2014 ENGINE

Engine Mechanical - 4.3L (LV1 LV3) - Repair Instructions - On Vehicle - Silverado 1500, Sierra 1500

REPAIR INSTRUCTIONS - ON VEHICLE

VACUUM PUMP BELT REPLACEMENT

Removal Procedure

1. Remove the air conditioning compressor belt. Refer to **Air Conditioning Compressor Belt Replacement**.

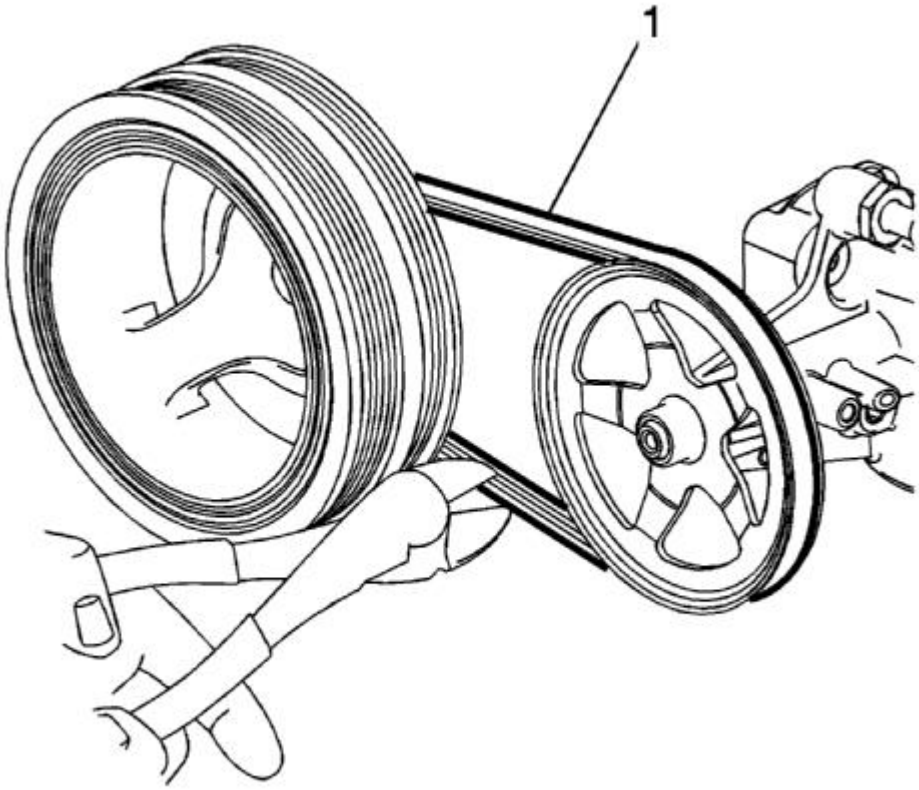


Fig. 1: Vacuum Pump Belt
Courtesy of GENERAL MOTORS COMPANY

2. Cut the belt (1) from the vacuum pump and crankshaft pulleys.

Installation Procedure

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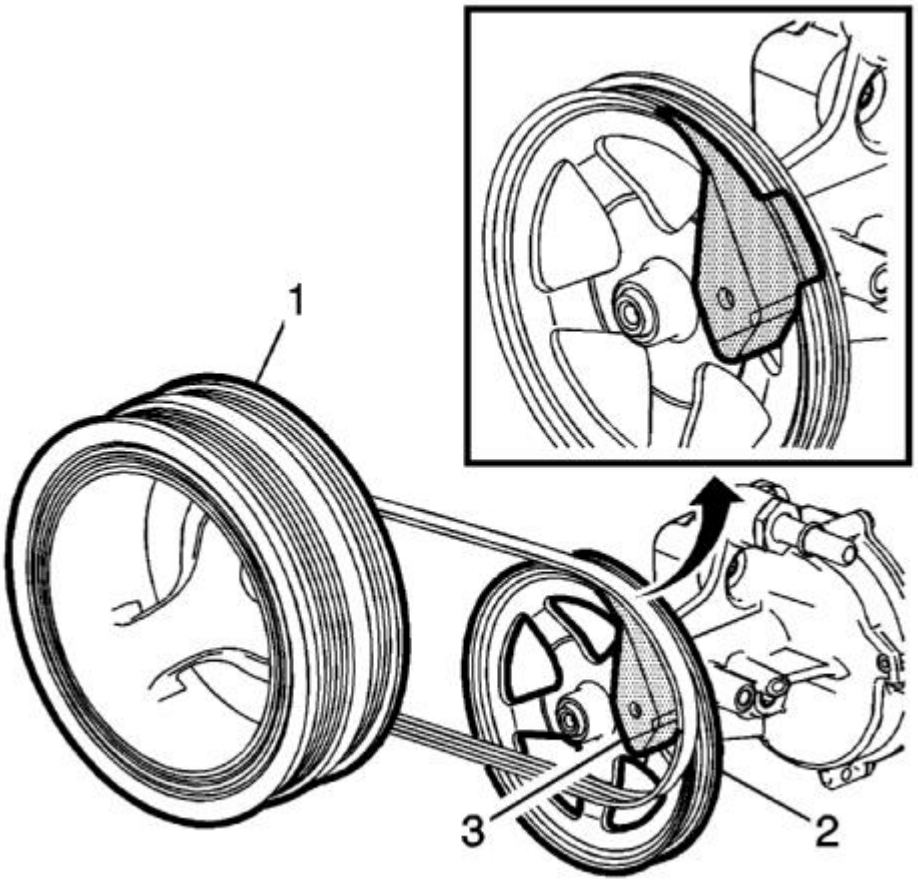


Fig. 2: Vacuum Pump Belt
Courtesy of GENERAL MOTORS COMPANY

NOTE: The OEM replacement stretchy belt is packaged with a disposable installation tool.

1. Position the belt on the crankshaft balancer (1) at the last belt placement inward and partially onto the vacuum pump pulley (2).
2. Install the belt installation tool (3) onto the vacuum pump pulley.

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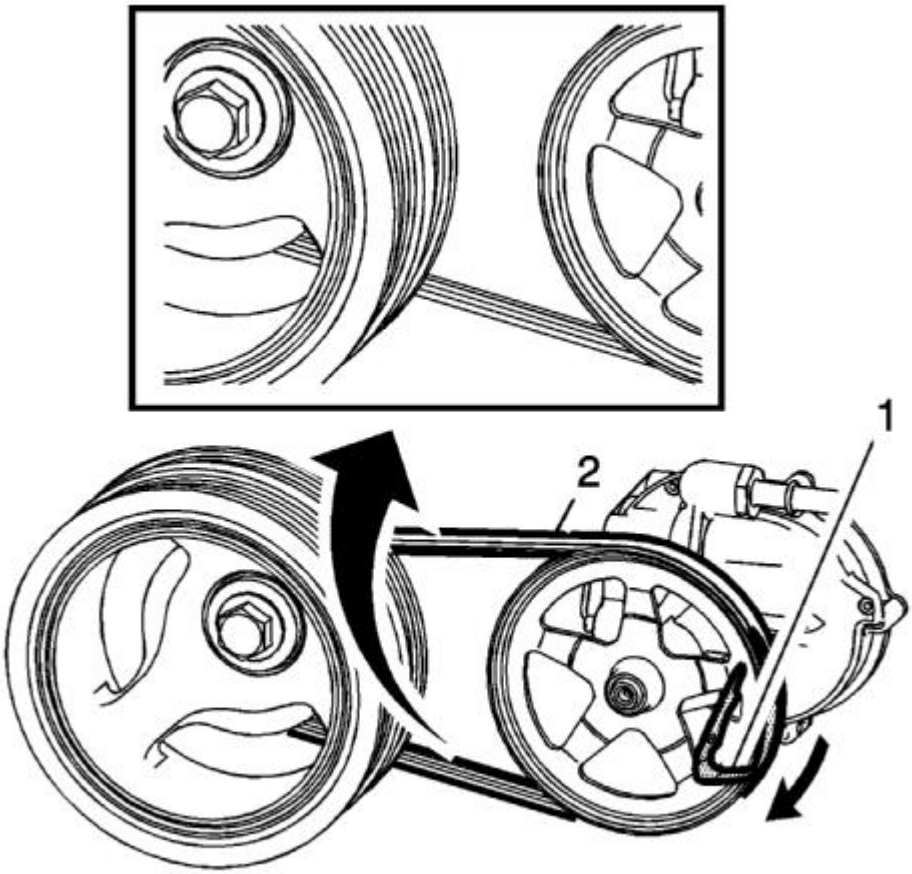


Fig. 3: Drive Belt Installation Tool
Courtesy of GENERAL MOTORS COMPANY

3. Slide the belt installation tool (1) downward, partially installing the belt (2) onto the vacuum pump pulley.
4. Slide the belt installation tool downward, applying light tension to the belt.

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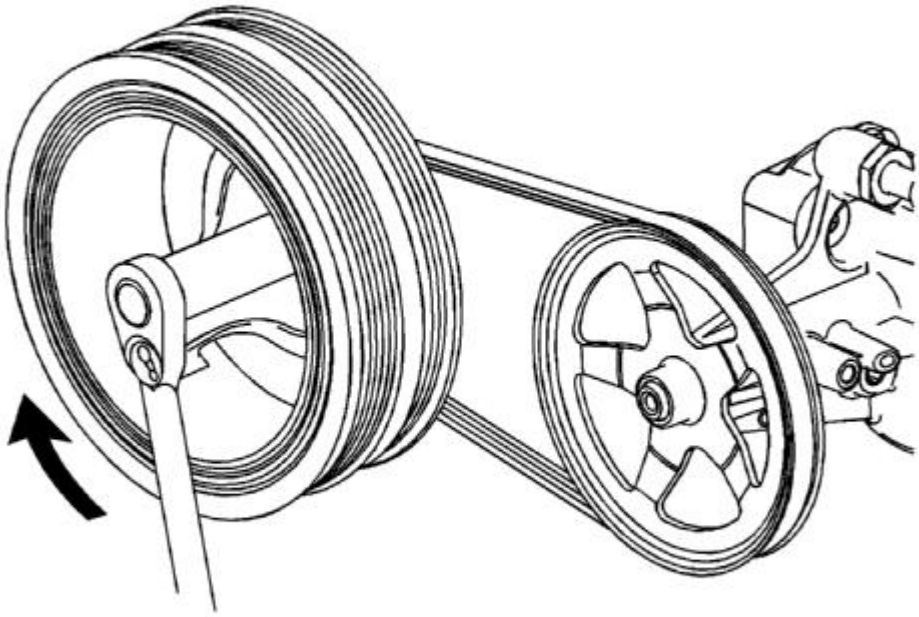


Fig. 4: Rotating Engine Clockwise
Courtesy of GENERAL MOTORS COMPANY

5. With the belt in position, rotate the engine clockwise to completely install the belt onto the vacuum pump and crankshaft pulleys.

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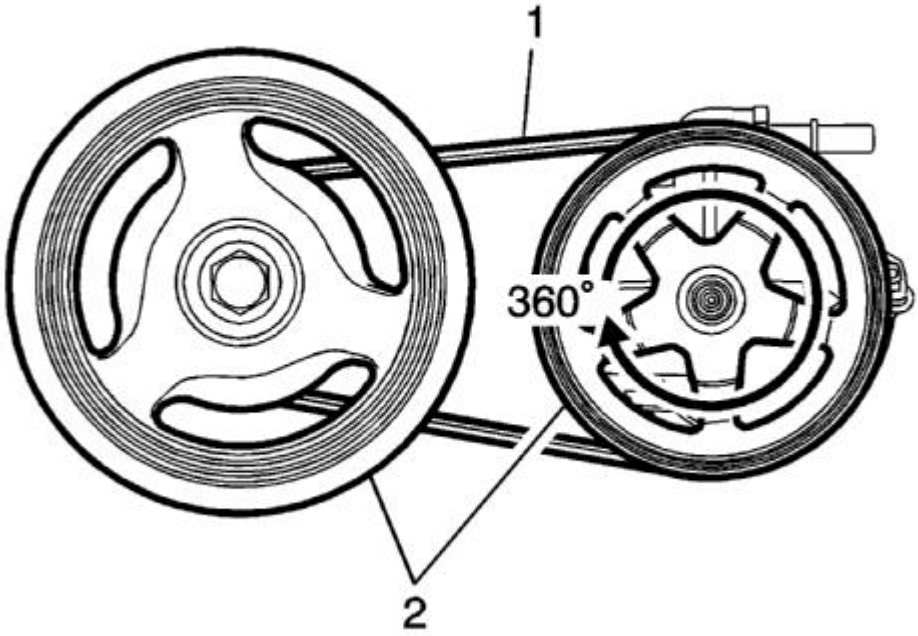


Fig. 5: Inspecting Ribbed Area Of Belt For Correct Alignment
Courtesy of GENERAL MOTORS COMPANY

6. Once the belt is installed, rotate the engine 360 degrees and inspect the ribbed area of the belt (1) to ensure that it is correctly aligned with the pulleys grooves (2).

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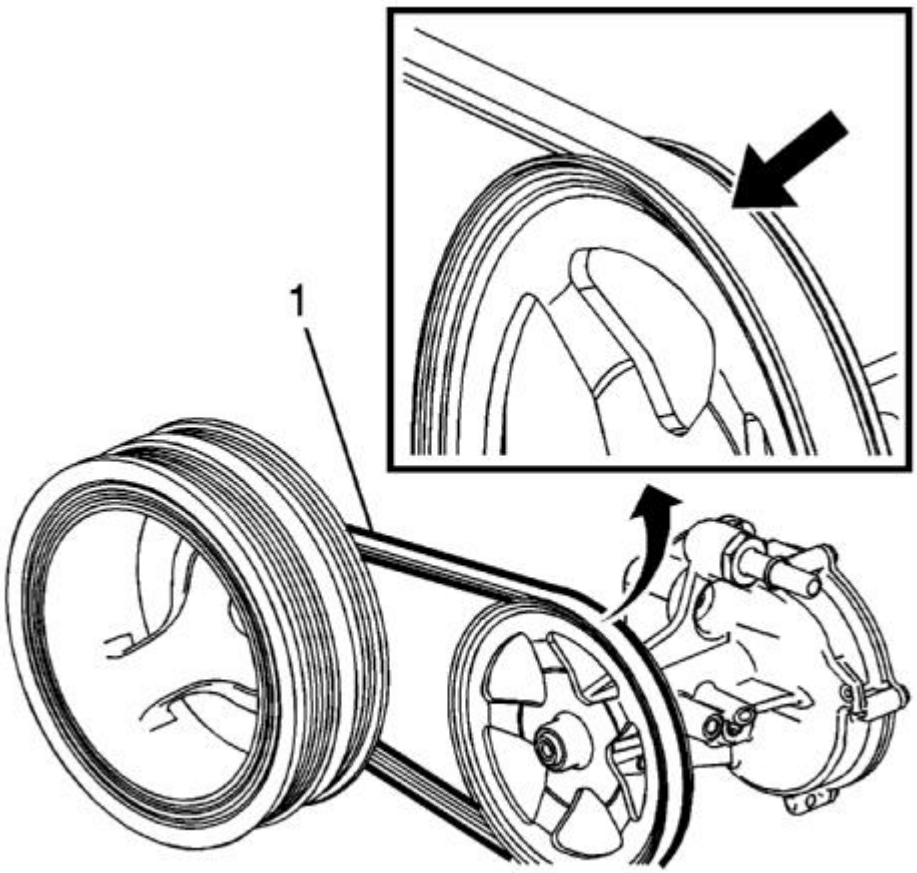


Fig. 6: Inspecting Back Side Of Vacuum Pump Belt
Courtesy of GENERAL MOTORS COMPANY

7. Inspect the back side of the vacuum pump belt (1) for proper orientation after rotating the engine.
8. Install the air conditioning compressor belt. Refer to **Air Conditioning Compressor Belt Replacement**.

DRIVE BELT REPLACEMENT - ACCESSORY

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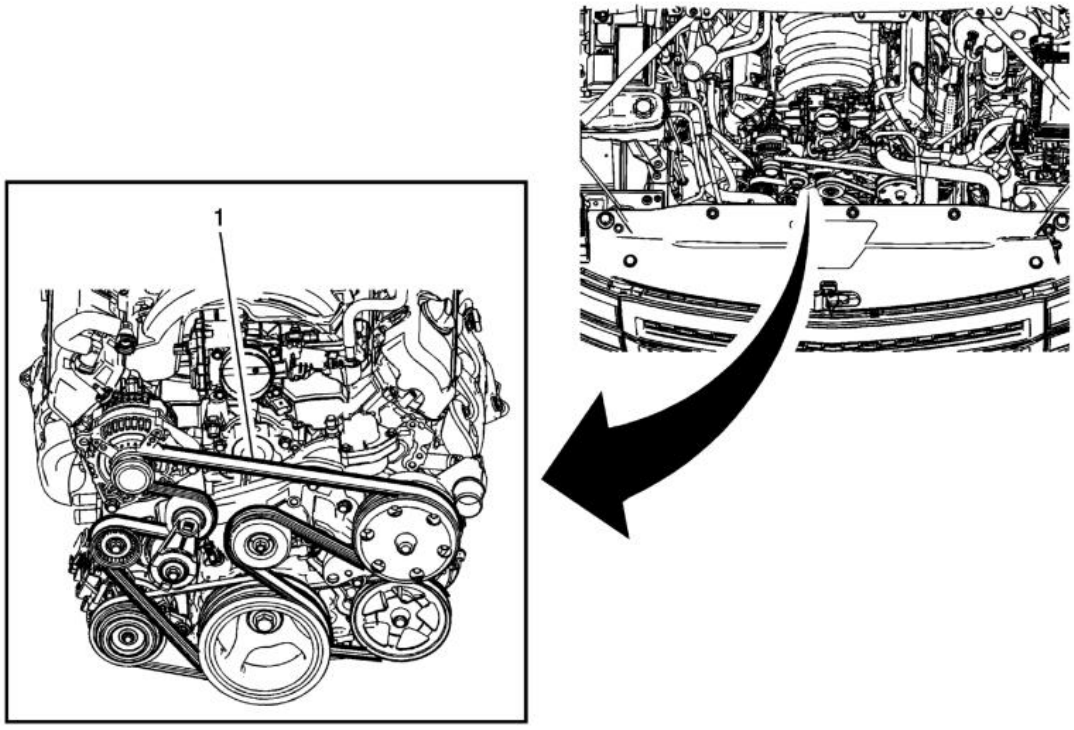


Fig. 7: Accessory Drive Belt Routing
Courtesy of GENERAL MOTORS COMPANY

Drive Belt Replacement - Accessory

Callout	Component Name
Preliminary Procedures Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .	
1	Drive Belt **Procedure** 1. Rotate the drive belt tensioner counterclockwise to release the drive belt tension. 2. Slide the drive belt off of the belt idler pulley. 3. Slowly release the drive belt tensioner.

AIR CONDITIONING COMPRESSOR BELT REPLACEMENT

Removal Procedure

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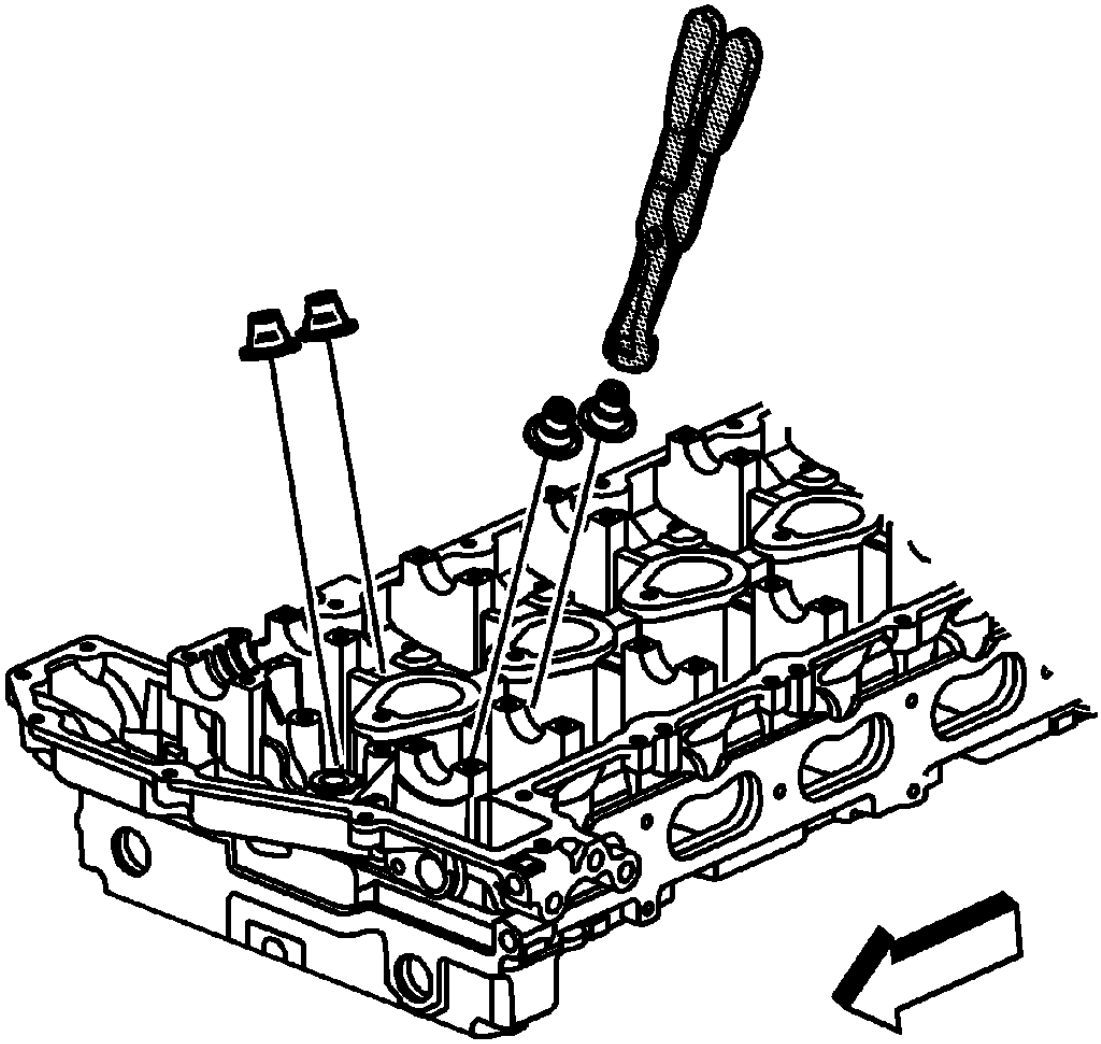


Fig. 8: Removing Belt
Courtesy of GENERAL MOTORS COMPANY

1. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**
2. Remove the skid plate. Refer to **Steering Gear Skid Shield Replacement** .
3. Cut the belt (1) from air conditioning (A/C) and crankshaft pulleys.

Installation Procedure

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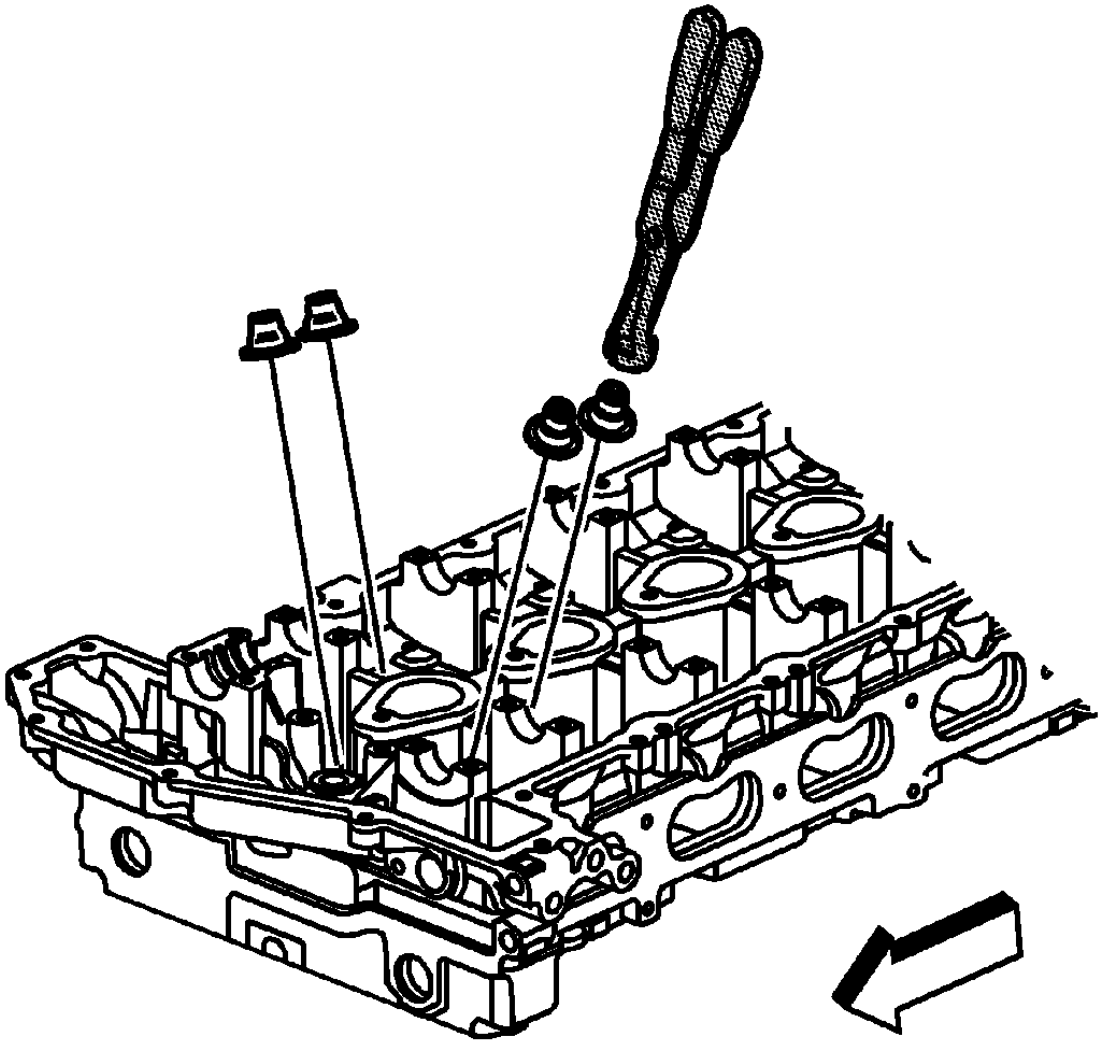


Fig. 9: Installing Belt
Courtesy of GENERAL MOTORS COMPANY

NOTE: The OEM replacement stretchy belt is packaged with a disposable installation tool.

1. Position the belt behind the rear face of the balancer (1) and off of the A/C pulley (2).
2. Install the belt installation tool (3) onto the balancer.

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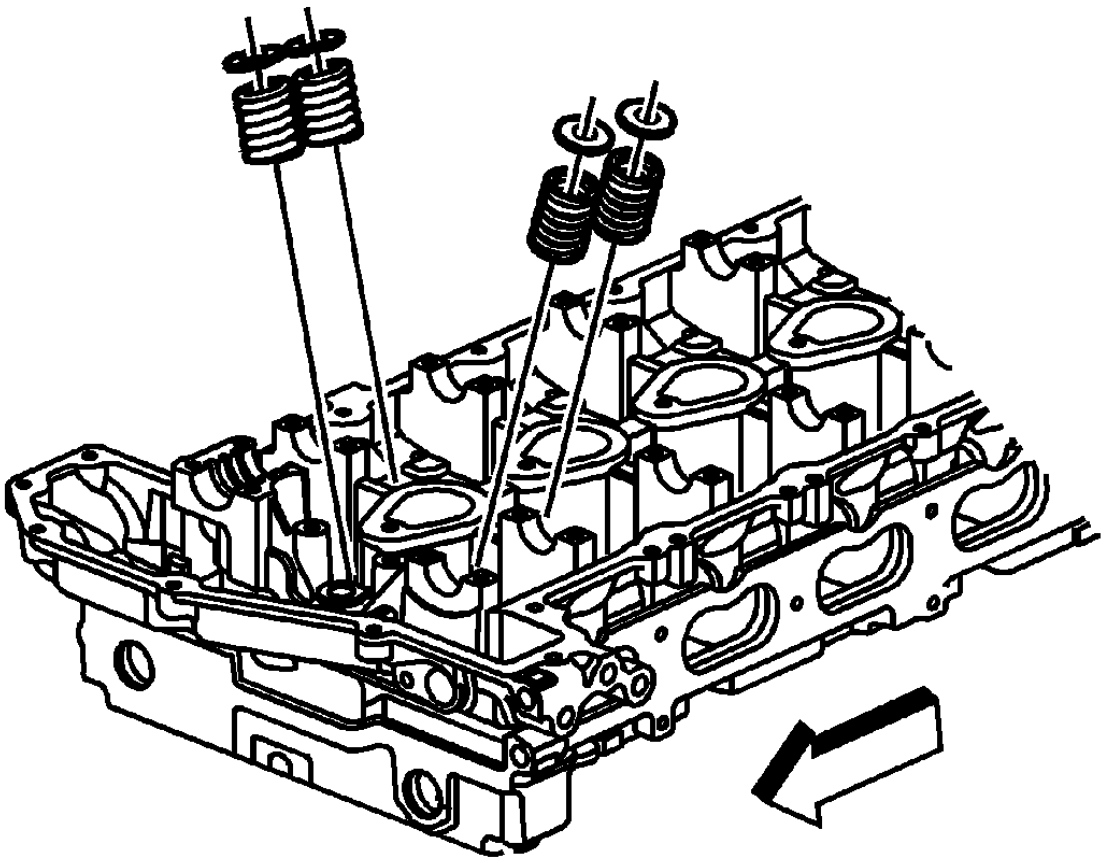


Fig. 10: Belt Installation Tool
Courtesy of GENERAL MOTORS COMPANY

3. Slide the belt installation tool (1) upward, installing the belt (2) onto the belt installation tool.
4. Slide the belt installation tool downward, positioning the belt onto the A/C pulley, applying light tension to the belt.

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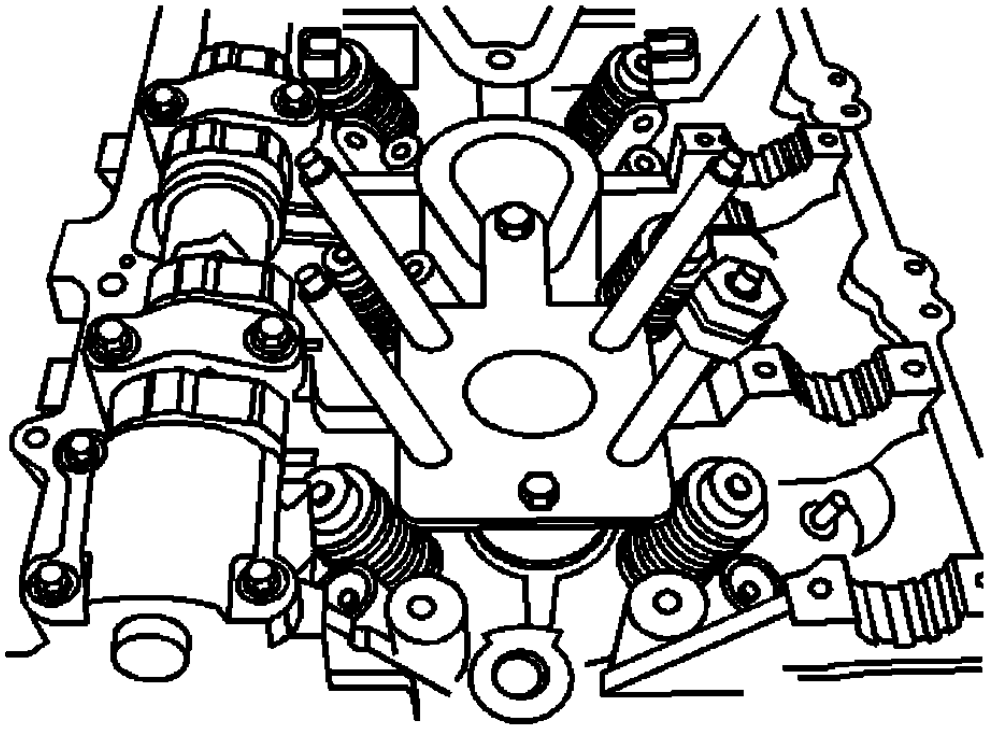


Fig. 11: Locating Lower Portion Of Belt & Ribbed Area Facing Forward
Courtesy of GENERAL MOTORS COMPANY

5. Position the lower portion of the belt (1) with the ribbed area facing forward.

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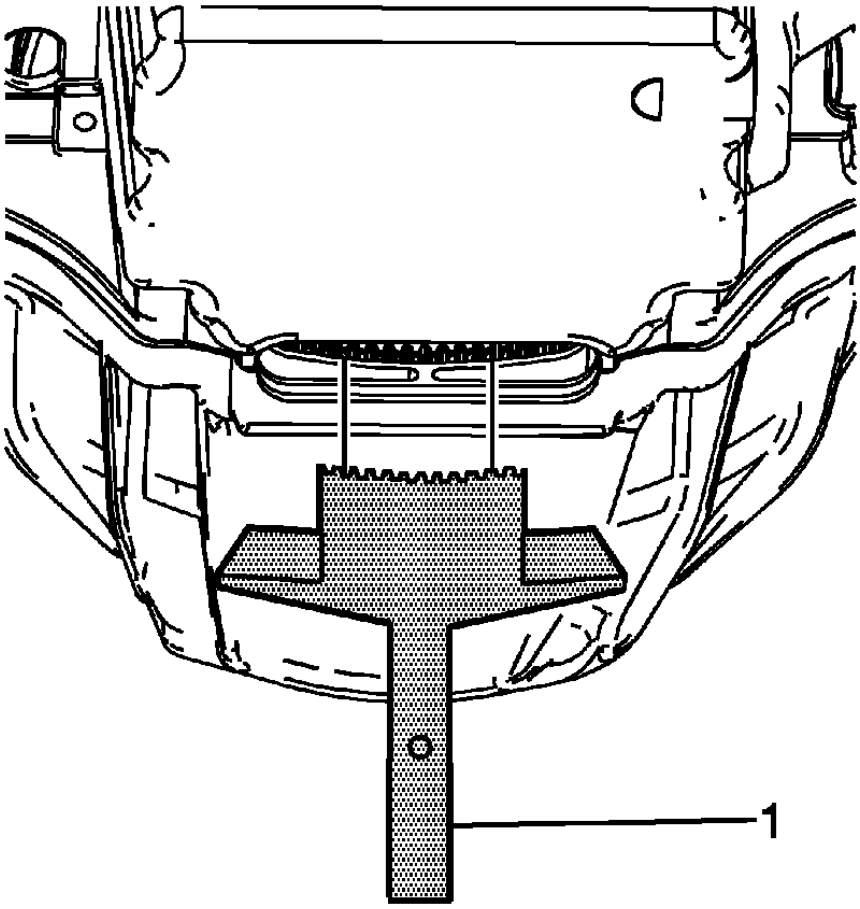


Fig. 12: Rotating Crankshaft Pulley
Courtesy of GENERAL MOTORS COMPANY

6. Slowly rotate the crankshaft pulley (1) in a clockwise direction while using finger pressure to pull the belt (2) forward. Ensure that the ribbed area of the belt remains facing forward and the belt aligns properly to the A/C pulley.

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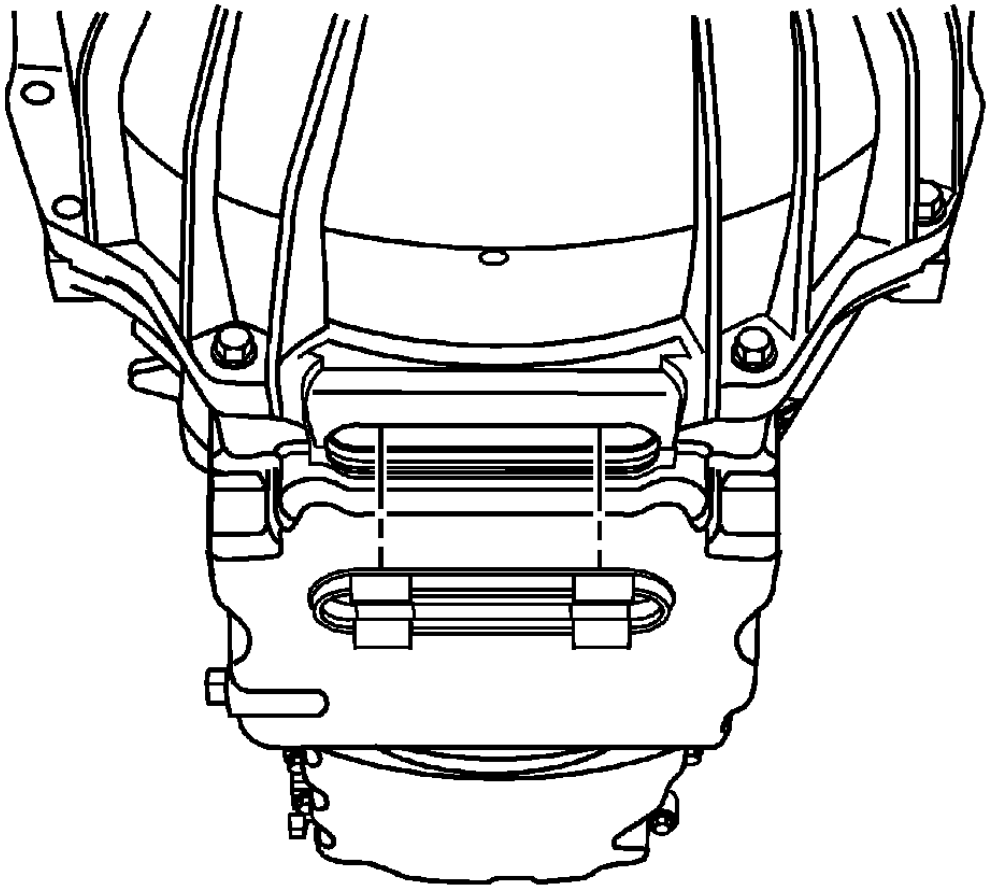


Fig. 13: Drive Belt Alignment
Courtesy of GENERAL MOTORS COMPANY

7. Inspect the drive belt (1) for proper installation and alignment.

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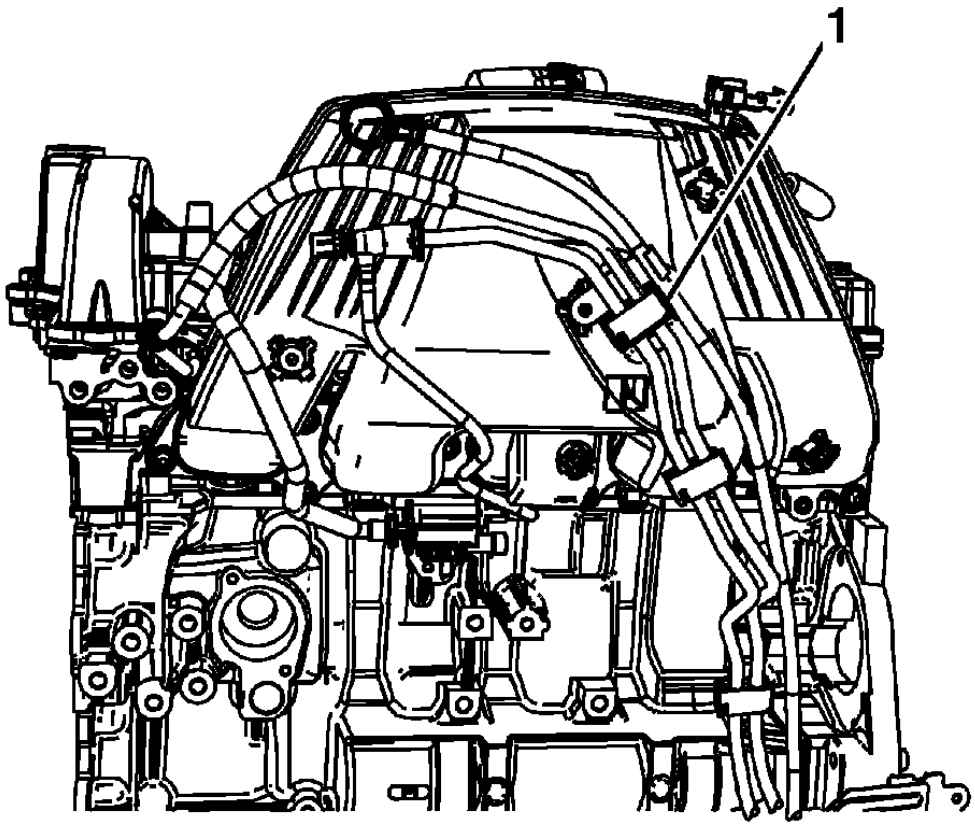


Fig. 14: A/C Compressor Drive Belt
Courtesy of GENERAL MOTORS COMPANY

8. Rotate the balancer (1) and additional 360 degrees to ensure proper belt installation.
9. Install the skid plate. Refer to **Steering Gear Skid Shield Replacement** .
10. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory**.

DRIVE BELT IDLER PULLEY REPLACEMENT

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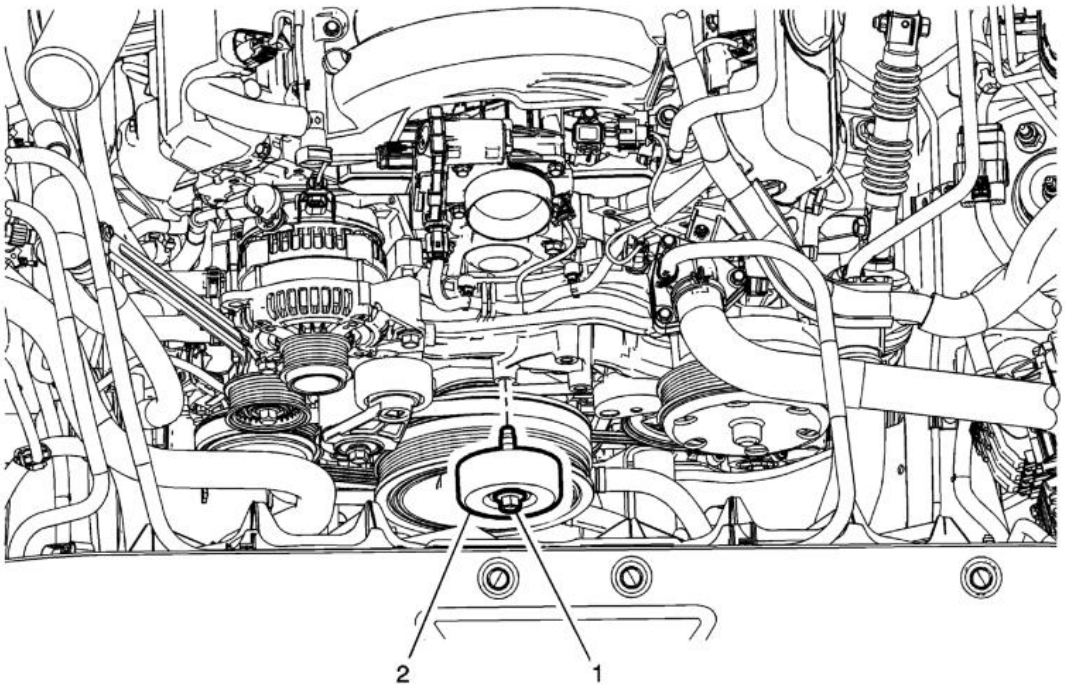


Fig. 15: Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS COMPANY

Drive Belt Idler Pulley Replacement

Callout	Component Name
Preliminary Procedure Remove the drive belt. Refer to **Drive Belt Replacement - Accessory**.	
1	Drive Belt Idler Pulley Fastener **CAUTION:** **Refer to Fastener Caution .** **TIghten** 50 (37 lb ft)
2	Drive Belt Idler Pulley

DRIVE BELT TENSIONER REPLACEMENT - ACCESSORY

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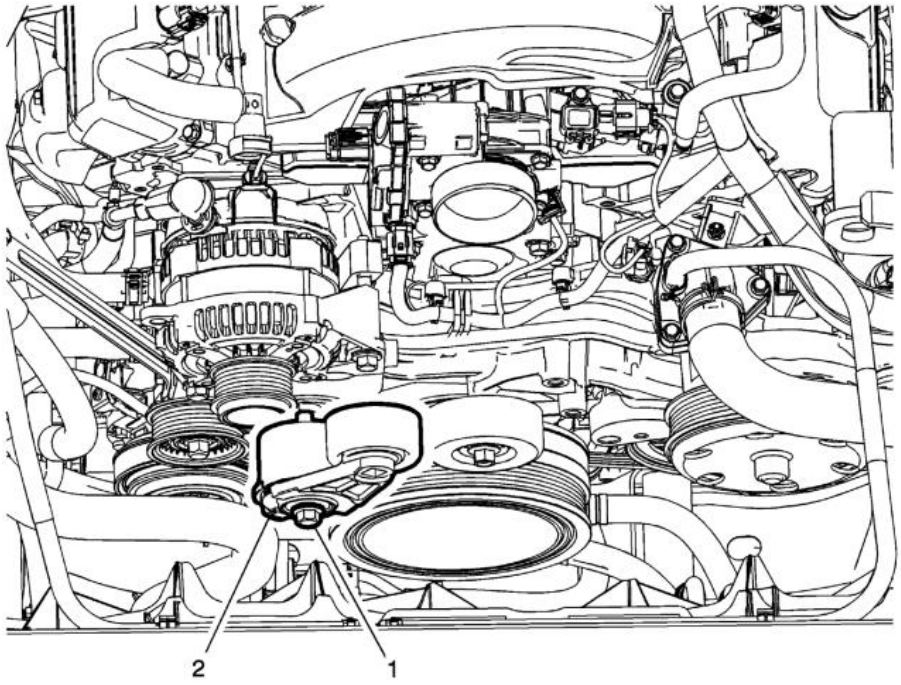


Fig. 16: Drive Belt Tensioner - Accessory
Courtesy of GENERAL MOTORS COMPANY

Drive Belt Tensioner Replacement - Accessory

Callout	Component Name
Preliminary Procedure Remove the drive belt. Refer to **Drive Belt Replacement - Accessory**.	
1	Drive Belt Tensioner Fastener **CAUTION:** **Refer to Fastener Caution .** **TIghten** 25 (18 lb ft)
2	Drive Belt Tensioner

ENGINE MOUNT REPLACEMENT - LEFT SIDE

Removal Procedure

CAUTION: When raising or supporting the engine for any reason, do not use a jack under any sheet metal or the crankshaft pulley or damage may occur.

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1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (L83, L86, LV1, LV3)** , **Battery Negative Cable Disconnection and Connection (K4B)** .
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
3. Remove the drivetrain and front suspension frame front crossmember. Refer to **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Light Duty)** , **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Heavy Duty)** .
4. Remove the left wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement - Left Side (Chevrolet)** , **Front Wheelhouse Liner Replacement - Left Side (GMC)** .
5. Remove the vacuum pump. Refer to **Vacuum Pump Replacement** .

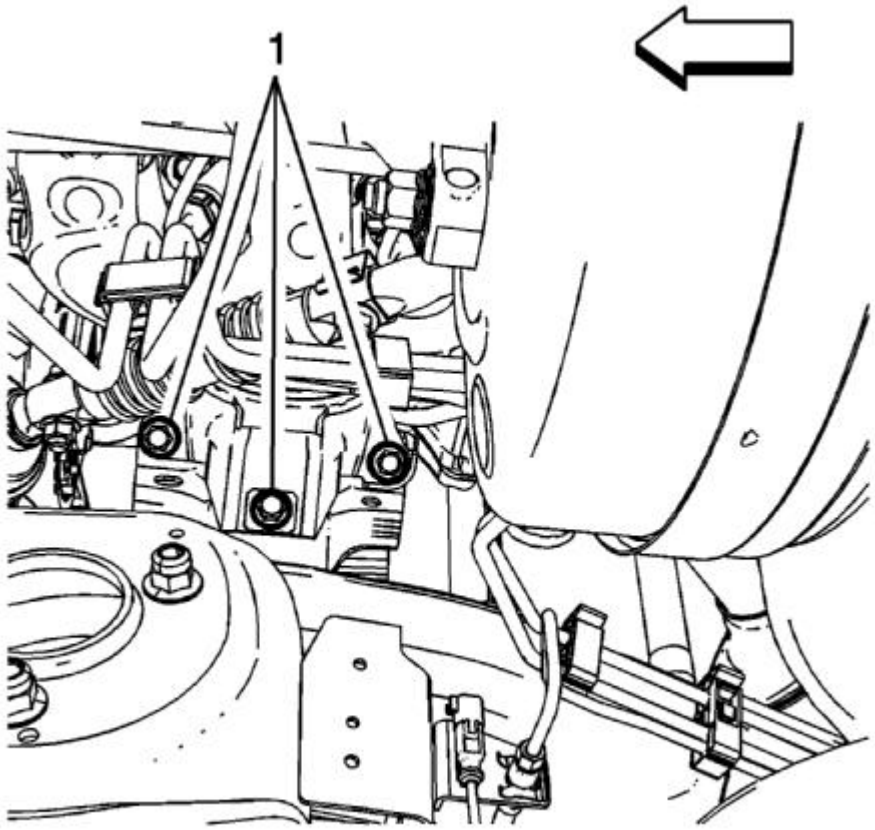


Fig. 17: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the engine mount to frame bolts (1).
7. Remove exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LV1, LV3)** .
8. Position a screw jack and a block of wood under the lower engine oil pan.

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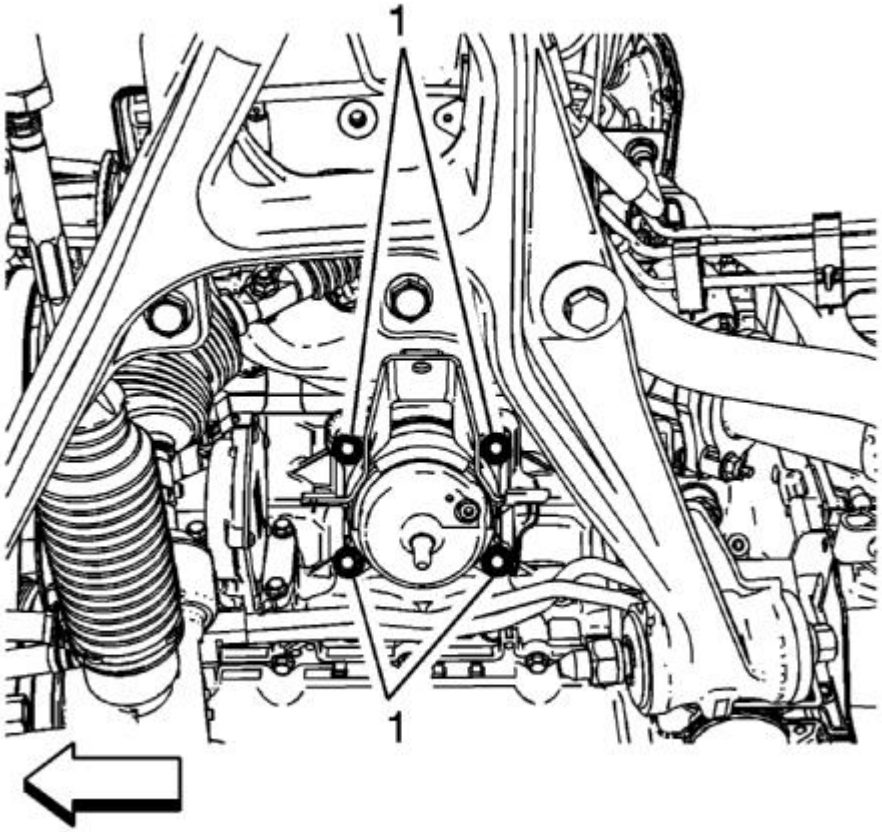


Fig. 18: Engine Mount To Engine Block Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Working through the wheelhouse opening, remove the engine mount to engine block bolts (1).

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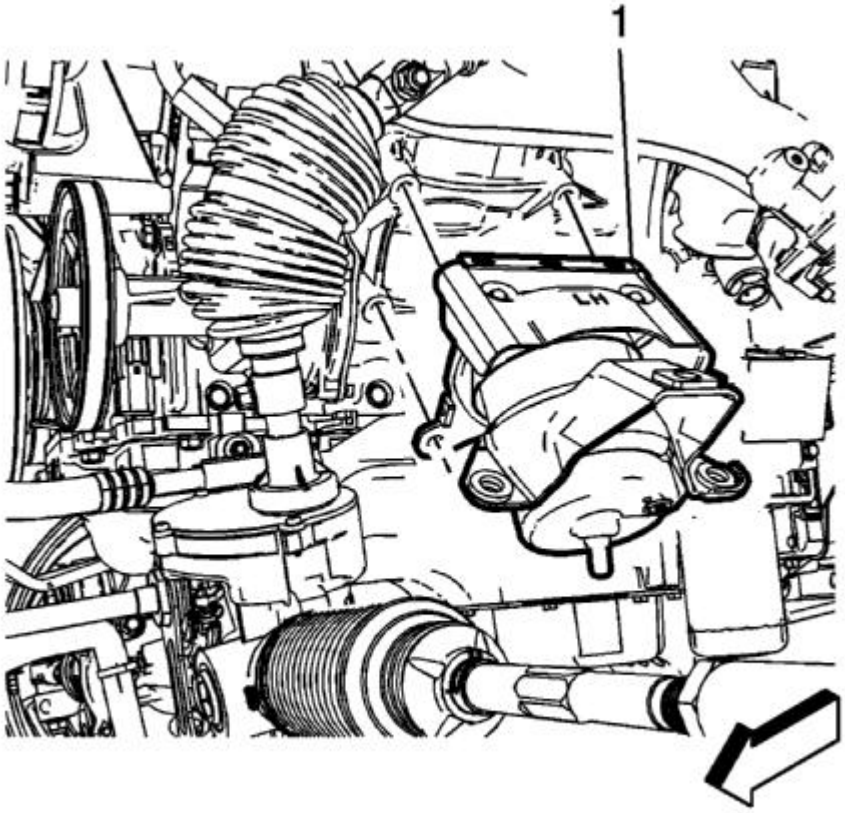


Fig. 19: Engine Mount
Courtesy of GENERAL MOTORS COMPANY

10. Remove the engine mount (1) toward the front of the vehicle.

Installation Procedure

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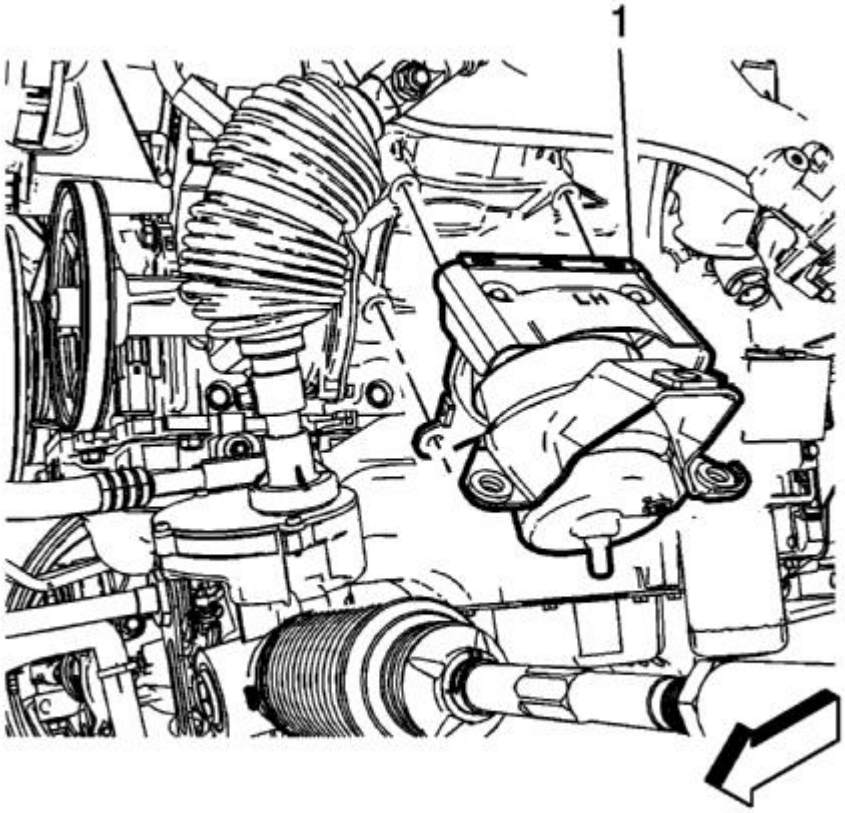


Fig. 20: Engine Mount
Courtesy of GENERAL MOTORS COMPANY

1. Position the engine mount (1) to the engine block.

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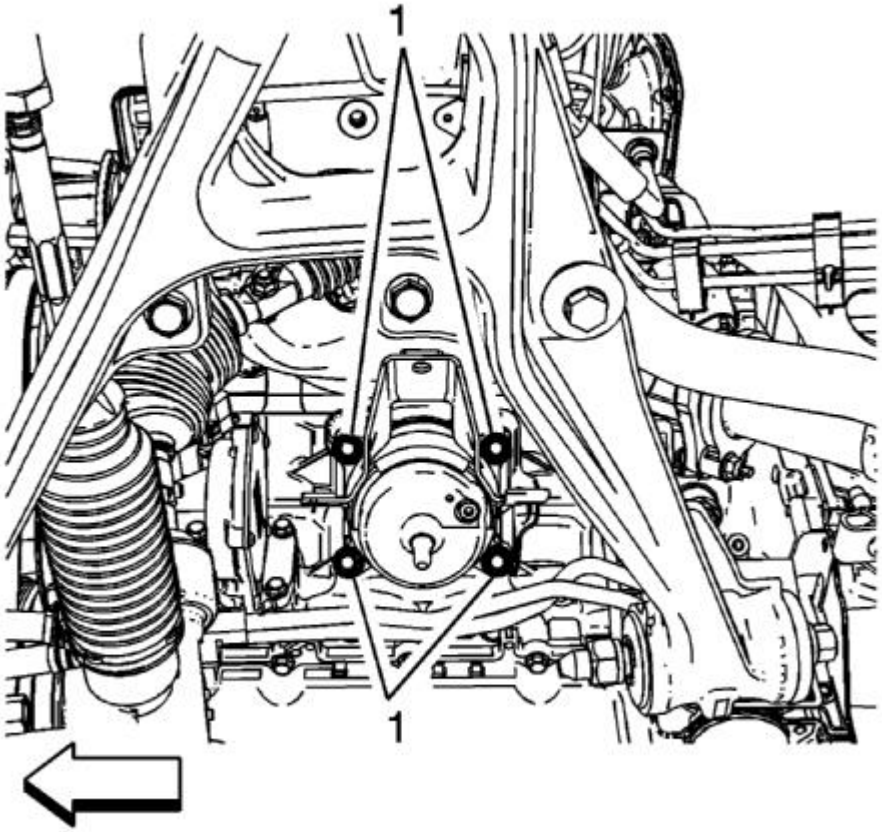


Fig. 21: Engine Mount To Engine Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Clean the threads of the engine mount to frame bolts (1) using denatured alcohol or equivalent.
3. Apply threadlocker or equivalent to the threads of the engine mount to engine mount bracket bolts. Refer to .
4. Install the engine mount to frame bolts and tighten to 65 (48 lb ft).
5. Using the adjustable jack, lower the engine until the engine mount is sitting flush on the frame.
6. Remove the adjustable jack and block of wood from the engine oil pan.

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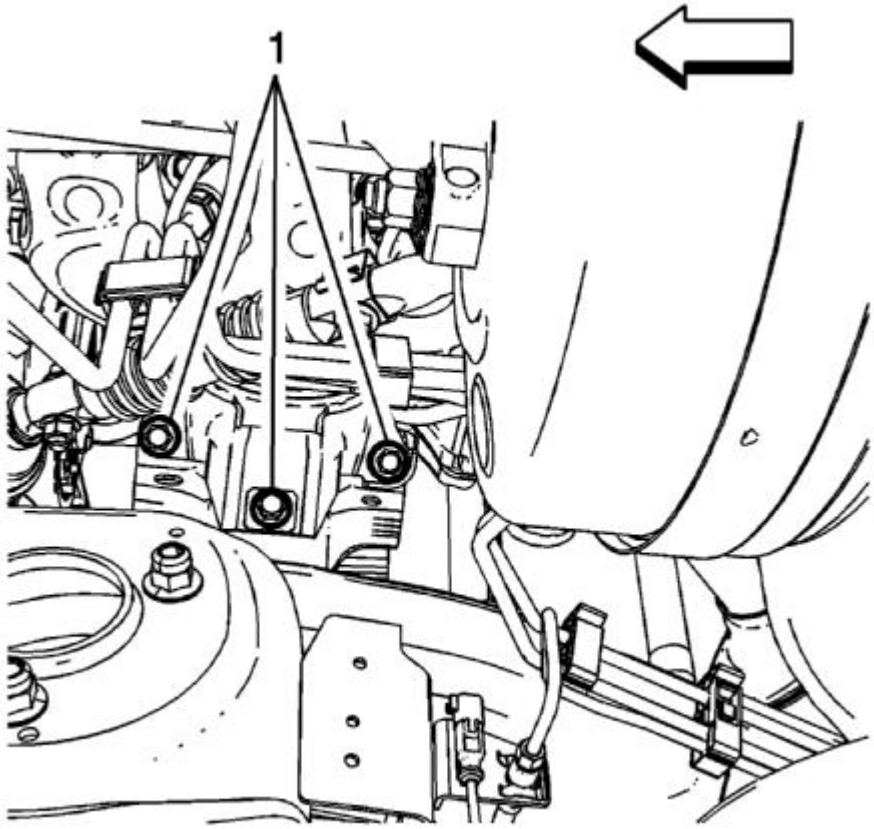


Fig. 22: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Clean the threads of the engine mount to frame bolts (1) using denatured alcohol or equivalent.
8. Apply threadlocker or equivalent to the threads of the engine mount to engine mount bracket bolts. Refer to .
9. Install the engine mount to frame bolts and tighten to 71 (52 lb ft).
10. Install the drivetrain and front suspension frame front crossmember. Refer to **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Light Duty)** , **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Heavy Duty)** .
11. Install exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LV1, LV3)** .
12. Install the vacuum pump. Refer to **Vacuum Pump Replacement** .
13. Install the left wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement - Left Side (Chevrolet)** , **Front Wheelhouse Liner Replacement - Left Side (GMC)** .
14. Lower the vehicle.
15. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
16. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (L83, L86, LV1, LV3)** .

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ENGINE MOUNT REPLACEMENT - RIGHT SIDE

Removal Procedure

CAUTION: When raising or supporting the engine for any reason, do not use a jack under any sheet metal or the crankshaft pulley or damage may occur.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (L83, L86, LV1, LV3)** , **Battery Negative Cable Disconnection and Connection (K4B)** .
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
3. Remove the drivetrain and front suspension frame front crossmember. Refer to **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Light Duty)** , **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Heavy Duty)** .
4. Remove the right wheelhouse liner. Refer to **Rear Wheelhouse Liner Replacement (Chevrolet)** , **Rear Wheelhouse Liner Replacement (GMC)** .

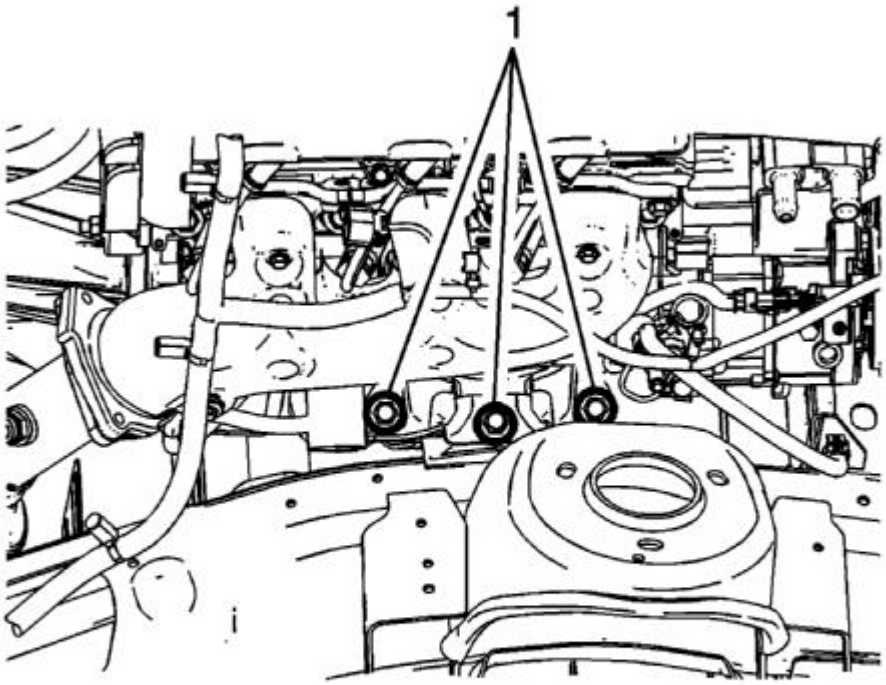


Fig. 23: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the engine mount to frame bolts (1).

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6. Remove exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LV1, LV3)** .
7. Position a screw jack and a block of wood under the lower engine oil pan.

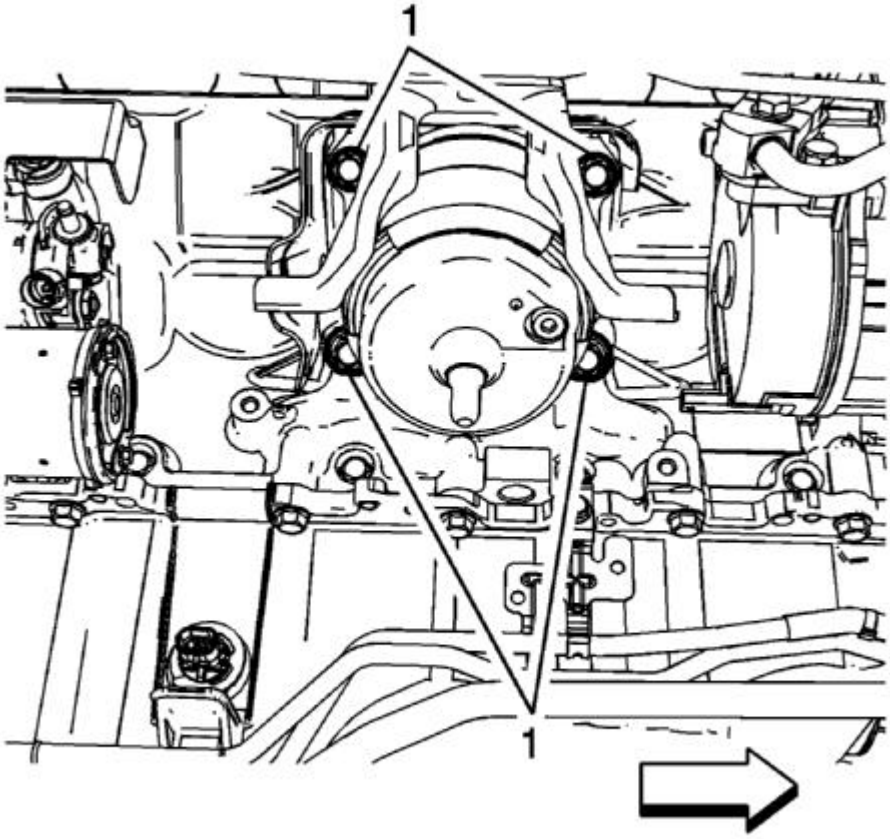


Fig. 24: Engine Mount To Engine Block Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Working through the wheelhouse opening, remove the engine mount to engine block bolts (1).

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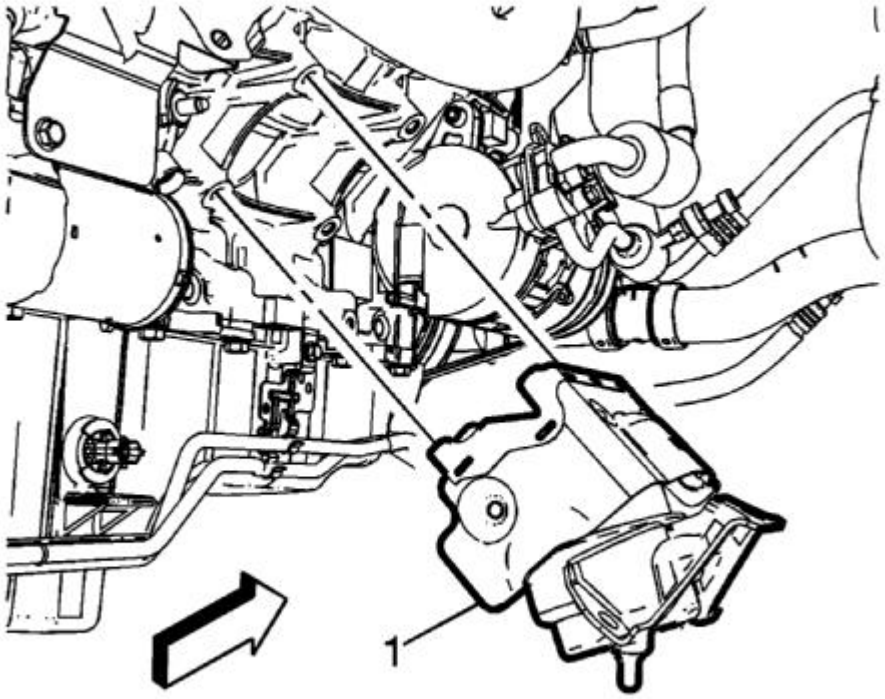


Fig. 25: Engine Mount
Courtesy of GENERAL MOTORS COMPANY

9. Remove the engine mount toward the front of the vehicle.

Installation Procedure

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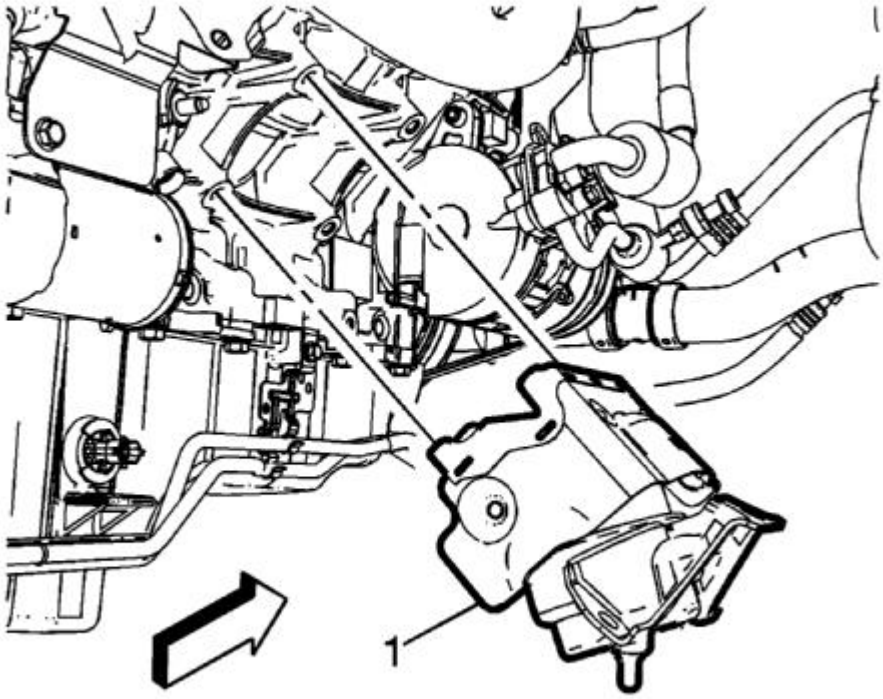


Fig. 26: Engine Mount
Courtesy of GENERAL MOTORS COMPANY

1. Position the engine mount to the engine block.

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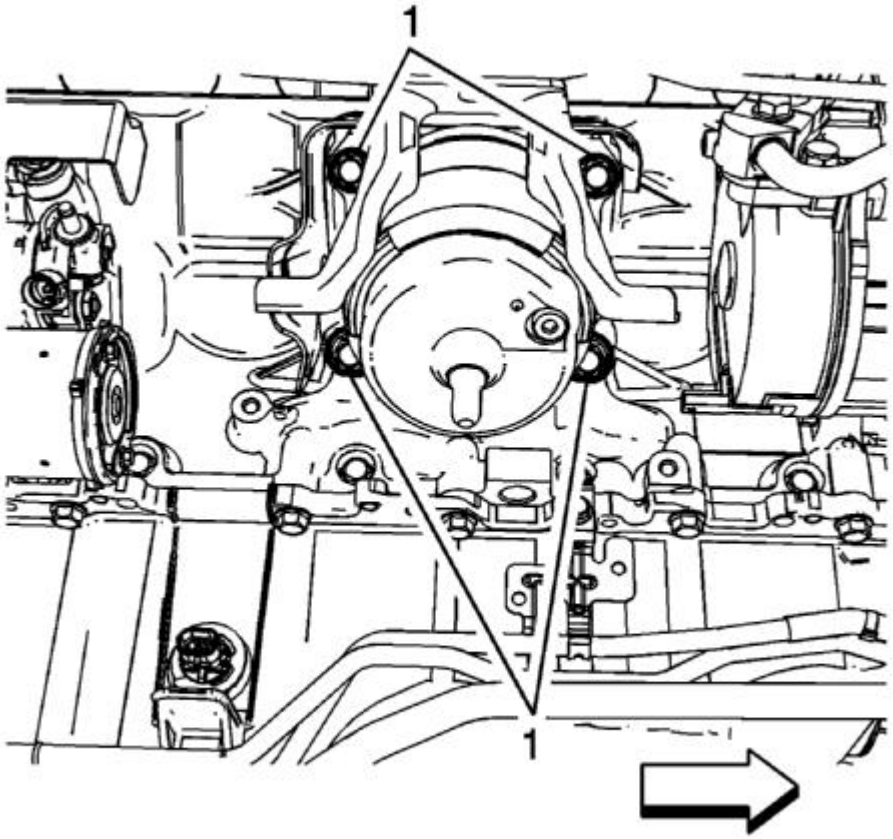


Fig. 27: Engine Mount To Engine Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Clean the threads of the engine mount to frame bolts (1) using denatured alcohol or equivalent.
3. Apply threadlocker or equivalent to the threads of the engine mount to engine mount bracket bolts. Refer to .
4. Install the engine mount to frame bolts (1) and tighten to 65 (48 lb ft).
5. Using the adjustable jack, lower the engine until the engine mount is sitting flush on the frame.
6. Remove the adjustable jack and block of wood from the engine oil pan.

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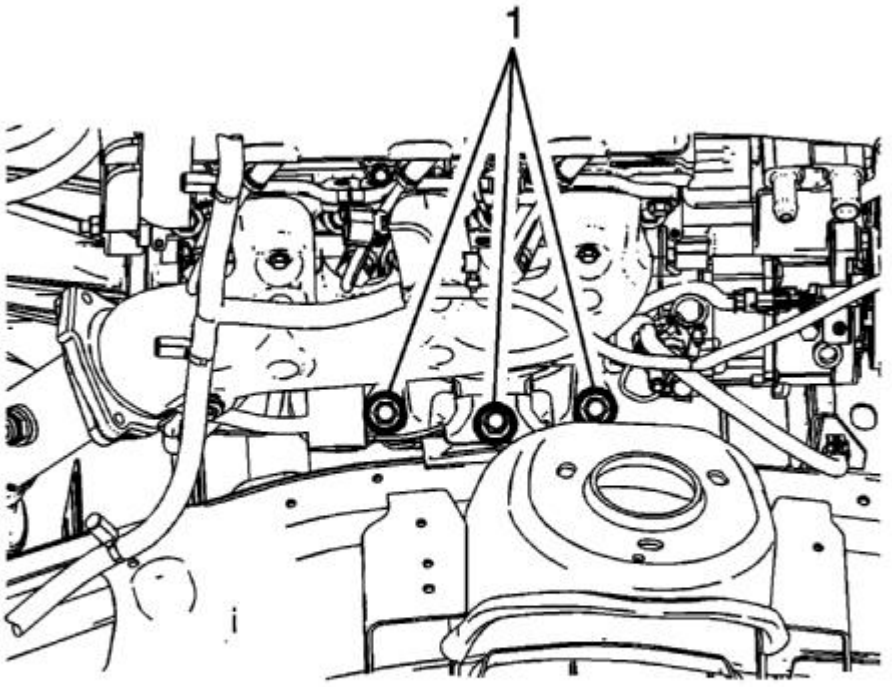


Fig. 28: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Clean the threads of the engine mount to frame bolts (1) using denatured alcohol or equivalent.
8. Apply threadlocker or equivalent to the threads of the engine mount to engine mount bracket bolts. Refer to .
9. Install the engine mount to frame bolts (1) and tighten to 71 (52 lb ft).
10. Install the drivetrain and front suspension frame front crossmember. Refer to **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Light Duty)** , **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Heavy Duty)** .
11. Install exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LV1, LV3)** .
12. Install the right wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement - Left Side (Chevrolet)** , **Front Wheelhouse Liner Replacement - Left Side (GMC)** .
13. Lower the vehicle.
14. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
15. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (L83, L86, LV1, LV3)** .

