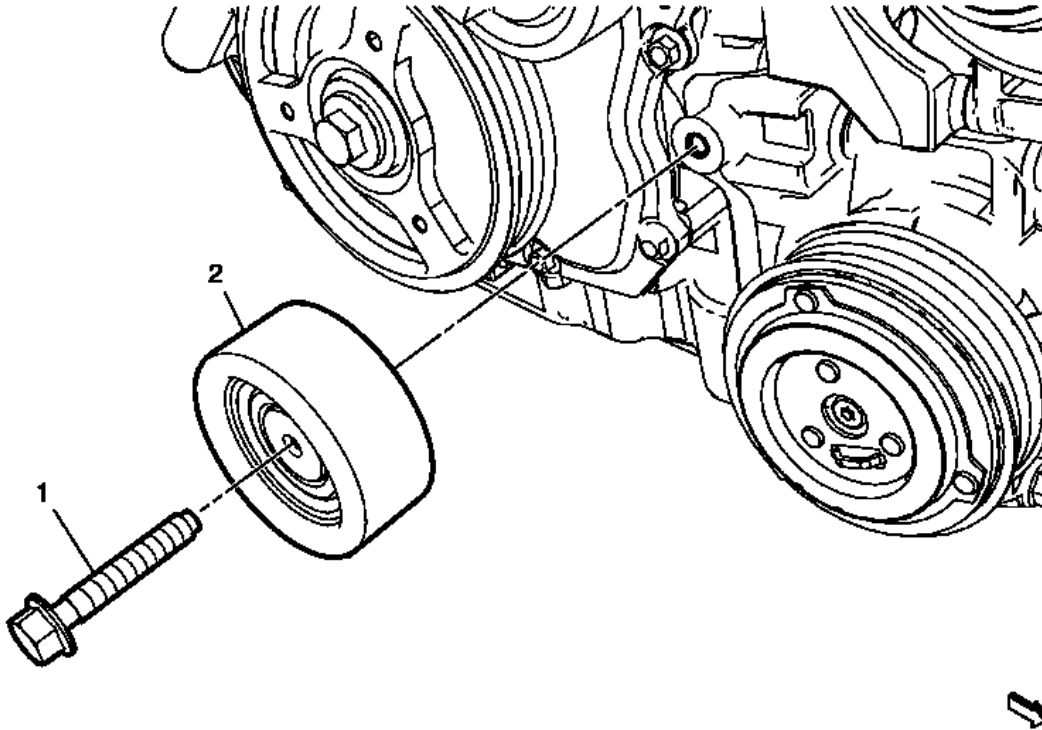


## 2014 ENGINE

## Engine Mechanical - 2.0L (LHU) - Repair Instructions - On Vehicle - Verano

## REPAIR INSTRUCTIONS - ON VEHICLE

## BELT IDLER PULLEY REPLACEMENT

**Fig. 1: Belt Idler Pulley**

Courtesy of GENERAL MOTORS COMPANY

## Belt Idler Pulley Replacement

| Callout                                                                                                | Component Name                                                                                                                        |
|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the drive belt. Refer to <b><u>Drive Belt Replacement</u></b> . |                                                                                                                                       |
| 1                                                                                                      | Belt Idler Pulley Bolt<br><br><b>CAUTION:</b><br>Refer to <b><u>Fastener Caution</u></b> .<br><br><b>Tighten</b><br>22 N.m (16 lb ft) |
| 2                                                                                                      | Belt Idler Pulley                                                                                                                     |

## DRIVE BELT REPLACEMENT

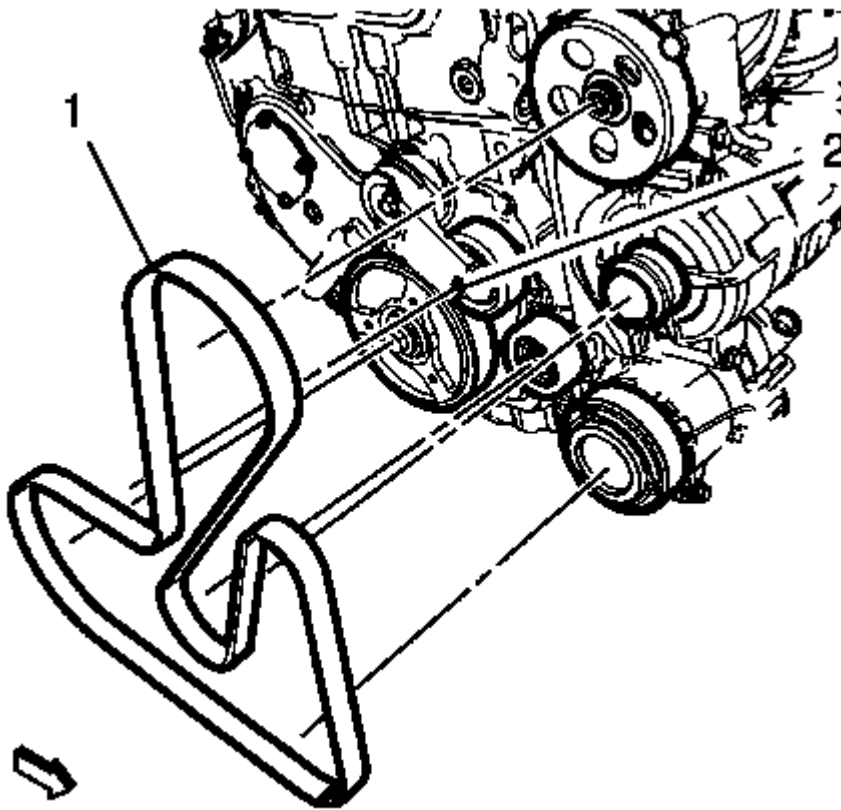
### Special Tools

#### EN-6151-A Chuck Key

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the front compartment splash shield - right side. Refer to **Front Compartment Splash Shield Replacement** .
3. Remove the front part of the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .

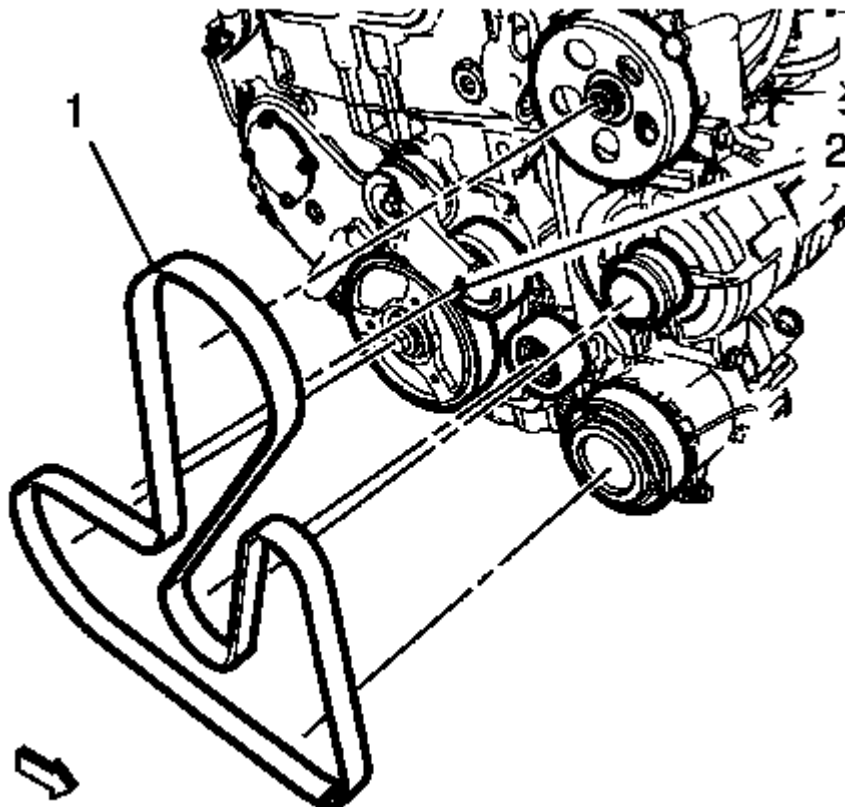


**Fig. 2: Drive Belt Routing & Tensioner Hole**  
Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-6151-A** chuck key to the drive belt tensioner hole (2).
5. Tension the drive belt tensioner counterclockwise and hold tension.
6. Remove the drive belt (1).

7. Release tension from the drive belt tensioner and allow the tensioner to slide back slowly.

#### Installation Procedure



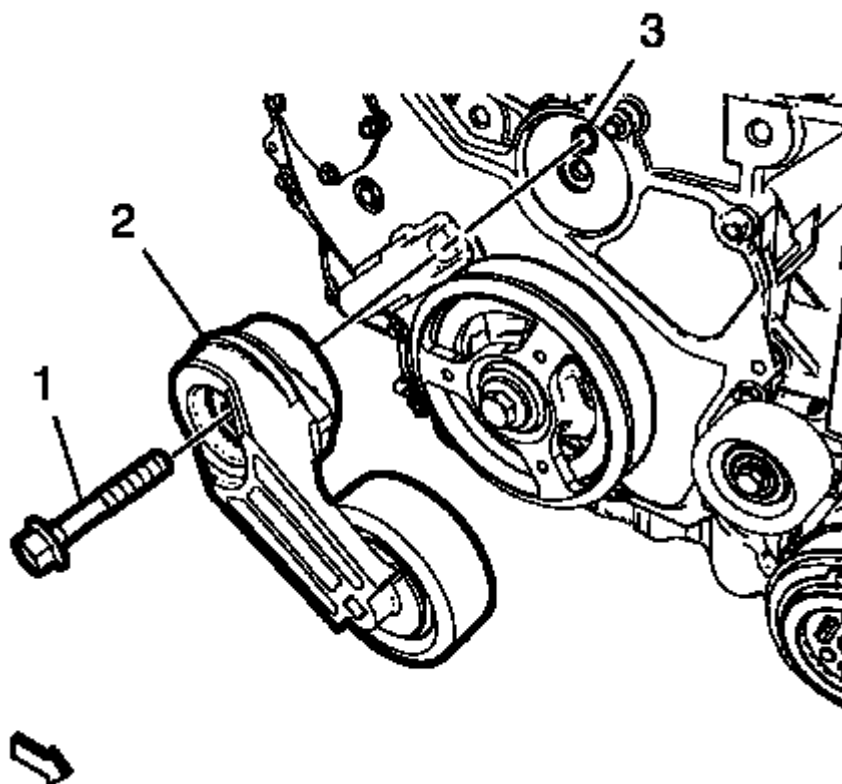
**Fig. 3: Drive Belt Routing & Tensioner Hole**  
Courtesy of GENERAL MOTORS COMPANY

1. Apply tension to the drive belt tensioner with the **EN-6151-A** chuck key by rotating counterclockwise and hold tension.
2. Install the drive belt (1).
3. Release tension from the drive belt tensioner and allow the tensioner to slide back slowly.
4. Remove the **EN-6151-A** chuck key from the drive belt tensioner hole (2).
5. Inspect the drive belt for proper seat.
6. Install the front part of the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**.
7. Install the front compartment splash shield - right side. Refer to **Front Compartment Splash Shield Replacement**.
8. Lower the vehicle.

#### DRIVE BELT TENSIONER REPLACEMENT

**Removal Procedure**

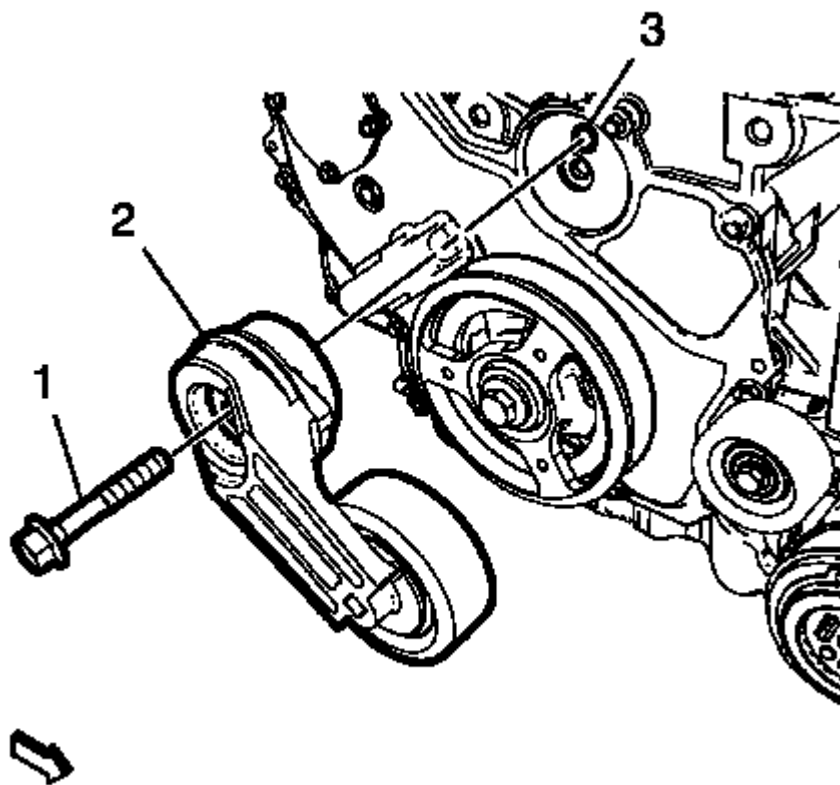
1. Remove the drive belt. Refer to Drive Belt Replacement.



**Fig. 4: Drive Belt Tensioner & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the drive belt tensioner bolt (1).
3. Remove the drive belt tensioner (2).

**Installation Procedure**



**Fig. 5: Drive Belt Tensioner & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

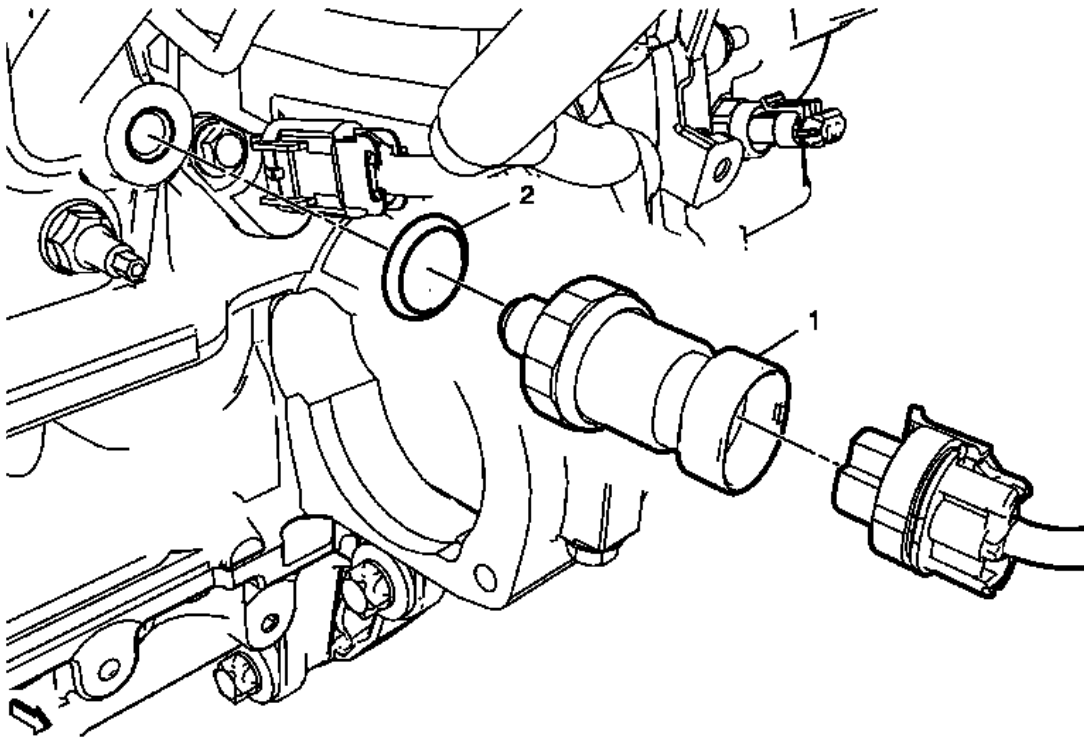
**NOTE:** Ensure that the drive belt tensioner notch fits into the engine front cover hole (3).

1. Install the drive belt tensioner (2).

**CAUTION:** Refer to Fastener Caution .

2. Install the drive belt tensioner bolt (1) and tighten to 45 N.m (33 lb ft).
3. Install the drive belt. Refer to Drive Belt Replacement.

## ENGINE OIL PRESSURE SWITCH REPLACEMENT



**Fig. 6: Engine Oil Pressure Switch & Seal Ring**  
 Courtesy of GENERAL MOTORS COMPANY

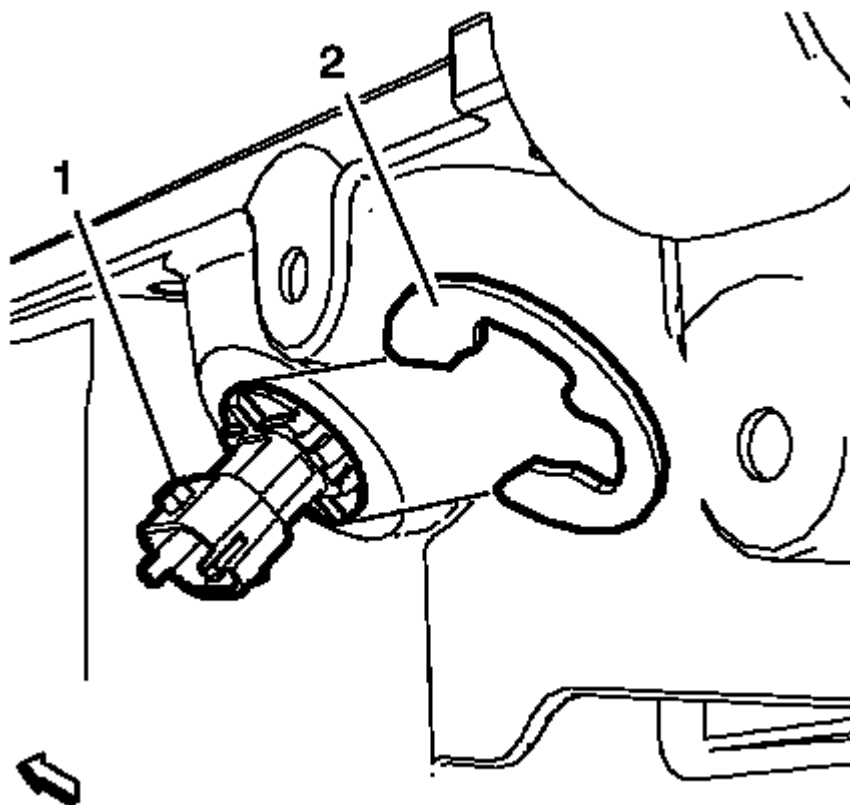
### Engine Oil Pressure Switch Replacement

| Callout                                                                                                                                                                                                              | Component Name                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                 |
| 1. Disconnect the battery negative cable. Refer to <b><u>Battery Negative Cable Disconnection and Connection</u></b> .<br>2. Raise and support the vehicle. Refer to <b><u>Lifting and Jacking the Vehicle</u></b> . |                                                                                                                                                                                                                                                                                                 |
| 1                                                                                                                                                                                                                    | Engine Oil Pressure Switch<br><br><b>CAUTION:</b><br>Refer to <b><u>Fastener Caution</u></b> .<br><br><b>Tighten</b><br>35 (26 lb ft)<br><b>Special Tools</b><br><b>EN-35749</b> Oil Pressure Sensor Socket<br>For equivalent regional tools, refer to <b><u>Special Tools (LDK, LHU)</u></b> . |
| 2                                                                                                                                                                                                                    | Engine Oil Pressure Switch Seal Ring                                                                                                                                                                                                                                                            |

### ENGINE OIL LEVEL SENSOR REPLACEMENT

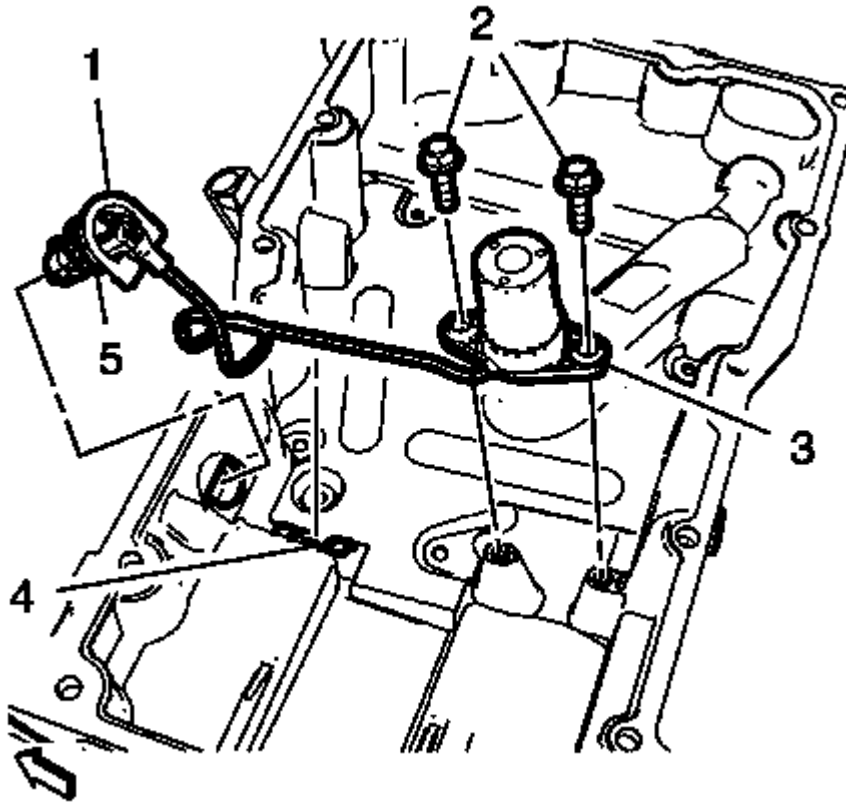
**Removal Procedure**

1. Remove the oil pan. Refer to **Oil Pan Replacement (Manual Transmission)**, **Oil Pan Replacement (Automatic Transmission)**.



**Fig. 7: Engine Oil Level Sensor Wiring Harness Plug & Clip**  
Courtesy of GENERAL MOTORS COMPANY

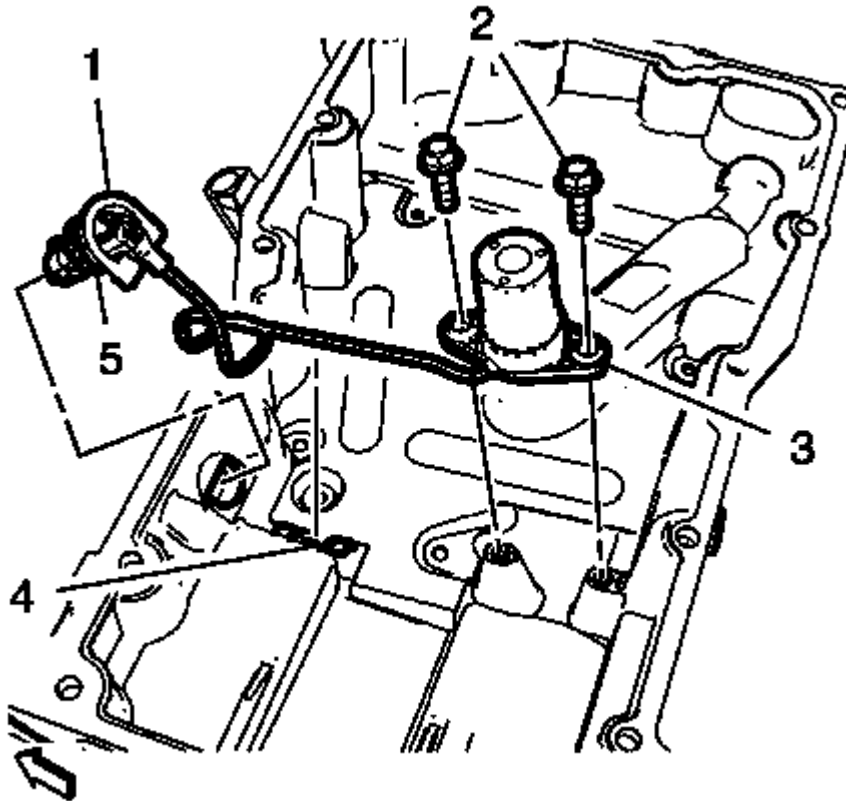
2. Remove the oil level sensor wiring harness plug clip.



**Fig. 8: Oil Level Sensor & Mounting Components**  
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 oil level sensor bolts (2).
4. Remove the oil level sensor wiring harness from the lashes in the oil pan (4)
5. Remove the oil level sensor wiring harness plug (1) from the oil pan. Remove and DISCARD the seal ring (5).
6. Remove the oil level sensor (3).

#### Installation Procedure

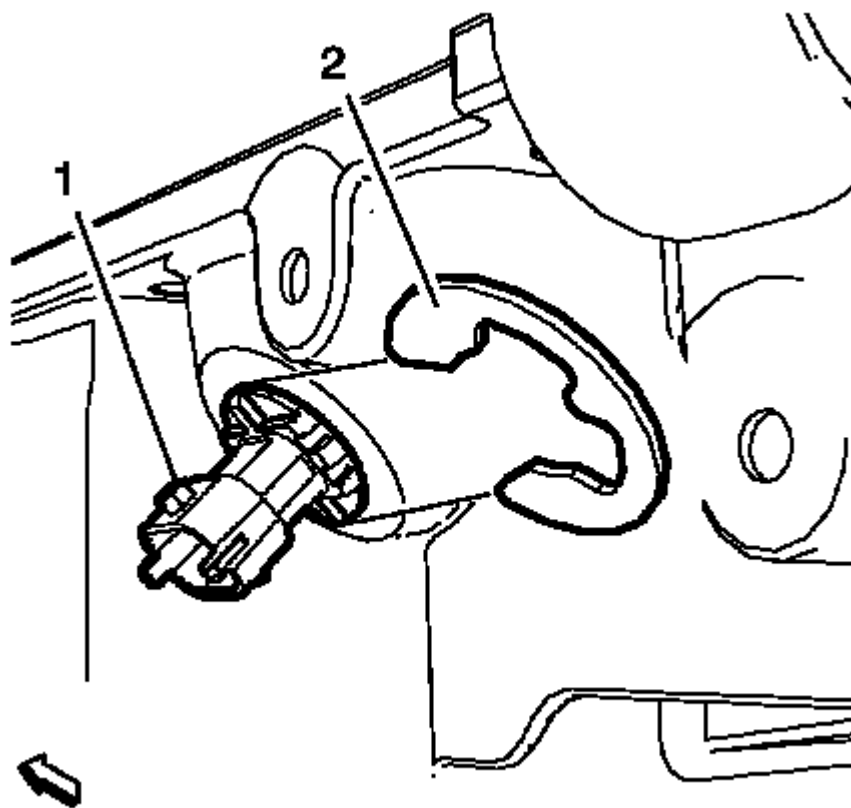


**Fig. 9: Oil Level Sensor & Mounting Components**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install the oil level sensor (3).
2. Install the oil level sensor wiring harness to the lashes in the oil pan (4)

**CAUTION: Refer to Fastener Caution .**

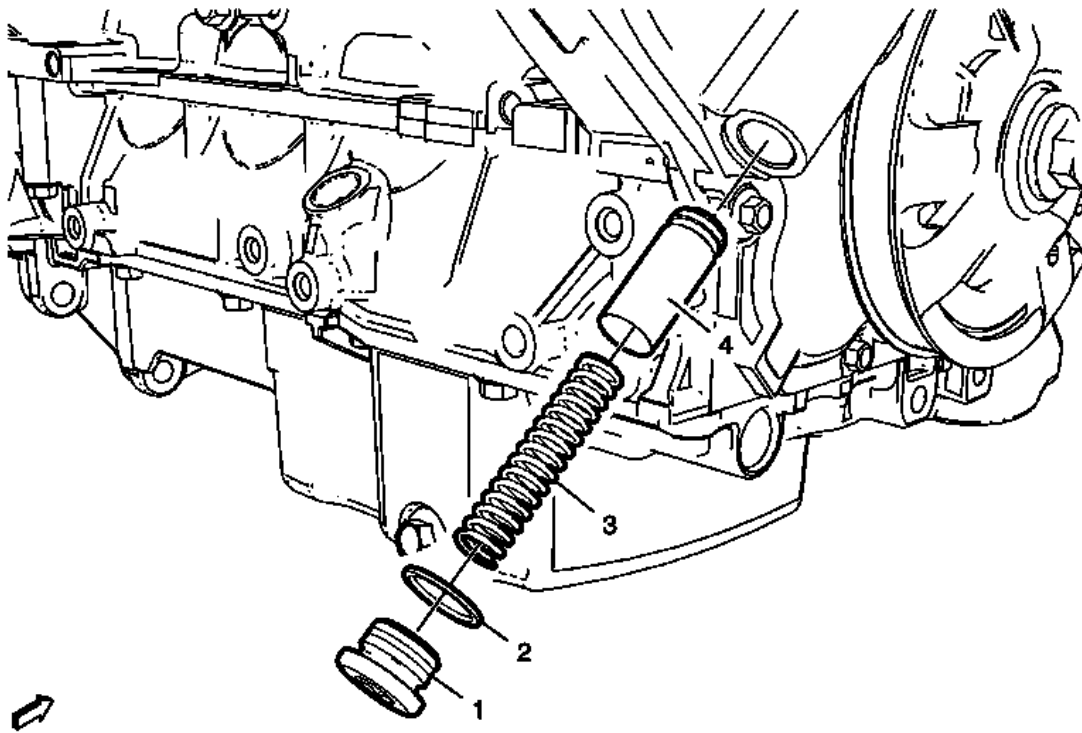
3. Install the 2 oil level sensor bolts (2) and tighten to 10 N.m (89 lb in).
4. Install the oil level sensor wiring harness plug (1) to the oil pan. Install a NEW seal ring (5)



**Fig. 10: Engine Oil Level Sensor Wiring Harness Plug & Clip**  
Courtesy of GENERAL MOTORS COMPANY

5. Install the oil level sensor wiring harness plug clip.
6. Install the oil pan. Refer to **Oil Pan Replacement (Manual Transmission)**, **Oil Pan Replacement (Automatic Transmission)**.

## OIL PRESSURE RELIEF VALVE REPLACEMENT



**Fig. 11: Oil Pressure Relief Valve Components**  
 Courtesy of GENERAL MOTORS COMPANY

### Oil Pressure Relief Valve Replacement

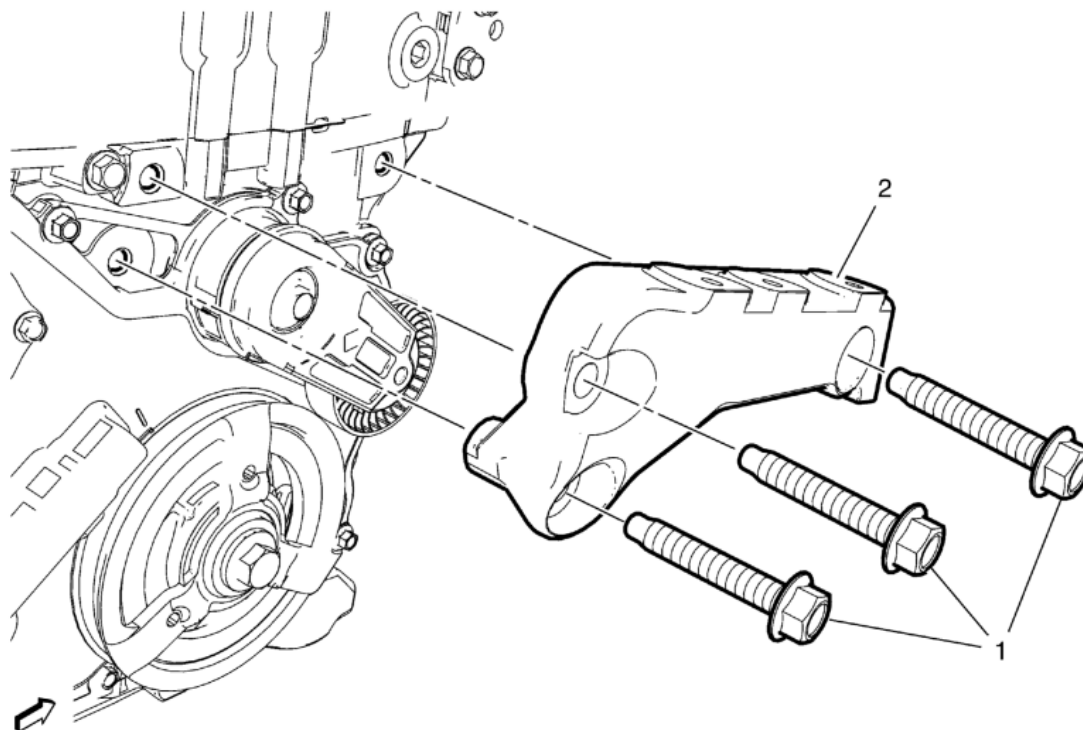
| Callout                                                                                                                                                                                                                                                                                                                                                       | Component Name                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                             |
| 1. Remove the front wheelhouse liner right side. Refer to <a href="#">Front Wheelhouse Liner Replacement</a> .<br>2. Remove the engine splash shield right side. Refer to <a href="#">Front Compartment Splash Shield Replacement</a> .<br>3. Remove the right wheel drive shaft. Refer to <a href="#">Front Wheel Drive Shaft Replacement - Right Side</a> . |                                                                                                                                                             |
| 1                                                                                                                                                                                                                                                                                                                                                             | Oil Pressure Relief Valve Seal Plug<br><br><b>CAUTION:</b><br><b>Refer to <a href="#">Fastener Caution</a> .</b><br><br><b>Tighten</b><br>40 N.m (30 lb ft) |
| 2                                                                                                                                                                                                                                                                                                                                                             | Oil Pressure Relief Valve Seal Ring<br><b>Procedure</b><br>Use a NEW oil pressure relief valve seal ring.                                                   |
| 3                                                                                                                                                                                                                                                                                                                                                             | Oil Pressure Relief Valve Seal Spring                                                                                                                       |

## ENGINE MOUNT INSPECTION

**NOTE:** 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 Mount Replacement.

## ENGINE MOUNT BRACKET REPLACEMENT

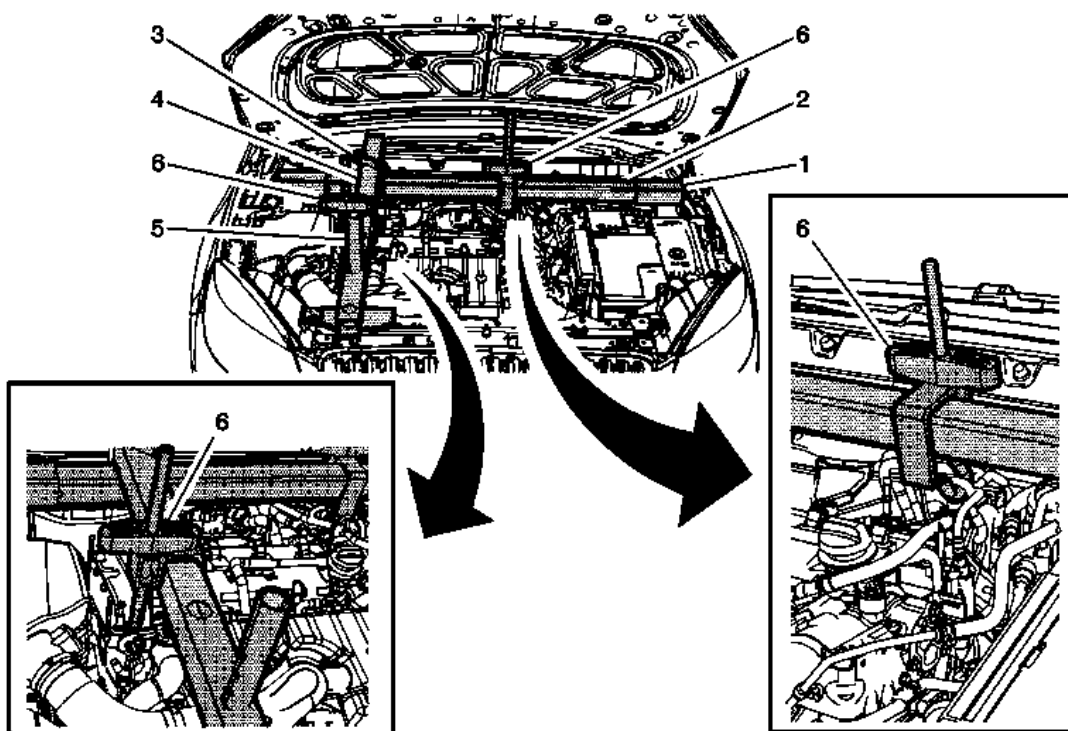


**Fig. 12: Engine Mount Bracket & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

### Engine Mount Bracket Replacement

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Component Name                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove the air cleaner assembly. Refer to <u><a href="#">Air Cleaner Assembly Replacement</a></u> .</li> <li>2. Remove the engine sight shield. Refer to <u><a href="#">Engine Sight Shield Replacement</a></u>.</li> <li>3. Support the engine with engine lifter.</li> <li>4. Remove the engine mount. Refer to <u><a href="#">Engine Mount Replacement</a></u>.</li> <li>5. Raise the engine as much as necessary in order to reach the engine mount bracket bolts.</li> </ol> |                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Engine Mount Bracket Bolt (Qty: 3)<br><br><b>CAUTION:</b><br>Refer to <u><a href="#">Fastener Caution</a></u> .<br><br><b>Tighten</b><br>100 (74 lb ft) |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Engine Mount Bracket                                                                                                                                    |

## ENGINE SUPPORT FIXTURE



**Fig. 13: Engine Support Fixture & Components**  
 Courtesy of GENERAL MOTORS COMPANY

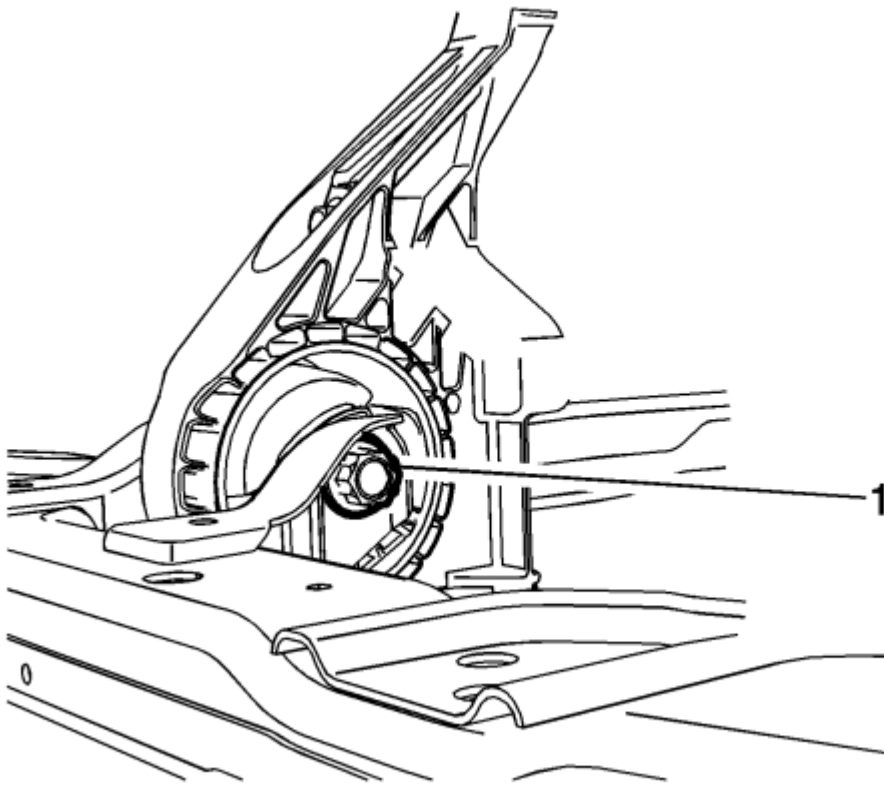
## Engine Support Fixture

| Callout                                                                                                                                                                                                                                                                                                                                                           | Component Name                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b>                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                 |
| <ol style="list-style-type: none"> <li>1. Remove the front compartment front sight shield. Refer to <b><u>Front Compartment Front Sight Shield Replacement</u></b> .</li> <li>2. Remove the engine sight shield. Refer to <b><u>Engine Sight Shield Replacement</u></b></li> </ol>                                                                                |                                                                                                                                 |
| <b>Special Tools</b>                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• EN-28467 Engine Support Fixture Adapter Legs</li> <li>• J-28467-518 Main Support Beam</li> <li>• J-28467-23A Cross Bracket</li> <li>• J-28467-2A Strut Tower Support Assembly</li> <li>• J-28467-14A Radiator Tube Shelf Assembly</li> <li>• J-36857 Engine Lift Bracket.</li> <li>• J-28467-8A Hook Assembly</li> </ul> |                                                                                                                                 |
| For equivalent regional tools, refer to <b><u>Special Tools (LDK, LHU)</u></b> .                                                                                                                                                                                                                                                                                  |                                                                                                                                 |
| 1                                                                                                                                                                                                                                                                                                                                                                 | Engine Support Fixture Adapter Leg (Qty: 2)                                                                                     |
| 2                                                                                                                                                                                                                                                                                                                                                                 | Main Support Beam                                                                                                               |
| 3                                                                                                                                                                                                                                                                                                                                                                 | Cross Bracket                                                                                                                   |
| 4                                                                                                                                                                                                                                                                                                                                                                 | Strut Tower Support Assembly<br><b>Procedure</b><br>Adjust the length of the strut tower support assembly.                      |
| 5                                                                                                                                                                                                                                                                                                                                                                 | Radiator Tube Shelf Assembly                                                                                                    |
| 6                                                                                                                                                                                                                                                                                                                                                                 | Hook Assembly (Qty: 2)<br><br><b>NOTE:</b><br>If the engine is not equipped with engine lift bracket, install J-36857 in place. |

**POWERTRAIN MOUNT BALANCING**

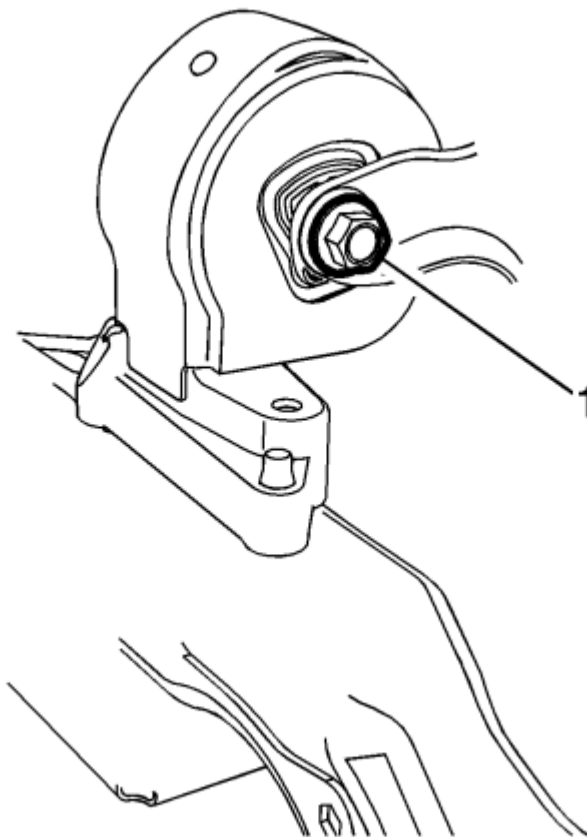
**NOTE:** Follow the balance procedure steps listed below when no starting point has been established such as in a collision repair.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .



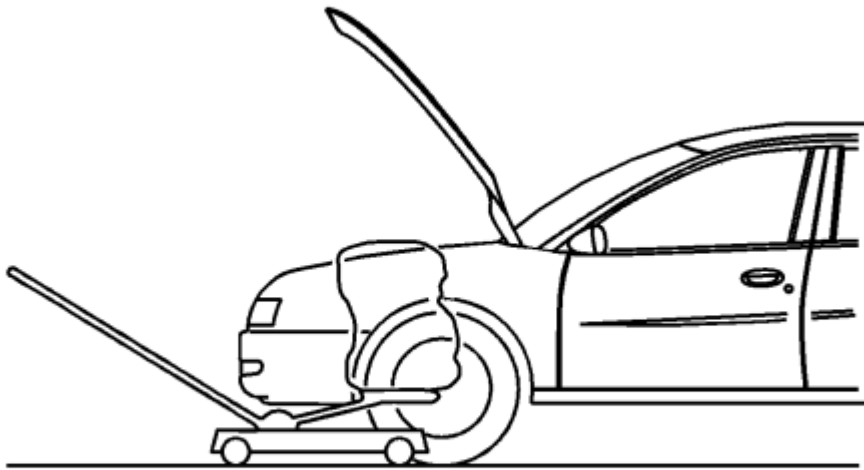
**Fig. 14: Front Transaxle Mount Through Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the front transaxle mount through bolt (1) until it is finger tight.



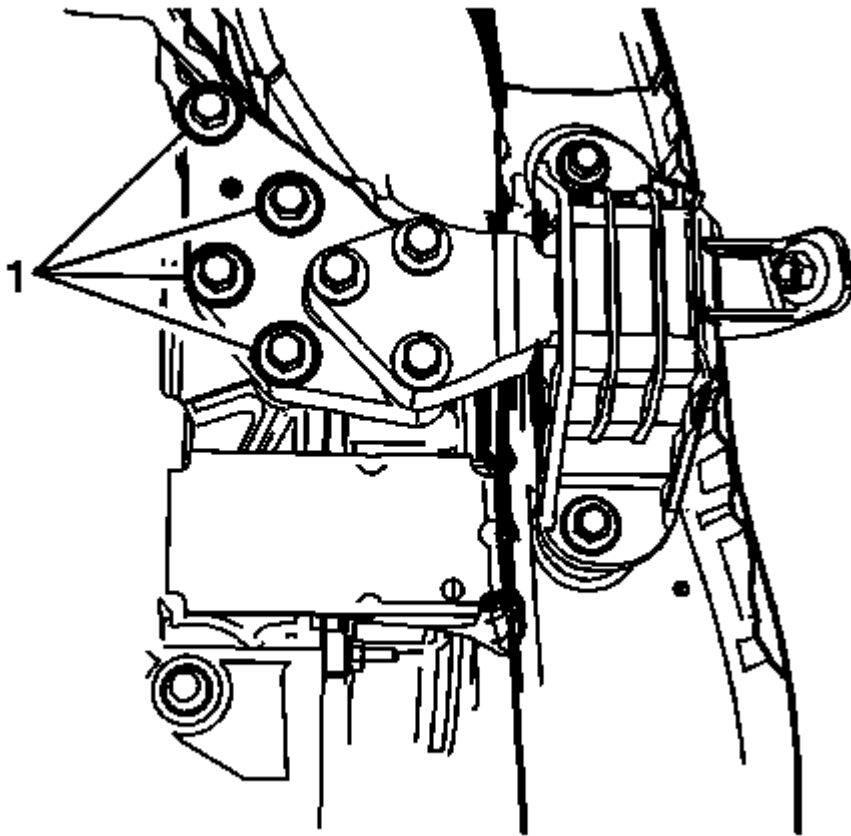
**Fig. 15: Rear Transaxle Mount Through Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Loosen the rear transaxle mount (1) through bolt until it is finger tight.
4. Lower the vehicle.



**Fig. 16: Supporting Engine/Transmission With Hydraulic Floor Jack**  
**Courtesy of GENERAL MOTORS COMPANY**

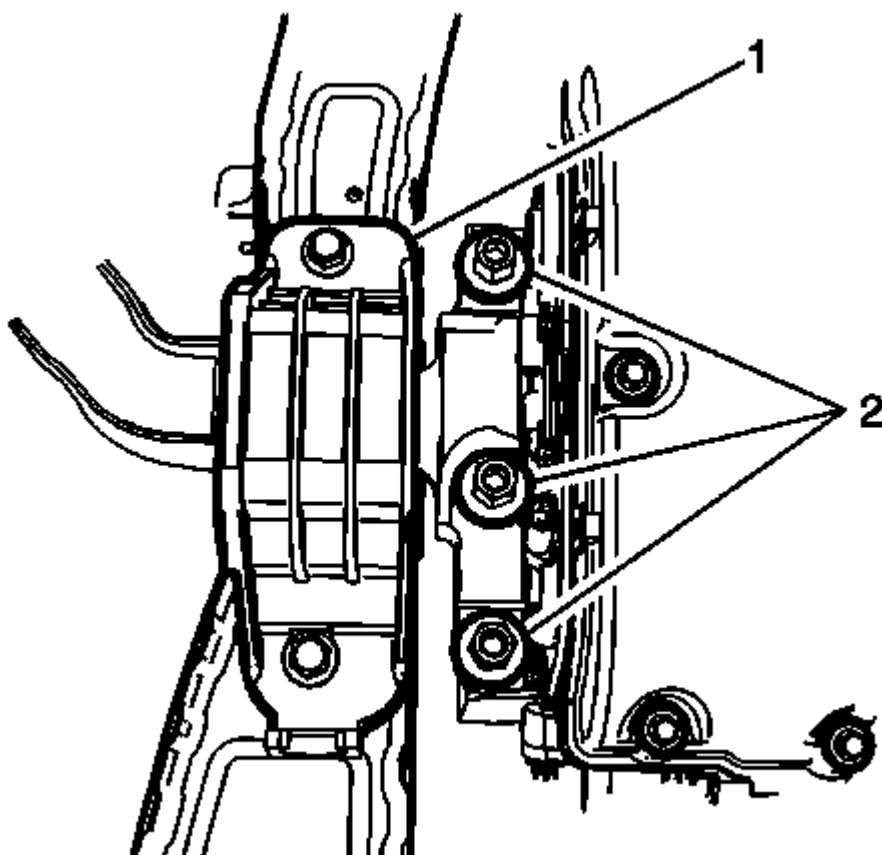
5. Position two floor jacks with wood blocks under the engine and transaxle in order to support the powertrain assembly.



**Fig. 17: Transaxle Bolts**

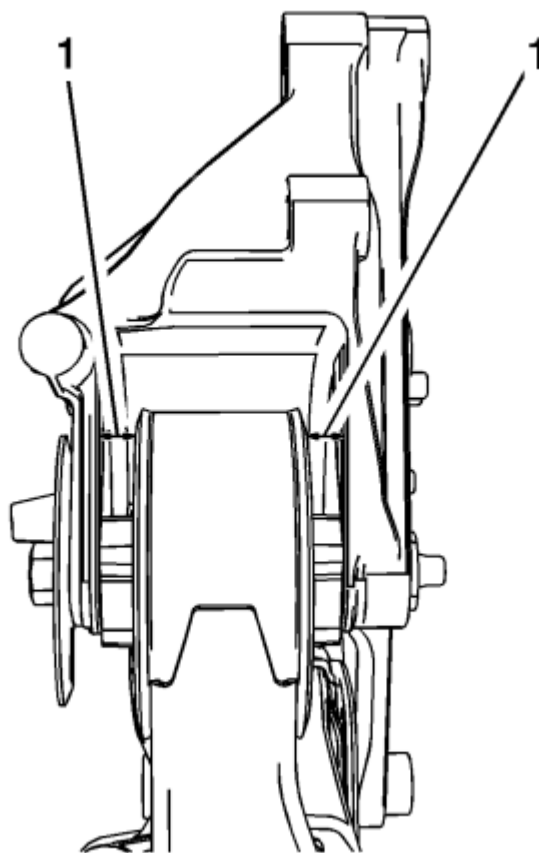
Courtesy of GENERAL MOTORS COMPANY

6. Loosen the transaxle adapter to transaxle bolts (1).



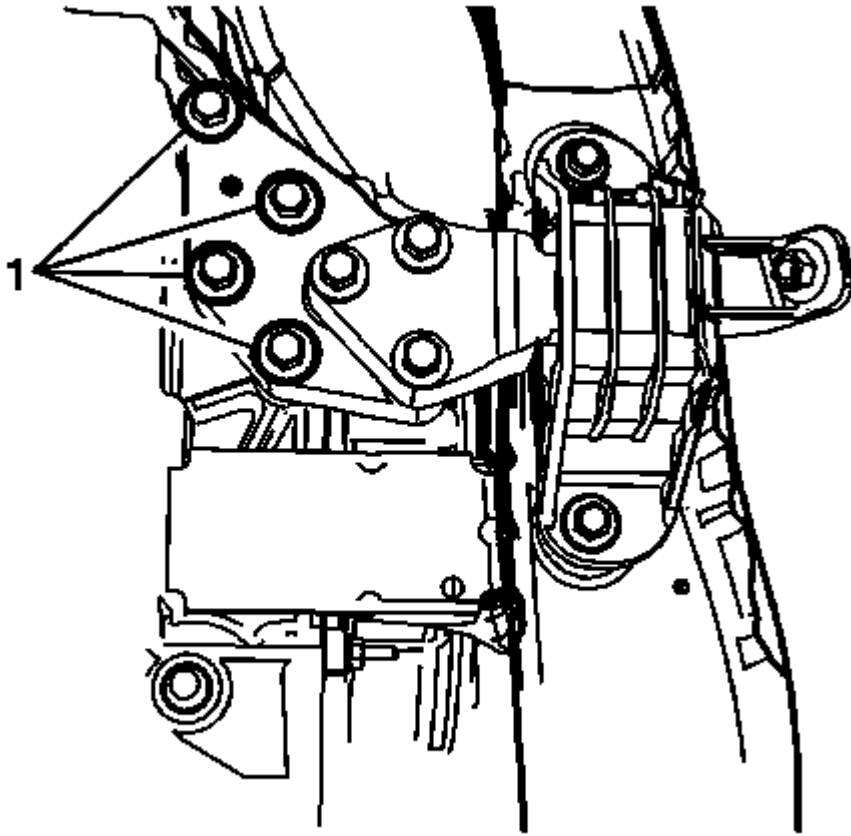
**Fig. 18: Engine Mount And Bracket Bolts**  
Courtesy of GENERAL MOTORS COMPANY

7. Loosen the engine mount (1) to bracket bolts (2).
8. Lower the floor jacks in order to allow a 1/4 inch (6 mm) gap between the upper engine mount and engine mount bracket and also between the transmission and left transmission mount.



**Fig. 19: Front And Rear Powertrain Mounts**  
**Courtesy of GENERAL MOTORS COMPANY**

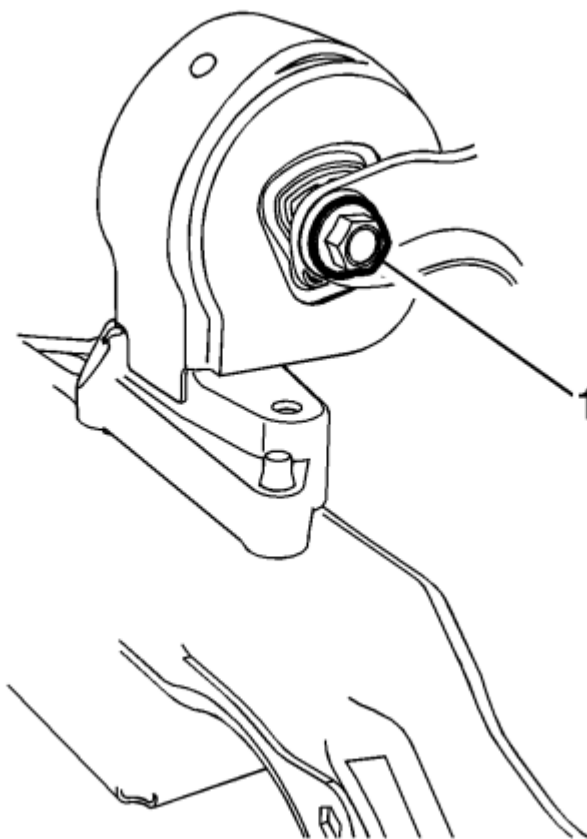
9. Check that the front and rear mounts are centered (1) in the mount brackets, adjust if necessary.
10. Tighten the left hand (transaxle side) mount bolts, starting with the bolt nearest to the center of the mount. See the appropriate transmission mount replacement procedure for the fastener tightening specifications.



**Fig. 20: Transaxle Bolts**

Courtesy of GENERAL MOTORS COMPANY

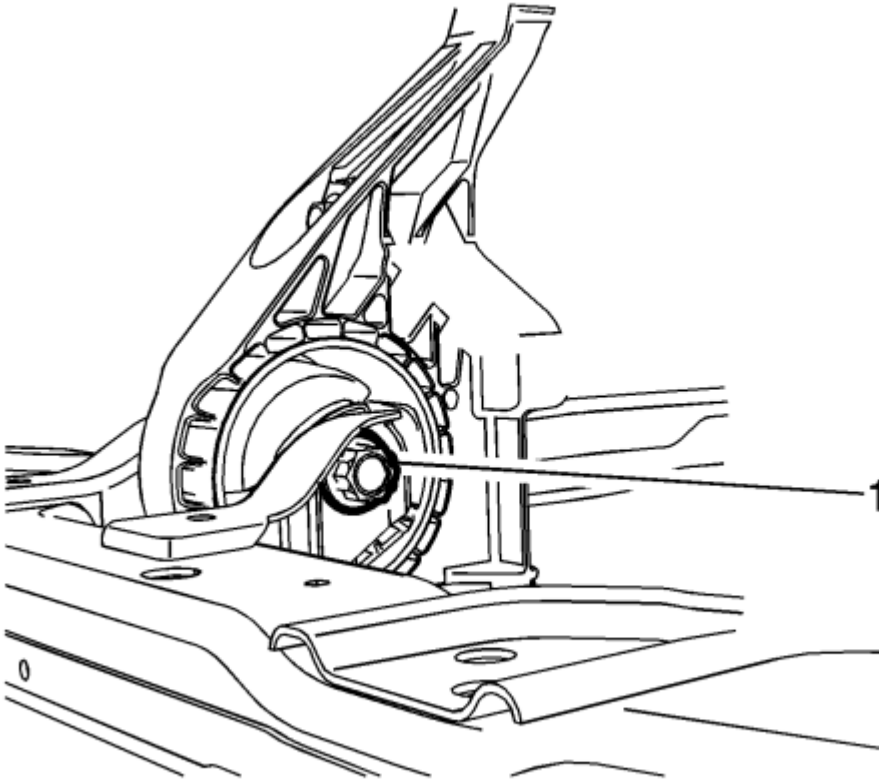
11. Tighten the right hand (engine side) mount bolts (1), starting with the bolt nearest to the center of the mount. See the appropriate engine mount replacement procedure for the fastener tightening specifications.
12. Remove the floor jacks from under the oil pan and transmission.
13. Raise the vehicle.
14. Shake the powertrain from front to rear and allow the powertrain to settle.



**Fig. 21: Rear Transaxle Mount Through Bolt**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** It is essential that the lower mount through bolts should be as close to centered as possible in the oversized mount insert holes before tightening to specification.

15. Tighten the rear transaxle mount through bolt (1). See the appropriate transmission mount replacement procedure for the fastener tightening specifications.



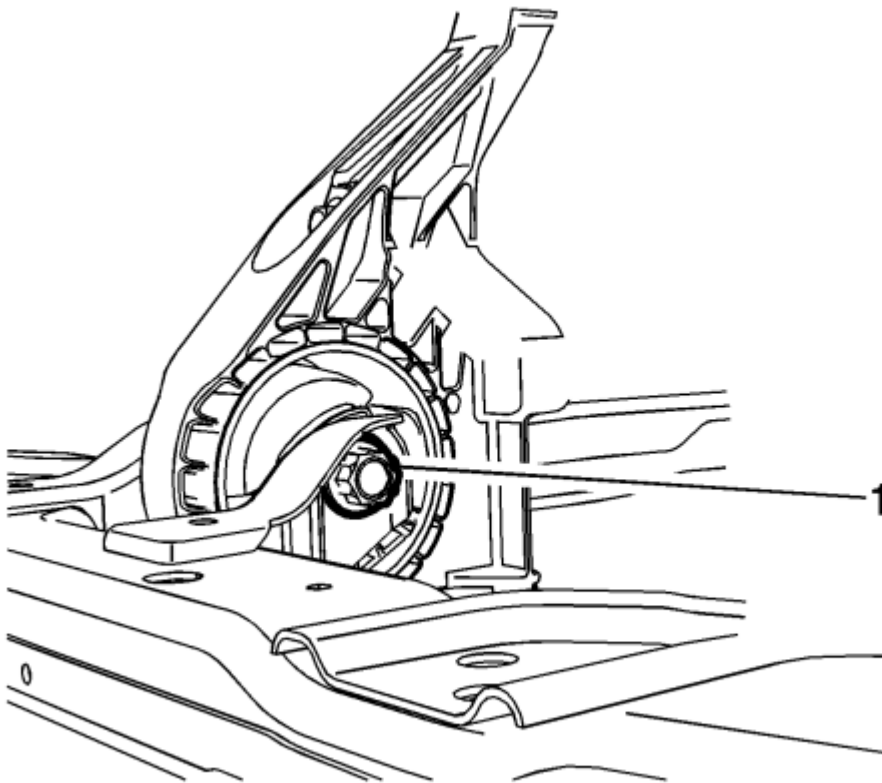
**Fig. 22: Front Transaxle Mount Through Bolt**  
Courtesy of GENERAL MOTORS COMPANY

16. Tighten the front transaxle mount through bolt (1). See the appropriate transmission mount replacement procedure for the fastener tightening specifications.
17. Lower the vehicle.

#### **POWERTRAIN MOUNT BALANCING - LOWER**

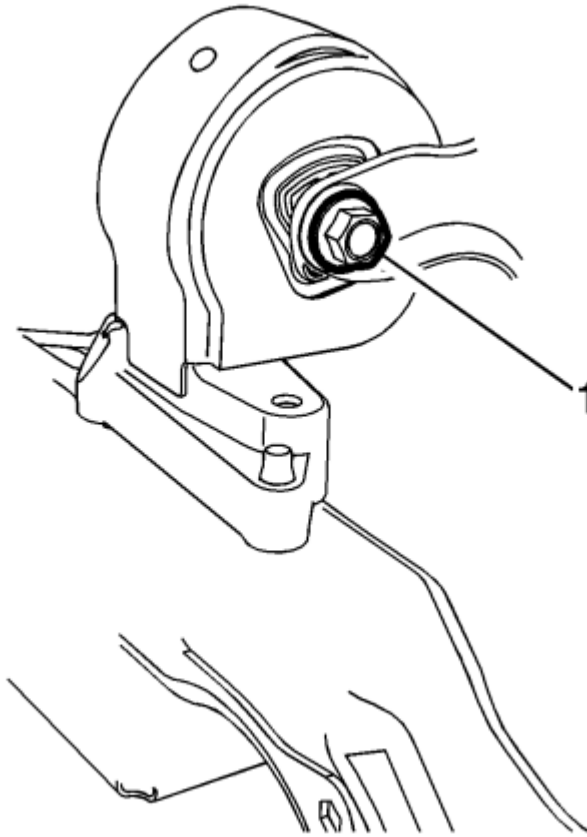
**NOTE:** Follow the balance procedure steps listed below when front or rear mounts through bolts are loosened or removed during a repair procedure.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .



**Fig. 23: Front Transaxle Mount Through Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the front transaxle mount through bolt (1).

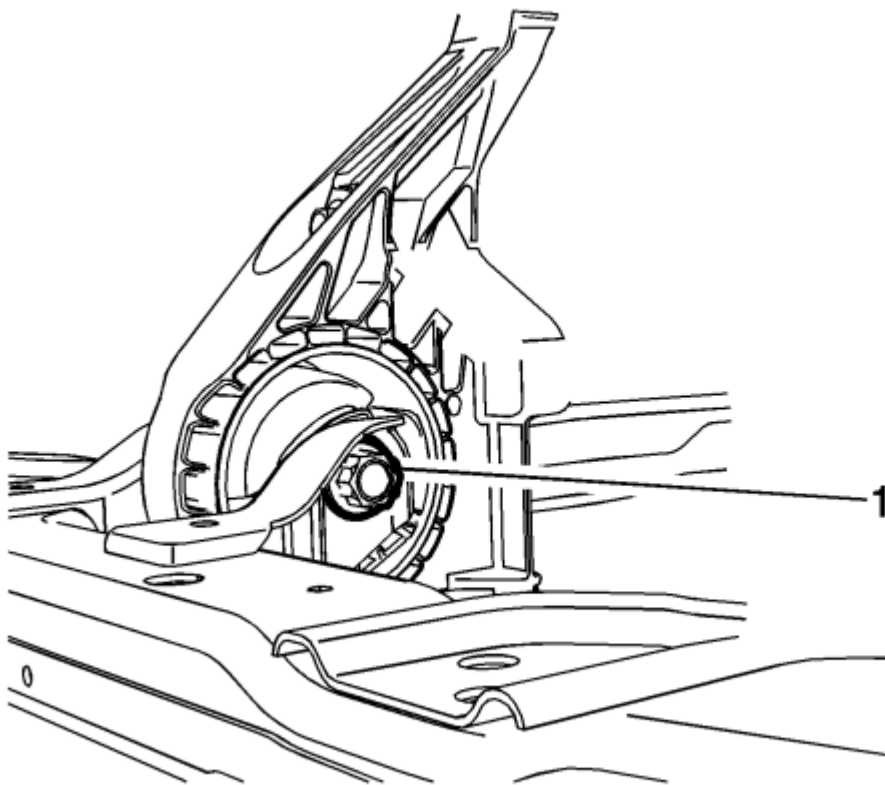


**Fig. 24: Rear Transaxle Mount Through Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Loosen the rear transaxle mount through bolt (1).
4. Shake the powertrain from front to rear and allow the powertrain to settle.

**NOTE:** It is essential that the through bolts are as close to centered as possible in the oversized mount insert holes before tightening to specification.

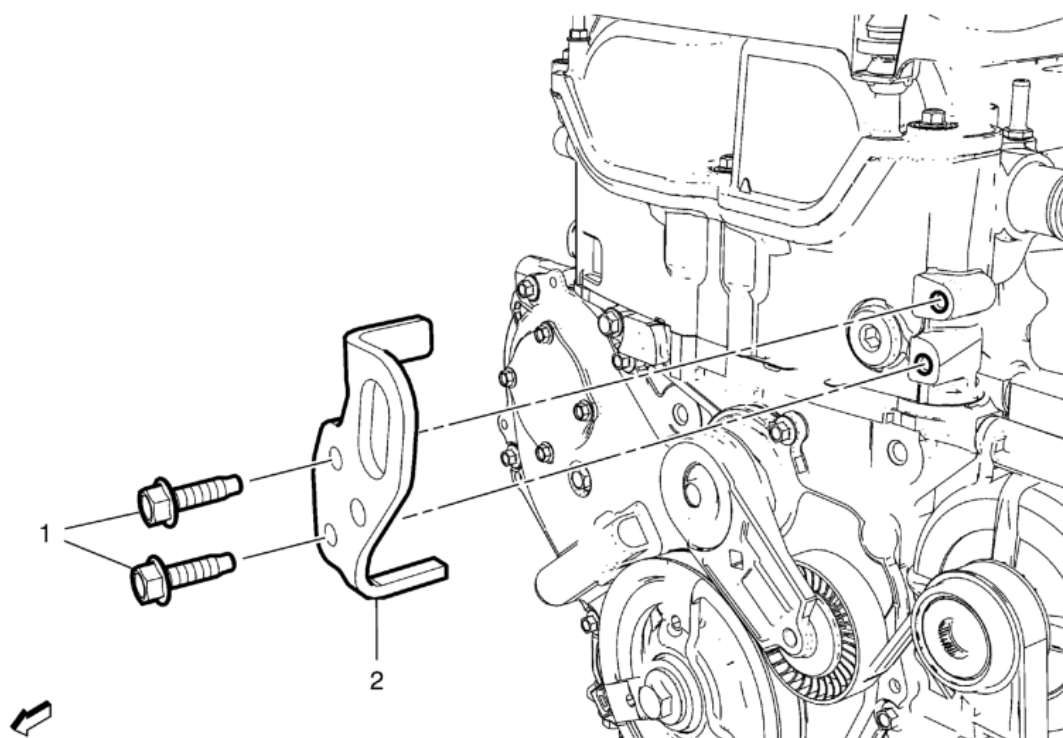
5. Tighten the rear transaxle mount through bolt (1). See the appropriate transmission mount replacement procedure for the fastener tightening specifications.



**Fig. 25: Front Transaxle Mount Through Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

6. Tighten the front transaxle mount through bolt (1). See the appropriate transmission mount replacement procedure for the fastener tightening specifications.
7. Lower the vehicle.

#### **ENGINE LIFT FRONT BRACKET REPLACEMENT**

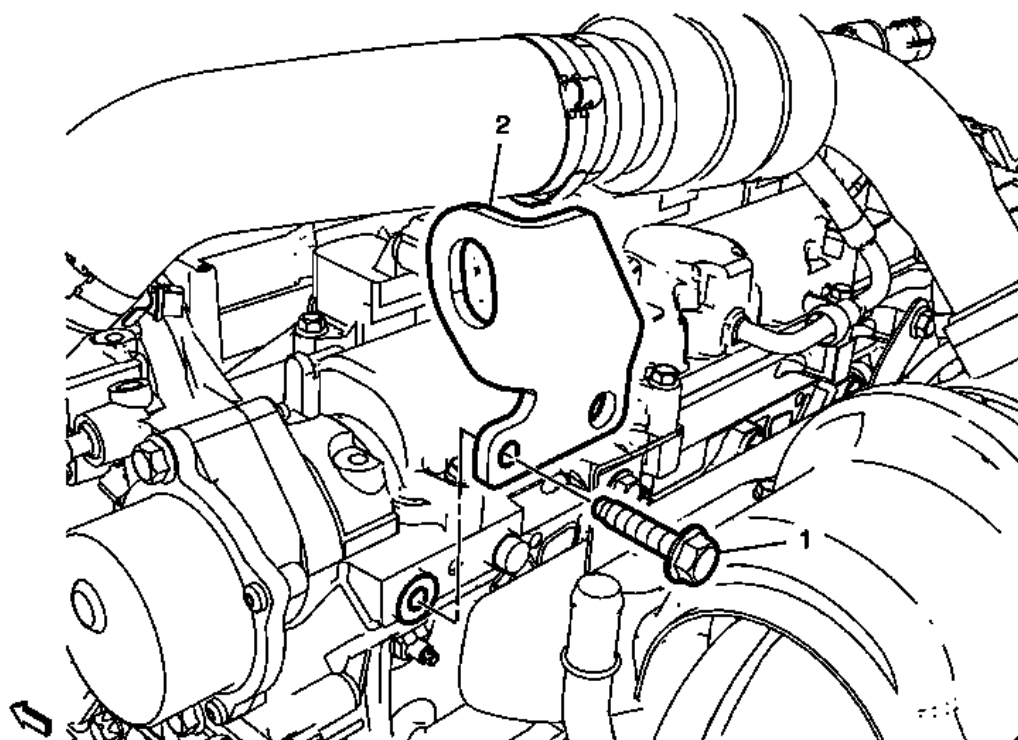


**Fig. 26: Engine Lift Front Bracket & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

### Engine Lift Front Bracket Replacement

| Callout                                                                                      | Component Name                                                                                                                                     |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                |                                                                                                                                                    |
| Remove the air cleaner assembly. Refer to <a href="#">Air Cleaner Assembly Replacement</a> . |                                                                                                                                                    |
| 1                                                                                            | Engine Lift Bracket Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>25 N.m (18 lb ft) |
| 2                                                                                            | Engine Lift Bracket - Front                                                                                                                        |

### ENGINE LIFT REAR BRACKET REPLACEMENT

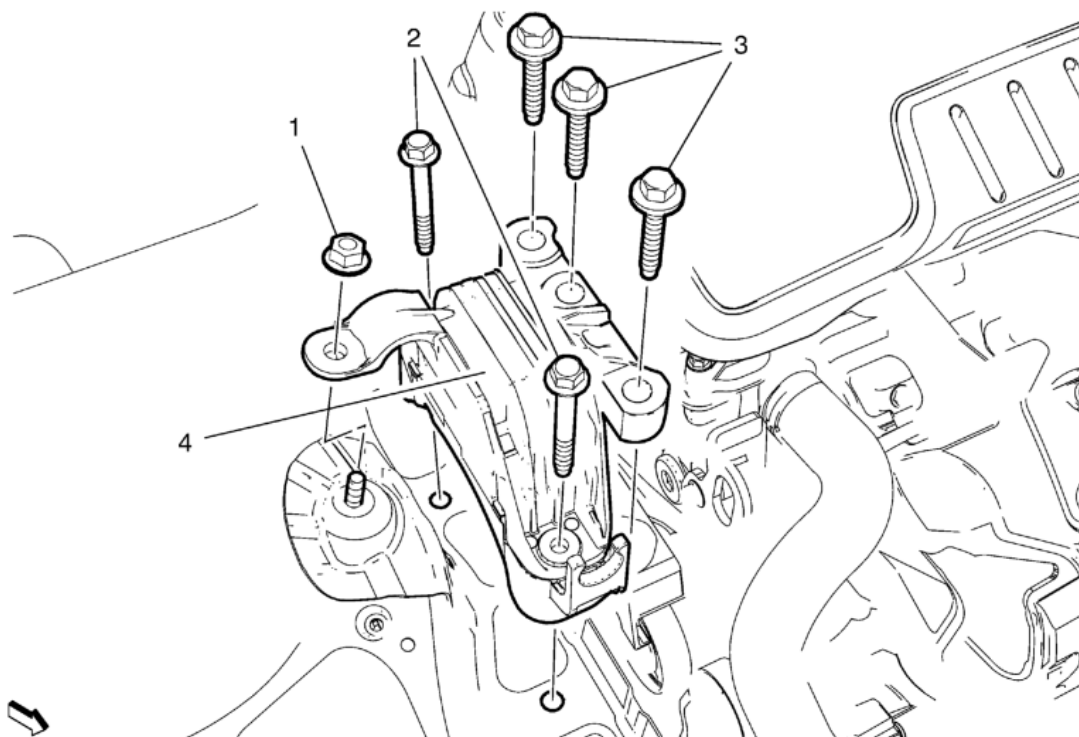
**Fig. 27: Engine Lift Rear Bracket & Bolts**

Courtesy of GENERAL MOTORS COMPANY

**Engine Lift Rear Bracket Replacement**

| Callout | Component Name                                                                                                                                 |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Engine Lift Bracket Rear Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>25 N.m (18 lb ft) |
| 2       | Engine Lift Bracket - Rear                                                                                                                     |

**ENGINE MOUNT REPLACEMENT**

**Fig. 28: Engine Mount & Components**

Courtesy of GENERAL MOTORS COMPANY

**Engine Mount Replacement**

| Callout                                                                                                                                                                                                                                                                                                        | Component Name                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                  |                                                                                                                                   |
| <ol style="list-style-type: none"> <li>1. Remove the air cleaner assembly. Refer to <a href="#">Air Cleaner Assembly Replacement</a> .</li> <li>2. Remove the engine sight shield. Refer to <a href="#">Engine Sight Shield Replacement</a>.</li> <li>3. Support the engine with the engine lifter.</li> </ol> |                                                                                                                                   |
| 1                                                                                                                                                                                                                                                                                                              | Engine Mount Nut<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>62 N.m (46 lb ft) |
| 2                                                                                                                                                                                                                                                                                                              | Engine Mount Bolt (Qty: 2)<br><b>Tighten</b><br>62 N.m (46 lb ft)                                                                 |
|                                                                                                                                                                                                                                                                                                                | Engine Mount Bracket Bolt (Qty: 3)<br><br><b>CAUTION:</b>                                                                         |

Refer to Torque-to-Yield Fastener Caution .

### Procedure

Install NEW bolts. DO NOT reuse the old bolts.

### Tighten

- First pass: 50 N.m (37 lb ft)
- Final pass: 60 - 75 degrees

### Special Tools

EN-45059 Angle Meter

For equivalent regional tools, refer to Special Tools (LDK, LHU) .

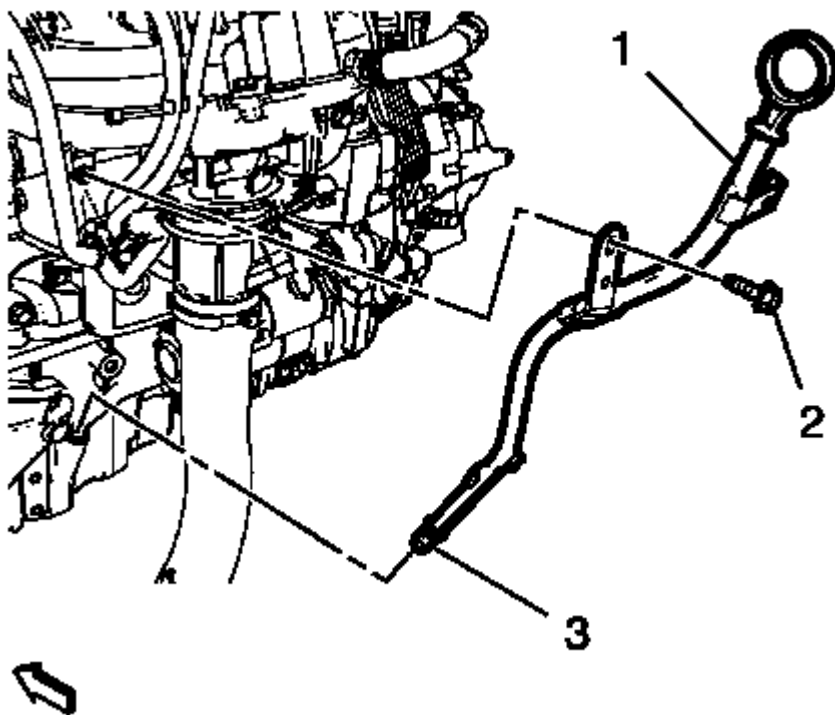
3

4

Engine Mount

## OIL LEVEL INDICATOR TUBE REPLACEMENT

### Removal Procedure

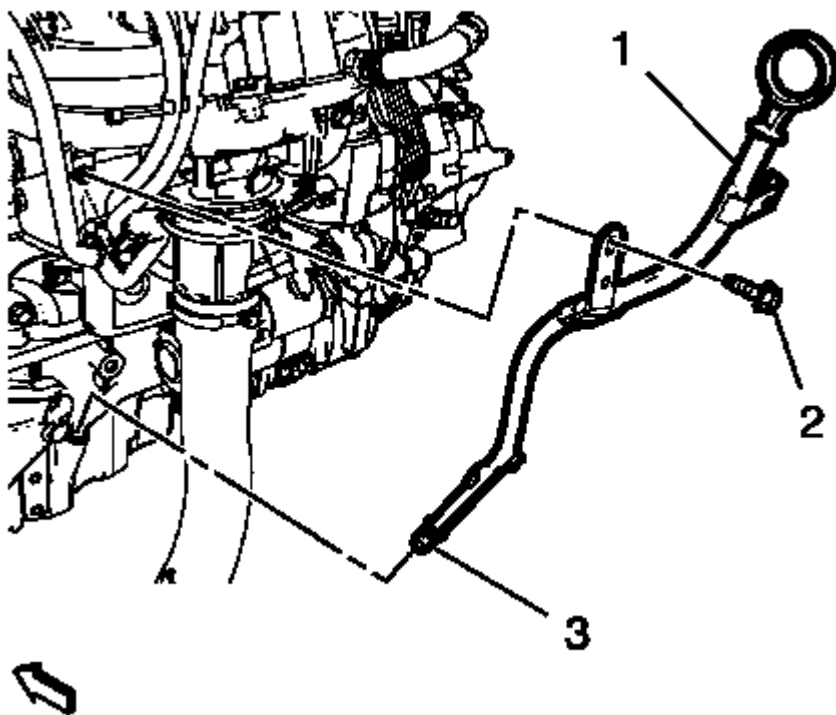


**Fig. 29: Oil Level Indicator Tube, Seal Ring & Bracket Bolt**

**Courtesy of GENERAL MOTORS COMPANY**

1. Remove the oil level indicator tube bracket bolt (2).
2. Unclip the ECM wiring harness, the generator wiring harness and the vacuum tank hose from the oil level indicator tube brackets.
3. Remove the oil level indicator tube (1) from the oil pan.
4. Remove and DISCARD the oil level indicator tube seal ring (3).

**Installation Procedure**



**Fig. 30: Oil Level Indicator Tube, Seal Ring & Bracket Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

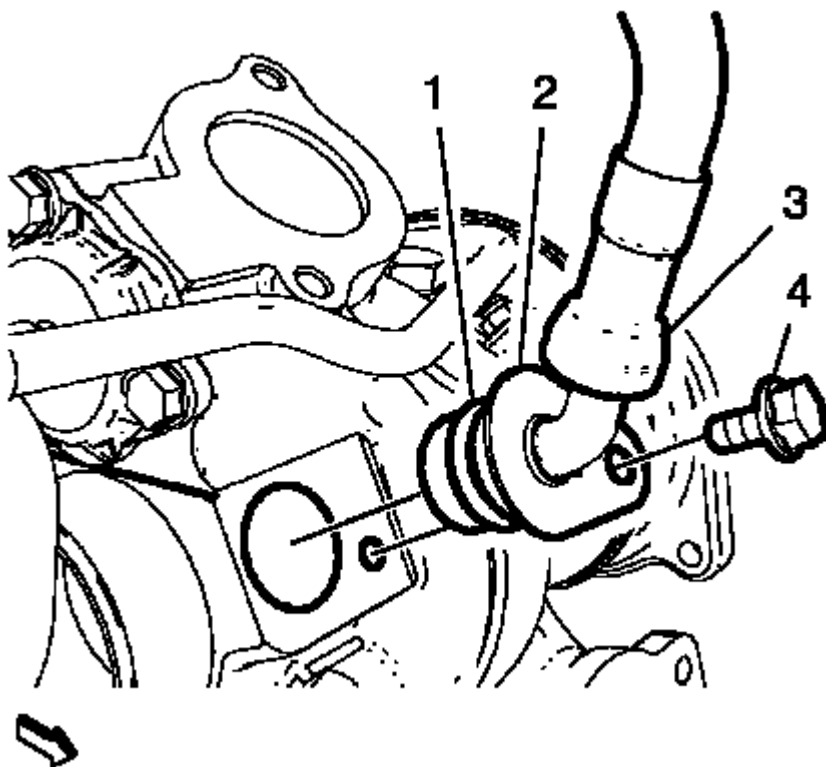
1. Install the oil level indicator tube (1) to the oil pan along with a NEW seal ring (3).

**CAUTION: Refer to Fastener Caution .**

2. Install the oil level indicator tube bracket bolt (2) and tighten to 10 N.m (89 lb in).
3. Clip the ECM wiring harness, the generator wiring harness and the vacuum tank hose to the oil level indicator tube brackets.

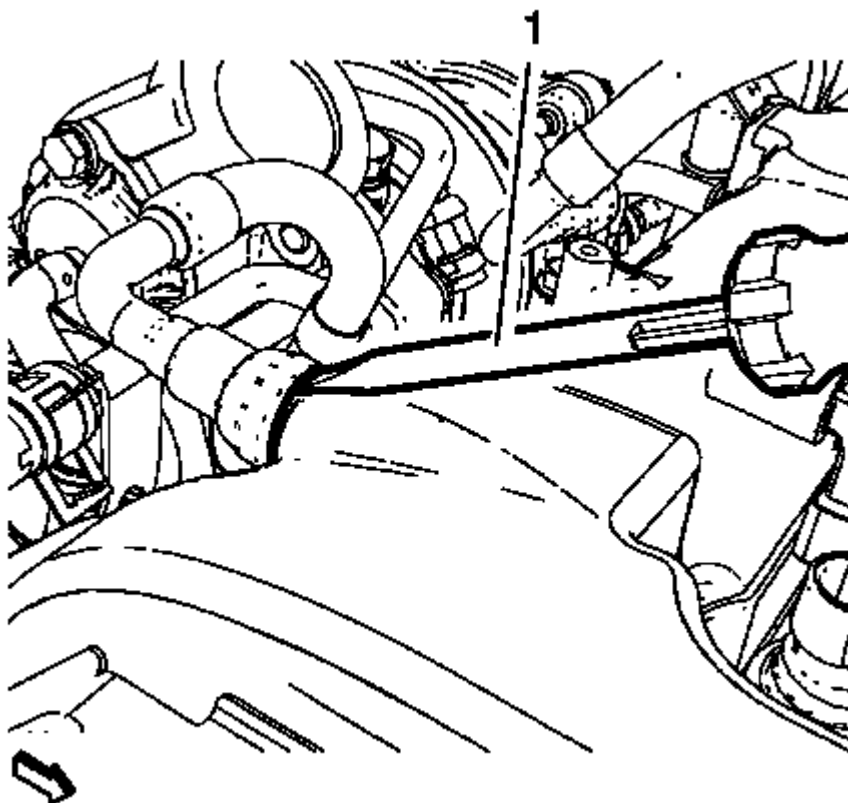
**POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (CAMSHAFT COVER TO TURBOCHARGER)****Removal Procedure**

1. Remove the engine sight shield. Refer to Engine Sight Shield Replacement.



**Fig. 31: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the positive crankcase ventilation (PCV) hose bolt (4) from the turbocharger.
3. Remove the positive crankcase ventilation stud (2).
4. Remove and DISCARD the positive crankcase ventilation hose seal ring (1).
5. Remove the PCV hose (3) from the PCV hose stud (2). Refer to Metal Collar Quick Connect Fitting Service.

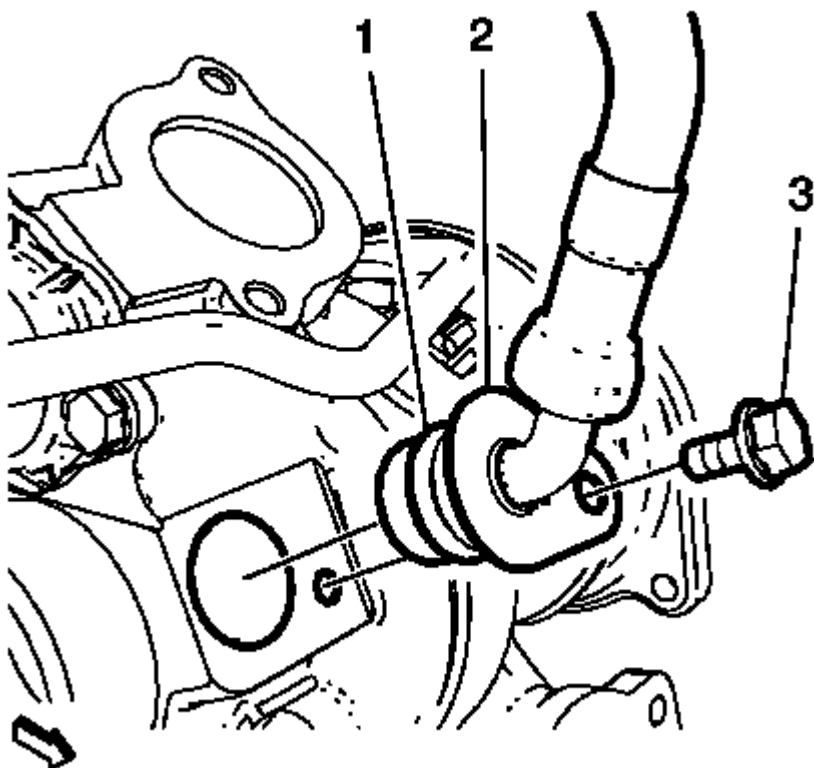


**Fig. 32: Removing PCV Hose With Screwdriver**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Detach the PCV hose carefully from the camshaft cover. After the removal the PCV hose must not be reused anymore.

6. Remove the PCV from the camshaft cover with a suitable screwdriver (1).

#### Installation Procedure

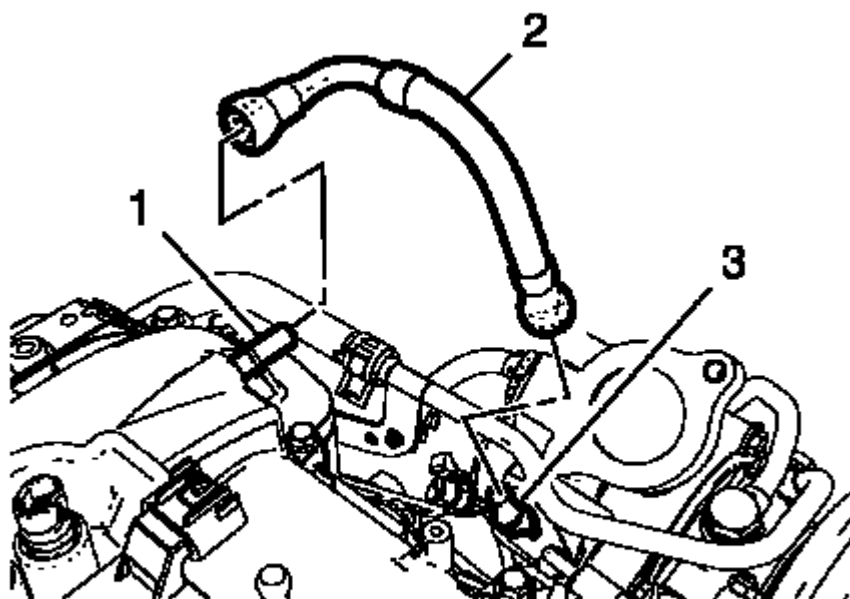


**Fig. 33: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW positive crankcase ventilation hose seal ring (1).
2. Install the positive crankcase ventilation hose (2).

**CAUTION:** Refer to Fastener Caution .

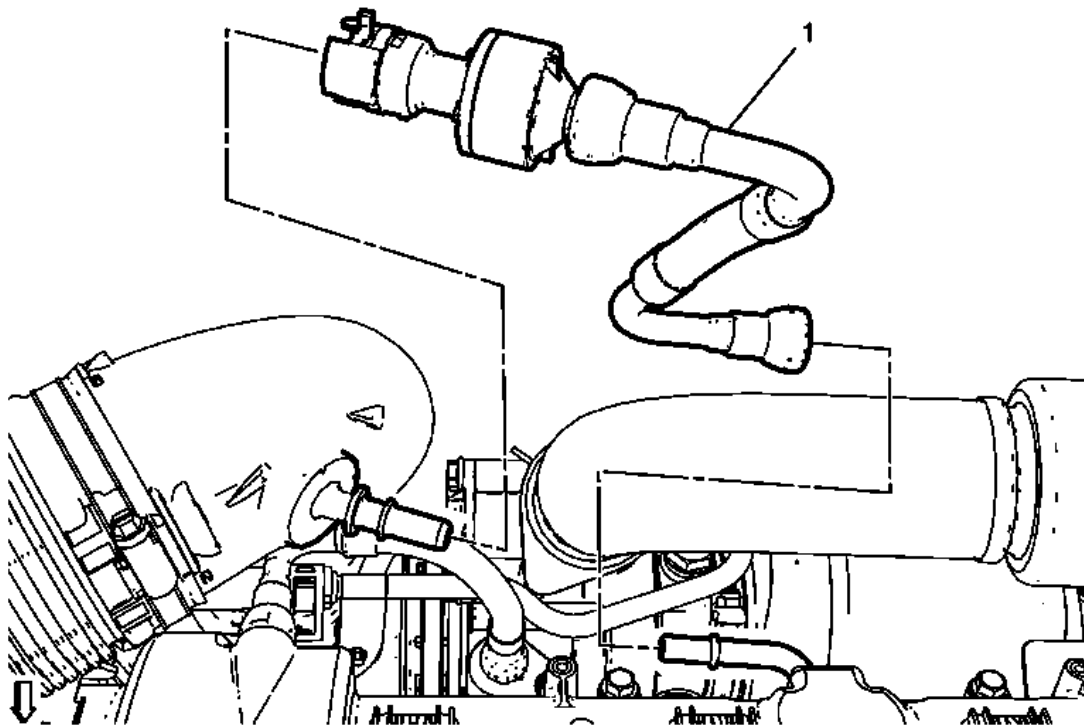
3. Install the positive crankcase ventilation hose bolt (3) and tighten to 10 N.m (89 lb in).



