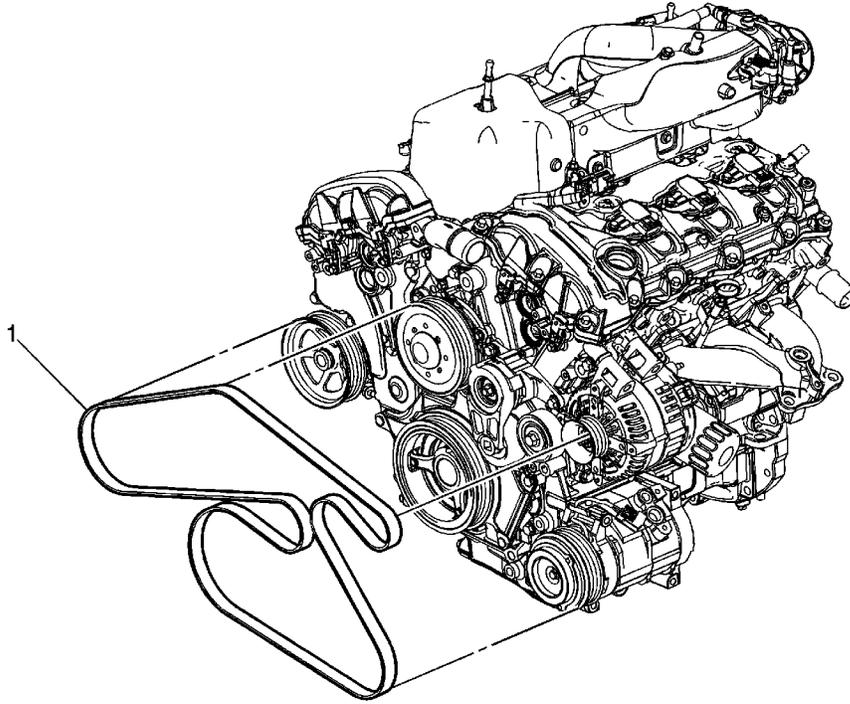
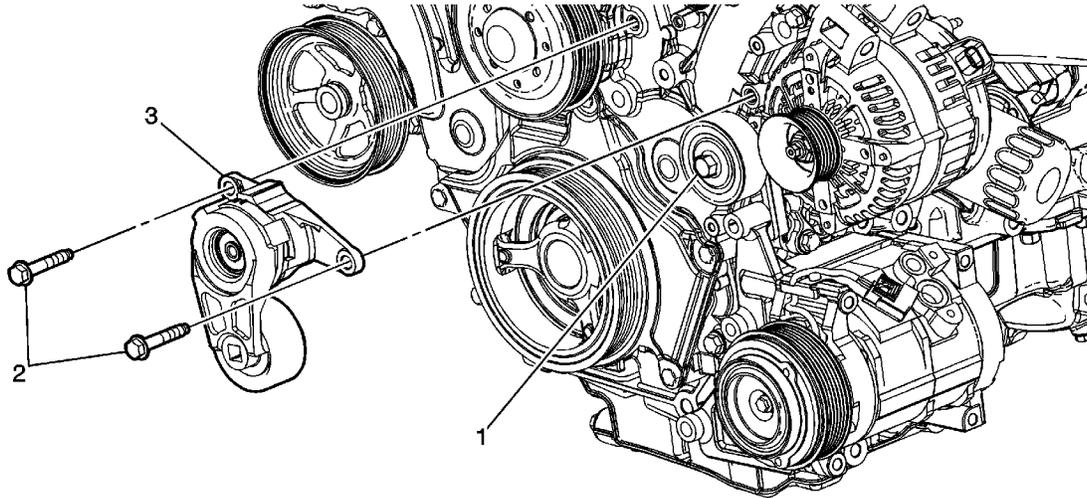


Drive Belt Replacement



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

Drive Belt Tensioner Replacement



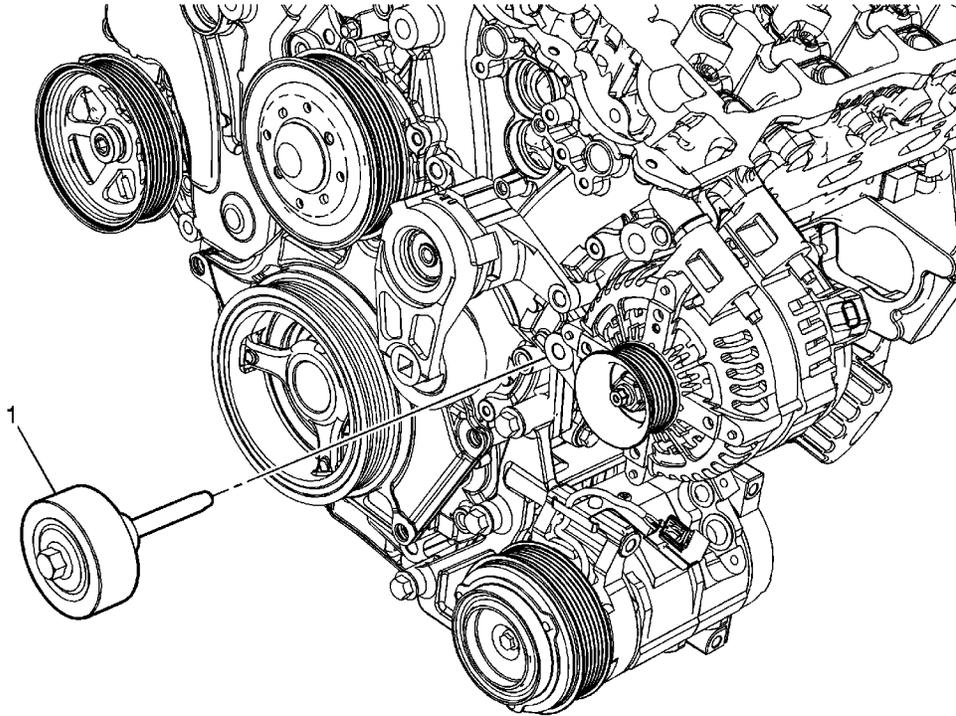
Callout	Component Name
Preliminary Procedures <ol style="list-style-type: none"> 1. Remove the right engine strut mount. Refer to Engine Mount Strut Replacement - Right Side. 2. Remove the right engine mount strut bracket. Refer to Engine Mount Strut Bracket Replacement - Right Side. 3. Remove the drive belt. Refer to Drive Belt Replacement. 	
1	Idler Pulley Bolt Caution: Refer to Fastener Caution in the Preface section. Tighten 50 N·m (37 lb ft)
2	Tensioner Bolt Tighten 50 N·m (37 lb ft)
3	Tensioner

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Tip

Remove wire harness retainer from tensioner.

Drive Belt Idler Pulley Replacement



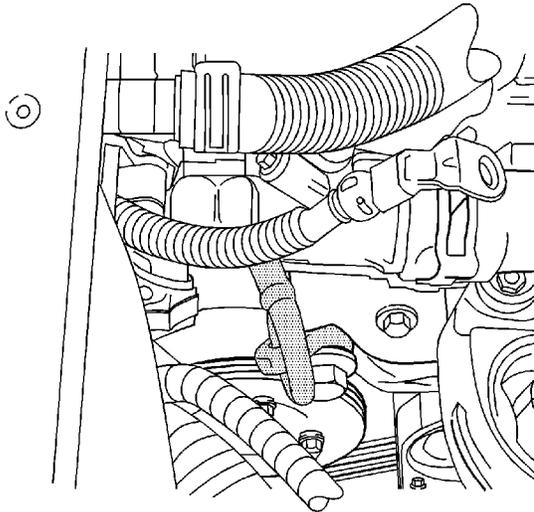
Callout	Component Name
<p>Preliminary Procedures</p> <ol style="list-style-type: none"> 1. Remove the right engine strut mount. Refer to Engine Mount Strut Replacement - Right Side. 2. Remove the right engine mount strut bracket. Refer to Engine Mount Strut Bracket Replacement - Right Side. 3. Remove the generator. Refer to Generator Replacement. 	
<p>1</p>	<p>Idler Pulley Bolt</p> <p>Caution: Refer to Fastener Caution in the Preface section.</p> <p>Tighten 50 N·m (37 lb ft)</p>

Engine Support Fixture

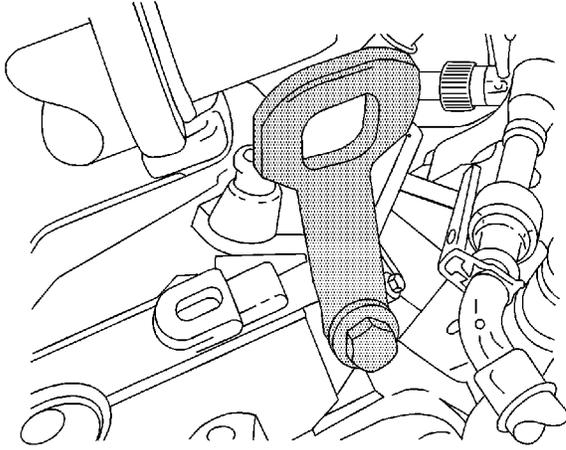
Installation Procedure

Special Tools

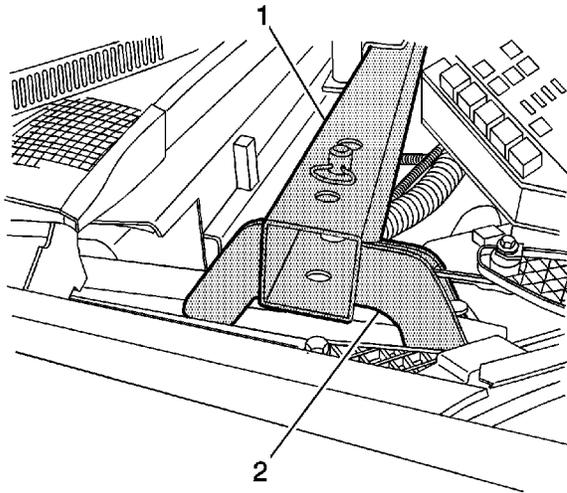
- [J 28467-B](#) Universal Engine Support Fixture
- [J 28467-7A](#) Bolt Hook
- [J 28467-34](#) Lift Hook Wing Nut and Washer
- [J-41803-9](#) Engine Lift Hook
- [J 42451-1](#) Engine Support Adapter



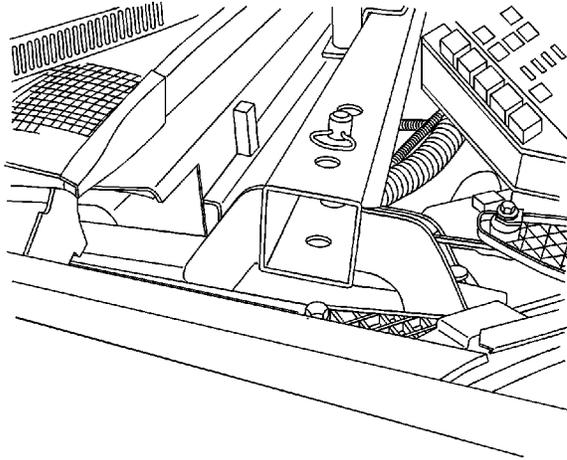
1. Remove the injector sight shield. Refer to [Fuel Injector Sight Shield Replacement](#).
2. Remove the underhood electrical center. Refer to [Underhood Electrical Center or Junction Block Replacement](#).
3. Remove the right engine strut mount. Refer to [Engine Mount Strut Replacement - Right Side](#).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



5. Install the [J-41803-9](#) to the left side front of the engine.



6. Using [J 28467-B](#) , install the ends of the strut tower tube J 28467-518 (1) to the engine support adapter legs (P/N) 48059 (2).

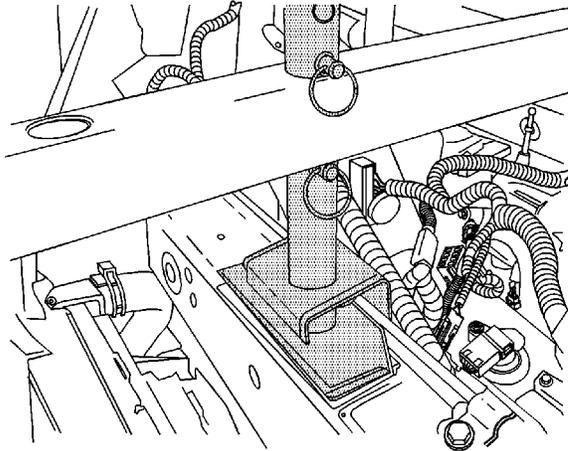


7. Place the strut tower tube J 28467-518 and the (P/N) 48059 on top of both the left and right fender lips, over the engine rear lift bracket.

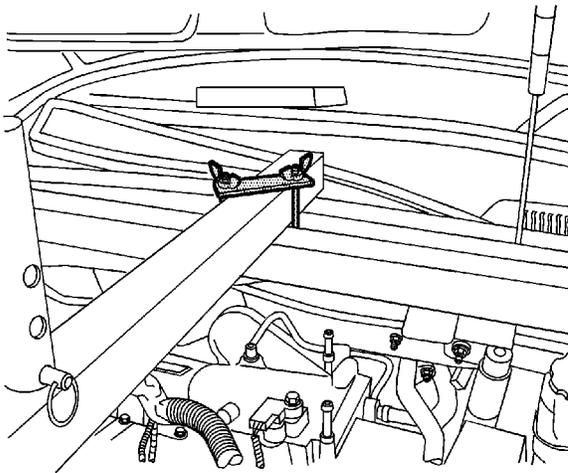
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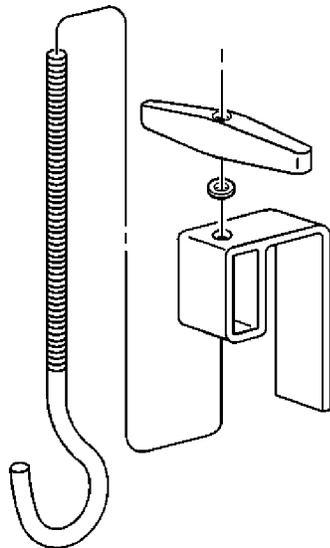
8. Install the radiator shelf tube J 36462-1A (2) on top of the strut tower tube J 28467-518 (1) above the left side of the engine.



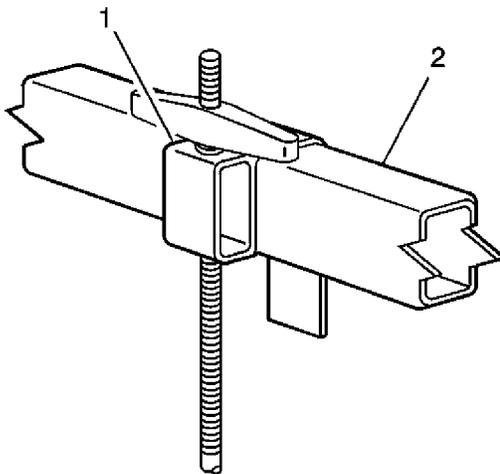
9. Install the round tube of the front support assembly J 28467-4A through the large hole in the radiator shelf tube J 36462-1A.
10. Remove the upper tie bar cover.
11. Locate the J 28467-4A front support assembly to the upper tie bar.
12. Install the J 28467-9 quick-release pin through the bottom hole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



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



16. Install the [J 28467-7A](#) bolt hook through the [J-41803-9](#) bracket.
17. Install the [J 28467-34](#) lift hook wing nut and washer to the [J 28467-7A](#) lift hook.
18. Repeat the previous 2 steps in order to assemble 2 lift hooks and brackets.



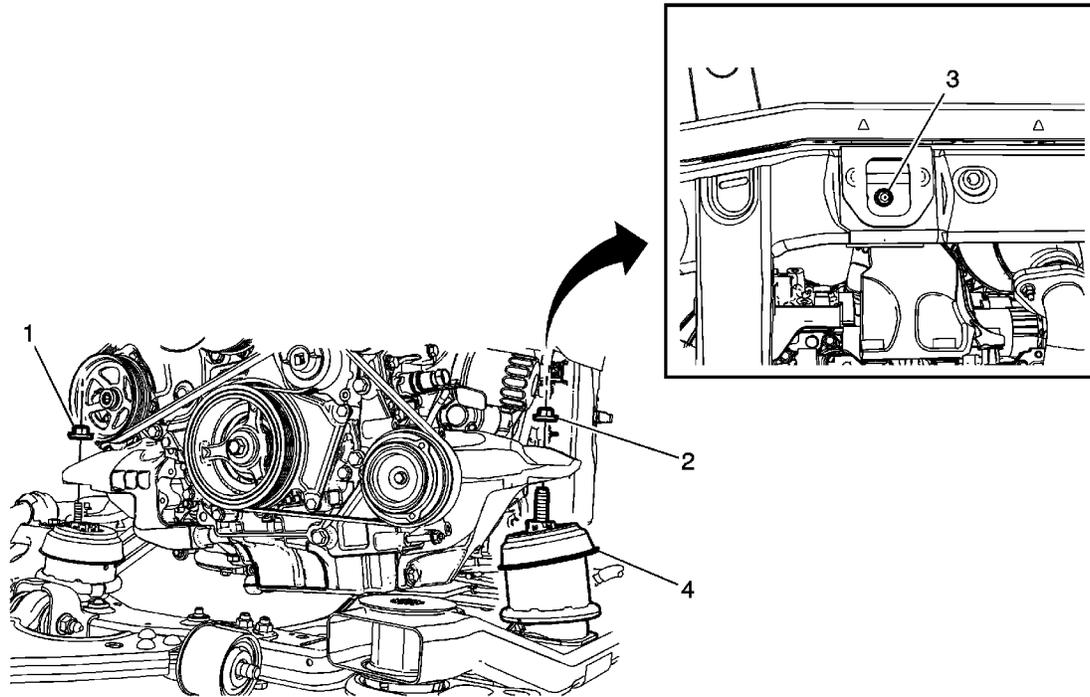
19. Install one of the lift hook and bracket assemblies (1) to the J 28467-518 strut tower tube (2) above the [J 42451-1](#) engine rear lift bracket.
20. Install the lift hook [J 28467-7A](#) through the [J 42451-1](#) engine rear lift bracket. Ensure the hook does not damage adjacent components.
21.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

Engine Mount Inspection

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

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

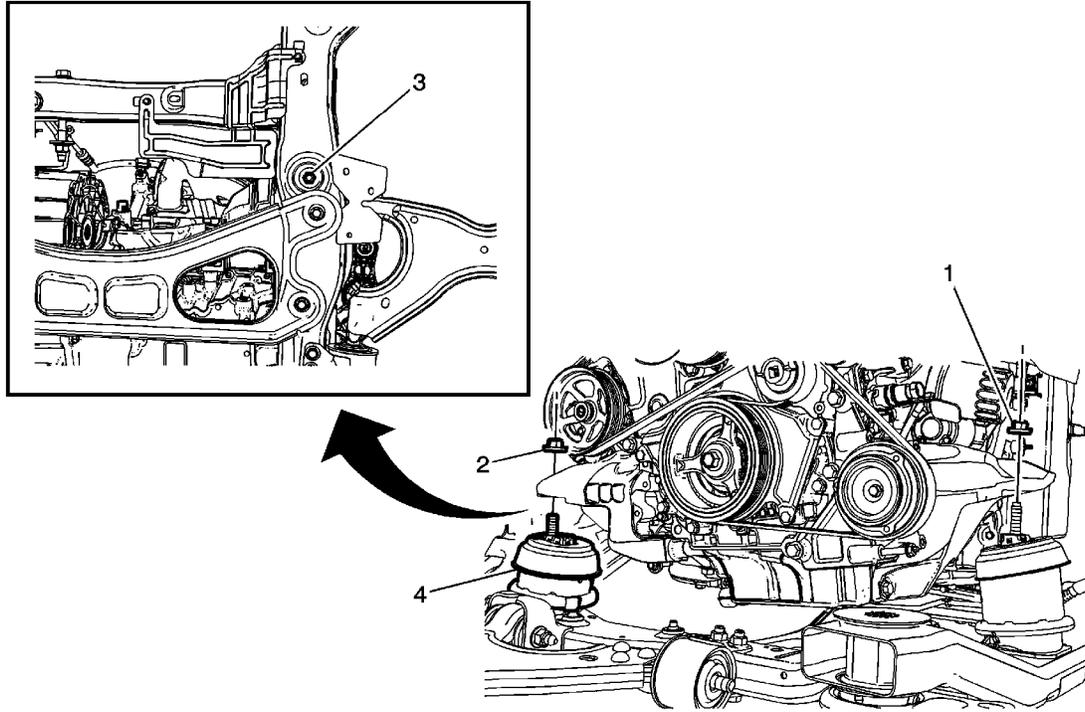
Engine Front Mount Replacement



Callout	Component Name
<p>Preliminary Procedures</p> <ol style="list-style-type: none"> Support the engine. Refer to Engine Support Fixture. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 	
<p>1</p>	<p>Rear Upper Engine Mount Nut</p> <p>Caution: Refer to Fastener Caution in the Preface section.</p> <p>Procedure</p> <ol style="list-style-type: none"> Remove and discard the rear engine mount nut. Apply threadlocker to the engine mount threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. <p>Tip The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.</p> <p>Tighten 75 N·m (55 lb ft)</p> <p><small>© 2010 General Motors Corporation. All rights reserved.</small></p>

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

Engine Rear Mount Replacement

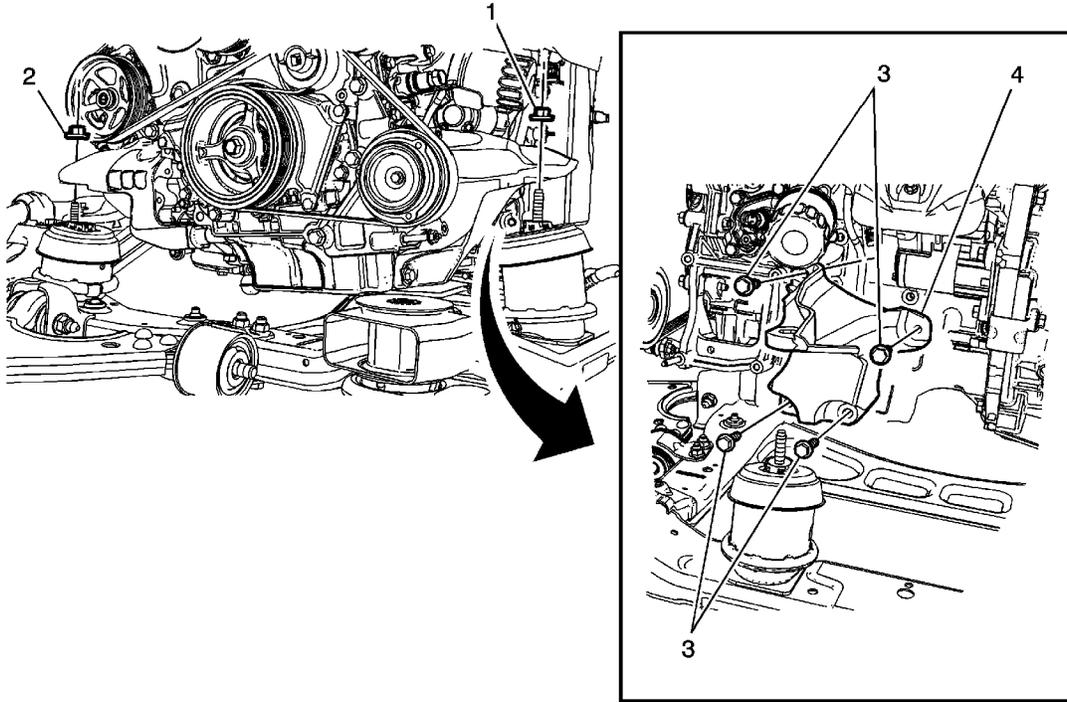


Callout	Component Name
<p>Preliminary Procedures</p> <ol style="list-style-type: none"> 1. Support the engine. Refer to Engine Support Fixture. 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 	
<p>1</p>	<p>Front Upper Engine Mount Nut</p> <p>Caution: Refer to Fastener Caution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

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

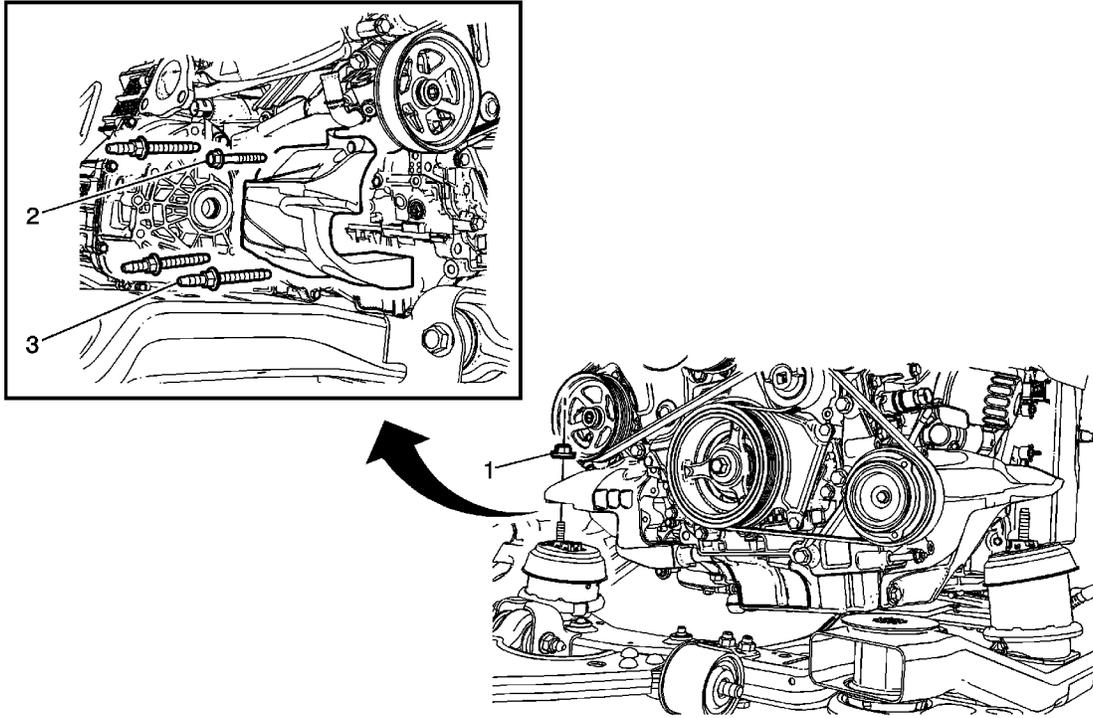
Engine Front Mount Bracket Replacement



Callout	Component Name
<p>Preliminary Procedures</p> <ol style="list-style-type: none"> 1. Remove the left side catalytic converter. Refer to Catalytic Converter Replacement - Left Side 2. Support the engine. Refer to Engine Support Fixture. 	
<p>1</p>	<p>Front Engine Mount Upper Nut</p> <p>Caution: Refer to Fastener Caution in the Preface section.</p> <p>Procedure</p> <ol style="list-style-type: none"> 1. Remove and discard front engine mount upper nut. 2. Allow adhesive on new engine mount nuts to cure for 24 hours after replacement. <p>Tip</p> <ul style="list-style-type: none"> • Use engine support fixture to raise engine. • The engine mount nuts must be replaced once removed. <p><small>© 2010 General Motors Corporation. All rights reserved.</small></p>

	<p>Tighten 50 N·m (37 lb ft)</p>
2	<p>Rear Engine Mount Upper Nut</p> <p>Procedure</p> <ol style="list-style-type: none"> 1. Remove and discard rear engine mount upper nut. 2. Allow adhesive on new engine mount nuts to cure for 24 hours after replacement. <p>Tip</p> <ul style="list-style-type: none"> • Use engine support fixture to raise engine. • The engine mount nuts must be replaced once removed. <p>Tighten 50 N·m (37 lb ft)</p>
3	<p>Front Engine Mount Bracket Bolt</p> <p>Tighten 58 N·m (43 lb ft)</p>
4	<p>Front Engine Mount Bracket</p> <p>Tip To remove engine mount bracket, use engine support fixture to raise engine.</p>

Engine Rear Mount Bracket Replacement

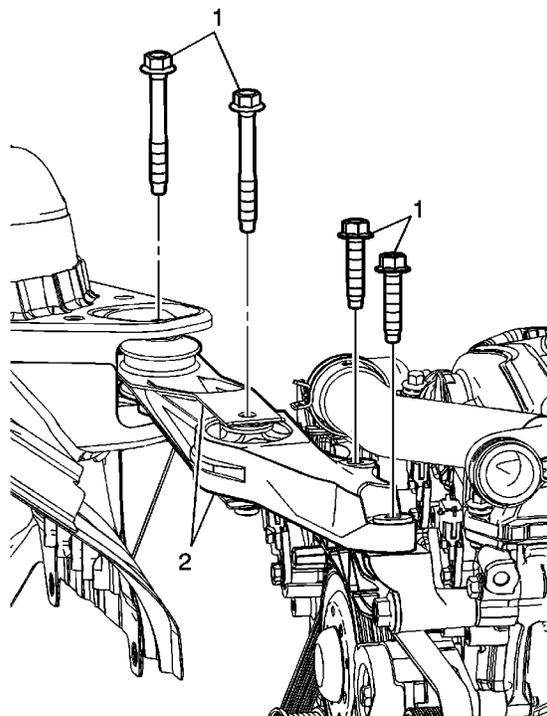


Callout	Component Name
<p>Preliminary Procedures</p> <ol style="list-style-type: none"> 1. If equipped with FWD, remove the intermediate drive shaft. Refer to Front Wheel Drive Intermediate Shaft Replacement. 2. Support the engine. Refer to Engine Support Fixture. 3. Remove the exhaust flexible pipe. Refer to Exhaust Flexible Pipe Replacement. 	
1	<p>Rear Engine Mount Upper Nut</p> <p>Caution: Refer to Fastener Caution in the Preface section.</p> <p>Procedure</p> <ol style="list-style-type: none"> 1. Remove and discard engine mount nut. 2. Apply threadlocker to the engine mount threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. <p>Tip</p> <ul style="list-style-type: none"> • The engine mount nuts must be replaced once removed. Allow adhesive on new engine mounts nuts to cure for 24 hours after replacement.

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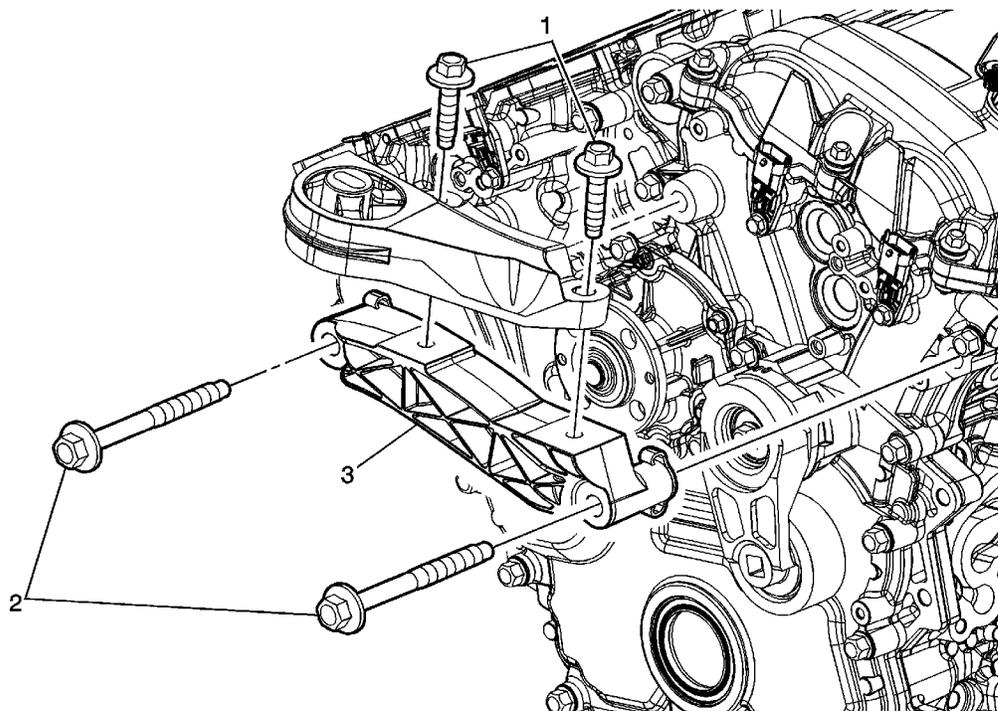
	<ul style="list-style-type: none">• Use engine support fixture to raise engine. Tighten 50 N·m (37 lb ft)
2	Rear Engine Mount Bracket Bolt Tighten 58 N·m (43 lb ft)
3	Rear Engine Mount Bracket Bolt Tighten 22 N·m (16 lb ft)

Engine Mount Strut Replacement - Right Side



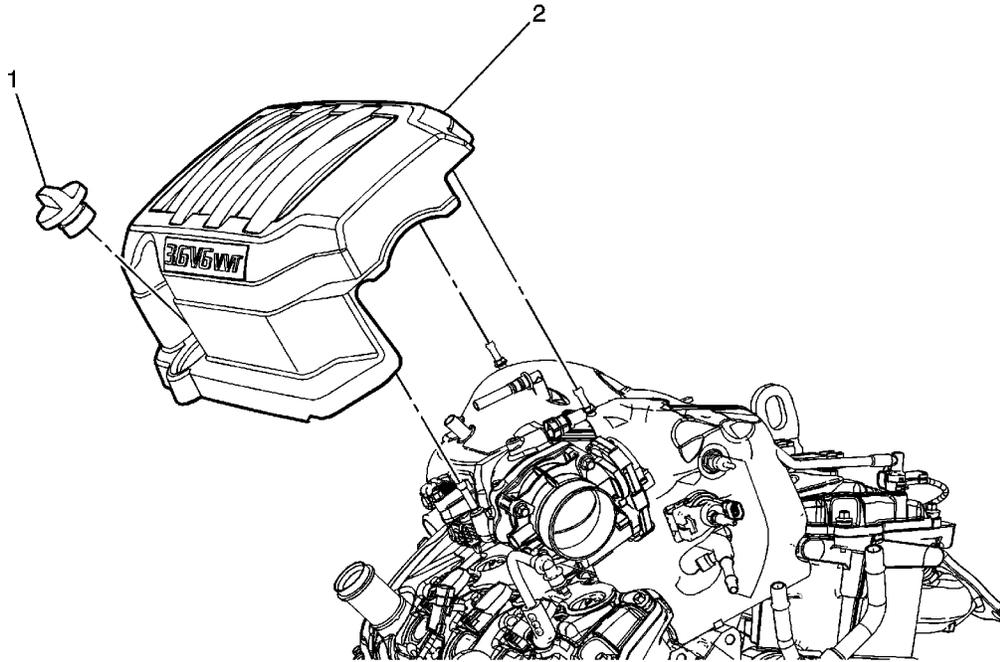
Callout	Component Name
<p>Preliminary Procedure</p> <ol style="list-style-type: none"> 1. Remove the radiator inlet hose from the water outlet tube. Refer to Radiator Inlet Hose Replacement. 2. Remove the underhood fuse block bracket and fuse block. Refer to Underhood Electrical Center or Junction Block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

Engine Mount Strut Bracket Replacement - Right Side



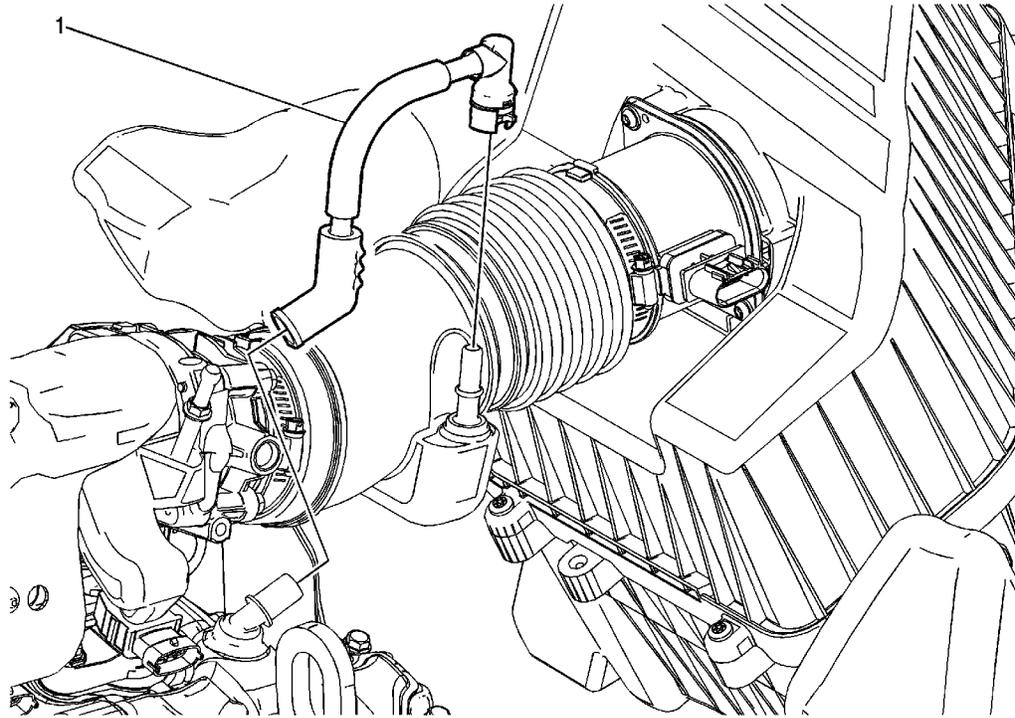
Callout	Component Name
Preliminary Procedure	
Remove the right engine mount strut mount. Refer to Engine Mount Strut Replacement - Right Side .	
1	Engine Mount Strut Bolt Caution: Refer to Fastener Caution in the Preface section. Tighten 58 N·m (43 lb ft)
2	Engine Mount Strut Bracket Bolt Tighten 90 N·m (66 lb ft)
3	Engine Mount Strut Bracket

Fuel Injector Sight Shield Replacement



Callout	Component Name
1	Oil Fill Cap
2	Fuel Injector Sight Shield
	Procedure
	Lift upward to remove sight shield from ballstuds.

