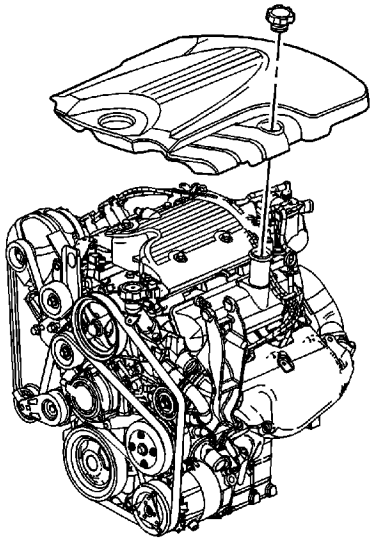
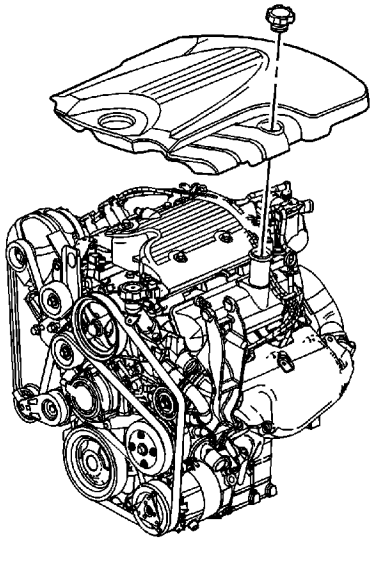
Intake Manifold Cover Replacement

Removal Procedure



1. Remove the engine oil fill cap.
2. Pull up on the cover in order to disengage the cover from the studs.

Installation Procedure



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1. Align the cover to the studs on the engine, push down on the cover above the studs in order to engage the cover to the studs.
2. Install the engine oil fill cap.

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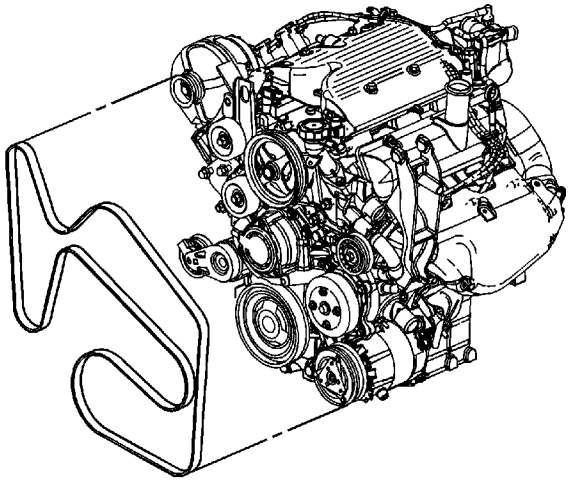
Drive Belt Replacement

Removal Procedure



1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement .
2. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
3. Remove the engine mount bracket. Refer to Engine Mount Bracket Replacement
4. Rotate the drive belt tensioner clockwise in order to release the spring tension.
5. Remove the drive belt from around the tensioner pulley.
6. Remove the drive belt from around all the other pulleys.
7. Remove the drive belt from the vehicle.

Installation Procedure

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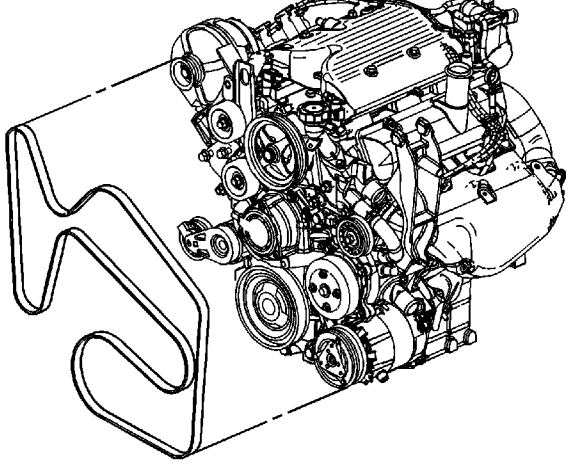

1. Install the drive belt to the vehicle.
2. Starting at the generator, route the drive belt around all of the pulleys, except for tensioner.
3. Rotate the drive belt tensioner clockwise in order to release the spring tension.
4. Install the drive belt around the tensioner.
5. Install the engine mount bracket. Refer to Engine Mount Bracket Replacement
6. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
7. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement .

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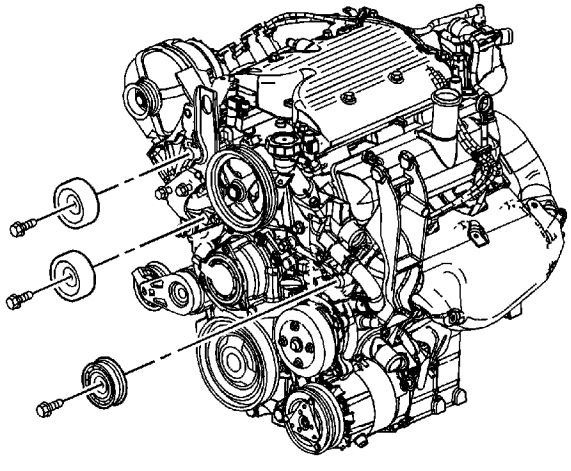
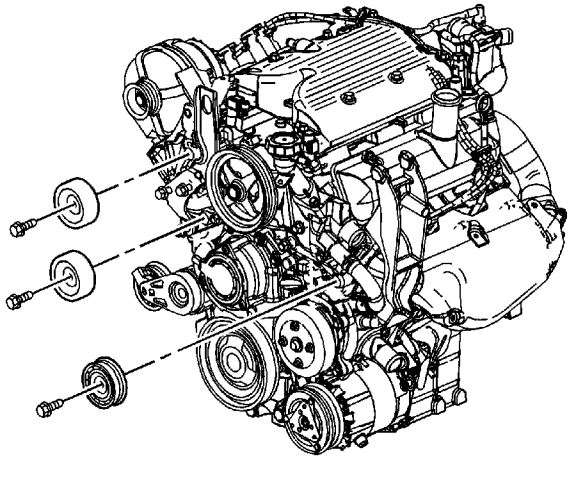
Drive Belt Idler Pulley Replacement

Removal Procedure



1. Remove the drive belt. Refer to Drive Belt Replacement.
2. Loosen the required drive belt idler pulley bolt.
3. Remove the required drive belt idler pulley.

Installation Procedure



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1. Install the required drive belt idler pulley.

   Caution: Refer to Fastener Caution in the Preface section.

2. Tighten the required drive belt idler pulley bolt to **50 N·m (37 lb ft)**.
3. Install the drive belt. Refer to Drive Belt Replacement.

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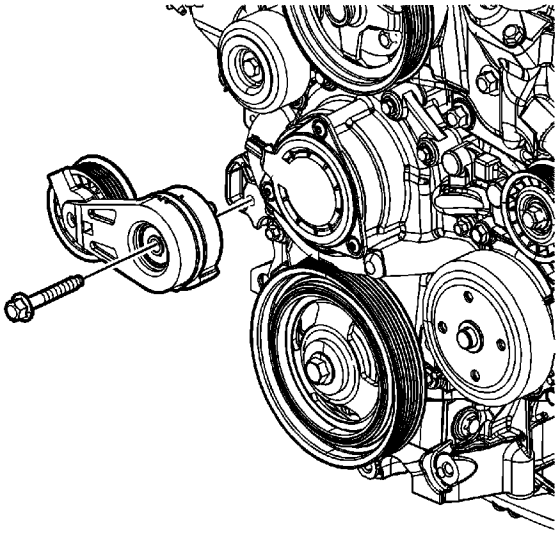
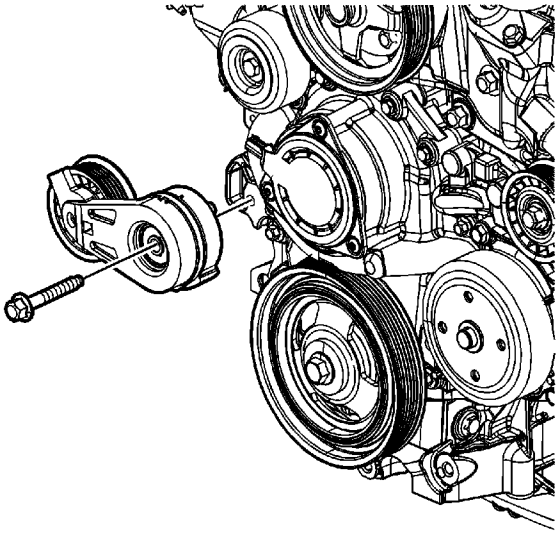
Drive Belt Tensioner Replacement

Removal Procedure



1. Remove the drive belt. Refer to Drive Belt Replacement.
2. Remove the drive belt tensioner bolt.
3. Remove the drive belt tensioner.

Installation Procedure



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1. Install the drive belt tensioner.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the drive belt tensioner bolt and tighten to **50 N·m (37 lb ft)**.
3. Install the drive belt. Refer to Drive Belt Replacement.

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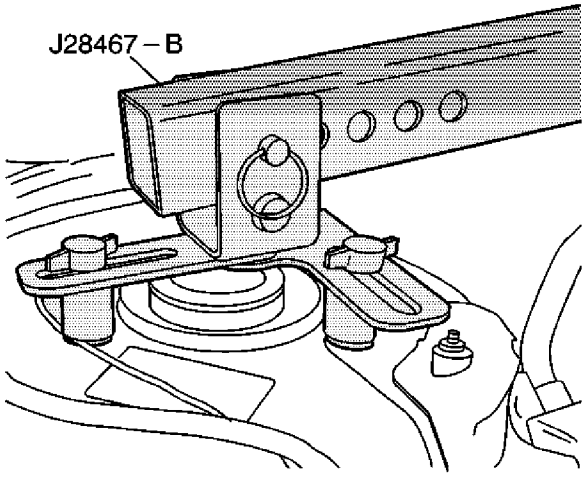
Engine Support Fixture

Tools Required

- J 28467-B Engine Support Fixture
- J 36462 Engine Support Adapter Leg



1. Raise the hood.
2. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement .
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
4. Install the thread support nuts J 28467-33A onto the strut attaching studs.
5. Install the strut tower support assemblies J 28467-5A over the thread support nuts J 28467-33A.
6. Install the T-bolts J 28467-5 with 5/16 inch washers through the strut tower support assemblies J 28467-5A into the thread support nuts J 28467-33A. Hand tighten the bolts.
7. Install the 2 cross bracket assemblies J 28467-1A over the strut tower tube J 28467-3.
8. Install the strut tower tube J 28467-3 into the strut tower support assemblies J 28467-5A.
9. Install the 1/2 inch x 2.5 inch quick release pin J 28467-10 through the strut tower support assemblies J 28467-5A and the strut tower tube J 28467-3 on one side only.

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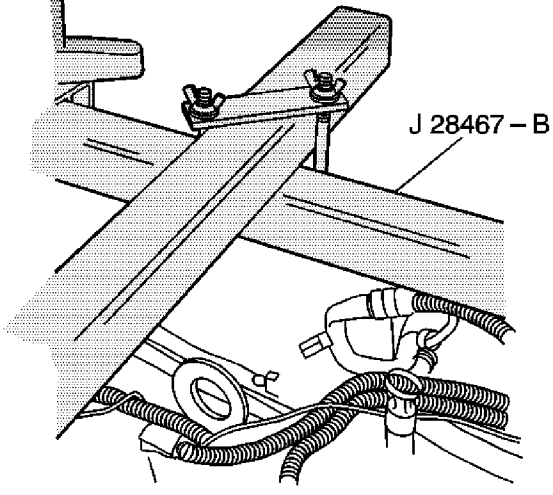

10. Install the radiator shelf tube J 28467-2A through the driver side cross bracket assembly J 28467-1A on the top of the strut tower tube J 28467-3.
11. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.
12. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
13. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
14. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
15. Install the assembled lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
16. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the left (front), rear of engine, lift hook bracket part of the left engine mount strut bracket.
17. Hand tighten the driver side cross bracket assembly J 28467-1A wing nuts.
18. Install the second radiator shelf tube J 28467-2A through the passenger side cross bracket assembly (J 28467-1A) on the top of the strut tower tube J 28467-3.
19. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.
20. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
21. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
22. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
23. Install the assemblage lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
24. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the right rear, front of engine, lift hook bracket located next to the generator.
25. Hand tighten the passenger side cross bracket assembly J 28467-1A wing nuts.
26. Hand tighten the lift hook wing nuts J 28467-34 securely in order to remove all slack from the engine support fixture assembly.

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Engine Mount Inspection

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

1. Install the engine support fixture. Refer to Engine Support Fixture.
2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
   - The hard rubber is covered with heat check cracks.
   - The rubber is separated from the metal plate of the engine mount.
   - The rubber is split through the center of the engine mount.
   - The engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to Engine Mount Replacement .

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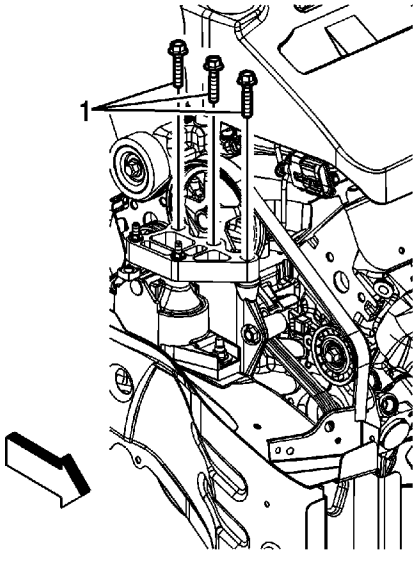
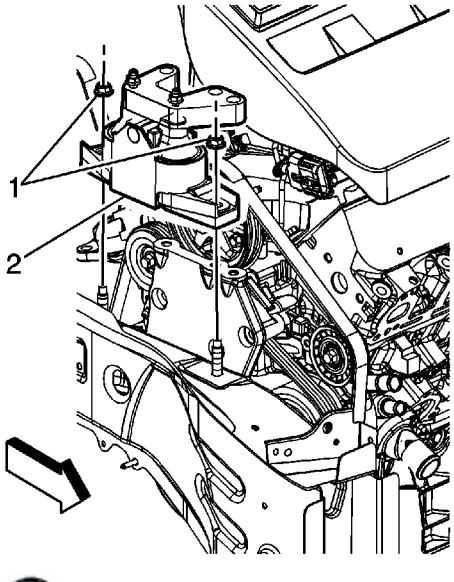
Engine Mount Replacement

Removal Procedure

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



2. Remove the engine mount bolts (1).



3. Remove the engine mount nuts (1).
4. Remove the engine mount (2).

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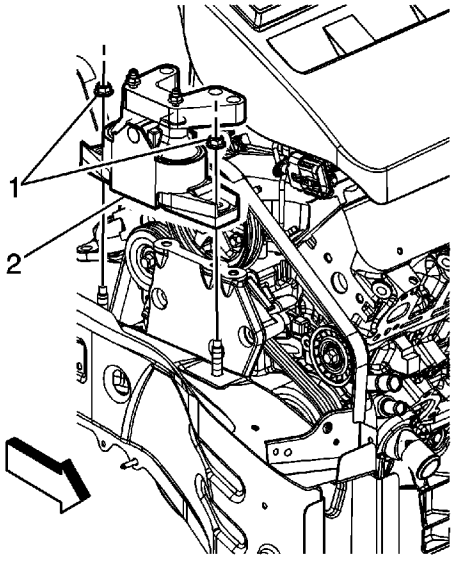
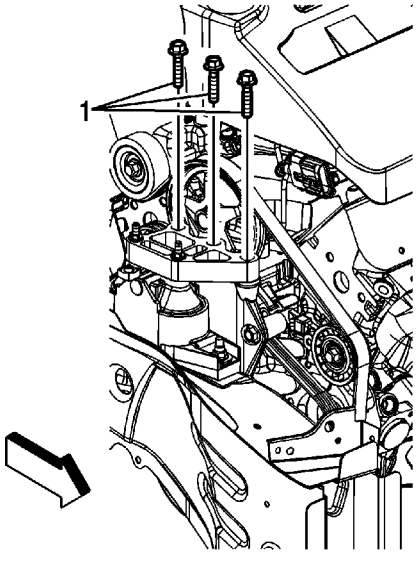


1. Install the engine mount (2).

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the engine mount nuts (1) and tighten to **85 N·m (63 lb ft)**.



3. Install the engine mount bolts (1) and tighten to **110 N·m (81 lb ft)**.
4. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.

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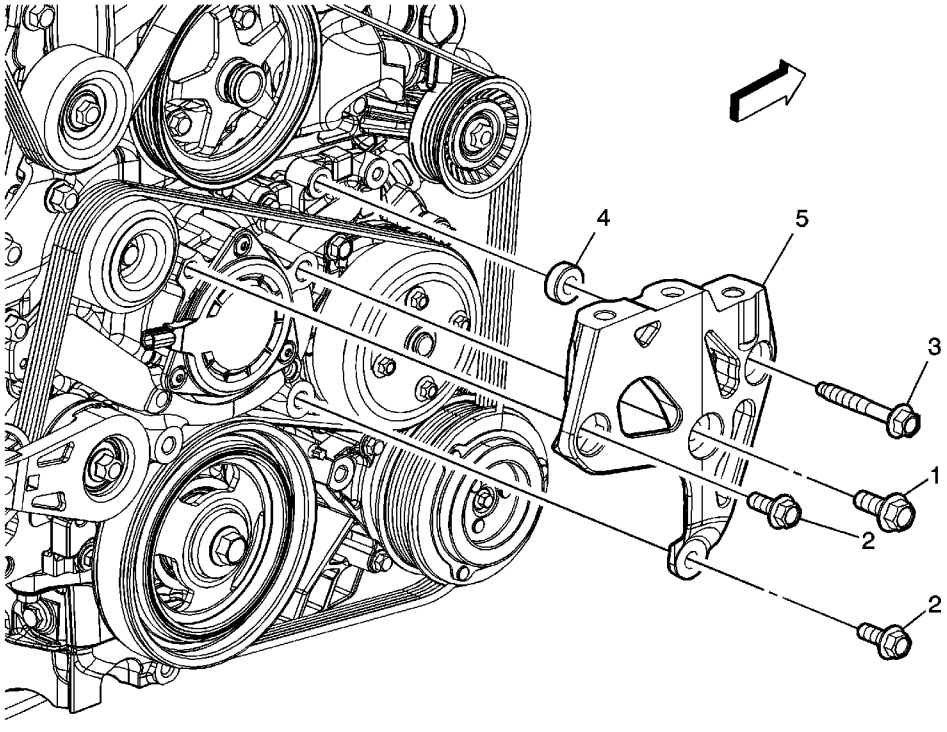
Engine Mount Bracket Replacement



Callout	Component Name
Preliminary Procedure Remove the engine mount. Refer to Engine Mount Replacement.	
1	Engine Mount Bracket Bolt **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 110 N·m (81 lb ft)
2	Engine Mount Bracket Bolt (Qty: 2) **Tighten** 50 N·m (37 lb ft)
3	Engine Mount Bracket Bolt **Tighten** 50 N·m (37 lb ft)
4	Engine Mount Spacer

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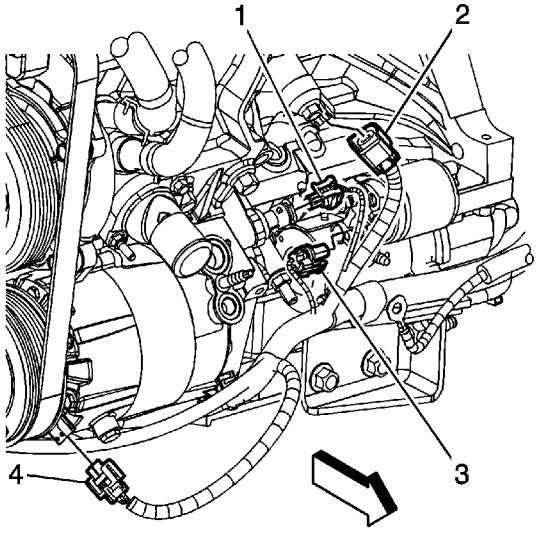
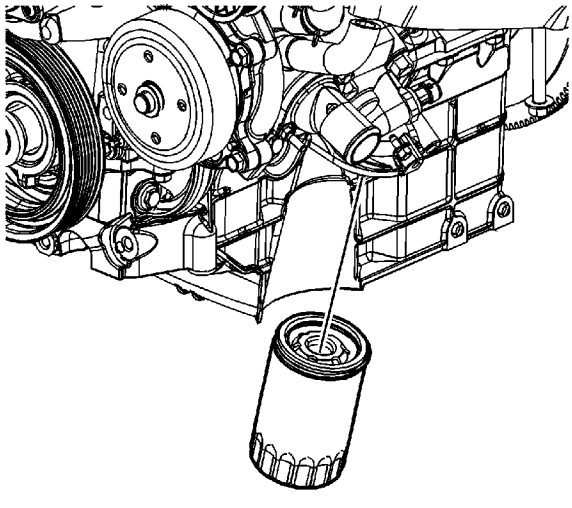
Oil Filter Adapter and Bypass Valve Assembly Replacement

Removal Procedure



1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Disconnect the oil pressure sensor electrical connector (1).



3. Remove the oil filter.

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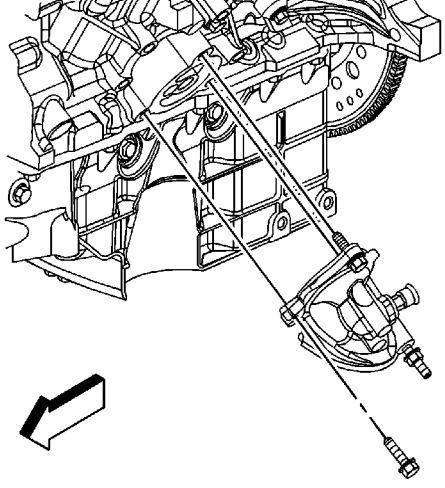
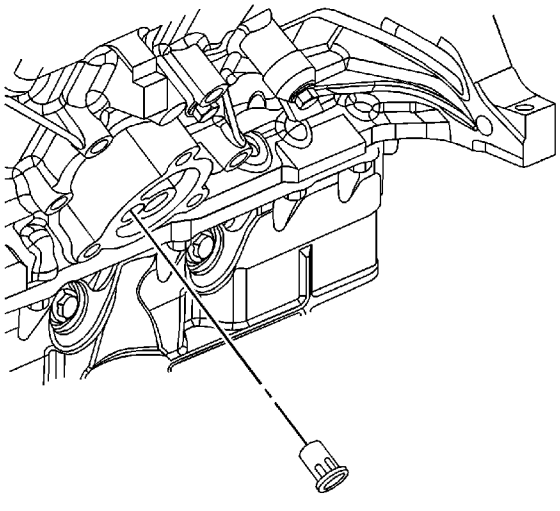


4. Remove the oil filter adapter bolts and stud.
5. Remove the oil filter adapter and gasket.



6. Insert a flat-bladed tool into the oil filter bypass hole and remove the oil filter bypass valve.

Installation Procedure

Notice: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

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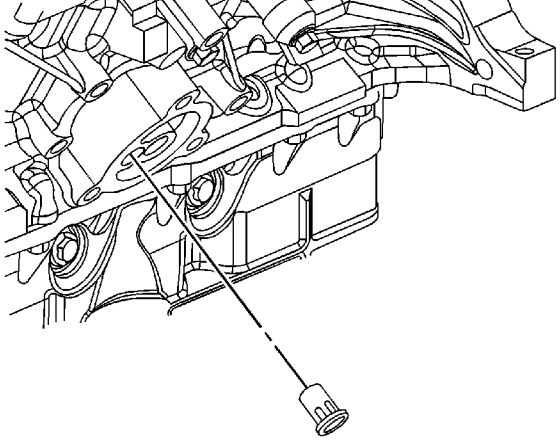
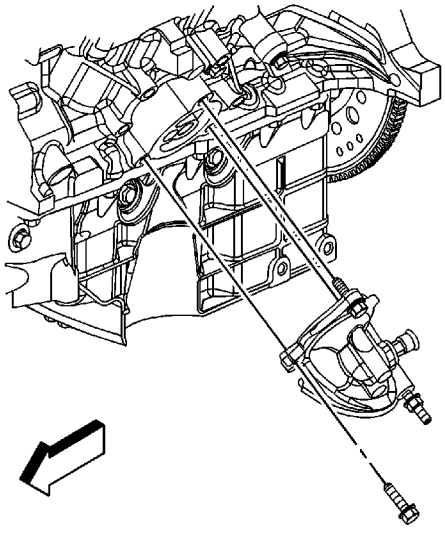


1. Install the oil filter bypass valve. Seat the valve fully below the bypass valve hole chamfer.



2. Position the oil filter adapter and gasket to the engine.
3. Apply threadlock to the bolt/stud threads, if required. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Caution: Refer to Fastener Caution in the Preface section.

