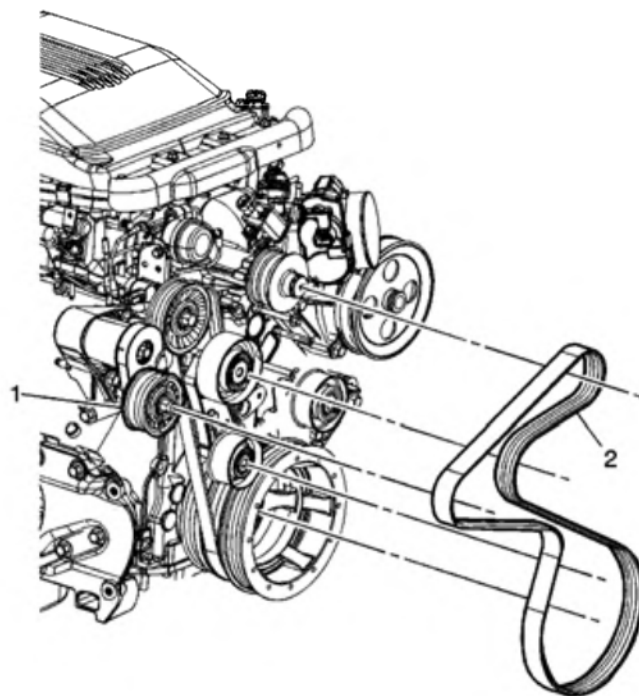
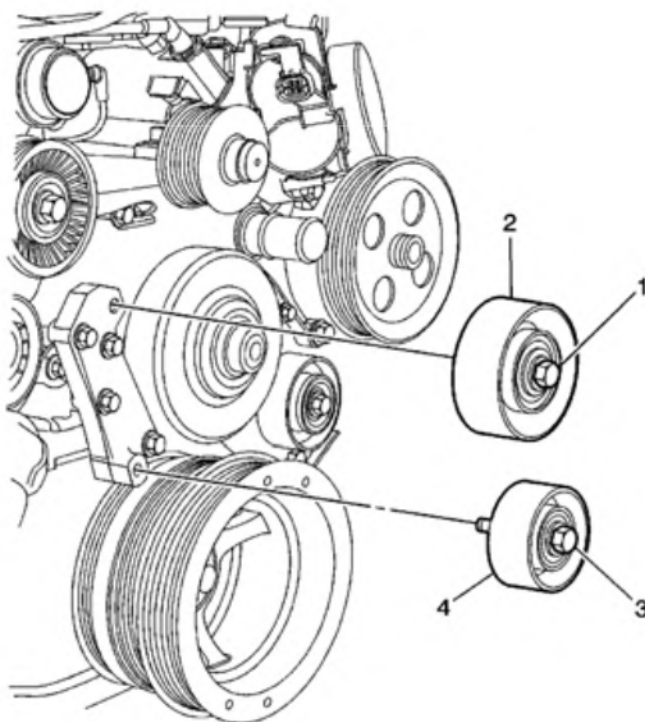


Supercharger Belt Replacement



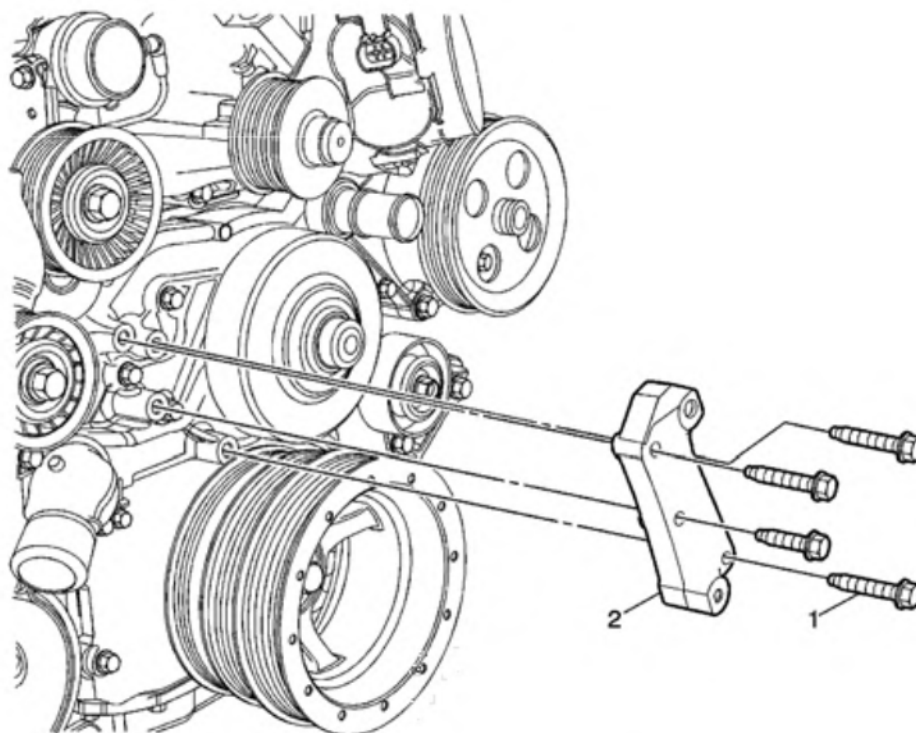
Callout	Component Name
Preliminary Procedure	
Remove the air intake duct, if necessary. Refer to Air Cleaner Assembly Replacement .	
1	Supercharger Tensioner Procedure 1. Use a 3/8 inch breaker bar to rotate the supercharger belt tensioner. 2. Remove the supercharger belt from the pulleys and tensioner.
2	Supercharger Belt Procedure 1. Clean and inspect the supercharger belt surfaces of all the pulleys. 2. Inspect the supercharger belt for correct alignment.

Supercharger Belt Idler Pulley Replacement



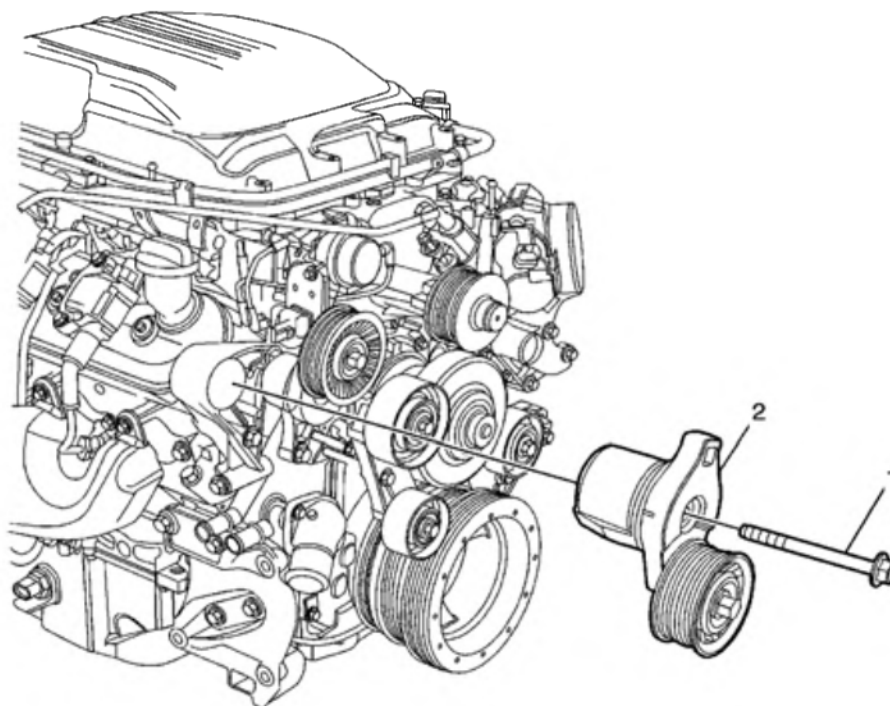
Callout	Component Name
Preliminary Procedure	
Remove the supercharger belt. Refer to Supercharger Belt Replacement .	
1	Supercharger Belt Idler Pulley Fastener Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Supercharger Belt Idler Pulley
3	Supercharger Belt Idler Pulley Fastener Tighten 50 N·m (37 lb ft)
4	Supercharger Belt Idler Pulley

Supercharger Belt Idler Pulley Bracket Replacement



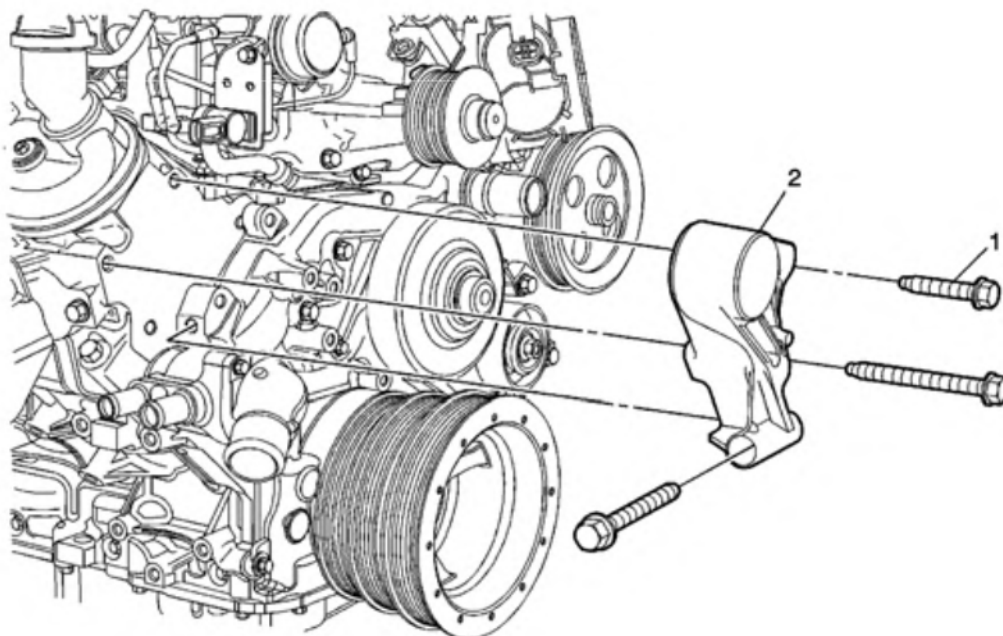
Callout	Component Name
Preliminary Procedure	
Remove the supercharger belt idler pulley. Refer to Supercharger Belt Idler Pulley Replacement .	
1	Supercharger Belt Idler Pulley Bracket Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Supercharger Belt Idler Pulley Bracket Procedure Transfer components as necessary.

Supercharger Belt Tensioner Replacement



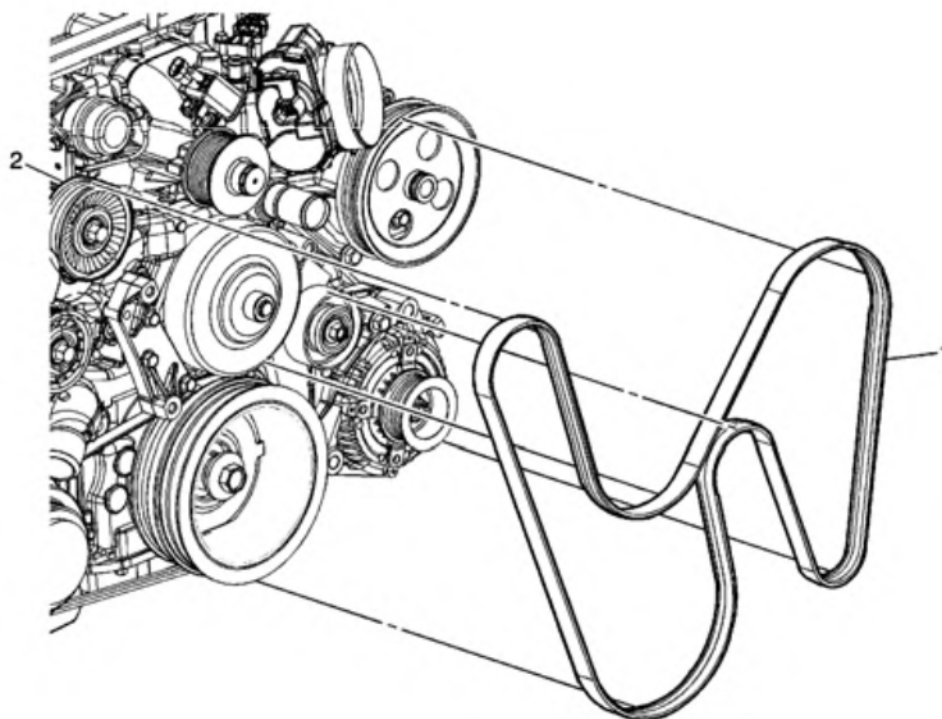
Callout	Component Name
Preliminary Procedure	
Remove the supercharger belt. Refer to Supercharger Belt Replacement .	
1	Supercharger Belt Tensioner Fastener Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Supercharger Belt Tensioner

Supercharger Belt Tensioner Bracket Replacement



Callout	Component Name
Preliminary Procedures	
1. Remove the supercharger belt tensioner. Refer to Supercharger Belt Tensioner Replacement. 2. Remove the drive belt tensioner. Refer to Drive Belt Tensioner Replacement - Accessory.	
1	Supercharger Belt Tensioner Bracket Fastener (Qty: 3) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Supercharger Belt Tensioner Bracket Procedure Transfer components as necessary.

Drive Belt Replacement - Accessory

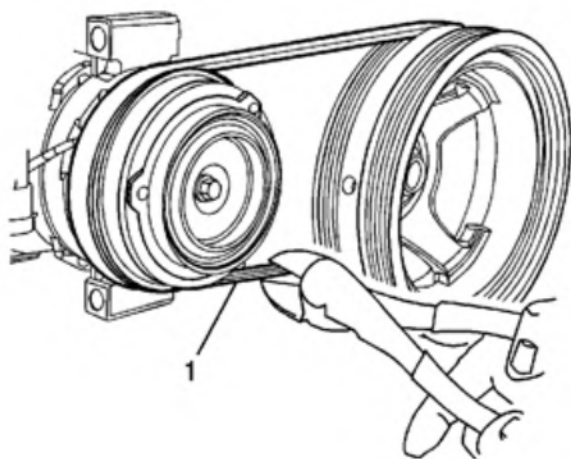


Callout	Component Name
Preliminary Procedure	
Remove the supercharger belt. Refer to Supercharger Belt Replacement .	
1	Drive Belt Tensioner Procedure 1. Use the proper tool to rotate the drive belt tensioner. 2. Remove the drive belt from the pulleys and tensioner.
2	Drive Belt Procedure 1. Clean and inspect the drive belt surfaces of all the pulleys. 2. Inspect the drive belt for correct alignment.

Air Conditioning Compressor Belt Replacement

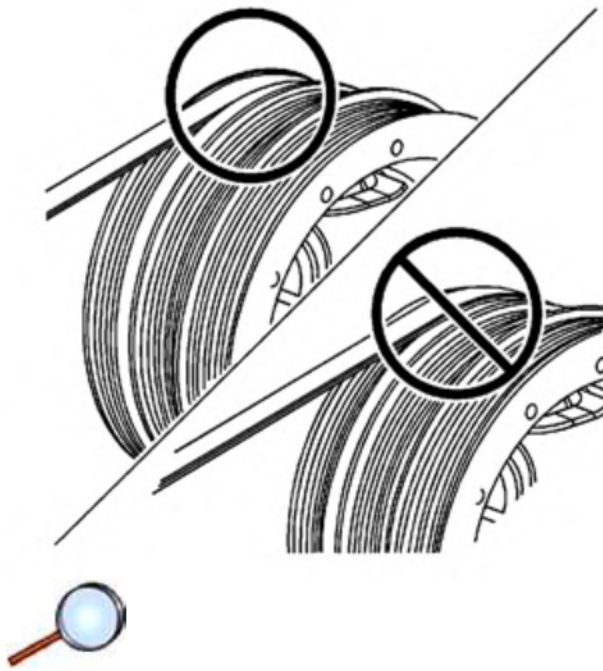
Removal Procedure

1. Remove the supercharger drive belt. Refer to [Supercharger Belt Replacement](#).
2. Remove the accessory drive belt. Refer to [Drive Belt Replacement - Accessory](#).
3. Remove the front air deflector. Refer to [Front Air Deflector Replacement](#).
4. Remove the front lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#).
5. Disconnect the charge air cooler pump electrical connector.
6. Remove the charged air cooler coolant pump. Refer to [Charge Air Cooler Coolant Pump Replacement](#).

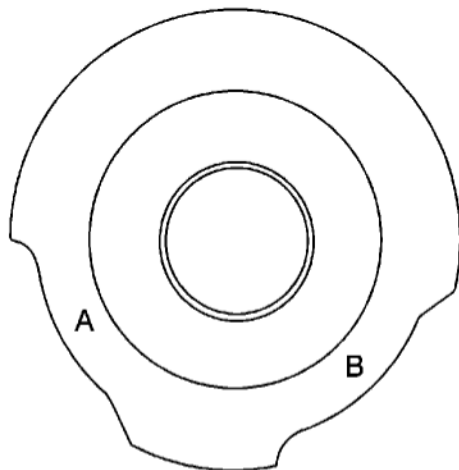


7. Cut the belt (1) from the air conditioning (A/C) and crankshaft pulleys and discard.

Installation Procedure



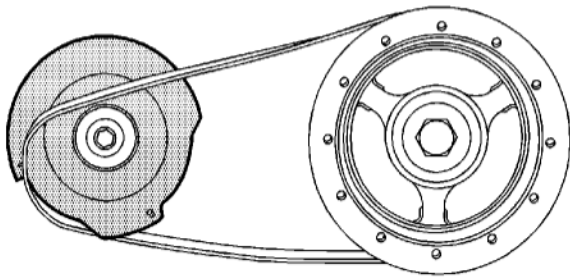
1. Position the belt on the rear of the crankshaft pulley. Ensure the belt is properly seated around the crankshaft pulley.



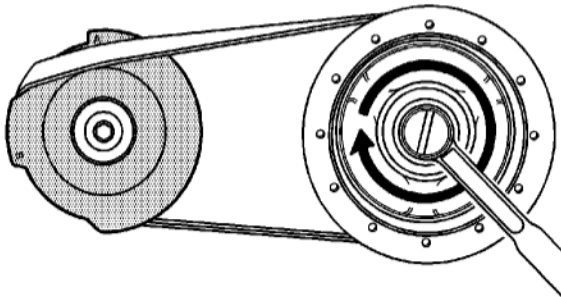
A – RPO LS7/LSA
B – RPO LS3



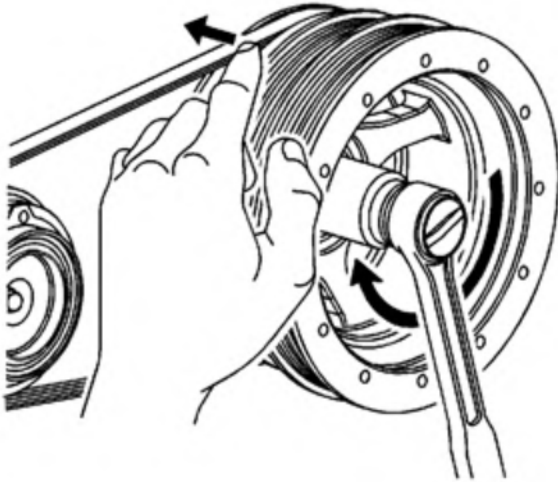
2. Install the belt installation tool onto the A/C compressor.



3. Position the belt onto the tool using position A.

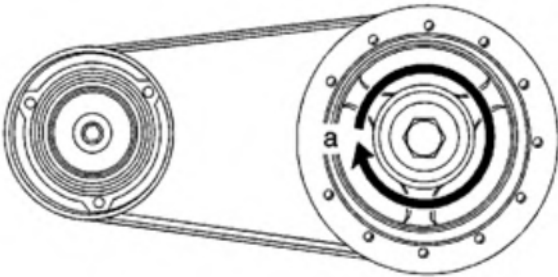


4. Rotate the belt installation tool clockwise to load tension on the belt.

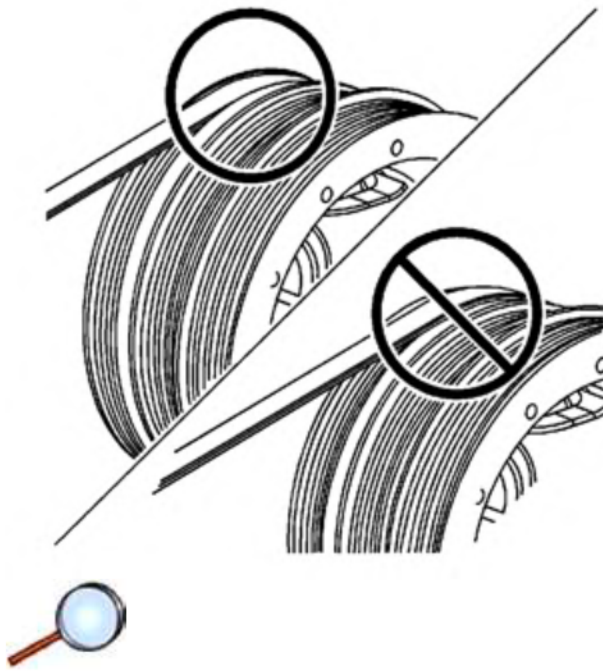


Note: Before rotating the crankshaft pulley ensure the top of the belt is tight and all the slack in the belt is at the bottom.

5. Slowly rotate the crankshaft pulley in a clockwise direction while using finger pressure to ensure the belt remains on the crankshaft pulley and does not walk off.
6. Ensure the ribbed area of the belt remains facing rearward and the belt aligns properly to the A/C pulley.

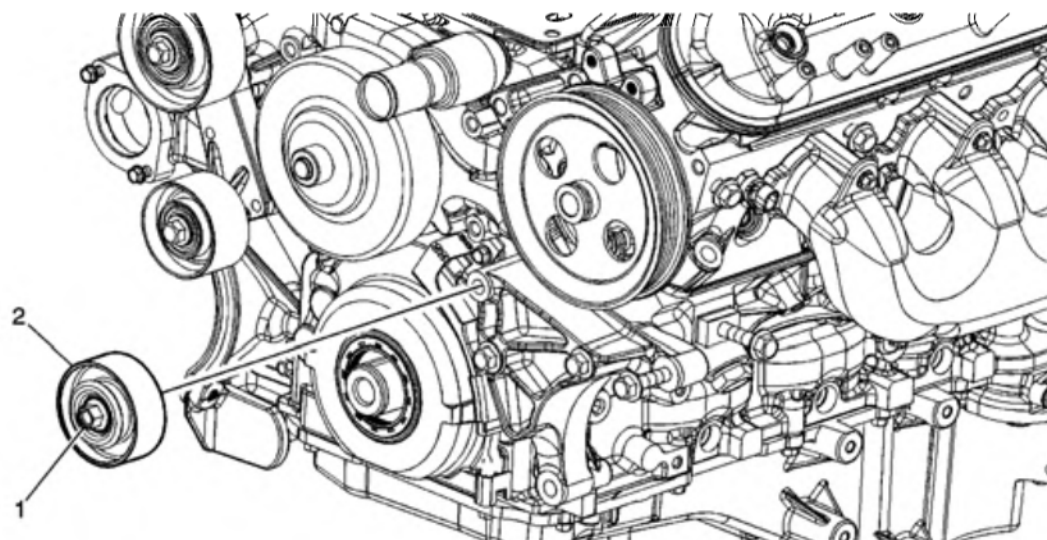


7. Rotate the balancer (1) an additional 360 degrees to ensure proper belt installation.



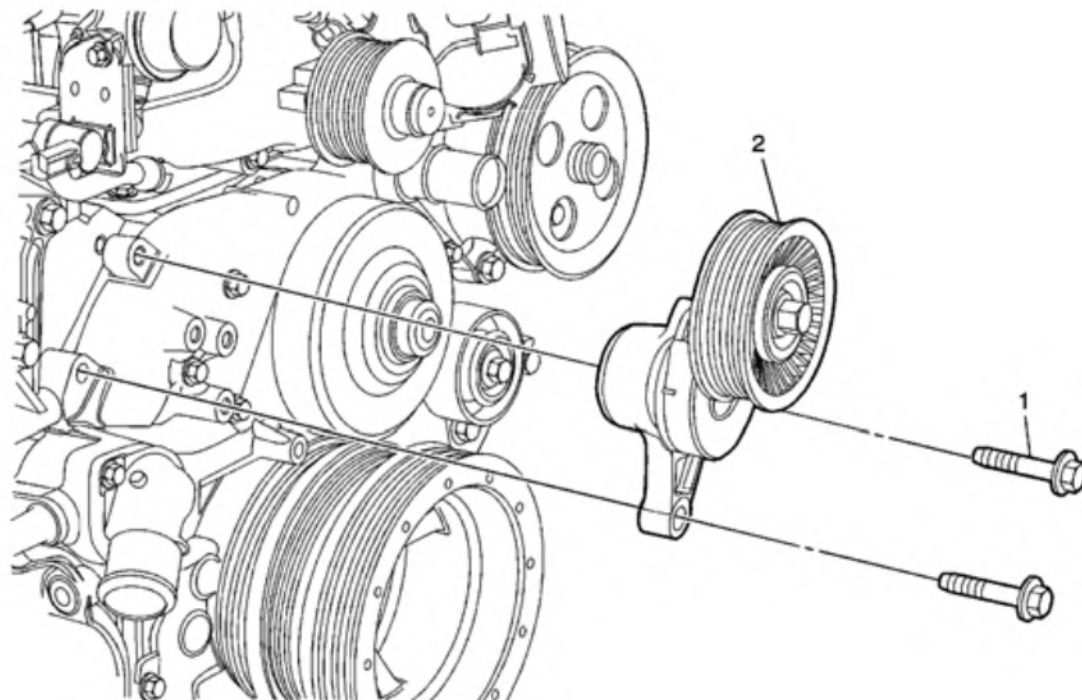
8. Inspect the belt for proper installation.
9. Install the charged air cooler coolant pump. Refer to [Charge Air Cooler Coolant Pump Replacement](#).
10. Connect the charge air cooler pump electrical connector.
11. Install the front lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#).
12. Install the front air deflector. Refer to [Front Air Deflector Replacement](#).
13. Lower the vehicle.
14. Install the accessory drive belt. Refer to [Drive Belt Replacement - Accessory](#).
15. Install the supercharger drive belt. Refer to [Supercharger Belt Replacement](#).

Drive Belt Idler Pulley Replacement



Callout	Component Name
Preliminary Procedure	
Remove the drive belt. Refer to Drive Belt Replacement - Accessory .	
1	Drive Belt Idler Pulley Fastener Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Drive Belt Idler Pulley Procedure Transfer components as necessary.

Drive Belt Tensioner Replacement - Accessory



Callout	Component Name
Preliminary Procedure	
Remove Drive Belt. Refer to Drive Belt Replacement - Accessory .	
1	Drive Belt Tensioner Fastener (Qty: 2) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 50 N·m (59 lb ft)
2	Drive Belt Tensioner Procedure Transfer components as necessary.

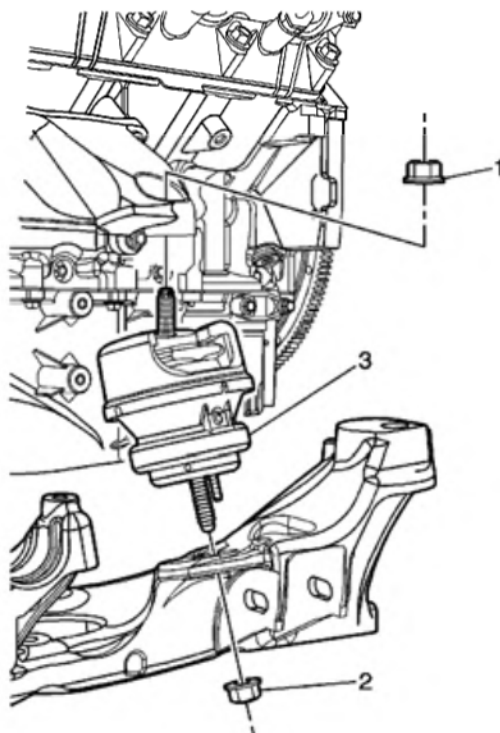
Engine Mount Inspection

Caution: Broken or deteriorated mounts can cause misalignment and destruction of certain drive train components. When a single mount breaks, the remaining mounts are subjected to abnormally high stresses.

Caution: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or the crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause the pan to be bent against the pump screen. This will result in a damaged oil pickup unit.

1. Measure the engine movement at the engine mount in order to check for damage to the rubber portions of the mount.
 - 1.1. Apply the park brake.
 - 1.2. Start the engine.
 - 1.3. Firmly apply and hold the primary brakes.
 - 1.4. Have an assistant stand to the side of the vehicle in order to observe for engine movement.
 - 1.5. Slightly load the engine shifting from drive to reverse a few times.
 - 1.6. If the engine moves more than 24 mm (0.945 in) from the at rest position, in either direction, check for loose engine mount or engine mount bracket attachments.
2. If the engine mount and engine mount bracket bolt torque is at specifications, check the condition of the engine mount.
3. Replace the engine mount if any of the following conditions exist:
 - Heat check cracks cover the rubber cushion surface.
 - The rubber cushion is separated from the metal plate of the mount.
 - There is a split through the rubber cushion.

