

2002 GMC Envoy

2002 ENGINES 4.2L 6-Cylinder - Bravada, Envoy & Trailblazer

2002 ENGINES**4.2L 6-Cylinder - Bravada, Envoy & Trailblazer****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS**

Application	Specification	
	Metric	English
A/C Line Bracket Nut at Oil Level Indicator Tube	7 N.m	61 lb in
A/C Line Bracket Bolt at Engine Lift Bracket	10 N.m	89 lb in
A/C Compressor bolts	50 N.m	37 lb ft
A.I.R. Cover Stud	25 N.m	18 lb ft
Camshaft Cap Bolt	12 N.m	106 lb in
Camshaft Cover Bolt	10 N.m	89 lb in
Cooling Fan Hubnut	56 N.m	41 lb ft
Crankshaft Balancer Bolt		
First Pass	150 N.m	110 lb ft
Final Pass	180 degrees	
Crankshaft Rear Housing Bolt	10 N.m	89 lb in
Cylinder Head Access Hole Plug (Plastic)	5 N.m	44 lb in
Cylinder Head Bolt (14)		
First Pass	30 N.m	22 lb ft
Final Pass	155 degrees	
Cylinder Head End Bolts (2 Short)	20 N.m	15 lb ft
Cylinder Head End Bolts (1 Long)	18 N.m	13 lb ft
Drive Belt Idler Pulley Bolt	50 N.m	37 lb ft
Drive Belt Tensioner Bolt	50 N.m	37 lb ft
Engine Flywheel Bolt		
First Pass	25 N.m	18 lb ft
Final Pass	50 degrees	
Engine Front Cover Bolt	10 N.m	89 lb in
Engine Front Cover Spacer Bolt	10 N.m	89 lb in
Engine Front Lift Bracket Bolt	50 N.m	37 lb ft
Engine Harness Bracket Bolt	50 N.m	37 lb ft
Engine Mount Bracket Bolt (engine)	50 N.m	37 lb ft
Engine Mount Bracket Bolt (frame)	110 N.m	81 lb ft
Engine Mount Nuts (upper and lower)	70 N.m	52 lb ft
Exhaust Camshaft Actuator Bolt		
First Pass	25 N.m	18 lb ft

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Final Pass	135 degrees	
Exhaust Pipe Bolts	50 N.m	37 lb ft
Front Differential Bolts	85 N.m	63 lb ft
Generator Battery Lead Nut	9 N.m	80 lb in
Heater Inlet Fitting	45 N.m	33 lb ft
Heater Outlet Fitting	45 N.m	33 lb ft
Intake Manifold Bolt	16 N.m	12 lb ft
Oil Filter (PF 58)		
First Pass	17 N.m	13 lb ft
Final Pass	150 degrees	
Oil Filter Adapter	30 N.m	22 lb ft
Oil Level Indicator Tube Stud	10 N.m	89 lb in
Oil Pan Bolt (Ends)	10 N.m	89 lb in
Oil Pan Bolt (Sides)	25 N.m	18 lb ft
Oil Pan Drain Plug	26 N.m	19 lb ft
Oil Pan Nut	25 N.m	18 lb ft
Oil Pan Stud	11 N.m	97 lb in
Oil Pressure Sensor	20 N.m	15 lb ft
Oil Pump Cover Bolt	10 N.m	89 lb in
Oil Pump Pressure Relief Valve	14 N.m	124 lb ft
Power Steering Pump Bolt	25 N.m	18 lb ft
Timing Chain Tensioner Bolt	25 N.m	18 lb ft
Timing Chain Tensioner Guide Bolt	14 N.m	124 lb in
Timing Chain Tensioner Shoe Bolt	25 N.m	18 lb ft
Timing Chain Top Guide Bolt	10 N.m	89 lb in
Torque Converter Bolts	60 N.m	44 lb ft
Transmission Bell Housing Bolts	50 N.m	37 lb ft
Transmission Fluid Tube to Air Adapter Nut	10 N.m	89 lb in

ENGINE MECHANICAL SPECIFICATIONS

Engine Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
Engine Type	In-Line-6	
Displacement	4.2 L	256 cu in
RPO (VIN Code)	LL8	
Bore	93 mm	3.66 in
Stroke	102 mm	4.02 in
Compression Ratio	10: 1	

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Firing Order	1-5-3-6-2-4	
Oil Pressure (At the sending unit) Warm - Minimum	85 kPa	12 psi @ 1200 RPM
Spark Plug Gap		
Maximum	1.25 mm	0.050 in
Minimum	1.14 mm	0.044 in

SEALERS, ADHESIVES, AND LUBRICANTS

Application	Type of Material	GM Part Number
Crankcase Ventilation Hose, Inner Diameter	Lubricant	12345884
Cylinder Head Bolt Threads	Threadlock	12345493
Engine Flywheel Bolt Threads	Threadlock	12345493
Engine Front Cover Surface	(3-Bond) Sealant	12378521
Engine Oil	5W-30 Oil	12345610
Exhaust Manifold Bolt Threads	Threadlock	12345493
Exhaust Manifold Heat Shield Nuts	Anti-Seive	12371386
Oil Level Indicator Tube Stud	Sealant	12346004
Oil Pan Surface	(3-Bond) Sealant	12378521
Rear Oil Seal Housing Surface	(3-Bond) Sealant	12378521
Timing Chain-Top Chain Guide Bolt	Threadlock	12345493

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Fig. 1: Sealers, Adhesives And Lubricants
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE MECHANICAL

Begin the system diagnosis by reviewing the **DISASSEMBLED VIEWS** , **DESCRIPTION AND OPERATION** , and **LUBRICATION DESCRIPTION** . Reviewing the description and operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Engine Mechanical** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

1. Perform A Diagnostic System Check in Engine Controls before using the symptom tables (if applicable).
2. Review the system operations in order to familiarize yourself with the system functions. Refer to **DISASSEMBLED VIEWS** , **DESCRIPTION AND OPERATION** , and **LUBRICATION DESCRIPTION** . All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system problem. The diagnostic flow is the place to start when repairs are necessary.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the engine.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Check for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds (if applicable) to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Base Engine Misfire without Internal Engine Noises
- Base Engine Misfire with Abnormal Internal Lower Engine Noises
- Base Engine Misfire with Abnormal Valve Train Noise
- Base Engine Misfire with Coolant Consumption
- Base Engine Misfire with Excessive Oil Consumption
- Engine Compression Test
- Engine Noise on Start-Up, but Only Lasting a Few Seconds
- Upper Engine Noise, Regardless of Engine Speed
- Lower Engine Noise, Regardless of Engine Speed
- Engine Noise Under Load
- Engine Will Not Crank - Crankshaft Will Not Rotate
- Oil Consumption Diagnosis
- Oil Pressure Diagnosis and Testing
- Oil Leak Diagnosis

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

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Cause	Correction
Abnormalities (severe cracking, bumps, or missing areas) in the accessory drive belt (Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.)	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout and may lead to a misfire DTC. (A misfire code may be present without an actual misfire condition.)	Inspect the components, and repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer (A misfire code may be present without an actual misfire condition.)	Repair or replace the flywheel and/or balancer as required.

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Fig. 2: Base Engine Misfire Without Internal Engine Noises (1 Of 2)
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Cause	Correction
Restricted exhaust system (A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters).	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder head or throttle body.	Replace the intake manifold, gaskets, cylinder head, and/or throttle body as required.
Improperly installed or damaged MAP sensor (The sealing grommet of the MAP sensor should not be torn or damaged.)	Repair or replace the MAP sensor as required.
Damage to the MAP sensor housing and/or O-ring seal	Replace the intake manifold.
Worn or loose valve rocker arms (The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position)	Replace the valve rocker arms as required.
Worn valve lash adjusters	Replace the valve lash adjusters.
Stuck valves (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lash adjusters.
Excessive oil pressure	- Perform an oil pressure test. Refer to <i>Oil Pressure Diagnosis and Testing</i>. - Repair or replace the oil pump as required.
Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system passages. (Coolant consumption may or may not cause the engine to overheat.)	- Inspect for spark plugs saturated by coolant. - Inspect the cylinder head, engine block, and/or head gasket. - Repair or replace as required.
Worn Piston Rings (Oil consumption may or may not cause the engine to misfire.)	- Inspect the spark plugs for oil deposits. - Inspect the cylinders for a loss of compression. Refer to <i>Engine Compression Test</i>. - Perform cylinder leak down and compression testing to identify the cause. - Repair or replace as required.
A damaged crankshaft reluctor wheel (A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage.) - Systems with electronic communications (DIS or coil per cylinder) and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position.) - Systems with electronic communication (DIS or coil per cylinder) and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a P0300 DTC may be set. - Systems with mechanical communications (high voltage switch) and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a P0300 DTC or P0336.	Replace the sensor and/or crankshaft as required.

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Fig. 3: Base Engine Misfire Without Internal Engine Noises (2 Of 2)
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BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

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Cause	Correction
Abnormalities (severe cracking, bumps or missing areas) in the accessory drive belt (Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.)	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout (A misfire code may be present without an actual misfire condition.)	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer (A misfire code may be present without an actual misfire condition.)	Repair or replace the flywheel and/or balancer as required.
Worn Piston Rings (Oil consumption may or may not cause the engine to misfire.)	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to <i>Engine Compression Test</i>. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.
Worn Crankshaft Thrust Bearings (Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition.)	Replace the crankshaft and bearings as required.

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Fig. 4: Base Engine Misfire With Abnormal Internal Lower Engine Noises
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BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Cause	Correction
Worn or loose valve rocker arms (The rocker arm bearing end caps and/or needle bearings should intact within the rocker arm assembly.)	Replace the valve rocker arms as required.
Stuck valves (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lash adjusters.
Sticking valve lash adjusters	Replace as required.

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Fig. 5: Base Engine Misfire With Abnormal Valve Train Noise
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BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Cause	Correction
Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system passages. (Coolant consumption may or may not cause the engine to overheat.)	• Inspect for spark plugs saturated by coolant. • Perform a cylinder leak down test. • Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

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Fig. 6: Base Engine Misfire With Coolant Consumption
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BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals	• Inspect the spark plugs for oil deposits. • Repair or replace as required.
Worn Piston Rings (Oil consumption may or may not cause the engine to misfire.)	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to <i>Engine Compression Test</i>. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.

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Fig. 7: Base Engine Misfire With Excessive Oil Consumption
Courtesy of GENERAL MOTORS CORP.

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Cause	Correction
Important: A cold piston knock which disappears in 1.5 minutes should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis. A light rattle/tapping noise may indicate a valve train (upper engine) concern, or a low rumble/knocking may indicate a crankshaft or piston (lower engine) concern.	
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
Worn crankshaft thrust bearing	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Damaged or faulty oil filter by-pass valve	• Inspect the oil filter by-pass valve for proper operation. • Repair or replace as required.

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Fig. 8: Engine Noise On Start-Up, But Only Lasting A Few Seconds
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UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

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Cause	Correction
Important: A cold piston knock which disappears in 1.5 minutes should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis. A light rattle/tapping noise may indicate a valve train (upper engine) concern.	
Low oil pressure	• Perform an oil pressure test. Refer to <i>Oil Pressure Diagnosis and Testing</i>. • Repair or replace as required.
Worn or damaged valve rocker arm	• Inspect the rocker arm for wear or missing needle bearings • Replace the valve rocker arms as required.
Improper lubrication to the valve rocker arms	Inspect the following components, and repair or replace as required: • The valve rocker arm • The valve lash adjusters • The oil filter bypass valve • The oil transfer tube • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn or dirty valve lash adjusters	Replace the valve lash adjusters.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn engine camshaft lobes	• Inspect the engine camshaft lobes. • Replace the camshaft and valve lash adjusters as required.
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides
Stuck Valves (Carbon on the valve stem or valve seat may cause the valve to stay open)	Inspect the following components, and repair as required: • The valves • The valve guides

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Fig. 9: Upper Engine Noise, Regardless Of Engine Speed
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LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

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Cause	Correction
Important: A cold piston knock which disappears in 1.5 minutes should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis. A low rumble/knocking may indicate a crankshaft or piston (lower engine) concern.	
Low oil pressure	- Perform an oil pressure test. Refer to <i>Oil Pressure Diagnosis and Testing</i>. - Repair or replace damaged components as required.
Worn accessory drive components (Abnormalities such as severe cracking, bumps or missing areas in the accessory drive belt and/or misalignment of system components.)	- Inspect the accessory drive system. - Repair or replace as required.
Loose or damaged crankshaft balancer	- Inspect the crankshaft balancer. - Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition controls system. Refer to Engine Controls.
Loose torque converter bolts	- Inspect the torque converter bolts and flywheel. - Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Oil pump screen loose, damaged or restricted	- Inspect the oil pump screen. - Repair or replace as required.
Oil transfer tube loose, damaged or restricted	- Inspect the transfer tube. - Repair or replace as required.
Excessive piston-to-cylinder bore clearance	- Inspect the piston and cylinder bore. - Repair as required.
Excessive piston pin-to-bore clearance	- Inspect the piston, piston pin, and the connecting rod. - Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: - The connecting rod bearings - The connecting rods - The crankshaft - The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: - The crankshaft bearings - The crankshaft journals
Incorrect piston, piston pin and connecting rod installation (Pistons must be installed with the mark or dimple on the top of the piston facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.)	- Verify the pistons, piston pins and connecting rods are installed correctly. - Repair as required.

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Fig. 10: Lower Engine Noise, Regardless Of Engine Speed
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ENGINE NOISE UNDER LOAD

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Cause	Correction
Important: A cold piston knock which disappears in 1.5 minutes should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis. A low rumble/knocking may indicate a crankshaft or piston (lower engine) concern.	
Low oil pressure	• Perform an oil pressure test. Refer to <i>Oil Pressure Diagnosis and Testing</i>. • Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition controls. Refer to Engine Controls.
Loose torque converter bolts	• Inspect the torque converter bolts and flywheel. • Repair as required.
Cracked flywheel (automatic transmission)	• Inspect the flywheel bolts and flywheel. • Repair as required.

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Fig. 11: Engine Noise Under Load (1 Of 2)
Courtesy of GENERAL MOTORS CORP.

Cause	Correction
Excessive connecting rod bearing clearance	Inspect the following components, and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components, and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore

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Fig. 12: Engine Noise Under Load (2 Of 2)
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ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

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Cause	Correction
Seized accessory drive system component	1. Remove the accessory drive belt. 2. Confirm that the engine will rotate. Rotate the crankshaft by hand at the crankshaft balancer or flywheel location. 3. Repair or replace the components as required.
Seized automatic transmission torque converter	1. Remove the torque converter-to-flywheel bolts. 2. Confirm that the engine will rotate. Rotate the crankshaft by hand at the crankshaft balancer or flywheel location. 3. Repair or replace the components as required.
Broken timing chain	• Inspect the timing chain and gears. • Repair or replace the components as required.
Seized timing chain or timing gears	• Inspect the timing chain and gears for foreign material or a seized chain. • Repair or replace the components as required.
Seized or broken camshaft	• Inspect the camshaft. • Repair or replace the components as required.
Bent valve in the cylinder head	• Inspect the valves and the cylinder head. • Repair or replace the components as required.
Seized oil pump	• Inspect the oil pump assembly. • Repair or replace as required.
Hydraulically locked cylinder • Coolant/antifreeze in the cylinder • Oil in the cylinder • Fuel in the cylinder	1. Remove spark plugs and check for fluid in the cylinder. When rotating the engine with the spark plugs removed, the piston (on compression stroke) will push fluid from the combustion chamber. 2. Inspect for failed/broken head gasket. 3. Inspect for a cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector. 5. Repair or replace the components as required.
Material in the cylinder • Broken valve • Broken piston ring(s) • Piston material • Foreign material	• Inspect the cylinder for damaged components and/or foreign materials. • Repair or replace the components as required.
Seized crankshaft or connecting rod bearings	• Inspect crankshaft and connecting rod bearings. • Repair or replace the components as required.
Bent or broken connecting rod	• Inspect the connecting rods. • Repair or replace the components as required.
Broken crankshaft	• Inspect the crankshaft. • Repair or replace the components as required.

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Fig. 13: Engine Will Not Crank - Crankshaft Will Not Rotate
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ENGINE COMPRESSION TEST

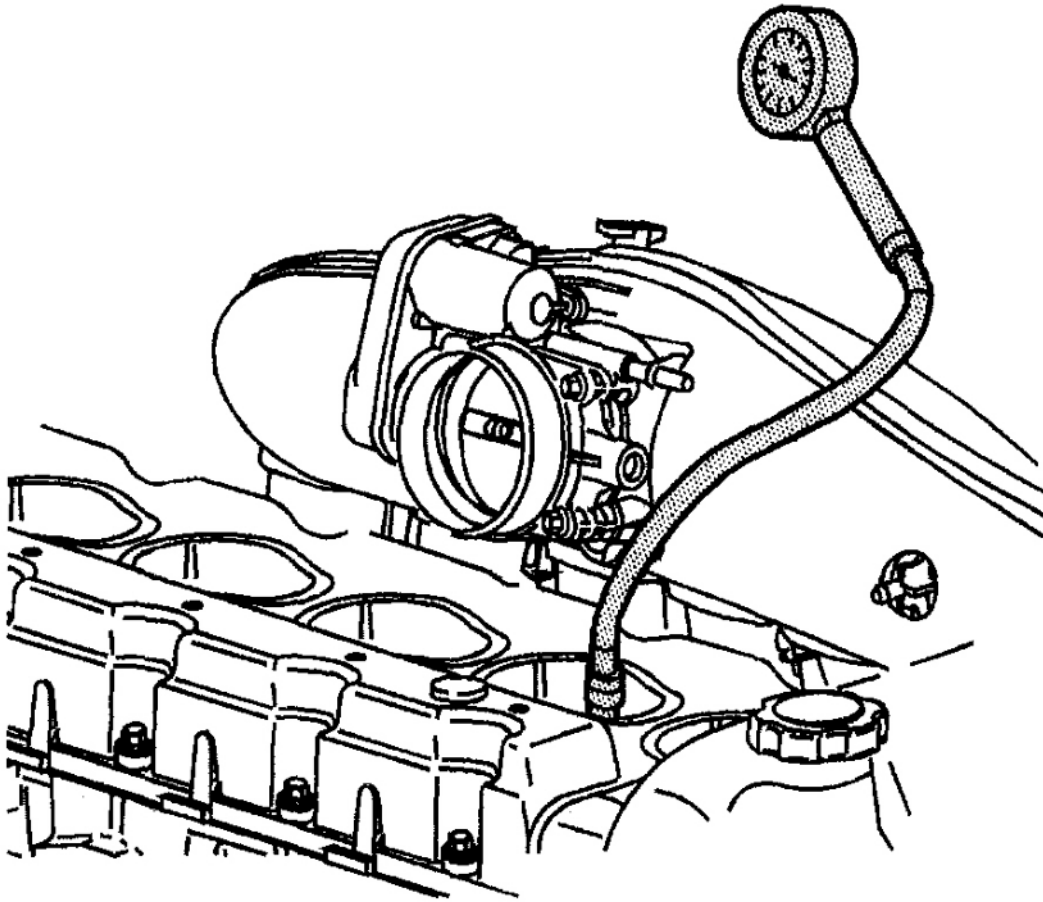
Tools Required : J 38722 Compression Tester

A compression pressure test of the engine cylinders determines the condition of the rings, the valves, and the head gasket.

IMPORTANT: The battery must be at or near full charge.

1. Remove the air duct from the throttle body.
2. Remove the ignition control modules.

3. Disable the fuel system.
4. Remove the spark plugs.
5. Measure the engine compression, using the following procedure:
 - 5.1. Firmly install J 38722 to the spark plug hole.



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Fig. 14: Installing J 38722 To Spark Plug Hole
Courtesy of GENERAL MOTORS CORP.

- 5.2. Have an assistant crank the engine through at least four compression strokes in the testing cylinder.
- 5.3. Check and record the readings on J 38722 at each stroke.
- 5.4. Disconnect J 38722.
- 5.5. Repeat the compression test for each cylinder.
6. Record the compression readings from all of the cylinders. A normal reading should be approximately

1482 kPa (215 psi).

The lowest reading should not be less than 70 percent of the highest reading.

7. The following are examples of the possible measurements:

- When the compression measurement is normal, the compression builds up quickly and evenly to the specified compression on each cylinder.
- When the compression is low on the first stroke and tends to build up on the following strokes, but does not reach the normal compression, or if the compression improves considerably with the addition of three squirts of oil, the piston rings may be the cause.
- When the compression is low on the first stroke and does not build up in the following strokes, or the addition of oil does not affect the compression, the valves may be the cause.
- When the compression is low on two adjacent cylinders, or coolant is present in the crankcase, the head gasket may be the cause.

8. Install the air duct to the throttle body.

9. Install the spark plugs.

10. Enable the fuel system.

11. Install the ignition control modules.

OIL CONSUMPTION DIAGNOSIS

Checks	Causes
Excessive oil consumption (not due to leaks) is the use of 0.95 L (1.0 qts) or more of engine oil within 2,414 kilometers (1,500 miles).	
Preliminary	The causes of excessive oil consumption may include the following conditions: • External oil leaks Refer to <i>Oil Leak Diagnosis</i>. • Incorrect oil level or improper reading of the oil level indicator With the vehicle on a level surface, run the engine for a few minutes, allow adequate drain down time (2–3 minutes) and check for the correct engine oil level. • Improper oil viscosity Refer to the vehicle owners manual and use the recommended SAE grade and viscosity for the prevailing temperatures. • Continuous high speed driving and/or severe usage • Crankcase ventilation system restrictions or malfunctioning components • Worn valve guides and/or valve stems • Worn or improperly installed valve stem oil seals • Piston rings broken, worn, not seated properly Allow adequate time for the rings to seat. Replace worn piston rings as necessary. • Piston and rings improperly installed or miss-fitted to the cylinder bore

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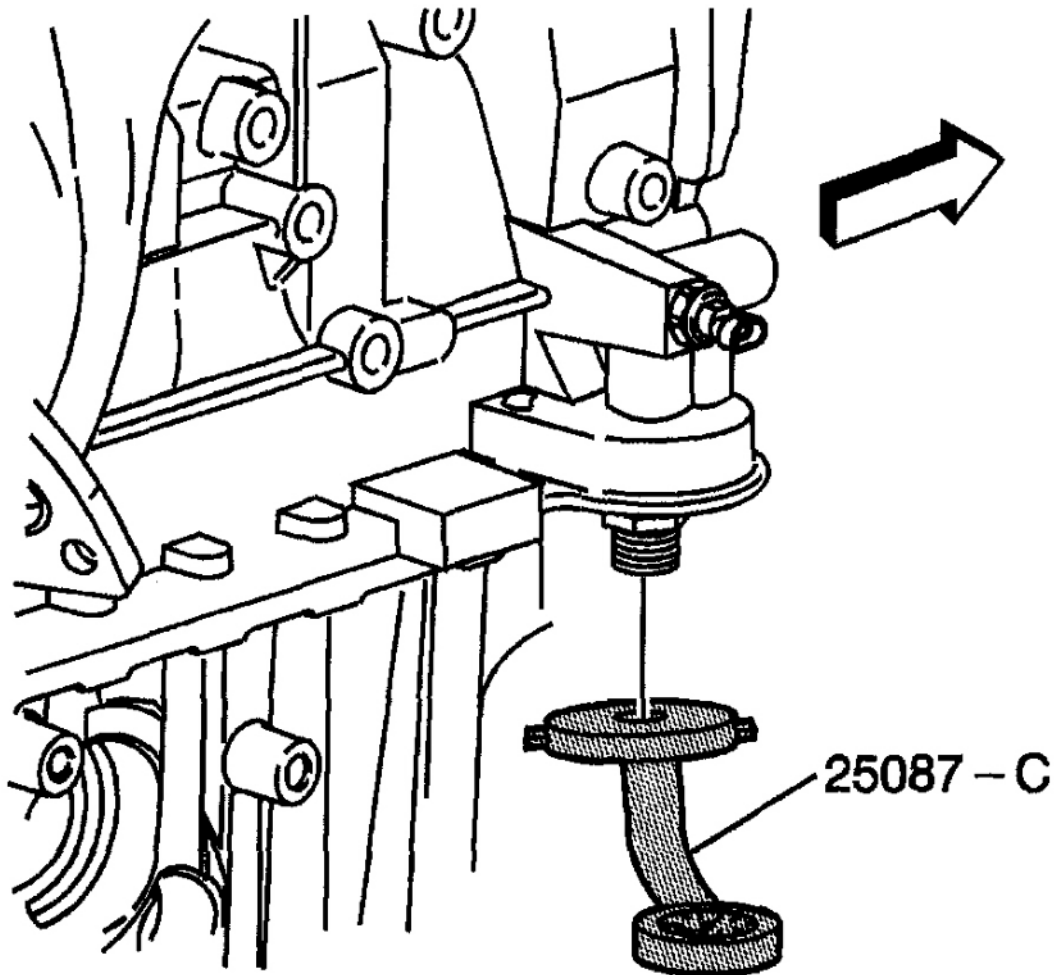
Fig. 15: Oil Consumption Diagnosis

Courtesy of GENERAL MOTORS CORP.

OIL PRESSURE DIAGNOSIS AND TESTING

Tools Required

- **J 21867** Pressure Gauge
 - **J 25087-C** Oil Pressure Tester and Pump Primer
1. With the vehicle on a level surface, run the vehicle for a few minutes, allow adequate drain down time (2-3 minutes) and measure for a low oil level.
 2. If required, add the recommended grade engine oil and fill the crankcase until the oil level measures full on the oil level indicator.
 3. Run the engine briefly (10-15 seconds) and verify low or no oil pressure on the vehicle gauge or light.
 4. Listen for a noisy valve train or a knocking noise.
 5. Inspect for the following:
 - Oil diluted by water or glycol (anti freeze)
 - Foamy oil
 6. Remove the oil filter and install the J 25087-C.



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Fig. 16: Removing Oil Filter And Install J 25087-C
Courtesy of GENERAL MOTORS CORP.

7. Install J 21867 or equivalent to the J 25087-C.
8. Run the engine and measure the engine oil pressure.
9. Compare the readings to **Engine Mechanical Specifications**.
10. If the engine oil pressure is below specifications, inspect the engine for one or more of the following:
 - Oil pump worn or dirty. Refer to **OIL PUMP CLEANING AND INSPECTION** .
 - Oil pump screen loose, plugged, or damaged
 - Oil pump screen O-ring seal missing or damaged
 - Malfunctioning oil pump pressure regulator valve
 - Excessive bearing clearance

- Cracked, porous, or restricted oil galleries
 - Oil gallery plugs missing or incorrectly installed Refer to **ENGINE BLOCK PLUG INSTALLATION** .
 - Broken valve lash adjusters Repair as necessary
11. If the reading on the J 21867 or equivalent is within specifications, inspect for the following:
- Plugged or incorrect oil filter and/or malfunctioning oil bypass valve
 - Malfunctioning vehicle oil pressure gauge or sensor Repair as necessary

OIL LEAK DIAGNOSIS

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Step	Action	Yes	No
Important: You can repair most fluid leaks by first visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the cause of the leak as well as the leak itself.			
1	1. Operate the vehicle until it reaches normal operating temperature. 2. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 3. Wait (15 minutes). 4. Check for drippings. Are drippings present?	Go to <i>Step 2</i>	System OK
2	Can you identify the type of fluid and the approximate location of the leak?	Go to <i>Step 10</i>	Go to <i>Step 3</i>
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to <i>Step 10</i>	Go to <i>Step 4</i>
4	1. Completely clean the entire engine and surrounding components. 2. Operate the vehicle for several kilometers (miles) at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface, over a large sheet of paper or other clean surface. 4. Wait (15 minutes). 5. Identify the type of fluid, and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to <i>Step 10</i>	Go to <i>Step 5</i>
5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to <i>Step 10</i>	Go to <i>Step 6</i>
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder (baby powder, foot powder, etc.) to the suspected area. 3. Operate the vehicle for several kilometers (miles) at normal operating temperature and at varying speeds. 4. Identify the type of fluid, and the approximate location of the leak, from the discolorations in the powder surface. Can you identify the type of fluid and the approximate location of the leak?	Go to <i>Step 10</i>	Go to <i>Step 7</i>

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Fig. 17: Oil Leak Diagnosis (Steps 1-6)
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Step	Action	Yes	No
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 8
8	Use J 28428-E in order to identify the type of fluid, and the approximate location of the leak. Refer to the manufacturer's instructions when using the tool. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 9
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Check for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	System OK
10	1. Inspect the engine for mechanical damage. Special attention should be shown to the following areas: • Higher than recommended fluid levels • Higher than recommended fluid pressures • Plugged or malfunctioning fluid filters or pressure bypass valves • Plugged or malfunctioning engine ventilation system • Improperly tightened or damaged fasteners • Cracked or porous components • Improper sealants or gaskets where required • Improper sealant or gasket installation • Damaged or worn gaskets or seals • Damaged or worn sealing surfaces 2. Inspect the engine for customer modifications. Is there mechanical damage, or customer modifications to the engine?	Go to Step 11	System OK
11	Repair or replace all damaged or modified components. Does the engine still leak oil?	Go to Step 1	System OK

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Fig. 18: Oil Leak Diagnosis (Steps 7-11)
Courtesy of GENERAL MOTORS CORP.