**Fig. 34: Camshaft Cover Stud, PCV Hose & Stud**  
Courtesy of GENERAL MOTORS COMPANY

4. Install the positive crankcase ventilation hose (2) to the positive crankcase ventilation stud (3) and the camshaft cover stud (1). Refer to **Metal Collar Quick Connect Fitting Service** .

**POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (CAMSHAFT COVER TO AIR CLEANER OUTLET DUCT REAR)**

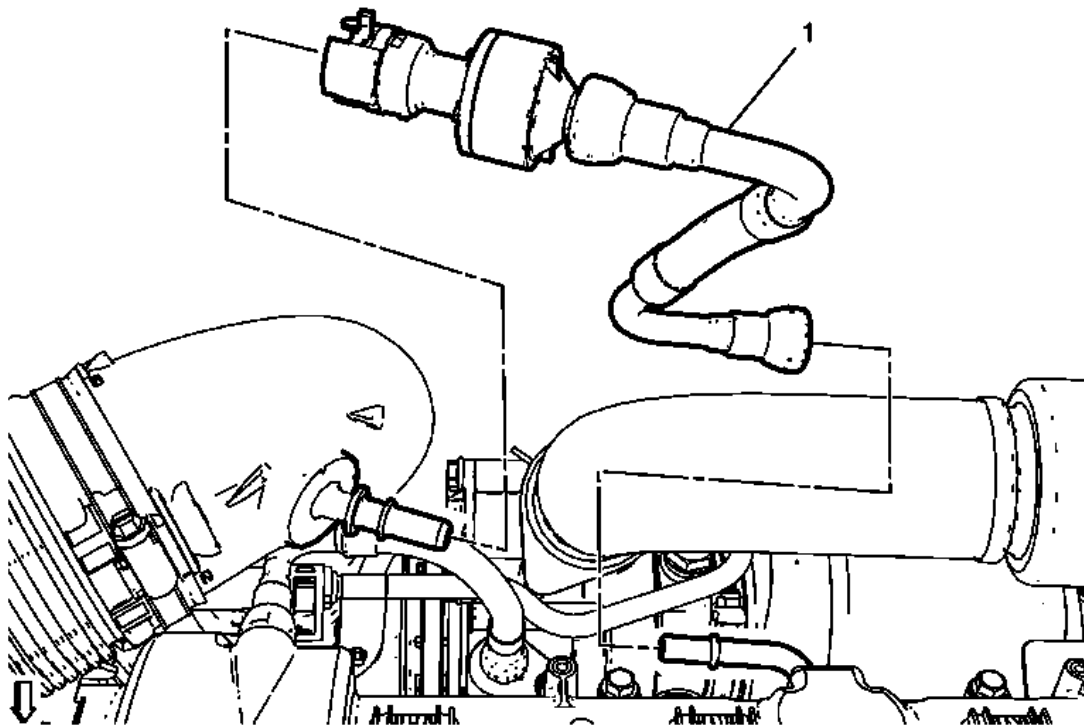


**Fig. 35: Positive Crankcase Ventilation Tube**  
Courtesy of GENERAL MOTORS COMPANY

**Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Camshaft Cover to Air Cleaner Outlet Duct Rear)**

| Callout | Component Name                                                                                                                                                                                                              |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Positive Crankcase Ventilation Tube <ul style="list-style-type: none"><li>• Refer to <u>Plastic Collar Quick Connect Fitting Service</u> .</li><li>• Refer to <u>Metal Collar Quick Connect Fitting Service</u> .</li></ul> |

**POSITIVE CRANKCASE VENTILATION TUBE REPLACEMENT - CAMSHAFT COVER TO AIR CLEANER OUTLET DUCT REAR**



**Fig. 36: Positive Crankcase Ventilation Tube**  
Courtesy of GENERAL MOTORS COMPANY

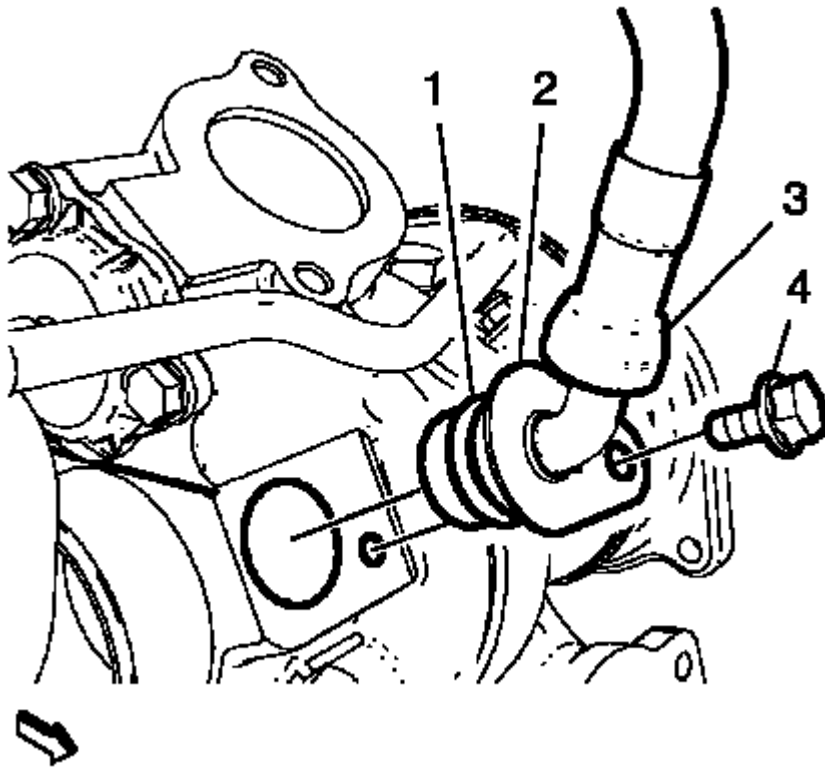
#### Positive Crankcase Ventilation Tube Replacement - Camshaft Cover to Air Cleaner Outlet Duct Rear

| Callout | Component Name                                                                                                                                                                                                                                |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Positive Crankcase Ventilation Tube <ul style="list-style-type: none"><li>• Refer to <a href="#">Plastic Collar Quick Connect Fitting Service</a> .</li><li>• Refer to <a href="#">Metal Collar Quick Connect Fitting Service</a> .</li></ul> |

#### POSITIVE CRANKCASE VENTILATION TUBE REPLACEMENT - CAMSHAFT COVER TO TURBO CHARGER

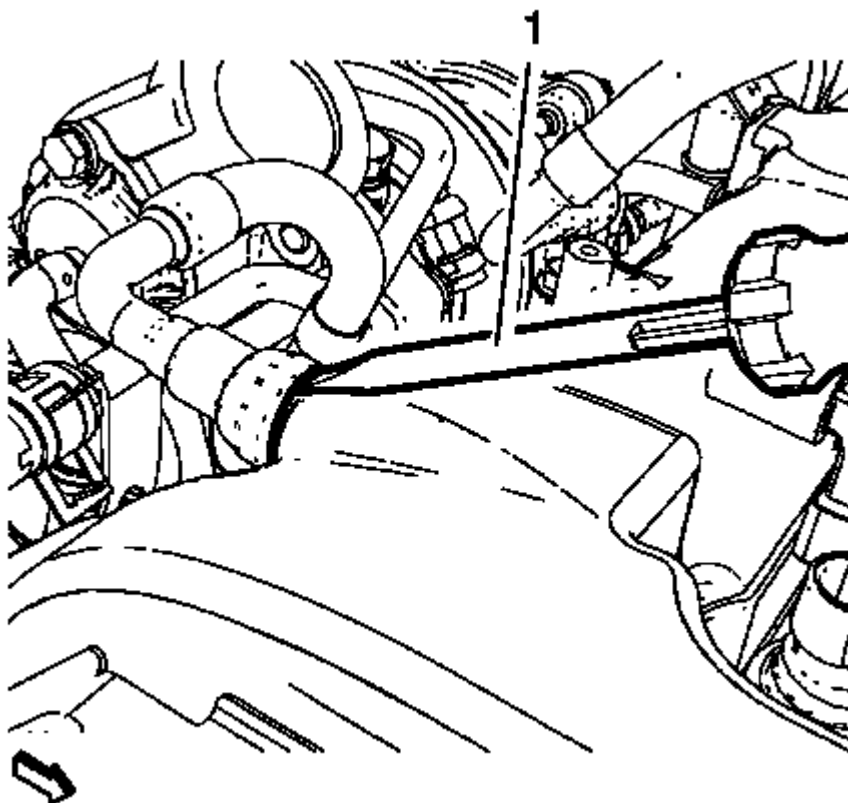
##### Removal Procedure

1. Remove the engine sight shield. Refer to [Engine Sight Shield Replacement](#).



**Fig. 37: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the positive crankcase ventilation (PCV) hose bolt (4) from the turbocharger.
3. Remove the positive crankcase ventilation stud (2).
4. Remove and DISCARD the positive crankcase ventilation hose seal ring (1).
5. Remove the PCV hose (3) from the PCV hose stud (2). Refer to **Metal Collar Quick Connect Fitting Service** .

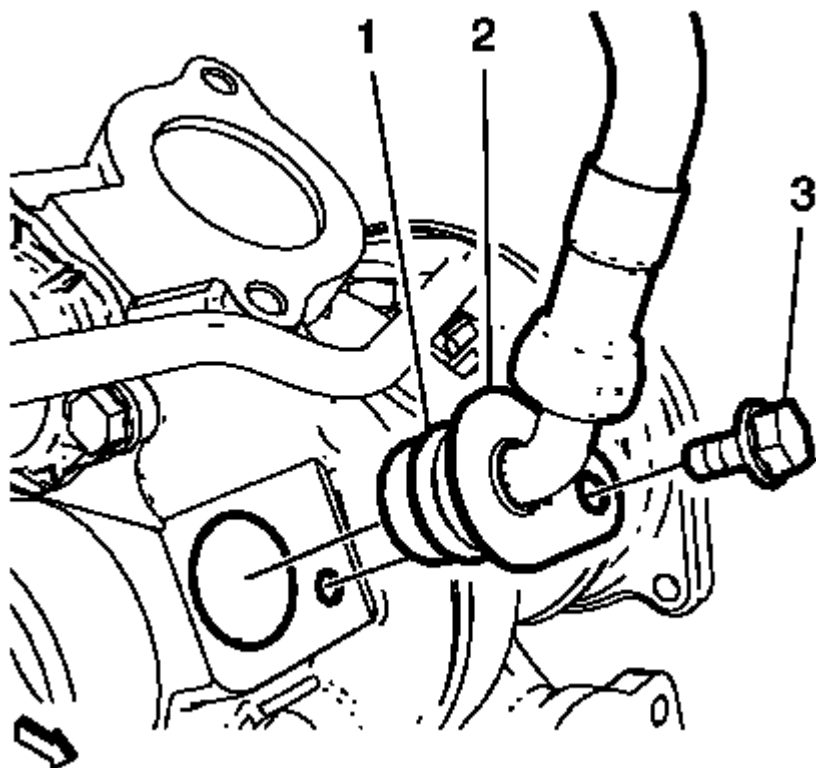


**Fig. 38: Removing PCV Hose With Screwdriver**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Detach the PCV hose carefully from the camshaft cover. After the removal the PCV hose must not be reused anymore.

6. Remove the PCV from the camshaft cover with a suitable screwdriver (1).

#### Installation Procedure

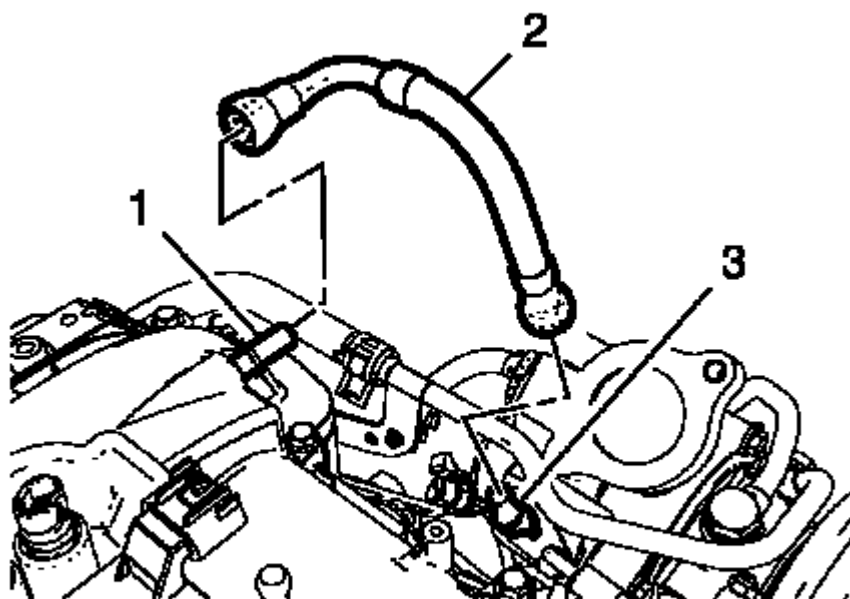


**Fig. 39: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW positive crankcase ventilation hose seal ring (1).
2. Install the positive crankcase ventilation hose (2).

**CAUTION:** Refer to Fastener Caution .

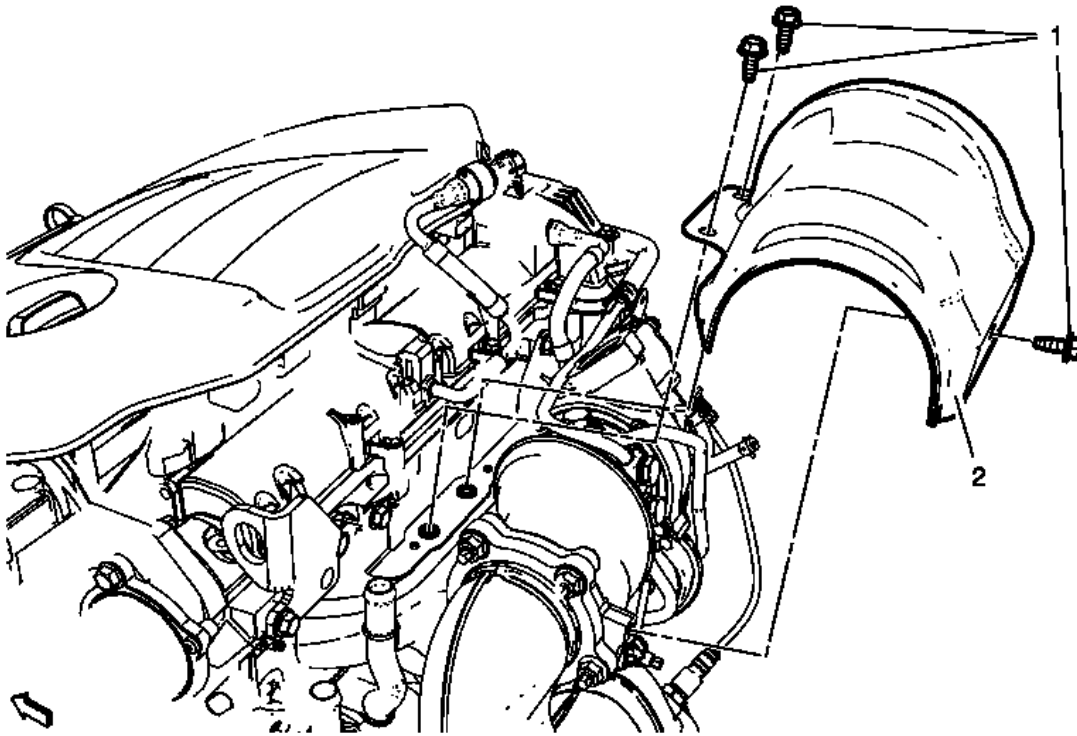
3. Install the positive crankcase ventilation hose bolt (3) and tighten to 10 N.m (89 lb in).



**Fig. 40: Camshaft Cover Stud, PCV Hose & Stud**  
Courtesy of GENERAL MOTORS COMPANY

4. Install the positive crankcase ventilation hose (2) to the positive crankcase ventilation stud (3) and the camshaft cover stud (1). Refer to **Metal Collar Quick Connect Fitting Service** .

#### **TURBOCHARGER HEAT SHIELD REPLACEMENT**

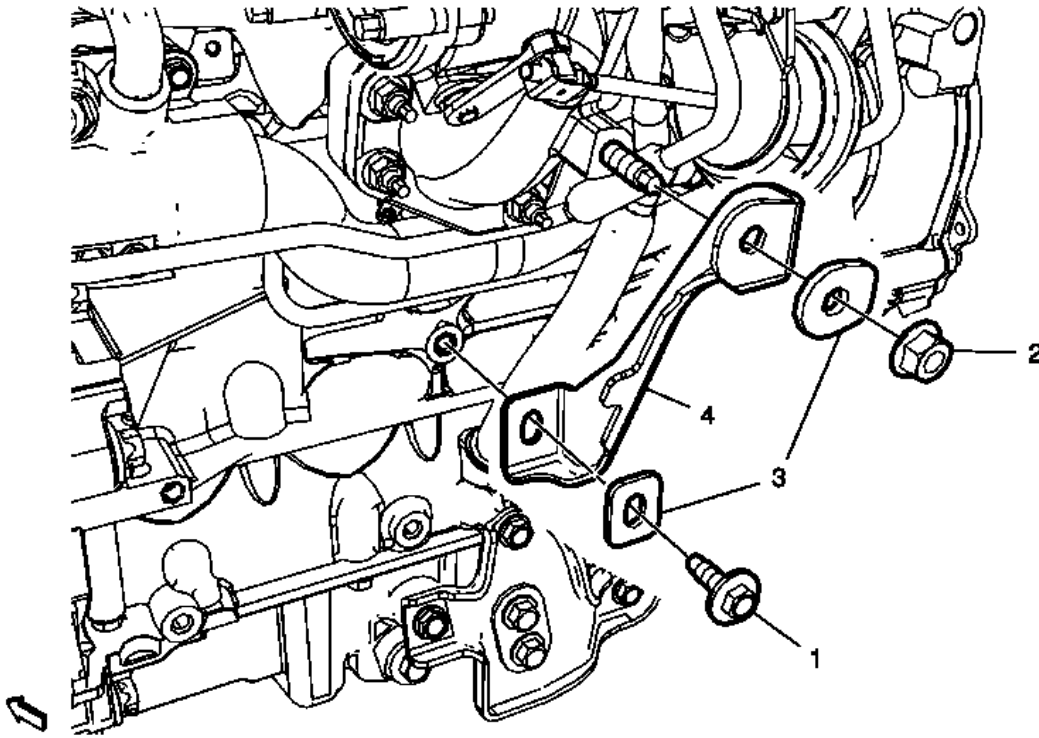


**Fig. 41: Turbocharger Heat Shield & Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

### Turbocharger Heat Shield Replacement

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Component Name                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove the engine sight shield. Refer to <u><b>Engine Sight Shield Replacement</b></u>.</li> <li>2. Remove the dash upper extension panel. Refer to <u><b>Dash Upper Extension Panel Opening Cover Replacement</b></u>.</li> <li>3. Remove the charge air cooler inlet pipe - turbocharger side. Refer to <u><b>Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)</b></u>, <u><b>Charge Air Cooler Inlet Hose Replacement (Turbocharger)</b></u>.</li> </ol> |                                                                                                                                                      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Turbocharger Heat Shield Fastener (Qty: 3)<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u>.</b><br><br><b>Tighten</b><br>10 (89 lb in) |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Turbocharger Heat Shield                                                                                                                             |

### TURBOCHARGER BRACE REPLACEMENT



**Fig. 42: Turbocharger Brace & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

### Turbocharger Brace Replacement

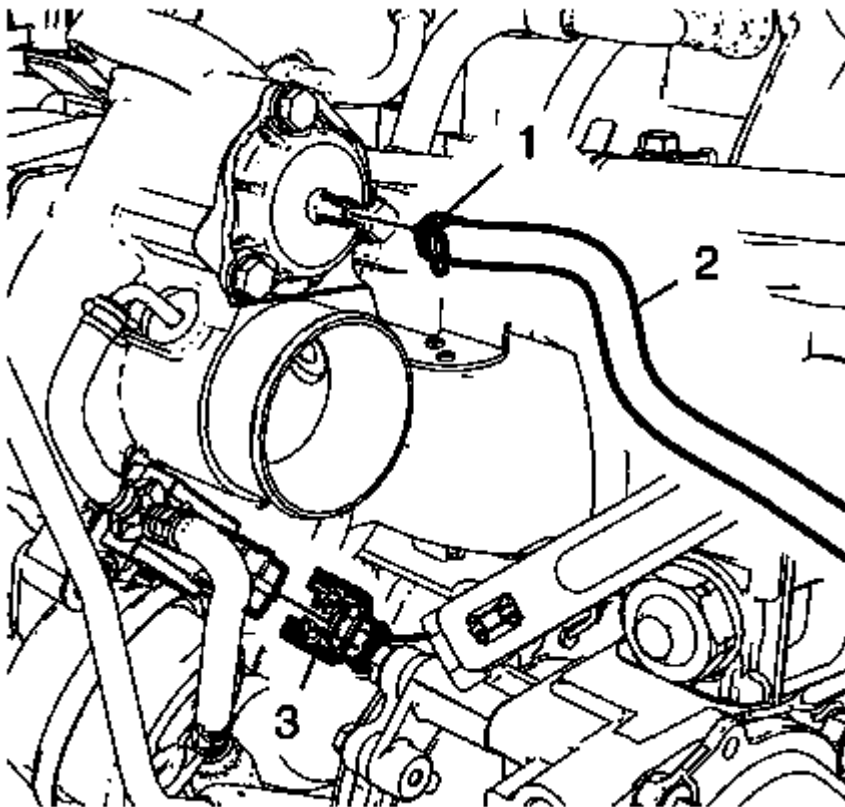
| Callout | Component Name                                                                                                                  |
|---------|---------------------------------------------------------------------------------------------------------------------------------|
| 1       | Turbocharger Brace Bolt<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>50 N.m (37 lb ft) |
| 2       | Turbocharger Brace Nut<br><b>Tighten</b><br>50 N.m (37 lb ft)                                                                   |
| 3       | Turbocharger Brace Washer (Qty: 2)                                                                                              |
| 4       | Turbocharger Brace                                                                                                              |

## TURBOCHARGER REPLACEMENT

### Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Drain the cooling system. Refer to Cooling System Draining and Filling (2.0L LHU) .

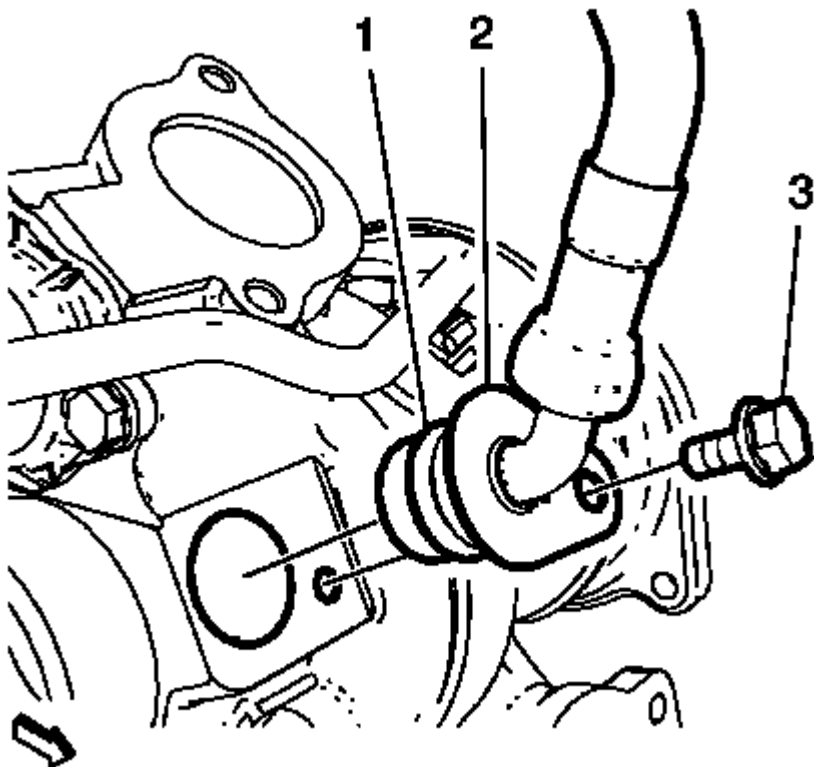
3. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
4. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.
5. Remove the air cleaner outlet rear duct. Refer to **Air Cleaner Outlet Rear Duct Replacement**.
6. Remove the charge air cooler inlet hose - turbocharger side. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)**, **Charge Air Cooler Inlet Hose Replacement (Turbocharger)**.
7. Remove the turbocharger heat shield. Refer to **Turbocharger Heat Shield Replacement**.
8. Remove the three way catalytic converter. Refer to **Three-Way Catalytic Converter Replacement (2.0L LHU)**.
9. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (2.0L LHU)**.
10. Remove the turbocharger oil return pipe. Refer to **Turbocharger Oil Return Pipe Replacement**.
11. Remove the turbocharger oil feed pipe. Refer to **Turbocharger Oil Feed Pipe Replacement**.
12. Remove the turbocharger coolant feed pipe. Refer to **Turbocharger Coolant Feed Pipe Replacement**.
13. Remove the turbocharger coolant return pipe. Refer to **Turbocharger Coolant Return Pipe Replacement**.



**Fig. 43: ECM Wiring Harness Plug, Vacuum Hose & Clamp**  
Courtesy of GENERAL MOTORS COMPANY

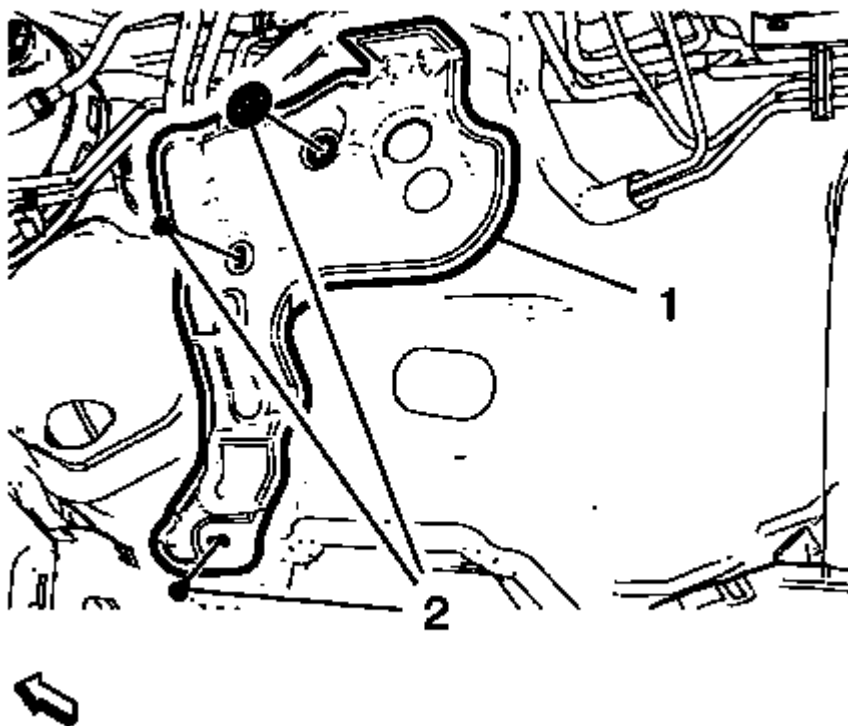
14. Disconnect the engine control module (ECM) wiring harness plug (3) from the turbocharger.
15. Loosen the vacuum hose clamp (1) and remove the vacuum hose (2) from the turbocharger air bypass

valve.



**Fig. 44: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

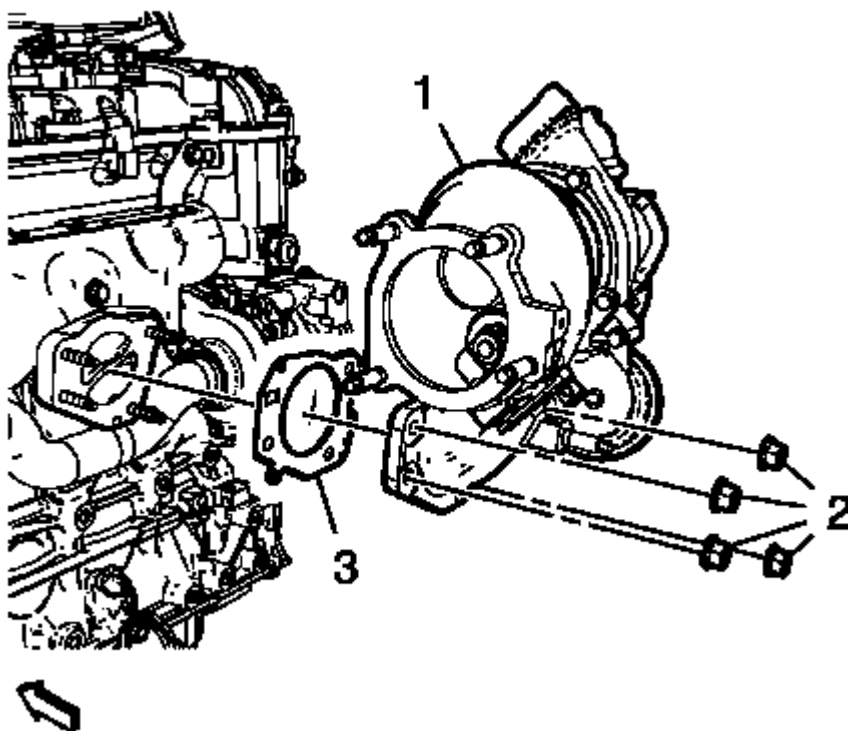
16. Remove the positive crankcase ventilation hose bolt (3).
17. Remove the positive crankcase ventilation hose (2).
18. Remove and DISCARD the positive crankcase ventilation hose seal ring (1).
19. Remove the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement**.
20. Remove the heater inlet hose from the heater inlet. Refer to **Heater Inlet Hose Replacement (2.0L LHU)**.
21. Remove the heater outlet hose from the heater outlet. Refer to **Heater Outlet Hose Replacement (2.0L LHU)**.



**Fig. 45: Fuel Pipe Heat Shield & Retainers**

Courtesy of GENERAL MOTORS COMPANY

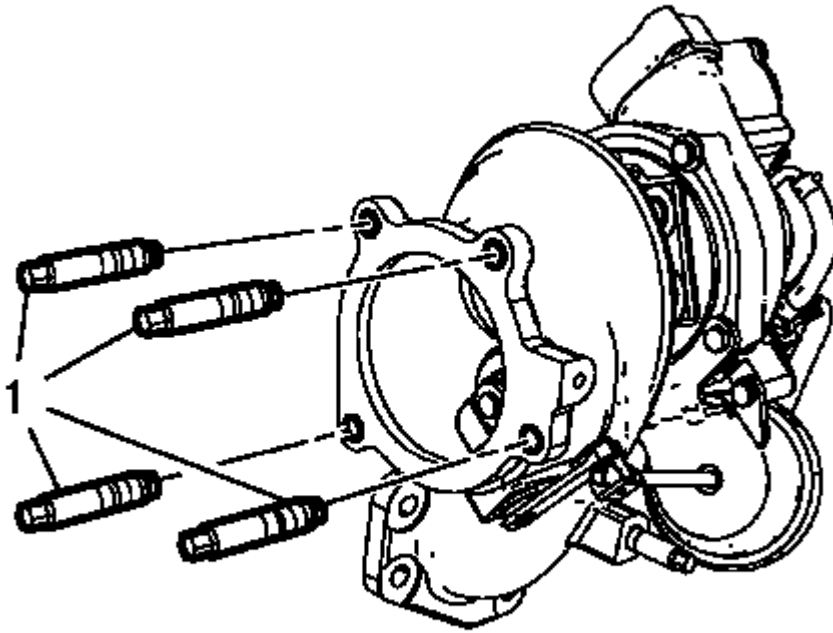
22. Remove the brake and fuel pipe heat shield fasteners (2).
23. Remove the brake and fuel pipe heat shield (1).
24. Remove the turbocharger brace. Refer to **Turbocharger Brace Replacement**.



**Fig. 46: Turbocharger, Gasket & Mounting Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

25. Remove and DISCARD the 4 turbocharger nuts (2).
26. Remove the turbocharger (1).
27. Remove and DISCARD the turbocharger gasket (3).

#### **Installation Procedure**

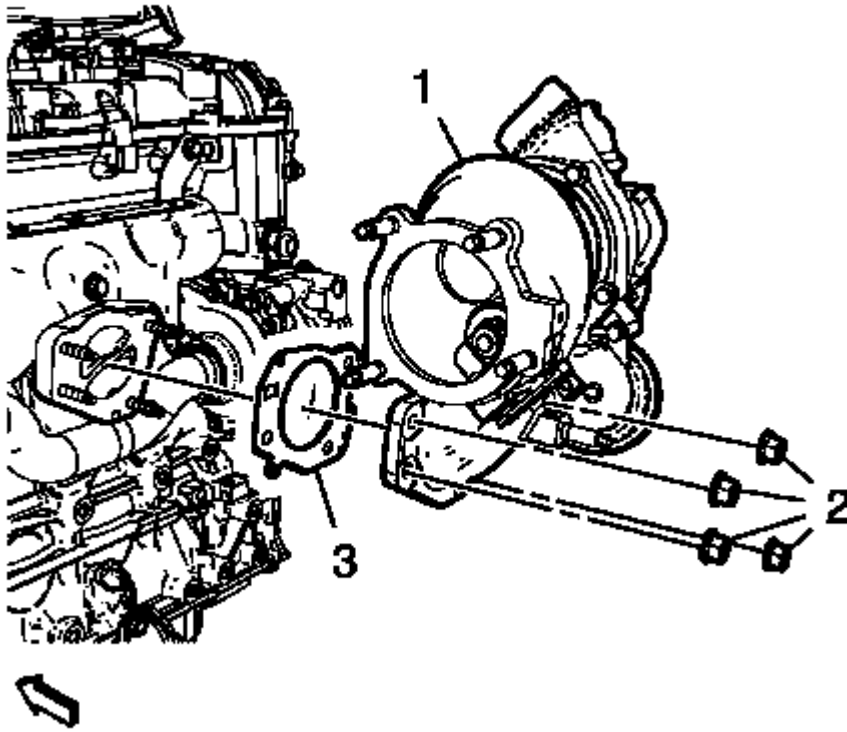


**Fig. 47: Turbocharger Mounting Studs**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:**

- If the turbocharger is being replaced, the new turbocharger will not include mounting studs. New mounting studs and nuts must be used.
- If the turbocharger is being reused, only replace the nuts.

1. Replace the three way catalytic converter to turbocharger studs and nuts if necessary.
  1. Install the turbocharger into a wise. Use softmetal braces.
  2. Install the 4 NEW three way catalytic converter to turbocharger studs and tighten the studs to 25 N.m (18 lb ft).

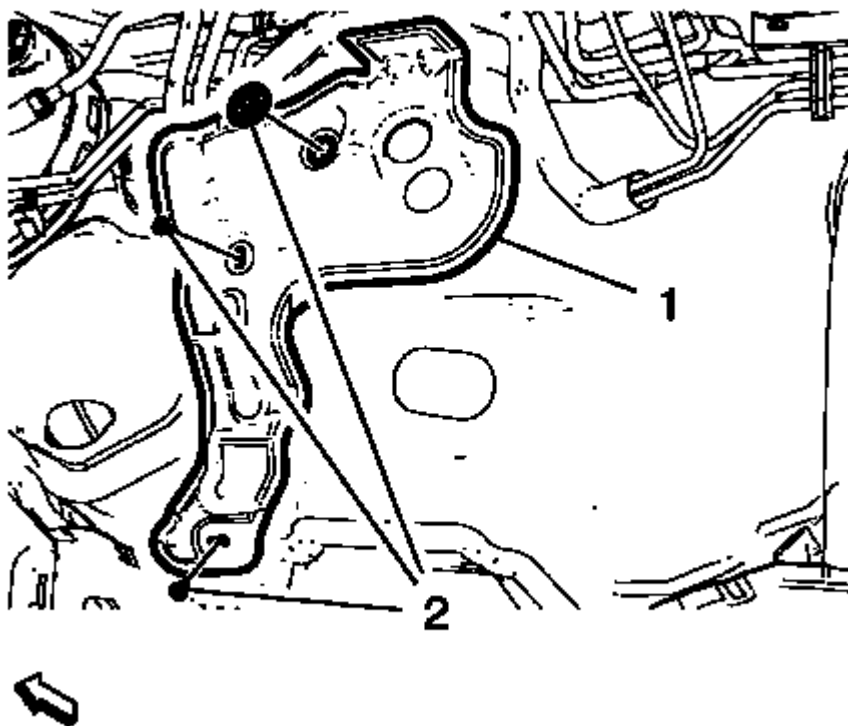


**Fig. 48: Turbocharger, Gasket & Mounting Nuts**  
 Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW turbocharger gasket (3).
3. Install the turbocharger (1).

**CAUTION:** Refer to Fastener Caution .

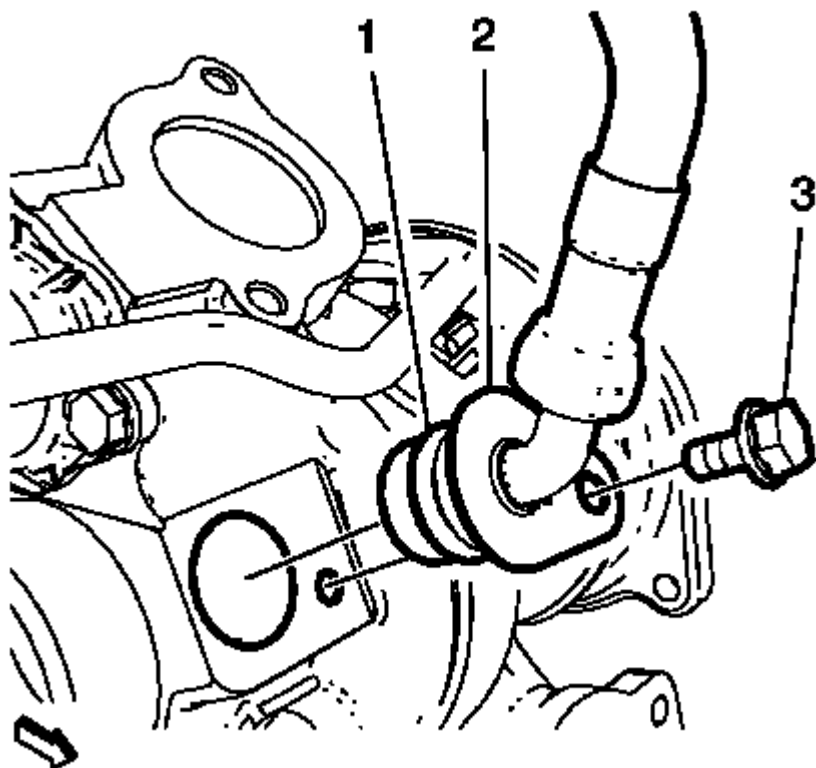
4. Install the 4 NEW turbocharger nuts (2) and tighten to 30 N.m (22 lb ft).
5. Install the turbocharger brace. Refer to Turbocharger Brace Replacement.



**Fig. 49: Fuel Pipe Heat Shield & Retainers**

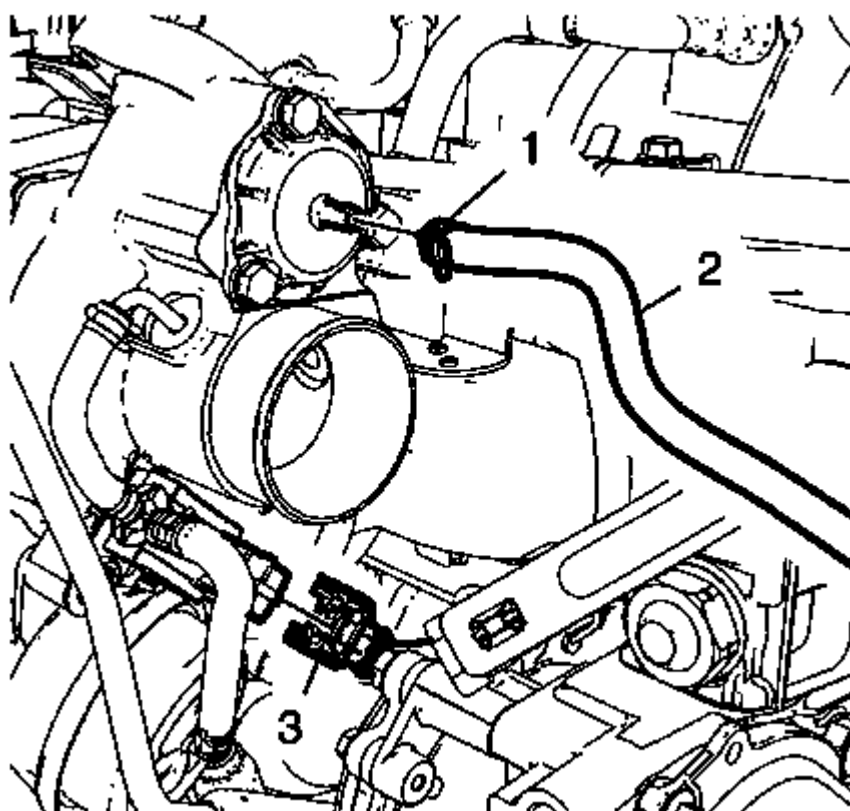
Courtesy of GENERAL MOTORS COMPANY

6. Install the brake and fuel pipe heat shield (1).
7. Install the brake and fuel pipe heat shield fasteners (2).
8. Install the heater inlet hose to the heater inlet. Refer to **Heater Inlet Hose Replacement (2.0L LHU)** .
9. Install the heater outlet hose to the heater outlet. Refer to **Heater Outlet Hose Replacement (2.0L LHU)** .
10. Install the steering gear heat shield. Refer to **Steering Gear Heat Shield Replacement** .



**Fig. 50: Positive Crankcase Ventilation Hose/Pipe/Tube, Seal Ring & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

11. Install a NEW positive crankcase ventilation hose seal ring (1).
12. Install the positive crankcase ventilation hose (2).
13. Install the positive crankcase ventilation hose bolt (3) and tighten to 10 N.m (89 lb in).

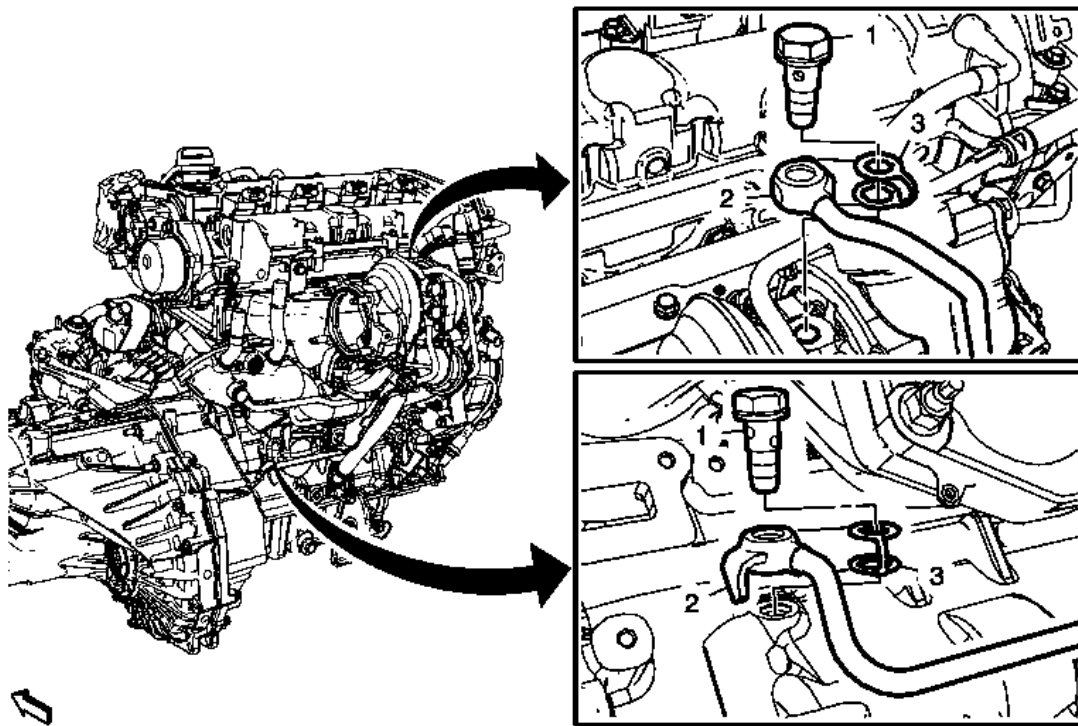


**Fig. 51: ECM Wiring Harness Plug, Vacuum Hose & Clamp**  
Courtesy of GENERAL MOTORS COMPANY

14. Connect the ECM wiring harness plug (3) to the turbocharger.
15. Install the vacuum hose (2) to the turbocharger air bypass valve and tighten the clamp (1).
16. Install the turbocharger coolant return pipe. Refer to **Turbocharger Coolant Return Pipe Replacement**.
17. Install the turbocharger coolant feed pipe. Refer to **Turbocharger Coolant Feed Pipe Replacement**.
18. Install the turbocharger oil feed pipe. Refer to **Turbocharger Oil Feed Pipe Replacement**.
19. Install the turbocharger oil return pipe. Refer to **Turbocharger Oil Return Pipe Replacement**.
20. Install the three way catalytic converter. Refer to **Three-Way Catalytic Converter Replacement (2.0L LHU)**.
21. Install the catalytic converter. Refer to **Catalytic Converter Replacement (2.0L LHU)**.
22. Lower and unsupport the vehicle. Refer to **Lifting and Jacking the Vehicle**.
23. Install the turbocharger heat shield. Refer to **Turbocharger Heat Shield Replacement**.
24. Install the charge air cooler inlet hose - turbocharger side. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)**, **Charge Air Cooler Inlet Hose Replacement (Turbocharger)**.
25. Install the air cleaner outlet rear duct. Refer to **Air Cleaner Outlet Rear Duct Replacement**.
26. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.
27. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.

28. Fill the cooling system. Refer to Cooling System Draining and Filling (2.0L LHU) .

## TURBOCHARGER OIL FEED PIPE REPLACEMENT



**Fig. 52: Oil Feed Pipe, Seal Rings & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

### Turbocharger Oil Feed Pipe Replacement

| Callout                                                                                                                                                                                                                                                                                    | Component Name                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                              |                                                                                                                                     |
| 1. Remove the catalytic converter. Refer to <u>Catalytic Converter Replacement (2.0L LHU)</u> .<br>2. Remove the turbocharger brace. Refer to <u>Turbocharger Brace Replacement</u> .<br>3. Remove the radiator outlet pipe. Refer to <u>Radiator Outlet Pipe Replacement (2.0L LHU)</u> . |                                                                                                                                     |
| 1                                                                                                                                                                                                                                                                                          | Oil Feed Pipe Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>35 N.m (26 lb ft) |
| 2                                                                                                                                                                                                                                                                                          | Oil Feed Pipe                                                                                                                       |
|                                                                                                                                                                                                                                                                                            | Oil Feed Pipe Seal Ring (Qty: 2)                                                                                                    |

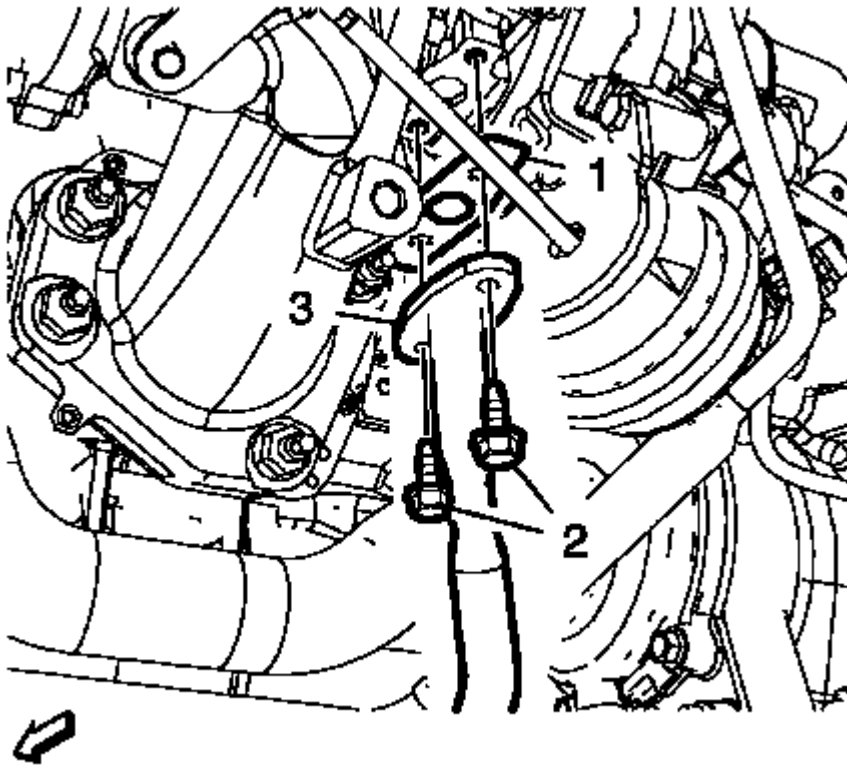
3

**Procedure**

Use a NEW seal ring.

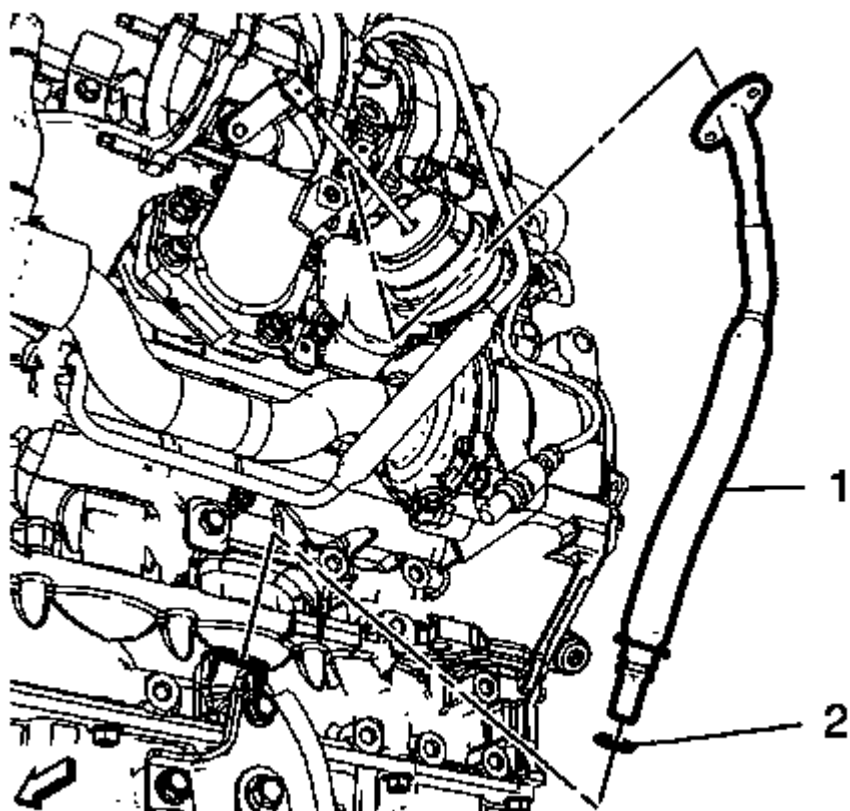
**TURBOCHARGER OIL RETURN PIPE REPLACEMENT****Removal Procedure**

1. Remove the catalytic converter. Refer Catalytic Converter Replacement (2.0L LHU) .



**Fig. 53: Turbocharger Oil Return Pipe, Bolts & Gasket**  
Courtesy of GENERAL MOTORS COMPANY

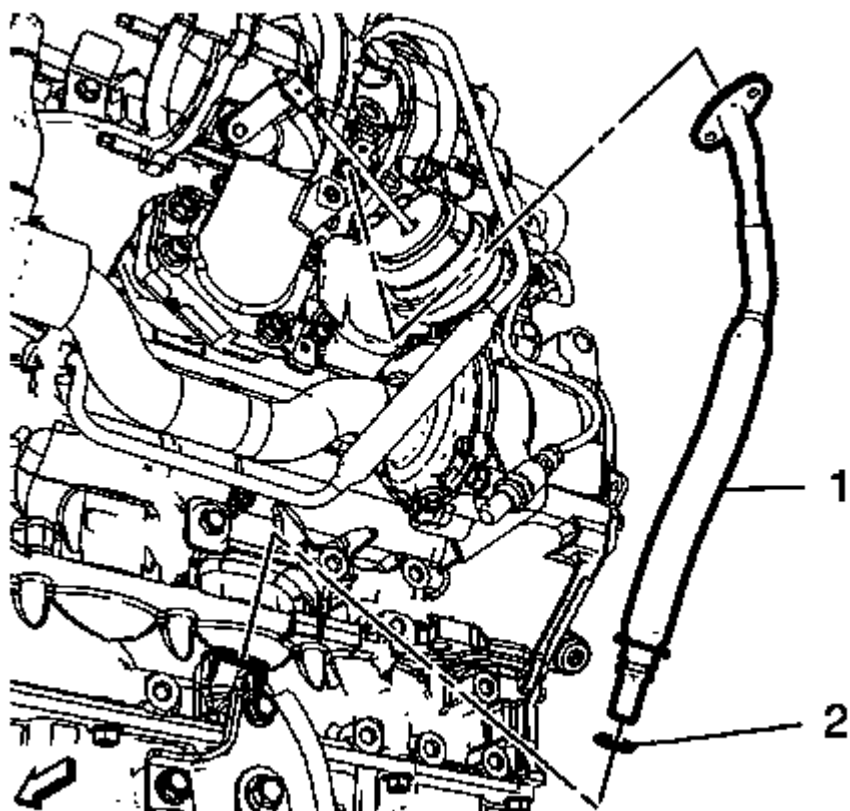
2. Remove the 2 turbocharger oil return pipe bolts (2) and loosen the turbocharger oil return pipe (3).
3. Remove and DISCARD the turbocharger oil return pipe gasket (1).



**Fig. 54: Turbocharger Oil Return Pipe & Seal Ring**  
**Courtesy of GENERAL MOTORS COMPANY**

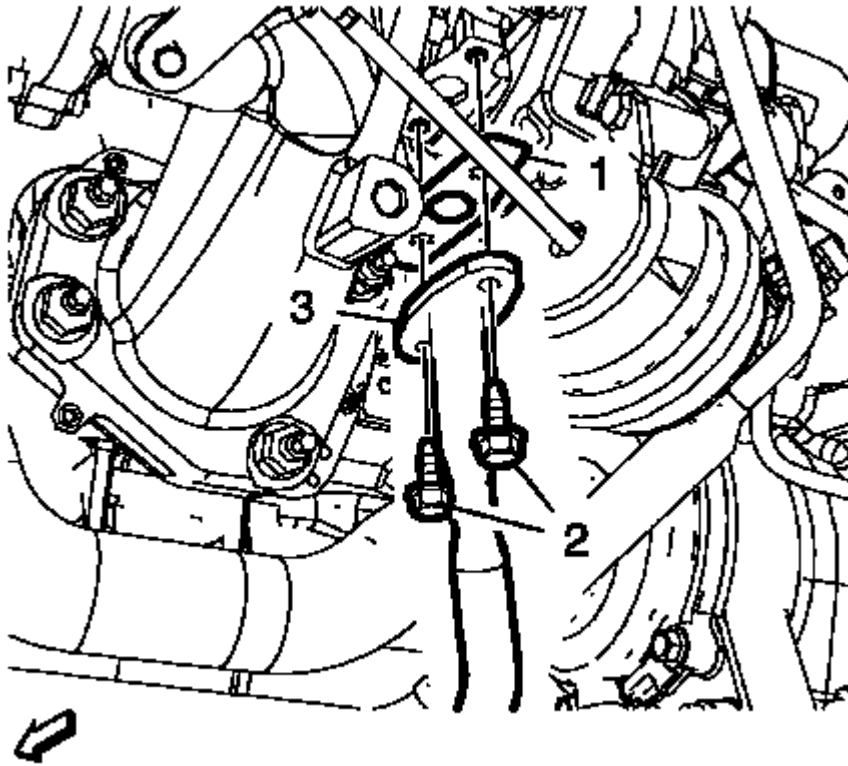
4. Remove the turbocharger oil return pipe (1) from the vehicle.
5. Remove and DISCARD the turbocharger oil return pipe seal ring (2).

#### **Installation Procedure**



**Fig. 55: Turbocharger Oil Return Pipe & Seal Ring**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Install a NEW turbocharger oil return pipe seal ring (2).
2. Install the turbocharger oil return pipe (1) to the vehicle.



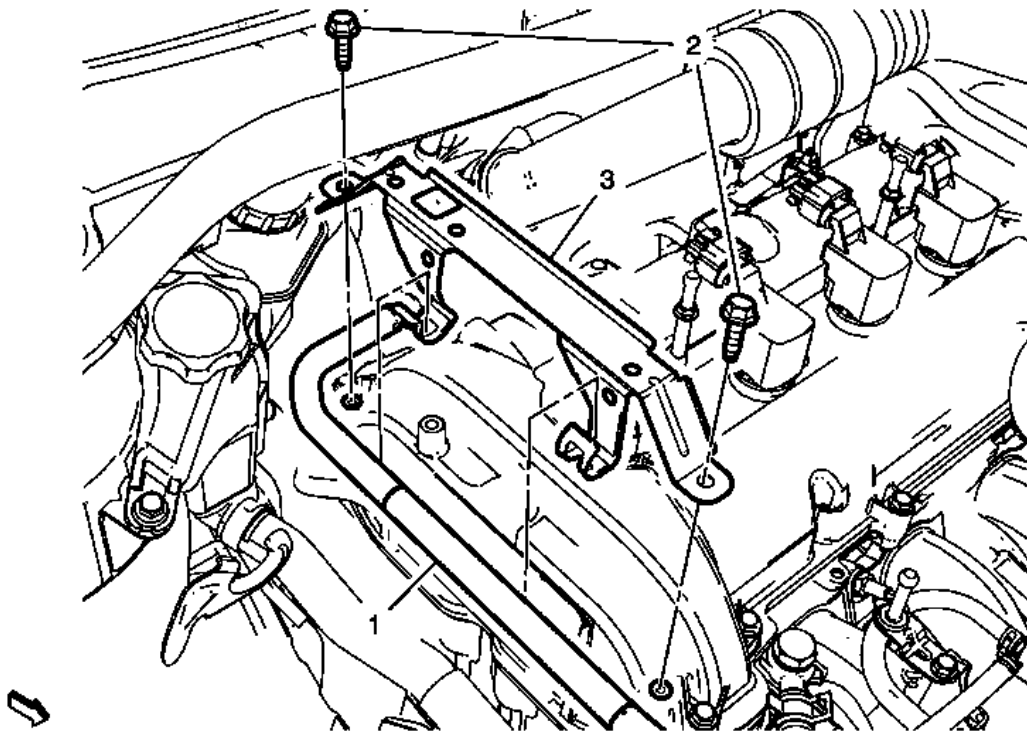
**Fig. 56: Turbocharger Oil Return Pipe, Bolts & Gasket**  
 Courtesy of GENERAL MOTORS COMPANY

3. Install a NEW turbocharger oil return pipe gasket (1).

**CAUTION:** Refer to Fastener Caution .

4. Install the 2 turbocharger oil return pipe bolts (2) and tighten to 10 N.m (89 lb in).
5. Install the catalytic converter. Refer to Catalytic Converter Replacement (2.0L LHU) .

## **TURBOCHARGER COOLANT FEED PIPE BRACKET REPLACEMENT**

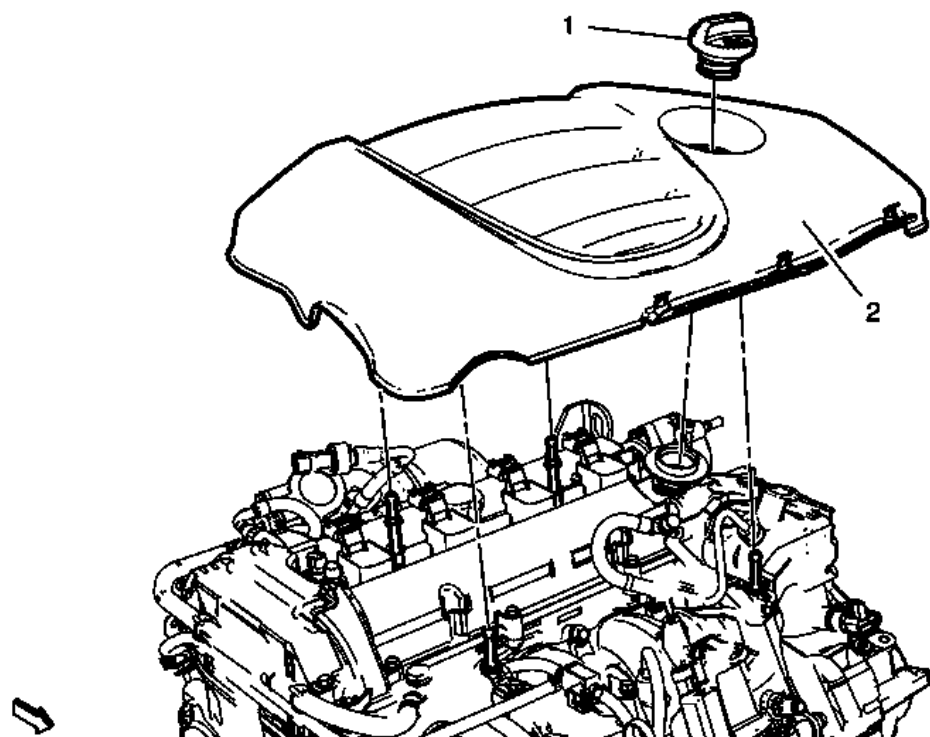


**Fig. 57: Turbocharger Coolant Feed Pipe, Bracket & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

#### Turbocharger Coolant Feed Pipe Bracket Replacement

| Callout                                                                                                                                                                                                                                                                                                                                                                      | Component Name                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                               |
| 1. Remove the engine sight shield. Refer to <a href="#">Engine Sight Shield Replacement</a> .<br>2. Remove the air cleaner outlet duct. Refer to <a href="#">Air Cleaner Outlet Duct Replacement</a> .<br>3. Remove the air cleaner outlet rear duct. Refer to <a href="#">Air Cleaner Outlet Rear Duct Replacement</a> .<br>4. Hang out the turbocharger coolant feed pipe. |                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                            | Turbocharger Coolant Feed Pipe Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>10 N.m (89 lb in) |
| 2                                                                                                                                                                                                                                                                                                                                                                            | Turbocharger Coolant Feed Pipe                                                                                                                                |
| 3                                                                                                                                                                                                                                                                                                                                                                            | Turbocharger Coolant Feed Pipe Bracket                                                                                                                        |

#### ENGINE SIGHT SHIELD REPLACEMENT

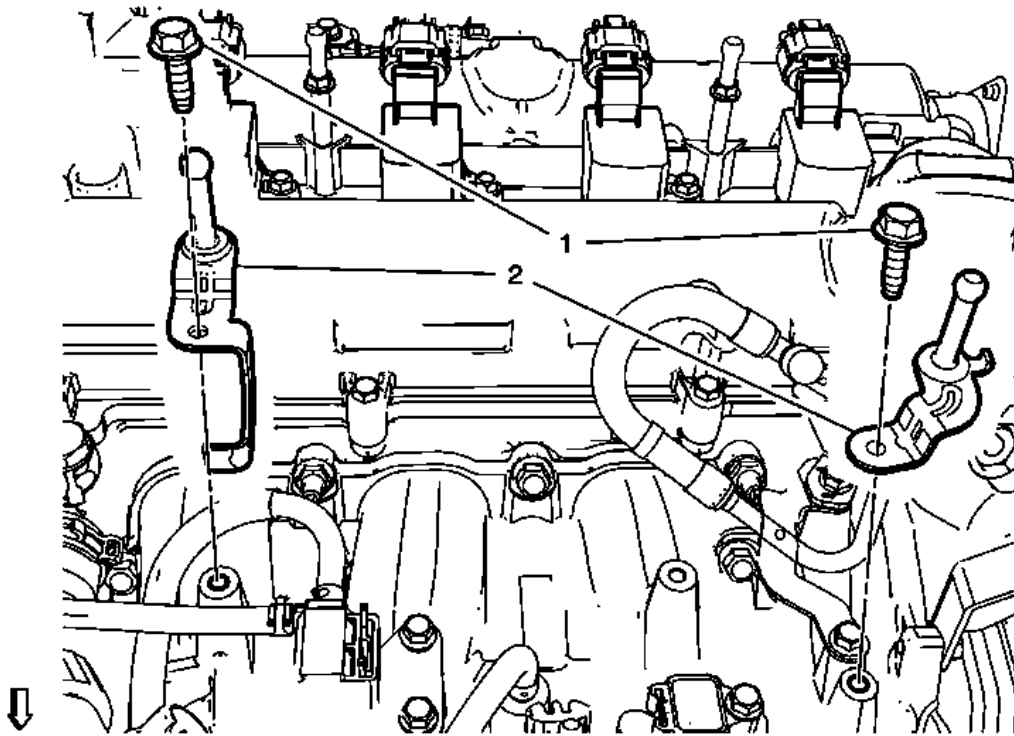


**Fig. 58: Engine Sight Shield & Oil Filler Cap**  
Courtesy of GENERAL MOTORS COMPANY

#### Engine Sight Shield Replacement

| Callout | Component Name        |
|---------|-----------------------|
| 1       | Engine Oil Filler Cap |
| 2       | Engine Sight Shield   |

#### ENGINE SIGHT BRACKET REPLACEMENT



**Fig. 59: Engine Sight Bracket & Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

### Engine Sight Bracket Replacement

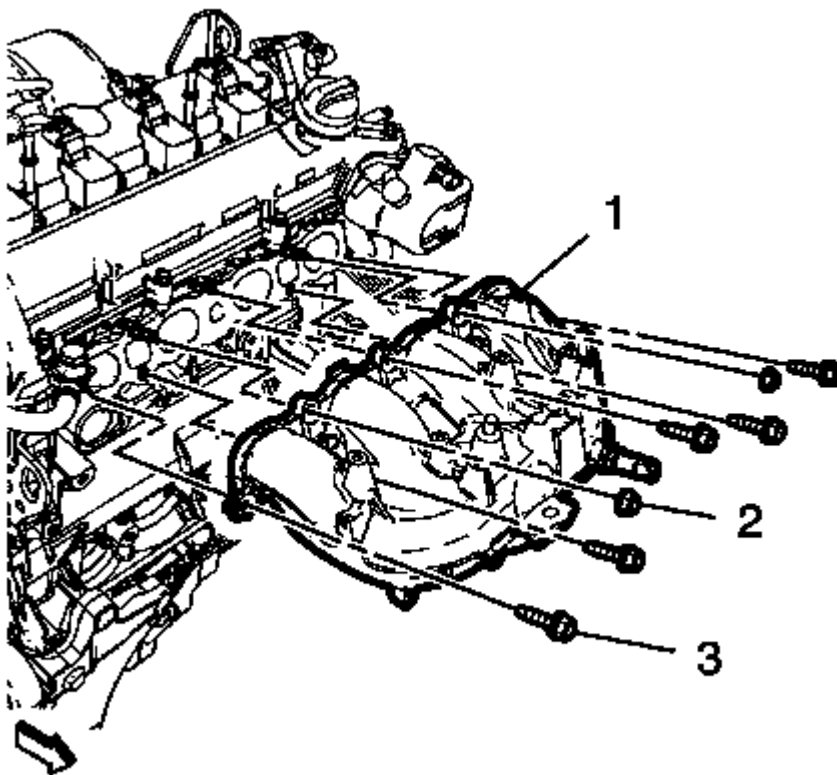
| Callout                                                                           | Component Name                                                                                                                       |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b>                                                      |                                                                                                                                      |
| Remove the engine sight shield. Refer to <b>Engine Sight Shield Replacement</b> . |                                                                                                                                      |
| 1                                                                                 | Engine Sight Shield Bracket Bolt<br><br><b>CAUTION:</b><br>Refer to <b>Fastener Caution</b> .<br><br><b>Tighten</b><br>10 (89 lb in) |
| 2                                                                                 | Engine Sight Shield Bracket                                                                                                          |

### INTAKE MANIFOLD REPLACEMENT

#### Removal Procedure

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement**.
2. Remove the radiator inlet hose from cylinder head. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)** .

3. Remove the evaporative emission canister purge solenoid valve. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .
4. Release the power brake booster vacuum pipe. Refer to **Power Brake Booster Vacuum Pipe Replacement (2.0 LHU - Engine Side)** , **Power Brake Booster Vacuum Pipe Replacement (2.0L LHU - Booster Side)** .
5. Remove the manifold absolute pressure sensor. Refer to **Manifold Absolute Pressure Sensor Replacement** .
6. Remove the turbocharger control solenoid valve. Refer to **Turbocharger Control Solenoid Valve Replacement** .
7. Remove the oil level indicator and tube. Refer to **Oil Level Indicator Tube Replacement**.
8. Release the throttle body assembly. Refer to **Throttle Body Assembly Replacement** .
9. Remove the intake manifold brace. Refer to **Intake Manifold Brace Replacement**.
10. Remove the fuel feed pipe. Refer to **Fuel Feed Pipe Replacement - Engine** .

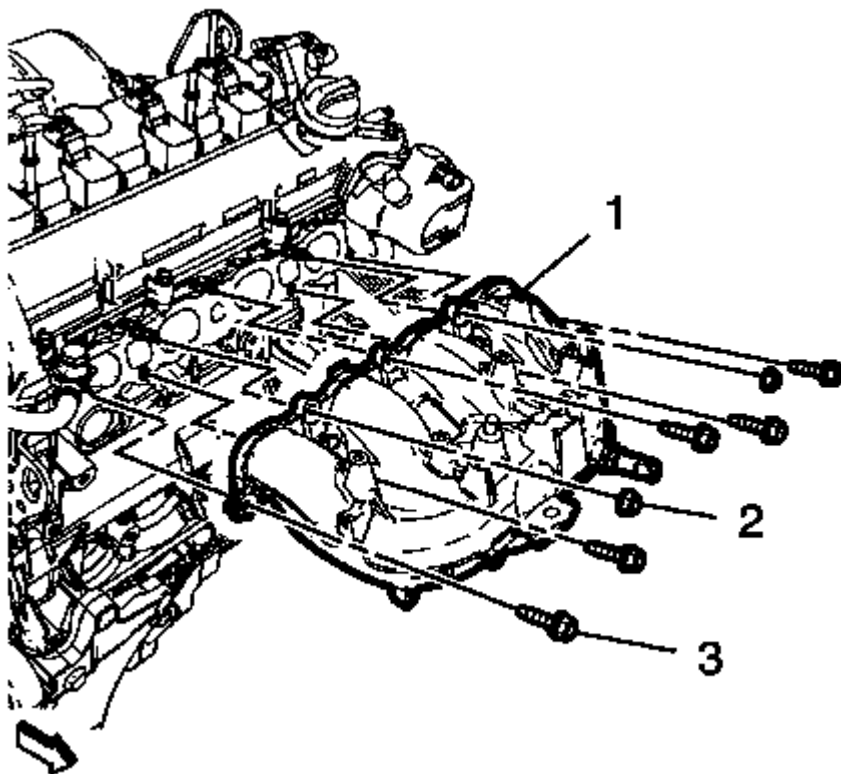


**Fig. 60: Intake Manifold & Mounting Components**

Courtesy of GENERAL MOTORS COMPANY

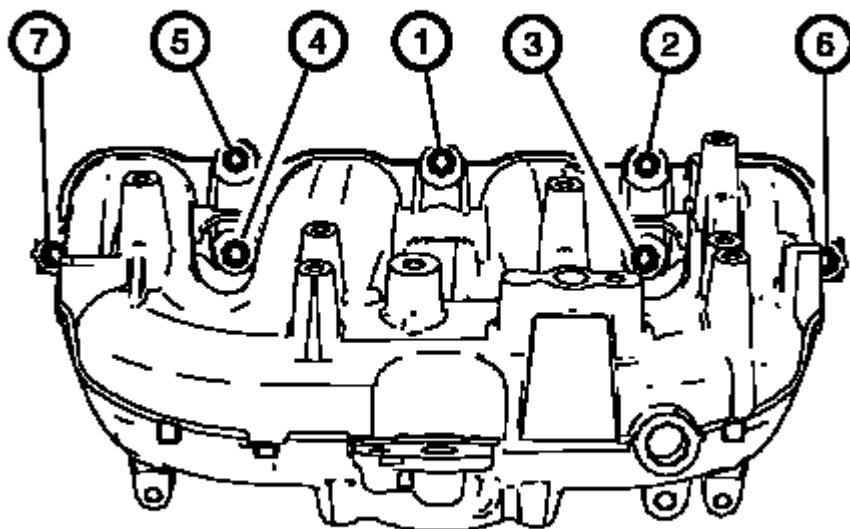
11. Remove the 5 intake manifold bolts (3) and the 2 intake manifold nuts (2) from the intake manifold (1).

#### Installation Procedure



**Fig. 61: Intake Manifold & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

1. Loosely install the 5 intake manifold bolts (3) and the 2 intake manifold nuts (2) to the intake manifold (1).



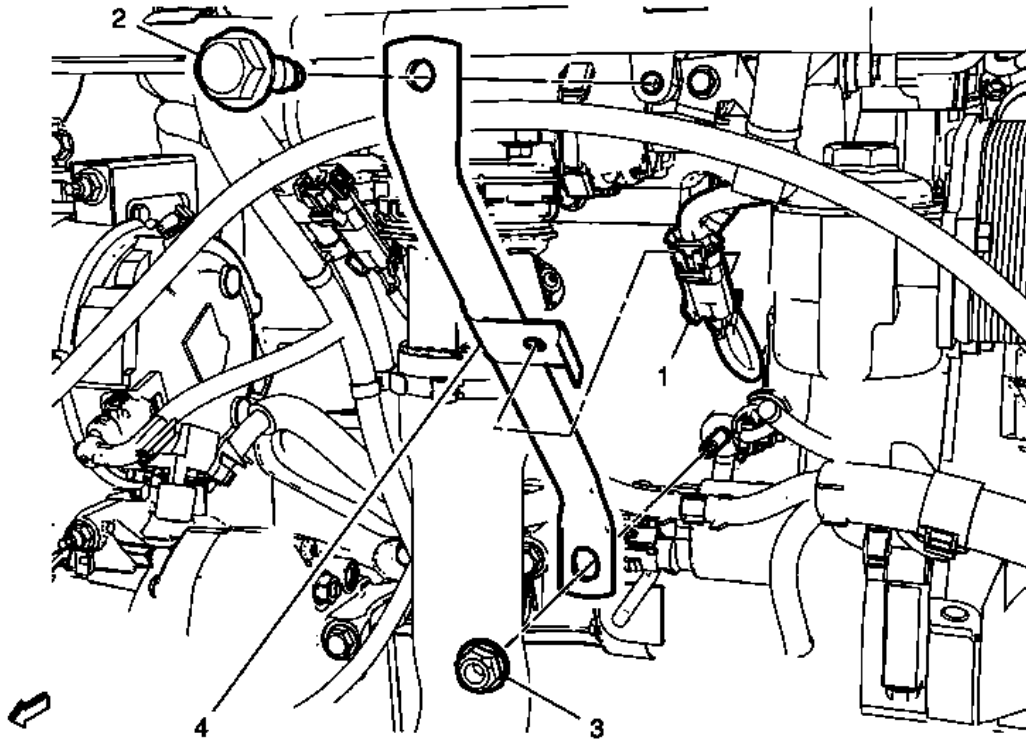
**Fig. 62: Intake Manifold Bolt Tightening Sequence**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

2. Tighten the intake manifold bolts and the nuts in sequence as shown to 25 N.m (18 lb ft).
3. Install the fuel feed pipe. Refer to Fuel Feed Pipe Replacement - Engine .
4. Install the intake manifold brace. Refer to Intake Manifold Brace Replacement.
5. Install the throttle body assembly. Refer to Throttle Body Assembly Replacement .
6. Install the oil level indicator and tube. Refer to Oil Level Indicator Tube Replacement.
7. Install the turbocharger control solenoid valve. Refer to Turbocharger Control Solenoid Valve Replacement .
8. Install the manifold absolute pressure sensor. Refer to Manifold Absolute Pressure Sensor Replacement .
9. Install the power brake booster vacuum pipe. Refer to Power Brake Booster Vacuum Pipe Replacement (2.0 LHU - Engine Side) , Power Brake Booster Vacuum Pipe Replacement (2.0L LHU - Booster Side) .
10. Install the evaporative emission canister purge solenoid valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement .

11. Install the radiator inlet hose to cylinder head. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)** .
12. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.

## INTAKE MANIFOLD BRACE REPLACEMENT



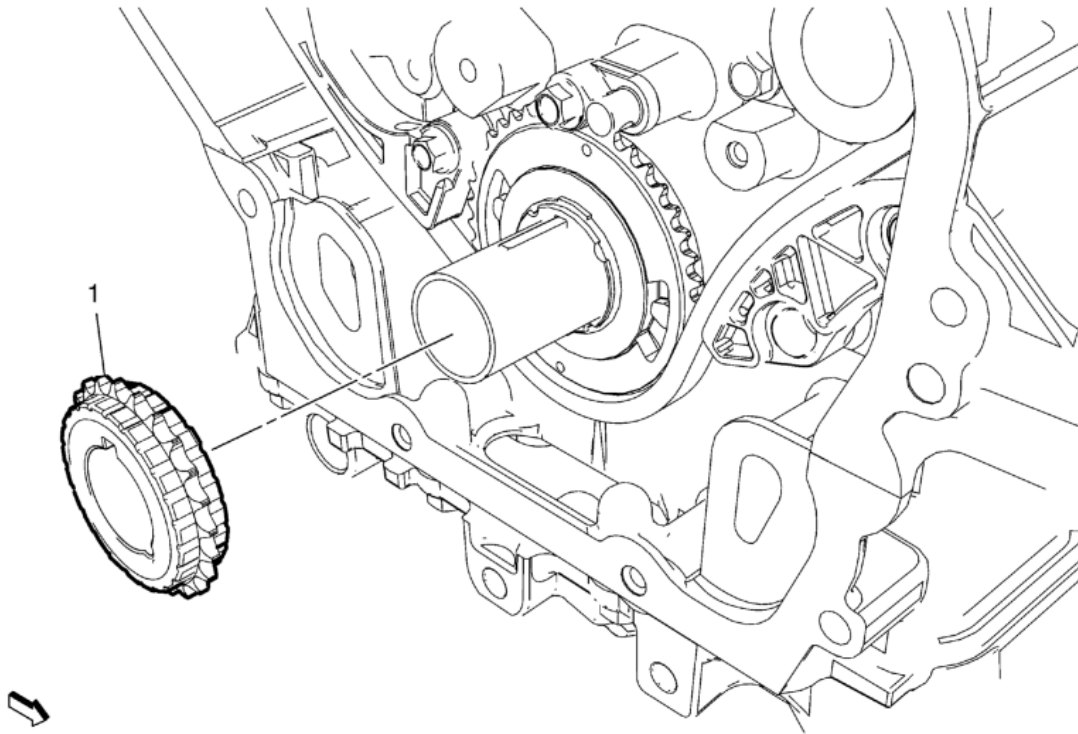
**Fig. 63: Intake Manifold Brace & Mounting Components**  
Courtesy of GENERAL MOTORS COMPANY

### Intake Manifold Brace Replacement

| Callout                                                                                                                                                                                                                                                                        | Component Name                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                  |                                                                                                                                       |
| <ol style="list-style-type: none"><li>1. Remove the engine sight shield. Refer to <b><u>Engine Sight Shield Replacement</u></b>.</li><li>2. Remove the charge air bypass valve vacuum tank. Refer to <b><u>Charge Air Bypass Valve Vacuum Tank Replacement</u></b> .</li></ol> |                                                                                                                                       |
| 1                                                                                                                                                                                                                                                                              | Knock Sensor Wiring Harness Plug                                                                                                      |
| 2                                                                                                                                                                                                                                                                              | Intake Manifold Brace Bolt<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten</b><br>25 (18 lb ft) |

|   |                                                              |
|---|--------------------------------------------------------------|
| 3 | Intake Manifold Brace Nut<br><b>Tighten</b><br>25 (18 lb ft) |
| 4 | Intake Manifold Brace                                        |

## TIMING CHAIN CRANKSHAFT SPROCKET REPLACEMENT



**Fig. 64: Timing Chain Crankshaft Sprocket**  
Courtesy of GENERAL MOTORS COMPANY

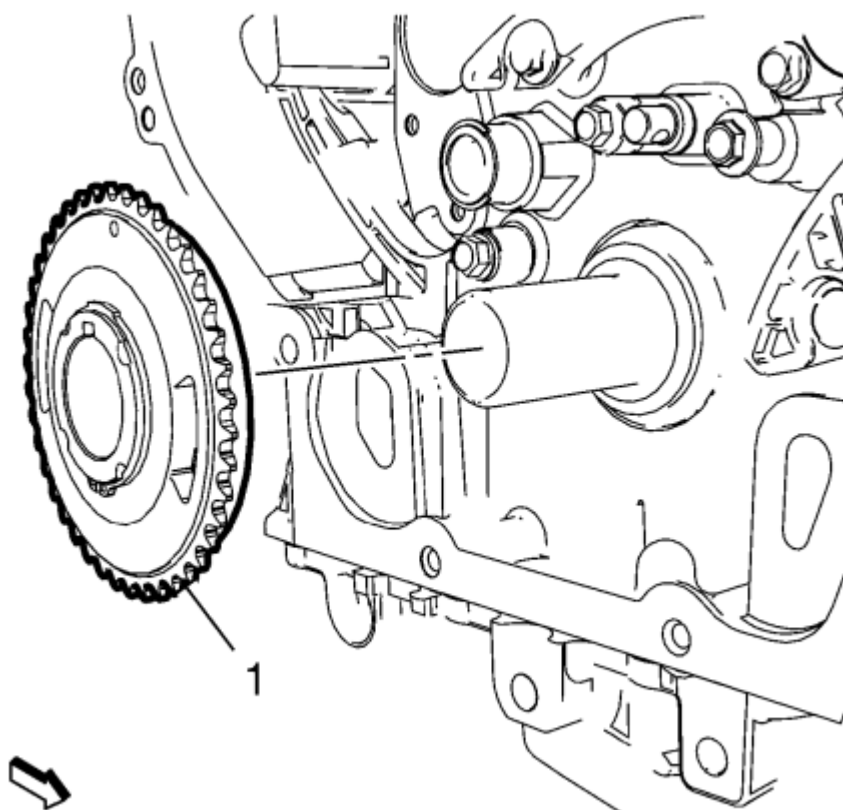
### Timing Chain Crankshaft Sprocket Replacement

| Callout                                                                                                    | Component Name                   |
|------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Preliminary Procedures</b>                                                                              |                                  |
| Remove the timing chain. Refer to <u><b>Camshaft Timing Chain, Sprocket and Tensioner Replacement.</b></u> |                                  |
| 1                                                                                                          | Timing Chain Crankshaft Sprocket |

## WATER PUMP AND BALANCE SHAFT CHAIN CRANKSHAFT SPROCKET REPLACEMENT

### Removal Procedure

1. Remove the water pump and balance shaft timing chain. Refer to **Water Pump and Balance Shaft Chain Replacement.**

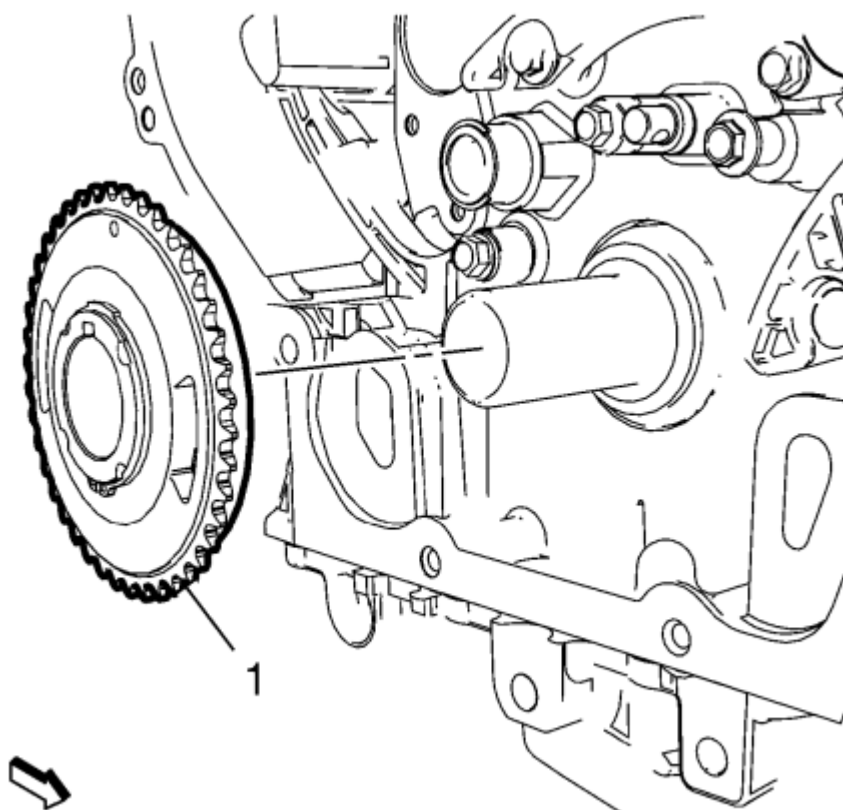


**Fig. 65: Water Pump & Balance Shaft Chain Crankshaft Sprocket**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** The cam is only plugged into the recess and may fall down.

2. Remove the water pump and balance shaft timing chain crankshaft sprocket (1).

#### **Installation Procedure**



**Fig. 66: Water Pump & Balance Shaft Chain Crankshaft Sprocket**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** The cam and the sprocket groove must align.

1. Install the water pump and balance shaft timing chain crankshaft sprocket (1).
2. Check the correct seat of the sprocket. The sprocket must not turn independent of the crankshaft.
3. Install the water pump and balance shaft timing chain. Refer to **Water Pump and Balance Shaft Chain Replacement**.

## CRANKSHAFT BALANCER REPLACEMENT

### Special Tools

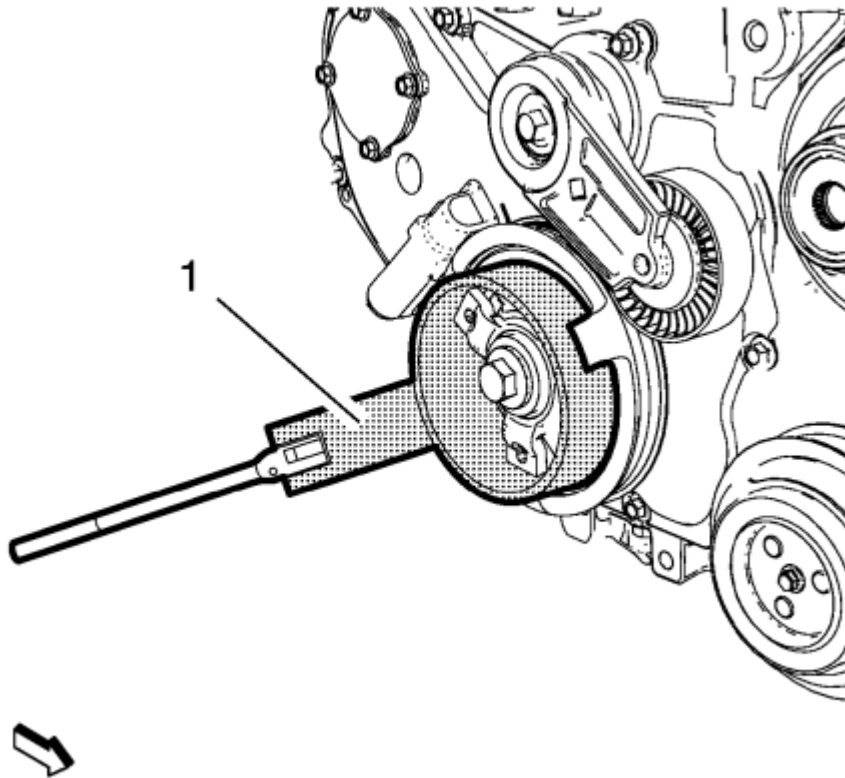
- EN-45059 Angle Meter
- EN-47981 Crankshaft Balancer Holder

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

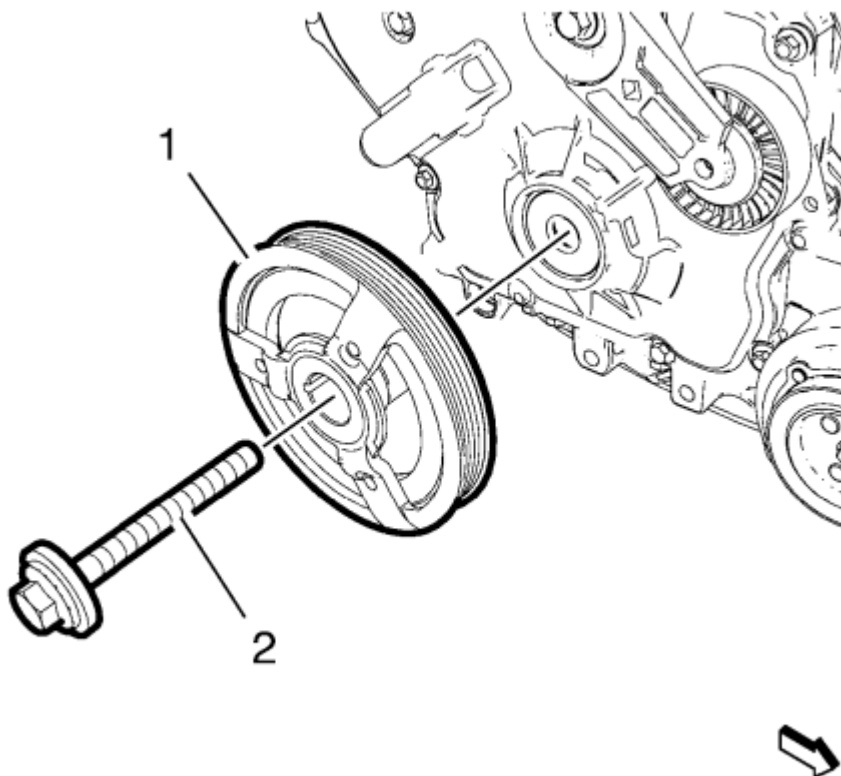
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

2. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** .
3. Remove the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
4. Remove the right front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement** .



