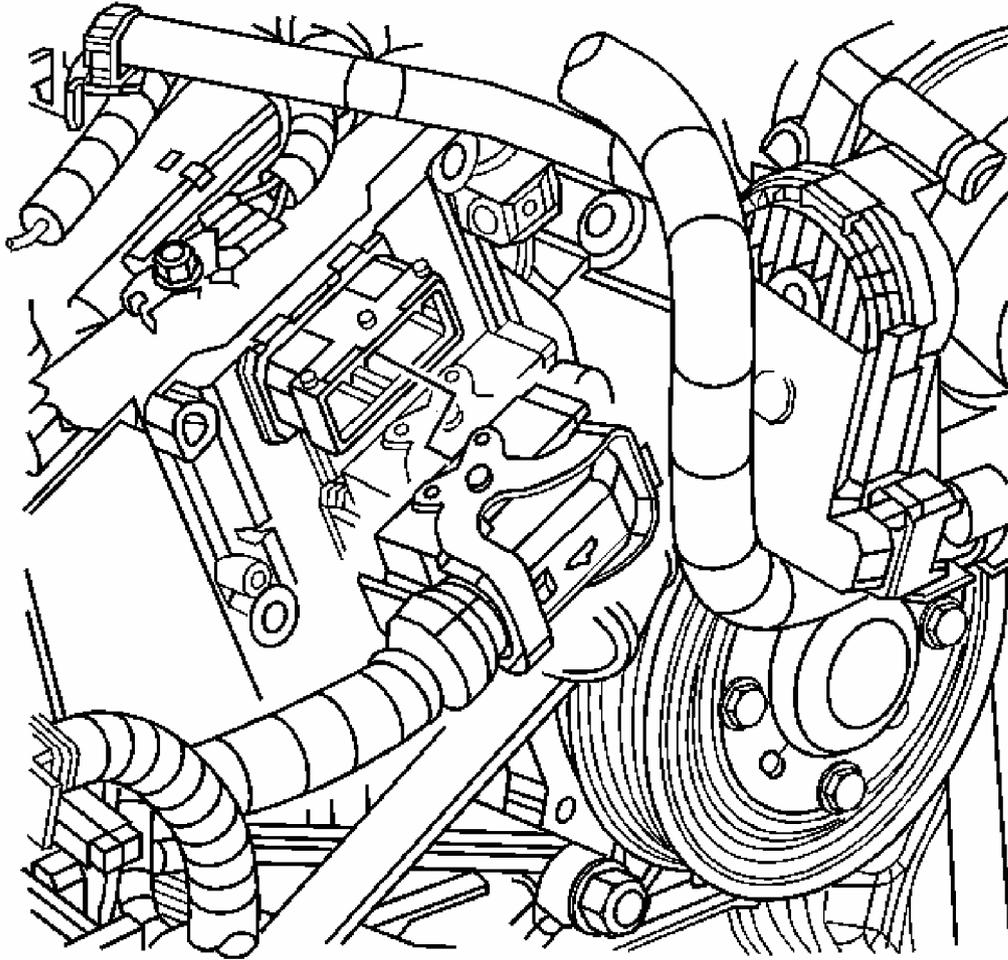
**Fig. 46: Identifying Frame Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

65. Remove the front frame bolts (2).

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

66. 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.



**Fig. 47: View Of Upper ECM Connector**  
Courtesy of GENERAL MOTORS CORP.

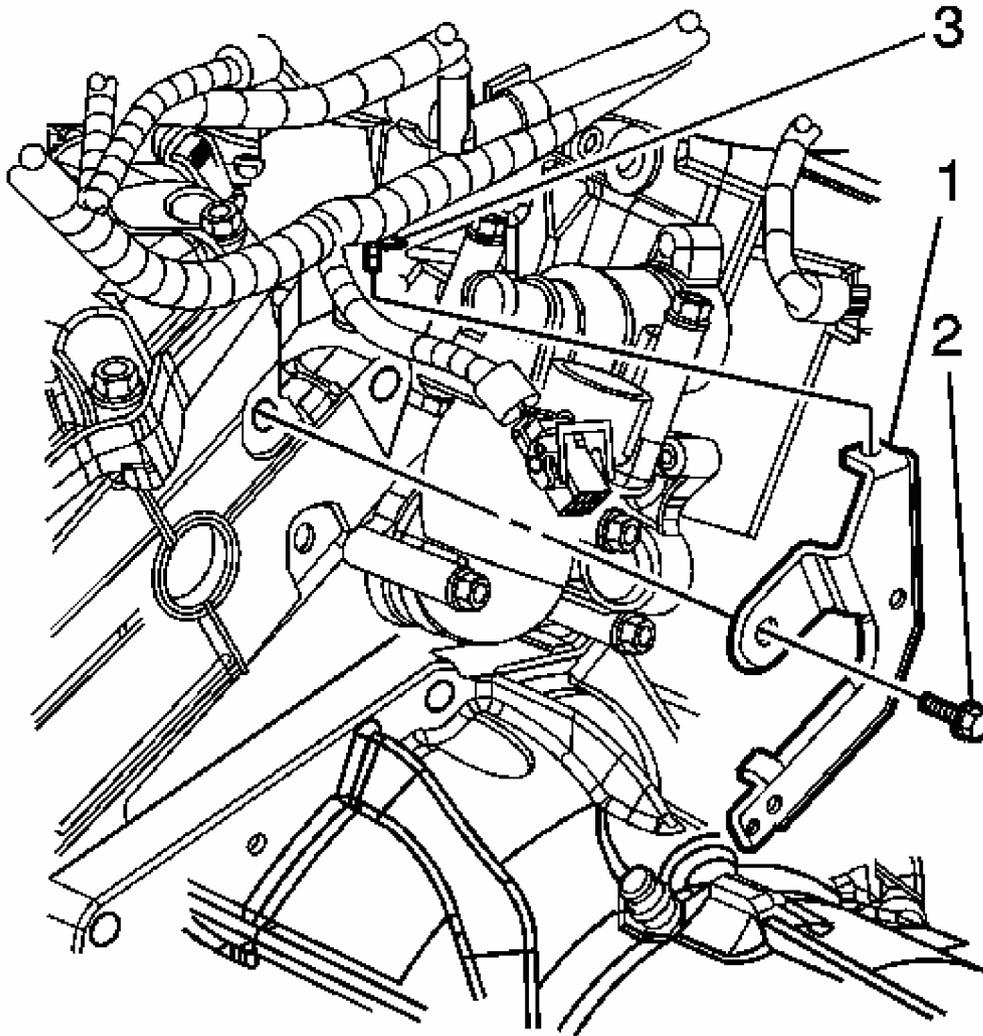
67. Disconnect the engine control module (ECM) upper (chassis side) electrical connector. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 3.6L (LY7).

**IMPORTANT: Do NOT remove the oxygen sensors.**

68. Remove the catalytic converters with the oxygen sensors. Refer to **Catalytic Converter Replacement - Left (LP1, LY7)** or **Catalytic Converter Replacement - Left (LS6)** and **Catalytic Converter Replacement - Right (LP1, LY7)** or **Catalytic Converter**

**Replacement - Right (LS6) in Engine Exhaust.**

69. Remove the thermostat housing with the heater pipes, heater hoses and surge tank outlet hose. Refer to **Thermostat Housing Removal** .
70. Remove the starter motor. Refer to **Starter Motor Replacement (LP1, LY7)** or **Starter Motor Replacement (LS6)** in Engine Electrical.
71. Remove the flywheel bolts.



**Fig. 48: View Of HO2S Connector Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

72. Remove the heated oxygen sensor (HO2S) connector bracket from the left cylinder head.

73. Remove the engine wiring harness and related components. Refer to **Engine Wiring Harness Assembly Removal** .
74. Disconnect the transmission oil cooler (TOC) pipes from the engine, radiator and the transmission. Refer to **Transmission Fluid Cooler Hose/Pipe Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.
75. Disconnect the radiator hoses from the water outlet housing and the coolant inlet pipe. Refer to **Radiator Hose Replacement - Inlet (LP1, LY7)** or **Radiator Hose Replacement - Inlet (LS6)** in Engine Cooling.
76. Disconnect the power steering cooler hoses from the condenser radiator and fan module (CRFM). Refer to **Power Steering Cooler Pipe/Hose Replacement** in Power Steering System.
77. Cap and plug the power steering hoses and pipes in order to prevent fluid loss and contamination.
78. Remove the CRFM with the radiator hoses from the frame.
79. Install the **EN 46114** to the engine. Refer to **Engine Support Fixture** .
80. Connect a floor crane to the engine lift brackets and raise the floor crane to partially support the engine.
81. Position a second powertrain lift table below the transmission.
82. Remove the transmission to engine bolts. Refer to **Transmission Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.
83. Remove the transmission from the engine.
84. Remove the drive belts. Refer to **Drive Belt Replacement - Generator and Water Pump** and **Drive Belt Replacement - Power Steering and Air Conditioning** .
85. Remove the generator and water pump drive belt tensioner. Refer to **Drive Belt Tensioner Removal - Right** .
86. Remove the A/C compressor and power steering drive belt tensioner. Refer to **Drive Belt Tensioner Removal - Left** .
87. Remove the idler pulley. Refer to **Drive Belt Idler Pulley Removal** .
88. Remove the generator and the generator bracket. Refer to **Generator Removal** .
89. Remove the air conditioning (A/C) compressor. Refer to **Air Conditioning (A/C) Compressor Removal** .
90. Remove the power steering pump. Refer to **Power Steering Pump Removal** .
91. Remove the power steering reservoir from the engine. Refer to **Remote Power Steering Fluid Reservoir Replacement (LP1, LY7)** or **Remote Power Steering Fluid Reservoir Replacement (LS6)** in Power Steering System.
92. Remove the oil level indicator. Refer to **Oil Level Indicator and Tube Removal** .
93. Remove the left exhaust manifold. Refer to **Exhaust Manifold Removal - Left** .

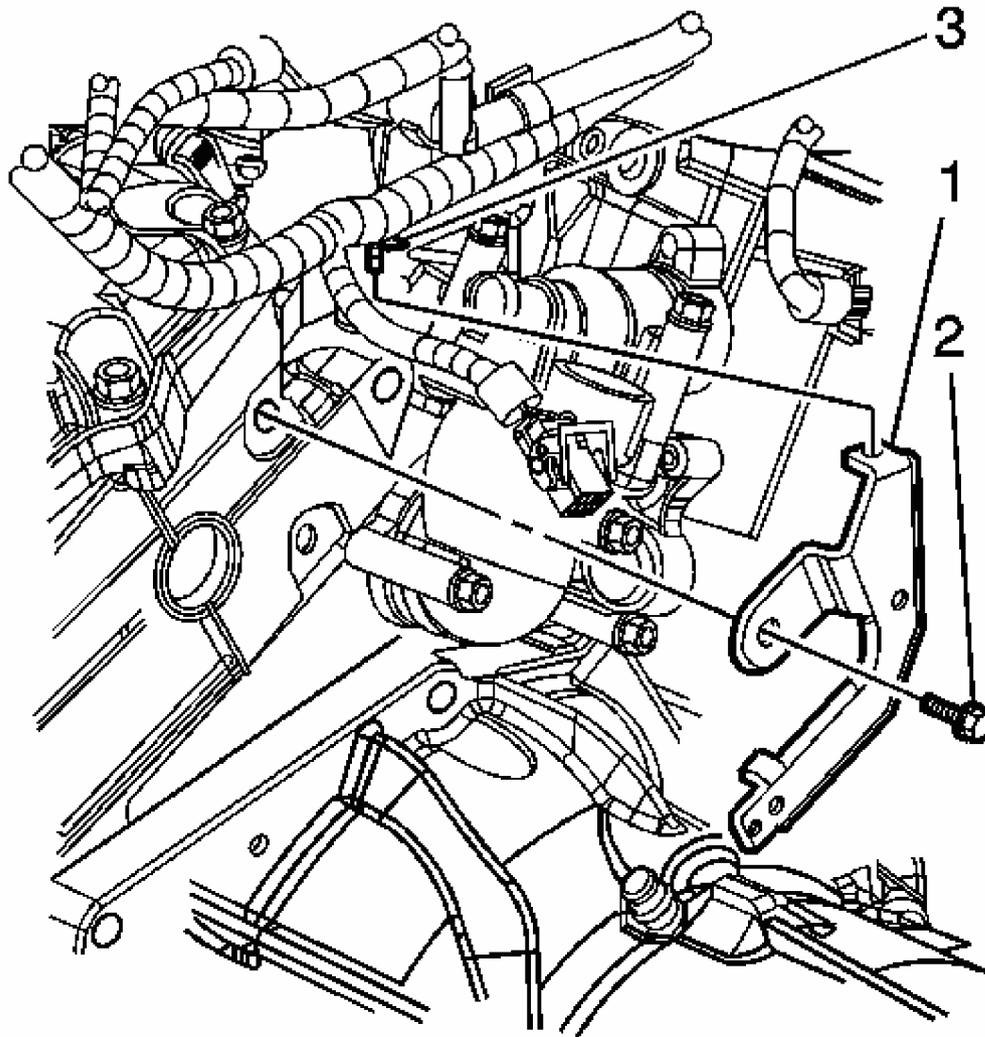
94. Remove the oil filter adapter. Refer to **Oil Filter Adapter Removal** .
95. Remove the right exhaust manifold. Refer to **Exhaust Manifold Removal - Right** .
96. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal** .
97. Remove the flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)** .
98. Remove the intake manifold. Refer to **Intake Manifold Removal** .
99. Remove the water outlet. Refer to **Water Outlet Removal** .
100. Remove the block heater. Refer to **Coolant Heater Replacement (LP1, LY7)** or **Coolant Heater Replacement (LS6)** in Engine Cooling.
101. Remove the ECM with the ECM bracket. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 3.6L (LY7).
102. Use a floor crane in order to remove the engine from the frame.
103. Remove the engine mount brackets with the engine mounts. Refer to **Engine Mount Bracket Replacement - Left** and **Engine Mount Bracket Replacement - Right** .

#### **Installation Procedure**

1. Install the engine mount brackets with the engine mounts. Refer to **Engine Mount Bracket Replacement - Left** and **Engine Mount Bracket Replacement - Right** .
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 (ECM) Replacement** in Engine Controls - 3.6L (LY7).
4. Install the water outlet. Refer to **Starter Motor Installation** .
5. Install the block heater. Refer to **Coolant Heater Replacement (LP1, LY7)** or **Coolant Heater Replacement (LS6)** in Engine Cooling.
6. Install the flywheel. Refer to **Engine Flywheel Installation (Automatic Transmission)** or **Engine Flywheel Installation (Manual Transmission)** .
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** .
10. Install the oil filter adapter. Refer to **Oil Filter Adapter Installation** .
11. Install the left exhaust manifold. Refer to **Exhaust Manifold Installation - Left** .
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 Installation** .
14. Install the power steering pump. Refer to **Power Steering Pump Installation** .
15. Install the power steering reservoir to the engine. Refer to **Remote Power Steering Fluid Reservoir Replacement (LP1, LY7)** or **Remote Power Steering Fluid** .

**Reservoir Replacement (LS6)** in Power Steering System.

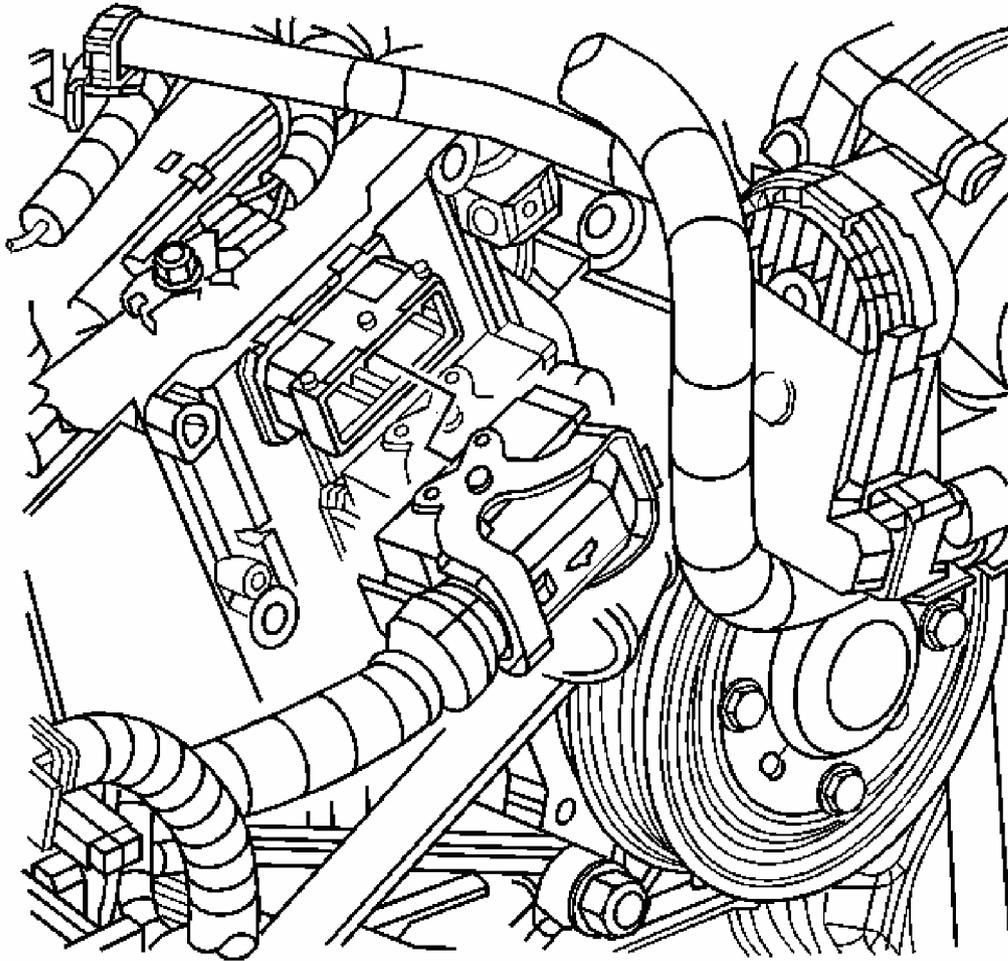
16. Install the A/C compressor. Refer to **Air Conditioning (A/C) Compressor Installation** .
17. Install the idler pulley. Refer to **Drive Belt Idler Pulley Installation** .
18. Install the A/C compressor and power steering drive belt tensioner. Refer to **Drive Belt Tensioner Installation - Left** .
19. Install the generator and water pump drive belt tensioner. Refer to **Drive Belt Tensioner Installation - Right** .
20. Install the drive belts. Refer to **Drive Belt Replacement - Generator and Water Pump** and **Drive Belt Replacement - Power Steering and Air Conditioning** .
21. Install the transmission-to-engine and flywheel-to-torque convertor bolts. Refer to **Transmission Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.
22. Install the starter motor. Refer to **Starter Motor Replacement (LP1, LY7)** or **Starter Motor Replacement (LS6)** in Engine Electrical.
23. Remove the **EN 46114** from the engine. Refer to **Engine Support Fixture** .
24. Install the CRFM with the radiator hoses to the frame.
25. Connect the power steering cooler hoses to the CRFM. Refer to **Power Steering Cooler Pipe/Hose Replacement** in Power Steering System.
26. Connect the radiator hoses to the water outlet housing and the coolant inlet pipe. Refer to **Radiator Hose Replacement - Inlet (LP1, LY7)** or **Radiator Hose Replacement - Inlet (LS6)** in Engine Cooling.
27. Install the transmission oil cooler (TOC) pipes to the engine, radiator and the transmission. Refer to **Transmission Fluid Cooler Hose/Pipe Replacement (LP1, LY7)** in Automatic Transmission - 5L40-E/5L50-E.
28. Install the engine wiring harness and related components. Refer to **Engine Wiring Harness Assembly Installation** .



**Fig. 49: View Of HO2S Connector Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

29. Install the HO2S connector bracket to the left cylinder head.
30. Install the thermostat housing with the heater pipes, heater hoses and surge tank outlet hose. Refer to **Thermostat Housing Removal** .
31. Install the catalytic converters with the oxygen sensors. Refer to **Catalytic Converter Replacement - Left (LP1, LY7)** or **Catalytic Converter Replacement - Left (LS6)** and **Catalytic Converter Replacement - Right (LP1, LY7)** or **Catalytic Converter Replacement - Right (LS6)** in Engine Exhaust.

32. Install the fuel lines to the fuel rail and the EVAP purge solenoid. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** in Engine Controls - 3.6L (LY7).

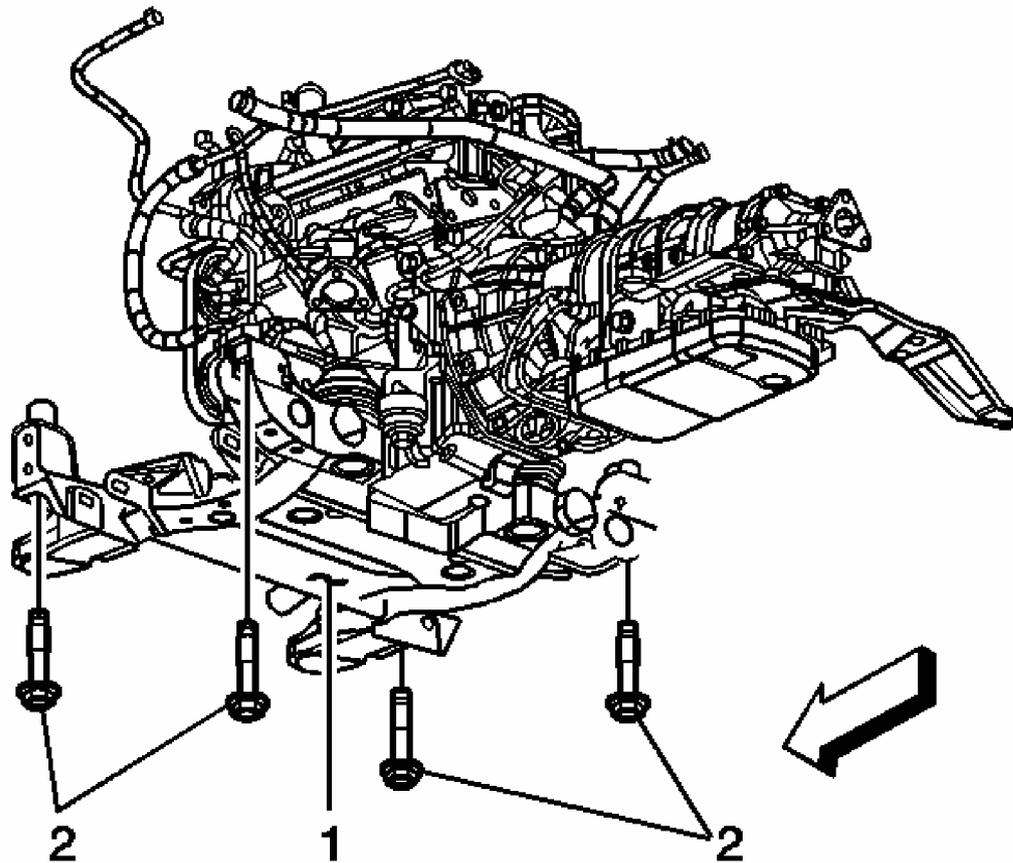


**Fig. 50: View Of Upper ECM Connector**  
Courtesy of GENERAL MOTORS CORP.

33. Connect the ECM upper (chassis side) electrical connector. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 3.6L (LY7).

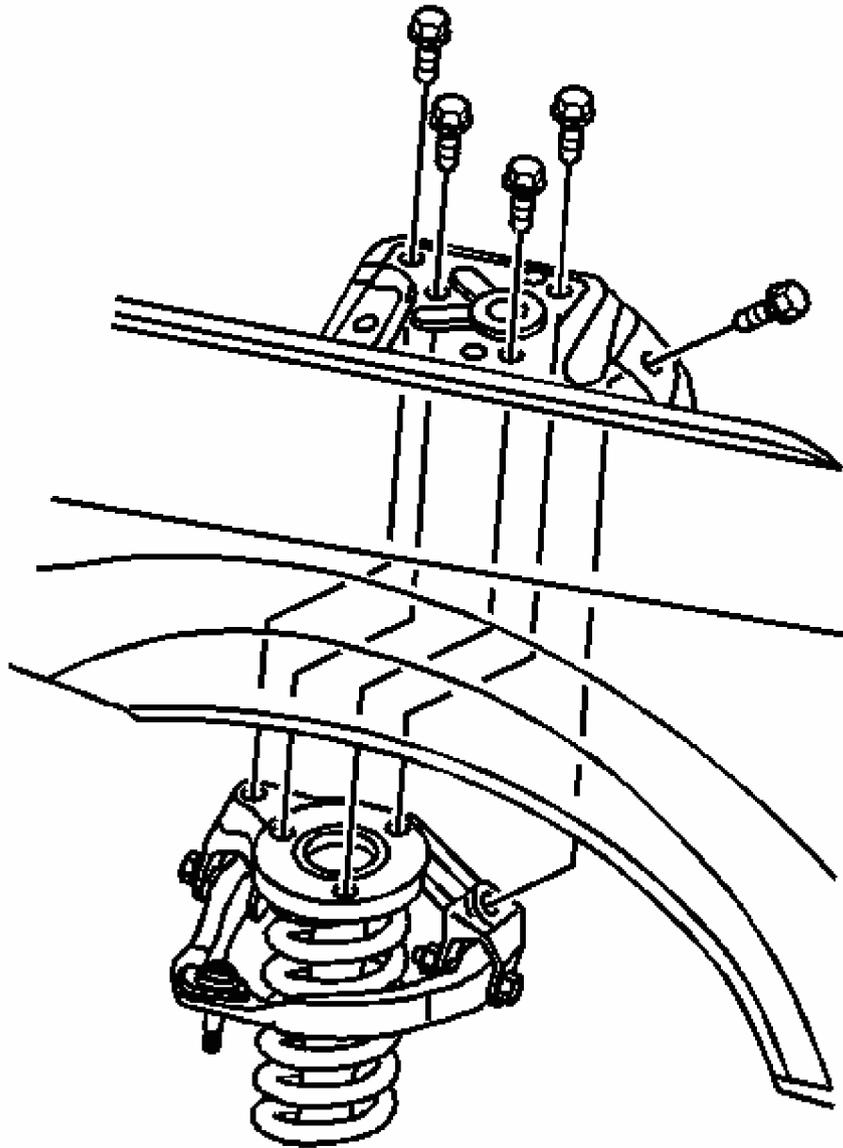
**IMPORTANT: Ensure that all the hoses, wires, pipes and shock modules clear the vehicle during the installation process.**

34. 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. 51: Identifying Frame Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

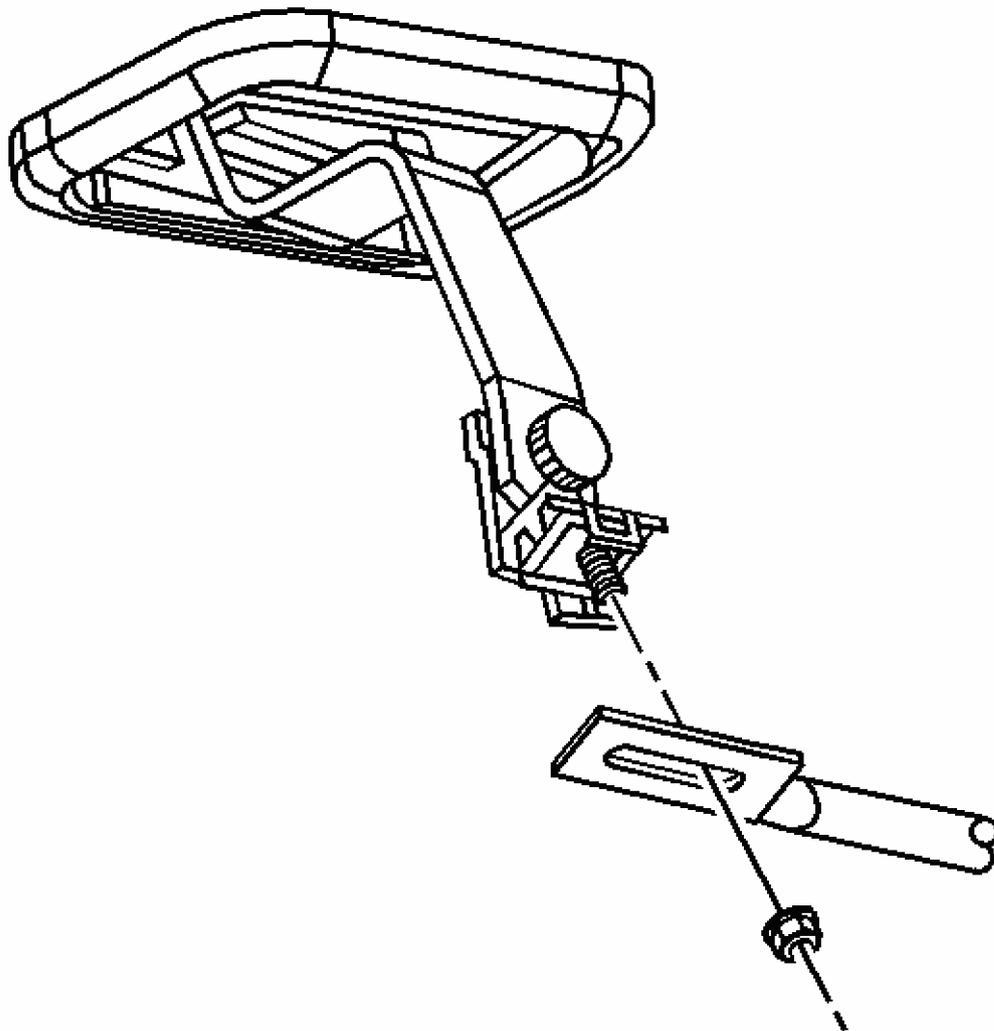
35. Install the front frame bolts (2). Refer to **Frame Replacement - Front** in Frame and Underbody.
36. Install the transmission support to underbody bolts. Refer to **Transmission Support Replacement** in Frame and Underbody.
37. Remove the powertrain lift/support table.



**Fig. 52: View Of Shock Module & Upper Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

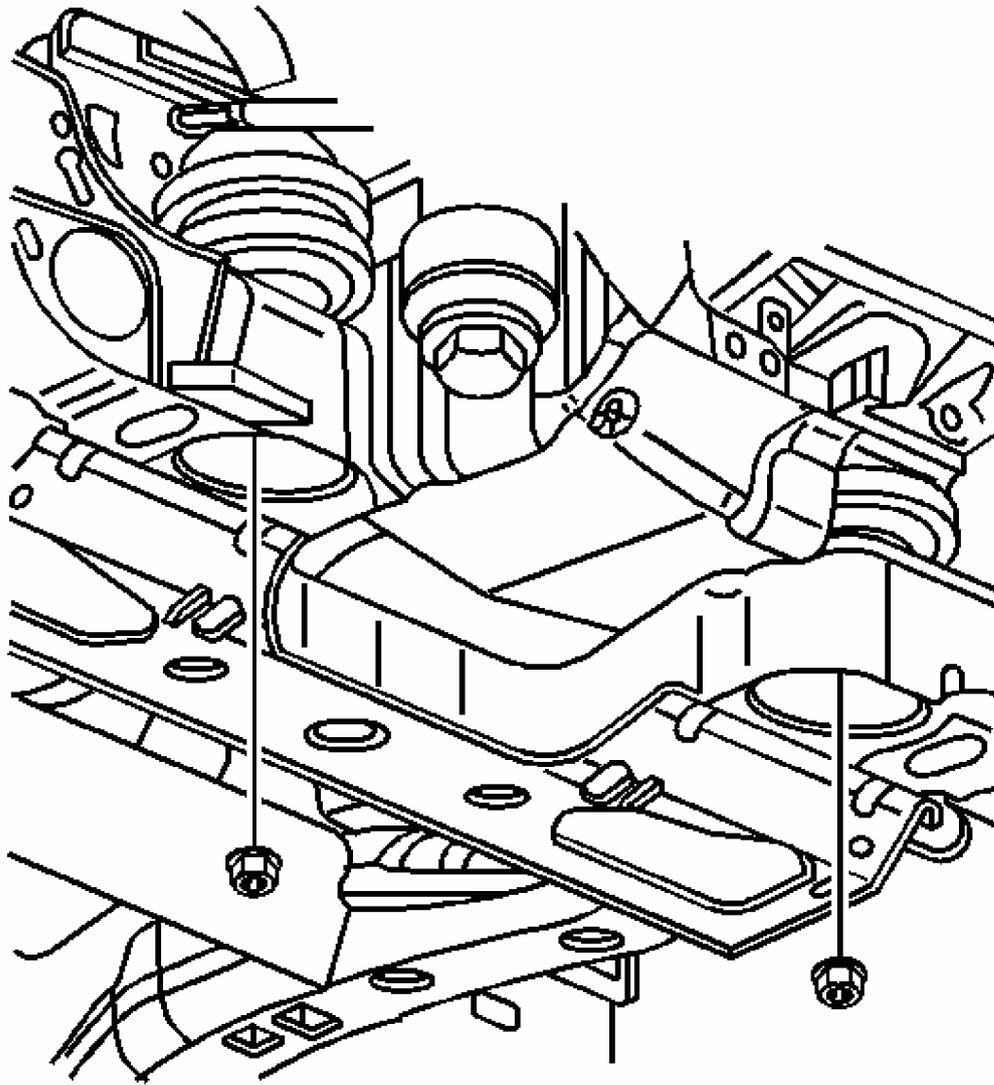
38. Install the right and left shock module upper mounting bolts. Refer to **Shock Module Replacement** in Front Suspension.
39. Secure the shock modules to the front frame with mechanics wire to avoid stretching the front brake hoses.
40. Install the headlamp leveling sensors. Refer to **Headlamp Leveling Sensor**

## Replacement - Front in Lighting Systems.



**Fig. 53: View Of Transmission Shift Linkage**  
Courtesy of GENERAL MOTORS CORP.

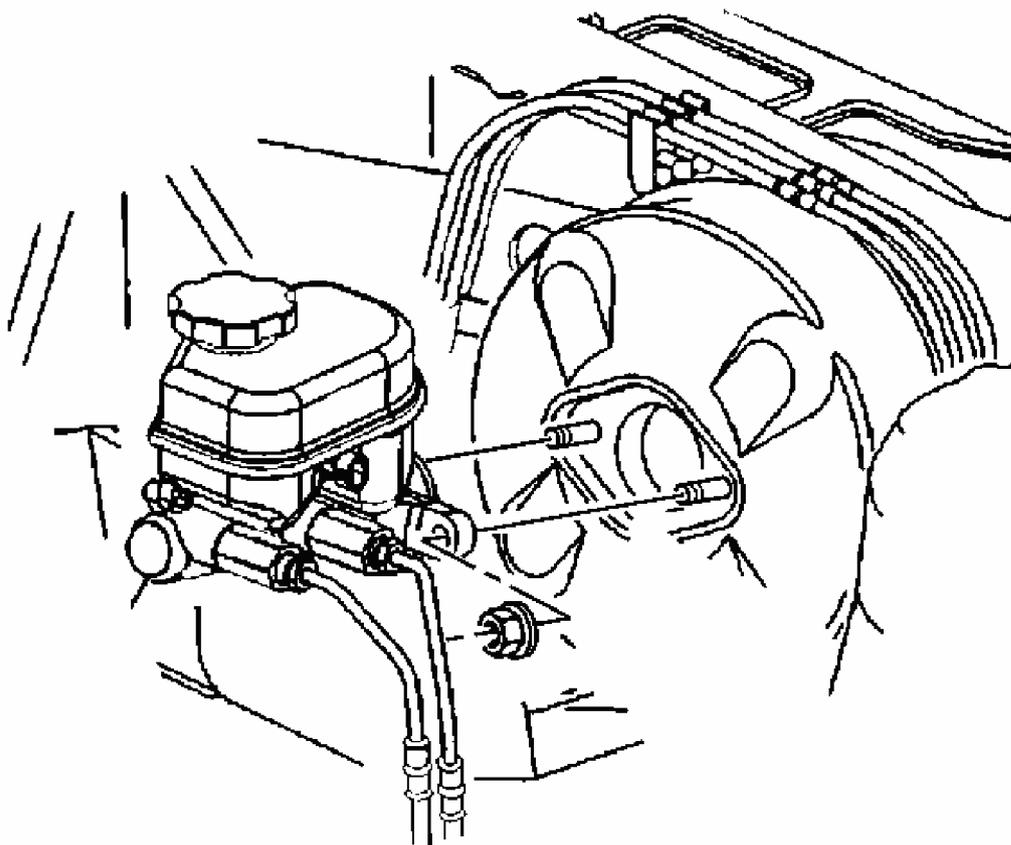
41. Connect the transmission shift linkage to the transmission. Refer to **Shift Control Linkage Replacement** Automatic Transmission - 5L40-E/5L50-E.
42. Connect the low oil level sensor electrical connector.



**Fig. 54: Identifying Frame Mounting Nuts**  
Courtesy of GENERAL MOTORS CORP.

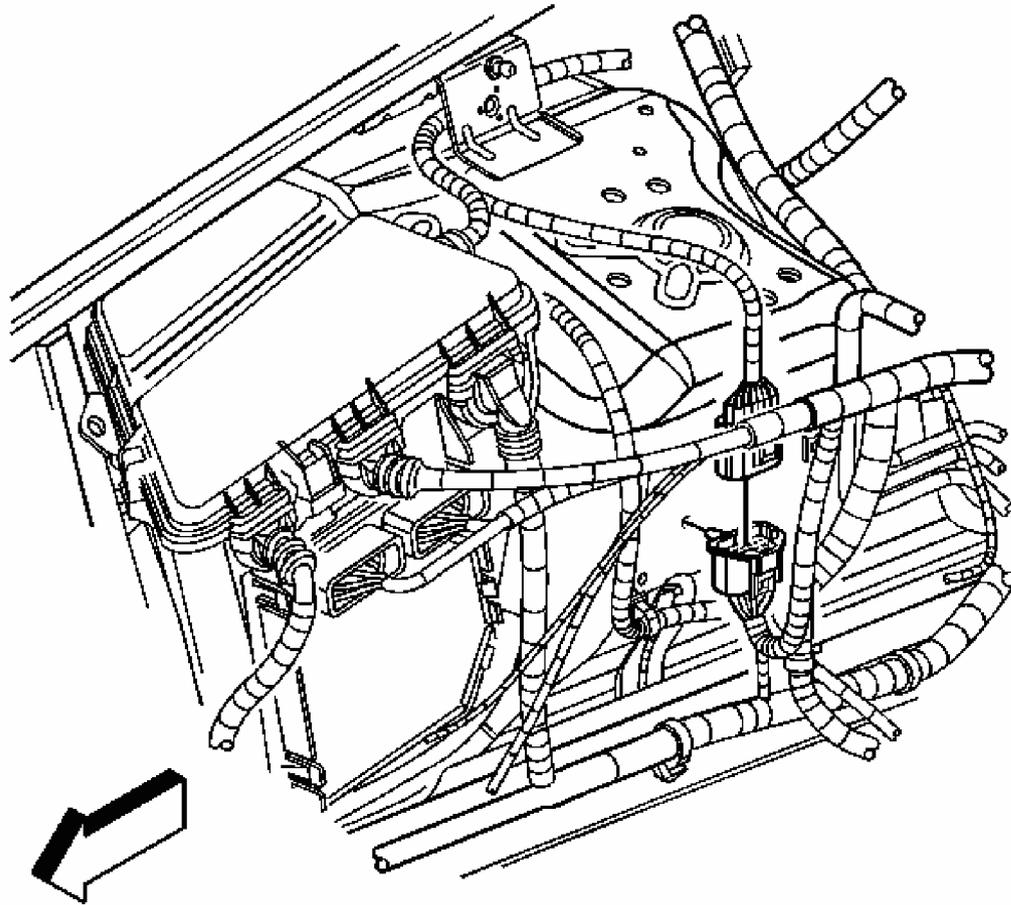
43. Install the lower engine mount nuts. Refer to **Engine Mount Replacement - Left** and **Engine Mount Replacement - Right** .
44. Install the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement - Center** in Steering Wheel and Column.
45. Install the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
46. Install the front brake pipes and retainers to the underbody.

47. Connect the rear brake pipes (two center pipes) to the BPVM. Refer to **Brake Pressure Modulator Valve (BPMV) Replacement (CTS)** or **Brake Pressure Modulator Valve (BPMV) Replacement (CTS-V)** in Antilock Brake System.
48. Connect the radiator side air baffles to the radiator.
49. Install the washer bottle bracket. Refer to **Washer Solvent Container Replacement (w/o CE4)** in Wiper/Washer Systems.
50. Install the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
51. Install the propeller shaft. Refer to **Propeller Shaft Replacement (Automatic Transmission)** or **Propeller Shaft Replacement (Manual Transmission)** or **Propeller Shaft Replacement (CTS-V)** in Propeller Shaft.
52. Install the muffler assembly. Refer to **Exhaust System Replacement (LP1)** or **Exhaust System Replacement (LY7)** or **Exhaust System Replacement (LS6)** in Engine Exhaust.



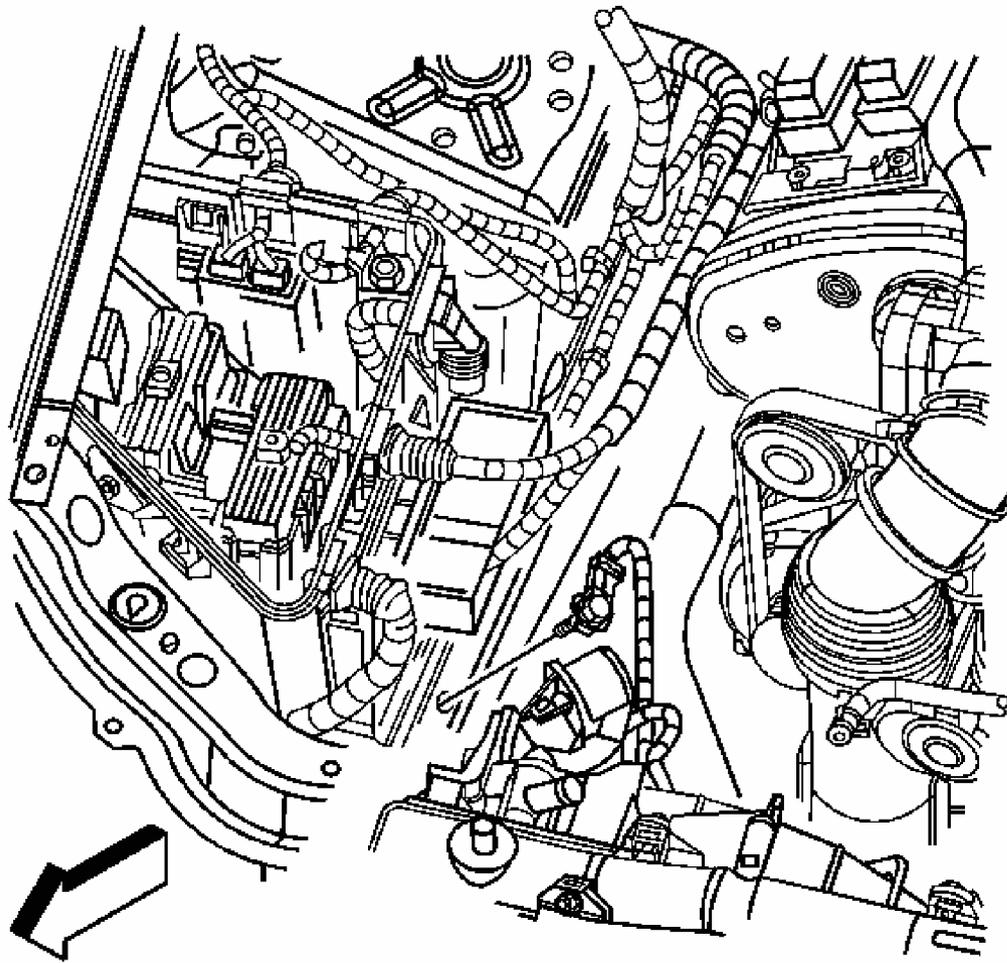
**Fig. 55: Removing & Installing Master Cylinder**  
Courtesy of GENERAL MOTORS CORP.

53. Install the master cylinder. Refer to **Master Cylinder Replacement** in Hydraulic Brakes.



**Fig. 56: View Of Longitudinal Rail Engine Harness Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

54. Connect the engine harness electrical connector at the longitudinal rail.

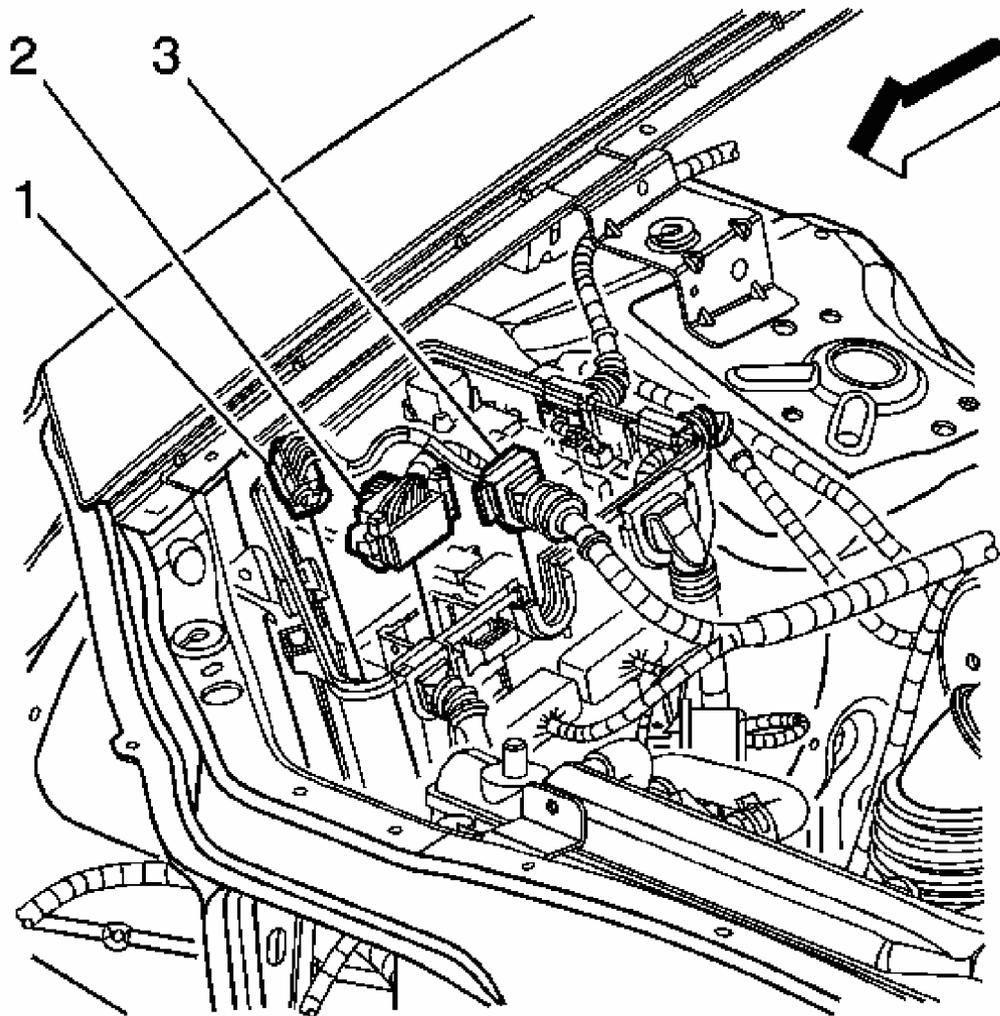


**Fig. 57: View Of Ground Bolt & Wire At Longitudinal Rail**  
Courtesy of GENERAL MOTORS CORP.

55. Install the ground wire and bolt to the longitudinal rail.

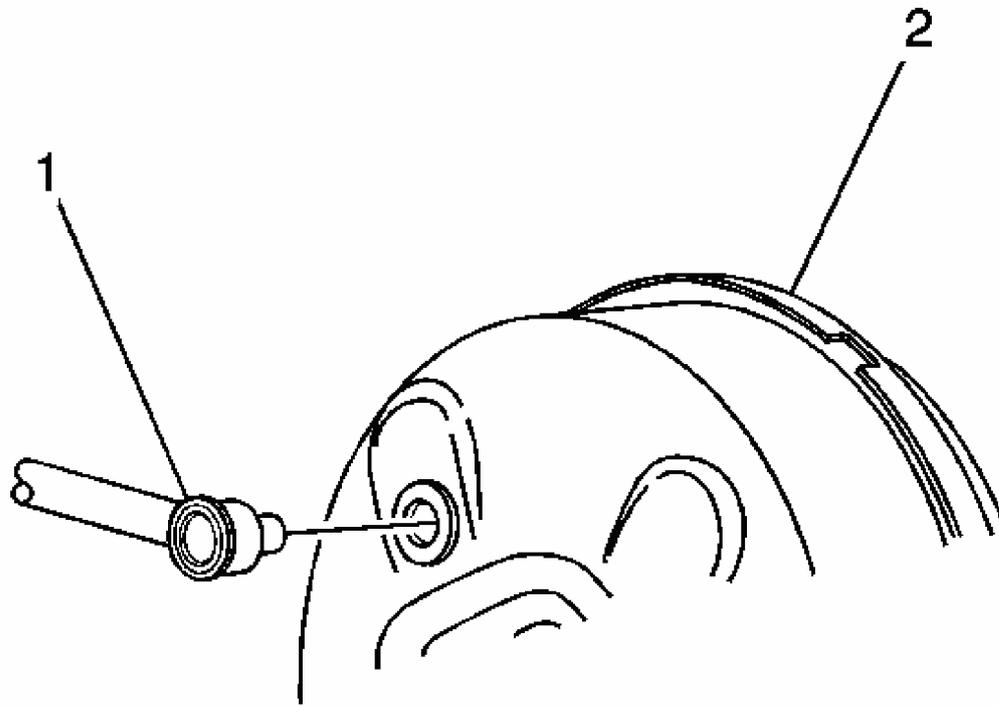
**Tighten:** Tighten the engine harness ground wire to longitudinal rail bolt to 10 N.m (89 lb in).

56. Connect the wiring harness to the transmission control module (TCM). Refer to **Torque Converter Replacement** in Automatic Transmission - 5L40-E/5L50-E.



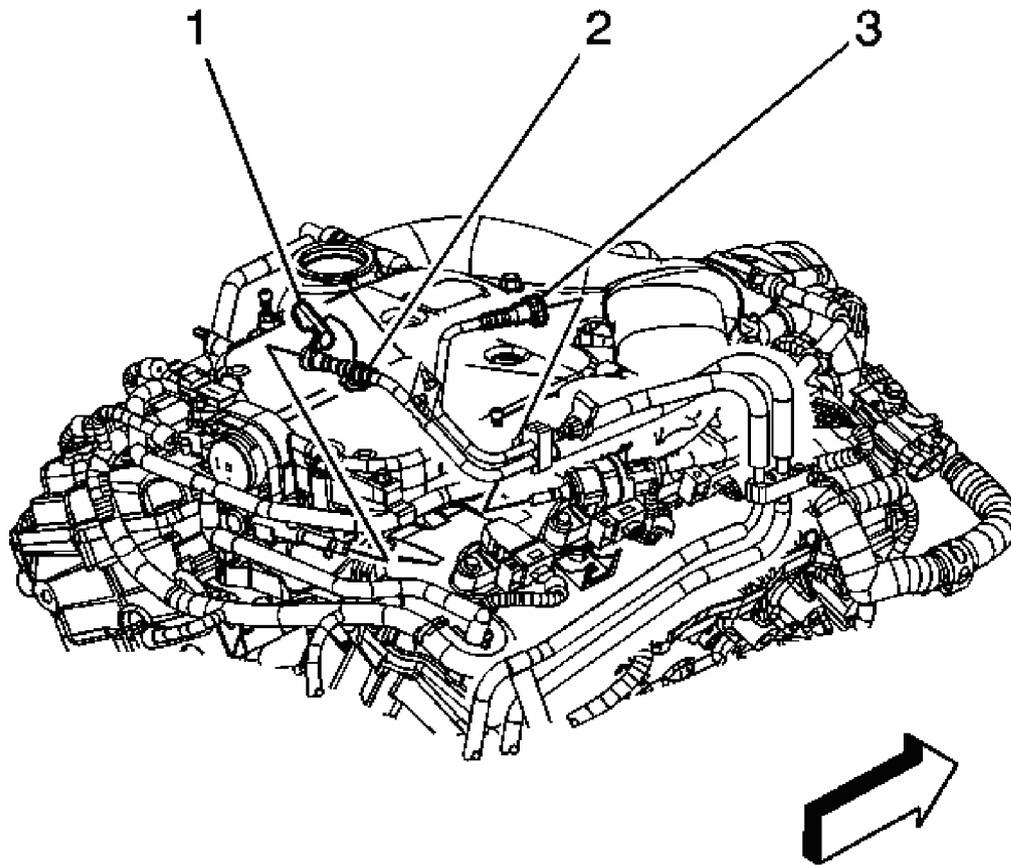
**Fig. 58: View Of Engine Module Wiring Harness Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

57. Connect the engine module wiring harness connectors (1-3) to the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems.
58. Connect and lock the instrument panel (I/P) electrical connector to the engine at the rear of the left (Bank 2) cylinder head.
59. Connect the mass air flow sensor electrical connector.
60. Connect the brake fluid level switch electrical connector from the master cylinder.



**Fig. 59: View Of Vacuum Check Valve & Brake Booster**  
**Courtesy of GENERAL MOTORS CORP.**

61. Connect the brake booster vacuum hose (1) to the brake booster (2).
62. Install the radiator support brackets. Refer to **Radiator Support Bracket Replacement (LP1, LY7)** or **Radiator Support Bracket Replacement (LS6)** in Engine Cooling.

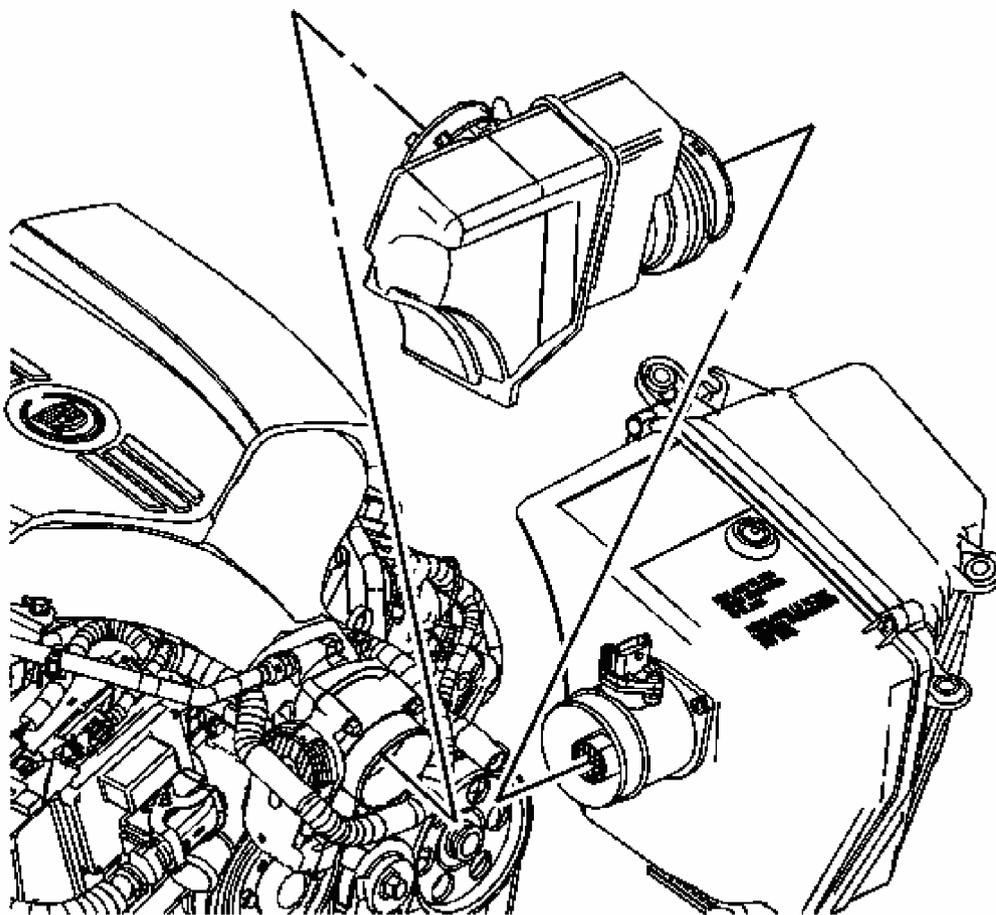


**Fig. 60: Top Of Engine View**  
**Courtesy of GENERAL MOTORS CORP.**

63. Connect the purge line (3) to the purge solenoid.
64. Connect the fuel pipe (2) to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** in Engine Controls - 3.6L (LY7).
65. Connect the heater hoses to the heater core. Refer to **Heater Hose Replacement - Inlet (LY7)** and **Heater Hose Replacement - Outlet (LY7)** in Heating, Ventilation and Air Conditioning.
66. Install the air inlet duct.
67. Position and secure the surge tank inlet (vent) hose to the vehicle.
68. Connect the surge tank inlet (vent) hose to the water outlet housing and the radiator. Refer to **Surge Tank Hose/Pipe Replacement - Outlet (LP1, LY7)** or **Surge Tank Hose/Pipe Replacement - Outlet (LS6)** in Engine Cooling.
69. Connect the surge tank outlet hose to the surge tank. Refer to **Surge Tank Hose/Pipe**

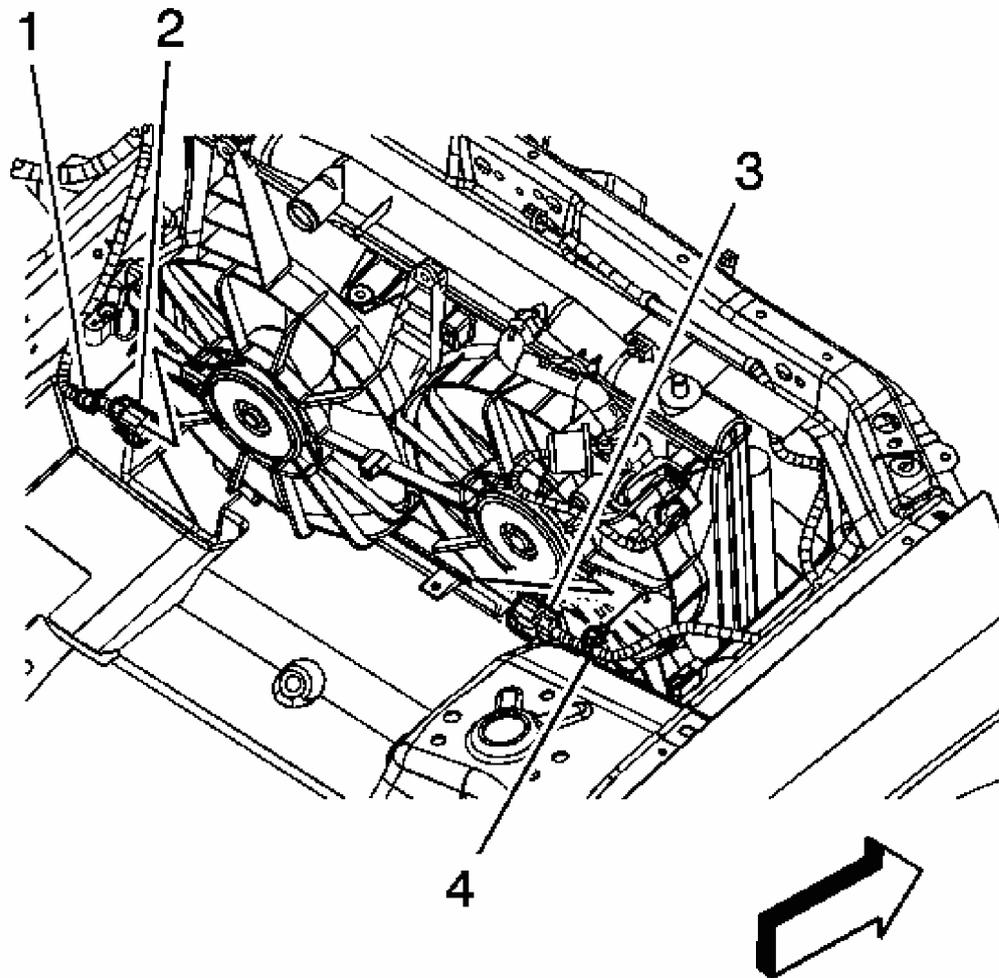
**Replacement - Inlet (LP1, LY7) or Surge Tank Hose/Pipe Replacement - Inlet (LS6)** in Engine Cooling.

70. Connect the air conditioning pressure switch electrical connector and the liquid line to the evaporator. Refer to **Liquid Line Replacement (2.8L (LP1))** or **Liquid Line Replacement (3.6L (LY7))** or **Liquid Line Replacement (5.7L (LS6))** in Heating, Ventilation and Air Conditioning.
71. Connect the air conditioning suction hose to the evaporator and install the suction hose bracket to the shock tower. Refer to **Suction Hose Replacement (2.8L (LP1))** or **Suction Hose Replacement (3.6L (LY7))** or **Suction Hose Replacement (5.7L (LS6))** in Heating, Ventilation and Air Conditioning.



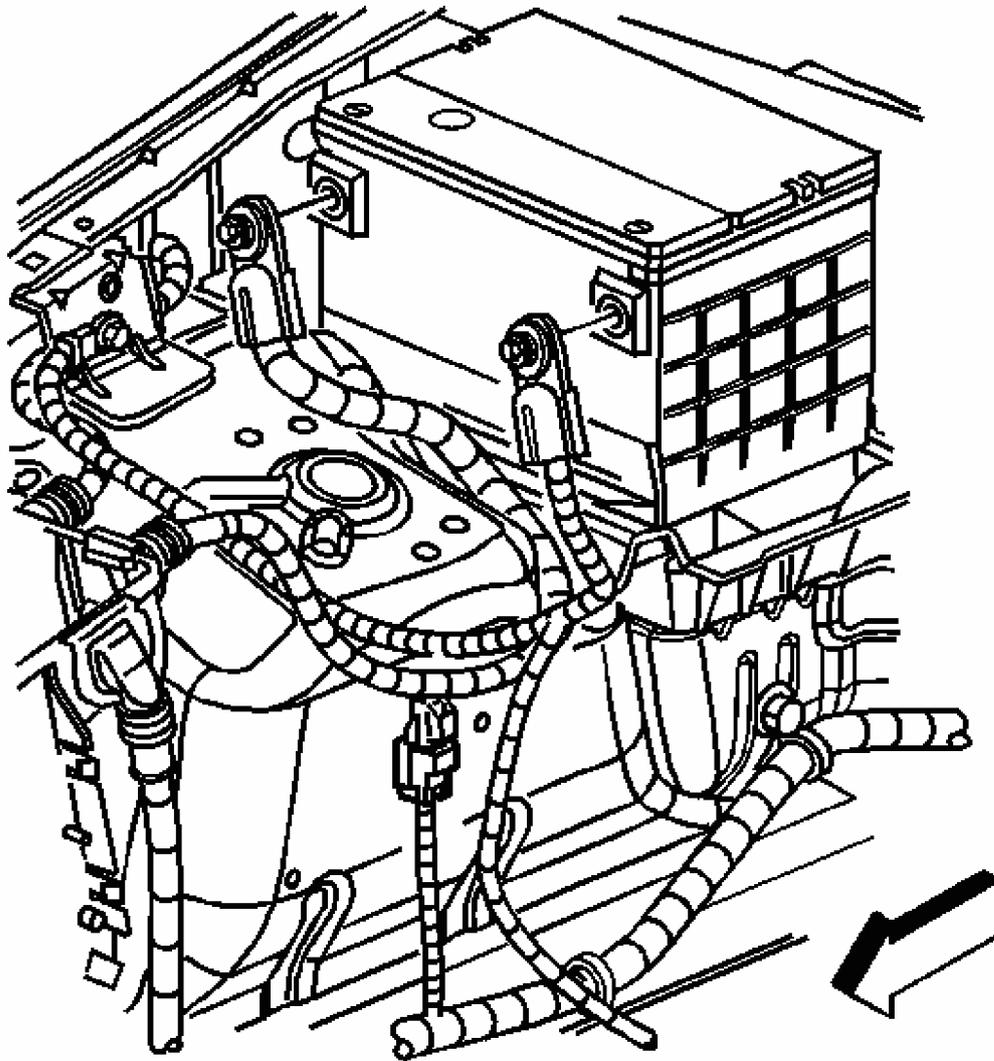
**Fig. 61: View Of Air Inlet Duct**  
Courtesy of GENERAL MOTORS CORP.

72. Install the air cleaner duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine



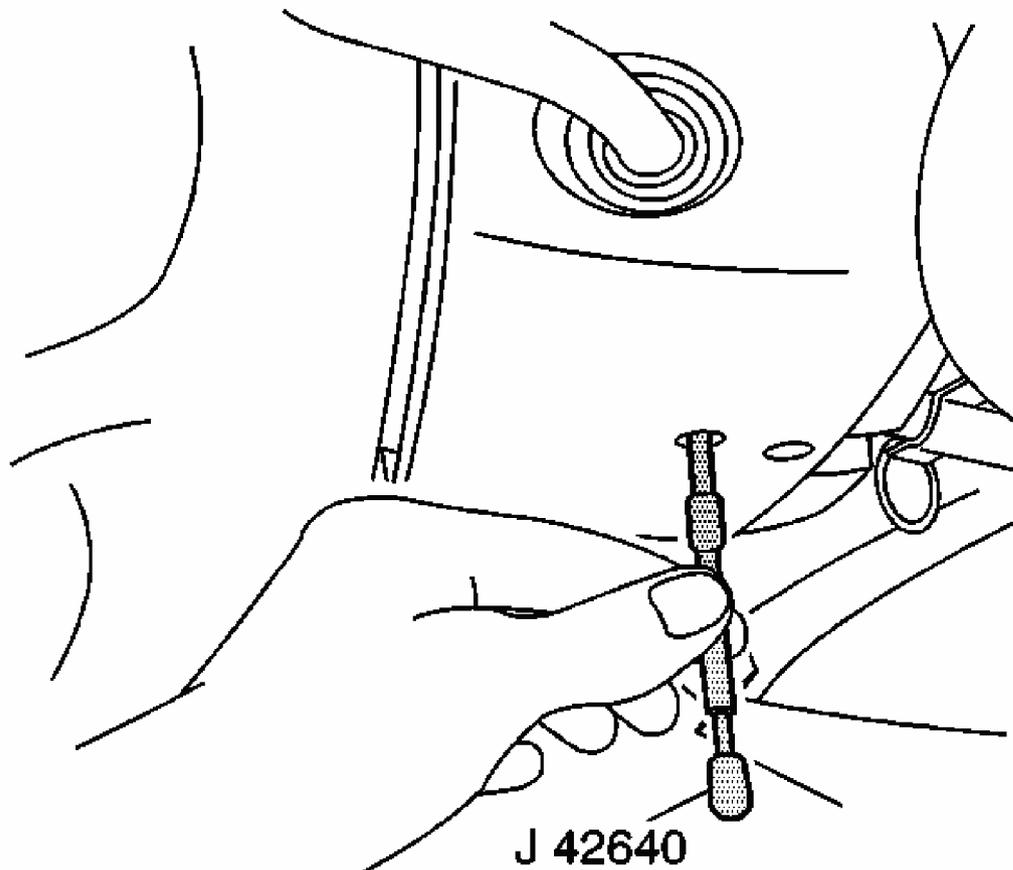
**Fig. 62: View Of Cooling Fan Wiring Harness & Electrical Connectors**  
Courtesy of GENERAL MOTORS CORP.