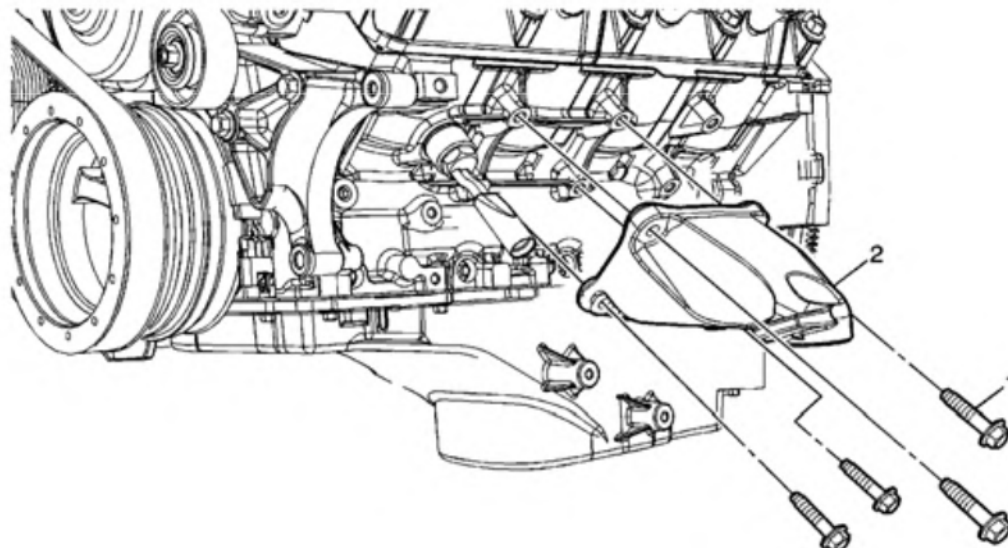
Engine Mount Replacement - Left Side (RWD)



Callout	Component Name
Preliminary Procedures	
1. Discharge the air conditioning (A/C) system. Refer to Refrigerant Recovery and Recharging. 2. Remove the tower brace. Refer to Cross Vehicle Brace Replacement. 3. Raise the vehicle. Refer to Lifting and Jacking the Vehicle. 4. Remove the suction hose from the A/C compressor. Refer to Suction Hose Replacement. 5. Position the hose aside to gain access to the engine mount top nut. 6. Lower the vehicle.	
1	Engine Mount Fastener Caution: Refer to Component Fastener Tightening Caution in the Preface section. Procedure 1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle. 2. Position a screw jack and a block of wood under the engine oil pan. Tighten

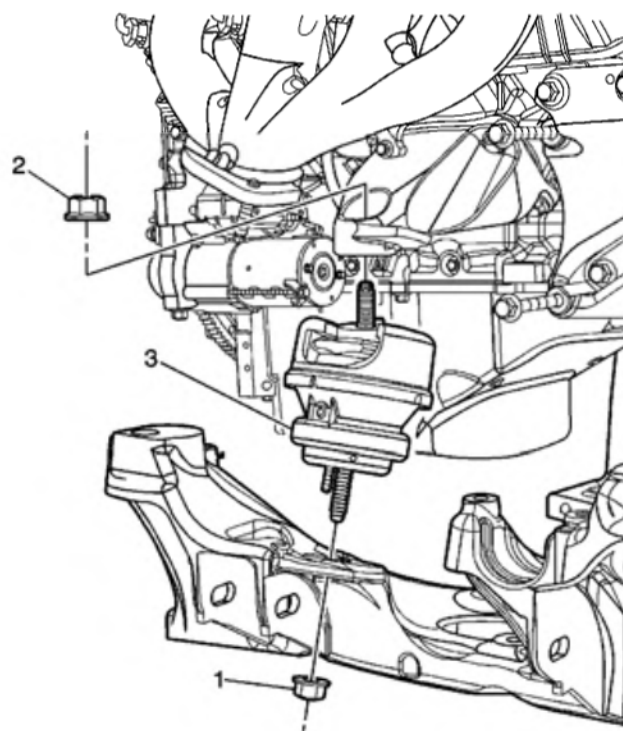
	100 N·m (74 lb ft)
2	Engine Mount Fastener Procedure The engine mount nuts must be replaced once loosened or removed. Tighten 100 N·m (74 lb ft)
3	Engine Mount Procedure 1. Using the screw jack, raise the engine enough to remove the engine mount. 2. Install the new right and left engine mount lower nut first.

Engine Mount Bracket Replacement - Left Side



Callout	Component Name
Preliminary Procedure	
Remove the engine mount. Refer to Engine Mount Replacement - Left Side .	
1	Engine Mount Bracket Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 60 N·m (44 lb ft)
2	Engine Mount Bracket Procedure Transfer components as necessary.

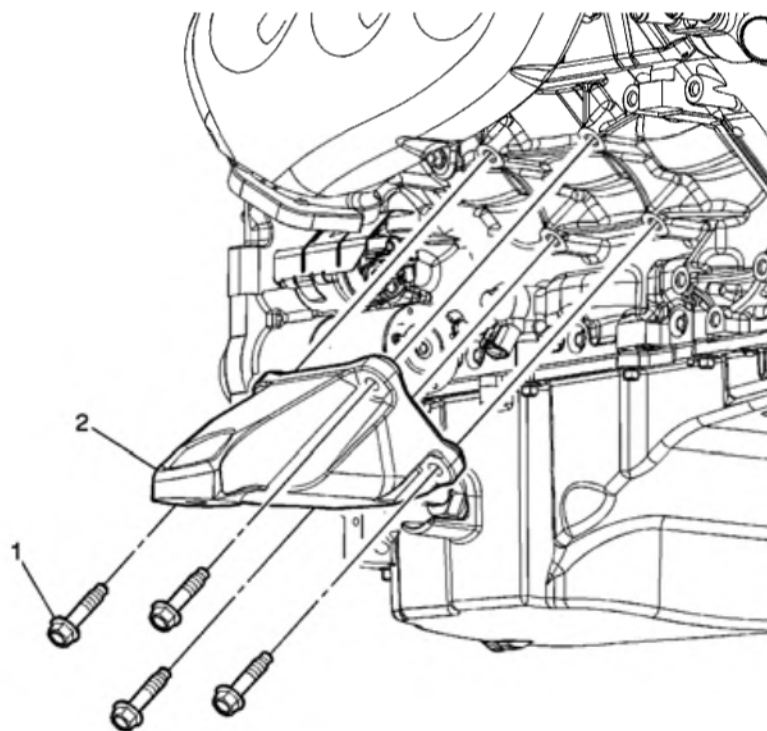
Engine Mount Replacement - Right Side (RWD)



Callout	Component Name
Preliminary Procedures	
1. Discharge the air conditioning (A/C) system. Refer to Refrigerant Recovery and Recharging. 2. Remove the tower brace. Refer to Cross Vehicle Brace Replacement. 3. Raise the vehicle. Refer to Lifting and Jacking the Vehicle. 4. Remove the suction hose from the A/C compressor. Refer to Suction Hose Replacement. 5. Position the hose aside to gain access to the engine mount top nut. 6. Lower the vehicle.	
1	Engine Mount Fastener Caution: Refer to Component Fastener Tightening Caution in the Preface section. Procedure 1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle. 2. Position a screw jack and a block of wood under the engine oil pan. Tighten

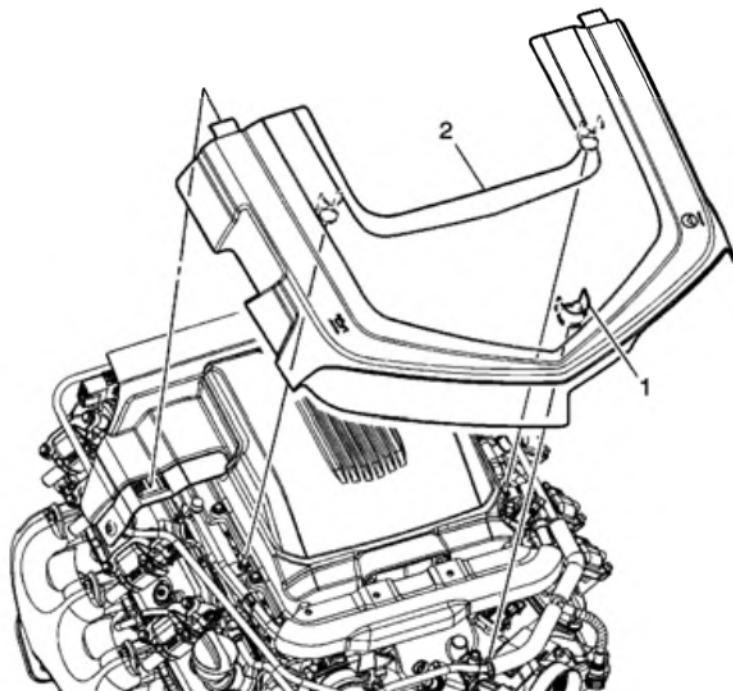
	100 N·m (74 lb ft)
2	Engine Mount Fastener Procedure The engine mount nuts must be replaced once loosened or removed. Tighten 100 N·m (74 lb ft)
3	Engine Mount Procedure 1. Using the screw jack, raise the engine enough to remove the engine mount. 2. Install the new right and left engine mount lower nut first.

Engine Mount Bracket Replacement - Right Side



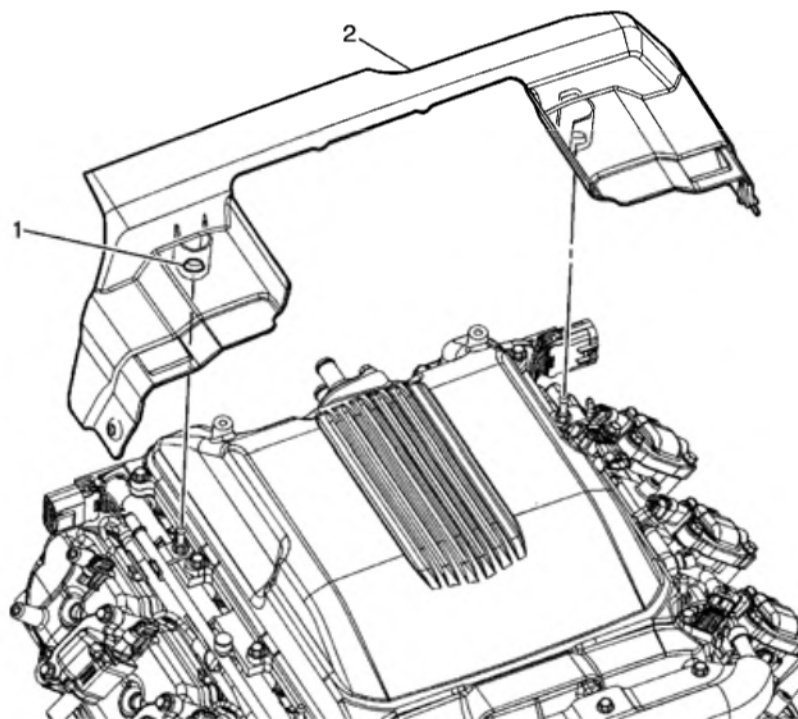
Callout	Component Name
Preliminary Procedure	
Remove the engine mount. Refer to Engine Mount Replacement - Right Side .	
1	Engine Mount Bracket Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 60 N·m (44 lb ft)
2	Engine Mount Bracket Procedure Transfer components as necessary.

Intake Manifold Cover Replacement - Front



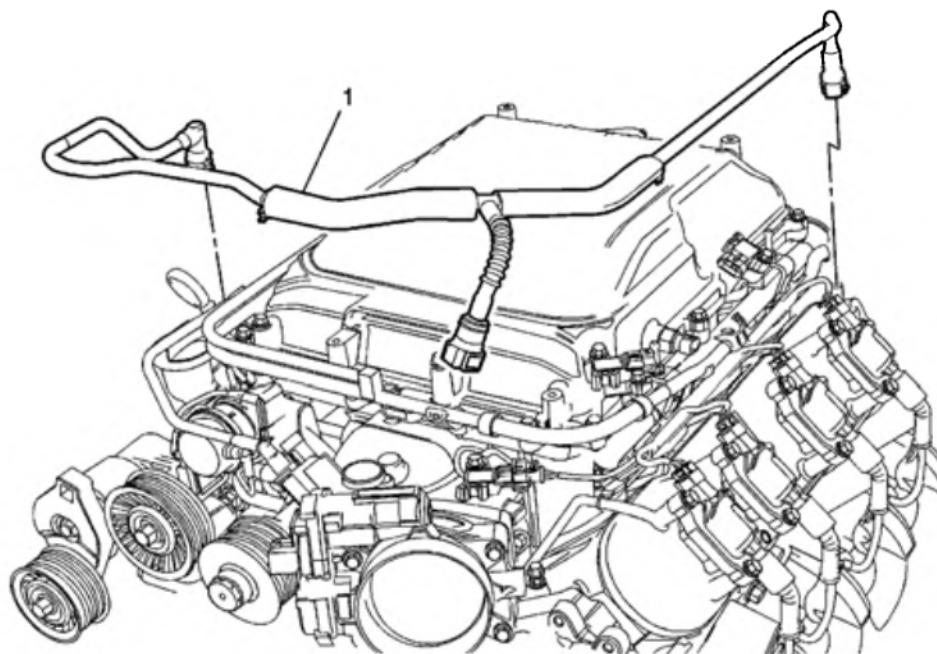
Callout	Component Name
1	Intake Manifold Cover Fastener (Qty: 3)
2	Intake Manifold Cover
	Procedure 1. Slid the intake manifold cover forward to remove. 2. Transfer components as necessary.

Intake Manifold Cover Replacement - Rear



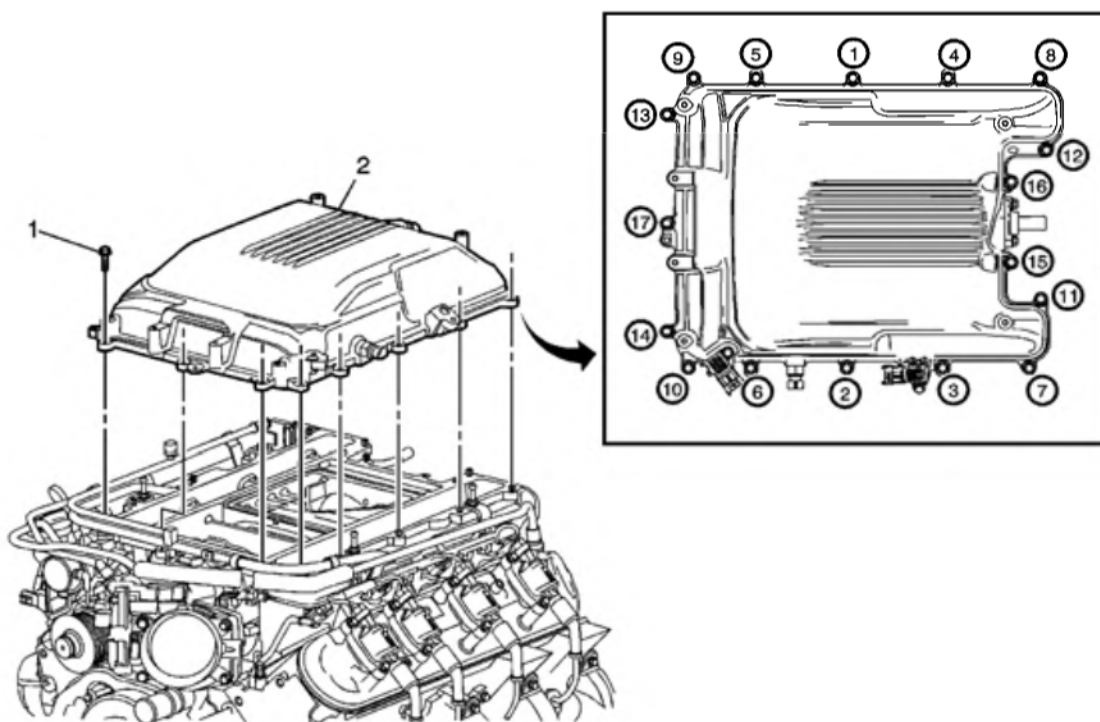
Callout	Component Name
Preliminary Procedures	
Remove Intake Manifold Cover Replacement. Intake Manifold Cover Replacement - Front	
1	Intake Manifold Cover Fastener (Qty: 2)
2	Intake Manifold Cover
Procedure	
Transfer components as necessary.	

Positive Crankcase Ventilation Hose / Pipe / Tube Replacement



Callout	Component Name
Preliminary Procedure	
Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement - Rear .	
1	Positive Crankcase Ventilation Hose/Pipe/Tube Procedure 1. Disconnect the electrical connectors, as needed. 2. Transfer components as necessary.

Charge Air Cooler Cover Replacement



Callout	Component Name
Preliminary Procedures 1. Remove the cross vehicle brace. Refer to Cross Vehicle Brace Replacement. 2. Remove the charge air cooler inlet hose. Refer to Charge Air Cooler Coolant Hose Replacement - Engine to Pipe. 3. Remove the charge air cooler outlet hose. Refer to Charge Air Cooler Coolant Hose Replacement - Engine to Reservoir.	
1	Charge Air Cooler Cover Fastener (Qty: 17) Caution: Refer to Fastener Caution in the Preface section. Tighten First Pass 5 N·m (44 lb ft) and final pass 10 N·m(89 lb ft)
2	Charge Air Cooler Cover Procedure 1. Disconnect any electrical connectors. 2. Discard the gasket. Do NOT reuse.

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3. Transfer components as necessary.

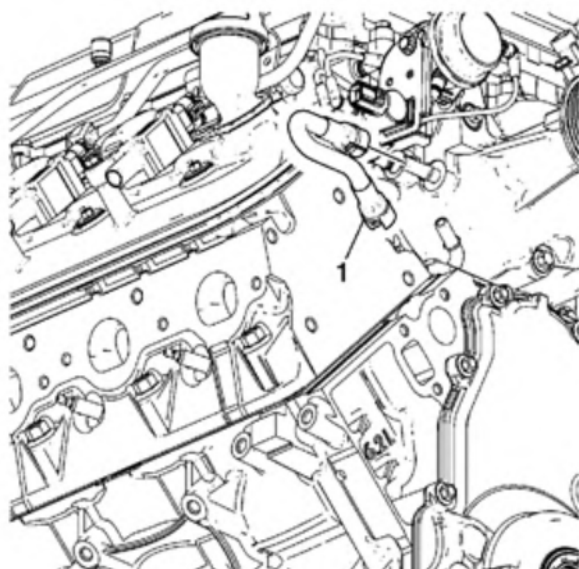
Supercharger Replacement

Special Tools

- [J 37088-A](#) Fuel Line Disconnect Tool Set
- [Supercharger Lift Fixture](#) Supercharger Lift Fixture

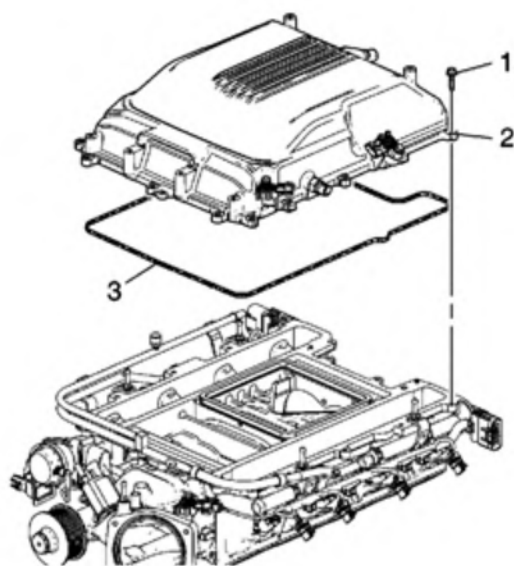
Removal Procedure

1. Remove the supercharger belt. Refer to [Supercharger Belt Replacement](#).
2. Remove the barometric pressure sensor. Refer to [Barometric Pressure Sensor Replacement](#).
3. Remove the fuel injection fuel rail assembly. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#).

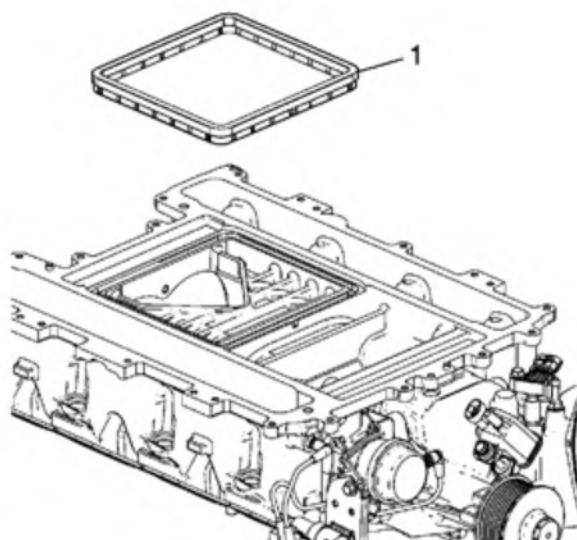


Note:

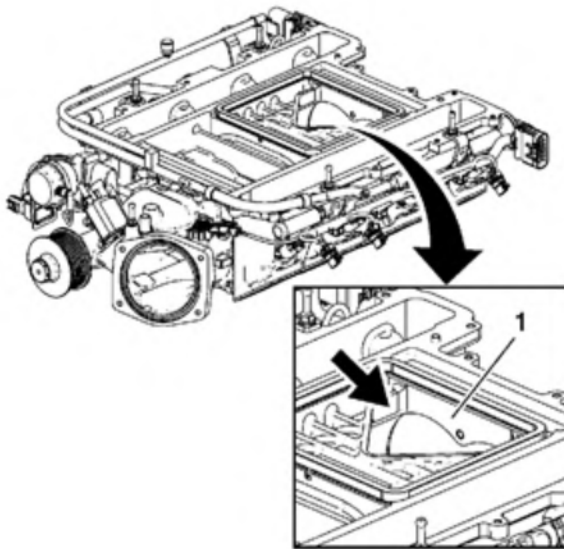
- The supercharger, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the supercharger as an assembly.
 - Cover the inlet area of the supercharger (1) to prevent dirt or debris contamination onto the rotors.
4. Remove the positive crankcase ventilation (PCV) dirty air hose (1) from the valley cover and supercharger.



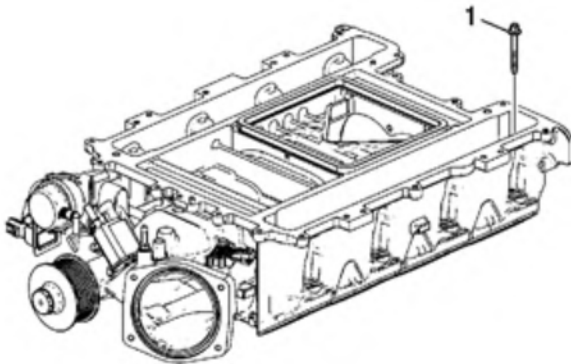
5. Remove the charge air cooler cover. Refer to [Charge Air Cooler Cover Replacement](#).
6. Remove the charge air cooler cover seal (3).



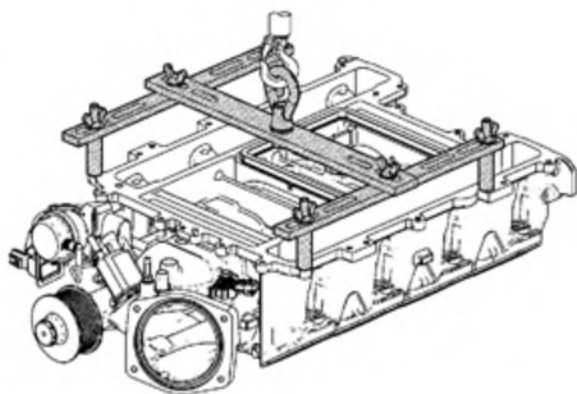
7. Remove the charge air cooler insulator (1).



8. Cover the supercharger rotors area (1) to prevent dirt or debris contamination onto the rotors.

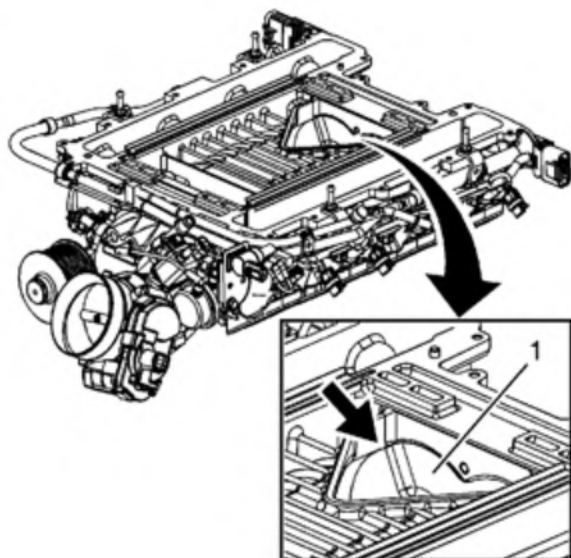


9. Remove the supercharger bolts (1).



10. Install the [Supercharger Lift Fixture](#) to the supercharger (1) and tighten the [Supercharger Lift Fixture](#) fixture studs and nuts until snug.
11. Using a lifting device, remove the supercharger from the engine.

Installation Procedure

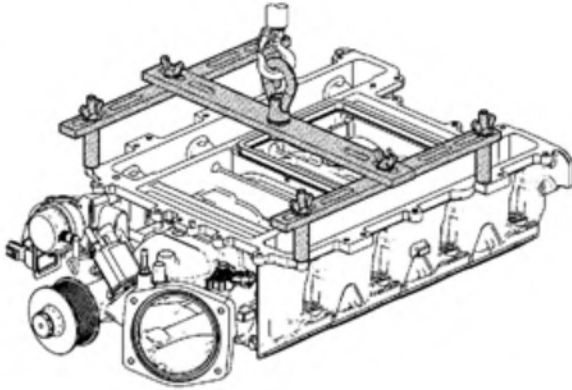


Note:

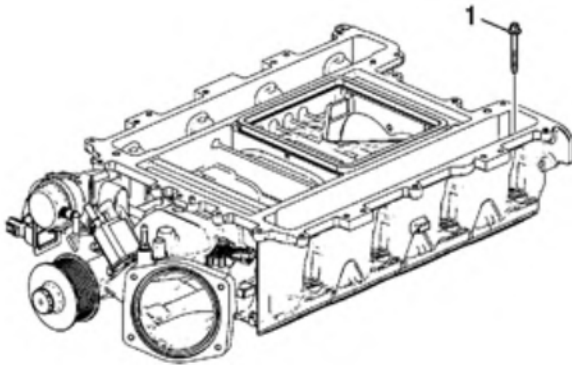
- The supercharger, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the supercharger as an assembly.

- Cover the inlet area of the supercharger (1) to prevent dirt or debris contamination onto the rotors.

1. Cover the supercharger rotors area (1) to prevent dirt or debris contamination onto the rotors.

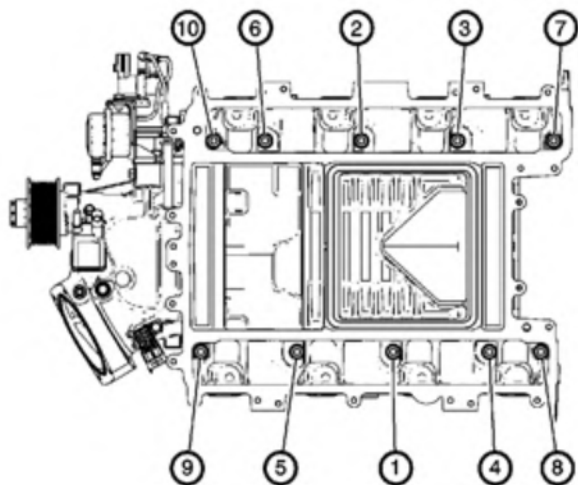


2. Install the [Supercharger Lift Fixture](#) fixture to the supercharger (1).
3. Tighten the [Supercharger Lift Fixture](#) fixture bolts and nuts until snug.
4. Using a lifting device, install the supercharger onto the engine. Align the dowel pin at the right front of the supercharger to the cylinder head.

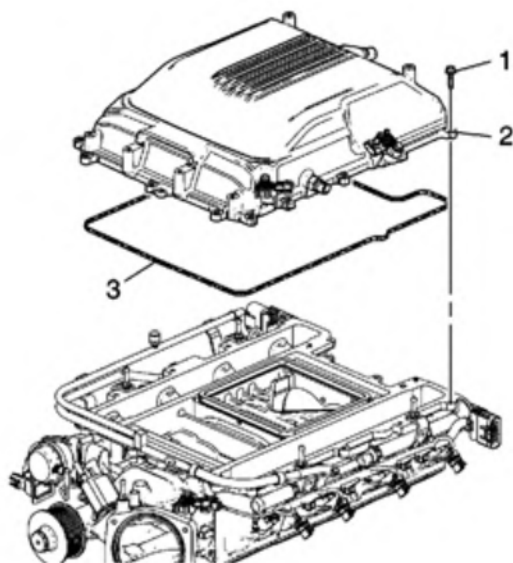


5. Apply a 5 mm (0.2 in) band of threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the bolts.
6. Install the supercharger bolts.

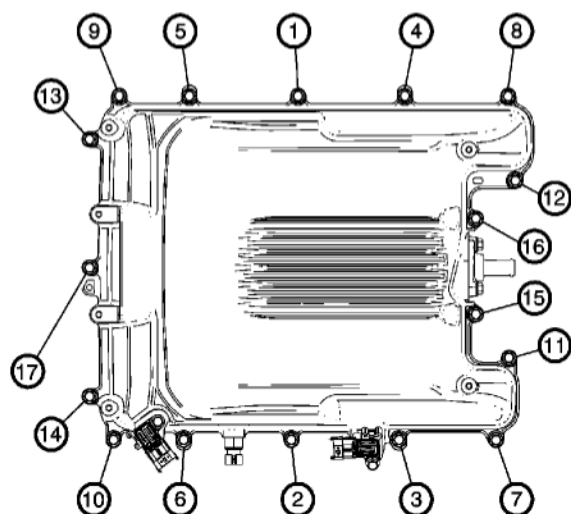
Caution: Refer to [Fastener Caution](#) in the Preface section.



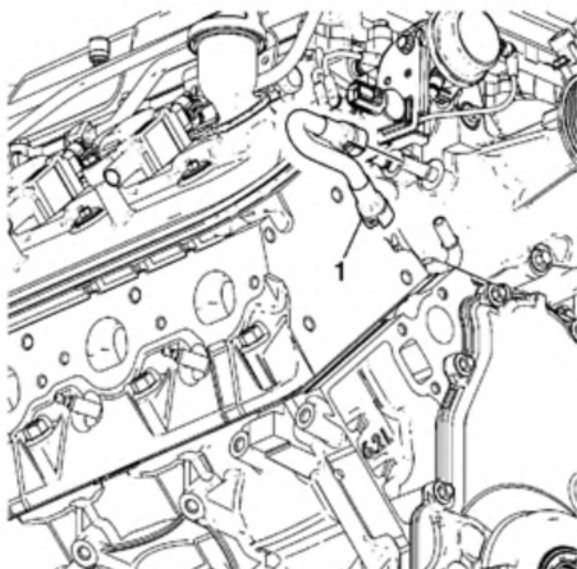
7. Tighten the bolts.
 - 7.1. Tighten the bolts a first pass in sequence to 5 N·m (44 lb in).
 - 7.2. Tighten the bolts a final pass in sequence to 10 N·m (89 lb in).