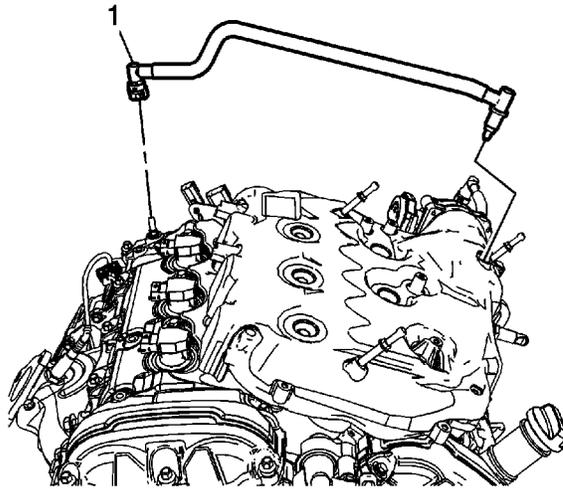
Positive Crankcase Ventilation Tube Replacement - Front



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

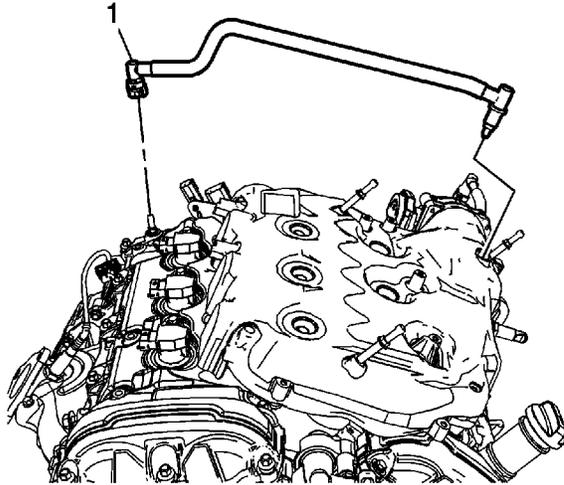
Positive Crankcase Ventilation Tube Replacement - Rear

Removal Procedure



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

Installation Procedure

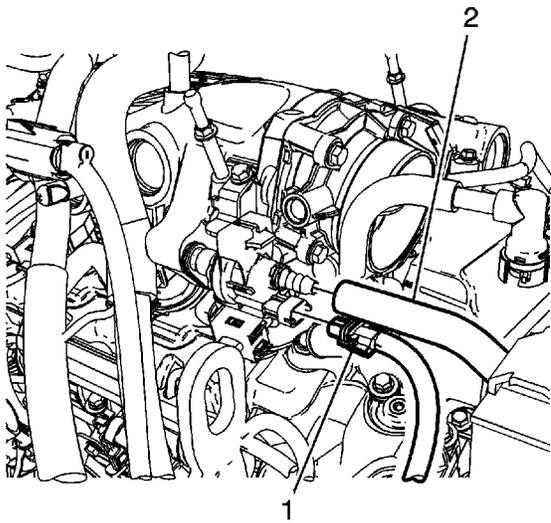


1. Connect the PCV air pipe (1) to the camshaft cover valve.
2. Connect the PCV air pipe to the intake manifold.
3. Remove the intake manifold insulator.
4. Install the fuel injector sight shield. Refer to [Fuel Injector Sight Shield Replacement](#).

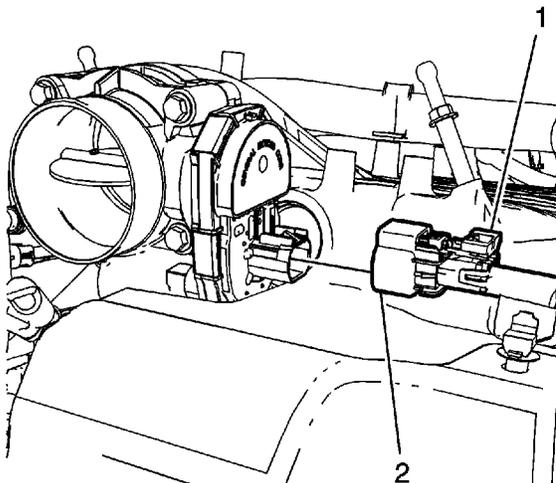
Intake Manifold Replacement

Removal Procedure

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

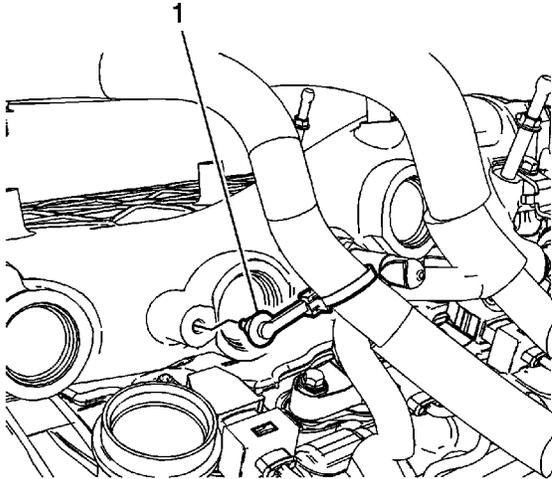


6. Disconnect the purge solenoid valve electrical connector (1).
7. Disconnect the purge line (2) from the purge solenoid valve.

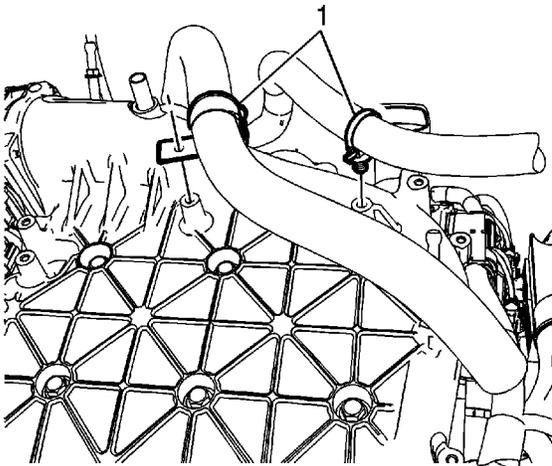




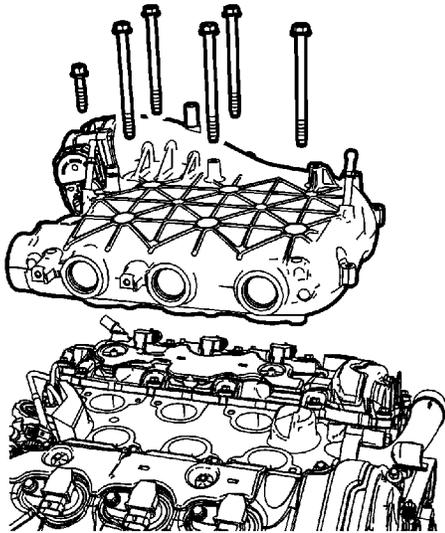
8. Remove the electrical connector retainer (1).
9. Disconnect the throttle body electrical connector (2).
10. Remove the fuel pipe shield. Refer to [Fuel Pipe Shield Replacement](#).



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

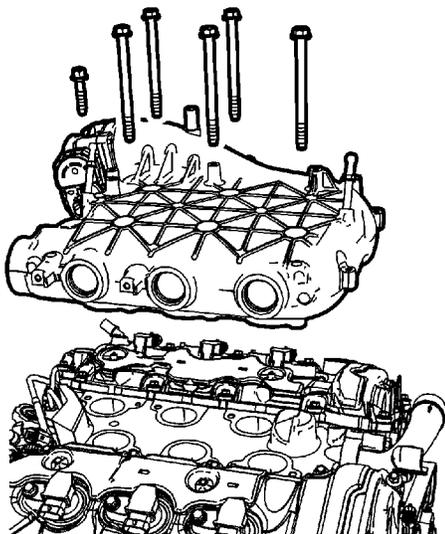


12. Remove the wiring harness retaining bolt.
13. Remove the engine wiring harness retaining clips (1) from the intake manifold.
14. Position the engine wiring harness aside.



15. Remove the intake manifold insulator.
16. Remove the intake manifold bolts (1).
17. Remove the intake manifold (2) with the throttle body.
18. If the intake manifold is being replaced, disassemble the intake manifold. Refer to [Intake Manifold Disassemble](#).
19. Clean and inspect the intake manifold. Refer to [Intake Manifold Cleaning and Inspection](#).

Installation Procedure



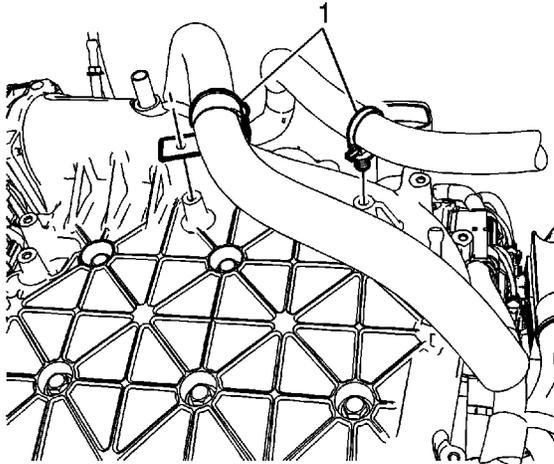
1. If the intake manifold is being replaced, assemble the intake manifold. Refer to [Intake Manifold Assemble](#).
2. Install a NEW intake manifold gasket.

3. Install the intake manifold (2).

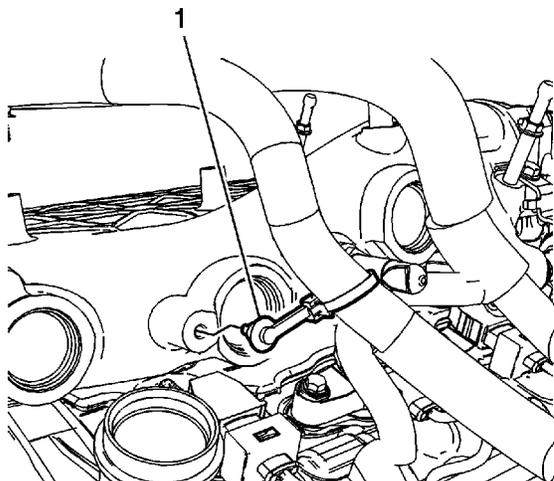
Caution: Refer to [Fastener Caution](#) in the Preface section.

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

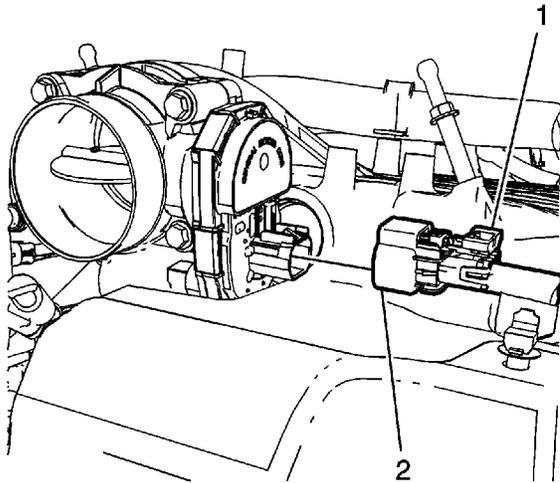
4. Install the intake manifold bolts (1) and tighten to **23 N·m (17 lb ft)**.



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



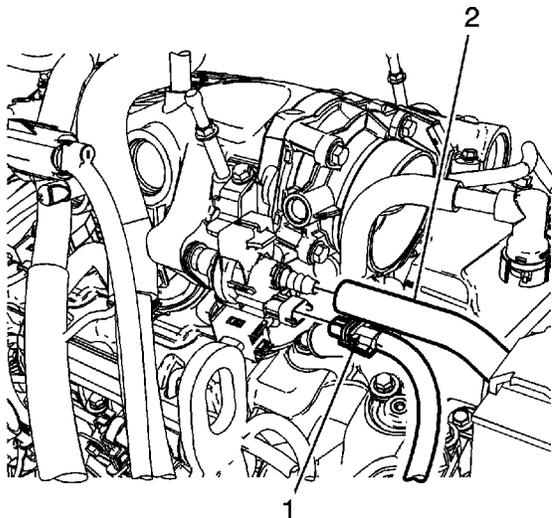
7. Install the engine wiring harness retaining clip (1) to the side of the intake manifold.



8. Install the fuel pipe shield. Refer to [Fuel Pipe Shield Replacement](#).

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

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

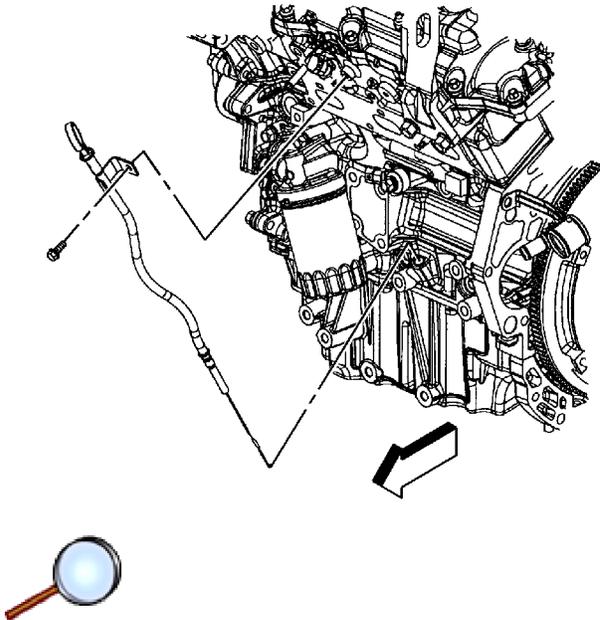


11. Connect the purge line (2) to the purge solenoid valve.
12. Connect the purge solenoid valve electrical connector (1).

13. Install the rear positive crankcase ventilation hose. Refer to [Positive Crankcase Ventilation Tube Replacement - Rear](#).
14. Connect the brake booster vacuum hose to the intake manifold.
15. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#).
16. Install the fuel injector sight shield. Refer to [Fuel Injector Sight Shield Replacement](#).

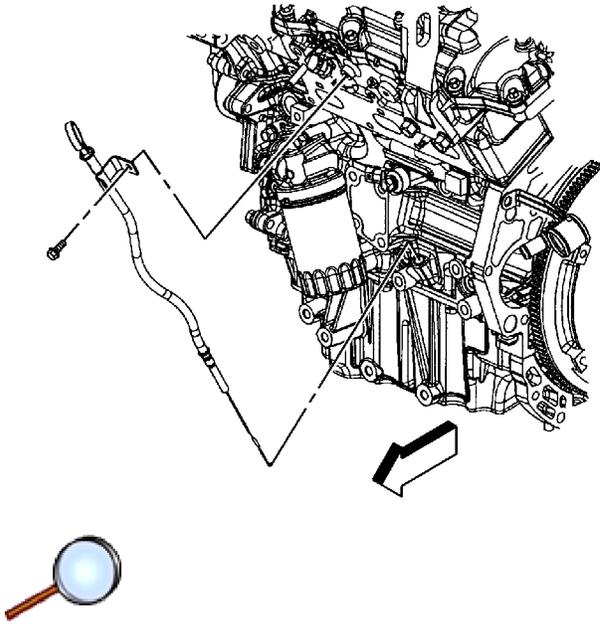
Oil Level Indicator Tube Replacement

Removal Procedure



1. Turn the ignition OFF.
2. Remove the oil level indicator from the oil level indicator tube.
3. Remove the oil level indicator tube bolt.
4. Remove the oil level indicator tube up through the exhaust manifold.
5. If you are replacing only the oil level indicator tube seal, remove and discard the old seal.

Installation Procedure



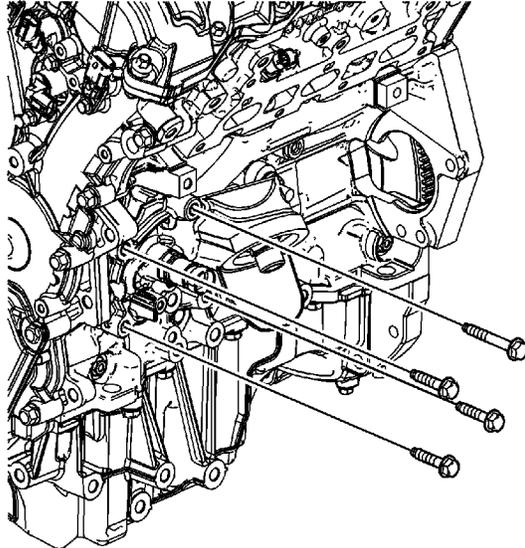
1. Install a new seal on the oil level indicator tube.
2. Install the oil level indicator tube.

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

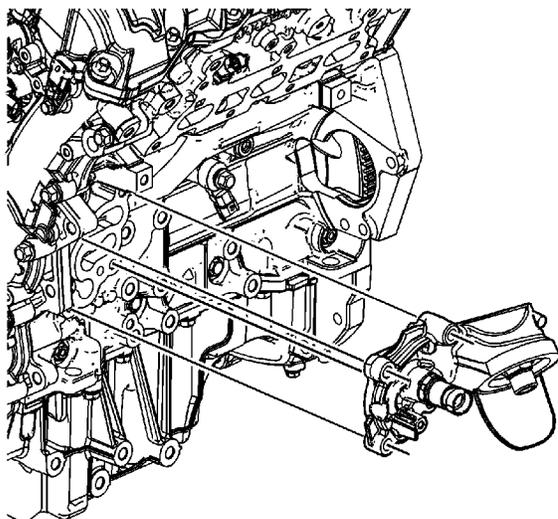
3. Install the oil level indicator tube bolt and tighten to **10 N·m (89 lb in)** .
4. Install the oil level indicator in the oil level indicator tube.

Oil Filter Adapter Replacement

Removal Procedure

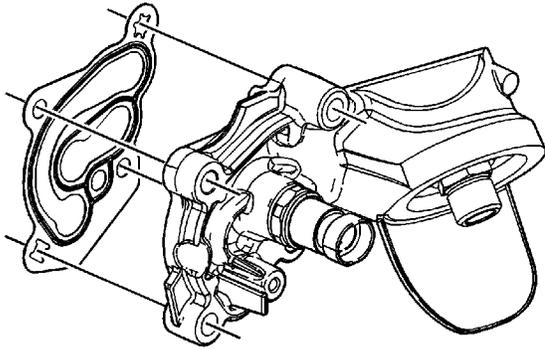


1. Remove the generator. Refer to [Generator Replacement](#) .
2. Remove and properly dispose of the oil filter. Refer to [Engine Oil and Oil Filter Replacement](#) .
3. Disconnect the oil pressure sensor electrical connector.
4. Remove the oil filter adapter bolts from the engine block.



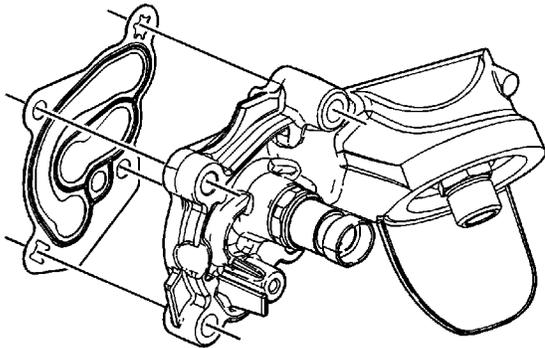
© 2010 General Motors Corporation. All rights reserved.

5. Remove the oil filter adapter.

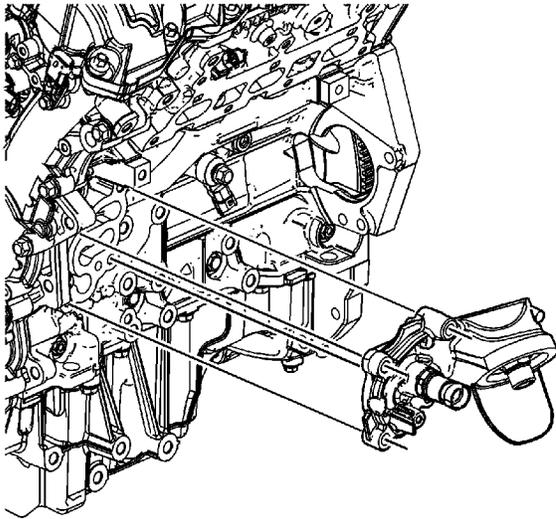


6. Remove and discard the oil filter adapter gasket.

Installation Procedure

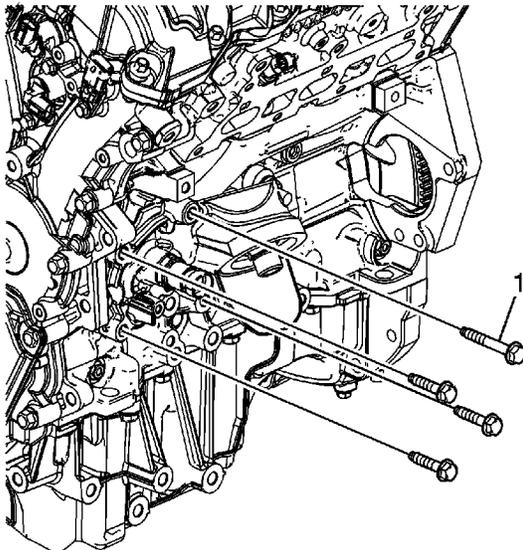


1. Position a NEW oil filter adapter gasket onto the oil filter adapter.



2. Place the oil filter adapter into position.

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



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

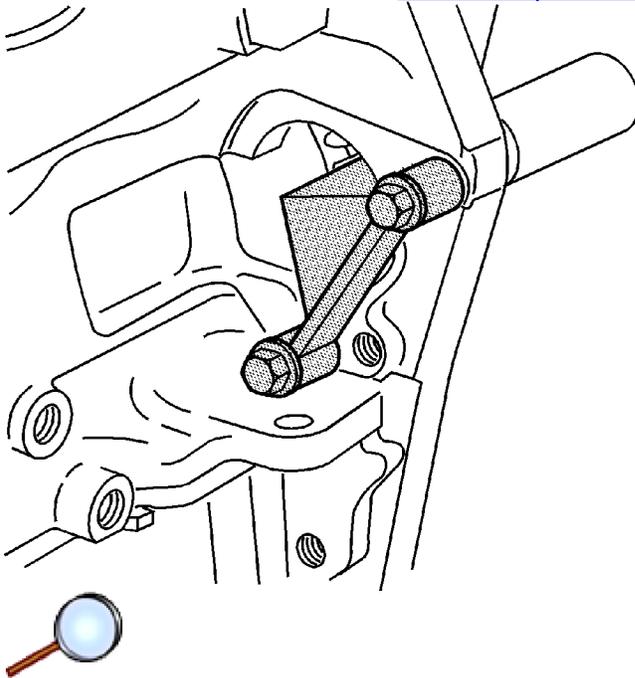
Crankshaft Balancer Replacement

Special Tools

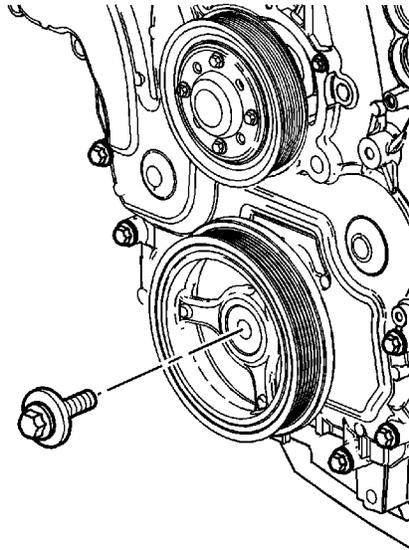
- [EN 46106](#) Flywheel Holding Tool
- [J 38416-2](#) Crankshaft Button
- [J 41816](#) Crankshaft Balancer Remover
- [J 41998-B](#) Crankshaft Balancer Installer

Removal Procedure

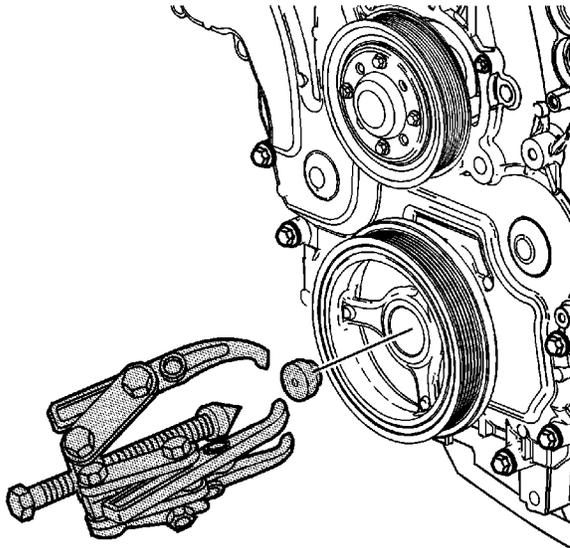
1. Remove the engine mount strut bracket. Refer to [Engine Mount Strut Bracket Replacement - Right Side](#).
2. Remove the drive belt. Refer to [Drive Belt Replacement](#).
3. Remove the starter. Refer to [Starter Replacement](#).



4. Install the [EN 46106](#) through the starter mounting hole.

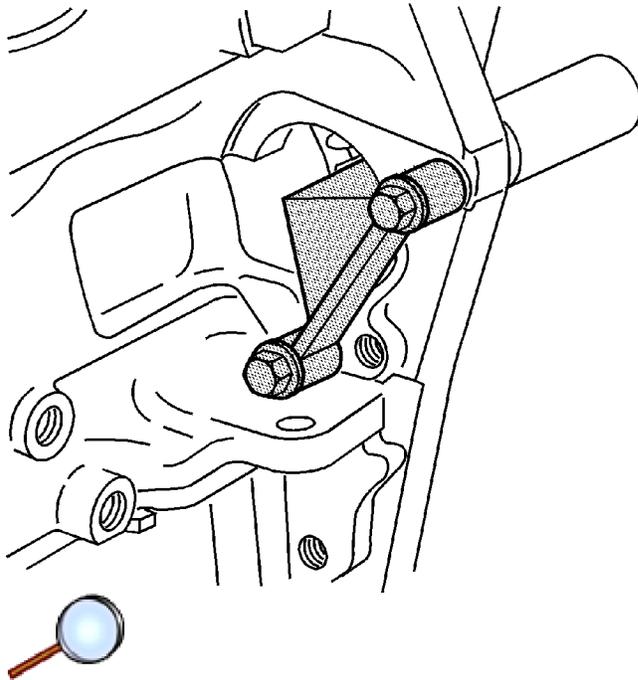


5. Support the right side of the frame with jackstands.
6. Remove the right side frame reinforcement bolts.
7. Loosen the right side frame bolts.
8. Lower the right side of the frame approximately 2 inches.
9. Remove the crankshaft balancer bolt.

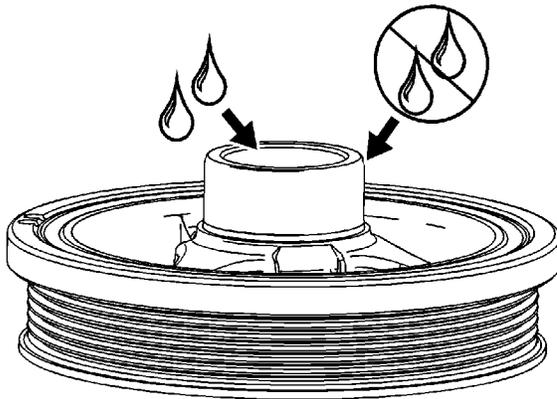


10. Install the [J 38416-2](#) in the nose of the crankshaft.
11. Install the [J 41816](#) in order to remove the crankshaft balancer.
12. Tighten the center bolt of the [J 41816](#) in order to pull the crankshaft balancer off of the crankshaft.
13. Remove the [J 41816](#) from the crankshaft balancer.

Installation Procedure

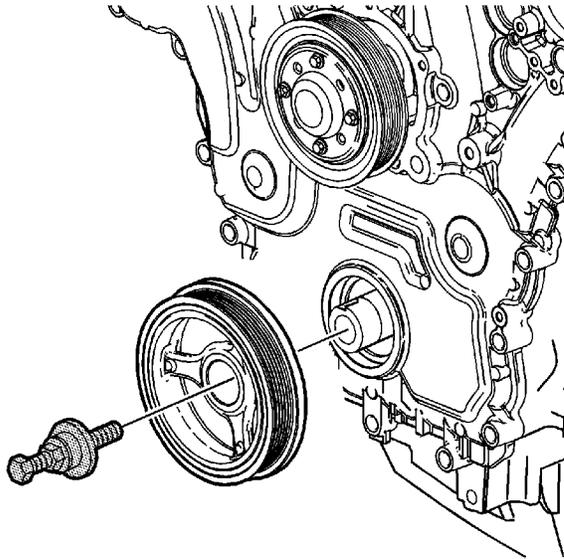


1. The [EN 46106](#) must be installed onto the flywheel.
2. Use the [J 41998-B](#) , nut, bearing and washer to install the crankshaft balancer.

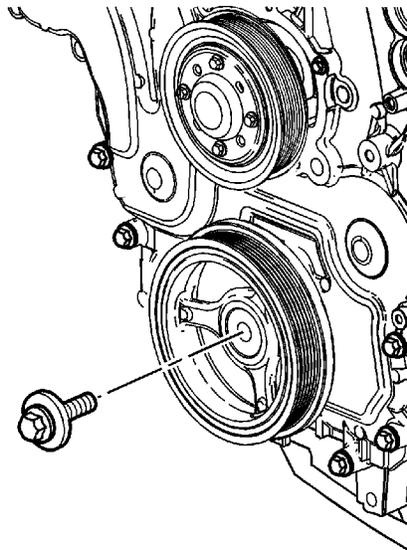


Note: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

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



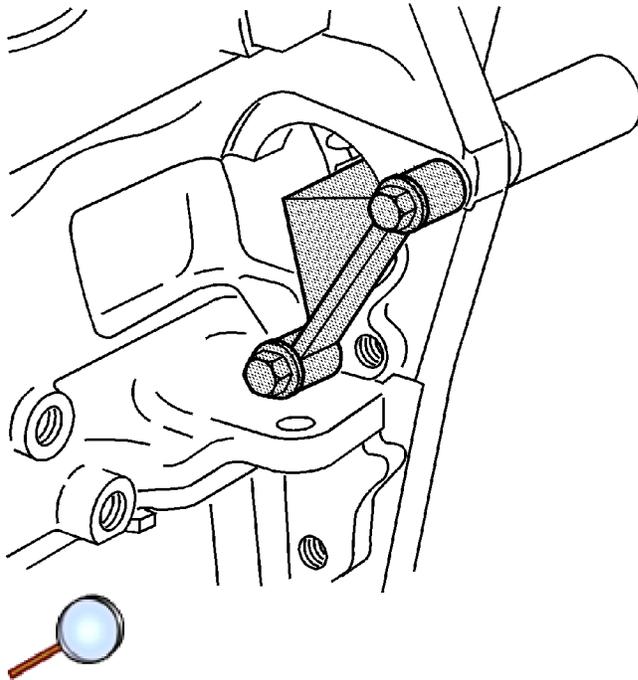
4. Place the crankshaft balancer in position on the crankshaft.
5. Thread the [J 41998-B](#) in the crankshaft. Ensure you engage at least 10 threads of the [J 41998-B](#) before pressing the crankshaft balancer in place.
6. Push the crankshaft balancer into position by tightening the nut on the [J 41998-B](#)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



8. Install the crankshaft balancer bolt.

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

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



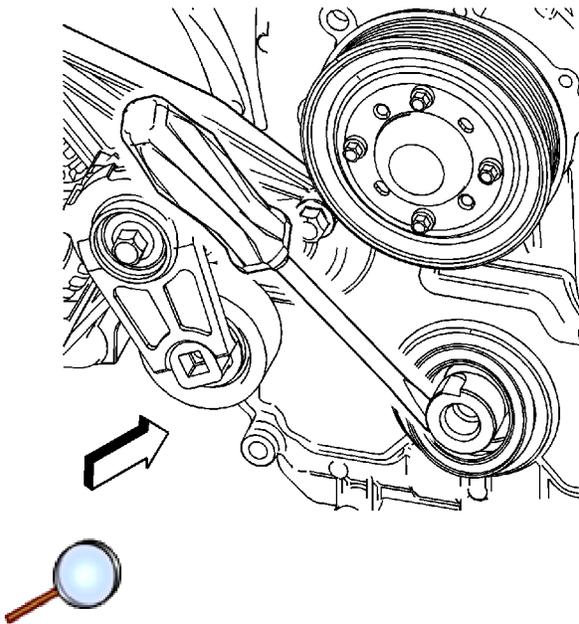
10. Remove the [EN 46106](#) .
11. Install the starter. Refer to [Starter Replacement](#).
12. Using engine support fixture, raise the engine into position.
13. Install the engine mount strut bracket. Refer to [Engine Mount Strut Bracket Replacement - Right Side](#).
14. Install the drive belt. Refer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

Crankshaft Front Oil Seal Replacement

Tools Required

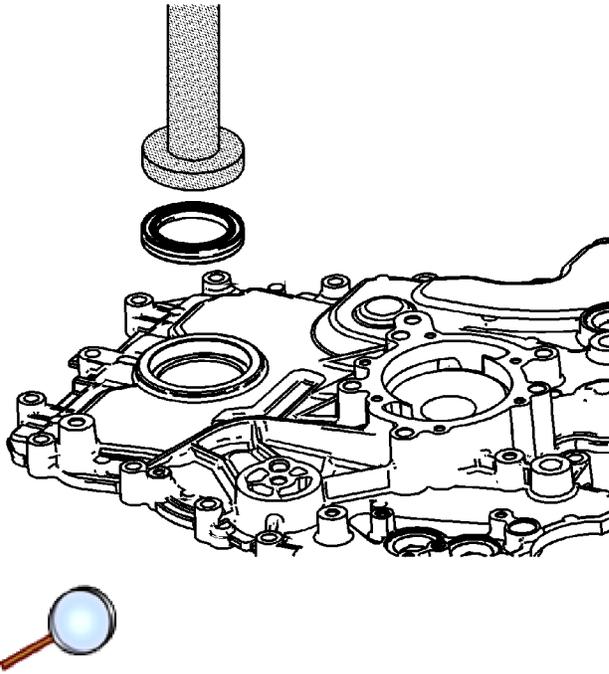
[J 29184](#) Oil Seal Installer

Removal Procedure



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

Installation Procedure



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

1. Use the [J 29184](#) or equivalent to install the crankshaft front oil seal.
2. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#) .