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (RIGHT SIDE /

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BANK 2)

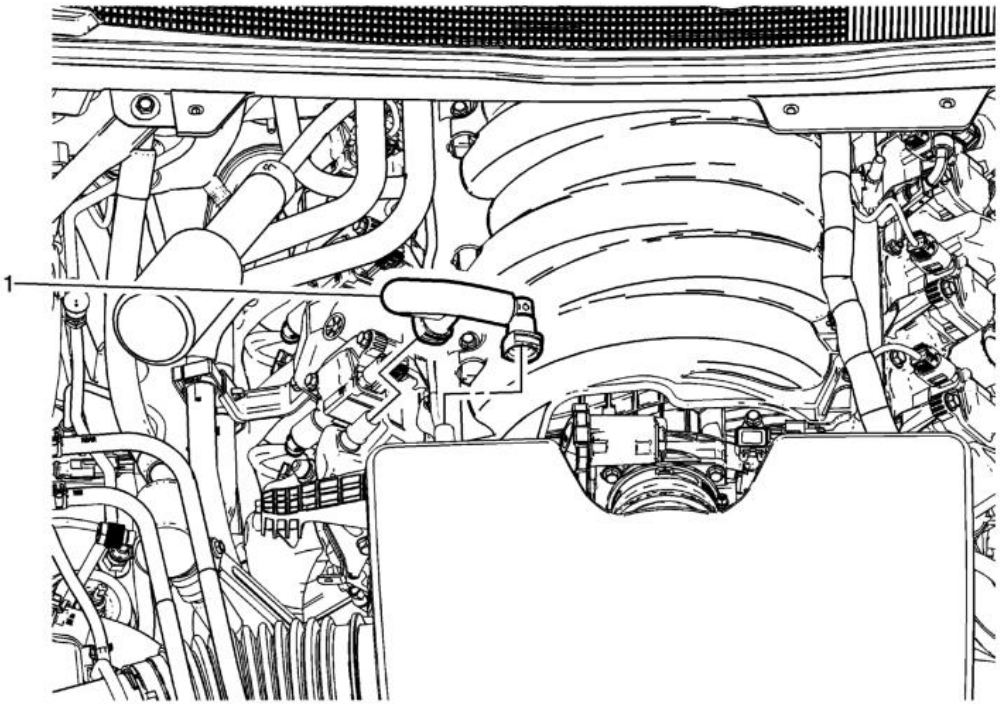


Fig. 29: Positive Crankcase Ventilation Hose/Pipe/Tube (Right Side / Bank 2)
Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)

Callout	Component Name
1	Positive Crankcase Ventilation Tube **Procedure** Disconnect the pcv tube from valve cover and air cleaner outlet tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT (LEFT SIDE / BANK 1)

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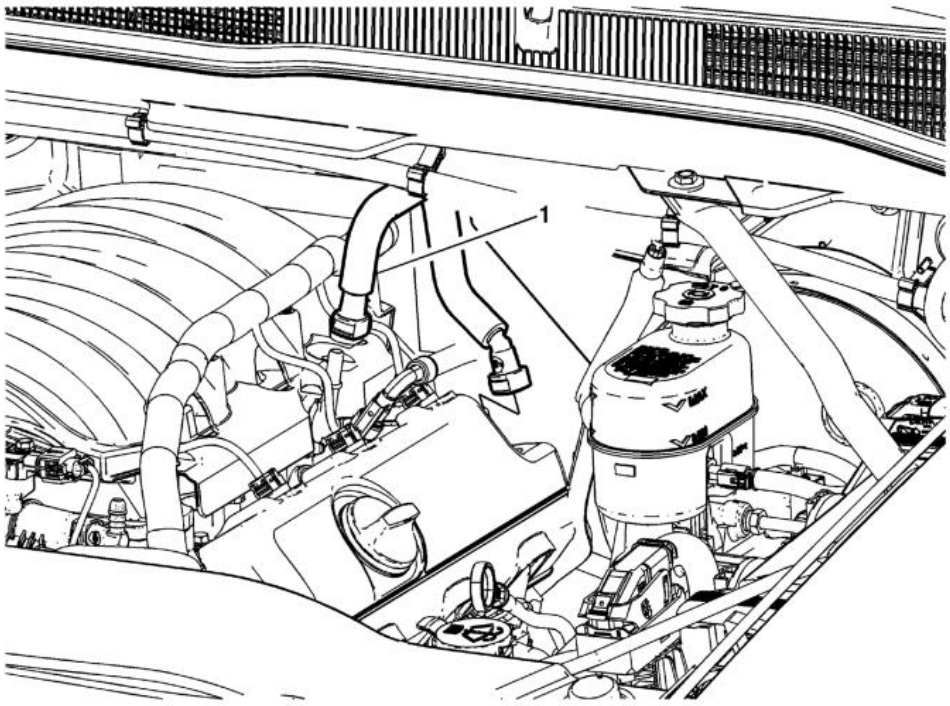


Fig. 30: Positive Crankcase Ventilation Hose/Pipe/Tube (Left Side / Bank 1)
Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)

Callout	Component Name
1	Positive Crankcase Ventilation Tube **Procedure** Disconnect the PCV tube from the intake manifold and valve cover. Refer to **Plastic Collar Quick Connect Fitting Service** .

POSITIVE CRANKCASE VENTILATION VALVE REPLACEMENT

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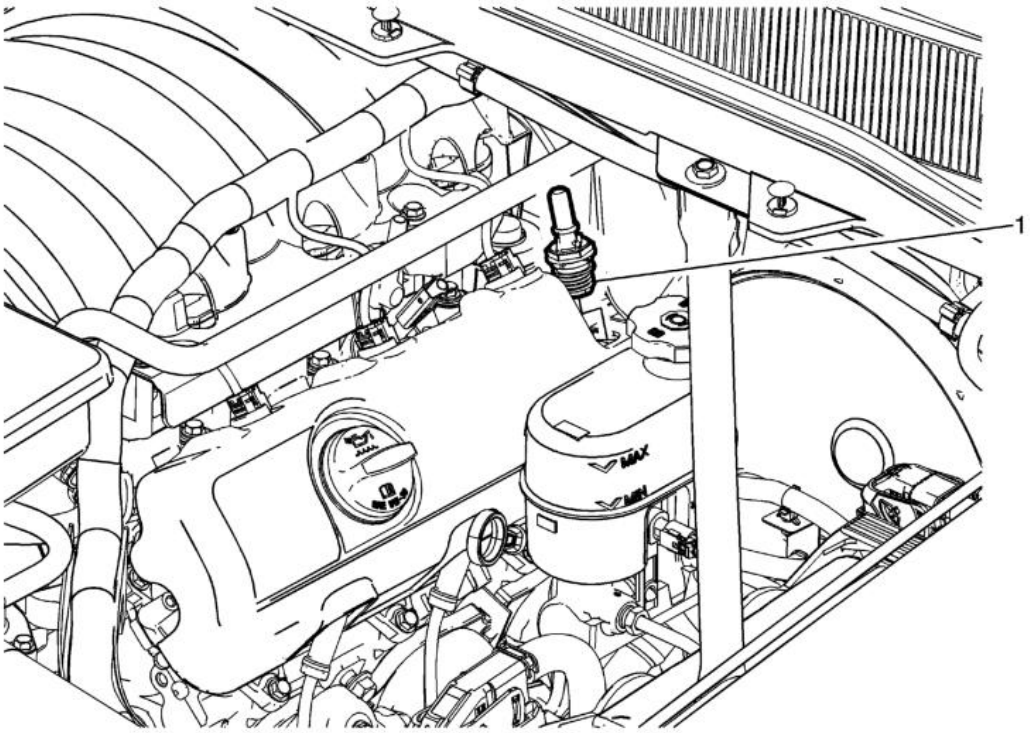


Fig. 31: Positive Crankcase Ventilation Valve
Courtesy of GENERAL MOTORS COMPANY

Positive Crankcase Ventilation Valve Replacement

Callout	Component Name
Preliminary Procedure Remove the left side PCV Hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.	
1	Positive Crankcase Ventilation Valve **CAUTION:** **Refer to Component Fastener Tightening Caution .** **Procedure** Reposition the fuel feed pipe as necessary. **Tighten** 6 (53 lb in)

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

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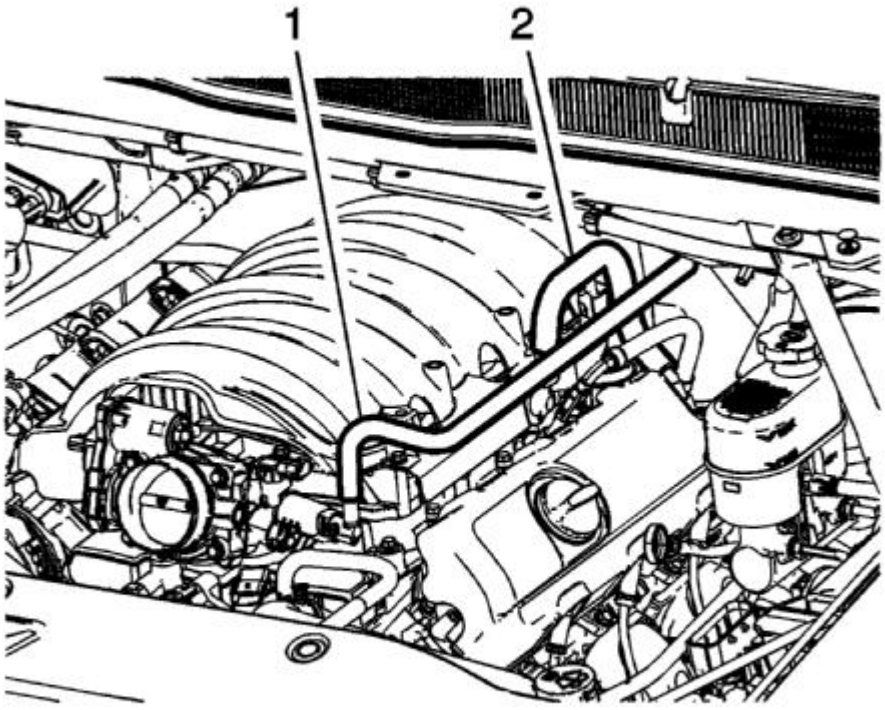


Fig. 32: EVAP Hose
Courtesy of GENERAL MOTORS COMPANY

2. Remove the EVAP hose (1). Refer to **Plastic Collar Quick Connect Fitting Service** .
3. Remove the PCV hose (2). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.
4. Disconnect electrical connectors as necessary.

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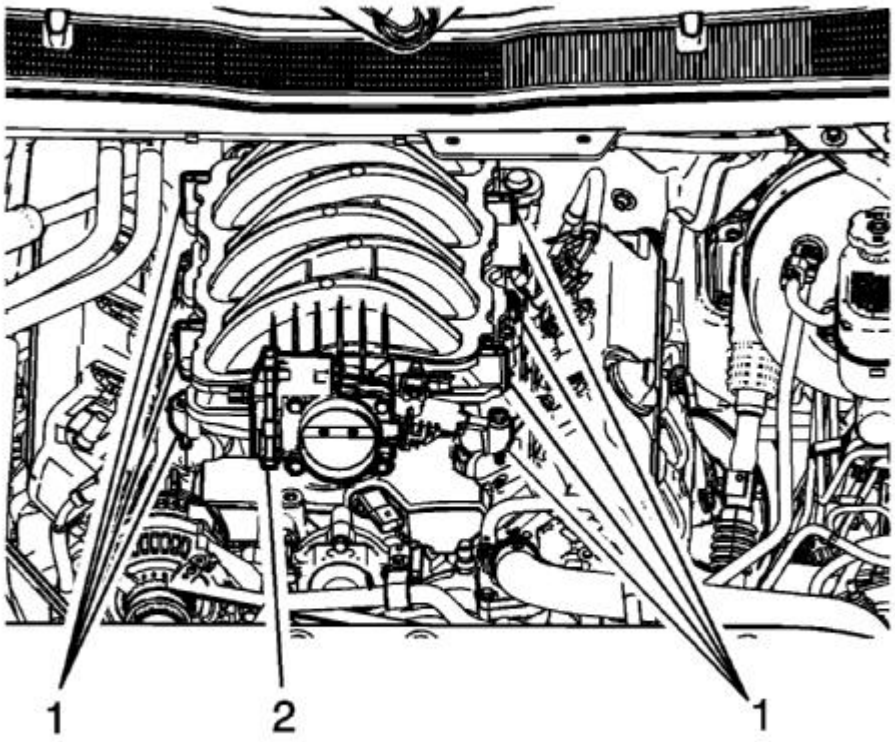


Fig. 33: Intake Manifold Bolts And Intake Manifold
Courtesy of GENERAL MOTORS COMPANY

5. Remove the intake manifold bolts (1) and intake manifold (2).

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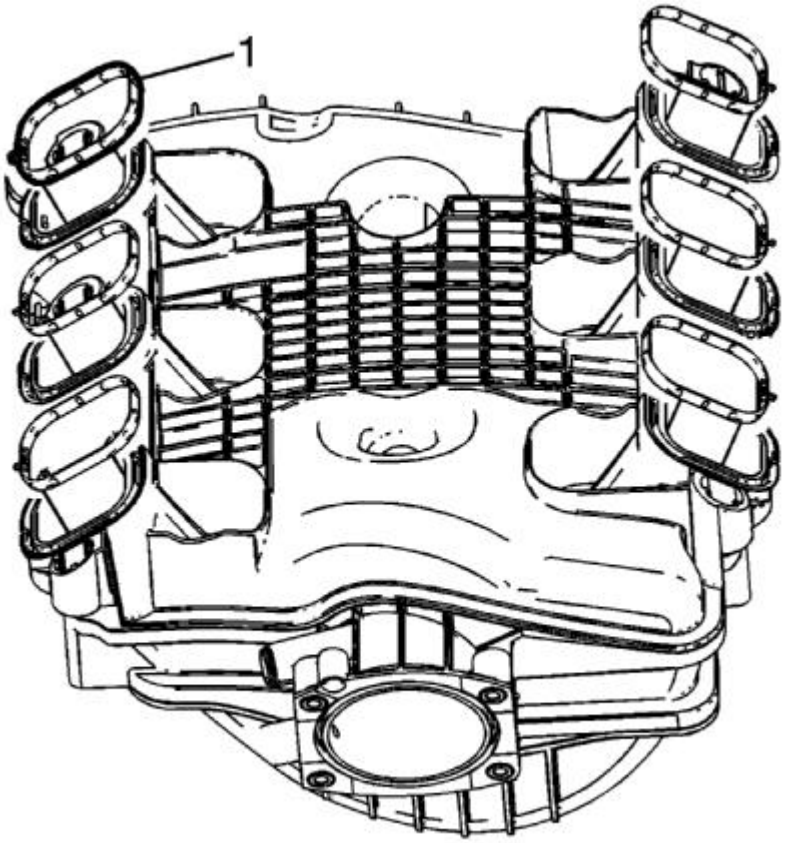


Fig. 34: Old Intake Manifold Gasket
Courtesy of GENERAL MOTORS COMPANY

6. Remove and DISCARD the old intake manifold gasket (1).
7. Transfer part as necessary.
8. For cleaning and inspection. Refer to **Intake Manifold Cleaning and Inspection** .

Installation Procedure

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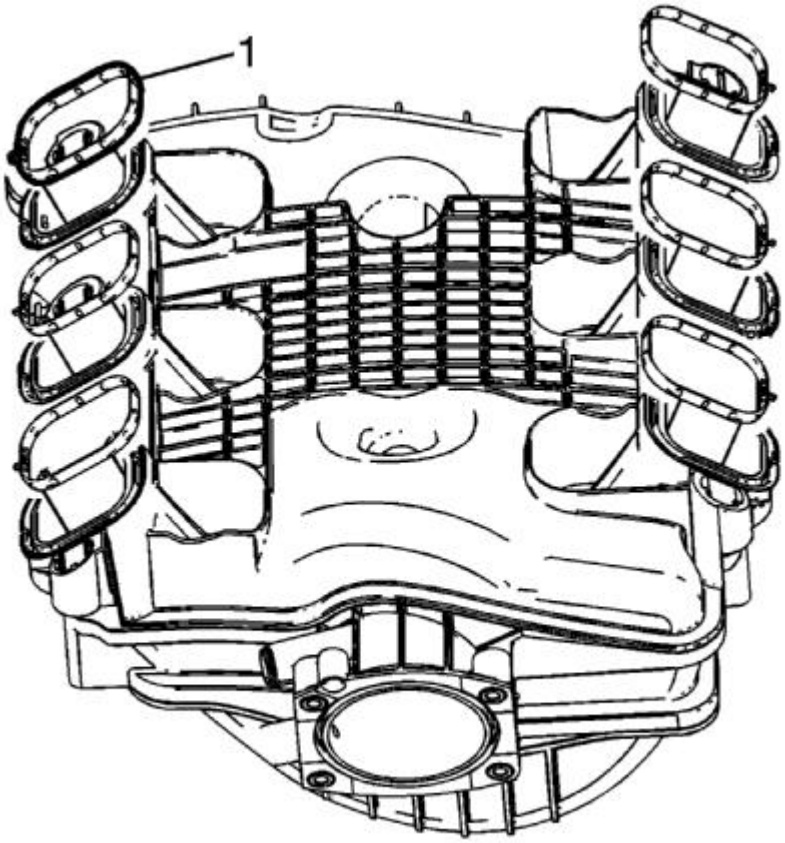


Fig. 35: Old Intake Manifold Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW intake manifold gasket (1).

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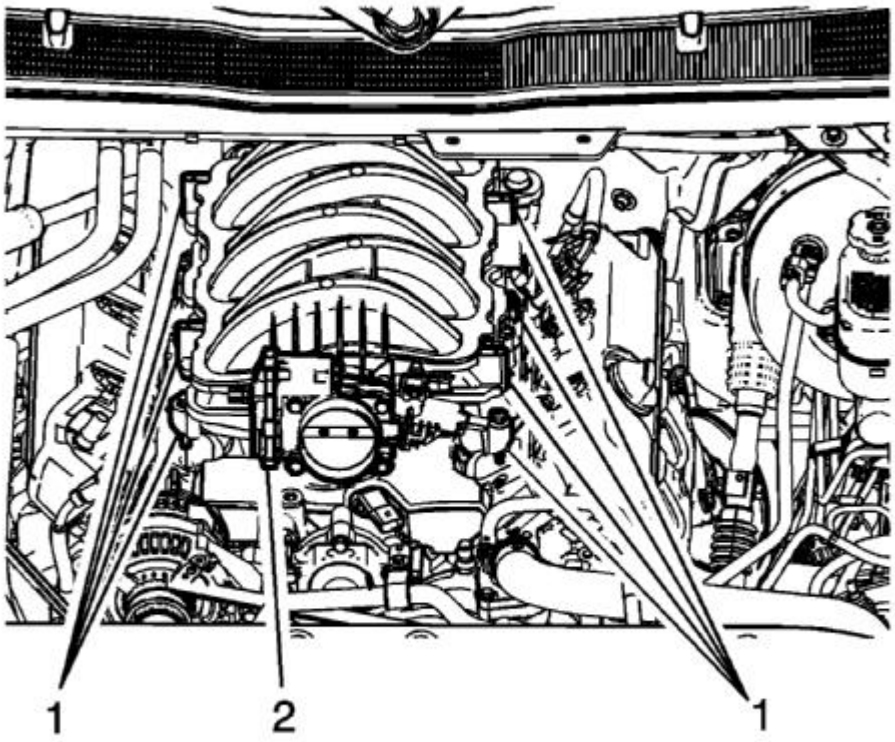


Fig. 36: Intake Manifold Bolts And Intake Manifold
Courtesy of GENERAL MOTORS COMPANY

2. Install the intake manifold (2) and hand tighten the bolts (1).

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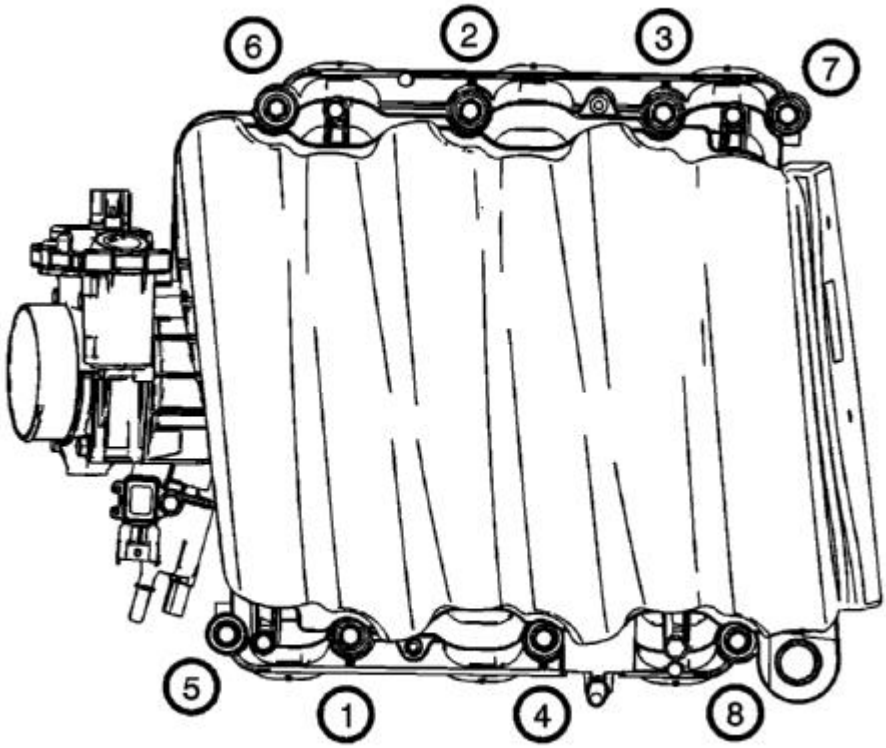


Fig. 37: Tightening Bolts In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Tighten the bolts in sequence as shown 10 (89 lb in).

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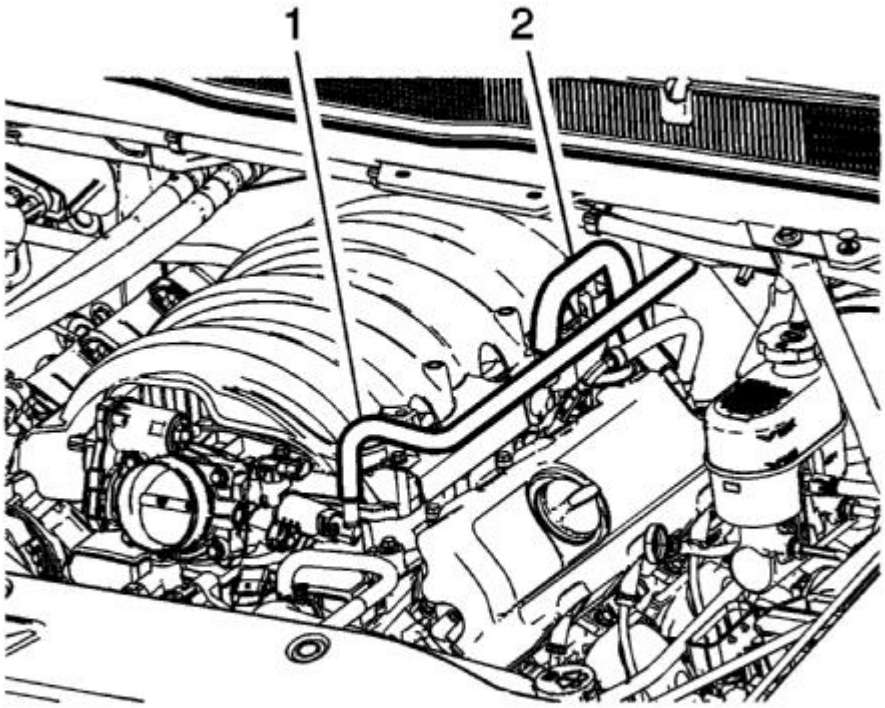


Fig. 38: EVAP Hose
Courtesy of GENERAL MOTORS COMPANY

4. Install the PCV hose (2). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.
5. Connect electrical connectors as necessary.
6. Install the EVAP hose (1). Refer to **Plastic Collar Quick Connect Fitting Service** .
7. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

VALVE LIFTER OIL MANIFOLD REPLACEMENT

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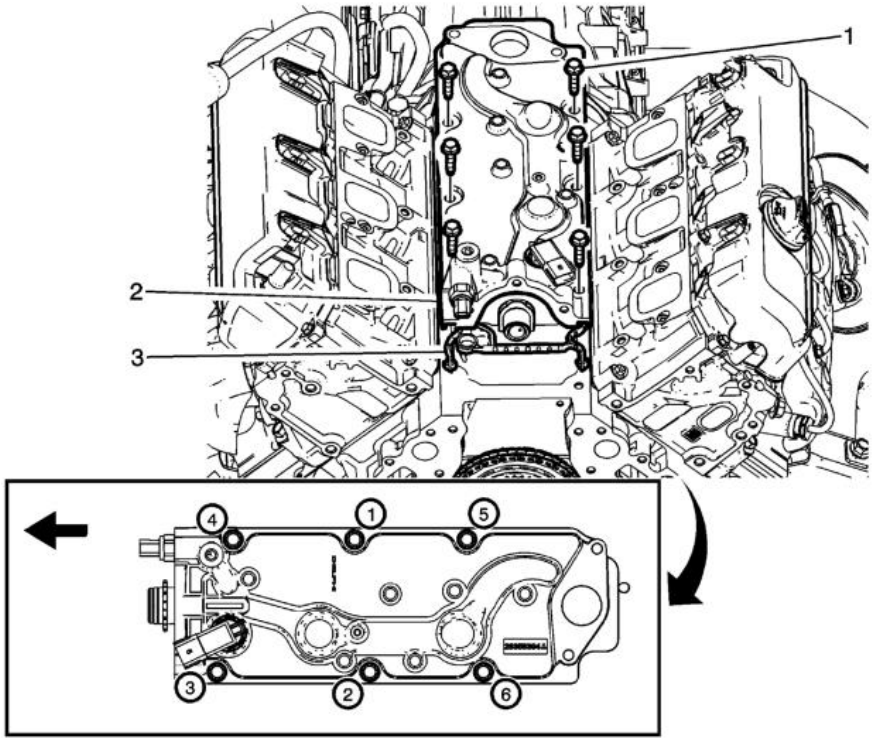


Fig. 39: Valve Lifter Oil Manifold
Courtesy of GENERAL MOTORS COMPANY

Valve Lifter Oil Manifold Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the fuel pump. Refer to **Fuel Pump Replacement** . 2. Remove the fuel injector rail. Refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 1** and **Fuel Injection Fuel Rail Assembly Replacement - Bank 2** . 3. Remove the balance shaft driven sprocket. Refer to **Balancer Shaft Driven Sprocket Replacement**.	
1	Valve Lifter Oil Manifold Fastener (Qty; 6) **CAUTION:** **Refer to Fastener Caution .** **TIghten** 25 (18 lb ft) **Procedure** Follow the tighten sequence above.
2	Valve Lifter Oil Manifold
3	Valve Lifter Oil Manifold Gasket

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VALVE LIFTER OIL FILTER REPLACEMENT

Removal Procedure

1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.

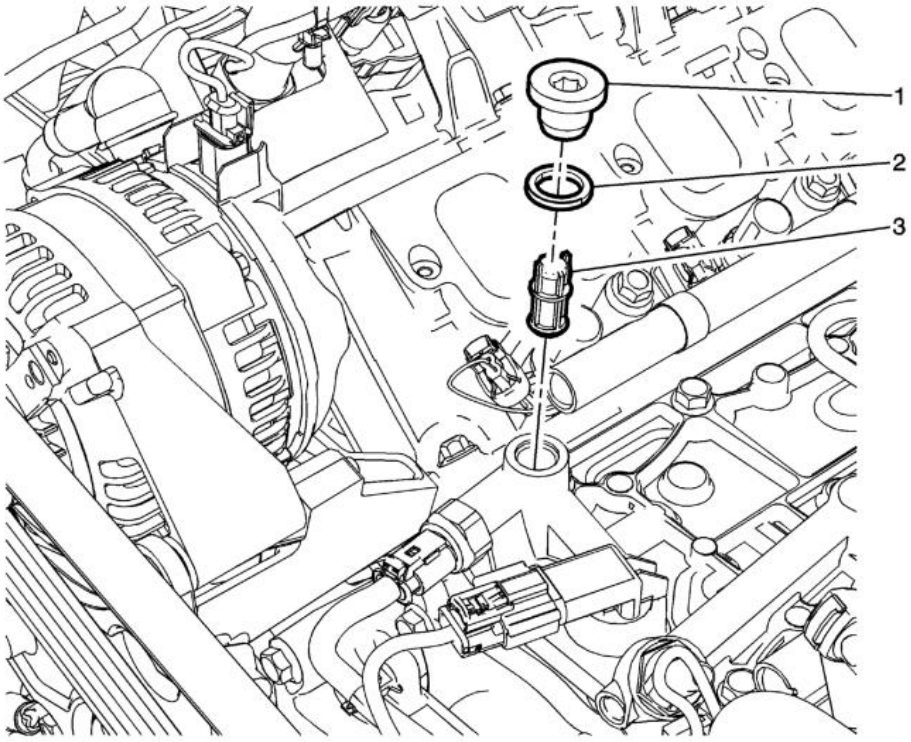


Fig. 40: Drive Motor Oil Filler Hole Plug And Washer
Courtesy of GENERAL MOTORS COMPANY

2. Remove the engine oil filler hole plug (1) and washer (2).
3. Remove and discard the valve lifter oil filter (3).

Installation Procedure

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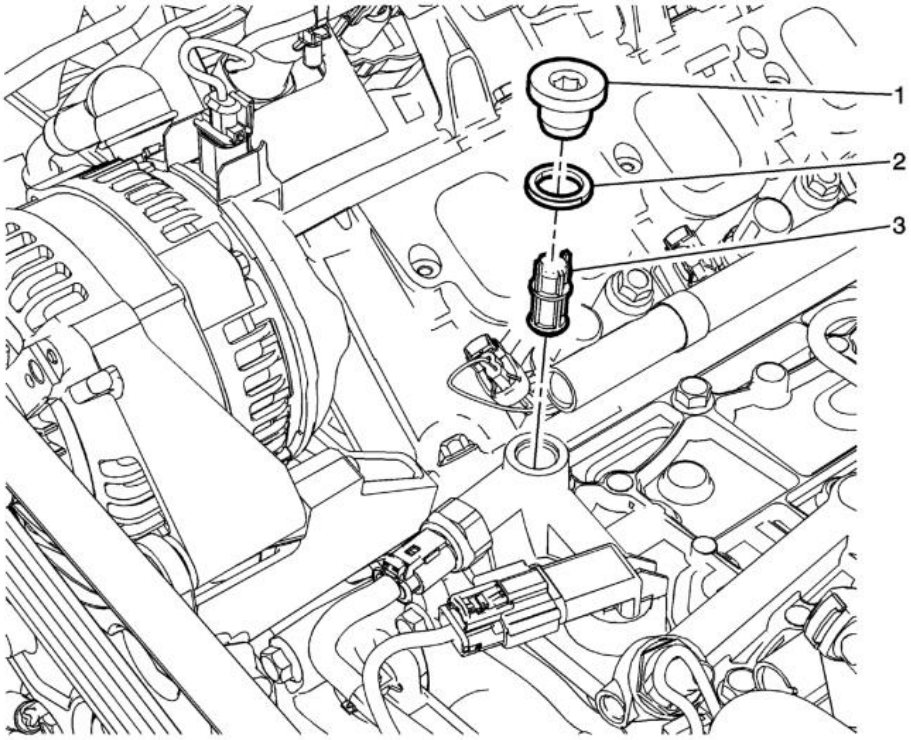


Fig. 41: Drive Motor Oil Filler Hole Plug And Washer
Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW valve lifter oil filter (3).
2. Apply sealant to the threads of the drive motor oil filler hole plug. Refer to **Adhesives, Fluids, Lubricants and Sealers** .

CAUTION: Refer to Component Fastener Tightening Caution .

3. Install the engine oil filler hole plug washer (2) and plug (1) and tighten to 65 (48 lb ft).
4. Install the intake manifold. Refer to **Intake Manifold Replacement**.

VALVE ROCKER ARM COVER INSULATOR REPLACEMENT - LEFT SIDE

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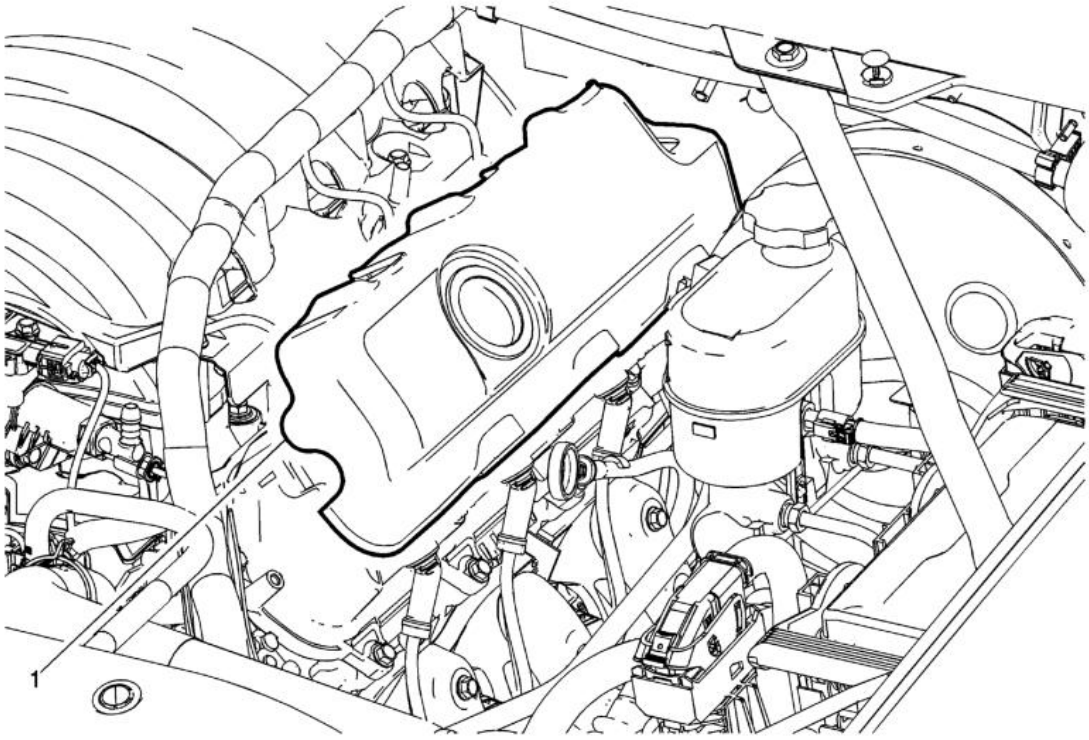


Fig. 42: Valve Rocker Arm Cover Insulator - Left Side
Courtesy of GENERAL MOTORS COMPANY

Valve Rocker Arm Cover Insulator Replacement - Left Side

Callout	Component Name
Preliminary Procedure Remove the left side PCV hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.	
1	Valve Rocker Arm Cover Insulator **Procedure** Remove the oil cap before removing the valve rocker arm cover insulator.

VALVE ROCKER ARM COVER INSULATOR REPLACEMENT - RIGHT SIDE

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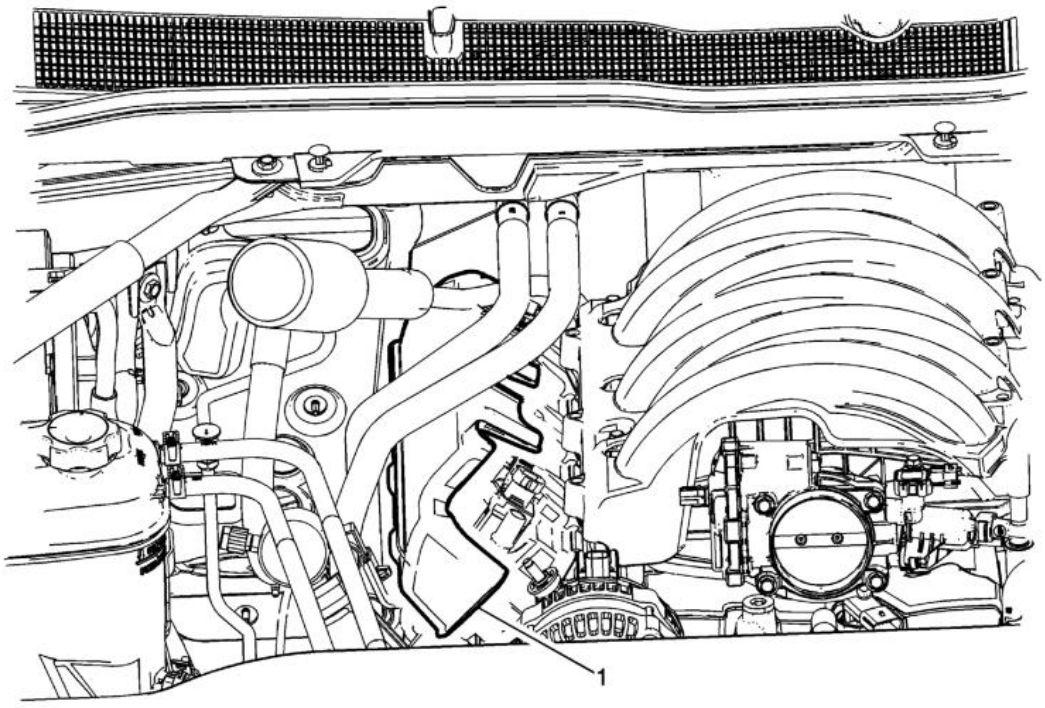


Fig. 43: Valve Rocker Arm Cover Insulator - Right Side
Courtesy of GENERAL MOTORS COMPANY

Valve Rocker Arm Cover Insulator Replacement - Right Side

Callout	Component Name
Preliminary Procedure Remove the right side PCV hose. Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.	
1	Valve Rocker Arm Cover Insulator

VALVE ROCKER ARM COVER REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

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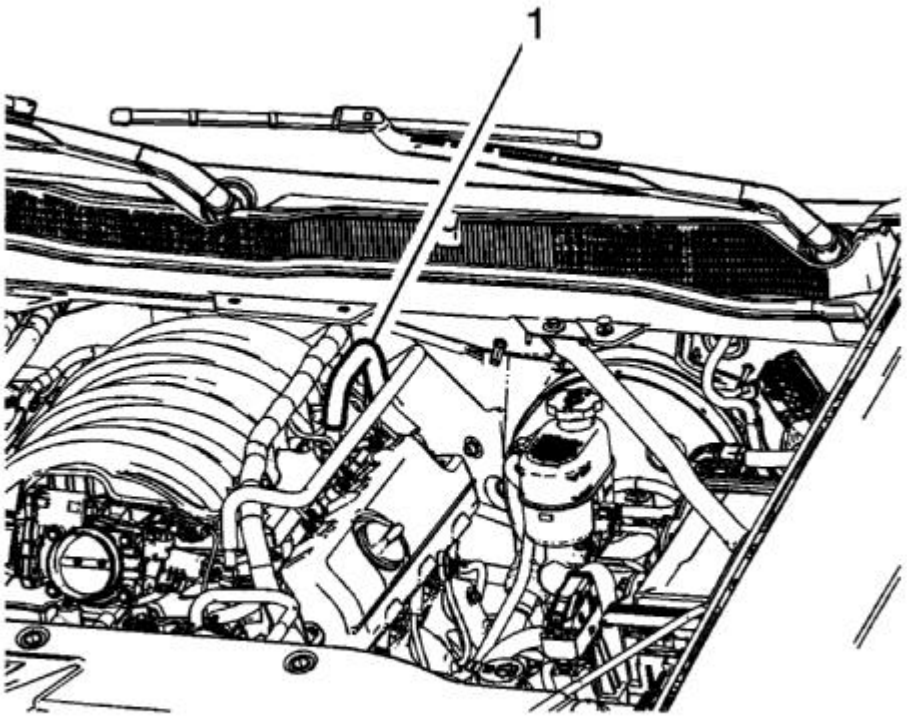


Fig. 44: PCV Tube
Courtesy of GENERAL MOTORS COMPANY

2. Remove the PCV tube (1). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.

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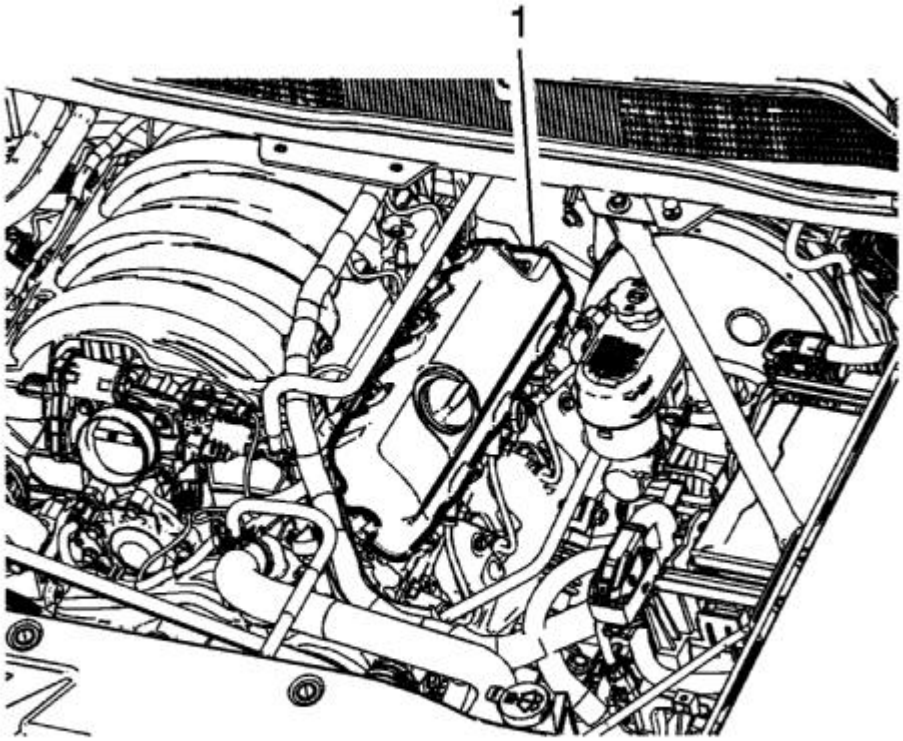


Fig. 45: Valve Rocker Arm Insulator
Courtesy of GENERAL MOTORS COMPANY

3. Remove the valve rocker arm insulator (1). Refer to **Valve Rocker Arm Cover Insulator Replacement - Left Side**.

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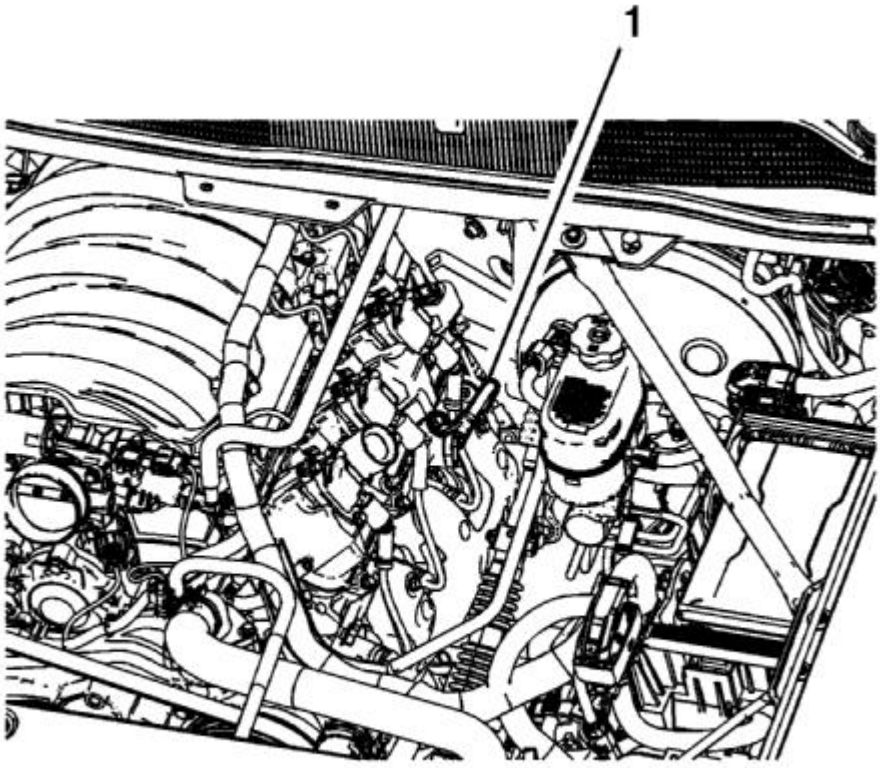


Fig. 46: Oil Indicator Tube
Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil indicator tube (1). Refer to **Oil Level Indicator Tube Replacement**.

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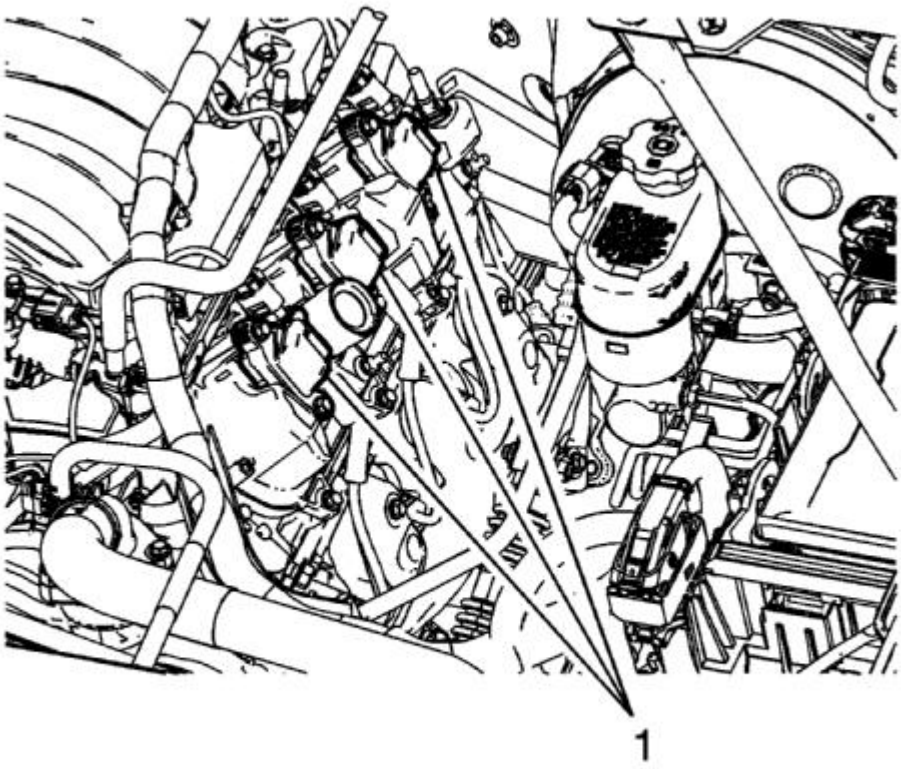


Fig. 47: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

5. Remove the ignition coil (1). Refer to **Ignition Coil Replacement** .

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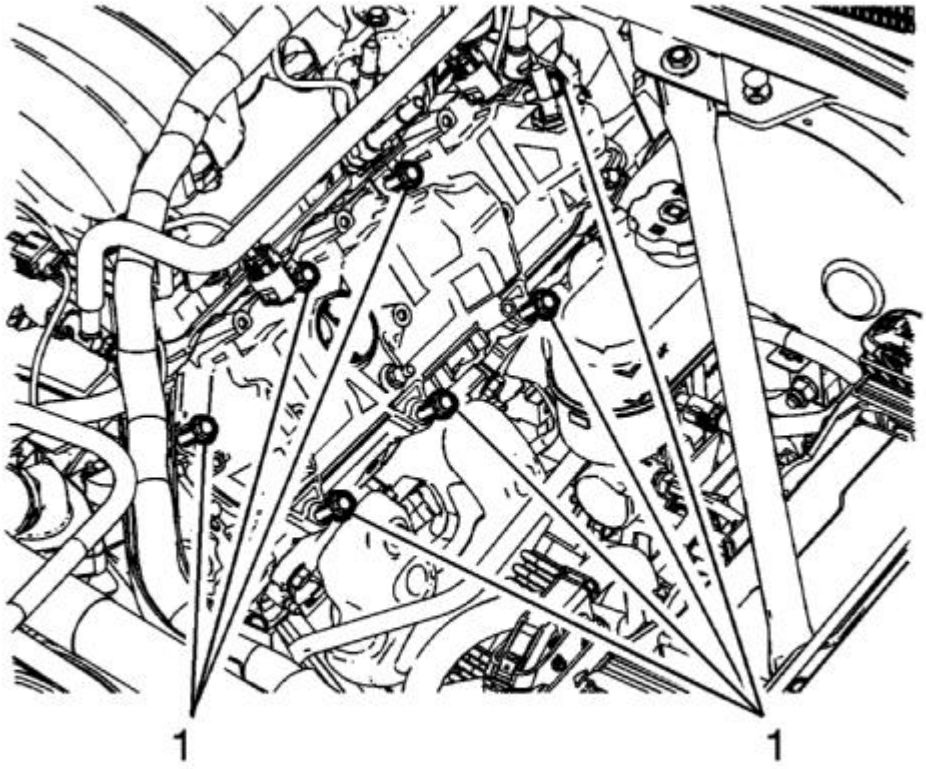


Fig. 48: Valve Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the valve rocker arm cover bolts (1).

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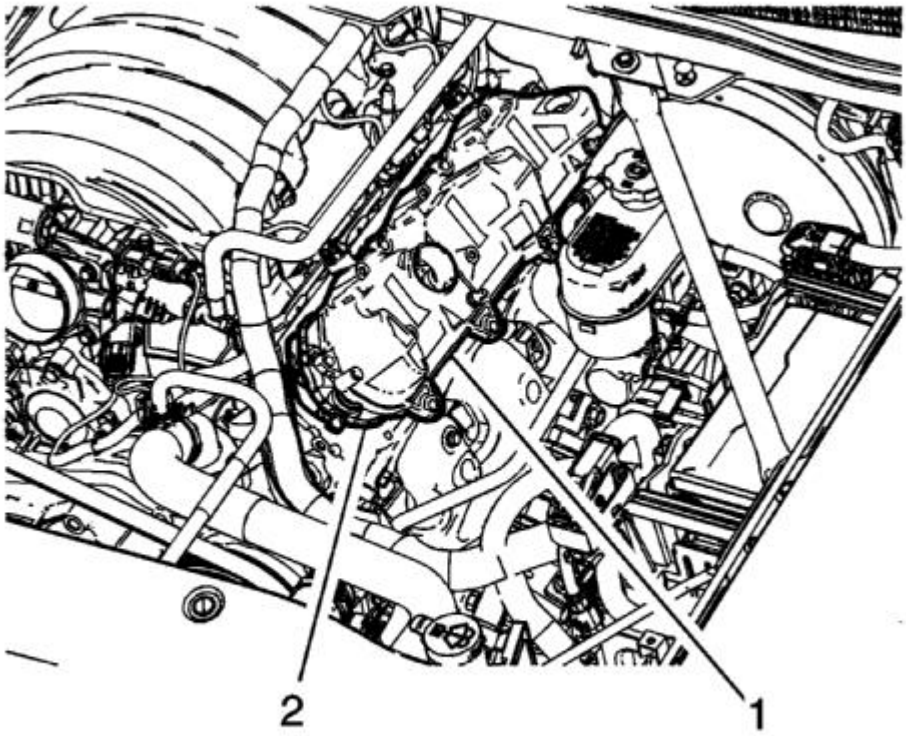


Fig. 49: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS COMPANY

7. Remove the valve rocker arm cover (1).
8. Remove and DISCARD valve rocker arm gasket (2). Refer to **Replacing Engine Gaskets** .
9. Clean and inspect the rocker arm cover. Refer to **Valve Rocker Arm Cover Cleaning and Inspection** .

Installation Procedure

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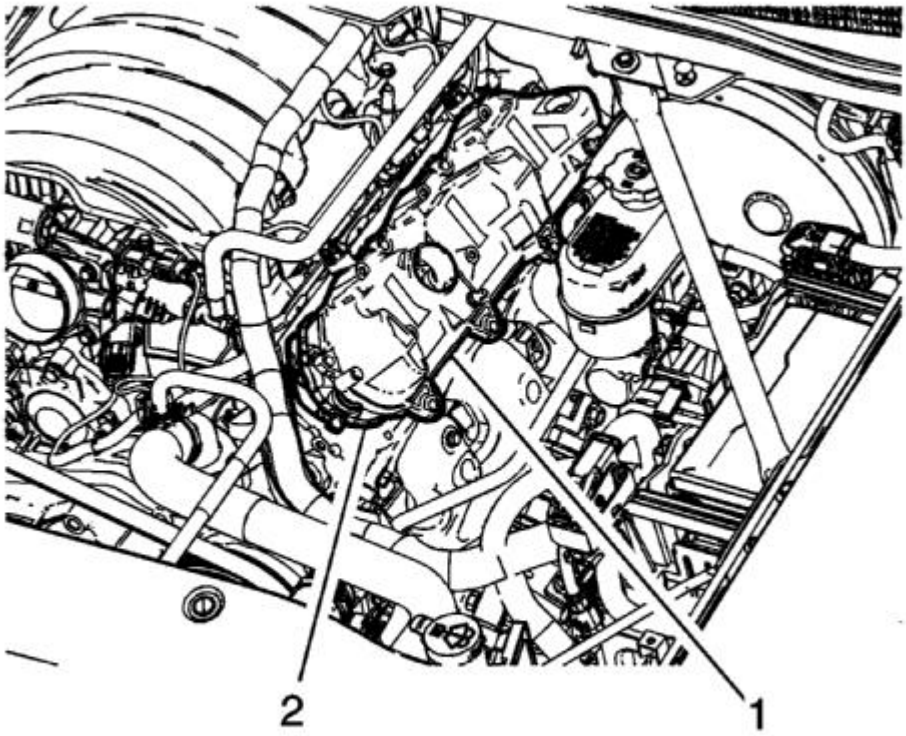


Fig. 50: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW valve rocker arm gasket (2).
2. Install the valve rocker arm cover (1).

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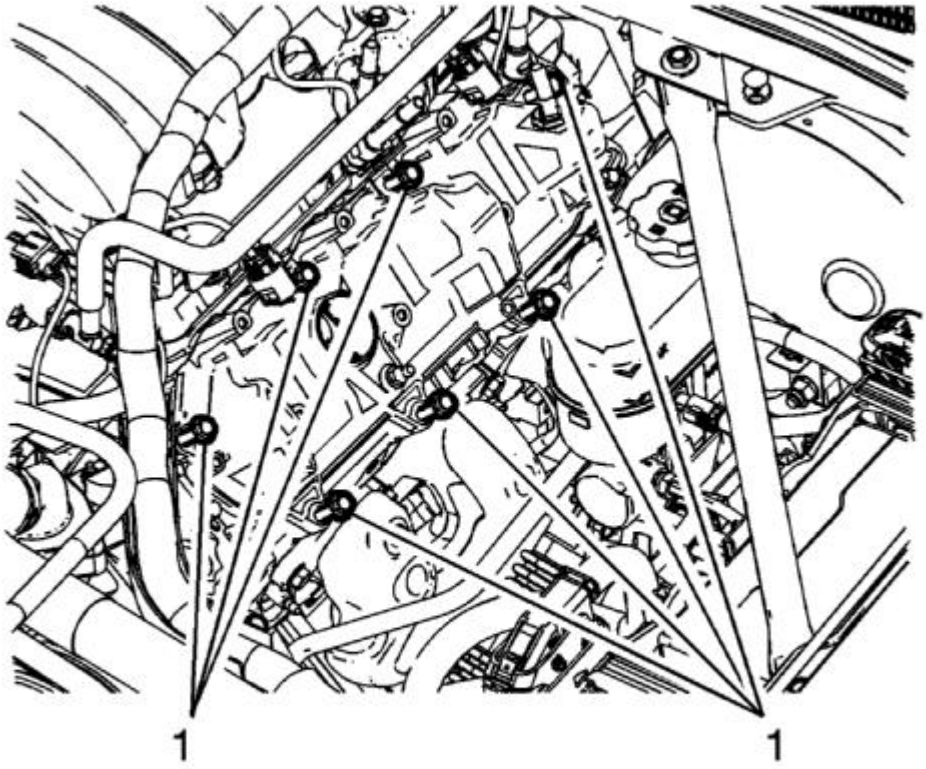


Fig. 51: Valve Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install valve rocker arm cover bolts (1) and hand tighten.

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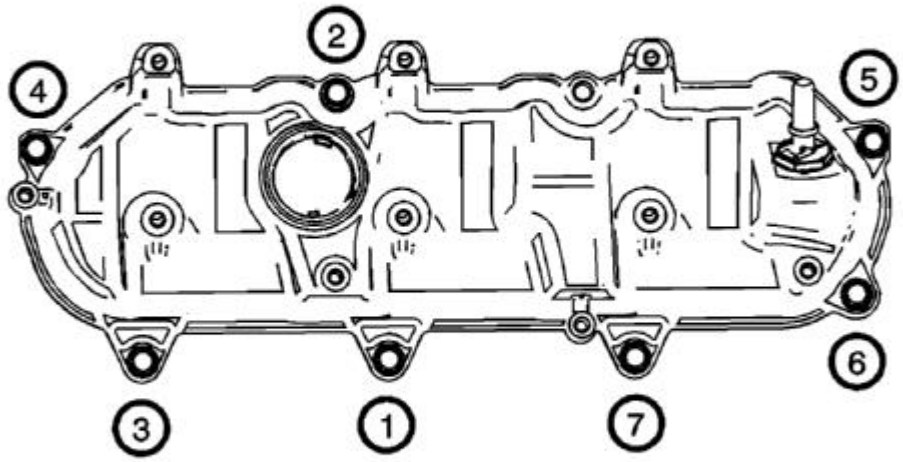


Fig. 52: Tightening Bolts In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Tighten the bolts in sequence to 10 (89 lb in)as shown.

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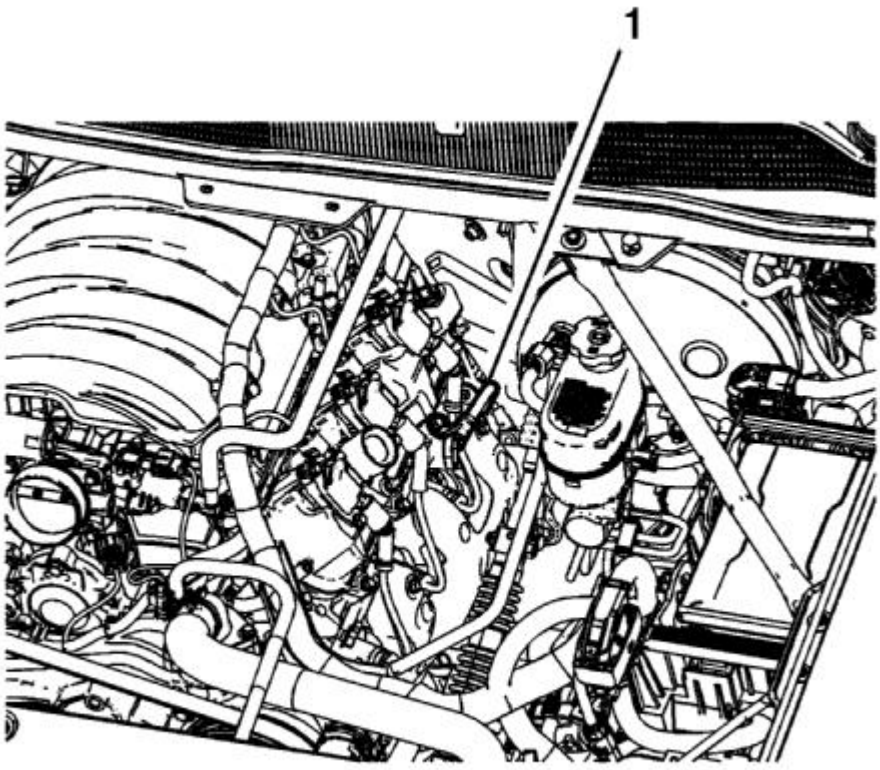


Fig. 53: Oil Indicator Tube
Courtesy of GENERAL MOTORS COMPANY

5. Install the oil indicator tube (1). Refer to **Oil Level Indicator Tube Replacement**.

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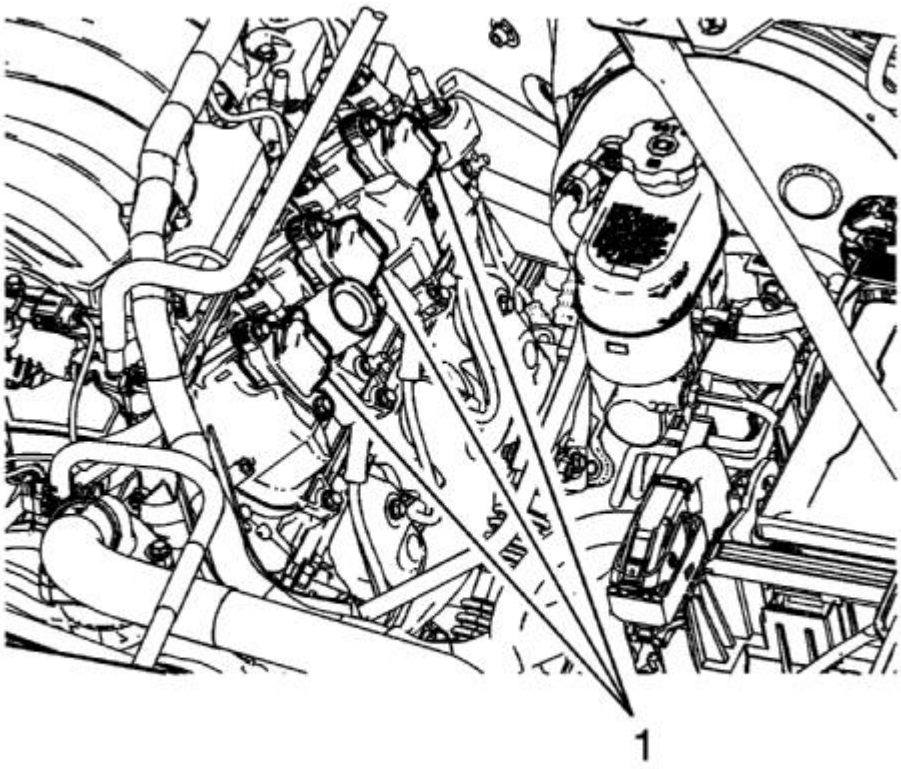


Fig. 54: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

6. Install the ignition coil (1). Refer to **Ignition Coil Replacement** .

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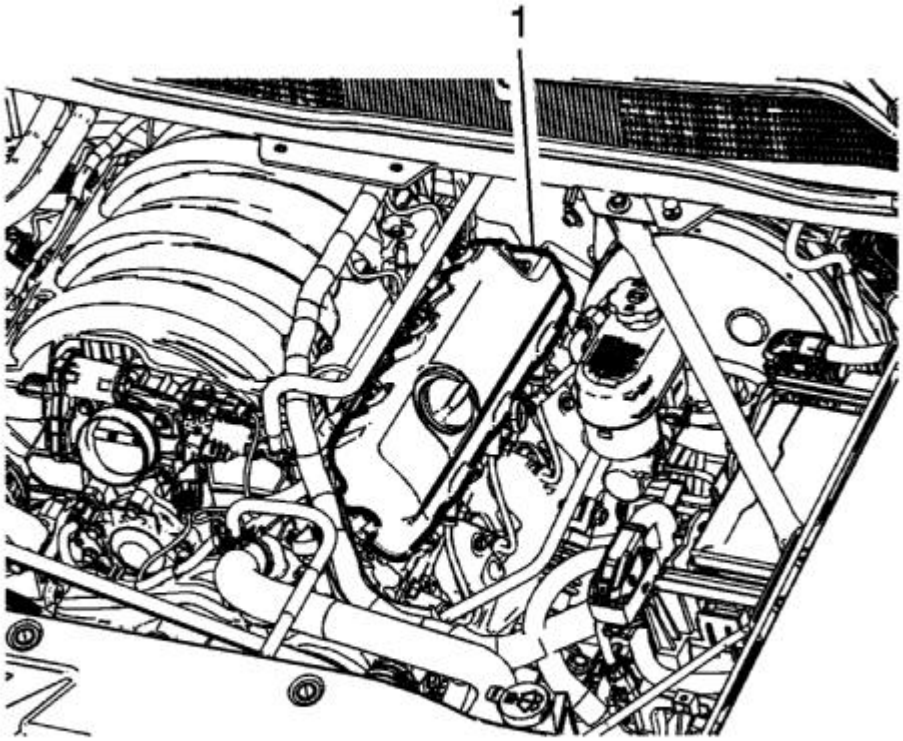


Fig. 55: Valve Rocker Arm Insulator
Courtesy of GENERAL MOTORS COMPANY

7. Install the valve rocker arm insulator (1). Refer to **Valve Rocker Arm Cover Insulator Replacement - Left Side**.

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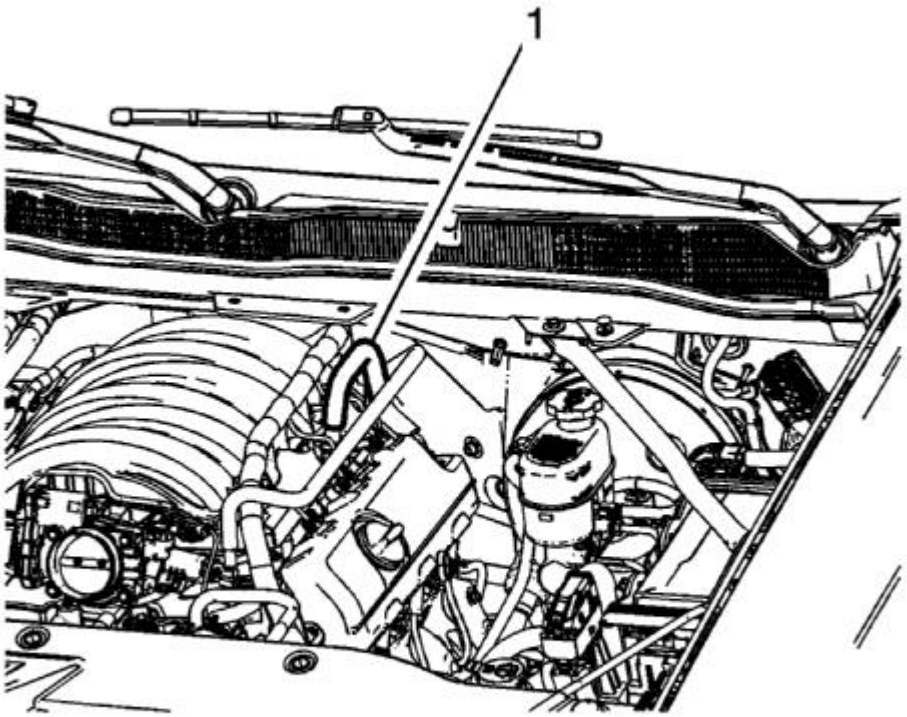


Fig. 56: PCV Tube
Courtesy of GENERAL MOTORS COMPANY

8. Install the PCV tube (1). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.
9. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

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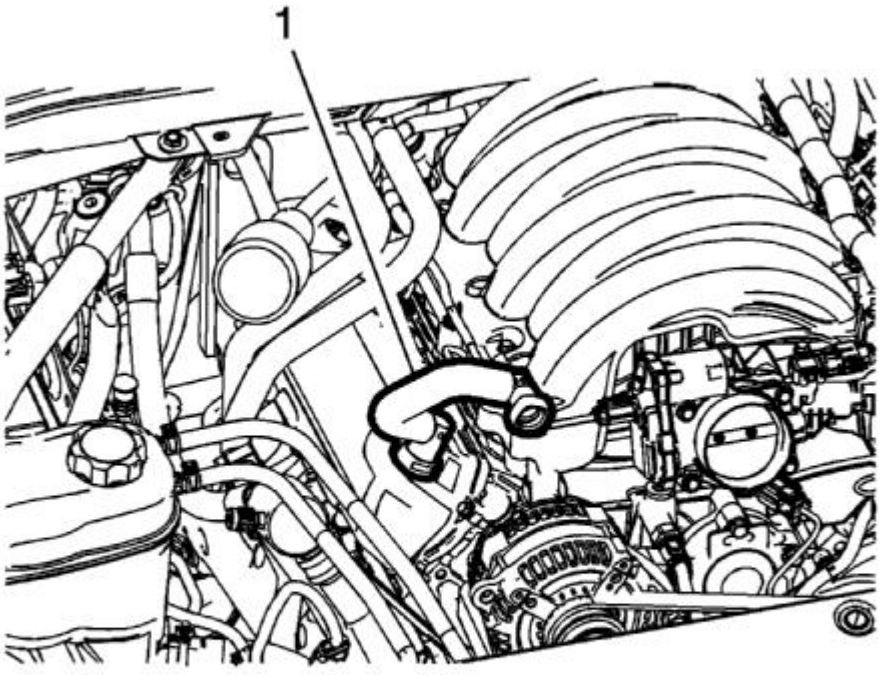


Fig. 57: PCV Tube
Courtesy of GENERAL MOTORS COMPANY

2. Remove the PCV tube (1). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.

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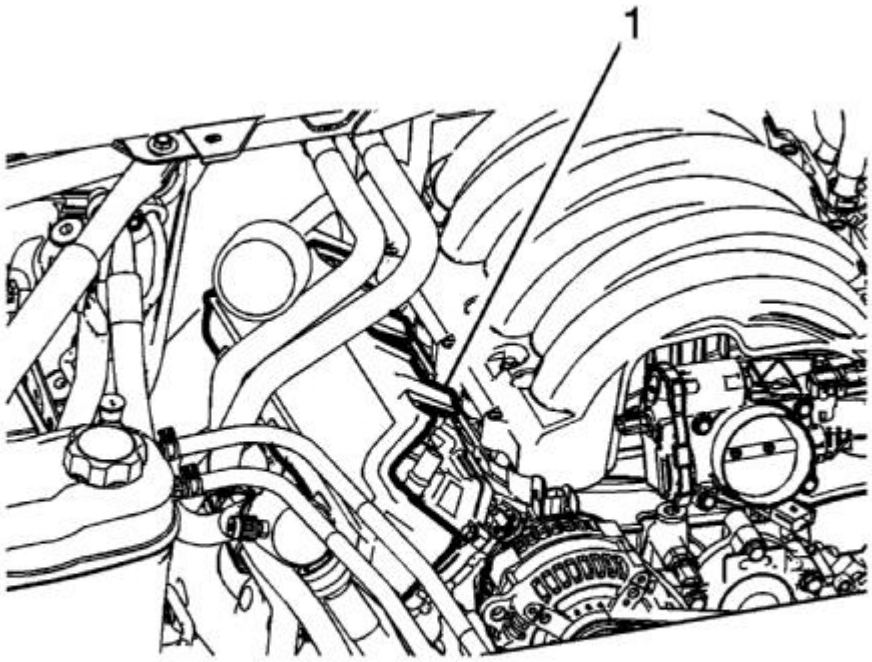


Fig. 58: Valve Rocker Arm Insulator
Courtesy of GENERAL MOTORS COMPANY

3. Remove the valve rocker arm insulator (1). Refer to **Valve Rocker Arm Cover Insulator Replacement - Right Side**.

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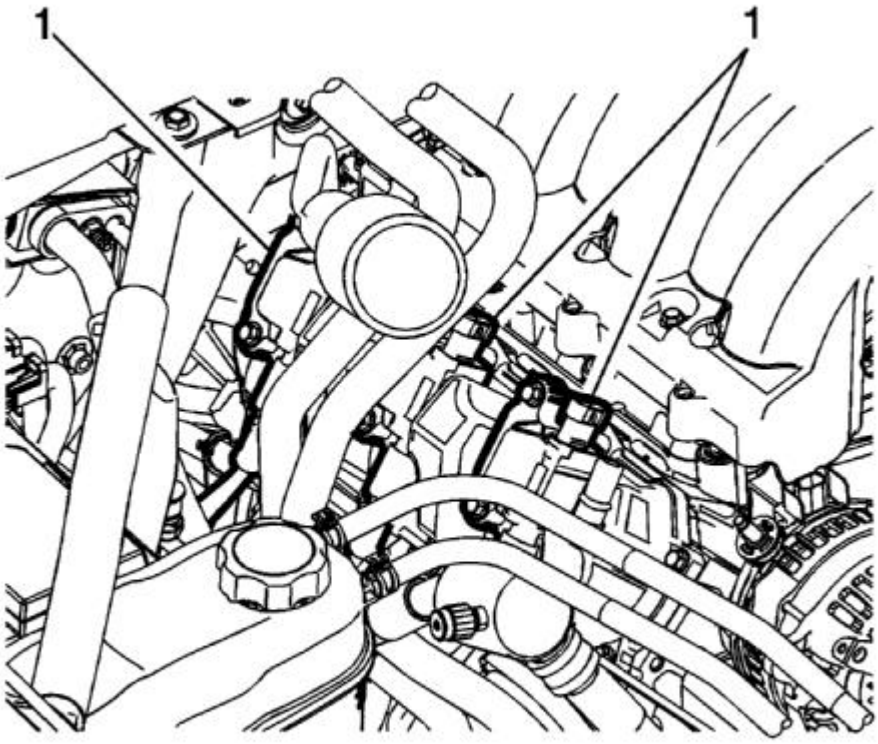


Fig. 59: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

4. Remove the ignition coil (1). Refer to **Ignition Coil Replacement** .

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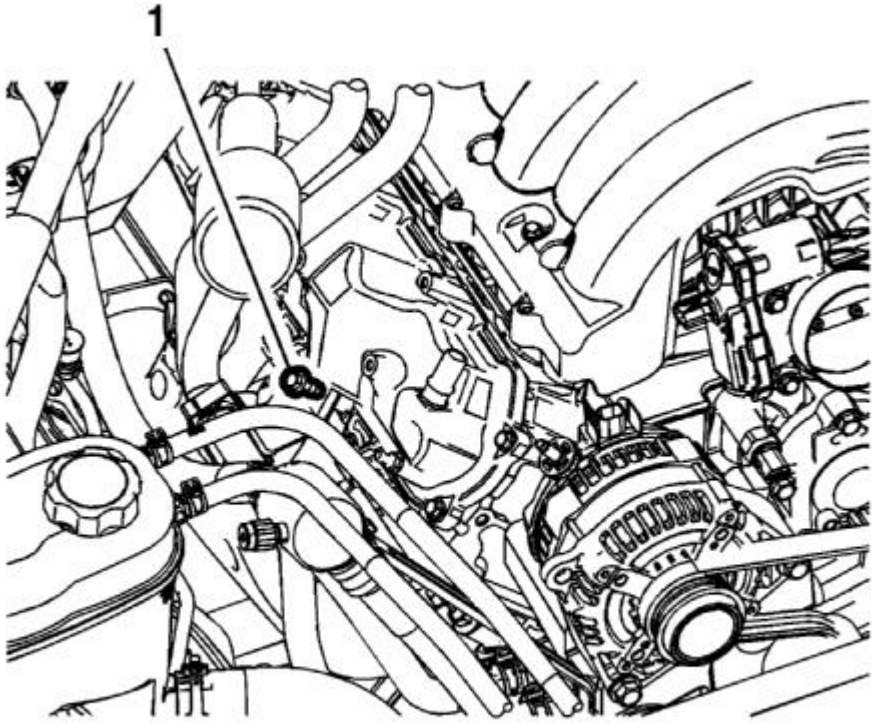


Fig. 60: Heater Hoses Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Remove the heater hoses (1) fastener.

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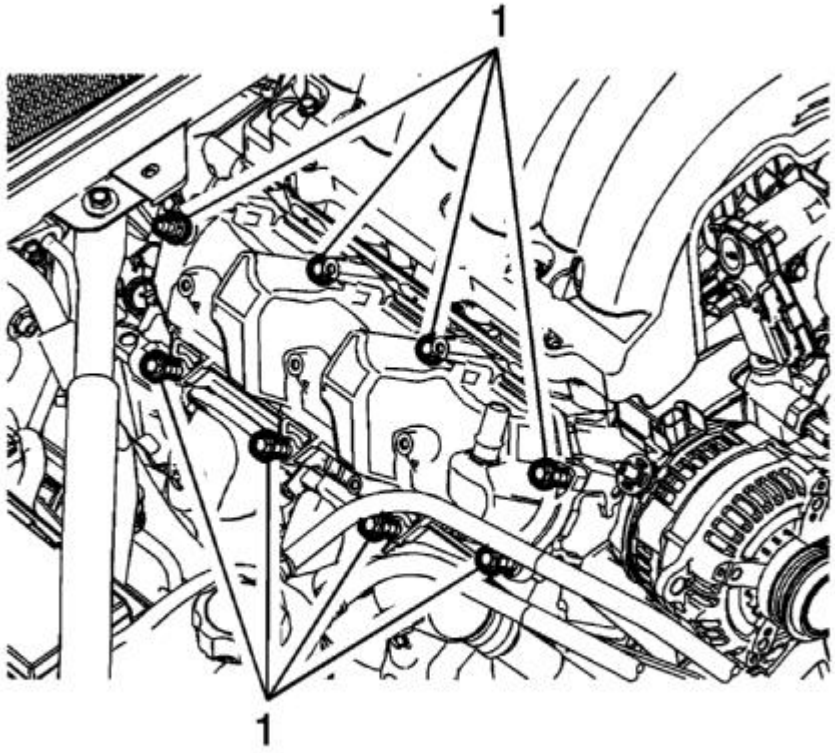


Fig. 61: Valve Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the valve rocker arm cover bolts (1).

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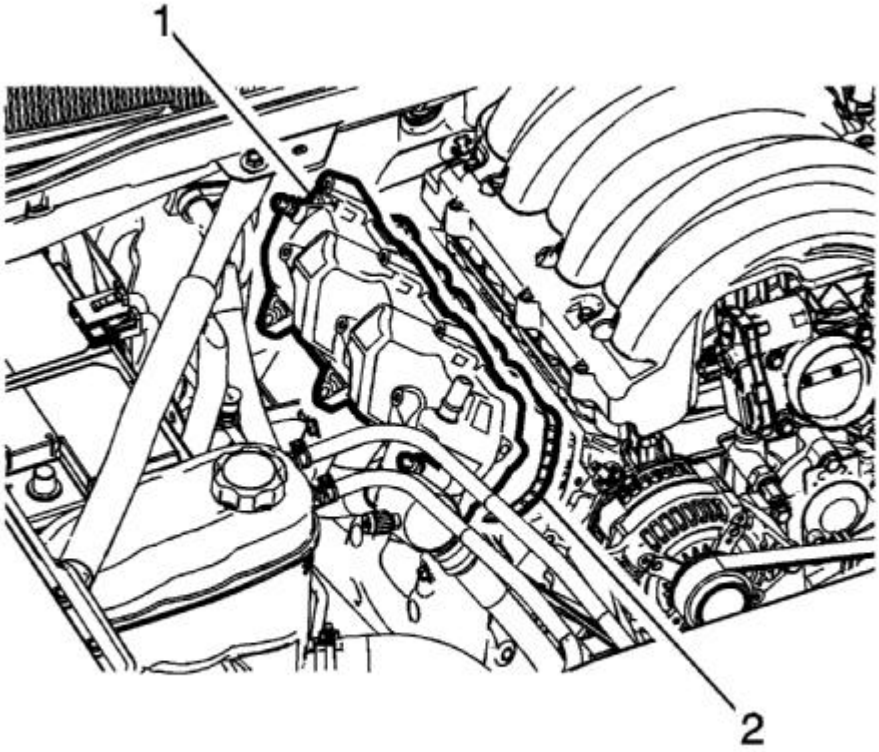


Fig. 62: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS COMPANY

7. Remove the valve rocker arm cover (1).
8. Remove and DISCARD valve rocker arm gasket (2). Refer to **Replacing Engine Gaskets** .
9. Clean and inspect the rocker arm cover. Refer to **Valve Rocker Arm Cover Cleaning and Inspection** .