8. Install the charge air cooler cover seal (3).
9. Install the charge air cooler cover bolts (1) and supercharger cover (2).

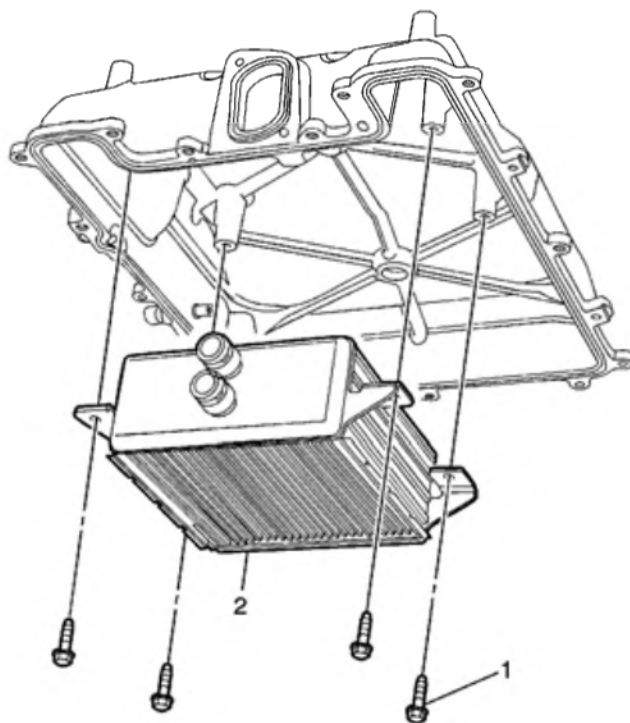


10. Tighten the bolts.
 - 10.1. Tighten the bolts a first pass in sequence to **5 N·m (44 lb in)**.
 - 10.2. Tighten the bolts a final pass in sequence to **10 N·m (89 lb in)**.



11. Install the PCV dirty air hose (1) to the valley cover and supercharger.
12. Install the fuel injection fuel rail assembly. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#).
13. Install the barometric pressure sensor. Refer to [Barometric Pressure Sensor Replacement](#).
14. Install the supercharger belt. Refer to [Supercharger Belt Replacement](#).

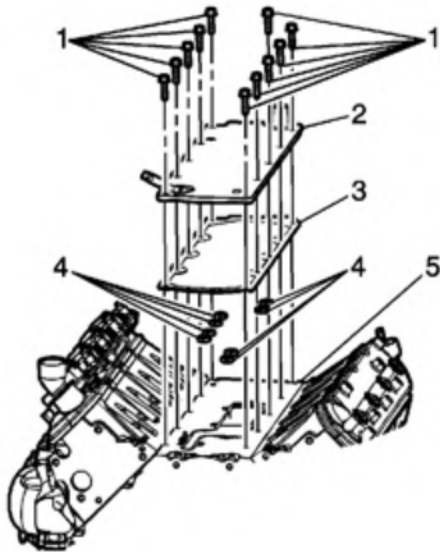
Charge Air Cooler Replacement



Callout	Component Name
Preliminary Procedure	
Remove the charge air cooler coolant outlet pipe. Refer to Charge Air Cooler Coolant Outlet Pipe Replacement .	
1	Charge Air Cooler Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 10 N·m (89 lb in) Tip Apply threadlocker before installing the fastener.
2	Charge Air Cooler Procedure 1. Discard the gasket. Do NOT reuse. 2. Transfer components as necessary.

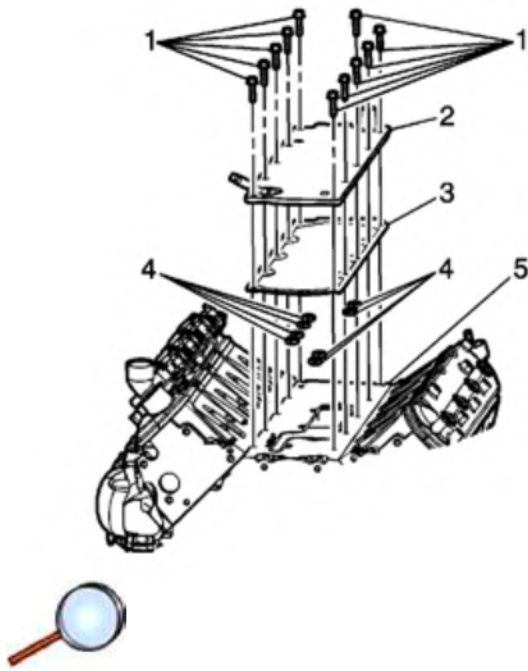
Engine Block Valley Cover Replacement

Removal Procedure



1. Remove the supercharger. Refer to [Supercharger Replacement](#).
2. Remove the oil pressure switch. Refer to [Engine Oil Pressure Sensor and/or Switch Replacement](#).
3. Remove the engine valley retaining bolts (1).
4. Remove the engine valley cover (2).
5. Remove the engine valley gasket (3).
6. Remove the O-rings (4) from the engine valley cover (2).

Installation Procedure

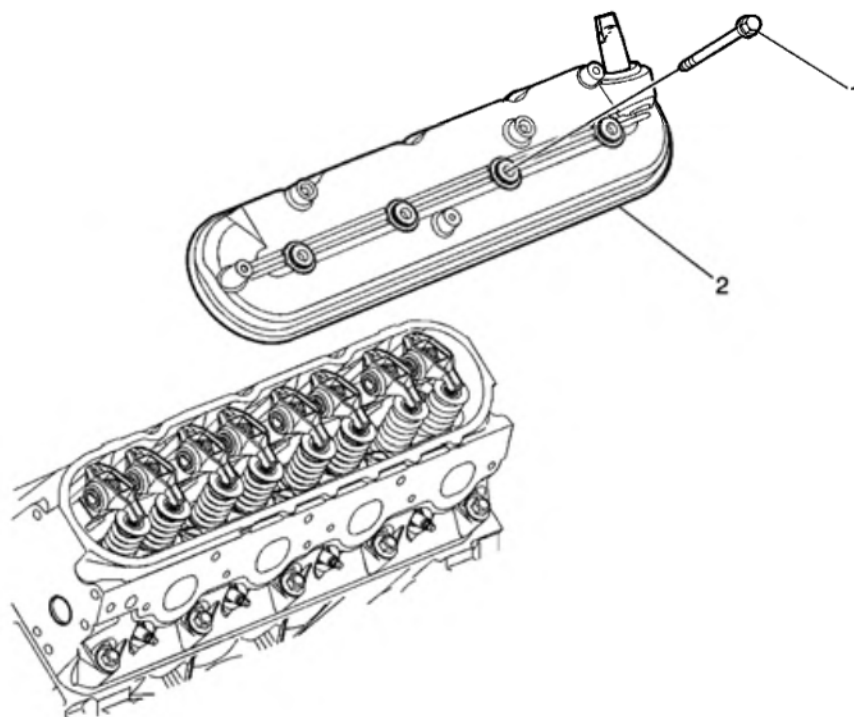


1. Install the O-rings (4) to the engine valley cover (2).
2. Install the engine valley gasket (3).
3. Install the engine valley cover (2).
4. Install the retaining bolts (1).

Caution: Refer to [Fastener Caution](#) in the Preface section.

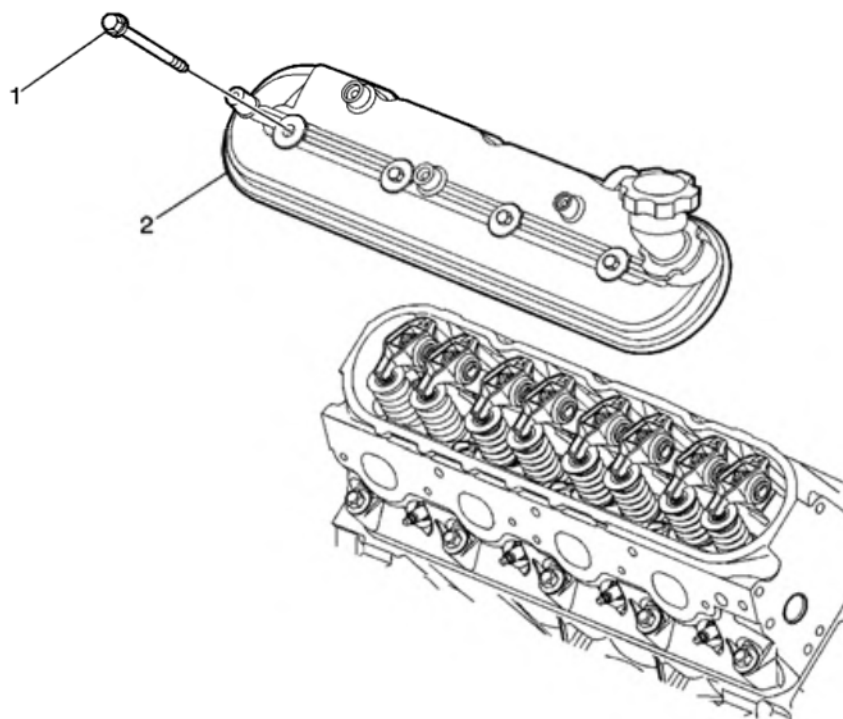
5. Tighten the engine valley retaining bolts to **25 N·m (18 lb ft)**.
6. Install the supercharger. Refer to [Supercharger Replacement](#).
7. Install the oil pressure switch. Refer to [Engine Oil Pressure Sensor and/or Switch Replacement](#).

Valve Rocker Arm Cover Replacement - Left Side (LSA / LS9)



Callout	Component Name
Preliminary Procedure 1. Remove the crankcase ventilation hoses/pipes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement. 2. Remove the ignition coil. Refer to Ignition Coil Replacement.	
1	Valve Rocker Arm Cover Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 12 N·m (106 lb in)
2	Valve Rocker Arm Cover Procedure 1. Disconnect any electrical connectors. 2. Transfer components as necessary.

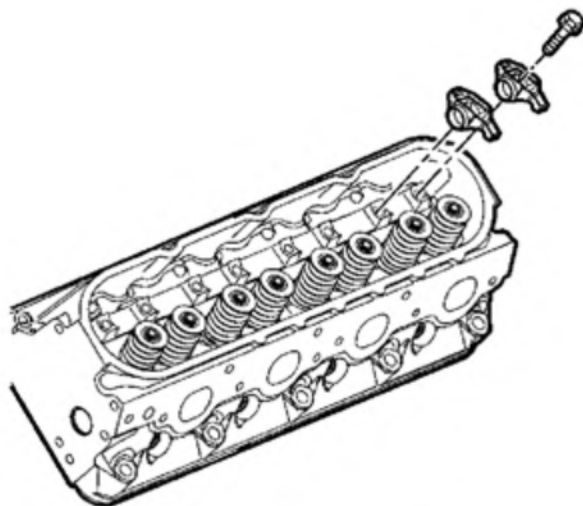
Valve Rocker Arm Cover Replacement - Right Side (LSA / LS9)



Callout	Component Name
Preliminary Procedure	
1. Remove the crankcase ventilation hoses/pipes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement. 2. Remove the ignition coil. Refer to Ignition Coil Replacement.	
1	Valve Rocker Arm Cover Fastener (Qty: 4) Caution: Refer to Component Fastener Tightening Caution in the Preface section. Tighten 12 N·m (106 lb in)
2	Valve Rocker Arm Cover Procedure 1. Disconnect any electrical connectors. 2. Transfer components as necessary.

Valve Rocker Arm and Push Rod Replacement

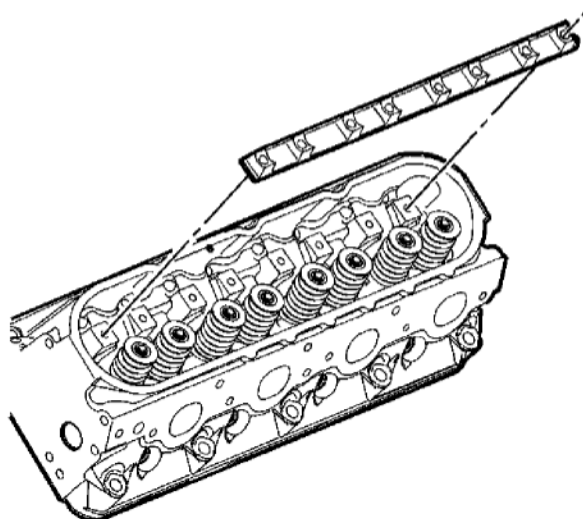
Removal Procedure



1. Remove the valve rocker arm covers. Refer to [Valve Rocker Arm Cover Replacement - Left Side](#) or [Valve Rocker Arm Cover Replacement - Right Side](#).

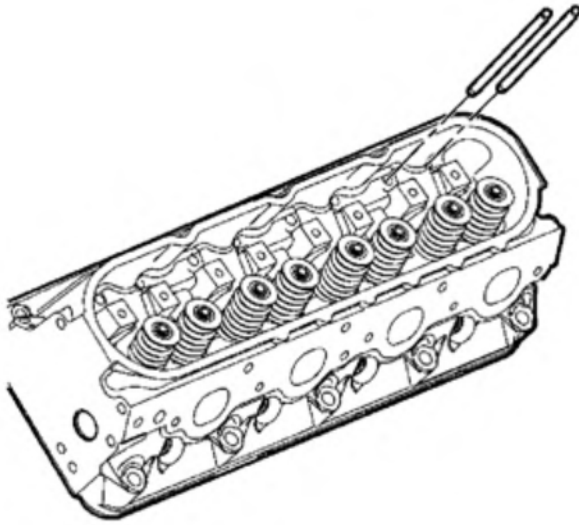
Note: Place the valve rocker arms, valve pushrods, and pivot support, in a rack so that they can be installed in the same location from which they were removed.

2. Remove the valve rocker arm bolts.
3. Remove the valve rocker arms.



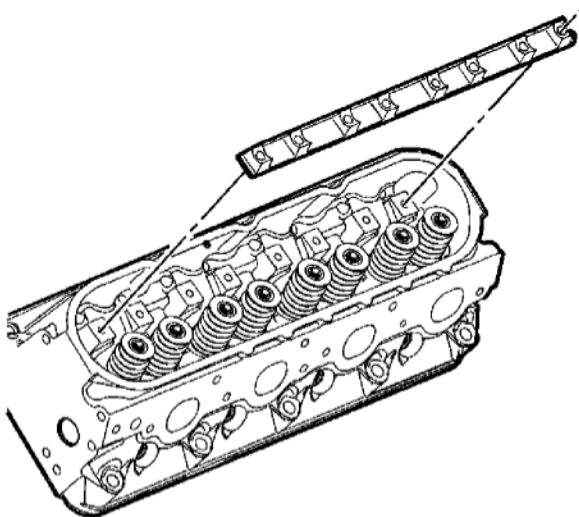


4. Remove the valve rocker arm pivot support.



5. Remove the pushrods.
6. Clean and inspect the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Cleaning and Inspection](#).

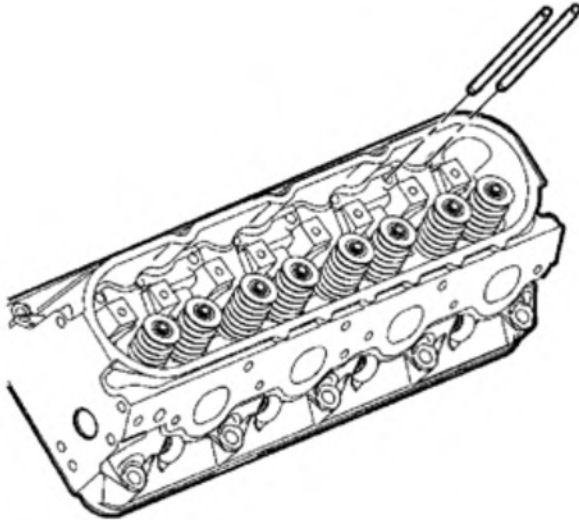
Installation Procedure



Note:

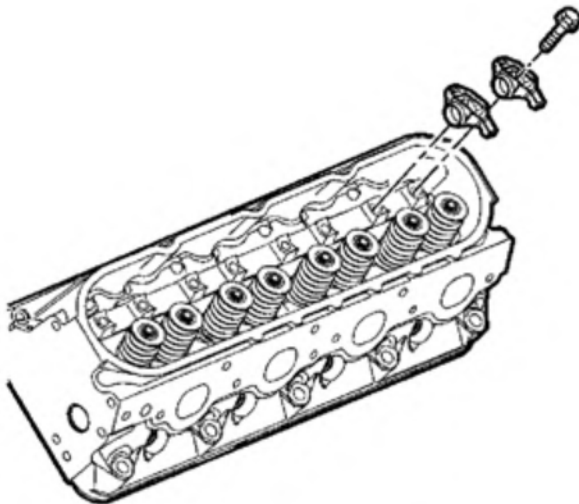
- When using the valve train components again, always install the components to the original location and position.
- Valve lash is net build, no valve adjustment is required.

1. Lubricate the valve rocker arms and pushrods with clean engine oil.
2. Lubricate the flange of the valve rocker arm bolts with clean engine oil.
3. Install the valve rocker arm pivot support.



Note: Ensure the pushrods seat properly to the valve lifter sockets.

4. Install the pushrods.



Note:

- Ensure the pushrods seat properly to the ends of the rocker arms.
- DO NOT tighten the rocker arm bolts at this time.

5. Install the rocker arms and bolts.



6. Rotate the crankshaft until number one piston is at top dead center of compression stroke.

In this position, cylinder number one rocker arms will be off lobe lift, and the crankshaft sprocket key will be at the 1:30 position. The camshaft and crankshaft sprocket alignment marks will be in the 12 o'clock positions. If viewing from the rear of the engine, the additional crankshaft pilot hole, non-threaded, will be in the 10:30 position.

The engine firing order is 1, 8, 7, 2, 6, 5, 4, 3.

Cylinders 1, 3, 5 and 7 are left bank.

Cylinders 2, 4, 6, and 8 are right bank.

Caution: Refer to [Fastener Caution](#) in the Preface section.

7. With the engine in the number one firing position, tighten the following valve rocker arm bolts:

Tighten

- Tighten exhaust valve rocker arm bolts 1, 2, 7, and 8 to 30 N·m (22 lb ft).
- Tighten intake valve rocker arm bolts 1, 3, 4, and 5 to 30 N·m (22 lb ft).

8. Rotate the crankshaft 360 degrees.
9. Tighten the following valve rocker arm bolts:

Tighten

- Tighten exhaust valve rocker arm bolts 3, 4, 5, and 6 to 30 N·m (22 lb ft).

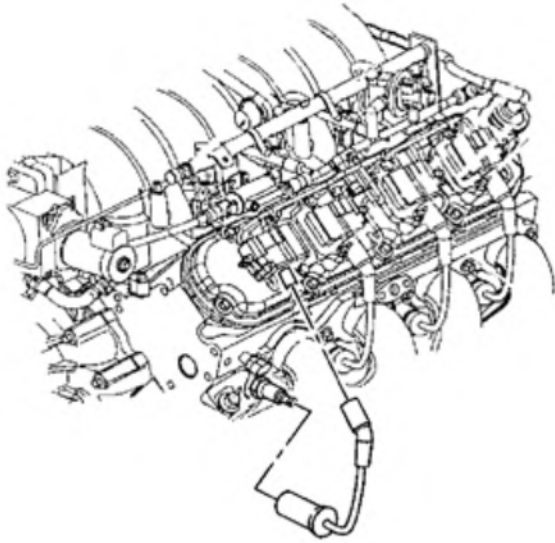
- Tighten intake valve rocker arm bolts 2, 6, 7, and 8 to 30 N·m (22 lb ft).
10. Install the valve rocker arm covers. Refer to [Valve Rocker Arm Cover Replacement - Left Side](#) or [Valve Rocker Arm Cover Replacement - Right Side](#).

Valve Stem Oil Seal and Valve Spring Replacement

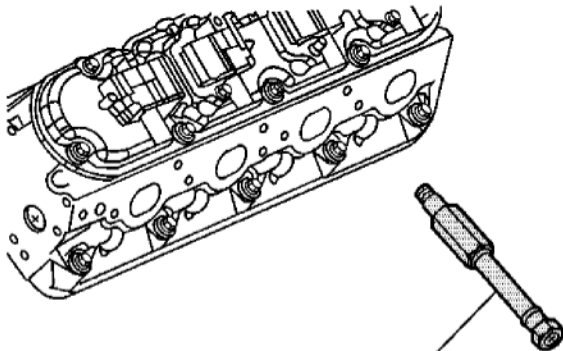
Special Tools

- [J 22794](#) Spark Plug Port Adapter
- [J 38606](#) Valve Spring Compressor (Head-on)

Removal Procedure



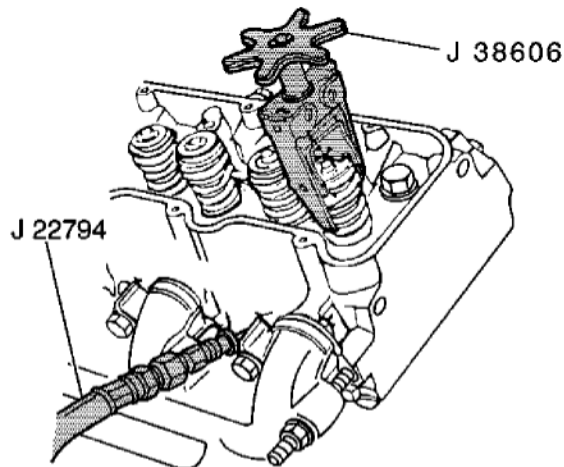
1. Remove the valve rocker arms. Refer to [Valve Rocker Arm and Push Rod Replacement](#).
2. Remove the spark plug. Refer to [Spark Plug Replacement](#).



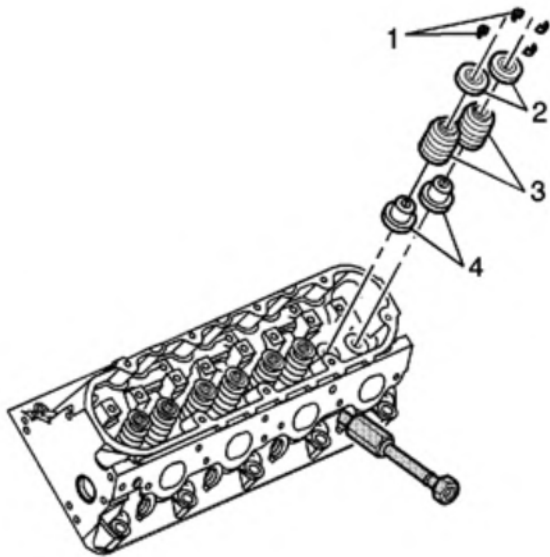
J 22794



3. Install the [J 22794](#) into the spark plug hole.
4. Attach an air hose to [J 22794](#).
5. Tap the end of the valve stem with a plastic face hammer in order to loosen any varnish on the valve stem keys.

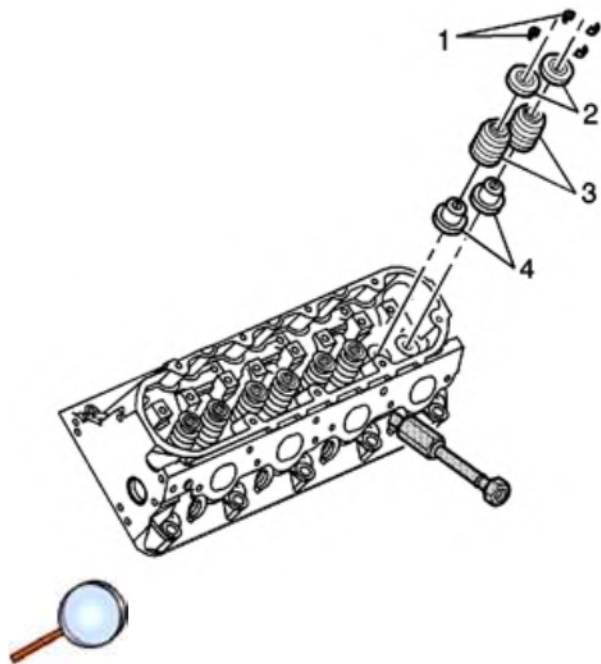


6. Use the [J 38606](#) in order to compress the valve spring.



7. Remove the valve stem keys (1).
8. Carefully release the valve spring tension.
9. Remove the [J 38606](#).
10. Remove the valve spring cap (2).
11. Remove the valve spring (3).
12. Remove the valve stem oil seal and shim (4).

Installation Procedure

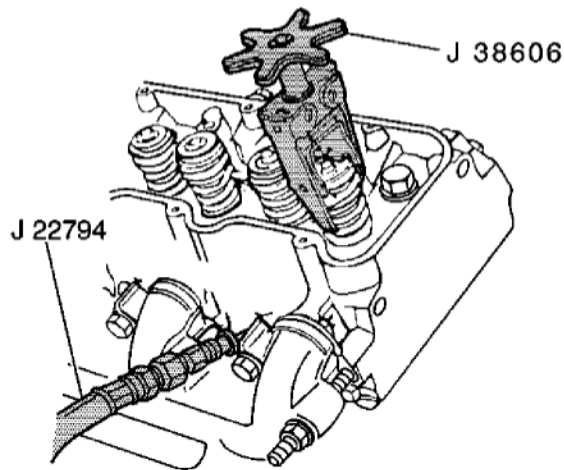


1. Clean the cylinder head valve spring seat and/or shim area.
2. Install the valve stem oil seal and shim (2).

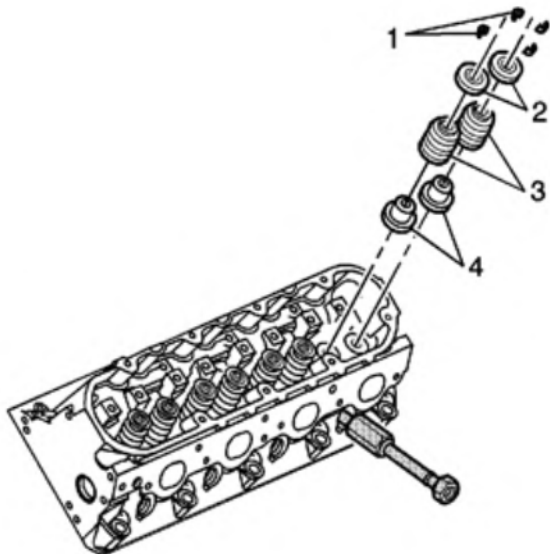
Important: The valve stem oil seal alignment and position on the valve guide is critical.

An improperly installed valve stem oil seal may lead to excessive oil consumption, and increased vehicle emissions.

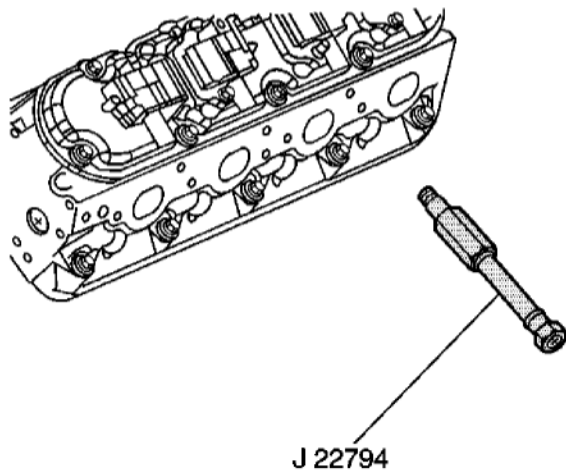
3. Install the valve stem oil seal onto the guide.
 - 3.1. Lubricate the valve guide and valve stem oil seal with clean engine oil.
 - 3.2. Install the valve stem oil seal onto the valve stem. Push the seal down until the seal contacts the valve guide.



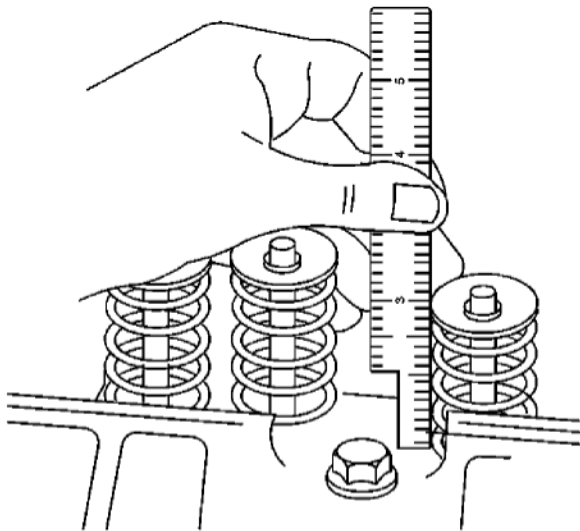
4. Install the valve spring to the [J 38606](#) .
5. Compress the valve spring using the [J 38606](#) .
6. Install the valve spring to the cylinder head.



7. Install the valve spring cap (2).
8. Install the valve stem keys (1).
 - 8.1. Use grease to hold the keys (2) in place and remove [J 38606](#) .
 - 8.2. Make sure the keys (2) seat properly in the groove of the valve stem.
 - 8.3. Carefully release the valve spring pressure, making sure the valve keys stay in place.
 - 8.4. Remove the [J 38606](#) .
 - 8.5. Tap the end to the valve stem with a plastic faced hammer to seat the keys, if necessary.



9. Disconnect and remove the air supply from the [J 22794](#).
10. Remove the [J 22794](#) from the spark plug hole.

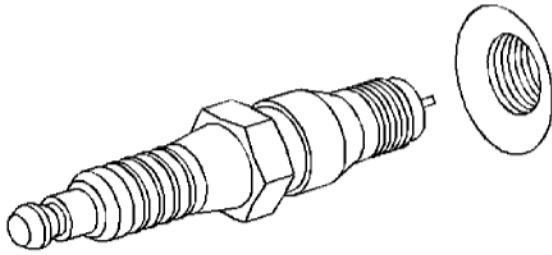


11. Measure the valve spring installed height using a ruler.

Measure from the base of the valve spring to the top of the valve spring.