73. Install the cooling fan wiring harnesses (1 and 4) to the fan shroud.
74. Install the cooling fan electrical connectors (2 and 3).
75. Install the wiper module. Refer to **Wiper Motor Module Replacement (LHD)** or **Wiper Motor Module Replacement (RHD)** .
76. Install the battery. Refer to **Battery Replacement (LHD)** or **Battery Replacement (RHD)** in Engine Electrical.
77. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .



**Fig. 63: View Of Battery Positive & Negative Cables**  
Courtesy of GENERAL MOTORS CORP.

78. Connect the battery positive cable to the battery and the underhood electrical center. Refer to **Battery Positive Cable Replacement (LP1, LY7)** or **Battery Positive Cable Replacement (LS6)** or **Battery Positive Cable Replacement (RHD)** in Engine Electrical.
79. Connect the battery negative cable from the battery and the body. Refer to **Battery Negative Cable Replacement (LP1, LY7)** or **Battery Negative Cable Replacement (LS6)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.



**Fig. 64: Identifying J 42640**  
Courtesy of GENERAL MOTORS CORP.

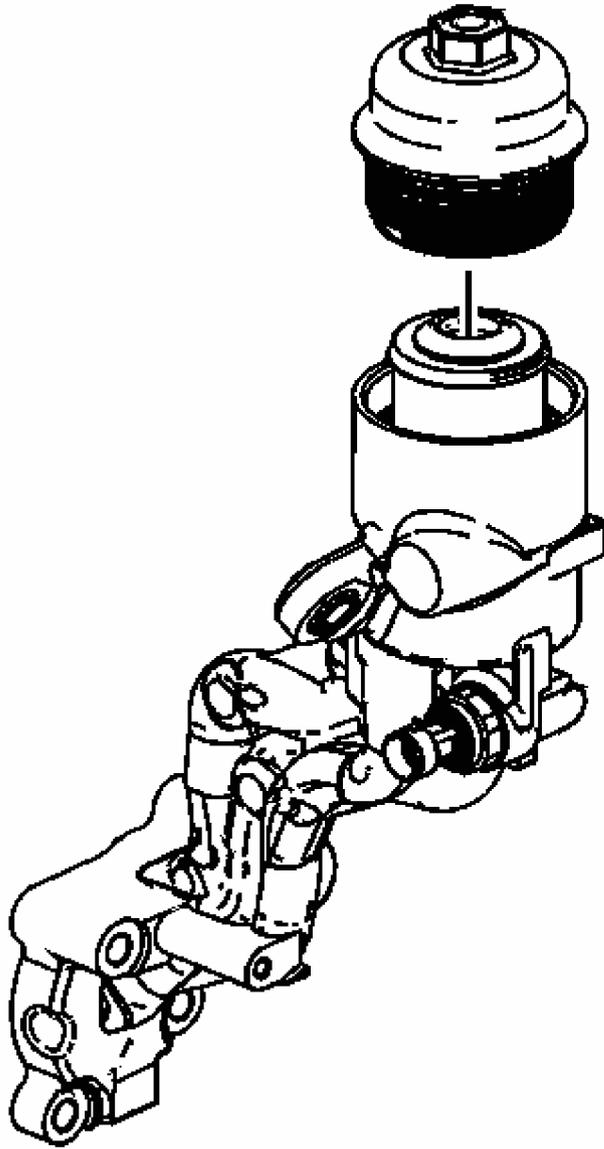
80. Install the **J 42640** from the steering column.
81. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7)** or **Draining and Filling Cooling System (LS6)** in Engine Cooling.
82. Charge the air conditioning system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
83. Bleed the brake rear circuits. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.

#### **ENGINE OIL AND OIL FILTER REPLACEMENT**

##### **Removal Procedure**

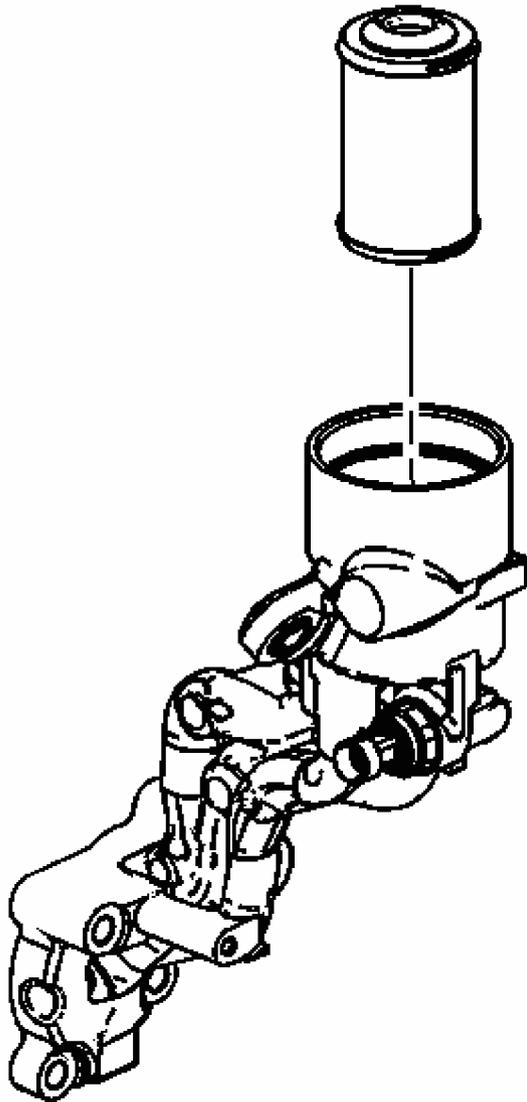
1. Turn the ignition OFF.

**IMPORTANT:** Use a six-point socket to remove the oil filter cap.



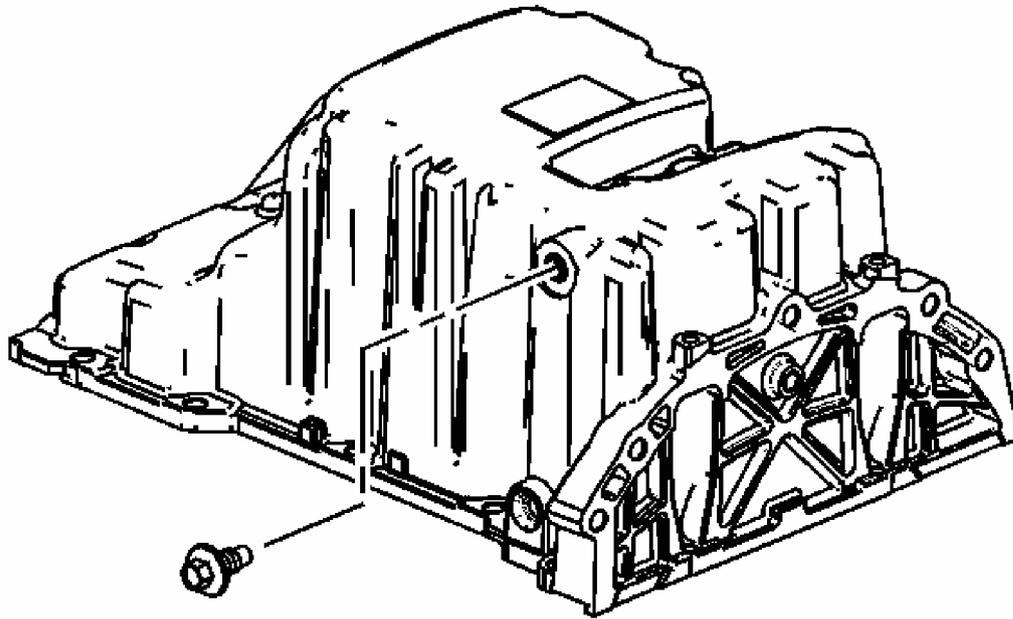
**Fig. 65: View Of Oil Filter Cap**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the oil filter cap.



**Fig. 66: View Of Oil Filter Cartridge**  
**Courtesy of GENERAL MOTORS CORP.**

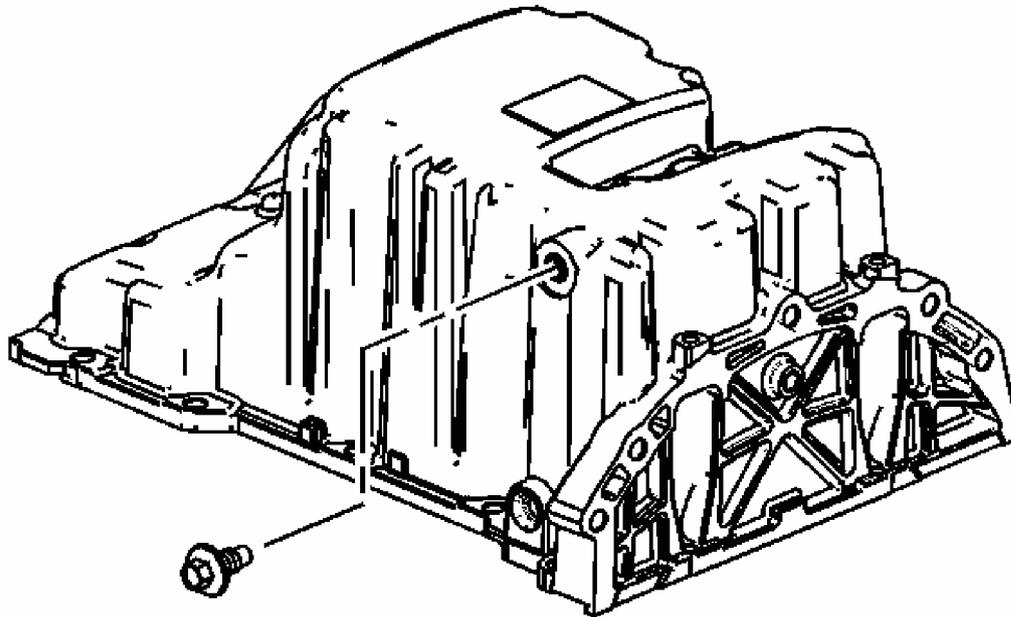
3. Remove and discard the oil filter cartridge.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Place a suitable drain below the oil pan drain plug.



**Fig. 67: View Of Oil Pan Drain Plug**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the oil pan drain plug.
7. Allow the oil to drain completely.

**Installation Procedure**



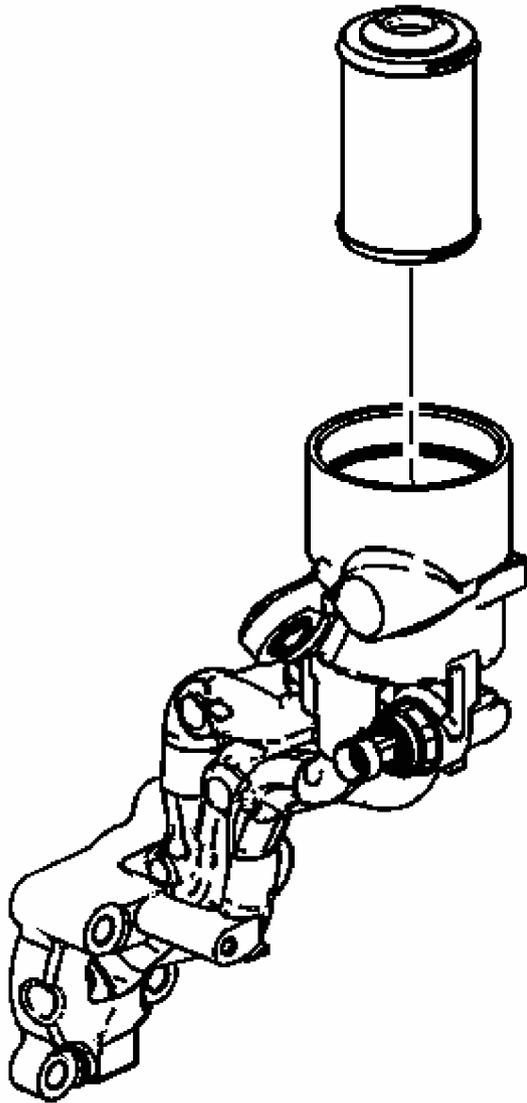
**Fig. 68: View Of Oil Pan Drain Plug**  
Courtesy of GENERAL MOTORS CORP.

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

1. Install the oil pan drain plug and NEW O-ring seal.

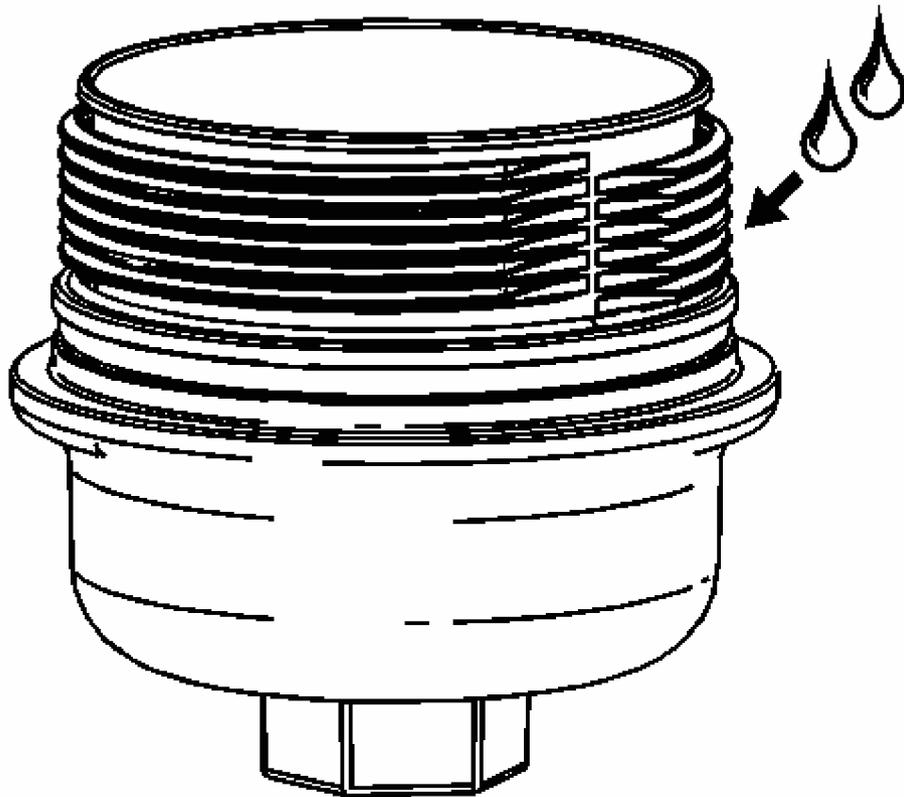
**Tighten:** Tighten the oil pan drain plug to 20 N.m (15 lb ft).

2. Lower the vehicle.



**Fig. 69: View Of Oil Filter Cartridge**  
**Courtesy of GENERAL MOTORS CORP.**

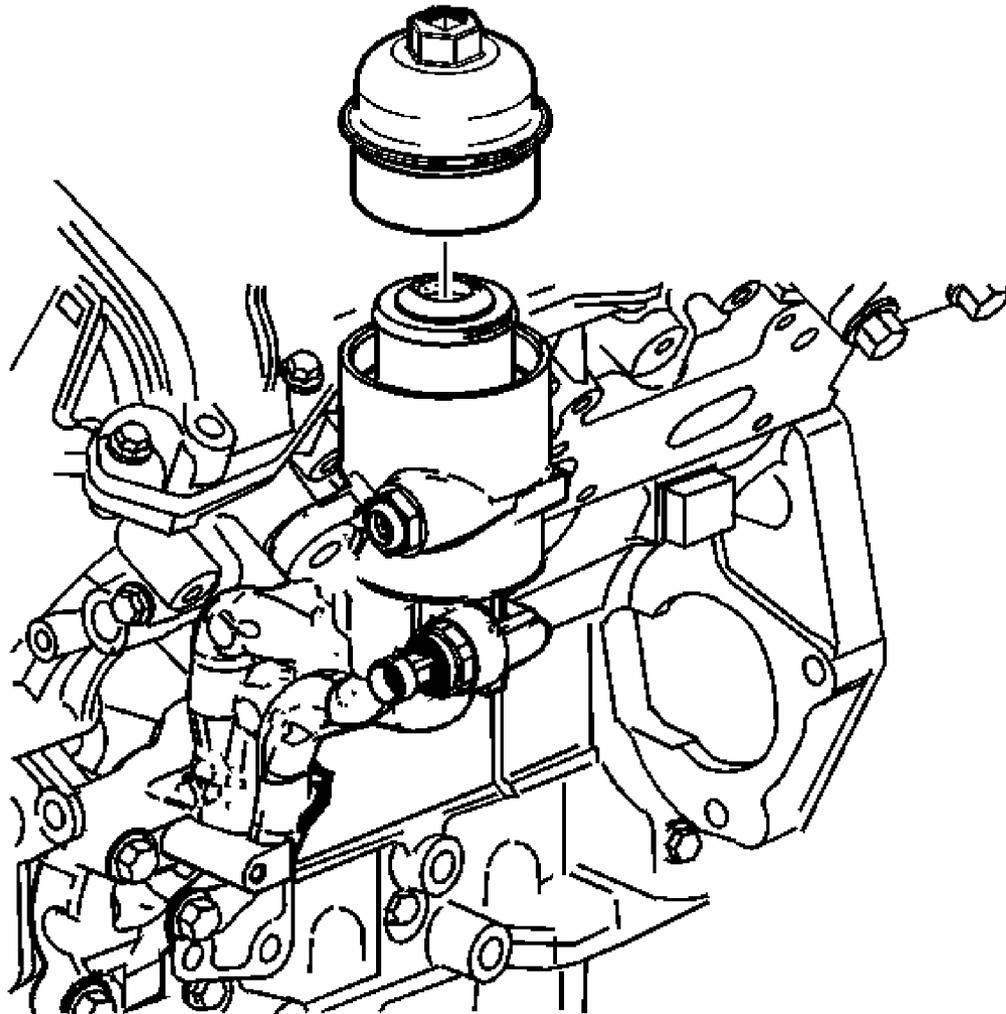
3. Install the NEW oil filter cartridge.



**Fig. 70: Lubricating Threads Of Oil Filter Cap**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Lubrication must be applied to the threads of the oil filter cap prior to installation. Failure to lubricate the oil filter cap threads can hinder later removal and cause possible oil filter cap damage.

4. Lubricate the oil filter cap threads with clean engine oil.



**Fig. 71: Installing Oil Filter Cap**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Proper oil filter cap tightening is mandatory. Failure to tighten the oil filter cap to the proper specification can hinder later removal and cause possible oil filter cap damage.

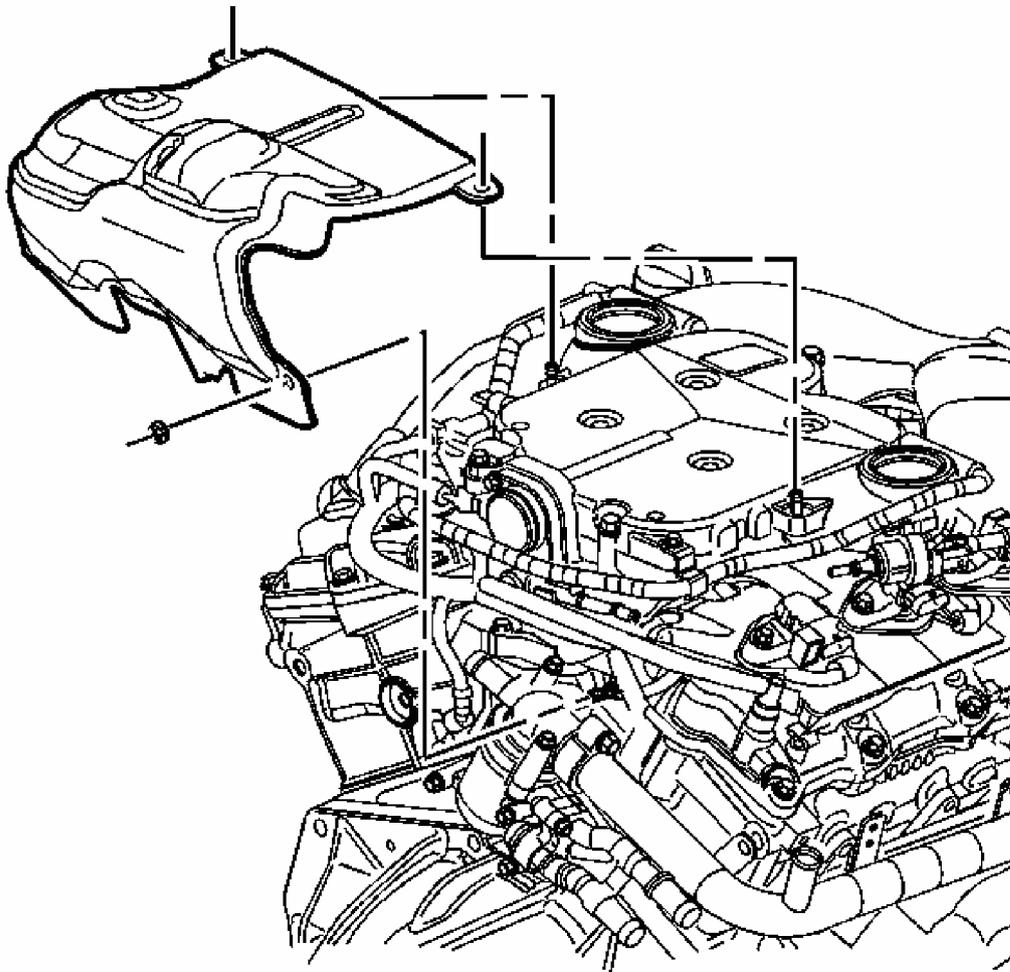
**IMPORTANT:** Use a six-point socket to install the oil filter cap.

5. Install the oil filter cap.

**Tighten:** Tighten the oil filter cap to 25 N.m (18 lb in).

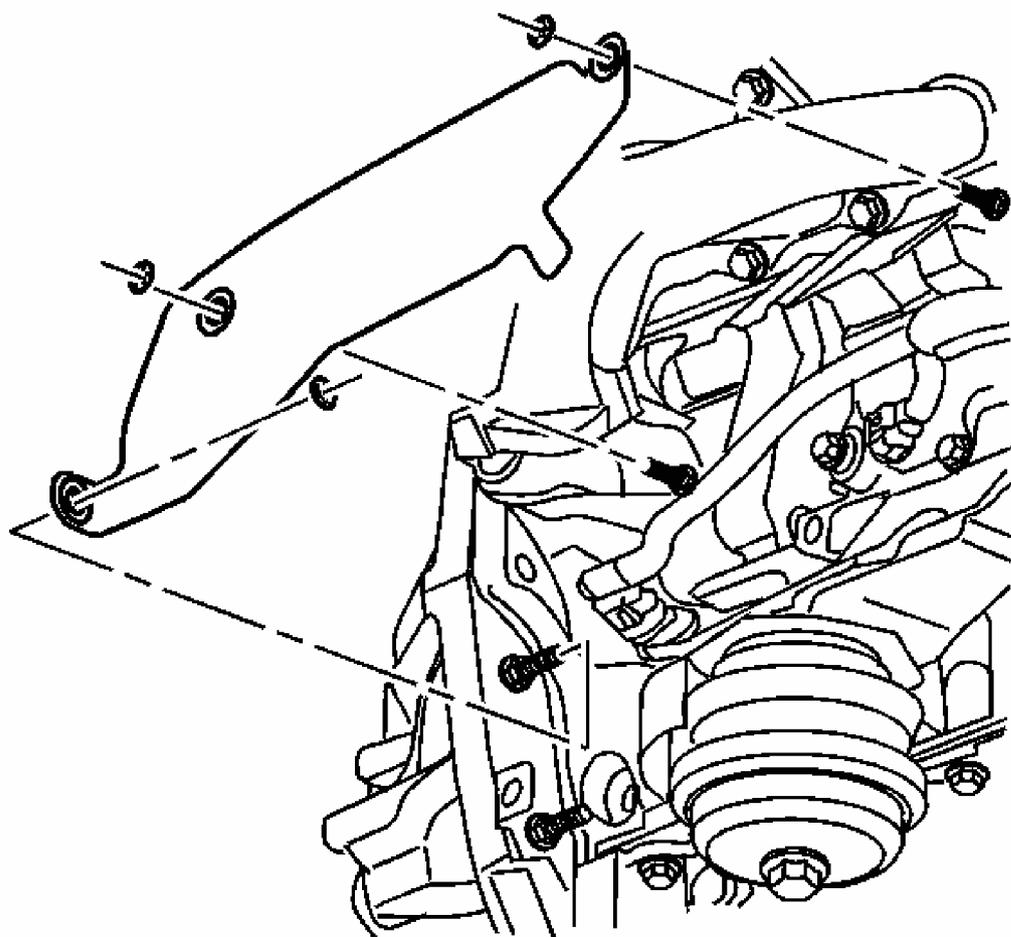
6. Install the oil fill cap.
7. Fill the engine with the appropriate oil type and quantity. Refer to **Fluid and Lubricant Recommendations** and **Capacities - Approximate Fluid** in Maintenance and Lubrication.

#### **ENGINE WIRING HARNESS ASSEMBLY REMOVAL**



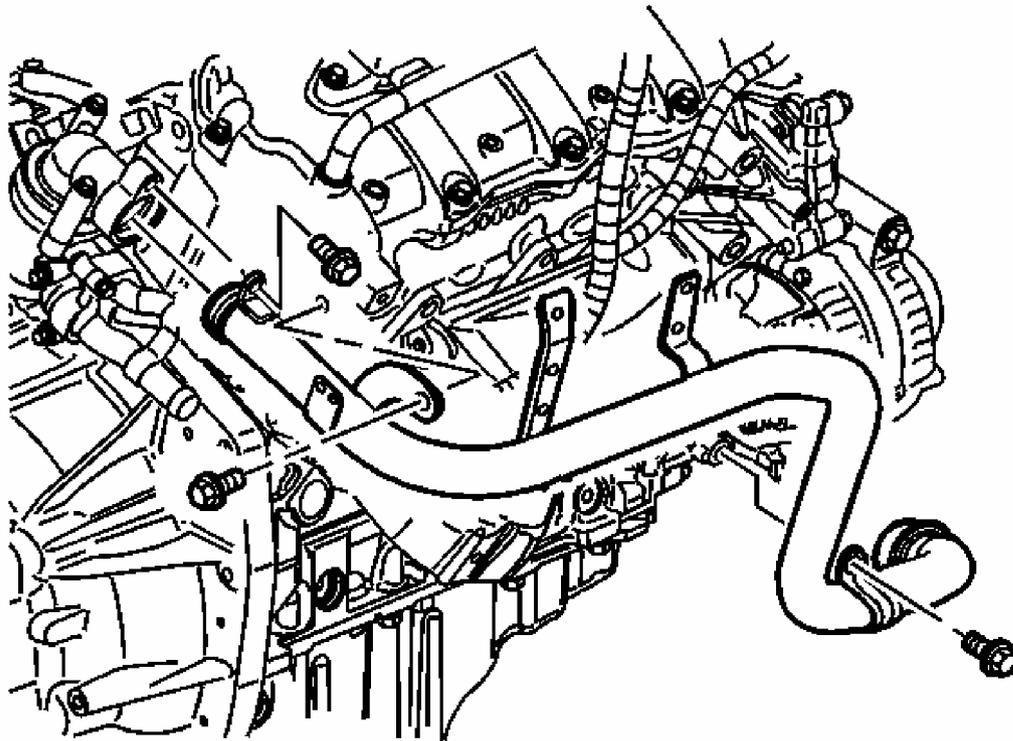
**Fig. 72: View Of Intake Manifold Insulator**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the intake manifold insulator nut.
2. Remove the intake manifold insulator.



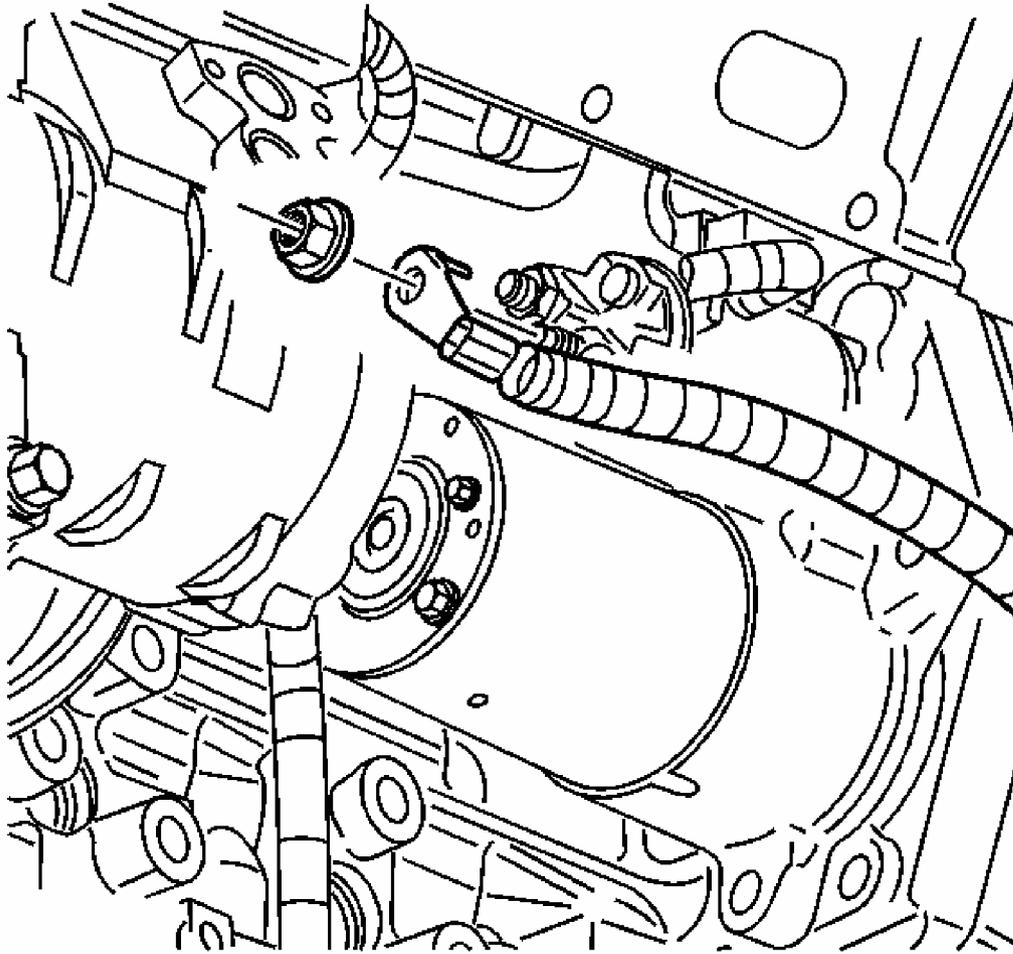
**Fig. 73: View Of Exhaust Manifold Lower Insulator Shield**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the right exhaust manifold lower insulator nuts.
4. Remove the right exhaust manifold lower insulator shield.



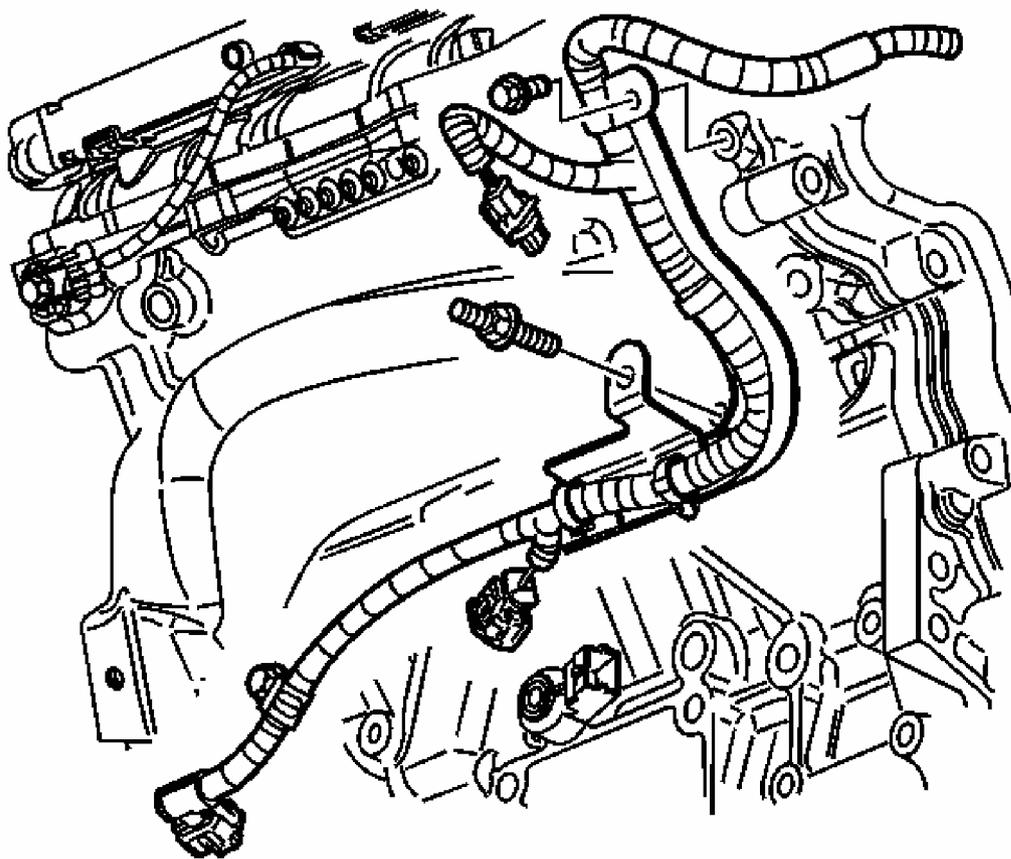
**Fig. 74: View Of Radiator Outlet Pipe & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the radiator outlet pipe bolts.
6. Remove the radiator outlet pipe.



**Fig. 75: View Of Battery Cable Harness At Starter Motor**  
**Courtesy of GENERAL MOTORS CORP.**

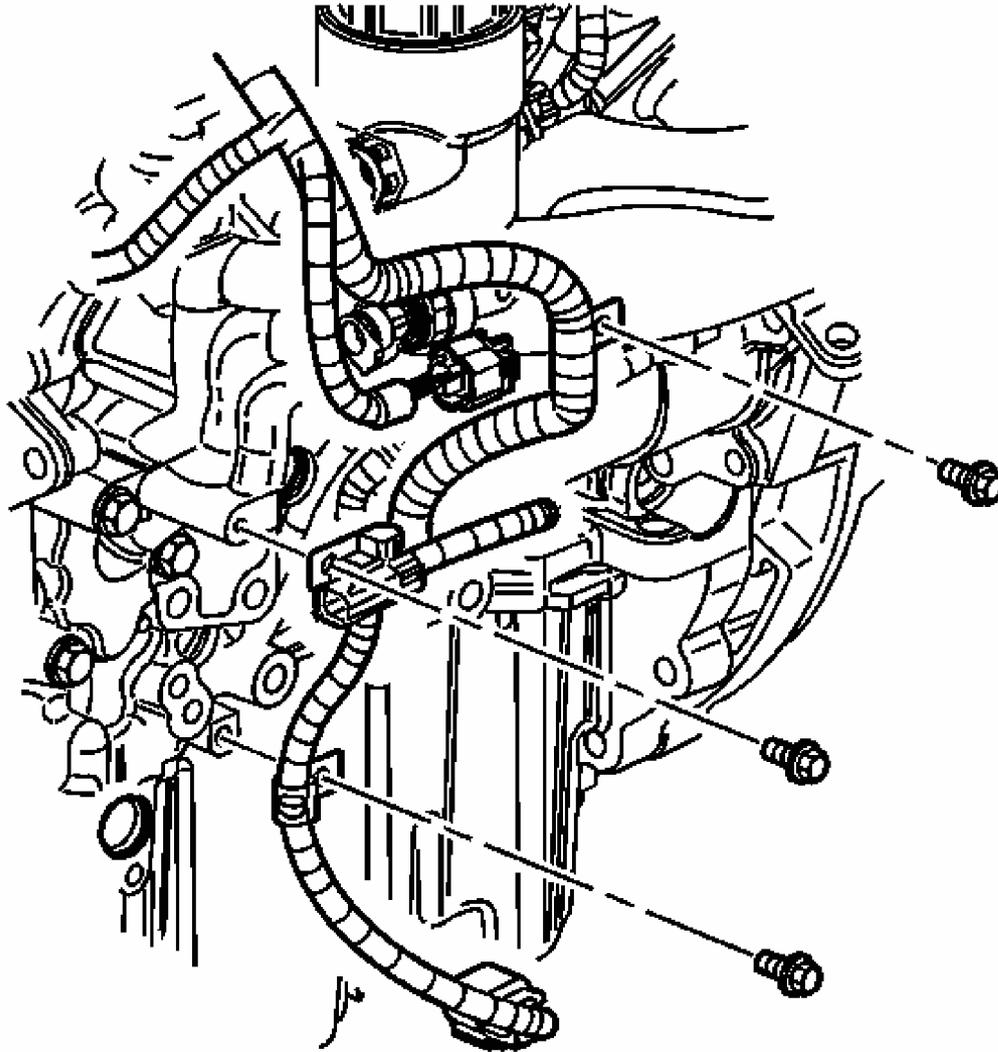
7. Disconnect the battery cable harness from the starter motor.



**Fig. 76: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud**

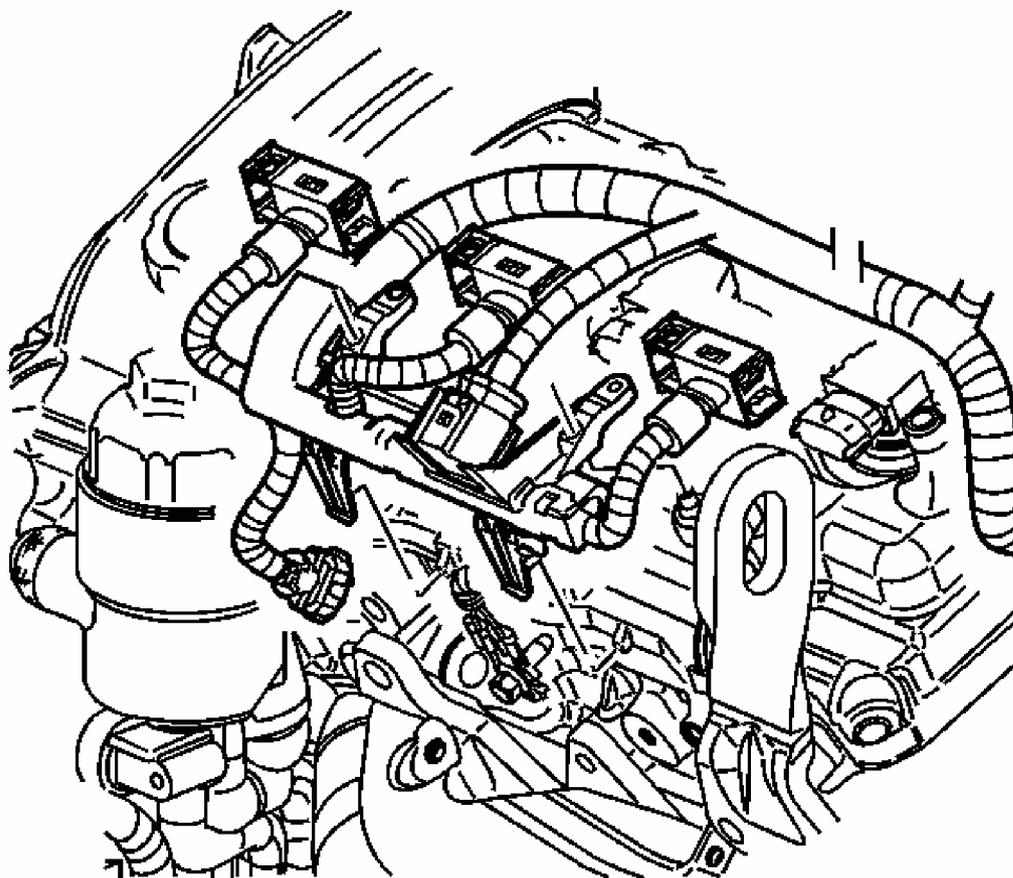
**Courtesy of GENERAL MOTORS CORP.**

8. Remove the engine wiring harness bracket bolt and stud from the lower right side of the engine.



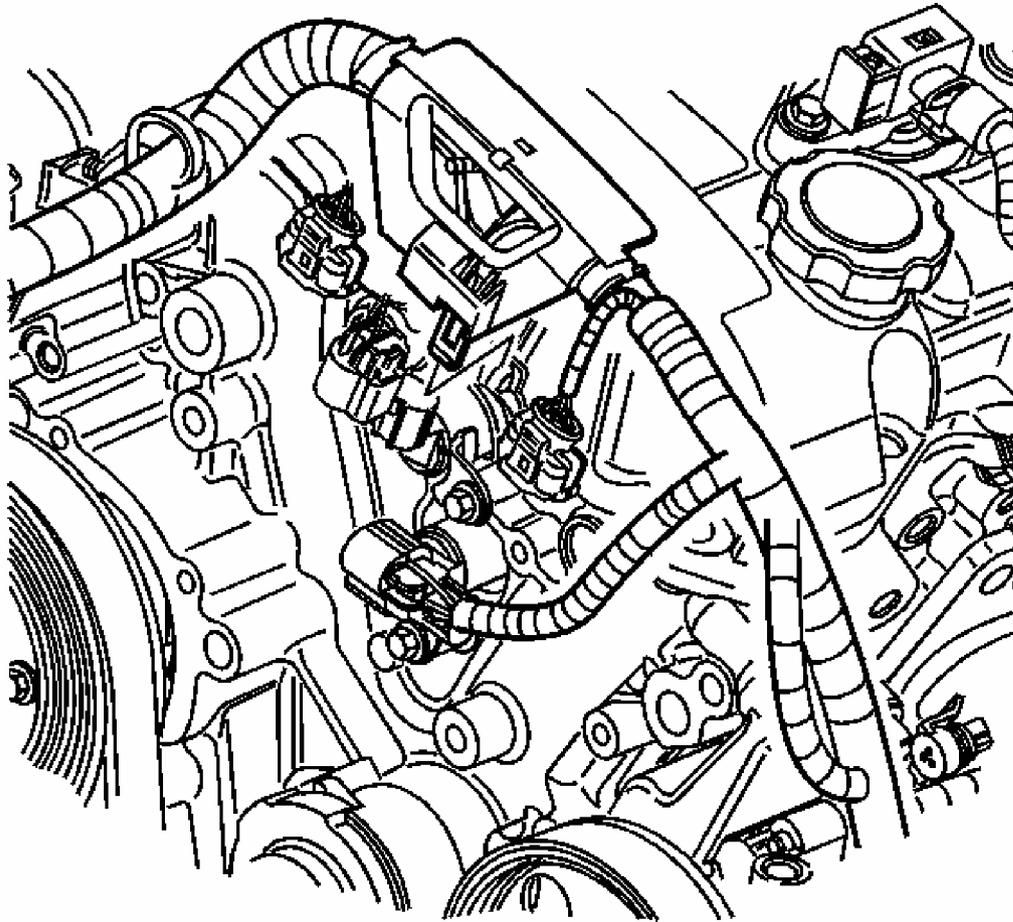
**Fig. 77: View Of Left Wiring Harness Conduit**  
**Courtesy of GENERAL MOTORS CORP.**

9. Remove the engine wiring harness bracket bolts from the lower left side of the engine.



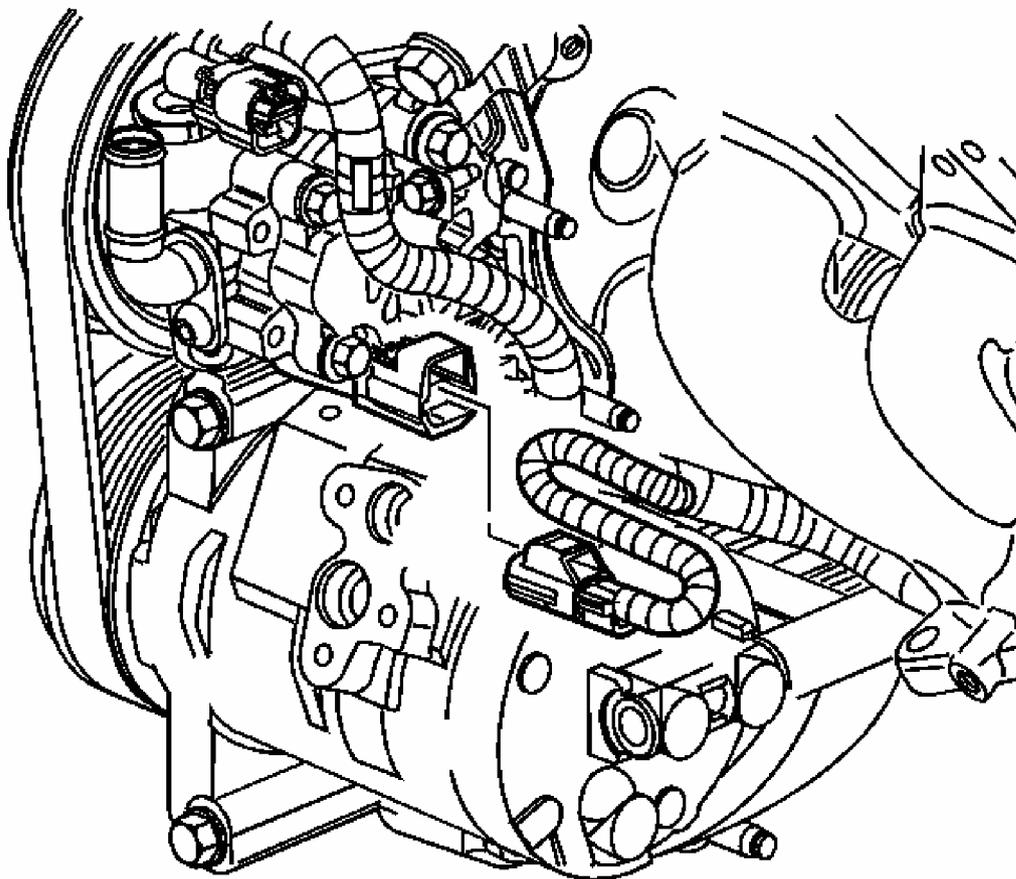
**Fig. 78: View Of Left Camshaft Cover Wiring Harness Connectors**  
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the engine wiring harness from the top of the left camshaft cover.



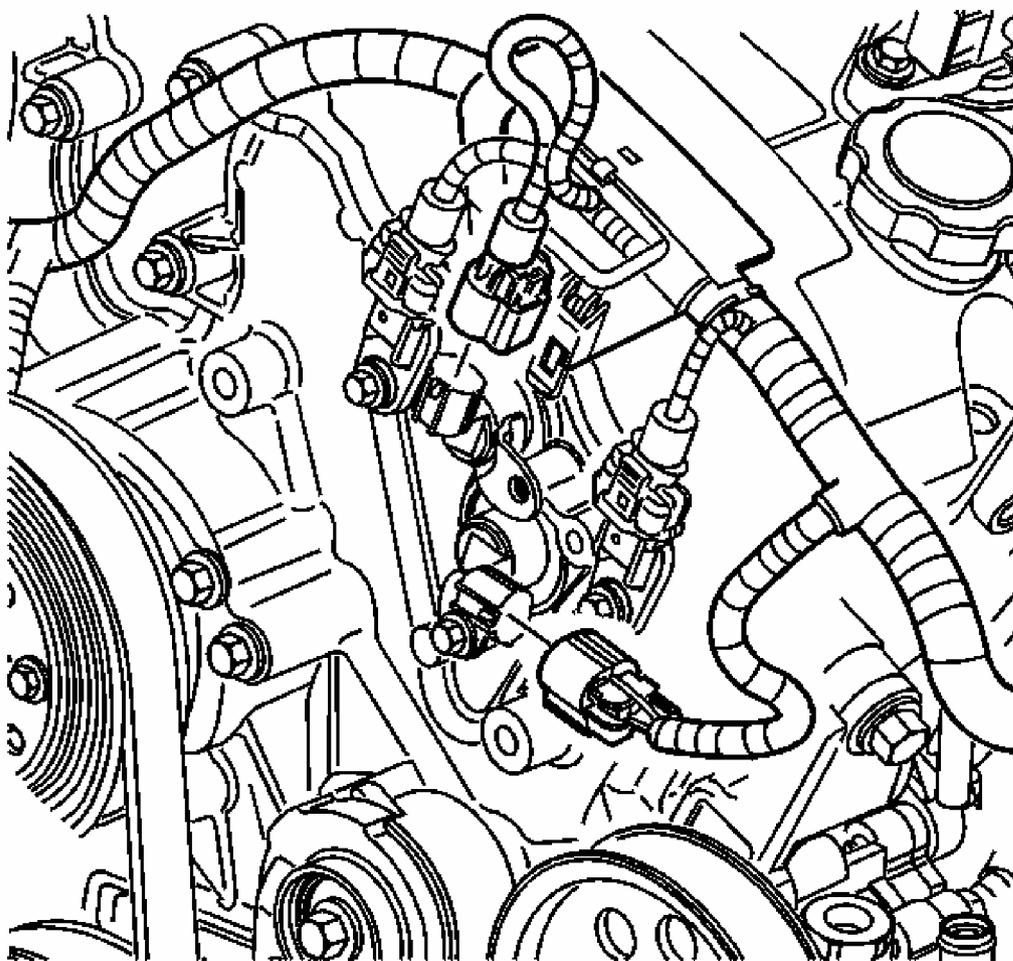
**Fig. 79: View Of Left Camshaft Cover Wiring Harness Connector - Front**  
**Courtesy of GENERAL MOTORS CORP.**

11. Disconnect the engine wiring harness from the front of the left camshaft cover.



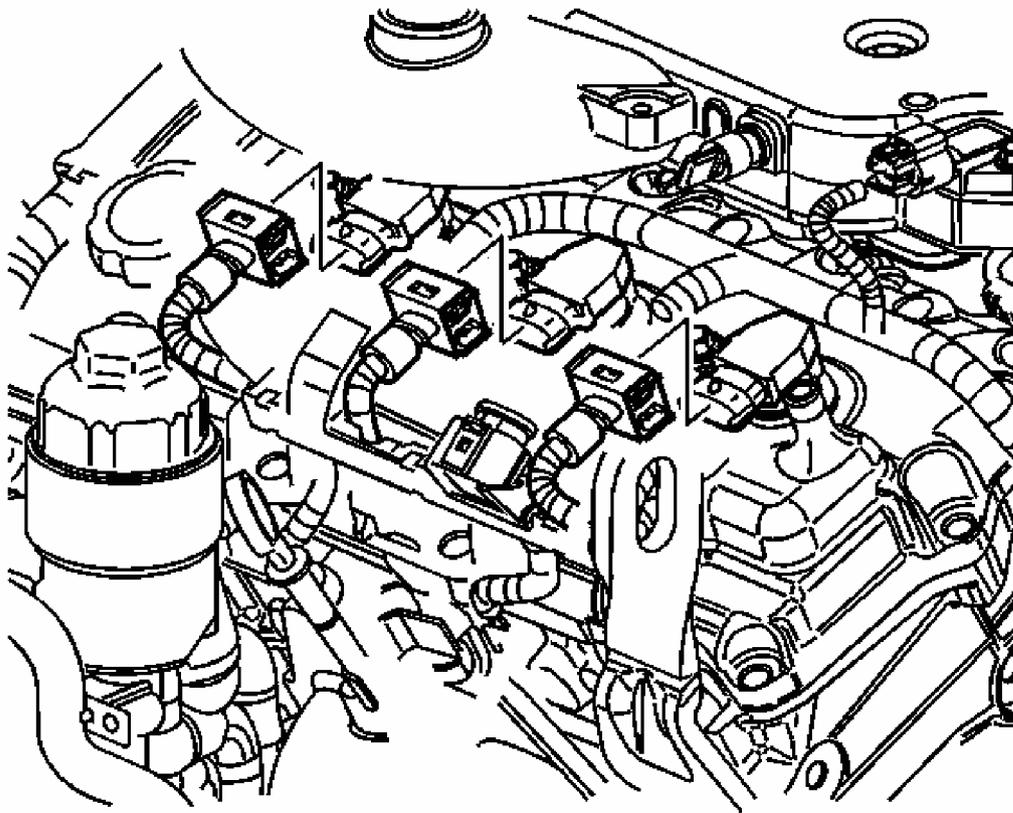
**Fig. 80: View Of A/C Compressor Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

12. Disconnect the engine wiring harness from the A/C compressor.



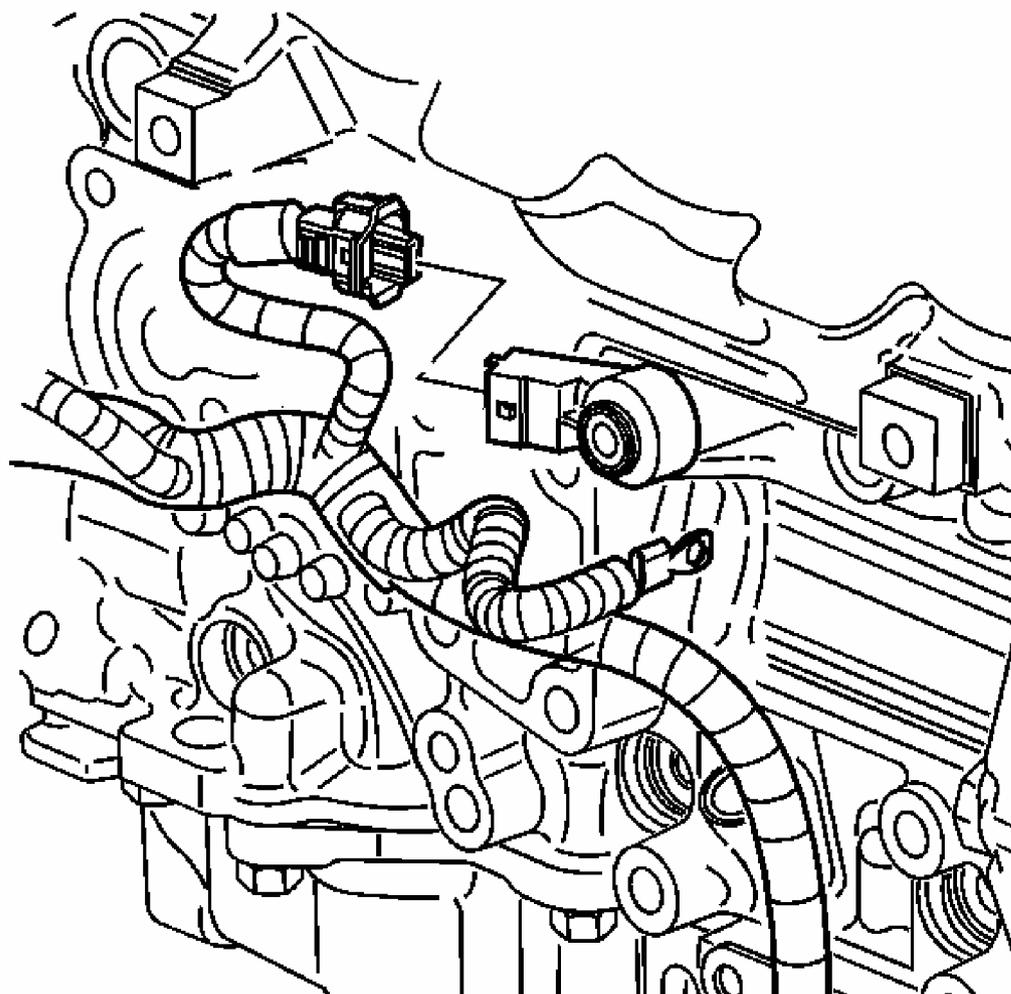
**Fig. 81: View Of Left Camshaft Position Actuator Valve Electrical Connectors**  
Courtesy of GENERAL MOTORS CORP.

13. Disconnect the engine wiring harness from the left camshaft position actuator valves.



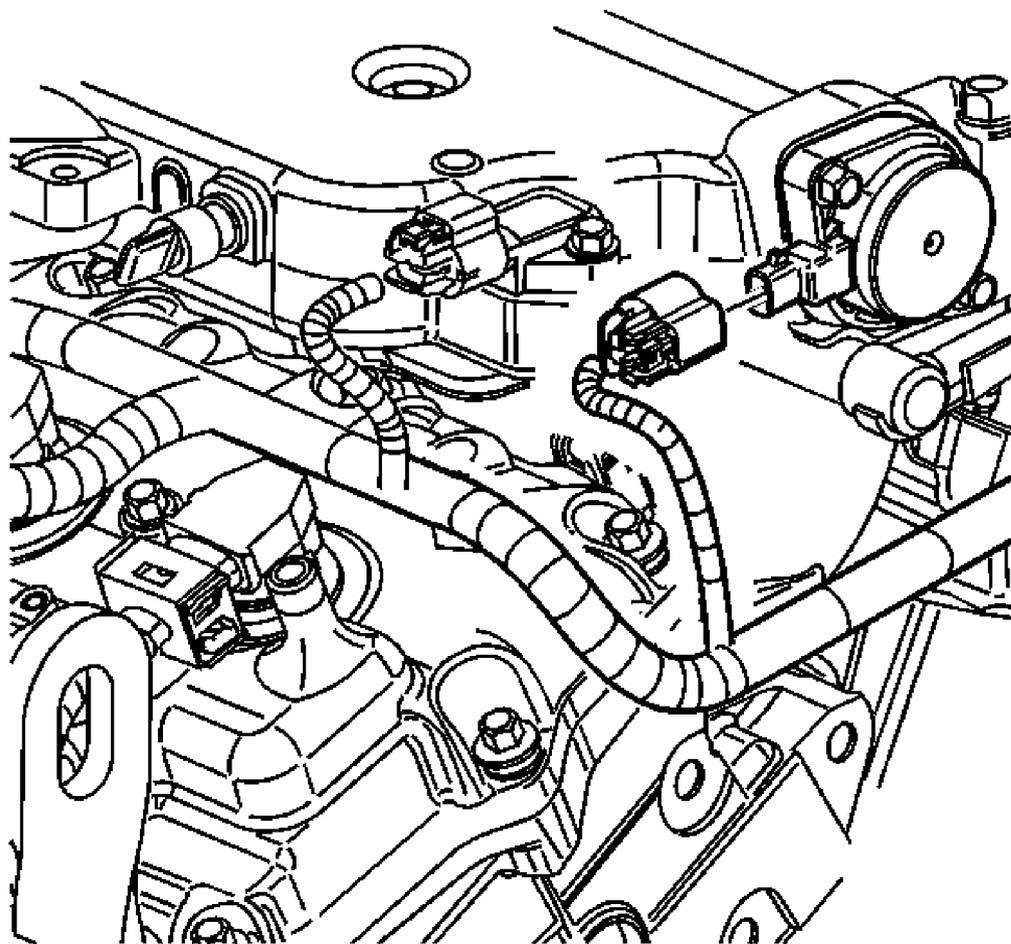
**Fig. 82: View Of Left Ignition Coils Wiring Harness Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

14. Disconnect the engine wiring harness from the left ignition coils.



**Fig. 83: View Of Left Knock Sensor And Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

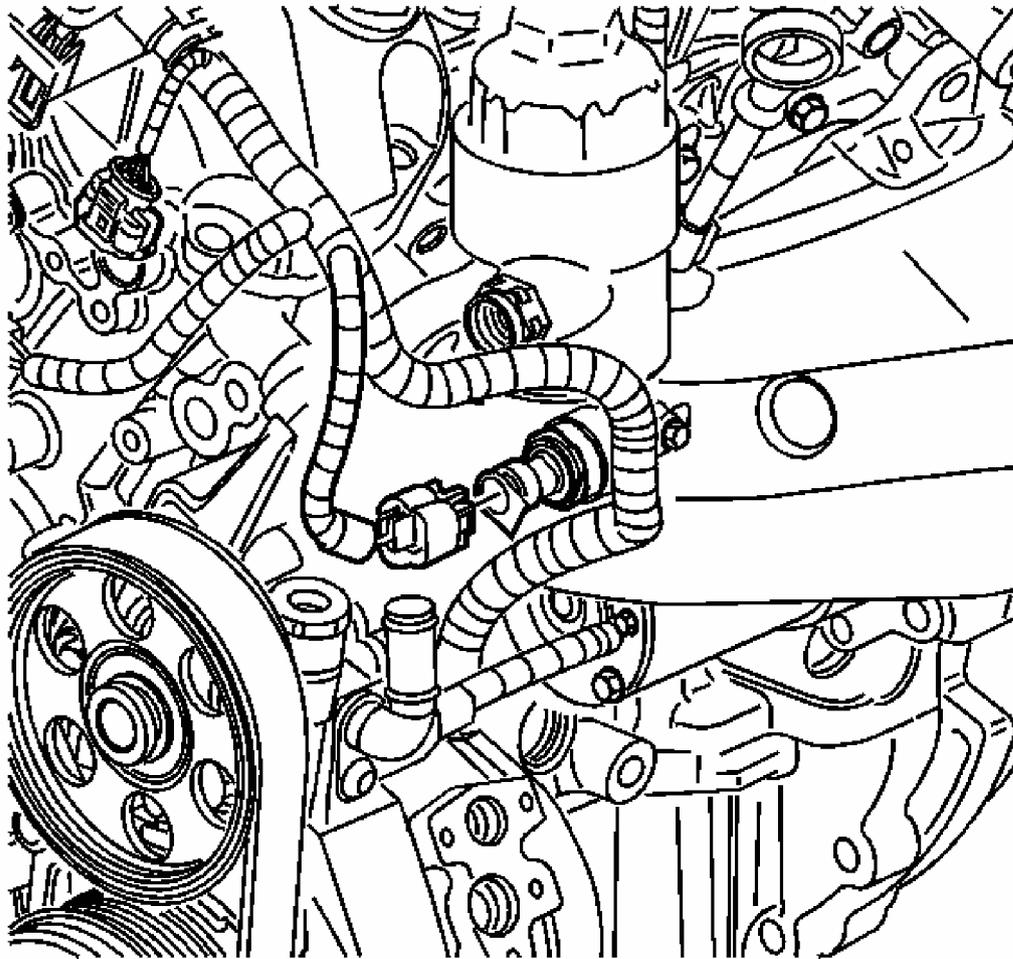
15. Disconnect the engine wiring harness from the left knock sensor.