CRANKCASE VENTILATION SYSTEM INSPECTION/DESCRIPTION

A crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. The air cleaner supplies fresh air through a filter to the crankcase. The crankcase mixes the fresh air with blow-by gases. This mixture then passes through a pipe located in the intake manifold.

The crankcase ventilation system has no serviceable components so no maintenance of the system is required.

DRIVE BELT CHIRPING DIAGNOSIS**Diagnostic Aids**

The symptom may be intermittent due to moisture on the drive belt(s) or the pulleys. It may be necessary to spray a small amount of water on the drive belt(s) in order to duplicate the customers concern. If spraying water on the drive belt(s) duplicates the symptom, cleaning the belt pulleys may be the probable solution.

A loose or improper installation of a body component, a suspension component, or other items of the vehicle may cause the chirping noise.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table.
3. The noise may be an internal engine noise. Removing the drive belt and operating the engine for a brief period will verify the noise is related to the drive belt. When removing the drive belt(s) the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.
4. Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills or it may be strings in the drive belt grooves from the accumulation of rubber dust.
6. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misalign pulley using a straight edge in the pulley grooves across two or three pulleys. If a misalign pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.
10. Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed.
12. Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.
14. Replacing the drive belt when it is not damaged or there is not excessive pilling will only be a temporary repair.

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Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: The following items are indications of chirping: - A high pitched noise that is heard once per revolution of the drive belt or a pulley. - It usually occurs on cold damp mornings and will subside once vehicle reached normal operating temp.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms Engine Mechanical
2	Verify that there is a chirping noise. Does the engine make the chirping noise?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt. Refer to <i>Drive Belt Replacement</i> . 2. Operate the engine for no longer than 30 to 40 seconds. Does the chirping noise still exist?	Go to Engine Noise Diagnosis	Go to Step 4
4	Inspect for severe pilling exceeding 1/3 of the belt groove depth. Does the belt grooves have pilling?	Go to Step 5	Go to Step 6
5	Clean the drive belt pulleys with a suitable wire brush. Did you complete the repair?	Go to Step 15	Go to Step 6
6	Inspect for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace or repair any misaligned pulleys. Did you complete the repair?	Go to Step 15	Go to Step 8
8	Inspect for bent or cracked brackets. Did you find any bent or cracked brackets?	Go to Step 9	Go to Step 10
9	Replace any bent or cracked brackets. Did you complete the repair?	Go to Step 15	Go to Step 10
10	Inspect for improper, loose or missing fasteners. Did you find the condition?	Go to Step 11	Go to Step 12
11	Tighten any loose fasteners. Replace any improper or missing fasteners. Refer to <i>Fastener Tightening Specifications</i> . Did you complete the repair?	Go to Step 15	Go to Step 12
12	Inspect for a bent pulley. Did you find the condition?	Go to Step 13	Go to Step 14
13	Replace the bent pulley. Did you complete the repair?	Go to Step 15	Go to Step 14
14	Replace the drive belt. Refer to <i>Drive Belt Replacement</i> . Did you complete the repair?	Go to Step 15	Go to Diagnostic Aids
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

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Fig. 19: Drive Belt Chirping Diagnosis
 Courtesy of GENERAL MOTORS CORP.

DRIVE BELT SQUEAL DIAGNOSIS

Diagnostic Aids

A loose or improper installation of a body component, a suspension component, or other items of the vehicle may cause the squeal noise.

If the noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. An overcharged A/C system, power steering system with a pinched hose or wrong fluid, or a generator failing are suggested items to inspect.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table
3. The noise may be an internal engine noise. Removing the drive belt and operating the engine for a brief period will verify the squeal noise is the drive belt(s) or an accessory drive component. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.
4. This test is to verify that an accessory drive component does not have a seized bearing. With the belt remove test the bearings in the accessory drive components for turning smoothly. Also test the accessory drive components with the engine operating by varying the load on the components to verify that the components operate properly.
5. This test is to verify that the drive belt tensioner operates properly. If the drive belt tensioner is not operating properly, proper belt tension may not be achieved to keep the drive belt from slipping which could cause a squeal noise.
6. This test is to verify that the drive belt(s) is not too long, which would prevent the drive belt tensioner from working properly. Also if an incorrect length drive belt was installed, it may not be routed properly and may be turning an accessory drive component in the wrong direction.
7. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misalign pulley using a straight edge in the pulley grooves across two or three pulleys. If a misalign pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.
8. This test is to verify that the pulleys are the correct diameter or width. Using a known good vehicle compare the pulley sizes.

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Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belt (this is unusual for a drive belt with multiple ribs) • The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle, or slipping on a seized pulley or a faulty accessory drive component.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to Drive Belt Replacement
2	Verify that there is a squeal noise. Does the engine make the squeal noise?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt(s). Refer to <i>Drive Belt Replacement</i> 2. Operate the engine for no longer than 30 to 40 seconds. Does the noise still exist?	Go to Drive Belt Replacement	Go to Step 4
4	Inspect for an accessory drive component seized bearing or a faulty accessory drive component. Did you find and correct the condition?	Go to Step 9	Go to Step 5
5	Test the drive belt tensioner for proper operation. Refer to <i>Drive Belt Tensioner Replacement</i> Did you find and correct the condition?	Go to Step 9	Go to Step 6
6	Inspect for the correct drive belt length. Refer to <i>Drive Belt Replacement</i> Did you find and correct the condition?	Go to Step 9	Go to Step 7
7	Inspect for misalignment of a pulley. Did you find and correct the condition?	Go to Step 9	Go to Step 8
8	Inspect for the correct pulley size. Did you find and correct the condition?	Go to Step 9	Go to Drive Belt Idler Pulley Replacement
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

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Fig. 20: Drive Belt Squeal Diagnosis
Courtesy of GENERAL MOTORS CORP.

DRIVE BELT WHINE DIAGNOSIS

Diagnostic Aids

The drive belt(s) will not cause the whine noise.

If the whine noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. Such items but not limited to may be an A/C system overcharged, the power steering system restricted or the wrong fluid, or the generator failing.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

3. This test is to verify that the noise is being caused by the drive belt(s) or the accessory drive components. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.

4. The inspection should include checking the drive belt tensioner and the drive belt idler pulley bearings. The drive belt(s) may have to be installed and the accessory drive components operated separately by varying their loads. Refer to the suspected accessory drive component for the proper inspection and

replacement procedure.

Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: A high pitched continuous noise that may be caused by an accessory drive component failed bearing.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to <i>Step 2</i>	Go to Symptoms Engine Mechanical
2	Verify that there is a whine noise. Does the engine make the whine noise?	Go to <i>Step 3</i>	Go to Diagnostic Aids
3	1. Remove the drive belt(s). Refer to <i>Drive Belt Replacement</i> . 2. Operate the engine for no longer than 30 to 40 seconds. Does the whine noise still exist?	Go to Engine Noise Diagnosis	Go to <i>Step 4</i>
4	Inspect for a failed accessory drive component bearing. Did you find and repair the condition?	Go to <i>Step 5</i>	Go to Diagnostic Aids
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	—

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Fig. 21: Drive Belt Whine Diagnosis
 Courtesy of GENERAL MOTORS CORP.

DRIVE BELT RUMBLING DIAGNOSIS

Diagnostic Aids

Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise. The drive belt(s) may have a condition that can not be seen or felt. Sometimes replacing the drive belt may be the only repair for the symptom.

If replacing the drive belt(s), completing the diagnostic table, and the noise is only heard when the drive belt(s) is installed, there might be an accessory drive component with a failure. Varying the load on the different accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.
3. This test is to verify that the drive belt(s) is causing the rumbling noise. Rumbling noise may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.
4. Inspecting the drive belt(s) is to ensure that it is not causing a the noise. Small cracks across the ribs of the drive belt will not cause the noise. Belt separation is identified by the plys of the belt separating and may be seen at the edge of the belt our felt as a lump in the belt.
5. Small amounts of pilling is normal condition and acceptable. When the pilling is severe the drive belt does not have a smooth surface for proper operation.

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Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: • A low pitch tapping, knocking, or thumping noise heard at or just above idle. • Heard once per revolution of the drive belt or a pulley. • Rumbling may be caused from: – Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belt pulley groove – The separation of the drive belt – A damaged drive belt			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms Engine Mechanical
2	Verify that there is a rumbling noise. Does the engine make the rumbling noise?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt(s). Refer to <i>Drive Belt Replacement</i> 2. Operate the engine for no longer than 30 to 40 seconds. Does the rumbling noise still exist?	Go to Engine Noise Diagnosis	Go to Step 4
4	Inspect the drive belt(s) for damage, separation, or sections of missing ribs. Did you find any of these conditions?	Go to Step 7	Go to Step 5
5	Inspect for severe pilling of more than 1/3 of the drive belt pulley grooves. Did you find severe pilling?	Go to Step 6	Go to Step 7
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall the drive belt. Refer to <i>Drive Belt Replacement</i> Did you complete the repair?	Go to Step 8	Go to Step 7
7	Install a new drive belt. Refer to <i>Drive Belt Replacement</i> Did you complete the replacement?	Go to Step 8	—
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Diagnostic Aids

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Fig. 22: Drive Belt Rumbling Diagnosis
Courtesy of GENERAL MOTORS CORP.

DRIVE BELT VIBRATION DIAGNOSIS

Diagnostic Aids

The accessory drive components can have an affect on engine vibration. Such as but not limited to the A/C system over charged, the power steering system restricted or the incorrect fluid, or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom such as the exhaust system, or the drivetrain.
3. This test is to verify that the drive belt(s) or accessory drive components may be causing the vibration. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belt removed.
4. The drive belt(s) may cause a vibration. While the drive belt(s) is removed this is the best time to

inspect the condition of the belt.

6. Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed.

8. This step should only be performed if the fan is driven by the drive belt. Inspect the engine cooling fan for bent, twisted, loose, or cracked blades. Inspect the fan clutch for smoothness, ease of turning. Inspect for a bent fan shaft or bent mounting flange.

9. This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smoothness and excessive play. Compare the water pump with a known good water pump.

10. Accessory drive component brackets that are bent, cracked, or loose may put extra strain on that accessory component causing it to vibrate.

Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms Engine Mechanical
2	Verify that the vibration is engine related. Does the engine make the vibration?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt. Refer to <i>Drive Belt Replacement</i> 2. Operate the engine for no longer than 30 to 40 seconds. Does the engine still make the vibration?	Go to Symptoms Engine Mechanical	Go to Step 4
4	Inspect the drive belt for wear, damage, debris build-up and missing drive belt ribs. Did you find any of these conditions?	Go to Step 5	Go to Step 6
5	Install a new drive belt. Refer to <i>Drive Belt Replacement</i> Did you complete the replacement?	Go to Step 11	Go to Step 6
6	Inspect for improper, loose or missing fasteners. Did you find any of these conditions?	Go to Step 7	Go to Step 8
7	1. Tighten any loose fasteners. 2. Replace improper or missing fasteners. Refer to <i>Fastener Tightening Specifications</i> . Did you complete the repair?	Go to Step 11	Go to Step 8
8	Inspect for damaged fan blades or bent fan clutch shaft, if the fan is belt driven. Refer to <i>Cooling Fan and Shroud Replacement</i> Did you find and correct the condition?	Go to Step 11	Go to Step 9
9	Inspect for a bent water pump shaft, if the water pump is belt driven. Refer to <i>Water Pump Replacement</i> . Did you find and correct the condition?	Go to Step 11	Go to Step 10
10	Inspect for bent or cracked brackets. Did you find and correct the condition?	Go to Step 11	Go to Diagnostic Aids
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

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Fig. 23: Drive Belt Vibration Diagnosis
 Courtesy of GENERAL MOTORS CORP.

DRIVE BELT FALLS OFF DIAGNOSIS

Diagnostic Aids

If the drive belt(s) repeatedly falls off the drive belt pulleys, this is because of pulley misalignment.

An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.

If the drive belt(s) is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

2. This inspection is to verify the condition of the drive belt. Damage may of occurred to the drive belt when the drive belt fell off. The drive belt may of been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing, or damaged belt plys.
4. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misalign pulley using a straight edge in the pulley grooves across two or three pulleys. If a misalign pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.
5. Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.
6. Accessory drive component brackets that are bent or cracked will let the drive belt fall off.
7. Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing, loose, or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.

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Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to <i>Step 2</i>	Go to Symptoms Engine Mechanical
2	Inspect for a damaged drive belt. Did you find the condition?	Go to <i>Step 3</i>	Go to <i>Step 4</i>
3	Install a new drive belt. Refer to <i>Drive Belt Replacement</i> . Does the drive belt continue to fall off?	Go to <i>Step 4</i>	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to <i>Step 12</i>	Go to <i>Step 5</i>
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to <i>Step 12</i>	Go to <i>Step 6</i>
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to <i>Step 12</i>	Go to <i>Step 7</i>
7	Inspect for improper, loose or missing fasteners. Did you find loose or missing fasteners?	Go to <i>Step 8</i>	Go to <i>Step 9</i>
8	1. Tighten any loose fasteners. 2. Replace improper or missing fasteners. Refer to <i>Fastener Tightening Specifications</i> . Does the drive belt continue to fall off?	Go to <i>Step 9</i>	System OK
9	Test the drive belt tensioner for operating correctly. Refer to <i>Drive Belt Tensioner Replacement</i> . Does the drive belt tensioner operate correctly?	Go to <i>Step 11</i>	Go to <i>Step 10</i>
10	Replace the drive belt tensioner. Refer to <i>Drive Belt Tensioner Replacement</i> . Does the drive belt continue to fall off?	Go to <i>Step 11</i>	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to <i>Step 12</i>	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <i>Step 2</i>

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Fig. 24: Drive Belt Falls Off Diagnosis
Courtesy of GENERAL MOTORS CORP.

DRIVE BELT EXCESSIVE WEAR DIAGNOSIS

Diagnostic Aids

Excessive wear on a drive belt(s) is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt(s) to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt(s) fall off.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

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2. The inspection is to verify the drive belt(s) is correctly installed on all of the drive belt pulleys. Wear on the drive belt(s) may be caused by mis-positioning the drive belt(s) by one groove on a pulley.
3. The installation of a drive belt that is two wide or two narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.
4. This inspection is to verify the drive belt(s) is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt(s) should not come in contact with an engine or a body component when snapping the throttle.

Step	Action	Yes	No
Notice: Refer to <i>(Belt Dressing Notice)</i> in Cautions and Notices. DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms Engine Mechanical
2	Inspect the drive belt(s) for the proper installation. Refer to <i>Drive Belt Replacement</i> . Did you find this condition?	Go to Step 5	Go to Step 3
3	Inspect for the proper drive belt. Did you find this condition?	Go to Step 5	Go to Step 4
4	Inspect for the drive belt rubbing against a bracket, hose, or wiring harness. Did you find and repair the condition?	Go to Step 6	Go to Diagnostic Aids
5	Replace the drive belt. Refer to <i>Drive Belt Replacement</i> . Did you complete the replacement?	Go to Step 6	—
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	—

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Fig. 25: Drive Belt Excessive Wear Diagnosis
Courtesy of GENERAL MOTORS CORP.

DRIVE BELT TENSIONER DIAGNOSIS

Inspection Procedure

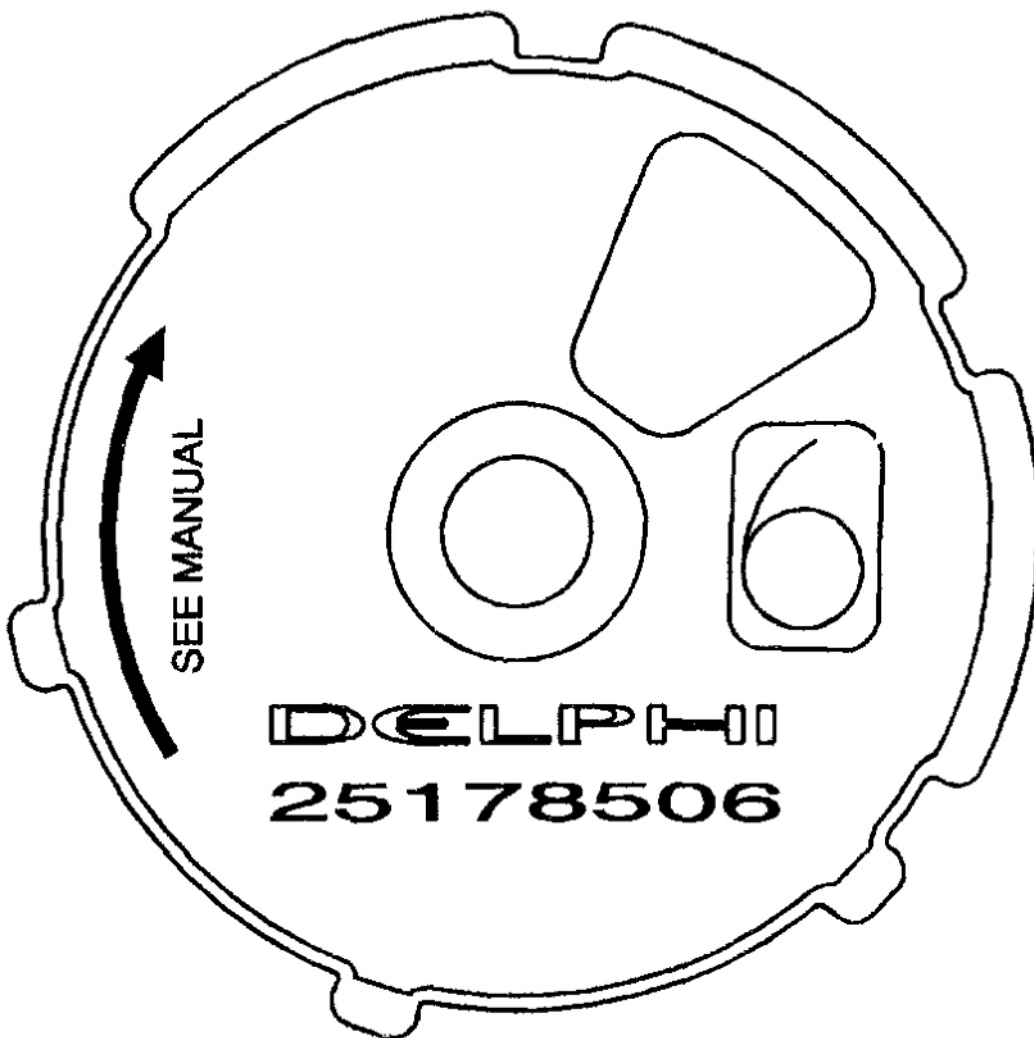
NOTE: Allowing the drive belt tensioner to snap into the free position may result in damage to the tensioner.

1. Remove the drive belts. Refer to **Drive Belt Replacement**.
2. Position a hex-head socket on the belt tensioner pulley bolt head.
3. Move the drive belt tensioner through it's full travel.
 - The movement should feel smooth.
 - There should be no binding.
 - The tensioner should return freely.
4. If any binding is observed, replace the tensioner. Refer to **Drive Belt Tensioner Replacement**.
5. Install the drive belt. Refer to **Drive Belt Replacement**.

CAMSHAFT POSITION (CMP) ACTUATOR DIAGNOSIS

The camshaft position actuator will only phase 25-cam degrees retard (counterclockwise). Full advance (clockwise) is 0 degrees. The arrow on the actuator shows advance direction.

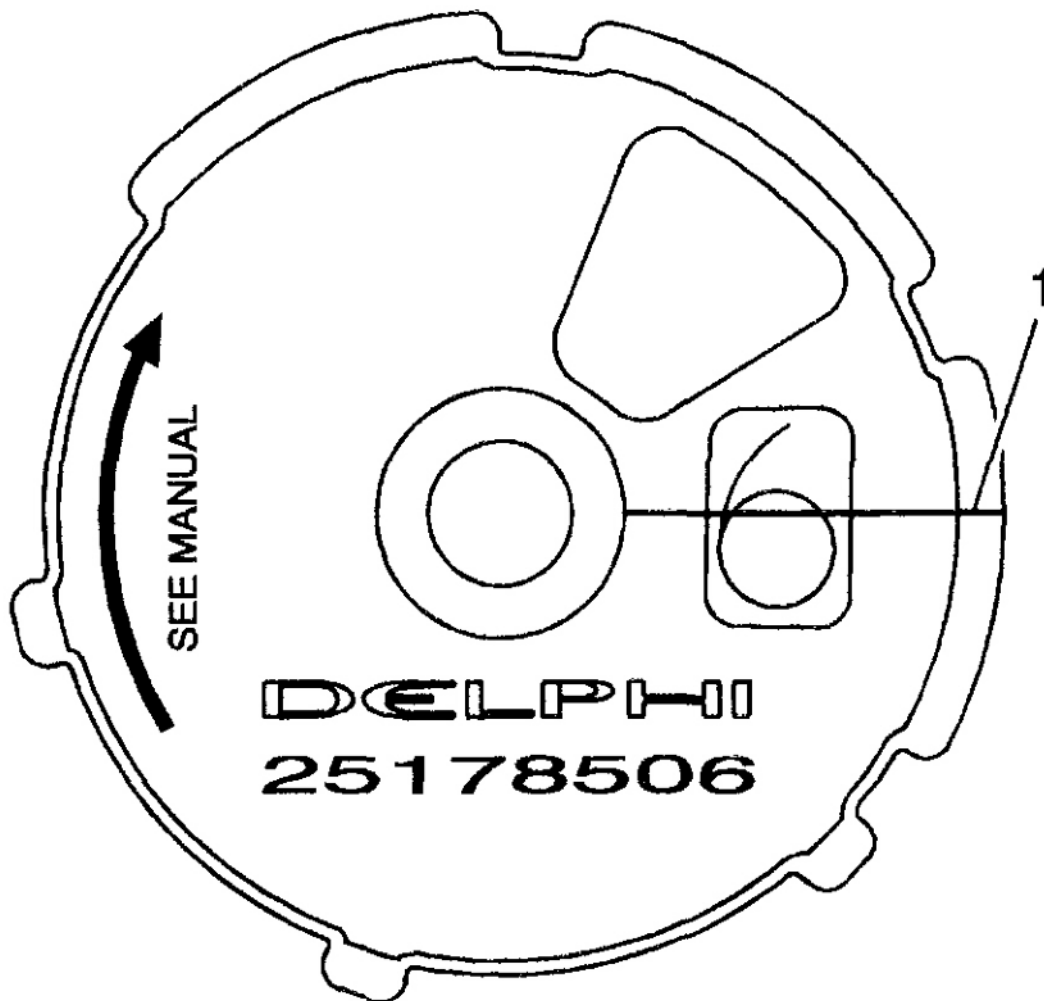
The camshaft position actuator should always be serviced/replaced in the full advanced position (full clockwise or 0 degrees). New replacement (service) camshaft position actuators are shipped at full advance or 0 degrees. To be sure the camshaft position actuator is performing properly, perform the following to help in the diagnostics.



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Fig. 26: Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

1. Use a 25 mm (1 in) wrench on the hex of the exhaust camshaft to rotate the exhaust camshaft and camshaft position actuator back and forth (clockwise and counterclockwise) to purge the oil out of the camshaft position actuator.
2. To perform an on-vehicle test, scribe or draw a line (1) on the camshaft position actuator, flush with the head, in the full advanced position. See arrow on the camshaft position actuator. With the engine at TDC on #1 cylinder, the wording should be level.

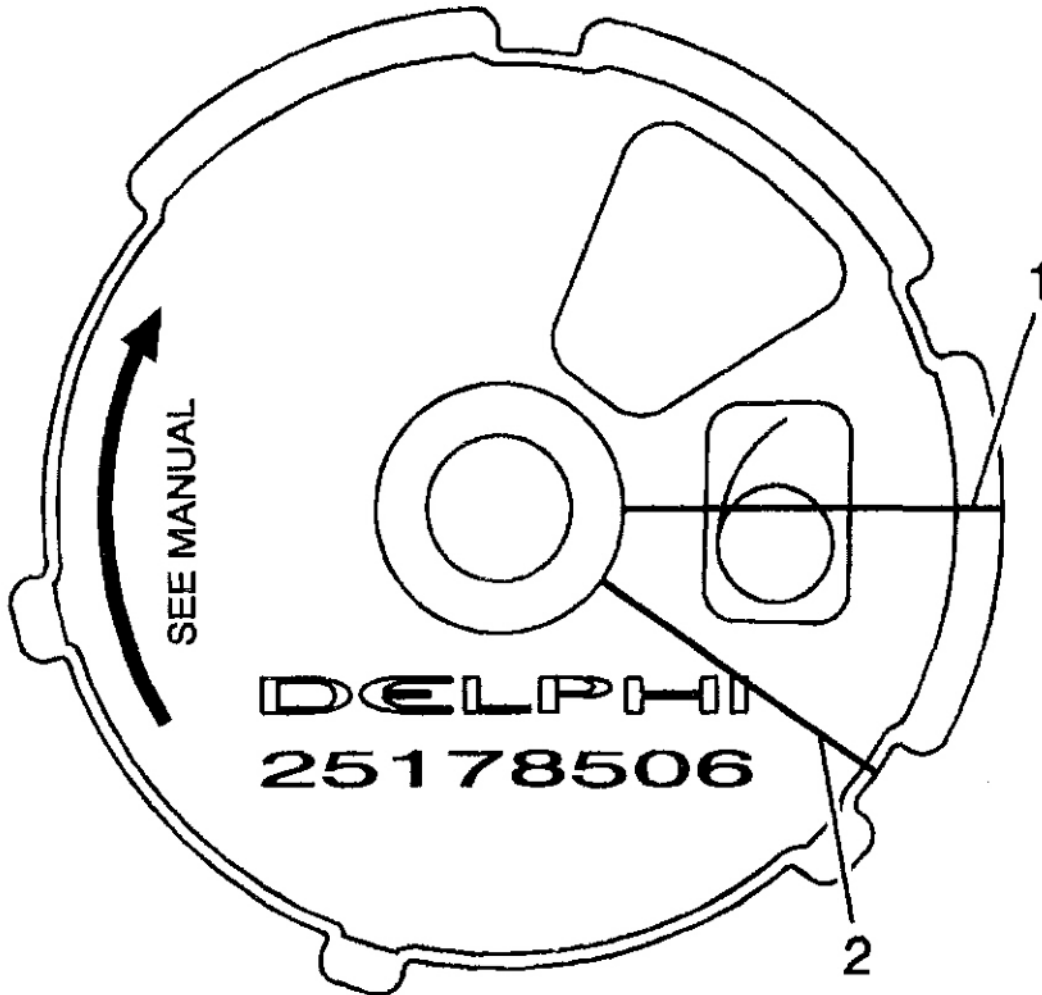


G01706200

Fig. 27: Scribing Or Drawing A Line Or Camshaft Position Actuator In Full Advanced Position
Courtesy of GENERAL MOTORS CORP.

3. Use a 25 mm (1 in) wrench on the hex of the exhaust camshaft to rotate the camshaft and camshaft position actuator counterclockwise to full retard.