**Fig. 67: Crankshaft Balancer Holder**  
**Courtesy of GENERAL MOTORS COMPANY**

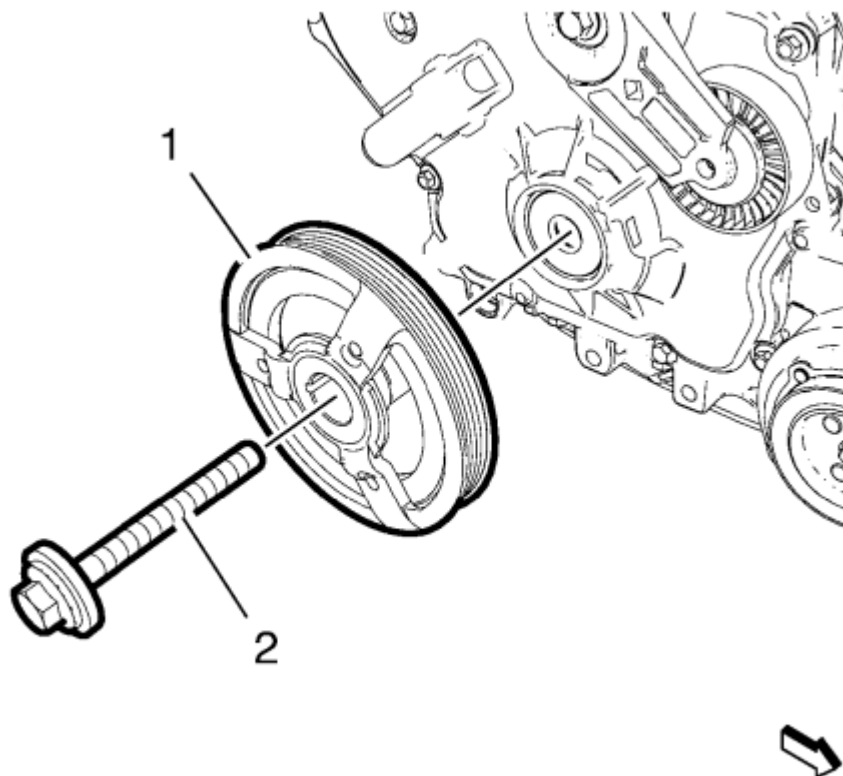
5. Use the **EN-47981** holder (1) to counterhold the crankshaft.



**Fig. 68: Crankshaft Balancer & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

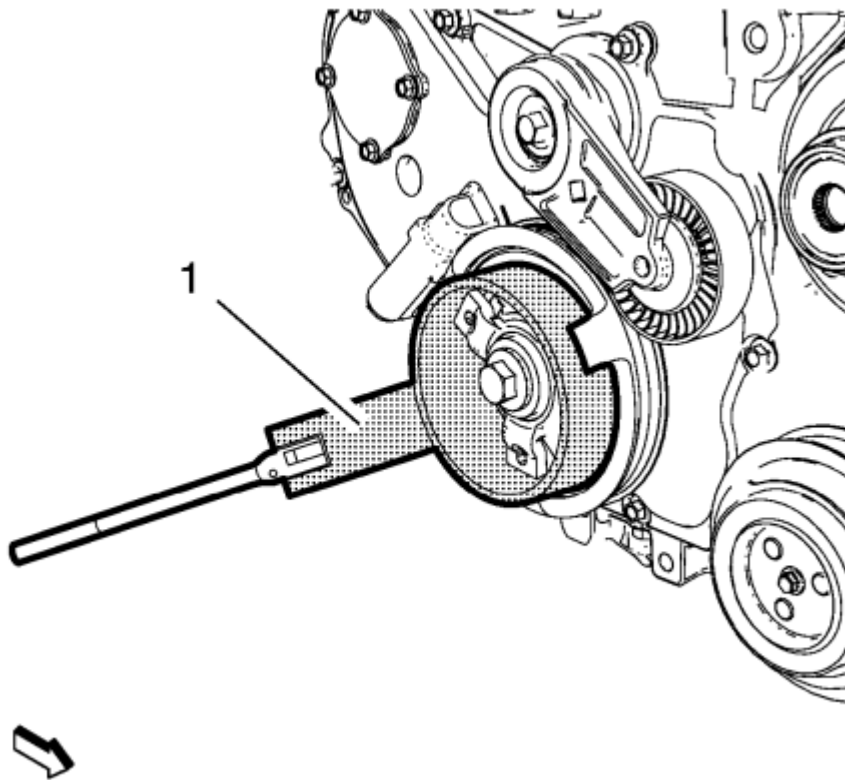
6. Remove and DISCARD the crankshaft balancer bolt (2) while counterholding the crankshaft.
7. Remove the crankshaft balancer (1).

#### Installation Procedure



**Fig. 69: Crankshaft Balancer & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

1. Install the crankshaft balancer (1).
2. Install a NEW crankshaft balancer bolt (2) and handtighten.



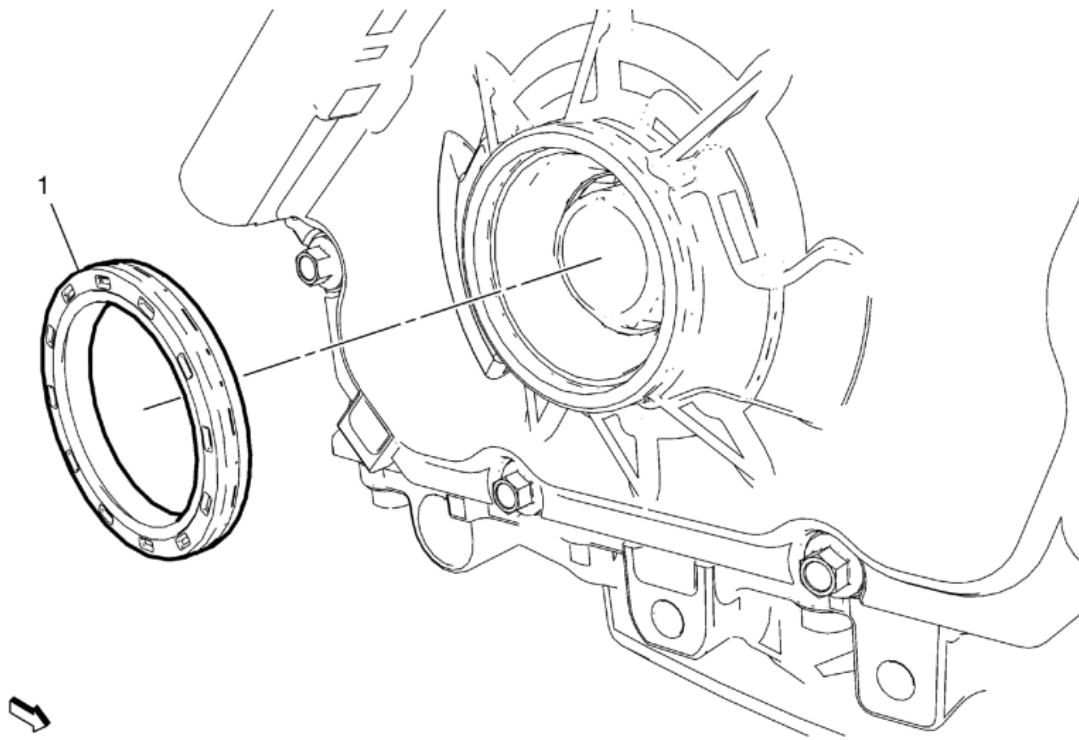
**Fig. 70: Crankshaft Balancer Holder**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Torque-to-Yield Fastener Caution .

**CAUTION:** Refer to Fastener Caution .

3. Tighten the crankshaft balancer bolt a first pass to 150 N.m (111 lb ft), using the **EN-45059** meter. Use the **EN-47981** holder (1) to counterhold the crankshaft.
4. Tighten the crankshaft balancer bolt a final pass to an additional 100 degrees, using the **EN-45059** meter. Use the **EN-47981** holder (1) to counterhold the crankshaft.
5. Install the right front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement** .
6. Install the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
7. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** .
8. Lower and unsupport the vehicle.

## CRANKSHAFT FRONT OIL SEAL REPLACEMENT

**Fig. 71: Crankshaft Front Oil Seal**

Courtesy of GENERAL MOTORS COMPANY

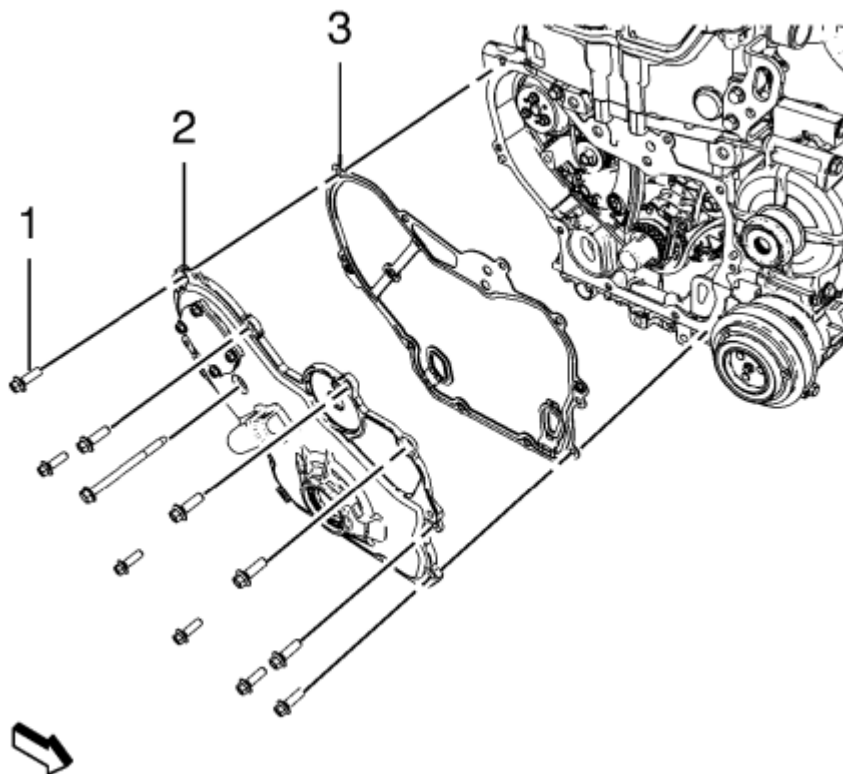
**Crankshaft Front Oil Seal Replacement**

| Callout                                                                                  | Component Name                                                  |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                            |                                                                 |
| Remove the crankshaft balancer. Refer to <b><u>Crankshaft Balancer Replacement</u></b> . |                                                                 |
| <b>Special Tools</b>                                                                     |                                                                 |
| <b>EN-34115</b> Front Crankshaft Seal Installer                                          |                                                                 |
| 1                                                                                        | Crankshaft Front Oil Seal<br>Use the <b>EN-34115</b> installer. |

**ENGINE FRONT COVER REPLACEMENT****Special Tools****EN-47649** Engine Support Fixture.For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .**Removal Procedure**

1. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
2. Set the crankshaft to TDC of combustion stroke 1. cylinder.
3. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

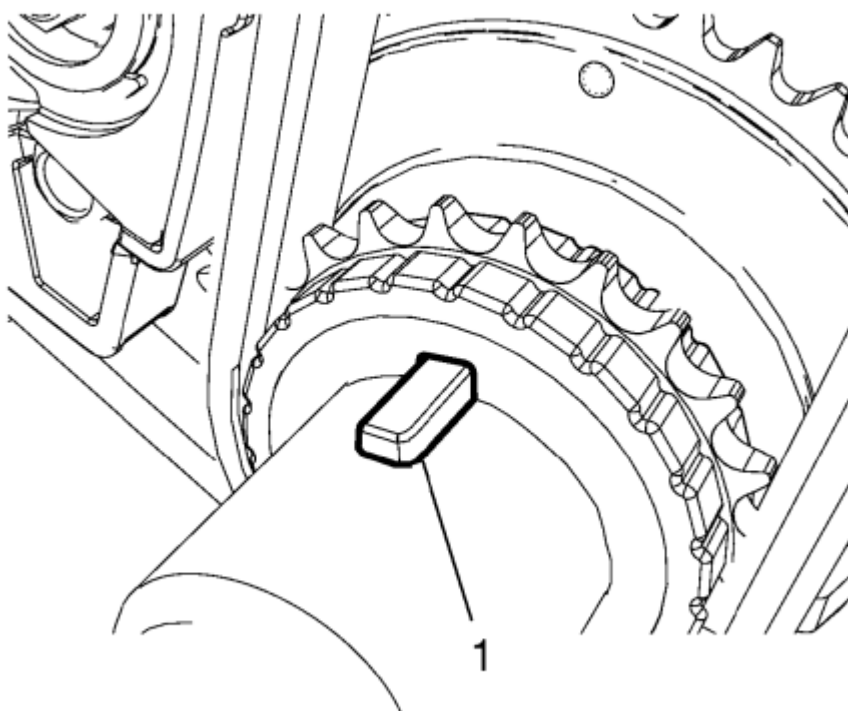
4. Install the **EN-47649** engine support fixture. Refer to **Engine Support Fixture**.
5. Remove the engine mount bracket. Refer to **Engine Mount Bracket Replacement**.
6. Lower the engine as deep as necessary to remove the engine front cover bolts/water pump bolt.



**Fig. 72: Engine Front Cover, Gasket & Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Remove the 11 the engine front cover bolts (1).
8. Remove the engine front cover (2) and the gasket (3).

#### **Installation Procedure**

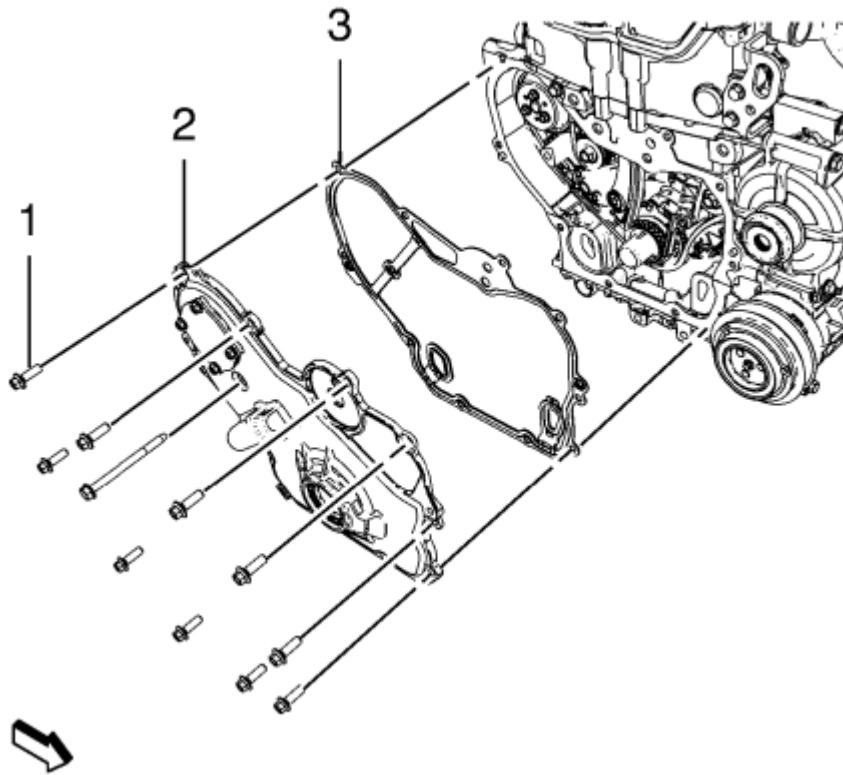


**Fig. 73: Oil Pump Driven Gear Cam**

Courtesy of GENERAL MOTORS COMPANY

**NOTE:** The cam (1) is only plugged into the recess.

1. The cam (1) and the groove in the oil pump driven gear must align. Rotate the oil pump driven gear to match cam and the groove in the oil pump driven gear.
2. Clean the sealing surfaces.



**Fig. 74: Engine Front Cover, Gasket & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

3. Install the engine front cover (2) and a NEW gasket (3).

**CAUTION:** Refer to Fastener Caution .

**NOTE:** Remind the longer water pump bolt.

4. Install the 11 engine front cover bolts (1) and tighten the bolts to 28 N.m (21 lb ft).
5. Install the engine mount bracket. Refer to Engine Mount Bracket Replacement.
6. Remove the **EN-47649** engine support fixture. Refer to Engine Support Fixture.
7. Install the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
8. Install the drive belt tensioner. Refer to Drive Belt Tensioner Replacement.

## CAMSHAFT TIMING CHAIN, SPROCKET AND TENSIONER REPLACEMENT

### Special Tools

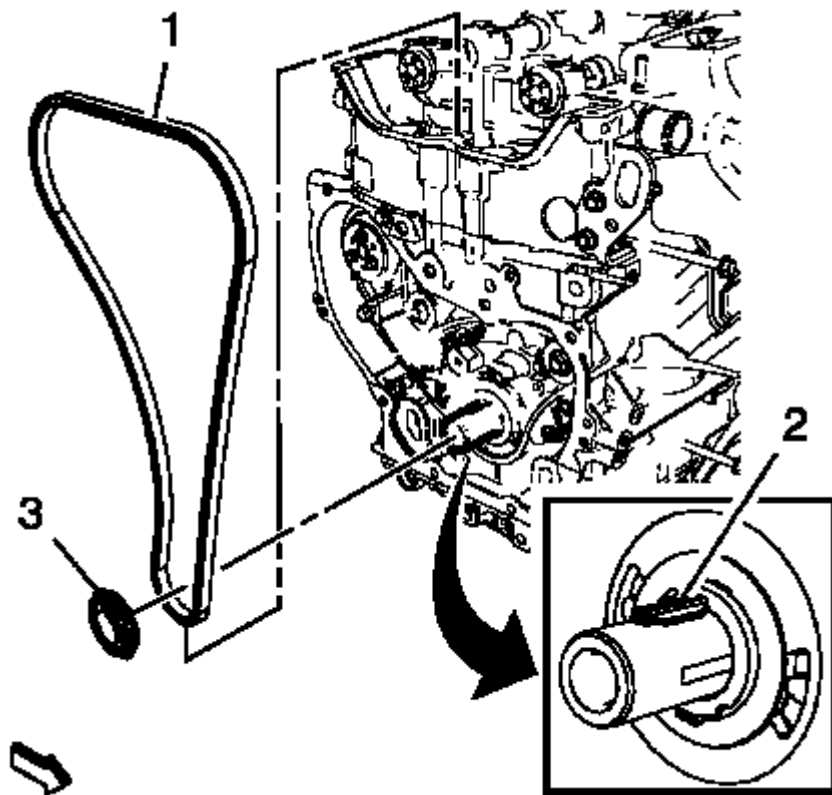
- **EN-45059** Angle Meter

- **EN-48953** Camshaft Actuator Locking Tool

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

#### Removal Procedure

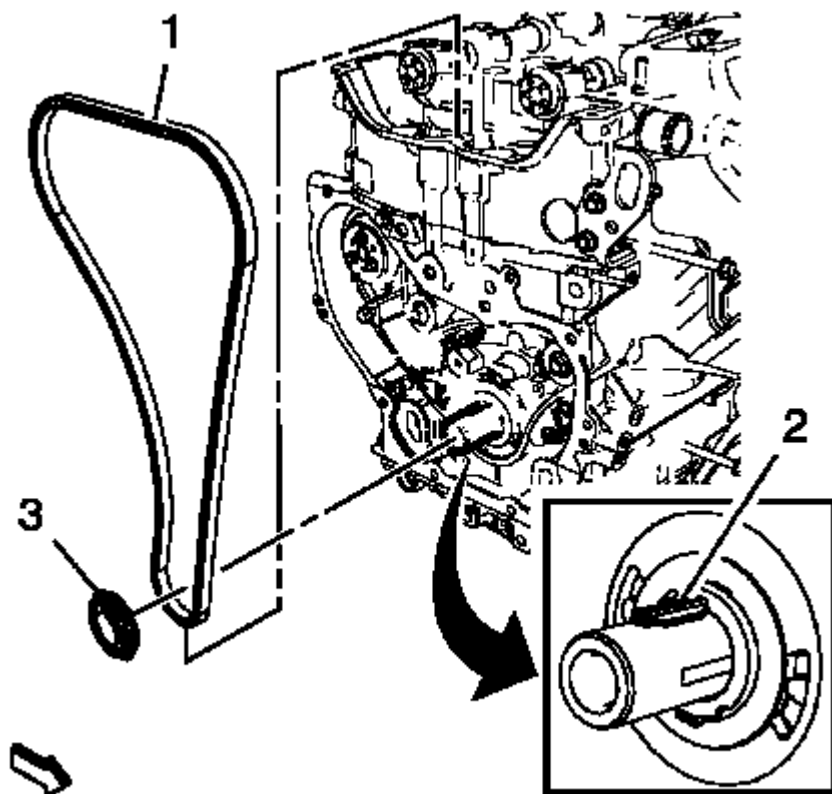
1. Remove the camshaft position exhaust actuator. Refer to **Camshaft Position Exhaust Actuator Replacement**.
2. Remove the camshaft position intake actuator. Refer to **Camshaft Position Intake Actuator Replacement**.
3. Remove the timing adjustable chain guide. Refer to **Adjustable Timing Chain Guide Replacement**.
4. Remove the timing chain guide. Refer to **Timing Chain Guide Replacement**.
5. Remove the timing chain oil nozzle. Refer to **Timing Chain Oil Nozzle Replacement**.



**Fig. 75: Timing Chain, Crankshaft Sprocket & Key**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Mind the crankshaft key (2).

6. Remove the timing chain crankshaft sprocket (2).
7. Remove the timing chain (1) in top direction.

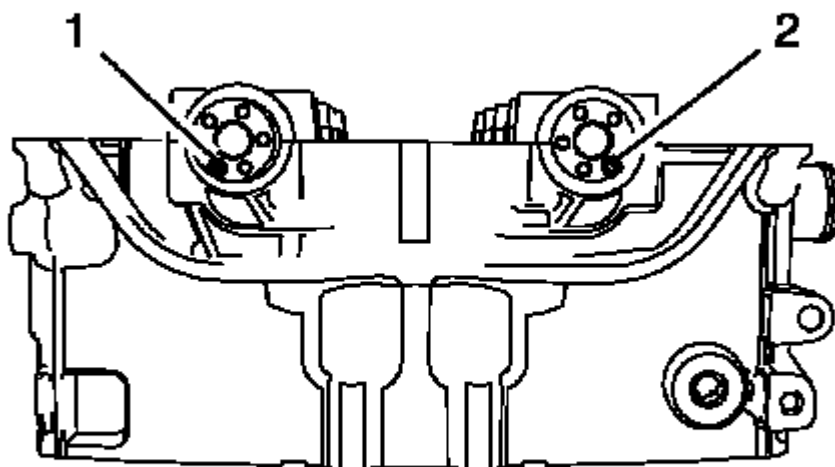
**Installation Procedure**

**Fig. 76: Timing Chain, Crankshaft Sprocket & Key**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the timing chain (1).

**NOTE:** Ensure that the crankshaft sprocket (3) fits into the crankshaft key (2).

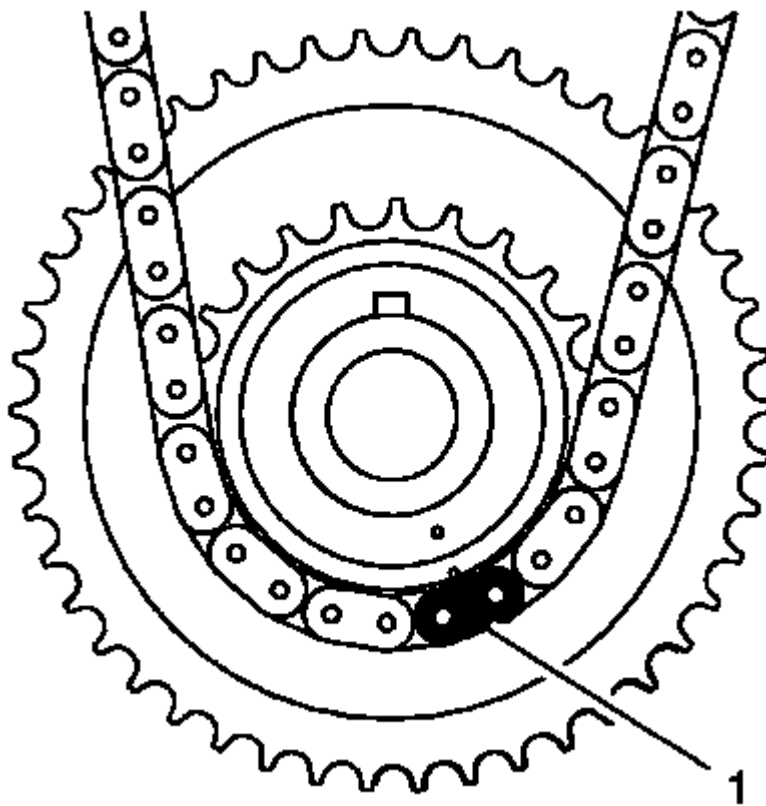
2. Install the crankshaft sprocket (3) to the crankshaft.



**Fig. 77: Camshaft Adjustment Positions**

**Courtesy of GENERAL MOTORS COMPANY**

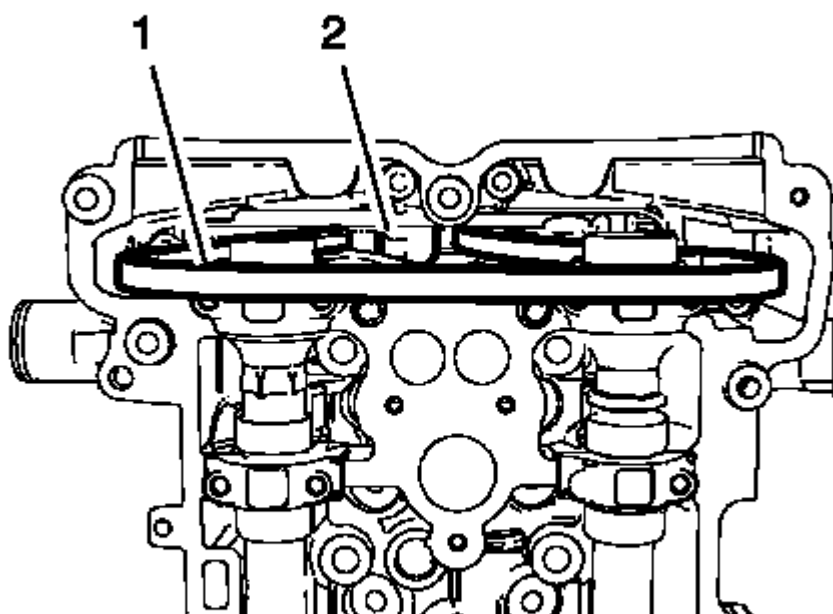
3. Set the exhaust camshaft to the position shown (1).
4. Set the intake camshaft to the position shown (2).
5. Ensure the crankshaft is still adjusted to top dead center (TDC) of the combustion stroke of the cylinder 1, correct if necessary.



**Fig. 78: Identifying Timing Mark**

Courtesy of GENERAL MOTORS COMPANY

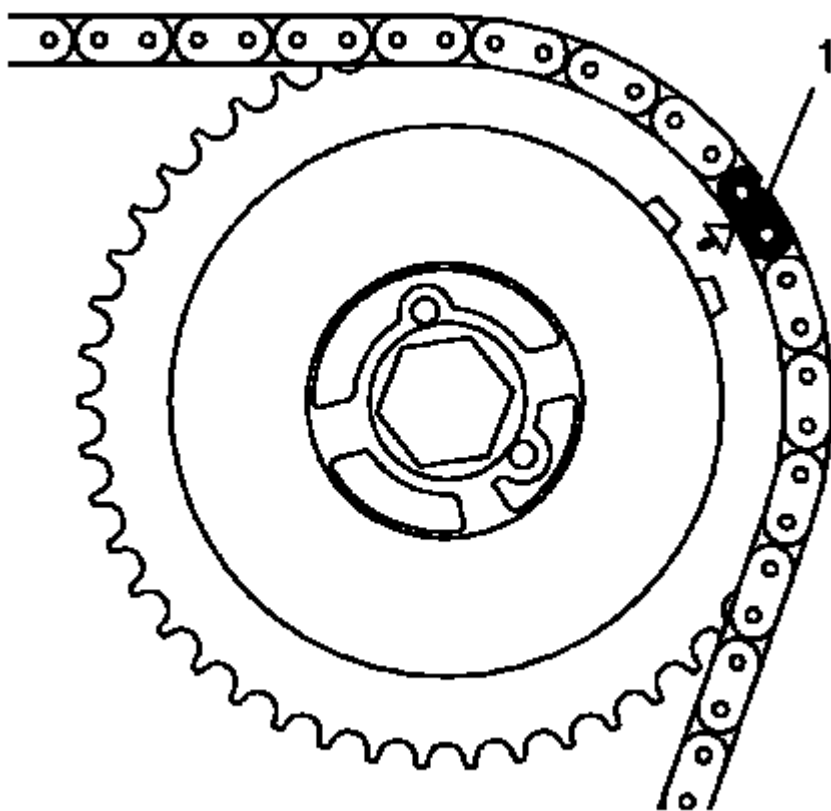
6. Route the timing chain around the crankshaft sprocket and line up the first matching colored link with the timing mark on the crankshaft sprocket, in approximately the 5 o'clock position (1).



**Fig. 79: Timing Chain & Bar**

Courtesy of GENERAL MOTORS COMPANY

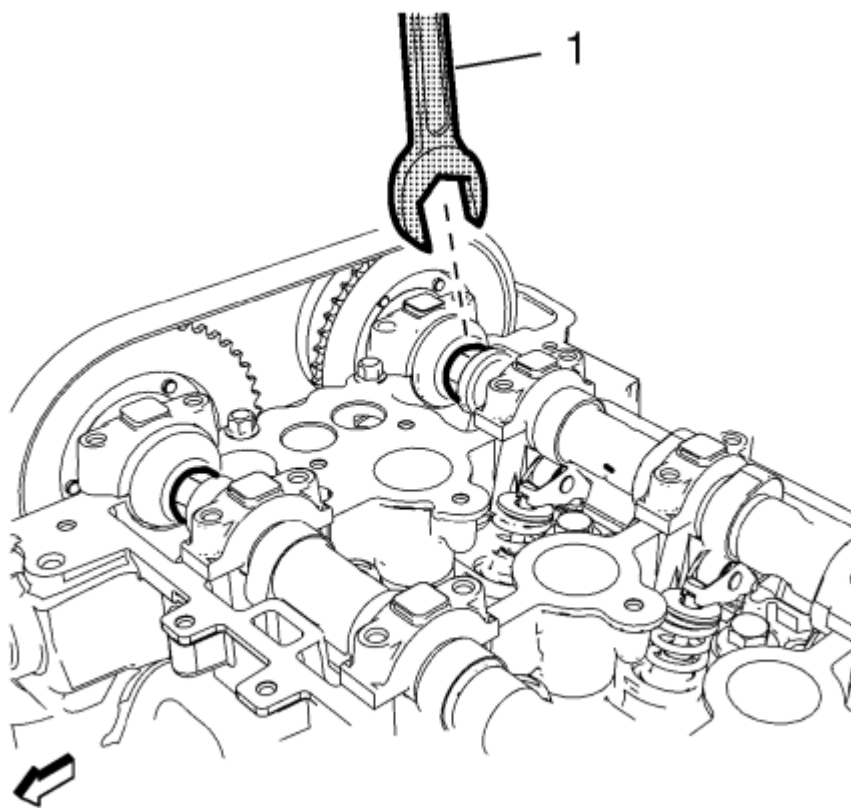
7. Ensure that the bar (2) is in center of the timing chain (1) routing.



**Fig. 80: Camshaft Actuator Mark**

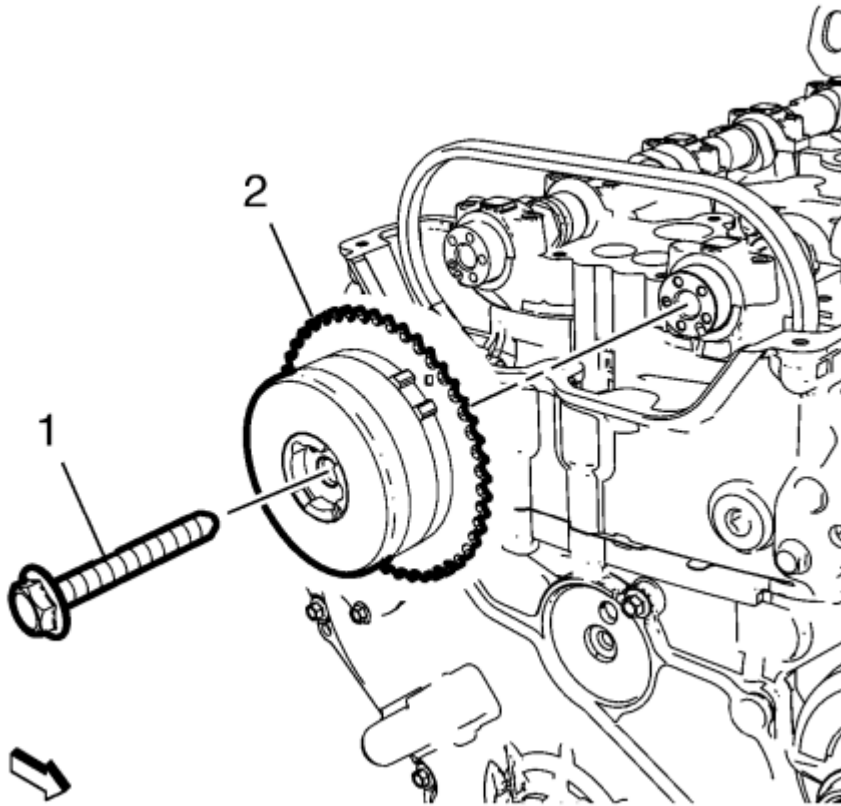
Courtesy of GENERAL MOTORS COMPANY

8. Install the intake camshaft actuator to the camshaft while also installing the actuator at the timing chain. Ensure that the colored link is at the mark on the camshaft actuator (1).



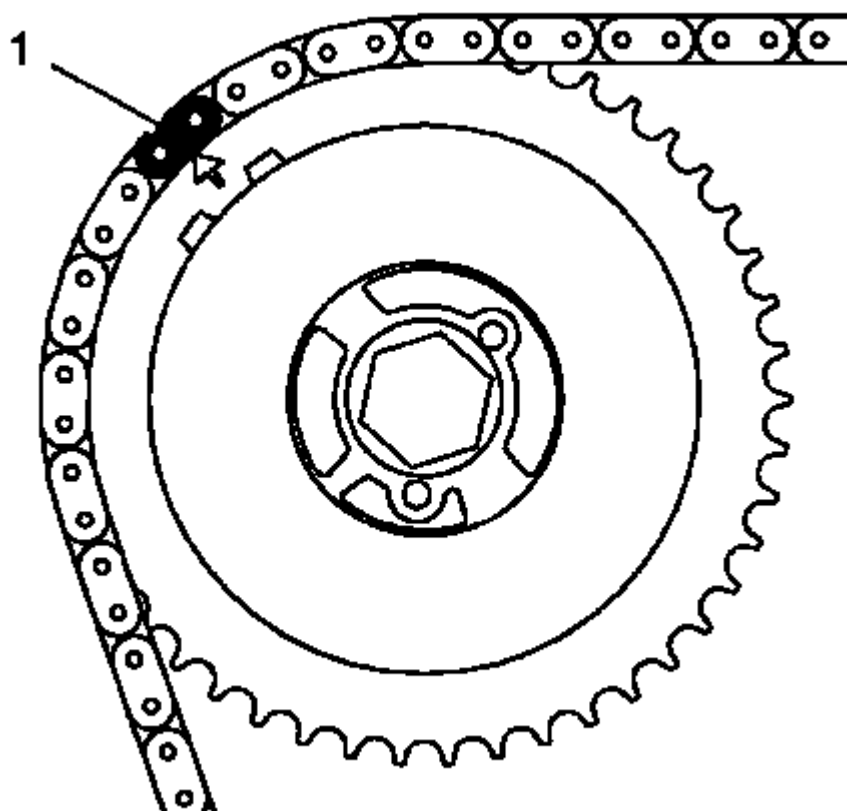
**Fig. 81: Open Ended Wrench & Actuator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

9. Rotate the intake camshaft with an open ended wrench (1) to install the camshaft exhaust actuator on the marked points.



**Fig. 82: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

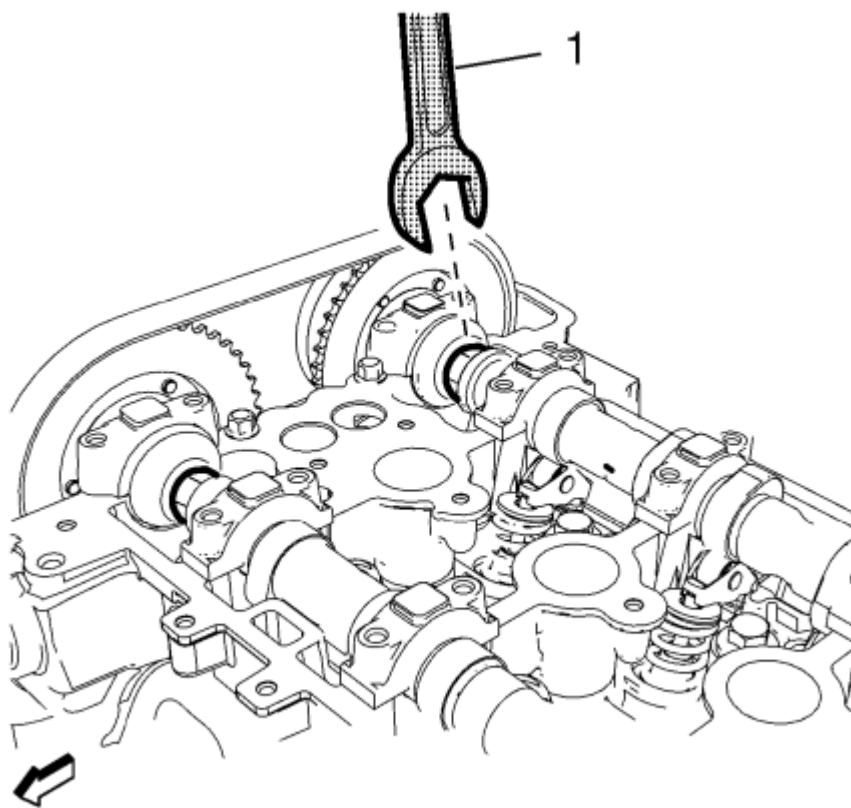
10. Install the NEW intake camshaft actuator bolt (1) to the intake camshaft actuator (2) and hand tighten.
11. Install the timing chain guide. Refer to **Timing Chain Guide Replacement**.
12. Install the adjustable timing chain guide. Refer to **Adjustable Timing Chain Guide Replacement**.



**Fig. 83: Mark On Timing Chain**

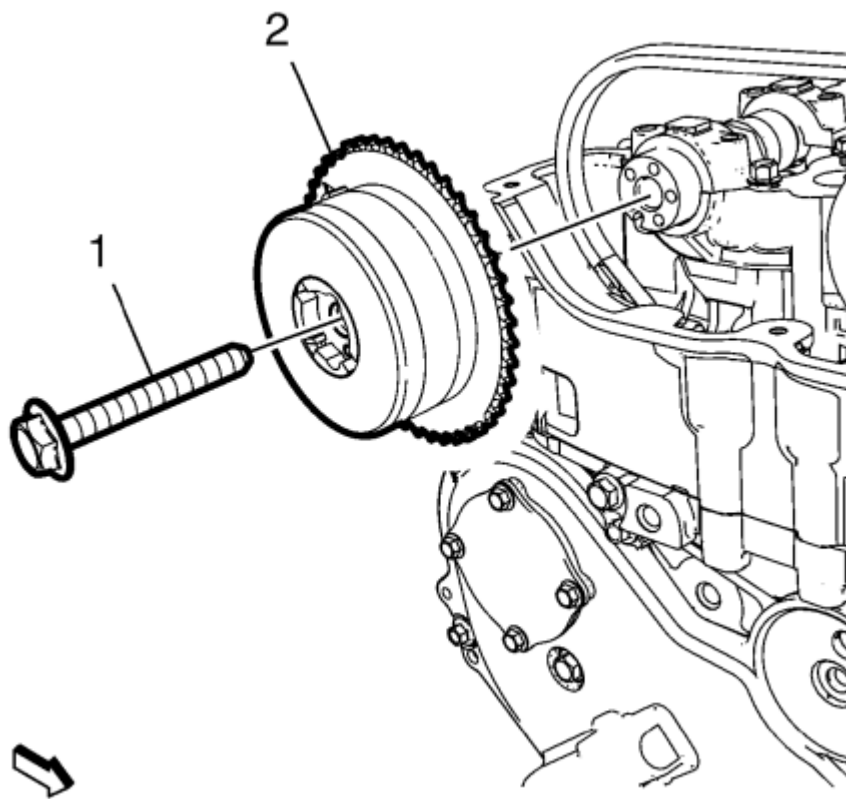
Courtesy of GENERAL MOTORS COMPANY

13. Install the exhaust camshaft actuator to the camshaft while also installing the actuator to the timing chain. Ensure that the colored link is at the mark on the camshaft actuator (1).



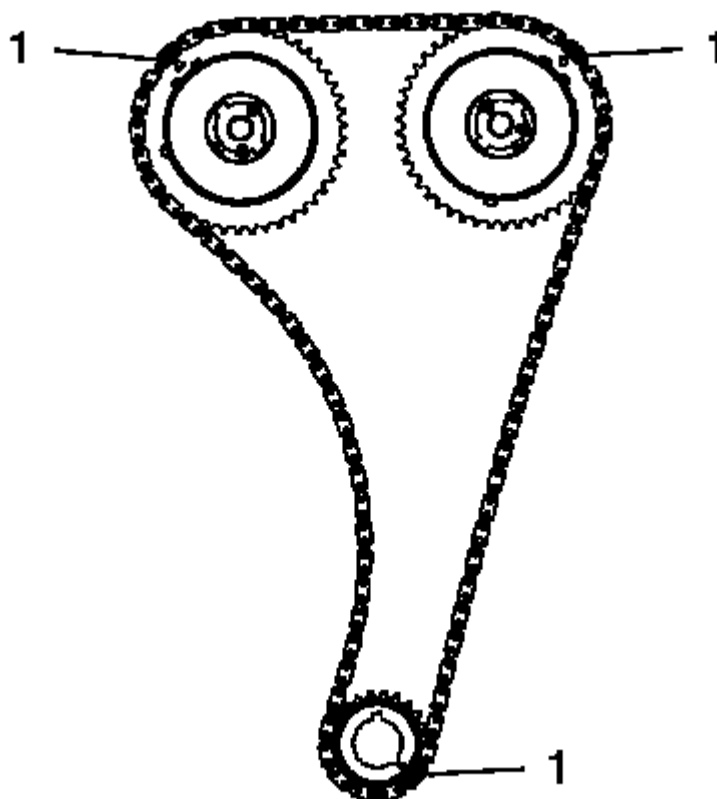
**Fig. 84: Open Ended Wrench & Actuator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

14. Rotate the exhaust camshaft with an open ended wrench (1) to install the camshaft exhaust actuator on the marked points.



**Fig. 85: Camshaft Position Exhaust Actuator & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

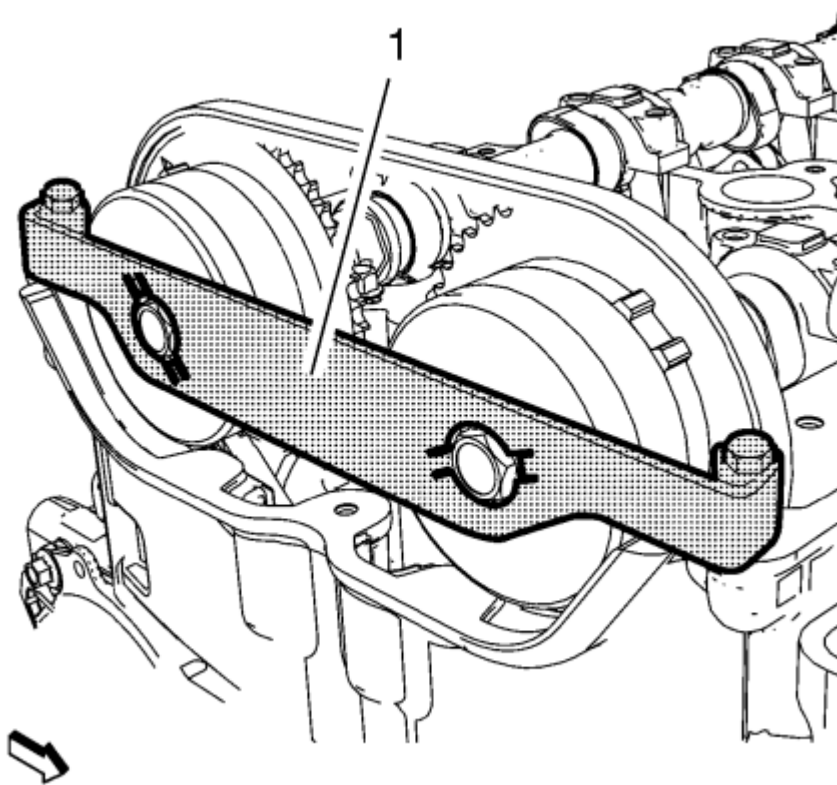
15. Install the NEW exhaust camshaft actuator bolt (1) to the exhaust camshaft actuator (2) and hand tighten.
16. Install the timing chain oil nozzle. Refer to **Timing Chain Oil Nozzle Replacement**.



**Fig. 86: Locating Timing Chain Marks**

Courtesy of GENERAL MOTORS COMPANY

17. Ensure again that the marks are on the points as shown (1).



**Fig. 87: Crankshaft Locking Tool**

Courtesy of GENERAL MOTORS COMPANY

18. Install the **EN-48953** locking tool (1) to the camshafts.
19. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).

**CAUTION: Refer to Fastener Caution .**

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

20. Tighten the exhaust camshaft actuator bolt a first pass to 30 N.m (22 lb ft).
21. Tighten the exhaust camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

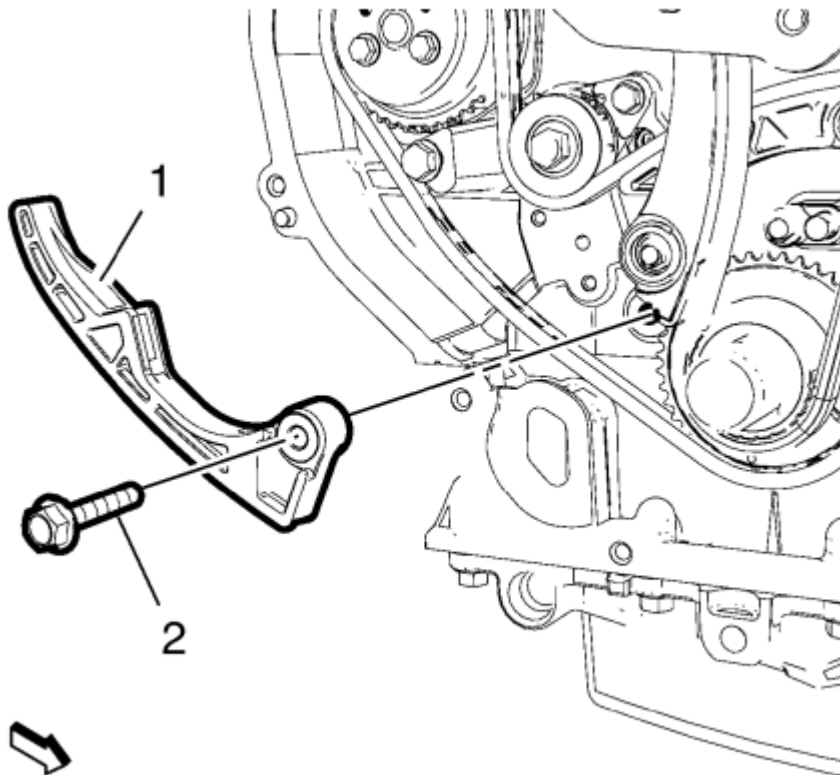
22. Tighten the intake camshaft actuator bolt a first pass to 30 N.m (22 lb ft).

23. Tighten the intake camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.
24. Remove the **EN-48953** locking tool.
25. Rotate the crankshaft clockwise at the crankshaft balancer bolt to 720 degrees and ensure that the marks are still fit. If the marks are not fit repeat complete repair procedure.
26. Install the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
27. Install the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
28. Install the 4 spark plugs. Refer to **Spark Plug Replacement** .
29. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

## BALANCER CHAIN ADJUST GUIDE REPLACEMENT

### Removal Procedure

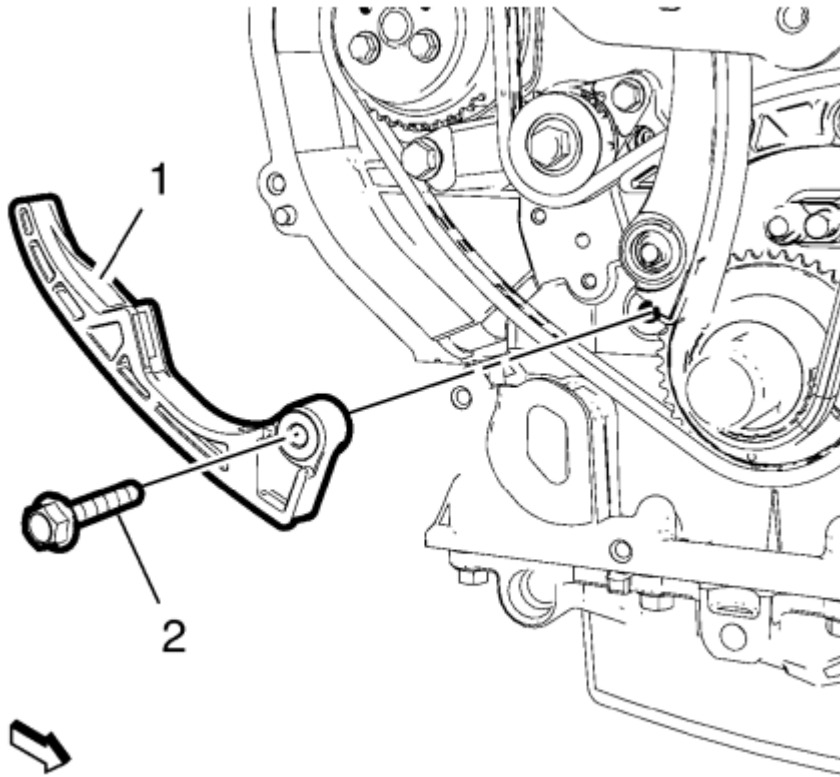
1. Remove the water pump and balance shaft chain tensioner. Refer to **Water Pump and Balance Shaft Chain Tensioner Replacement**.



**Fig. 88: Balancer Chain Adjust Guide & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the balancer chain guide bolt (2) and the balancer chain guide (1).

## Installation Procedure



**Fig. 89: Balancer Chain Adjust Guide & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

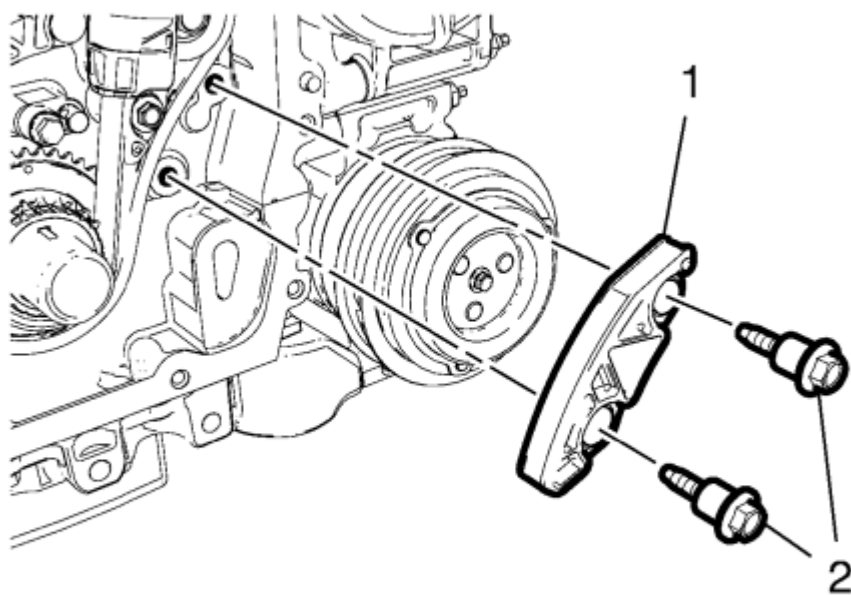
**CAUTION:** Refer to Fastener Caution .

1. Install the balancer chain guide (1) and the balancer chain guide bolt (2) and tighten to 12 N.m (106 lb in).
2. Install the water pump and balance shaft chain tensioner. Refer to Water Pump and Balance Shaft Chain Tensioner Replacement.

## BALANCER CHAIN GUIDE REPLACEMENT - LOWER

### Removal Procedure

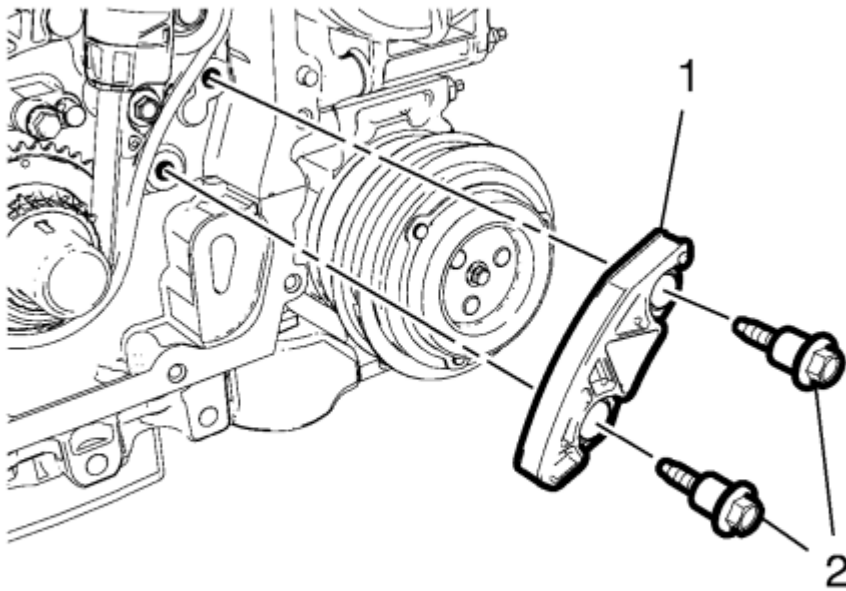
1. Remove the water pump and balance shaft chain tensioner. Refer to Water Pump and Balance Shaft Chain Tensioner Replacement.



**Fig. 90: Balancer Chain Guide & Bolts - Lower**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the balancer chain guide bolt (2) and the balancer chain guide (1).

#### **Installation Procedure**



**Fig. 91: Balancer Chain Guide & Bolts - Lower**  
 Courtesy of GENERAL MOTORS COMPANY

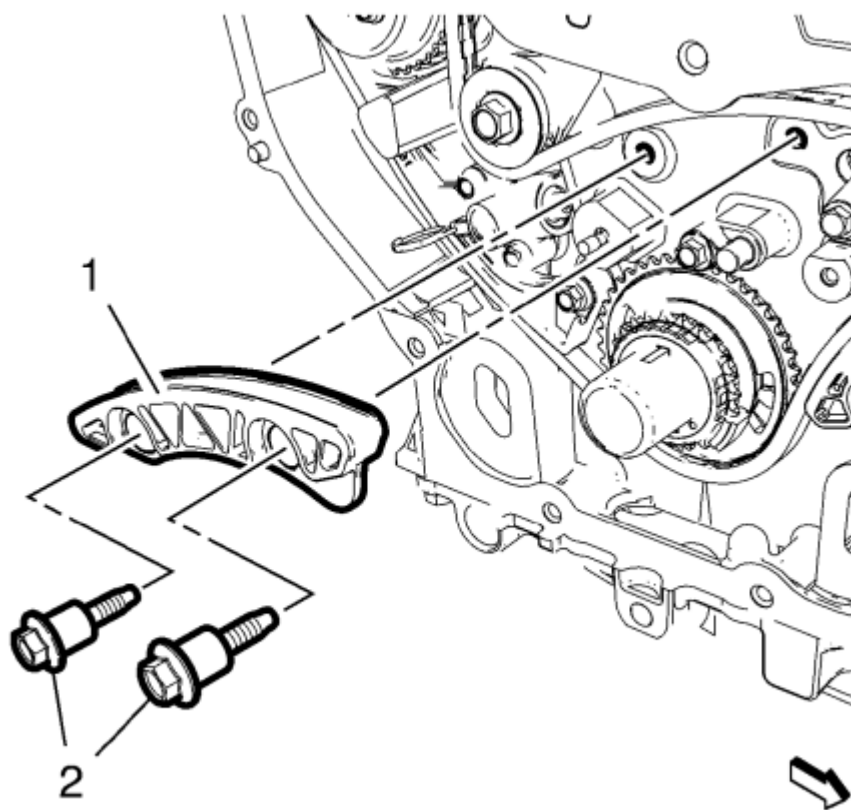
**CAUTION:** Refer to Fastener Caution .

1. Install the balancer chain guide (1) and the balancer chain guide bolt (2) and tighten to 12 N.m (106 lb in).
2. Install the water pump and balance shaft chain tensioner. Refer to Water Pump and Balance Shaft Chain Tensioner Replacement.

## BALANCER CHAIN GUIDE REPLACEMENT - UPPER

### Removal Procedure

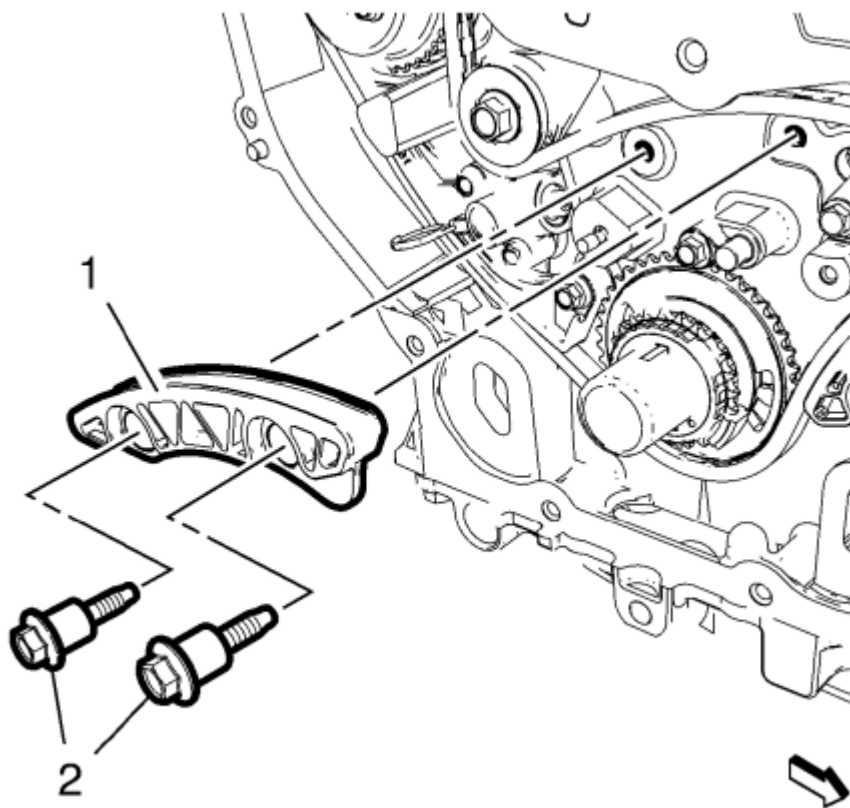
1. Remove the water pump and balance shaft chain. Refer to Water Pump and Balance Shaft Chain Replacement.



**Fig. 92: Balancer Chain Guide & Bolts - Upper**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 2 balancer chain guide bolts (2) and the balancer chain guide - upper (1).

#### **Installation Procedure**



**Fig. 93: Balancer Chain Guide & Bolts - Upper**  
 Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

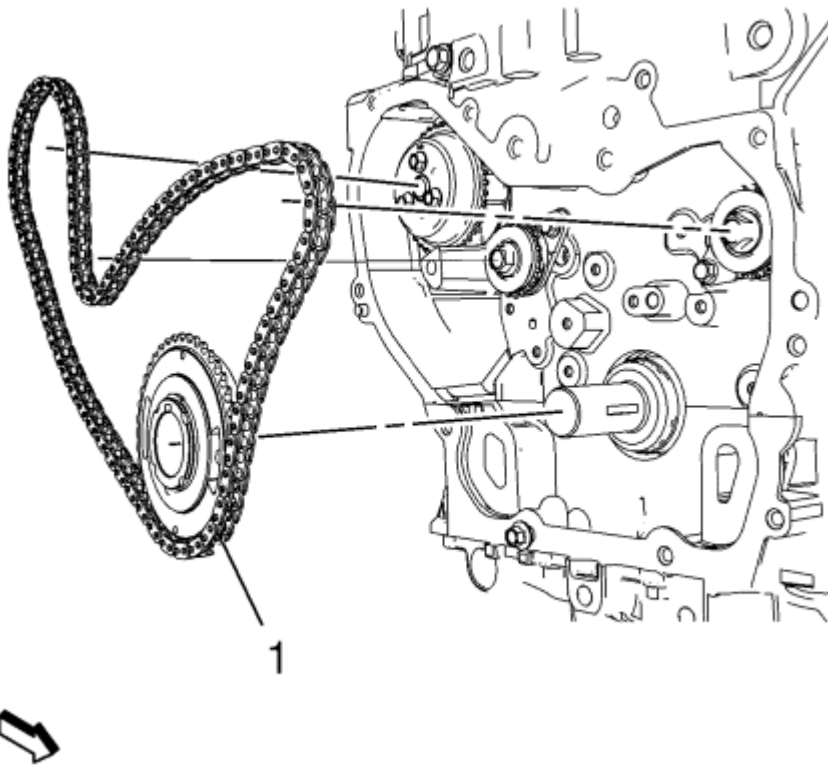
1. Install the balancer chain guide - upper (1) and the 2 balancer chain guide bolt (2) and tighten to 12 N.m (106 lb in).
2. Install the water pump and balance shaft chain. Refer to Water Pump and Balance Shaft Chain Replacement.

## WATER PUMP AND BALANCE SHAFT CHAIN REPLACEMENT

### Removal Procedure

1. Remove the camshaft timing chain. Refer to Camshaft Timing Chain, Sprocket and Tensioner Replacement.
2. Remove the water pump and balance shaft timing chain tensioner. Refer to Water Pump and Balance Shaft Chain Tensioner Replacement.
3. Remove the water pump and balance shaft timing chain guide - upper. Refer to Balancer Chain Guide Replacement - Upper.

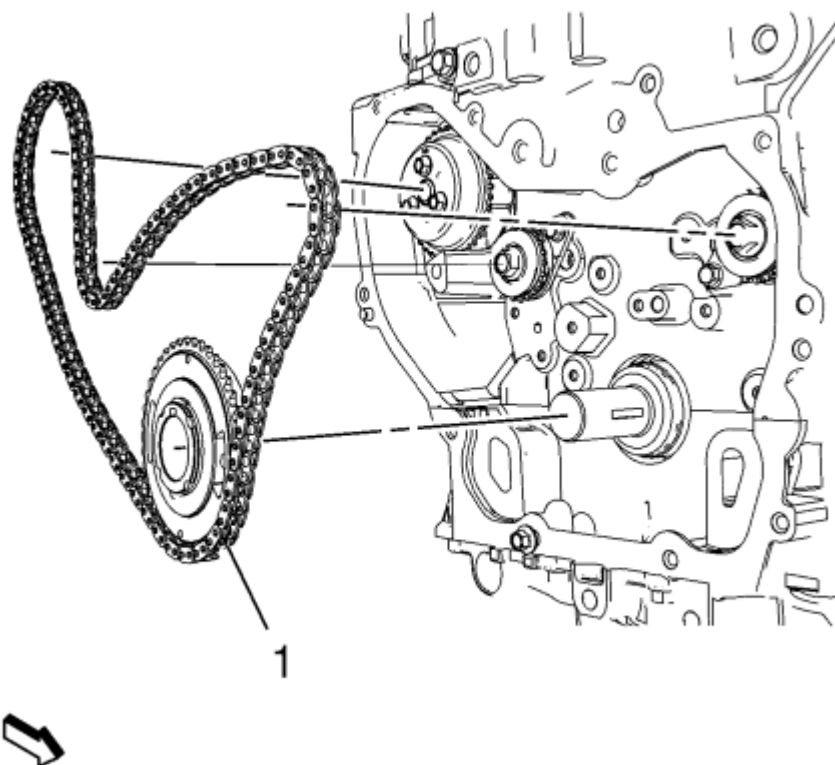
4. Remove the water pump and balance shaft timing chain guide - lower. Refer to **Balancer Chain Guide Replacement - Lower**.
5. Remove the water pump and balance shaft timing chain adjustable guide. Refer to **Balancer Chain Adjust Guide Replacement**.



**Fig. 94: Water Pump/Balance Shaft Chain & Sprocket**  
Courtesy of GENERAL MOTORS COMPANY

6. Remove the water pump and balance shaft timing chain with the sprocket (1).

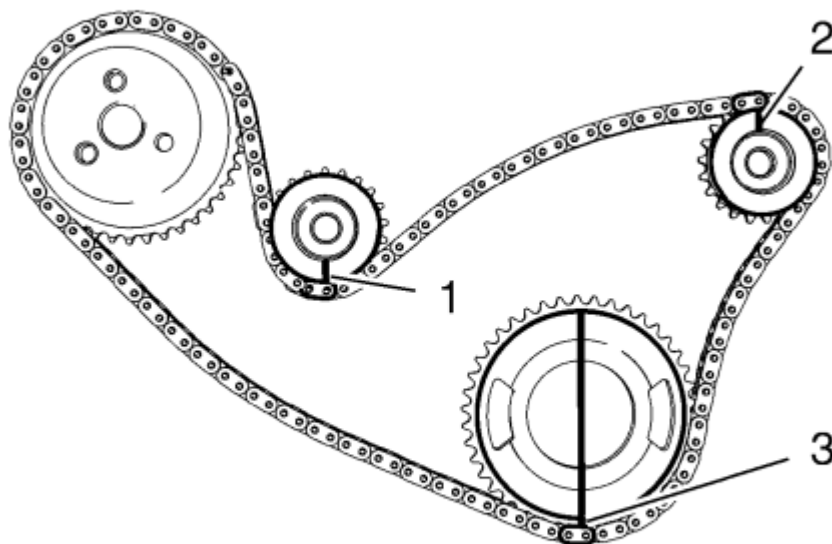
#### **Installation Procedure**



**Fig. 95: Water Pump/Balance Shaft Chain & Sprocket**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Ensure that the crankshaft is still on TDC combustion stroke of 1 cylinder.

1. Install the water pump and balance shaft timing chain crankshaft sprocket. Refer to **Water Pump and Balance Shaft Chain Crankshaft Sprocket Replacement**.

**Fig. 96: Sprocket Timing Marks**

Courtesy of GENERAL MOTORS COMPANY

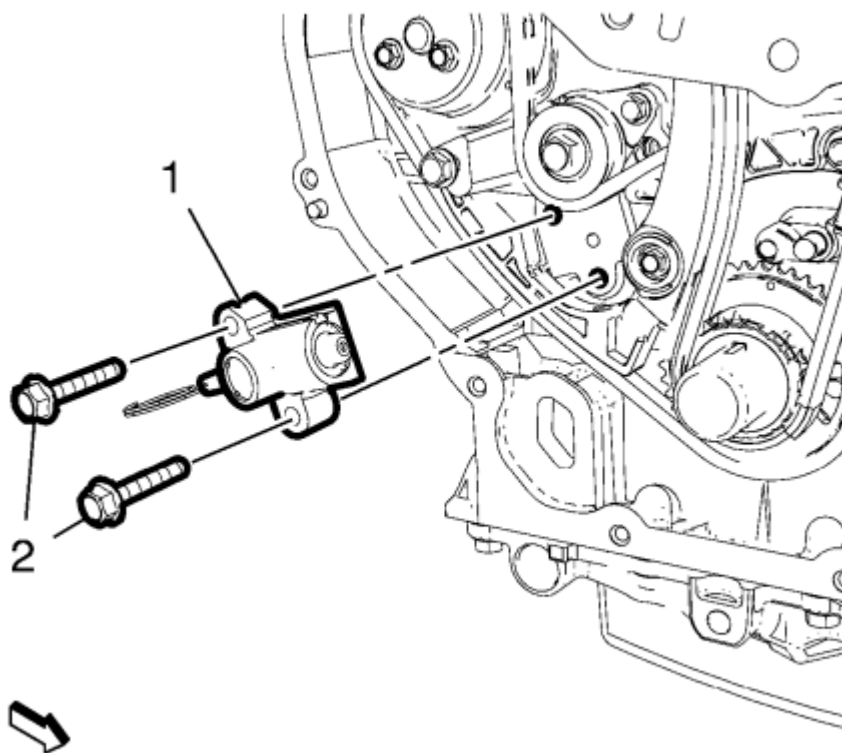
2. Use the following procedure to line up the links with the sprockets:
  1. Ensure that the balance shaft exhaust side timing mark is at 6 o'clock and the balance shaft intake side is at 12 o'clock.
  2. Install the balance shaft drive chain with the colored links lined up on with the marks on the balance shaft drive sprockets and the crankshaft sprocket. There are 3 colored links on the chain. 2 links are of matching colors and 1 link is of a unique color.
  3. Place the uniquely colored link so that it lines up with the timing mark on the intake side balance shaft sprocket (2).
  4. Working clockwise around the chain, place the first matching colored link in line with the timing mark on the crankshaft drive sprocket - approximately at the 6 o'clock position on the crank sprocket (3).
  5. Place the timing chain on the water pump sprocket. There is no timing mark.
  6. Align the last matching colored link with the timing mark on the exhaust side balance shaft drive sprocket (1).
3. Install the water pump and balance shaft timing chain guide - lower. Refer to **Balancer Chain Guide Replacement - Lower**.
4. Install the water pump and balance shaft timing chain guide - upper. Refer to **Balancer Chain Guide Replacement - Upper**.

5. Install the water pump and balance shaft timing chain adjustable guide. Refer to **Balancer Chain Adjust Guide Replacement**.
6. Install the water pump and balance shaft timing chain tensioner. Refer to **Water Pump and Balance Shaft Chain Tensioner Replacement**.
7. Install the camshaft timing chain. Refer to **Camshaft Timing Chain, Sprocket and Tensioner Replacement**.

## WATER PUMP AND BALANCE SHAFT CHAIN TENSIONER REPLACEMENT

### Removal Procedure

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



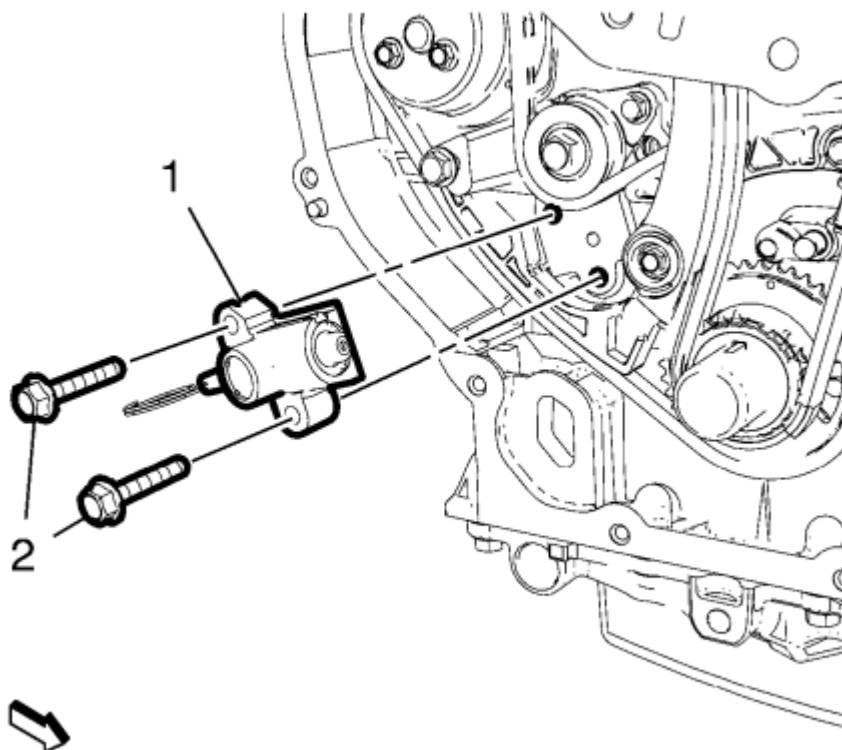
**Fig. 97: Water Pump/Balance Shaft Chain Tensioner & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 2 tensioner bolts (2) and the water pump and balance shaft chain tensioner (1).

### Installation Procedure

1. Reset the water pump and the balance shaft chain tensioner by performing the following steps:
  1. Turn the tensioner plunger 90° in its bore and compress the plunger.

2. Turn the tensioner back to the original 12 o'clock position and insert a paper clip through the hole in the plunger body and into the hole in the tensioner plunger.
2. Clean the water pump and balance shaft chain tensioner sealing surface.

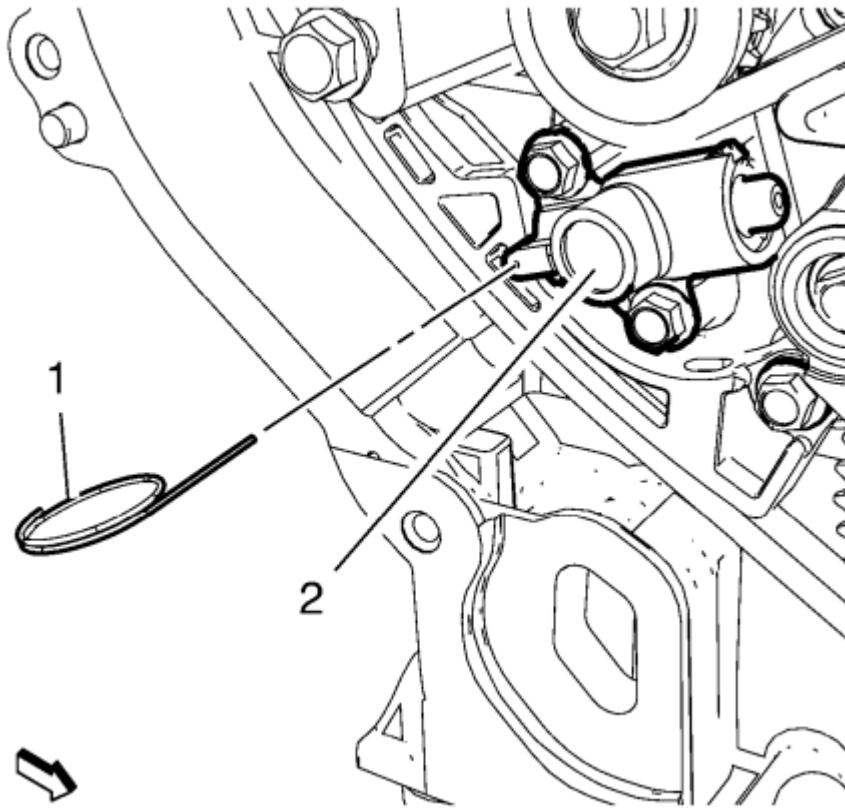


**Fig. 98: Water Pump/Balance Shaft Chain Tensioner & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

3. Install the water pump and the balance shaft chain tensioner (1).

**CAUTION: Refer to Fastener Caution .**

4. Install the 2 water pump and balance shaft chain tensioner bolts (2) and tighten the bolts to 10 N.m (89 lb in).



**Fig. 99: Paper Pin & Tensioner**

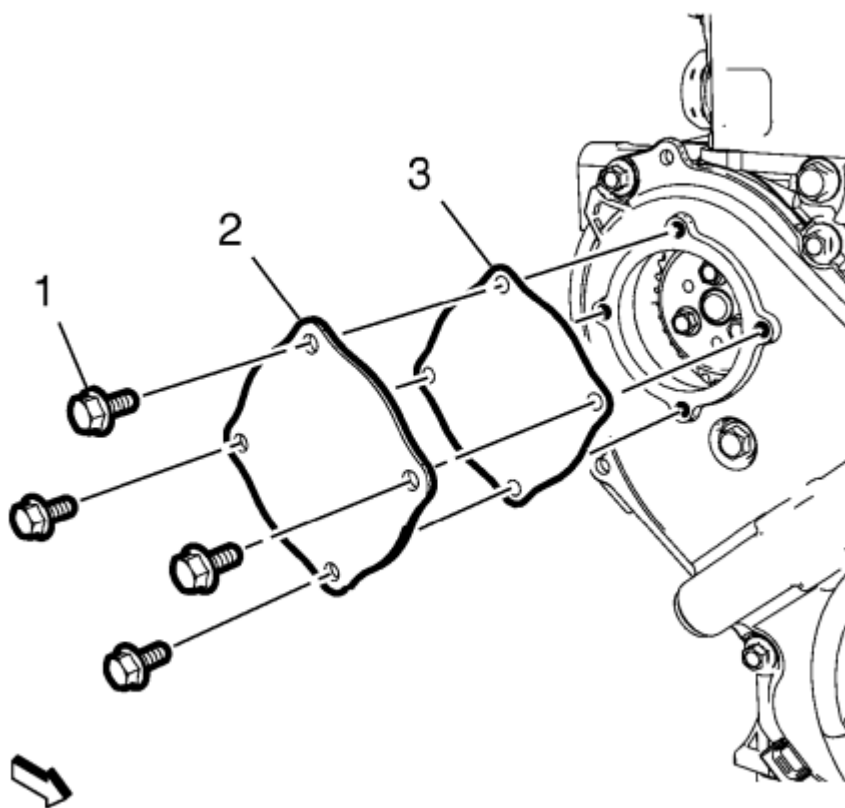
Courtesy of GENERAL MOTORS COMPANY

5. Remove the paper pin (1) from the tensioner (2).
6. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

## WATER PUMP COVER REPLACEMENT

### Removal Procedure

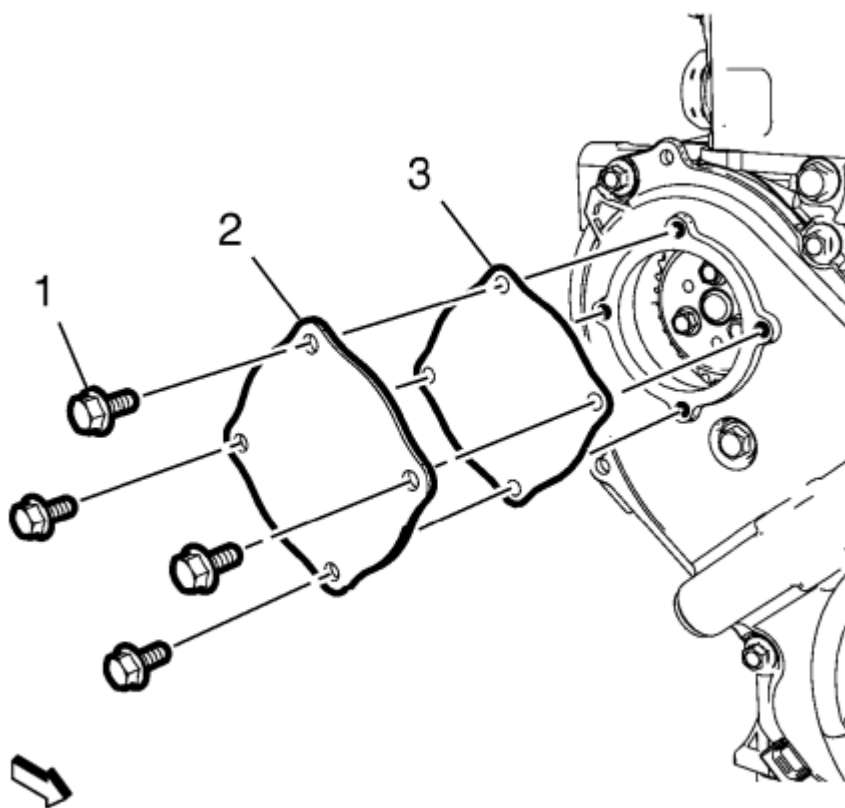
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the front wheelhouse liner right side. Refer to **Front Wheelhouse Liner Replacement** .
3. Remove the engine splash shield right side. Refer to **Front Compartment Splash Shield Replacement** .



**Fig. 100: Water Pump Cover, Gasket & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

4. Remove the 4 water pump cover bolts (1) and the water pump cover (2).

#### Installation Procedure



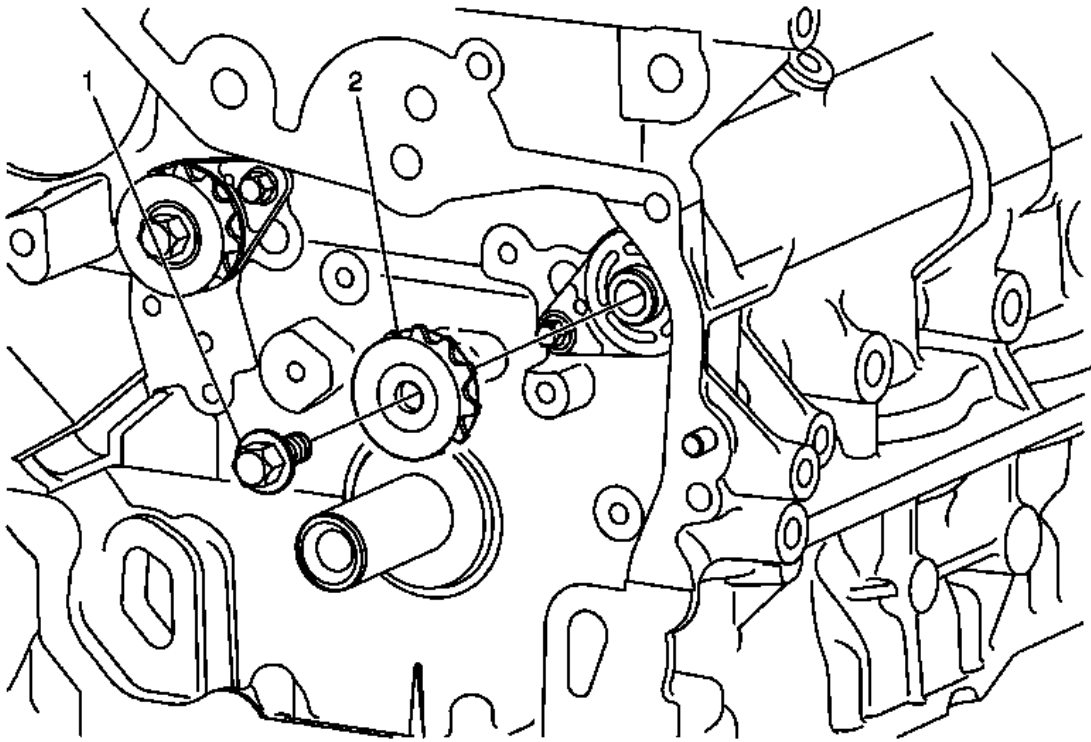
**Fig. 101: Water Pump Cover, Gasket & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Use an **NEW** water pump cover gasket (3).

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

1. Install the water pump cover (2) and the 4 water pump bolts (1) and tighten to 10 N.m (89 lb in).
2. Install the engine splash shield right side. Refer to **Front Compartment Splash Shield Replacement** .
3. Install the front wheelhouse liner right side. Refer to **Front Wheelhouse Liner Replacement** .
4. Lower and unsupport the vehicle.

## **BALANCE SHAFT SPROCKET REPLACEMENT - EXHAUST SIDE**

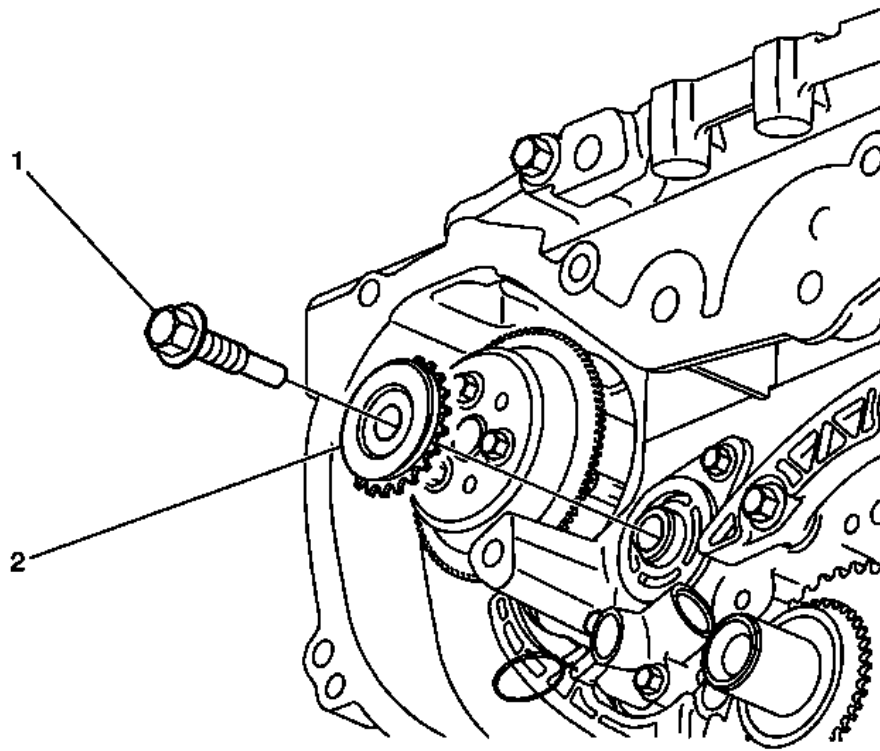


**Fig. 102: Balance Shaft Sprocket & Fastener - Exhaust Side**  
Courtesy of GENERAL MOTORS COMPANY

#### Balance Shaft Sprocket Replacement - Exhaust Side

| Callout                                                                                                                                                 | Component Name                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the water pump and balancer shaft chain. Refer to <b><u>Water Pump and Balance Shaft Chain Replacement</u></b> . |                                                                                                                                                          |
| 1                                                                                                                                                       | Balancer Shaft Sprocket Fastener<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten</b><br>20 (15 lb ft) + 35 degrees |
| 2                                                                                                                                                       | Balancer Shaft Sprocket                                                                                                                                  |

#### BALANCE SHAFT SPROCKET REPLACEMENT - INTAKE SIDE



**Fig. 103: Balance Shaft Sprocket & Fastener - Intake Side**  
 Courtesy of GENERAL MOTORS COMPANY

#### Balance Shaft Sprocket Replacement - Intake Side

| Callout                                                                                                                                                 | Component Name                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the water pump and balancer shaft chain. Refer to <u><b>Water Pump and Balance Shaft Chain Replacement</b></u> . |                                                                                                                                                          |
| 1                                                                                                                                                       | Balancer Shaft Sprocket Fastener<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten</b><br>20 (15 lb ft) + 35 Degrees |
| 2                                                                                                                                                       | Balancer Shaft Sprocket                                                                                                                                  |

#### AUTOMATIC TRANSMISSION FLEX PLATE REPLACEMENT

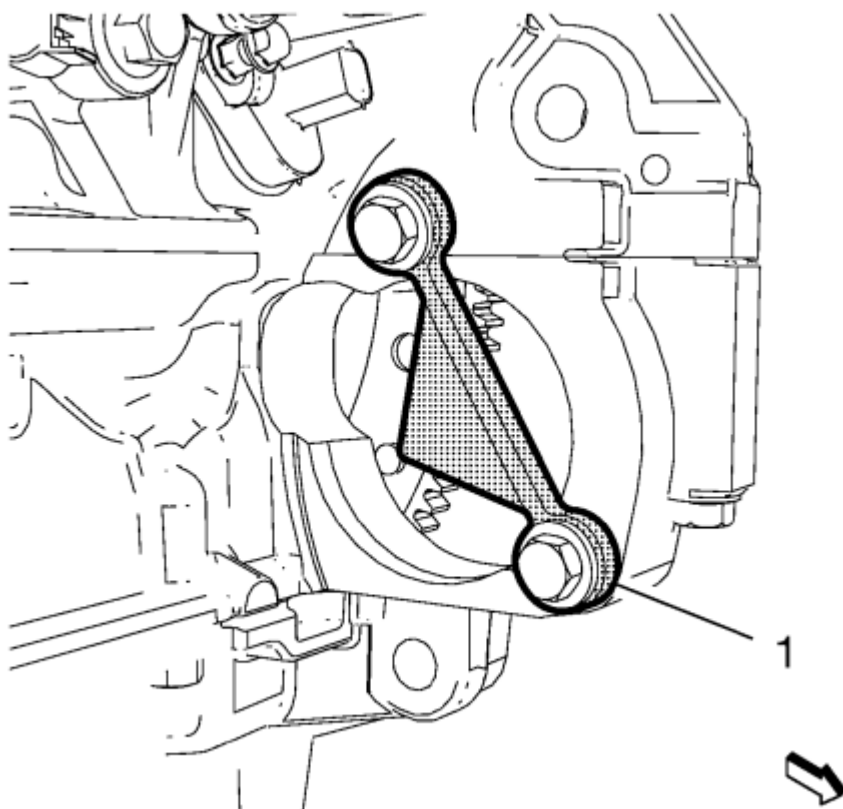
##### Special Tools

- **EN-43653** Flywheel Holding Tool
- **EN-45059** Angle Meter

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

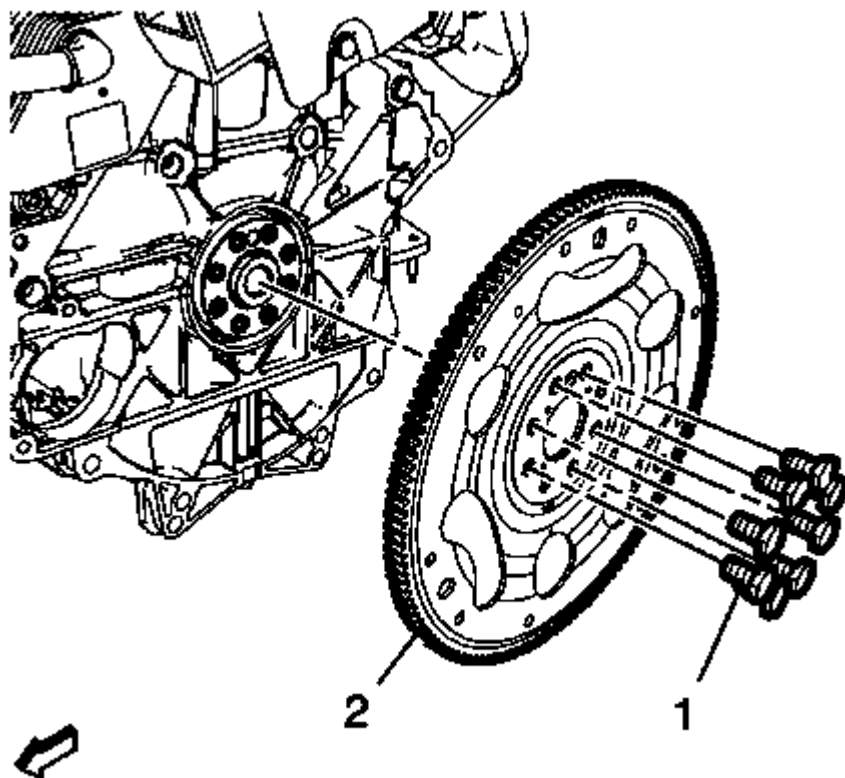
1. Remove the automatic transmission. Refer to **Transmission Replacement (2.0L LHU)** .