**Fig. 84: View Of Communicator And Intake Manifold Runner Control Solenoid Electrical Connectors**

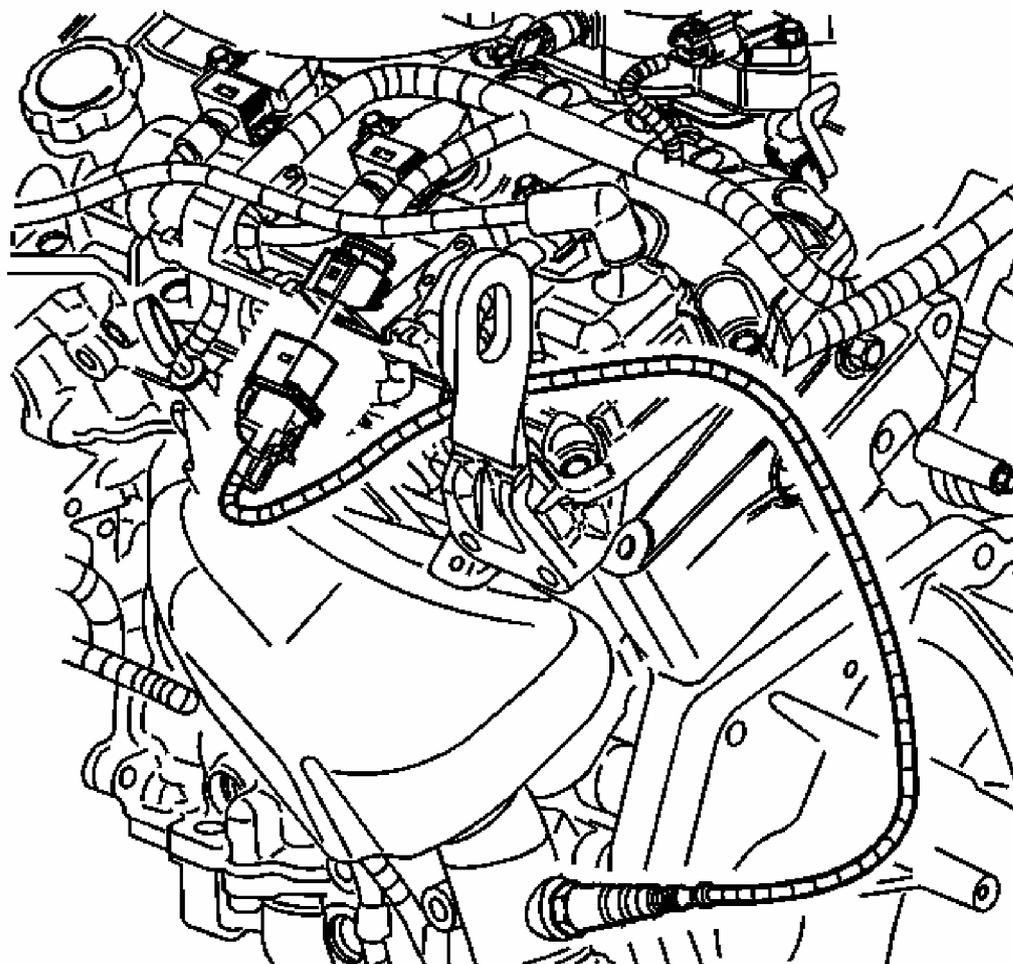
**Courtesy of GENERAL MOTORS CORP.**

16. Disconnect the engine wiring harness from the communicator valve.



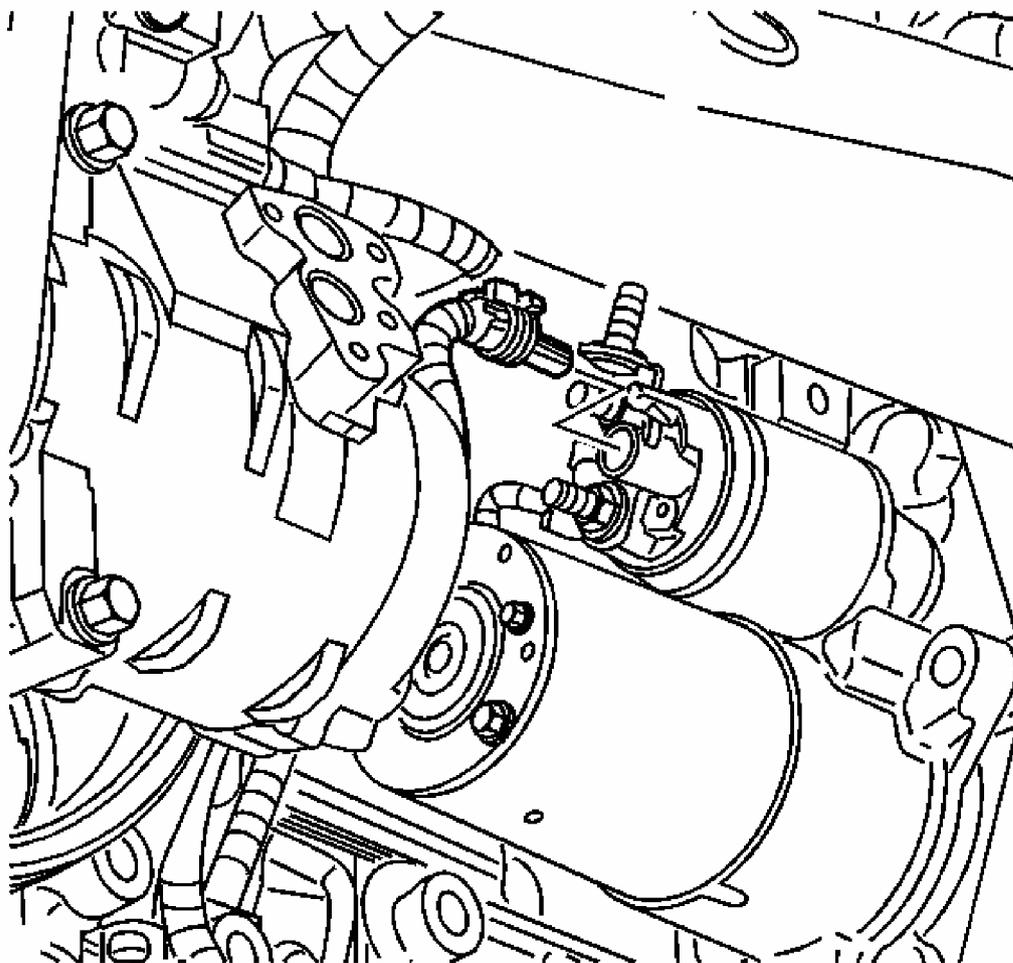
**Fig. 85: View Of Oil Pressure Sensor Wiring Harness**  
**Courtesy of GENERAL MOTORS CORP.**

17. Disconnect the engine wiring harness from the oil pressure sender.



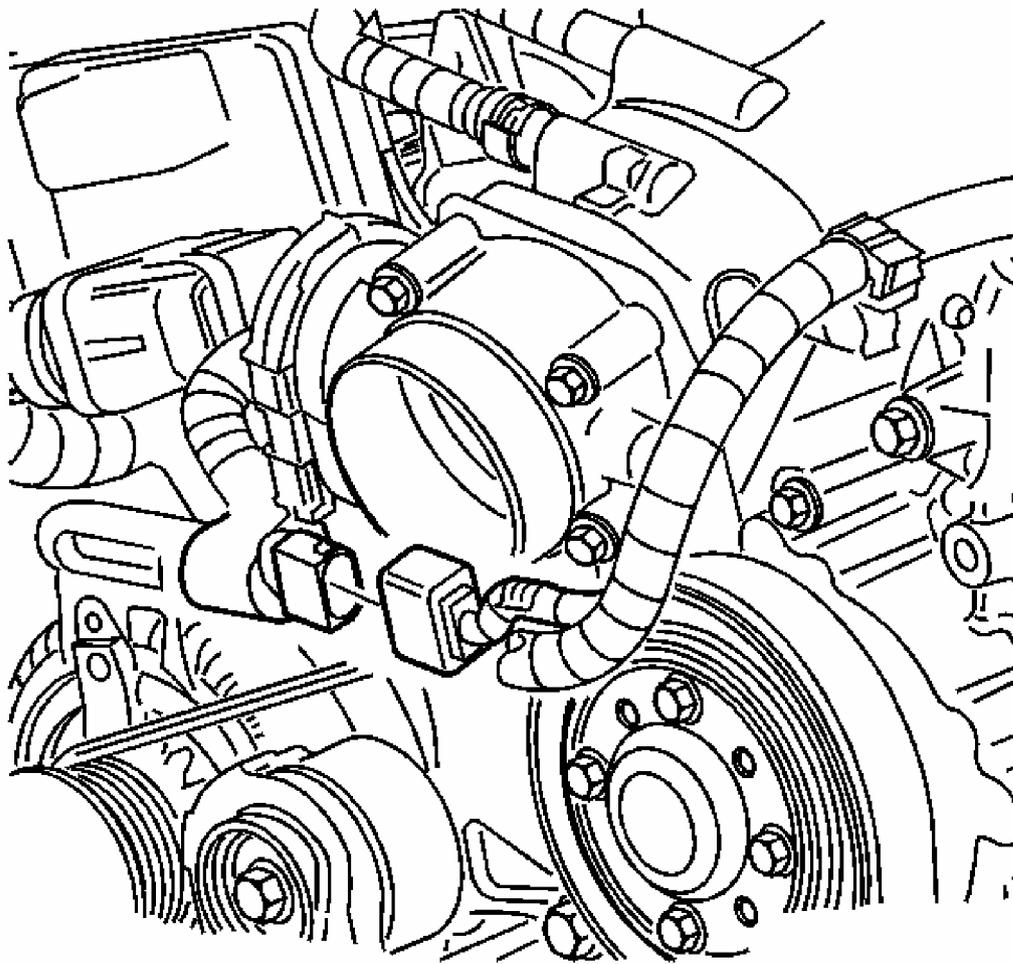
**Fig. 86: View Of Left Oxygen Sensor Harness Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

18. Disconnect the engine wiring harness from the left oxygen sensor harness.



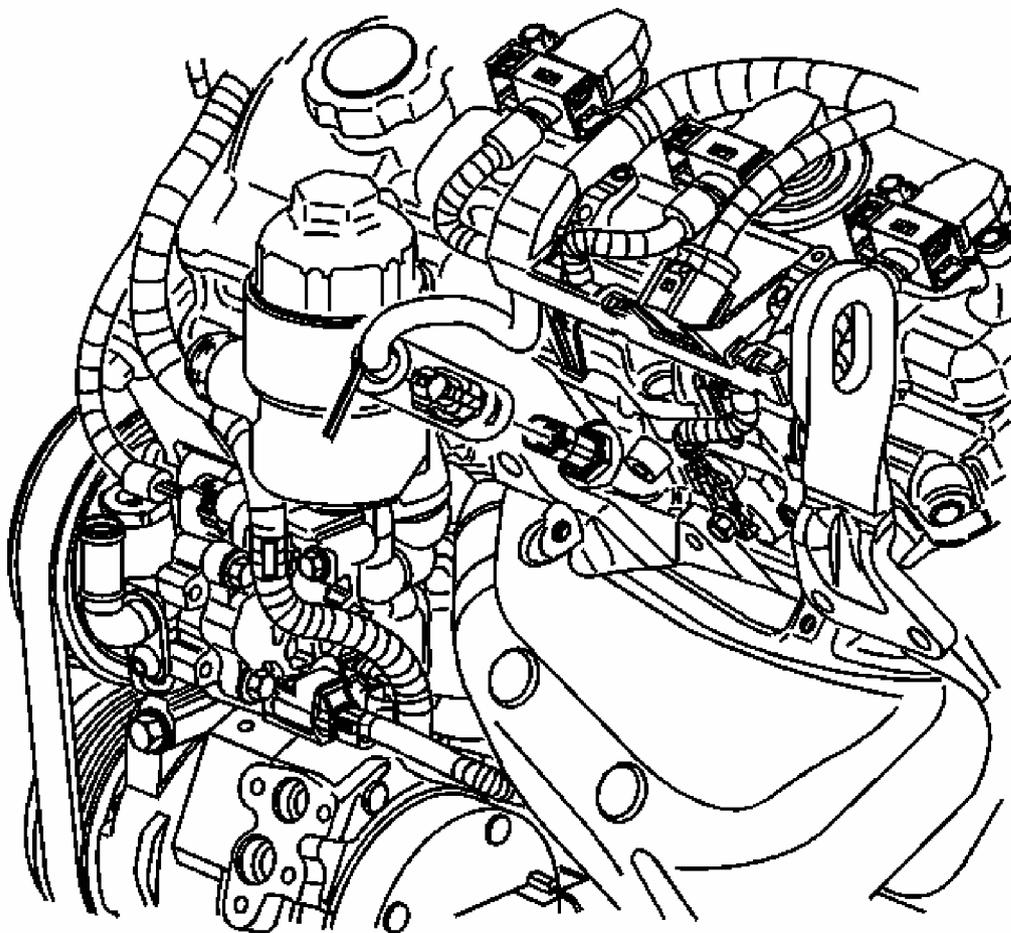
**Fig. 87: View Of Starter Motor Solenoid Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

19. Disconnect the engine wiring harness from the starter motor solenoid.



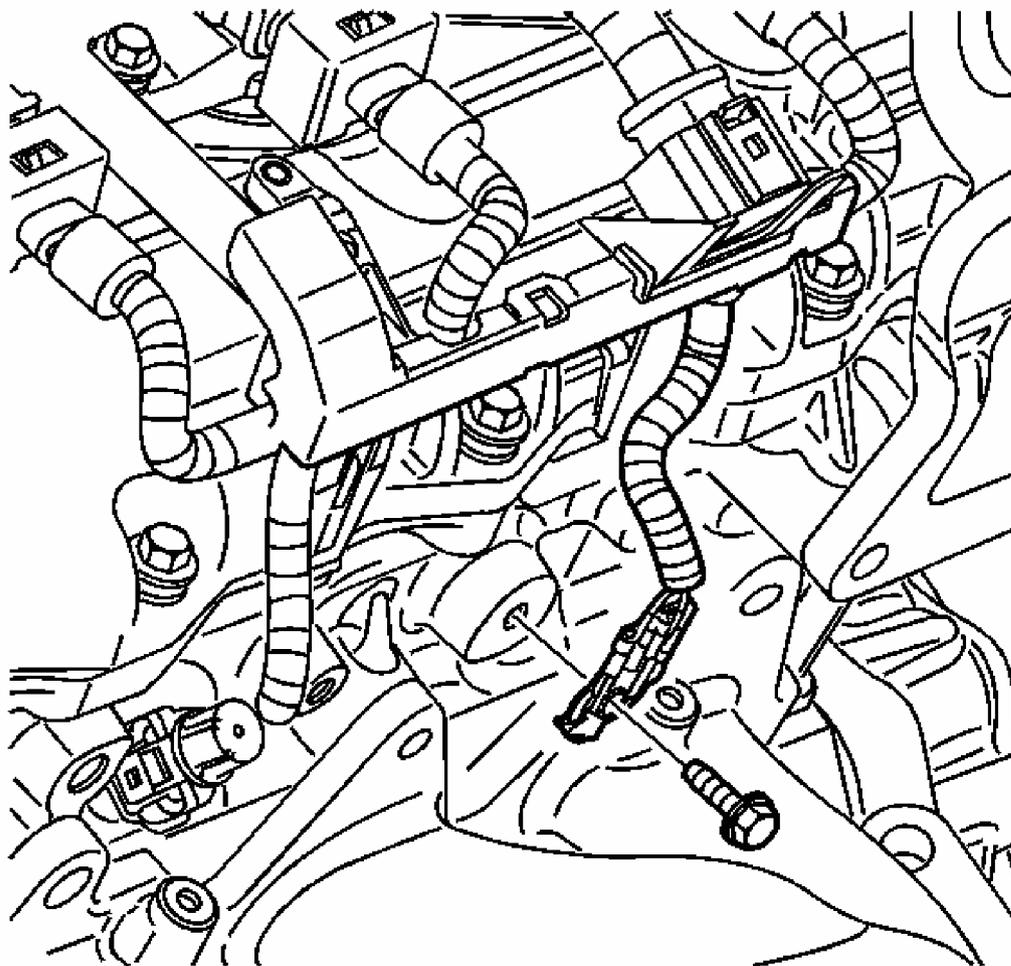
**Fig. 88: View Of Throttle Body Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** DO NOT use any mechanical device such as pliers or screwdrivers to disengage the connector. In order to prevent damage to the connector or harness wiring, both of the latches on the connector must be depressed with finger pressure only. When the latches are depressed the connector must then be pulled straight back without pulling on the wires in order to disengage. Failure to follow this procedure can lead to connector or wiring harness damage and failure.



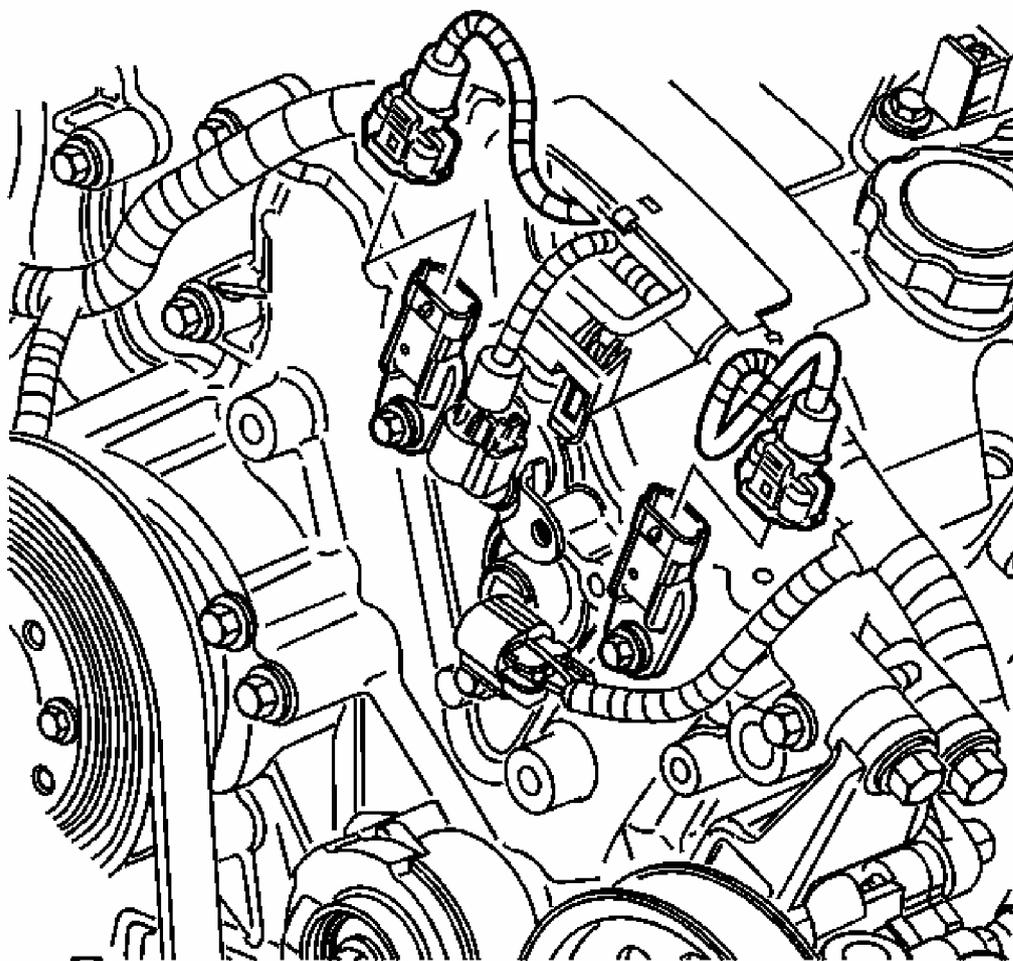
**Fig. 89: View Of Coolant Temperature Sensor And Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

21. Disconnect the engine wiring harness from the engine coolant temperature (ECT) sensor.



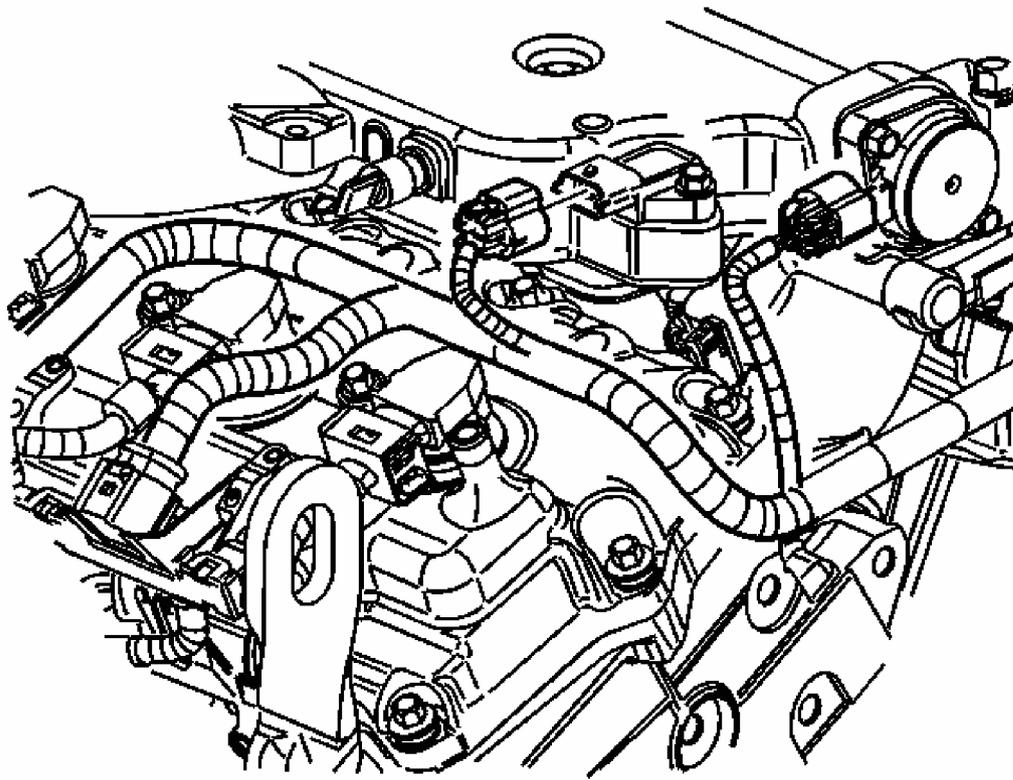
**Fig. 90: View Of Left Cylinder Head Wiring Harness Ground Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

22. Remove the engine wiring harness ground bolt from the left cylinder head.



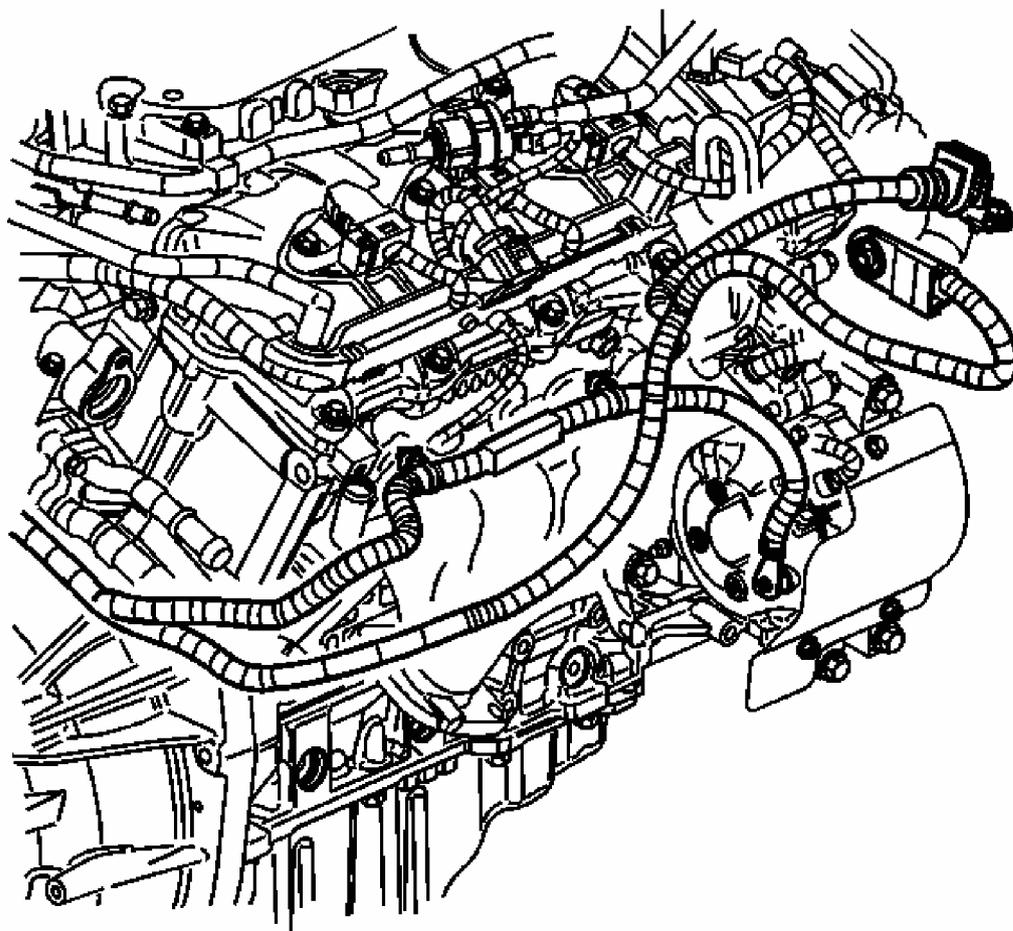
**Fig. 91: View Of Left Camshaft Position Sensors Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

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



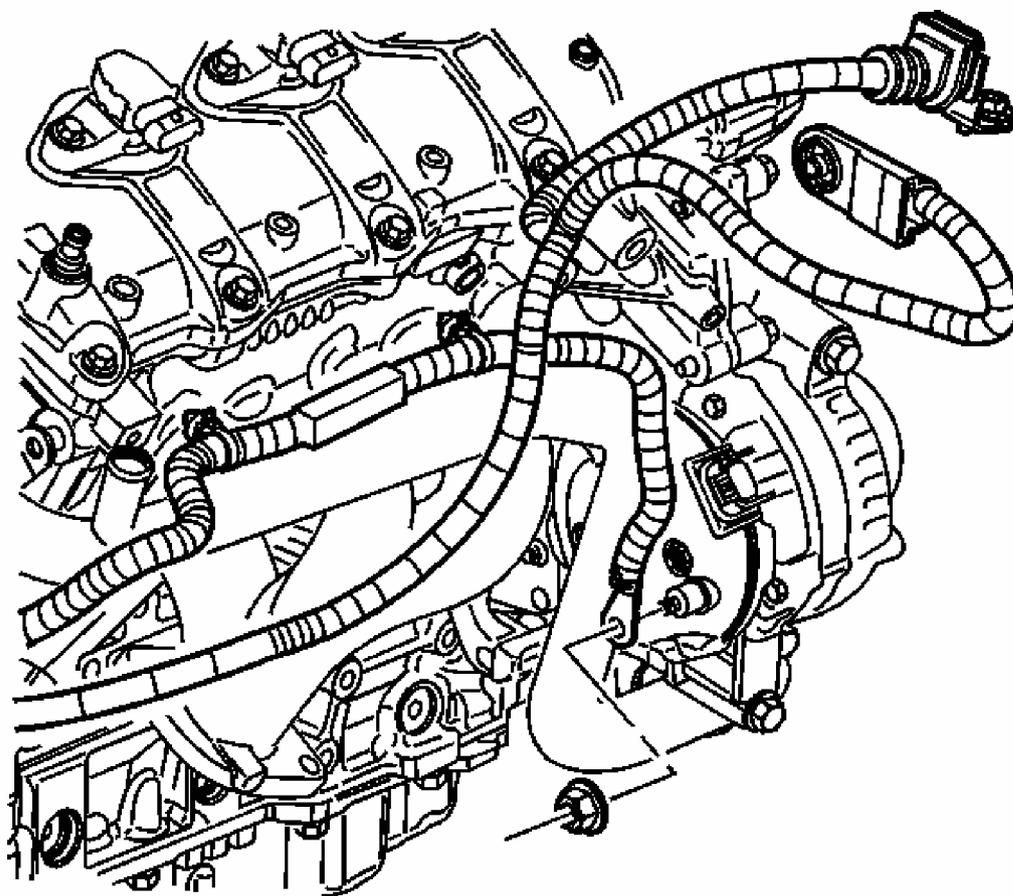
**Fig. 92: Identifying Barometric Pressure Sensor And Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

24. Disconnect the engine wiring harness from the barometric (BARO) sensor.



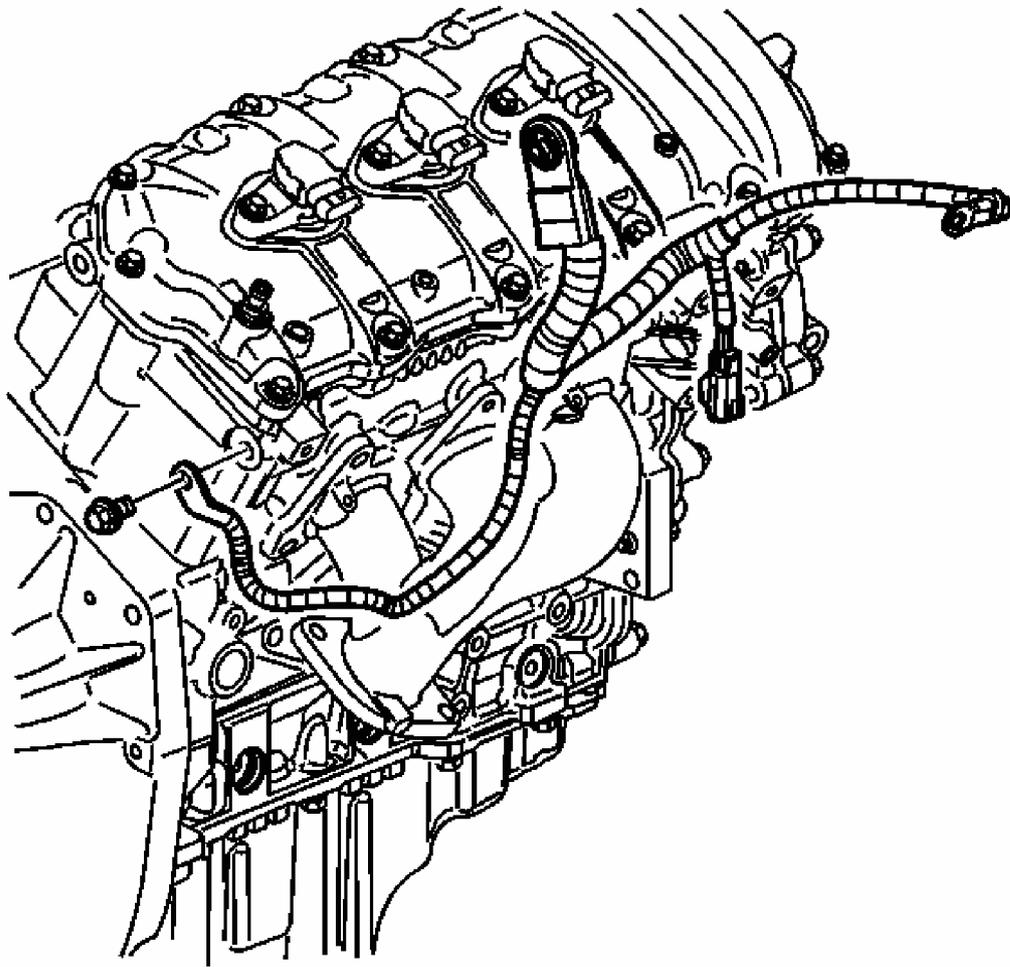
**Fig. 93: View Of Right Battery Cable Harness At Right Side Of Engine**  
Courtesy of GENERAL MOTORS CORP.

25. Disconnect the battery cable harness from the right side of the engine.



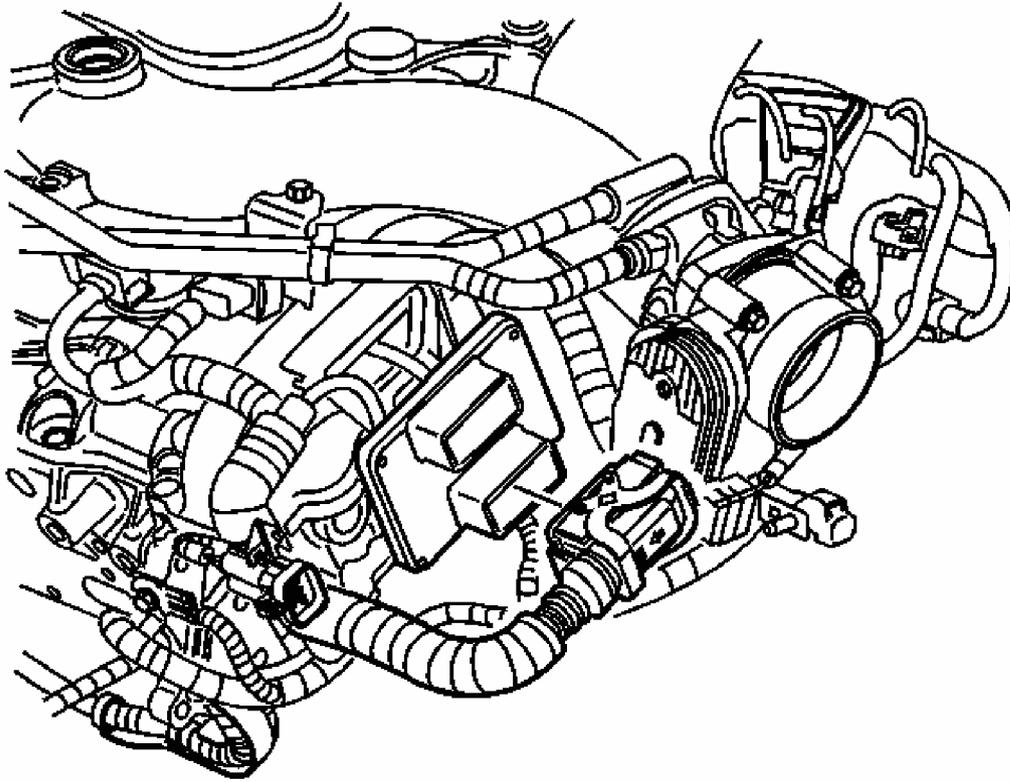
**Fig. 94: View Of Generator Battery Cable**  
**Courtesy of GENERAL MOTORS CORP.**

26. Remove the battery cable/generator nut from the generator.
27. Disconnect the battery cable from the generator.



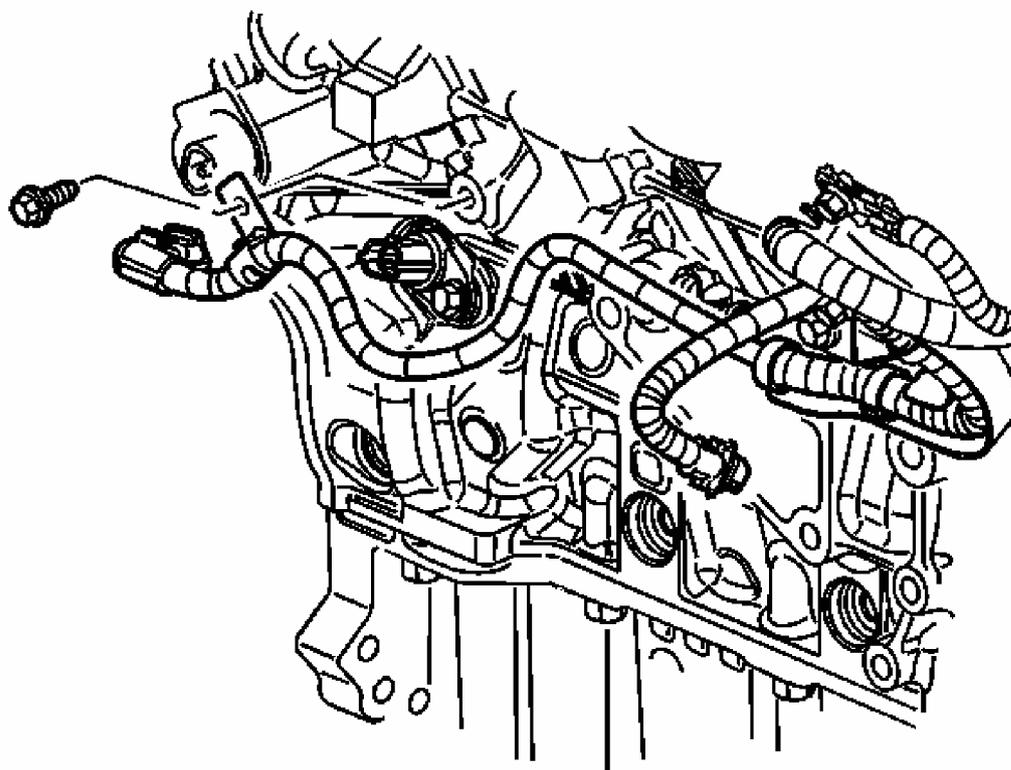
**Fig. 95: View Of Battery Cable Ground At Rear Of Right Cylinder Head**  
**Courtesy of GENERAL MOTORS CORP.**

28. Remove the battery cable ground bolt from the rear of the right cylinder head.
29. Remove the battery cable ground.



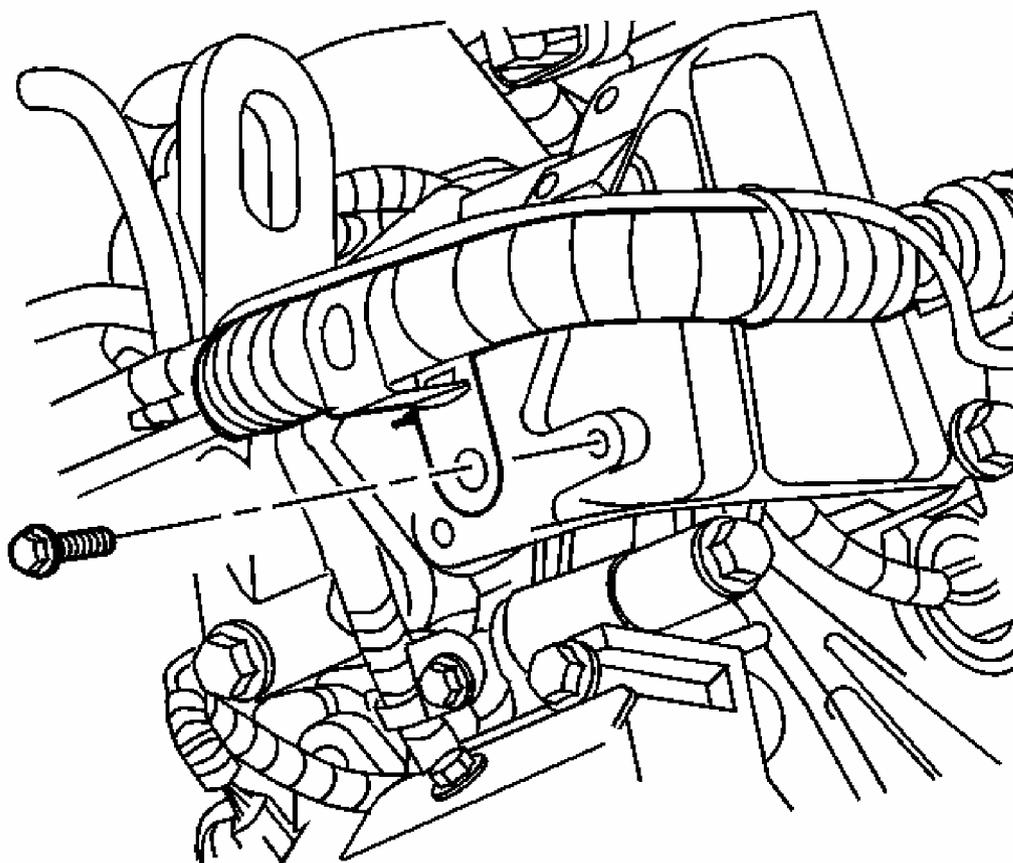
**Fig. 96: View Of ECM Wiring Harness Connector**  
**Courtesy of GENERAL MOTORS CORP.**

30. Disconnect the engine wiring harness from the engine control module (ECM).



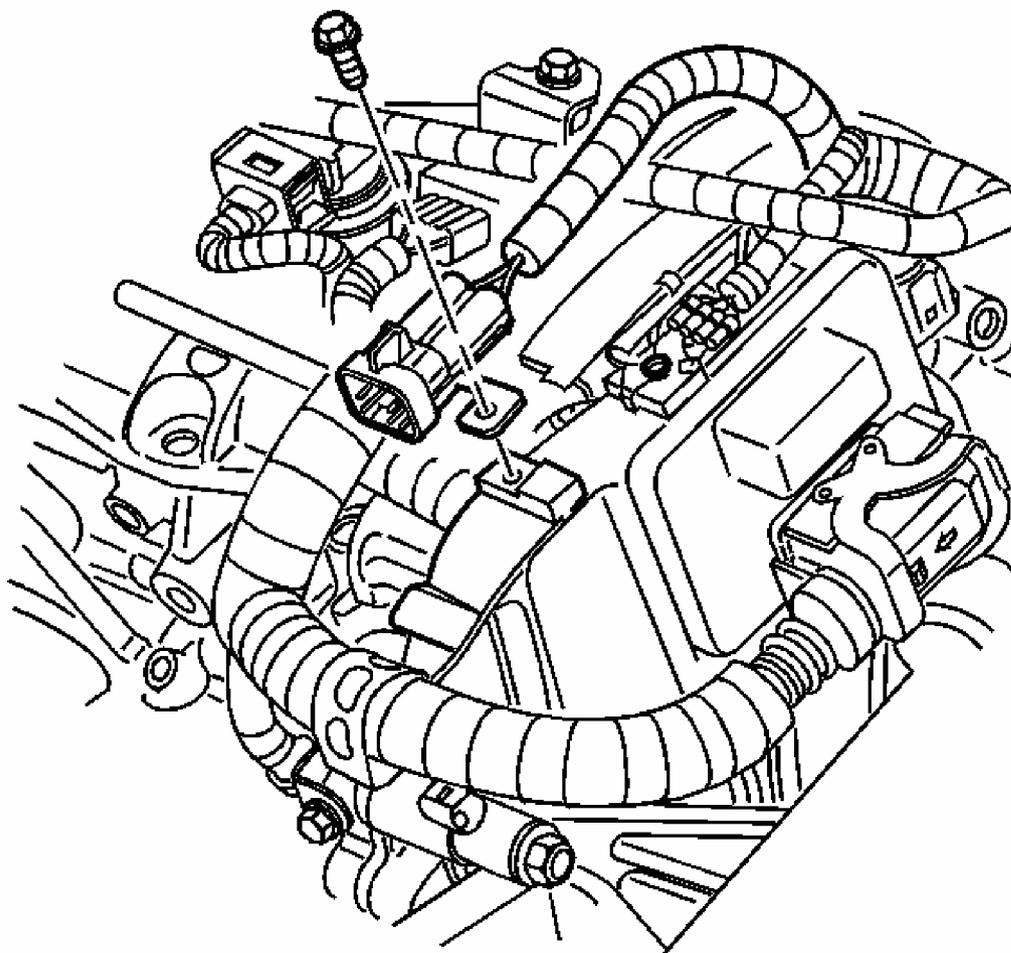
**Fig. 97: View Of Engine Wiring Harness Bracket Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

31. Disconnect the engine wiring harness from the crankshaft position sensor.
32. Remove the engine wiring harness bracket bolt.



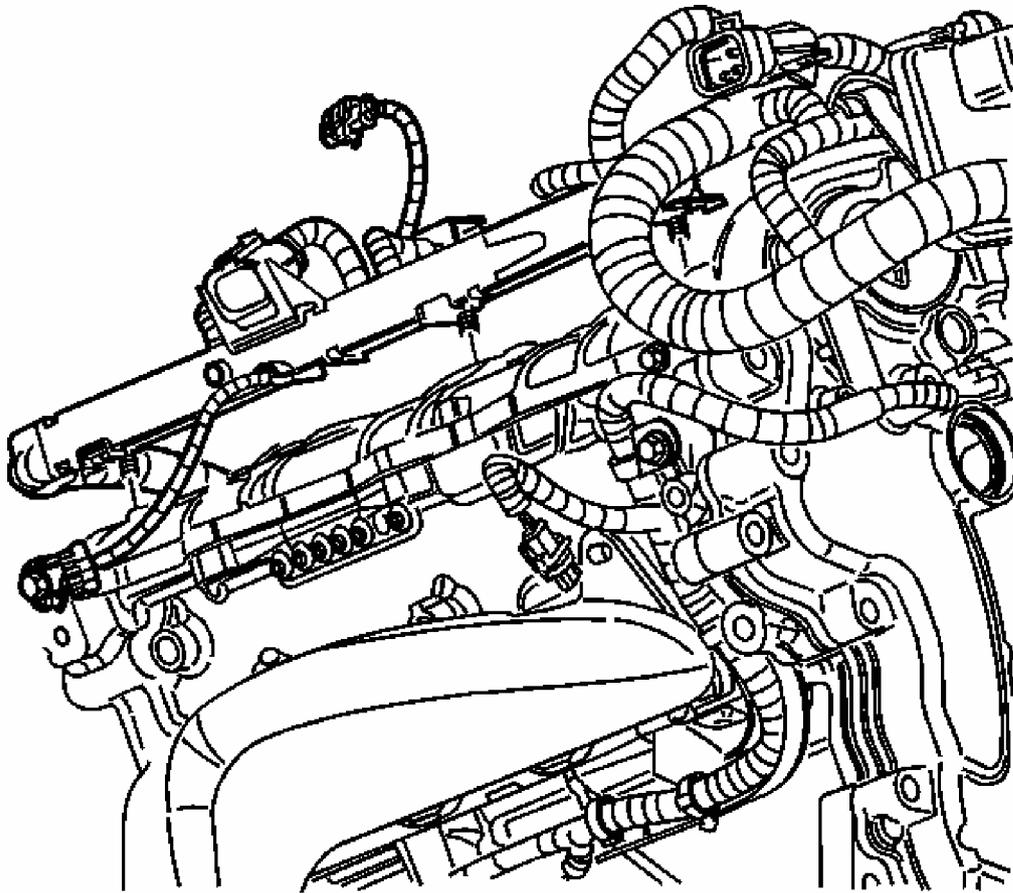
**Fig. 98: View Of Engine Wiring Harness Bracket Bolt - Side Of ECM Bracket**  
Courtesy of GENERAL MOTORS CORP.

33. Remove the engine wiring harness bracket bolt from the side of the ECM bracket.



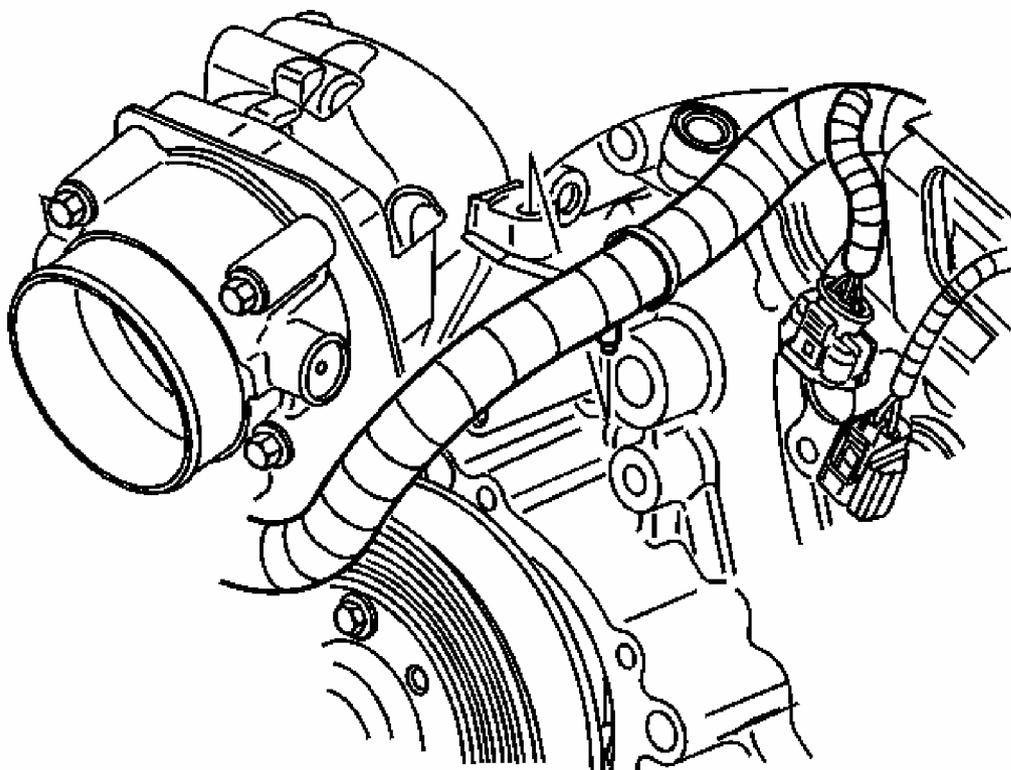
**Fig. 99: View Of Engine Wiring Harness Bracket Bolt - Top Of ECM Bracket**  
Courtesy of GENERAL MOTORS CORP.

34. Remove the engine wiring harness bracket bolt from the top of the ECM bracket.



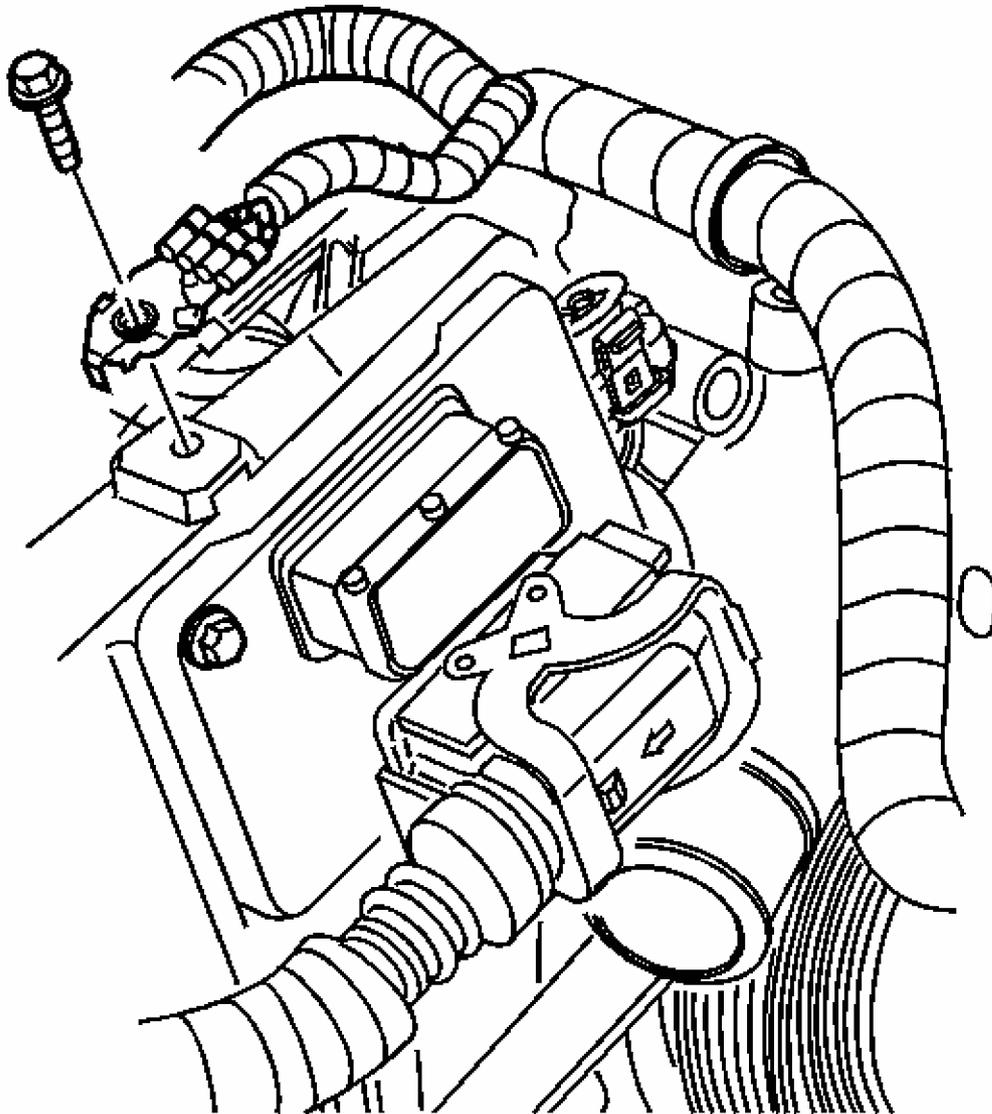
**Fig. 100: View Of Right Camshaft Cover Wiring Harness Connector - Top**  
**Courtesy of GENERAL MOTORS CORP.**

35. Disconnect the engine wiring harness from the top of the right camshaft cover.



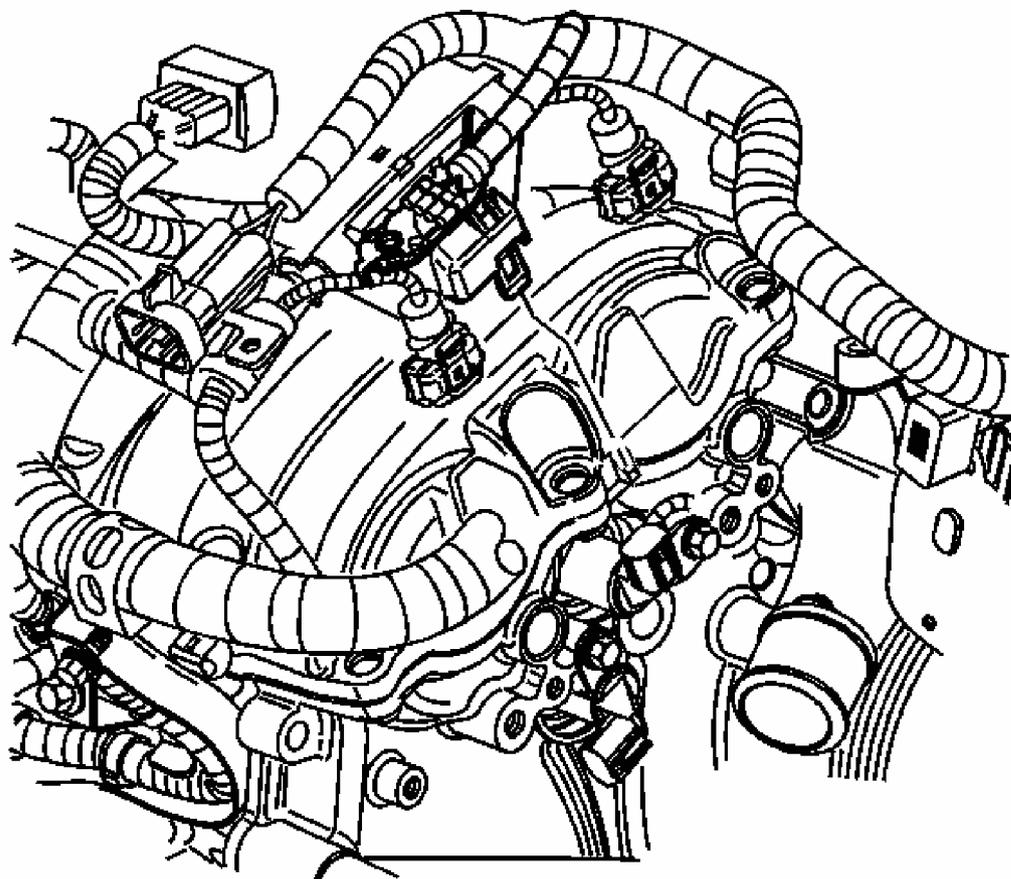
**Fig. 101: View Of Engine Wiring Harness At Left Side Of Throttle Body/Intake Manifold**  
Courtesy of GENERAL MOTORS CORP.

36. Disconnect the engine wiring harness from the left side of the throttle body/intake manifold.



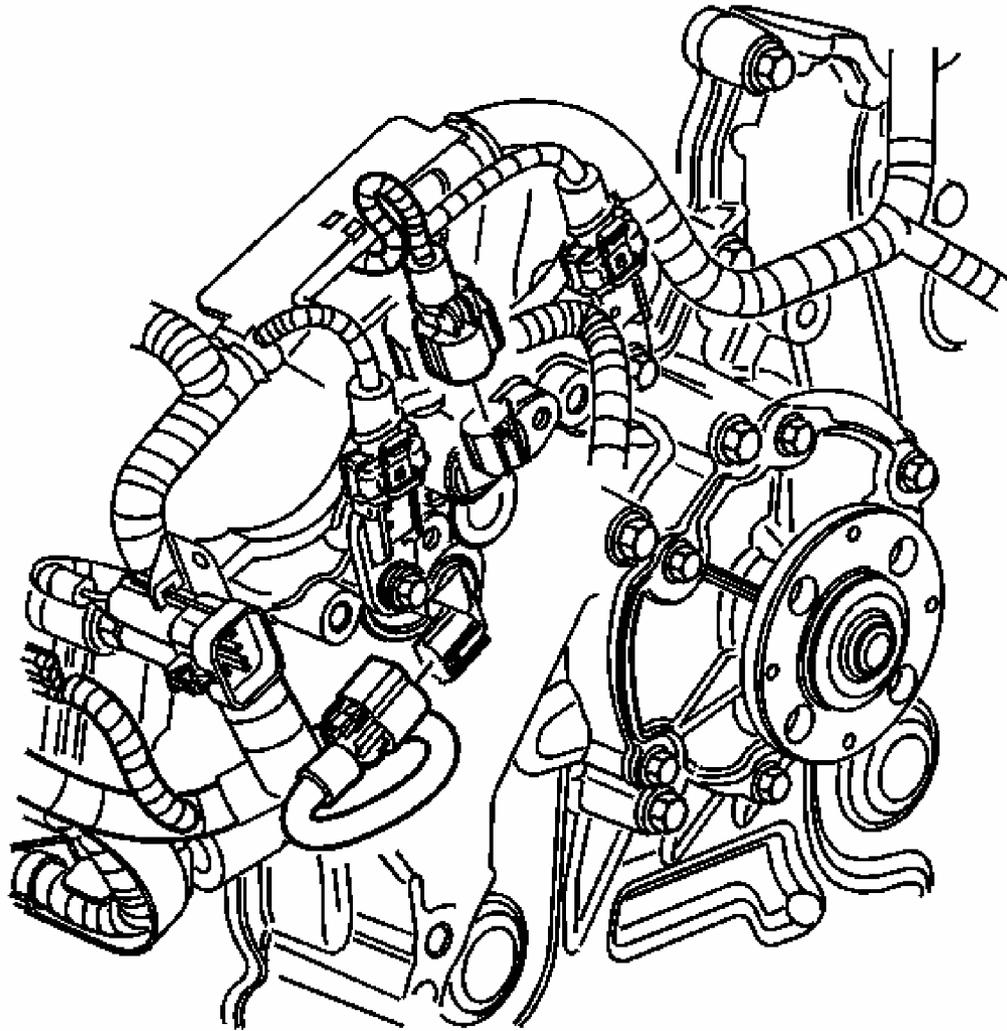
**Fig. 102: View Of ECM Ground Harness Terminal Screw**  
**Courtesy of GENERAL MOTORS CORP.**

37. Remove the ECM ground harness terminal screw from the ECM lug.



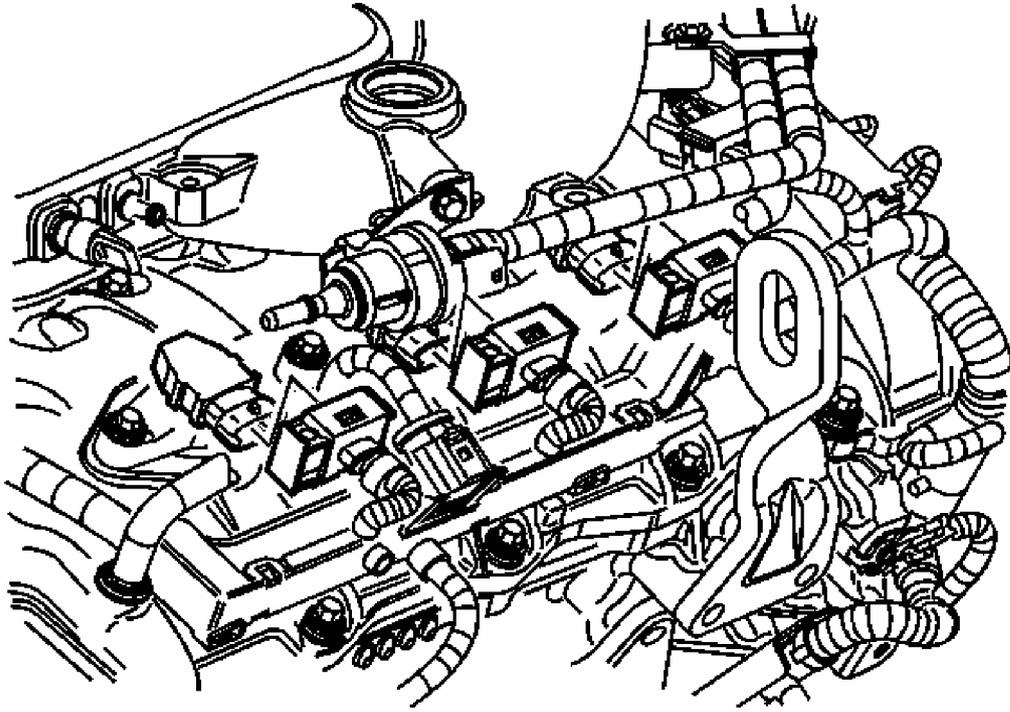
**Fig. 103: View Of Right Camshaft Cover Wiring Harness Connector - Front**  
Courtesy of GENERAL MOTORS CORP.

38. Disconnect the engine wiring harness from the front of the right camshaft cover.



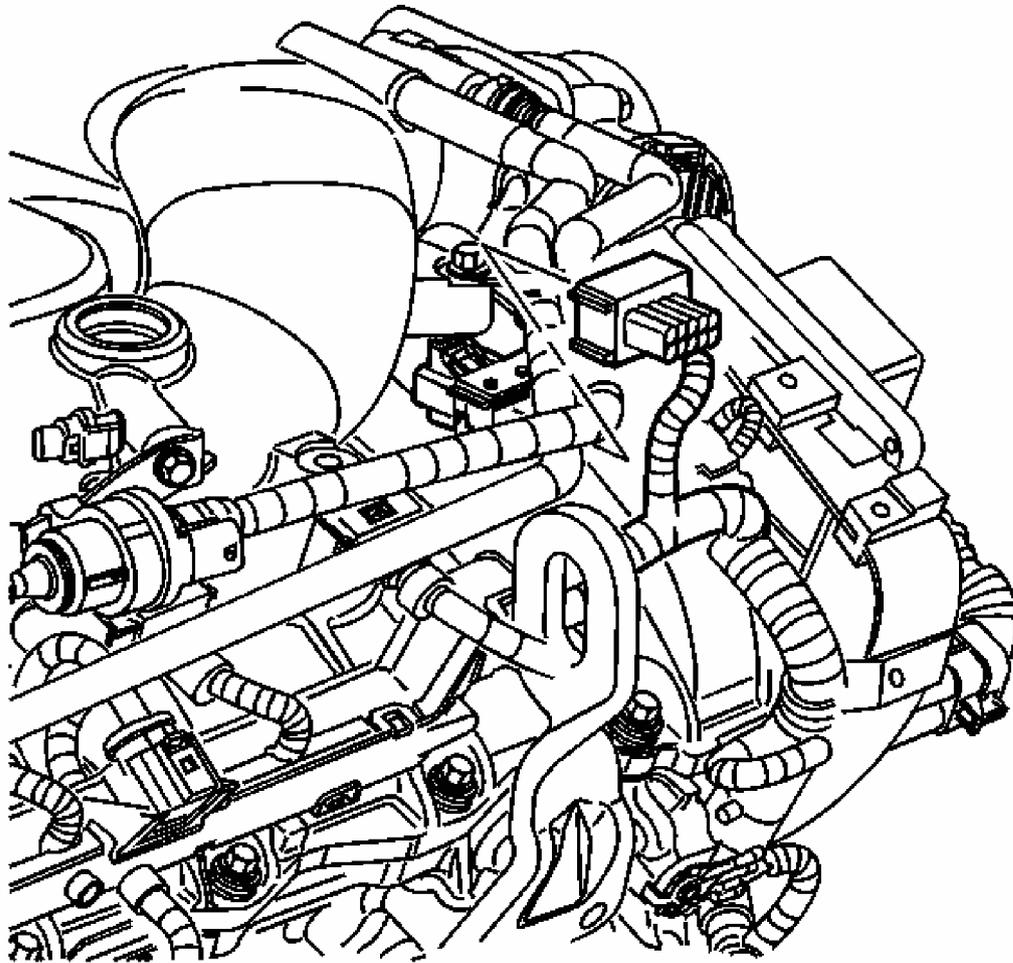
**Fig. 104: View Of Right Camshaft Position Actuator Valves Electrical Connectors**  
Courtesy of GENERAL MOTORS CORP.

