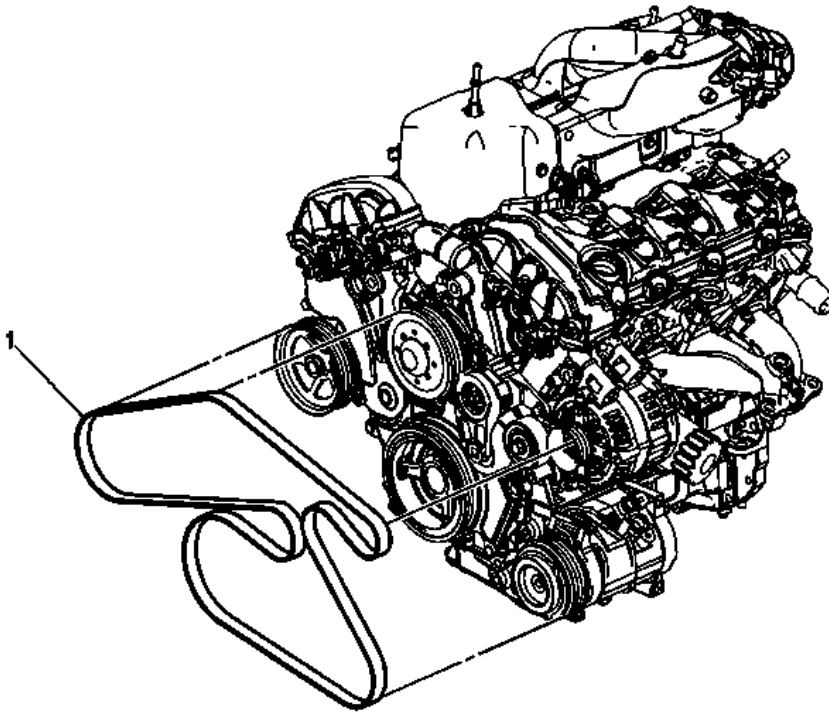


## 2010 ENGINE

Engine Mechanical - 2.8L, 3.0L, 3.2L, or 3.6L - Repair Instructions - On Vehicle - Acadia, Enclave, Outlook & Traverse

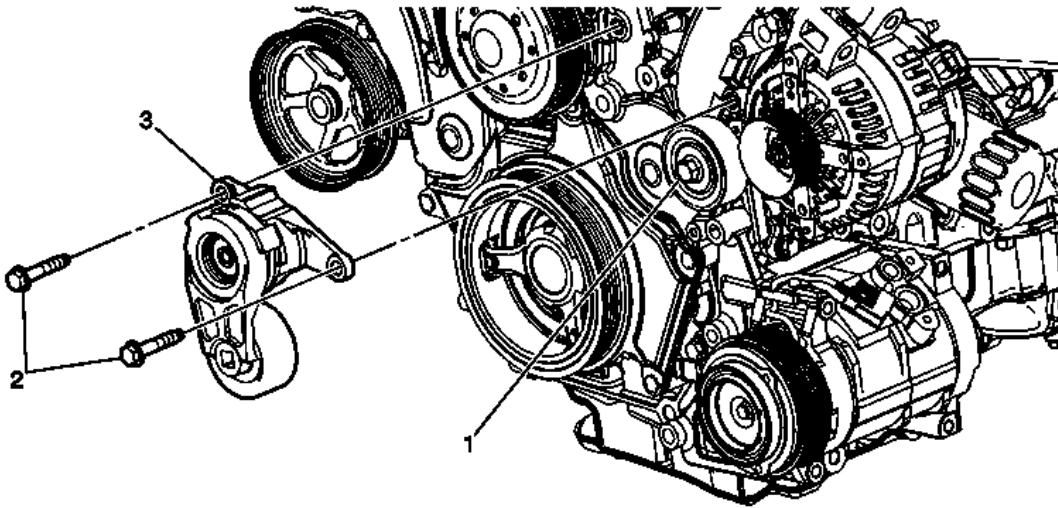
## DRIVE BELT REPLACEMENT



**Fig. 1: Identifying Drive Belt Routing**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                           | Component Name |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Preliminary Procedure</b>                                                                                                                                                                                                                                                                                                      |                |
| <ol style="list-style-type: none"><li>1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .</li><li>2. Rotate the drive belt tensioner clockwise to release the drive belt tension.</li><li>3. Slide the drive belt off of the belt idler pulley.</li><li>4. Slowly release the drive belt tensioner.</li></ol> |                |
| 1                                                                                                                                                                                                                                                                                                                                 | Drive Belt     |

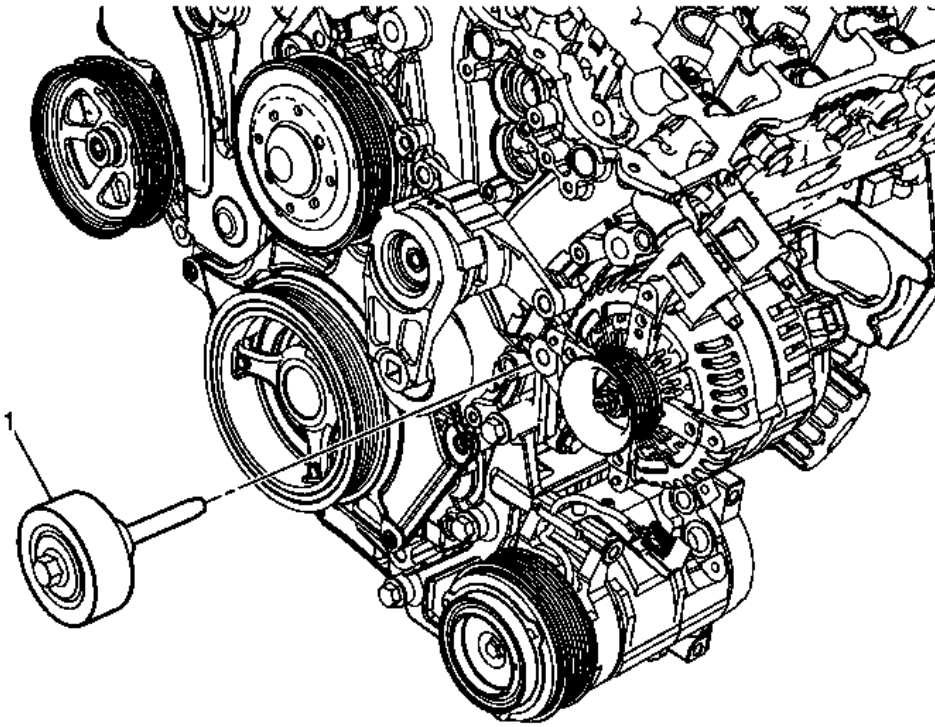
## DRIVE BELT TENSIONER REPLACEMENT



**Fig. 2: View Of Drive Belt Tensioner**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                         | Component Name                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                   |                                                                                                                         |
| <ol style="list-style-type: none"> <li>1. Remove the right engine strut mount. Refer to <u>Engine Mount Strut Replacement - Right Side</u>.</li> <li>2. Remove the right engine mount strut bracket. Refer to <u>Engine Mount Strut Bracket Replacement - Right Side</u>.</li> <li>3. Remove the drive belt. Refer to <u>Drive Belt Replacement</u>.</li> </ol> |                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                               | Idler Pulley Bolt<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten:</b> 50 N.m (37 lb ft) |
| 2                                                                                                                                                                                                                                                                                                                                                               | Tensioner Bolt<br><br><b>Tighten:</b> 50 N.m (37 lb ft)                                                                 |
| 3                                                                                                                                                                                                                                                                                                                                                               | Tensioner<br><b>Tip:</b> Remove wire harness retainer from tensioner.                                                   |

## DRIVE BELT IDLER PULLEY REPLACEMENT



**Fig. 3: Identifying Drive Belt Idler Pulley**  
 Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                            | Component Name                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                      |                                                                                                                         |
| 1. Remove the right engine strut mount. Refer to <u>Engine Mount Strut Replacement - Right Side</u> .<br>2. Remove the right engine mount strut bracket. Refer to <u>Engine Mount Strut Bracket Replacement - Right Side</u> .<br>3. Remove the generator. Refer to <u>Generator Replacement</u> . |                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                  | Idler Pulley Bolt<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten:</b> 50 N.m (37 lb ft) |

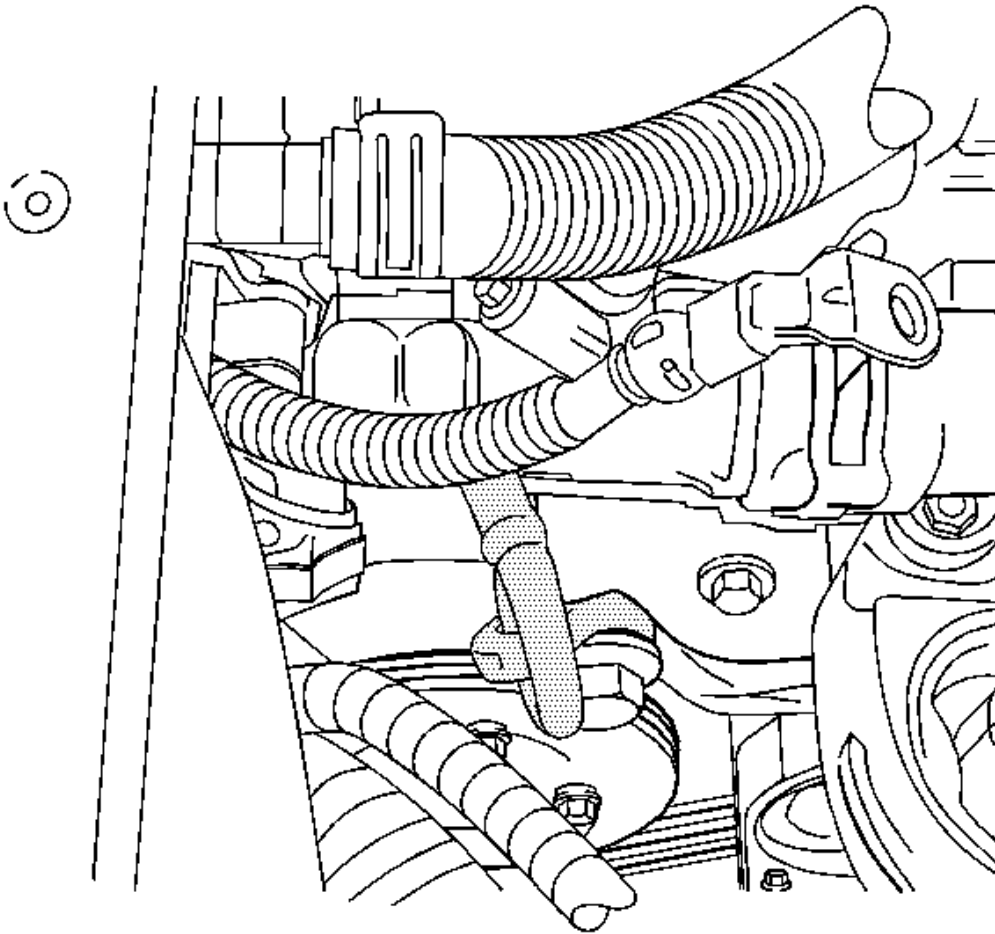
## ENGINE SUPPORT FIXTURE

### SPECIAL TOOLS

- **J 28467-B** Universal Engine Support Fixture. See Special Tools .
- **J 28467-7A** Bolt Hook. See Special Tools .
- **J 28467-34** Lift Hook Wing Nut and Washer. See Special Tools .

- **J-41803-9** Engine Lift Hook
- **J 42451-1** Engine Support Adapter

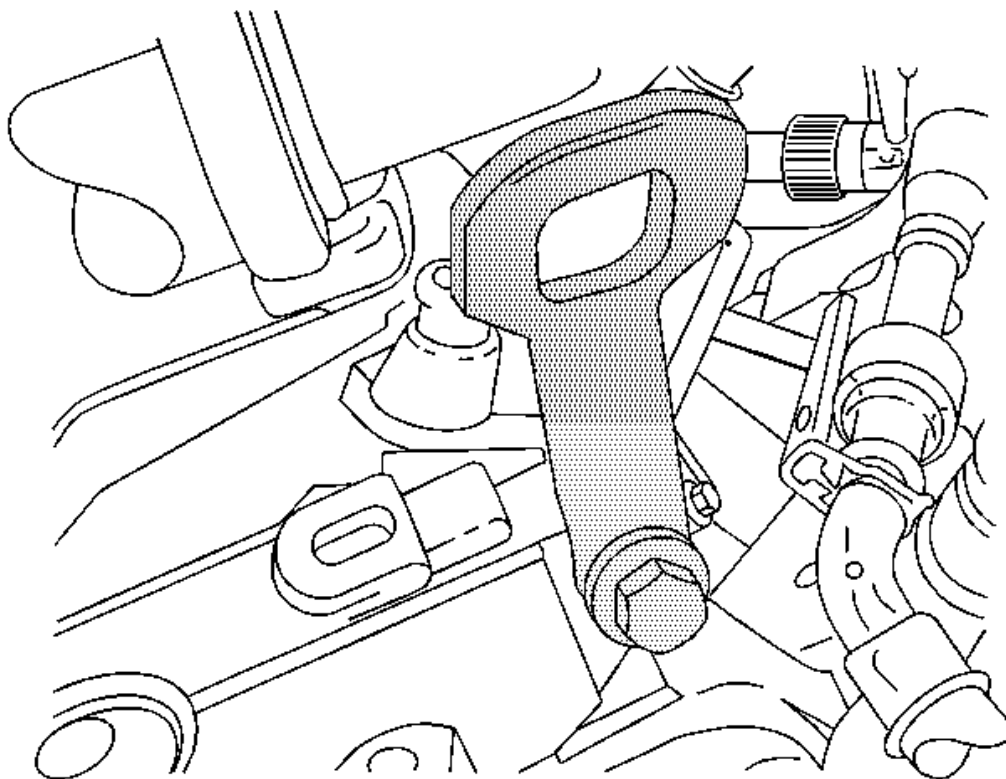
## INSTALLATION PROCEDURE



**Fig. 4: Identifying Special Tool - J 42451-1**  
Courtesy of GENERAL MOTORS CORP.

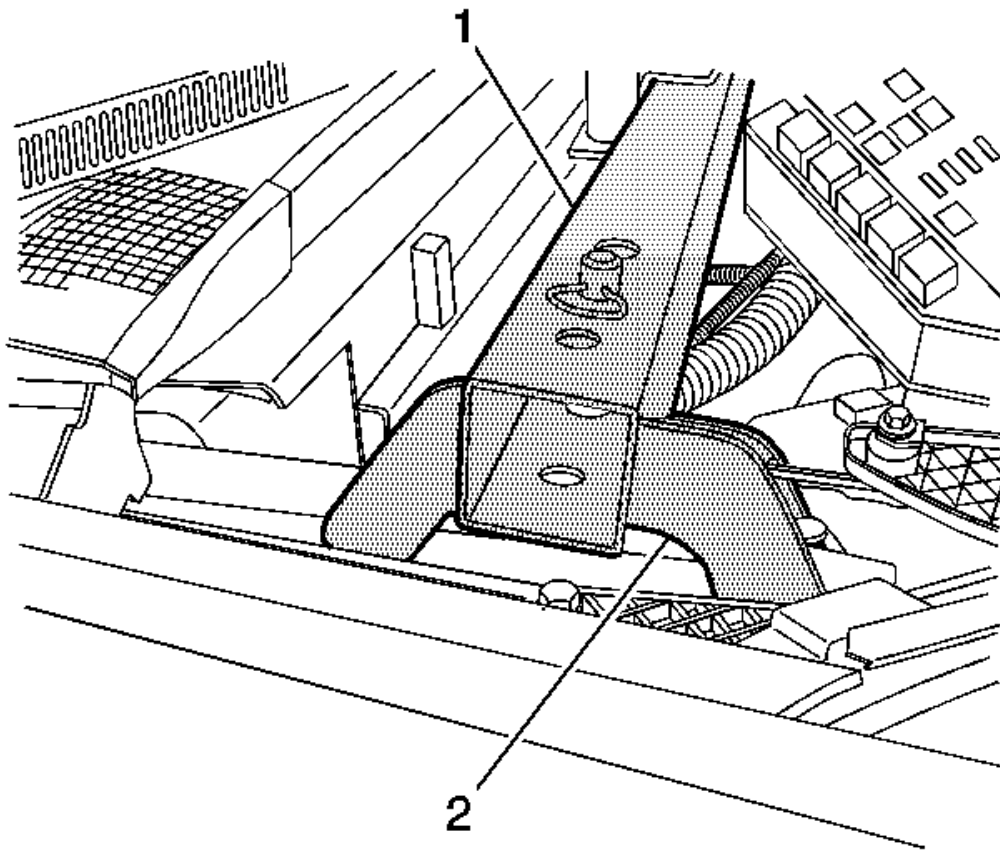
1. Remove the injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Remove the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement**.
3. Remove the right engine strut mount. Refer to **Engine Mount Strut Replacement - Right Side**.
4. Install the **J 42451-1** to the right side of the engine.

5. Remove the Mass air flow sensor. Refer to **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement**



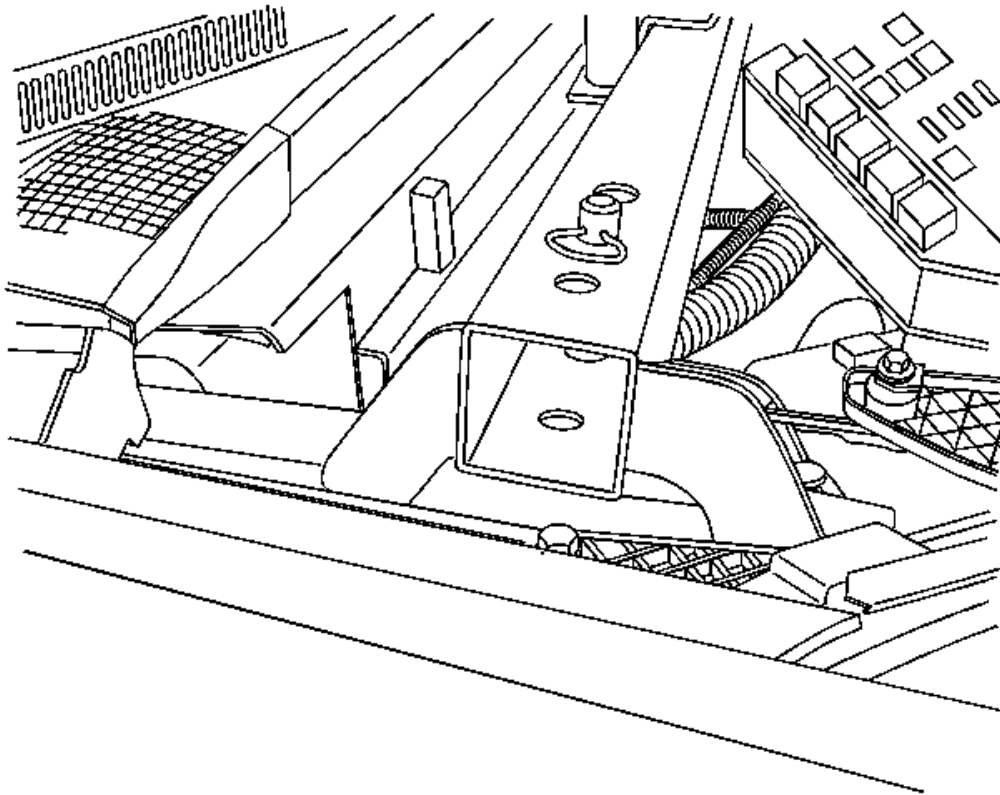
**Fig. 5: Identifying Special Tool - J-41803-9**  
Courtesy of GENERAL MOTORS CORP.

6. Install the **J-41803-9** to the left side front of the engine.



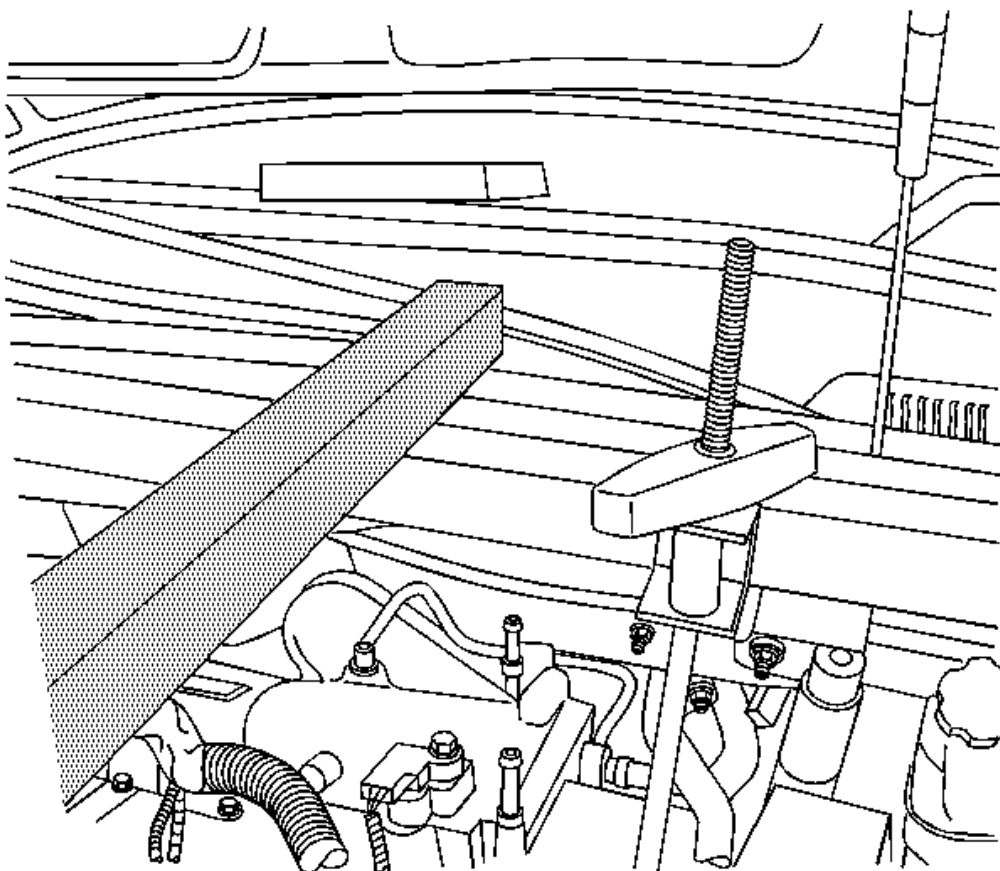
**Fig. 6: Identifying Special Tools - J 28467-3 & J 43405**  
Courtesy of GENERAL MOTORS CORP.

7. Using **J 28467-B** , install the ends of the strut tower tube J 28467-518 (1) to the engine support adapter legs (P/N) 48059 (2). See **Special Tools** .



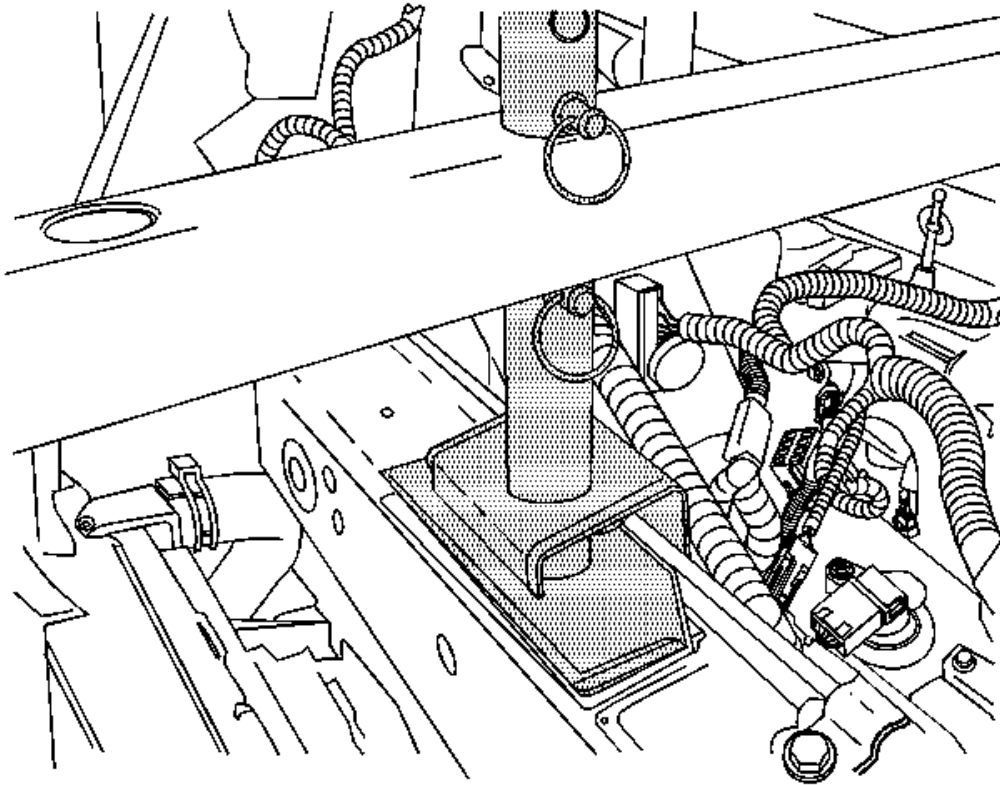
**Fig. 7: Identifying Special Tools - J 28467-3 & J-48059**  
**Courtesy of GENERAL MOTORS CORP.**

8. Place the strut tower tube J 28467-518 and the (P/N) 48059 on top of both the left and right fender lips, over the engine rear lift bracket.



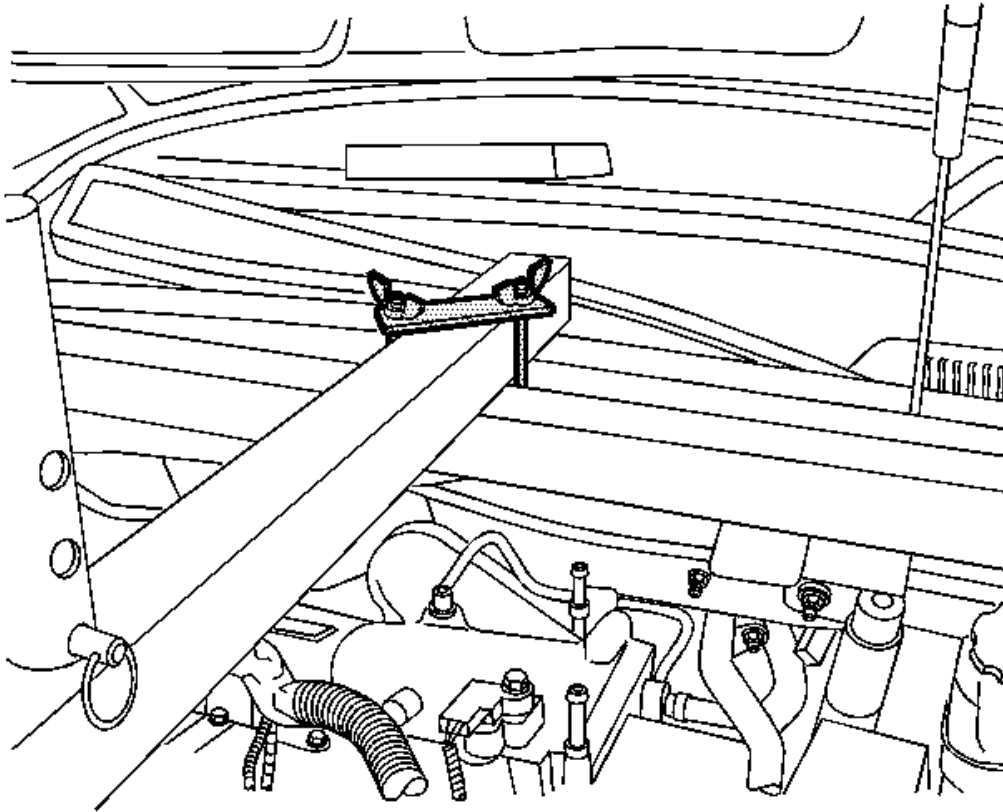
**Fig. 8: Identifying Special Tools - J 36462-1A & J 28467-51**  
**Courtesy of GENERAL MOTORS CORP.**

9. Install the radiator shelf tube J 36462-1A (2) on top of the strut tower tube J 28467-518 (1) above the left side of the engine.



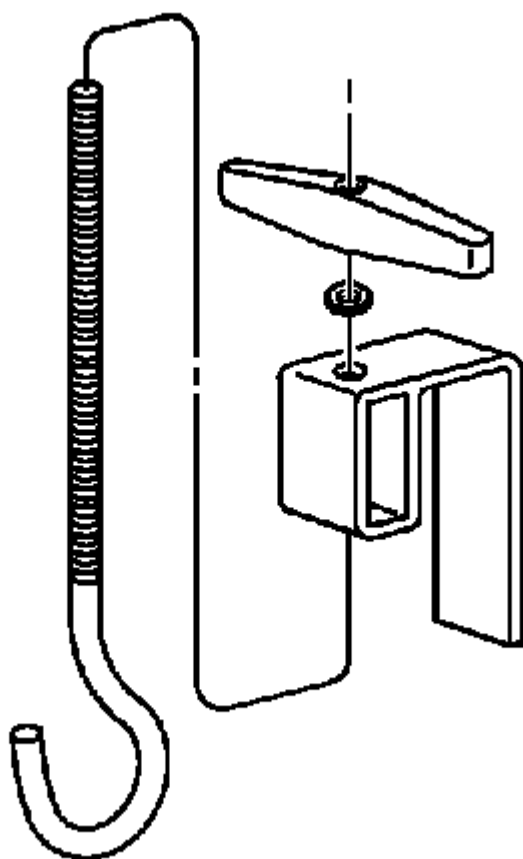
**Fig. 9: Identifying Special Tools - J 28467-4A & J 36462-1A**  
Courtesy of GENERAL MOTORS CORP.

10. Install the round tube of the front support assembly J 28467-4A through the large hole in the radiator shelf tube J 36462-1A.
11. Remove the upper tie bar cover.
12. Locate the J 28467-4A front support assembly to the upper tie bar.
13. Install the J 28467-9 quick-release pin through the bottom hole in the J 28467-4A front support assembly.
14. Install the J 28467-9 quick-release pin through the hole above the J-36462-1A radiator shelf tube.



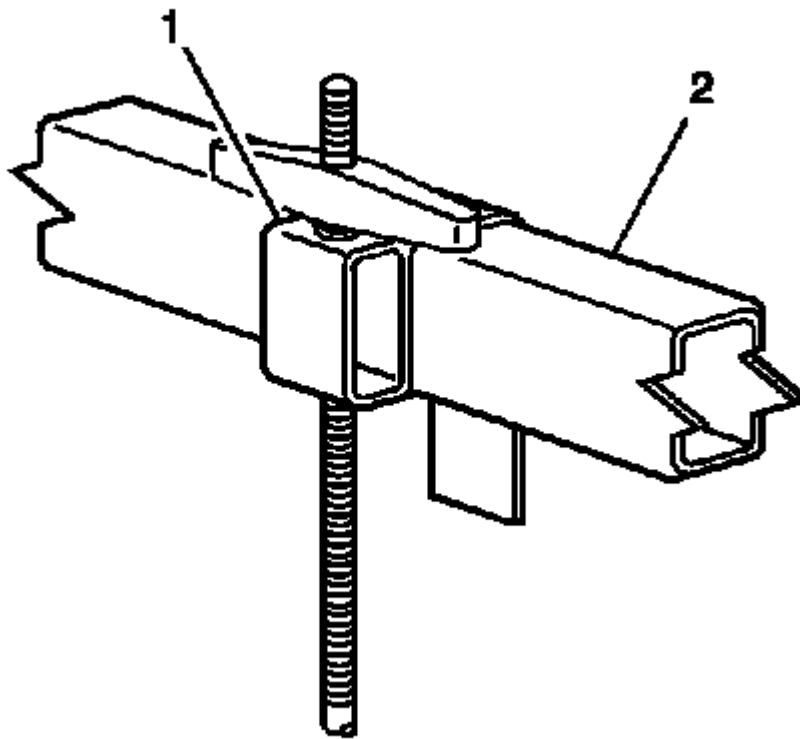
**Fig. 10: Identifying Special Tools - J 28467-1A**  
Courtesy of GENERAL MOTORS CORP.

15. Install the J 28467-1A cross bracket assembly.
16. Hand tighten the J 28467-1A cross bracket wing nuts.



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

17. Install the **J 28467-7A** bolt hook through the **J-41803-9** bracket. See **Special Tools** .
18. Install the **J 28467-34** lift hook wing nut and washer to the **J 28467-7A** lift hook. See **Special Tools** .
19. Repeat the previous 2 steps in order to assemble 2 lift hooks and brackets.



**Fig. 12: View Of Lift Hook & Bracket Assembly At Longitudinal Mounted Cross Bar**  
Courtesy of GENERAL MOTORS CORP.

20. Install one of the lift hook and bracket assemblies (1) to the J 28467-518 strut tower tube (2) above the **J 42451-1** engine rear lift bracket.
21. Install the lift hook **J 28467-7A** through the **J 42451-1** engine rear lift bracket. Ensure the hook does not damage adjacent components.
22. Install the other lift hook and bracket assembly (1) to the J 28467-2A radiator shelf tube (2) above the engine front lift bracket.
23. Install the lift hook **J 28467-7A** through the **J-41803-9** engine front lift bracket. Ensure the hook does not damage adjacent components.
24. Hand tighten the lift hook wing nuts **J 28467-34** in order to remove all slack from the engine support fixture assembly. See **Special Tools**.

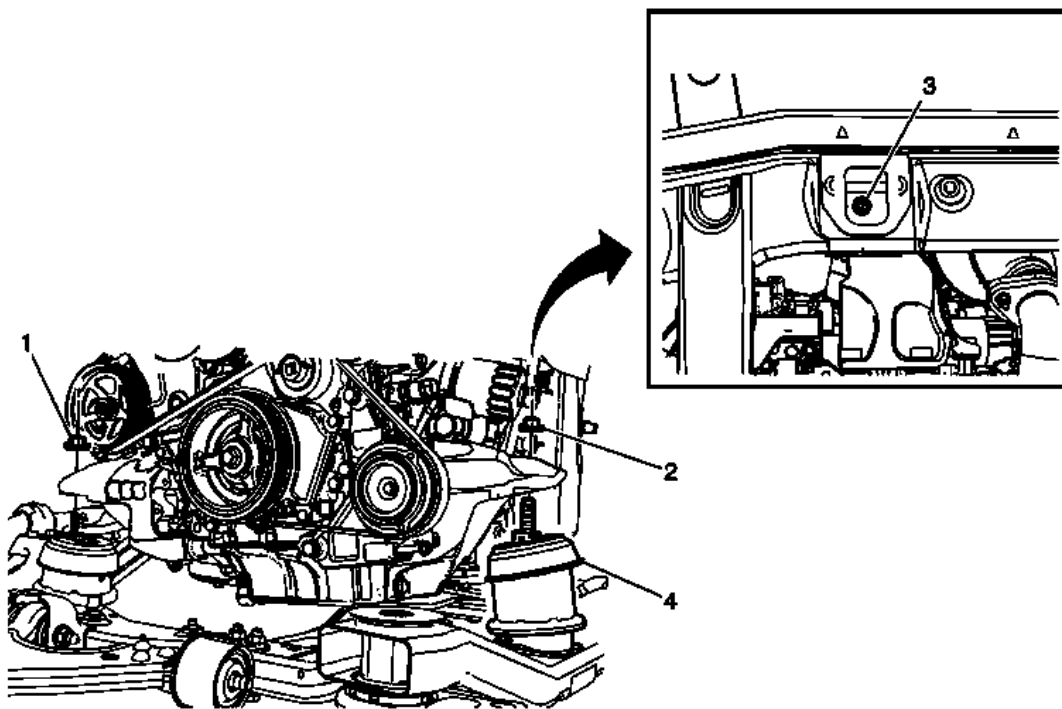
## ENGINE MOUNT INSPECTION

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

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

2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
  - The hard rubber is covered with heat check cracks.
  - The rubber is separated from the metal plate of the engine mount.
  - The rubber is split through the center of the engine mount.
  - The engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to **Engine Front Mount Replacement**, **Engine Rear Mount Replacement** or **Transmission Mount Replacement - Left Side**.

## ENGINE FRONT MOUNT REPLACEMENT

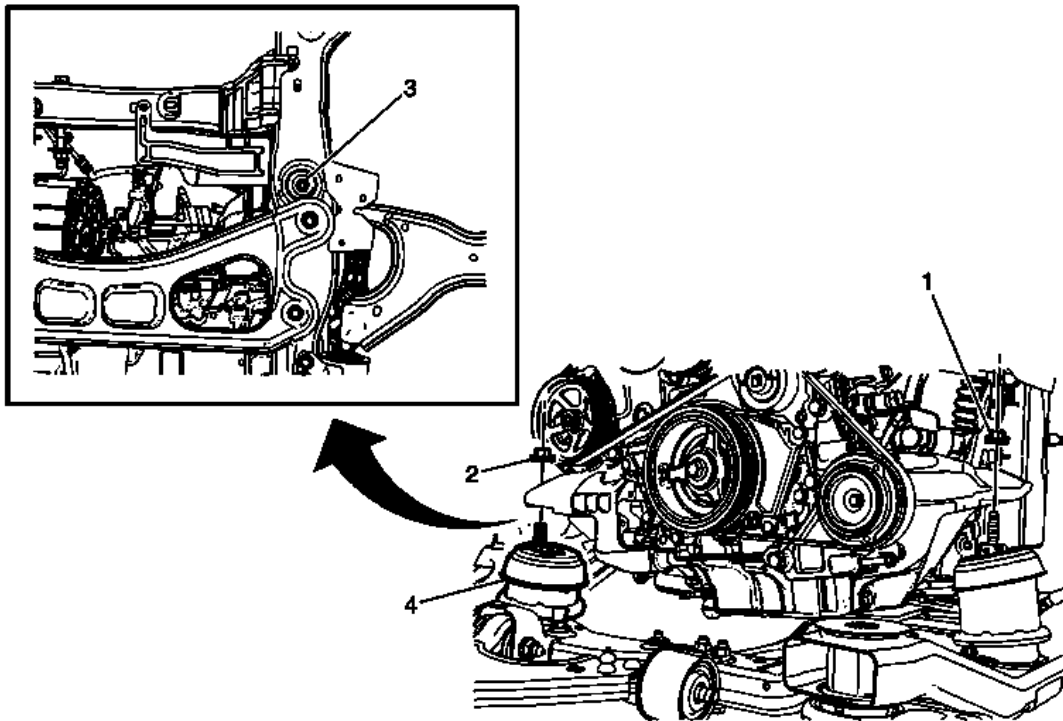


**Fig. 13: Identifying Engine Front Mount Assembly**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                    | Component Name              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                              |                             |
| <ol style="list-style-type: none"> <li>1. Support the engine. Refer to <b><u>Engine Support Fixture</u></b>.</li> <li>2. Raise and support the vehicle. Refer to <b><u>Lifting and Jacking the Vehicle</u></b>.</li> </ol> |                             |
|                                                                                                                                                                                                                            | Rear Upper Engine Mount Nut |
|                                                                                                                                                                                                                            | <b>CAUTION:</b>             |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <p><b>Refer to <u>Fastener Caution</u></b></p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard the rear engine mount nut.</li> <li>2. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li> </ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p>                                                                |
| 2 | <p>Front Upper Engine Mount Nut</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard the front engine mount nut.</li> <li>2. Disconnect the active engine mount vacuum line, if equipped.</li> <li>3. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li> </ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p> |
| 3 | <p>Front Lower Engine Mount Nut</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard the lower front engine mount nut.</li> <li>2. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li> </ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p>                                                                    |
| 4 | <p>Engine Mount</p> <p><b>Tip:</b> To remove the engine mount, use the engine support fixture to raise engine.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## ENGINE REAR MOUNT REPLACEMENT



**Fig. 14: Identifying Engine Rear Mount Assembly Components**  
Courtesy of GENERAL MOTORS CORP.

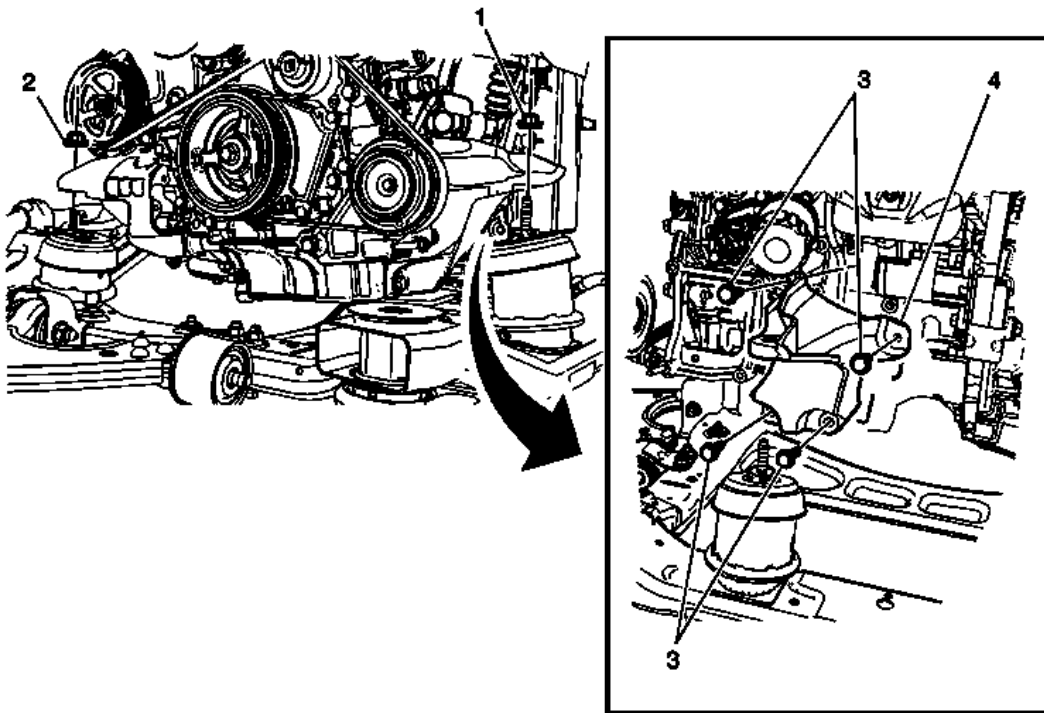
| Callout                                                                                                                                                                                                      | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <ol style="list-style-type: none"> <li>1. Support the engine. Refer to <u>Engine Support Fixture</u>.</li> <li>2. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u>.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 1                                                                                                                                                                                                            | <p>Front Upper Engine Mount Nut</p> <p><b>CAUTION:</b><br/>Refer to <u>Fastener Caution</u></p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard the engine mount nut.</li> <li>2. Disconnect the active engine mount vacuum line, if equipped.</li> <li>3. Apply threadlocker to the engine mount threads. Refer to <u>Adhesives, Fluids, Lubricants, and Sealers</u>.</li> </ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> |

## 2010 GMC Acadia SL

2010 ENGINE Engine Mechanical - 2.8L, 3.0L, 3.2L, or 3.6L - Repair Instructions - On Vehicle - Acadia, Enclave, Outlook & Traverse

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Tighten:</b> 90 N.m (66 lb ft)                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 2 | <p>Rear Upper Engine Mount Nut</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"><li>1. Remove and discard the engine mount nut.</li><li>2. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li></ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p> |
| 3 | <p>Rear Lower Engine Mount Nut</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"><li>1. Remove and discard the engine mount nut.</li><li>2. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li></ol> <p><b>Tip:</b> The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p><b>Tighten:</b> 75 N.m (55 lb ft)</p> |
| 4 | <p>Engine Mount</p> <p><b>Tip:</b> To remove the engine mount, use the engine support fixture to raise engine.</p>                                                                                                                                                                                                                                                                                                                                                                      |

## ENGINE FRONT MOUNT BRACKET REPLACEMENT

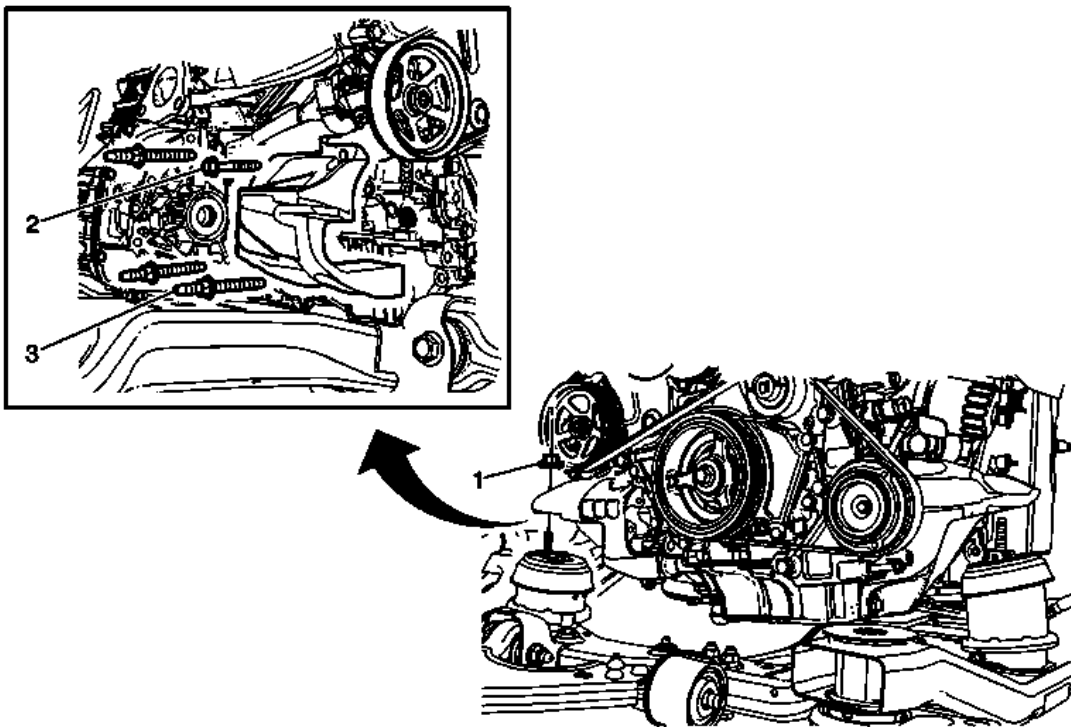


**Fig. 15: Identifying Engine Font Mount Assembly Components**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                            | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>1. Remove the left side catalytic converter. Refer to <u>Catalytic Converter Replacement - Left Side</u></li> <li>2. Support the engine. Refer to <u>Engine Support Fixture</u>.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1                                                                                                                                                                                                                                  | <p>Front Engine Mount Upper Nut</p> <p><b>CAUTION:</b><br/><b>Refer to <u>Fastener Caution</u></b></p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard front engine mount upper nut.</li> <li>2. Allow adhesive on new engine mount nuts to cure for 24 hours after replacement.</li> </ol> <p><b>Tip:</b></p> <ul style="list-style-type: none"> <li>• Use engine support fixture to raise engine.</li> <li>• The engine mount nuts must be replaced once removed.</li> </ul> |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Tighten:</b> 90 N.m (66 lb ft)                                                                                                                                                                                                                                                                                                                                                                                                                    |
|   | Rear Engine Mount Upper Nut                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 2 | <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Remove and discard rear engine mount upper nut.</li> <li>2. Allow adhesive on new engine mount nuts to cure for 24 hours after replacement.</li> </ol> <p><b>Tip:</b></p> <ul style="list-style-type: none"> <li>• Use engine support fixture to raise engine.</li> <li>• The engine mount nuts must be replaced once removed.</li> </ul> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p> |
| 3 | <p>Front Engine Mount Bracket Bolt</p> <p><b>Tighten:</b> 58 N.m (43 lb ft)</p>                                                                                                                                                                                                                                                                                                                                                                      |
| 4 | <p>Front Engine Mount Bracket</p> <p><b>Tip:</b> To remove engine mount bracket, use engine support fixture to raise engine.</p>                                                                                                                                                                                                                                                                                                                     |

## ENGINE REAR MOUNT BRACKET REPLACEMENT



**Fig. 16: Identifying Engine Rear Mount Bracket**

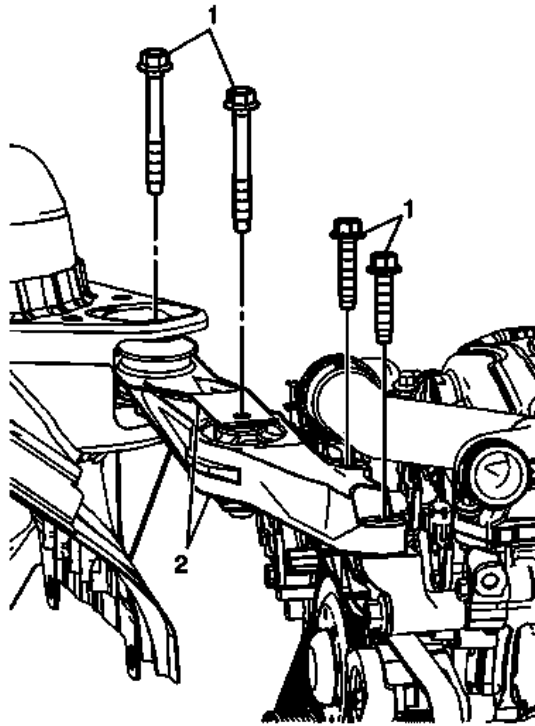
## 2010 GMC Acadia SL

2010 ENGINE Engine Mechanical - 2.8L, 3.0L, 3.2L, or 3.6L - Repair Instructions - On Vehicle - Acadia, Enclave, Outlook & Traverse

Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                                                                     | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"><li>1. If equipped with FWD, remove the intermediate drive shaft. Refer to <b><u>Front Wheel Drive Intermediate Shaft Replacement</u></b> .</li><li>2. Support the engine. Refer to <b><u>Engine Support Fixture</u></b>.</li><li>3. Remove the exhaust flexible pipe. Refer to <b><u>Exhaust Flexible Pipe Replacement</u></b> .</li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1                                                                                                                                                                                                                                                                                                                                                                                                           | <p>Rear Engine Mount Upper Nut</p> <p><b>CAUTION:</b><br/>Refer to <b><u>Fastener Caution</u></b></p> <p><b>Procedure</b></p> <ol style="list-style-type: none"><li>1. Remove and discard engine mount nut.</li><li>2. Apply threadlocker to the engine mount threads. Refer to <b><u>Adhesives, Fluids, Lubricants, and Sealers</u></b> .</li></ol> <p><b>Tip:</b></p> <ul style="list-style-type: none"><li>• The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</li><li>• Use engine support fixture to raise engine.</li></ul> <p><b>Tighten:</b> 90 N.m (66 lb ft)</p> |
| 2                                                                                                                                                                                                                                                                                                                                                                                                           | <p>Rear Engine Mount Bracket Bolt</p> <p><b>Tighten:</b> 22 N.m (16 lb ft)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3                                                                                                                                                                                                                                                                                                                                                                                                           | <p>Rear Engine Mount Bracket Bolt</p> <p><b>Tighten:</b> 58 N.m (43 lb ft)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

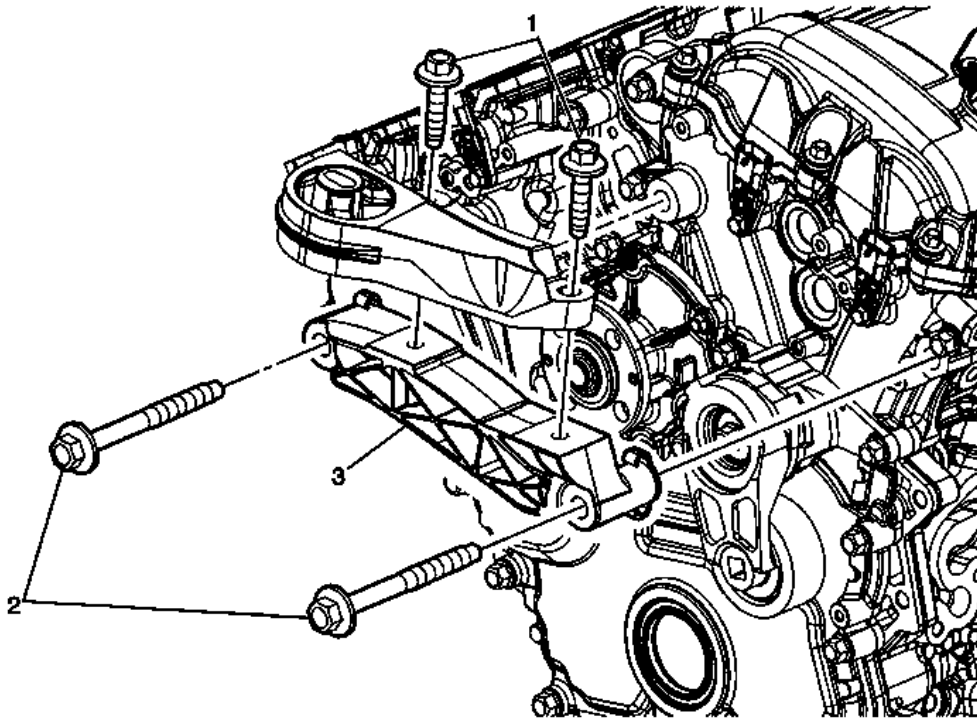
## ENGINE MOUNT STRUT REPLACEMENT - RIGHT SIDE



**Fig. 17: View Of Right Side Engine Mount Strut**  
 Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                      | Component Name                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b> <ol style="list-style-type: none"> <li>1. Remove the radiator inlet hose from the water outlet tube. Refer to <b><u>Radiator Inlet Hose Replacement</u></b> .</li> <li>2. Remove the underhood fuse block bracket and fuse block. Refer to <b><u>Underhood Electrical Center or Junction Block Replacement</u></b> .</li> </ol> |                                                                                                                                      |
| 1                                                                                                                                                                                                                                                                                                                                                            | Engine Mount Strut Bolt<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten:</b> 58 N.m (43 lb ft) |
| 2                                                                                                                                                                                                                                                                                                                                                            | Engine Mount Strut                                                                                                                   |

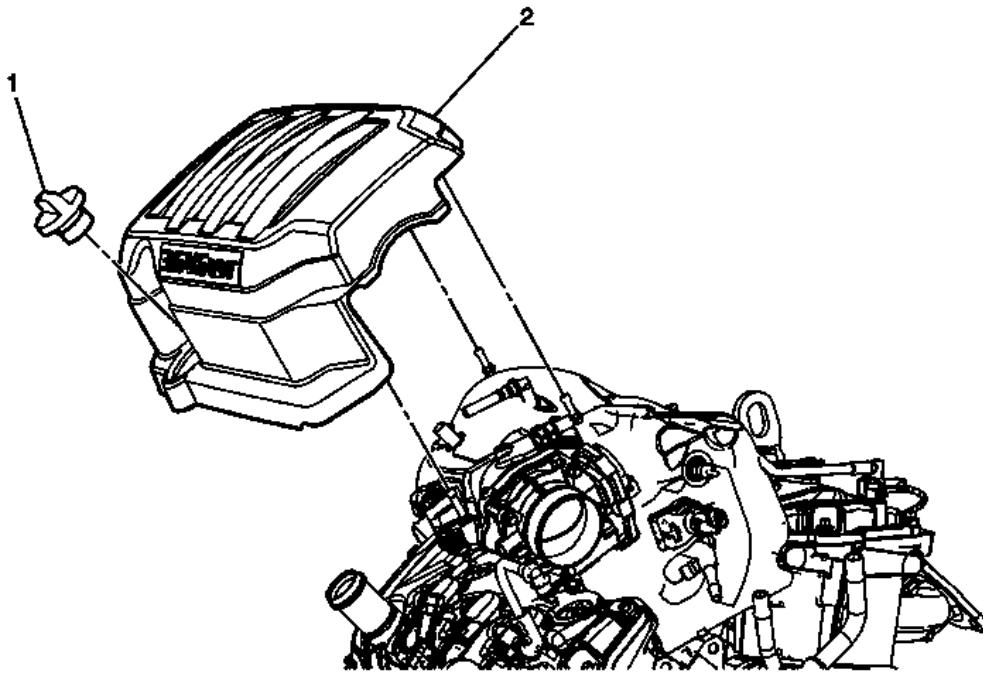
## ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT SIDE



**Fig. 18: Identifying Right Side Engine Mount Strut Bracket**  
 Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                   | Component Name                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure:</b><br>Remove the right engine mount strut mount. Refer to <b>Engine Mount Strut Replacement - Right Side</b> . |                                                                                                                                      |
| 1                                                                                                                                         | Engine Mount Strut Bolt<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten:</b> 58 N.m (43 lb ft) |
| 2                                                                                                                                         | Engine Mount Strut Bracket Bolt<br><br><b>Tighten:</b> 90 N.m (66 lb ft)                                                             |
| 3                                                                                                                                         | Engine Mount Strut Bracket                                                                                                           |

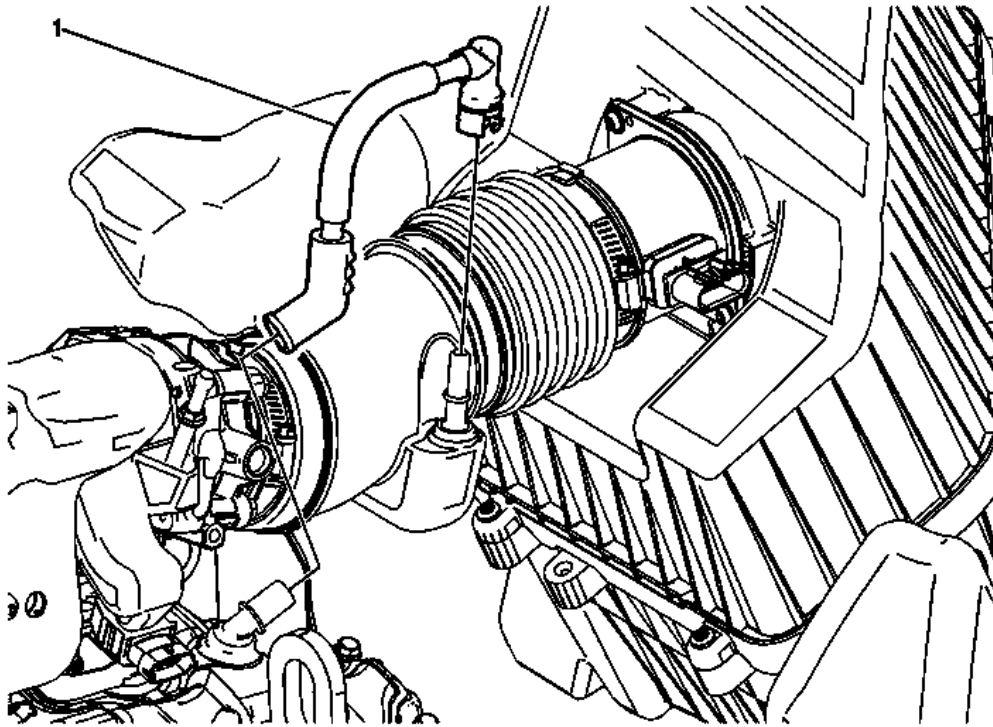
## FUEL INJECTOR SIGHT SHIELD REPLACEMENT



**Fig. 19: View Of Fuel Injector Sight Shield**  
Courtesy of GENERAL MOTORS CORP.

| Callout | Component Name                                                                                        |
|---------|-------------------------------------------------------------------------------------------------------|
| 1       | Oil Fill Cap                                                                                          |
| 2       | Fuel Injector Sight Shield<br><b>Procedure:</b><br>Lift upward to remove sight shield from ballstuds. |

## POSITIVE CRANKCASE VENTILATION TUBE REPLACEMENT - FRONT

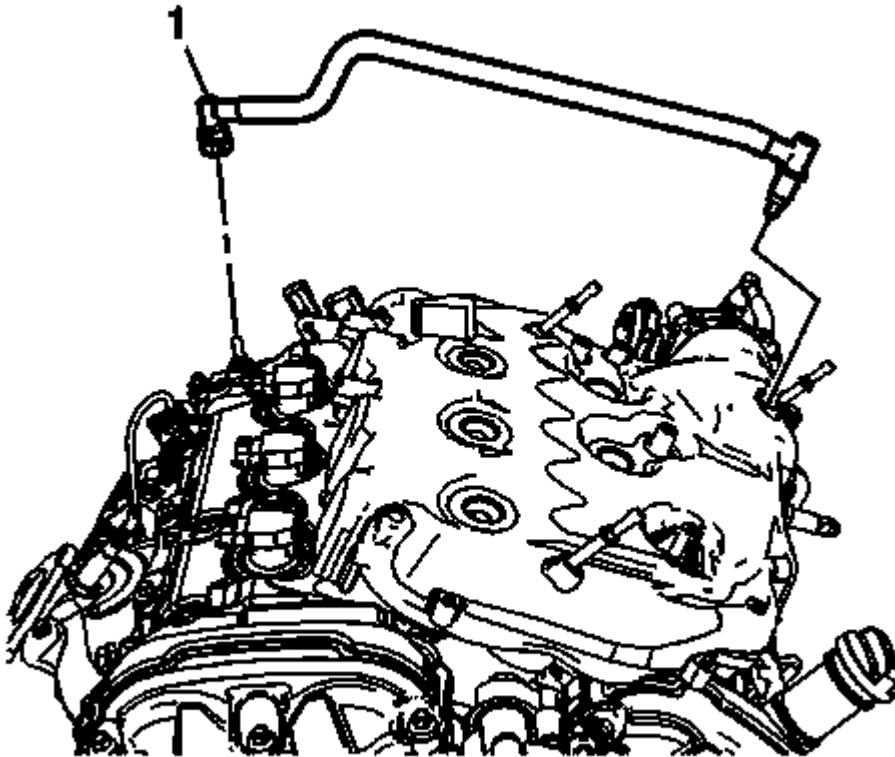


**Fig. 20: Identifying Front Positive Crankcase Ventilation Tube**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                          | Component Name                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure:</b><br>Remove the fuel injector sight shield. Refer to <u>Fuel Injector Sight Shield Replacement</u> . |                                                                                                                                                                      |
| 1                                                                                                                                | Positive Crankcase Ventilation Tube<br><b>Procedure:</b><br>Disconnect the PCV tube quick disconnect. Refer to <u>Plastic Collar Quick Connect Fitting Service</u> . |

## POSITIVE CRANKCASE VENTILATION TUBE REPLACEMENT - REAR

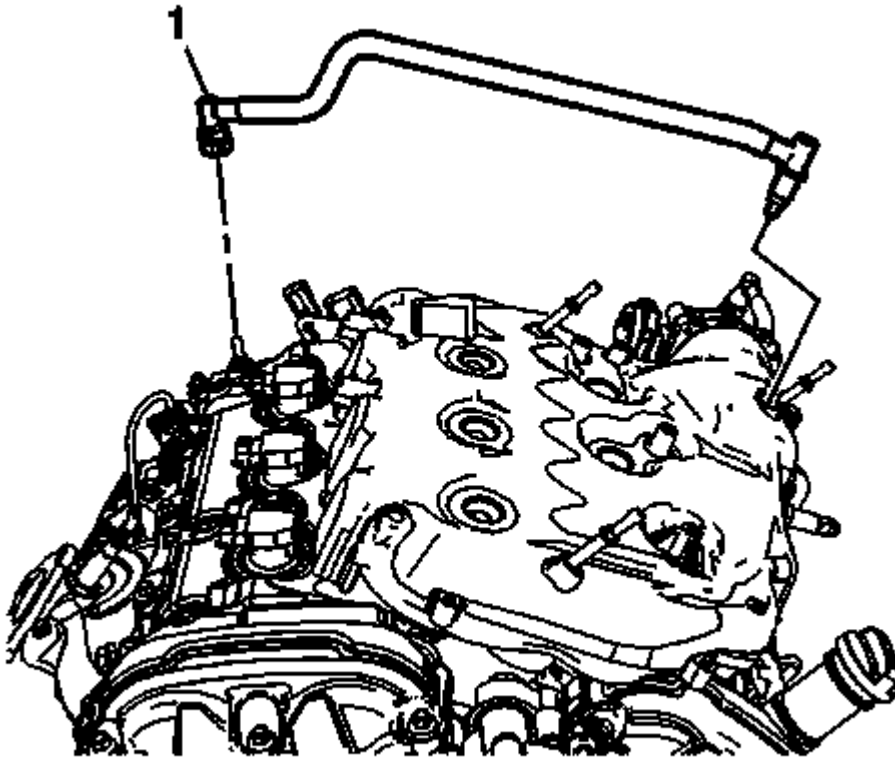
### REMOVAL PROCEDURE



**Fig. 21: View Of Rear Positive Crankcase Ventilation Tube**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Disconnect the positive crankcase ventilation (PCV) fresh air pipe (1) from the intake manifold.
3. Disconnect the PCV air pipe from the camshaft cover.

## INSTALLATION PROCEDURE



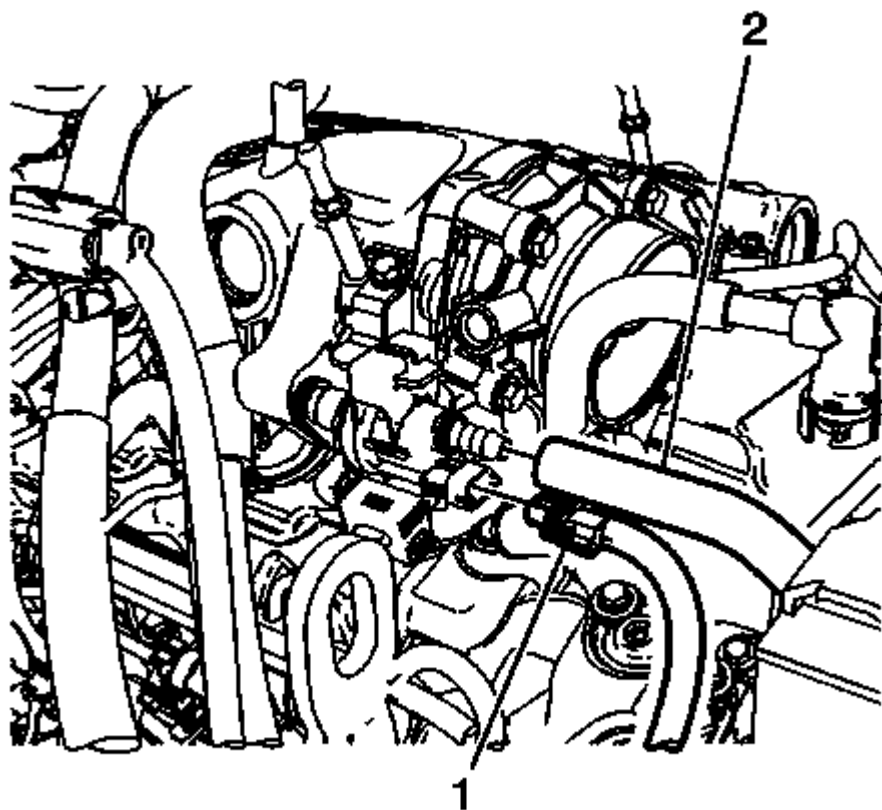
**Fig. 22: View Of Rear Positive Crankcase Ventilation Tube**  
Courtesy of GENERAL MOTORS CORP.

1. Connect the PCV air pipe (1) to the camshaft cover valve.
2. Connect the PCV air pipe to the intake manifold.
3. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

## **INTAKE MANIFOLD REPLACEMENT**

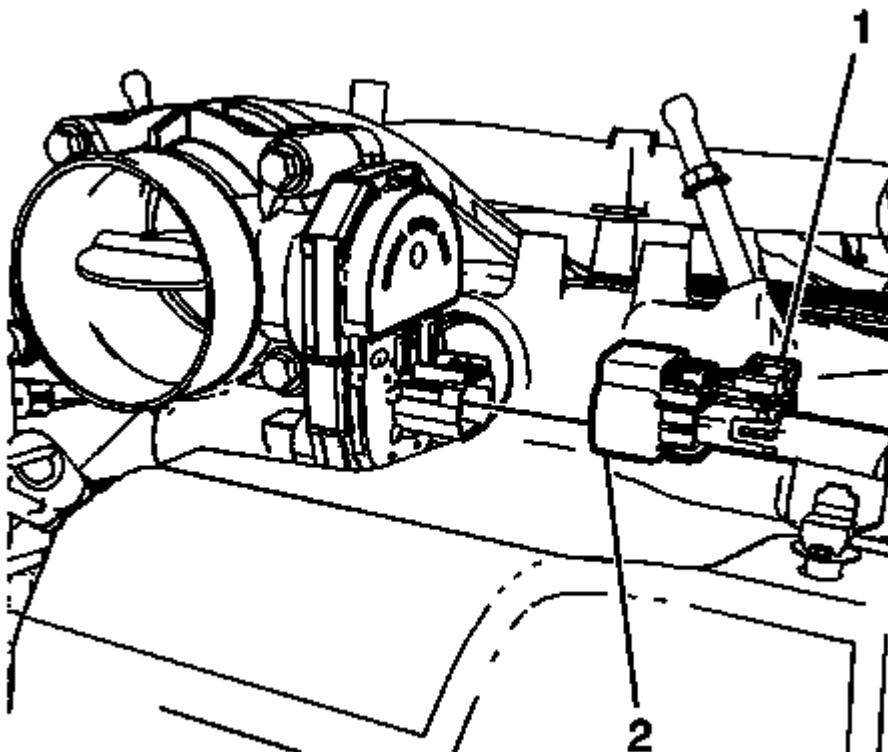
### **REMOVAL PROCEDURE**

1. Turn the ignition OFF.
2. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
3. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.
4. Disconnect the brake booster vacuum hose from the intake manifold.
5. Remove the rear positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Tube Replacement - Rear**.



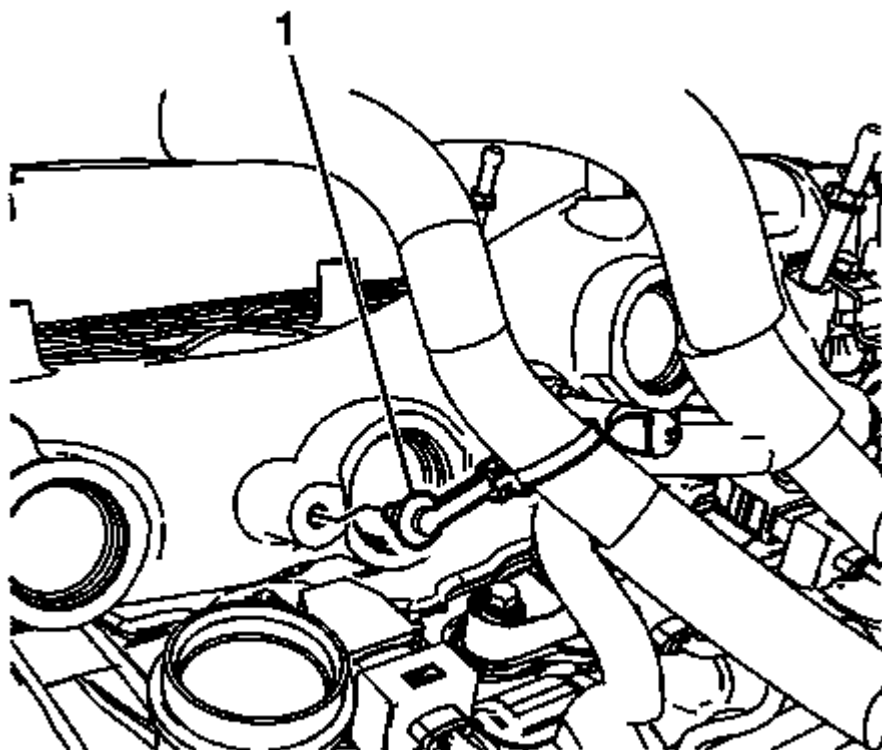
**Fig. 23: Identifying Purge Solenoid Valve Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the purge solenoid valve electrical connector (1).
7. Disconnect the purge line (2) from the purge solenoid valve.



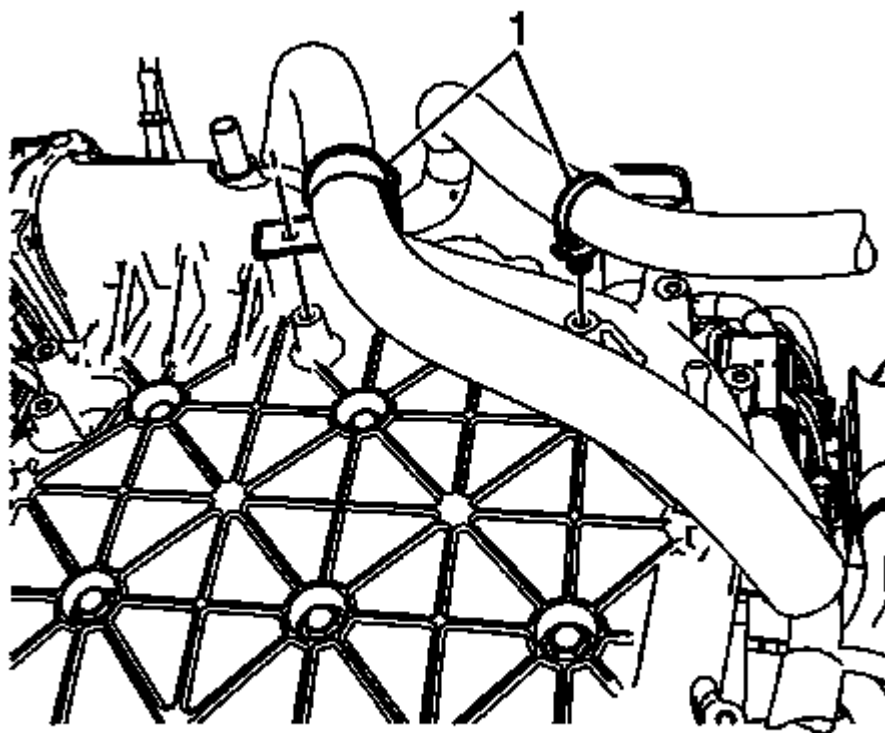
**Fig. 24: Identifying Purge Solenoid Valve Electrical Connector Retainer**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the electrical connector retainer (1).
9. Disconnect the throttle body electrical connector (2).
10. Remove the fuel pipe shield. Refer to **Fuel Pipe Shield Replacement** .