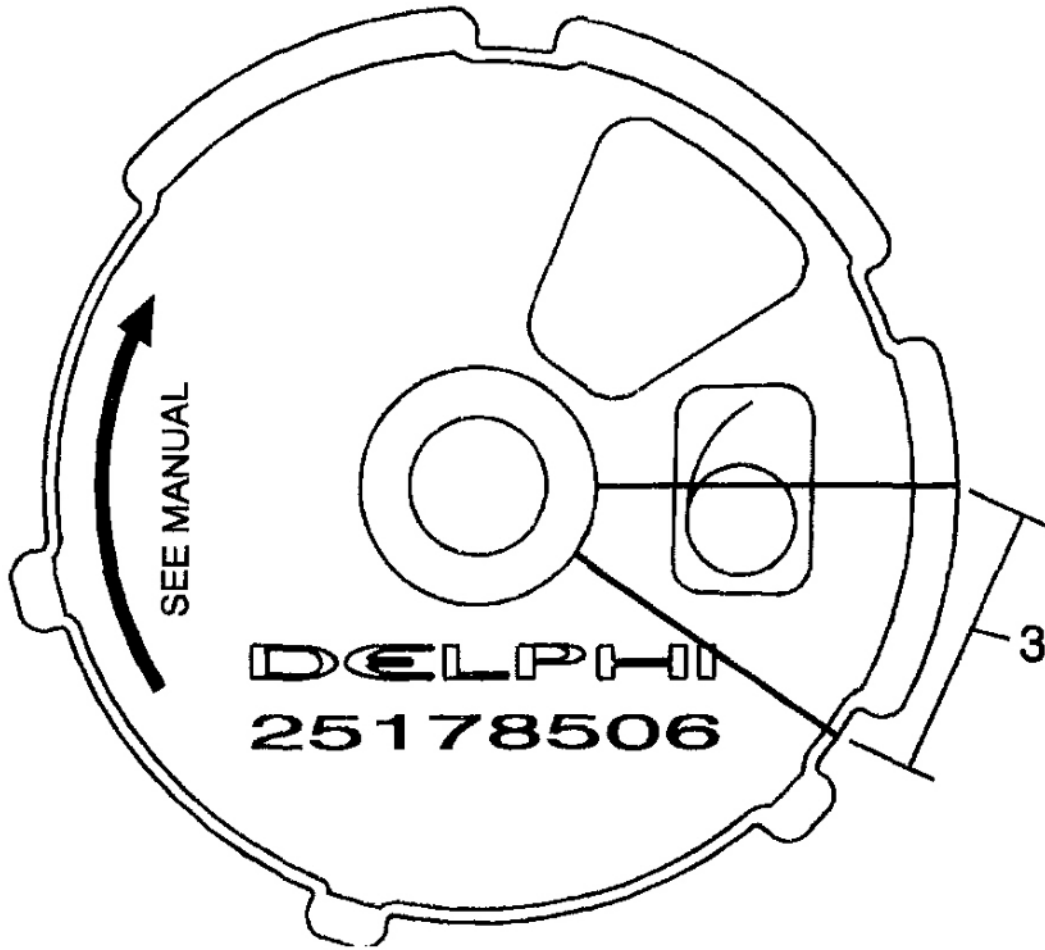
4. Scribe or draw a line (2) on the camshaft position actuator position.



G01706201

Fig. 28: Scribing Or Drawing A Line Or Camshaft Position Actuator Position
Courtesy of GENERAL MOTORS CORP.

5. Measure the distance between the two lines. The measurement (3) should be 14- 15 mm (0.55-0.59 in). If the measurement is far more or far less, the camshaft position actuator needs to be replaced.



G01706202

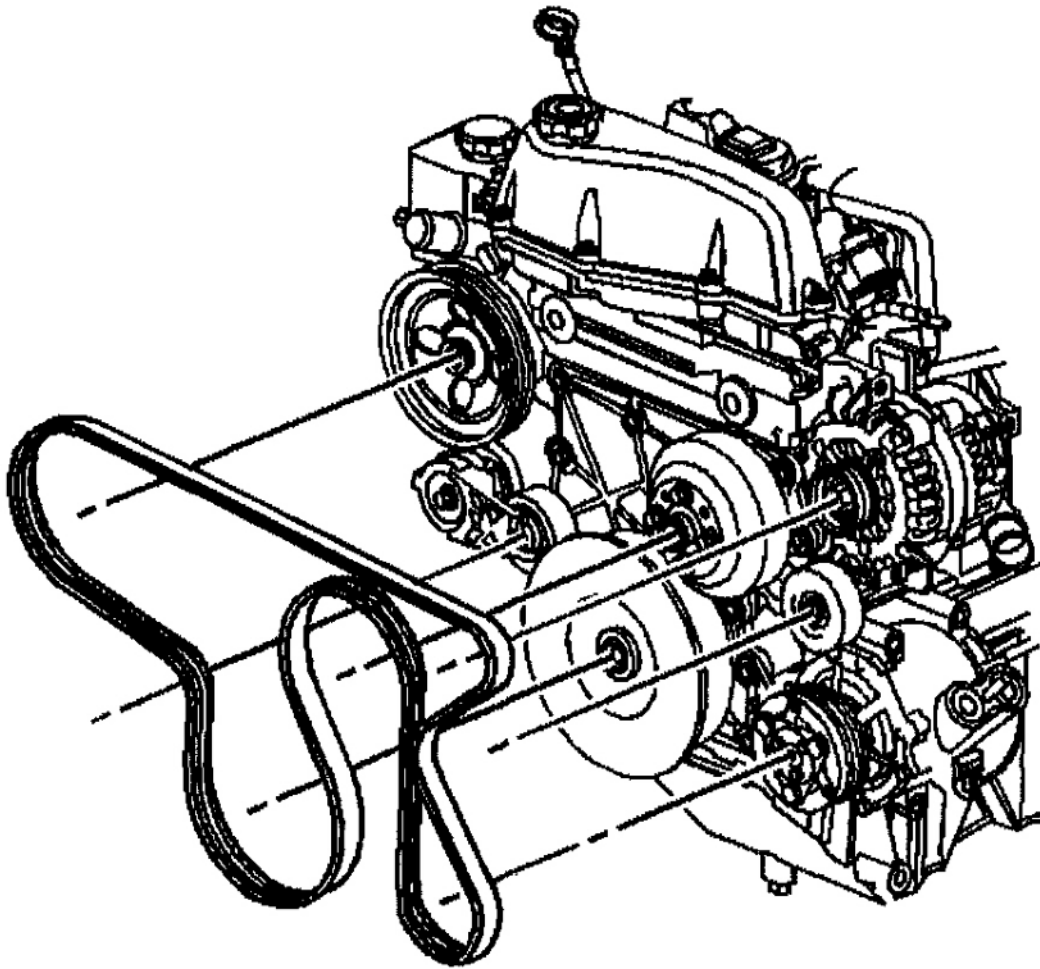
Fig. 29: Camshaft Position Actuator Measurement Between Two Scribed Lines
Courtesy of GENERAL MOTORS CORP.

REPAIR INSTRUCTIONS

DRIVE BELT REPLACEMENT

Removal Procedure

1. Install 3/8 inch breaker bar on the drive belt tensioner arm and turn the breaker bar clockwise enough to relieve the tension on the drive belt.
2. Remove the drive belt.



G01706203

Fig. 30: Removing Drive Belt
Courtesy of GENERAL MOTORS CORP.

3. Release the tension on the tensioner arm.

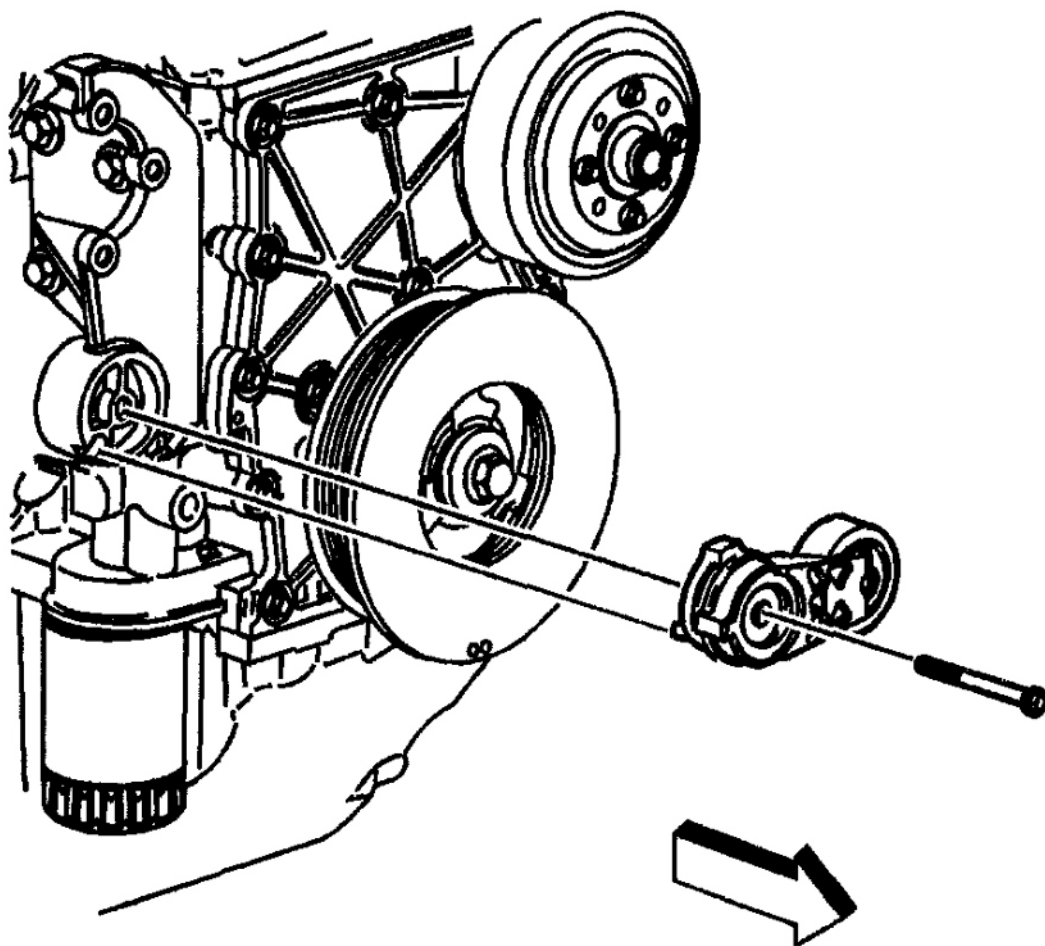
Installation Procedure

1. Route the drive belt over all the pulleys except the drive belt tensioner pulley.
2. Install the 3/8 inch breaker bar on the drive belt tensioner arm and turn the breaker bar clockwise.
3. Install the drive belt over the drive belt tensioner pulley.
4. Slowly release the tension to the drive belt tensioner arm.
5. Inspect for proper installation of the drive belt on the pulleys.

DRIVE BELT TENSIONER REPLACEMENT

Removal Procedure

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Inspect the drive belt. Change the drive belt as necessary.
3. Using a wrench loosen and remove the drive belt tensioner bolt.
4. Remove the drive belt tensioner.

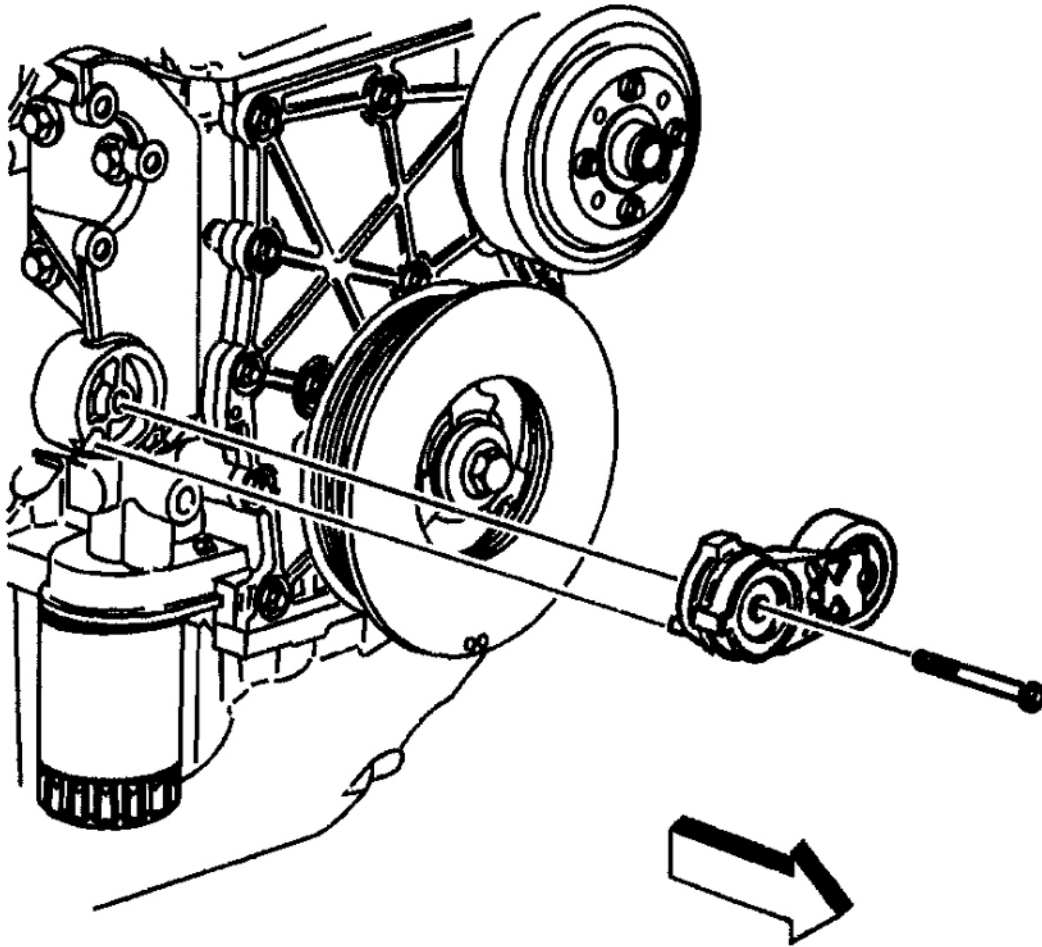


G01706204

Fig. 31: Removing Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the drive belt tensioner.



G01706205

Fig. 32: Installing Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

2. Install the drive belt tensioner bolt.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence

and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the drive belt tensioner bolt to 50 N.m (37 lb ft).

3. Install the drive belt **Drive Belt Replacement**.

DRIVE BELT IDLER PULLEY REPLACEMENT**Removal Procedure**

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the idler pulley bolt from the idler pulley bracket.
3. Remove idler pulley.

Installation Procedure

1. Install the idler pulley and secure the pulley with the bolt.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the idler pulley bolt to 50 N.m (37 lb ft).

2. Install the drive belt. Refer to **Drive Belt Replacement**.

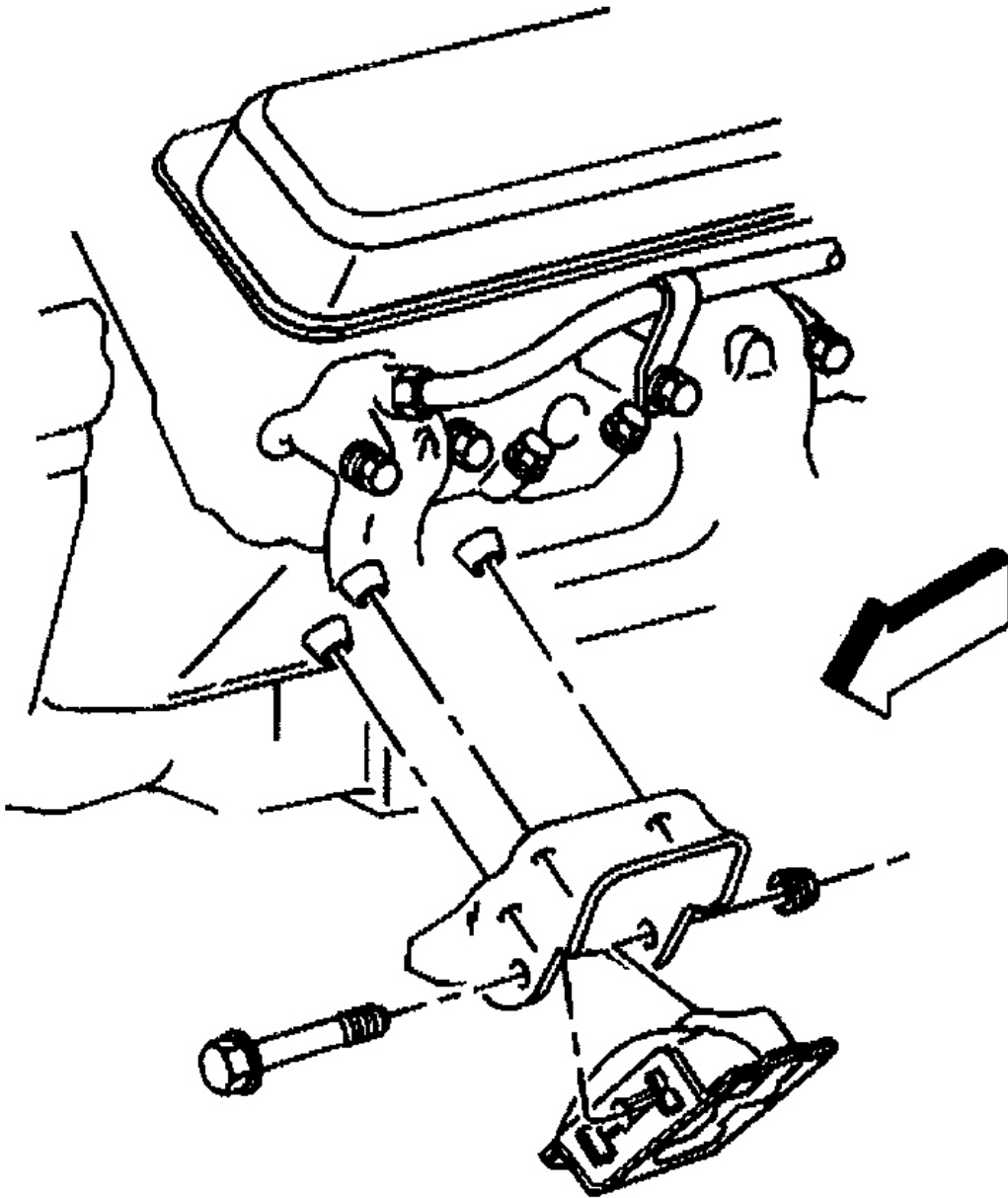
ENGINE MOUNT INSPECTION**Front Engine Mount**

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

NOTE: When raising or supporting the engine for any reason, do not use a jack under

the oil pan, any sheet metal, or the crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause the pan to be bent against the pump screen. This will result in a damaged oil pickup unit.

1. Raise the engine in order to remove the weight from the mount and to place a slight tension on the rubber cushion.
2. Use a jack on the square tab at the rear of the engine block. Observe both mounts while raising the engine.



G01706206

Fig. 33: Using A Jack On Square Tab At Rear Of Engine Block
Courtesy of GENERAL MOTORS CORP.

3. Replace the mount if any of the following conditions exist:
 - Hard rubber surface covered with heat check cracks
 - The rubber cushion separated from the metal plate of the mount

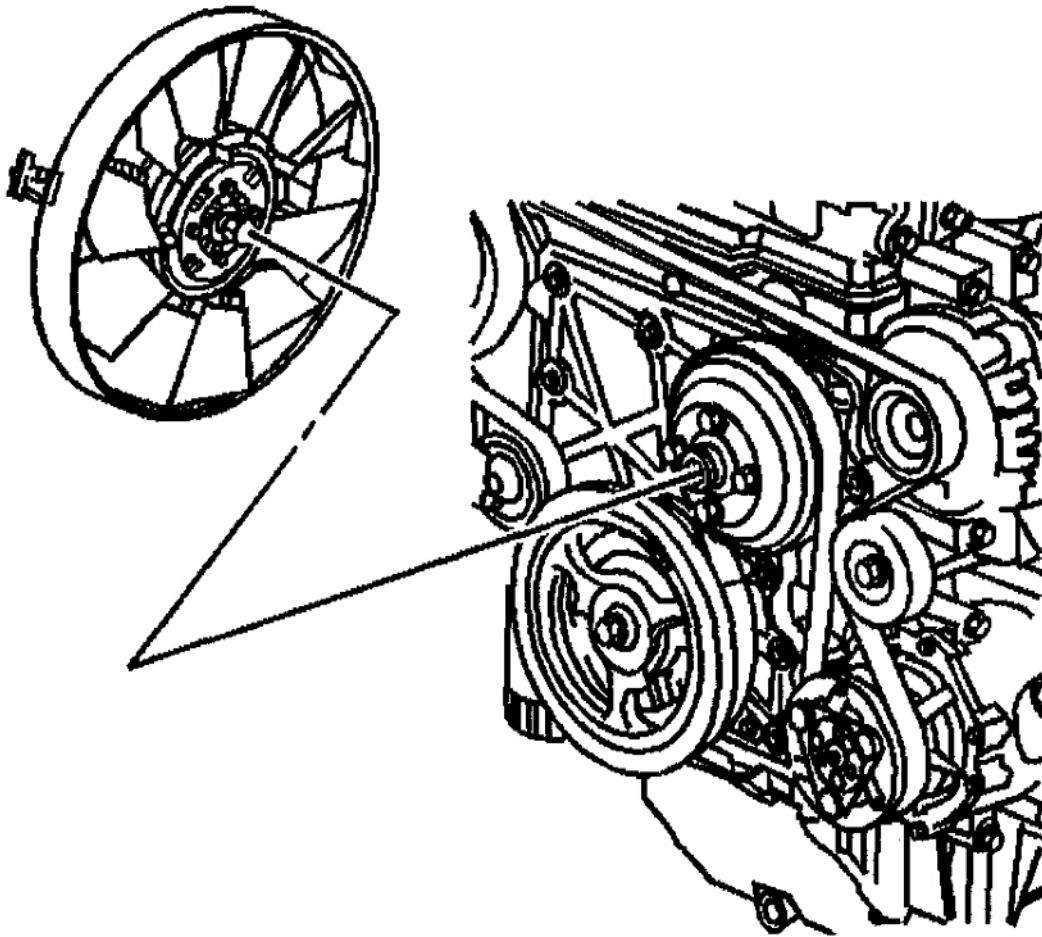
- The rubber cushion is split through the center
4. If there is movement between a metal plate of the mount and its attaching points, lower the engine and tighten the bolts or nuts attaching the mount to the engine, the frame or the bracket.

ENGINE MOUNT AND BRACKET REPLACEMENT - LEFT**Tools Required**

J 41240 Fan Clutch Remover and Installer

Removal Procedure

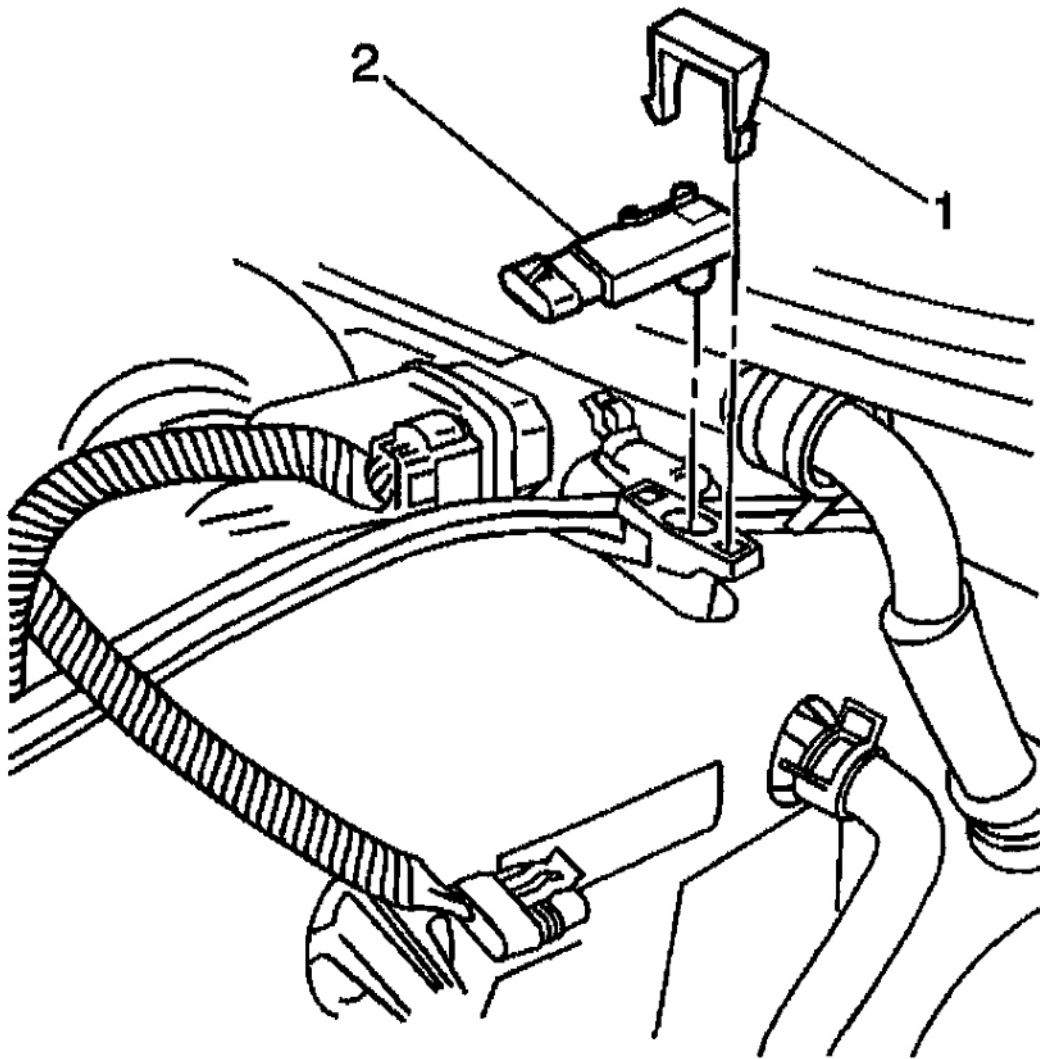
1. Disconnect the negative battery cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Electrical.
2. Using the J 41240 to secure the water pump pulley, loosen the cooling fan hub nut from the water pump shaft.



G01706207

Fig. 34: Loosening Cooling Fan Hub Nut From Water Pump Shaft
Courtesy of GENERAL MOTORS CORP.

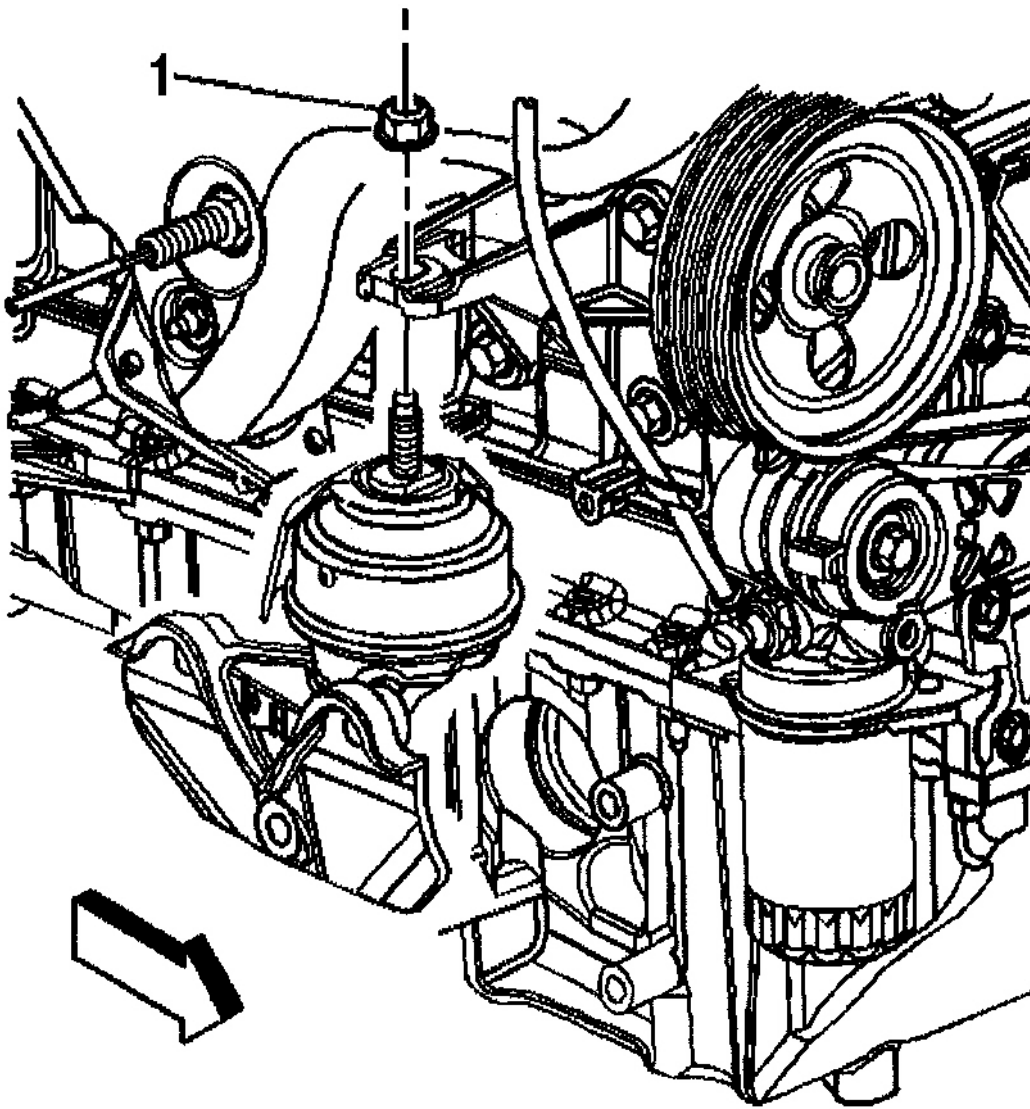
3. Remove the MAP sensor electrical connector and the retainer (1).