4. Install the oil filter adapter bolts and stud and tighten to **25 N·m (18 lb ft)**.

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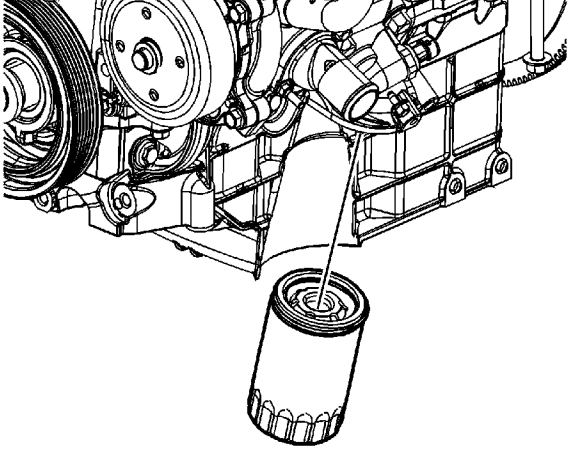
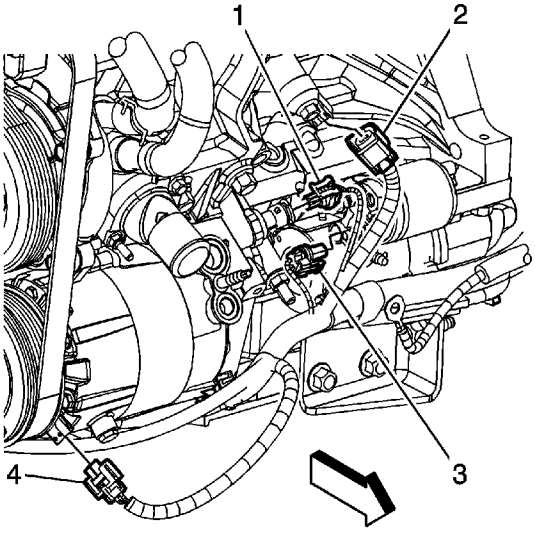


5. Install the oil filter and tighten to **30 N·m (22 lb ft)**.



6. Disconnect the oil pressure sensor electrical connector (1).
7. Lower the vehicle.
8. Check and fill the crankcase, if necessary.

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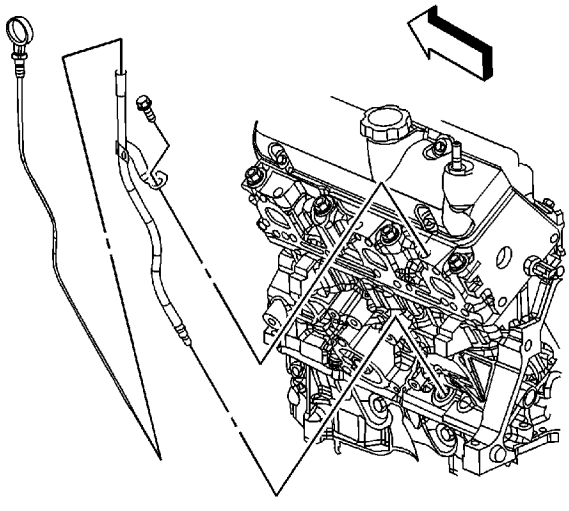
Oil Level Indicator Tube Replacement

Removal Procedure



1. Remove the oil level indicator.
2. Remove the oil level indicator tube bracket bolt.
3. Remove the oil level indicator tube.
4. Inspect the oil level indicator tube O-ring seal, for damage, replace as necessary.

Installation Procedure

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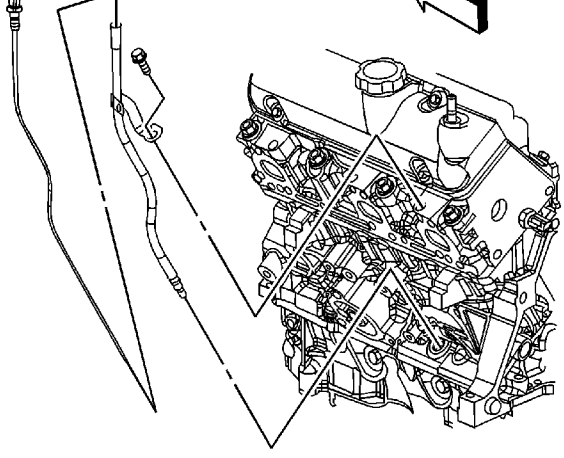

1. Lubricate the oil level indicator tube O-ring seal with clean engine oil.
2. Install the oil level indicator tube into the engine block.

Caution: Refer to Fastener Caution in the Preface section.

3. Install the oil level indicator tube bracket bolt and tighten to **25 N·m (18 lb ft)**.
4. Install the oil level indicator.

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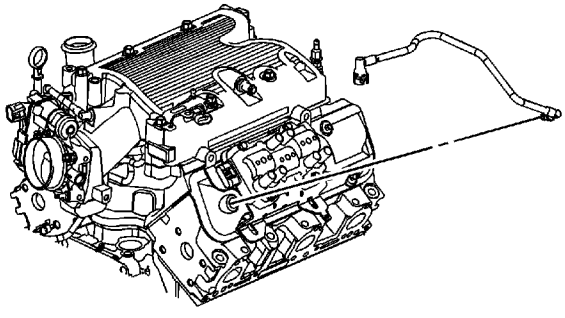
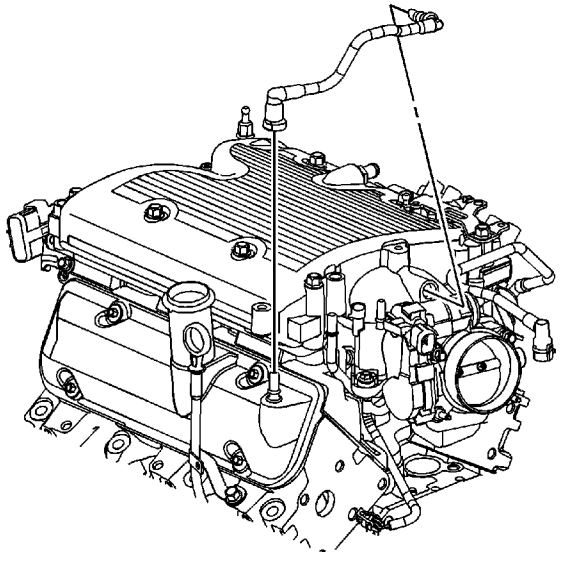
Upper Intake Manifold Replacement

Removal Procedure



1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
3. Drain the cooling system. Refer to Cooling System Draining and Filling.
4. Remove the positive crankcase ventilation (PCV) fresh air tube. Refer to Plastic Collar Quick Connect Fitting Service.



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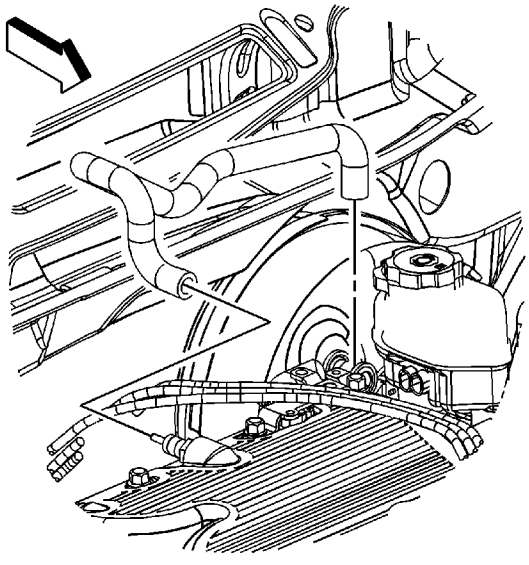
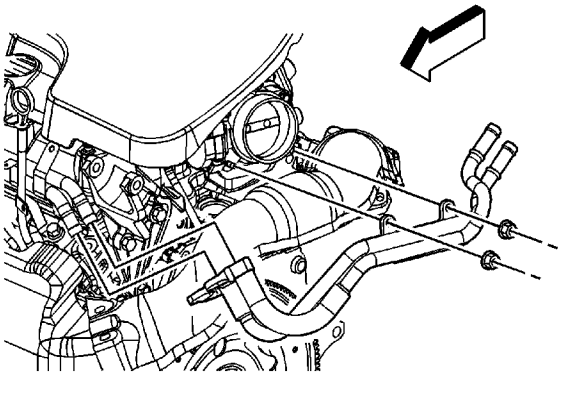
5. Remove the PCV foul air tube. Refer to Plastic Collar Quick Connect Fitting Service.



6. Remove the vacuum hose from the intake manifold.



7. Reposition the heater inlet and outlet hose/pipe clamps at the engine pipes.
8. Remove the heater inlet and outlet hose/pipe clamp nuts from the throttle body studs.
9. Remove the heater inlet and outlet hoses/pipes from the engine pipes and the throttle body studs.
10. Reposition the hoses/pipes out of the way.

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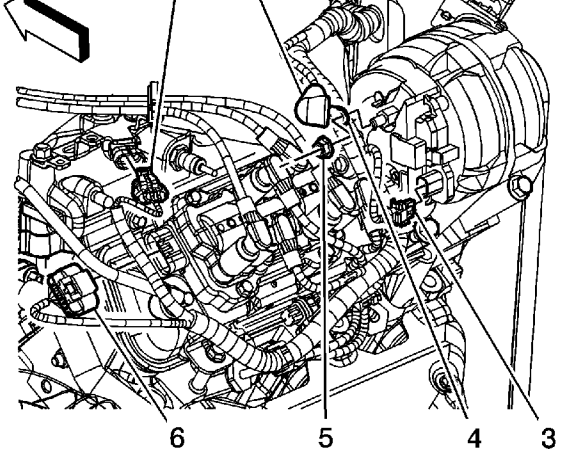
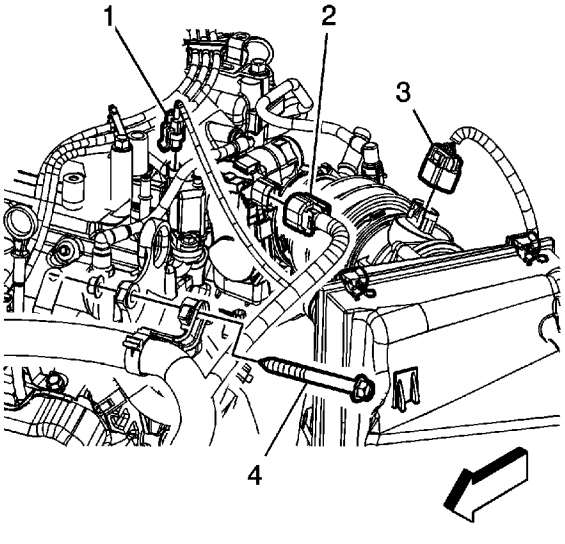


11. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).



12. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
13. Disconnect the chassis EVAP line quick connect fitting from the purge solenoid. Refer to Plastic Collar Quick Connect Fitting Service.
14. Disconnect the electronic throttle control (ETC) electrical connector (2).

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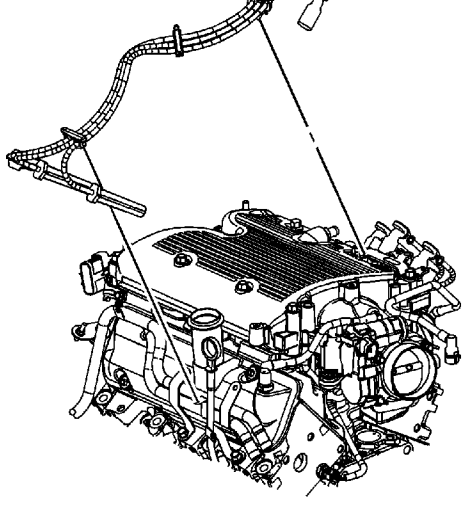
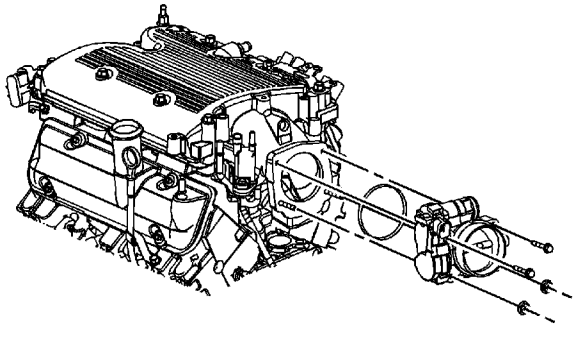


15. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
16. Disconnect the left side spark plug wires from the spark plugs.
17. Disconnect the left side spark plug wires from the ignition coil.
18. Disengage the spark plug wire retainer clips from the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
19. Remove the left side spark plug wires.



20. Remove the throttle body bolts and nuts.
21. Remove the throttle body and gasket.

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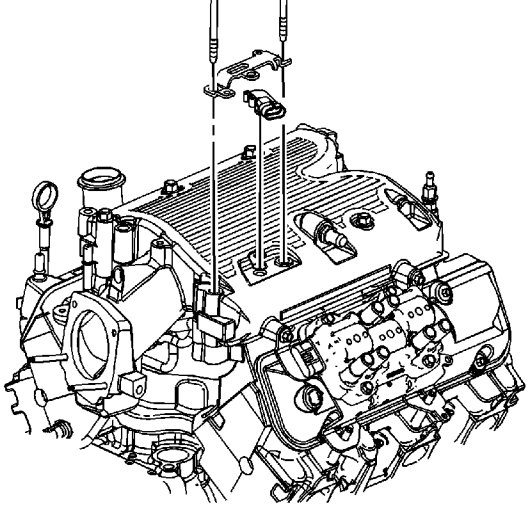
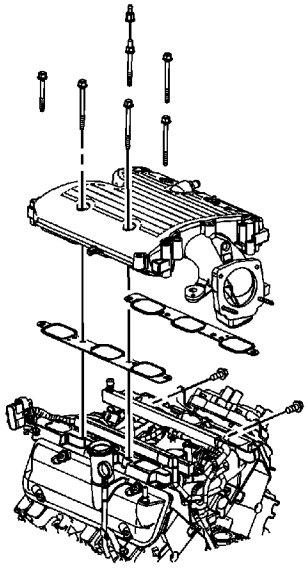


22. Remove the MAP sensor bracket bolts.
23. Remove the MAP sensor bracket and sensor.



24. Remove the ignition coil bracket (to intake manifold) bolts.
25. Remove the intake manifold cover ball stud nut from the intake manifold stud.
26. Remove the upper intake manifold bolts and stud.
27. Separate and remove the upper intake manifold from the lower intake manifold.
28. Remove the upper to lower intake manifold gaskets.
29. Clean the upper intake to lower intake gasket mating surfaces.

Installation Procedure

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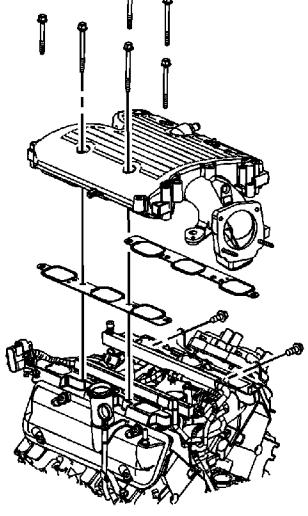
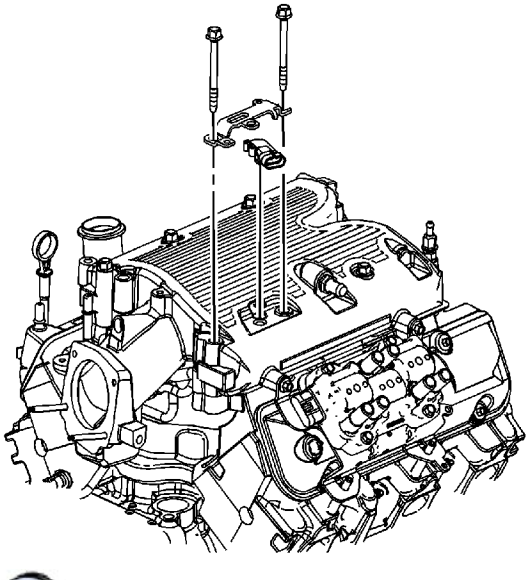


1. Install NEW upper to lower intake manifold gaskets.
2. Install the upper intake manifold onto the lower intake manifold.
3. Apply threadlock to the upper intake manifold bolts/stud threads. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Caution: Refer to Fastener Caution in the Preface section.

4. Install the upper intake manifold bolts and stud and tighten to **25 N·m (18 lb ft)**.
5. Install the intake manifold cover ball stud nut to the intake manifold stud and tighten the nut to **5 N·m (44 lb in)**.
6. Install the ignition coil bracket (to intake manifold) bolts and tighten to **25 N·m (18 lb ft)**.



7. Install the MAP sensor and bracket.
8. Install the MAP sensor bracket bolts and tighten to **25 N·m (18 lb ft)**.

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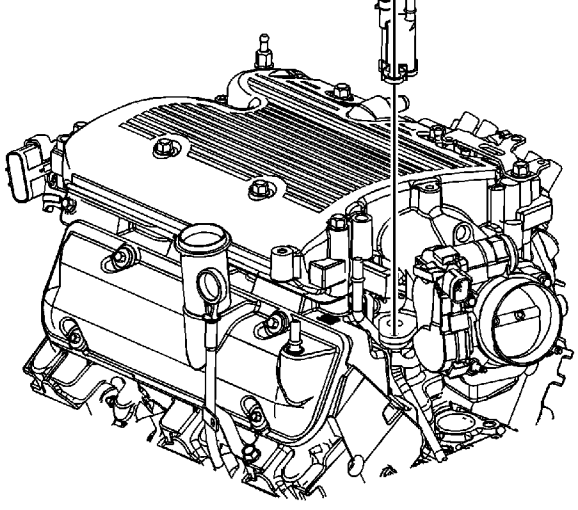
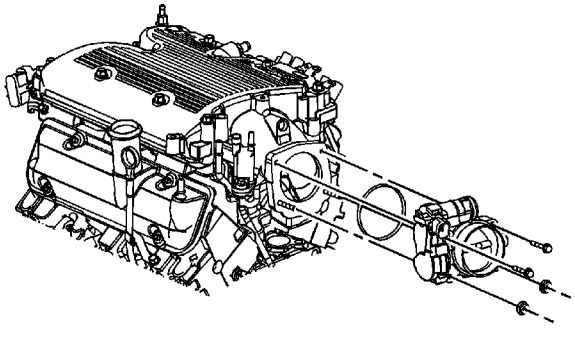


9. Install the EVAP canister purge solenoid valve.
10. Install the EVAP canister purge solenoid valve bolt and tighten to **16 N·m (12 lb ft)**.



11. Inspect the throttle body seal for damage, replace as necessary.
12. Apply threadlock to the throttle body bolts/studs threads. Refer to Adhesives, Fluids, Lubricants, and Sealers.
13. Position the throttle body gasket and throttle body to the intake.
14. Install the throttle body bolts and nuts and tighten to **10 N·m (89 lb in)**.

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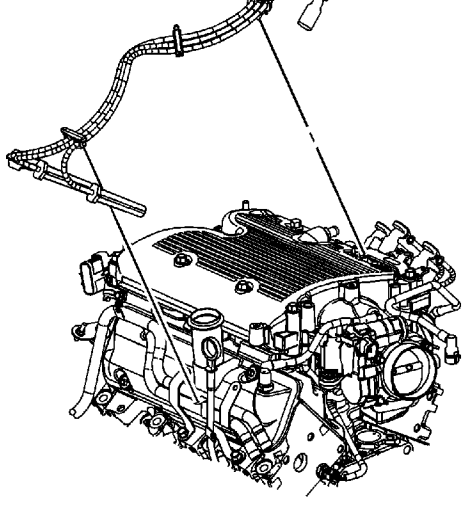
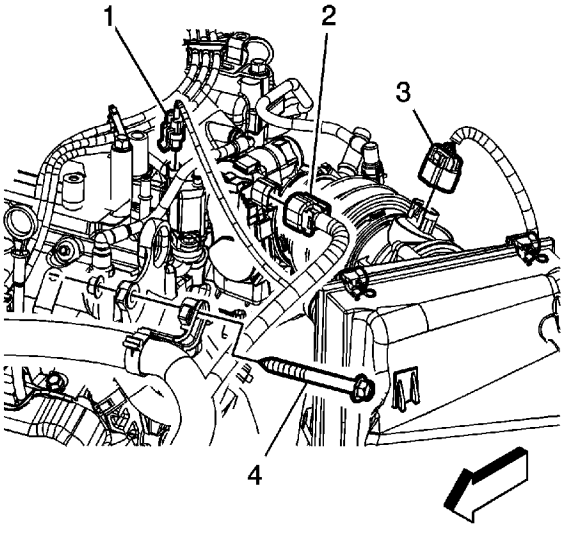


15. Install the left side spark plug wires.
16. Engage the spark plug wire retainer clips to the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
17. Connect the left side spark plug wires to the ignition coil.
18. Connect the left side spark plug wires to the spark plugs.
19. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.



20. Connect the EVAP canister purge solenoid electrical connector (1).
21. Connect the chassis EVAP line quick connect fitting to the purge solenoid. Refer to Plastic Collar Quick Connect Fitting Service.
22. Connect the ETC electrical connector (2).

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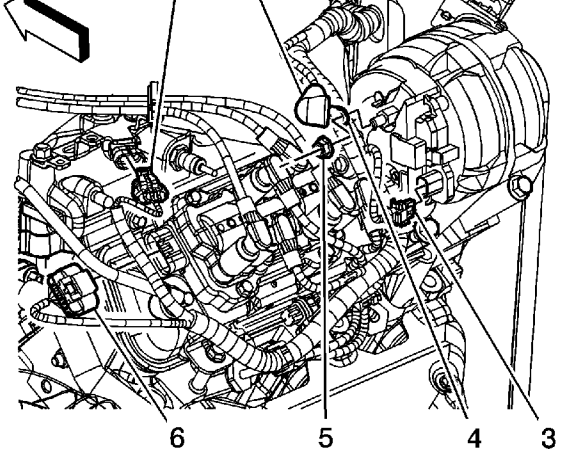
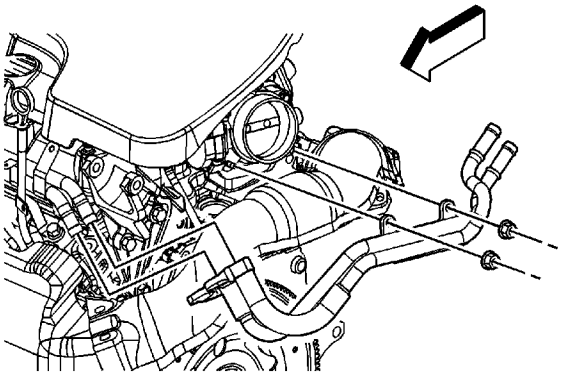


23. Connect the MAP sensor electrical connector (1).



24. Position the hoses/pipes.
25. Install the heater inlet and outlet hoses/pipes to the engine pipes and the throttle body studs.
26. Install the heater inlet and outlet hose/pipe clamp nuts to the throttle body studs and tighten the nuts to **10 N·m (89 lb in)**.
27. Position the heater inlet and outlet hose/pipe clamps at the engine pipes.