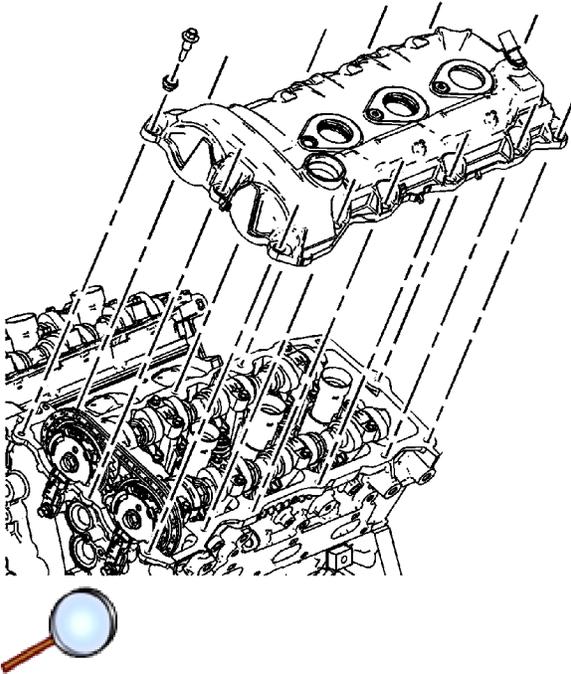
Camshaft Cover Replacement - Left Side

Special Tools

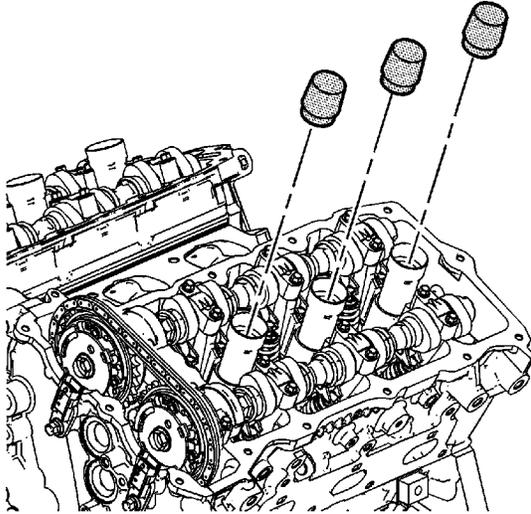
[EN 46101](#) Spark Plug Tube Seal Guide

Removal Procedure

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

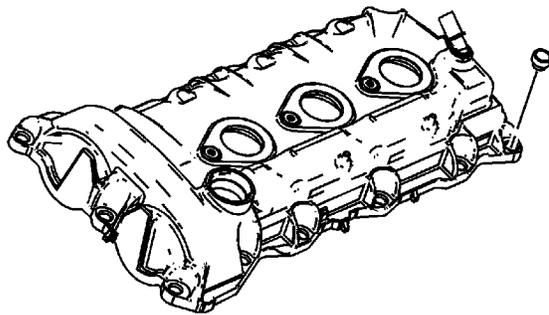


5. Remove the left camshaft cover bolts.
6. Remove the left camshaft cover from the left cylinder head.
7. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to [Camshaft Cover Cleaning and Inspection](#).

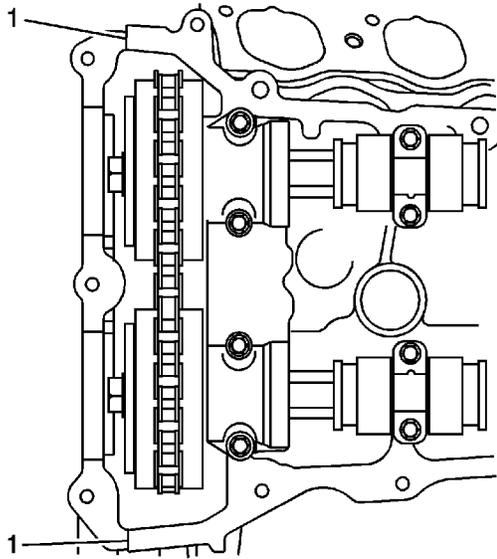


8. Install the [EN 46101](#) onto the spark plug tubes of the left cylinder head.

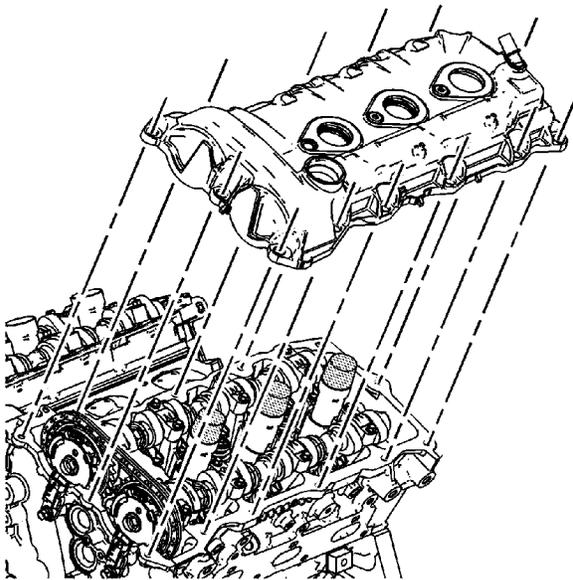
Installation Procedure



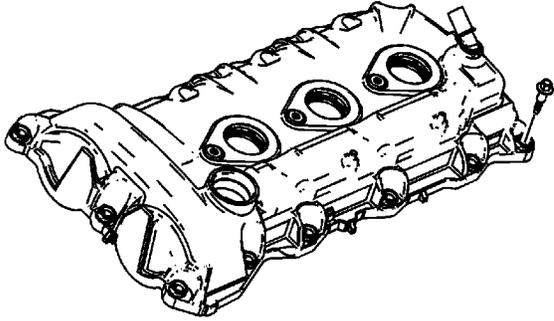
1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.



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

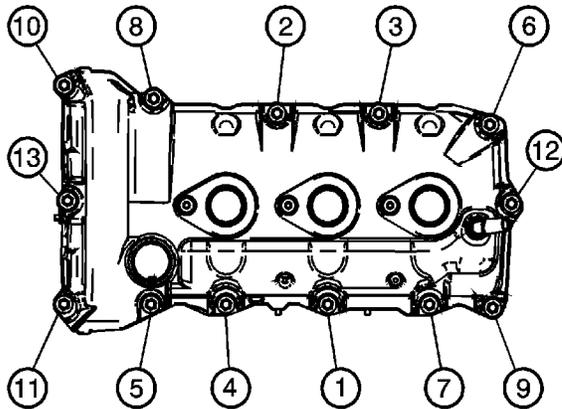


3. Place the left camshaft cover into position onto the left cylinder head.



- Loosely install the left camshaft cover bolts.

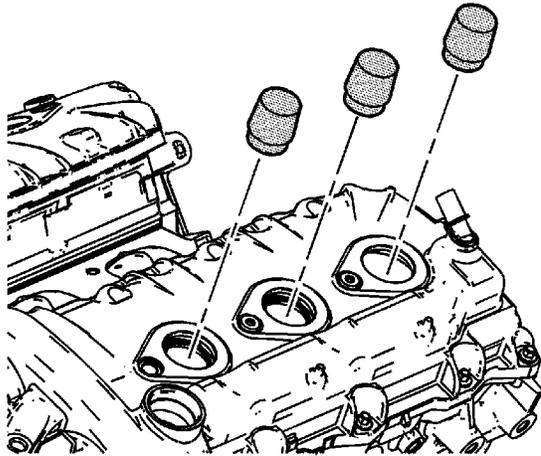
Caution: Refer to [Fastener Caution](#) in the Preface section.



- Tighten the left camshaft cover bolts in sequence shown.

Tighten

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



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

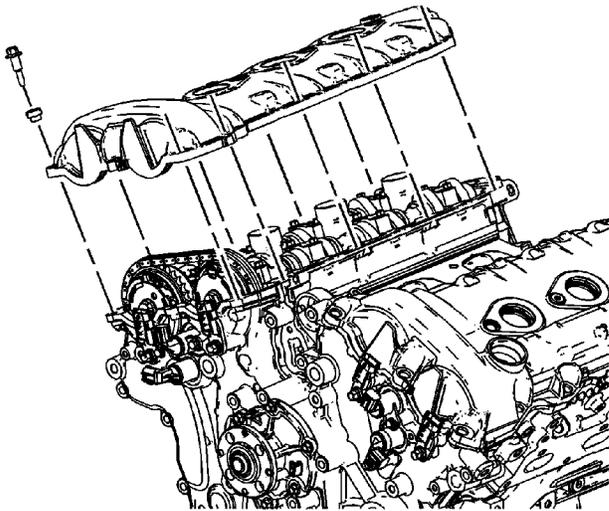
Camshaft Cover Replacement - Right Side

Special Tools

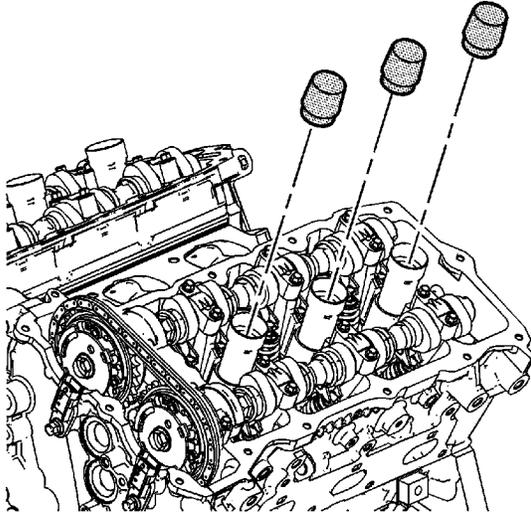
[EN 46101](#) Spark Plug Tube Seal Guide

Removal Procedure

1. Remove the intake manifold. Refer to [Intake Manifold Replacement](#).
2. Remove the right bank spark plugs. Refer to [Spark Plug Replacement](#).
3. Unbolt the power steering reservoir and position aside. Refer to [Remote Power Steering Fluid Reservoir Replacement](#).

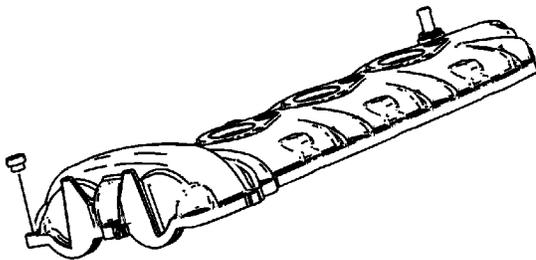


4. Remove the right camshaft cover bolts.
5. Remove the right camshaft cover from the right cylinder head.
6. Clean the mating surfaces of the cylinder head and the camshaft cover. Refer to [Camshaft Cover Cleaning and Inspection](#).

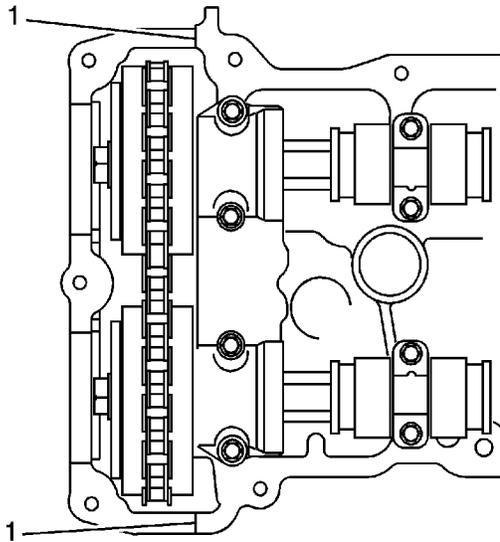


7. Install the [EN 46101](#) onto the spark plug tubes of the right cylinder head.

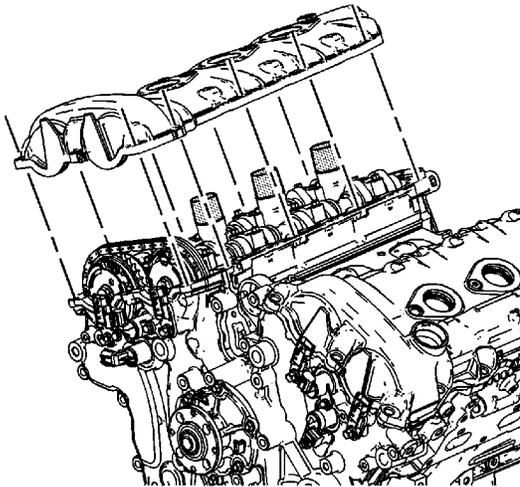
Installation Procedure



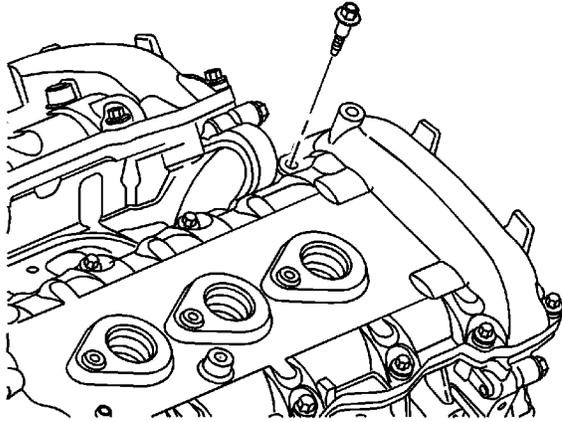
1. Install new camshaft cover bolt grommets prior to installing the camshaft cover bolts.



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

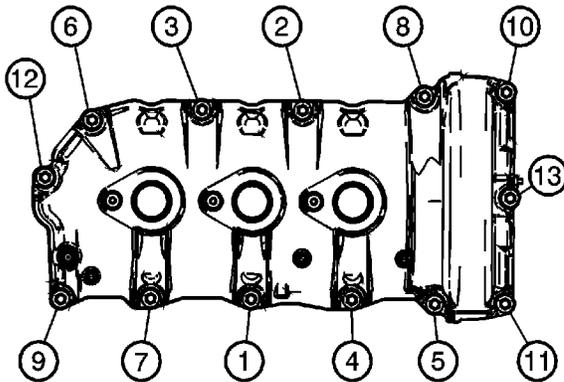


3. Place the right camshaft cover into position onto the right cylinder head.



4. Loosely install the right camshaft cover bolts.

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

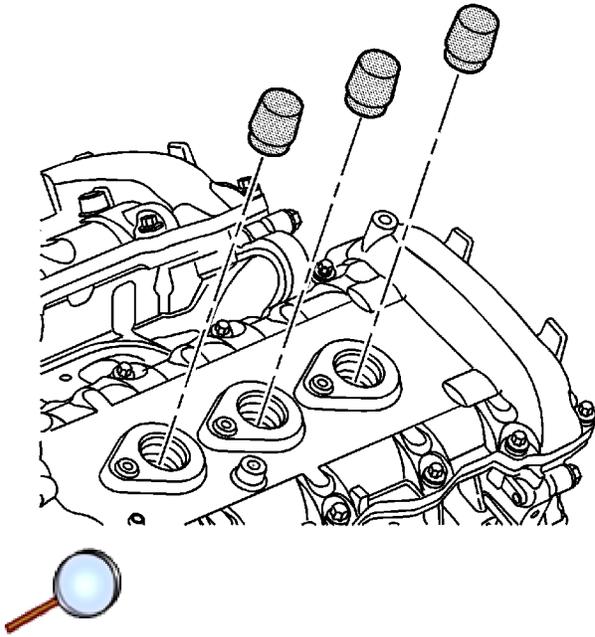


5. Tighten the right camshaft cover bolts in sequence.

Tighten

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

6. Install the power steering reservoir. Refer to [Remote Power Steering Fluid Reservoir Replacement](#).



7. Remove the [EN 46101](#) from the spark plug tubes of the right cylinder head.
8. Install NEW spark plugs into the right cylinder head. Refer to [Spark Plug Replacement](#).
9. Install the intake manifold. Refer to [Intake Manifold Replacement](#).

Engine Front Cover Replacement

Special Tools

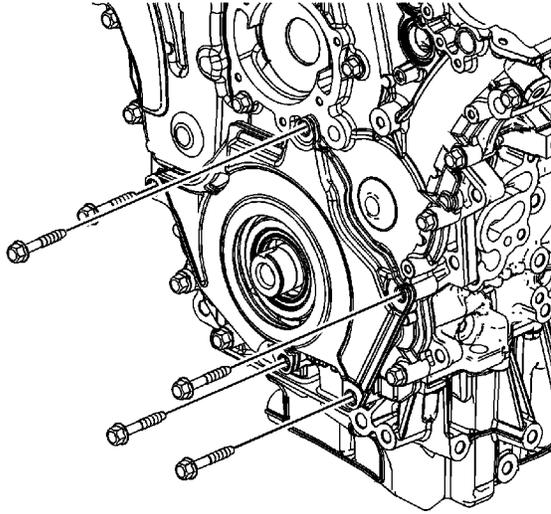
- [EN 46105](#) Camshaft Locking Tool
- [EN 46109](#) Guide Pin Set
- [EN 46111](#) Crankshaft Rotational Socket

Removal Procedure

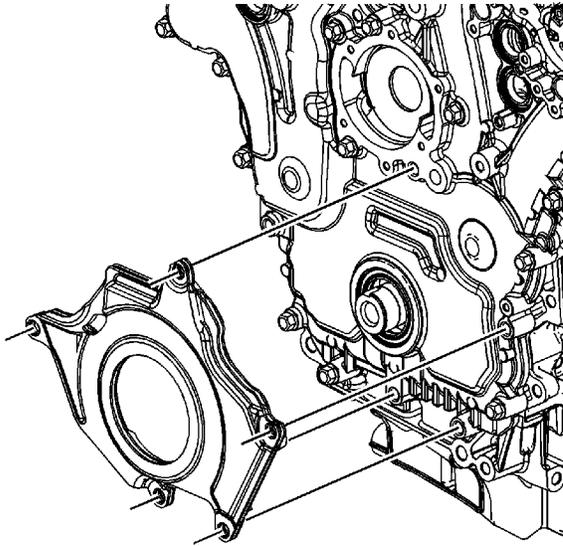
1. Remove the frame from the body with the engine and transmission. Refer to [Engine Replacement](#).

Follow steps 1-40 in the Engine Replacement Removal.

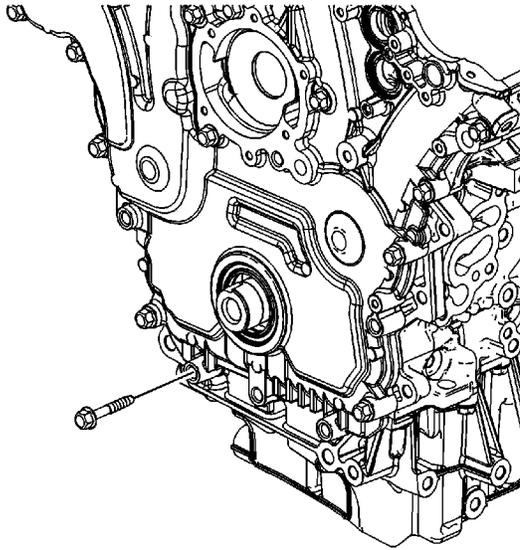
2. Remove the intake manifold. Refer to [Intake Manifold Replacement](#).
3. Remove the camshaft covers. Refer to [Camshaft Cover Replacement - Left Side](#) and [Camshaft Cover Replacement - Right Side](#).
4. Remove the water outlet housing assembly. Refer to [Water Outlet Replacement](#).
5. Remove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



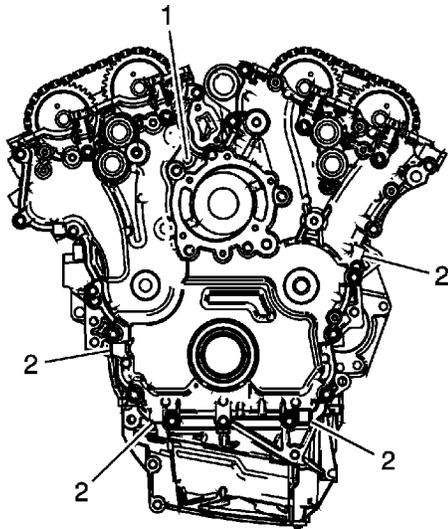
12. Remove the engine front cover bolts that hold the engine front cover deadener into position.



13. Remove the engine front cover deadener.

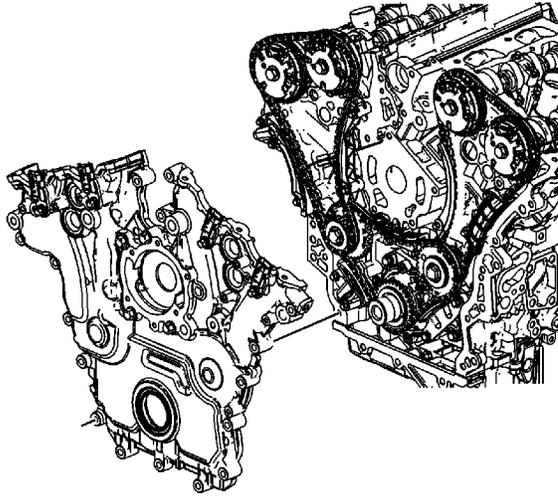


14. Remove the remaining engine front cover bolts.

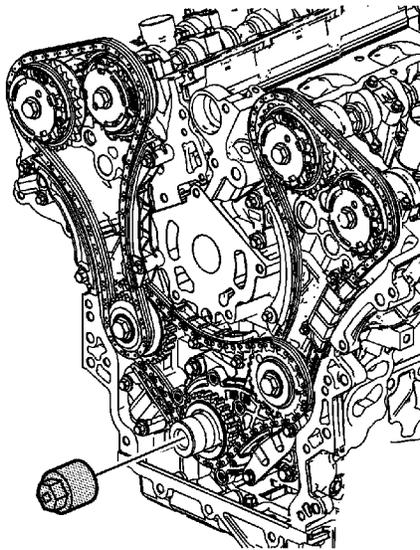


Caution: Do not pry between the engine front cover and the camshaft position sensors or the camshaft position actuators in order to separate the RTV. Use the pry points and a bolt in the jackscrew hole in order to remove the engine front cover. Damage to the camshaft position sensors or the camshaft position actuators may occur if the camshaft position sensors or the camshaft position actuators are used to pry against in order to remove the engine front cover.

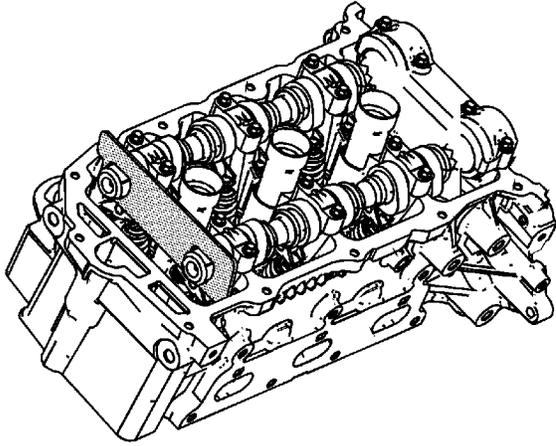
15. Loosely install a 10 x 1.5 mm bolt in the "jackscrew" hole (1).
16. Using the pry points (2) located at the edge of the front cover and the "jackscrew", separate the RTV sealant.



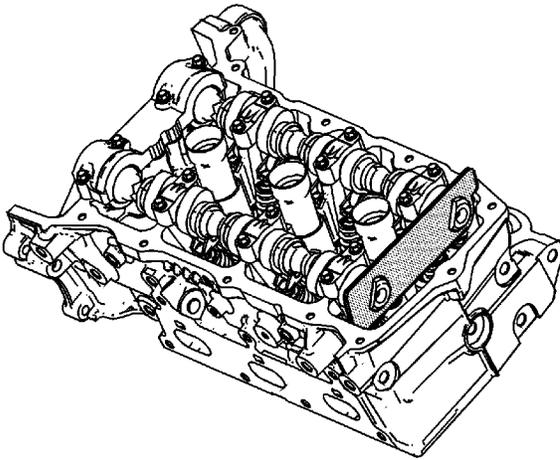
17. Remove the engine front cover.



18. Using the [EN 46111](#) , rotate the crankshaft until the left cylinder head camshafts align with the EN 46105-2 and the right cylinder head camshafts align with the EN 46105-1.

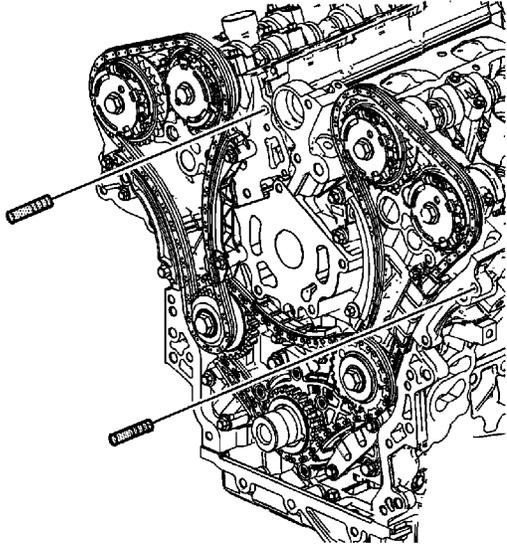


19. Install the EN 46105-1 to the right camshafts.

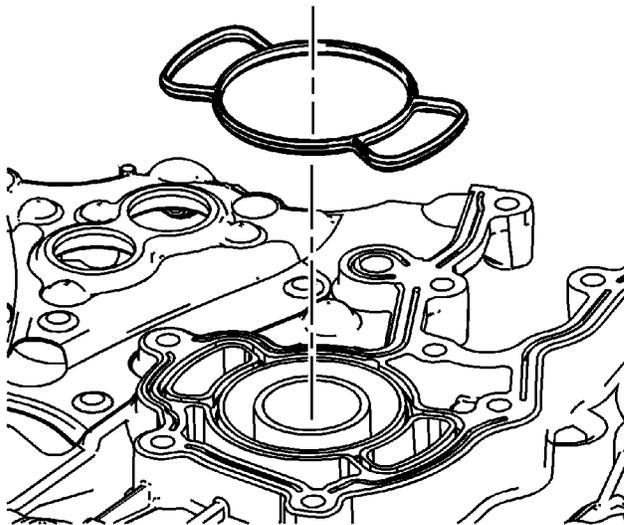


20. Install the EN 46105-2 to the left camshafts.

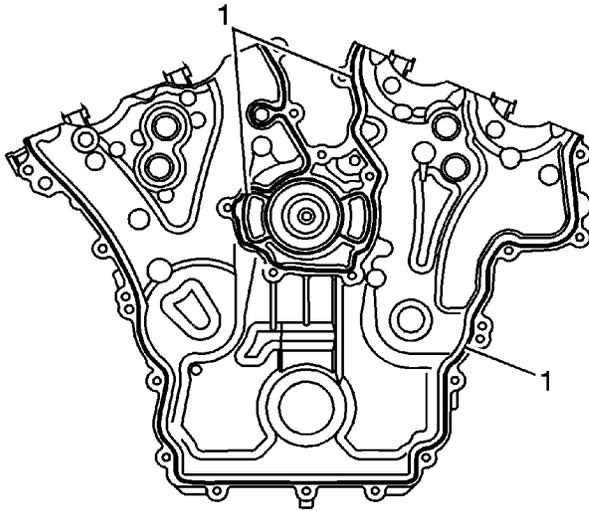
Installation Procedure



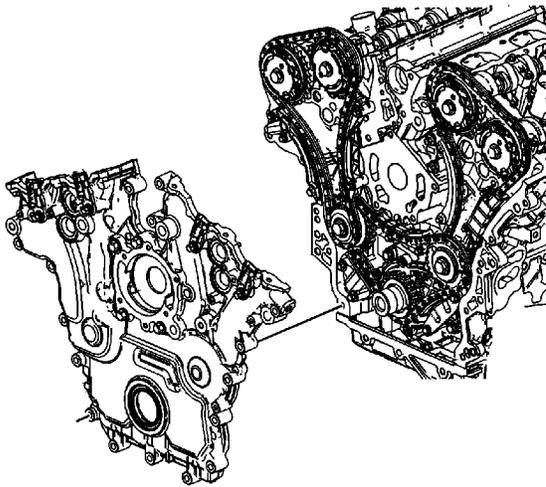
1. Install the 8 mm (0.315 in) guide from the [EN 46109](#) into the cylinder block positions as shown.



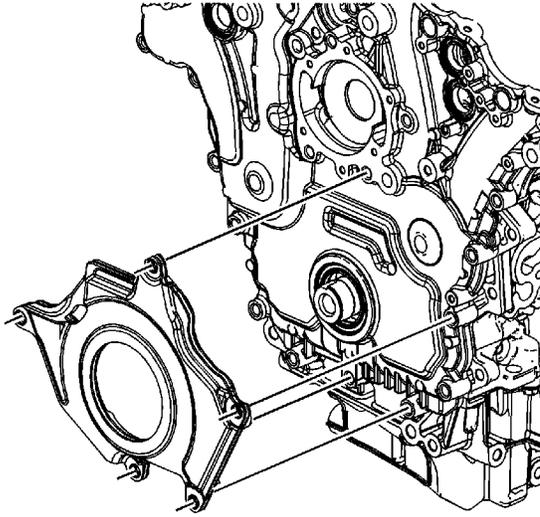
2. Install the engine front cover to cylinder block seal.



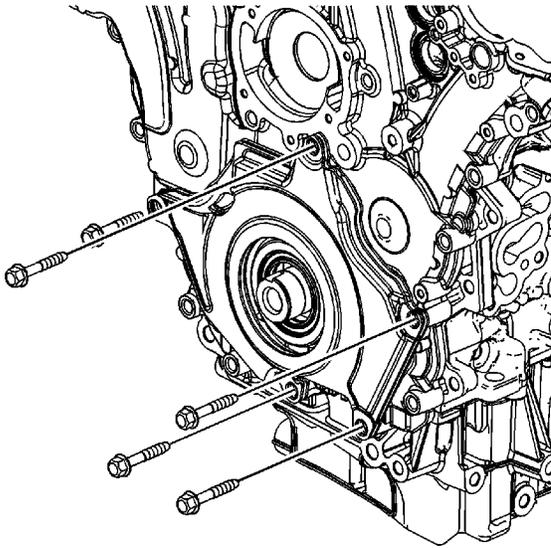
3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine (1).



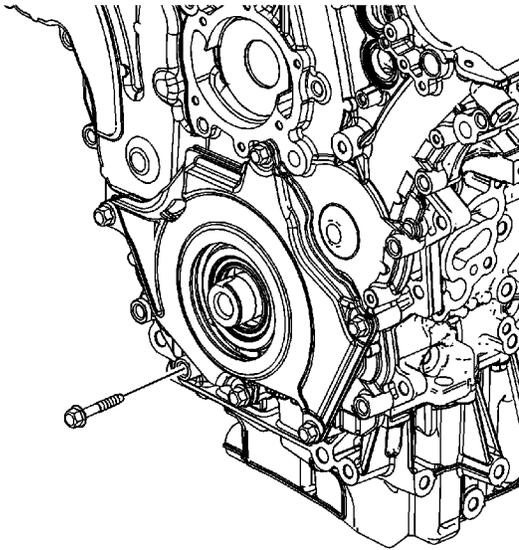
4. Place the engine front cover onto the [EN 46109](#) and slide into position.
5. Remove the [EN 46109](#) from the cylinder block.



6. Install the engine front cover deadener.

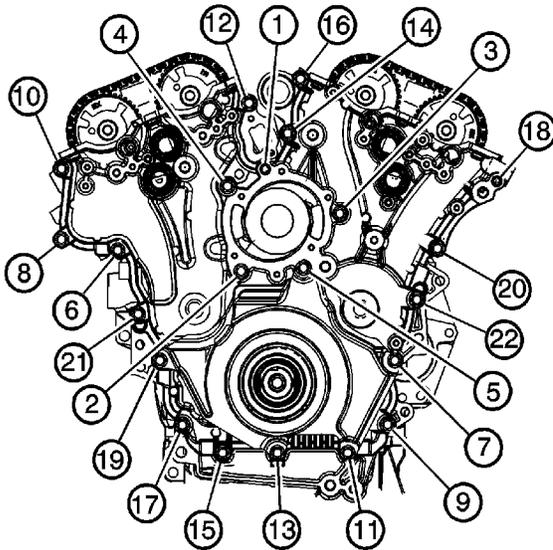


7. Loosely install the engine front cover bolts to hold the engine front cover deadener into position.



8. Loosely install the remaining front cover bolts.

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



9. Tighten the engine front cover bolts in the sequence shown.
 - 9.1. Tighten the engine front cover bolts a first pass in sequence to **20 N·m (14 lb ft)**.
 - 9.2. Tighten the engine front cover bolts a second pass in sequence an additional **60 degrees**.
10. Install the generator. Refer to [Generator Replacement](#).
11. Install the camshaft position actuator solenoid valves to the front cover. Refer to [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\) Intake](#) , [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\)](#)

[Exhaust](#) , [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 \(Left Side\) Intake](#) , and [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 \(Left Side\) Exhaust](#).

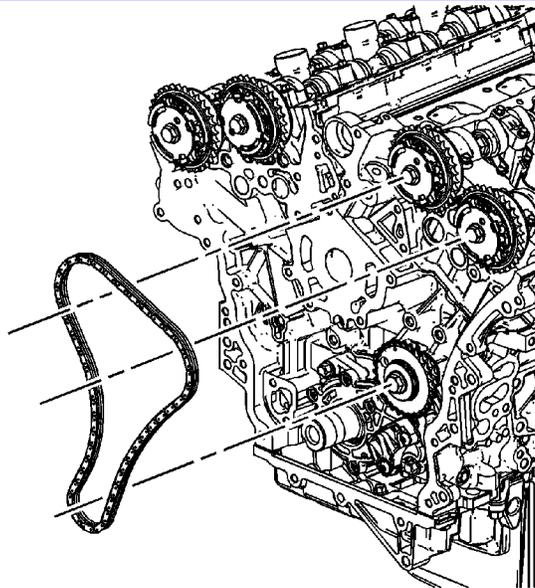
12. Install the camshaft position sensors. Refer to [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Exhaust](#) , [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Intake](#) , [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Exhaust](#) and [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#).
13. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).
14. Install the power steering pump. Refer to [Power Steering Pump Replacement](#).
15. Install the water pump pulley. Refer to [Water Pump Replacement](#).
16. Install the water outlet housing assembly. Refer to [Water Outlet Replacement](#).
17. Install the drive belt tensioner. Refer to [Drive Belt Tensioner Replacement](#).
18. Install the camshaft covers. Refer to [Camshaft Cover Replacement - Left Side](#) and [Camshaft Cover Replacement - Right Side](#).
19. Install the intake manifold. Refer to [Intake Manifold Replacement](#).
20. Install the frame with the engine and transmission. Refer to [Engine Replacement](#).

Follow steps 16-49 in Engine Replacement Installation.

Secondary Camshaft Drive Chain Replacement - Left Side

Removal Procedure

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

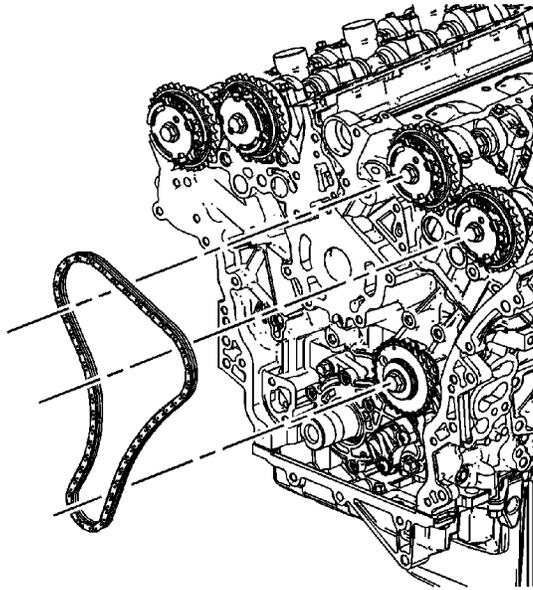


14. Remove the left bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Removal - Left Side](#) .

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15. Clean and inspect all of the camshaft timing drive components. Refer to [Camshaft Timing Drive Components Cleaning and Inspection](#) . Replace components as necessary.