Installation Procedure

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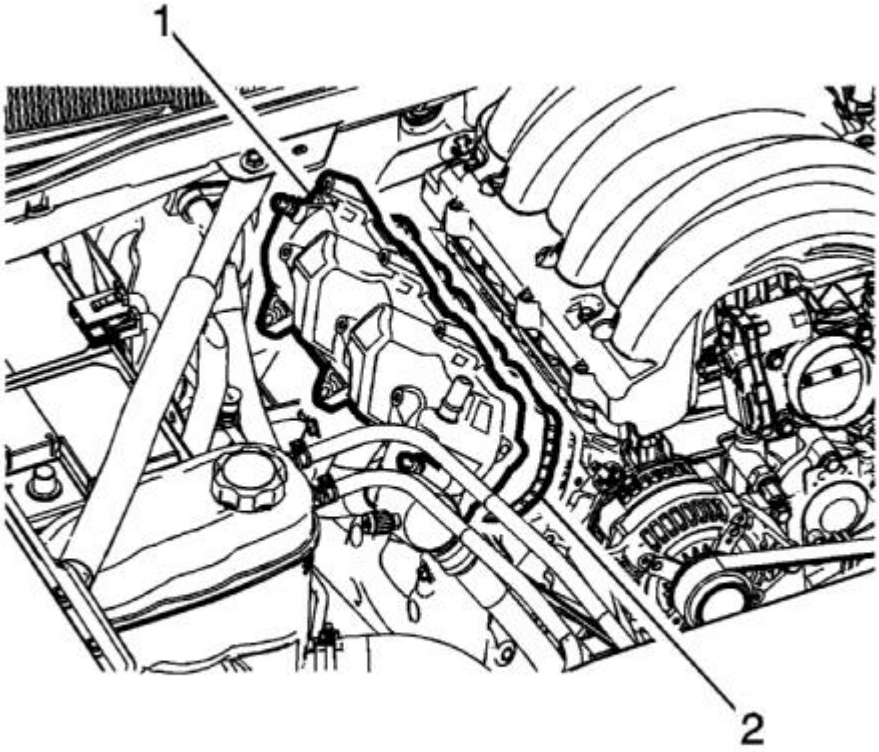


Fig. 63: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW valve rocker arm gasket (2).
2. Install the valve rocker arm cover (1).

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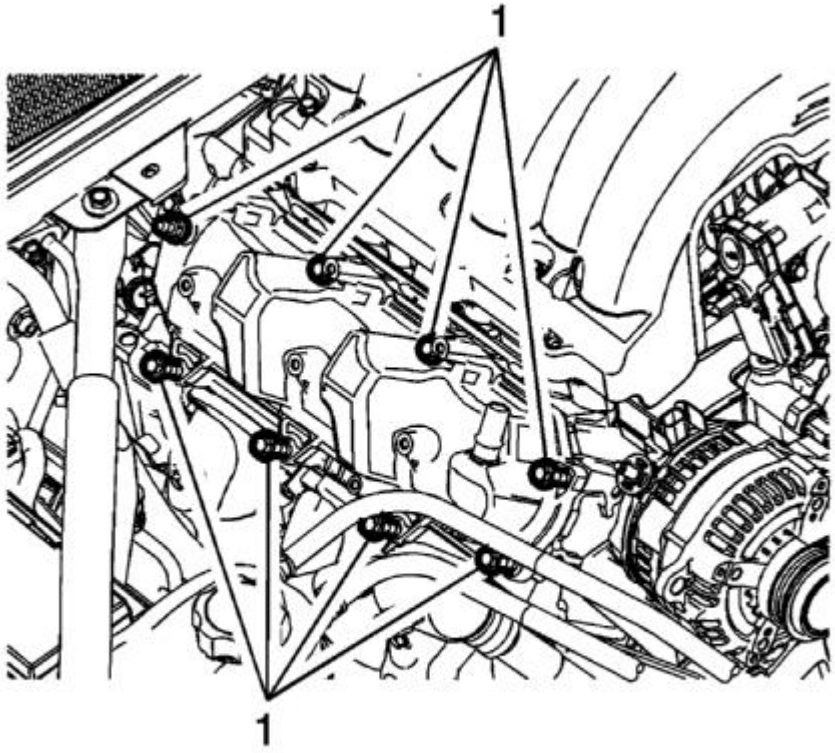


Fig. 64: Valve Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install valve rocker arm cover bolts (1) and hand tighten.

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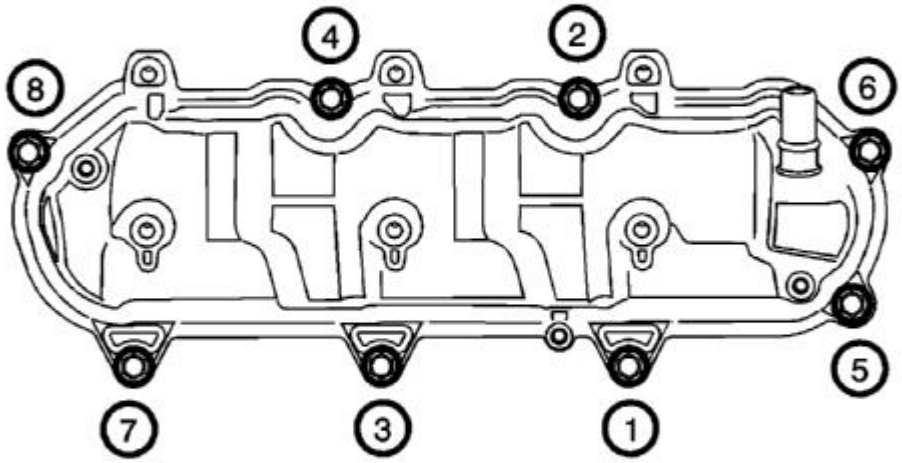


Fig. 65: Tightening Bolts In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Tighten the bolts in sequence to 10 (89 lb in) as shown.

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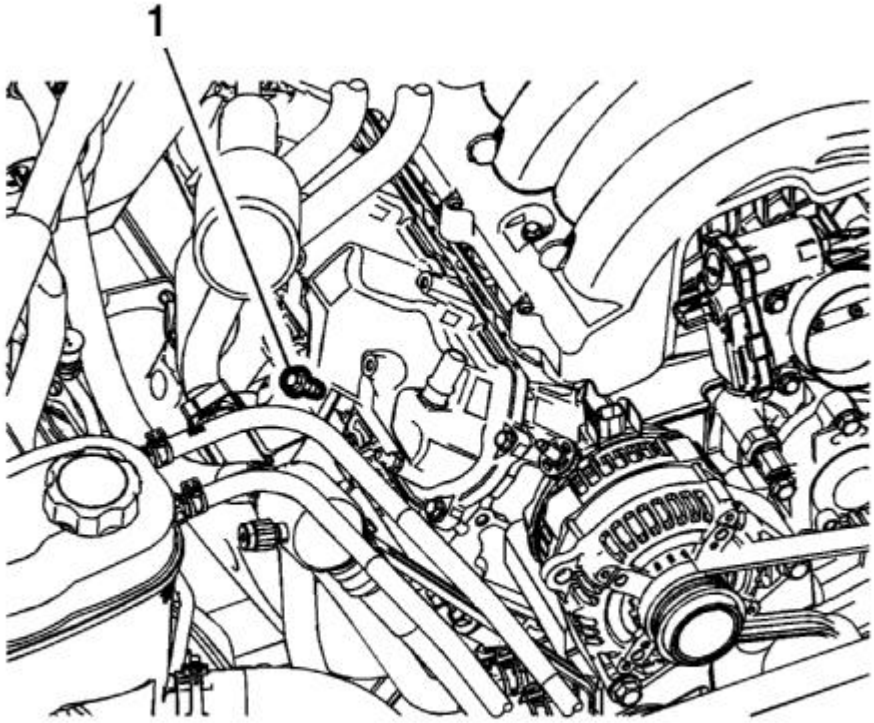


Fig. 66: Heater Hoses Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Install the heater hose fastener (1) and tighten to 10 (89 lb in).

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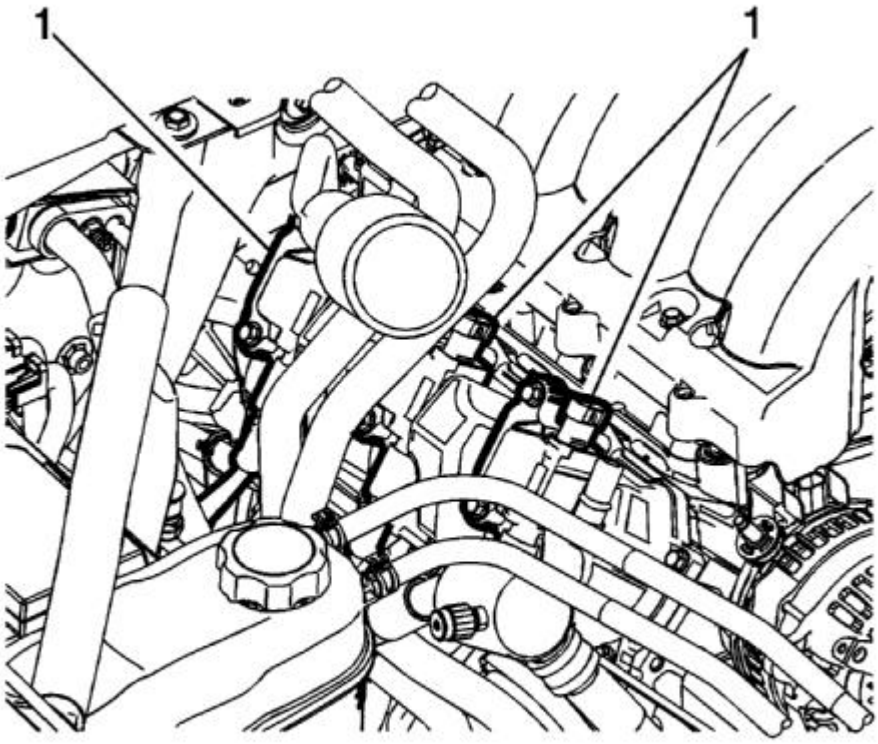


Fig. 67: Ignition Coil
Courtesy of GENERAL MOTORS COMPANY

6. Install the ignition coil (1). Refer to **Ignition Coil Replacement** .

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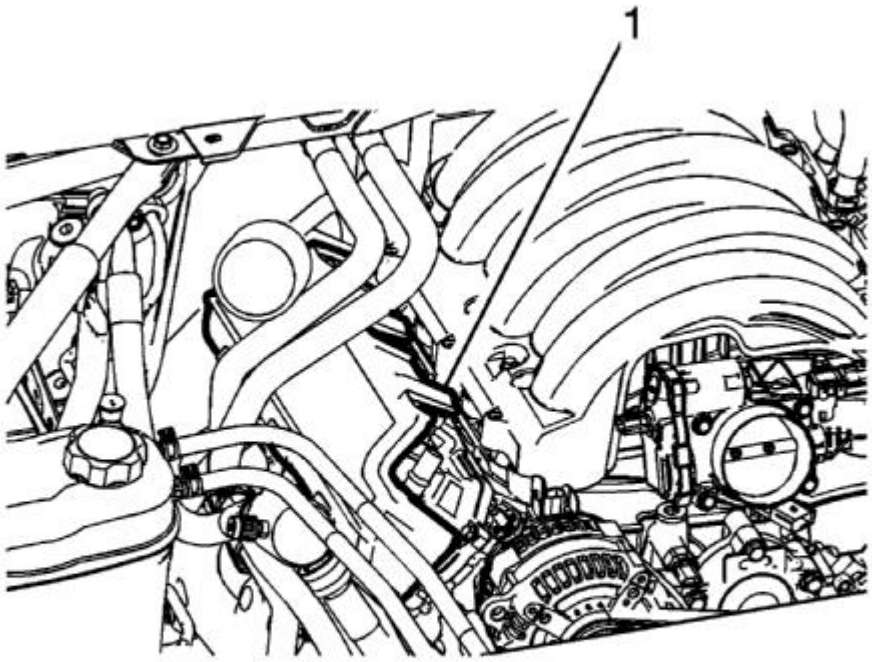


Fig. 68: Valve Rocker Arm Insulator
Courtesy of GENERAL MOTORS COMPANY

7. Install the valve rocker arm insulator (1). Refer to **Valve Rocker Arm Cover Insulator Replacement - Right Side**.

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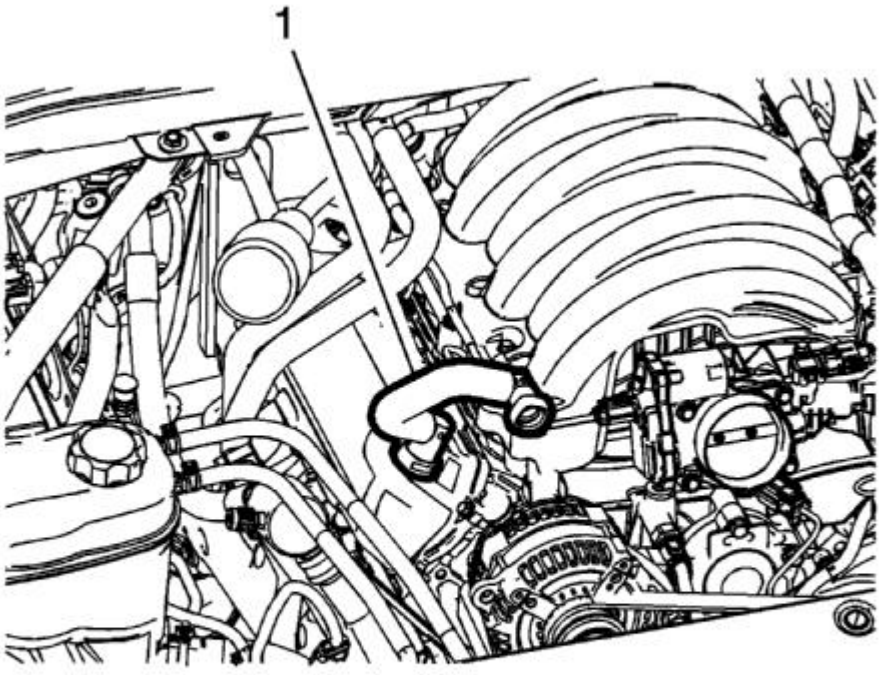


Fig. 69: PCV Tube
Courtesy of GENERAL MOTORS COMPANY

8. Install the PCV tube (1). Refer to **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Right Side / Bank 2)**, **Positive Crankcase Ventilation Hose/Pipe/Tube Replacement (Left Side / Bank 1)**.
9. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT (RIGHT SIDE / BANK 2)

Removal Procedure

1. Remove the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right Side**.

NOTE:

- **Be sure to keep parts in order. Parts must be reinstalled into the original location and position.**
- **The rocker arm bolts are not serviced separately.**

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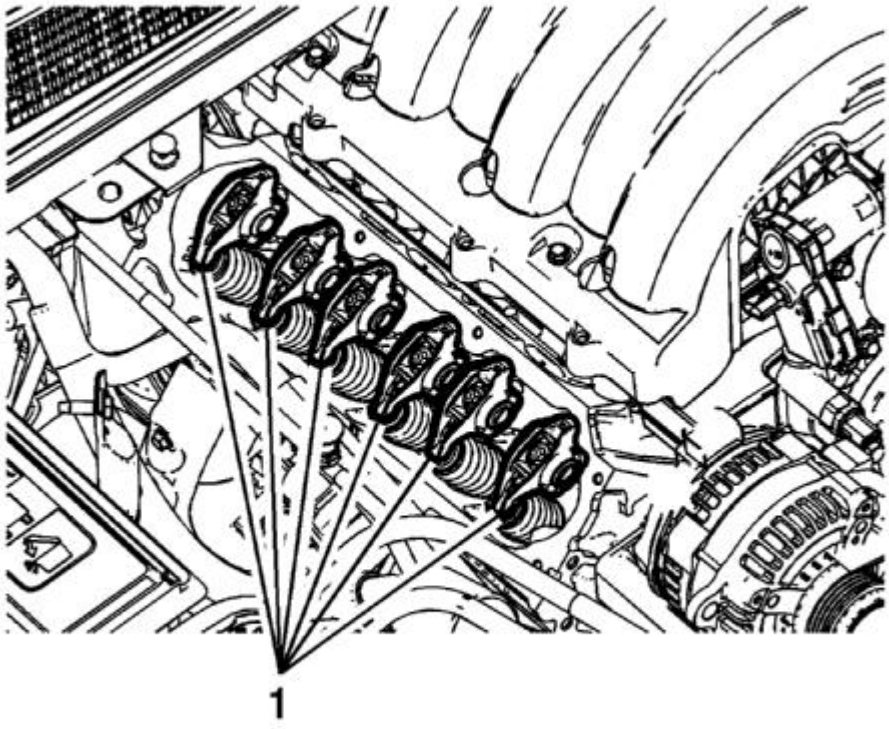


Fig. 70: Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

2. Remove the valve rocker arm (1).

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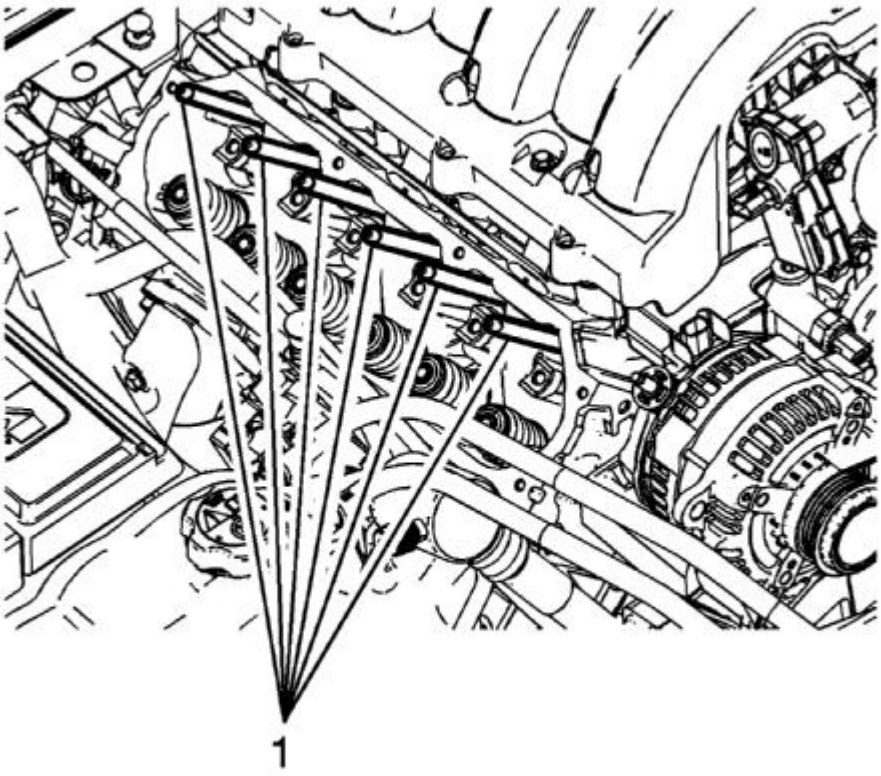


Fig. 71: Pushrods
Courtesy of GENERAL MOTORS COMPANY

3. Remove the pushrods (1).
4. Clean and inspect the rocker arms and/or pushrods, if necessary. Refer to **Valve Rocker Arm and Push Rod Cleaning and Inspection** .

Installation Procedure

NOTE:

- **When using the valve train components again, always install the components to the original location and position.**
- **Valve lash is net build. No valve adjustment is required.**
- **Lubricate the flange of the valve rocker arm bolts with clean engine oil.**
- **Lubricate the valve rocker arms and pushrods with clean engine oil.**
- **Ensure the pushrods seat properly to the valve lifter sockets.**
- **The rocker arm bolts are not serviced separately.**
- **Ensure the pushrods seat properly to the ends of the rocker arms.**

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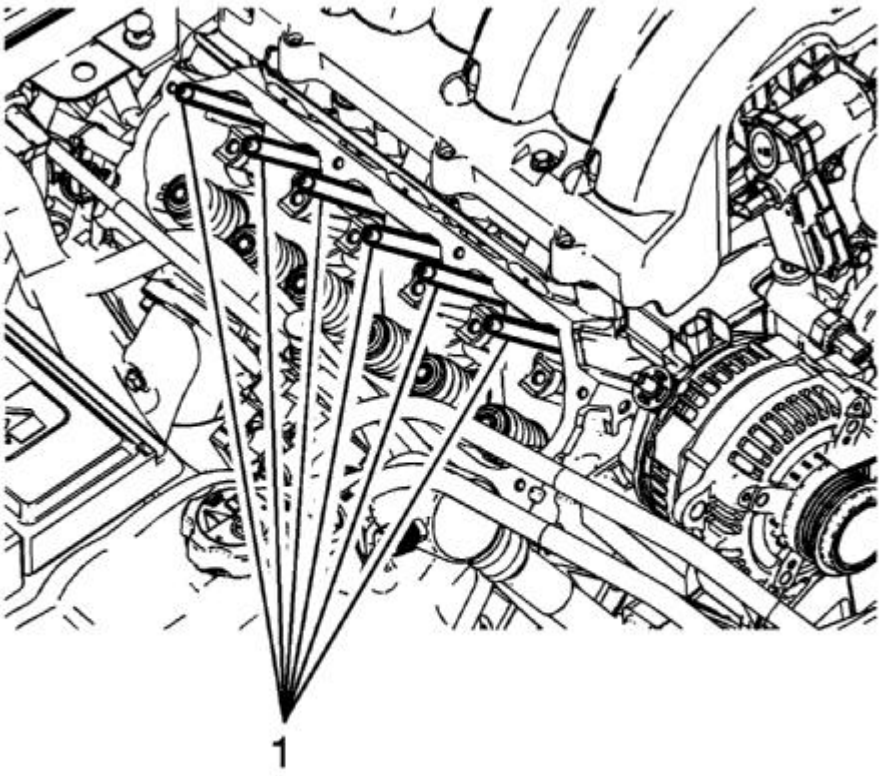


Fig. 72: Pushrods
Courtesy of GENERAL MOTORS COMPANY

1. Install the pushrods.

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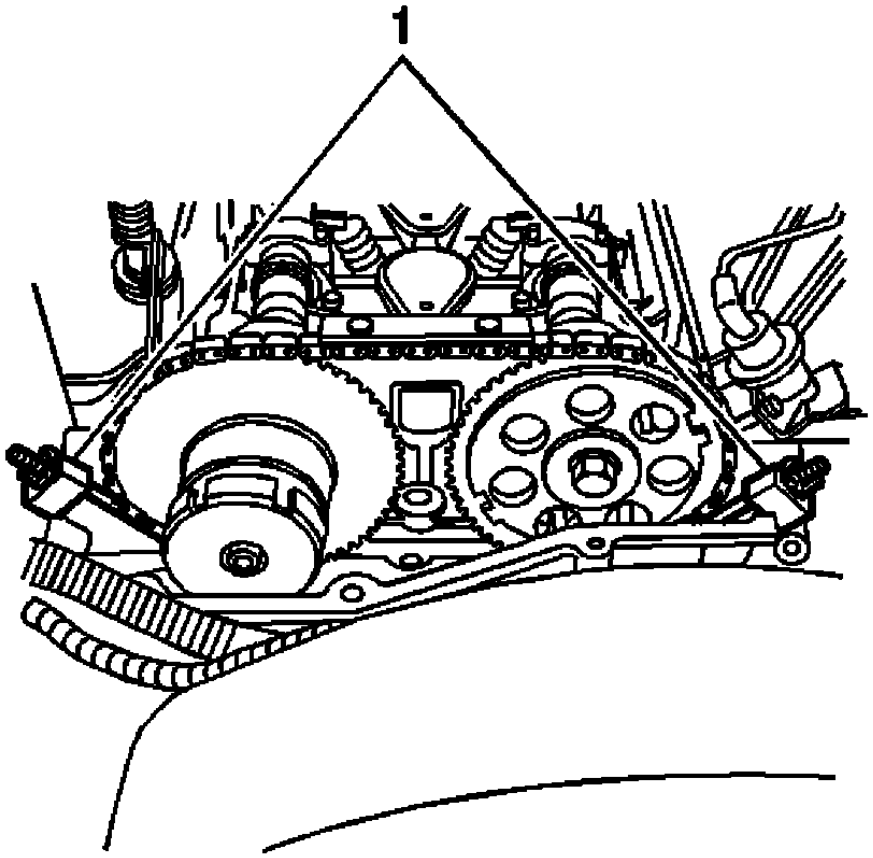


Fig. 73: Pushrod Socket, Roller Pivot & Valve Stem Tip
Courtesy of GENERAL MOTORS COMPANY

2. Apply lubricant to the following rocker arm contact surfaces:
    - Pushrod socket (1)
    - Roller pivot (2)
    - Valve stem tip (3)

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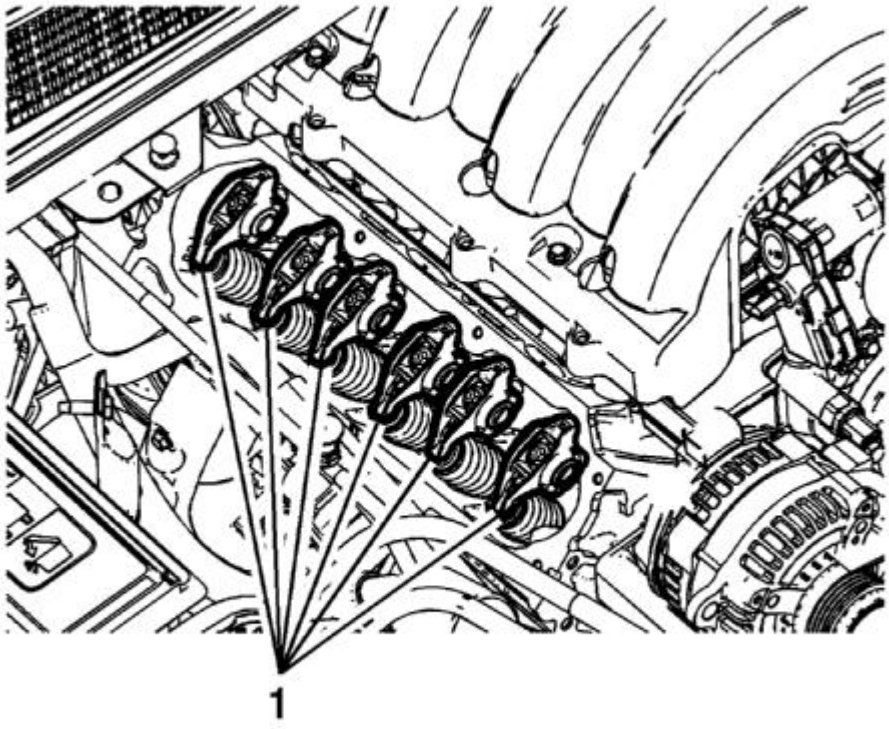


Fig. 74: Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

3. Install the all valve rocker arm (1) and hand tighten the bolts.
4. Tighten the rocker arm bolts to 30 (22 lb ft).
5. Install the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right Side**.

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT (LEFT SIDE / BANK 1)

Removal Procedure

1. Remove the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left Side**.

NOTE:

- **Be sure to keep parts in order. Parts must be reinstalled into the original location and position.**
- **The rocker arm bolts are not serviced separately.**

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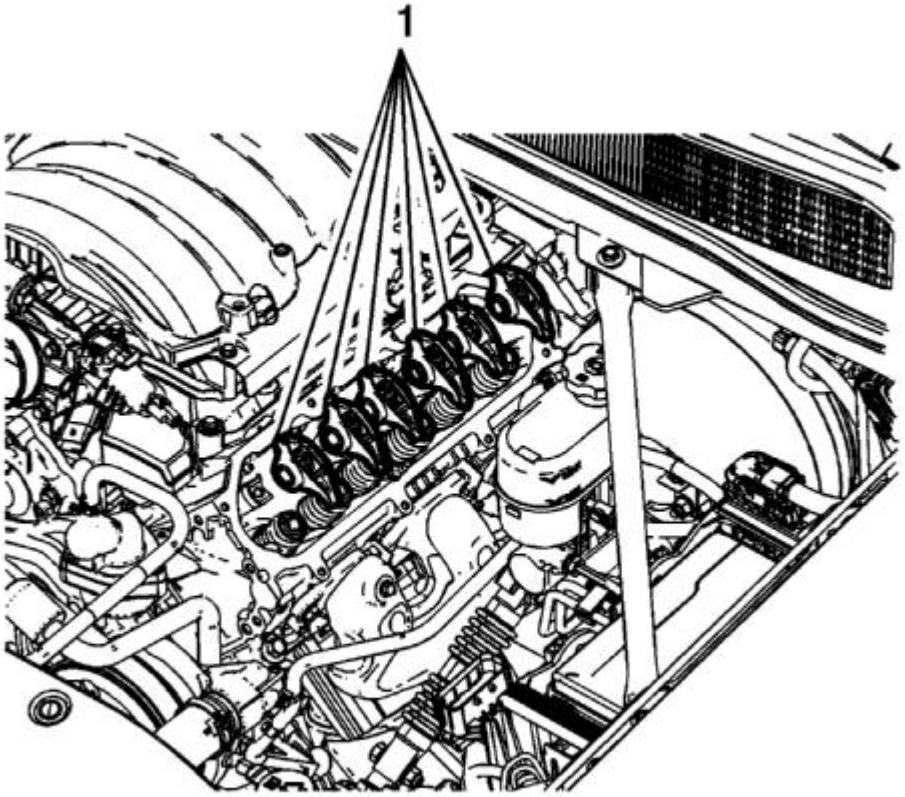


Fig. 75: Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

2. Remove the valve rocker arm (1).

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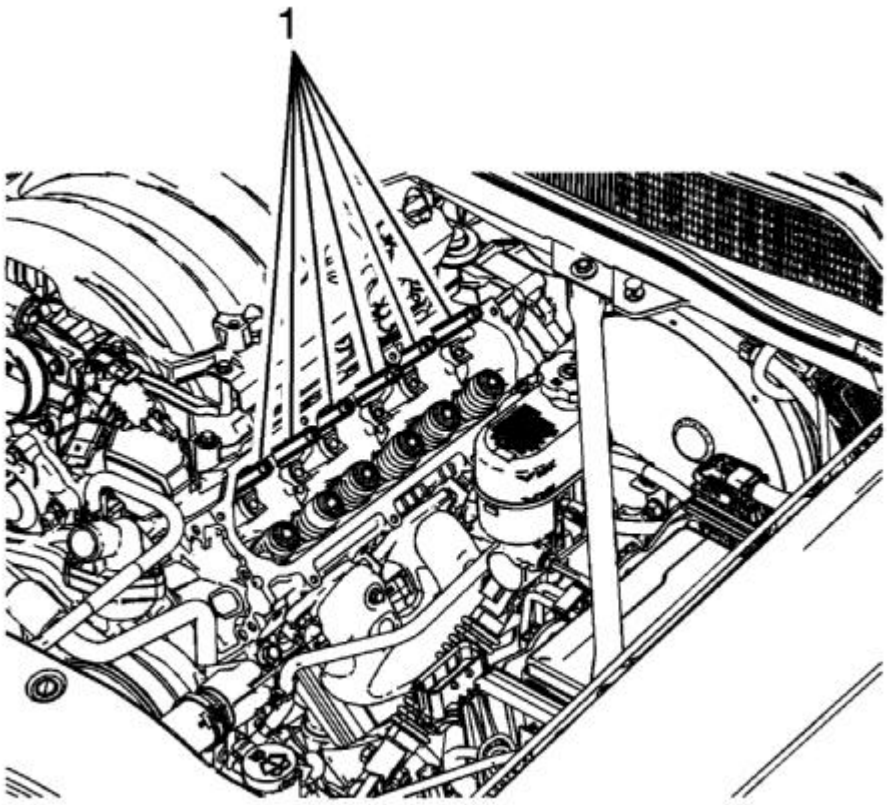


Fig. 76: Pushrods
Courtesy of GENERAL MOTORS COMPANY

3. Remove the pushrods (1).
4. Clean and inspect the rocker arms and/or pushrods, if necessary. Refer to **Valve Rocker Arm and Push Rod Cleaning and Inspection** .

Installation Procedure

NOTE: Be sure to keep parts in order. Parts must be reinstalled into the original location and position.

NOTE:

- **When using the valve train components again, always install the components to the original location and position.**
- **Valve lash is net build. No valve adjustment is required.**
- **Lubricate the flange of the valve rocker arm bolts with clean engine oil.**
- **Lubricate the valve rocker arms and pushrods with clean engine oil.**
- **Ensure the pushrods seat properly to the valve lifter sockets.**

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- **The rocker arm bolts are not serviced separately.**
- **Ensure the pushrods seat properly to the ends of the rocker arms.**

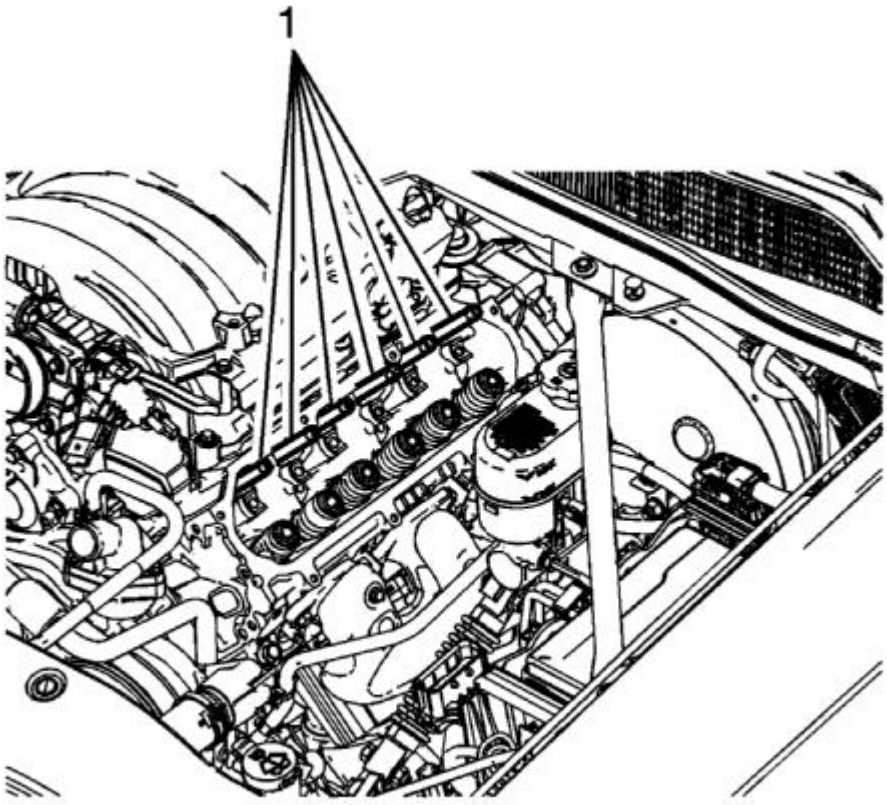


Fig. 77: Pushrods
Courtesy of GENERAL MOTORS COMPANY

1. Install the pushrods.

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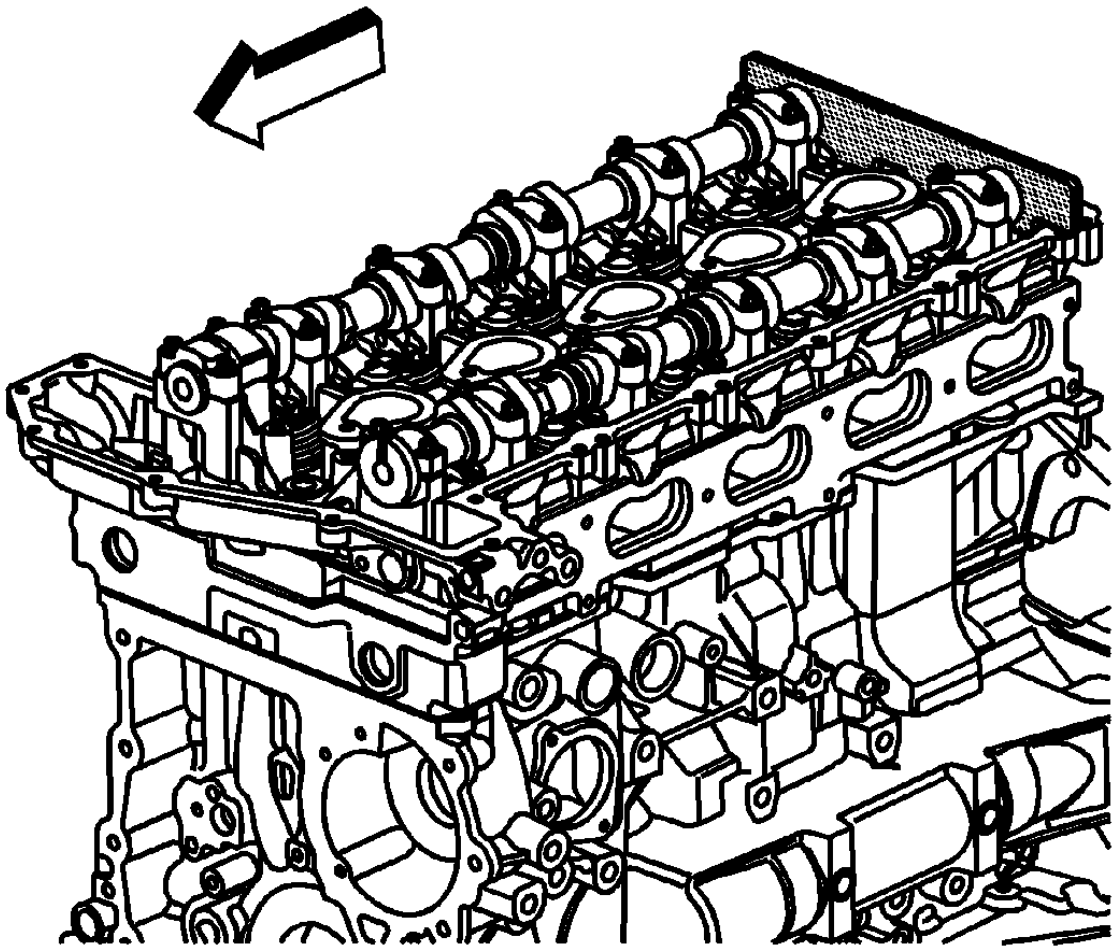


Fig. 78: Pushrod Socket, Roller Pivot & Valve Stem Tip
Courtesy of GENERAL MOTORS COMPANY

2. Apply lubricant to the following rocker arm contact surfaces:
   - Pushrod socket (1)
   - Roller pivot (2)
   - Valve stem tip (3)

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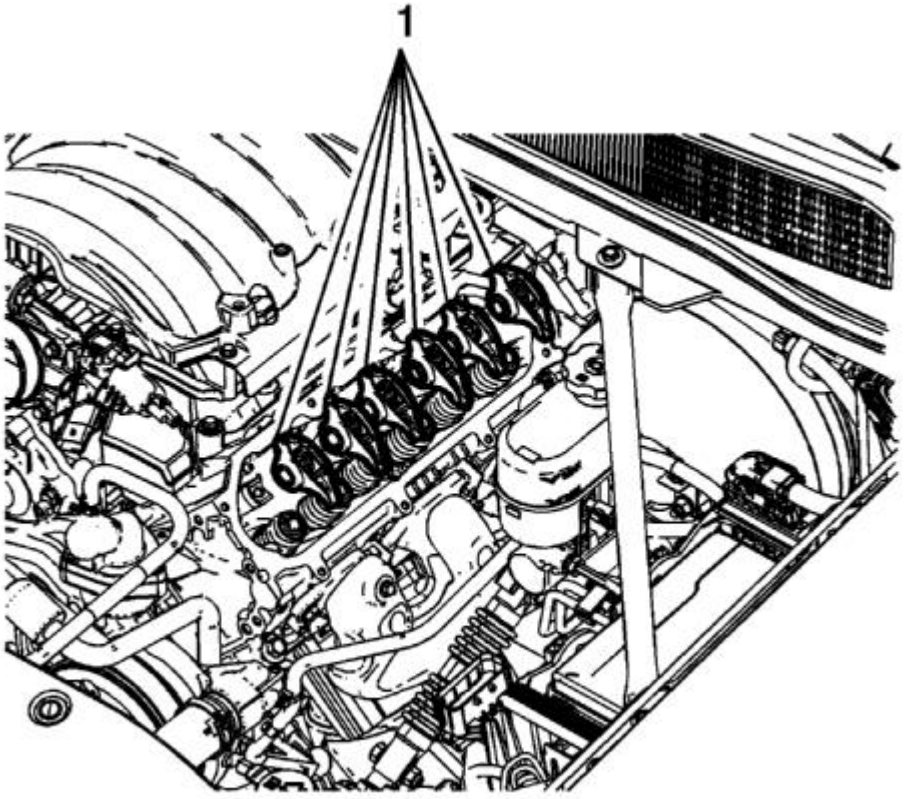


Fig. 79: Valve Rocker Arm
Courtesy of GENERAL MOTORS COMPANY

3. Install the all valve rocker arm (1) and hand tighten the bolts.
4. Tighten the rocker arm bolts to 30 (22 lb ft).
5. Install the valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left Side**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Special Tools

- **J-22794** Spark Plug Port Adapter
- **J-38606** Valve Spring Compressor

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

Removal Procedure

1. Remove the valve rocker arms as needed. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
2. Remove the spark plugs as needed. Refer to **Spark Plug Replacement** .

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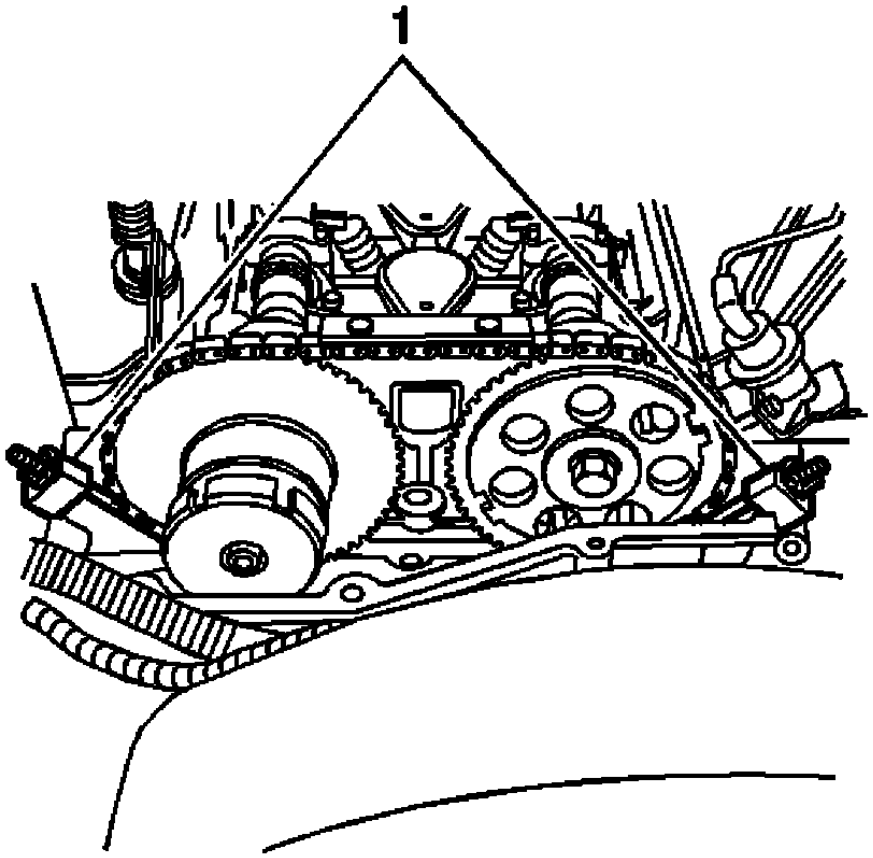


Fig. 80: Special Tool In Spark Plug Hole
Courtesy of GENERAL MOTORS COMPANY

3. Install the **J- 22794** adapter into the spark plug hole.
4. Connect a shop air supply hose and apply compressed air in order to hold the valves in place.

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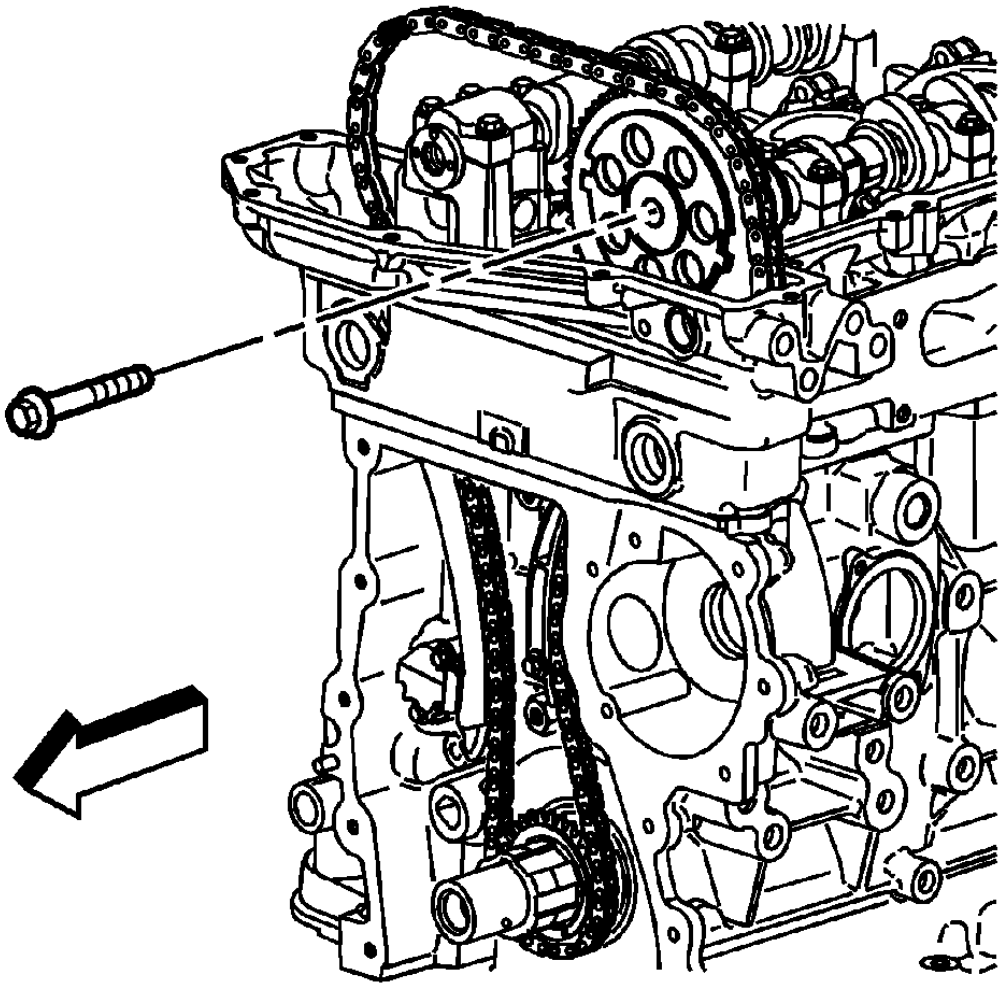


Fig. 81: View Of J 38606 Compressing Valve Spring
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Completely engage the J 38606 jaws on the valve spring. The J 38606 may slip off and scratch the valve spring. Replace the valve spring if the valve spring becomes scratch.

5. Use **J 38606** compressor.

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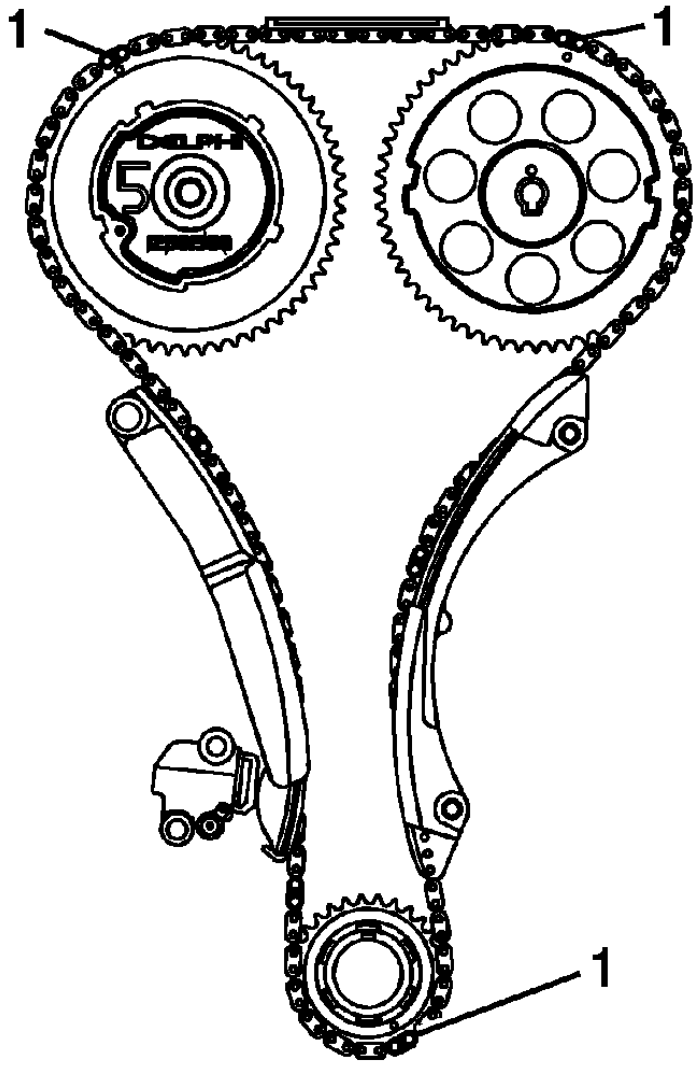


Fig. 82: Identifying Valve Components
Courtesy of GENERAL MOTORS COMPANY

6. Remove the valve keys (1).
7. Carefully release the valve spring tension.
8. Remove the **J-38606** compressor.
9. Remove the valve spring cap (2) and valve spring (3).
10. Remove the valve stem oil seal (4).

Installation Procedure

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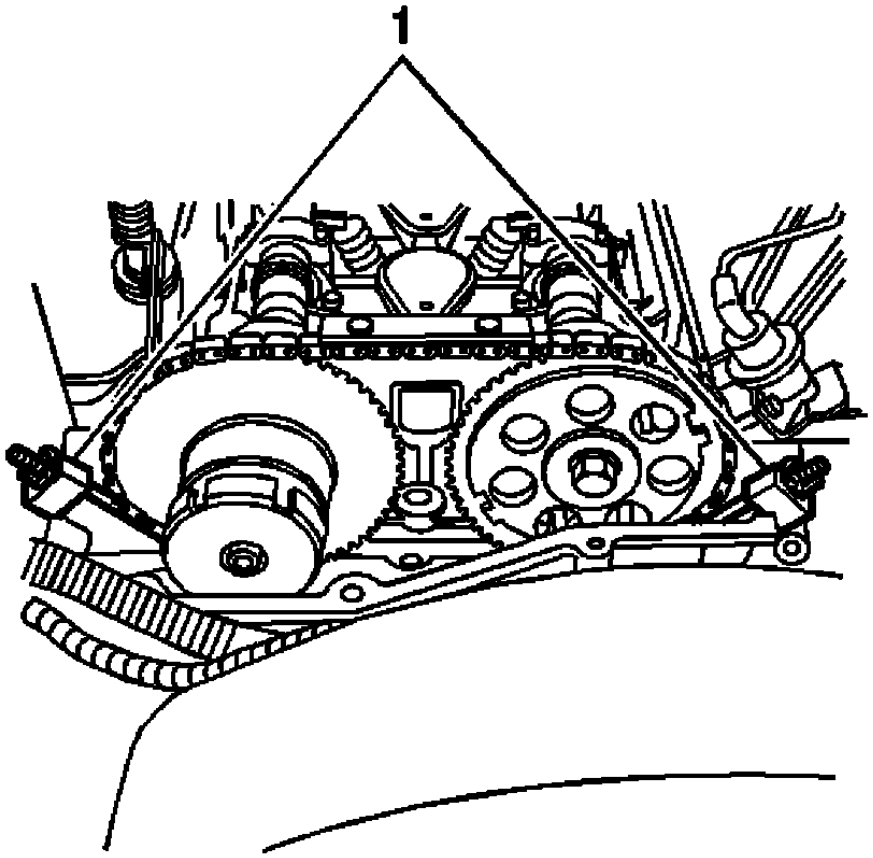


Fig. 83: Identifying Valve Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the valve spring (3).
2. Install the valve spring cap (2) onto the valve spring (3), over the valve stem.
3. Apply steady pressure on the valve spring cap until the valve keys are accessible.

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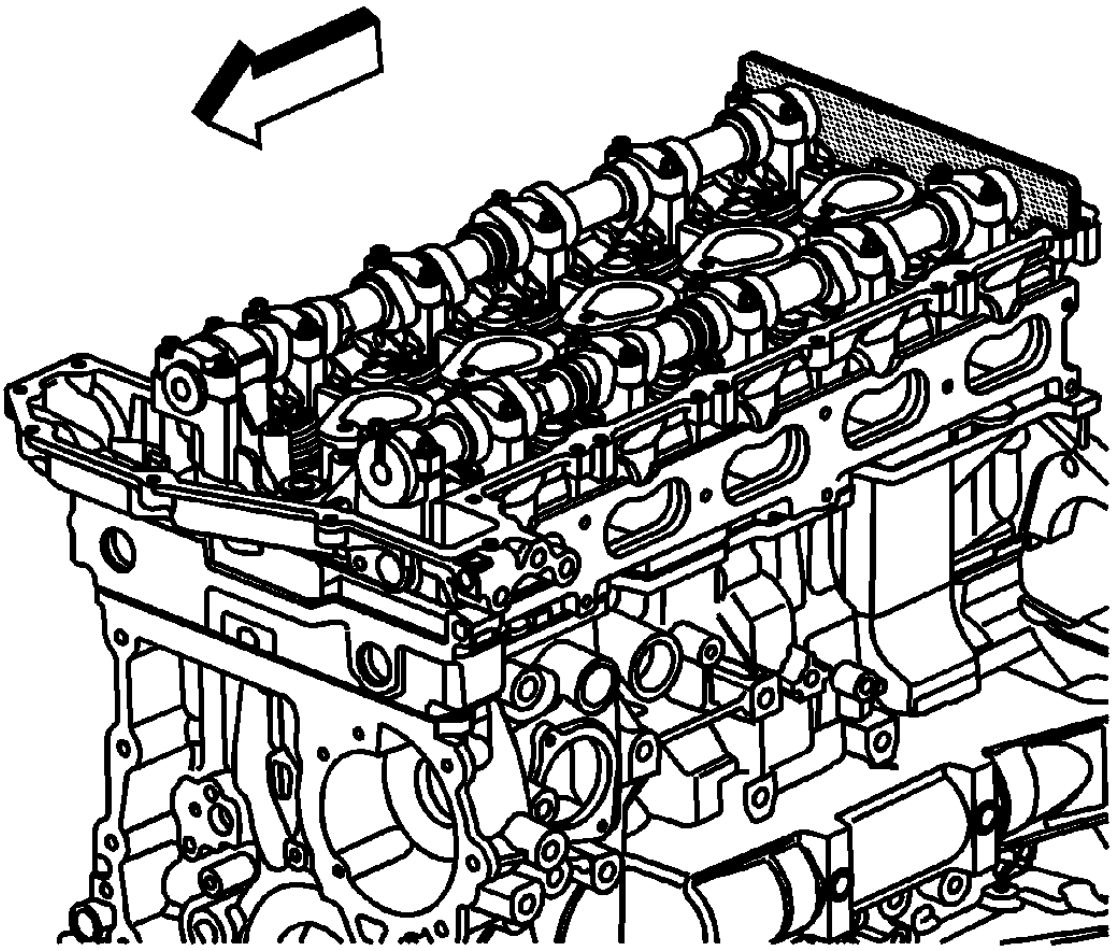


Fig. 84: View Of J 38606 Compressing Valve Spring
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Completely engage the J 38606 jaws on the valve spring. The J 38606 may slip off and scratch the valve spring. Replace the valve spring if the valve spring becomes scratch.

4. Use the **J-38606** compressor.
5. Install the valve stem O-ring seal.

NOTE: Use grease in order to hold the valve stem keys in place.

6. Install the valve stem keys.
7. Carefully release the valve spring pressure, making sure the valve stem keys stay in place.

CAUTION: The valve stem keys must correctly seat in the valve spring cap.

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Engine damage may occur by not installing properly.

8. Remove the **J-38606** compressor.
    1. Look to ensure that the valve stem keys seat properly in the upper groove of the valve stem.
    2. Tap the end of the valve stem with a plastic faced hammer in order to seat the valve stem keys, if necessary.

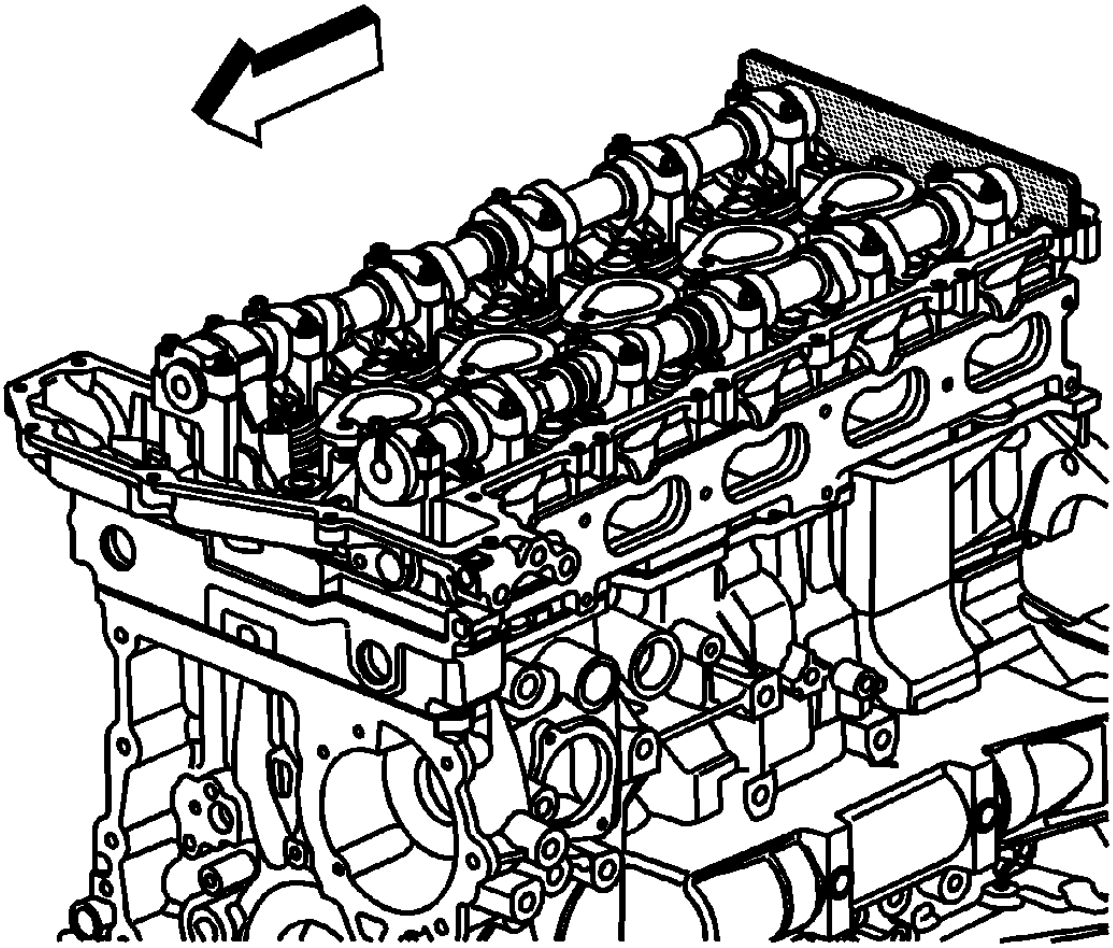


Fig. 85: Special Tool In Spark Plug Hole
Courtesy of GENERAL MOTORS COMPANY

9. Remove the **J-22794** adapter.
10. Install the spark plugs. Refer to **Spark Plug Replacement** .
11. Install the valve rocker arms. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.

OIL LEVEL INDICATOR TUBE REPLACEMENT

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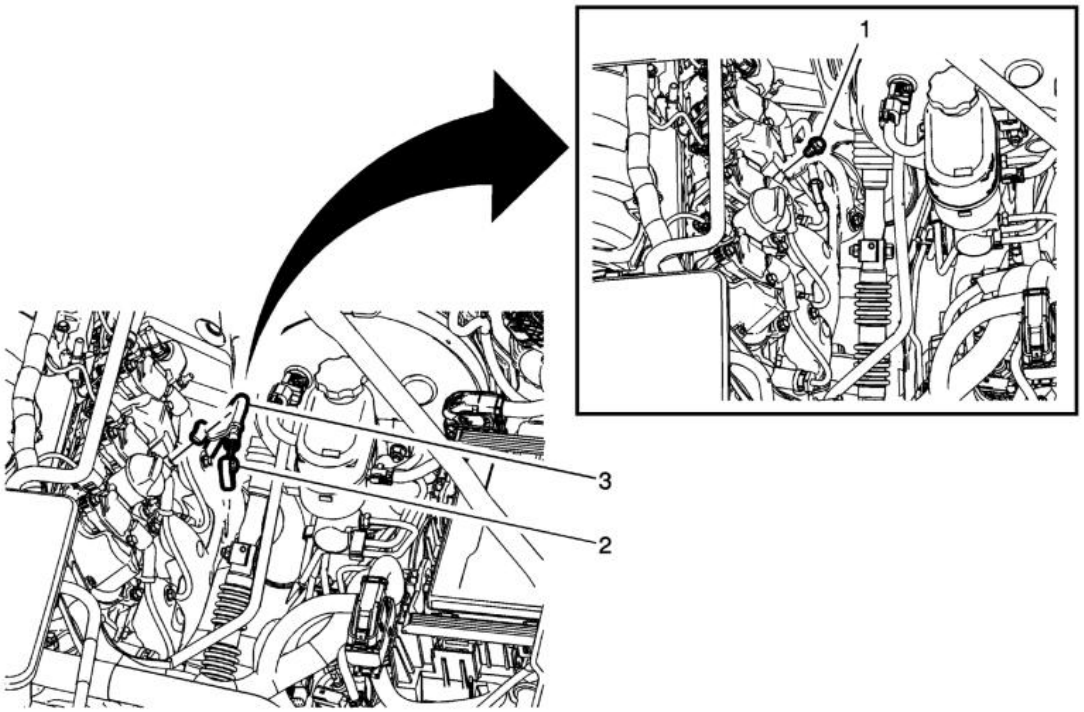


Fig. 86: Oil Level Indicator Tube
Courtesy of GENERAL MOTORS COMPANY

Oil Level Indicator Tube Replacement

Callout	Component Name
1	Oil Level Indicator Tube Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 10 (89 lb in)
2	Oil Level Indicator
3	Oil Level Indicator Tube **Procedure** Use a NEW oil level indicator tube seal when installing the tube.

CYLINDER HEAD REPLACEMENT - LEFT SIDE

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill Gasoline)** , **Cooling System Draining and Filling (Static Fill)** .
2. Remove the fuel injector rail. Refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 1** .

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3. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LV1, LV3)** .
4. Remove the valve rocker arm and push rod. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
5. Disconnect electrical connectors as necessary.

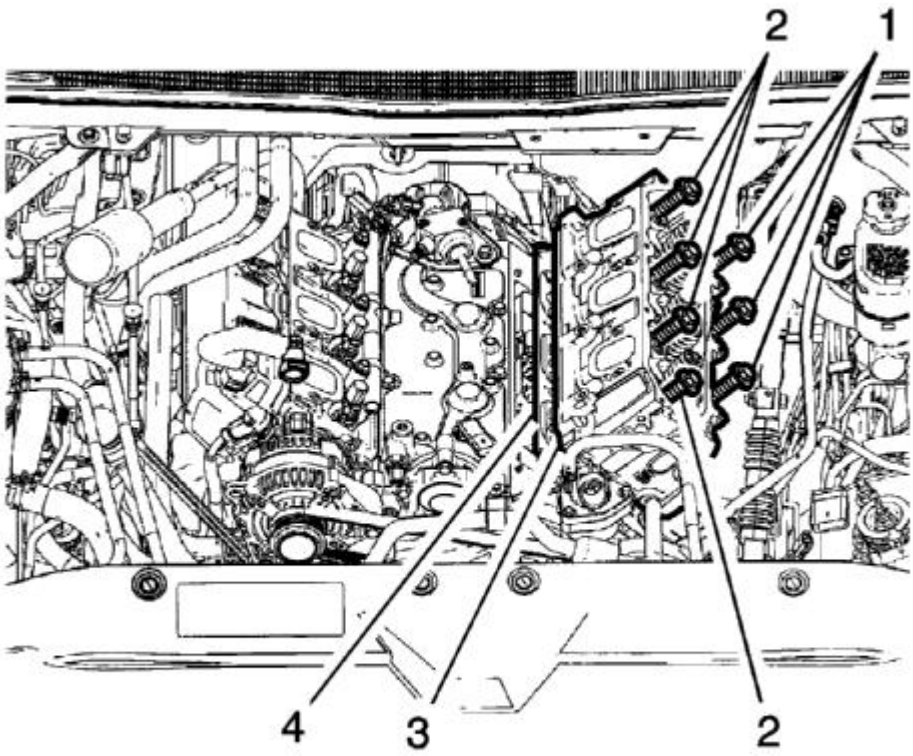


Fig. 87: Cylinder Head And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: DISCARD all cylinder head bolts.

6. Remove the cylinder head bolts (1, 2).
7. Remove cylinder head (3).
8. Remove and DISCARD cylinder head gasket (4). Refer to **Replacing Engine Gaskets** .
9. For cleaning and inspection. Refer to **Cylinder Head Cleaning and Inspection** .
10. For cylinder head disassemble. Refer to **Cylinder Head Disassemble** .

Installation Procedure

1. For cylinder head assemble. Refer to **Cylinder Head Assemble** .

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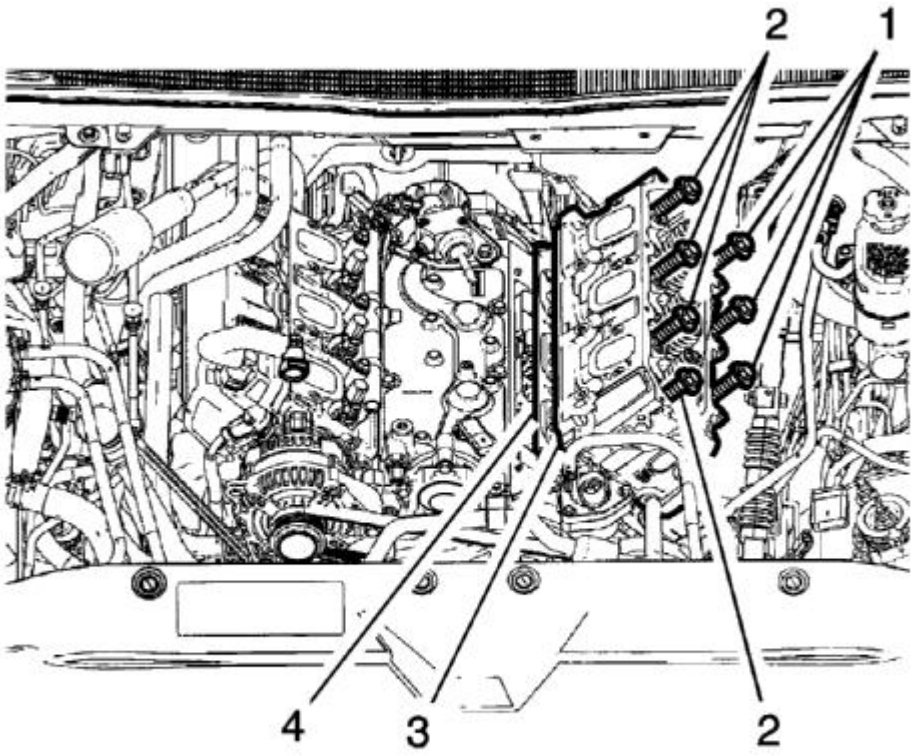


Fig. 88: Cylinder Head And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW cylinder head gasket (4).
3. Install cylinder head (3).
4. Hand start NEW cylinder head bolts (1, 2).

CAUTION: Refer to Fastener Caution .

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

5. Tighten cylinder head bolts in sequence. Refer to **Cylinder Head Installation - Left Side (with AFM)** , **Cylinder Head Installation - Left Side (without AFM)** .
6. Install the valve rocker arm and push rod. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
7. Install the exhaust manifold. Refer to, **Exhaust Manifold Replacement - Left Side (LV1, LV3)** .
8. Connect electrical connectors as necessary.

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9. Install the fuel injector rail. Refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 1** .
10. Refill the cooling system. Refer to **Cooling System Draining and Filling (Vac-N-Fill Gasoline)** , **Cooling System Draining and Filling (Static Fill)** .

CYLINDER HEAD REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Drain the coolant system. Refer to **Cooling System Draining and Filling (Vac-N-Fill Gasoline)** , **Cooling System Draining and Filling (Static Fill)** .
2. Remove the transmission fill tube. Refer to **Transmission Fluid Filler Tube and Seal Replacement** .
3. Remove the generator bracket. Refer to **Generator Bracket Replacement (LV1, LV3)** .
4. Remove the fuel injector rail. Refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 2** .
5. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LV1, LV3)** .
6. Remove the valve rocker arm and push rod. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
7. Disconnect electrical connectors as necessary.

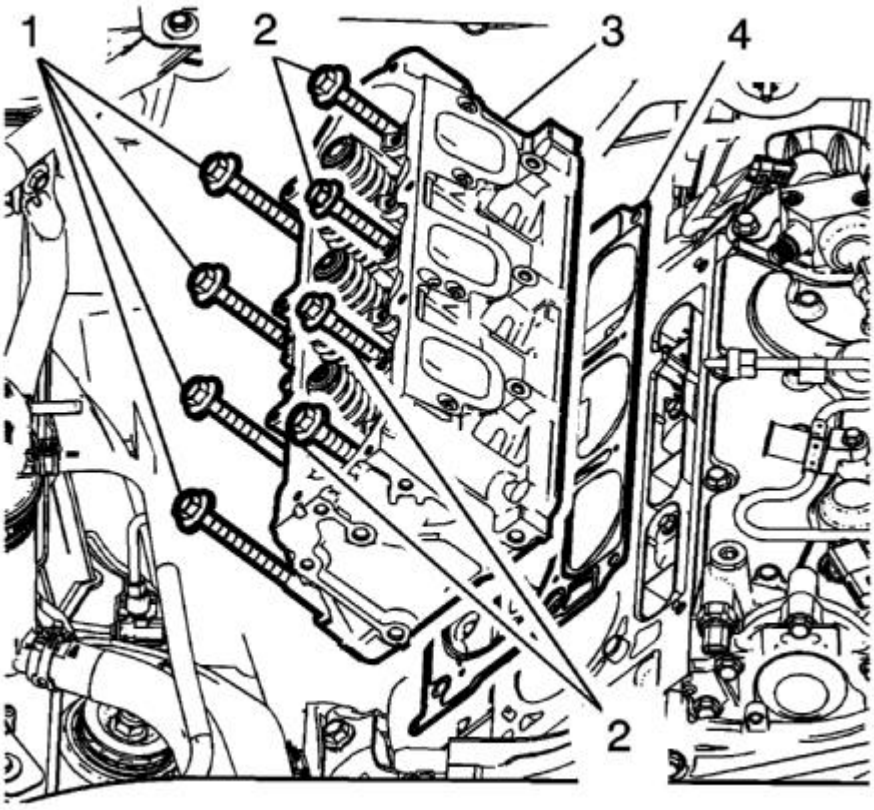


Fig. 89: Cylinder Head And Bolts
Courtesy of GENERAL MOTORS COMPANY

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NOTE: DISCARD all cylinder head bolts.

8. Remove the cylinder head bolts (1, 2).
9. Remove cylinder head (3).
10. Remove and DISCARD cylinder head gasket (4). Refer to **Replacing Engine Gaskets** .
11. For cleaning and inspection. Refer to **Cylinder Head Cleaning and Inspection** .
12. For cylinder head disassemble. Refer to **Cylinder Head Disassemble** .

Installation Procedure

1. For cylinder head assemble. Refer to **Cylinder Head Assemble** .

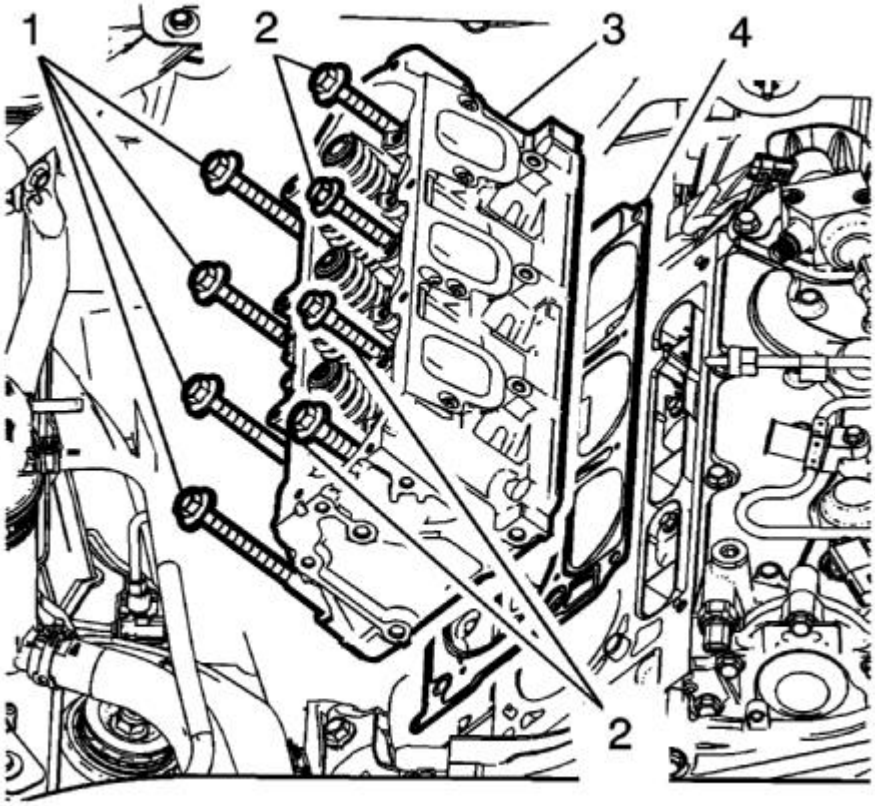


Fig. 90: Cylinder Head And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW cylinder head gasket (4).
3. Install cylinder head (3).
4. Hand start NEW cylinder head bolts (1, 2).

CAUTION: Refer to Fastener Caution .

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

5. Tighten cylinder head bolts in sequence. Refer to **Cylinder Head Installation - Right Side (with AFM)** , **Cylinder Head Installation - Right Side (without AFM)** .
6. Install the valve rocker arm and push rod. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
7. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LV1, LV3)** .
8. Install the fuel injector rail. Refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 2** .
9. Install the generator bracket. Refer to **Generator Bracket Replacement (LV1, LV3)** .
10. Install the transmission fill tube. Refer to **Transmission Fluid Filler Tube and Seal Replacement** .
11. Connect electrical connectors as necessary.
12. Refill the coolant system. Refer to **Cooling System Draining and Filling (Vac-N-Fill Gasoline)** , **Cooling System Draining and Filling (Static Fill)** .

VALVE LIFTER FOLLOWER GUIDE REPLACEMENT

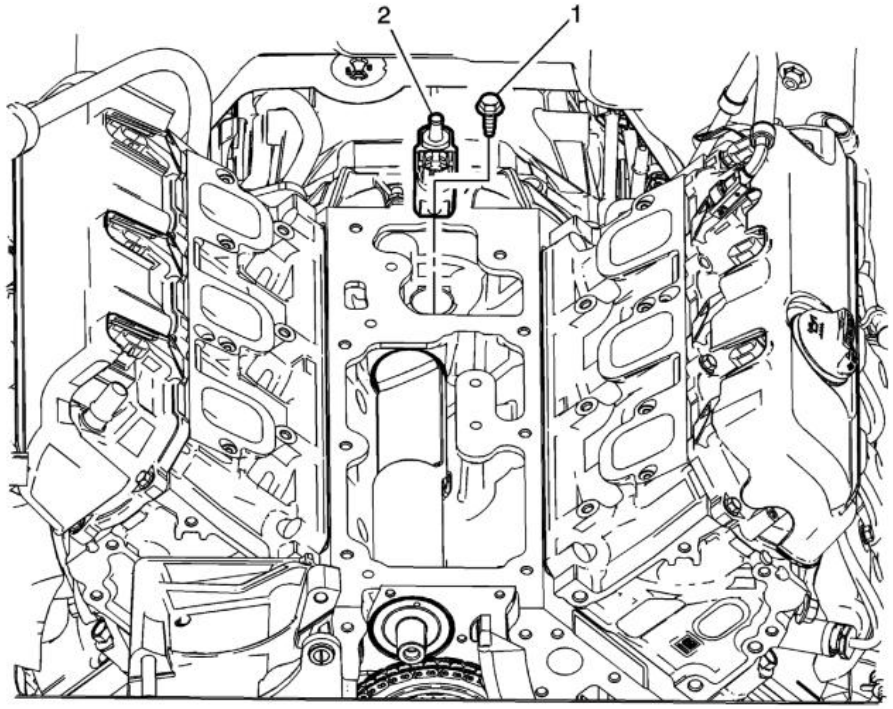


Fig. 91: Valve Lifter Follower Guide
Courtesy of GENERAL MOTORS COMPANY

Valve Lifter Follower Guide Replacement

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Callout	Component Name
Preliminary Procedure Remove the valve lifter oil manifold. Refer to **Valve Lifter Oil Manifold Replacement**.	
1	Valve Lifter Follower Guide Fastener **CAUTION:** **Refer to Fastener Caution .** **TIghten** 12 (9 lb ft)
2	Valve Lifter Follower Guide

VALVE LIFTER REPLACEMENT

Removal Procedure

1. Remove the cylinder head. Refer to **Cylinder Head Replacement - Left Side** or **Cylinder Head Replacement - Right Side**.