- If the installed height exceeds 46.25 mm (1.82 in), install a valve spring shim of approximately 0.5 mm (0.02 in) thick.
- Do not shim the valve spring to obtain less than the specified height.
- Do not assemble the components without a spring shim on the cylinder head.

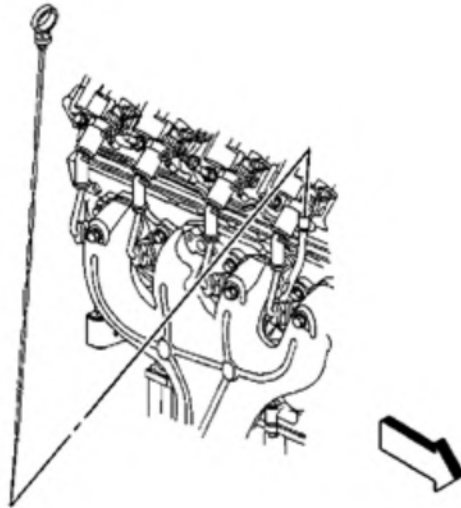
12. Remove the air hose from the [J 22794](#).



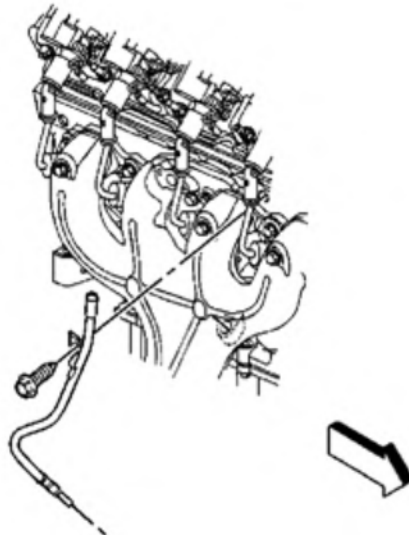
13. Install the spark plug. Refer to [Spark Plug Replacement](#).
14. Install the valve rocker arms. Refer to [Valve Rocker Arm and Push Rod Replacement](#).

Oil Level Indicator Tube Replacement

Removal Procedure



1. Remove the oil level indicator.



2. Remove the oil level indicator tube bolt.
3. Remove the oil level indicator tube.

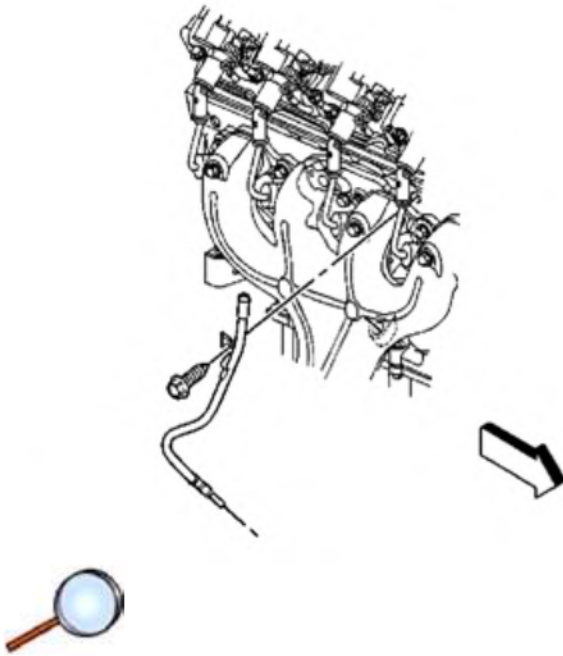
Note: Inspect the O-

may be reused if not cut

or damaged.

4. Remove the O-ring from the oil level indicator tube, if required.

Installation Procedure



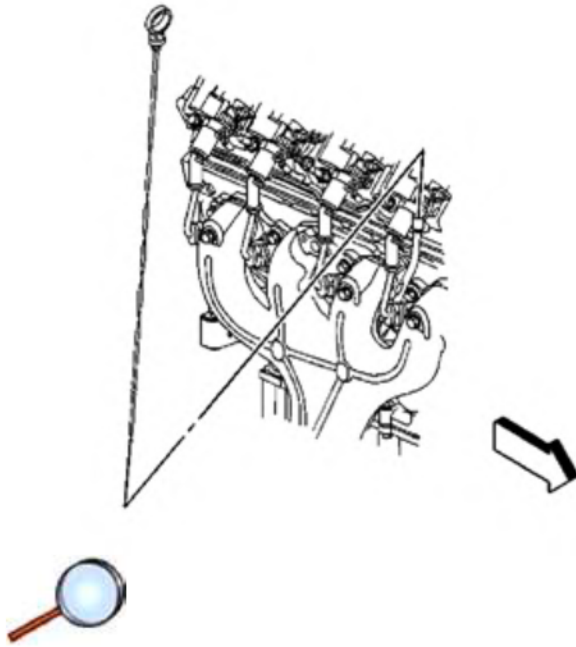
1. Lubricate the O-ring seal with clean engine oil.
2. Install the oil level indicator tube into position.
3. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
4. Insert the oil level indicator tube into the engine block until the collar is flush with the block.

Caution: Refer to [Fastener Caution](#) in the Preface section.

5. Lower the vehicle.
6. Install the oil level indicator tube bolt.

Tighten

Tighten the oil level indicator tube bolt to 25 N·m (18 lb ft).



7. Install the oil level indicator.
8. Check the oil level and add if necessary.

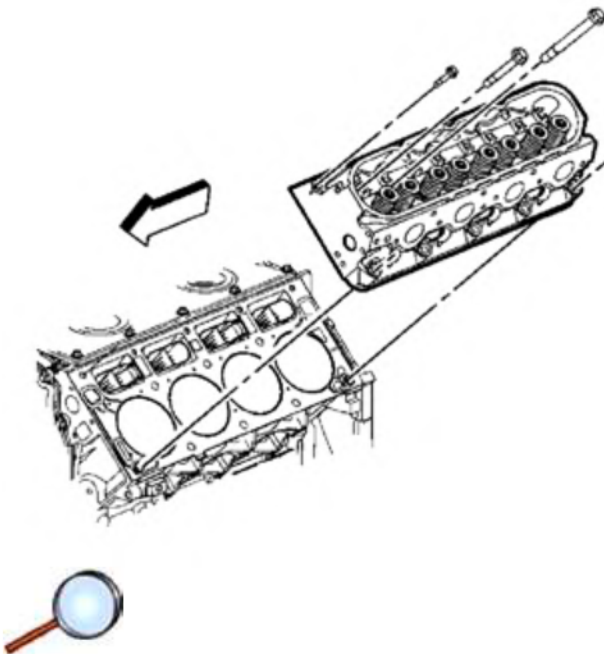
Cylinder Head Replacement - Left Side (LSA)

Special Tools

- [J 45059](#) Angle Meter
- [J 42385-100](#) Head/Main Bolt Thread Repair Kit

Removal Procedure

1. Remove the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Replacement](#).
2. Remove the power steering pump bracket. Refer to [Power Steering Pump Bracket Replacement](#).
3. Remove the exhaust manifold. Refer to [Exhaust Manifold Replacement - Left Side](#).
4. Remove the supercharger. Refer to [Supercharger Replacement](#).
5. Remove the engine wiring harness ground bolt from the rear of the left cylinder head.
6. Reposition the engine wire harness ground strap away from the cylinder head.

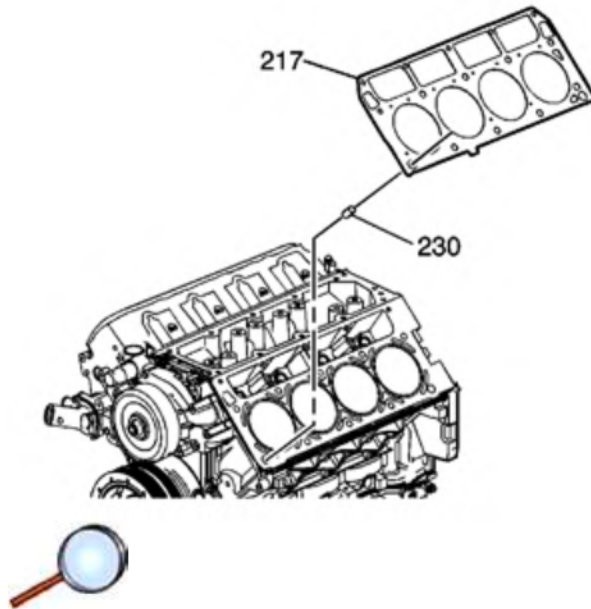


Note: The cylinder head bolts are NOT reusable.

7. Remove the cylinder head bolts.

Caution: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

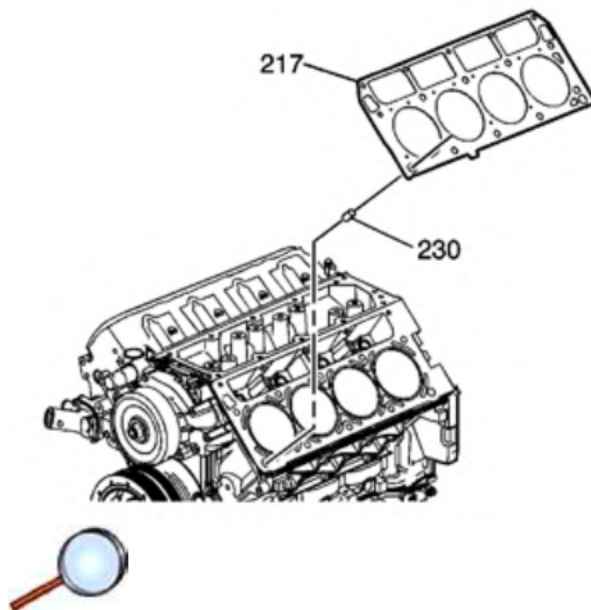
8. Remove the cylinder



9. Remove the cylinder head gasket (217).
10. Discard the gasket.
11. Discard all M8 and M11 cylinder head bolts.
12. Clean and inspect the cylinder head. Refer to [Cylinder Head Cleaning and Inspection](#).

Installation Procedure

Warning: Refer to [Safety Glasses Warning](#) in the Preface section.



Caution: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened

fasteners or damage to components.

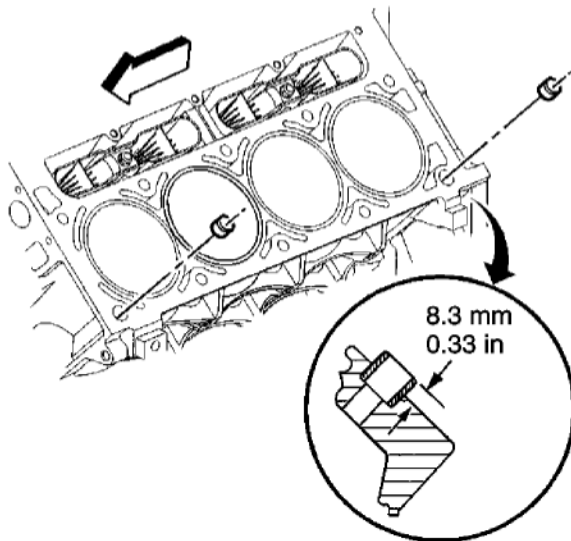
Note:

- Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.
- Do not use any type of sealant on the cylinder head gasket, unless specified.
- The cylinder head gaskets must be installed in the proper direction and position.

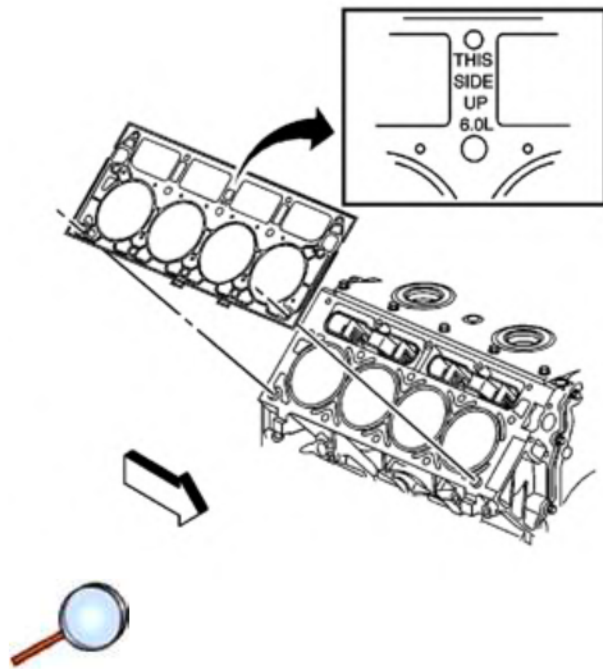
1. Clean the engine block cylinder head bolt holes, if required.

Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

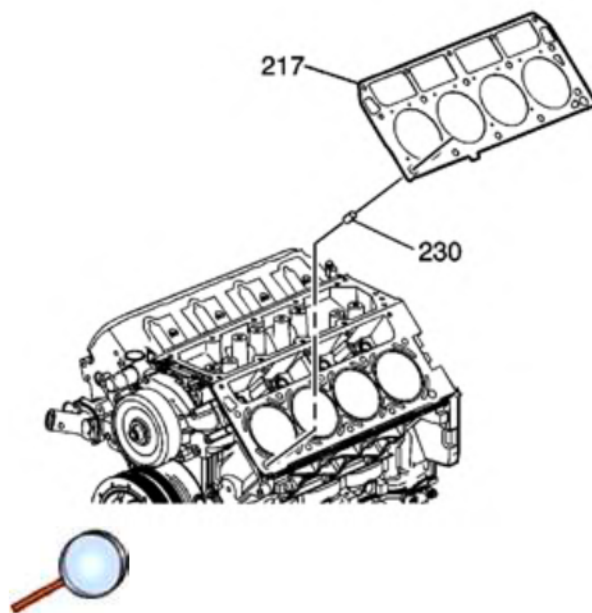
2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).



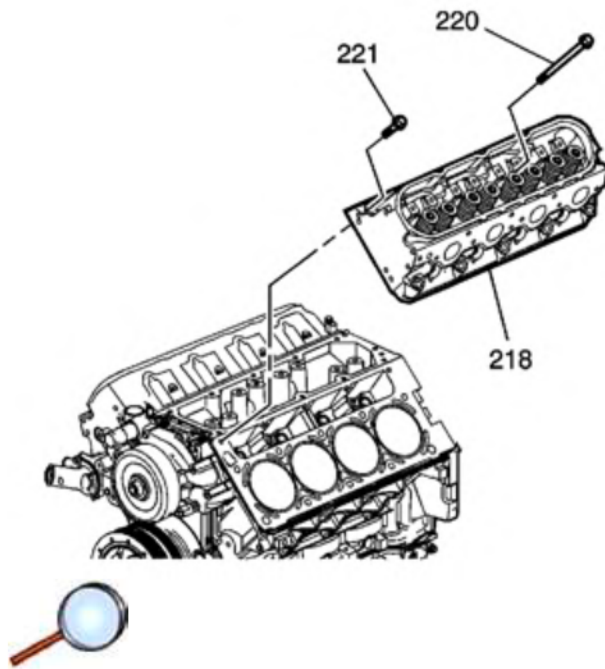
5. Inspect the locating pins for proper installation.



6. Inspect the displacement markings on the gasket for proper usage.

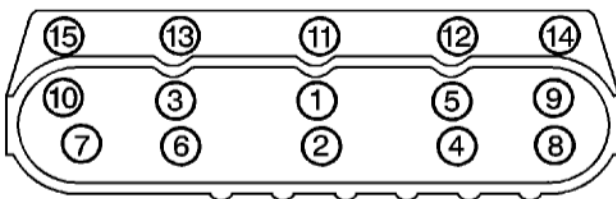


7. Install the NEW cylinder head gasket (217) onto the locating pins.



8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (200, 221).

Caution: Refer to [Fastener Caution](#) in the Preface section.



10. Tighten the cylinder head bolts.
 - 10.1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to **50 N·m (37 lb ft)**.
 - 10.2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to **80 degrees** using the [J 45059](#).
 - 10.3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to **55 degrees**.

using the [J 45059](#) .

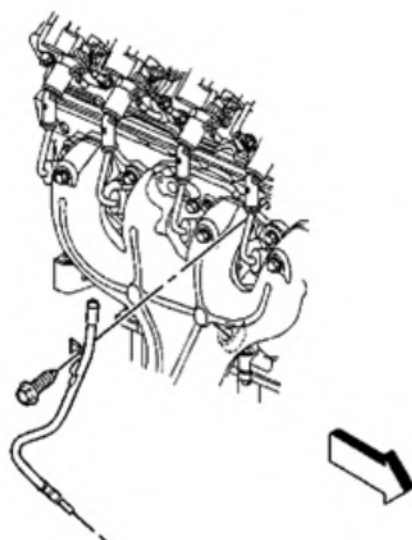
- 10.4. Tighten the M8 cylinder head bolts (11-15) to **30 N·m (22 lb ft)**. Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.
11. Install the supercharger. Refer to [Supercharger Replacement](#).
12. Position the engine wire harness ground strap against the cylinder head.
13. Install the engine wiring harness ground bolt to the rear of the left cylinder head. Tighten the engine wire harness ground bolt to **32 N·m (24 lb ft)**.
14. Install the exhaust manifold. Refer to [Exhaust Manifold Replacement - Left Side](#).
15. Install the power steering pump bracket. Refer to [Power Steering Pump Bracket Replacement](#).
16. Install the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Replacement](#).

Cylinder Head Replacement - Right Side (LSA)

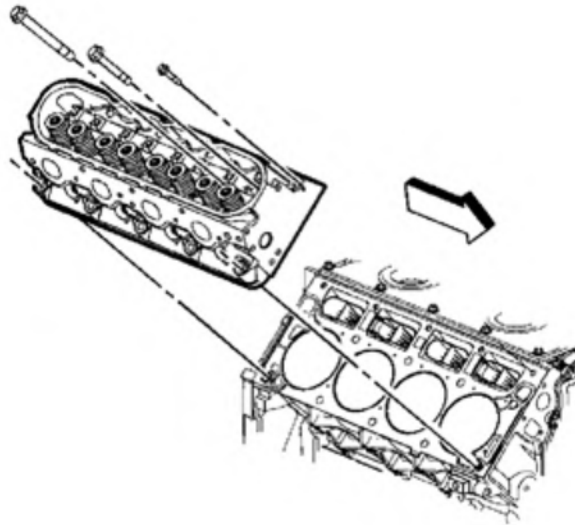
Special Tools

- [J 45059](#) Angle Meter
- [J 42385-100](#) Head/Main Bolt Thread Repair Kit

Removal Procedure



1. Remove the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Replacement](#).
2. Remove the supercharger belt tensioner bracket. Refer to [Supercharger Belt Tensioner Bracket Replacement](#).
3. Remove the exhaust manifold. Refer to [Exhaust Manifold Replacement - Right Side](#).
4. Remove the oil level indicator tube bolt.
5. Reposition the oil level indicator tube, if necessary.
6. Remove the supercharger. Refer to [Supercharger Replacement](#).
7. Remove the wiring harness from the clip at the rear of the cylinder head.

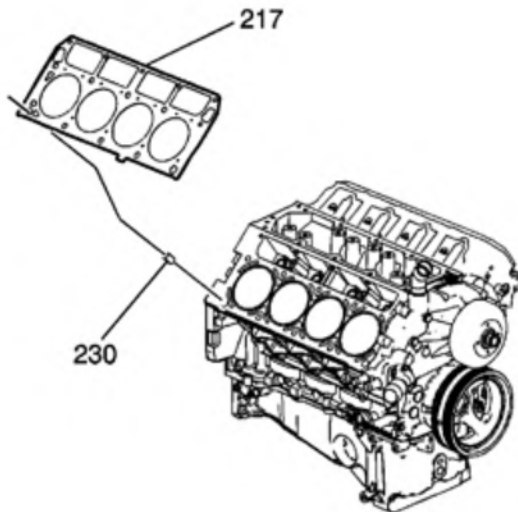


Note: The cylinder head bolts are NOT reusable.

8. Remove the cylinder head bolts.

Caution: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

9. Remove the cylinder head.

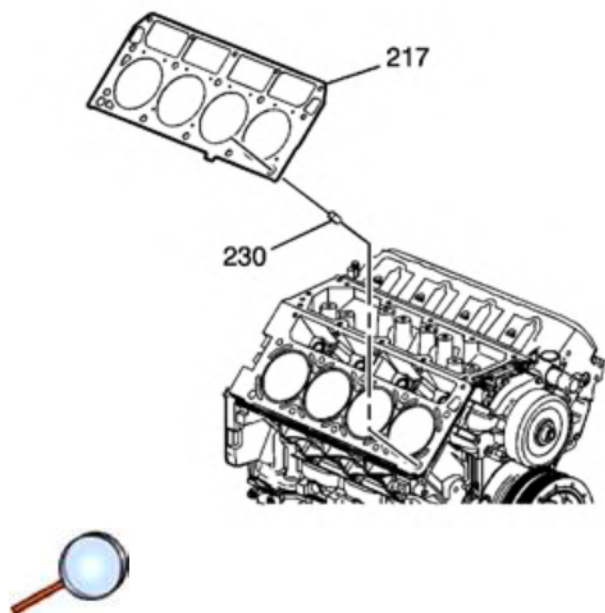


10. Remove the cylinder head gasket (217).
11. Discard the gasket.
12. Discard the cylinder head bolts.
13. Clean and inspect the cylinder head. Refer to [Cylinder Head Cleaning and Inspection](#).

Installation Procedure

Warning: Refer to [Safety Glasses Warning](#) in the Preface section.

Caution: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.



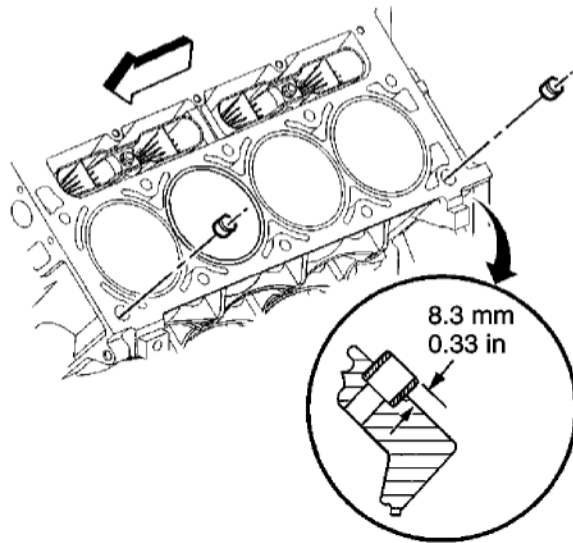
Note:

- Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.
- Do not use any type of sealant on the cylinder head gasket, unless specified.
- The cylinder head gaskets (217) must be installed in the proper direction and position.

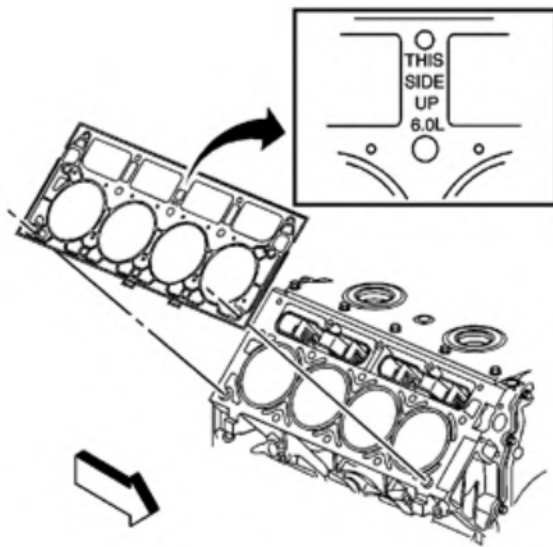
1. Clean the engine block cylinder head bolt holes, if required.

Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

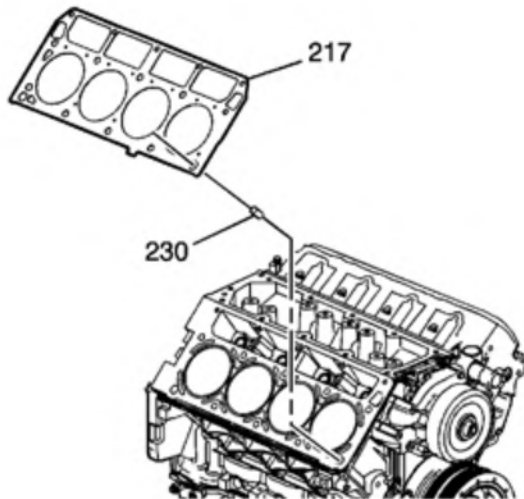
2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).



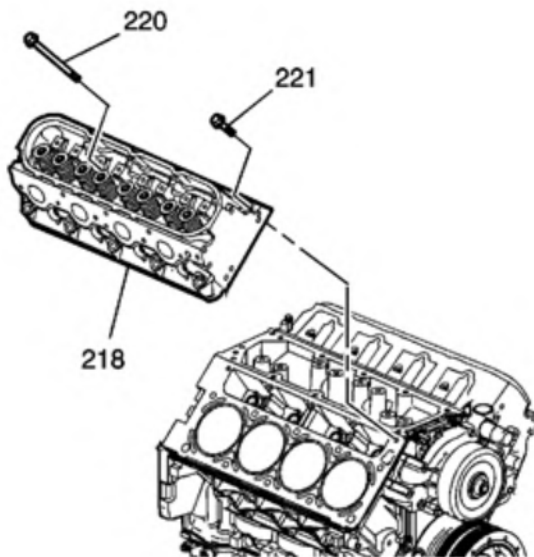
5. Inspect the locating pins for proper installation.



6. Inspect the displacement markings on the gasket for proper usage.

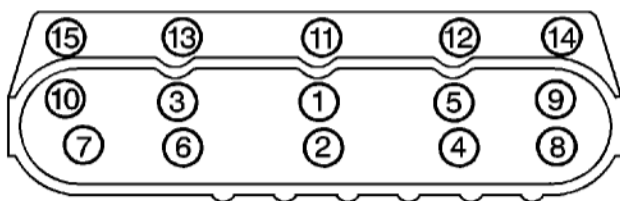


7. Install the NEW cylinder head gasket (217) onto the locating pins.

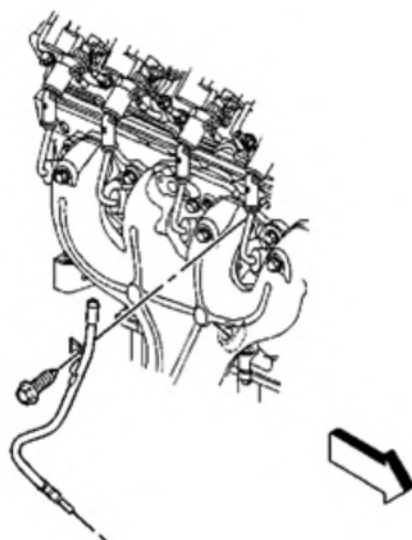


8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (220, 221).

Caution: Refer to [Fastener Caution](#) in the Preface section.



10. Tighten the cylinder head bolts.
 - 10.1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to **50 N·m (37 lb ft)**.
 - 10.2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to **80 degrees** using the [J 45059](#).
 - 10.3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to **55 degrees** using the [J 45059](#).
 - 10.4. Tighten the M8 cylinder head bolts (11-15) to **30 N·m (22 lb ft)**. Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.
11. Install the supercharger. Refer to [Supercharger Replacement](#).



12. Position the oil level indicator tube into place.
13. Install the oil level indicator tube bolt and tighten to **25 N·m (18 lb ft)**.

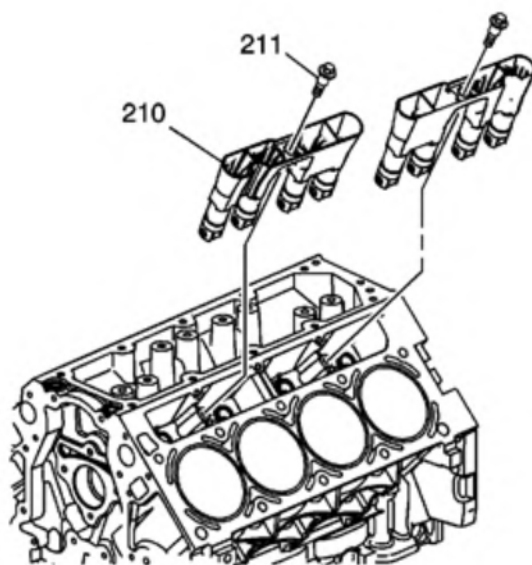
14. Install the exhaust manifold. Refer to [Exhaust Manifold Replacement - Right Side](#).
15. Install the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Replacement](#).
16. Install the supercharger belt tensioner bracket. Refer to [Supercharger Belt Tensioner Bracket Replacement](#).

Valve Lifter Replacement

Special Tools

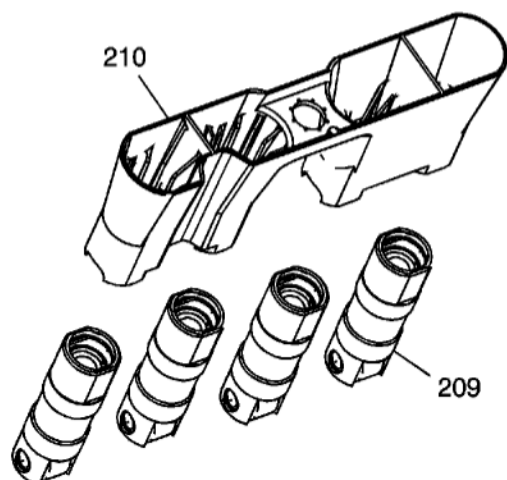
[J 3049-A](#) Valve Lifter Remover

Removal Procedure



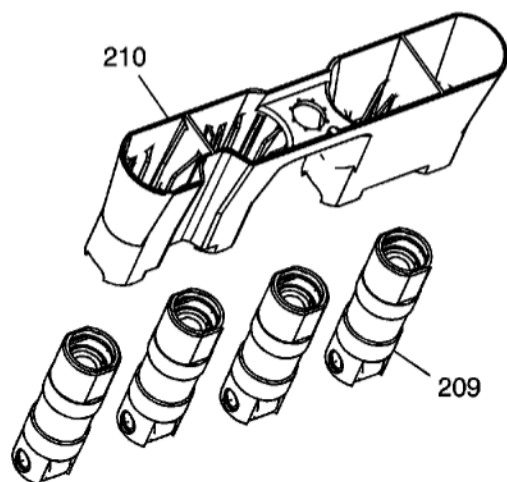
1. Remove the cylinder head. Refer to [Cylinder Head Replacement - Left Side](#) or [Cylinder Head Replacement - Right Side](#).
2. Remove the guide bolts (211).
3. Remove the guides (210) with lifters.