39. Disconnect the engine wiring harness from the right camshaft position actuator valves.



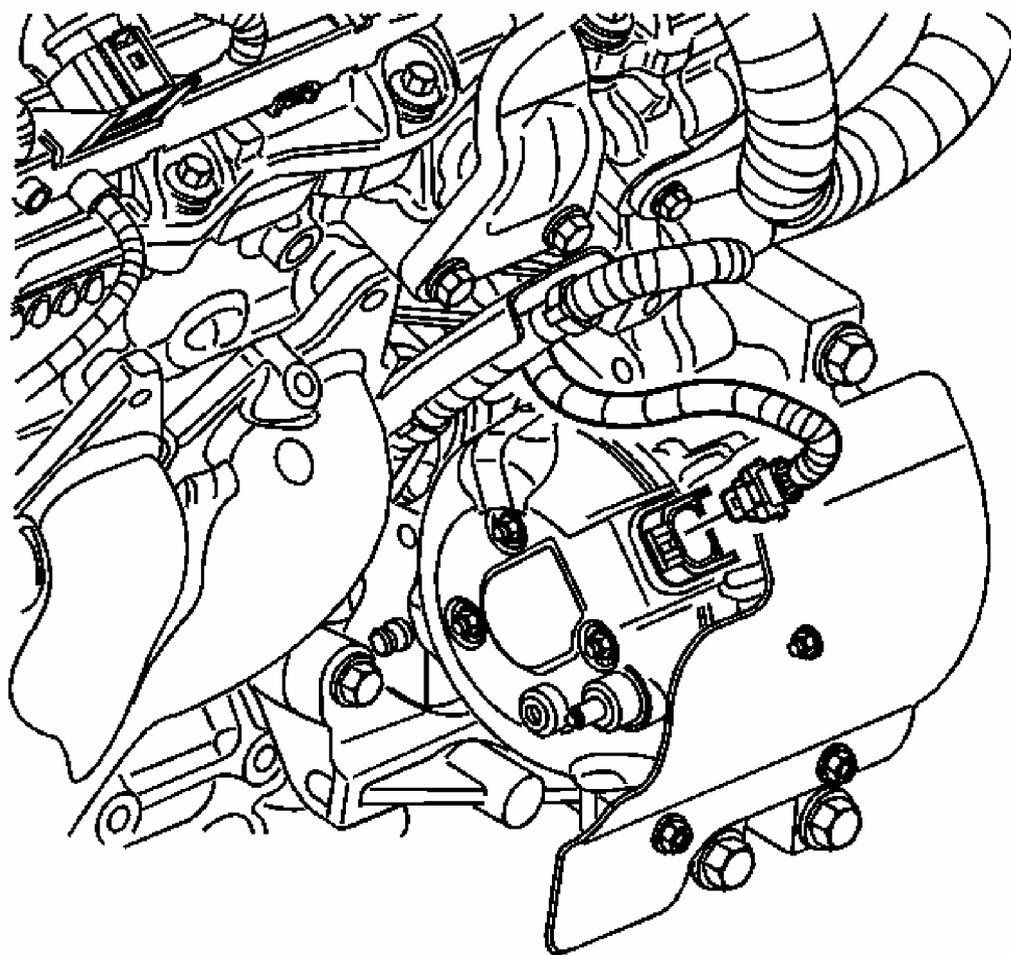
**Fig. 105: View Of Right Ignition Coils Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

40. Disconnect the engine wiring harness from the right ignition coils.



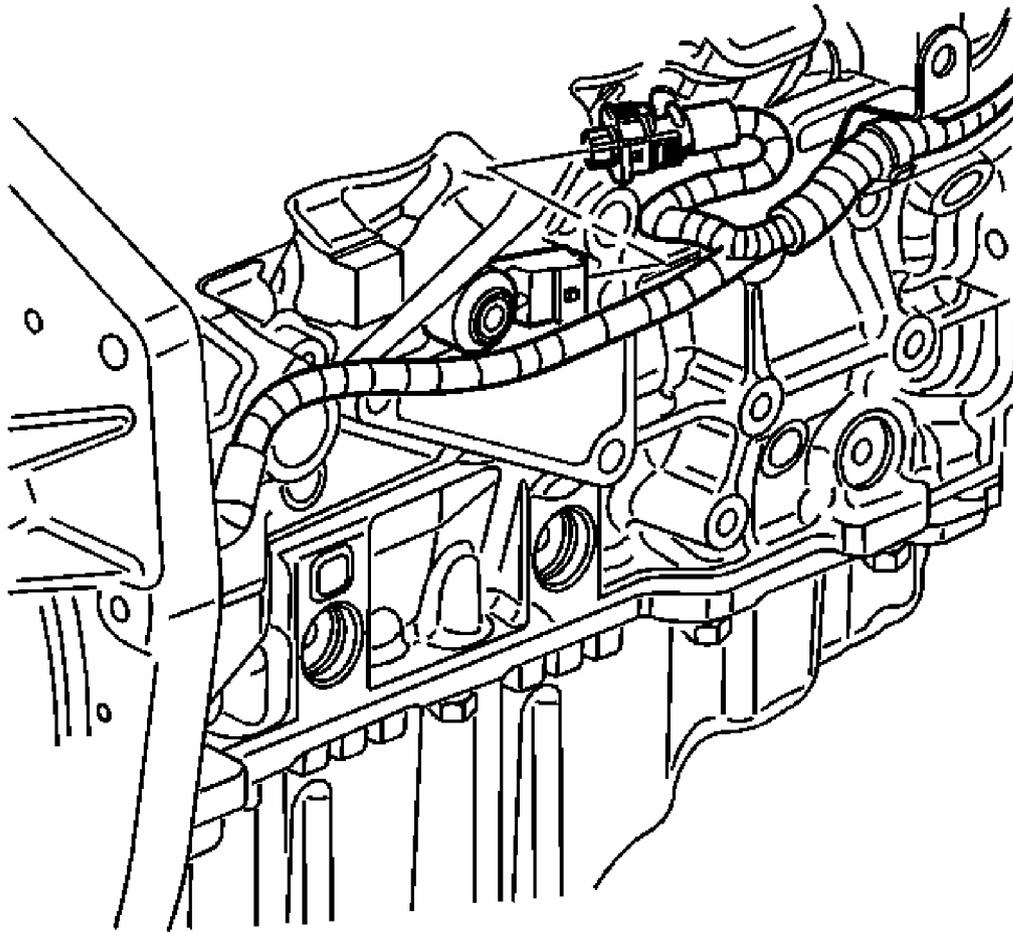
**Fig. 106: View Of Fuel Injector Harness Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

41. Disconnect the engine wiring harness from the fuel injector harness.



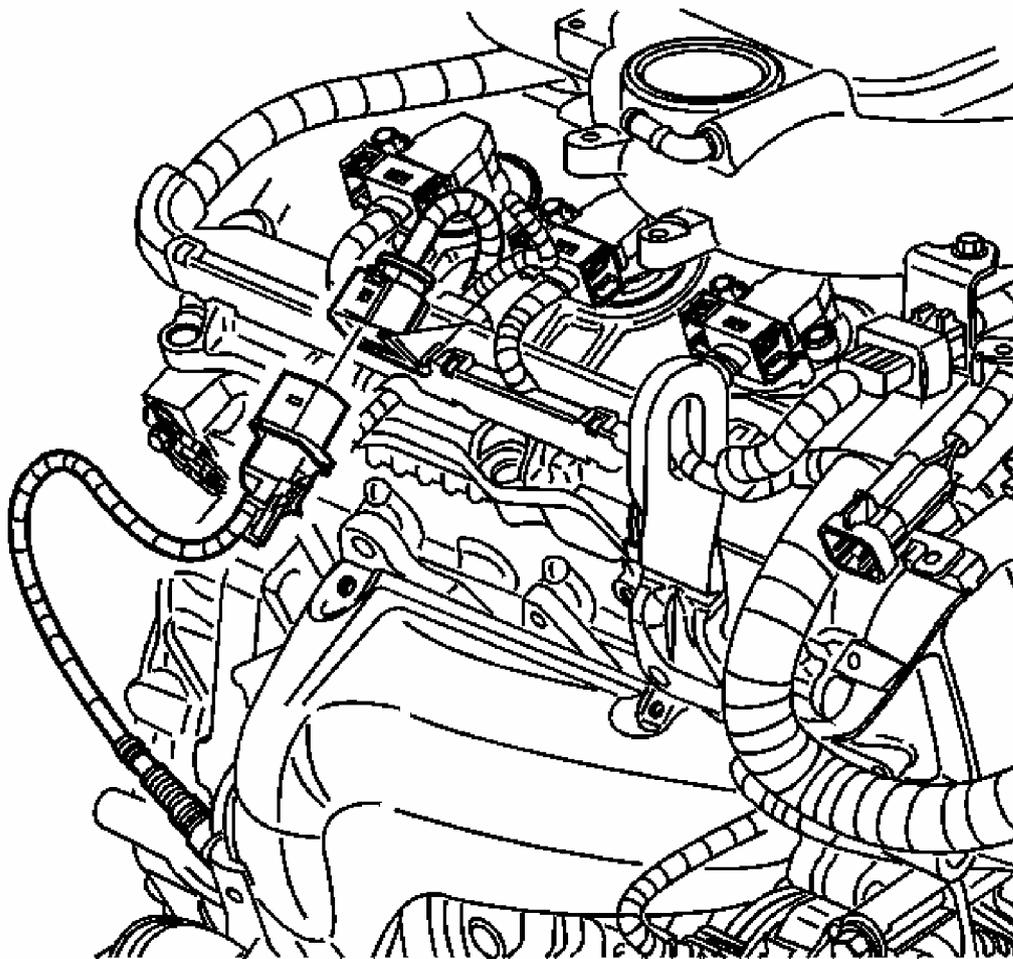
**Fig. 107: View Of Generator Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

42. Disconnect the engine wiring harness from the generator.



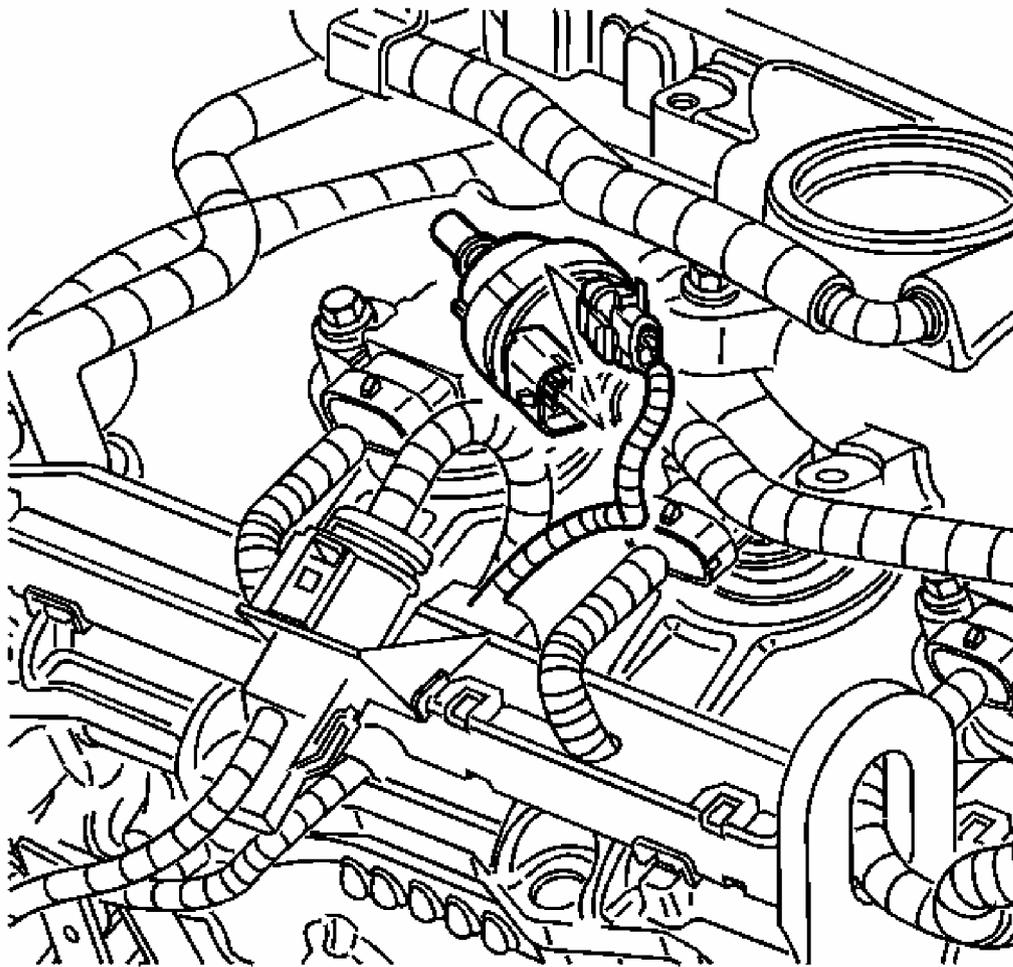
**Fig. 108: View Of Right Knock Sensor And Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

43. Disconnect the engine wiring harness from the right knock sensor.



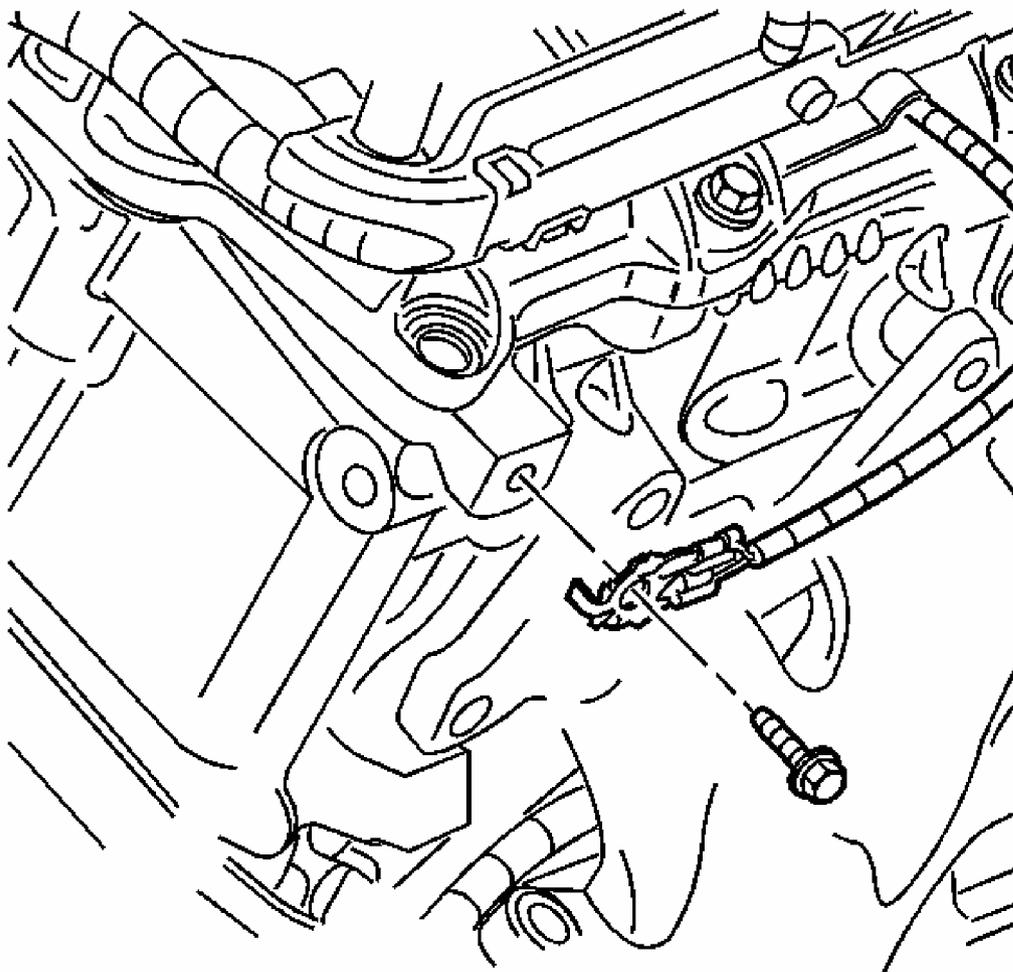
**Fig. 109: View Of Right Oxygen Sensor Harness Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

44. Disconnect the engine wiring harness from the right oxygen sensor harness.



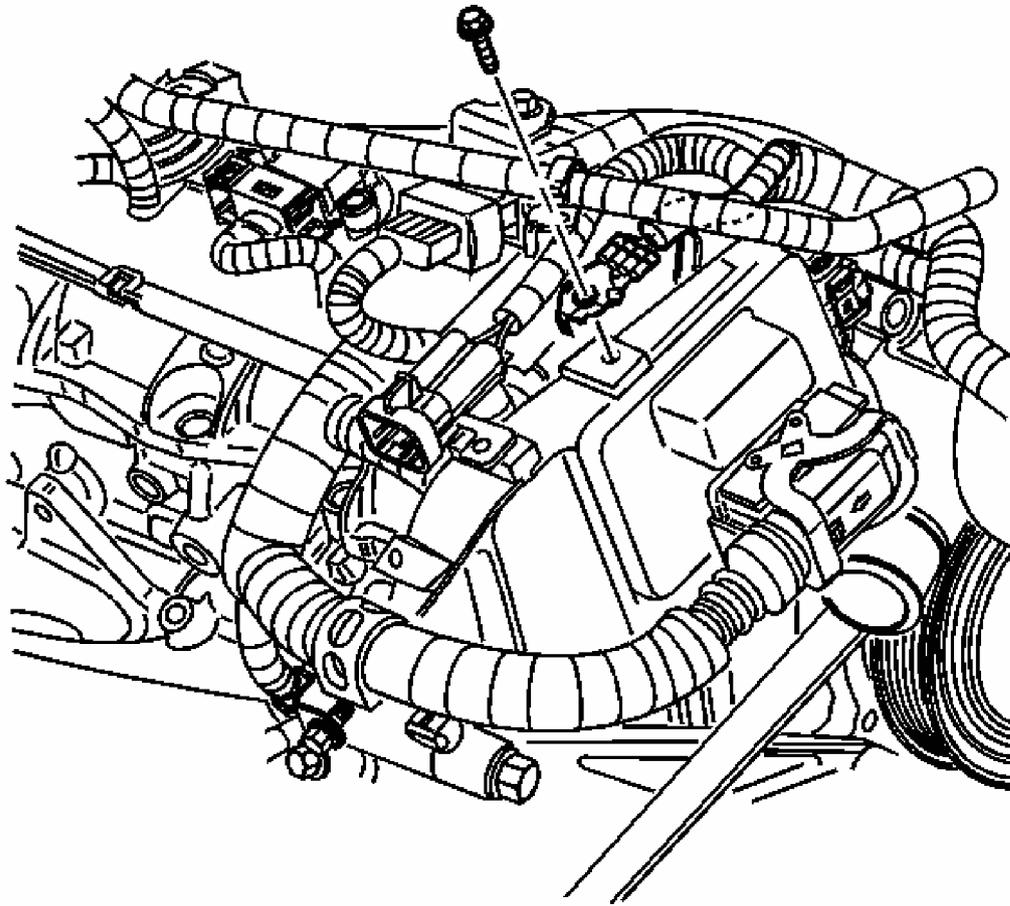
**Fig. 110: View Of EVAP Solenoid Electrical Connector**  
**Courtesy of GENERAL MOTORS CORP.**

45. Disconnect the engine wiring harness from the evaporative emission (EVAP) solenoid.



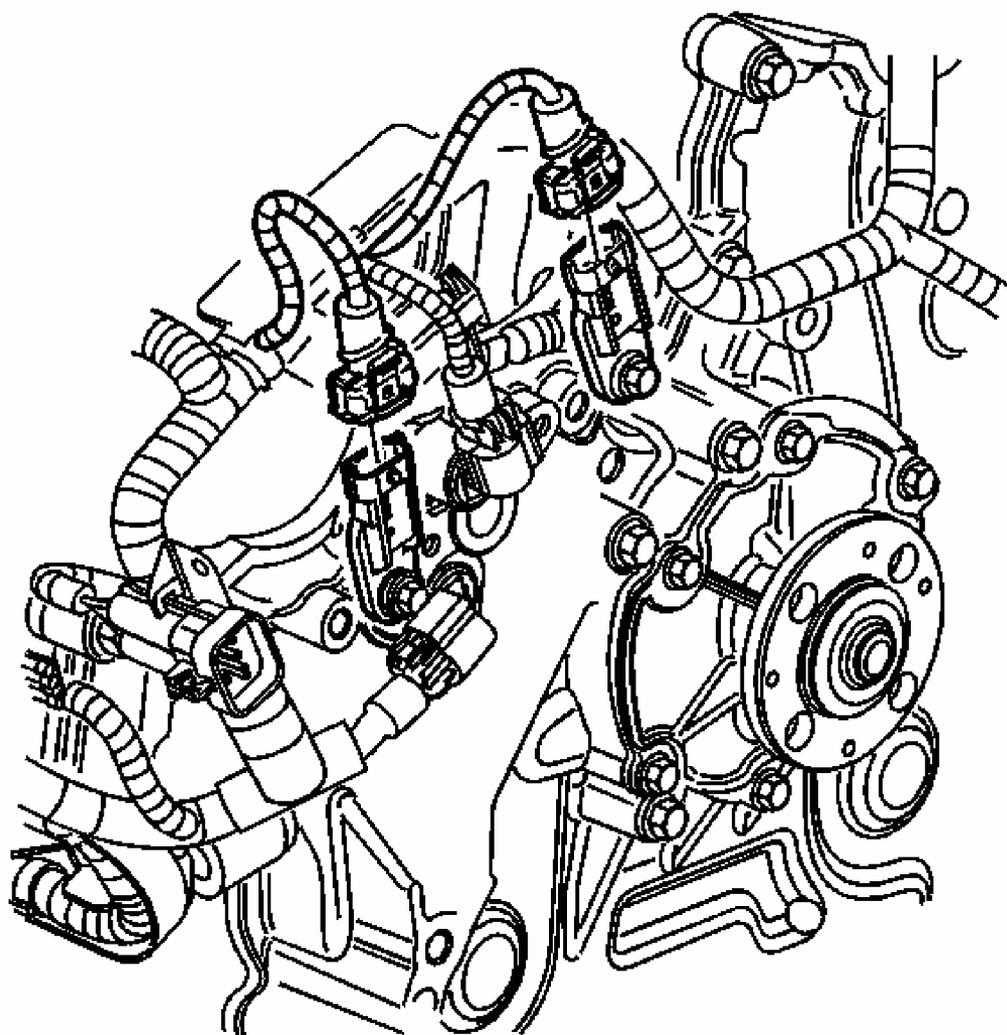
**Fig. 111: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head**  
Courtesy of GENERAL MOTORS CORP.

46. Remove the engine wiring harness ground bolt from the side of the right cylinder head.



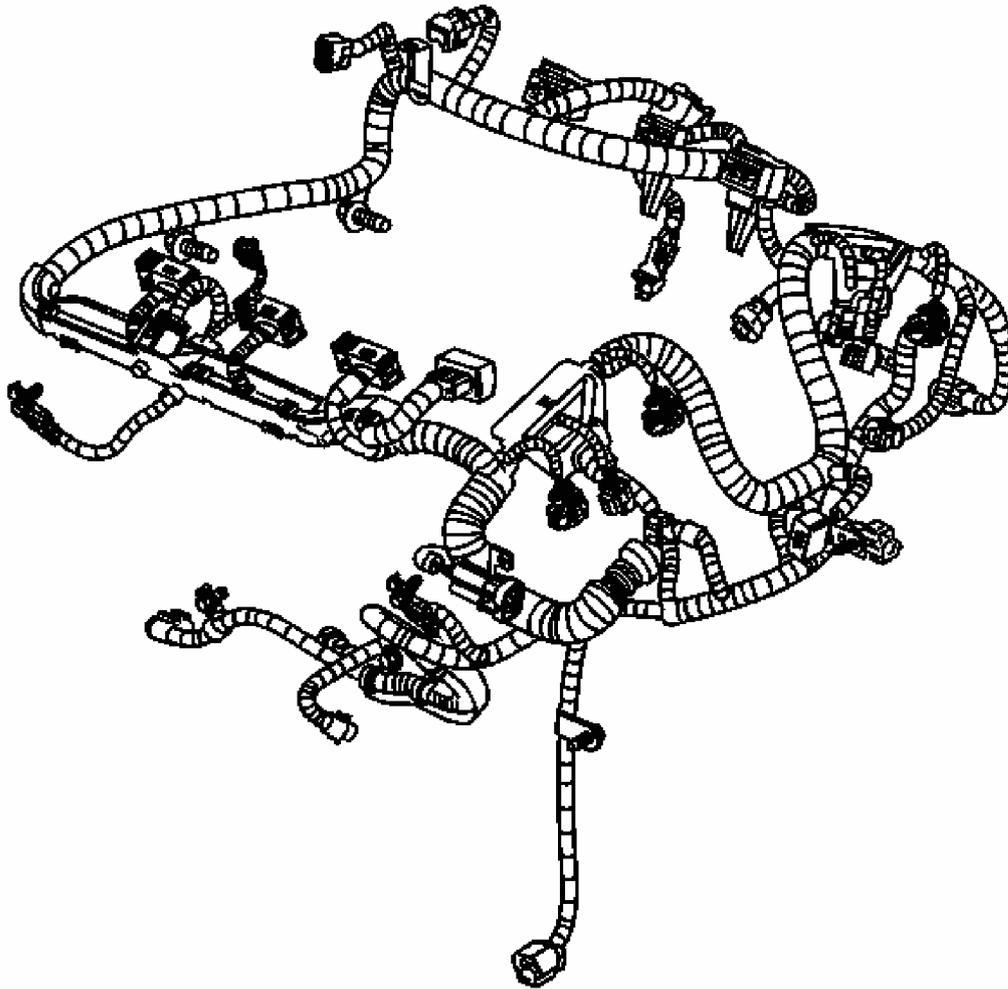
**Fig. 112: View Of ECM Bracket Wiring Harness Ground Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

47. Remove the engine wiring harness ground bolt from the ECM bracket.



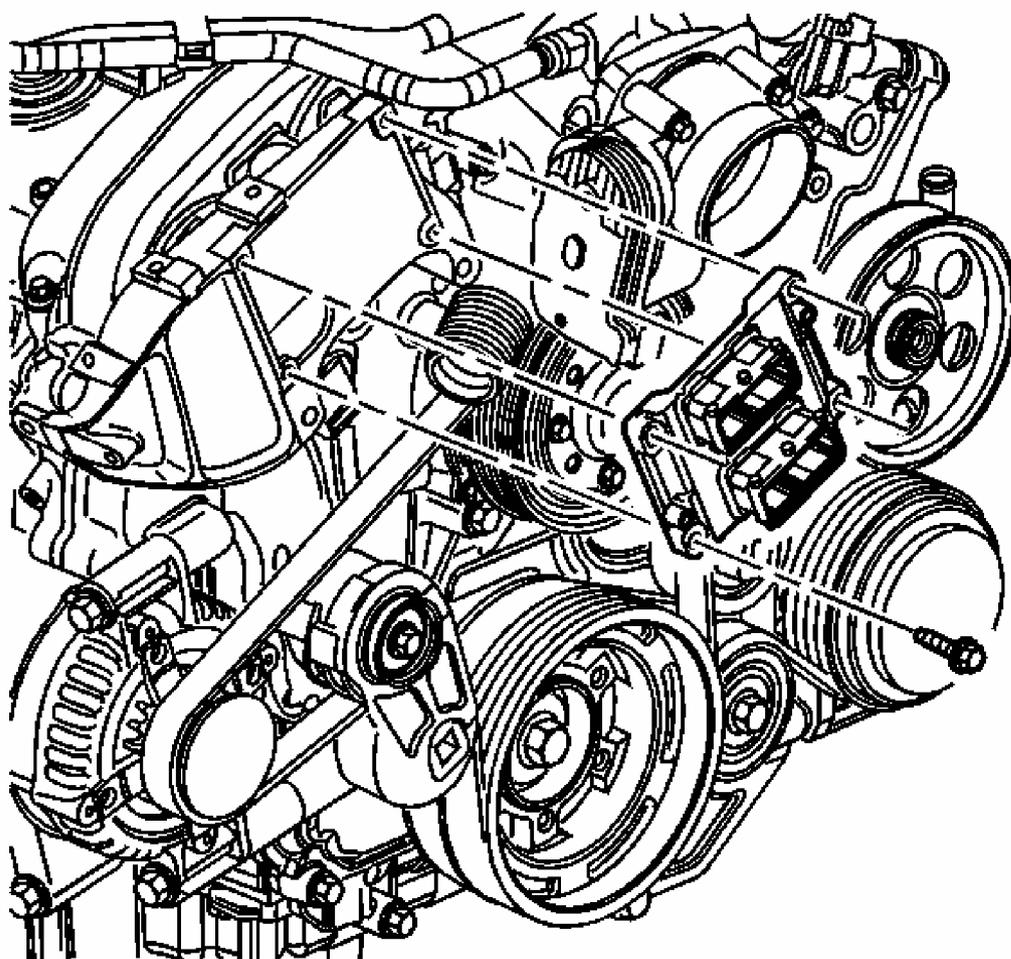
**Fig. 113: View Of Right Camshaft Position Sensors Electrical Connectors**  
**Courtesy of GENERAL MOTORS CORP.**

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



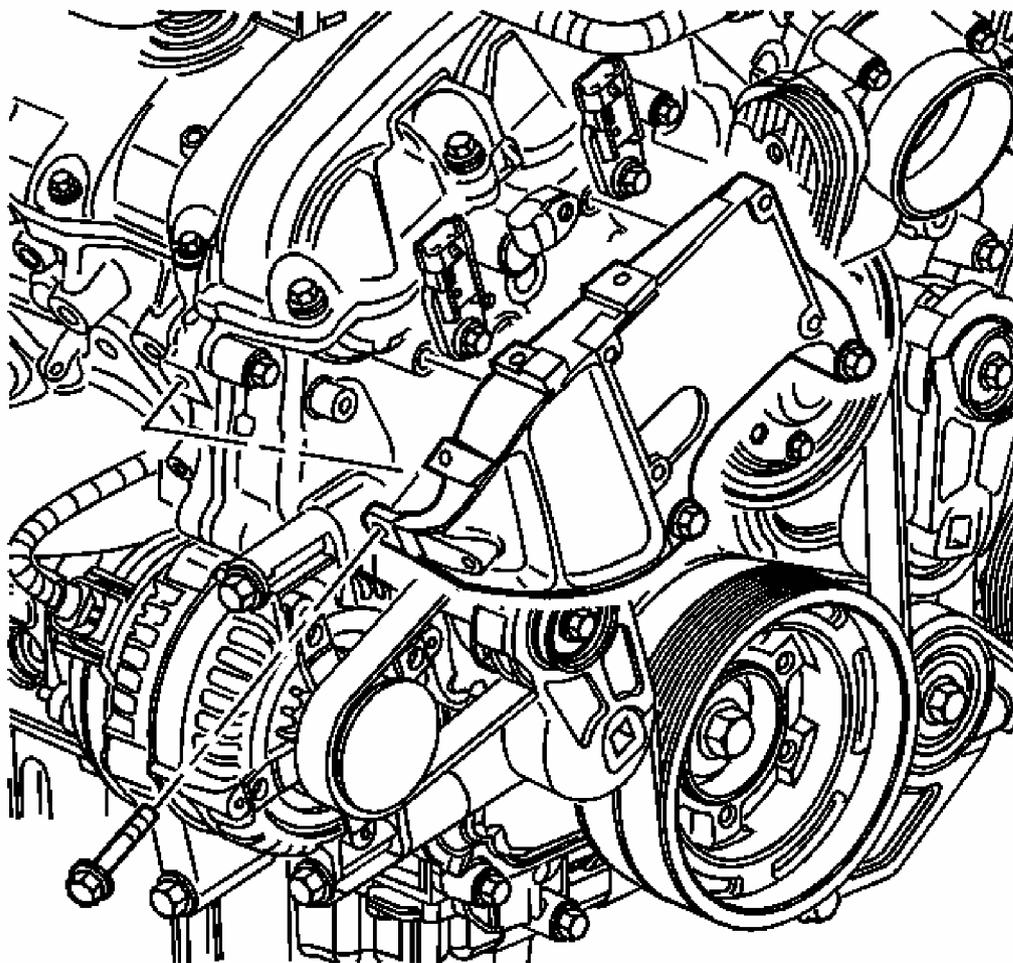
**Fig. 114: View Of Engine Wiring Harness**  
**Courtesy of GENERAL MOTORS CORP.**

49. Remove the engine wiring harness from the engine.



**Fig. 115: View Of ECM Module**  
**Courtesy of GENERAL MOTORS CORP.**

50. Remove the ECM module bolts.
51. Remove the ECM module from the ECM bracket.

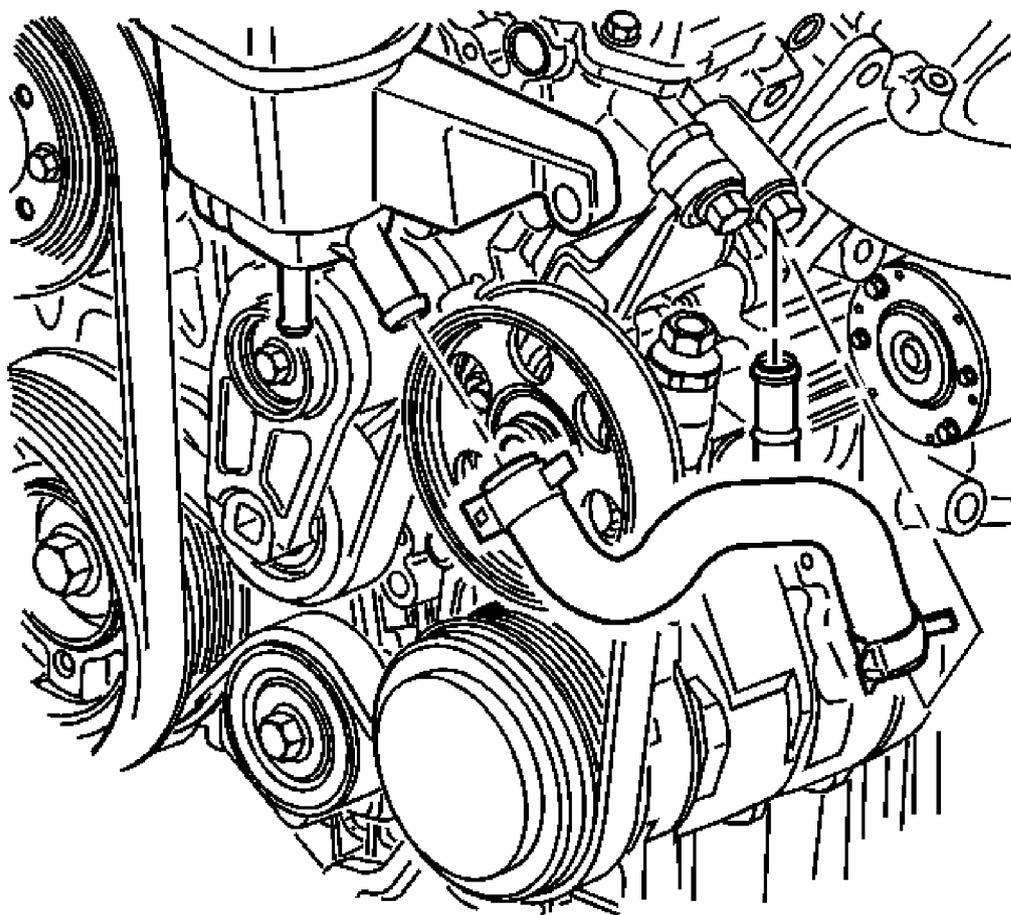


**Fig. 116: View Of ECM Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

52. Remove the ECM bracket bolts.
53. Remove the ECM bracket.

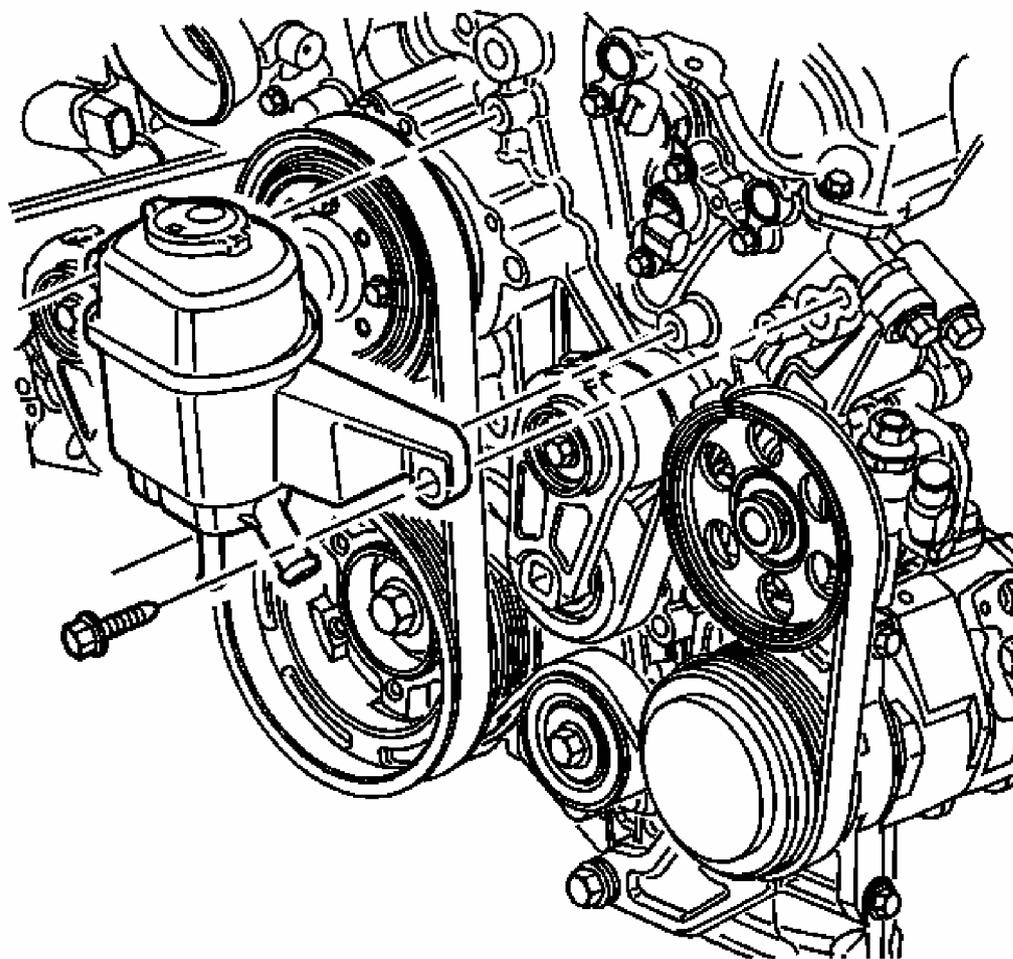
#### **DRIVE BELT REMOVAL**

**Outer Drive Belt**



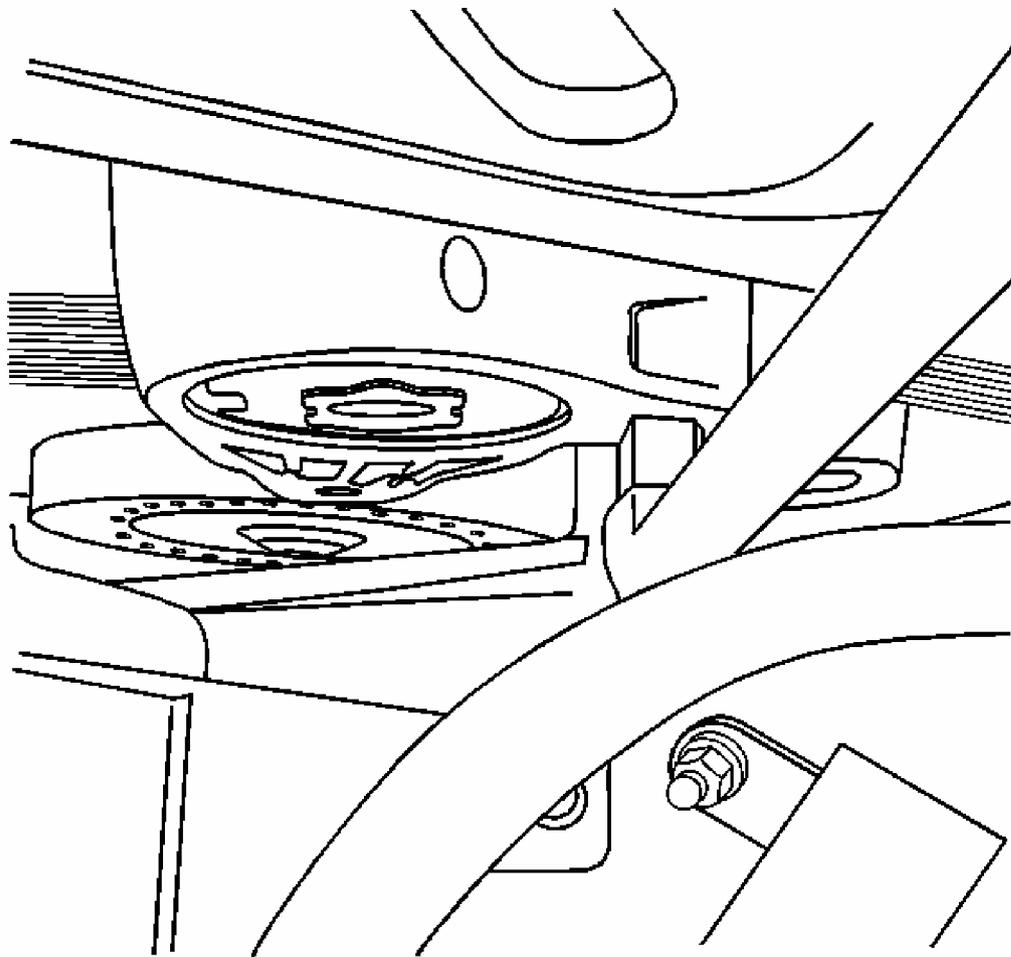
**Fig. 117: Removing & Installing Power Steering Reservoir Hose**  
**Courtesy of GENERAL MOTORS CORP.**

1. Compress and reposition the clamp on the power steering reservoir hose in order to remove the hose from the power steering pump.
2. Remove the power steering reservoir hose from the power steering pump.



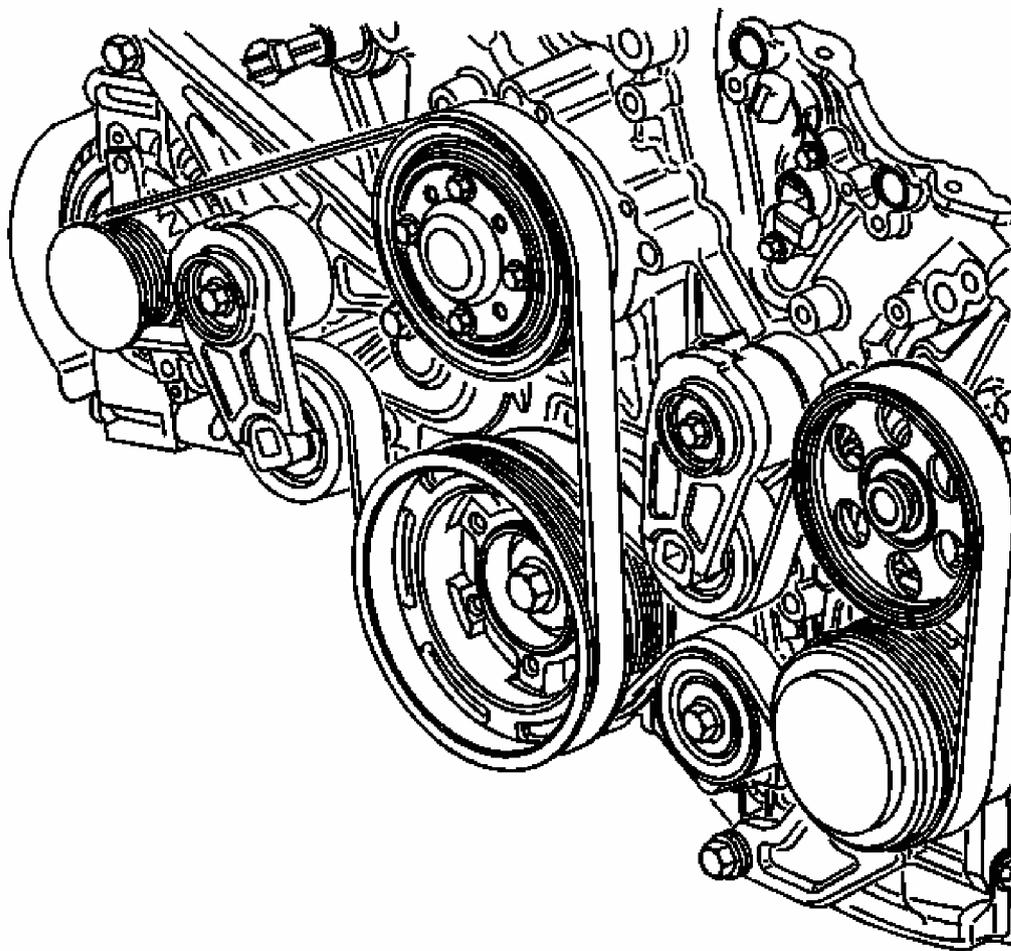
**Fig. 118: Removing & Installing Power Steering Pump Reservoir**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the power steering pump reservoir bolts.
4. Remove the power steering pump reservoir.



**Fig. 119: View Of Drive Belt Tensioner & Pulleys**  
**Courtesy of GENERAL MOTORS CORP.**

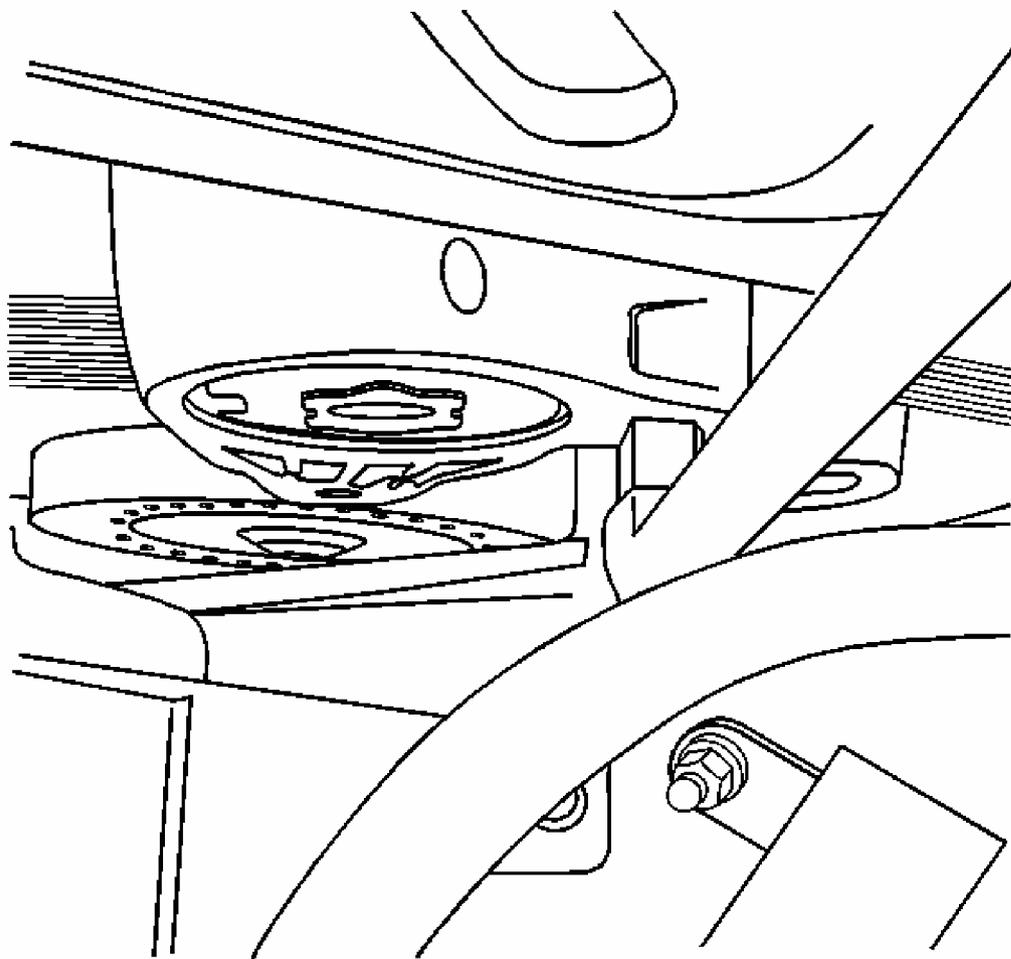
5. Insert a 1/2 inch drive ratchet into the outer drive belt tensioner.
6. Rotate the drive belt tensioner clockwise.
7. Remove the drive belt from around the drive belt tensioner.
8. Slowly rotate the drive belt tensioner counter-clockwise.
9. Remove the 1/2 inch drive ratchet.



**Fig. 120: Identifying Outer Drive Belt**  
Courtesy of GENERAL MOTORS CORP.

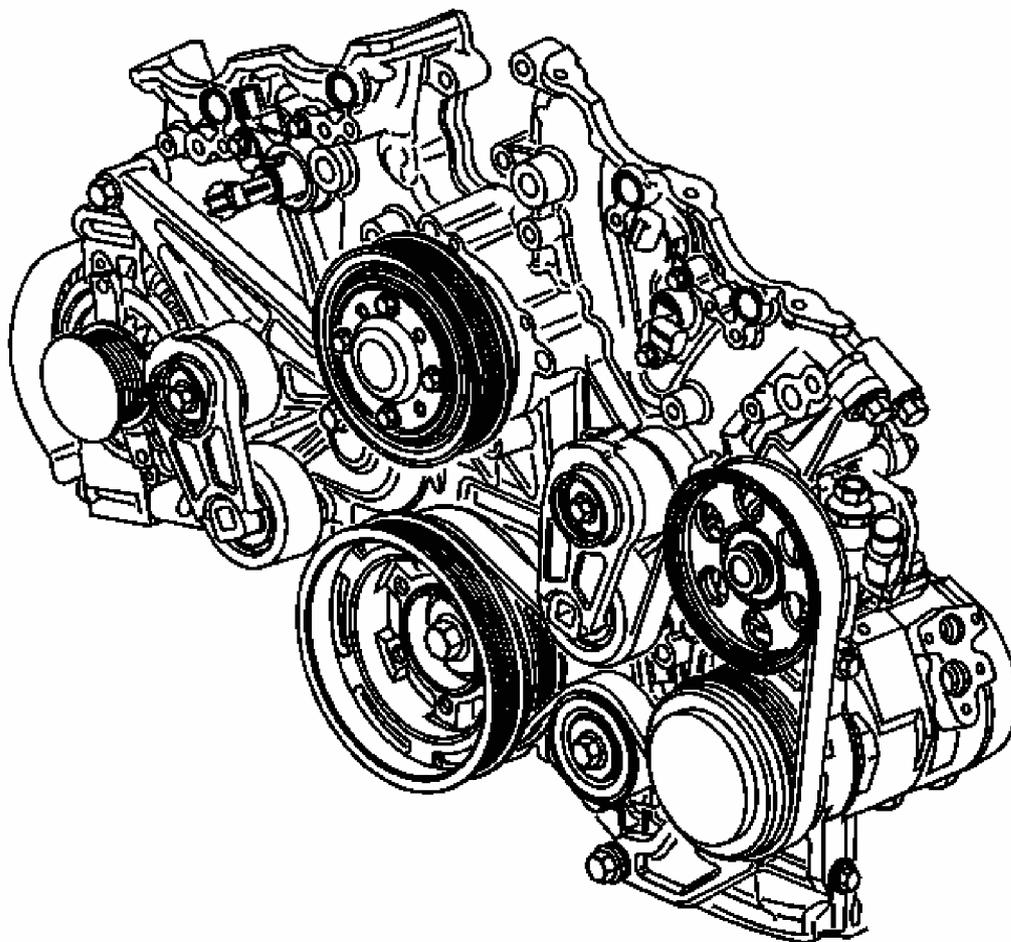
10. Remove the drive belt from around the following:
  - Crankshaft balancer
  - Generator

**Inner Drive Belt**



**Fig. 121: View Of Drive Belt Tensioner & Pulleys**  
**Courtesy of GENERAL MOTORS CORP.**

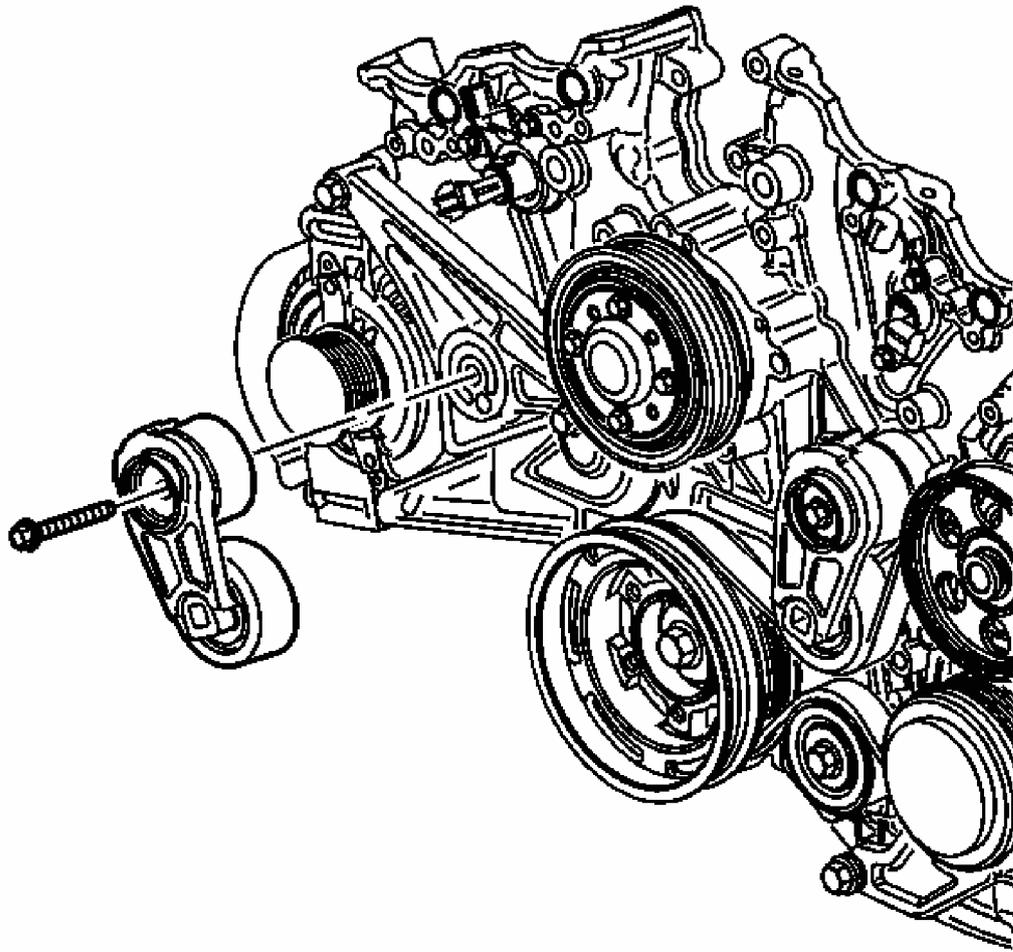
1. Insert a 1/2 inch drive ratchet into the inner drive belt tensioner.
2. Rotate the drive belt tensioner clockwise.
3. Remove the drive belt from around the drive belt idler.
4. Slowly rotate the drive belt tensioner counter-clockwise.
5. Remove the 1/2 inch drive ratchet.



**Fig. 122: Identifying Inner Drive Belt**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the drive belt from around the following:
  - Crankshaft balancer
  - Air conditioning compressor
  - Drive belt tensioner
  - Power steering pump
  - Water pump pulley

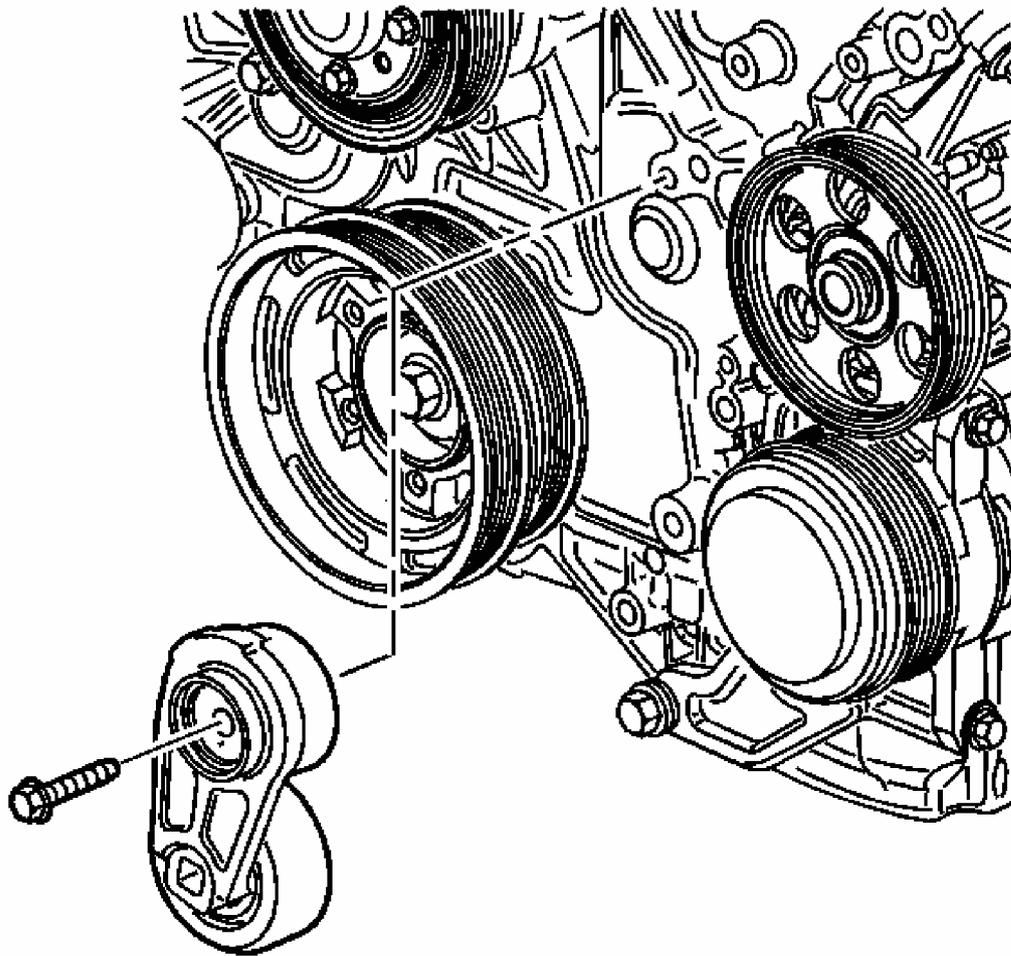
**DRIVE BELT TENSIONER REMOVAL - RIGHT**



**Fig. 123: Removing & Installing Right Drive Belt Tensioner**  
Courtesy of GENERAL MOTORS CORP.

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

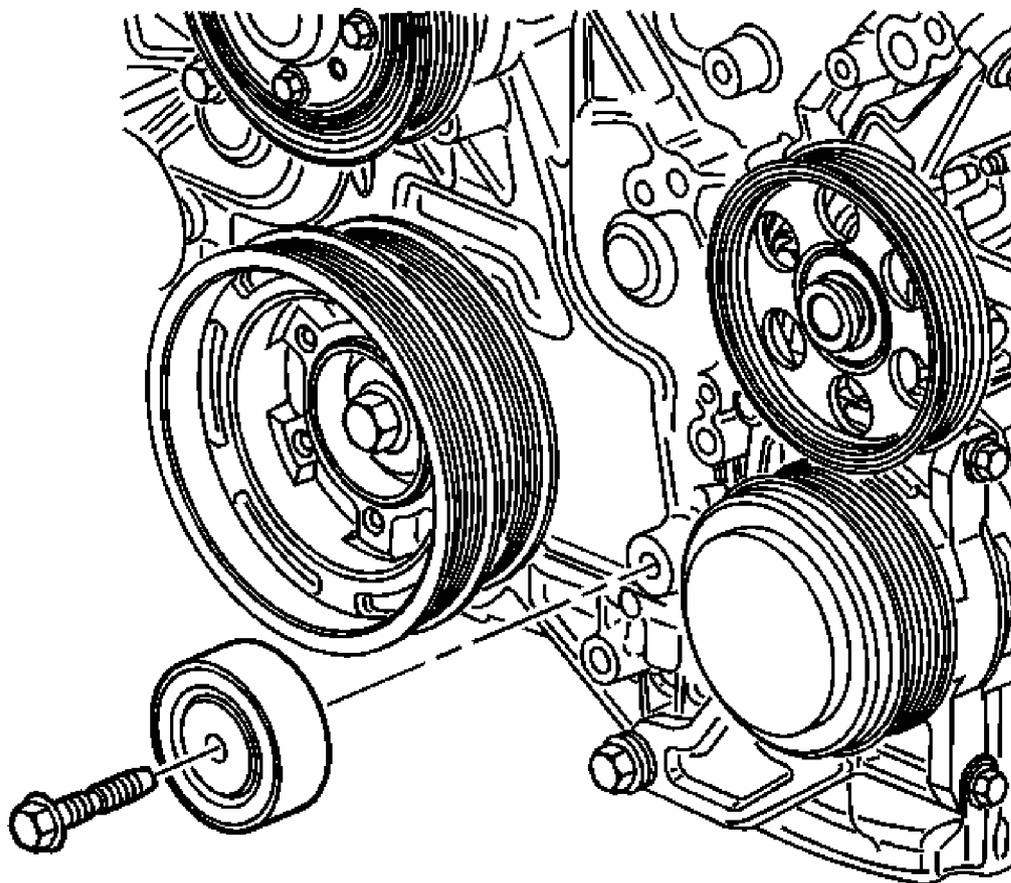
**DRIVE BELT TENSIONER REMOVAL - LEFT**



**Fig. 124: View Of Left Drive Belt Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

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

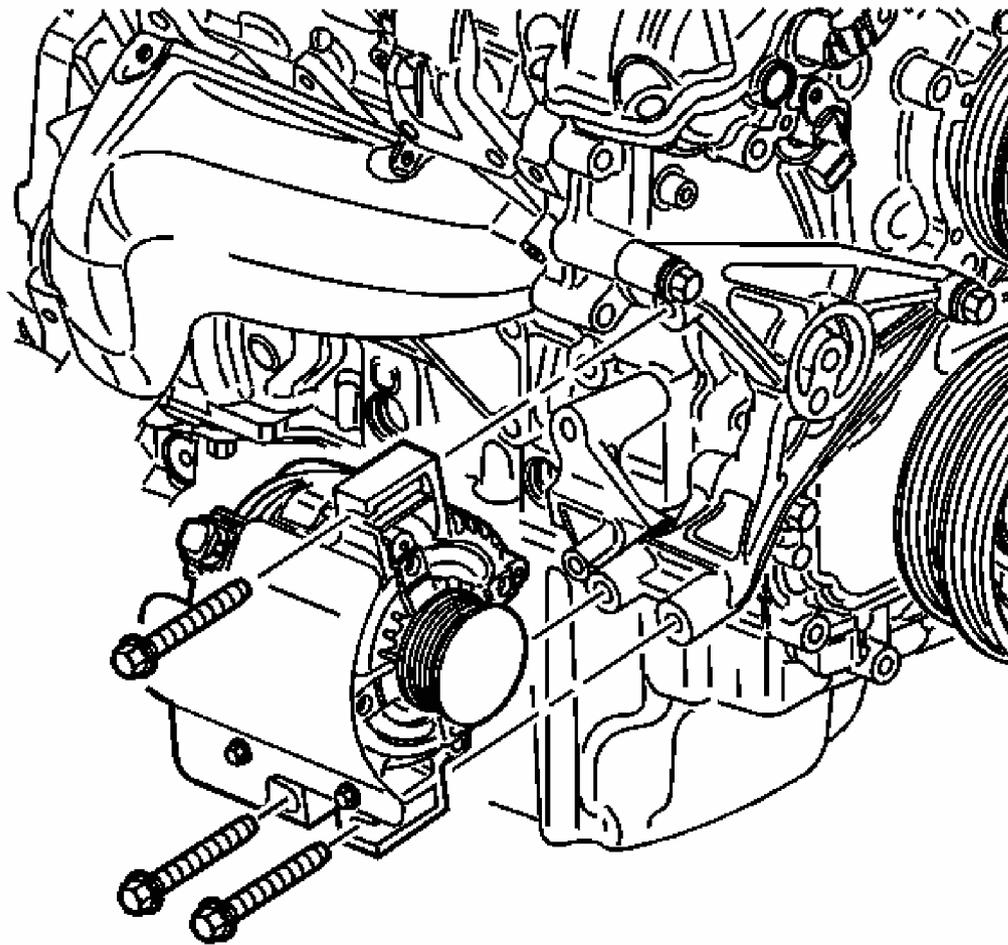
#### **DRIVE BELT IDLER PULLEY REMOVAL**



**Fig. 125: Removing & Installing Drive Belt Idler Pulley**  
Courtesy of GENERAL MOTORS CORP.

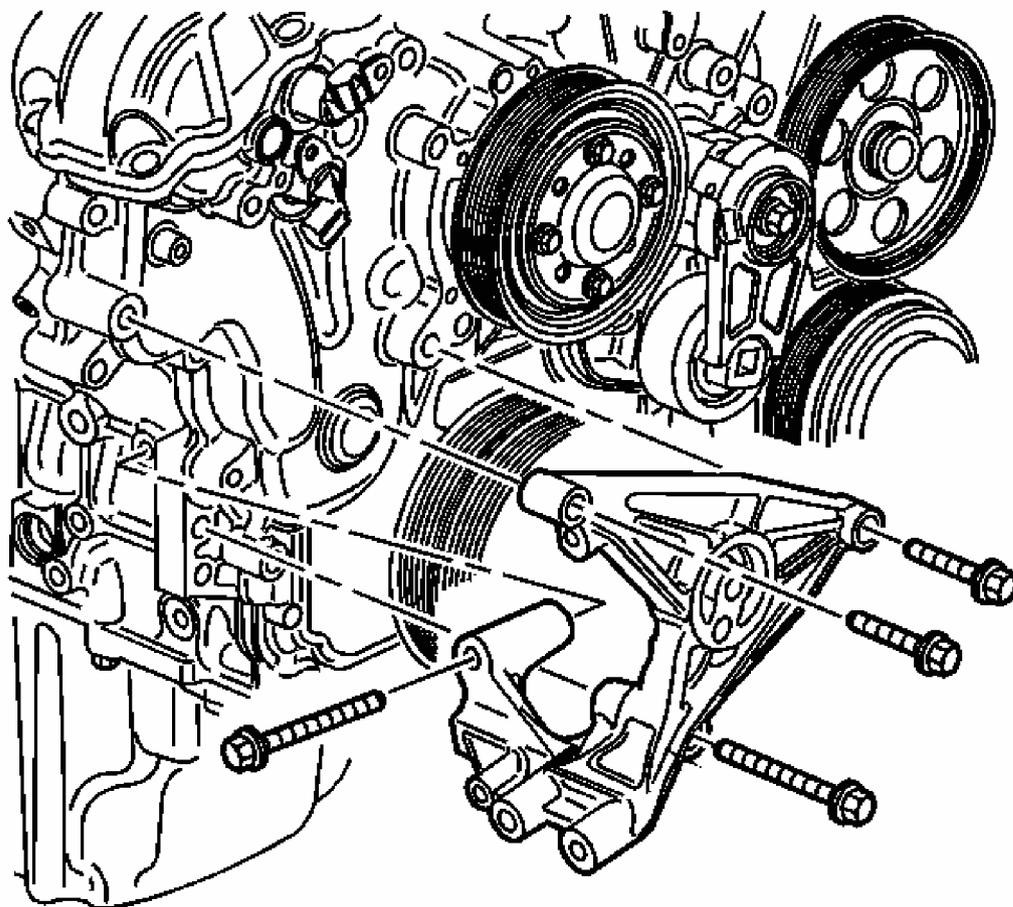
1. Remove the drive belt idler pulley bolt.
2. Remove the drive belt idler pulley.

#### **GENERATOR REMOVAL**



**Fig. 126: Removing & Installing Generator**  
**Courtesy of GENERAL MOTORS CORP.**

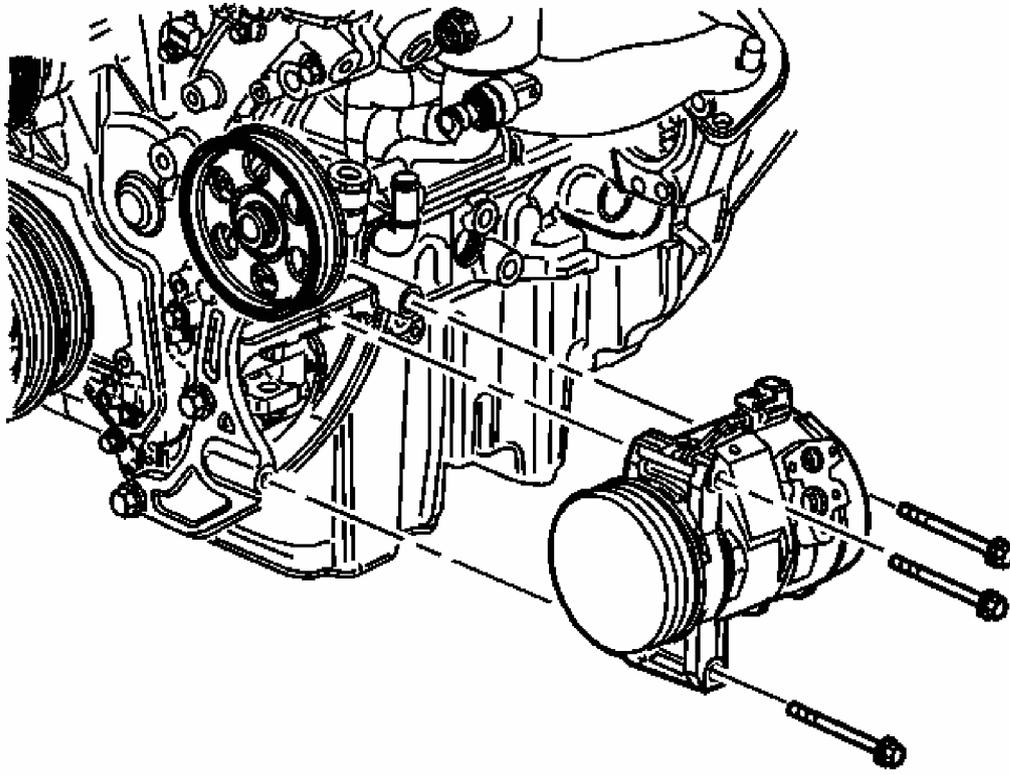
1. Remove the generator bolts.
2. Remove the generator.



**Fig. 127: View Of Generator Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

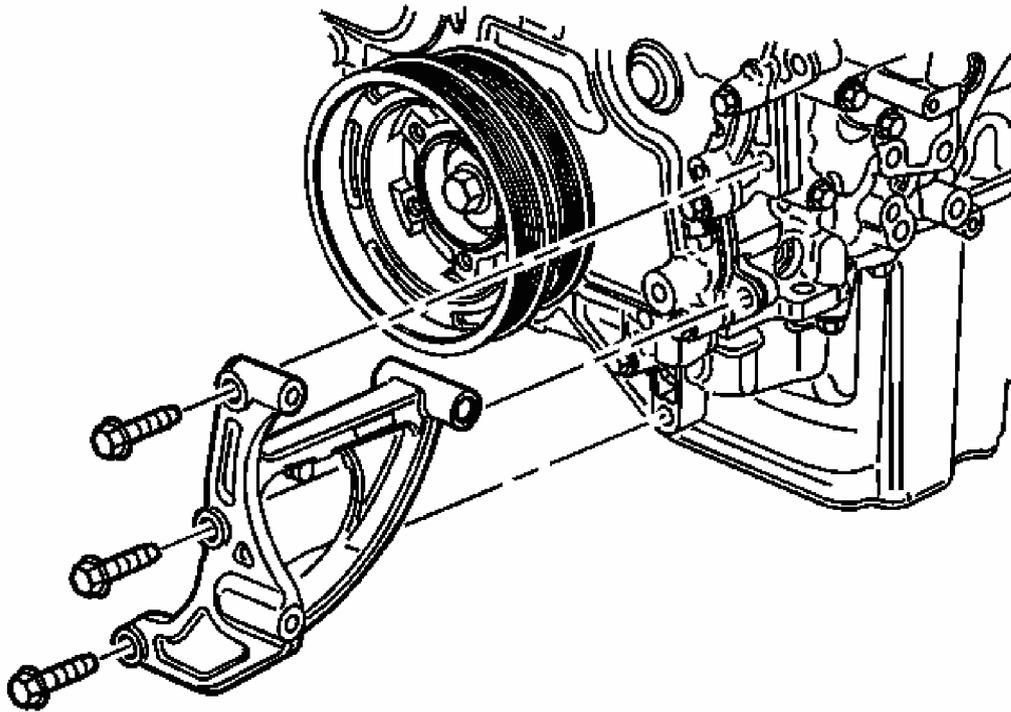
3. Remove the generator bracket bolts.
4. Remove the generator bracket.