**Fig. 104: Flywheel Holding Tool**

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-43653** holding tool (1) in the starter assembly location, engaging the automatic transmission flex plate, in order to prevent crankshaft rotation.

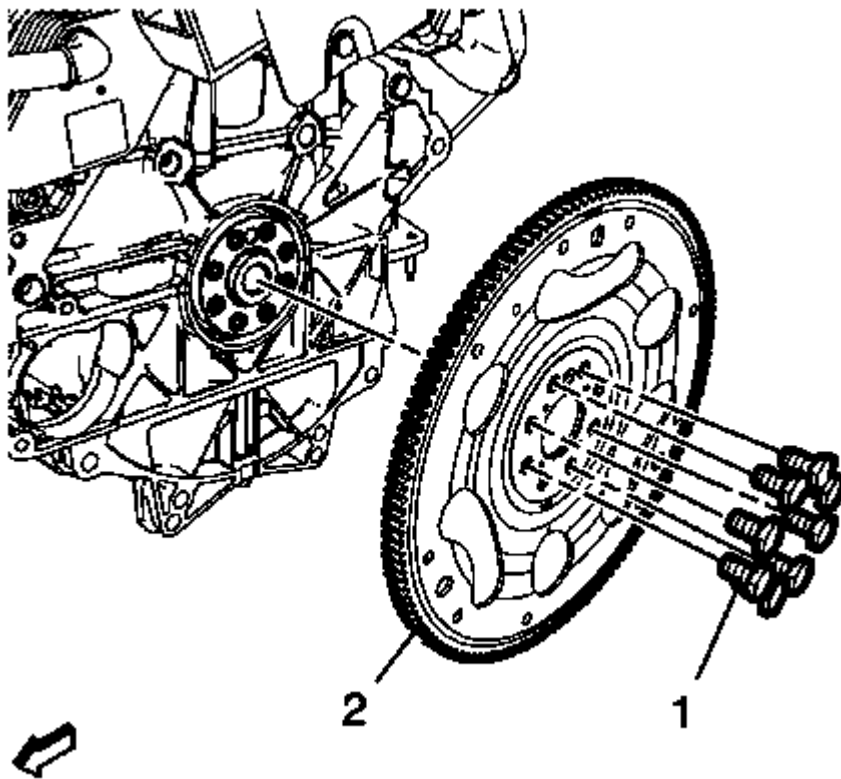


**Fig. 105: Automatic Transmission Flex Plate & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD the 8 automatic transmission flex plate bolts (1) and the automatic transmission flex plate (2).

#### Installation Procedure

1. Re-cut the 8 automatic transmission flex plate bolt threads in the crankshaft.



**Fig. 106: Automatic Transmission Flex Plate & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

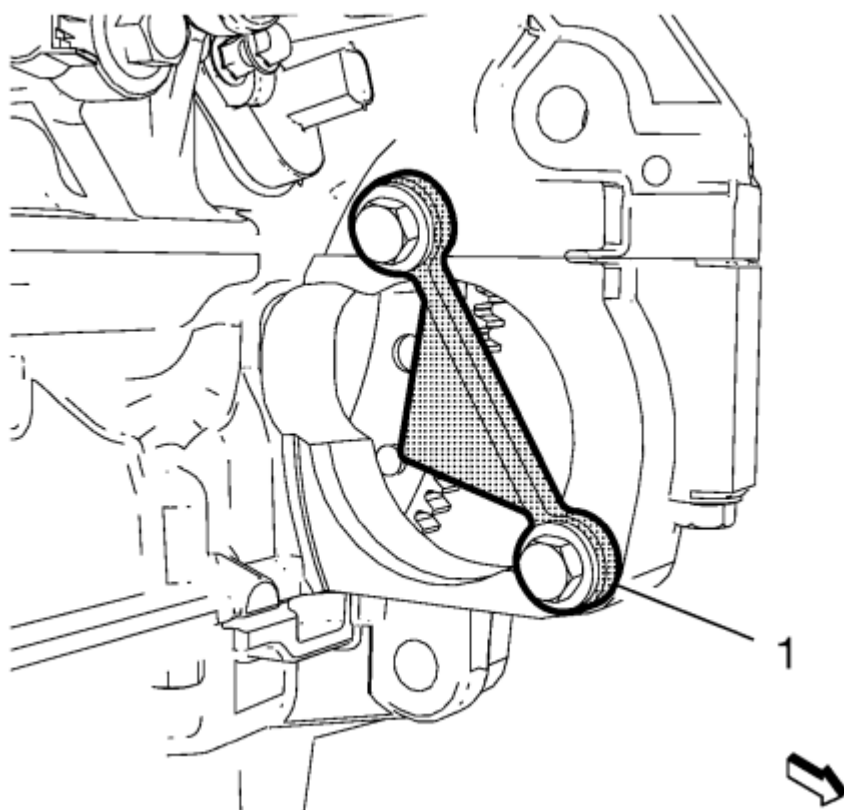
**NOTE:** Service may offer bolts that are not microencapsulated. If this is the case apply thread lock agent to the bolt. If fastener is microencapsulated, install 8 NEW engine flywheel bolts. DO NOT reuse the old bolt.

2. Install the automatic transmission flex plate (2) and 8 NEW automatic transmission flex plate bolts (1) hand tighten.

**CAUTION:** Refer to Fastener Caution .

**CAUTION:** Refer to Torque-to-Yield Fastener Caution .

3. Tighten the automatic transmission flex plate bolts first pass to 53 N.m (39 lb ft).
4. Tighten the automatic transmission flex plate bolts a final pass to an additional 25 degrees, using the **EN-45059** meter.

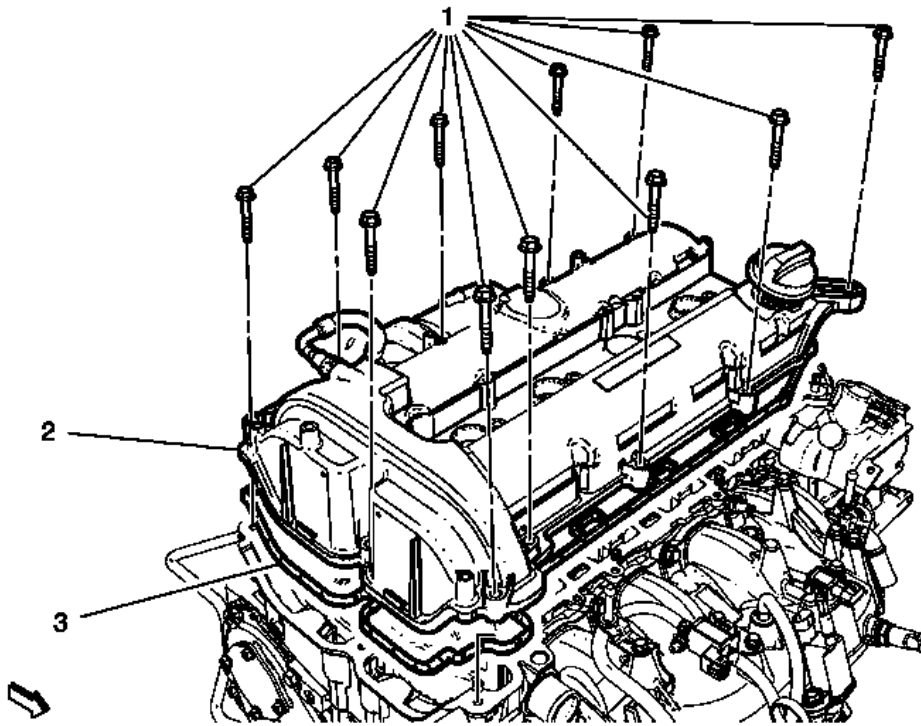


**Fig. 107: Flywheel Holding Tool**

Courtesy of GENERAL MOTORS COMPANY

5. Remove the **EN-43653** holding tool (1) from the starter assembly location.
6. Install the automatic transmission. Refer to **Transmission Replacement (2.0L LHU)**.

## CAMSHAFT COVER REPLACEMENT



**Fig. 108: Camshaft Cover, Gasket & Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

### Camshaft Cover Replacement

| Callout                       | Component Name                                                                                                                                                                                                             |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> |                                                                                                                                                                                                                            |
| 1.                            | Remove the engine sight shield. Refer to <u><b>Engine Sight Shield Replacement</b></u> .                                                                                                                                   |
| 2.                            | Remove the ignition coil. Refer to <u><b>Ignition Coil Replacement</b></u> .                                                                                                                                               |
| 3.                            | Remove the engine sight shield brackets. Refer to <u><b>Engine Sight Bracket Replacement</b></u> .                                                                                                                         |
| 4.                            | Remove the air cleaner outlet duct. Refer to <u><b>Air Cleaner Outlet Duct Replacement</b></u> .                                                                                                                           |
| 5.                            | Remove the air cleaner rear outlet duct. Refer to <u><b>Air Cleaner Outlet Rear Duct Replacement</b></u> .                                                                                                                 |
| 6.                            | Remove the charge air cooler inlet hose - turbocharger side. Refer to <u><b>Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)</b></u> , <u><b>Charge Air Cooler Inlet Hose Replacement (Turbocharger)</b></u> . |
| 7.                            | Remove the positive crankcase ventilation hose. Refer to <u><b>Positive Crankcase Ventilation Tube Replacement - Camshaft Cover to Turbo Charger</b></u> .                                                                 |
| 8.                            | Remove the positive crankcase ventilation hose. Refer to <u><b>Positive Crankcase Ventilation Tube Replacement - Camshaft Cover to Air Cleaner Outlet Duct Rear</b></u> .                                                  |
| 9.                            | Remove the turbocharger coolant feed pipe bracket. Refer to <u><b>Turbocharger Coolant Feed Pipe Bracket Replacement</b></u> .                                                                                             |
|                               | Camshaft Cover Fastener (Qty: 11)                                                                                                                                                                                          |

|   |                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------|
| 1 | <b>CAUTION:</b><br>Refer to <b><u>Fastener Caution</u></b> .<br><br><b>Tighten</b><br>10 N.m (89 lb in) |
| 2 | Camshaft Cover                                                                                          |
| 3 | Camshaft Cover Gasket<br><b>Procedure</b><br>Use a NEW gasket.                                          |

## TIMING CHAIN TENSIONER REPLACEMENT

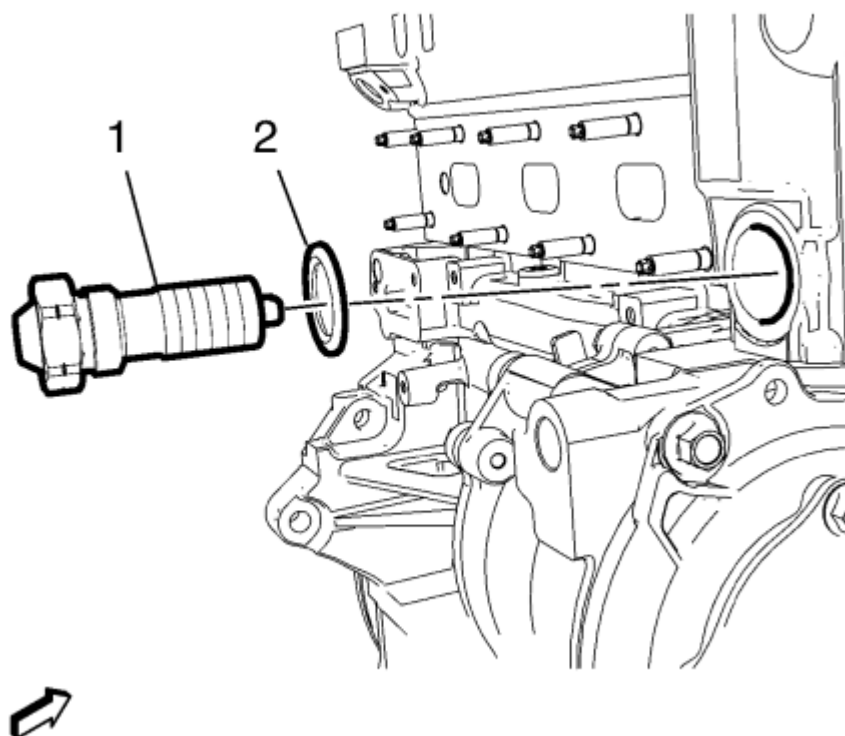
### Special Tools

- **EN-45027-1** Tensioner Tool
- **EN-45027-2** Tensioner Tool

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.

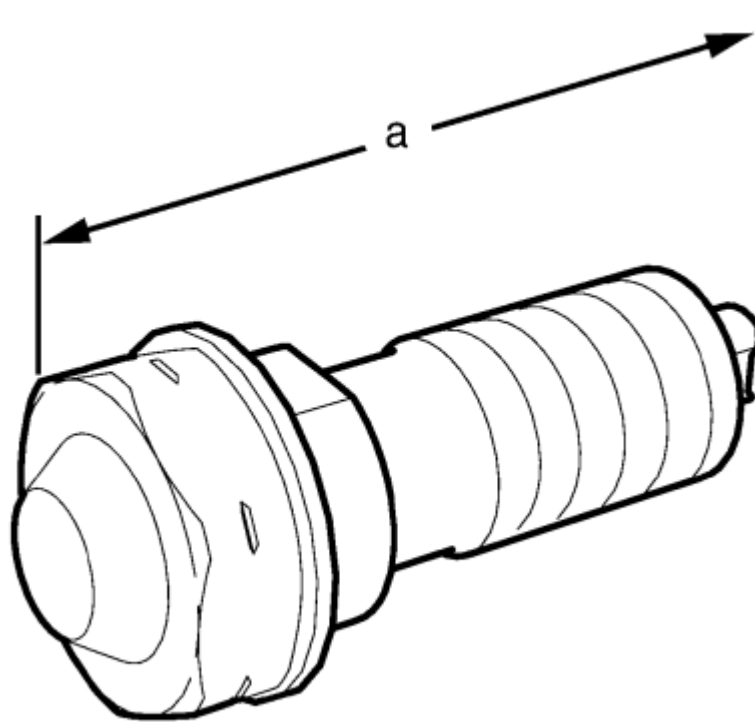


**Fig. 109: Timing Chain Tensioner & Seal Ring**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the timing chain tensioner (1) and the timing chain tensioner seal ring (2).

#### **Installation Procedure**

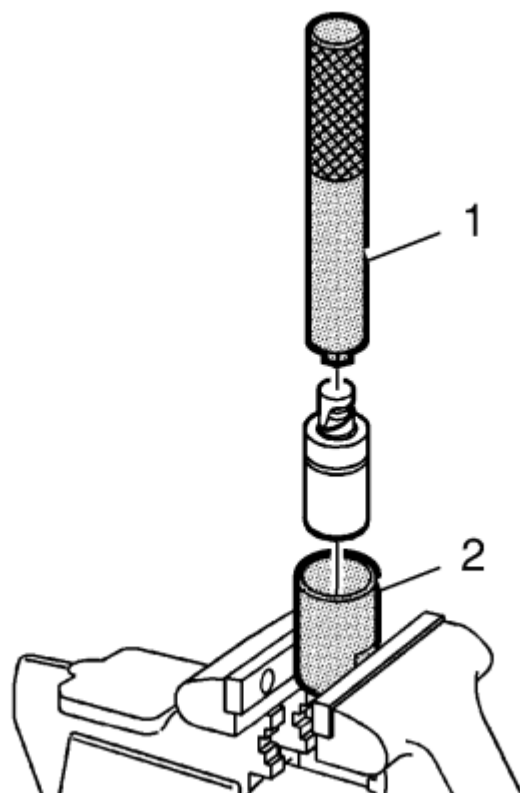
1. Inspect the timing chain tensioner. If the timing chain tensioner is damaged, replace the timing chain tensioner.



**Fig. 110: Timing Chain Tensioner Length**

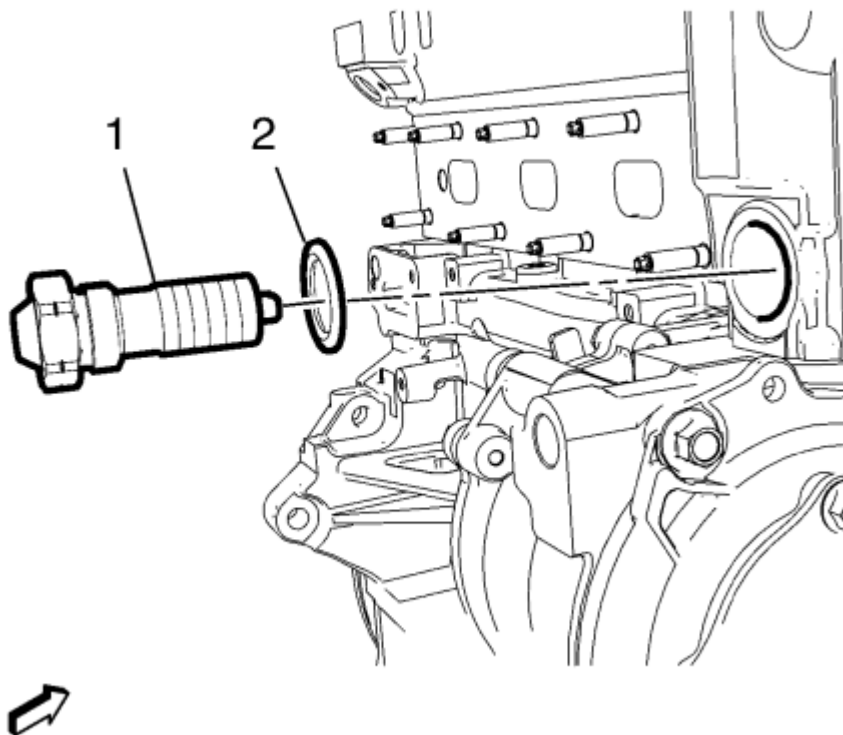
Courtesy of GENERAL MOTORS COMPANY

2. Measure the timing chain tensioner assembly from end to end. If the timing chain tensioner is to be replaced, a new tensioner should be supplied in the fully compressed non-active state. A tensioner in the compressed state will measure 72 mm (2.83 in) (a) from end to end. A tensioner in the active state will measure 85 mm (3.35 in) (a) from end to end.



**Fig. 111: Timing Chain Tensioner & Compression Tools**  
Courtesy of GENERAL MOTORS COMPANY

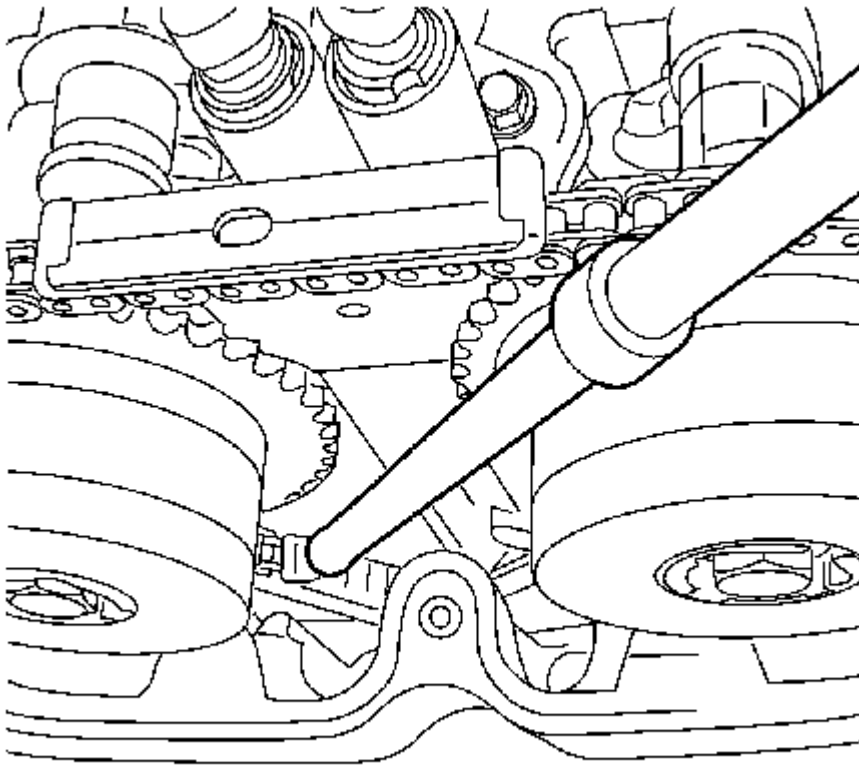
3. If the timing chain tensioner is not in the compressed state, perform the following steps:
  1. Remove the locking ring from the tensioner body.
  2. Remove the piston assembly from the tensioner body of the timing chain tensioner by pulling it out.
  3. Install the **EN-45027-2** tensioner tool (2) into a vise.
  4. Install the notch end of the piston assembly into the **EN-45027-2** tensioner tool (2).
  5. Using the **EN-45027-1** tensioner tool (1), turn the ratchet cylinder into the piston.
4. Inspect the bore of the tensioner body for dirt, debris and damage. If any damage appears, replace the tensioner. Clean dirt or debris out with a lint-free cloth.
5. Inspect to ensure all dirt and debris is removed from the timing chain tensioner threaded hole in the cylinder head.



**Fig. 112: Timing Chain Tensioner & Seal Ring**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

6. Install the timing chain tensioner (1) with a NEW seal ring (2) and tighten to 75 N.m (55 lb ft).



**Fig. 113: Timing Chain Tensioner Release Tool**

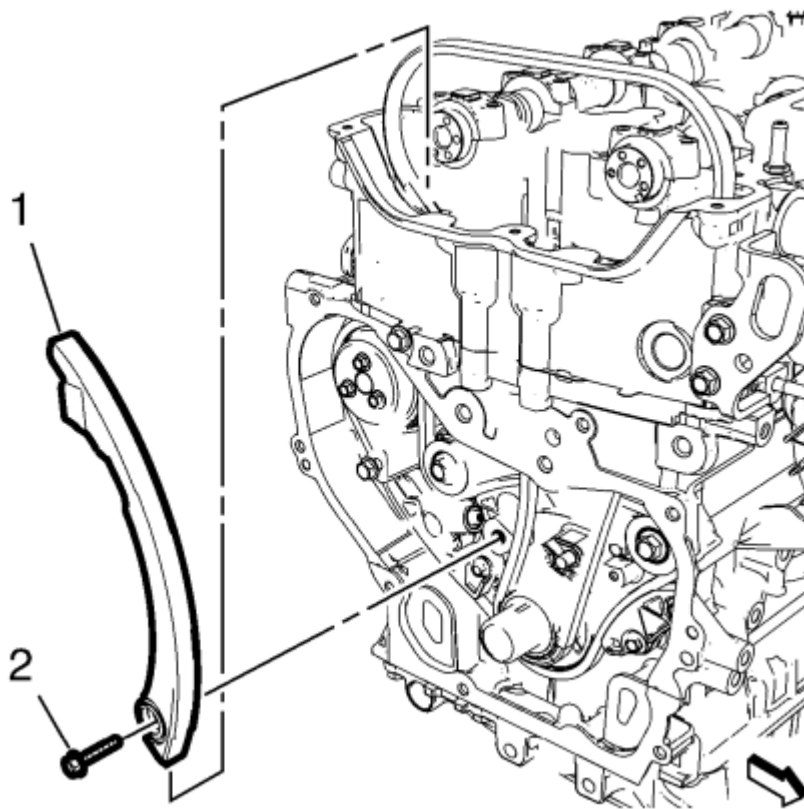
Courtesy of GENERAL MOTORS COMPANY

7. The timing chain tensioner is released by compressing the tensioner 2 mm (0.079 in) which will release the locking mechanism in the ratchet. To release the timing chain tensioner, use a suitable tool with a rubber tip on the end. Feed the tool down through the cam drive chest to rest on the cam chain. Then give a sharp jolt diagonally downwards to release the tensioner.
8. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

## ADJUSTABLE TIMING CHAIN GUIDE REPLACEMENT

### Removal Procedure

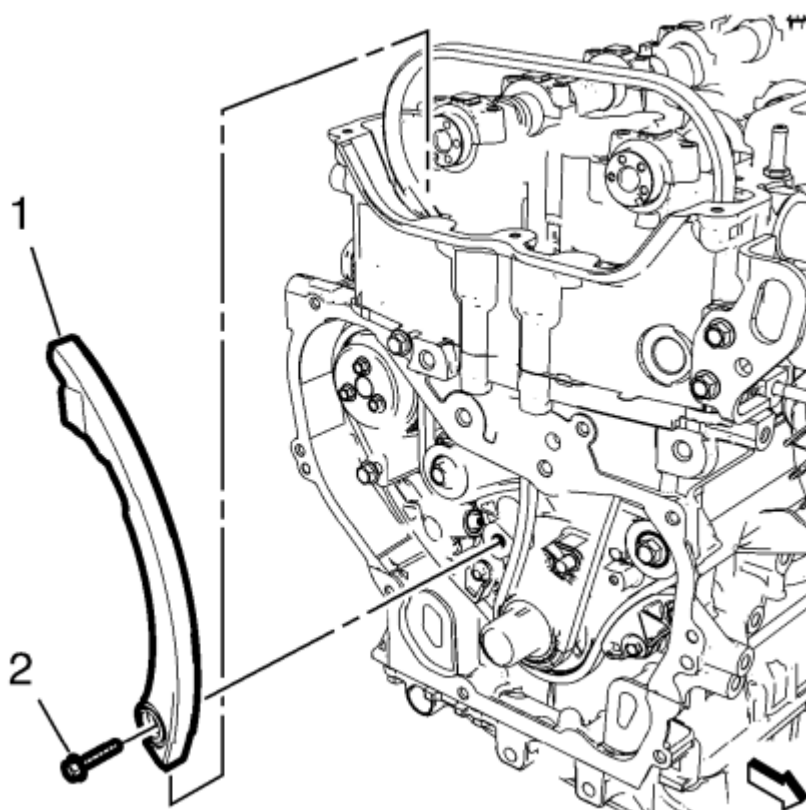
1. Remove the camshaft position exhaust actuator. Refer to **Camshaft Position Exhaust Actuator Replacement**.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.



**Fig. 114: Adjustable Timing Chain Guide & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Remove the timing chain adjustable guide bolt (2) and the timing chain adjustable guide (1).

#### **Installation Procedure**



**Fig. 115: Adjustable Timing Chain Guide & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

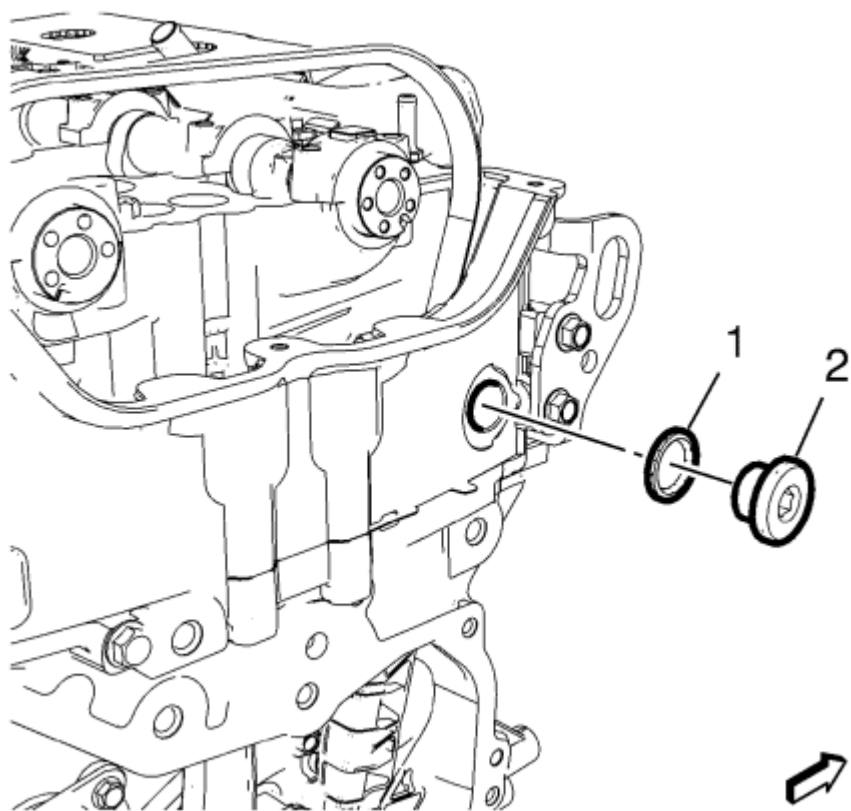
**CAUTION:** Refer to Fastener Caution .

1. Install the timing chain adjustable guide (1) and the timing chain adjustable guide bolt (2) and tighten to 12 N.m (106 lb in).
2. Install the engine front cover. Refer to Engine Front Cover Replacement.
3. Install the camshaft position exhaust actuator. Refer to Camshaft Position Exhaust Actuator Replacement.

## TIMING CHAIN GUIDE REPLACEMENT

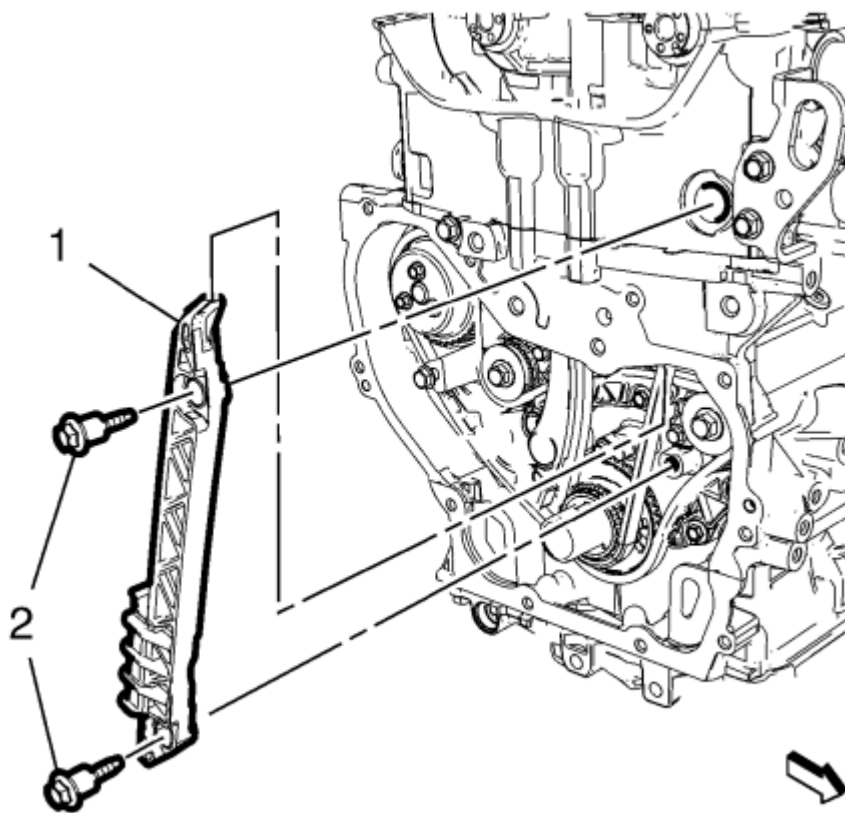
### Removal Procedure

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



**Fig. 116: Timing Chain Guide Access Hole Plug & Washer**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the timing chain guide access hole plug (2) and remove and DISCARD the washer (1).

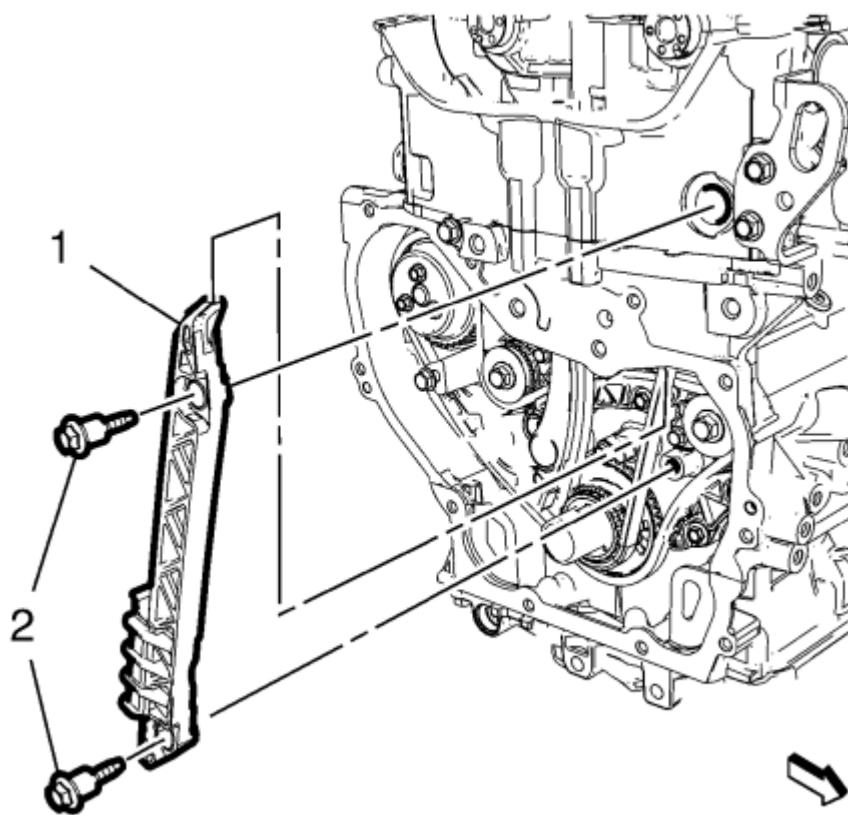


**Fig. 117: Timing Chain Guide & Bolts**

Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 timing chain guide bolts (2) and the timing chain guide (1).

#### Installation Procedure

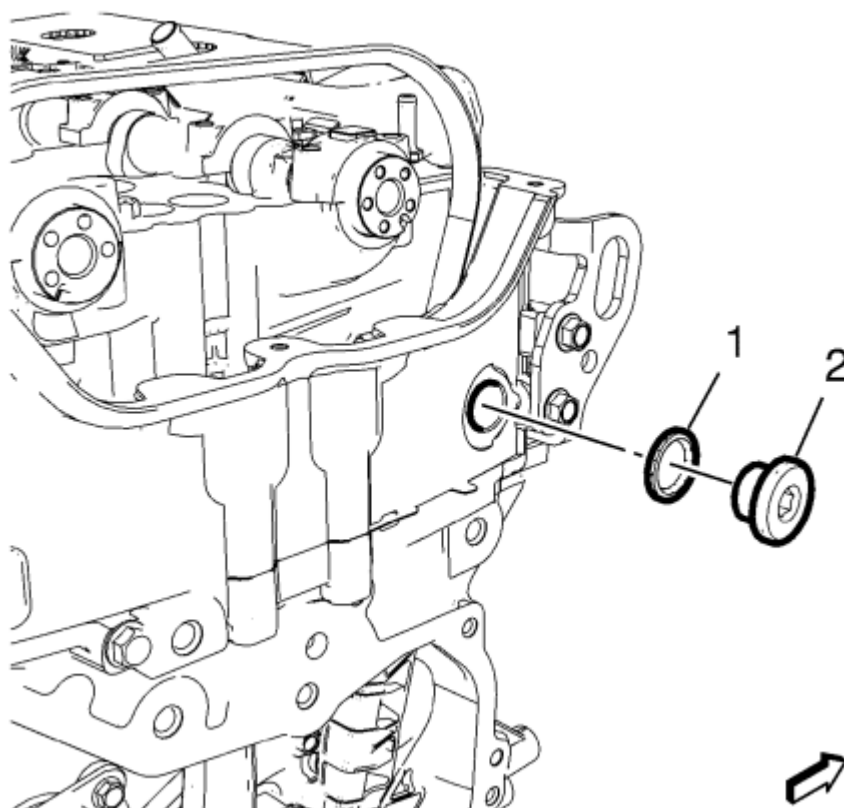


**Fig. 118: Timing Chain Guide & Bolts**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION: Refer to Fastener Caution .**

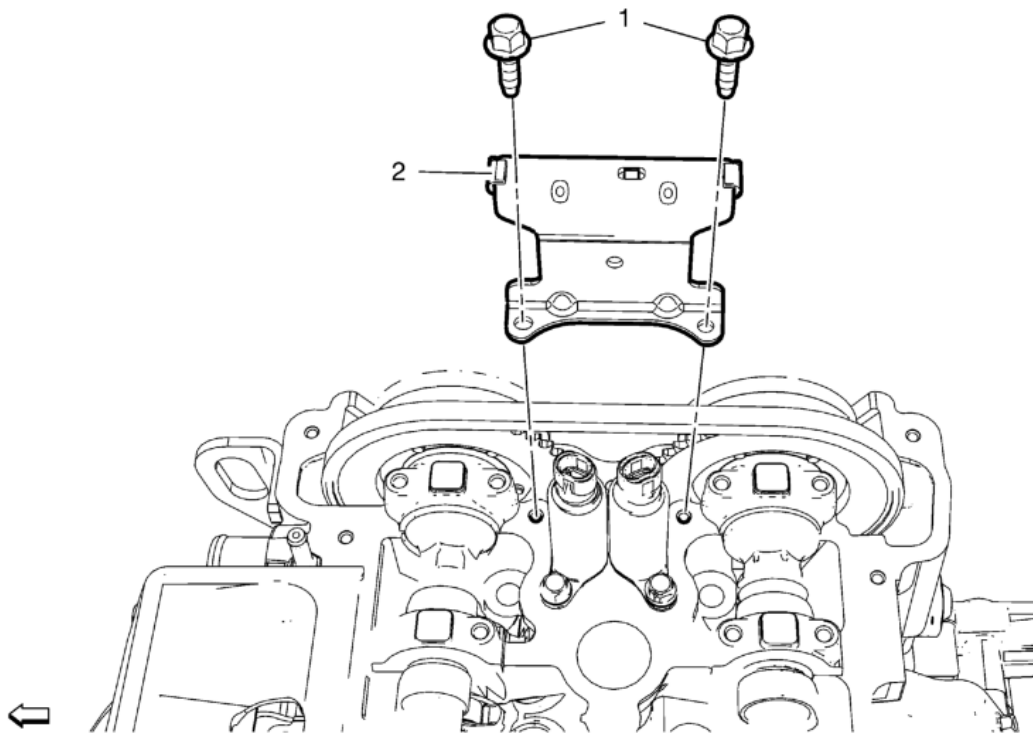
1. Install the timing chain guide (1) and the 2 timing chain guide bolts (2) and tighten to 12 N.m (106 lb in).



**Fig. 119: Timing Chain Guide Access Hole Plug & Washer**  
 Courtesy of GENERAL MOTORS COMPANY

2. Install the timing chain guide access hole plug (2) and the NEW washer (1) and tighten to 75 N.m (55 lb ft).
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

## **TIMING CHAIN UPPER GUIDE REPLACEMENT**

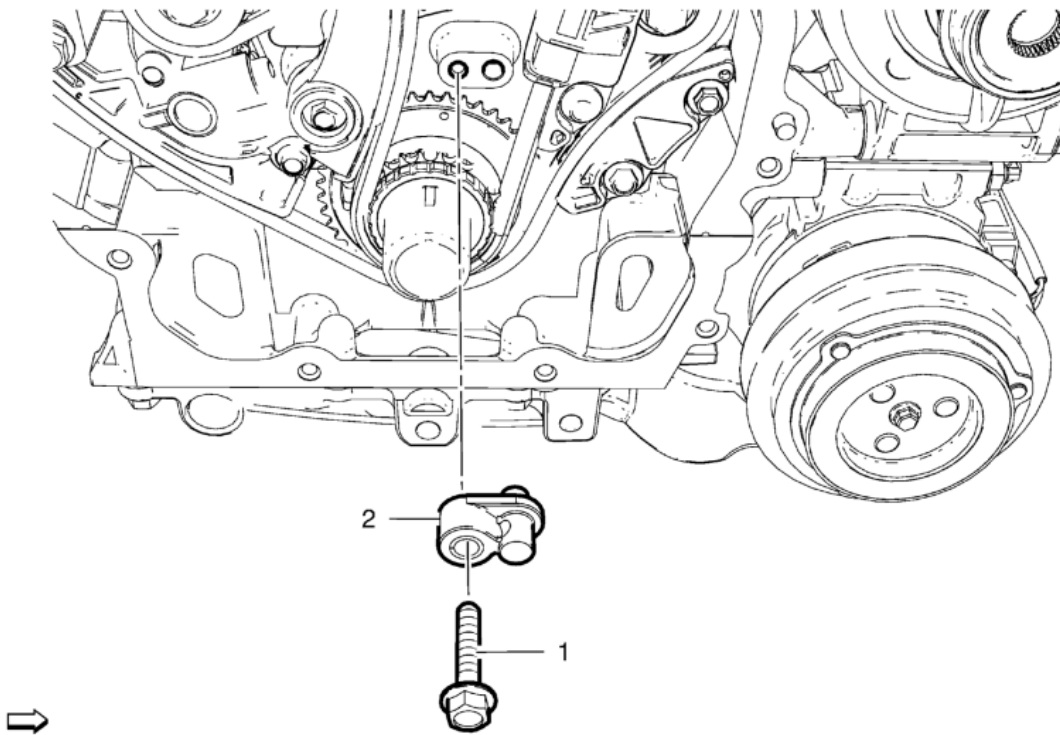


**Fig. 120: Timing Chain Upper Guide & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

### Timing Chain Upper Guide Replacement

| Callout                                                                                                 | Component Name                                                                                                                           |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the camshaft cover. Refer to <u>Camshaft Cover Replacement</u> . |                                                                                                                                          |
| 1                                                                                                       | Timing Chain Guide Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <u>Fastener Caution</u> .<br><br><b>Tighten</b><br>10 N.m (89 lb in) |
| 2                                                                                                       | Timing Chain Guide - Upper                                                                                                               |

### TIMING CHAIN OIL NOZZLE REPLACEMENT



**Fig. 121: Timing Chain Oil Nozzle & Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

### Timing Chain Oil Nozzle Replacement

| Callout                                                                         | Component Name                                                                                                                       |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                   |                                                                                                                                      |
| Remove the engine front cover. Refer to <b>Engine Front Cover Replacement</b> . |                                                                                                                                      |
| 1                                                                               | Timing Chain Oil Nozzle Bolt<br><br><b>CAUTION:</b><br>Refer to <b>Fastener Caution</b> .<br><br><b>Tighten</b><br>10 N.m (89 lb in) |
| 2                                                                               | Timing Chain Oil Nozzle                                                                                                              |

### INTAKE CAMSHAFT REPLACEMENT

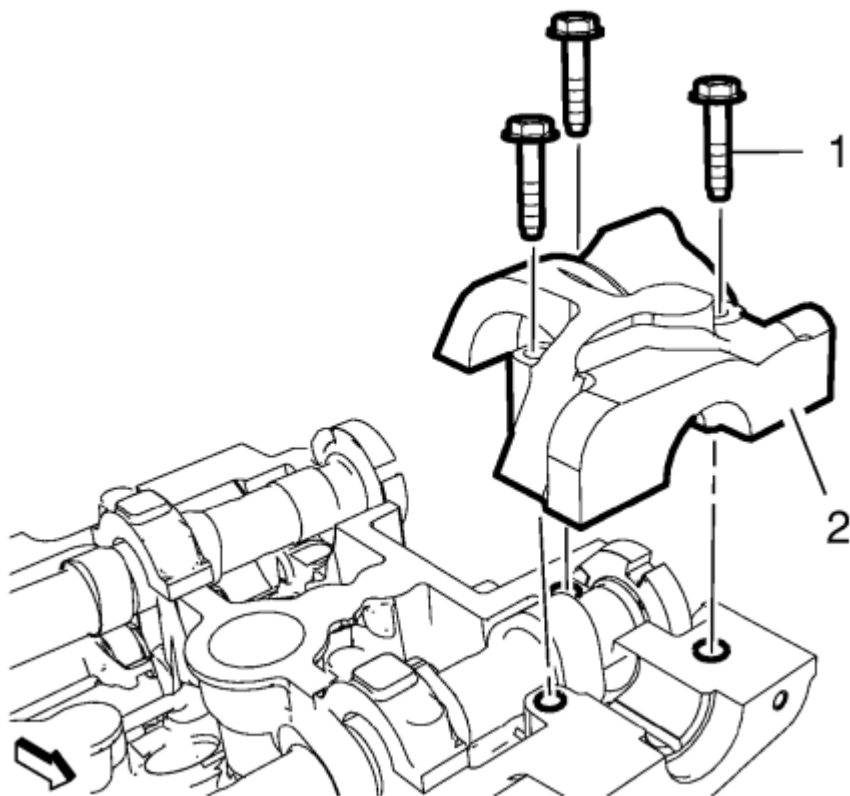
#### Special Tools

- **EN-45059** Angle Meter
- **EN-48749** Timing Chain Retention Tool
- **EN-48953** Camshaft Actuator Locking Tool

For equivalent regional tools, refer to Special Tools (LDK, LHU) .

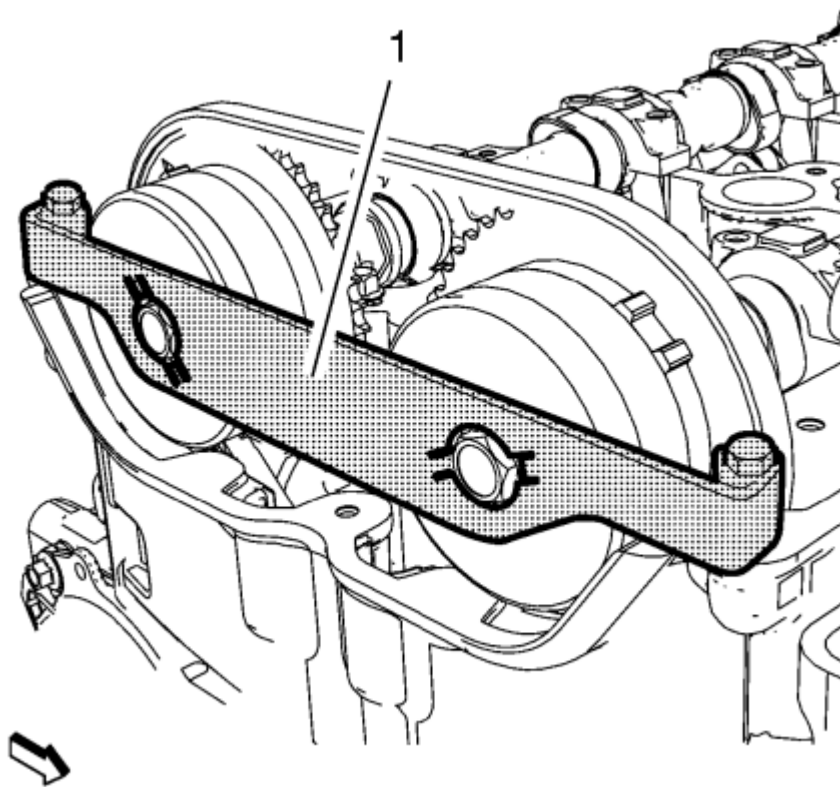
### Removal Procedure

1. Remove the dash upper extension panel opening cover. Refer to Dash Upper Extension Panel Opening Cover Replacement .
2. Remove the spark plugs. Refer to Spark Plug Replacement .
3. Remove the camshaft cover. Refer to Camshaft Cover Replacement.
4. Remove the upper timing chain guide. Refer to Timing Chain Upper Guide Replacement.
5. Remove the front wheelhouse liner. Refer to Front Wheelhouse Liner Replacement .
6. Remove the fuel pump. Refer to Fuel Pump Replacement .



**Fig. 122: Rear Bearing Block & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the 3 rear bearing block bolts (1) and remove the rear bearing block (2).

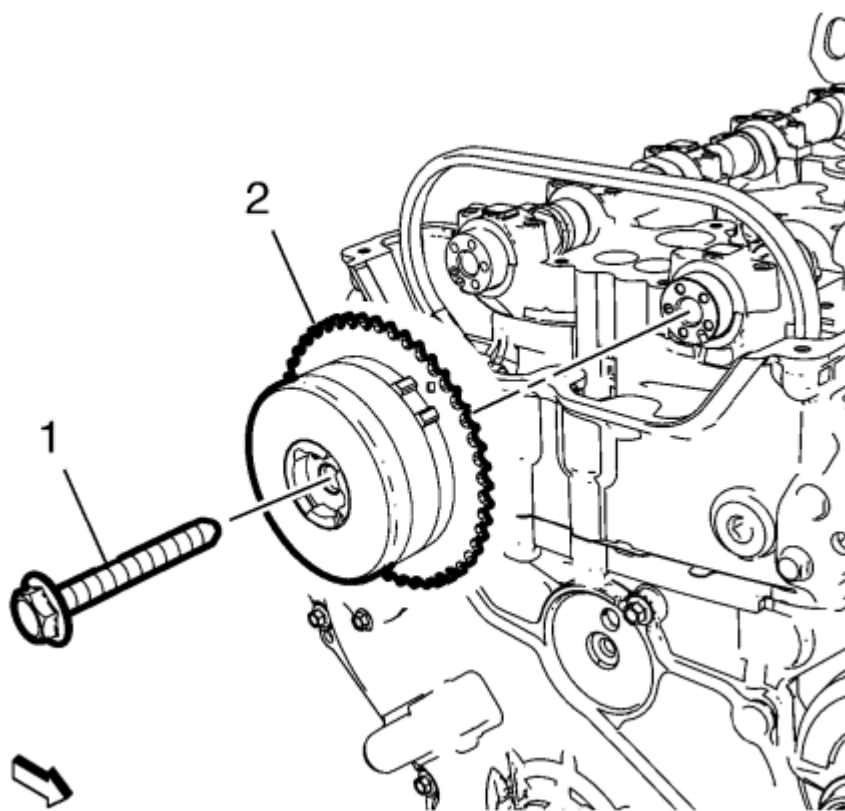


**Fig. 123: Crankshaft Locking Tool**  
 Courtesy of GENERAL MOTORS COMPANY

8. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1) to the camshafts.

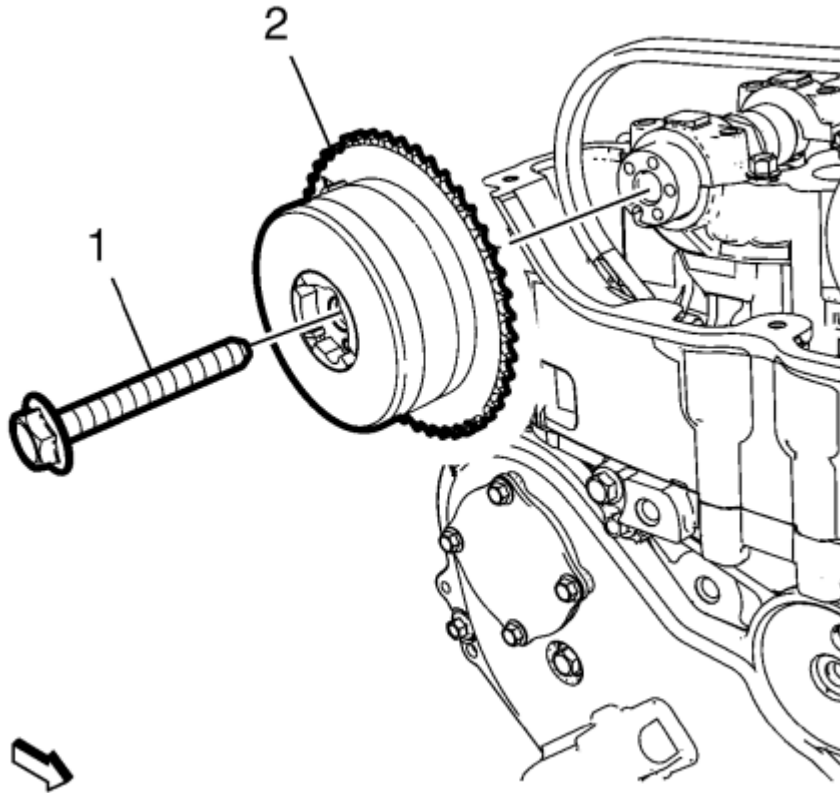
**CAUTION: Refer to Fastener Caution .**

9. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).



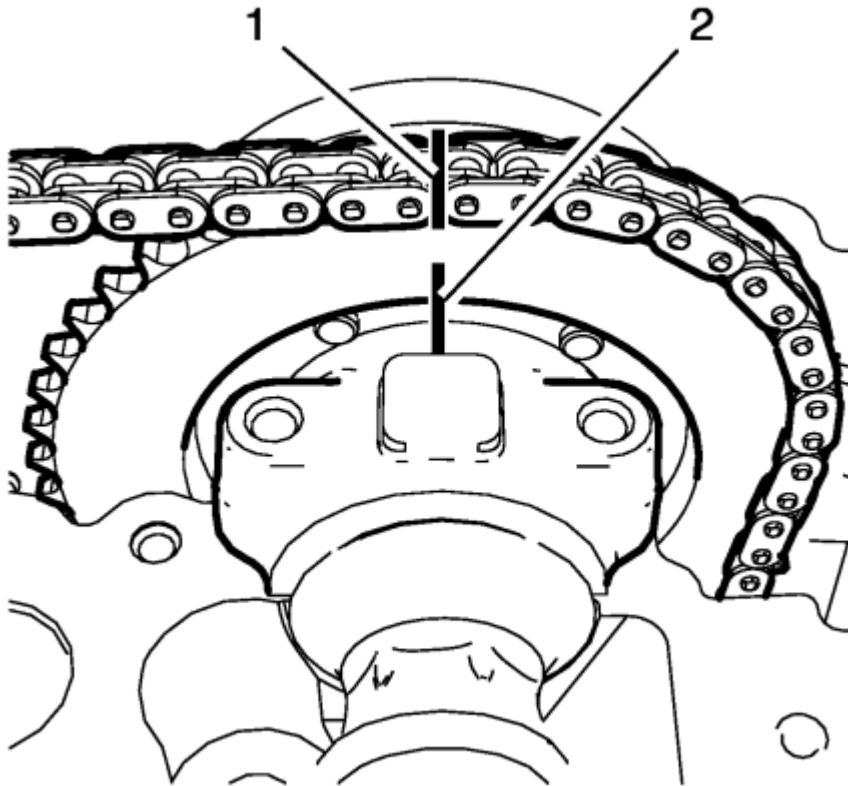
**Fig. 124: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

10. Loosen, but DO NOT remove, the camshaft position intake actuator bolt (1).



**Fig. 125: Camshaft Position Exhaust Actuator & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

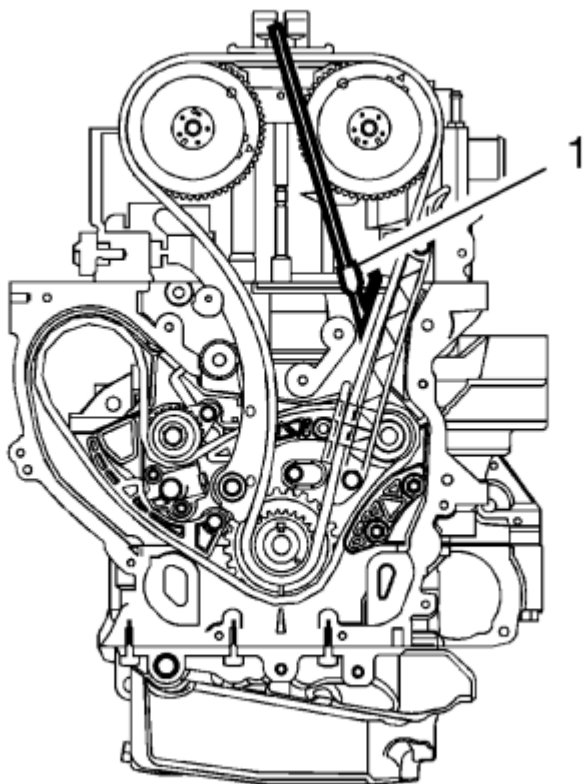
11. Loosen, but DO NOT remove, the camshaft position exhaust actuator bolt (1) from the exhaust camshaft actuator (2).
12. Remove the **EN-48953** locking tool.
13. Rotate the crankshaft clockwise at the crankshaft balancer bolt to the TDC of combustion stroke of cylinder 1.



**Fig. 126: Timing Chain & Camshaft Bearing Cover Marks**  
Courtesy of GENERAL MOTORS COMPANY

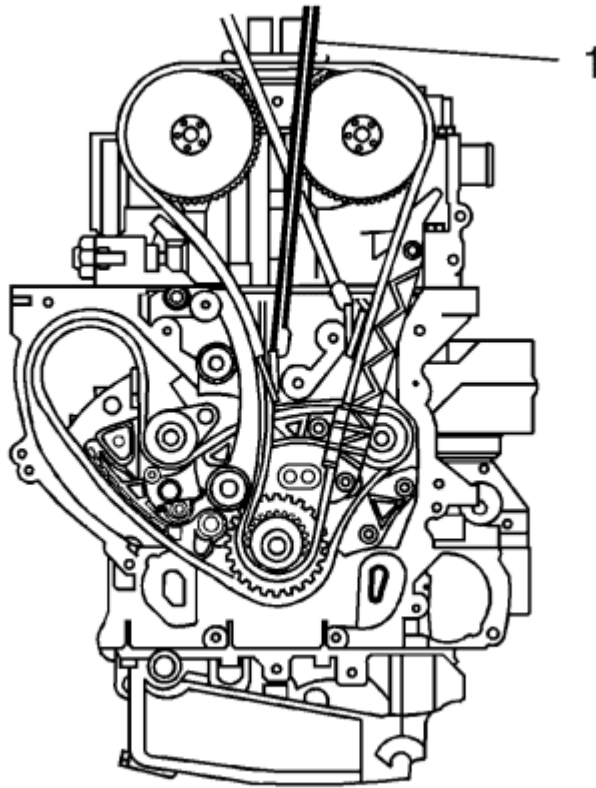
**NOTE:** Ensure the timing chain and the camshaft position actuators are marked for proper assembly.

14. Mark both camshaft actuators and their respective locations on the timing chain (1). Mark additional the position from the camshaft actuator to the camshaft bearing cover (2).
15. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



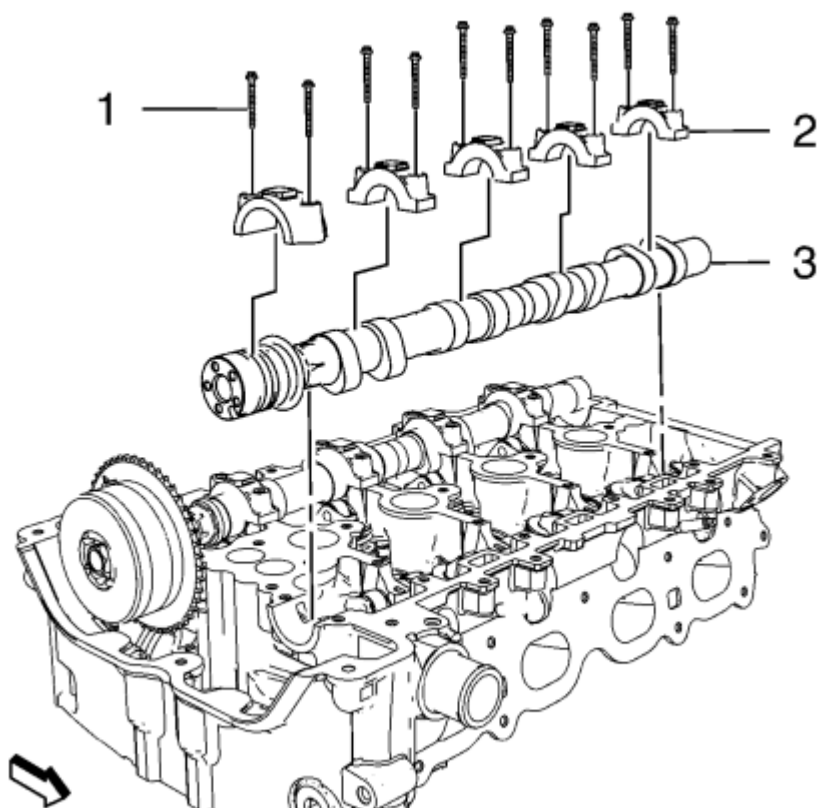
**Fig. 127: Timing Chain Retention Tool On Intake Side**  
**Courtesy of GENERAL MOTORS COMPANY**

16. Install the **EN-48749** retention tool (1) to the intake side of the timing chain.



**Fig. 128: Timing Chain Retention Tool On Exhaust Side**  
**Courtesy of GENERAL MOTORS COMPANY**

17. Install the **EN-48749** retention tool (1) to the exhaust side of the timing chain.
18. Remove and DISCARD the camshaft position intake actuator bolt (1).
19. Remove the intake camshaft actuator from the camshaft while also removing the actuator from the timing chain.
20. Remove and DISCARD the camshaft position exhaust actuator bolt.
21. Remove the exhaust camshaft actuator from the camshaft while also removing the actuator from the timing chain.
22. Mark the bearing caps to ensure they are installed in the original position.

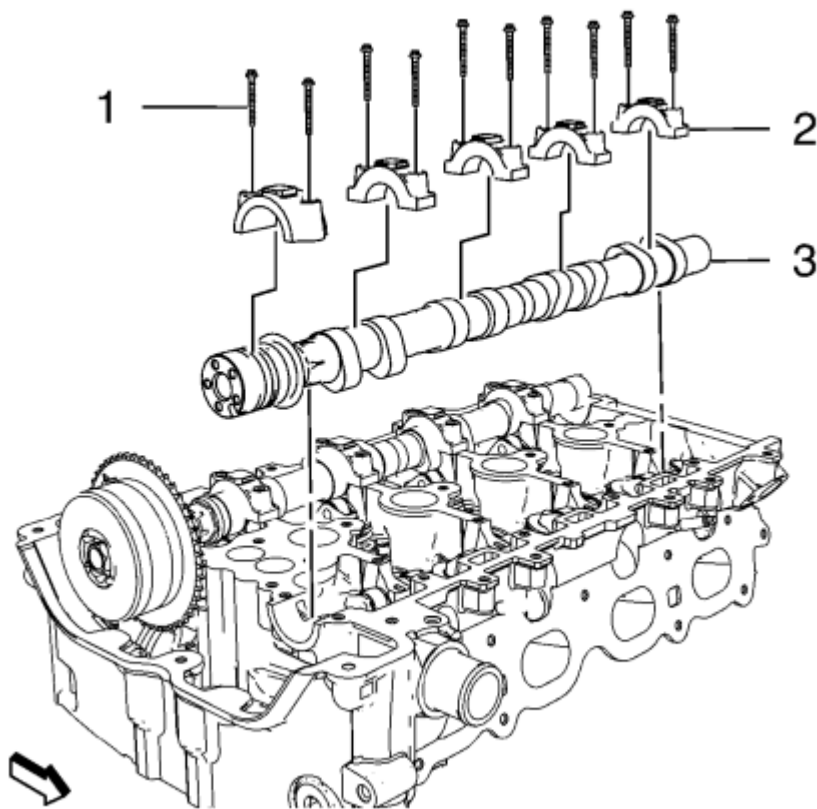


**Fig. 129: Intake Camshaft, Bearing Cap & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Remove each bolt on each cap one turn at a time until there is no spring tension pushing on the camshaft.

23. Remove the 10 bearing cap bolts (1).
24. Remove the 5 bearing caps (2).
25. Remove the intake camshaft (3).

#### Installation Procedure

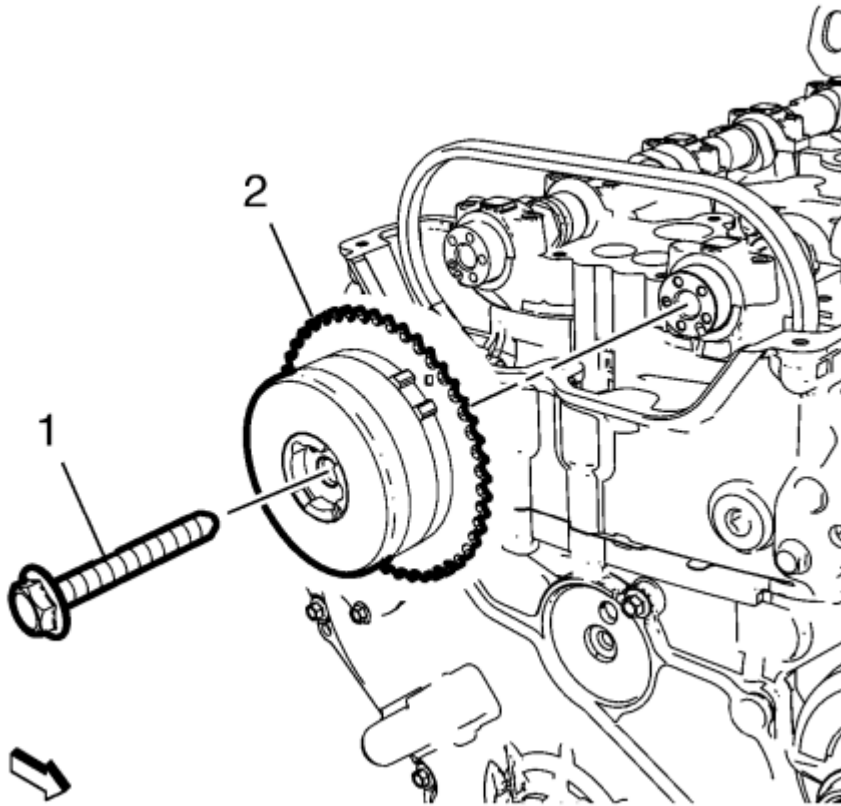


**Fig. 130: Intake Camshaft, Bearing Cap & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install the intake camshaft (3).

**CAUTION: Refer to Fastener Caution .**

2. Install the 5 bearing caps (2).
3. Install the 10 bearing cap bolts (1) and hand tighten.
4. Tighten the bearing cap bolts in increments of 3 turns until they are seated.
5. When all the bearing caps are seated, tighten the bolts to 10 N.m (89 lb in).

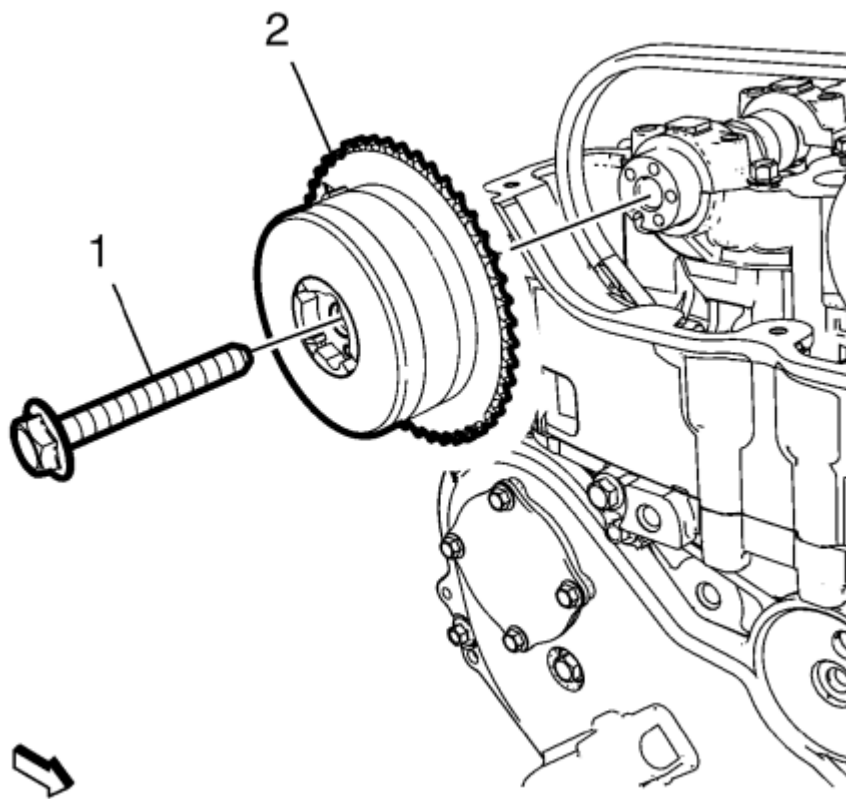


**Fig. 131: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Ensure the timing chain and the camshaft position actuators are on their marked points.

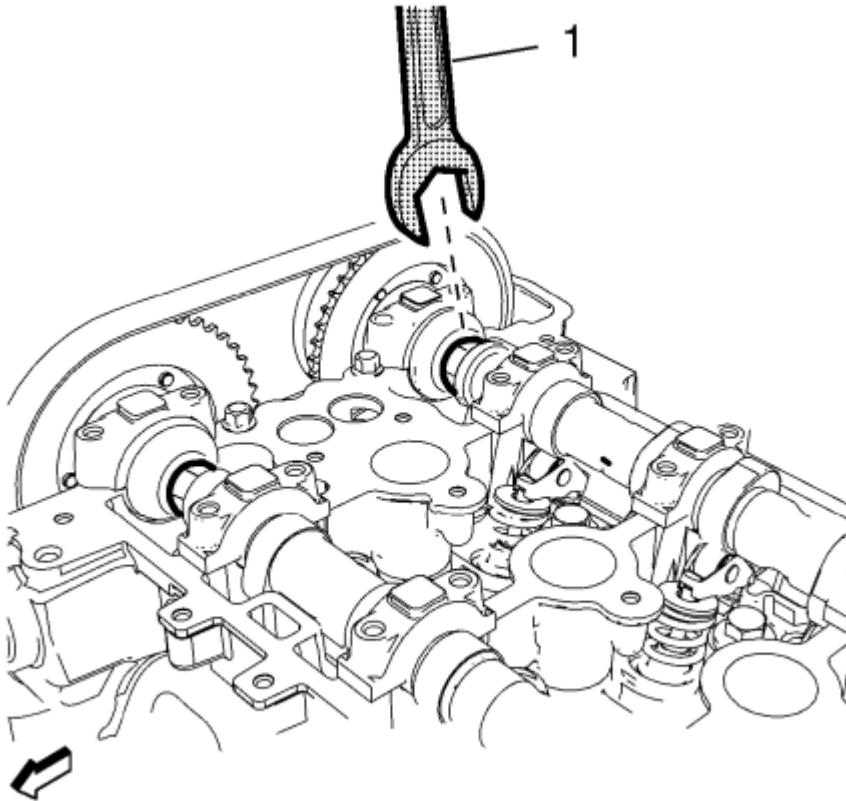
Ensure that the exhaust camshaft actuator fully fits in the exhaust camshaft.

6. Install the intake camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.



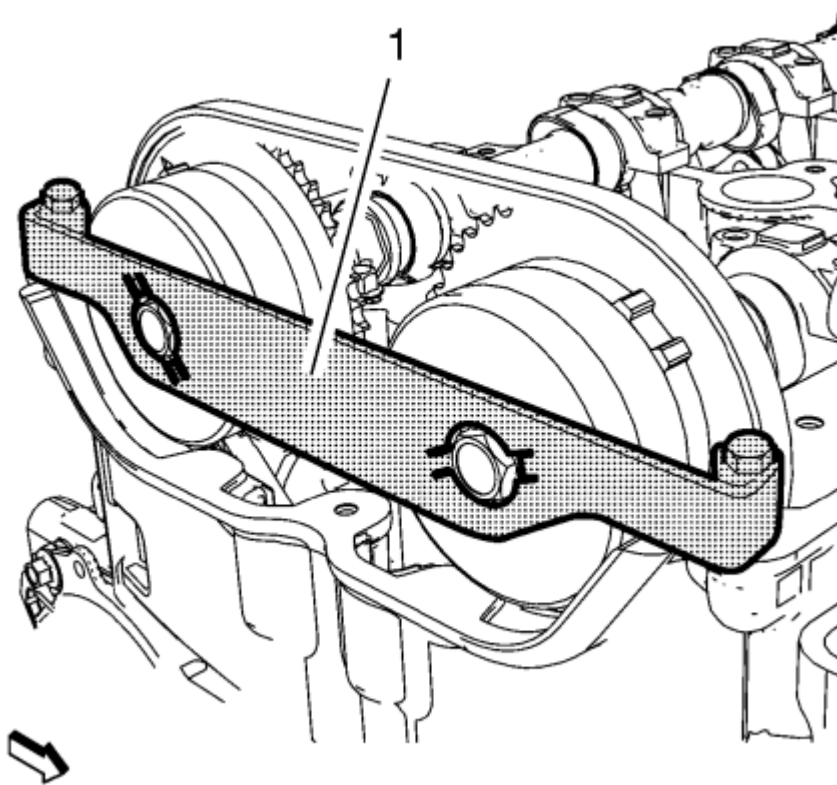
**Fig. 132: Camshaft Position Exhaust Actuator & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Install the exhaust camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.



**Fig. 133: Open Ended Wrench & Actuator Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

8. Rotate the intake camshaft with a open ended wrench to install the camshaft intake actuator on the marked points.
9. Install the NEW camshaft position intake actuator bolt (1) and hand tighten.
10. Rotate the exhaust camshaft with a open ended wrench (1) to install the camshaft exhaust actuator on the marked points.
11. Install the NEW camshaft position exhaust actuator bolt handtighten.
12. Remove both **EN-48749** retention tool from the timing chain.
13. Reset and install the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



**Fig. 134: Crankshaft Locking Tool**  
Courtesy of GENERAL MOTORS COMPANY

14. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1) to the camshafts.
15. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).

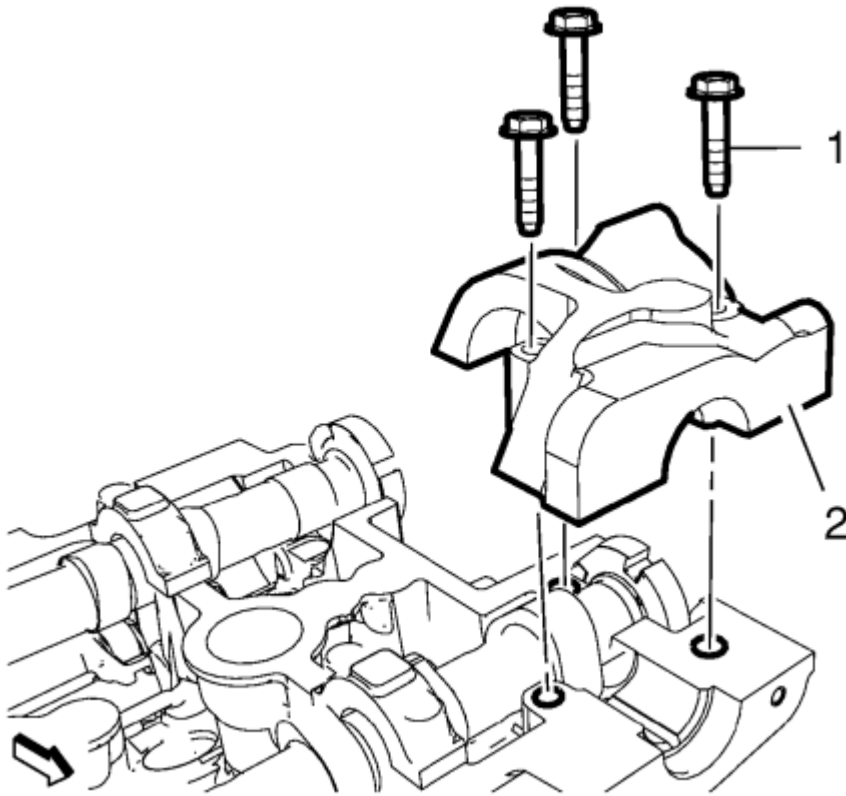
**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

16. Tighten the intake camshaft actuator bolt a first pass to 30 N.m (22 lb ft).
17. Tighten the intake camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

18. Tighten the exhaust camshaft actuator bolt a first pass to 30 N.m (22 lb ft).
19. Tighten the exhaust camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.

20. Remove the **EN-48953** locking tool.



**Fig. 135: Rear Bearing Block & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

21. Install the rear bearing block (2) and tighten the 3 rear bearing block bolts (1) to 12 N.m (106 lb in).
22. Rotate the crankshaft clockwise at the crankshaft balancer bolt to 720 degrees and ensure that the marks are still fit. If the marks are not fit, refer to **Camshaft Timing Chain, Sprocket and Tensioner Replacement**.
23. Install the fuel pump. Refer to **Fuel Pump Replacement**.
24. Install the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**.
25. Install the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
26. Install the spark plugs. Refer to **Spark Plug Replacement**.
27. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.
28. Install the dash upper extension panel opening cover. Refer to **Dash Upper Extension Panel Opening Cover Replacement**.

## EXHAUST CAMSHAFT REPLACEMENT

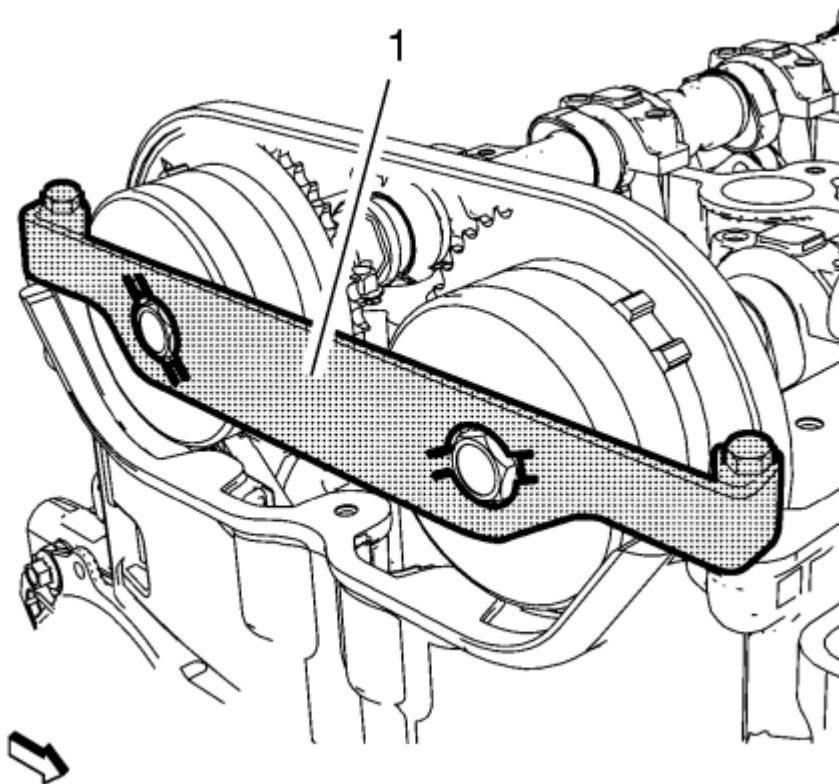
### Special Tools

- **EN-45059** Angle Meter
- **EN-48749** Timing Chain Retention Tool
- **EN-48953** Camshaft Actuator Locking Tool

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

#### **Removal Procedure**

1. Remove the dash upper extension panel opening cover. Refer to **Dash Upper Extension Panel Opening Cover Replacement** .
2. Remove the power brake booster vacuum pump. Refer to **Power Brake Booster Pump Replacement (2.0L LHU)** .
3. Remove the spark plugs. Refer to **Spark Plug Replacement** .
4. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
5. Remove the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
6. Remove the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .



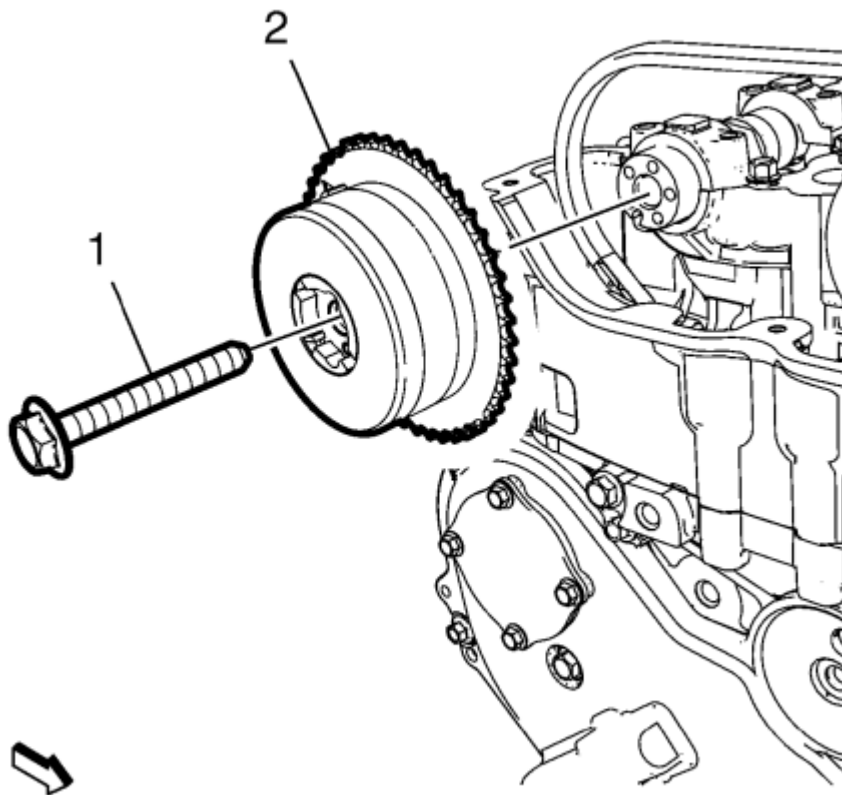
**Fig. 136: Crankshaft Locking Tool**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1)

to the camshafts.

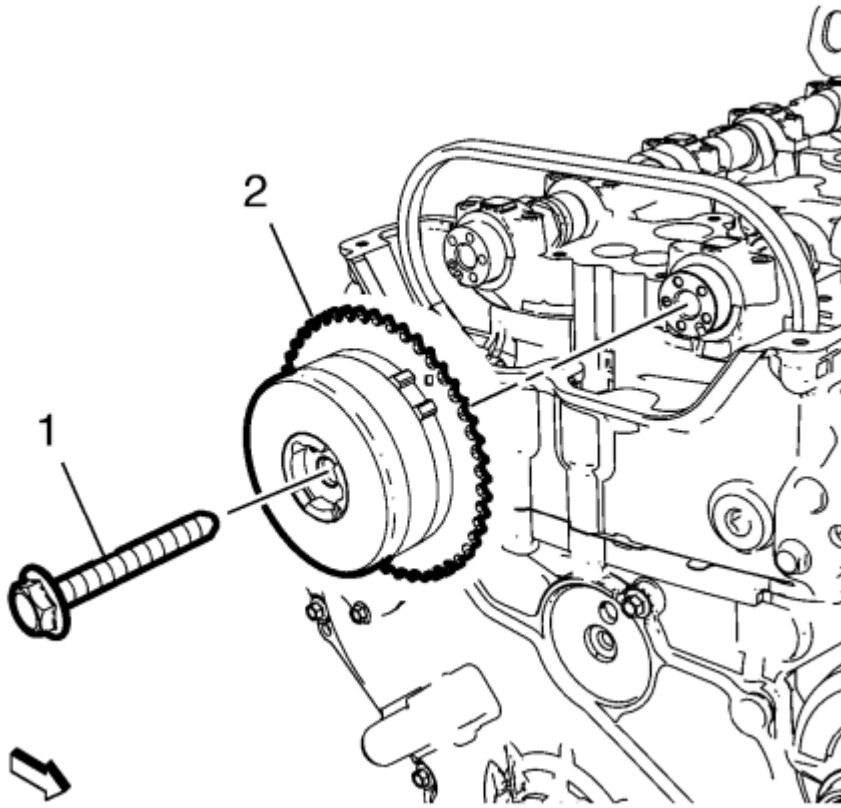
**CAUTION:** Refer to Fastener Caution .

8. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).



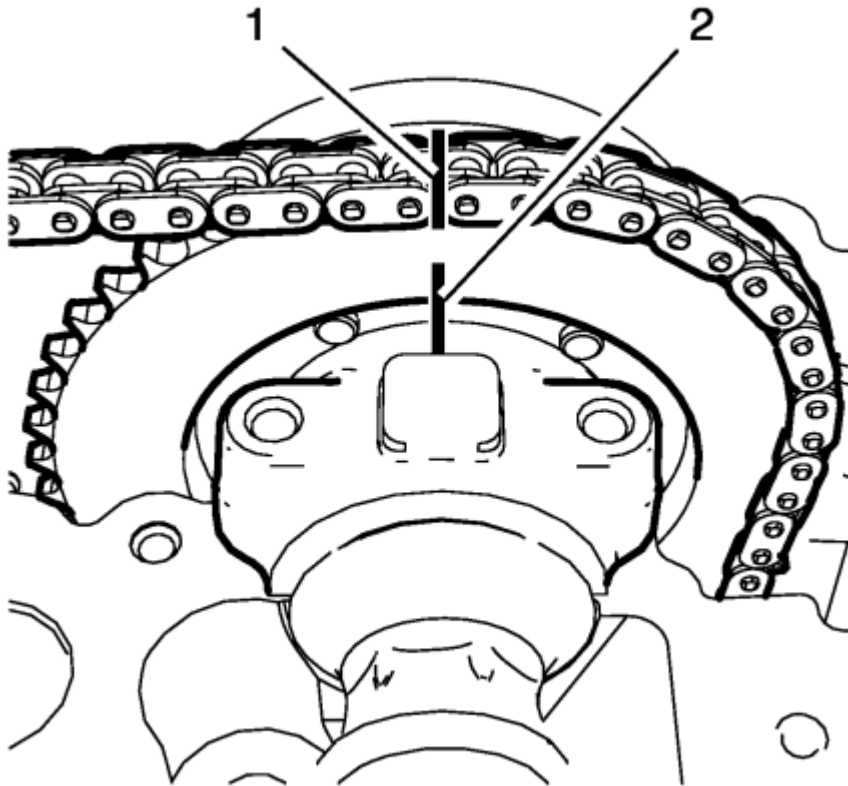
**Fig. 137: Camshaft Position Exhaust Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

9. Loosen, but DO NOT remove, the camshaft position exhaust actuator bolt (1) from the exhaust camshaft actuator (2).



**Fig. 138: Camshaft Intake Actuator & Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

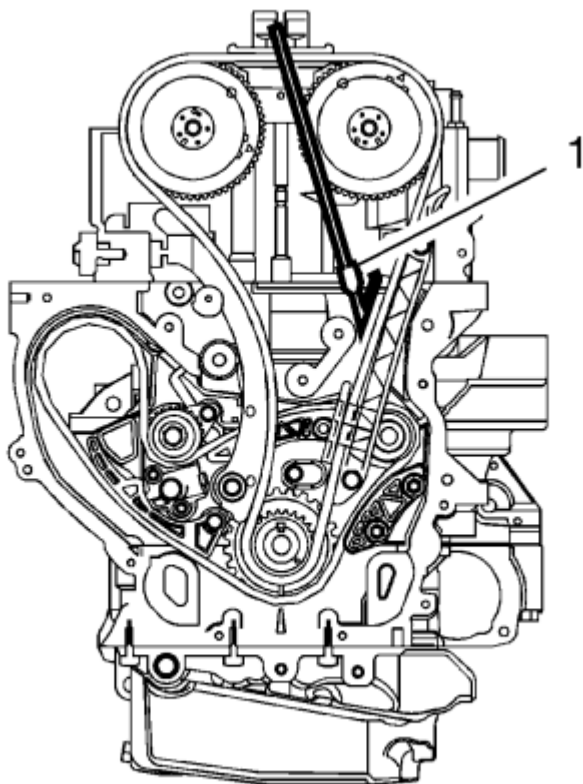
10. Loosen, but DO NOT remove, the camshaft position intake actuator bolt (1) from the camshaft position intake actuator (2).
11. Remove the **EN-48953** locking tool.
12. Rotate the crankshaft clockwise at the crankshaft balancer bolt to the TDC of the combustion stroke of cylinder 1.



**Fig. 139: Timing Chain & Camshaft Bearing Cover Marks**  
 Courtesy of GENERAL MOTORS COMPANY

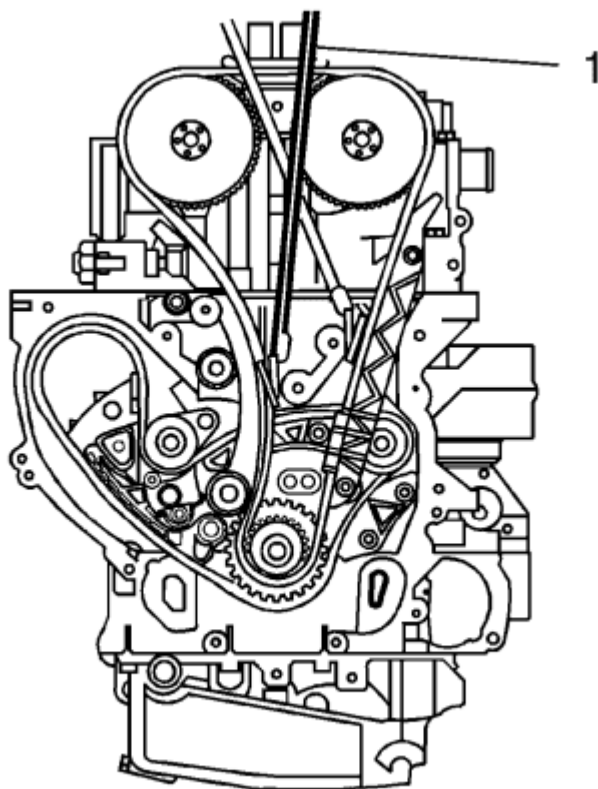
**NOTE:** Ensure the timing chain and the camshaft position actuators are marked for proper assembly.