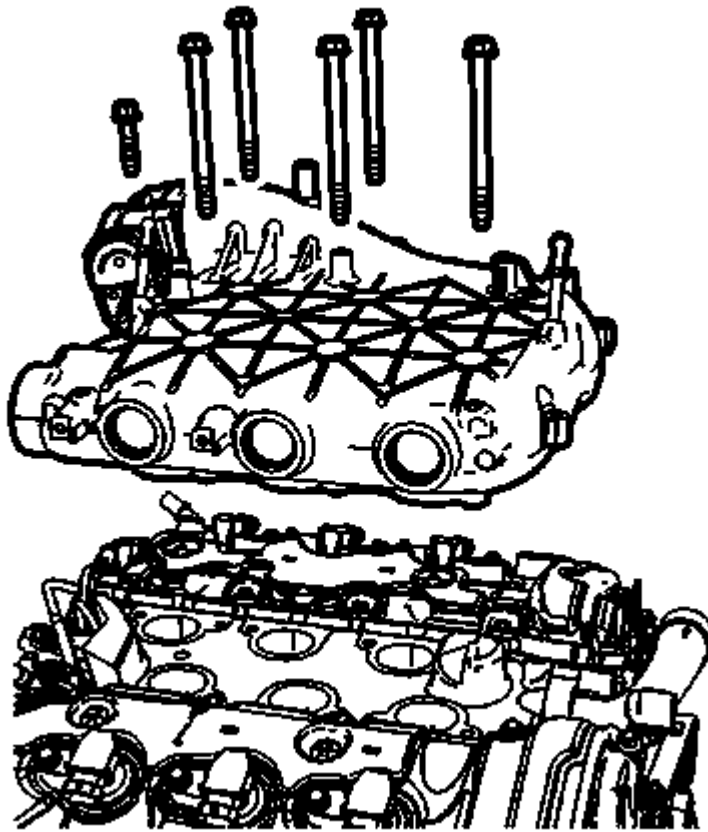
**Fig. 25: Identifying Intake Manifold Wiring Harness Retaining Clip**  
Courtesy of GENERAL MOTORS CORP.

11. Remove the engine wiring harness retaining clip (1) from the side of the intake manifold.



**Fig. 26: View Of Wiring Harness Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

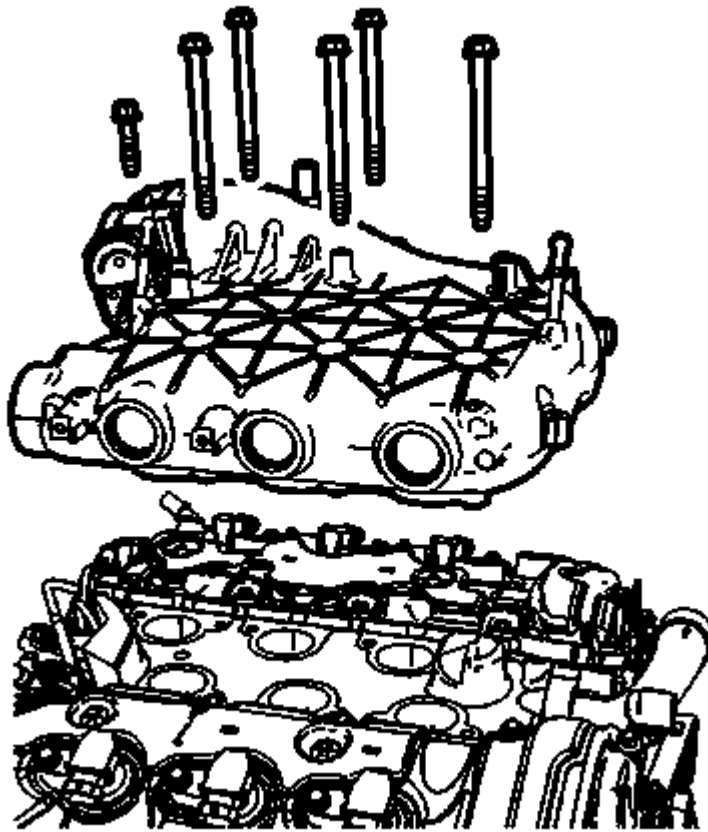
12. Remove the wiring harness retaining bolt.
13. Remove the engine wiring harness retaining clips (1) from the intake manifold.
14. Position the engine wiring harness aside.



**Fig. 27: View Of Intake Manifold & Bolts**  
Courtesy of GENERAL MOTORS CORP.

15. Remove the intake manifold insulator.
16. Remove the intake manifold bolts.
17. Remove the intake manifold with the throttle body.
18. If the intake manifold is being replaced, disassemble the intake manifold. Refer to **Intake Manifold Disassemble** .
19. Clean and inspect the intake manifold. Refer to **Intake Manifold Cleaning and Inspection** .

## INSTALLATION PROCEDURE



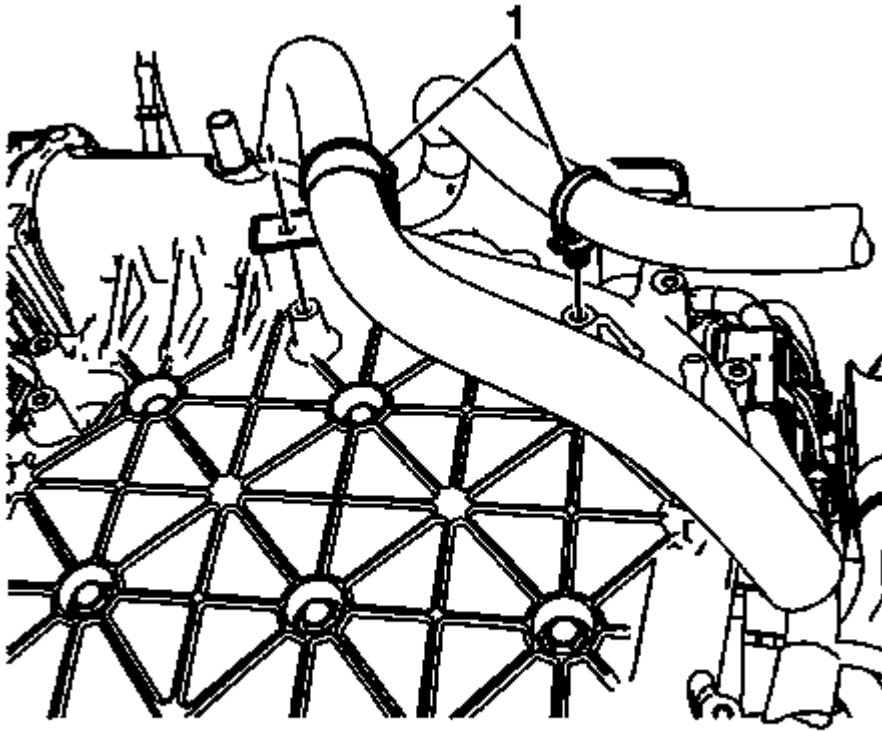
**Fig. 28: View Of Intake Manifold & Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. If the intake manifold is being replaced, assemble the intake manifold. Refer to **Intake Manifold Assemble** .
2. Install a NEW intake manifold gasket.
3. Install the intake manifold.

**CAUTION:** Refer to **Fastener Caution**

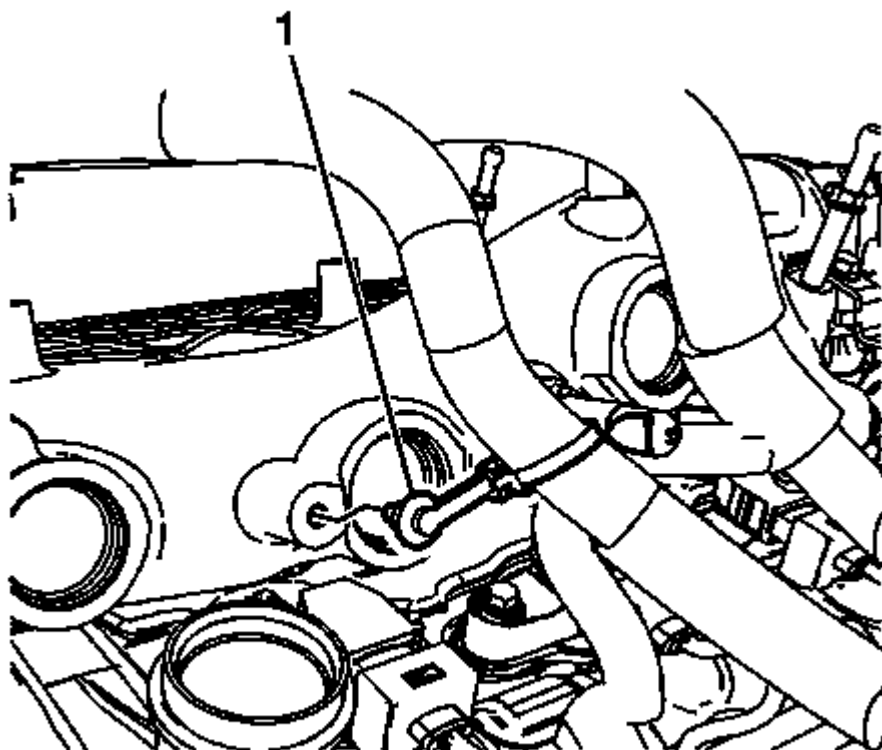
**NOTE:** Tighten the intake manifold bolts in a circular pattern starting at the center (long bolts) and moving outward.

4. Install the intake manifold bolts and tighten to 23 N.m (17 lb ft).



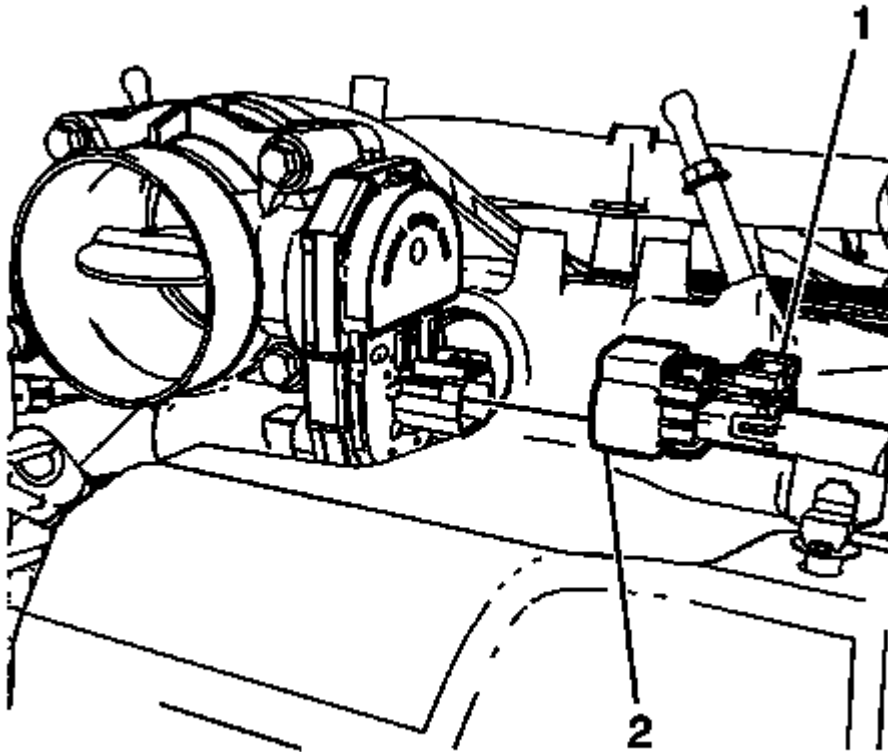
**Fig. 29: View Of Wiring Harness Retaining Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

5. Position the engine wiring harness in place.
6. Install the engine wiring harness retaining clips (1) to the intake manifold.



**Fig. 30: Identifying Intake Manifold Wiring Harness Retaining Clip**  
Courtesy of GENERAL MOTORS CORP.

7. Install the engine wiring harness retaining clip (1) to the side of the intake manifold.

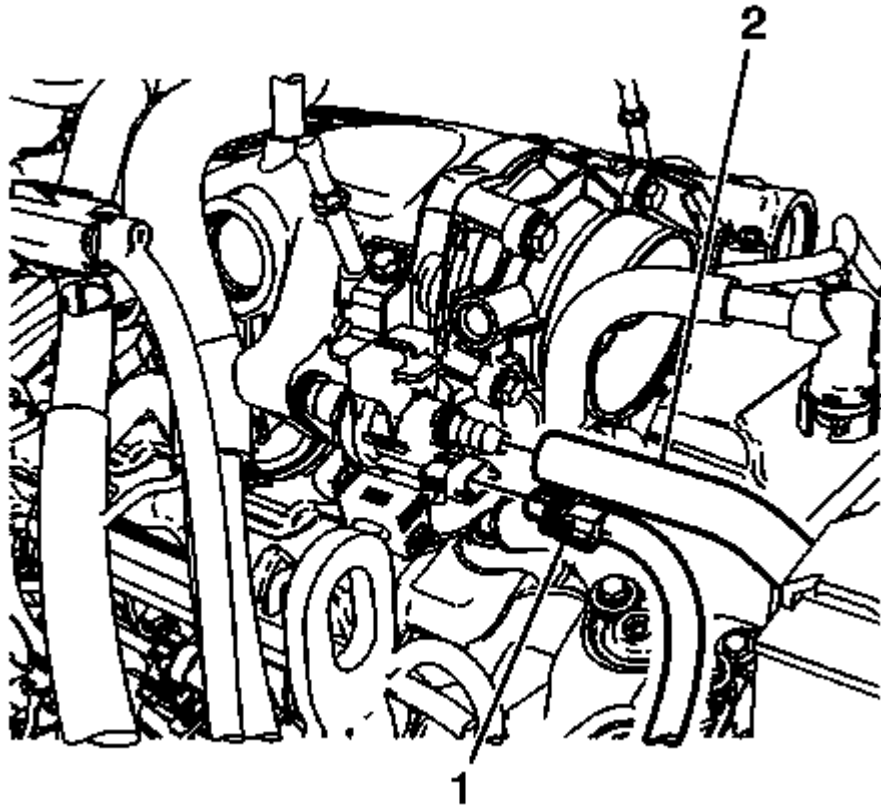


**Fig. 31: Identifying Purge Solenoid Valve Electrical Connector Retainer**  
Courtesy of GENERAL MOTORS CORP.

8. Install the fuel pipe shield. Refer to Fuel Pipe Shield Replacement .

**CAUTION:** Ensure proper engagement of the wiring harness connector. The wiring harness connector must be installed straight onto the component connector and firmly seated. Visually inspect the connector to ensure that the connector latches are engaged and locked. Any damage to the connector or wiring must be repaired. Failure to follow this procedure can lead to an intermittent electrical connection, driveability concerns, and/or wiring harness or wiring harness connector damage or failure.

9. Connect the electrical connector (2) to the throttle body.
10. Install the electrical connector retainer (1).

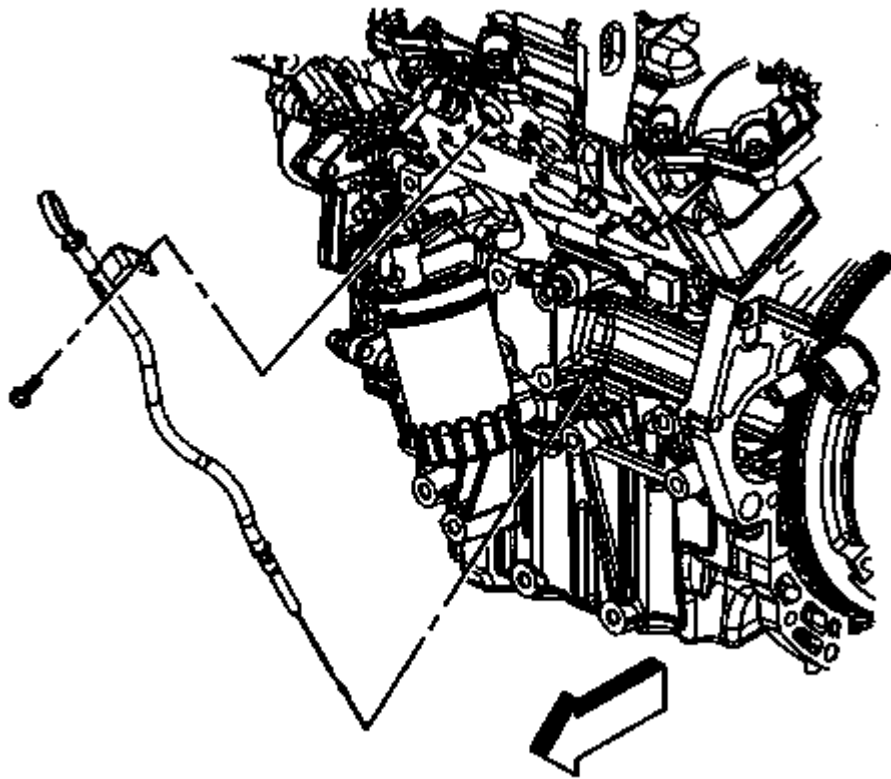


**Fig. 32: Identifying Purge Solenoid Valve Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

11. Connect the purge line (2) to the purge solenoid valve.
12. Connect the purge solenoid valve electrical connector (1).
13. Install the rear positive crankcase ventilation hose. Refer to **Positive Crankcase Ventilation Tube Replacement - Rear**.
14. Connect the brake booster vacuum hose to the intake manifold.
15. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.
16. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

## **OIL LEVEL INDICATOR TUBE REPLACEMENT**

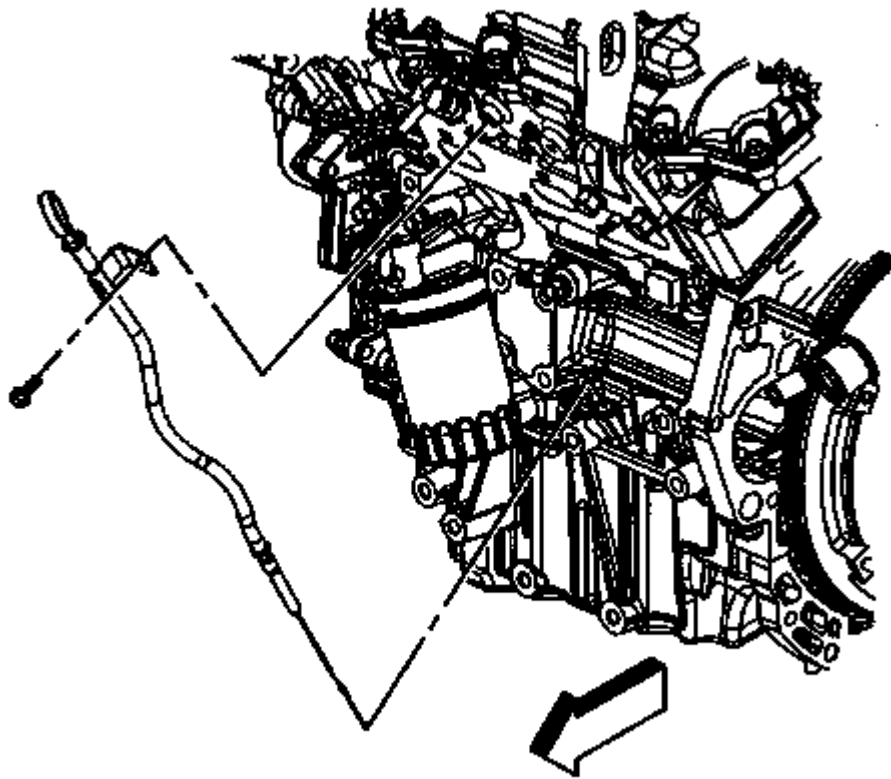
### **REMOVAL PROCEDURE**



**Fig. 33: Identifying Oil Level Indicator Tube & Bolt**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the Fuel Injector Sight Shield. Refer to **Fuel Injector Sight Shield Replacement**
2. Remove the oil level indicator from the oil level indicator tube.
3. Remove the oil level indicator tube bolt.
4. Remove the oil level indicator tube up through the exhaust manifold.
5. If you are replacing only the oil level indicator tube seal, remove and discard the old seal.

## **INSTALLATION PROCEDURE**



**Fig. 34: Identifying Oil Level Indicator Tube & Bolt**  
Courtesy of GENERAL MOTORS CORP.

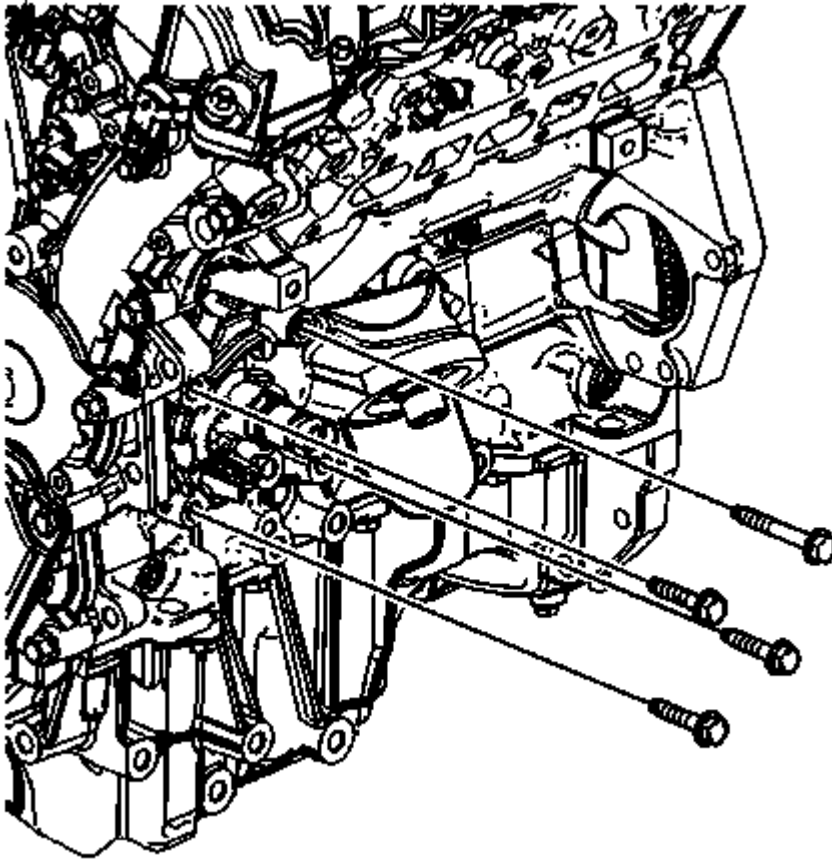
1. Install a new seal on the oil level indicator tube.
2. Install the oil level indicator tube.

**CAUTION: Refer to Fastener Caution .**

3. Install the oil level indicator tube bolt and tighten to 10 N.m (89 lb in).
4. Install the oil level indicator in the oil level indicator tube.
5. Install the Fuel Injector Sight Shield. Refer to **Fuel Injector Sight Shield Replacement**

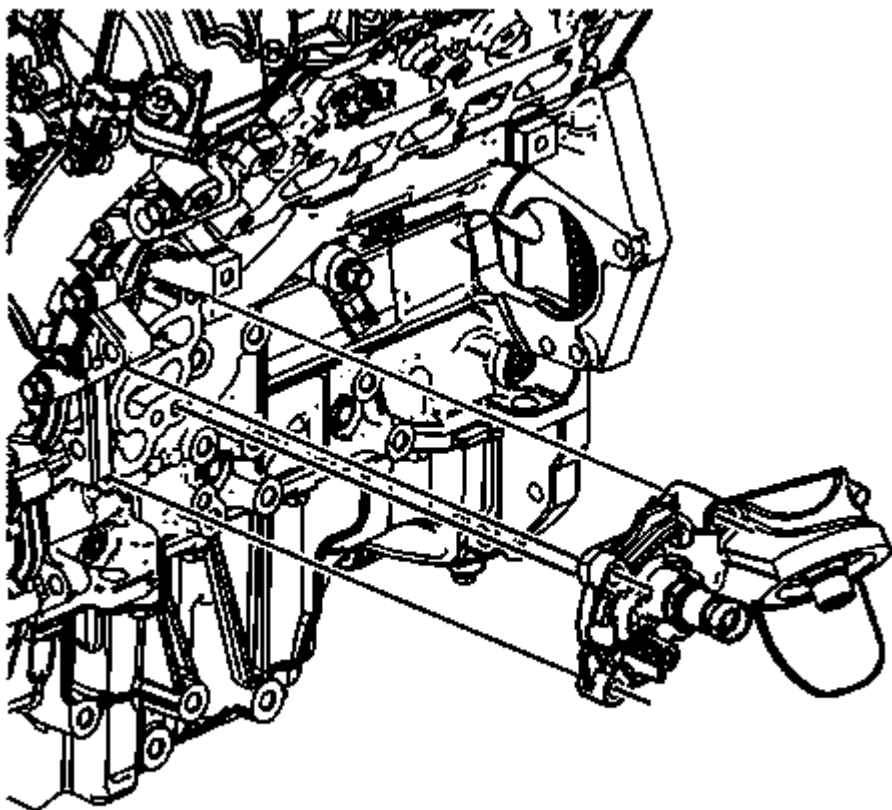
## **OIL FILTER ADAPTER REPLACEMENT**

### **REMOVAL PROCEDURE**



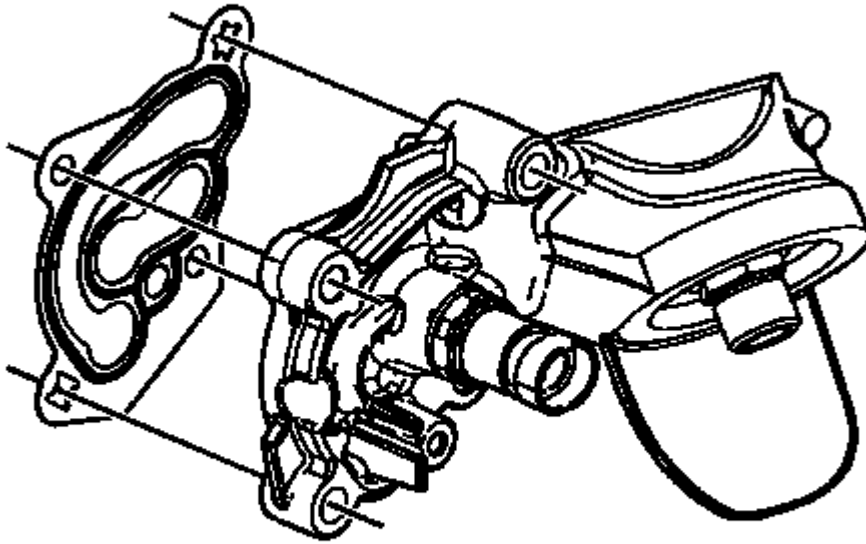
**Fig. 35: Locating Oil Filter Adapter Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement** .
2. Remove and properly dispose of the oil filter. Refer to **Engine Oil and Oil Filter Replacement** .
3. Disconnect the oil pressure sensor electrical connector.
4. Remove the oil filter adapter bolts from the engine block.



**Fig. 36: Identifying Oil Filter Adapter**  
Courtesy of GENERAL MOTORS CORP.

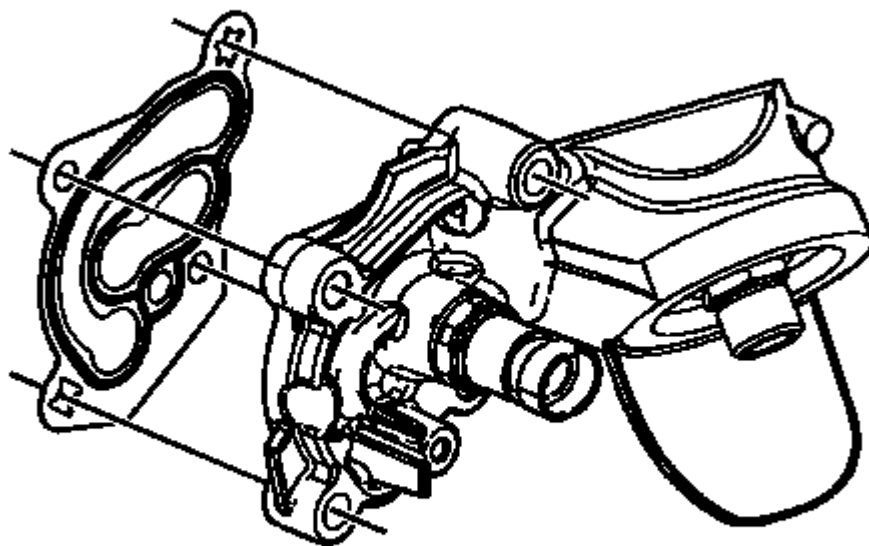
5. Remove the oil filter adapter.



**Fig. 37: View Of Oil Filter Adapter Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

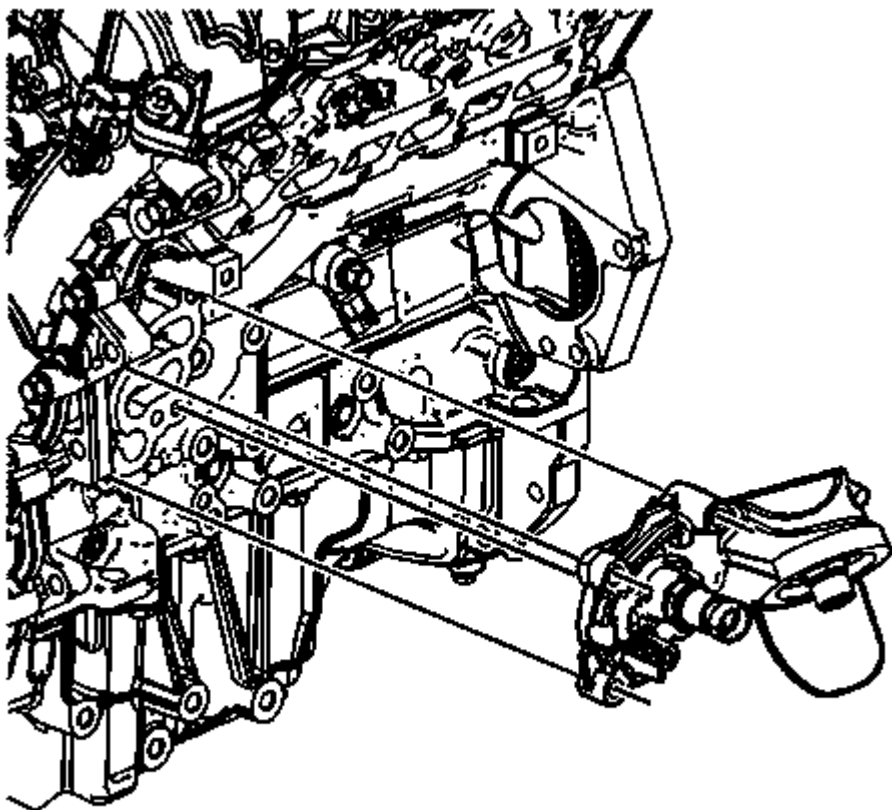
6. Remove and discard the oil filter adapter gasket.

## **INSTALLATION PROCEDURE**



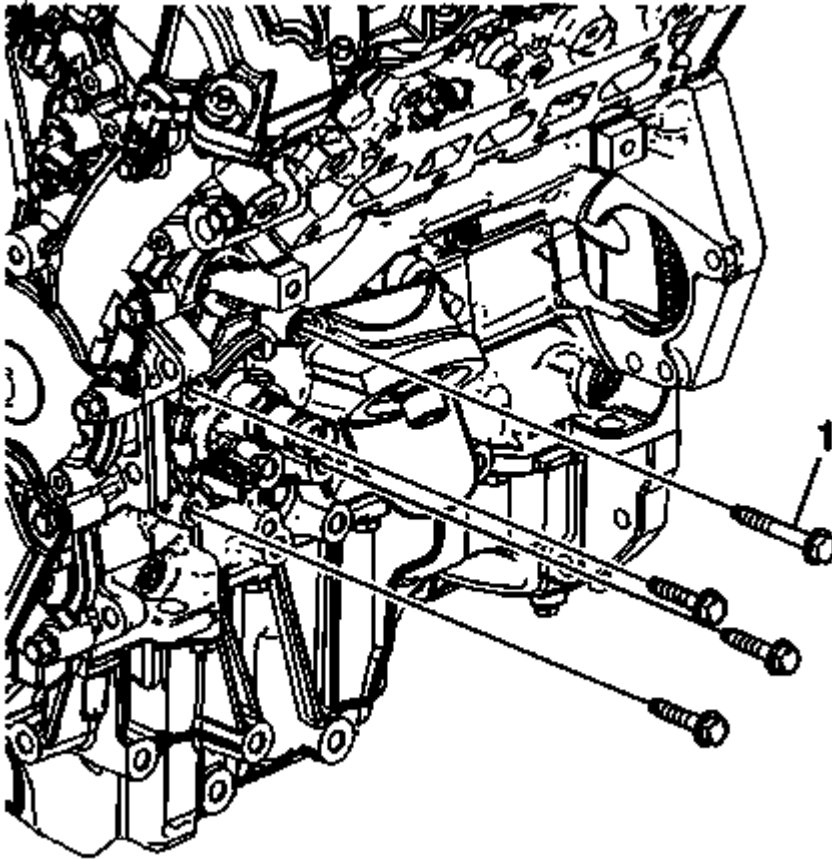
**Fig. 38: View Of Oil Filter Adapter Gasket**  
**Courtesy of GENERAL MOTORS CORP.**

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



**Fig. 39: Identifying Oil Filter Adapter**  
**Courtesy of GENERAL MOTORS CORP.**

2. Place the oil filter adapter into position.



**Fig. 40: Identifying Correct Position Of Longer Bolt**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

3. Install the oil filter adapter bolts. Ensure the longer bolts (1) is installed in the upper rear position and tighten to 23 N.m (17 lb ft).
4. Install a NEW oil filter. Refer to Engine Oil and Oil Filter Replacement .
5. Install the generator. Refer to Generator Replacement .

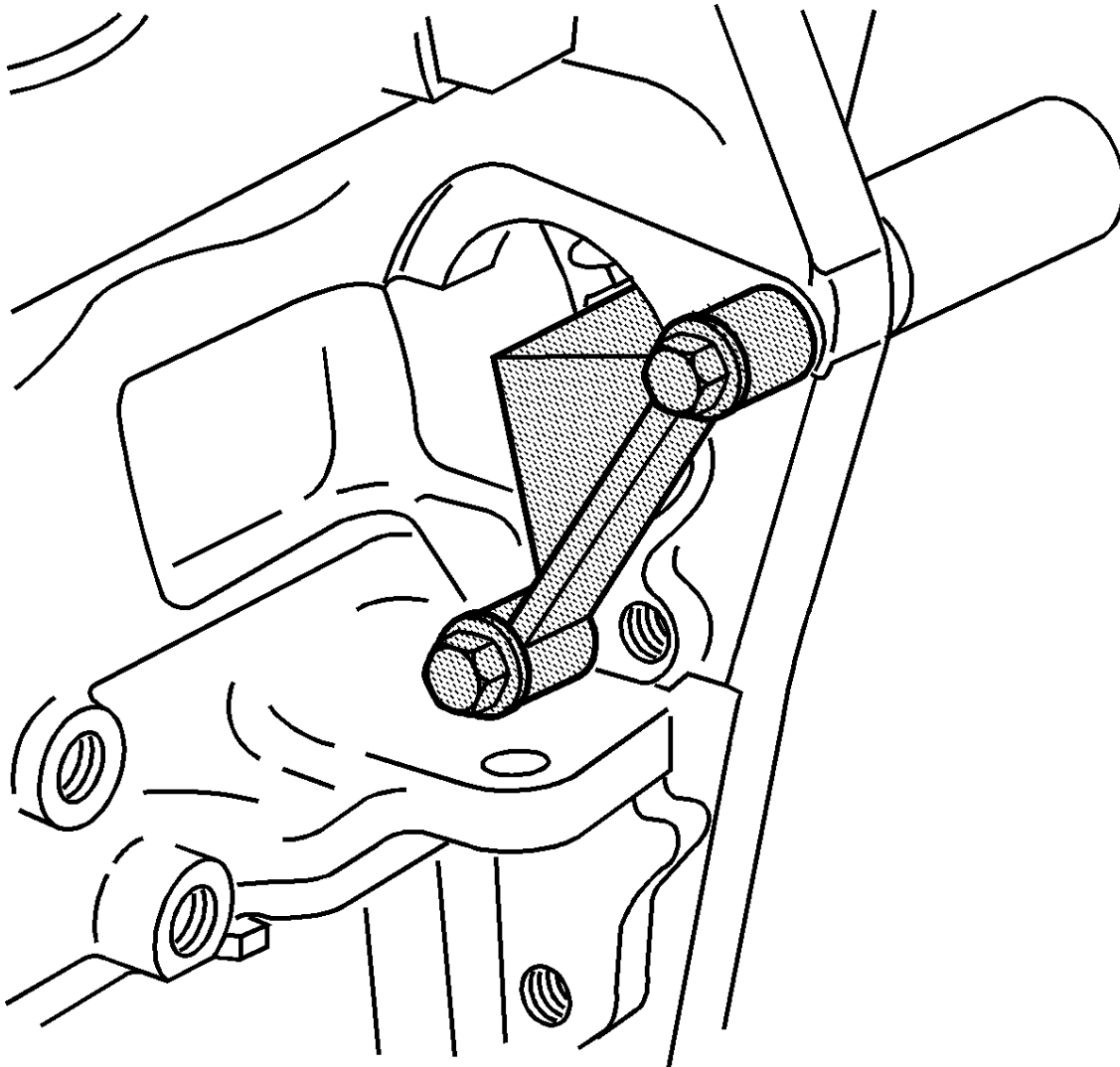
## **CRANKSHAFT BALANCER REPLACEMENT**

### **SPECIAL TOOLS**

- **EN 46106** Flywheel Holding Tool. See Special Tools .
- **J 38416-2** Crankshaft Button. See Special Tools .
- **J 41816** Crankshaft Balancer Remover
- **J 41998-B** Crankshaft Balancer Installer. See Special Tools .

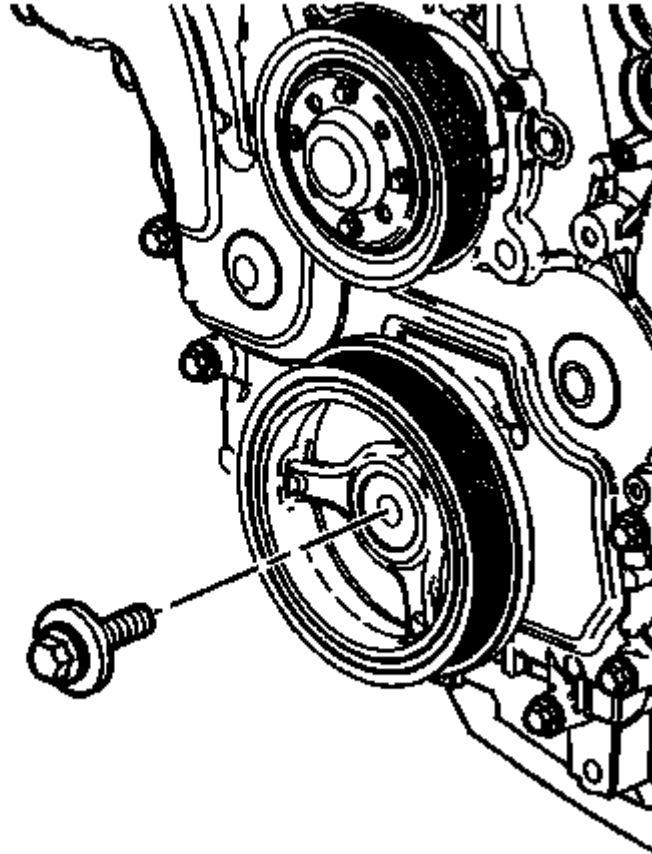
**REMOVAL PROCEDURE**

1. Remove the engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Right Side**.
2. Remove the drive belt. Refer to **Drive Belt Replacement**.
3. Remove the starter. Refer to **Starter Replacement**.



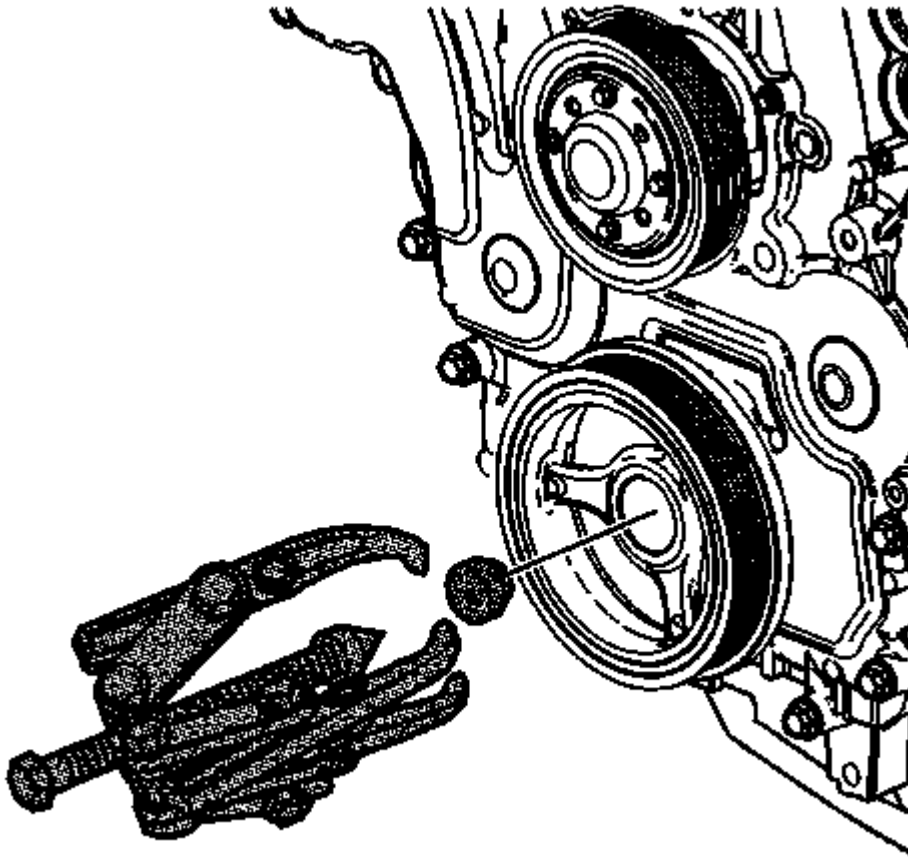
**Fig. 41: Identifying Special Tool - EN 46106**  
Courtesy of GENERAL MOTORS CORP.

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



**Fig. 42: Identifying Crankshaft Balancer Bolt**  
Courtesy of GENERAL MOTORS CORP.

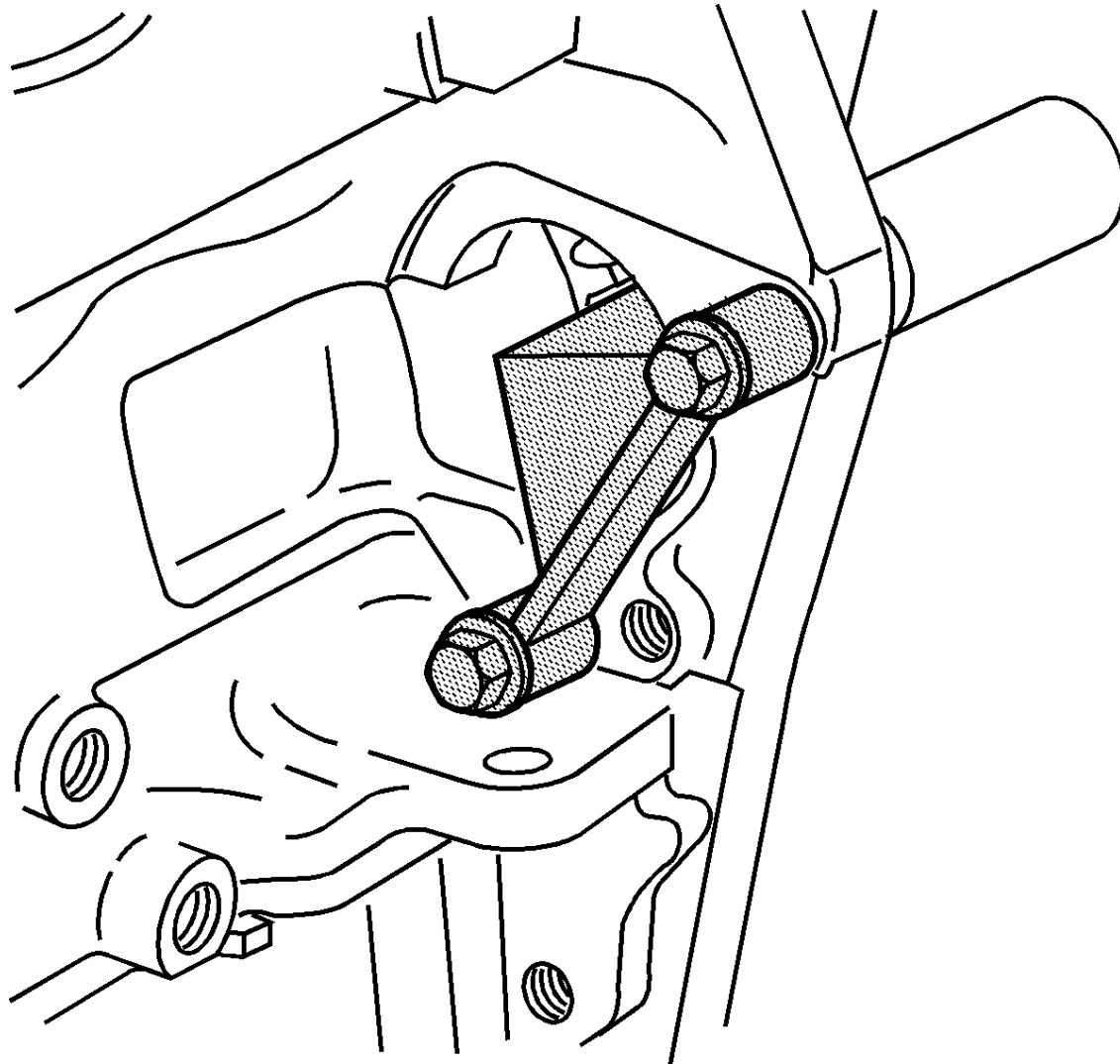
5. Support the right side of the frame with jackstands.
6. Remove the right side frame reinforcement bolts.
7. Loosen the right side frame bolts.
8. Lower the right side of the frame approximately 2 inches.
9. Remove the crankshaft balancer bolt.



**Fig. 43: View Of J 38416-2 In Nose Of Crankshaft**  
**Courtesy of GENERAL MOTORS CORP.**

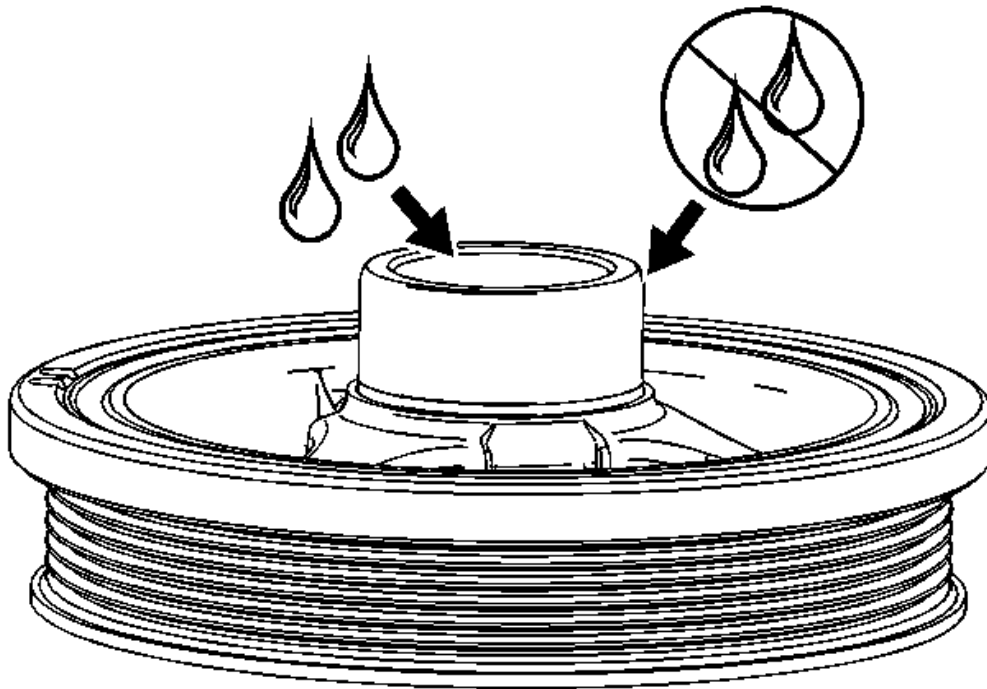
10. Install the **J 38416-2** in the nose of the crankshaft. See **Special Tools** .
11. Install the **J 41816** in order to remove the crankshaft balancer.
12. Tighten the center bolt of the **J 41816** in order to pull the crankshaft balancer off of the crankshaft.
13. Remove the **J 41816** from the crankshaft balancer.

## **INSTALLATION PROCEDURE**



**Fig. 44: Identifying Special Tool - EN 46106**  
Courtesy of GENERAL MOTORS CORP.

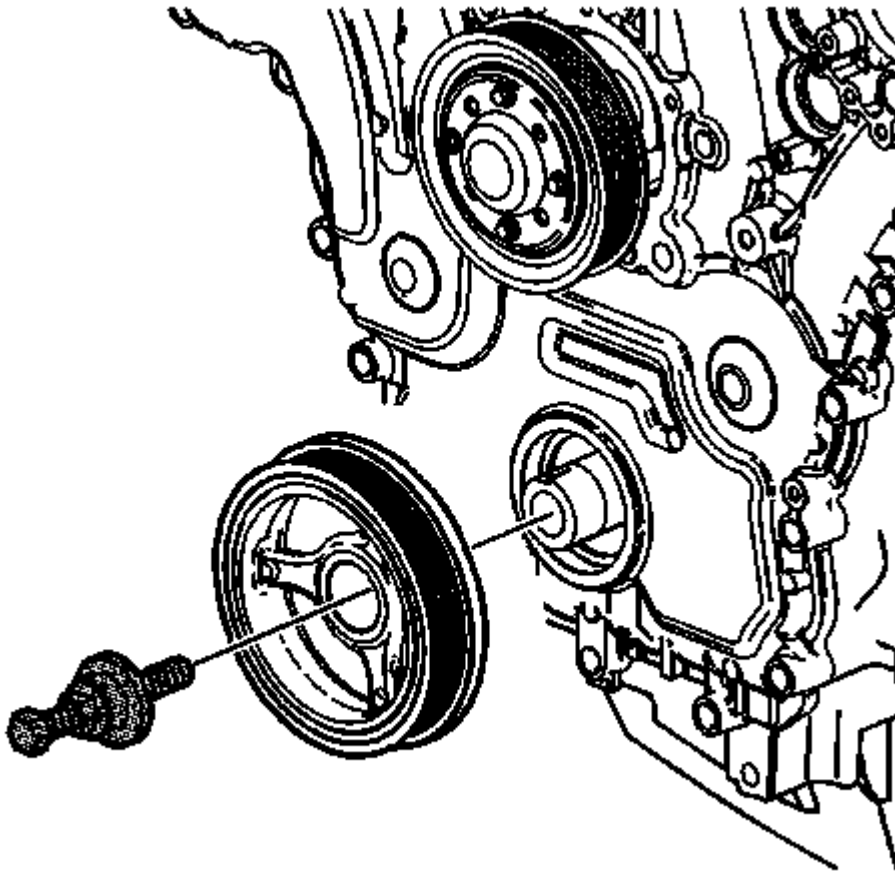
1. The **EN 46106** must be installed onto the flywheel. See **Special Tools** .
2. Use the **J 41998-B** , nut, bearing and washer to install the crankshaft balancer. See **Special Tools** .



**Fig. 45: Identifying Lubrication & Non-Lubrication Areas On Crankshaft Balancer**  
Courtesy of GENERAL MOTORS CORP.

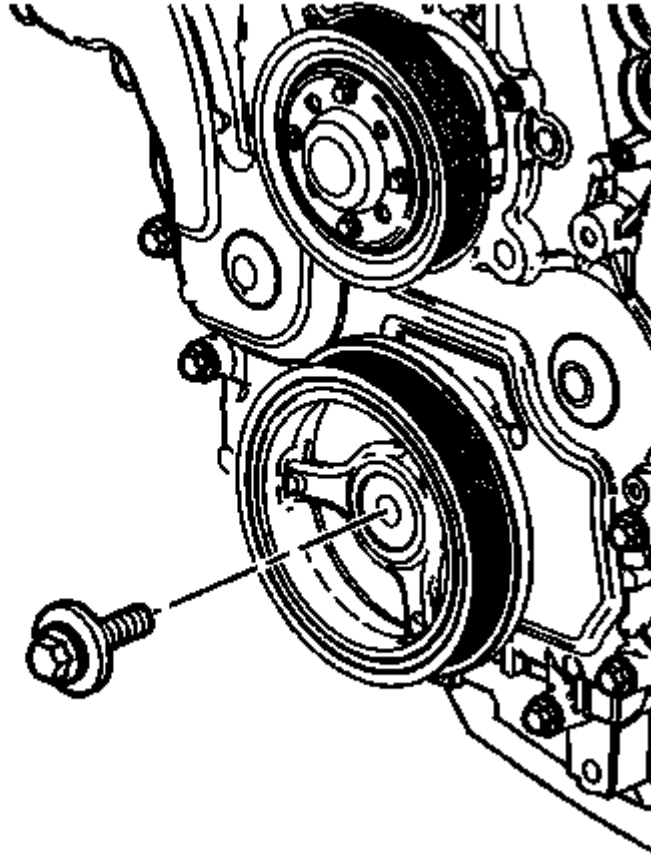
**NOTE:** Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

3. Apply lubricant to the inside of the crankshaft balancer hub bore.



**Fig. 46: View Of Crankshaft Balancer & Installation Tool J 41998-B**  
Courtesy of GENERAL MOTORS CORP.

4. Place the crankshaft balancer in position on the crankshaft.
5. Thread the **J 41998-B** in the crankshaft. See **Special Tools** . Ensure you engage at least 10 threads of the **J 41998-B** before pressing the crankshaft balancer in place. See **Special Tools** .
6. Push the crankshaft balancer into position by tightening the nut on the **J 41998-B** until the large washer bottoms out on the crankshaft end. See **Special Tools** .
7. Remove the **J 41998-B** . See **Special Tools** .

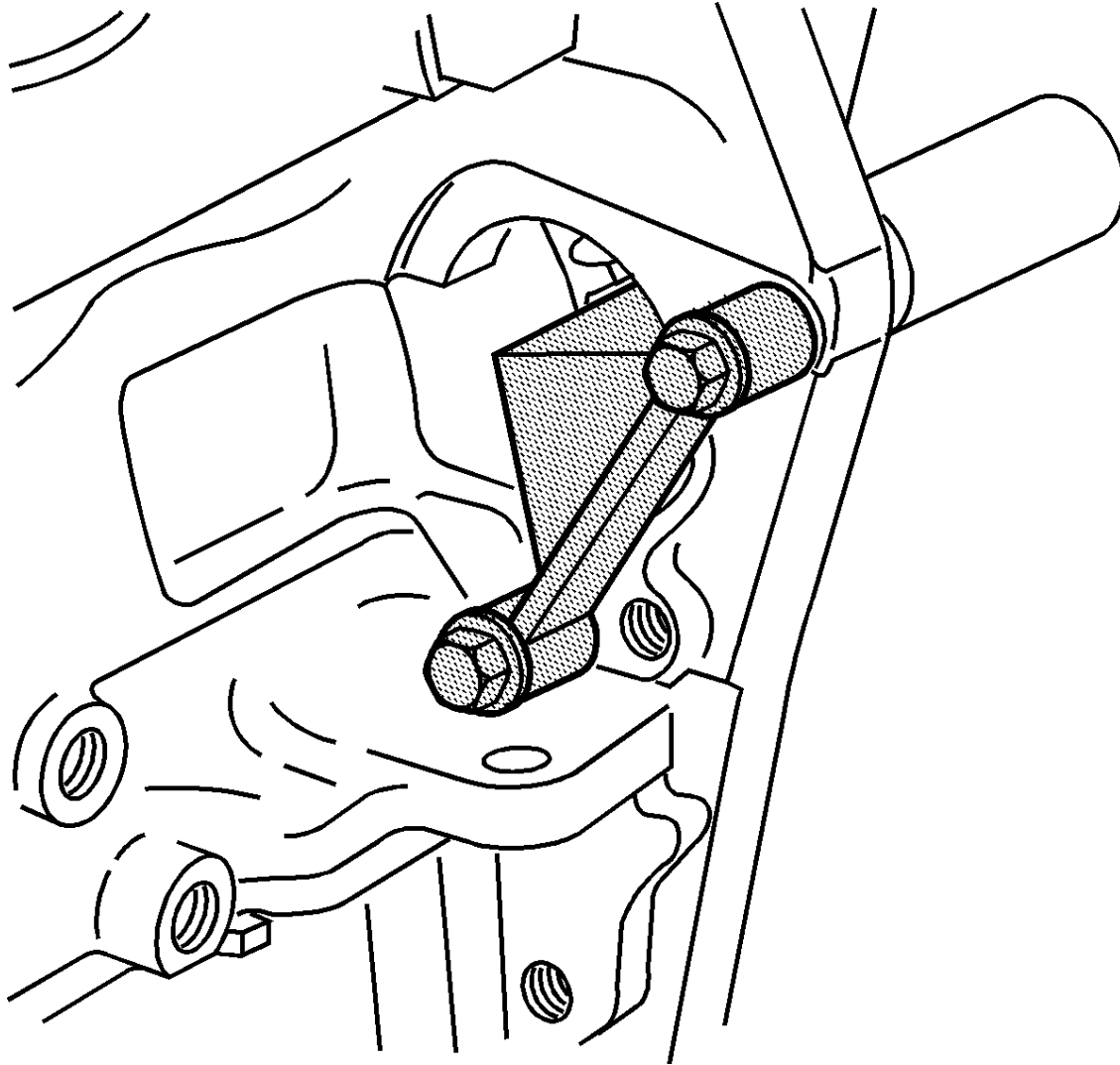


**Fig. 47: Identifying Crankshaft Balancer Bolt**  
Courtesy of GENERAL MOTORS CORP.

8. Install the crankshaft balancer bolt.

**CAUTION: Refer to Fastener Caution**

9. Tighten the crankshaft balancer bolt.
  - Tighten the crankshaft balancer bolt to 100 N.m (74 lb ft).
  - Tighten the crankshaft balancer bolt an additional 150 degrees using the **J 45059**.



**Fig. 48: Identifying Special Tool - EN 46106**  
Courtesy of GENERAL MOTORS CORP.

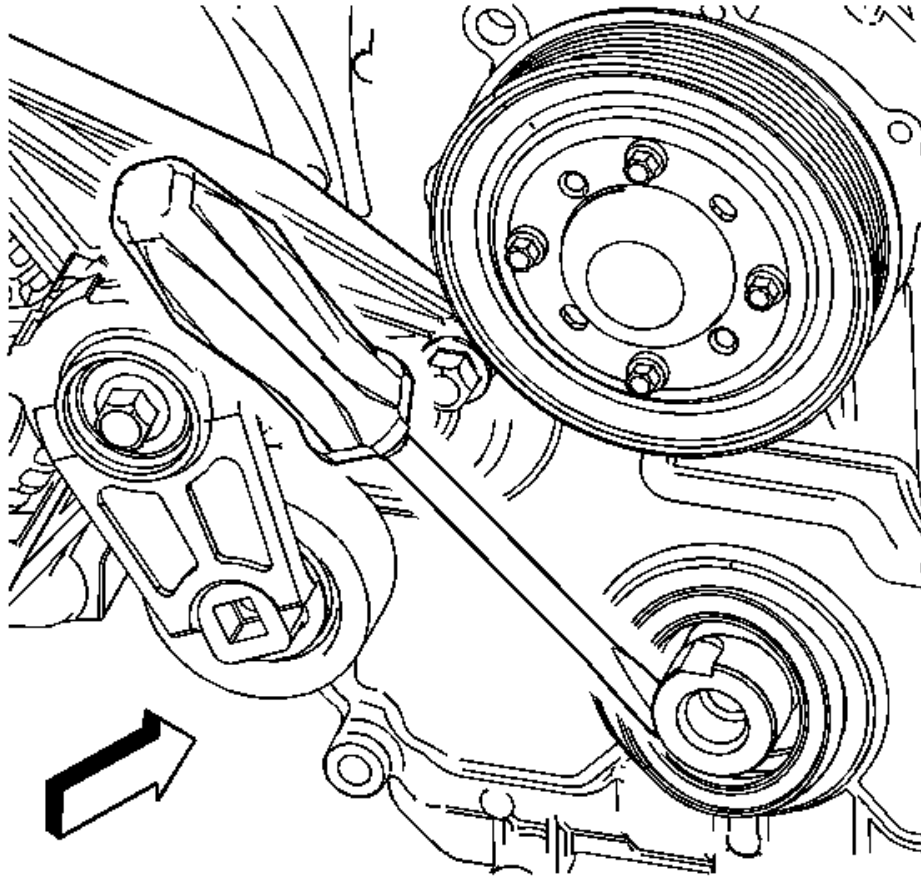
10. Remove the **EN 46106** . See **Special Tools** .
11. Install the starter. Refer to **Starter Replacement** .
12. Using engine support fixture, raise the engine into position.
13. Install the engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Right Side**.
14. Install the drive belt. Refer to **Drive Belt Replacement**.

## **CRANKSHAFT FRONT OIL SEAL REPLACEMENT**

### **TOOLS REQUIRED**

**J 29184** Oil Seal Installer. See **Special Tools** .

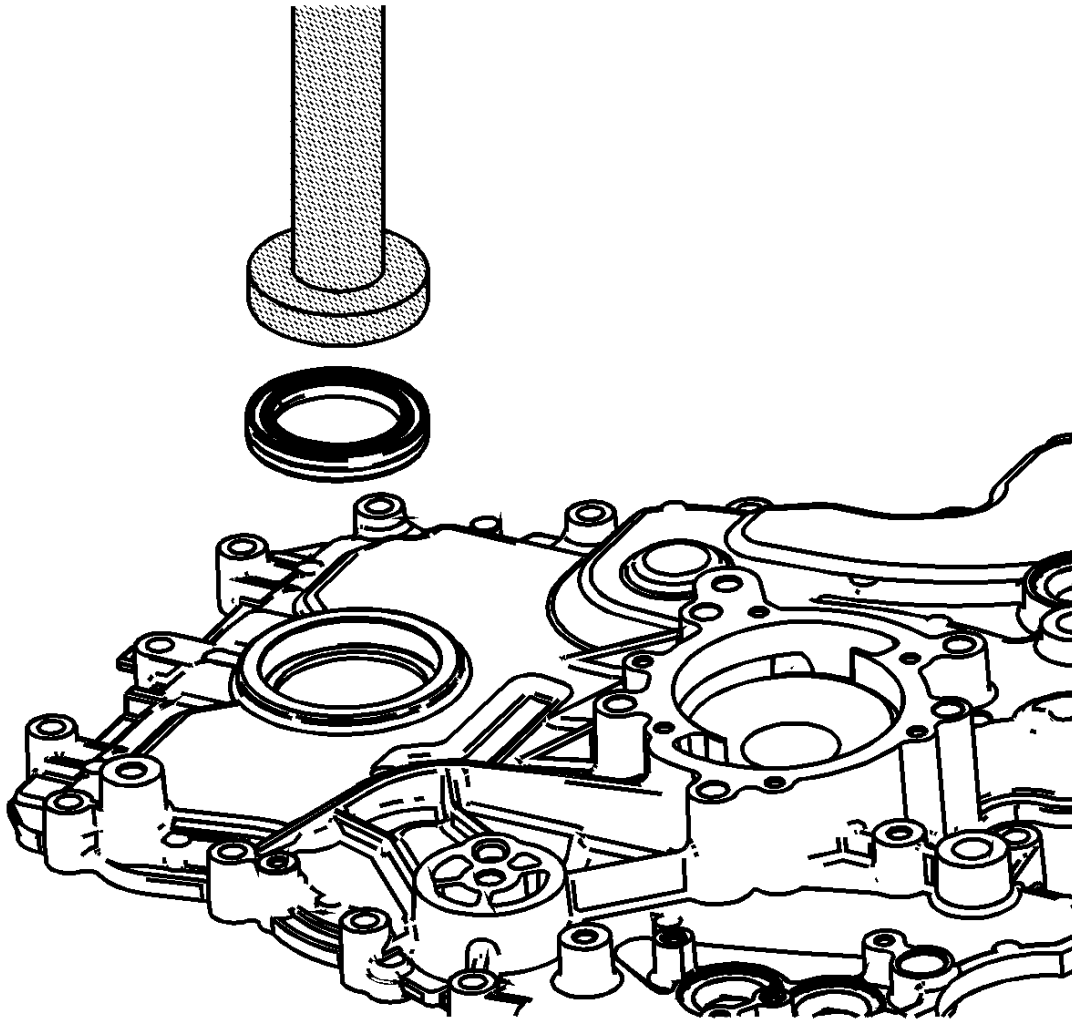
## REMOVAL PROCEDURE



**Fig. 49: View Of Crankshaft Front Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Use a flat-bladed tool in order to remove the crankshaft oil seal. Use care not to damage the engine front cover or the crankshaft.

## INSTALLATION PROCEDURE



**Fig. 50: Installing Crankshaft Front Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

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

1. Use the **J 29184** or equivalent to install the crankshaft front oil seal. See **Special Tools** .
2. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

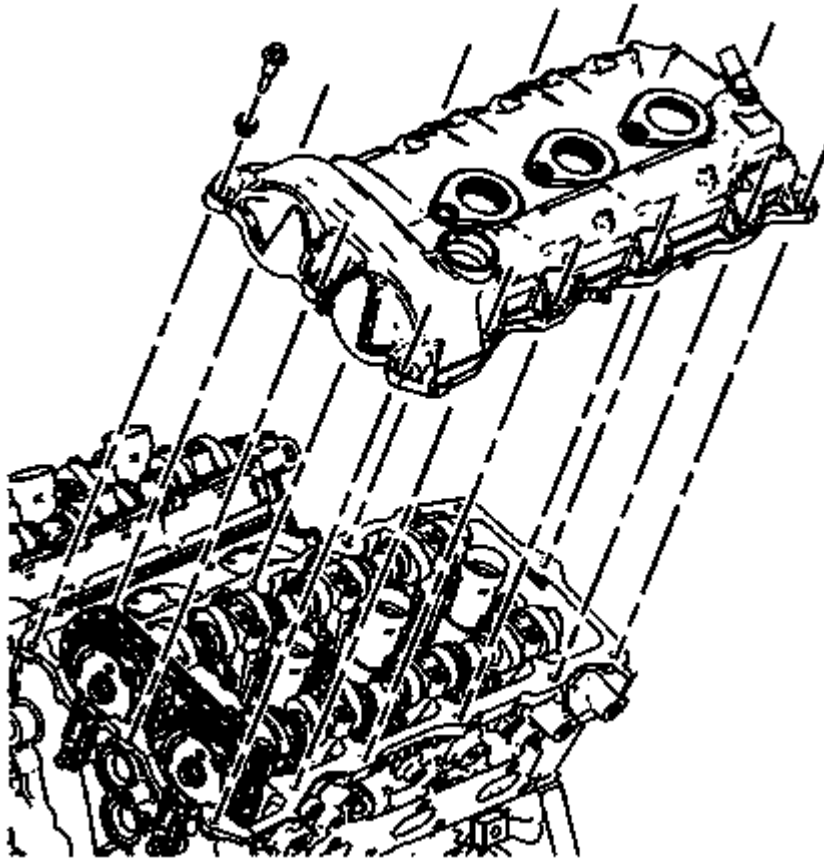
## **CAMSHAFT COVER REPLACEMENT - LEFT SIDE**

### **SPECIAL TOOLS**

**EN 46101** Spark Plug Tube Seal Guide. See **Special Tools** .

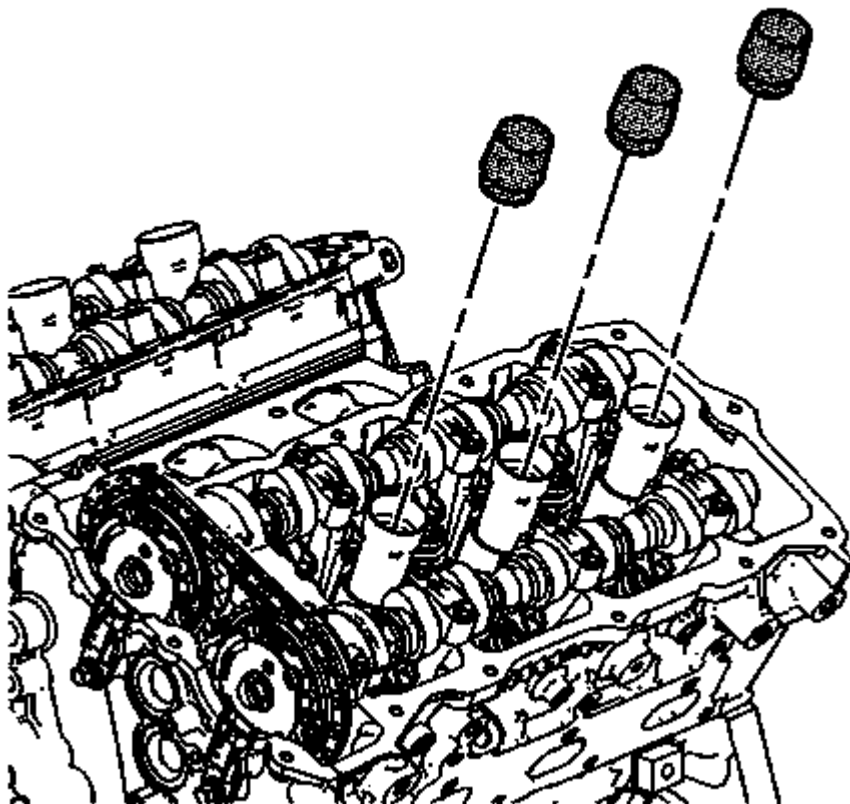
### **REMOVAL PROCEDURE**

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the left side ignition coils. Refer to **Ignition Coil Replacement - Bank 2**.
3. Unclip and reposition the wire harness from the camshaft cover.
4. Remove the power steering reservoir bracket. Refer to **Power Steering Fluid Reservoir Bracket Replacement**.



**Fig. 51: View Of Left Camshaft Cover**  
Courtesy of GENERAL MOTORS CORP.

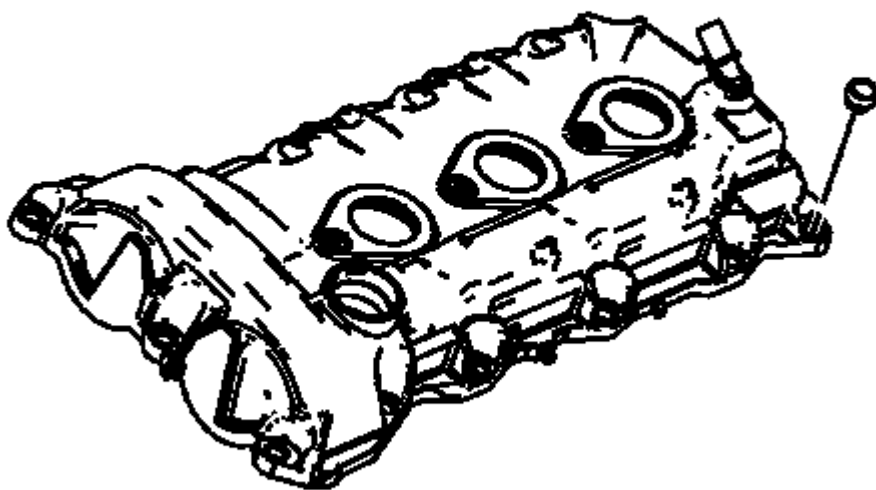
5. Remove the left camshaft cover bolts.
6. Remove the left camshaft cover from the left cylinder head.
7. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **Camshaft Cover Cleaning and Inspection (LLT)**.



**Fig. 52: Identifying Special Tool - EN 46101**  
Courtesy of GENERAL MOTORS CORP.

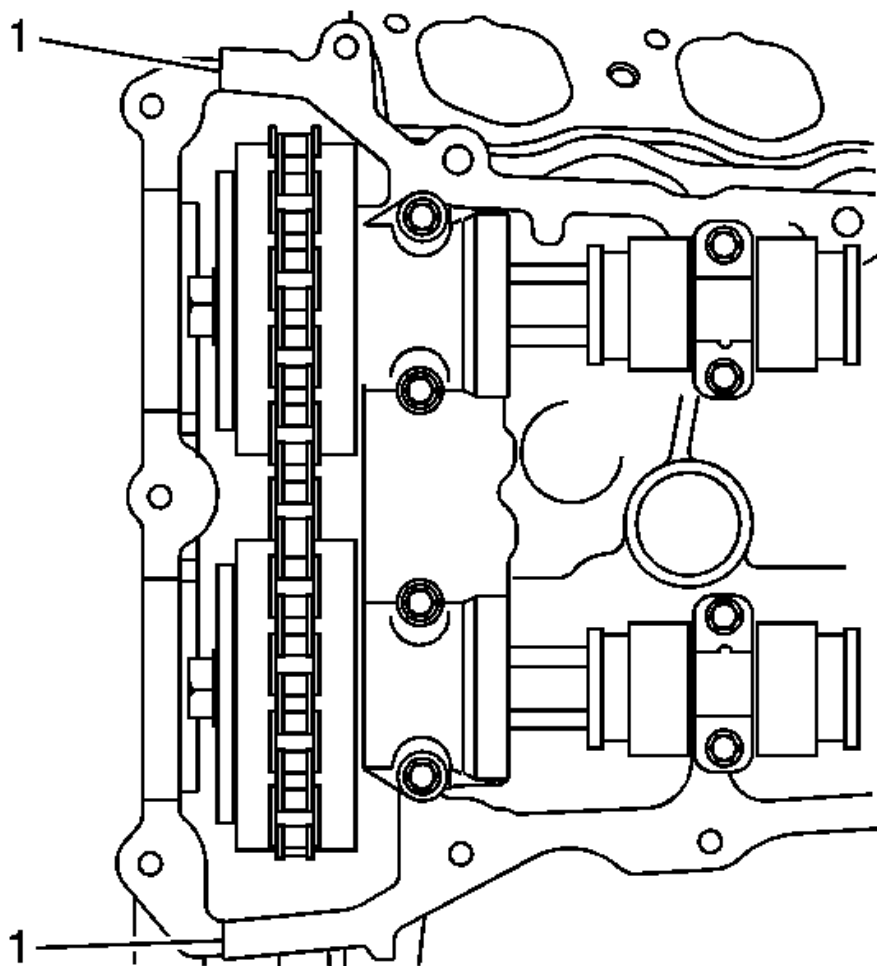
8. Install the **EN 46101** onto the spark plug tubes of the left cylinder head. See **Special Tools** .