#### **AIR CONDITIONING (A/C) COMPRESSOR REMOVAL**



**Fig. 128: Removing & Installing A/C Compressor**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the air conditioning compressor bolts.
2. Remove the air conditioning compressor.



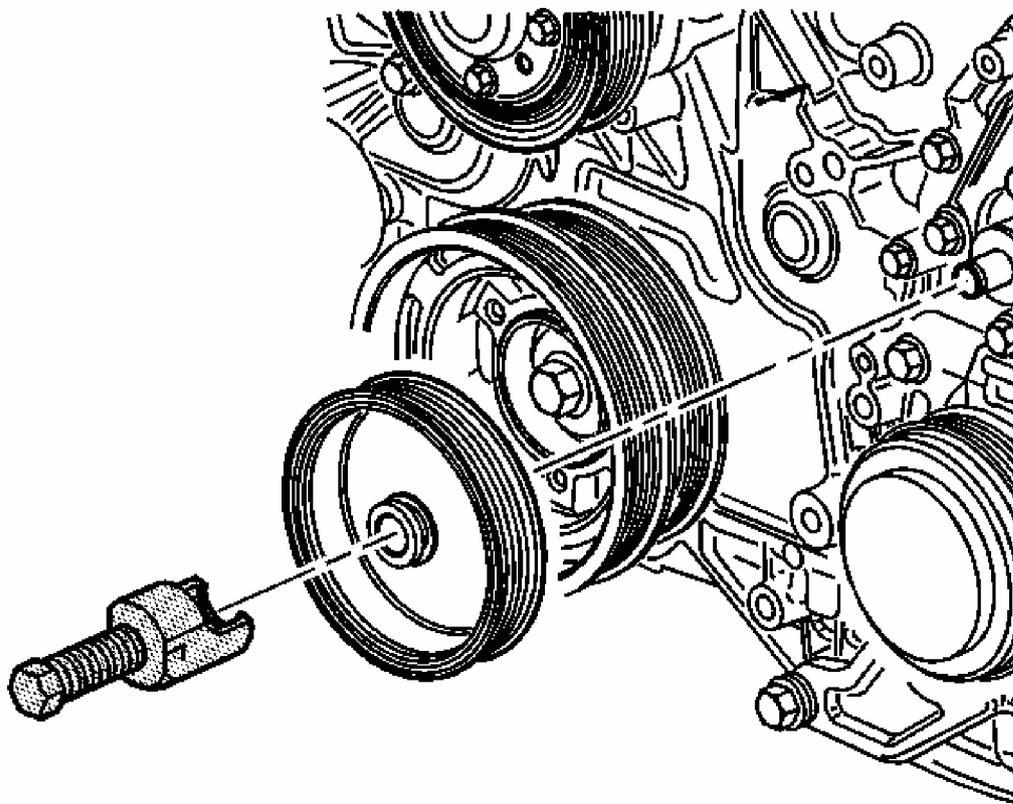
**Fig. 129: Removing & Installing Air Conditioning Compressor Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the air conditioning compressor bracket bolts.
4. Remove the air conditioning compressor bracket.

#### **POWER STEERING PUMP REMOVAL**

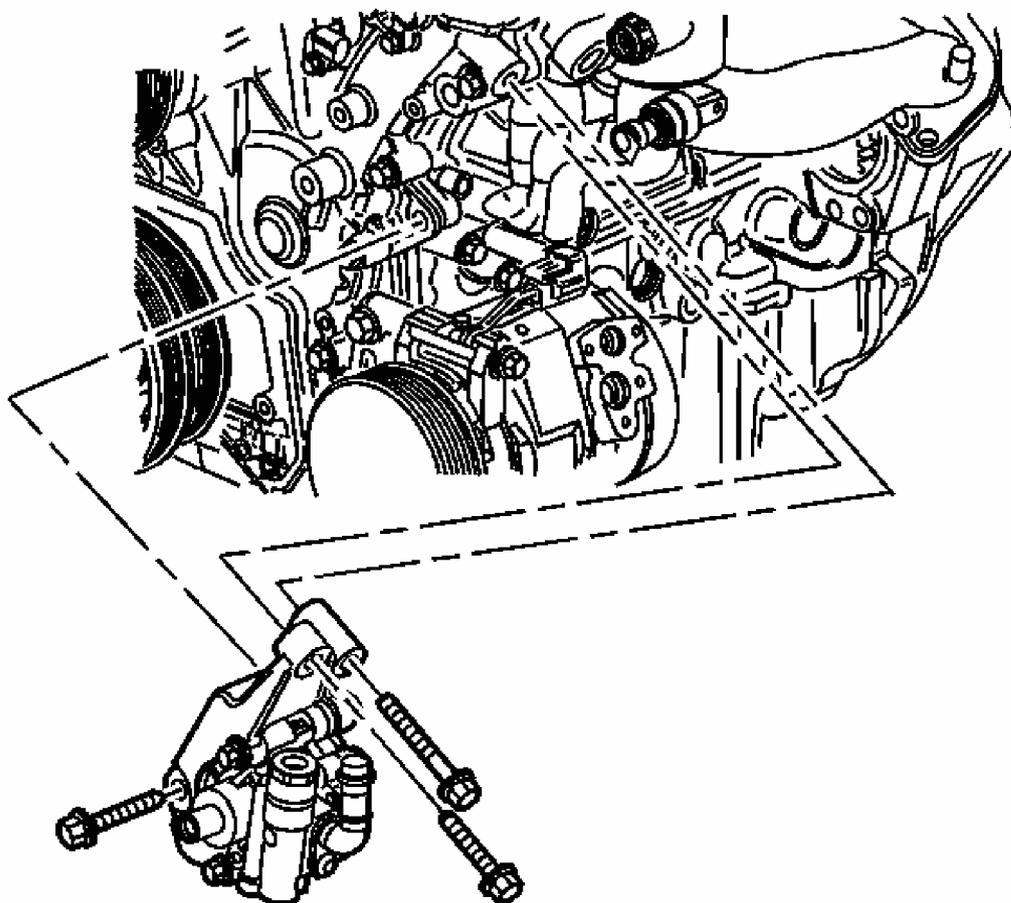
##### **Tools Required**

**J 25034-C Pulley Remover**



**Fig. 130: Removing The Power Steering Pump Pulley Using J 25034-C**  
**Courtesy of GENERAL MOTORS CORP.**

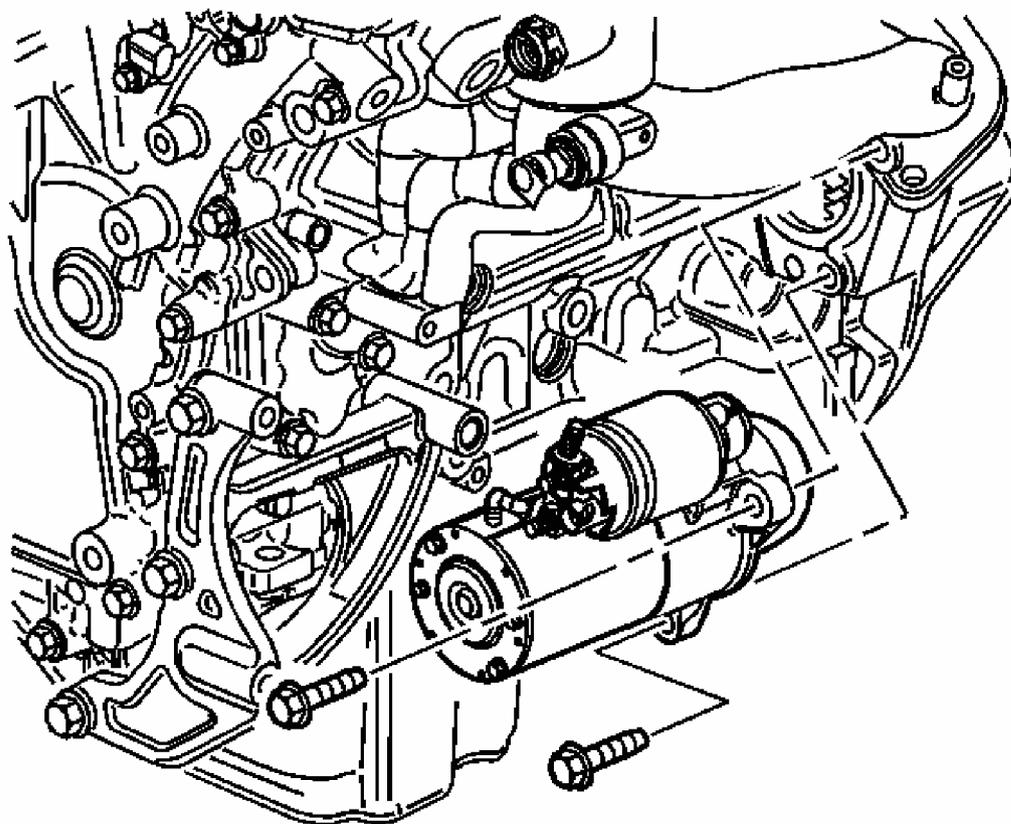
1. Using the **J 25034-C** remove the power steering pump pulley to access the power steering pump bolts.



**Fig. 131: View Of Power Steering Pump**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the power steering pump bolts.
3. Remove the power steering pump.

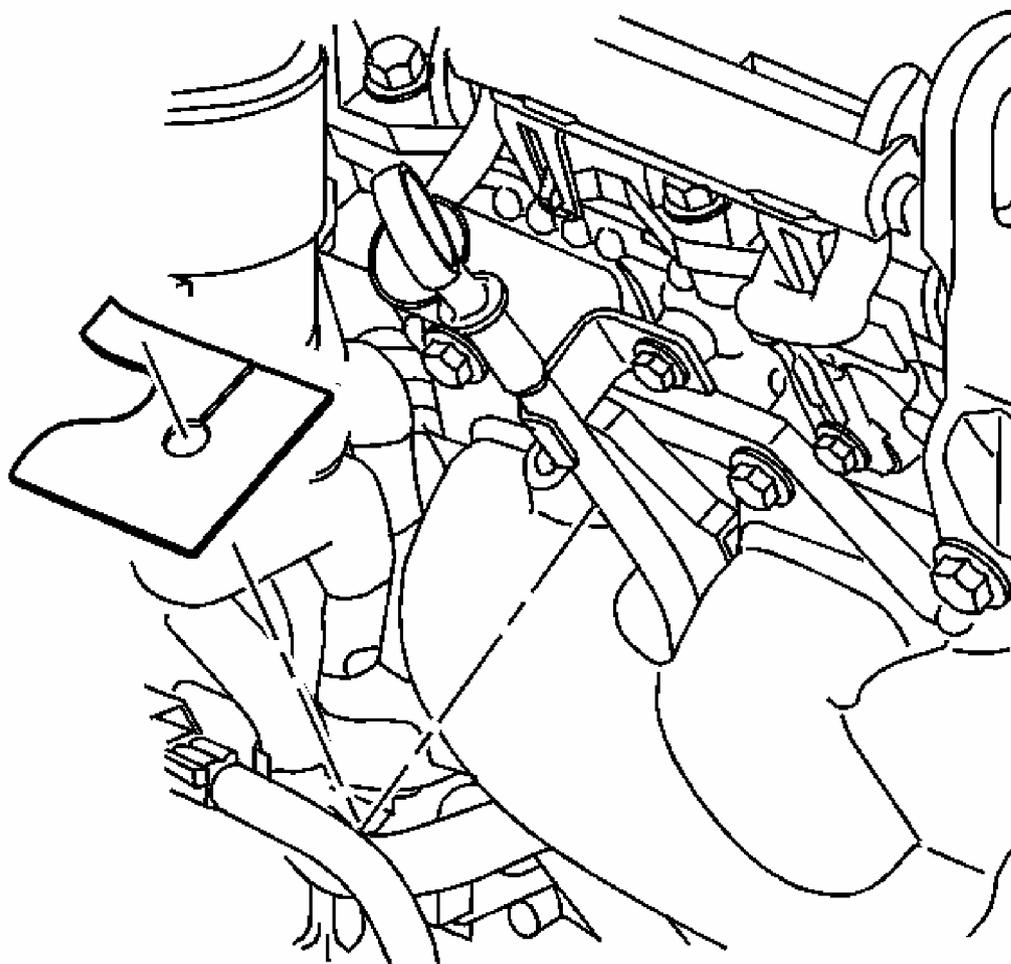
#### **STARTER MOTOR REMOVAL**



**Fig. 132: View Of Starter Motor**  
**Courtesy of GENERAL MOTORS CORP.**

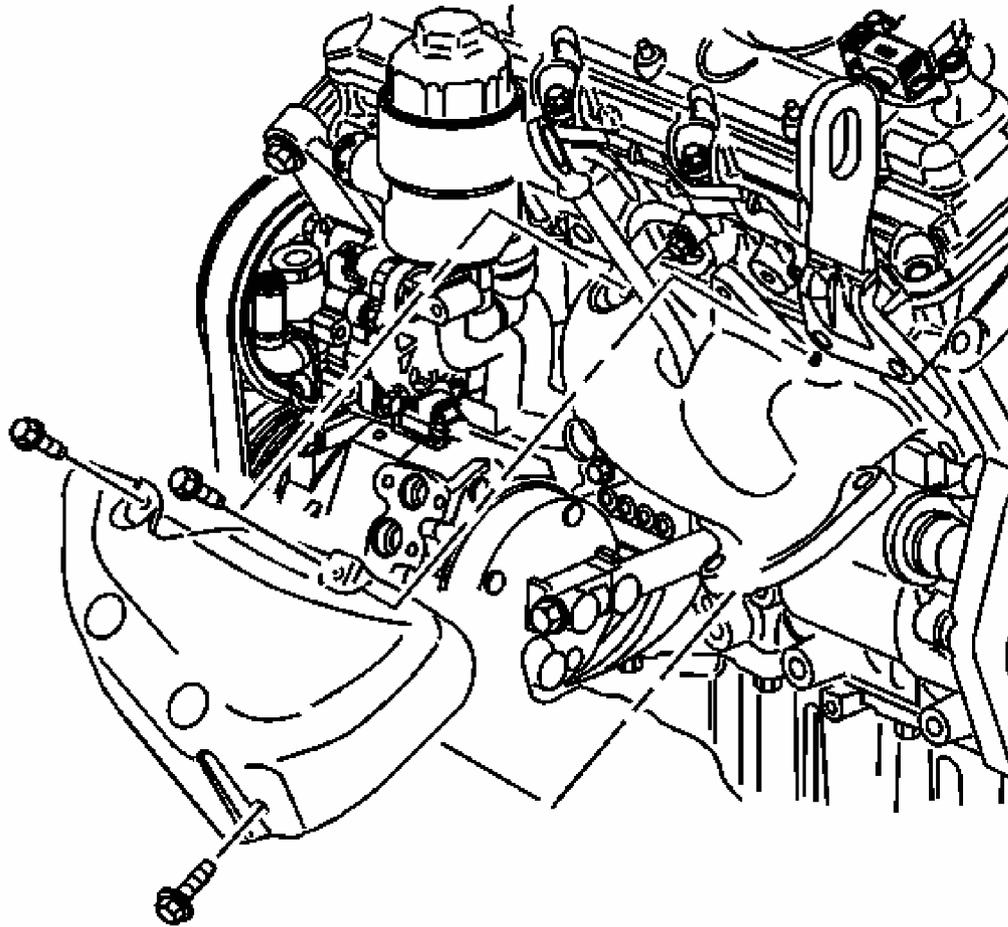
1. Remove the starter motor bolts.
2. Remove the starter motor.

#### **OIL LEVEL INDICATOR AND TUBE REMOVAL**



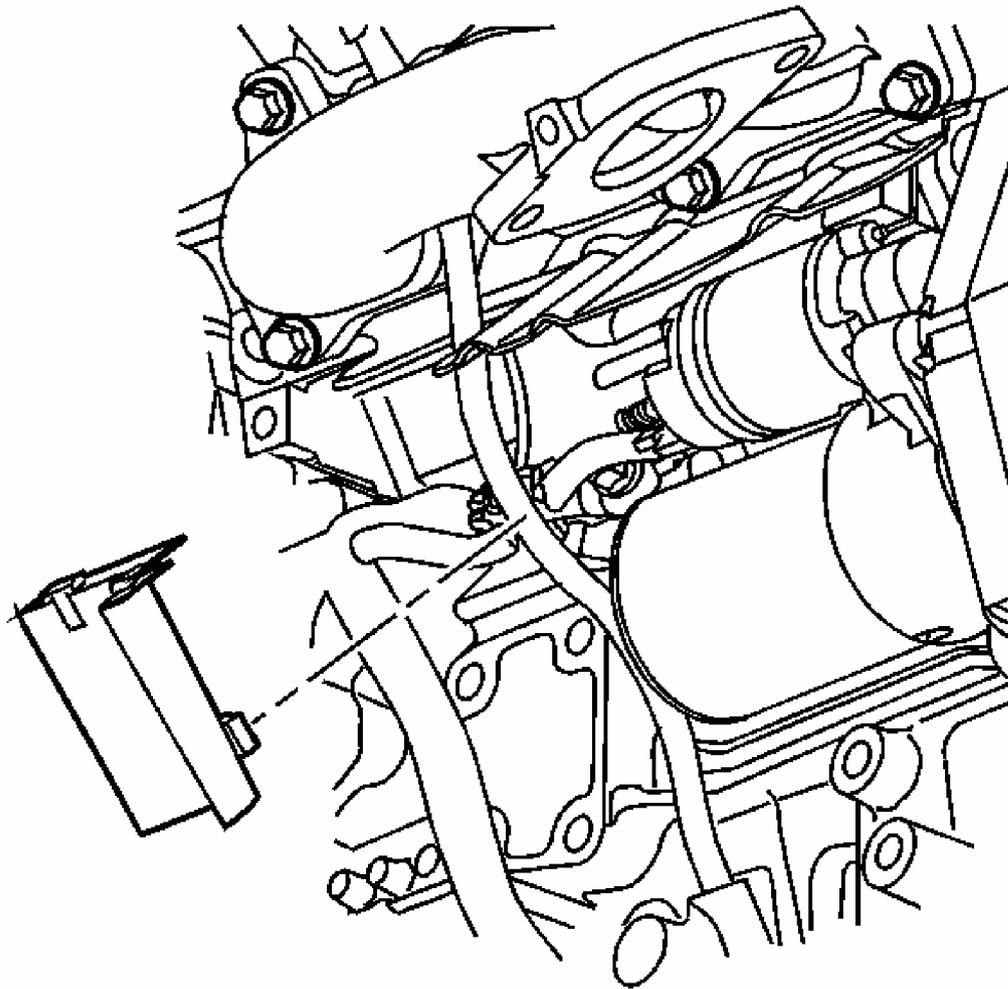
**Fig. 133: View Of Left Exhaust Manifold Upper Insulator**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the left exhaust manifold upper insulator from the oil level indicator tube.



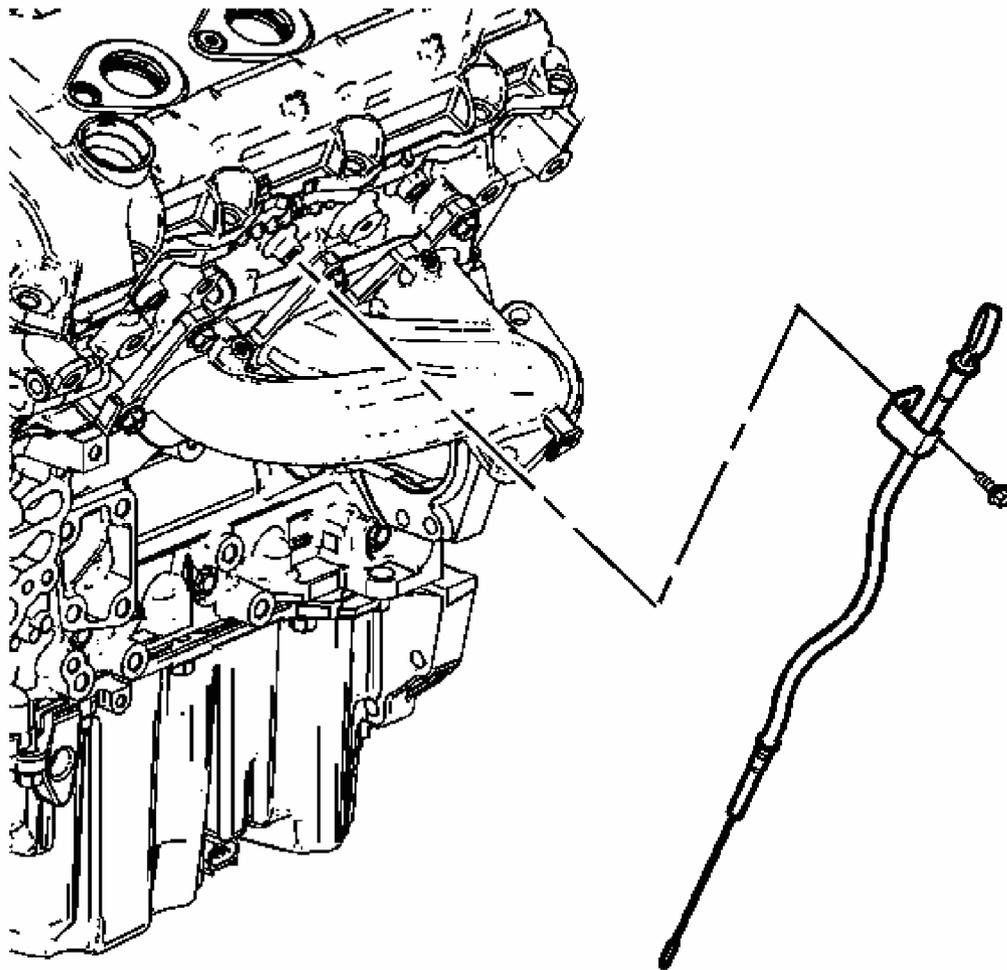
**Fig. 134: View Of Left Exhaust Manifold Heat Shield**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 135: View Of Left Exhaust Manifold Lower Insulator**  
**Courtesy of GENERAL MOTORS CORP.**

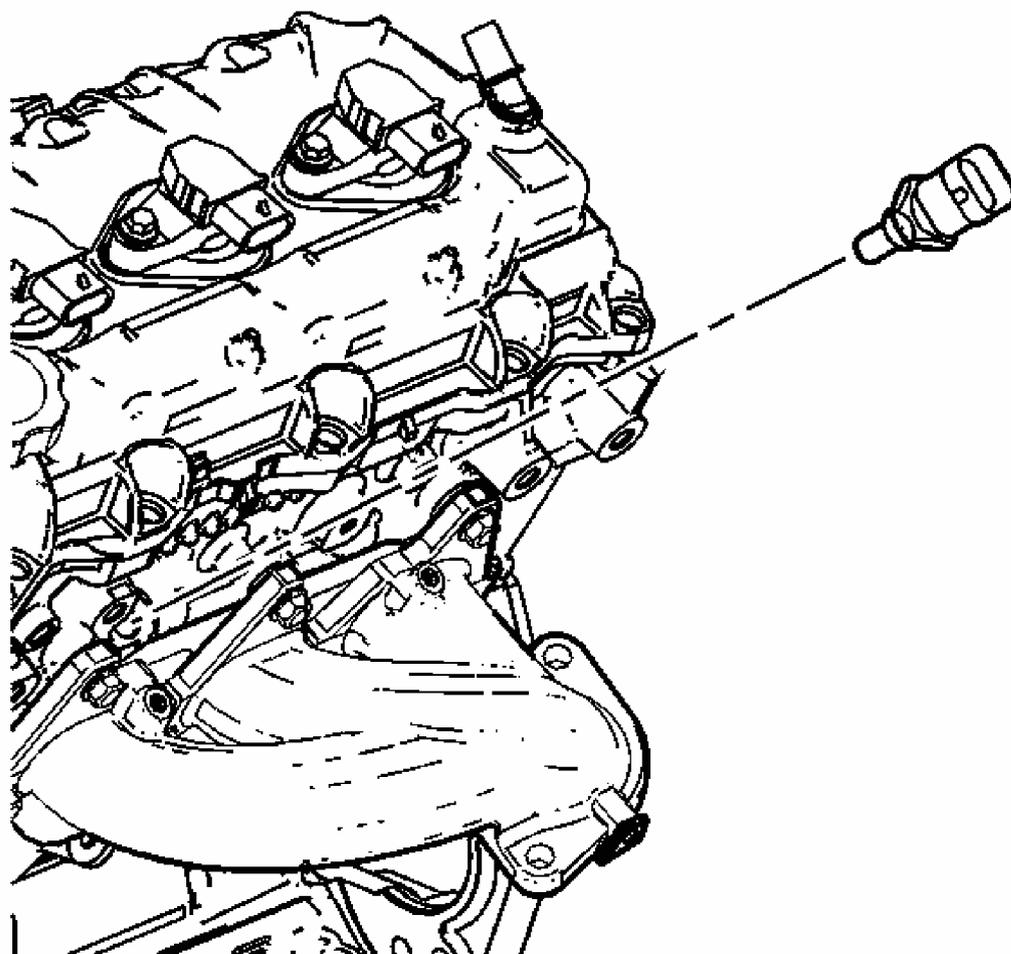
4. Remove the left exhaust manifold lower insulator from the oil level indicator tube.



**Fig. 136: View Of Oil Level Indicator Tube**  
**Courtesy of GENERAL MOTORS CORP.**

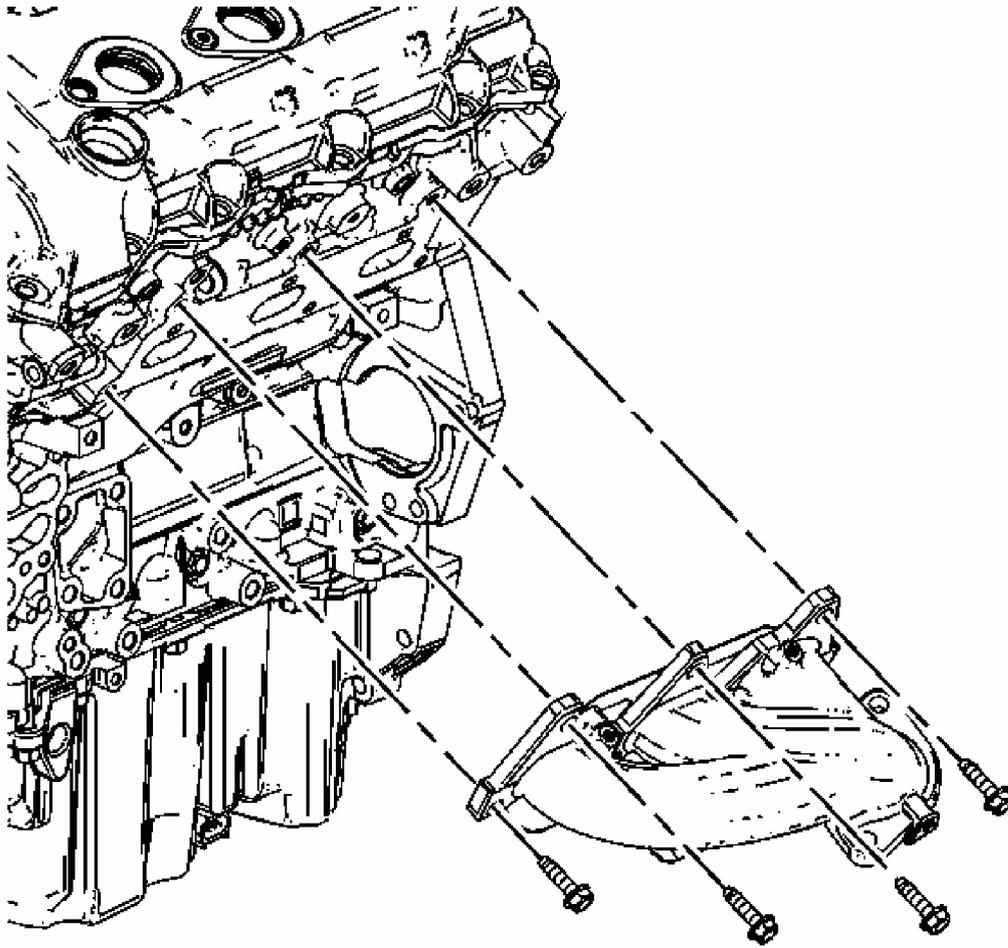
5. Remove the oil level indicator tube bracket bolt.
6. Remove the oil level indicator and tube by sliding the tube out from the lower crankcase hole.
7. Remove and discard the O-ring from the oil level indicator tube if damaged.

**EXHAUST MANIFOLD REMOVAL - LEFT**



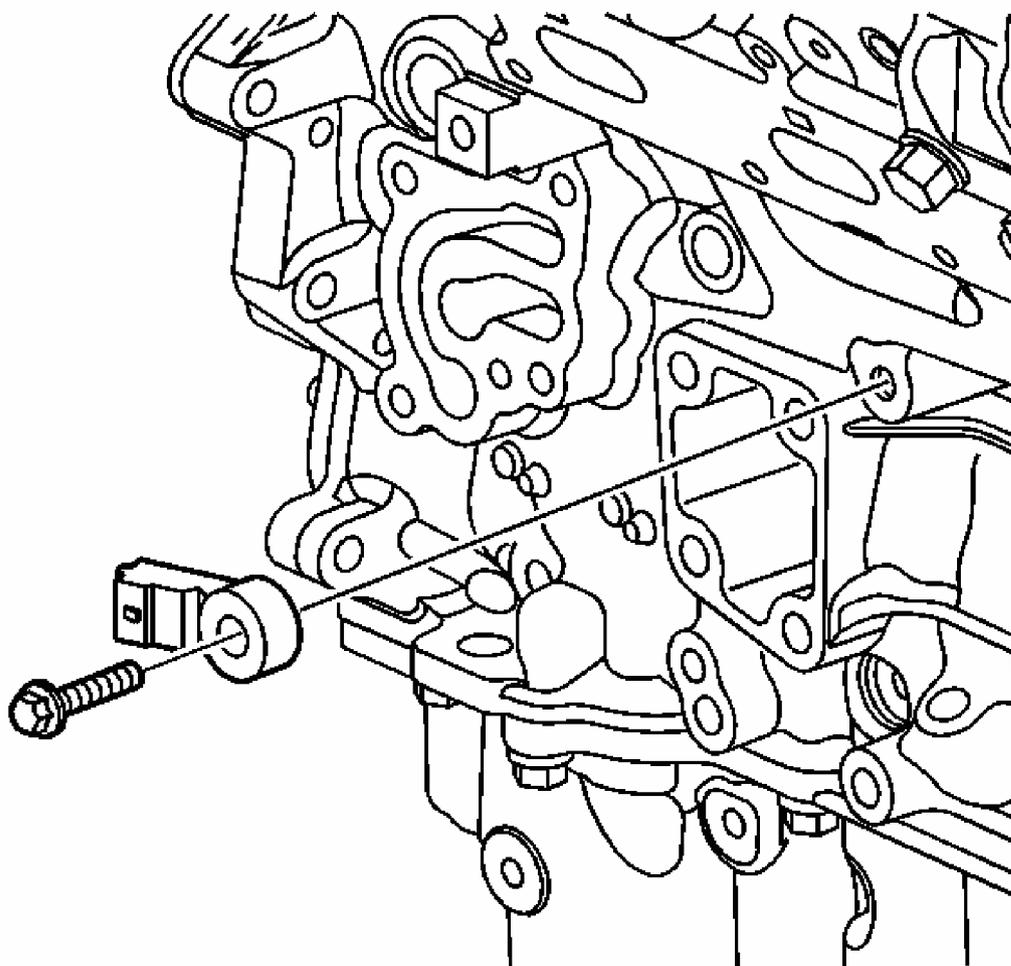
**Fig. 137: View Of ECT Sensor**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the ECT sensor.



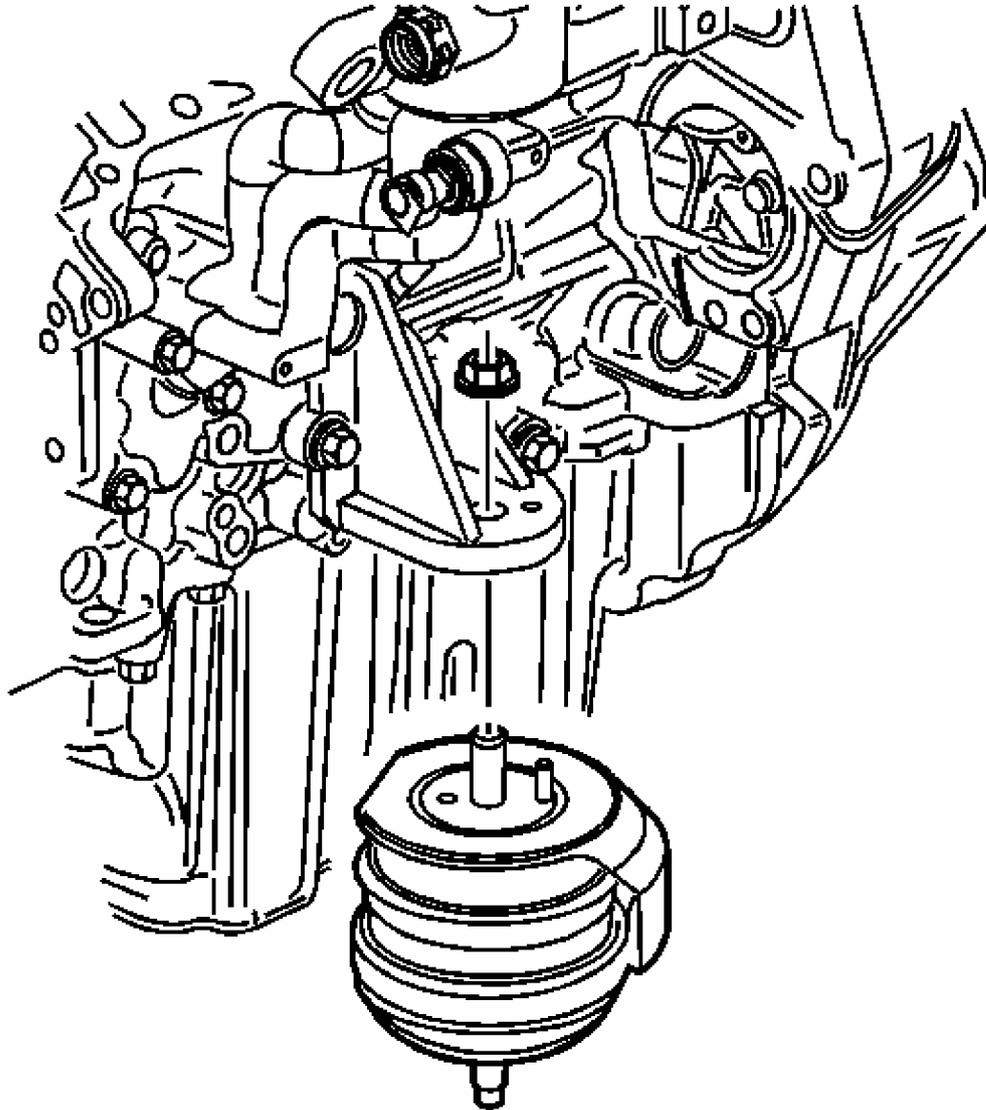
**Fig. 138: View Of Left Exhaust Manifold**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the exhaust manifold bolts from the left cylinder head.
3. Remove the left exhaust manifold.
4. Remove and discard the exhaust manifold gasket from the left cylinder head.



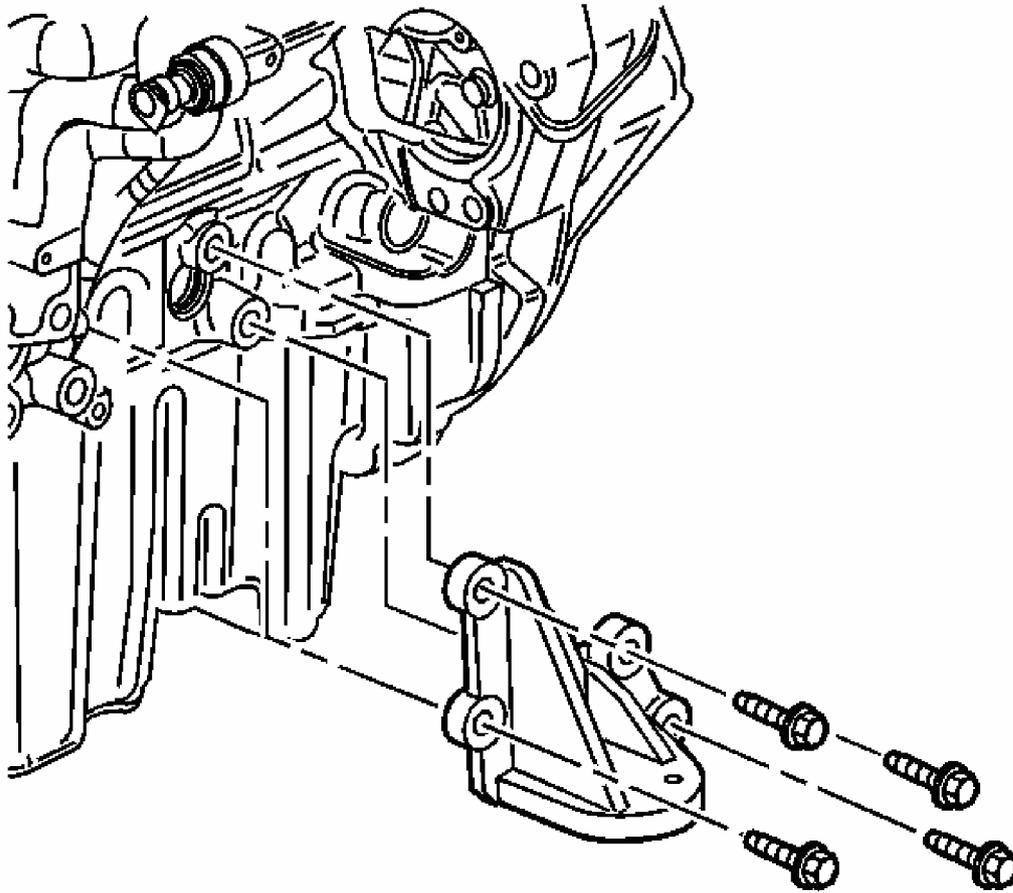
**Fig. 139: View Of Left Knock Sensor**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the left knock sensor bolt.
6. Remove the left knock sensor.



**Fig. 140: Removing & Installing Left Engine Mount**  
**Courtesy of GENERAL MOTORS CORP.**

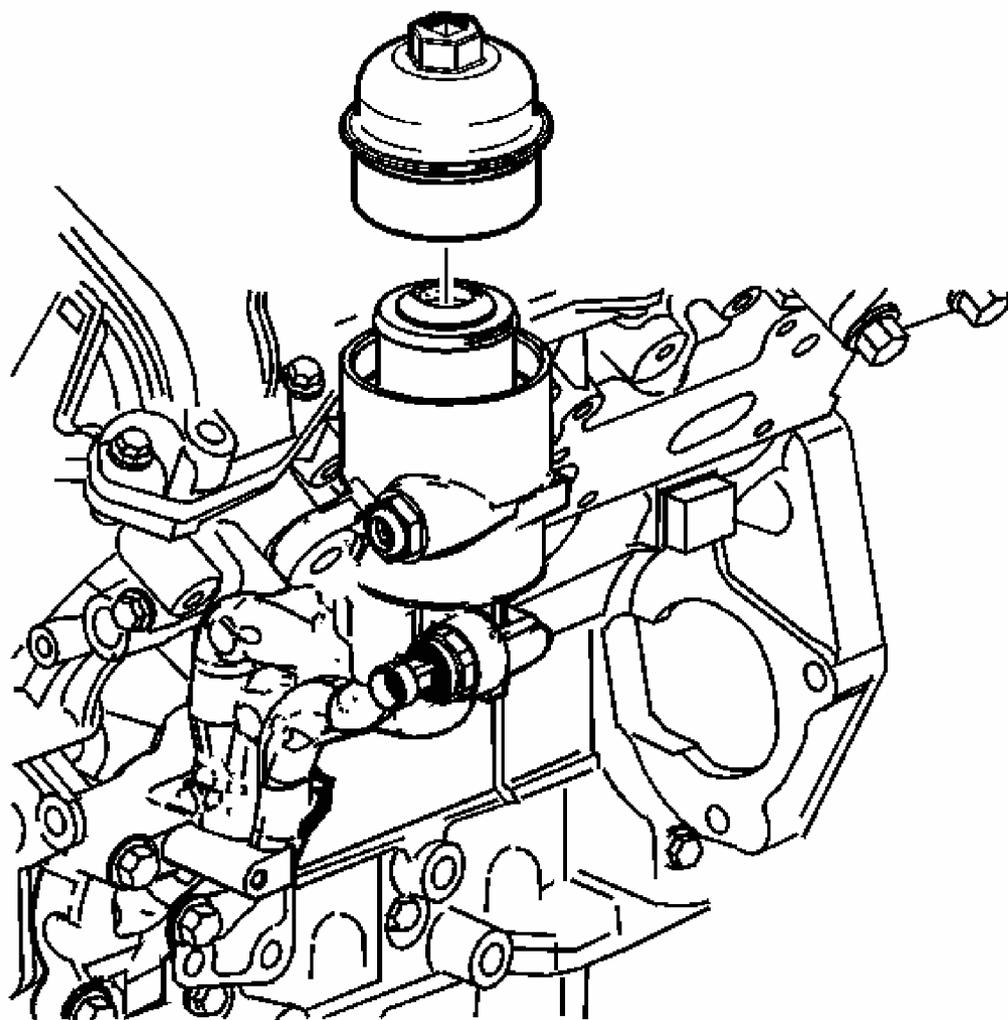
7. Remove the left engine mount nut.
8. Remove the left engine mount.



**Fig. 141: Removing & Installing Engine Mount Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

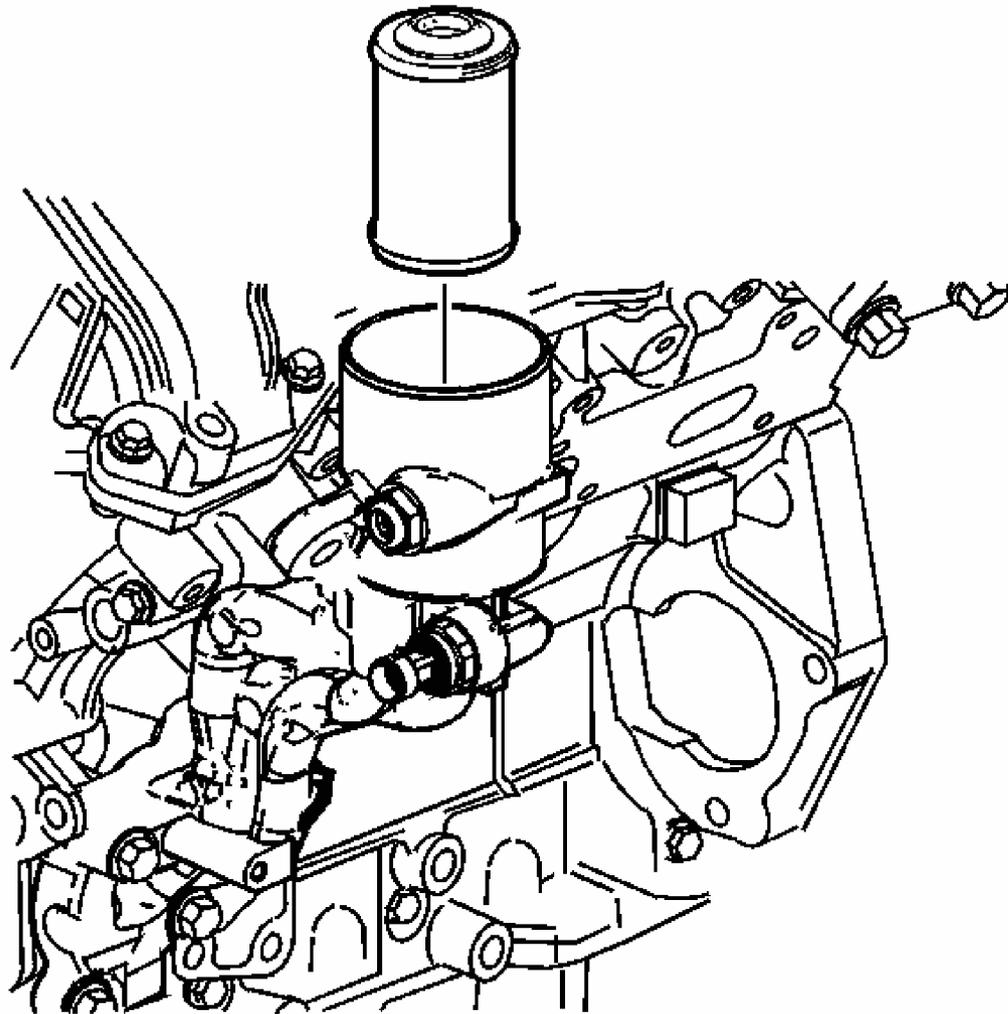
9. Remove the left engine mount bracket bolt.
10. Remove the left engine mount bracket.

#### **OIL FILTER ADAPTER REMOVAL**



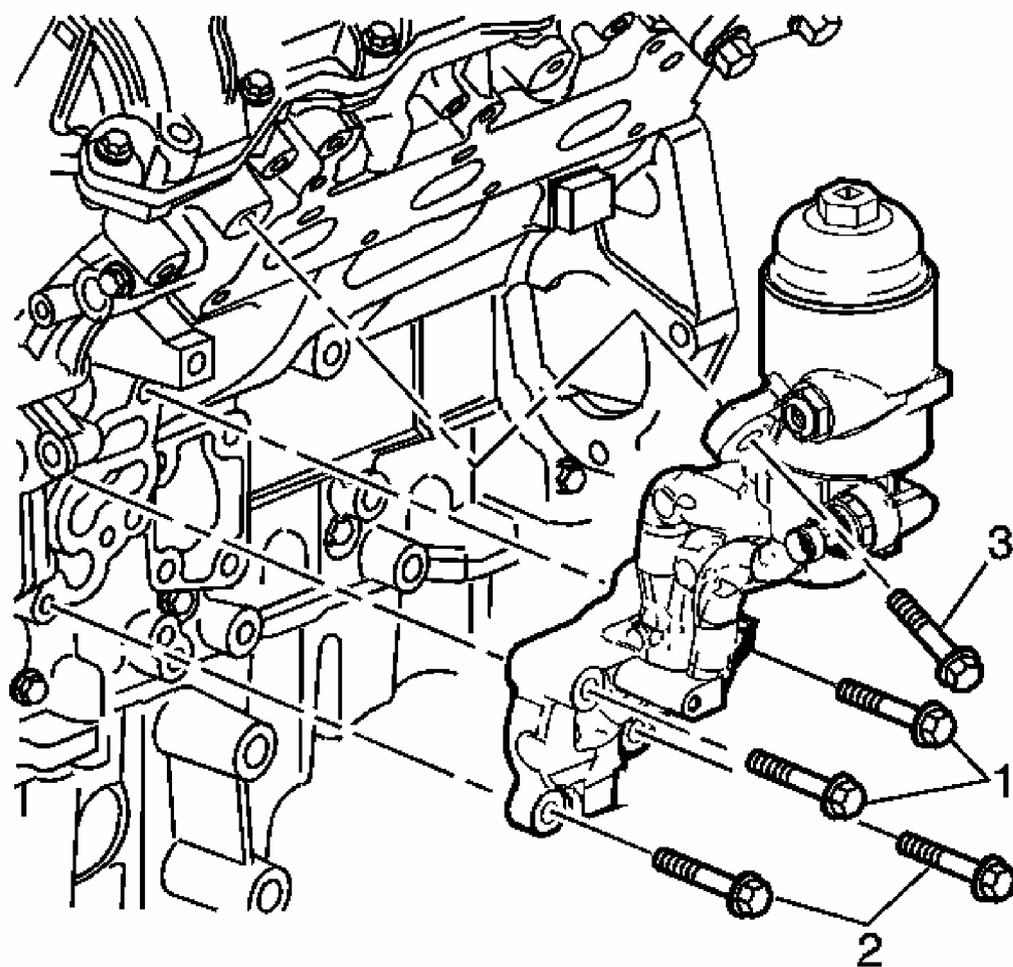
**Fig. 142: Installing Oil Filter Cap**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter cap.



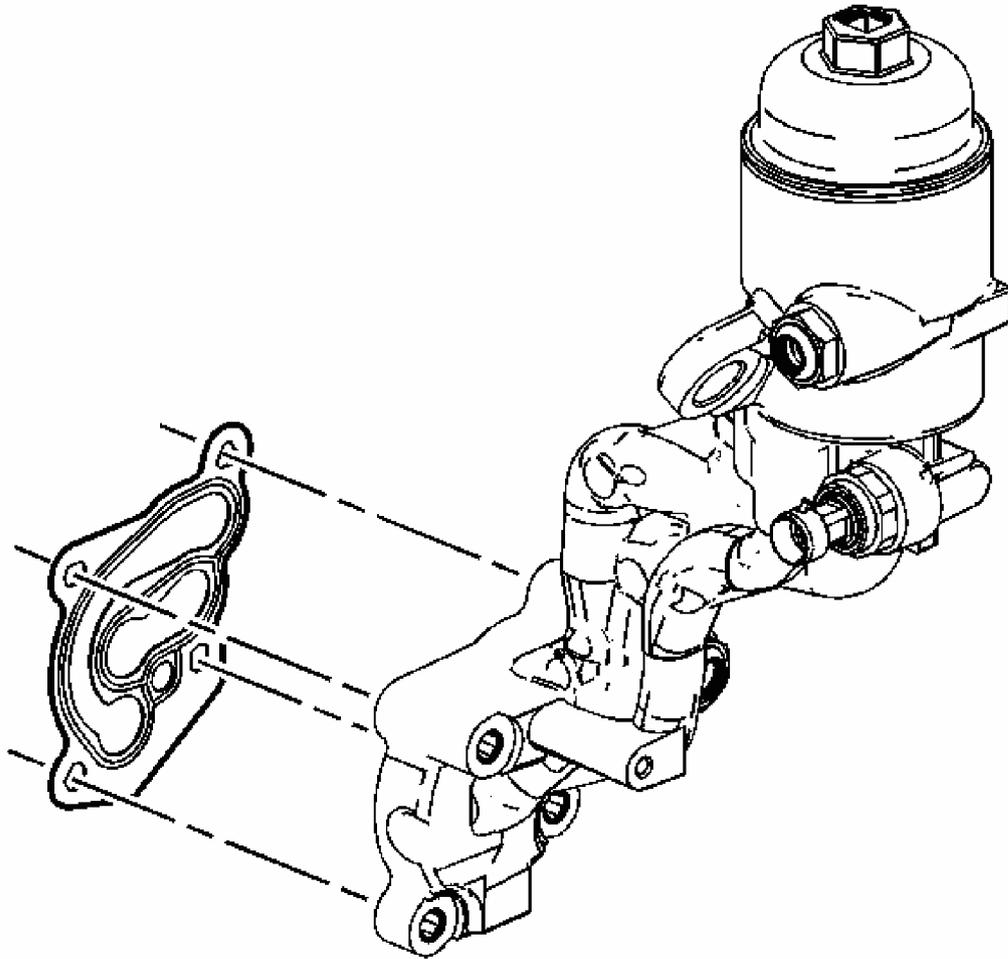
**Fig. 143: View Of Oil Filter Cartridge**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove and properly dispose of the oil filter cartridge.
3. Re-install the oil filter cap.



**Fig. 144: View Of Oil Filter Adapter & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

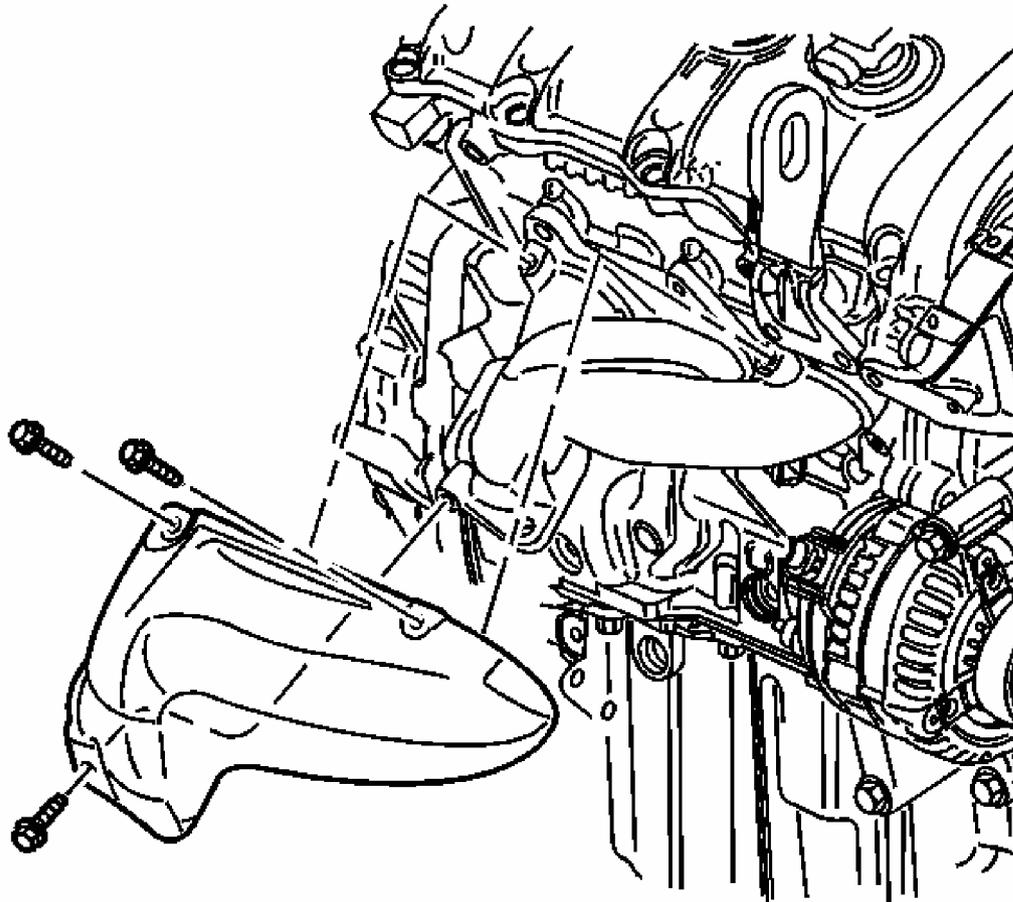
4. Remove the oil filter adapter bolts (1-3) from the engine block.
5. Remove the oil filter adapter.



**Fig. 145: View Of Oil Filter Adapter & Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

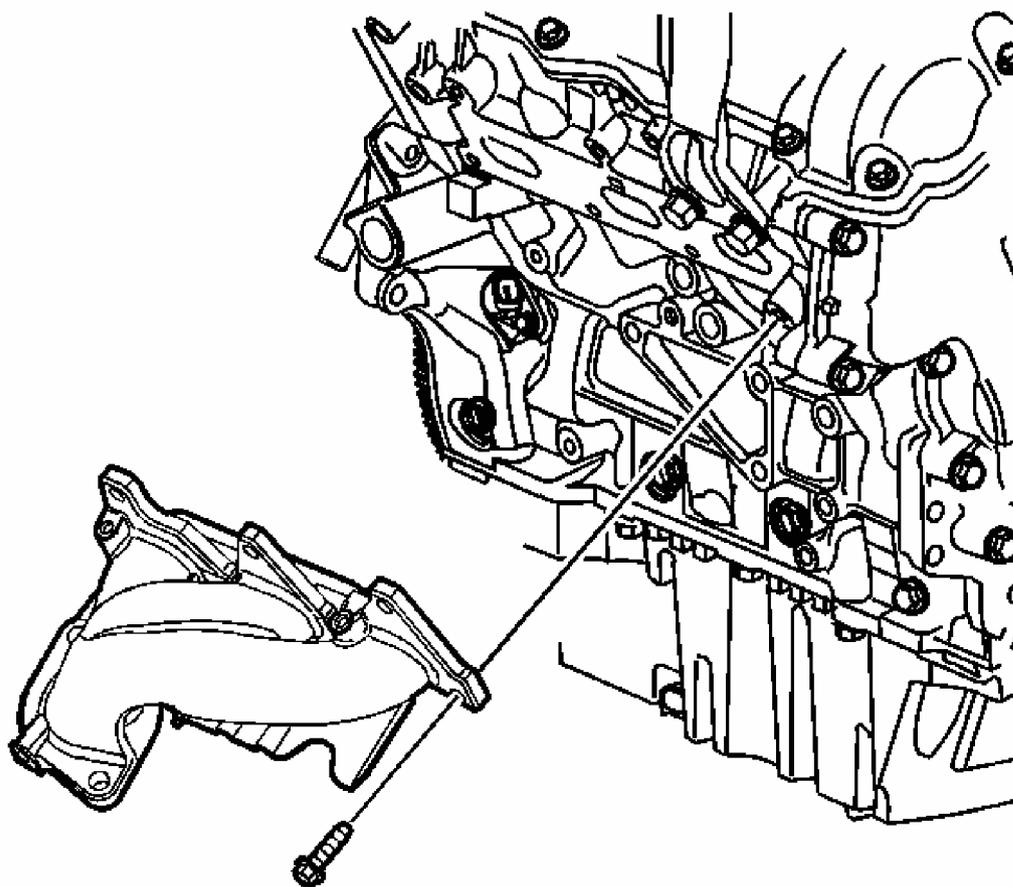
6. Remove and discard the oil filter adapter gasket.

**EXHAUST MANIFOLD REMOVAL - RIGHT**



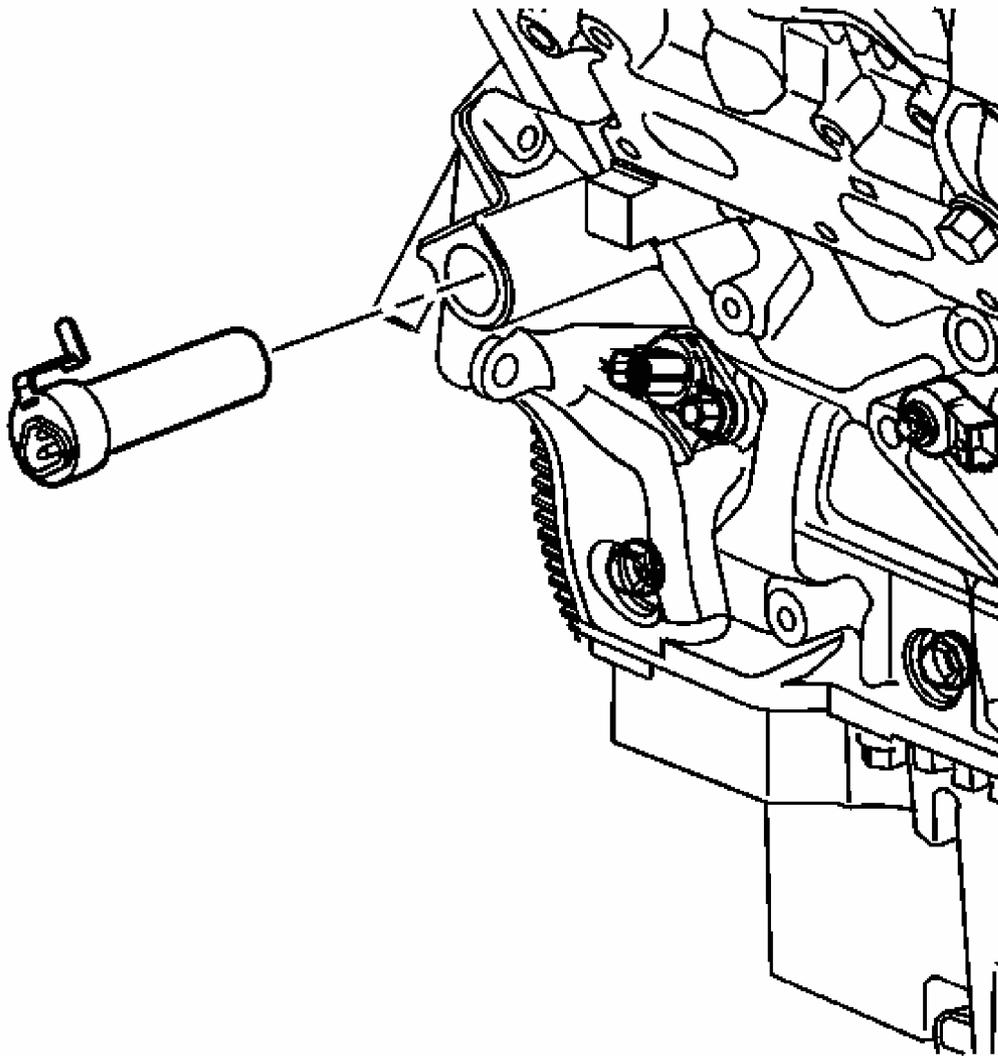
**Fig. 146: View Of Right Exhaust Manifold Heat Shield**  
**Courtesy of GENERAL MOTORS CORP.**

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



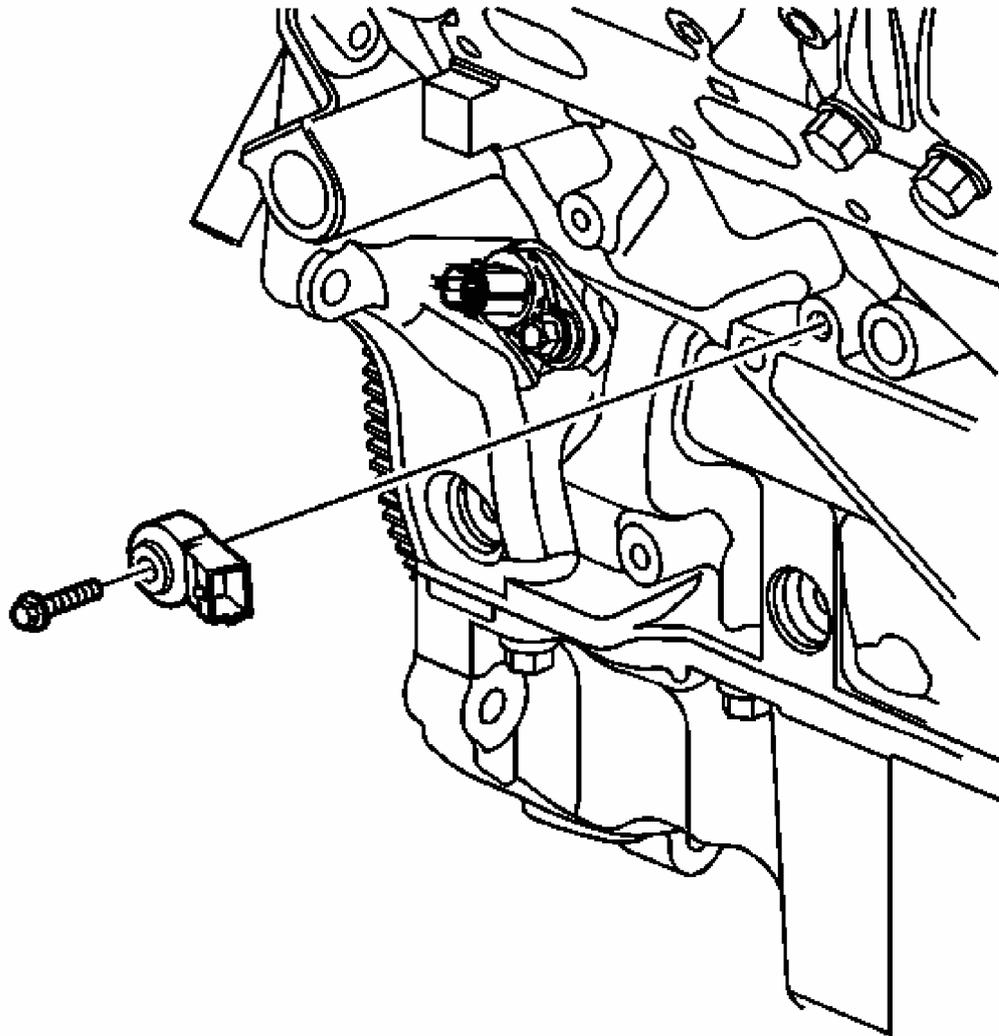
**Fig. 147: Removing & Installing Right Exhaust Manifold**  
Courtesy of GENERAL MOTORS CORP.

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 from the right cylinder head.