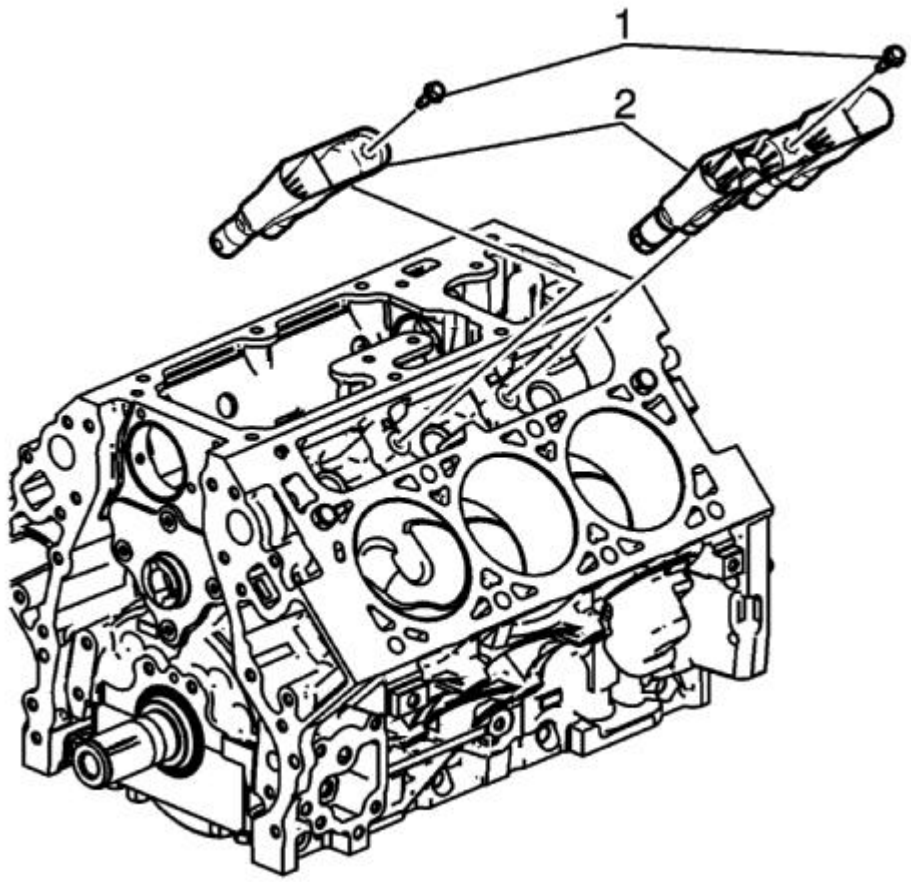


Fig. 92: Guides With Lifters And Bolts

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Courtesy of GENERAL MOTORS COMPANY

2. Remove the bolts (1).

NOTE: Installed position of the guides. The notched area of the guide is to align with the locating tab of the block.

3. Remove the guides (2) with lifters.

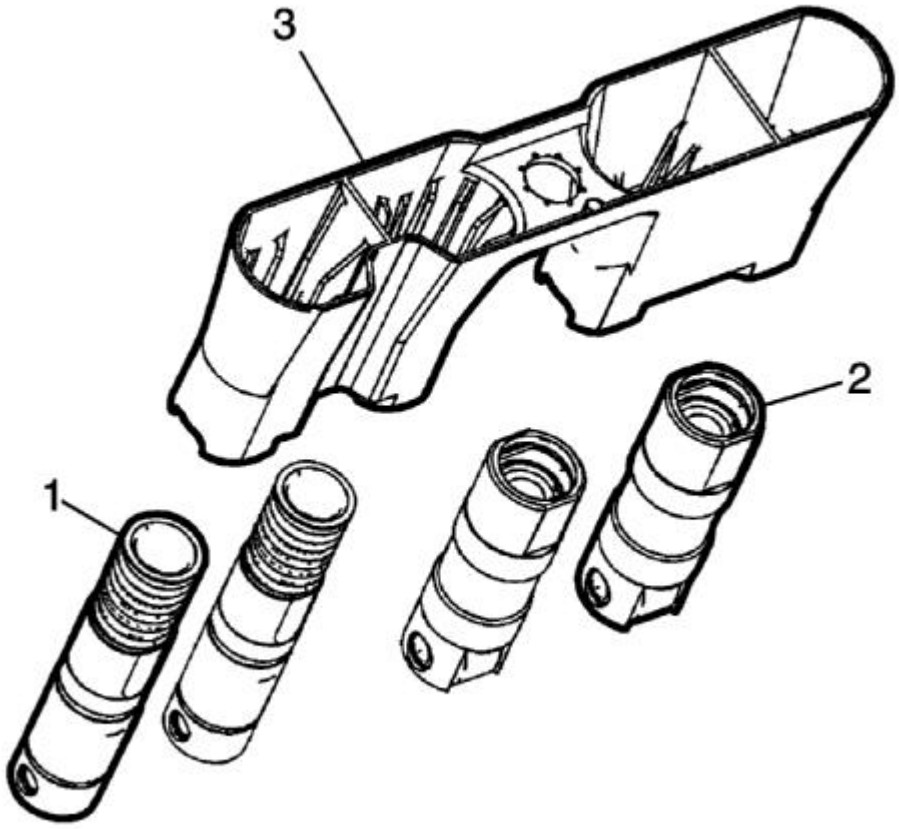


Fig. 93: Valve Lifters And Guide
Courtesy of GENERAL MOTORS COMPANY

4. Remove the valve lifters (1, 2) from the guide (3).

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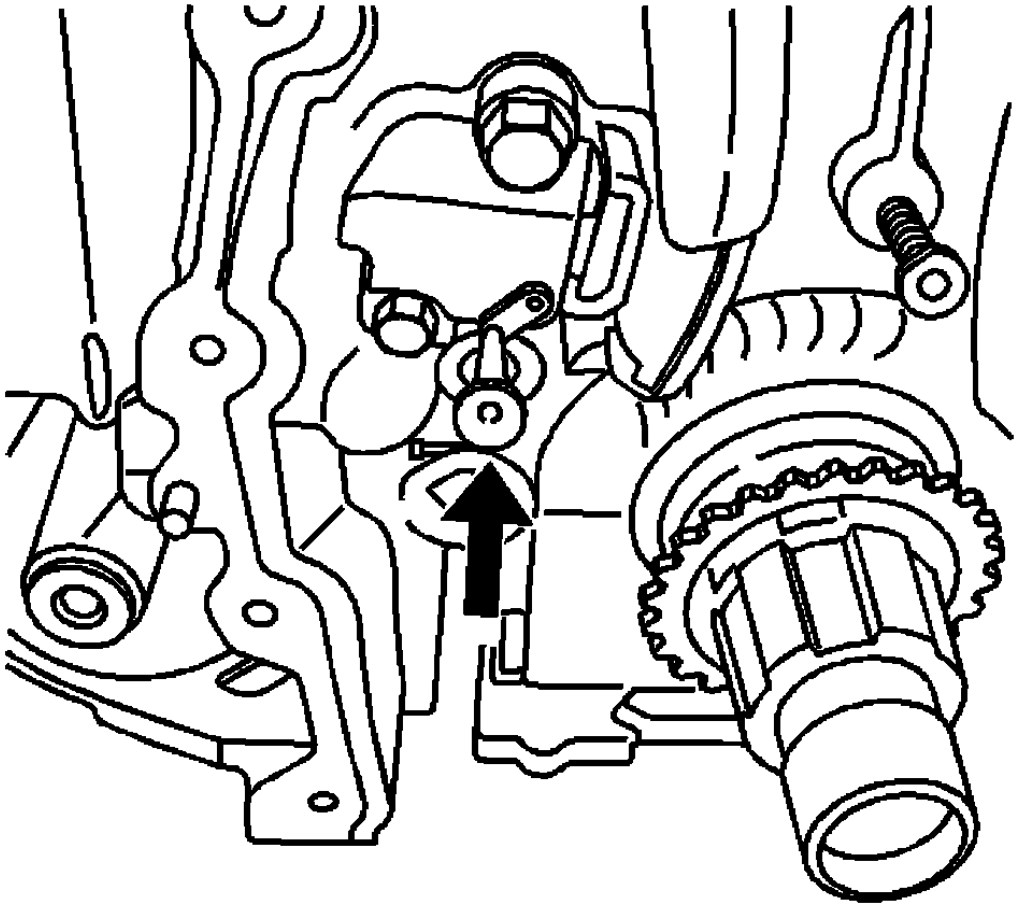


Fig. 94: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS COMPANY

5. Organize or mark the components so they can be installed in the same location from which they were removed. The active fuel management lifters (4) are installed into the guide by aligning the notched area of the guide (1) with the raised surface on the side of the lifter (2). Refer to **Separating Parts** .
6. For valve lifter and guide cleaning and inspection. Refer to **Valve Lifter and Guide Cleaning and Inspection** .

Installation Procedure

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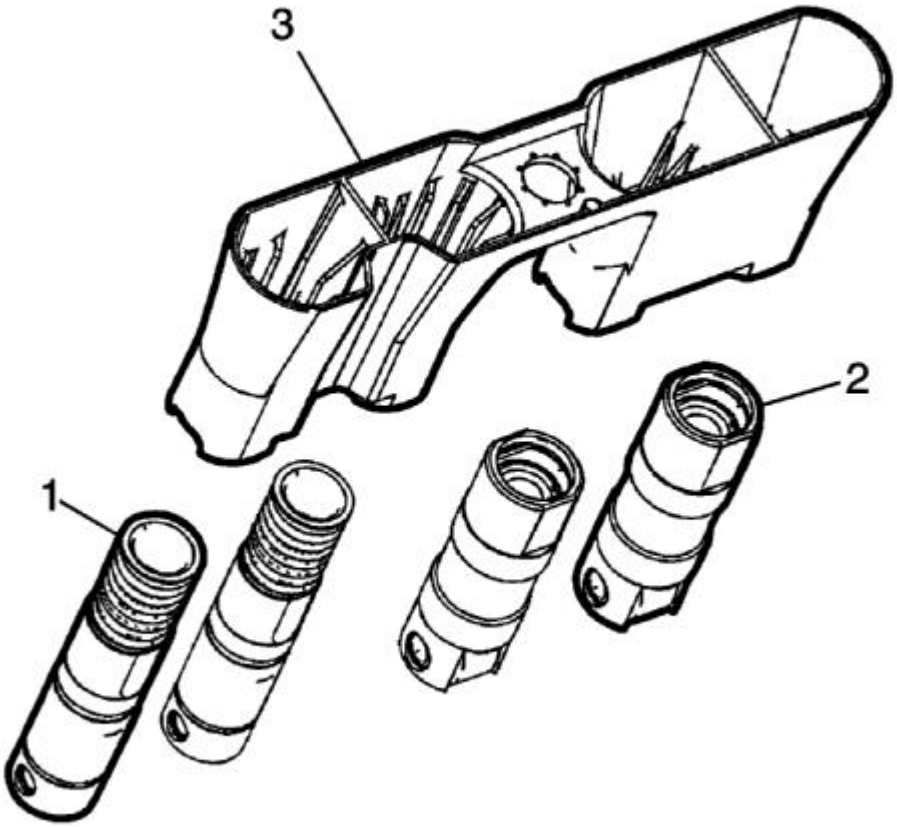


Fig. 95: Valve Lifters And Guide
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **When using the valve lifters again, install the lifters to their original locations.**
- **If camshaft replacement is required, the valve lifters must also be replaced.**
- **Each of the 4 valve guide assemblies will contain 2 active fuel management valve lifters and 2 non-active fuel management valve lifters.**
- **With the lifters and guides properly installed, cylinders 1, 4, 6 and 7 lifter bores will each contain 2 active fuel management valve lifters.**

1. Lubricate the valve lifters (1, 2) and engine block valve lifter bores with clean engine oil.

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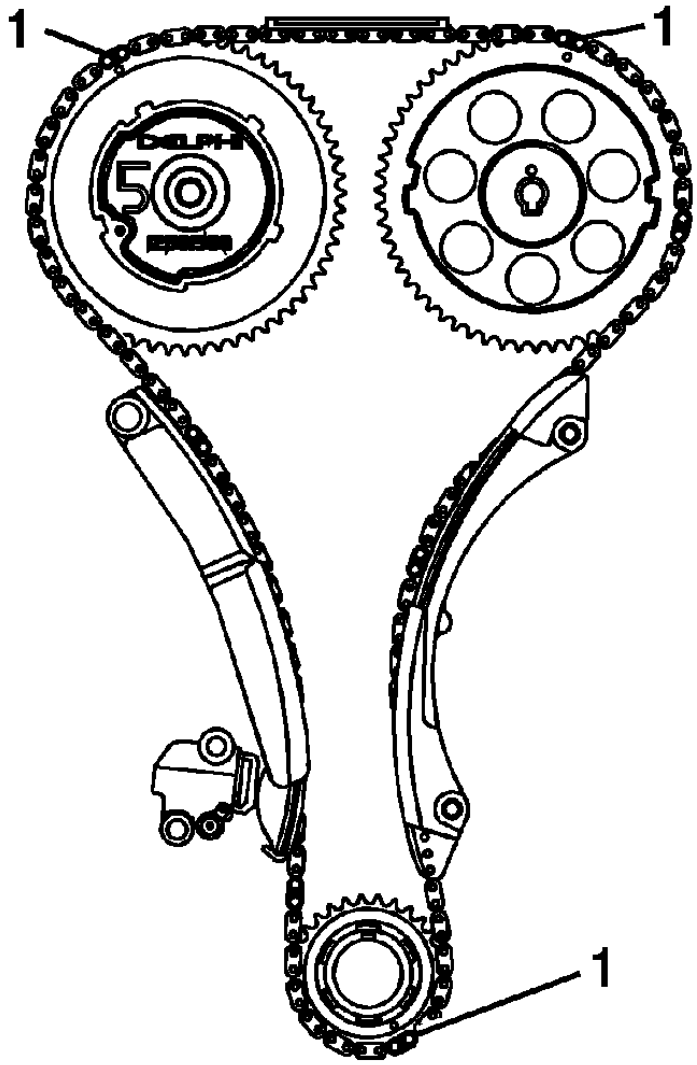


Fig. 96: Inserting Valve Lifters Into Lifter Guides
Courtesy of GENERAL MOTORS COMPANY

2. Insert the valve lifters into the lifter guides.
    - Align the flat area (3) on the top of the non-active fuel management lifter with the flat area in the lifter guide bore. Push the lifter completely into the guide bore.
    - The active fuel management lifters (4) are to be installed into the guide, with the notch in the guide (1) aligned with the raised area (2) of the lifter.

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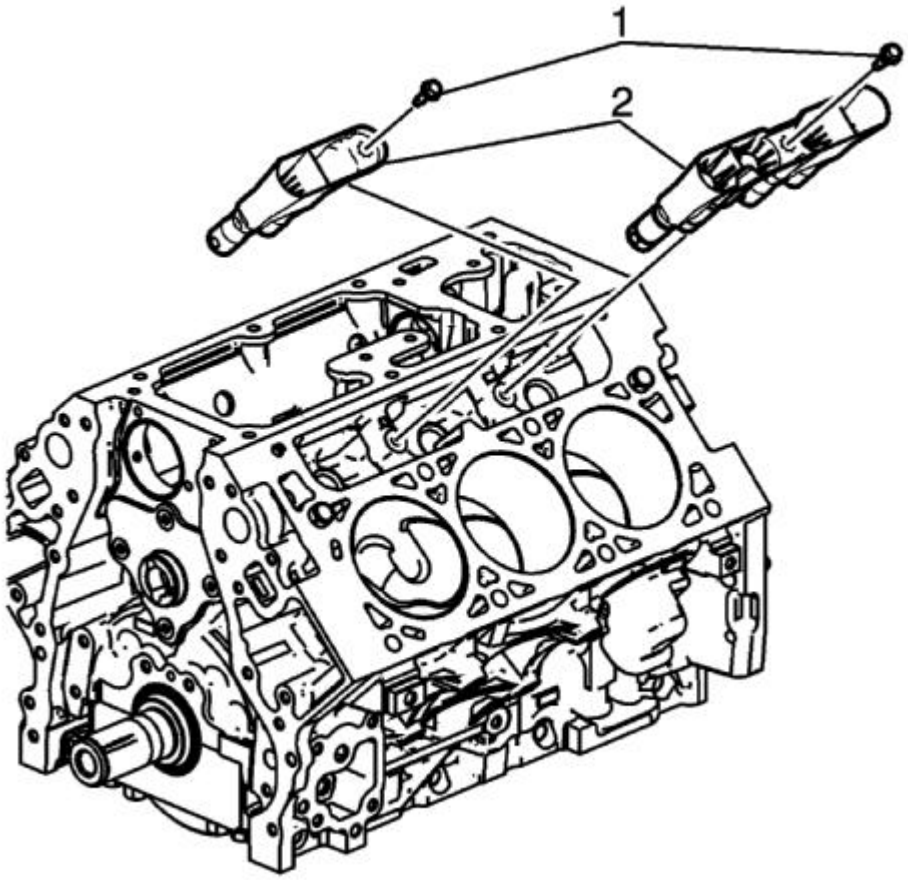


Fig. 97: Guides With Lifters And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the valve lifters and guide assembly (2) to the engine block.

CAUTION: Refer to Fastener Caution .

4. Install the valve lifter guide bolts (1) and tighten to 12 (9 lb ft).
5. Install the cylinder head. Refer to **Cylinder Head Replacement - Left Side** or **Cylinder Head Replacement - Right Side**.

BALANCER SHAFT REPLACEMENT

Special Tools

EN-46330 tension pin

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

Removal Procedure

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1. Remove engine. Refer to **Engine Replacement**.
2. Remove the balancer shaft driven. Refer to **Balancer Shaft Driven Sprocket Replacement**.

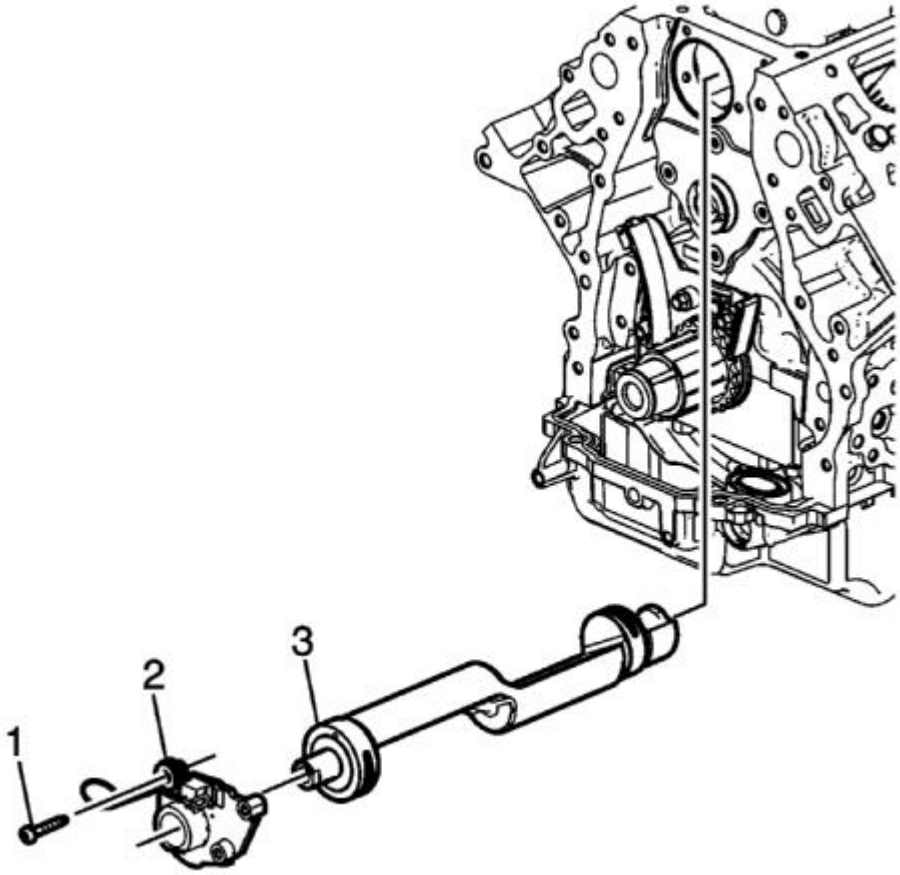


Fig. 98: Remaining Balancer Shaft Retainer Bolt And Balancer Shaft Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Remove the balancer shaft retainer bolt (1) and the balancer shaft retainer (2).
4. Remove the balancer shaft assembly (3).

Installation Procedure

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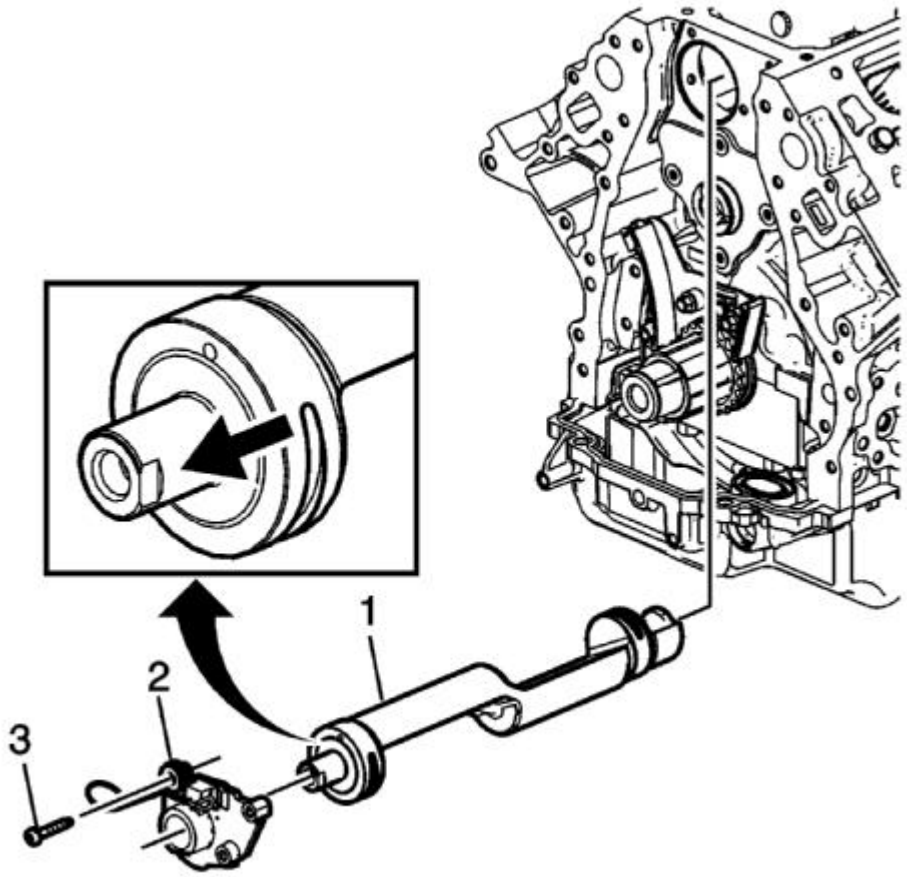


Fig. 99: Balancer Shaft And Balancer Shaft Retainer
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: Ensure the balancer shaft (1) is installed with the flat spot facing the 3 o'clock position.

1. Install the balancer shaft (1) and the balancer shaft retainer (2) with EN-46330 installed.
2. Install the 11 o'clock position balancer shaft retainer bolt (3) hand tight.
3. Install the balancer shaft driven. Refer to **Balancer Shaft Driven Sprocket Replacement**.
4. Install engine. Refer to **Engine Replacement**.

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

- **EN-41665** Crankshaft Balancer and Sprocket Installer
- **EN-41816** Crankshaft Balancer Remover

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- **EN-42386-A** Flywheel Holding Tool
- **EN-45059** Angle Meter

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

Removal Procedure

1. Remove the vacuum pump belt. Refer to **Vacuum Pump Belt Replacement**.
2. Remove the starter motor. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .

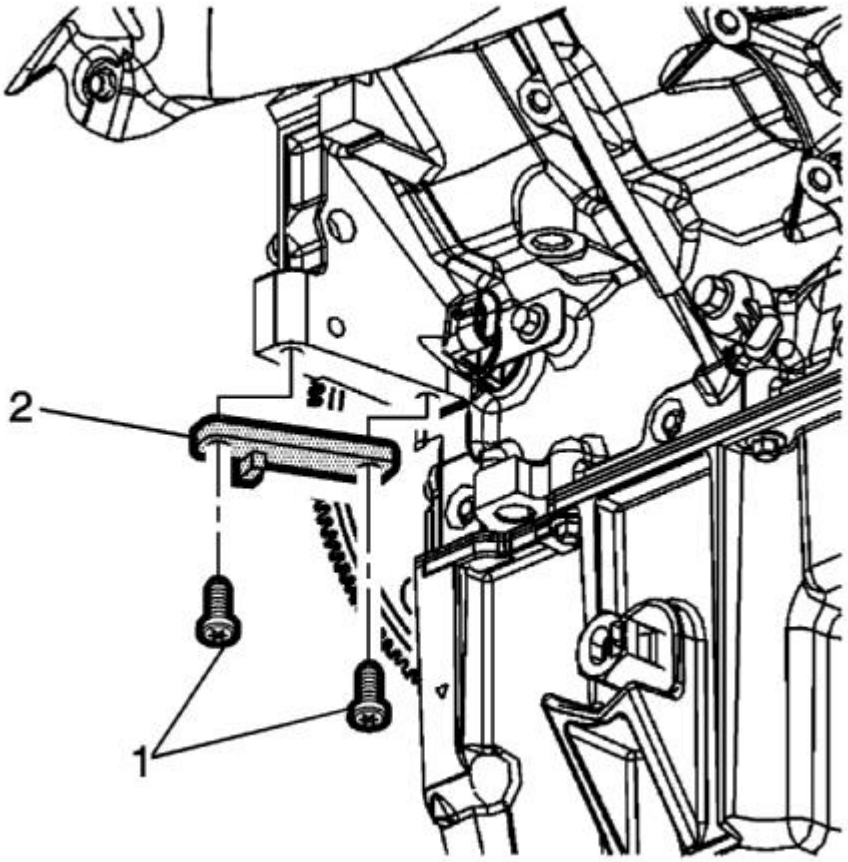


Fig. 100: EN-42386-A Flywheel Holding Tool And Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

NOTE: Ensure that the teeth of the EN-42386-A flywheel holding tool mesh with the teeth of the engine flywheel.

3. Install the **EN-42386-A** flywheel holding tool (2) and bolts. Use one M10-1.5 x 120 mm and one M10-

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1.5 x 45 mm bolt for proper tool operation. Tighten the **EN-42386-A** flywheel holding tool bolts (1) to 50 (37 lb ft).

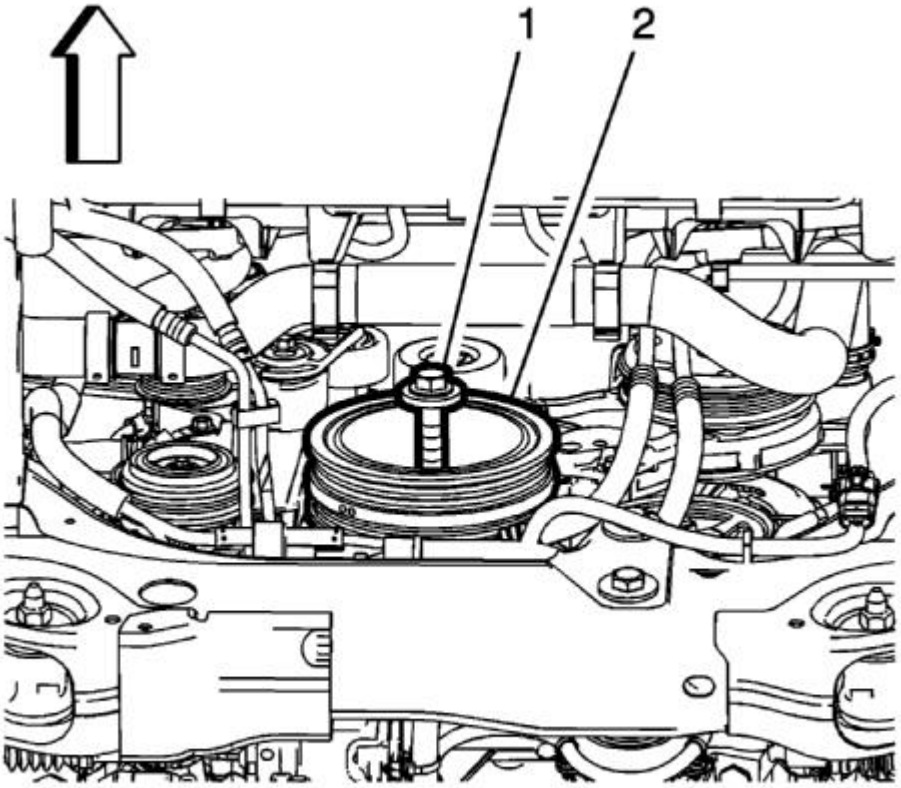


Fig. 101: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the crankshaft balancer bolt (1). Do not discard the crankshaft balancer bolt at this time. The old balancer bolt will be used during the balancer installation procedure.

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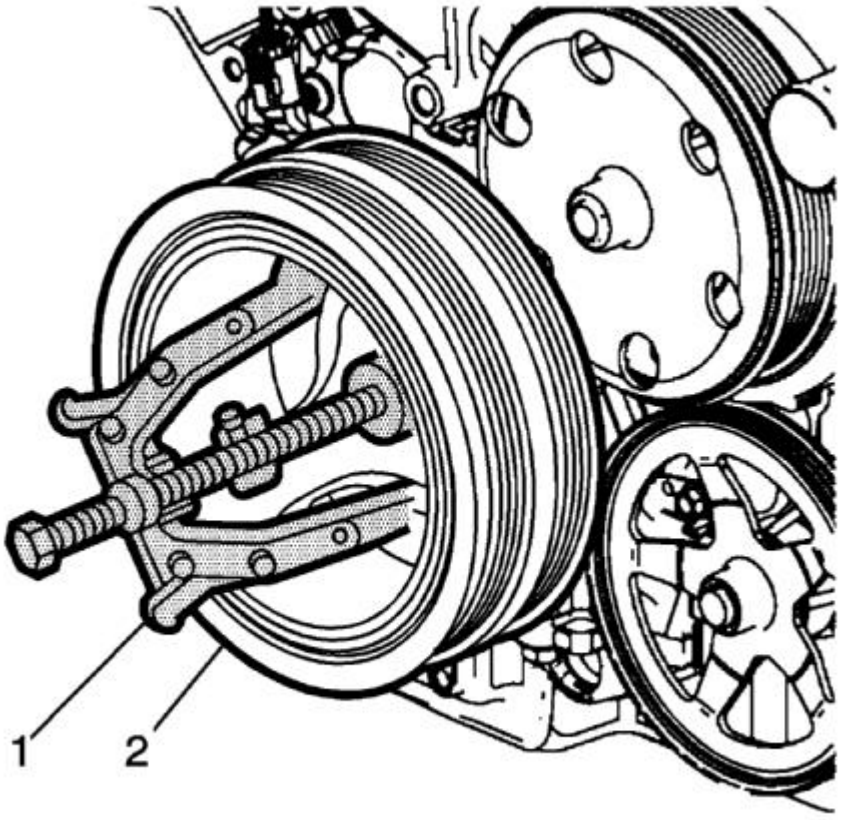


Fig. 102: EN-41816 Crankshaft Balancer Remover
Courtesy of GENERAL MOTORS COMPANY

5. Install the **EN-41816** crankshaft balancer remover (1) and **EN-41816-24** crankshaft end protector to the crankshaft balancer.
6. Remove the crankshaft balancer (2).
7. For crankshaft balancer cleaning and inspection. Refer to **Crankshaft Balancer Cleaning and Inspection** .

Installation Procedure

NOTE:

- **The crankshaft balancer installation and bolt tightening involves a four stage tightening process. The first pass ensures that the balancer is installed completely onto the crankshaft. The second, third and fourth passes tighten the NEW bolt to the proper torque.**
- **The used crankshaft balancer bolt will be used ONLY during the first pass of the balancer installation procedure. Install a NEW bolt and tighten as described in the second, third and fourth passes of the balancer bolt tightening procedure.**

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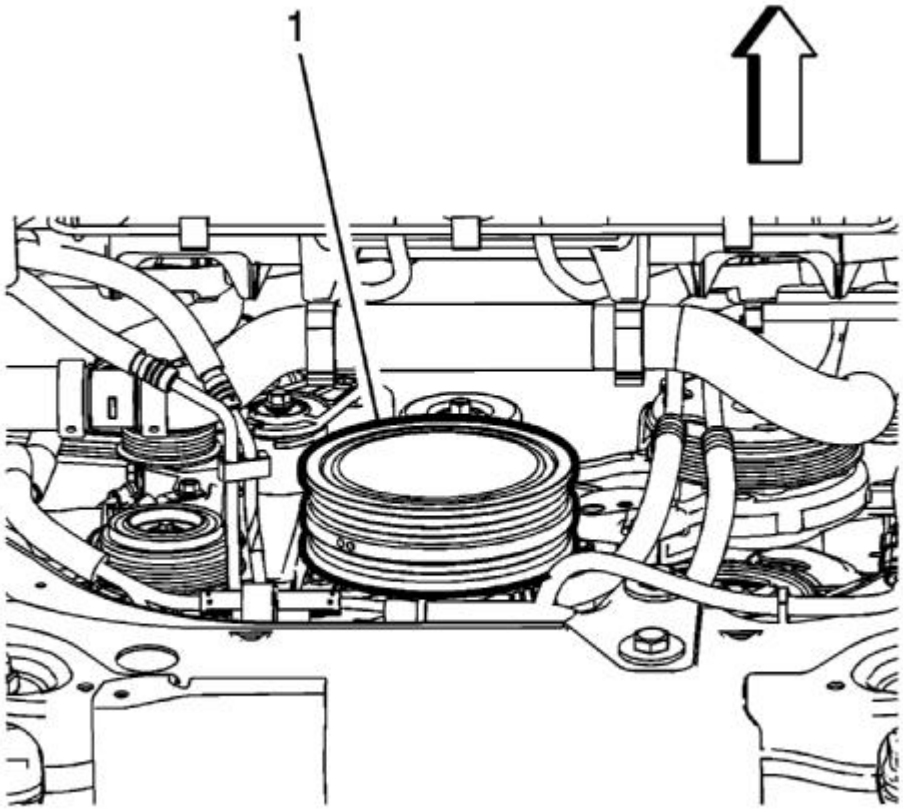


Fig. 103: Crankshaft Balancer
Courtesy of GENERAL MOTORS COMPANY

NOTE: The balancer should be positioned onto the end of the crankshaft as straight as possible prior to tool installation.

1. Position the crankshaft balancer (1) onto the end of the crankshaft.

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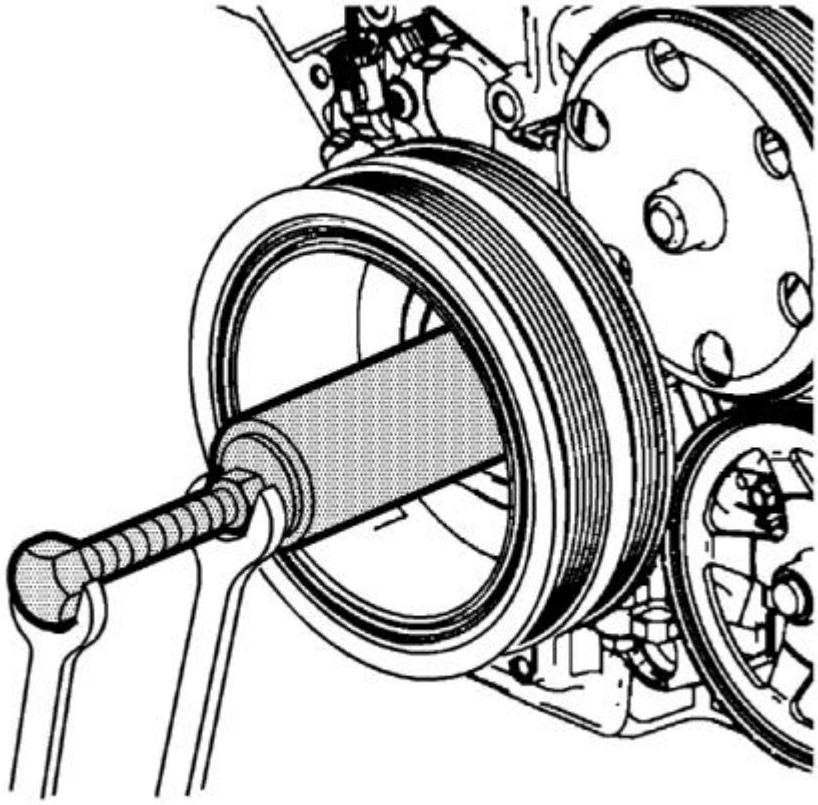


Fig. 104: Crankshaft Balancer And Crankshaft Front Oil Seal Installer
Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-41665** crankshaft balancer and sprocket installer and the threaded rod from the **EN-41478** crankshaft front oil seal installer to crankshaft balancer and install the balancer.
    1. Assemble the threaded rod, nut, washer and installer. Insert the smaller end of the installer into the front of the balancer.
    2. Use a wrench and hold the hex end of the threaded rod.
    3. Use a second wrench and rotate the installation tool nut clockwise until the balancer is started onto the crankshaft.
    4. Remove the tool and reverse the installation tool.

       Position the larger end of the installer against the front of the balancer.

    5. Use a wrench and hold the hex end of the threaded rod.
    6. Use a second wrench and rotate the installation tool nut clockwise until the balancer is installed onto the crankshaft.
    7. Remove the **J 41665** crankshaft balancer and sprocket installer and the threaded rod.

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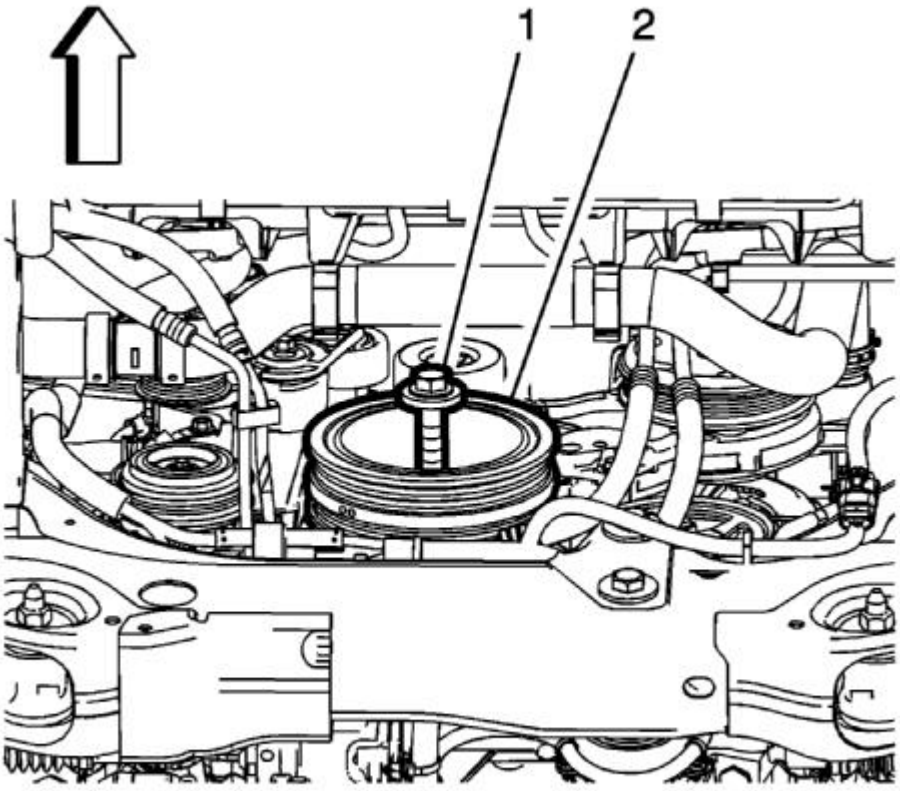


Fig. 105: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install the USED crankshaft balancer bolt (1). Tighten the USED bolt to 330 (240 lb ft).
4. Remove the USED crankshaft balancer bolt.

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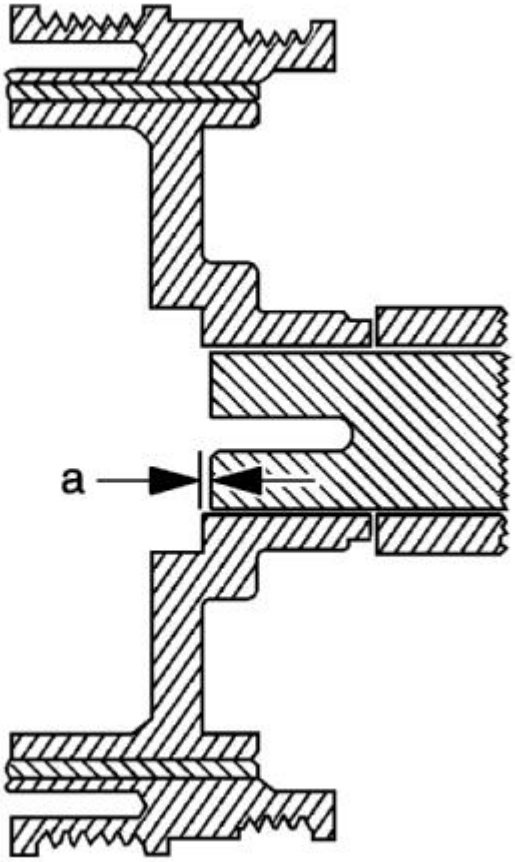


Fig. 106: EN-41665 Crankshaft Balancer And Sprocket Installer
Courtesy of GENERAL MOTORS COMPANY

NOTE: The nose of the crankshaft should be recessed 2.4-4.48 mm (0.094-0.176 in) into the balancer bore.

5. Measure for a correctly installed balancer. If the balancer is not installed to the proper dimension, install the **EN-41665** crankshaft balancer and sprocket installer and repeat the installation procedure.

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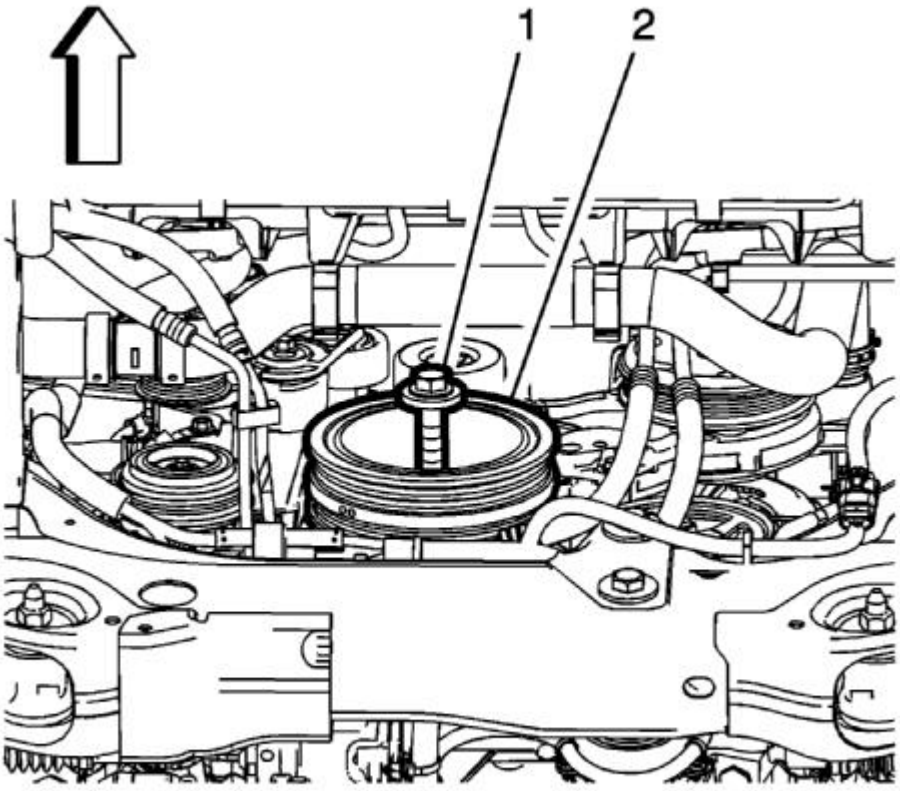


Fig. 107: Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS COMPANY

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

6. Install the NEW crankshaft balancer bolt (1).
    1. Tighten the bolt a first pass to 120 (89 lb ft).
    2. Loosen 360 degrees.
    3. Tighten the bolt a second pass to 80 (59 lb ft).
    4. Tighten the bolt a final pass to 200 degrees using **EN-45059** angle meter.

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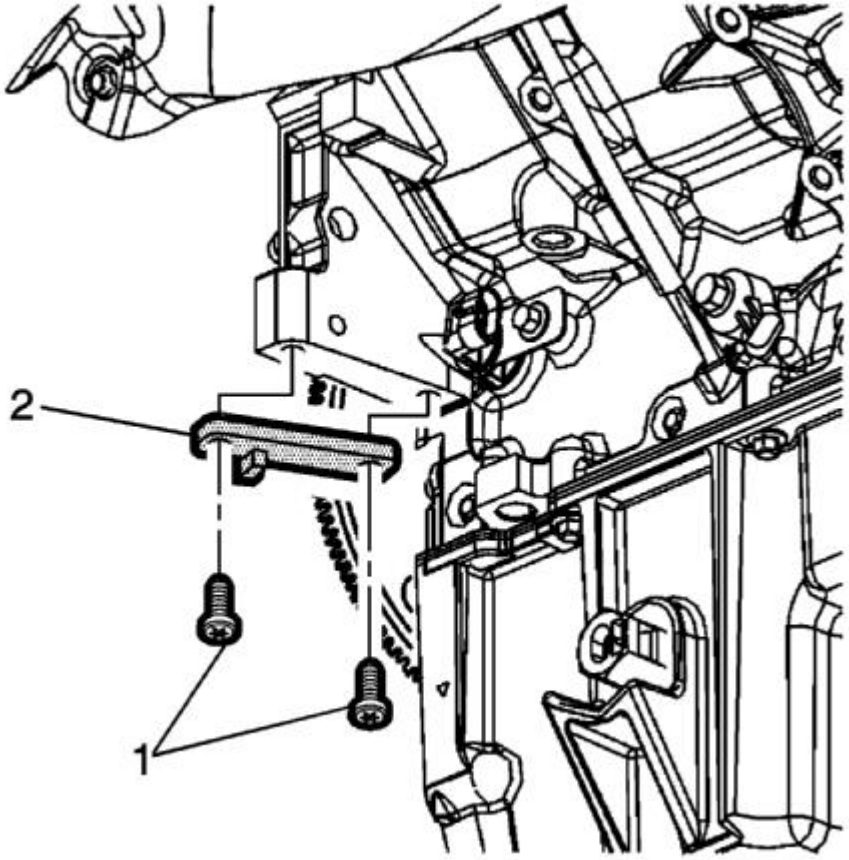


Fig. 108: EN-42386-A Flywheel Holding Tool And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the **EN-42386-A** flywheel holding tool (2) and bolts.
8. Install the starter motor. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .
9. Install the vacuum pump belt. Refer to **Vacuum Pump Belt Replacement**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tools

- **J-41478-A** Crankshaft Front Oil Seal Installer
- **EN-51091** Crankshaft Front Oil Seal Installer

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

Removal Procedure

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

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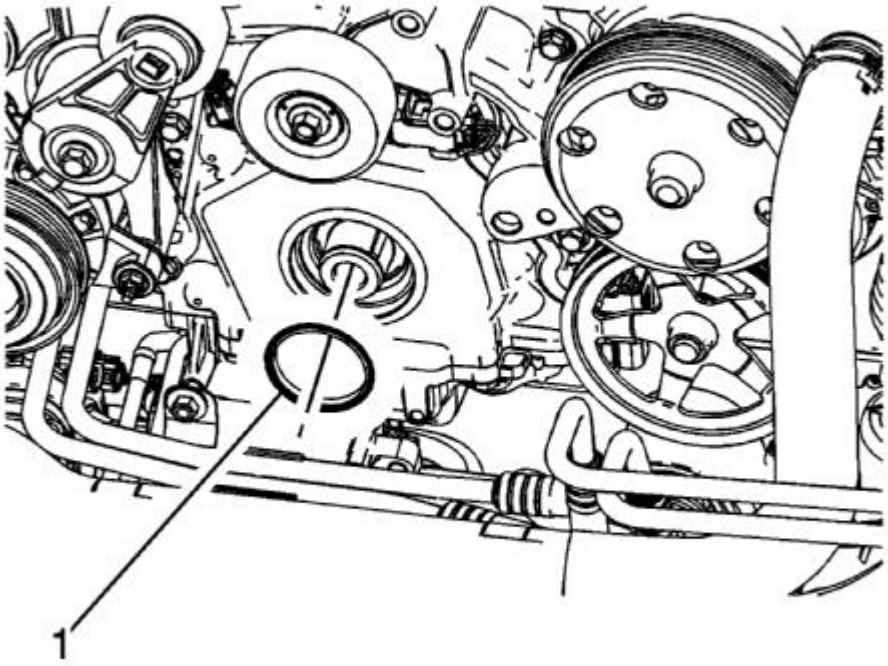


Fig. 109: Crankshaft Front Oil Seal And Front Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use suitable tool to remove the crankshaft front seal.

2. Remove the crankshaft front oil seal (1) from the front cover.

Installation Procedure

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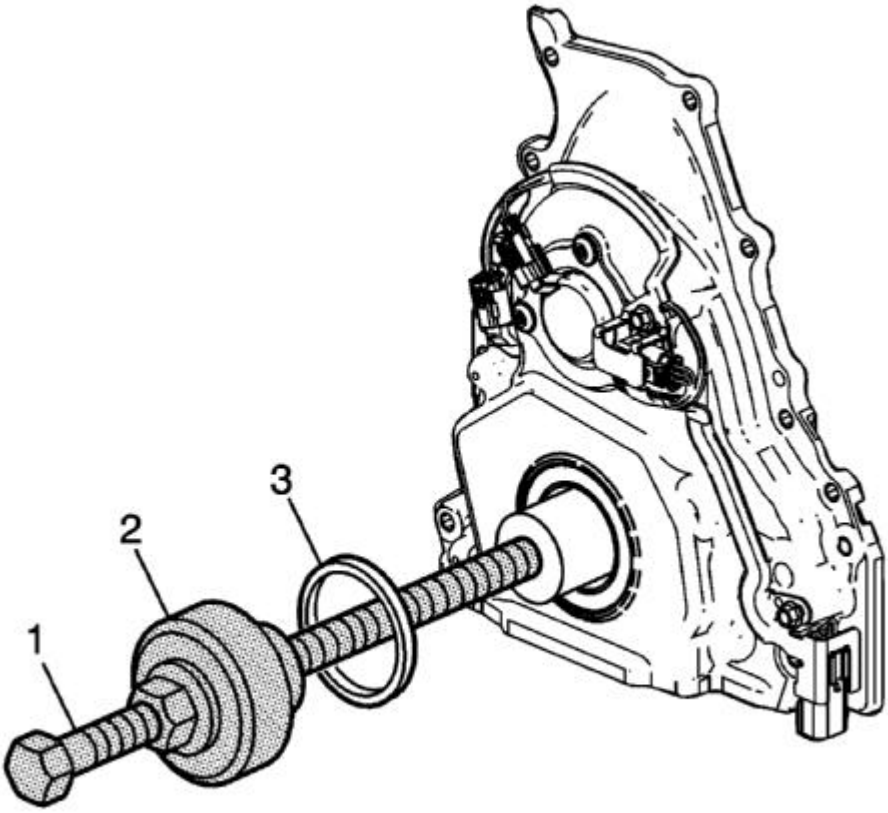


Fig. 110: Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install the crankshaft front oil seal (3) onto the threaded rod, nut and washer from **J-41478-A** crankshaft front oil seal installer (1) and **EN-51091** crankshaft front oil seal installer (2).
2. Install the **J-41478-A** crankshaft front oil seal installer threaded rod, nut and washer (1) and **EN-51091** crankshaft front oil seal installer (2) and oil seal (3), into the end of the crankshaft.
3. Use the **J-41478-A** crankshaft front oil seal installer (1) and **EN-51091** crankshaft front oil seal installer (2) in order to install the oil seal (3) into the cover bore.
    1. Use a wrench and hold the hex on the installer bolt.
    2. Use a second wrench and rotate the installer nut clockwise until the seal bottoms in the cover bore.
    3. Remove the tool.
    4. Inspect the oil seal for proper installation. The oil seal should be installed evenly and completely into the front cover bore.
4. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

ENGINE FRONT COVER REPLACEMENT

Removal Procedure

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1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Remove the vacuum pump. Refer to **Vacuum Pump Belt Replacement**.
3. Remove the engine coolant manifold. Refer to **Engine Coolant Manifold Replacement (LV3)** .
4. Remove the A/C compressor. Refer to **Air Conditioning Compressor Replacement (LV3)** .

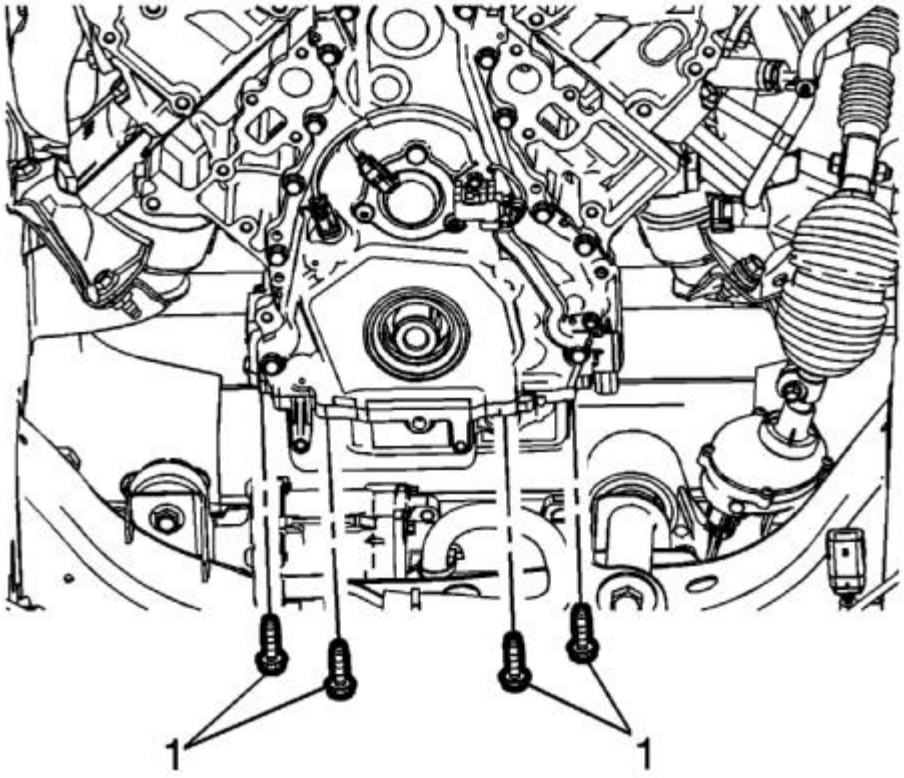


Fig. 111: Oil Pan-To-Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil pan-to-front cover bolts (1).
6. Disconnect electrical connectors as necessary.

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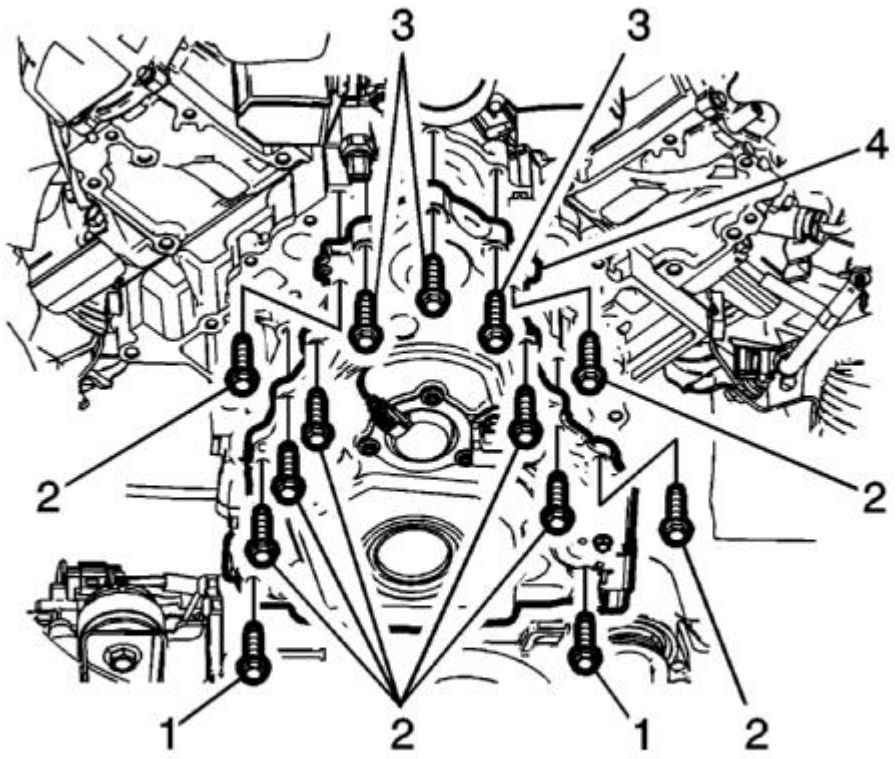


Fig. 112: Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove the front cover bolts (1-3).
8. Remove front cover (4).
9. Ensure to clean and inspect the engine front cover. Refer to **Engine Front Cover Cleaning and Inspection** .

Installation Procedure

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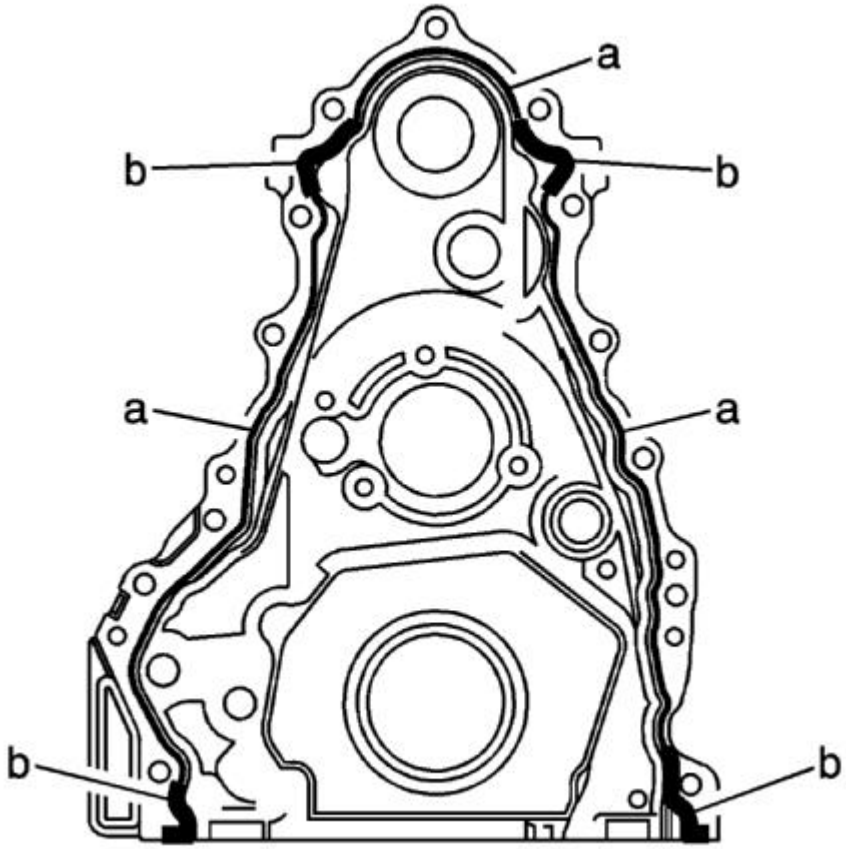


Fig. 113: Applying 3 mm (0.118 in) Bead Of RTV Sealant On Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

1. Apply a 3 mm (0.118 in)bead of RTV sealant on the engine front cover as shown (a). Apply a 5 mm (0.197 in)bead of RTV sealant on the engine front cover as shown (b). Refer to **Adhesives, Fluids, Lubricants and Sealers** .

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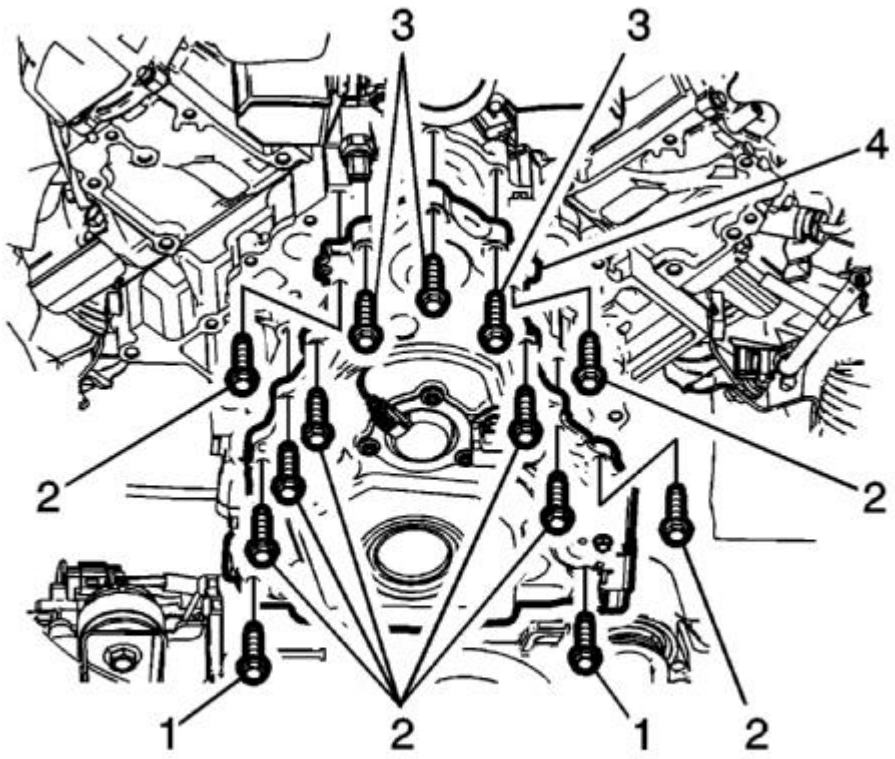


Fig. 114: Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the front cover (4).

CAUTION: Refer to Fastener Caution .

3. Install the front cover bolts (1-3) and tighten to 25 (18 lb ft).

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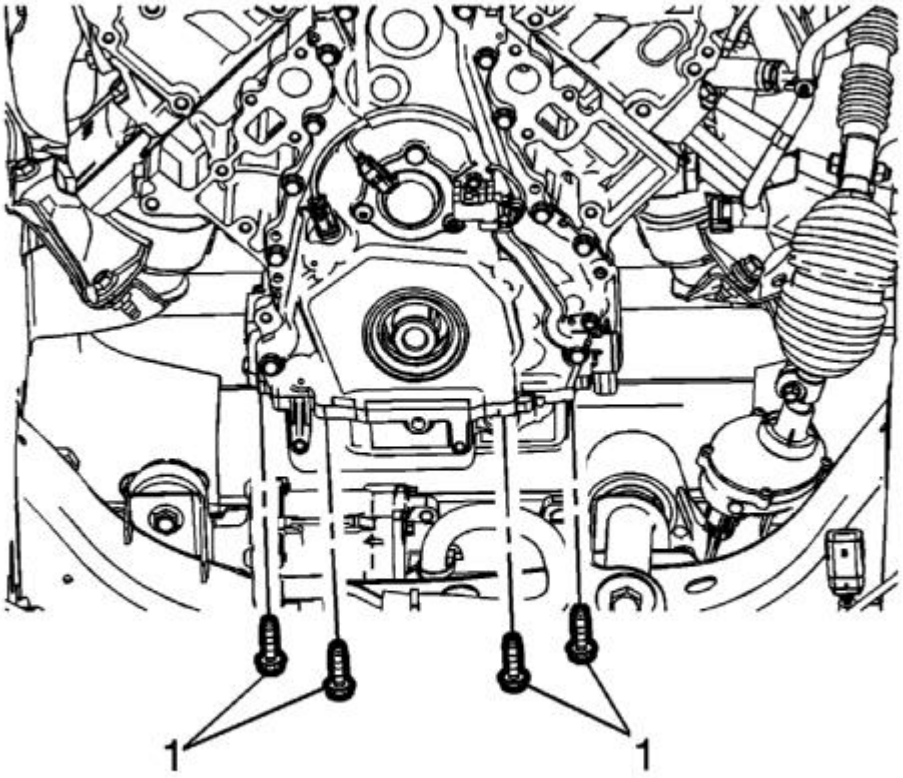


Fig. 115: Oil Pan-To-Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the oil pan-to-front cover bolts (1) and tighten to 25 (18 lb ft)
5. Connect electrical connectors as necessary.
6. Install the engine coolant manifold. Refer to **Engine Coolant Manifold Replacement (LV3)** .
7. Install the vacuum pump. Refer to **Vacuum Pump Belt Replacement**.
8. Install the A/C compressor. Refer to **Air Conditioning Compressor Replacement (LV3)** .
9. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

OIL PUMP REPLACEMENT

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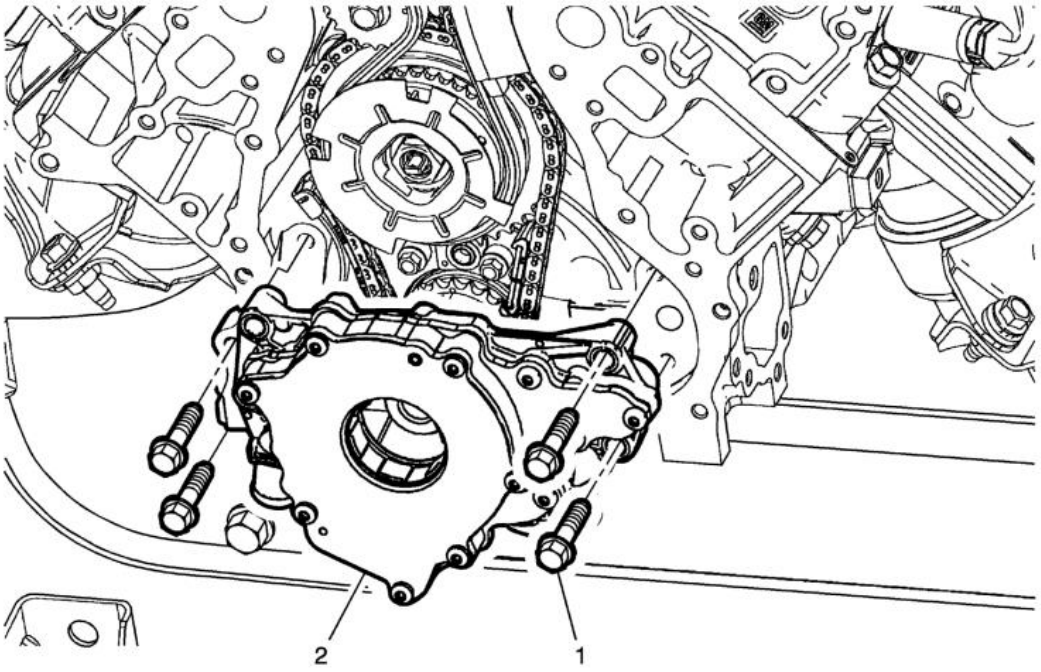


Fig. 116: Oil Pump
Courtesy of GENERAL MOTORS COMPANY

Oil Pump Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**. 2. Remove the oil pan. Refer to **Oil Pan Replacement**.	
1	Oil Pump Fastener (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **Procedure** For oil pump tighten sequence. Refer to **Oil Pump Installation (with AFM)** , **Oil Pump Installation (without AFM)** . **NOTE:** **Upward pressure must be applied to the oil pump while tightening the fasteners** **Tighten** 25 (18 lb ft)

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2	Oil Pump **Procedure** For oil pump cleaning and inspection. Refer to **Oil Pump Cleaning and Inspection** .

OIL FILTER CENTER TUBE REPLACEMENT

Removal Procedure

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

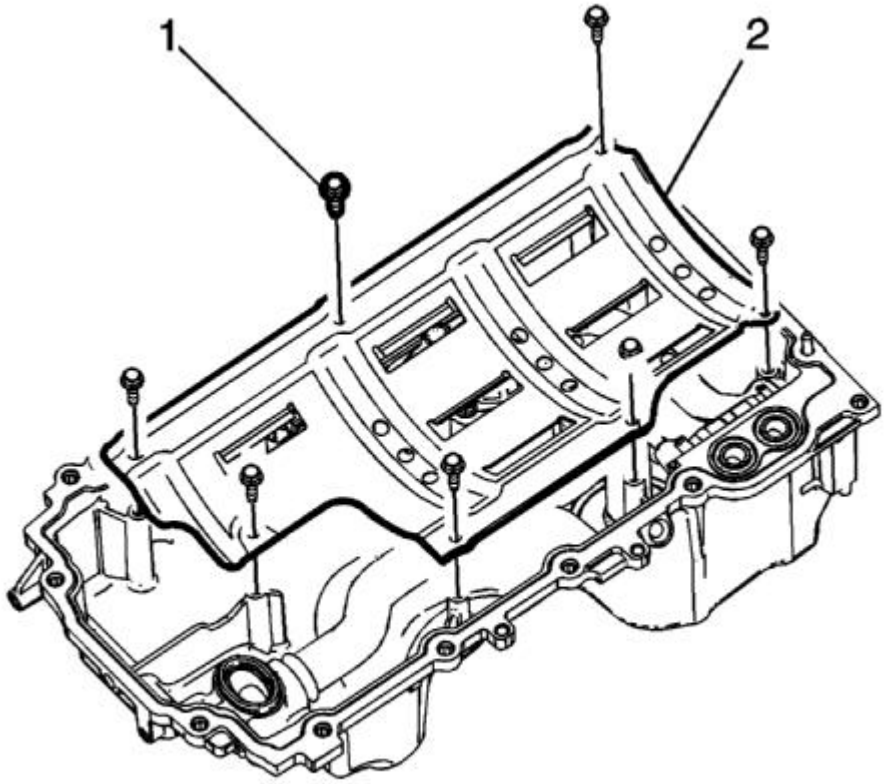


Fig. 117: Crankshaft Oil Deflector Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the crankshaft oil deflector bolts (1).
3. Remove the crankshaft oil deflector (2).

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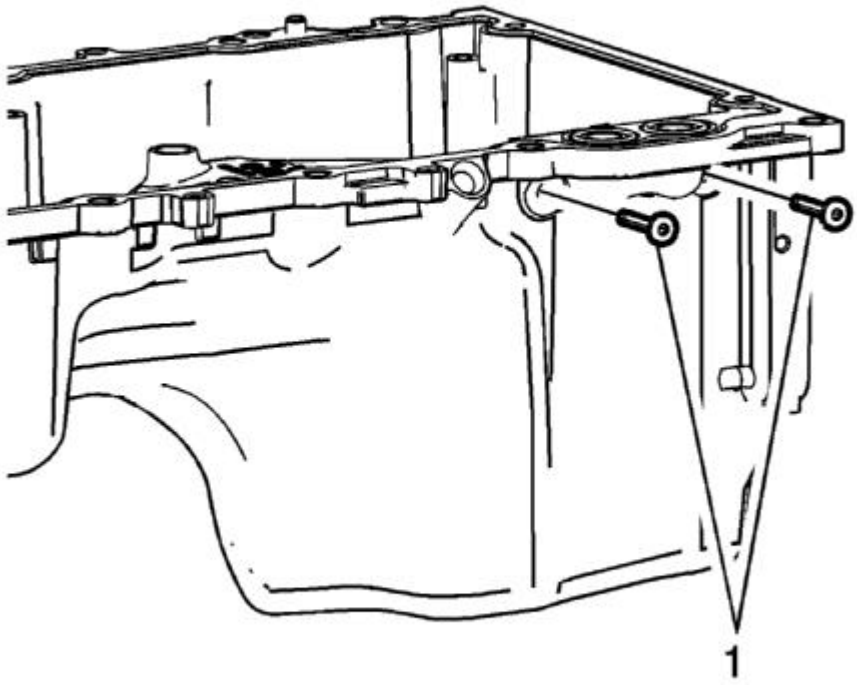


Fig. 118: Oil Filter Center Tube Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil filter center tube bolts (1)

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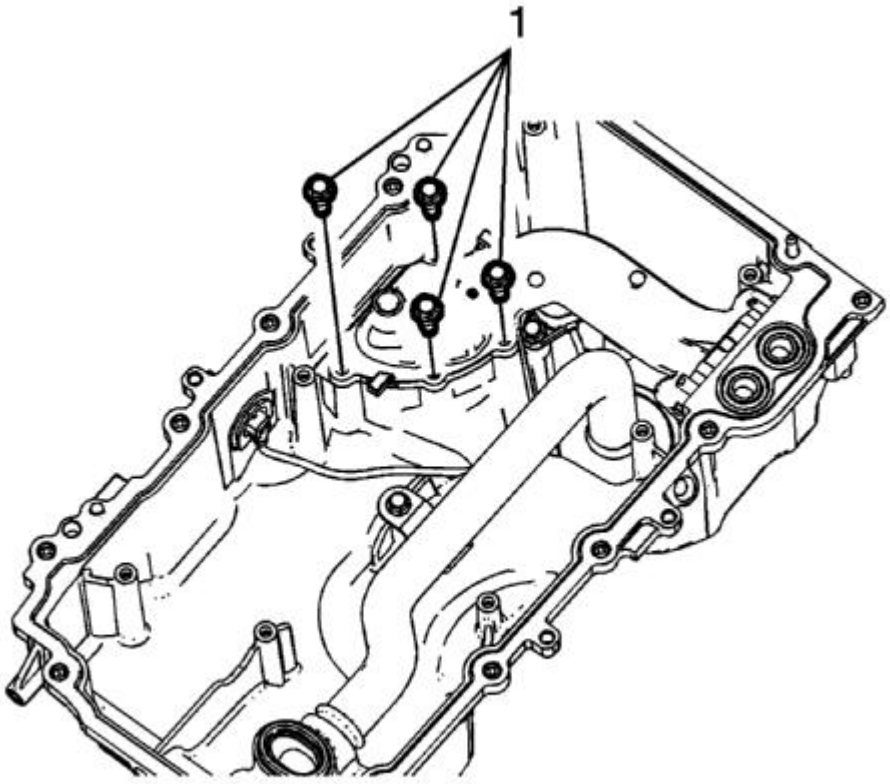


Fig. 119: Oil Filter Center Tube Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil filter center tube bolts (1).