13. Mark both camshaft actuators and their respective locations on the timing chain (1). Mark additional the position from the camshaft actuator to the camshaft bearing cover (2).
14. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



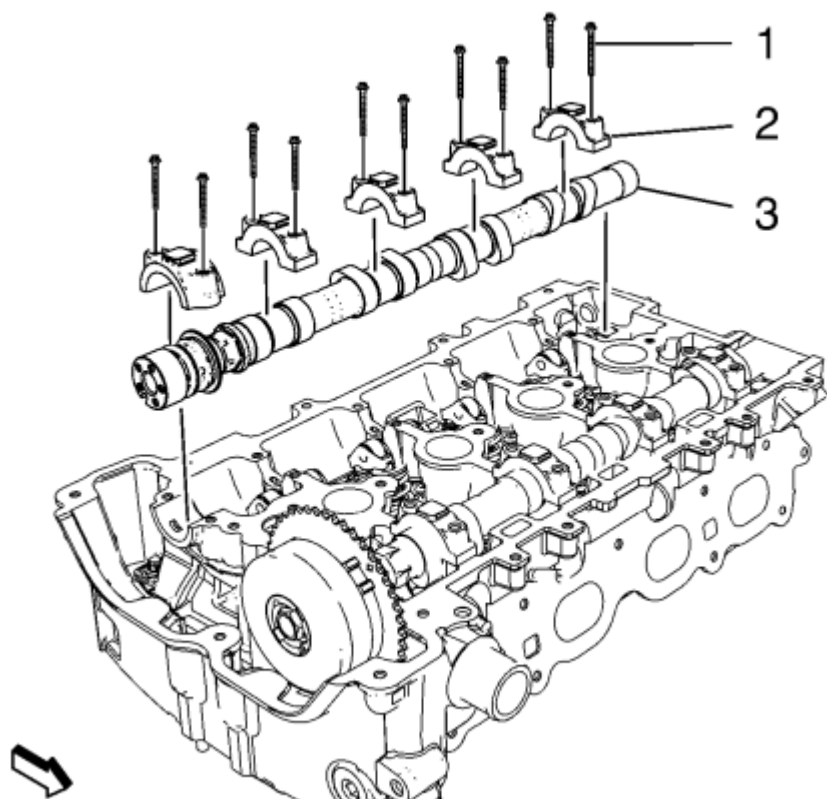
**Fig. 140: Timing Chain Retention Tool On Intake Side**  
**Courtesy of GENERAL MOTORS COMPANY**

15. Install the **EN-48749** retention tool (1) to the intake side of the timing chain.



**Fig. 141: Timing Chain Retention Tool On Exhaust Side**  
**Courtesy of GENERAL MOTORS COMPANY**

16. Install the **EN-48749** retention tool (1) to the exhaust side of the timing chain.
17. Remove and DISCARD the camshaft position exhaust actuator bolt.
18. Remove the exhaust camshaft actuator from the camshaft while also removing the actuator from the timing chain.
19. Remove and DISCARD the camshaft position intake actuator bolt.
20. Remove the intake camshaft actuator from the camshaft while also removing the actuator from the timing chain.
21. Mark the bearing caps to ensure they are installed in the original position.

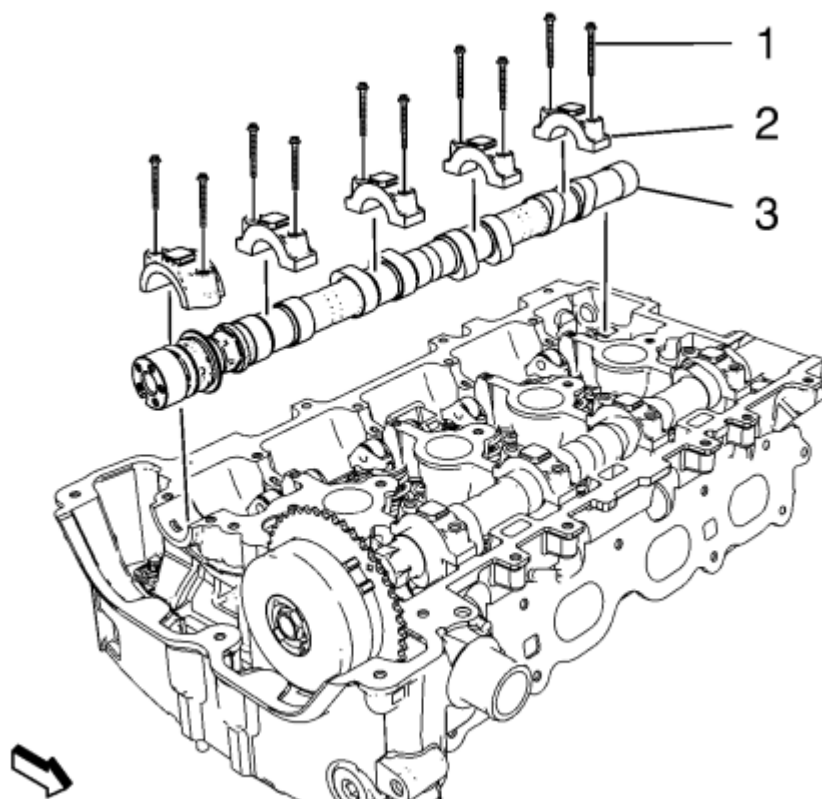


**Fig. 142: Exhaust Camshaft, Bearing Caps & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Remove each bolt on each cap one turn at a time until there is no spring tension pushing on the camshaft.

22. Remove the 10 bearing cap bolts (1)
23. Remove the 5 bearing caps (2)
24. Remove the exhaust camshaft (3).

#### Installation Procedure

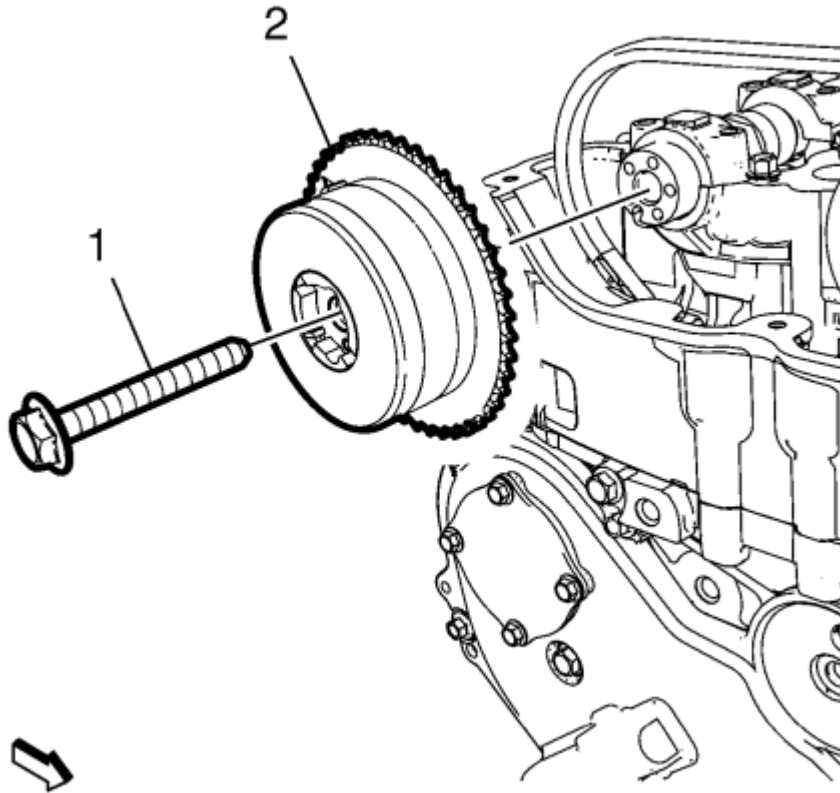


**Fig. 143: Exhaust Camshaft, Bearing Caps & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the exhaust camshaft (3).
2. Install the 5 bearing caps (2).
3. Install the 10 bearing cap bolts (1) hand tighten.

**CAUTION: Refer to Fastener Caution .**

4. Tighten the bearing cap bolts in increments of 3 turns until they are seated.
5. When all the bearing caps are seated, tighten the bolts to 10 N.m (89 lb in).

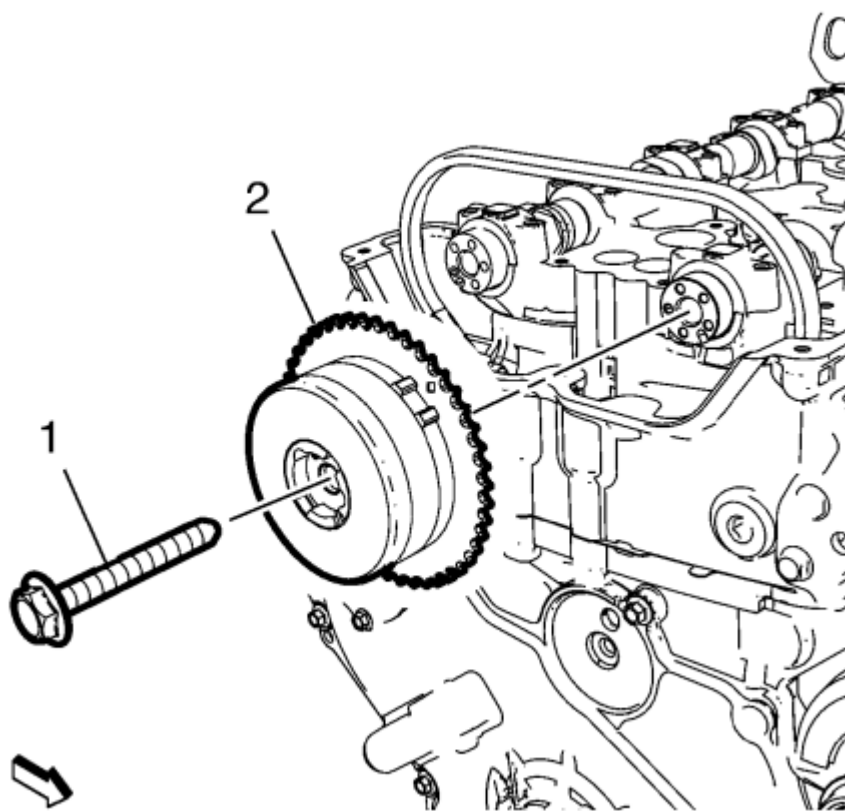


**Fig. 144: Camshaft Position Exhaust Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Ensure the timing chain and the camshaft position actuators are on their marked points.

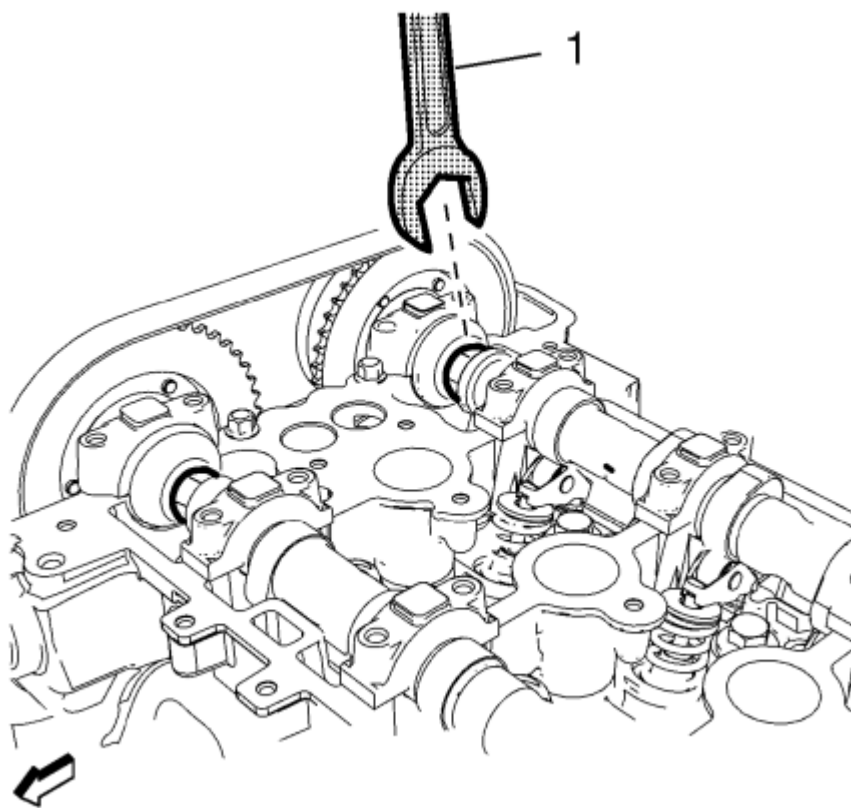
**Ensure that the exhaust camshaft actuator fully fits in the exhaust camshaft.**

6. Install the exhaust camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.



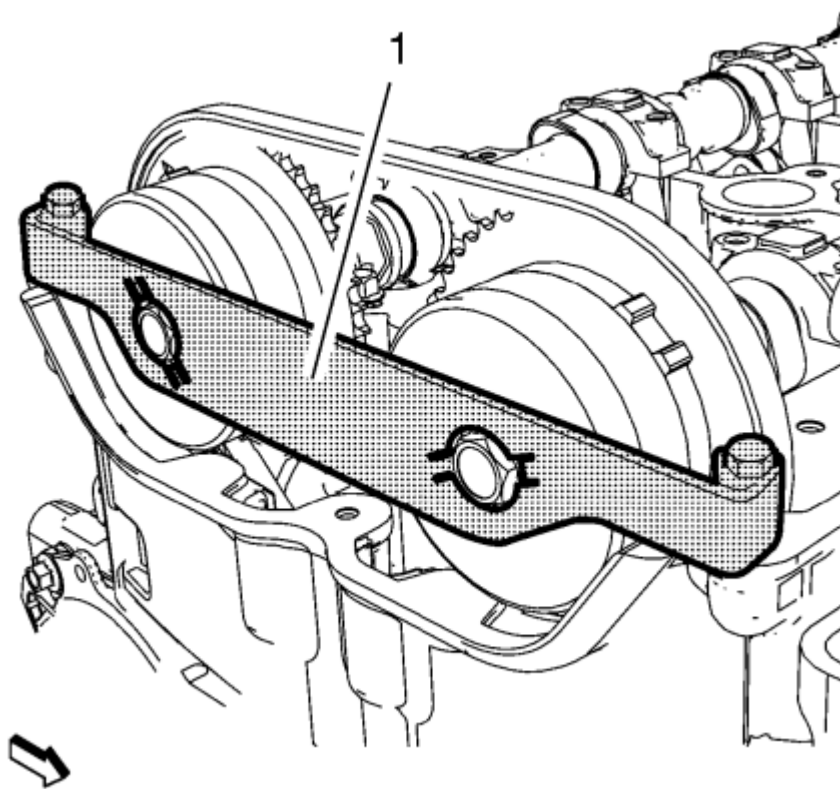
**Fig. 145: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

7. Install the intake camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.



**Fig. 146: Open Ended Wrench & Actuator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

8. Rotate the exhaust camshaft with a open ended wrench (1) to install the camshaft exhaust actuator on the marked points.
9. Install the NEW camshaft position exhaust actuator bolt hand tighten.
10. Rotate the intake camshaft with a open ended wrench (1) to install the camshaft intake actuator on the marked points.
11. Install the NEW camshaft position intake actuator bolt hand tighten.
12. Remove both **EN-48749** retention tool from the timing chain.
13. Reset and install the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



**Fig. 147: Crankshaft Locking Tool**  
Courtesy of GENERAL MOTORS COMPANY

14. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1) to the camshafts.
15. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

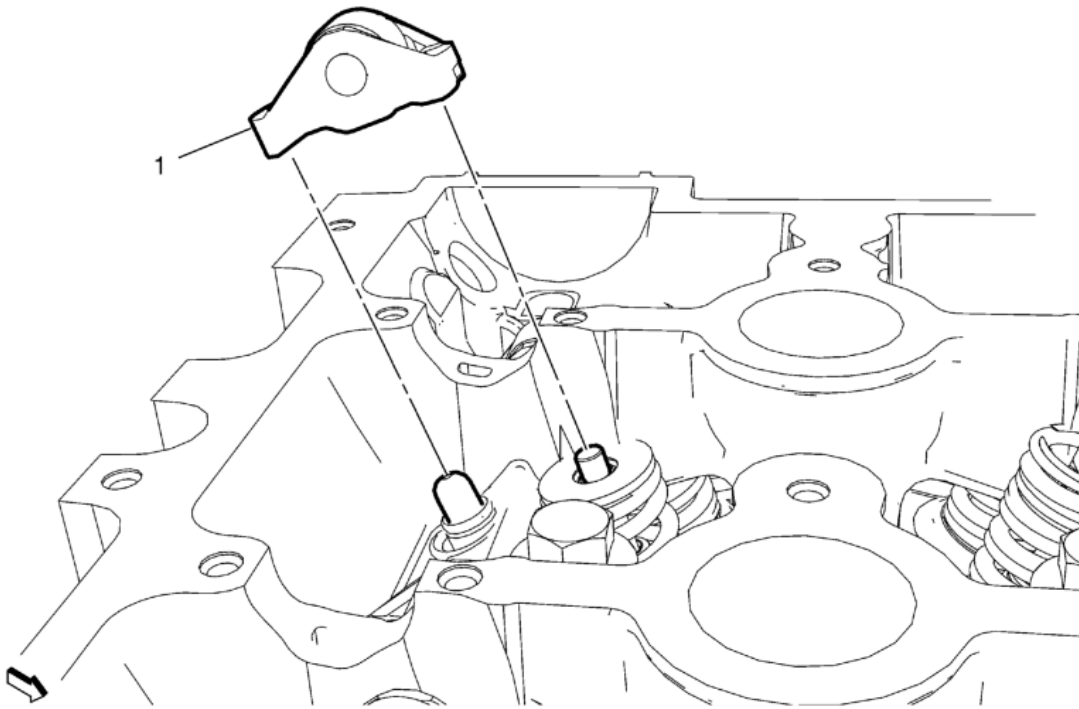
16. Tighten the NEW exhaust camshaft actuator bolt a first pass to 30 N.m (22 lb ft).
17. Tighten the exhaust camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

18. Tighten the NEW intake camshaft actuator bolt a first pass to 30 N.m (22 lb ft).
19. Tighten the intake camshaft actuator bolt a final pass to an additional 100 degrees, using the **EN-45059** meter.

20. Remove the **EN-48953** locking tool.
21. Rotate the crankshaft clockwise at the crankshaft balancer bolt to 720 degrees and ensure that the marks are still fit. If the marks are not fit, refer to **Camshaft Timing Chain, Sprocket and Tensioner Replacement**.
22. Install the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**.
23. Install the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
24. Install the spark plugs. Refer to **Spark Plug Replacement**.
25. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.
26. Install the power brake booster vacuum pump. Refer to **Power Brake Booster Pump Replacement (2.0L LHU)**.
27. Install the dash upper extension panel opening cover. Refer to **Dash Upper Extension Panel Opening Cover Replacement**.

## VALVE ROCKER ARM REPLACEMENT



**Fig. 148: Valve Rocker Arms**

Courtesy of GENERAL MOTORS COMPANY

### Valve Rocker Arm Replacement

| Callout                       | Component Name                                                                     |
|-------------------------------|------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> |                                                                                    |
| 1.                            | Remove the exhaust camshaft. Refer to <b><u>Exhaust Camshaft Replacement</u></b> . |

2. Remove the intake camshaft. Refer to **Intake Camshaft Replacement**.

|   |                            |
|---|----------------------------|
| 1 | Valve Rocker Arm (Qty: 16) |
|---|----------------------------|

## CAMSHAFT POSITION INTAKE ACTUATOR REPLACEMENT

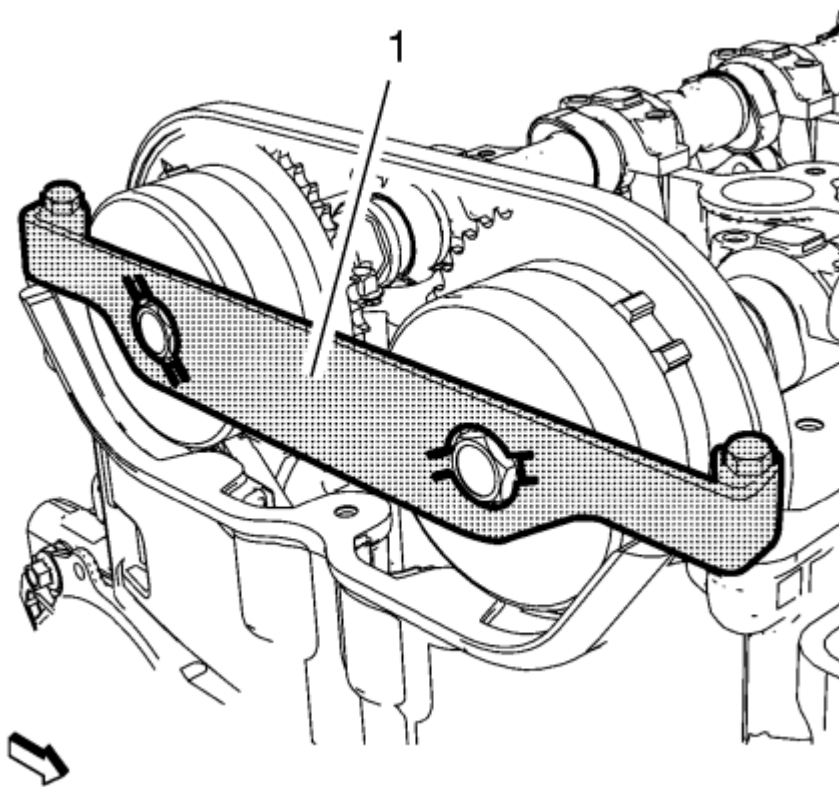
### Special Tools

- **EN-45059** Angle Meter
- **EN-48749** Timing Chain Retention Tool Kit
- **EN-48953** Camshaft Actuator Locking Tool

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

1. Remove the spark plugs. Refer to **Spark Plug Replacement** .
2. Remove the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
3. Remove the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .

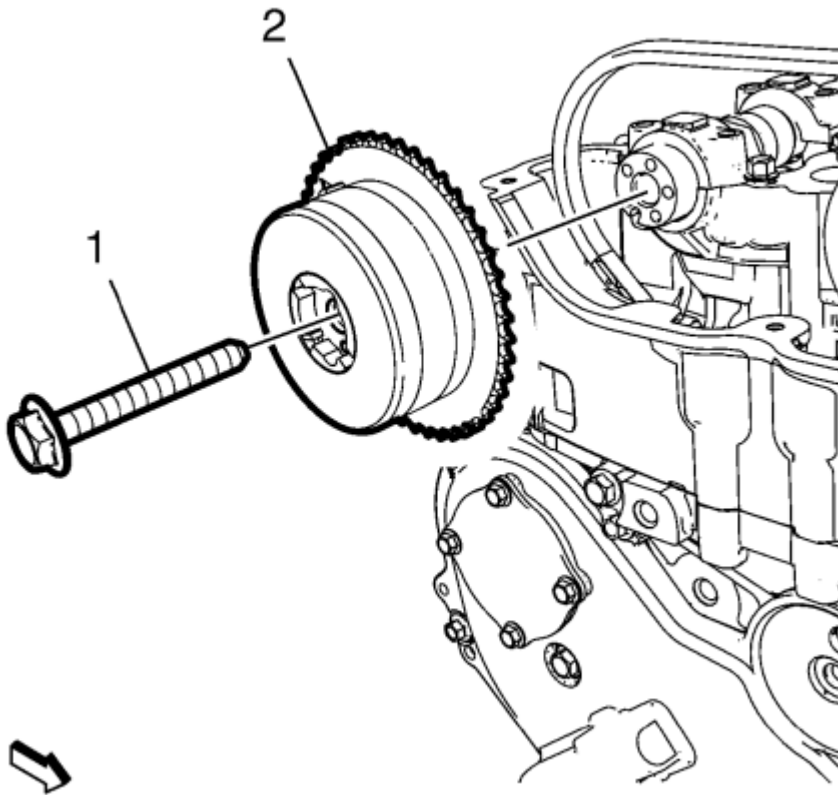


**Fig. 149: Crankshaft Locking Tool**  
 Courtesy of GENERAL MOTORS COMPANY

4. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1) to the camshafts.

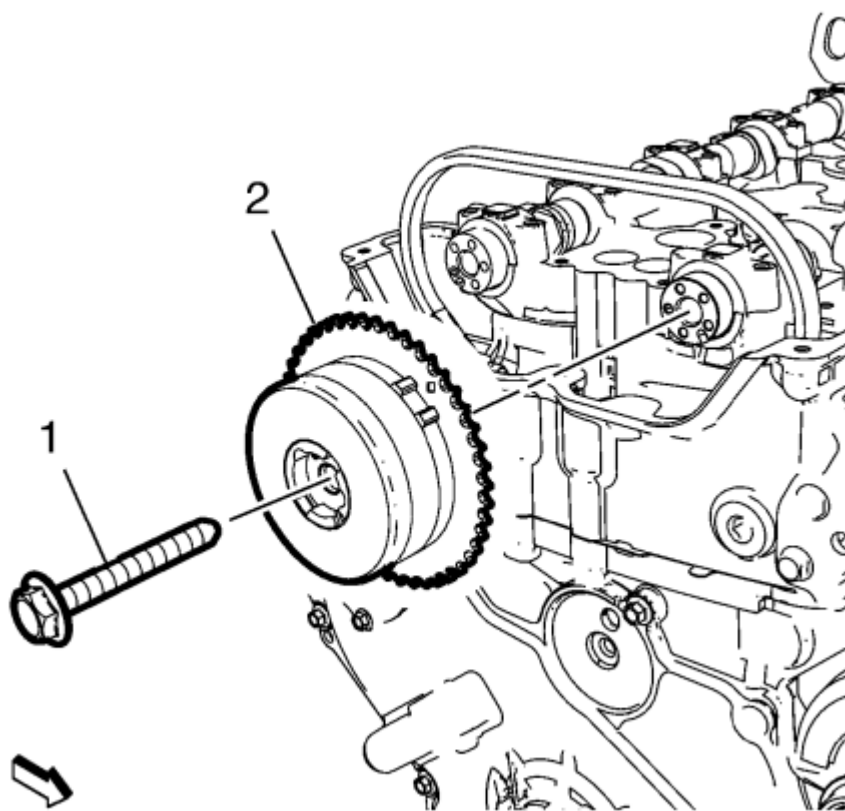
**CAUTION:** Refer to **Fastener Caution** .

5. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).



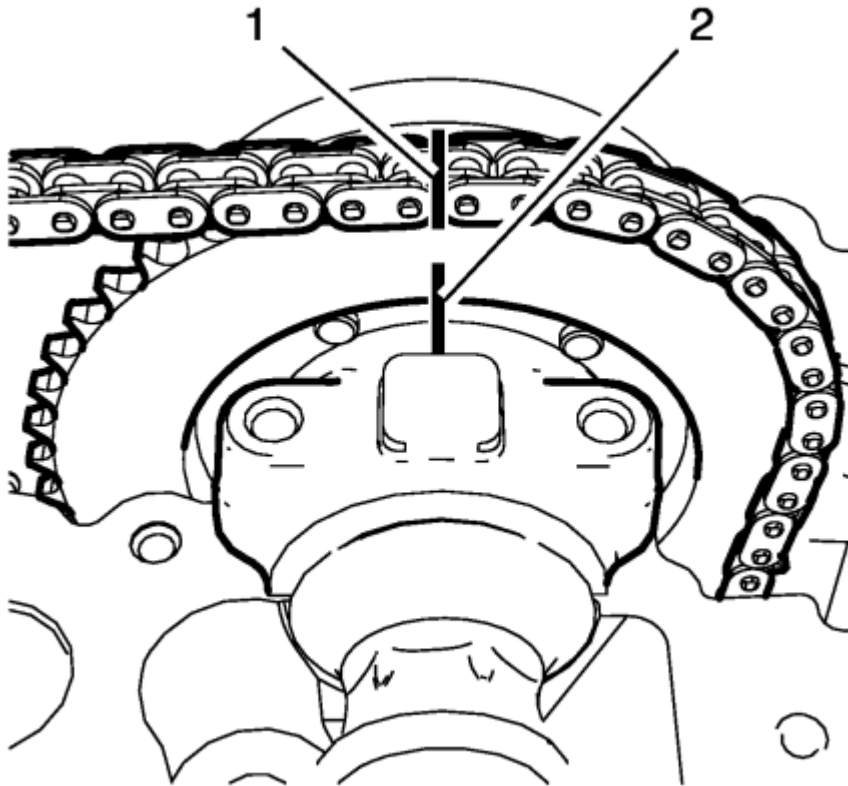
**Fig. 150: Camshaft Position Exhaust Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

6. Loosen, but DO NOT remove, the camshaft position exhaust actuator bolt (1)



**Fig. 151: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

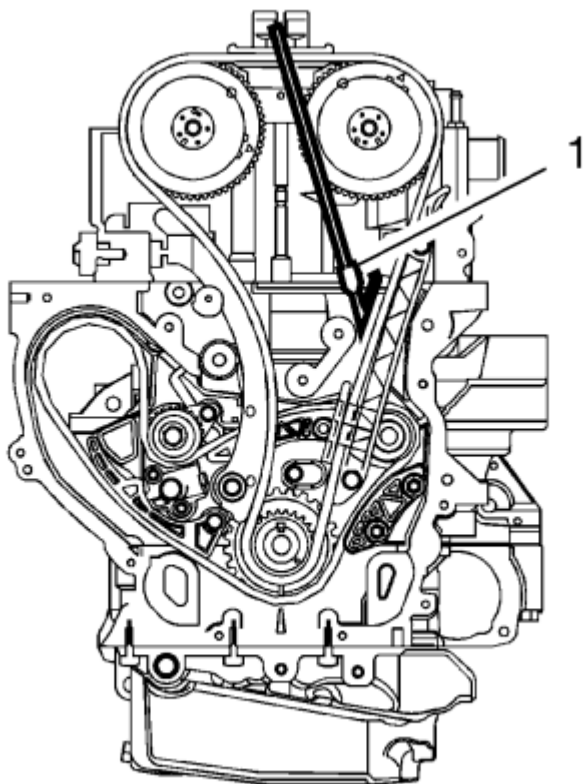
7. Loosen, but DO NOT remove, the camshaft position intake actuator bolt (1).
8. Remove the **EN-48953** locking tool.



**Fig. 152: Timing Chain & Camshaft Bearing Cover Marks**  
 Courtesy of GENERAL MOTORS COMPANY

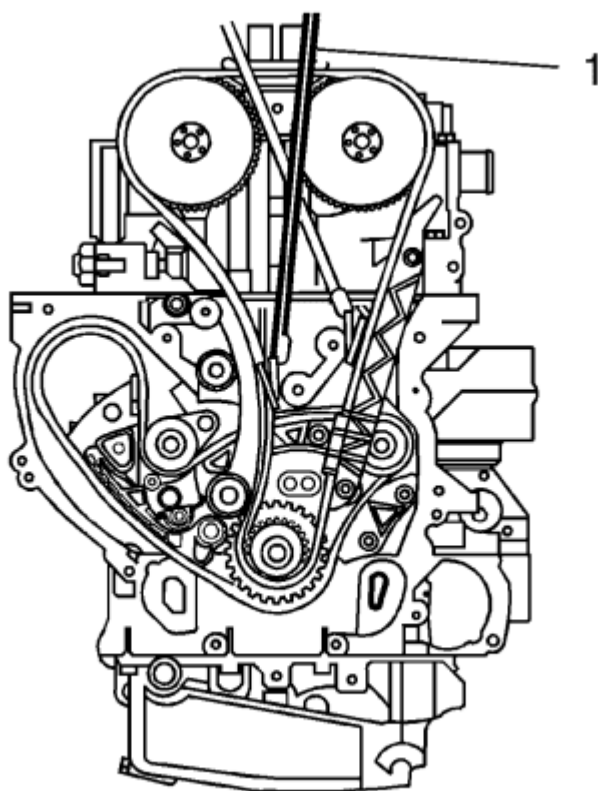
**NOTE:** Ensure the timing chain and the camshaft position actuators are marked for proper assembly.

9. Mark the intake and exhaust camshaft actuators and the respective locations on the timing chain (1). Mark additional the position from each camshaft actuator to the camshaft bearing cover (2).
10. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



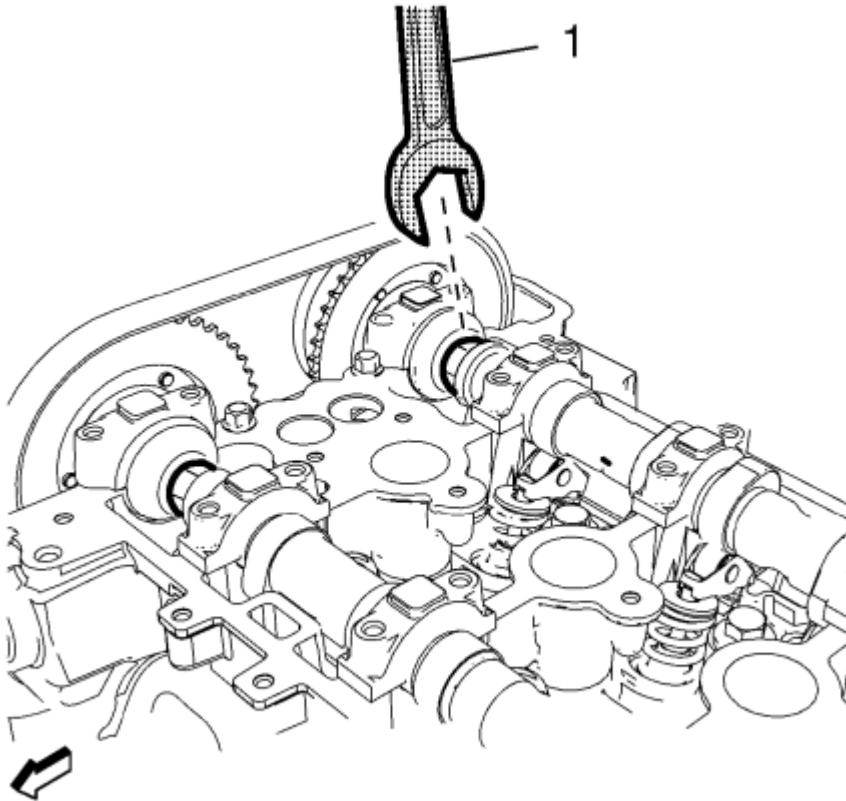
**Fig. 153: Timing Chain Retention Tool On Intake Side**  
**Courtesy of GENERAL MOTORS COMPANY**

11. Install the **EN-48749** retention tool (1) to the intake side of the timing chain.



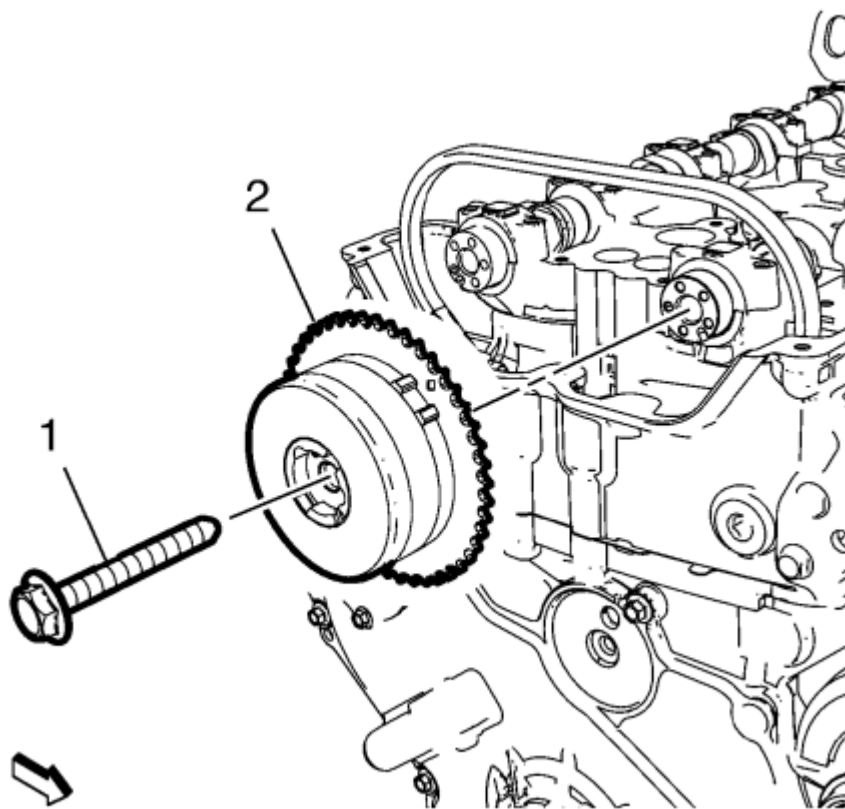
**Fig. 154: Timing Chain Retention Tool On Exhaust Side**  
**Courtesy of GENERAL MOTORS COMPANY**

12. Install the **EN-48749** retention tool (1) to the exhaust side of the timing chain.
13. Remove and DISCARD the camshaft position exhaust actuator bolt.



**Fig. 155: Open Ended Wrench & Actuator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

14. Rotate the exhaust camshaft clockwise with a open ended wrench slightly to take the tension off of the timing chain.
15. Remove the exhaust camshaft actuator from the camshaft while also removing the actuator from the timing chain.
16. Release tension from the exhaust camshaft and allow the exhaust camshaft to slide back slowly.



**Fig. 156: Camshaft Intake Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

17. Remove and DISCARD the camshaft position intake actuator bolt (1)
18. Remove the intake camshaft actuator (2) from the camshaft while also removing the actuator from the timing chain.

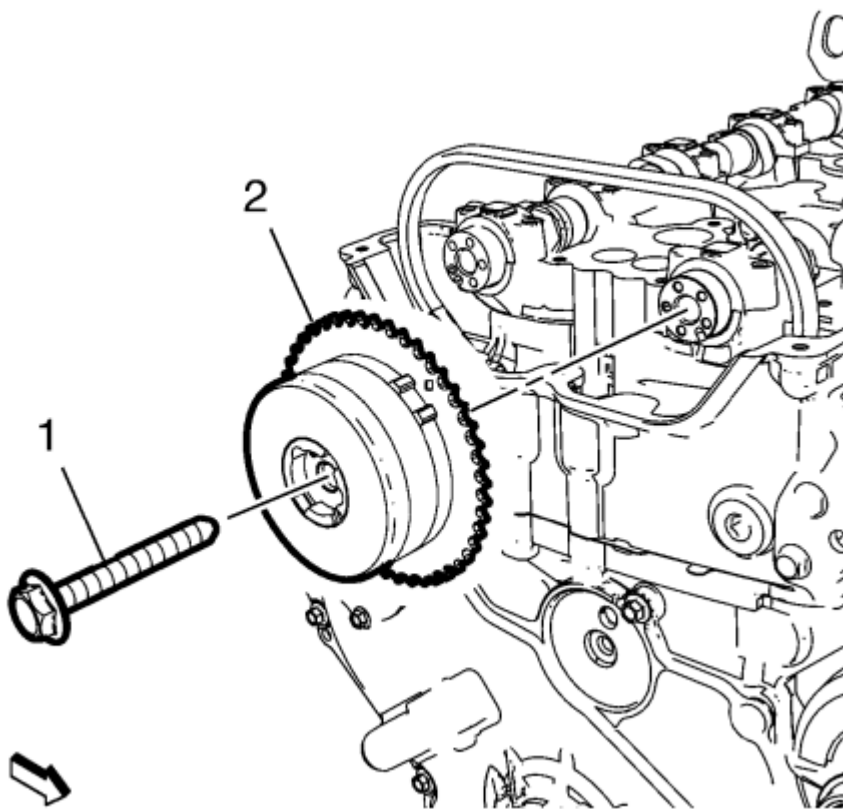
#### Installation Procedure

1. Mark the new intake camshaft actuator at the same point as the old intake camshaft actuator.

**NOTE:** Ensure the timing chain and the camshaft position actuator is the marked points.

**Ensure that the intake camshaft actuator fully fits in the intake camshaft.**

2. Rotate the intake camshaft clockwise with a open ended wrench slightly to fit the intake camshaft actuator in the intake camshaft.



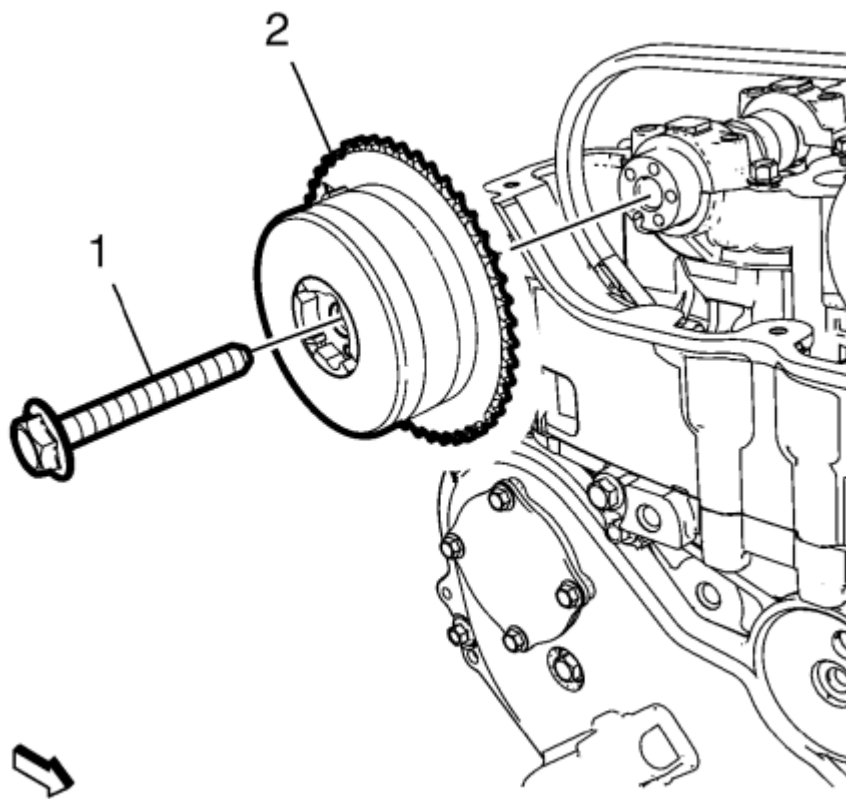
**Fig. 157: Camshaft Intake Actuator & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Install the intake camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.
4. Release tension slowly from the intake camshaft.
5. Install the NEW camshaft position intake actuator bolt (1) handtighten.
6. Mark the new camshaft exhaust actuator at the same point as the old camshaft exhaust actuator.

**NOTE:**      **Ensure the timing chain and the camshaft position actuators are on their marked points.**

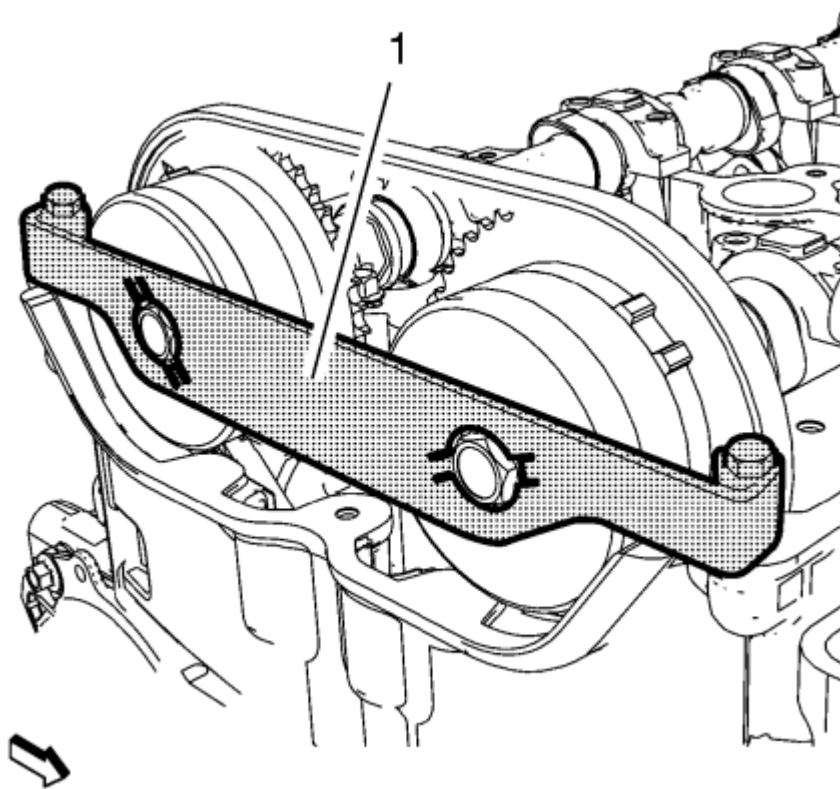
**Ensure that the exhaust camshaft actuator fully fits in the exhaust camshaft.**

7. Rotate the exhaust camshaft clockwise with a open ended wrench slightly to fit the exhaust camshaft actuator in the exhaust camshaft.



**Fig. 158: Camshaft Position Exhaust Actuator & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

8. Install the exhaust camshaft actuator (2) to the exhaust camshaft while also installing the actuator at the timing chain.
9. Release tension slowly from the exhaust camshaft.
10. Install the NEW camshaft position exhaust actuator bolt (1) handtighten.
11. Remove both **EN-48749** retention tool from the timing chain.
12. Reset and install the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



**Fig. 159: Crankshaft Locking Tool**  
Courtesy of GENERAL MOTORS COMPANY

13. Install the **EN-48953** locking tool (1) to the camshafts.

**CAUTION: Refer to Fastener Caution .**

14. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).
15. Tighten the exhaust camshaft actuator (2) a first pass to 30 N.m (22 lb ft).

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

16. Tighten the exhaust camshaft actuator (2) a final pass to an additional 100°, using the **EN-45059** meter.
17. Tighten the intake camshaft actuator (2) a first pass to 30 N.m (22 lb ft).

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

18. Tighten the intake camshaft actuator (2) a final pass to an additional 100°, using the **EN-45059** meter.
19. Remove the **EN-48953** locking tool.
20. Rotate the crankshaft clockwise at the crankshaft balancer bolt to 720 degrees and ensure that the marks are still fit. If the marks are not fit, refer to **Camshaft Timing Chain, Sprocket and Tensioner Replacement**.
21. Install the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
22. Install the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
23. Install the 4 spark plugs. Refer to **Spark Plug Replacement** .

## **CAMSHAFT POSITION EXHAUST ACTUATOR REPLACEMENT**

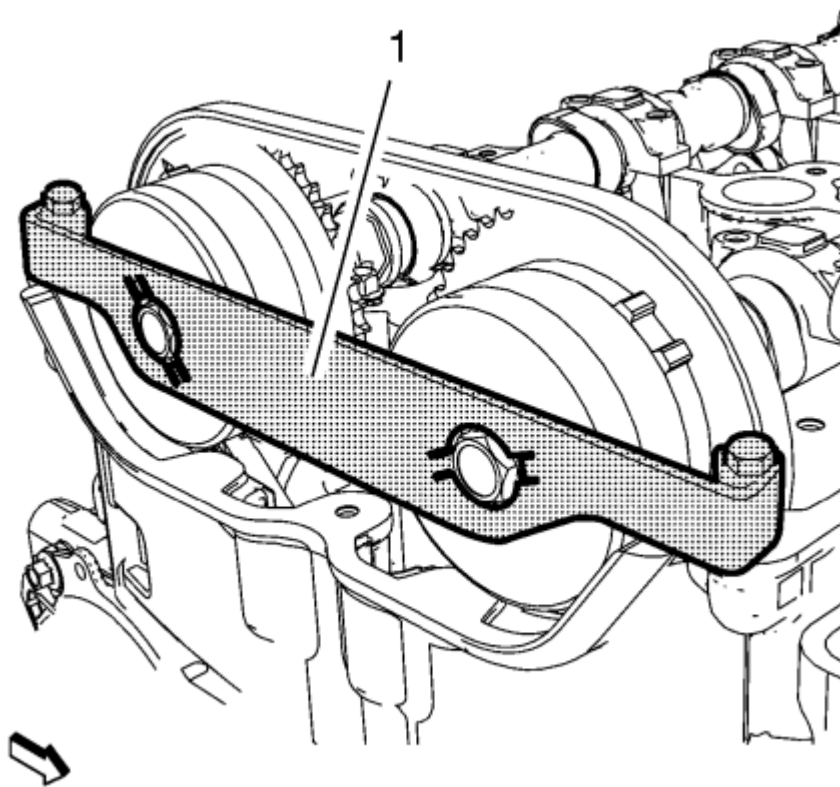
### **Special Tools**

- **EN-45059** Angle Meter
- **EN-48749** Timing Chain Retention Tool Kit
- **EN-48953** Camshaft Actuator Locking Tool

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### **Removal Procedure**

1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** .
3. Remove the upper timing chain guide. Refer to **Timing Chain Upper Guide Replacement**.
4. Remove the front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .

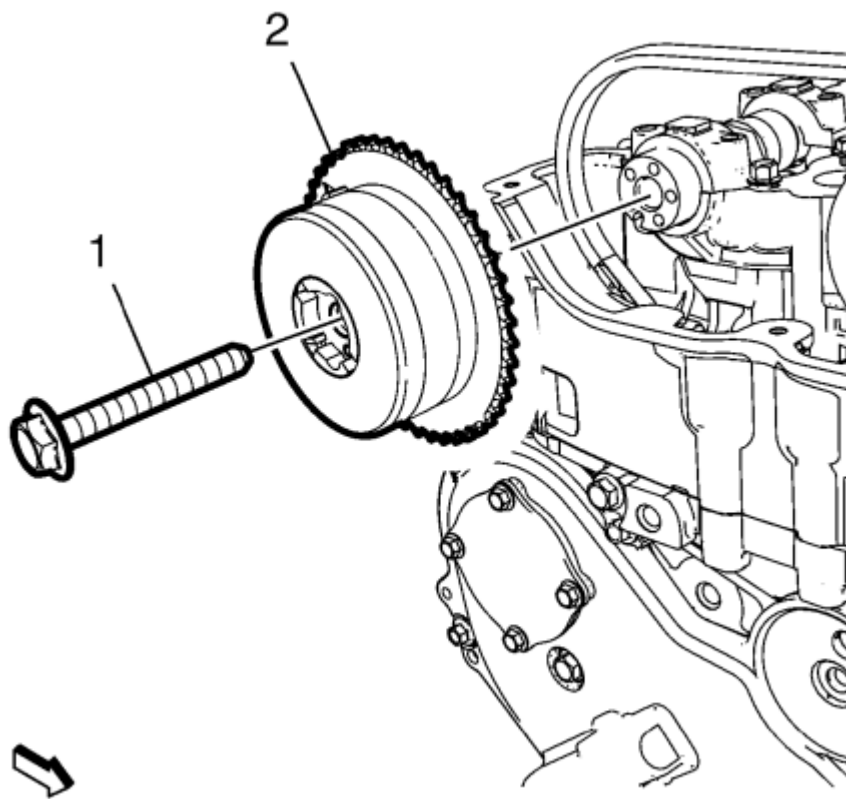


**Fig. 160: Crankshaft Locking Tool**  
 Courtesy of GENERAL MOTORS COMPANY

5. Rotate the crankshaft clockwise at the crankshaft balancer bolt and install the **EN-48953** locking tool (1) to the camshafts.

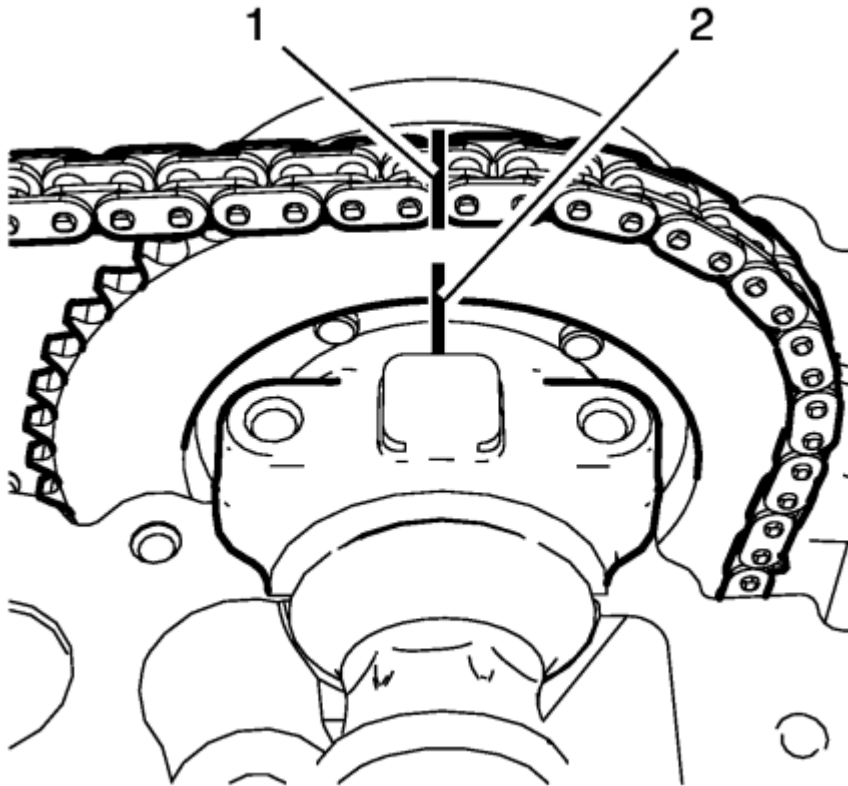
**CAUTION: Refer to Fastener Caution .**

6. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).



**Fig. 161: Camshaft Position Exhaust Actuator & Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

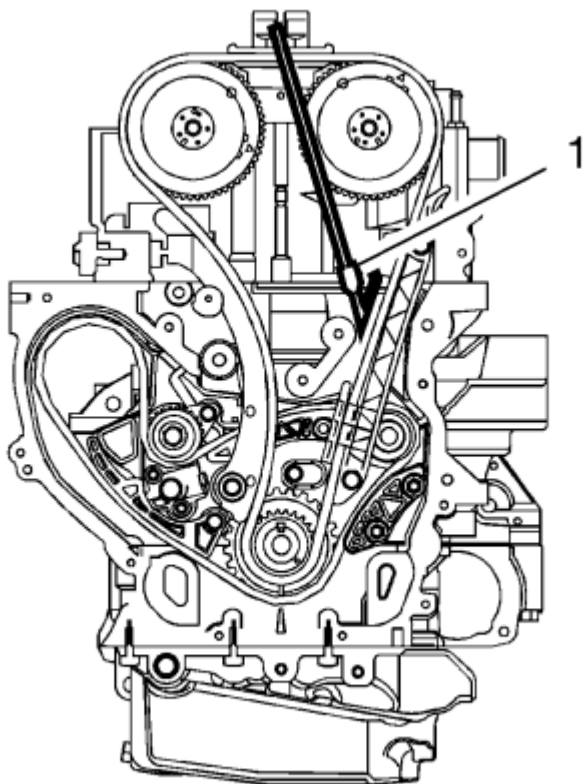
7. Loosen, but DO NOT remove, the camshaft position exhaust actuator bolt (1).
8. Remove the **EN-48953** locking tool.



**Fig. 162: Timing Chain & Camshaft Bearing Cover Marks**  
 Courtesy of GENERAL MOTORS COMPANY

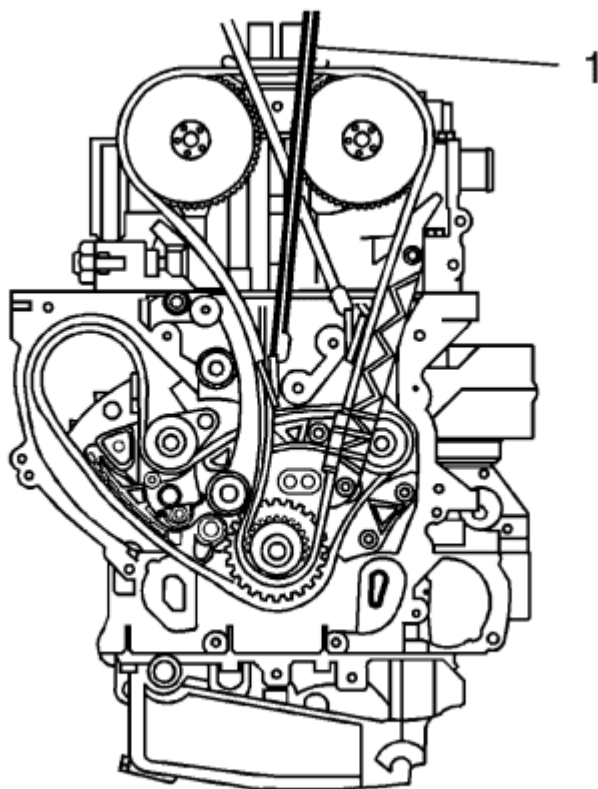
**NOTE:** Ensure the timing chain and the camshaft position actuators are marked for proper assembly.

9. Mark the intake and exhaust camshaft actuators and the respective locations on the timing chain (1). Mark additional the position from each camshaft actuator to the camshaft bearing cover (2).
10. Remove the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



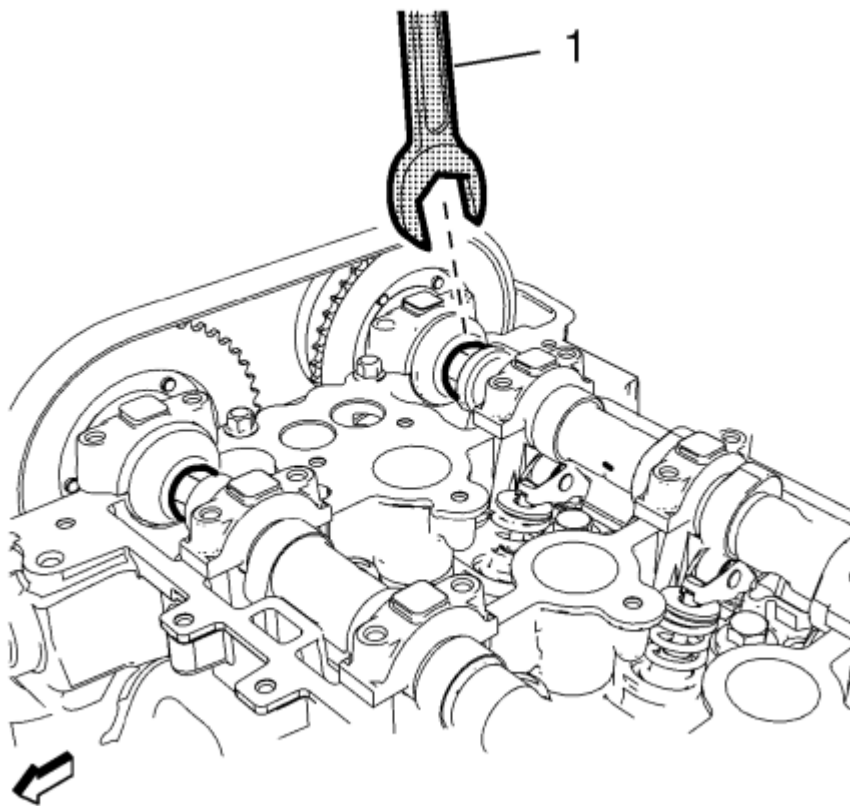
**Fig. 163: Timing Chain Retention Tool On Intake Side**  
Courtesy of GENERAL MOTORS COMPANY

11. Install the **EN-48749** retention tool (1) to the intake side of the timing chain.



**Fig. 164: Timing Chain Retention Tool On Exhaust Side**  
**Courtesy of GENERAL MOTORS COMPANY**

12. Install the **EN-48749** retention tool (1) to the exhaust side of the timing chain.
13. Remove and DISCARD the camshaft position exhaust actuator bolt.



**Fig. 165: Open Ended Wrench & Actuator Bolt**  
**Courtesy of GENERAL MOTORS COMPANY**

14. Rotate the exhaust camshaft clockwise with a open ended wrench slightly to take the tension off of the timing chain on the intake actuator.
15. Remove the exhaust camshaft actuator (2) from the camshaft while also removing the actuator from the timing chain.
16. Release tension from the exhaust camshaft and allow the exhaust camshaft to slide back slowly.

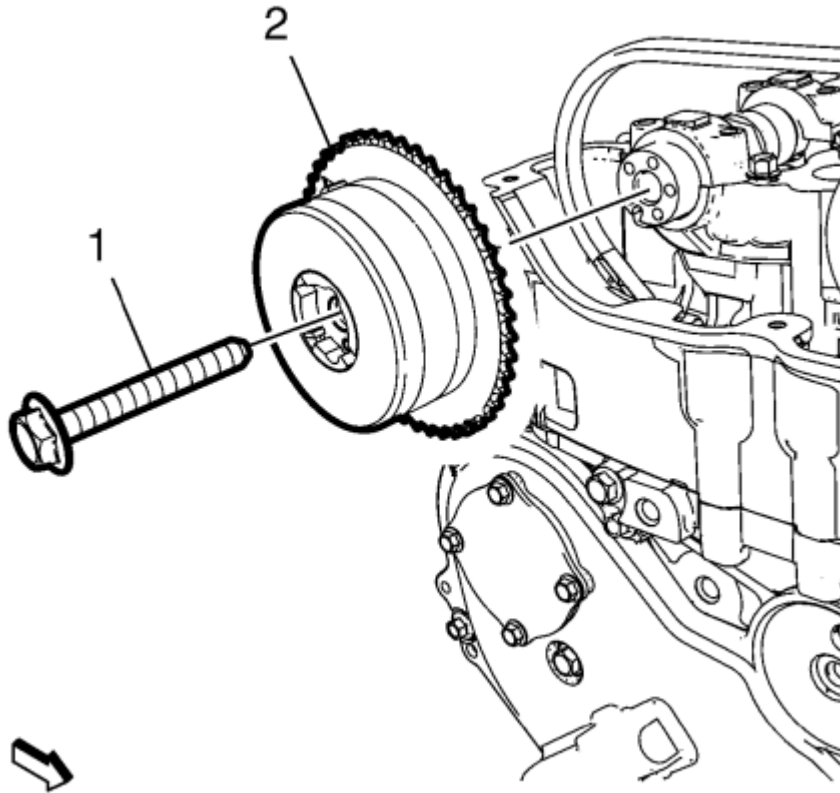
#### **Installation Procedure**

1. Mark the new exhaust camshaft actuator at the same point as the old exhaust camshaft actuator.

**NOTE:**        **Ensure the timing chain and the camshaft position actuators are on their marked points.**

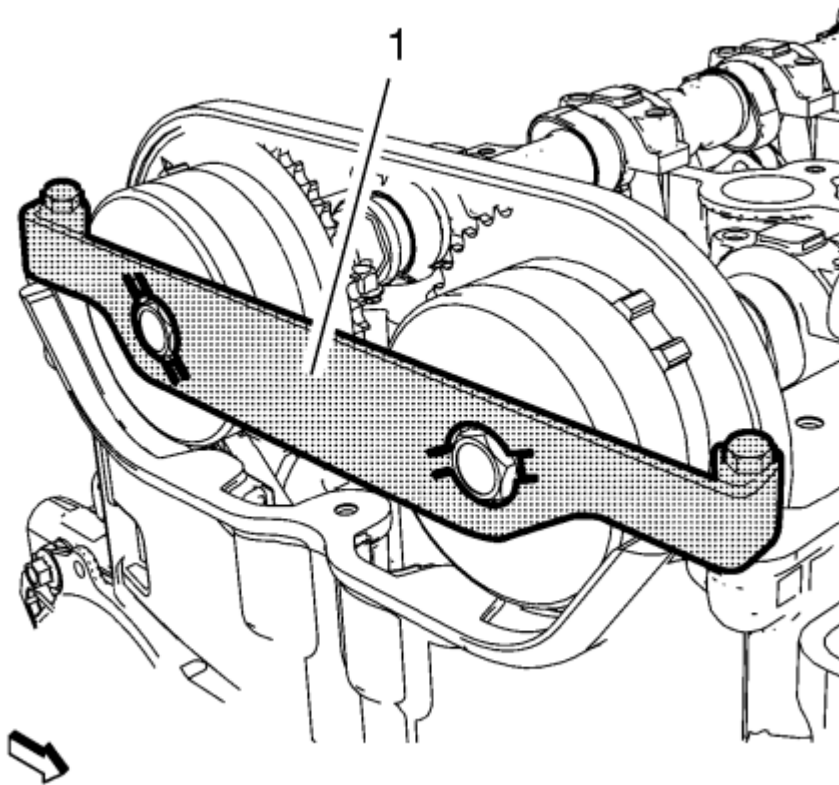
**Ensure that the exhaust camshaft actuator fully fits in the exhaust camshaft.**

2. Rotate the exhaust camshaft clockwise with a open ended wrench slightly to fit the exhaust camshaft actuator in the exhaust camshaft.



**Fig. 166: Camshaft Position Exhaust Actuator & Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

3. Install the exhaust camshaft actuator (2) to the camshaft while also installing the actuator at the timing chain.
4. Release tension slowly from the exhaust camshaft.
5. Install the NEW camshaft position exhaust actuator bolt (1) hand tighten.
6. Remove both **EN-48749** retention tool from the timing chain.
7. Reset and install the timing chain tensioner. Refer to **Timing Chain Tensioner Replacement**.



**Fig. 167: Crankshaft Locking Tool**  
Courtesy of GENERAL MOTORS COMPANY

8. Install the **EN-48953** locking tool (1) to the camshafts.

**CAUTION: Refer to Fastener Caution .**

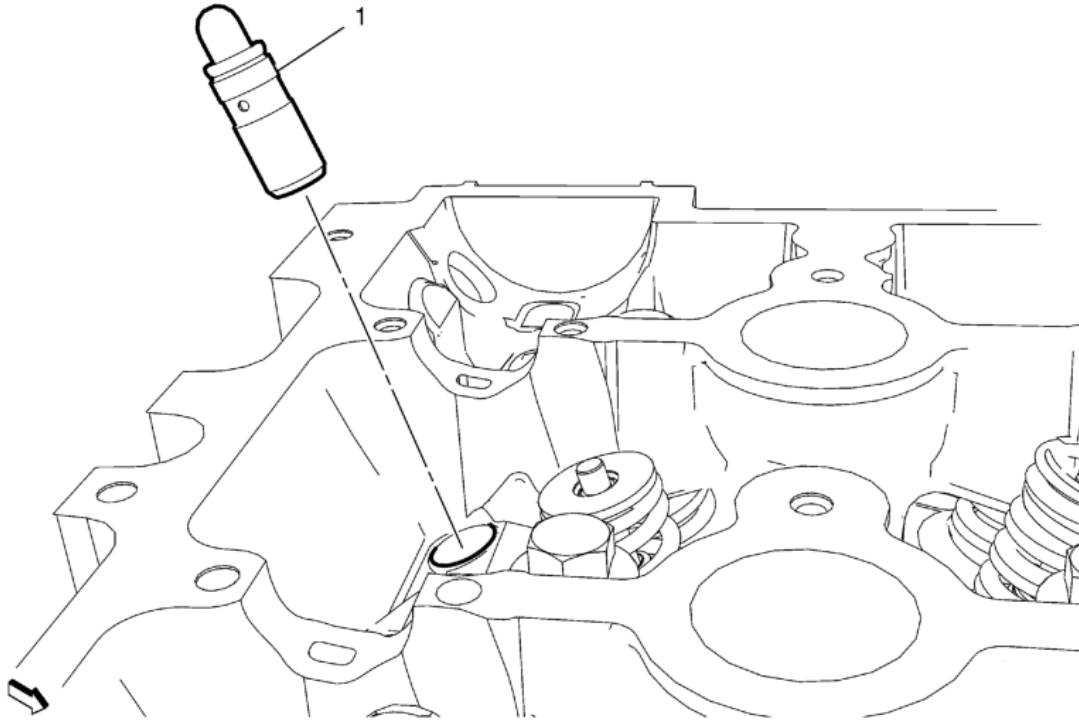
9. Install the **EN-48953** locking tool bolts and tighten to 10 N.m (89 lb in).

**CAUTION: Refer to Torque-to-Yield Fastener Caution .**

10. Tighten the NEW exhaust camshaft actuator bolts (2) a first pass in the sequence shown to 30 N.m (22 lb in).
11. Tighten the exhaust camshaft actuator bolts a final pass in the sequence shown to an additional 100 degrees, using the **EN-45059** meter.
12. Remove the **EN-48953** locking tool.
13. Rotate the crankshaft clockwise at the crankshaft balancer bolt to 720 degrees and ensure that the marks are still fit. If the marks are not fit, refer to **Camshaft Timing Chain, Sprocket and Tensioner Replacement**.

14. Install the front wheelhouse liner. Refer to [Front Wheelhouse Liner Replacement](#).
15. Install the upper timing chain guide. Refer to [Timing Chain Upper Guide Replacement](#).
16. Install the spark plugs. Refer to [Spark Plug Replacement](#).
17. Install the camshaft cover. Refer to [Camshaft Cover Replacement](#).

## HYDRAULIC VALVE LASH ADJUSTER REPLACEMENT



**Fig. 168: Hydraulic Valve Lash Adjusters**  
 Courtesy of GENERAL MOTORS COMPANY

### Hydraulic Valve Lash Adjuster Replacement

| Callout                                                                                                                                                                                                                                                                                                                                 | Component Name                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                           |                                                                                                                               |
| <ol style="list-style-type: none"> <li>1. Remove the exhaust camshaft. Refer to <a href="#">Exhaust Camshaft Replacement</a>.</li> <li>2. Remove the intake camshaft. Refer to <a href="#">Intake Camshaft Replacement</a>.</li> <li>3. Remove the valve rocker arms. Refer to <a href="#">Valve Rocker Arm Replacement</a>.</li> </ol> |                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                       | Hydraulic Valve Lash Adjuster (Qty: 16)<br><b>Procedure</b><br>Install the new hydraulic valve lash adjuster with engine oil. |

## VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

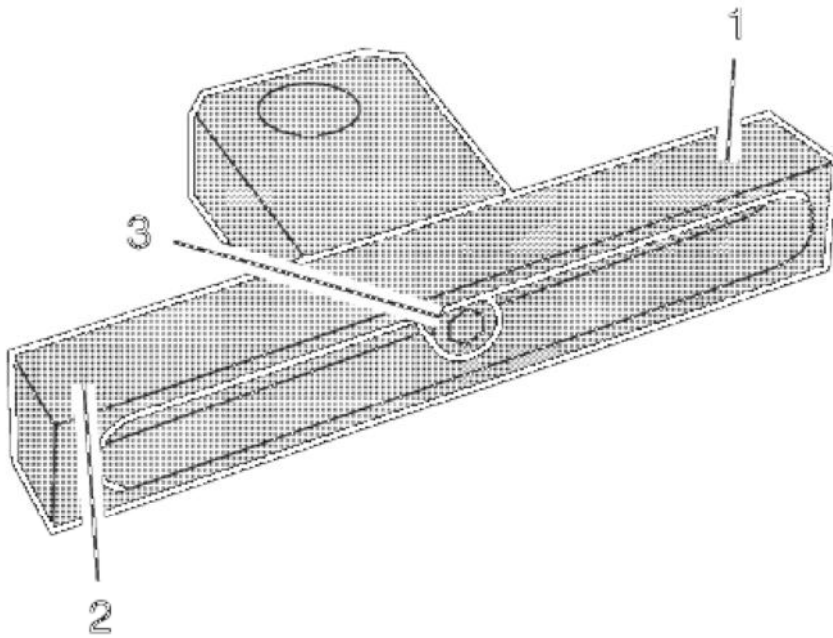
### Special Tools

- **EN-840** Pliers/Remover
- **EN-6086** Basic Kit, Spring and Wedge Replacer
- **EN-6152** Valve Stem Oil Seal Installer

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

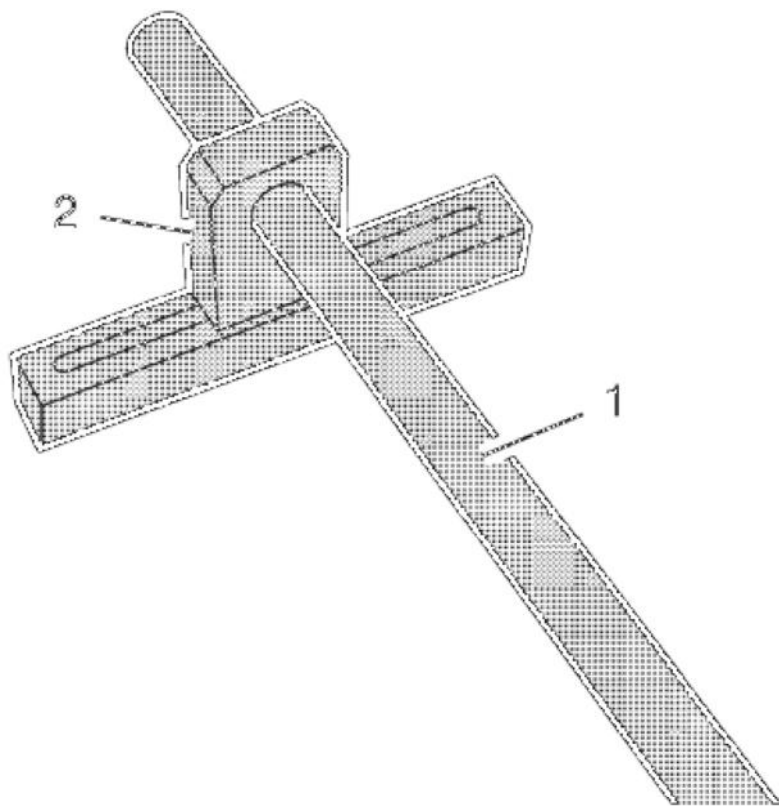
#### **Removal Procedure**

1. Remove the hydraulic valve lash adjusters. Refer to **Hydraulic Valve Lash Adjuster Replacement**.
2. Remove the spark plugs. Refer to **Spark Plug Replacement** .



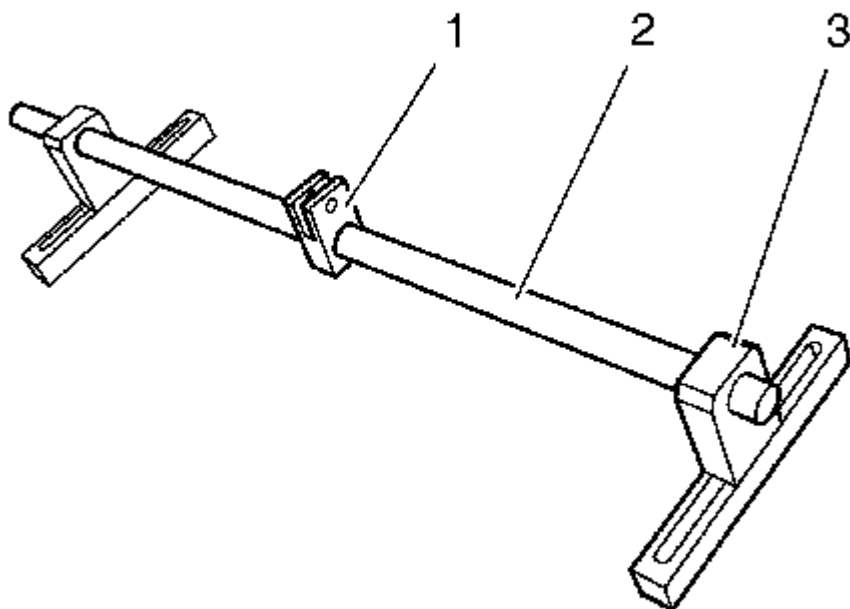
**Fig. 169: Support Head, Rail And Fastener**  
**Courtesy of GENERAL MOTORS COMPANY**

3. Tighten one of the support head (1) in the center of the rail (2) with the bolt (3).



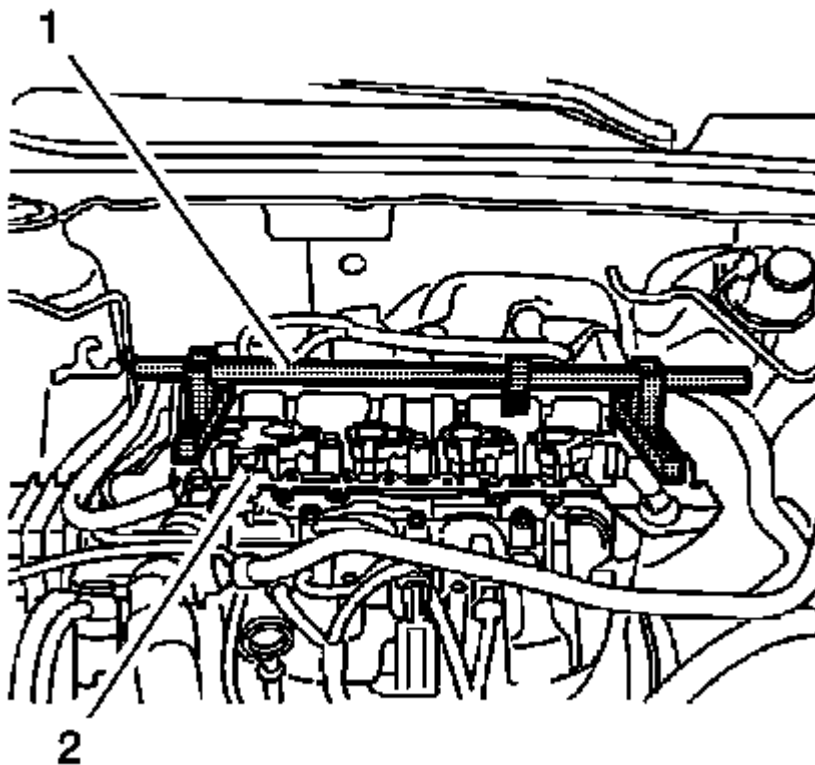
**Fig. 170: Mounting Shaft And Support**  
Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-6086-5** mounting shaft (1) to one of the **EN-6086-6** support (2).



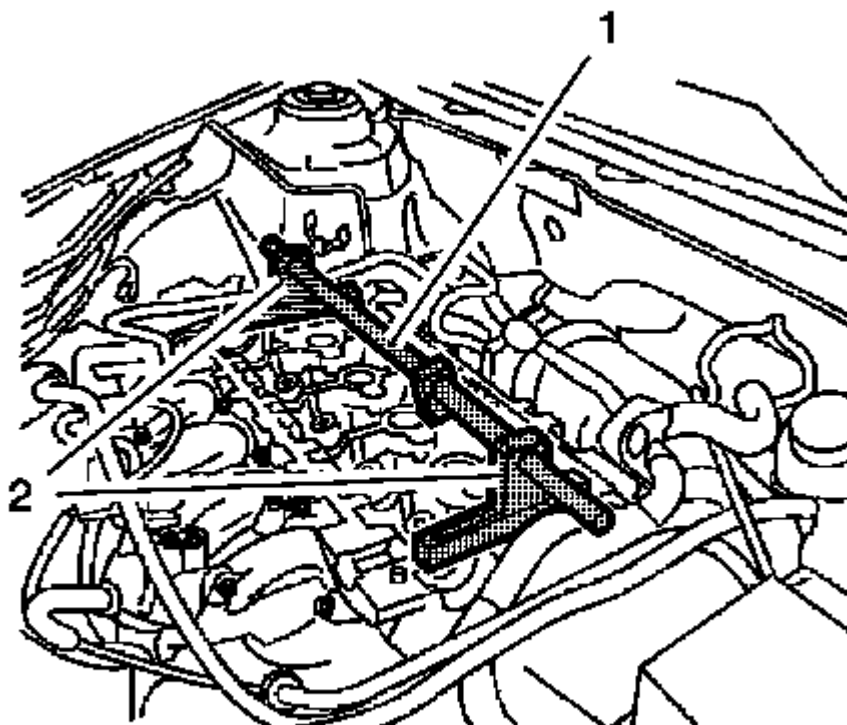
**Fig. 171: Spring & Wedge Replacer Components**  
Courtesy of GENERAL MOTORS COMPANY

5. Install the **EN-6086-8** knuckle (1) to the **EN-6086-5** mounting shaft (2).
6. Install the second **EN-6086-6** support (3) to the **EN-6086-5** mounting shaft (2).



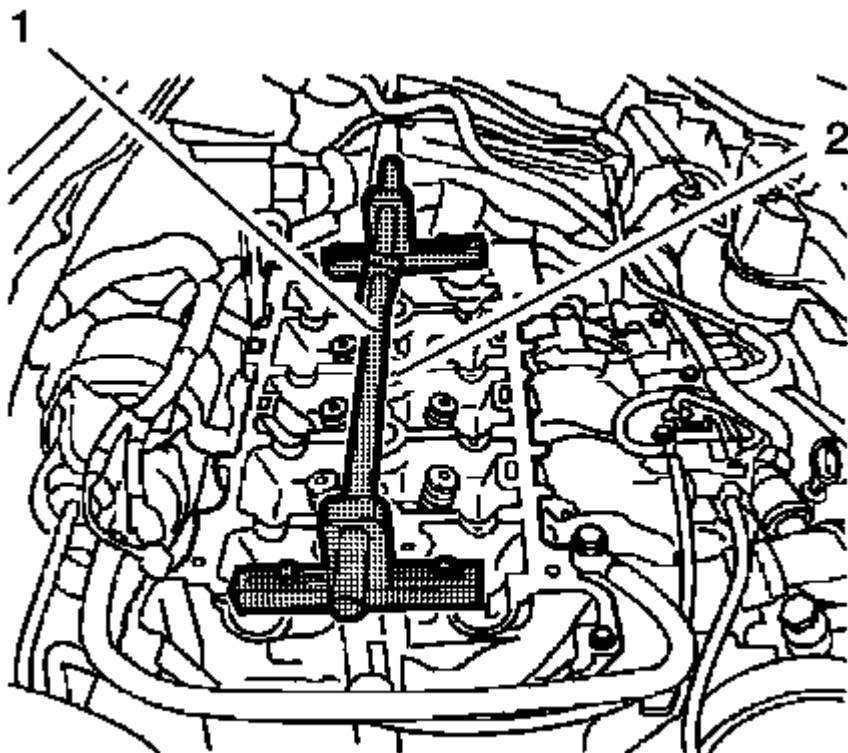
**Fig. 172: Special Tool & Cylinder Head**  
Courtesy of GENERAL MOTORS COMPANY

7. Install the lever arm bracket (1) to the cylinder head (2).
  - Install the fixed side of the lever arm bracket on the left side of the cylinder head but do not tighten yet.
  - Install the unfixed side of the lever arm bracket on the right side of the cylinder head but do not tighten yet.



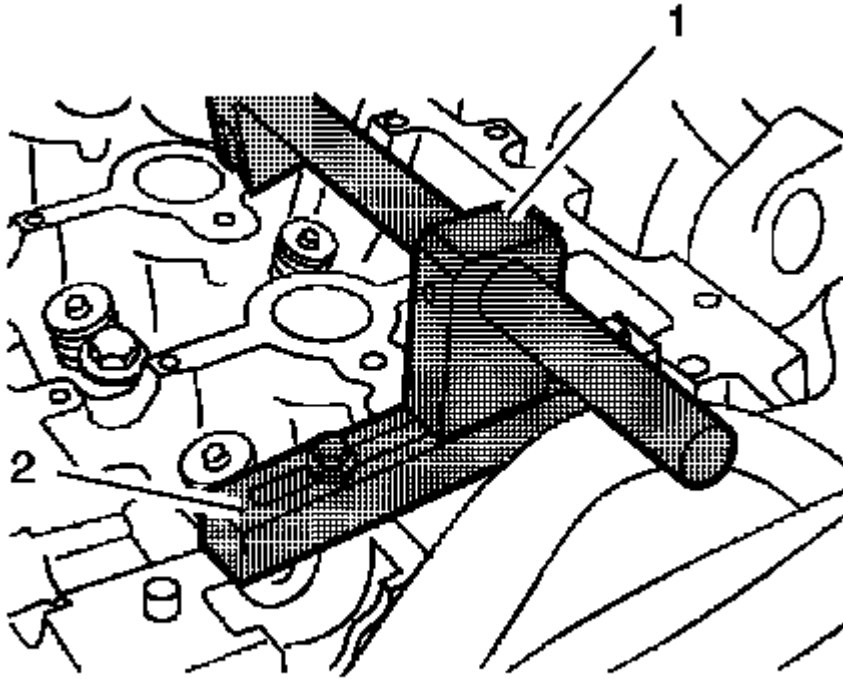
**Fig. 173: Special Tool Mounting Shaft & Support Head Bolts**  
Courtesy of GENERAL MOTORS COMPANY

8. Fix the **EN-6086-5** mounting shaft (1) with both support head bolts (2).



**Fig. 174: Lever Arm Bracket & Spark Plug Drillings**  
Courtesy of GENERAL MOTORS COMPANY

9. Align the lever arm bracket (1) in the center of the cylinder head on the basis of the spark plug drillings (2).
10. Tighten both EN-6086-6 supports to the cylinder head.



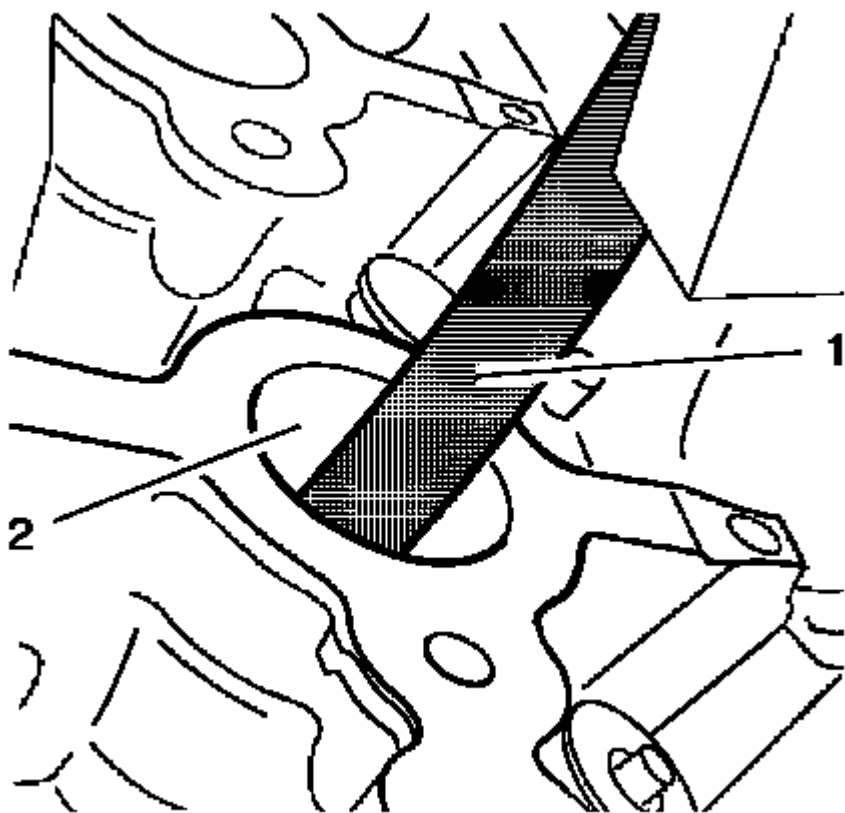
**Fig. 175: Support Head & Rail**

Courtesy of GENERAL MOTORS COMPANY

11. Fix the second support head (1) to the rail (2).
12. Set the crankshaft to TDC of the first cylinder.
13. Lower the vehicle.

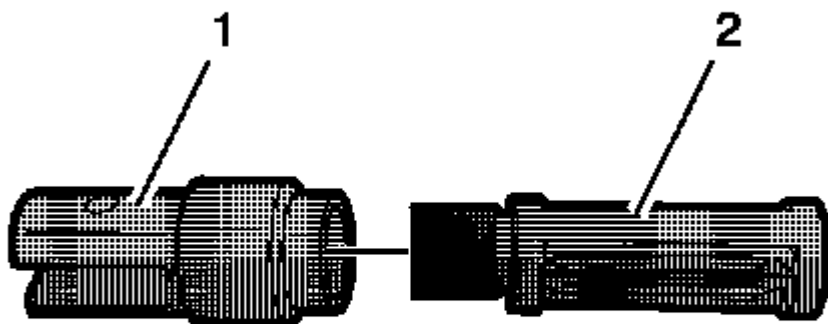
**NOTE:** All wheels must be in contact with the ground.

14. Block the crankshaft.
  1. Engage the 6th gear
  2. Tighten the park brake



**Fig. 176: Pneumatic Adapter In First Cylinder**  
Courtesy of GENERAL MOTORS COMPANY

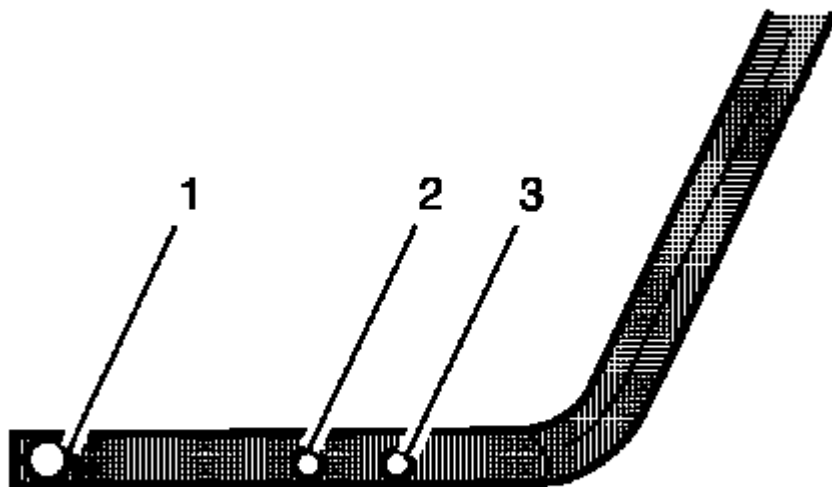
15. Install the **EN-6086-15** adapter (1) to the spark plug drill (2) of the first cylinder.
16. Apply compressed air to the first cylinder.



**Fig. 177: Adapter & Removal Parts**

**Courtesy of GENERAL MOTORS COMPANY**

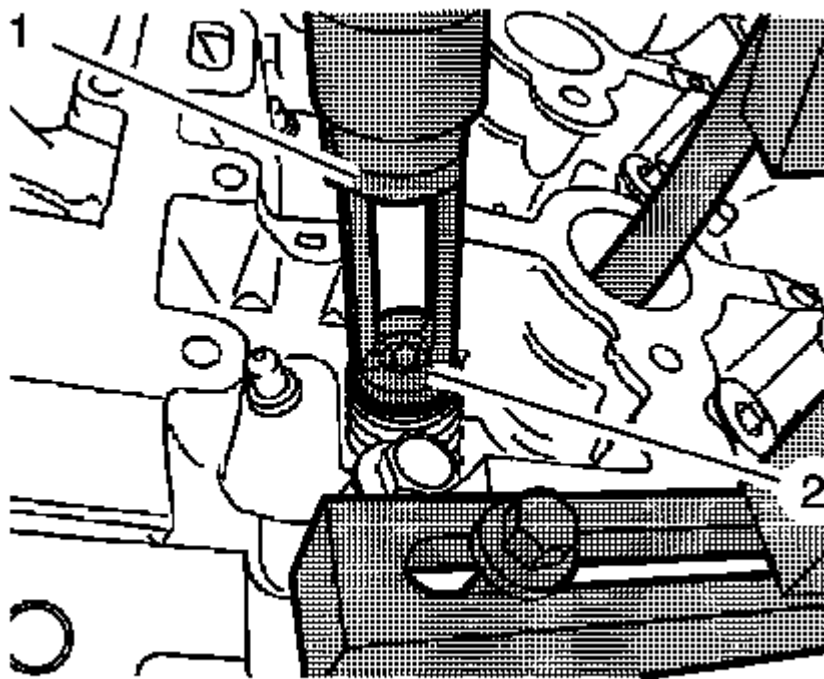
17. Install the **EN-6086-12** adapter part small (1) to the **EN-6086-11** removal part small (2).