Note the installed position of the guides. The notched area of the guide is to align with the locating tab on the block.



4. Remove the valve lifters (209) from the guide (210).
5. Organize or mark the components so they can be installed in the same location from which they were removed. Refer to [Separating Parts](#).

Installation Procedure

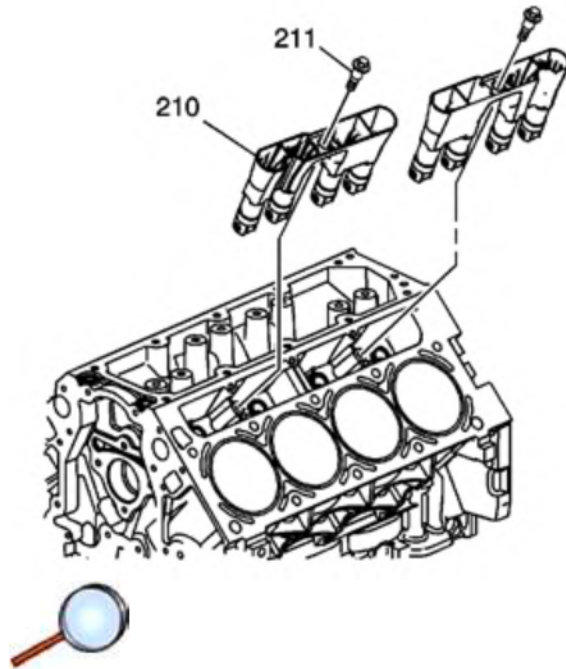


Note:

- When using the valve lifters again, install the lifters to their original locations.
- If camshaft replacement is required, the valve lifters must also be replaced.

1. Lubricate the valve lifters (209) and engine block valve lifter bores with clean engine oil.
2. Insert the valve lifters into the lifter guides (210).

Align the flat area on the top of the lifter with the flat area in the lifter guide bore. Push the lifter completely into the guide bore.



3. Install the valve lifters and guide assembly (210) to the engine block.

Caution: Refer to [Fastener Caution](#) in the Preface section.

4. Install the valve lifter guide bolts (211).

Tighten

Tighten the valve lifter guide bolts to 10 N·m (89 lb in).

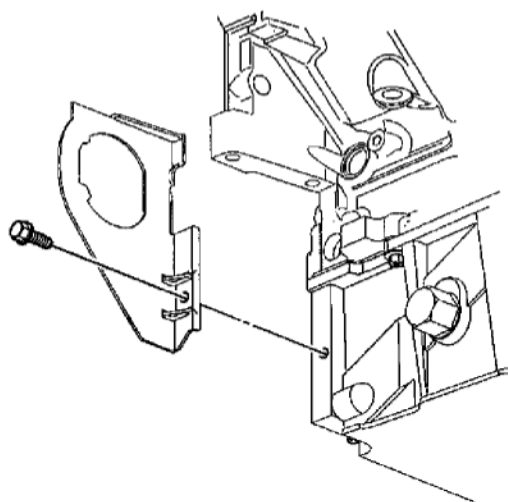
5. Install the cylinder head. Refer to [Cylinder Head Replacement - Left Side](#) or [Cylinder Head Replacement - Right Side](#).

Crankshaft Balancer Replacement (LS9 / LSA)

Special Tools

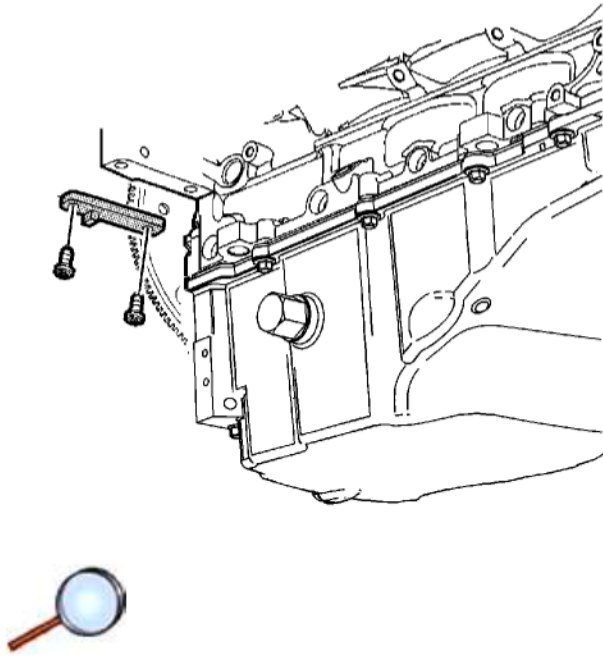
- [J 41816](#) Crankshaft Balancer Remover
- [J 41816-2](#) Crankshaft End Protector
- [J 42386-A](#) Flywheel Holding Tool
- [J 41665](#) Crankshaft Balancer and Sprocket Installer
- [J 45059](#) Angle Meter
- [EN-47812](#) Installer Bolt

Removal Procedure



1. Remove the air conditioning (A/C) drive belt. Refer to [Air Conditioning Compressor Belt Replacement](#).
2. Remove the power steering gear. Refer to [Steering Gear Replacement](#).
3. Remove the starter motor. Refer to [Starter Replacement](#).
4. Remove the right transmission cover and bolt.

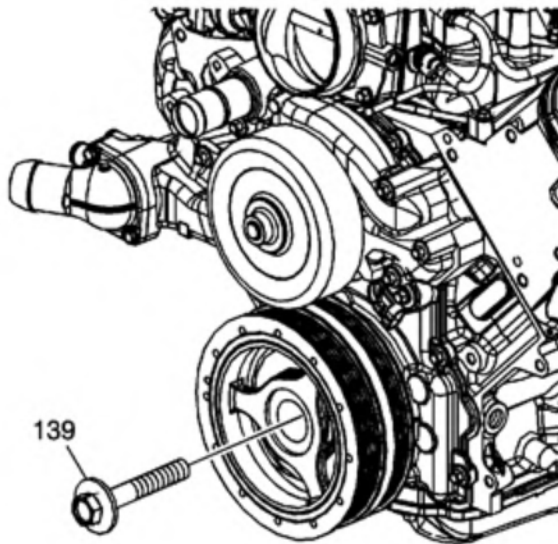
Caution: Refer to [Fastener Caution](#) in the Preface section.

**Note:**

- If replacing the crankshaft balancer on manual transmission applications, note the location of any existing balance weights, if applicable. Crankshaft balance weights must be installed into the new balancer in the same location as the old balancer. A properly installed balance weight will be either flush or below flush with the face of the balancer. Refer to [Engine Balancing](#).
- Do not use the crankshaft balancer bolt again. Install a NEW crankshaft balancer bolt during final assembly.

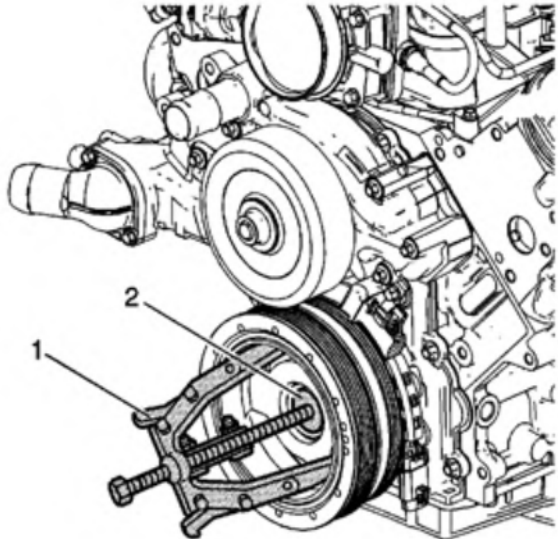
5. Install the [J 42386-A](#) and bolts.

Use one M10 - 1.5 x 120 mm and one M10 - 1.5 x 45 mm bolt for proper tool operation. Tighten the [J 42386-A](#) bolts to 50 N·m (37 lb ft).

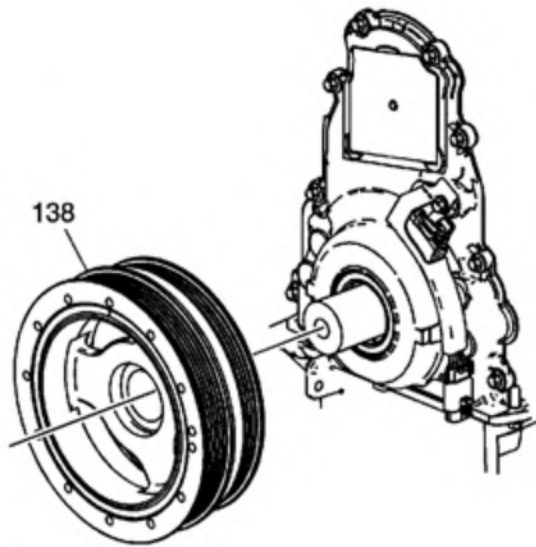


6. Remove the crankshaft balancer bolt (139).

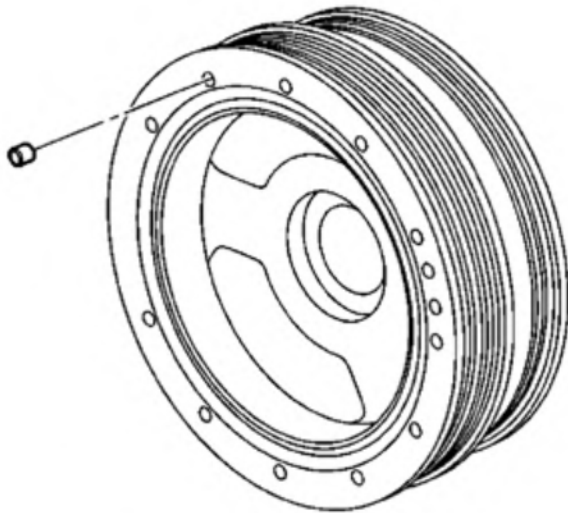
Do not discard the crankshaft balancer bolt. The balancer bolt will be used during the balancer installation procedure.



7. Use the [J 41816](#) (1) and the [J 41816-2](#) (2) in order to remove the crankshaft balancer.

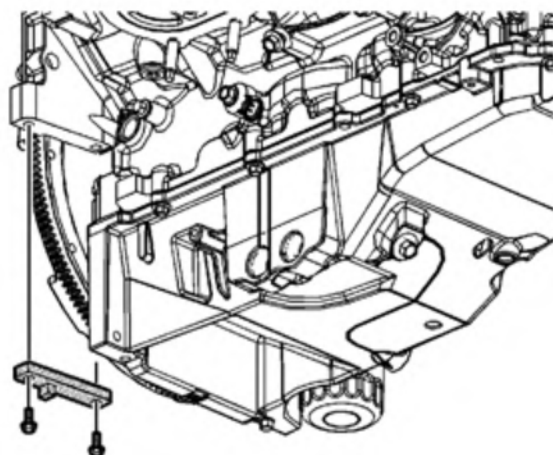


8. Remove the crankshaft balancer (138).



9. Note the position of the crankshaft balance weights, if applicable. Refer to [Engine Balancing](#) and [Crankshaft Balancer Cleaning and Inspection](#).

Installation Procedure

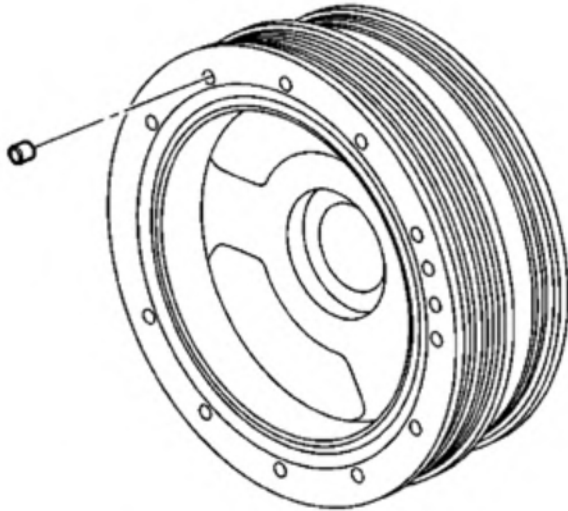
**Note:**

- If replacing the crankshaft balancer, note the location of any existing balance weights, if applicable. Install new balance weights into the new crankshaft balancer, if applicable. Crankshaft balance weights must be installed into the new balancer in the same location as the old balancer. A properly installed balance weight will be either flush or below flush with the face of the balancer. Refer to [Engine Balancing](#) and [Crankshaft Balancer Cleaning and Inspection](#).
- The crankshaft balancer installation and bolt tightening involves a four step tightening process. The first pass ensures that the balancer is installed completely onto the crankshaft. The second, third and fourth passes tighten the NEW bolt to the proper torque.

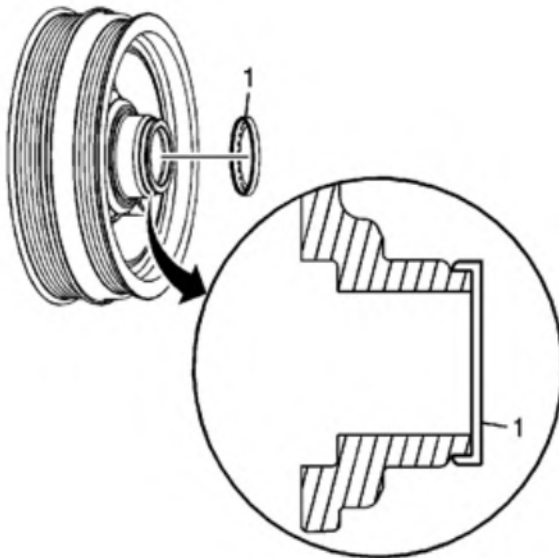
1. Install the [J 42386-A](#) and bolts.

Use one M10 - 1.5 x 120 mm and one M10 - 1.5 x 45 mm bolt for proper tool operation.

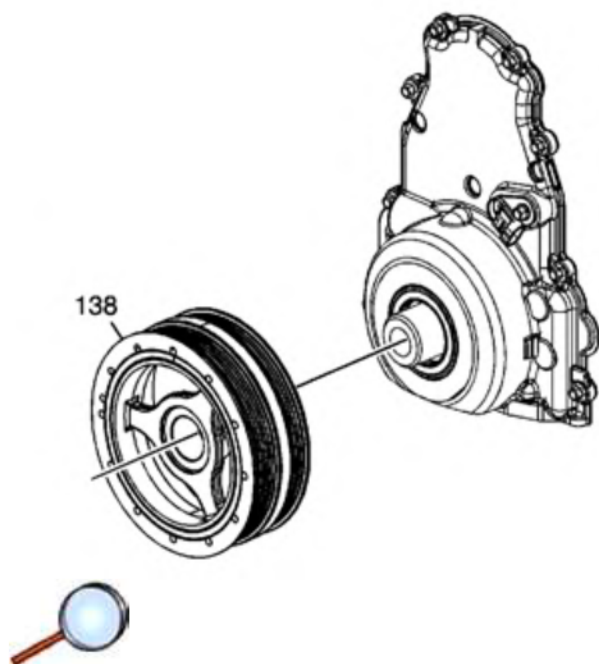
Tighten the [J 42386-A](#) bolts to 50 N·m (37 lb ft).



2. Using the old balancer as a reference, mark or scribe the new balancer in the same location, if applicable. Refer to [Crankshaft Balancer Cleaning and Inspection](#)
3. Install balance weights into the new balancer, if applicable.

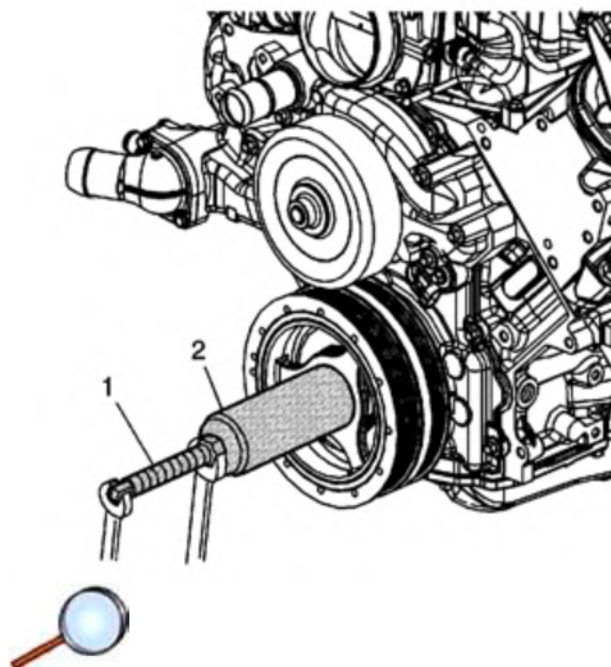


4. Install the crankshaft balancer washer (1) onto the crankshaft balancer.



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

5. Position the balancer (138) onto the end of the crankshaft.



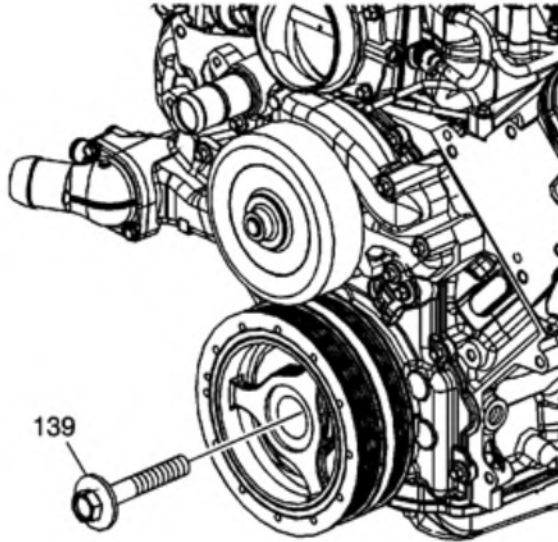
6. Use the [J 41665](#) (2) and the [EN-47812](#) (1) in order to install the balancer.

Assemble the [EN-47812](#) (1), nut, washer and the [J 41665](#) .

7. Insert the smaller end of the [J 41665](#) (2) into the front of the balancer.
 - 7.1. Use a wrench and hold the hex end of the [EN-47812](#) (1).
 - 7.2. Use a second wrench and rotate the installation tool nut clockwise until the balancer is

started onto the crankshaft.

- 7.3. Remove the [J 41665](#) (2) and reverse the installation tool.
8. Position the larger end of the [J 41665](#) (2) against the front of the balancer.
 - 8.1. Use a wrench and hold the hex end of the [EN-47812](#) (1).
 - 8.2. Use a second wrench and rotate the installation tool nut clockwise until the balancer is installed onto the crankshaft.
 - 8.3. Remove the balancer installation tools.



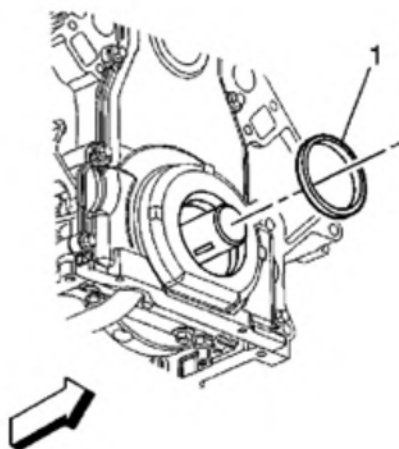
9. Install the NEW crankshaft balancer bolt (139).
 - Tighten the crankshaft balancer bolt a first pass to **150 N·m (110 lb ft)**.
 - Loosen the crankshaft balancer bolt a second pass to **360 degrees**.
 - Tighten the crankshaft balancer bolt a third pass to **50 N·m (37 lb ft)**.
 - Tighten the crankshaft balancer bolt a final pass to **230 degrees** using the [J 45059](#).
10. Remove the [J 42386-A](#).
11. Install the starter motor. Refer to [Starter Replacement](#).
12. Install the power steering gear. Refer to [Steering Gear Replacement](#).
13. Install the A/C drive belt. Refer to [Air Conditioning Compressor Belt Replacement](#).
14. Perform the crankshaft position (CKP) system variation learn procedure. Refer to [Crankshaft Position System Variation Learn](#).

Crankshaft Front Oil Seal Replacement

Special Tools

[J 41478](#) Crankshaft Front Oil Seal Installer

Removal Procedure

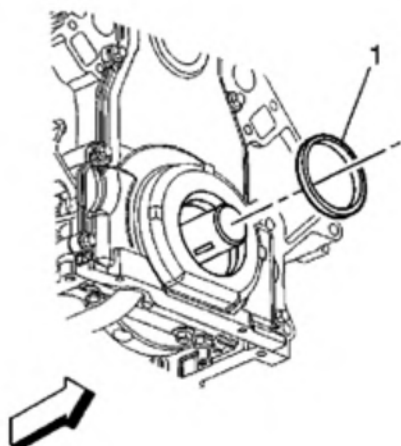


1. Remove the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).
2. Gently pry the crankshaft oil seal (1) from the front cover.

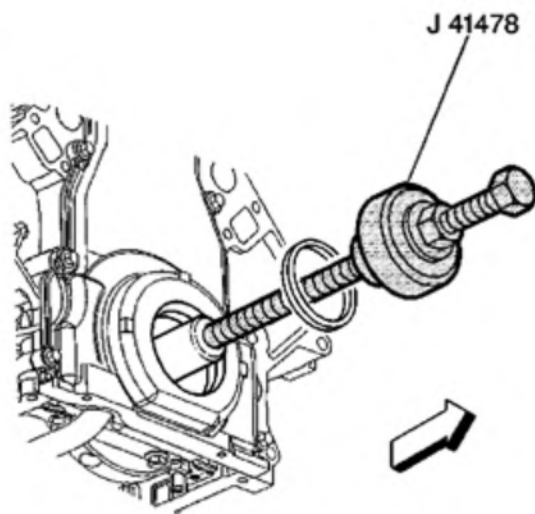
Installation Procedure

Important:

- Do not lubricate the oil seal sealing surface.
- Do not reuse the crankshaft oil seal.



1. Lubricate the outer edge of the oil seal (1) with clean engine oil.
2. Lubricate the front cover oil seal bore with clean engine oil.



3. Install the crankshaft front oil seal onto the [J 41478](#) guide.
4. Install the [J 41478](#) threaded rod (with nut, washer, guide, and oil seal) into the end of the crankshaft.
5. Use the [J 41478](#) in order to install the oil seal into the cover bore.
 - 5.1. Use a wrench and hold the hex on the installer tool.
 - 5.2. Use a second wrench and rotate the installer nut clockwise until the seal bottoms in the cover bore.
 - 5.3. Remove the tool.
 - 5.4. Inspect the oil seal for proper installation. The oil seal should be installed evenly and completely into the front cover bore.

6. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).

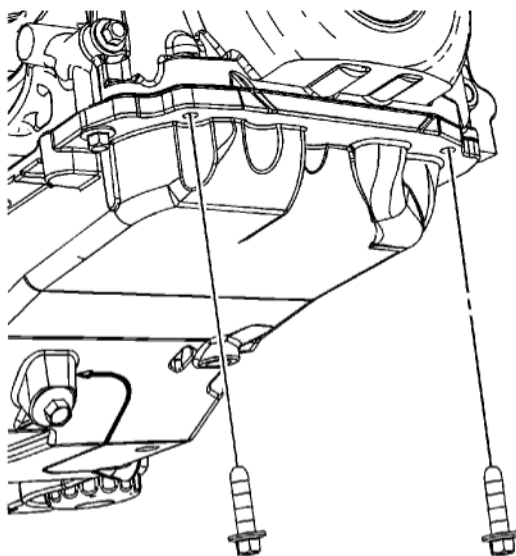
Engine Front Cover Replacement (6.2L and 7.0L)

Special Tools

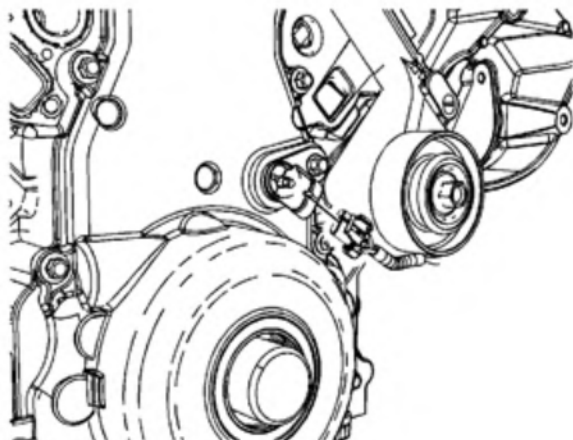
[EN-48853](#) Front Cover Alignment Tool

Removal Procedure

1. Remove the accessory drive belt. Refer to [Drive Belt Replacement - Accessory](#).
2. Remove the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).

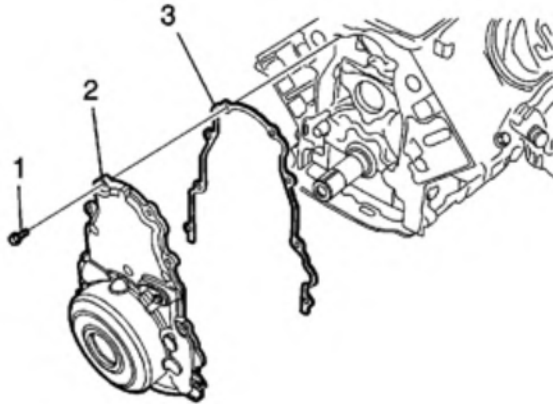


3. Remove the 2 front oil pan to front cover M8 bolts.
4. Remove the water pump. Refer to [Water Pump Replacement](#).

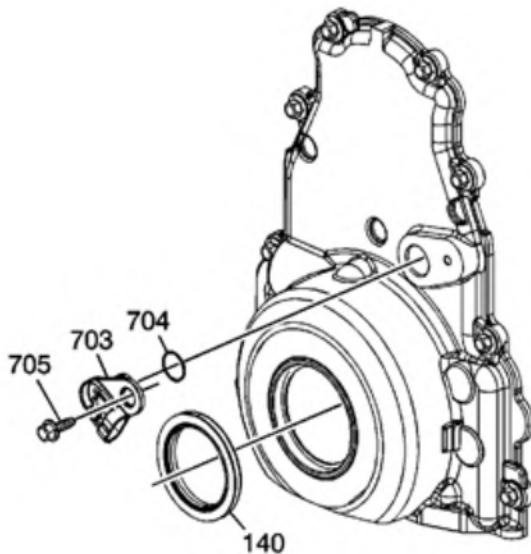




5. Disconnect the camshaft position (CMP) sensor electrical connector.

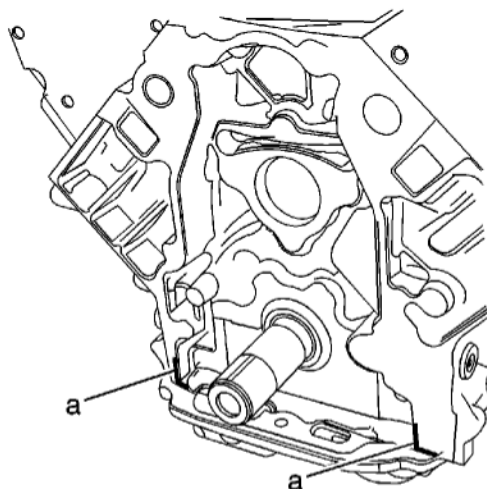


6. Remove the front cover bolts (1).
7. Remove the front cover (2) and gasket (3).
8. Discard the front cover gasket.
9. Clean and inspect the engine front cover. Refer to [Engine Front Cover Cleaning and Inspection](#).

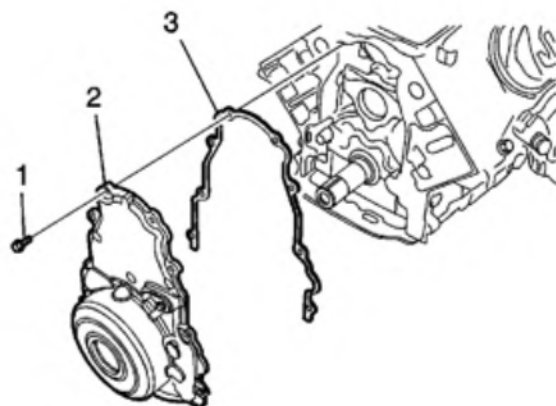


10. Remove the oil seal (140).
11. Remove the bolt (705), camshaft position (CMP) sensor (703).
12. Remove the O-ring (704) from the sensor, as required.

Installation Procedure



1. Apply a 5 mm (0.2 in) bead of sealant 20 mm (0.8 in) long to the engine block. Apply the sealant to the T joint location where the oil pan meets the front of the engine block. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the correct part number.



Note:

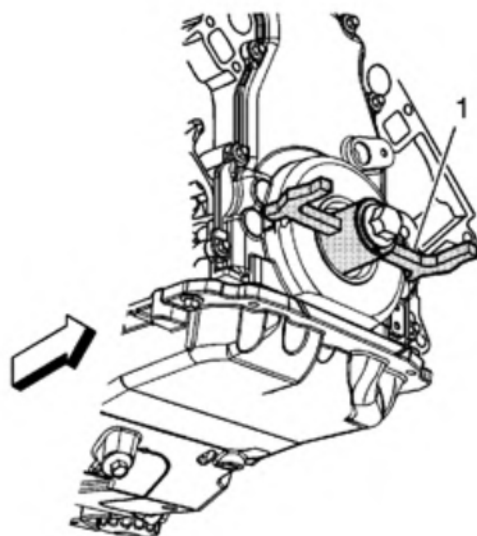
- Do not use the crankshaft oil seal or the engine front cover gasket again.
- Do not apply any type of sealant to the front cover gasket, unless specified.
- The special tools in this procedure are used to properly align the engine front cover at the oil pan surface and to center the crankshaft front oil seal.