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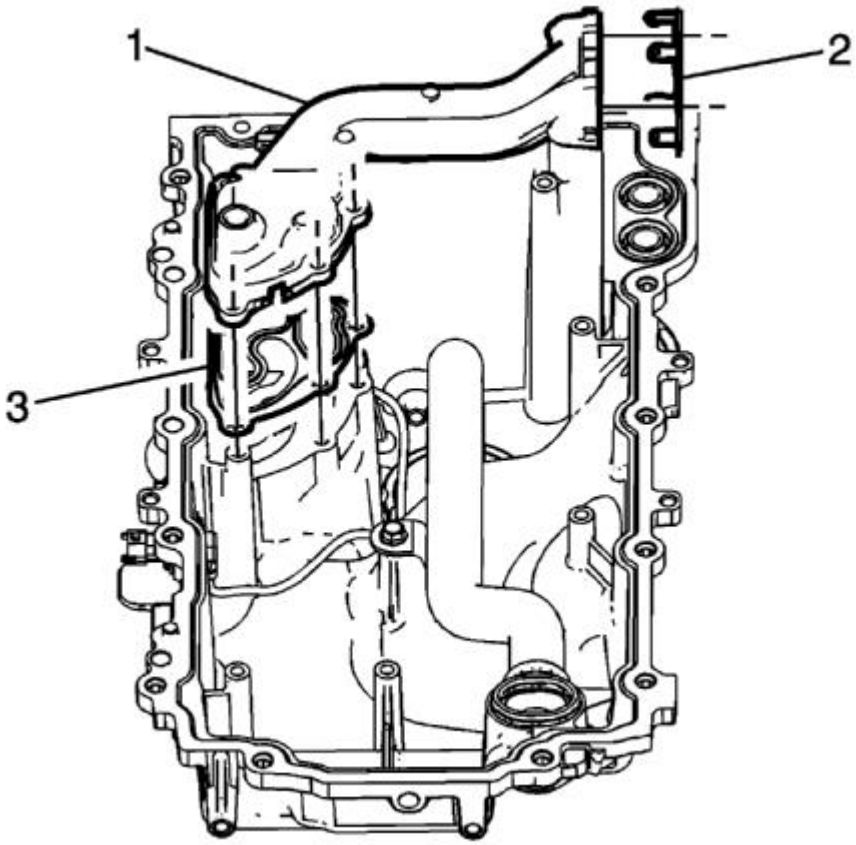


Fig. 120: Oil Filter Center Tube
Courtesy of GENERAL MOTORS COMPANY

6. Remove the oil filter center tube (1).
7. Remove the and DISCARD oil filter center tube gasket (2, 3).

Installation Procedure

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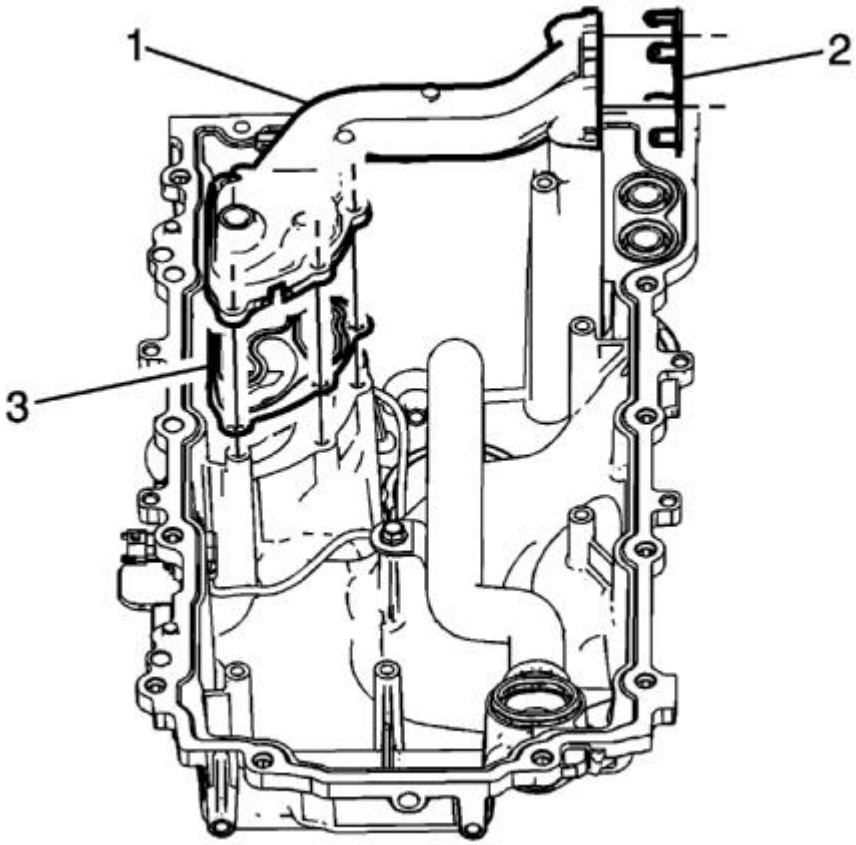


Fig. 121: Oil Filter Center Tube
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW oil filter center tube gasket (2, 3).
2. Install the oil filter center tube (1).

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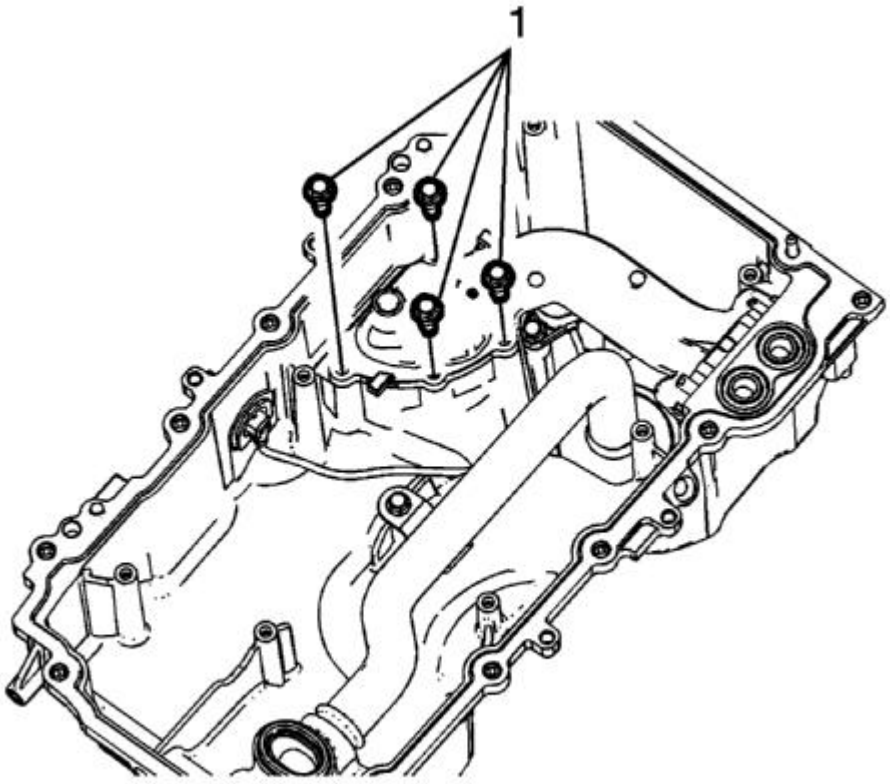


Fig. 122: Oil Filter Center Tube Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the oil filter center tube bolts (1) and tighten to 10 (89 lb in).

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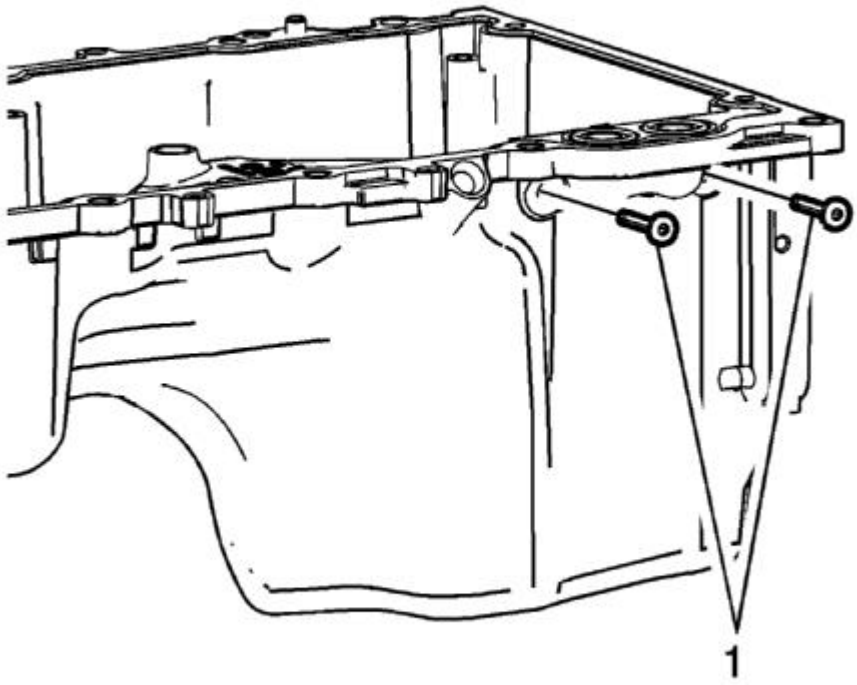


Fig. 123: Oil Filter Center Tube Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Install the oil filter center tube bolts (1) and tighten to 10 (89 lb in).

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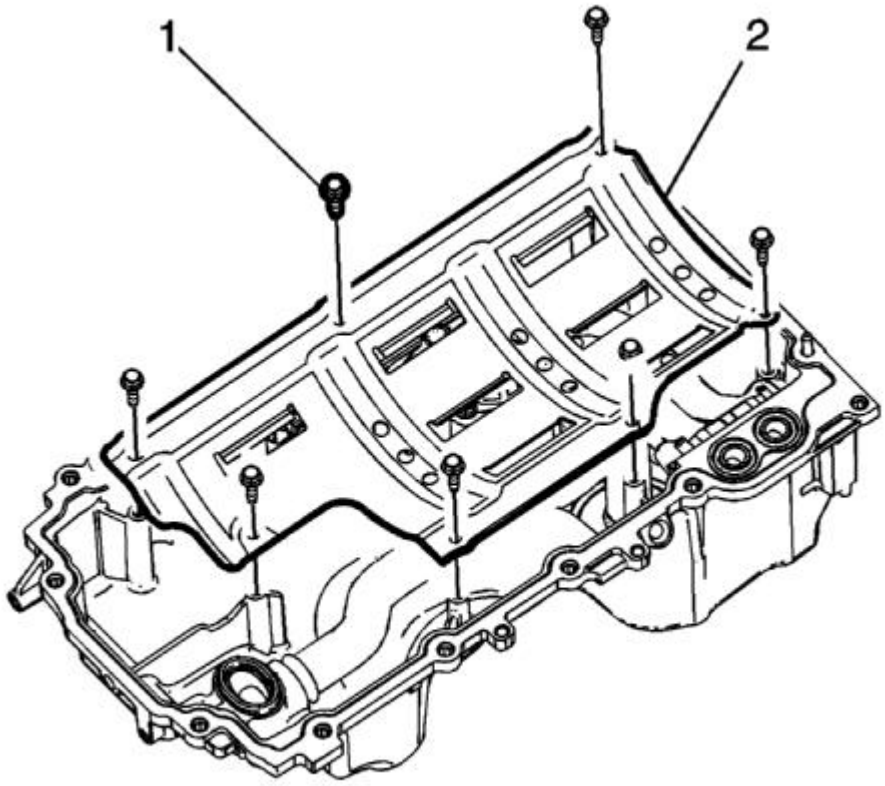


Fig. 124: Crankshaft Oil Deflector Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install the crankshaft oil deflector (2).
6. Install the crankshaft oil deflector bolts (1) and tighten to 10 (89 lb in)
7. Install the oil pan. Refer to **Oil Pan Replacement**.

OIL PUMP FLOW CONTROL SOLENOID VALVE REPLACEMENT

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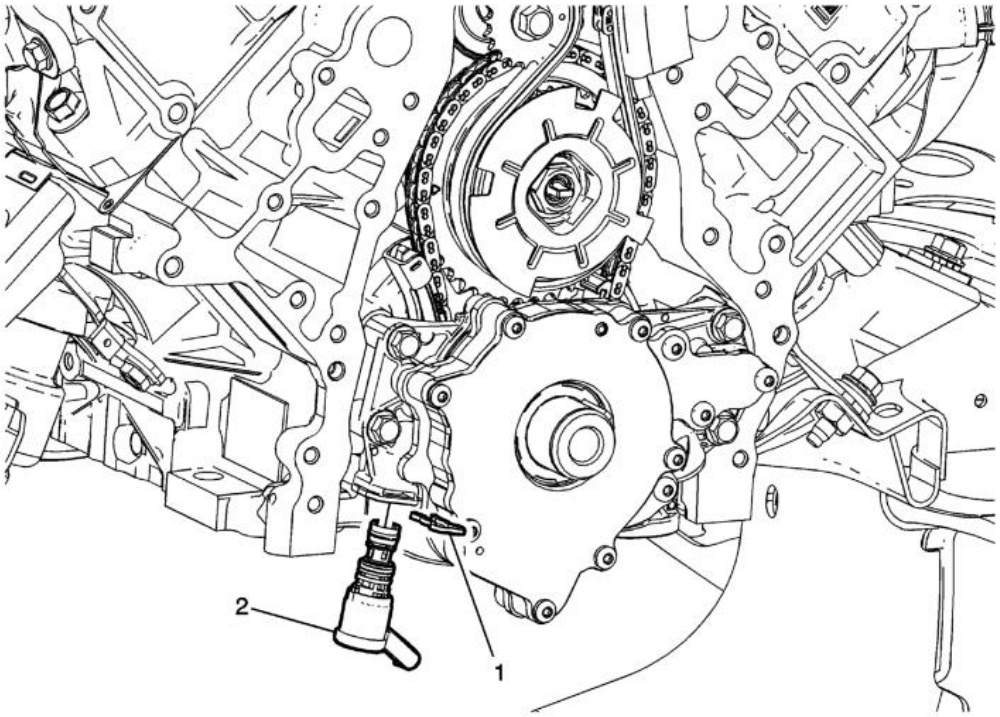


Fig. 125: Oil Pump Flow Control Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

Oil Pump Flow Control Solenoid Valve Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**. 2. Remove the oil pan. Refer to **Oil Pan Replacement**.	
1	Oil Pump Flow Control Solenoid Valve Clip
2	Oil Pump Flow Control Solenoid Valve **Procedure** Disconnect the electrical connectors as necessary.

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT

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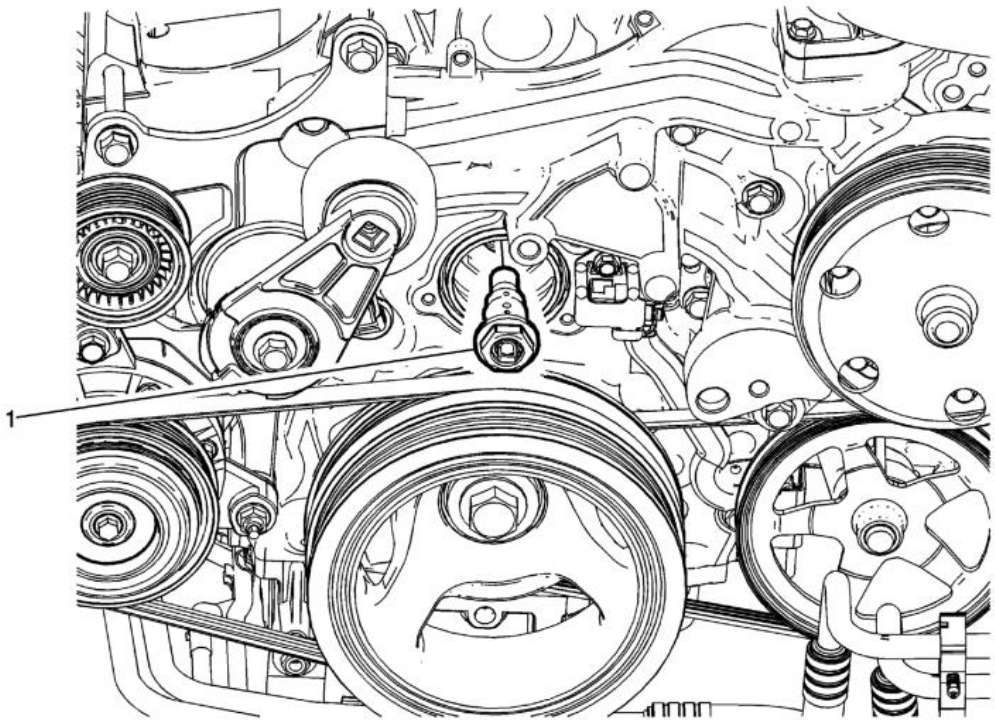


Fig. 126: Camshaft Position Actuator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

Camshaft Position Actuator Solenoid Valve Replacement

Callout	Component Name
Preliminary Procedure Remove the camshaft position actuator-Magnet. Refer to **Camshaft Position Actuator Replacement (Magnet)** .	
1	Camshaft Position Actuator Solenoid Valve **WARNING:** **Refer to Camshaft Position Actuator Removal and Installation Warning .** **CAUTION:** **Refer to Component Fastener Tightening Caution .** **CAUTION:** **The camshaft position actuator solenoid valves must be kept parallel to the engine front cover during removal and installation. The camshaft position actuator solenoid valves can be damaged if they become wedged or stuck during this process.** **Tighten** 1. First pass 65 (48 lb ft).

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	2. Final pass 90 degrees. **J 45059** Angle Meter For equivalent regional tools, refer to **Special Tools** .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Special Tools

- **EN-51096** Crankshaft Rear Seal Remover
- **GE-23907-1** Slide Hammer
- **EN-41479** Crankshaft Rear Oil Seal Installer
- **EN-41479-2A** Crankshaft Rear Oil Seal Installation Guide
- **EN-41479-10** Crankshaft Rear Oil Seal Installer Adapter

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

Removal Procedure

1. If equipped with an automatic transmission, remove the automatic transmission flexplate. Refer to **Automatic Transmission Flex Plate Replacement**
2. If equipped with a manual transmission, remove the flywheel. Refer to **Engine Flywheel Replacement**.

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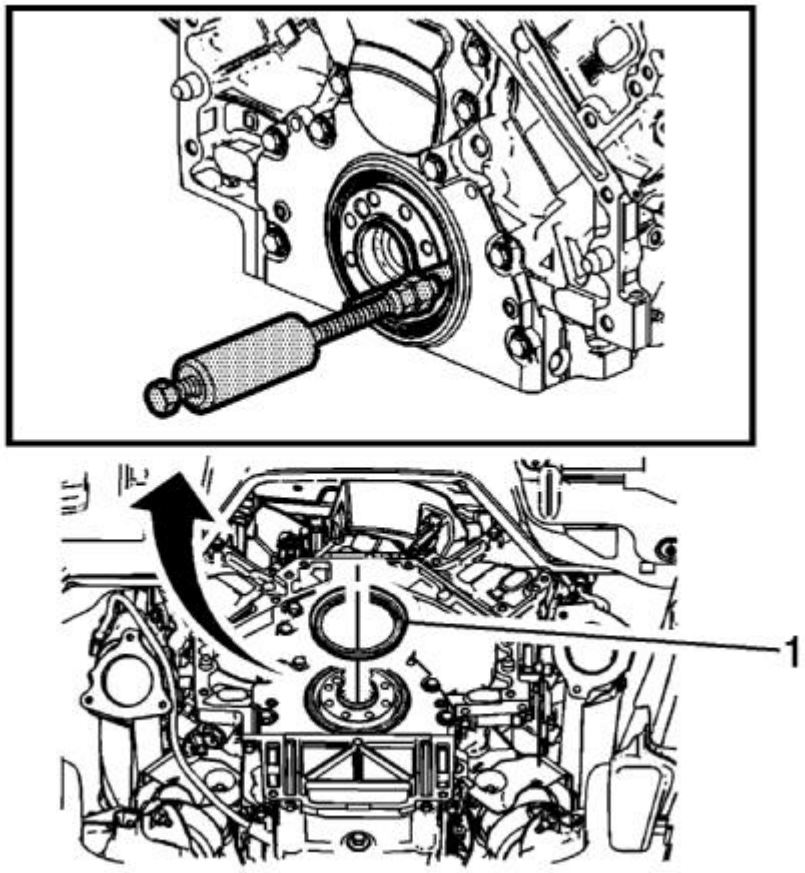


Fig. 127: EN-51096 Crankshaft Rear Seal Remover
Courtesy of GENERAL MOTORS COMPANY

NOTE: EN-51096 crankshaft rear seal remover has two ends. The end with the small bend will be used to remove the seal.

3. Install **EN-51096** crankshaft rear seal remover onto **GE-23907-1** slide hammer.
4. Slide the small bend of **EN-51096** crankshaft rear seal remover between the lip of the rear seal and crankshaft. Ensure that the small bend of **EN-51096** crankshaft rear seal remover engages the rear side of the rear seal (1). While rotating **EN-51096** crankshaft rear seal remover and **GE-23907-1** slide hammer around the seal and use the slide hammer to remove the seal.
5. Remove and DISCARD the crankshaft rear oil seal (1).

Installation Procedure

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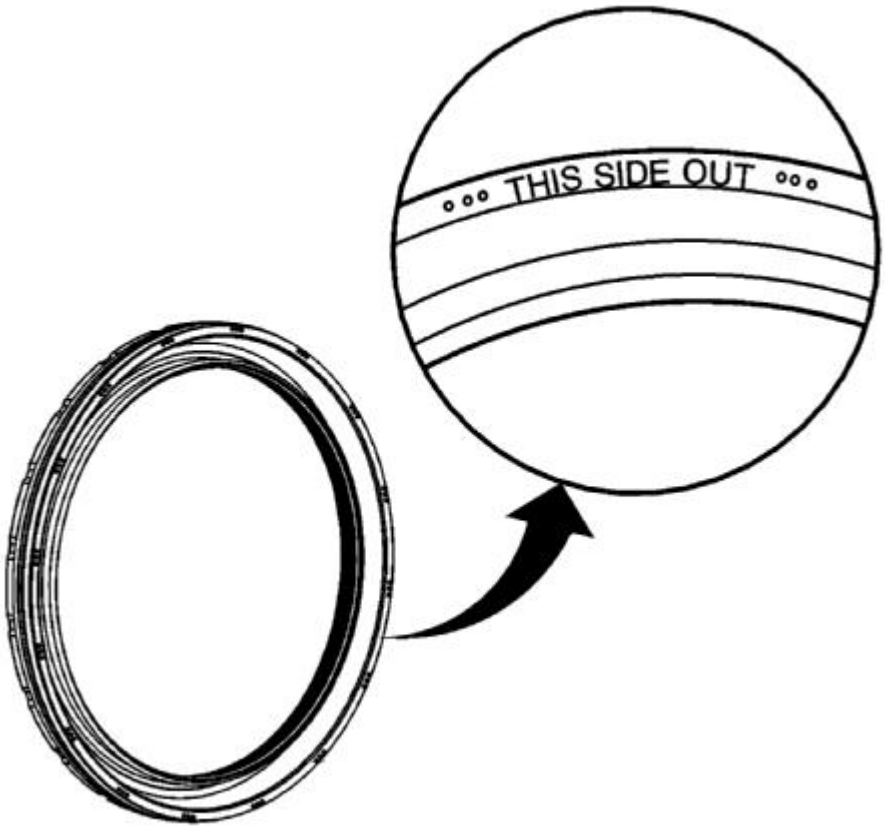


Fig. 128: Inspecting Seal For Proper Orientation
Courtesy of GENERAL MOTORS COMPANY

IMPORTANT: For proper orientation, note the installation direction of the oil seal. The oil seal is a reverse-lip design. Install with "THIS SIDE OUT" displayed as shown.

1. Inspect the seal for proper orientation.

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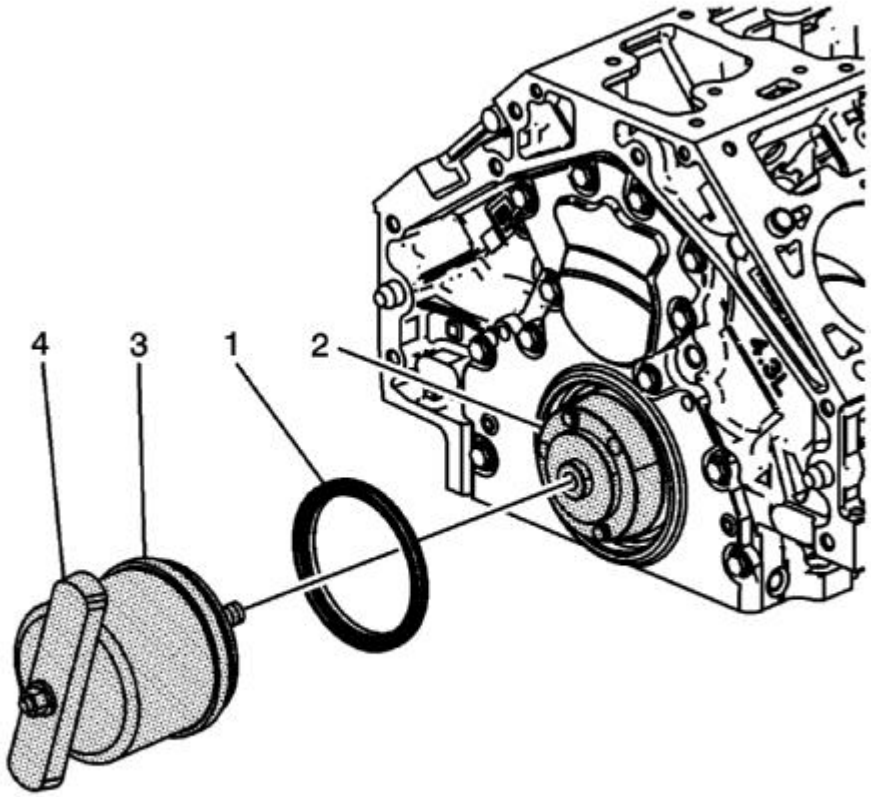


Fig. 129: Crankshaft Rear Oil Seal Installation Guide Cone
Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-41479-2A** crankshaft rear oil seal installation guide cone (2) and bolts onto the rear of the crankshaft.
3. Tighten the bolts until snug. Do not overtighten.
4. Install the rear oil seal (1) onto the tapered cone (2) and push the seal to the rear seal bore. Install the oil seal with "THIS SIDE OUT" facing away from the engine.
5. Install the **EN-41479-10** crankshaft rear oil seal installer adapter (3) onto **EN-41479** crankshaft rear oil seal installer (4).
6. Thread the **EN-41479** crankshaft rear oil seal installer threaded rod into the tapered cone until the tool contacts the oil seal.
7. Align the oil seal (1) onto the tool.
8. Rotate the handle of the tool clockwise until the seal enters the rear housing and bottoms into the seal bore.
9. Remove the tool.
10. If equipped with an automatic transmission, install the automatic transmission flexplate. Refer to **Automatic Transmission Flex Plate Replacement**
11. If equipped with a manual transmission, install the flywheel. Refer to **Engine Flywheel Replacement**.

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CRANKSHAFT REAR OIL SEAL HOUSING REPLACEMENT

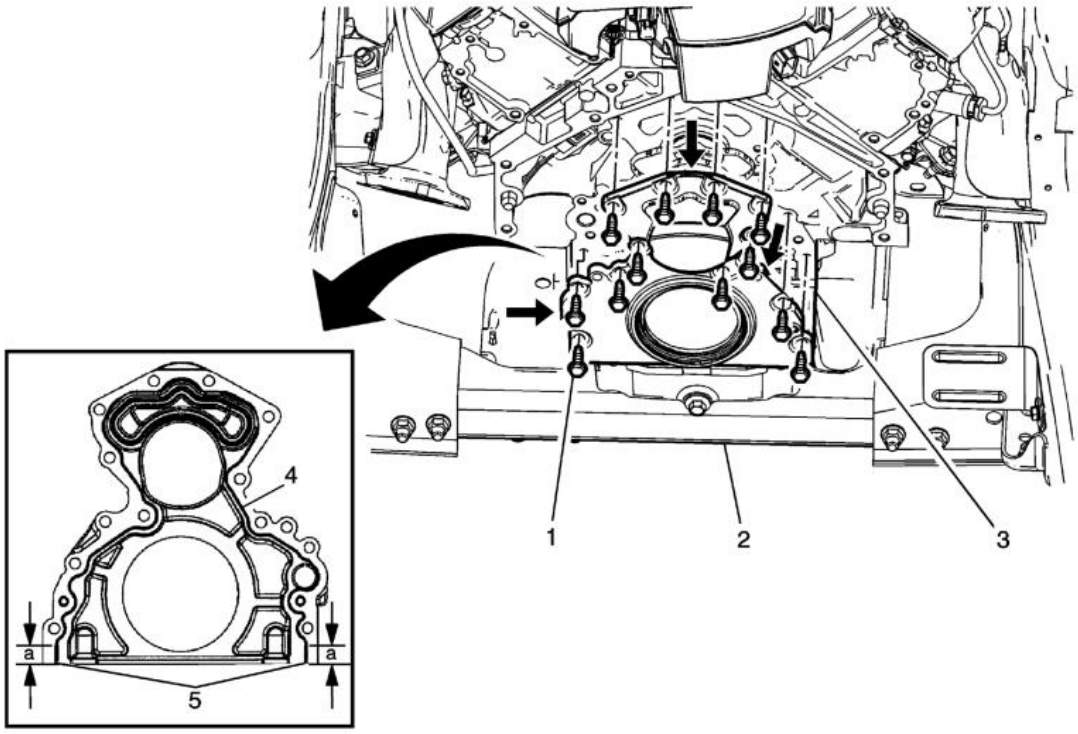


Fig. 130: Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS COMPANY

Crankshaft Rear Oil Seal Housing Replacement

Callout	Component Name
Preliminary Procedures 1. If equipped with an automatic transmission, remove the automatic transmission flexplate. Refer to **Automatic Transmission Flex Plate Replacement**. 2. If equipped with a manual transmission, remove the flywheel. Refer to **Engine Flywheel Replacement**.	
1	Crankshaft Rear Oil Seal Housing Fastener (Qty; 12) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 25 (18 lb ft)
	Crankshaft Rear Oil Seal Housing **Procedure**

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2	1. To separate the rear housing from the engine, pry at the points that are shown by the arrows. 2. Apply a 3 mm (0.118 in) bead of RTV sealant on the engine rear cover as shown (4). Apply a 5 mm (0.197 in) bead of RTV sealant on the engine rear cover as shown (5). The 5 mm (0.197 in) bead (5) must be applied only 10 mm (0.393 in) up from the bottom of the rear cover as shown (a). Refer to **Adhesives, Fluids, Lubricants and Sealers** .
3	Crankshaft Rear Oil Seal Housing Gasket **Procedure** 1. For gasket replacement. Refer to **Replacing Engine Gaskets** . 2. A NEW gasket must be used when installing the rear housing.

OIL PAN COVER REPLACEMENT

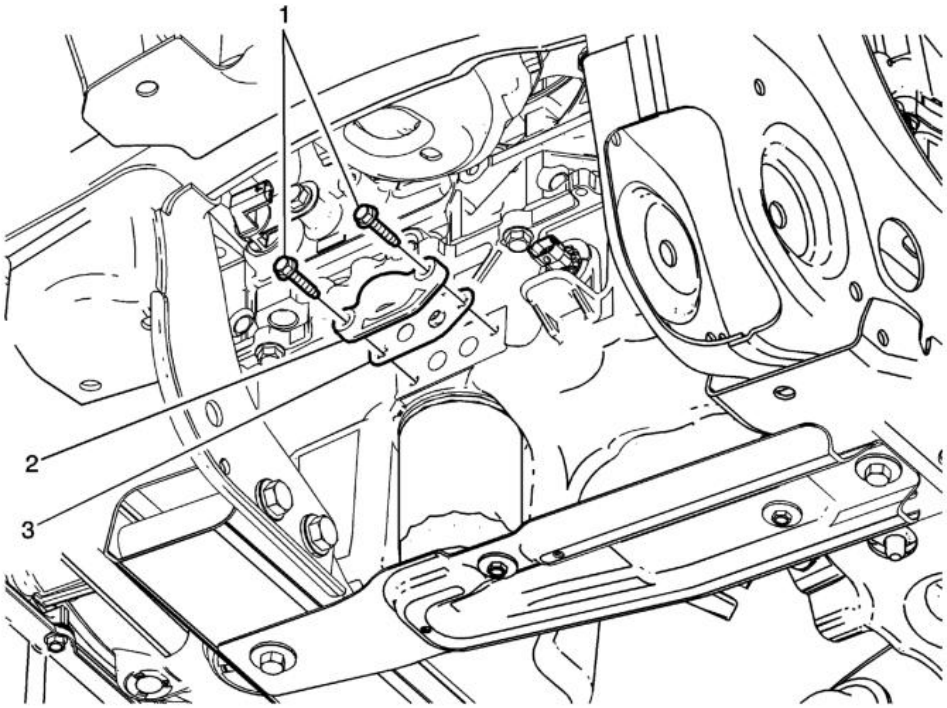


Fig. 131: Oil Pan Cover
Courtesy of GENERAL MOTORS COMPANY

Oil Pan Cover Replacement

Callout	Component Name
Preliminary Procedure Remove the steering gear skid shield. Refer to **Steering Gear Skid Shield Replacement**	
	Oil Pan Cover Fastener

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1	**CAUTION:** **Refer to Fastener Caution .** **Tighten** 10 (89 lb in)
2	Oil Pan Cover
3	Oil Pan Cover Gasket **Procedure** A NEW gasket must be used when installing the oil pan cover.

OIL PAN REPLACEMENT

Removal Procedure

1. Remove the steering rack. Refer to **Electric Belt Drive Rack and Pinion Steering Gear Replacement** .
2. Remove the starter. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .
3. If equipped with 4WD, remove the differential carrier assembly. Refer to **Differential Carrier Assembly Replacement (1500 4WD)** .

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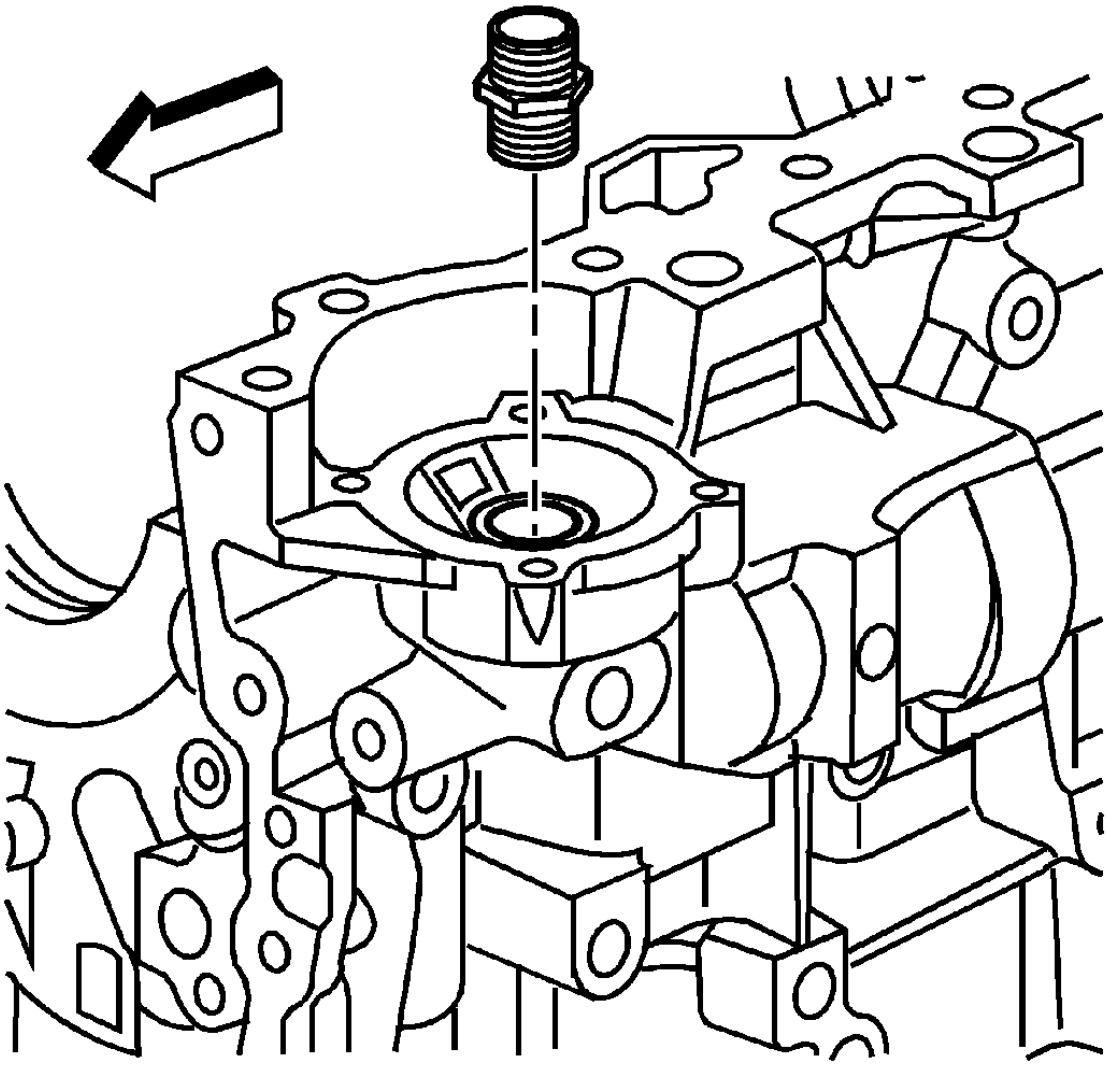


Fig. 132: View Of Lower Control Arm Crossmember, Front Crossmember Bolts & Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drivetrain and front suspension frame front crossmember (3). Refer to **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Light Duty)** , **Drivetrain and Front Suspension Frame Front Crossmember Replacement (Heavy Duty)** .

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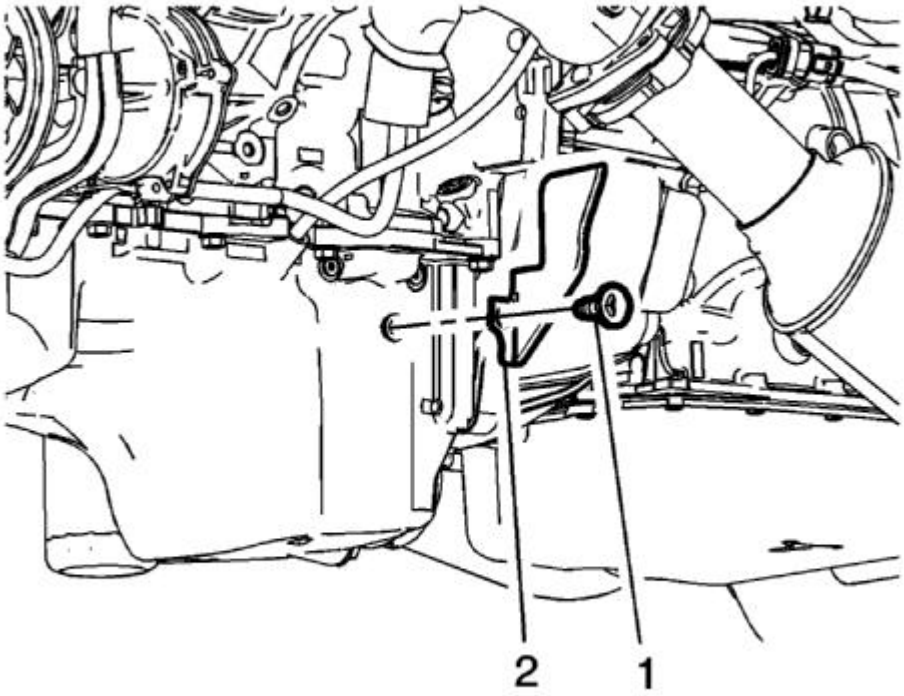


Fig. 133: Left Flywheel Inspection Cover Bolt And Cover
Courtesy of GENERAL MOTORS COMPANY

5. Remove the left flywheel inspection cover bolt (1) and cover (2).

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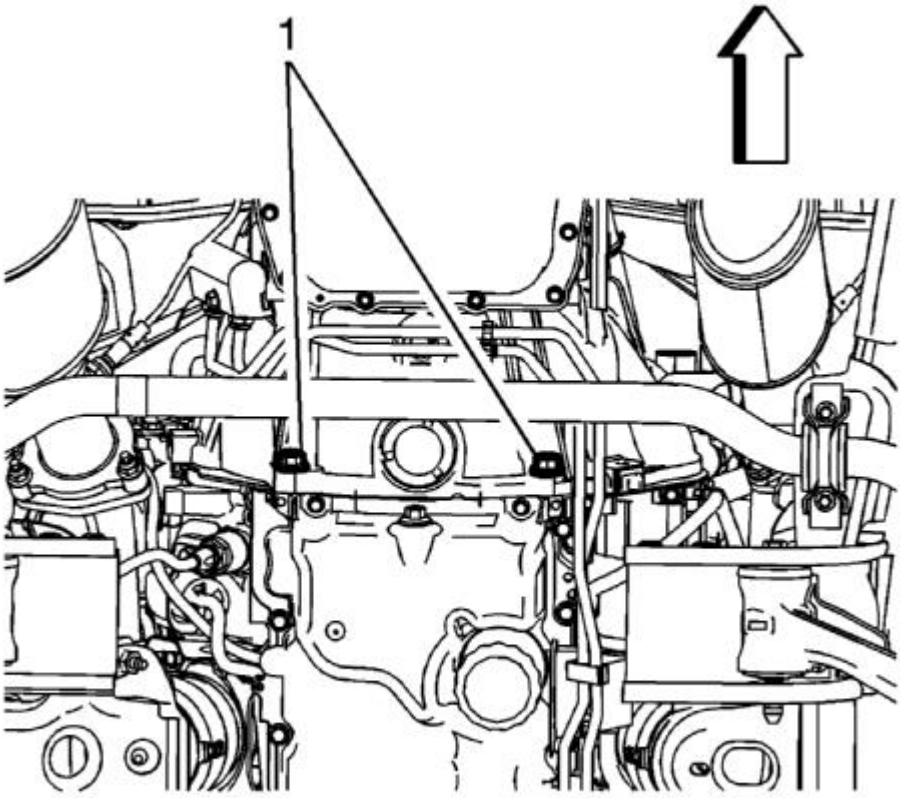


Fig. 134: Transmission To Oil Pan Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the transmission to oil pan bolts (1).
7. Disconnect electrical connectors as necessary.

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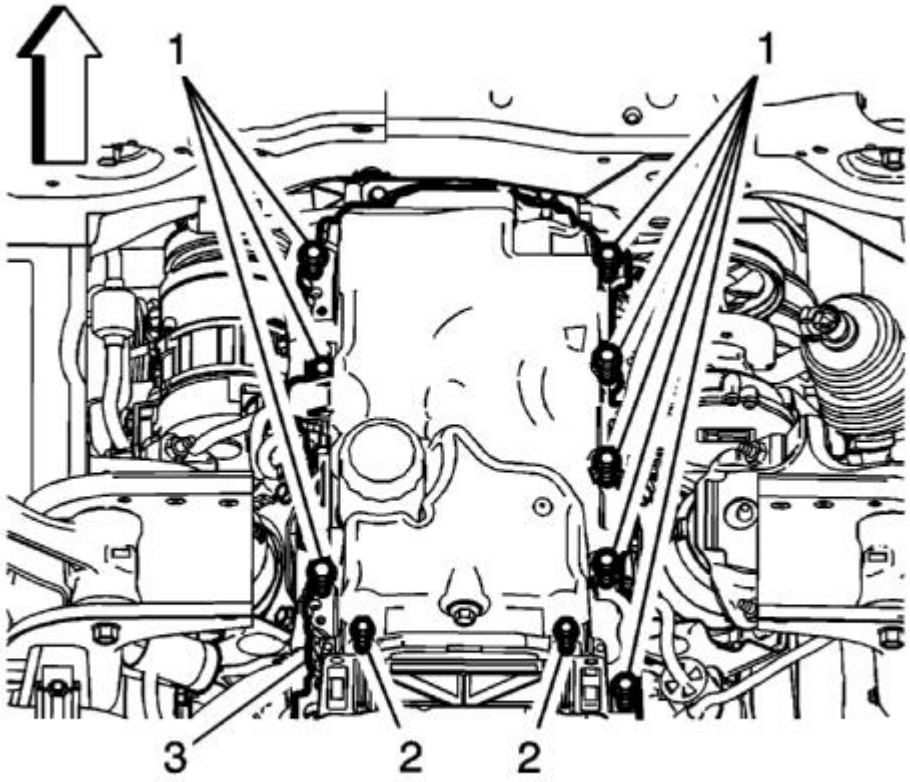


Fig. 135: Oil Pan And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the oil pan bolts (1, 2).
9. Remove the oil pan (3).
10. Transfer parts as necessary.
11. For oil pan disassemble. Refer to **Oil Pan Disassemble** .
12. For cleaning and inspection. Refer to **Oil Pan Cleaning and Inspection** .

Installation Procedure

1. For oil pan assemble. Refer to **Oil Pan Assemble** .

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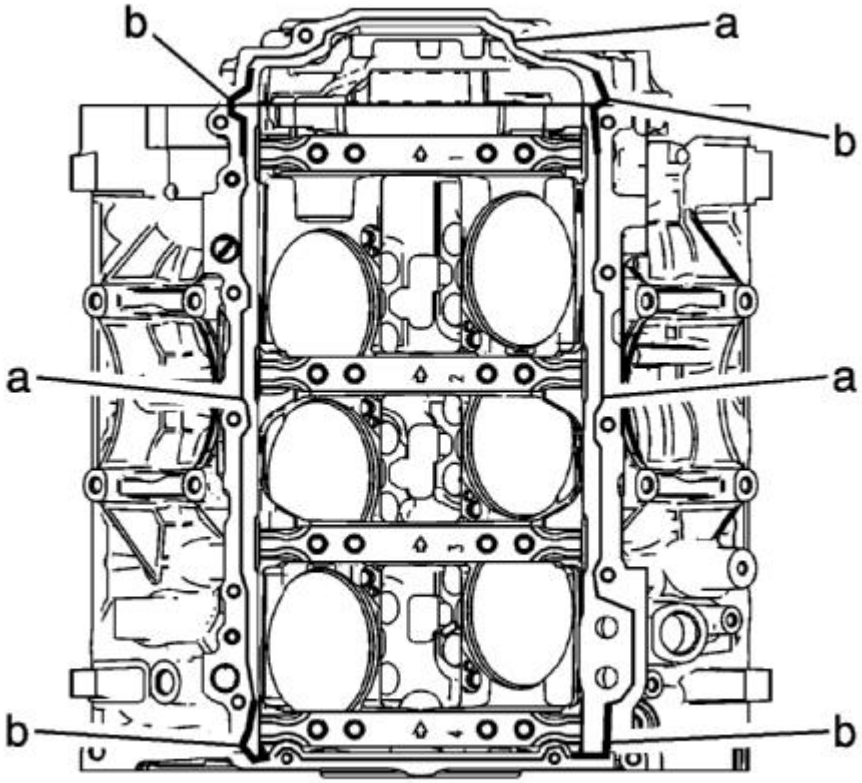


Fig. 136: Applying 3 mm (0.118 in) Bead Of RTV Sealant On Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

2. Apply a 3 mm (0.118 in) bead of RTV sealant on the engine front cover as shown (a). Apply a 5 mm (0.197 in) bead of RTV sealant on the engine front cover as shown (b). Refer to **Adhesives, Fluids, Lubricants and Sealers** .

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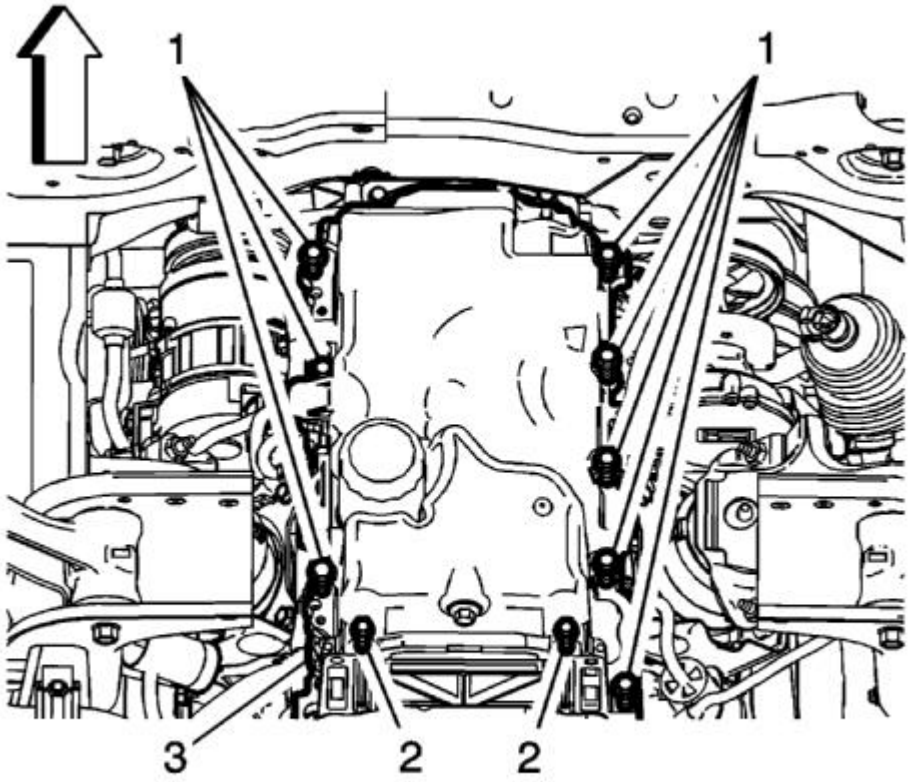


Fig. 137: Oil Pan And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the oil pan (3).
4. Install the oil pan bolts (1, 2) and hand tighten.

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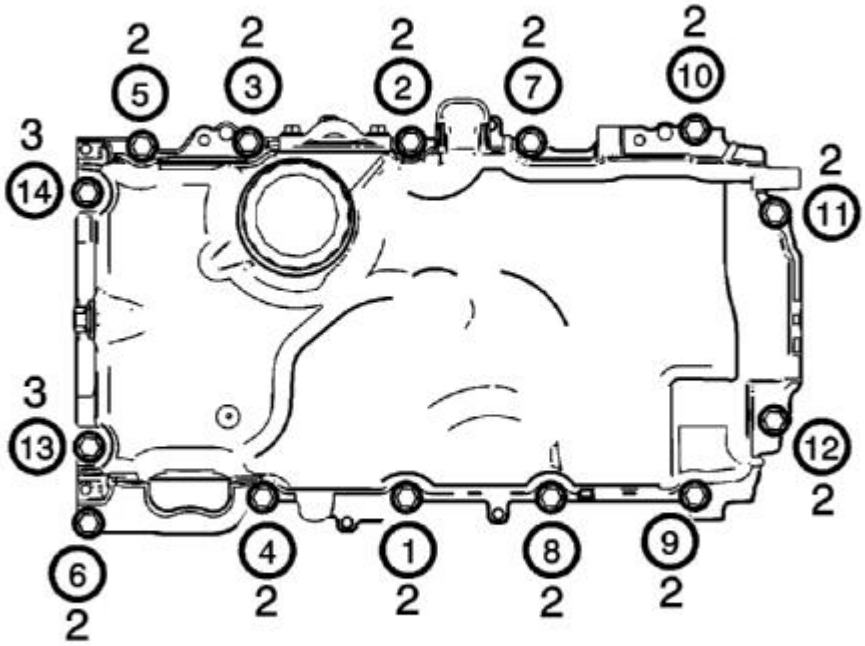


Fig. 138: Tightening Oil Pan Bolts In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Tighten the oil pan bolts in sequence as shown above.
    1. Oil pan bolts (2) 25 (18 lb ft).
    2. Oil pan bolts (3) 18 (13 lb ft).

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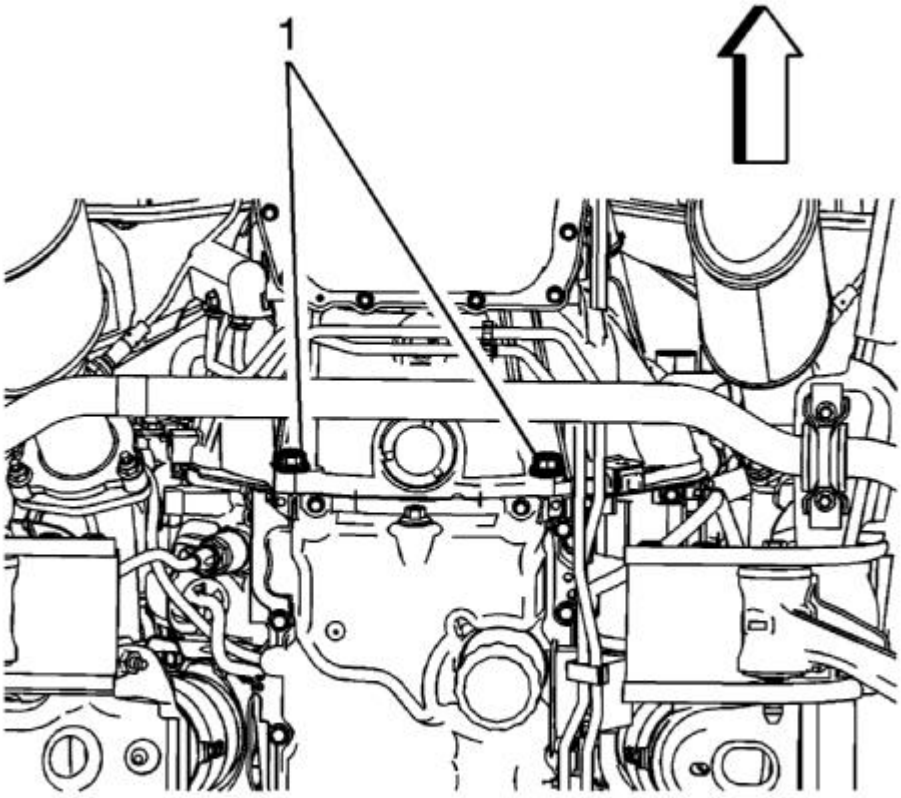


Fig. 139: Transmission To Oil Pan Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the transmission to oil pan bolts (1) and tighten to 50 (37 lb ft)

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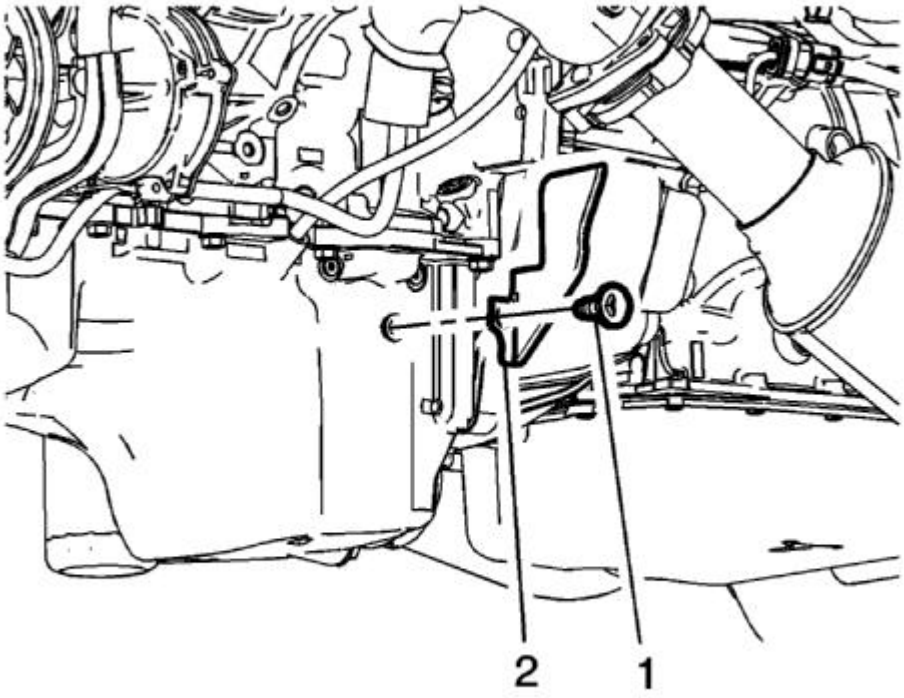


Fig. 140: Left Flywheel Inspection Cover Bolt And Cover
Courtesy of GENERAL MOTORS COMPANY

7. Install the left flywheel inspection cover (2) and tighten the bolt (1) to 10 (89 lb in).
8. Connect electrical connectors as necessary.
9. If equipped with 4WD, install the differential carrier assembly. Refer to **Differential Carrier Assembly Replacement (1500 4WD)** .
10. Install the starter. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .
11. Install the steering rack. Refer to **Electric Belt Drive Rack and Pinion Steering Gear Replacement** .

ENGINE OIL LEVEL INDICATOR SWITCH REPLACEMENT

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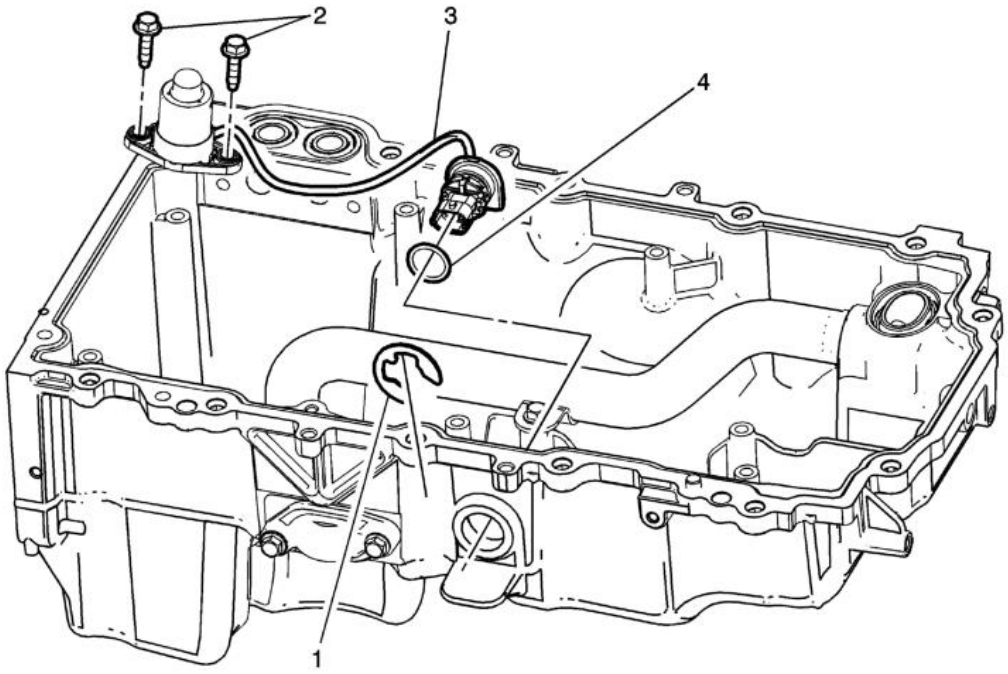


Fig. 141: Engine Oil Level Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

Engine Oil Level Indicator Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the oil filter center tube. Refer to **Oil Filter Center Tube Replacement**.	
1	Engine Oil Level Indicator Switch Clip
2	Engine Oil Level Indicator Switch Fastener (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 10 (89 lb in)
3	Engine Oil Level Indicator Switch
4	Engine Oil Level Indicator Switch Seal

BALANCE CHAIN REPLACEMENT

Special Tools

- **EN-42386-A** Flywheel Holding Tool.

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- **EN-46330** Tension Pin

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

Removal Procedure

1. Remove the oil pump. Refer to **Oil Pump Replacement**
2. Lock the flex plate using the EN-42386-A flywheel holding tool. Use 1 M10 - 1.5 x 120 mm and 1 M10 - 1.5 x 45 mm bolt for proper tool operation and tighten bolts to 50 (37 lb ft).
3. Align timing marks before disassembly. Refer to **Balancer Shaft and Timing Chain Assembly Installation (with AFM)** , **Balancer Shaft and Timing Chain Assembly Installation (without AFM)** .

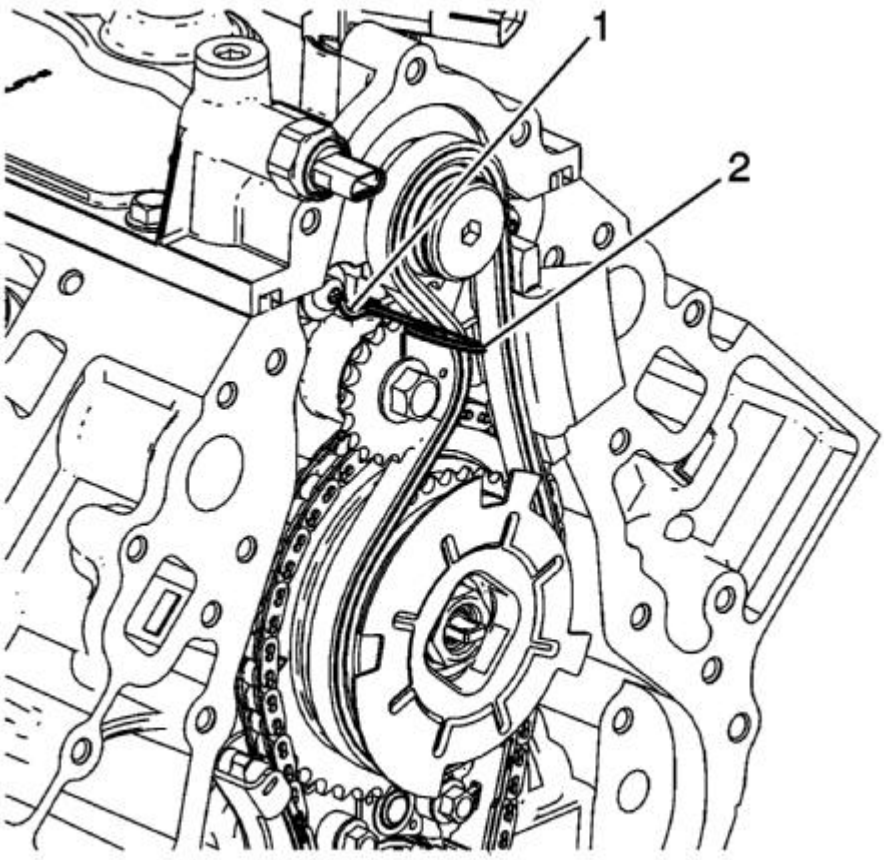


Fig. 142: Balance Shaft Thrust Plate Torsion Spring And Tension Pin
Courtesy of GENERAL MOTORS COMPANY

4. Push down the balance shaft thrust plate torsion spring (1) and install **EN-46330** tension pin (2).

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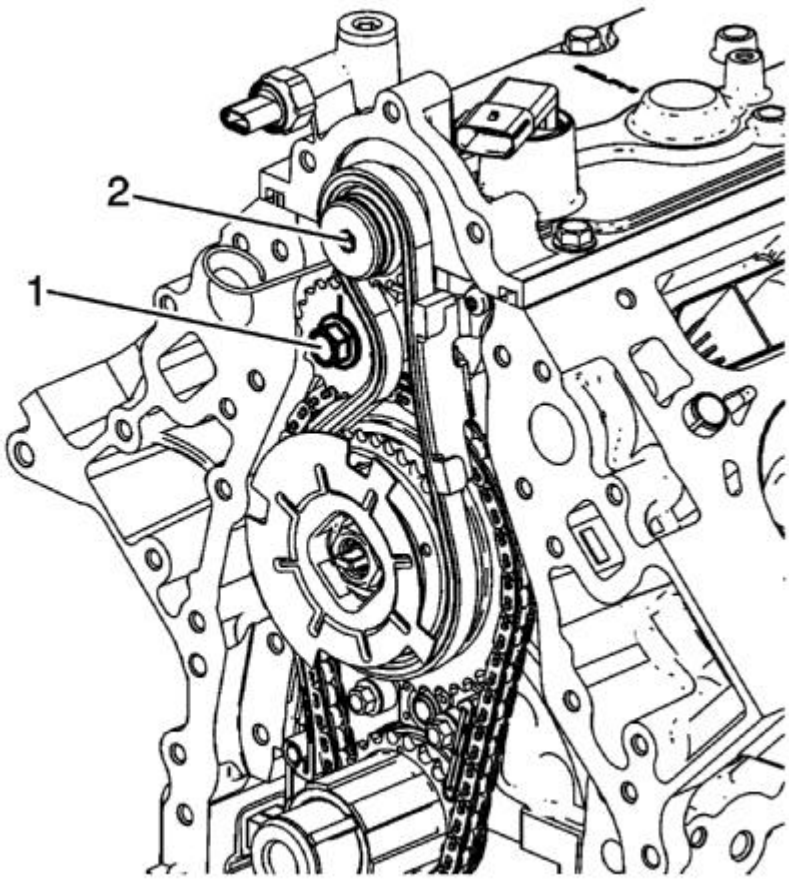


Fig. 143: Balancer Shaft Bolt And Idler Shaft Sprocket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the balancer shaft bolt (1) and the idler shaft sprocket bolt (2).

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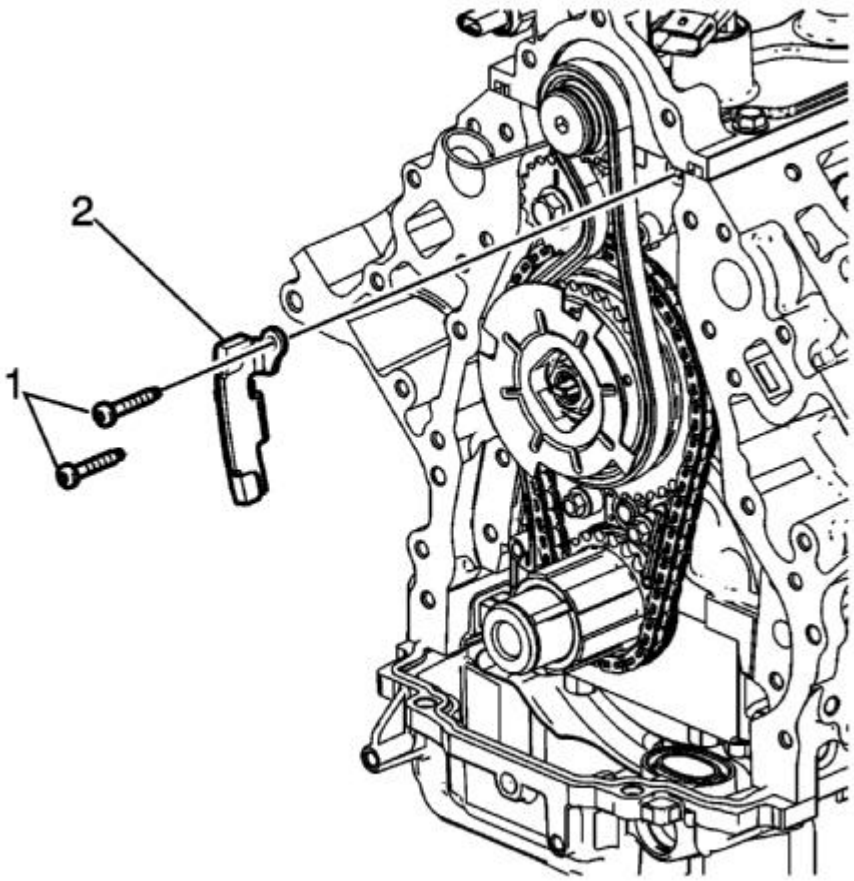


Fig. 144: Balancer Shaft Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the two balancer shaft retainer bolts (1).
7. Remove the balancer chain guide (2).

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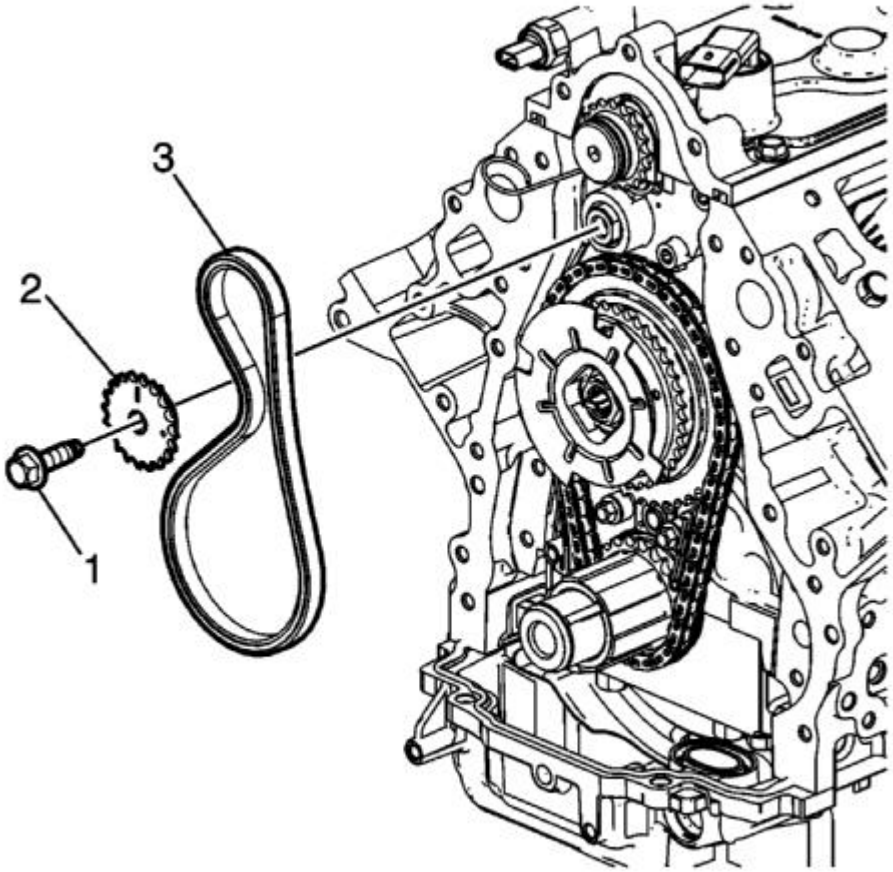


Fig. 145: Balancer Shaft Driven Sprocket Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the balancer shaft driven sprocket bolt (1) and the balancer shaft driven sprocket (2).
9. Remove the balancer shaft chain (3).

Installation Procedure

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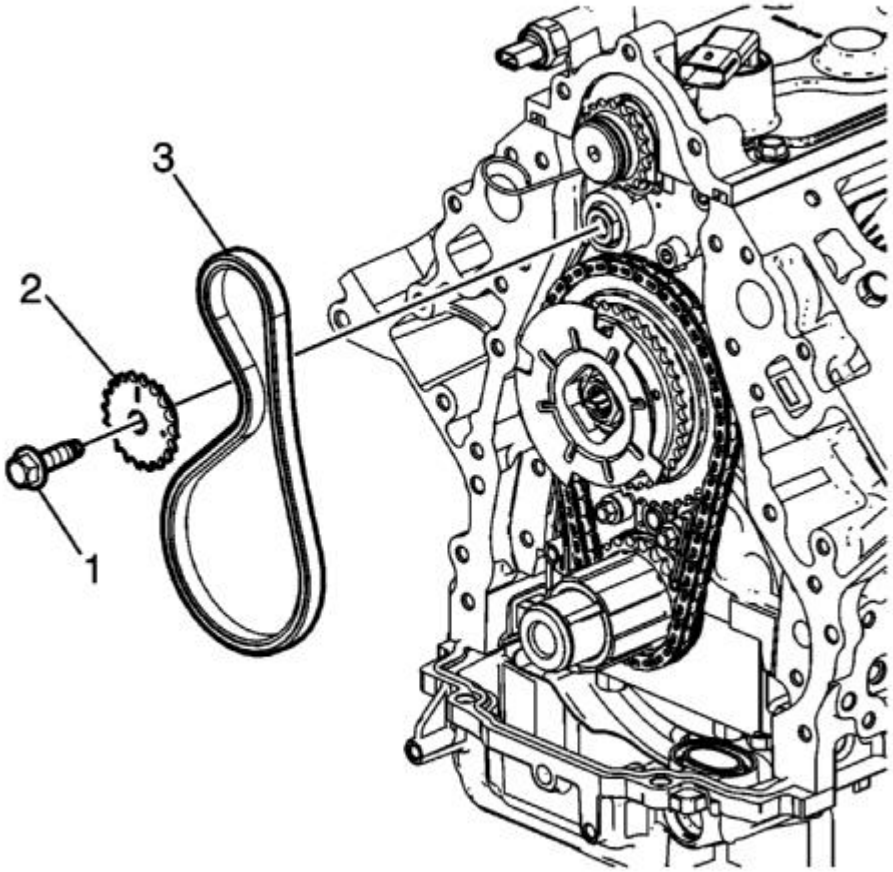


Fig. 146: Balancer Chain And Driven Sprocket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the balancer shaft (2) is installed with the flat spot facing the 3 o'clock position.

1. Install the balancer chain (3) by wrapping it around the camshaft actuator and the balancer shaft idler sprocket.
2. Install the driven sprocket (2) and driven sprocket bolt (1) hand tight.

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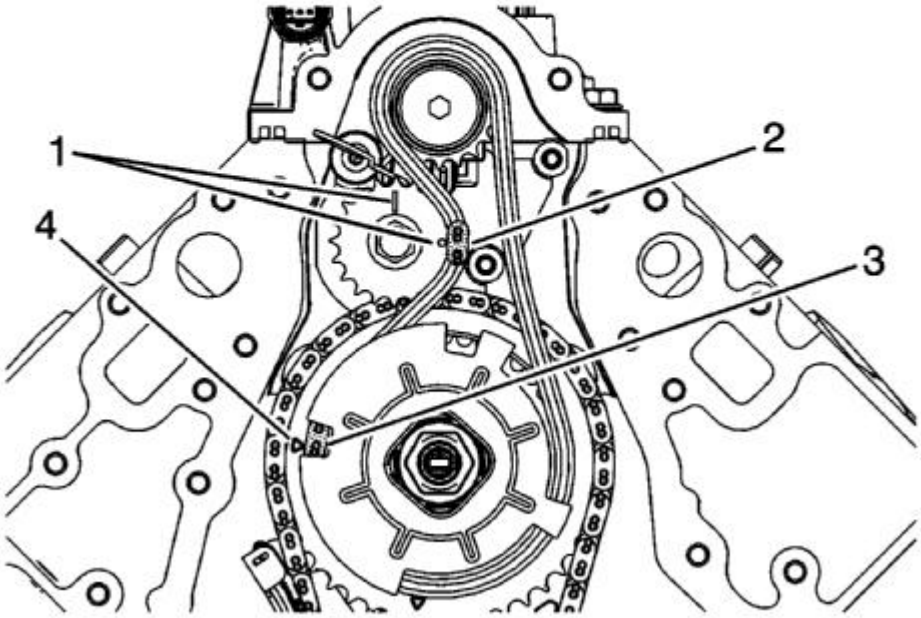


Fig. 147: Blue Link Plate And Camshaft Actuator Triangle Mark
Courtesy of GENERAL MOTORS COMPANY

3. The lower blue link plate (3) of the balancer chain must align with the camshaft actuator triangle mark (4).
4. The upper blue link plate (2) of the balancer chain must alight with the dot (1) on balancer driven sprocket. The 20 tooth driven sprocket will also have a molded in vertical line (1) pointing at 12 o'clock.

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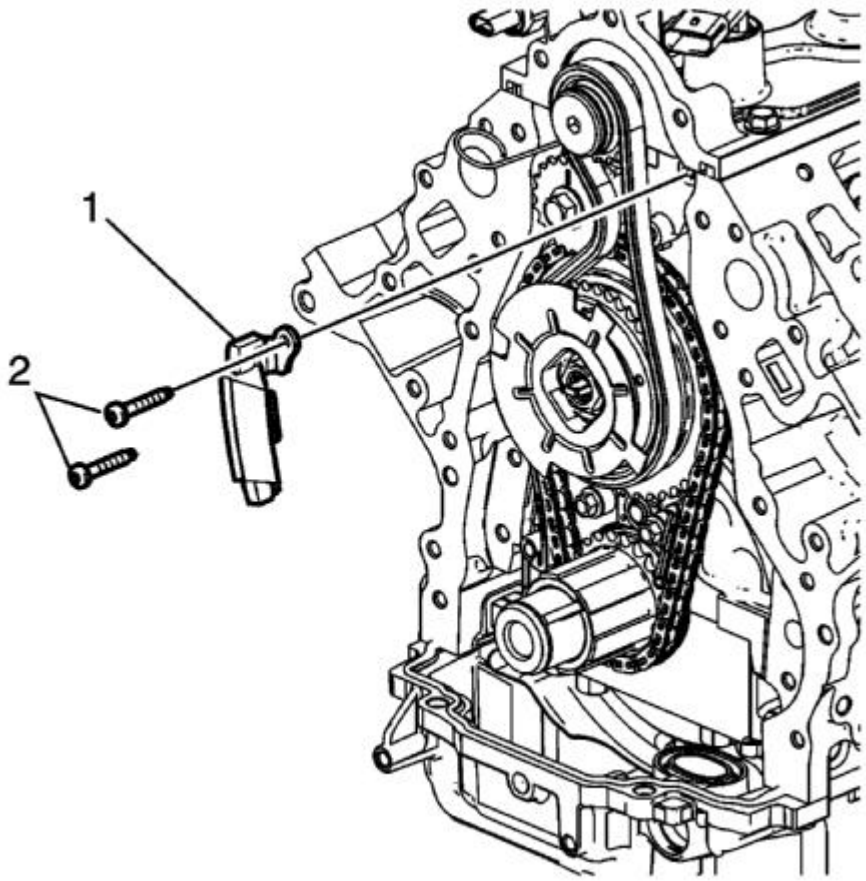


Fig. 148: Balancer Chain Guide With Shim And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: If plastic shim is not available, a 1.1 mm (0.04 in) size shim will need to be placed between the balancer chain and guide during installation.

5. Install the balancer chain guide with shim (1) and bolts (2).

CAUTION: Refer to Fastener Caution .

6. Tighten the 2 o'clock and 3:30 o'clock position guide bolts (2) to 10 N.m (88 lb in).

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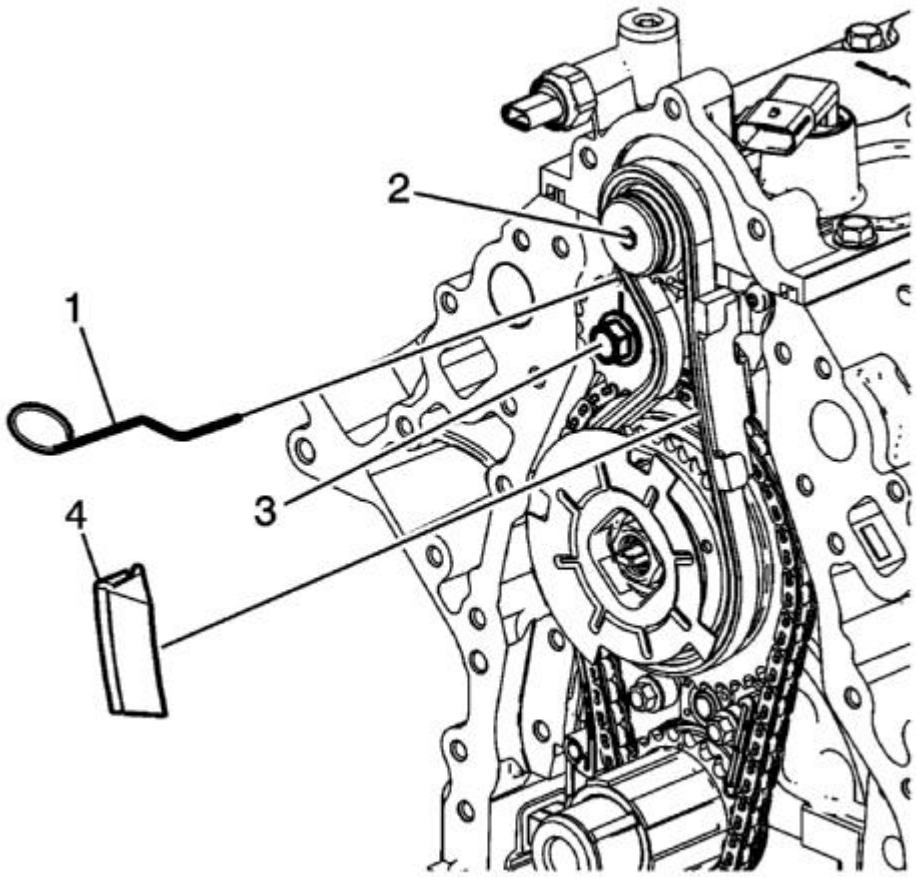


Fig. 149: Driven Sprocket Bolt And Idler Sprocket
Courtesy of GENERAL MOTORS COMPANY

7. Tighten the driven sprocket bolt (3) to 58 N.m (43 lb ft).
8. With the idler sprocket (2) free to slide up and down, pull (remove) the **EN-46330** tension pin (1).
9. Tighten the idler sprocket bolt (2) to 58 N.m (43 lb ft).
10. The chain should now be tight. Remove the shim (4) from between the balancer guide and the chain. The chain should now be slightly loose.
11. Remove the **EN-42386-A** flywheel holding tool.
12. Install the oil pump. Refer to **Oil Pump Replacement**.