**Fig. 178: Lever Arm Components**

Courtesy of GENERAL MOTORS COMPANY

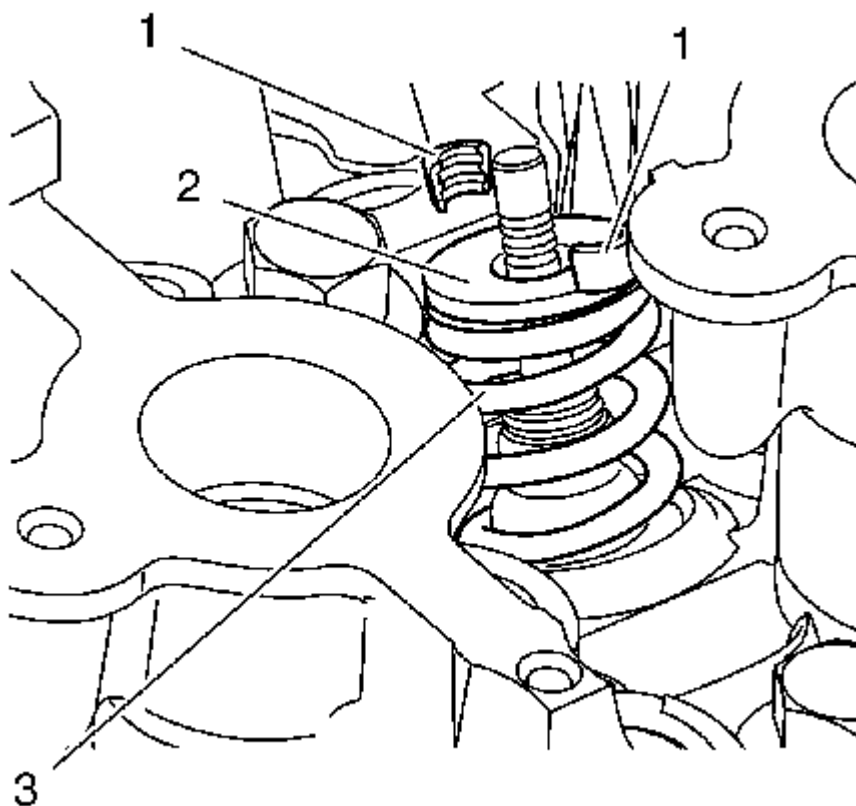
18. Install the **EN-6086-12** adapter part small and the **EN-6086-11** removal part small to position 3 to the **EN-6086-7** lever arm. Tighten the tools with **EN-6086-2** pin.
19. Install the **EN-6086-7** lever arm to the **EN-6086-8** knuckle.
  - Use the position 1 of the lever arm.
  - Tighten the tools with **EN-6086-2** pin.



**Fig. 179: Intake Valve Spring Retainer & Removal Tool**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Note the installation construction units position of the valve stem keys, valve spring retainer and valve spring.

20. Set the **EN-6086-11** removal part small (1) on the intake valve spring retainer (2) on the left side of the first cylinder.



**Fig. 180: Valve Stem Key, Valve Spring & Retainer**  
Courtesy of GENERAL MOTORS COMPANY

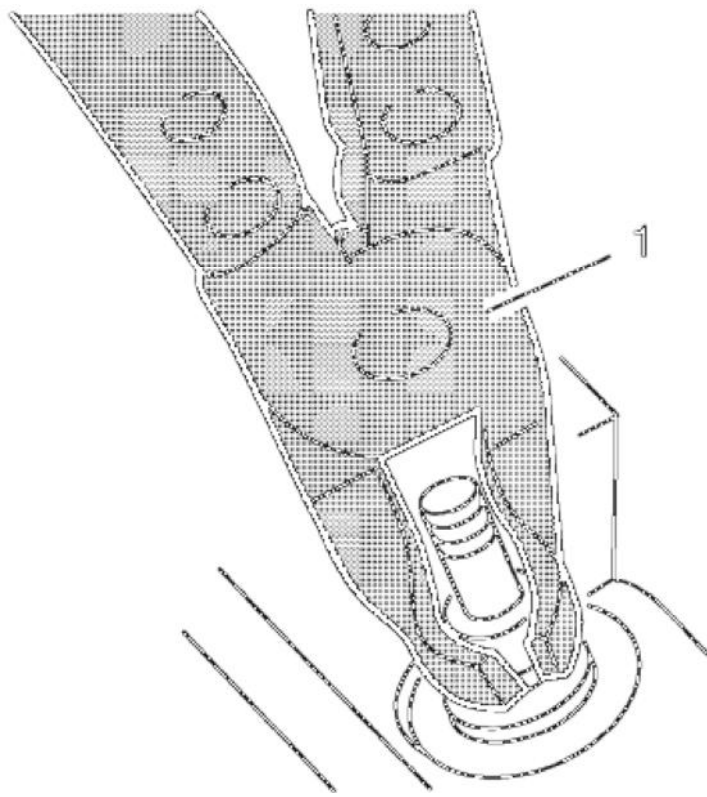
21. To remove the valve stem key (1), valve spring retainer (2) and valve spring (3) press the lever arm downward.

**NOTE: Do not use magnetic tools.**

22. If the valve stem key are fallen out, remove the valve stem keys with **EN-6086-13** round awl and **EN-6086-14** special caliper.
23. Set the **EN-6086-11** removal part small on that intake valve spring retainer on the right side to the first cylinder.
24. To remove from the valve stem keys, valve spring retainer and valve spring press the lever arm downward.

**NOTE: Do not use magnetic tools.**

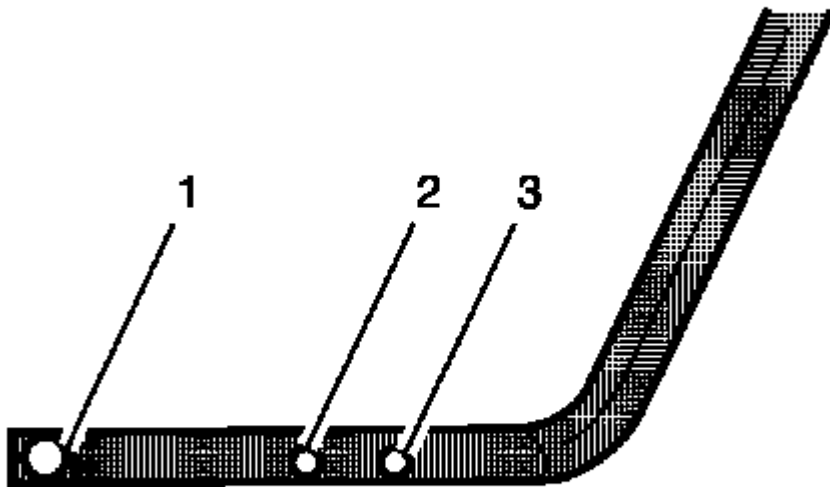
25. If the valve stem key are loosen, remove the valve stem keys with **EN-6086-13** round awl and **EN-6086-14** special caliper.



**Fig. 181: Valve Stem Seal Removal Tool**

Courtesy of GENERAL MOTORS COMPANY

26. Remove both valve stem oil seal rings with **EN-840** valve stem oil seal remover (1) from the cylinder head intake side.



**Fig. 182: Lever Arm Components**

Courtesy of GENERAL MOTORS COMPANY

27. Install the **EN-6086-12** adapter part small and the **EN-6086-11** removal part small to the position 1 to the **EN-6086-7** lever arm. Tighten those tools with **EN-6086-2** pin.
28. Install the **EN-6086-7** lever arm to **EN-6086-8** knuckle.
  - Use the position 3 to the lever arm.
  - Tighten the tools with **EN-6086-2** pin.

**NOTE:**      **Note the position of the valve stem keys, valve spring retainer and valve spring.**

29. Set the **EN-6086-11** removal part small on that exhaust valve spring retainer on the left side at the first cylinder.
30. To remove the valve stem key, valve spring retainer and valve spring press the lever arm upward.

**NOTE:**      **Do not use magnetic tools.**

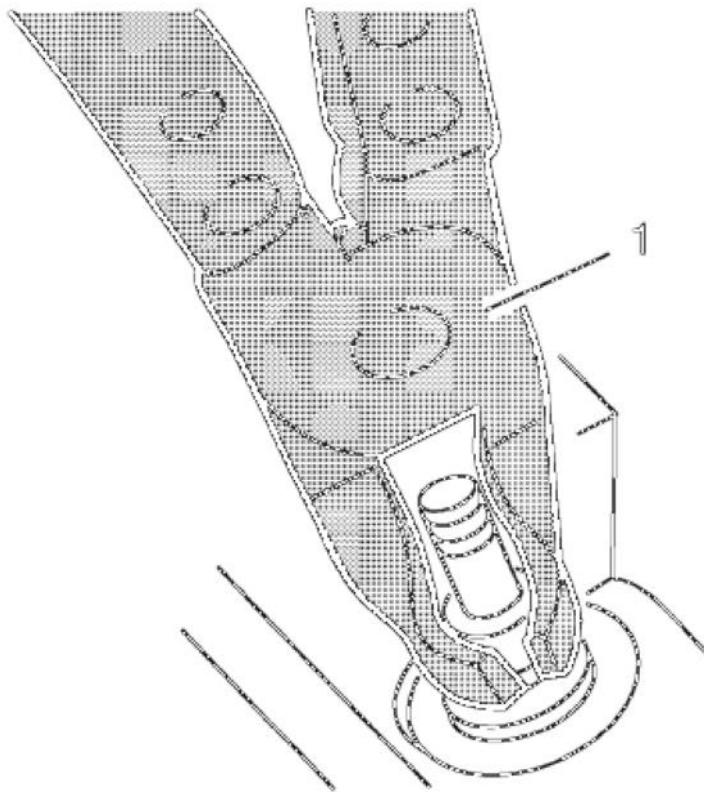
31. If the valve stem key are loosen, remove the valve stem keys with **EN-6086-13** round awl and **EN-6086-14** special caliper.
32. Set the **EN-6086-11** removal part small on that exhaust valve spring retainer on the right side to the first

cylinder.

33. To remove the valve stem keys, valve spring retainer and valve spring press the lever arm upward.

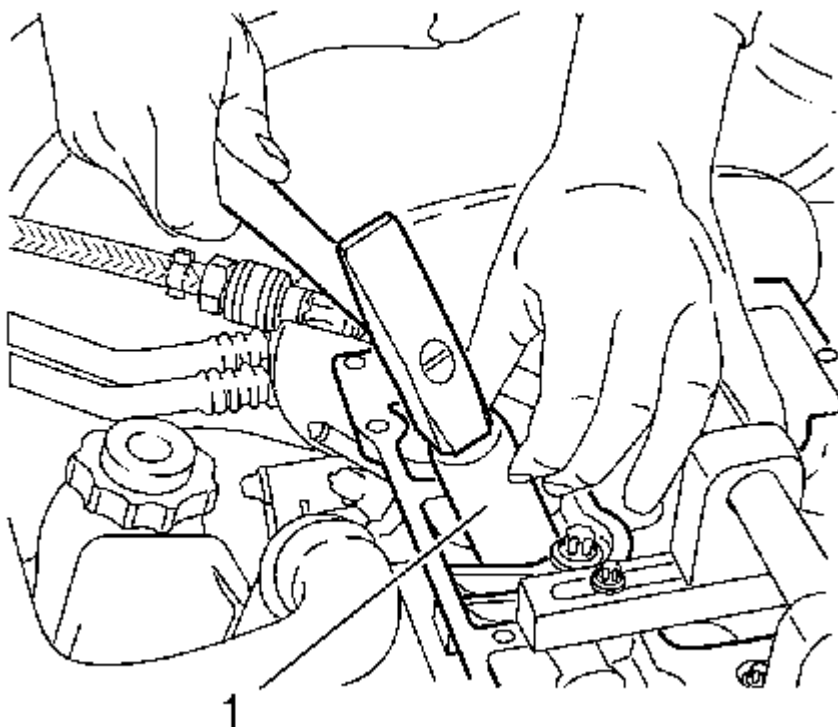
**NOTE:** Do not use magnetic tools.

34. If the valve stem key are loosen, remove the valve stem keys with **EN-6086-13** round awl and **EN-6086-14** special caliper.



**Fig. 183: Valve Stem Seal Removal Tool**  
Courtesy of GENERAL MOTORS COMPANY

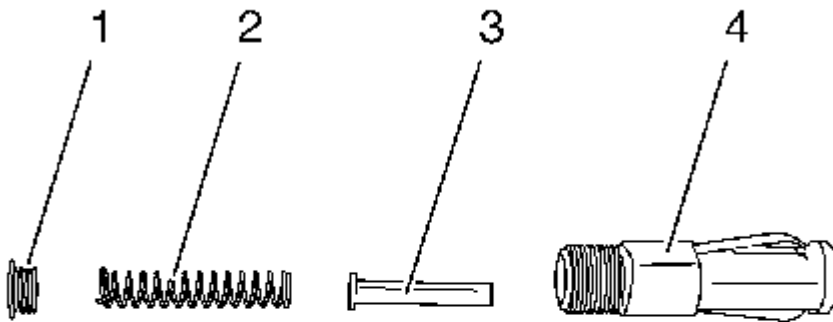
35. Remove both valve stem oil seal rings with **EN-840** valve stem oil seal remover (1) from the cylinder head exhaust side.



**Fig. 184: Valve Stem Oil Seal Installer**  
Courtesy of GENERAL MOTORS COMPANY

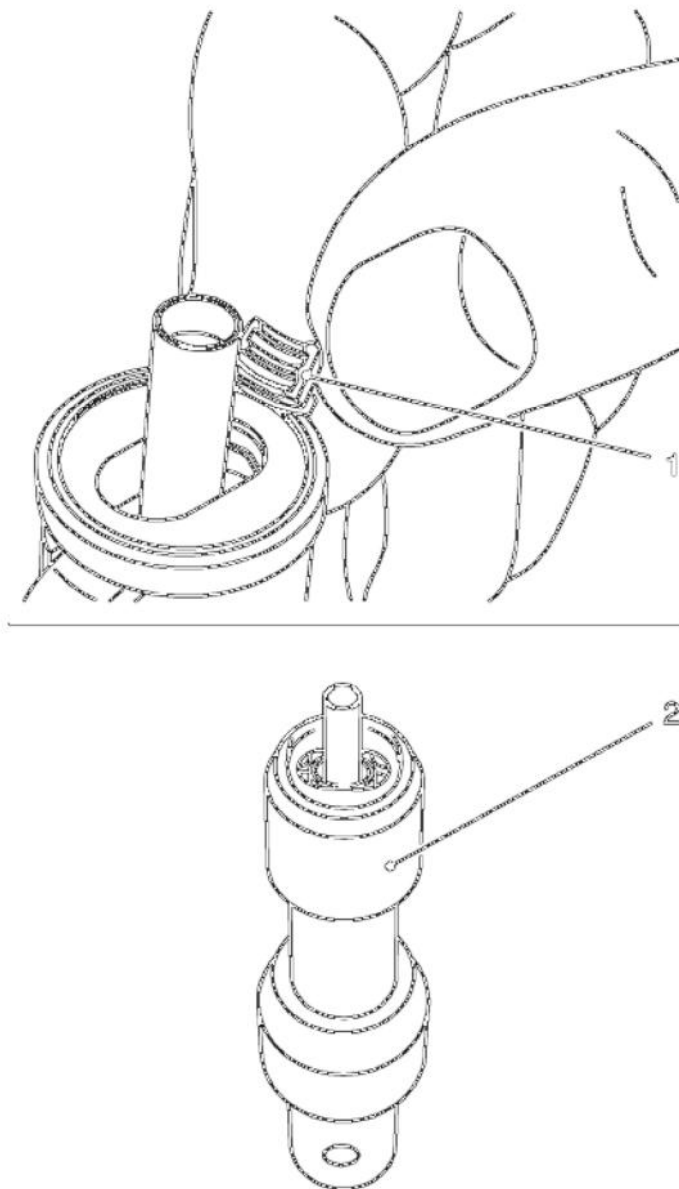
**NOTE:** Do not press the valve downward.

36. Install with **EN-6152** valve stem oil seal installer (1) the new valve stem oil seal rings to the cylinder head.
  - Coat the valve stems with engine oil
  - Connect the valve stem seals onto the valve stem.
  - Using the **EN-6152** installer, drive to limit stop.



**Fig. 185: Fastener, Spring, Adapter & Mounting Part**  
**Courtesy of GENERAL MOTORS COMPANY**

37. Install **EN-6086-100-15** adapter 6 (3) to **EN-6086-100-10** mounting part (4).
  - Remove the fastener (1) from the mounting part (4).
  - Remove the spring (2) from the mounting part (4).
  - Install the pressure adapter 6 (3) into the mounting part (4).
  - Install the spring (2) into the mounting part (4).
  - Install the fastener (1) to the mounting part (4).

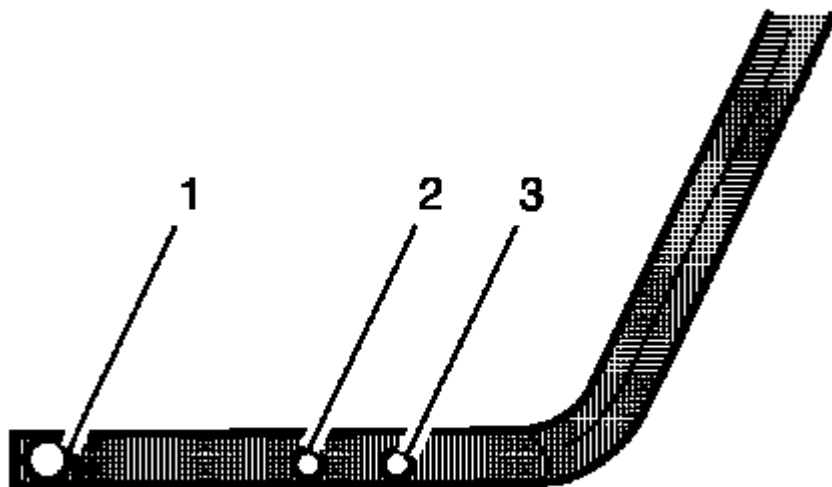


**Fig. 186: View Of Valve Cotters And Clamping Sleeve**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Only one attempt. If the attempt failed, repeat step 3 to 8 for the exhaust

**left side and step 9 to 13 for the exhaust right side.**

38. Install the valve stem keys (1) to the **EN-6086-100-10** mounting part (2).
  1. Pull the ring back that the springs are loosen.
  2. Install the valve stem keys with the narrow side upward.
  3. Pull the ring forward till the springs are the valve stem keys locking.
39. Install the **EN-6086-100-10** mounting part to the **EN-6086-12** adapter part.
40. Install both parts to the **EN-6086-7** lever arm.
41. Install the left exhaust valve spring and the left exhaust valve retainer to the cylinder head.
42. Set the **EN-6086-100-15** pressure adapter to the left exhaust valve.
43. Press the lever arm up to audibly engage the left valve stem keys.
44. Install the valve stem keys to the **EN-6086-100-10** mounting part.
  1. Pull the ring back that the springs are loosen.
  2. Install the valve stem keys with the narrow side upward.
  3. Pull the ring forward till the springs are the valve stem keys locking.
45. Install the **EN-6086-100-10** mounting part to the **EN-6086-12** adapter part.
46. Install both parts to the **EN-6086-7** lever arm.
47. Install the right exhaust valve spring and the right exhaust valve retainer to the cylinder head.
48. Set the **EN-6086-100-15** pressure adapter to the right exhaust valve.
49. Press the lever arm up to audibly engage the right valve stem keys.
50. Remove the **EN-6086-7** lever arm from the **EN-6086-8** knuckle.



**Fig. 187: Lever Arm Components**

Courtesy of GENERAL MOTORS COMPANY

51. Install the **EN-6086-7** lever arm (1) to the **EN-6086-8** knuckle (2).

1. Use the position 1 from the lever arm.
2. Tighten those tools with **EN-6086-2** pin.

**NOTE:** Do not press the valve downward.

52. Install with **EN-6152** valve stem oil seal installer the new valve stem oil seal rings to the cylinder head.

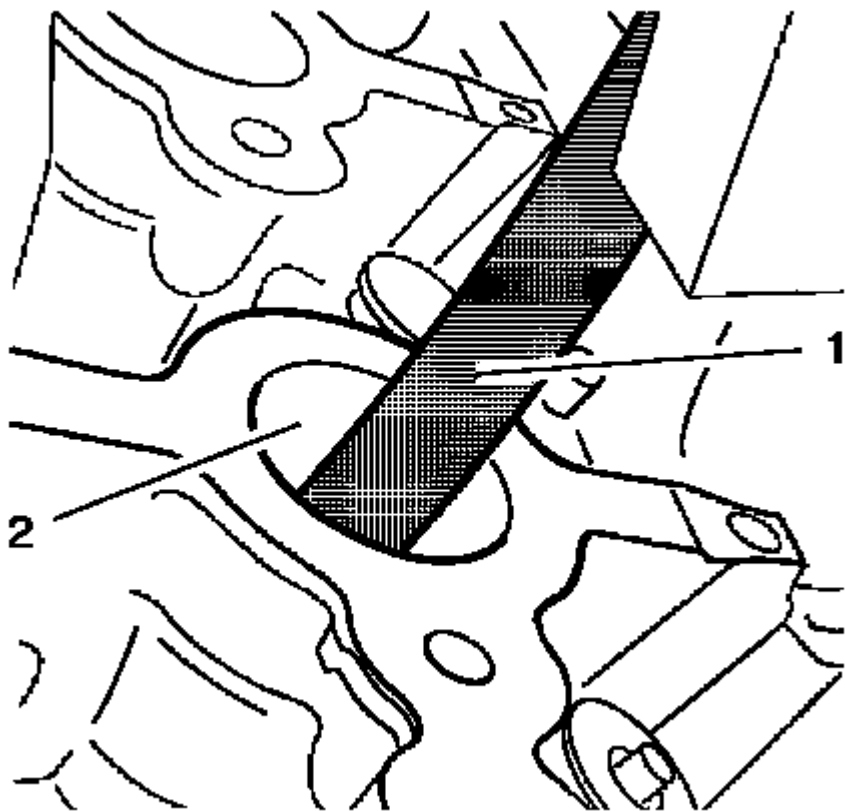
1. Press the valve stem oil seal ring with the finger downward.
2. The **EN-6152** valve stem oil seal installer must rest upon at the lower edge of the valve stem oil seal ring.
3. Knock with a rubber hammer on the **EN-6152** valve stem oil seal installer tool to sit the valve stem oil seal ring to the cylinder head.

**NOTE:** Only one attempt. If the attempt failed, repeat step 18 to 23 for the intake left side and step 24 to 29 for the intake right side.

53. Install the valve stem keys to the **EN-6086-100-10** mounting part.

1. Pull the ring back that the springs are loosen.

2. Install the valve stem keys with the narrow side upward.
3. Pull the ring forward till the springs are the valve stem keys locking.
54. Install the **EN-6086-100-10** mounting part to the **EN-6086-12** adapter part.
55. Install both parts to the **EN-6086-7** lever arm.
56. Install the left intake valve spring and the left intake valve retainer to the cylinder head.
57. Set the **EN-6086-100-15** pressure adapter to the left intake valve.
58. Press the lever arm down to audibly engage the left valve stem keys.
59. Install the valve stem keys (1) to the **EN-6086-100-10** mounting part (2).
  1. Pull the ring back that the springs are loosen.
  2. Install the valve stem keys with the narrow side upward.
  3. Pull the ring forward till the springs are the valve stem keys locking.
60. Install the **EN-6086-100-10** mounting part to the **EN-6086-12** adapter part.
61. Install both parts to the **EN-6086-7** lever arm.
62. Install the right intake valve spring and the right intake valve retainer to the cylinder head.
63. Set the **EN-6086-100-15** pressure adapter to the right intake valve.
64. Press the lever arm down to audibly engage the right valve stem keys.
65. Remove the **EN-6086-7** lever arm from the **EN-6086-8** knuckle.



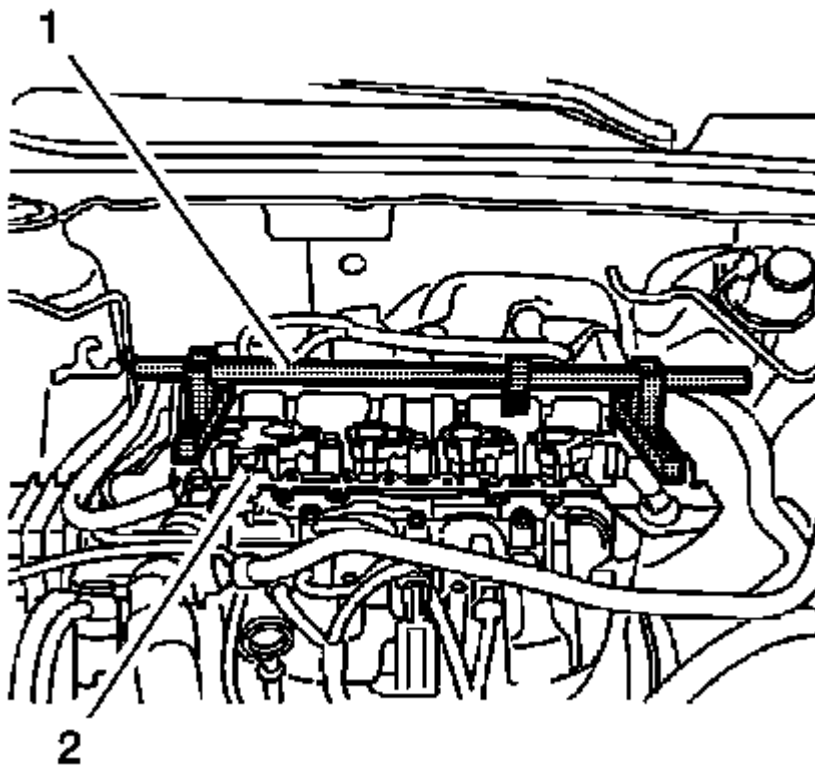
**Fig. 188: Pneumatic Adapter In First Cylinder**  
**Courtesy of GENERAL MOTORS COMPANY**

66. Transfer the **EN-6086-15** pneumatic adapter (1).
  1. Interrupt the compressed air feed.
  2. Remove the adapter from cylinder number 1.
  3. Install the adapter to cylinder number 4.
  4. Apply compressed air to cylinder number 4.
67. Replace the valve stem seal of cylinder 4 by analogy with step 17 - 65.
68. Remove the **EN-6086-15** pneumatic adapter.
  1. Interrupt the compressed air feed.
  2. Remove the adapter from cylinder number 4.
69. Unblock the crankshaft.

Disengage the 6th gear

**NOTE:**        **A second mechanic must hold the primary timing chain upward.**

70. To replace the valve stem oil seals of the cylinders 2 and 3 turn the crankshaft by 180 degrees to TDC of cylinder 3.
  - Set 2 marks, by 180 degrees transferred, at the oil pump housing.
  - Set 1 mark at the crankshaft balancer.
  - Turn the timing chain clockwise 180 degrees.
71. Replace the valve stem seal of cylinder 2 and 3 by analogy with step 14 - 68.



**Fig. 189: Special Tool & Cylinder Head**  
Courtesy of GENERAL MOTORS COMPANY

72. Remove the **EN-6086** tool (1) from the cylinder head (2).

#### Installation Procedure

1. Unblock the crankshaft.
  1. Disengage the 6th gear
  2. Loosen the park brake.

**NOTE:** A second mechanic must hold the primary timing chain upward.

2. Rotate the crankshaft to TDC of first cylinder.
3. Install the spark plugs. Refer to **Spark Plug Replacement**.
4. Install the hydraulic valve lash adjusters. Refer to **Hydraulic Valve Lash Adjuster Replacement**.

#### CYLINDER HEAD REPLACEMENT

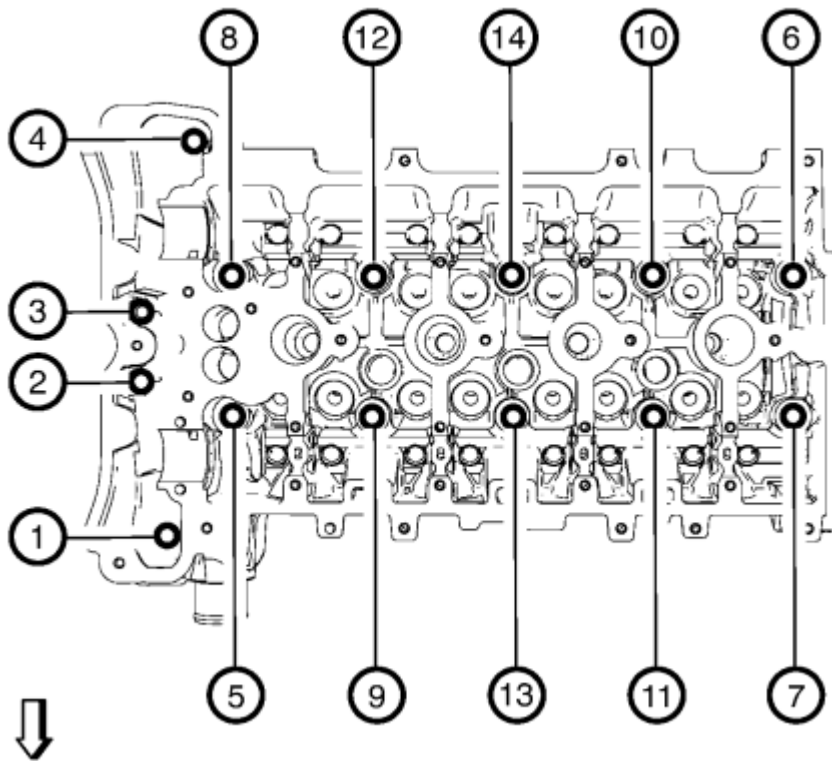
##### Special Tools

**EN-45059** Angle Meter

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

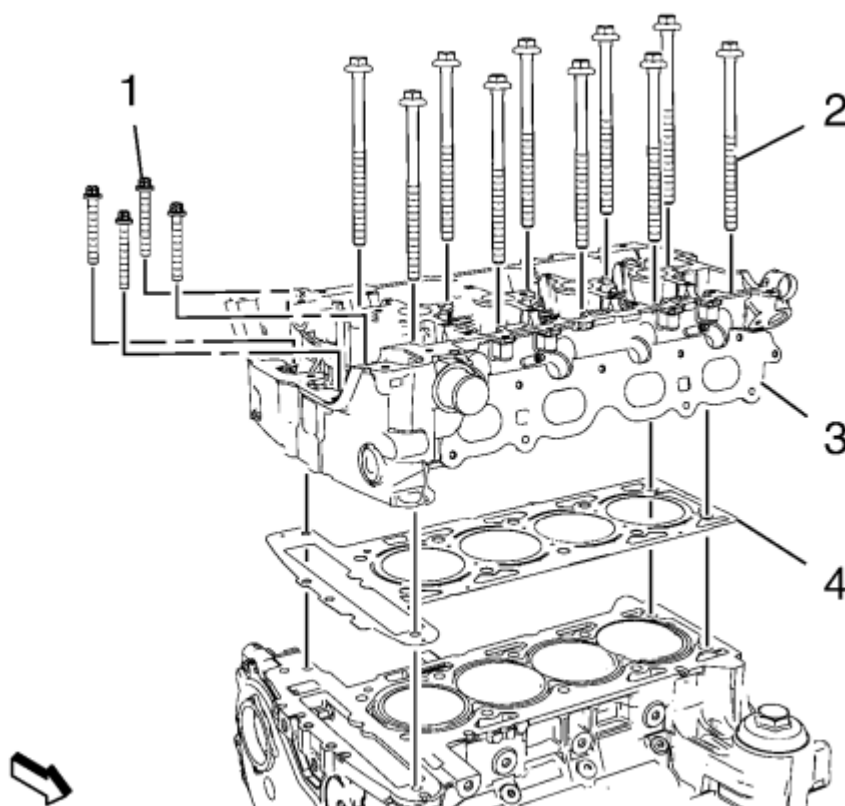
#### Removal Procedure

1. Remove the engine coolant air bleed hose. Refer to **Engine Coolant Air Bleed Hose Replacement** .
2. Remove the turbocharger. Refer to **Turbocharger Replacement**.
3. Remove the exhaust camshaft. Refer to **Exhaust Camshaft Replacement**.
4. Remove the intake camshaft. Refer to **Intake Camshaft Replacement**.



**Fig. 190: Cylinder Head Bolt Loosening Sequence**  
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the cylinder head bolts in sequence as shown.



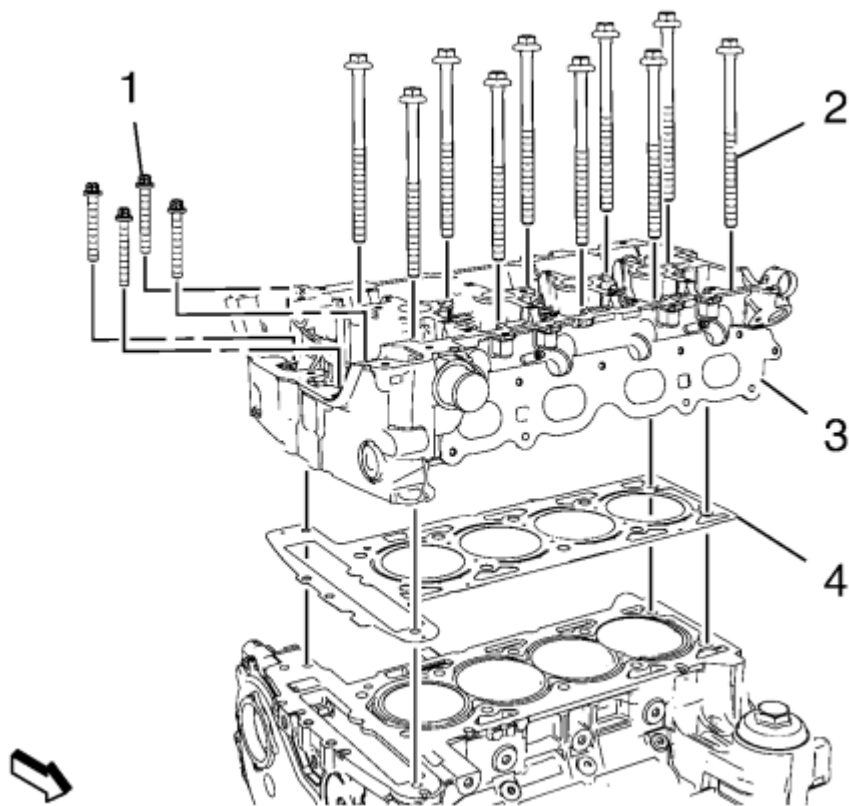
**Fig. 191: Cylinder Head, Gasket & Bolts**

Courtesy of GENERAL MOTORS COMPANY

6. Remove and DISCARD the 14 cylinder head bolts (1) and (2).
7. Remove the cylinder head (3).
8. Remove and DISCARD the cylinder head gasket (4).
9. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
10. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement (2.0L LHU)**.
11. Remove the fuel rail assembly. Refer to **Fuel Injection Fuel Rail Assembly Replacement**.
12. Remove the hydraulic valve lash adjuster. Refer to **Hydraulic Valve Lash Adjuster Replacement**.

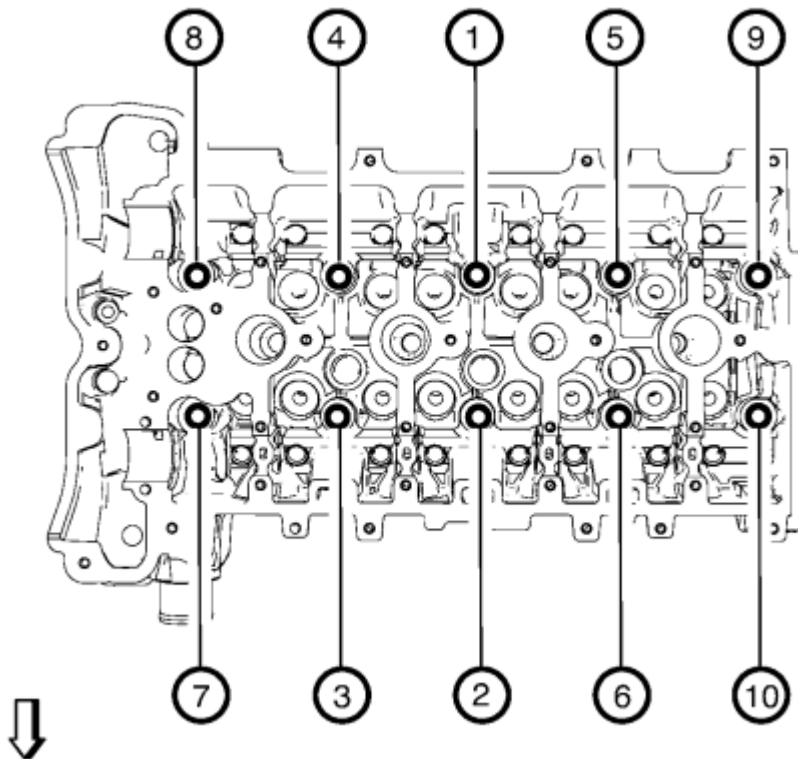
#### Installation Procedure

1. Install the hydraulic valve lash adjuster. Refer to **Hydraulic Valve Lash Adjuster Replacement**.
2. Install the fuel rail assembly. Refer to **Fuel Injection Fuel Rail Assembly Replacement**.
3. Install the intake manifold. Refer to **Intake Manifold Replacement**.
4. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement (2.0L LHU)**.
5. Clean the sealing surfaces of cylinder head and engine block.



**Fig. 192: Cylinder Head, Gasket & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

6. Install a NEW cylinder head gasket (4).
7. Install the cylinder head (3).
8. Install the 14 cylinder head bolts (1) and (2).



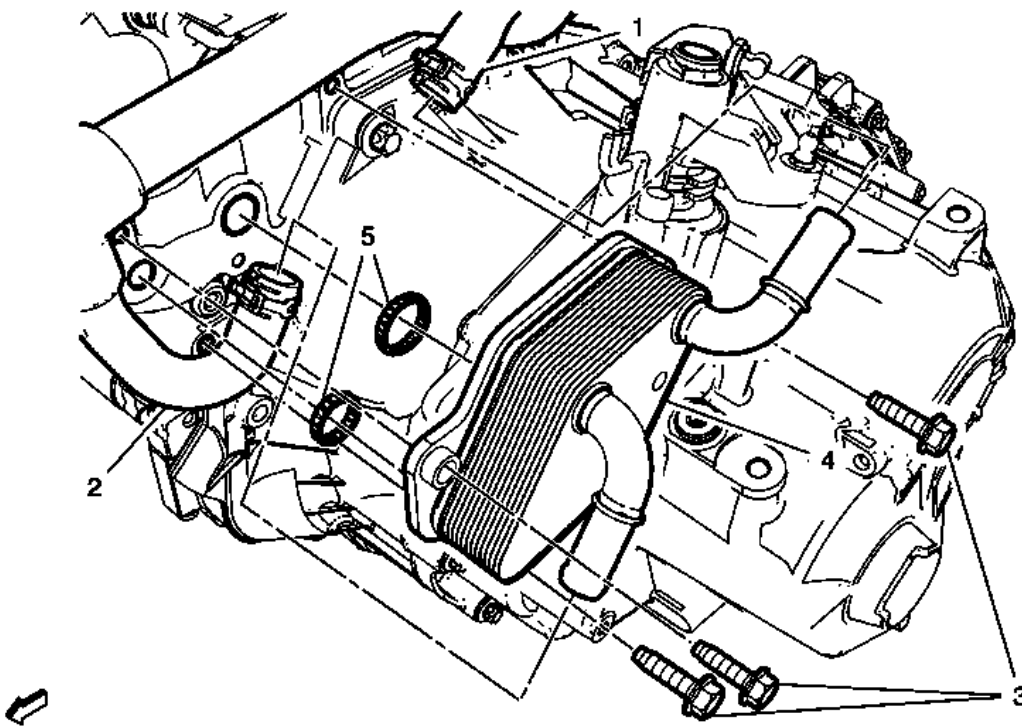
**Fig. 193: Cylinder Head Bolt Tightening Sequence**  
Courtesy of GENERAL MOTORS COMPANY

9. Fasten the cylinder head bolts handtighten in sequence as shown.

**CAUTION:** Refer to Fastener Caution .

**CAUTION:** Refer to Torque-to-Yield Fastener Caution .

10. Tighten the NEW cylinder head bolts a first pass in the sequence as shown to 30 N.m (22 lb ft).
11. Tighten the cylinder head bolts a final pass in the sequence shown and additional 155 degrees, using the **EN-45059** meter.
12. Tighten the 4 cylinder head front bolts to 35 N.m (26 lb ft).
13. Install the intake camshaft. Refer to Intake Camshaft Replacement.
14. Install the exhaust camshaft. Refer to Exhaust Camshaft Replacement.
15. Install the engine coolant air bleed hose. Refer to Engine Coolant Air Bleed Hose Replacement .
16. Install the turbocharger. Refer to Turbocharger Replacement.
17. Replace the engine oil filter and the engine oil. Refer to Engine Oil and Oil Filter Replacement.

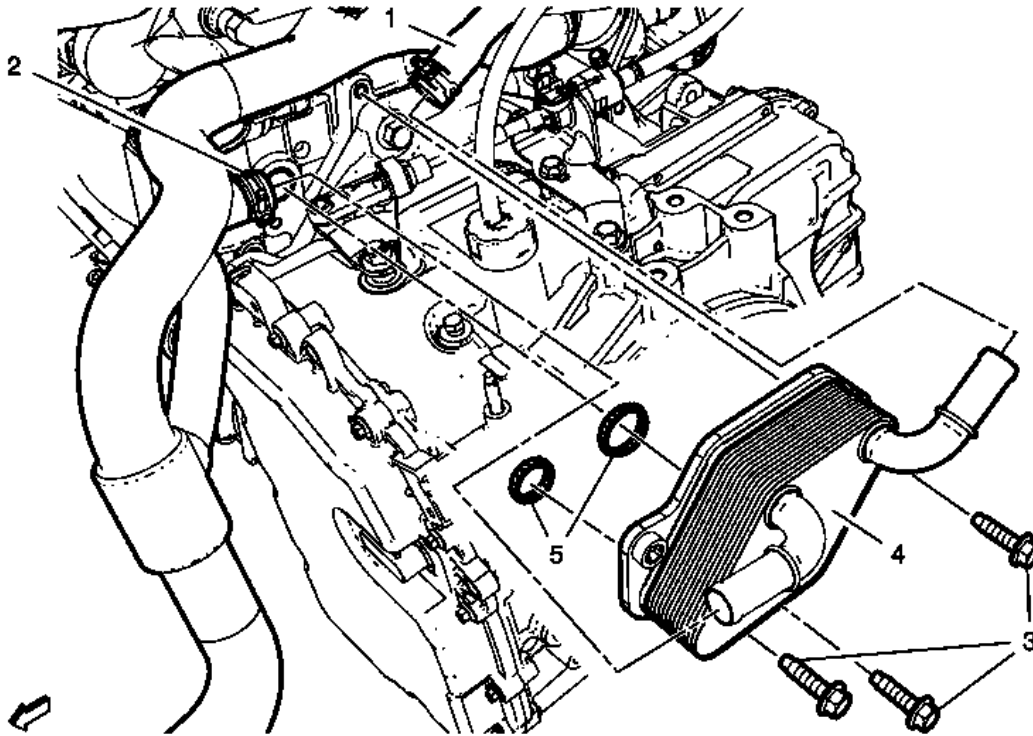
**ENGINE OIL COOLER REPLACEMENT (MANUAL TRANSMISSION)**

**Fig. 194: Engine Oil Cooler Components & Radiator Hoses (Manual Transmission)**  
 Courtesy of GENERAL MOTORS COMPANY

**Engine Oil Cooler Replacement (Manual Transmission)**

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                           | Component Name                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                         |
| 1. Remove the charge air cooler inlet hose - charge air cooler side. Refer to <u><b>Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)</b></u> , <u><b>Charge Air Cooler Inlet Hose Replacement (Turbocharger)</b></u> .<br>2. Detach the ECM from the battery tray. Refer to <u><b>Engine Control Module Replacement</b></u> .<br>3. Drain the cooling system. Refer to <u><b>Cooling System Draining and Filling (2.0L LHU)</b></u> . |                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Radiator Surge Tank Engine Hose                                                                                                                         |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Radiator Outlet Hose                                                                                                                                    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Engine Oil Cooler Core Fastener (Qty: 3)<br><br><b>CAUTION:</b><br>Refer to <u><b>Fastener Caution</b></u> .<br><br><b>Tighten</b><br>25 N.m (18 lb ft) |

|   |                                                                                                      |
|---|------------------------------------------------------------------------------------------------------|
| 4 | Engine Oil Cooler                                                                                    |
| 5 | Engine Oil Cooler Seal Ring (Qty: 2)<br><b>Procedure</b><br>DISCARD the seal rings and use only NEW. |

**ENGINE OIL COOLER REPLACEMENT (AUTOMATIC TRANSMISSION)**

**Fig. 195: Engine Oil Cooler Components & Radiator Hoses (Automatic Transmission)**  
Courtesy of GENERAL MOTORS COMPANY

**Engine Oil Cooler Replacement (Automatic Transmission)**

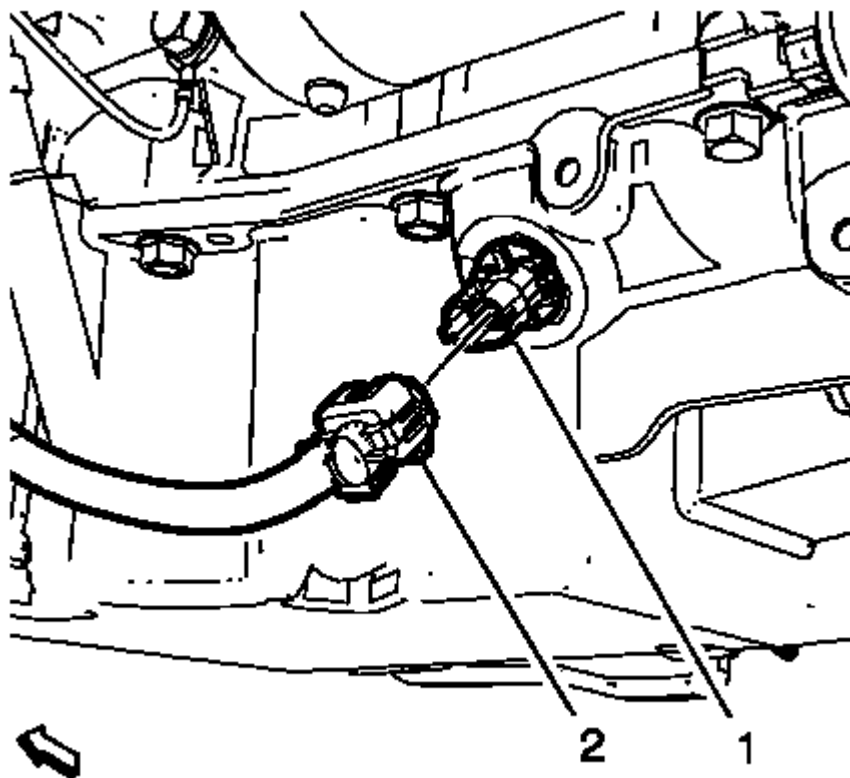
| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Component Name                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                 |
| <ol style="list-style-type: none"> <li>1. Remove the charge air cooler inlet hose - charge air cooler side. Refer to <b><u>Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)</u></b> , <b><u>Charge Air Cooler Inlet Hose Replacement (Turbocharger)</u></b> .</li> <li>2. Detach the ECM from the battery tray. Refer to <b><u>Engine Control Module Replacement</u></b> .</li> <li>3. Drain the cooling system. Refer to <b><u>Cooling System Draining and Filling (2.0L LHU)</u></b> .</li> <li>4. Remove the transmission oil cooler outlet pipe from the transmission and reposition. Refer to <b><u>Transmission Fluid Cooler Outlet Pipe Replacement (2.0L LHU)</u></b> .</li> <li>5. Remove the transmission oil cooler inlet pipe from the transmission and reposition. Refer to <b><u>Transmission Fluid Cooler Inlet Pipe Replacement (2.0L LHU)</u></b> .</li> </ol> |                                 |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Radiator Surge Tank Engine Hose |

|   |                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Radiator Outlet Hose                                                                                                                                |
| 3 | Engine Oil Cooler Core Fastener (Qty: 3)<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten</b><br>25 (18 lb ft) |
| 4 | Engine Oil Cooler                                                                                                                                   |
| 5 | Engine Oil Cooler Seal Ring (Qty: 2)<br><b>Procedure</b><br>DISCARD the seal rings and use only NEW.                                                |

## OIL PAN REPLACEMENT (MANUAL TRANSMISSION)

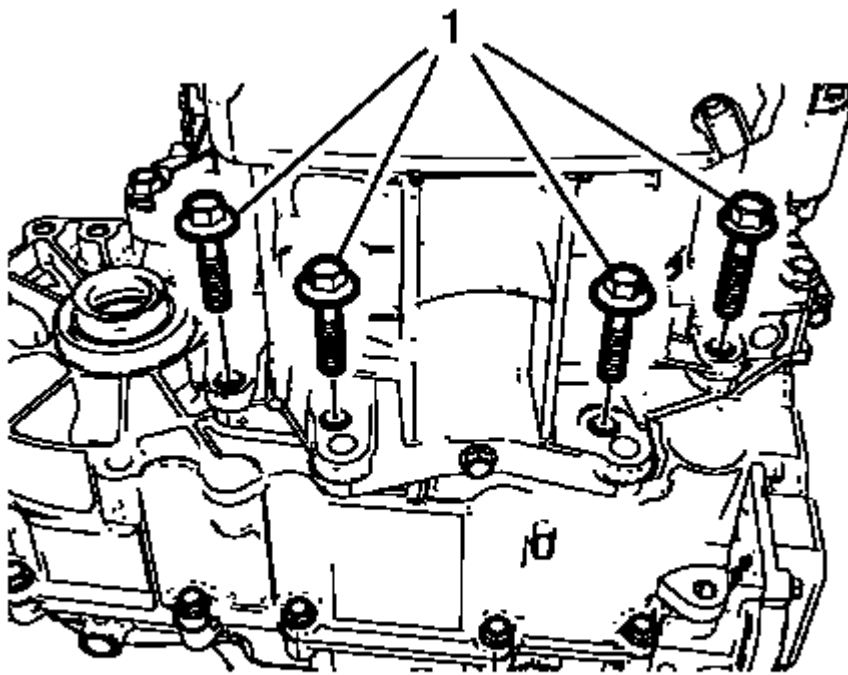
### Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging** .
2. Remove the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
3. Install the engine support fixture. Refer to **Engine Support Fixture**.
4. Remove the engine mount. Refer to **Engine Mount Replacement**.
5. Lift the engine high as necessary to increase enough space between oil pan and front suspension frame.
6. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
7. If equipped, remove the front compartment insulator. Refer to **Front Compartment Insulator Replacement** .
8. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the A/C compressor bracket. Refer to **Air Conditioning Compressor Bracket Replacement** .
10. Remove the catalytic converter brace. Refer to **Catalytic Converter Brace Replacement (2.0L LHU)** .



**Fig. 196: Oil Level Sensor & Wiring Harness Plug**  
Courtesy of GENERAL MOTORS COMPANY

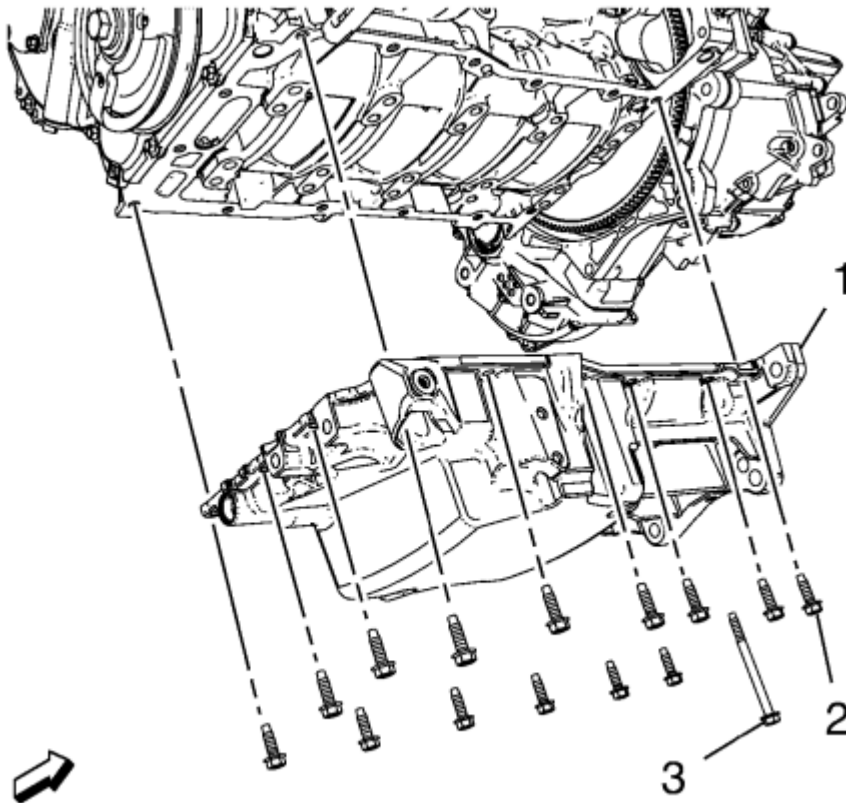
11. Disconnect the oil level sensor wiring harness plug (2) from the oil level sensor (1).



**Fig. 197: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

12. Remove the 4 gearbox bolts (1) from the gearbox.



**Fig. 198: Oil Pan & Bolts**

Courtesy of GENERAL MOTORS COMPANY

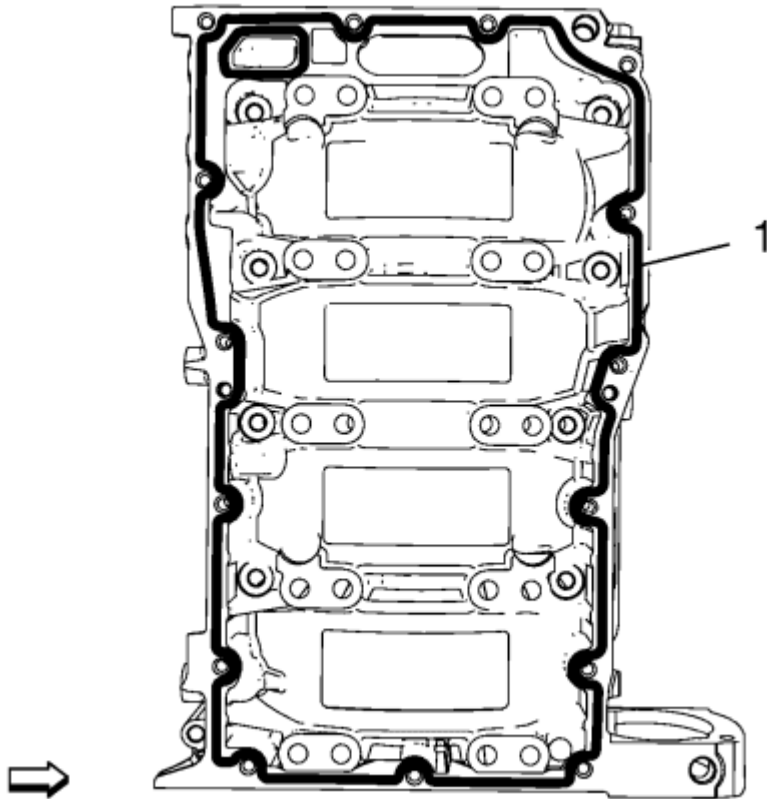
13. Remove the long oil pan bolt (3).
14. Remove the 14 short oil pan bolts (2).

**CAUTION:** Pry the oil pan carefully in order to prevent damage to the transaxle case or the oil pan sealing surfaces.

15. Remove the oil pan (1).
16. Remove the oil level sensor from the oil pan. Refer to Engine Oil Level Sensor Replacement.

#### Installation Procedure

1. Install the oil level sensor to the oil pan. Refer to Engine Oil Level Sensor Replacement.
2. Clean the sealing surfaces.

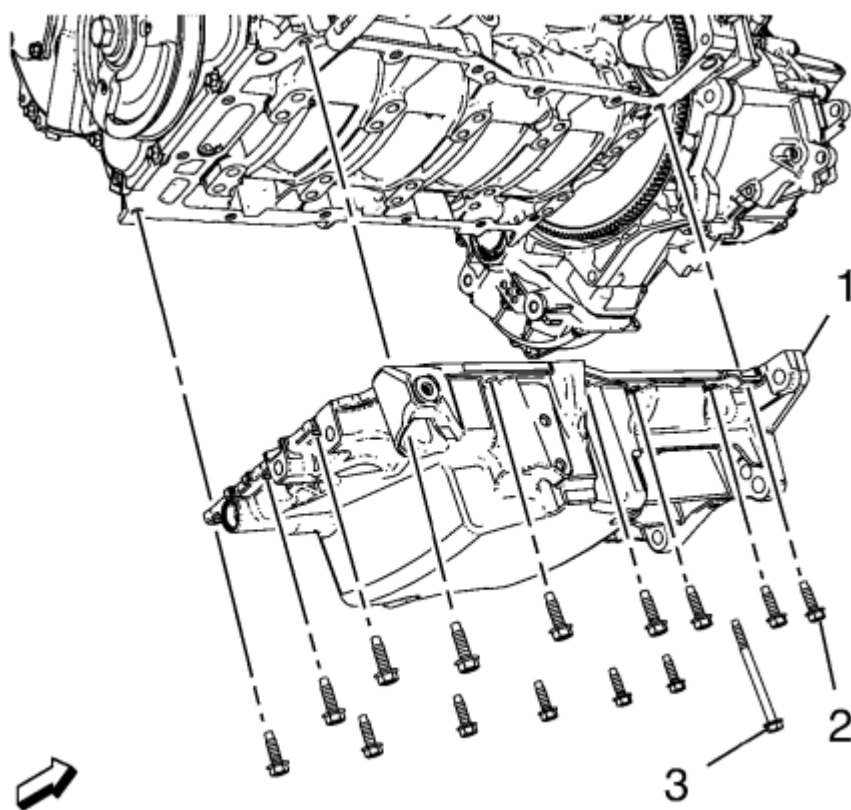


**Fig. 199: Oil Pan Sealant Bead**

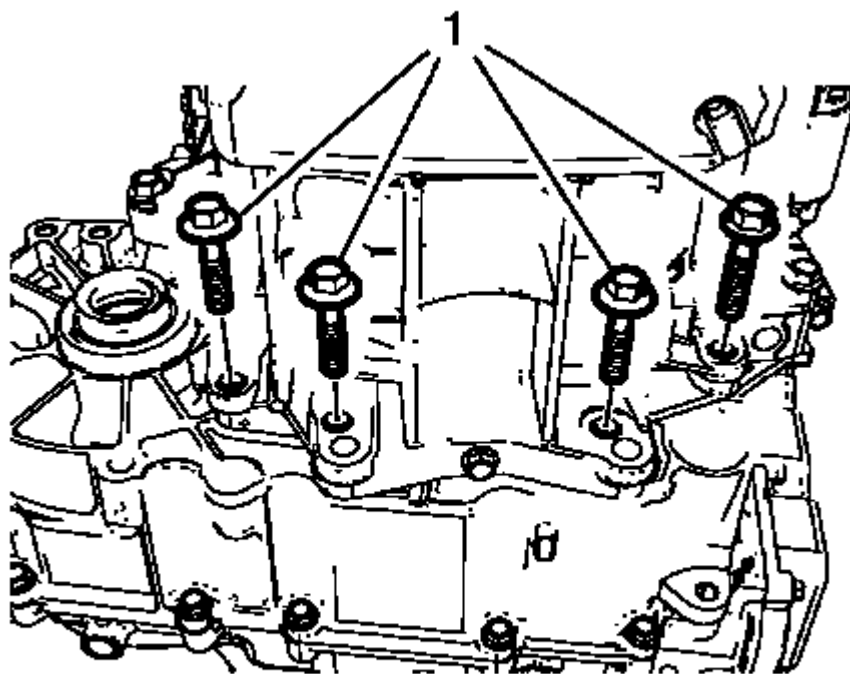
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** The complete installation procedure of the lower oil pan should be done in 10 minutes. Do not coat sealing compound on the oil pan bolt bores and threads.

3. Ensure that the oil pan and the sealing surface on the lower crankcase are free of all oil and debris.
4. Apply a 2 mm (0.079 in) bead of suitable sealant (1) around the perimeter of the oil pan and the oil suction port opening. DO NOT over apply the sealant. More than a 2 mm (0.079 in) bead is not required.

**Fig. 200: Oil Pan & Bolts****Courtesy of GENERAL MOTORS COMPANY**

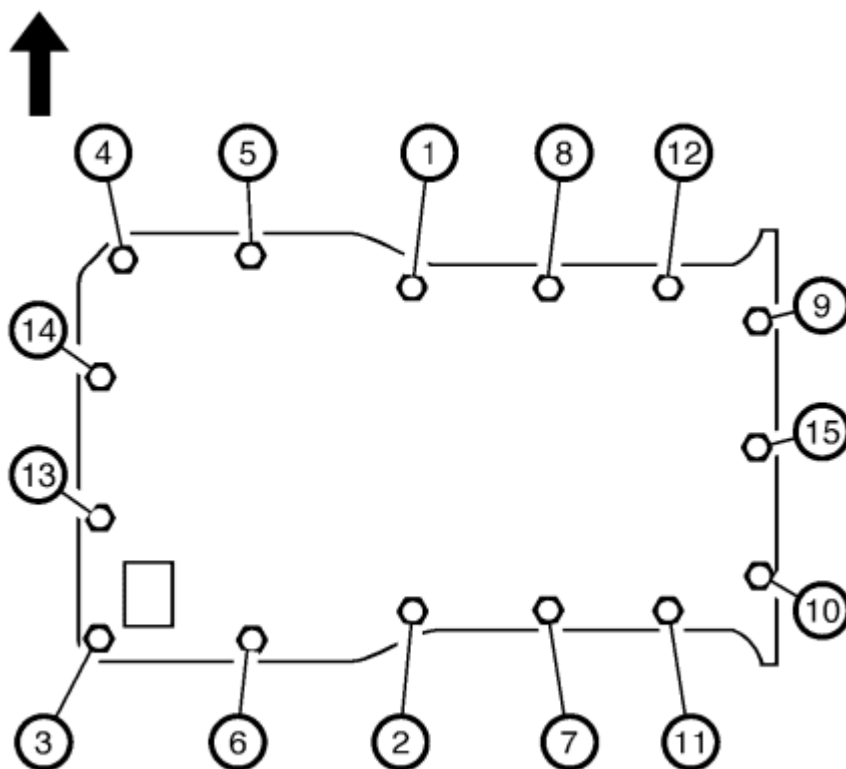
5. Install the oil pan (1).
6. Install 14 short oil pan bolts (2) and tighten loosely.
7. Install the long oil pan bolt (3) and tighten loosely.



**Fig. 201: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

8. Install the 4 transmission bolts (1) and tighten loosely.

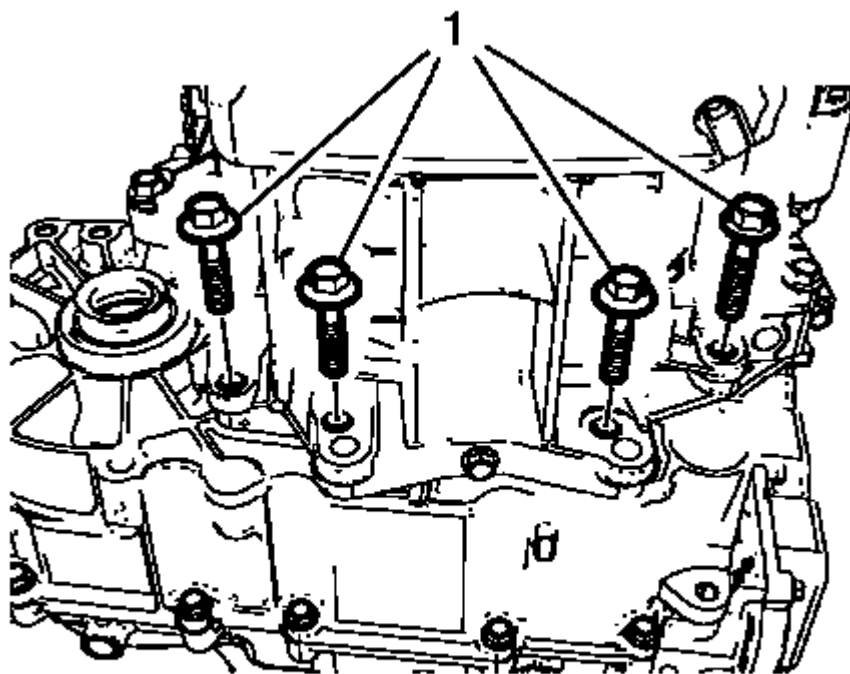


**Fig. 202: Oil Pan Bolt Tightening Sequence**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

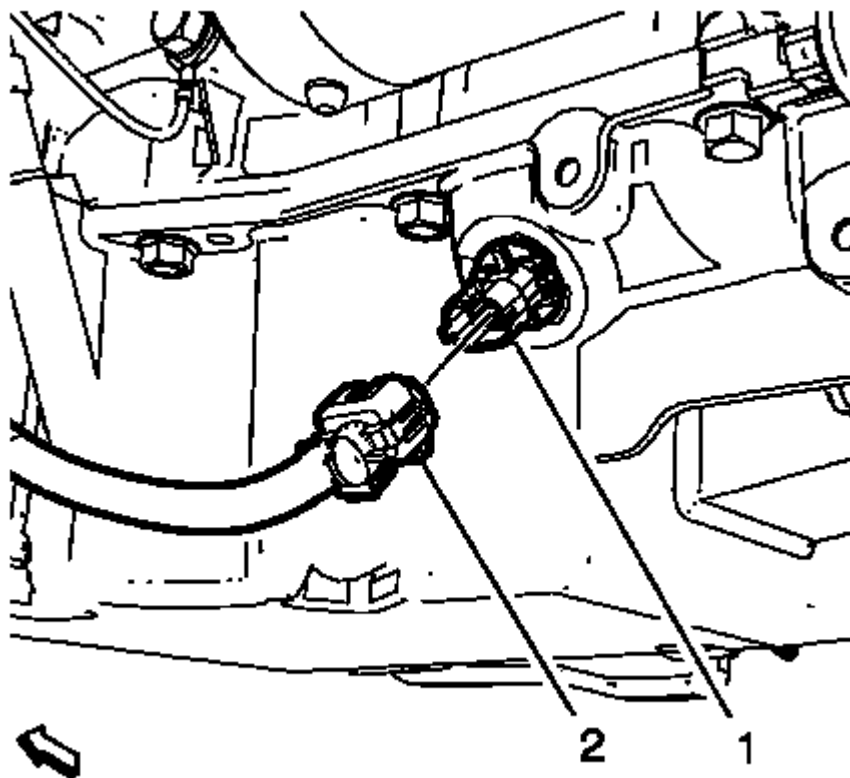
9. Tighten the oil pan bolts in a sequence as shown in the graphic above to 25 (18 lb ft).



**Fig. 203: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

10. Install the 4 gear box bolts (1) and tighten to:
  - For vehicles with automatic transmission 58 (43 lb ft).
  - For vehicles with manual transmission 60 (44 lb ft).



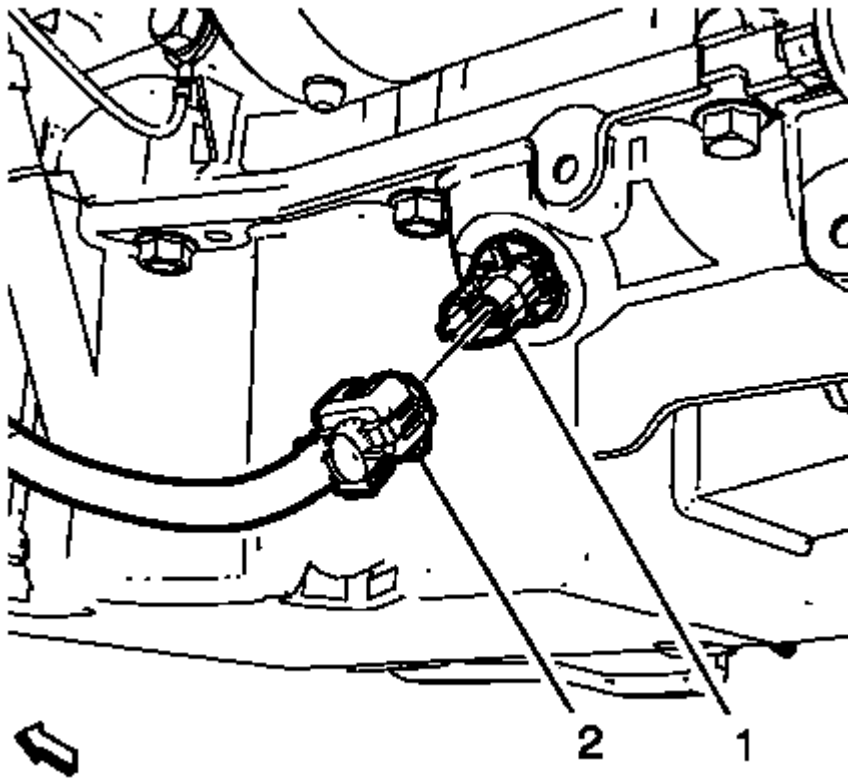
**Fig. 204: Oil Level Sensor & Wiring Harness Plug**  
Courtesy of GENERAL MOTORS COMPANY

11. Connect the oil level sensor wiring harness plug (2) to the oil level sensor (1).
12. Install the catalytic converter brace. Refer to **Catalytic Converter Brace Replacement (2.0L LHU)**.
13. Install the A/C compressor bracket. Refer to **Air Conditioning Compressor Bracket Replacement**.
14. If equipped, install the front compartment insulator. Refer to **Front Compartment Insulator Replacement**.
15. Lower the vehicle.
16. Lower the engine deep as necessary to install the engine mount.
17. Install the engine mount. Refer to **Engine Mount Replacement**.
18. Remove the engine support fixture. Refer to **Engine Support Fixture**.
19. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
20. Fill up the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
21. Recharge the refrigerant. Refer to **Refrigerant Recovery and Recharging**.

## OIL PAN REPLACEMENT (AUTOMATIC TRANSMISSION)

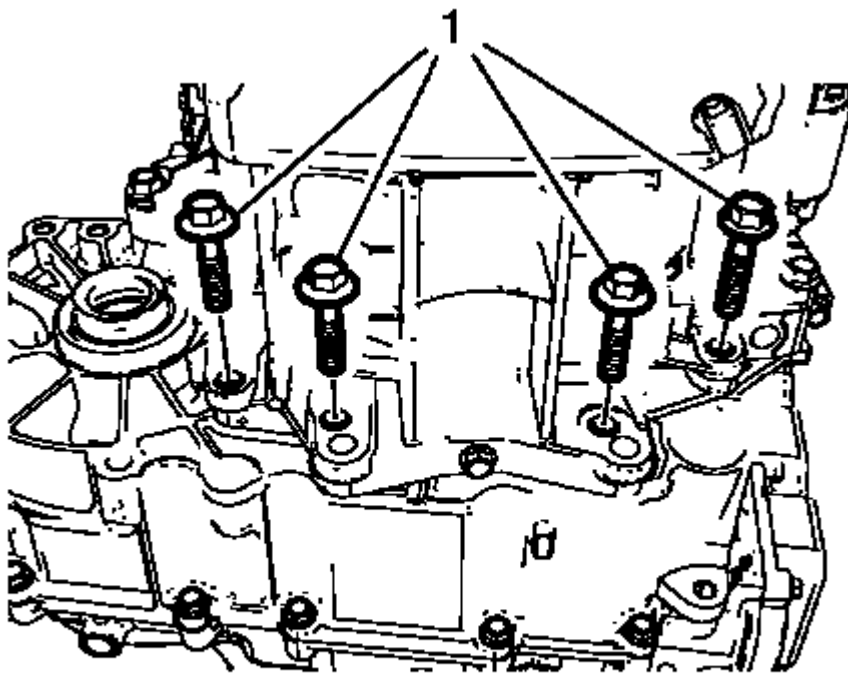
### Removal Procedure

1. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging** .
2. Remove the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
3. Install the engine support fixture. Refer to **Engine Support Fixture**.
4. Remove the engine mount. Refer to **Engine Mount Replacement**.
5. Lift the engine as high as necessary to increase enough space between oil pan and front suspension frame.
6. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
7. If equipped, remove the front compartment insulator. Refer to **Front Compartment Insulator Replacement** .
8. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the A/C compressor bracket. Refer to **Air Conditioning Compressor Bracket Replacement** .
10. Remove the catalytic converter brace. Refer to **Catalytic Converter Brace Replacement (2.0L LHU)** .



**Fig. 205: Oil Level Sensor & Wiring Harness Plug**  
 Courtesy of GENERAL MOTORS COMPANY

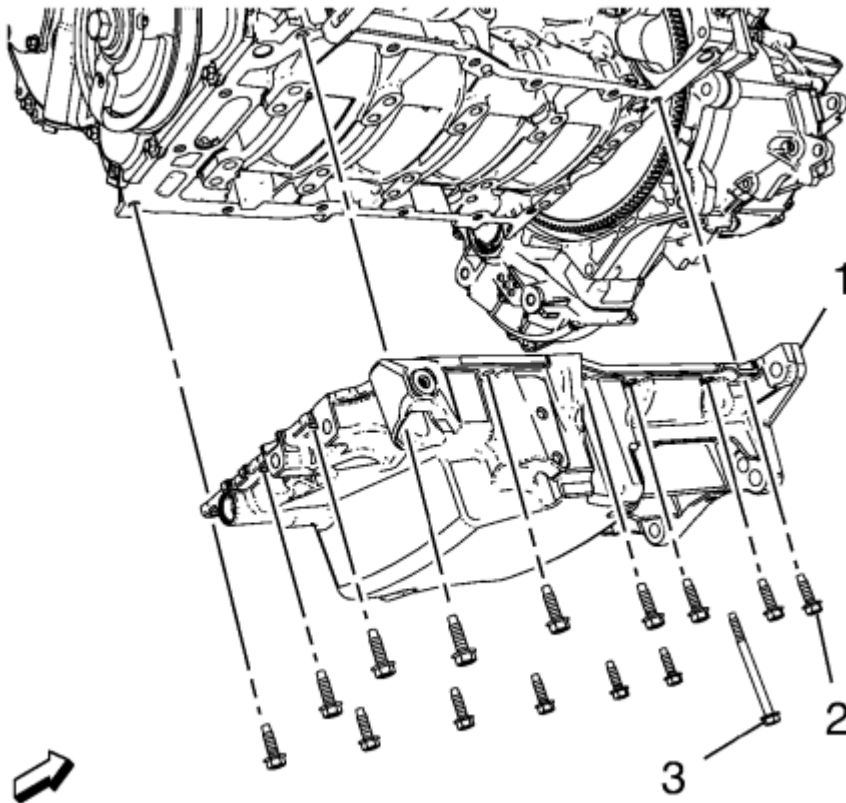
11. Disconnect the oil level sensor wiring harness plug (2) from the oil level sensor (1).



**Fig. 206: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

12. Remove the 4 gearbox bolts (1) from the gearbox.



**Fig. 207: Oil Pan & Bolts**

Courtesy of GENERAL MOTORS COMPANY

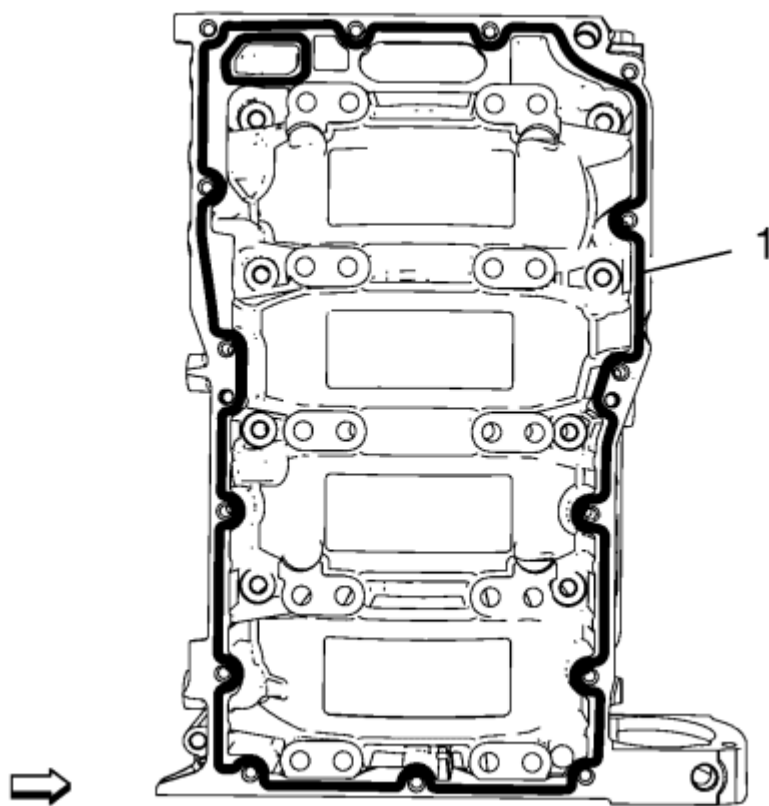
13. Remove the long oil pan bolt (3).
14. Remove the 14 short oil pan bolts (2).

**CAUTION:** Pry the oil pan carefully in order to prevent damage to the transaxle case or the oil pan sealing surfaces.

15. Remove the oil pan (1).
16. Remove the oil level sensor from the oil pan. Refer to Engine Oil Level Sensor Replacement.

#### Installation Procedure

1. Install the oil level sensor to the oil pan. Refer to Engine Oil Level Sensor Replacement.
2. Clean the sealing surfaces.

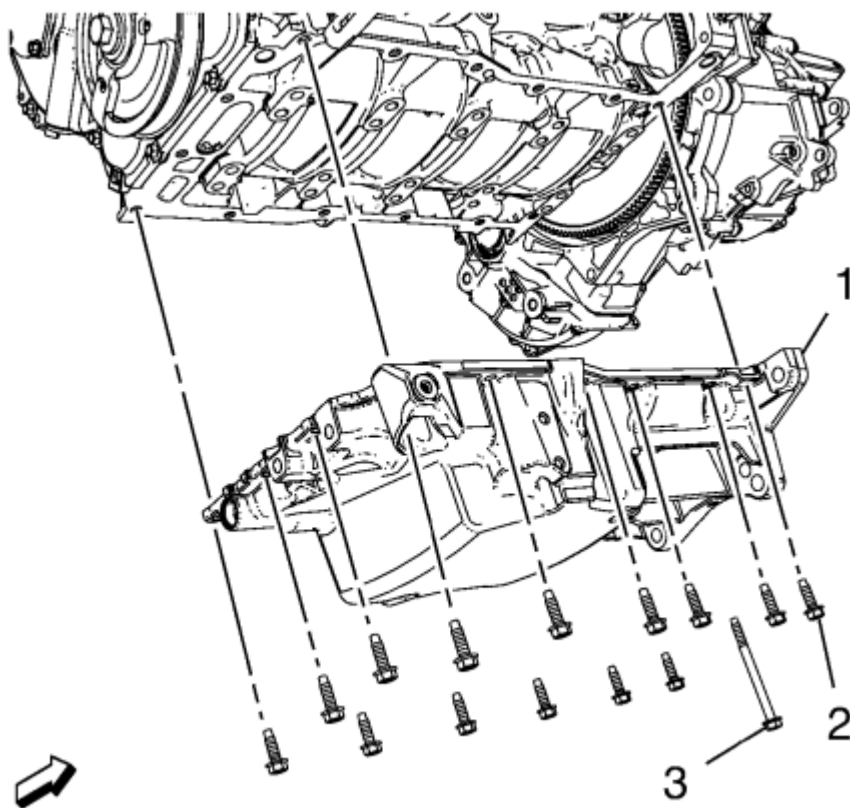


**Fig. 208: Oil Pan Sealant Bead**

Courtesy of GENERAL MOTORS COMPANY

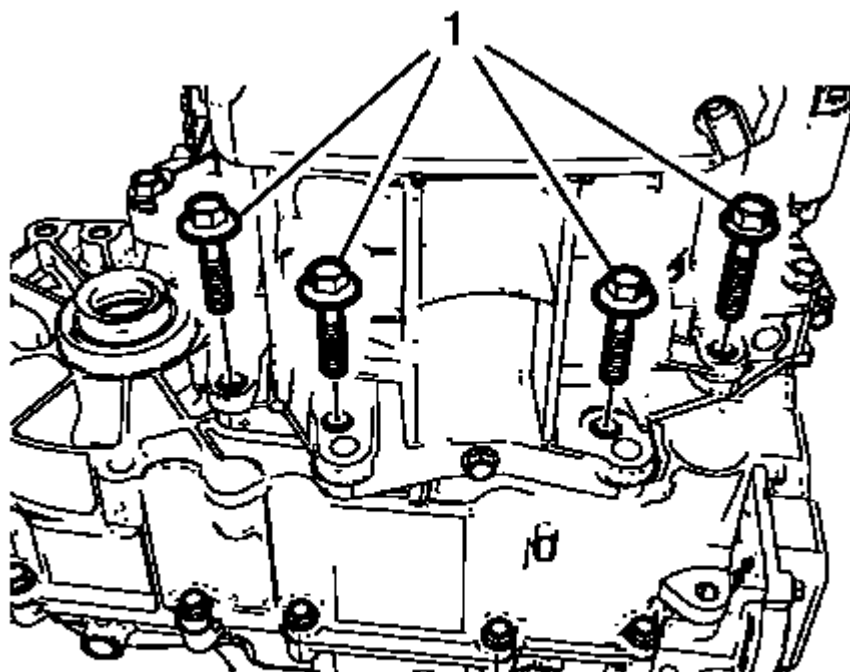
**NOTE:** The complete installation procedure of the lower oil pan should be done in 10 minutes. Do not coat sealing compound on the oil pan bolt bores and threads.

3. Ensure that the oil pan and the sealing surface on the lower crankcase are free of all oil and debris.
4. Apply a 2 mm (0.079 in) bead of suitable sealant (1) around the perimeter of the oil pan and the oil suction port opening. DO NOT over apply the sealant. More than a 2 mm (0.079 in) bead is not required.

**Fig. 209: Oil Pan & Bolts**

Courtesy of GENERAL MOTORS COMPANY

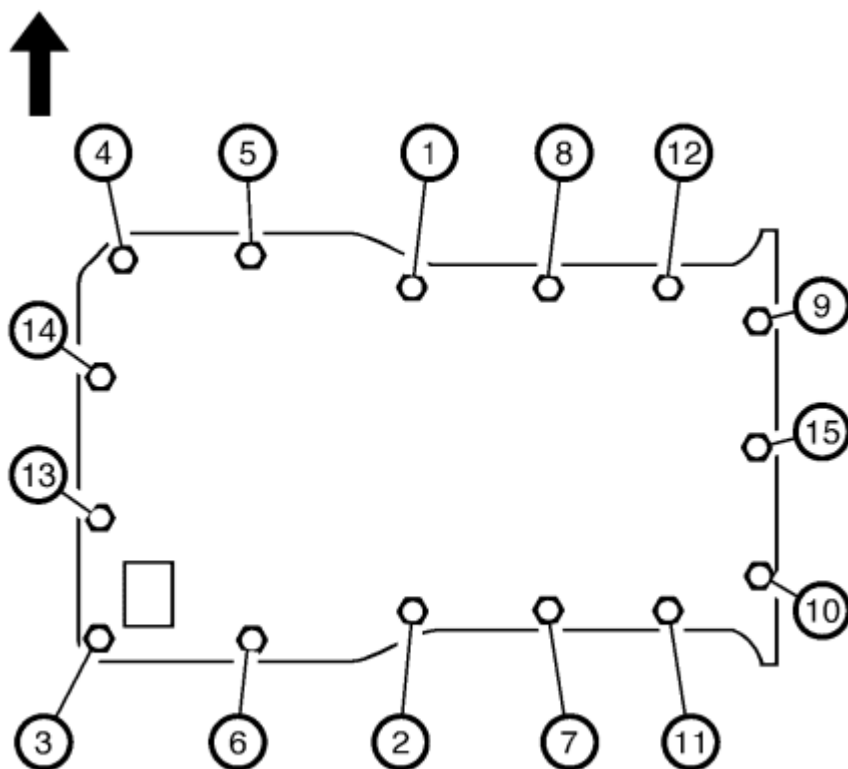
5. Install the oil pan (1).
6. Install 14 short oil pan bolts (2) and tighten loosely.
7. Install the long oil pan bolt (3) and tighten loosely.



**Fig. 210: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

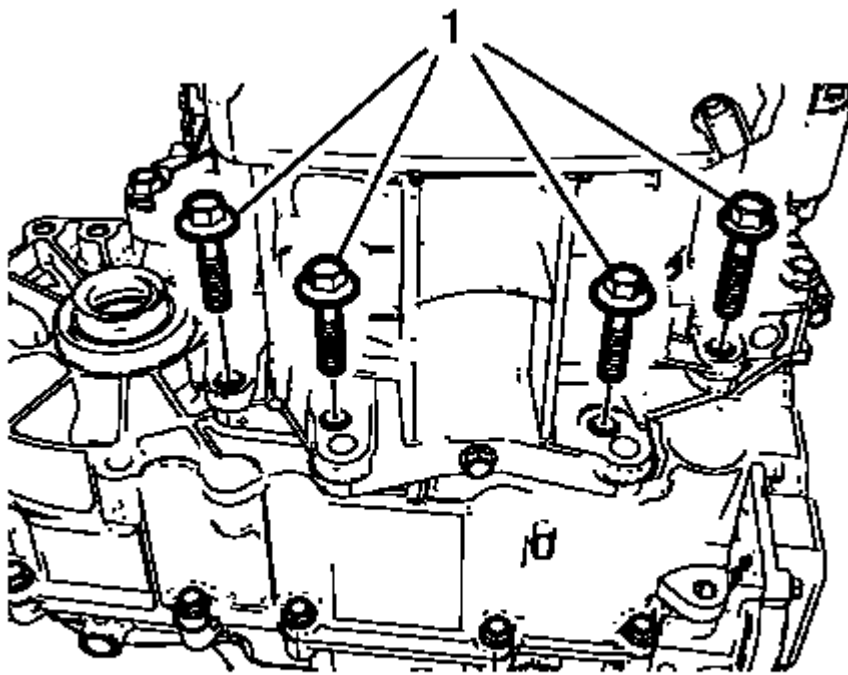
8. Install the 4 gear box bolts (1) and loosely tighten.



**Fig. 211: Oil Pan Bolt Tightening Sequence**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to Fastener Caution .

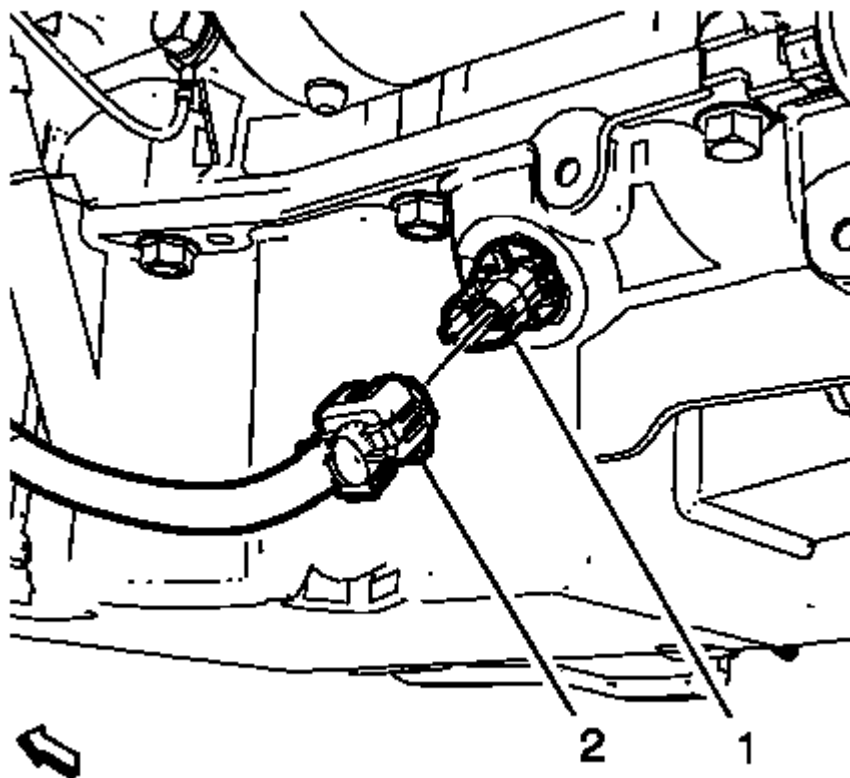
9. Tighten the oil pan bolts in a sequence as shown in the graphic above to 25 (18 lb ft).



**Fig. 212: Transmission Bolts**

Courtesy of GENERAL MOTORS COMPANY

10. Tighten the 4 gear box bolts (1) to 58 (43 lb ft).



**Fig. 213: Oil Level Sensor & Wiring Harness Plug**  
**Courtesy of GENERAL MOTORS COMPANY**

11. Connect the oil level sensor wiring harness plug (2) to the oil level sensor (1).
12. Install the catalytic converter brace. Refer to **Catalytic Converter Brace Replacement (2.0L LHU)**.
13. Install the A/C compressor bracket. Refer to **Air Conditioning Compressor Bracket Replacement**.
14. If equipped, install the front compartment insulator. Refer to **Front Compartment Insulator Replacement**.
15. Lower the vehicle.
16. Lower the engine deep as necessary to install the engine mount.
17. Install the engine mount. Refer to **Engine Mount Replacement**.
18. Remove the engine support fixture. Refer to **Engine Support Fixture**.
19. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
20. Fill up the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
21. Recharge the refrigerant. Refer to **Refrigerant Recovery and Recharging**.