- All gasket surfaces should be free of oil or other foreign material during assembly.
 - The crankshaft front oil seal MUST be centered in relation to the crankshaft.
 - The oil pan sealing surface at the front cover and engine block MUST be aligned within specifications.
 - An improperly aligned front cover may cause premature front oil seal wear and/or engine assembly oil leaks.
2. Install a NEW crankshaft front oil seal. Refer to [Crankshaft Front Oil Seal Replacement](#).
 3. Install the front cover gasket (3), front cover (2), and bolts (1).

Caution: Refer to [Fastener Caution](#) in the Preface section.

Note: Start the tool-to-front cover bolts. Do not tighten the bolts at this time.

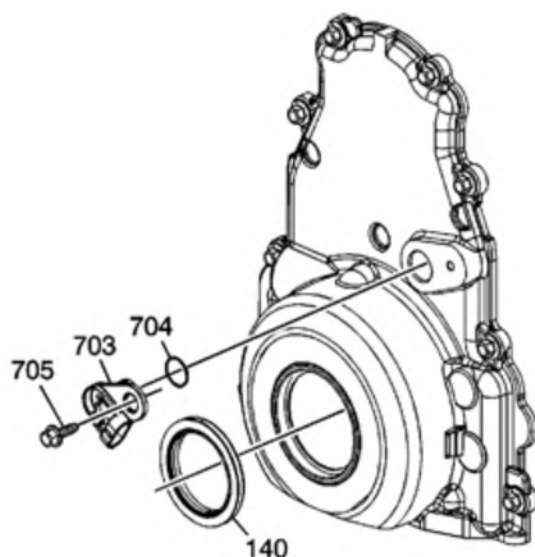
4. Tighten the cover bolts finger tight. Do not overtighten. Tighten the tool-to-engine block bolts to 25 N·m (18 lb ft).



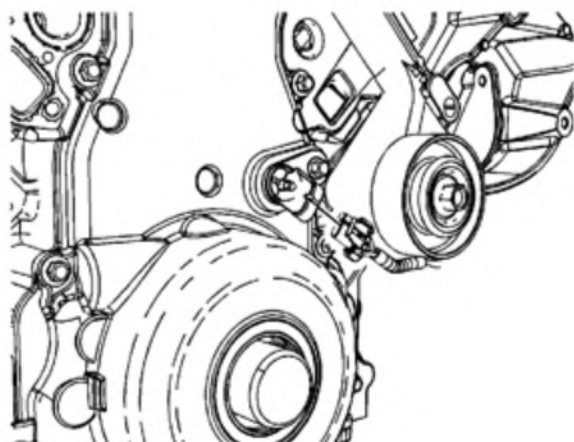
5. Install the [EN-48853](#) onto the crankshaft.
6. Tighten the crankshaft balancer bolt by hand until snug. Do not overtighten.
7. Install the front cover.

Note: Align the tapered legs of the tool with the machined alignment surfaces on the front cover.

8. Remove the tool.



9. Inspect the CMP sensor O-ring seal (704) for cuts or damage. If the seal is not cut or damaged, it may be used again.
10. Lubricate the O-ring seal with clean engine oil.
11. Install the O-ring seal onto the sensor (703).
12. Install the sensor to the cover.
13. Install the CMP sensor and bolt (705) and tighten to **12 N·m (106 lb in)**.
14. Install the new crankshaft front oil seal. Refer to [Crankshaft Front Oil Seal Replacement](#).



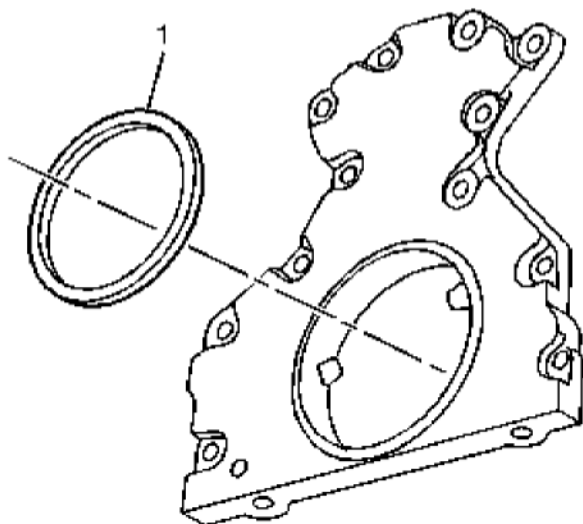
15. Connect the CMP sensor electrical connector.
16. Install the water pump. Refer to [Water Pump Replacement](#).
17. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).
18. Install the accessory drive belt. Refer to [Drive Belt Replacement - Accessory](#).

Crankshaft Rear Oil Seal Replacement

Special Tools

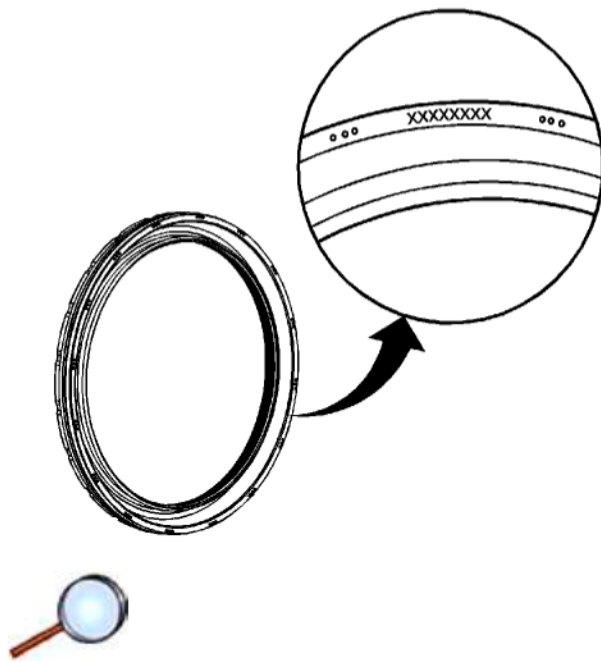
[J 41479](#) Crankshaft Rear Oil Seal Installer

Removal Procedure



1. Remove the engine flywheel. Refer to [Engine Flywheel Replacement](#).
2. Gently pry the crankshaft rear oil seal (1) from the rear cover.

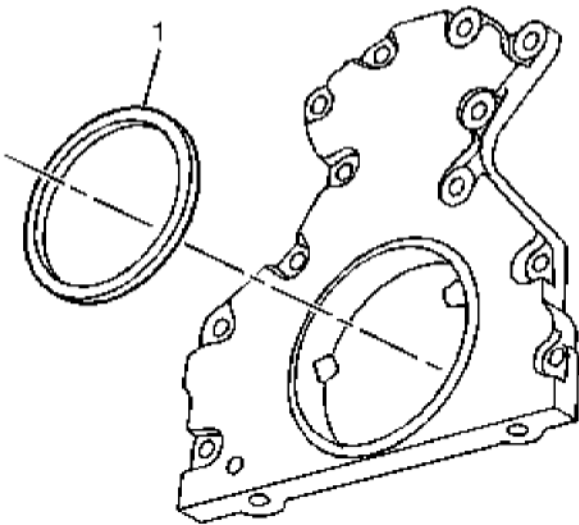
Installation Procedure



Important: For proper orientation, note the installation direction of the oil seal. The oil seal is a reverse-lip design.

The part number is applied to the outside face of the seal, as shown.

1. Inspect the seal and identify the part number markings for proper orientation.



Important:

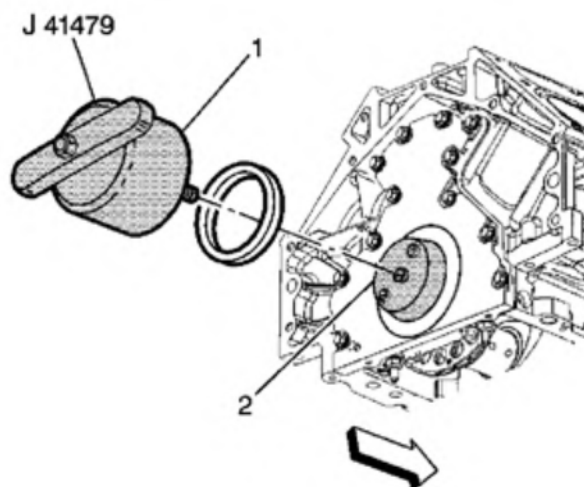
- Do not lubricate the oil seal inside diameter (ID) of the crankshaft surface.
- Do not reuse the crankshaft rear oil seal.

2. Lubricate the outside diameter (OD) of the oil seal (1) with clean engine oil.

DO NOT allow oil or other lubricants to contact the seal surface.

3. Lubricate the rear cover oil seal bore with clean engine oil.

DO NOT allow oil or other lubricants to contact the crankshaft surface.



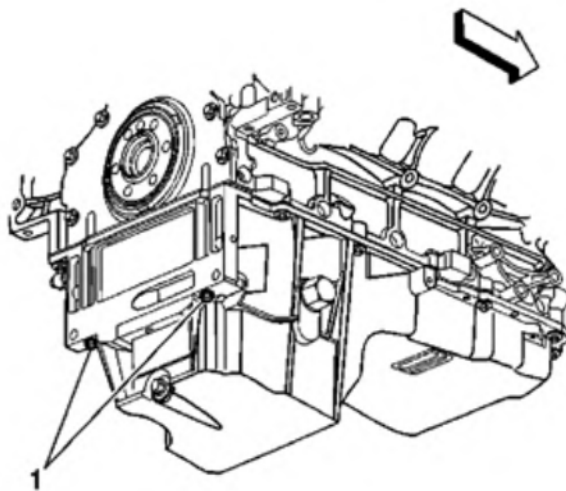
4. Install the [J 41479](#) cone (2) and bolts onto the rear of the crankshaft.
5. Tighten the bolts until snug. Do not overtighten.
6. Install the rear oil seal onto the tapered cone (2) and push the seal to the rear cover bore.
7. Thread the [J 41479](#) threaded rod into the tapered cone until the tool (1) contacts the oil seal.
8. Align the oil seal onto the tool (1).
9. Rotate the handle of the tool (1) clockwise until the seal enters the rear cover and bottoms into the cover bore.
10. Remove the [J 41479](#).
11. Install the engine flywheel. Refer to [Engine Flywheel Replacement](#).

Crankshaft Rear Oil Seal Housing Replacement

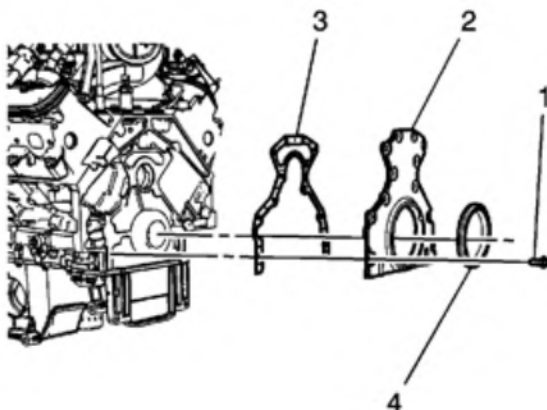
Special Tools

- [J 41476](#) Front and Rear Cover Alignment Tool
- [J 41479-2A](#) Crankshaft Rear Oil Seal Installation Guide

Removal Procedure



1. Remove the engine flywheel. Refer to [Engine Flywheel Replacement](#).
2. Remove the oil pan-to-rear oil seal housing bolts (1).



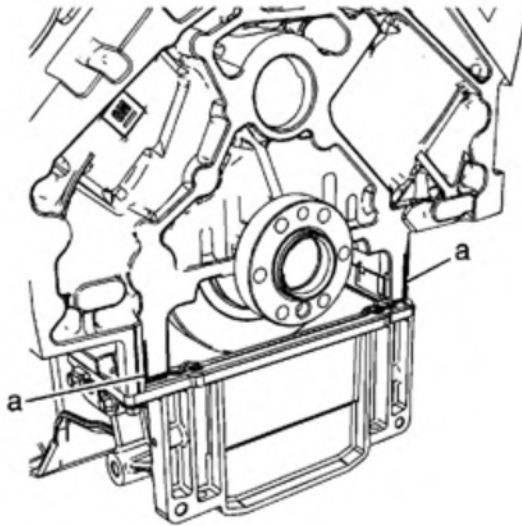


3. Remove the rear oil seal housing bolts (1).
4. Remove the rear oil seal housing (2) and gasket (3). Discard the gasket.
5. Remove and discard the rear oil seal (4).

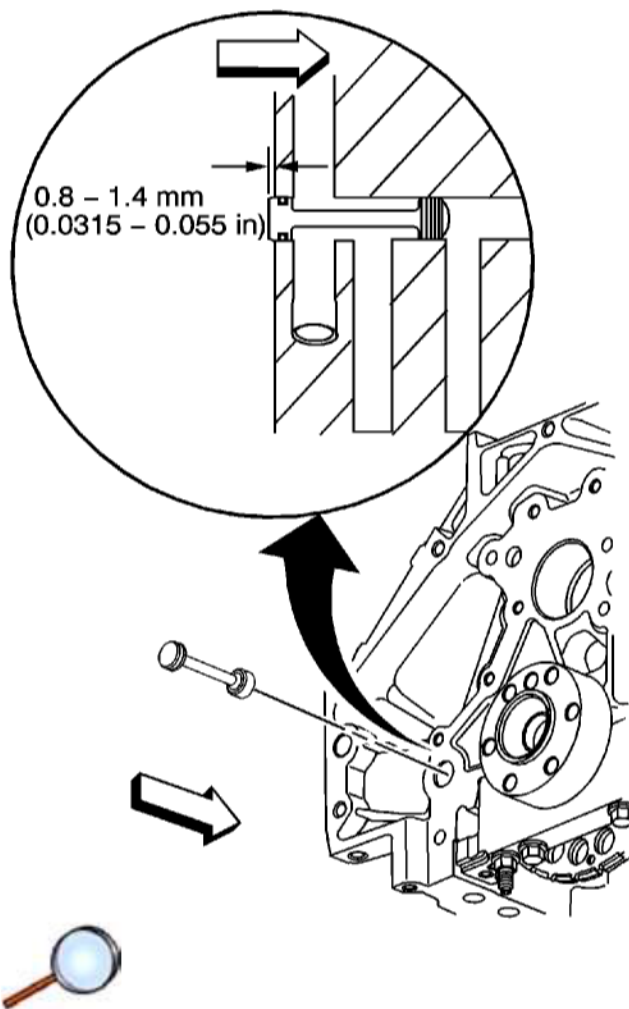
Installation Procedure

Note:

- Do not reuse the crankshaft oil seal or rear cover gasket.
- Do not apply any type of sealant to the rear cover gasket, unless specified.
- The special tool in this procedure is used to properly center the crankshaft rear oil seal.
- All gasket surfaces should be free of oil or other foreign material during assembly.
- The crankshaft rear oil seal **MUST** be centered in relation to the crankshaft.
- An improperly aligned rear cover may cause premature rear oil seal wear and/or engine assembly oil leaks.



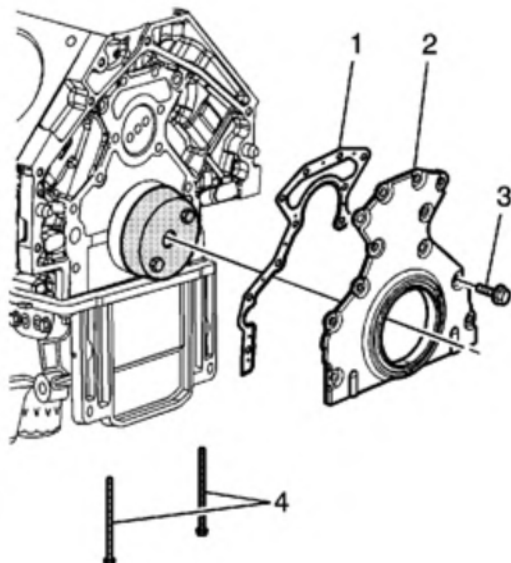
1. Apply a 5 mm (0.2 in) bead of sealant, 20 mm (0.8 in) to the 2 joints (a) at the rear of the block/pan. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).



2. Inspect the rear oil gallery plug for proper installation.

Installation Procedure - Cover with Seal

1. Install the [J 41479-2A](#) cone and bolts onto the rear of the crankshaft.





2. Install the NEW rear housing gasket (1), rear housing with seal (2), rear housing-to-engine bolts (3) and oil pan-to-rear housing bolts (4).

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Tighten the rear housing-to-engine bolts (3) until snug. Do not overtighten.

Tighten

Tighten the oil pan-to-rear housing bolts (4) to 12 N·m (106 lb in).

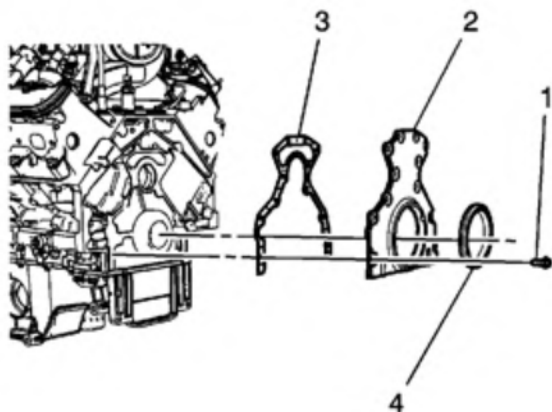
4. Tighten the rear housing-to-engine bolts (3).

Tighten

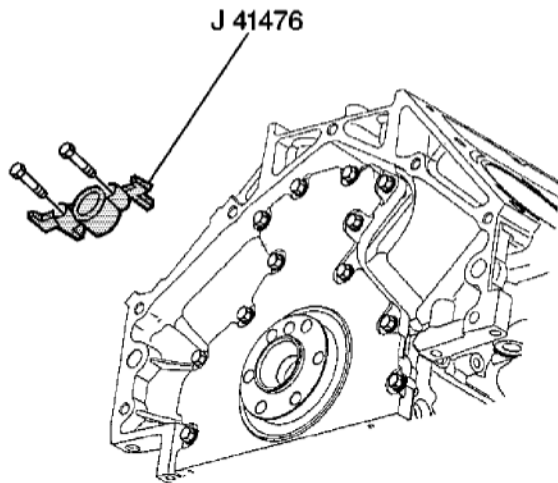
Tighten the bolts to 30 N·m (22 lb ft).

5. Remove the [J 41479-2A](#).
6. Install the engine flywheel. Refer to [Engine Flywheel Replacement](#).

Installation Procedure - Cover without Seal

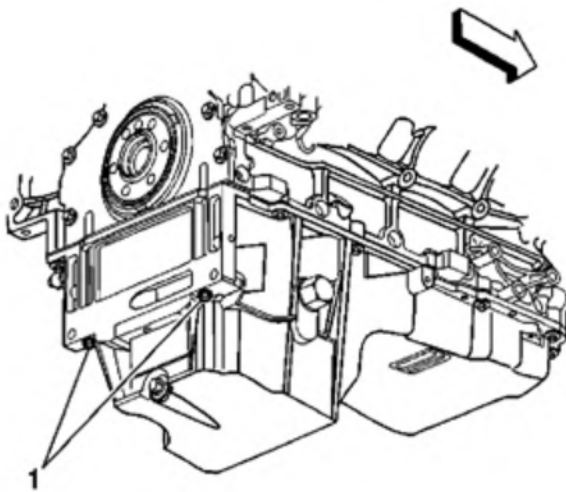


1. Position a NEW rear oil seal housing gasket (3) and the housing (2) to the engine.
2. Install the rear oil seal housing bolts (1) until snug. Do not overtighten.
3. Rotate the crankshaft until 2 opposing flywheel bolts holes are parallel to the oil pan surface.



Note: The tapered legs of the alignment tool must enter the rear cover oil seal bore.

4. Install the [J 41476](#) and bolts onto the rear of the crankshaft.
5. Tighten the [J 41476](#) bolts until snug. Do not overtighten.



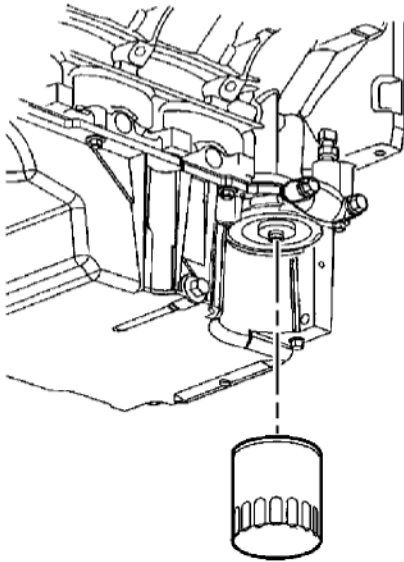
6. Install the oil pan-to-rear oil seal housing bolts (1).

Tighten

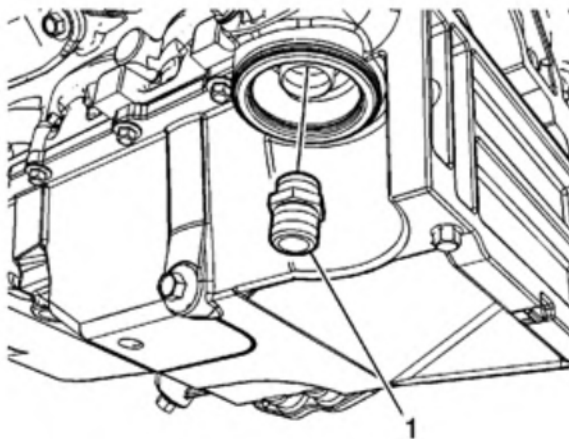
1. Tighten the oil pan-to-rear cover bolts to 12 N·m (106 lb in).
2. Tighten the rear oil seal housing-to-engine bolts to 30 N·m (22 lb ft).
7. Remove the [J 41476](#).
8. Install a NEW crankshaft rear oil seal. Refer to [Crankshaft Rear Oil Seal Replacement](#).
9. Install the engine flywheel. Refer to [Engine Flywheel Replacement](#).

Oil Filter Adapter Replacement

Removal Procedure



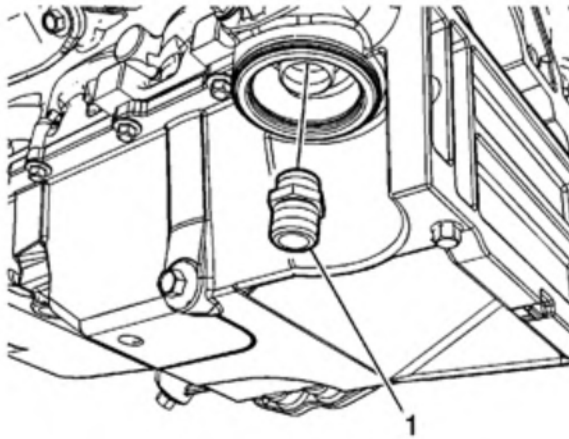
1. Remove the oil filter.



2. Remove the oil filter adapter (1).

Installation Procedure

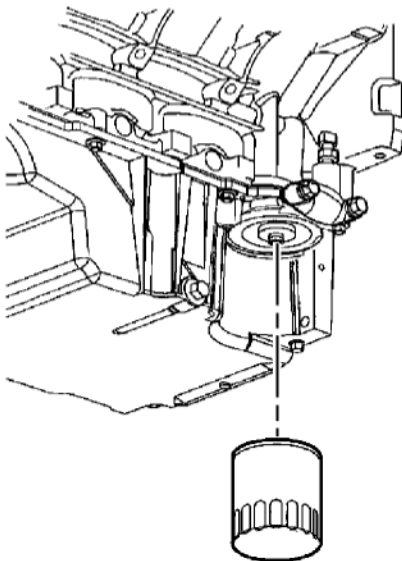
Caution: Refer to [Fastener Caution](#) in the Preface section.



1. Install the oil filter adapter (1).

Tighten

Tighten the oil filter adapter to 55 N·m (40 lb ft).

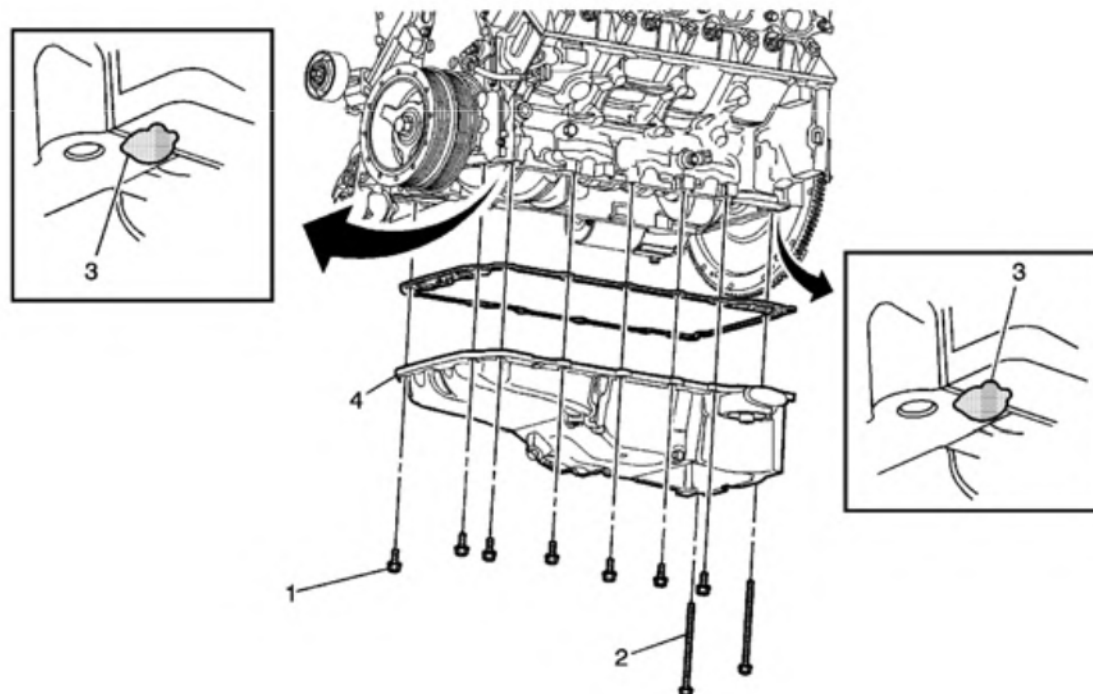


2. Install the oil filter.

Tighten

Tighten the oil filter to 30 N·m (22 lb ft).

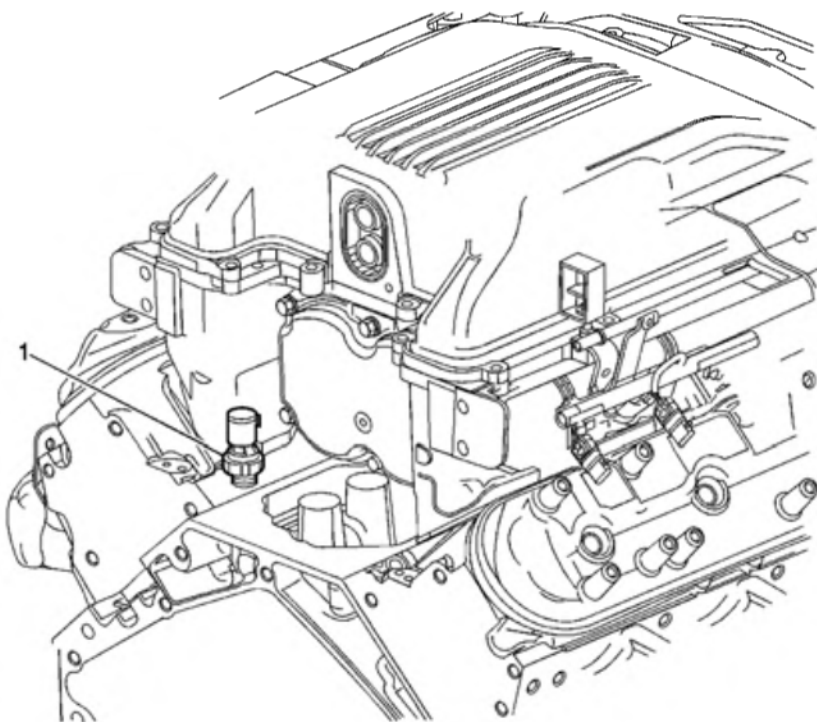
Oil Pan Replacement



Callout	Component Name
Preliminary Procedures 1. Remove the front frame. Refer to Front Frame Replacement. 2. Remove the oil filter. Refer to Engine Oil and Oil Filter Replacement. 3. Remove the starter assembly. Refer to Starter Motor Replacement. 4. Reposition the oil cooler lines as needed.	
1	Oil Pan Fastener (Qty: 12) Caution: Refer to Fastener Caution in the Preface section. Tighten 25 N·m (18 lb ft)
2	Oil Pan Fastener (Qty: 2) Tighten 12 N·m (106 lb in)
	Oil Pan Sealant Procedure

3	1. Apply a 5 mm (0.2 in) bead of sealant 20 mm (0.8 in) long to the engine block. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Apply the sealant directly onto the tabs of the front cover gasket that protrude into the oil pan surface. Tip • The alignment of the structural oil pan is critical. The rear bolt hole locations of the oil pan provide mounting points for the transmission housing. To ensure the rigidity of the powertrain and correct transmission alignment, it is important that the rear of the block and the rear of the oil pan are flush or even. The rear of the oil pan must NEVER protrude beyond the engine block and the transmission housing plane. • A new oil pan gasket should be used whenever the oil pan is removed from the engine assembly.
4	Oil Pan Procedure 1. Disconnect any electrical connectors. 2. Transfer components as necessary.