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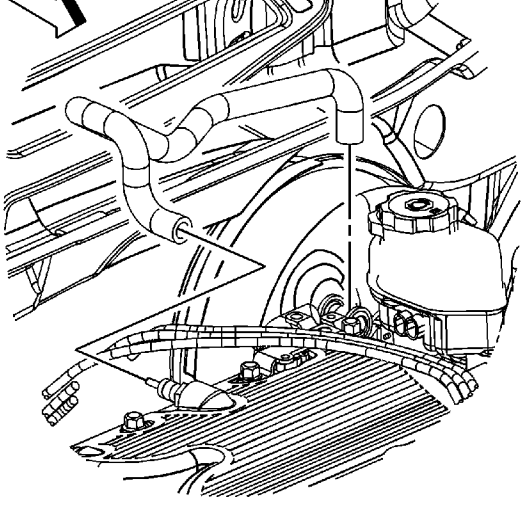
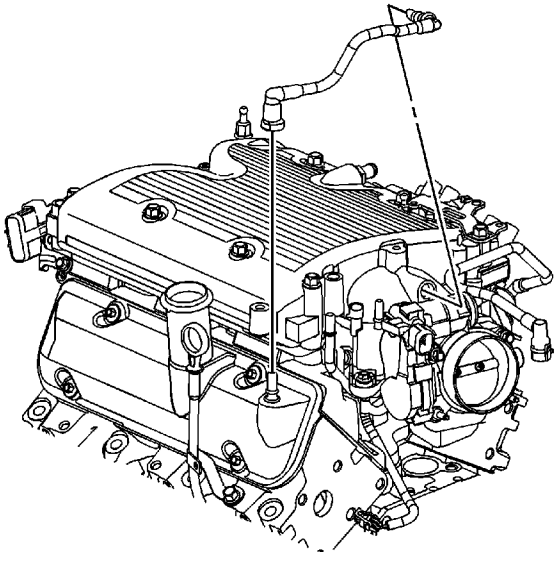


28. Install the vacuum hose to the intake manifold.



29. Install the PCV foul air tube. Refer to Plastic Collar Quick Connect Fitting Service.

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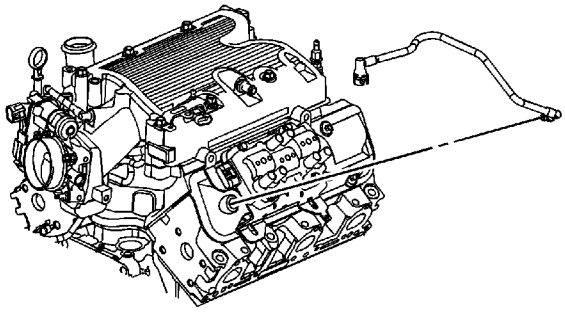

30. Install the PCV fresh air tube. Refer to Plastic Collar Quick Connect Fitting Service.
31. Fill the cooling system. Refer to Cooling System Draining and Filling.
32. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
33. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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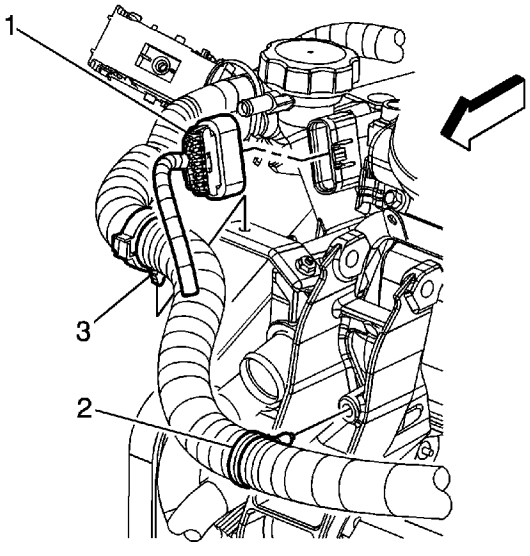
Lower Intake Manifold Replacement

Removal Procedure

Note: This engine uses a sequential multiport fuel injection system. Injector wiring harness connectors must be connected to their appropriate fuel injector or exhaust emissions and engine performance may be seriously affected.

1. Disconnect the battery ground negative cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the upper intake manifold. Refer to Upper Intake Manifold Replacement.
3. Remove the left valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Left Side.
4. Remove the right valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Right Side.
5. Disconnect the fuel feed line from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.



6. Disconnect fuel injector inline connector.

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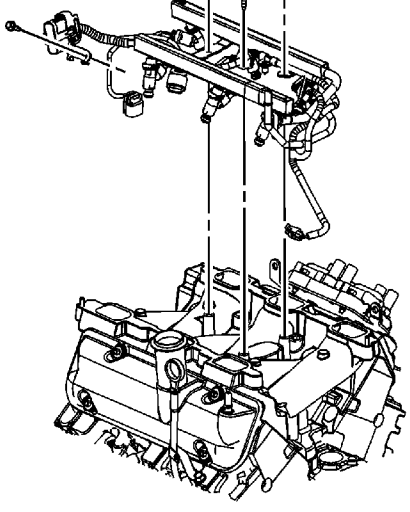
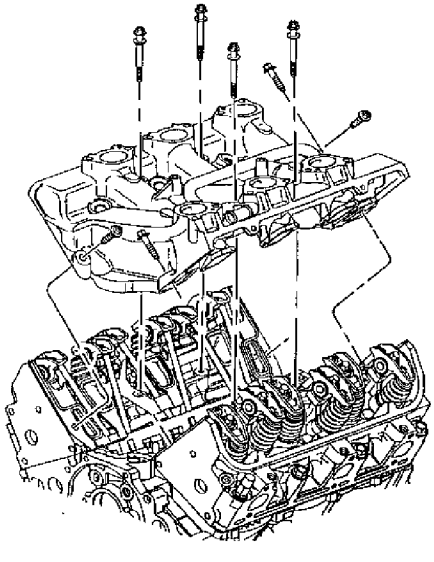


7. Remove the fuel injector harness connector bracket bolt from the intake manifold.
8. Disconnect the engine coolant temperature (ECT) electrical connector.
9. Disconnect the camshaft position (CMP) sensor electrical connector.
10. Remove the fuel injector rail bolts.
11. Remove the fuel rail.



12. Remove the lower intake manifold bolts.
13. Remove the lower intake manifold.

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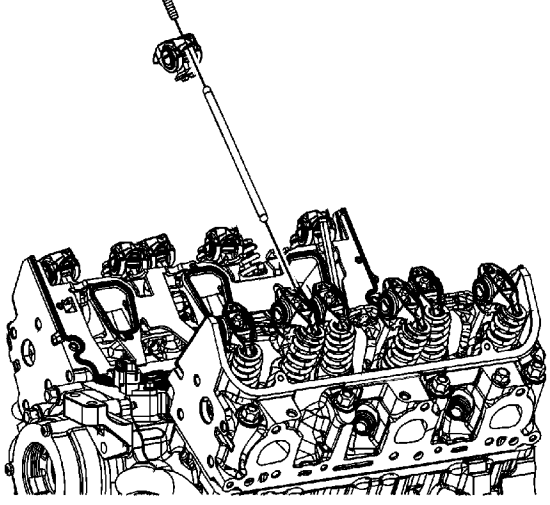
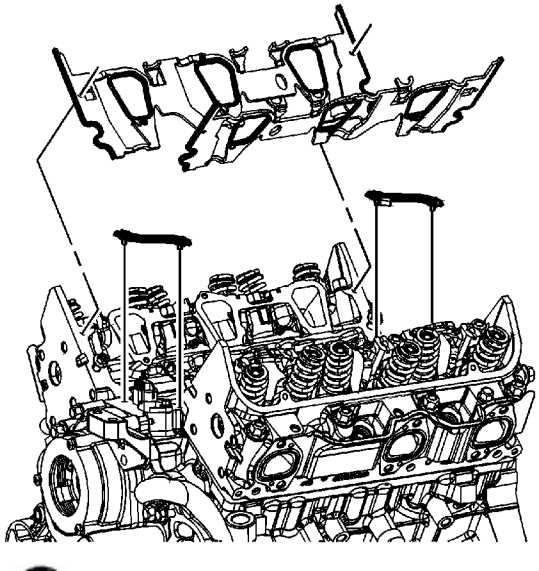


14. Loosen the valve rocker arm bolts.

Note: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they where removed.

15. Remove the valve rocker arms.
16. Remove the push rods:
    - The intake push rods measure 147.51 mm (5.81 in).
    - The exhaust push rods measure 154.87 mm (6.1 in).



17. Remove the lower intake manifold gaskets and seals.
18. Clean the lower intake manifold gasket and seal surfaces on the cylinder heads and the engine block.

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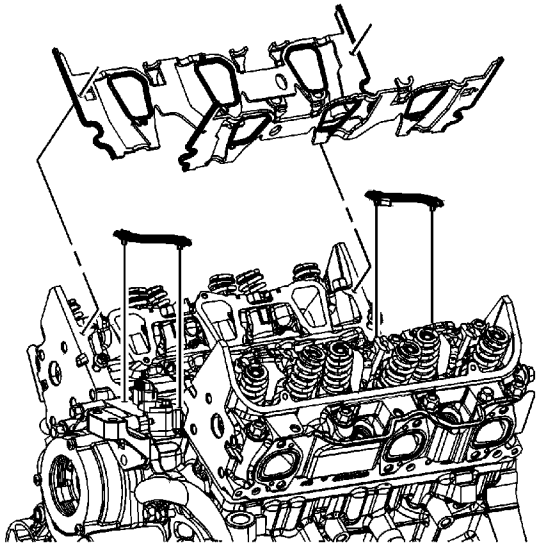
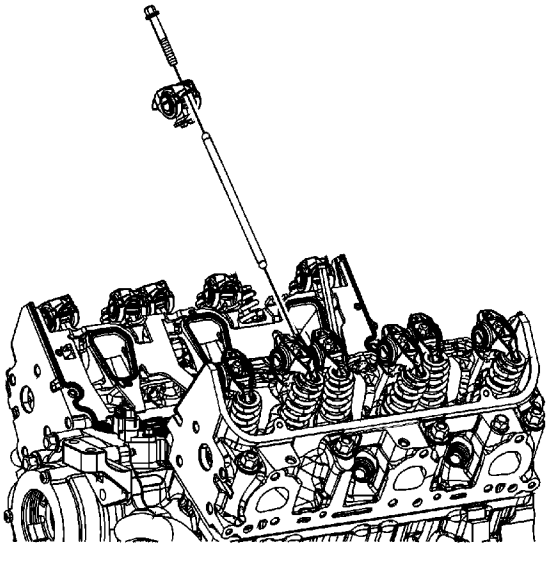
Installation Procedure



Note: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers.

Note: RTV sealer is NOT to be placed under the lower intake manifold gaskets.

1. Install the lower intake manifold gaskets and seals.



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2. Coat the ends of the push rods using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Note: The intake valve push rods measure 146.0 mm (5.75 in) and the exhaust valve push rods measure 152.5 mm (6.0 in).

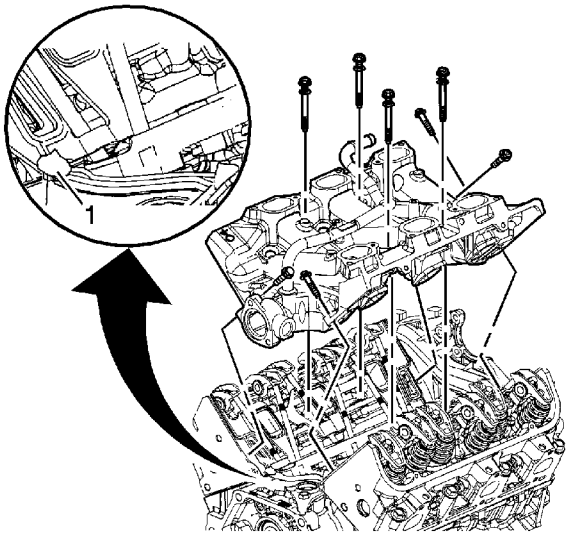
3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Note: Shims (P/N 88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the valve rocker arms in their original positions.

   Caution: Refer to Fastener Caution in the Preface section.

6. Install the valve rocker arm bolts and tighten to **34 N·m (25 lb ft)**.



7. With the NEW gaskets and seals in place, apply a small drop, 8-10 mm (.031-0.39 in) of RTV sealer to the 4 corners of the intake manifold to engine block joints (1). Refer to Adhesives, Fluids, Lubricants, and Sealers.
8. Install the lower intake manifold.

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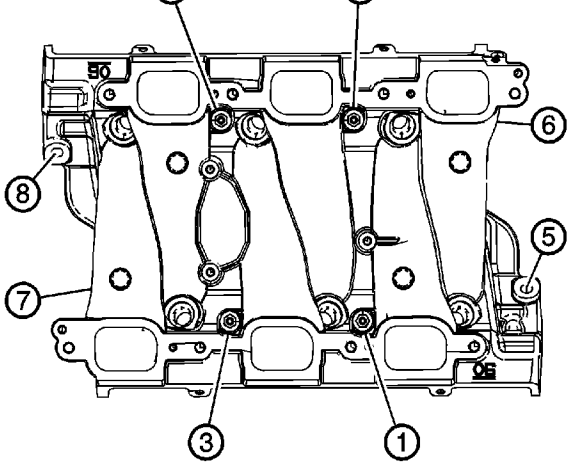
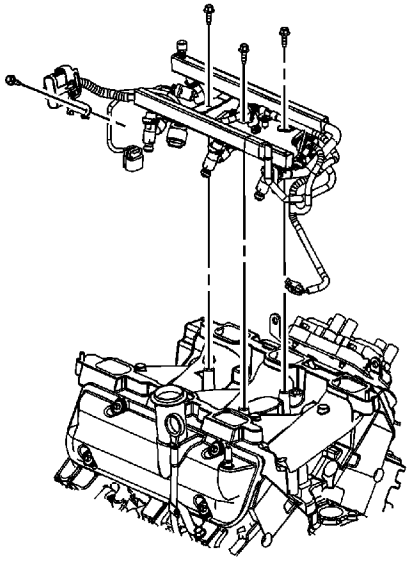


Caution: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

Caution: Failure to tighten vertical bolts before the diagonal bolts may cause an oil leak.

9. Apply sealer to the lower intake manifold bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers.
10. Install the lower intake manifold bolts.
11. Tighten the lower intake manifold bolts in the sequence shown.
    - Tighten the bolts (1, 2, 3, 4) in sequence to **16 N·m (12 lb ft)**.
    - Tighten the bolts (5, 6, 7, 8) in sequence to **25 N·m (18 lb ft)**.



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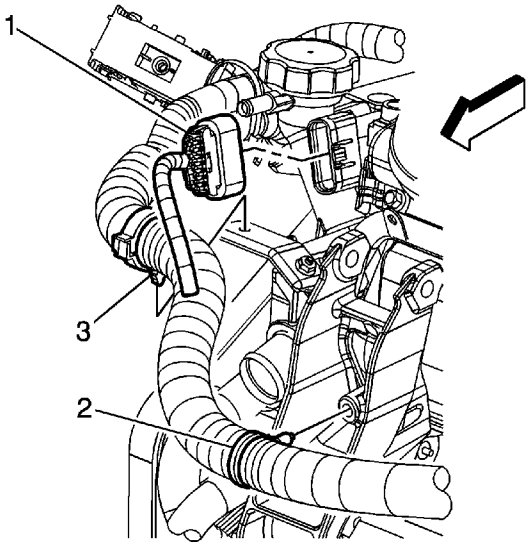
12. Inspect the fuel rail, fuel injectors and fuel injector O-rings for damage and replace, as necessary.
13. Lubricate the fuel injector O-rings using engine oil. Refer to Adhesives, Fluids, Lubricants, and Sealers.
14. Install the injector nozzles into the lower intake manifold injector bores.
15. Press on the injector rail using the palms of both hands until the injector are fully seated.
16. Install the fuel injector rail bolts and tighten to **10 N·m (89 lb in)**.
17. Connect the CMP sensor electrical connector.
18. Connect the ECT electrical connector.
19. Position the fuel injector harness connector bracket to the intake manifold.
20. Install the fuel injector harness connector bracket bolt and tighten to **8 N·m (71 lb in)**.



21. Connect fuel injector inline connector.
22. Connect the fuel feed line to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
23. Install the right valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Right Side.
24. Install the left valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Left Side.
25. Install the upper intake manifold. Refer to Upper Intake Manifold Replacement.
26. Connect the battery ground negative cable. Refer to Battery Negative Cable Disconnection and Connection.

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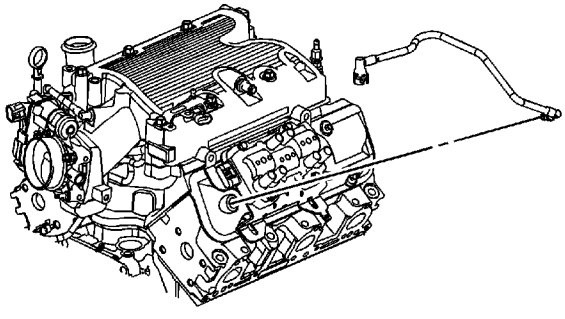
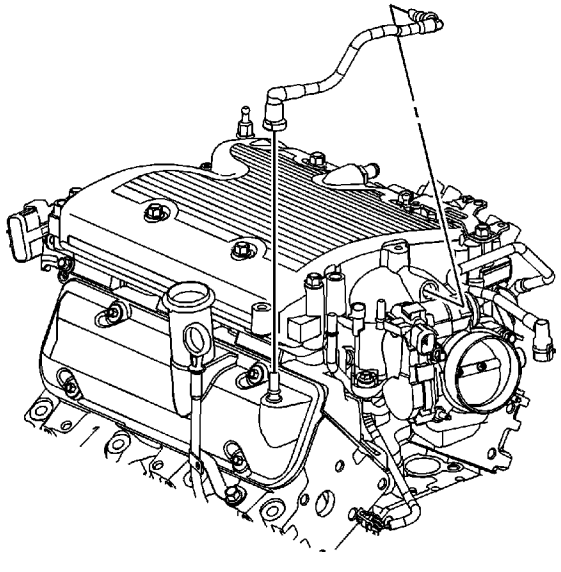
Positive Crankcase Ventilation Hose / Pipe / Tube Replacement

Removal Procedure



1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement .
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to Plastic Collar Quick Connect Fitting Service .
3. Remove the PCV fresh air tube from the rocker arm cover.
4. Remove the PCV fresh air tube from the vehicle.



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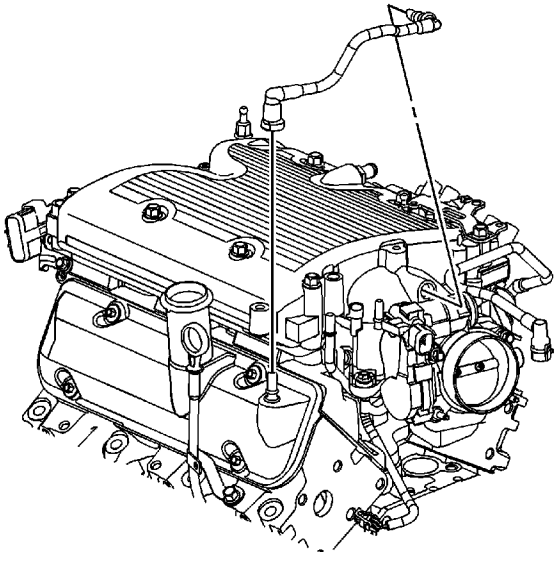
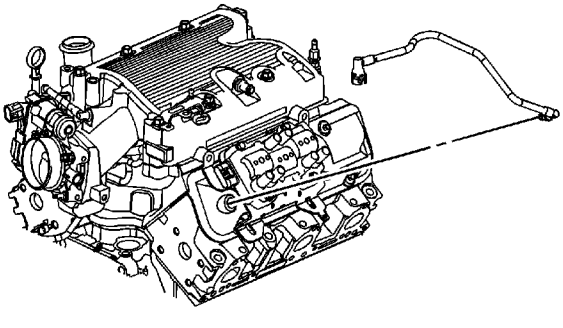
5. Disconnect the PCV foul air tube from the PCV valve. Refer to Plastic Collar Quick Connect Fitting Service .
6. Remove the PCV foul air tube from the intake manifold.
7. Remove the PCV foul air tube from the vehicle.

Installation Procedure



1. Install the PCV foul air tube to the vehicle.
2. Install the PCV foul air tube to the intake manifold.
3. Connect the PCV foul air tube to the PCV valve. Refer to Plastic Collar Quick Connect Fitting Service .



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4. Install the PCV fresh air tube to the vehicle.
5. Install the PCV fresh air tube to the rocker arm cover.
6. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to Plastic Collar Quick Connect Fitting Service .
7. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement .

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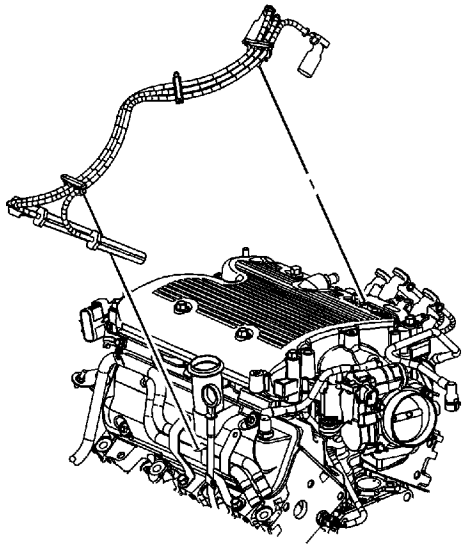
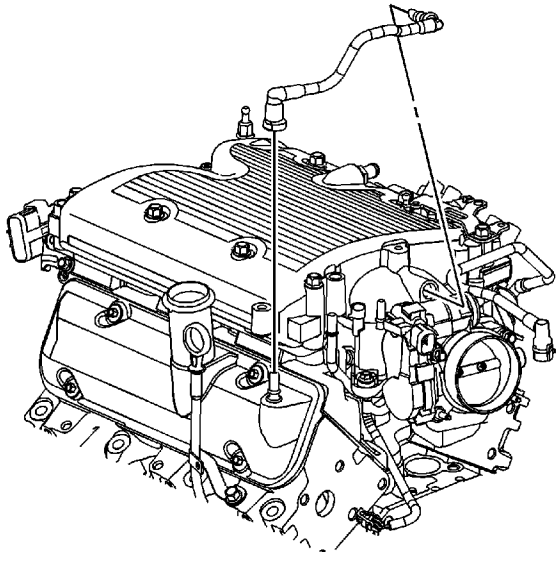
Valve Rocker Arm Cover Replacement - Left Side

Removal Procedure

1. Partially drain the cooling system. Refer to Cooling System Draining and Filling.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
3. Remove the oil level indicator and tube. Refer to Oil Level Indicator and Tube Replacement.