G01706208

Fig. 35: Removing MAP Sensor Electrical Connector And Retainer
 Courtesy of GENERAL MOTORS CORP.

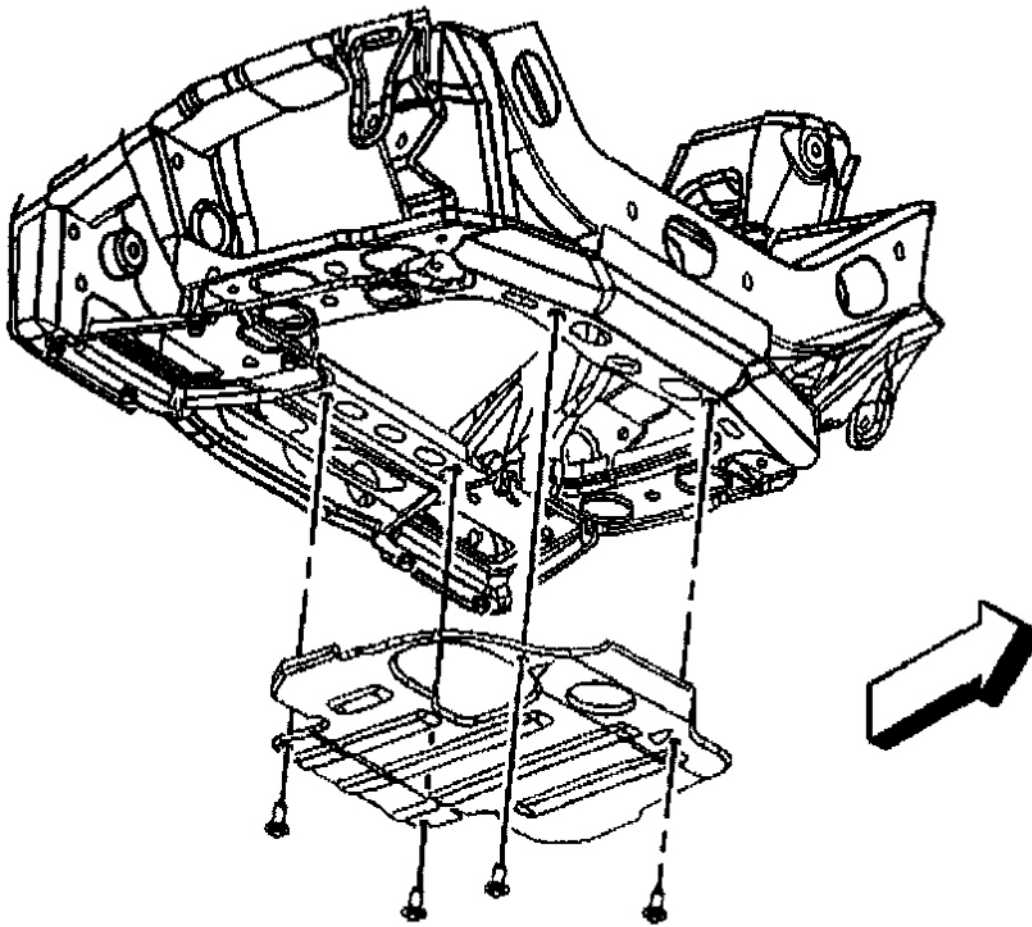
4. Remove the MAP sensor (2).
5. Remove the left shock module (if frame mount is being removed). Refer to Shock Module Replacement in Front Suspension.
6. Remove the right and the left upper engine mount nuts.



G01706209

Fig. 36: Removing Right And Left Upper Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

7. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
8. Remove the right and the left lower engine mount nuts.
9. Remove the engine protection shield mount bolts.



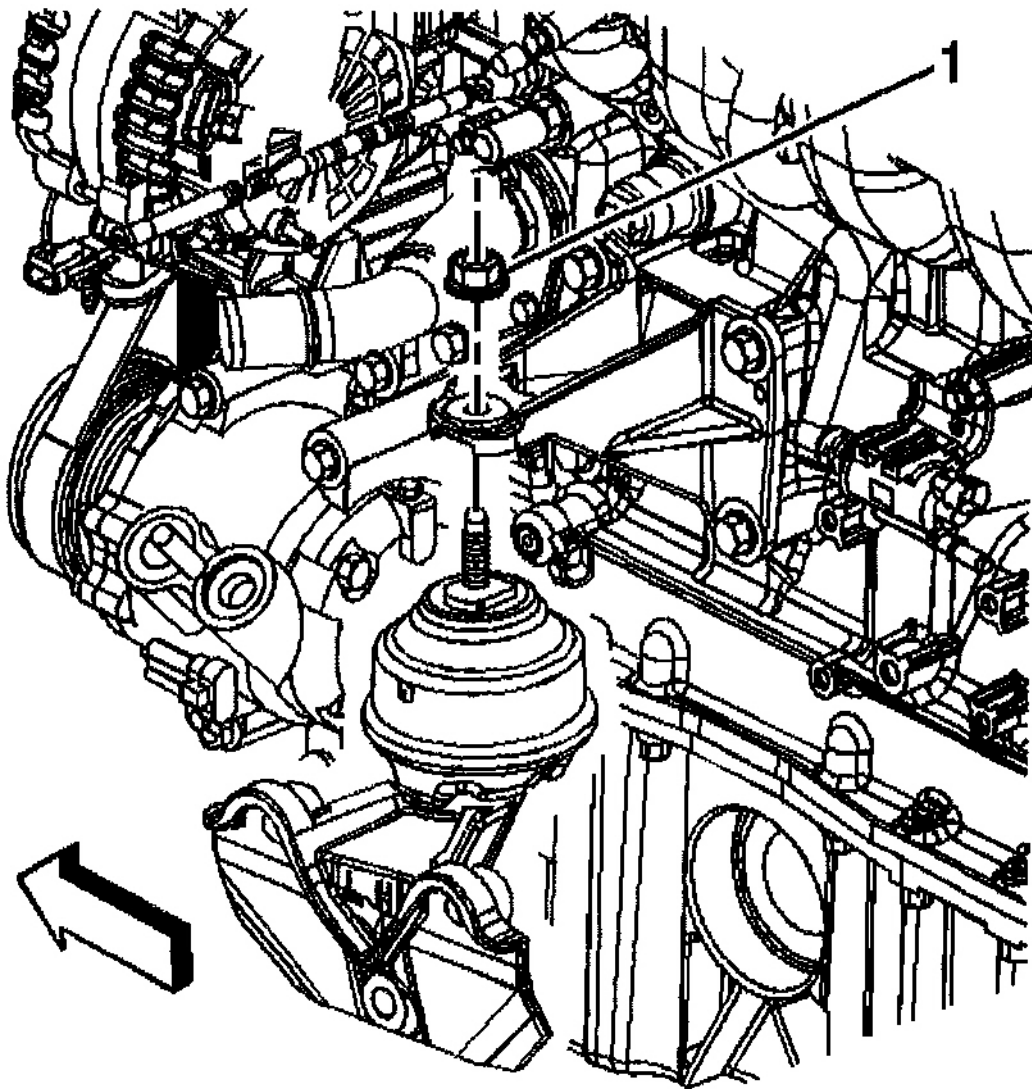
G01706210

Fig. 37: Removing Engine Protection Shield Mount Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the engine protection shield.

IMPORTANT: When placing jack onto the oil pan, pay close attention to not damage the oil level sender.

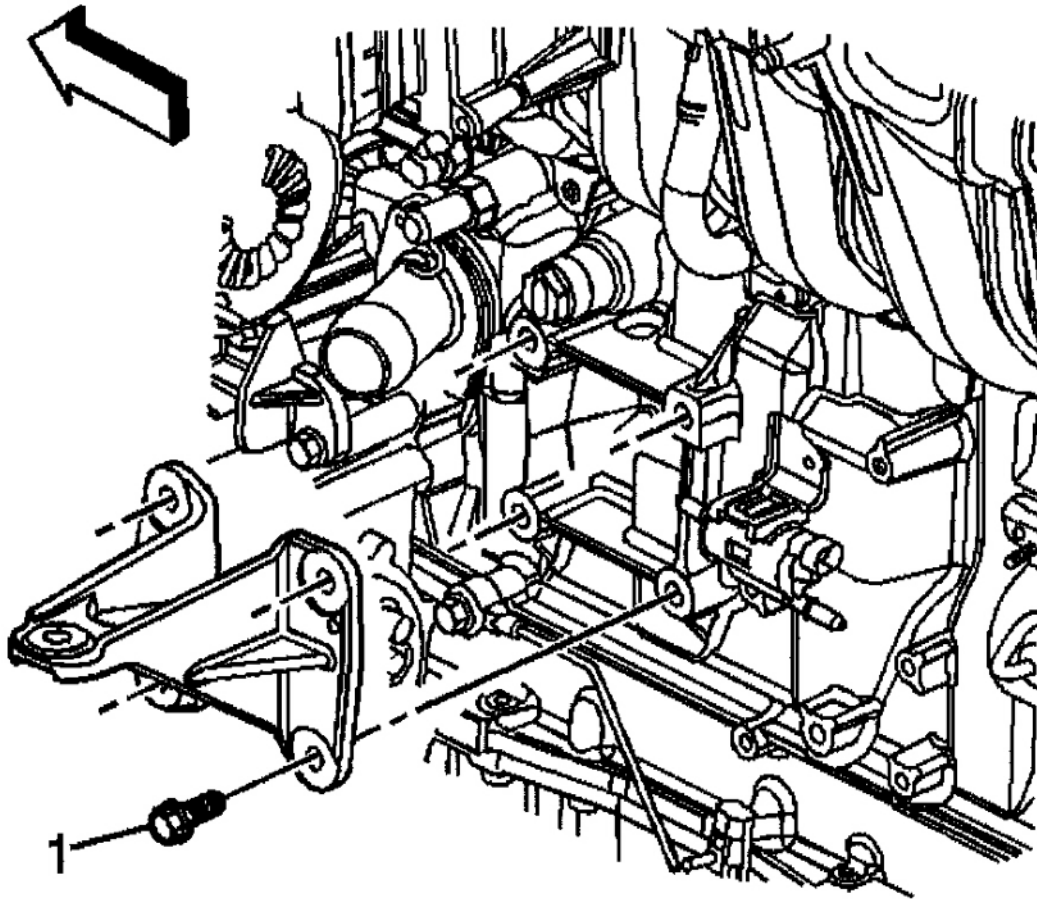
11. Lower the vehicle and place a floor jack under the oil pan with a block of wood.
12. Raise the engine with the jack just enough to clear the engine mount studs.
13. Remove the left engine mount from the bracket.



G01706211

Fig. 38: Removing Left Engine Mount From Bracket
Courtesy of GENERAL MOTORS CORP.

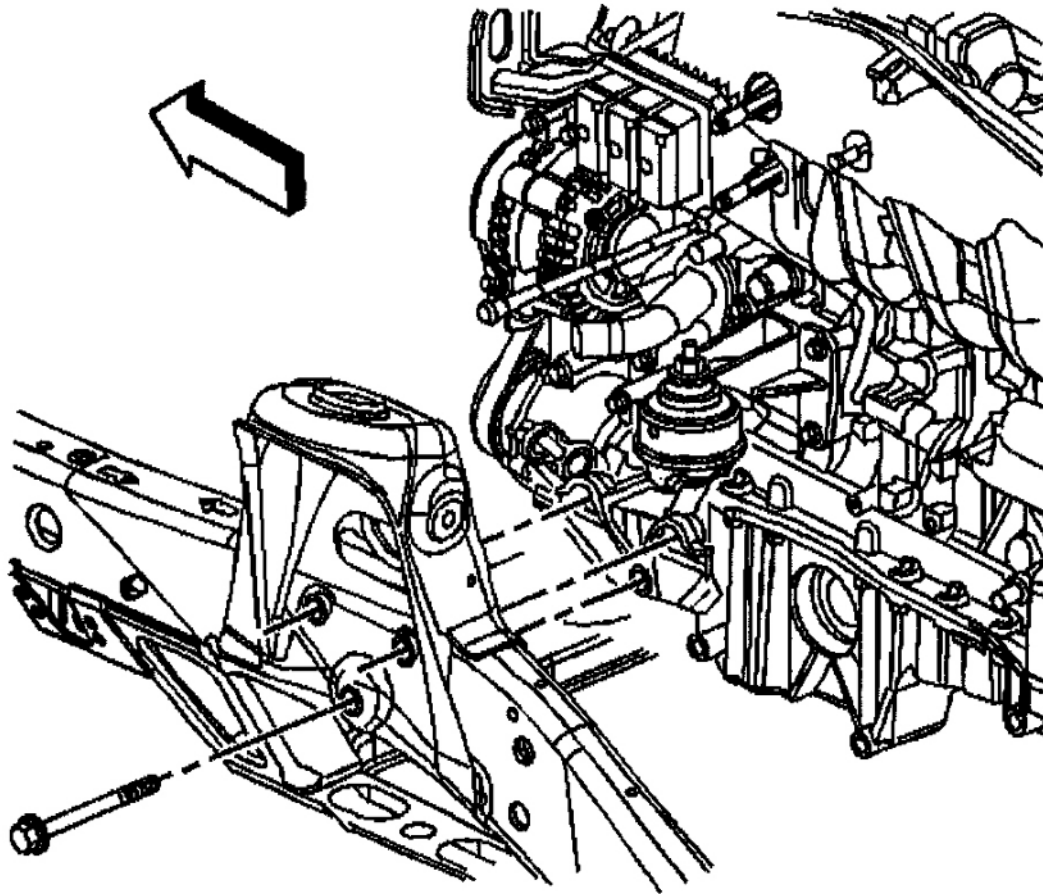
14. Remove the left engine mount bracket bolts.



G01706212

Fig. 39: Removing Left Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the left engine mount bracket.
16. Remove the left frame engine mount bracket bolts, if required.



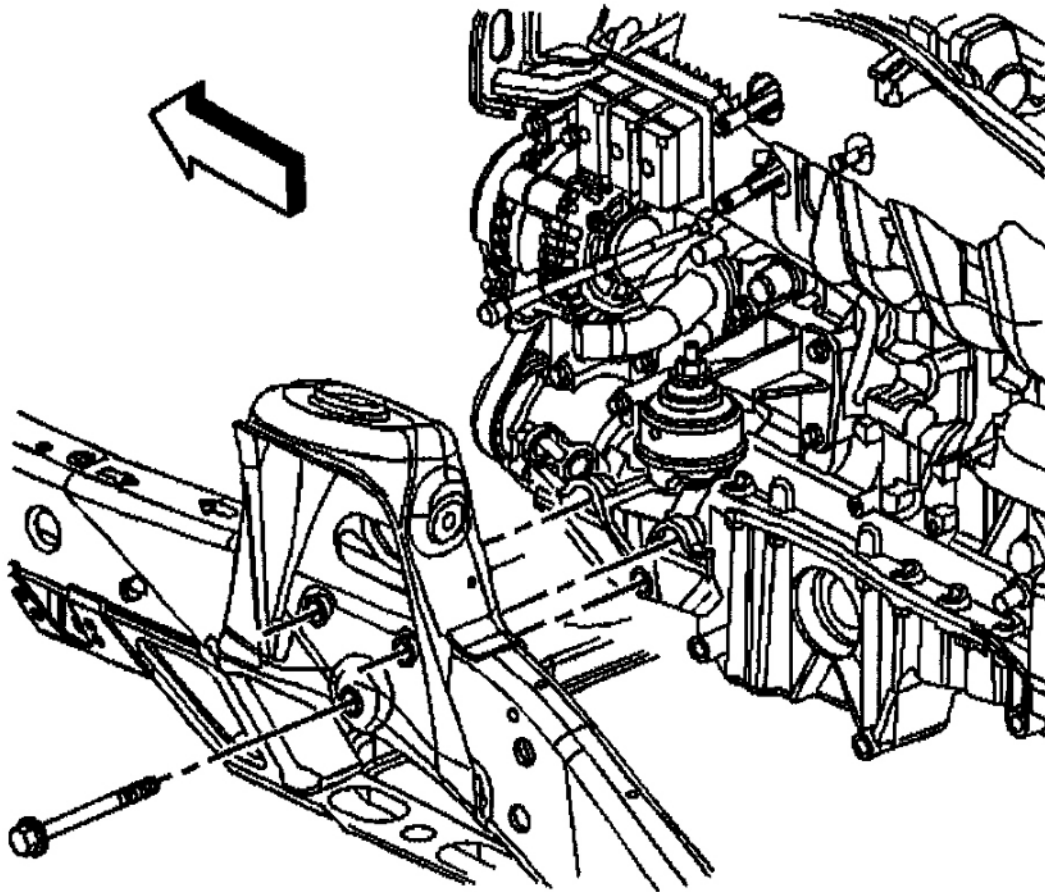
G01706213

Fig. 40: Removing Left Frame Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the left frame engine mount bracket, if required.

Installation Procedure

1. Install the left frame engine mount bracket, if removed.



G01706214

Fig. 41: Installing Left Frame Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

2. Install the left frame engine mount bracket bolts, if removed.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

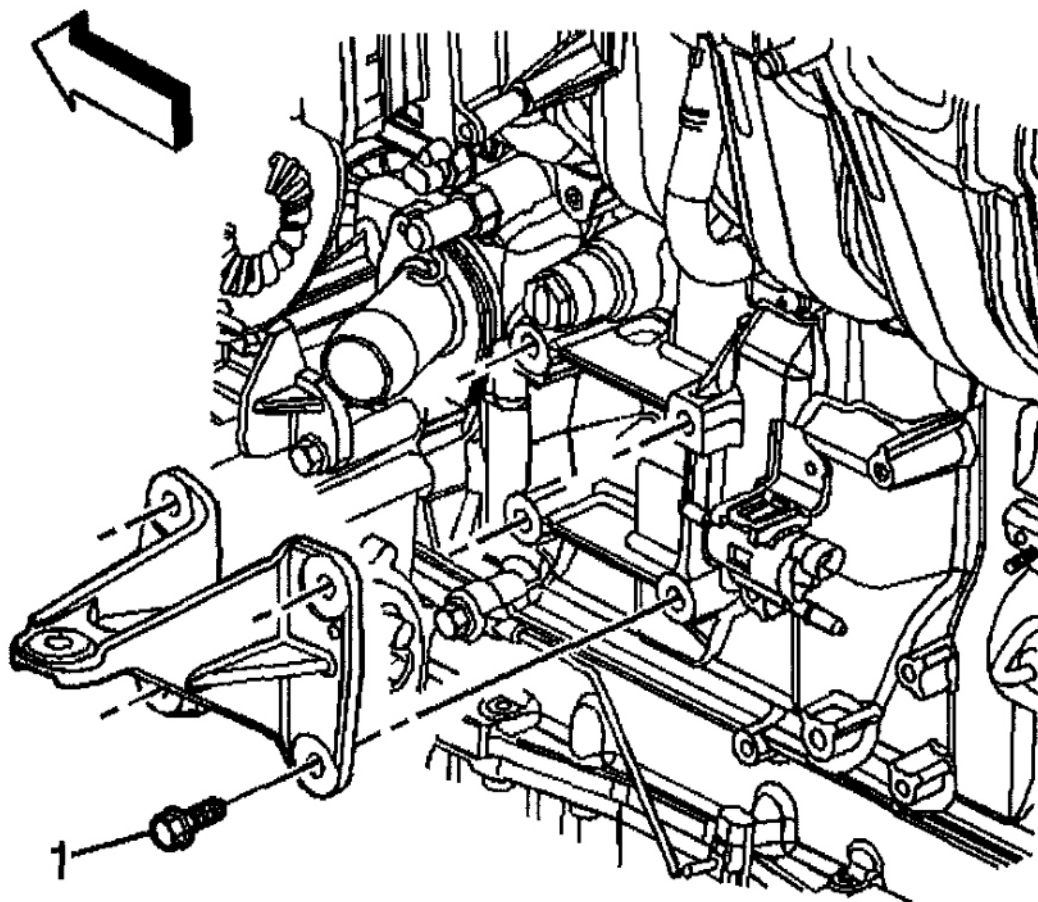
Tighten

Tighten the mount bracket bolts to 110 N.m (81 lb ft).

3. Install the left engine mount bracket and secure the bracket with the bolts (1).

Tighten

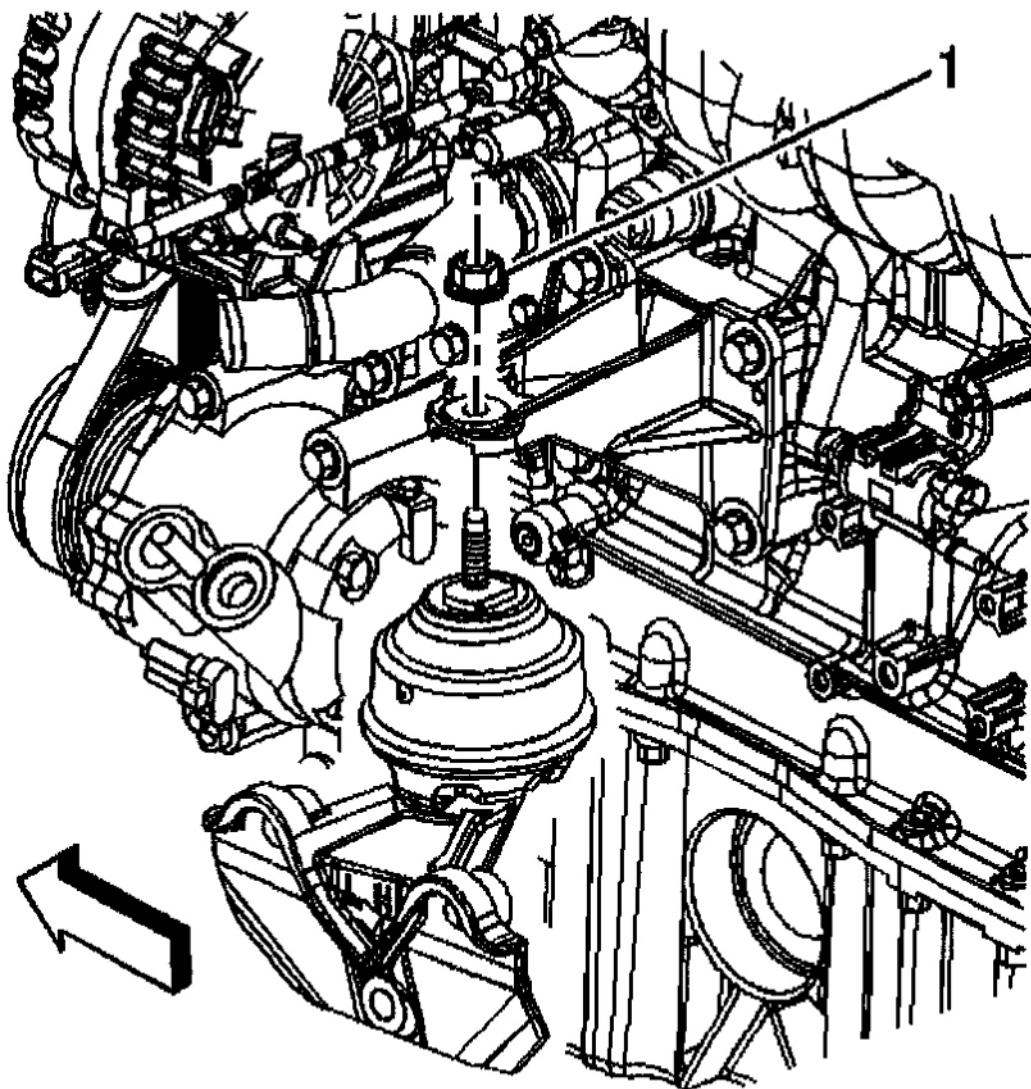
Tighten the engine mount bracket bolts to 50 N.m (37 lb ft).



G01706215

Fig. 42: Installing Left Engine Mount Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the left engine mount onto the bracket.



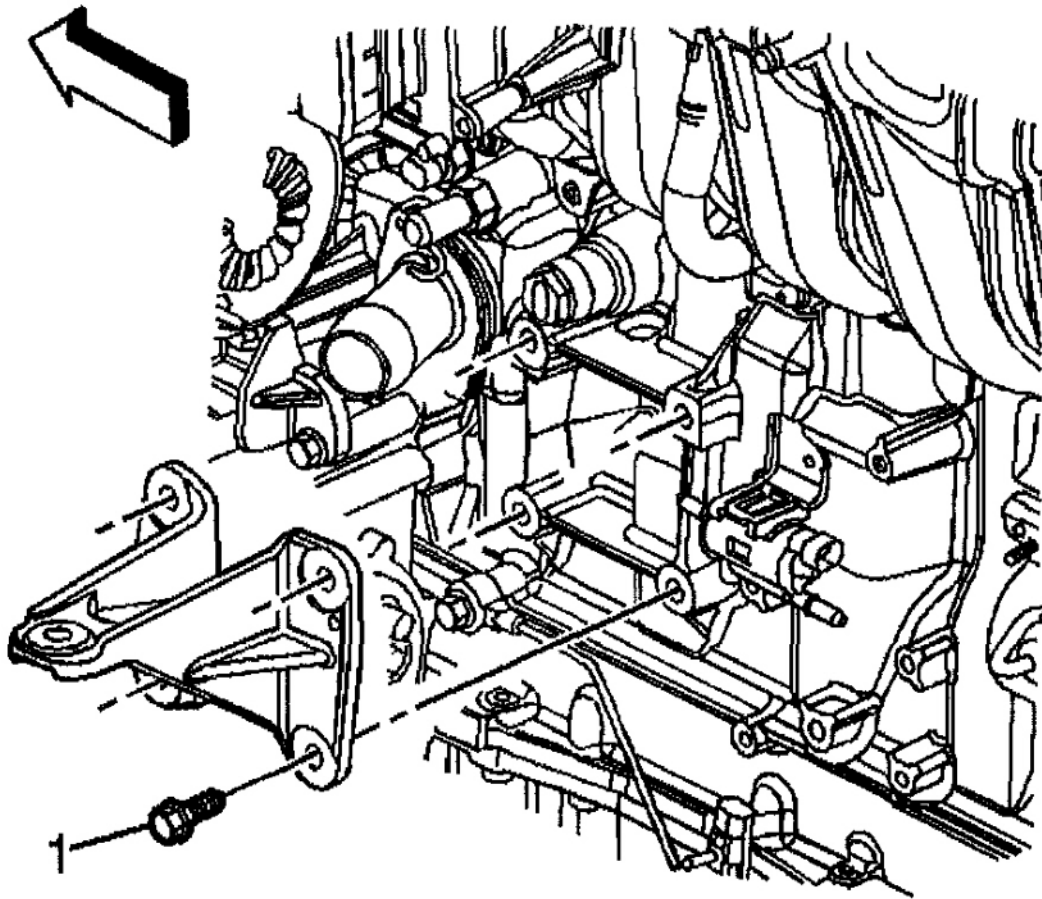
G01706216

Fig. 43: Installing Left Engine Mount Onto Bracket
Courtesy of GENERAL MOTORS CORP.