## **INSTALLATION PROCEDURE**



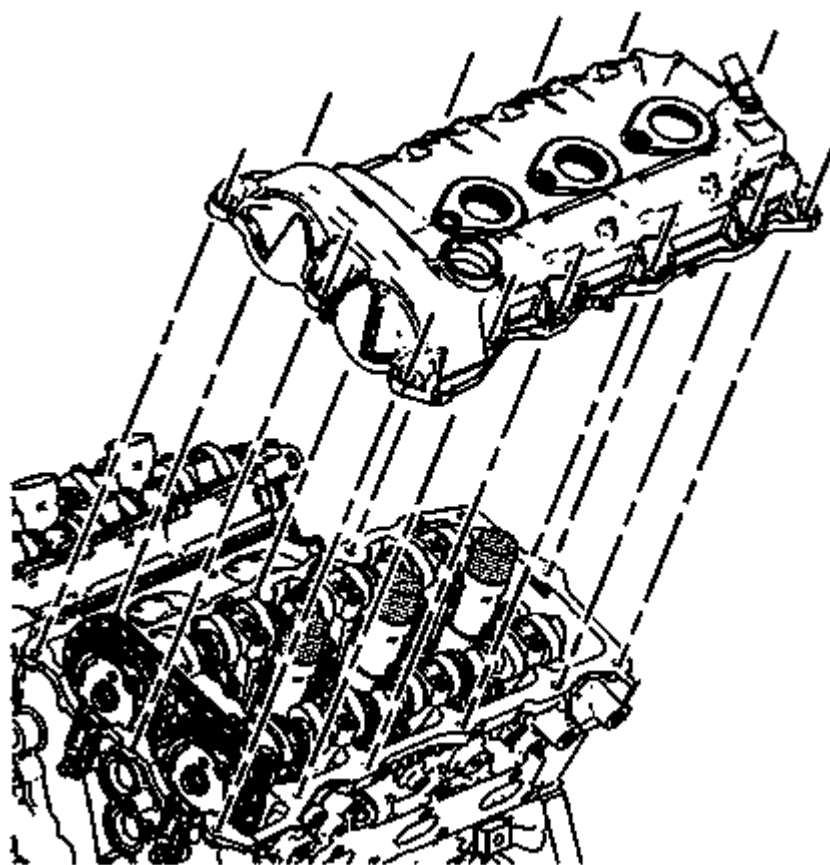
**Fig. 53: Identifying Camshaft Cover Bolt Grommets**  
Courtesy of GENERAL MOTORS CORP.

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



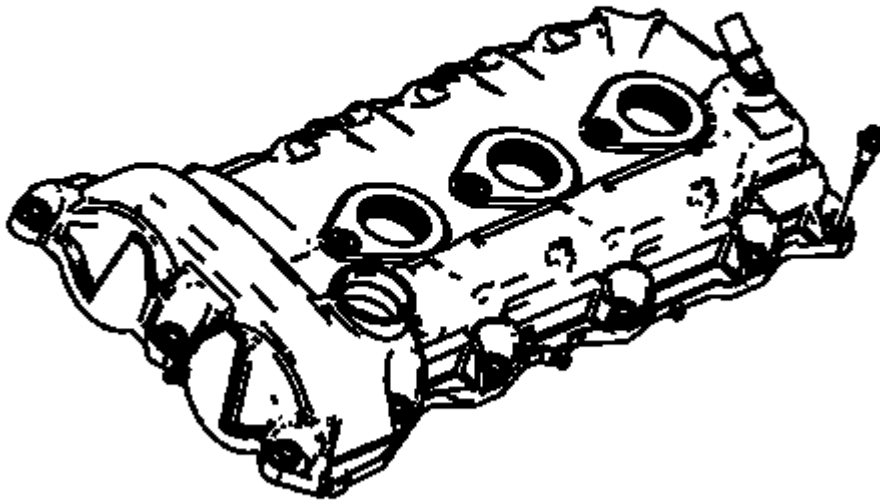
**Fig. 54: Locating Engine Front Cover Split Lines**  
Courtesy of GENERAL MOTORS CORP.

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).



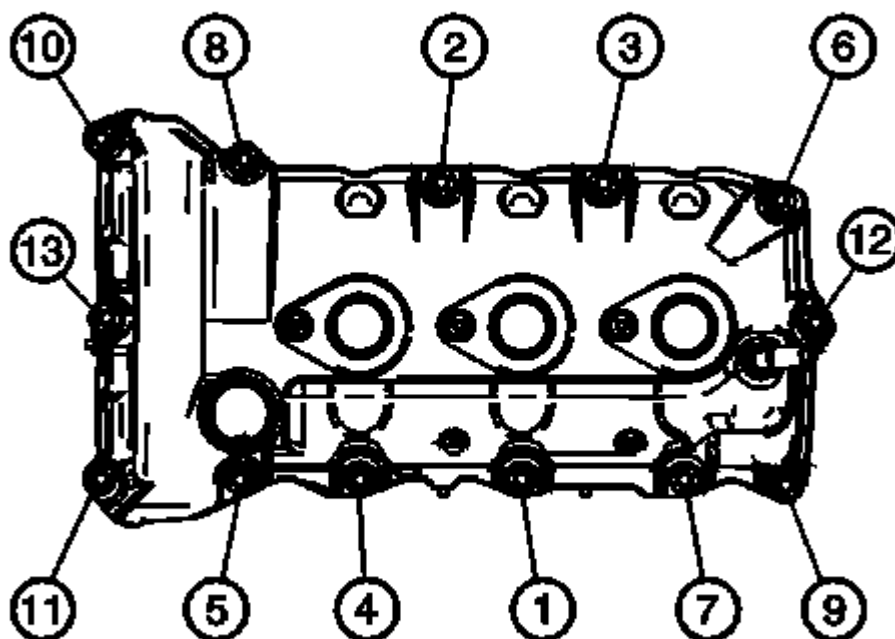
**Fig. 55: Aligning Left Camshaft Cover On Left Cylinder Head**  
Courtesy of GENERAL MOTORS CORP.

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



**Fig. 56: Identifying Left Camshaft Cover Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

4. Loosely install the left camshaft cover bolts.

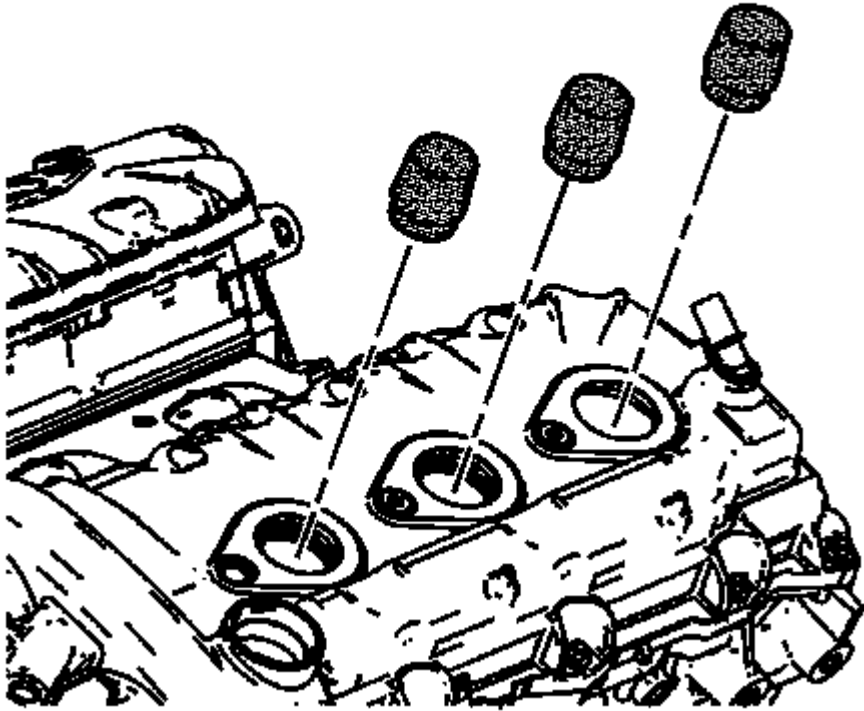


**Fig. 57: Identifying Left Camshaft Cover Tightening Sequence**  
 Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

5. Tighten the left camshaft cover bolts in sequence shown.

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



**Fig. 58: Identifying Special Tool - EN 46101**  
Courtesy of GENERAL MOTORS CORP.

6. Remove the **EN 46101** from the spark plug tubes of the left cylinder head. See **Special Tools** .
7. Install the power steering reservoir bracket. Refer to **Power Steering Fluid Reservoir Bracket Replacement** .
8. Position the wire harness and clip to the camshaft cover.
9. Install the left side ignition coils. Refer to **Ignition Coil Replacement - Bank 2** .
10. Install the lower intake manifold. Refer to **Intake Manifold Replacement**.

## **CAMSHAFT COVER REPLACEMENT - RIGHT SIDE**

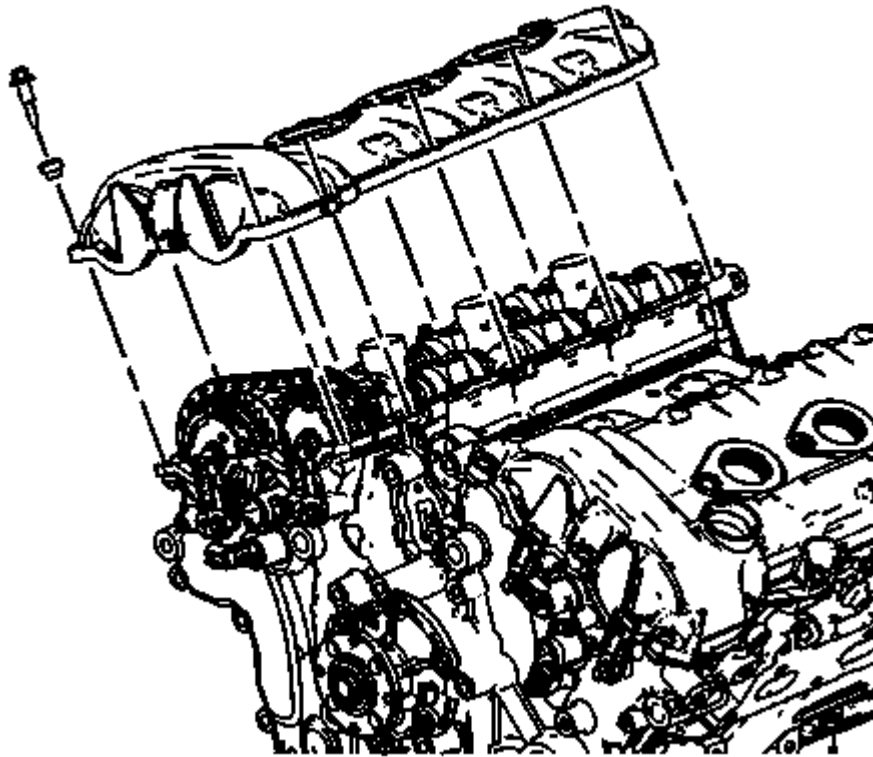
### **SPECIAL TOOLS**

**EN 46101** Spark Plug Tube Seal Guide. See **Special Tools** .

### **REMOVAL PROCEDURE**

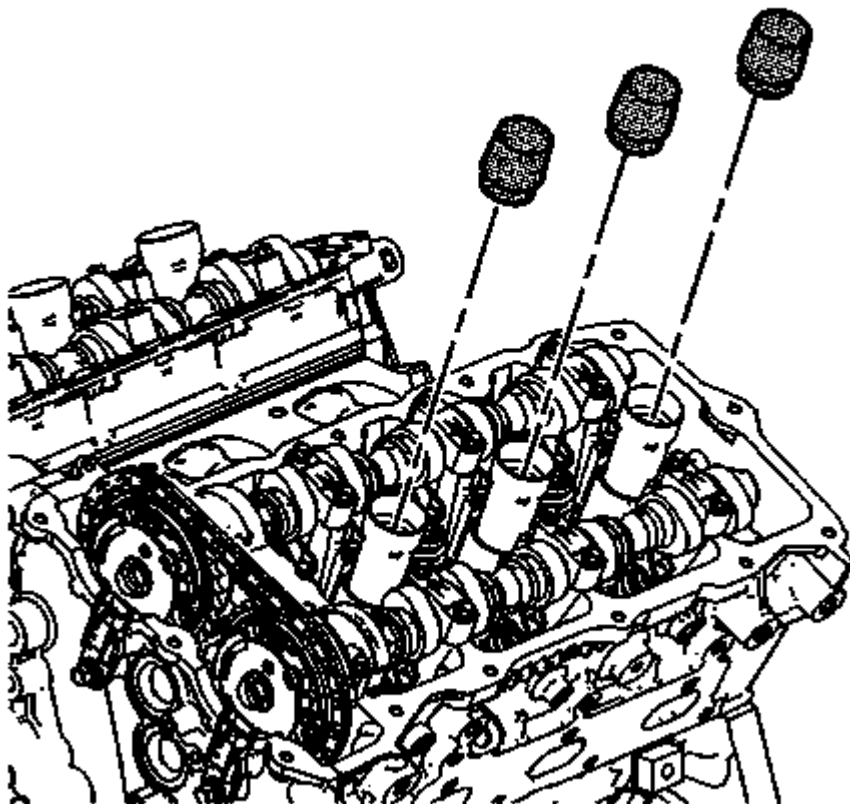
1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the right bank spark plugs. Refer to **Spark Plug Replacement** .

3. Unbolt the power steering reservoir and position aside. Refer to **Power Steering Fluid Reservoir Replacement** .



**Fig. 59: Identifying Right Camshaft Cover & Bolts**  
Courtesy of GENERAL MOTORS CORP.

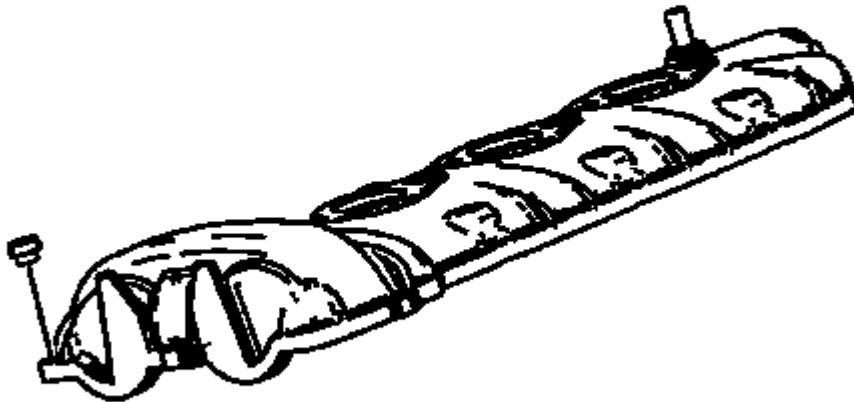
4. Remove the right camshaft cover bolts.
5. Remove the right camshaft cover from the right cylinder head.
6. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to **Camshaft Cover Cleaning and Inspection (LLT)** .



**Fig. 60: Identifying Special Tool - EN 46101**  
Courtesy of GENERAL MOTORS CORP.

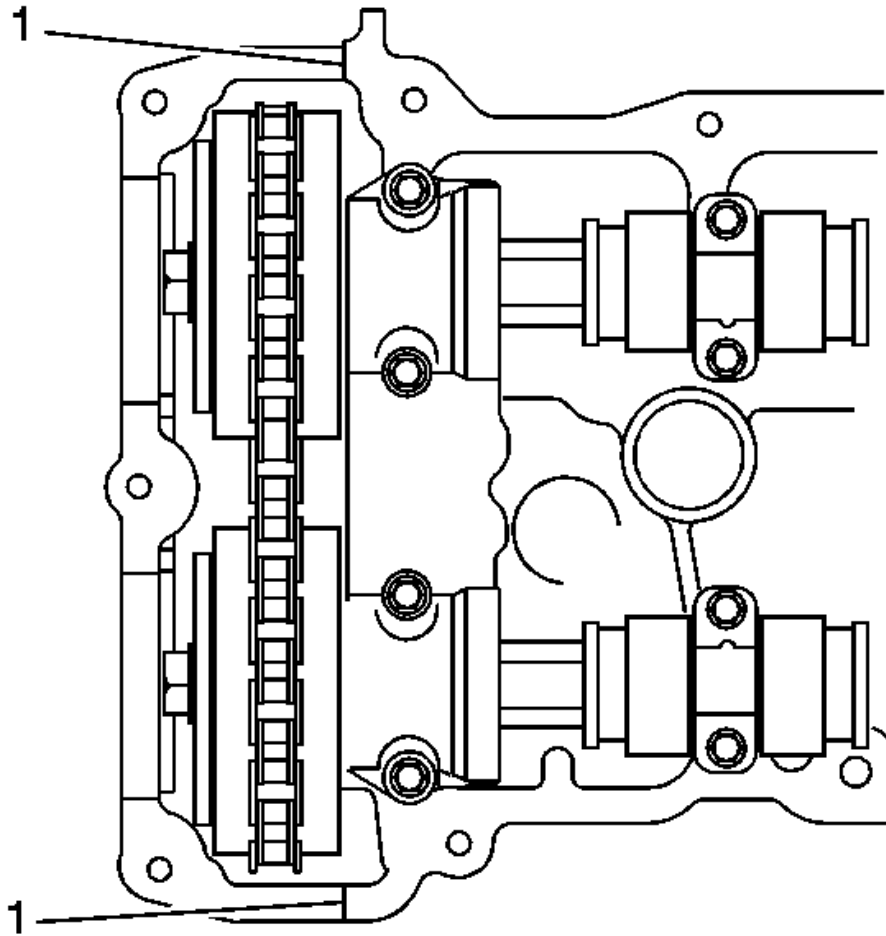
7. Install the **EN 46101** onto the spark plug tubes of the right cylinder head. See **Special Tools** .

## **INSTALLATION PROCEDURE**



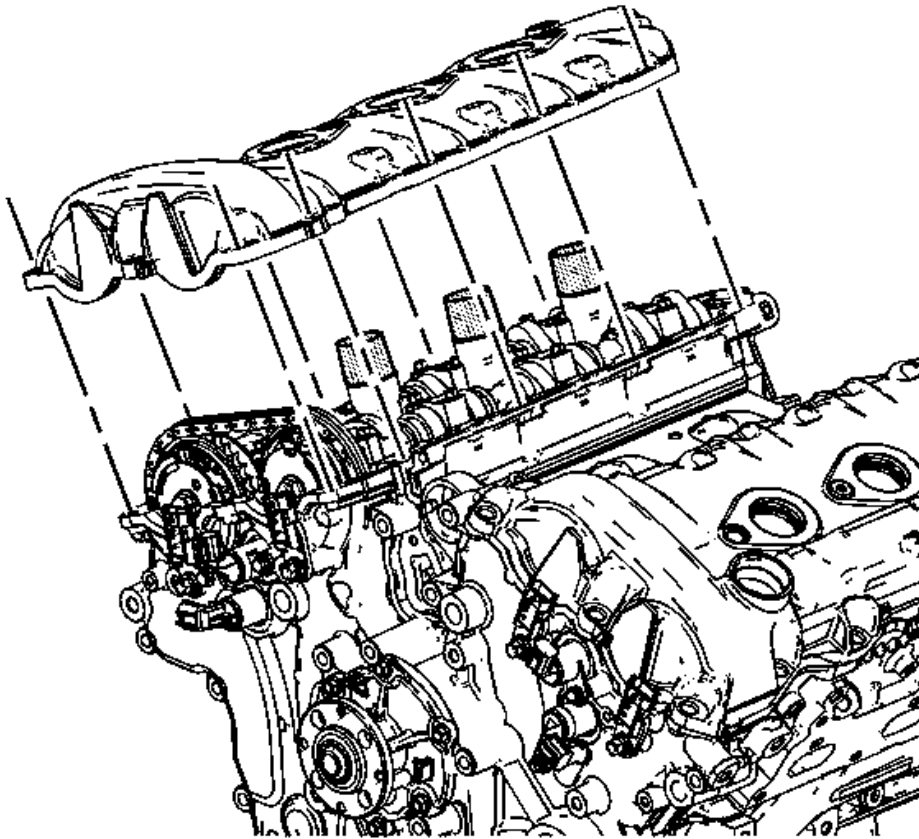
**Fig. 61: Locating Camshaft Cover Bolt Grommets**  
Courtesy of GENERAL MOTORS CORP.

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



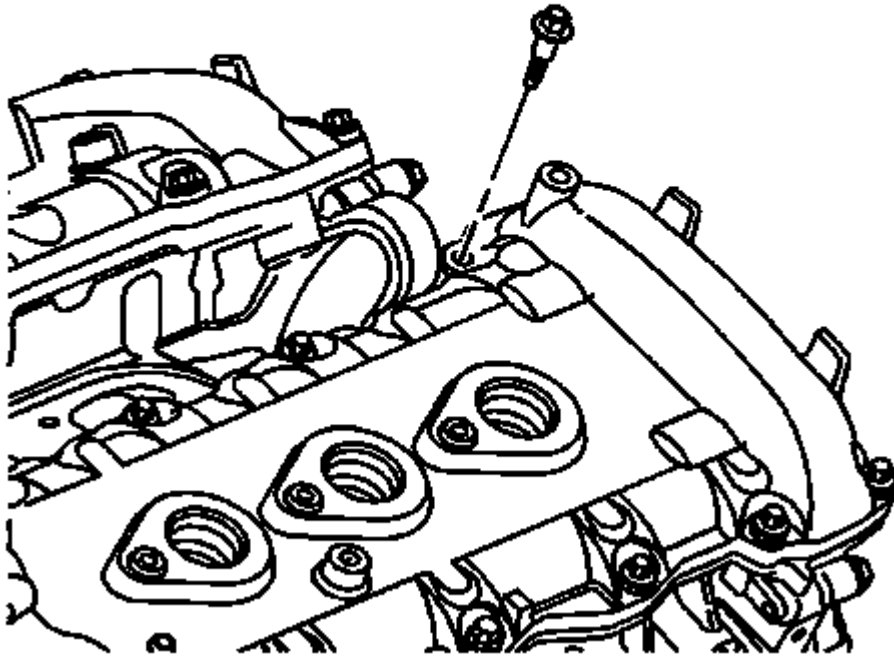
**Fig. 62: Identifying Engine Front Cover Split Lines**  
Courtesy of GENERAL MOTORS CORP.

2. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).



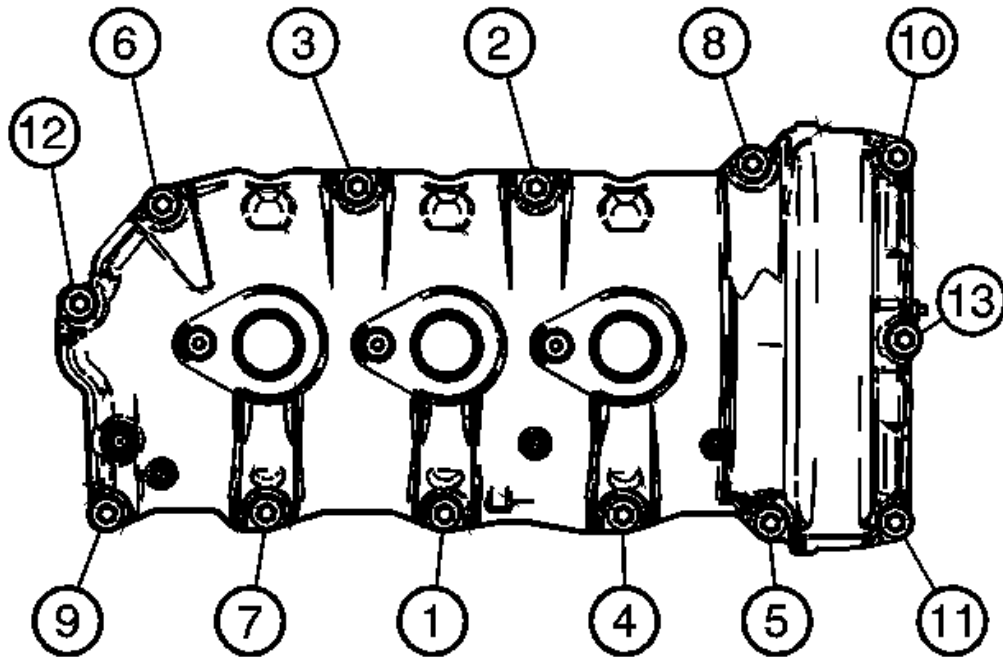
**Fig. 63: View Of Right Camshaft Cover**  
Courtesy of GENERAL MOTORS CORP.

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



**Fig. 64: Locating Right Camshaft Cover Bolts**  
Courtesy of GENERAL MOTORS CORP.

4. Loosely install the right camshaft cover bolts.



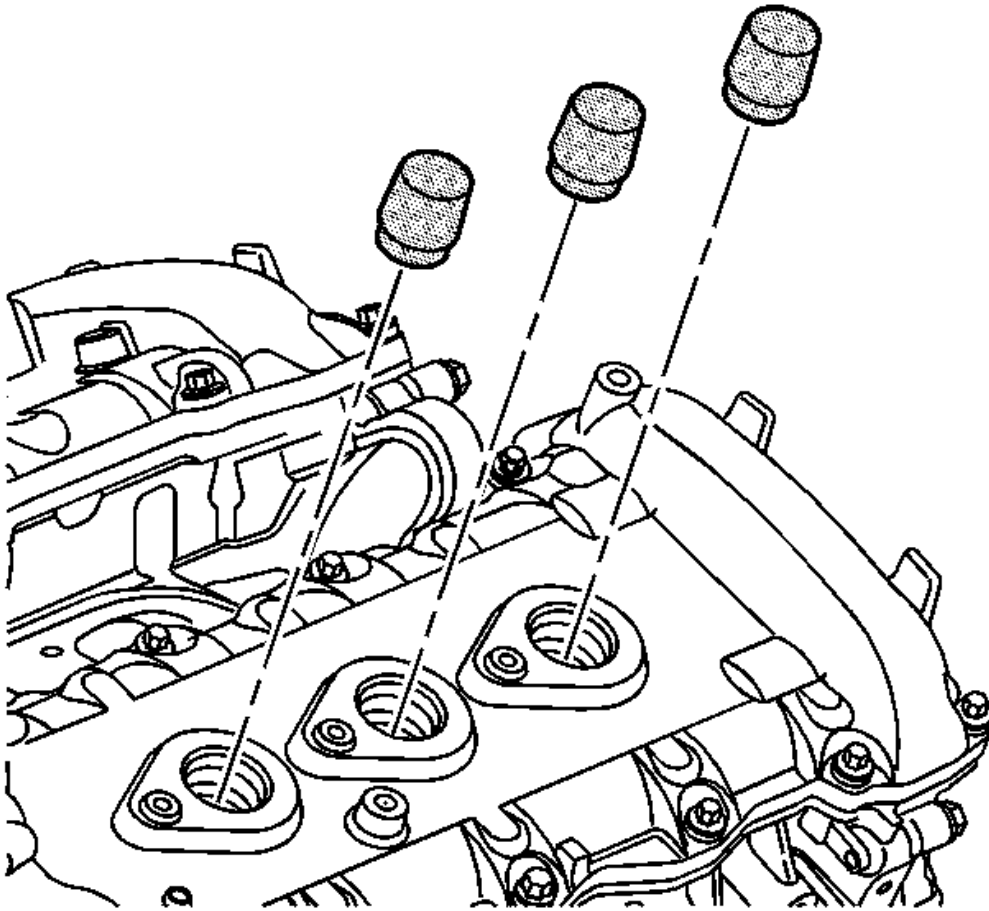
**Fig. 65: Identifying Tightening Sequence For Right Camshaft Cover Bolts**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

5. Tighten the right camshaft cover bolts in sequence.

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

6. Install the power steering reservoir. Refer to Power Steering Fluid Reservoir Replacement .



**Fig. 66: Identifying Special Tool - EN 46101**  
Courtesy of GENERAL MOTORS CORP.

7. Remove the **EN 46101** from the spark plug tubes of the right cylinder head. See **Special Tools** .
8. Install NEW spark plugs into the right cylinder head. Refer to **Spark Plug Replacement** .
9. Install the intake manifold. Refer to **Intake Manifold Replacement**.

## ENGINE FRONT COVER REPLACEMENT

### SPECIAL TOOLS

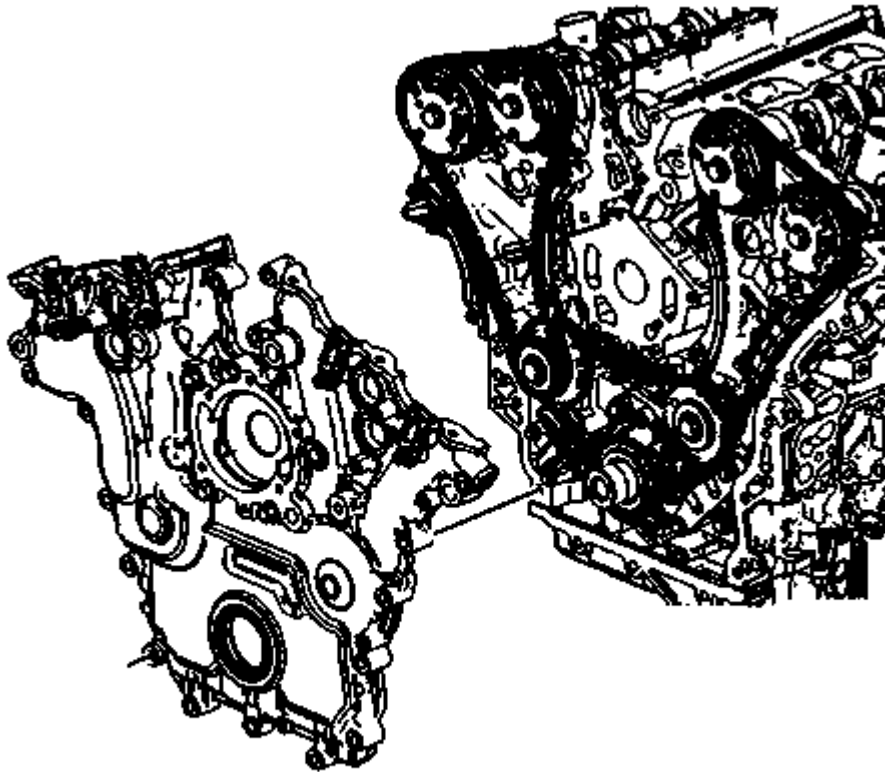
- **EN 46109** Guide Pin Set. See **Special Tools** .
- **EN-48383** Camshaft Retaining Tools. See **Special Tools** .
- **EN-48589** Crankshaft Rotational Socket. See **Special Tools** .

### REMOVAL PROCEDURE

1. Remove the frame from the body with the engine and transmission. Refer to **Engine Replacement** .

Follow steps 1-40 in the Engine Replacement Removal.

2. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
3. Remove the camshaft covers. Refer to **Camshaft Cover Replacement - Left Side** and **Camshaft Cover Replacement - Right Side**.
4. Remove the water outlet housing assembly. Refer to **Water Outlet Replacement**.
5. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
6. Remove the water pump pulley. Refer to **Water Pump Replacement**.
7. Remove the power steering pump. Refer to **Power Steering Pump Replacement**.
8. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
9. Remove the camshaft position sensors. Refer to **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust**, **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake**, **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust** and **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake**.
10. Remove the camshaft position actuator solenoid valves from the front cover. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake**, **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust**, **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake**, and **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust**.
11. Remove the generator. Refer to **Generator Replacement**.

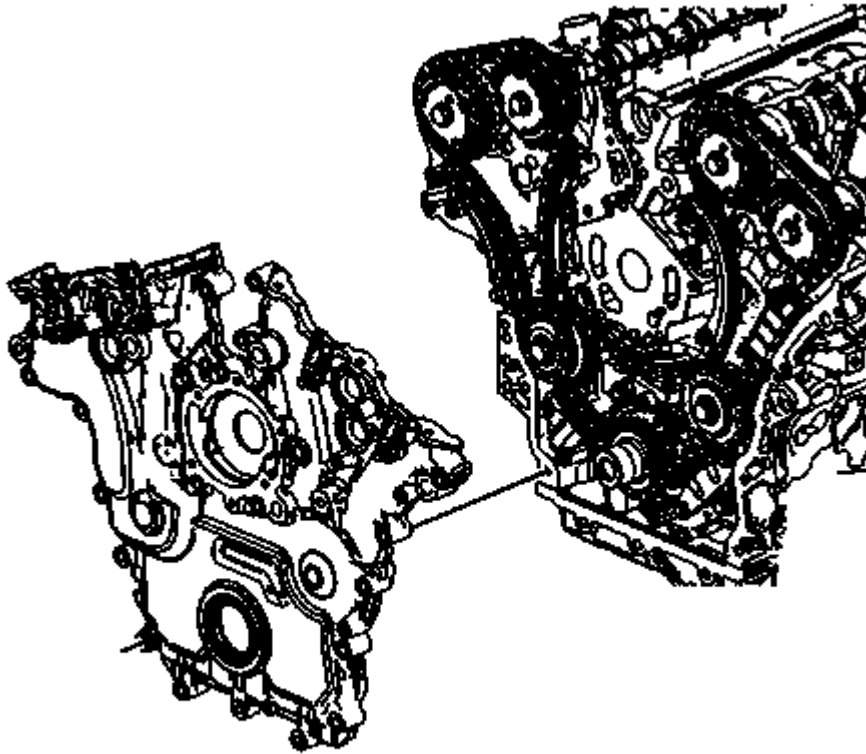


**Fig. 67: Identifying Engine Front Cover**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** There are a total of 22 M8 bolts that must be removed and 3 optional M12 bolts that may need to be removed before the front cover will separate from the engine block.

12. Remove the engine front cover. Engine Front Cover Removal .

## INSTALLATION PROCEDURE



**Fig. 68: View Of Engine Front Cover**  
Courtesy of GENERAL MOTORS CORP.

1. Install front cover. Refer to **Engine Front Cover Installation** .
2. Install the generator. Refer to **Generator Replacement** .
3. Install the camshaft position actuator solenoid valves to the front cover. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake** , **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust** , **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake** , and **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust** .
4. Install the camshaft position sensors. Refer to **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust** , **Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake** , **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust** and **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake** .
5. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement** .
6. Install the power steering pump. Refer to **Power Steering Pump Replacement** .
7. Install the water pump pulley. Refer to **Water Pump Replacement** .
8. Install the water outlet housing assembly. Refer to **Water Outlet Replacement** .
9. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .
10. Install the camshaft covers. Refer to **Camshaft Cover Replacement - Left Side** and **Camshaft Cover** .

**Replacement - Right Side.**

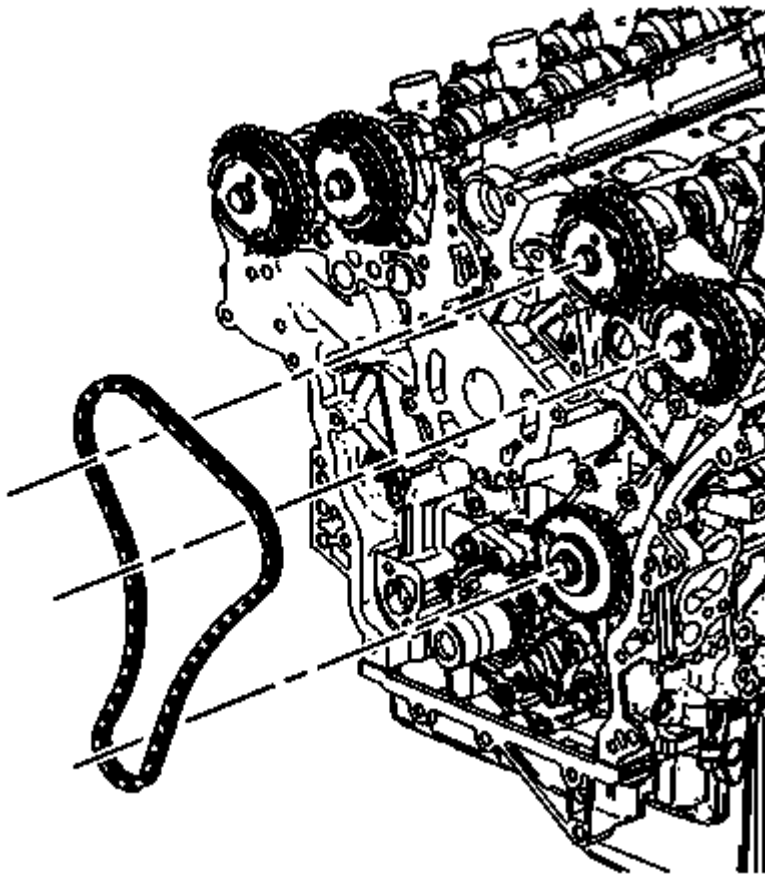
11. Install the intake manifold. Refer to **Intake Manifold Replacement**.
12. Install the frame with the engine and transmission. Refer to **Engine Replacement**.

Follow steps 16-49 in Engine Replacement Installation.

## **SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**

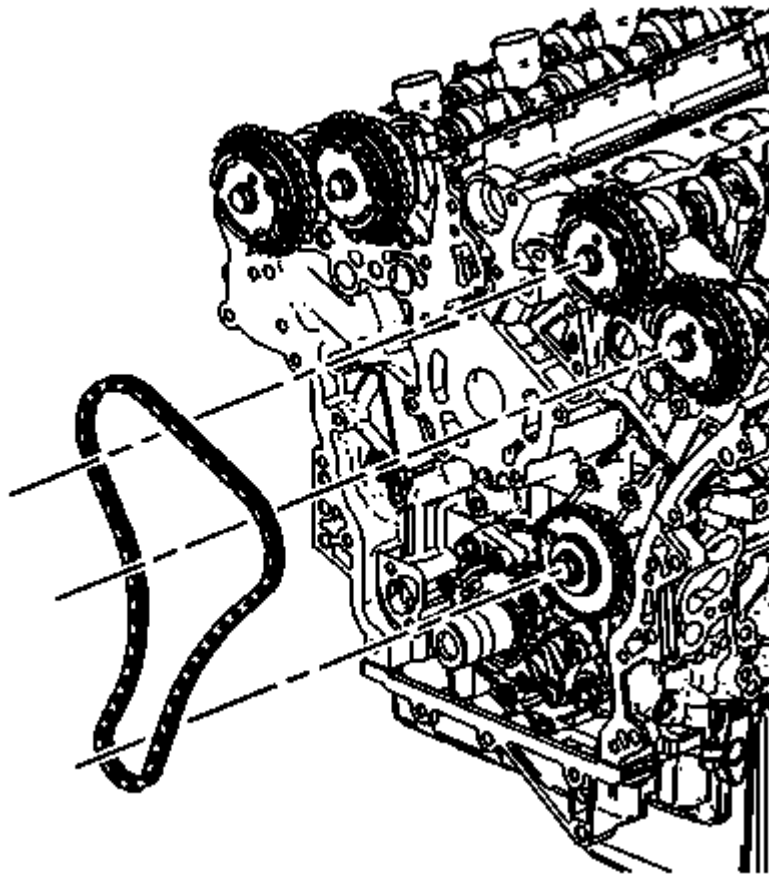
1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side**.
3. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft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



**Fig. 69: View Of Left Bank Secondary Camshaft Drive Chain**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



**Fig. 70: View Of Left Bank Secondary Camshaft Drive Chain**  
Courtesy of GENERAL MOTORS CORP.

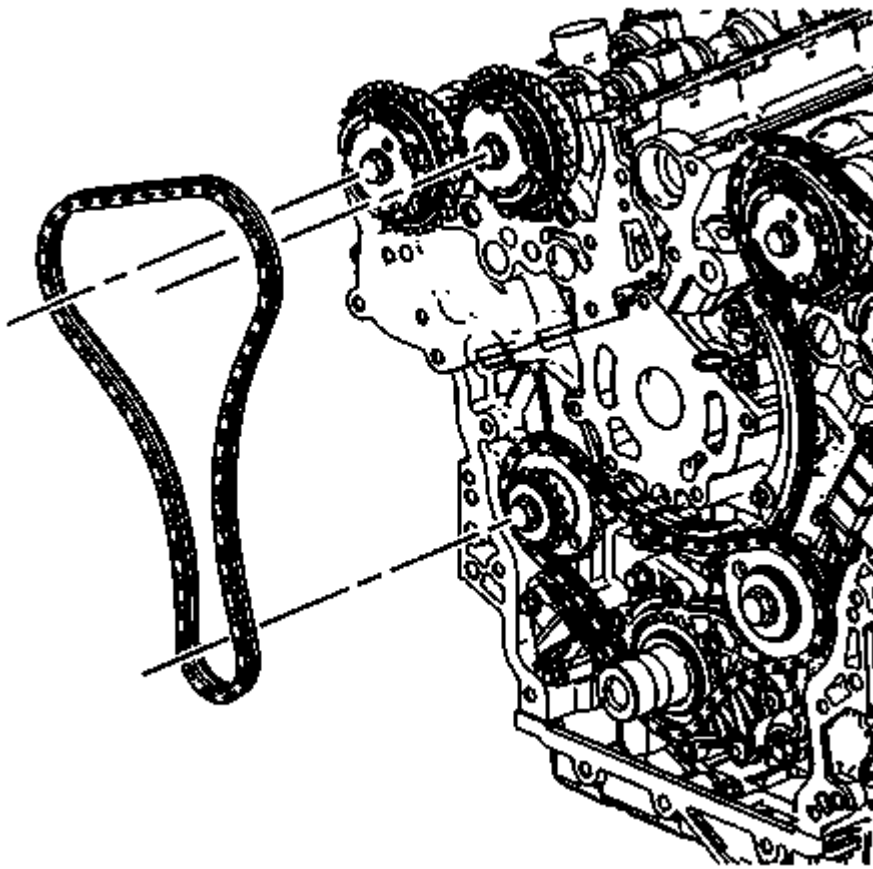
1. Install the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Left Side (LLT or LCS)**.
2. Install the left bank camshaft intermediate drive chain idler. Refer to **Timing Chain Idler Sprocket Installation - Left Side**.
3. Install the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

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

## **SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

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

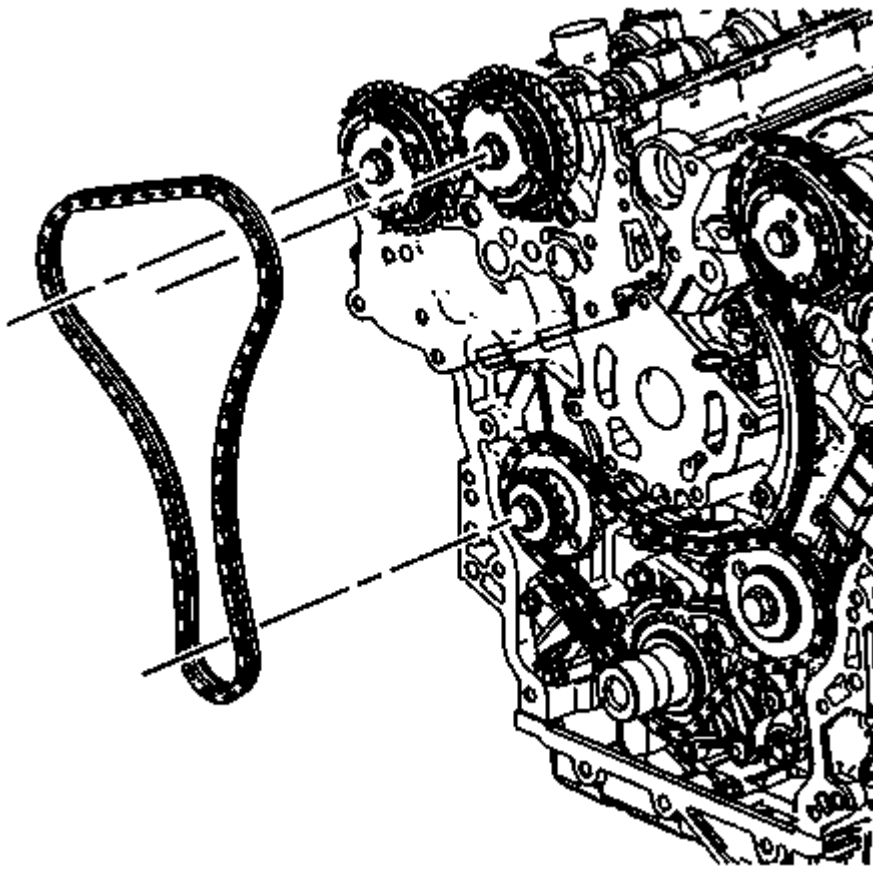


**Fig. 71: View Of Right Bank Secondary Camshaft Drive Chain**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE

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



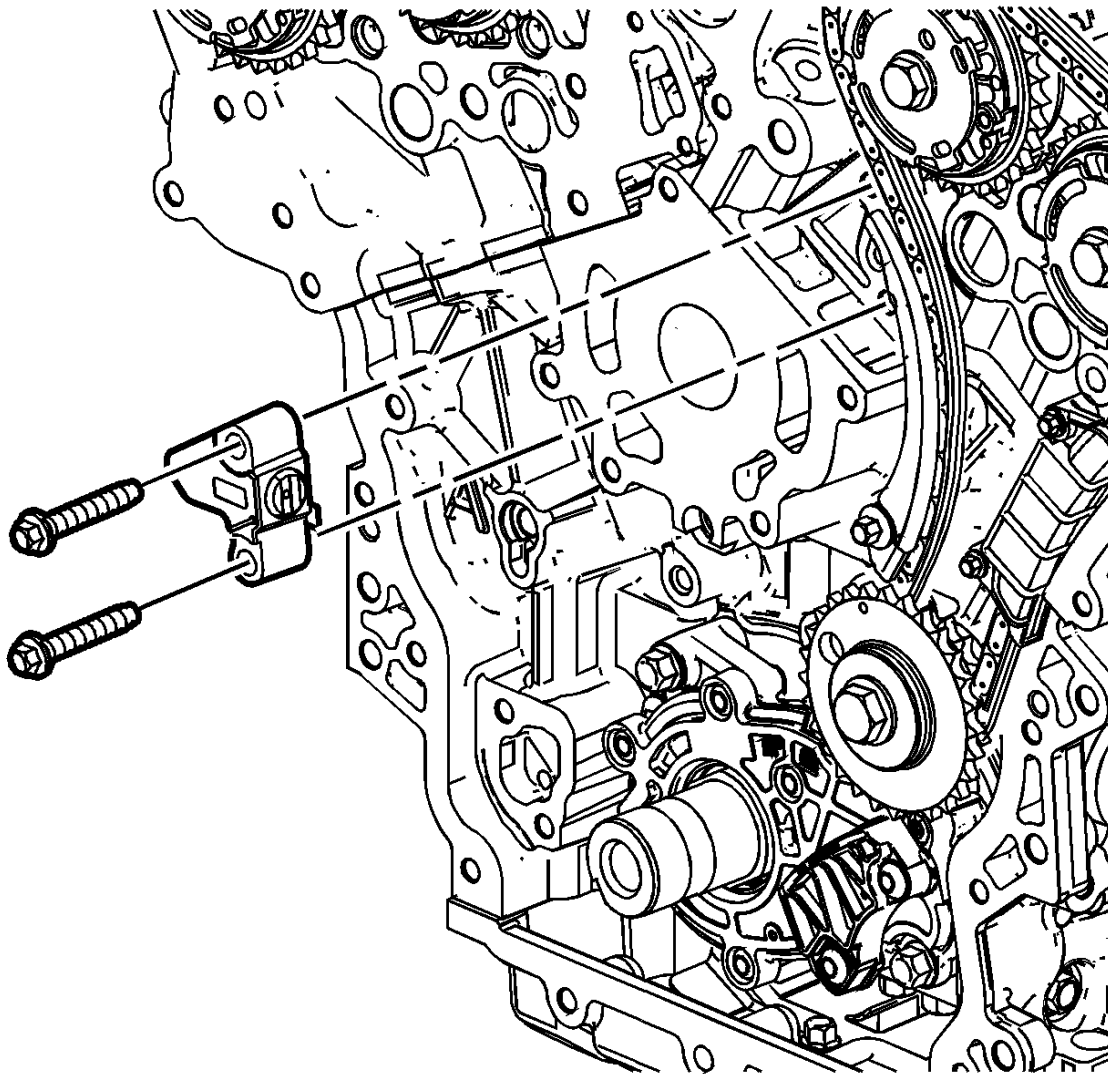
**Fig. 72: View Of Right Bank Secondary Camshaft Drive Chain**  
Courtesy of GENERAL MOTORS CORP.

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

## **SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**

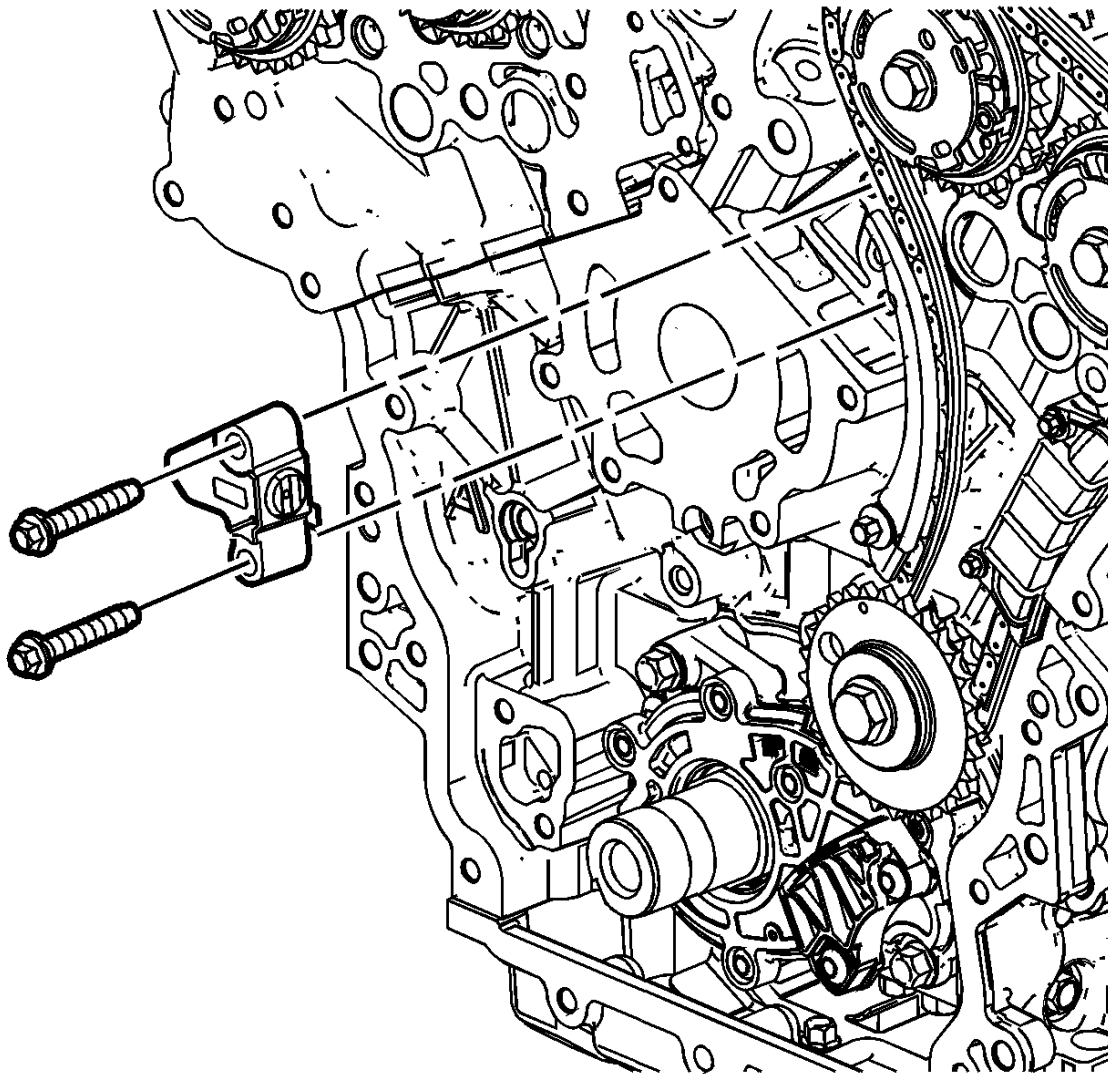
1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .



**Fig. 73: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



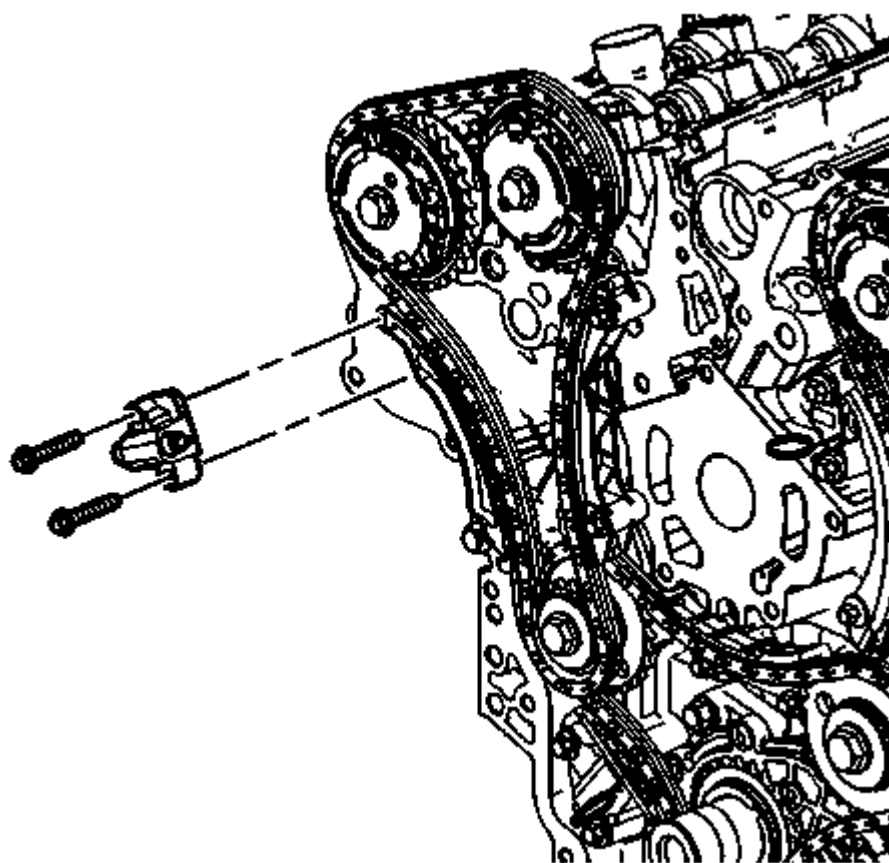
**Fig. 74: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

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

## **SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

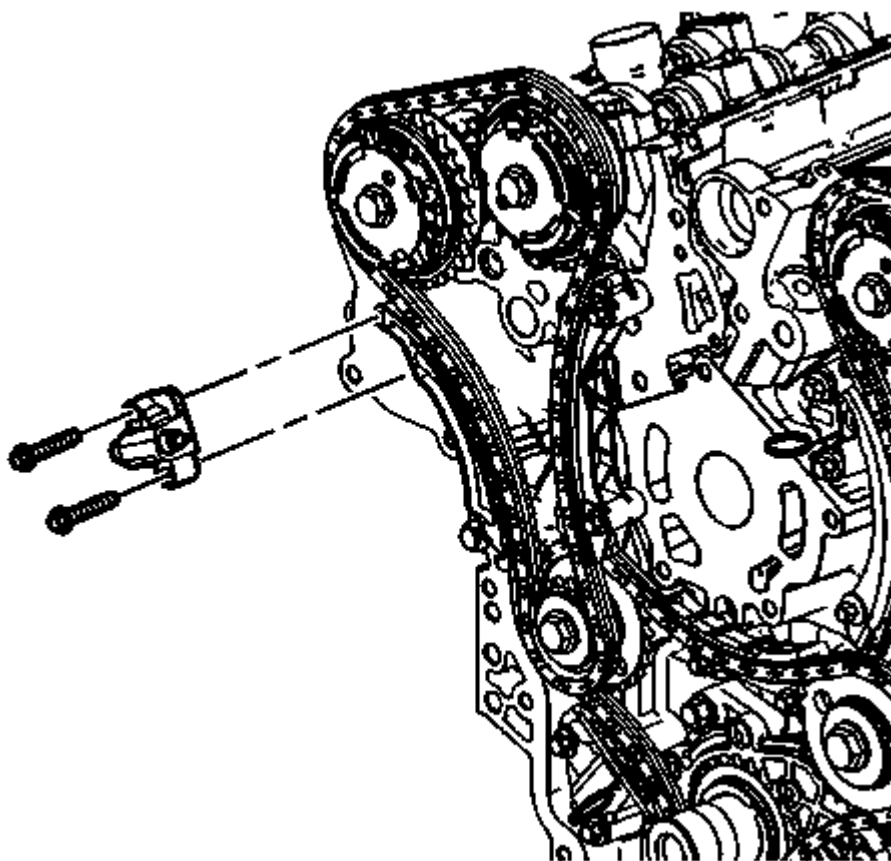
1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .



**Fig. 75: View Of Right Bank Secondary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



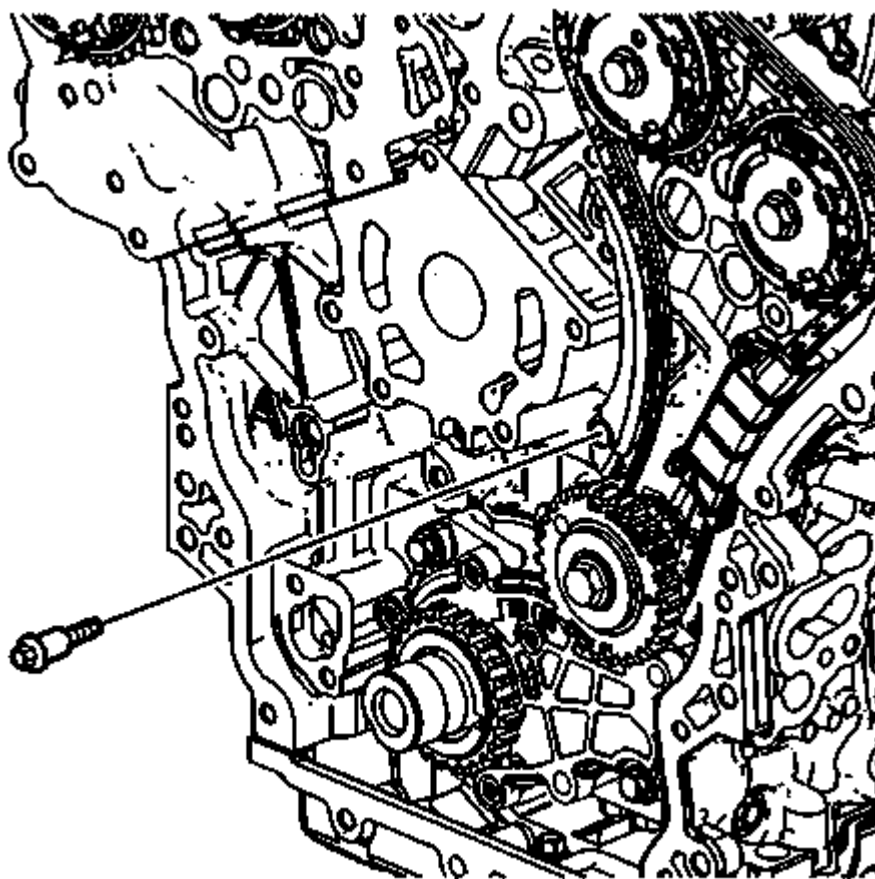
**Fig. 76: View Of Right Bank Secondary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

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

## **SECONDARY TIMING CHAIN TENSIONER SHOE REPLACEMENT - LEFT SIDE**

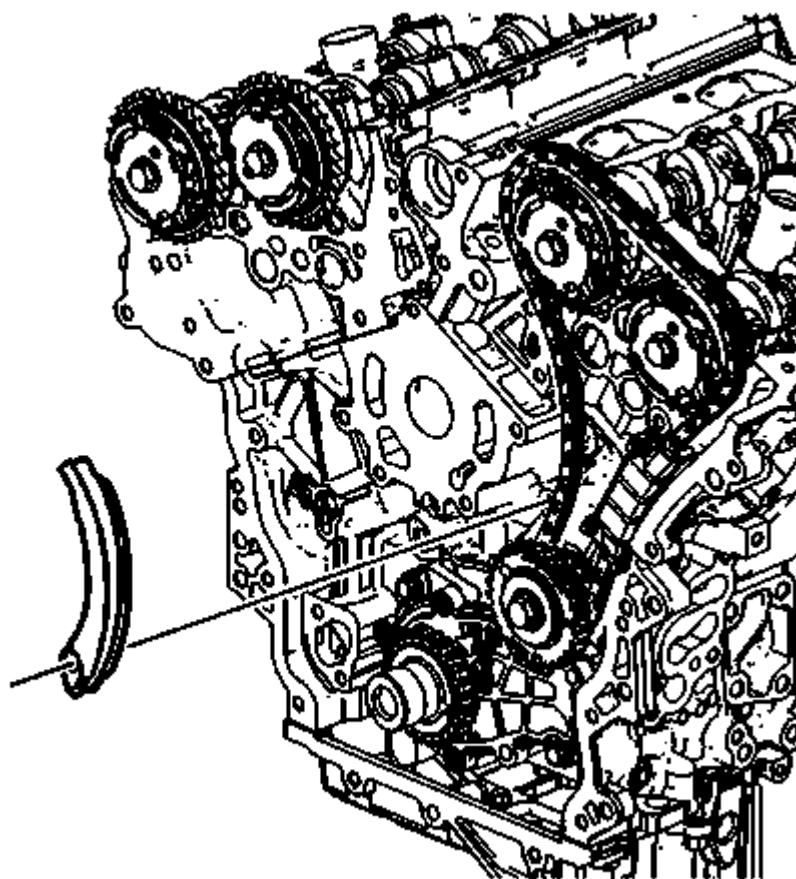
### **REMOVAL PROCEDURE**

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .
3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .



**Fig. 77: Identifying Secondary Camshaft Drive Chain Shoe Bolt**  
Courtesy of GENERAL MOTORS CORP.

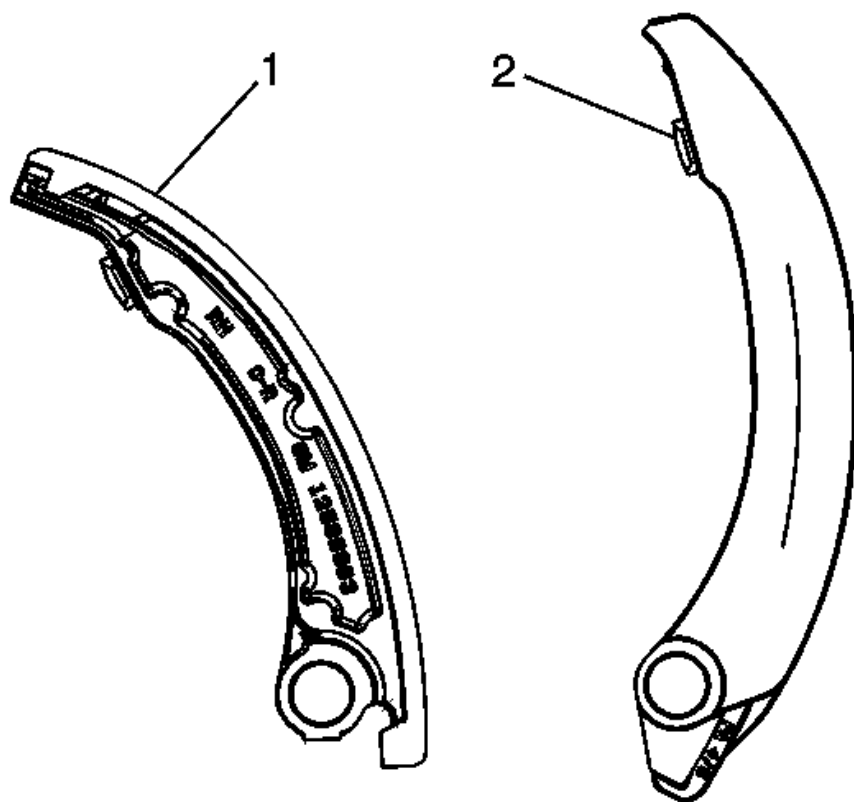
4. Remove the left secondary camshaft drive chain shoe bolt.



**Fig. 78: View Of Left Secondary Camshaft Drive Chain Shoe**  
Courtesy of GENERAL MOTORS CORP.

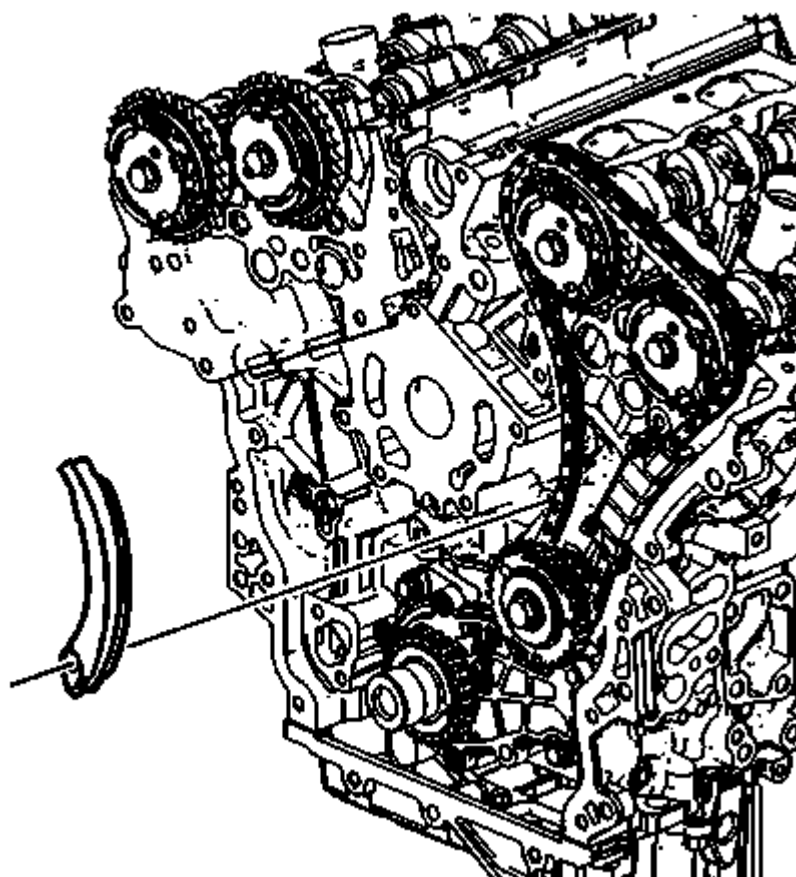
5. Remove the left secondary camshaft drive chain shoe.

## INSTALLATION PROCEDURE



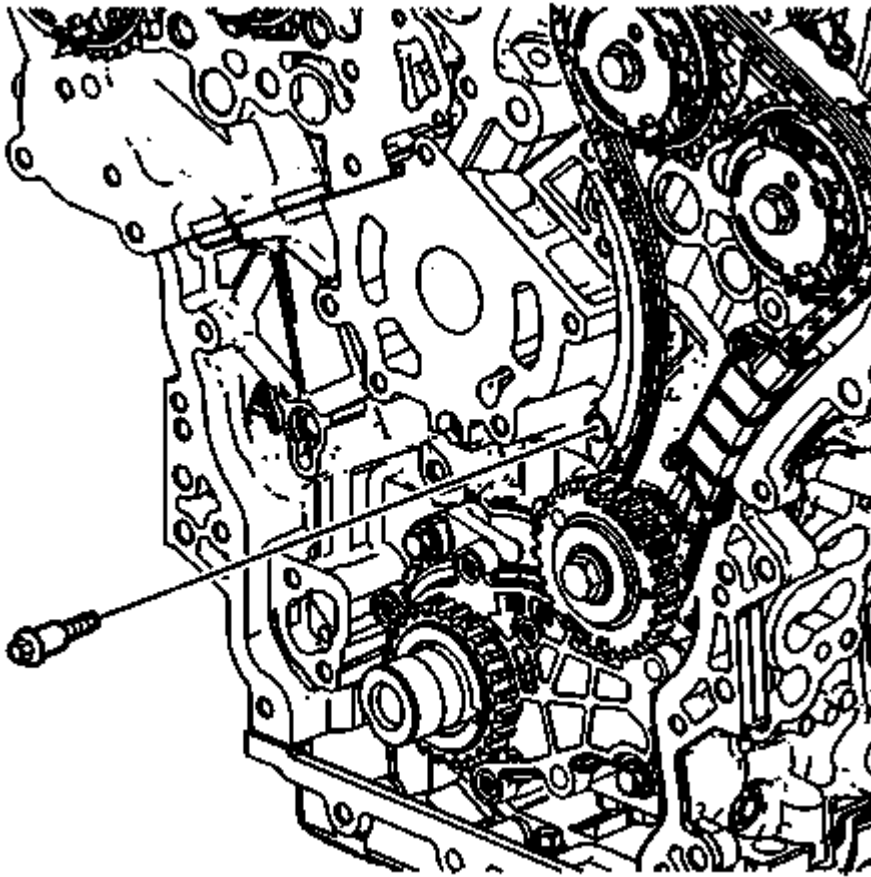
**Fig. 79: Identifying Right Secondary Camshaft Drive Chain Shoe**  
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the left secondary camshaft drive chain shoe (2) is being installed.



**Fig. 80: View Of Left Secondary Camshaft Drive Chain Shoe**  
**Courtesy of GENERAL MOTORS CORP.**

2. Position the left secondary camshaft drive chain shoe.



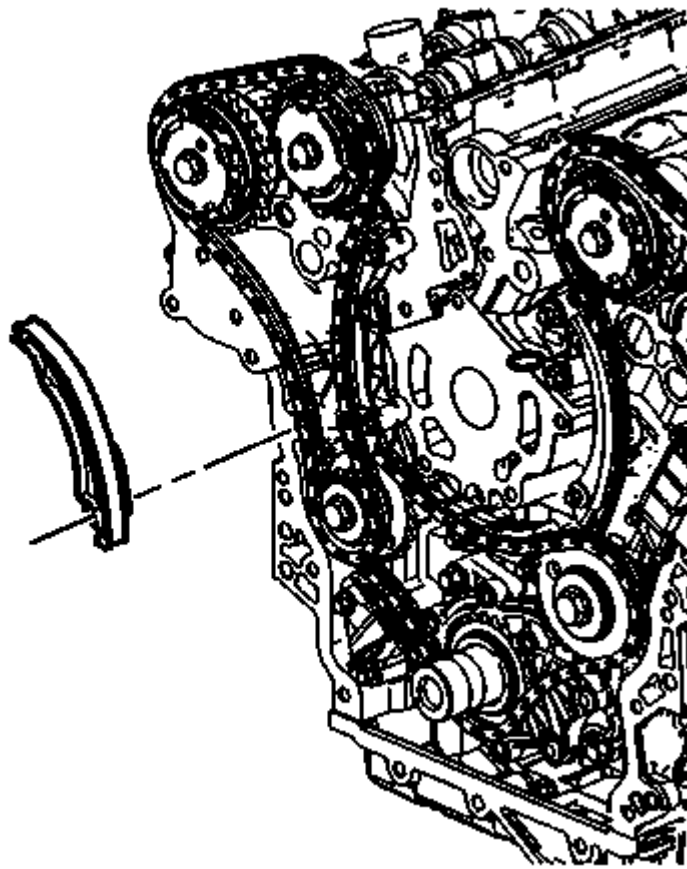
**Fig. 81: Identifying Secondary Camshaft Drive Chain Shoe Bolt**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

3. Install the secondary camshaft drive chain shoe bolt and tighten to 23 N.m (17 lb ft).
4. Install the engine front cover. Refer to Engine Front Cover Replacement.
5. Install the spark plugs. Refer to Spark Plug Replacement .

## SECONDARY TIMING CHAIN TENSIONER SHOE REPLACEMENT - RIGHT SIDE

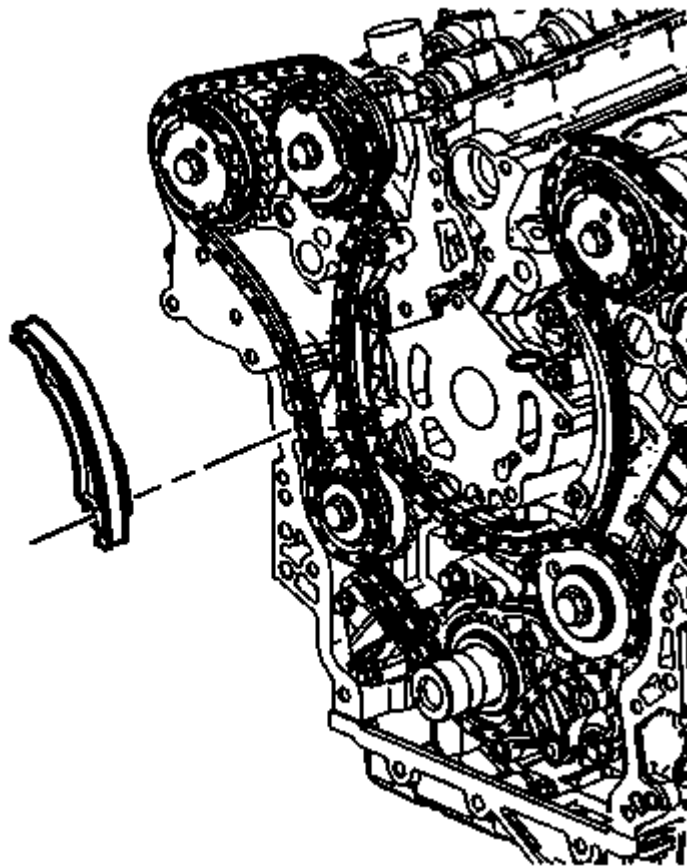
### REMOVAL PROCEDURE



**Fig. 82: View Of Right Secondary Camshaft Drive Chain Shoe**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



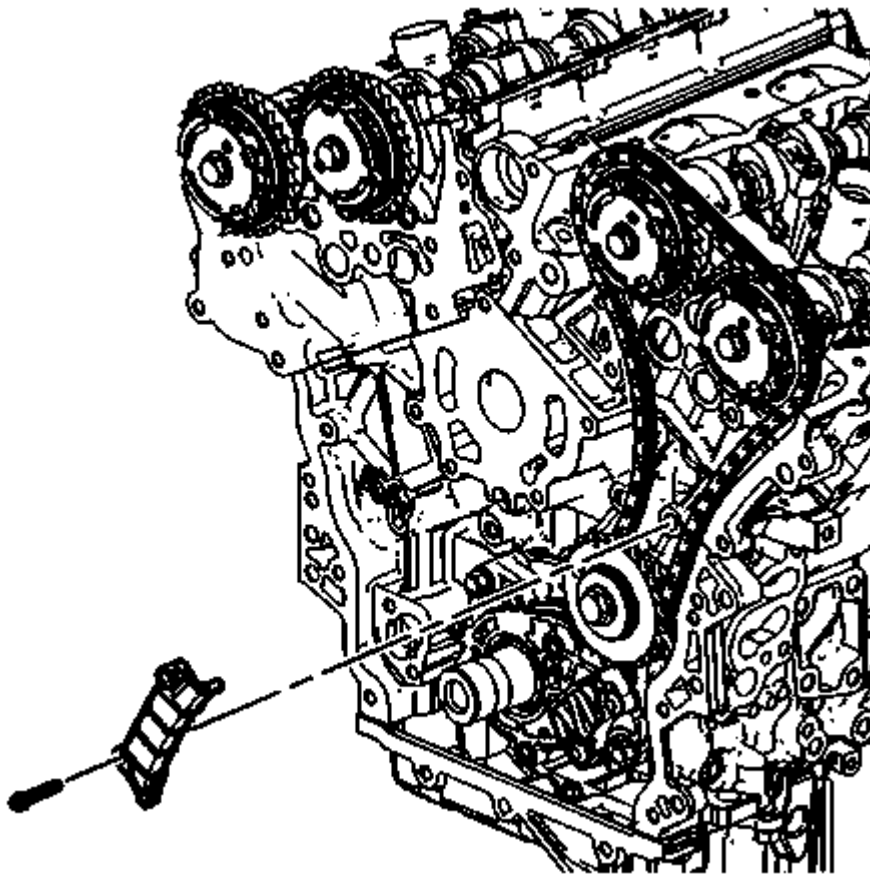
**Fig. 83: View Of Right Secondary Camshaft Drive Chain Shoe**  
Courtesy of GENERAL MOTORS CORP.