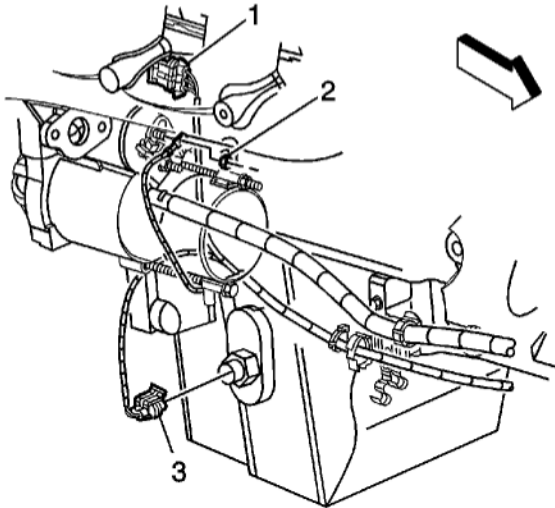
Engine Oil Pressure Sensor and/or Switch Replacement



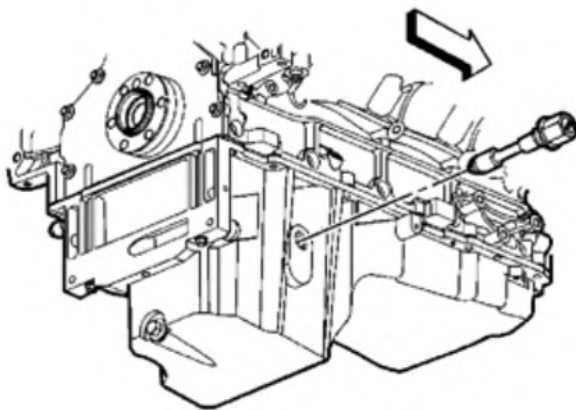
Callout	Component Name
Preliminary Procedure	
Remove the rear intake manifold cover. Refer to Intake Manifold Cover Replacement - Rear .	
1	Engine Oil Pressure Sensor and/or Switch Caution: Refer to Fastener Caution in the Preface section. Procedure 1. Disconnect any electrical connectors. 2. Transfer components as necessary. Tighten 35 N·m (25 lb ft)

Engine Oil Level Sensor and/or Switch Replacement

Removal Procedure



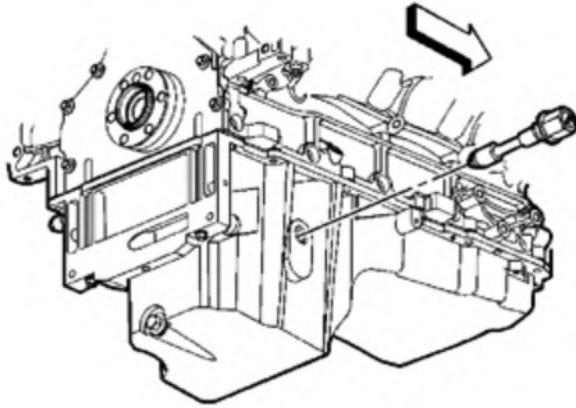
1. Raise the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Drain the engine of oil.
3. Disconnect the electrical connector (1).



4. Remove the engine oil level sensor.

Installation Procedure

Caution: Refer to [Fastener Caution](#) in the Preface section.



1. Install the drain plug.

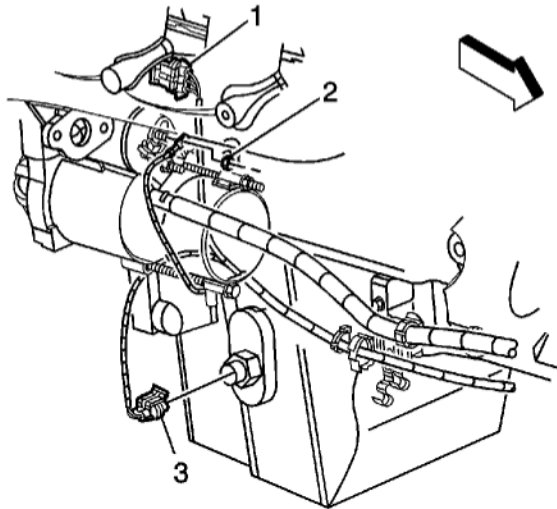
Tighten

Tighten the drain plug to 25 N·m (18 lb ft).

2. Install the engine oil level sensor.

Tighten

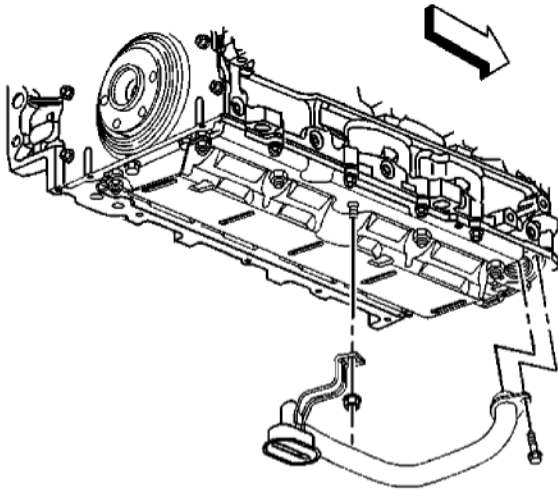
Tighten the drain plug to 20 N·m (15 lb ft).



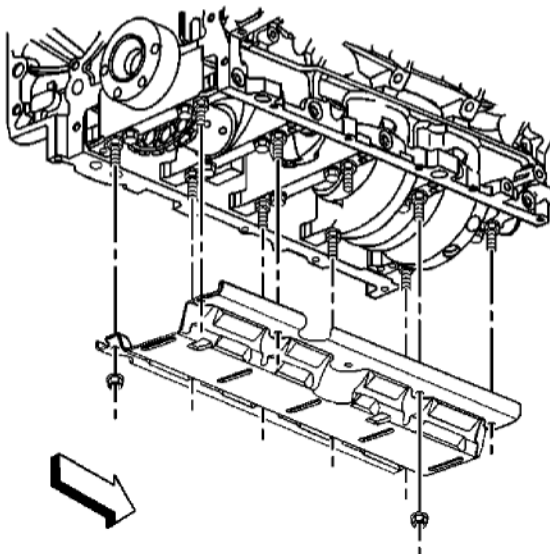
3. Reconnect the electrical connector (1).
4. Lower the vehicle.
5. Refill the engine. Refer to [Approximate Fluid Capacities](#).

Oil Pump, Screen, and Crankshaft Oil Deflector Replacement

Removal Procedure

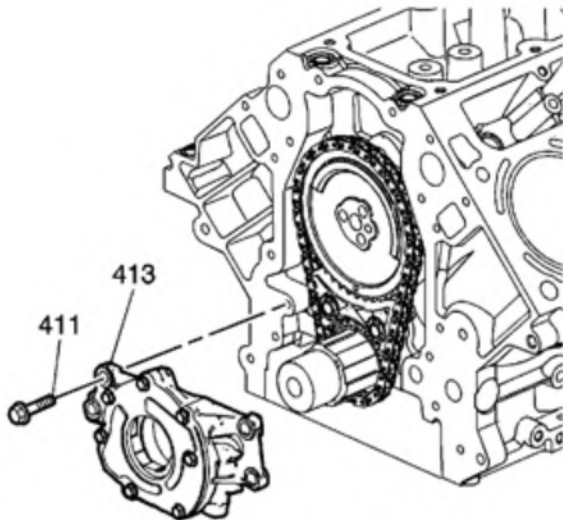


1. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).
2. Remove the engine oil pan. Refer to [Oil Pan Replacement](#).
3. Remove the oil pump screen bolt and nut.
4. Remove the oil pump screen and O-ring seal.
5. Remove the O-ring seal from the pump screen.
6. Discard the O-ring seal.





7. Remove the remaining crankshaft oil deflector nuts.
8. Remove the crankshaft oil deflector.



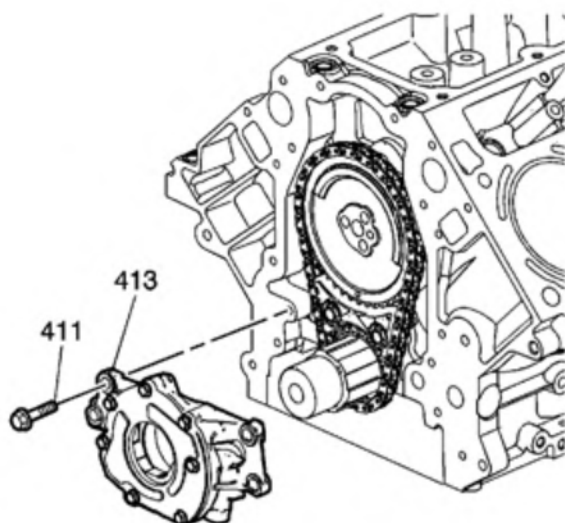
9. Remove the oil pump (413) and bolts (411).

Note: Do not allow dirt or debris to enter the oil pump, cap the ends as necessary.

10. Remove the oil pump.
11. Clean and inspect the oil pump. Refer to [Oil Pump Cleaning and Inspection](#).

Installation Procedure

Note: Inspect the engine block oil gallery passages. These surfaces must be clear and free of debris or restrictions.



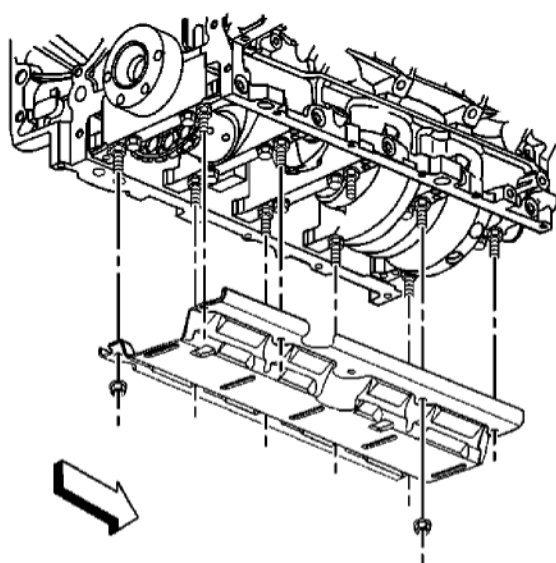
1. Align the splined surfaces of the crankshaft sprocket and the oil pump drive gear and install the oil pump (413).
2. Install the oil pump (413) onto the crankshaft sprocket until the pump housing contacts the face of the engine block.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Install the oil pump bolts (411).

Tighten

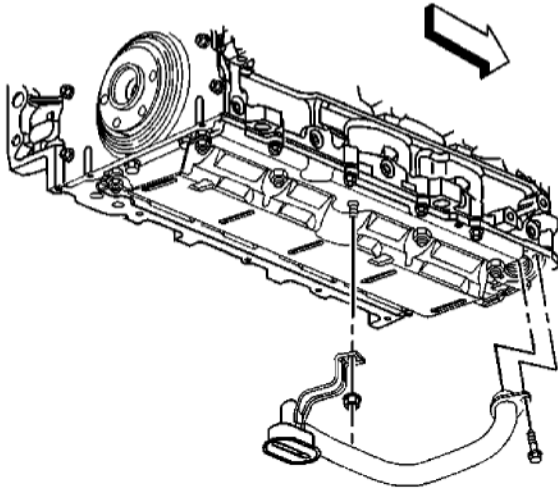
Tighten the oil pump bolts to 25 N·m (18 lb ft).



4. Install the crankshaft oil deflector.
5. Install the crankshaft oil deflector nuts.

Tighten

Tighten the crankshaft oil deflector nuts to 25 N·m (18 lb ft).



6. Lubricate a NEW oil pump screen O-ring seal with clean engine oil.
7. Install the NEW O-ring seal onto the oil pump screen.

Note: Push the oil pump screen tube completely into the oil pump prior to tightening the bolt. Do not allow the bolt to pull the tube into the pump.

Align the oil pump screen brackets with the correct crankshaft bearing cap studs.

8. Install the oil pump screen.
9. Install the oil pump screen bolt and nut.

Tighten

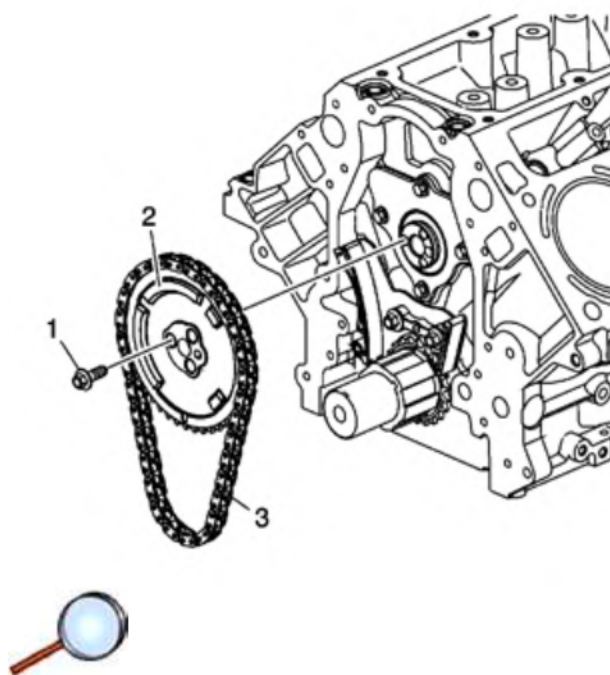
- Tighten the oil pump screen bolt to 12 N·m (106 lb in).
 - Tighten the oil pump screen nut to 25 N·m (18 lb ft).
10. Install the engine oil pan. Refer to [Oil Pan Replacement](#).
 11. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

Camshaft Timing Chain and Sprocket Replacement (LSA)

Special Tools

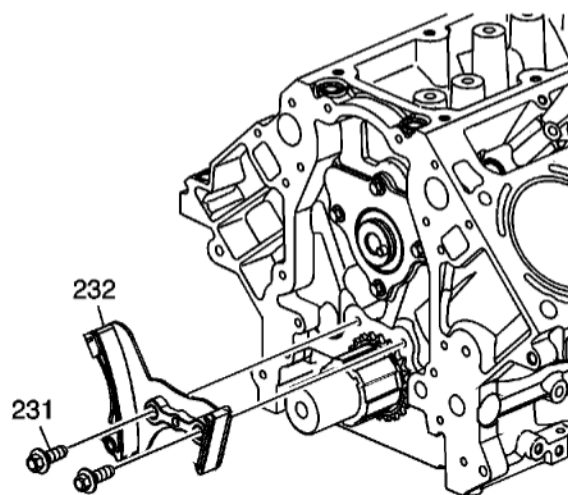
- [EN 46330](#) Timing Belt Tensioner Retaining Pin
- [J 8433](#) Pulley Puller
- [J 41478](#) Crankshaft Front Oil Seal Installer
- [J 41558](#) Crankshaft Sprocket Remover
- [J 41665](#) Crankshaft Balancer and Sprocket Installer
- [J 41816-2](#) Crankshaft End Protector

Removal Procedure

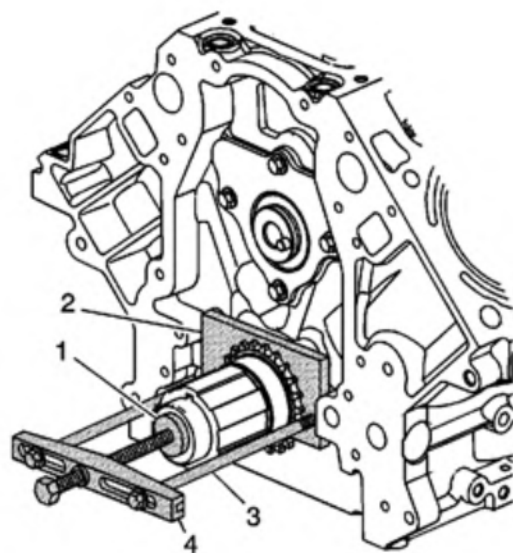


Caution: Do not turn the crankshaft assembly after the timing chain has been removed in order to prevent damage to the piston assemblies or the valves.

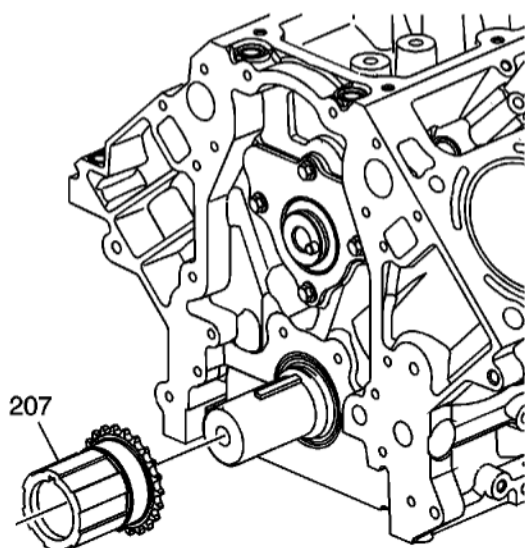
1. Remove the oil pump. Refer to [Oil Pump, Screen and Crankshaft Oil Deflector Removal](#).
2. Remove and discard the camshaft sprocket bolt (1).
3. Remove the camshaft sprocket (2) and timing chain (3).



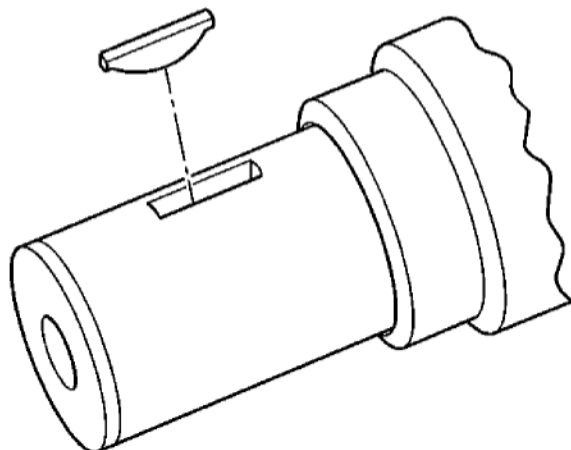
4. Remove the bolts (231) and timing chain tensioner (232).



5. Use the [J 41816-2](#) (1), the [J 41558](#) (2), bolts (3), and the [J 8433](#) (4) in order to remove the crankshaft sprocket.

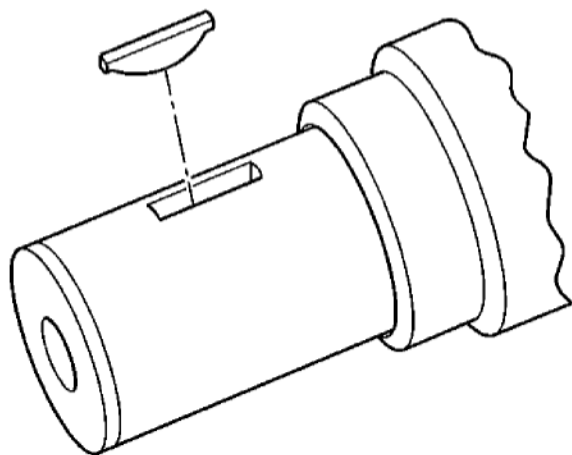


6. Remove the crankshaft sprocket (207).

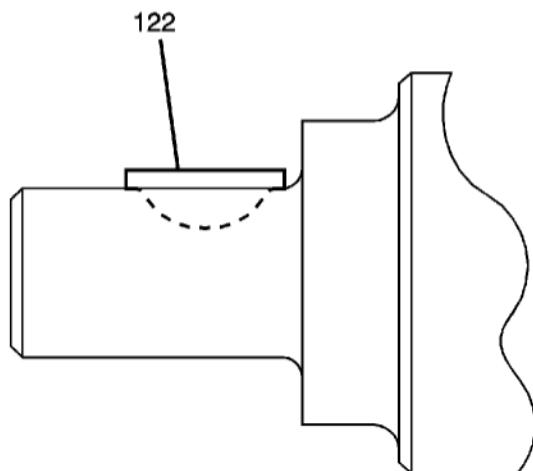


7. Remove the crankshaft sprocket key, as required.

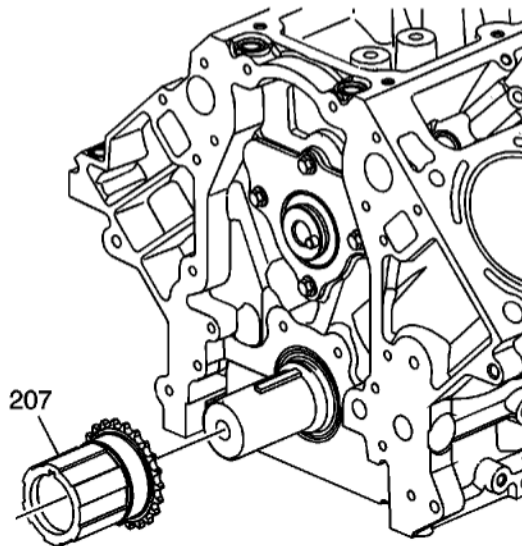
Installation Procedure



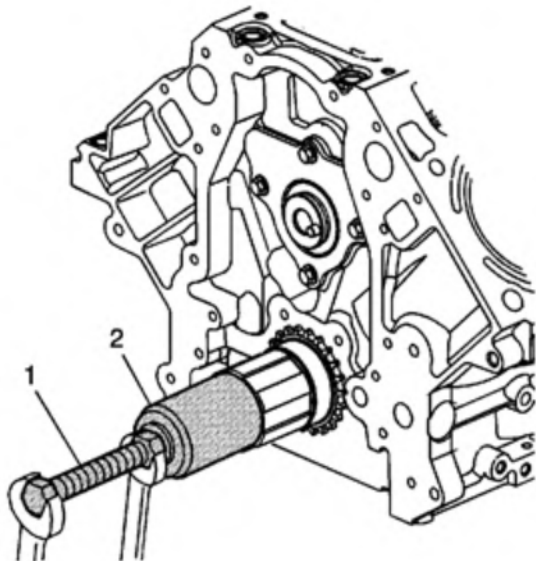
1. Install the key into the crankshaft keyway, if previously removed.



2. Tap the key (122) into the keyway until both ends of the key bottom onto the crankshaft.



3. Install the crankshaft sprocket (207) onto the front of the crankshaft. Align the crankshaft key with the crankshaft sprocket keyway.

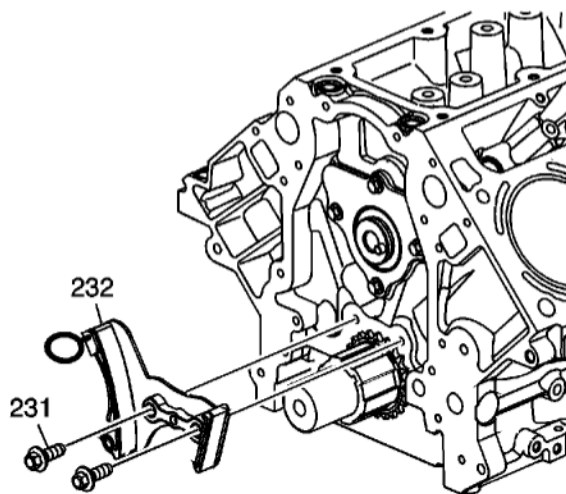


4. Use the [J 41478](#) (1) and the [J 41665](#) (2) in order to install the crankshaft sprocket.
Install the sprocket onto the crankshaft until fully seated against the crankshaft flange.
5. Rotate the crankshaft sprocket until the alignment mark is in the 12 o'clock position.

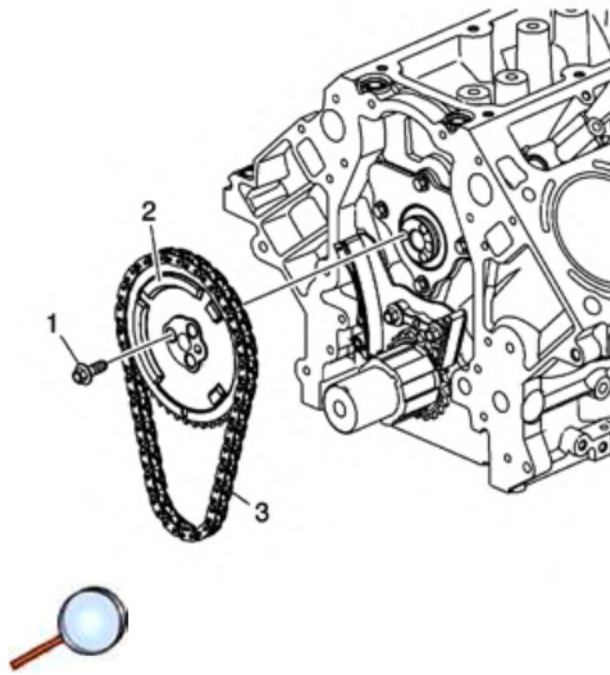


6. Compress the timing chain tensioner guide and install the [EN 46330](#) .

Caution: Refer to [Fastener Caution](#) in the Preface section.

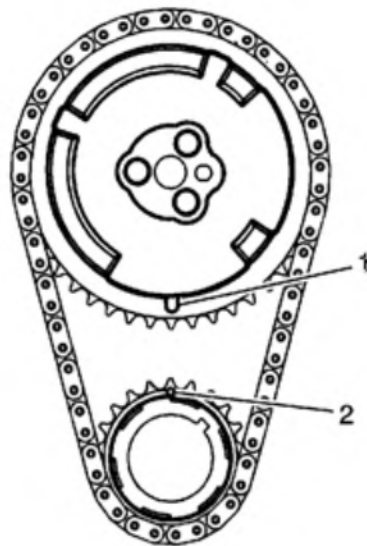


7. Install the timing chain tensioner (232) and bolts (231) and tighten the bolts to **25 N·m (18 lb ft)**.

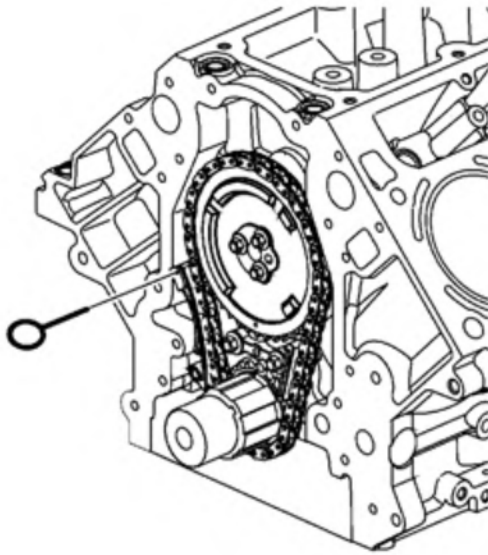
**Note:**

- The sprocket teeth and timing chain must mesh.
- The camshaft and the crankshaft sprocket alignment marks **MUST** be aligned properly.

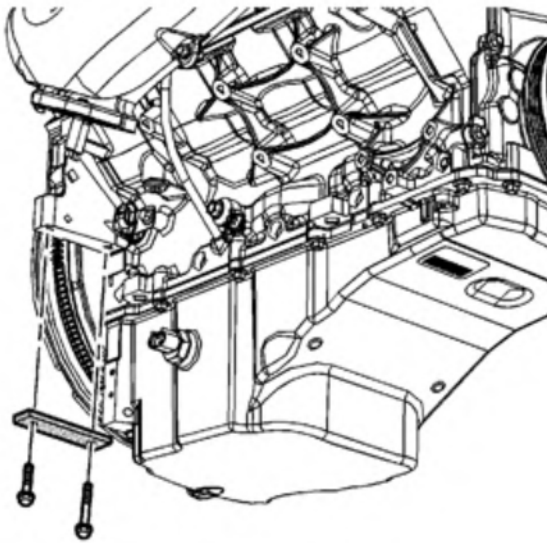
8. Install the camshaft sprocket (2), timing chain (3), and bolt (1).



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



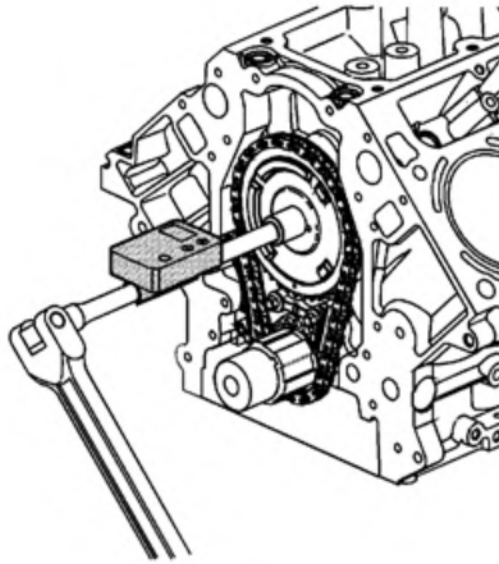
10. Remove the [EN 46330](#) .



Note: Do not apply threadlock to the flex plate bolts at this time.

11. Temporarily install the automatic transmission flex plate or manual transmission flywheel and bolts. Refer to [Engine Flywheel Installation](#).
12. Install the [J 42386-A](#) and bolts. Use 1 M10-1.5 x 120 mm bolt and 1 M10-1.5 x 45 mm bolt for proper tool operation.

Tighten the [J 42386-A](#) bolts to 50 N·m (37 lb ft).



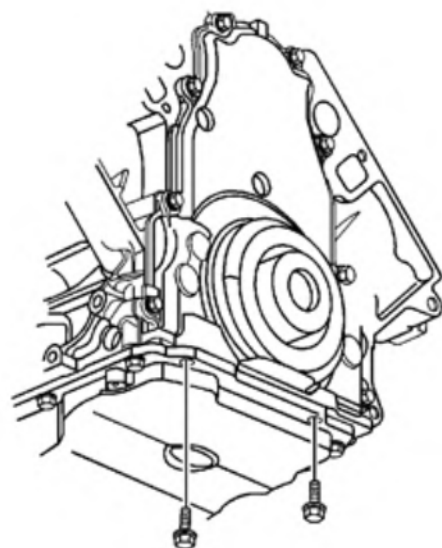
13. Tighten the camshaft sprocket bolt.
 - Tighten the camshaft sprocket bolt a first pass to **75 N·m (55 lb ft)**.
 - Tighten the camshaft sprocket bolt a final pass an additional **50 degrees** using the [J 45059](#).
14. Remove the [J 42386-A](#) and bolts.
15. Remove the automatic transmission flex plate or manual transmission flywheel and bolts. Refer to [Engine Flywheel Removal](#).
16. Install the oil pump. Refer to [Oil Pump, Screen and Crankshaft Oil Deflector Removal](#).