5. Lower the engine onto the engine mounts.
6. Install the right and the left upper engine mount nuts.

Tighten

Tighten the upper engine mount nuts to 70 N.m (52 lb ft).



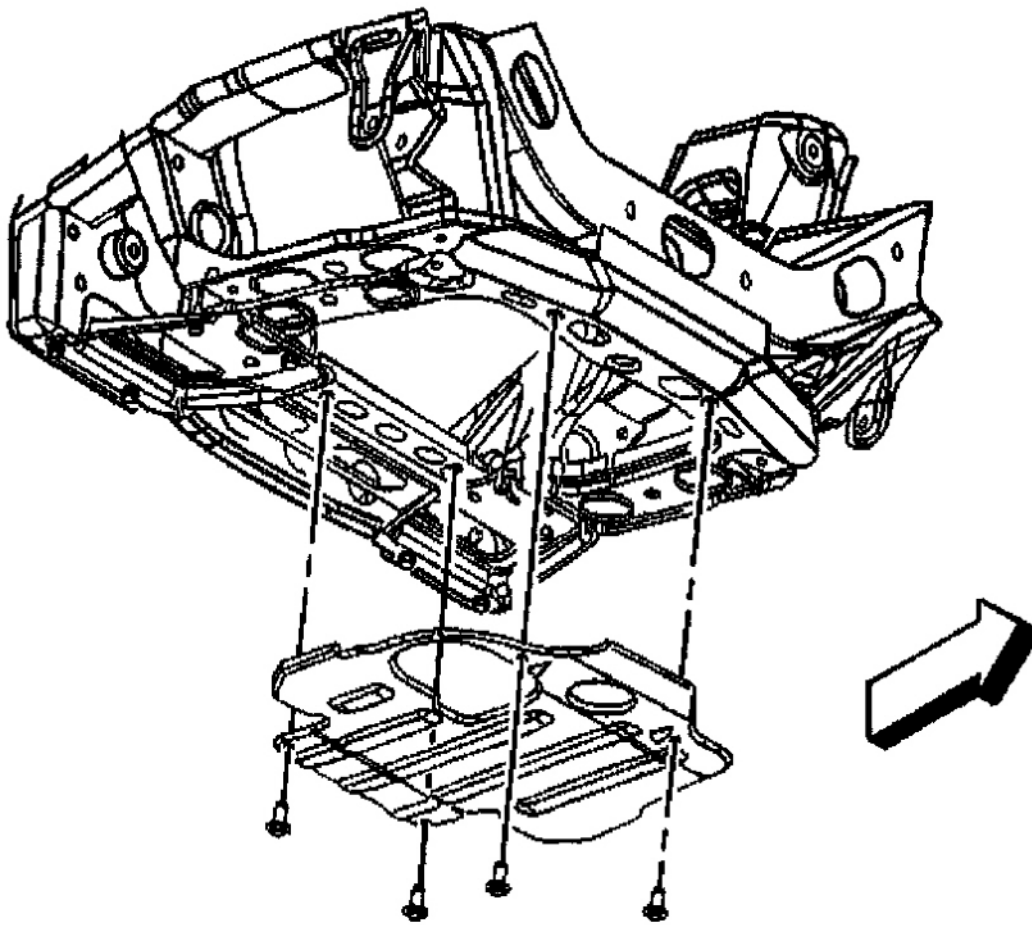
G01706217

Fig. 44: Installing Right And Left Upper Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

7. Raise the vehicle and remove the jack from under the vehicle.
8. Install the engine protection shield and secure the shield with the bolts.

Tighten

Tighten the engine protection shield bolts to 25 N.m (18 lb ft).



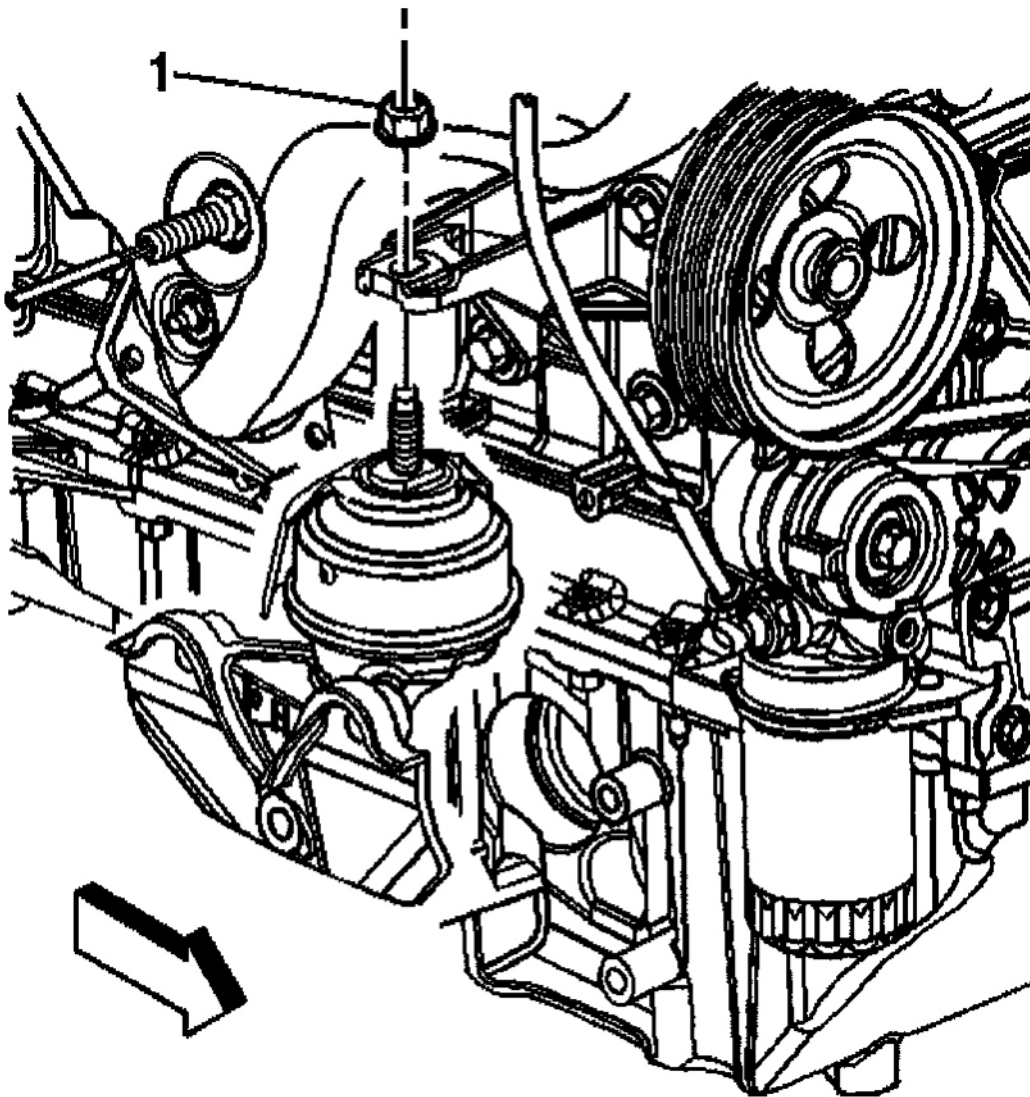
G01706218

Fig. 45: Installing Engine Protection Shield
Courtesy of GENERAL MOTORS CORP.

9. Install the right and the left lower engine mount nuts.

Tighten

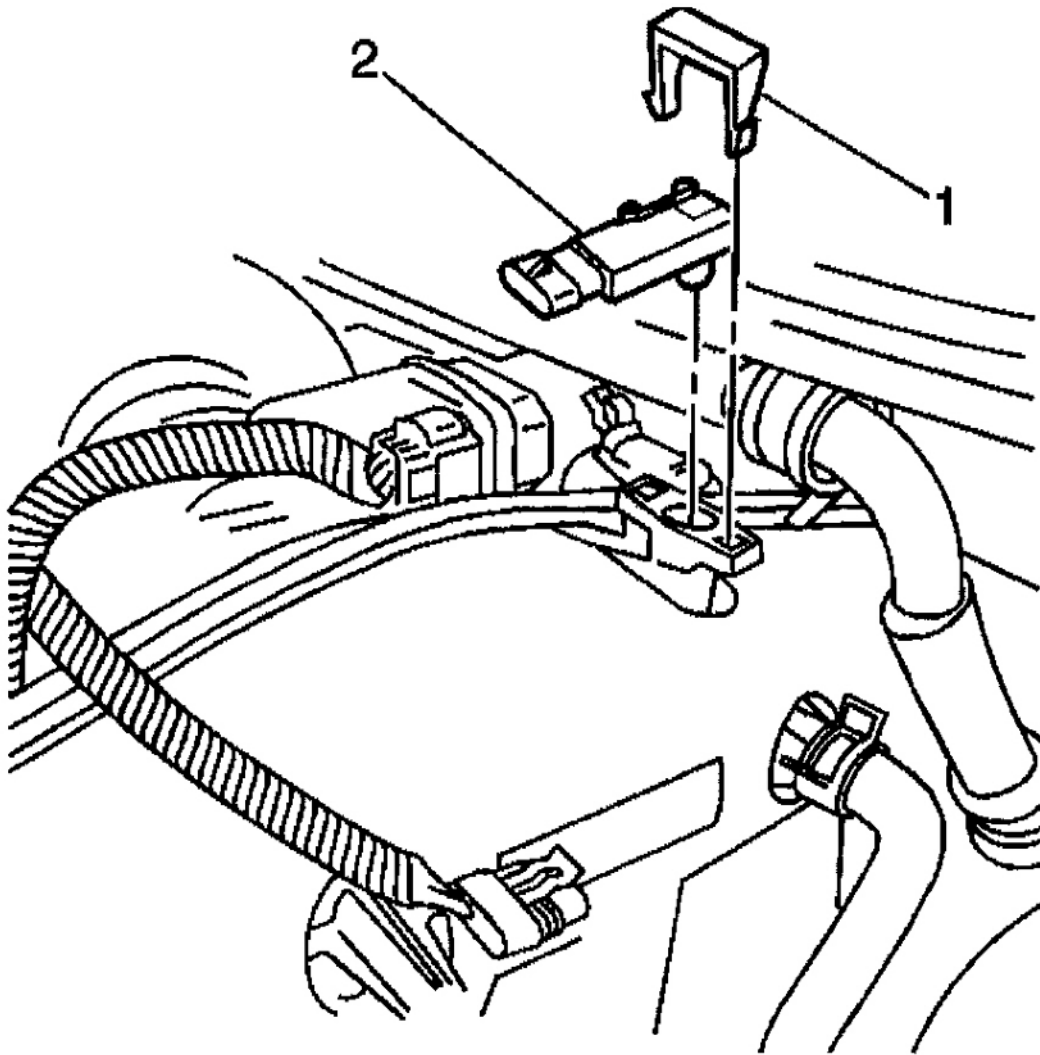
Torque the lower engine mount nuts to 70 N.m (52 lb ft).



G01706219

Fig. 46: Installing Right And Left Lower Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

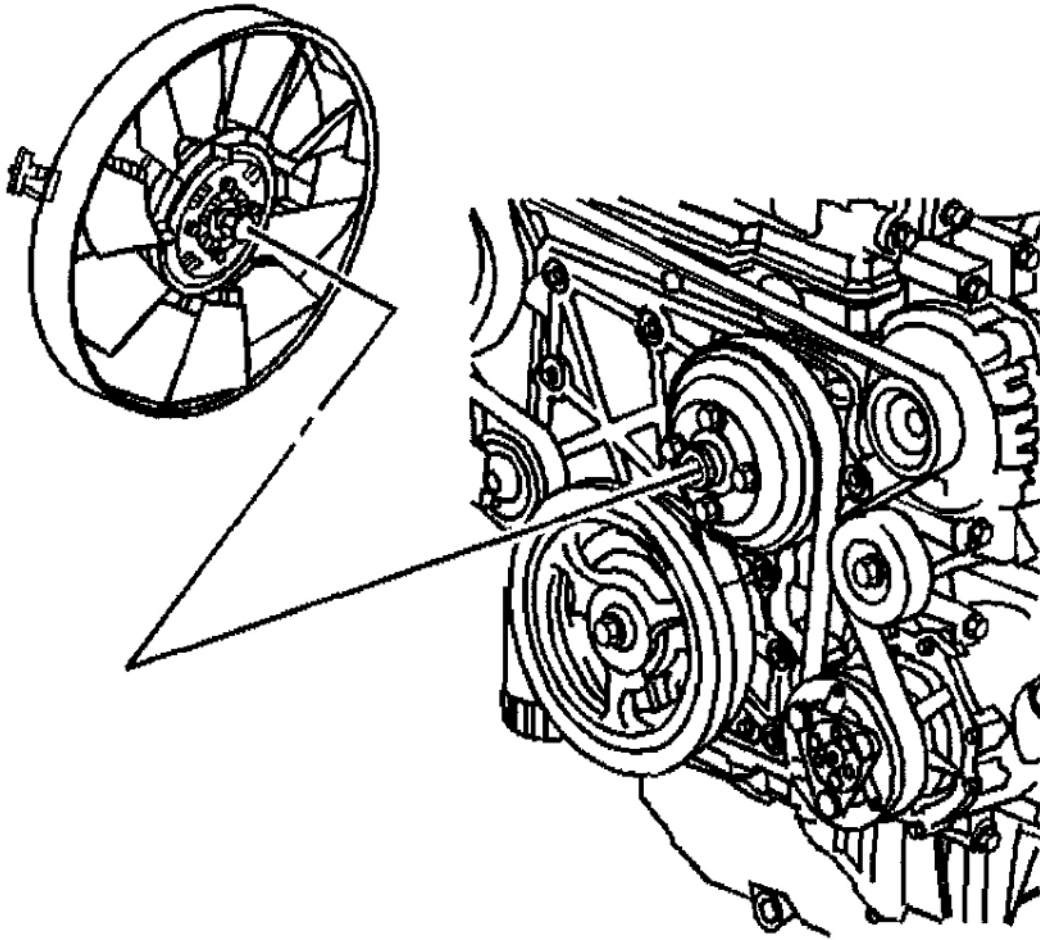
10. Lower the vehicle.
11. Install the left shock module. Refer to Shock Module Replacement in Front Suspension.
12. Install the MAP sensor (2).



G01706220

Fig. 47: Installing MAP Sensor
Courtesy of GENERAL MOTORS CORP.

13. Install the MAP sensor retainer (1) and the electrical connector.
14. Connect the cooling fan hub nut to the water pump shaft.



G01706221

Fig. 48: Connecting Cooling Fan Hub Nut To Water Pump Shaft
Courtesy of GENERAL MOTORS CORP.

15. Install the J 41240 to the water pump pulley and tighten the cooling fan hub nut.

Tighten

Tighten the hub nut to 56 N.m (41 lb ft).

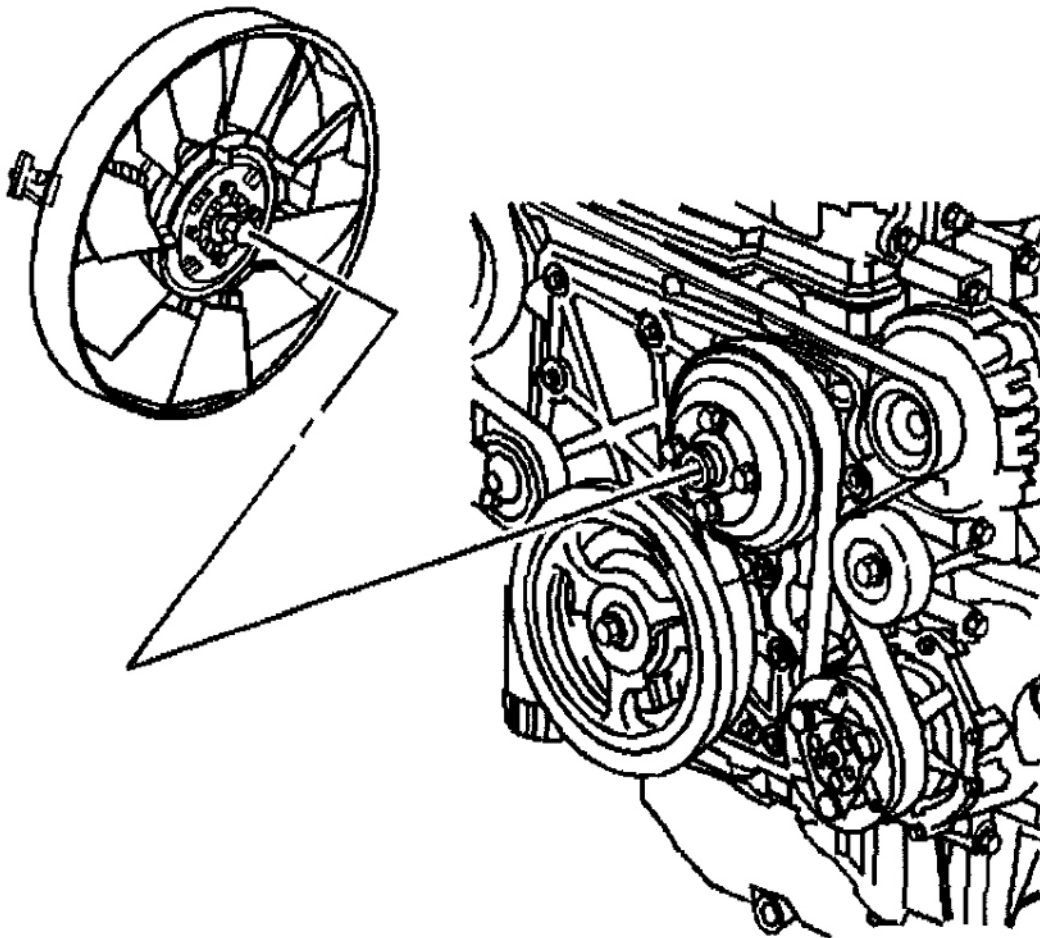
16. Connect the battery negative cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Engine Electrical.

ENGINE MOUNT AND BRACKET REPLACEMENT - RIGHT

Tools Required

J 41240 Fan Clutch Remover and Installer**Removal Procedure**

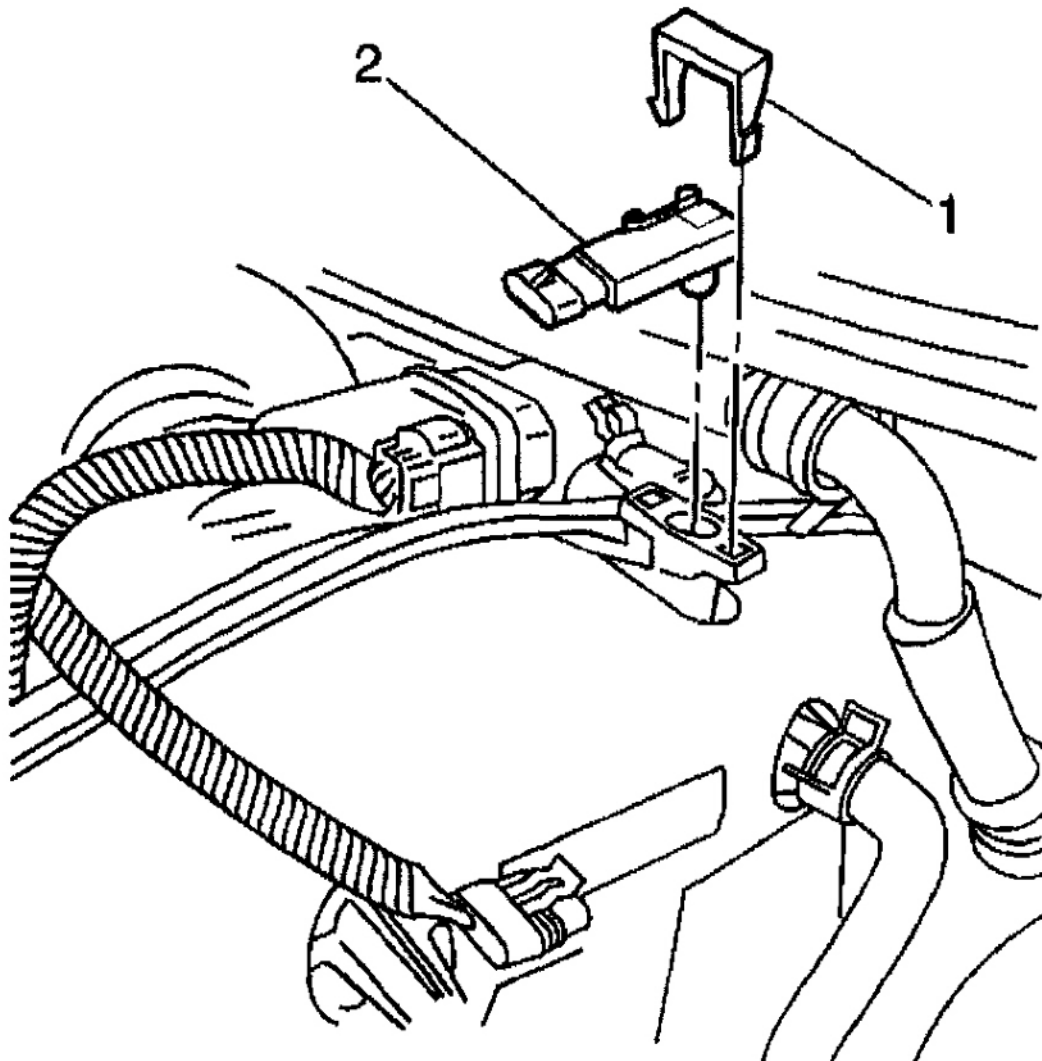
1. Disconnect the battery negative cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Engine Electrical.
2. Using the J 41240 to secure the water pump pulley. Loosen the cooling fan hub nut from the water pump shaft.



G01706222

Fig. 49: Loosening Cooling Fan Hub Nut From Water Pump Shaft
Courtesy of GENERAL MOTORS CORP.

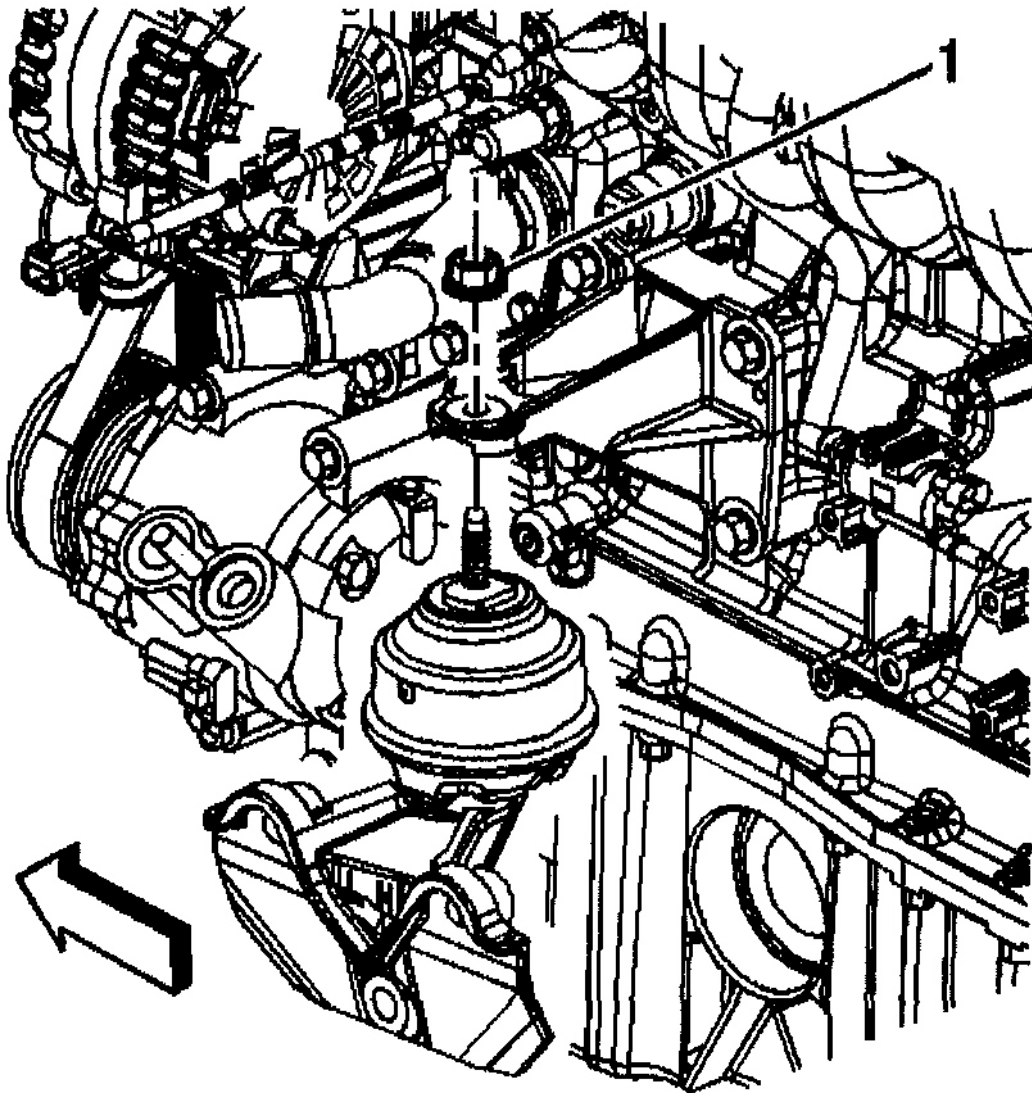
3. Remove the MAP sensor electrical connector and retainer (1).



G01706223

Fig. 50: Removing MAP Sensor Electrical Connector And Retainer
 Courtesy of GENERAL MOTORS CORP.

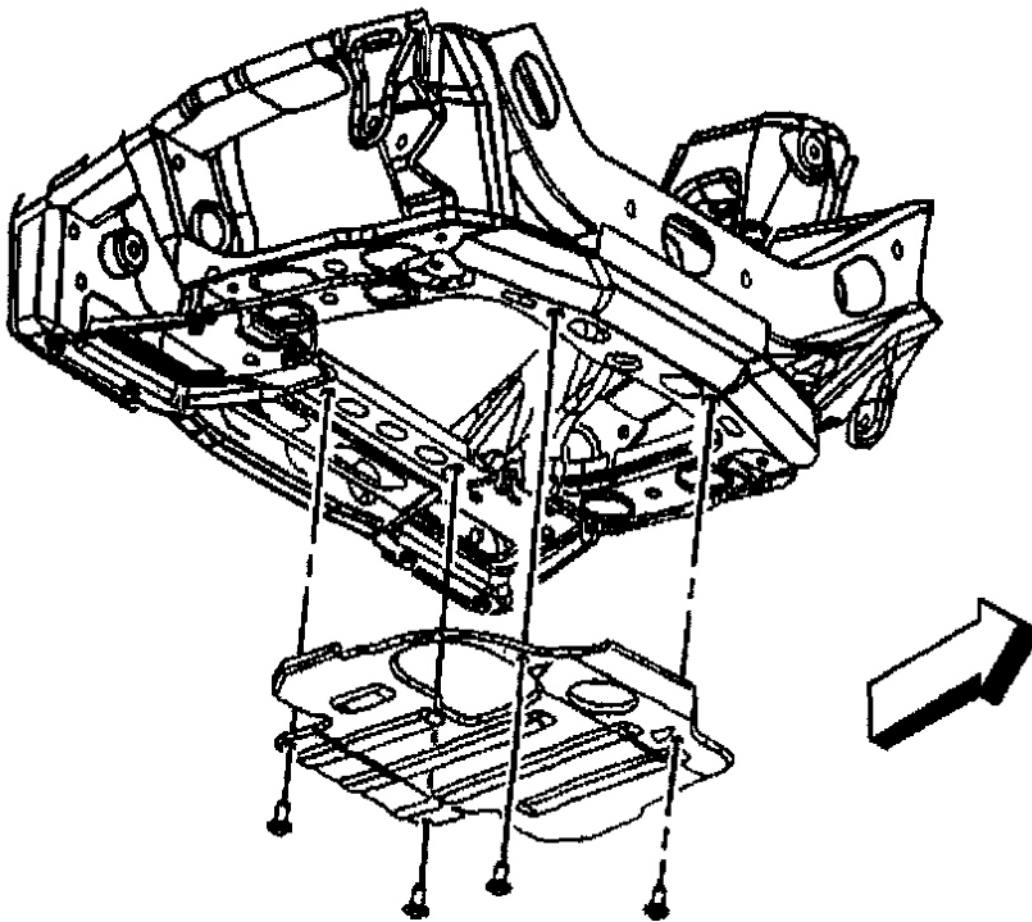
4. Remove the MAP sensor (2).
5. Remove the right shock module, if frame engine mount is being removed. Refer to Shock Module Replacement in Front Suspension.
6. Remove the right and the left upper engine mount nuts.