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

## **SECONDARY TIMING CHAIN GUIDE REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**

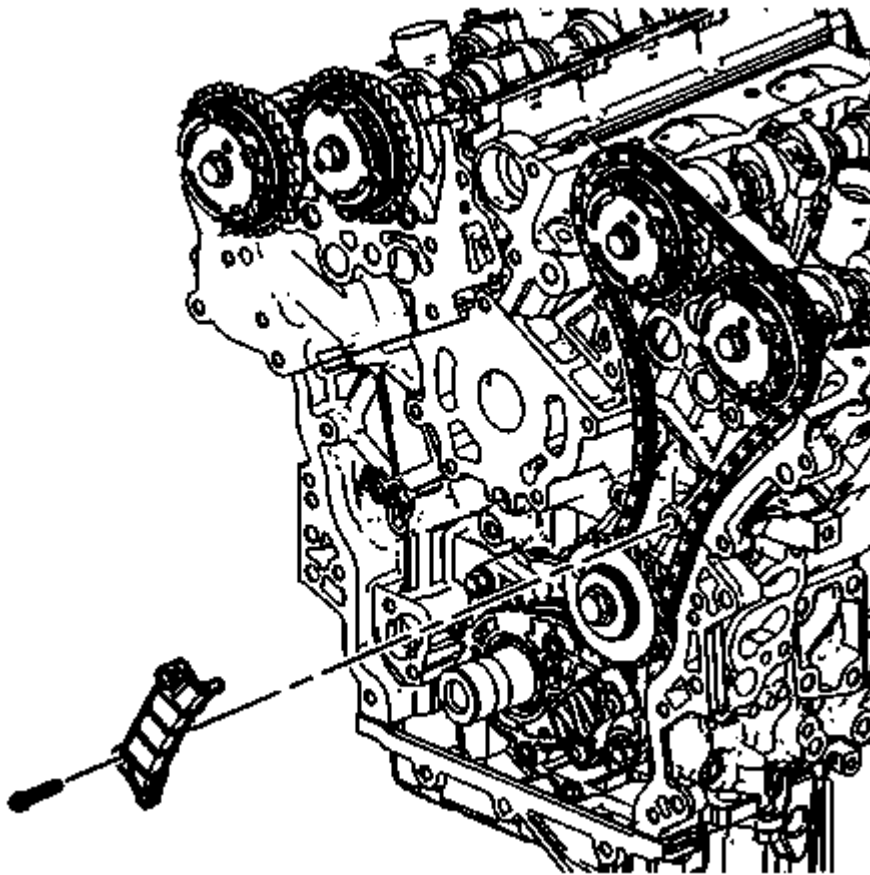
1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .
3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Left Side** .



**Fig. 84: View Of Left Bank Secondary Camshaft Drive Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



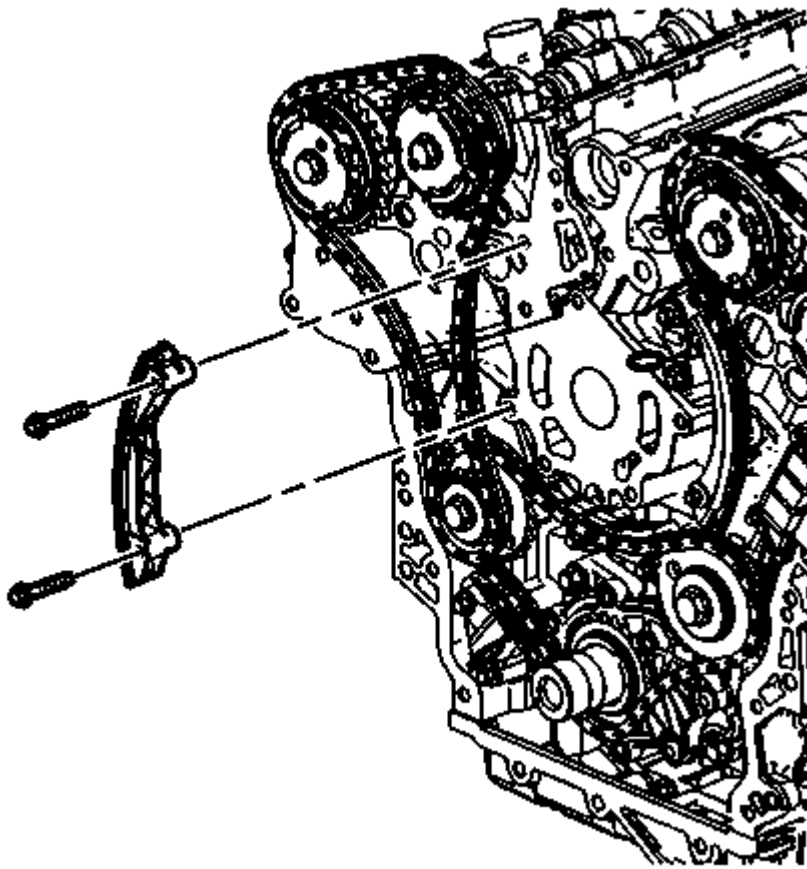
**Fig. 85: View Of Left Bank Secondary Camshaft Drive Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

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

## **SECONDARY TIMING CHAIN GUIDE REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

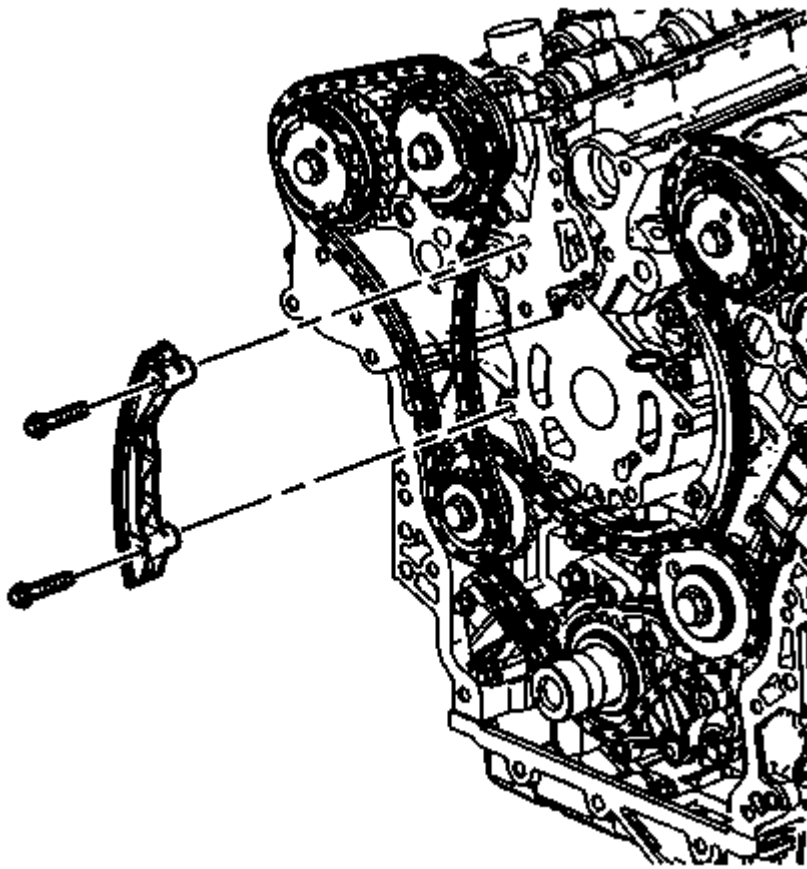
1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Removal - Right Side** .



**Fig. 86: View Of Right Secondary Camshaft Drive Chain Guide & Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



**Fig. 87: View Of Right Secondary Camshaft Drive Chain Guide & Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

## **PRIMARY CAMSHAFT DRIVE CHAIN AND SPROCKETS REPLACEMENT**

### **SPECIAL TOOLS**

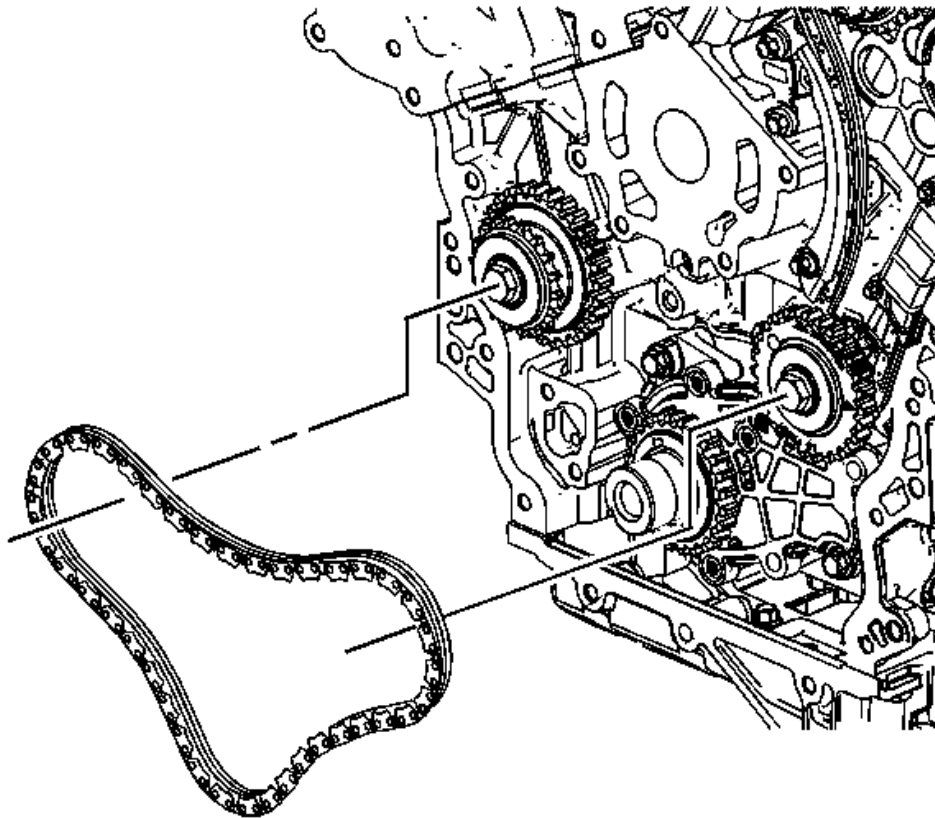
EN 46111 Crankshaft Rotation Socket. See **Special Tools** .

### **REMOVAL PROCEDURE**

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain**

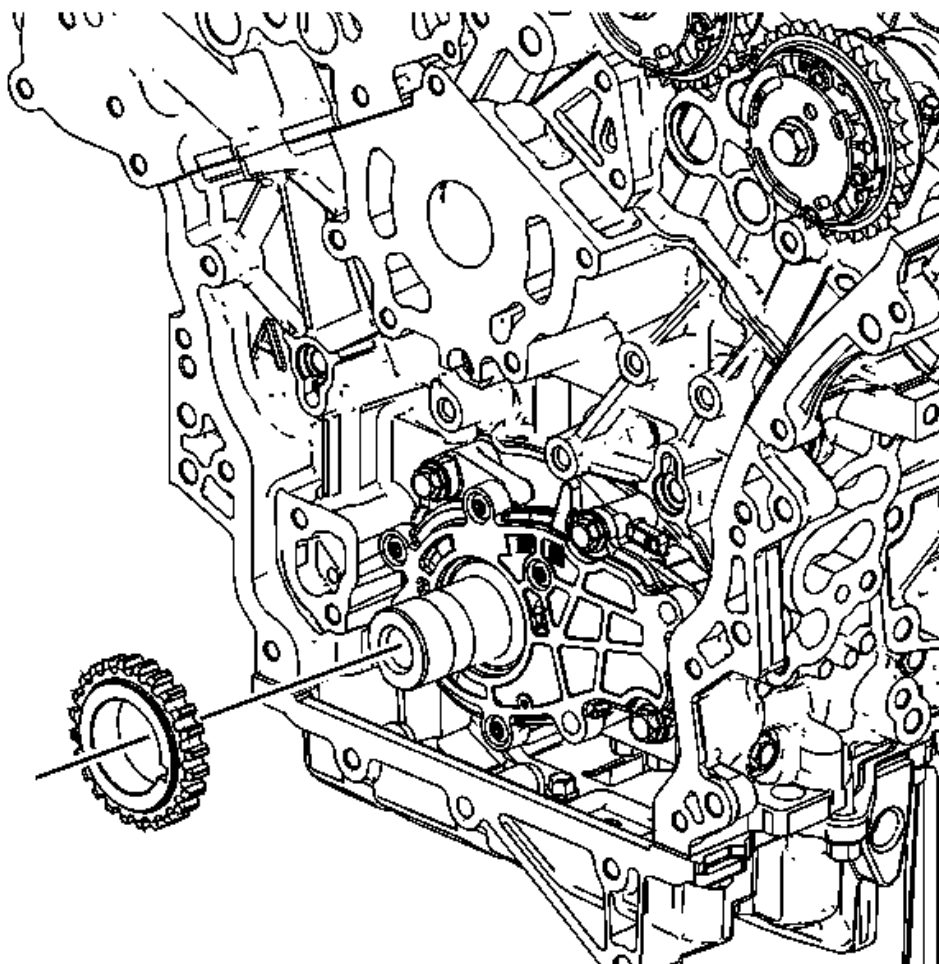
**Tensioner Removal - Right Side .**

4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right Side .**
5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Removal - Right Side .**
6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side .**
7. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal .**
8. Remove the primary camshaft drive chain upper guide. Refer to **Primary Timing Chain Guide Removal - Upper .**



**Fig. 88: Identifying Primary Camshaft Timing Chain**  
Courtesy of GENERAL MOTORS CORP.

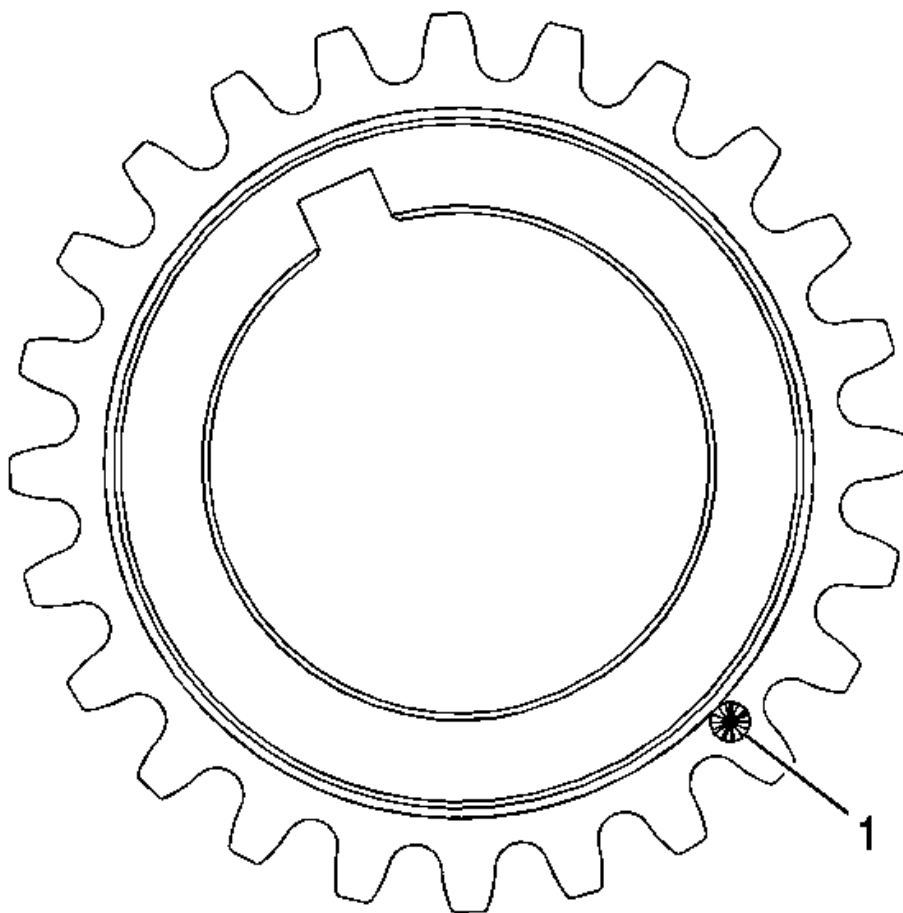
9. Remove the primary camshaft timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Removal - Right Side .**



**Fig. 89: View Of Crankshaft Sprocket**  
Courtesy of GENERAL MOTORS CORP.

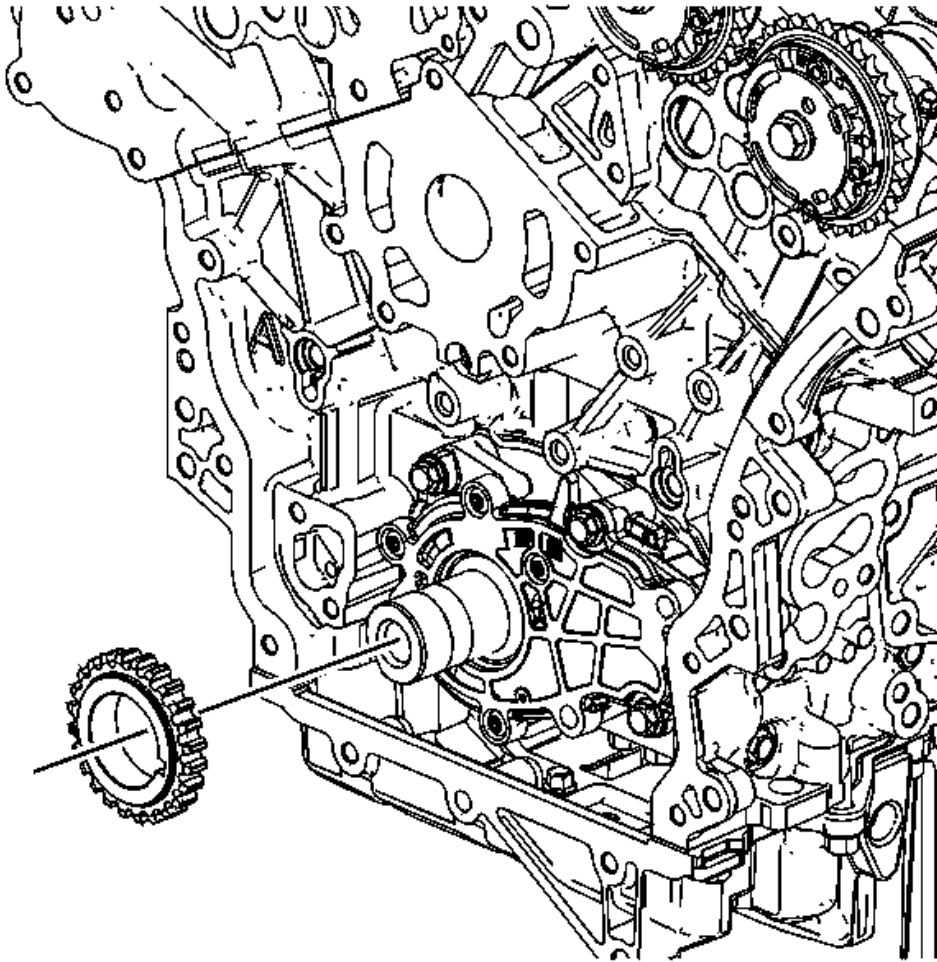
10. Remove the crankshaft sprocket from the nose of the crankshaft.

## INSTALLATION PROCEDURE



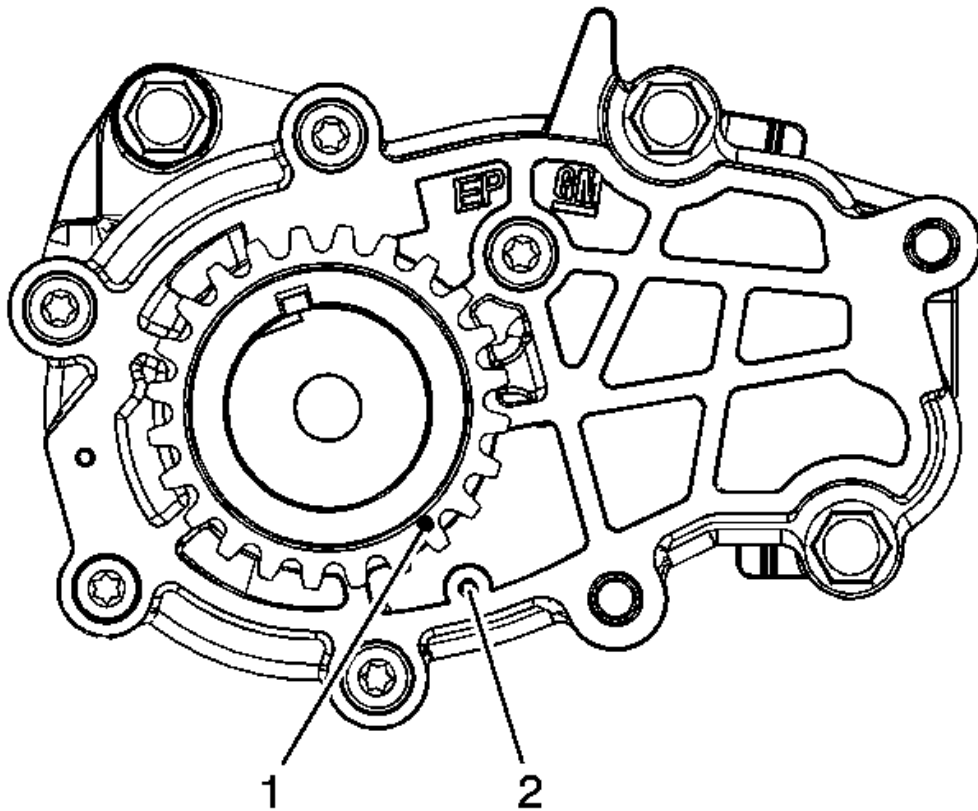
**Fig. 90: Locating Timing Mark**  
Courtesy of GENERAL MOTORS CORP.

1. Ensure the crankshaft sprocket is installed with the timing mark (1) visible.



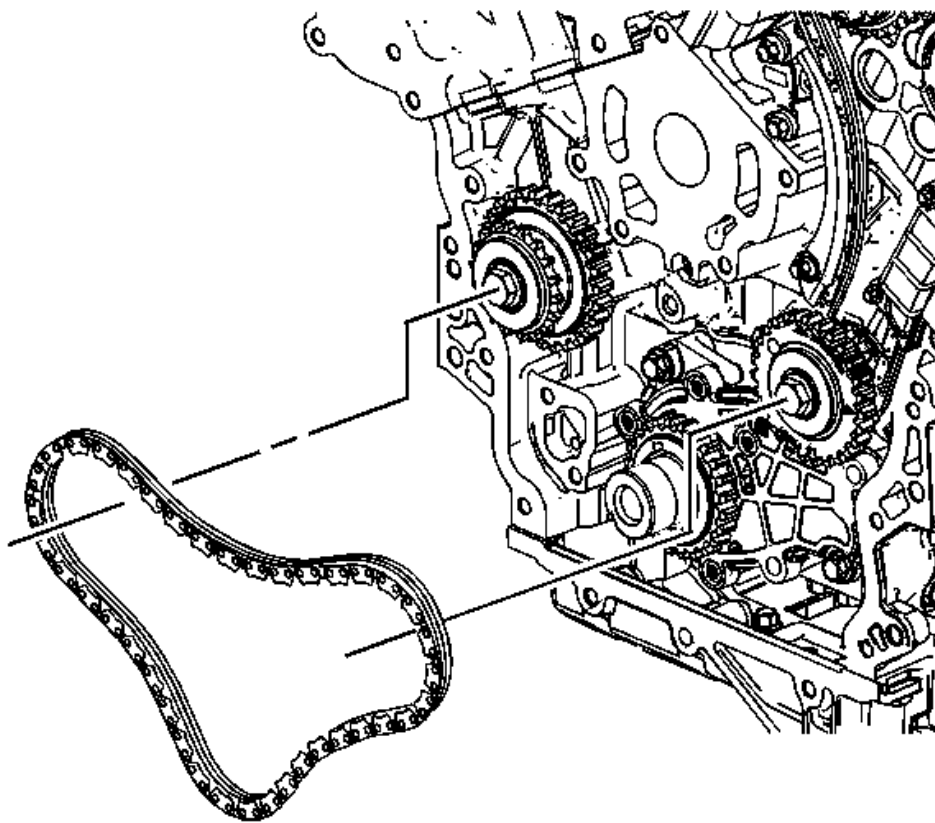
**Fig. 91: View Of Crankshaft Sprocket**  
Courtesy of GENERAL MOTORS CORP.

2. Install the crankshaft sprocket on to the nose of the crankshaft.
3. Align the notch in the crankshaft sprocket with the pin in the crankshaft.
4. Slide the crankshaft sprocket on the crankshaft nose until the crankshaft sprocket contacts the step in the crankshaft.



**Fig. 92: View Of Timing Mark And Oil Pump Cover**  
Courtesy of GENERAL MOTORS CORP.

5. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the **EN 46111** . See **Special Tools** . Refer to **Timing Chain Alignment Diagram** - Stage One.



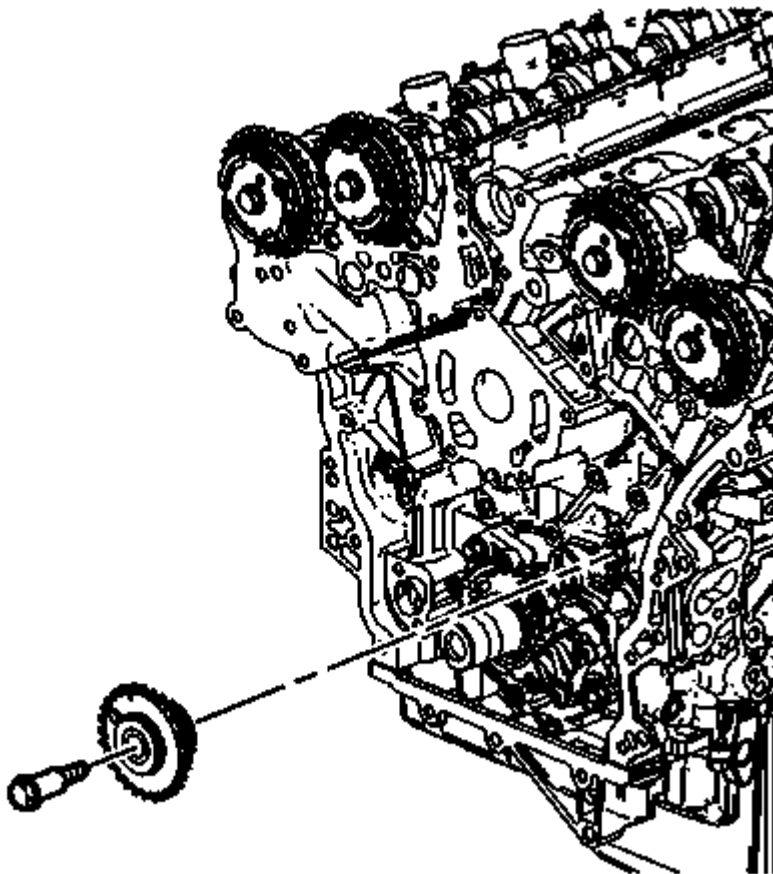
**Fig. 93: Identifying Primary Camshaft Timing Chain**  
Courtesy of GENERAL MOTORS CORP.

6. Install the primary camshaft timing chain. Refer to **Primary Camshaft Intermediate Drive Chain Installation** .
7. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
8. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
9. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Installation - Right Side** .
10. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Timing Chain Guide Installation - Right Side** .
11. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right Side** .
12. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Timing Chain Tensioner Installation - Right Side** .

13. Install the spark plugs. Refer to [Spark Plug Replacement](#) .
14. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

## **TIMING CHAIN IDLER SPROCKET REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**

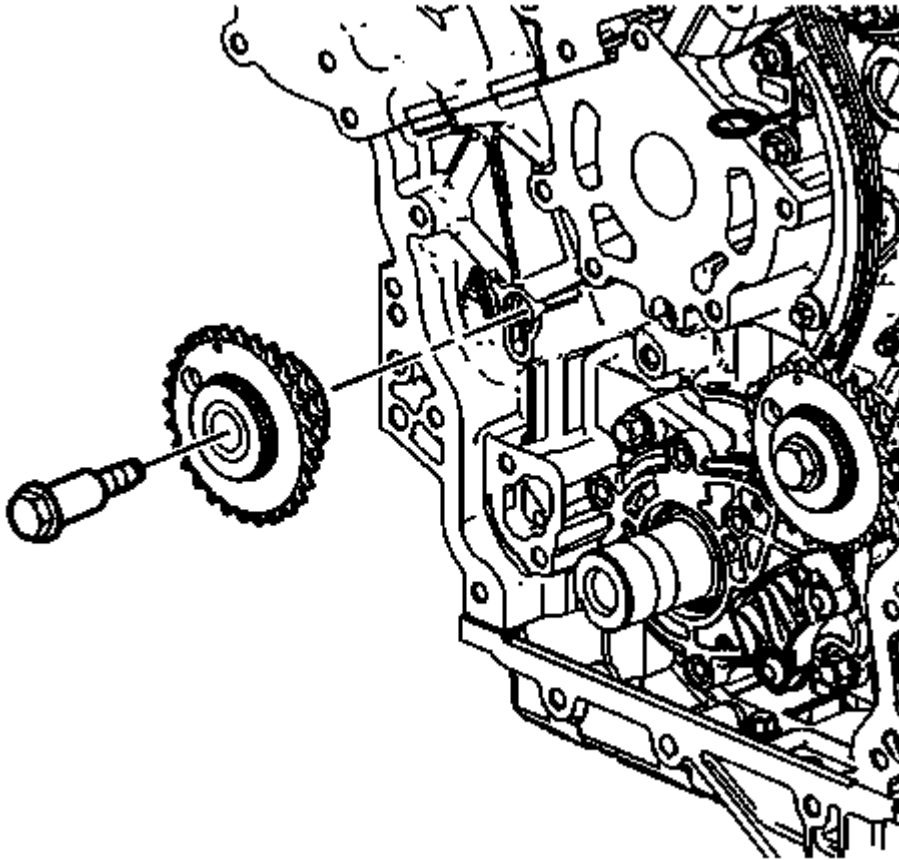


**Fig. 94: View Of Left Camshaft Intermediate Drive Chain Idler**  
Courtesy of GENERAL MOTORS CORP.

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

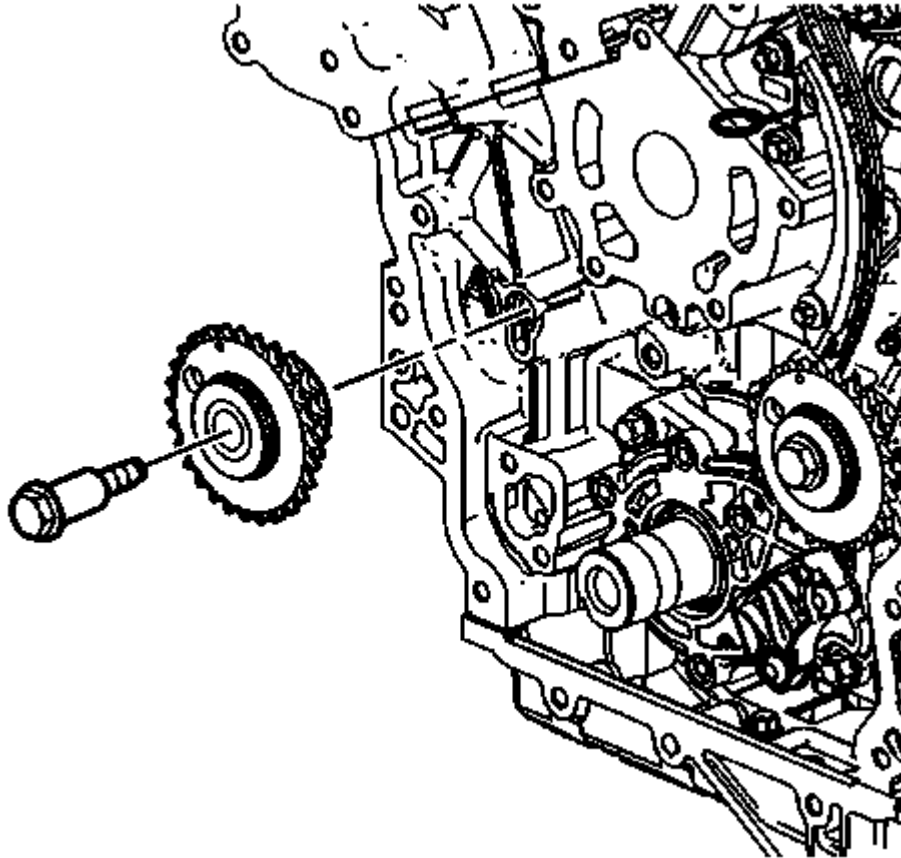
**Chain Tensioner Removal .**

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



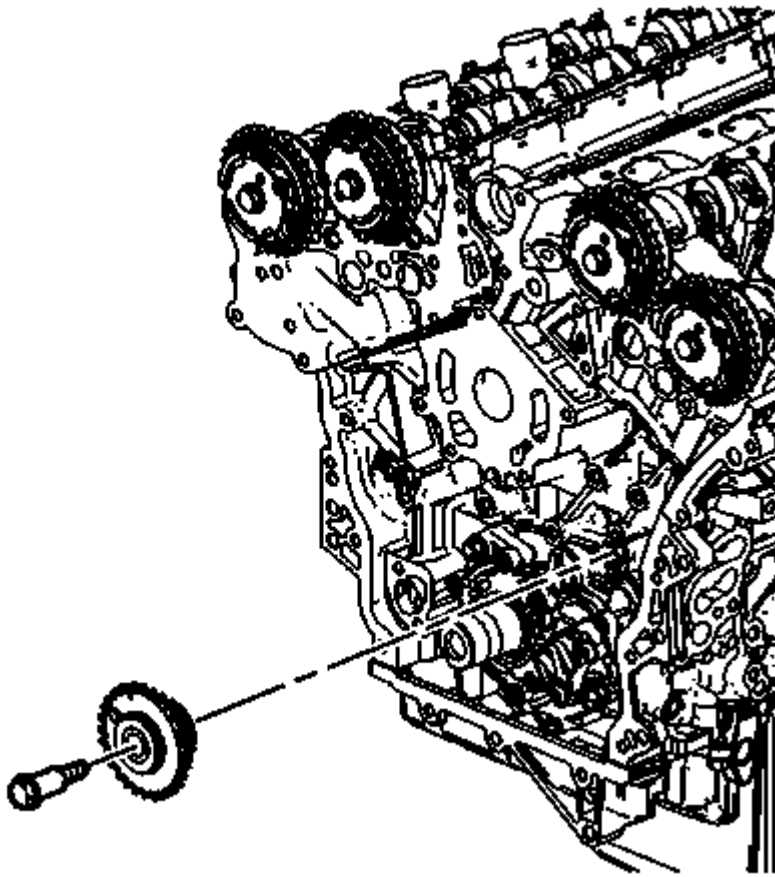
**Fig. 95: View Of Right & Left Camshaft Intermediate Drive Chain Idlers**  
Courtesy of GENERAL MOTORS CORP.

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

**Sprocket Removal - Left Side .****INSTALLATION PROCEDURE**

**Fig. 96: View Of Right & Left Camshaft Intermediate Drive Chain Idlers**  
**Courtesy of GENERAL MOTORS CORP.**

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

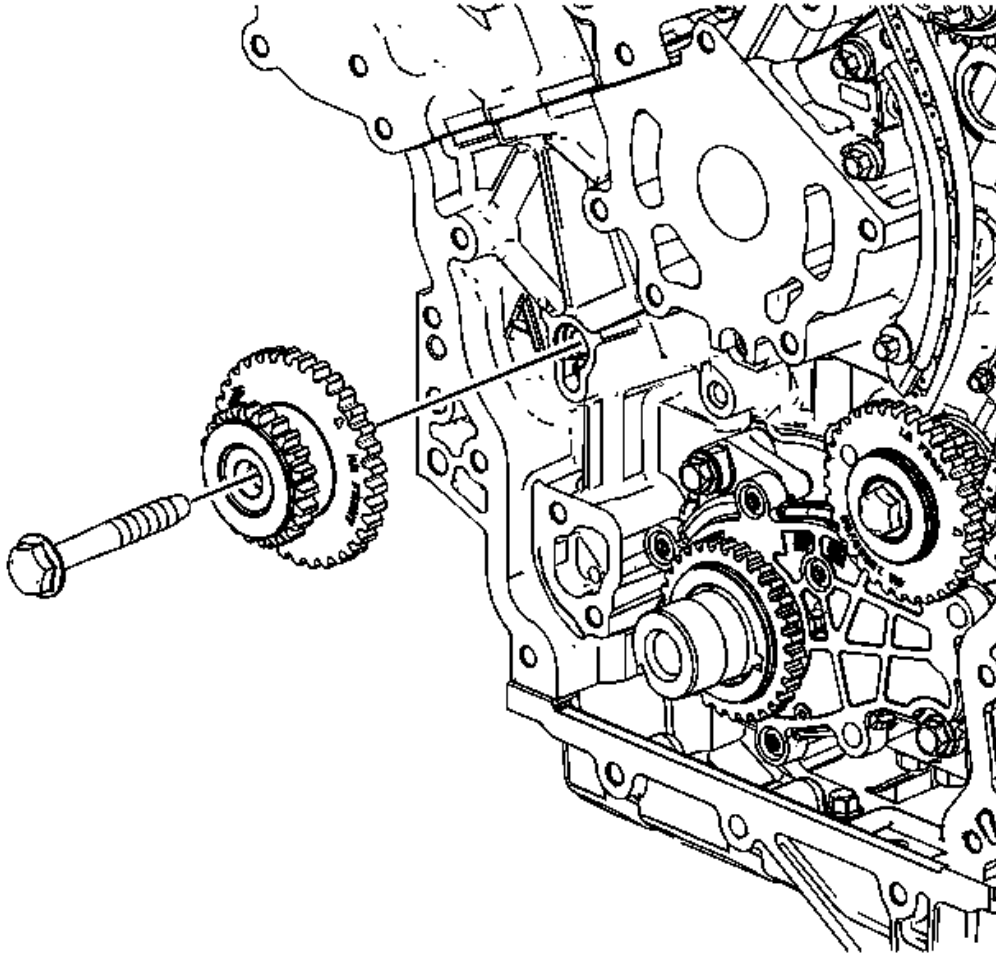


**Fig. 97: View Of Left Camshaft Intermediate Drive Chain Idler**  
Courtesy of GENERAL MOTORS CORP.

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

## **TIMING CHAIN IDLER SPROCKET REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

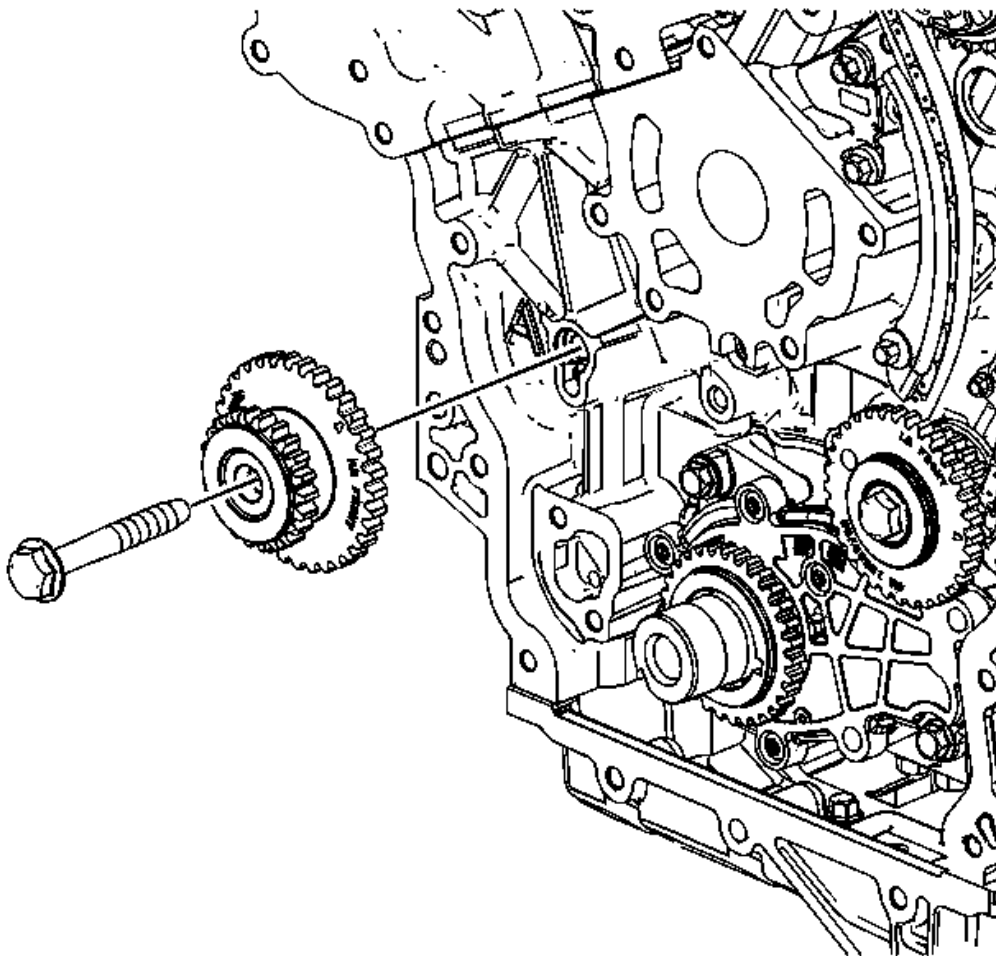


**Fig. 98: Identifying Camshaft Intermediate Drive Chain Idler & Bolt**  
Courtesy of GENERAL MOTORS CORP.

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

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

## INSTALLATION PROCEDURE



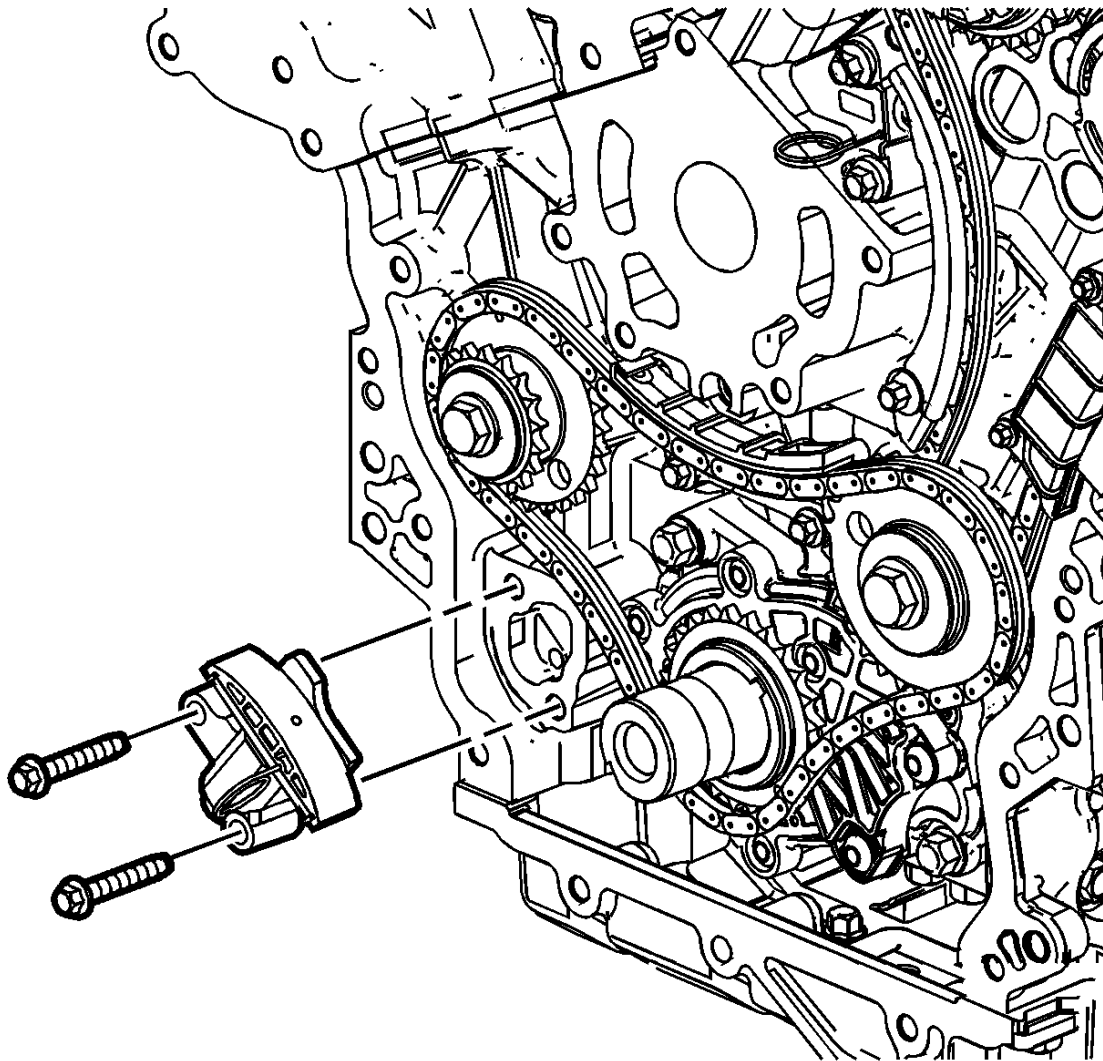
**Fig. 99: Identifying Camshaft Intermediate Drive Chain Idler & Bolt**  
Courtesy of GENERAL MOTORS CORP.

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

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

## **PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER REPLACEMENT**

### **REMOVAL PROCEDURE**



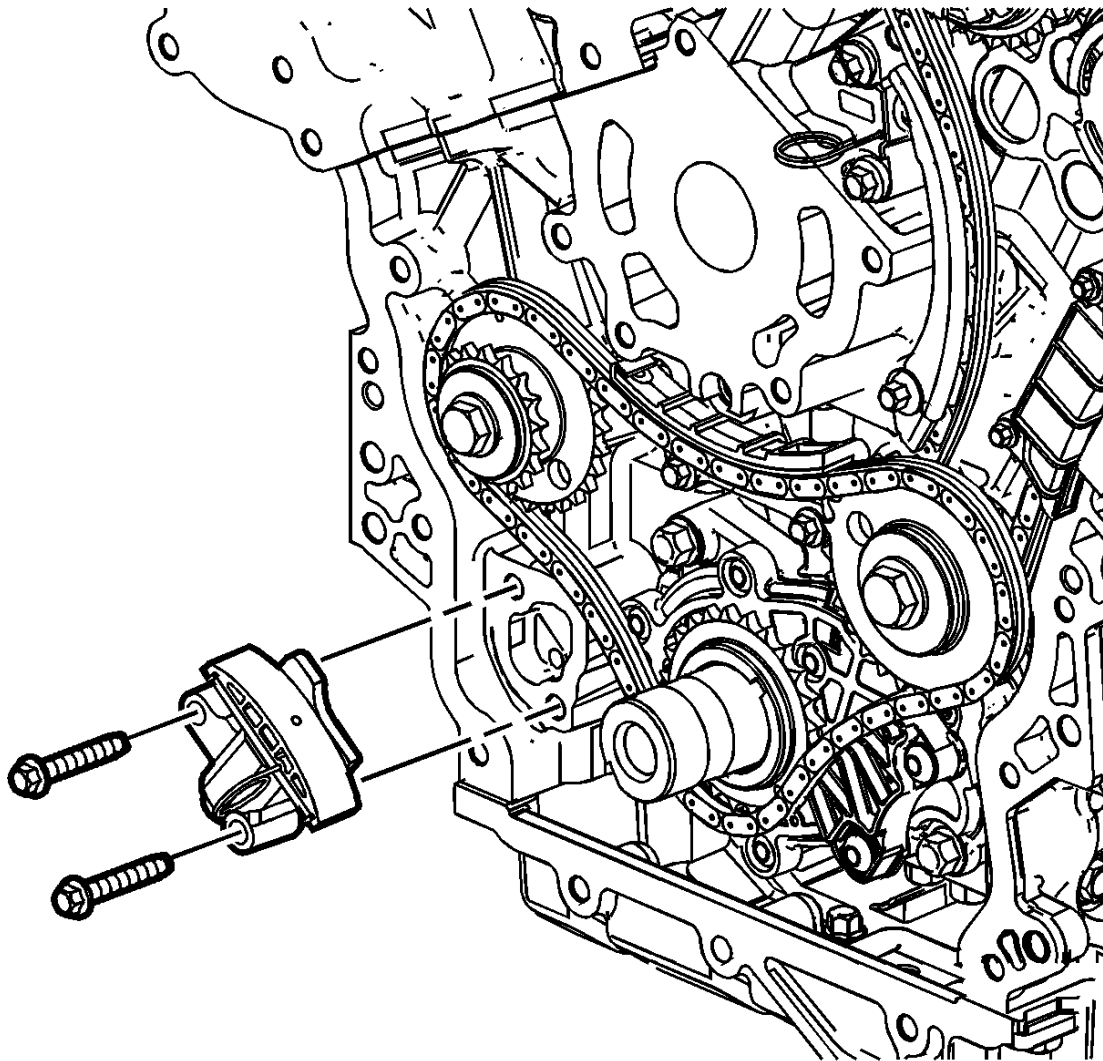
**Fig. 100: View Of Primary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement**.

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

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

## INSTALLATION PROCEDURE



**Fig. 101: View Of Primary Camshaft Drive Chain Tensioner**  
Courtesy of GENERAL MOTORS CORP.

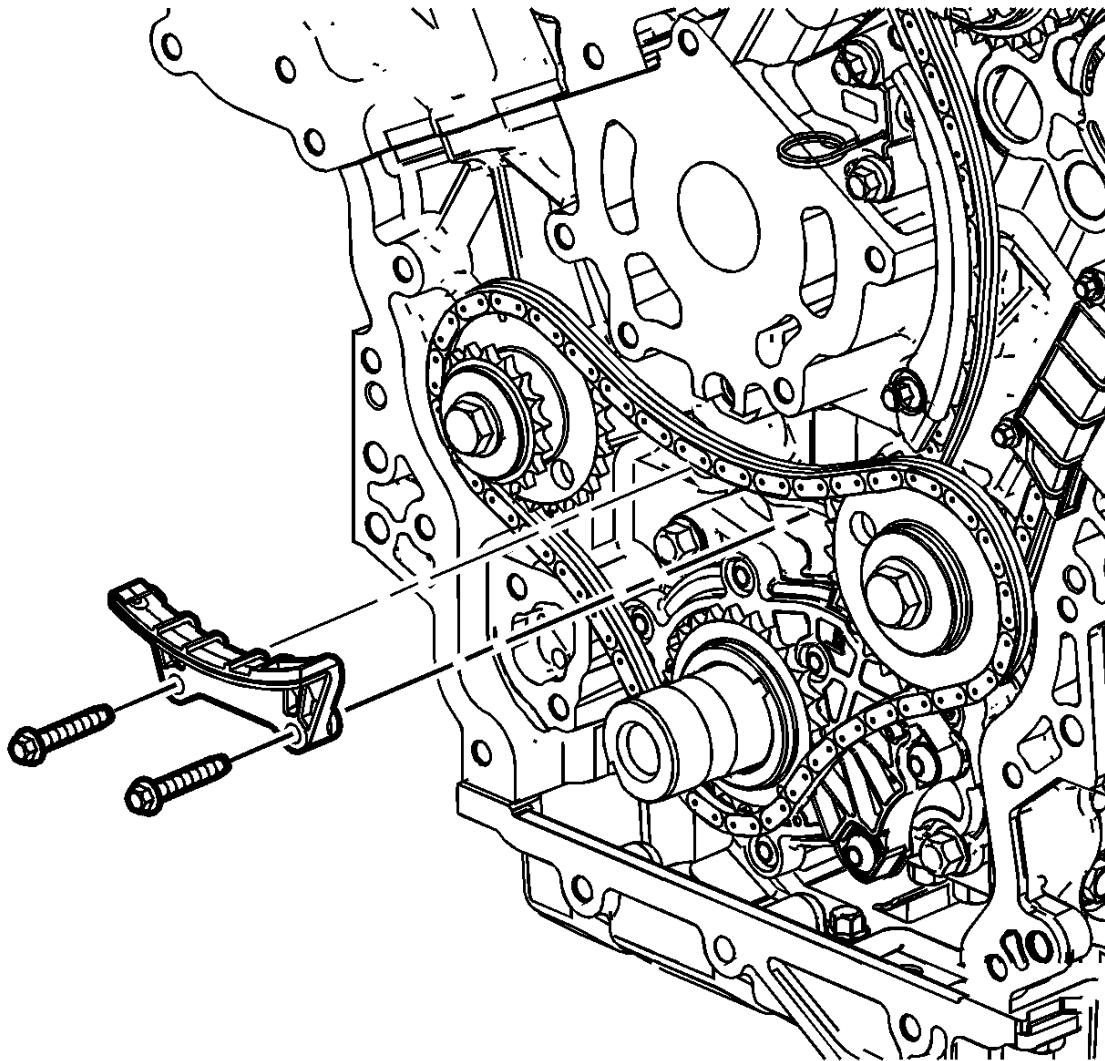
1. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
2. Install the spark plugs. Refer to **Spark Plug Replacement** .
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

## **PRIMARY TIMING CHAIN GUIDE REPLACEMENT - LOWER**

The primary camshaft drive chain guide is not serviceable separately. If the guide is worn or damaged, the guide must be replaced with the oil pump.

## **PRIMARY TIMING CHAIN GUIDE REPLACEMENT - UPPER**

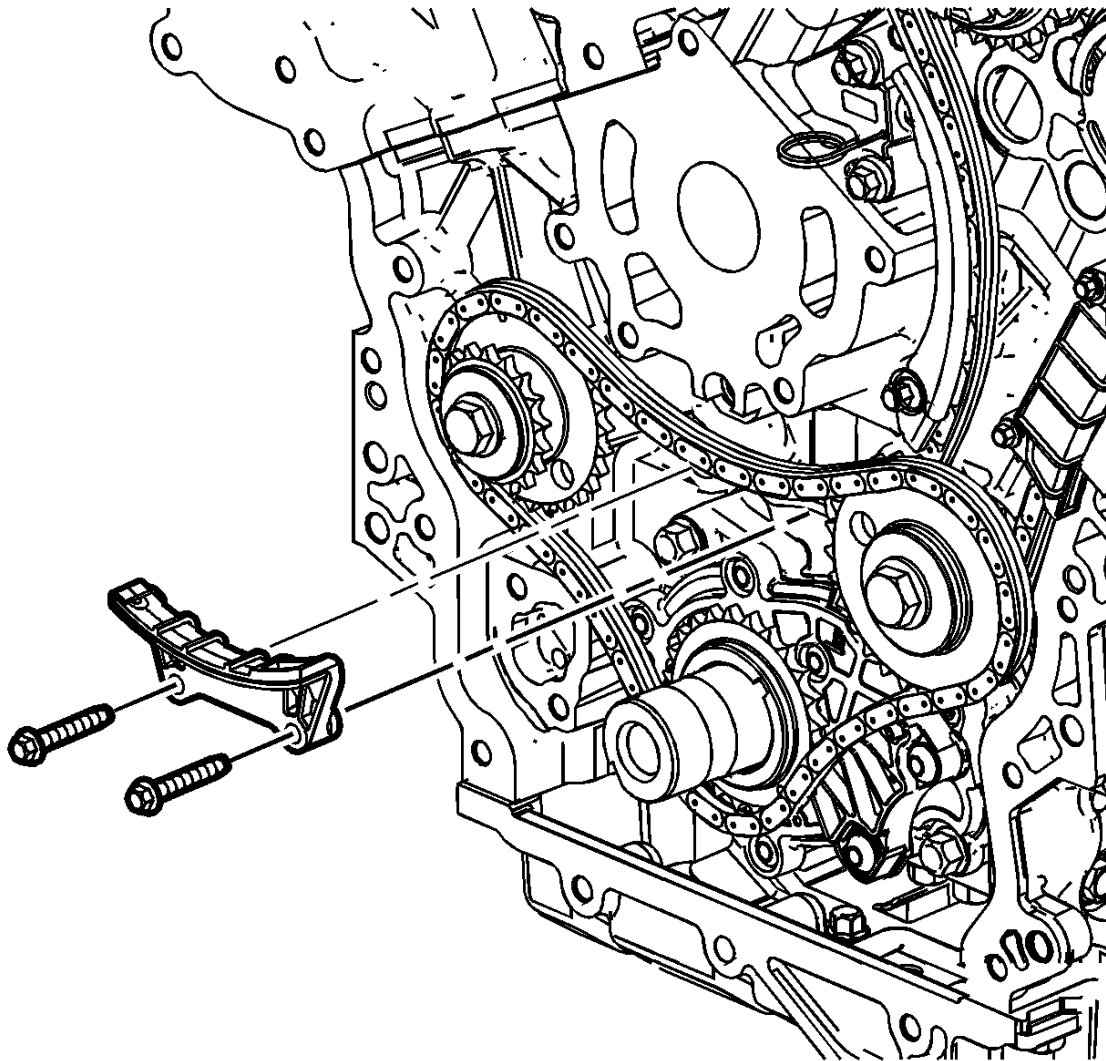
### **REMOVAL PROCEDURE**



**Fig. 102: View Of Upper Primary Camshaft Drive Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** .
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Removal** .
4. Remove the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Removal - Upper** .

## INSTALLATION PROCEDURE



**Fig. 103: View Of Upper Primary Camshaft Drive Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

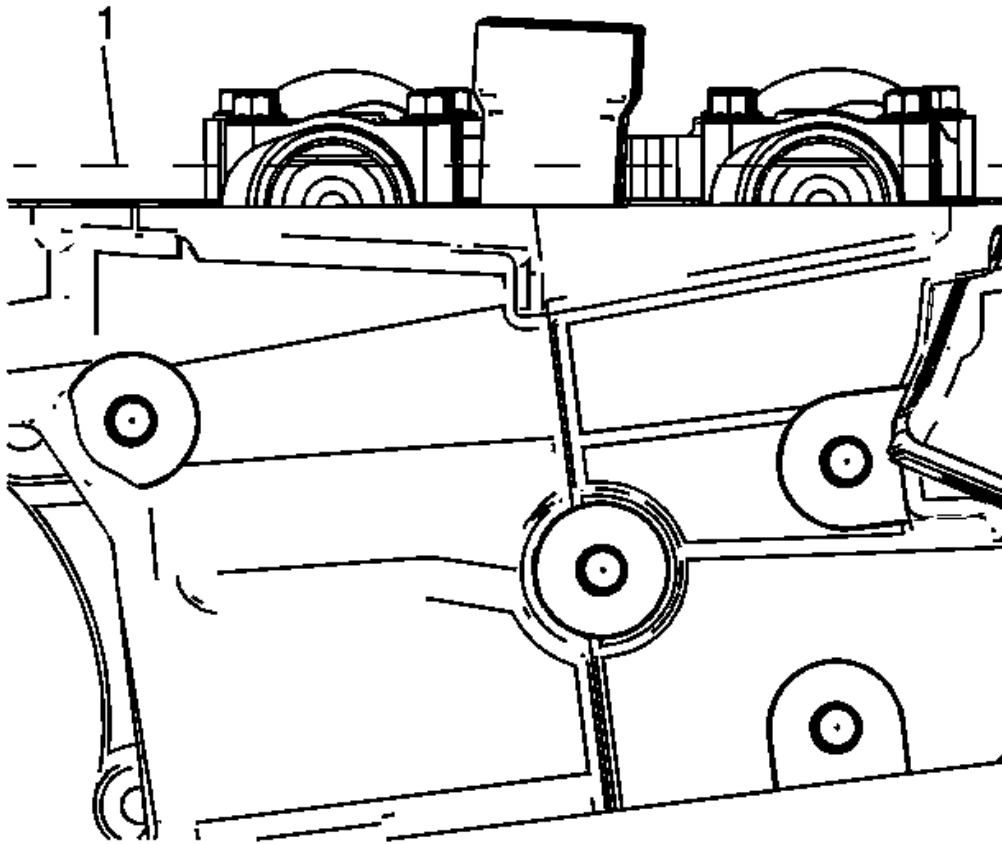
1. Install the primary upper camshaft drive chain guide. Refer to **Primary Timing Chain Guide Installation - Upper** .
2. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Intermediate Drive Chain Tensioner Installation** .
3. Install the engine front cover. Refer to **Engine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

## **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) EXHAUST**

### **SPECIAL TOOLS**

**EN-48313:** Timing Chain Retention Tool

## REMOVAL PROCEDURE

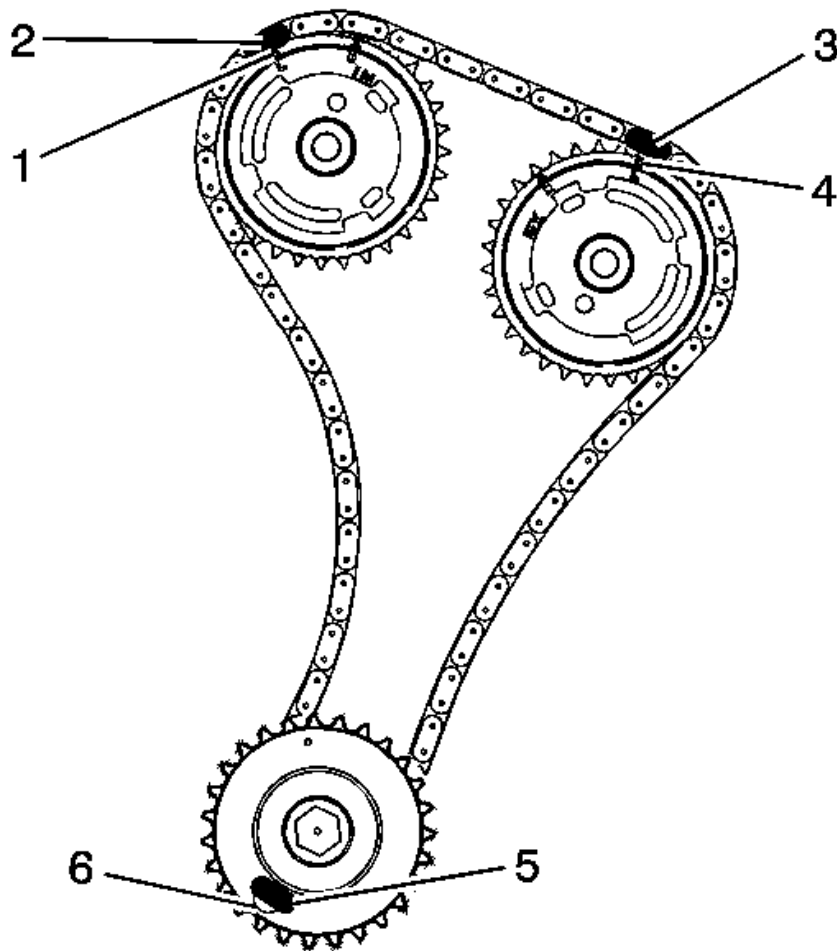


**Fig. 104: Identifying Camshaft Flats Parallel With Camshaft Cover Rail**  
Courtesy of GENERAL MOTORS CORP.

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

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

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



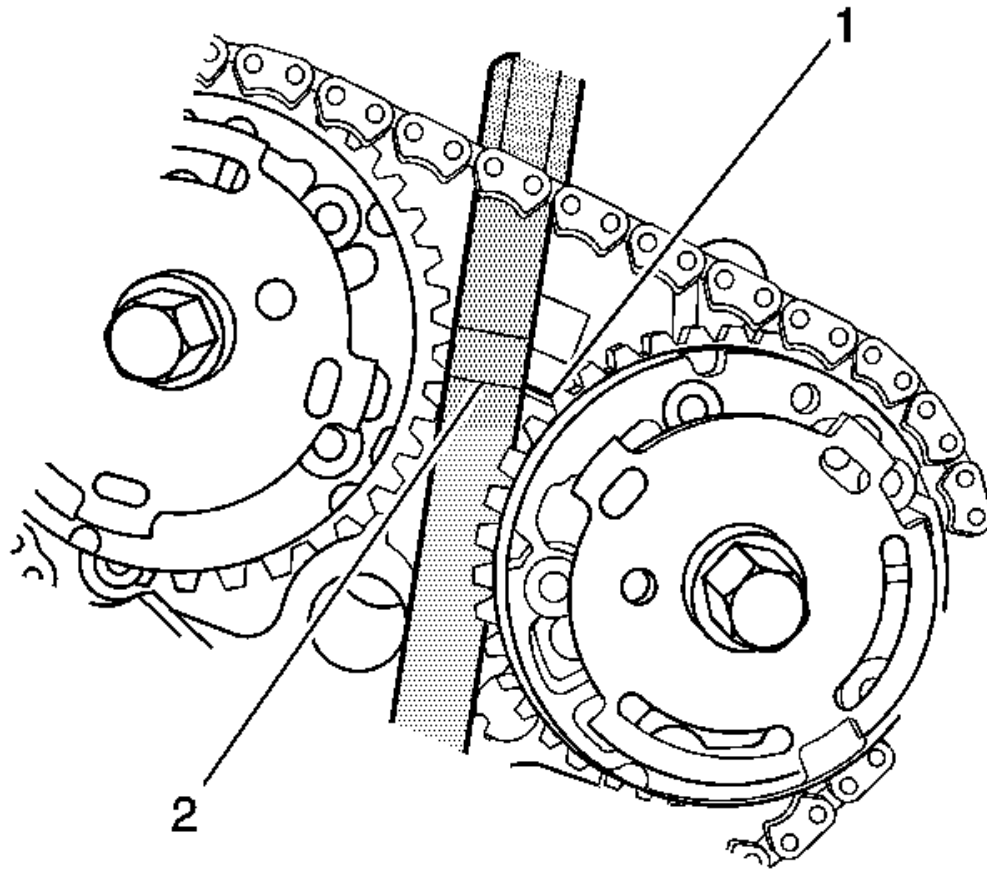
**Fig. 105: Locating Left Secondary Camshaft Drive Chain Timing Marks**  
Courtesy of GENERAL MOTORS CORP.

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

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

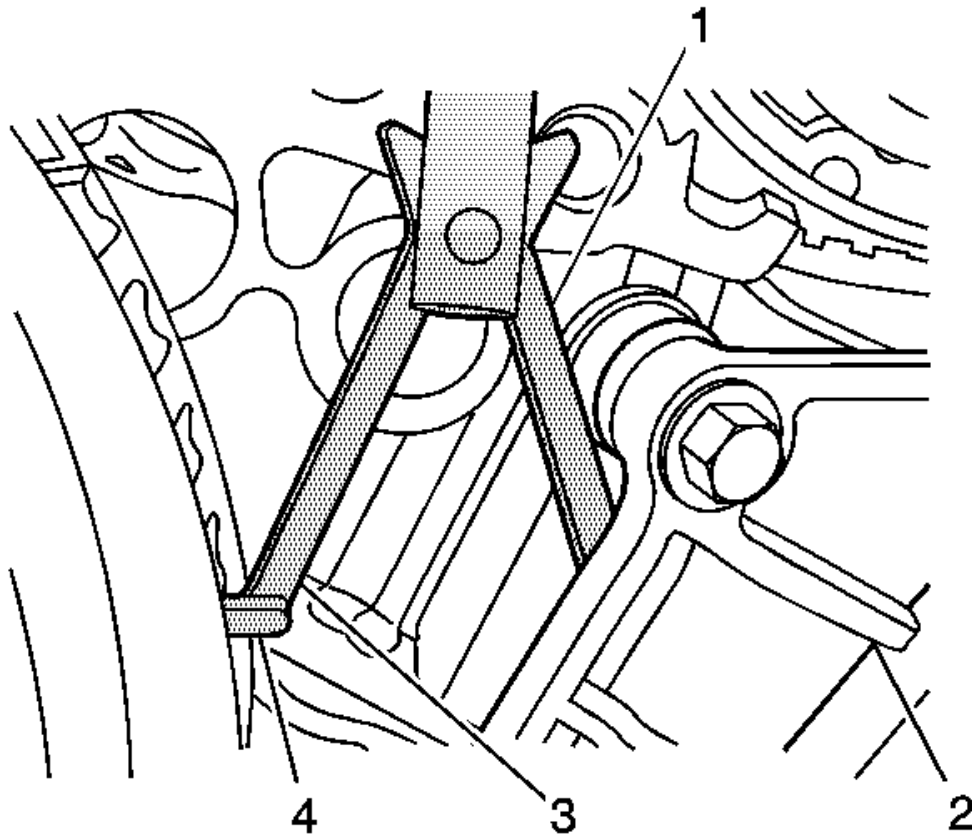
**CAUTION:** Refer to Torque Reaction Against Timing Drive Chain Caution .

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



**Fig. 106: Inserting Timing Chain Retention Tool**  
Courtesy of GENERAL MOTORS CORP.

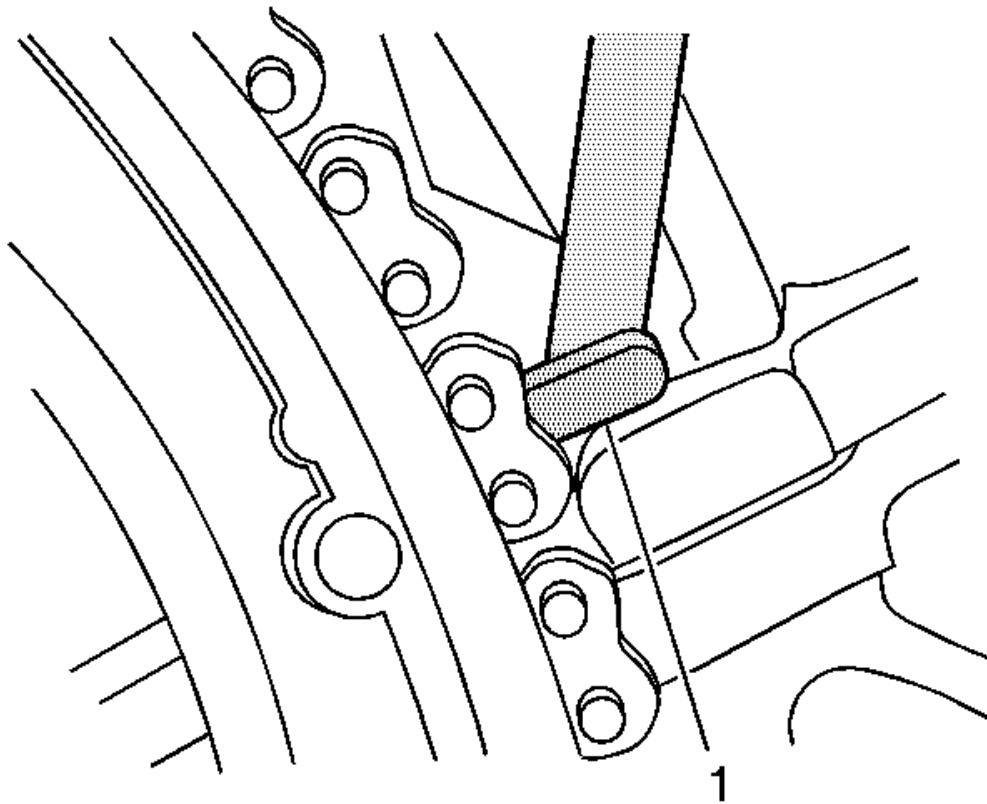
9. Unscrew the **EN-48313**: tool so that the legs of the tool are retracted.
10. Insert the **EN-48313**: tool between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This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



**Fig. 107: Identifying Feet & Legs Of Timing Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

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

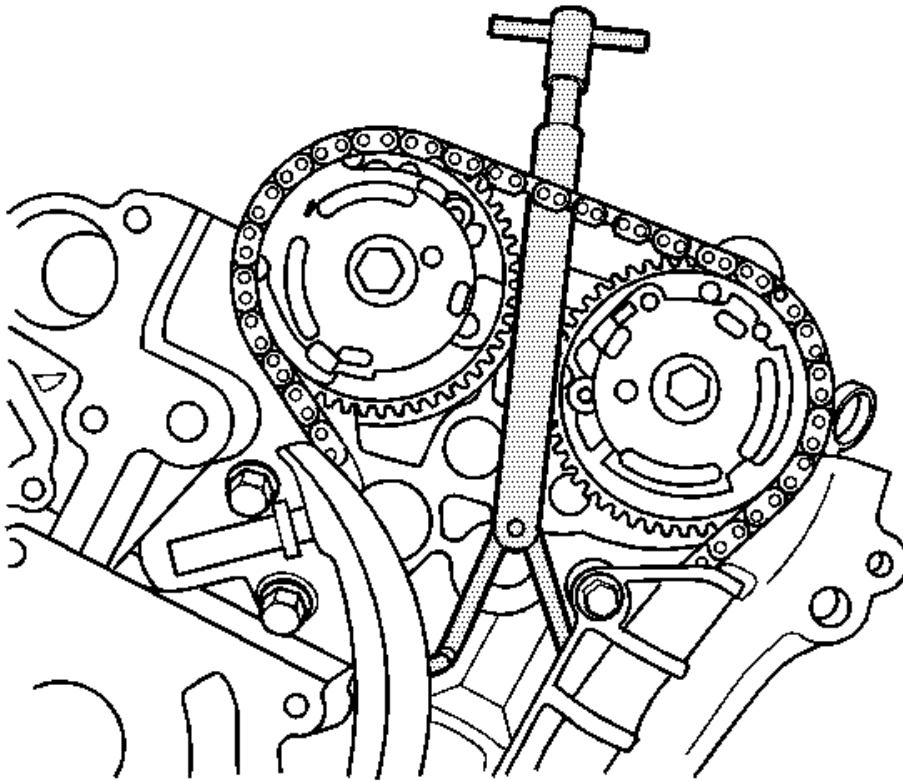
11. Ensure that the feet (4) on the legs of the tool are facing the front of the engine.
12. Partially expand the legs (1, 3) of the **EN-48313** tool by turning the T-shaped handle clockwise.
13. Insert the leg of the tool (1) behind the timing chain guide (2).
14. Continue expanding the **EN-48313**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



**Fig. 108: Foot of Timing Chain Retention Tool EN-48313**  
Courtesy of GENERAL MOTORS CORP.

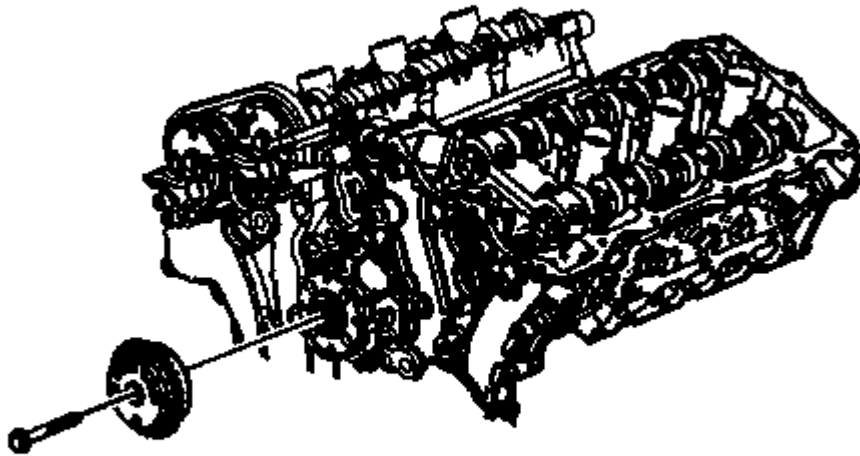
**NOTE:** Ensure that the foot (1) of the EN-48313: tool is engaged into one of the link pockets to prevent tool slippage during tightening of the EN-48313: tool.