4. Remove the left side spark plug wires from the vehicle.



5. Remove the positive crankcase ventilation (PCV) foul air tube. Refer to Plastic Collar Quick Connect Fitting Service.

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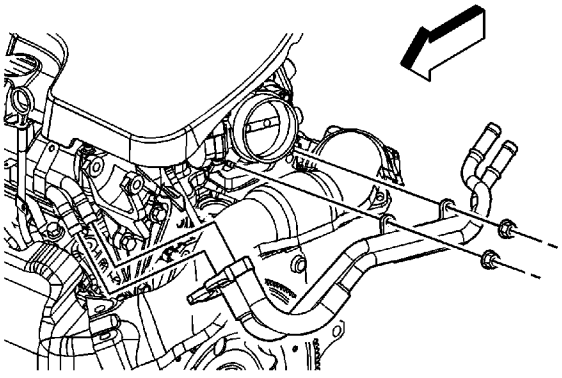
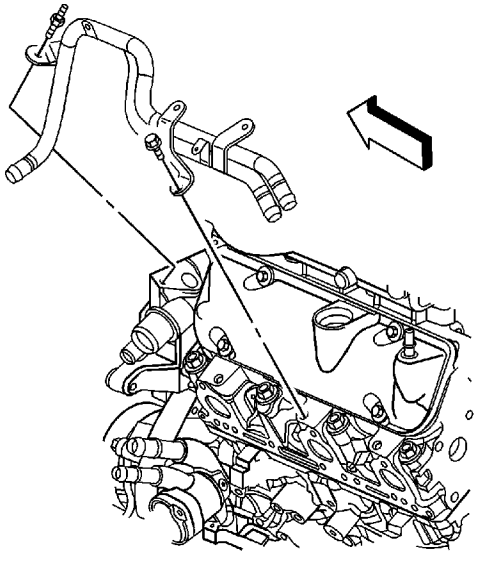


6. Reposition the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
7. Remove the heater inlet and outlet hose/pipe clip nuts at the throttle body.
8. Remove the heater inlet and outer hoses/pipes from the engine inlet and outlet pipes.
9. Remove the clips from the throttle body studs. Reposition the hose/pipe assembly.



10. Remove the front heater outlet hose from the outlet heater pipe.
11. Remove the heater inlet and outlet pipe bolt and stud.
12. Remove the heater inlet and outlet pipe from the vehicle.

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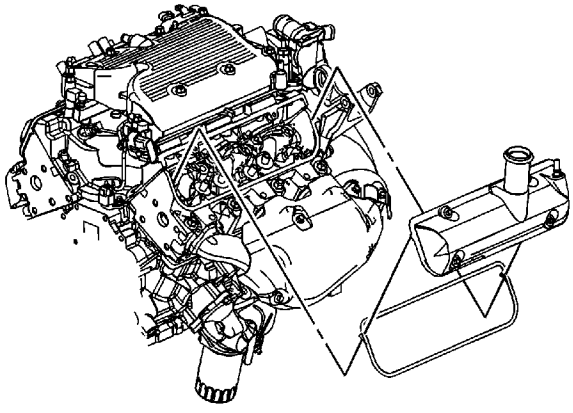

13. Loosen the left side valve rocker arm cover bolts.

    Note: When removing the left side valve rocker arm cover, ensure the left side valve rocker arm cover gasket stays in place attached to the left side cylinder head.

14. Remove the left side valve rocker arm cover. If necessary, bump the end of the left side valve rocker arm cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
15. Cut the RTV in the channel where the lower intake manifold, left side cylinder head and left side valve rocker arm cover meet with a suitable tool.
16. Remove the left side valve rocker arm cover gasket.
17. Clean the sealing surface on the cylinder head with degreaser.

Installation Procedure

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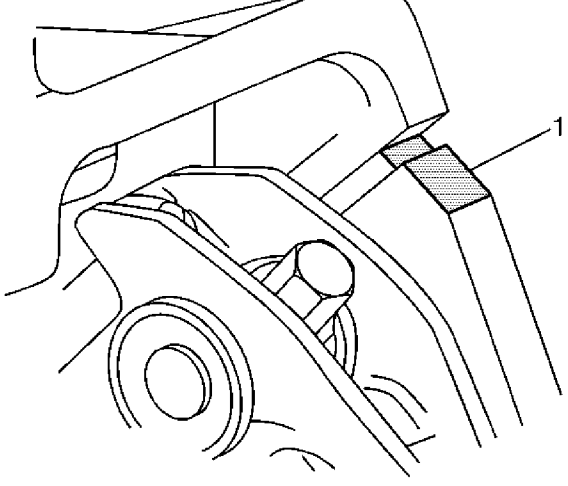
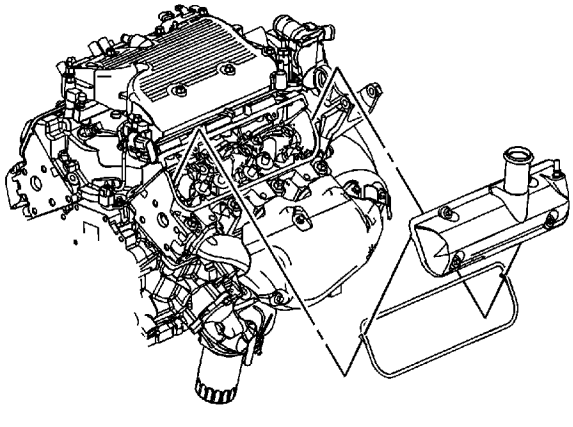


Note: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers.

1. Install a NEW left side valve rocker arm cover gasket into the groove in the left side valve rocker arm cover. Ensure that the gasket is properly seated.
2. Apply sealant at the left side cylinder head to the surfaces where the left side cylinder head and lower intake manifold meet (1). Refer to Adhesives, Fluids, Lubricants, and Sealers.



3. Install the left side valve rocker arm cover.

Caution: Refer to Fastener Caution in the Preface section.

Note: Use an alternating criss-cross pattern when tightening the left side valve rocker arm

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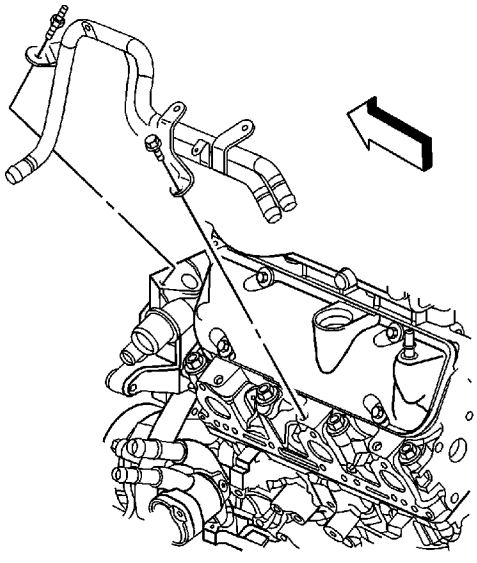
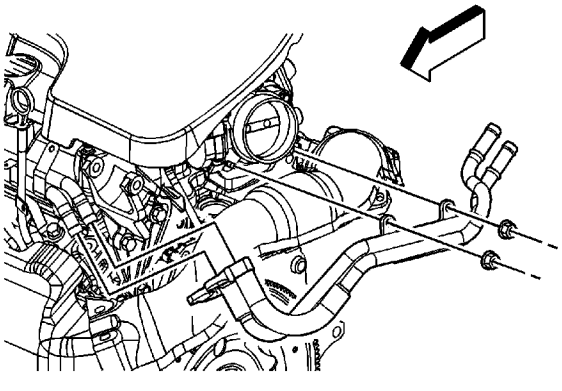
4. Tighten the left side valve rocker arm cover bolts to **10 N·m (89 lb in)**.



5. Install the heater inlet and outlet pipe to the vehicle.
6. Install the heater inlet and outlet pipe bolt and stud.
   - Tighten the bolt to **25 N·m (18 lb ft)**.
   - Tighten the stud to **10 N·m (89 lb in)**.
7. Install the front heater outlet hose to the outlet heater pipe.



8. Position the hose/pipe assembly. Install the clips to the throttle body studs.
9. Install the heater inlet and outer hoses/pipes to the engine inlet and outlet pipes.
10. Install the heater inlet and outlet hose/pipe clip nuts at the throttle body and tighten to **10 N·m (89 lb in)**.
11. Position the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.

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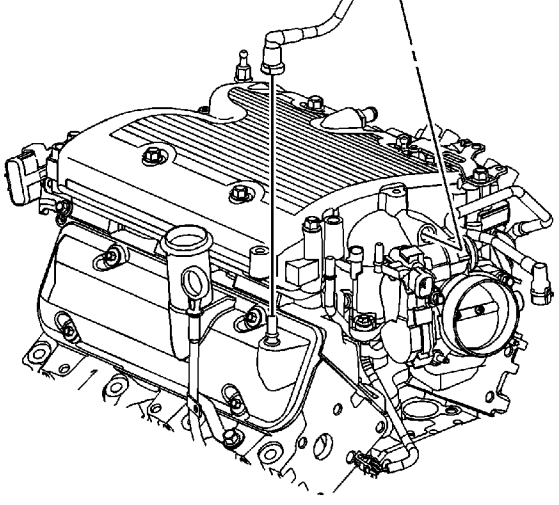
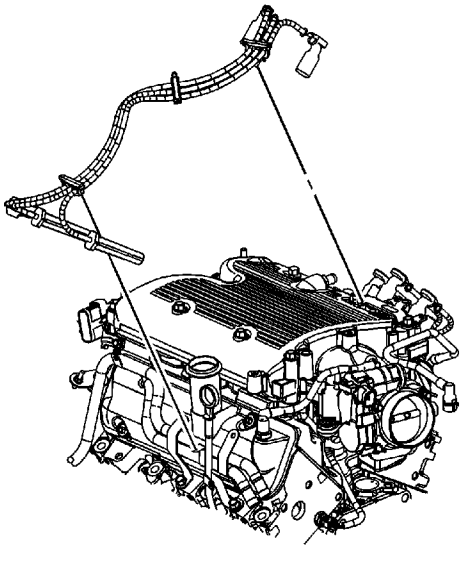


12. Install the PCV foul air tube. Refer to Plastic Collar Quick Connect Fitting Service.



13. Install the left side spark plug wires.
14. Install the oil level indicator and tube. Refer to Oil Level Indicator and Tube Replacement.
15. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
16. Fill the cooling system. Refer to Cooling System Draining and Filling.

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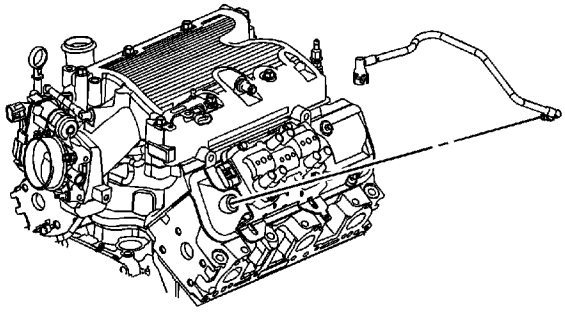
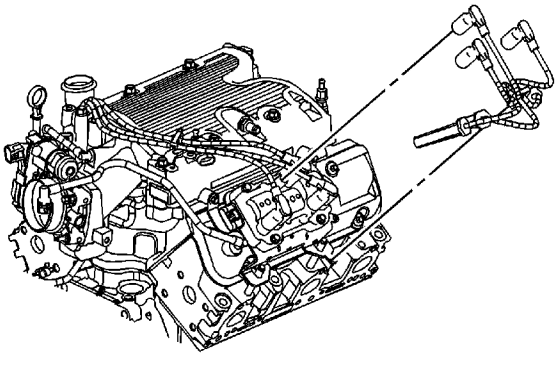
Valve Rocker Arm Cover Replacement - Right Side

Removal Procedure



1. Remove the generator. Refer to Generator Replacement.
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to Plastic Collar Quick Connect Fitting Service.
3. Remove the PCV fresh air tube from the right side valve rocker arm cover.



4. Disconnect the right side spark plug wires from the spark plugs.

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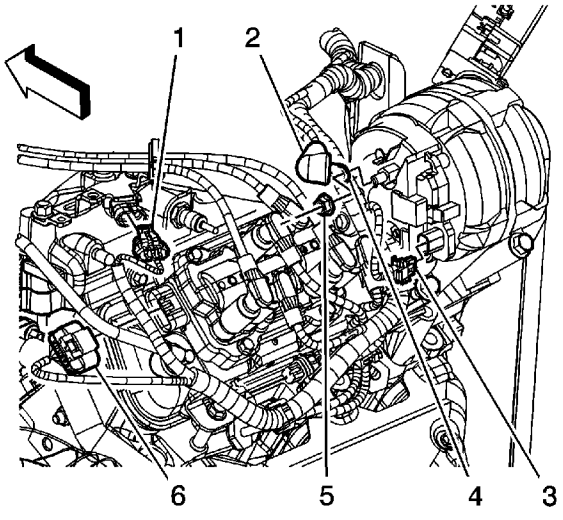
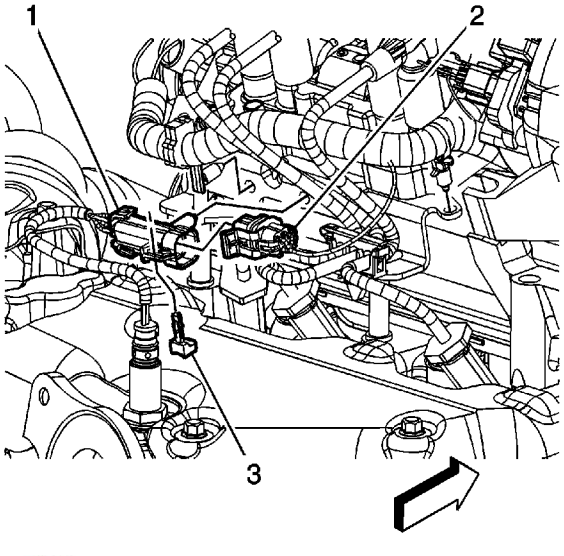
7. Remove the spark plug harness.



8. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
9. Disconnect the ignition coil electrical connector (6).
10. Remove the engine harness clip from the ignition coil bracket.



11. Remove the heated oxygen sensor (HO2S) electrical connector clip (1) from the ignition coil bracket.

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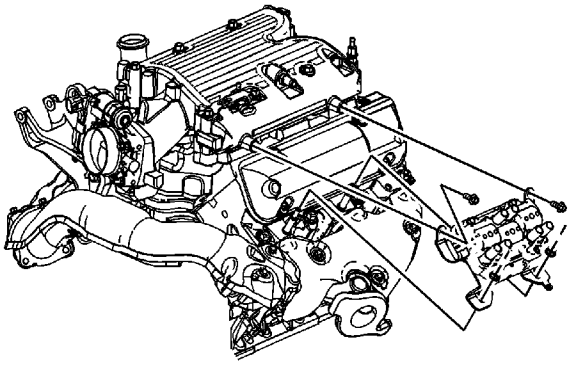
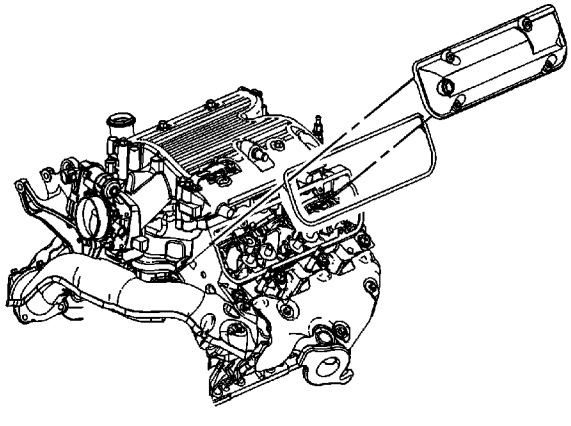


12. Remove the ignition coil bracket nuts.
13. Remove the ignition coil bracket bolts.
14. Remove the ignition coil.
15. Remove the coolant crossover pipe. Refer to Engine Coolant Crossover Pipe Replacement.



16. Loosen the valve rocker arm cover bolts.

Note: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. Bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.

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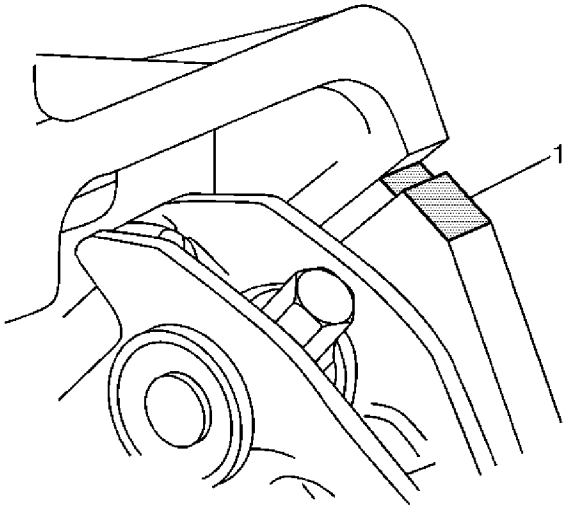
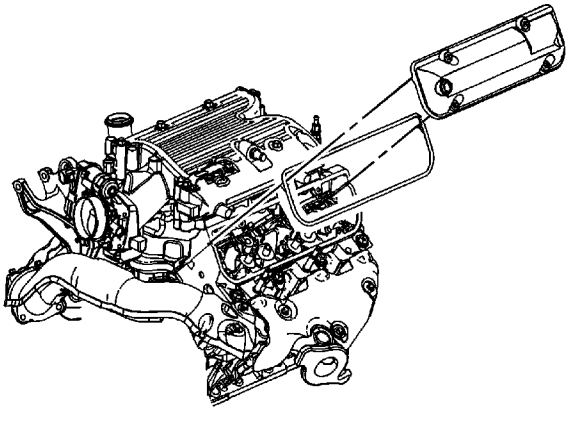
Installation Procedure

Note: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers.



1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1). Refer to Adhesives, Fluids, Lubricants, and Sealers.



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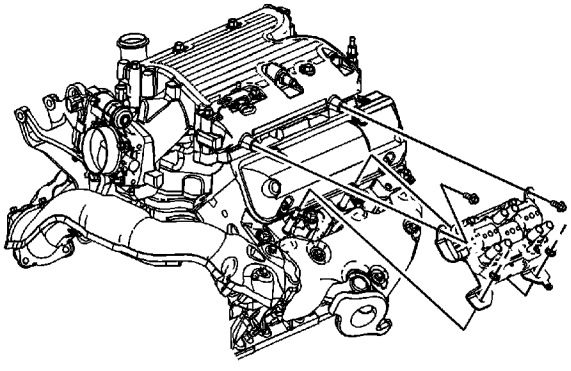
4. Install the right valve rocker arm cover.

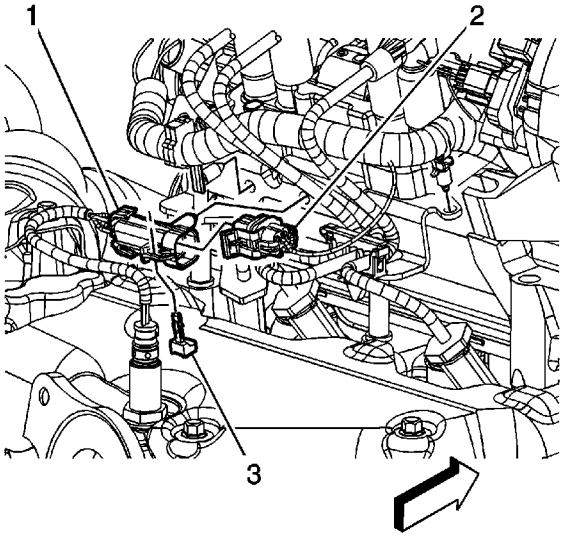
Caution: Refer to Fastener Caution in the Preface section.

Note: Use an alternating criss-cross pattern when tightening the valve rocker cover bolts. Failure to do so may result in oil leakage from the valve cover due to improper seating of the gasket.

5. Tighten the valve rocker arm cover bolts to **10 N·m (89 lb in)**.
6. Install the coolant crossover pipe. Refer to Engine Coolant Crossover Pipe Replacement.



7. Install the ignition coil.
8. Install the ignition coil bracket bolts.
9. Install the ignition coil bracket nuts and tighten to **25 N·m (18 lb ft)**.



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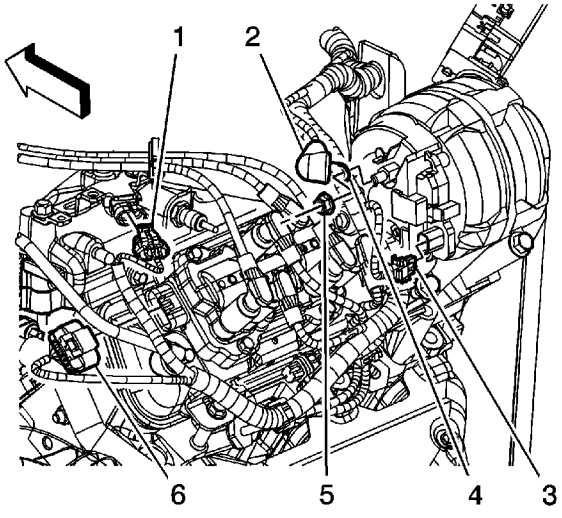
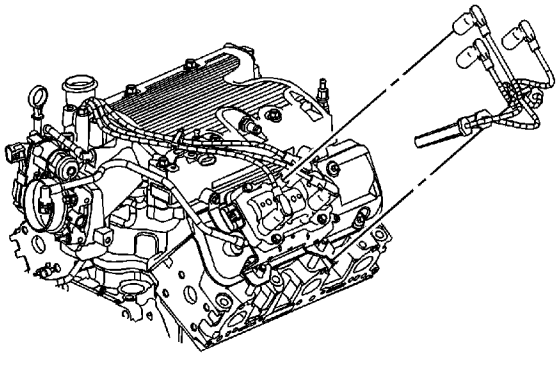
10. Install the HO2S electrical connector clip (1) to the ignition coil bracket.



11. Install the engine harness clip to the ignition coil bracket.
12. Connect the ignition coil electrical connector (6).
13. Connect the MAP sensor electrical connector (1).



14. Install the spark plug harness.
15. Connect the right side spark plug wires to the spark plugs.
16. Connect the right side spark plug wires to the ignition coil.
17. Install the right side spark plug harness clip to the ignition coil bracket.

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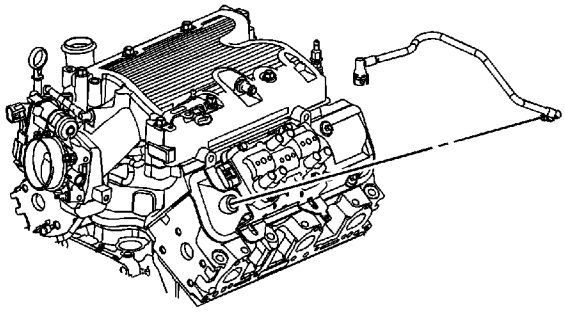

18. Install the PCV fresh air tube to the right side valve rocker arm cover.
19. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to Plastic Collar Quick Connect Fitting Service.
20. Install the generator. Refer to Generator Replacement.

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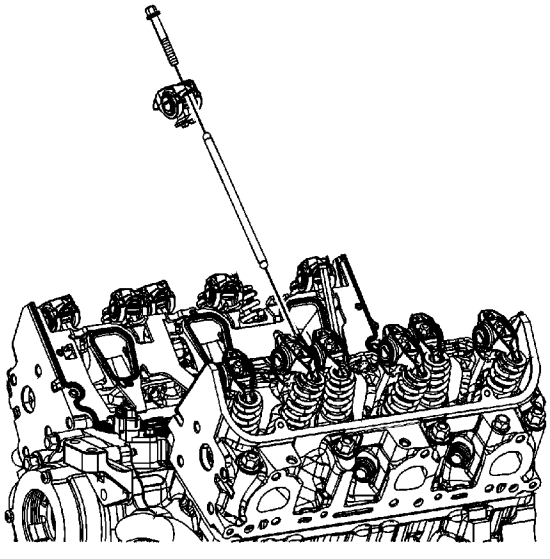
Valve Rocker Arm and Push Rod Replacement

Removal Procedure

Note: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they were removed.