Installation Procedure

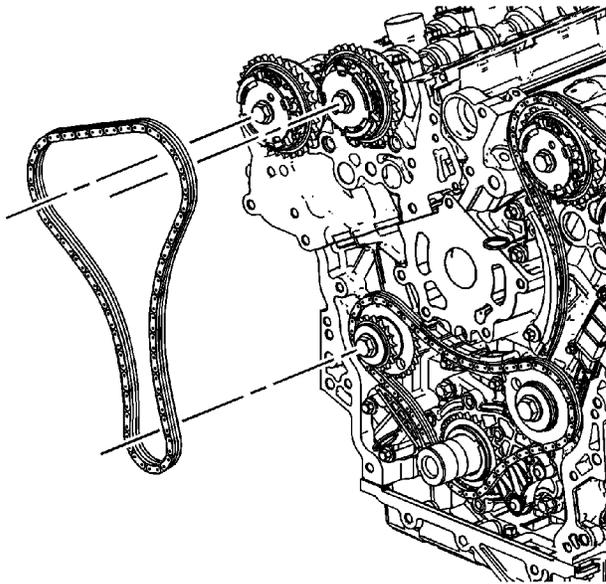


1. Install the left bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Installation - Left Side](#) .
2. Install the left bank camshaft intermediate drive chain idler. Refer to [Camshaft Intermediate Drive Chain Idler Installation - Left Side](#) .
3. Install the left bank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

Secondary Camshaft Drive Chain Replacement - Right Side

Removal Procedure

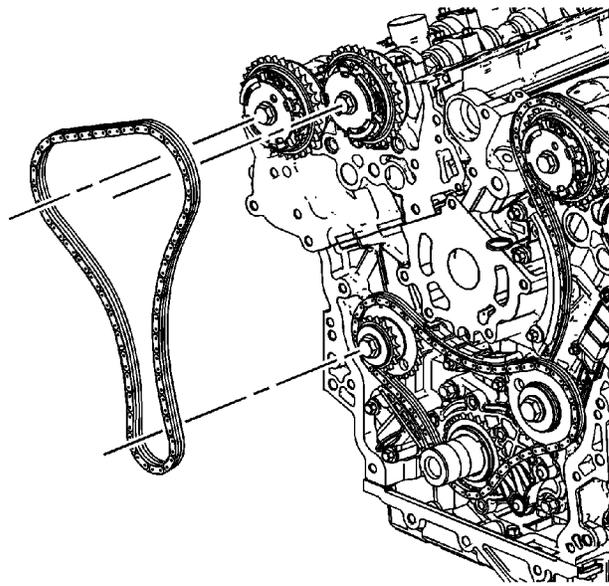
1. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#).
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner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



6. Remove the right bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Removal - Right Side](#).

Installation Procedure

1. Ensure the stage 1 camshaft timing is correct. Refer to [Setting Camshaft Timing](#).

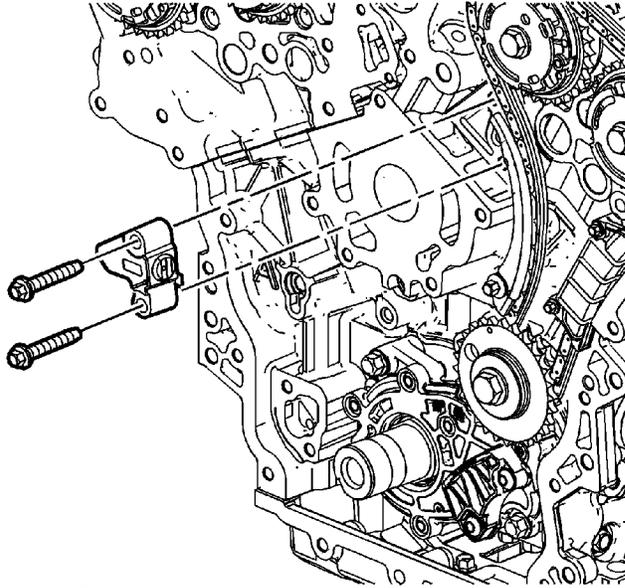


2. Install the right bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Installation - Right Side](#).
3. Install the right bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Installation - Right Side](#).
4. Install the right bank secondary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

Secondary Camshaft Drive Chain Tensioner Replacement - Left Side

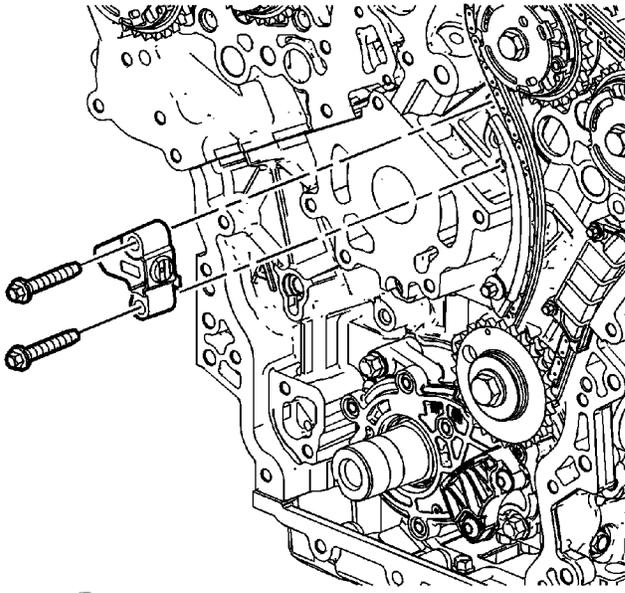
Removal Procedure

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



3. Remove the left bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Removal - Left Side](#).

Installation Procedure

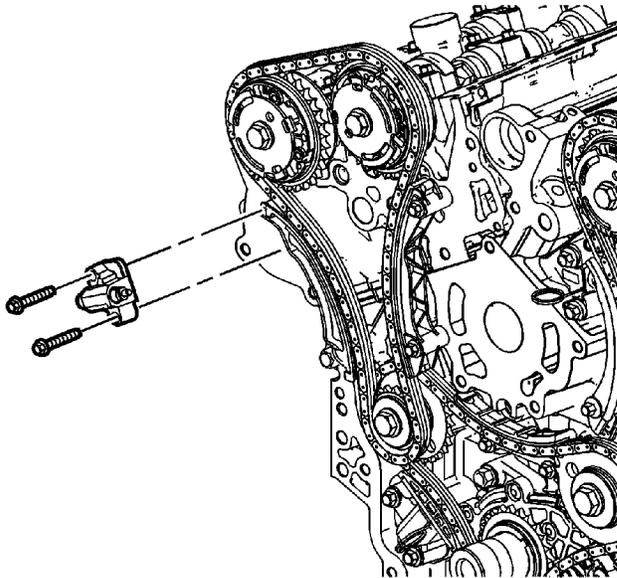


1. Install the left bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Left Side](#).
2. Install the spark plugs. Refer to [Spark Plug Replacement](#).
3. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

Secondary Camshaft Drive Chain Tensioner Replacement - Right Side

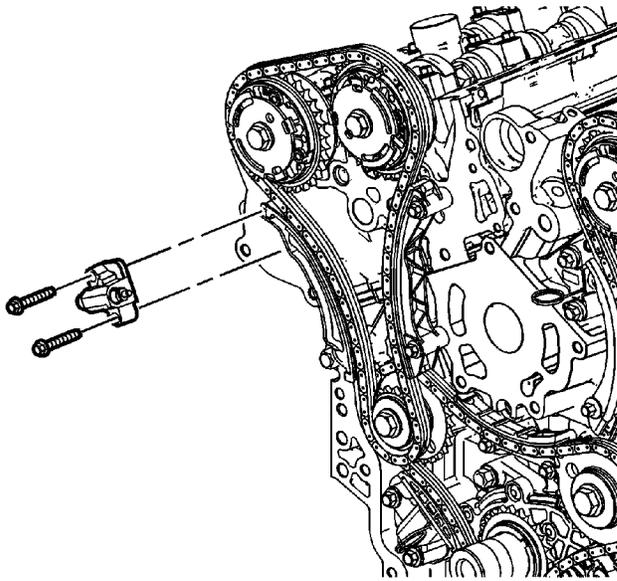
Removal Procedure

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



3. Remove the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Removal - Right Side](#).

Installation Procedure

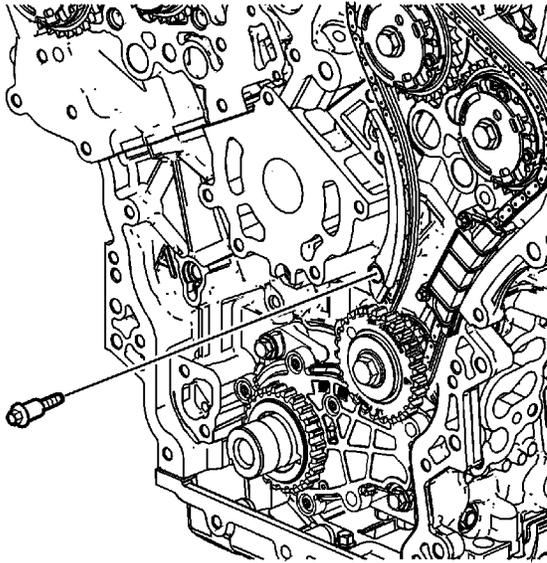


1. Install the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Right Side](#).
2. Install the spark plugs. Refer to [Spark Plug Replacement](#).
3. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

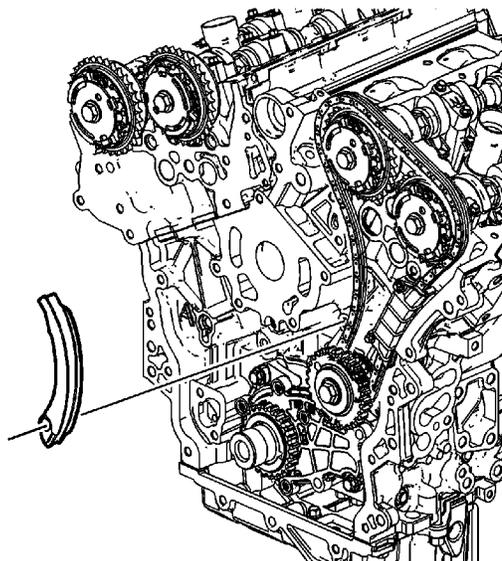
Secondary Camshaft Drive Chain Shoe Replacement - Left Side

Removal Procedure

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



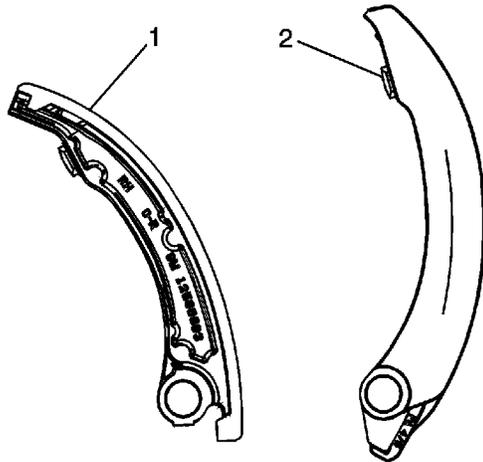
4. Remove the left secondary camshaft drive chain shoe bolt.



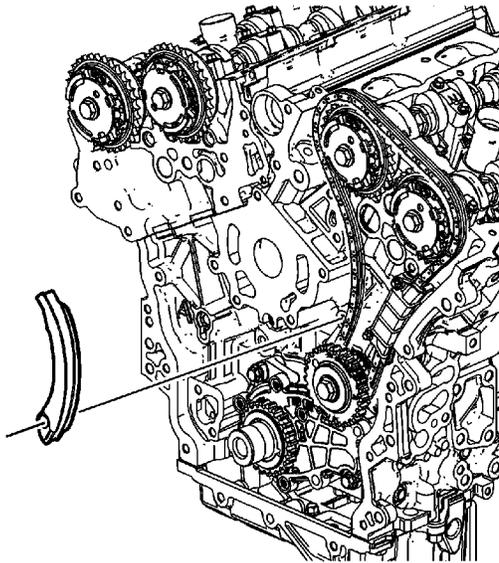


5. Remove the left secondary camshaft drive chain shoe.

Installation Procedure

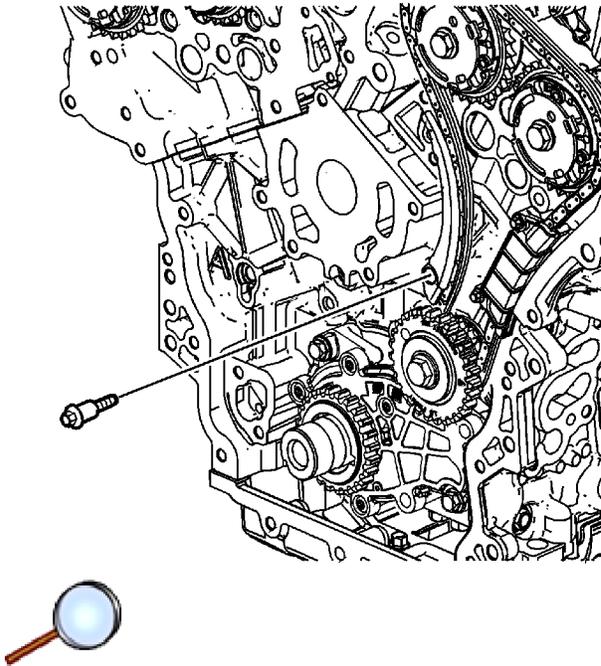


1. Ensure that the left secondary camshaft drive chain shoe (2) is being installed.



2. Position the left secondary camshaft drive chain shoe.

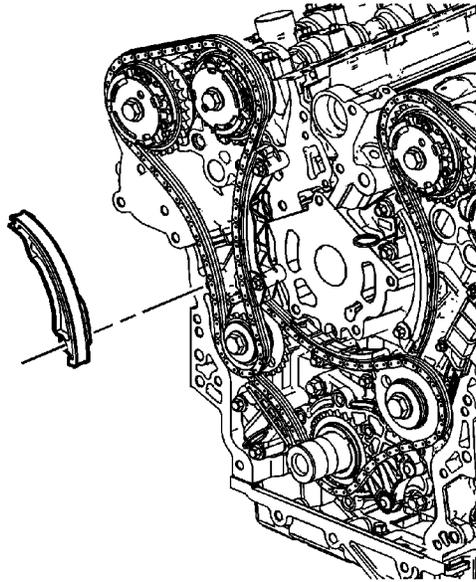
Caution: Refer to [Fastener Caution](#) in the Preface section.



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

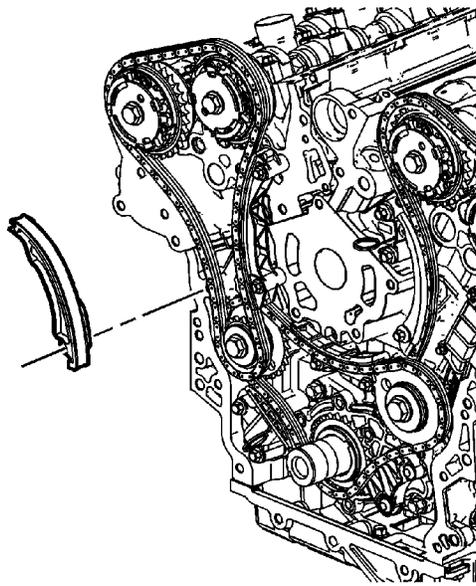
Secondary Camshaft Drive Chain Shoe Replacement - Right Side

Removal Procedure



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

Installation Procedure

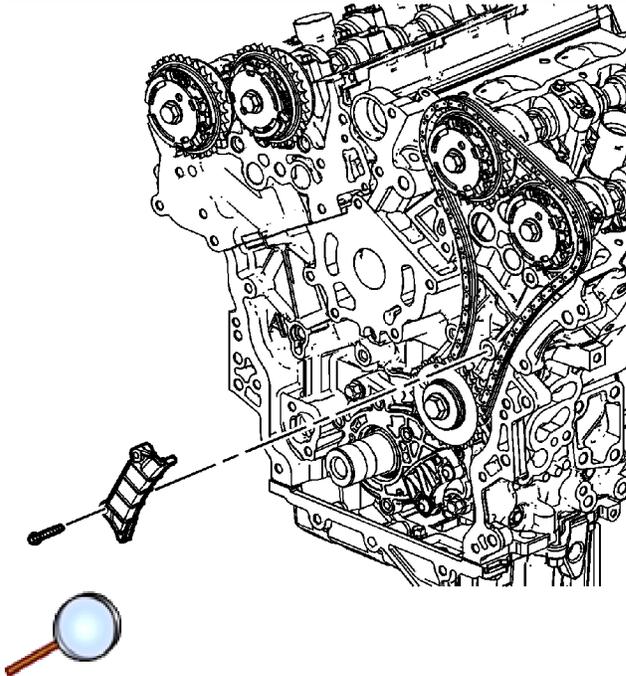


1. Install the right bank secondary camshaft drive chain shoe. Refer to [Secondary Camshaft Drive Chain Shoe Installation - Right Side](#).
2. Install the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Right Side](#).
3. Install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

Secondary Camshaft Drive Chain Guide Replacement - Left Side

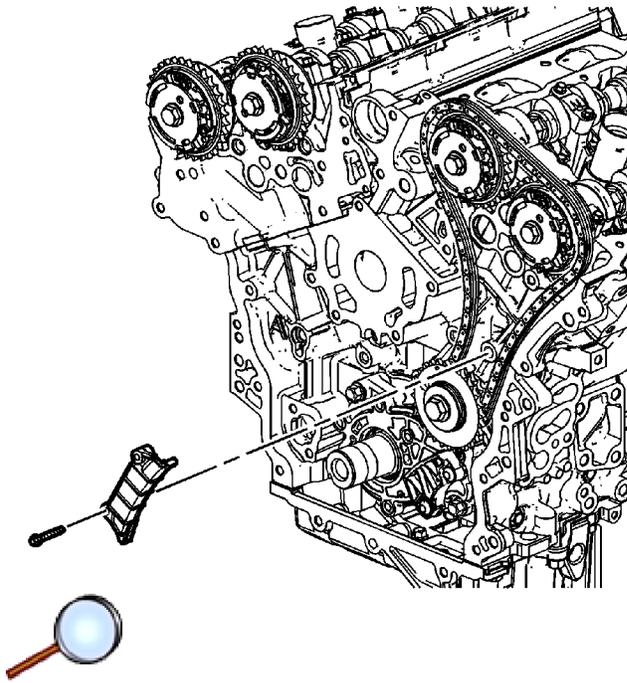
Removal Procedure

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



4. Remove the left bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Removal - Left Side](#).

Installation Procedure

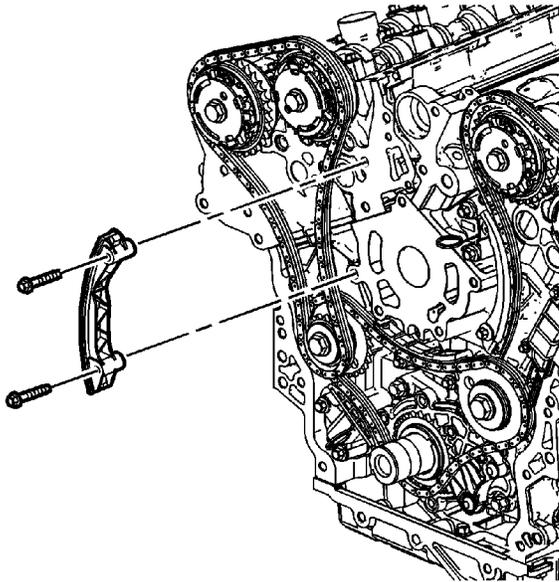


1. Install the left bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Installation - Left Side](#).
2. Install the left bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Left Side](#).
3. Install the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

Secondary Camshaft Drive Chain Guide Replacement - Right Side

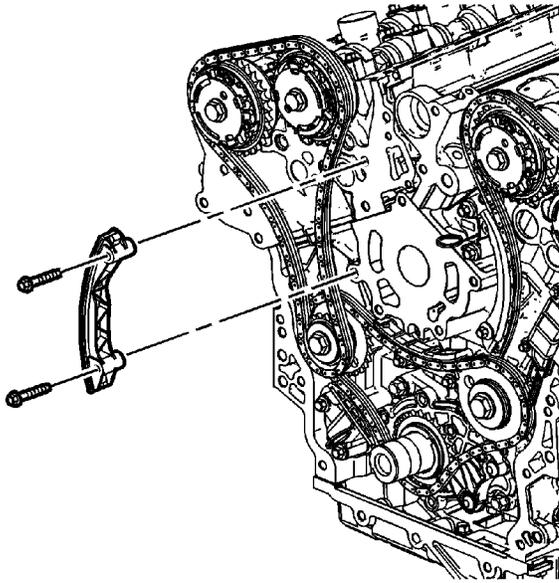
Removal Procedure

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



4. Remove the right bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Removal - Right Side](#).

Installation Procedure



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

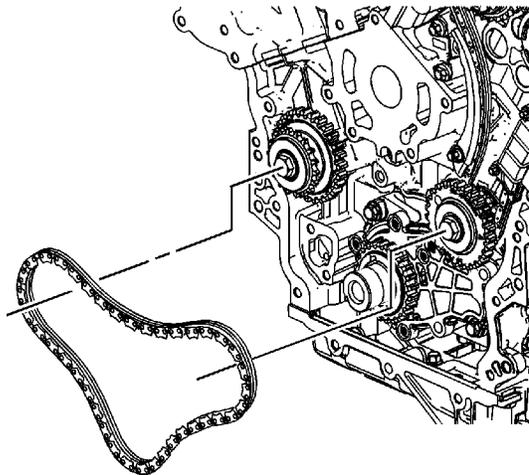
Primary Camshaft Drive Chain and Sprockets Replacement

Special Tools

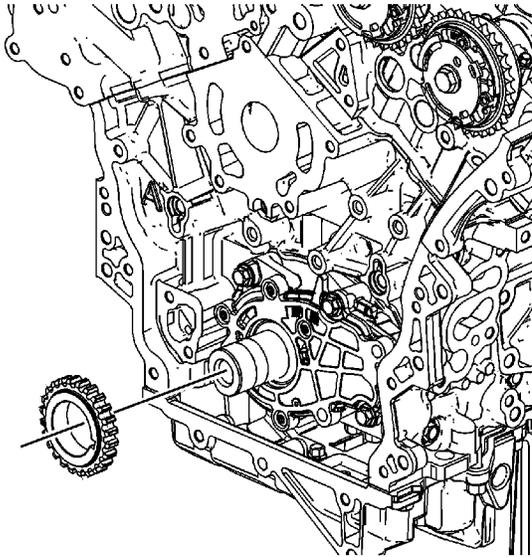
[EN 46111](#) Crankshaft Rotation Socket

Removal Procedure

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

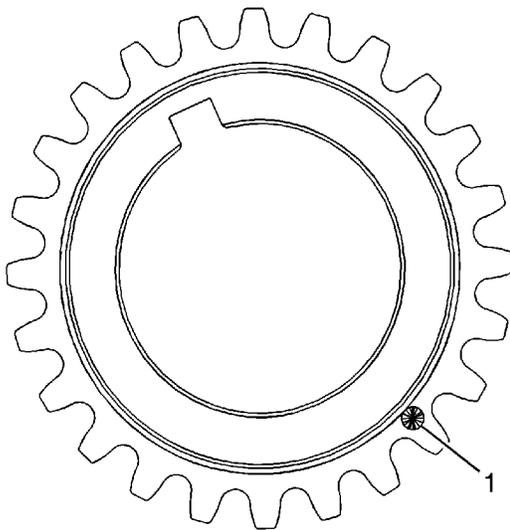


9. Remove the primary camshaft timing chain. Refer to [Secondary Camshaft Drive Chain Removal - Right Side](#).

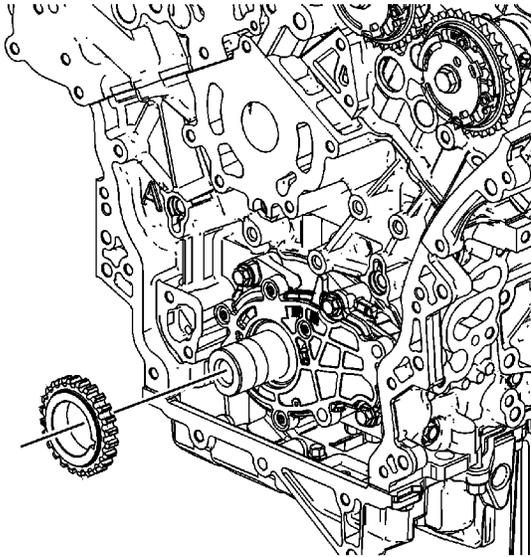


10. Remove the crankshaft sprocket from the nose of the crankshaft.

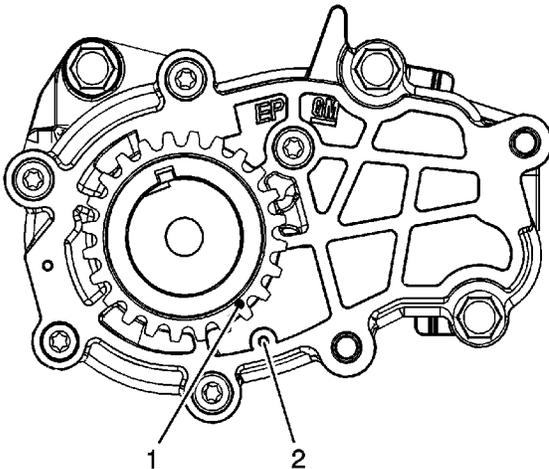
Installation Procedure



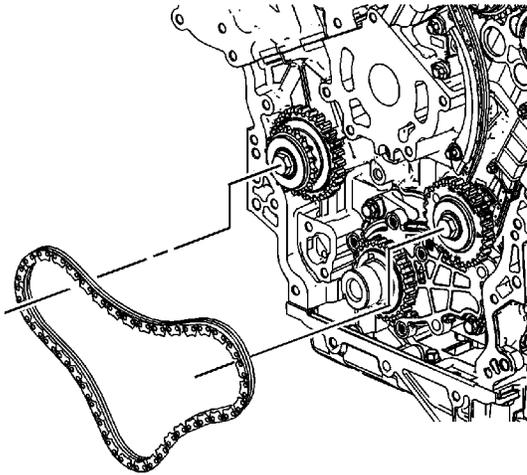
1. Ensure the crankshaft sprocket is installed with the timing mark (1) visible.



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



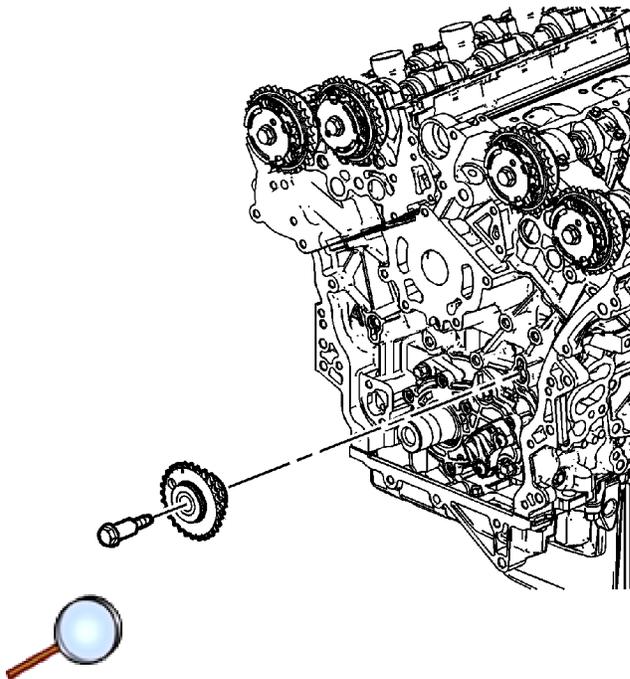
5. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the [EN 46111](#) . Refer to [Camshaft Timing Drive Chain Alignment Diagram](#) - Stage One.



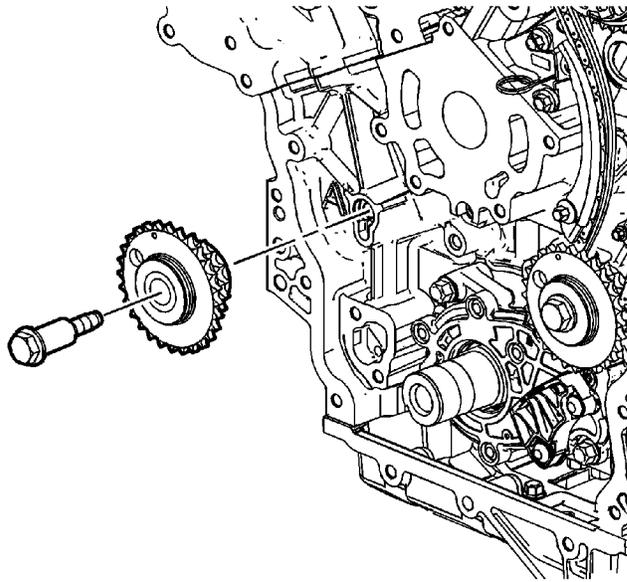
6. Install the primary camshaft timing chain. Refer to [Primary Camshaft Intermediate Drive Chain Installation](#).
7. Install the primary upper camshaft drive chain guide. Refer to [Primary Timing Chain Guide Installation - Upper](#).
8. Install the primary camshaft drive chain tensioner. Refer to [Primary Camshaft Intermediate Drive Chain Tensioner Installation](#).
9. Install the right bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Installation - Right Side](#).
10. Install the right bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Installation - Right Side](#).
11. Install the right bank secondary camshaft drive chain shoe. Refer to [Secondary Camshaft Drive Chain Shoe Installation - Right Side](#).
12. Install the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Right Side](#).
13. Install the spark plugs. Refer to [Spark Plug Replacement](#).
14. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

Timing Chain Idler Sprocket Replacement - Left Side

Removal Procedure

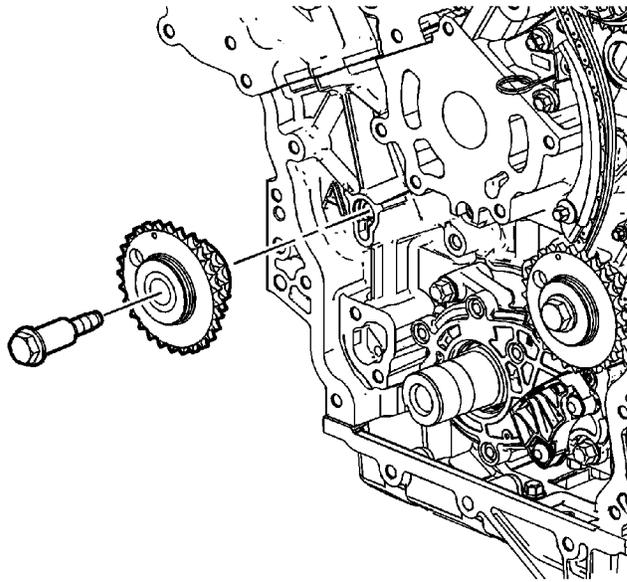


1. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#).
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner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

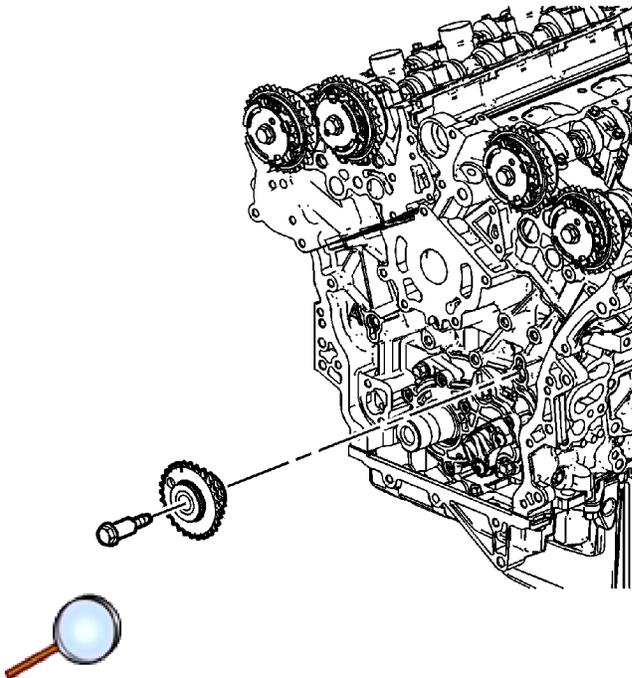


11. If you are servicing the left bank camshaft intermediate drive chain idler, perform the following steps:
 - 11.1. Remove the left bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Removal - Left Side](#).
 - 11.2. Remove the left bank secondary camshaft drive chain shoe. Refer to [Secondary Camshaft Drive Chain Shoe Removal - Left Side](#).
 - 11.3. Remove the left bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Removal - Left Side](#).
 - 11.4. Remove the left bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Removal - Left Side](#).
 - 11.5. Remove the left bank camshaft intermediate drive chain idler. Refer to [Camshaft Intermediate Drive Chain Idler Removal - Left Side](#).

Installation Procedure



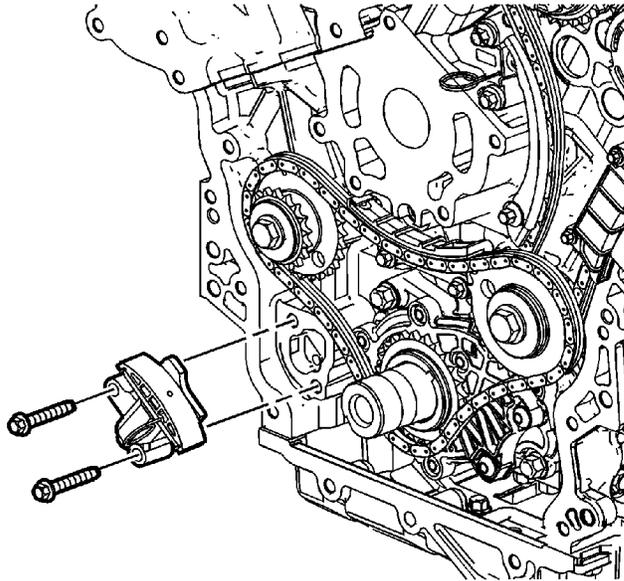
1. If you are servicing the left bank idler sprocket, perform the following steps:
 - 1.1. Install the left bank camshaft intermediate drive chain idler. Refer to [Camshaft Intermediate Drive Chain Idler Installation - Left Side](#).
 - 1.2. Install the left bank secondary camshaft drive chain. Refer to [Secondary Camshaft Drive Chain Installation - Left Side](#).
 - 1.3. Install the left bank secondary camshaft drive chain guide. Refer to [Secondary Camshaft Drive Chain Guide Installation - Left Side](#).
 - 1.4. Install the left bank secondary camshaft drive chain shoe. Refer to [Secondary Camshaft Drive Chain Shoe Installation - Left Side](#).
 - 1.5. Install the left bank secondary camshaft drive chain tensioner. Refer to [Secondary Camshaft Drive Chain Tensioner Installation - Left Side](#).