## PISTON, CONNECTING ROD AND BEARING REPLACEMENT

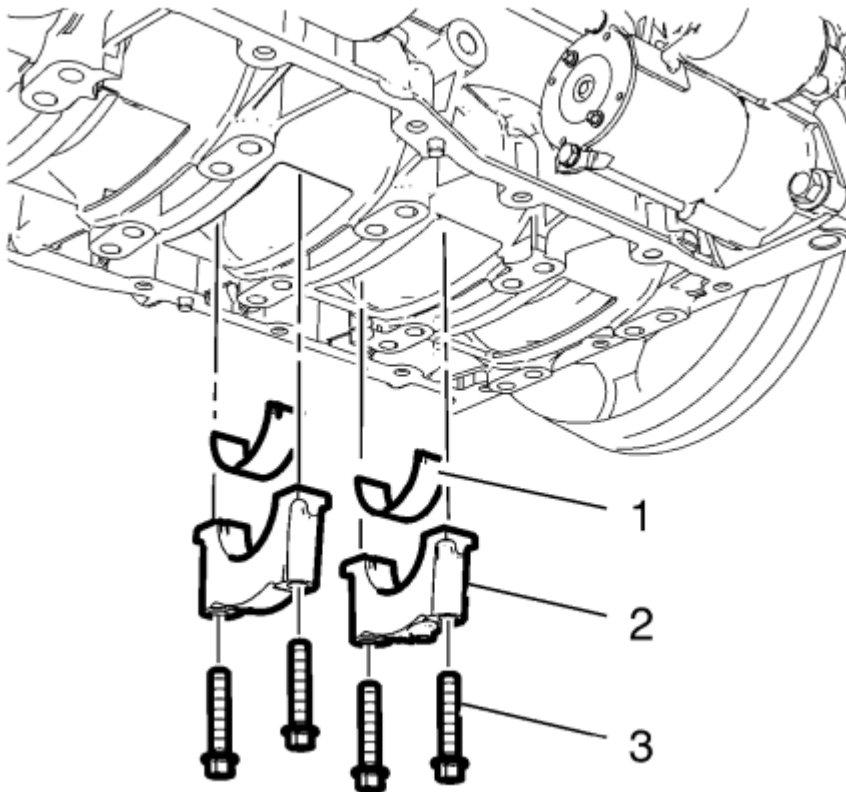
### Special Tools

- **EN-43953** Ring Compressor
- **EN-43966-1** Connecting Rod Guides
- **EN-45059** Angle Meter

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

#### Removal Procedure

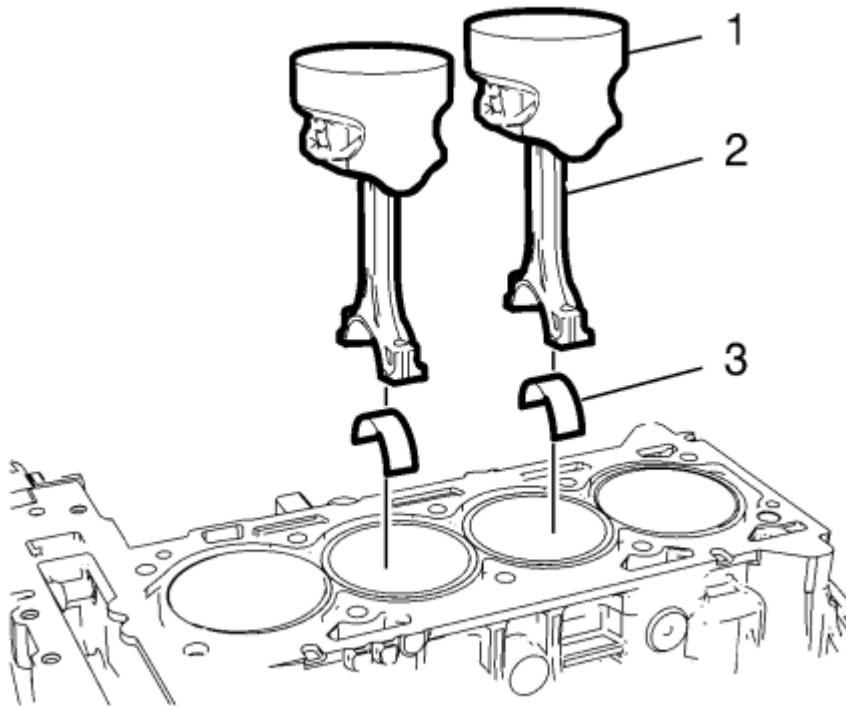
1. Remove the cylinder head. Refer to **Cylinder Head Replacement**.
2. Remove the oil pan. Refer to **Oil Pan Replacement (Manual Transmission)**, **Oil Pan Replacement (Automatic Transmission)**.
3. Rotate the crankshaft to a position where the connecting rod fasteners are the best accessible.
4. Mark the connecting rod and cap with the cylinder position. Also mark their orientation. This will ensure the caps and connecting rods will re-assembled properly.
5. Remove any ridge at the top of the cylinder bore to avoid damage to the piston ring lands.



**Fig. 214: Lower Piston Bearing, Bearing Caps & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

6. Remove the bearing cap bolts (3) and the bearing caps (2) with the lower bearing (1).
7. Install the **EN-43966-1** connecting guides on the connecting rod threads before removing the piston and

connecting rod assembly.

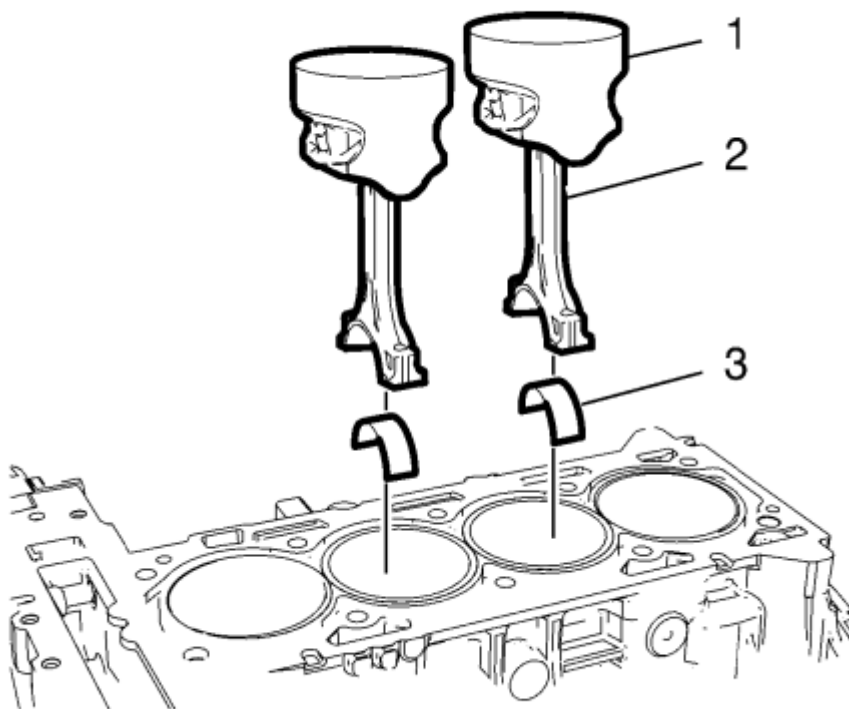


**Fig. 215: Upper Piston Bearing, Piston & Connecting Rod**  
Courtesy of GENERAL MOTORS COMPANY

8. Remove the piston (1) with the connecting rod (2) and the upper bearing (3).
9. Remove the **EN-43966-1** connecting guides.

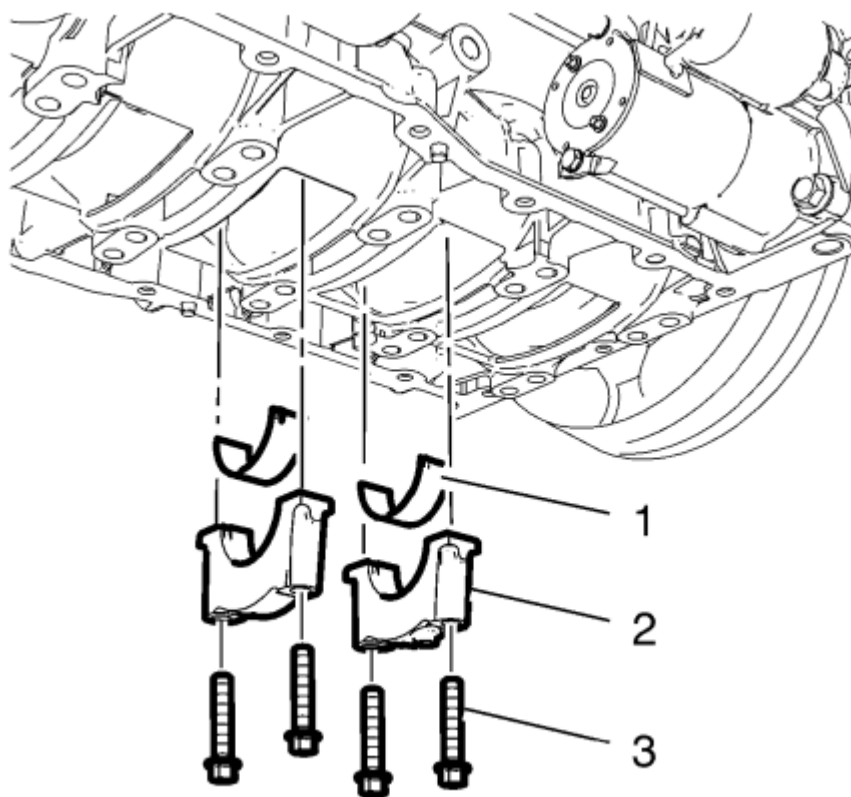
#### Installation Procedure

1. Install the **EN-43966-1** connecting guides to the connecting rod threads. This protects the crankshaft journal during piston and connecting rod installation.
2. Install the **EN-43953** ring compressor to the piston and the connecting rod to the correct bore.



**Fig. 216: Upper Piston Bearing, Piston & Connecting Rod**  
Courtesy of GENERAL MOTORS COMPANY

3. Install the piston (1) with the connecting rod (2) and the NEW upper bearing (3).
4. Hold the **EN-43953** ring compressor against the engine block until all the rings have entered the cylinder bore.
5. Remove the **EN-43966-1** connecting guides.



**Fig. 217: Lower Piston Bearing, Bearing Caps & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Install the bearing caps (1) in their original position.

6. Install the NEW lower bearing (1) with the bearing caps (2).

**CAUTION:** Refer to Fastener Caution .

**CAUTION:** Refer to Torque-to-Yield Fastener Caution .

7. Install the bearing caps bolts (3) and tighten a first pass to 25 N.m (18 lb ft).
8. Tighten the bearing caps bolts (3) a final pass to an additional 100°, using the **EN-45059** meter.
9. Install the oil pan. Refer to Oil Pan Replacement (Manual Transmission), Oil Pan Replacement (Automatic Transmission).
10. Install the cylinder head. Refer to Cylinder Head Replacement.

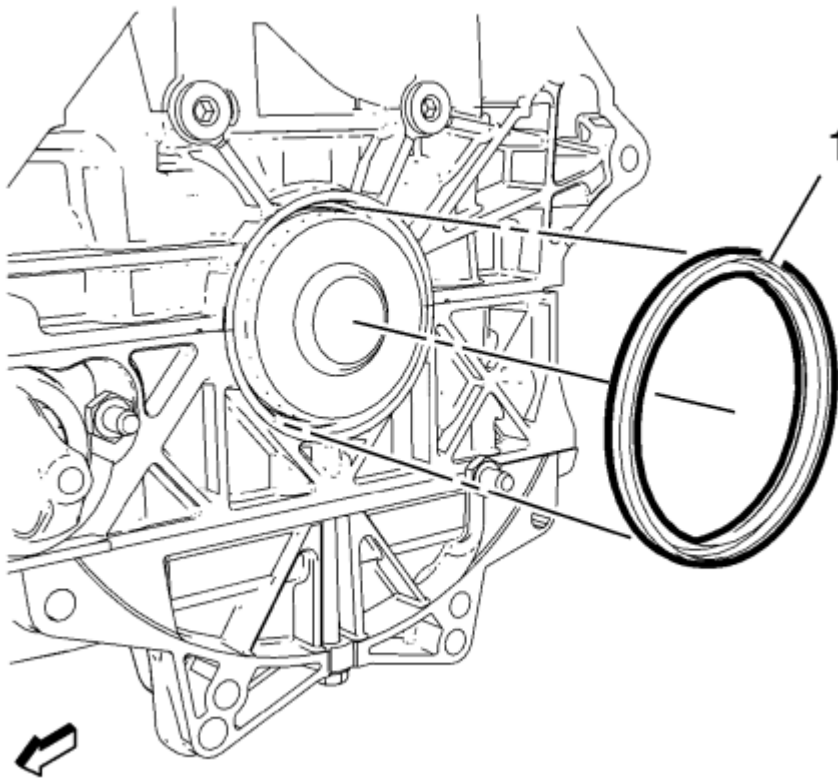
#### CRANKSHAFT REAR OIL SEAL REPLACEMENT (AUTOMATIC TRANSMISSION)

**Special Tools****EN-42067** Rear Main Seal Installer

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

**Removal Procedure**

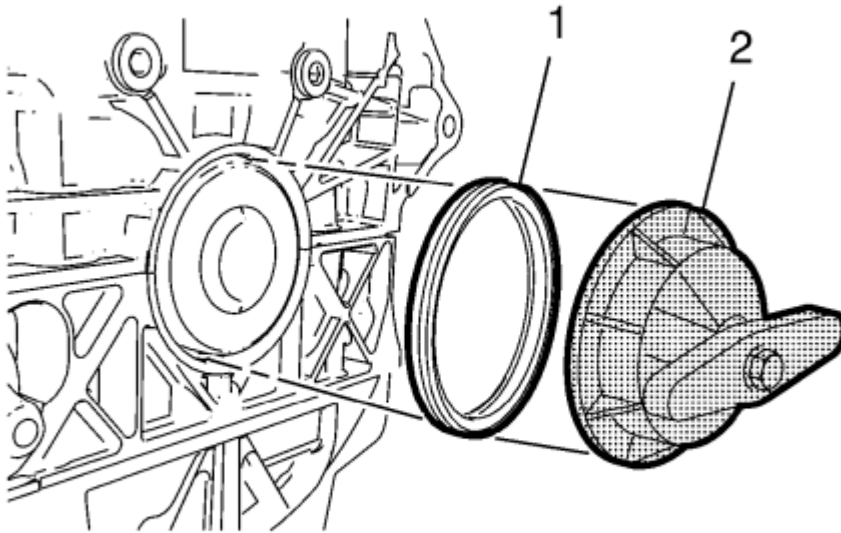
1. Remove the automatic transmission flex plate. Refer to **Automatic Transmission Flex Plate Replacement**.



**Fig. 218: Crankshaft Rear Oil Seal**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the crankshaft rear oil seal (1) with a suitable tool.

**Installation Procedure**



**Fig. 219: Crankshaft Rear Oil Seal & Installer**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install the crankshaft rear oil seal (1) using the **EN-42067** installer (2).
2. Install the automatic transmission flex plate. Refer to **Automatic Transmission Flex Plate Replacement**.

## CRANKSHAFT REAR OIL SEAL REPLACEMENT (MANUAL TRANSMISSION)

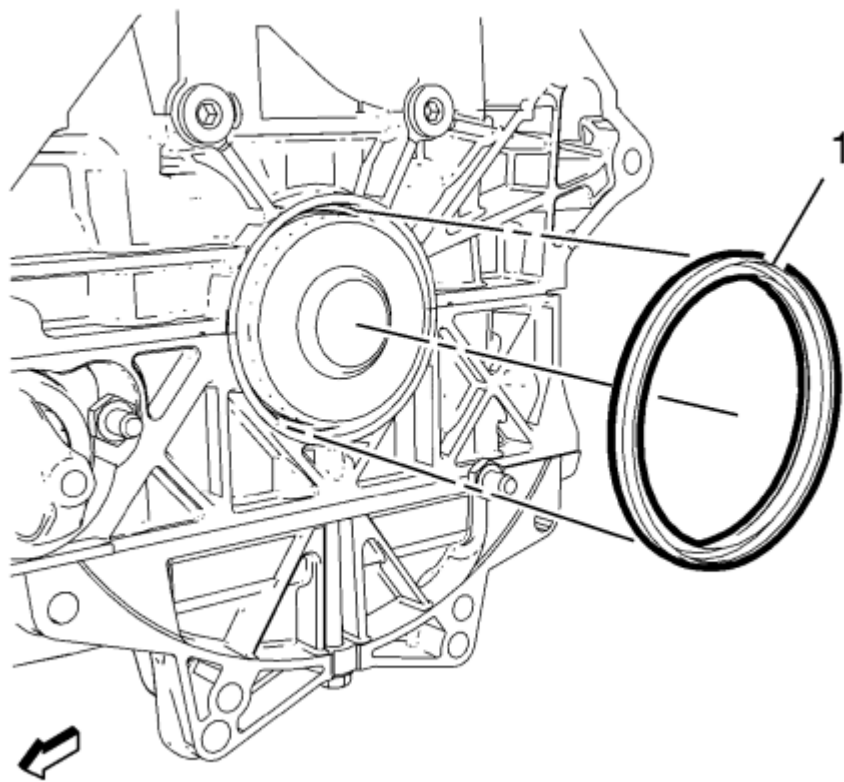
### Special Tools

**EN-42067** Rear Main Seal Installer

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

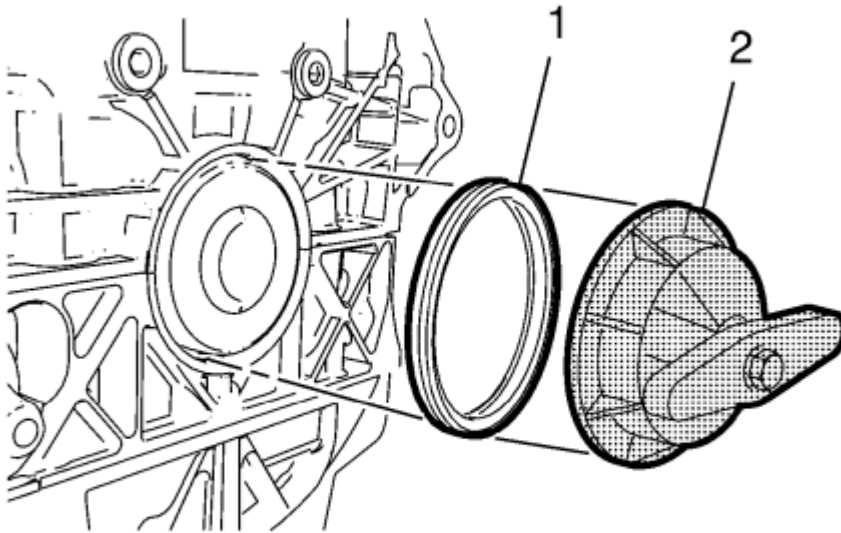
1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.



**Fig. 220: Crankshaft Rear Oil Seal**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the crankshaft rear oil seal (1) with a suitable tool.

**Installation Procedure**



**Fig. 221: Crankshaft Rear Oil Seal & Installer**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install the crankshaft rear oil seal (1) using the **EN-42067** installer (2).
2. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

## ENGINE FLYWHEEL REPLACEMENT

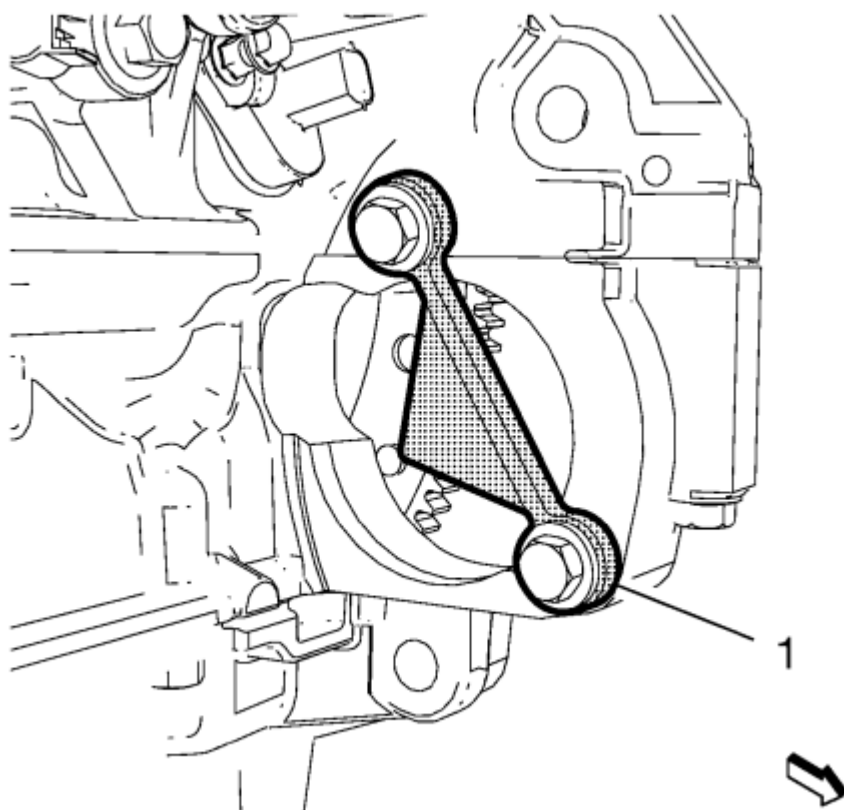
### Special Tools

- **EN-43653** Flywheel Holding Tool
- **EN-45059** Angle Meter

For equivalent regional tools, refer to **Special Tools (LDK, LHU)** .

### Removal Procedure

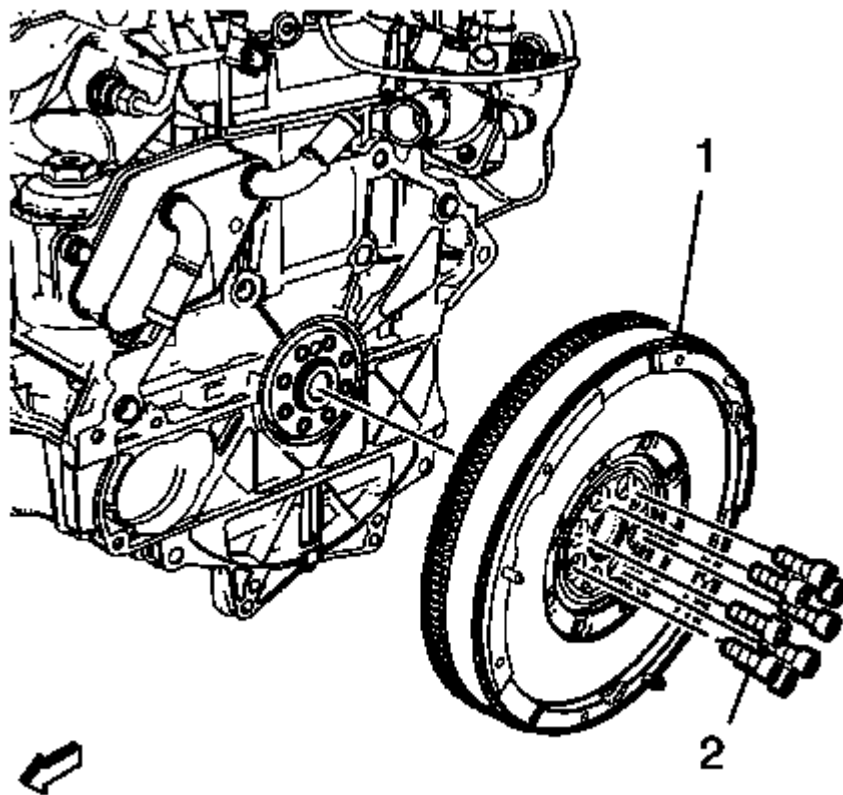
1. Remove the manual transmission. Refer to **Transmission Replacement** .



**Fig. 222: Flywheel Holding Tool**

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-43653** holding tool (1) in the starter assembly location, engaging the flywheel, in order to prevent crankshaft rotation.



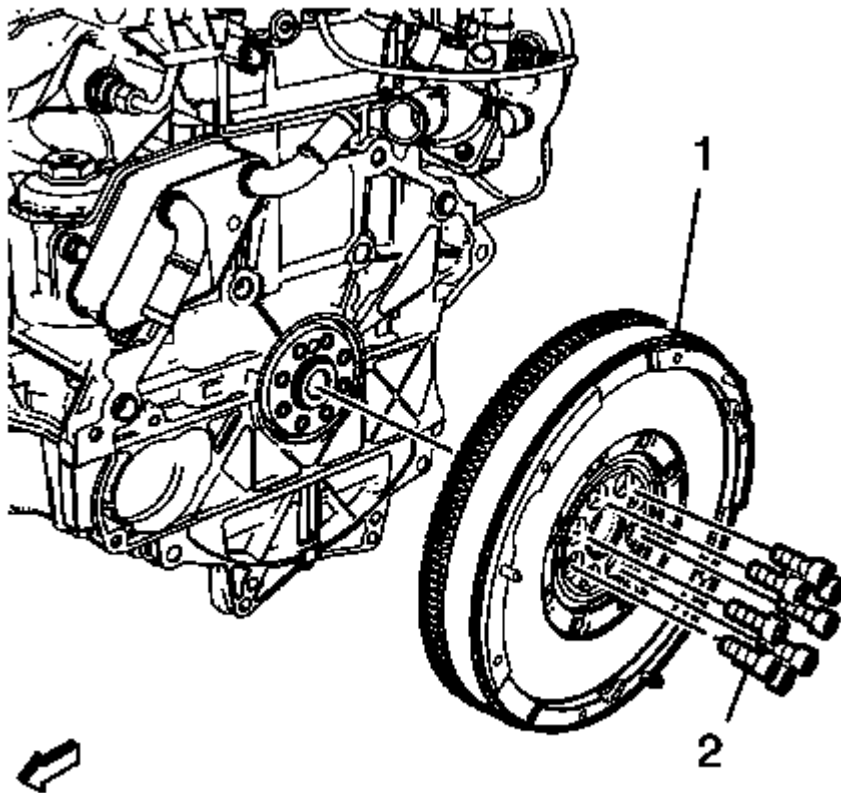
**Fig. 223: Engine Flywheel & Bolts**

Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD the 8 engine flywheel bolts (2) and the engine flywheel (1).

#### Installation Procedure

1. Re-cut the 8 engine flywheel bolt threads in the crankshaft.



**Fig. 224: Engine Flywheel & Bolts**

Courtesy of GENERAL MOTORS COMPANY

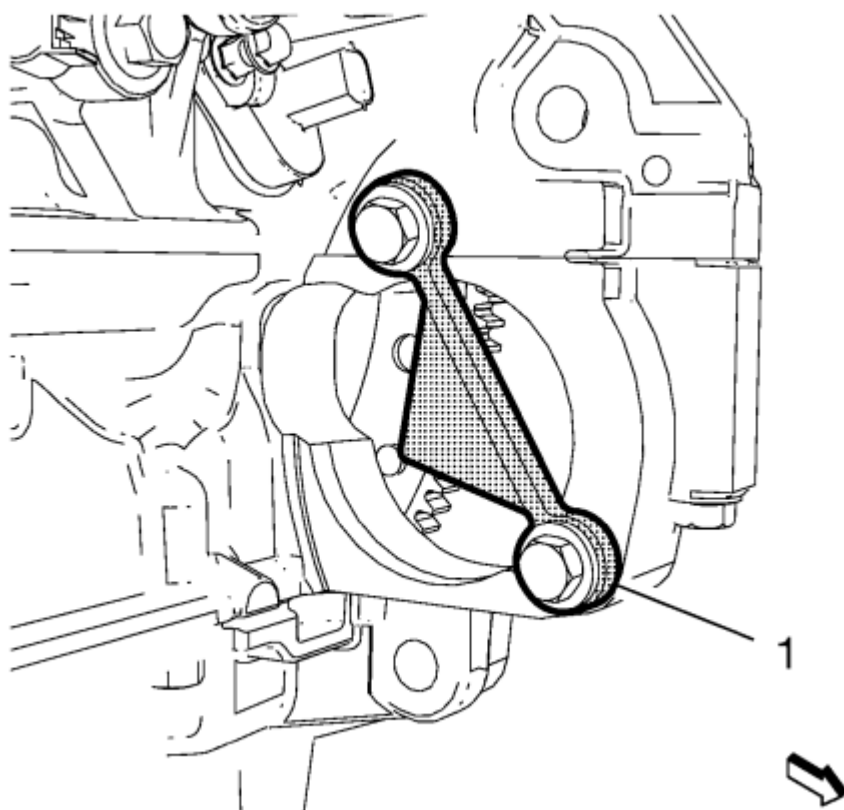
**NOTE:** Service may offer bolts that are not microencapsulated. If this is the case apply thread lock agent to the bolt. If fastener is microencapsulated, install 8 NEW engine flywheel bolts. DO NOT reuse the old bolt.

2. Install the engine flywheel (1) and 8 NEW engine flywheel bolts (2) hand tighten.

**CAUTION:** Refer to Fastener Caution .

**CAUTION:** Refer to Torque-to-Yield Fastener Caution .

3. Tighten the 8 engine flywheel bolts (2) in a first pass to 53 N.m (39 lb ft).
4. Tighten the flywheel bolts in a final pass to an additional 25 degrees, using the **EN-45059** meter.



**Fig. 225: Flywheel Holding Tool**

Courtesy of GENERAL MOTORS COMPANY

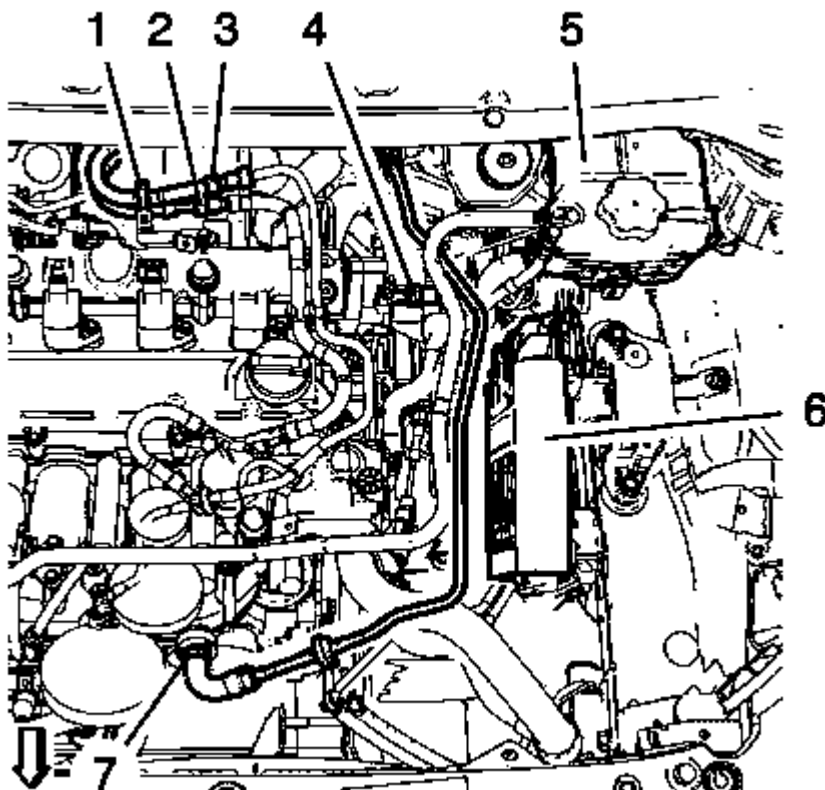
5. Remove the **EN-43653** holding tool (1) from the starter assembly location.
6. Install the manual transmission. Refer to **Transmission Replacement** .

## ENGINE REPLACEMENT (MANUAL TRANSMISSION)

### Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement** .
3. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging** .
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Drain the cooling system. Refer to **Cooling System Draining and Filling (2.0L LHU)** .
6. Drain the transmission. Refer to **Transmission Fluid Drain and Fill** .
7. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
9. Remove the air cleaner outlet rear duct. Refer to **Air Cleaner Outlet Rear Duct Replacement** .

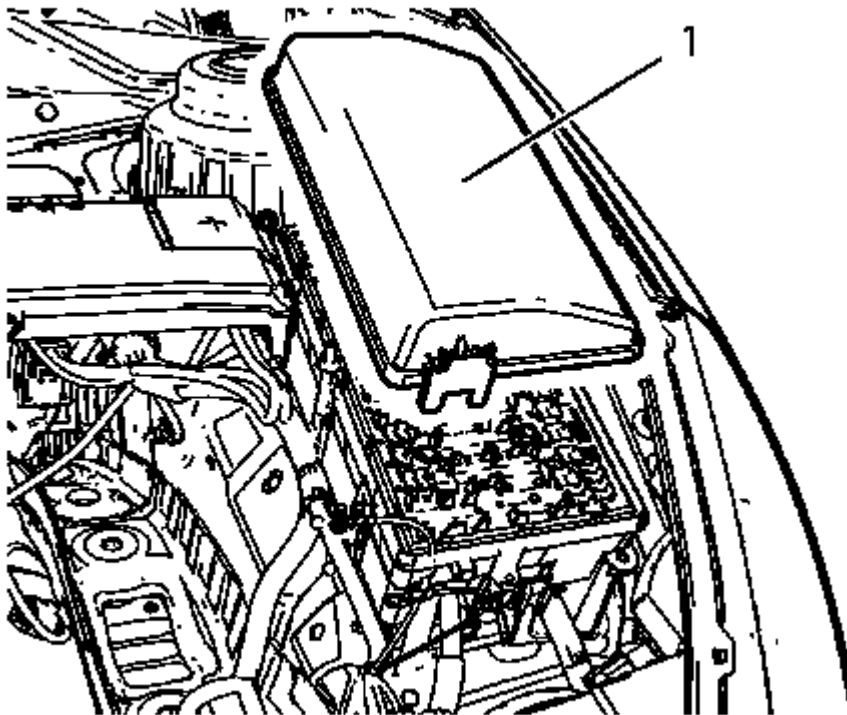
10. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
11. Remove the lower intermediate steering shaft bolt. Refer to **Intermediate Steering Shaft Replacement** .
12. Disconnect the electronic power steering connectors from the electronic power steering assembly. Refer to **FEP Connectors (Steering Gear)** .



**Fig. 226: ECM, EVAP Line, Fuel Feed Line & Vacuum Line Components**  
Courtesy of GENERAL MOTORS COMPANY

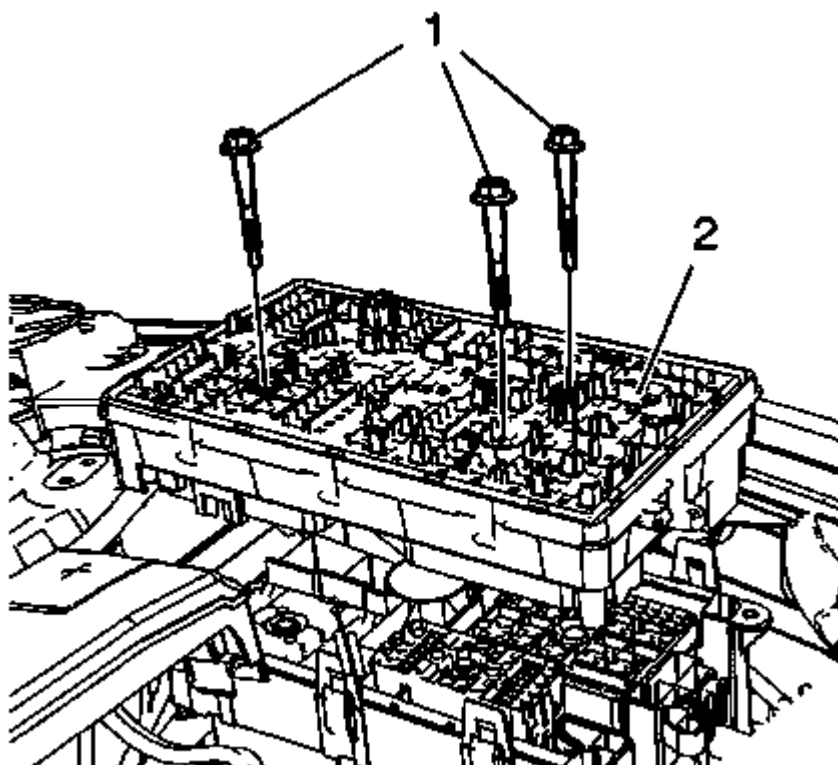
13. Disconnect the fuel feed line at the connector (2), clip out of the bracket (1) and reposition away from the engine. Refer to **Metal Collar Quick Connect Fitting Service** .
14. Disconnect the EVAP line at the connector (3), clip out of the bracket (1) and reposition away from the engine. Refer to **Metal Collar Quick Connect Fitting Service** .
15. Disconnect the vacuum line from the vacuum pump at the connector (4) and reposition away from the engine. Refer to **Plastic Collar Quick Connect Fitting Service** .
16. Remove the radiator surge tank (5) and position onto the engine. Refer to **Radiator Surge Tank Replacement** .
17. Remove the ECM (6) and position onto the engine. Refer to **Engine Control Module Replacement** .
18. Remove the 2 manual transmission selector lever cable from the transmission. Refer to **Manual Transmission Shift Lever and Selector Lever Cable Replacement** .
19. Disconnect clutch actuator cylinder front pipe from clutch actuator cylinder pipe elbow.

20. Remove the vacuum pipe (7) and reposition away from the engine.
21. Remove the battery tray. Refer to **Battery Tray Replacement**.



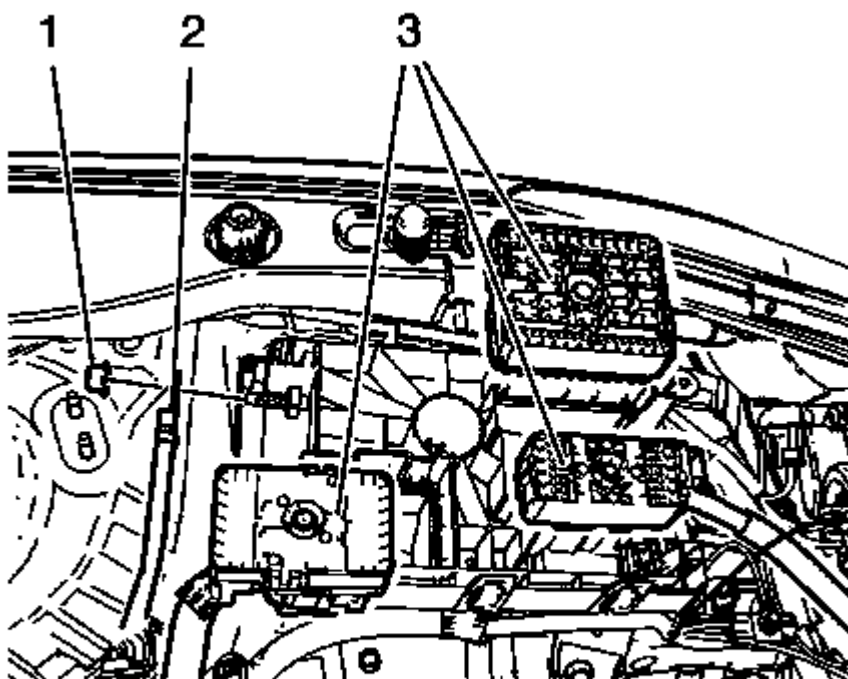
**Fig. 227: Front Compartment Fuse Block Cover**  
Courtesy of GENERAL MOTORS COMPANY

22. Remove the front compartment fuse block cover (1).



**Fig. 228: Front Compartment Fuse Block & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

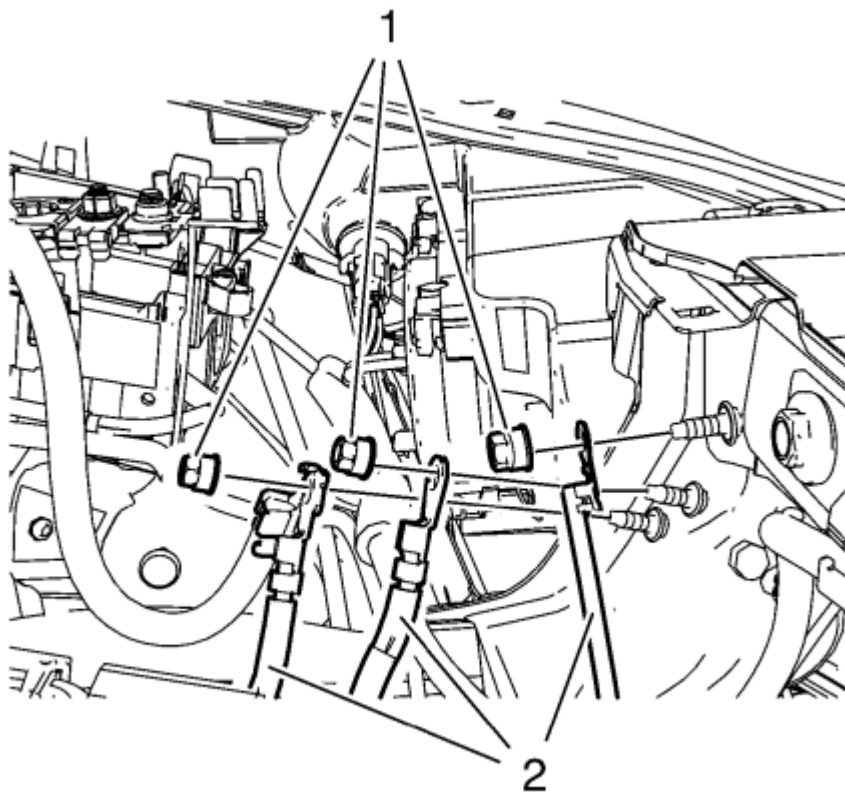
23. Remove the 3 front compartment fuse block bolts (1).
24. Remove the front compartment fuse block (2).



**Fig. 229: Wiring Harnesses & Plugs**

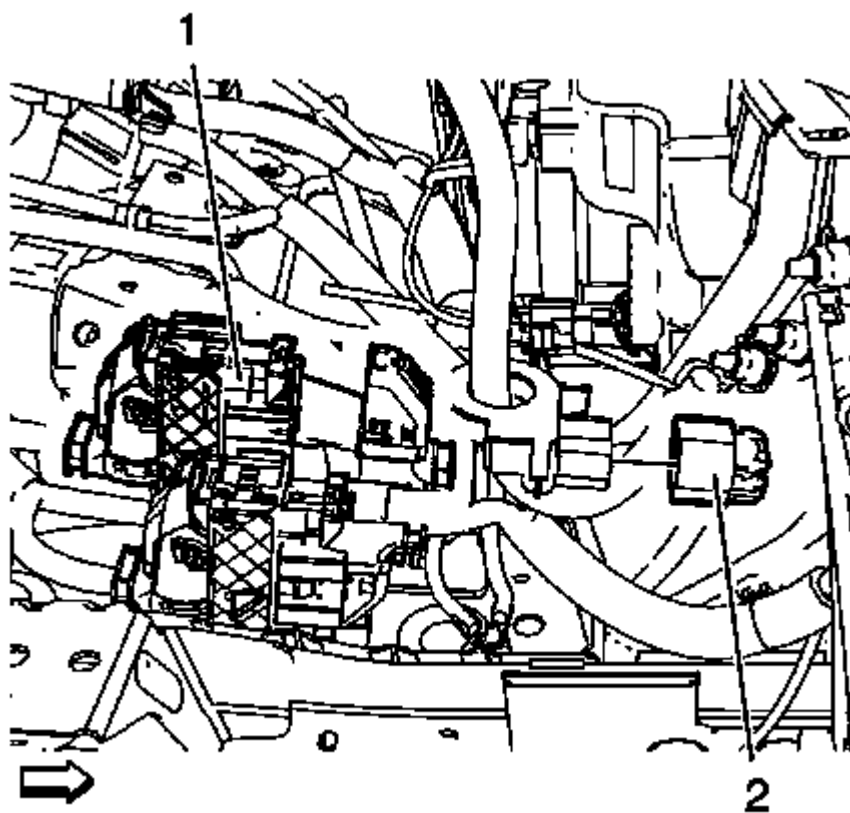
**Courtesy of GENERAL MOTORS COMPANY**

25. Unclip the 3 wiring harness plugs (3).
26. Disconnect the wiring harness plug from the front compartment fuse block.



**Fig. 230: Wiring Harnesses And Ground Nuts**  
Courtesy of GENERAL MOTORS COMPANY

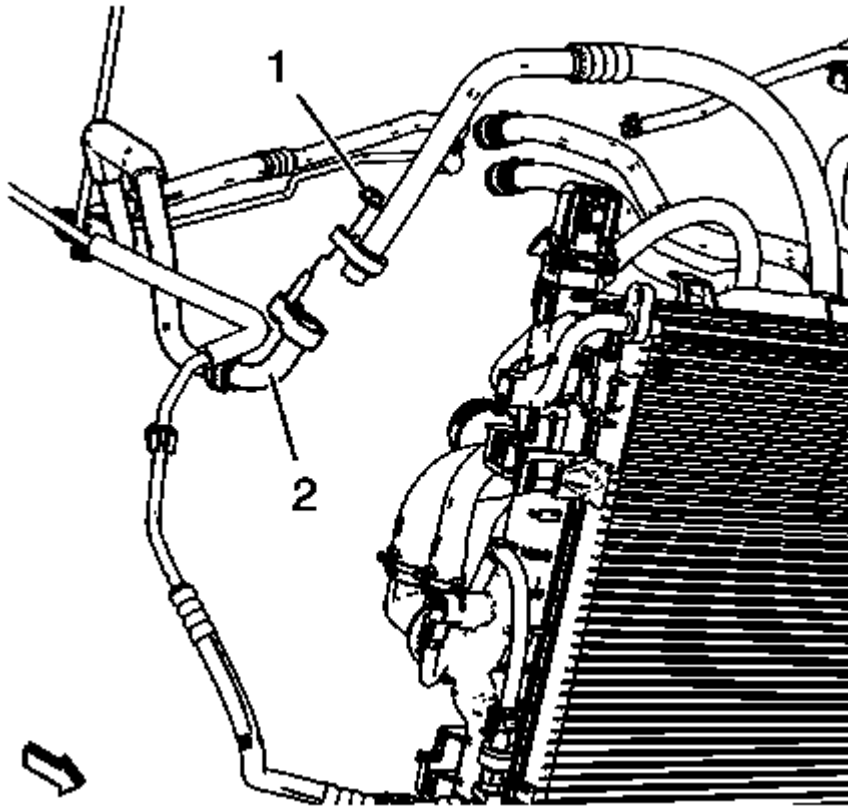
27. Remove the 3 ground nuts (1) and put the 4 wiring harness (2) aside.



**Fig. 231: Wiring Harness Plugs**

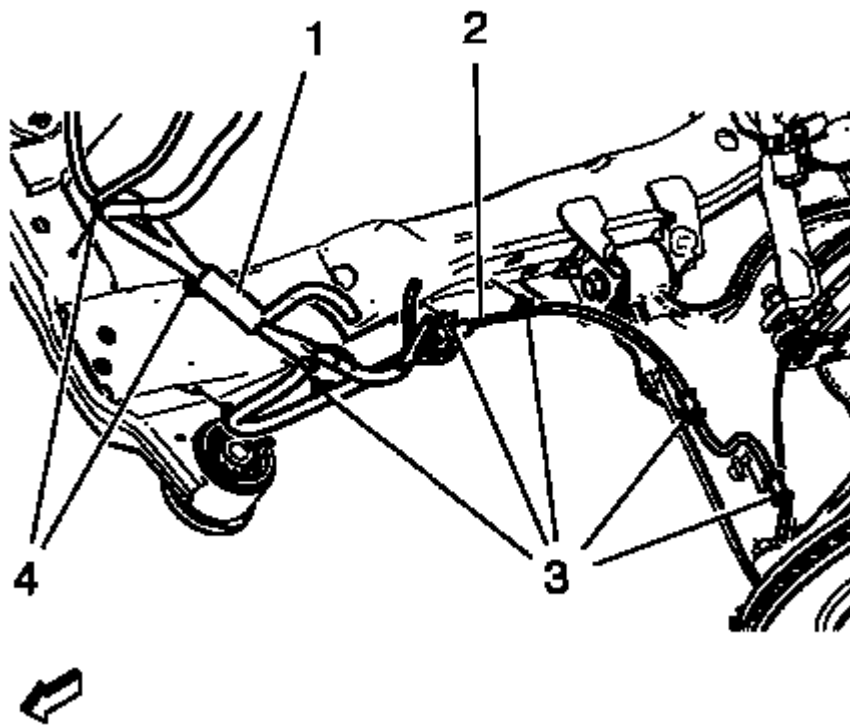
Courtesy of GENERAL MOTORS COMPANY

28. Disconnect the 2 wiring harness plugs (1, 2).



**Fig. 232: Air Conditioning Evaporator Hose**  
Courtesy of GENERAL MOTORS COMPANY

29. Remove A/C compressor and condenser hose nut (1) from refrigerant hose (2).
30. Remove the catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT (2.0L LHU)**.
31. Remove the heater inlet hose. Refer to **Heater Inlet Hose Replacement (2.0L LHU)**.
32. Remove the heater outlet hose. Refer to **Heater Outlet Hose Replacement (2.0L LHU)**.

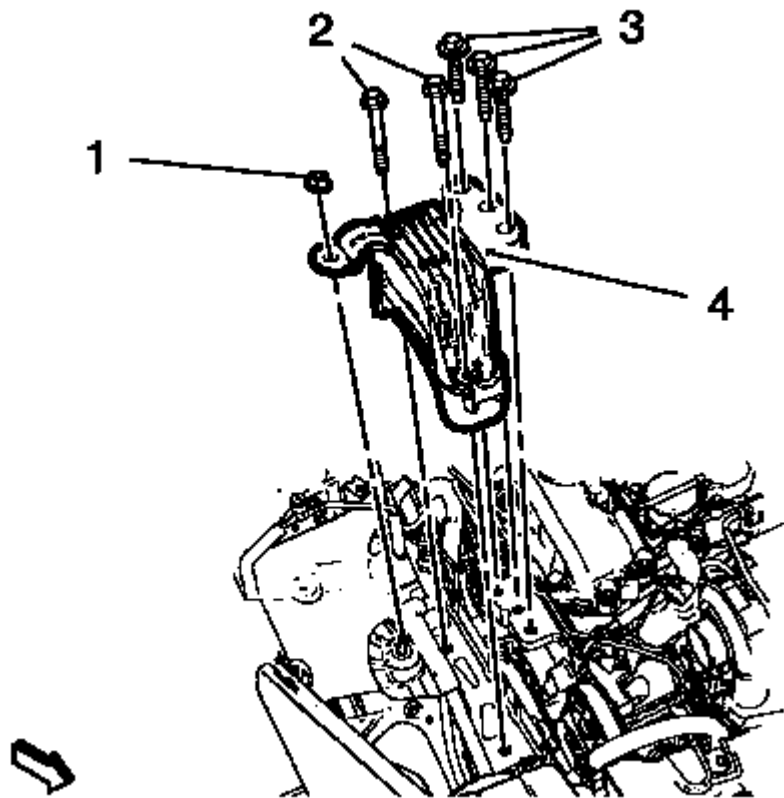


**Fig. 233: Radiator Wiring Harness, Wheel Speed Sensor Wiring Harness And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

33. Remove the wheel speed sensor wiring harness (2) from the frame on both sides.
34. Remove the wiring harness retainers (3) from the frame and the lower control arm.
35. Remove the left and right stabilizer shaft link from the strut assemblies. Refer to **Stabilizer Shaft Link Replacement** .
36. Remove the left and right steering outer tie rod from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement** .
37. Remove the left and right front lower control arm from the steering knuckles. Refer to **Lower Control Arm Replacement** .
38. Remove the left wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Left Side** .
39. Remove the right wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .
40. Install the engine support fixture. Refer to **Engine Support Fixture**.

**NOTE:** Use the engine support fixture to slightly raise the powertrain assembly to aid in the removal of the engine and transmission mount bolts.

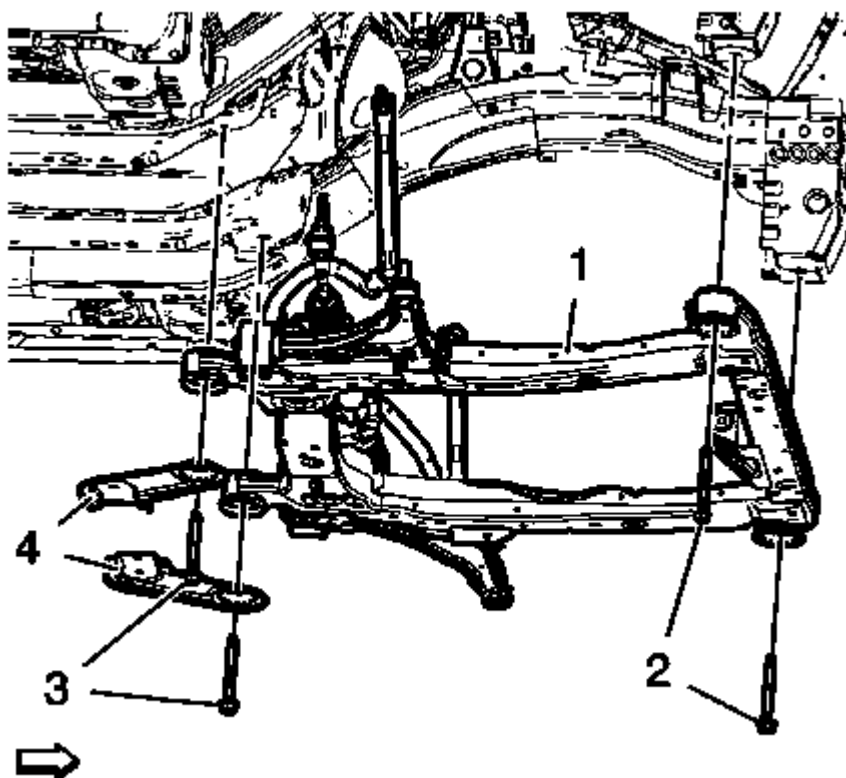
41. Adjust engine support fixture as needed.



**Fig. 234: Engine Mount Components**

Courtesy of GENERAL MOTORS COMPANY

42. Mark the location of the bolts (2, 3) before removing.
43. Remove the 5 engine mount bracket retaining bolts (2, 3) and the engine mount retaining nut (1).
44. Remove the engine mount (4).
45. Mark the location of the transmission mount bolts before removing.
46. Remove the transmission mount - left side. Refer to **Transmission Mount Replacement - Left Side**.
47. Raise the vehicle.
48. Using a suitable engine support table, lower the vehicle until the drivetrain and front suspension frame contacts the engine support table.
49. Position blocks of wood below the oil pan and transmission to stabilize the powertrain on the support table.
50. Using the engine support fixture, lower the powertrain down until it is resting on the engine support table.
51. Remove the engine support fixture. Refer to **Engine Support Fixture**.



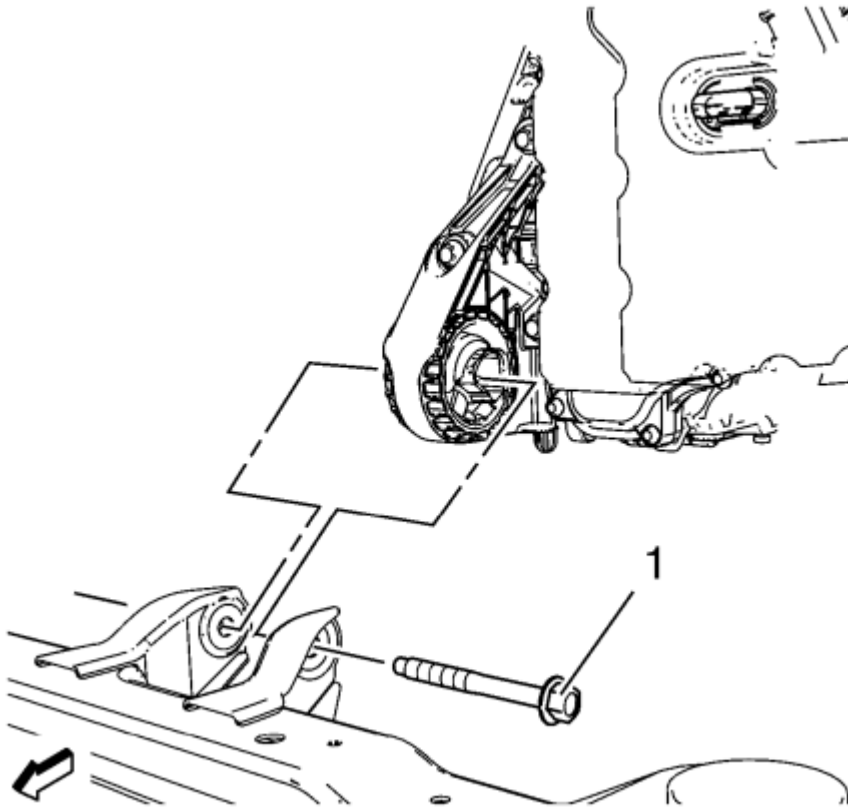
**Fig. 235: Frame Reinforcements & Bolts**

Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Simplified graphic. Suspension frame is supported by engine support table.

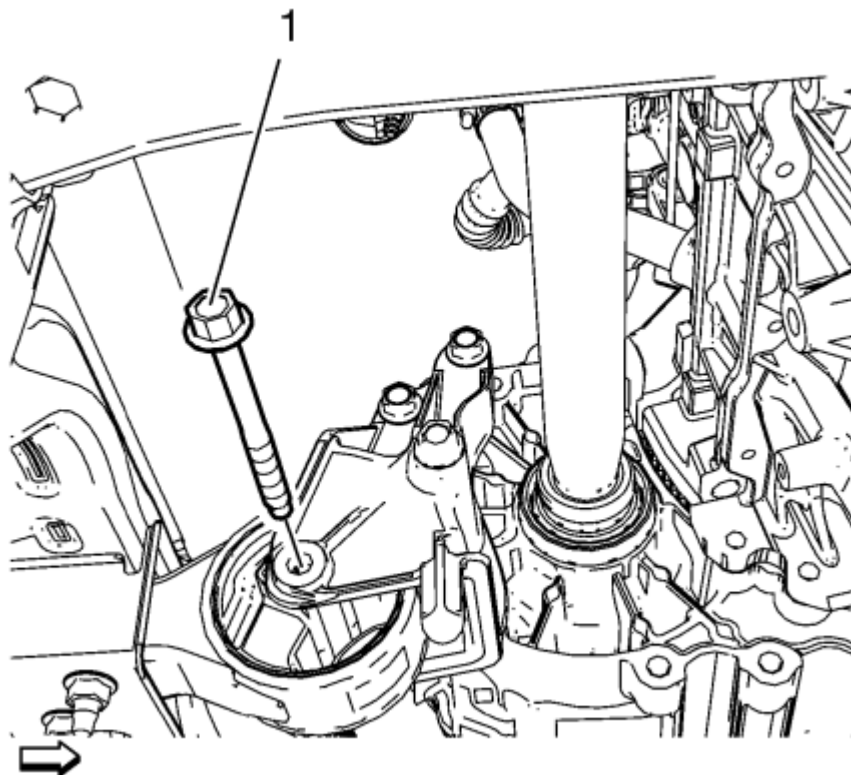
52. Remove the front frame bolts (2).
53. Remove the rear frame bolts (3).
54. Remove the frame reinforcements (4).
55. Slowly and carefully raise the vehicle, ensure the engine, transmission, radiator assembly and drivetrain suspension frame are free from wiring, hoses and other engine compartment components.
56. Remove the intermediate drive shaft. Refer to **Front Wheel Drive Intermediate Shaft Replacement** .
57. Remove the radiator inlet hose from the radiator. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)** .
58. Remove the radiator outlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement (2.0L LHU)** .
59. Remove the charge air cooler inlet hose from the radiator. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)** , **Charge Air Cooler Inlet Hose Replacement (Turbocharger)** .
60. Remove the charge air cooler outlet hose from the radiator. Refer to **Charge Air Cooler Outlet Hose Replacement** .

61. Install a suitable cable to the engine lift brackets.
62. Install a suitable engine lifting device to the cable.
63. Extend the engine lifting device until the steel cables are slightly tensioned.



**Fig. 236: Front Transmission Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

64. Remove the front transmission mount through bolt (1).



**Fig. 237: Transmission Bracket Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

65. Remove the transmission bracket mount to mount through bolt (1).
66. Put the engine transmission unit down on a wooden pallet.
67. Disconnect the backup lamp switch.
68. Loosen the 9 transmission bolts and remove 8 of them. Refer to **Transmission Replacement** .

**NOTE: Second technician required.**

69. Remove the last transmission bolt and the transmission.
70. Install the engine to an engine stand.
71. Transfer parts as needed.

#### Installation Procedure

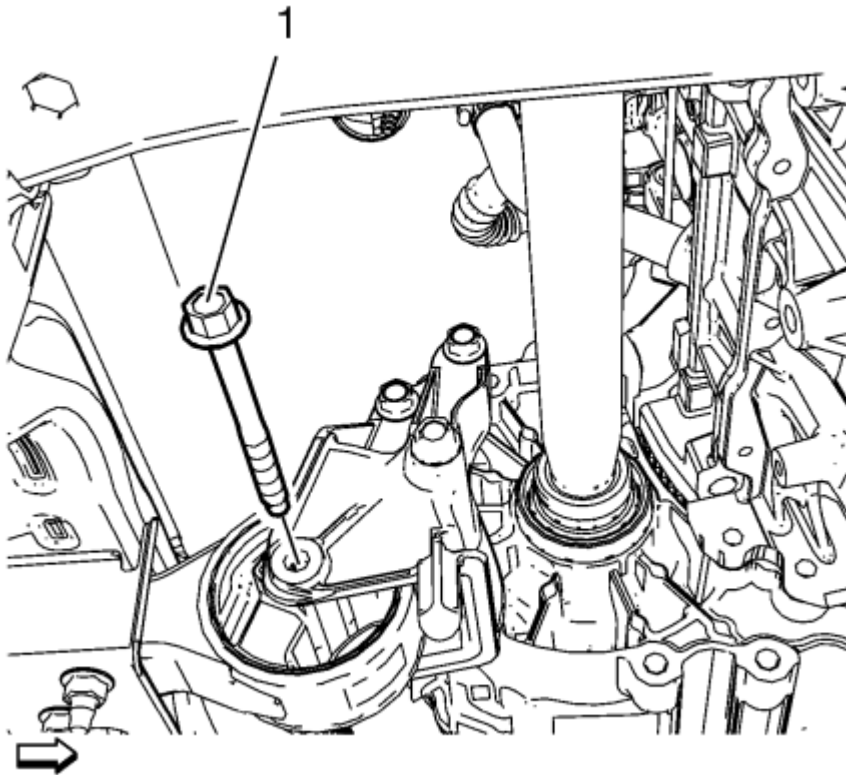
1. Remove the engine from the engine stand.
2. Put the engine down on a wooden pallet.

**NOTE: Second technician required.**

3. Install the transmission and one transmission bolt.
4. Install the 8 transmission bolts.

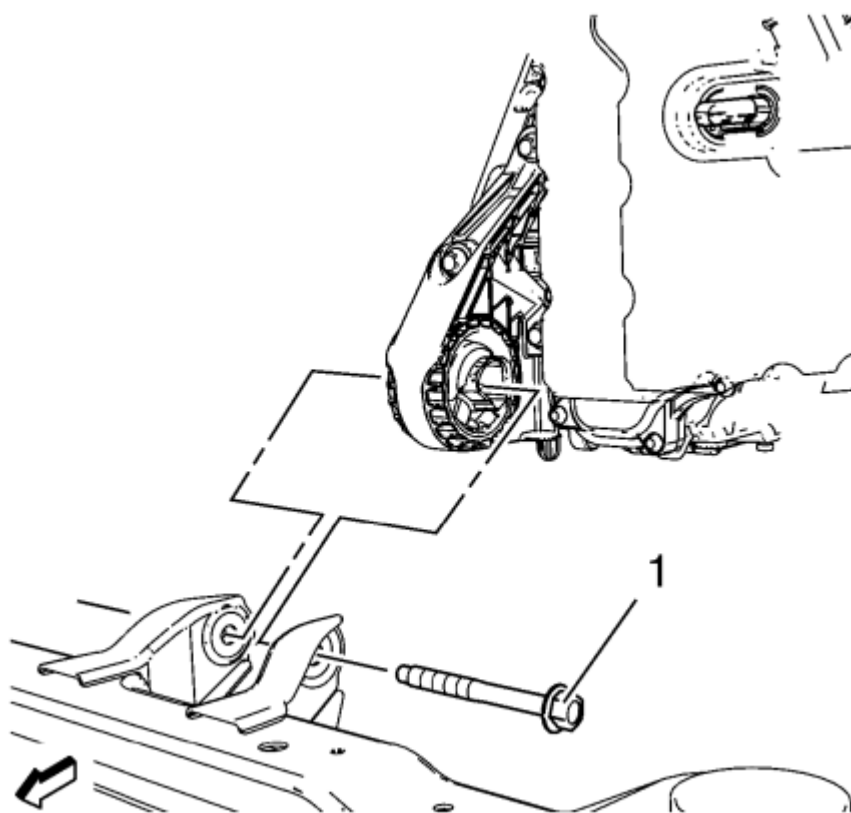
**CAUTION:** Refer to Fastener Caution .

5. Tighten the 9 transmission bolts. Refer to Transmission Replacement .
6. Connect the backup lamp switch.
7. Place the engine transmission unit to the front frame.
8. Position blocks of wood below the oil pan and transmission to stabilize the powertrain on the support table.



**Fig. 238: Transmission Bracket Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

9. Install the transmission bracket mount to mount through bolt (1) and tighten to 100 N.m (74 lb ft).

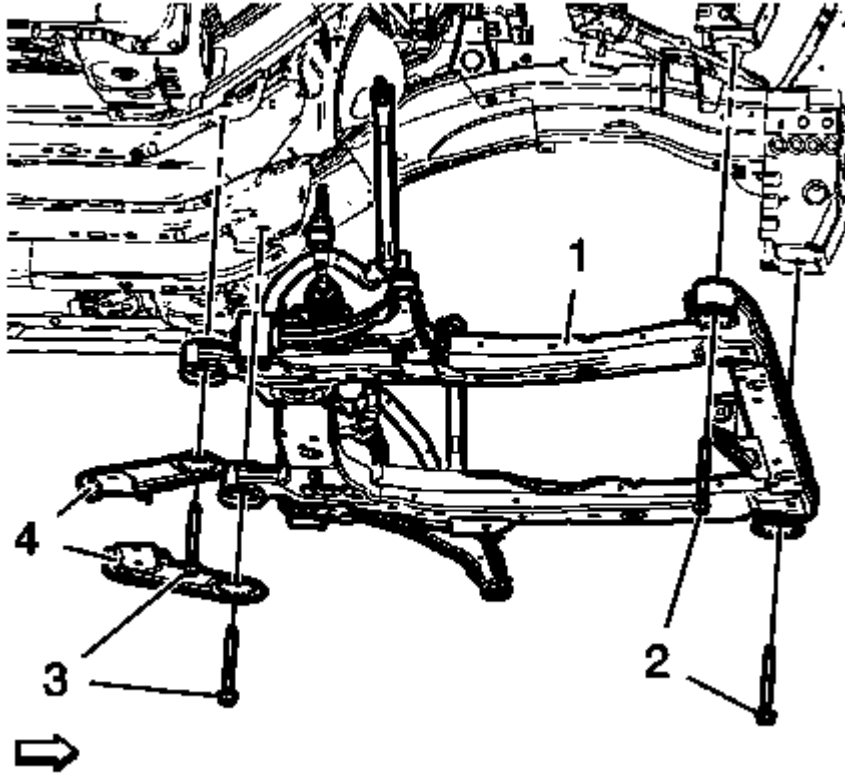


**Fig. 239: Front Transmission Mounting Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

10. Install the transmission mount through bolt (1) and tighten to 100 N.m (74 lb ft).
11. Remove the cable from the engine lift brackets.
12. Install the charge air cooler outlet hose to the radiator. Refer to **Charge Air Cooler Outlet Hose Replacement** .
13. Install the charge air cooler inlet hose to the radiator. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)** , **Charge Air Cooler Inlet Hose Replacement (Turbocharger)** .
14. Install the radiator outlet hose to the radiator. Refer to **Radiator Outlet Hose Replacement (2.0L LHU)** .
15. Install the radiator inlet hose to the radiator. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)** .
16. Install the intermediate drive shaft. Refer to **Front Wheel Drive Intermediate Shaft Replacement** .
17. Position the engine, transmission, radiator assembly and drivetrain suspension frame under the vehicle.
18. Slowly and carefully lower the vehicle, ensure the engine, transmission, radiator assembly and drivetrain suspension frame are free from wiring, hoses and other engine compartment components.
19. Install the engine support fixture. Refer to **Engine Support Fixture**.

**NOTE:** Use the engine support fixture to slightly raise the powertrain assembly to aid in the installation of the engine and transmission mount bolts.

20. Raise the engine/transmission unit as needed.

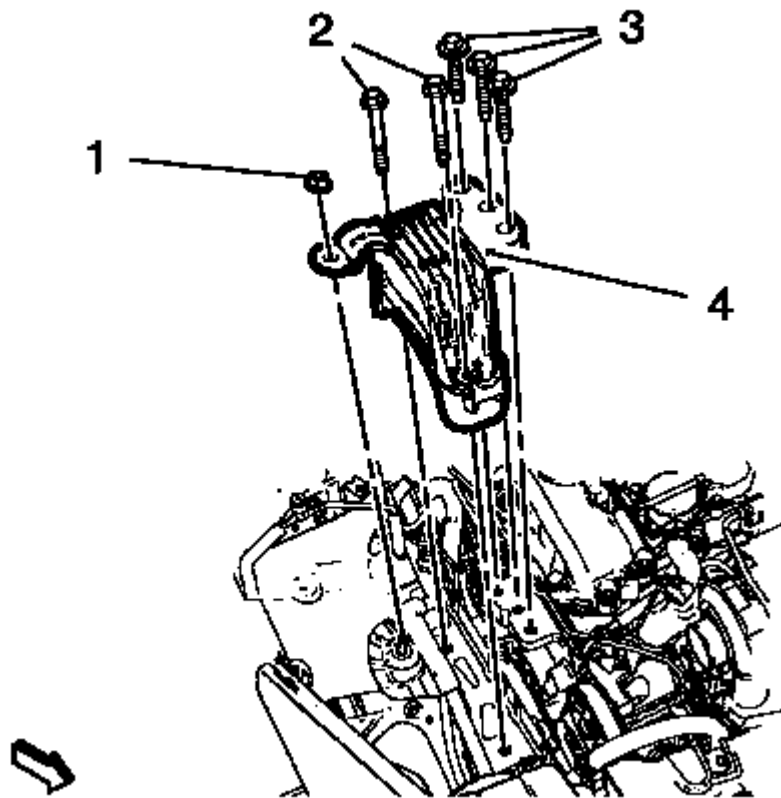


**Fig. 240: Frame Reinforcements & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

21. Install the frame reinforcements (4).  
22. Install frame rear bolts (2). Hand tighten ONLY.  
23. Install frame front bolts (3). Hand tighten ONLY.

**NOTE:** Remind the location marks of the transmission mount bolts before tightening the bolts.

24. Install the transmission mount - left side. Refer to [Transmission Mount Replacement - Left Side](#)



**Fig. 241: Engine Mount Components**

Courtesy of GENERAL MOTORS COMPANY

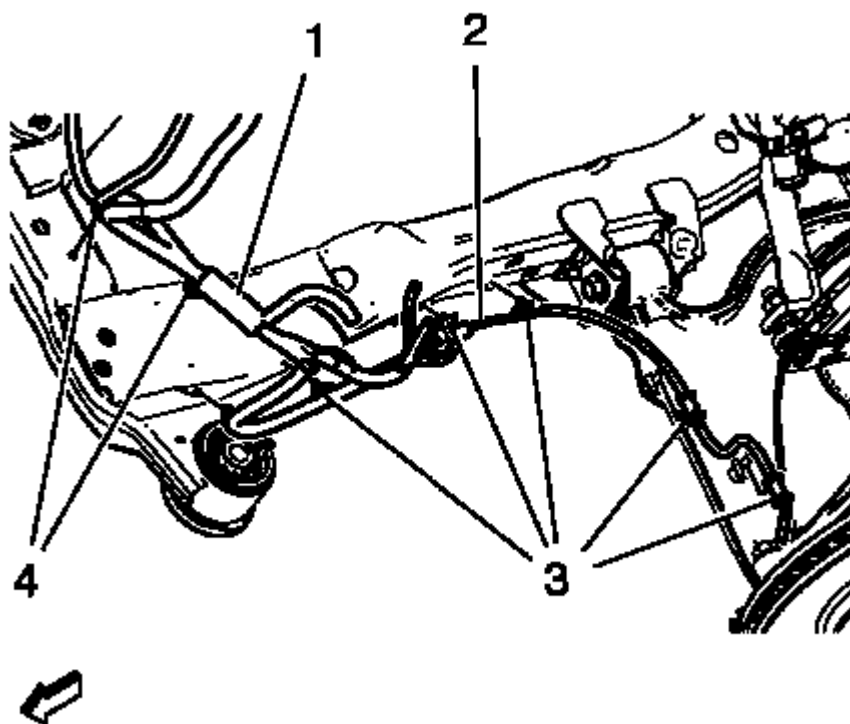
25. Install the engine mount bracket (4).
26. Install the 3 engine mount retaining bolts (3). Do not tighten the bolts yet.
27. Install the 2 engine mount retaining bolts (2) and the retaining nut (1).
  1. Tighten the bolts (2) to 58 N.m (43 lb ft).
  2. Tighten the nut (1) to 62 N.m (46 lb ft).

**NOTE:** Remind the location marks of the engine mount bolts before tightening the bolts.

3. Align the engine transmission unit.
4. Tighten the bolts (3) to 58 N.m (43 lb ft).
28. Remove the engine support fixture. Refer to Engine Support Fixture.
29. Install the right wheel drive shaft. Refer to Front Wheel Drive Shaft Replacement - Right Side.
30. Install the left wheel drive shaft. Refer to Front Wheel Drive Shaft Replacement - Left Side.
31. Install the left and right front lower control arm to the steering knuckles. Refer to Lower Control Arm Replacement.
32. Install the left and right steering outer tie rod to the steering knuckles. Refer to Steering Linkage Outer

**Tie Rod Replacement .**

33. Install the left and right stabilizer shaft link to the strut assemblies. Refer to **Stabilizer Shaft Link Replacement .**

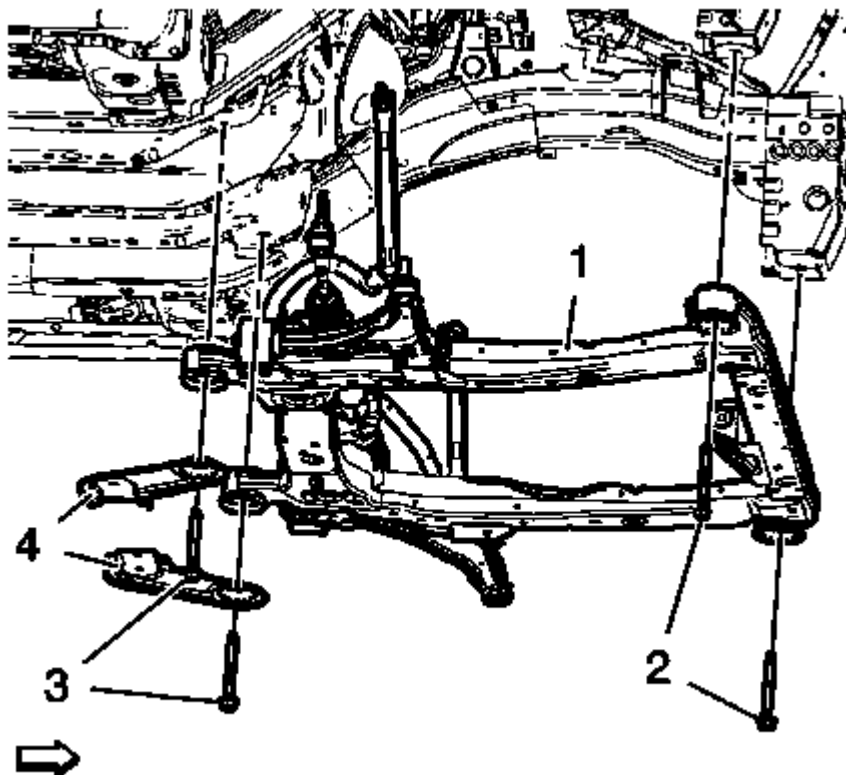


**Fig. 242: Radiator Wiring Harness, Wheel Speed Sensor Wiring Harness And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

34. Install the wheel speed sensor wiring harness (2) to the frame on both sides.

Install the wiring harness retainers (3) to the frame and the lower control arm.

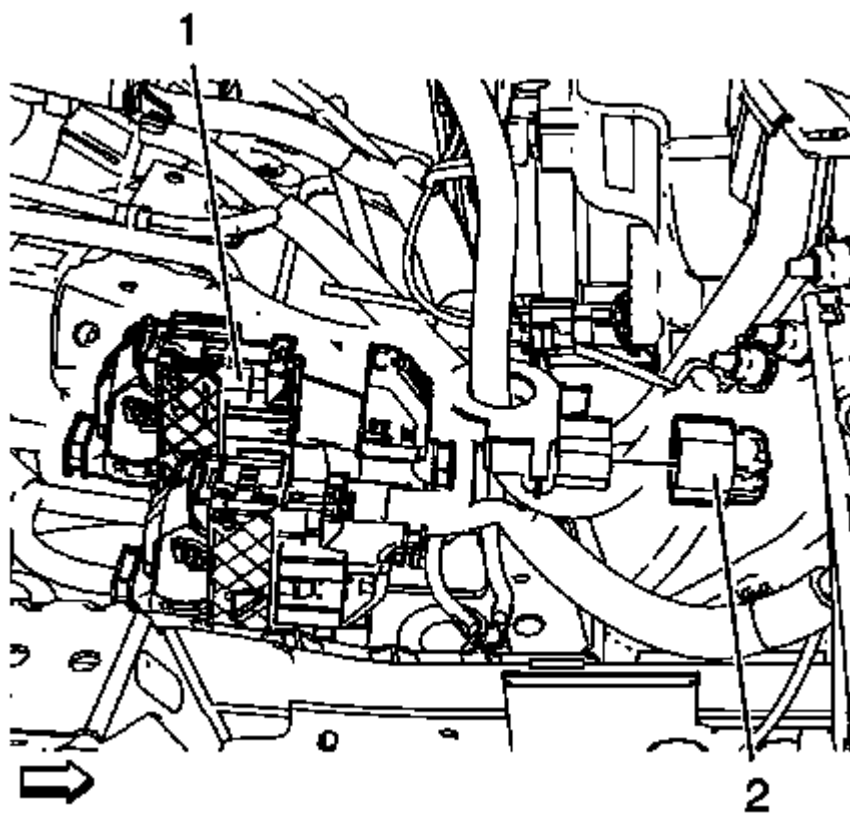
35. Install the heater inlet hose. Refer to **Heater Inlet Hose Replacement (2.0L LHU) .**  
36. Install the heater outlet hose. Refer to **Heater Outlet Hose Replacement (2.0L LHU) .**  
37. Install the catalytic converter. Refer to **Catalytic Converter Replacement (2.0L LHU) .**



**Fig. 243: Frame Reinforcements & Bolts**

Courtesy of GENERAL MOTORS COMPANY

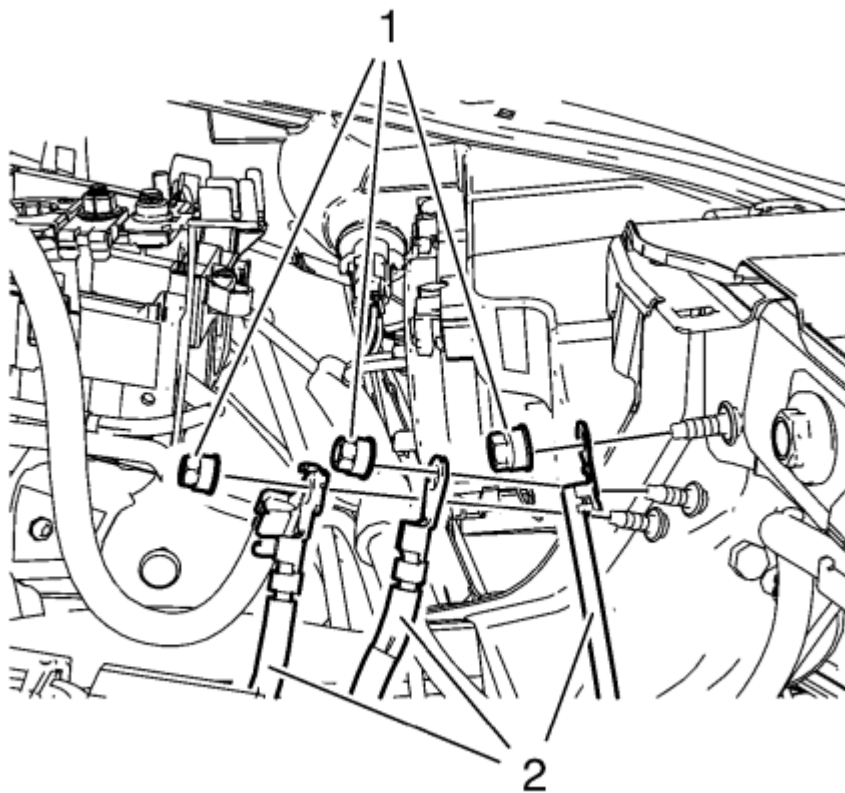
38. Tighten the rear frame bolts (2) and tighten to 160 N.m (118 lb ft).
39. Tighten the front frame bolts (1) and tighten to 160 N.m (118 lb ft).



**Fig. 244: Wiring Harness Plugs**

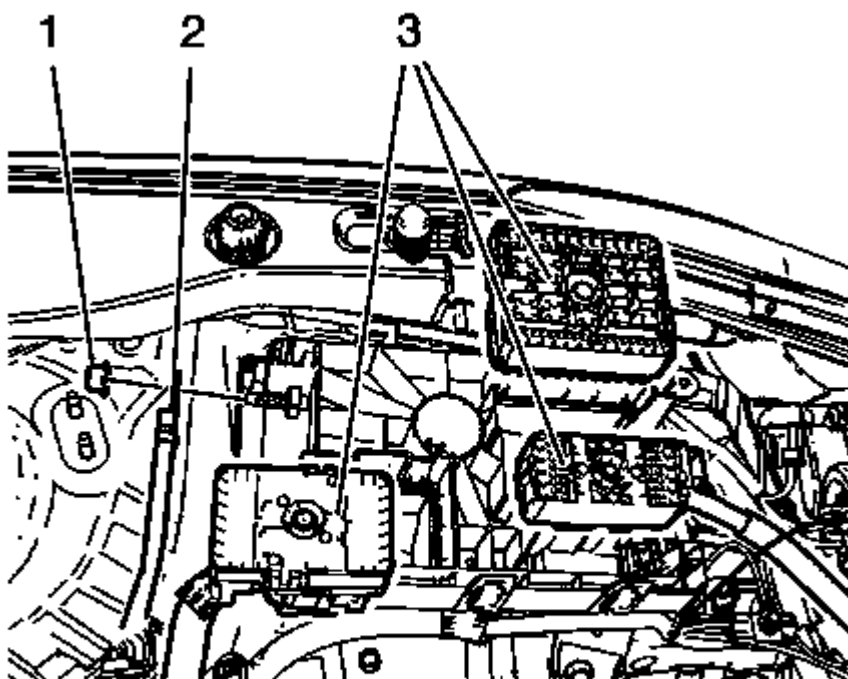
Courtesy of GENERAL MOTORS COMPANY

40. Connect the 2 wiring harness plugs (1, 2).



**Fig. 245: Wiring Harnesses And Ground Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

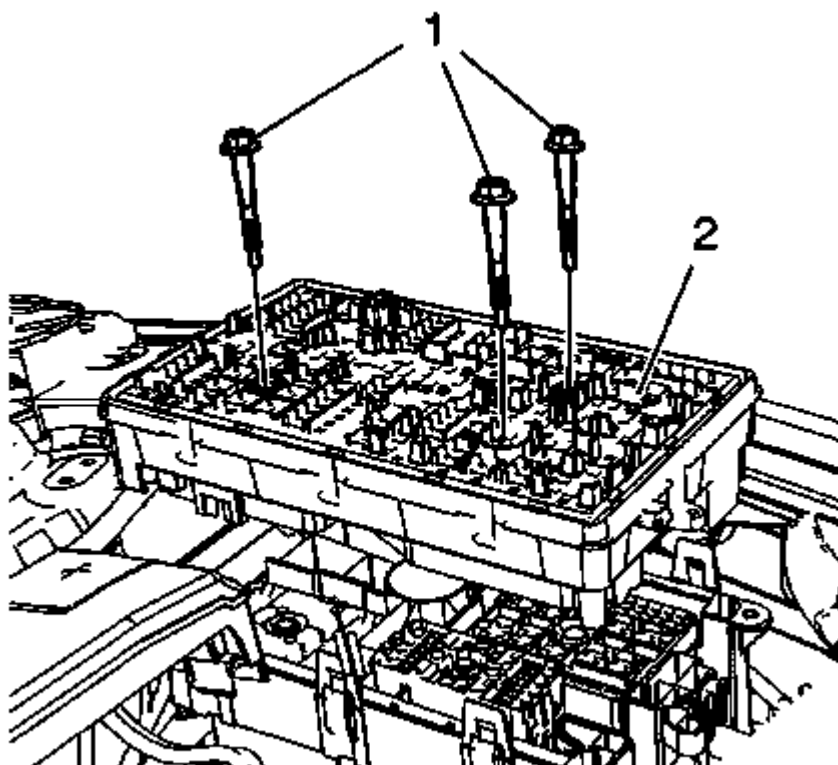
41. Install the 4 wiring harness (2).
42. Install the 3 ground nuts (1) and tighten to 9 N.m (80 lb in).



**Fig. 246: Wiring Harnesses & Plugs**

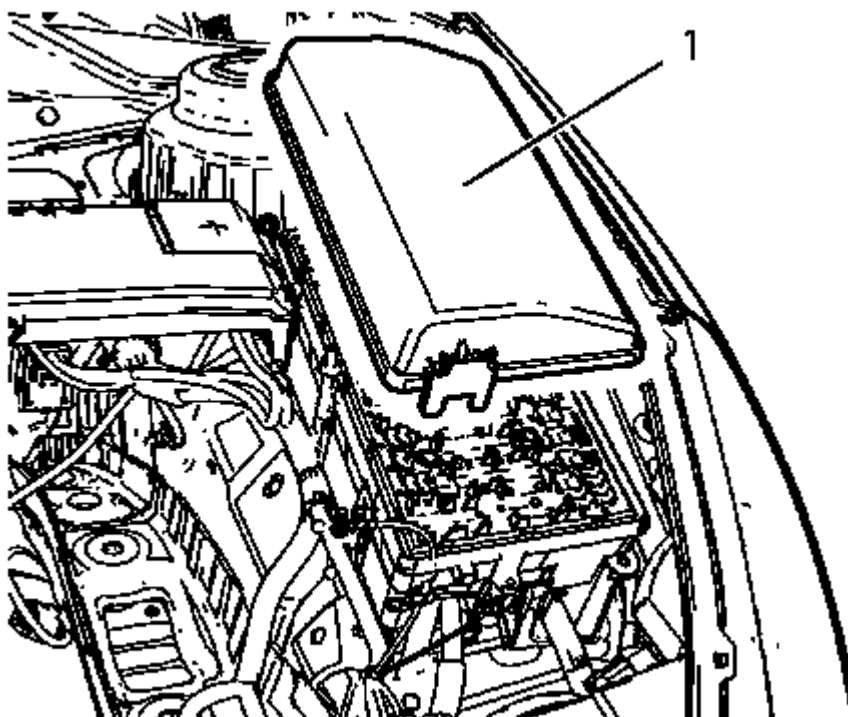
**Courtesy of GENERAL MOTORS COMPANY**

43. Clip in the 3 wiring harness plugs (3).
44. Connect the wiring harness plug to the front compartment fuse block.



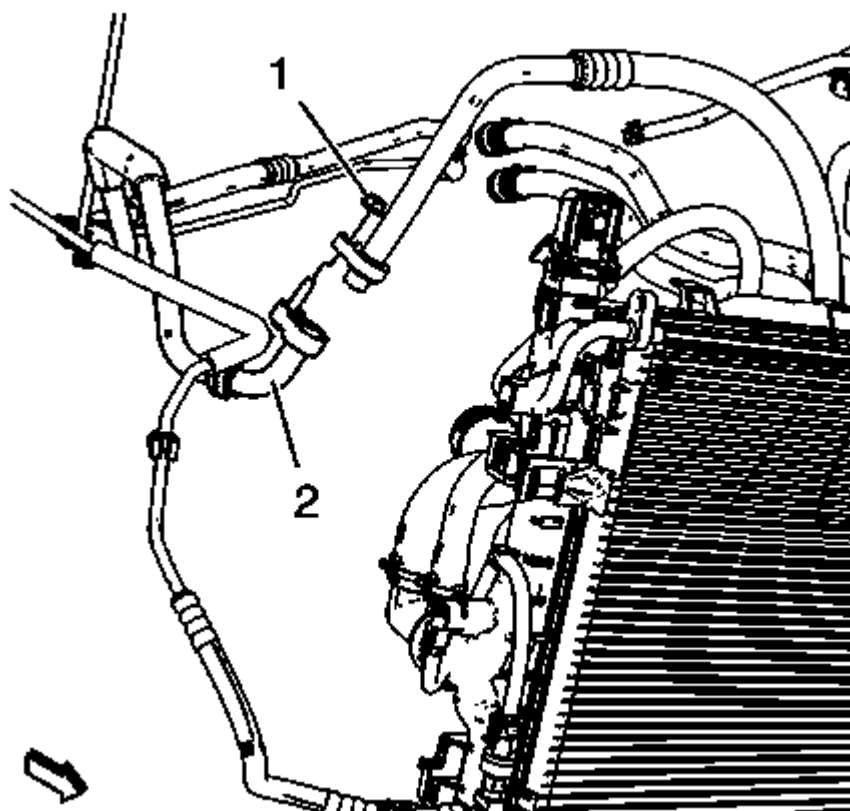
**Fig. 247: Front Compartment Fuse Block & Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

45. Install the front compartment fuse block (2).
46. Install the 3 front compartment fuse block bolts (1) and tighten to 22 N.m (16 lb ft).



**Fig. 248: Front Compartment Fuse Block Cover**  
Courtesy of GENERAL MOTORS COMPANY

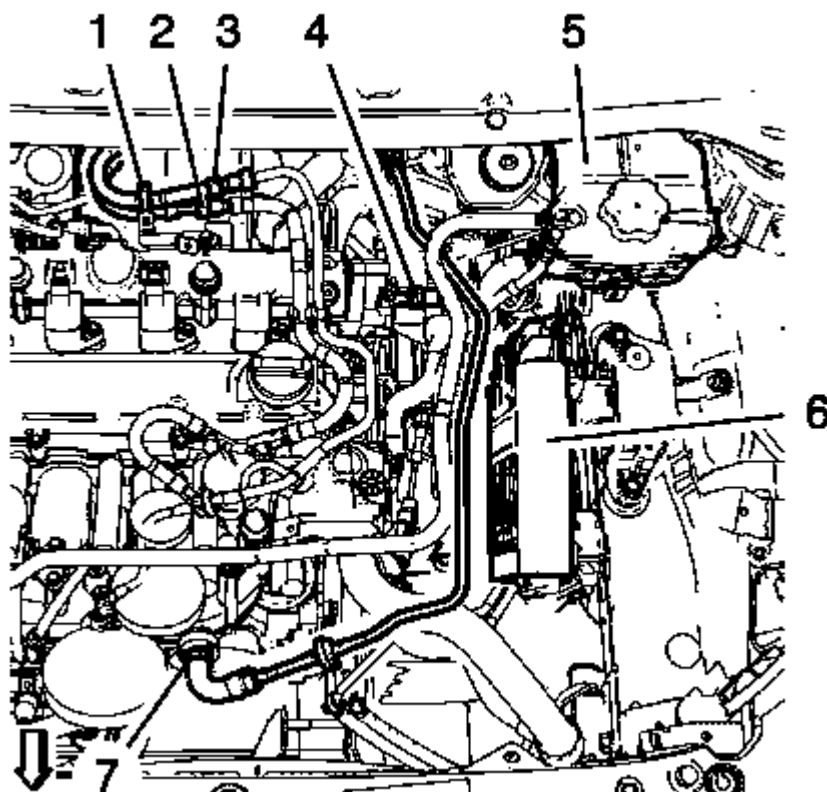
47. Install the front compartment fuse block cover (1).
48. Install the battery tray. Refer to **Battery Tray Replacement** .