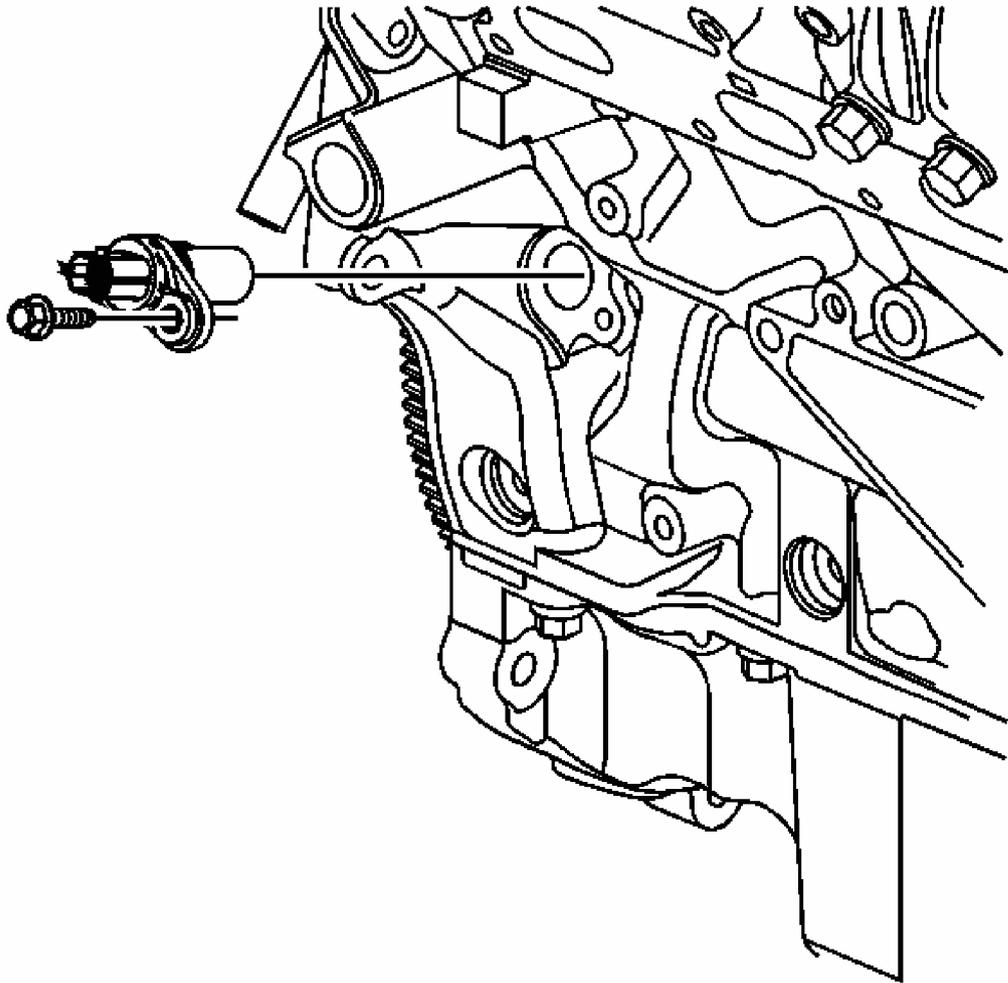
**Fig. 148: View Of Block Heater Cartridge**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the block heater cartridge.



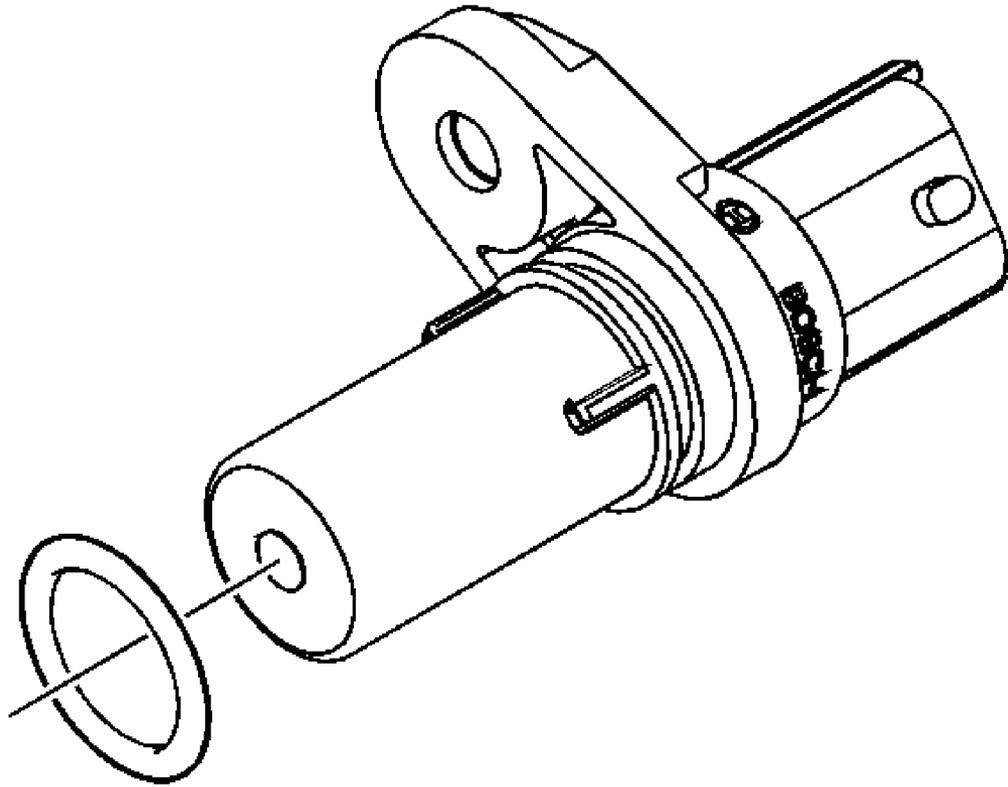
**Fig. 149: View Of Right Knock Sensor & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

7. Remove the right knock sensor bolt.
8. Remove the right knock sensor.



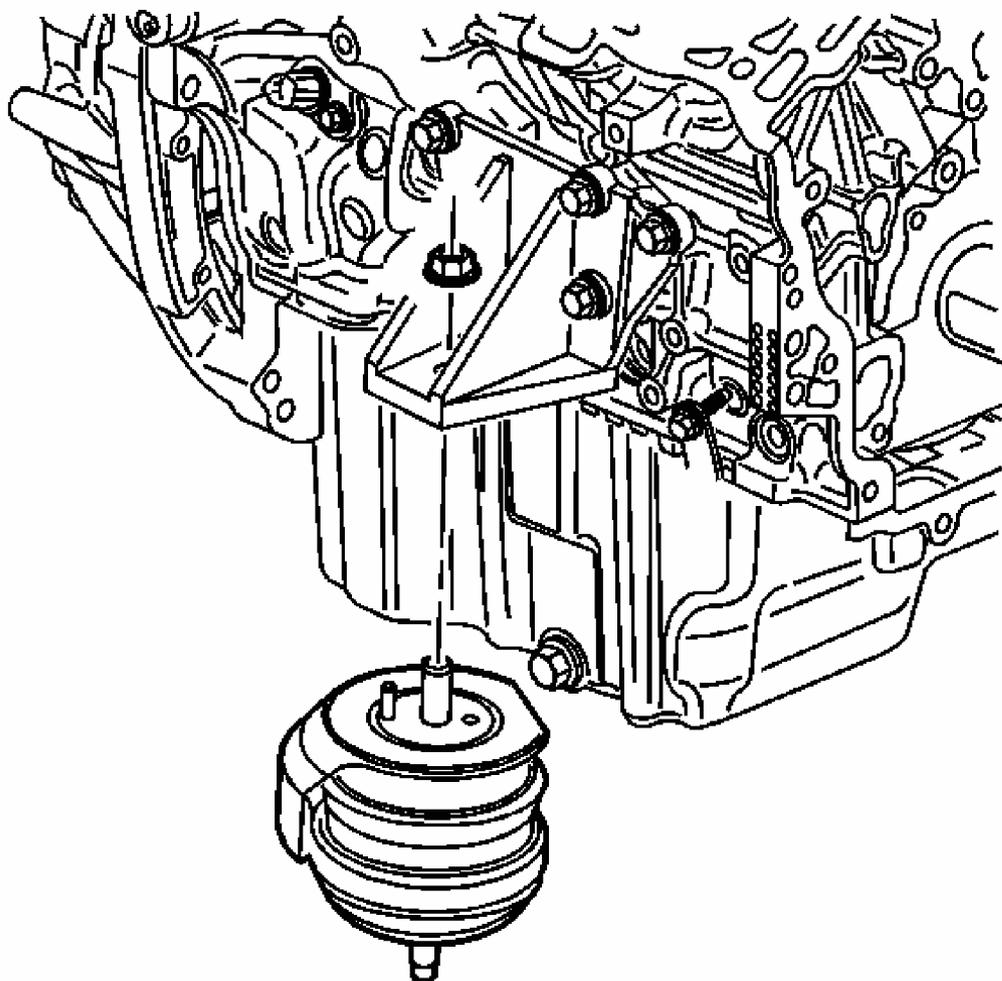
**Fig. 150: View Of Crankshaft Position Sensor & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

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



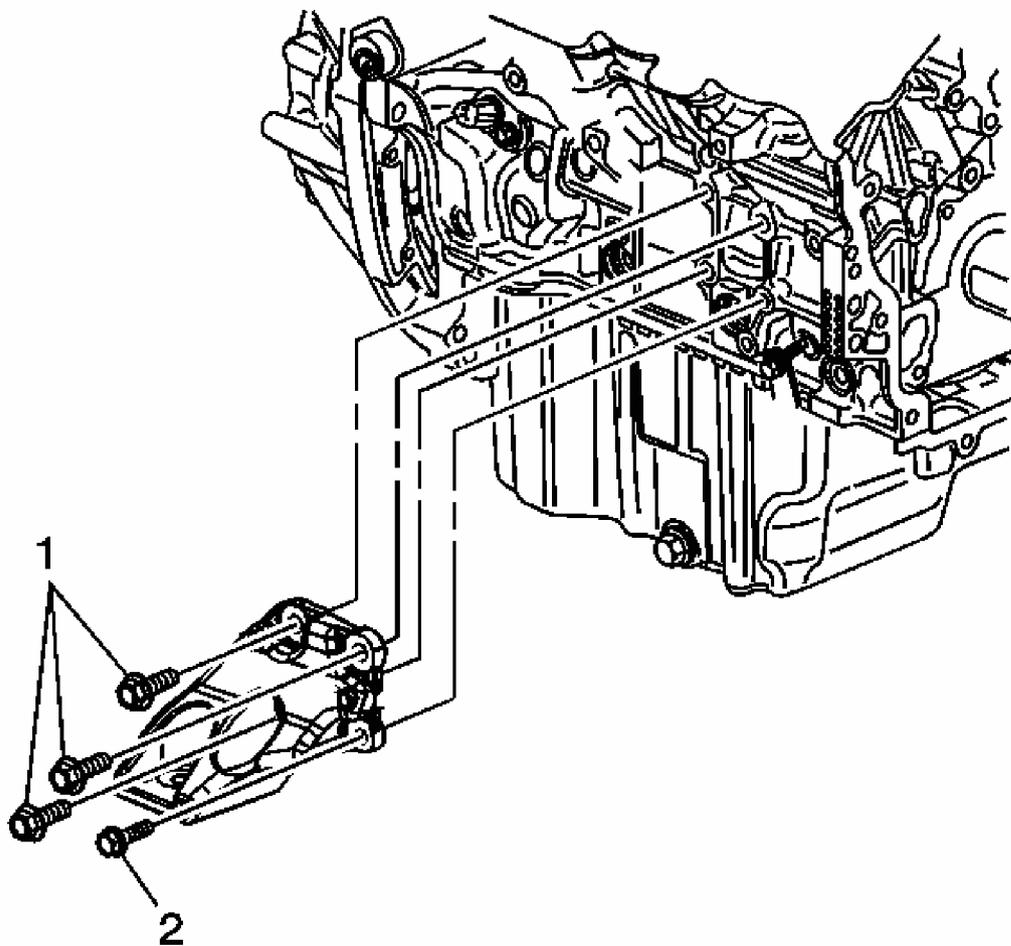
**Fig. 151: View Of Crankshaft Position Sensor O-Ring**  
**Courtesy of GENERAL MOTORS CORP.**

11. Remove and discard the crankshaft position sensor O-ring, if damaged.



**Fig. 152: Removing & Installing Engine Mount**  
**Courtesy of GENERAL MOTORS CORP.**

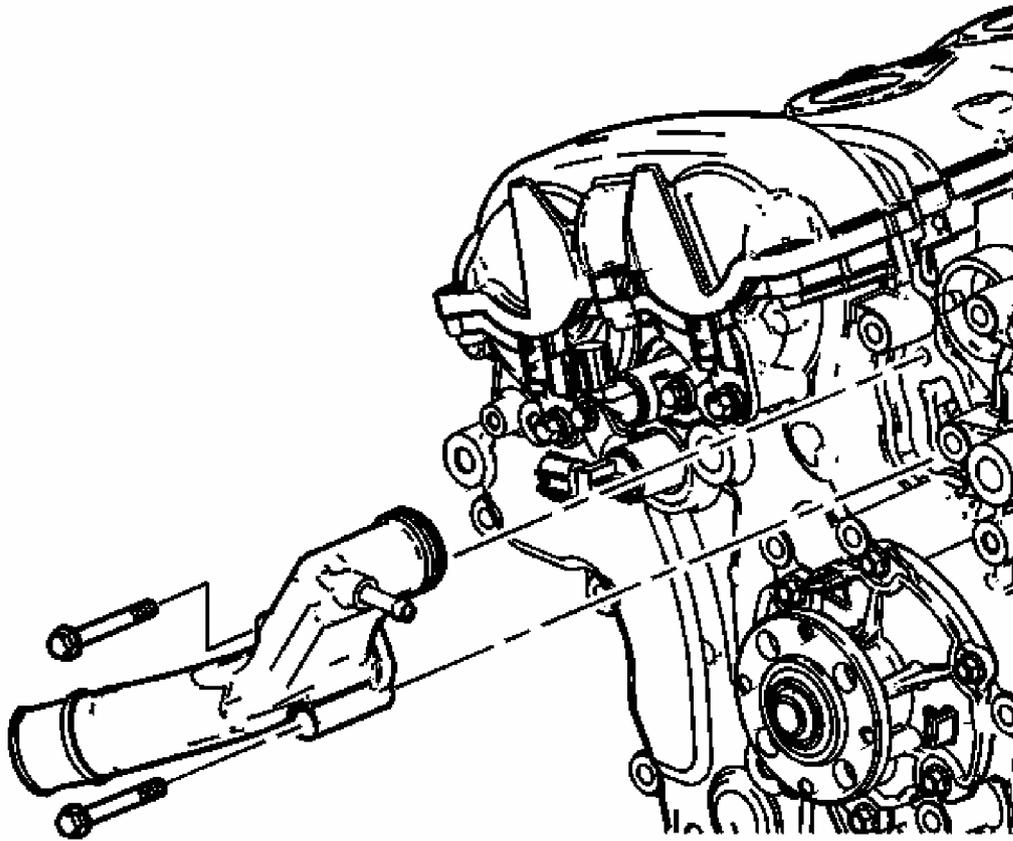
12. Remove the engine mount nut.
13. Remove the engine mount.



**Fig. 153: Removing & Installing Engine Mount Bracket**  
Courtesy of GENERAL MOTORS CORP.

14. Remove the engine mount bracket bolts.
15. Remove the engine mount bracket.

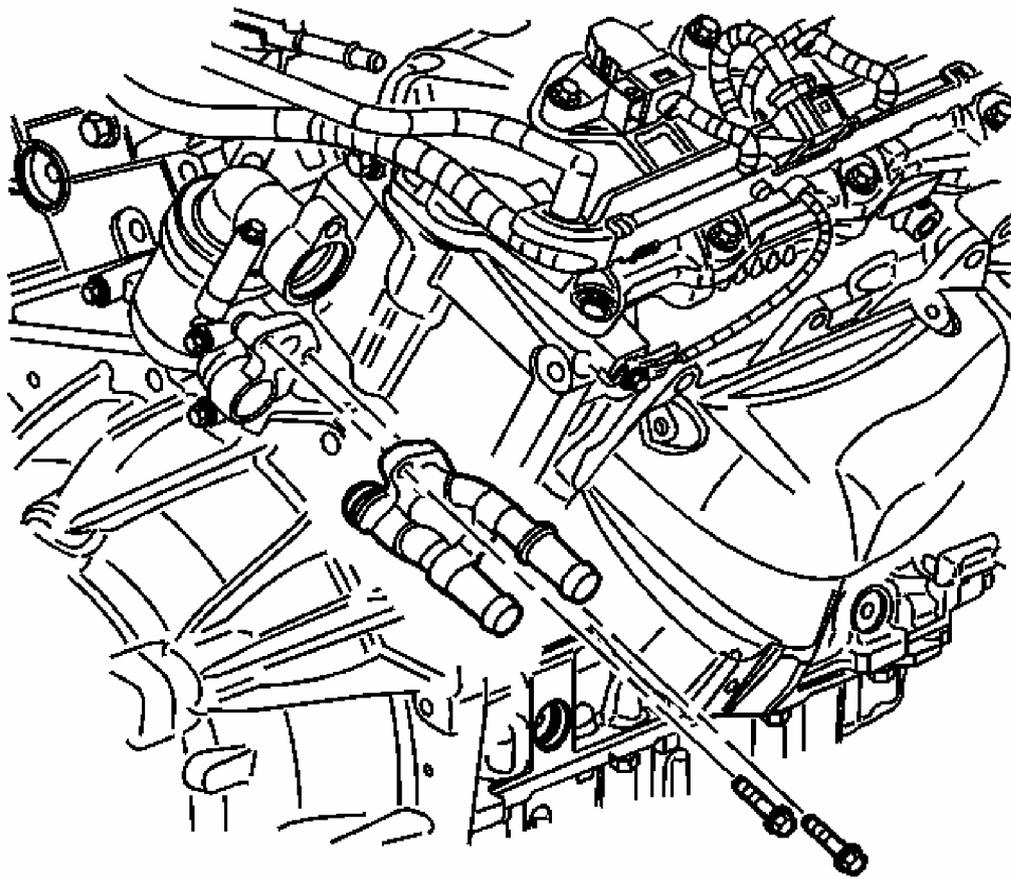
#### **WATER OUTLET REMOVAL**



**Fig. 154: View Of Water Outlet Housing**  
**Courtesy of GENERAL MOTORS CORP.**

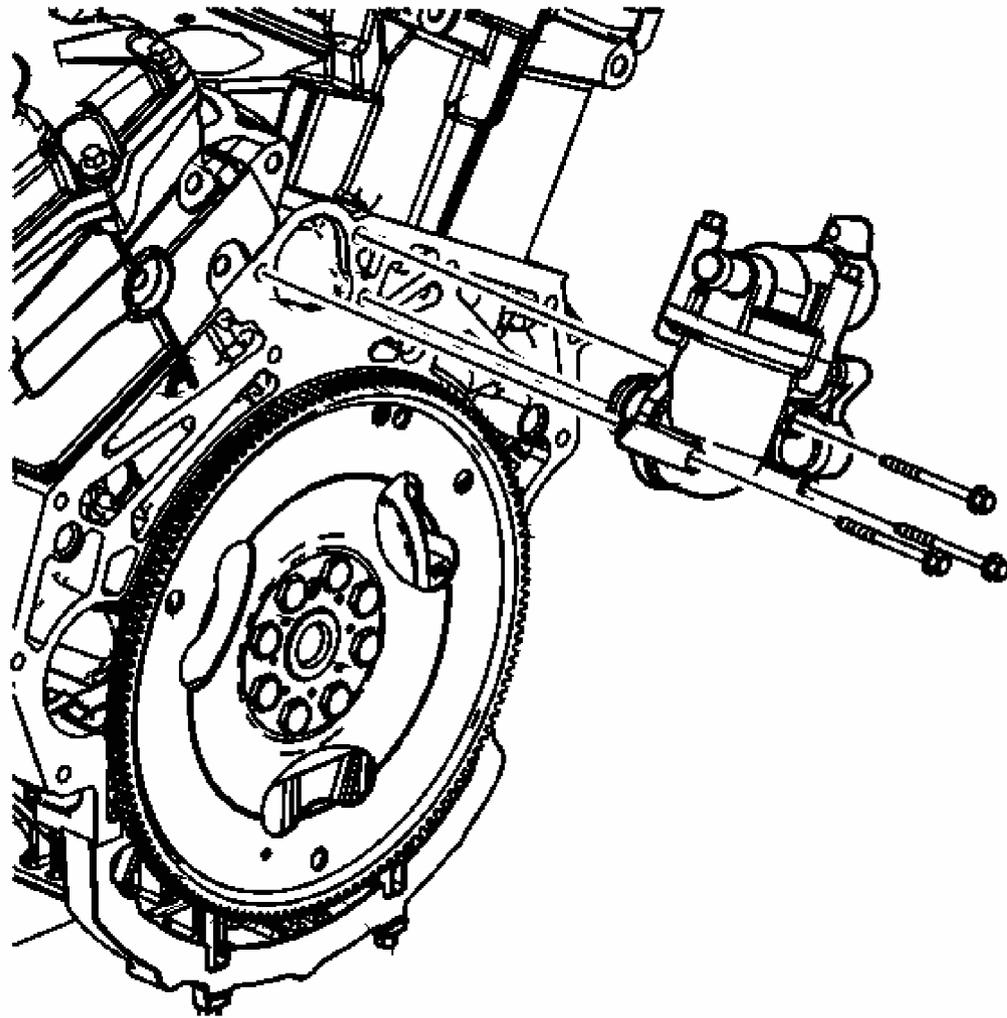
1. Remove the water outlet bolts.
2. Remove the water outlet.
3. Remove the water outlet gasket.

#### **THERMOSTAT HOUSING REMOVAL**



**Fig. 155: View Of Heater Inlet/Outlet Pipe Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 156: View Of Thermostat Housing With Heater Pipes, Heater Hoses, Gasket & Bolts**

**Courtesy of GENERAL MOTORS CORP.**

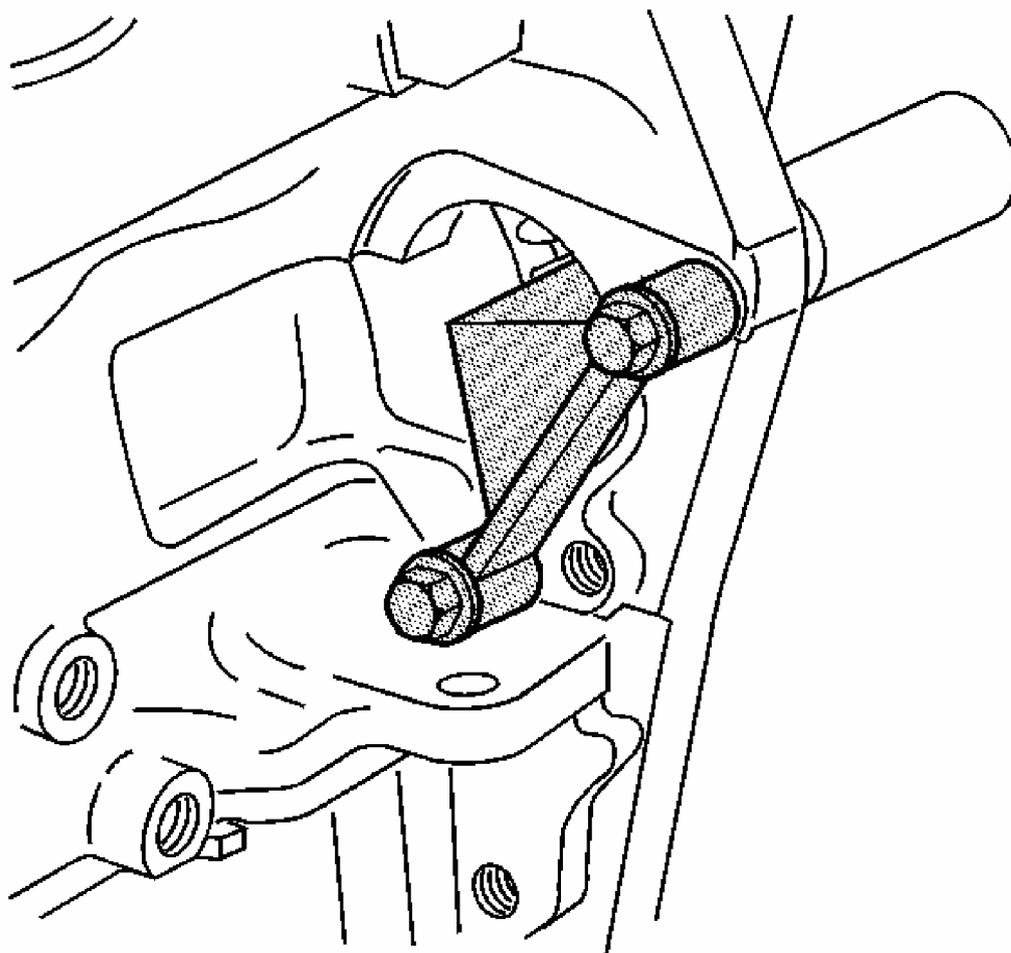
3. Remove the thermostat housing bolts.
4. Remove the thermostat housing.
5. Remove the thermostat housing gasket.

#### **CRANKSHAFT BALANCER REMOVAL**

#### **Tools Required**

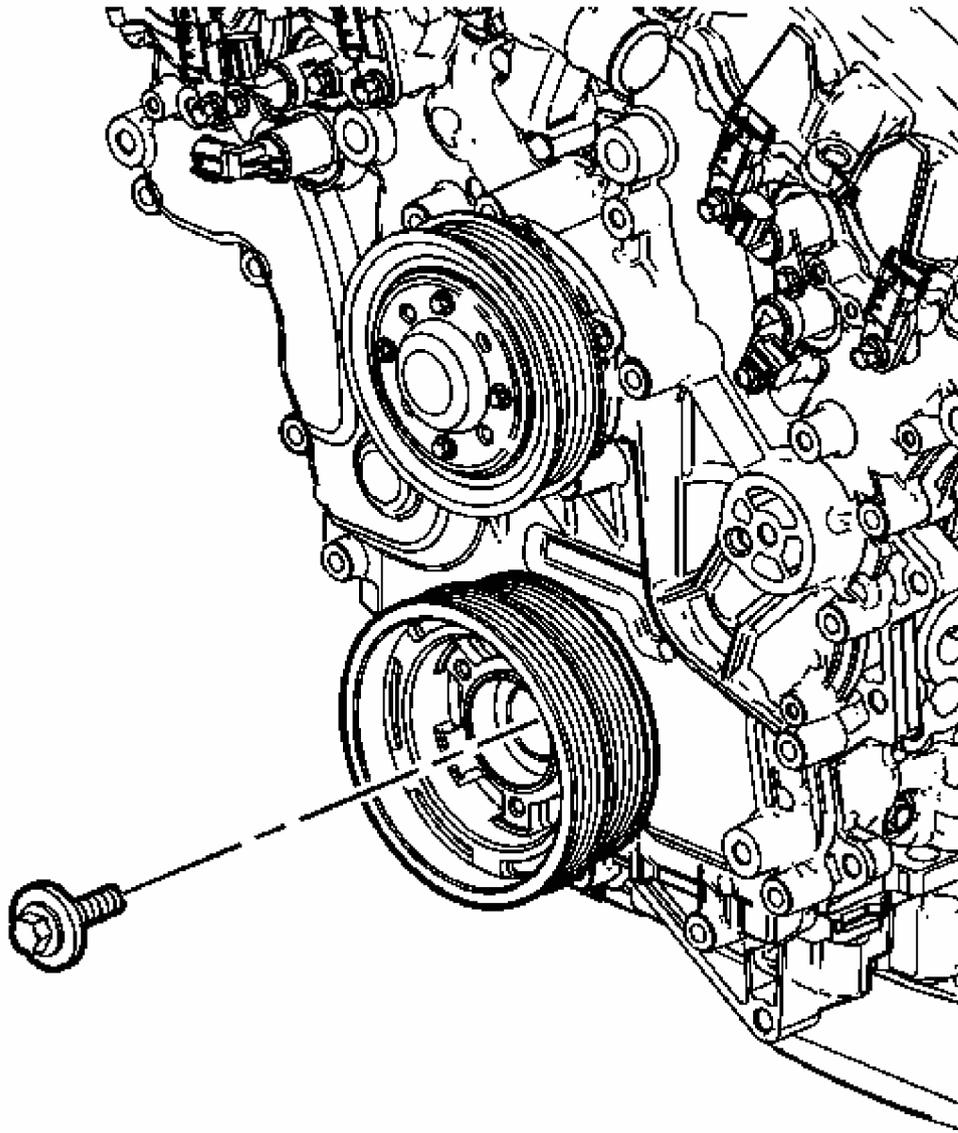
- EN 46106 Flywheel Holding Tool

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



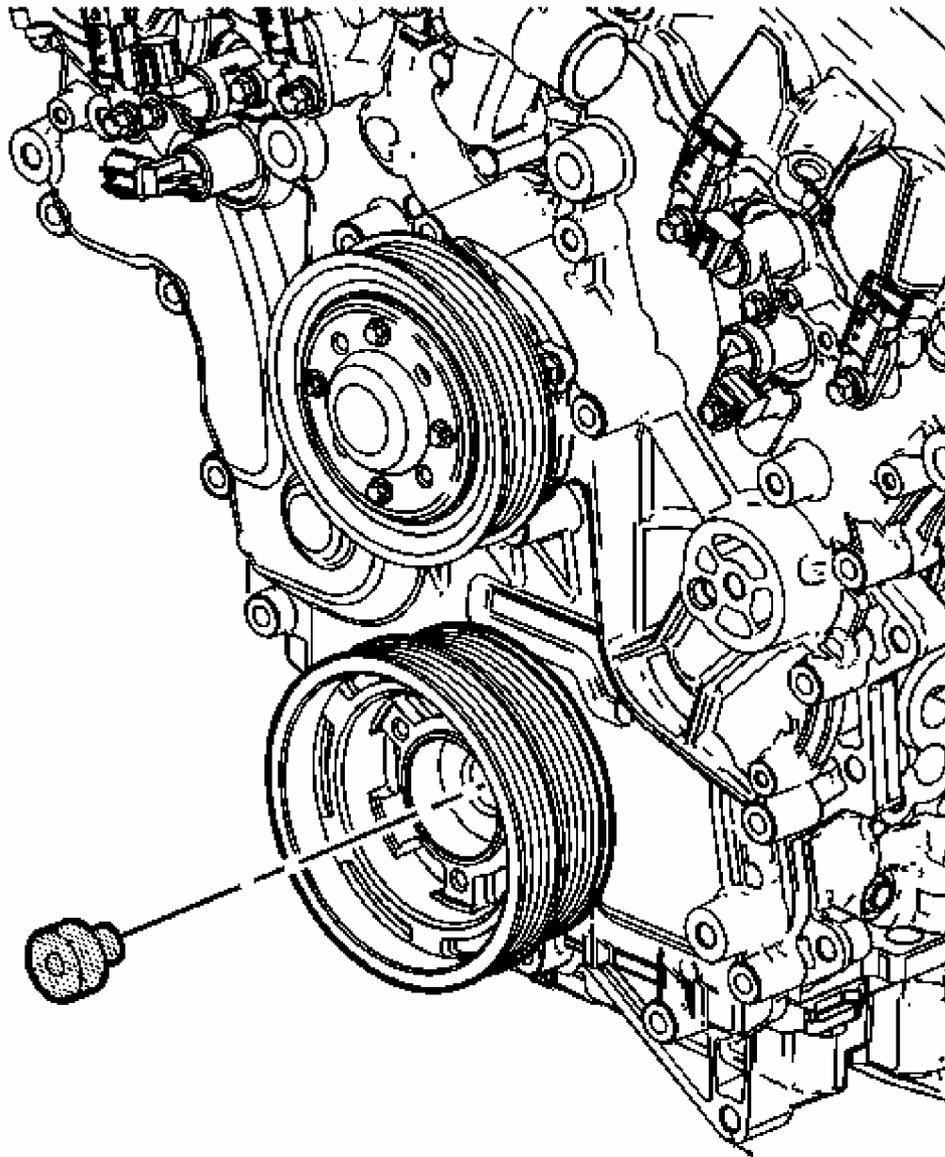
**Fig. 157: View Of Tool EN 46106**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the EN 46106 through the starter mounting hole.



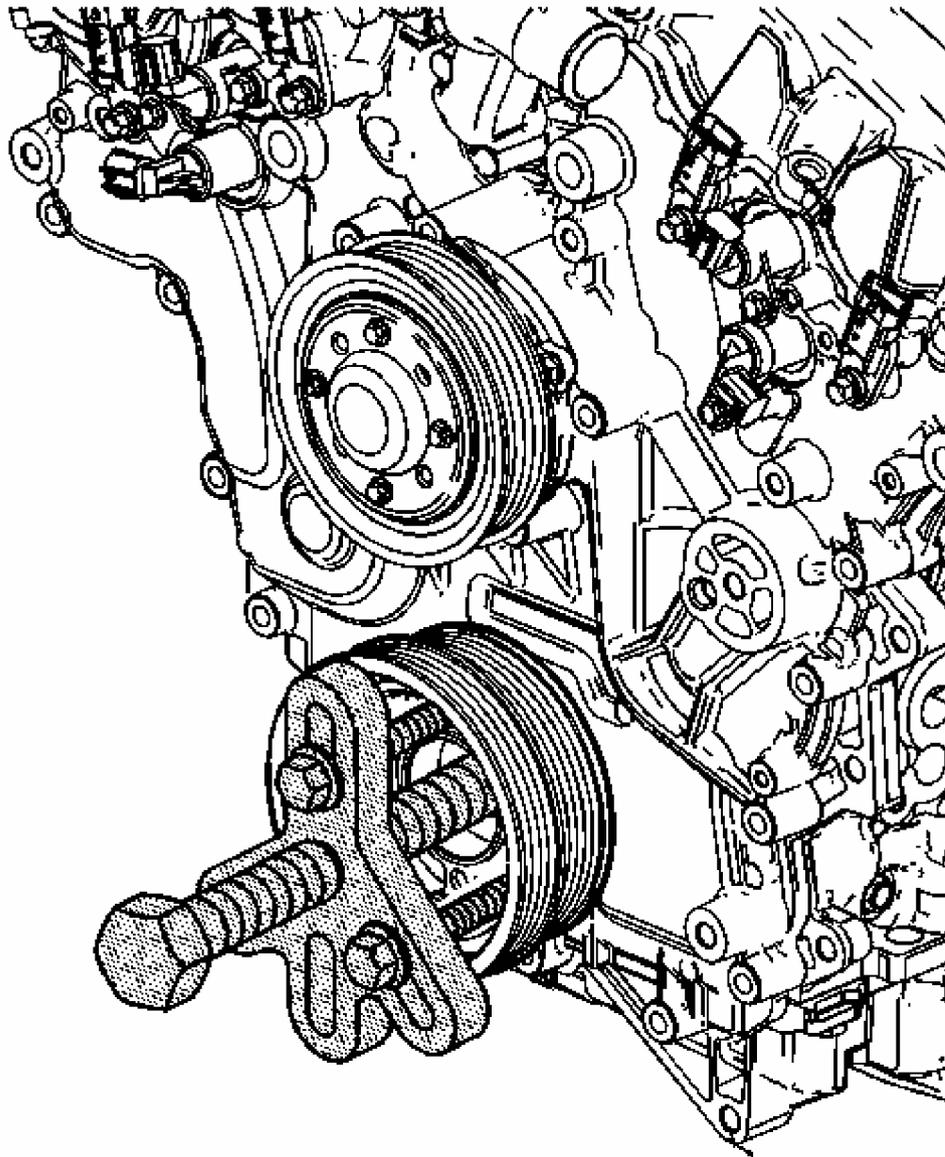
**Fig. 158: View Of Crankshaft Balancer & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the crankshaft balancer bolt.



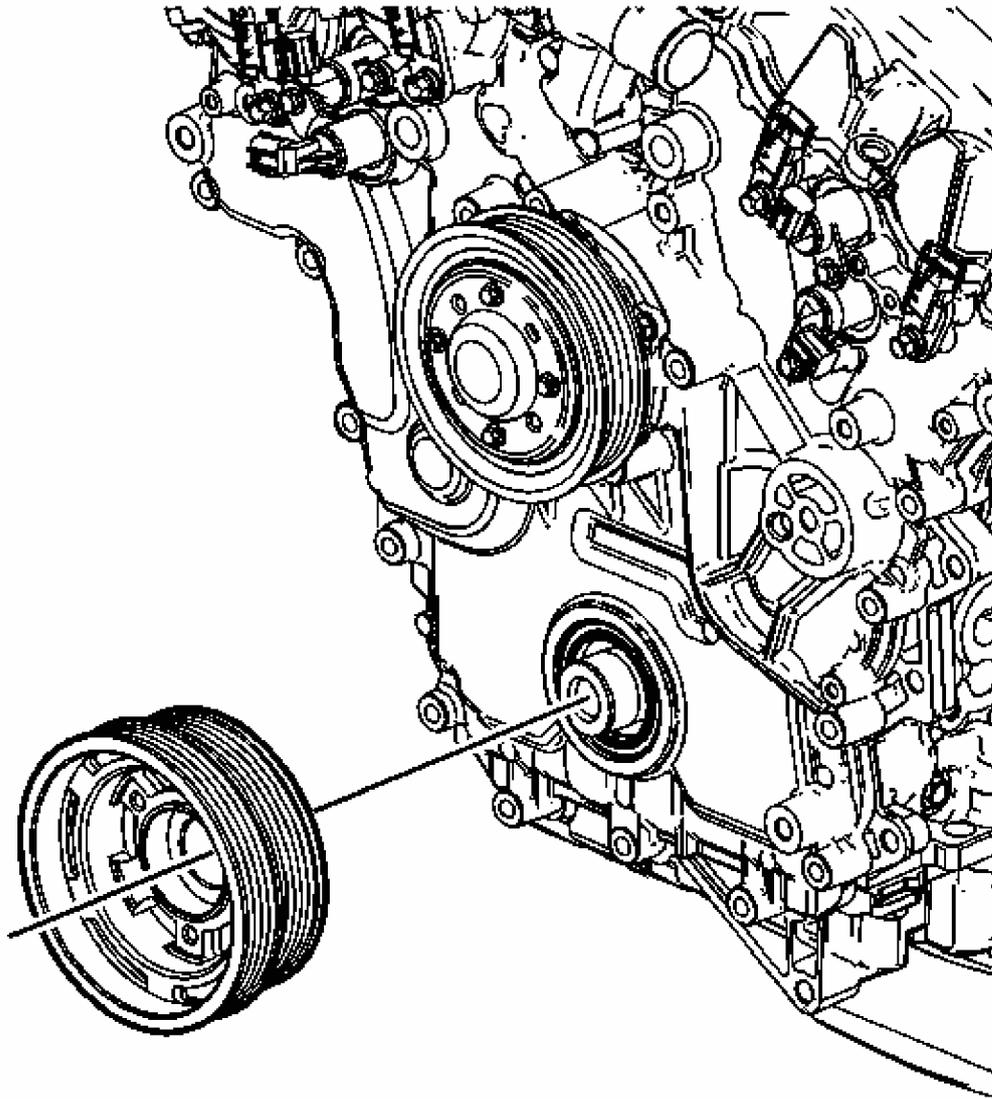
**Fig. 159: Installing J 38416-2**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install the J 38416-2 in the nose of the crankshaft.



**Fig. 160: Installing J 24420-C**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the J 24420-C in order to remove the crankshaft balancer.

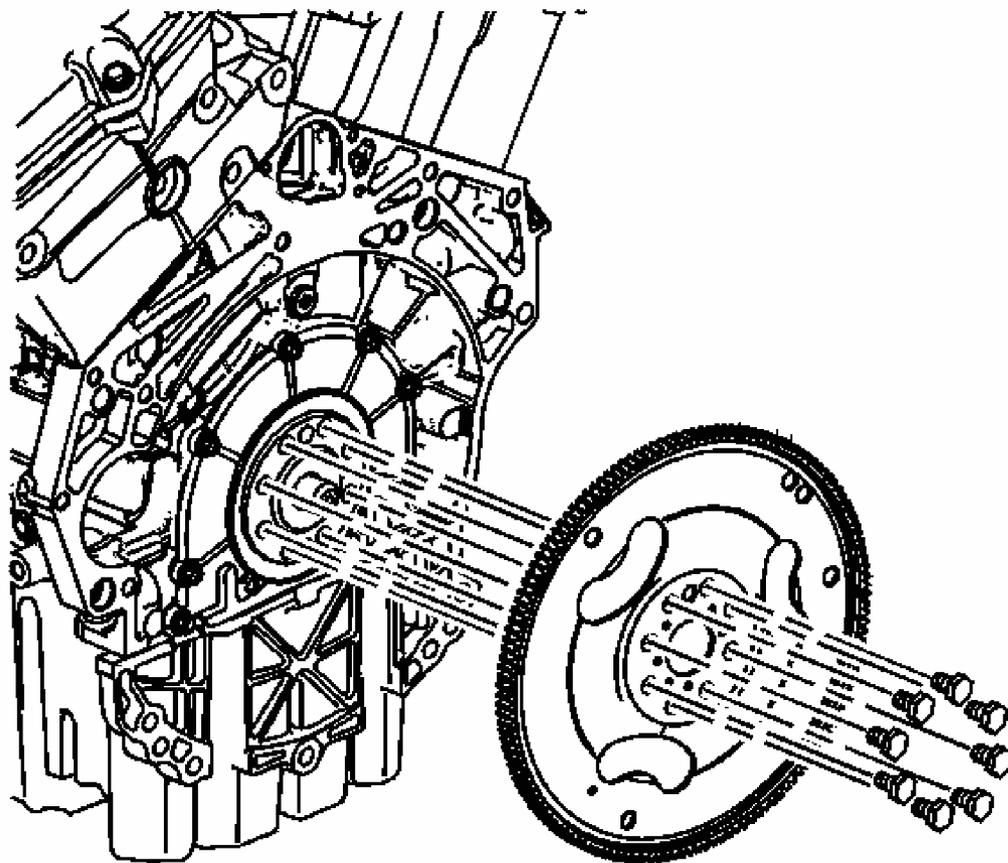


**Fig. 161: View Of Crankshaft Balancer**  
**Courtesy of GENERAL MOTORS CORP.**

5. Pull the crankshaft balancer off by tightening the center bolt on the **J 24420-C** until the crankshaft balancer pulls off of the crankshaft end.
6. Remove the **J 24420-C** from the crankshaft balancer.

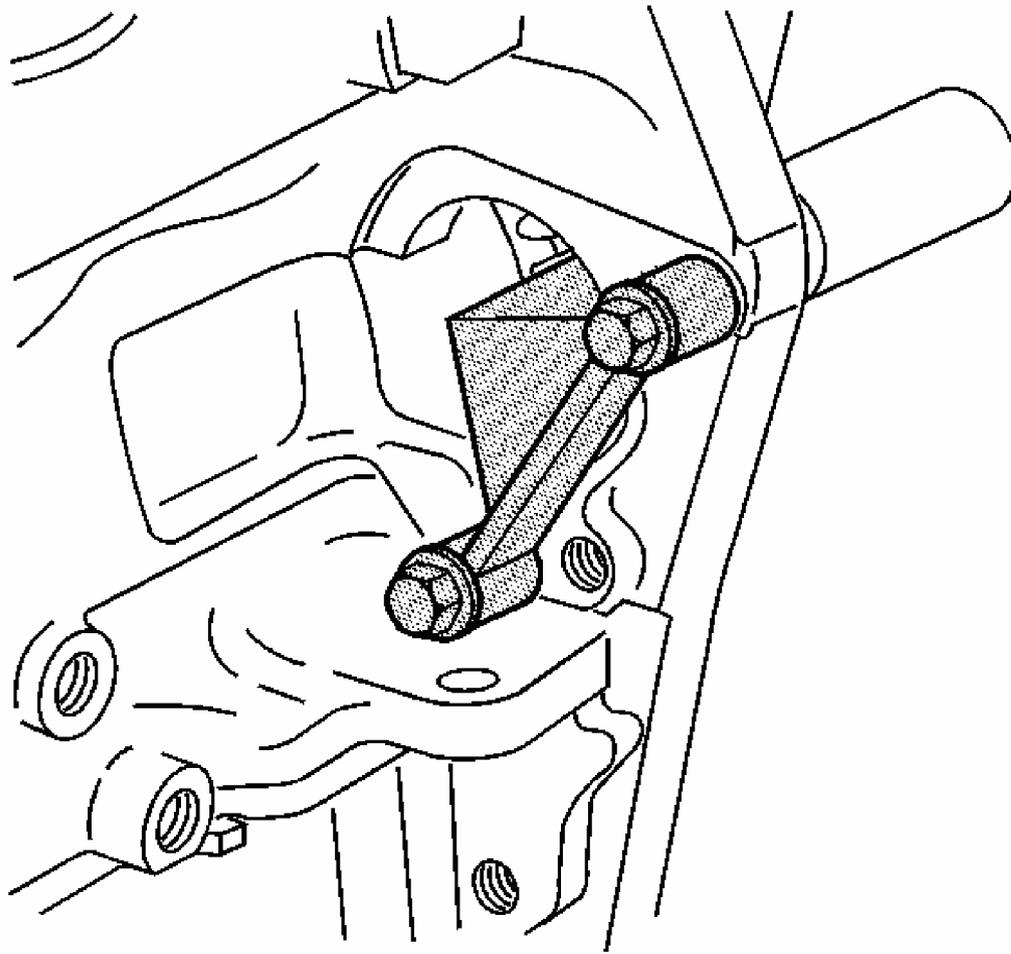
#### **ENGINE FLYWHEEL REMOVAL (AUTOMATIC TRANSMISSION)**

**Tools Required**



**Fig. 162: View Of Engine Flywheel**  
**Courtesy of GENERAL MOTORS CORP.**

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



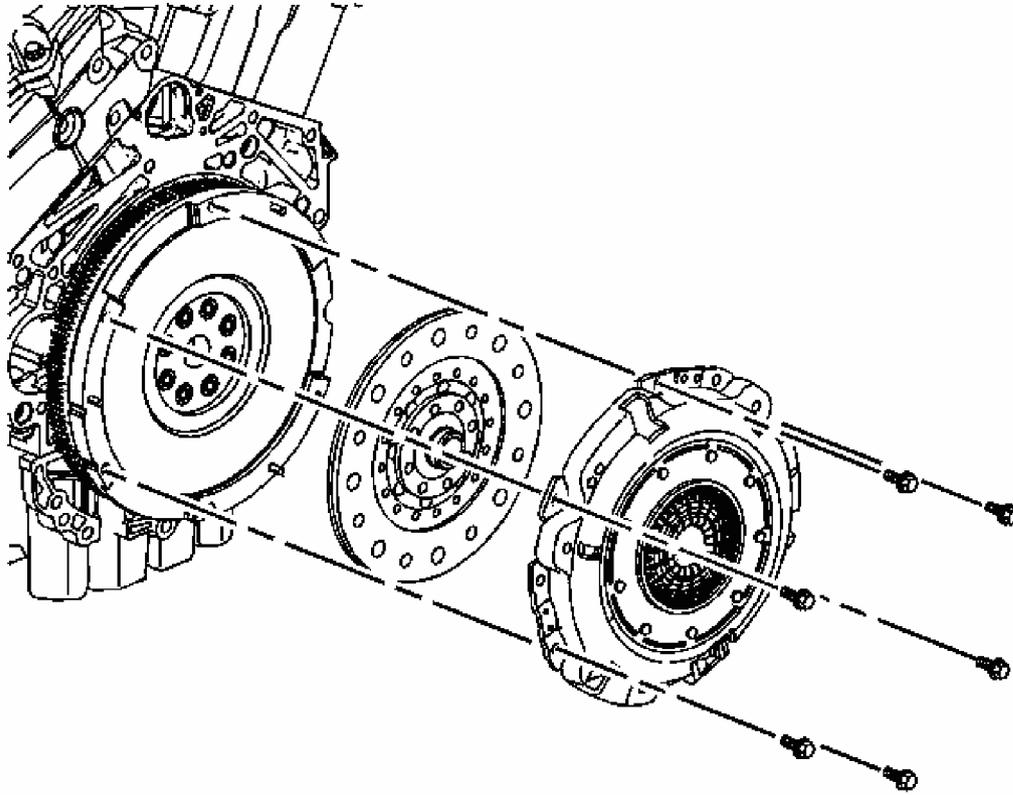
**Fig. 163: View Of Tool EN 46106**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the EN 46106 .

### **ENGINE FLYWHEEL REMOVAL (MANUAL TRANSMISSION)**

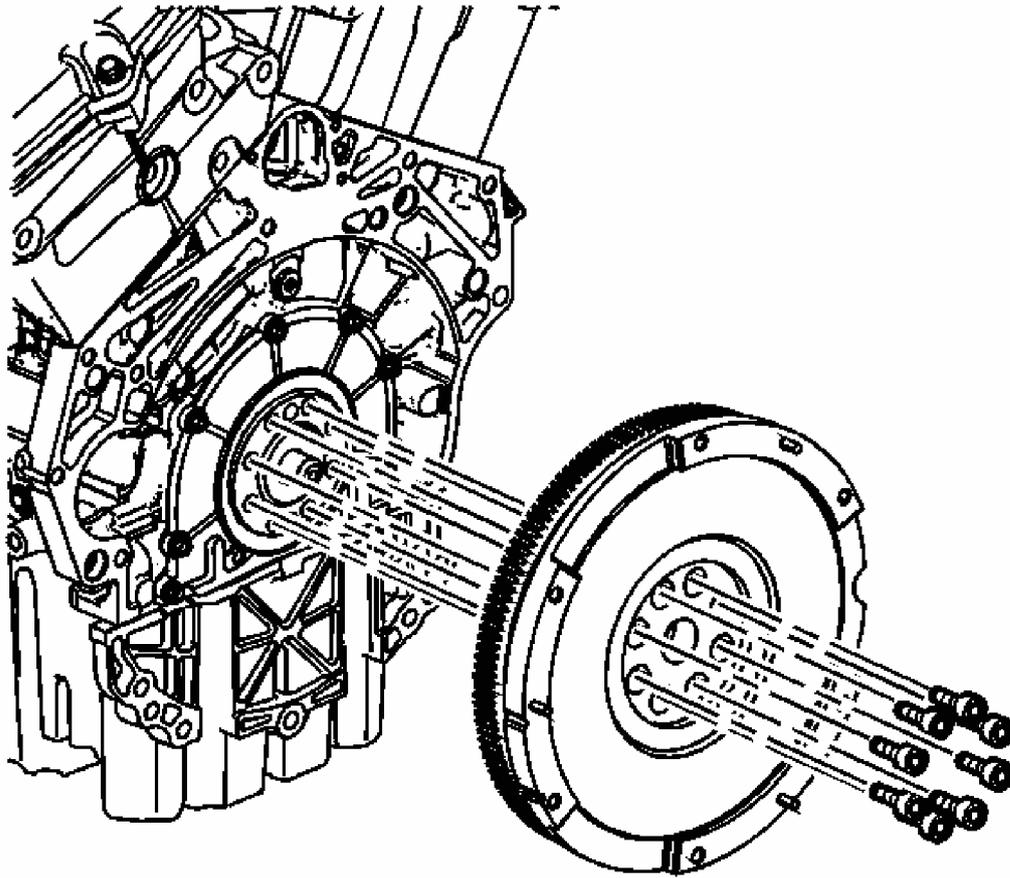
#### **Tools Required**

**EN 46106** Flywheel Holding Tool



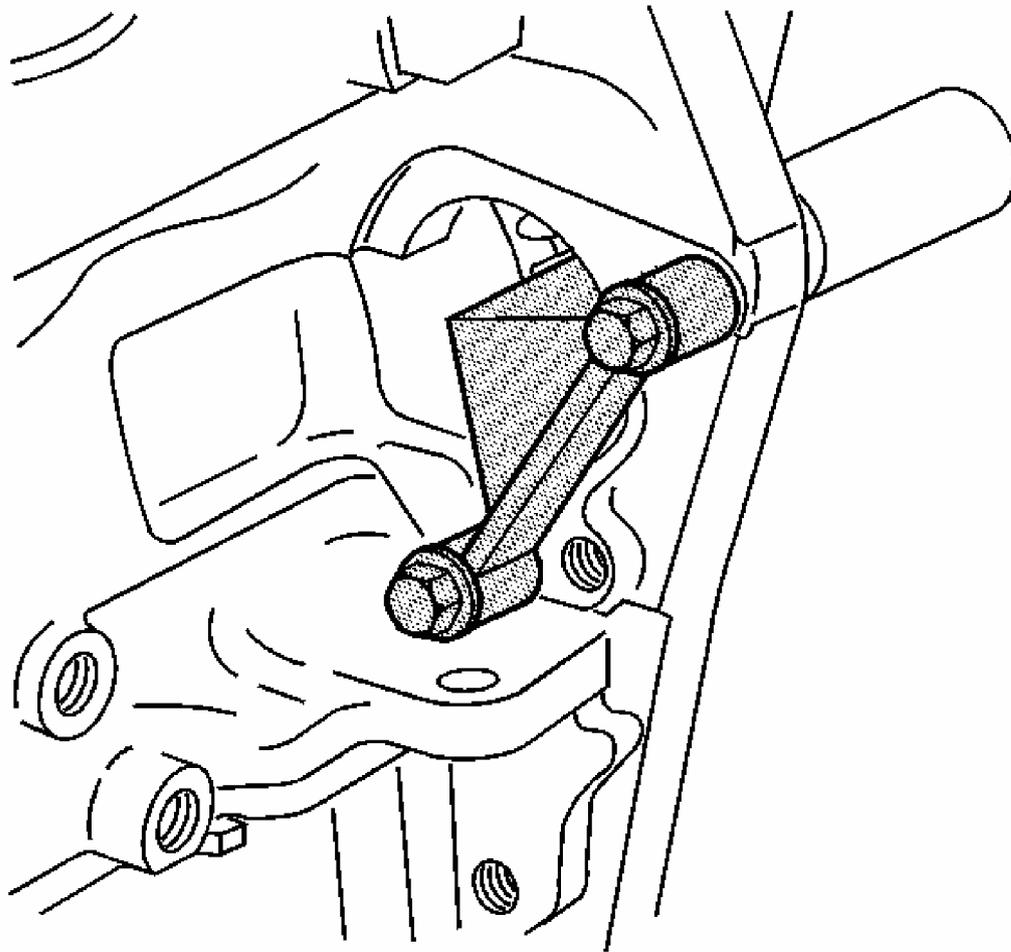
**Fig. 164: View Of Clutch Pressure Plate & Clutch Disc**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the clutch pressure plate bolts.
2. Remove the clutch pressure plate and the clutch driven plate disc.



**Fig. 165: View Of Flywheel & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

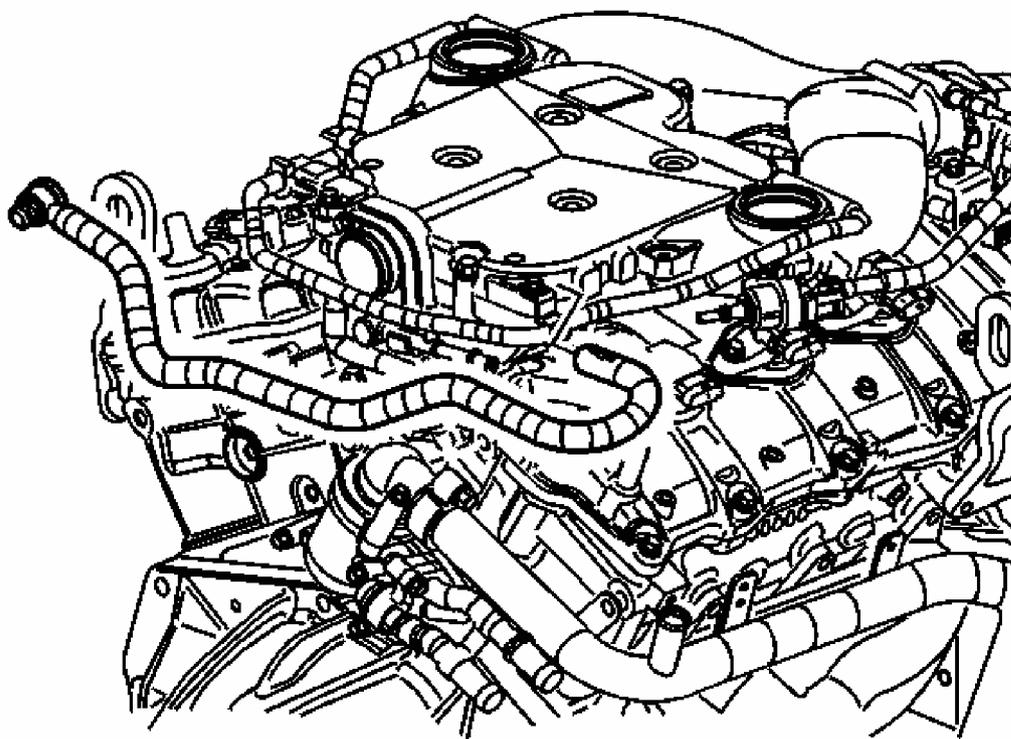
3. Remove the engine flywheel bolts and discard.
4. Remove the engine flywheel from the crankshaft.



**Fig. 166: View Of Tool EN 46106**  
**Courtesy of GENERAL MOTORS CORP.**

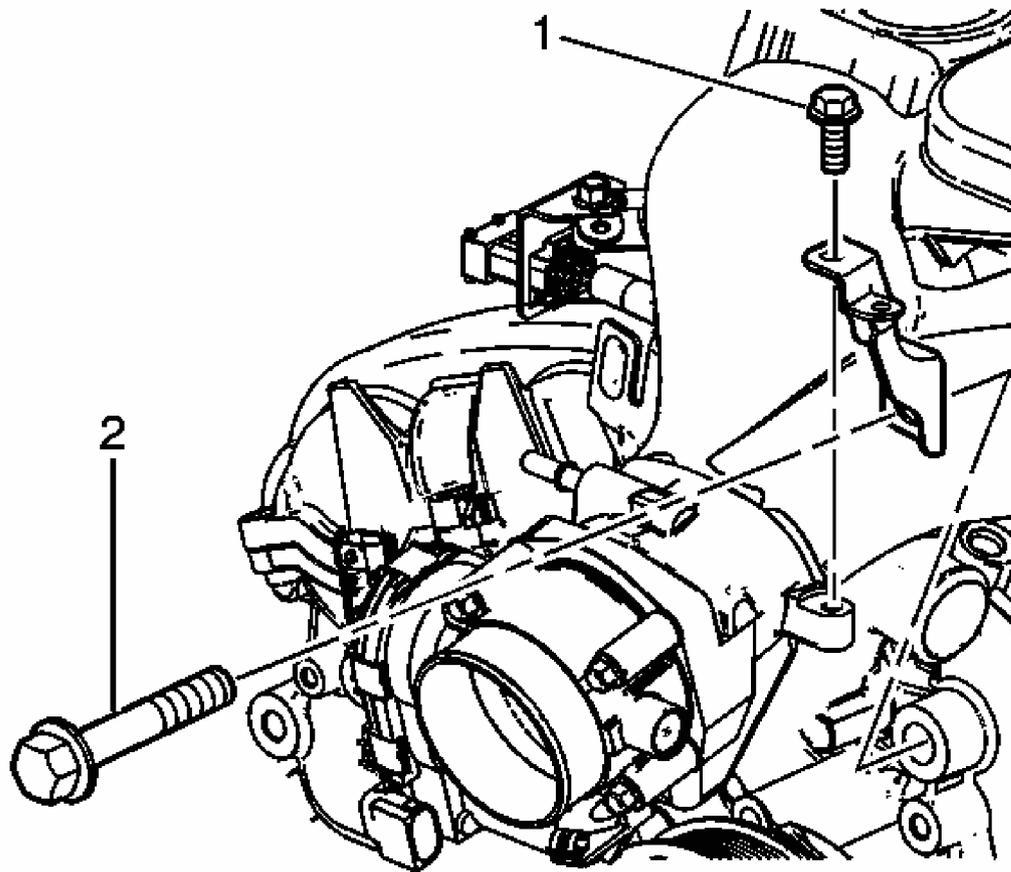
5. Remove the EN 46106 .

#### **INTAKE MANIFOLD REMOVAL**



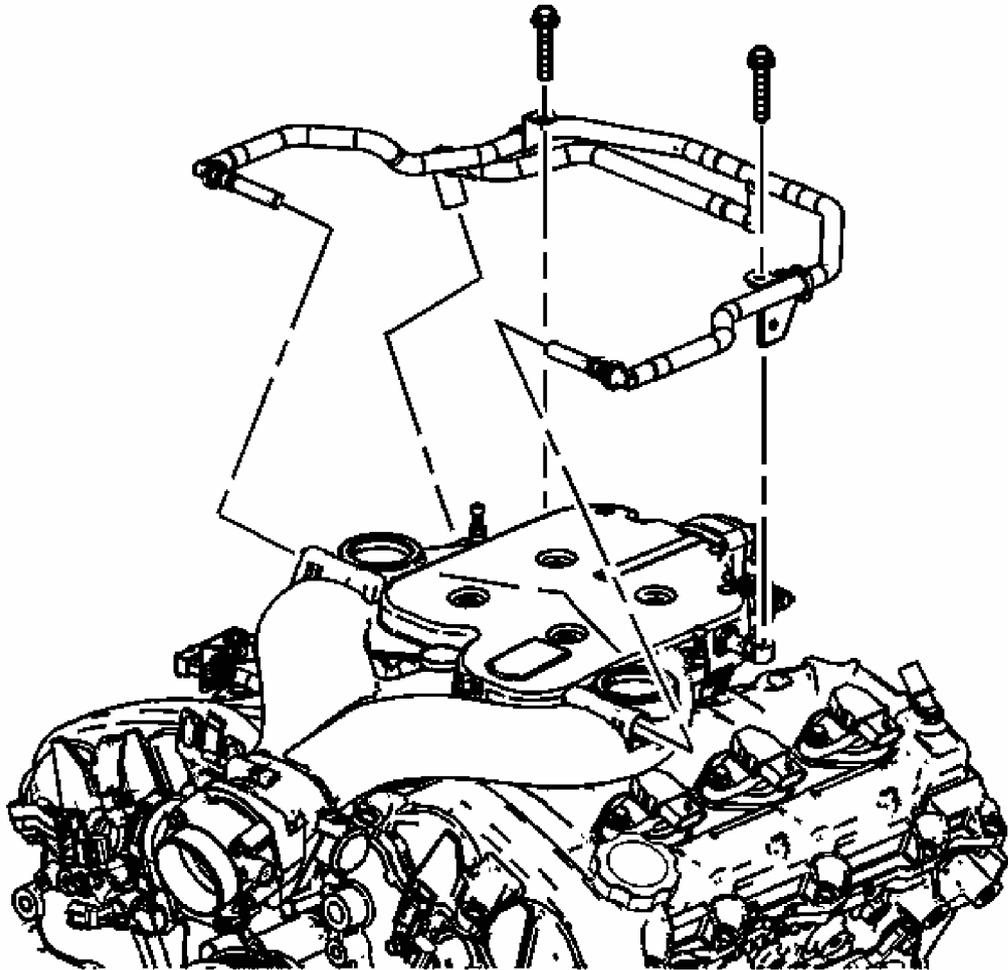
**Fig. 167: View Of Brake Booster Hose**  
**Courtesy of GENERAL MOTORS CORP.**

1. Disconnect and remove the brake booster hose from the upper intake manifold.



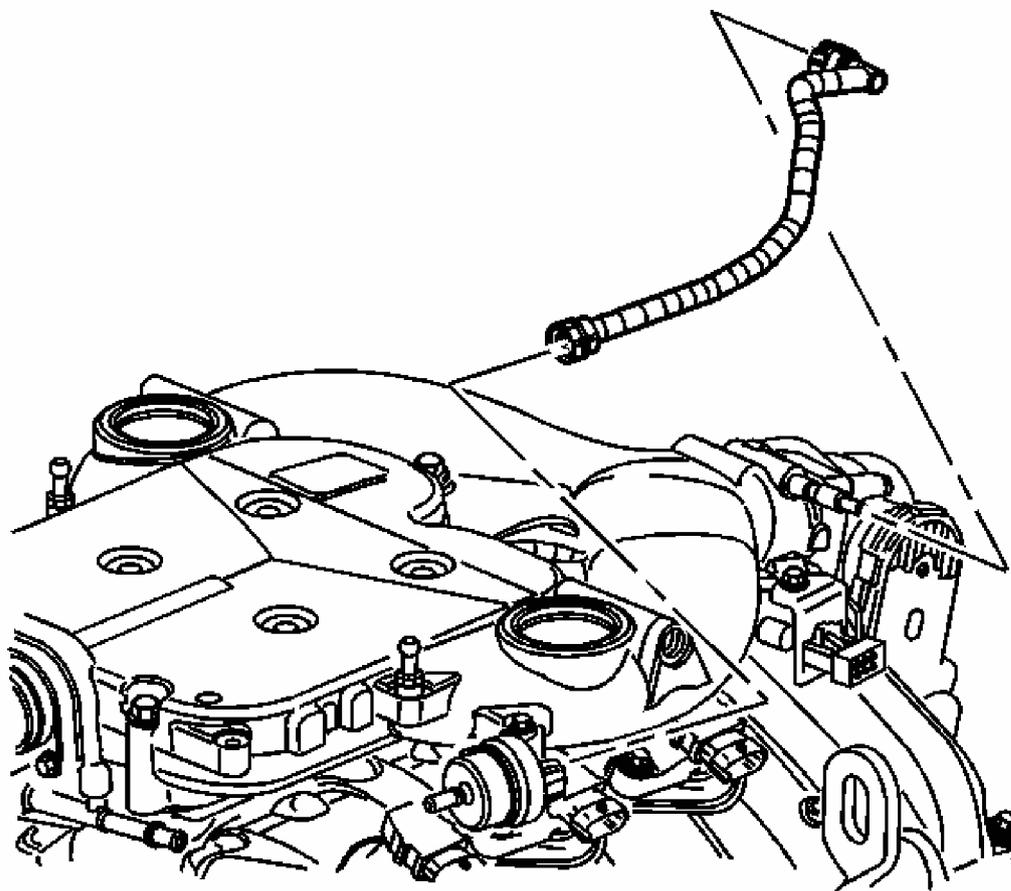
**Fig. 168: View Of Intake Manifold Brace & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the intake manifold brace bolts (1 and 2).
3. Remove the intake manifold brace.



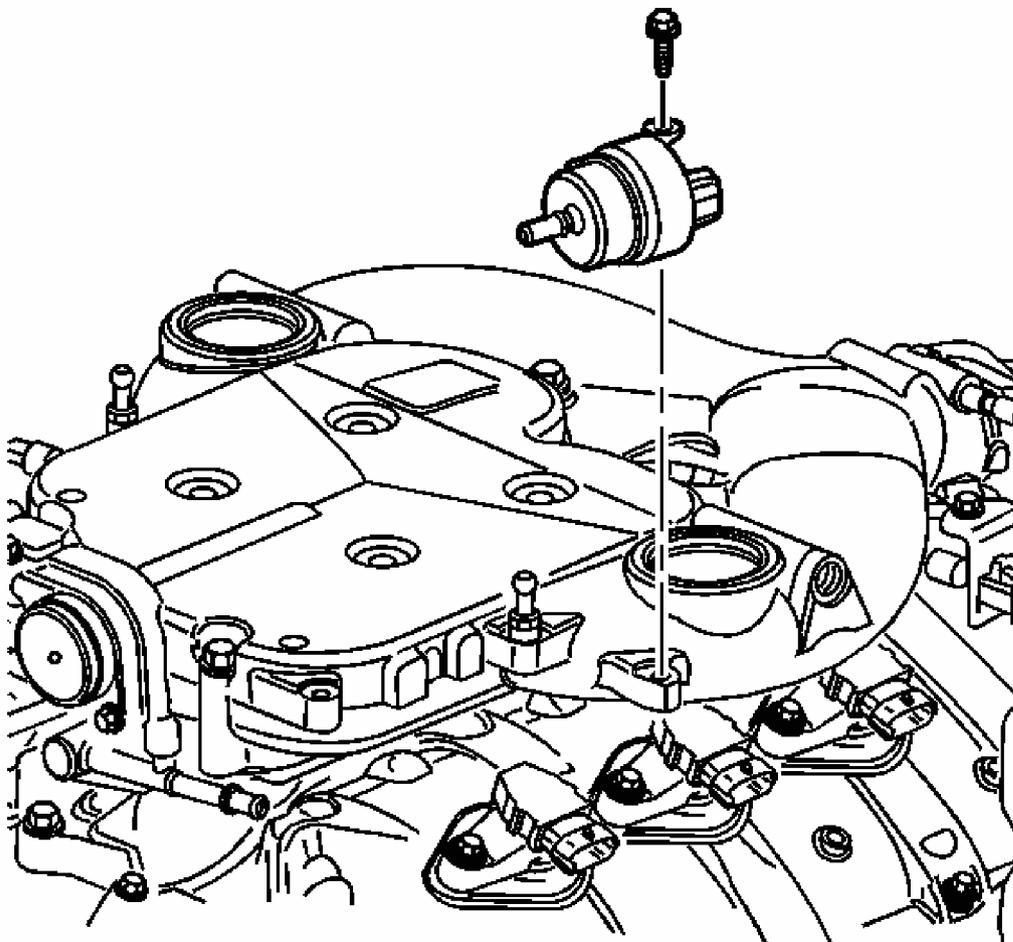
**Fig. 169: View Of PCV Dirty Air Tube**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the PCV tube assembly bracket bolts.
5. Disconnect and remove the PCV tube assembly from the upper intake manifold and right camshaft cover.