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



**Fig. 109: Identifying Special Tool - EN-48313**  
Courtesy of GENERAL MOTORS CORP.

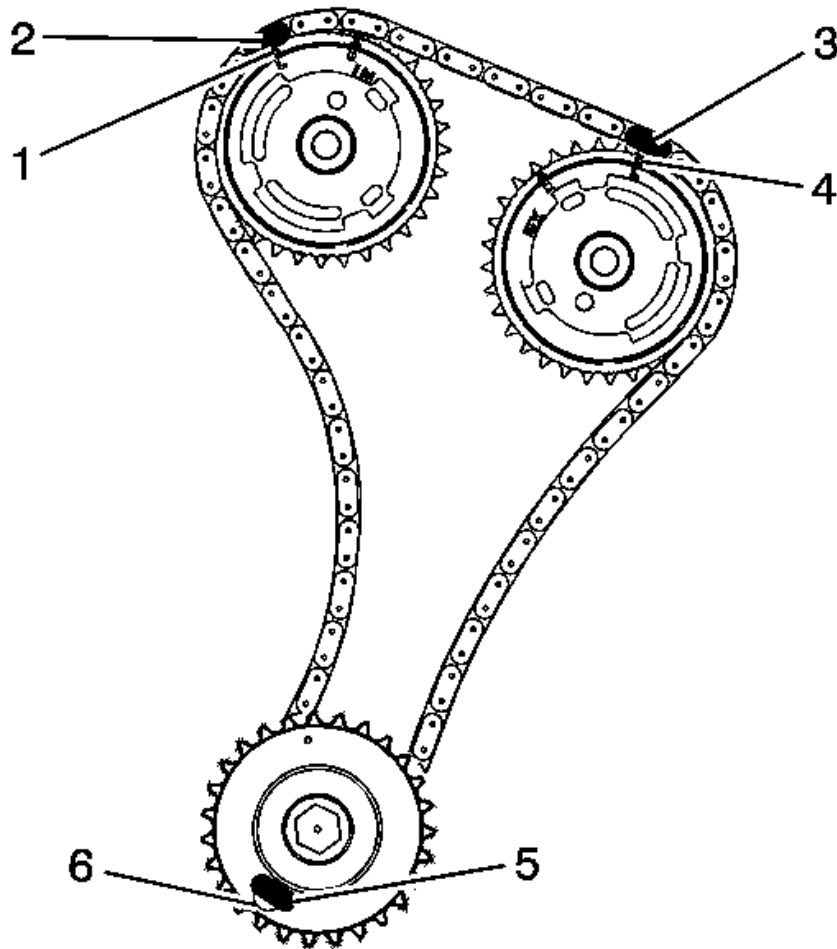
17. The **EN-48313** tool is now properly installed to hold the timing chain in position.



**Fig. 110: View Of Camshaft Position Actuator**  
**Courtesy of GENERAL MOTORS CORP.**

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

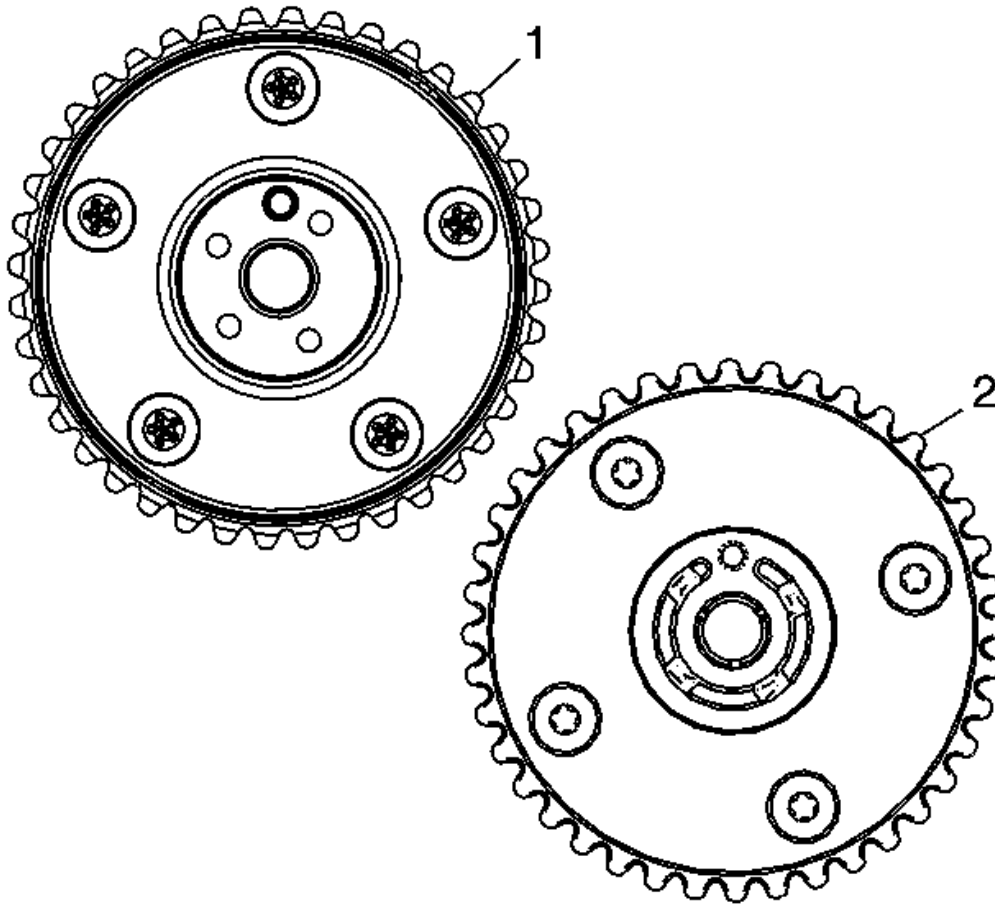
## **INSTALLATION PROCEDURE**



**Fig. 111: Locating Left Secondary Camshaft Drive Chain Timing Marks**  
Courtesy of GENERAL MOTORS CORP.

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

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

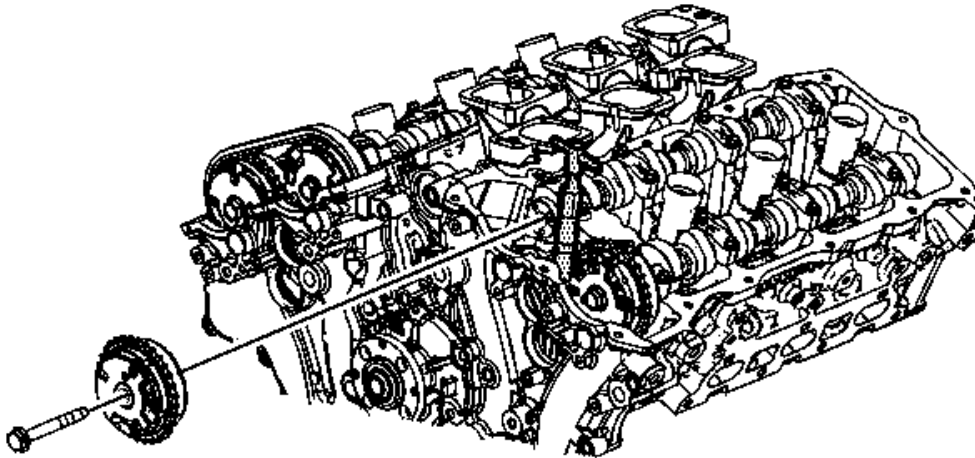


**Fig. 112: Identifying Camshaft Position Actuators**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:**

- The camshaft position actuator will vary depending on application.
- Camshaft thrust washers must be installed on all 2010 applications when servicing the camshaft position actuators. Do not install washers on 2009 applications if they are not already present.

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



**Fig. 113: View Of Camshaft Position Actuator Bolt**  
Courtesy of GENERAL MOTORS CORP.

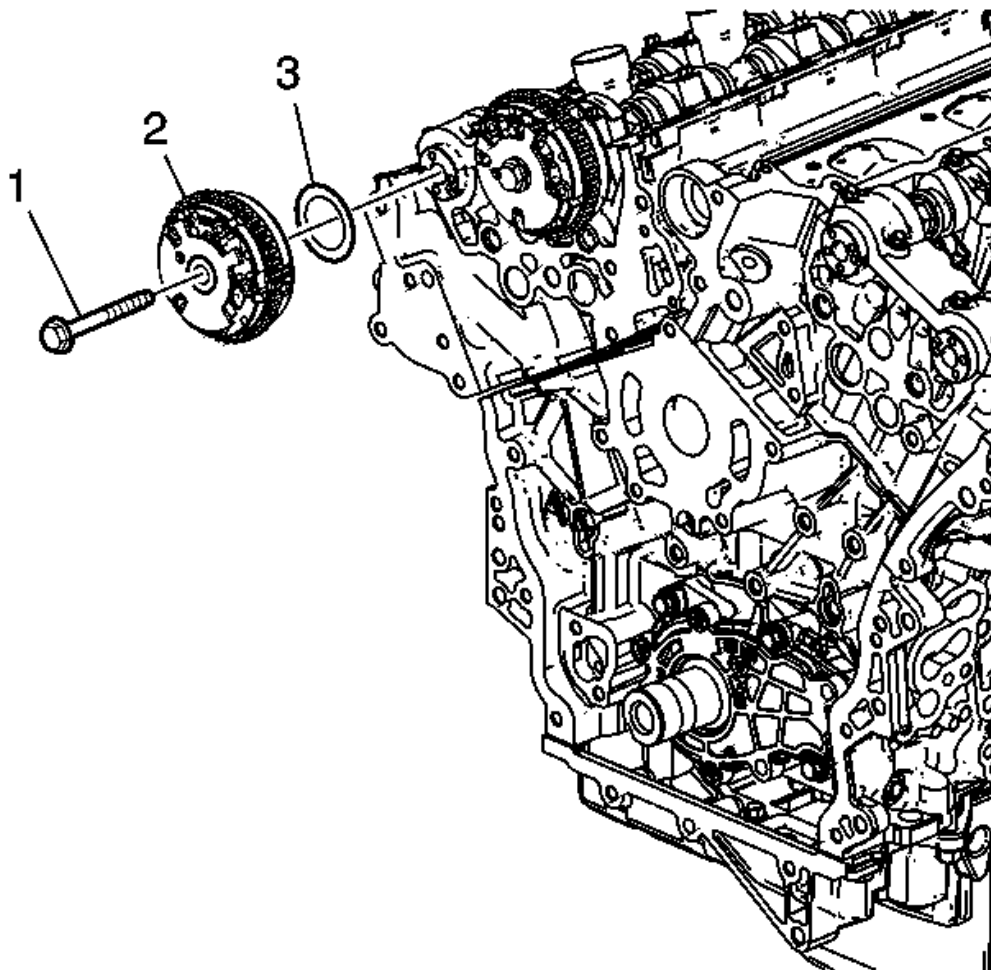
**CAUTION: Refer to Fastener Caution .**

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

## **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE)**

## EXHAUST

### REMOVAL PROCEDURE



**Fig. 114: Identifying Camshaft Position Actuator & Bolt**  
Courtesy of GENERAL MOTORS CORP.

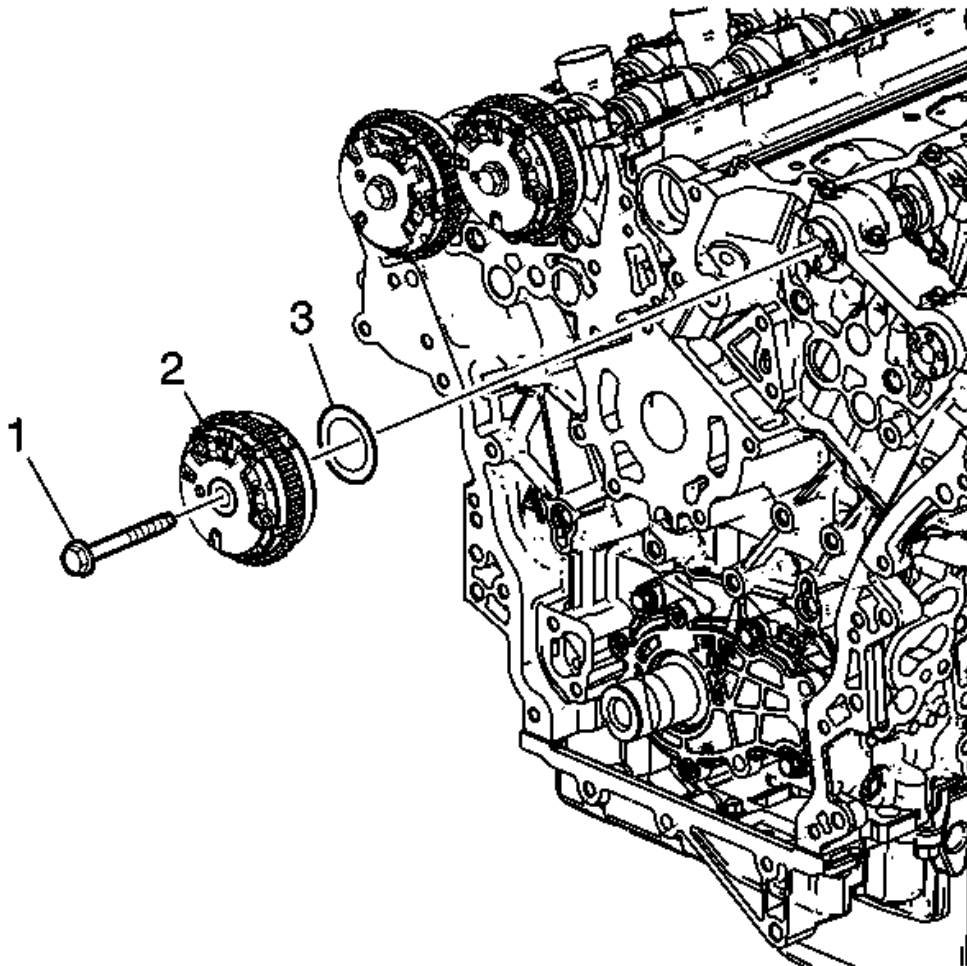
1. Remove the right hand secondary camshaft intermediate drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Right Side**.
2. Use an open end wrench on the hex cast into the camshaft in order to prevent engine rotation when loosening the camshaft position actuator bolt.
3. Remove the right exhaust camshaft position actuator bolt (1).
4. Remove the right exhaust camshaft position actuator (2).
5. Remove the camshaft thrust washer (3), if applicable.

### INSTALLATION PROCEDURE

1. Install the exhaust camshaft position actuator. Refer to **Camshaft Position Actuator Installation - Right**

**Side Exhaust .**

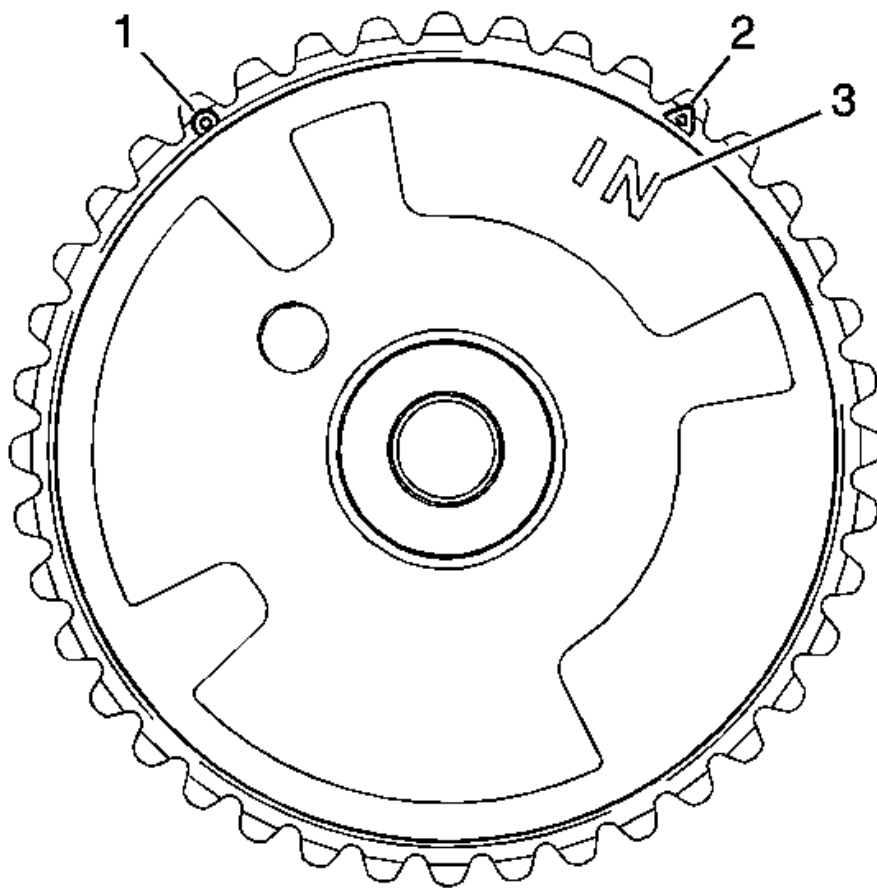
2. Install the right side secondary camshaft intermediate drive chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Right Side.**

**CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 2 (LEFT SIDE) INTAKE****REMOVAL PROCEDURE**

**Fig. 115: View Of Camshaft Position Actuator Bolt**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the left exhaust camshaft actuator. Refer to **Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust.**
2. Remove the intake camshaft position actuator bolt.
3. Remove the left intake camshaft position actuator.

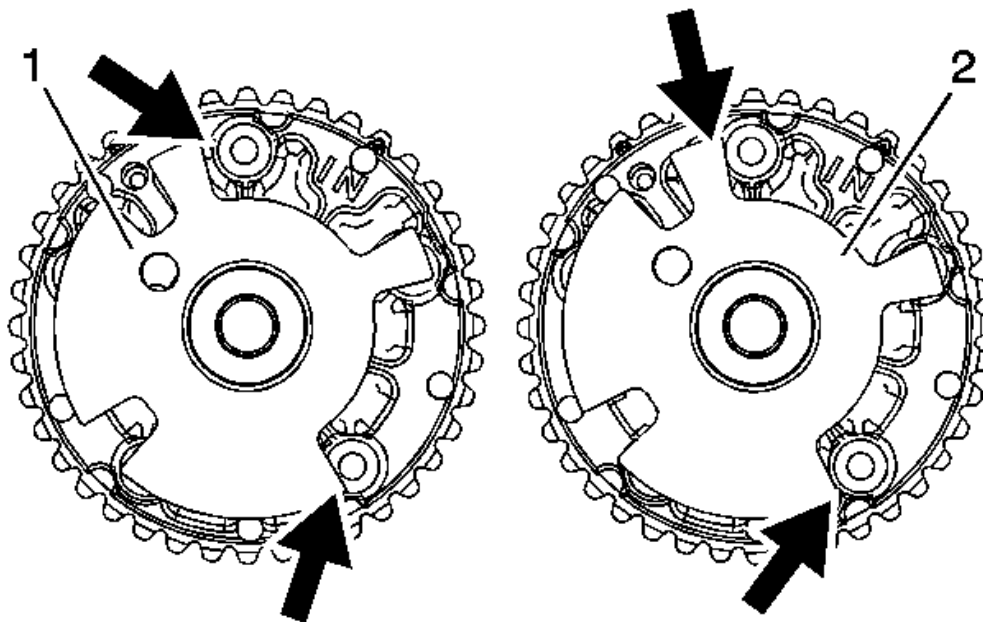
**INSTALLATION PROCEDURE**



**Fig. 116: Identifying Camshaft Position Actuator Marks**  
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the IN marking (3).

The marking is for an intake camshaft position actuator.

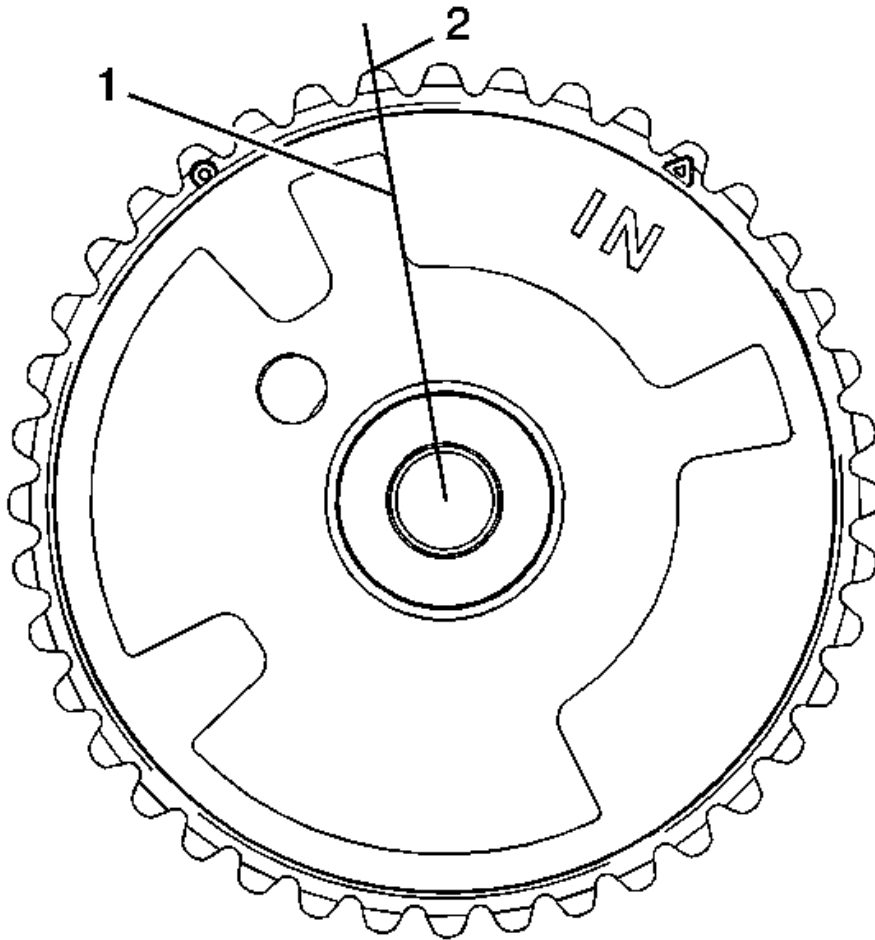


**Fig. 117: View Of Right Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator**

Courtesy of GENERAL MOTORS CORP.

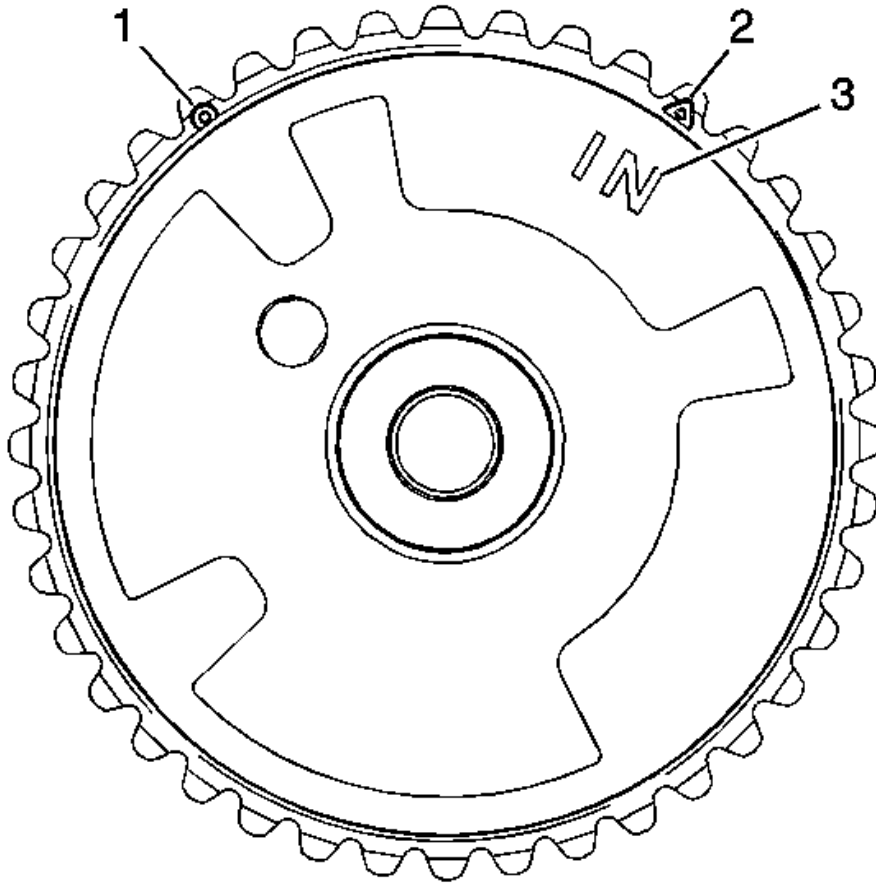
**CAUTION:** Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).



**Fig. 118: View Of Reluctor Wheel Lines Up With Peak**  
Courtesy of GENERAL MOTORS CORP.

3. On the left intake camshaft actuator the edge of the reluctor wheel (1) lines up with the peak (2) of the sprocket tooth.



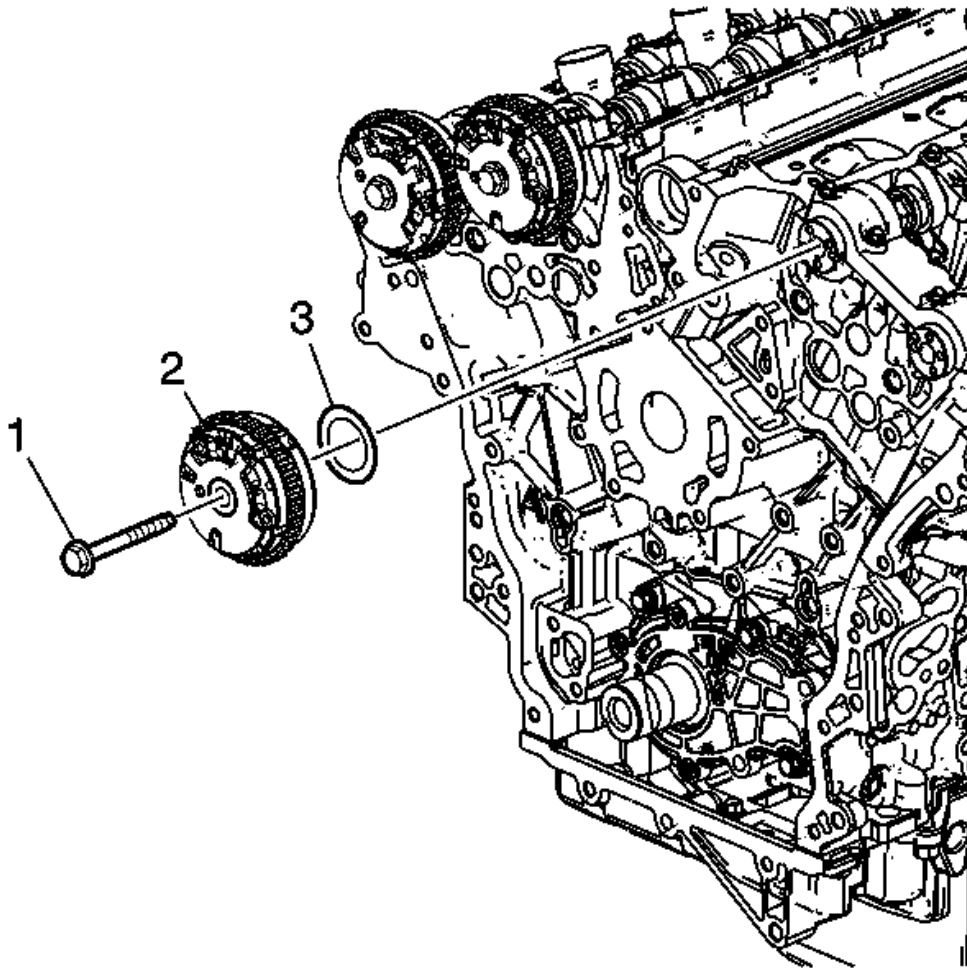
**Fig. 119: Identifying Camshaft Position Actuator Marks**  
Courtesy of GENERAL MOTORS CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (1).

The circle marking is for alignment to the highlighted timing chain link on the left side of the engine.

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

5. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.



**Fig. 120: View Of Camshaft Position Actuator Bolt**  
Courtesy of GENERAL MOTORS CORP.

6. Locate the intake camshaft position actuator to the camshaft and loosely install the bolt.

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

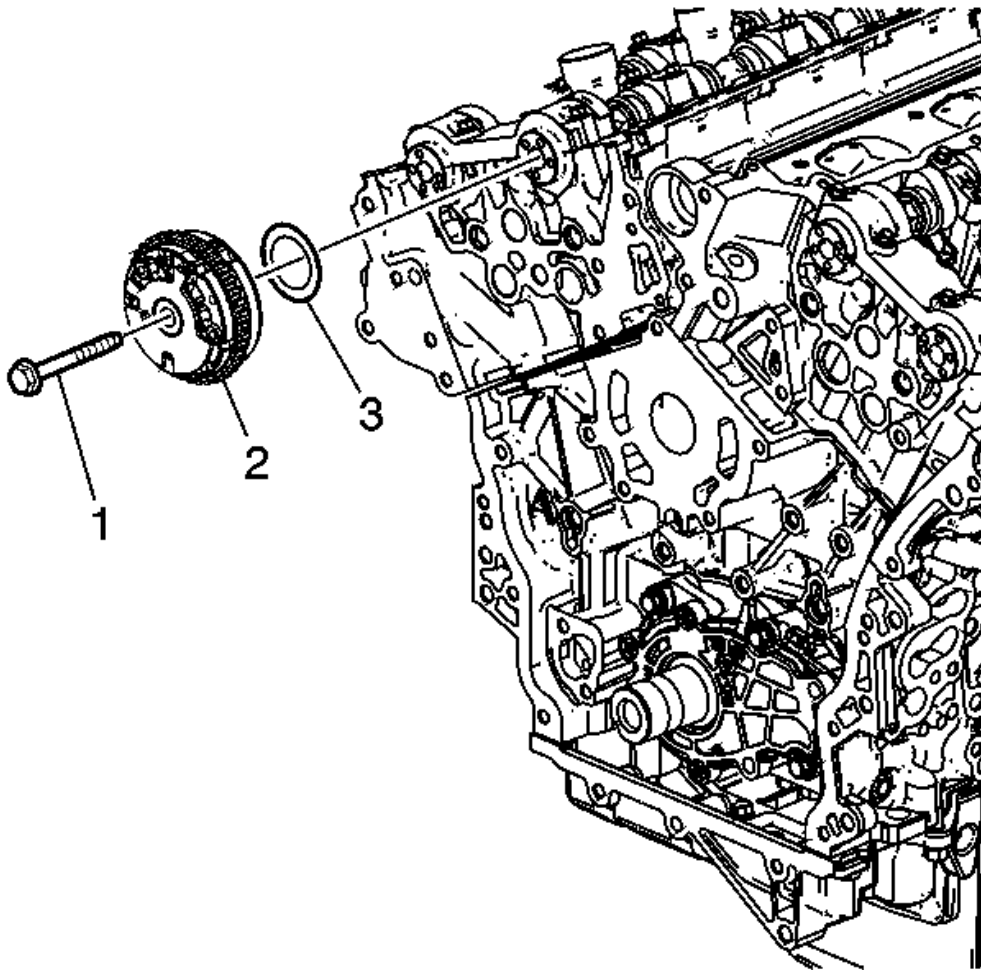
**NOTE:** Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

7. Tighten the camshaft position actuator bolt. Refer to Camshaft Position Actuator Installation - Left Side Intake .
8. Install the left exhaust camshaft actuator. Refer to Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust.

## **CAMSHAFT POSITION ACTUATOR REPLACEMENT - BANK 1 (RIGHT SIDE)**

## INTAKE

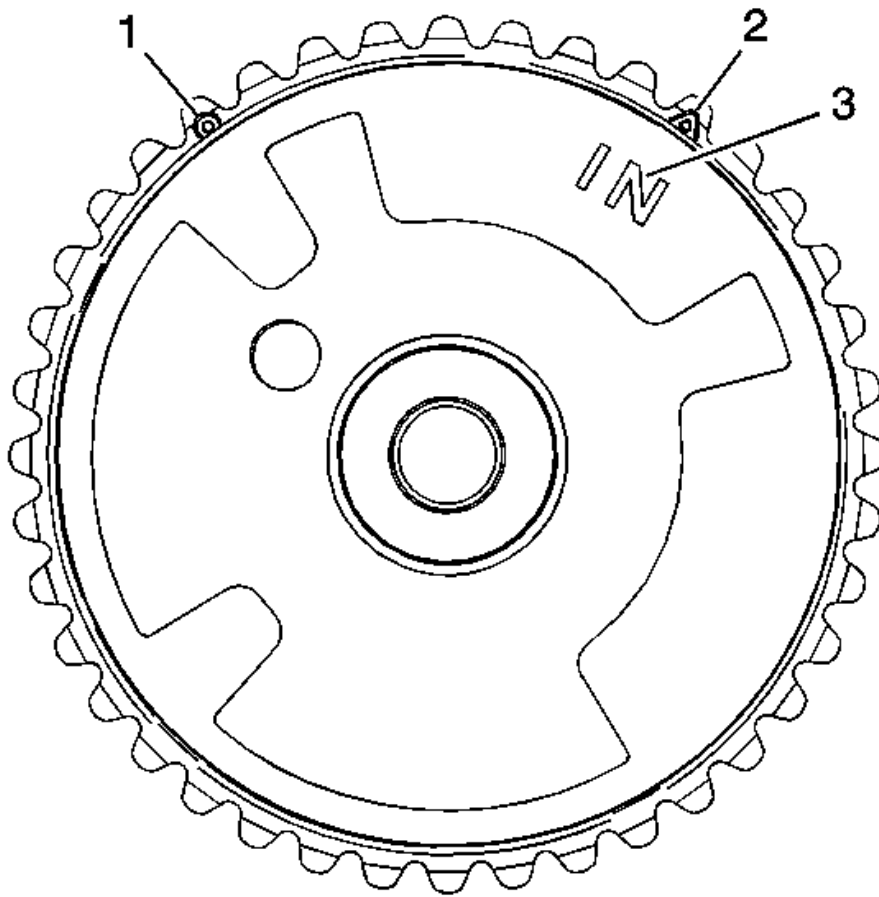
### REMOVAL PROCEDURE



**Fig. 121: Identifying Intake Camshaft Position Actuator & Bolt**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the right exhaust camshaft actuator. Refer to **Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust**.
2. Remove the intake camshaft position actuator bolt.
3. Remove the right intake camshaft position actuator.

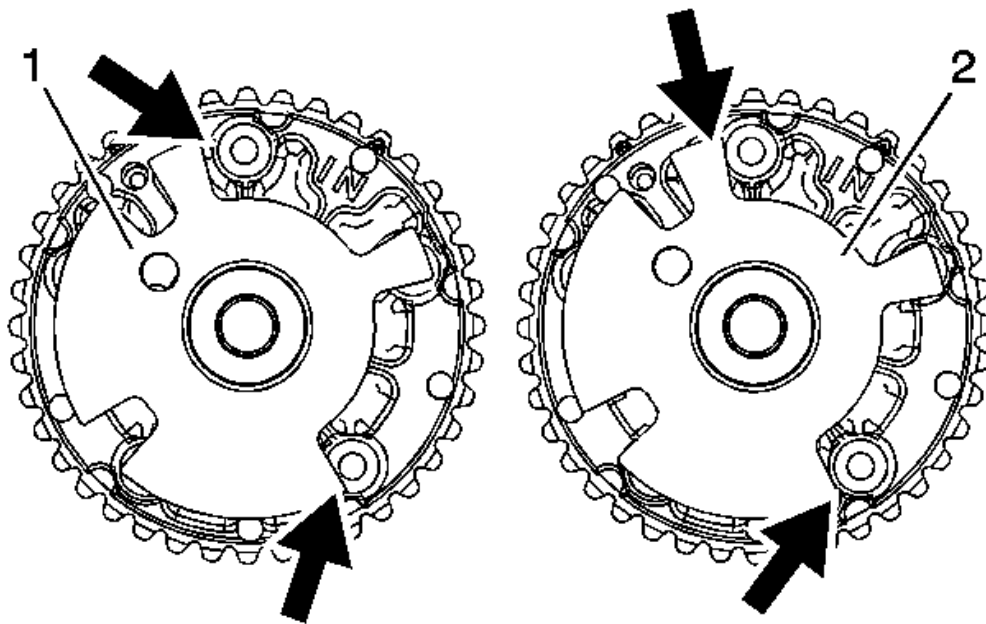
### INSTALLATION PROCEDURE



**Fig. 122: View Of Camshaft Position Actuator Markings**  
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the IN marking (3).

The marking is for an exhaust camshaft position actuator.

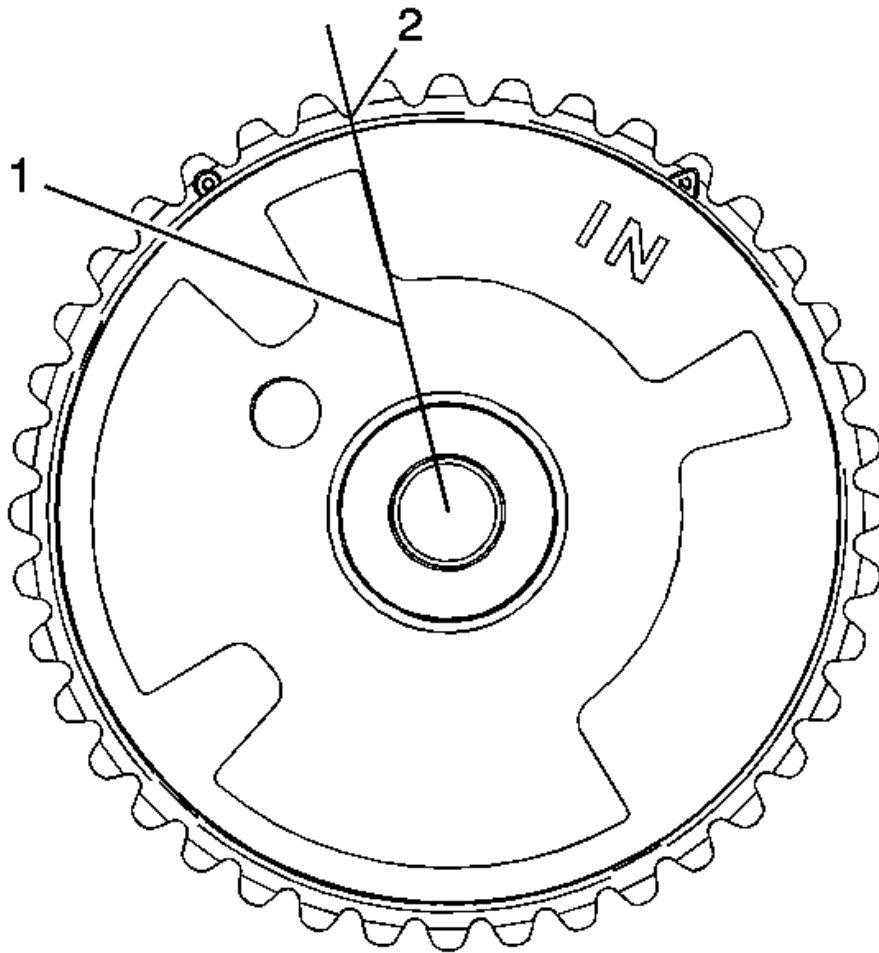


**Fig. 123: View Of Right Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator**

Courtesy of GENERAL MOTORS CORP.

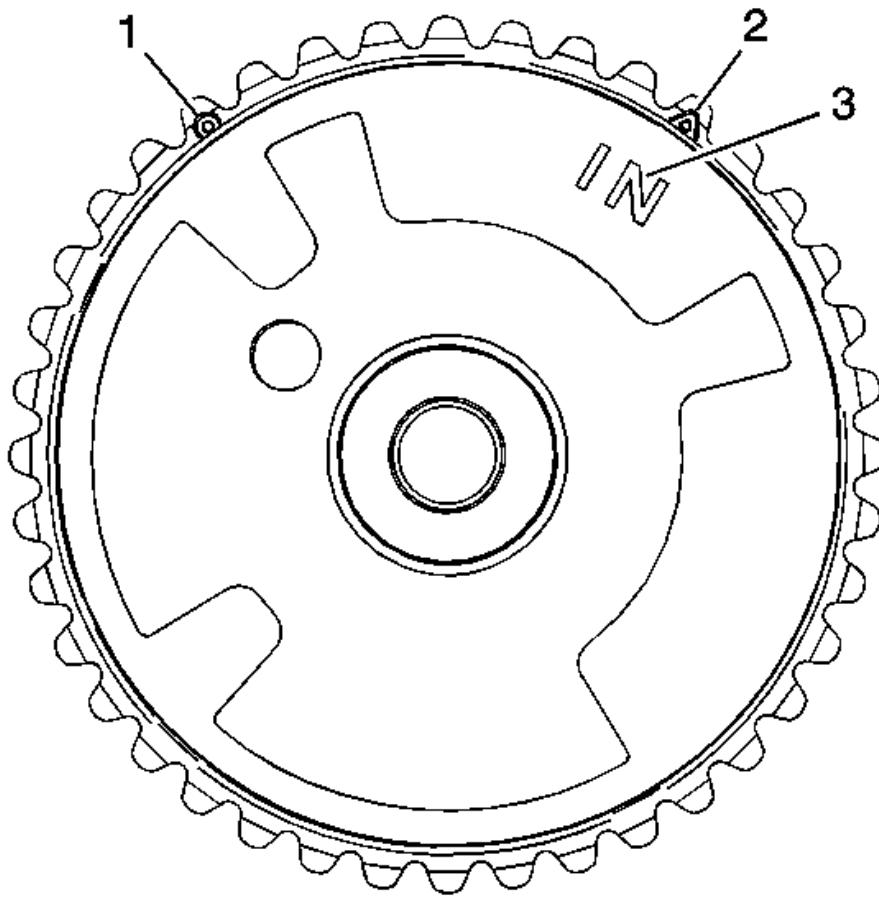
**CAUTION:** Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).



**Fig. 124: View Of Reluctor Wheel & Valley**  
**Courtesy of GENERAL MOTORS CORP.**

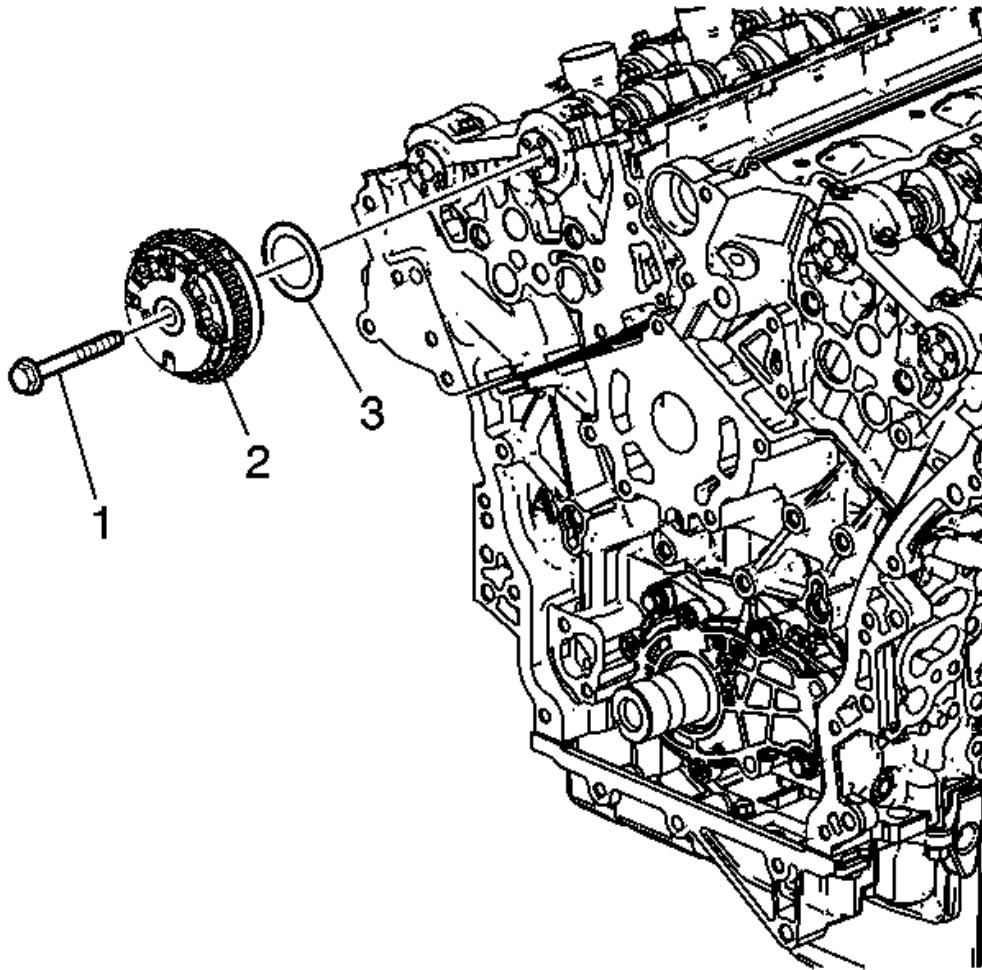
3. On the right intake camshaft actuator the edge of the reluctor wheel (1) lines up with the valley (2) of the sprocket tooth.



**Fig. 125: View Of Camshaft Position Actuator Markings**  
Courtesy of GENERAL MOTORS CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2).

The triangle marking is for alignment to the highlighted timing chain link on the right side of the engine.



**Fig. 126: Identifying Intake Camshaft Position Actuator & Bolt**  
Courtesy of GENERAL MOTORS CORP.

5. Locate the intake camshaft position actuator to the camshaft and loosely install the bolt.

**CAUTION:** Refer to Fastener Caution .

**NOTE:** Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Tighten the camshaft position actuator bolt. Refer to Camshaft Position Actuator Installation - Right Side Intake .
7. Install the right exhaust camshaft actuator. Refer to Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust.

## SETTING CAMSHAFT TIMING

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

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

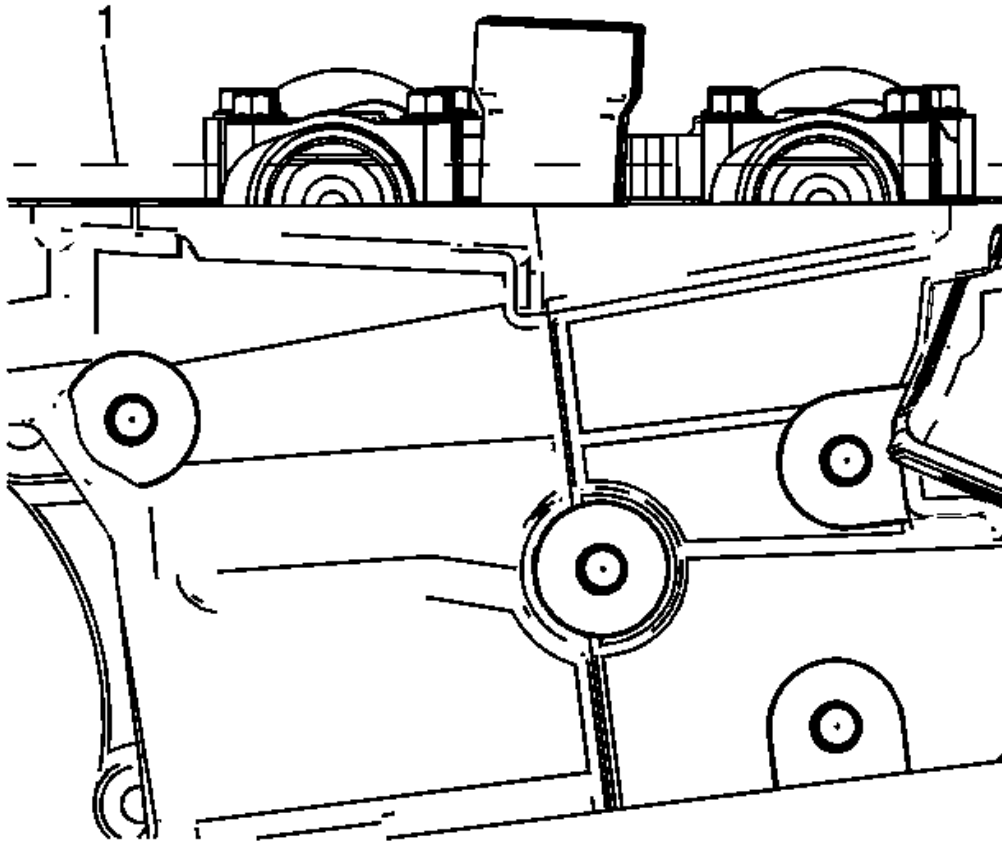
## **CAMSHAFT REPLACEMENT - LEFT SIDE**

### **SPECIAL TOOLS**

- **EN-48313** Timing Chain Retention Tool. See Special Tools .
- **EN 46111** Crankshaft Rotation Socket. See Special Tools .

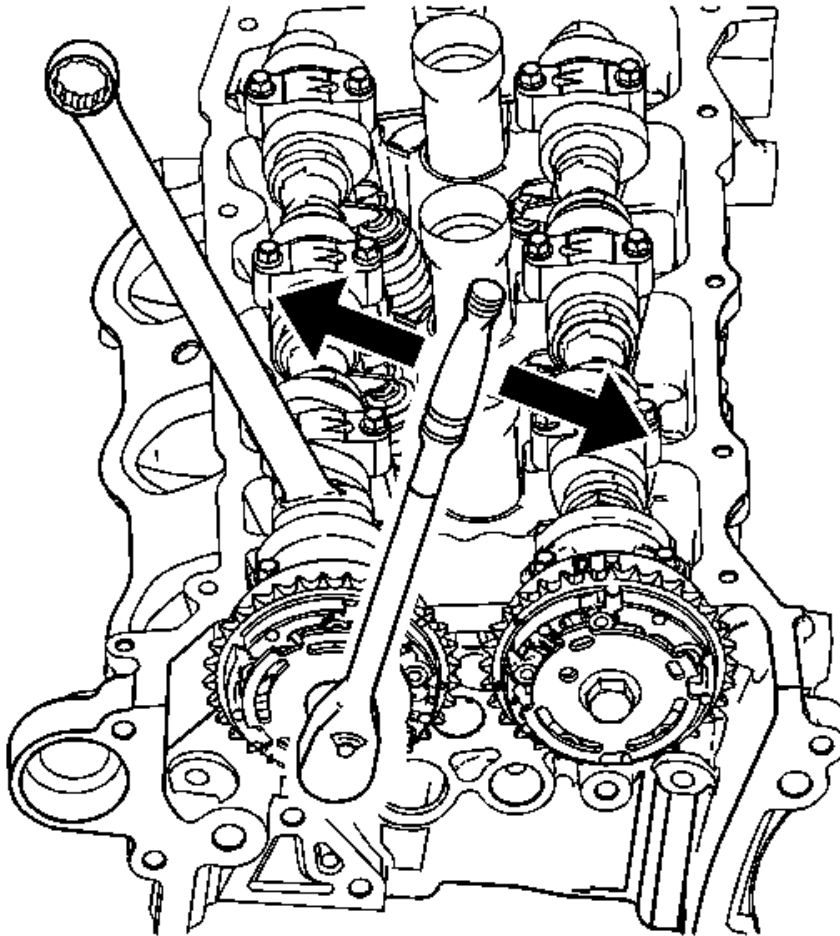
### **REMOVAL PROCEDURE**

1. Remove the intake manifold. Refer to Intake Manifold Replacement.
2. Remove the left bank camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
3. Remove the camshaft sensors. Refer to Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake .
4. Remove the camshaft position actuator solenoid. Refer to Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake .
5. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement.



**Fig. 127: Identifying Camshaft Flats Parallel With Camshaft Cover Rail**  
Courtesy of GENERAL MOTORS CORP.

6. Rotate the crankshaft with the **EN 46111** until the camshafts are in a neutral (low tension) position. See **Special Tools** . The camshaft flats will be parallel with the camshaft cover rail (1).



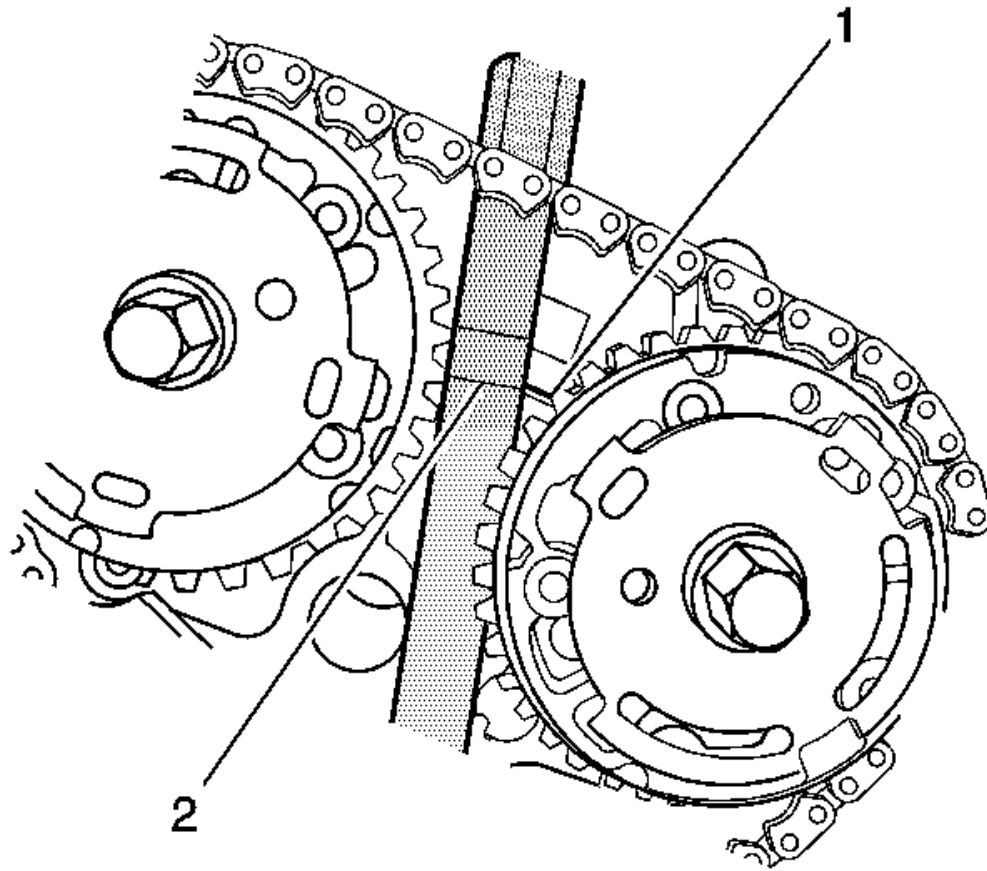
**Fig. 128: Preventing Camshaft/Engine Rotation Using Open-End Wrench**  
Courtesy of GENERAL MOTORS CORP.

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

**NOTE:**

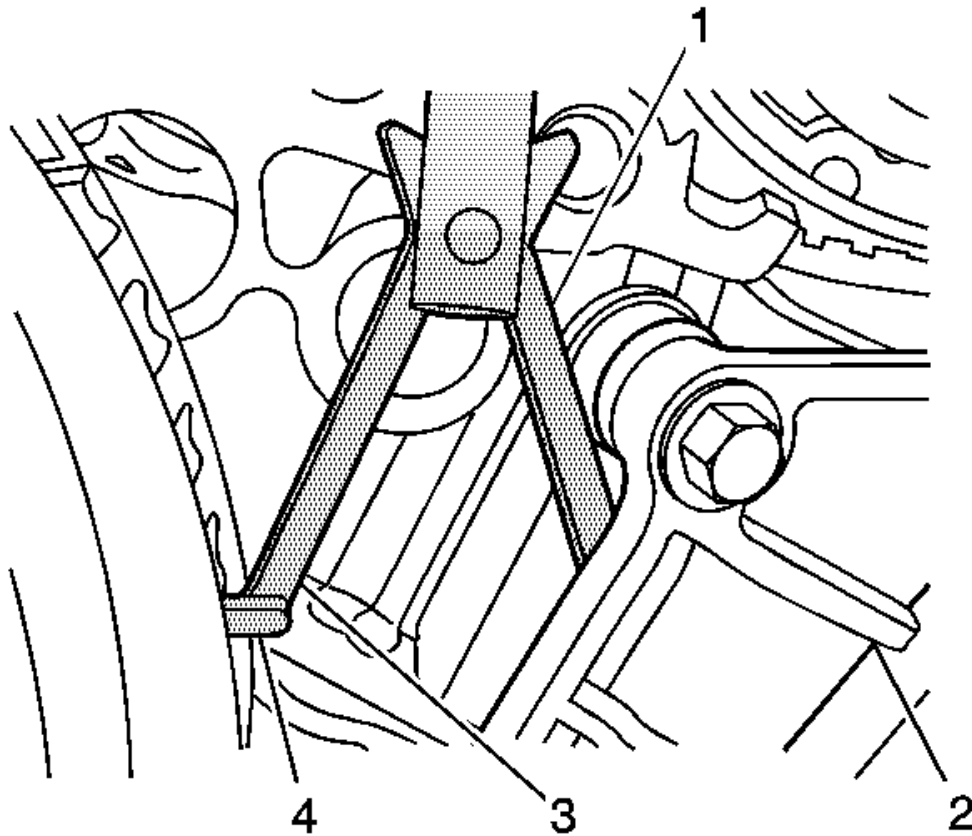
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator bolt at this time.

7. Loosen the camshaft position actuator bolt.



**Fig. 129: Inserting Timing Chain Retention Tool**  
Courtesy of GENERAL MOTORS CORP.

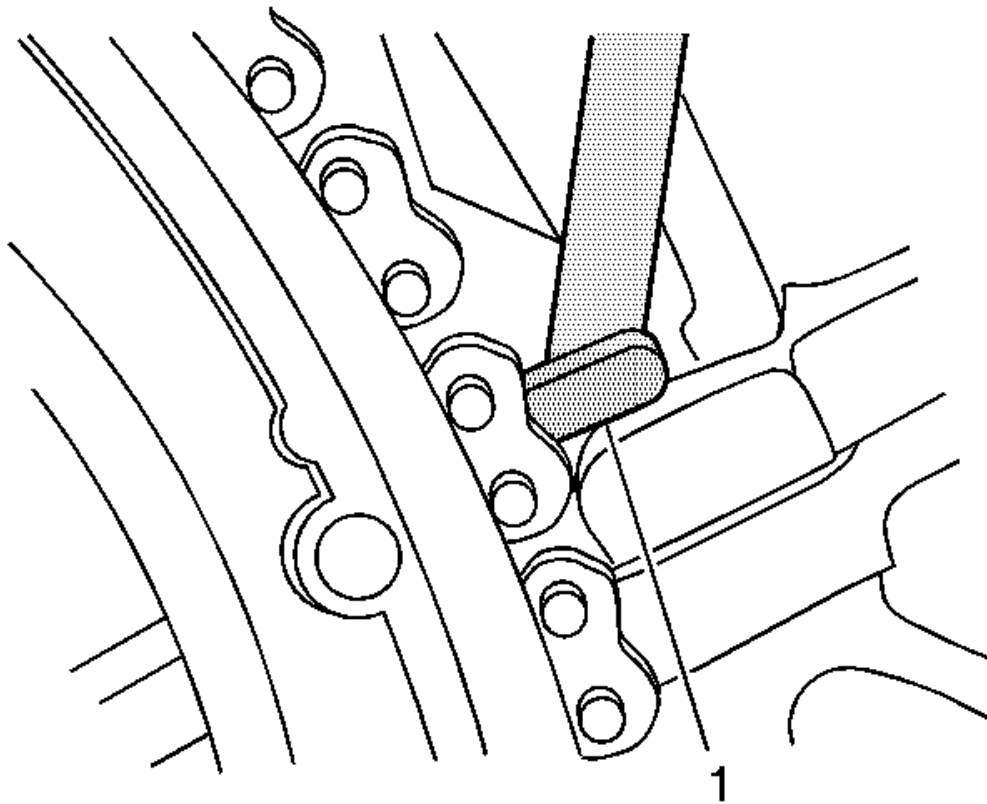
8. Unscrew the **EN-48313** so that the legs of the tool are retracted. See **Special Tools** .
9. Insert the **EN-48313** between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head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



**Fig. 130: Identifying Feet & Legs Of Timing Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

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

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



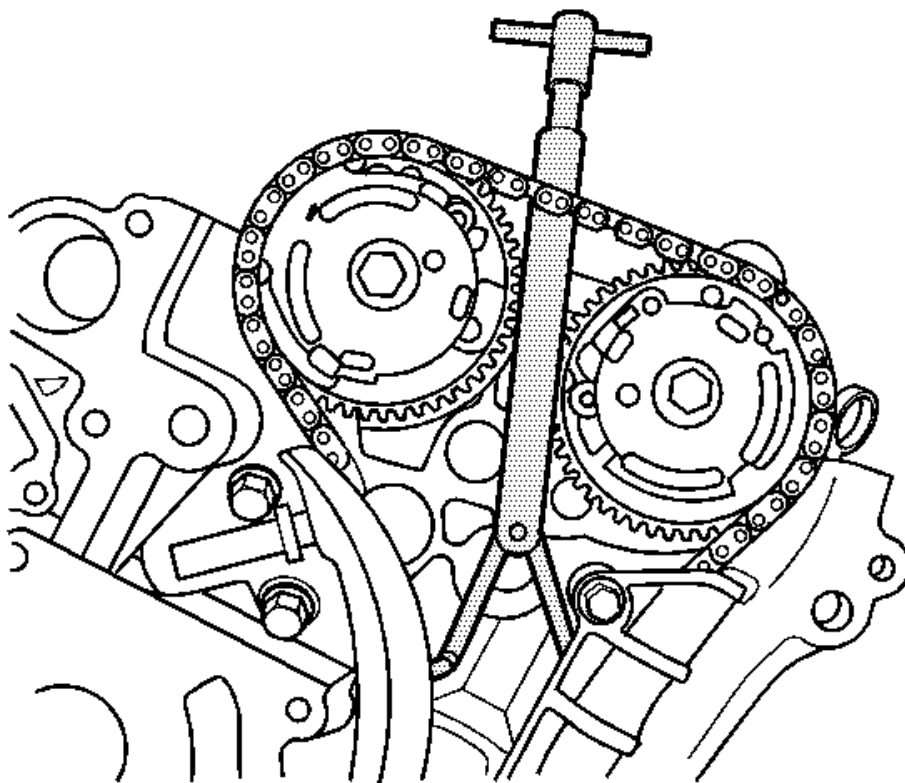
**Fig. 131: Foot of Timing Chain Retention Tool EN-48313**  
Courtesy of GENERAL MOTORS CORP.

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

14. Hand tighten the EN-48313 . See Special Tools .

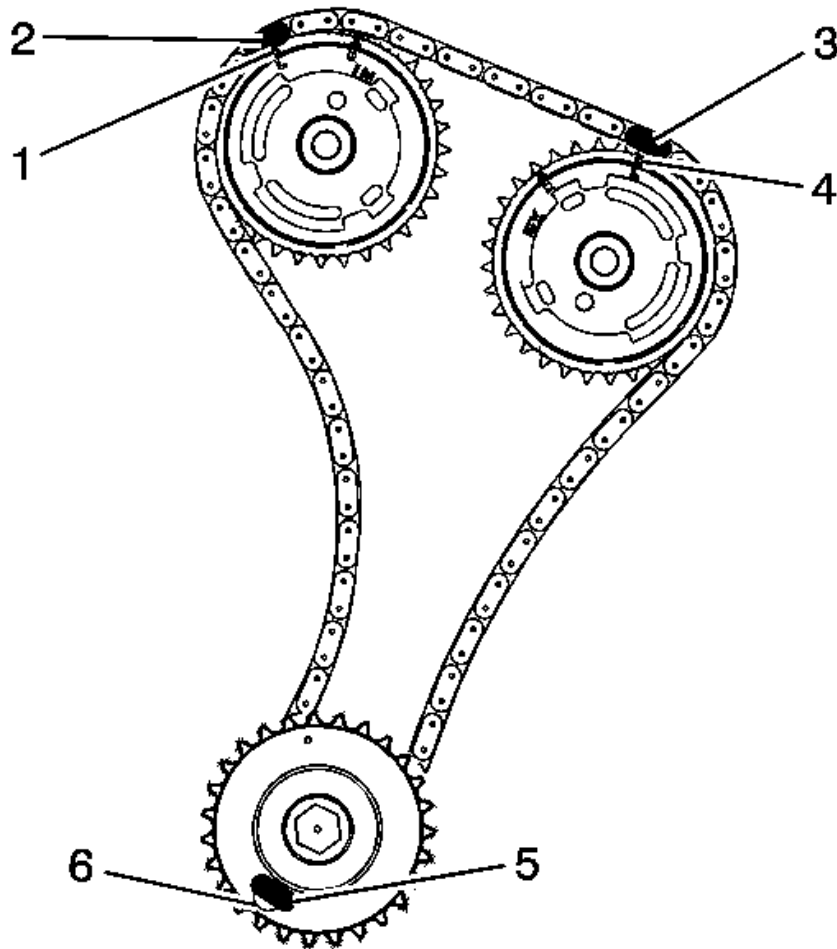
**CAUTION:** Refer to Torque Reaction Against Timing Drive Chain Caution

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



**Fig. 132: Identifying Special Tool - EN-48313**  
Courtesy of GENERAL MOTORS CORP.

16. The **EN-48313** is now properly installed to hold the timing chain in position. See **Special Tools** .

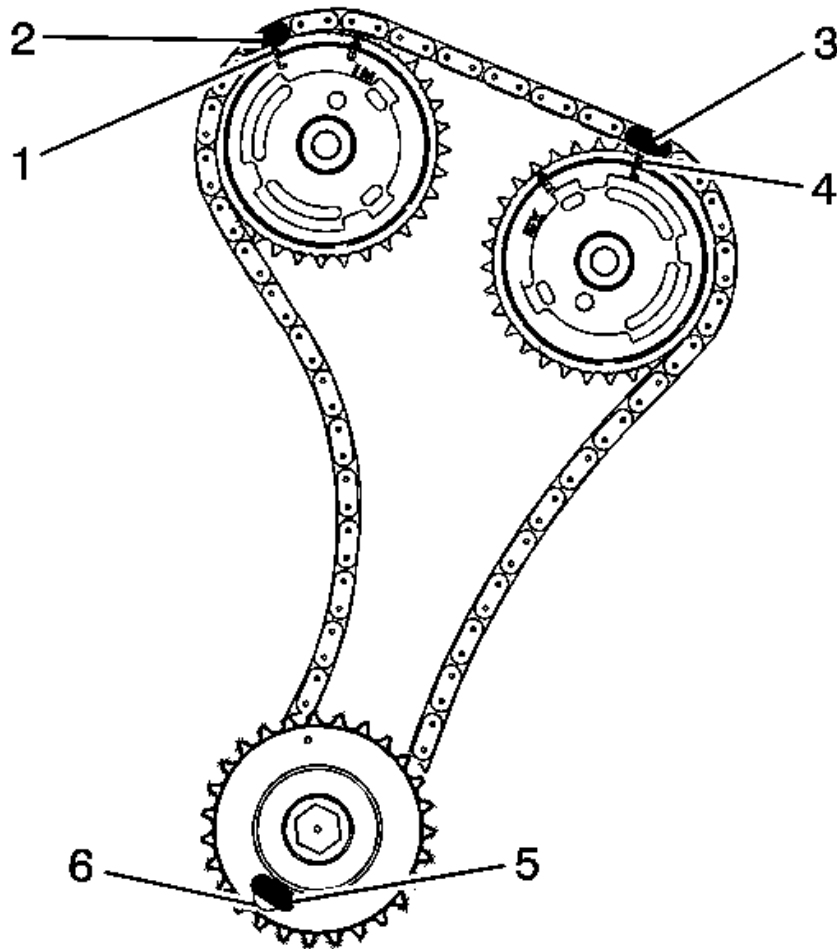


**Fig. 133: Locating Left Secondary Camshaft Drive Chain Timing Marks**  
Courtesy of GENERAL MOTORS CORP.

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

17. Mark the timing chain and the respective locations on the camshaft position actuators (1-4).
18. Remove the camshaft position actuator bolt.
19. Remove the camshafts. Refer to **Camshaft Removal - Left Side (LLT)**.

## INSTALLATION PROCEDURE

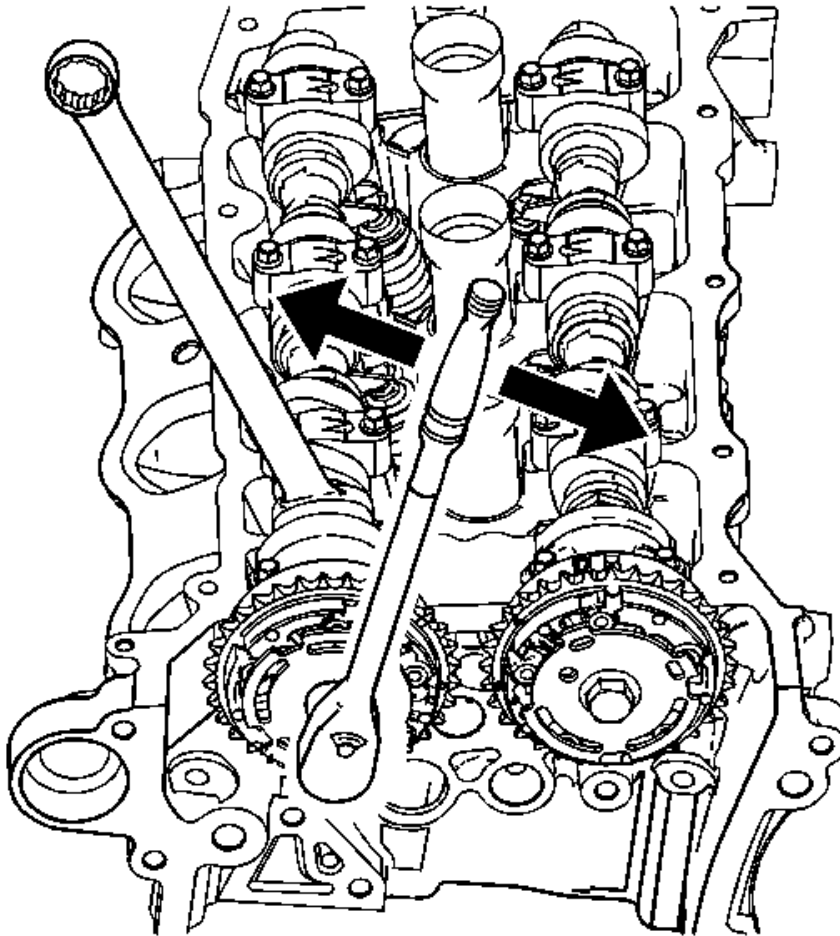


**Fig. 134: Locating Left Secondary Camshaft Drive Chain Timing Marks**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:**

- Ensure that the marks on the camshaft position actuator and the timing chain (1-4) are aligned.
- DO NOT tighten the camshaft position actuator bolt at this time.

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **Camshaft Installation - Left Side**.
3. Remove the **EN-48313**. See **Special Tools**.



**Fig. 135: Preventing Camshaft/Engine Rotation Using Open-End Wrench**  
Courtesy of GENERAL MOTORS CORP.

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

**NOTE:** Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

4. Install and tighten the camshaft position actuators. Refer to Camshaft Position Actuator Installation - Left Side Intake and Camshaft Position Actuator Installation - Left Side Exhaust .
5. Install the intake camshaft position actuator solenoid. Refer to Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake .
6. Install the camshaft sensors. Refer to Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake .
7. Install the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
8. Install the camshaft cover. Refer to Camshaft Cover Replacement - Left Side.

9. Install the intake manifold. Refer to **Intake Manifold Replacement**.

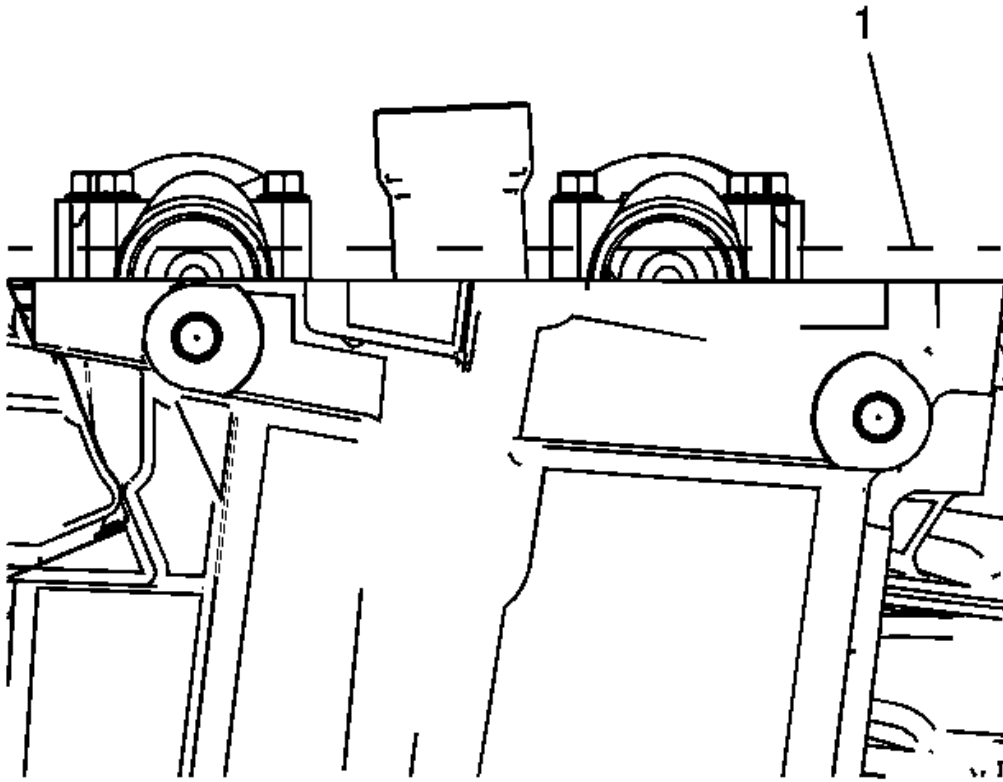
## **CAMSHAFT REPLACEMENT - RIGHT SIDE**

### **SPECIAL TOOLS**

- **EN-48313** Timing Chain Retention Tool. See **Special Tools** .
- **EN 46111** Crankshaft Rotation Socket. See **Special Tools** .