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

Primary Camshaft Drive Chain Tensioner Replacement

Removal Procedure

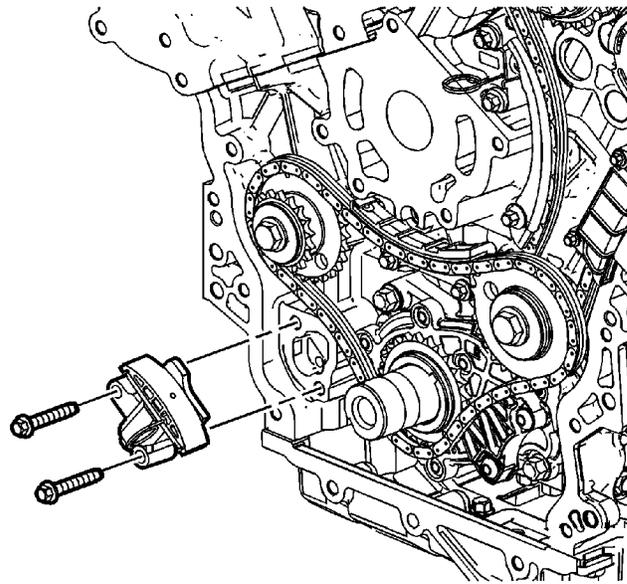


1. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#).

Important: If the entire camshaft timing system is not in stage 2 ([Camshaft Timing Drive Chain Alignment Diagram](#)), mark the timing chain and sprockets in order to ensure proper reassembly.

3. Remove the primary camshaft drive chain tensioner. Refer to [Primary Camshaft Intermediate Drive Chain Tensioner Removal](#).

Installation Procedure



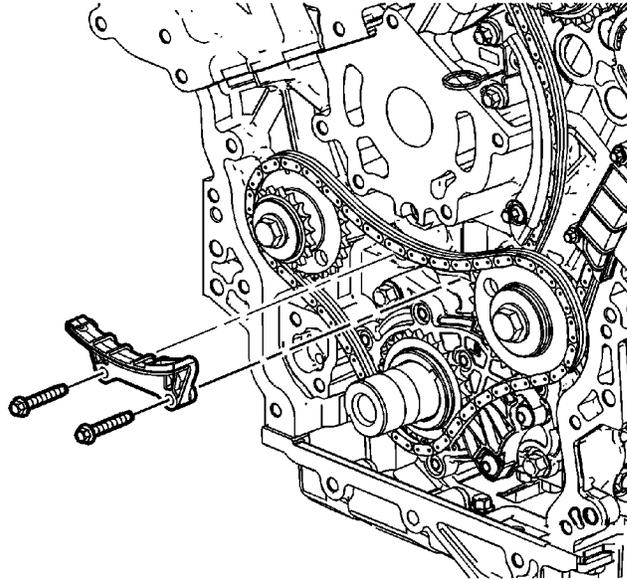
1. Install the primary camshaft drive chain tensioner. Refer to [Primary Camshaft Intermediate Drive Chain Tensioner Installation](#).
2. Install the spark plugs. Refer to [Spark Plug Replacement](#).
3. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

Primary Camshaft Drive Chain Guide Replacement - Lower

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

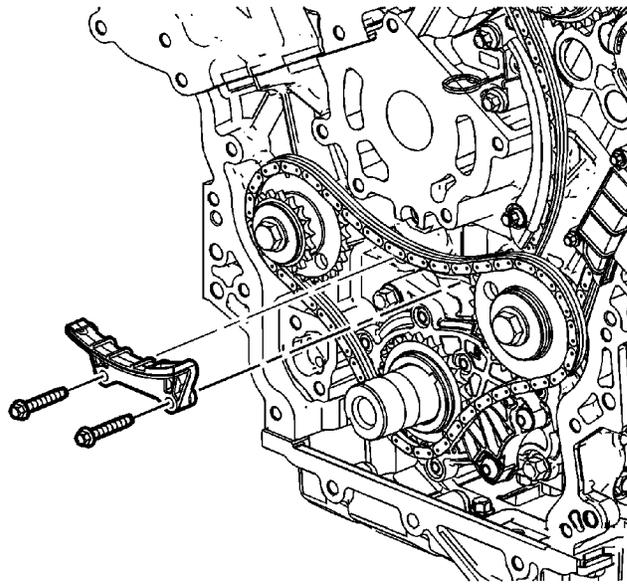
Primary Camshaft Drive Chain Guide Replacement - Upper

Removal Procedure



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

Installation Procedure



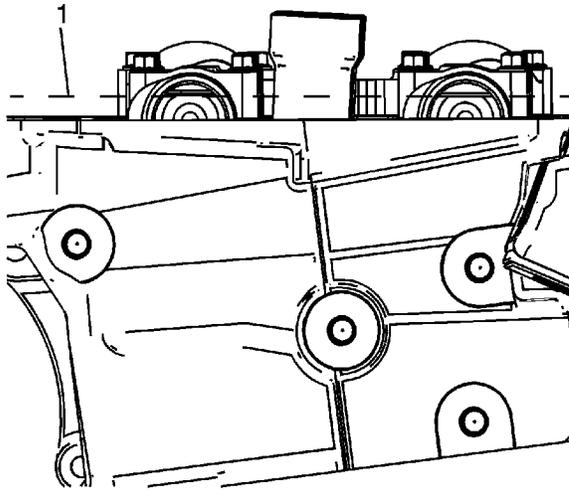
1. Install the primary upper camshaft drive chain guide. Refer to [Primary Camshaft Drive Chain Guide Installation - Upper](#) .
2. Install the primary camshaft drive chain tensioner. Refer to [Primary Camshaft Drive Chain Tensioner Installation](#) .
3. Install the engine front cover. Refer to [Engine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

Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust

Special Tools

[EN-48313](#) Timing Chain Retention Tool

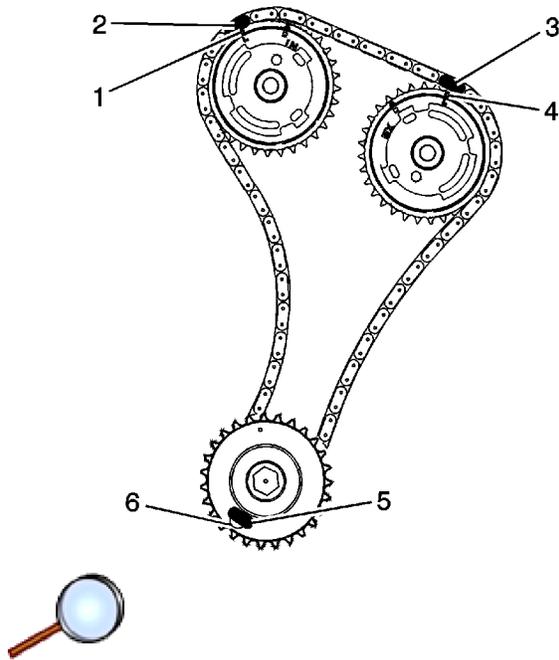
Removal Procedure



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

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

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

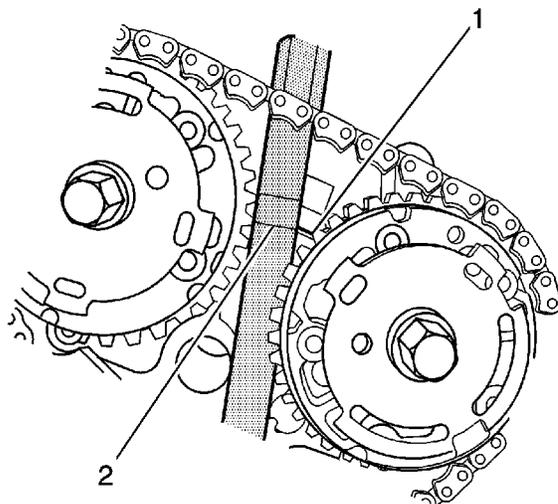


Note: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

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

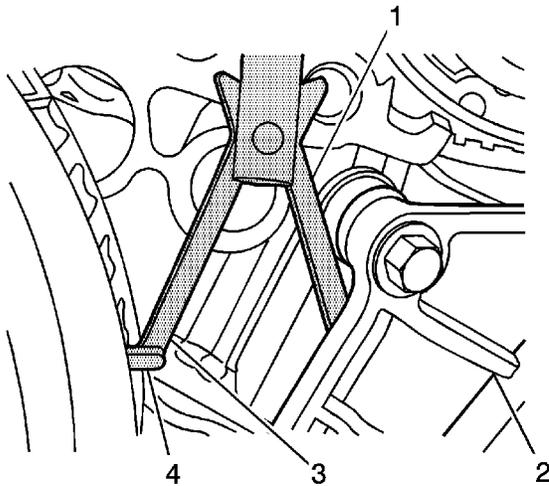
Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



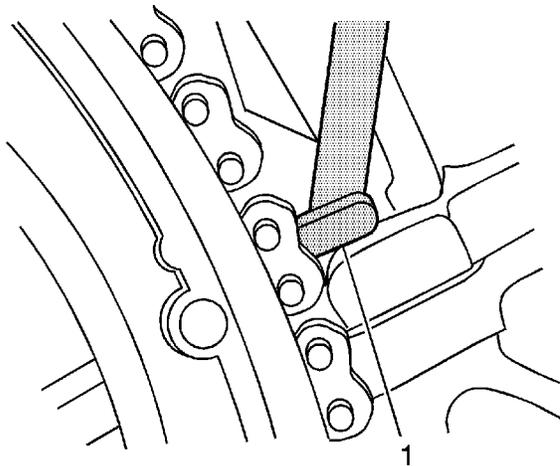


9. Unscrew the [EN-48313](#) so that the legs of the tool are retracted.
10. Insert the [EN-48313](#) between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This is the approximate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



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

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



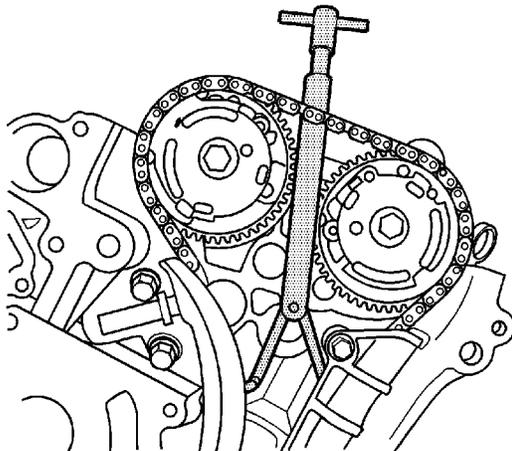


Note: Ensure that the foot (1) of the [EN-48313](#) is engaged into one of the link pockets to prevent tool slippage during tightening of the [EN-48313](#) .

15. Hand tighten the [EN-48313](#) .

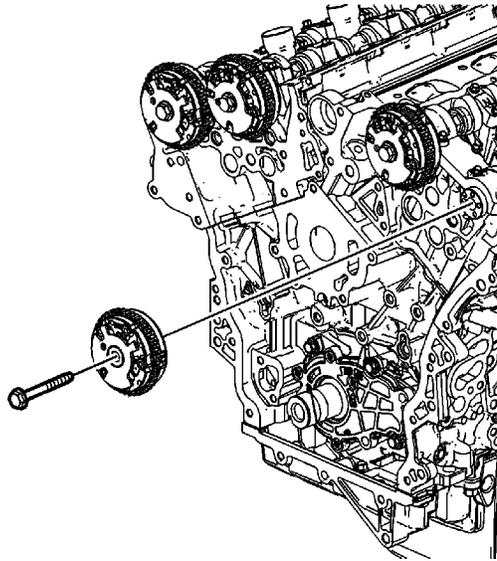
Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



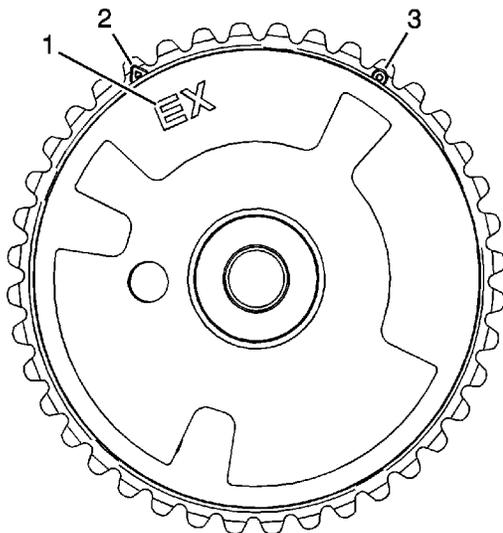
17. The [EN-48313](#) is now properly installed to hold the timing chain in position.

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.



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

Installation Procedure

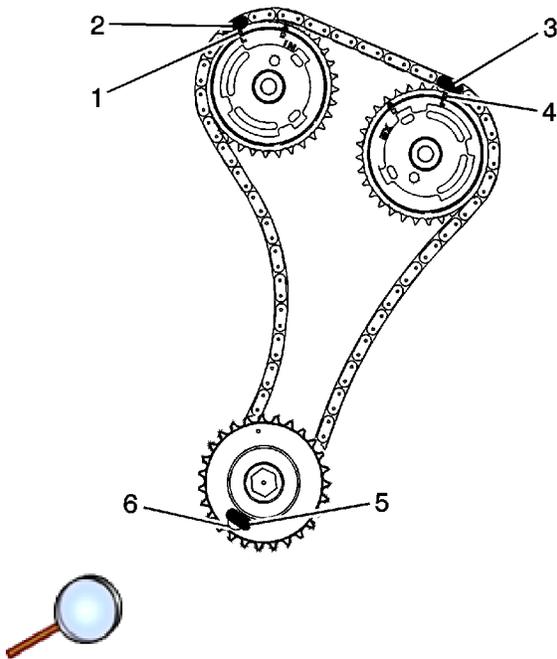


1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the EX marking (1).

The marking is for an exhaust camshaft position actuator,

2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (3).

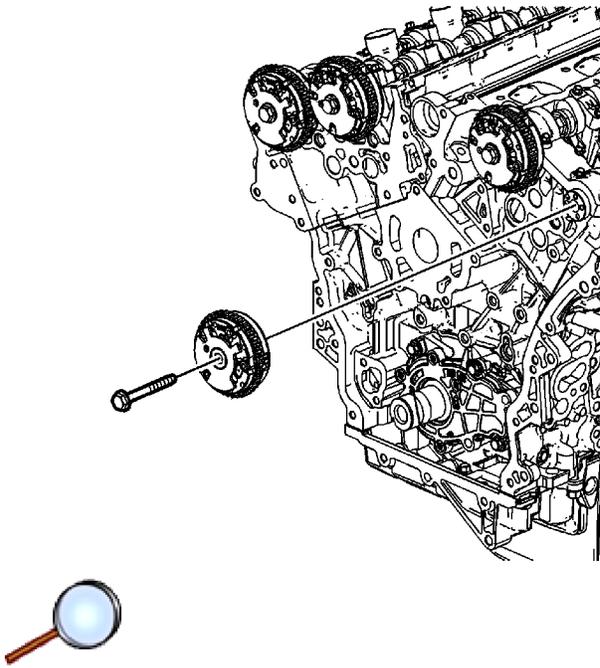
The marking is for alignment to the highlighted timing chain link on the left side of the engine.



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

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

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



7. Tighten the exhaust camshaft position actuator bolt.

Tighten

Tighten the bolt to 58 N·m (43 lb ft).

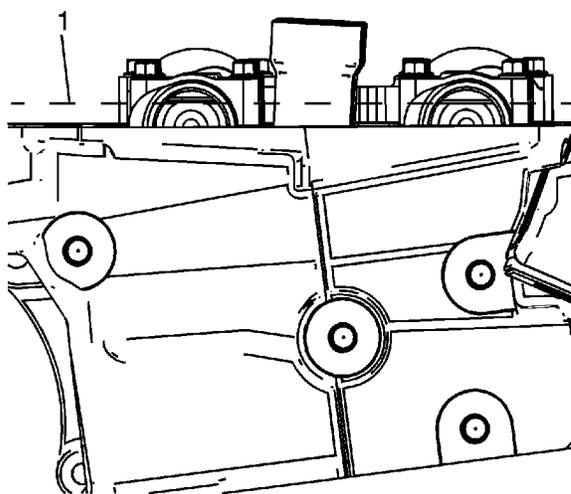
8. Install the left intake and exhaust camshaft position actuator solenoids. Refer to [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 \(Left Side\) Intake](#) and [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 \(Left Side\) Exhaust](#).
9. Install the left intake and exhaust camshaft position sensors. Refer to [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Intake](#) and [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Exhaust](#).
10. Install the left camshaft cover. Refer to [Camshaft Cover Replacement - Left Side](#).
11. Install the intake manifold. Refer to [Intake Manifold Replacement](#).

Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust

Special Tools

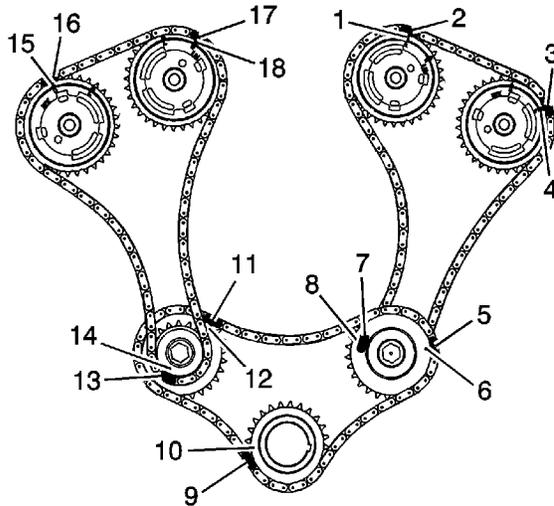
[EN-48313](#) Timing Chain Retention Tool

Removal Procedure



1. Remove the intake manifold. Refer to [Intake Manifold Replacement](#).
2. Remove the right camshaft cover. Refer to [Camshaft Cover Replacement - Right Side](#).
3. Remove the right intake and exhaust camshaft position sensors. Refer to [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#) and [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Exhaust](#).
4. Remove the right intake and exhaust camshaft position actuator solenoids. Refer to [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\) Intake](#) and [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\) Exhaust](#).
5. Rotate the crankshaft balancer bolt in a clockwise direction ONLY.

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

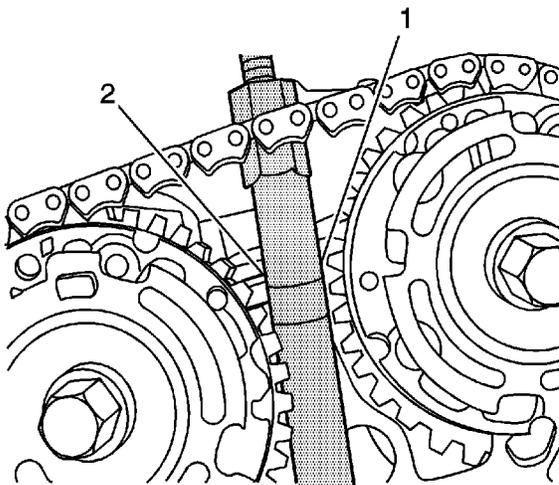


Note: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

6. Use a paint stick to create an alignment mark (17) on one of the timing chain links and the adjacent tooth on the exhaust camshaft position actuator (18).
7. Use a paint stick to create an alignment mark (16) on one of the timing chain links and the adjacent tooth on the intake camshaft position actuator (15).

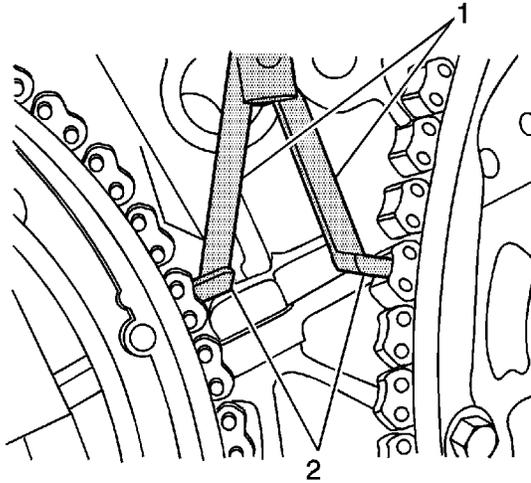
Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



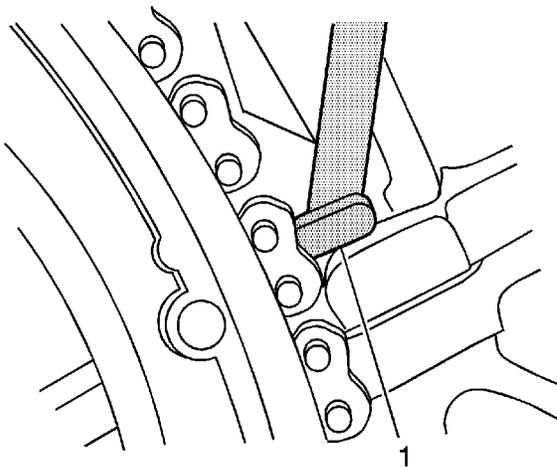


9. Unscrew the [EN-48313](#) so that the legs of the tool are retracted.
10. Insert the [EN-48313](#) between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate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



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

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



**Note:**

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

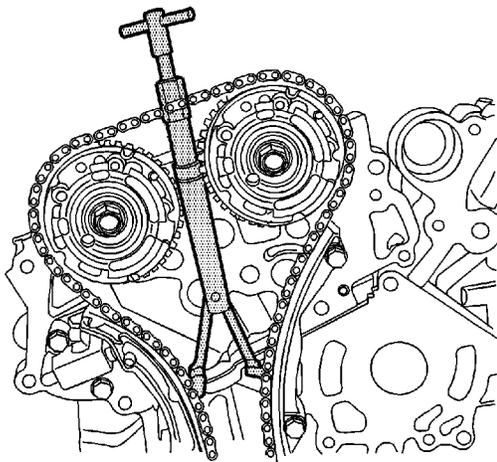
14. Hand tighten the [EN-48313](#) .

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

15. Use an open end wrench on the hex cast into the body of the [EN-48313](#) and hand tighten the T-handle.

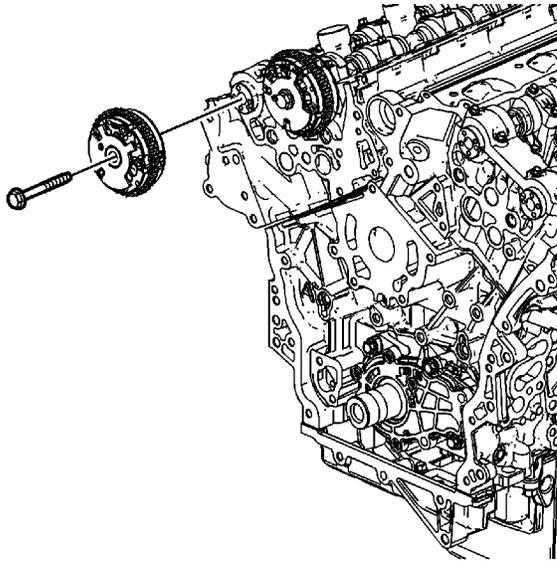
Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



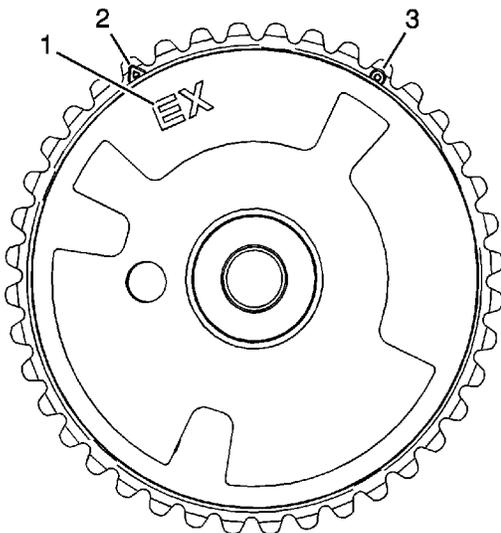
17. The [EN-48313](#) is now properly installed to hold the timing chain in position.

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.



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

Installation Procedure



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

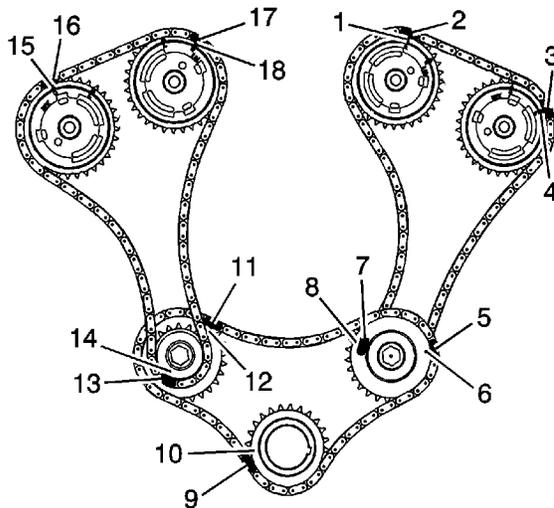
The marking is for an exhaust camshaft position actuator,

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

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

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

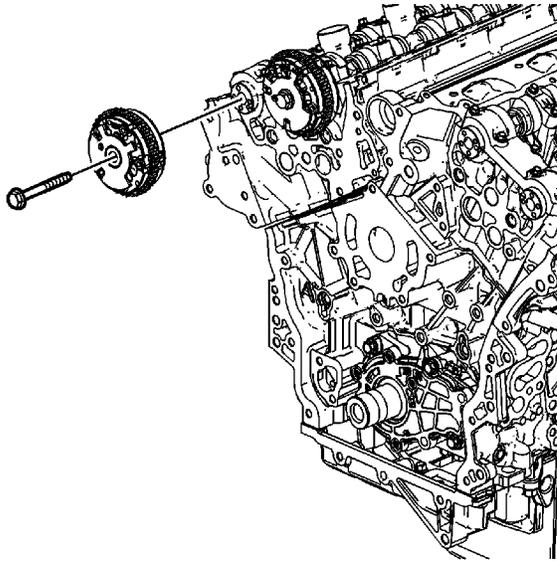
3. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.



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

4. Align the exhaust camshaft actuator alignment mark (18) to the timing chain alignment mark (17) made during disassembly.
5. Ensure that the intake camshaft actuator alignment mark (15) and the timing chain alignment mark (16) are also aligned.
6. Position the exhaust camshaft actuator to the camshaft and install the actuator bolt hand tight.
7. Remove the [EN-48313](#).

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



8. Tighten the right exhaust camshaft position actuator bolt.

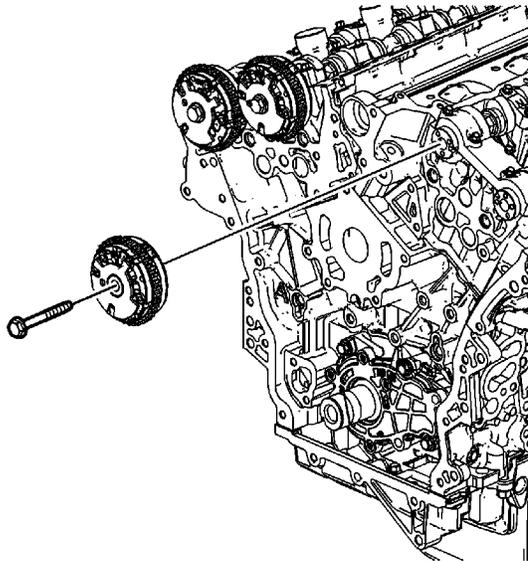
Tighten

Tighten the bolt to 58 N·m (43 lb ft).

9. Install the right intake and exhaust camshaft position actuator solenoids. Refer to [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\) Intake](#) and [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 \(Right Side\) Exhaust](#).
10. Install the right intake and exhaust camshaft position sensors. Refer to [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#) and [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Exhaust](#).
11. Install the right camshaft cover. Refer to [Camshaft Cover Replacement - Right Side](#).
12. Install the intake manifold. Refer to [Intake Manifold Replacement](#).

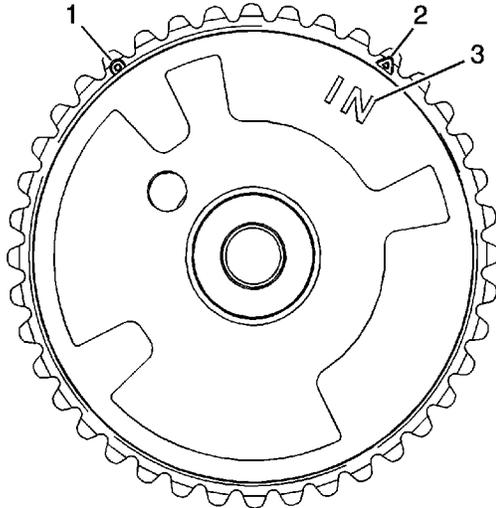
Camshaft Position Actuator Replacement - Bank 2 (Left Side) Intake

Removal Procedure



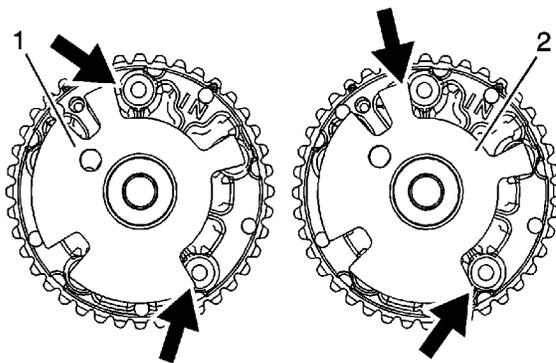
1. Remove the left exhaust camshaft actuator. Refer to [Camshaft Position Actuator Replacement - Bank 2 \(Left Side\) Exhaust](#).
2. Remove the intake camshaft position actuator bolt.
3. Remove the left intake camshaft position actuator.

Installation Procedure



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

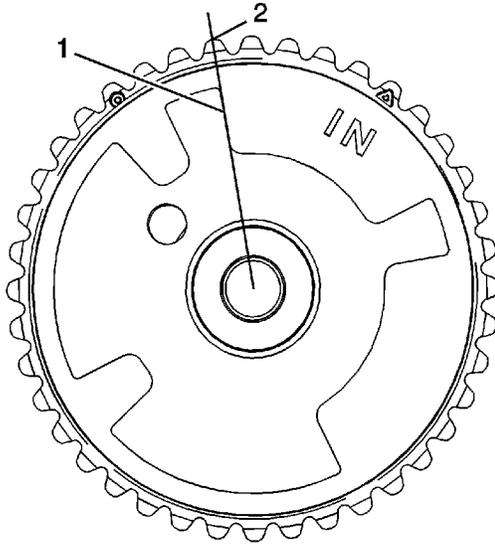
The marking is for an intake camshaft position actuator.



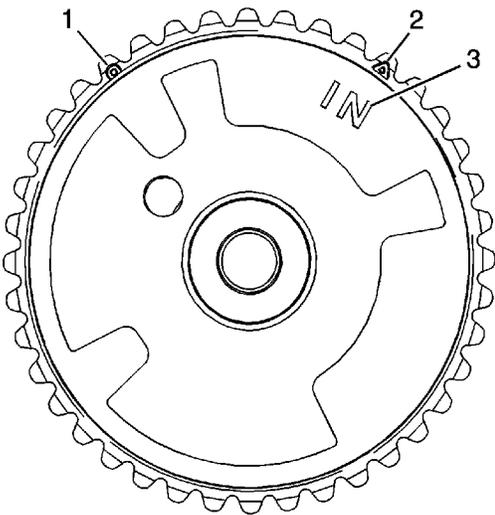
Caution: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

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

left intake camshaft position actuator (2).



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

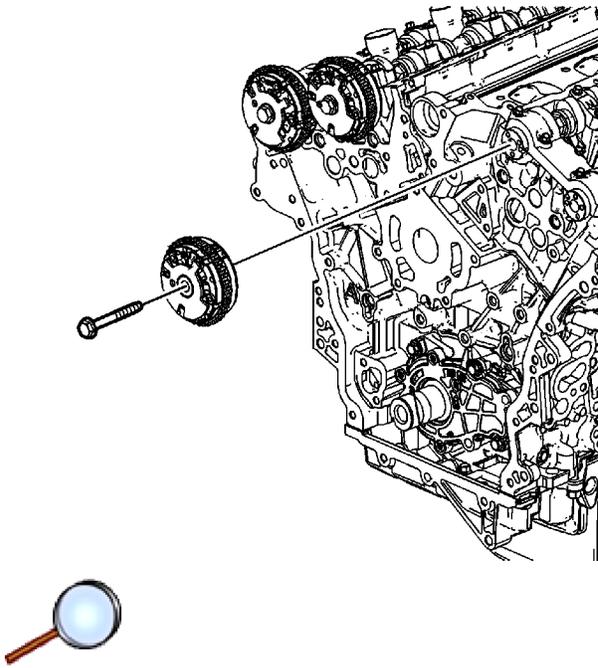


4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (1).

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

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



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

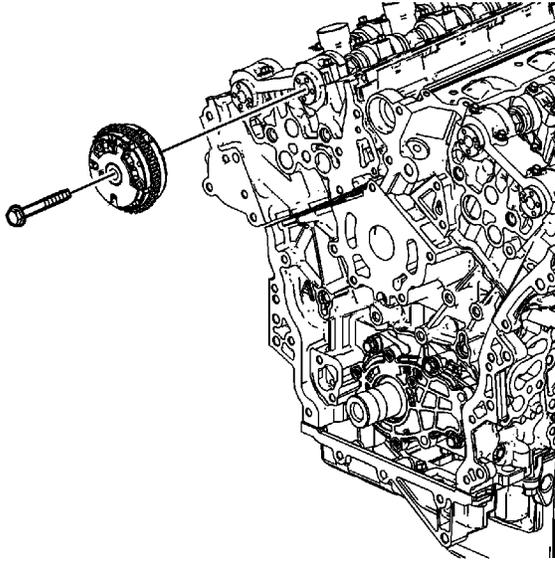
Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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

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

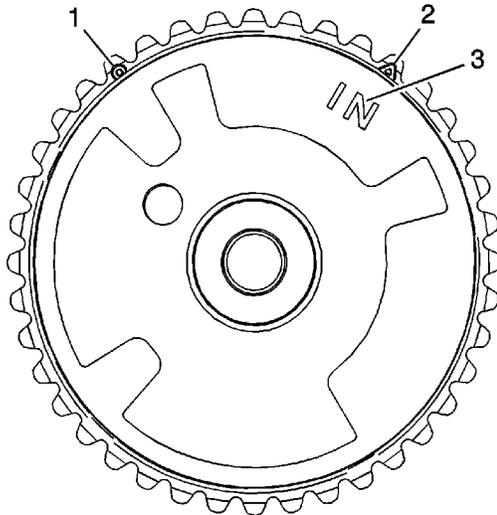
Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake

Removal Procedure



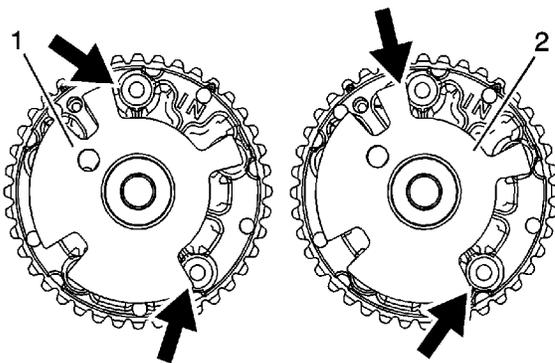
1. Remove the right exhaust camshaft actuator. Refer to [Camshaft Position Actuator Replacement - Bank 1 \(Right Side\) Exhaust](#).
2. Remove the intake camshaft position actuator bolt.
3. Remove the right intake camshaft position actuator.

Installation Procedure



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

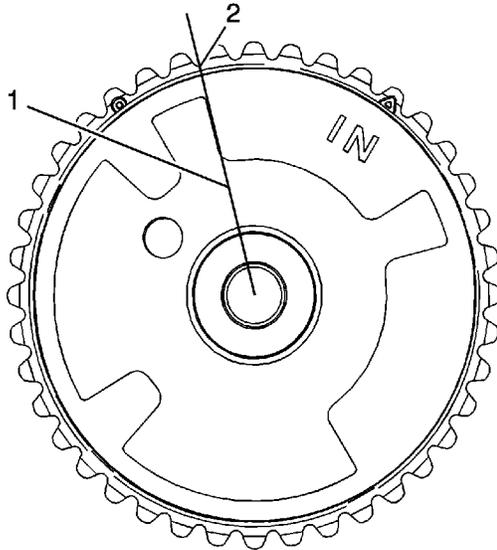
The marking is for an exhaust camshaft position actuator.