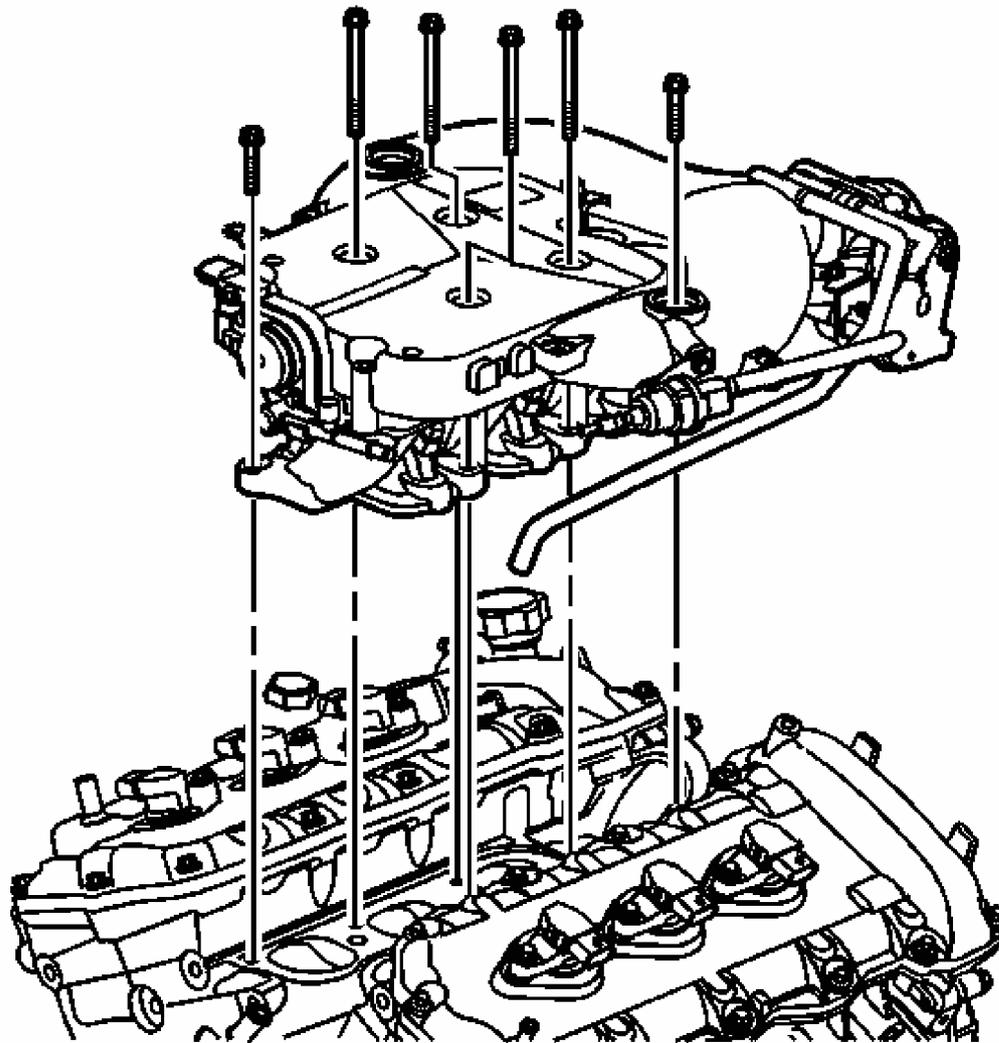
**Fig. 170: View Of EVAP Hose**  
**Courtesy of GENERAL MOTORS CORP.**

6. Disconnect the evaporative emission (EVAP) hose from the upper intake manifold and EVAP solenoid.



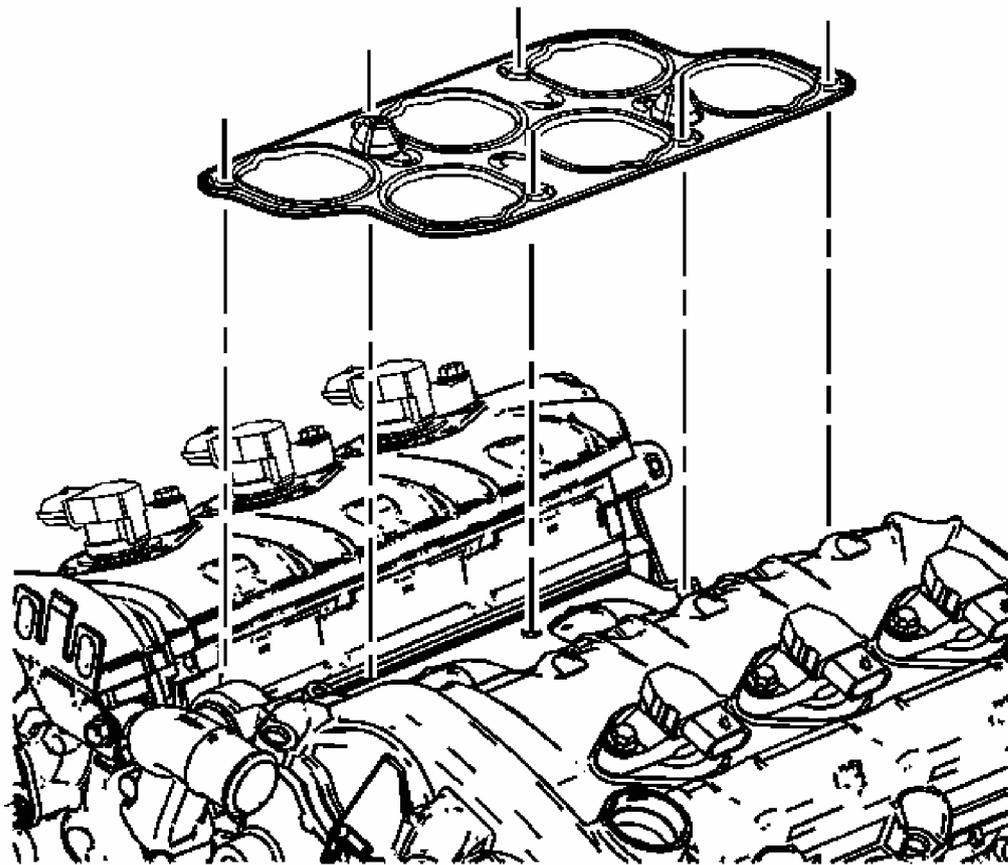
**Fig. 171: View Of EVAP Solenoid**  
**Courtesy of GENERAL MOTORS CORP.**

7. Remove the EVAP solenoid bolt.
8. Remove the EVAP solenoid.



**Fig. 172: View Of Intake Manifold Assembly**  
**Courtesy of GENERAL MOTORS CORP.**

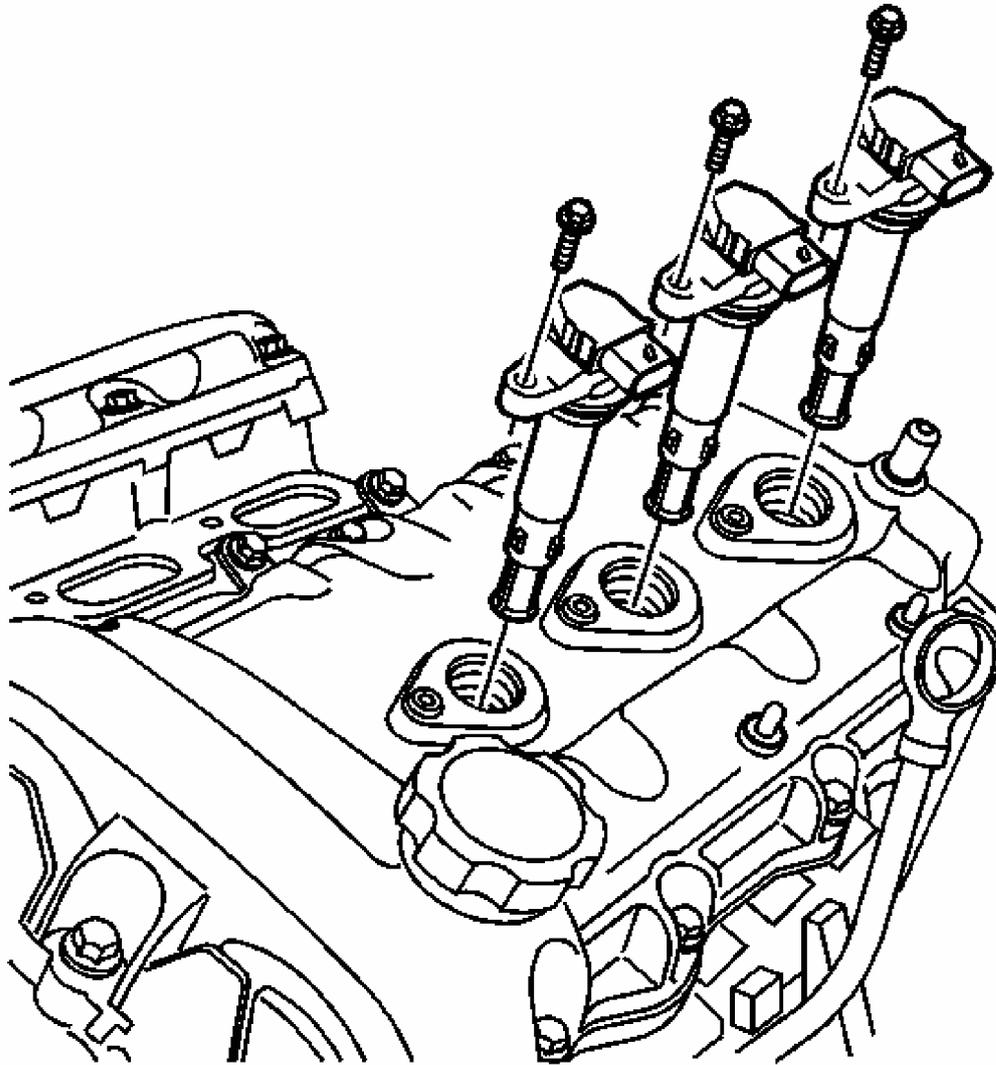
9. Remove the intake manifold bolts.
10. Remove the intake manifold assembly.



**Fig. 173: View Of Lower Intake Manifold Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

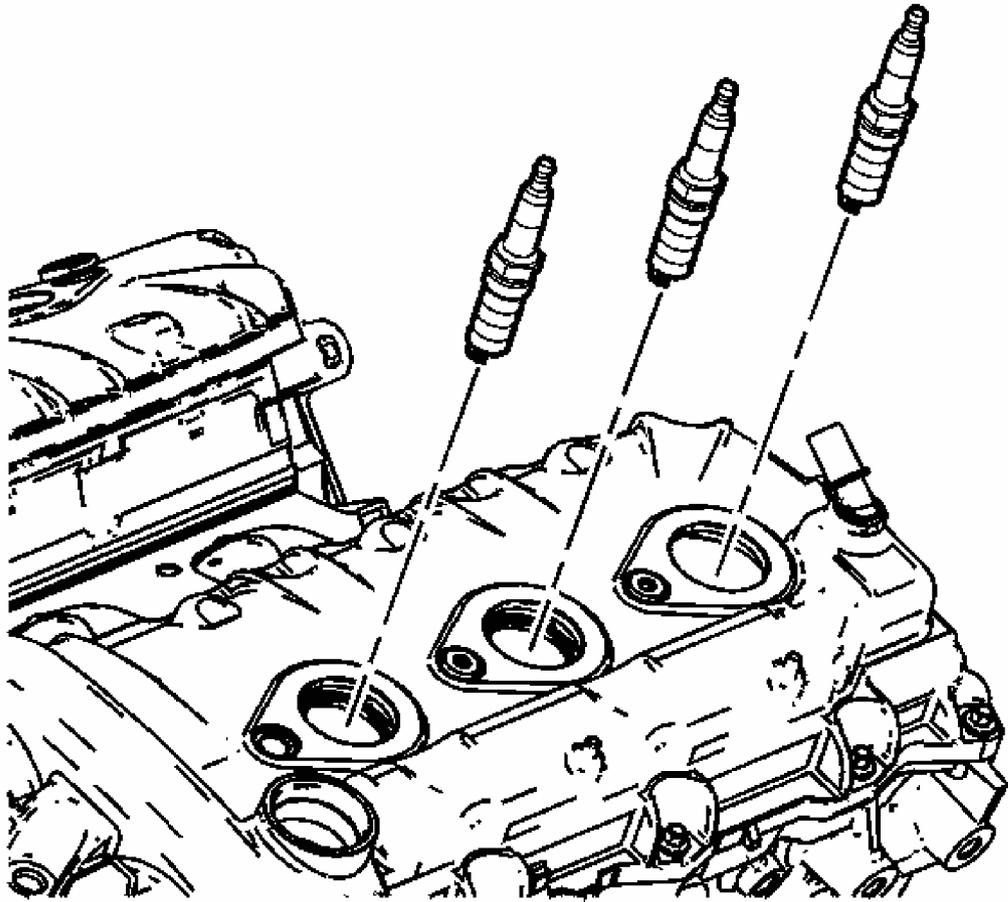
11. Remove the lower intake manifold gasket.

**CAMSHAFT COVER REMOVAL - LEFT**



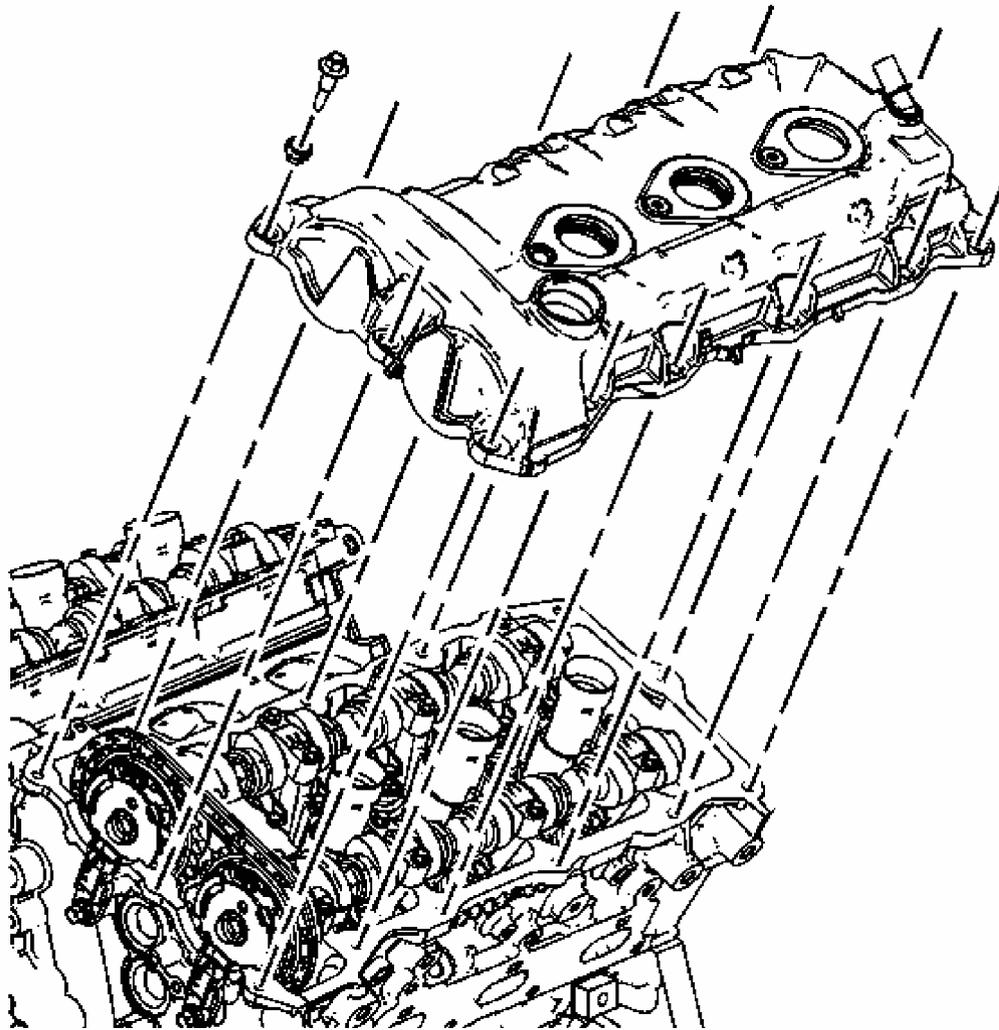
**Fig. 174: Identifying Left Cylinder Head Ignition Coils**  
Courtesy of GENERAL MOTORS CORP.

1. Remove each ignition coil bolt.
2. Raise each ignition coil through the camshaft cover from the spark plug tube. DO NOT damage the spark plug or ignition coil perimeter seals.



**Fig. 175: View Of Spark Plugs**  
**Courtesy of GENERAL MOTORS CORP.**

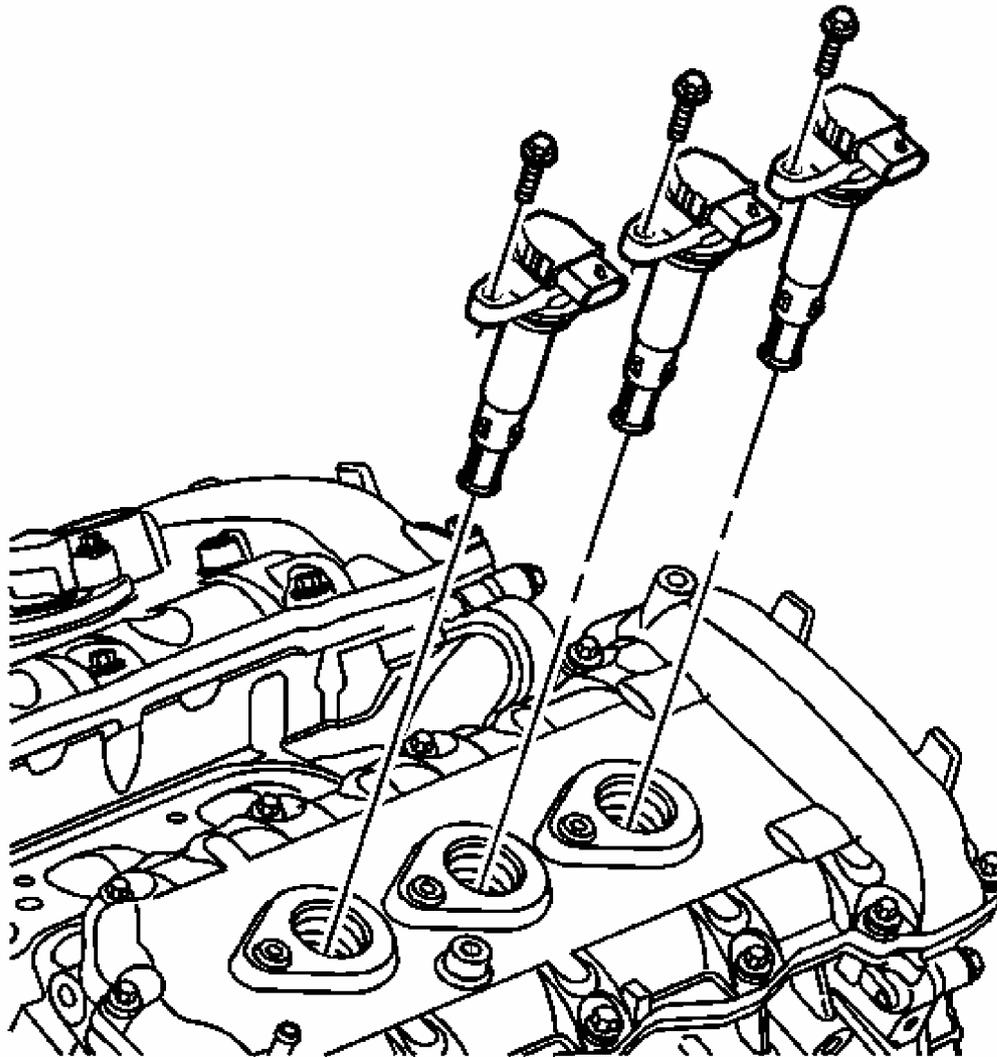
3. Remove the spark plugs.



**Fig. 176: Removing & Installing Left Camshaft Cover**  
Courtesy of GENERAL MOTORS CORP.

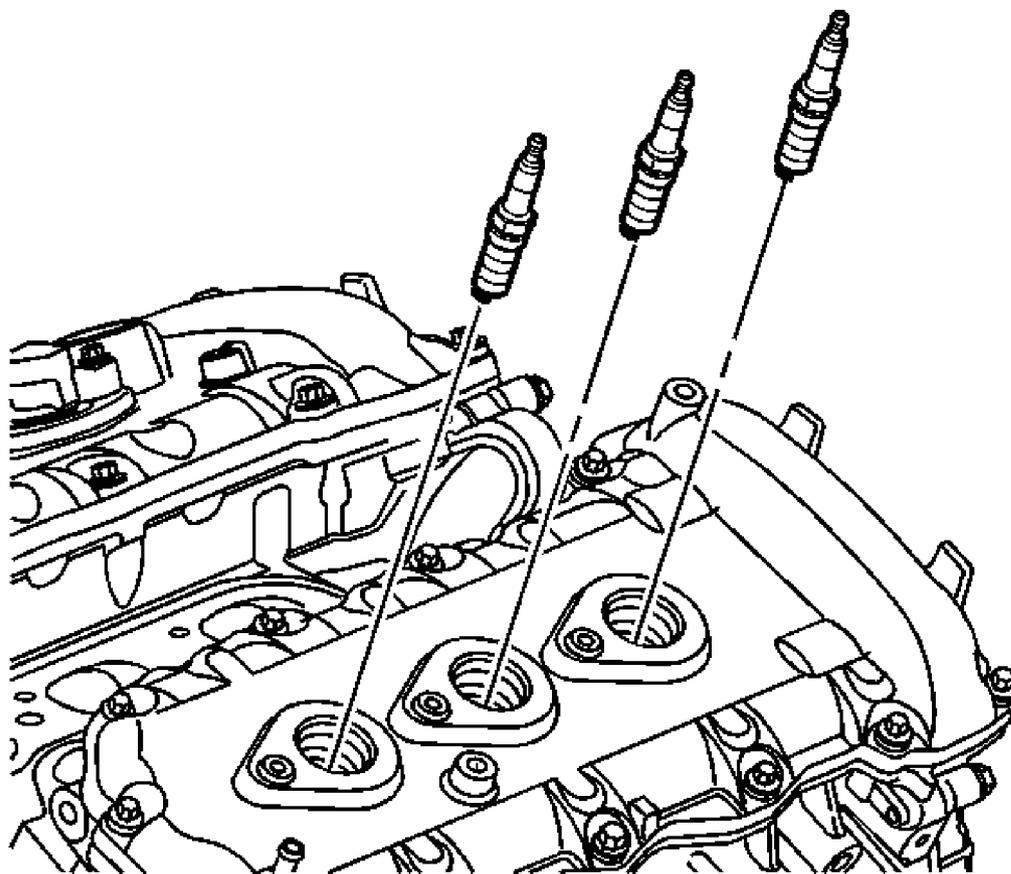
4. Remove the left camshaft cover bolts.
5. Remove the left camshaft cover from the left cylinder head.

**CAMSHAFT COVER REMOVAL - RIGHT**



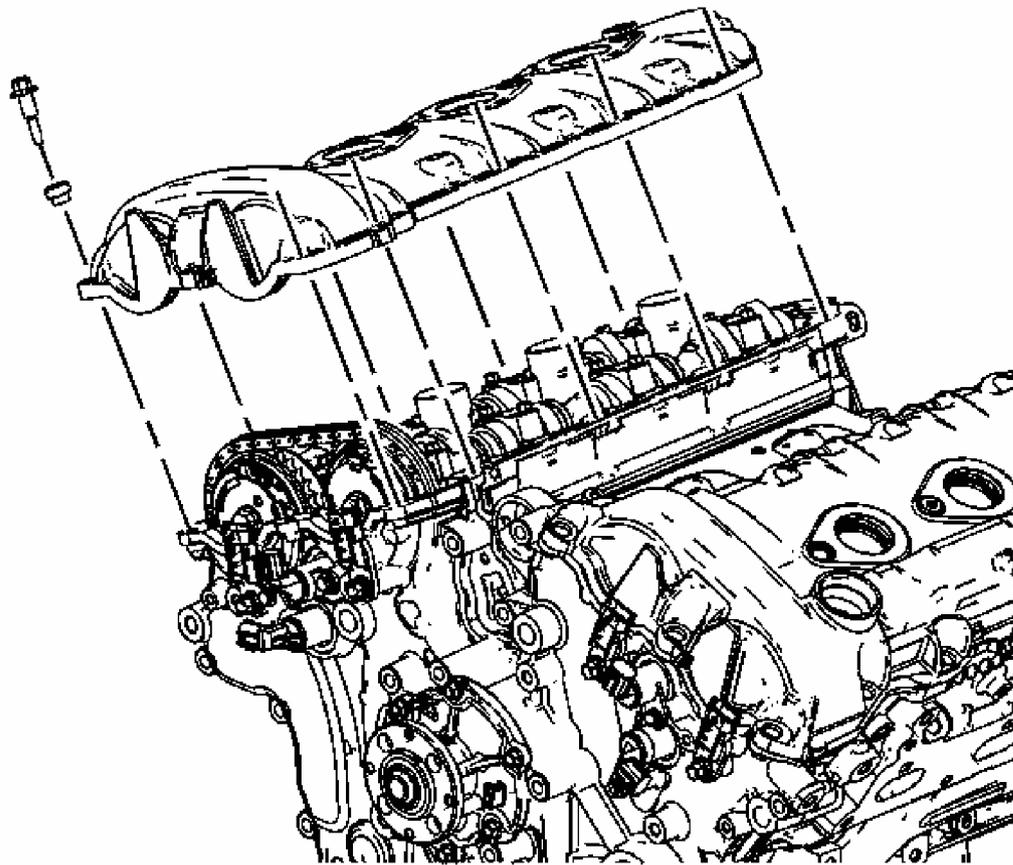
**Fig. 177: Ignition Coil View**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove each ignition coil bolt.
2. Raise each ignition coil through the camshaft cover from the spark plug tube. DO NOT damage the spark plug or ignition coil perimeter seals.



**Fig. 178: View Of Spark Plugs**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the spark plugs.



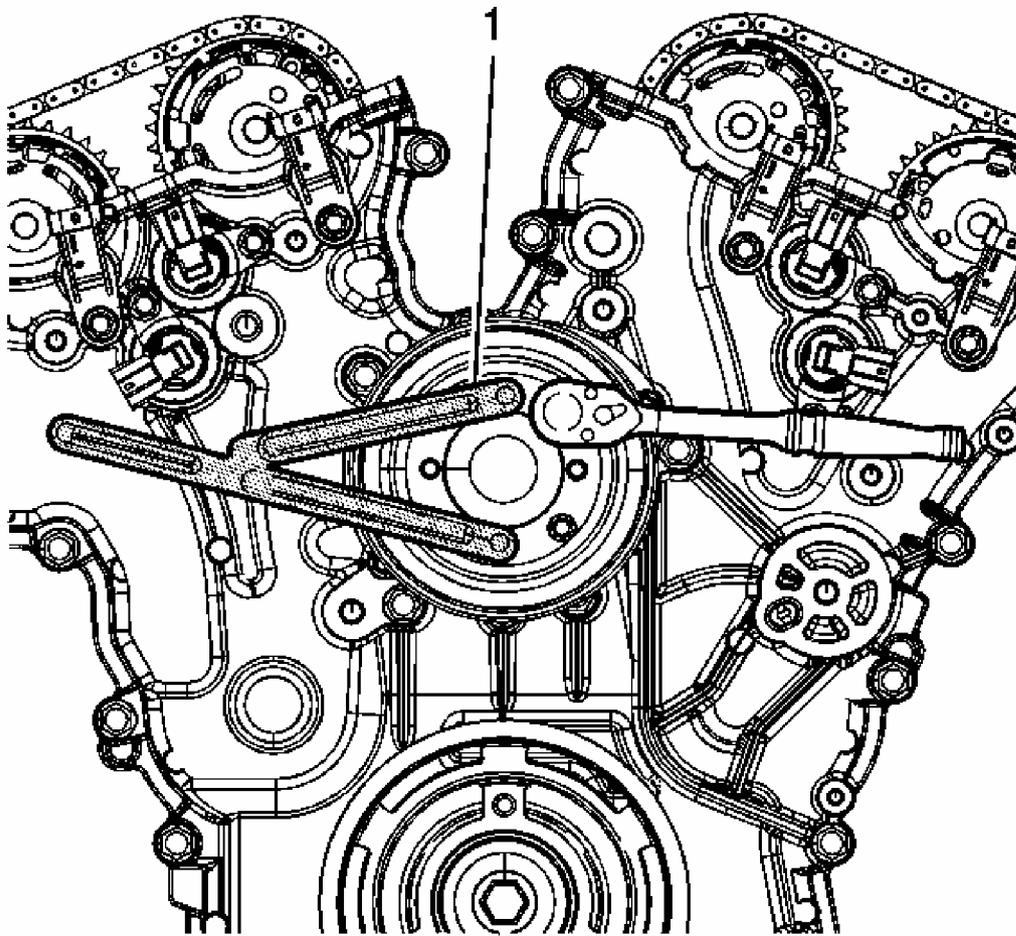
**Fig. 179: Removing & Installing Camshaft Cover**  
**Courtesy of GENERAL MOTORS CORP.**

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

#### **WATER PUMP REMOVAL**

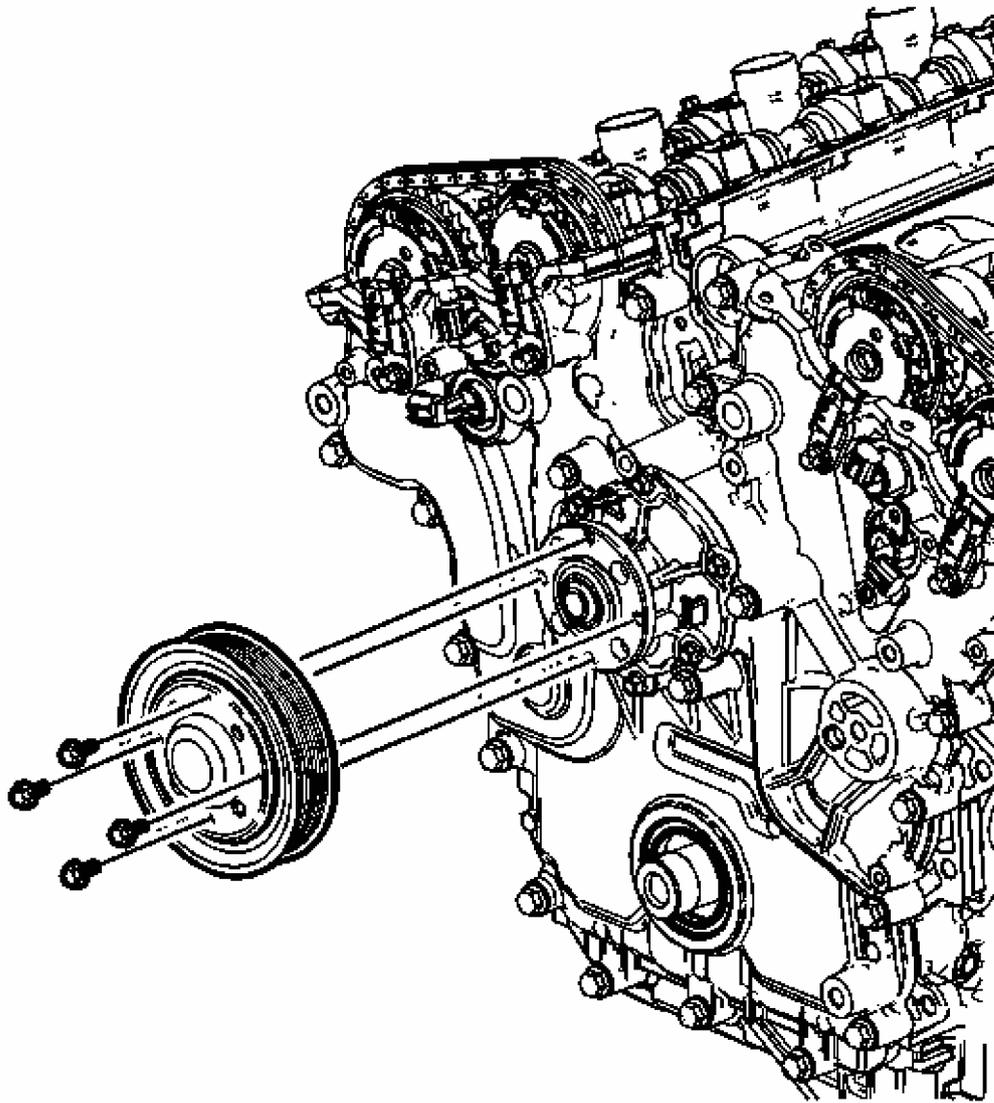
##### **Tools Required**

**EN 46104** Water Pump Pulley Holding Tool



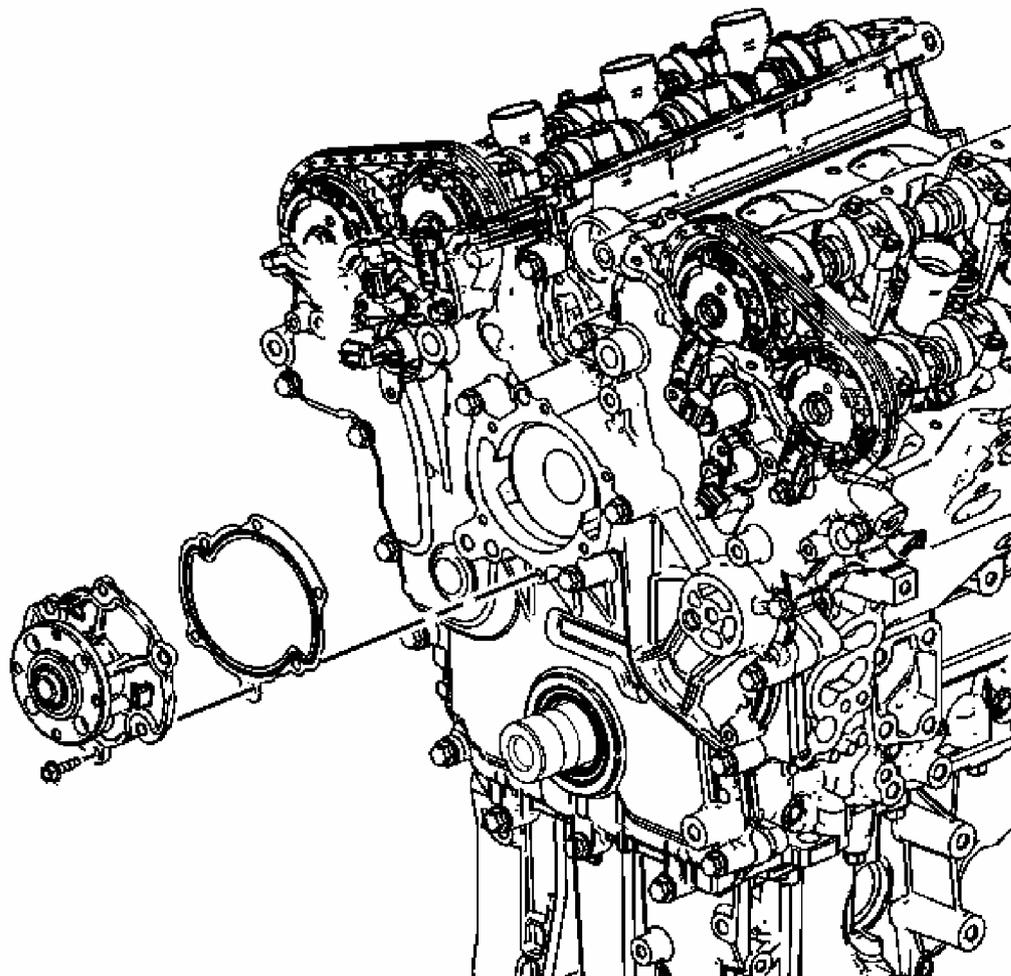
**Fig. 180: View Of EN 46104**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 181: View Of Water Pump Pulley**  
**Courtesy of GENERAL MOTORS CORP.**

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



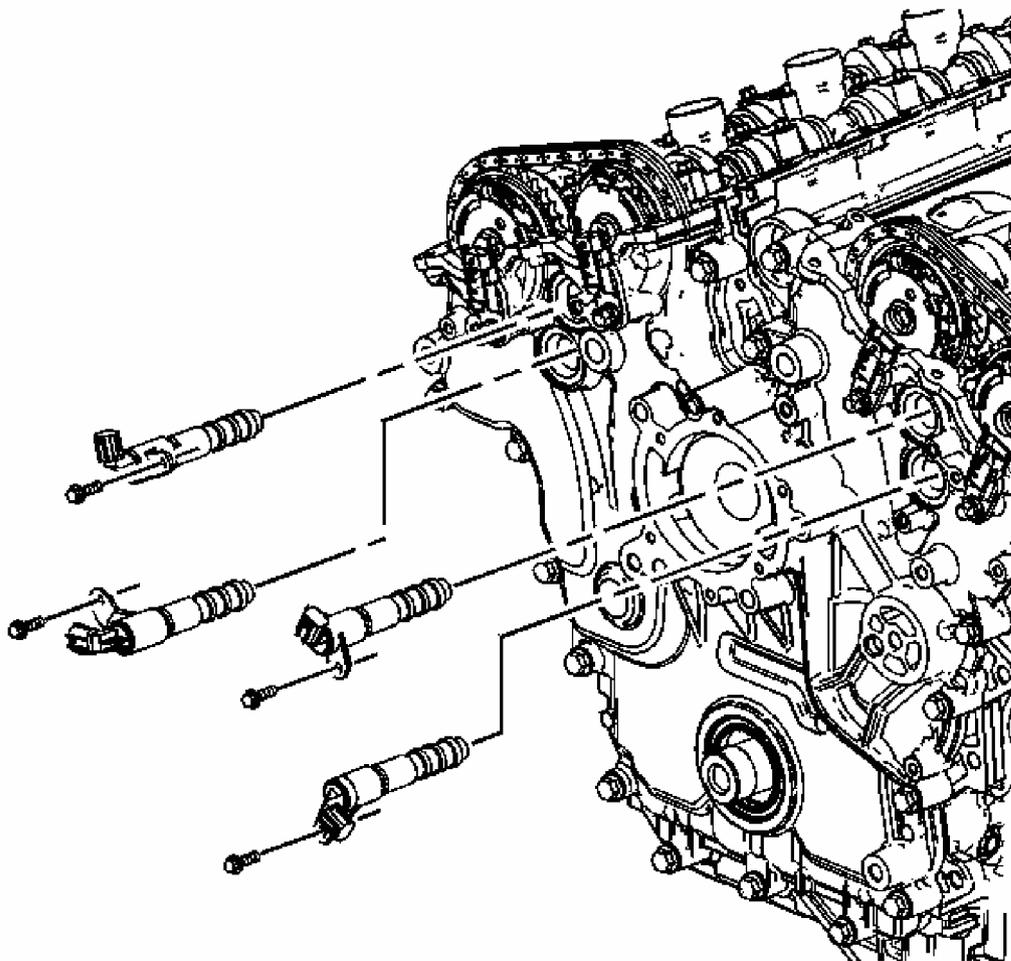
**Fig. 182: View Of Water Pump & Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

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**

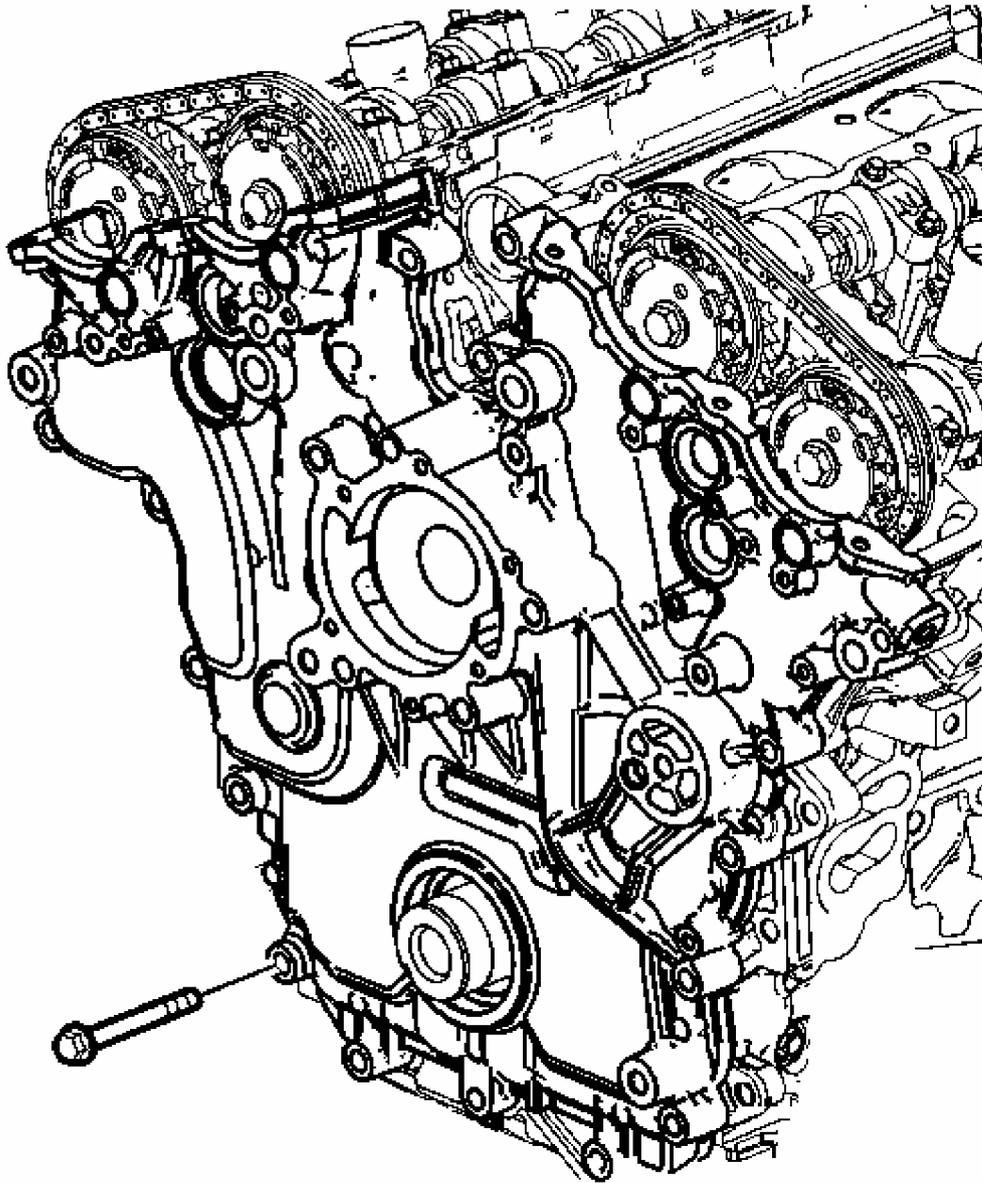
#### **Tools Required**

- EN 46105 Camshaft Locking Tool
- EN 46111 Crankshaft Rotation Socket



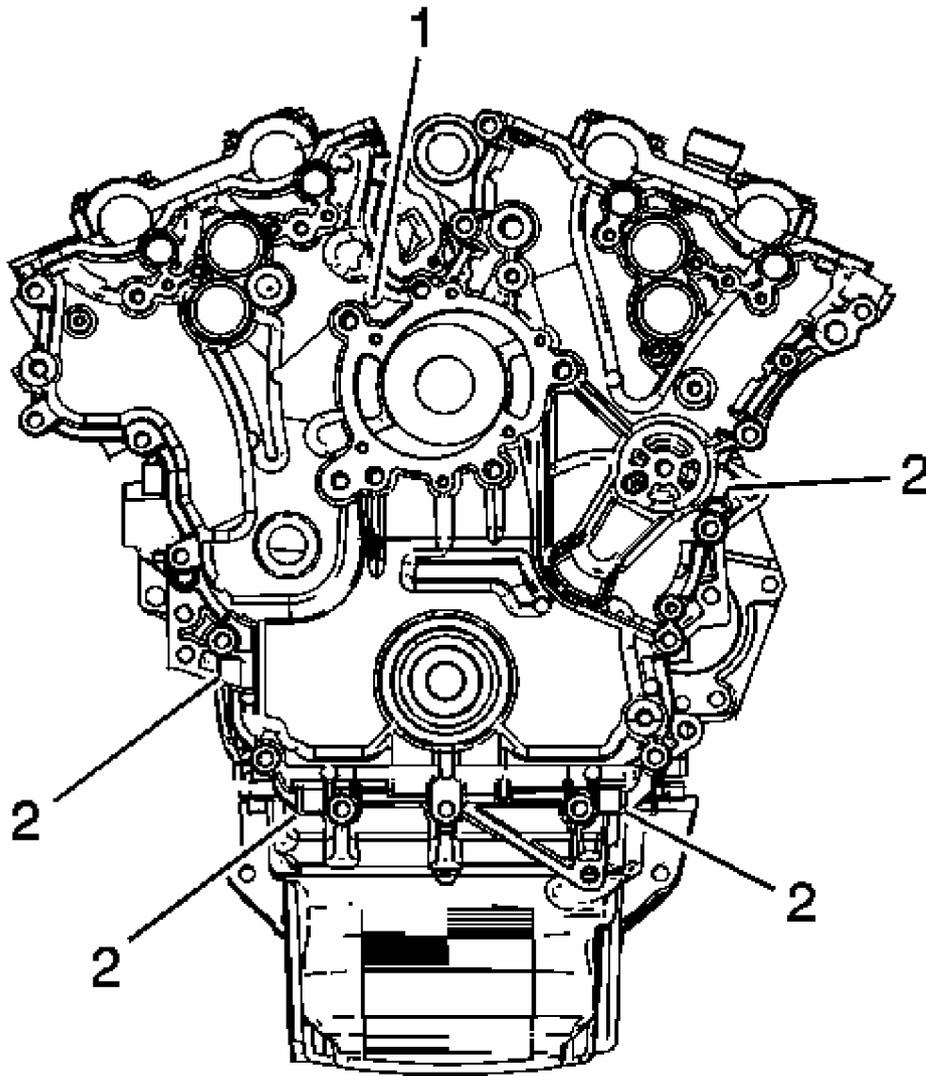
**Fig. 183: View Of Camshaft Position Actuator Valves**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 184: View Of Engine Front Cover Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the engine front cover bolts.

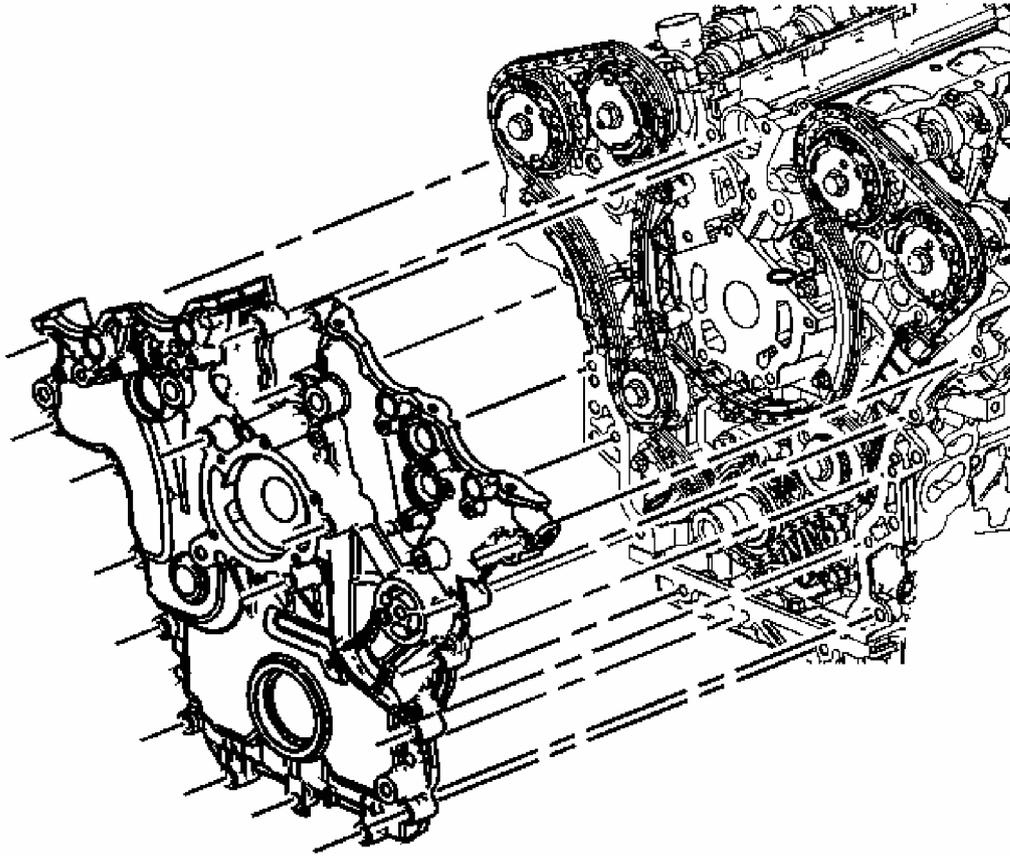


**Fig. 185: Locating Jackscrew Hole & Pry Points**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not pry between the engine front cover and the camshaft position sensors or the camshaft position actuators in order to shear 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

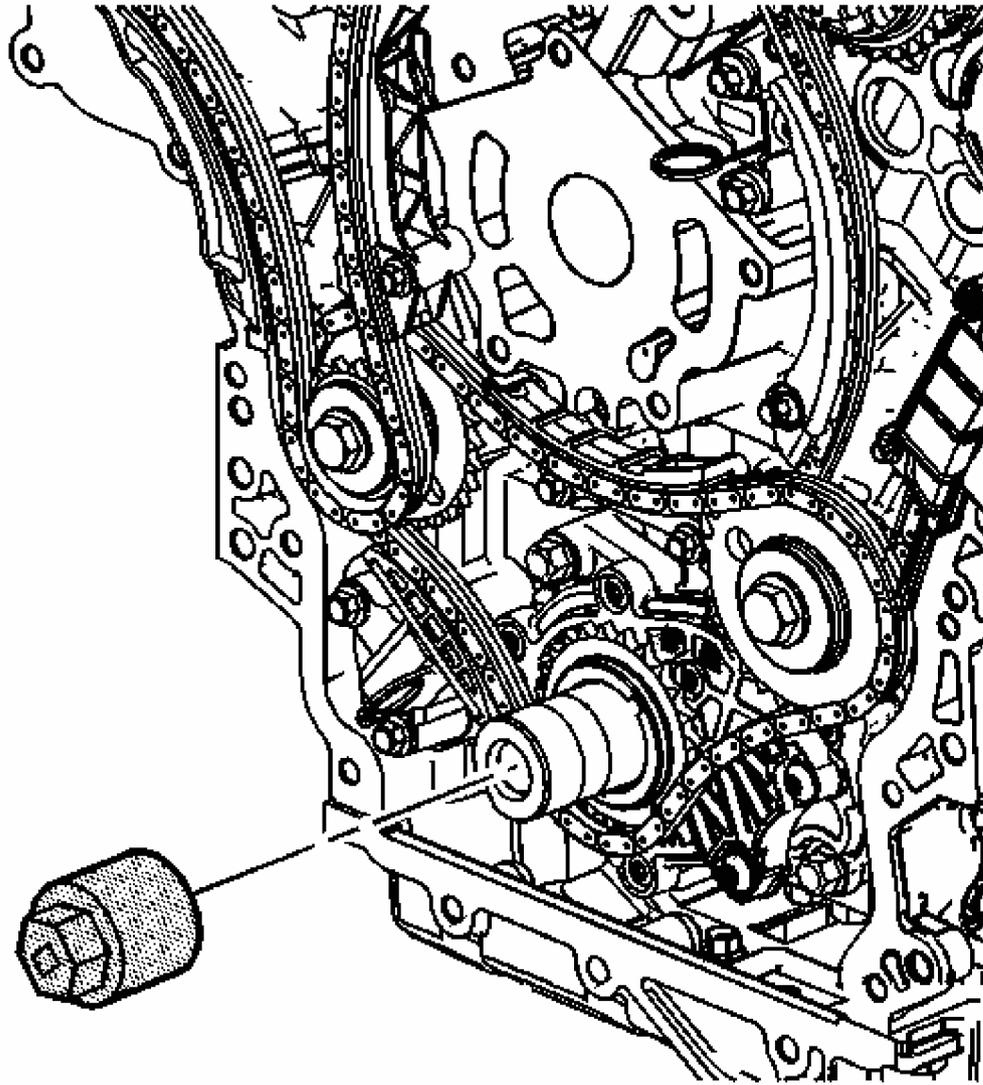
against in order to remove the engine front cover.

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.



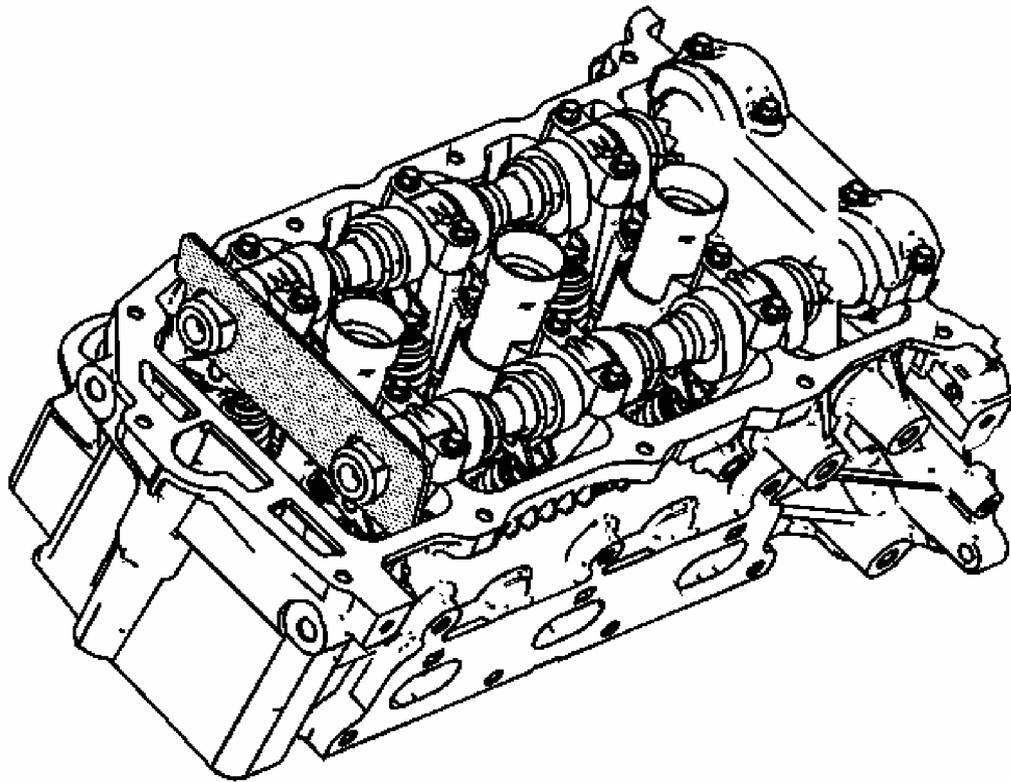
**Fig. 186: View Of Engine Front Cover**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the engine front cover.



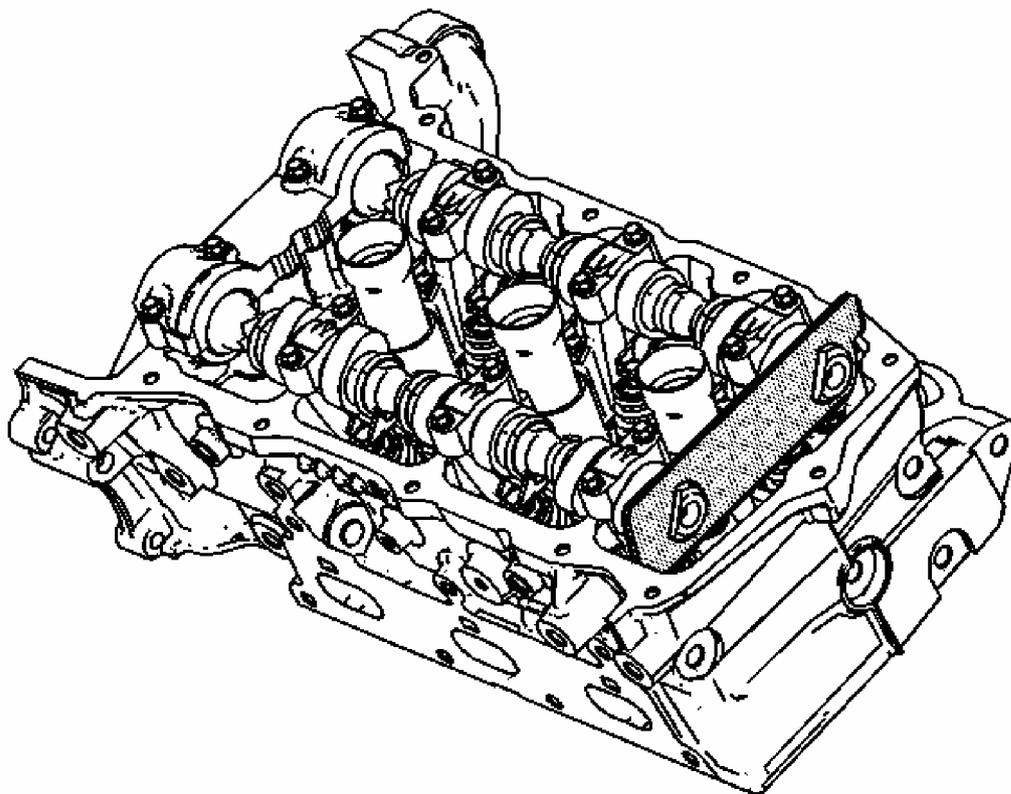
**Fig. 187: View Of EN 46111**  
**Courtesy of GENERAL MOTORS CORP.**

7. Using the EN 46111 , rotate the crankshaft until the left cylinder head camshafts align with the EN 46105-2 and the right cylinder head camshafts align with the EN 46105-1.



**Fig. 188: EN 46105-1 Installed To Right Camshafts**  
**Courtesy of GENERAL MOTORS CORP.**

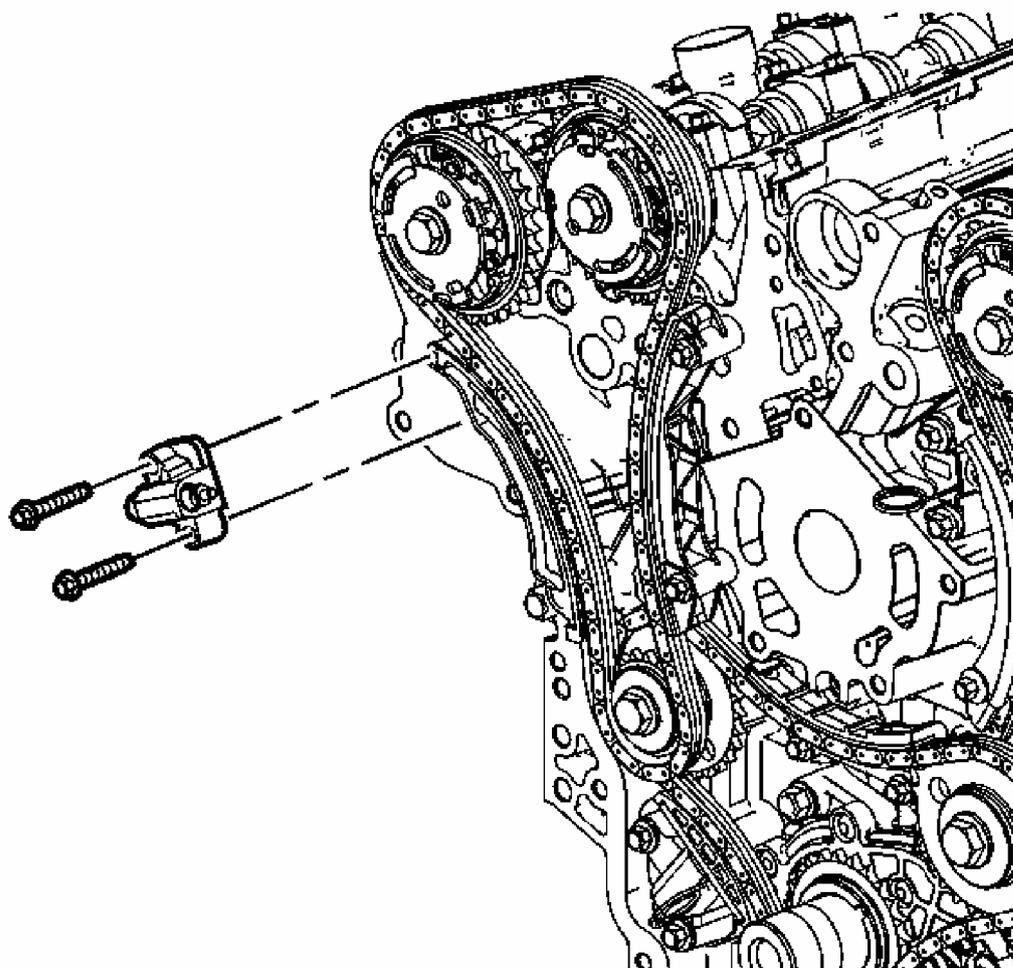
8. Install the EN 46105-1 to the right camshafts.



**Fig. 189: EN 46105-2 Installed To Left Camshafts**  
**Courtesy of GENERAL MOTORS CORP.**

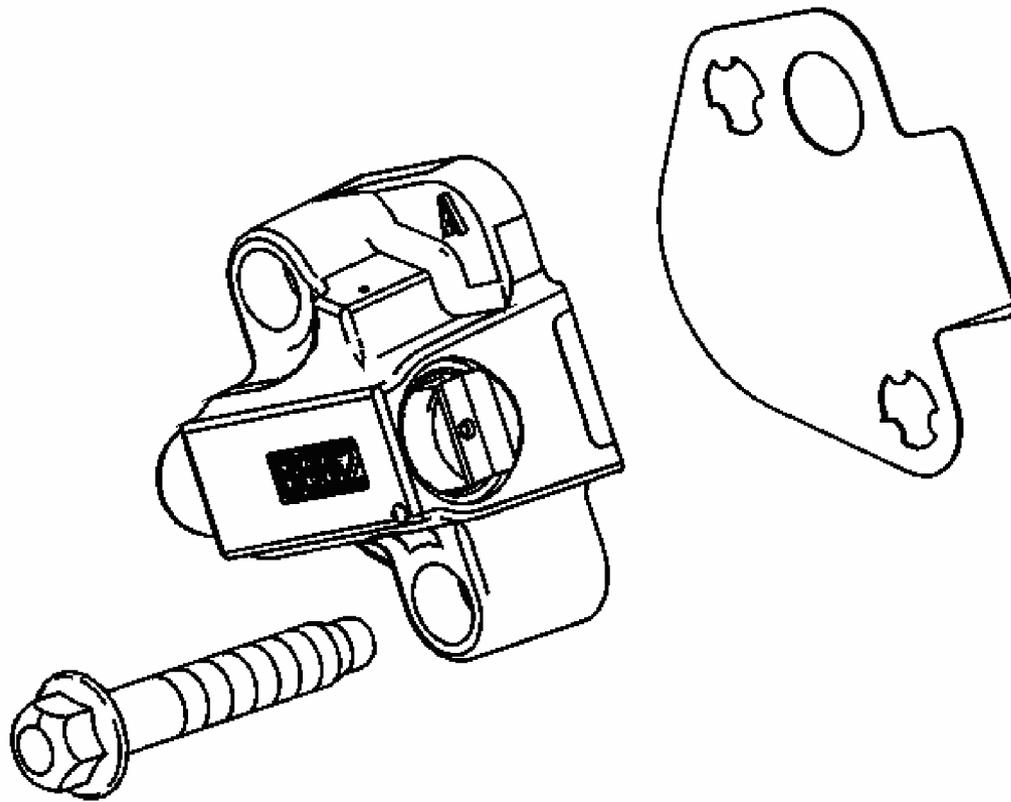
9. Install the EN 46105-2 to the left camshafts.

**SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - RIGHT**



**Fig. 190: View Of Right Bank Secondary Camshaft Drive Chain Tensioner**  
**Courtesy of GENERAL MOTORS CORP.**

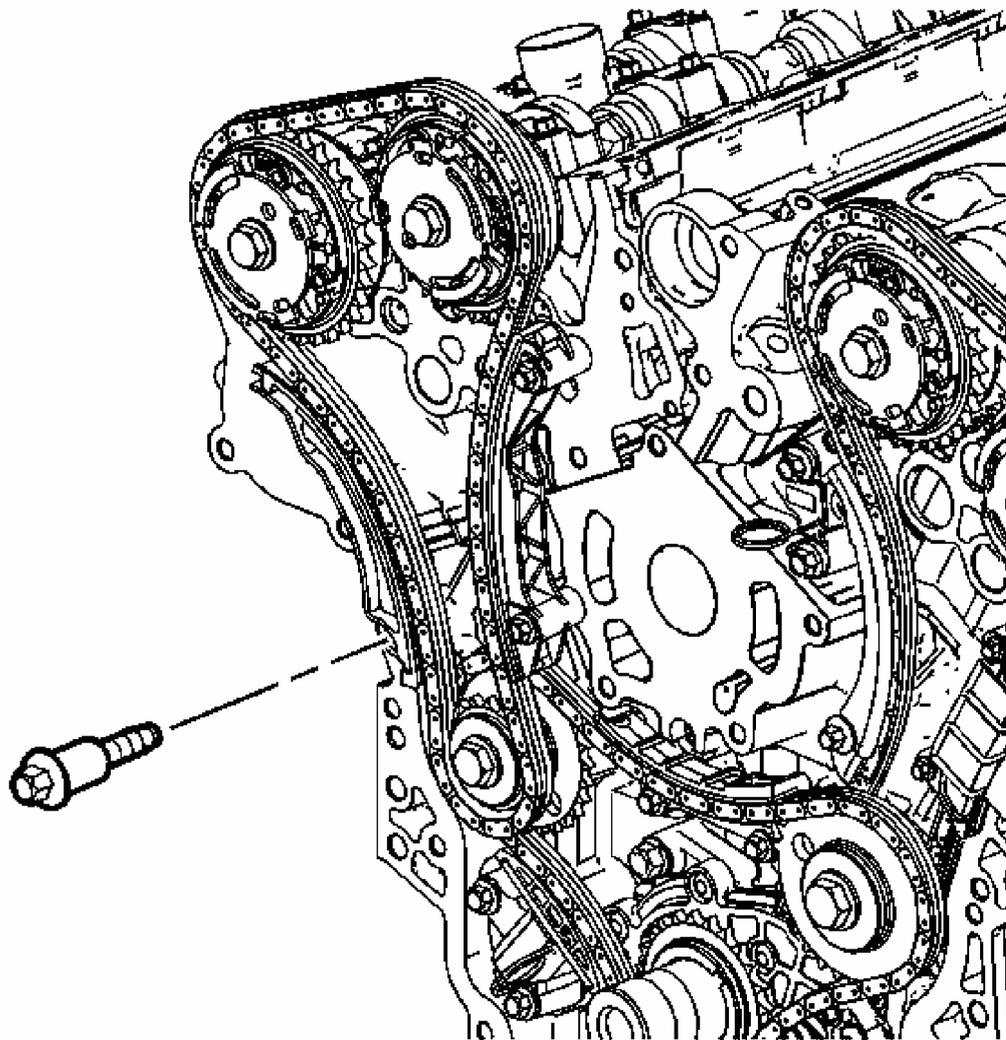
1. Remove the right secondary camshaft drive chain tensioner bolts.
2. Remove the right secondary camshaft drive chain tensioner.



**Fig. 191: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

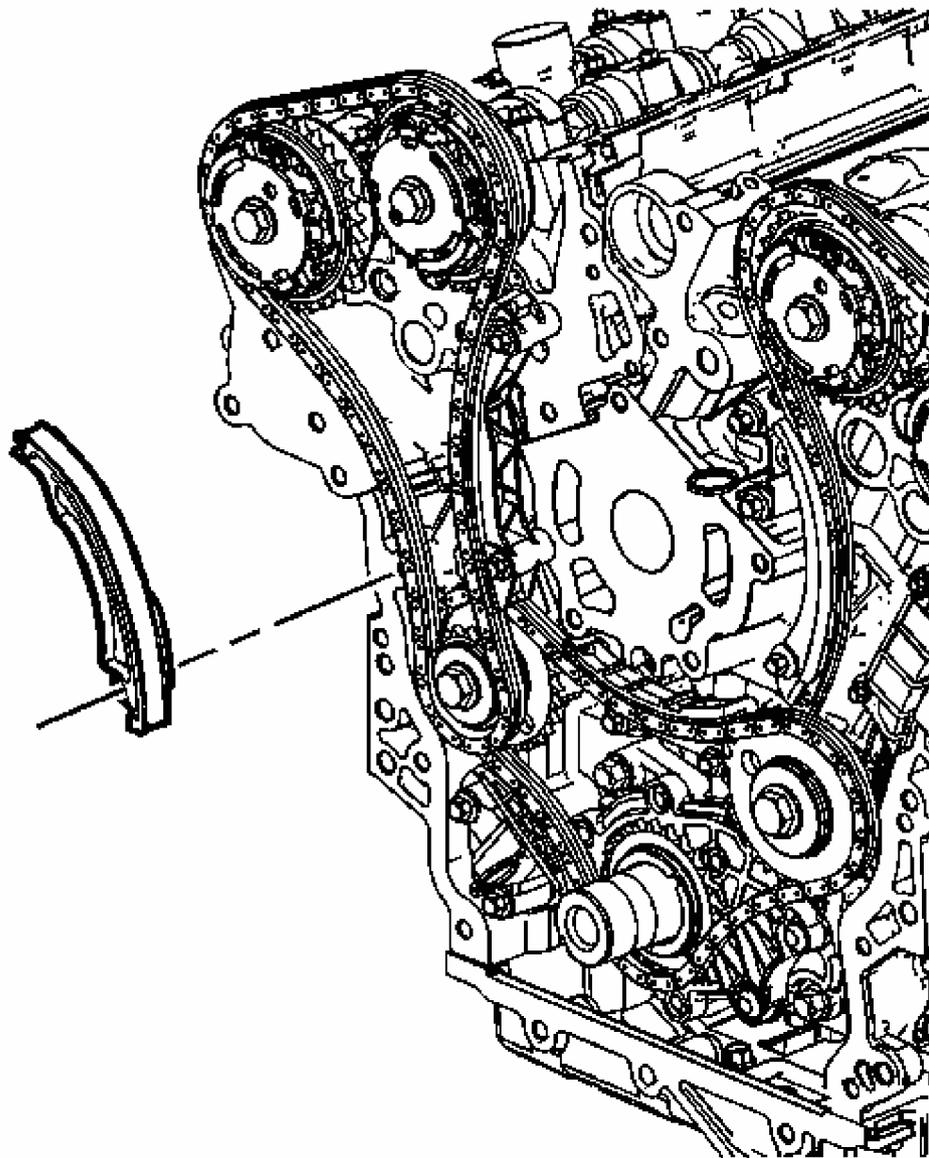
3. Remove and discard the right secondary camshaft drive chain tensioner gasket.
4. Inspect the right secondary camshaft drive chain tensioner mounting surface on the right cylinder head for burrs or any defects that would degrade the sealing of the NEW right secondary camshaft drive chain tensioner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

**SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - RIGHT**



**Fig. 192: Locating Right Secondary Camshaft Drive Chain Shoe Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

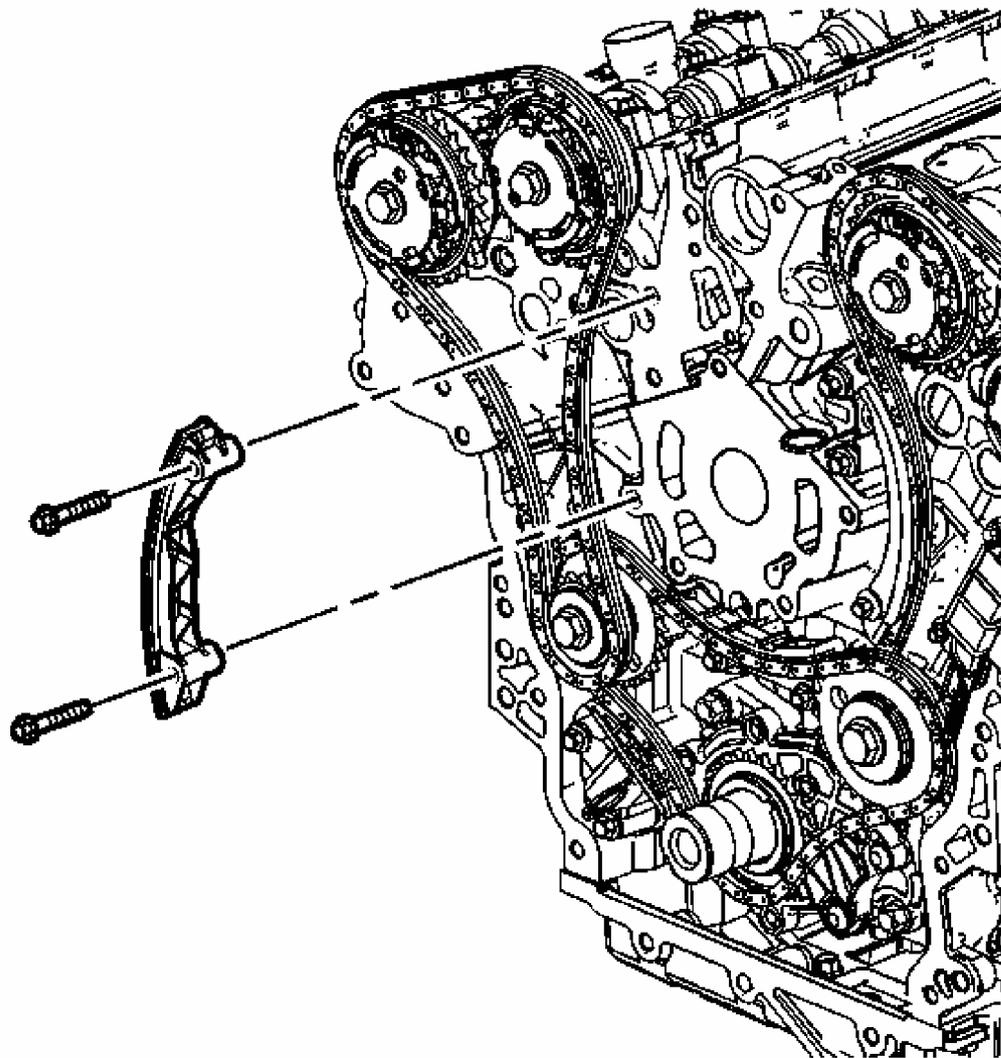
1. Remove the right secondary camshaft drive chain shoe bolt.



**Fig. 193: View Of Right Secondary Camshaft Drive Chain Shoe**  
**Courtesy of GENERAL MOTORS CORP.**

2. Remove the right secondary camshaft drive chain shoe.

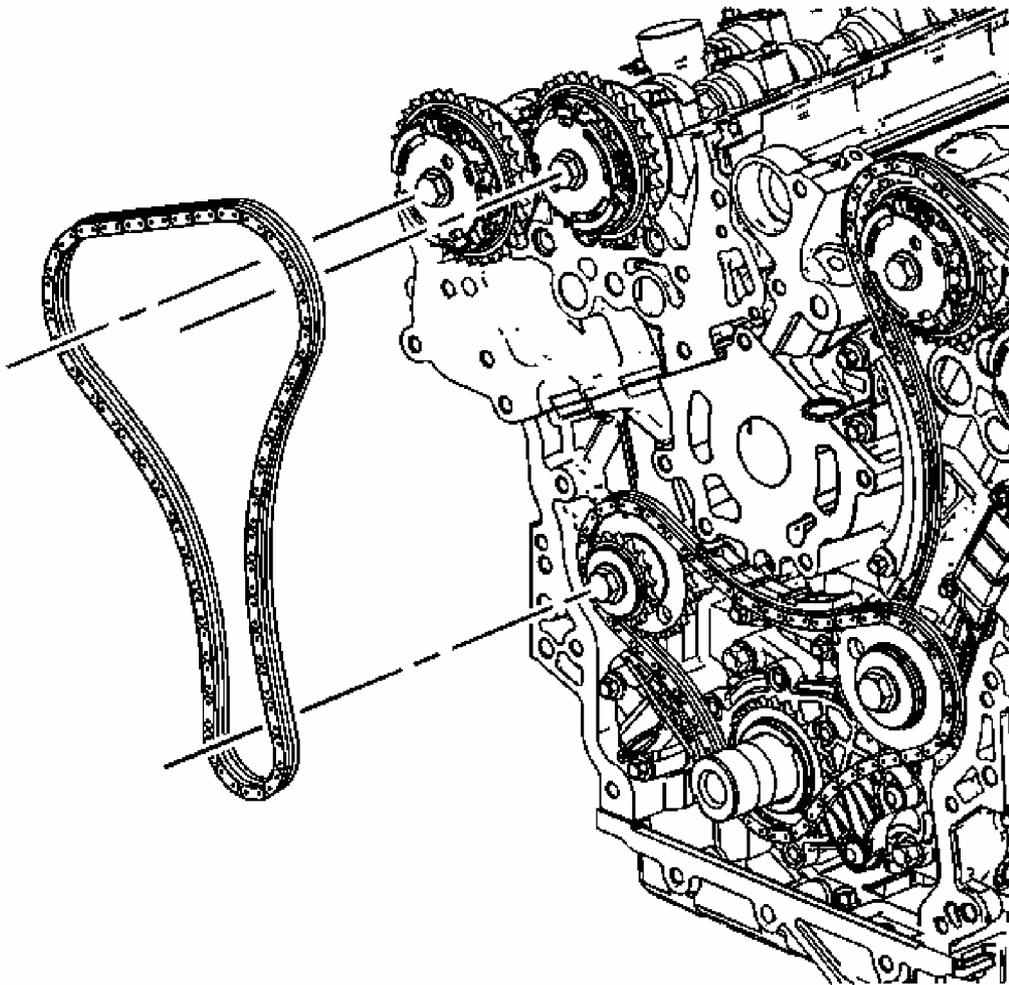
**SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - RIGHT**



**Fig. 194: View Of Right Secondary Camshaft Drive Chain Guide & 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.

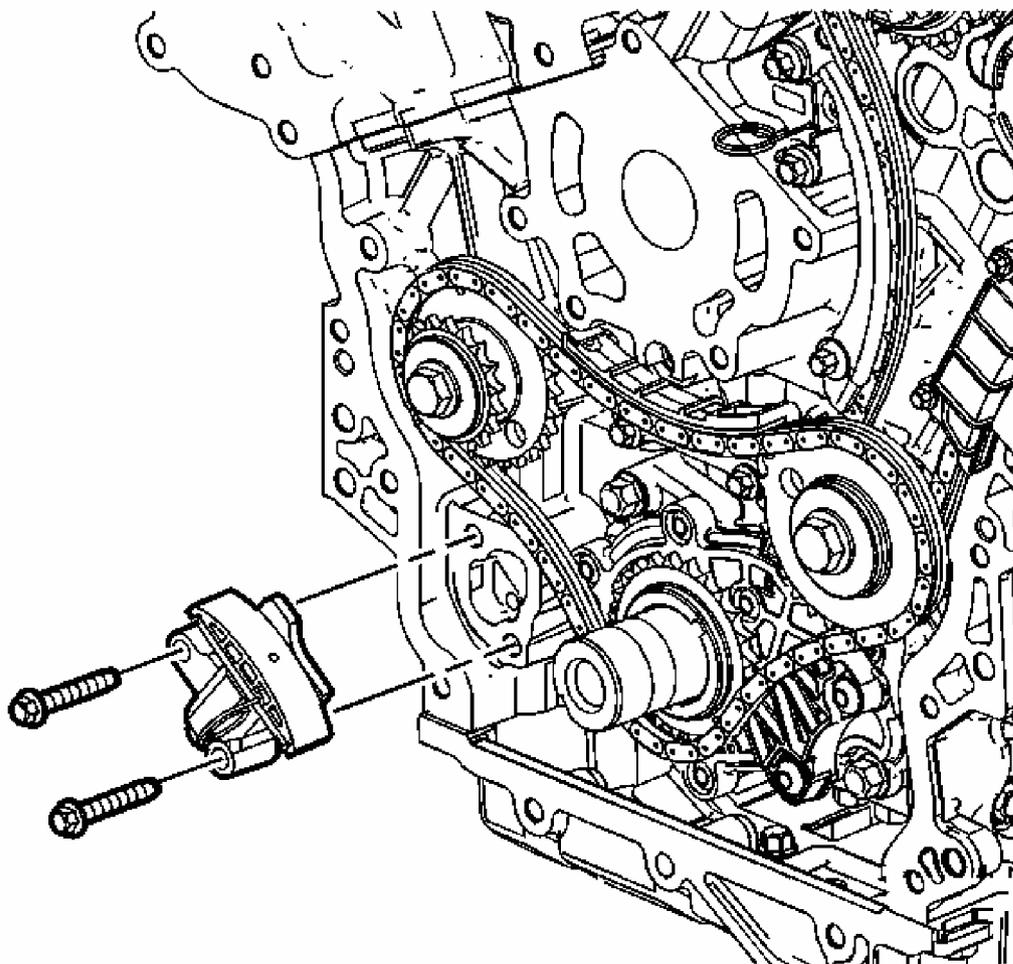
**SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - RIGHT**



**Fig. 195: View Of Right Bank Secondary Camshaft Drive Chain**  
**Courtesy of GENERAL MOTORS CORP.**

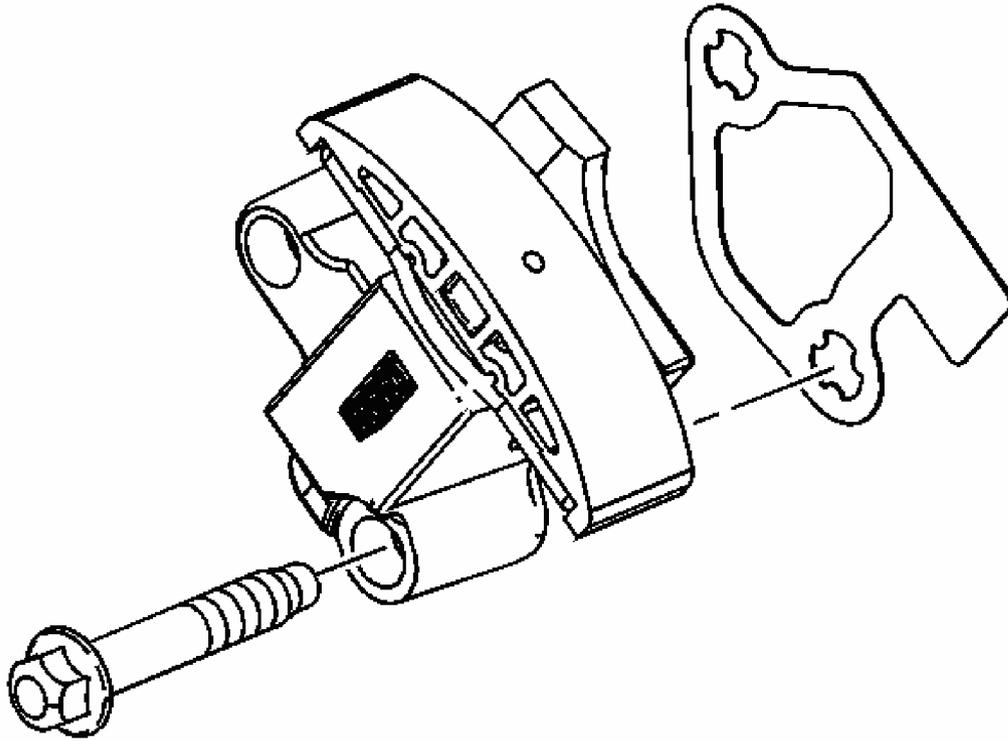
Remove the right secondary camshaft drive chain from the right camshaft position actuators and the right camshaft intermediate drive chain idler sprocket.

**PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL**



**Fig. 196: View Of Primary Camshaft Drive Chain Tensioners**  
**Courtesy of GENERAL MOTORS CORP.**

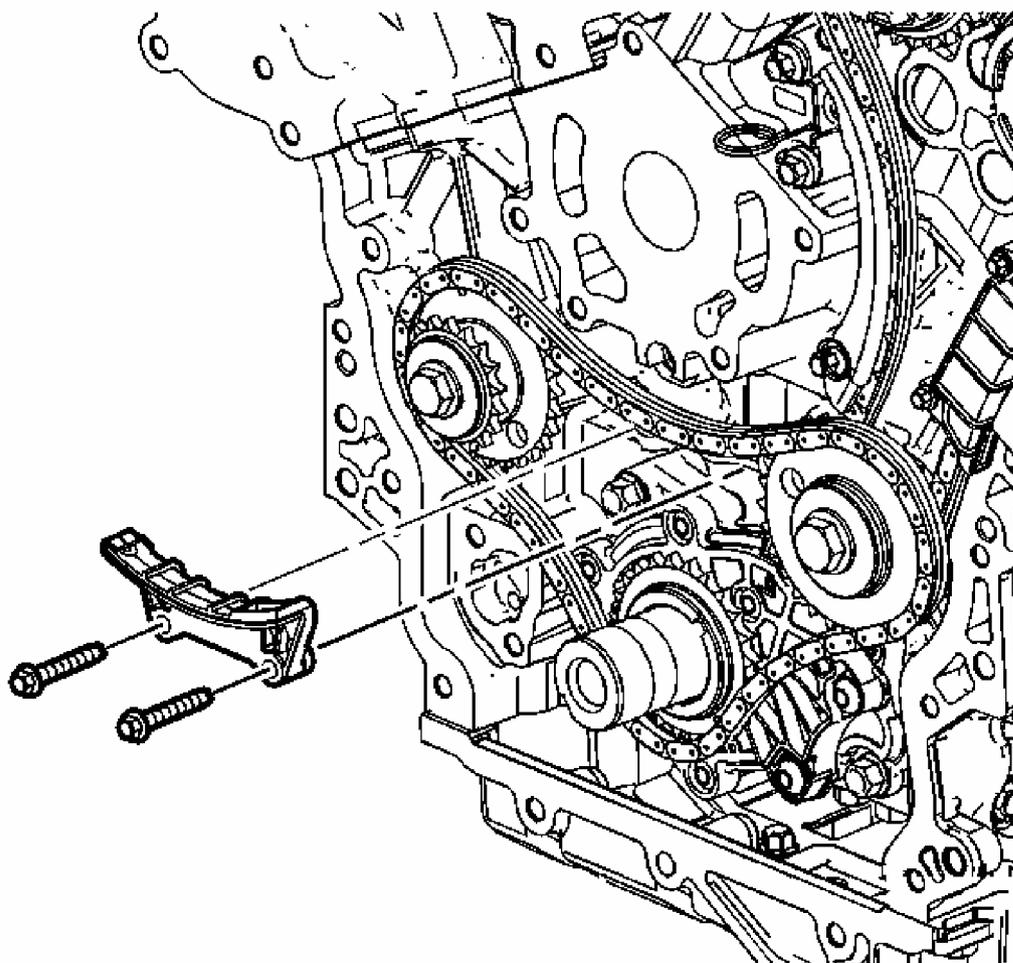
1. Remove the primary camshaft drive chain tensioner bolts.
2. Remove the primary camshaft drive chain tensioner.



**Fig. 197: 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.

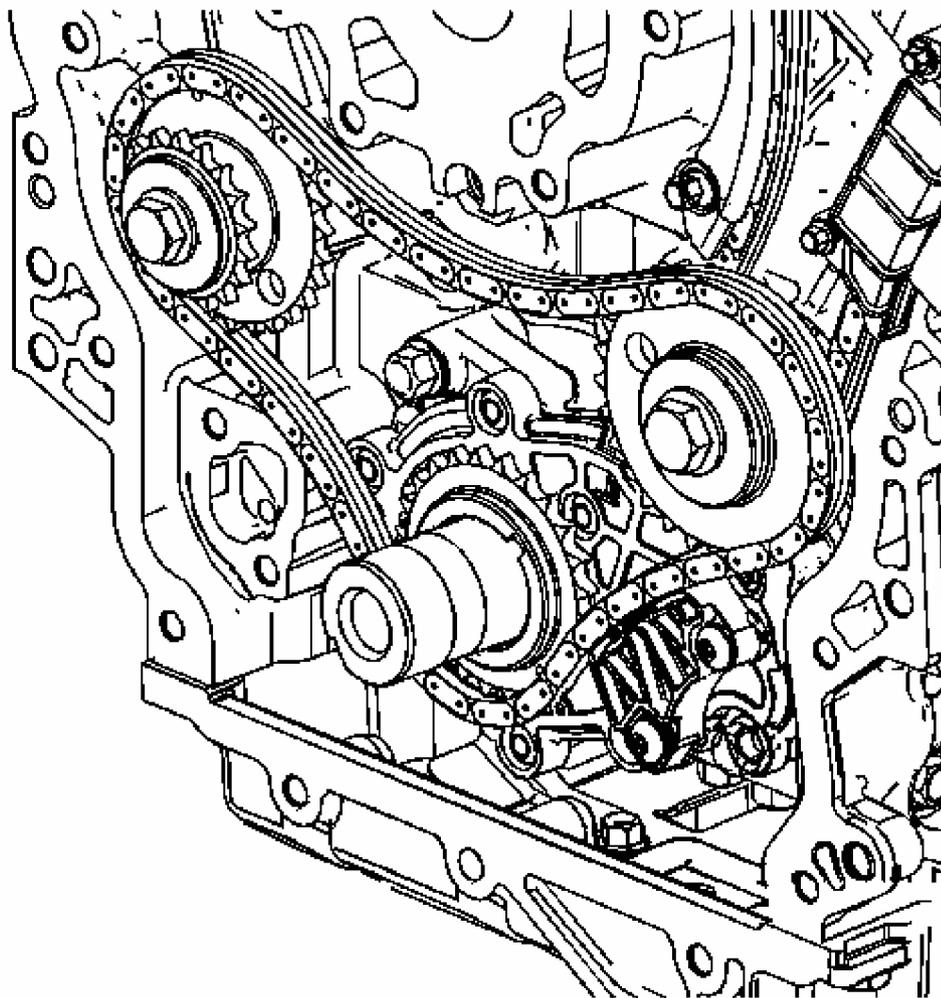
**PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - UPPER**



**Fig. 198: View Of Upper Primary Camshaft Drive Chain Guides**  
**Courtesy of GENERAL MOTORS CORP.**

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

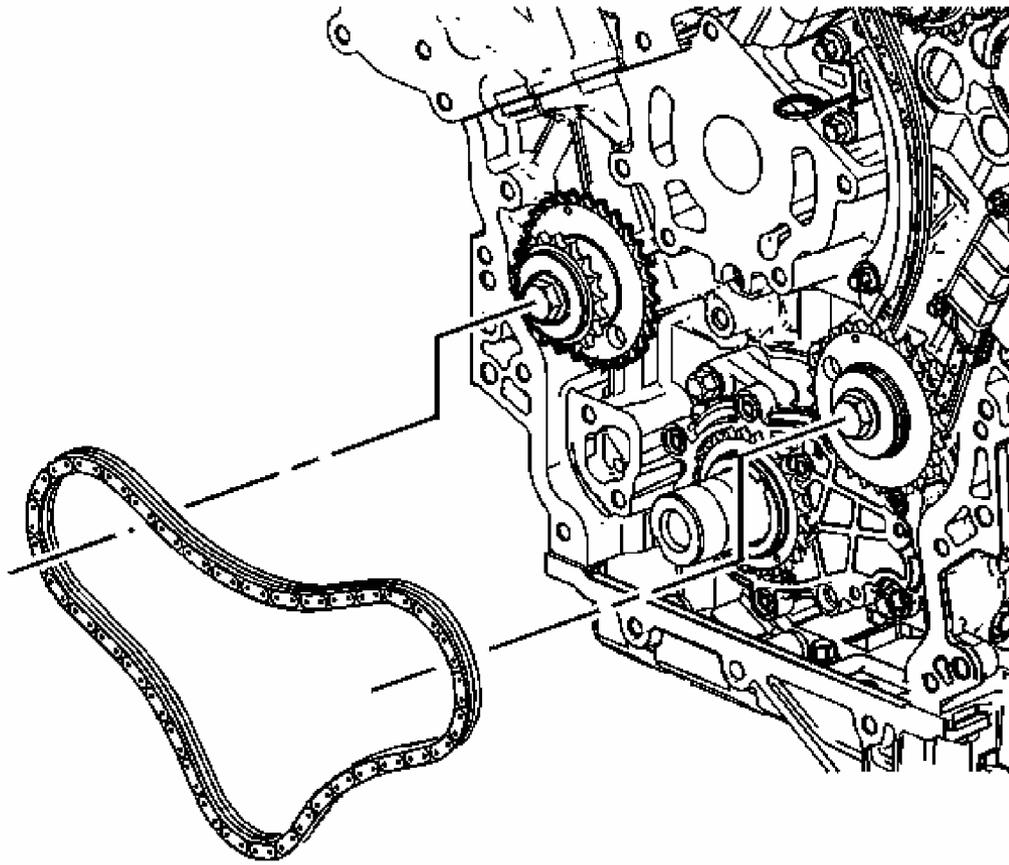
**PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LOWER**



**Fig. 199: View Of Primary Camshaft Drive Chain Guide**  
**Courtesy of GENERAL MOTORS CORP.**

Do not remove the primary camshaft drive chain lower guide. The primary camshaft drive chain lower guide is not serviceable separately. If the primary camshaft drive chain lower guide must be replaced, the oil pump must be replaced.

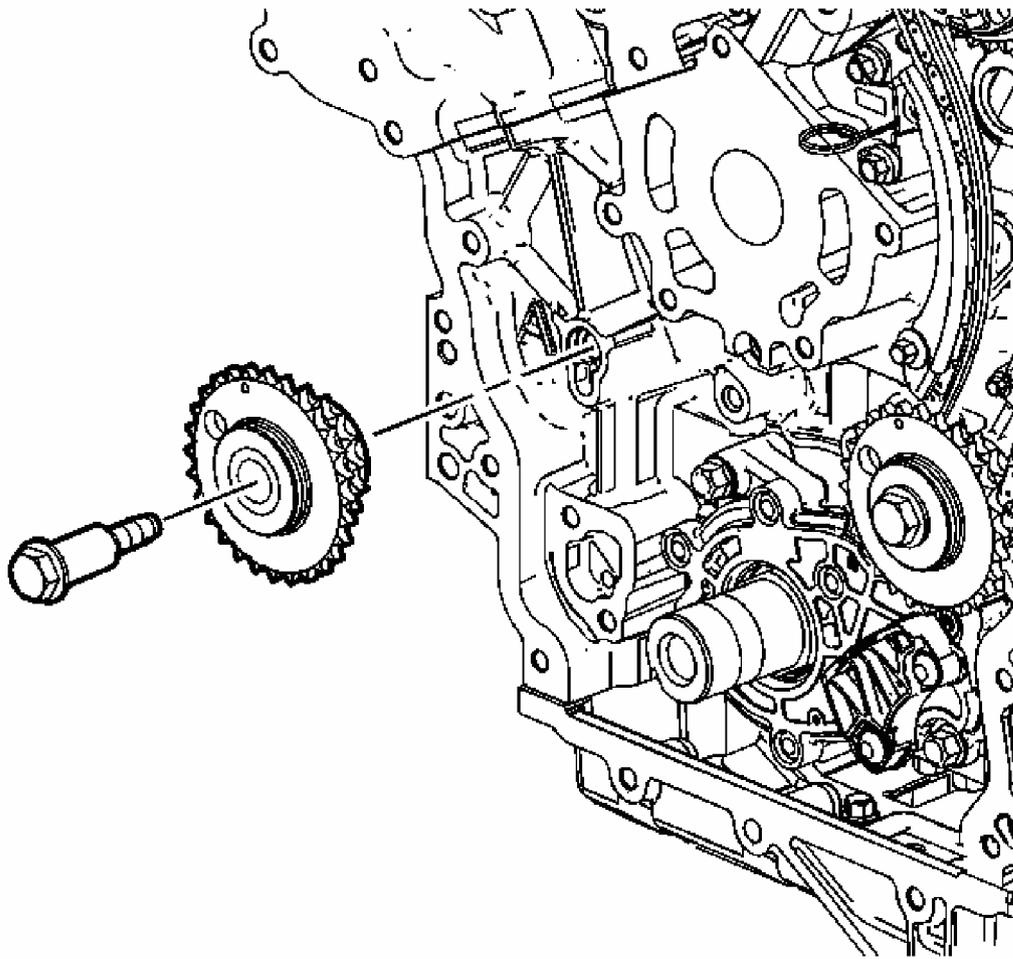
#### **PRIMARY CAMSHAFT DRIVE CHAIN REMOVAL**



**Fig. 200: View Of Primary Camshaft Timing Chain**  
**Courtesy of GENERAL MOTORS CORP.**

Remove the primary camshaft drive chain.

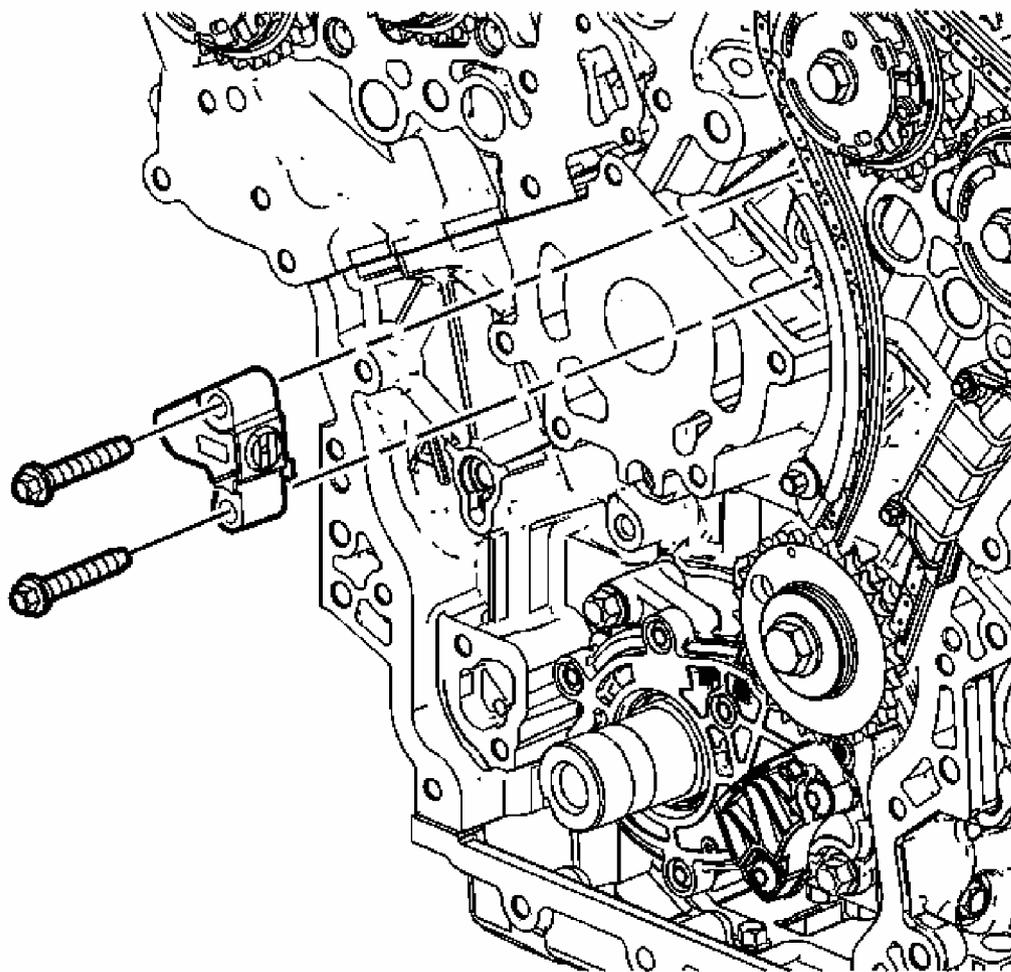
**CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - RIGHT**



**Fig. 201: View Of Right And Left Camshaft Intermediate Drive Chain Idlers**  
**Courtesy of GENERAL MOTORS CORP.**

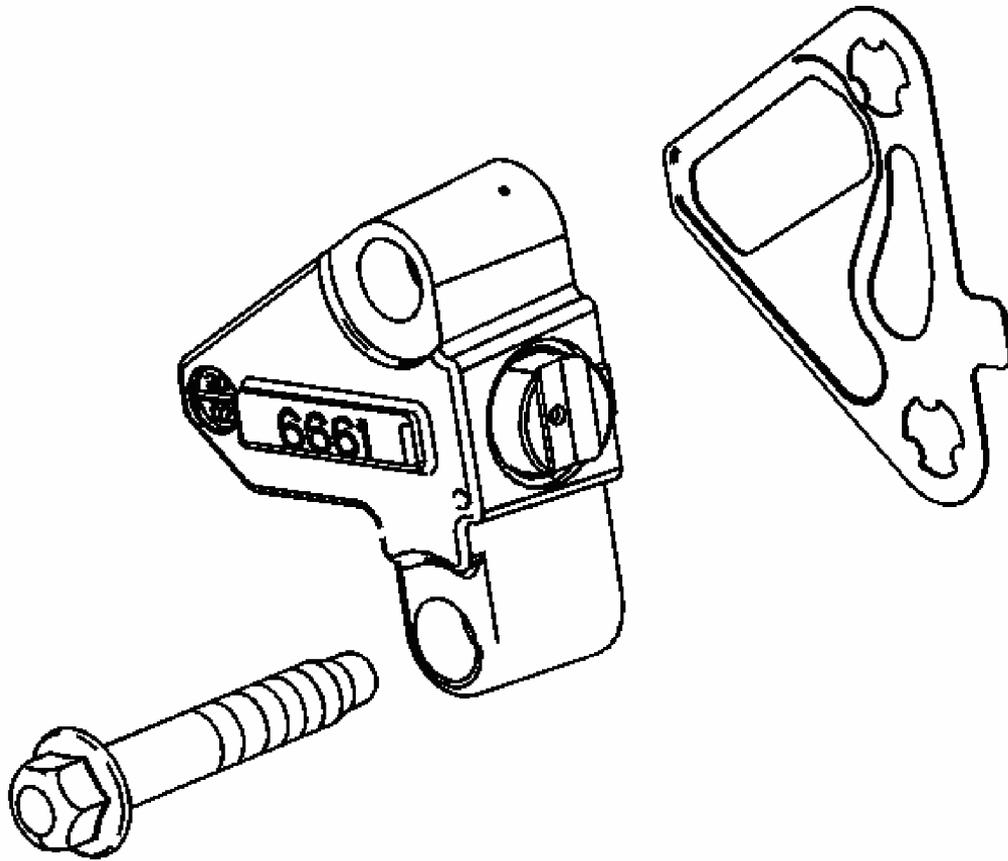
1. Remove the right camshaft intermediate drive chain idler bolt.
2. Remove the right camshaft intermediate drive chain idler.

**SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REMOVAL - LEFT**



**Fig. 202: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

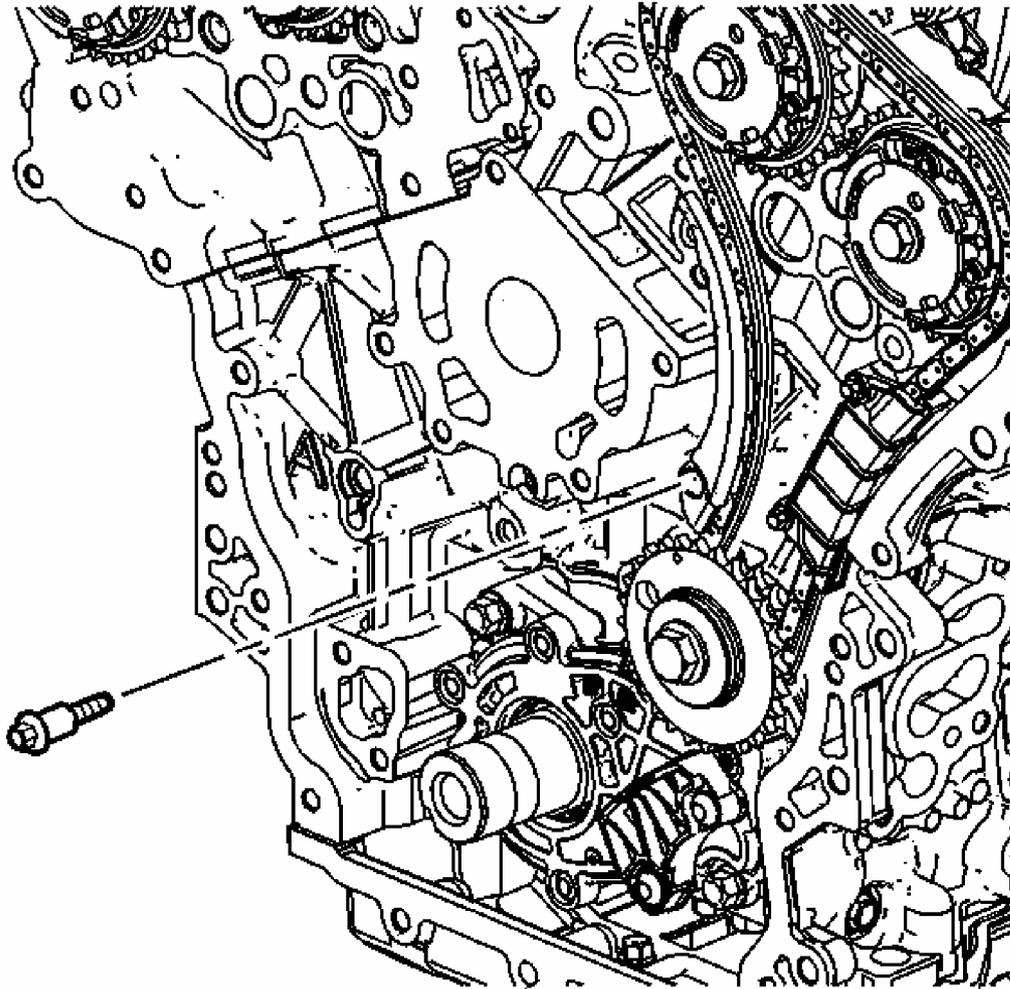
1. Remove the left secondary camshaft drive chain tensioner bolts.
2. Remove the left secondary camshaft drive chain tensioner.



**Fig. 203: Identifying Left Secondary Camshaft Drive Chain Tensioner & Gasket**  
Courtesy of GENERAL MOTORS CORP.

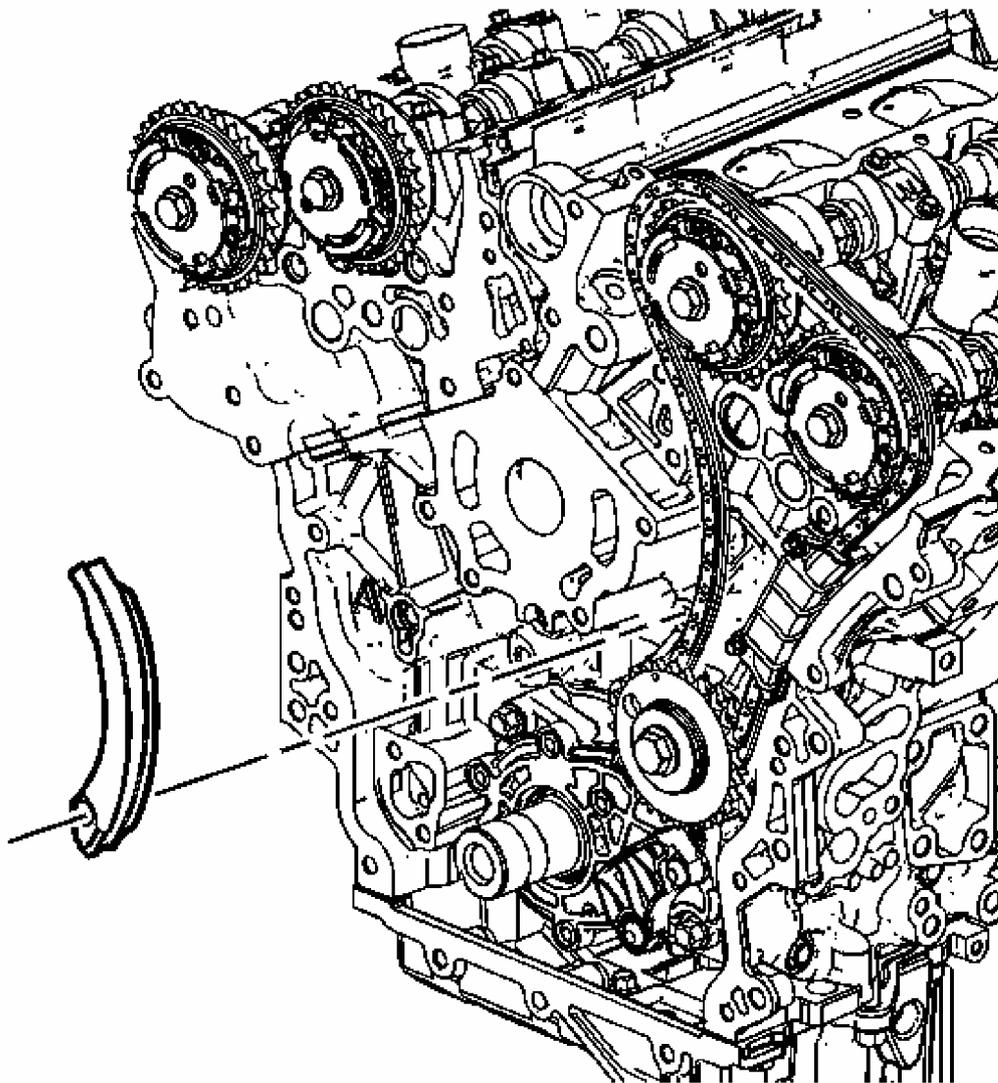
3. Remove and discard the left secondary camshaft drive chain tensioner gasket.
4. Inspect the left secondary camshaft drive chain tensioner mounting surface on the left cylinder head for burrs or any defects that would degrade the sealing of the NEW left secondary camshaft drive chain tensioner gasket.

#### **SECONDARY CAMSHAFT DRIVE CHAIN SHOE REMOVAL - LEFT**



**Fig. 204: Locating Left Secondary Camshaft Drive Chain Shoe Bolt**  
Courtesy of GENERAL MOTORS CORP.

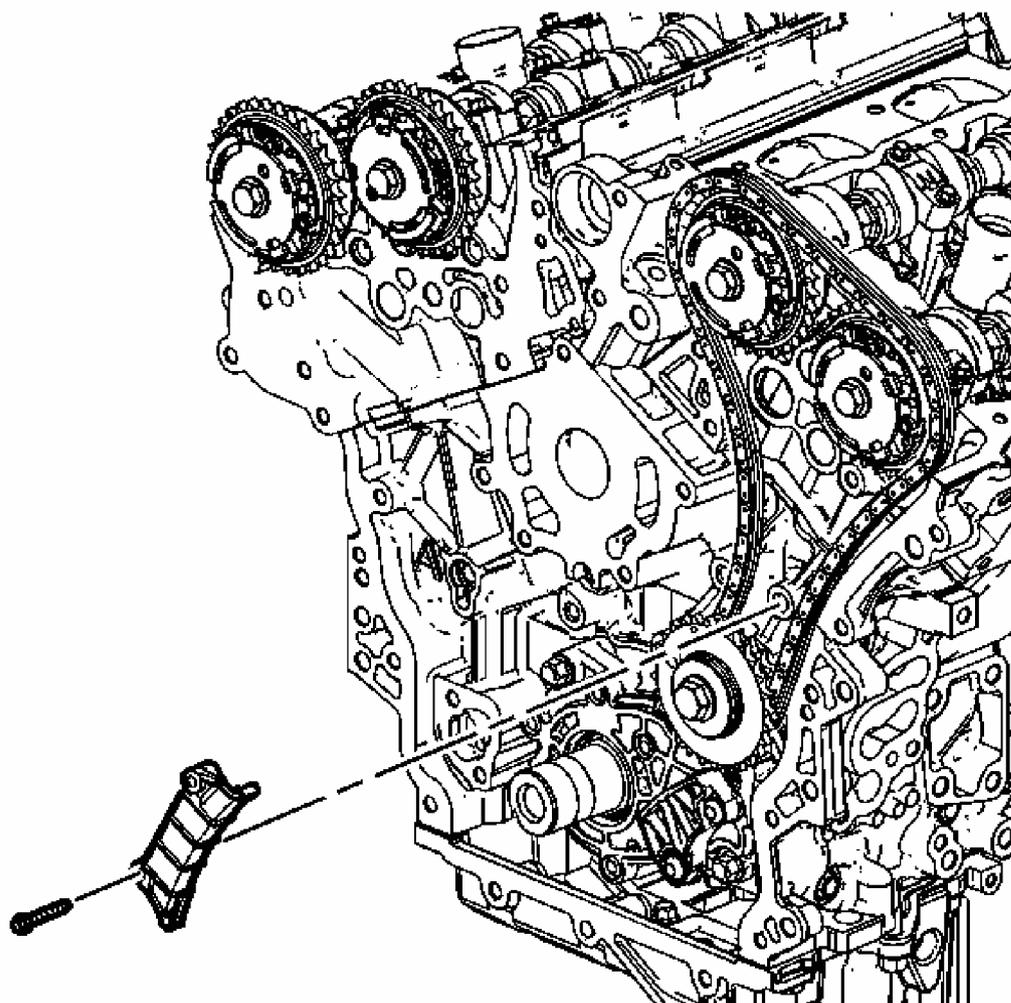
1. Remove the left secondary camshaft drive chain shoe bolt.



**Fig. 205: View Of Left Secondary Camshaft Drive Chain Shoe**  
Courtesy of GENERAL MOTORS CORP.

2. Remove the left secondary camshaft drive chain shoe.

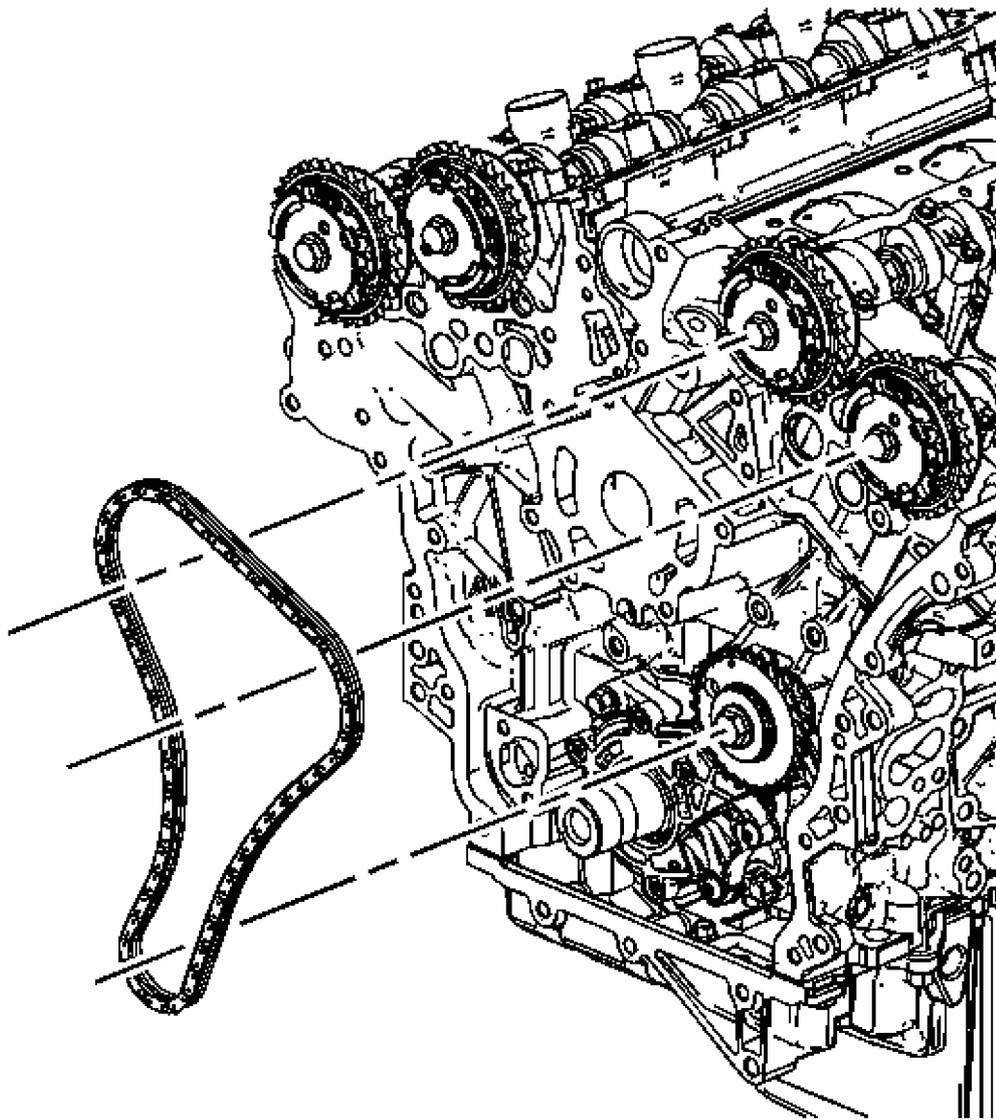
**SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REMOVAL - LEFT**



**Fig. 206: View Of Left Bank Secondary Camshaft Drive Chain Guide**  
**Courtesy of GENERAL MOTORS CORP.**

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

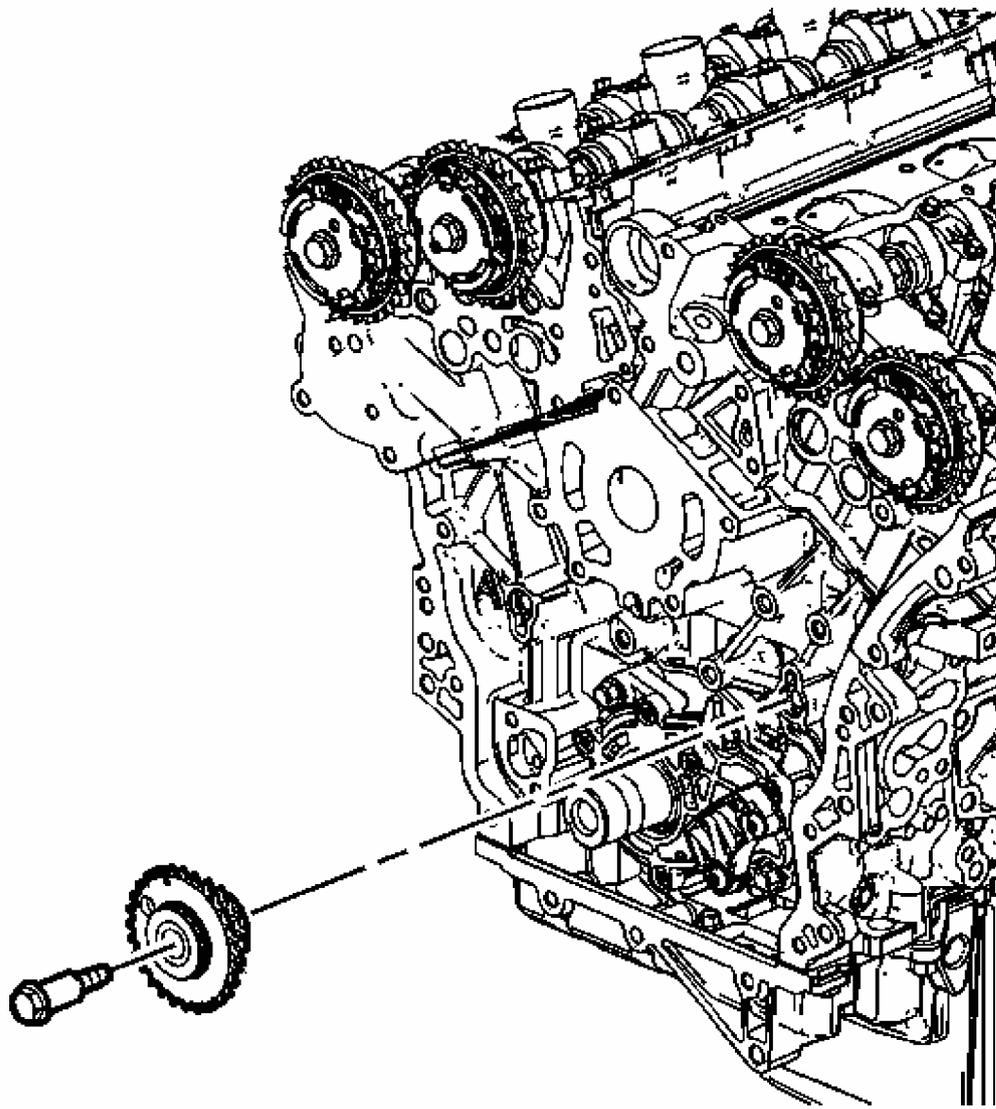
**SECONDARY CAMSHAFT DRIVE CHAIN REMOVAL - LEFT**



**Fig. 207: View Of Left Bank 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.

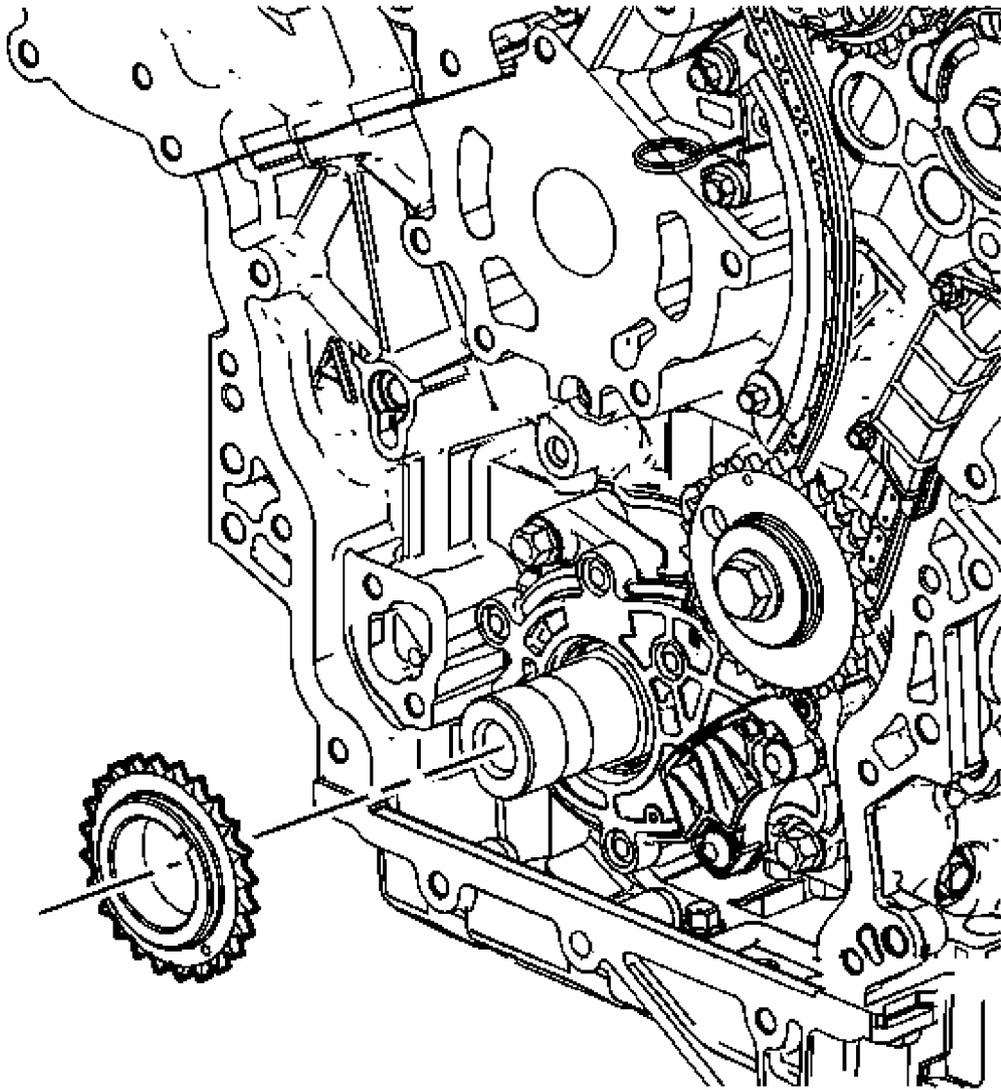
**CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER REMOVAL - LEFT**



**Fig. 208: View Of Left Camshaft Intermediate Drive Chain Idler**  
**Courtesy of GENERAL MOTORS CORP.**

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

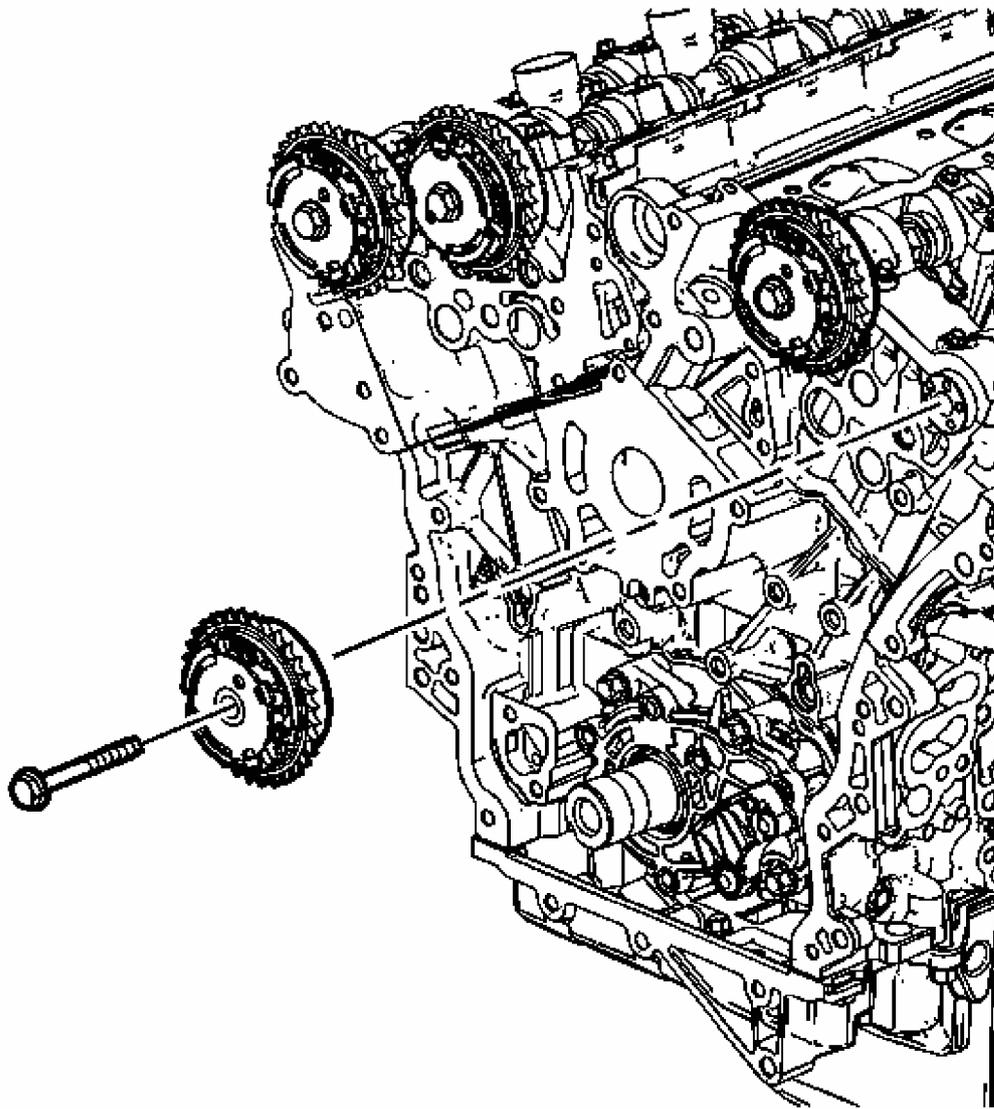
#### **CRANKSHAFT SPROCKET REMOVAL**



**Fig. 209: Crankshaft Sprocket**  
**Courtesy of GENERAL MOTORS CORP.**

Remove the crankshaft sprocket from the nose of the crankshaft.

**CAMSHAFT POSITION (CMP) ACTUATOR REMOVAL - LEFT EXHAUST**



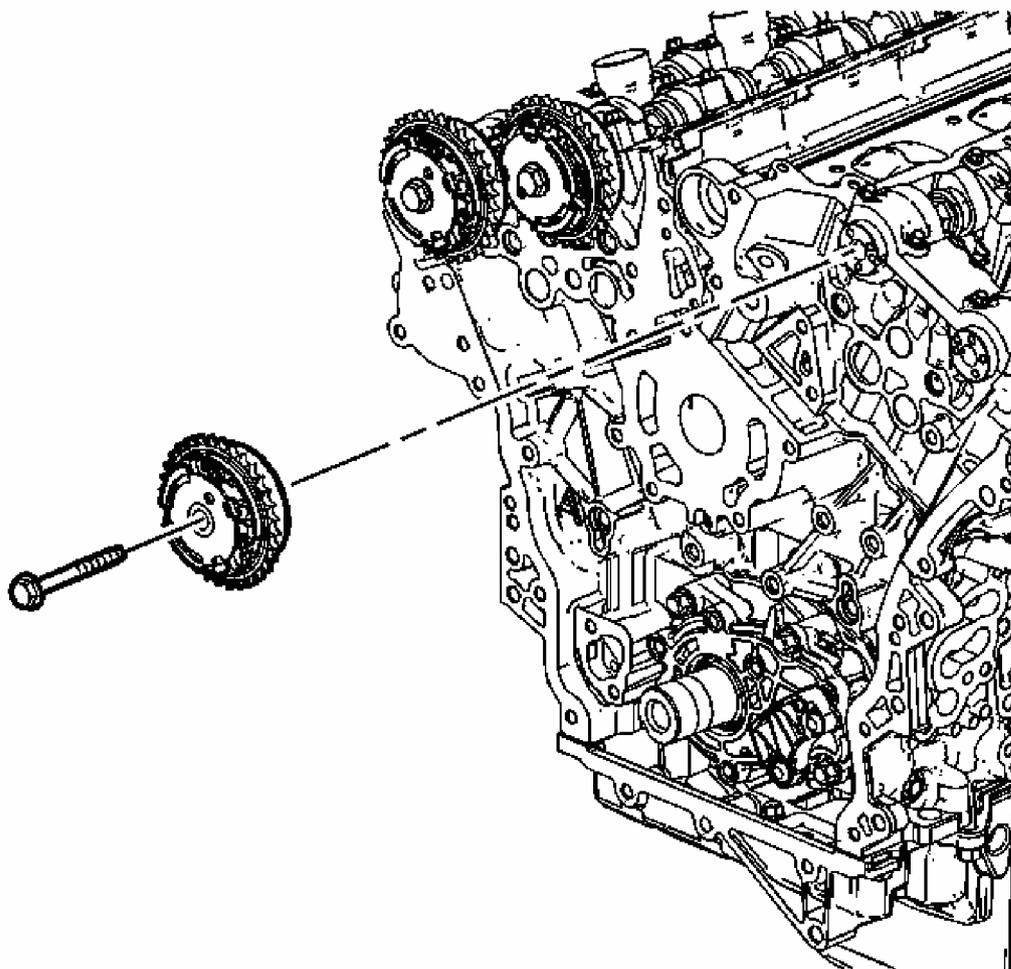
**Fig. 210: View Of Camshaft Position (CMP) Actuator - Bank 2 Exhaust**  
Courtesy of GENERAL MOTORS CORP.

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

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 (CMP) ACTUATOR REMOVAL - LEFT INTAKE



**Fig. 211: Removing/Installing Camshaft Position (CMP) Actuator**  
Courtesy of GENERAL MOTORS CORP.

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

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.