G01706224

Fig. 51: Removing Right And Left Upper Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

7. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
8. Remove the right and the left lower engine mount nuts.
9. Remove the engine protection shield mounting bolts.



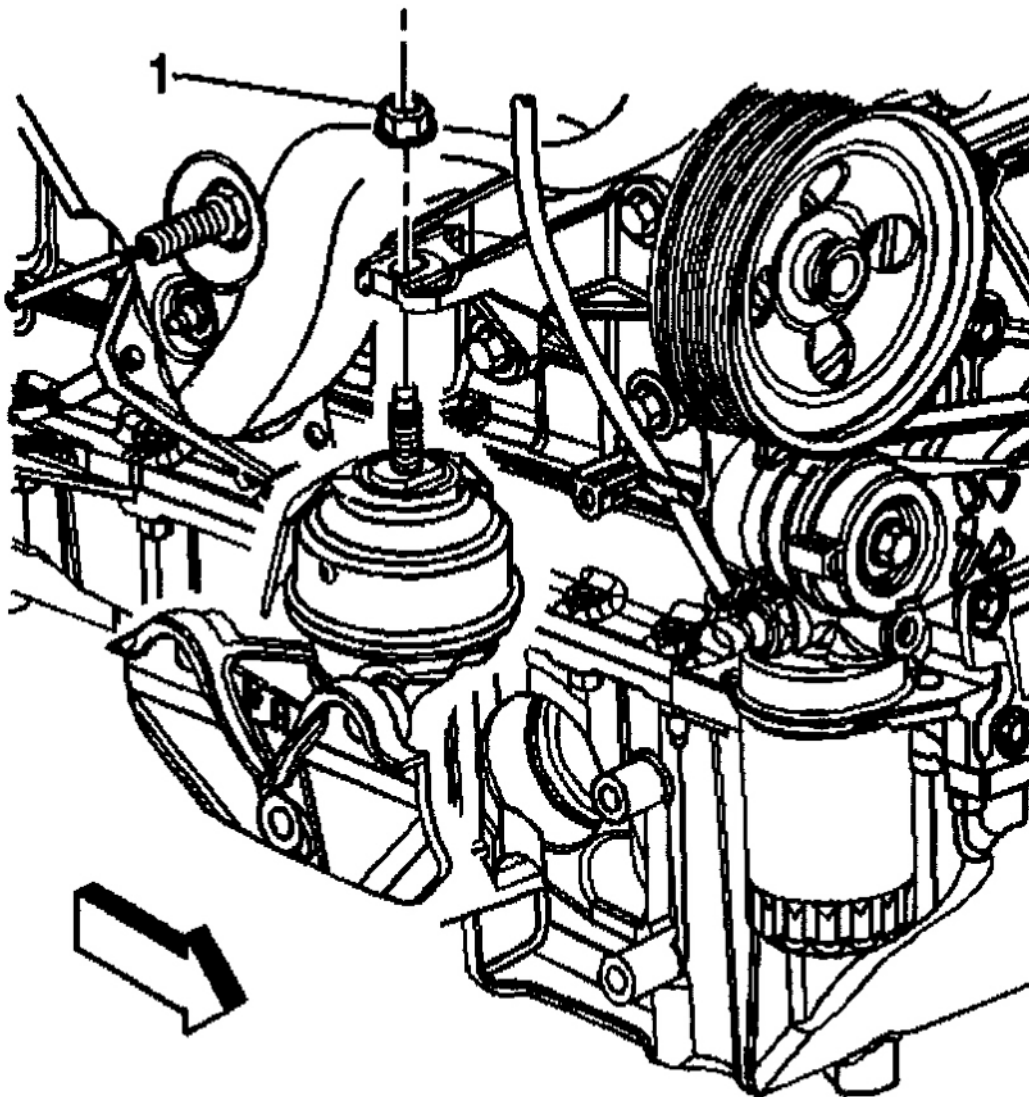
G01706225

Fig. 52: Removing Engine Protection Shield Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the engine protection shield.

IMPORTANT: When placing jack onto the oil pan, pay close attention to not damaging the oil level sender.

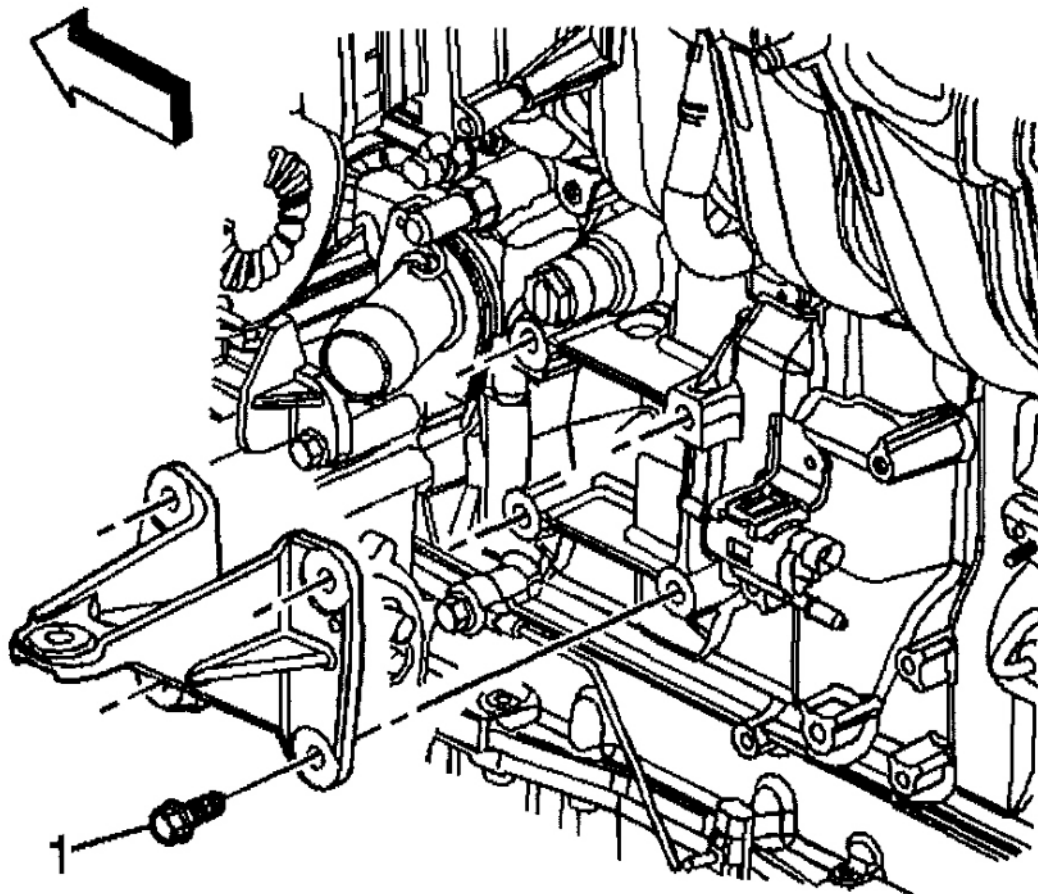
11. Lower the vehicle and place a floor jack under the oil pan with a block of wood.
12. Raise the engine with the jack just enough to clear the engine mount studs.
13. Remove the right engine mount from the bracket.



G01706226

Fig. 53: Removing Right Engine Mount From Bracket
Courtesy of GENERAL MOTORS CORP.

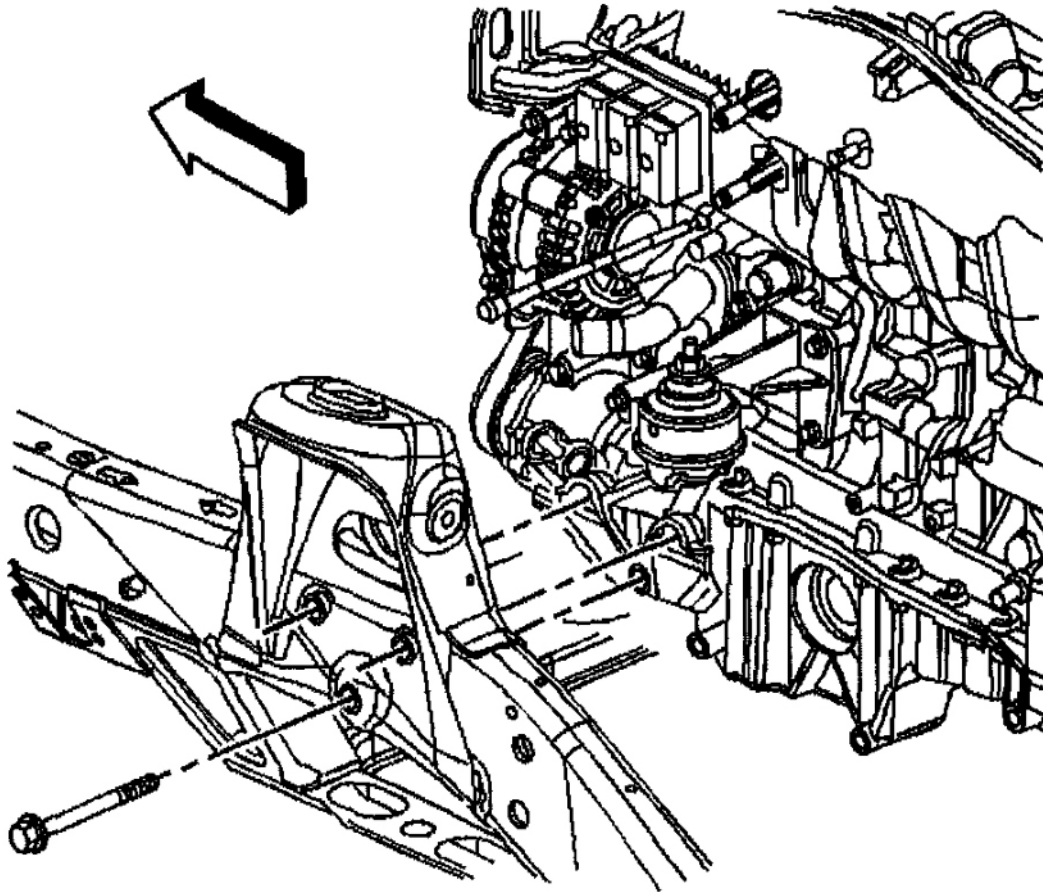
14. Remove the right engine mount bracket bolts. Graphic shows left, right is similar.



G01706227

Fig. 54: Removing Right Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the right engine mount bracket.
16. Remove the right frame engine mount bracket bolts, if required. Graphic shows left, right is similar.



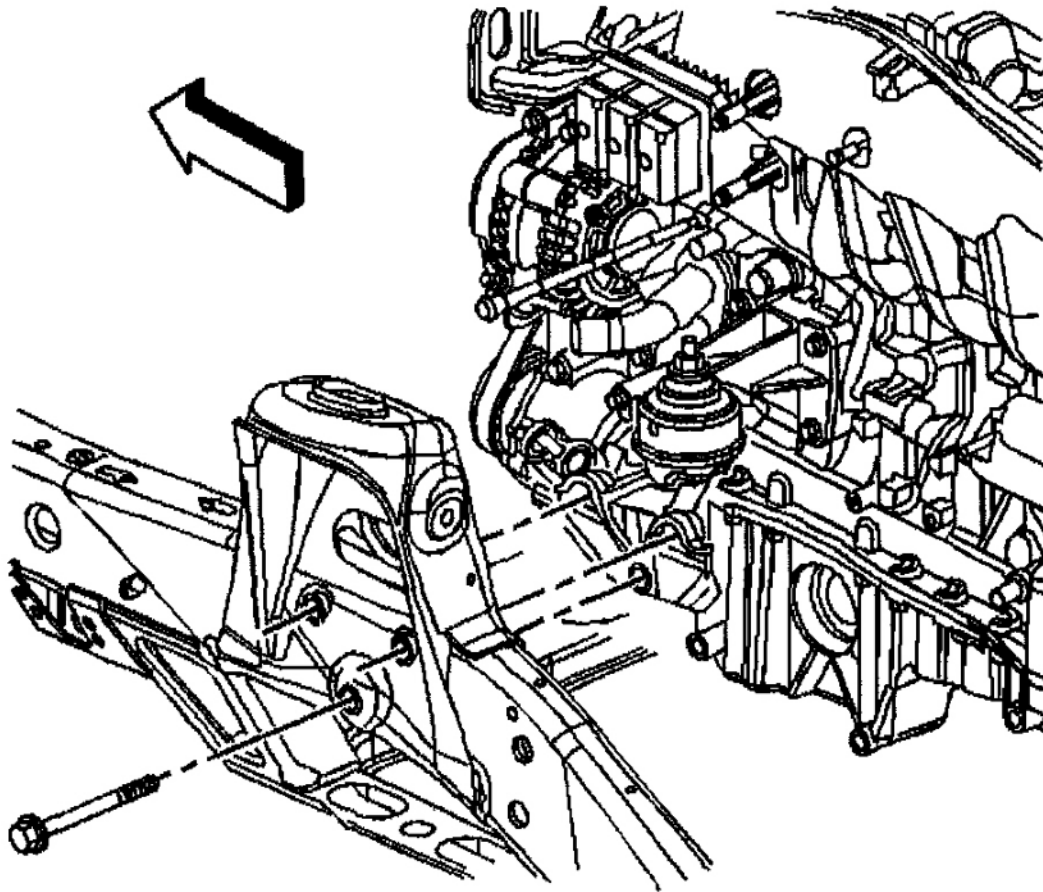
G01706228

Fig. 55: Removing Right Frame Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the right frame engine mount bracket, if required.

Installation Procedure

1. Install the right frame engine mount bracket, if removed. Graphic shows left, right is similar.



G01706229

Fig. 56: Installing Right Frame Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

2. Install the right frame engine mount bracket bolts, if removed.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

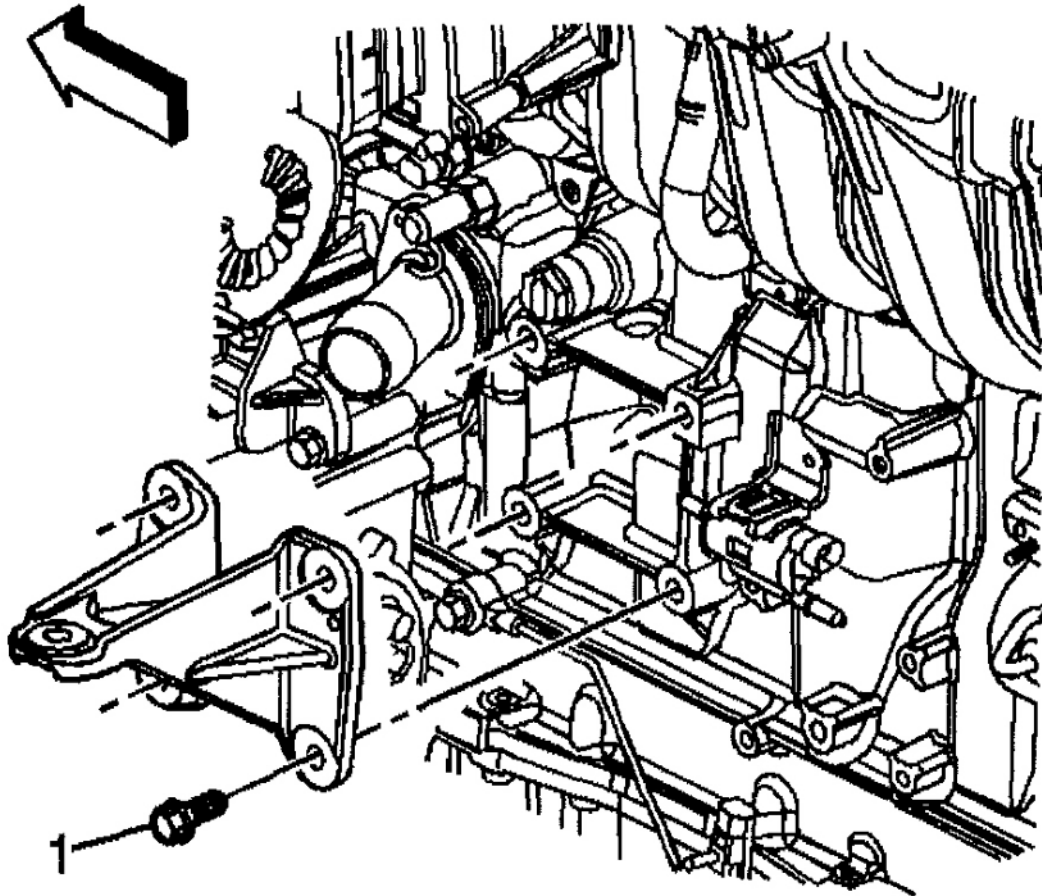
Tighten

Tighten the mount bracket bolts to 110 N.m (81 lb ft).

3. Install the right engine mount bracket and secure with the bolts (1). Graphic shows left, right is similar.

Tighten

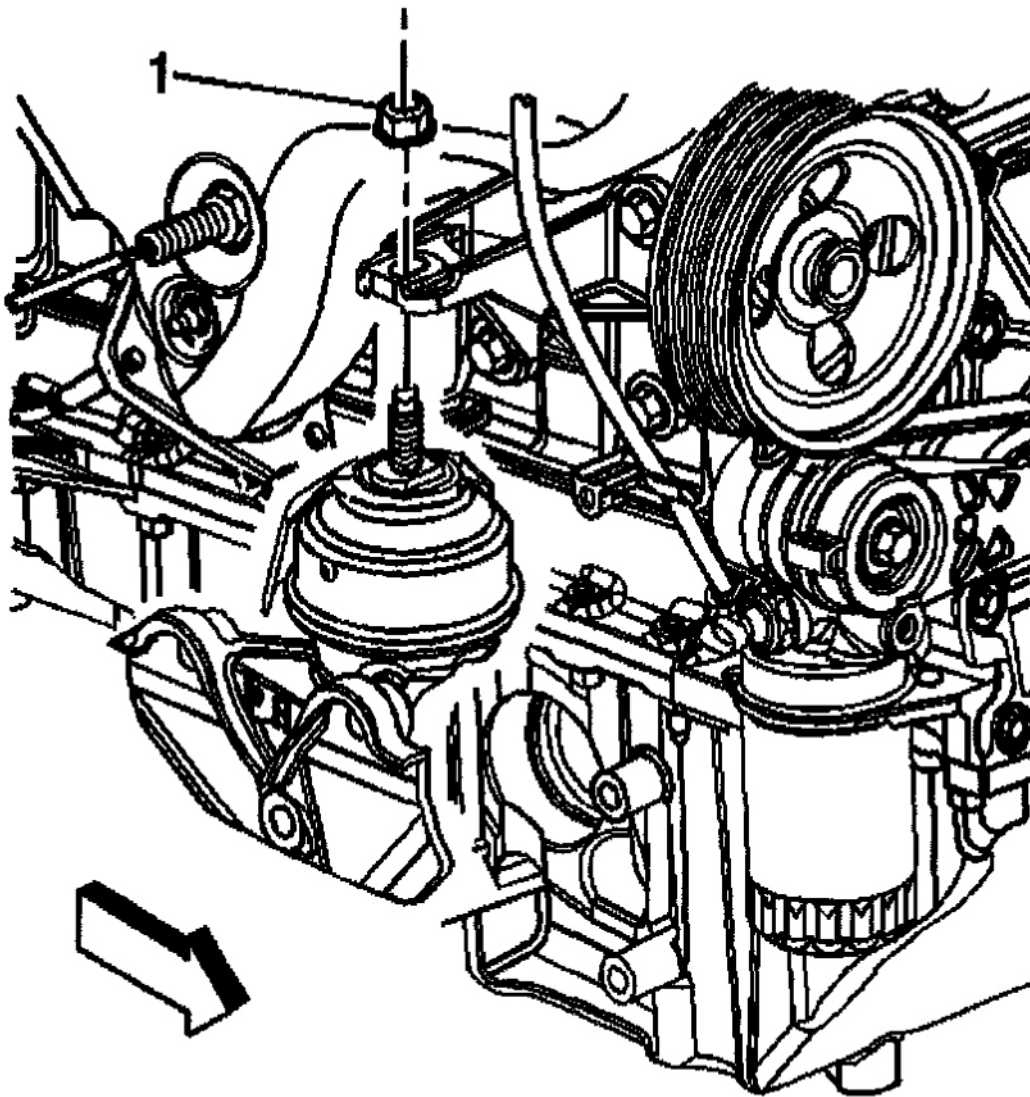
Tighten the engine mount bracket bolts to 50 N.m (37 lb ft).



G01706230

Fig. 57: Installing Right Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

4. Install the right engine mount.



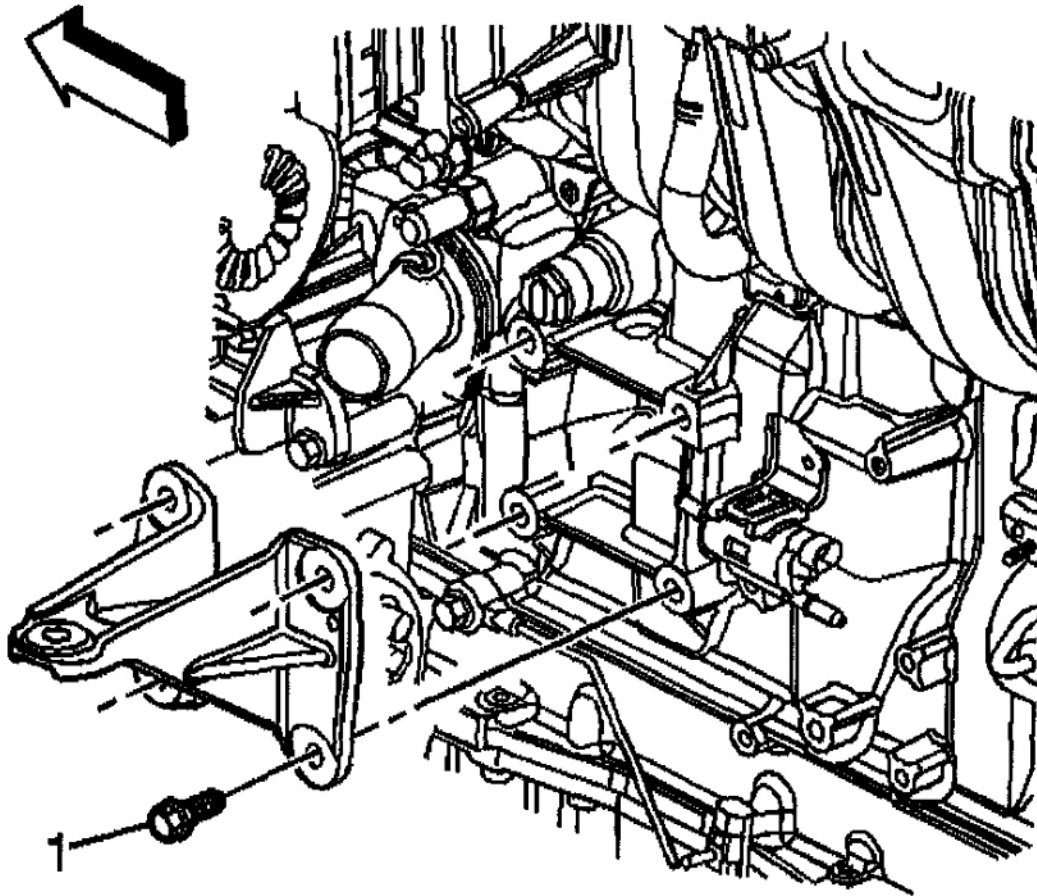
G01706231

Fig. 58: Installing Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

5. Lower the engine onto the engine mounts.
6. Install the right and the left upper engine mount nuts.

Tighten

Tighten the upper engine mount nuts to 70 N.m (52 lb ft).



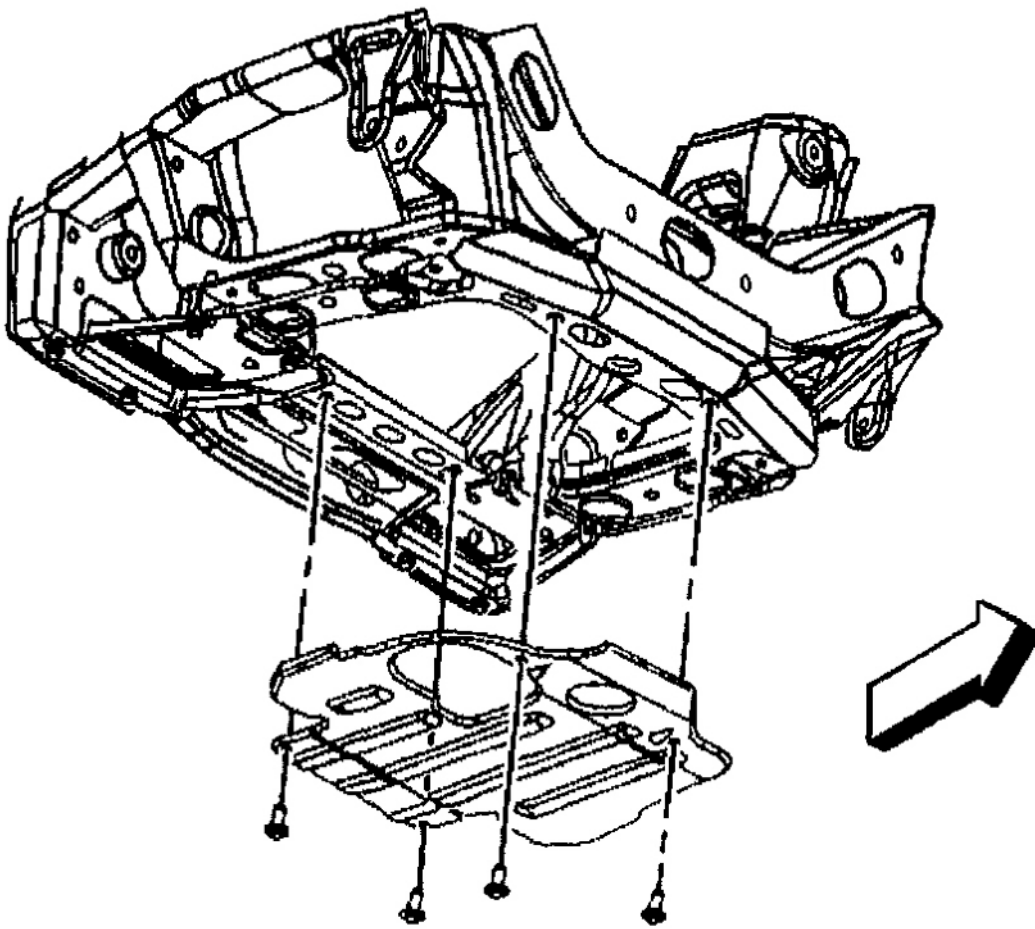
G01706232

Fig. 59: Installing Right And Left Upper Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

7. Raise the vehicle and remove the floor jack from under the vehicle.
8. Install the engine protection shield and secure with the bolts.

Tighten

Tighten the engine protection shield bolts to 25 N.m (18 lb ft).