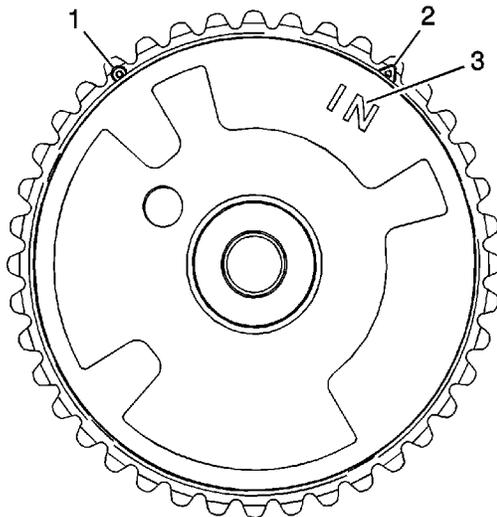
Caution: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

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

left intake camshaft position actuator (2).

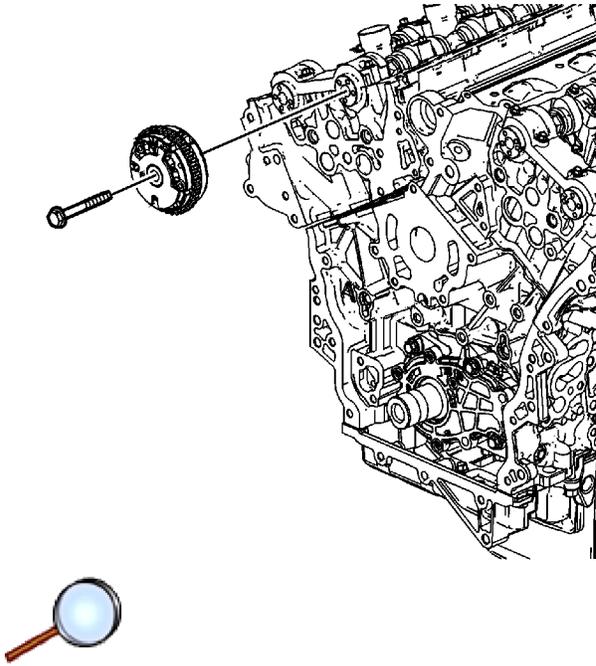


3. On the right intake camshaft actuator the edge of the reluctor wheel (1) lines up with the valley (2) of the sprocket tooth.



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

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



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

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

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

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

Setting Camshaft Timing

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

Follow the left bank secondary camshaft drive chain replacement procedures to reset the camshaft timing. Refer to [Secondary Camshaft Drive Chain Replacement - Left Side](#) .

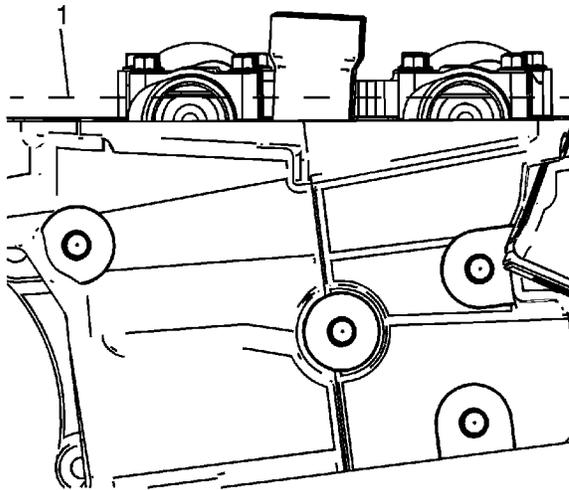
Camshaft Replacement - Left Side

Special Tools

- [EN-48313](#) Timing Chain Retention Tool
- [EN 46111](#) Crankshaft Rotation Socket

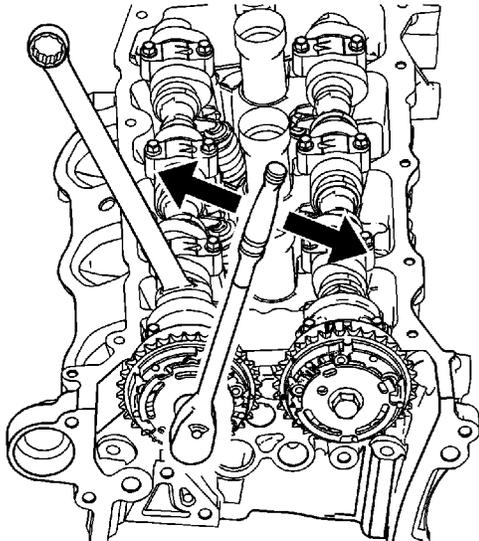
Removal Procedure

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



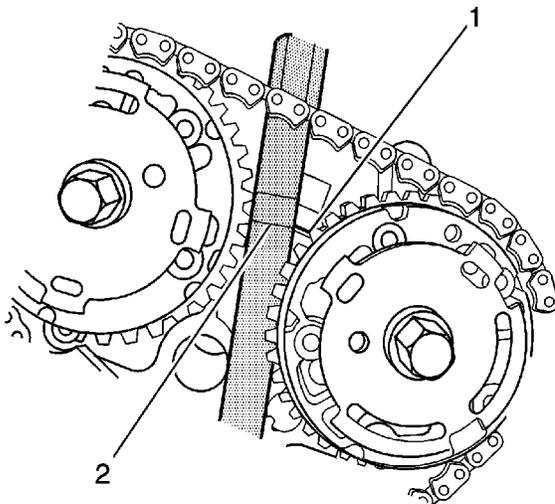
6. Rotate the crankshaft with the [EN 46111](#) until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

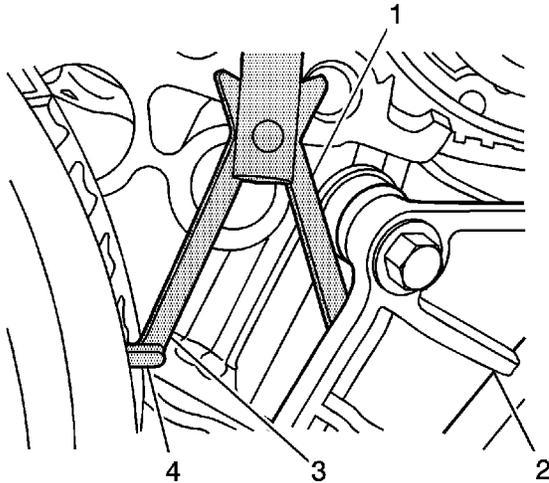
**Note:**

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

7. Loosen the camshaft position actuator bolt.

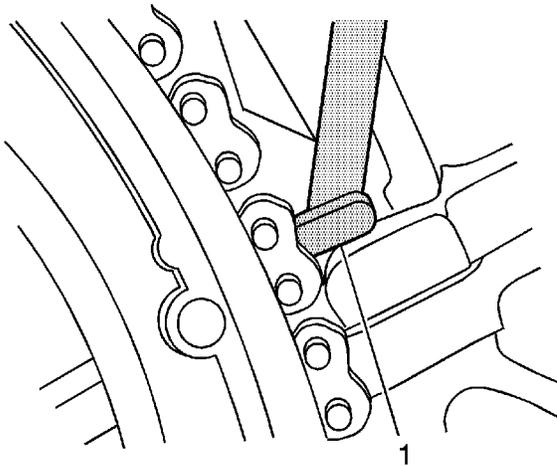


8. Unscrew the [EN-48313](#) so that the legs of the tool are retracted.
9. Insert the [EN-48313](#) between the camshaft actuators, rearward of the timing chain until the bottom line that is scribed in the body of the tool (2) is adjacent to the top surface of the cylinder head (1). This is the approximate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



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

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

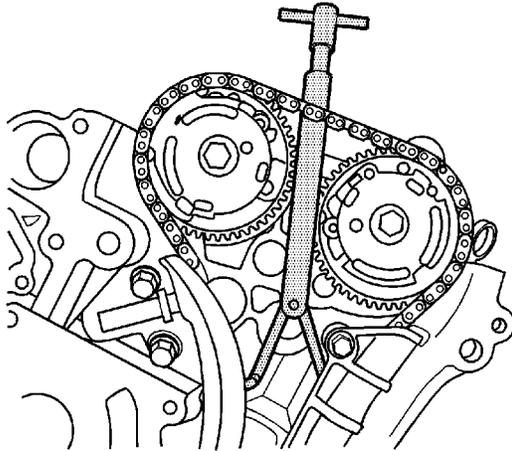


Note: Ensure that the foot (1) of the [EN-48313](#) is engaged into one of the link pockets to prevent tool slippage during tightening of the [EN-48313](#).

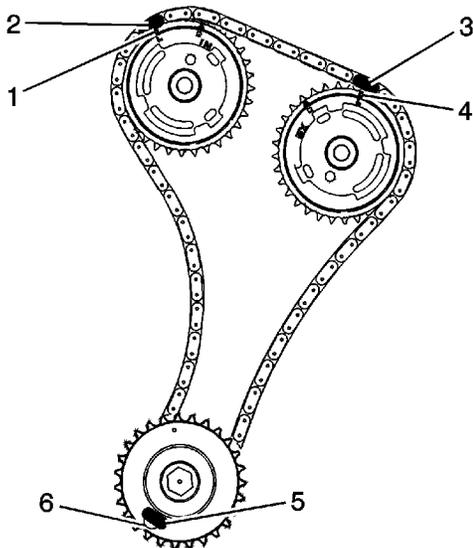
14. Hand tighten the [EN-48313](#) .

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



16. The [EN-48313](#) is now properly installed to hold the timing chain in position.

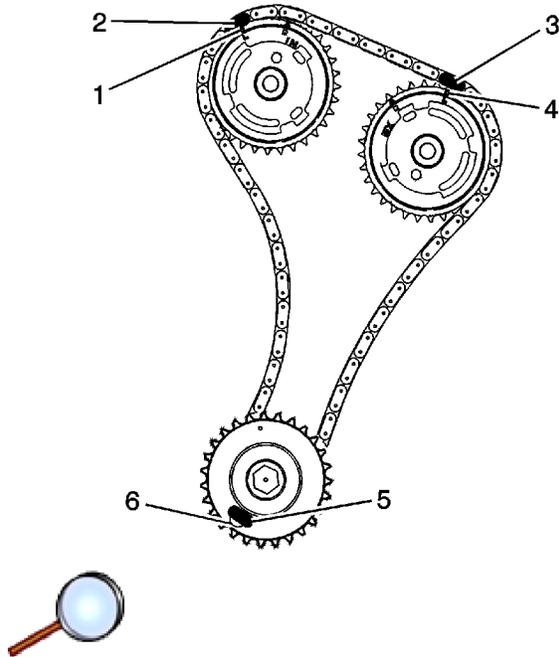


Note: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

17. Mark the timing chain and the respective locations on the camshaft position actuators (1-4).

18. Remove the camshaft position actuator bolt.
19. Remove the camshafts. Refer to [Camshaft Removal - Left Side](#).

Installation Procedure

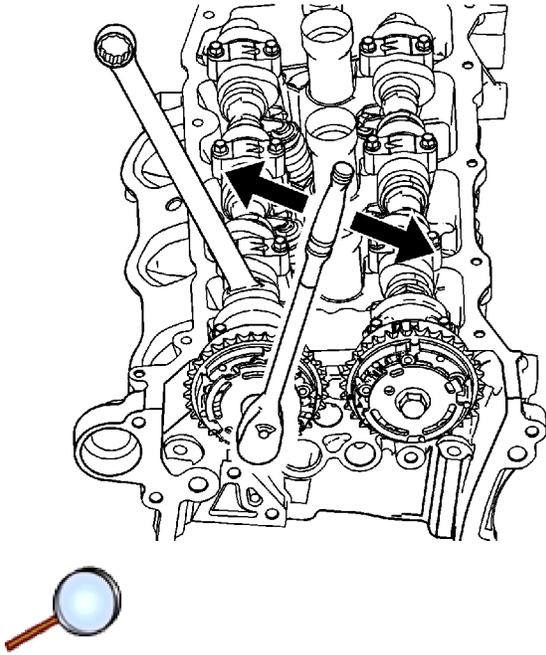


Note:

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

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to [Camshaft Installation - Left Side](#).
3. Remove the [EN-48313](#) .

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.



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

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

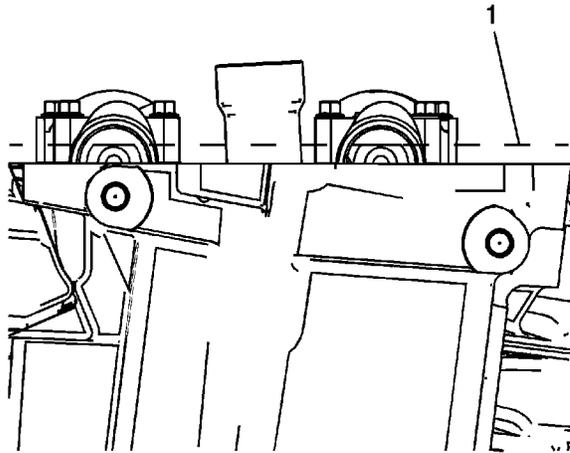
Camshaft Replacement - Right Side

Special Tools

- [EN-48313](#) Timing Chain Retention Tool
- [EN 46111](#) Crankshaft Rotation Socket

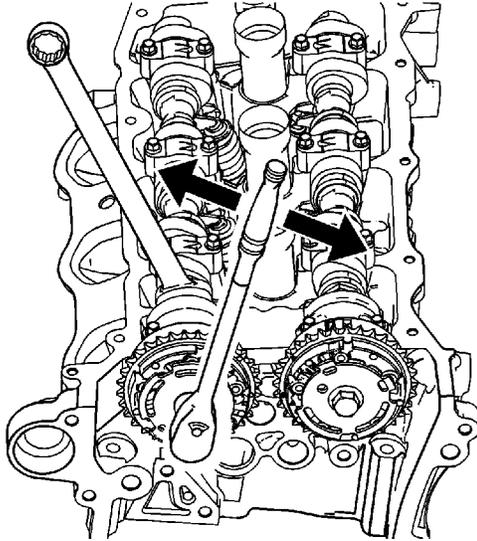
Removal Procedure

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



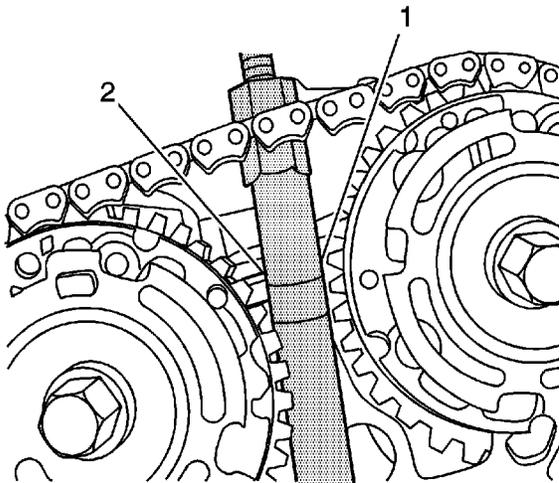
6. Rotate the crankshaft with the [EN 46111](#) until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

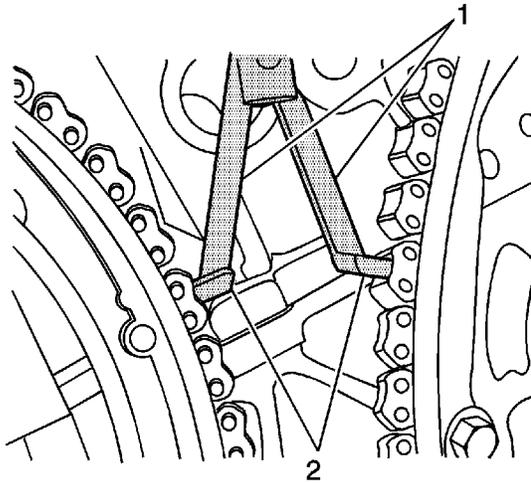
**Note:**

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

7. Loosen the camshaft position actuator bolt.

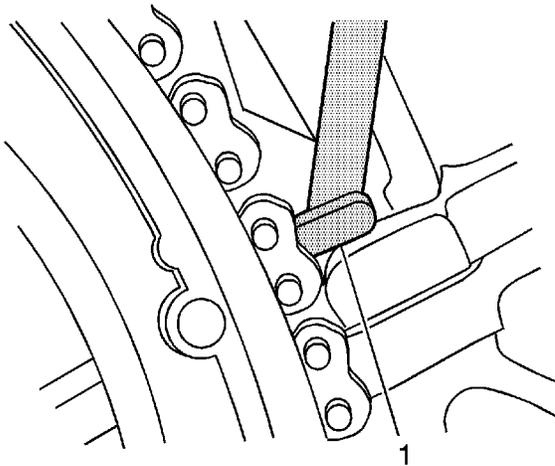


8. Unscrew the [EN-48313](#) so the legs of the tool are retracted.
9. Insert the [EN-48313](#) between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate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



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

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



Note:

- Ensure that the foot (1) of the [EN-48313](#) is engaged into one of the link pockets to prevent chain slippage during tightening of the [EN-48313](#) .

- Do not allow the body of the [EN-48313](#) to rotate when tightening the T-handle.

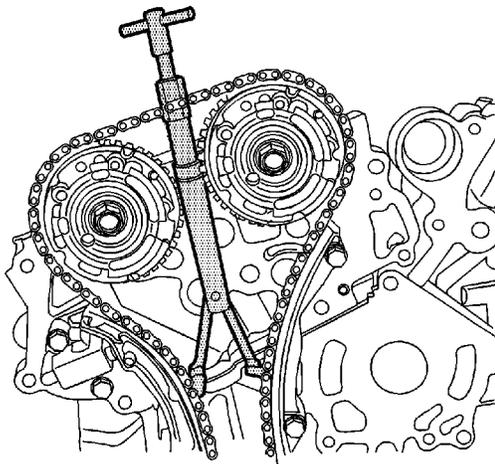
13. Hand tighten the [EN-48313](#) .

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

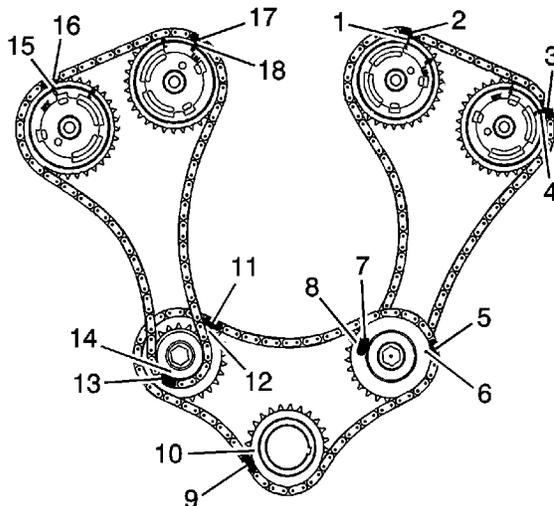
14. Use an open end wrench on the hex cast into the body of the [EN-48313](#) and hand tighten the T-handle.

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.

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



16. The [EN-48313](#) is now properly installed to hold the timing chain in position.

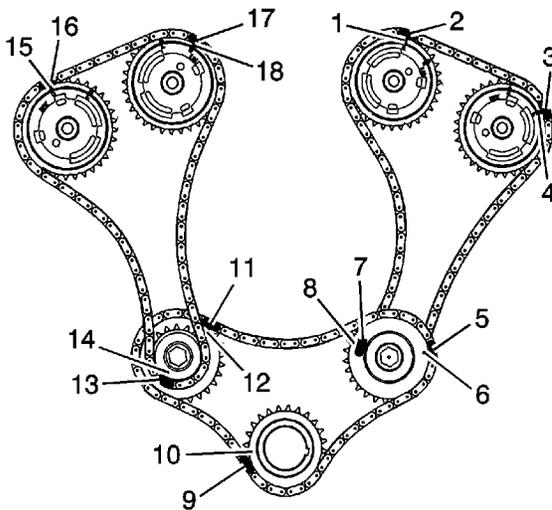




Note: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

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

Installation Procedure

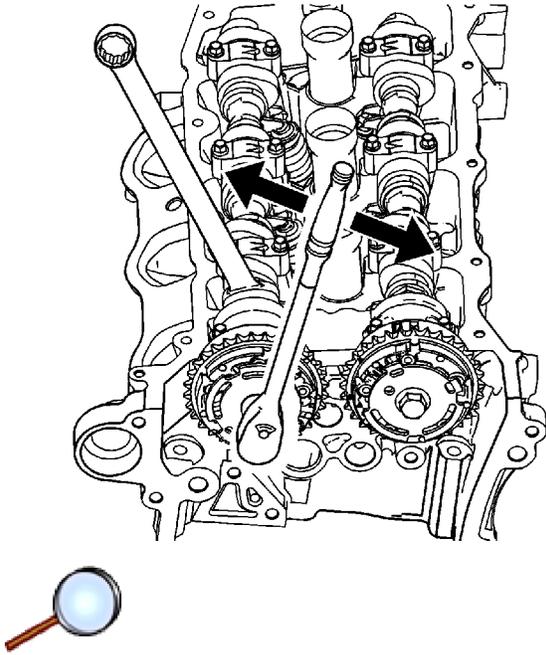


Note:

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

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to [Camshaft Installation - Right Side](#).
3. Remove the [EN-48313](#).
4. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).

Caution: Refer to [Torque Reaction Against Timing Drive Chain Caution](#) in the Preface section.



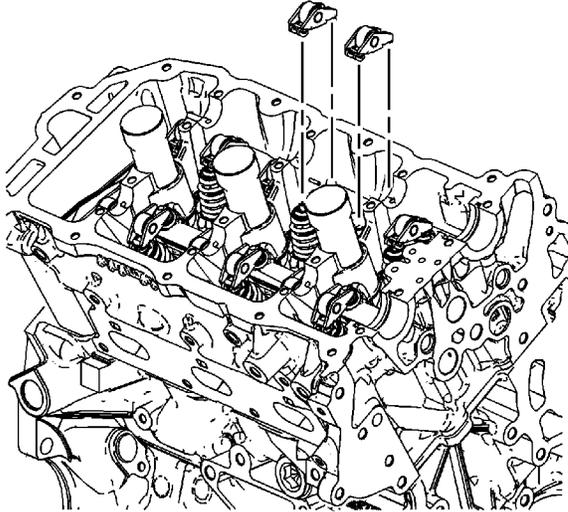
Note: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

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

Valve Rocker Arm Replacement - Left Side

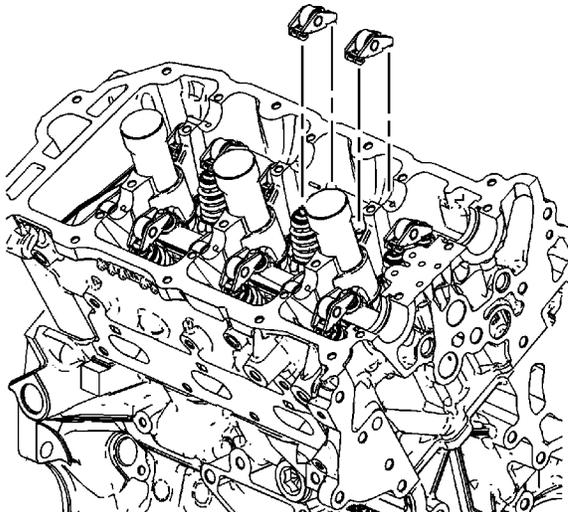
Removal Procedure

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



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

Installation Procedure



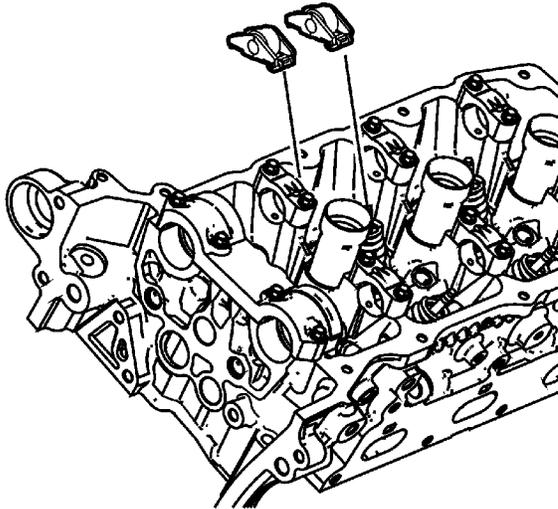


1. Install the rocker arms. Refer to [Valve Rocker Arm Installation - Left Side](#).
2. Install the applicable camshaft(s). Refer to [Camshaft Replacement - Left Side](#).

Valve Rocker Arm Replacement - Right Side

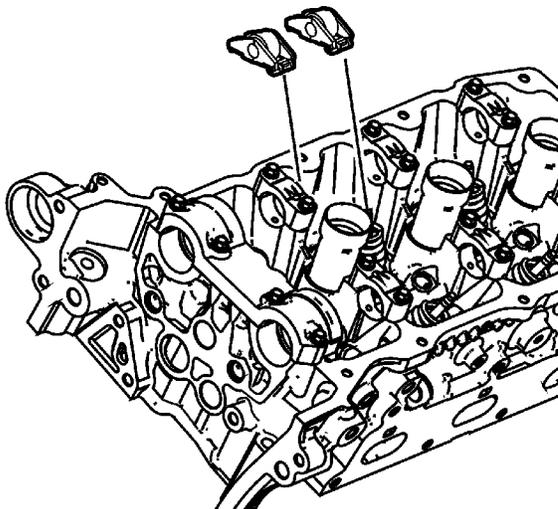
Removal Procedure

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



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

Installation Procedure



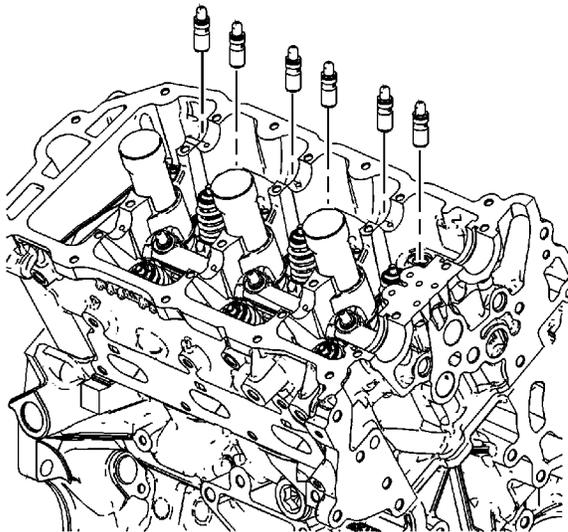


1. Install the rocker arms.
2. Install the applicable camshaft(s). Refer to [Valve Rocker Arm Installation - Right Side](#).

Valve Lifter Replacement - Left Side

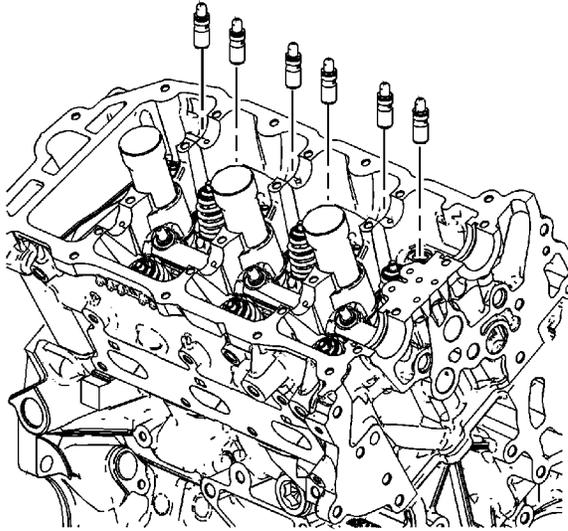
Removal Procedure

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



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

Installation Procedure

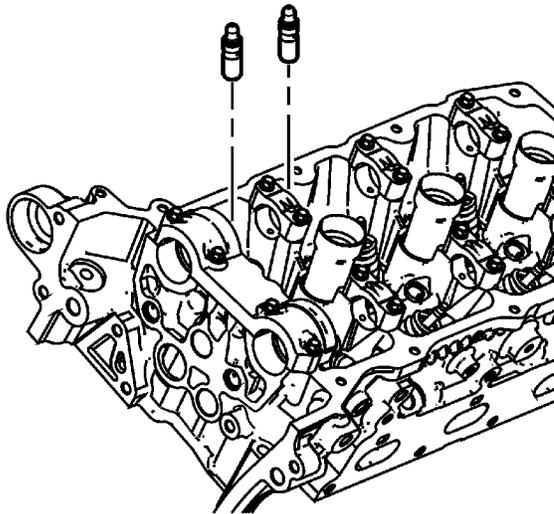


1. Install the lifters. Refer to [Valve Lifter Installation - Left Side](#).
2. Install the rocker arms. Refer to [Valve Rocker Arm Installation - Left Side](#).
3. Install the applicable camshaft(s). Refer to [Camshaft Replacement - Left Side](#).

Valve Lifter Replacement - Right Side

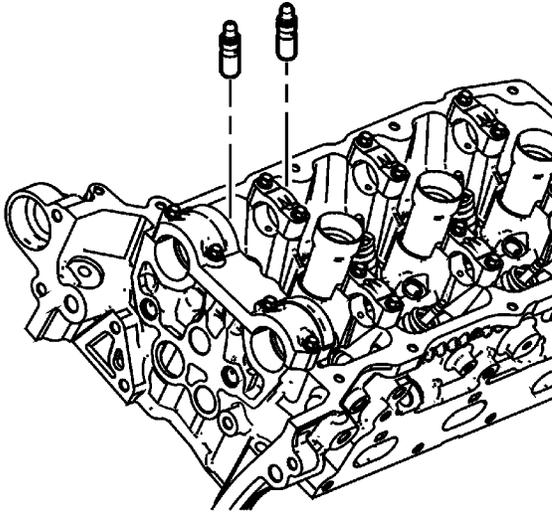
Removal Procedure

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



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

Installation Procedure



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

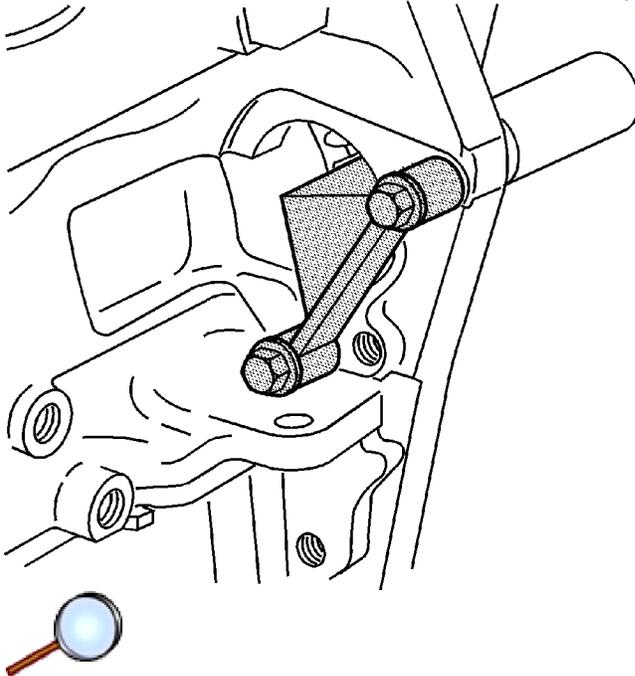
Valve Stem Oil Seal and Valve Spring Replacement - Left Side

Special Tools

- [EN 46106](#) Flywheel Holding Tool
- [EN 46110](#) On-Vehicle Valve Spring Compressor
- [EN 46116](#) Valve Stem Seal Remover/Installer
- [J 39313](#) Spark Plug Port Adapter

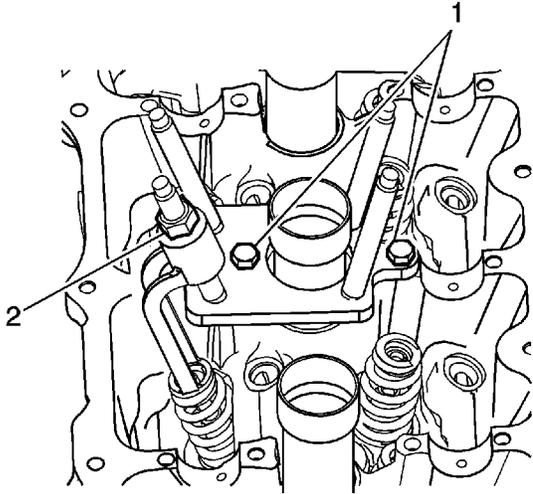
Removal Procedure

1. Remove the starter motor. Refer to [Starter Replacement](#).

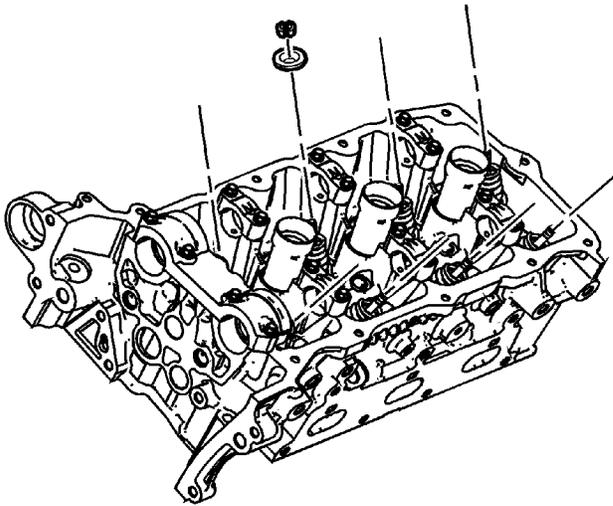


Important: If the [EN 46106](#) is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

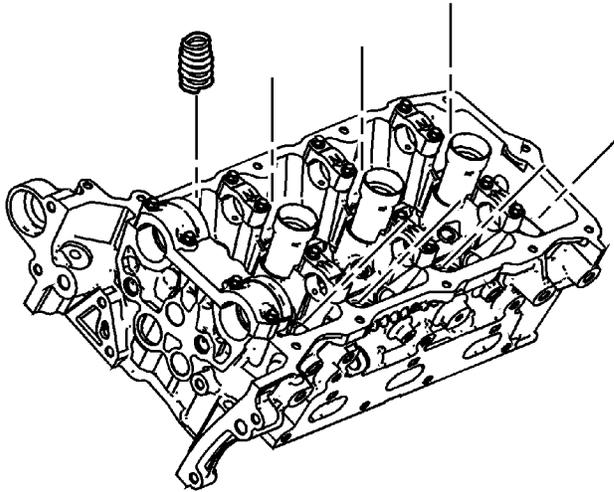
2. Install the [EN 46106](#) in order to prevent crankshaft rotation.
3. Remove the camshafts and rocker arms. Refer to [Camshaft Replacement - Left Side](#).
4. Remove the spark plug from the applicable cylinder. Refer to [Spark Plug Replacement](#).
5. Remove Rocker arms. refer to [Valve Rocker Arm Replacement - Left Side](#)
6. Install the [J 39313](#) to the applicable cylinder.
7. Connect the [J 39313](#) to a compressed air source.



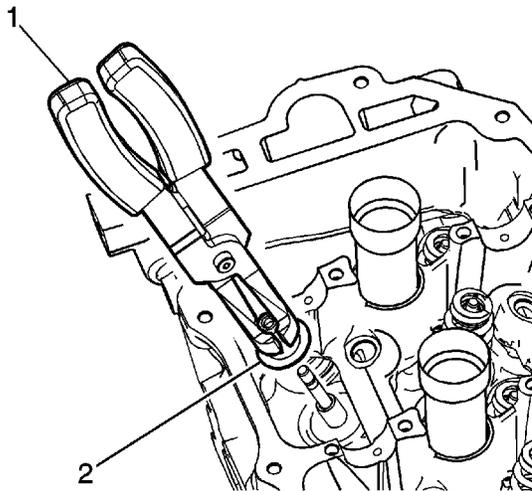
8. Install the [EN 46110](#) above the applicable cylinder as shown.
9. Tighten the [EN 46110](#) valve spring compressor nut (2).