BALANCER SHAFT DRIVEN SPROCKET REPLACEMENT

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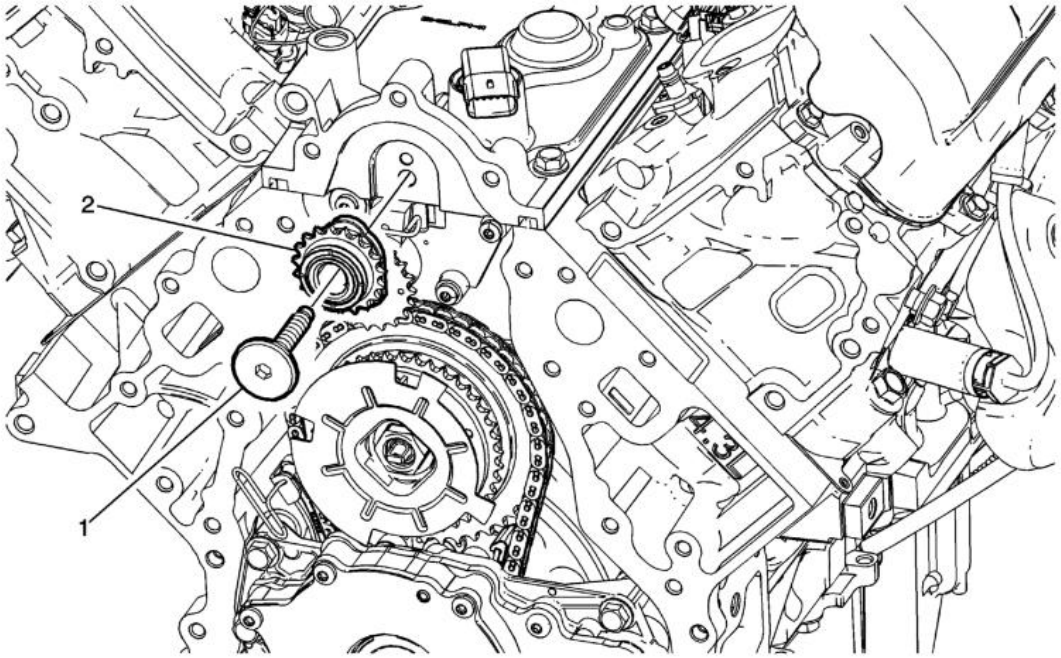


Fig. 150: Balancer Shaft Driven Sprocket
Courtesy of GENERAL MOTORS COMPANY

Balancer Shaft Driven Sprocket Replacement

Callout	Component Name
Preliminary Procedure Remove the balancer chain. Refer to **Balance Chain Replacement**.	
1	Balancer Shaft Driven Sprocket Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 58 (43 lb ft)
2	Balancer Shaft Driven Sprocket

TIMING CHAIN, CRANKSHAFT SPROCKET, CAMSHAFT POSITION ACTUATOR AND SOLENOID VALVE REPLACEMENT

Special Tools

- **EN-42386-A** Flywheel Holding Tool.
- **EN-46330** Tension Pin

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- **EN-45059** Angle Meter

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

Removal Procedure

1. Remove oil pump. Refer to **Oil Pump Replacement**.
2. Remove the starter. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .
3. Align timing and install flywheel locking tool.

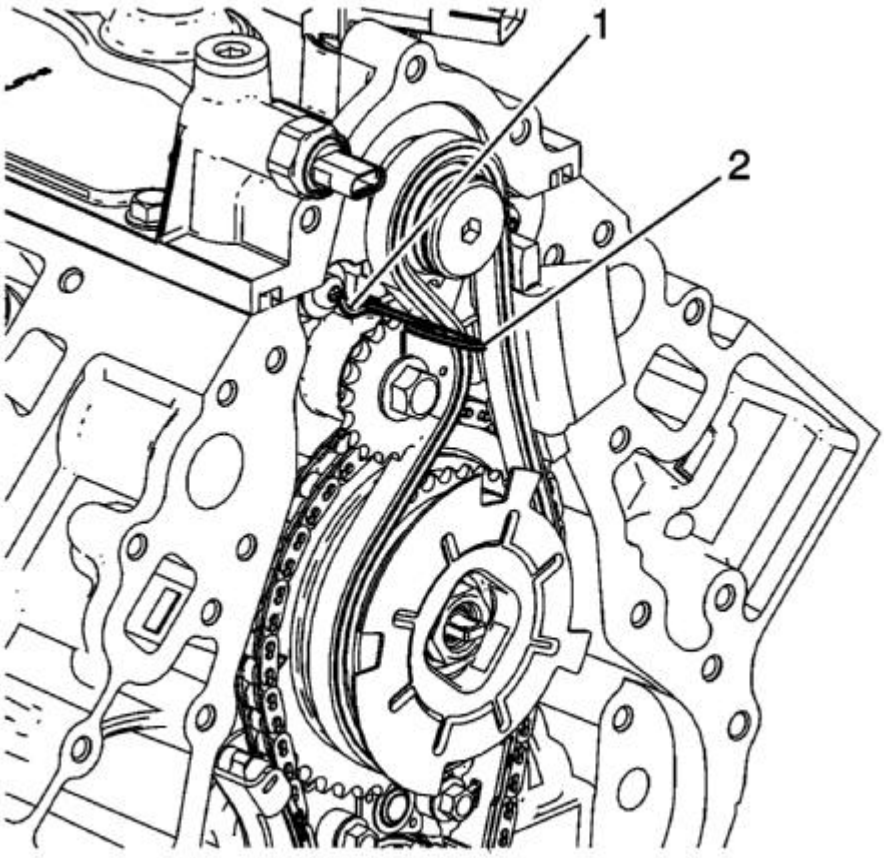


Fig. 151: Balance Shaft Thrust Plate Torsion Spring And Tension Pin
Courtesy of GENERAL MOTORS COMPANY

4. Push down the balance shaft thrust plate torsion spring (1) and install **EN-46330** tension pin (2).

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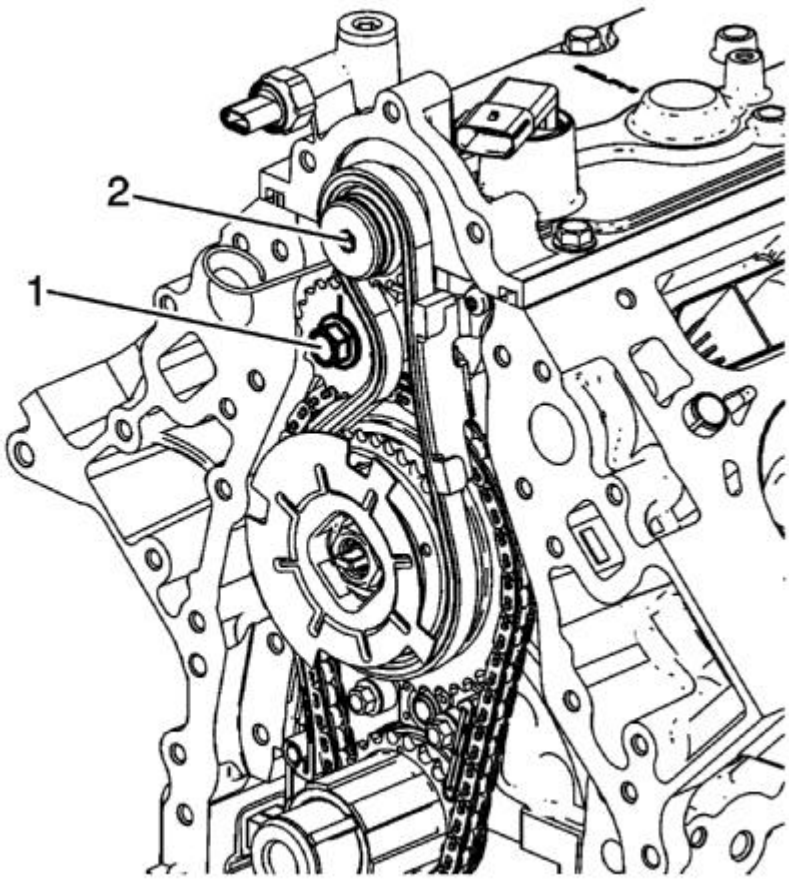


Fig. 152: Balancer Shaft Bolt And Idler Shaft Sprocket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the balancer shaft bolt (1) and the idler shaft sprocket bolt (2).

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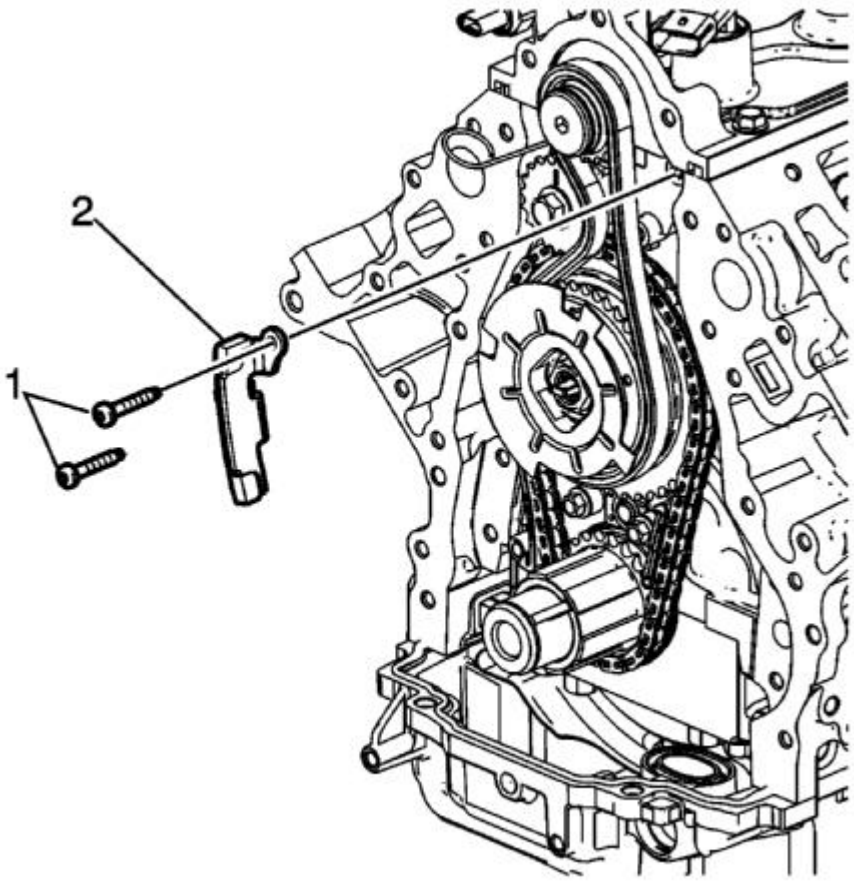


Fig. 153: Balancer Shaft Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the two balancer shaft retainer bolts (1).
7. Remove the balancer chain guide (2).

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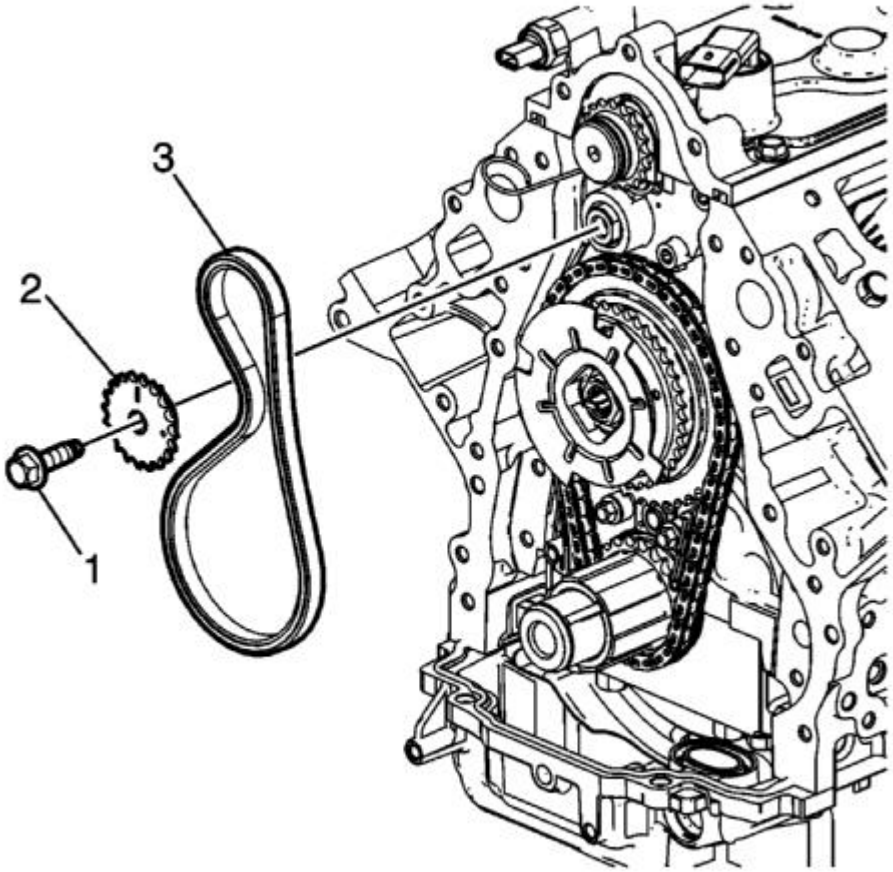


Fig. 154: Balancer Shaft Driven Sprocket Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the balancer shaft driven sprocket bolt (1) and the balancer shaft driven sprocket (2).
9. Remove the balancer shaft chain (3).

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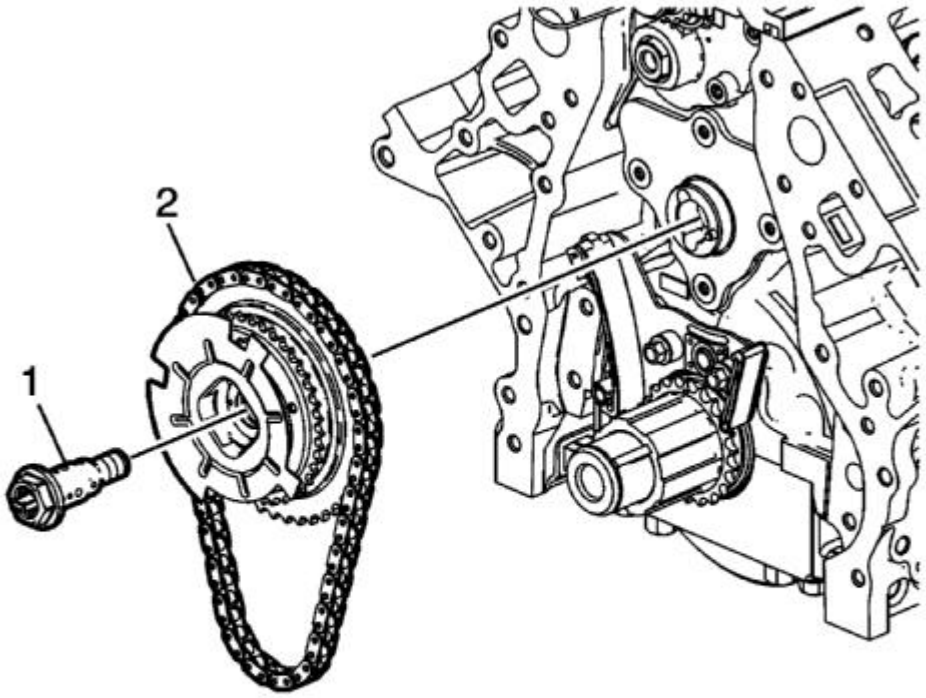


Fig. 155: Actuator And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

10. Remove the CMP actuator solenoid valve (1).
11. Loosen and separate the CMP actuator and timing chain (2) from the camshaft. Position fingers behind the actuator sprocket and pull the actuator away from the front of the camshaft. Never pull on the reluctor wheel when attempting to remove the actuator.

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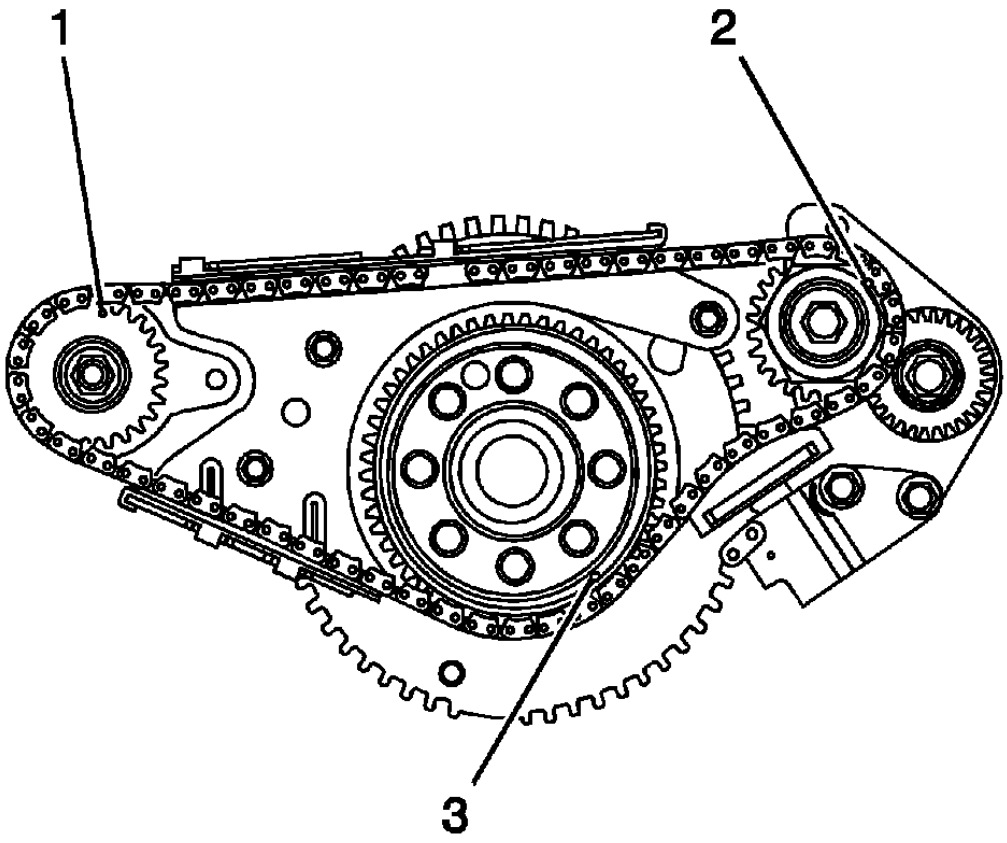


Fig. 156: View Of Tie Strap Through Center Of Actuator
Courtesy of GENERAL MOTORS COMPANY

12. Insert a tie strap (1) through the center of the actuator and over the reluctor wheel.

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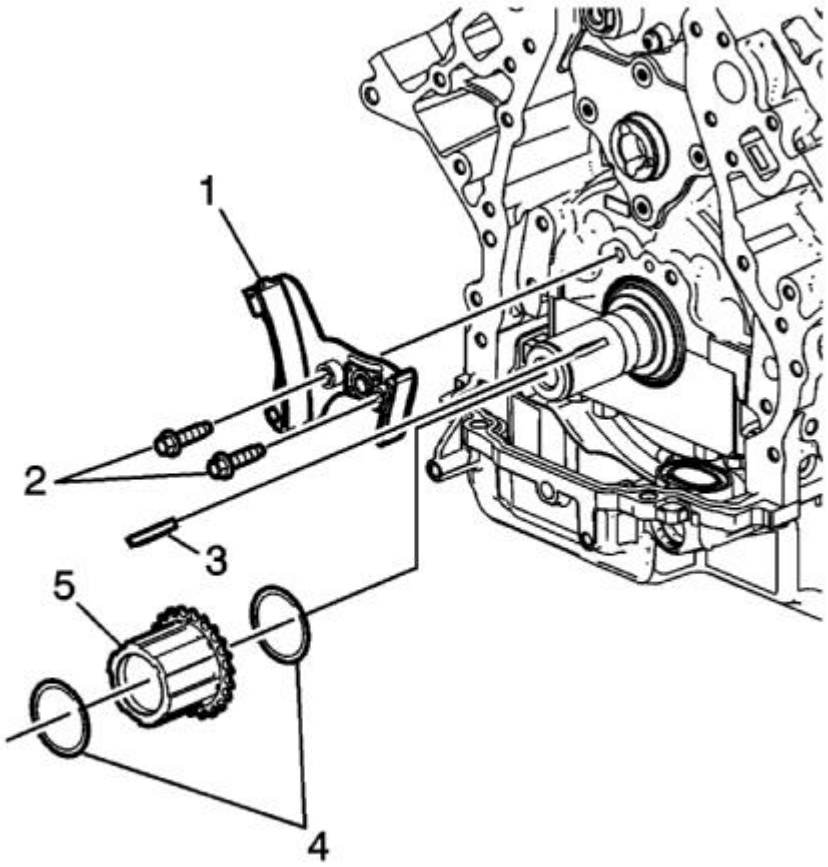


Fig. 157: Crankshaft Sprocket Washers, Crankshaft Sprocket And Key
Courtesy of GENERAL MOTORS COMPANY

13. Remove the crankshaft sprocket washers (4), crankshaft sprocket (5) and key (3).
14. Remove the timing chain tensioner bolts (2) and the timing chain tensioner (1).

Installation Procedure

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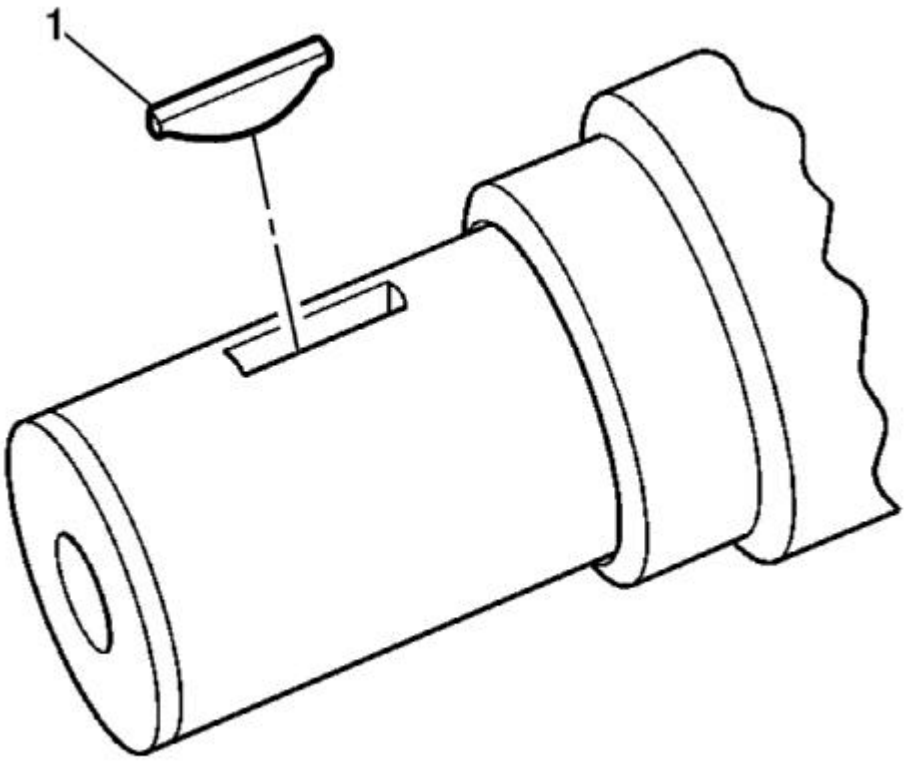


Fig. 158: Key Into Crankshaft Keyway
Courtesy of GENERAL MOTORS COMPANY

1. Install the key into the crankshaft keyway (1), if previously removed.

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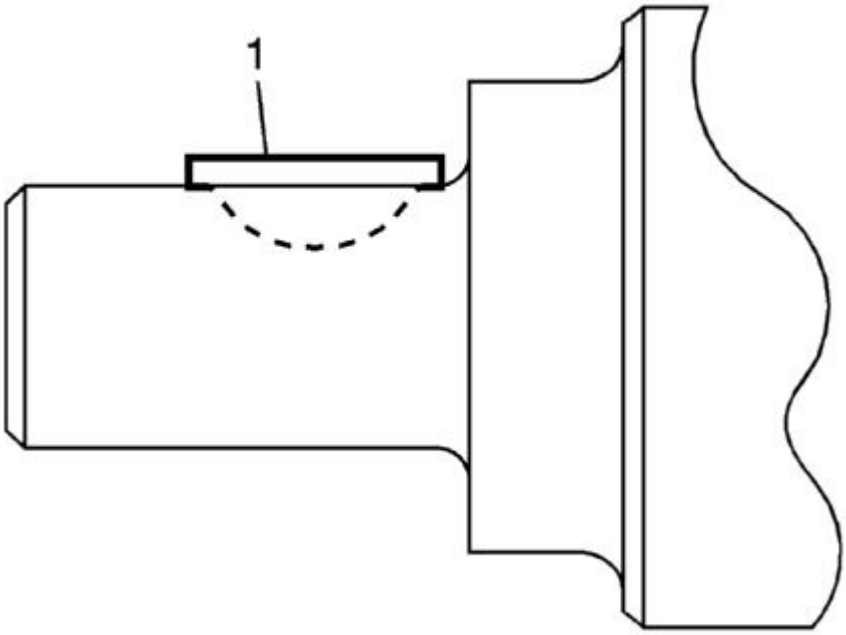


Fig. 159: Key Into Keyway
Courtesy of GENERAL MOTORS COMPANY

2. Tap the key (1) into the keyway until both ends of the key bottom onto the crankshaft.

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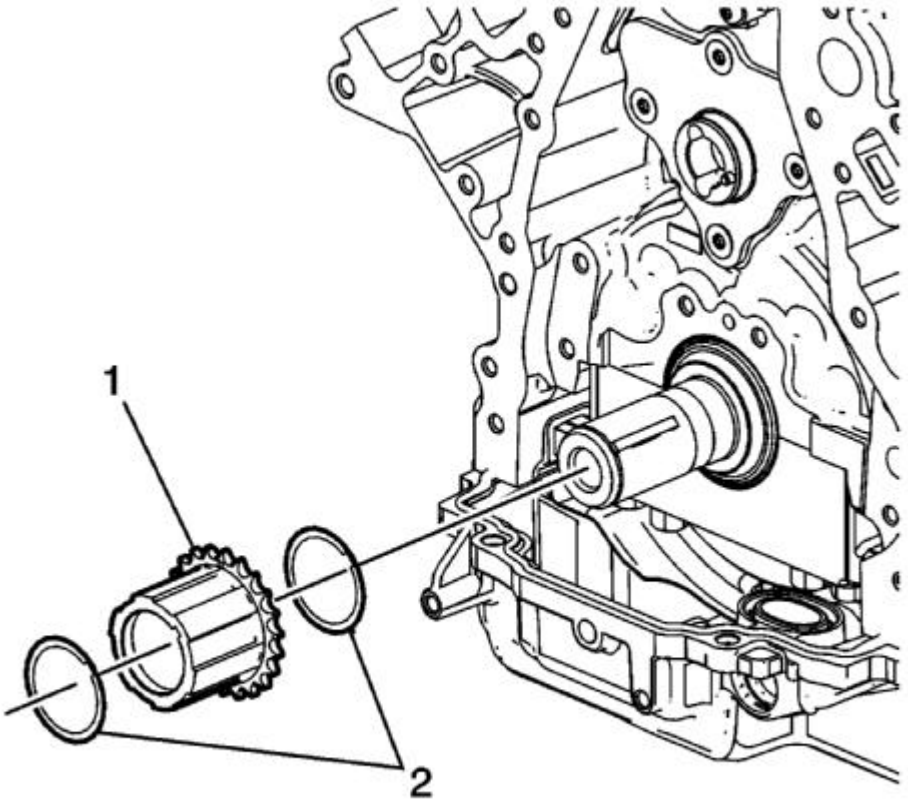


Fig. 160: Crankshaft Sprocket Washers And Crankshaft Sprocket
Courtesy of GENERAL MOTORS COMPANY

3. Install the crankshaft sprocket washers (2) and the crankshaft sprocket (1). Align the crankshaft key with the crankshaft sprocket keyway.

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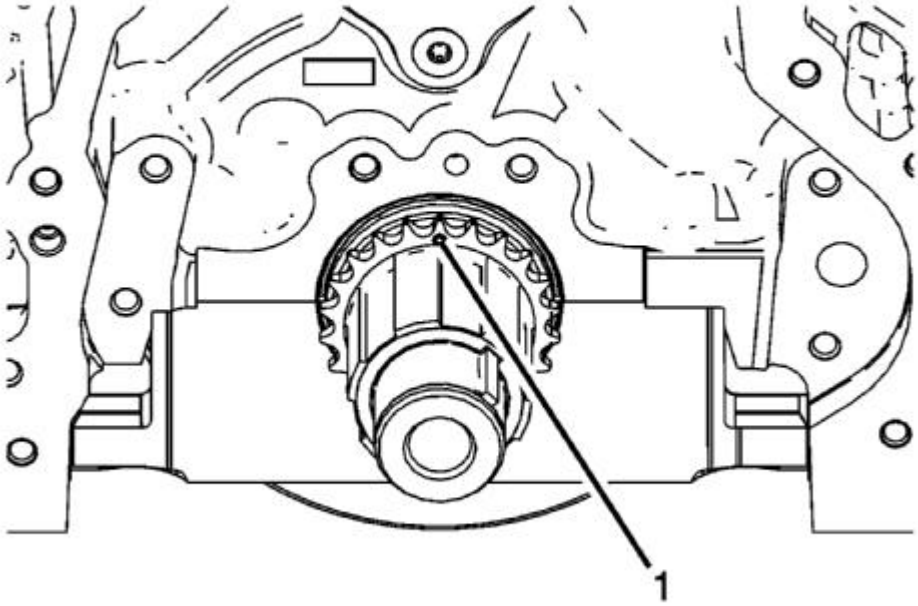


Fig. 161: Rotating Crankshaft Until Sprocket Alignment Mark
Courtesy of GENERAL MOTORS COMPANY

4. Rotate the crankshaft until the sprocket alignment mark (1) is in the 12 o'clock position.

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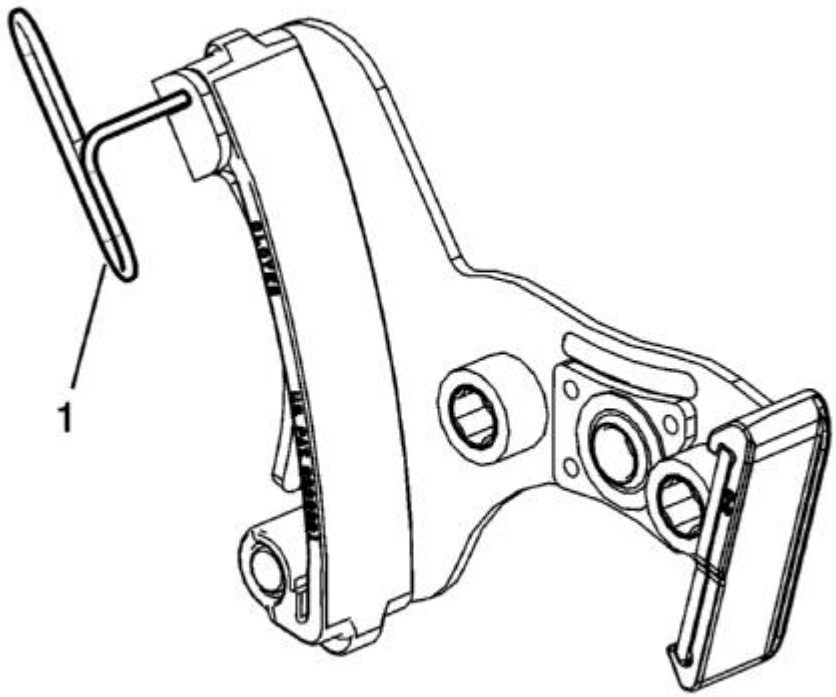


Fig. 162: Timing Chain Tensioner Guide And EN 46330 Pin
Courtesy of GENERAL MOTORS COMPANY

5. Compress the timing chain tensioner guide and install the **EN-46330** tension pin (1).

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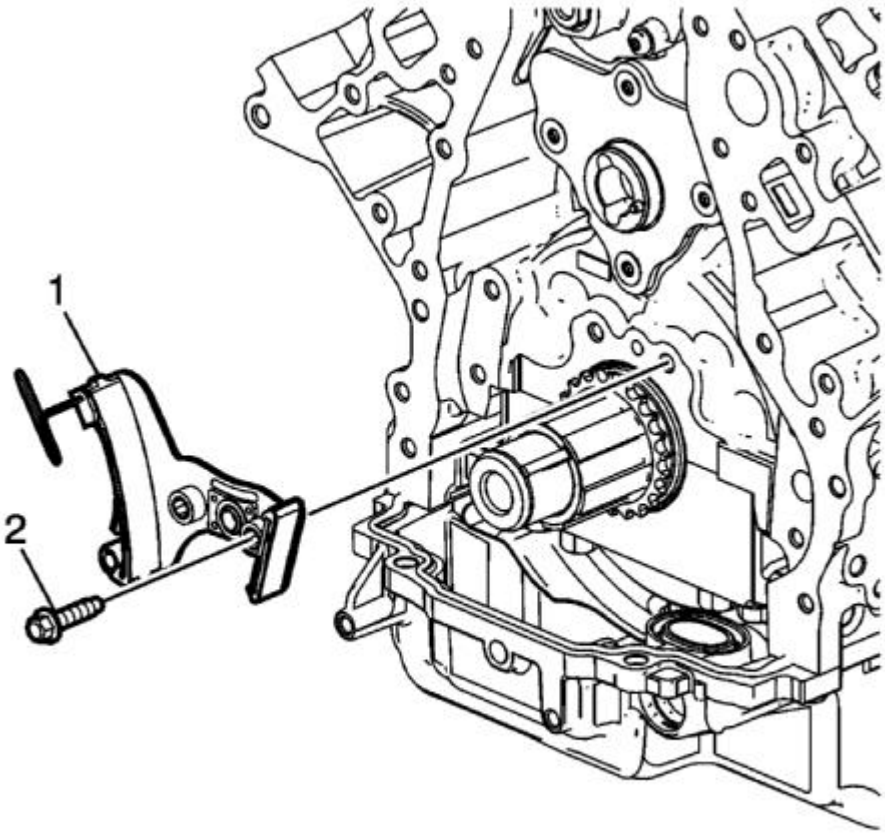


Fig. 163: Timing Chain Tensioner And Left Side Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install the timing chain tensioner and left side bolt (1) hand tight. Do not install the right side bolt at this time. The right side bolt will be installed after the camshaft position (CMP) actuator and chain have been installed onto the engine.

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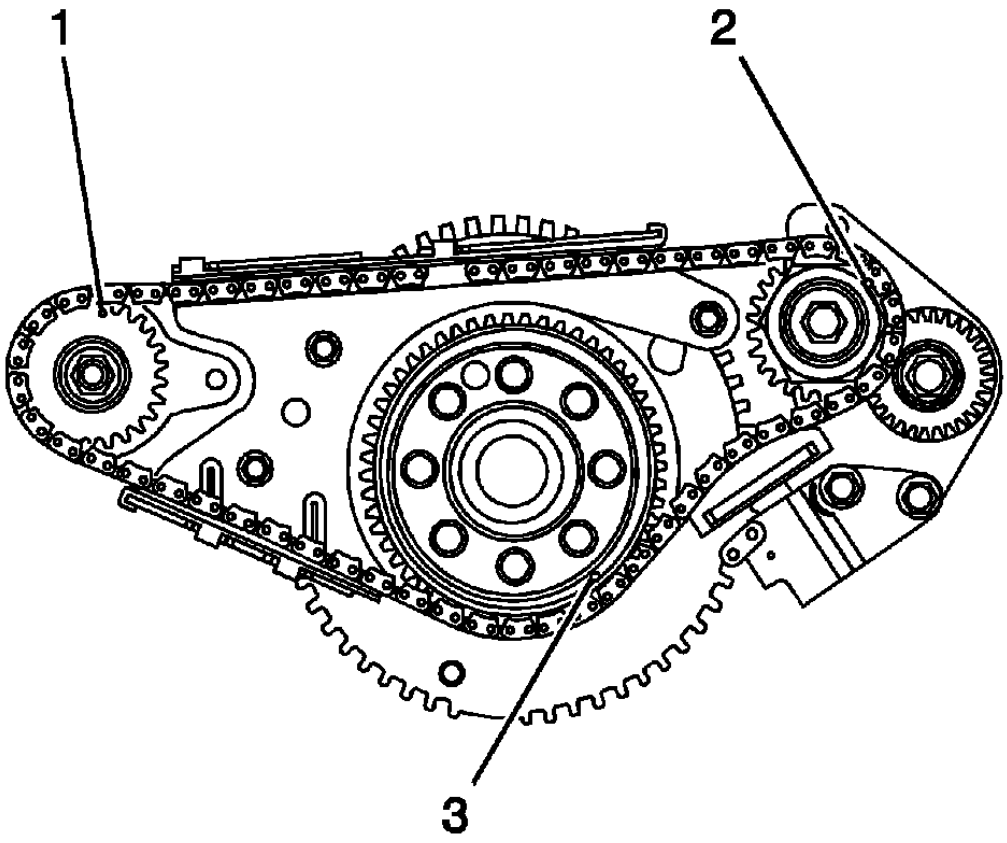


Fig. 164: View Of Tie Strap Through Center Of Actuator
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to Camshaft Position Actuator Removal and Installation Warning .

7. Remove the tie strap (1) from the actuator.

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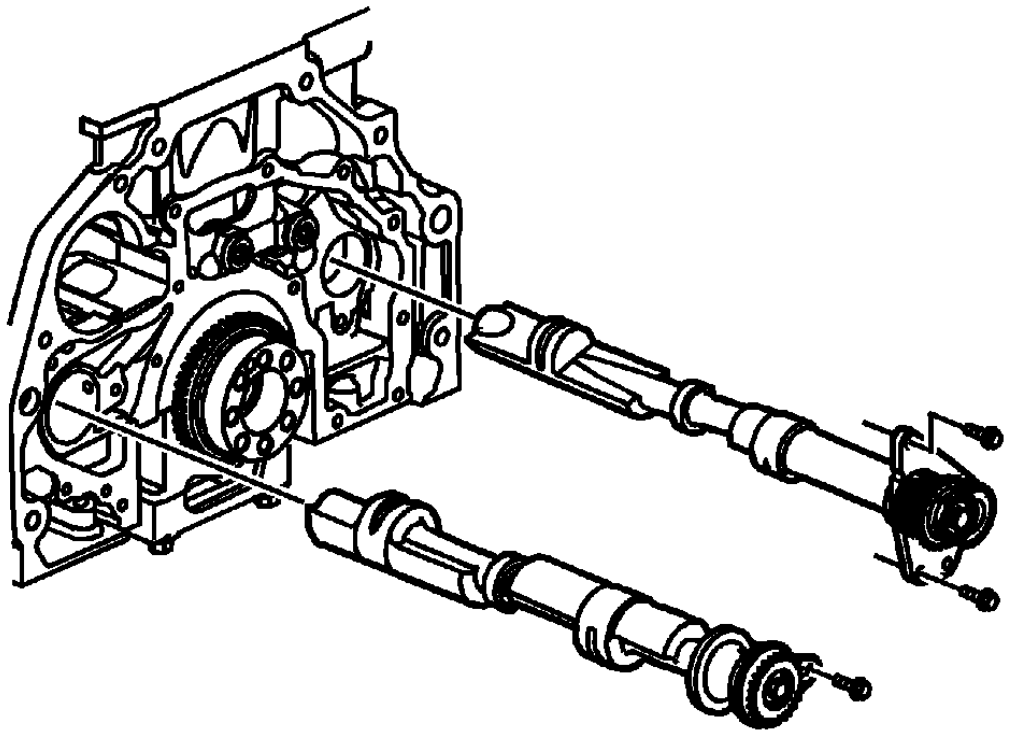


Fig. 165: Identifying Alignment Hole & Locating Pin
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Properly locate the CMP actuator onto the locating pin of the camshaft.**
- **The sprocket teeth and timing chain must mesh**
- **The camshaft and the sprocket alignment marks MUST be aligned properly.**
- **Do not use the CMP solenoid valve again. Install a NEW valve during assembly.**

8. Identify the alignment hole (1) in the rear face of the CMP actuator and the locating pin (2) on the front face of the camshaft.

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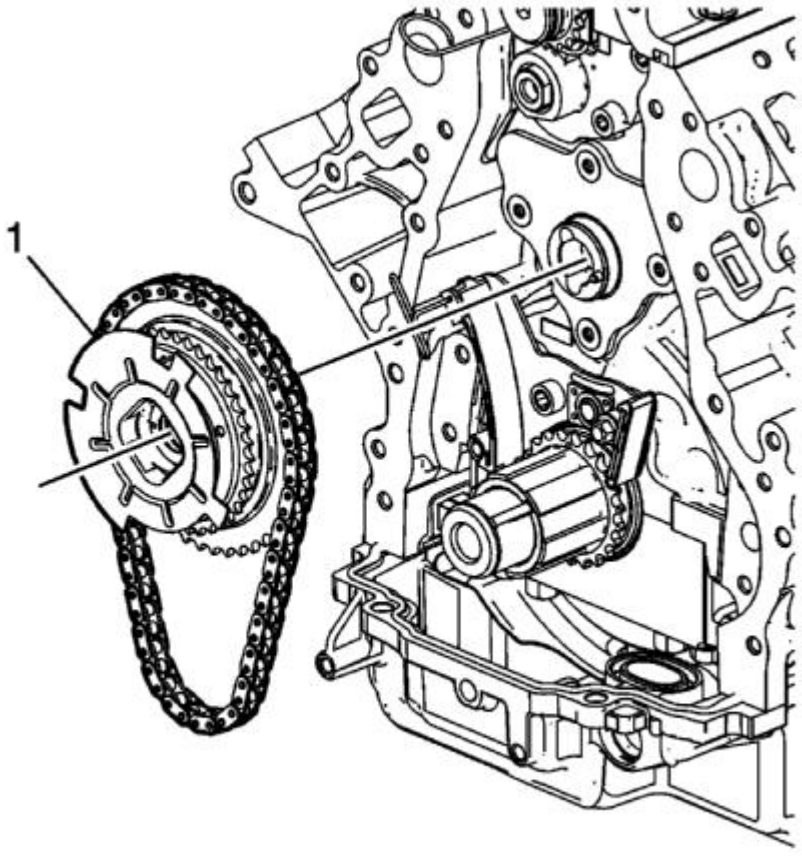


Fig. 166: CMP Actuator And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

9. Install the CMP actuator and timing chain (1). Use care to install the actuator completely onto the front of the camshaft. Position fingers onto the face of the actuator sprocket and push the actuator onto the front of the camshaft. Never push on the reluctor wheel when attempting to install the actuator.

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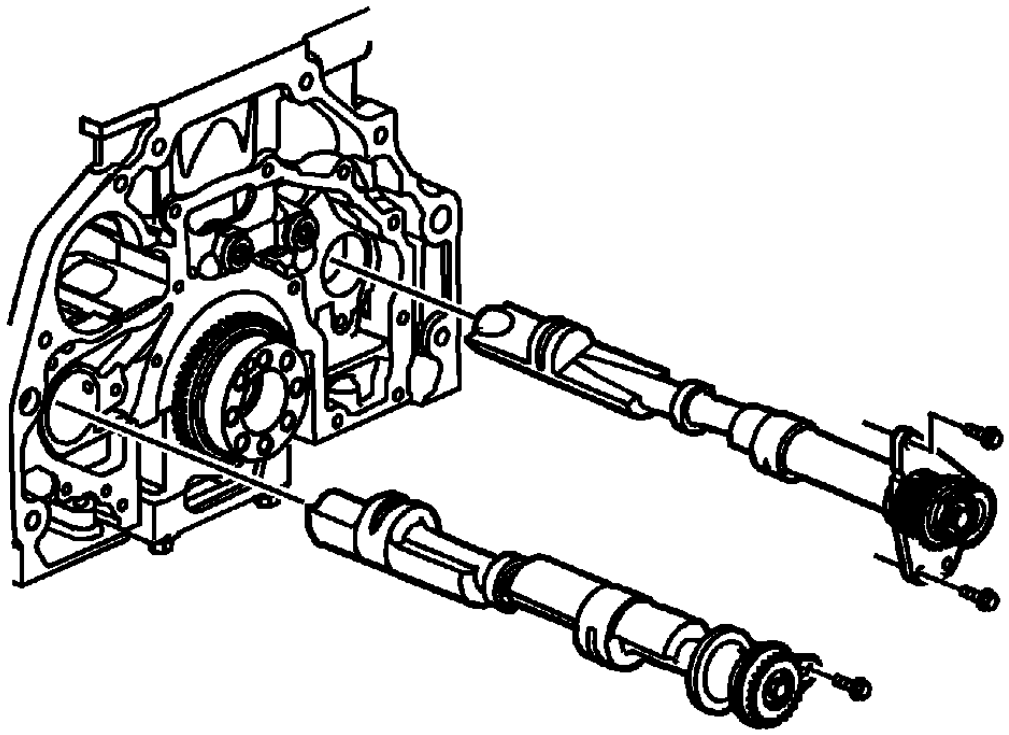


Fig. 167: View Of CMP Actuator Alignment Mark & Crankshaft Sprocket Alignment Mark
Courtesy of GENERAL MOTORS COMPANY

10. Inspect the sprockets for proper alignment. The mark on the CMP actuator sprocket (1) should be in the 6 o'clock position and the mark on the crankshaft sprocket (2) should be located in the 12 o'clock position.

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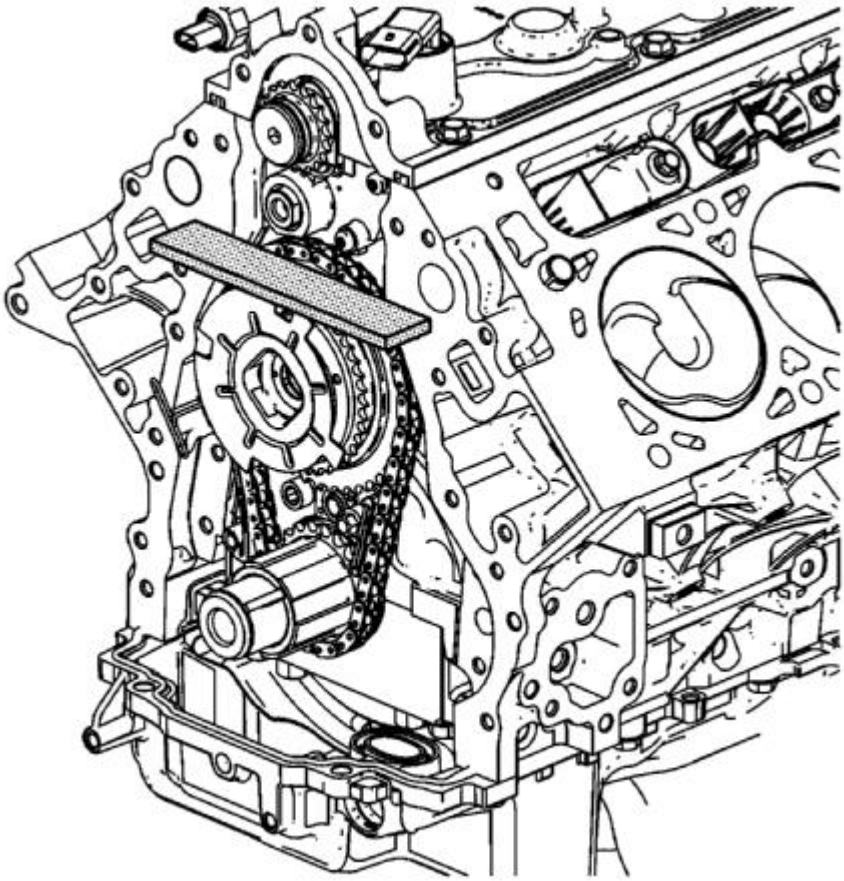


Fig. 168: CMP Actuator And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

NOTE: It is possible to push the camshaft rearward when installing the CMP actuator. Verify that the camshaft lobes are centered in the valve lifter bores after the CMP actuator is installed.

11. Locate a straight edge across the front face of the engine block and inspect for proper installation of the CMP actuator and timing chain. With the CMP actuator properly and completely installed onto the front of the camshaft, the timing chain will not protrude beyond the front face of the engine block.

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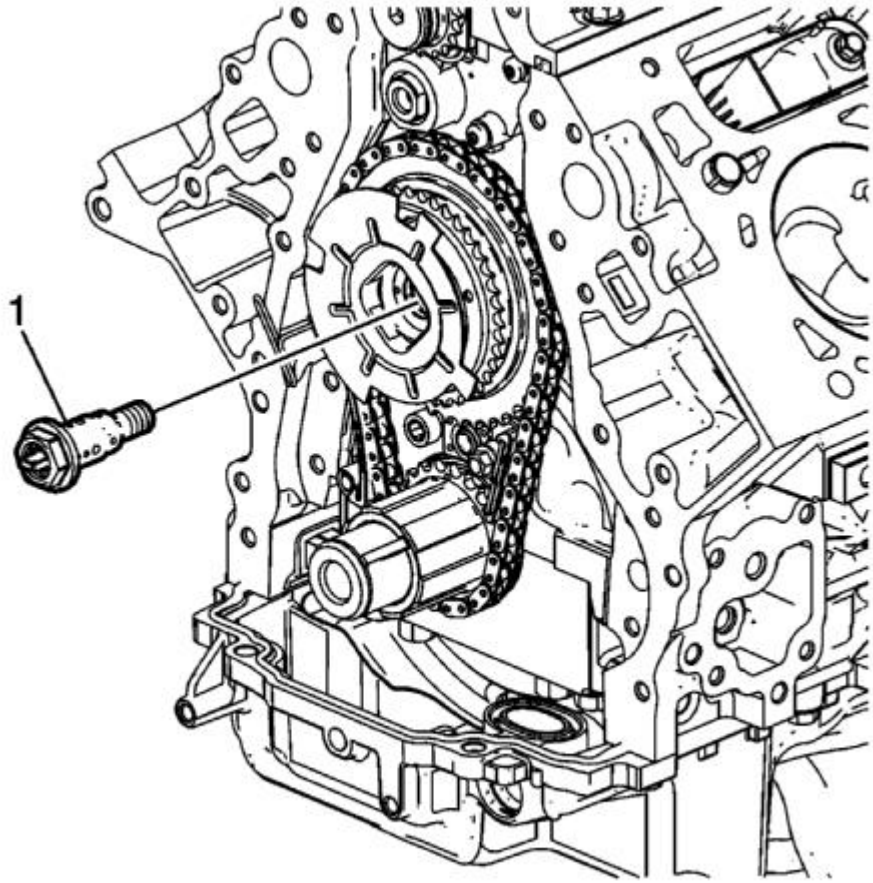


Fig. 169: NEW CMP Actuator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

12. Install a NEW CMP actuator solenoid valve (1). With the CMP actuator properly positioned onto the camshaft, the CMP actuator solenoid valve can be threaded completely into the camshaft using light hand pressure. Tighten by hand until snug.
    1. First pass 65 (48 lb ft).
    2. Final pass 90 degrees.

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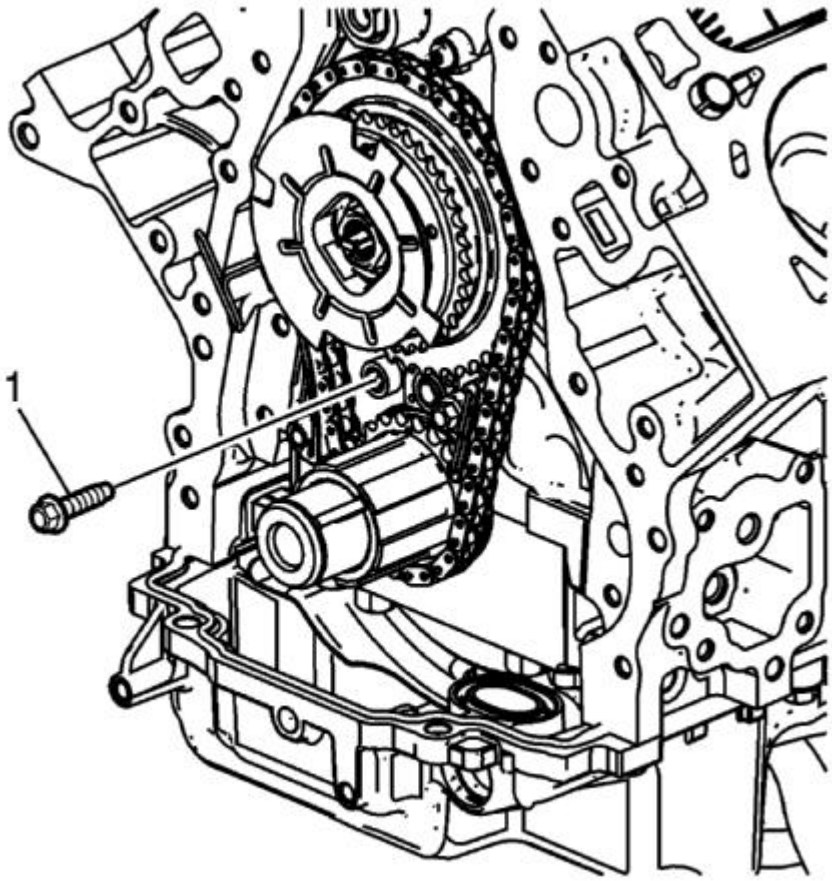


Fig. 170: Left Side Bolt And Timing Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

13. Install the right side bolt (1) onto the timing chain tensioner. Tighten both bolts to 30 N.m (22 lb ft).

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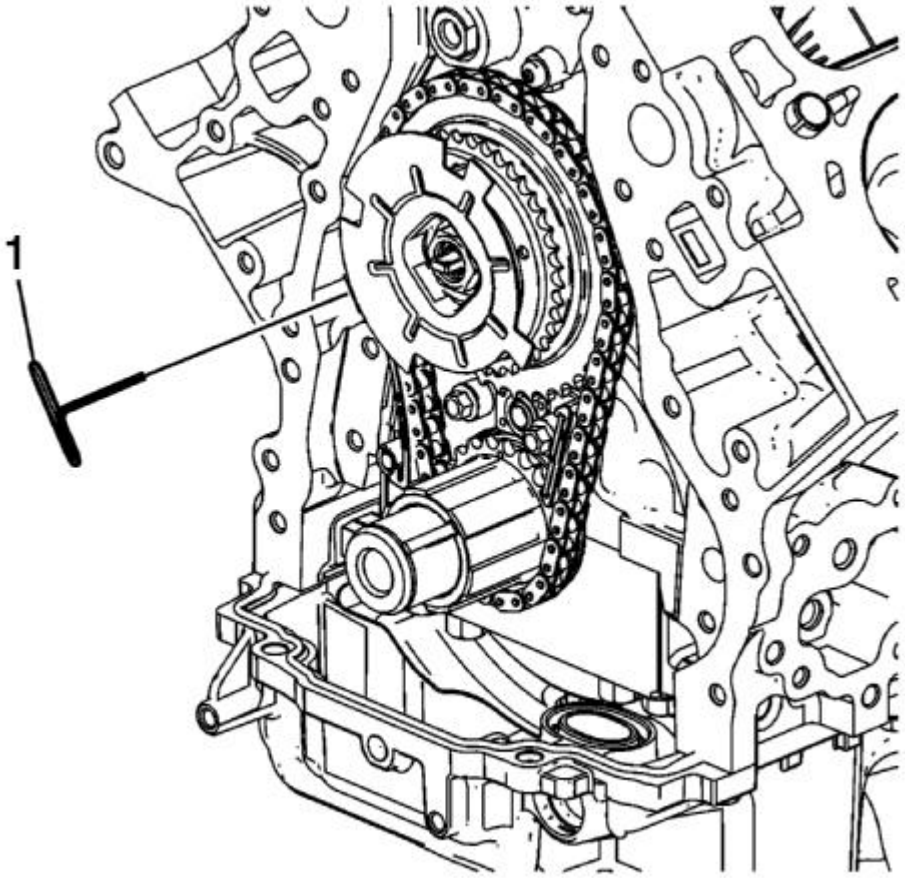


Fig. 171: EN-46330 Tension Pin
Courtesy of GENERAL MOTORS COMPANY

14. Remove the **EN-46330** tension pin.

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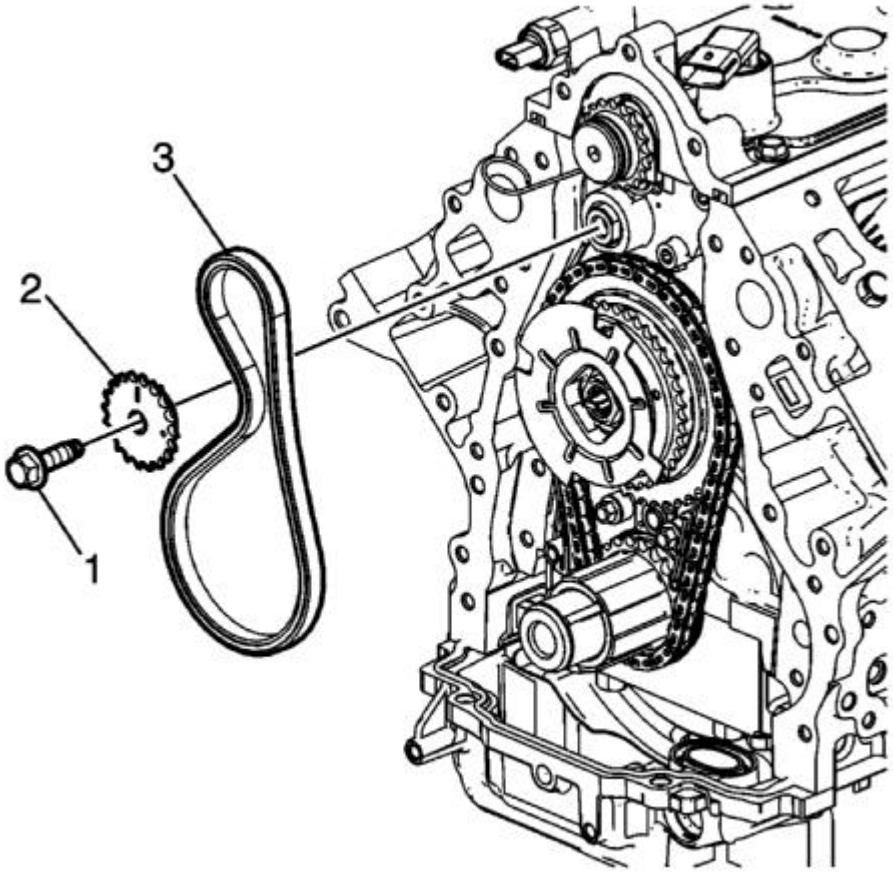


Fig. 172: Balancer Chain And Driven Sprocket
Courtesy of GENERAL MOTORS COMPANY

15. Install the balancer chain (3) by wrapping it around the camshaft actuator and the balancer shaft idler sprocket.
16. Install the driven sprocket (2) and driven sprocket bolt (1) hand tight.

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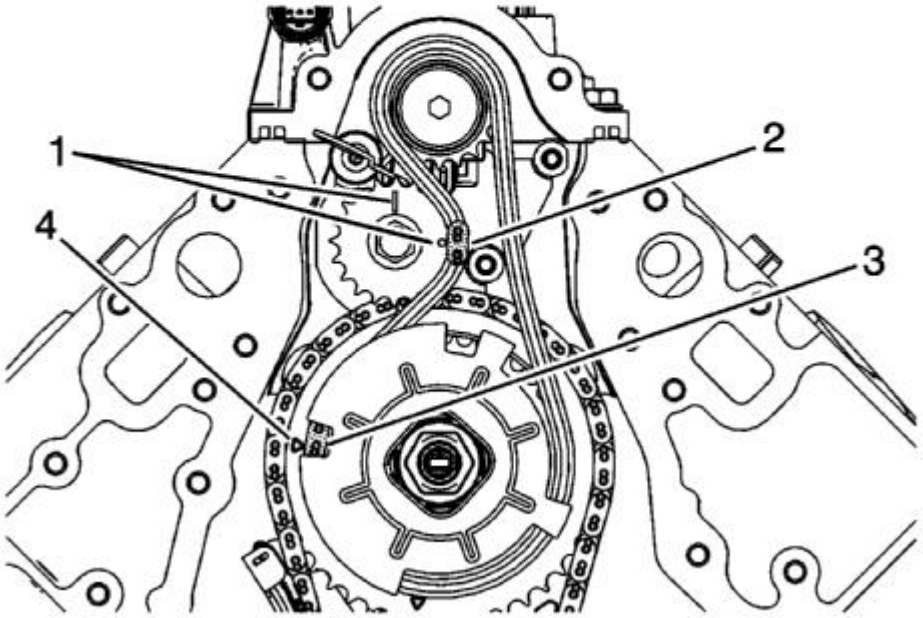


Fig. 173: Blue Link Plate And Camshaft Actuator Triangle Mark
Courtesy of GENERAL MOTORS COMPANY

17. The lower blue link plate (3) of the balancer chain must align with the camshaft actuator triangle mark (4).
18. The upper blue link plate (2) of the balancer chain must alight with the dot (1) on balancer driven sprocket. The 20 tooth driven sprocket will also have a molded in vertical line (1) pointing at 12 o'clock.

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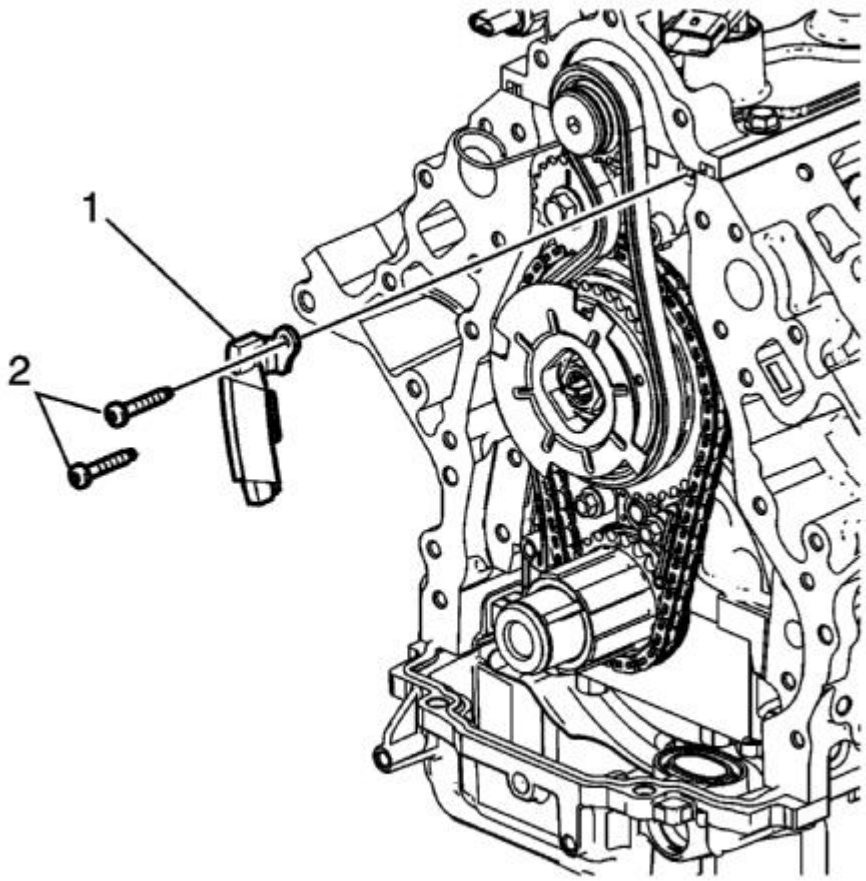


Fig. 174: Balancer Chain Guide With Shim And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: If plastic shim is not available, a 1.1 mm (0.04 in) size shim will need to be placed between the balancer chain and guide during installation.

19. Install the balancer chain guide with shim (1) and bolts (2).
20. Tighten the 2 o'clock and 3:30 o'clock position guide bolts (2) to 10 N.m (88 lb in).

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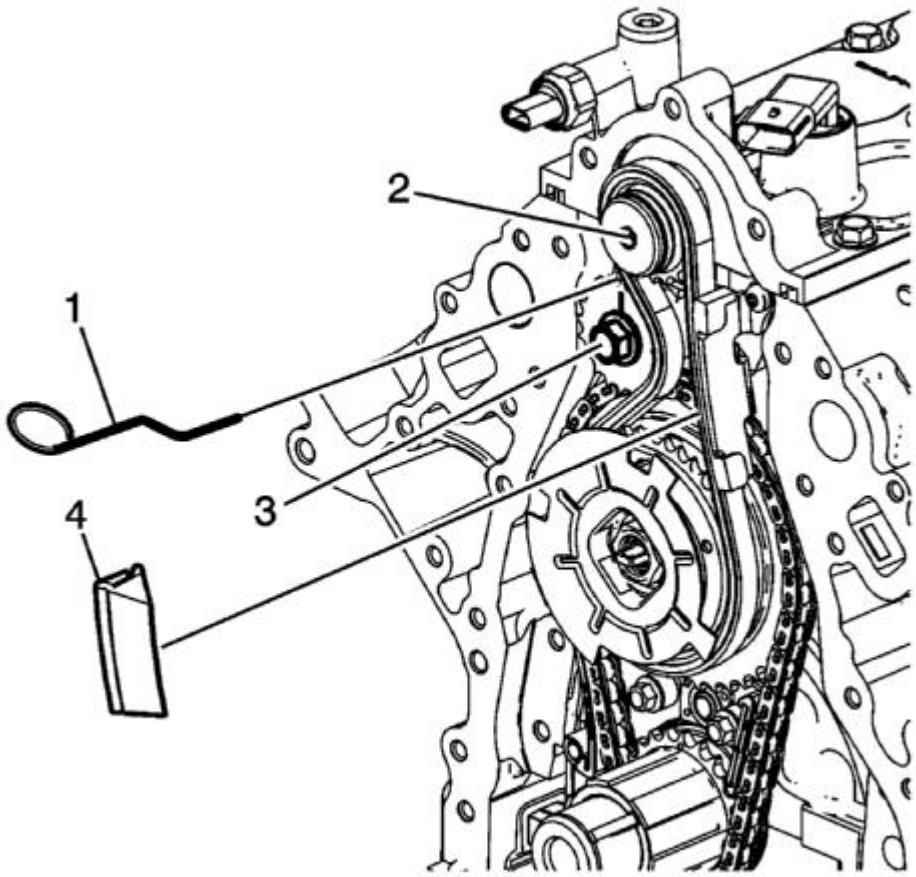


Fig. 175: Driven Sprocket Bolt And Idler Sprocket
Courtesy of GENERAL MOTORS COMPANY

21. Tighten the driven sprocket bolt (3) to 58 N.m (43 lb ft).
22. With the idler sprocket (2) free to slide up and down, pull (remove) the **EN-46330** tension pin (1).
23. Tighten the idler sprocket bolt (2) to 58 N.m (43 lb ft).
24. The chain should now be tight. Remove the shim (4) from between the balancer guide and the chain. The chain should now be slightly loose.
25. Remove flywheel locking tool.
26. Install the starter. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .
27. Install oil pump. Refer to **Oil Pump Replacement**.

CAMSHAFT REPLACEMENT

Removal Procedure

1. Remove the engine. Refer to **Engine Replacement**.
2. Remove the valve rocker arm and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
3. Remove the valve lifter follower guide. Refer to **Valve Lifter Follower Guide Removal** .

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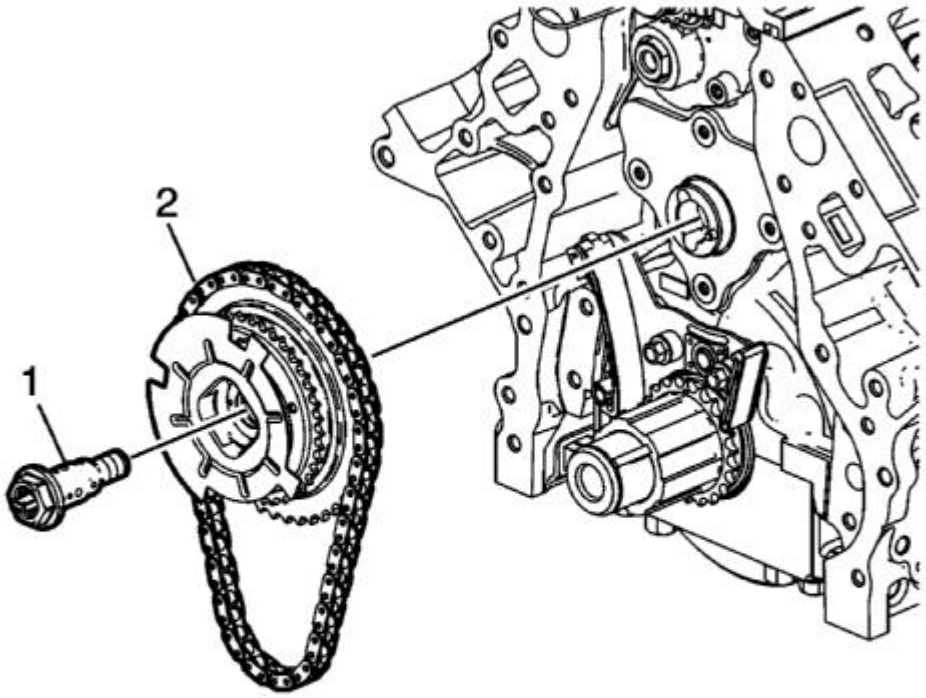


Fig. 176: Actuator And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

4. Remove the CMP actuator and timing chain (2). Refer to **Timing Chain, Crankshaft Sprocket, Camshaft Position Actuator and Solenoid Valve Replacement**.

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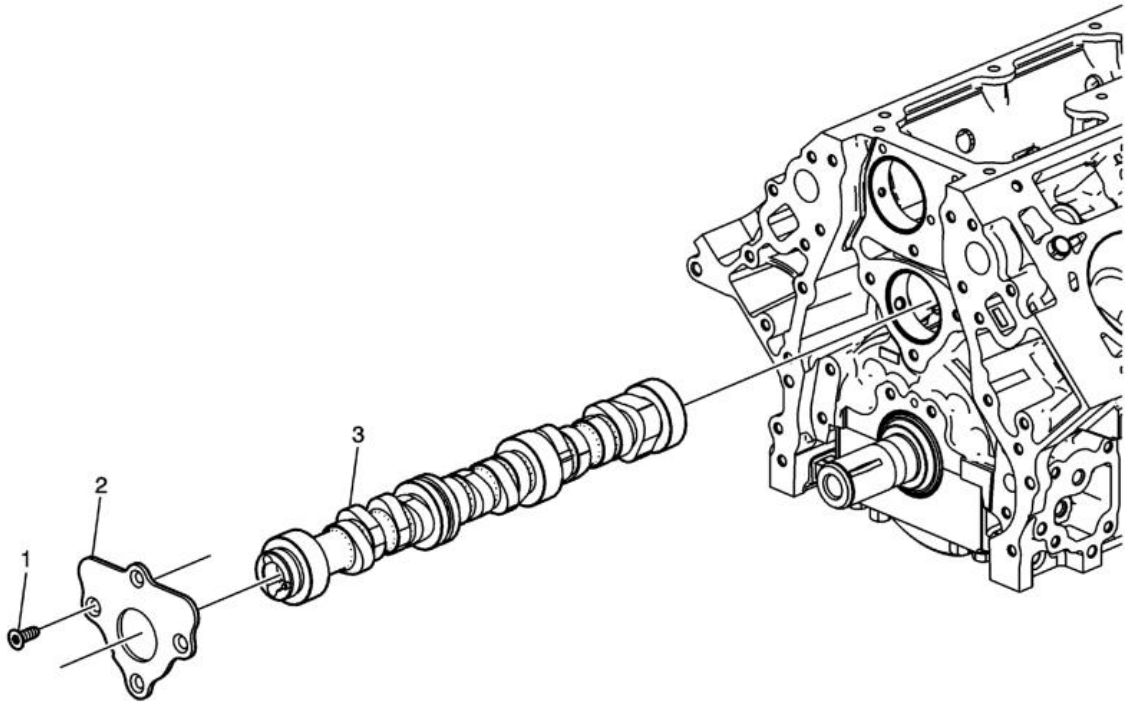


Fig. 177: Camshaft Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the camshaft retainer bolt (1).
6. Remove the camshaft retainer (2).
7. Remove the camshaft (3).
8. For camshaft cleaning and inspection, refer to **Camshaft and Bearings Cleaning and Inspection** .

Installation Procedure

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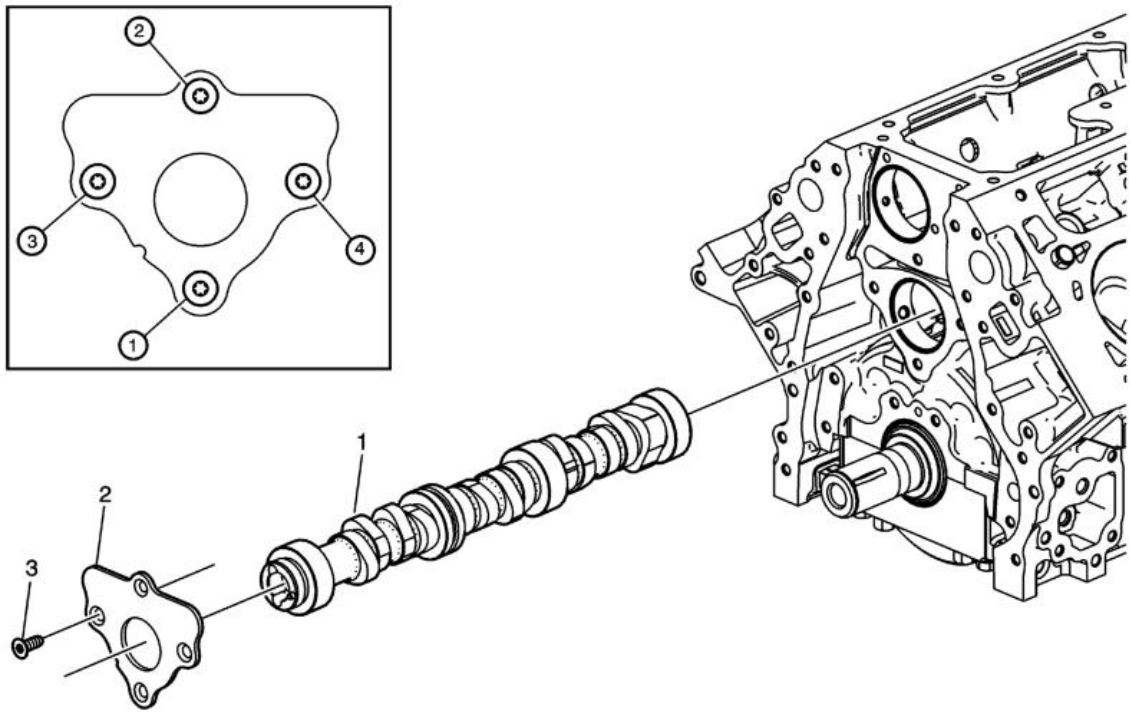


Fig. 178: Camshaft Retainer And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the camshaft (1), camshaft retainer (2) and camshaft retainer bolts (3). Refer to **Camshaft Installation** .

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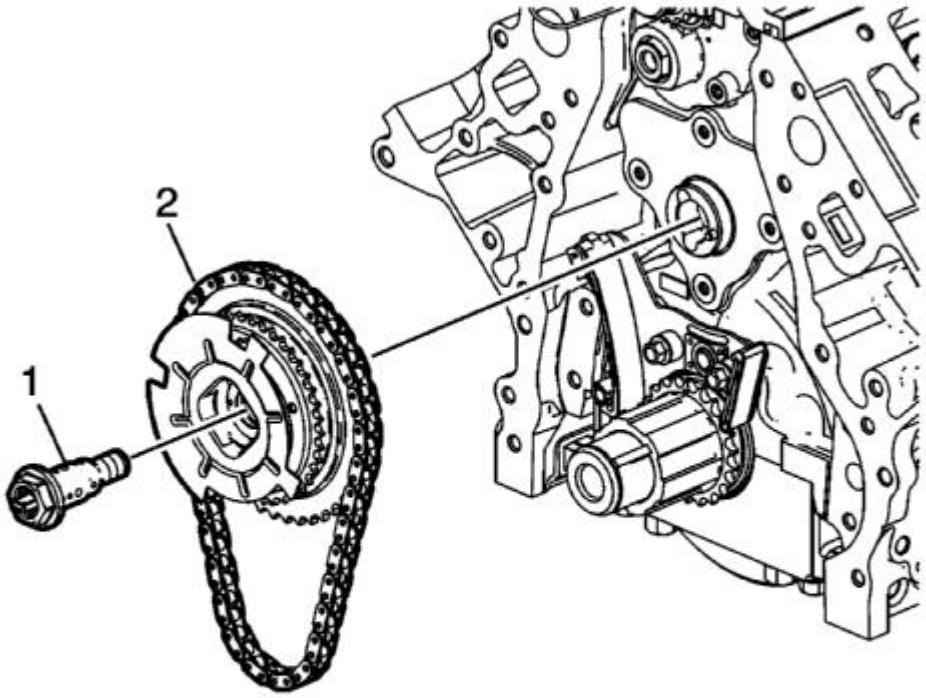


Fig. 179: Actuator And Timing Chain
Courtesy of GENERAL MOTORS COMPANY

2. Install the CMP actuator and timing chain (2). Refer to **Timing Chain, Crankshaft Sprocket, Camshaft Position Actuator and Solenoid Valve Replacement**.
3. Install the valve lifter follower guide. Refer to **Valve Lifter Follower Guide Installation** .
4. Install the valve rocker arm and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement (Right Side / Bank 2)**, **Valve Rocker Arm and Push Rod Replacement (Left Side / Bank 1)**.
5. Install the engine. Refer to **Engine Replacement**.