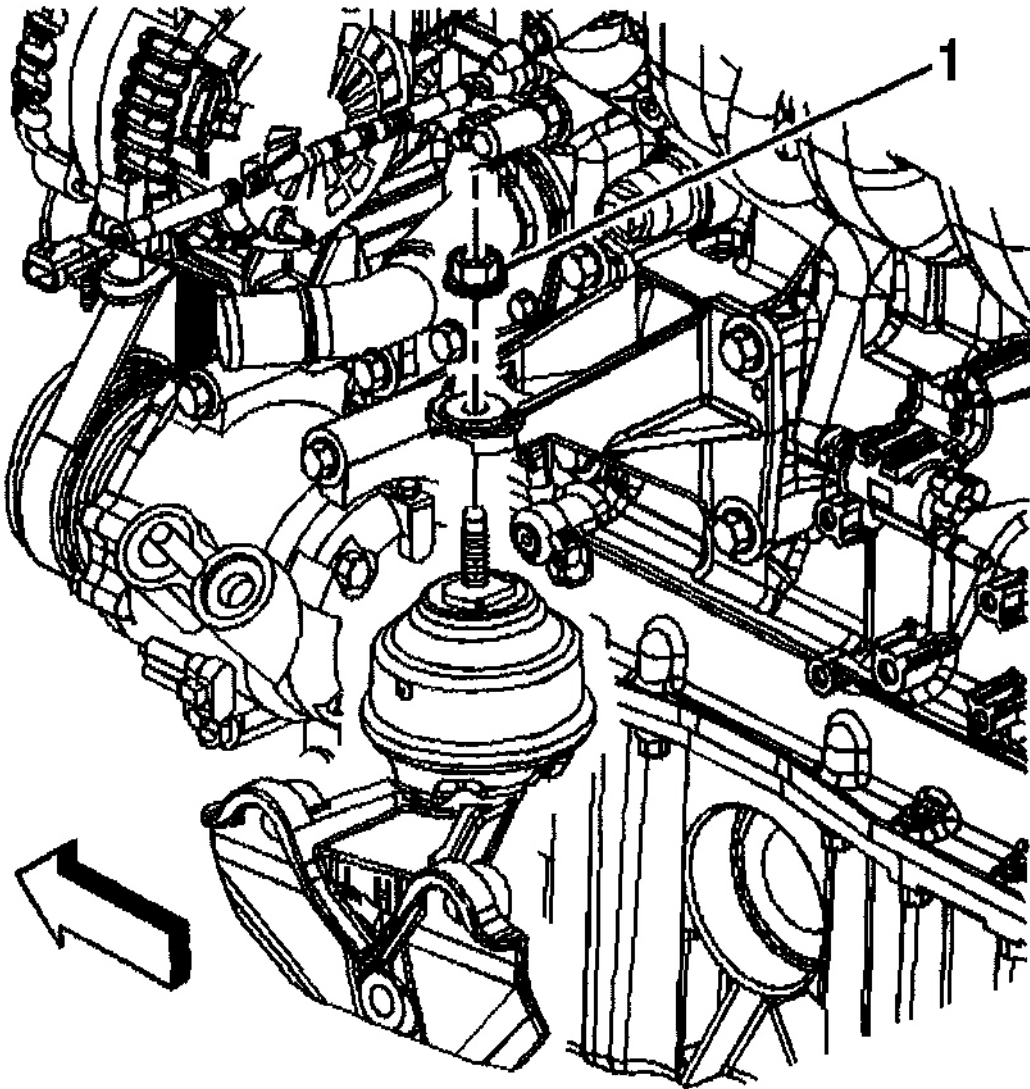
G01706233

Fig. 60: Installing Engine Protection Shield
Courtesy of GENERAL MOTORS CORP.

9. Install the right and the left lower engine mount nuts.

Tighten

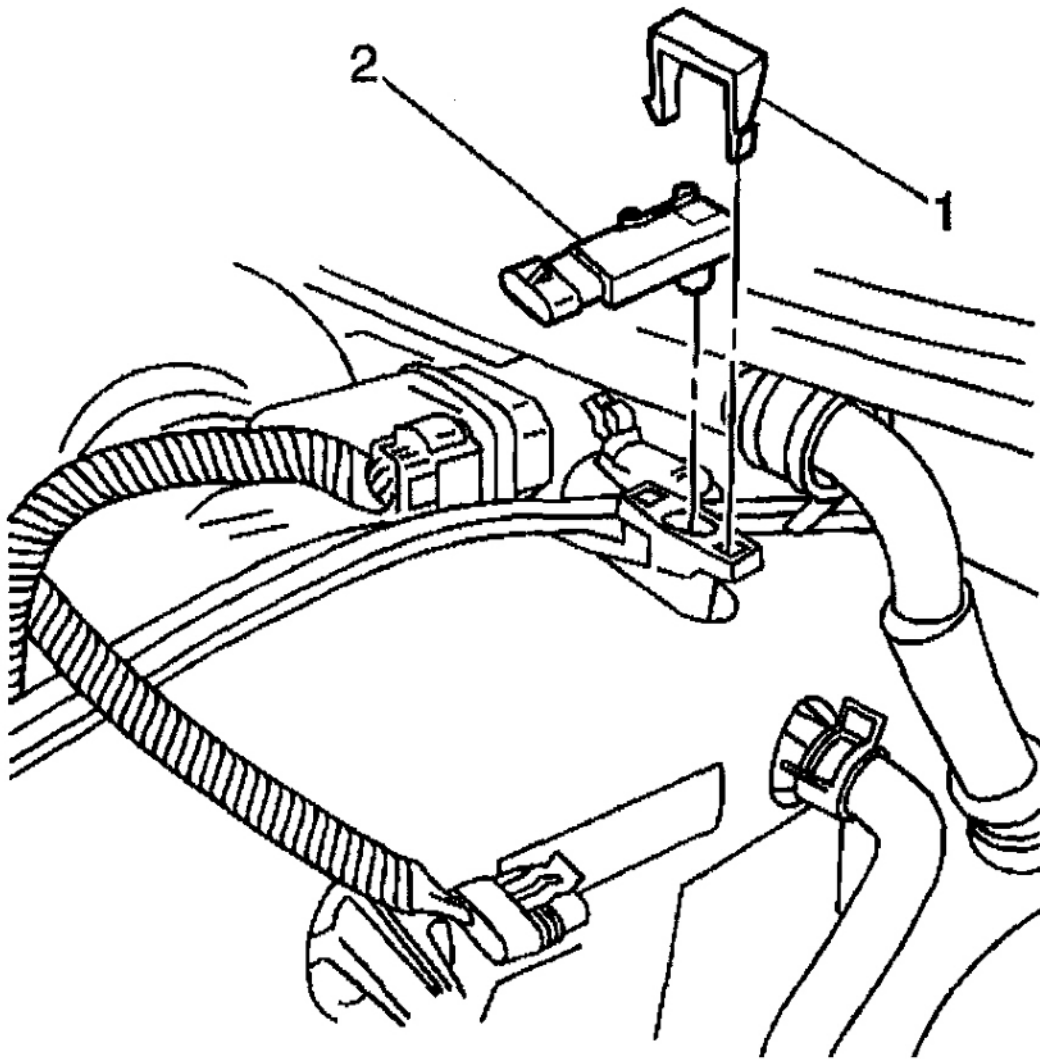
Tighten the lower engine mount nuts to 70 N.m (52 lb ft).



G01706234

Fig. 61: Installing Right And Left Lower Engine Mount Nuts
Courtesy of GENERAL MOTORS CORP.

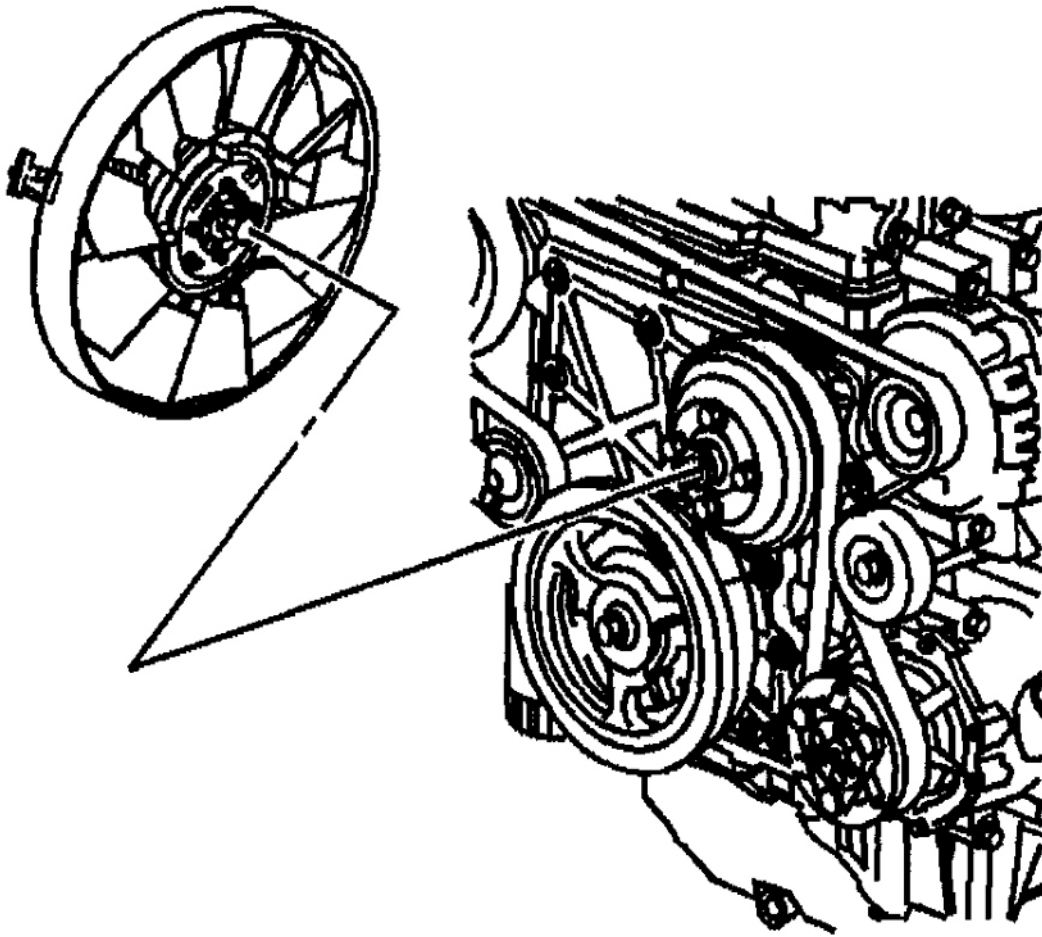
10. Lower the vehicle.
11. Install the right shock module. Refer to Shock Module Replacement in Front Suspension.
12. Install the MAP sensor (2).



G01706235

Fig. 62: Installing MAP Sensor
Courtesy of GENERAL MOTORS CORP.

13. Install the MAP sensor retainer (1) and the electrical connector.
14. Connect the cooling fan hub nut to the water pump shaft.



G01706236

Fig. 63: Connecting Cooling Fan Hub Nut To Water Pump Shaft
Courtesy of GENERAL MOTORS CORP.

15. Install the J 41240 to the water pump pulley and tighten the cooling fan hub nut.

Tighten

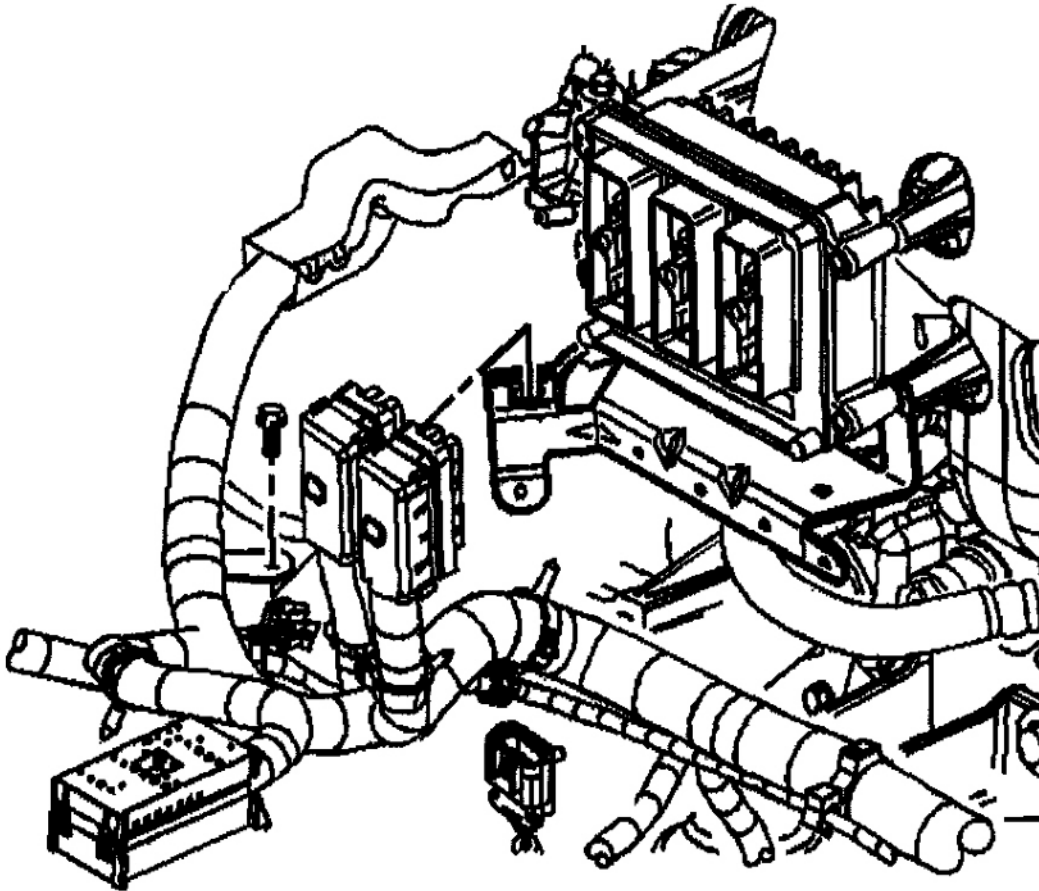
Tighten the cooling fan hub nut to 56 N.m (41 lb ft).

16. Connect the battery negative cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Engine Electrical.

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

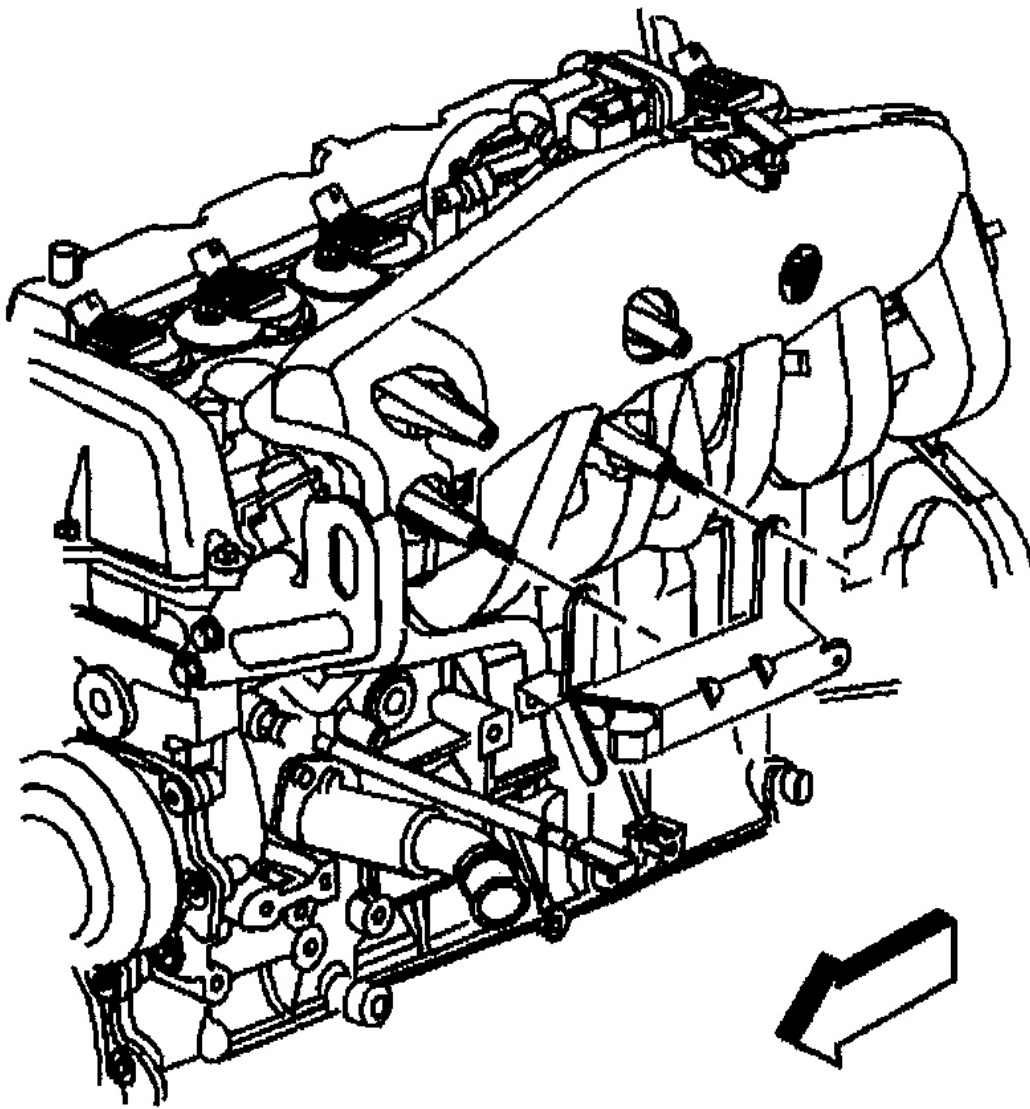
1. Remove the throttle body. Refer to **THROTTLE BODY** in Engine Controls.
2. Remove the PCM. Refer to **POWERTRAIN CONTROL MODULE** in Engine Controls-4.2L
3. Disconnect all harnesses from the engine harness bracket.



G01706237

Fig. 64: Disconnect All Harnesses From Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

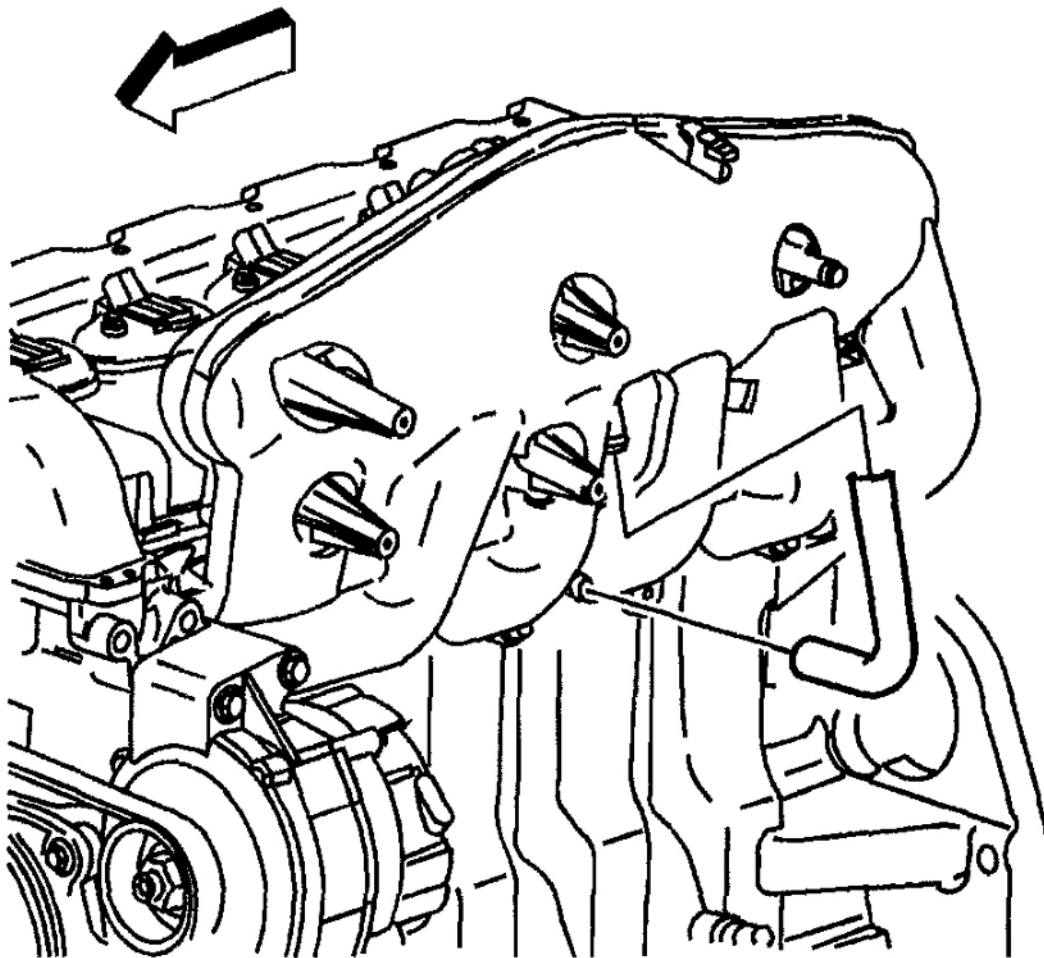
4. Remove the front differential vent hose from the bracket clip.
5. Remove the engine harness bracket bolt and remove the bracket.



G01706238

Fig. 65: Removing Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

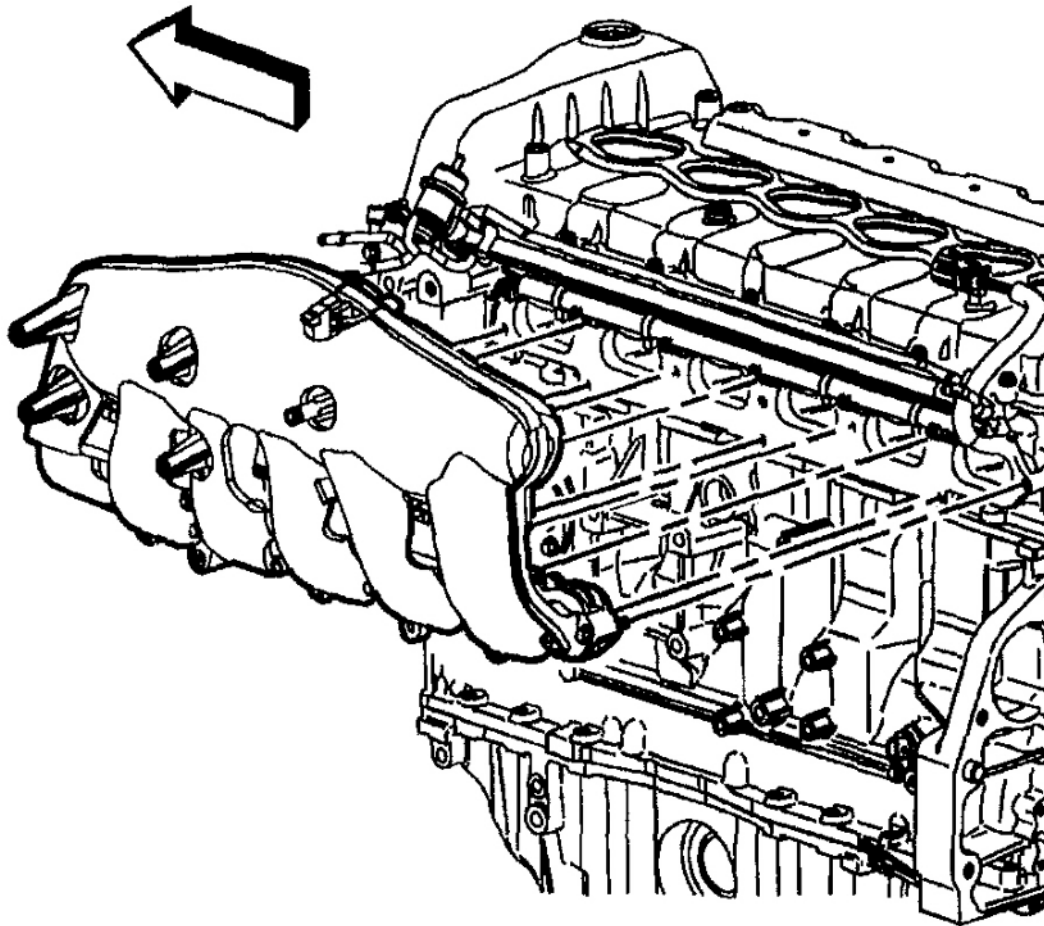
6. Disconnect the MAP sensor electrical connector.
7. Disconnect the crankcase ventilation hose.



G01706239

Fig. 66: Disconnecting Crankcase Ventilation Hose
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the brake hose at the booster.
9. Remove the generator. Refer to **GENERATOR** in Electrical.
10. Loosen and remove the intake manifold bolts.
11. Remove the intake manifold.

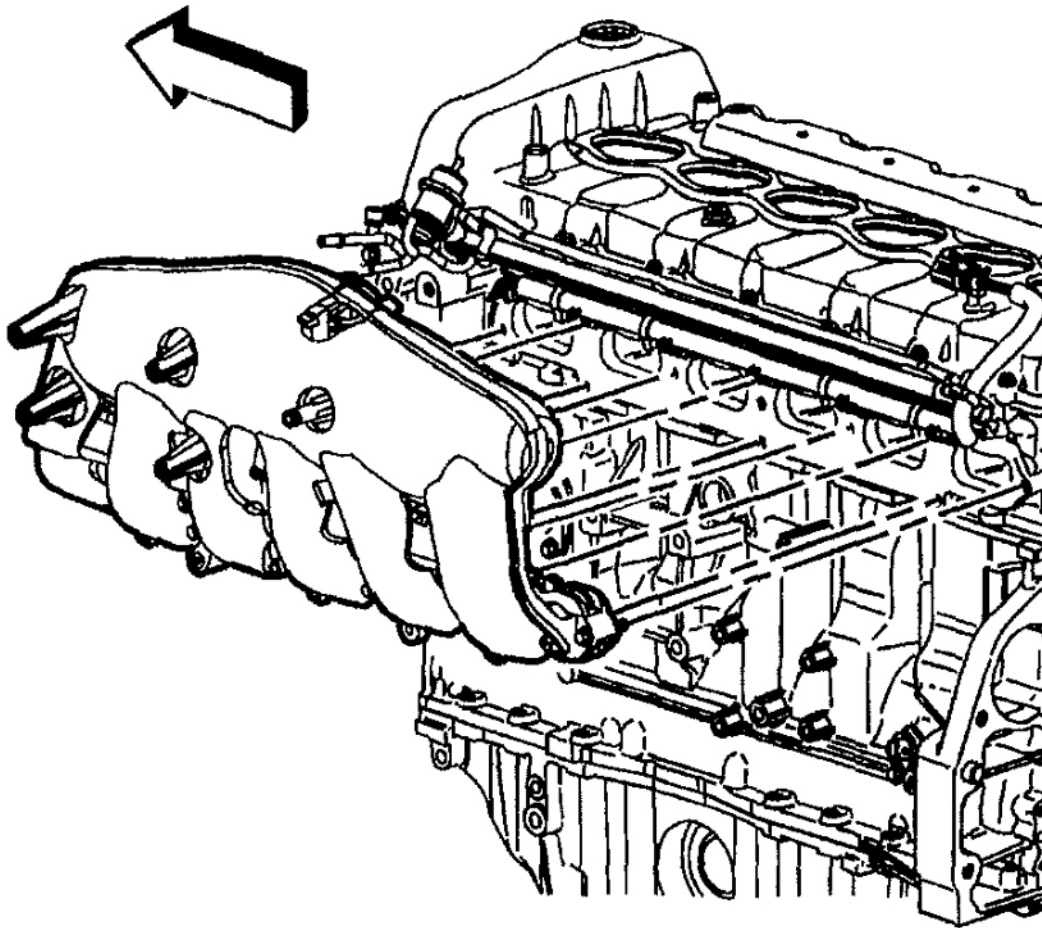


G01706240

Fig. 67: Removing Intake Manifold
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install a new intake manifold gasket.