1. Remove the valve rocker arm cover(s). Refer to Valve Rocker Arm Cover Replacement - Left Side or Valve Rocker Arm Cover Replacement - Right Side.
2. Loosen the valve rocker arm bolts.
3. Remove the rocker arms.
4. Remove the pushrods:
   - The intake push rods measure 147.51 mm (5.81 in).
   - The exhaust push rods measure 154.87 mm (6.1 in).

Installation Procedure

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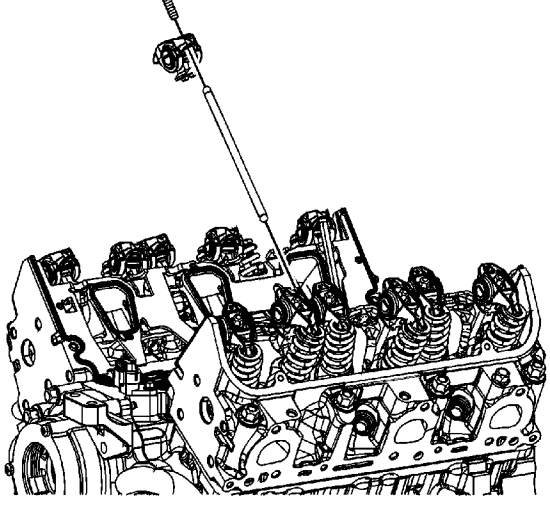

1. Coat the ends of the pushrods using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers.
2. Install the pushrods.
   - The intake pushrods are identified with yellow stripes.
   - The exhaust pushrods are identified with blue stripes.
3. Ensure that the pushrods seat in the lifter bore.
4. Coat the rocker arm friction surfaces using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Note: Shims (88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

5. Install the rocker arms.

   Caution: Refer to Fastener Caution in the Preface section.

6. Install the rocker arm bolts and tighten to **34 N·m (25 lb ft)**.
7. Install the valve rocker arm cover(s). Refer to Valve Rocker Arm Cover Replacement - Left Side or Valve Rocker Arm Cover Replacement - Right Side.

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Valve Stem Oil Seal and Valve Spring Replacement

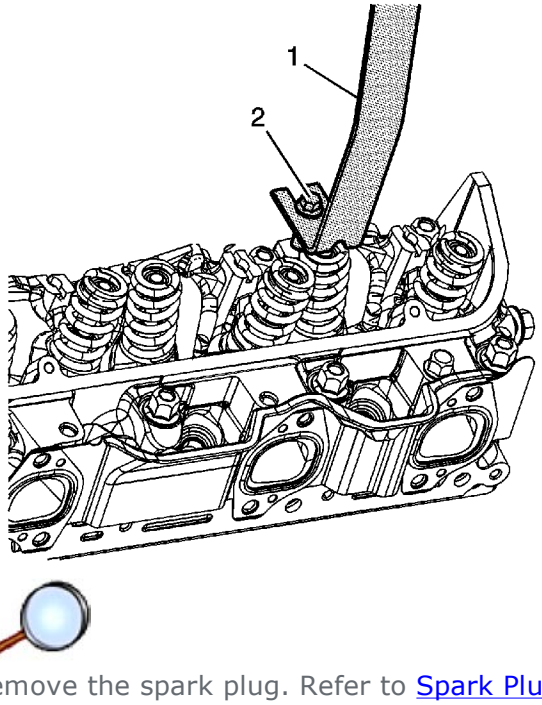
Tools Required

- EN-47823 Valve Spring Compressor Adapter
- J 22794 Spark Plug Port Adapter
- J 5892-D Valve Spring Compressor

Removal Procedure

Important:

- Before removing the valve locks, rotate the engine so that the piston in the cylinder you are working on is at top dead center (TDC). This will eliminate the possibility of the valve accidentally falling inside the cylinder.
- Loosen the spark plug, and clean any dirt and/or debris from the spark plug recess area before removing.



1. Remove the spark plug. Refer to Spark Plug Replacement .
2. Remove the rocker arm. Refer to Valve Rocker Arm and Push Rod Replacement .
3. Install the J 22794 into the spark plug port. Apply compressed air in order to hold the valve in place.
4. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve spring using the J 5892-D (1) and the EN-47823 (2).

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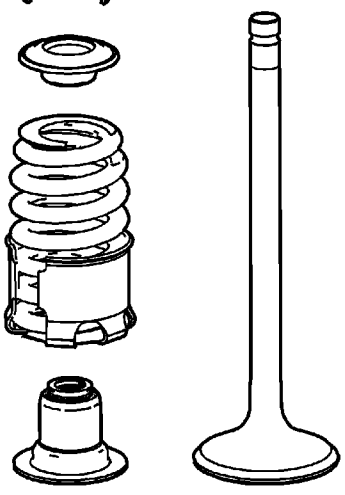
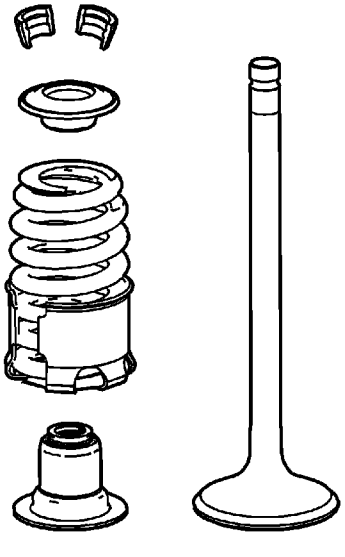


5. Remove the valve spring cap keys.
6. Remove the valve cap.
7. Remove the valve spring.
8. Remove the valve stem oil seal.

Installation Procedure



1. Lubricate the valve stem with clean engine oil.
2. Install the valve stem oil seal, ensuring the proper seals (intake - black seal and exhaust - brown seal) are installed.
3. Install the valve spring.
4. Install the valve cap.

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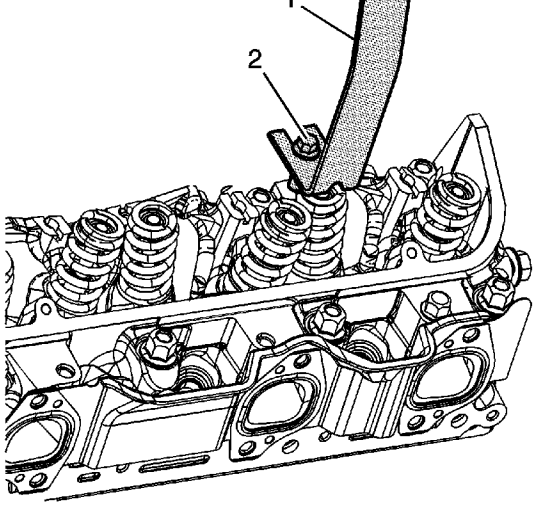

5. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve spring using the J 5892-D (1) and the EN-47823 (2).
6. Install the valve cap keys. If necessary, use grease in order to hold the valve cap keys in place.
7. Ensure the valve cap keys are seated.
8. Remove the compressed air and remove the J 22794 from the spark plug port.
9. Install the rocker arm. Refer to Valve Rocker Arm and Push Rod Replacement .
10. Install the spark plug. Refer to Spark Plug Replacement .

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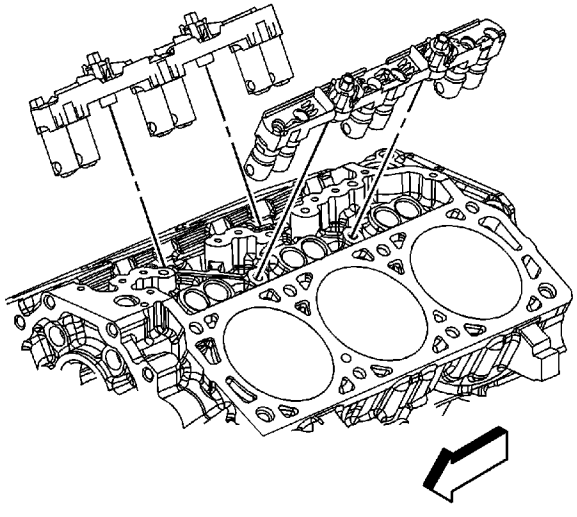
Valve Lifter Replacement

Removal Procedure



1. Remove the lower intake manifold. Refer to Lower Intake Manifold Replacement.
2. Remove the valve rocker arms and pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.

   Note: The valve lifter guide bolts are not removable.

3. Loosen the valve lifter guide bolts.
4. Remove the valve lifter guides.

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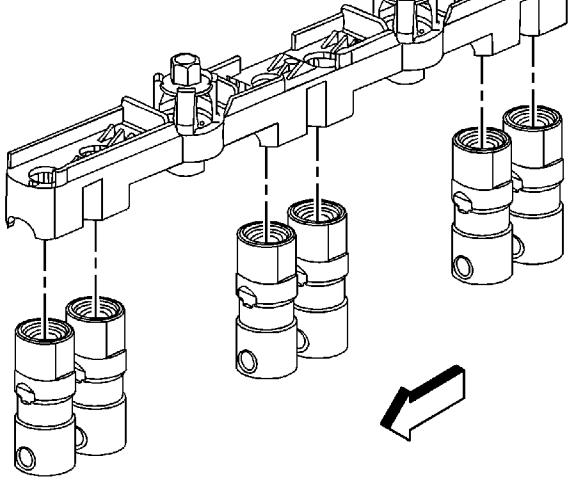
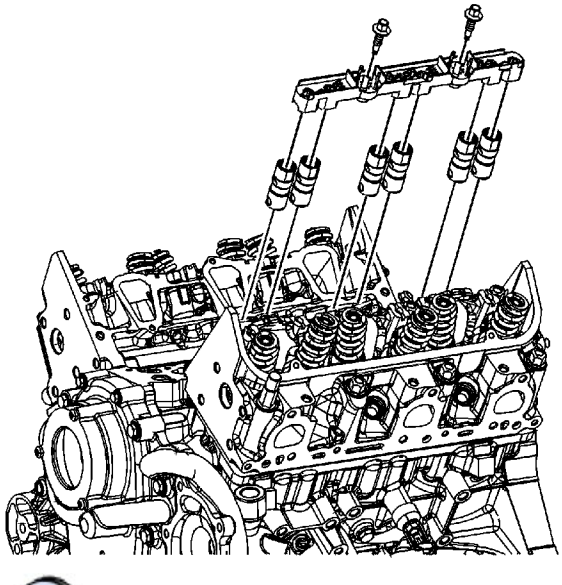


5. Remove the valve lifters from the valve lifter guides.
6. Clean all gasket surfaces with degreaser.

Installation Procedure



1. Coat the valve lifters using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers.
2. Install the valve lifters to the cylinder bores.
3. Apply threadlock to the valve lifter guide bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers.
4. Install the valve lifter guides.

Caution: Refer to Fastener Caution in the Preface section.

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Replacement.

7. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.

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Crankshaft Balancer Replacement

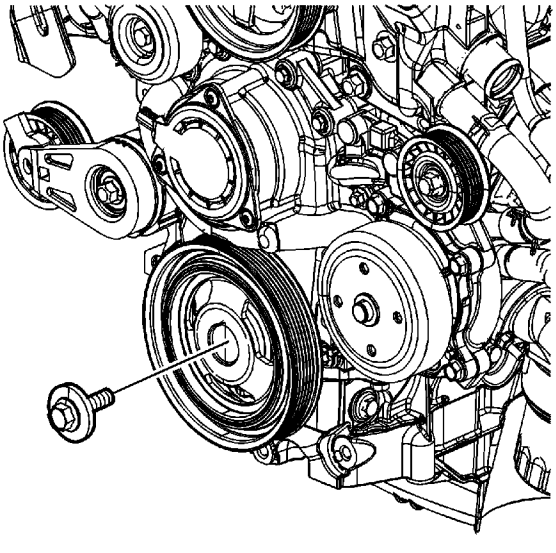
Special Tools

- EN 46359 Puller End Protector
- J 29113 Balancer and Crank Sprocket Installer
- J 37096 Flywheel Holder
- J 41816 Harmonic Balancer Remover
- J 45059 Angle Meter

Removal Procedure

Caution: The inertial weight section of the crankshaft balancer is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertial weight section of the hub will destroy the tuning of the crankshaft balancer.

1. Remove the drive belt. Refer to Drive Belt Replacement.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
3. Remove the right front tire and wheel. Refer to Tire and Wheel Removal and Installation.
4. Remove the right engine splash shield. Refer to Engine Splash Shield Replacement.
5. Install adjustable jack stands under the frame.
6. Loosen the left side frame bolts and remove the right side frame bolts.
7. Using the jack stands, lower the right side of the frame in order to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the J 37096 to the flywheel in order to prevent flywheel rotation.



10. Remove the crankshaft balancer bolt and the washer.

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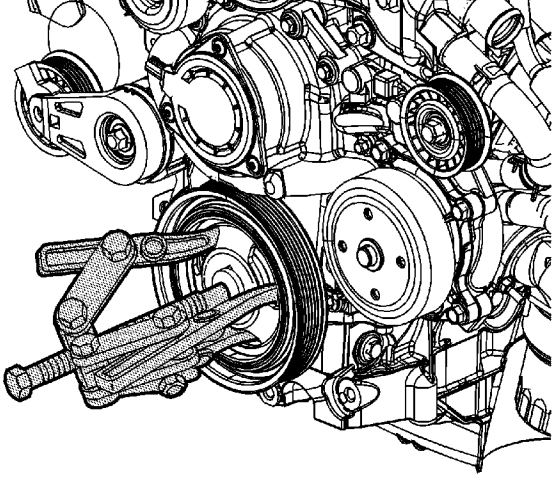
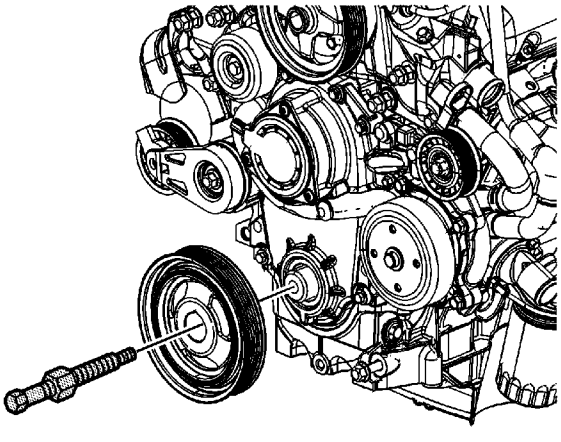


Caution: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

11. Remove the crankshaft balancer using the J 41816 and EN 46359 .

Installation Procedure



1. Apply sealer to the keyway of the crankshaft balancer. Refer to Adhesives, Fluids, Lubricants, and Sealers.

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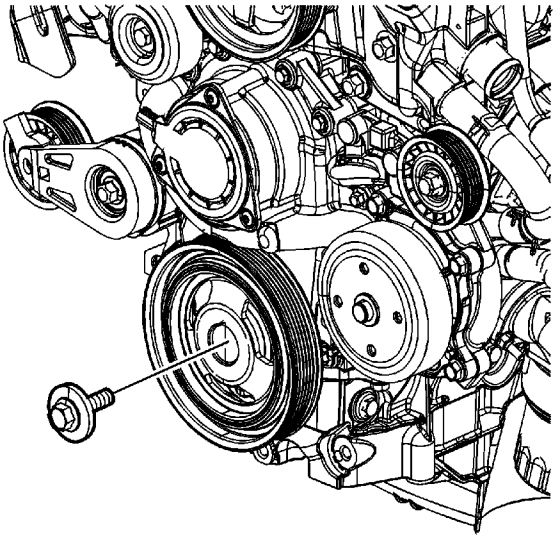
Caution: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

3. Thread the J 29113 into the crankshaft.
4. Rotate the hex nut on the J 29113 in order to install the crankshaft balancer onto the crankshaft.
5. Remove the J 29113 from the crankshaft.



6. Install the crankshaft balancer washer and the bolt.

Caution: Refer to Fastener Caution in the Preface section.

7. Install the used crankshaft balancer bolt and tighten to **125 N·m (92 lb ft)**.
8. Remove the used crankshaft balancer bolt.
9. Install the NEW crankshaft balancer bolt.
   - Tighten the crankshaft balancer bolt a first pass to **125 N·m (92 lb ft)**.
   - Tighten the crankshaft balancer bolt a final pass to **130 degrees** using the J 45059 .
10. Remove the J 37096 from the flywheel.
11. Install the torque converter covers.
12. Raise the frame into the original position.
13. Install and tighten the right and left side frame bolts to **100 N·m (74 lb ft) plus an additional 90 degrees** using the J 45059 .
14. Install the right engine splash shield. Refer to Engine Splash Shield Replacement.
15. Install the right front tire and wheel. Refer to Tire and Wheel Removal and Installation.
16. Lower the vehicle.
17. Install the drive belt. Refer to Drive Belt Replacement.

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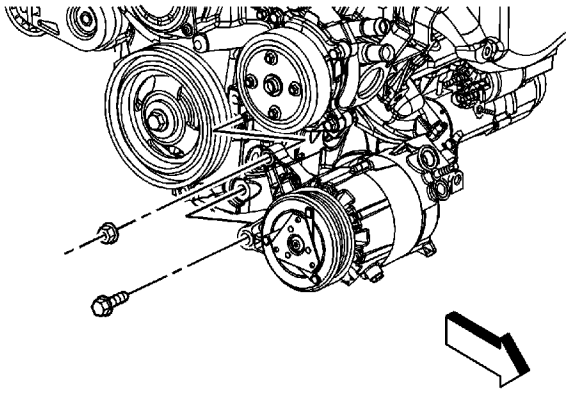
Oil Pan Replacement

Special Tools

J 39505 Torque Wrench Adapter

Removal Procedure

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Install the engine support fixture. Refer to Engine Support Fixture.
3. Drain the engine oil. Refer to Engine Oil and Oil Filter Replacement.
4. Remove the oil filter adapter and bypass valve assembly. Refer to Oil Filter Adapter and Bypass Valve Assembly Replacement.
5. Remove the starter motor. Refer to Starter Motor Replacement.
6. Remove the left side catalytic converter. Refer to Catalytic Converter Replacement - Left Side.
7. Remove the transfer case. Refer to Transfer Case Assembly Replacement.



8. Remove the air conditioning (A/C) compressor nut and bolt.

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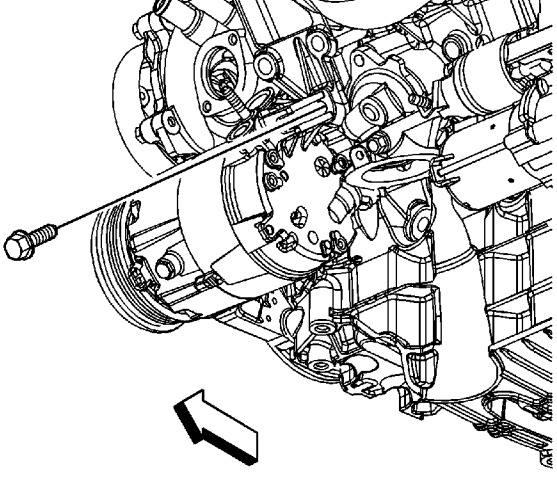
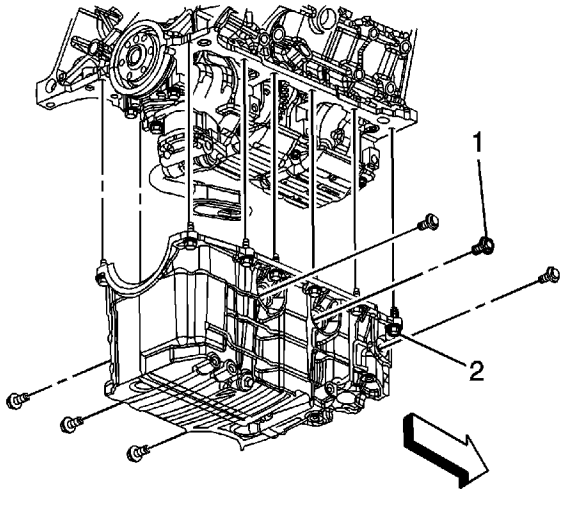


9. Remove the A/C compressor rear bolt and position the A/C compressor aside.



10. Remove the horizontal oil pan bolts (1).
11. Remove the vertical oil pan bolts (2).
12. Remove the oil pan.
13. Remove the oil pan gasket.
14. Clean the following items:
    - The oil pan flanges
    - The oil pan rail
    - The engine front cover
    - All threaded holes

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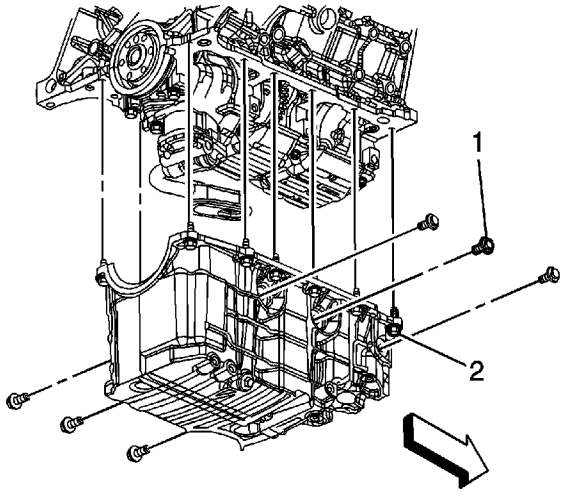
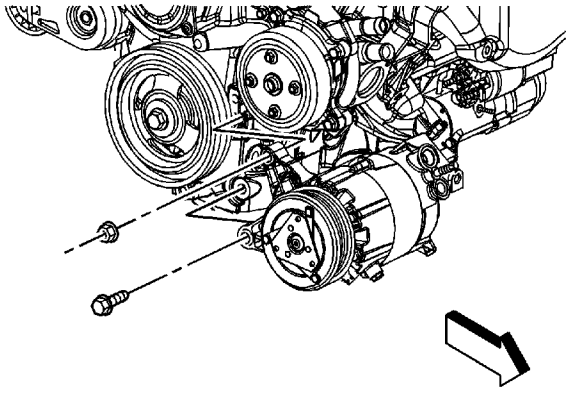
1. Install a NEW oil pan gasket.



2. Position the oil pan to the engine and hand start all the oil pan bolts.

   Caution: Refer to Fastener Caution in the Preface section.

3. Torque the vertical oil pan bolts (2) to **25 N·m (18 lb ft)**.
4. Torque the horizontal oil pan bolts (1) to **50 N·m (37 lb ft)**.



Note: Hand start all the A/C compressor bolts before finalizing any torques.