10. Remove the valve keepers.
11. Loosen the [EN 46110](#) valve spring compressor nut.
12. Remove the valve spring retainer.

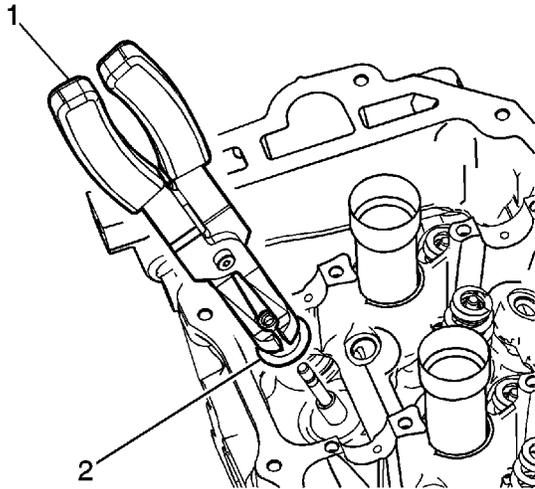


13. Remove the valve spring.

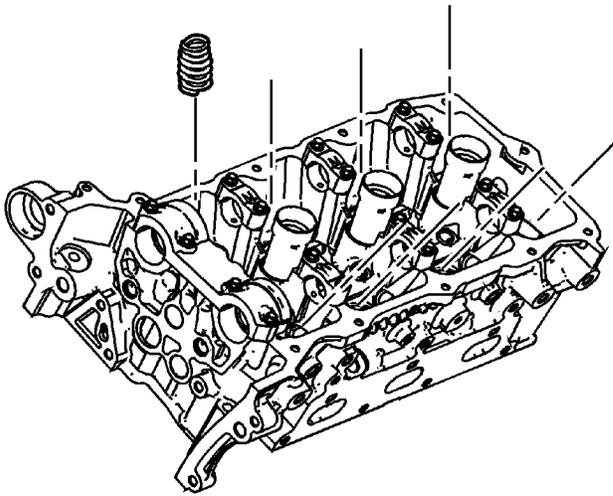


14. Use the [EN 46116](#) (1) in order to remove the valve stem seal (2).

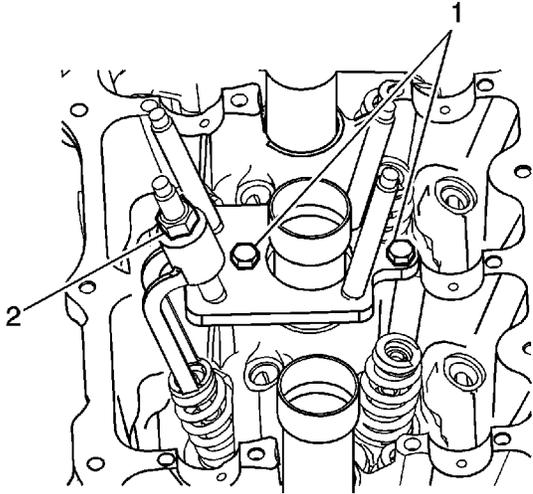
Installation Procedure



1. Use the [EN 46116](#) (1) in order to install the valve stem seal (2).

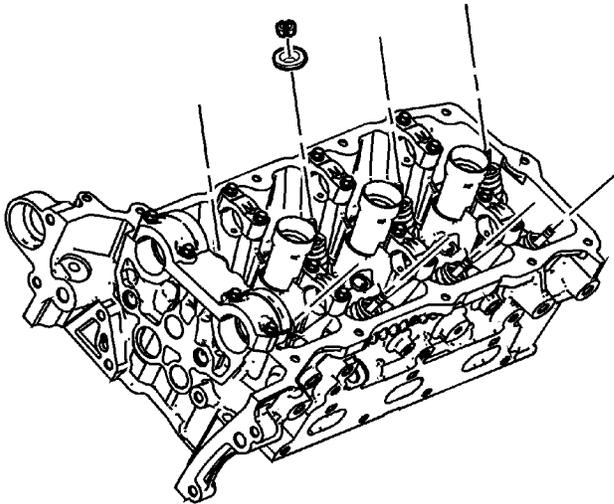


2. Install the valve spring.
3. Install the valve spring retainer.



4. Install the [EN 46110](#) above the applicable valve spring as shown.

Tighten the [EN 46110](#) valve spring compressor nut (2).



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

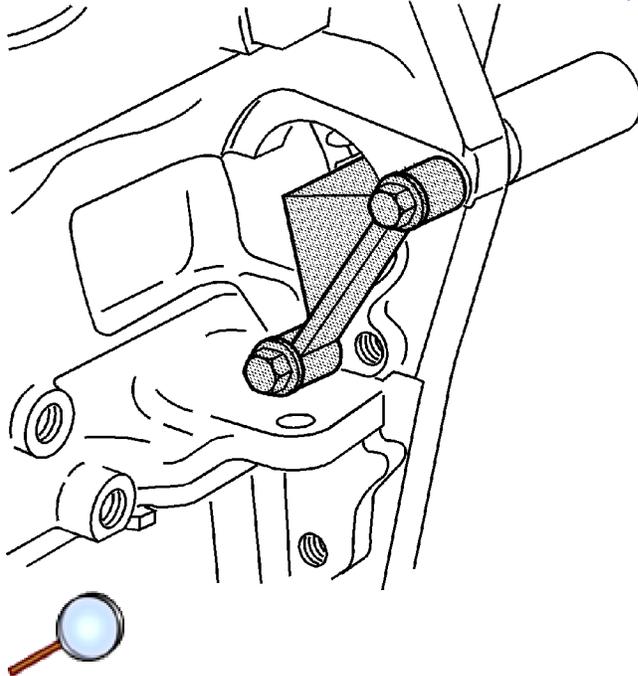
Valve Stem Oil Seal and Valve Spring Replacement - Right Side

Special Tools

- [EN 46106](#) Flywheel Holding Tool
- [EN 46110](#) On-Vehicle Valve Spring Compressor
- [EN 46116](#) Valve Stem Seal Remover/Installer
- [J 39313](#) Spark Plug Port Adapter

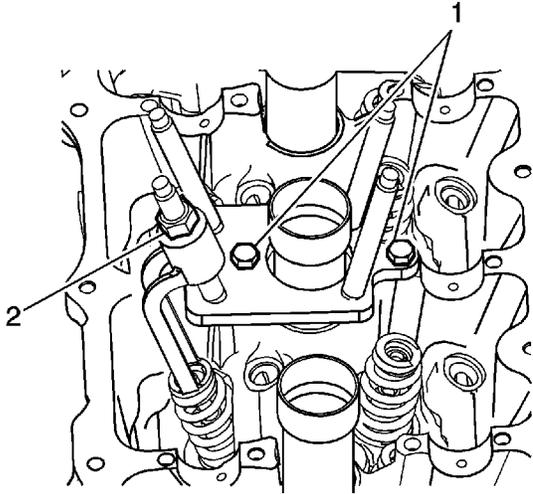
Removal Procedure

1. Remove the starter motor. Refer to [Starter Replacement](#).

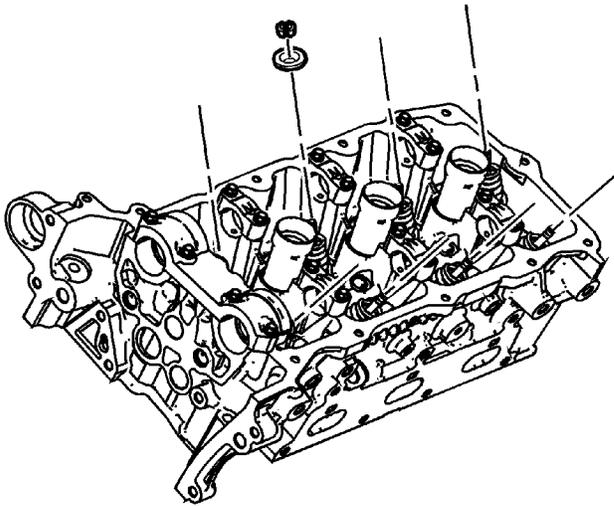


Important: If the [EN 46106](#) is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

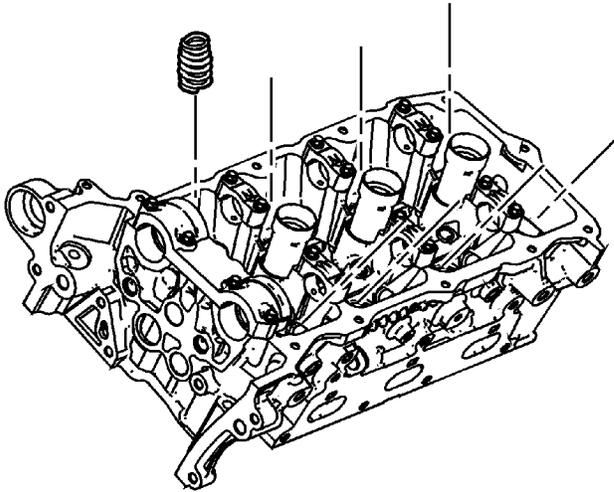
2. Install the [EN 46106](#) in order to prevent crankshaft rotation.
3. Remove the camshafts and rocker arms. Refer to [Camshaft Replacement - Right Side Valve Rocker Arm Replacement - Right Side](#).
4. Remove the spark plug from the applicable cylinder. Refer to [Spark Plug Replacement](#).
5. Install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



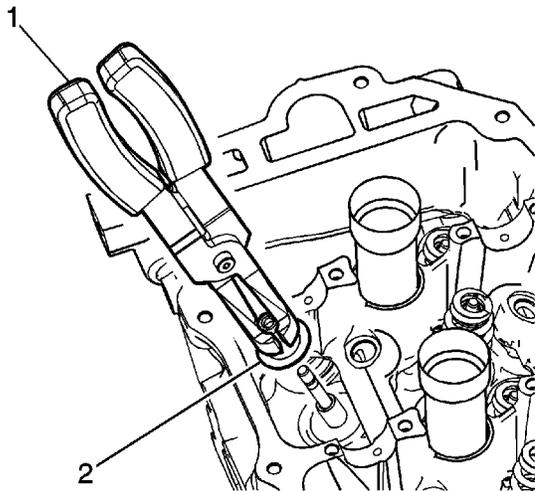
7. Install the [EN 46110](#) above the applicable cylinder as shown.
8. Tighten the [EN 46110](#) valve spring compressor nut (2).



9. Remove the valve keepers.
10. Loosen the [EN 46110](#) valve spring compressor nut.
11. Remove the valve spring retainer.

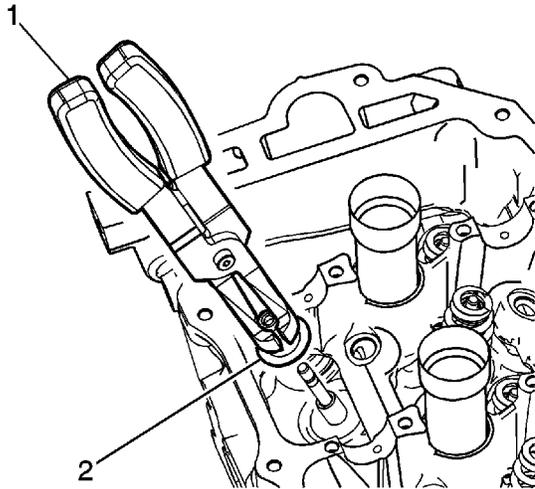


12. Remove the valve springs.

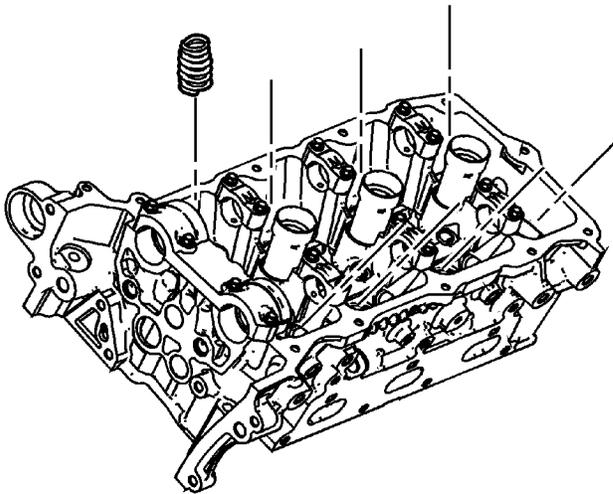


13. Use the [EN 46116](#) (1) in order to remove the valve stem seal (2).

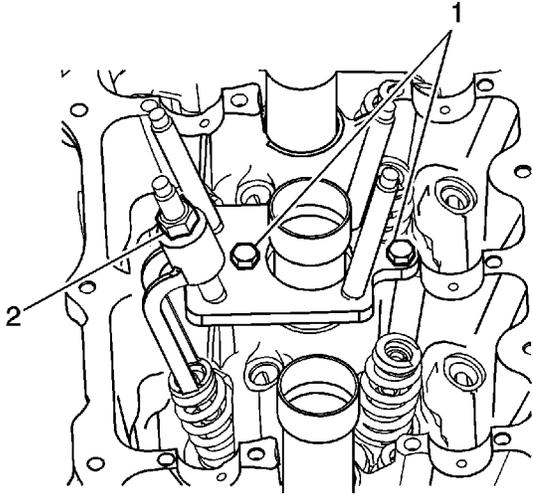
Installation Procedure



1. Use the [EN 46116](#) (1) in order to install the valve stem seals (2).

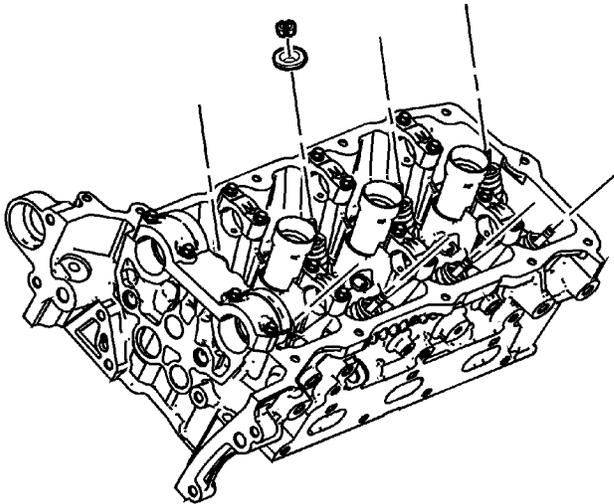


2. Install the valve spring.
3. Install the valve spring retainer.



4. Install the [EN 46110](#) above the applicable valve spring as shown.

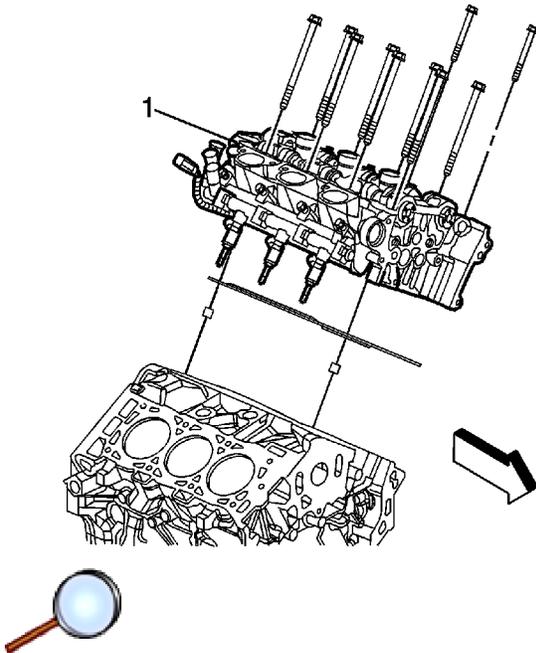
Tighten the [EN 46110](#) valve spring compressor nut (2).



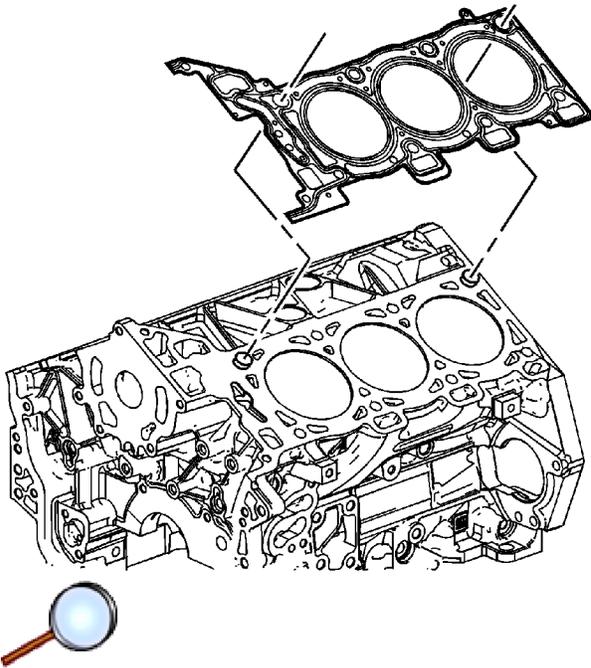
5. Install the valve spring keepers.
6. Remove the [EN 46110](#) .
7. Disconnect the [J 39313](#) from the compressed air source.
8. Remove the [J 39313](#) .
9. Install the spark plugs. Refer to [Spark Plug Replacement](#).
10. Install the rocker arms and camshafts. Refer to [Camshaft Replacement -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

Cylinder Head Replacement - Left Side

Removal Procedure

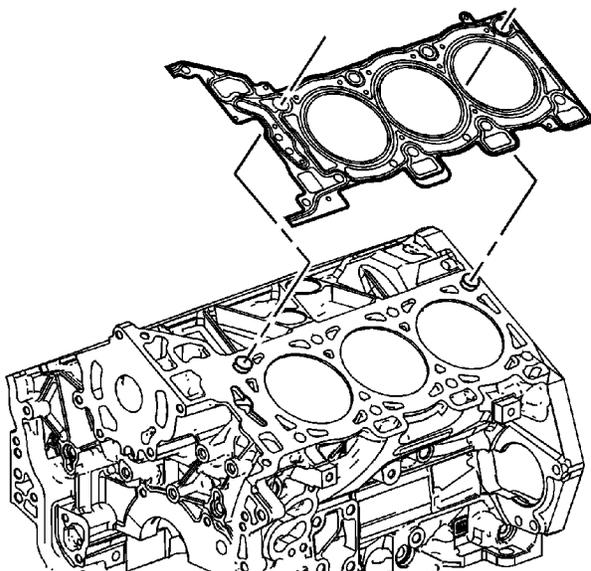


1. Remove the left bank secondary timing chain. Refer to [Secondary Camshaft Drive Chain Replacement - Left Side](#).
2. Remove the oil level indicator. Refer to [Oil Level Indicator and Tube Replacement](#).
3. Disconnect the coolant temperature sensor electrical connector.
4. Remove the catalytic converter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



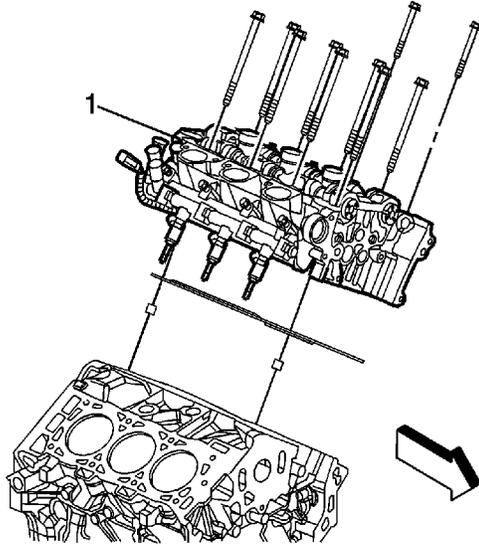
7. Remove and discard the cylinder head gasket.
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to [Cylinder Head Cleaning and Inspection](#) and [Engine Block Cleaning and Inspection](#).
9. If necessary, perform the following steps:
 - Remove the exhaust manifold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

Installation Procedure





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

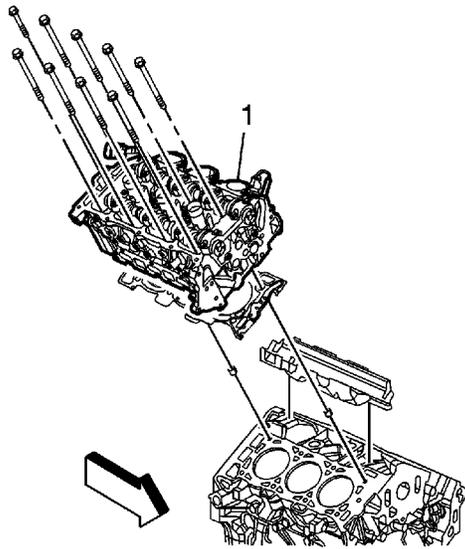


3. Carefully install the cylinder head with the exhaust manifold to the engine. Refer to [Cylinder Head Installation - Left Side](#).
4. Install the camshaft position actuator solenoid valve. Refer to [Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 \(Left Side\) Intake](#) and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

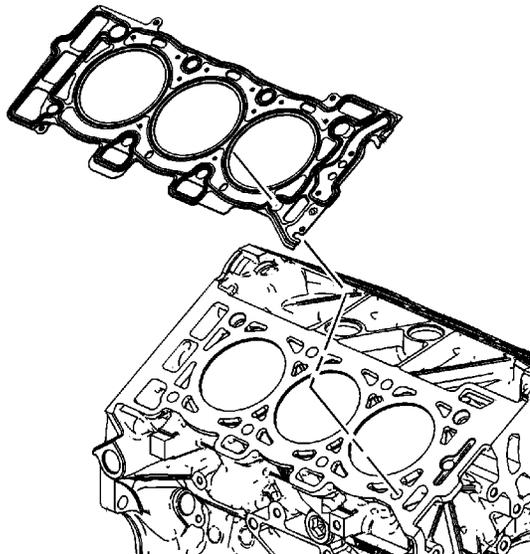
Cylinder Head Replacement - Right Side

Removal Procedure

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



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



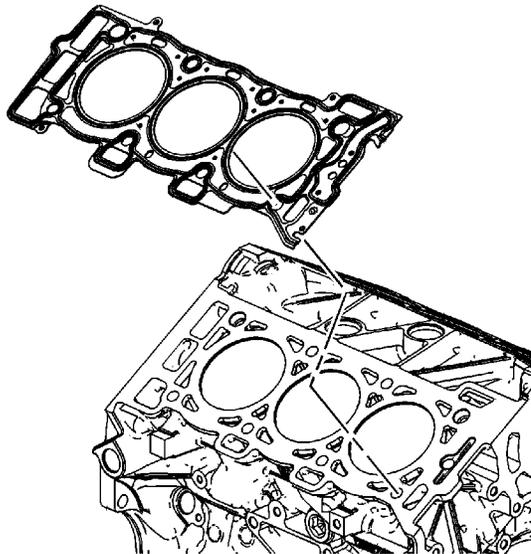
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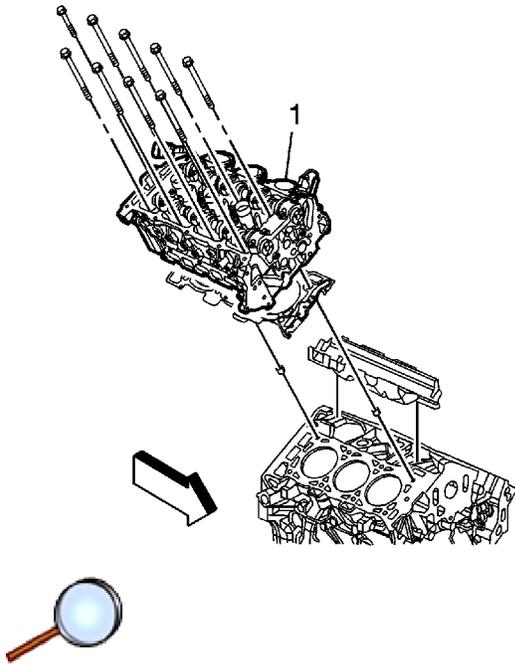
7. Remove and discard the cylinder head gasket.
8. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to [Cylinder Head Cleaning and Inspection](#) and [Engine Block Cleaning and Inspection](#).
9. If necessary, perform the following steps:
 - Remove the exhaust manifold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

Installation Procedure

1. If necessary, perform the following steps:
 - Assemble the cylinder head. Refer to [Cylinder Head Assemble](#).
 - Install the camshaft. Refer to [Camshaft Installation - Right Side](#).
 - Install the exhaust manifold to the cylinder head. Refer to [Exhaust Manifold Installation - Right Side](#).



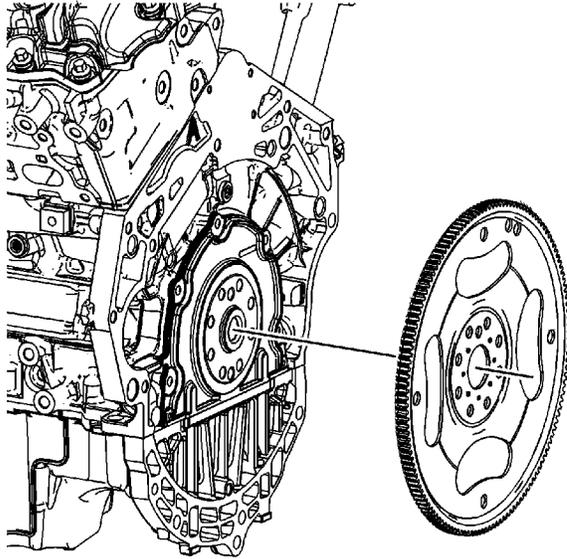
2. Install a NEW cylinder head gasket.



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

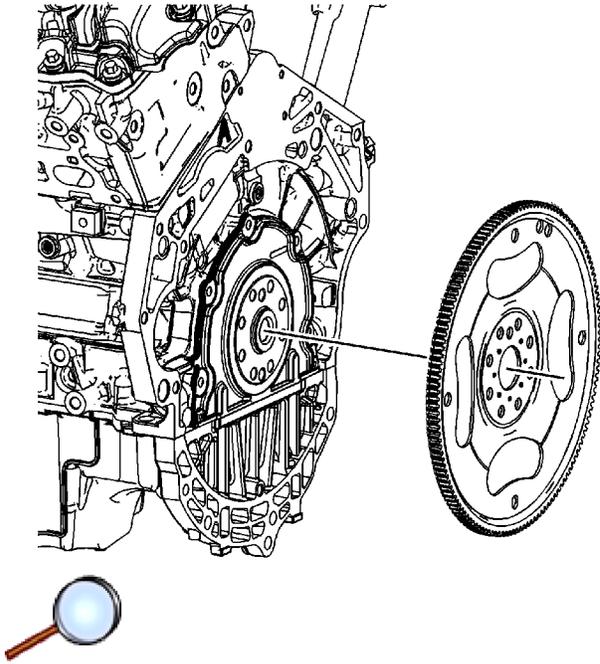
Engine Flywheel Replacement

Removal Procedure



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

Installation Procedure

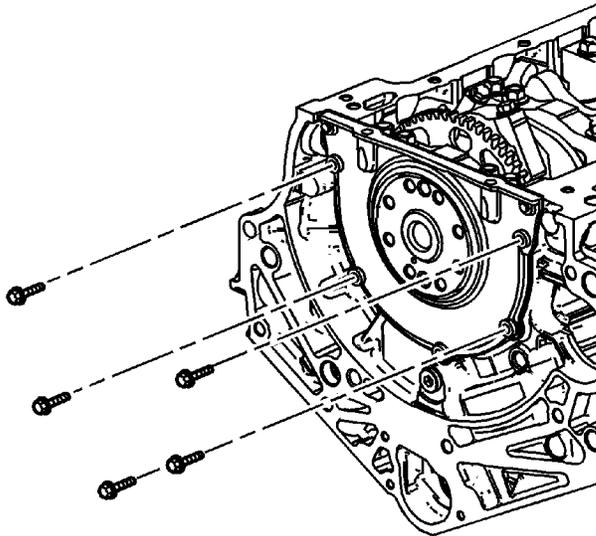


1. Install the engine flywheel and bolts. Refer to [Engine Flywheel Installation](#).
2. Install the transmission. Refer to [Transmission Replacement](#).

Crankshaft Rear Oil Seal and Housing Replacement

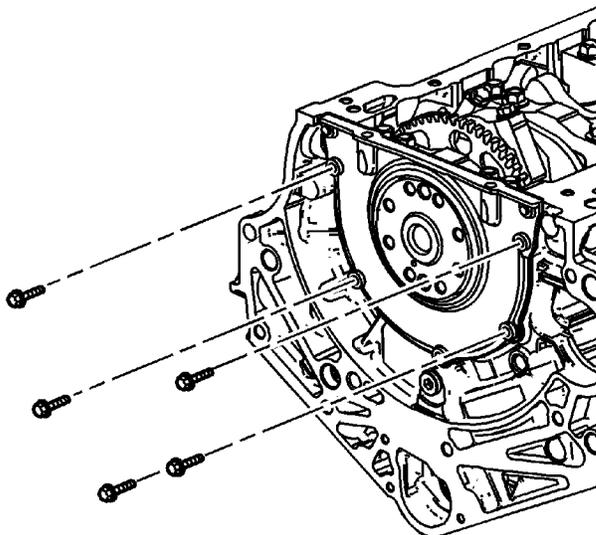
Removal Procedure

1. Remove the oil pan. Refer to [Oil Pan Replacement](#).
2. Remove the engine flywheel. Refer to [Engine Flywheel Replacement](#).



3. Remove the crankshaft rear oil seal and housing. Refer to [Crankshaft Rear Oil Seal and Housing Removal](#).

Installation Procedure



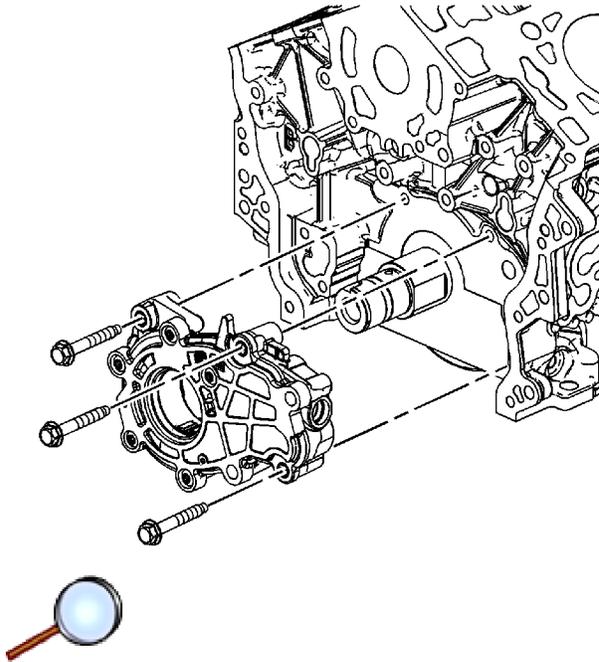
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1. Install the crankshaft rear oil seal and housing. Refer to [Crankshaft Rear Oil Seal and Housing Installation](#).
2. Install the engine flywheel. Refer to [Engine Flywheel Replacement](#).
3. Install the oil pan. Refer to [Oil Pan Replacement](#).

Oil Pump Replacement

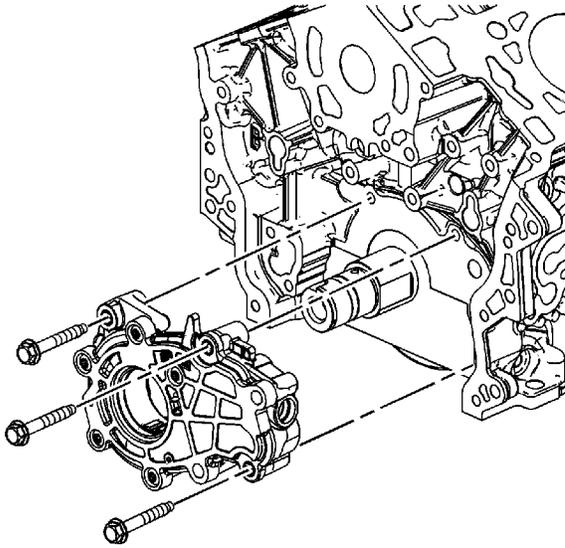
Removal Procedure



Important: Do not remove the left bank idler sprocket.

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

Installation Procedure



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

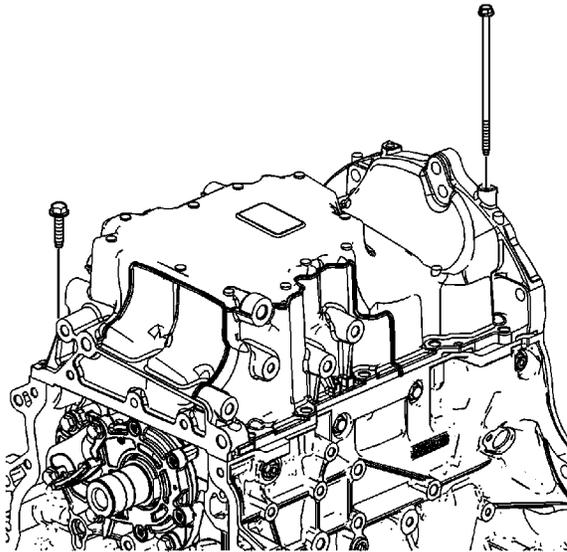
Oil Pan Replacement

Special Tools

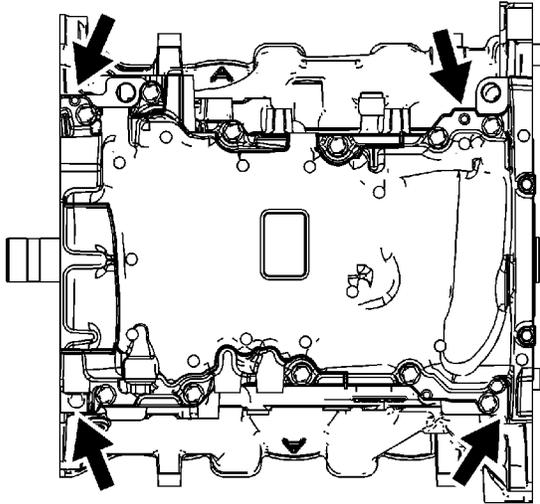
- [EN 46109](#) Guide Pin Set
- [J 39505](#) Torque Wrench Adapter

Removal Procedure

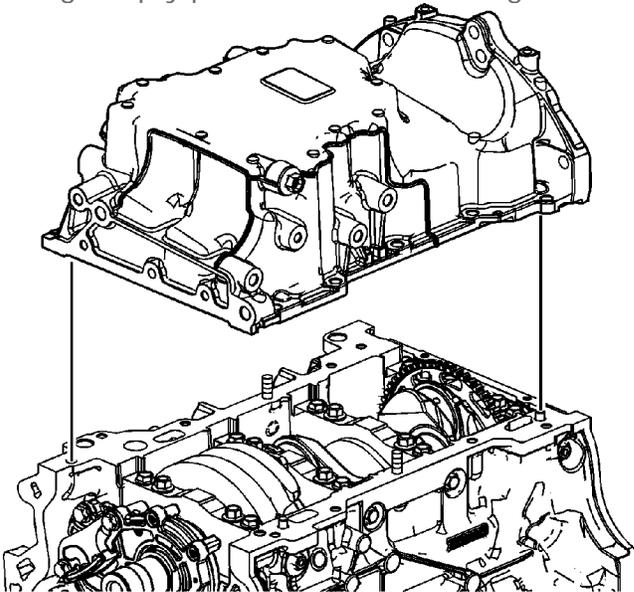
1. Drain the engine oil and remove the oil filter. Refer to [Engine Oil and Oil Filter Replacement](#).
2. Remove the exhaust flexible pipe. Refer to [Exhaust Flexible Pipe Replacement](#).
3. Remove the engine. Refer to [Engine Replacement](#).
4. Remove the engine front cover. Refer to [Engine Front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



5. Remove the oil pan bolts.

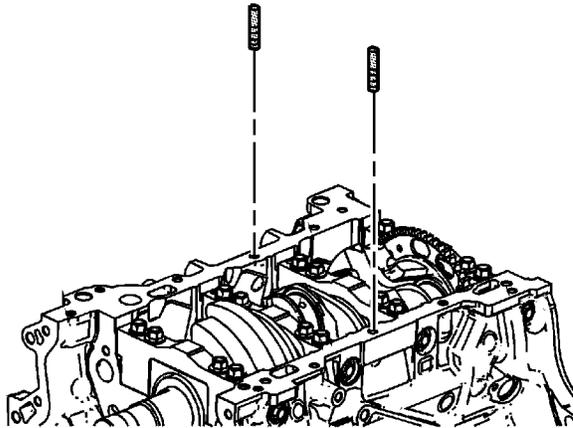


6. Using the pry points located at the edge of the oil pan separate the RTV sealant.

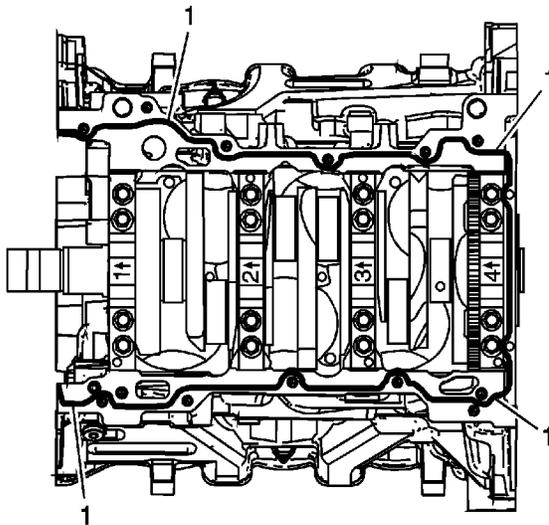


7. Remove the oil pan from the block.
8. Clean the oil pan and the engine block gasket surface. Refer to [Oil Pan Cleaning and Inspection](#).