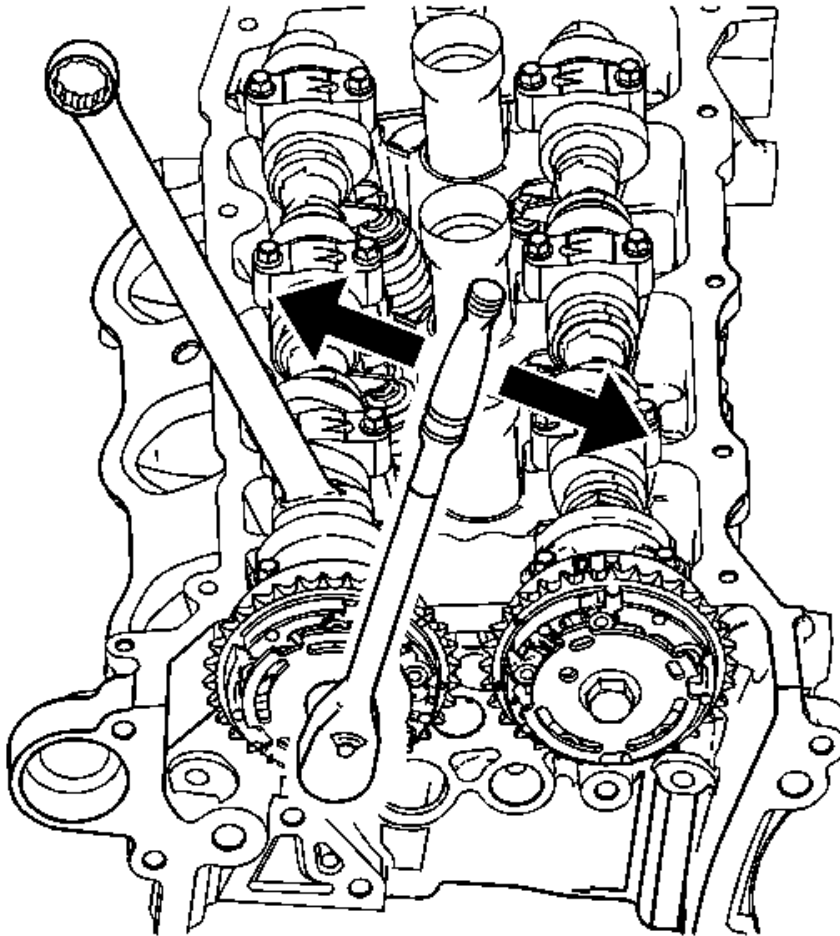
### **REMOVAL PROCEDURE**

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Remove the camshaft cover. Refer to **Camshaft Cover Replacement - Right Side**.
3. Remove the camshaft sensors. Refer to **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust** and **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake** .
4. Remove the intake camshaft position actuator solenoid. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake** .
5. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.



**Fig. 136: Identifying Camshaft Neutral (Low Tension) Position**  
Courtesy of GENERAL MOTORS CORP.

6. Rotate the crankshaft with the **EN 46111** until the camshafts are in a neutral (low tension) position. See **Special Tools** . The camshaft flats will be parallel with the camshaft cover rail (1).



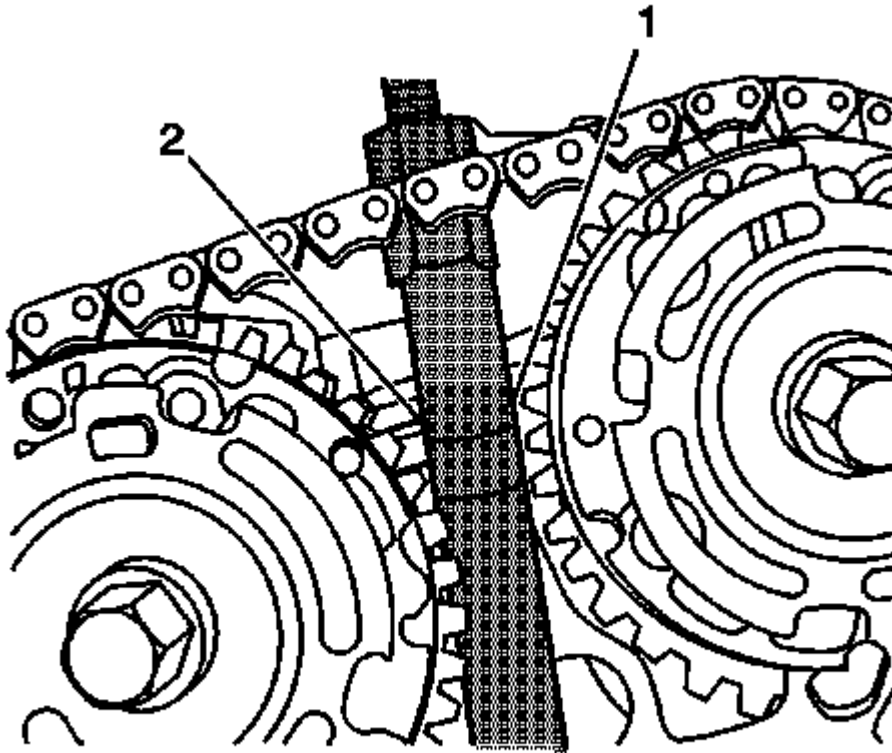
**Fig. 137: Preventing Camshaft/Engine Rotation Using Open-End Wrench**  
Courtesy of GENERAL MOTORS CORP.

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

**NOTE:**

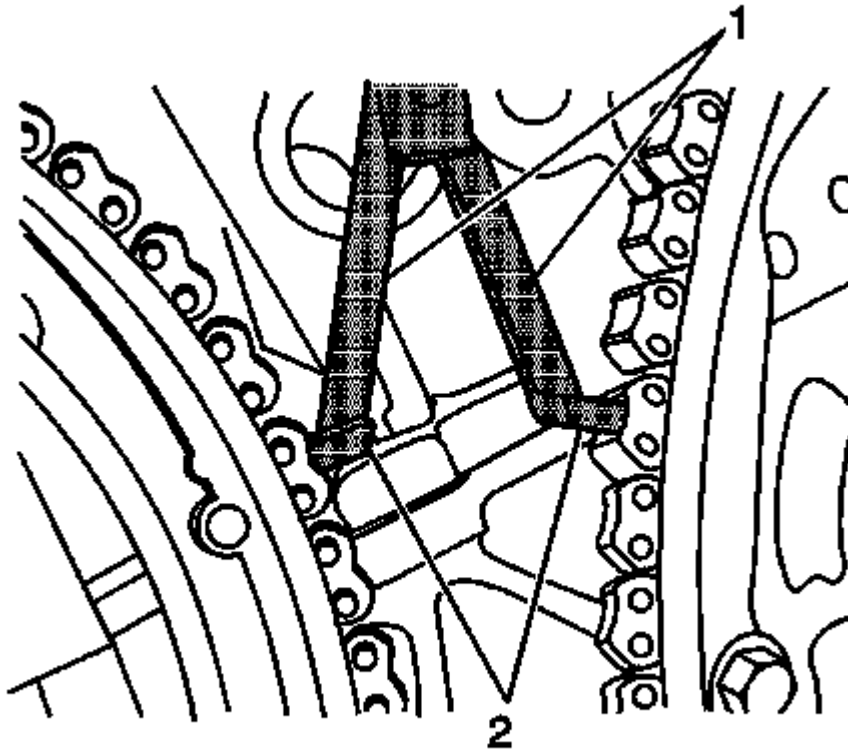
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator bolt at this time.

7. Loosen the camshaft position actuator bolt.



**Fig. 138: View Of Special Tool And Cylinder Head**  
Courtesy of GENERAL MOTORS CORP.

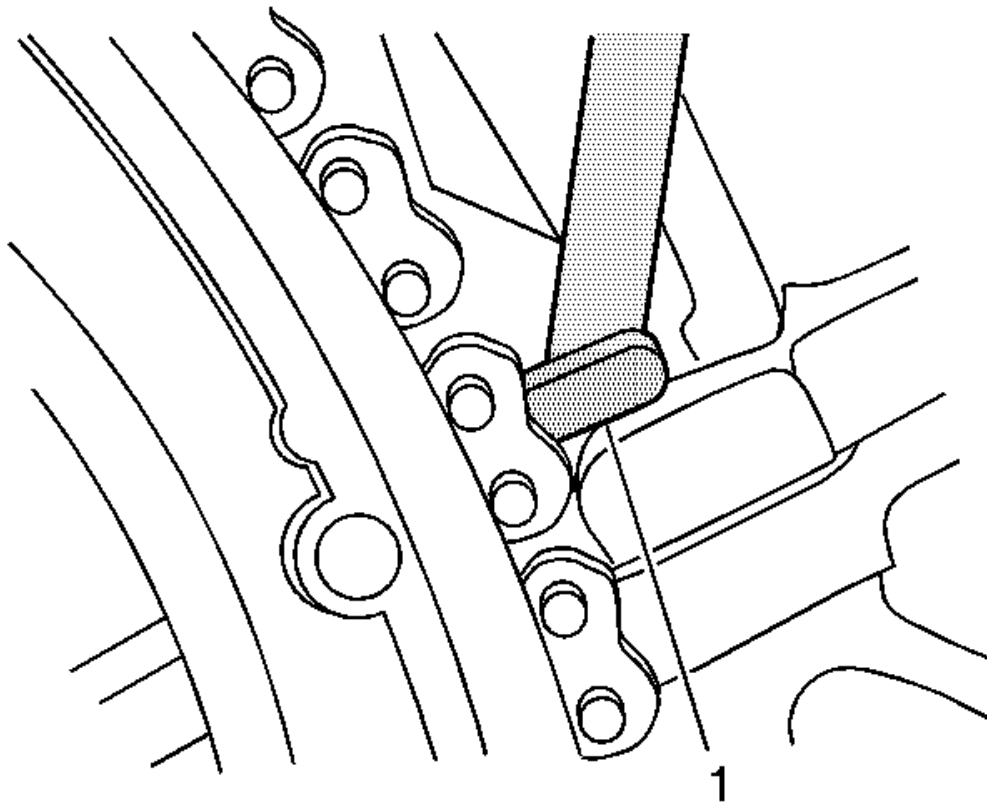
8. Unscrew the **EN-48313** so the legs of the tool are retracted. See **Special Tools** .
9. Insert the **EN-48313** between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). See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



**Fig. 139: View Of Feet, Legs & Timing Chain Guide**  
Courtesy of GENERAL MOTORS CORP.

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

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



**Fig. 140: Foot of Timing Chain Retention Tool EN-48313**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:**

- Ensure that the foot (1) of the EN-48313 is engaged into one of the link pockets to prevent chain slippage during tightening of the EN-48313 . See Special Tools .
- Do not allow the body of the EN-48313 to rotate when tightening the T-handle. See Special Tools .

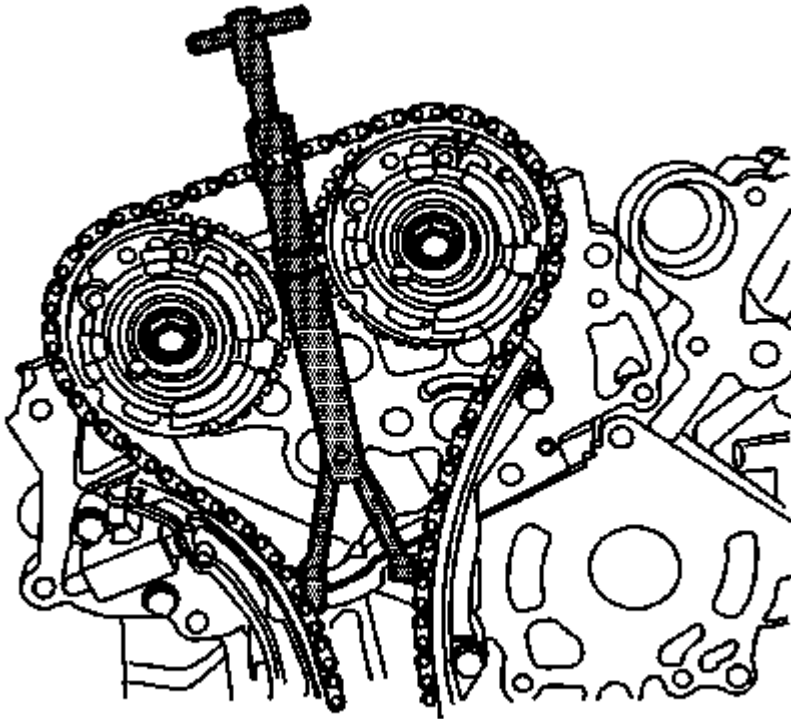
13. Hand tighten the EN-48313 . See Special Tools .

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

14. Use an open end wrench on the hex cast into the body of the EN-48313 and hand tighten the T-handle. See Special Tools .

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

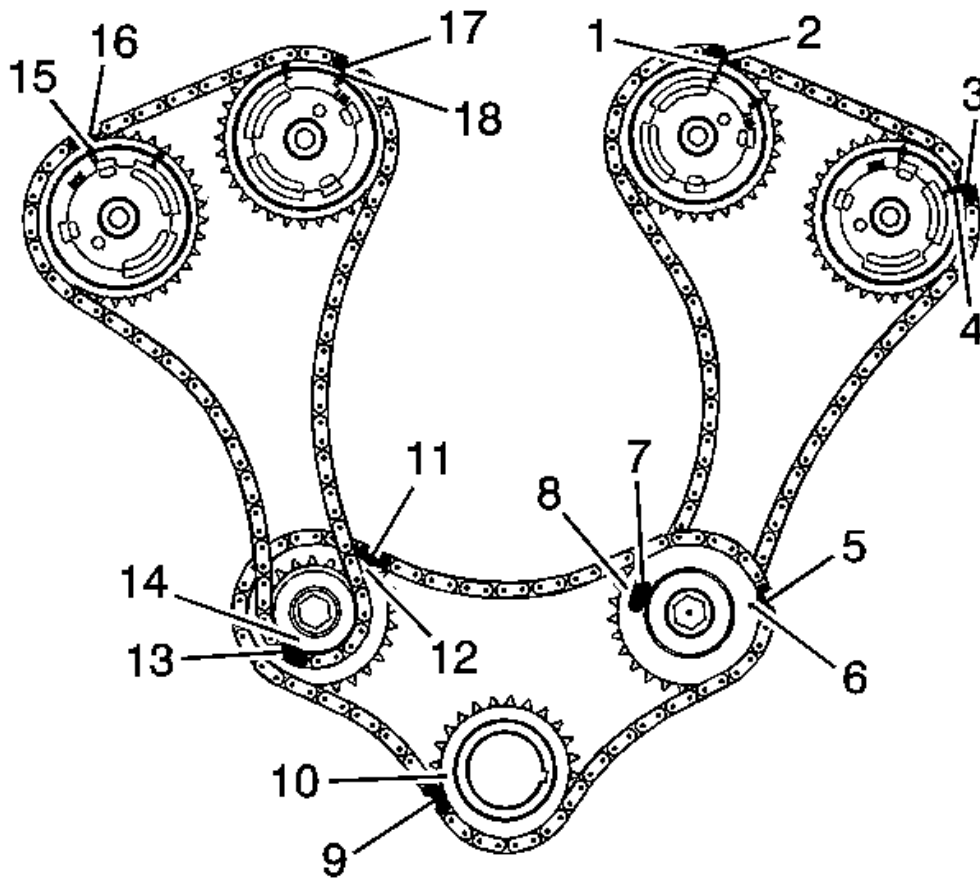
15. Use an open end wrench on the hex cast into the right intake and exhaust camshafts and rotate the camshafts towards each other in order to create slack in the chain between the actuators.



**Fig. 141: View Of EN-48313**

Courtesy of GENERAL MOTORS CORP.

16. The **EN-48313** is now properly installed to hold the timing chain in position. See **Special Tools** .



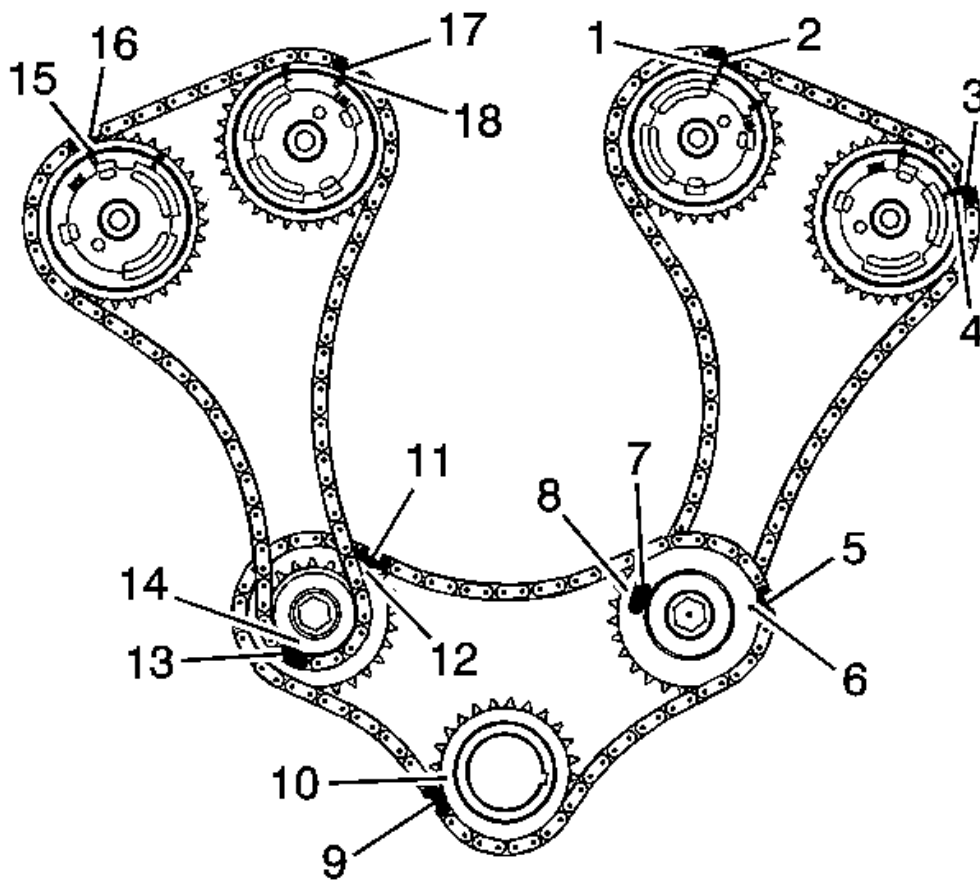
**Fig. 142: Identifying Timing Chain Marks And Their Respective Locations On Gears, Sprockets And Actuators**

Courtesy of GENERAL MOTORS CORP.

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

17. Mark the timing chain and the respective locations on camshaft position actuators (15-18).
18. Remove the camshaft position actuator bolt.
19. Remove the camshaft bearing caps and the camshaft. Refer to Camshaft Removal - Right Side.

## INSTALLATION PROCEDURE



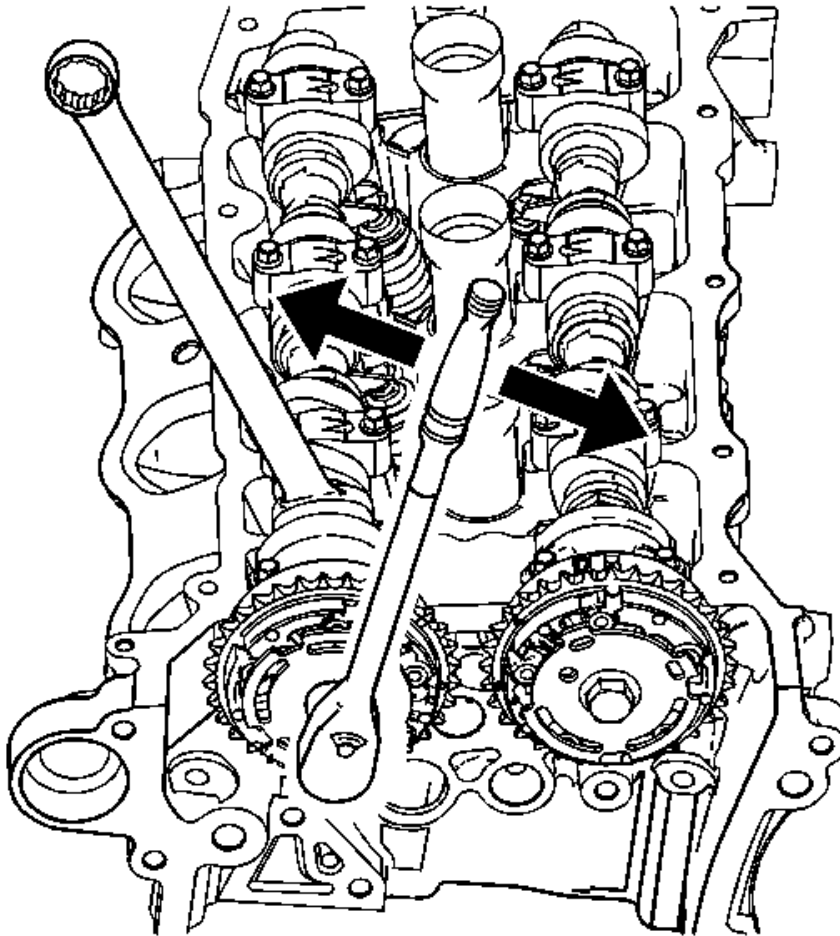
**Fig. 143: Identifying Timing Chain Marks And Their Respective Locations On Gears, Sprockets And Actuators**

Courtesy of GENERAL MOTORS CORP.

**NOTE:**

- Ensure that the marks on the camshaft position actuators and the timing chain (15-18) are aligned.
- **DO NOT** tighten the camshaft position actuator bolt at this time.

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **Camshaft Installation - Right Side**.
3. Remove the **EN-48313**. See **Special Tools**.
4. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.



**Fig. 144: Preventing Camshaft/Engine Rotation Using Open-End Wrench**  
Courtesy of GENERAL MOTORS CORP.

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

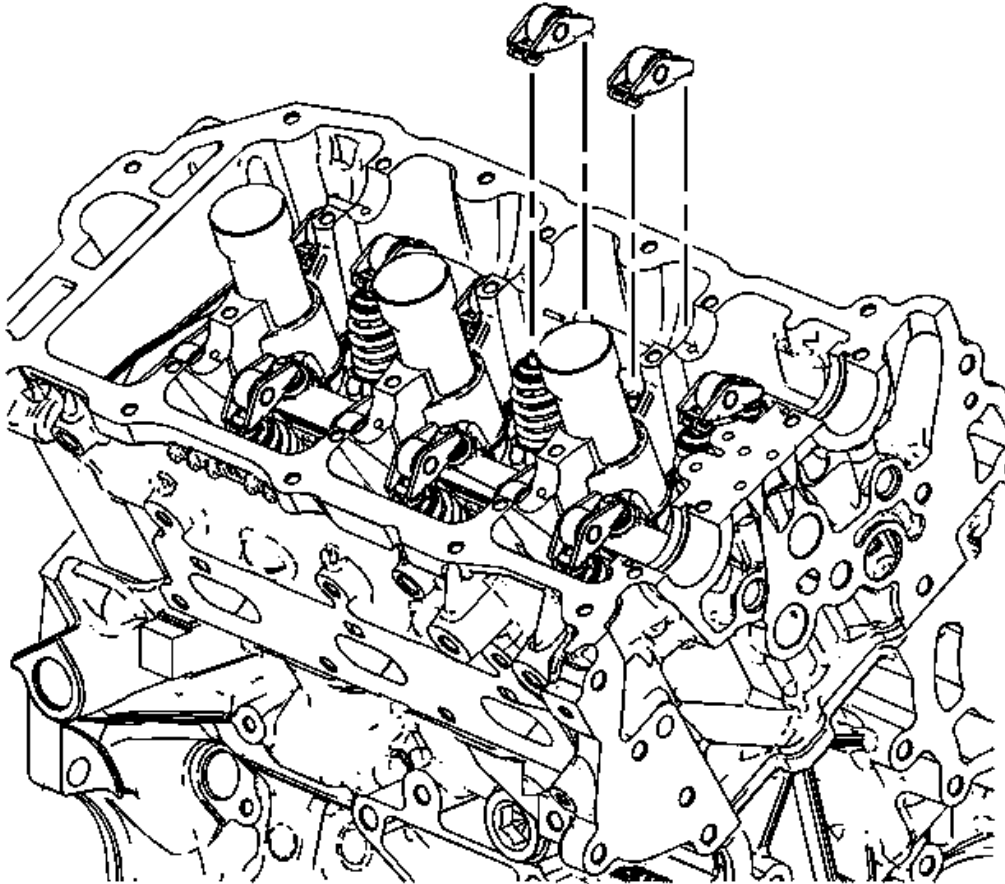
**NOTE:** Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

5. Install and tighten the camshaft position actuators. Refer to Camshaft Position Actuator Installation - Right Side Intake and Camshaft Position Actuator Installation - Right Side Exhaust .
6. Install the intake camshaft position actuator solenoid. Refer to Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake .
7. Install the camshaft sensors. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake .
8. Install the camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
9. Install the intake manifold. Refer to Intake Manifold Replacement.

## VALVE ROCKER ARM REPLACEMENT - LEFT SIDE

### REMOVAL PROCEDURE

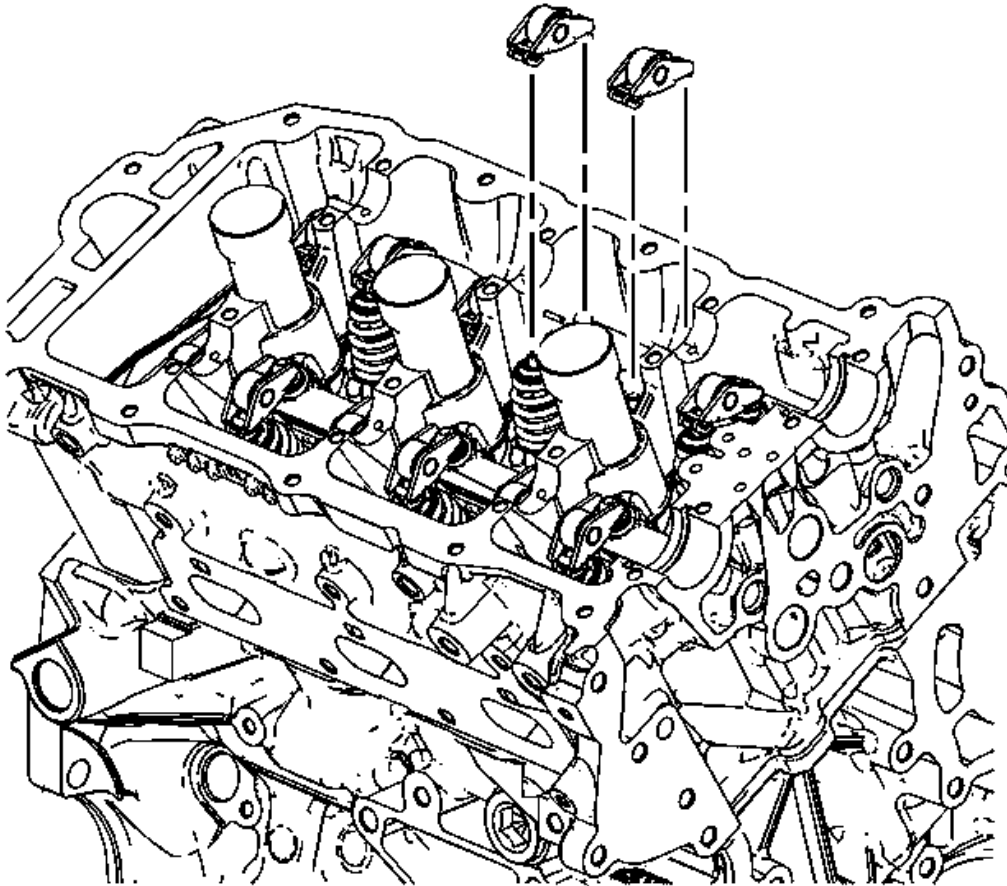
1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.



**Fig. 145: Identifying Valve Rocker Arms**  
Courtesy of GENERAL MOTORS CORP.

2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Left Side (LLT).
3. Clean and inspect the camshaft(s) and the rocker arm(s). Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection and Valve Rocker Arm Cleaning and Inspection.

### INSTALLATION PROCEDURE



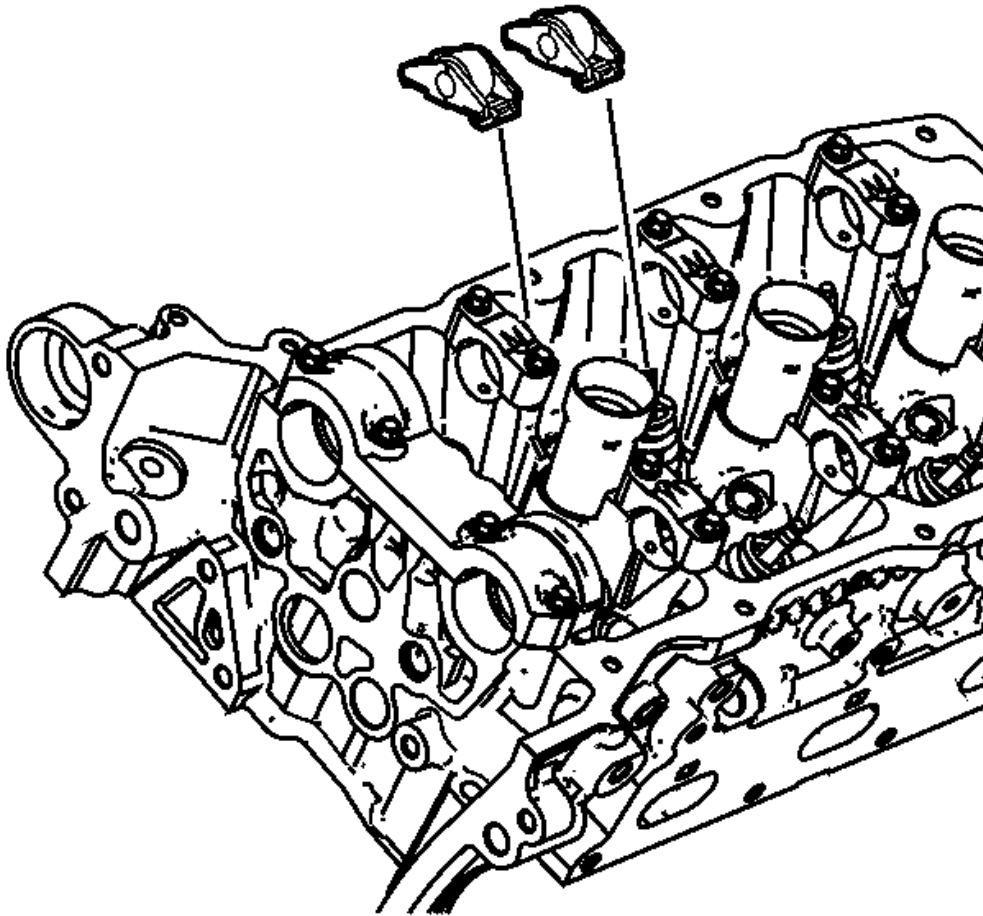
**Fig. 146: Identifying Valve Rocker Arms**  
Courtesy of GENERAL MOTORS CORP.

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

## **VALVE ROCKER ARM REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

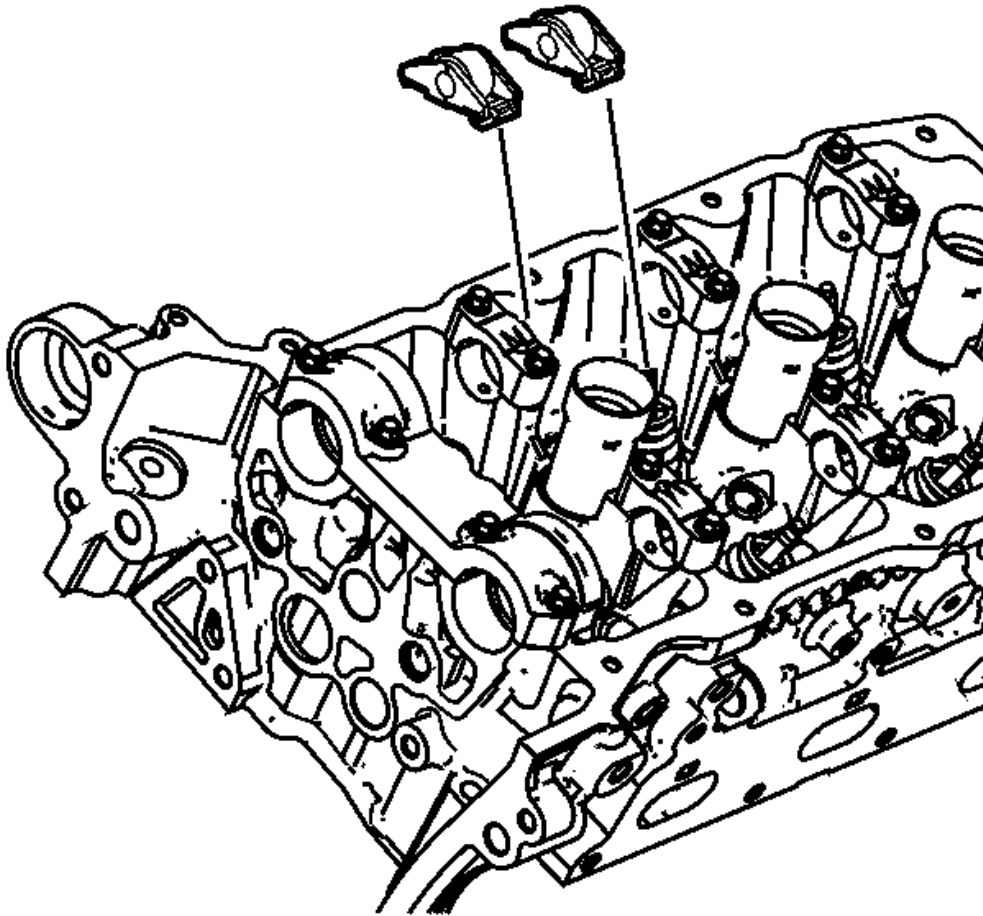
1. Remove the applicable camshaft(s). Refer to **Camshaft Replacement - Right Side**.



**Fig. 147: View Of Valve Rocker Arm**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



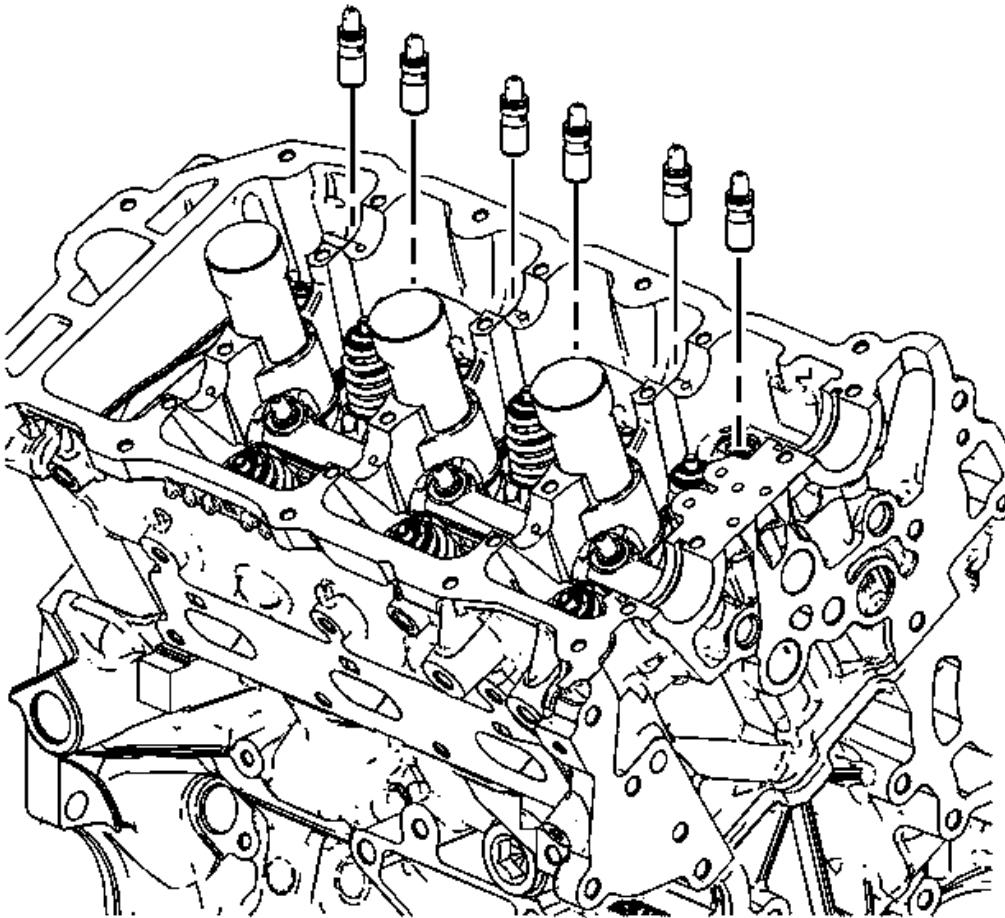
**Fig. 148: View Of Valve Rocker Arm**  
Courtesy of GENERAL MOTORS CORP.

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

## **VALVE LIFTER REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**

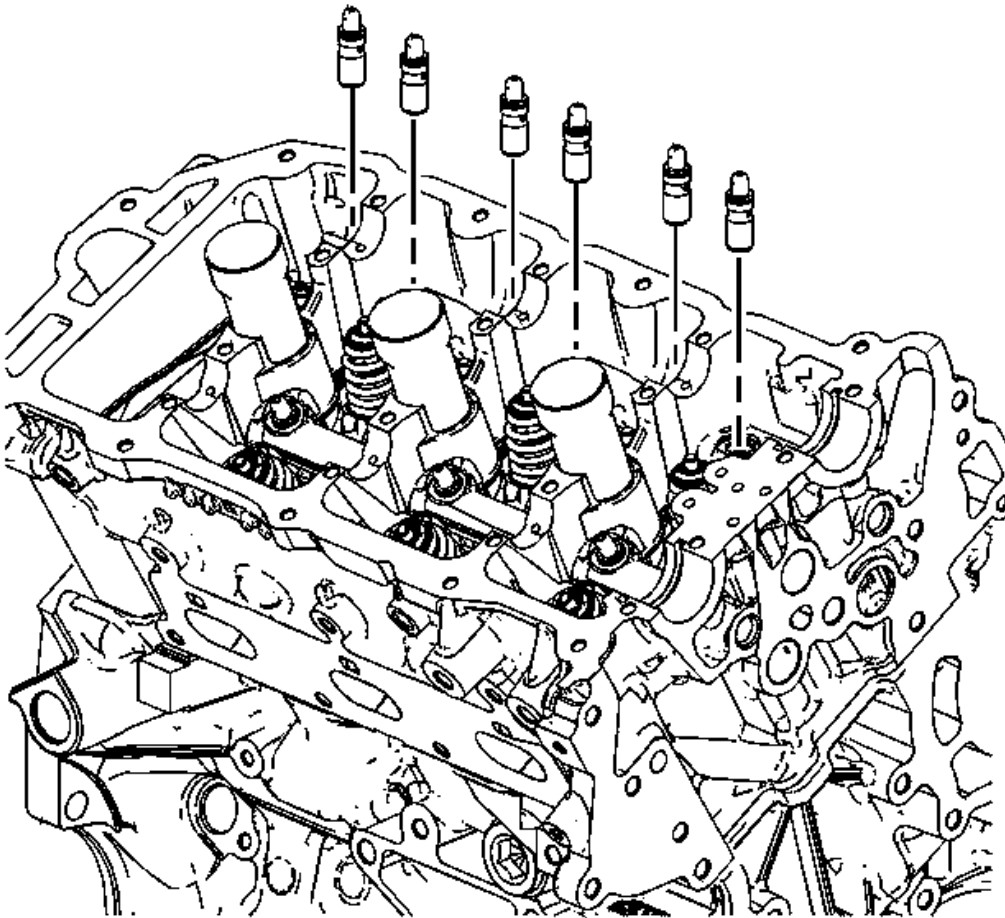
1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Left Side (LLT) .



**Fig. 149: Identifying Stationary Hydraulic Lash Adjuster (SHLA)**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



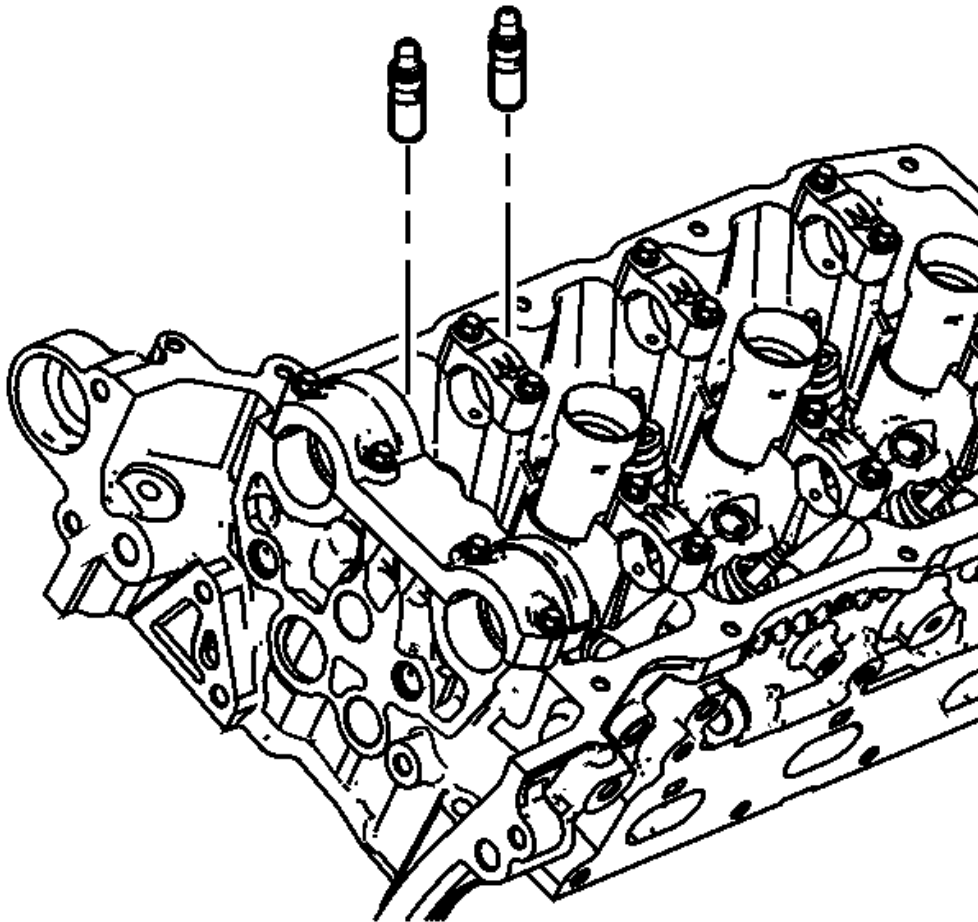
**Fig. 150: Identifying Stationary Hydraulic Lash Adjuster (SHLA)**  
Courtesy of GENERAL MOTORS CORP.

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

## **VALVE LIFTER REPLACEMENT - RIGHT SIDE**

### **REMOVAL PROCEDURE**

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

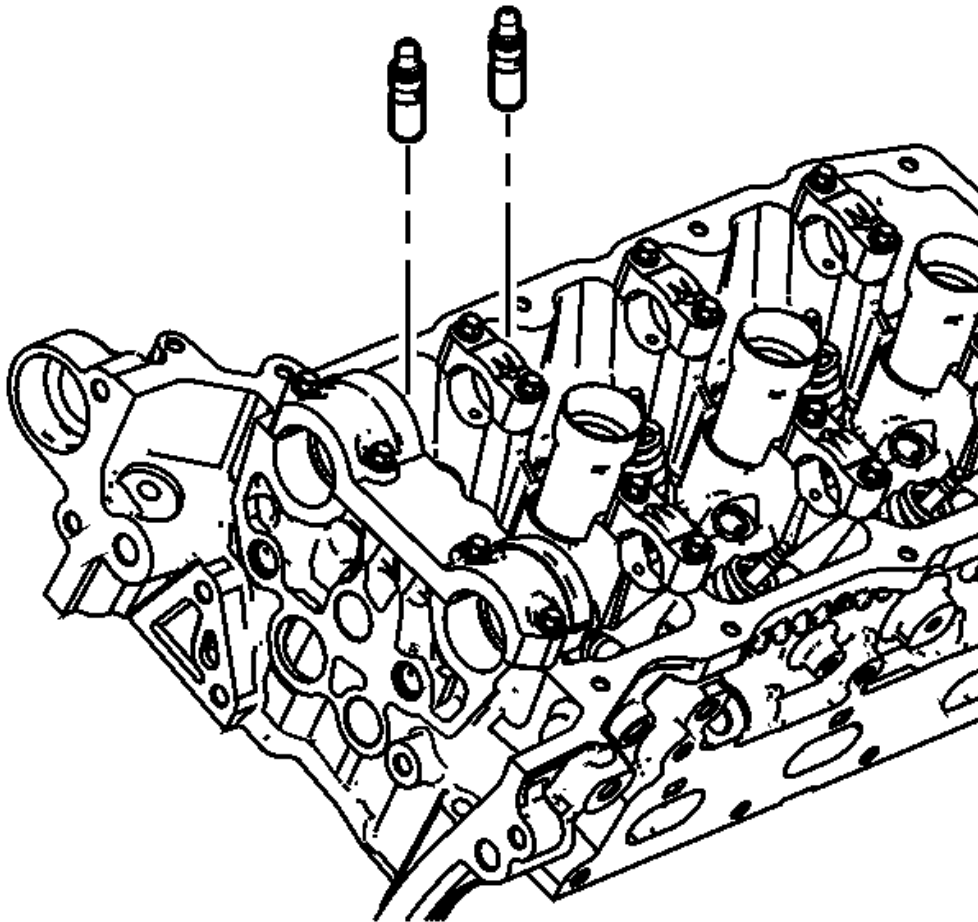


**Fig. 151: View Of SHLAs**

Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



**Fig. 152: View Of SHLAs**

Courtesy of GENERAL MOTORS CORP.

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

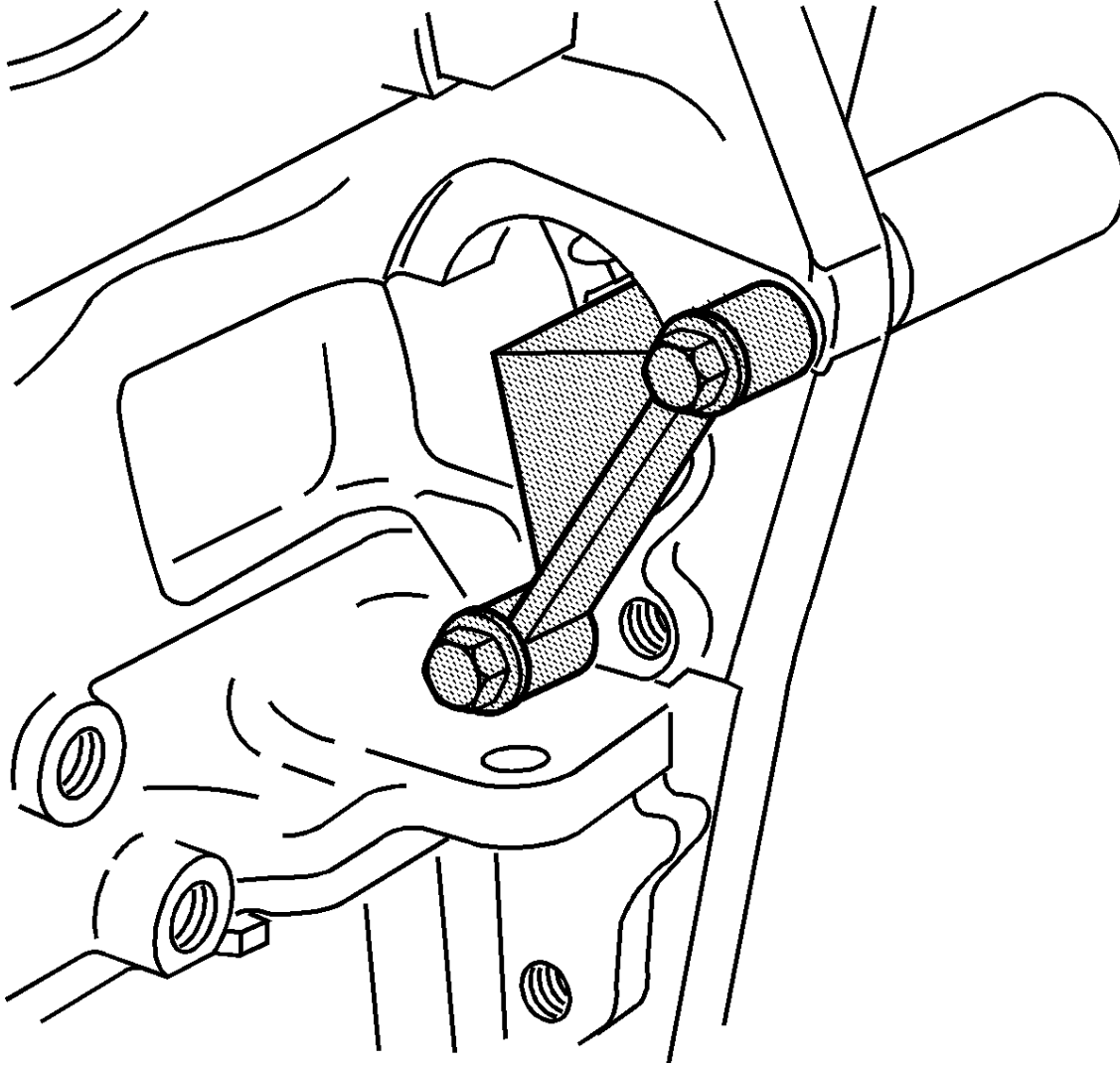
## **VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - LEFT SIDE**

### **SPECIAL TOOLS**

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

## REMOVAL PROCEDURE

1. Remove the starter motor. Refer to **Starter Replacement** .

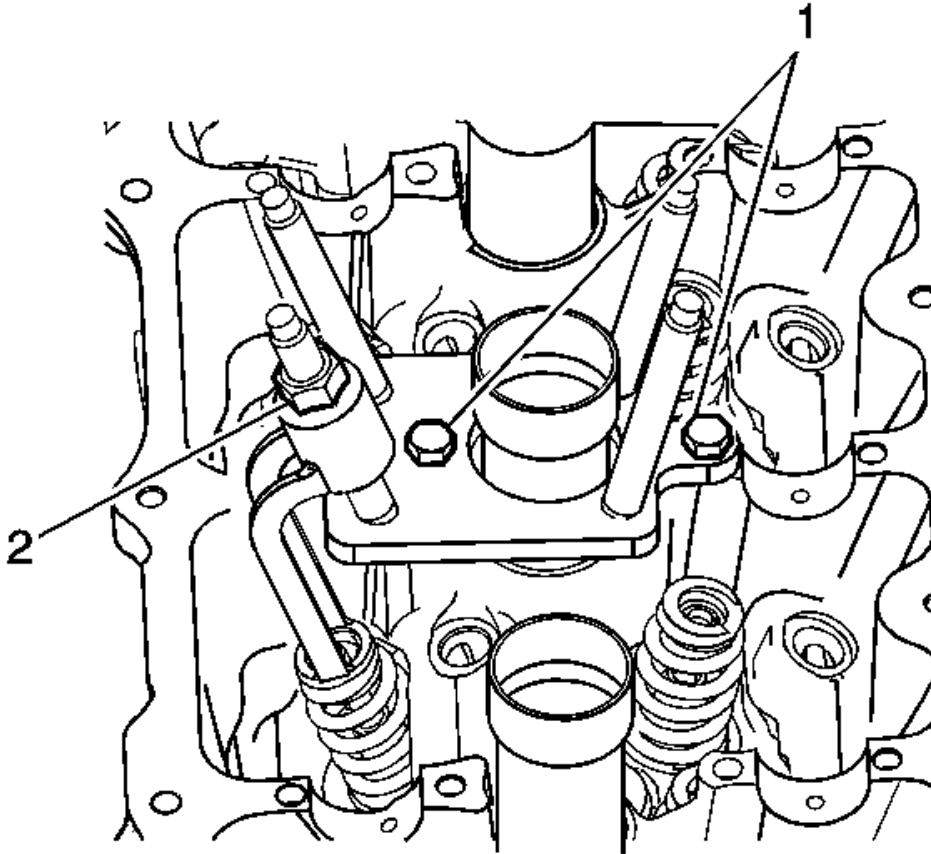


**Fig. 153: Identifying Special Tool - EN 46106**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** If the EN 46106 is not installed, the crankshaft may rotate. See **Special Tools** . If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

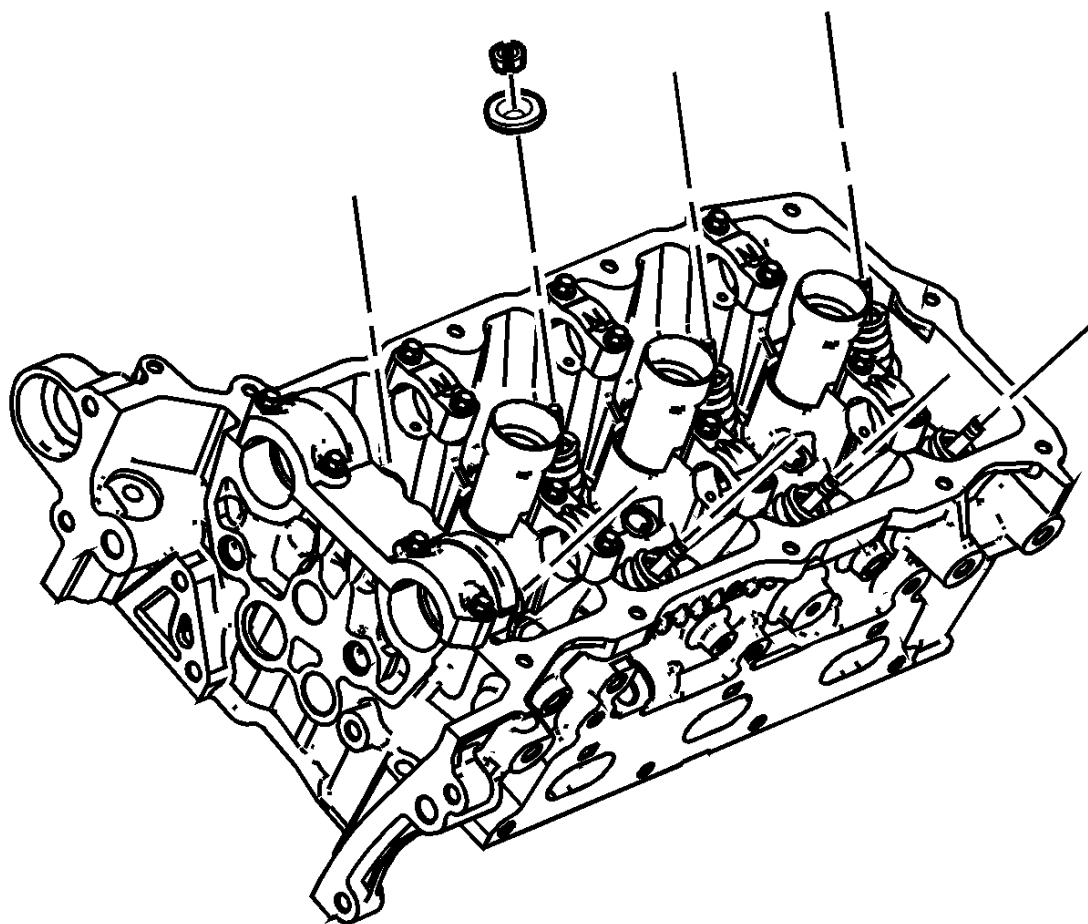
2. Install the **EN 46106** in order to prevent crankshaft rotation. See **Special Tools** .
3. Remove the camshafts and rocker arms. Refer to **Camshaft Replacement - Left Side**.
4. Remove the spark plug from the applicable cylinder. Refer to **Spark Plug Replacement** .
5. Remove Rocker arm. refer to **Valve Rocker Arm Replacement - Left Side**
6. Install the **J 39313** to the applicable cylinder. See **Special Tools** .

7. Connect the **J 39313** to a compressed air source. See **Special Tools** .



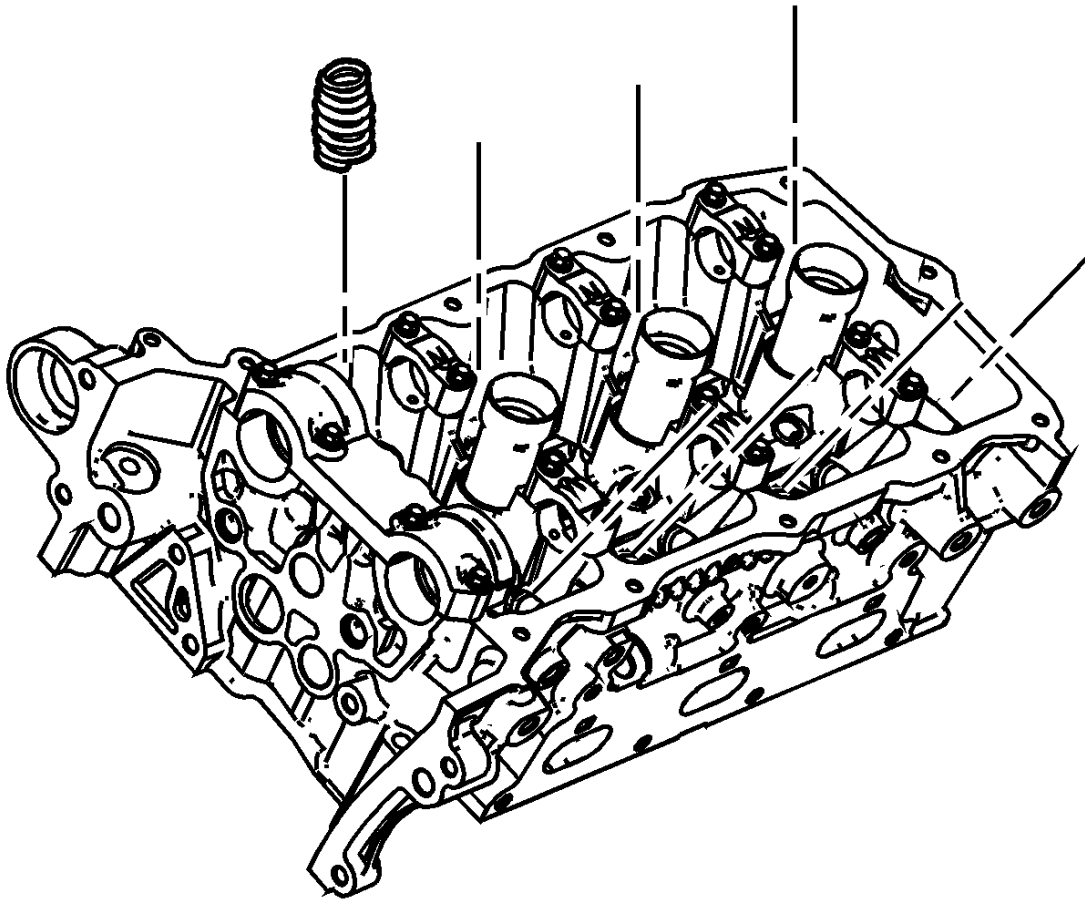
**Fig. 154: View Of Installed Valve Spring Compressor Tool**  
Courtesy of GENERAL MOTORS CORP.

8. Install the **EN 46110** above the applicable cylinder as shown. See **Special Tools** .
9. Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .



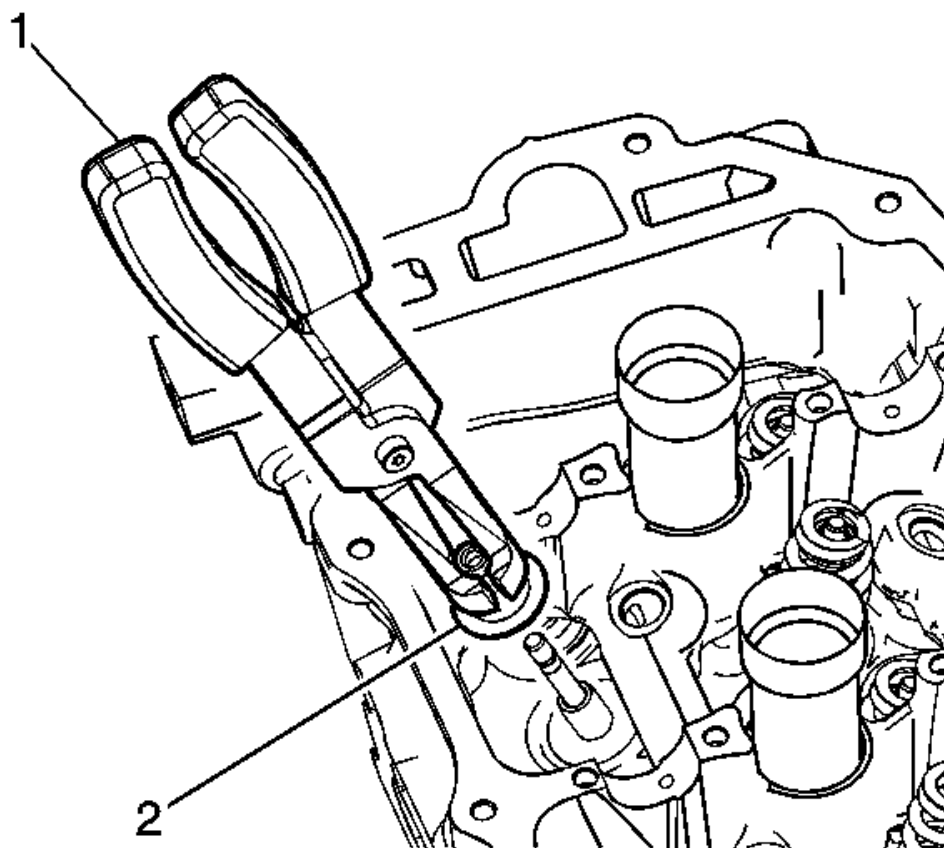
**Fig. 155: View Of Valve Spring Keepers**  
Courtesy of GENERAL MOTORS CORP.

10. Remove the valve keepers.
11. Loosen the **EN 46110** valve spring compressor nut. See **Special Tools** .
12. Remove the valve spring retainer.



**Fig. 156: View Of Valve Spring**  
Courtesy of GENERAL MOTORS CORP.

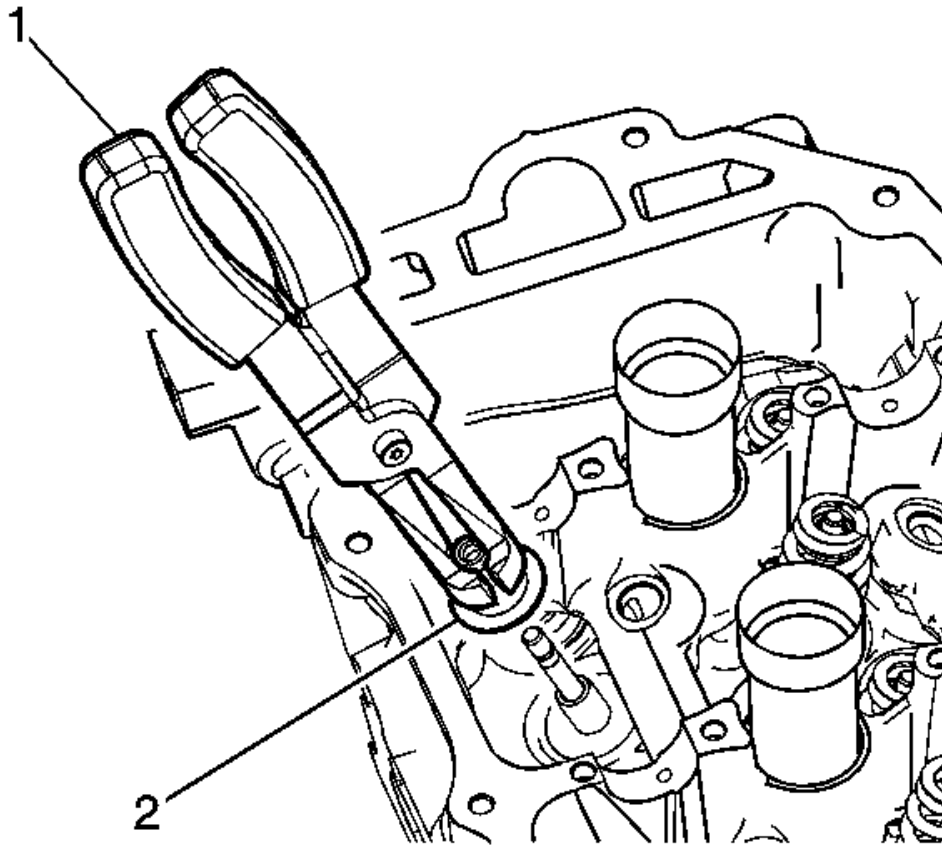
13. Remove the valve spring.



**Fig. 157: Identifying Special Tool - EN-46116 & Valve Stem Seal**  
Courtesy of GENERAL MOTORS CORP.

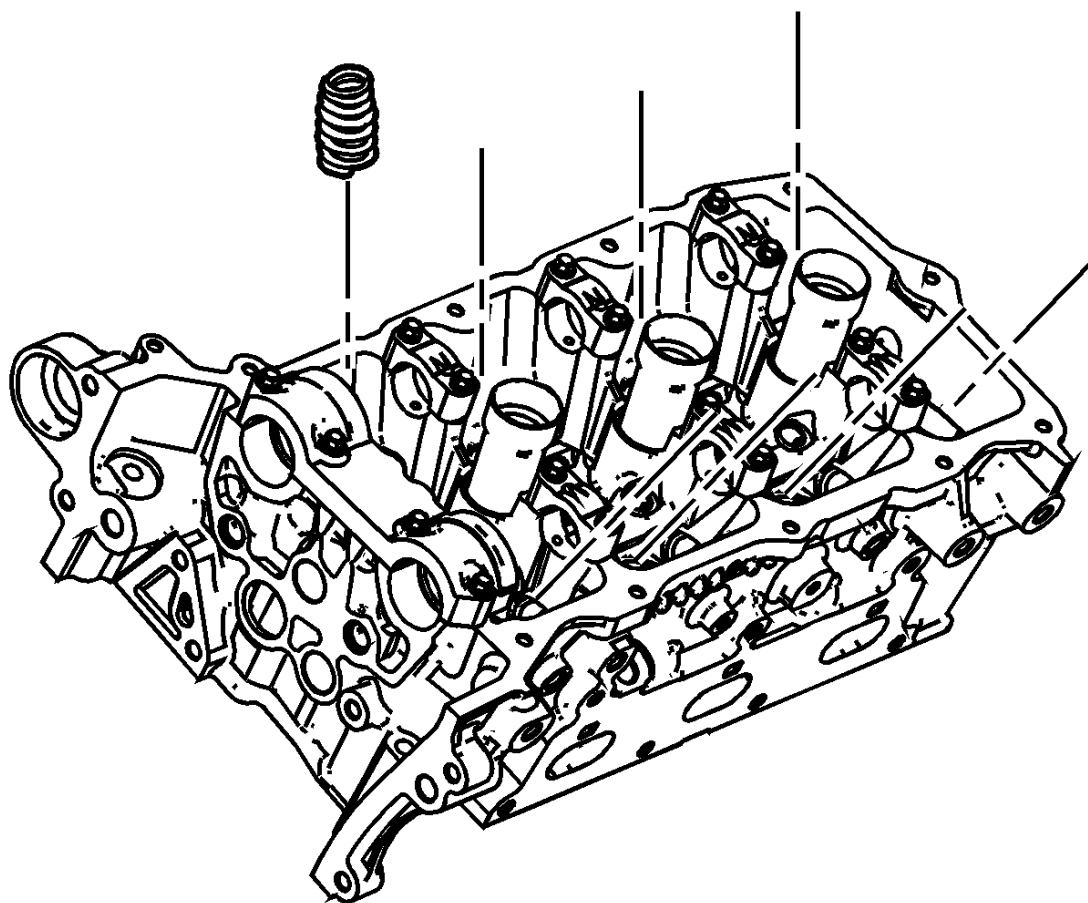
14. Use the **EN 46116** (1) in order to remove the valve stem seal (2). See **Special Tools** .

## **INSTALLATION PROCEDURE**



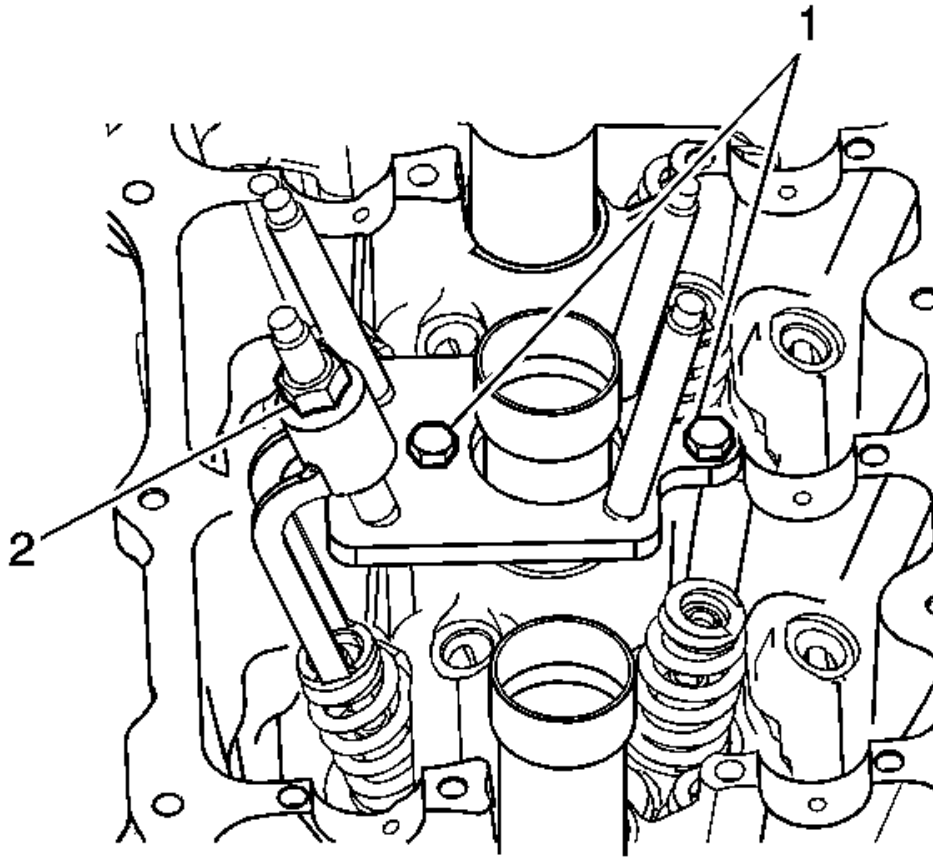
**Fig. 158: Identifying Special Tool - EN-46116 & Valve Stem Seal**  
Courtesy of GENERAL MOTORS CORP.

1. Use the **EN 46116** (1) in order to install the valve stem seal (2). See **Special Tools** .



**Fig. 159: View Of Valve Spring**  
Courtesy of GENERAL MOTORS CORP.

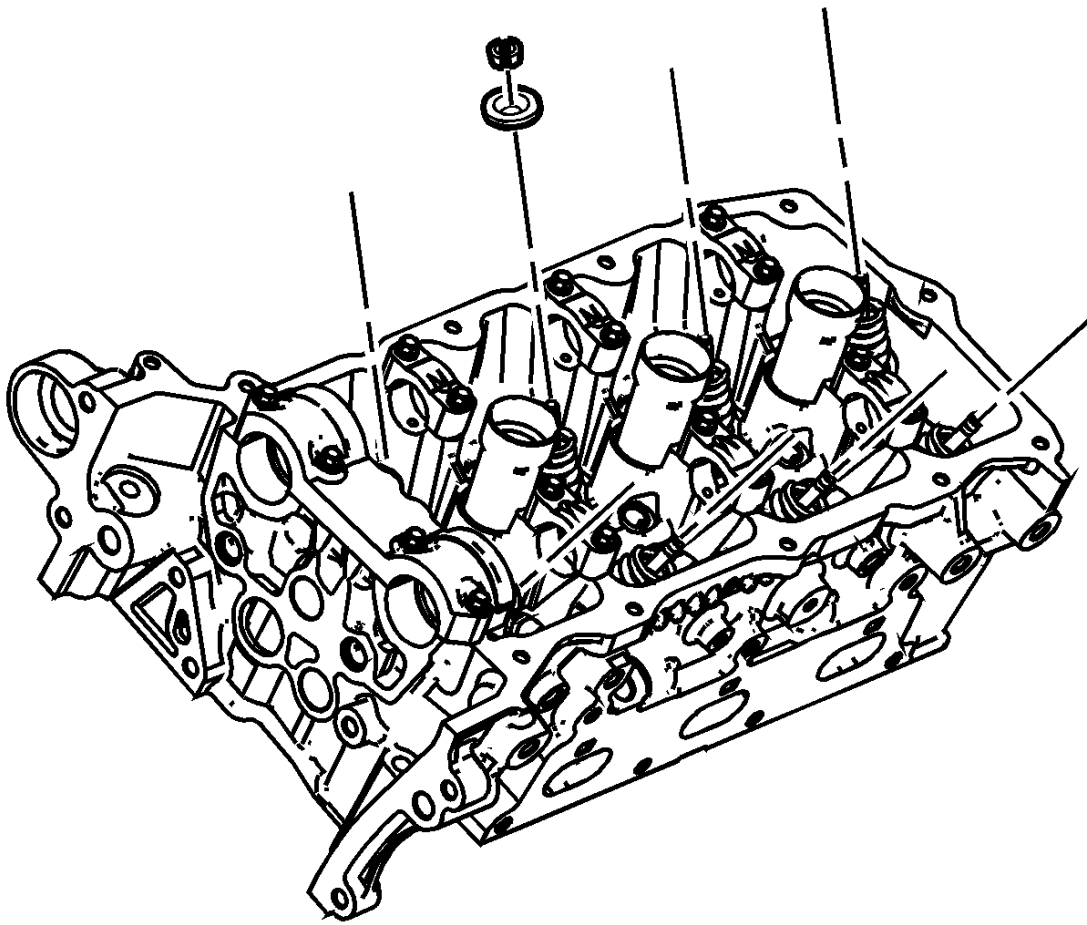
2. Install the valve spring.
3. Install the valve spring retainer.