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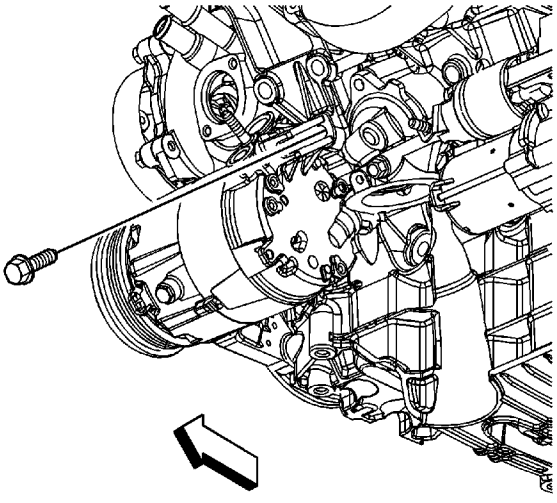

6. Tighten the A/C compressor rear bolt to **50 N·m (37 lb ft)**.
7. Install the transfer case. Refer to Transfer Case Assembly Replacement.
8. Install the left side catalytic converter. Refer to Catalytic Converter Replacement - Left Side.
9. Install the starter motor. Refer to Starter Motor Replacement.
10. Install the oil filter adapter and bypass valve assembly. Refer to Oil Filter Adapter and Bypass Valve Assembly Replacement.
11. Fill the engine oil. Refer to Engine Oil and Oil Filter Replacement.
12. Remove the engine support fixture. Refer to Engine Support Fixture.
13. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

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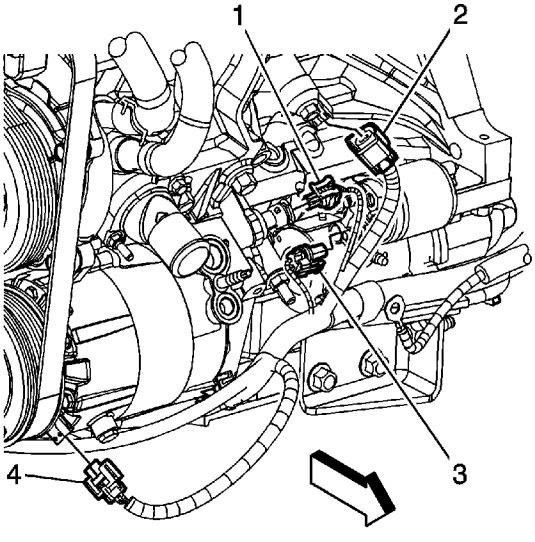
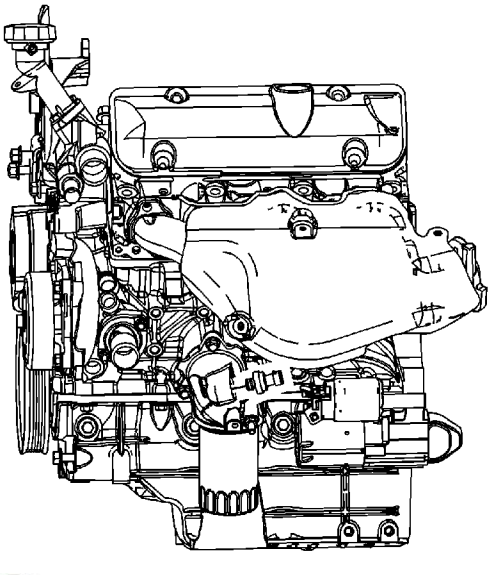
Engine Oil Pressure Sensor and/or Switch Replacement

Removal Procedure

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



2. Disconnect the engine oil pressure sensor/switch electrical connector (1).



3. Remove the engine oil pressure sensor/switch.

Installation Procedure

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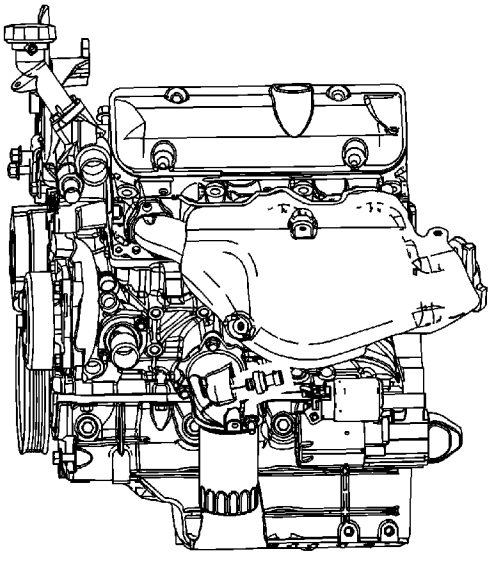
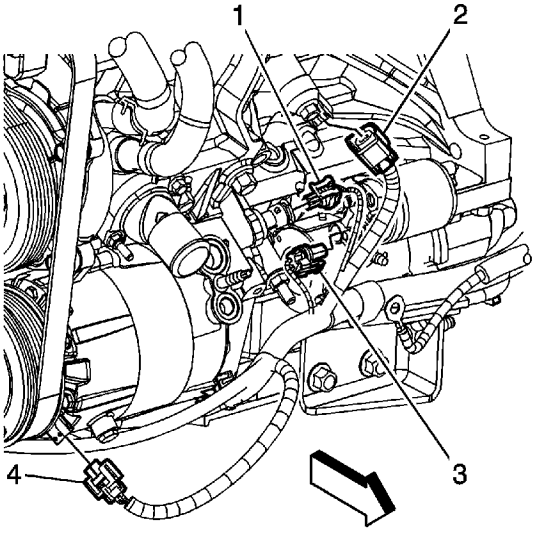


1. Install the engine oil pressure sensor/switch and tighten to **16 N·m (12 lb ft)**.



2. Connect the engine oil pressure sensor/switch electrical connector (1).

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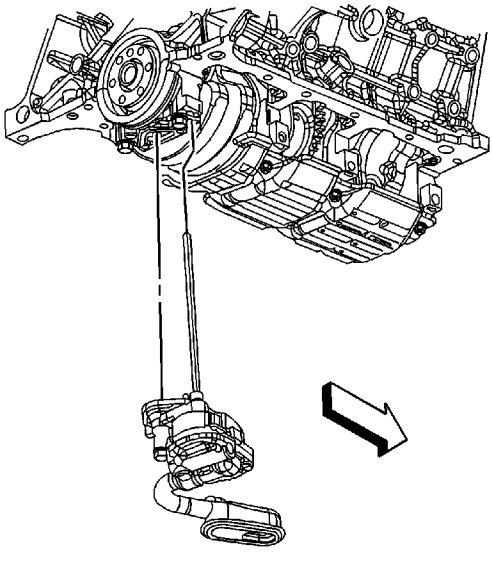
Oil Pump Replacement

Removal Procedure



1. Remove the oil pan. Refer to Oil Pan Replacement.
2. Remove the oil pump bolt.
3. Remove the oil pump and the oil pump drive shaft.

Installation Procedure

Note: Rotate the oil pump drive shaft as necessary in order to obtain the engagement with the oil pump drive unit.

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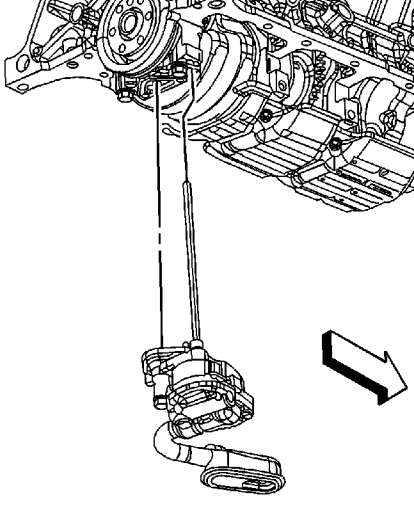

1. Install the oil pump drive shaft and the oil pump.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the oil pump bolt and tighten to **41 N·m (30 lb ft)**.
3. Install the oil pan. Refer to Oil Pan Replacement.

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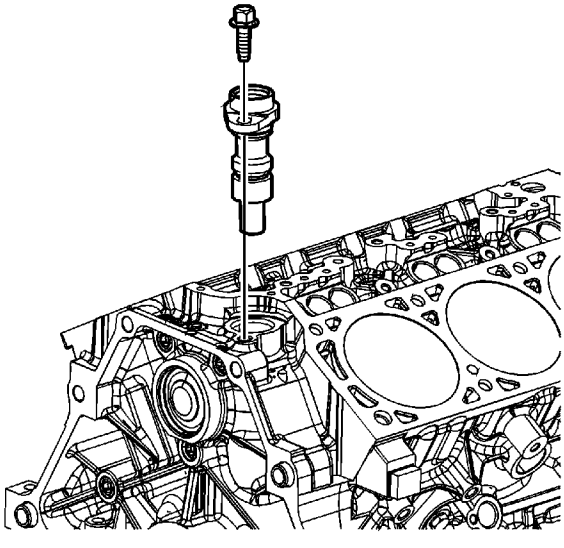
Oil Pump Drive Replacement

Removal Procedure



1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
2. Remove the oil pump drive bolt.
3. Remove the oil pump drive.
4. Remove the oil pump drive seal.

Installation Procedure

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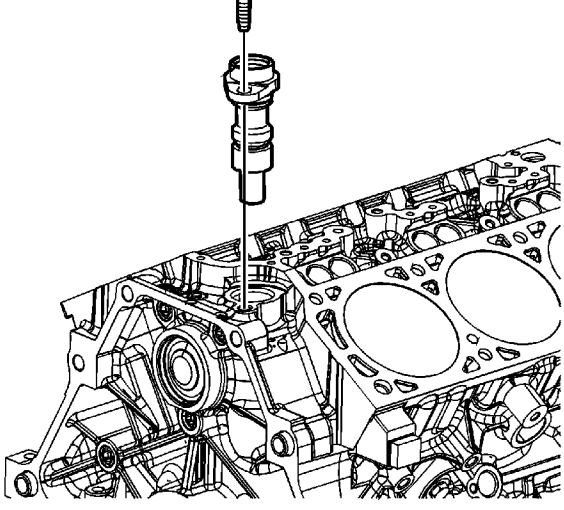

1. Install the oil pump drive seal. Coat the seal or bore in the engine block with clean engine oil.
2. Apply prelube to the oil pump drive gear. Refer to Adhesives, Fluids, Lubricants, and Sealers.
3. Install the oil pump drive.

   Caution: Refer to Fastener Caution in the Preface section.

4. Install the oil pump drive bolt and tighten to **50 N·m (37 lb ft)**.
5. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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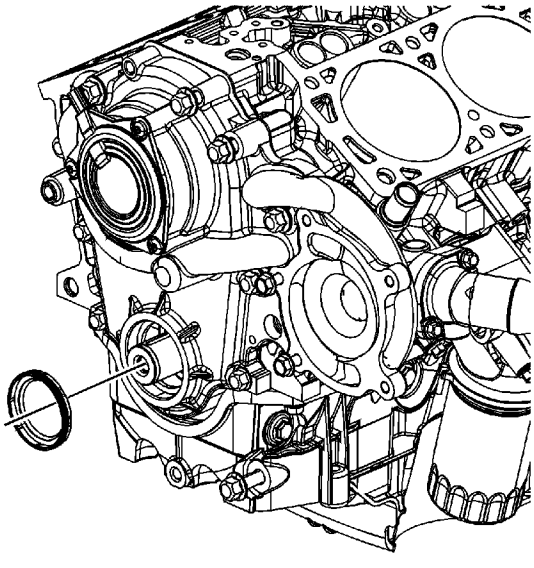
Crankshaft Front Oil Seal Replacement

Special Tools

EN-48869 Front Crankshaft Seal Installer

Removal Procedure



1. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement .
2. Remove the crankshaft key from the keyway.
3. Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

Installation Procedure

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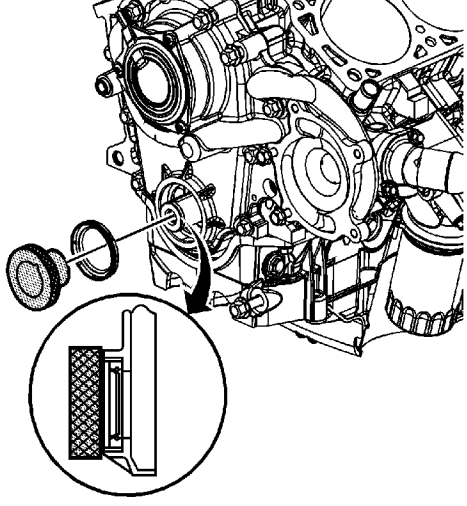

1. Lubricate the NEW oil seal with clean engine oil.
2. Align the EN-48869 and the crankshaft front oil seal with the engine front cover and crankshaft.
3. Install the crankshaft front oil seal using EN-48869 and a suitable tool.
4. Install the crankshaft key into the keyway.
5. Install the crankshaft balancer. Refer to Crankshaft Balancer Replacement .

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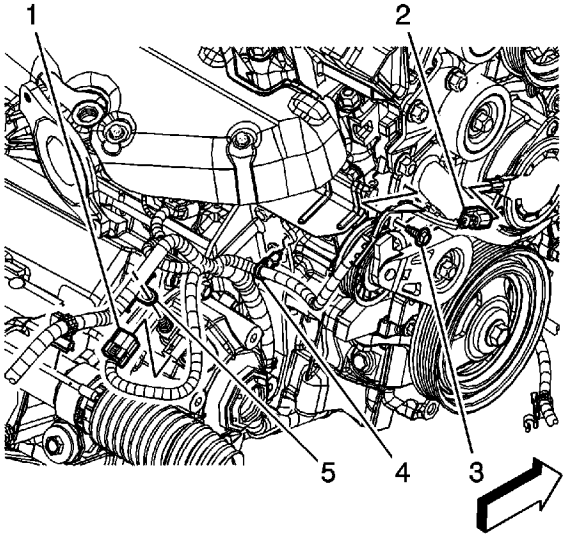
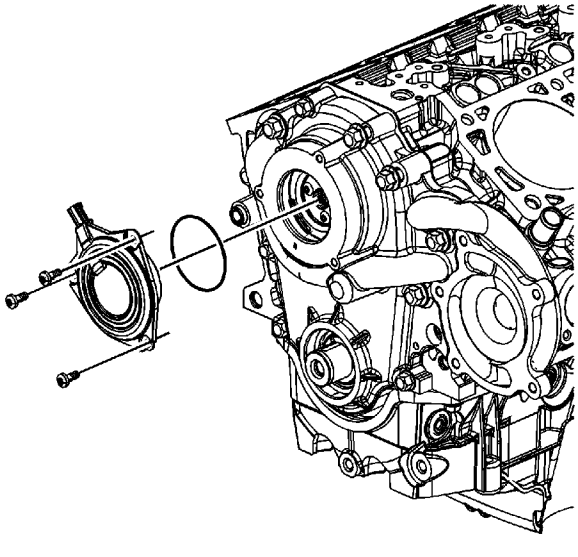
Camshaft Position Actuator Magnet Replacement

Removal Procedure



1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
2. Disconnect the camshaft position actuator magnet electrical connector (2).



3. Remove the camshaft position actuator magnet bolts.
4. Remove the camshaft position actuator magnet and O-ring seal.

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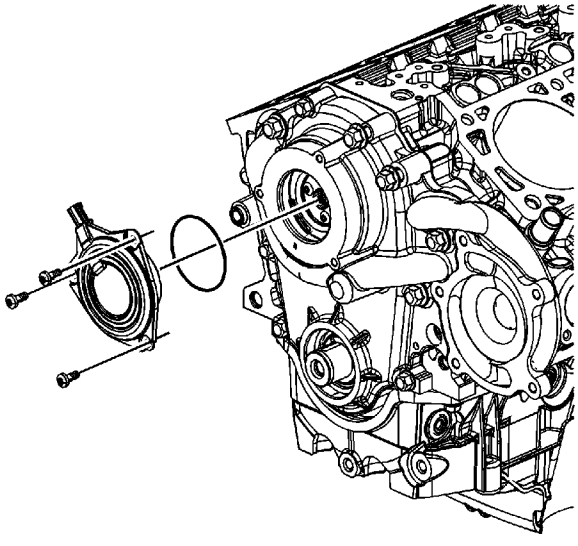
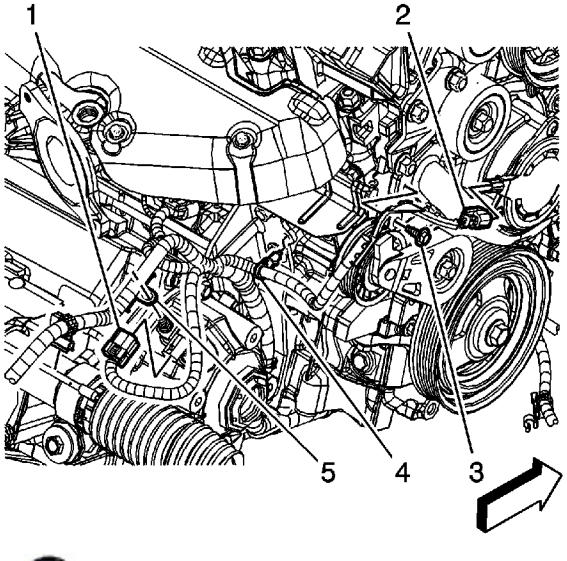


1. Install the camshaft position actuator magnet O-ring seal and magnet.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the camshaft position actuator magnet bolts and tighten to **10 N·m (89 lb in)**.



3. Connect the camshaft position actuator magnet electrical connector (2).
4. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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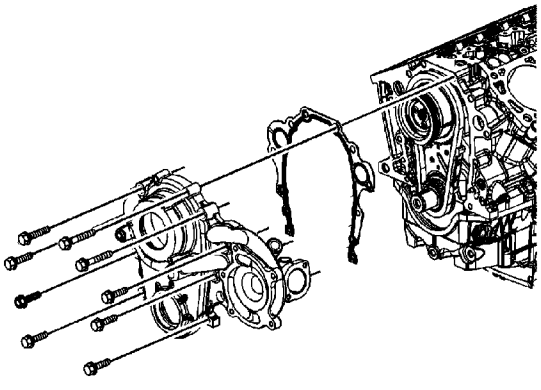
Engine Front Cover Replacement

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling.
2. Remove the drive belt tensioner. Refer to Drive Belt Tensioner Replacement.
3. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
4. Remove the crankshaft position actuator magnet. Refer to Camshaft Position Actuator Magnet Replacement.
5. Remove the thermostat housing. Refer to Engine Coolant Thermostat Housing Replacement.
6. Remove the water pump. Refer to Water Pump Replacement.
7. Drain the engine oil. Refer to Engine Oil and Oil Filter Replacement.
8. Remove the oil pan. Refer to Oil Pan Replacement.



9. Remove the engine front cover bolts.
10. Remove the engine front cover.
11. Remove the engine front cover gasket.
12. Clean and transfer any parts as needed.

Installation Procedure

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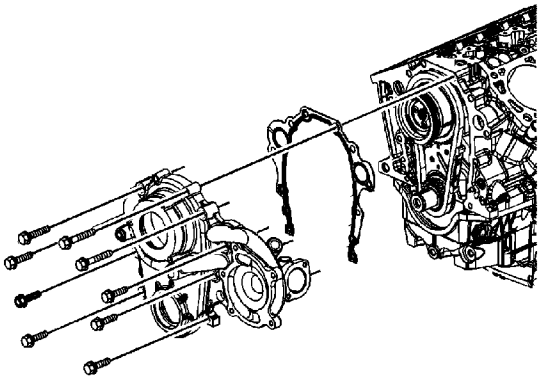

1. Install the engine front cover gasket.
2. Install the engine front cover.

Caution: Refer to Fastener Caution in the Preface section.

3. Install the engine front cover bolts and tighten to **25 N·m (18 lb ft)**.
4. Install the oil pan. Refer to Oil Pan Replacement.
5. Install the water pump. Refer to Water Pump Replacement.
6. Install the thermostat housing. Refer to Engine Coolant Thermostat Housing Replacement.
7. Install the crankshaft position actuator magnet. Refer to Camshaft Position Actuator Magnet Replacement.
8. Install the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
9. Install the drive belt tensioner. Refer to Drive Belt Tensioner Replacement.
10. Fill the cooling system. Refer to Cooling System Draining and Filling.
11. Fill the engine with oil. Refer to Engine Oil and Oil Filter Replacement.

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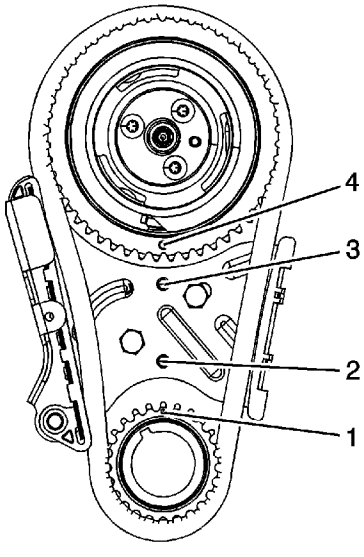
Camshaft Timing Chain and Sprocket Replacement

Special Tools

EN-47719 Tensioner Compressor

Removal Procedure



1. Remove the engine front cover. Refer to Engine Front Cover Replacement.
2. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
3. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

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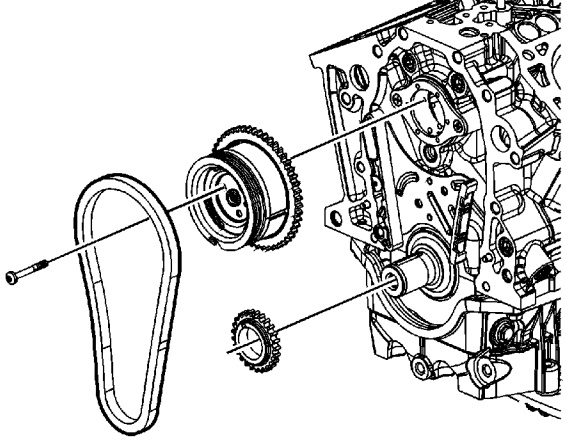
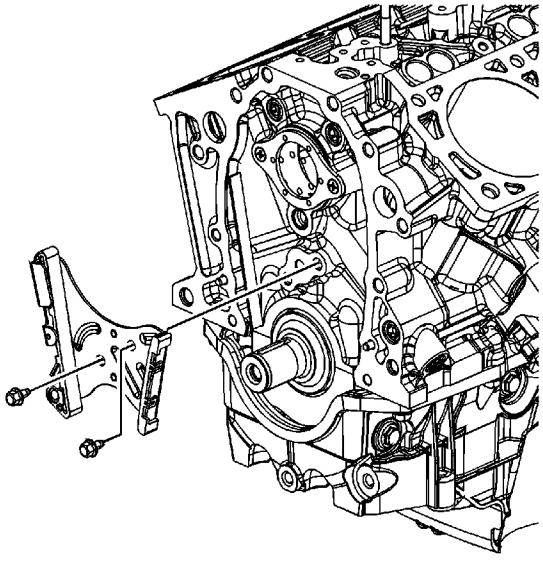


4. Remove the camshaft sprocket bolts.
5. Remove the timing chain, camshaft, and crankshaft sprockets.



6. Remove the timing chain tensioner bolts.
7. Remove the timing chain tensioner.

Installation Procedure

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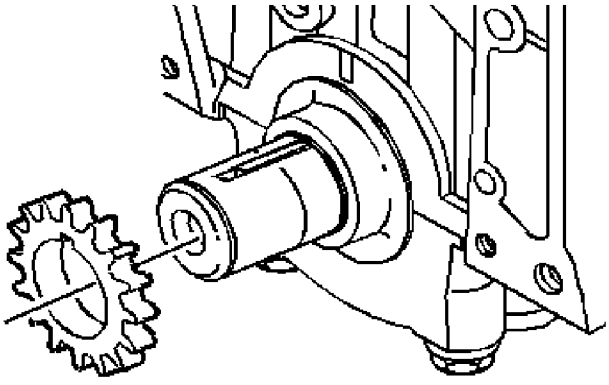
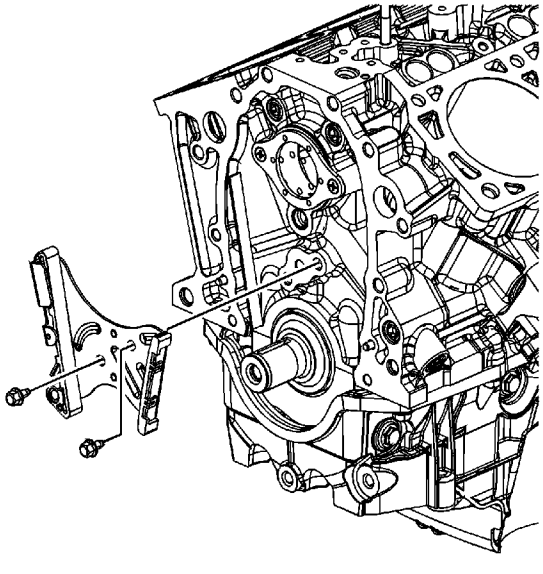


1. Install the crankshaft sprocket.
2. Apply prelube to the crankshaft sprocket thrust surface. Refer to Adhesives, Fluids, Lubricants, and Sealers.



3. Install the timing chain tensioner.

   Caution: Refer to Fastener Caution in the Preface section.