Camshaft Replacement (6.2L and 7.0L)

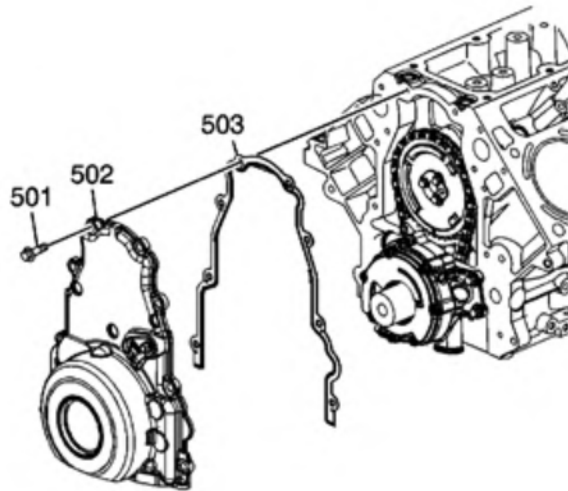
Special Tools

- [EN-47812](#) Installer Bolt
- [EN-47813](#) Front Cover Alignment

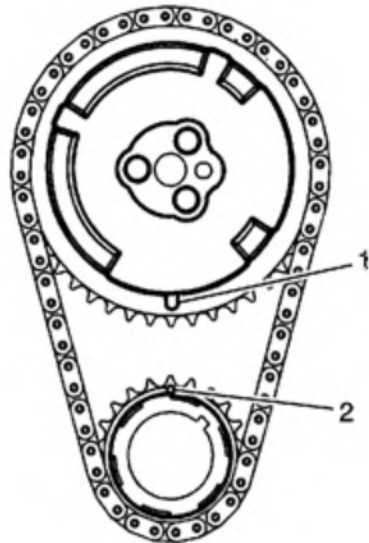
Removal Procedure



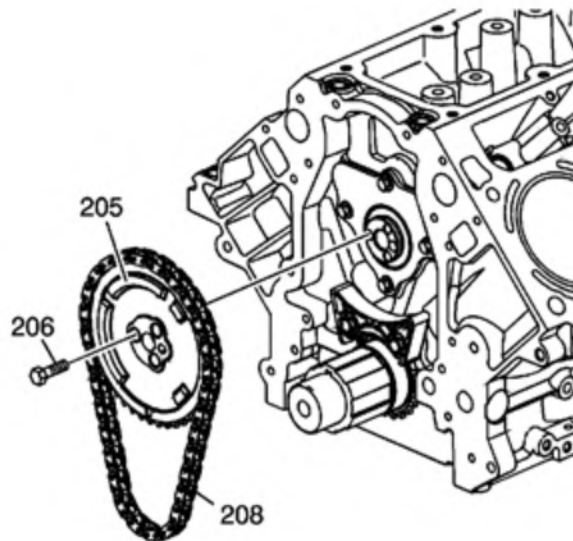
1. Remove the engine assembly. Refer to [Engine Replacement](#).
2. Remove the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).
3. Remove the left and right exhaust manifolds Refer to [Exhaust Manifold Removal - Left Side](#) and [Exhaust Manifold Removal - Right Side](#).
4. Remove the water pump. Refer to [Water Pump Removal](#).
5. Remove the supercharger. Refer to [Supercharger Removal](#).
6. Remove the left and right valve rocker arm covers. Refer to [Valve Rocker Arm Cover Removal - Left Side](#) and [Valve Rocker Arm Cover Removal - Right Side](#).
7. Remove the valve rocker arms and push rods. Refer to [Valve Rocker Arm and Push Rod Removal](#).
8. Remove the left and right cylinder heads. Refer to [Cylinder Head Removal - Left Side](#) and [Cylinder Head Removal - Right Side](#).
9. Remove the valve lifters. Refer to [Valve Lifter Removal](#).
10. Remove the oil pan-to-front cover bolts.



11. Remove the front cover bolts (501).
12. Remove the front cover (502) and gasket (503). Discard the old gasket.

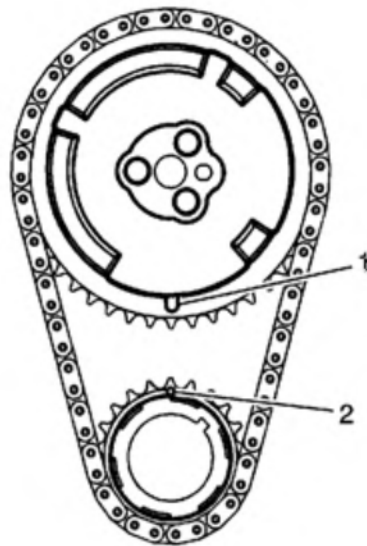


13. Rotate the engine in order to align the timing marks (1, 2).

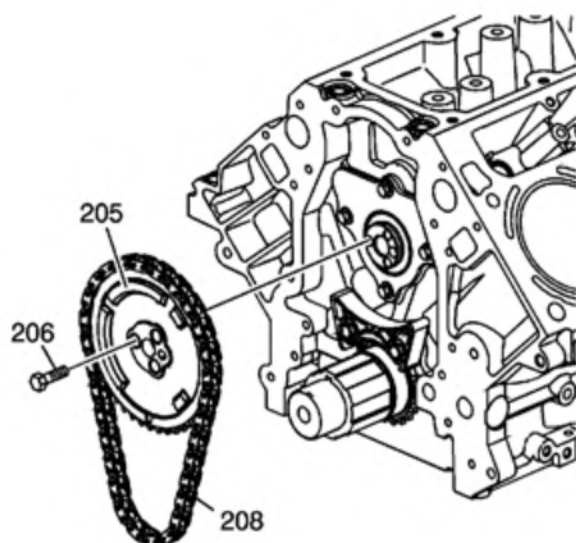


14. Remove the camshaft sprocket bolts.
15. Remove the timing chain from the camshaft sprocket, and allow the timing chain to rest on the crankshaft sprocket.
16. Remove the camshaft. Refer to [Camshaft Removal](#).

Installation Procedure



1. Install the camshaft. Refer to [Camshaft Installation](#).
2. Align the camshaft sprocket alignment mark in the 6 o'clock position (1).

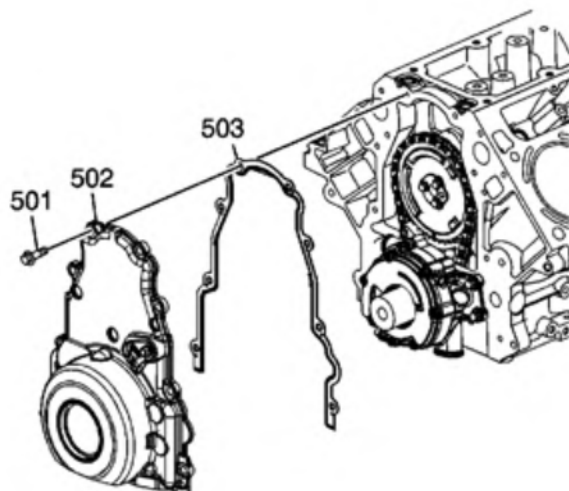


3. Install the camshaft sprocket and timing chain.

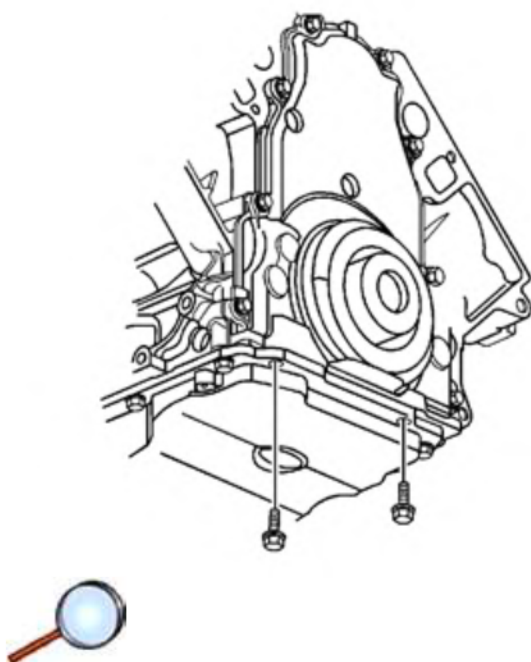
Recheck the alignment of the timing marks.

Caution: Refer to [Fastener Caution](#) in the Preface section.

4. Install the camshaft sprocket bolts and tighten to **30 N·m (22 lb ft)**.
5. Apply a 5 mm (0.2 in) bead of sealant 20 mm (0.8 in) long to the oil pan to engine block junction. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the correct part number.



6. Install the front cover (502) and a new gasket (503).
7. Install the front cover bolts (501) until snug.



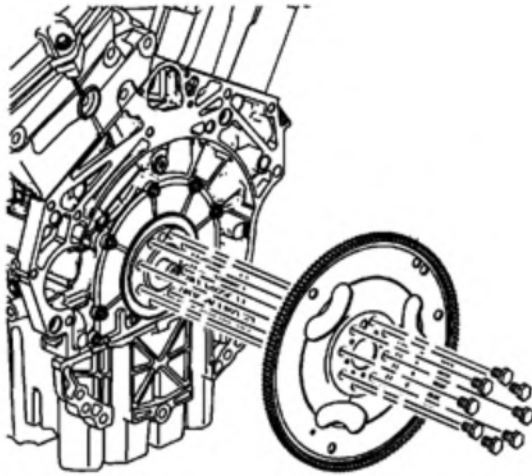
8. Install the oil pan-to-front cover bolts until snug.
9. Install the [EN-47812](#) over the bolt to the crankshaft.
10. Install the [EN-47813](#).
11. Insert the tapered surface of the tool into the oil seal bore of the cover [EN-47812](#) washer and nut.

Tighten the nut by hand until snug. Do not overtighten. Tighten the engine front cover bolts to **30 N·m (22 lb ft)**.

12. Remove the tools.
13. Install a NEW crankshaft front oil seal. Refer to [Crankshaft Front Oil Seal Installation](#).
14. Install the valve lifters. Refer to [Valve Lifter Installation](#).
15. Install the right and left cylinder heads. Refer to [Cylinder Head Installation - Right Side](#) and [Cylinder Head Installation - Left Side](#).
16. Install the valve rocker arms and push rods. Refer to [Valve Rocker Arm and Push Rod Installation](#).
17. Install the right and left valve rocker arm covers. Refer to [Valve Rocker Arm Cover Installation - Right Side](#) and [Valve Rocker Arm Cover Installation - Left Side](#).
18. Install the supercharger. Refer to [Supercharger Installation](#).
19. Install the water pump. Refer to [Water Pump Installation](#).
20. Install the left and right exhaust manifolds. Refer to [Exhaust Manifold Installation - Left Side](#) and [Exhaust Manifold Installation - Right Side](#).
21. Install the crankshaft balancer. Refer to [Crankshaft Balancer Installation](#).
22. Install the engine assembly. Refer to [Engine Replacement](#).

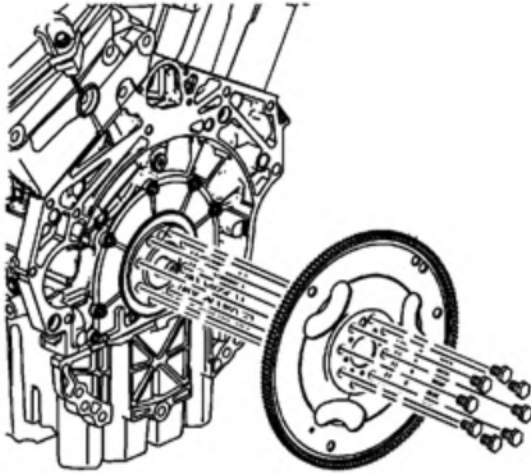
Engine Flywheel Replacement

Removal Procedure



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

Installation Procedure



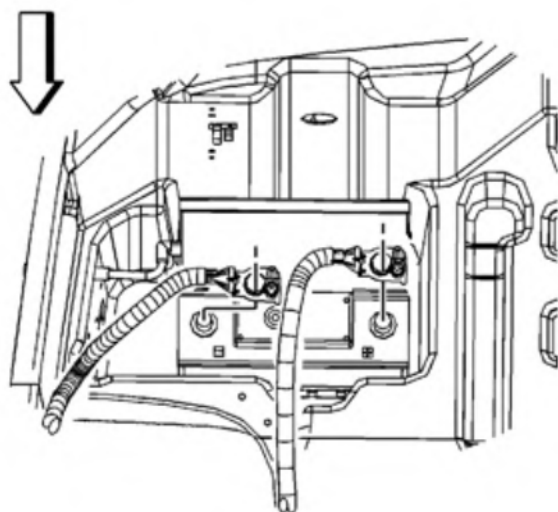
1. Install the engine flywheel. Refer to [Engine Flywheel Installation](#).
2. Install the transmission. Refer to [Transmission Replacement](#).

Engine Replacement

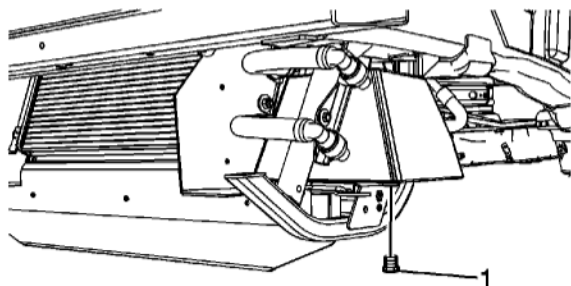
Special Tools

- [J 39580](#) Engine Support Stand
- [EN 46114](#) Engine Lift Brackets

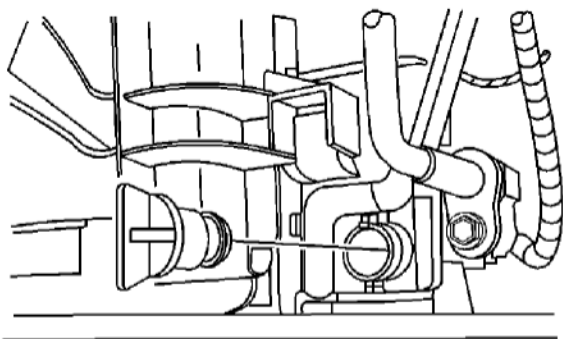
Removal Procedure



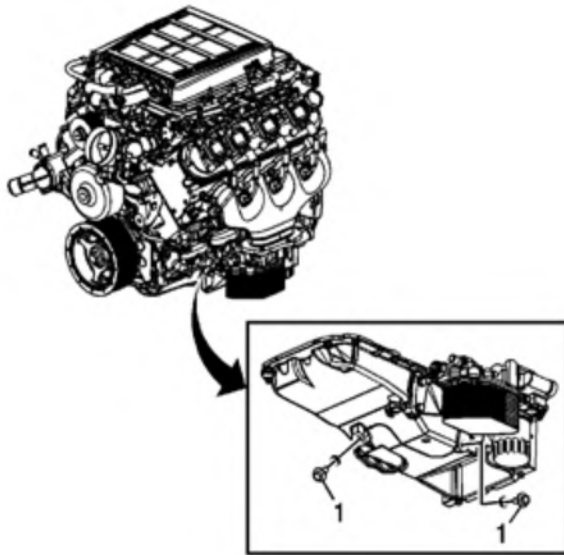
1. Disconnect the negative battery cable.
2. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement - Rear](#).
3. Discharge the air conditioning (A/C) system. Refer to [Refrigerant Recovery and Recharging](#).
4. Raise the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
5. Remove the front tires. Refer to [Tire and Wheel Removal and Installation](#).
6. Remove the transmission. Refer to [Transmission Replacement](#).



7. Drain the supercharger cooling system. Refer to [Charge Air Cooling System Draining and Filling](#).



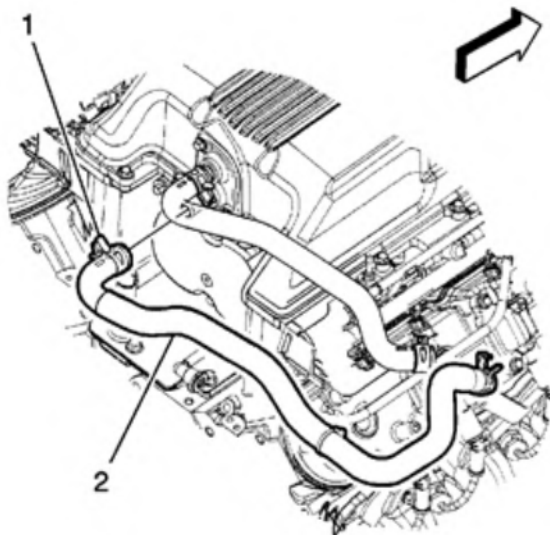
8. Drain the engine cooling system. Refer to [Cooling System Draining and Filling](#).



9. Drain the engine oil from the oil pan and dry sump oil tank.

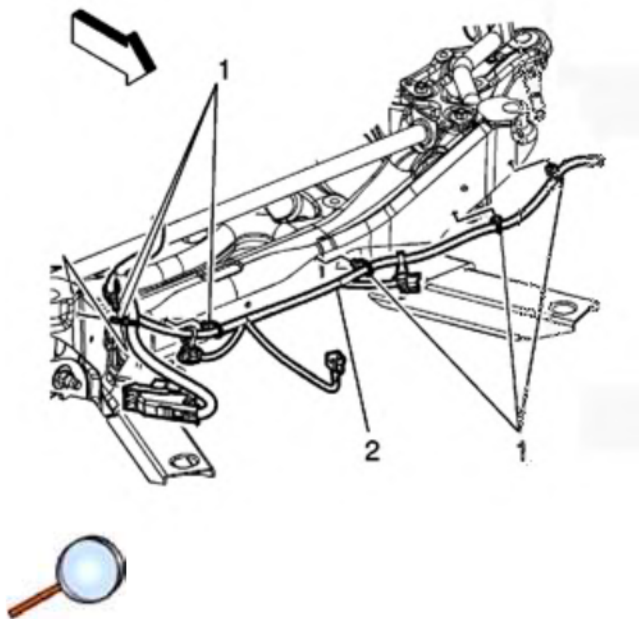
Remove the two drain plugs from the oil pan to drain.

10. Install the drain plugs to the oil pan and tighten.
11. Lower the vehicle.
12. Remove the air cleaner resonator outlet duct. Refer to [Air Cleaner Resonator Outlet Duct Replacement](#).



13. Disconnect the supercharger intercooler cooling hoses.
14. Remove the radiator inlet hose. Refer to [Radiator Inlet Hose Replacement](#).
15. Remove the radiator outlet hose. Refer to [Radiator Outlet Hose Replacement](#).
16. Disconnect all necessary engine harness electrical connectors. Refer to [Powertrain Component Views](#) and [Harness Routing Views](#).

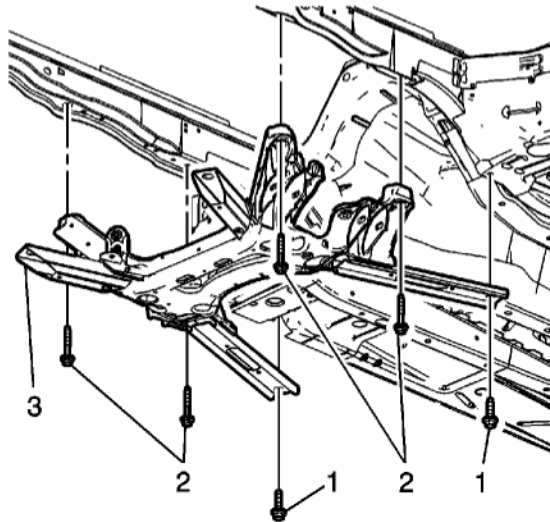
17. Install the engine support fixture.
18. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
19. Remove the front compartment lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#).



20. Remove the electrical harness retainers (1) securing the engine harness (2) to the frame.
21. Remove the wheel speed sensor wire harness from the frame.
22. Remove the brake pipes from the frame.
23. Remove the brake pressure modulator valve (BPMV) from the bracket assembly. Refer to [Brake Pressure Modulator Valve Replacement](#).
24. Using mechanics wire, support the radiator and A/C condenser assembly to the vehicle body.
25. Remove the washer bottle bracket from the frame. Refer to [Windshield Washer Solvent Container Replacement](#).

Note: Mark the stabilizer shaft to ensure the correct position when reinstalling.

26. Loosen the stabilizer shaft mounting bolts.
27. Remove the lower stabilizer shaft link from the lower control arm. Refer to [Stabilizer Shaft Link Replacement](#).
28. Remove the power steering gear mounting bolts. Refer to [Steering Gear Replacement](#).
29. Using mechanics wire, secure the power steering gear to the engine.
30. Separate the outer tie rod from the steering knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
31. Disconnect the lower ball joint from the steering knuckle. Refer to [Lower Control Arm Replacement](#).
32. Remove the shock module yokes from the lower control arms. Refer to [Front Shock Absorber Yoke Replacement](#).



33. Install the [J 39580](#) under the frame.
34. Lower the vehicle to the frame support table.
35. Remove the frame mounting bolts (1, 2).
36. With the aid of an assistant, carefully raise the body from the frame.
37. Ensure when raising the body the following components are clear from the frame:
 - Brake pipes
 - Steering knuckle assembly
 - Electrical wiring harness
38. Remove the stabilizer shaft. Refer to [Stabilizer Shaft Replacement](#).
39. With the aid of an assistant, remove the frame from the support fixture.
40. Remove the power steering rack from the vehicle. Refer to [Steering Gear Replacement](#).
41. Remove the engine mount brackets with the engine mounts. Refer to [Engine Mount Bracket Replacement - Left Side](#) and [Engine Mount Bracket Replacement - Right Side](#).
42. With the aid of an assistant, lower the engine and disconnect the electrical connector as needed.

Installation Procedure

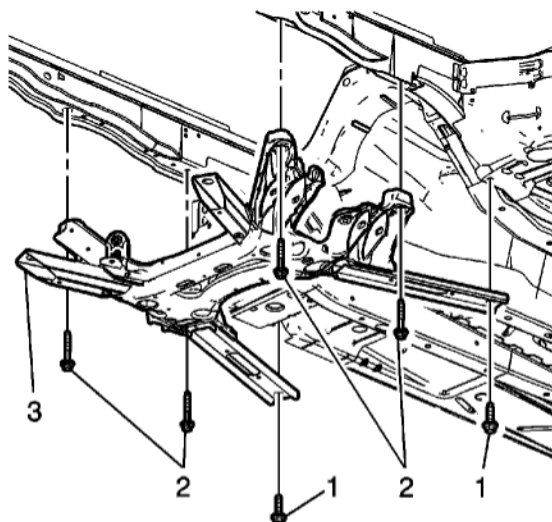
1. Install the engine.
2. Install the transmission. Refer to [Transmission Replacement](#).
3. Install the lower control arm to the frame. Refer to [Lower Control Arm Replacement](#).

Note: Do not tighten the stabilizer shaft mounting bolts at this time.

4. Install the stabilizer shaft to the frame. Refer to [Stabilizer Shaft Replacement](#).
5. With the aid of an assistant, position and secure the new frame assembly to the support fixture.
6. With the aid of an assistant, carefully lower the body to the frame.
7. Ensure the following components are clear from the frame:
 - Electrical wiring harness
 - Steering knuckle assembly

- Brake pipes

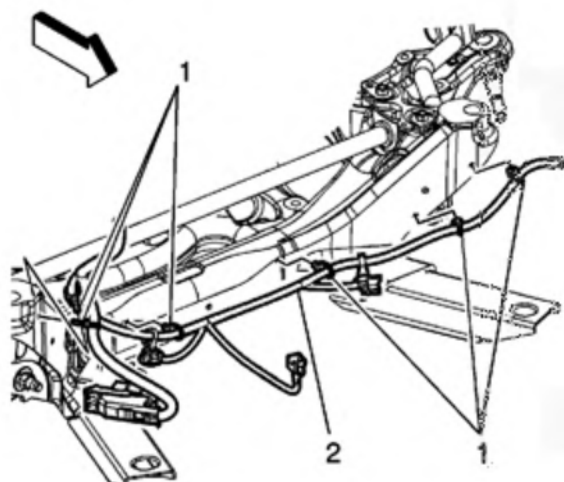
Caution: Refer to [Fastener Caution](#) in the Preface section.



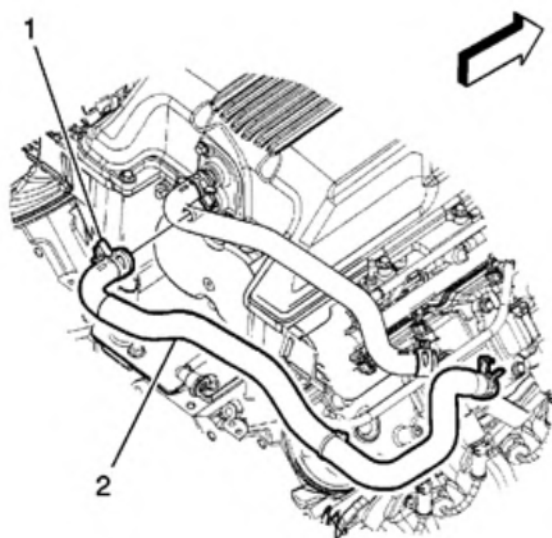
8. Install the frame mounting bolts (2) and tighten to **191 N·m (141 lb ft)**.
9. Raise the vehicle.
10. Install the engine mount lower retaining nuts and tighten to **50 N·m (37 lb ft)**.
11. Remove the [J 39580](#) from under the vehicle.
12. Remove the mechanics wire supporting the power steering gear.
13. Install the shock module yokes to the lower control arms. Refer to [Front Shock Absorber Yoke Replacement](#).
14. Install the power steering gear mounting bolts. Refer to [Steering Gear Replacement](#).
15. Install the ball joint to the steering knuckle. Refer to [Lower Control Arm Replacement](#).
16. Install the outer tie rod to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).

Note: Ensure the correct position from the previously marked spots.

17. Tighten the stabilizer shaft bolts to **60 N·m (44 lb ft)**.
18. Install the stabilizer shaft link to the lower control arms. Refer to [Stabilizer Shaft Link Replacement](#).
19. Install the BPMV to the bracket. Refer to [Brake Pressure Modulator Valve Replacement](#).
20. Install the brake pipes to the frame.
21. Install the washer bottle bracket to the frame. Refer to [Windshield Washer Solvent Container Replacement](#).
22. Remove the mechanics wire supporting the radiator.
23. Install the wheel speed sensor wire harness to the frame.



24. Install the electrical harness retainers (1) securing the engine harness (2) to the frame.
25. Install the front compartment lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#).
26. Install the front tires and wheels. Refer to [Tire and Wheel Removal and Installation](#).
27. Remove the engine support fixture.
28. Install the radiator inlet hose. Refer to [Radiator Inlet Hose Replacement](#).
29. Install the radiator outlet hose. Refer to [Radiator Outlet Hose Replacement](#).
30. Install the supercharger intercooler cooling hoses.

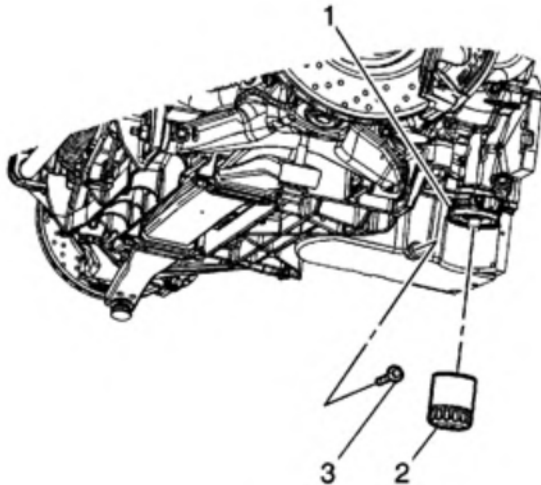


31. Install all necessary engine harness electrical connectors. Refer to [Powertrain Component Views](#) and [Harness Routing Views](#).
32. Install the air cleaner resonator outlet duct. Refer to [Air Cleaner Resonator Outlet Duct Replacement](#).
33. Refill the coolant system. Refer to [Cooling System Draining and Filling](#).
34. Refill the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling](#).

35. Charge the A/C system. Refer to [Refrigerant Recovery and Recharging](#).
36. Align the vehicle. Refer to [Wheel Alignment Measurement](#).

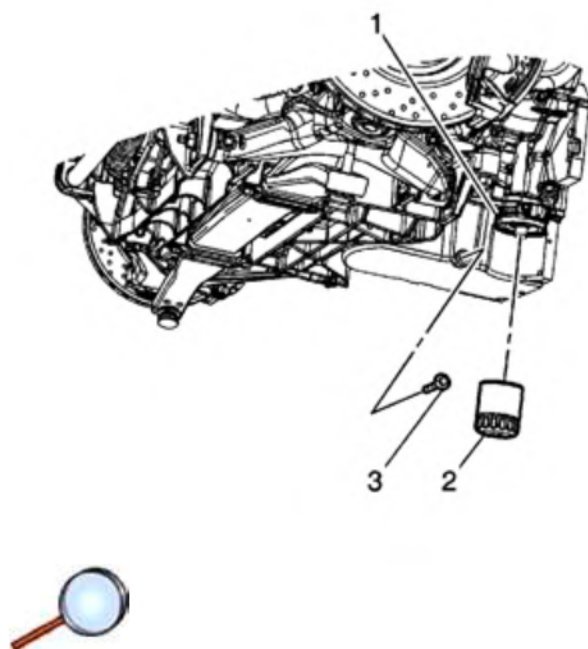
Engine Oil and Oil Filter Replacement

Removal Procedure



1. Open the hood.
2. Remove the oil fill cap.
3. Remove the front compartment lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#)
4. Remove the oil pan drain plug (3).
5. Drain the engine oil into an appropriate container.
6. Remove the engine oil filter (1) from the engine block (2).

Installation Procedure



Note: Before installing the new oil filter, ensure that the old oil filter seal has been removed. If not, removed the old seal.

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

Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the oil filter (2) to the engine block (1) and tighten the engine oil filter to **30 N·m (22 lb ft)**.
3. Install the oil pan drain plug (3) and tighten to **25 N·m (18 lb ft)**.
4. Install the front compartment lower noise shield. Refer to [Front Compartment Lower Noise Shield Replacement](#)
5. Lower the vehicle.
6. Fill the engine with the appropriate amount and type of engine oil. Refer to [Approximate Fluid Capacities](#) and [Fluid and Lubricant Recommendations](#).
7. Start the engine, check for leaks and correct.
8. Shut the engine off and check the oil level.
9. Install the oil fill cap.
10. Close the hood.
11. Reset the engine oil life monitor. Refer to [GM Oil Life System Resetting](#).