**Fig. 249: Air Conditioning Evaporator Hose**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Use a NEW seal ring

49. Install A/C compressor and condenser hose nut (1) to refrigerant hose (2) and tighten to 19 N.m (14 lb ft).



**Fig. 250: ECM, EVAP Line, Fuel Feed Line & Vacuum Line Components**  
**Courtesy of GENERAL MOTORS COMPANY**

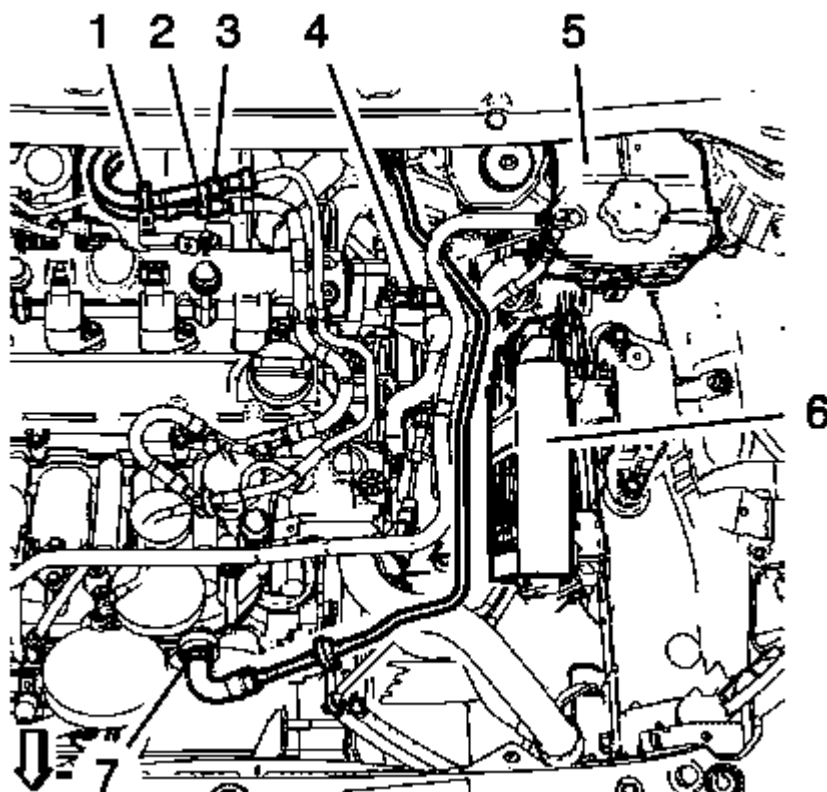
50. Connect the fuel feed line at the connector (2), clip into the bracket (1). Refer to **Metal Collar Quick Connect Fitting Service** .
51. Connect the EVAP line at the connector (3), clip into the bracket (1). Refer to **Plastic Collar Quick Connect Fitting Service** .
52. Connect the vacuum line to the vacuum pump at the connector (4). Refer to **Plastic Collar Quick Connect Fitting Service** .
53. Connect clutch actuator cylinder front pipe to clutch actuator cylinder pipe elbow.
54. Install the 2 manual transmission selector lever cable to the transmission. Refer to **Manual Transmission Shift Lever and Selector Lever Cable Replacement** .
55. Install the radiator surge tank (5). Refer to **Radiator Surge Tank Replacement** .
56. Install the ECM (6). Refer to **Engine Control Module Replacement** .
57. Install the vacuum pipe (7).
58. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
59. Lower and unsupport the vehicle.
60. Install the lower intermediate shaft bolt. Refer to **Intermediate Steering Shaft Replacement** .
61. Connect the electronic power steering connectors to the electronic power steering assembly. Refer to **FEP Connectors (Steering Gear)** .

62. Install the air cleaner outlet rear duct. Refer to [Air Cleaner Outlet Rear Duct Replacement](#) .
63. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .
64. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
65. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#) .
66. Fill the transmission. Refer to [Transmission Fluid Drain and Fill](#) .
67. Fill the engine cooling system. Refer to [Cooling System Draining and Filling \(2.0L LHU\)](#) .
68. Bleed the hydraulic clutch system. Refer to [Hydraulic Clutch System Bleeding](#) .
69. Install the engine sight shield. Refer to [Engine Sight Shield Replacement](#) .
70. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .

## **ENGINE REPLACEMENT (AUTOMATIC TRANSMISSION)**

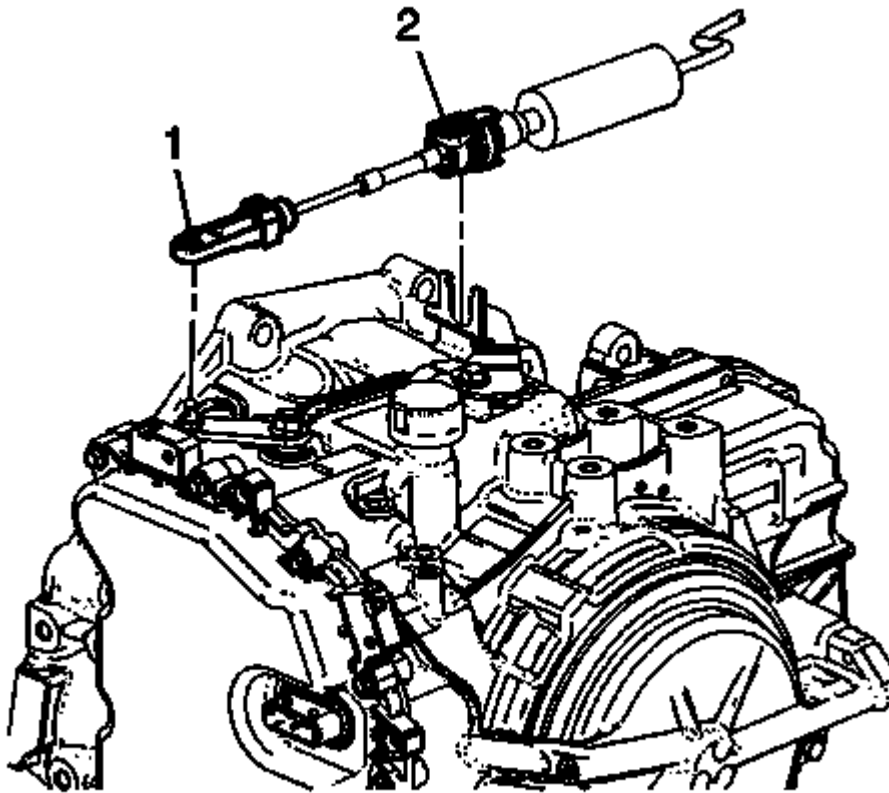
### **Removal Procedure**

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
2. Remove the engine sight shield. Refer to [Engine Sight Shield Replacement](#) .
3. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#) .
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
5. Drain the cooling system. Refer to [Cooling System Draining and Filling \(2.0L LHU\)](#) .
6. Drain the transmission. Refer to [Transmission Fluid Drain and Fill](#) .
7. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
8. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .
9. Remove the air cleaner outlet rear duct. Refer to [Air Cleaner Outlet Rear Duct Replacement](#) .
10. Remove the front bumper fascia. Refer to [Front Bumper Fascia Replacement](#) .
11. Remove the lower intermediate steering shaft bolt. Refer to [Intermediate Steering Shaft Replacement](#) .
12. Disconnect the electronic power steering connectors from the electronic power steering assembly. Refer to [FEP Connectors \(Steering Gear\)](#) .



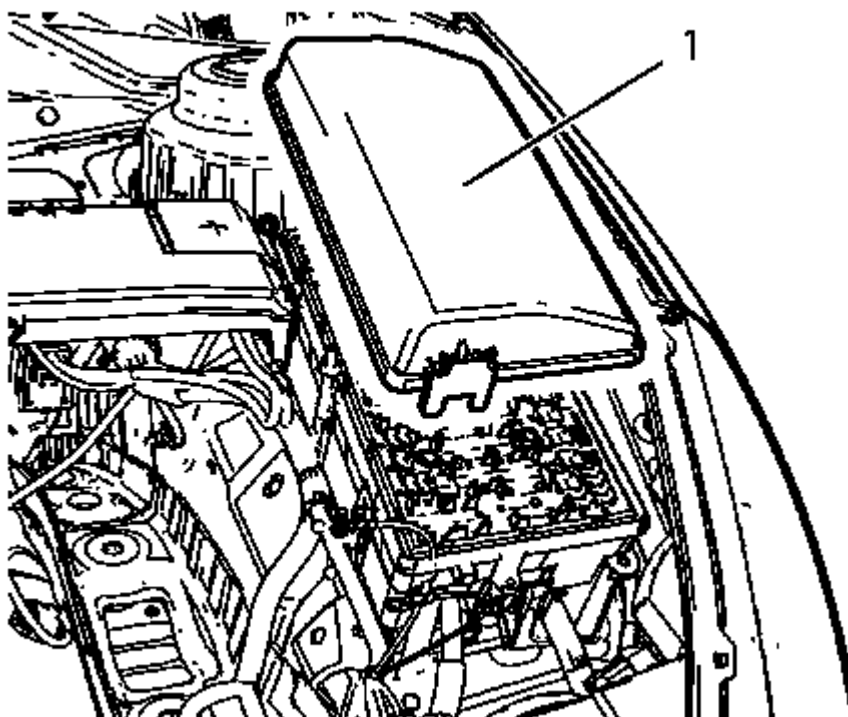
**Fig. 251: ECM, EVAP Line, Fuel Feed Line & Vacuum Line Components**  
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the fuel feed line at the connector (2), clip out of the bracket (1) and reposition away from the engine. Refer to **Metal Collar Quick Connect Fitting Service** .
14. Disconnect the EVAP line at the connector (3), clip out of the bracket (1) and reposition away from the engine. Refer to **Metal Collar Quick Connect Fitting Service** .
15. Disconnect the vacuum line from the vacuum pump at the connector (4) and reposition away from the engine. Refer to **Plastic Collar Quick Connect Fitting Service** .
16. Remove the radiator surge tank (5) and position onto the engine. Refer to **Radiator Surge Tank Replacement** .
17. Remove the ECM (6) and position onto the engine. Refer to **Engine Control Module Replacement** .
18. Remove the break booster vacuum pipe from intake manifold (7) and reposition.



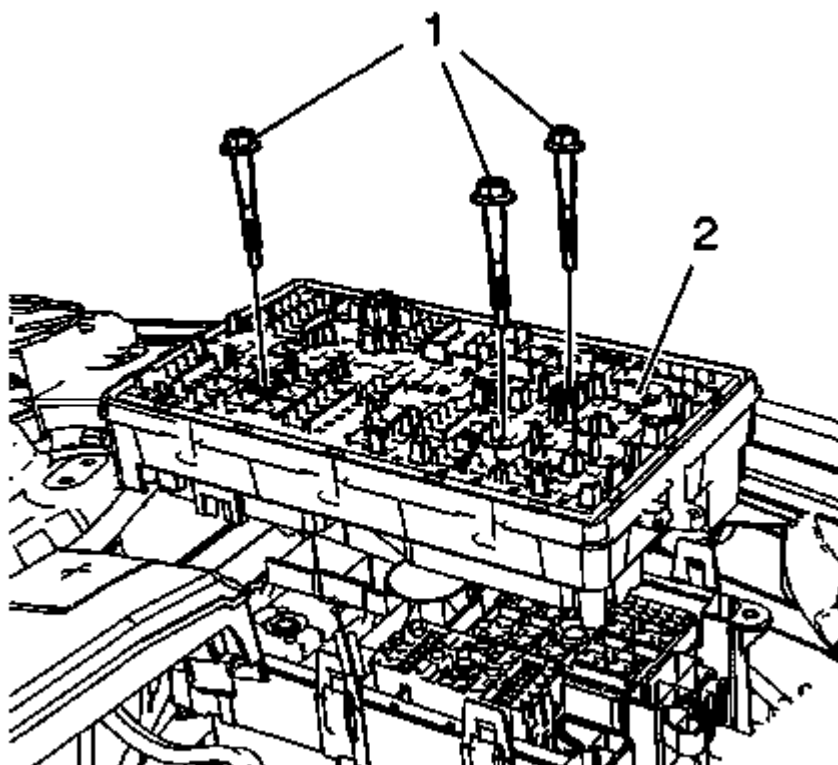
**Fig. 252: View Of Transmission Range Selector Lever & Cable Connection**  
 Courtesy of GENERAL MOTORS COMPANY

19. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual shift lever pin.
20. Press the locking tabs inward in order to release the transmission range selector lever cable (2) from the cable bracket.
21. Remove the vacuum pipe (8) and reposition away from the engine.
22. Remove the battery tray. Refer to **Battery Tray Replacement**.



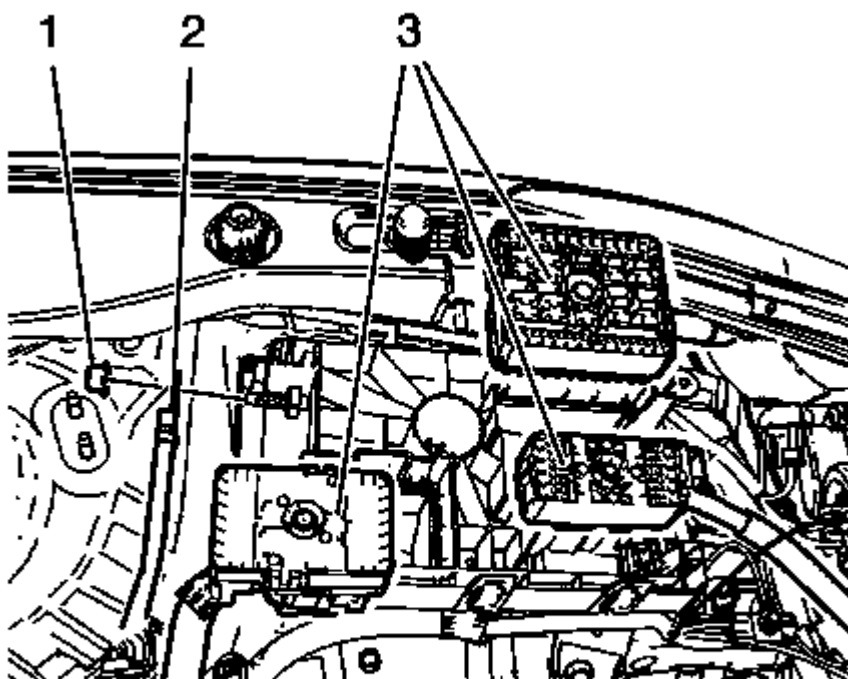
**Fig. 253: Front Compartment Fuse Block Cover**  
**Courtesy of GENERAL MOTORS COMPANY**

23. Remove the front compartment fuse block cover (1).



**Fig. 254: Front Compartment Fuse Block & Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

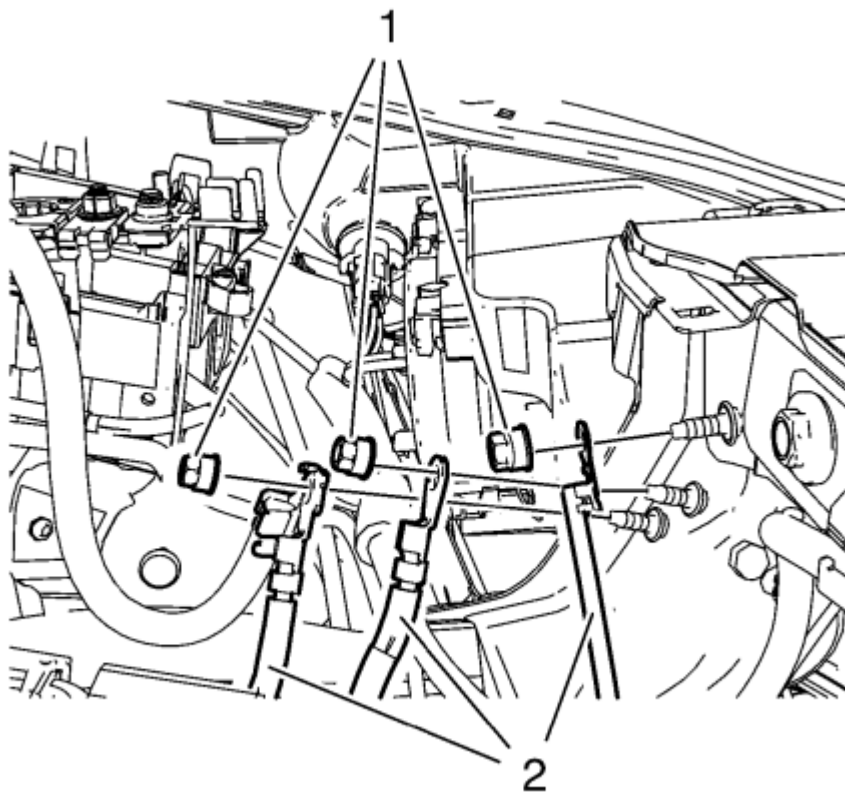
24. Remove the 3 front compartment fuse block bolts (1).
25. Remove the front compartment fuse block (2).



**Fig. 255: Wiring Harnesses & Plugs**

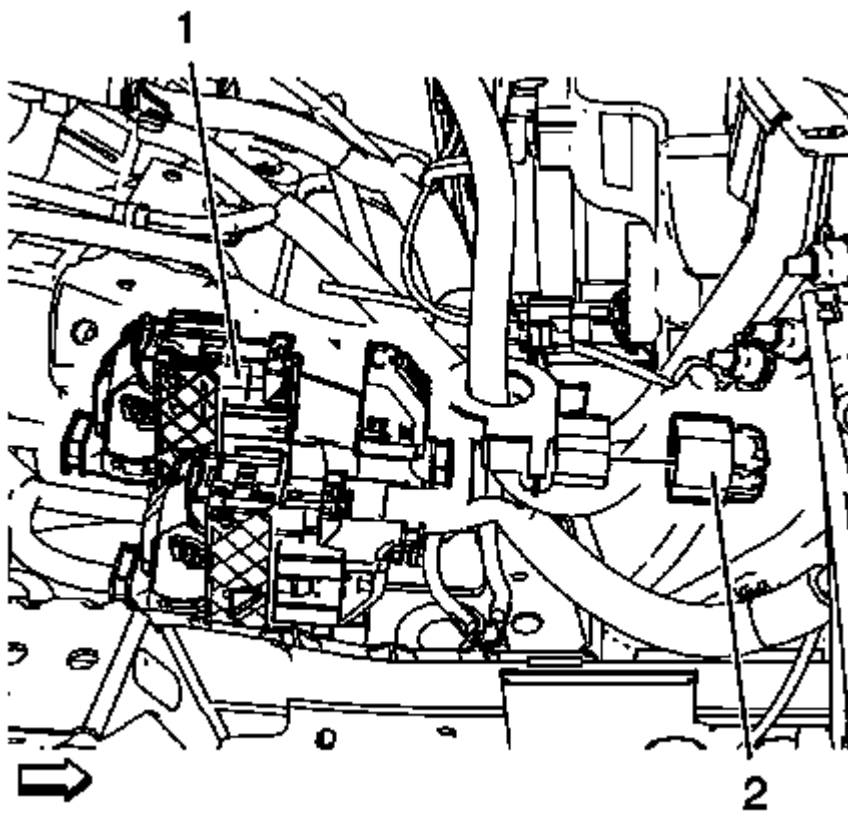
**Courtesy of GENERAL MOTORS COMPANY**

26. Unclip the 3 wiring harness plugs (3).
27. Disconnect the wiring harness plug from the front compartment fuse block.



**Fig. 256: Wiring Harnesses And Ground Nuts**  
Courtesy of GENERAL MOTORS COMPANY

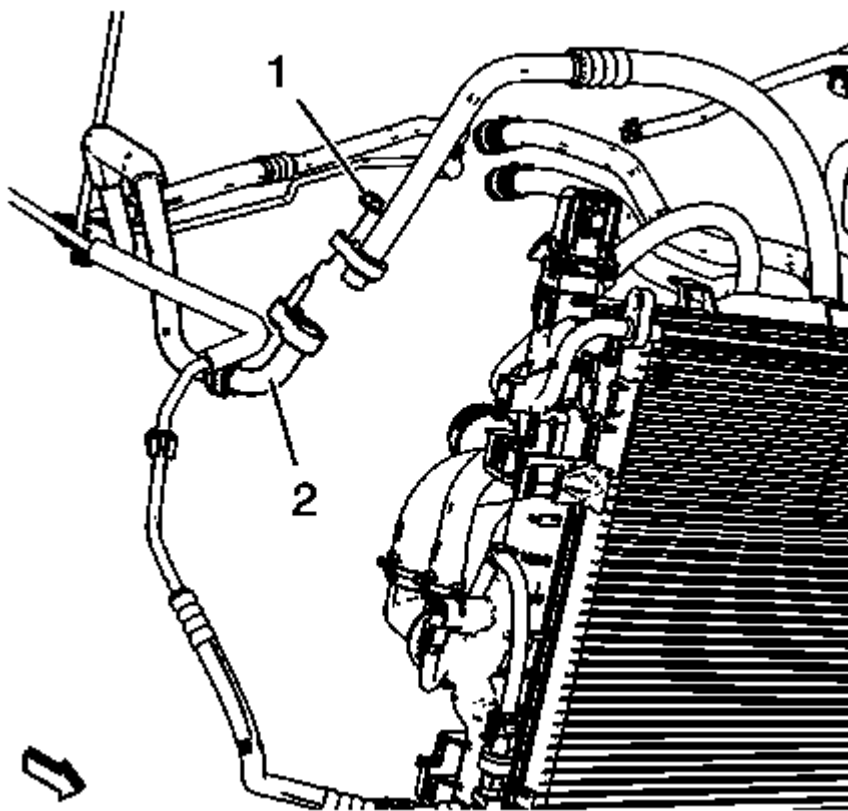
28. Remove the 3 ground nuts (1) and put the 4 wiring harness (2) aside.



**Fig. 257: Wiring Harness Plugs**

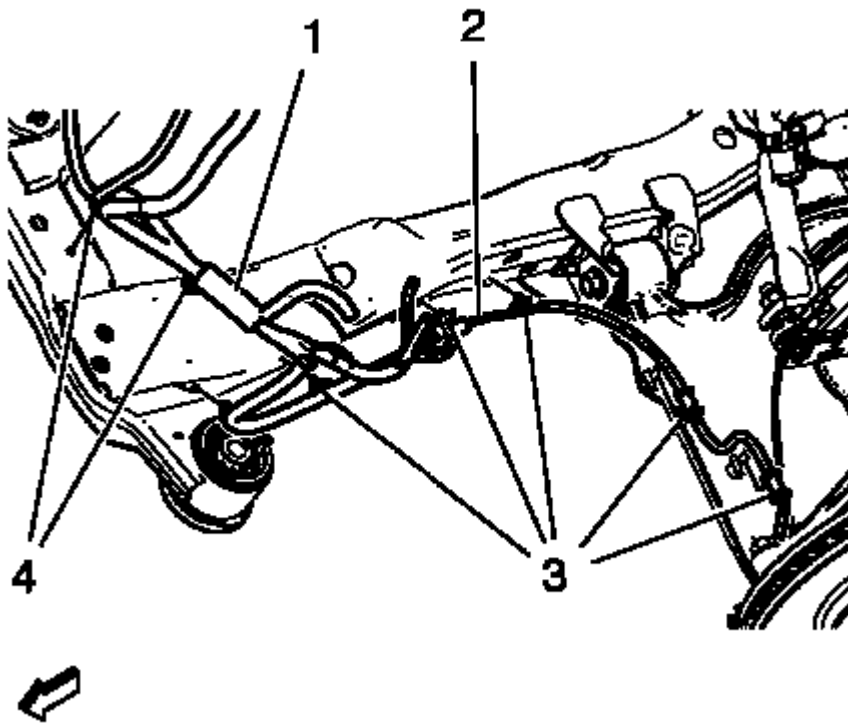
Courtesy of GENERAL MOTORS COMPANY

29. Disconnect the 2 wiring harness plugs (1, 2).



**Fig. 258: Air Conditioning Evaporator Hose**  
Courtesy of GENERAL MOTORS COMPANY

30. Remove A/C compressor and condenser hose nut (1) from refrigerant hose (2).
31. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (2.0L LHU)** .
32. Remove the heater inlet hose. Refer to **Heater Inlet Hose Replacement (2.0L LHU)** .
33. Remove the heater outlet hose. Refer to **Heater Outlet Hose Replacement (2.0L LHU)** .

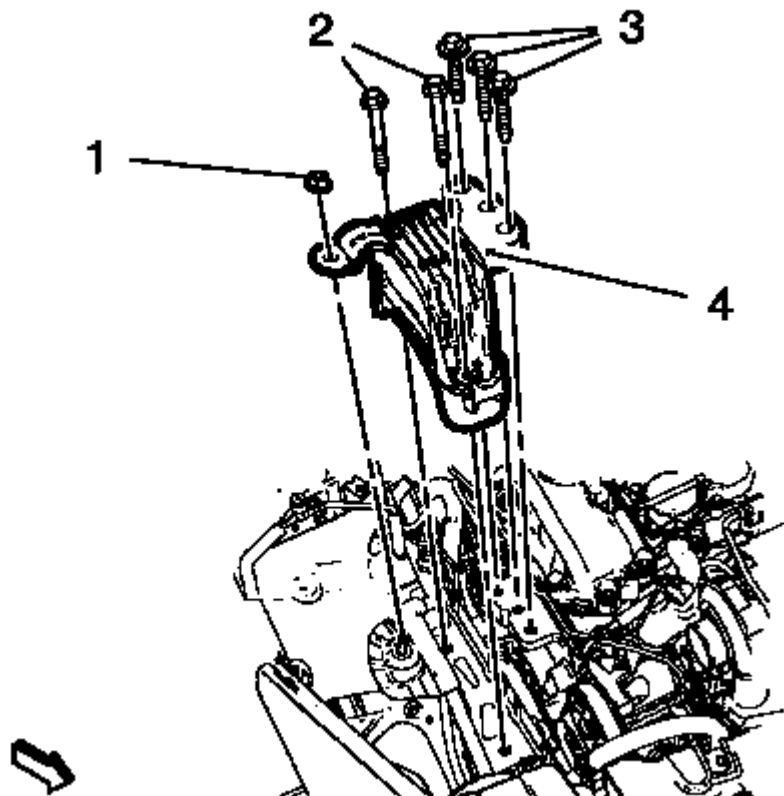


**Fig. 259: Radiator Wiring Harness, Wheel Speed Sensor Wiring Harness And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

34. Remove the wheel speed sensor wiring harness (2) from the frame on both sides.
35. Remove the wiring harness retainers (3) from the frame and the lower control arm.
36. Remove the left and right stabilizer shaft link from the strut assemblies. Refer to **Stabilizer Shaft Link Replacement** .
37. Remove the left and right steering outer tie rod from the steering knuckles. Refer to **Steering Linkage Outer Tie Rod Replacement** .
38. Remove the left and right front lower control arm from the steering knuckles. Refer to **Lower Control Arm Replacement** .
39. Remove the left wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Left Side** .
40. Remove the right wheel drive shaft. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .
41. Install the engine support fixture. Refer to **Engine Support Fixture**.

**NOTE:** Use the engine support fixture to slightly raise the powertrain assembly to aid in the removal of the engine and transmission mount bolts.

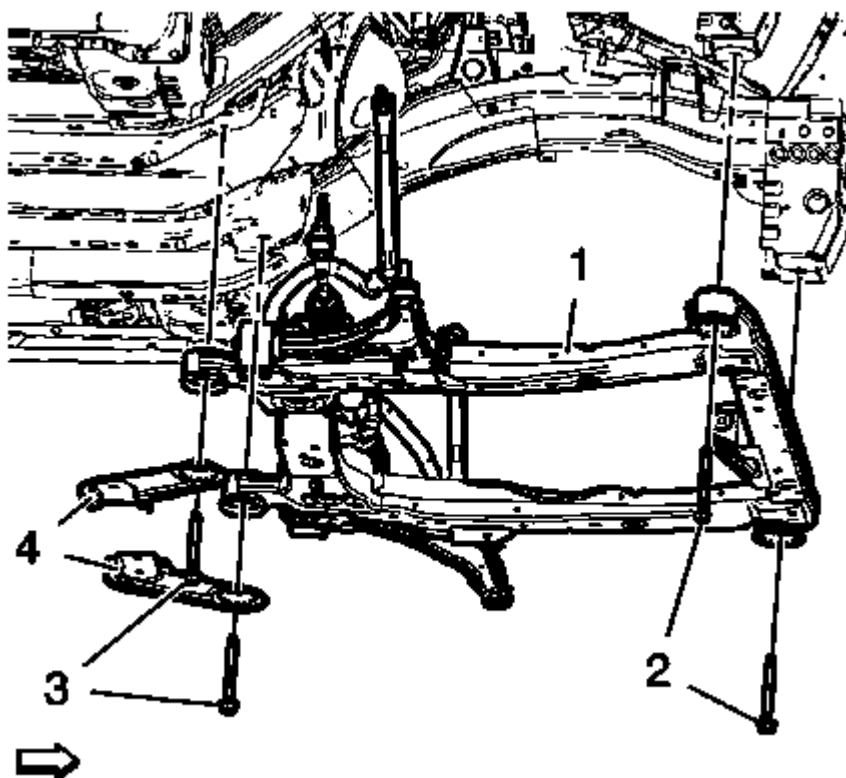
42. Adjust engine support fixture as needed.



**Fig. 260: Engine Mount Components**

Courtesy of GENERAL MOTORS COMPANY

43. Mark the location of the bolts (2, 3) before removing.
44. Remove the 5 engine mount bracket retaining bolts (2, 3) and the engine mount retaining nut (1).
45. Remove the engine mount (4).
46. Mark the location of the transmission mount bolts before removing.
47. Remove the transmission mount - left side. Refer to **Transmission Mount Replacement - Left Side**.
48. Raise the vehicle.
49. Using a suitable engine support table, lower the vehicle until the drivetrain and front suspension frame contacts the engine support table.
50. Position blocks of wood below the oil pan and transmission to stabilize the powertrain on the support table.
51. Using the engine support fixture, lower the powertrain down until it is resting on the engine support table.
52. Remove the engine support fixture. Refer to **Engine Support Fixture**.



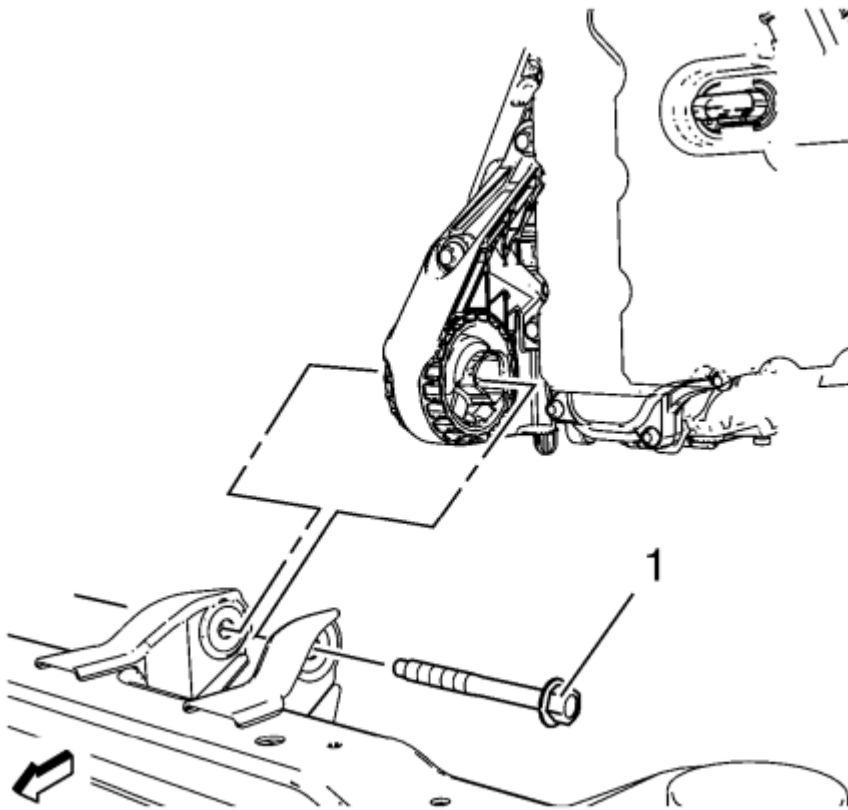
**Fig. 261: Frame Reinforcements & Bolts**

Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Simplified graphic. Suspension frame is supported by engine support table.

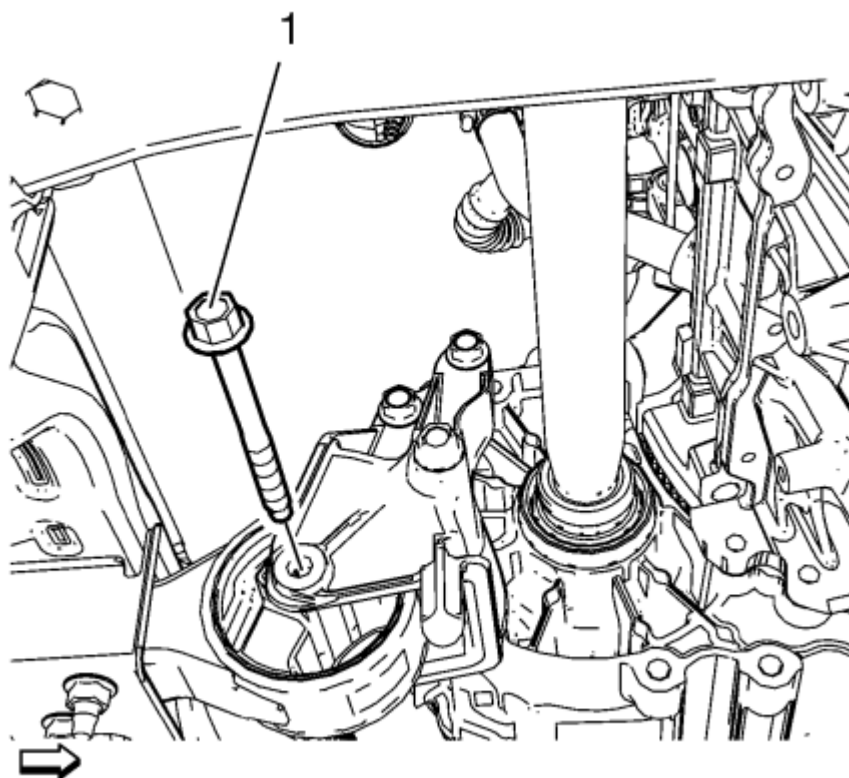
53. Remove the drivetrain and front suspension frame bolts (2).
54. Remove the rear frame bolts (3).
55. Remove the frame reinforcements (4).
56. Slowly and carefully raise the vehicle, ensure the engine, transmission, radiator assembly and drivetrain suspension frame are free from wiring, hoses and other engine compartment components.
57. Remove the intermediate drive shaft. Refer to **Front Wheel Drive Intermediate Shaft Replacement** .
58. Remove the radiator inlet hose from the radiator. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)** .
59. Remove the radiator outlet hose from the radiator. Refer to **Radiator Outlet Hose Replacement (2.0L LHU)** .
60. Remove the charge air cooler inlet hose from the radiator. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)** , **Charge Air Cooler Inlet Hose Replacement (Turbocharger)** .
61. Remove the charge air cooler outlet hose from the radiator. Refer to **Charge Air Cooler Outlet Hose Replacement** .

62. Remove the transmission fluid cooler inlet pipe. Refer to **Transmission Fluid Cooler Inlet Pipe Replacement (2.0L LHU)**.
63. Remove the transmission fluid cooler outlet pipe. Refer to **Transmission Fluid Cooler Outlet Pipe Replacement (2.0L LHU)**.
64. Install suitable cable to the engine lift brackets.
65. Install a suitable engine lifting device to the cable.
66. Extend the engine lifting device until the steel cables are slightly tensioned.



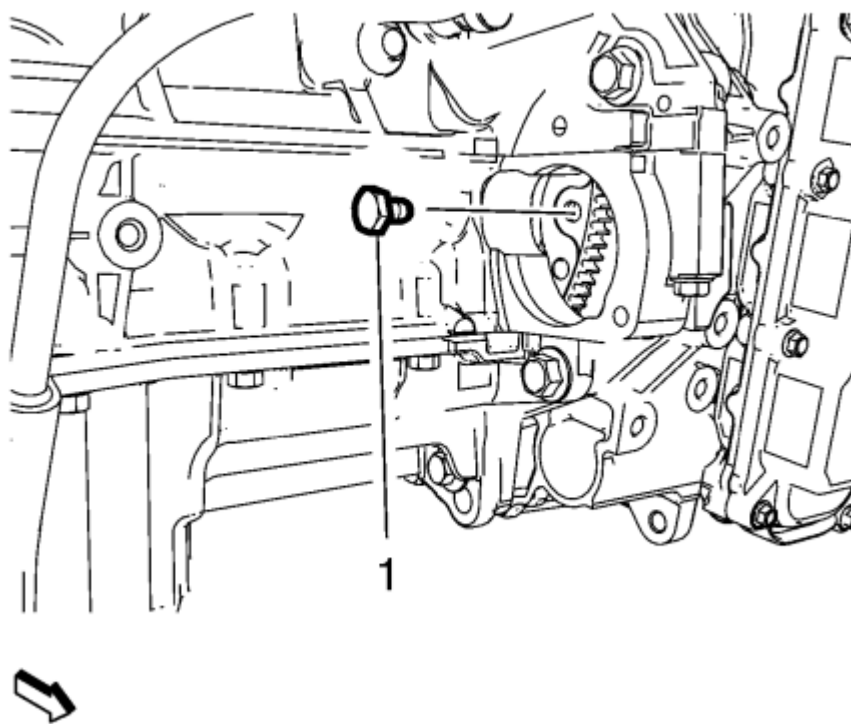
**Fig. 262: Front Transmission Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

67. Remove the front transmission mount through bolt (1).



**Fig. 263: Transmission Bracket Mounting Bolts**  
**Courtesy of GENERAL MOTORS COMPANY**

68. Remove the transmission bracket mount to mount through bolt (1).
69. Put the engine transmission unit down on a wooden pallet.
70. Disconnect the backup lamp switch.
71. Remove the starter. Refer to **Starter Replacement (2.0L LHU)** .
72. Remove the access cover from the transmission.



**Fig. 264: Torque Converter Bolts**

Courtesy of GENERAL MOTORS COMPANY

73. Remove and DISCARD the 3 flex plate to the torque converter bolts (1).
74. Loosen the 9 transmission bolts and remove 8 of them. Refer to **Transmission Replacement (2.0L LHU)**.

**NOTE:**        **Second technician required.**

75. Remove the last transmission bolt and the transmission.
76. Install the engine to an engine stand.
77. Transfer parts as needed.

#### Installation Procedure

1. Remove the engine from the engine stand.
2. Put the engine down on a wooden pallet.

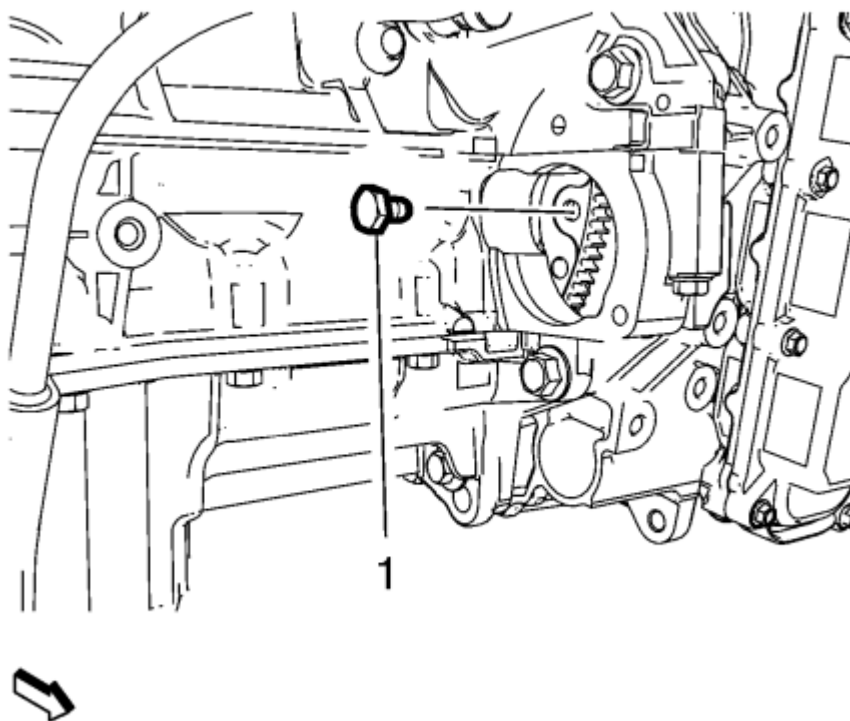
**NOTE:**        **Second technician required.**

3. Install the transmission and one transmission bolt.

4. Install the 8 transmission bolts.

**CAUTION:** Refer to Fastener Caution .

5. Tighten the 9 transmission bolts. Refer to Transmission Replacement (2.0L LHU) .



**Fig. 265: Torque Converter Bolts**

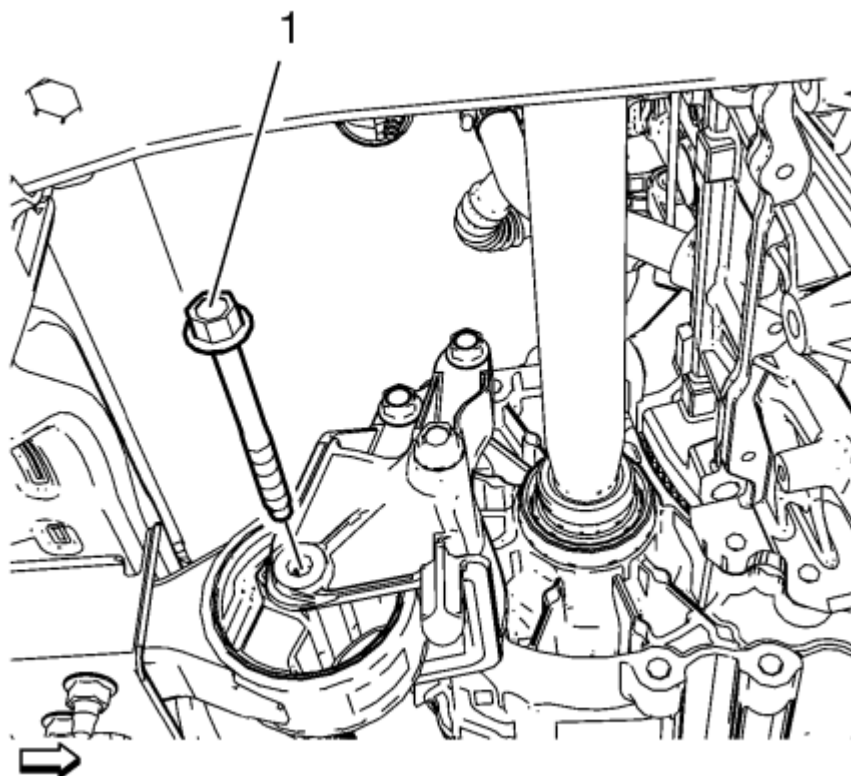
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Service may offer bolts that are not microencapsulated. If this is the case apply thread lock agent to the bolts.

If fasteners are microencapsulated, install NEW torque converter to flywheel bolts. DO NOT reuse the old bolts.

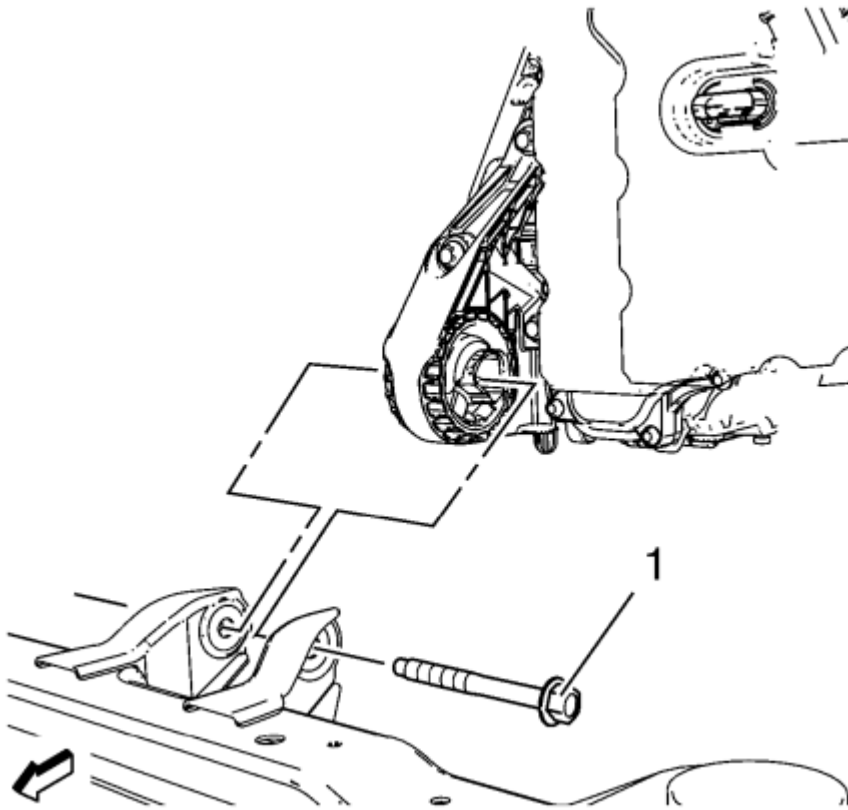
6. Install 3 NEW flex plate to torque converter bolts (1) and tighten to 60 N.m (44 lb ft).
7. Install the access cover on the transmission.
8. Install the starter. Refer to Starter Replacement (2.0L LHU) .
9. Connect the backup lamp switch.

10. Place the engine transmission unit to the drivetrain and front suspension frame.
11. Position blocks of wood below the oil pan and transmission to stabilize the powertrain on the support table.



**Fig. 266: Transmission Bracket Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

12. Install the transmission bracket mount to mount through bolt (1) and tighten to 100 N.m (74 lb ft).



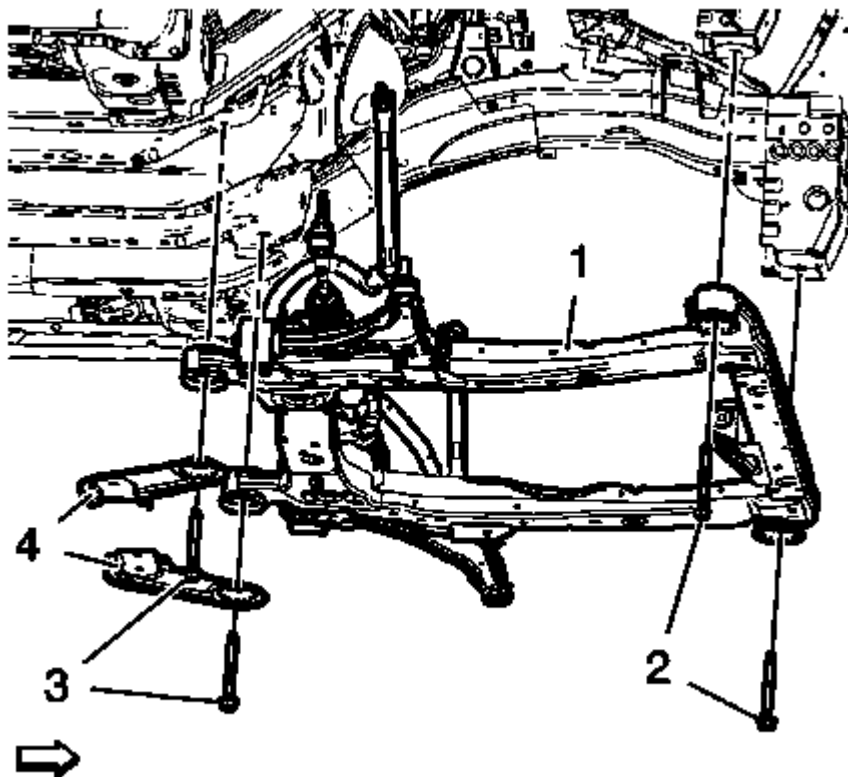
**Fig. 267: Front Transmission Mounting Bolts**  
Courtesy of GENERAL MOTORS COMPANY

13. Install the transmission mount through bolt (1) and tighten to 100 N.m (74 lb ft).
14. Remove the cable from the engine lift brackets.
15. Install the transmission fluid cooler inlet pipe. Refer to **Transmission Fluid Cooler Inlet Pipe Replacement (2.0L LHU)**.
16. Install the transmission fluid cooler outlet pipe. Refer to **Transmission Fluid Cooler Outlet Pipe Replacement (2.0L LHU)**.
17. Install the charge air cooler outlet hose to the radiator. Refer to **Charge Air Cooler Outlet Hose Replacement**.
18. Install the charge air cooler inlet hose to the radiator. Refer to **Charge Air Cooler Inlet Hose Replacement (Charge Air Cooler)**, **Charge Air Cooler Inlet Hose Replacement (Turbocharger)**.
19. Install the radiator outlet hose to the radiator. Refer to **Radiator Outlet Hose Replacement (2.0L LHU)**.
20. Install the radiator inlet hose to the radiator. Refer to **Radiator Inlet Hose Replacement (2.0L LHU)**.
21. Install the intermediate drive shaft. Refer to **Front Wheel Drive Intermediate Shaft Replacement**.
22. Position the engine, transmission, radiator assembly and drivetrain suspension frame under the vehicle.
23. Slowly and carefully lower the vehicle, ensure the engine, transmission, radiator assembly and drivetrain suspension frame are free from wiring, hoses and other engine compartment components.

24. Install the engine support fixture. Refer to Engine Support Fixture.

**NOTE:** Use the engine support fixture to slightly raise the powertrain assembly to aid in the installation of the engine and transmission mount bolts.

25. Raise the engine/transmission unit as needed.

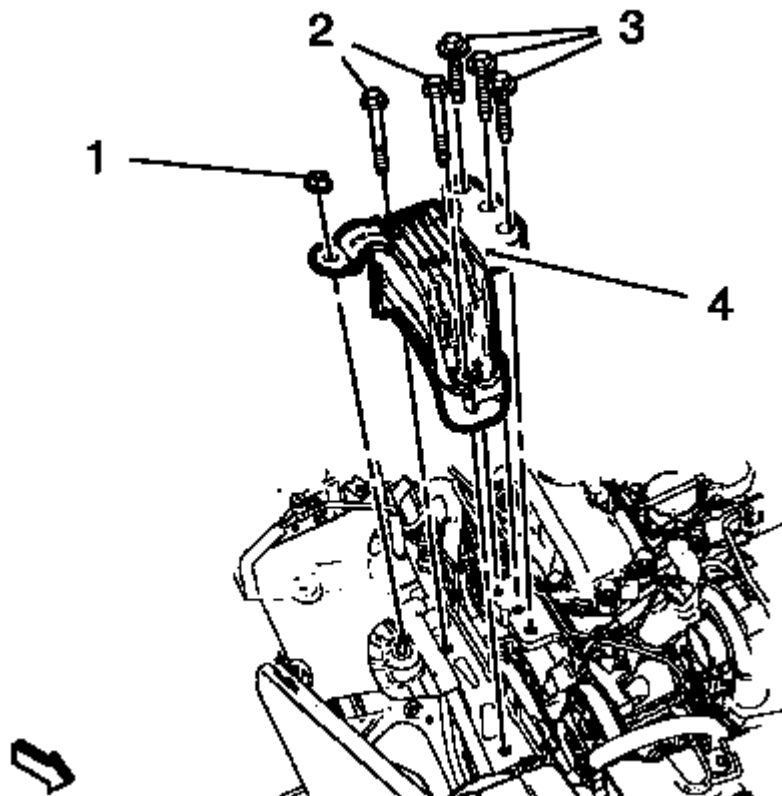


**Fig. 268: Frame Reinforcements & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

26. Install the frame reinforcements (4).  
27. Install frame rear bolts (2). Hand tighten ONLY.  
28. Install frame front bolts (3). Hand tighten ONLY.

**NOTE:** Remind the location marks of the transmission mount bolts before tightening the bolts.

29. Install the transmission mount - left side. Refer to Transmission Mount Replacement - Left Side.



**Fig. 269: Engine Mount Components**

Courtesy of GENERAL MOTORS COMPANY

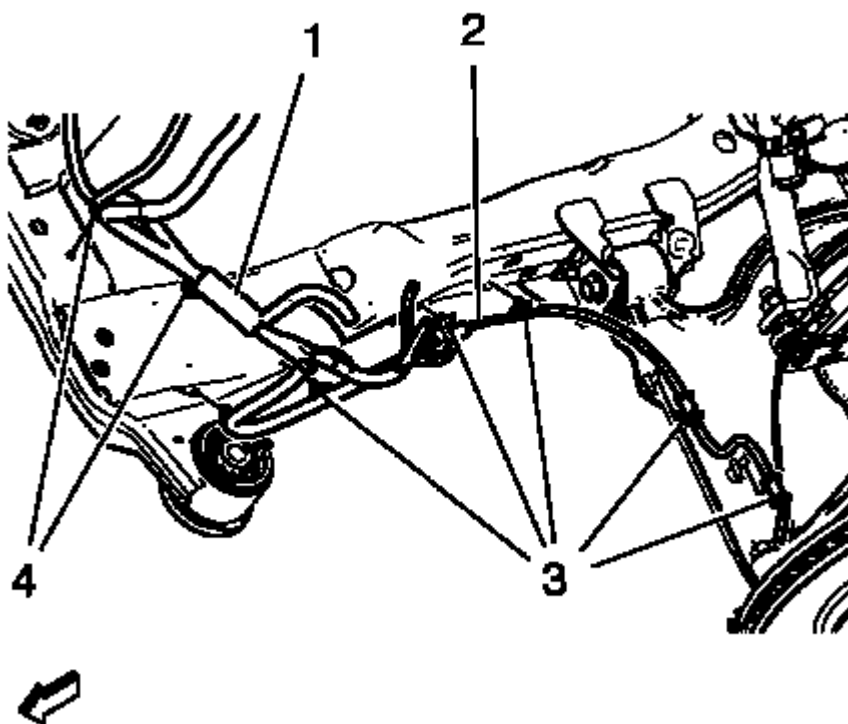
30. Install the engine mount bracket (4).
31. Install the 3 engine mount retaining bolts (3). Do not tighten the bolts yet.
32. Install the 2 engine mount retaining bolts (2) and the retaining nut (1).
  1. Tighten the bolts (2) to 58 N.m (43 lb ft).
  2. Tighten the nut (1) to 62 N.m (46 lb ft).

**NOTE:** Remind the location marks of the engine mount bolts before tightening the bolts.

3. Align the engine transmission unit.
4. Tighten the bolts (3) to 58 N.m (43 lb ft).
33. Remove the engine support fixture. Refer to Engine Support Fixture.
34. Install the right wheel drive shaft. Refer to Front Wheel Drive Shaft Replacement - Right Side.
35. Install the left wheel drive shaft. Refer to Front Wheel Drive Shaft Replacement - Left Side.
36. Install the left and right front lower control arm to the steering knuckles. Refer to Lower Control Arm Replacement.
37. Install the left and right steering outer tie rod to the steering knuckles. Refer to Steering Linkage Outer

**Tie Rod Replacement .**

38. Install the left and right stabilizer shaft link to the strut assemblies. Refer to **Stabilizer Shaft Link Replacement .**

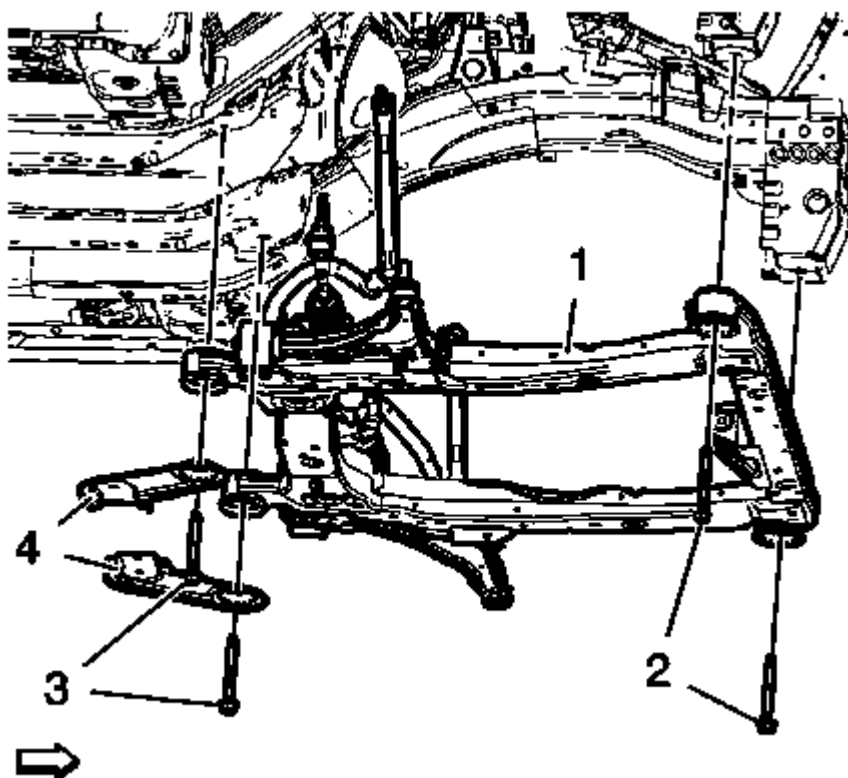


**Fig. 270: Radiator Wiring Harness, Wheel Speed Sensor Wiring Harness And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

39. Install the wheel speed sensor wiring harness (2) to the frame on both sides.

Install the wiring harness retainers (3) to the frame and the lower control arm.

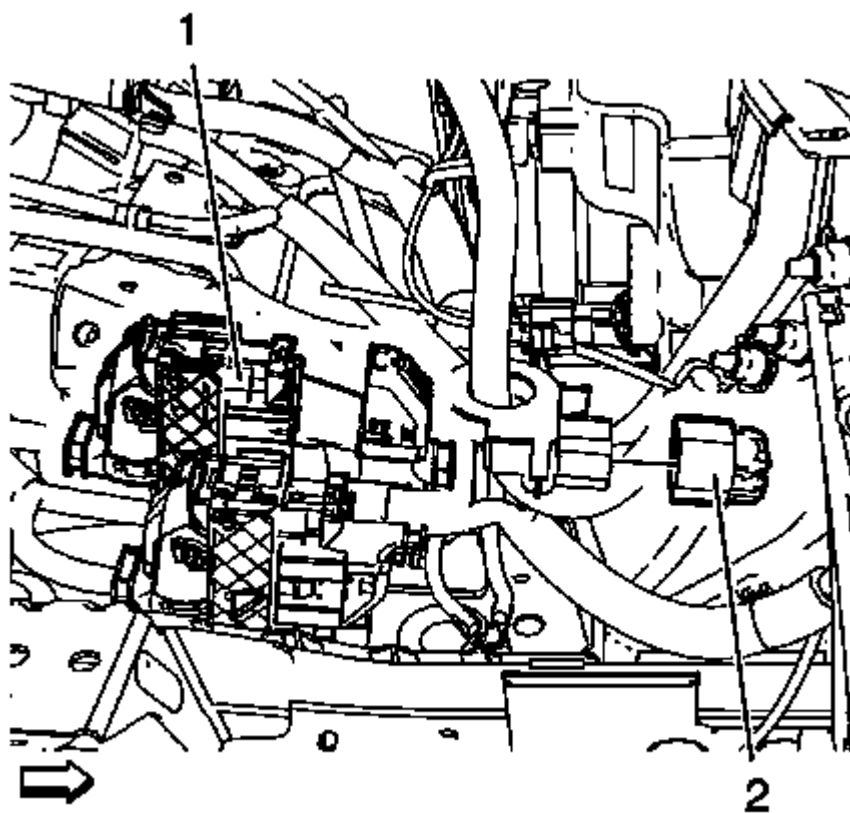
40. Install the heater inlet hose. Refer to **Heater Inlet Hose Replacement (2.0L LHU) .**
41. Install the heater outlet hose. Refer to **Heater Outlet Hose Replacement (2.0L LHU) .**
42. Install the catalytic converter. Refer to **Catalytic Converter Replacement (2.0L LHU) .**



**Fig. 271: Frame Reinforcements & Bolts**

Courtesy of GENERAL MOTORS COMPANY

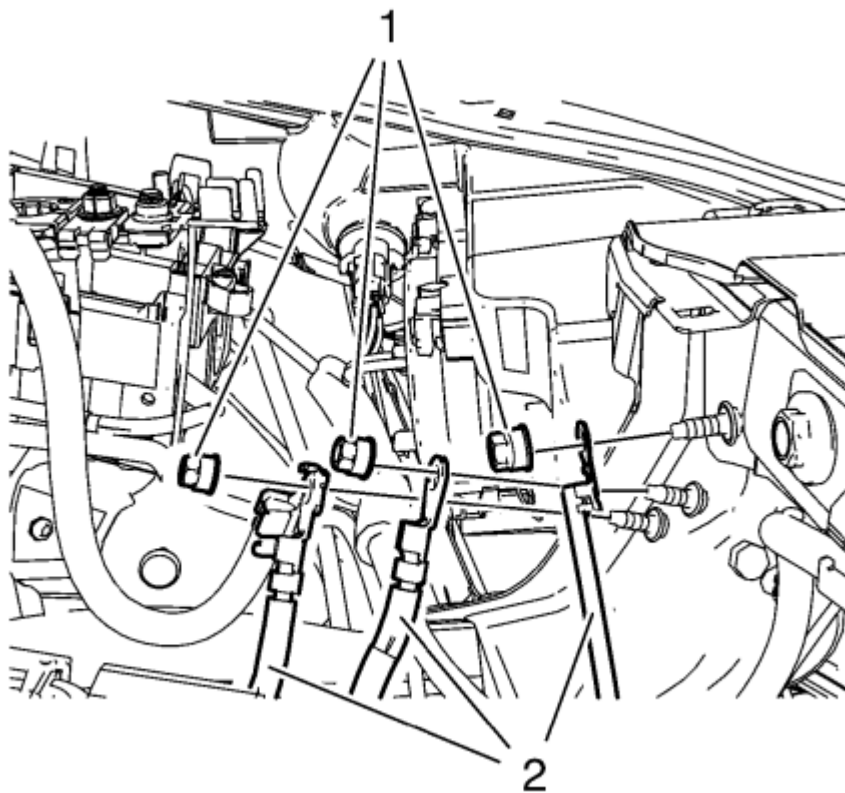
43. Tighten the rear frame bolts (2) and tighten to 160 N.m (118 lb ft).
44. Tighten the drivetrain and front suspension frame bolts (1) and tighten to 160 N.m (118 lb ft).



**Fig. 272: Wiring Harness Plugs**

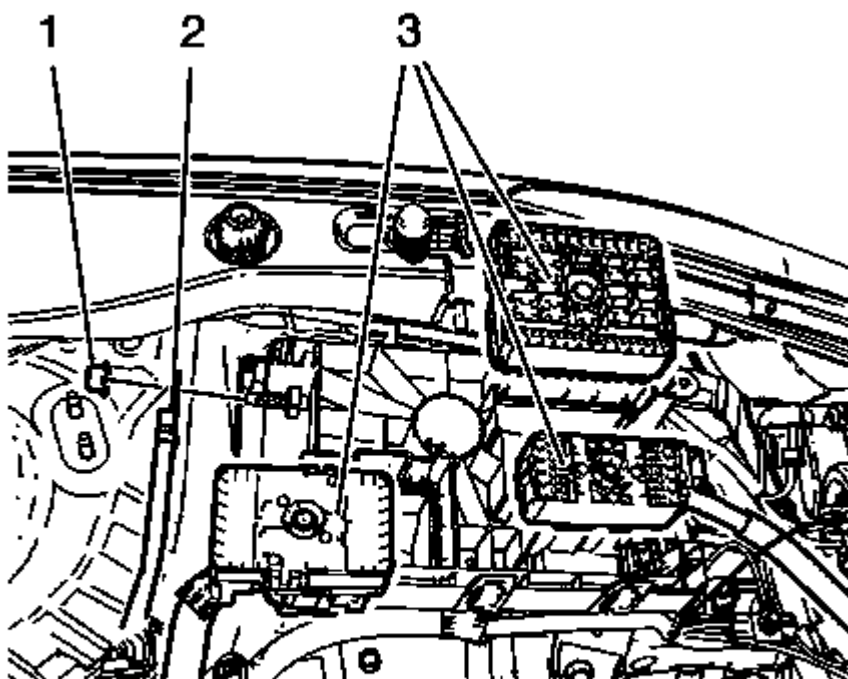
Courtesy of GENERAL MOTORS COMPANY

45. Connect the 2 wiring harness plugs (1, 2).



**Fig. 273: Wiring Harnesses And Ground Nuts**  
**Courtesy of GENERAL MOTORS COMPANY**

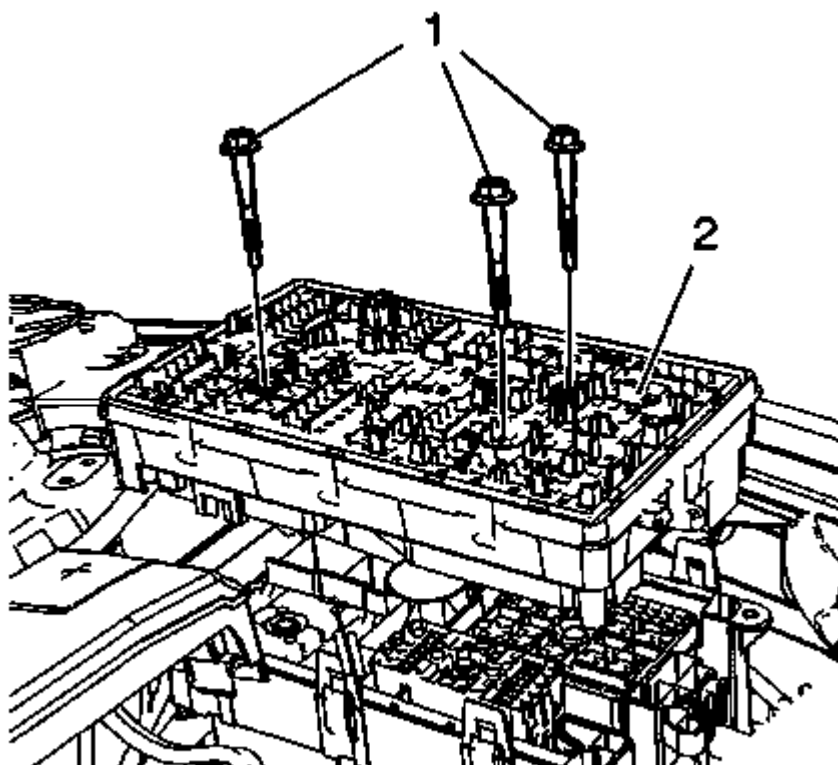
46. Install the 4 wiring harness (2).
47. Install the 3 ground nuts (1) and tighten to 9 N.m (80 lb in).



**Fig. 274: Wiring Harnesses & Plugs**

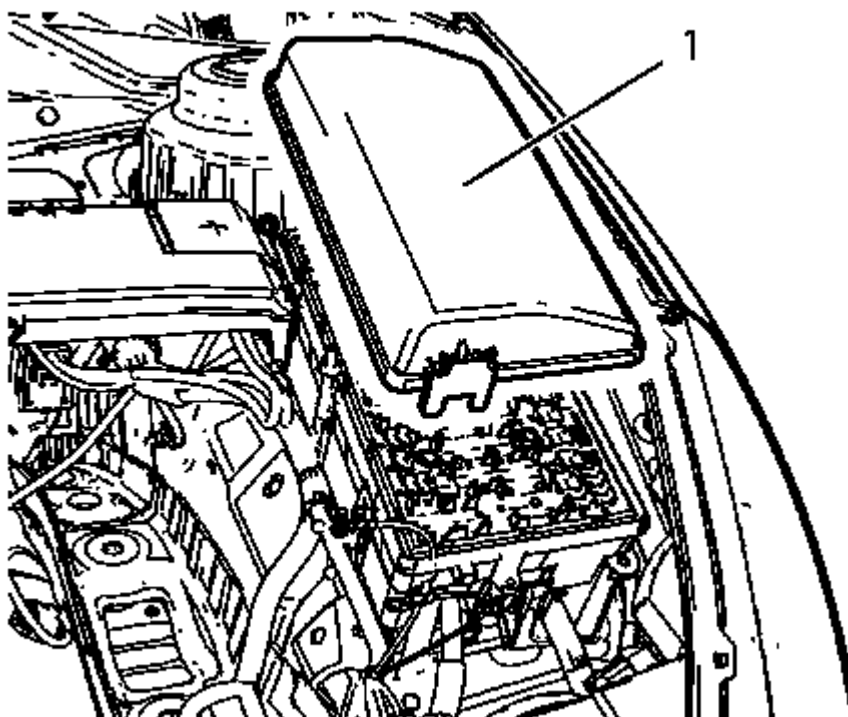
**Courtesy of GENERAL MOTORS COMPANY**

48. Clip in the 3 wiring harness plugs (3).
49. Connect the wiring harness plug to the front compartment fuse block.



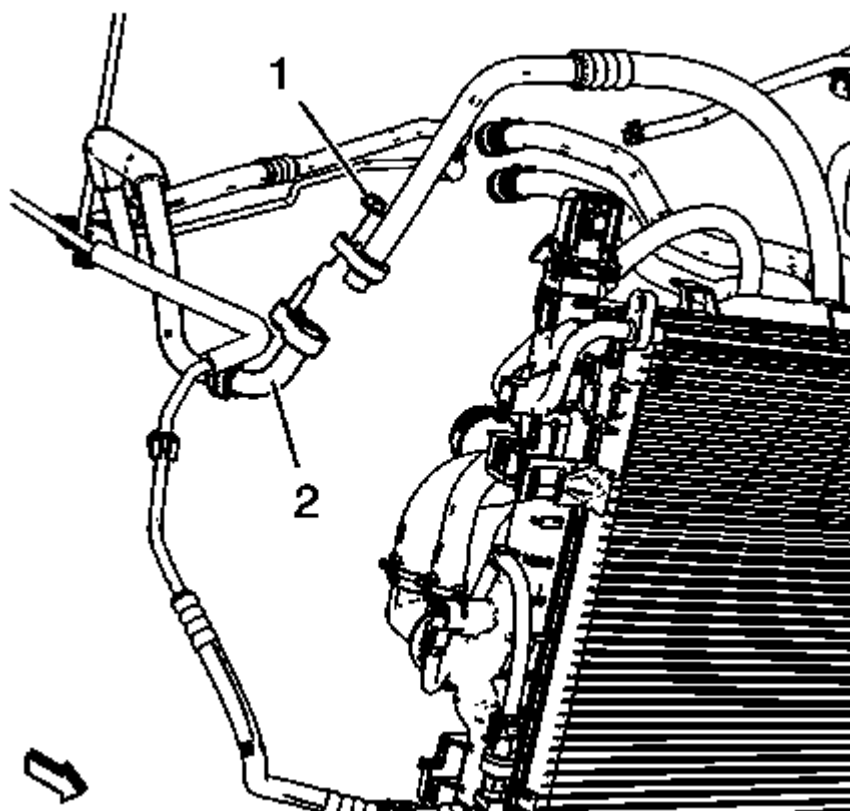
**Fig. 275: Front Compartment Fuse Block & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

50. Install the front compartment fuse block (2).
51. Install the 3 front compartment fuse block bolts (1) and tighten to 22 N.m (16 lb ft).



**Fig. 276: Front Compartment Fuse Block Cover**  
Courtesy of GENERAL MOTORS COMPANY

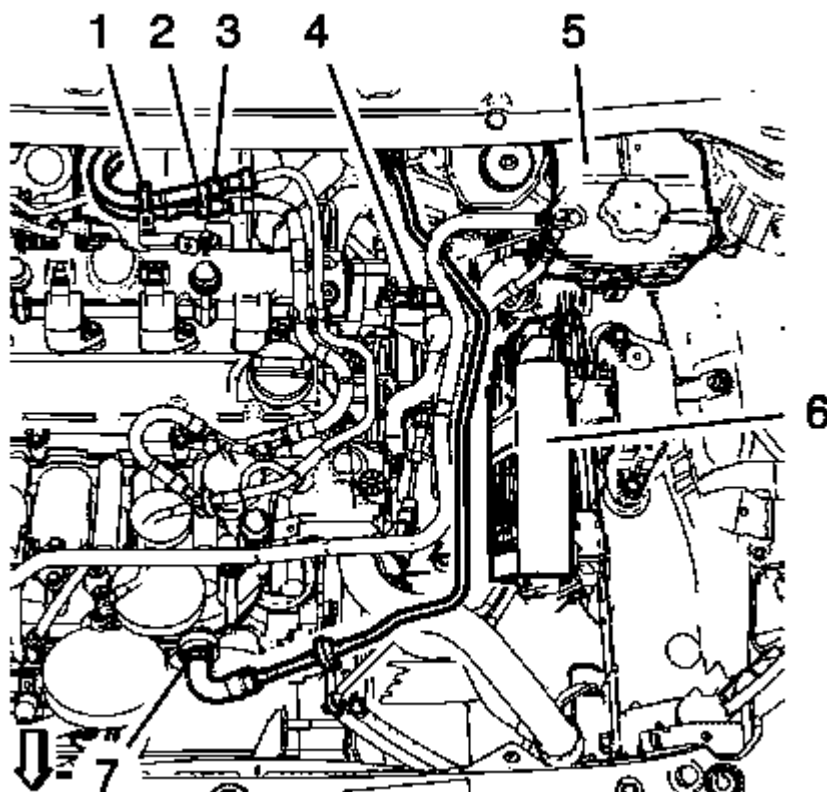
52. Install the front compartment fuse block cover (1).
53. Install the battery tray. Refer to **Battery Tray Replacement** .



**Fig. 277: Air Conditioning Evaporator Hose**  
 Courtesy of GENERAL MOTORS COMPANY

**NOTE:** Use a NEW seal ring

54. Install A/C compressor and condenser hose nut (1) to refrigerant hose (2) and tighten to 19 N.m (14 lb ft).



**Fig. 278: ECM, EVAP Line, Fuel Feed Line & Vacuum Line Components**  
**Courtesy of GENERAL MOTORS COMPANY**

55. Connect the fuel feed line at the connector (2), clip into the bracket (1). Refer to **Metal Collar Quick Connect Fitting Service** .
56. Connect the EVAP line at the connector (3), clip into the bracket (1). Refer to **Plastic Collar Quick Connect Fitting Service** .
57. Connect the vacuum line to the vacuum pump at the connector (4). Refer to **Plastic Collar Quick Connect Fitting Service** .
58. Install the radiator surge tank (5). Refer to **Radiator Surge Tank Replacement** .
59. Install the ECM (6). Refer to **Engine Control Module Replacement** .
60. Install the vacuum pipe (7).
61. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement** .
62. Lower and unsupport the vehicle.
63. Install the lower intermediate shaft bolt. Refer to **Intermediate Steering Shaft Replacement** .
64. Connect the electronic power steering connectors to the electronic power steering assembly. Refer to **FEP Connectors (Steering Gear)** .
65. Install the air cleaner outlet rear duct. Refer to **Air Cleaner Outlet Rear Duct Replacement** .
66. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
67. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

68. Evacuate and charge the refrigerant system. Refer to Refrigerant Recovery and Recharging .
69. Fill the transmission. Refer to Transmission Fluid Drain and Fill .
70. Fill the engine cooling system. Refer to Cooling System Draining and Filling (2.0L LHU) .
71. Install the engine sight shield. Refer to Engine Sight Shield Replacement.
72. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection .

## ENGINE OIL AND OIL FILTER REPLACEMENT

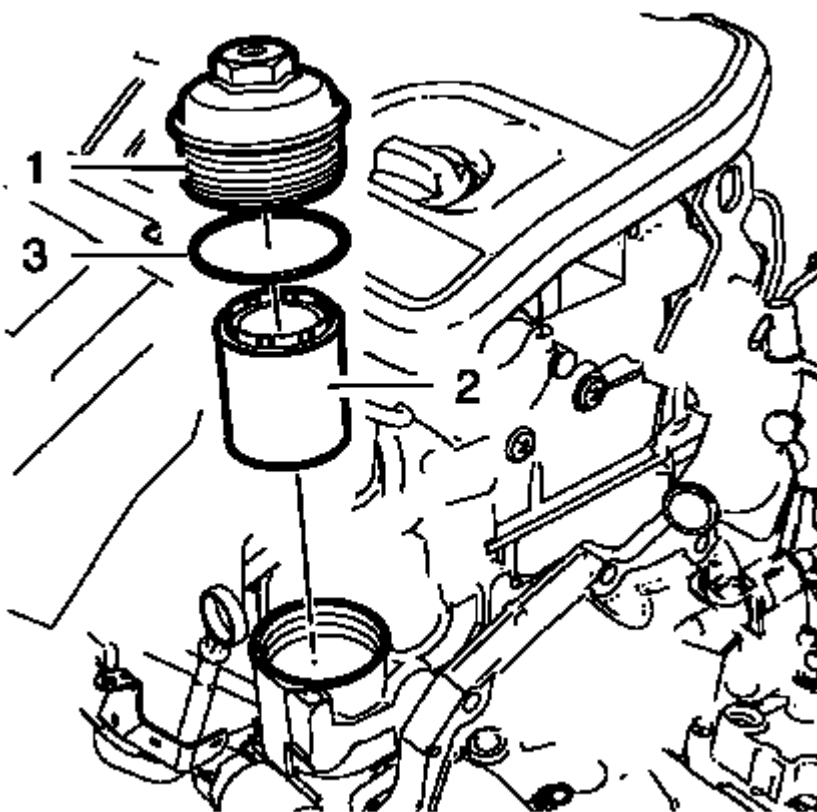
### Special Tools

**EN-44887** Oil Filter Wrench

For equivalent regional tools, refer to Special Tools (LDK, LHU) .

### Removal Procedure

1. Remove the engine sight shield. Refer to Engine Sight Shield Replacement.

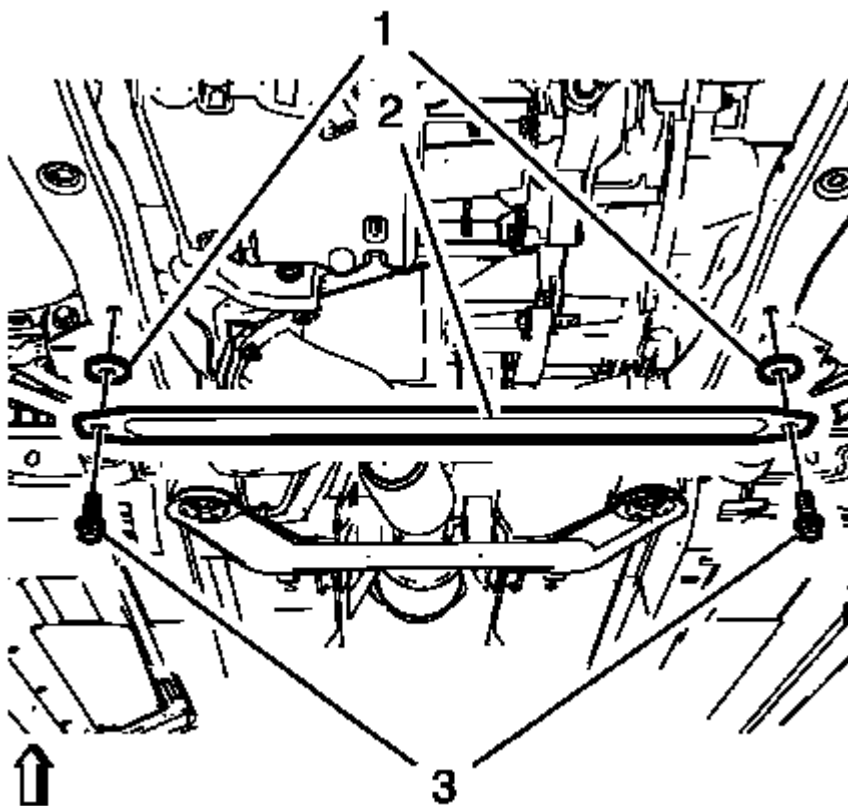


**Fig. 279: Oil Filter, Cap & Seal**

Courtesy of GENERAL MOTORS COMPANY

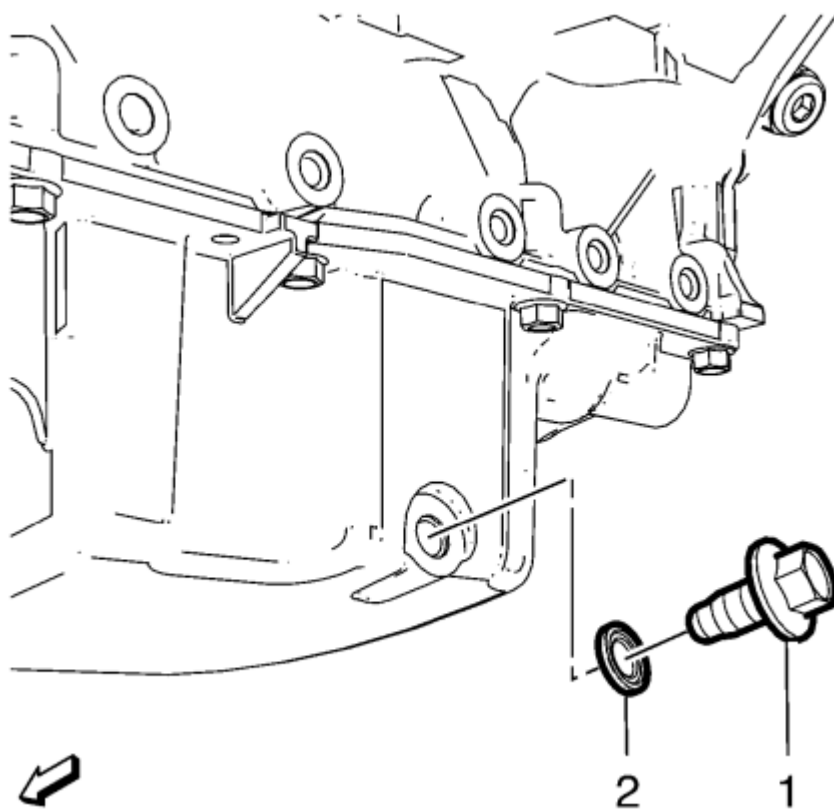
2. Remove the oil filter cap (1) with the **EN-44887** wrench.

3. Remove the oil filter (2) and the oil filter cap seal (3) from the oil filter cap.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the right and left front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement** .



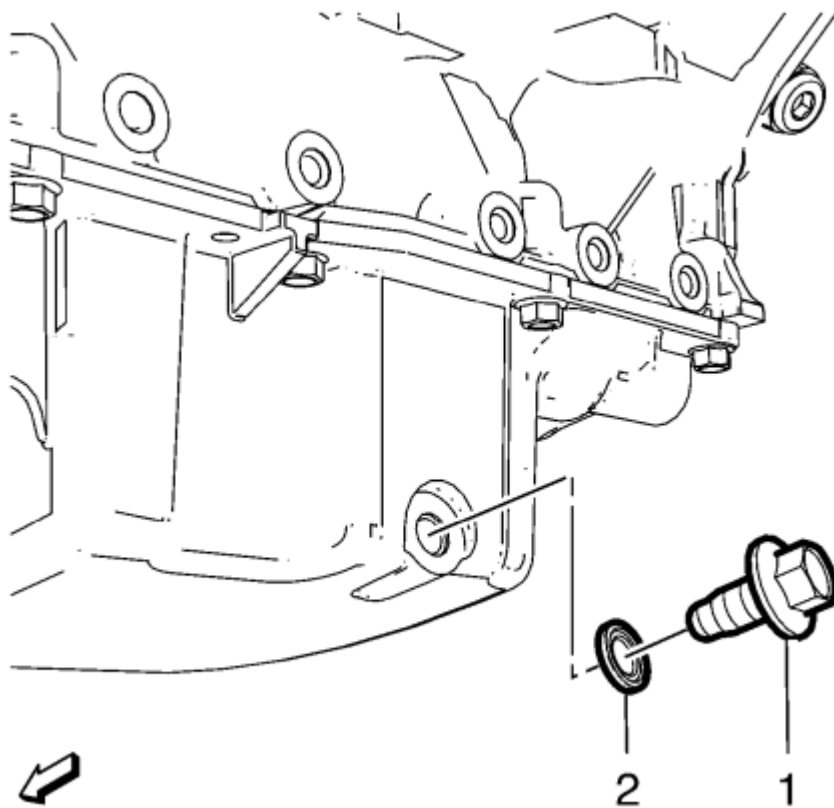
**Fig. 280: Front & Suspension Frame Brace Drivetrain & Bolts**  
 Courtesy of GENERAL MOTORS COMPANY

6. Remove the front and suspension frame brace drivetrain bolts (3) in conjunction with the front and suspension frame brace drivetrain (2) and the front and suspension frame brace drivetrain washers (2).
7. Place a drain pan under the oil drain plug.

**Fig. 281: Drain Plug & Seal Ring****Courtesy of GENERAL MOTORS COMPANY**

8. Remove the oil drain plug (1) and the oil drain plug seal ring (2).
9. Drain the engine oil.

**Installation Procedure**

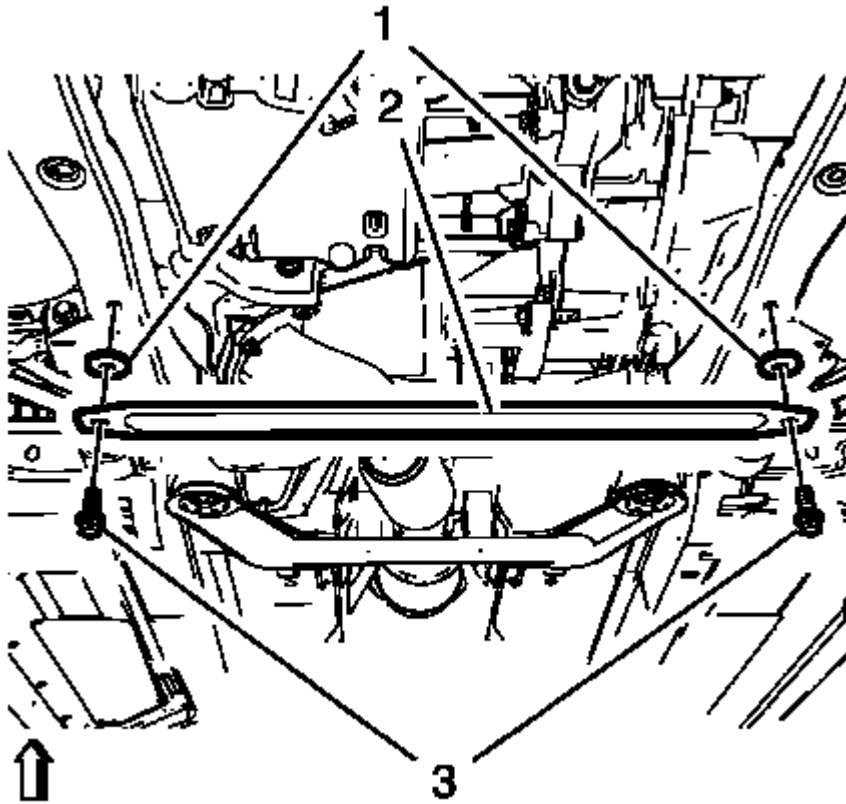


**Fig. 282: Drain Plug & Seal Ring**

Courtesy of GENERAL MOTORS COMPANY

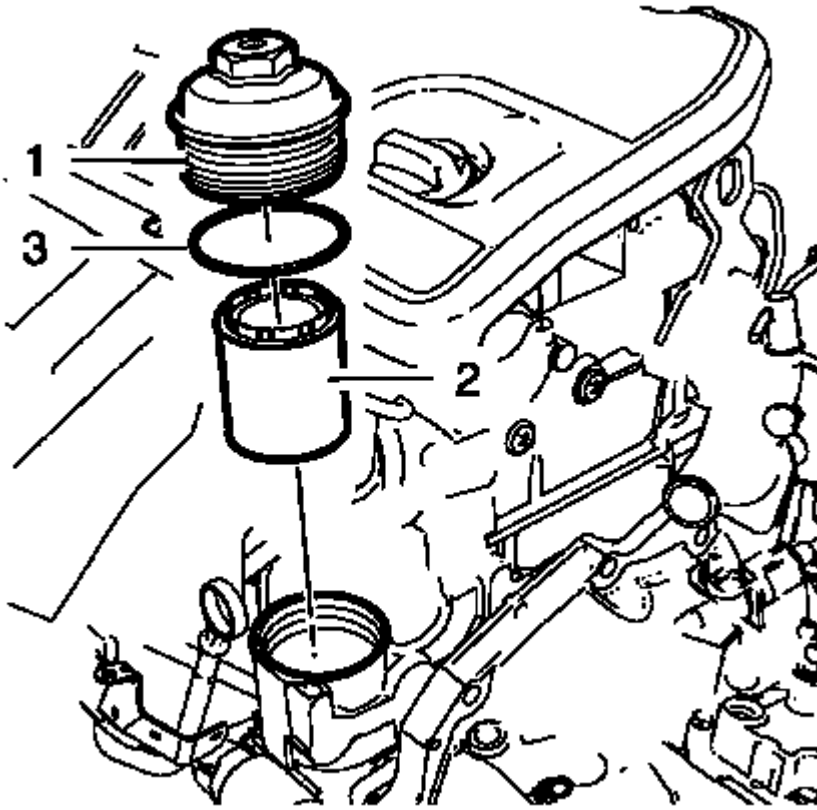
**CAUTION:** Refer to Fastener Caution .

1. Install the oil drain plug (1) with a NEW oil drain plug seal ring (2) and tighten to 25 N.m (18 lb ft).
2. Remove the oil drain pan.



**Fig. 283: Front & Suspension Frame Brace Drivetrain & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

3. Install the front and suspension frame brace drivetrain (2) and the front and suspension frame brace drivetrain washers (2) in conjunction with the front and suspension frame brace drivetrain bolts (3).
4. Tighten the front and suspension frame brace drivetrain bolts (3) to 100 N.m (74 lb ft).
5. Install the right and left front compartment splash shield. Refer to **Front Compartment Splash Shield Replacement**.
6. Lower and unsupport the vehicle.



**Fig. 284: Oil Filter, Cap & Seal**

Courtesy of GENERAL MOTORS COMPANY

7. Install a NEW oil filter (2) and a NEW oil filter cap seal (3) to the oil filter cap (1).
8. Install the oil filter cap with the **EN-44887** wrench and tighten to 25 N.m (18 lb ft).
9. Fill the engine with engine oil. Refer to **Engine Mechanical Specifications (LDK, LHU)** .
10. Install the engine sight shield. Refer to **Engine Sight Shield Replacement**.
11. Reset the GM oil life system. Refer to **GM Oil Life System Resetting** .