4. Install the timing chain tensioner bolts and tighten to **21 N·m (15 lb ft)**.

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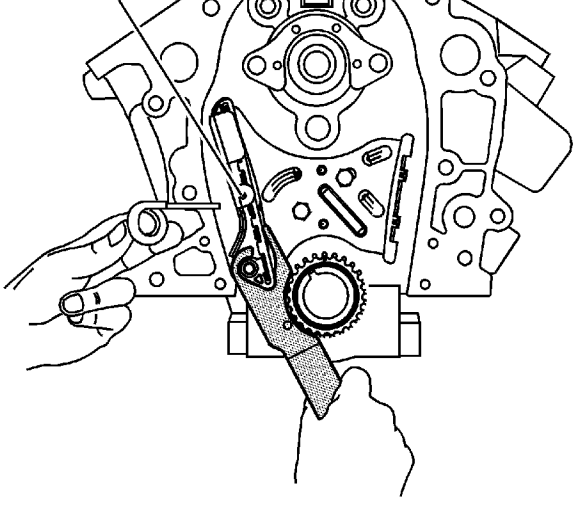
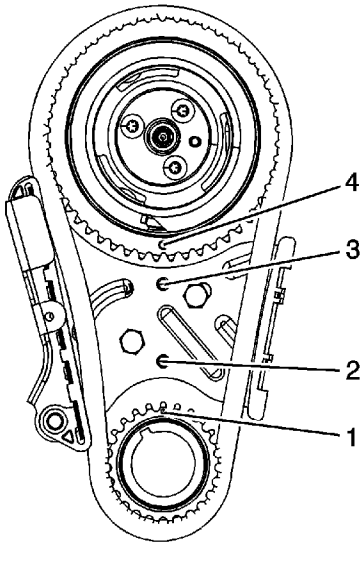


5. Using the EN-47719 , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1).



6. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
7. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
8. Align the timing mark on the camshaft gear (3) with the timing mark on top of the timing chain tensioner (4).

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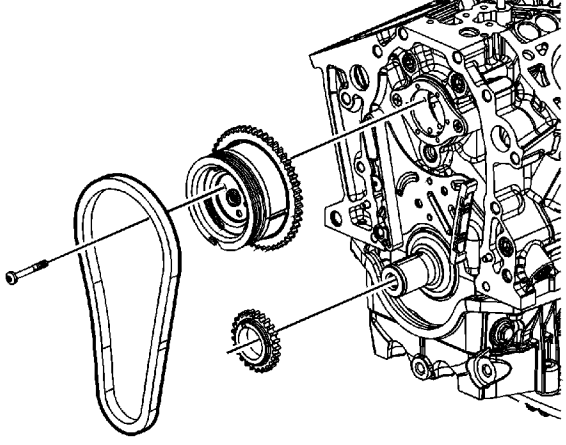

9. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
10. Draw the camshaft sprocket onto the camshaft using the mounting bolts. Tighten the bolts **16 N·m (12 lb ft)**.
11. Coat the crankshaft and camshaft sprockets with clean engine oil.
12. Install the engine front cover. Refer to Engine Front Cover Replacement.

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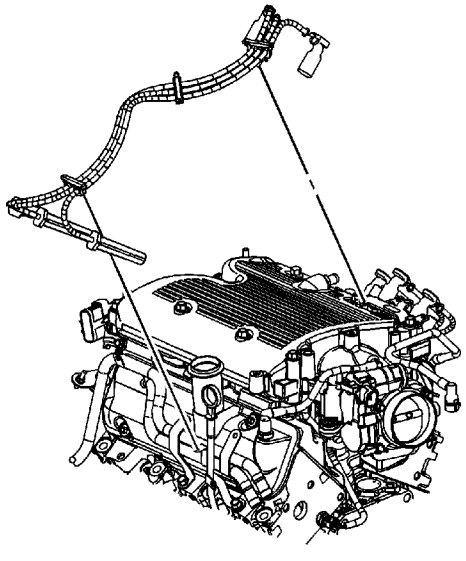
Cylinder Head Replacement - Left Side

Special Tools

J 45059 Angle Meter

Removal Procedure



1. Drain the cooling system. Refer to Cooling System Draining and Filling.
2. Drain the engine oil. Refer to Engine Oil and Oil Filter Replacement.
3. Lower the vehicle.
4. Remove the lower intake manifold. Refer to Lower Intake Manifold Replacement.
5. Remove the valve rocker arms and the pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.
6. Remove the exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side.
7. Remove the oil level indicator tube. Refer to Oil Level Indicator and Tube Replacement.
8. Disconnect the left spark plug wires from the spark plugs.
9. Remove the spark plug wire clips from the brackets.
10. Disconnect and remove the left spark plug wires from the ignition coil.

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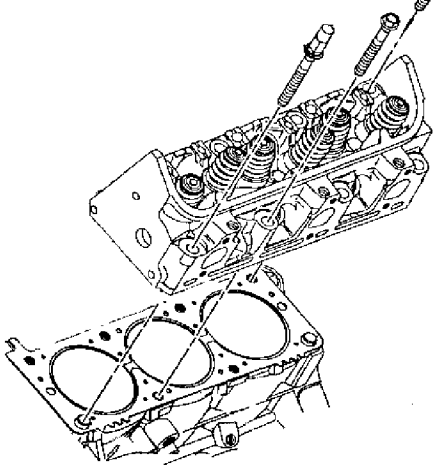
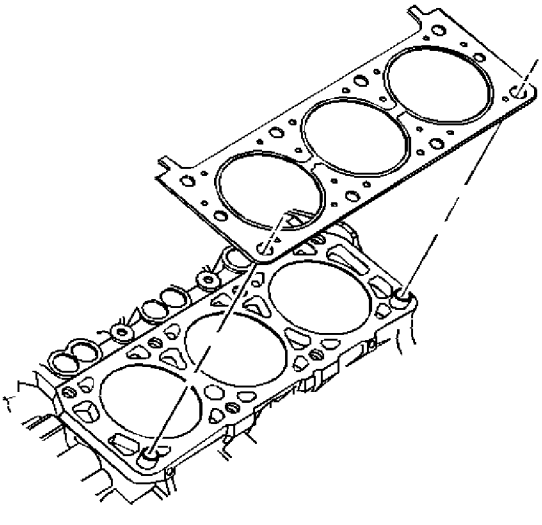


11. Remove the left spark plugs. Refer to Spark Plug Replacement.
12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.



14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

Installation Procedure

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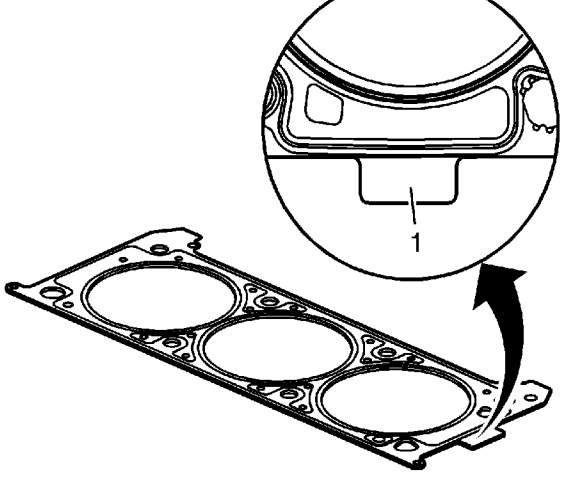
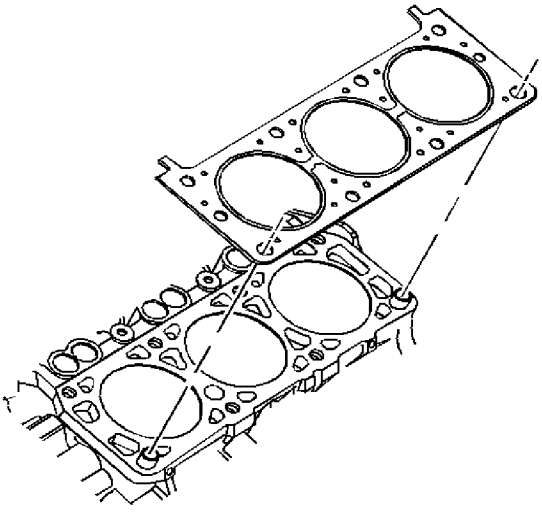


Caution: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.



3. Install a NEW cylinder head gasket.

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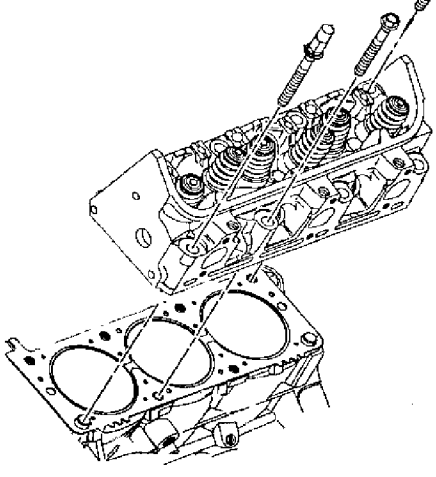
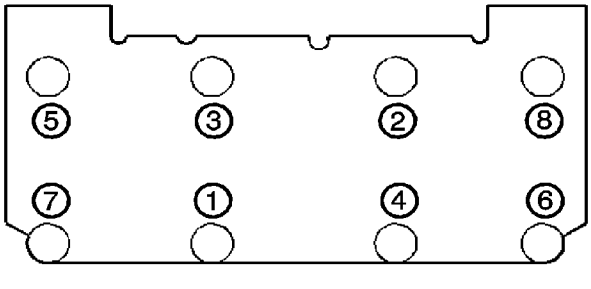


4. Install the cylinder head onto the locator pins and the engine.

   Caution: This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.

5. Install NEW cylinder head bolts finger tight.

   Caution: Refer to Fastener Caution in the Preface section.



6. Tighten the cylinder head bolts in sequence to **60 N·m (44 lb ft) plus an additional**

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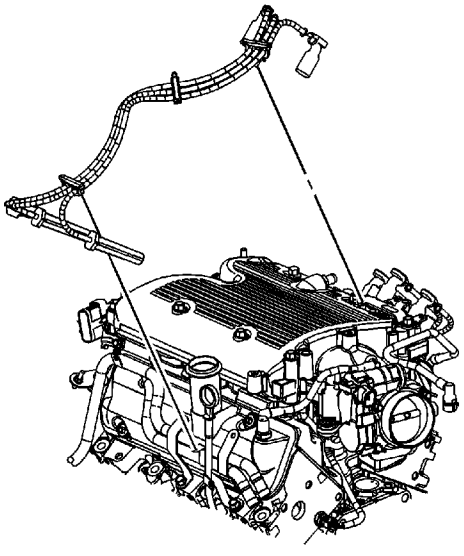

8. Install and connect the left spark plug wires to the ignition coil.
9. Install the spark plug wire clips to the brackets.
10. Connect the left spark plug wires to the spark plugs.
11. Install the oil level indicator tube. Refer to Oil Level Indicator and Tube Replacement.
12. Install the exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side.
13. Install the valve rocker arms and the pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.
14. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.
15. Fill the engine with oil. Refer to Engine Oil and Oil Filter Replacement.
16. Fill the cooling system. Refer to Cooling System Draining and Filling.
17. Inspect for leaks.

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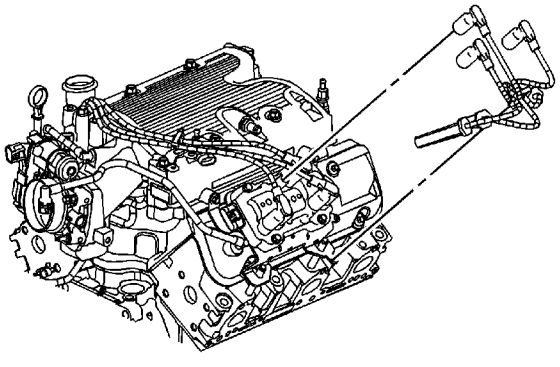
Cylinder Head Replacement - Right Side

Special Tools

J 45059 Angle Meter

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling.



2. Remove the spark plug wires from the right side of the vehicle.
3. Remove the lower intake manifold. Refer to Lower Intake Manifold Replacement.
4. Remove the valve rocker arms and pushrods from the right cylinder head. Refer to Valve Rocker Arm and Push Rod Replacement.
5. Remove the right side exhaust manifold. Refer to Exhaust Manifold Replacement - Right Side.
6. Remove the spark plugs from the right side cylinder head. Refer to Spark Plug Replacement.

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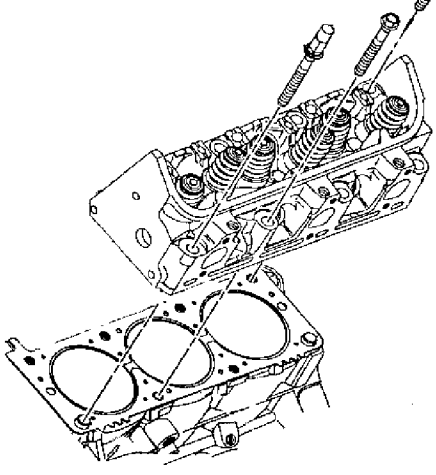
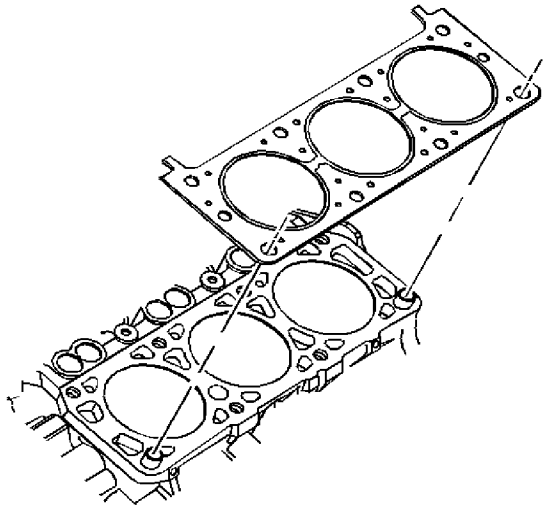


7. Remove and discard the right side cylinder head bolts.
8. Remove the right side cylinder head.



9. Remove and discard the right side cylinder head gasket.
10. Remove the right side cylinder head locator dowel pins, if necessary.
11. Clean and transfer any parts as needed.

Installation Procedure

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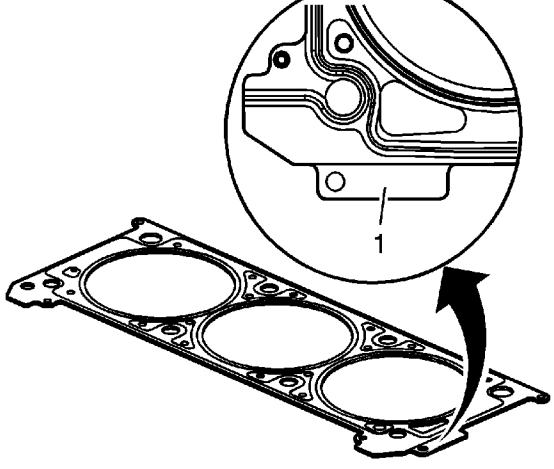
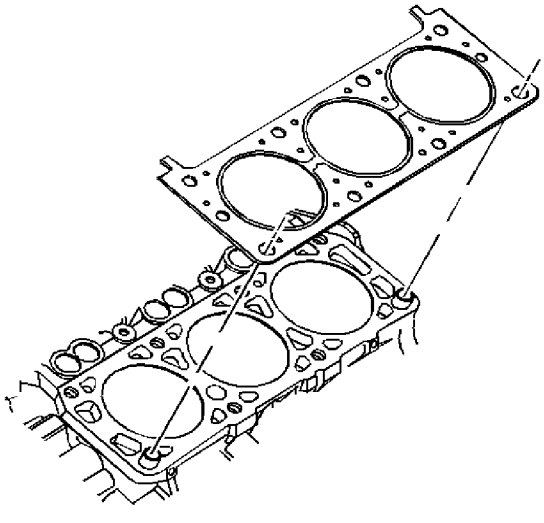


Caution: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the right side cylinder head locator dowel pins and ensure proper installation before proceeding.



2. Install the NEW right side cylinder head gasket.

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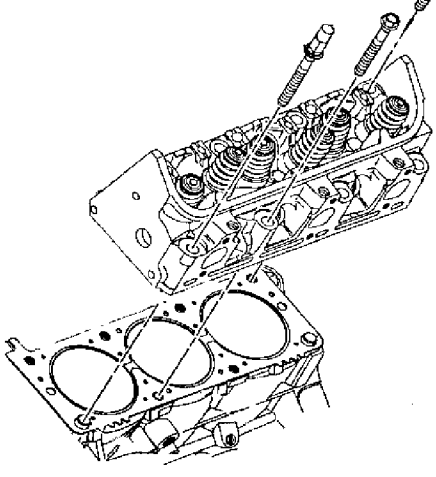
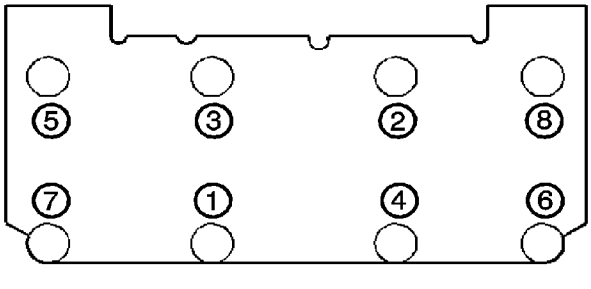


Caution: This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.

3. Install the right side cylinder head onto the locator dowel pins and the engine block.
4. Install the NEW right side cylinder head bolts finger tight.

Caution: Refer to Fastener Caution in the Preface section.



5. Tighten the right side cylinder head bolts in sequence to **60 N·m (44 lb ft) plus an**

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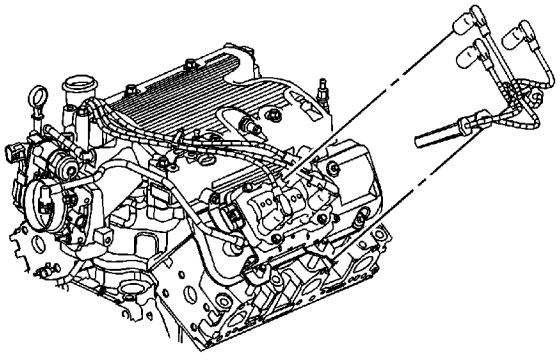
7. Install the right side exhaust manifold. Refer to Exhaust Manifold Replacement - Right Side.
8. Install the valve rocker arms and pushrods to the right cylinder head. Refer to Valve Rocker Arm and Push Rod Replacement.
9. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.



10. Install the spark plug wires to the right side of the vehicle.
11. Change the engine oil. Refer to Engine Oil and Oil Filter Replacement.
12. Fill the cooling system. Refer to Cooling System Draining and Filling.
13. Inspect for any leaks.

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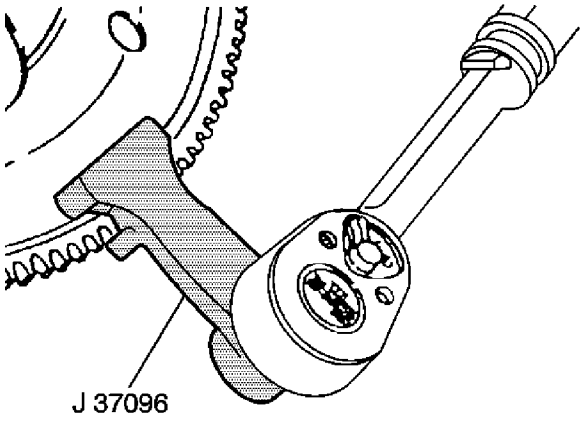
Engine Flywheel Replacement

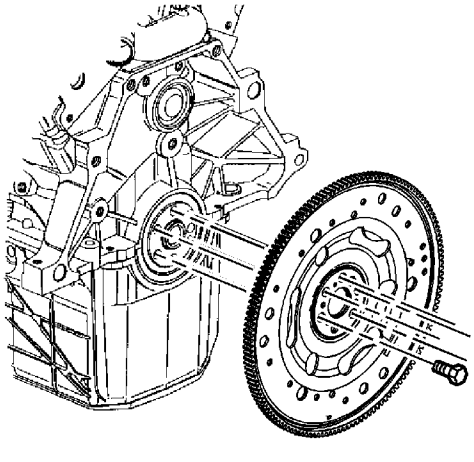
Special Tools

J 37096 Flywheel Holder

Removal Procedure



1. Remove the automatic transaxle, if equipped. Refer to Transmission Replacement.
2. Use the J 37096 to secure the flywheel in order to prevent the crankshaft from rotating.



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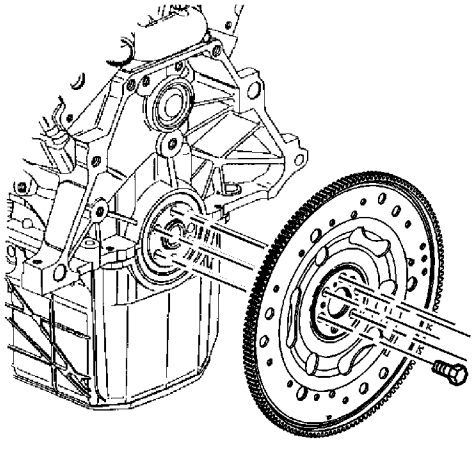
3. Loosen the flywheel bolts.
4. Remove 5 of the 6 flywheel bolts leaving one bolt at the top of the crankshaft.
5. Grip the flywheel and remove the remaining bolt. Do not drop the flywheel when removing the final bolt.
6. Remove the engine flywheel.
7. Clean the engine flywheel bolt threads and bolt holes.

Installation Procedure



1. Position the flywheel to the crankshaft.
2. Install the flywheel bolts finger tight.
3. Use the J 37096 to secure the flywheel in order to prevent the crankshaft from rotating.

   Caution: Refer to Fastener Caution in the Preface section.

4. Tighten the engine flywheel bolts to **70 N·m (52 lb ft)**.
5. Install the automatic transaxle, if equipped. Refer to Transmission Replacement.

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Crankshaft Rear Oil Seal Replacement

Removal Procedure

1. Remove the engine flywheel. Refer to Engine Flywheel Replacement .
2. Remove the crankshaft rear main oil seal. Refer to Crankshaft Rear Oil Seal Removal .

Installation Procedure

1. Install the rear main seal. Refer to Crankshaft Rear Oil Seal Installation .
2. Install the engine flywheel. Refer to Engine Flywheel Replacement .