**Fig. 160: View Of Installed Valve Spring Compressor Tool**  
Courtesy of GENERAL MOTORS CORP.

4. Install the **EN 46110** above the applicable valve spring as shown. See **Special Tools** .

Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .



**Fig. 161: View Of Valve Spring Keepers**  
Courtesy of GENERAL MOTORS CORP.

5. Install the valve spring keepers.
6. Remove the **EN 46110** . See **Special Tools** .
7. Disconnect the **J 39313** from the compressed air source. See **Special Tools** .
8. Remove the **J 39313** . See **Special Tools** .
9. Install the spark plugs. Refer to **Spark Plug Replacement** .
10. Install the rocker arms and camshafts. Refer to **Camshaft Replacement - Left Side**.
11. Remove the **EN 46106** in order to prevent crankshaft rotation. See **Special Tools** .
12. Install the starter motor. Refer to **Starter Replacement** .

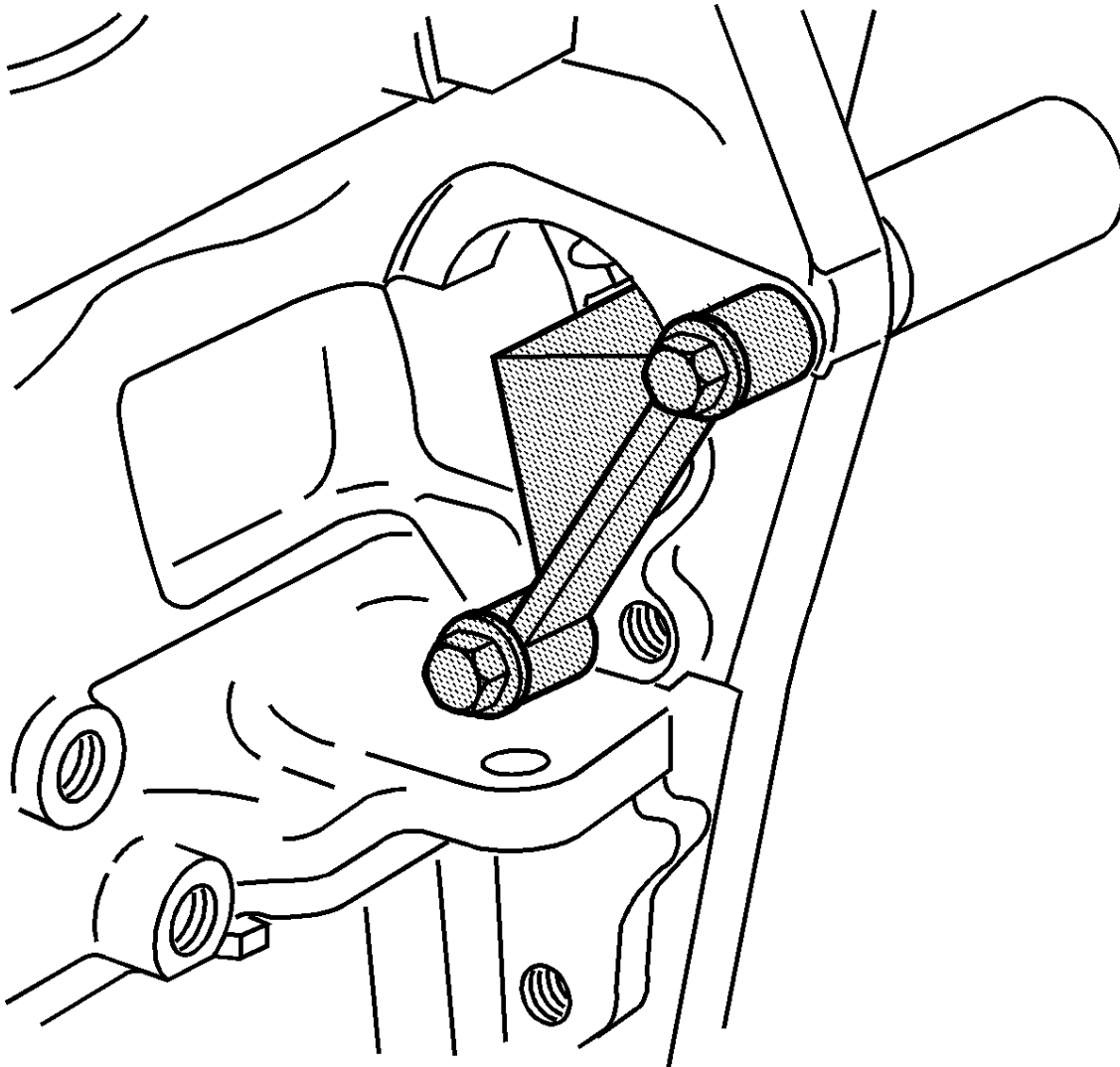
## **VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - RIGHT SIDE**

### **SPECIAL TOOLS**

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

## REMOVAL PROCEDURE

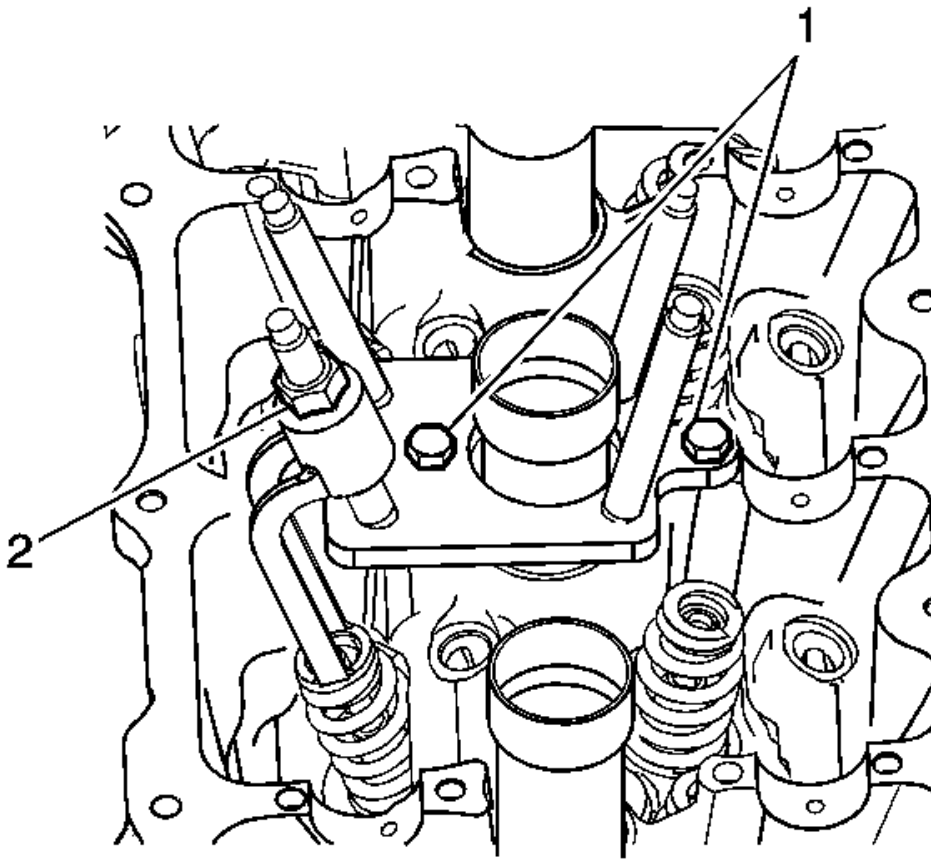
1. Remove the starter motor. Refer to Starter Replacement .



**Fig. 162: Identifying Special Tool - EN 46106**  
Courtesy of GENERAL MOTORS CORP.

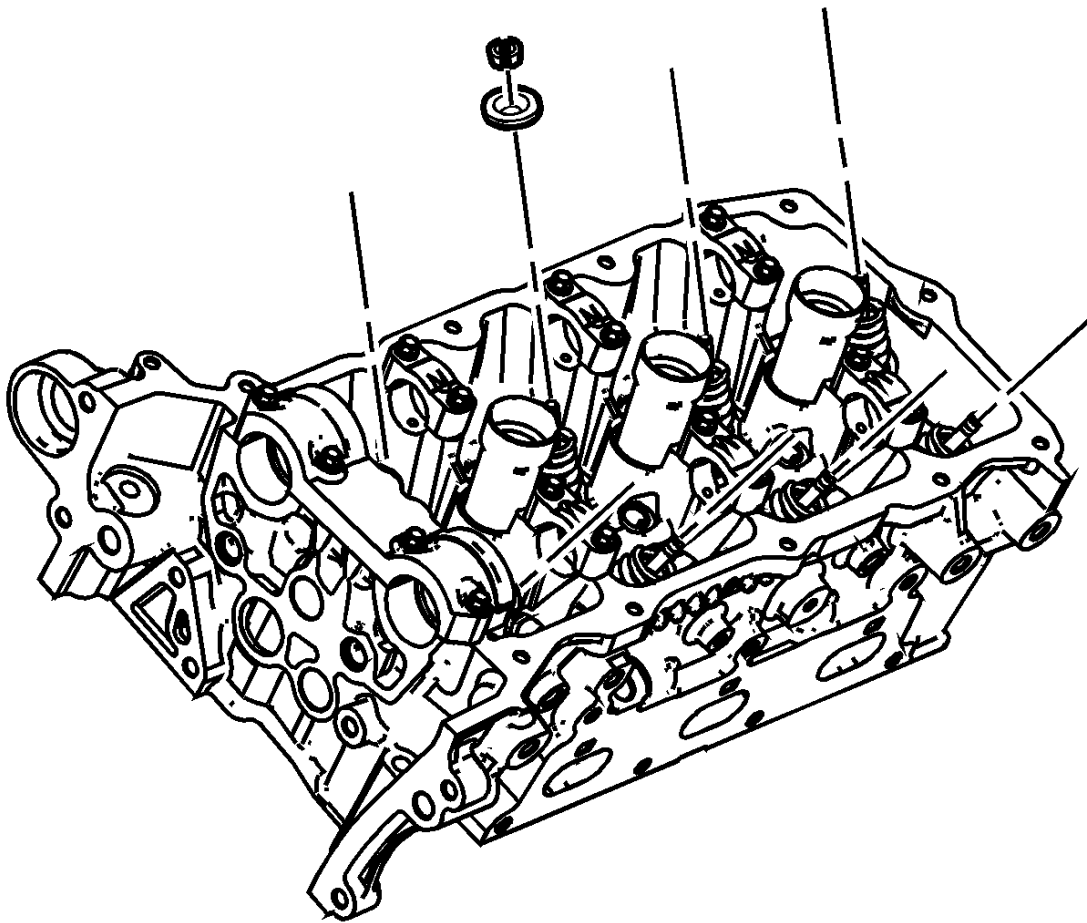
**IMPORTANT:** If the EN 46106 is not installed, the crankshaft may rotate. See Special Tools . If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the **EN 46106** in order to prevent crankshaft rotation. See **Special Tools** .
3. Remove the camshafts and rocker arms. Refer to **Camshaft Replacement - Right Side Valve Rocker Arm Replacement - Right Side**.
4. Remove the spark plug from the applicable cylinder. Refer to **Spark Plug Replacement** .
5. Install the **J 39313** to the applicable cylinder. See **Special Tools** .
6. Connect the **J 39313** to a compressed air source. See **Special Tools** .



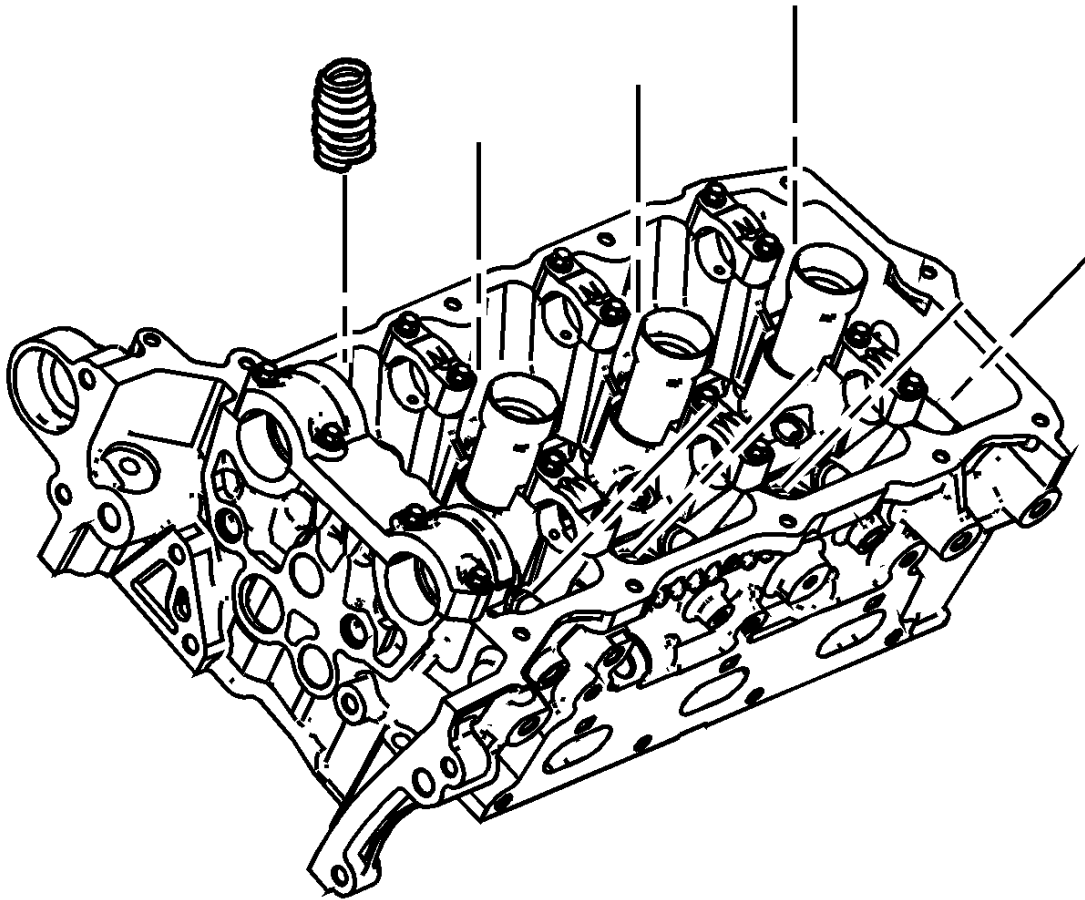
**Fig. 163: View Of Installed Valve Spring Compressor Tool**  
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 46110** above the applicable cylinder as shown. See **Special Tools** .
8. Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .



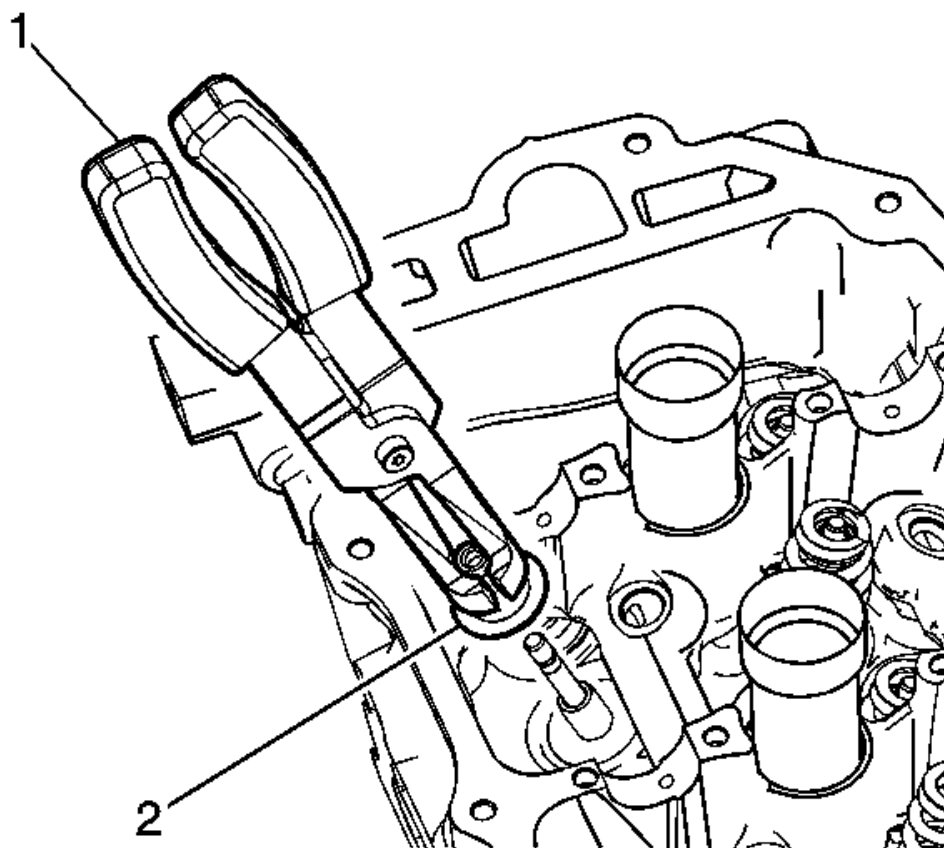
**Fig. 164: View Of Valve Spring Keepers**  
Courtesy of GENERAL MOTORS CORP.

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



**Fig. 165: View Of Valve Spring**  
Courtesy of GENERAL MOTORS CORP.

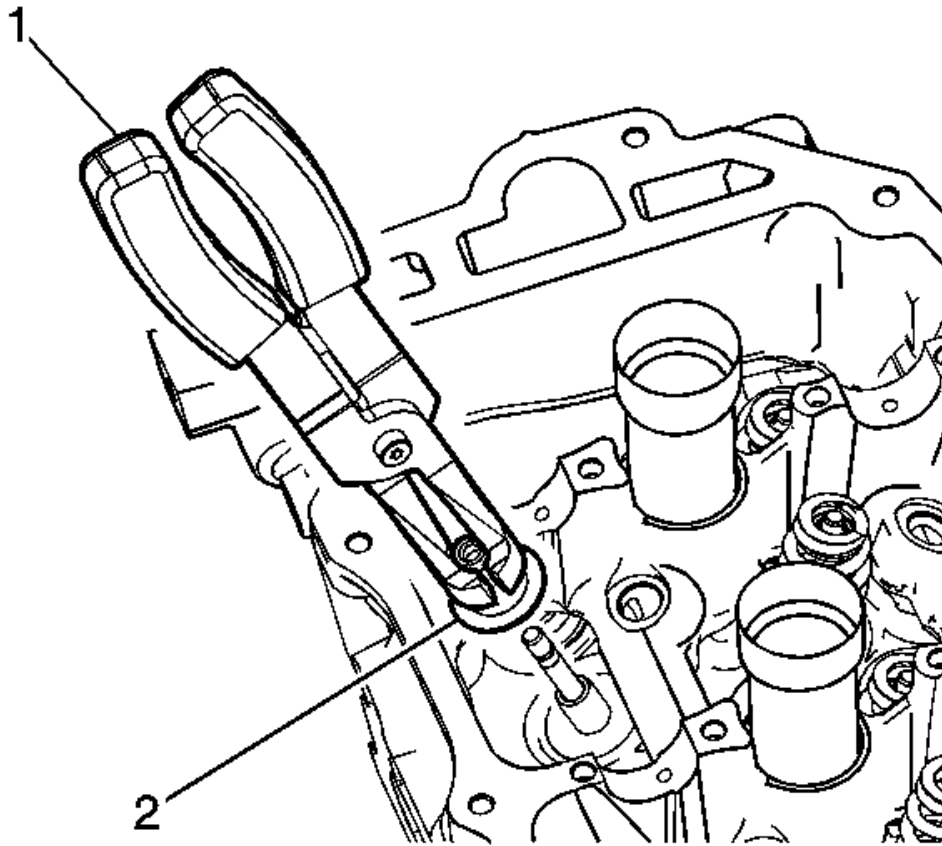
12. Remove the valve springs.



**Fig. 166: Identifying Special Tool - EN-46116 & Valve Stem Seal**  
Courtesy of GENERAL MOTORS CORP.

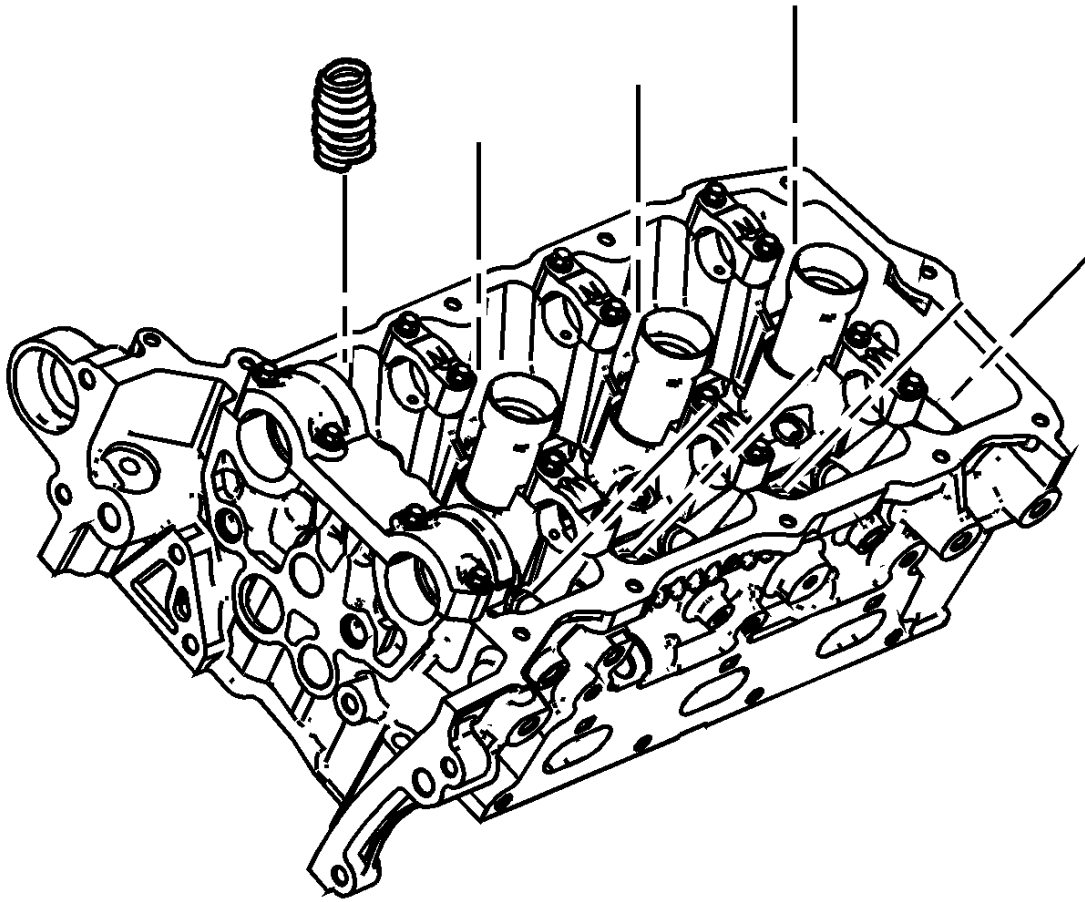
13. Use the **EN 46116** (1) in order to remove the valve stem seal (2). See **Special Tools** .

## **INSTALLATION PROCEDURE**



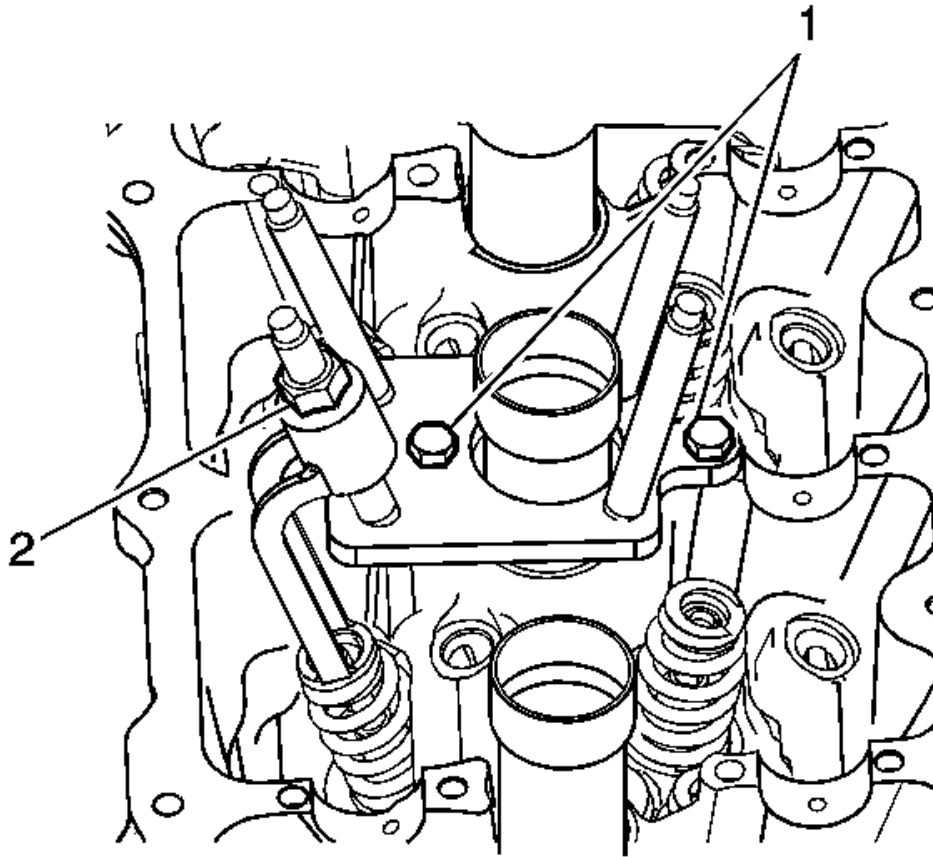
**Fig. 167: Identifying Special Tool - EN-46116 & Valve Stem Seal**  
Courtesy of GENERAL MOTORS CORP.

1. Use the **EN 46116** (1) in order to install the valve stem seals (2). See **Special Tools** .



**Fig. 168: View Of Valve Spring**  
Courtesy of GENERAL MOTORS CORP.

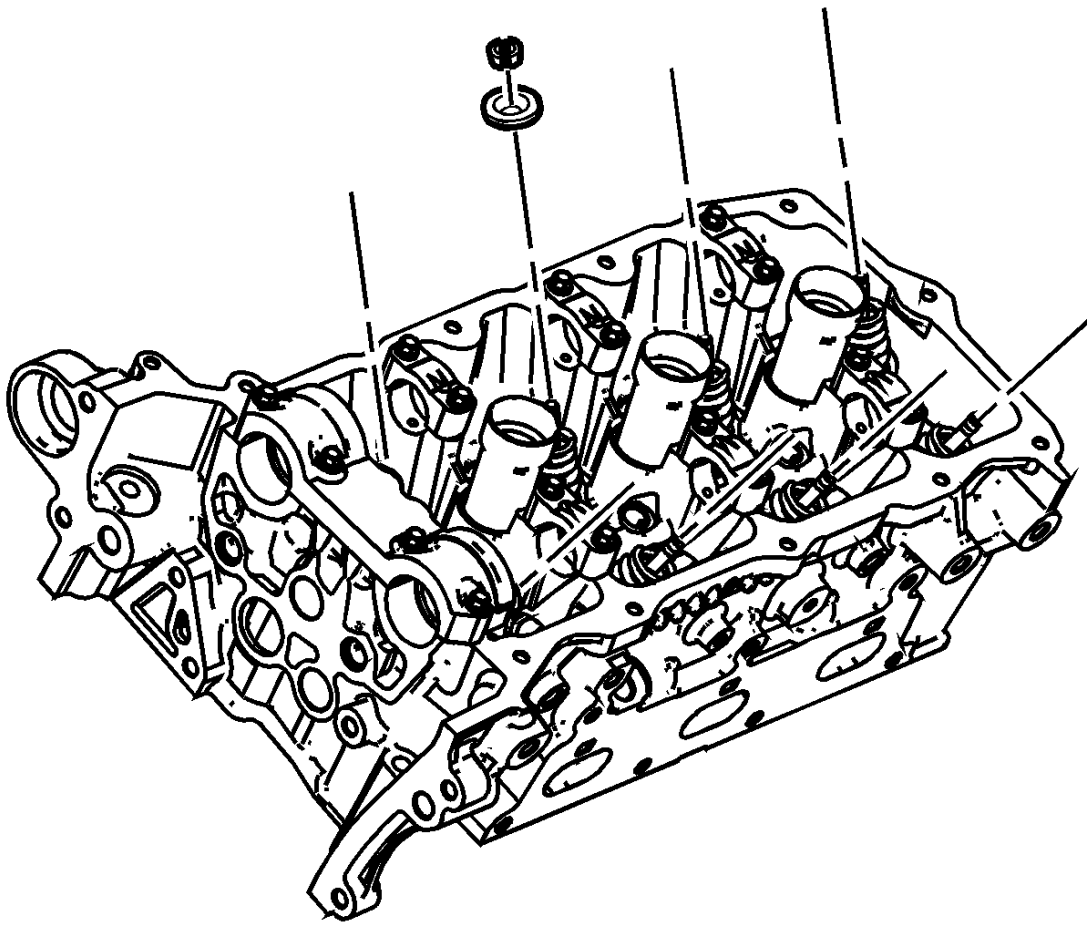
2. Install the valve spring.
3. Install the valve spring retainer.



**Fig. 169: View Of Installed Valve Spring Compressor Tool**  
Courtesy of GENERAL MOTORS CORP.

4. Install the **EN 46110** above the applicable valve spring as shown. See **Special Tools** .

Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .

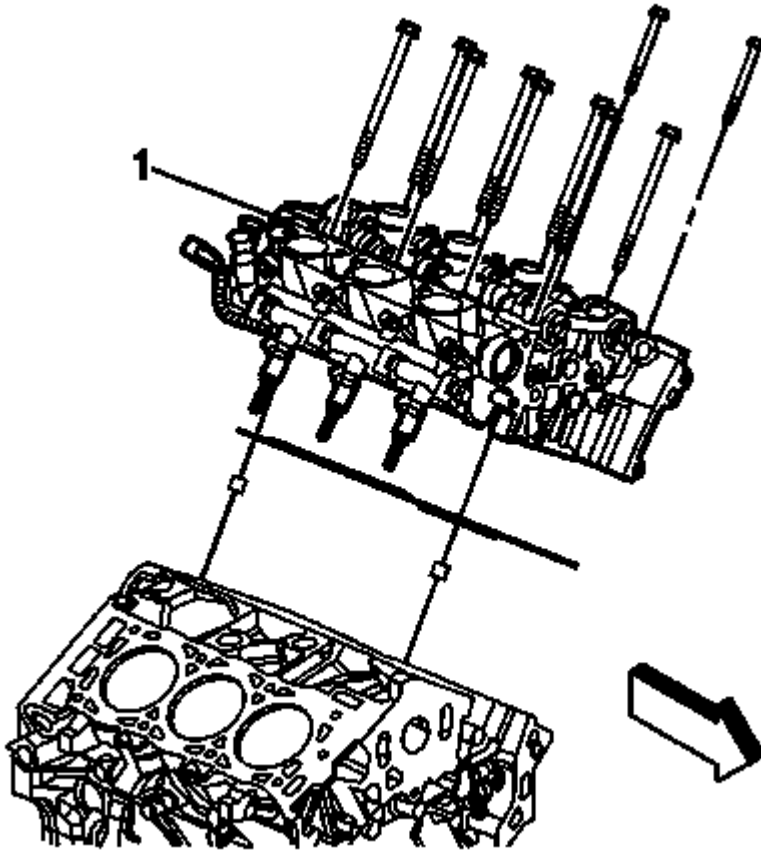


**Fig. 170: View Of Valve Spring Keepers**  
Courtesy of GENERAL MOTORS CORP.

5. Install the valve spring keepers.
6. Remove the **EN 46110** . See **Special Tools** .
7. Disconnect the **J 39313** from the compressed air source. See **Special Tools** .
8. Remove the **J 39313** . See **Special Tools** .
9. Install the spark plugs. Refer to **Spark Plug Replacement** .
10. Install the rocker arms and camshafts. Refer to **Camshaft Replacement - Right Side**.
11. Remove the **EN 46106** . See **Special Tools** .
12. Install the starter motor. Refer to **Starter Replacement** .

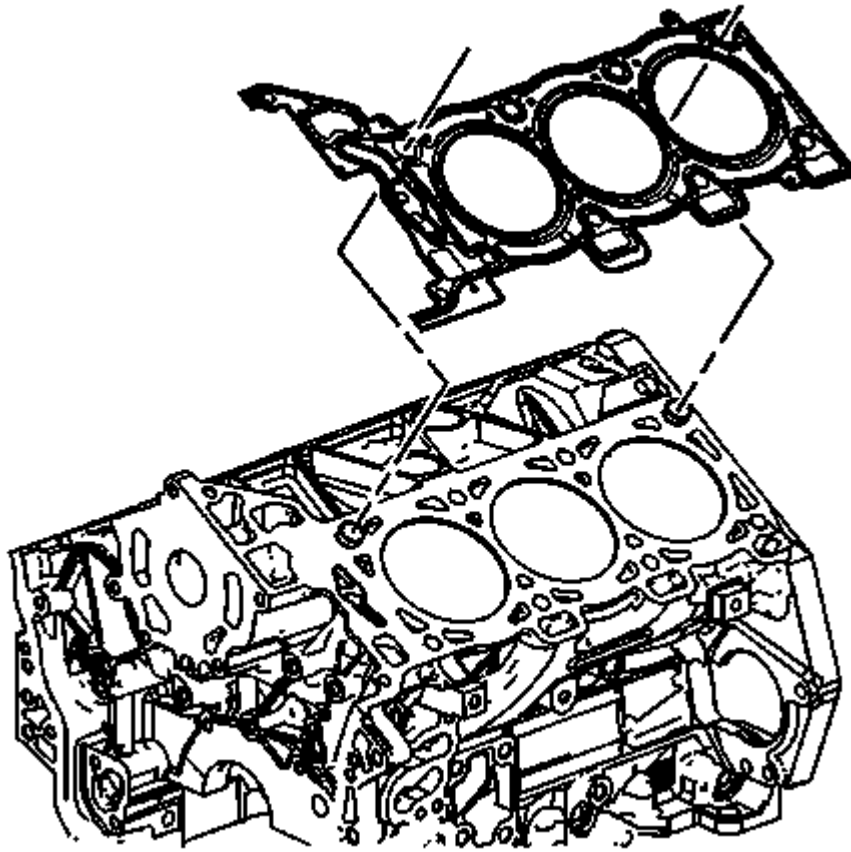
## **CYLINDER HEAD REPLACEMENT - LEFT SIDE**

### **REMOVAL PROCEDURE**



**Fig. 171: Identifying Cylinder Head and Exhaust Manifold Assembly**  
Courtesy of GENERAL MOTORS CORP.

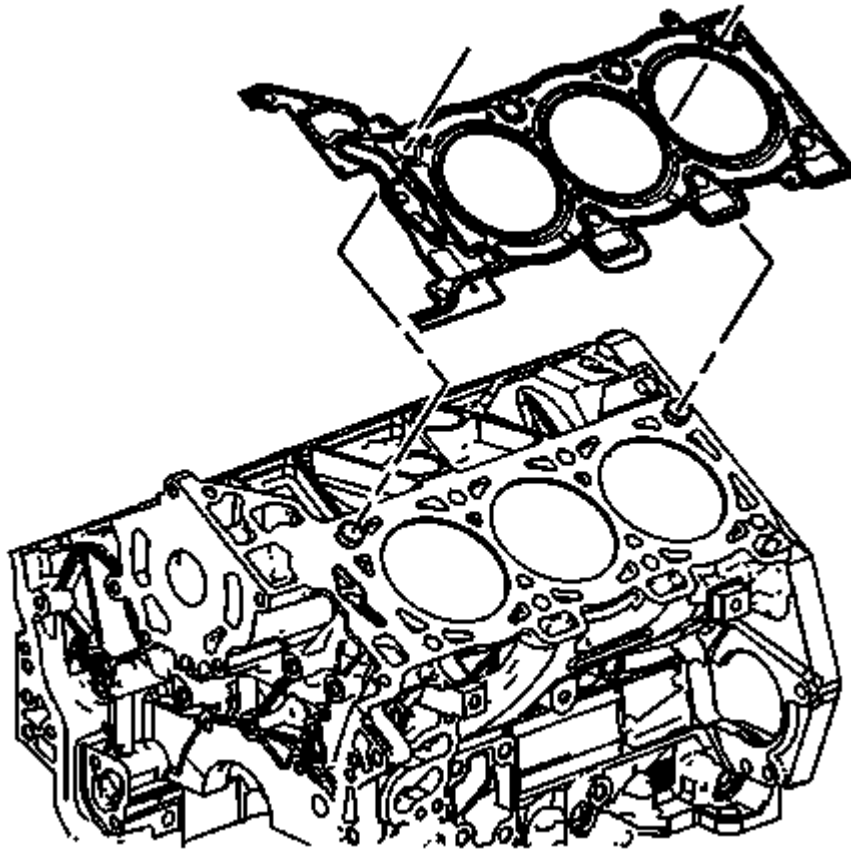
1. Remove the left bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Left Side**.
2. Remove the oil level indicator. Refer to **Oil Level Indicator Tube Replacement**.
3. Disconnect the coolant temperature sensor electrical connector.
4. Remove the catalytic converter from the exhaust manifold. Refer to **Catalytic Converter Replacement - Left Side**.
5. Remove the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake** and **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust**.
6. Remove the cylinder head (1) with the exhaust manifold. Refer to **Cylinder Head Removal - Left Side (LLT)**.



**Fig. 172: View Of Cylinder Head Gasket**  
Courtesy of GENERAL MOTORS CORP.

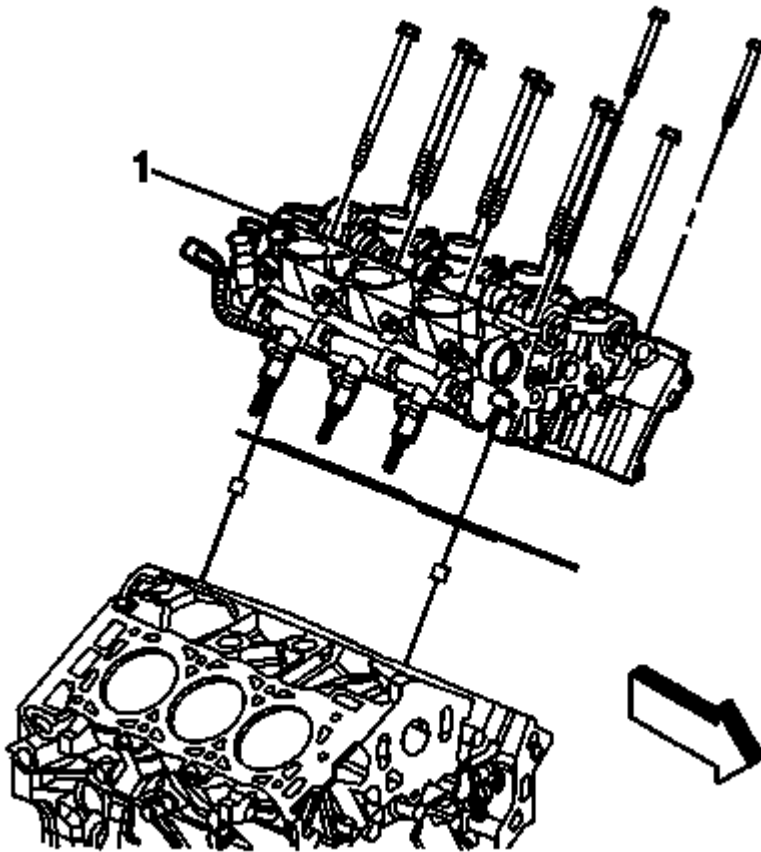
7. Remove and discard the cylinder head gasket.
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to Cylinder Head Cleaning and Inspection and Engine Block Cleaning and Inspection .
9. If necessary, perform the following steps:
  - Remove the exhaust manifold from the cylinder head. Refer to Exhaust Manifold Removal - Left Side .
  - Remove the camshaft. Refer to Camshaft Removal - Left Side (LLT) .
  - Disassemble the cylinder head. Refer to Cylinder Head Disassemble .
  - Remove the coolant sensor. Refer to Engine Coolant Temperature Sensor Replacement .

## INSTALLATION PROCEDURE



**Fig. 173: View Of Cylinder Head Gasket**  
Courtesy of GENERAL MOTORS CORP.

1. If necessary, perform the following steps:
  - Install the coolant sensor. Refer to **Engine Coolant Temperature Sensor Replacement** .
  - Assemble the cylinder head. Refer to **Cylinder Head Assemble (LLT)** .
  - Install the camshaft. Refer to **Camshaft Installation - Left Side** .
  - Install the exhaust manifold to the cylinder head. Refer to **Exhaust Manifold Installation - Left Side** .
2. Install a NEW cylinder head gasket.



**Fig. 174: Identifying Cylinder Head and Exhaust Manifold Assembly**  
Courtesy of GENERAL MOTORS CORP.

3. Carefully install the cylinder head with the exhaust manifold to the engine. Refer to **Cylinder Head Installation - Left Side**.
4. Install the camshaft position actuator solenoid valve. Refer to **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake** and **Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust**.
5. Install the catalytic converter to the exhaust manifold. Refer to **Catalytic Converter Replacement - Left Side**.
6. Connect the wiring harness electrical connector located at the side of the cylinder head.
7. Install the coolant temperature sensor electrical connector.
8. Install the oil level indicator. Refer to **Oil Level Indicator Tube Replacement**.
9. Install the left bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Left Side**.

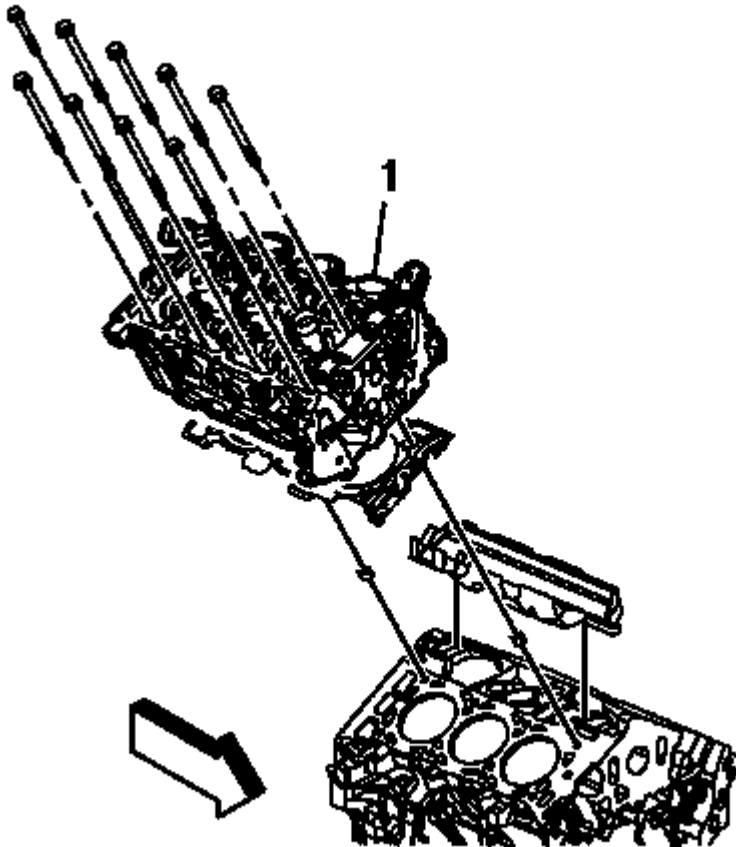
**2010 ENGINE**

**Engine Mechanical - 2.8L, 3.0L, 3.2L, or 3.6L - Repair Instructions - On Vehicle - Acadia, Enclave, Outlook & Traverse**

**CYLINDER HEAD REPLACEMENT - RIGHT SIDE**

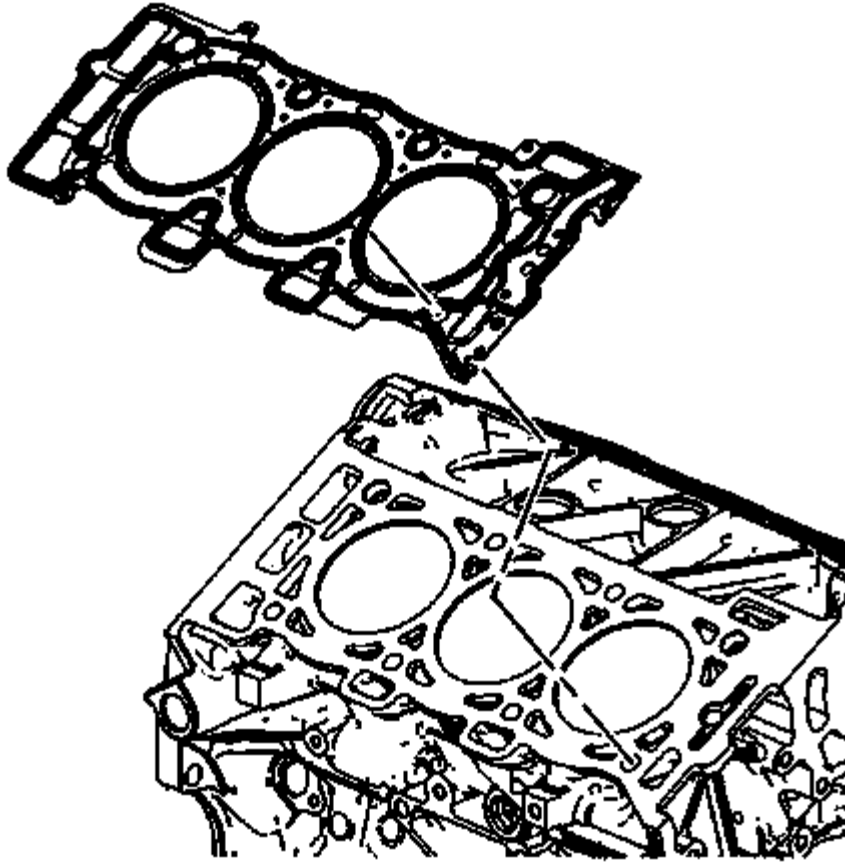
**REMOVAL PROCEDURE**

1. Remove the right bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Right Side** .
2. Remove the right side catalytic converter from the exhaust manifold. Refer to **Catalytic Converter Replacement - Right Side** .
3. Remove the ground wires from the cylinder head.
4. Disconnect and unclip the heated oxygen sensor (HO2) wiring harness.
5. Unbolt the power steering hose retainer.



**Fig. 1: View Of Cylinder Head & Exhaust Manifold**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the cylinder head (1) with the exhaust manifold. Refer to **Cylinder Head Removal - Right Side (LLT)** .



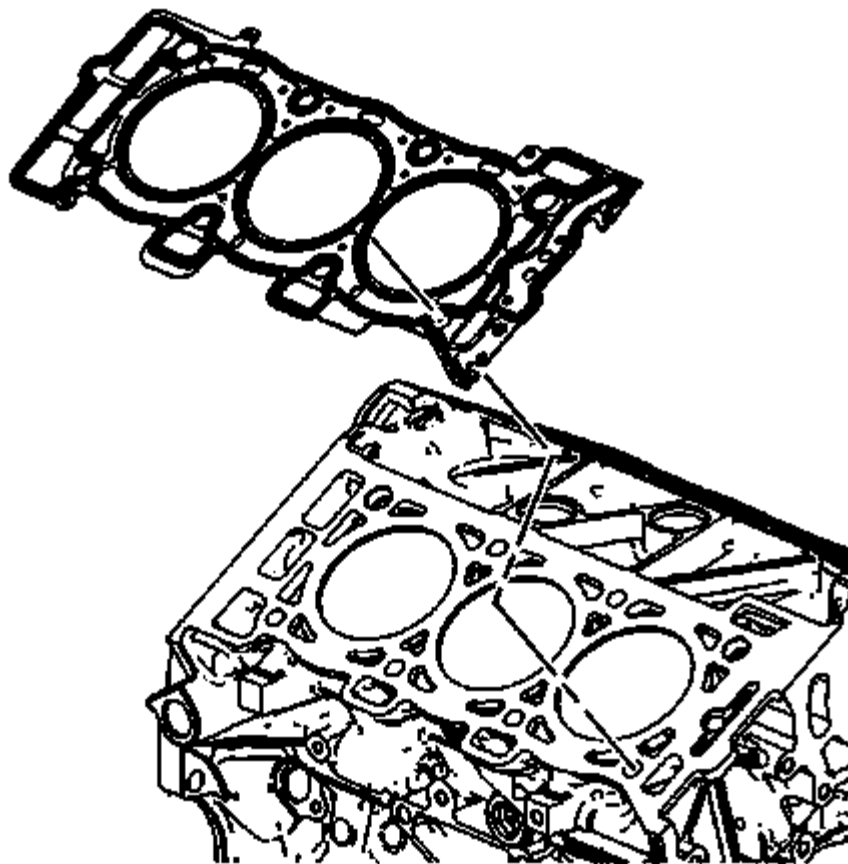
**Fig. 2: View Of Cylinder Head Gasket**  
Courtesy of GENERAL MOTORS CORP.

7. Remove and discard the cylinder head gasket.
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** and **Engine Block Cleaning and Inspection** .
9. If necessary, perform the following steps:
  - Remove the exhaust manifold from the cylinder head. Refer to **Exhaust Manifold Removal - Right Side** .
  - Remove the camshaft. Refer to **Camshaft Removal - Right Side** .
  - Disassemble the cylinder head. Refer to **Cylinder Head Disassemble** .

## INSTALLATION PROCEDURE

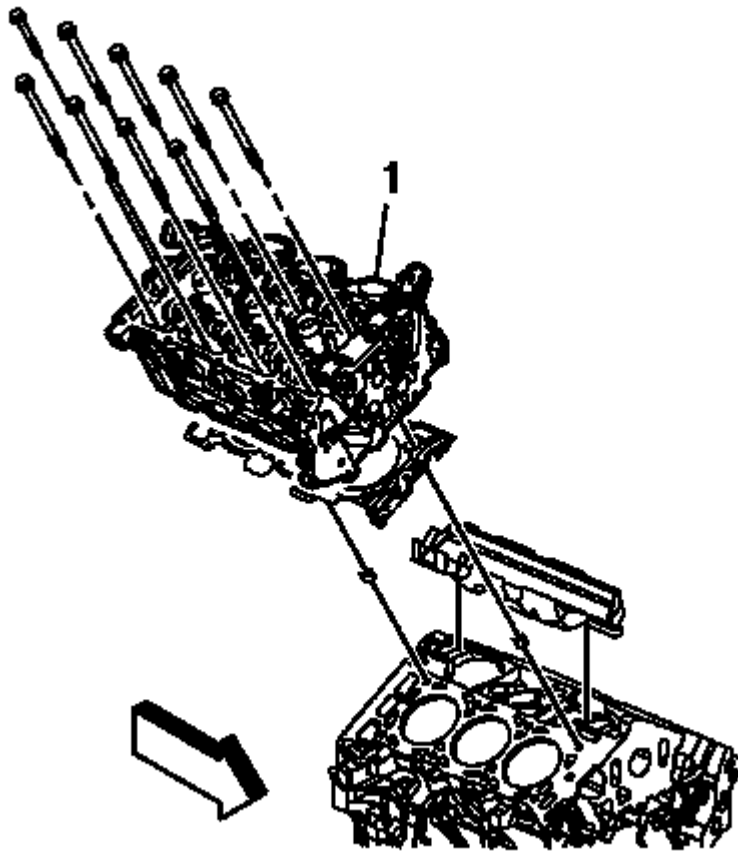
1. If necessary, perform the following steps:
  - Assemble the cylinder head. Refer to **Cylinder Head Assemble (LLT)** .
  - Install the camshaft. Refer to **Camshaft Installation - Right Side** .

- Install the exhaust manifold to the cylinder head. Refer to **Exhaust Manifold Installation - Right Side**.



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

2. Install a NEW cylinder head gasket.

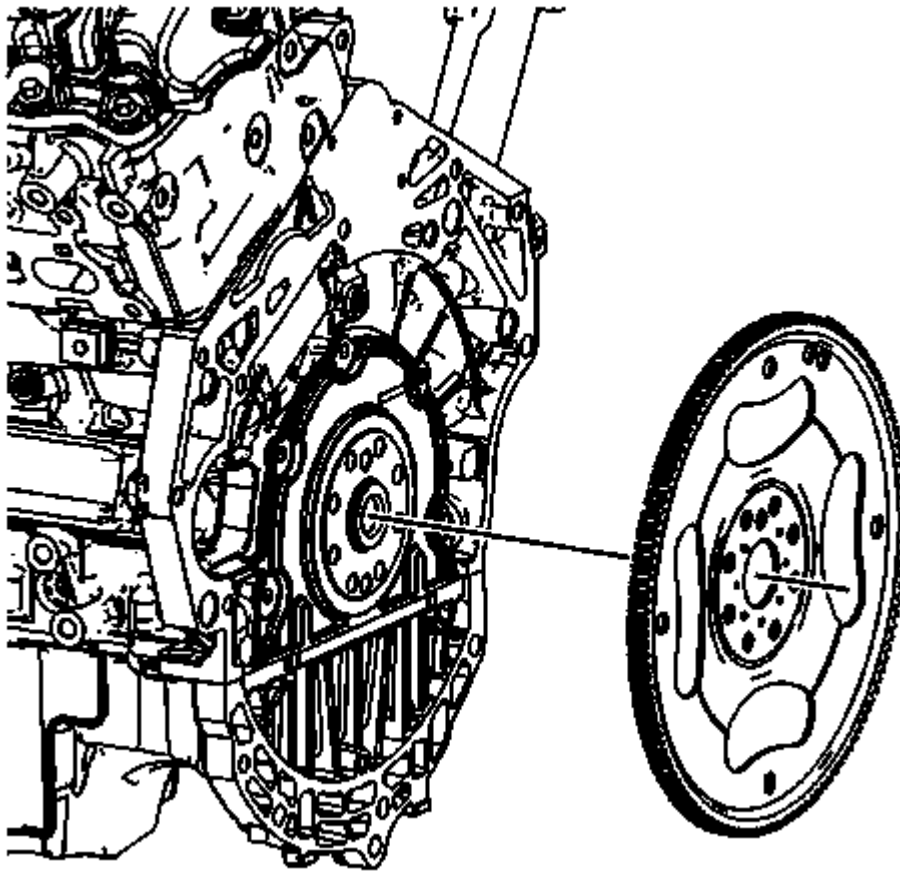


**Fig. 4: View Of Cylinder Head & Exhaust Manifold**  
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head (1) with the exhaust manifold to the engine. Refer to **Cylinder Head Installation - Right Side** .
4. Install the power steering hose retainer.
5. Connect and clip the HO2 sensor wiring harness.
6. Install the ground wires to the cylinder head.
7. Install the right side catalytic converter to the exhaust manifold. Refer to **Catalytic Converter Replacement - Right Side** .
8. Install the right bank secondary timing chain. Refer to **Secondary Camshaft Intermediate Drive Chain Replacement - Right Side** .

## ENGINE FLYWHEEL REPLACEMENT

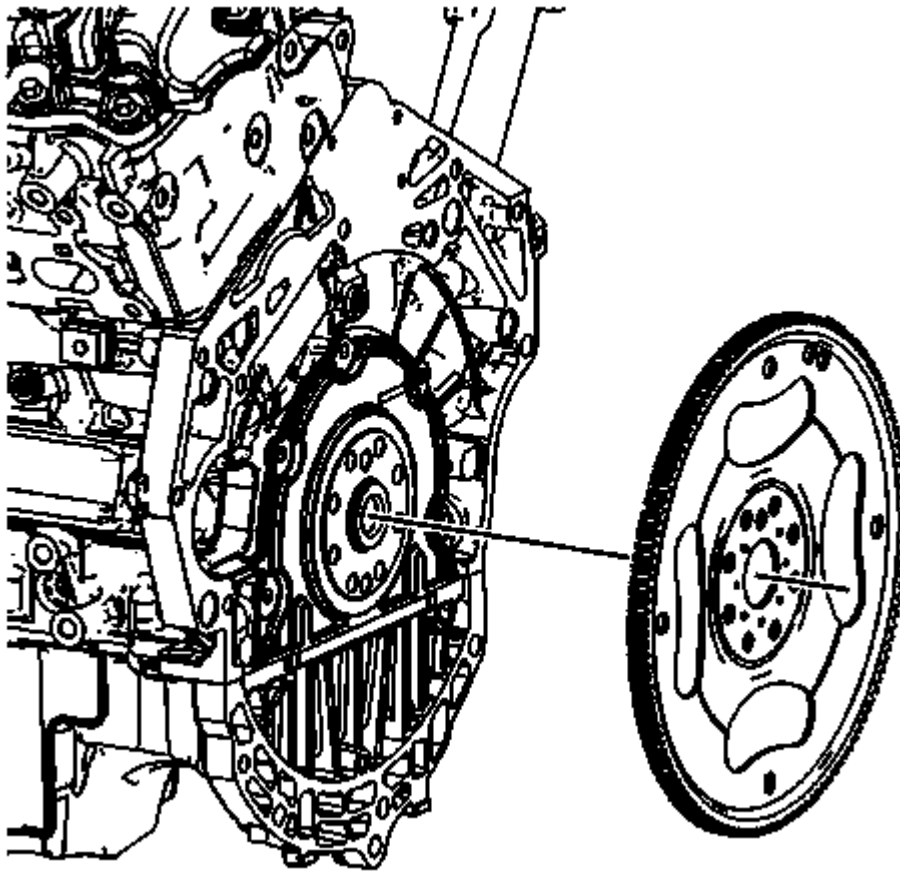
### REMOVAL PROCEDURE



**Fig. 5: View Of Engine Flywheel**  
Courtesy of GENERAL MOTORS CORP.

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

## INSTALLATION PROCEDURE



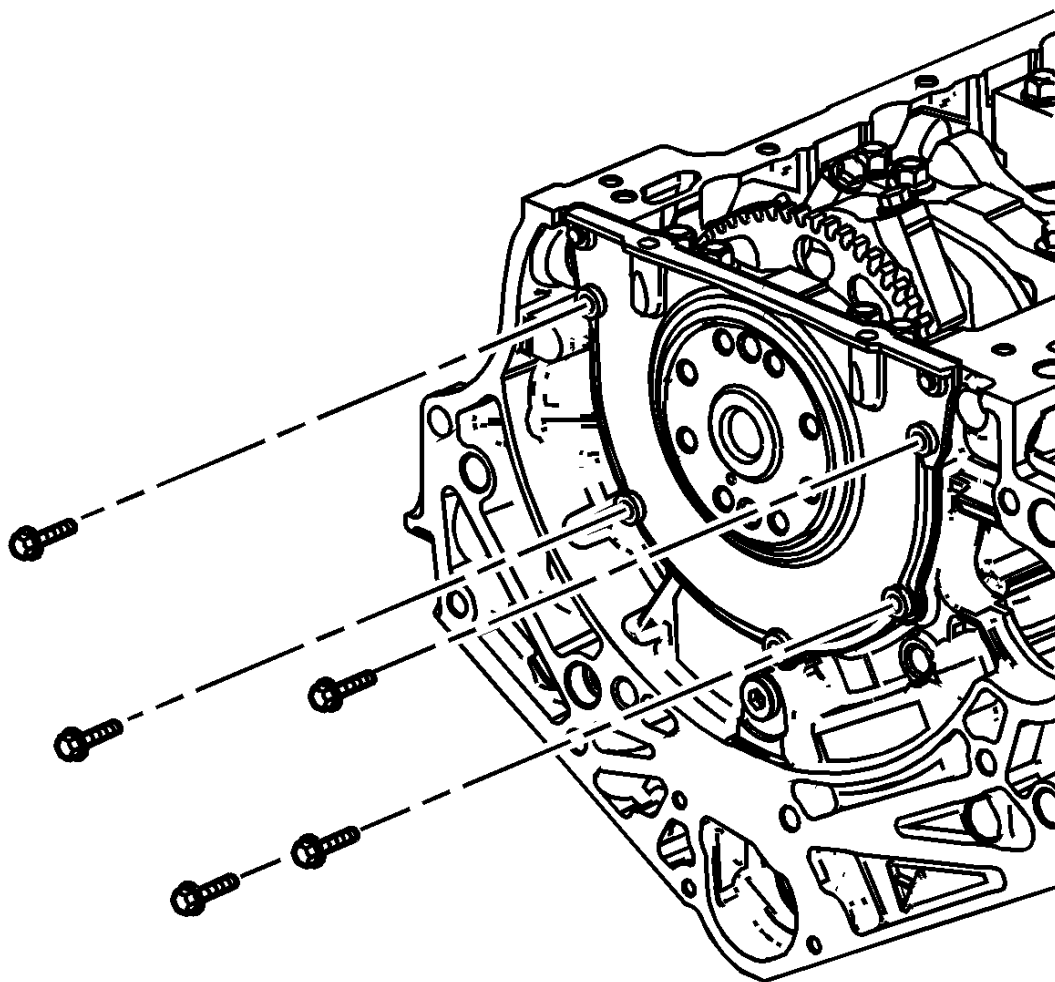
**Fig. 6: View Of Engine Flywheel**  
Courtesy of GENERAL MOTORS CORP.

1. Install the engine flywheel and bolts. Refer to **Engine Flywheel Installation** .
2. Install the transmission. Refer to **Transmission Replacement (All Wheel Drive)** or **Transmission Replacement (Front Wheel Drive)** .

## CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

### REMOVAL PROCEDURE

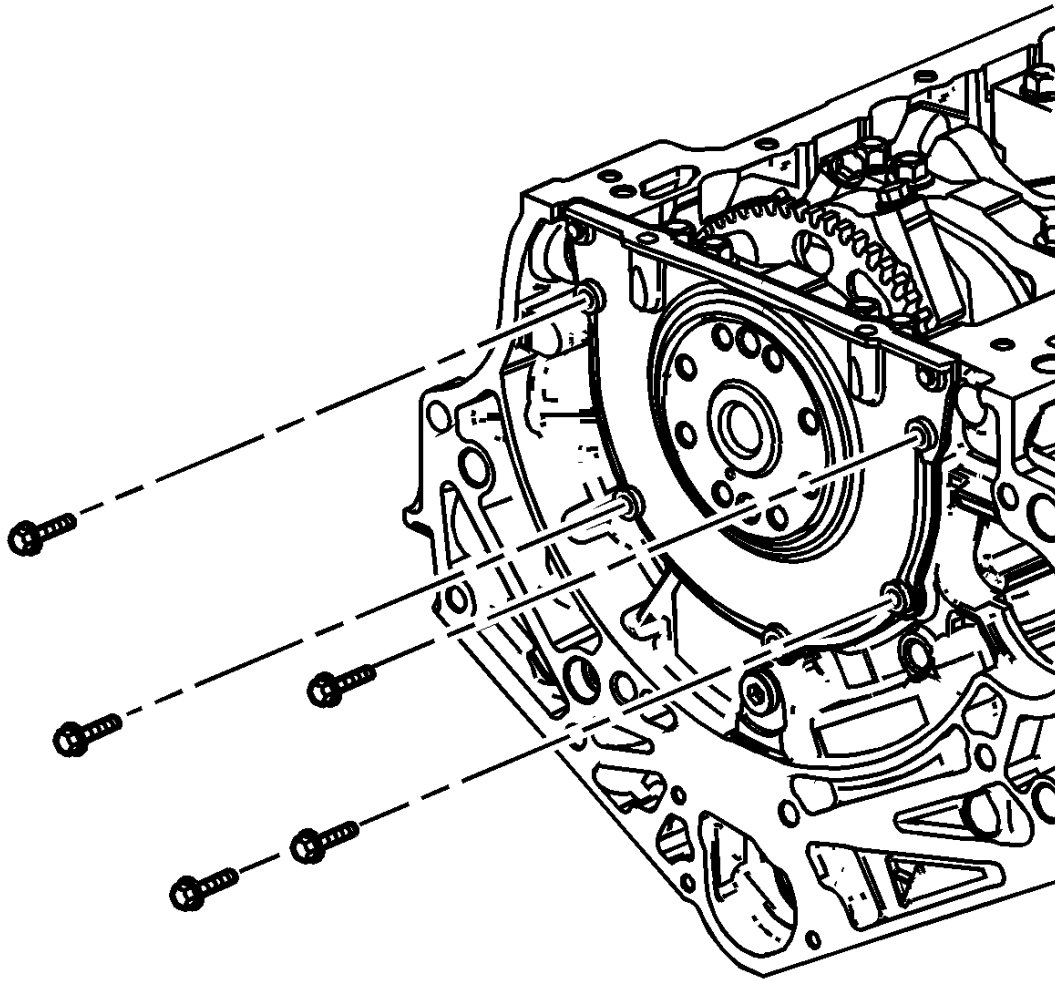
1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.



**Fig. 7: Locating Crankshaft Rear Oil Seal Housing Bolts**  
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

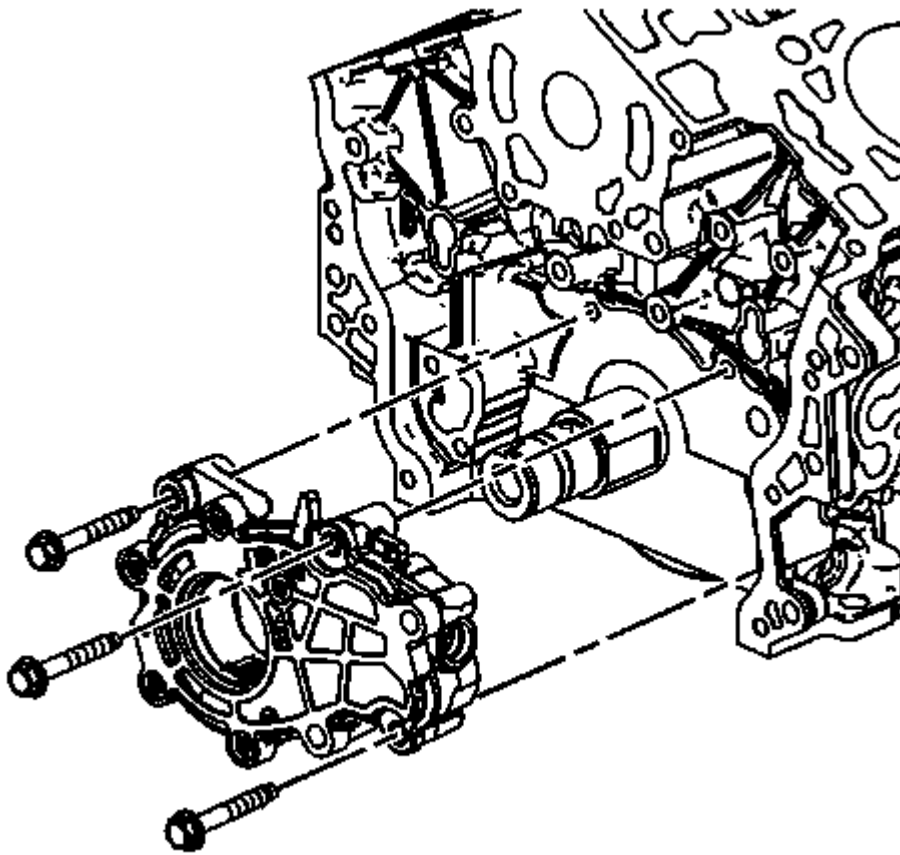


**Fig. 8: Locating Crankshaft Rear Oil Seal Housing Bolts**  
Courtesy of GENERAL MOTORS CORP.

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

## **OIL PUMP REPLACEMENT**

### **REMOVAL PROCEDURE**

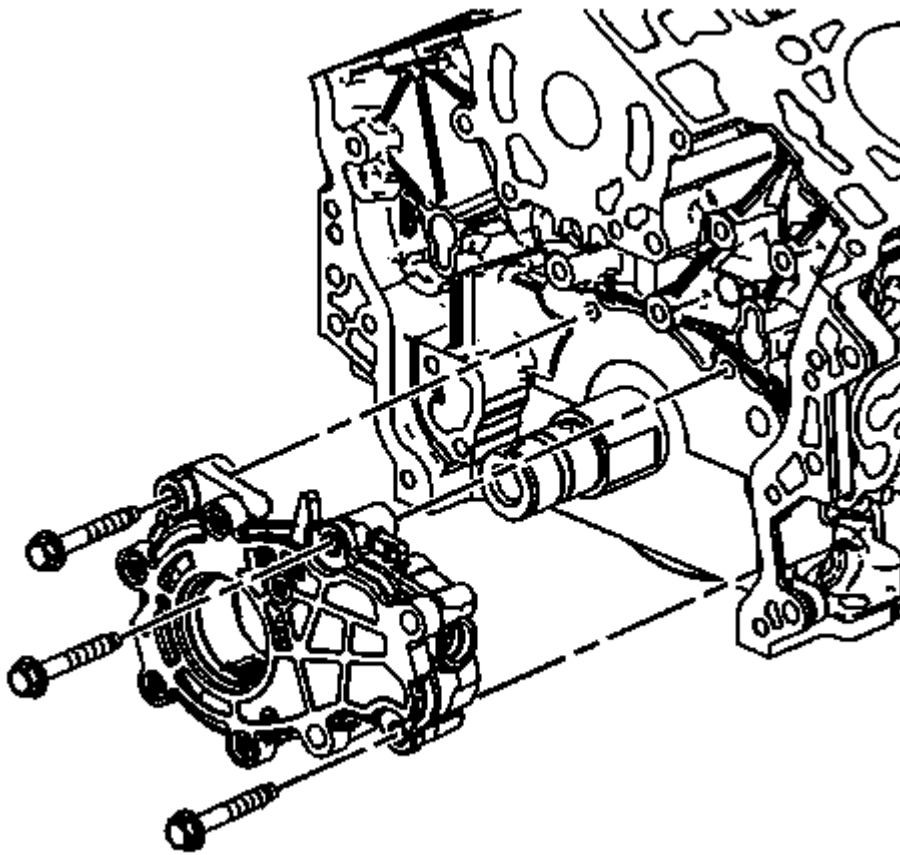


**Fig. 9: Identifying Oil Pump & Bolts**  
Courtesy of GENERAL MOTORS CORP.

**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 oil pump bolts and the oil pump. Refer to **Oil Pump Removal** .

## INSTALLATION PROCEDURE



**Fig. 10: Identifying Oil Pump & Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump. Refer to [Oil Pump Installation](#) .
2. Install the primary timing chain. Refer to [Primary Camshaft Drive Chain and Sprockets Replacement](#) .

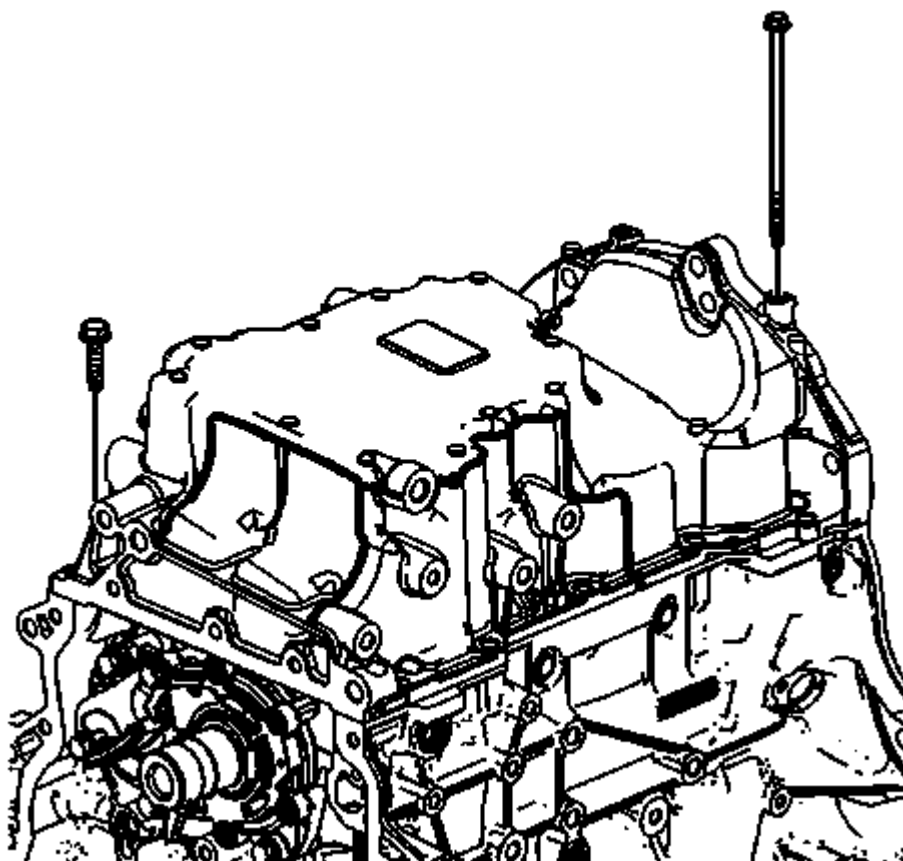
## **OIL PAN REPLACEMENT**

### **SPECIAL TOOLS**

- **EN 46109** Guide Pin Set. See [Special Tools](#) .
- **J 39505** Torque Wrench Adapter

### **REMOVAL PROCEDURE**

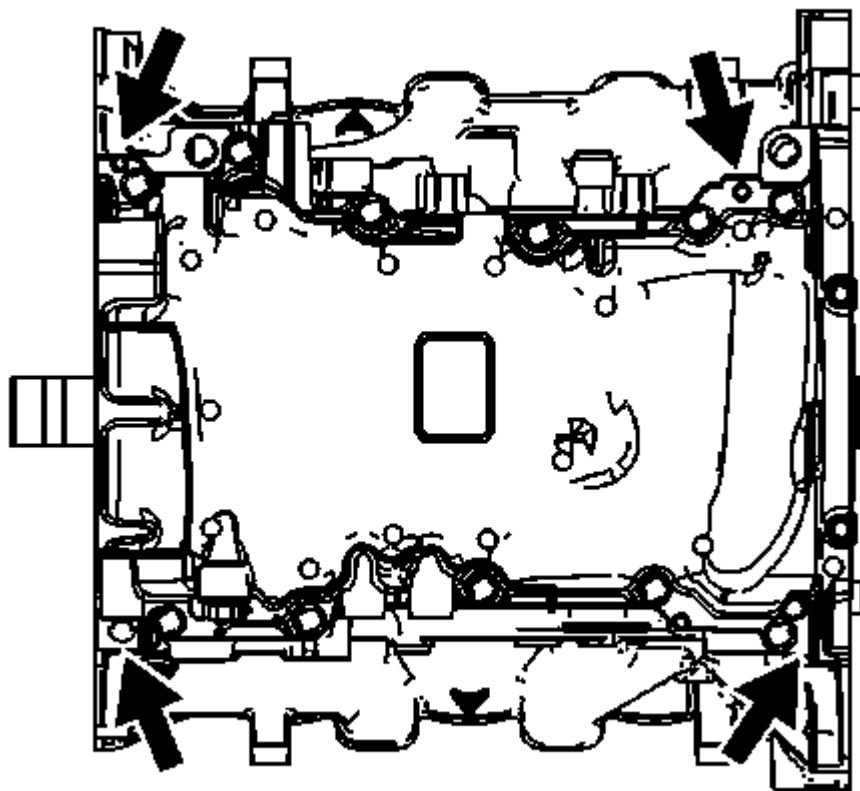
1. Drain the engine oil and remove the oil filter. Refer to [Engine Oil and Oil Filter Replacement](#).
2. Remove the exhaust flexible pipe. Refer to [Exhaust Flexible Pipe Replacement](#) .
3. Remove the engine. Refer to [Engine Replacement](#).
4. Remove the engine front cover. Refer to [Engine Front Cover Removal](#) .