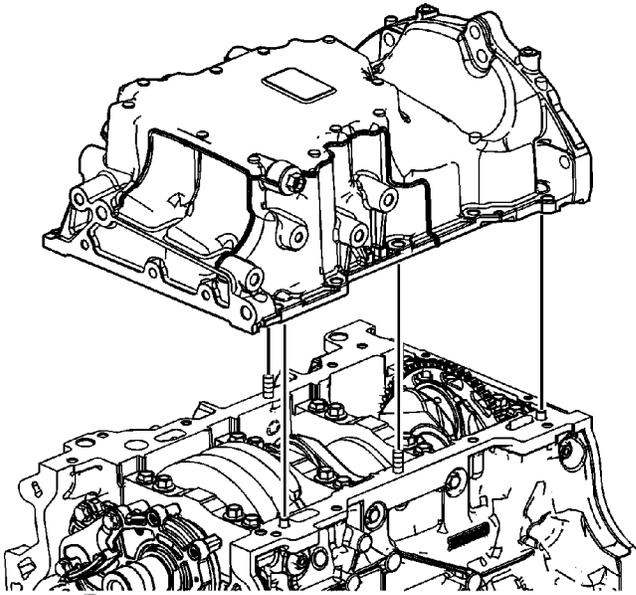
Installation Procedure



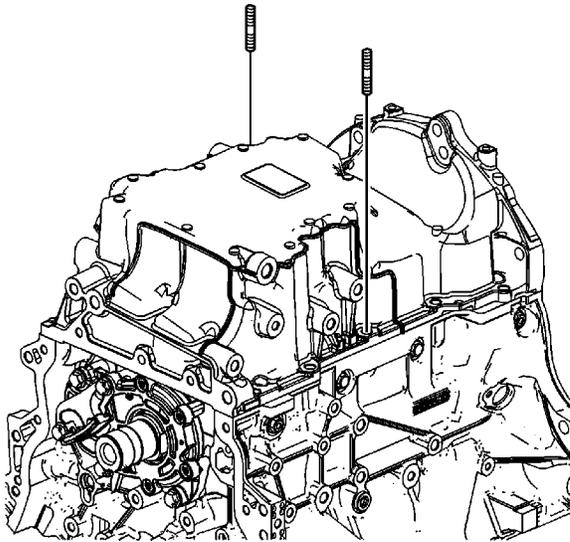
1. Install the 8 mm (0.315 in) guides from the [EN 46109](#) into the center oil pan rail bolt hole on each side of the engine block.



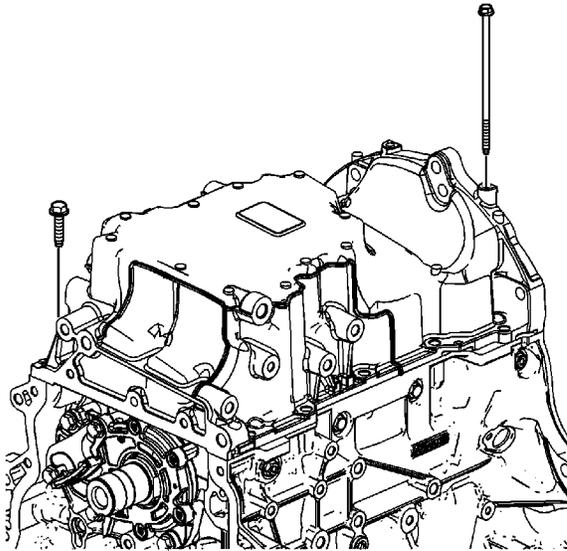
2. Place a 3 mm (0.118 in) bead (1) of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the block pan rail and the crankshaft rear oil seal housing.



3. Position the oil pan onto the block.

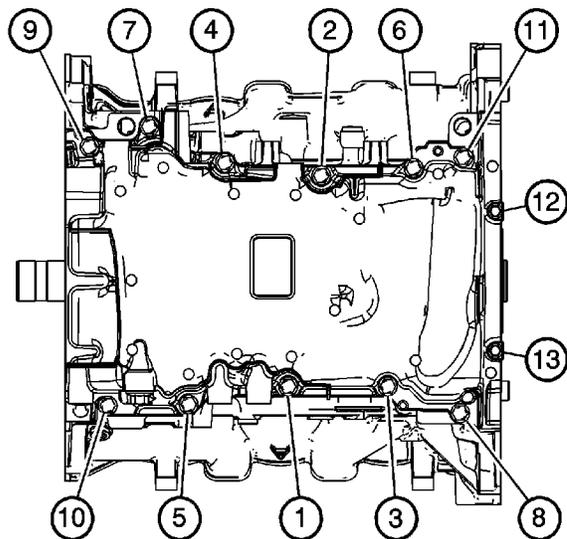


4. Remove the [EN 46109](#) 8 mm (0.315 in) guides from the engine block.



5. Loosely install the oil pan bolts.

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



6. Tighten the oil pan bolts in sequence shown.

Tighten

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

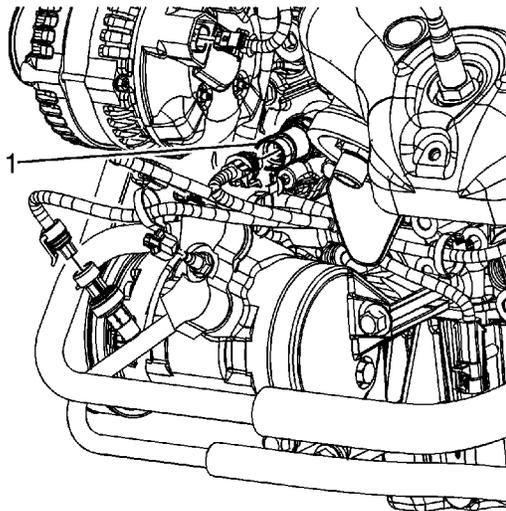
10. Refill the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#).

Engine Oil Pressure Sensor and/or Switch Replacement

Special Tools

[J 41712](#) Oil Pressure Switch Socket

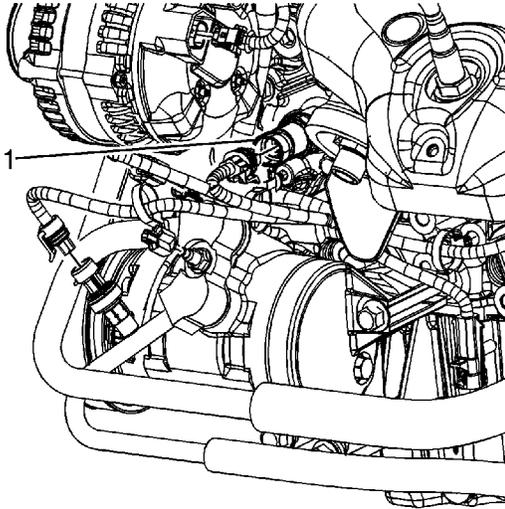
Removal Procedure



1. Turn the ignition OFF.
2. Disconnect the oil pressure sensor electrical connector.
3. Remove the oil pressure sensor (1).

Installation Procedure

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



1. Install the oil pressure sensor (1).

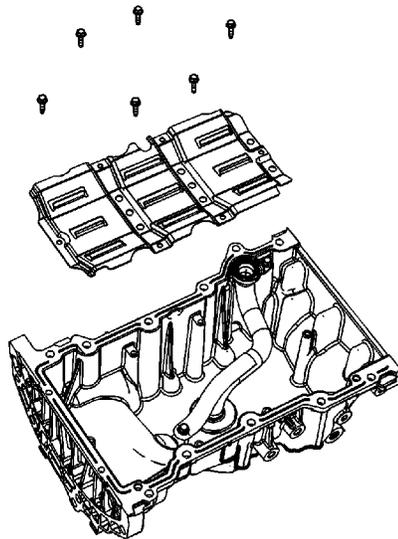
Tighten

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

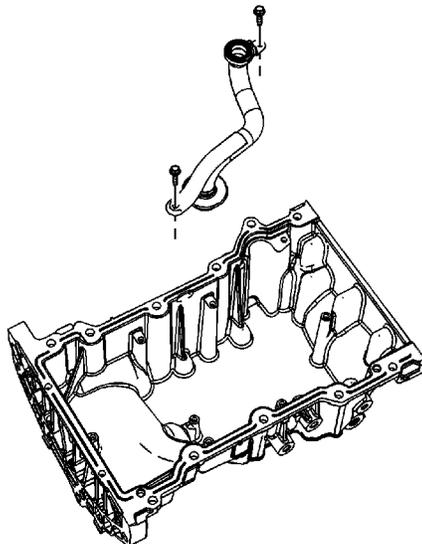
2. Connect the oil pressure sensor electrical connector.

Oil Pump Suction Pipe and Screen Assembly Replacement

Removal Procedure

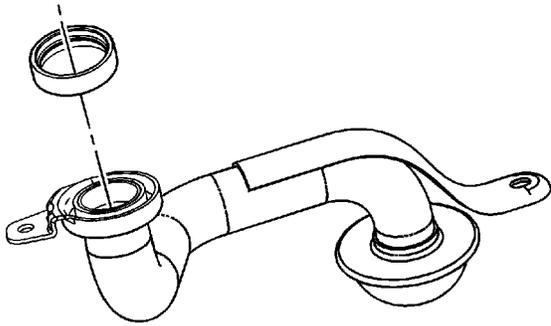


1. Remove the oil pan. Refer to [Oil Pan Replacement](#).
2. Remove the oil pan scraper bolts.
3. Remove the oil pan scraper.



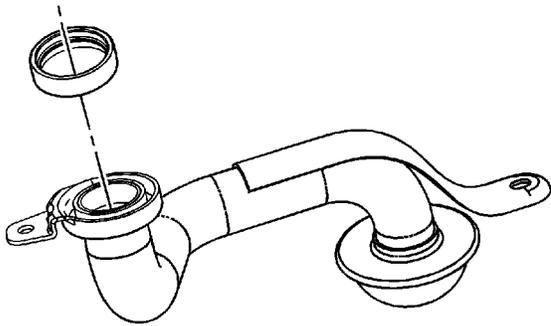
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4. Remove the oil suction pipe bolts.
5. Remove the oil suction pipe.

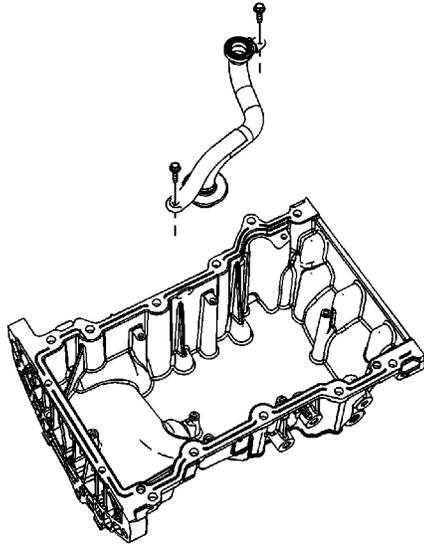


6. Remove the oil suction tube seal from the oil suction tube. Discard the oil suction tube seal.

Installation Procedure



1. Install a NEW oil suction tube seal onto the oil suction tube. DO NOT reuse the old oil suction tube seal.



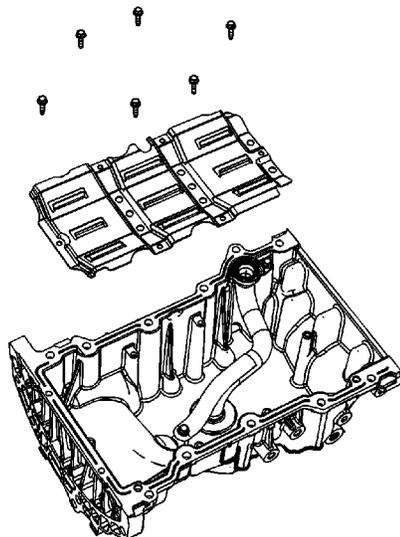
2. Install the oil suction pipe.

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

3. Install the oil suction pipe bolts.

Tighten

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



4. Install the oil pan scraper.
5. Install the oil pan scraper bolts.

Tighten

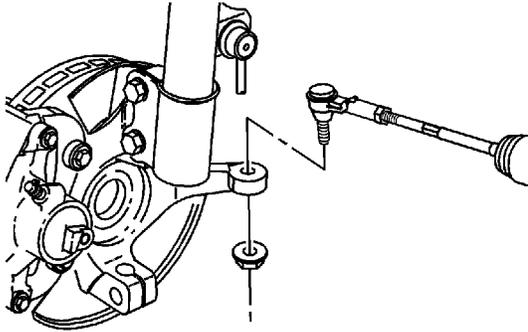
Tighten the oil pan scraper bolts to 10 N·m (89 lb in).

6. Install the oil pan. Refer to [Oil Pan Replacement](#).

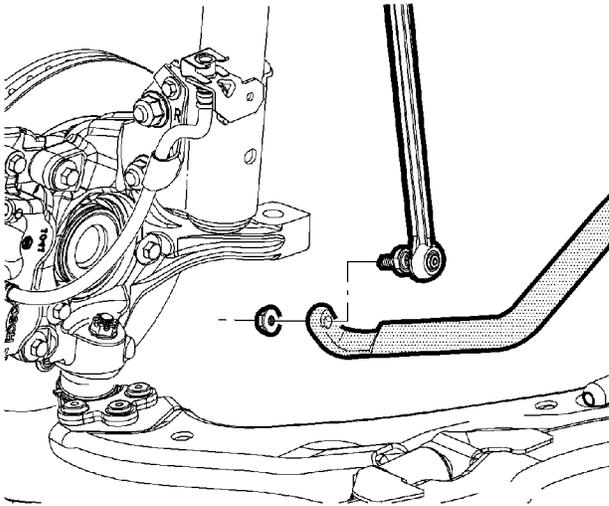
Engine Replacement

Removal Procedure

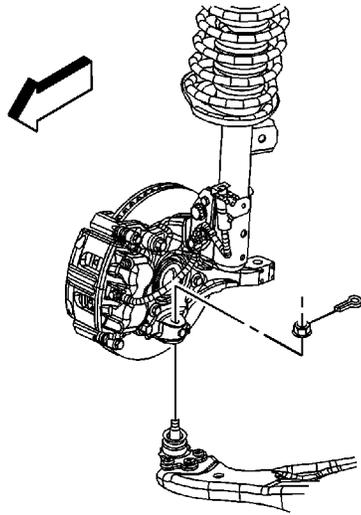
1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
2. Remove the fuel injector sight shield. Refer to [Fuel Injector Sight Shield Replacement](#).
3. Release the clamp from the brake booster vacuum hose connection.
4. Disconnect the brake booster vacuum hose from the intake manifold.
5. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#).
6. Discharge the fuel system. Refer to [Fuel Pressure Relief](#).
7. Disconnect the evaporative emission (EVAP) hose/pipe from the EVAP canister purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Disconnect the engine fuel hose/pipe from the chassis fuel hose/pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
9. Discharge the air conditioning (A/C) system. Refer to [Refrigerant Recovery and Recharging](#).
10. Remove the A/C compressor suction hose assembly from the compressor. Cap or plug the hoses and compressor to prevent contamination. Refer to [Suction Hose Replacement](#).
11. Remove the A/C compressor discharge hose assembly from the compressor. Cap or plug the hoses and compressor to prevent contamination. Refer to [Discharge Hose Replacement](#).
12. Drain the engine coolant from the cooling system. Refer to [Cooling System Draining and Filling](#).
13. Tie the radiator, A/C condenser and fan module assembly to the upper radiator support to keep the assembly with the vehicle when the frame and drivetrain is removed.
14. Remove the coolant recovery reservoir. Refer to [Coolant Recovery Reservoir Replacement](#).
15. Disconnect the inlet coolant heater hose from the engine. Refer to [Heater Inlet Hose Replacement](#).
16. Disconnect the outlet coolant heater hose from the engine. Refer to [Heater Outlet Hose Replacement](#).
17. Remove the radiator inlet hose. Refer to [Radiator Inlet Hose Replacement](#).
18. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
19. Remove the exhaust flexible pipe and secure the rear half of the exhaust system to the vehicle underbody. Refer to [Exhaust Flexible Pipe Replacement](#).
20. Remove the front tires. Refer to [Tire and Wheel Removal and Installation](#).
21. Remove the engine splash shield. Refer to [Engine Splash Shield Replacement](#).
22. Remove the steering intermediate shaft pinch bolt and discard the bolt.
23. Disconnect the steering intermediate shaft from the steering gear.



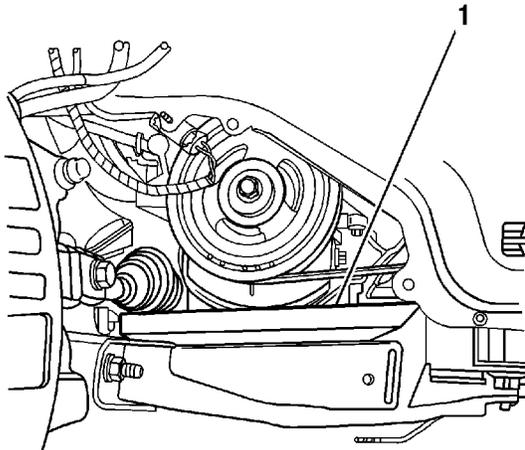
24. Remove the right and left steering linkage outer tie rod ends from the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).



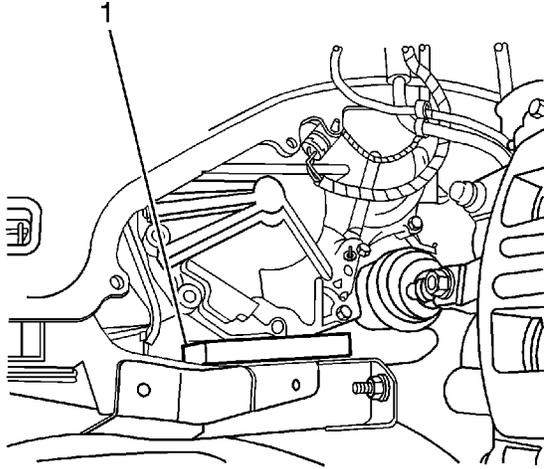
25. Remove the right and left stabilizer shaft links from the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#).



26. Remove the right and left lower ball joints from the steering knuckles. Refer to [Lower Control Arm Replacement](#).
27. On front wheel drive (FWD) models, place a drain pan under the transaxle then separate the right and left front wheel drive shafts from the transaxle. Refer to [Front Wheel Drive Shaft Replacement](#).
28. On all wheel drive (AWD) models, remove the driveline torque tube. Refer to [Driveline Torque Tube Replacement](#).



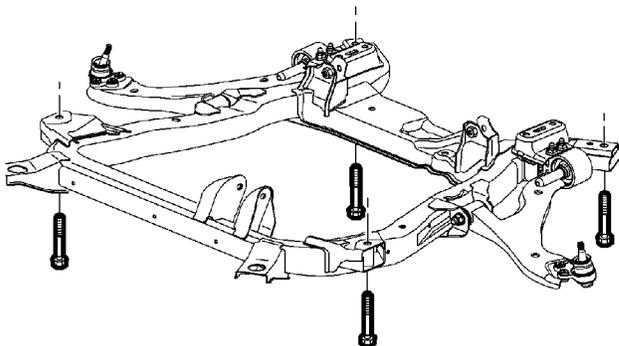
29. On all models, place a block of wood (1) between the frame and the engine oil pan in order to support the engine once the bolts are removed from the right engine mount.



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

Note: Ensure the vehicle body is secured to the hoist.

33. Disconnect and reposition the engine harness as necessary.
34. Raise the vehicle.
35. Disconnect the power steering hoses at the power steering fluid cooler. Refer to [Power Steering Cooler Pipe/Hose Replacement](#).
36. Place a universal frame support fixture or jackstands under the frame.
37. Lower the vehicle until the frame contacts the frame support fixture or jackstands.



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

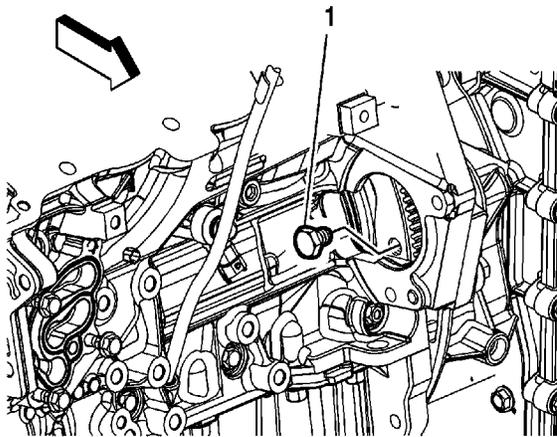
Note: Inspect for areas of body to powertrain contact or entanglement of wires and hoses while separating the vehicle body and powertrain.

39. Carefully raise the vehicle body up away from the powertrain.

40. Disconnect all necessary engine electrical wiring harness connectors.

41. Remove the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#).

42. Remove the starter motor. Refer to [Starter Replacement](#).



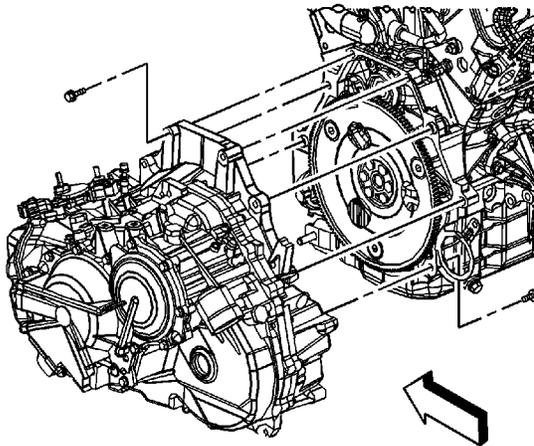
43. Remove the torque converter bolts (1).

44. Install the engine lift hooks.

45. Install an engine lift chain to the engine lift hooks.

46. Remove the engine and transmission mount nuts from the frame.

47. Support the engine weight with an engine hoist and raise the engine and transmission assembly off the frame.

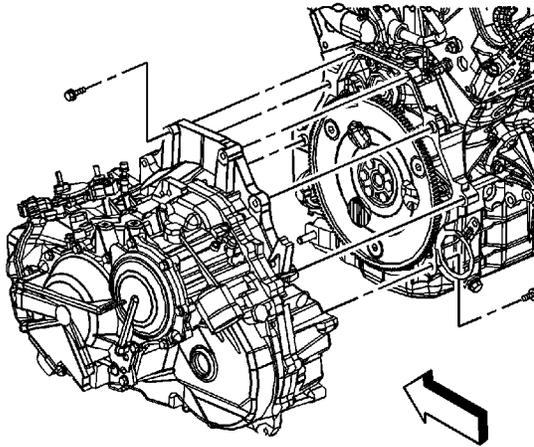




48. Lower the engine/transmission assembly to a suitable work area.
49. Remove the automatic transaxle bolts.
50. Separate the automatic transaxle from the engine.
51. Lift the engine away from the automatic transaxle.
52. Secure the engine to an engine stand.
53. Remove any additional engine components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

Installation Procedure

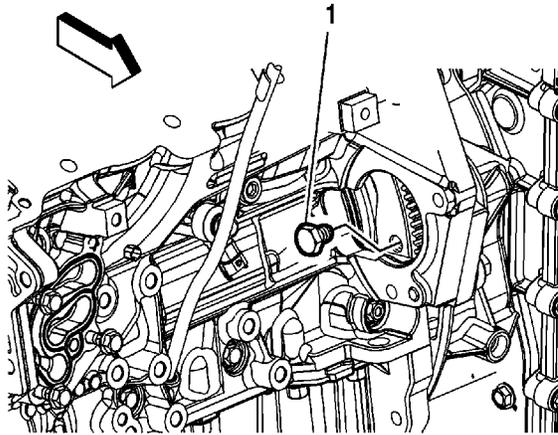
1. Remove the engine from the engine stand.



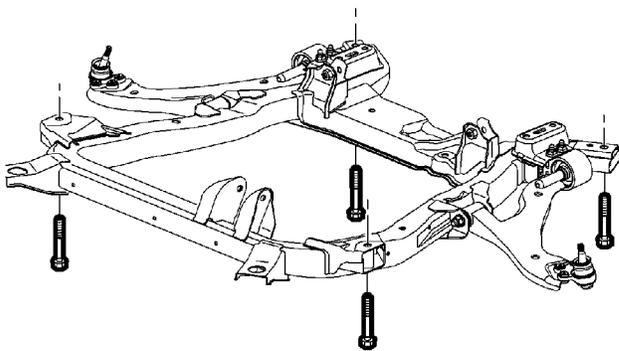
2. Align the engine to the frame and automatic transaxle.

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

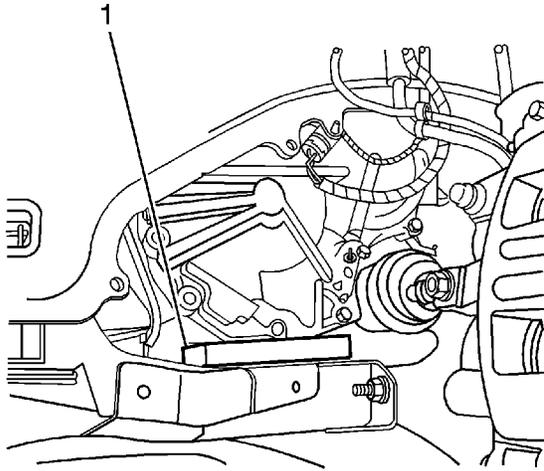
3. Install the automatic transaxle bolts and tighten to **75 N·m (55 lb ft)**.
4. Place a block of wood between the frame and the engine oil pan in order to support the engine on the frame once the engine hoist is removed.
5. Remove the engine hoist and lift chain.



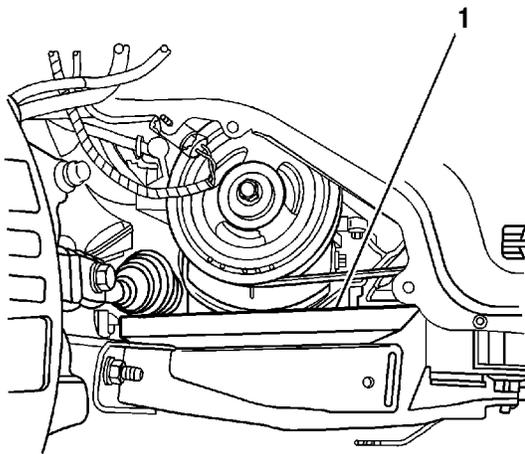
6. Install the torque converter bolts and tighten to **60 N·m (44 lb ft)**.
7. Install the starter motor. Refer to [Starter Replacement](#).
8. Install the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#).
9. Connect all necessary engine electrical wiring harness connectors.



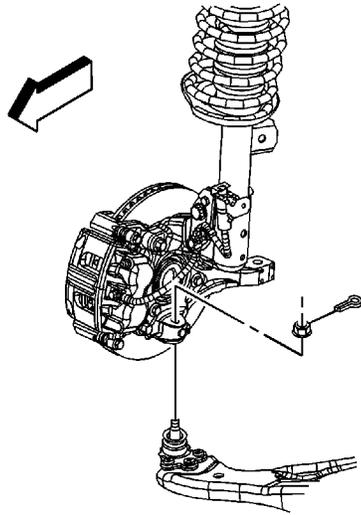
10. Install NEW frame-to-body bolts and tighten to **155 N·m (114 lb ft)**.
11. Raise the vehicle up away from the frame support fixture or jackstands and remove the support fixture or jackstands from under the vehicle.
12. Connect the power steering hoses to the power steering fluid cooler. Refer to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



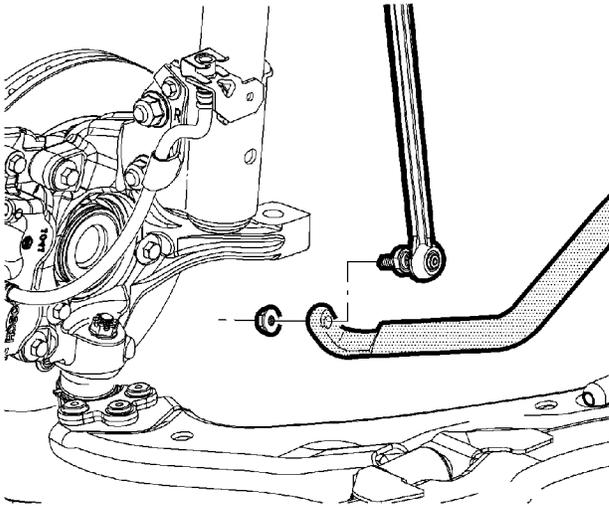
17. Remove the block of wood (1) between the frame and the transaxle used to support the transaxle while the bolts were removed from the left transaxle mount bracket.



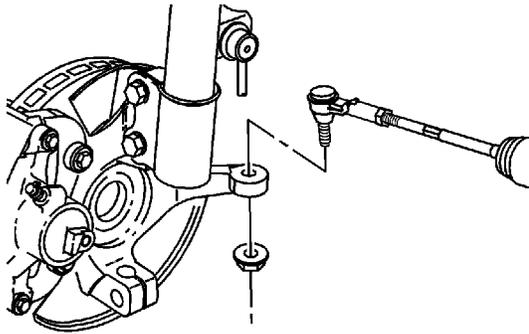
18. Remove the block of wood (1) between the frame and the engine oil pan used to support the engine while the bolts were removed from the right engine mount.
19. On AWD models, install the driveline torque tube. Refer to [Driveline Torque Tube Replacement](#).
20. On FWD models, install the right and left front wheel drive shafts into the transaxle. Refer to [Front Wheel Drive Shaft Replacement](#).



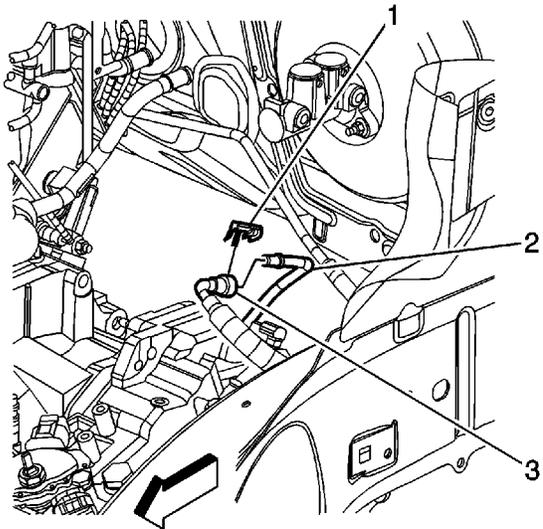
21. On all models, install the right and left lower ball joints to the steering knuckles. Refer to [Lower Control Arm Replacement](#).



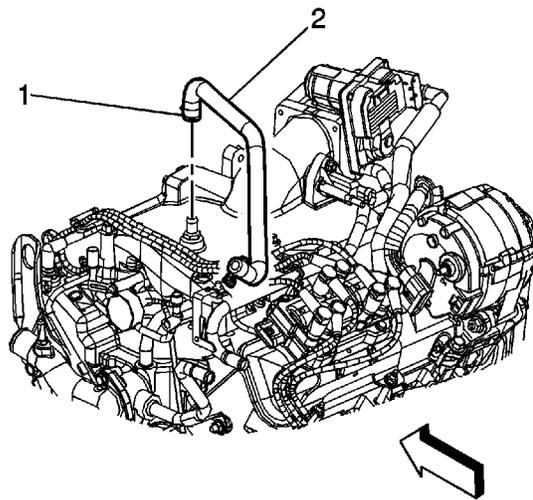
22. Install the right and left stabilizer shaft links to the stabilizer shaft. Refer to [Stabilizer Shaft Link Replacement](#).



23. Install the right and left steering linkage outer tie rod ends to the steering knuckles. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
24. Connect the steering intermediate shaft to the steering gear.
25. Install a NEW pinch bolt to the steering intermediate shaft and tighten to **34 N·m (25 lb ft)**.
26. Install the engine splash shield. Refer to [Engine Splash Shield Replacement](#).
27. Install the front tires. Refer to [Tire and Wheel Removal and Installation](#).
28. Install the exhaust flexible pipe. Refer to [Exhaust Flexible Pipe Replacement](#).
29. Install the radiator outlet hose. Refer to [Radiator Outlet Hose Replacement](#).
30. Lower the vehicle.
31. Install the radiator inlet hose. Refer to [Radiator Inlet Hose Replacement](#).
32. Connect the outlet coolant heater hose to the engine. Refer to [Heater Outlet Hose Replacement](#).
33. Connect the inlet coolant heater hose to the engine. Refer to [Heater Inlet Hose Replacement](#).
34. Install the coolant recovery reservoir. Refer to [Coolant Recovery Reservoir Replacement](#).
35. Untie the radiator, AC condenser, and fan module assembly from the upper radiator support.
36. Install the A/C compressor discharge hose assembly to the compressor. Refer to [Discharge Hose Replacement](#).
37. Install the A/C compressor suction hose assembly to the compressor. Refer to [Suction Hose Replacement](#).



38. Connect the engine fuel hose/pipe (3) to the chassis fuel hose/pipe (2). Refer to [Metal Collar Quick Connect Fitting Service](#).
39. Connect the EVAP hose/pipe to the EVAP canister purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
40. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#).



41. Connect the brake booster vacuum hose (2) to the intake manifold.
42. Position the clamp (1) on the brake booster vacuum hose connection.
43. Install the fuel injector sight shield. Refer to [Fuel Injector Sight Shield Replacement](#).
44. Fill the engine with engine oil. Refer to [Approximate Fluid Capacities](#) , [Fluid and Lubricant Recommendations](#) , and [Maintenance Schedule](#).
45. Fill the engine with coolant. Refer to [Cooling System Draining and Filling](#).
46. Check the transaxle fluid level. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) , [Transmission General Specifications](#) , and [Approximate Fluid Capacities](#).
47. Charge the AC system. Refer to [Refrigerant Recovery and Recharging](#).

48. Add power steering fluid and bleed air from the power steering system. Refer to [Power Steering System Bleeding](#).
49. Prime the fuel system.
 - 49.1. Cycle the ignition ON for 5 seconds then OFF for 10 seconds. Repeat cycling twice.
 - 49.2. Crank the engine until it starts. The maximum starter motor cranking time is 20 seconds.
 - 49.3. If the engine does not start, repeat the steps.