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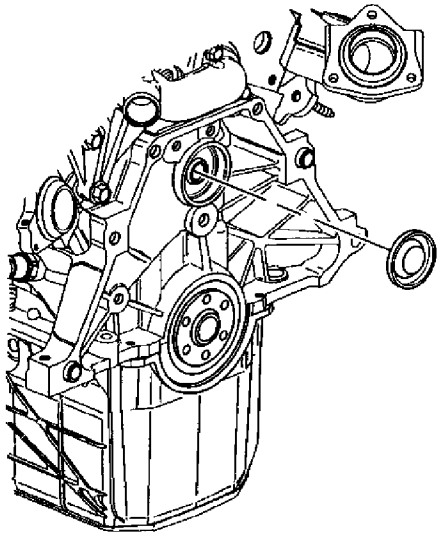
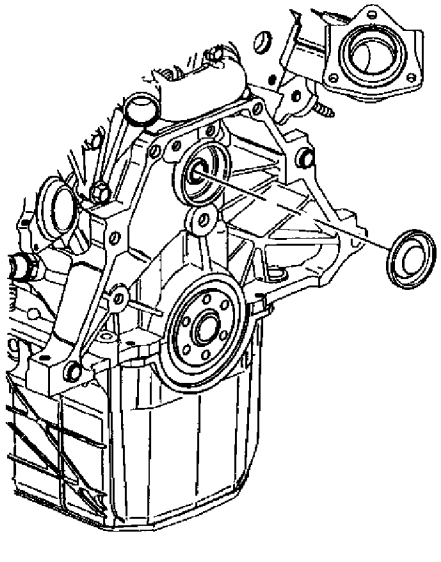
Camshaft Rear Bearing Hole Plug Replacement

Removal Procedure



1. Remove the engine flywheel. Refer to Engine Flywheel Replacement .
2. Remove the camshaft rear bearing hole plug.

Installation Procedure



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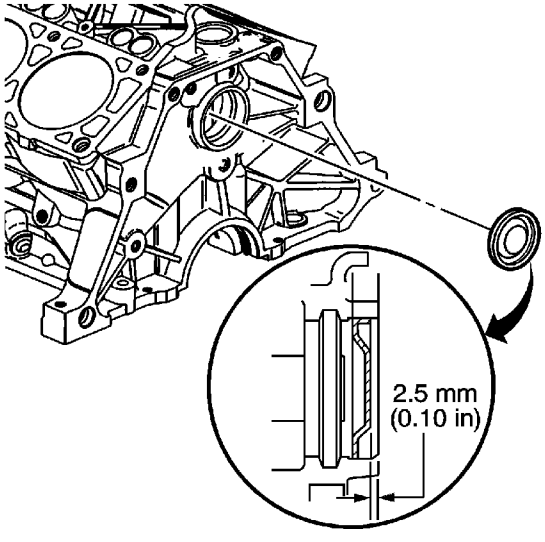
1. Coat the camshaft rear bearing hole plug with sealer. Refer to Adhesives, Fluids, Lubricants, and Sealers .
2. Install the camshaft rear bearing hole plug.



3. Ensure that the camshaft rear bearing plug is installed to specifications.
4. Install the engine flywheel. Refer to Engine Flywheel Replacement .

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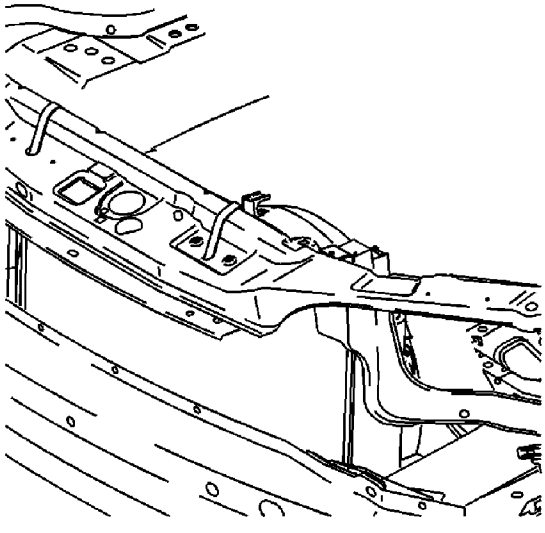
Engine Replacement

Removal Procedure

1. With the tires in the straight forward position, remove the key from the ignition.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
4. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.



5. Secure the cooling module to the upper body structure.
6. Remove the battery and battery box. Refer to Battery Box Replacement.
7. Disconnect the transmission shifter cable.
8. Disconnect the wiring harness from the underhood junction block. Refer to Underhood Electrical Center or Junction Block Replacement.
9. Evacuate the A/C system. Refer to Refrigerant Recovery and Recharging.

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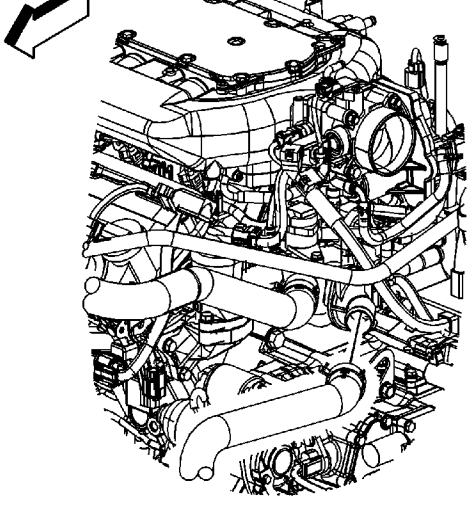
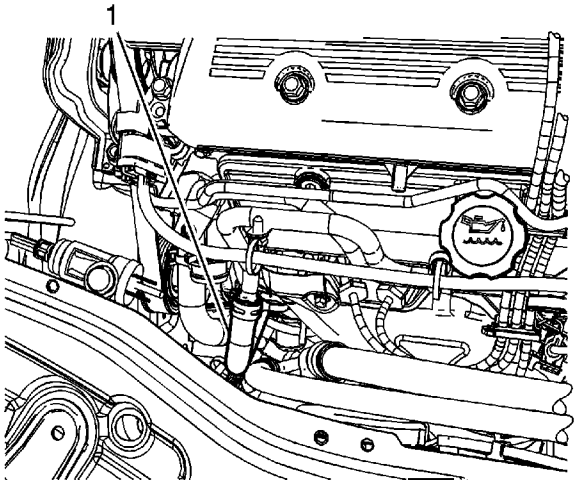


10. Drain the cooling system. Refer to Cooling System Draining and Filling.
11. Disconnect the radiator inlet and outlet hoses from the engine.
12. Remove the engine control module (ECM). Refer to Engine Control Module Replacement.
13. Remove the A/C low pressure tube at the front lift bracket.
14. Disconnect the generator positive cable. Refer to Generator Replacement.
15. Disconnect the A/C high pressure switch harness.
16. Remove the A/C tube from the A/C compressor. Refer to Compressor Hose Assembly Replacement.
17. Disconnect the A/C line from the condenser to compressor.
18. Disconnect the coolant reservoir hose from the engine to reservoir.



19. Remove the heater outlet hose (1).
20. Remove the starter positive cable.
21. Relieve the fuel pressure. Refer to Fuel Pressure Relief.
22. Disconnect the fuel feed line. Refer to Fuel Hose/Pipes Replacement - Chassis.

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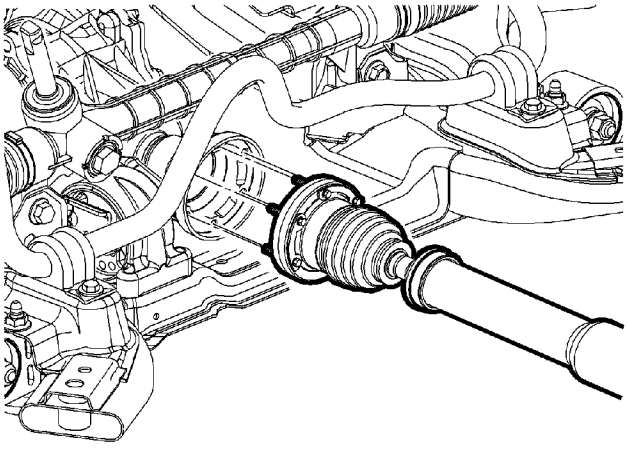
25. Remove the lower transaxle-to-engine bolts.
26. Remove the torque convertor inspection cover.
27. Remove the torque convertor to flywheel bolts.
28. Remove the transfer case. Refer to Transfer Case Assembly Replacement.
29. Remove the front wheels. Refer to Tire and Wheel Removal and Installation.
30. Remove the left wheelhouse liner. Refer to Front Wheelhouse Liner Replacement.
31. Disconnect the transmission cooler lines from the transmission and bracket. Refer to Transmission Mount Bracket Replacement - Rear.
32. Remove the left and right tie rod ends from the steering knuckles. Refer to Steering Linkage Outer Tie Rod Replacement.
33. Remove the left and right stabilizer bar links. Refer to Stabilizer Shaft Link Replacement.
34. Disconnect the left and right lower ball joints. Refer to Lower Control Arm Ball Joint Replacement.
35. Remove the left and right axle shaft nuts. Refer to Front Wheel Drive Shaft Replacement.



36. For AWD, remove the propeller shaft completely from the vehicle. Refer to Propeller Shaft Replacement.

Note: In order to prevent possible SIR system deployment, do not attempt to rotate the steering shaft.

37. Disconnect the steering shaft coupling from the steering gear. Refer to Steering Shaft Coupling Replacement.
38. Remove the front exhaust pipe. Refer to Catalytic Converter Replacement - Left Side.
39. Remove the 3 front fender pushpins to allow the front fender to flex.
40. Use a paint pen or magic marker to mark the frame to the body position.
41. Support the engine in the cradle with wood blocks.
42. Disconnect the front transmission mount from the body. Refer to Transmission Front Mount Replacement.

Note: During the powertrain removal, support the vehicle body by placing a jack at the rear of the vehicle.

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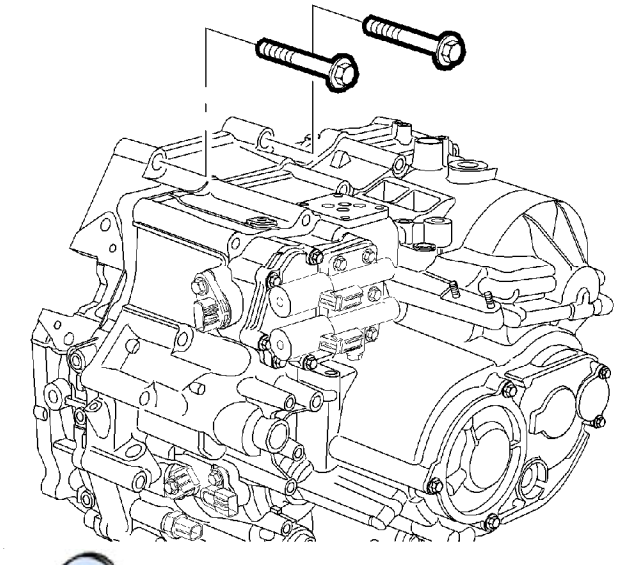
45. Remove the cradle bolts.
46. Slowly lower the table to the floor.
47. Remove the starter. Refer to Starter Motor Replacement.
48. Remove the following components:
    48.1. Remove the A/C compressor. Refer to Air Conditioning Compressor Replacement.
    48.2. Remove the generator. Refer to Generator Replacement.
    48.3. Remove the front covers. Refer to Engine Front Cover Replacement.
    48.4. Remove the rocker covers. Refer to Valve Rocker Arm Cover Replacement - Left Side and Valve Rocker Arm Cover Replacement - Right Side.
    48.5. Remove the catalytic converters. Refer to Catalytic Converter Replacement - Left Side and Catalytic Converter Replacement - Right Side.
    48.6. Remove the timing chain. Refer to Camshaft Timing Chain and Sprocket Replacement.
    48.7. Remove the cylinder heads. Refer to Cylinder Head Replacement - Left Side and Cylinder Head Replacement - Right Side.
49. Remove the front transmission mount from the engine. Refer to Transmission Front Mount Replacement.
50. Remove the right engine mount. Refer to Engine Mount Replacement.
51. Separate the engine from the transmission.

Installation Procedure

1. Align the engine to the transmission.

   Caution: Refer to Fastener Caution in the Preface section.



2. Apply sealant to the two upper transmission-to-engine bolts only, and install the transmission-to-engine mounting bolts. Refer to Adhesives, Fluids, Lubricants, and Sealers for the correct part number.

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3. Install the right engine mount. Refer to Engine Mount Replacement.
4. Install the front transmission mount to the engine. Refer to Transmission Front Mount Replacement.
5. Install the following components:
    5.1. Install the cylinder heads. Refer to Cylinder Head Replacement - Left Side and Cylinder Head Replacement - Right Side.
    5.2. Install the timing chain. Refer to Camshaft Timing Chain and Sprocket Replacement.
    5.3. Install the catalytic converters. Refer to Catalytic Converter Replacement - Left Side and Catalytic Converter Replacement - Right Side.
    5.4. Install the rocker covers. Refer to Valve Rocker Arm Cover Replacement - Left Side and Valve Rocker Arm Cover Replacement - Right Side.
    5.5. Install the front covers. Refer to Engine Front Cover Replacement.
    5.6. Install the generator. Refer to Generator Replacement.
    5.7. Install the A/C compressor. Refer to Air Conditioning Compressor Replacement.
6. Install the starter. Refer to Starter Motor Replacement.
7. Install the powertrain assembly to the vehicle.
8. Install the cradle bolts. Refer to Frame Replacement.
9. Remove the engine support table.
10. Install the front transmission mount bolts to the body. Refer to Transmission Front Mount Replacement.
11. Remove the wood blocks from the cradle.
12. Install the lower transaxle-to-engine bolts and tighten to **75 N·m (55 lb ft)**.
13. Install the transfer case. Refer to Transfer Case Assembly Replacement.
14. Install the torque convertor-to-flywheel bolts and tighten to **62 N·m (46 lb ft)**.
15. Install the torque convertor inspection cover and tighten the bolts to **12 N·m (106 lb in)**.
16. Install the 3 front fender pushpins.
17. Install the front exhaust pipe. Refer to Catalytic Converter Replacement - Left Side.
18. Connect the steering shaft coupling from the steering gear. Refer to Steering Shaft Coupling Replacement.
19. Install the propeller shaft. Refer to Propeller Shaft Replacement.
20. Install the left and right axle shaft nuts. Refer to Front Wheel Drive Shaft Replacement.
21. Connect the left and right lower ball joints. Refer to Lower Control Arm Ball Joint Replacement.
22. Install the left and right stabilizer bar links. Refer to Stabilizer Shaft Link Replacement.
23. Install the left and right tie rod ends to the steering knuckles. Refer to Steering Linkage Outer Tie Rod Replacement.
24. Connect the transmission cooler lines to the transmission and bracket. Refer to Transmission Mount Bracket Replacement - Rear.
25. Install the left wheelhouse liner. Refer to Front Wheelhouse Liner Replacement.
26. Install the front tires. Refer to Tire and Wheel Removal and Installation.
27. Lower the vehicle.

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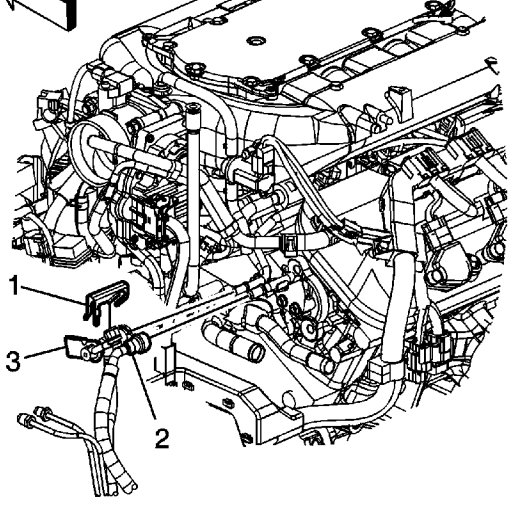
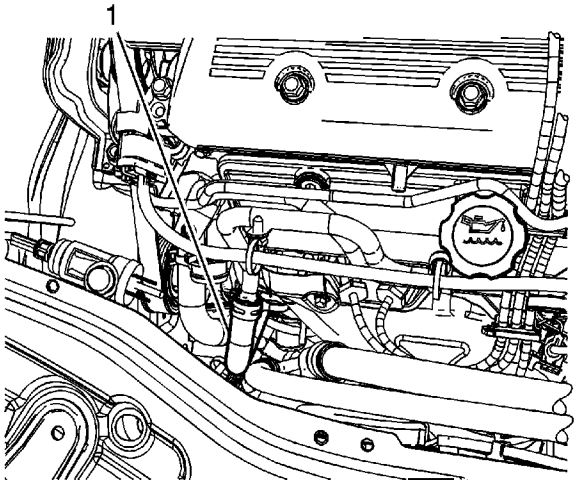


28. Install the fuel EVAP line.
29. Connect the fuel feed line. Refer to Fuel Hose/Pipes Replacement - Chassis.
30. Install the starter positive cable and tighten to **10 N·m (89 lb in)**.



31. Install the heater outlet hose (1).
32. Install the A/C tube to the A/C compressor. Refer to Compressor Hose Assembly Replacement.
33. Connect the coolant reservoir hose from the engine to reservoir.
34. Connect the A/C line from the condenser to compressor.
35. Connect the A/C high pressure switch harness.
36. Connect the generator positive cable and nut and tighten to **12 N·m (106 lb in)**.
37. Install the A/C lower pressure tube at the front lift bracket. Refer to Liquid Line Replacement.
38. Install the ECM. Refer to Engine Control Module Replacement.

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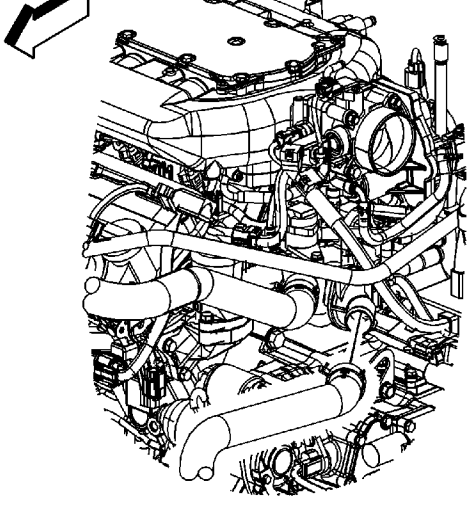
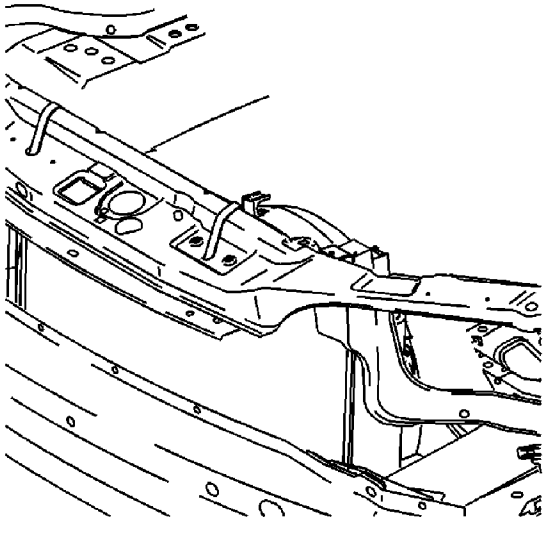


39. Connect the radiator inlet and outlet hoses to the engine.
40. Fill the vehicle with coolant. Refer to Cooling System Draining and Filling.
41. Connect the wiring harness to the underhood junction block. Refer to Underhood Electrical Center or Junction Block Replacement.
42. Connect the transmission shifter cable.



43. Install the battery box and battery. Refer to Battery Box Replacement.
44. Remove the cooling module support.
45. Install the air outlet duct assembly. Refer to Air Cleaner Outlet Duct Replacement.
46. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
47. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
48. Perform the throttle learn procedure. Refer to Throttle Learn.

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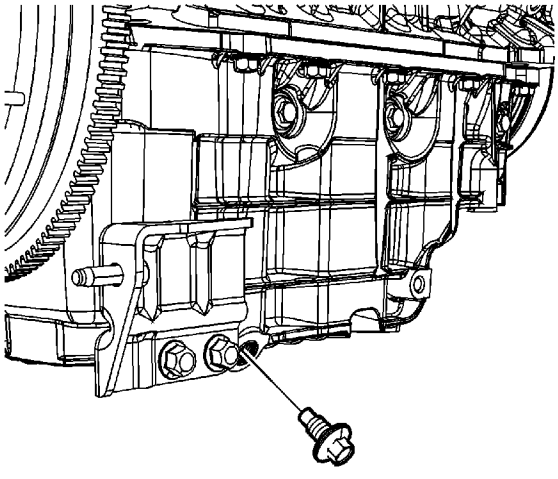
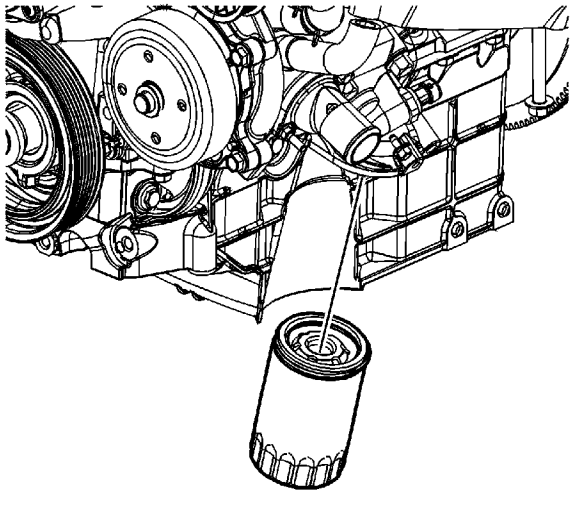
Engine Oil and Oil Filter Replacement

Removal Procedure



1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Position a suitable drain pan under the oil pan drain plug.
3. Remove the oil pan drain plug.
4. Allow the engine oil to drain completely.
5. Clean and inspect the oil pan drain plug sealing surface, replace the oil pan if necessary.
6. Wipe any remaining oil from the drain plug hole and reinstall the oil pan drain plug until snug.



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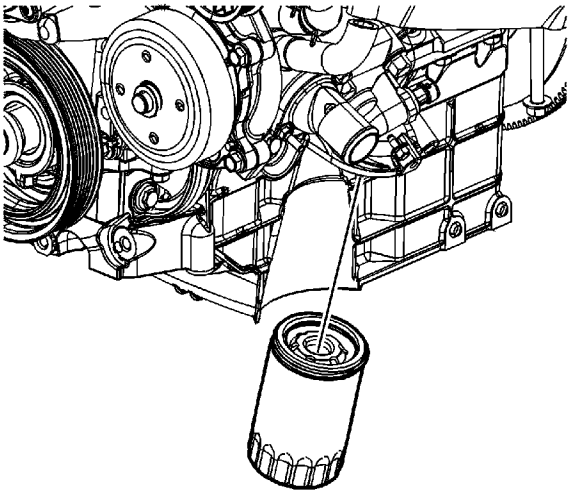
7. Position a suitable drain pan under the oil filter.
8. Remove the oil filter.
9. Ensure that the oil filter gasket is still on the old filter. If not remove the oil filter gasket from the adapter.

Installation Procedure



1. Apply clean engine oil to the NEW oil filter gasket.

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

2. Install the NEW oil filter.

   Caution: Refer to Fastener Caution in the Preface section.

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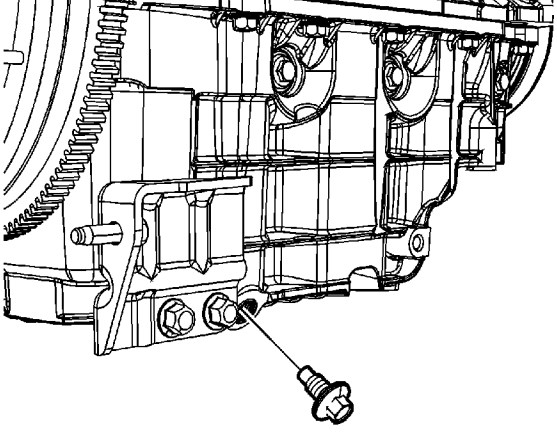

3. Tighten the oil pan drain plug to **26 N·m (19 lb ft)**.
4. Remove the oil drain pan from under the vehicle.
5. Lower the vehicle.
6. Fill the engine with new engine oil. Refer to Approximate Fluid Capacities and Fluid and Lubricant Recommendations.
7. Start the engine.
8. Inspect the for oil leaks after engine start up.
9. Turn OFF the engine and allow the oil a few minutes to drain back into the oil pan.
10. Remove the oil level indicator from the oil level indicator tube.
11. Clean off the indicator end of the oil level indicator with a clean paper towel or cloth.
12. Install the oil level indicator into the oil level indicator tube until the oil level indicator handle contacts the top of the oil level indicator tube.
13. Again, remove the oil level indicator from the oil level indicator tube keeping the tip of the oil level indicator down.
14. Check the level if the engine oil on the oil level indicator.
15. If necessary, adjust the oil level by adding or draining oil.
16. Check for oil leaks.

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