ENGINE FLYWHEEL REPLACEMENT

Special Tools

- **EN-42386-A** Flywheel Holding Tool
- **EN-45059** Angle Meter

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

Removal Procedure

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1. Remove the clutch assemble. Refer to **Clutch Assembly Replacement** .
2. Install the **EN-42386-A** flywheel holding tool in order to lock the flywheel.

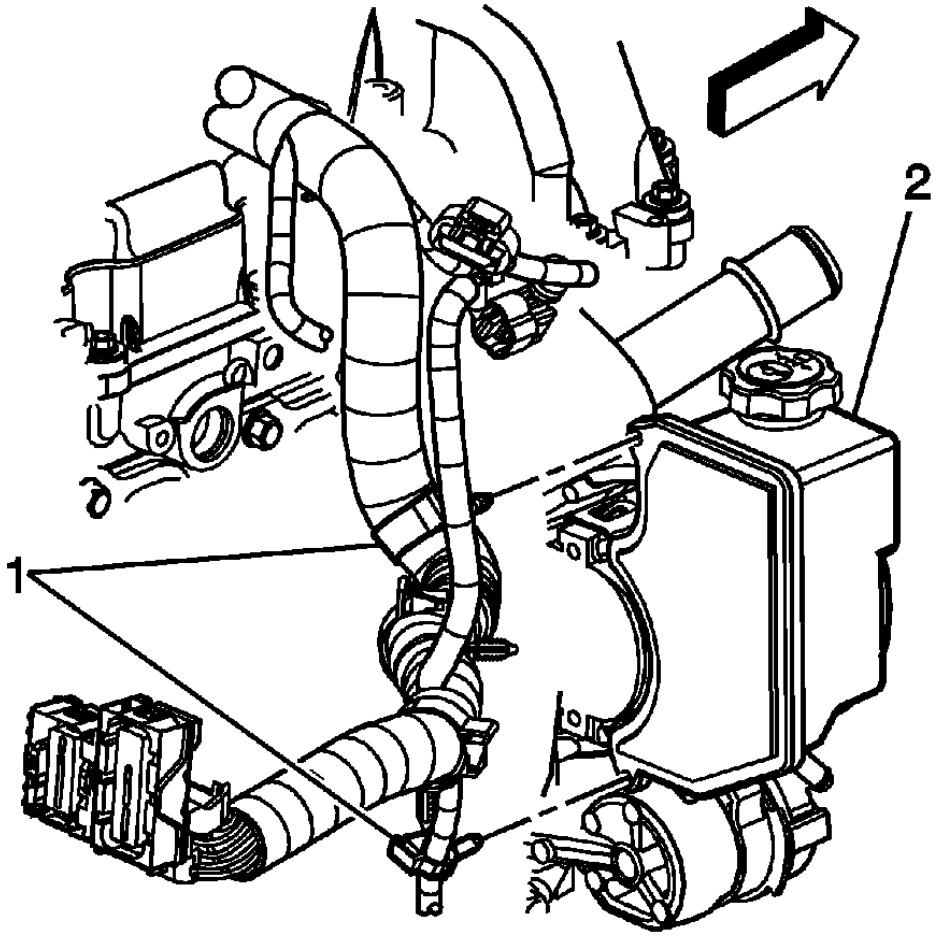


Fig. 180: Mark End Of Crankshaft & Manual Transmission Flywheel
Courtesy of GENERAL MOTORS COMPANY

NOTE: The flywheel does not use a locating pin for alignment. Mark or scribe the end of the crankshaft and the flywheel before component removal. The existing engine flywheel must be installed to the original position and direction. The engine flywheel will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flywheel bolts.

3. Mark or scribe the end of the crankshaft and the engine flywheel.

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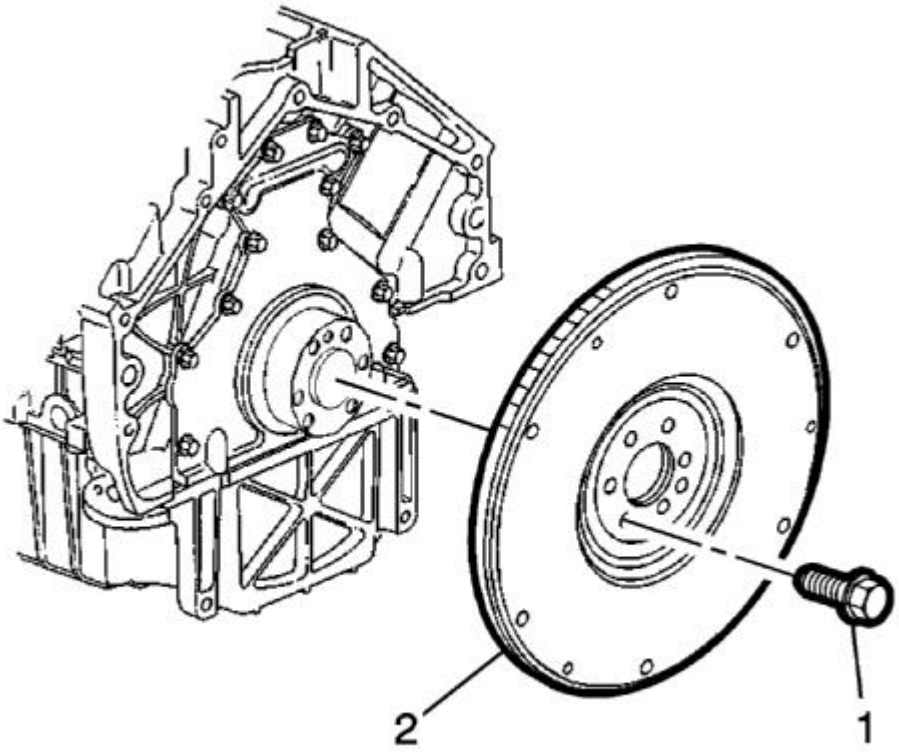


Fig. 181: Engine Flywheel Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD the engine flywheel bolts (1).
5. Remove the engine flywheel (2).

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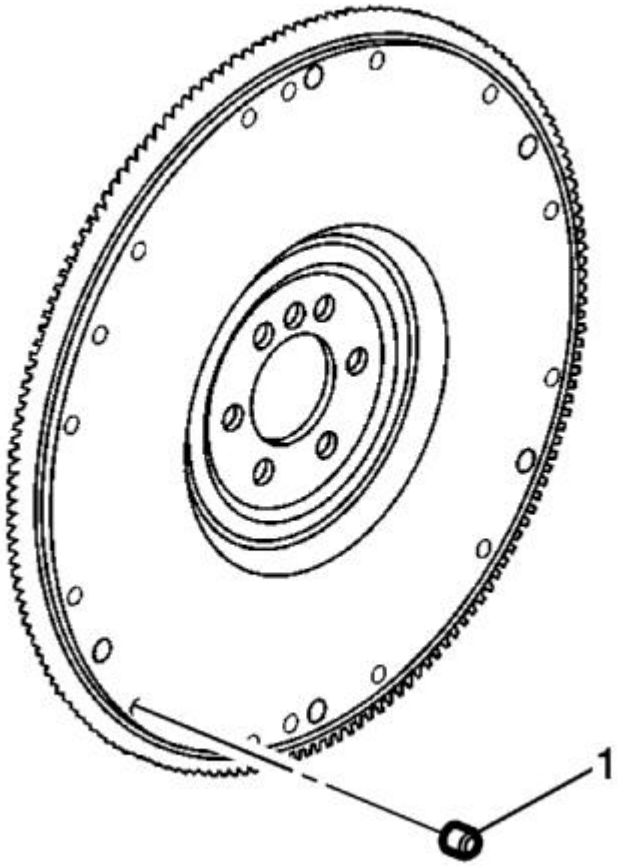


Fig. 182: Engine Flywheel Balance Weights
Courtesy of GENERAL MOTORS COMPANY

6. Note the location of the engine flywheel balance weights (1).
7. Remove the **EN-42386-A** flywheel holding tool.

Installation Procedure

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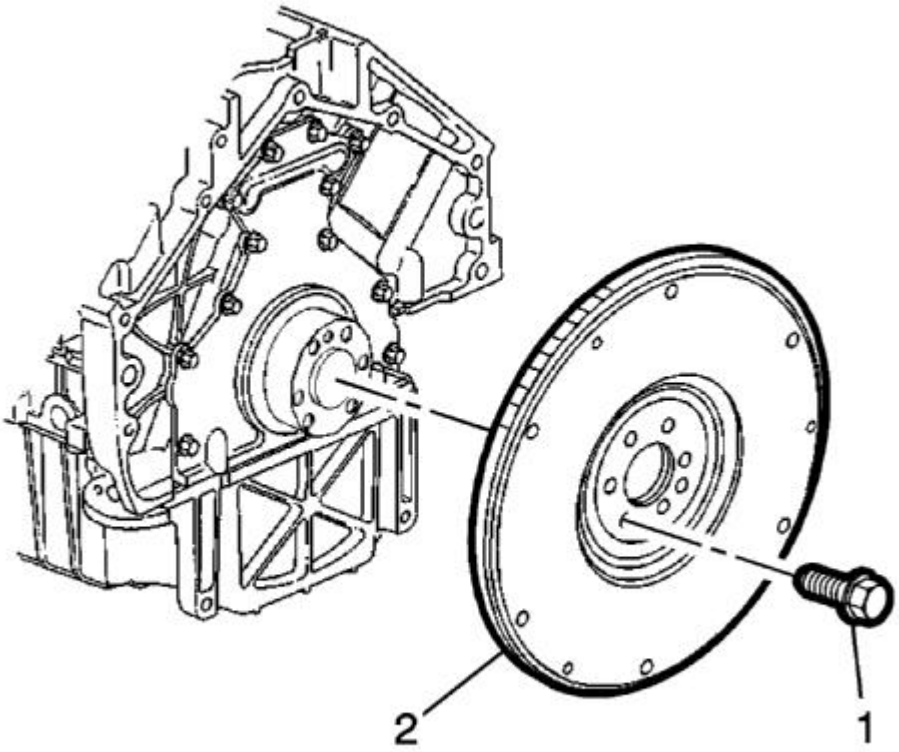


Fig. 183: Engine Flywheel Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Note the position and direction of the engine flywheel before removal. Mark or scribe the end of the crankshaft and flywheel before component removal. The existing engine flywheel must be installed to the original position and direction.**
- **The flywheel does not use a locating pin for alignment and will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flywheel bolts. This procedure requires a 3 stage tightening process.**

1. Install the engine flywheel (2) to the crankshaft, in the original position and direction.
2. Apply threadlock to the threads of the bolts (1). Refer to **Adhesives, Fluids, Lubricants and Sealers** .

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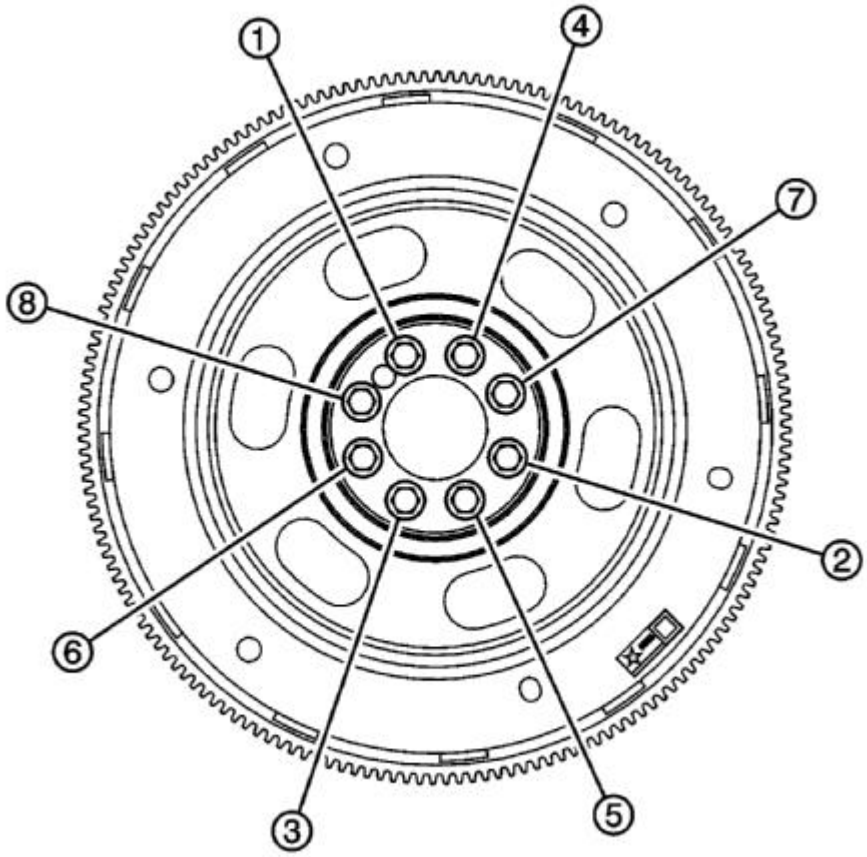


Fig. 184: NEW Engine Flex Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

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

3. Install NEW bolts.
    1. Install the **EN-42386-A** flywheel holding tool in order to lock the flywheel.
    2. Tighten the bolts (1-8) a first pass in sequence to 15 N.m (11 lb ft).
    3. Tighten the bolts (1-8) a second pass in sequence to 30 N.m (22 lb ft).
    4. Tighten the bolts (1-8) a final pass in sequence an additional 30 degrees using **EN-45059** angle meter.
4. Remove the **EN-42386-A** flywheel holding tool.
5. Install the clutch assemble. Refer to **Clutch Assembly Replacement** .

AUTOMATIC TRANSMISSION FLEX PLATE REPLACEMENT

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Special Tools

- **EN-42386-A** Flywheel Holding Tool
- **EN-45059** Angle Meter

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

Removal Procedure

1. Remove the transmission. Refer to **Transmission Replacement** .
2. Install the **EN-42386-A** flywheel holding tool in order to lock the flywheel.

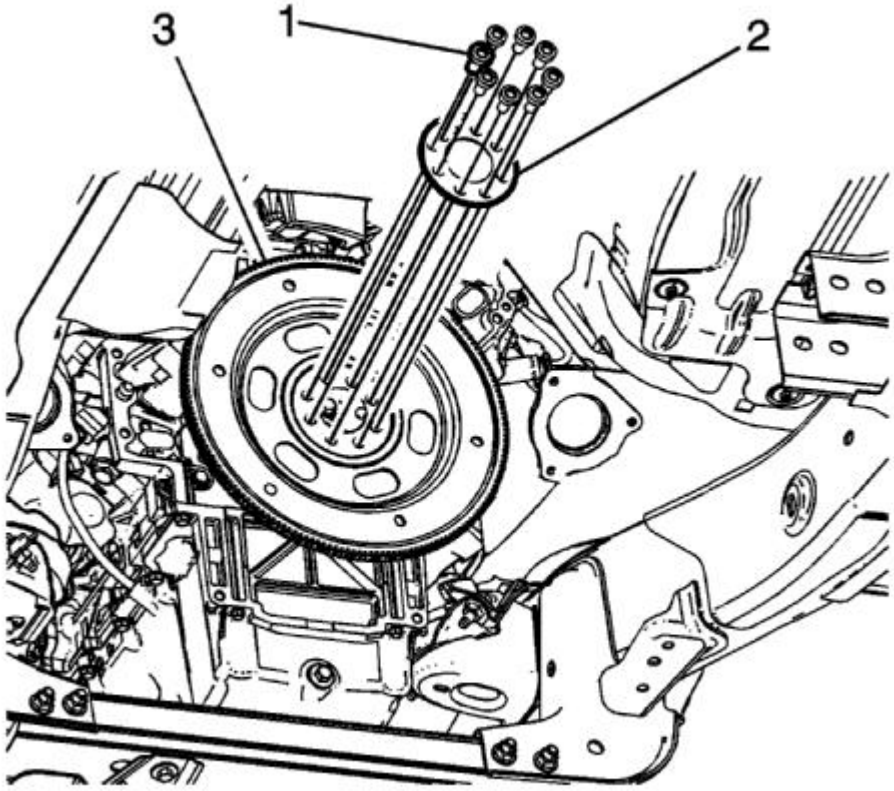


Fig. 185: Automatic Transmission Flex Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: The flex plate does not use a locating pin for alignment and will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flex plate bolts. This procedure requires a 3 stage tightening process.

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

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4. Remove the automatic transmission flex plate washer (2).
5. Remove the automatic transmission flex plate assembly (3).
6. Remove the **EN-42386-A** flywheel holding tool.

Installation Procedure

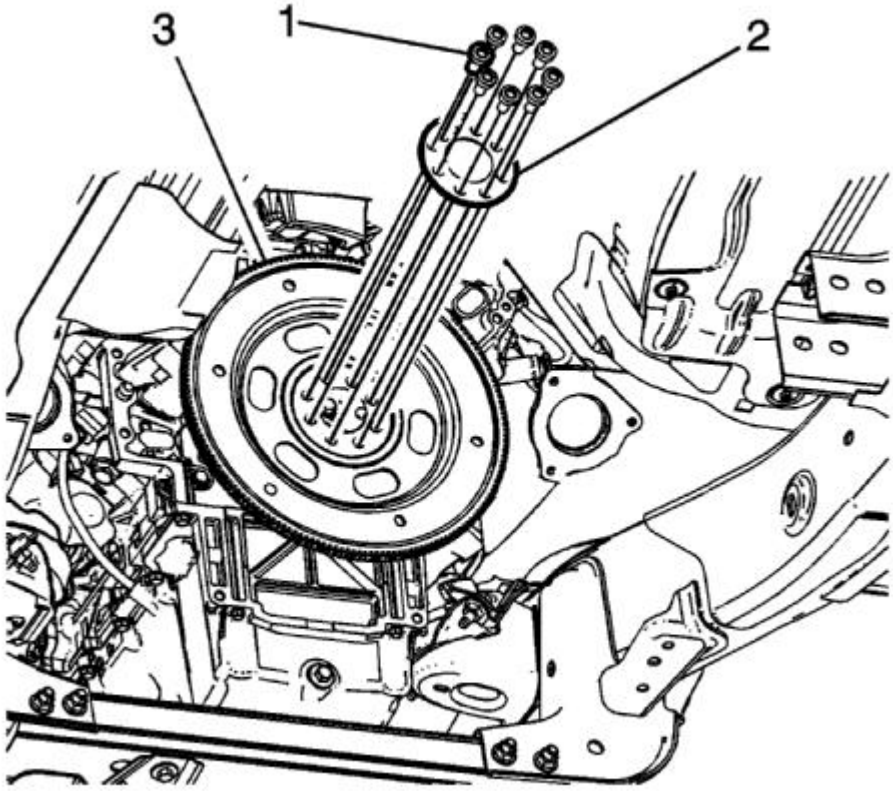


Fig. 186: Automatic Transmission Flex Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: The flex plate does not use a locating pin for alignment and will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flex plate bolts. This procedure requires a 3 stage tightening process.

1. Install the flex plate (1) to the crankshaft.
2. Install the flex plate washer (2).
3. Apply threadlock to the threads of the NEW flex plate bolts (2). Refer to **Adhesives, Fluids, Lubricants and Sealers** .

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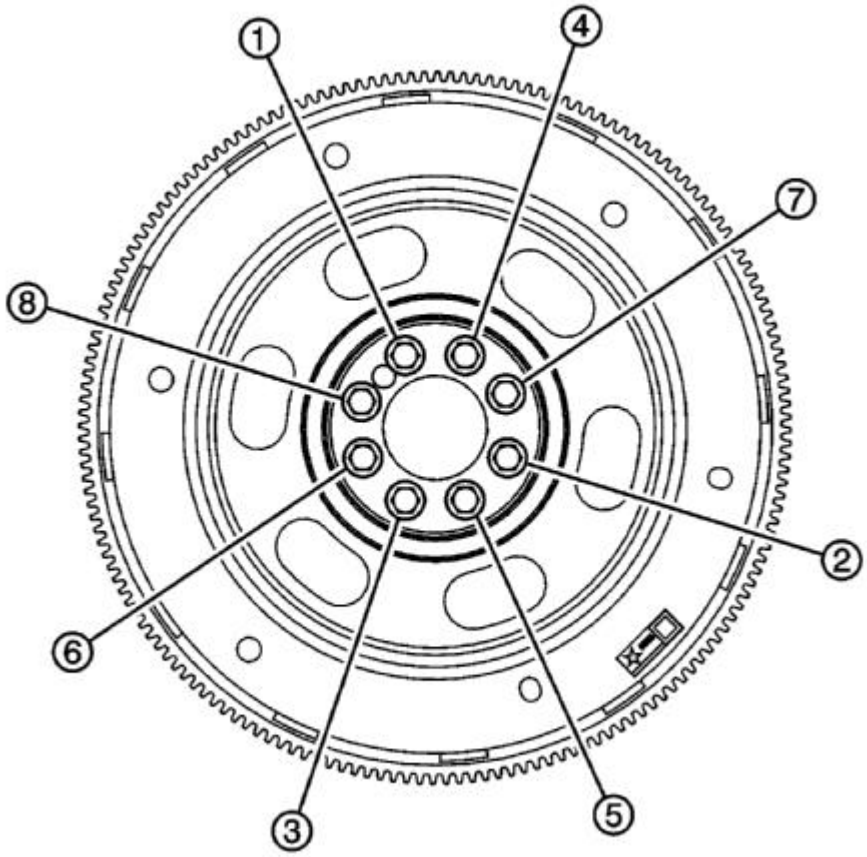


Fig. 187: NEW Engine Flex Plate Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

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

4. Install the NEW engine flex plate bolts.
    1. Install the **EN-42386-A** flywheel holding tool.
    2. Tighten the engine flex plate bolts (1-8) a first pass in sequence to 15 N.m (11 lb ft).
    3. Tighten the engine flex plate bolts (1-8) a second pass in sequence to 30 N.m (22 lb ft).
    4. Tighten the engine flex plate bolts (1-8) a final pass in sequence an additional 30 degrees using **EN-45059** angle meter.
5. Remove the **EN-42386-A** flywheel holding tool.
6. Install the transmission. Refer to **Transmission Replacement** .

ENGINE REPLACEMENT

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Special Tools

J-21366 Converter Holding Strap

j-36857 Engine Lift Bracket (Qty 2)

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

Removal Procedure

1. Place the hood in the service position. Refer to **Hood Service Positioning** .

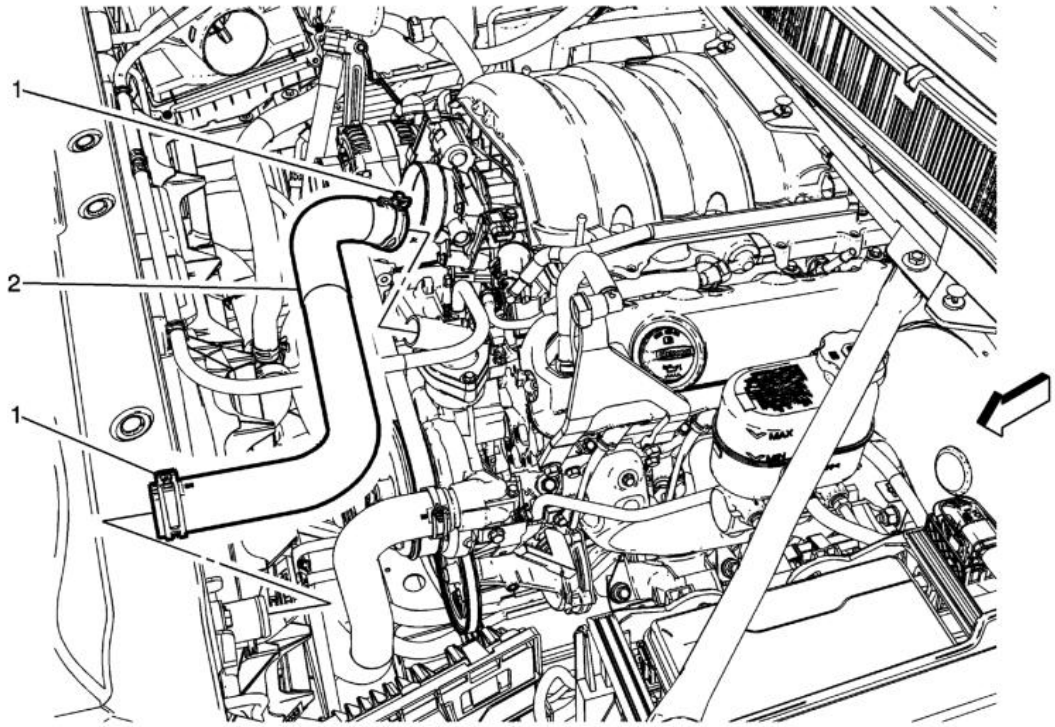


Fig. 188: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

2. Remove the radiator inlet hose (2). Refer to **Radiator Inlet Hose Replacement (LV3)** .

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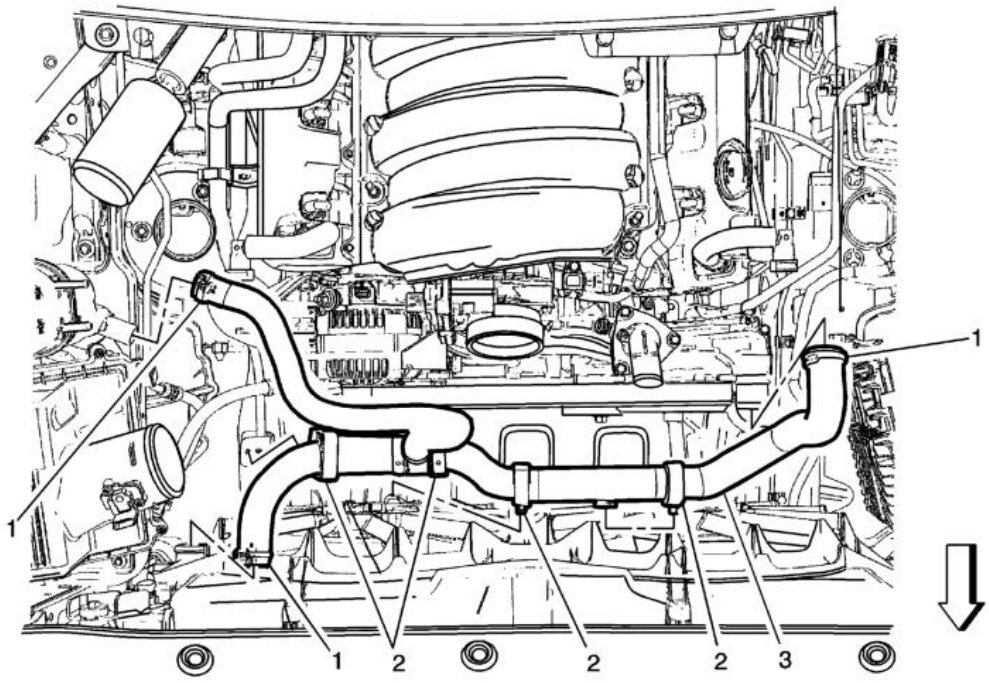


Fig. 189: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Remove the radiator outlet hose (3). Refer to **Radiator Outlet Hose Replacement (LV3)** .

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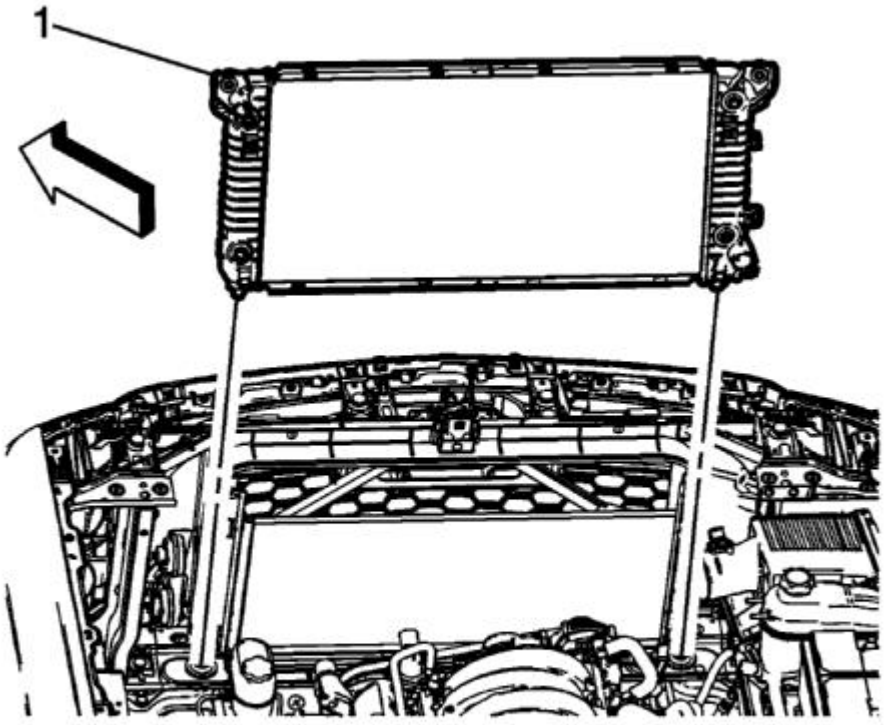


Fig. 190: Radiator
Courtesy of GENERAL MOTORS COMPANY

4. Remove the radiator. Refer to **Radiator Replacement (LV3)** .

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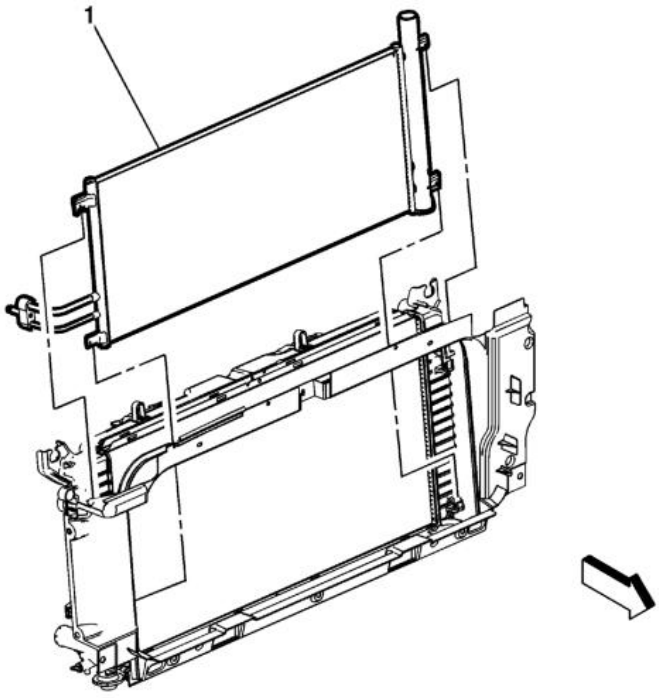


Fig. 191: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

5. Remove the air conditioning condenser. Refer to **Air Conditioning Condenser Replacement (LV3)** .
6. Remove the headlamp and radiator grille mount panel. Refer to **Headlamp and Radiator Grille Mount Panel Replacement** .
7. Remove the front end upper tie bar support. Refer to **Front End Upper Tie Bar Support Replacement** .

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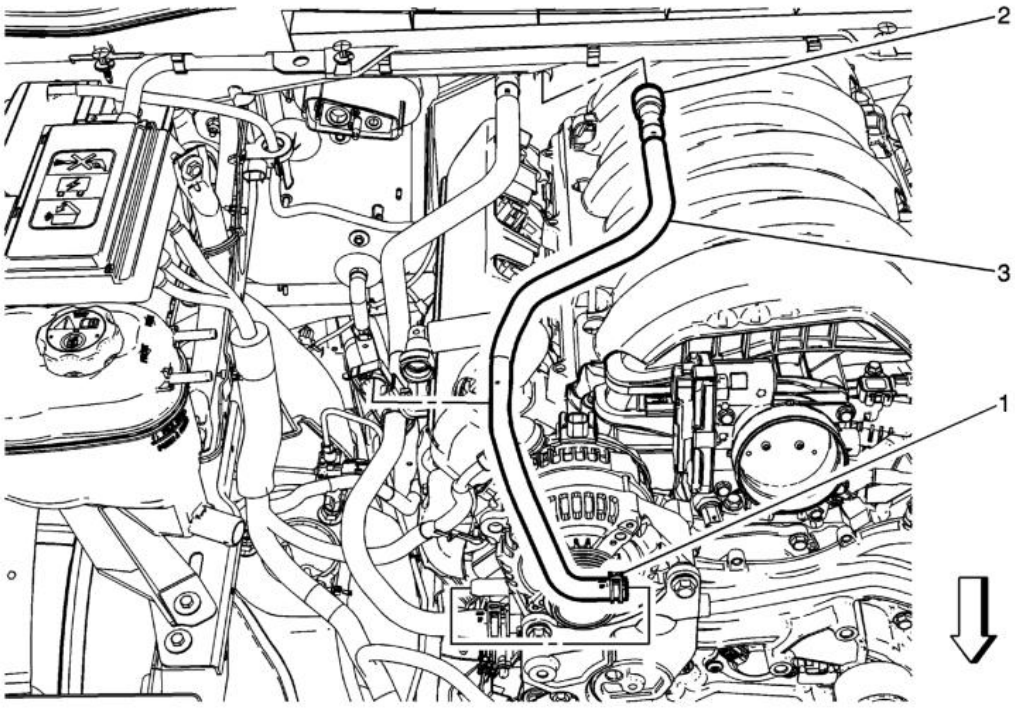


Fig. 192: Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

8. Remove the heater inlet hose (1). Refer to **Heater Inlet Hose Replacement (LV3)** .
9. Remove the heater outlet hose. Refer to **Heater Outlet Hose Replacement (LV3)** .

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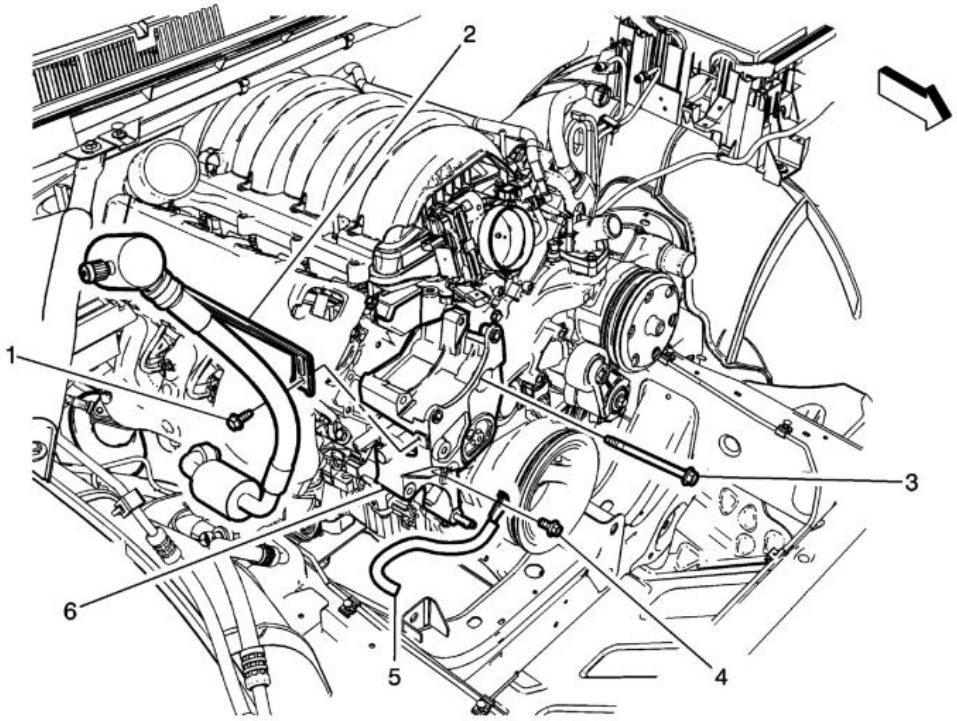


Fig. 193: Generator Bracket (LV1, LV3)
Courtesy of GENERAL MOTORS COMPANY

10. Remove the generator bracket (6) from the engine assembly. Refer to **Generator Bracket Replacement (LV1, LV3)** .

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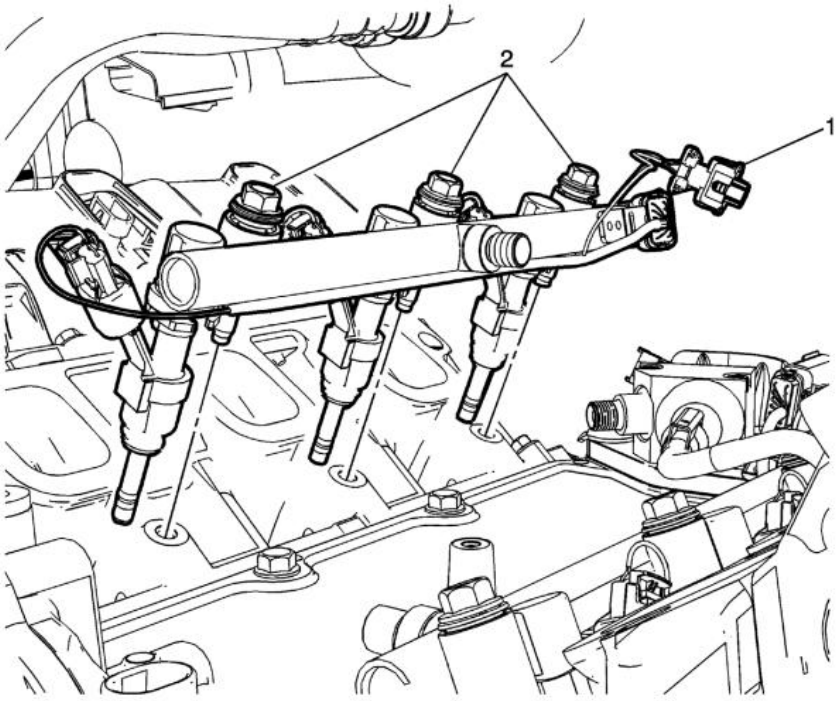


Fig. 194: Fuel Injection Fuel Rail Assembly - bank 2
Courtesy of GENERAL MOTORS COMPANY

11. Remove the fuel injection fuel rail assembly - bank 2 (2). refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 2** .

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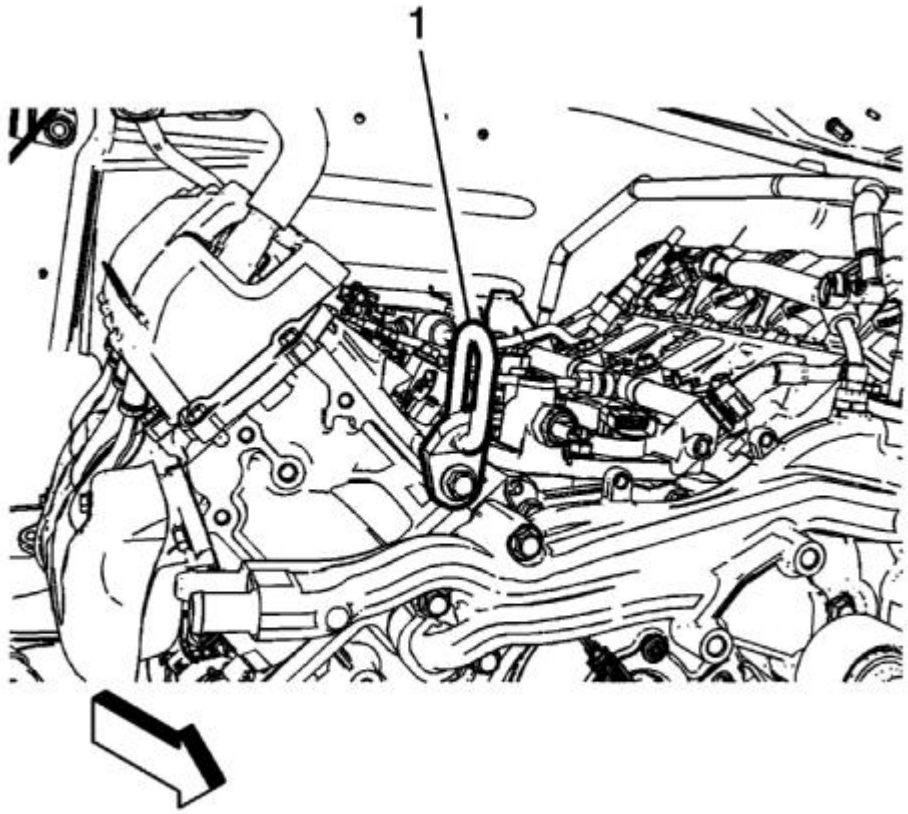


Fig. 195: Front Engine Lift Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure using a correct length bolt to keep the engine lift bracket firmly against the cylinder head.

12. Install the front engine lift bracket (1) to the position shown.

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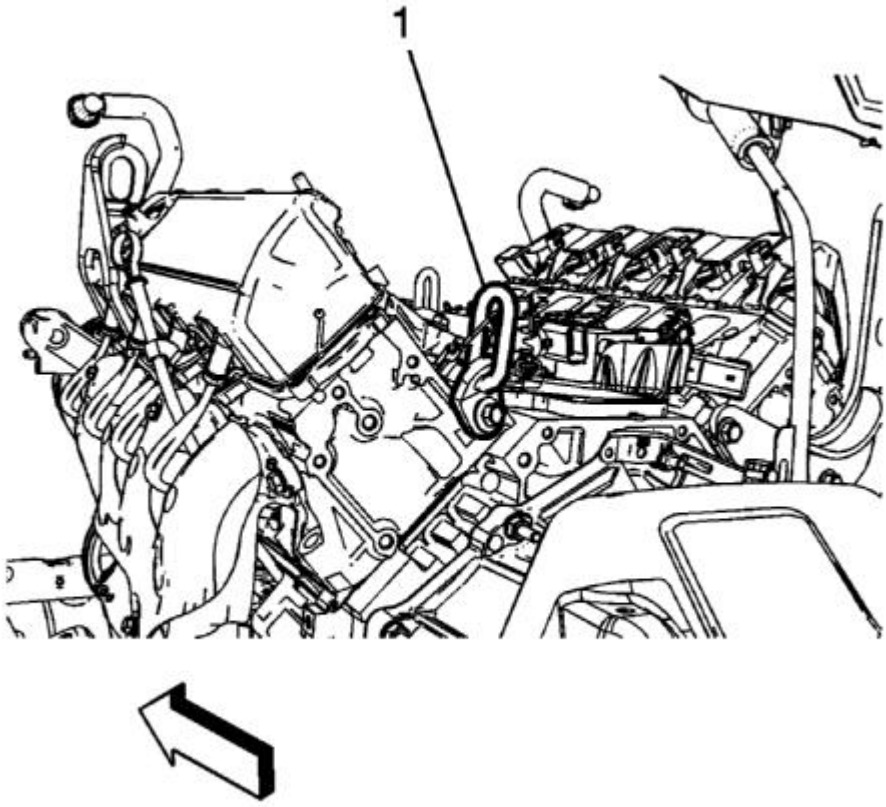


Fig. 196: Rear Engine Lift Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure using a correct length bolt to keep the engine lift bracket firmly against the cylinder head.

13. Install the rear engine lift bracket (1) to the position shown.

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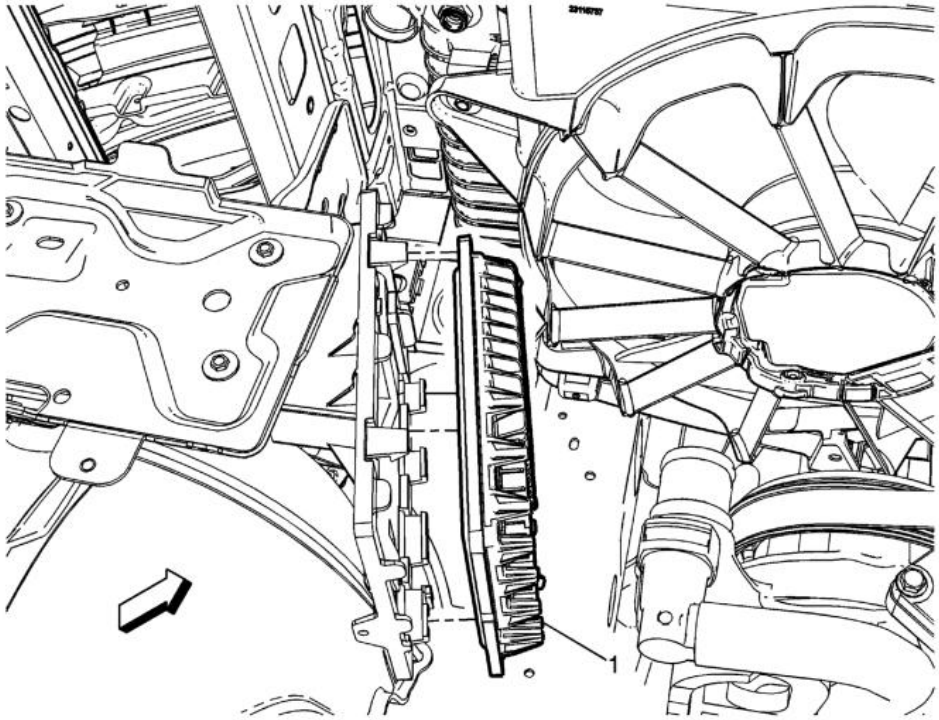


Fig. 197: Engine Control Module
Courtesy of GENERAL MOTORS COMPANY

14. Remove the engine control module (1). Refer to **Engine Control Module Replacement** .

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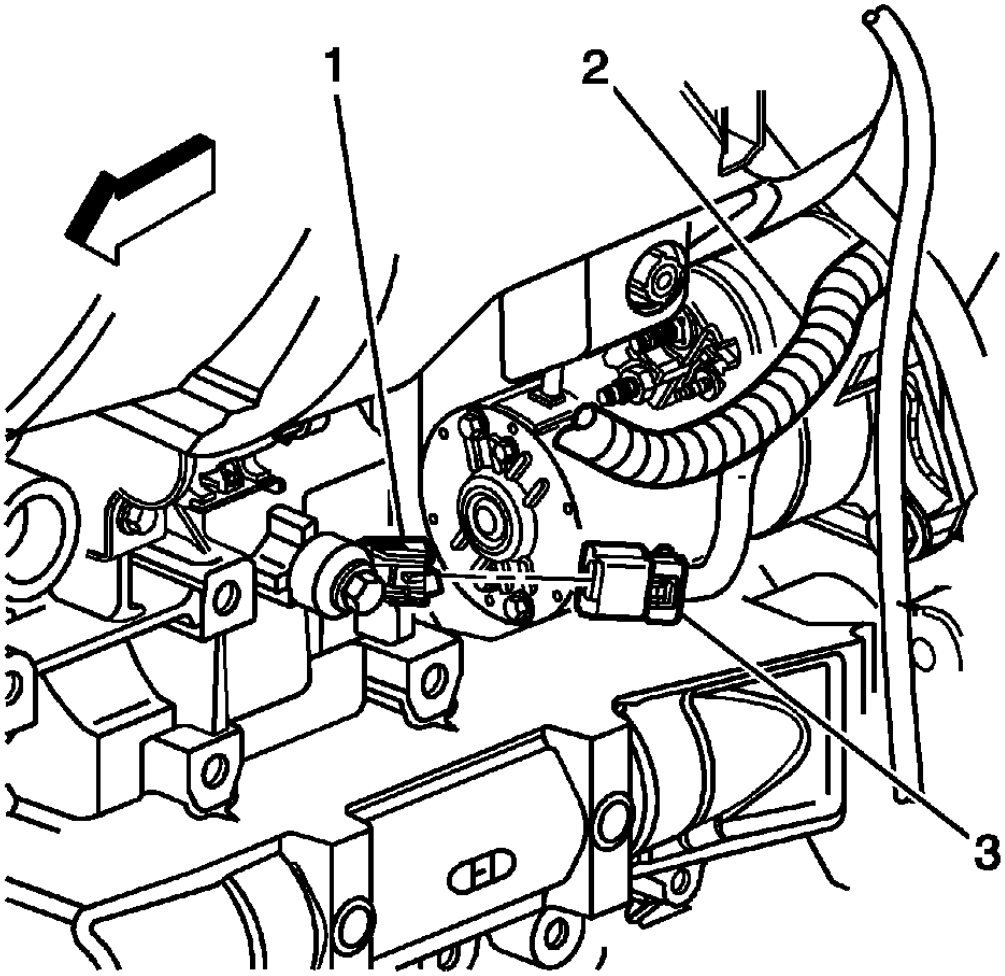


Fig. 198: View Of Underhood Electrical Center/Junction Block
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect the engine main wiring harness from the underhood electrical center junction block (1). Refer to **Underhood Electrical Center or Junction Block Replacement** .
16. Position the engine main wiring harness on to the engine assembly.

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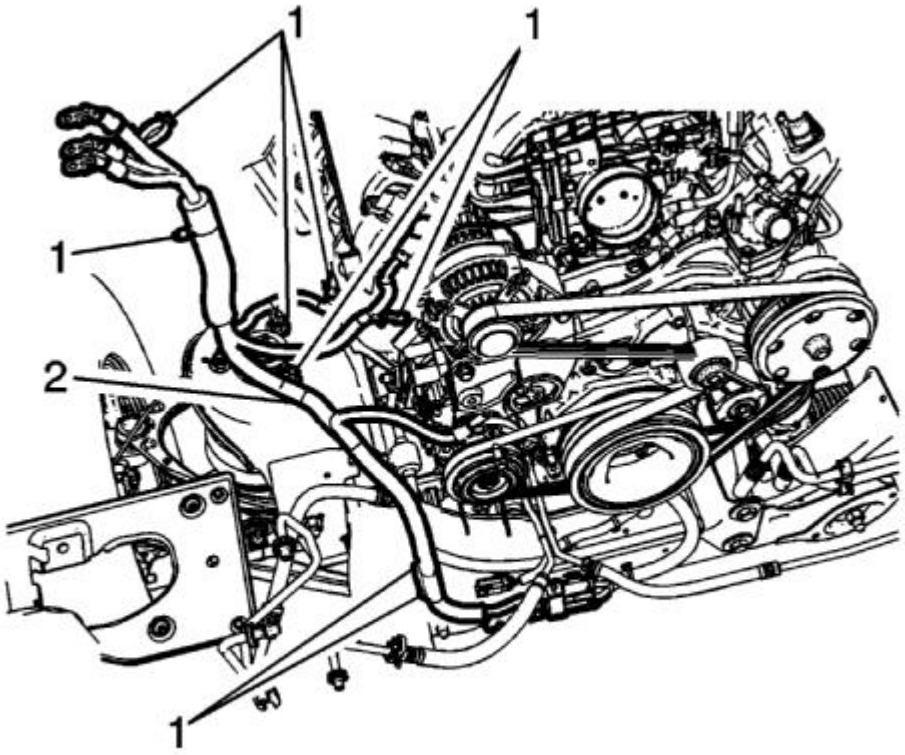


Fig. 199: Generator Battery Control Wiring Harness Retainers And Generator Battery Control Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

17. Remove the generator battery control wiring harness (2). Refer to **Generator Battery Control Wiring Harness Replacement (L83, L86, LV1, LV3)** .
18. Disconnect the fuel feed pipe from the fuel pump feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
19. Remove the engine oil cooler hose assembly from the engine. Refer to **Engine Oil Cooler Hose Replacement**.

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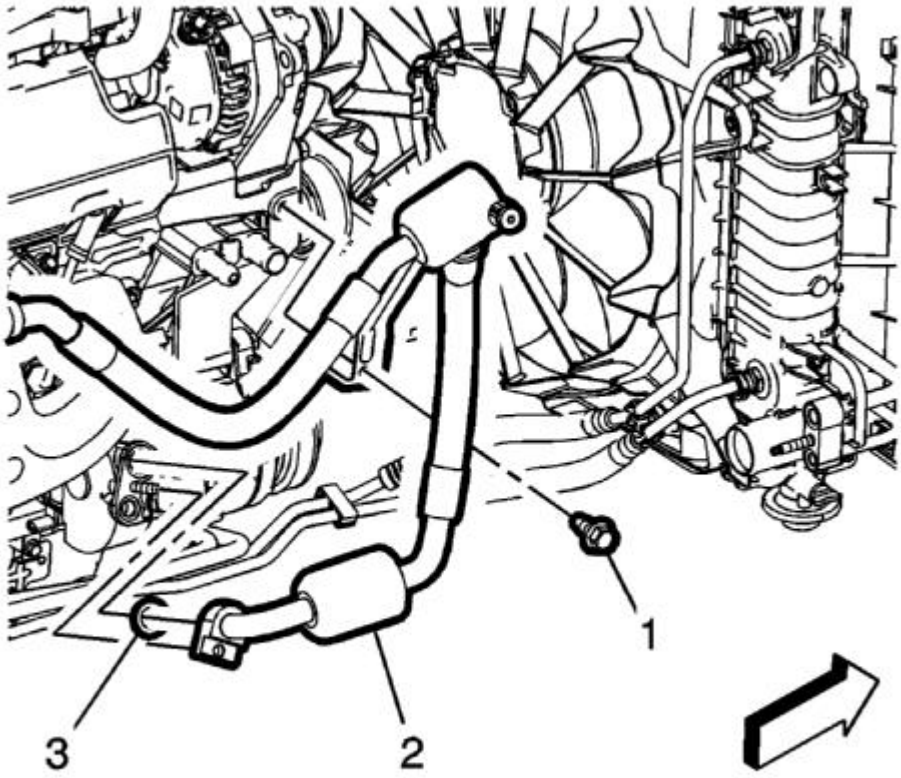


Fig. 200: Air Conditioning Tube Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

20. Remove the air conditioning tube bracket bolt (1) from the generator and drive belt tensioner bracket.
21. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
22. If the vehicle is equipped with a transfer case, remove the front propeller shaft. Refer to **Front Axle Propeller Shaft Replacement** .

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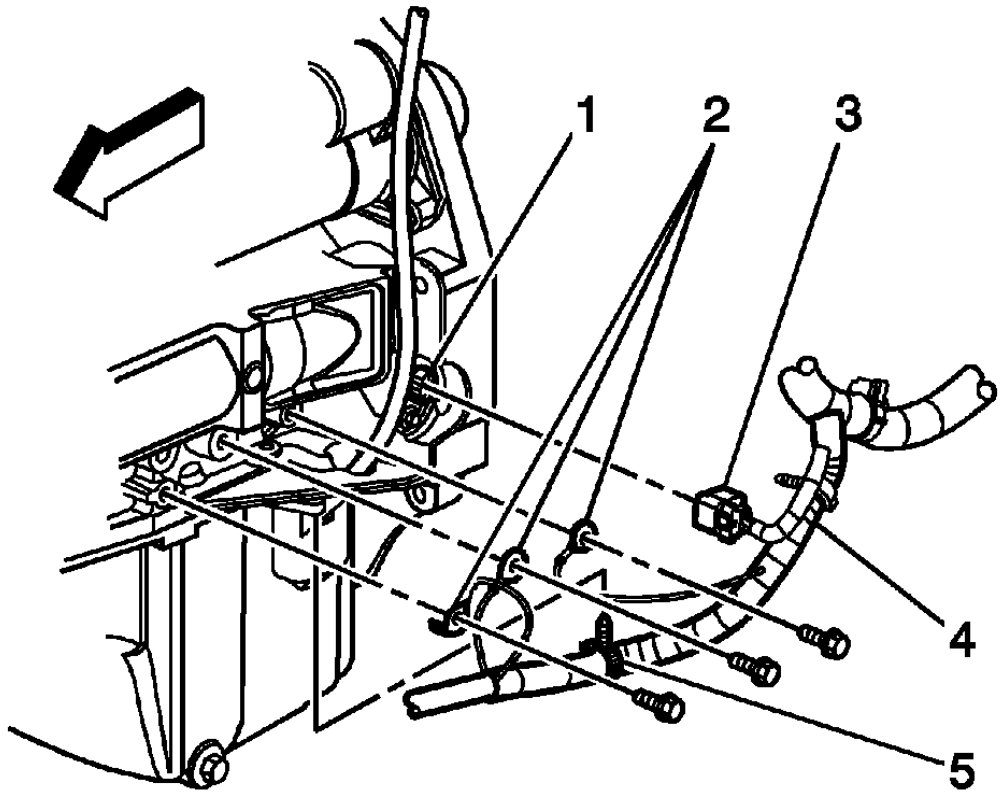


Fig. 201: View Of Left Flywheel Inspection Cover
Courtesy of GENERAL MOTORS COMPANY

23. Remove the left flywheel inspection cover.
24. Remove the starter motor. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .

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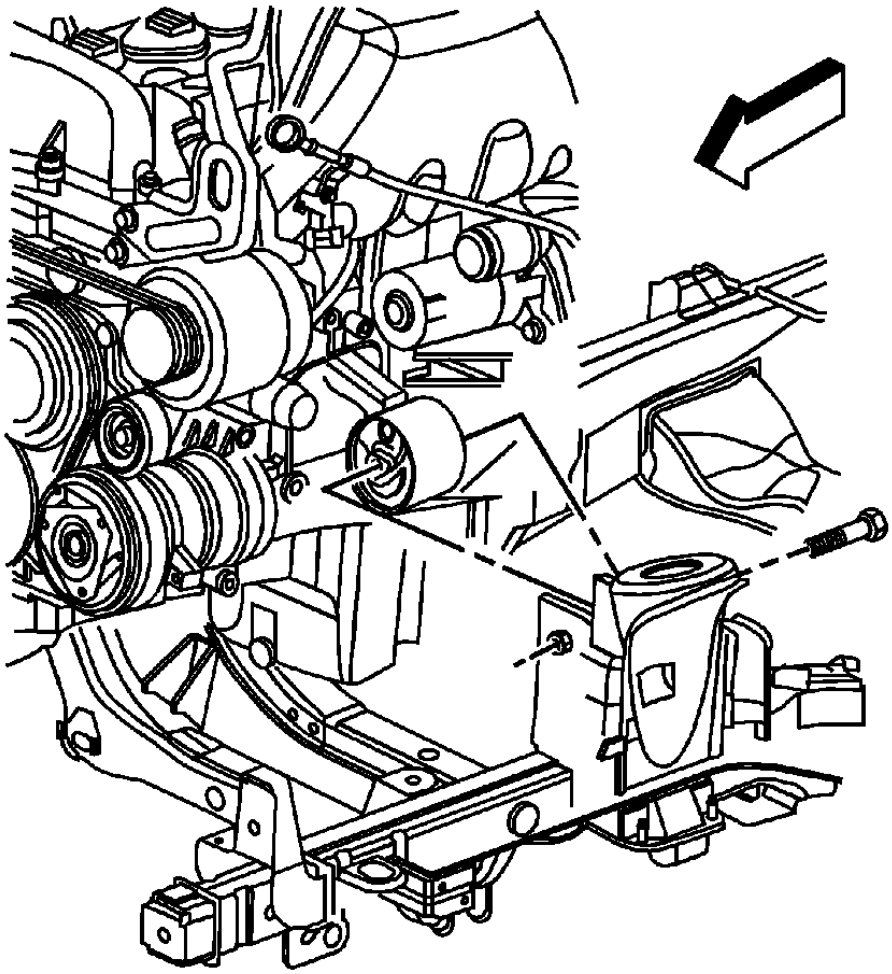


Fig. 202: View Of Right Flywheel Inspection Cover
Courtesy of GENERAL MOTORS COMPANY

25. Remove the right flywheel inspection cover.
26. Support the transmission with a transmission jack.

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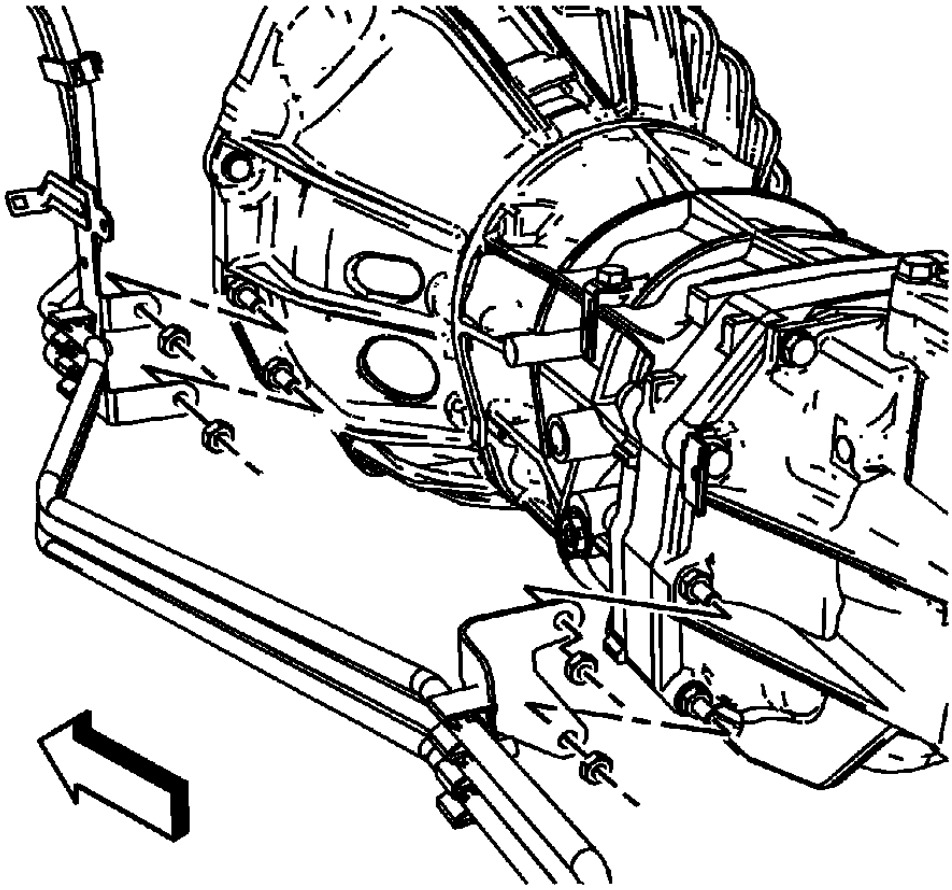


Fig. 203: View Of Transmission Crossmember, Crossmember Bolts & Nuts
Courtesy of GENERAL MOTORS COMPANY

27. Remove the transmission crossmember (4). Refer to **Transmission Support Crossmember Replacement (Two Wheel Drive - Light Duty)** , **Transmission Support Crossmember Replacement (Two Wheel Drive - Heavy Duty)** , **Transmission Support Crossmember Replacement (Four Wheel Drive - Heavy Duty)** , **Transmission Support Crossmember Replacement (Four Wheel Drive - Light Duty)** .

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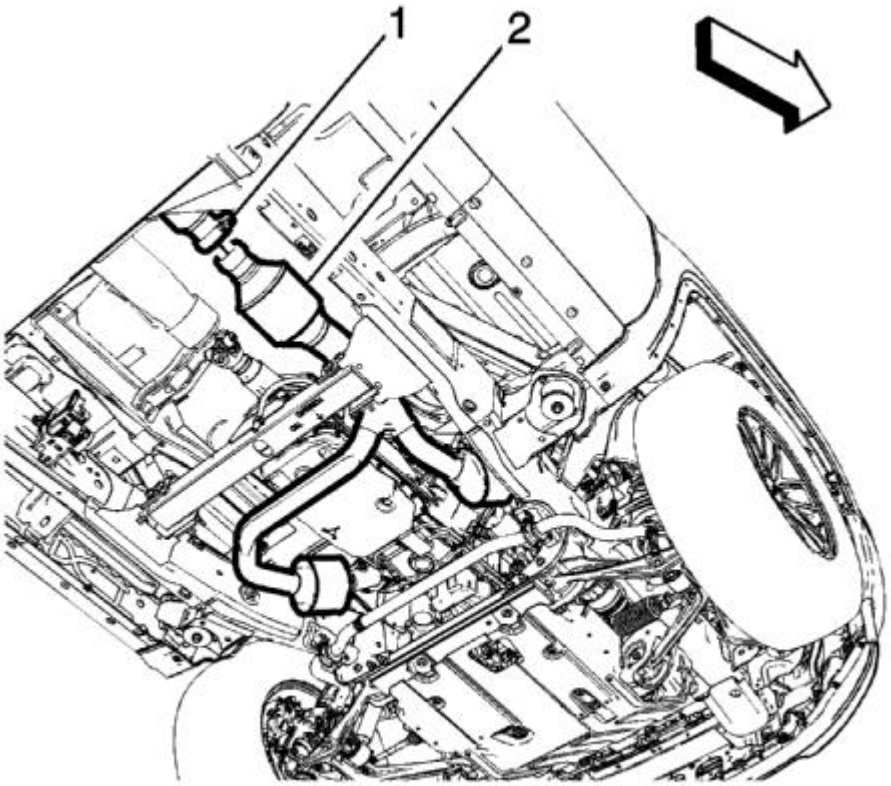


Fig. 204: Exhaust Front Pipe
Courtesy of GENERAL MOTORS COMPANY

28. Remove the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (L83, L86, LV1, LV3)** .

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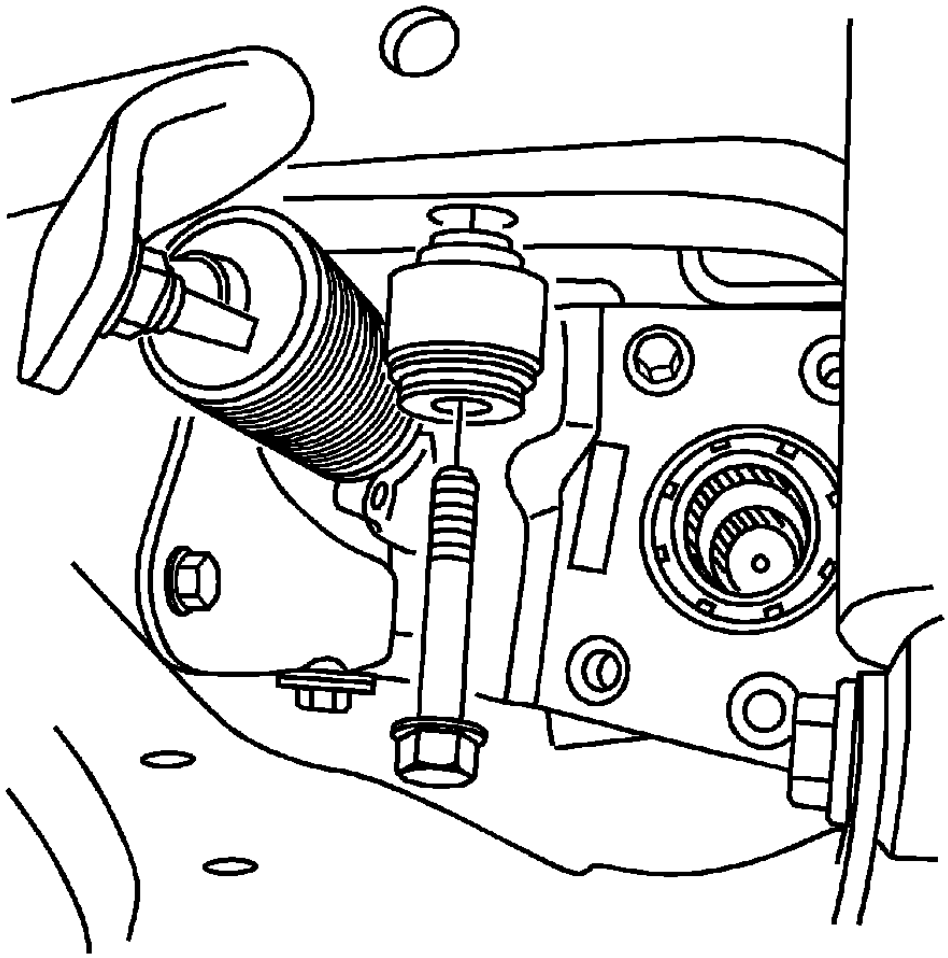


Fig. 205: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

29. Remove the flywheel to torque converter bolts.
30. Lower the transmission to gain access to the top and sides of the transmission.

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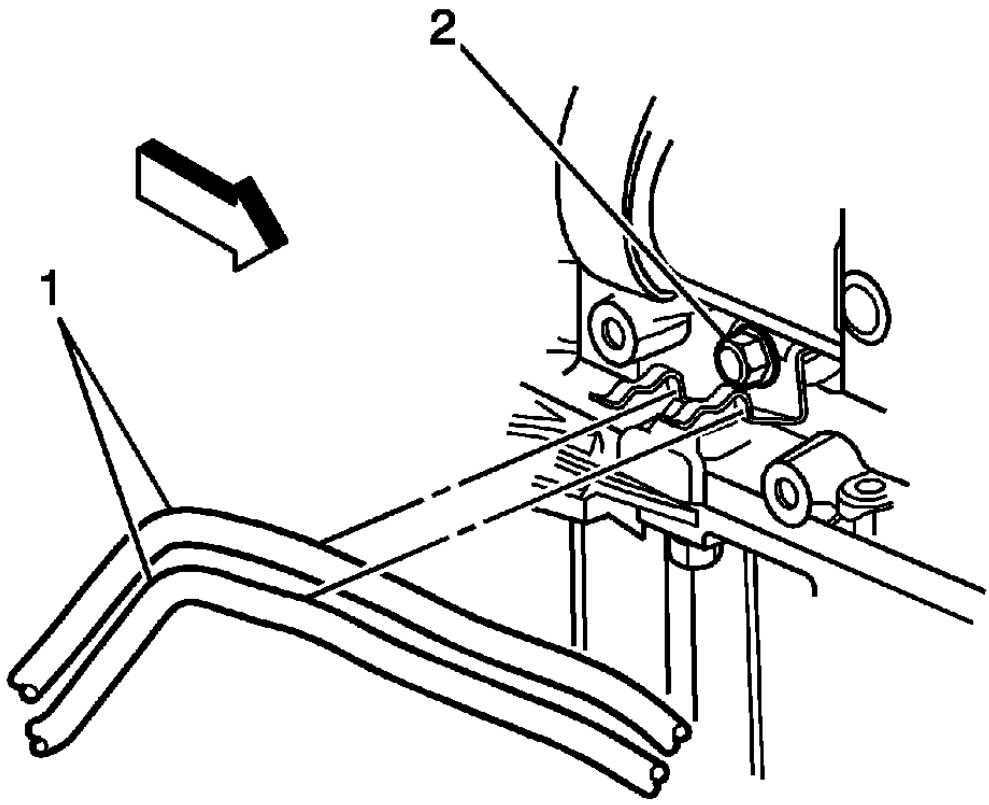


Fig. 206: View Of Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Leave the two lower transmission bolts in place.

31. Remove the 6 upper bolts securing the transmission to the engine.
32. Raise the transmission to the original installation position.

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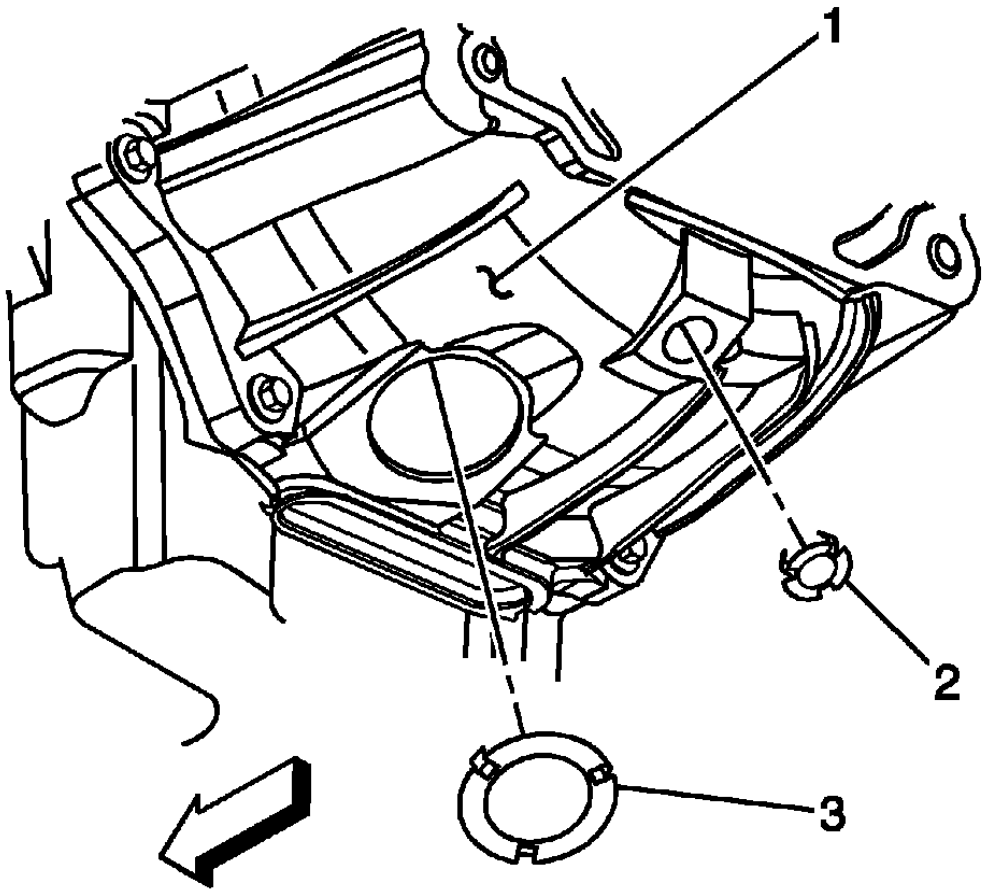


Fig. 207: View Of Transmission Crossmember, Crossmember Bolts & Nuts
Courtesy of GENERAL MOTORS COMPANY

33. Temporary install the transmission crossmember (4) to support the transmission.
34. Disconnect the electrical connectors from the transmission assembly, then position the wiring harness on the engine assembly.

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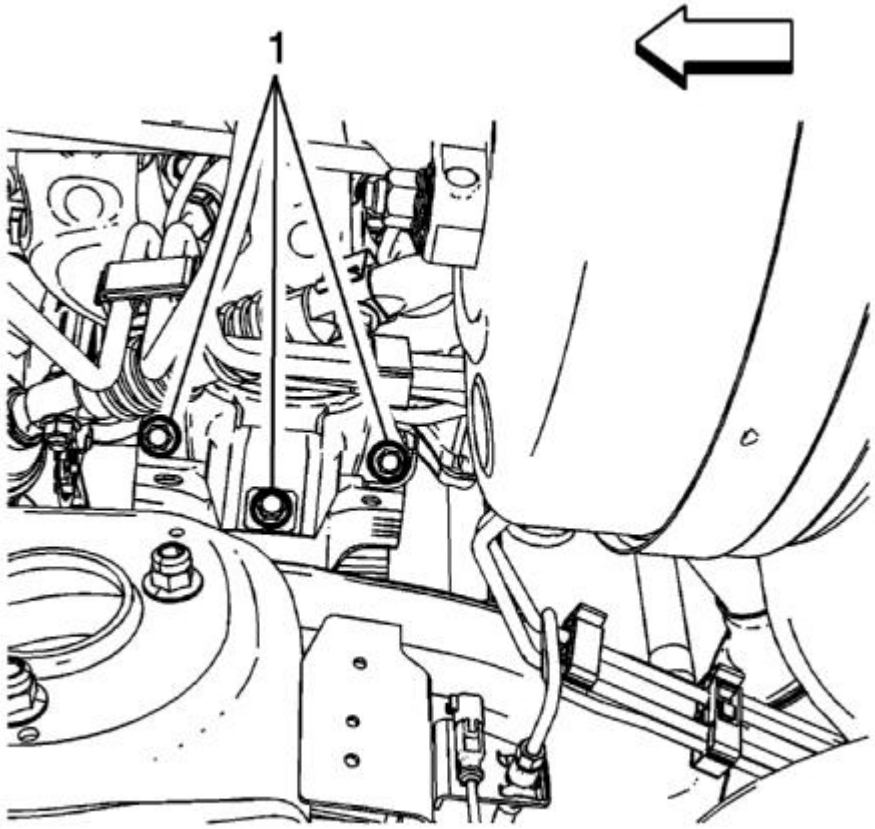


Fig. 208: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

35. Remove the left upper engine mount bolts (1). Refer to **Engine Mount Replacement - Left Side**.

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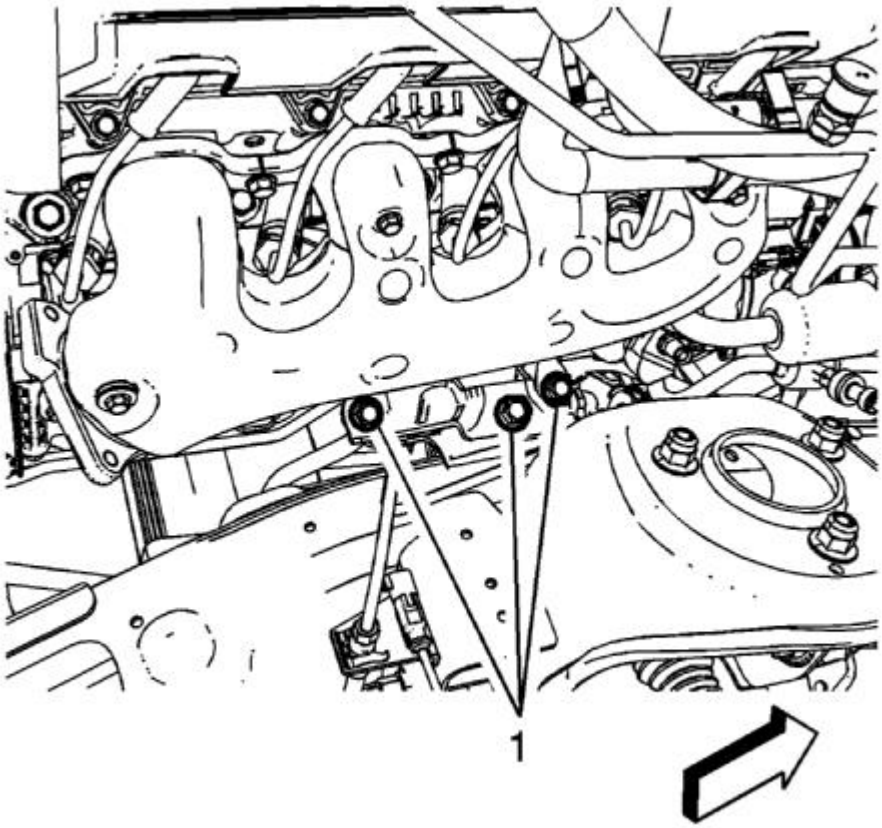


Fig. 209: Right Upper Engine Mount Bolts
Courtesy of GENERAL MOTORS COMPANY

36. Remove the right upper engine mount bolts (1). Refer to **Engine Mount Replacement - Right Side**.
37. Install a suitable chain as tight as possible to the two engine lift brackets.
38. Remove the two lower transmission to engine retaining bolts.
39. Using a suitable engine lifting device, remove the engine from the vehicle.
40. Install the **J-21366** strap onto the transmission bell housing to retain the torque converter.
41. Transfer components as necessary.