**Fig. 11: Locating Oil Pan Bolts**

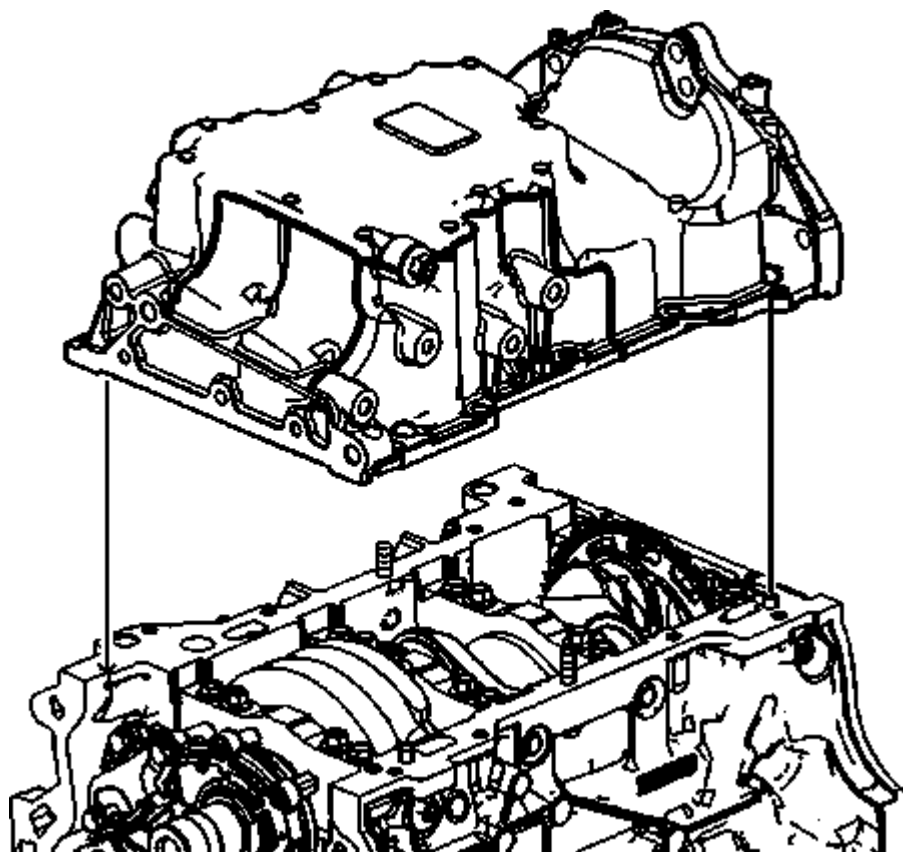
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pan bolts.



**Fig. 12: Identifying Oil Pan RTV Sealant Pry Points**  
Courtesy of GENERAL MOTORS CORP.

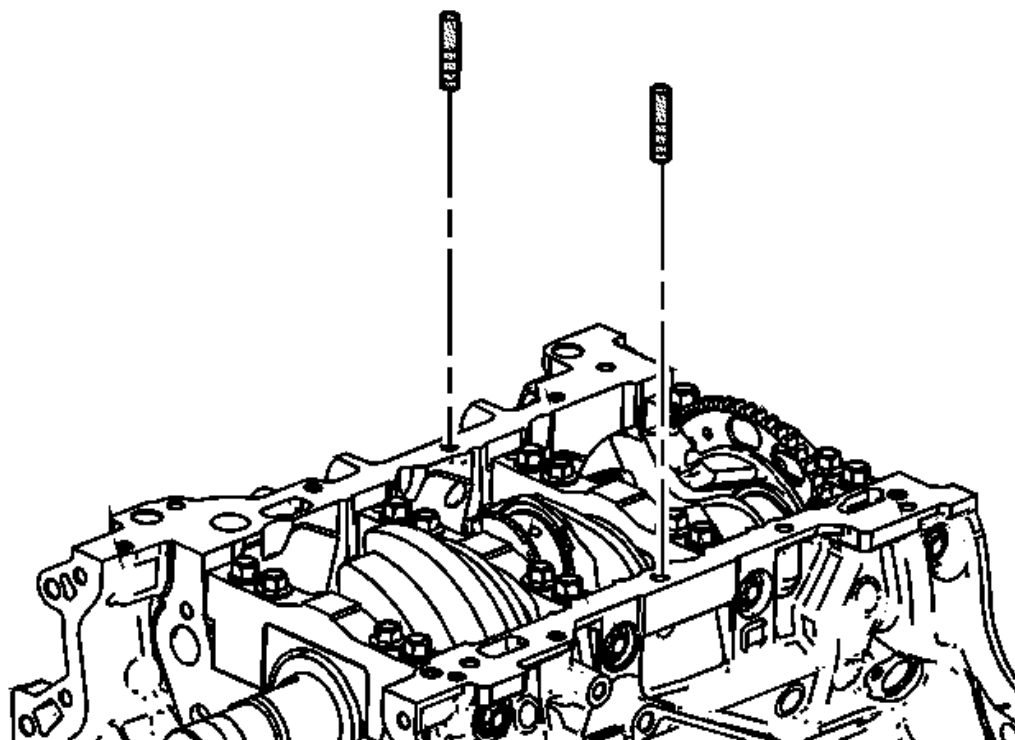
6. Using the pry points located at the edge of the oil pan separate the RTV sealant.



**Fig. 13: View Of Oil Pan & Block**  
Courtesy of GENERAL MOTORS CORP.

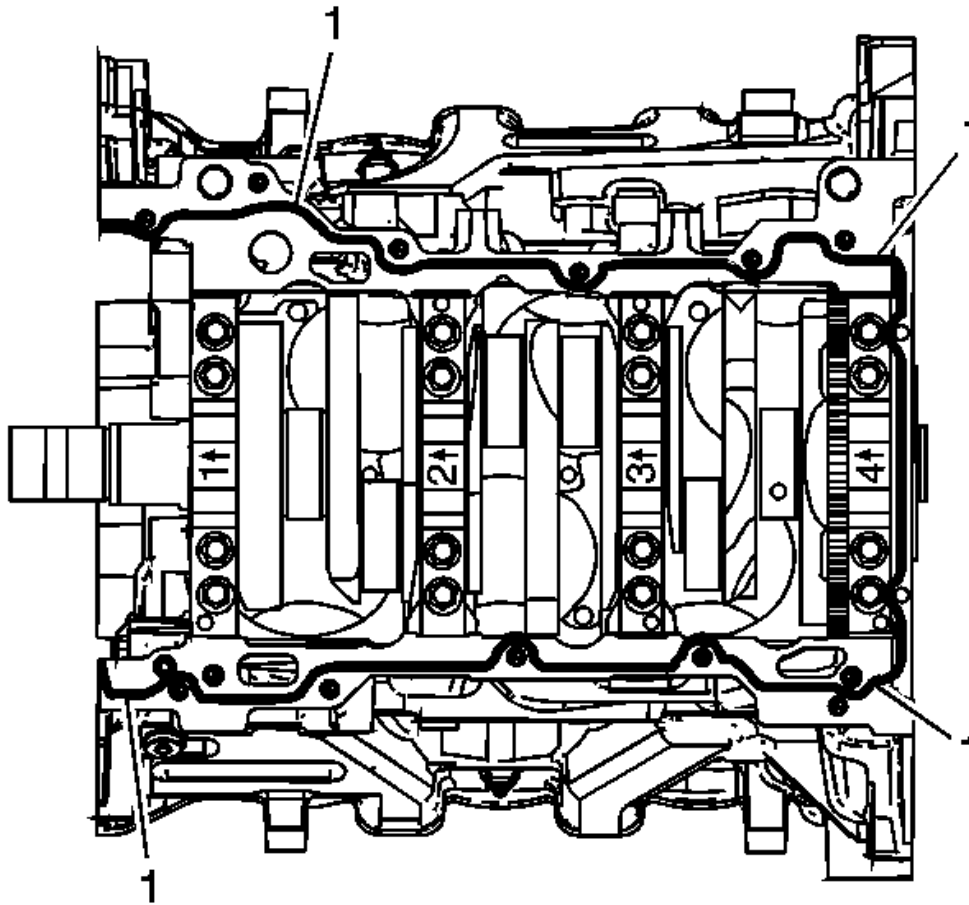
7. Remove the oil pan from the block.
8. Clean the oil pan and the engine block gasket surface. Refer to **Oil Pan Cleaning and Inspection** .

## INSTALLATION PROCEDURE



**Fig. 14: Identifying Special Tool - EN 46109 Guides**  
Courtesy of GENERAL MOTORS CORP.

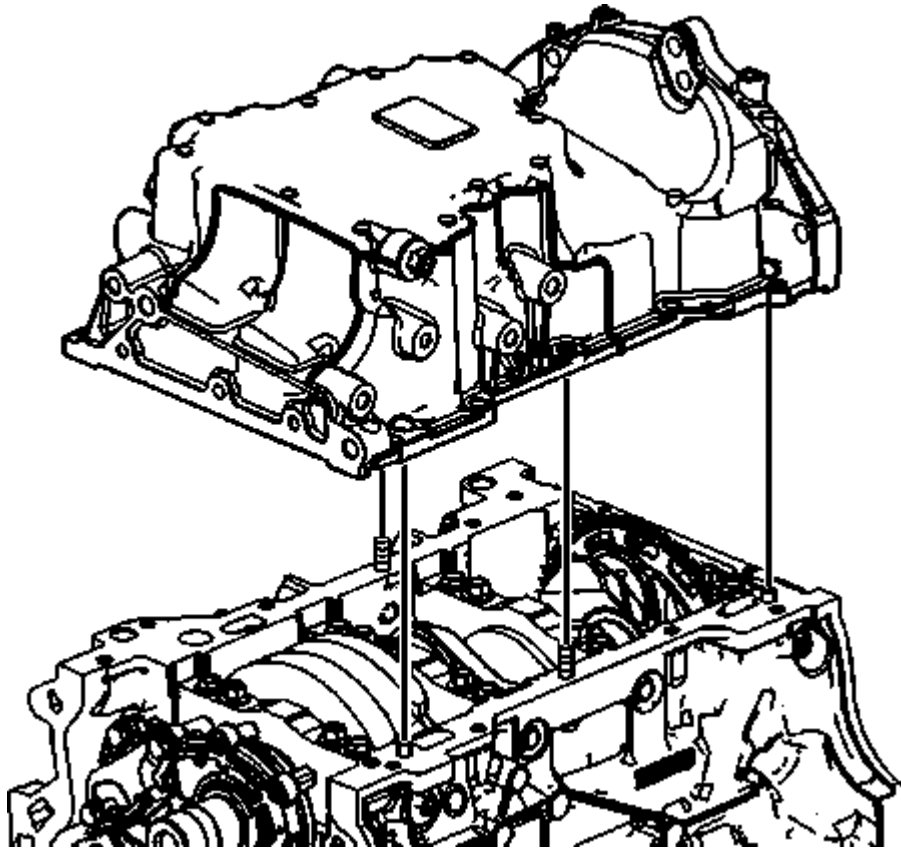
1. Install the 8 mm (0.315 in) guides from the **EN 46109** into the center oil pan rail bolt hole on each side of the engine block. See **Special Tools** .



**Fig. 15: Identifying Sealant Application Locations On Block Pan Rail & Crankshaft Rear Oil Seal Housing**

Courtesy of GENERAL MOTORS CORP.

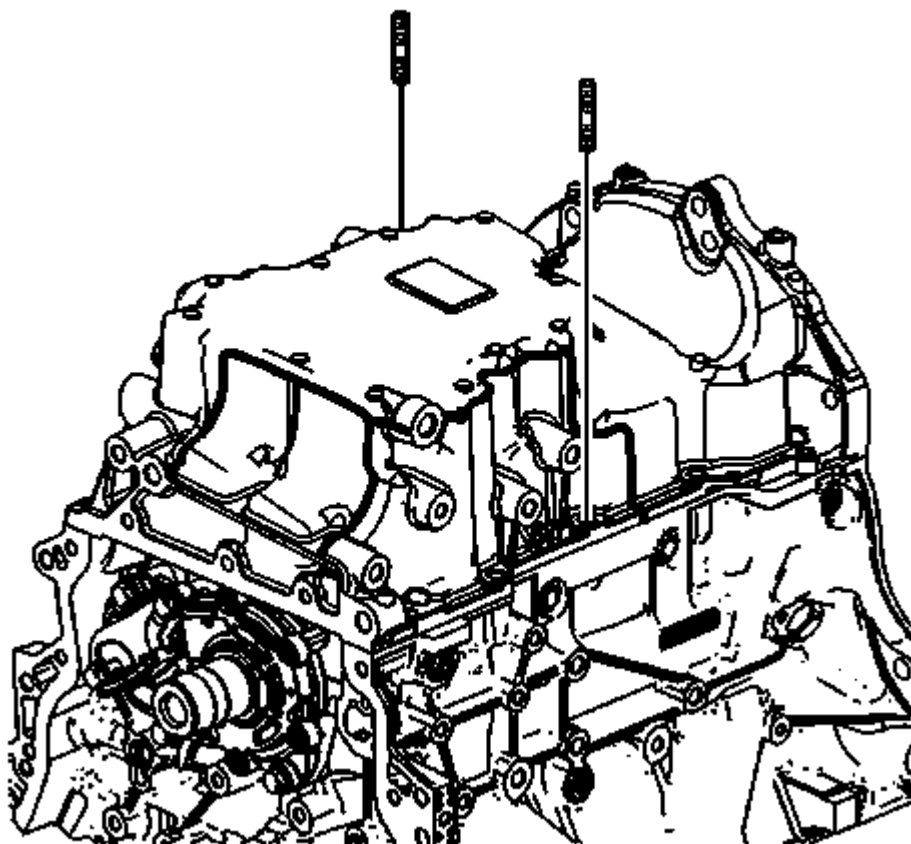
2. Place a 3 mm (0.118 in) bead (1) of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the block pan rail and the crankshaft rear oil seal housing.



**Fig. 16: View Of Oil Pan**

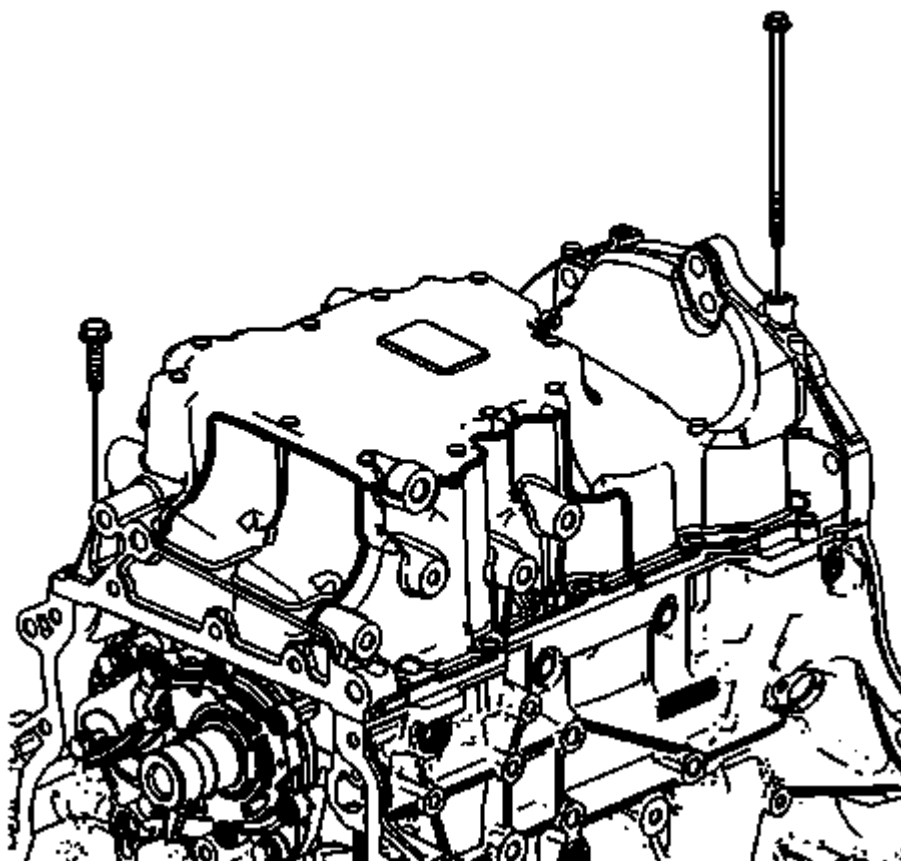
Courtesy of GENERAL MOTORS CORP.

3. Position the oil pan onto the block.



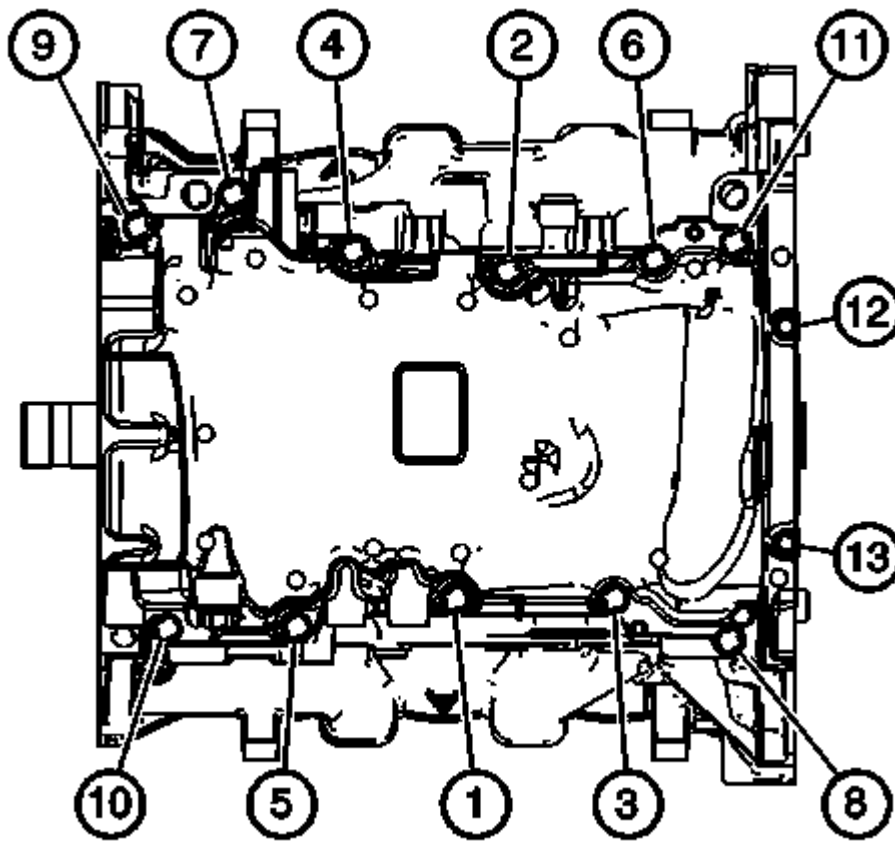
**Fig. 17: Identifying Special Tools - EN 46109**  
Courtesy of GENERAL MOTORS CORP.

4. Remove the **EN 46109** 8 mm (0. See **Special Tools** .315 in) guides from the engine block.



**Fig. 18: Locating Oil Pan Bolts**  
Courtesy of GENERAL MOTORS CORP.

5. Loosely install the oil pan bolts.



**Fig. 19: Identifying Oil Pan Bolt Tightening Sequence**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

6. Tighten the oil pan bolts in sequence shown.

**Tighten:**

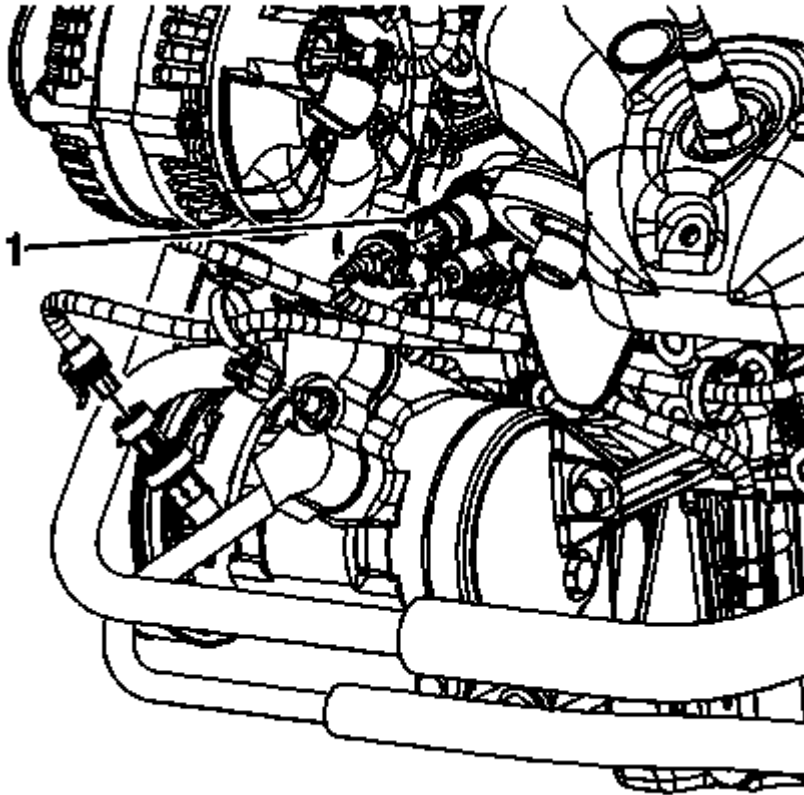
1. Tighten the 8 mm bolts (1-11) to 23 N.m (17 lb ft).
2. Tighten the 6 mm bolts (12, 13) to 10 N.m (89 lb in).
7. Install the engine front cover. Refer to Engine Front Cover Installation .
8. Install the engine. Refer to Engine Replacement.
9. Install the exhaust flexible pipe. Refer to Exhaust Flexible Pipe Replacement .
10. Refill the engine oil. Refer to Engine Oil and Oil Filter Replacement.

## ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

## **SPECIAL TOOLS**

**J 41712** Oil Pressure Switch Socket

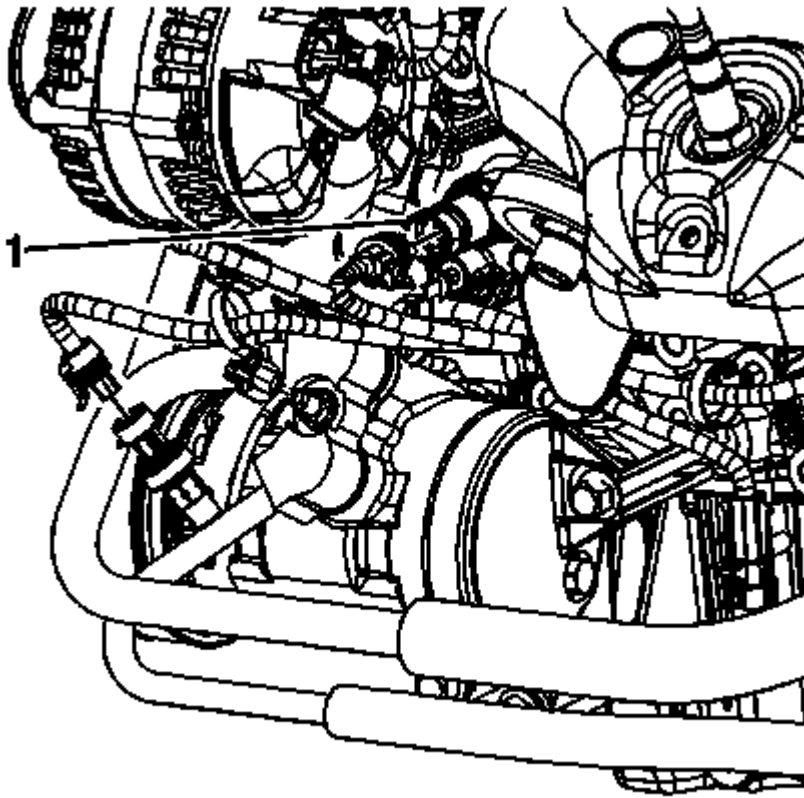
## **REMOVAL PROCEDURE**



**Fig. 20: Identifying Oil Pressure Sensor**  
Courtesy of GENERAL MOTORS CORP.

1. Turn the ignition OFF.
2. Remove the generator. Refer to **GENERATOR REPLACEMENT** .
3. Disconnect the oil pressure sensor electrical connector.
4. Remove the oil pressure sensor (1).

## **INSTALLATION PROCEDURE**



**Fig. 21: Identifying Oil Pressure Sensor**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Refer to Fastener Caution .

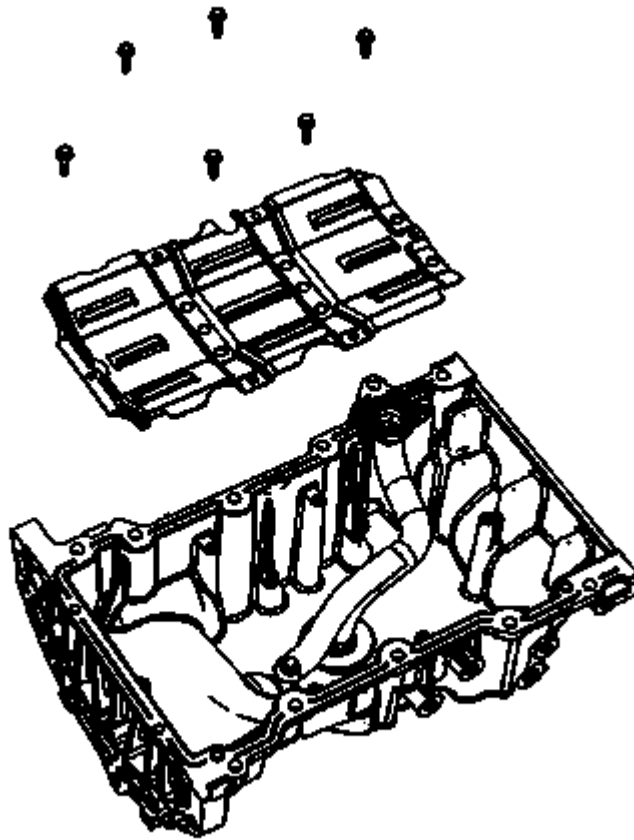
1. Install the oil pressure sensor (1).

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

2. Connect the oil pressure sensor electrical connector.
3. Install the generator. Refer to GENERATOR REPLACEMENT .

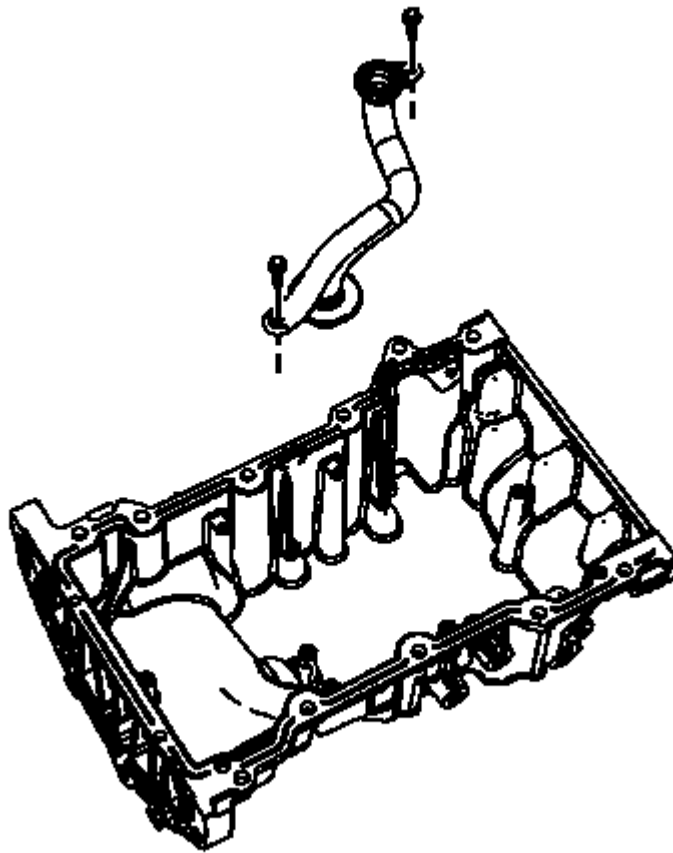
## OIL PUMP SUCTION PIPE AND SCREEN ASSEMBLY REPLACEMENT

### REMOVAL PROCEDURE



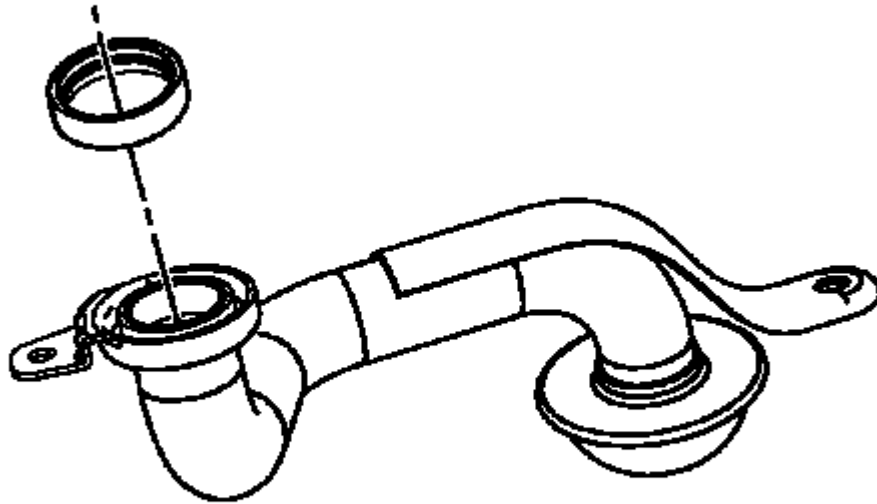
**Fig. 22: Identifying Oil Pan Scraper Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the oil pan scraper bolts.
3. Remove the oil pan scraper.



**Fig. 23: View Of Oil Suction Pipe & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

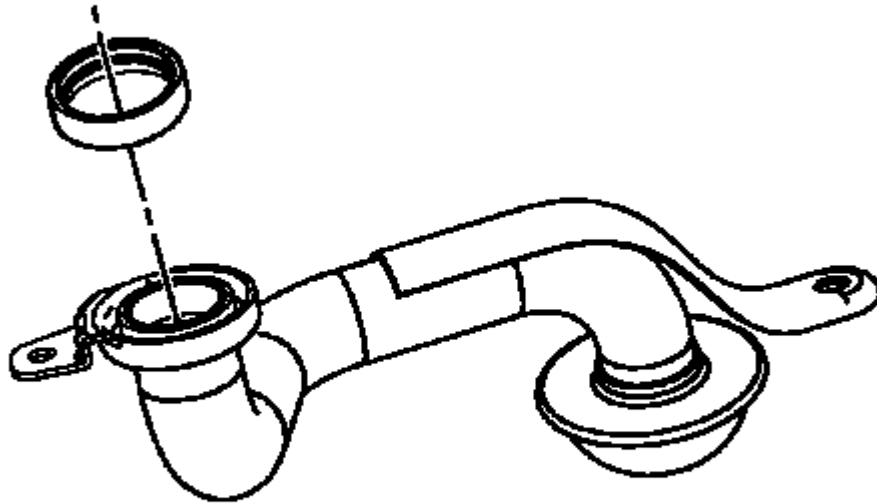
4. Remove the oil suction pipe bolts.
5. Remove the oil suction pipe.



**Fig. 24: Locating Oil Suction Tube Seal**  
Courtesy of GENERAL MOTORS CORP.

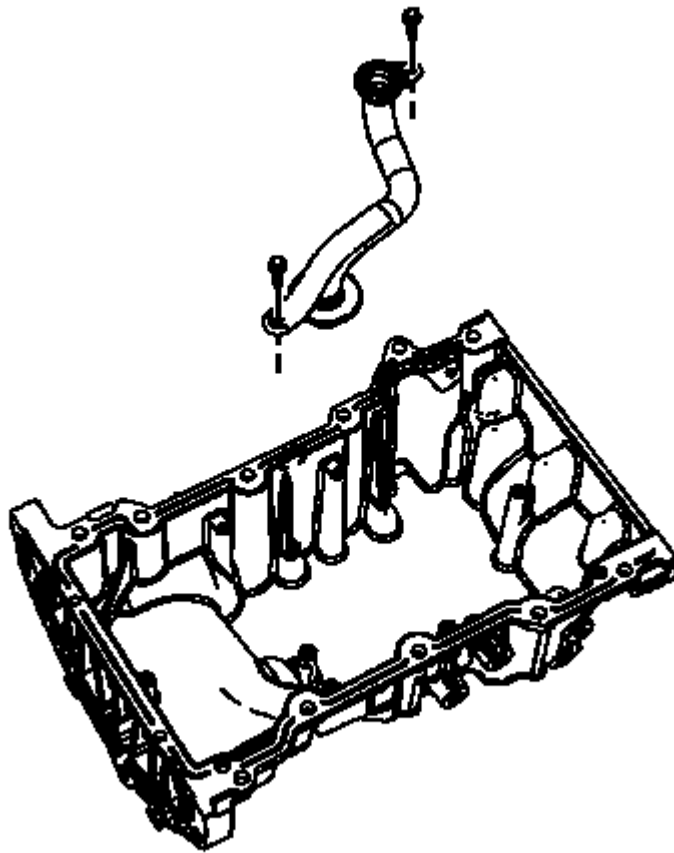
6. Remove the oil suction tube seal from the oil suction tube. Discard the oil suction tube seal.

## INSTALLATION PROCEDURE



**Fig. 25: Locating Oil Suction Tube Seal**  
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.



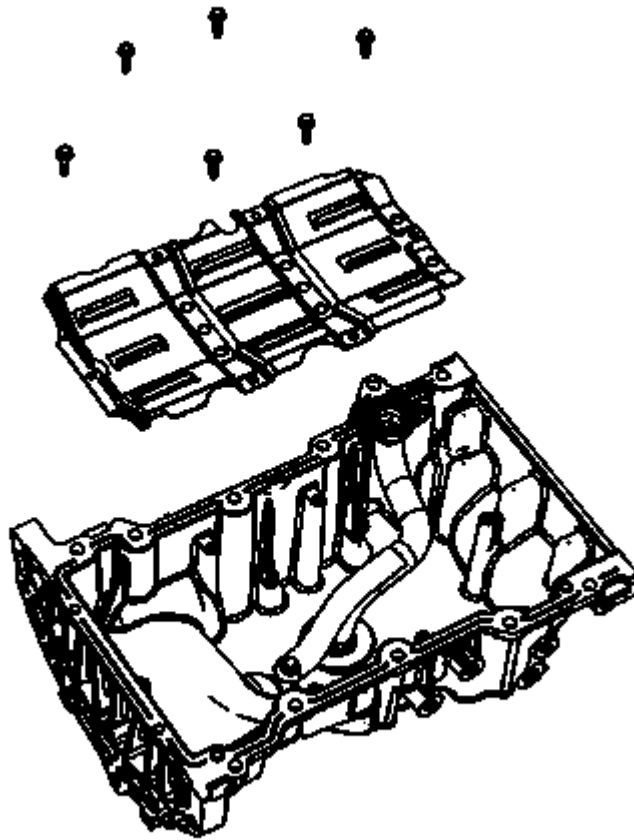
**Fig. 26: View Of Oil Suction Pipe & Bolts**  
Courtesy of GENERAL MOTORS CORP.

2. Install the oil suction pipe.

**CAUTION:** Refer to Fastener Caution .

3. Install the oil suction pipe bolts.

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



**Fig. 27: Identifying Oil Pan Scraper 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).

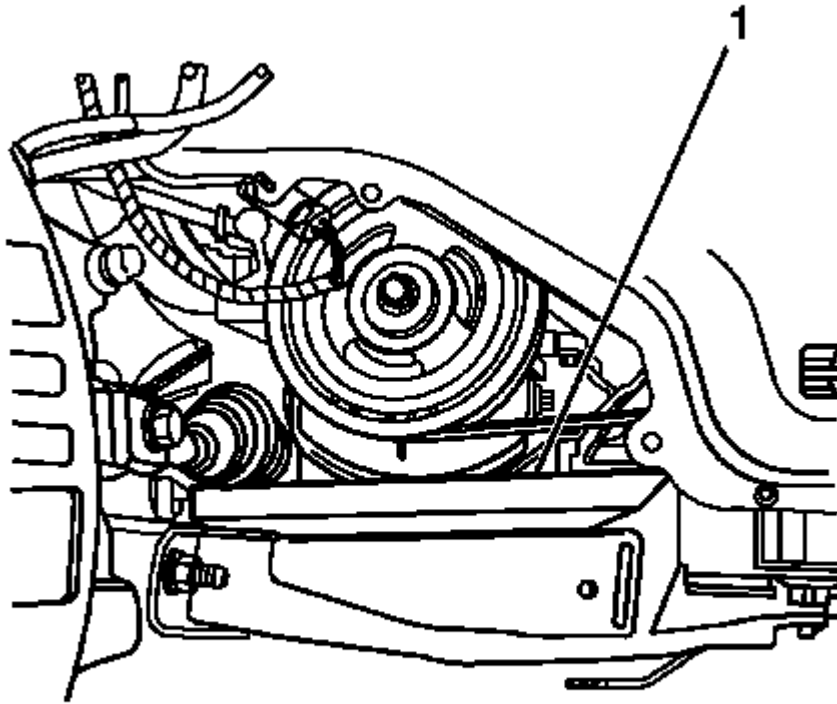
6. Install the oil pan. Refer to Oil Pan Replacement.

## ENGINE REPLACEMENT

### REMOVAL PROCEDURE

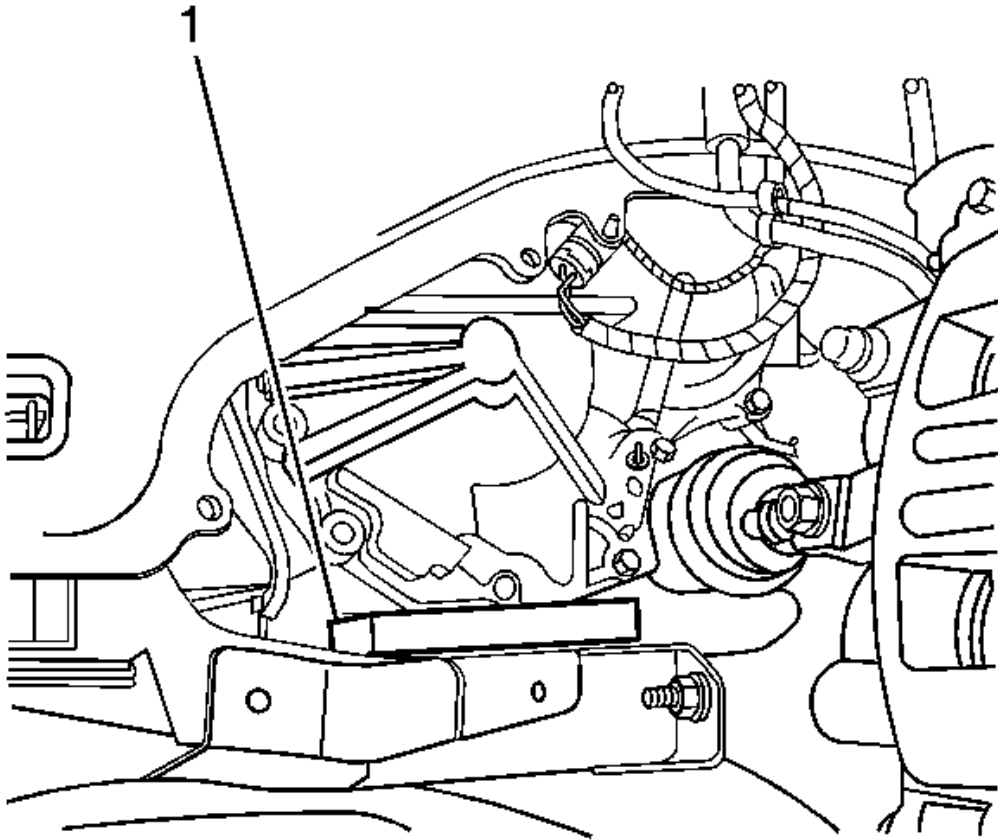
1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.
3. Release the clamp from the brake booster vacuum hose connection.
4. Disconnect the brake booster vacuum hose from the intake manifold.
5. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.

6. Discharge the fuel system. Refer to **Fuel Pressure Relief (With CH-48027)** or **Fuel Pressure Relief (Without CH-48027)**.
7. Disconnect the evaporative emission (EVAP) hose/pipe from the EVAP canister purge solenoid valve. Refer to **Plastic Collar Quick Connect Fitting Service**.
8. Disconnect the engine fuel hose/pipe from the chassis fuel hose/pipe. Refer to **Metal Collar Quick Connect Fitting Service**.
9. Discharge the air conditioning (A/C) system. Refer to **Refrigerant Recovery and Recharging**.
10. Remove the A/C compressor suction hose assembly from the compressor. Cap or plug the hoses and compressor to prevent contamination. Refer to **Suction Hose Replacement**.
11. Remove the A/C compressor discharge hose assembly from the compressor. Cap or plug the hoses and compressor to prevent contamination. Refer to **Discharge Hose Replacement**.
12. Drain the engine coolant from the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac N Fill)**.
13. Tie the radiator, A/C condenser and fan module assembly to the upper radiator support to keep the assembly with the vehicle when the frame and drivetrain is removed.
14. Remove the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement**.
15. Disconnect the inlet coolant heater hose from the engine. Refer to **Heater Inlet Hose Replacement**.
16. Disconnect the outlet coolant heater hose from the engine. Refer to **Heater Outlet Hose Replacement**.
17. Remove the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement**.
18. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
19. Remove the exhaust flexible pipe and secure the rear half of the exhaust system to the vehicle underbody. Refer to **Exhaust Flexible Pipe Replacement**.
20. Remove the front tires. Refer to **Tire and Wheel Removal and Installation**.
21. Remove the engine splash shield. Refer to **Engine Splash Shield Replacement**.
22. Disconnect the steering intermediate shaft from the steering gear. Refer to **Intermediate Steering Shaft Replacement**.
23. Disconnect the right and left steering linkage outer tie rod ends from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement**.
24. Disconnect the right and left stabilizer shaft links from the stabilizer shaft. Refer to **Stabilizer Shaft Link Replacement**.
25. Disconnect the right and left lower ball joints from the steering knuckles. Refer to **Lower Control Arm Replacement**.
26. On front wheel drive (FWD) models, place a drain pan under the transaxle then separate the right and left front wheel drive shafts from the transaxle. Refer to **Front Wheel Drive Shaft Replacement**.
27. On all wheel drive (AWD) models, remove the driveline torque tube. Refer to **Driveline Torque Tube Replacement**.



**Fig. 28: Identifying Block Of Wood Between Frame & Engine Oil Pan**  
Courtesy of GENERAL MOTORS CORP.

28. On all models, place a block of wood (1) between the frame and the engine oil pan in order to support the engine once the bolts are removed from the right engine mount.



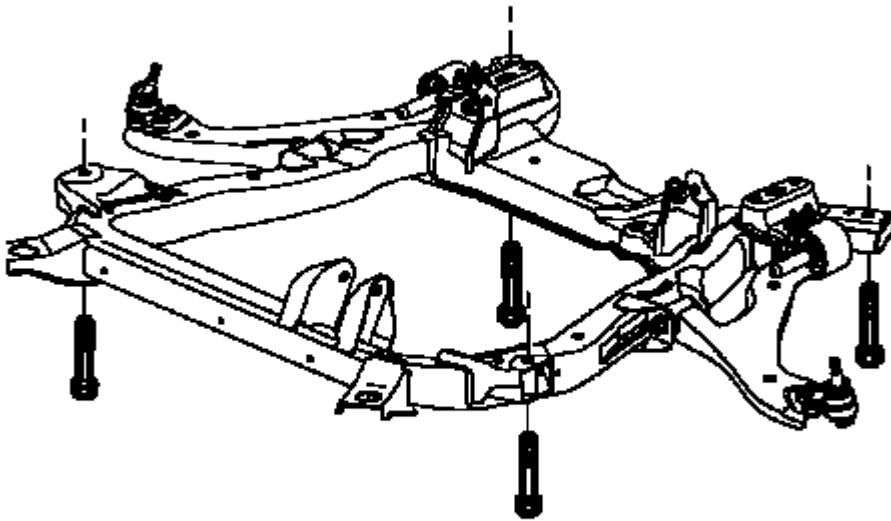
**Fig. 29: Identifying Block Of Wood Between Frame & Transaxle**  
Courtesy of GENERAL MOTORS CORP.

29. Place a block of wood (1) between the frame and the transaxle in order to support the transaxle once the bolts are removed from the left transaxle mount bracket.
30. Lower the vehicle.
31. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement - Right Side** .

**NOTE:**        **Ensure the vehicle body is secured to the hoist.**

32. Disconnect and reposition the engine harness as necessary.
33. Raise the vehicle.
34. Disconnect the power steering hoses at the power steering fluid cooler. Refer to **Power Steering Cooler Pipe/Hose Replacement** .
35. Place a universal frame support fixture or jackstands under the frame.

36. Lower the vehicle until the frame contacts the frame support fixture or jackstands.

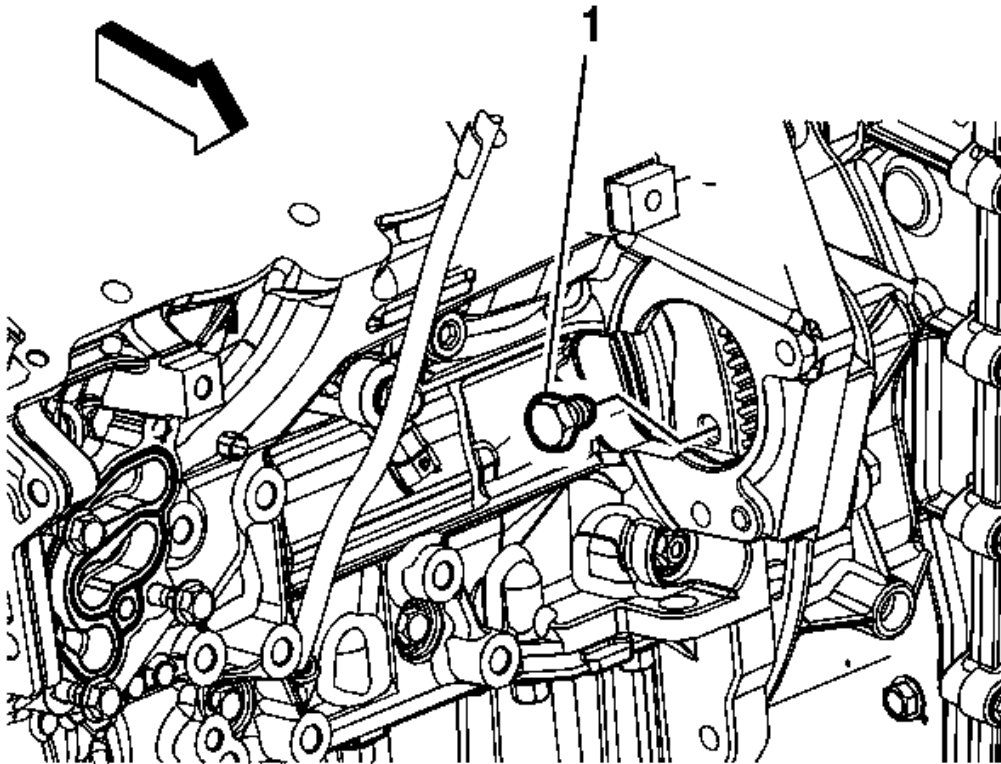


**Fig. 30: View Of Frame & Frame-To-Body Bolts**  
Courtesy of GENERAL MOTORS CORP.

37. Remove the frame-to-body and frame reinforcement bolts. Discard the bolts.

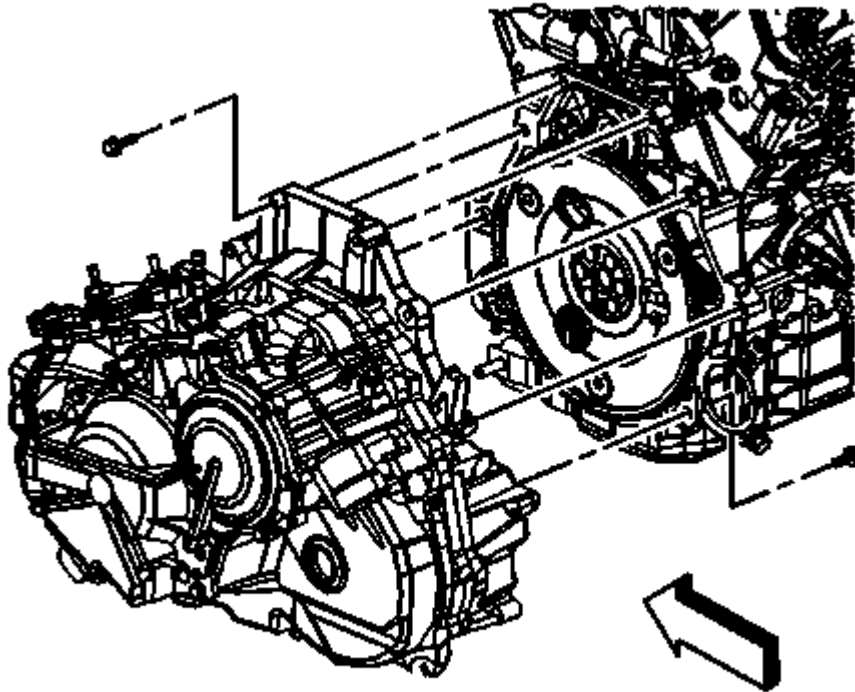
**NOTE:**        **Inspect for areas of body to powertrain contact or entanglement of wires and hoses while separating the vehicle body and powertrain.**

38. Carefully raise the vehicle body up away from the powertrain.  
39. Disconnect all necessary engine electrical wiring harness connectors.  
40. Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement** .  
41. Remove the starter motor. Refer to **Starter Replacement** .



**Fig. 31: Identifying Torque Converter Bolts**  
Courtesy of GENERAL MOTORS CORP.

42. Remove the torque converter bolts (1).
43. Install the engine lift hooks.
44. Install an engine lift chain to the engine lift hooks.
45. Remove the engine and transmission mount nuts from the frame.
46. Support the engine weight with an engine hoist and raise the engine and transmission assembly off the frame.

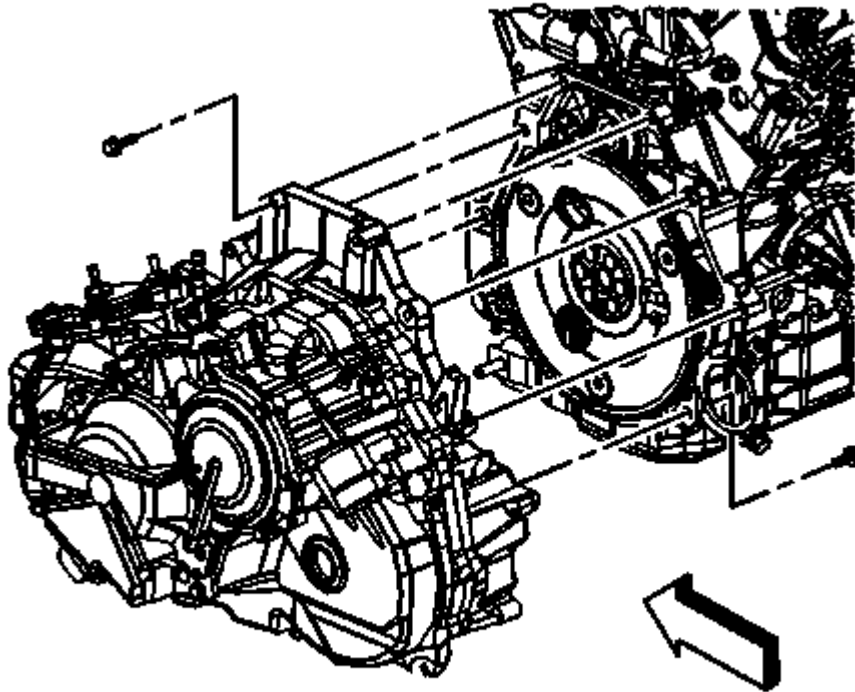


**Fig. 32: View Of Transaxle & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

47. Lower the engine/transmission assembly to a suitable work area.
48. Remove the automatic transaxle bolts.
49. Separate the automatic transaxle from the engine.
50. Lift the engine away from the automatic transaxle.
51. Secure the engine to an engine stand.
52. Remove any additional engine components as necessary. Refer to appropriate component sections in manual if needed.

## **INSTALLATION PROCEDURE**

1. Remove the engine from the engine stand.

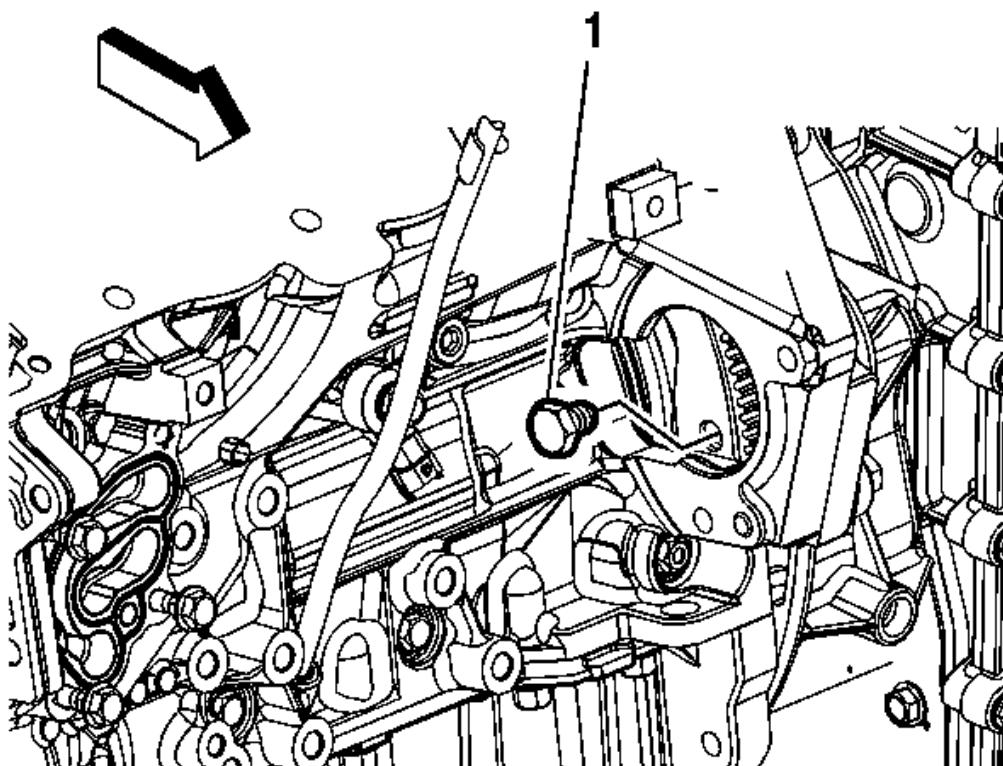


**Fig. 33: View Of Transaxle & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

2. Align the engine to the frame and automatic transaxle.

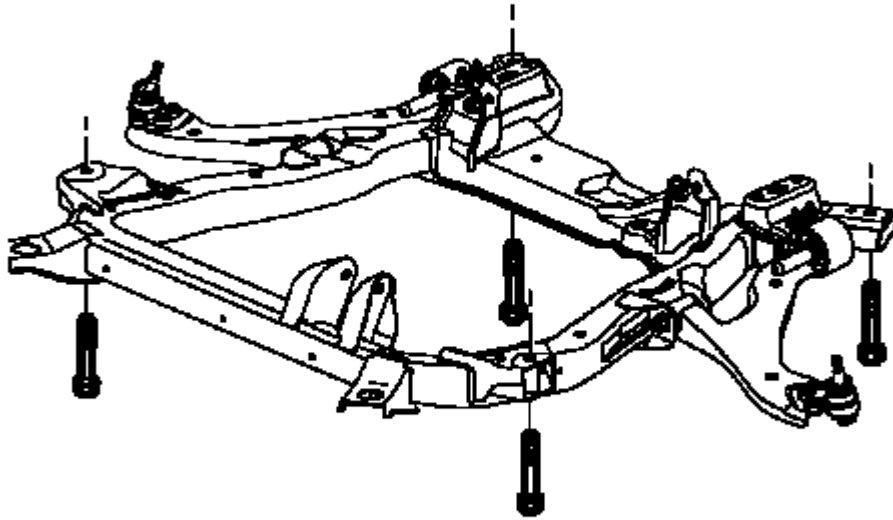
**CAUTION: Refer to Fastener Caution .**

3. Install the automatic transaxle bolts and tighten to 75 N.m (55 lb ft).
4. Place a block of wood between the frame and the engine oil pan in order to support the engine on the frame once the engine hoist is removed.
5. Remove the engine hoist and lift chain.



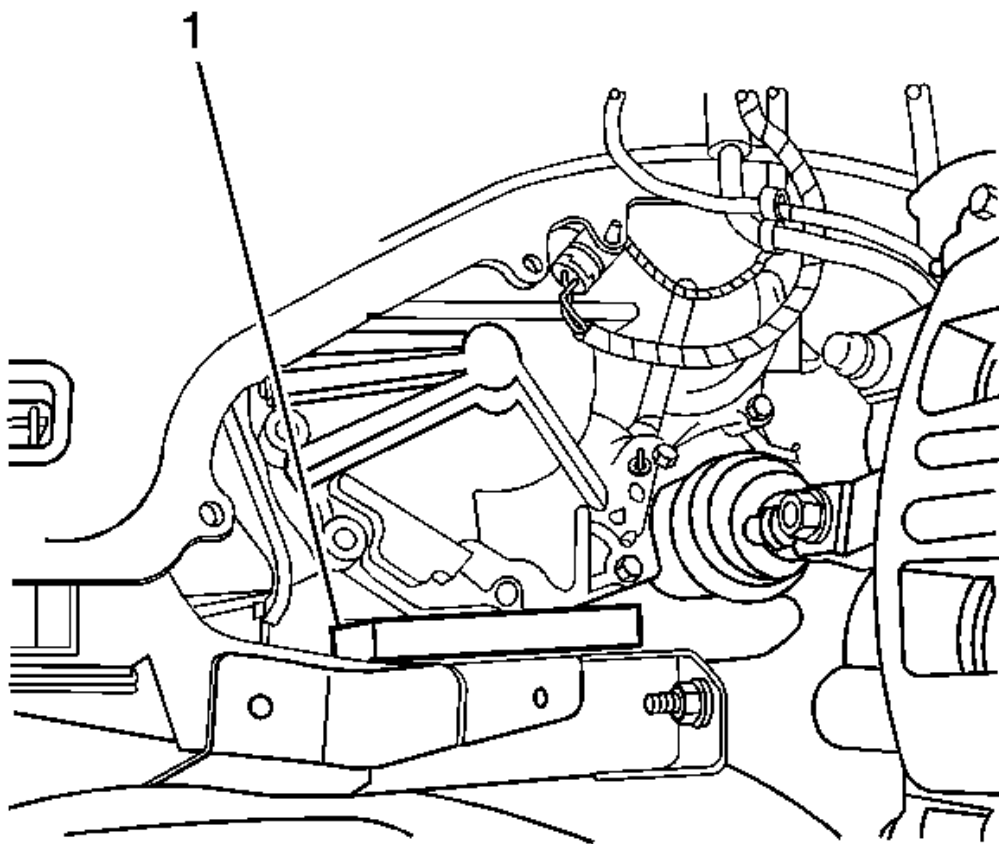
**Fig. 34: Identifying Torque Converter Bolts**  
Courtesy of GENERAL MOTORS CORP.

6. Install the torque converter bolts (1) and tighten to 60 N.m (44 lb ft).
7. Install the starter motor. Refer to **Starter Replacement** .
8. Install the throttle body assembly. Refer to **Throttle Body Assembly Replacement** .
9. Connect all necessary engine electrical wiring harness connectors.



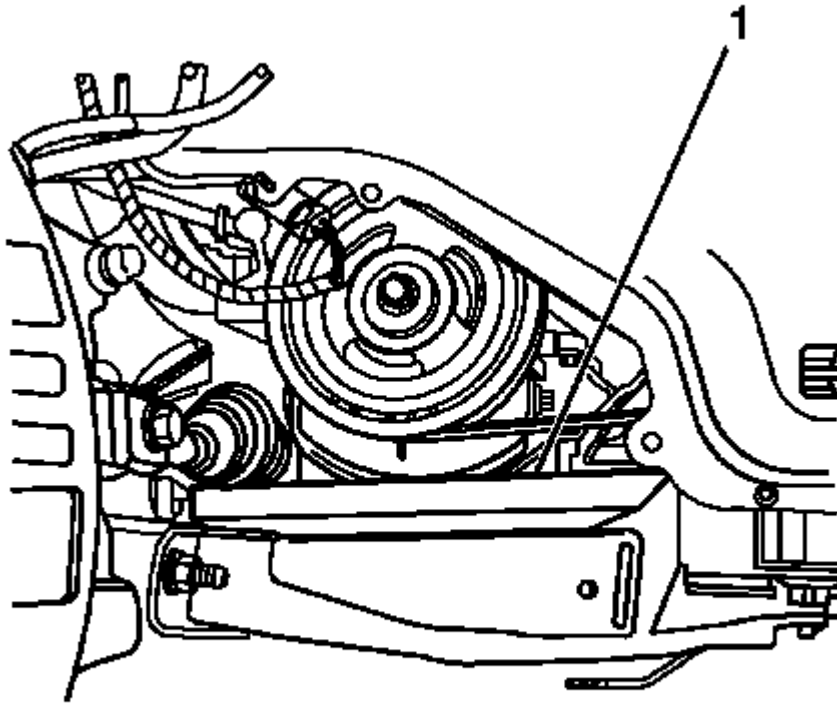
**Fig. 35: View Of Frame & Frame-To-Body Bolts**  
Courtesy of GENERAL MOTORS CORP.

10. Install NEW frame-to-body bolts and tighten to 155 N.m (114 lb ft).
11. Raise the vehicle up away from the frame support fixture or jackstands and remove the support fixture or jackstands from under the vehicle.
12. Connect the power steering hoses to the power steering fluid cooler. Refer to **Power Steering Cooler Pipe/Hose Replacement** .
13. Lower the vehicle.
14. Install the left transaxle mount bracket. Refer to **Transmission Mount Bracket Replacement - Left Side** .
15. Install the engine mount strut. Refer to **Engine Mount Strut Replacement - Right Side** .
16. Raise the vehicle.



**Fig. 36: Identifying Block Of Wood Between Frame & Transaxle**  
Courtesy of GENERAL MOTORS CORP.

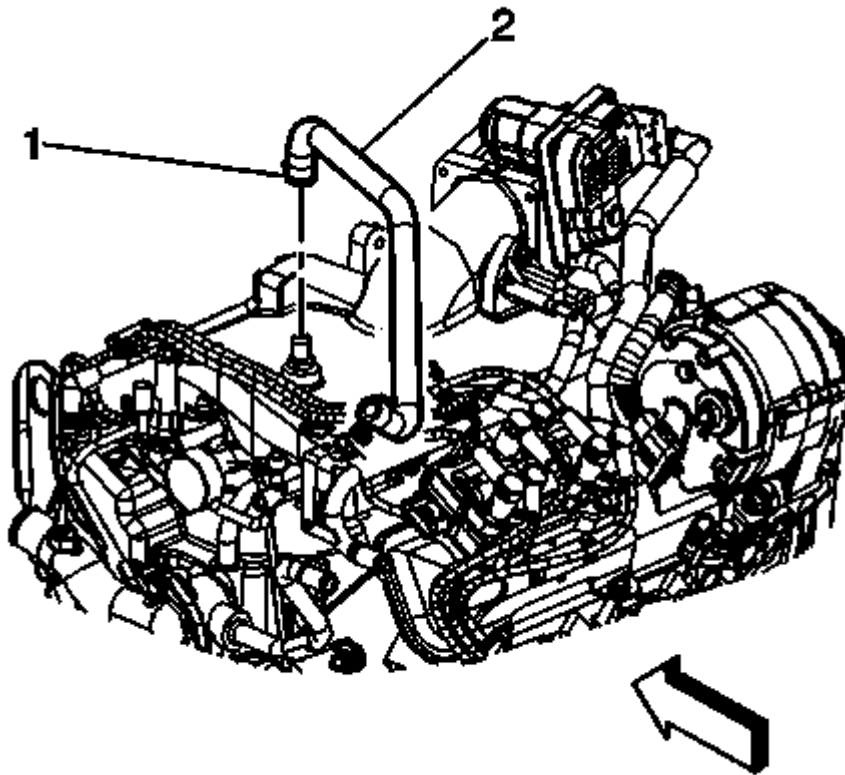
17. Remove the block of wood (1) between the frame and the transaxle used to support the transaxle while the bolts were removed from the left transaxle mount bracket.



**Fig. 37: Identifying Block Of Wood Between Frame & Engine Oil Pan**  
Courtesy of GENERAL MOTORS CORP.

18. Remove the block of wood (1) between the frame and the engine oil pan used to support the engine while the bolts were removed from the right engine mount.
19. On AWD models, install the driveline torque tube. Refer to **Driveline Torque Tube Replacement** .
20. On FWD models, install the right and left front wheel drive shafts into the transaxle. Refer to **Front Wheel Drive Shaft Replacement** .
21. On all models, connect the right and left lower ball joints to the steering knuckles. Refer to **Lower Control Arm Replacement** .
22. Connect the right and left stabilizer shaft links to the stabilizer shaft. Refer to **Stabilizer Shaft Link Replacement** .
23. Connect the right and left steering linkage outer tie rod ends to the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement** .
24. Connect the steering intermediate shaft to the steering gear. Refer to **Intermediate Steering Shaft Replacement** .
25. Install the engine splash shield. Refer to **Engine Splash Shield Replacement** .
26. Install the front tires. Refer to **Tire and Wheel Removal and Installation** .
27. Install the exhaust flexible pipe. Refer to **Exhaust Flexible Pipe Replacement** .

28. Install the radiator outlet hose. Refer to **Radiator Outlet Hose Replacement** .
29. Lower the vehicle.
30. Install the radiator inlet hose. Refer to **Radiator Inlet Hose Replacement** .
31. Connect the outlet coolant heater hose to the engine. Refer to **Heater Outlet Hose Replacement** .
32. Connect the inlet coolant heater hose to the engine. Refer to **Heater Inlet Hose Replacement** .
33. Install the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement** .
34. Untie the radiator, AC condenser, and fan module assembly from the upper radiator support.
35. Install the A/C compressor discharge hose assembly to the compressor. Refer to **Discharge Hose Replacement** .
36. Install the A/C compressor suction hose assembly to the compressor. Refer to **Suction Hose Replacement** .
37. Connect the engine fuel hose/pipe to the chassis fuel hose/pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
38. Connect the EVAP hose/pipe to the EVAP canister purge solenoid valve. Refer to **Plastic Collar Quick Connect Fitting Service** .
39. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

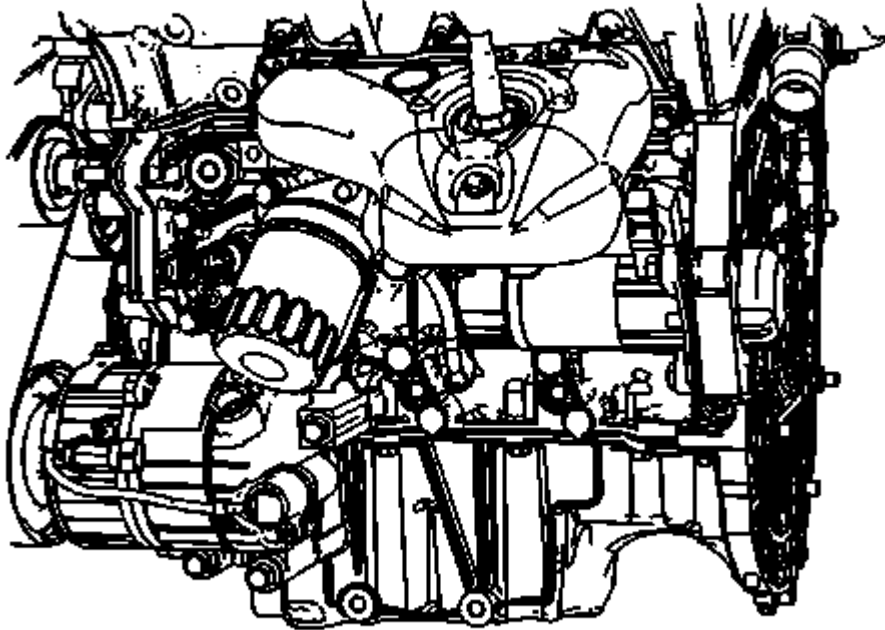


**Fig. 38: View Of Brake Booster Vacuum Hose**  
Courtesy of GENERAL MOTORS CORP.

40. Connect the brake booster vacuum hose (2) to the intake manifold.
41. Position the clamp (1) on the brake booster vacuum hose connection.
42. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .
43. Fill the engine with engine oil. Refer to **Approximate Fluid Capacities** , **Fluid and Lubricant Recommendations (USA and Canada)** , and **Maintenance Schedule (North American Emissions)** .
44. Fill the engine with coolant. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (Vac N Fill)** .
45. Check the transaxle fluid level. Refer to **Adhesives, Fluids, Lubricants, and Sealers** , **Transmission General Specifications** , and **Approximate Fluid Capacities** .
46. Charge the AC system. Refer to **Refrigerant Recovery and Recharging** .
47. Add power steering fluid and bleed air from the power steering system. Refer to **Power Steering System Bleeding** .
48. Prime the fuel system.
  1. Cycle the ignition ON for 5 seconds then OFF for 10 seconds. Repeat cycling twice.
  2. Crank the engine until it starts. The maximum starter motor cranking time is 20 seconds.
  3. If the engine does not start, repeat the steps.

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

### **REMOVAL PROCEDURE**

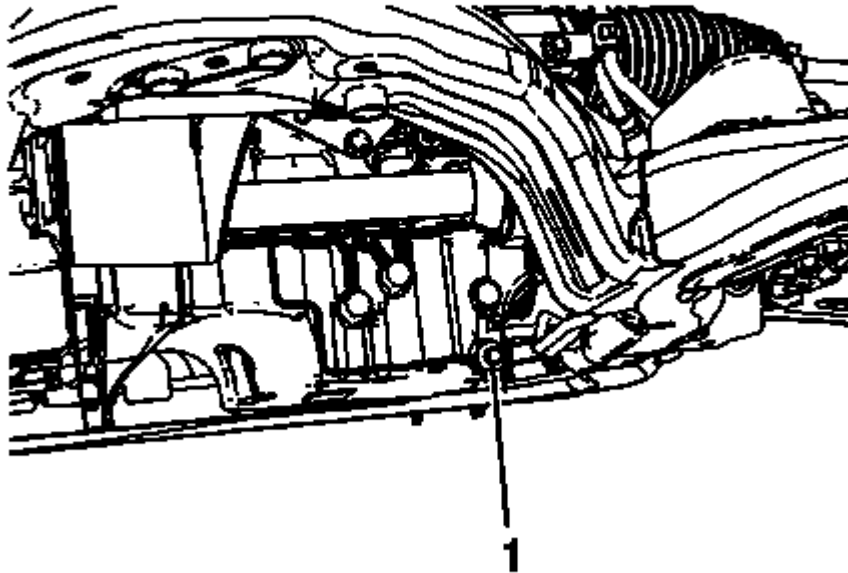


**Fig. 39: View of Oil Filter**

Courtesy of GENERAL MOTORS CORP.

**WARNING:** Refer to Hot Exhaust System Warning .

1. Place the drain pan under the oil filter.
2. Loosen the oil filter. Allow the oil to drain completely.
3. Wrap the oil filter in a disposable towel or rag. Remove the oil filter, keep it upright until it is clear of the vehicle.
4. Thoroughly clean all oil spillage.
5. Lubricate the NEW oil filter gasket with clean engine oil and Tighten the oil filter to 30 N.m (22 lb ft).



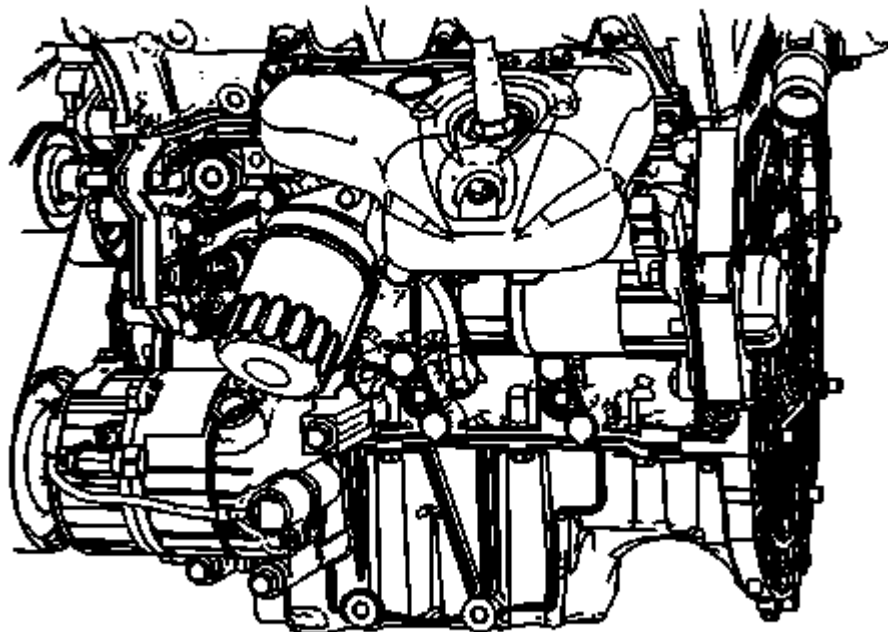
**Fig. 40: Locating Oil Drain Plug**  
Courtesy of GENERAL MOTORS CORP.

6. Place a drain pan under the oil pan drain plug.
7. Remove the oil pan drain plug (1). Allow the oil to drain completely.

## INSTALLATION PROCEDURE

**CAUTION:** Refer to Fastener Caution .

1. Install the oil pan drain plug and tighten to 20 N.m (15 lb ft).
2. Clean the oil pan drain plug and oil filter areas from below.
3. Lower the vehicle.



**Fig. 41: View of Oil Filter**

**Courtesy of GENERAL MOTORS CORP.**

4. Refill the engine oil. Refer to **Approximate Fluid Capacities** .
5. Start the engine and inspect for leaks.