Installation Procedure

1. Remove the **J-21366** strap from the transmission bell housing which is retaining the torque converter.
2. Install the engine to the vehicle.
3. Align and install the engine to the transmission. Raise or lower the transmission as required using a suitable jack.

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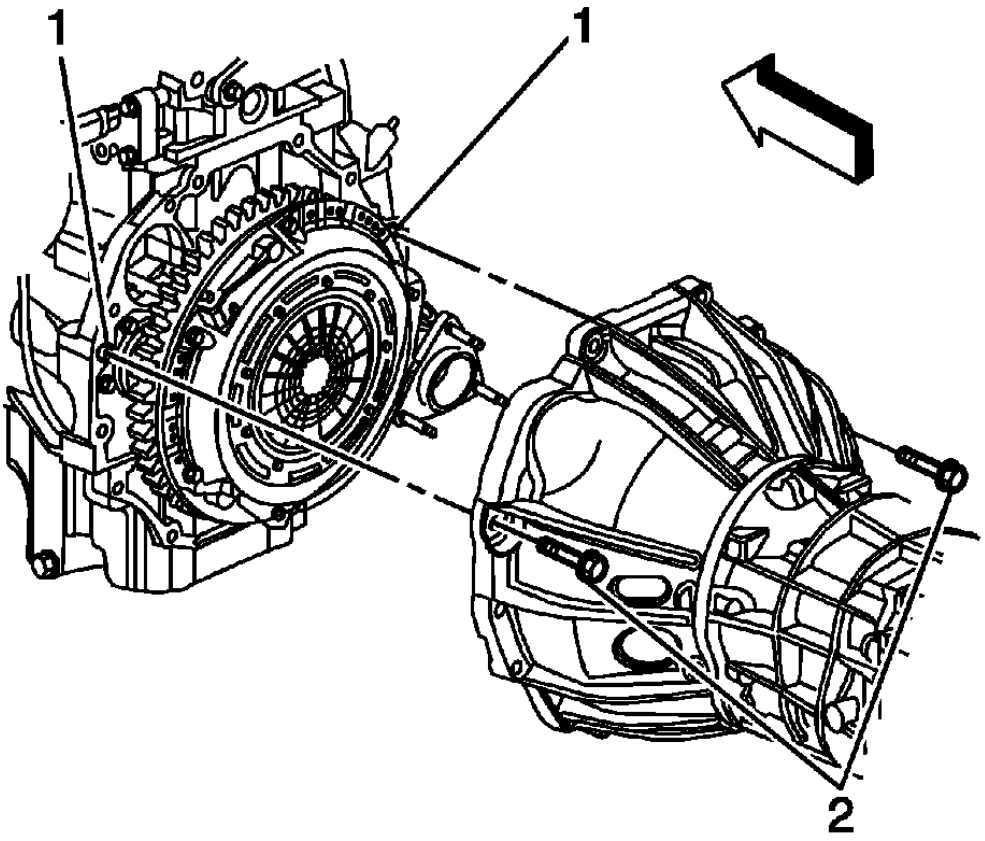


Fig. 210: View Of Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install the 2 lower bolts securing the transmission to the engine and tighten to 50 (37 lb ft).
5. Once aligned and mated together completely lower and remove the engine lift brackets.

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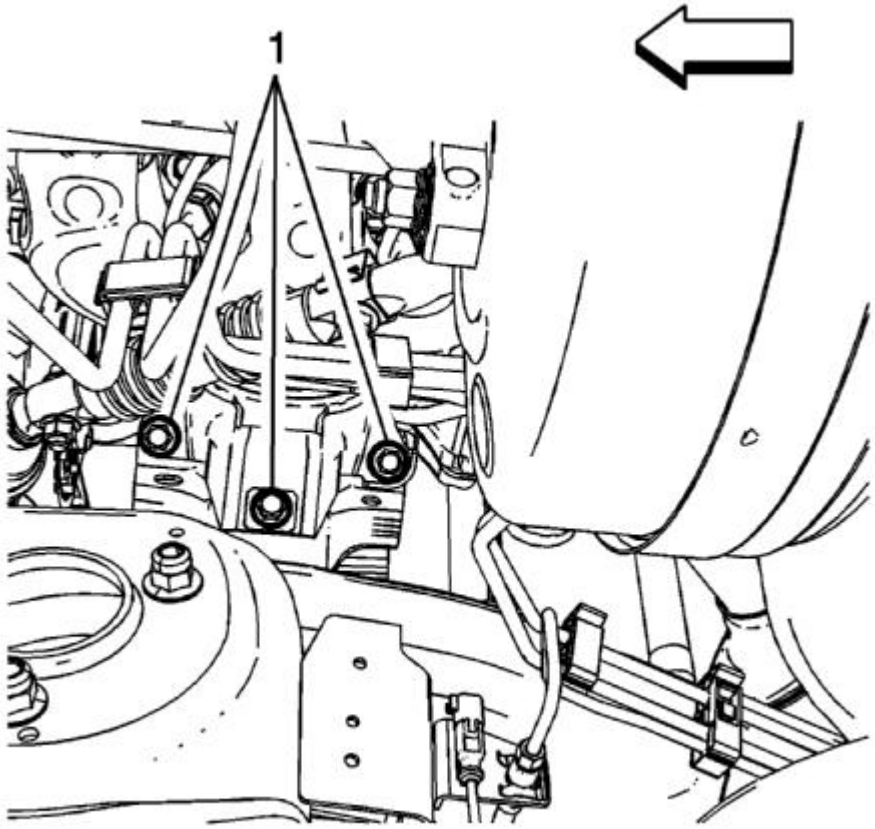


Fig. 211: Engine Mount To Frame Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the left upper engine mount bolts (1). Refer to **Engine Mount Replacement - Left Side**.

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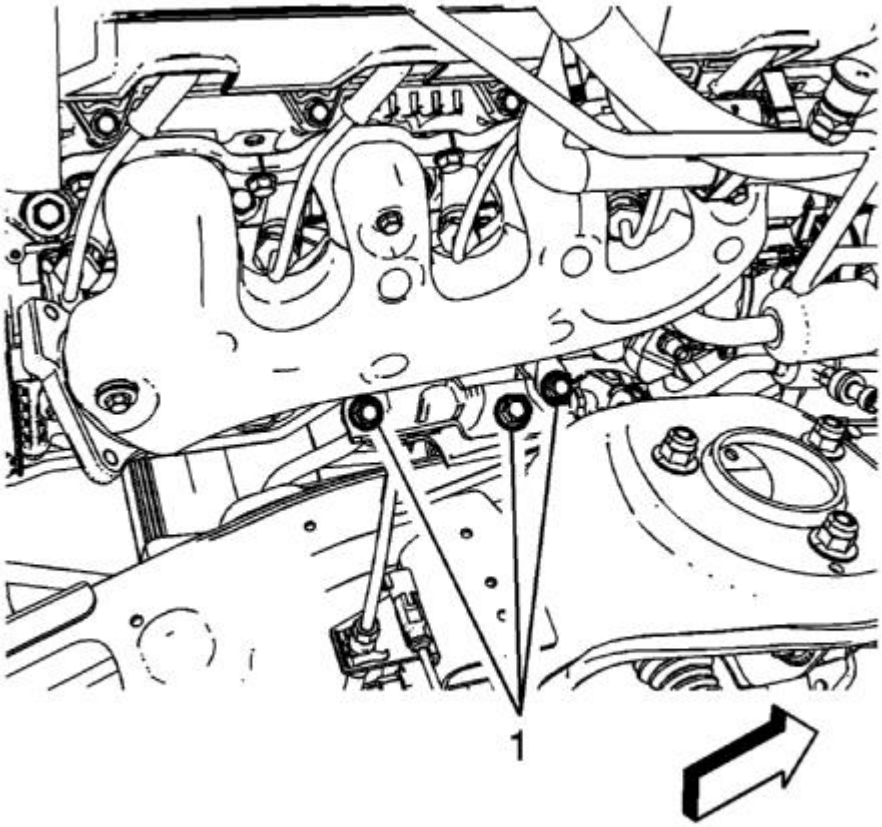


Fig. 212: Right Upper Engine Mount Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install the right upper engine mount bolts (1). Refer to **Engine Mount Replacement - Right Side**.
8. Raise the vehicle.

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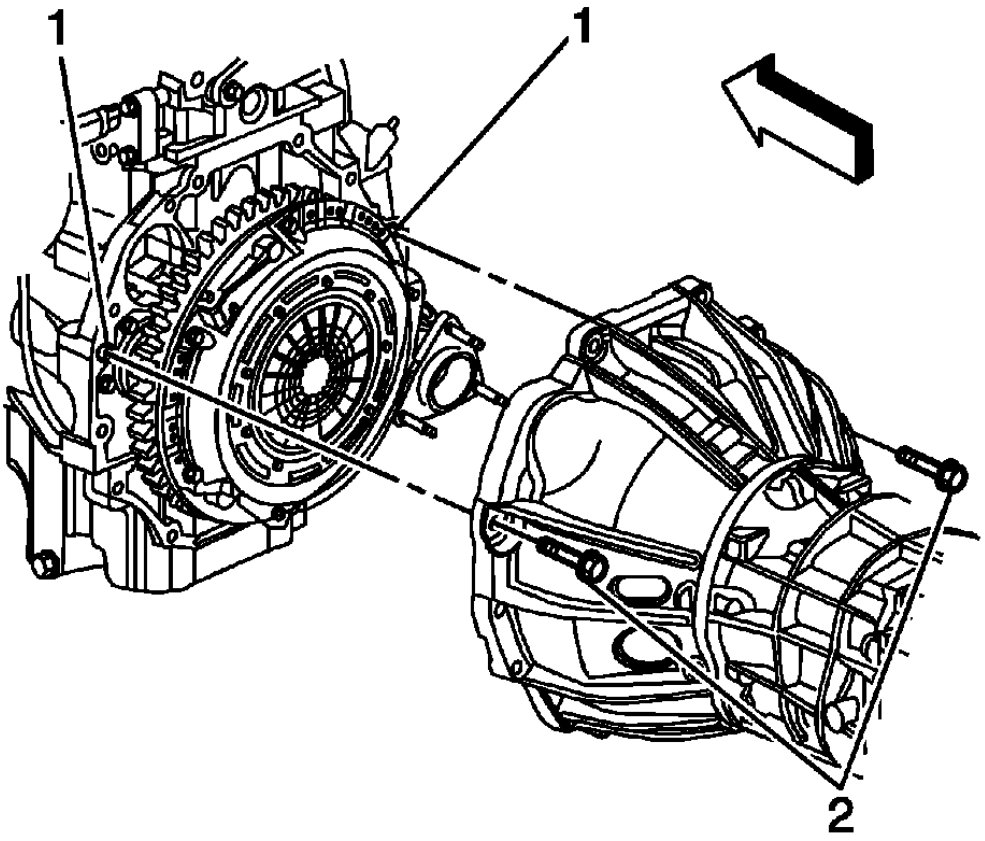


Fig. 213: View Of Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Install the 6 upper bolts securing the transmission to the engine and tighten to 50 (37 lb ft).

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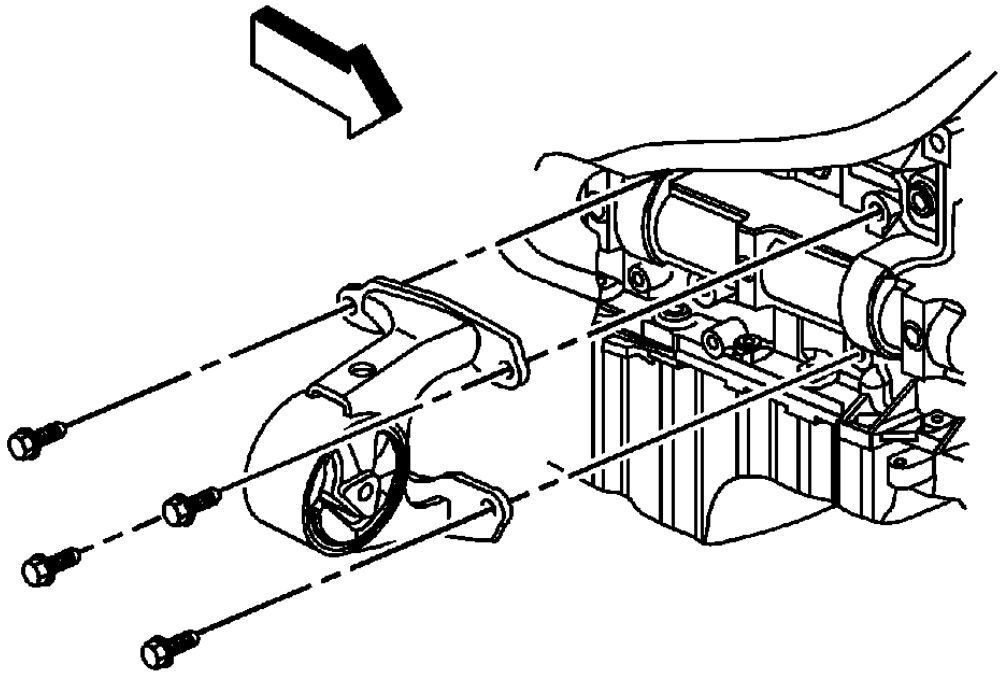


Fig. 214: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Align the torque converter bolt holes to the flywheel bolt holes.
11. Install the flywheel to torque converter bolts and tighten to 60 (44 lb ft).

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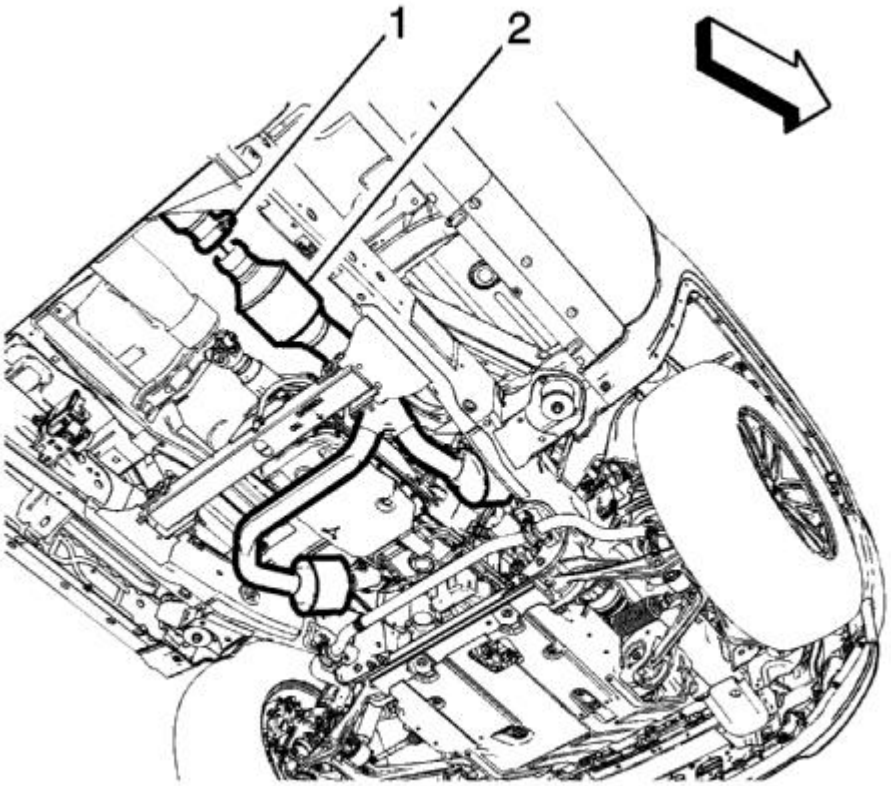


Fig. 215: Exhaust Front Pipe
Courtesy of GENERAL MOTORS COMPANY

12. Install the exhaust front pipe. Refer to **Exhaust Front Pipe Replacement (L83, L86, LV1, LV3)** .

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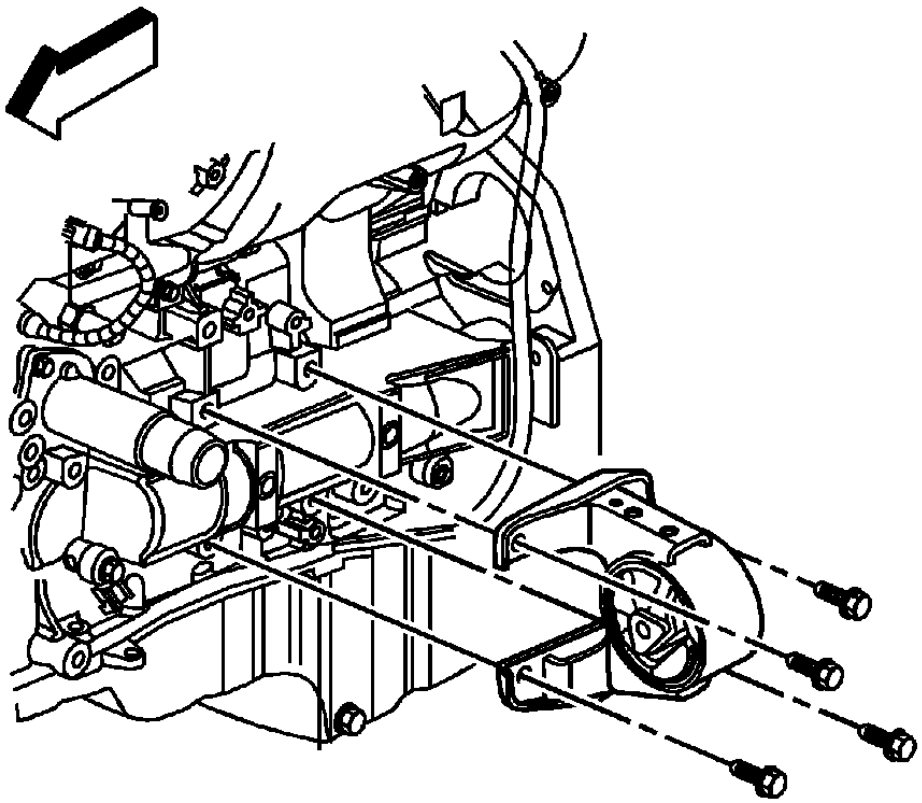


Fig. 216: View Of Transmission Crossmember, Crossmember Bolts & Nuts
Courtesy of GENERAL MOTORS COMPANY

13. Install the transmission crossmember (4). Refer to **Transmission Support Crossmember Replacement (Two Wheel Drive - Light Duty)** , **Transmission Support Crossmember Replacement (Two Wheel Drive - Heavy Duty)** , **Transmission Support Crossmember Replacement (Four Wheel Drive - Heavy Duty)** , **Transmission Support Crossmember Replacement (Four Wheel Drive - Light Duty)** .
14. Connect the electrical connectors to the transmission assembly.

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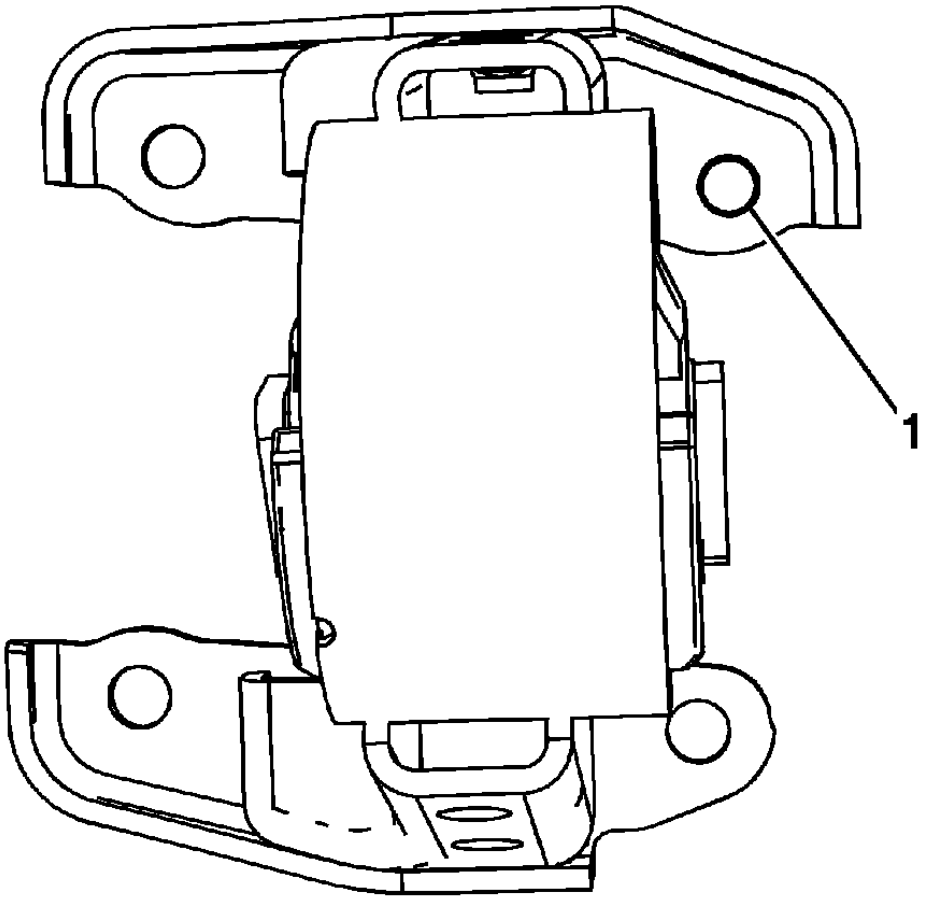


Fig. 217: View Of Right Flywheel Inspection Cover
Courtesy of GENERAL MOTORS COMPANY

15. Install the right flywheel inspection cover and bolt. Tighten the bolt to 10 (89 lb in).
16. Install the starter motor. Refer to **Starter Replacement (L83, L86, LV1, LV3)** .

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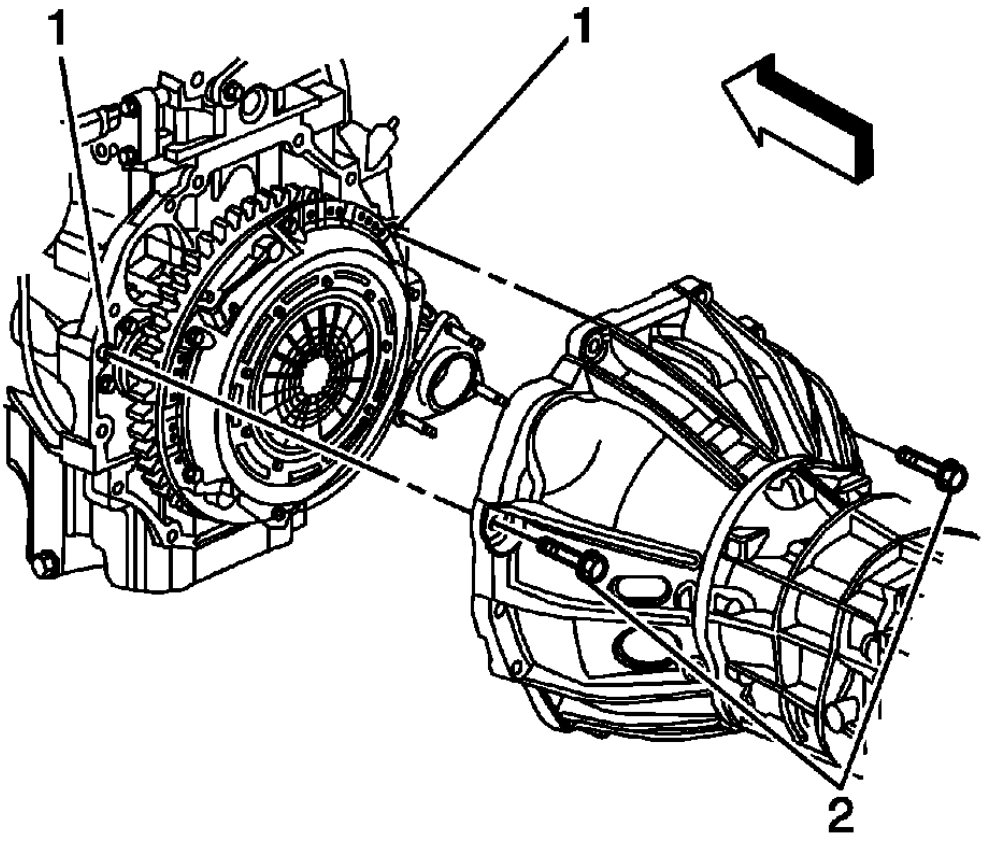


Fig. 218: View Of Left Flywheel Inspection Cover
Courtesy of GENERAL MOTORS COMPANY

17. Install the left flywheel inspection cover and bolt. Tighten the bolt to 10 (89 lb in).
18. If the vehicle is equipped with a transfer case, install the front propeller shaft. Refer to **Front Axle Propeller Shaft Replacement** .
19. Lower the vehicle.

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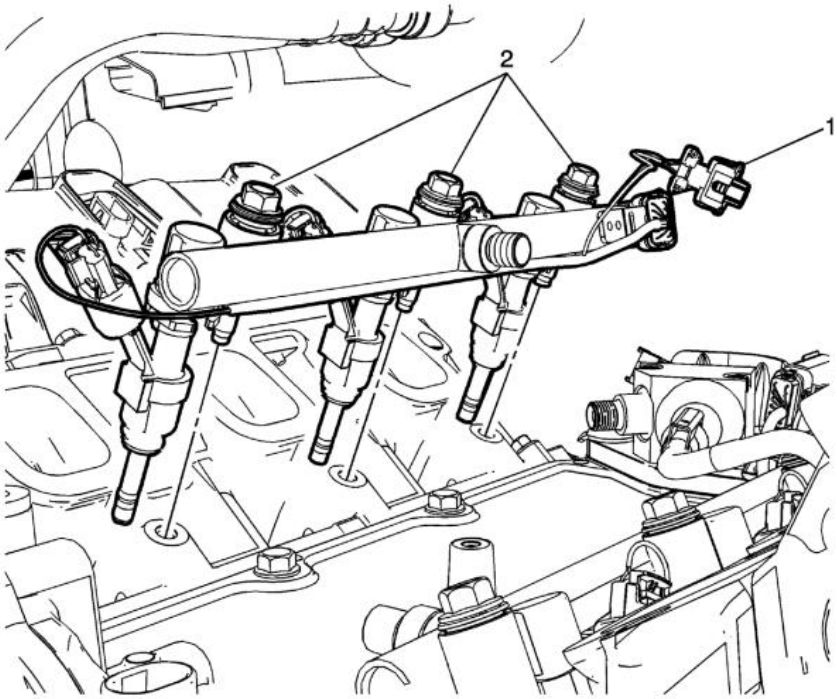


Fig. 219: Fuel Injection Fuel Rail Assembly - bank 2
Courtesy of GENERAL MOTORS COMPANY

20. Install the fuel injection fuel rail assembly - bank 2 (2). refer to **Fuel Injection Fuel Rail Assembly Replacement - Bank 2** .

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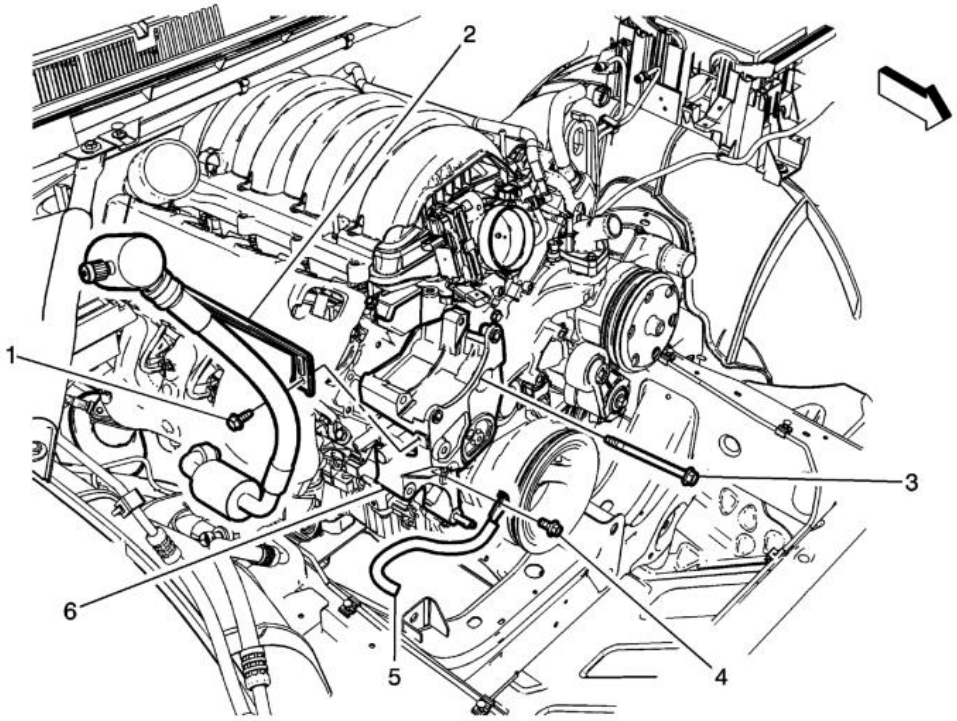


Fig. 220: Generator Bracket (LV1, LV3)
Courtesy of GENERAL MOTORS COMPANY

21. Install the generator bracket (6) to the engine assembly. Refer to **Generator Bracket Replacement (LV1, LV3)** .

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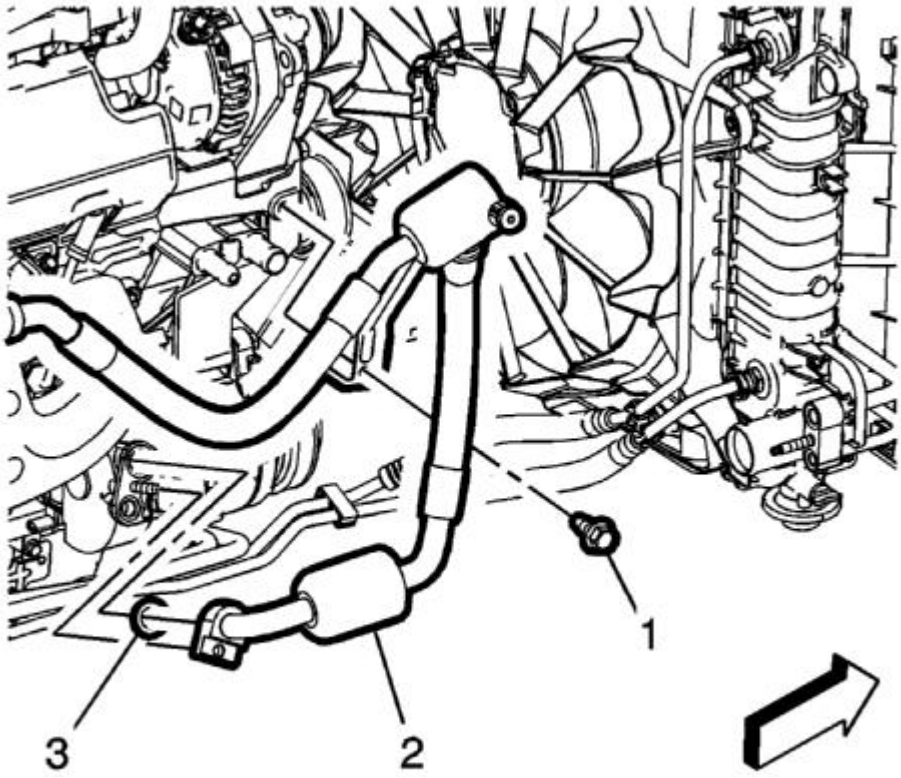


Fig. 221: Air Conditioning Tube Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

22. Install the air conditioning tube bracket bolt (1) to the generator and drive belt tensioner bracket and tighten to 22 (16 lb ft).

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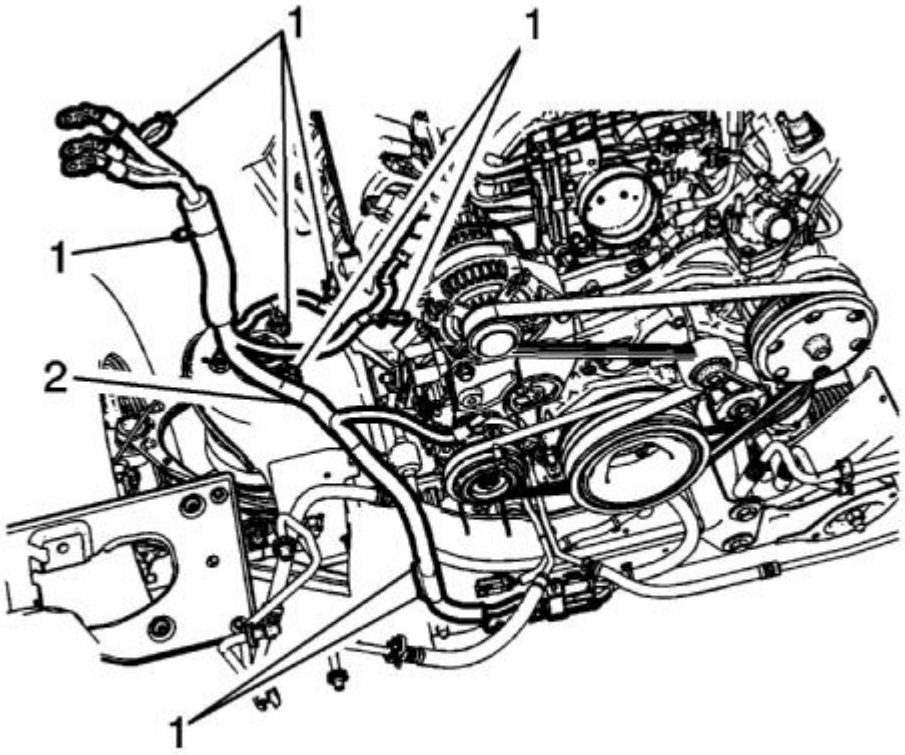


Fig. 222: Generator Battery Control Wiring Harness Retainers And Generator Battery Control Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

23. Install the generator battery control wiring harness (2). Refer to **Generator Battery Control Wiring Harness Replacement (L83, L86, LV1, LV3)** .
24. Install the headlamp and radiator grille mount panel. Refer to **Headlamp and Radiator Grille Mount Panel Replacement** .
25. Install the front end upper tie bar support. Refer to **Front End Upper Tie Bar Support Replacement** .

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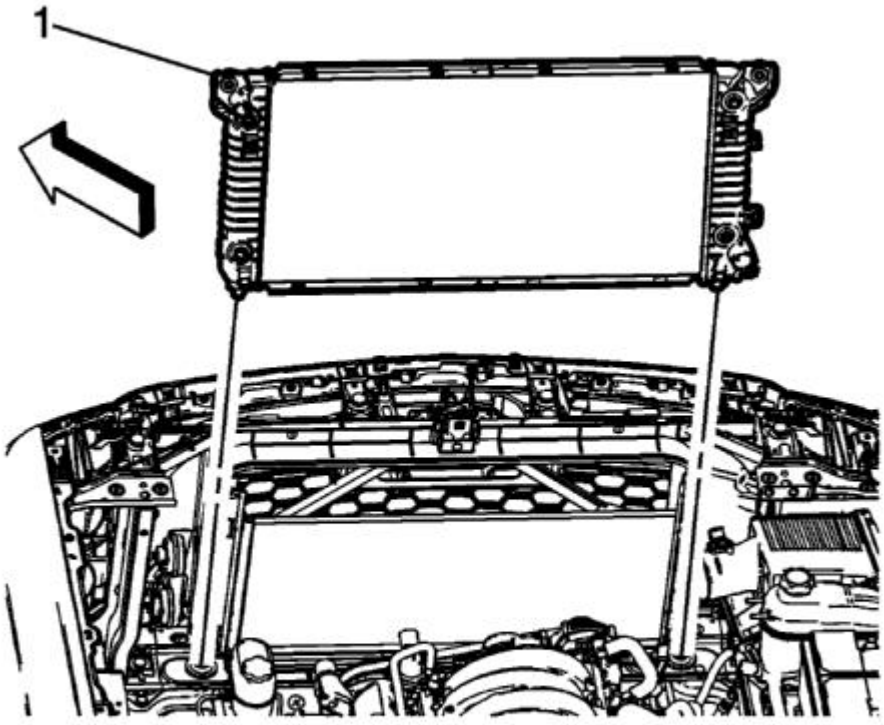


Fig. 223: Radiator
Courtesy of GENERAL MOTORS COMPANY

26. Install the radiator. Refer to **Radiator Replacement (LV3)** .

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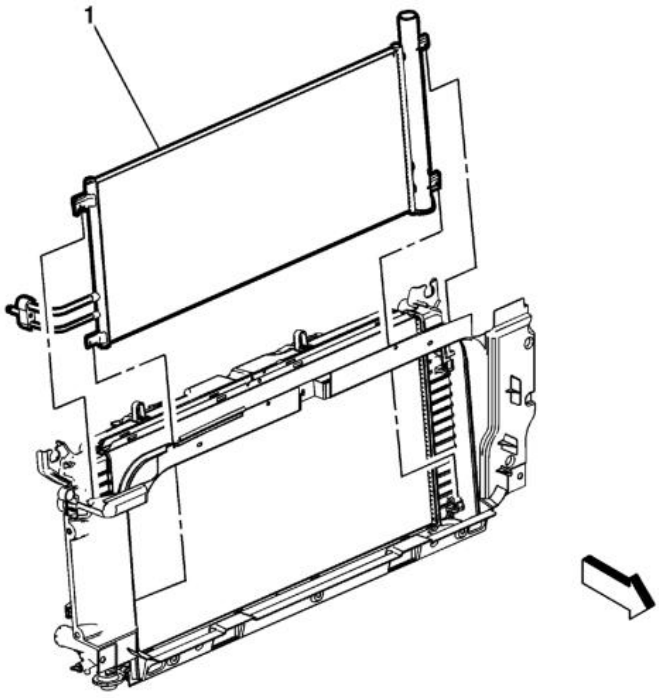
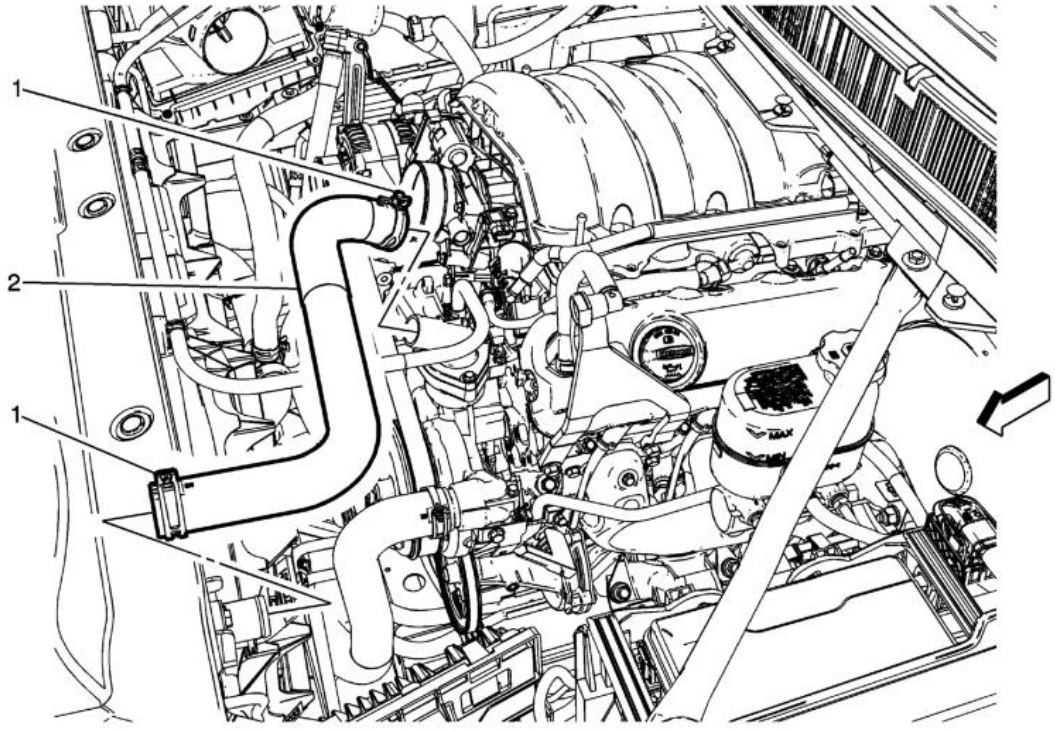


Fig. 224: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

27. Install the air conditioning condenser. Refer to **Air Conditioning Condenser Replacement (LV3)** .



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Fig. 225: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

28. Install the radiator inlet hose (2). Refer to **Radiator Inlet Hose Replacement (LV3)** .

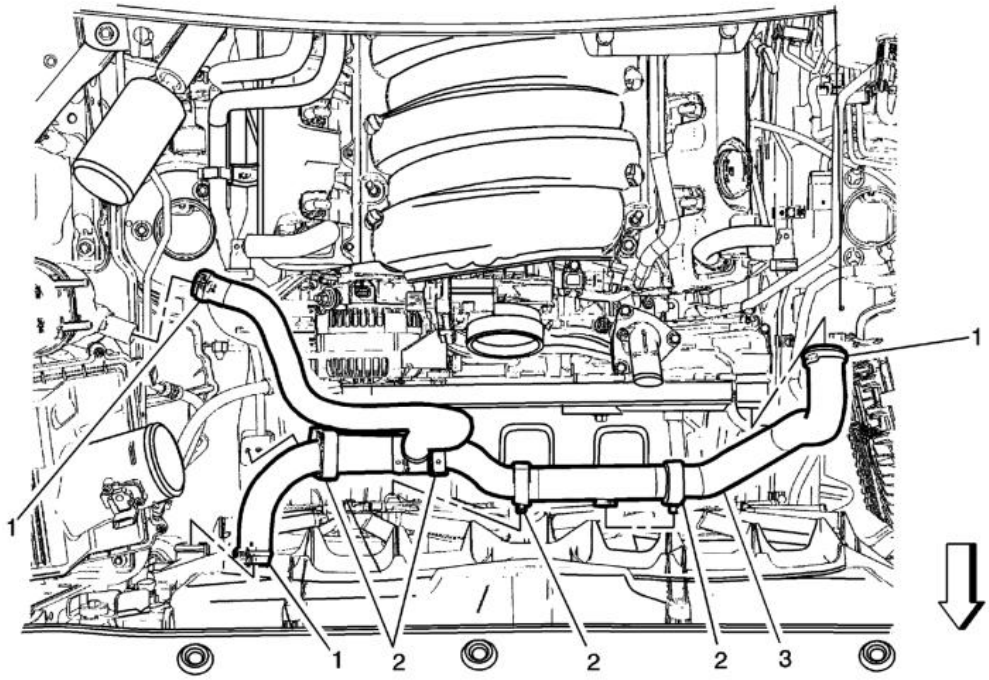


Fig. 226: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

29. Install the radiator outlet hose (3). Refer to **Radiator Outlet Hose Replacement (LV3)** .

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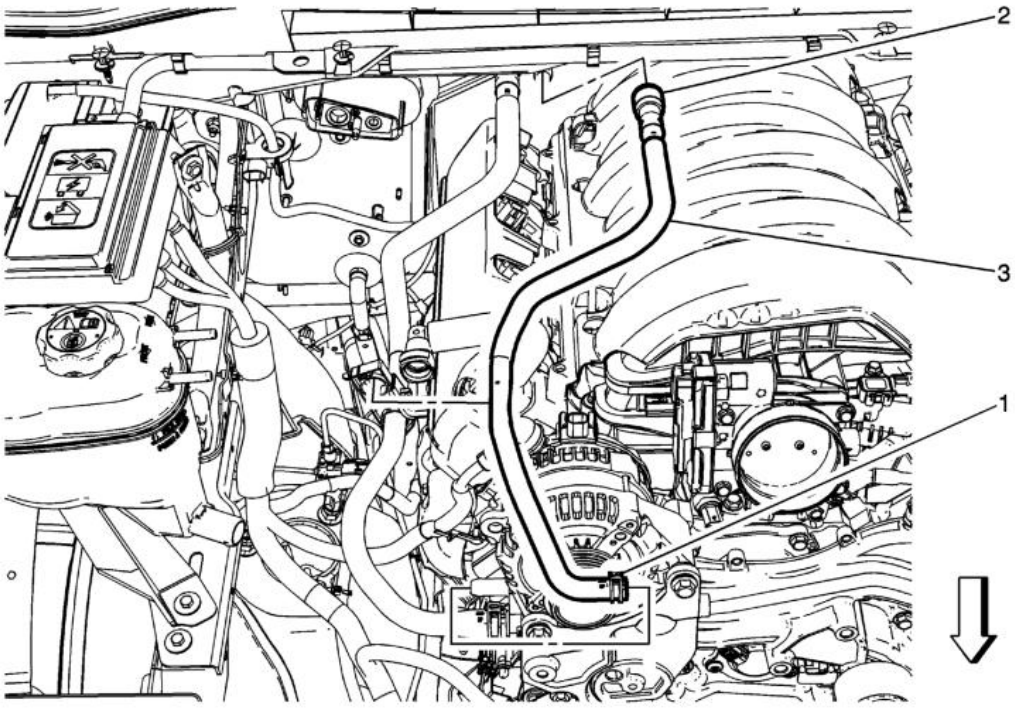


Fig. 227: Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

30. Install the heater inlet hose (1). Refer to **Heater Inlet Hose Replacement (LV3)** .
31. Install the heater outlet hose. Refer to **Heater Outlet Hose Replacement (LV3)** .

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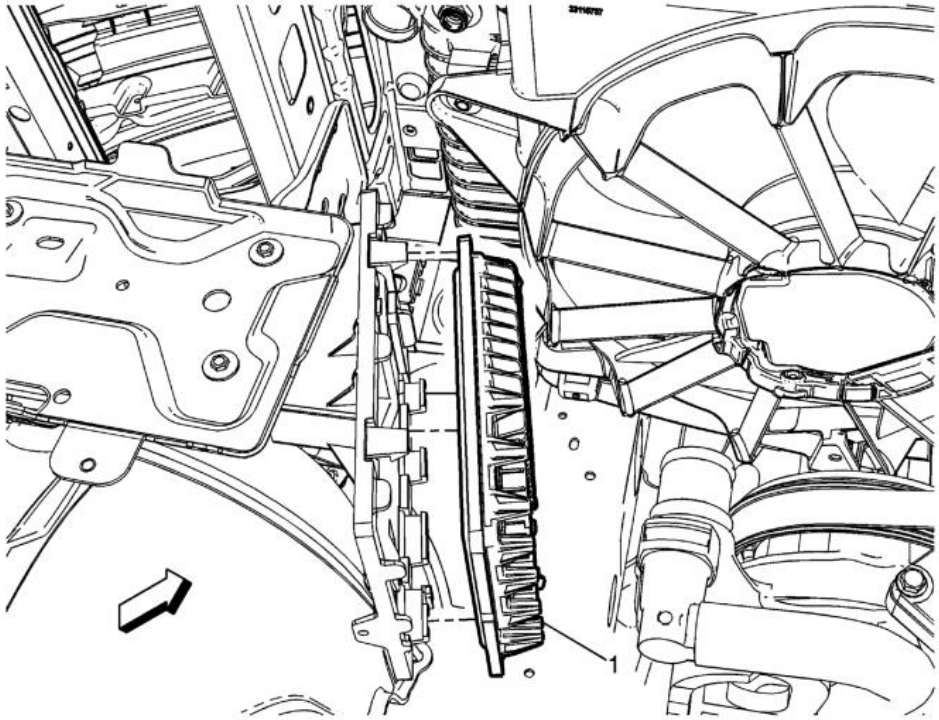


Fig. 228: Engine Control Module
Courtesy of GENERAL MOTORS COMPANY

32. Install the engine control module (1). Refer to **Engine Control Module Replacement** .

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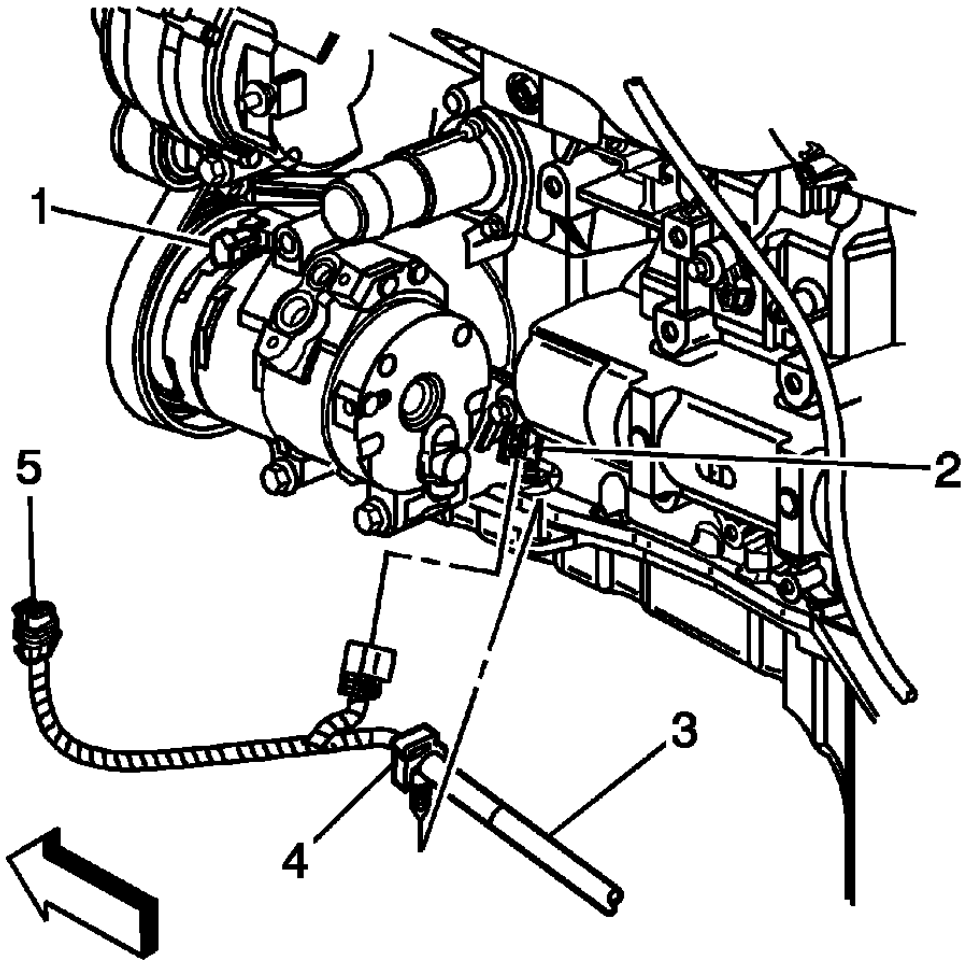


Fig. 229: View Of Underhood Electrical Center/Junction Block
Courtesy of GENERAL MOTORS COMPANY

33. Connect the engine main wiring harness to the underhood electrical center junction block (1). Refer to **Underhood Electrical Center or Junction Block Replacement** .
34. Connect the fuel feed pipe to the fuel pump feed pipe. Refer to **Metal Collar Quick Connect Fitting Service** .
35. Install the engine oil cooler hose assembly to the engine. Refer to **Engine Oil Cooler Hose Replacement**.
36. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (L83, L86, LV1, LV3)** , **Battery Negative Cable Disconnection and Connection (K4B)** .
37. Place the hood in the normal operating position. Refer to **Hood Service Positioning** .
38. If a NEW TCM has been installed into the vehicle, the NEW module needs to be reprogrammed. Refer to **Service Programming System (SPS)** .

NOTE: The Service Fast Learn Adapts procedure must be performed when one of the following repairs have been made to the vehicle. Failure to perform the

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procedure after one of the following repairs may result in poor transmission performance, as well as transmission DTCs being set:

- **Transmission internal service/overhaul**
- **Valve body repair or replacement**
- **Control solenoid valve assembly replacement**
- **TCM software/calibration update**
- **Any service in response to a shift quality concern**

39. Perform the Reset Transmission Adapts. Refer to **Reset Transmission Adapts** .

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Remove the skid plate. Refer to **Steering Gear Skid Shield Replacement** .

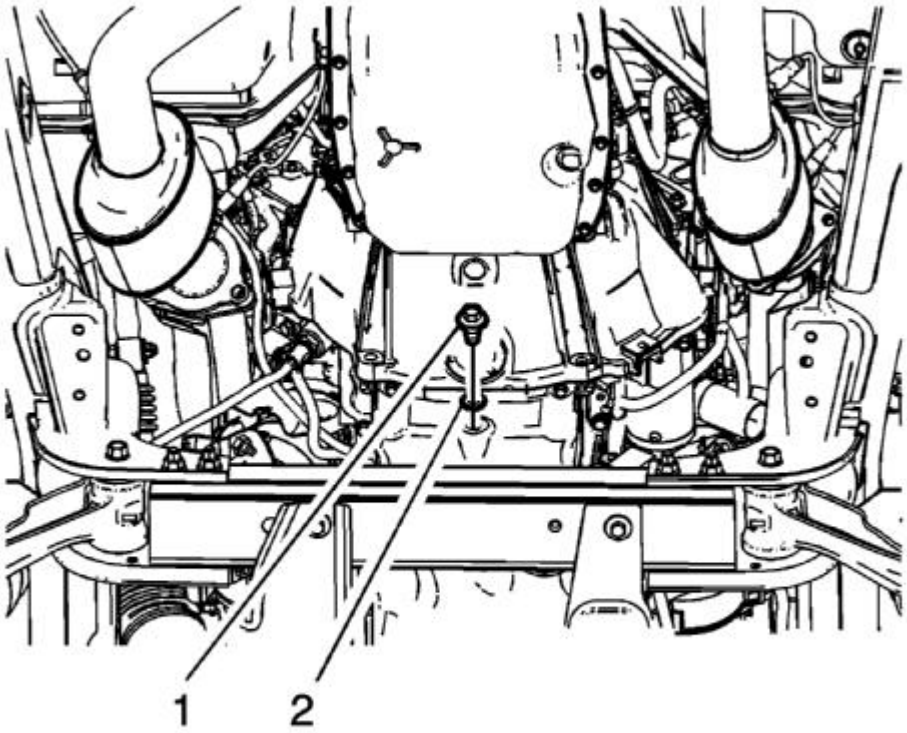


Fig. 230: Oil Drain Plug
Courtesy of GENERAL MOTORS COMPANY

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2. Position a suitable drain pan under the oil pan drain plug.
3. Remove the oil drain plug (1).
4. Clean and inspect the oil pan drain plug, replace if necessary.
5. Clean and inspect the oil pan drain plug sealing surface (2), replace the oil pan drain plug sealing surface if necessary.

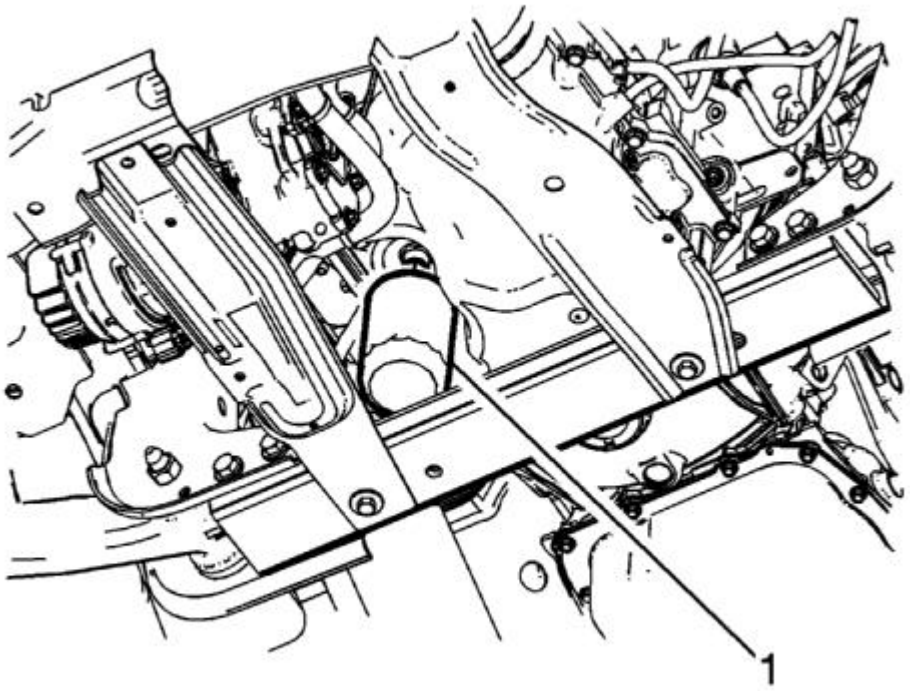


Fig. 231: Oil Filter
Courtesy of GENERAL MOTORS COMPANY

6. Remove the oil filter (1).
7. Inspect to ensure the engine oil filter gasket is removed.

Installation Procedure

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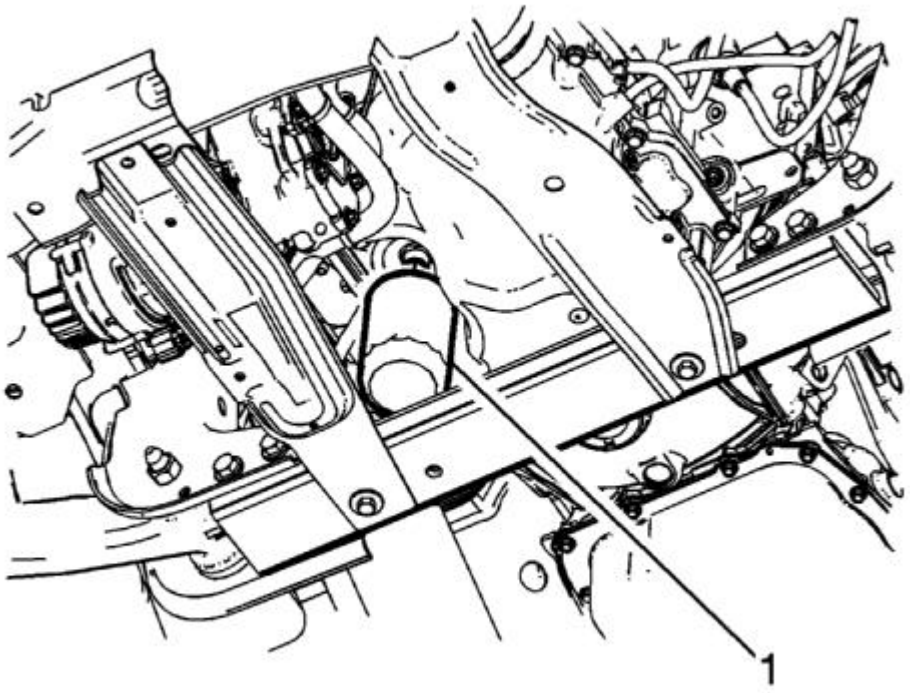


Fig. 232: Oil Filter
Courtesy of GENERAL MOTORS COMPANY

1. Lubricate the oil filter gasket with clean engine oil.

CAUTION: Refer to Fastener Caution .

2. Install the oil filter (1) and tighten to 30 (22 lb ft).

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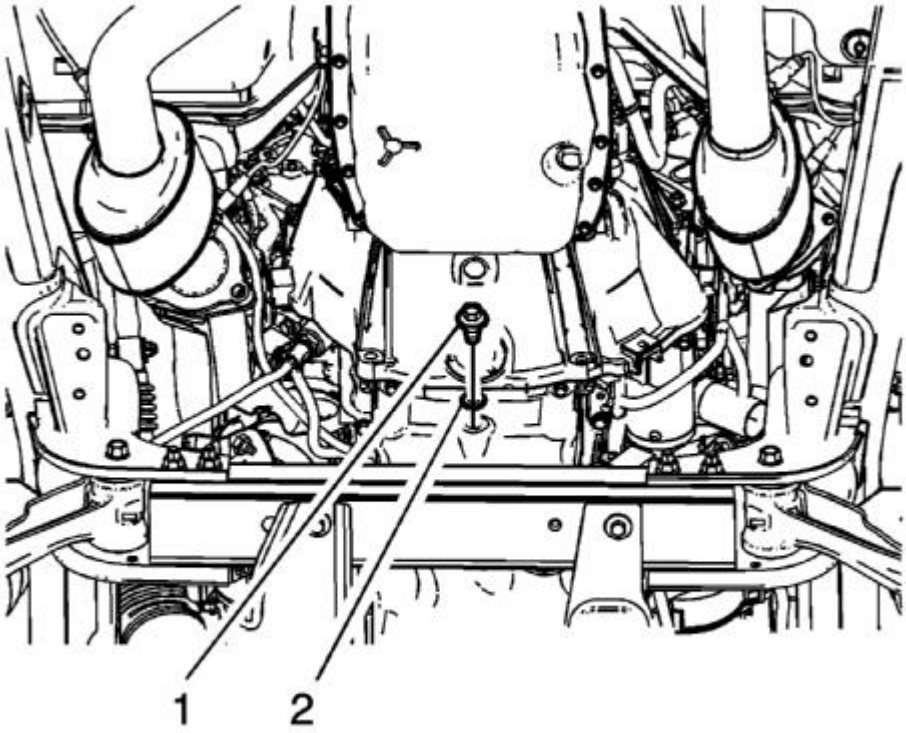


Fig. 233: Oil Drain Plug
Courtesy of GENERAL MOTORS COMPANY

3. Install the drain plug (1) and tighten to 25 (18 lb ft).
4. Lower the vehicle.
5. Fill the engine with the proper capacity and quality of engine oil. Refer to **Adhesives, Fluids, Lubricants and Sealers** .
6. Operate the engine, check for leaks and oil pressure.
7. Install the skid plate. Refer to **Steering Gear Skid Shield Replacement** .
8. Reset the oil monitor

ENGINE OIL COOLER HOSE REPLACEMENT

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

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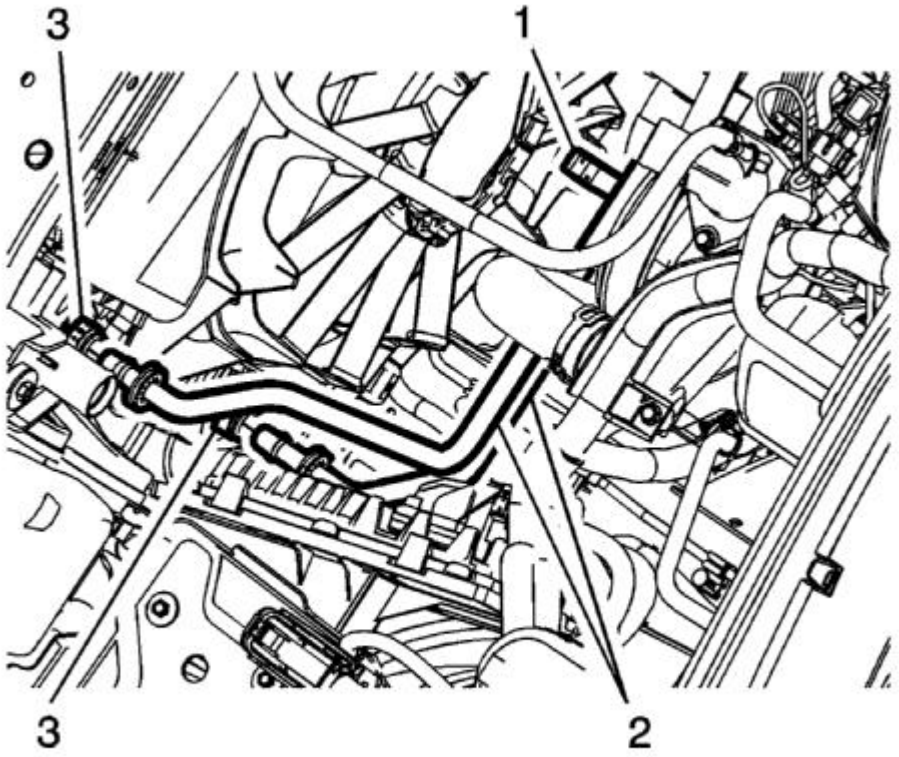


Fig. 234: Engine Oil Cooler Hoses And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Remove the engine oil cooler hoses (2) from the retainer (1).
3. Disconnect the engine oil cooler hoses (2) from the radiator fittings (3). Refer to **Metal Collar Quick Connect Fitting Service** .
4. Remove the steering gear skid shield. Refer to **Steering Gear Skid Shield Replacement** .

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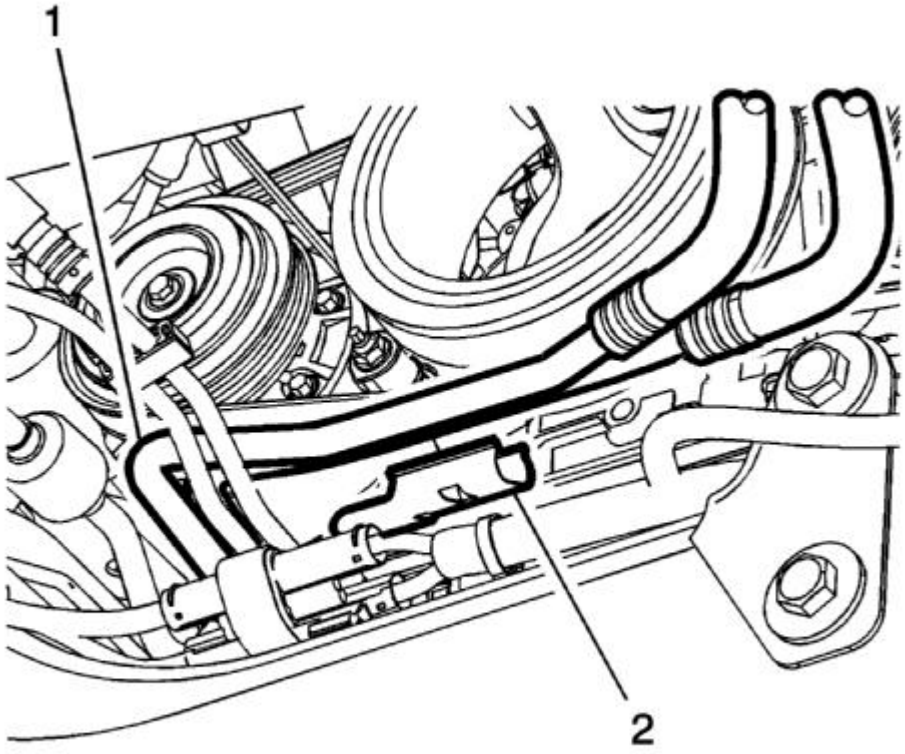


Fig. 235: Oil Cooler Hoses And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil cooler hoses (1) from the retaining clip (2).
6. Using a suitable adjustable Jack, support the front axle.
7. Remove the two left side front axle bolts and lower the axle enough to create clearance for oil cooler line removal.

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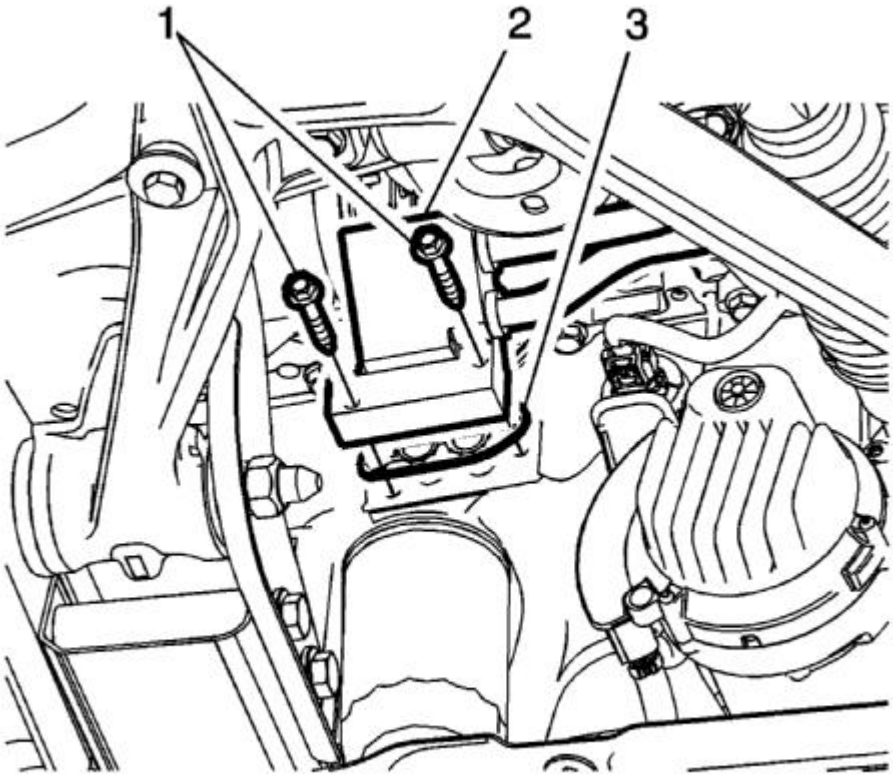


Fig. 236: Engine Oil Cooler Adapter Fasteners And Separate Oil Cooler Adapter
Courtesy of GENERAL MOTORS COMPANY

8. Remove the engine oil cooler adapter fasteners (1) and separate the oil cooler adapter (2) from the engine block.

   DISCARD the oil cooler adapter gasket (3).

   NOTE: Note the routing and orientation of the engine oil cooler hoses to insure proper installation.

9. Remove the oil cooler hoses and gasket from the vehicle.

Installation Procedure

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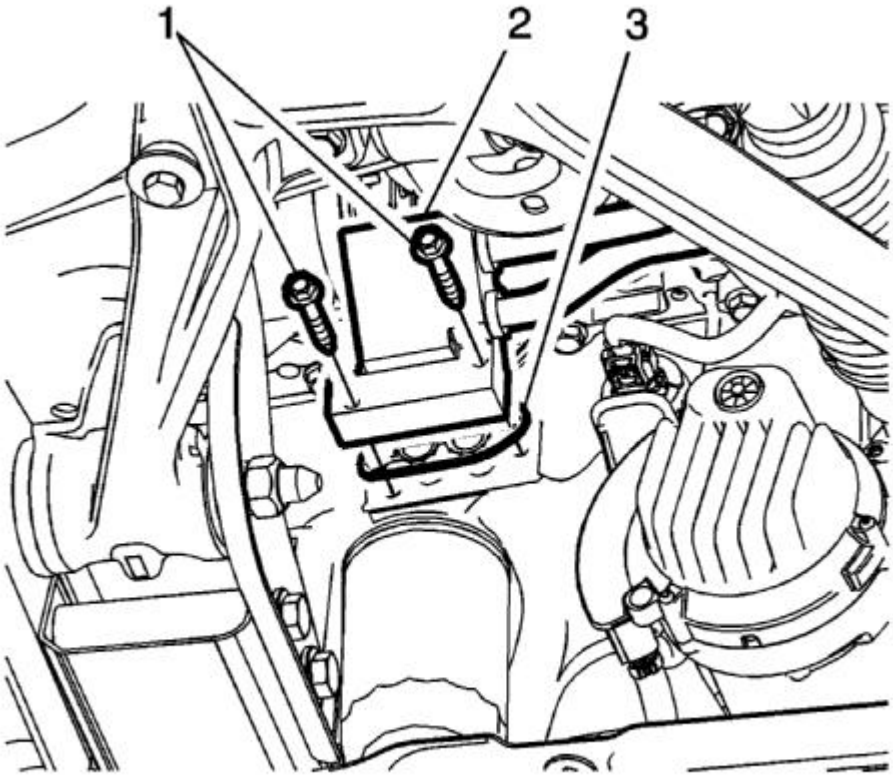


Fig. 237: Engine Oil Cooler Adapter Fasteners And Separate Oil Cooler Adapter
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install a NEW oil cooler adapter gasket (3) and the oil cooler hose adapter (2) and tighten the fasteners (1) to 12 (9 lb ft).

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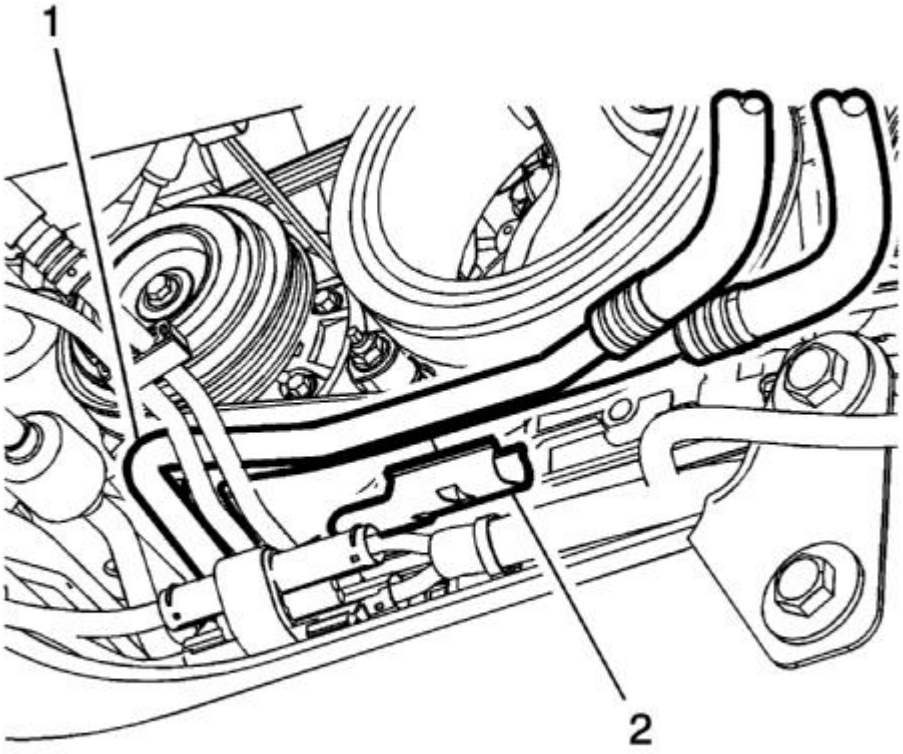


Fig. 238: Oil Cooler Hoses And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

2. Install the oil cooler hoses into the retaining clip.
3. Raise the axle into position.
4. Install the left axle bolts and tighten to 75 (55 lb ft).
5. Remove the adjustable jack.
6. Install the steering gear skid shield. Refer to **Steering Gear Skid Shield Replacement** .
7. Lower the vehicle.

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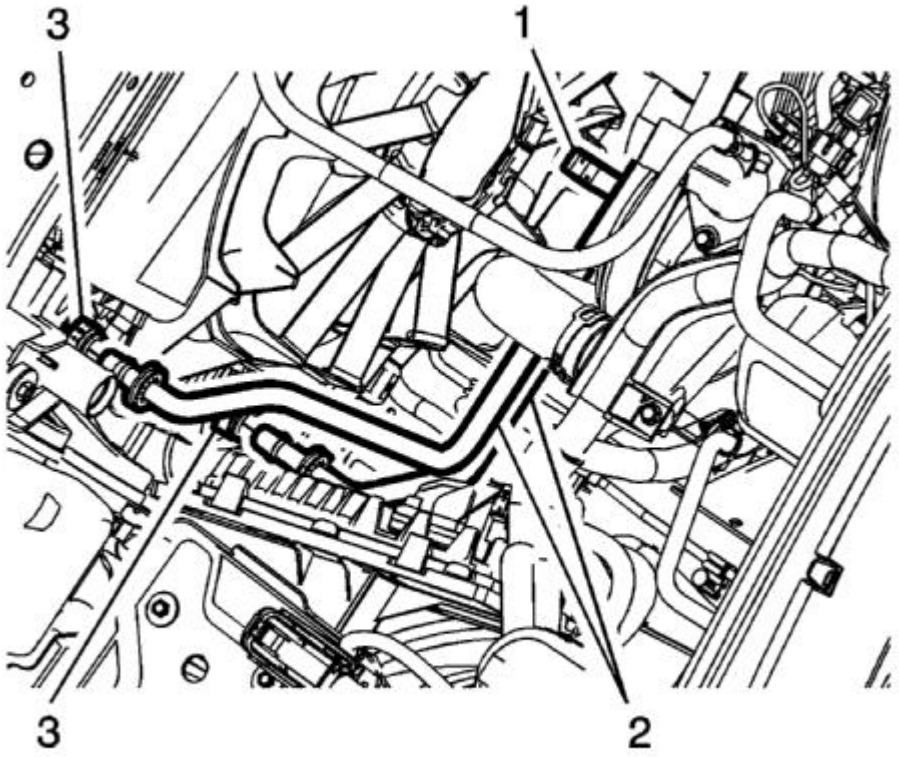


Fig. 239: Engine Oil Cooler Hoses And Retainer
Courtesy of GENERAL MOTORS COMPANY

8. Install the engine oil cooler hoses (2) into the radiator fittings (3). Refer to **Metal Collar Quick Connect Fitting Service** .

   Install the engine oil cooler hoses (2) into the retainer (1).

9. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

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