G01706241

Fig. 68: Installing New Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

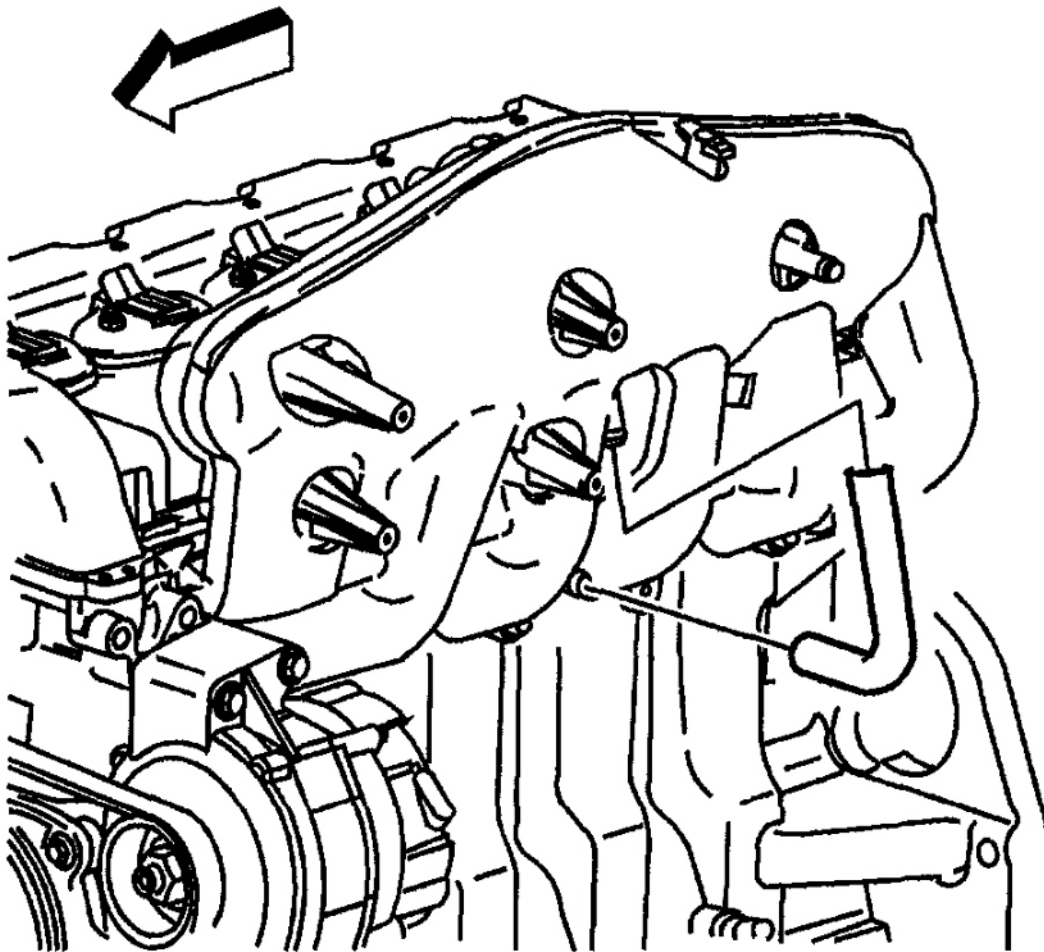
2. Install the intake manifold onto the engine and secure the manifold with the bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the intake manifold bolts to 16 N.m (12 lb ft).

3. Install the generator. Refer to **GENERATOR** in Electrical.
4. Install the brake hose to the booster.
5. Lubricate the inner diameter of the crankcase ventilation hose with GM P/N 12345884 or equivalent.
6. Install the crankcase ventilation hose.



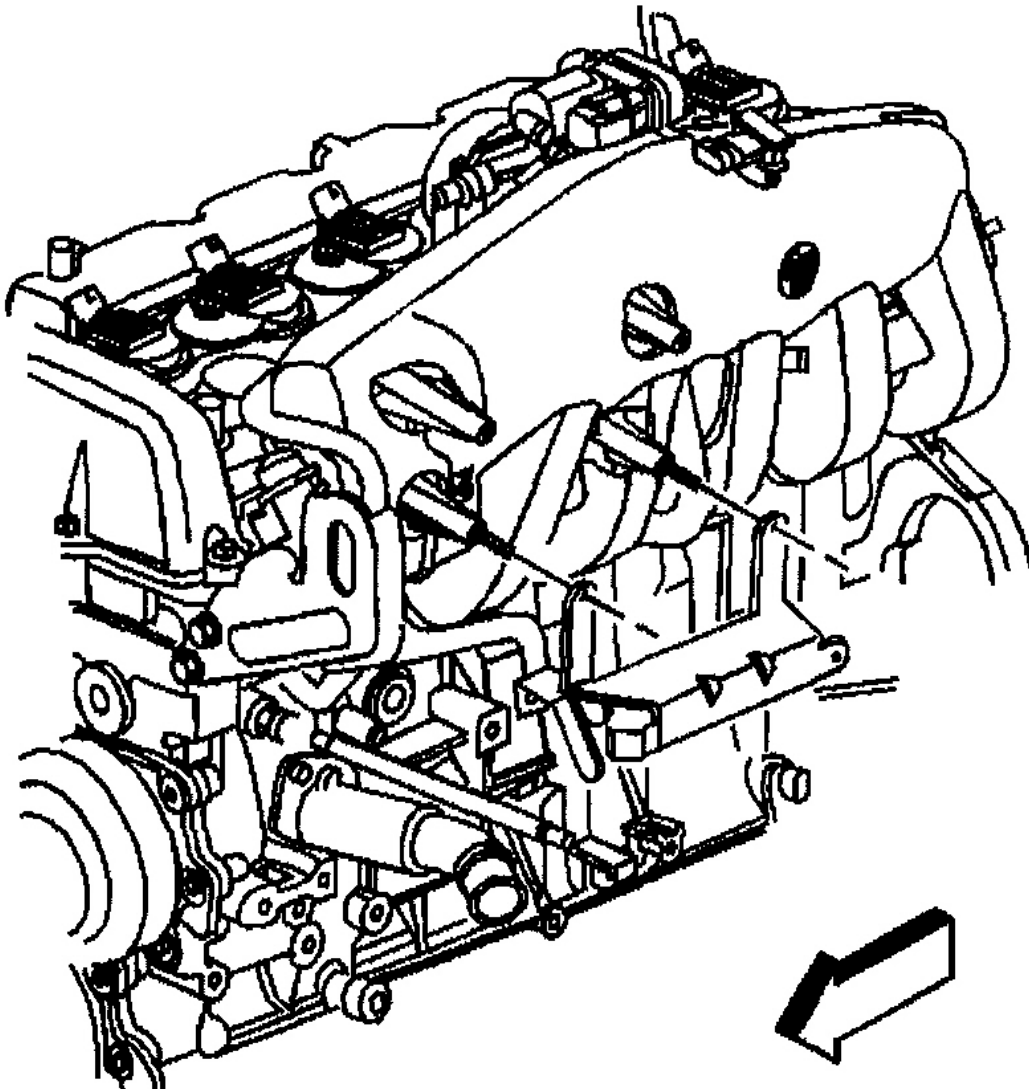
G01706242

Fig. 69: Installing Crankcase Ventilation Hose
Courtesy of GENERAL MOTORS CORP.

7. Install the MAP sensor electrical connector.
8. Install the engine harness bracket. Secure the bracket with the bolt.

Tighten

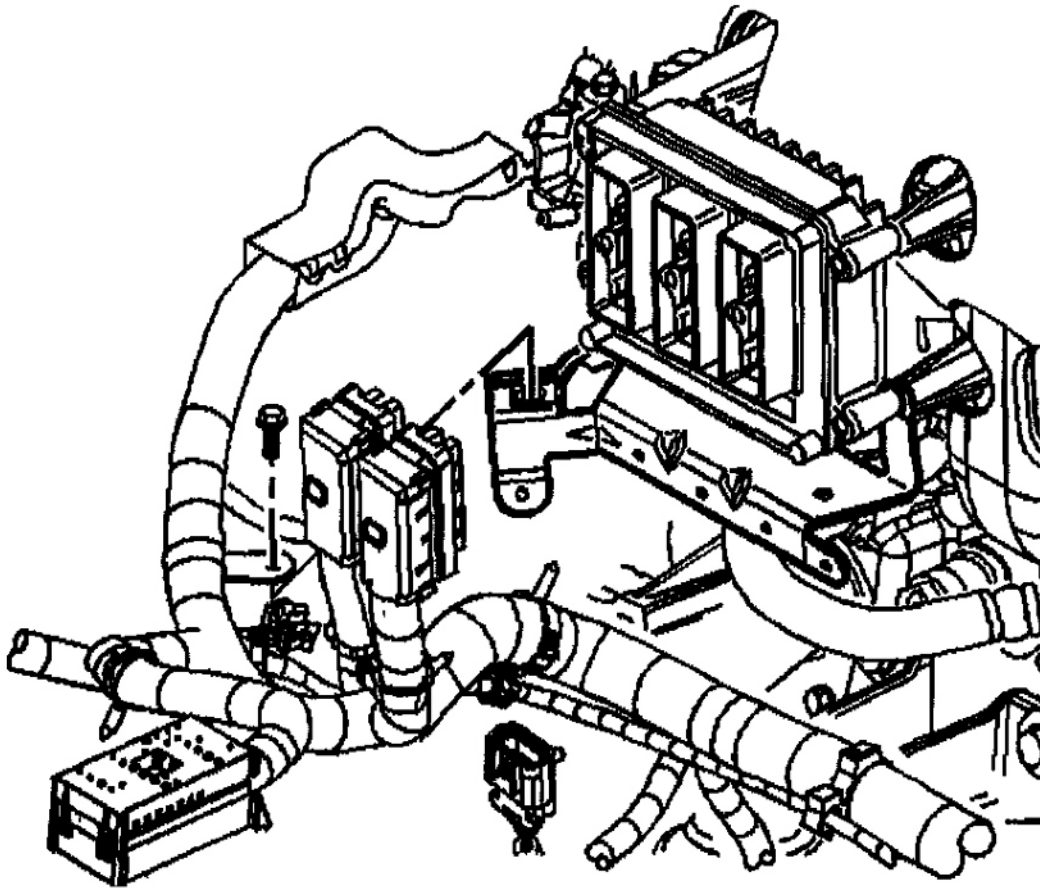
Tighten the engine harness bracket bolt to 50 N.m (37 lb ft).



G01706243

Fig. 70: Installing Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

9. Install the front differential vent hose to the engine harness bracket clip.
10. Install all harnesses to the original location onto the engine harness bracket.



G01706244

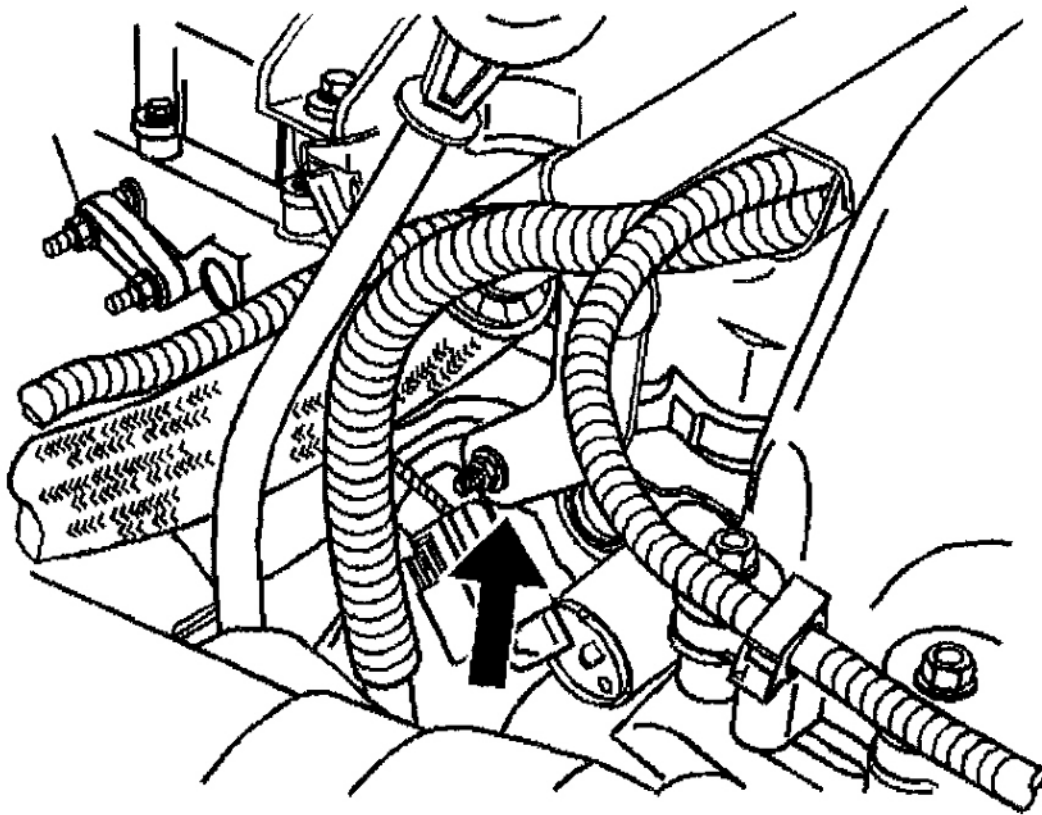
Fig. 71: Installing All Harnesses To Original Location Onto Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

11. Install the PCM. Refer to **POWERTRAIN CONTROL MODULE** , in Engine Controls-4.2L
12. Install the throttle body. Refer to **THROTTLE BODY** in Engine Controls.

CAMSHAFT COVER REPLACEMENT

Removal Procedure

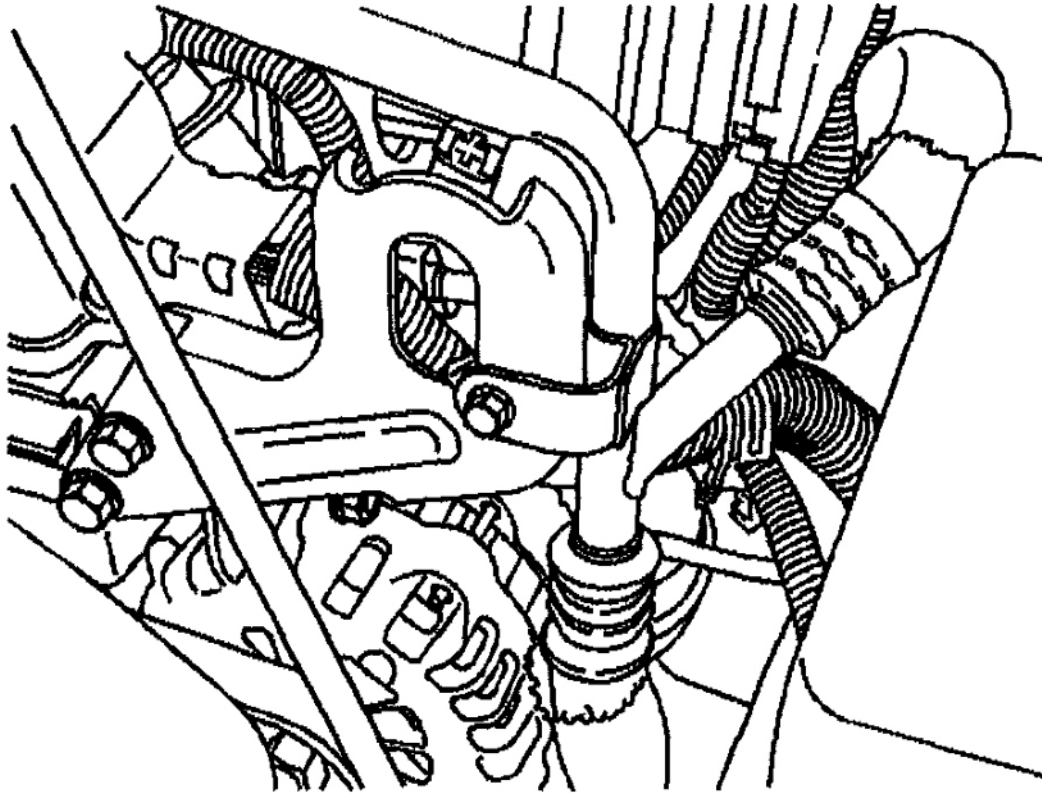
1. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
2. Discharge the A/C. Refer to Refrigerant Recovery and Recharging in Heating, Ventilation and Air Conditioning.
3. Remove the A/C line at the oil level indicator tube bracket nut.



G01706245

Fig. 72: Removing A/C Line At Oil Level Indicator Tube Bracket Nut
Courtesy of GENERAL MOTORS CORP.

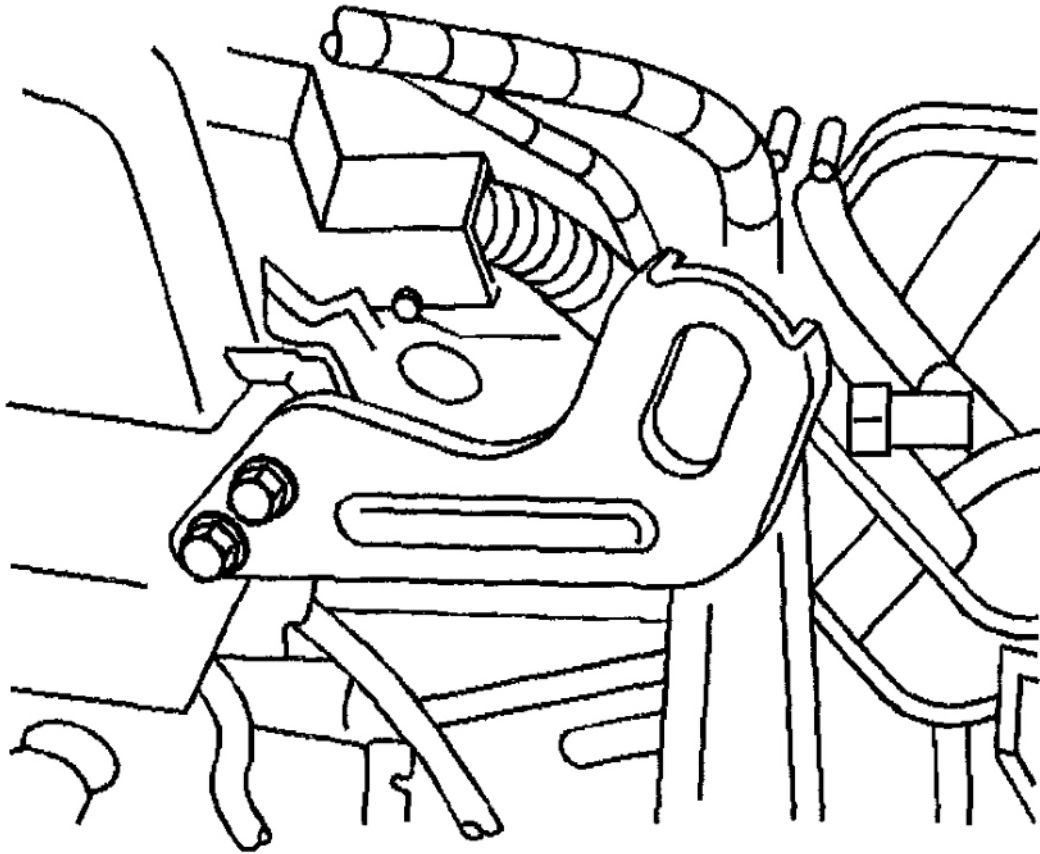
4. Remove the A/C line from the accumulator.
5. Remove the A/C bracket bolt from the engine lift hook.



G01706246

Fig. 73: Removing A/C Bracket Bolt From Engine Lift Hook
Courtesy of GENERAL MOTORS CORP.

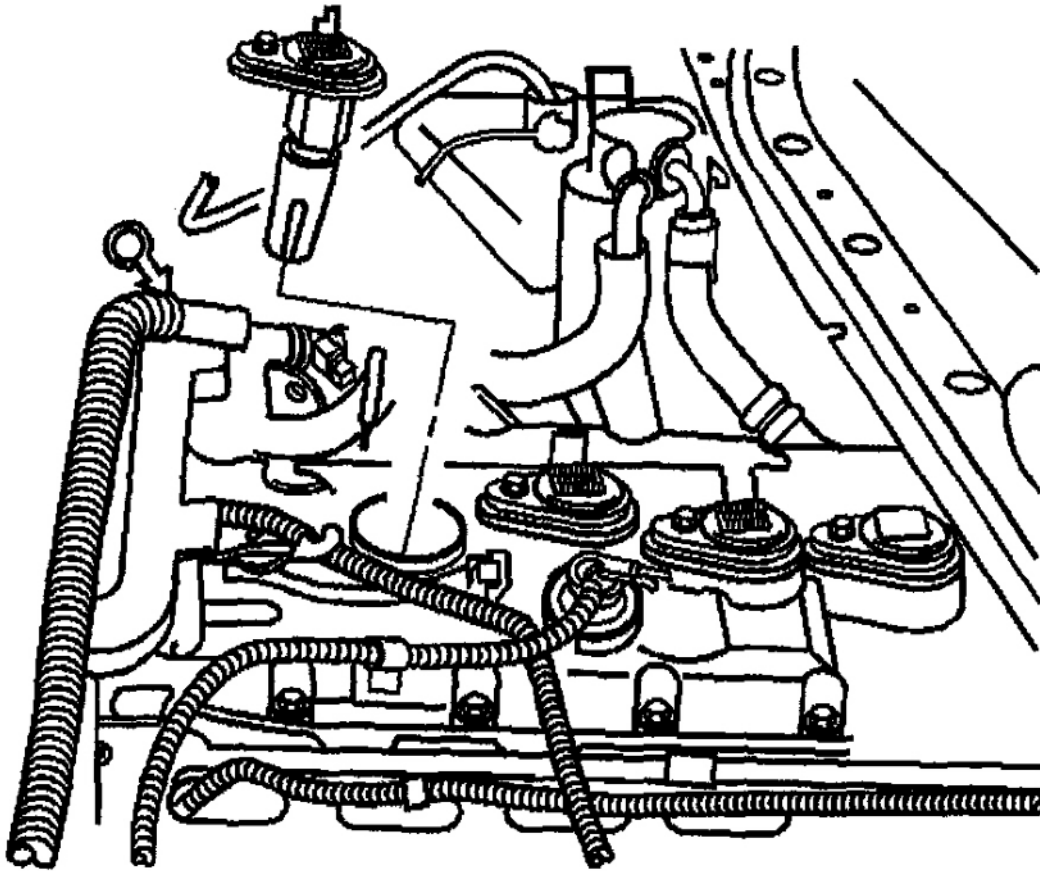
6. Remove the engine lift bracket.



G01706247

Fig. 74: Removing Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the ignition control module electrical connectors.
8. Loosen and remove the ignition control module bolts.
9. Remove the ignition control module.

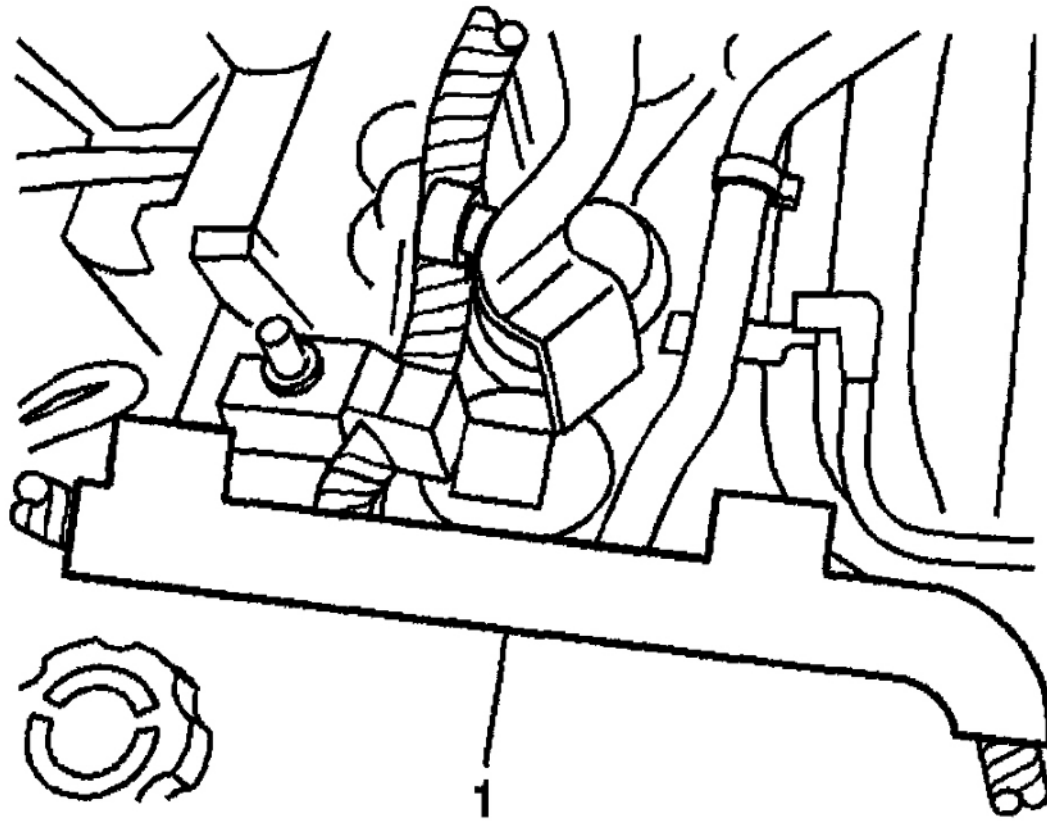


G01706248

Fig. 75: Removing Ignition Control Module

Courtesy of GENERAL MOTORS CORP.

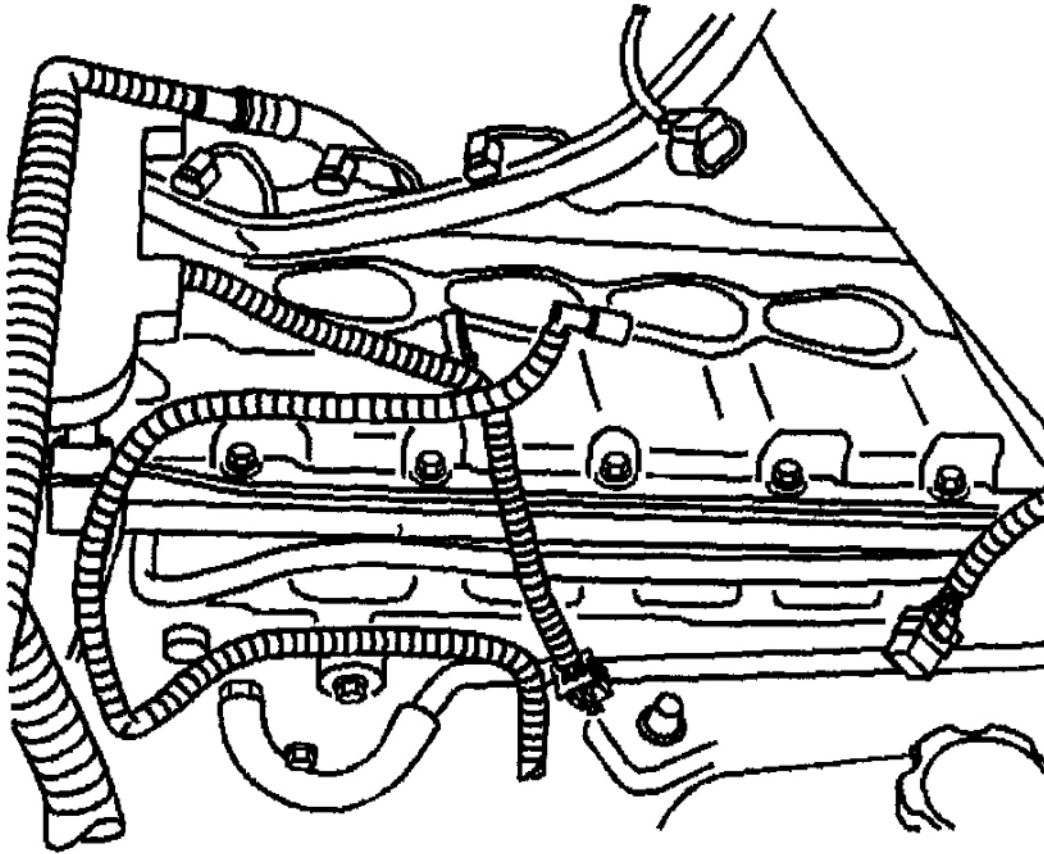
10. Disconnect the engine electrical harness housing from the camshaft cover (1) taking care not to damage the clips that hold the housing in place.



G01706249

Fig. 76: Disconnecting Engine Electrical Harness Housing From Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

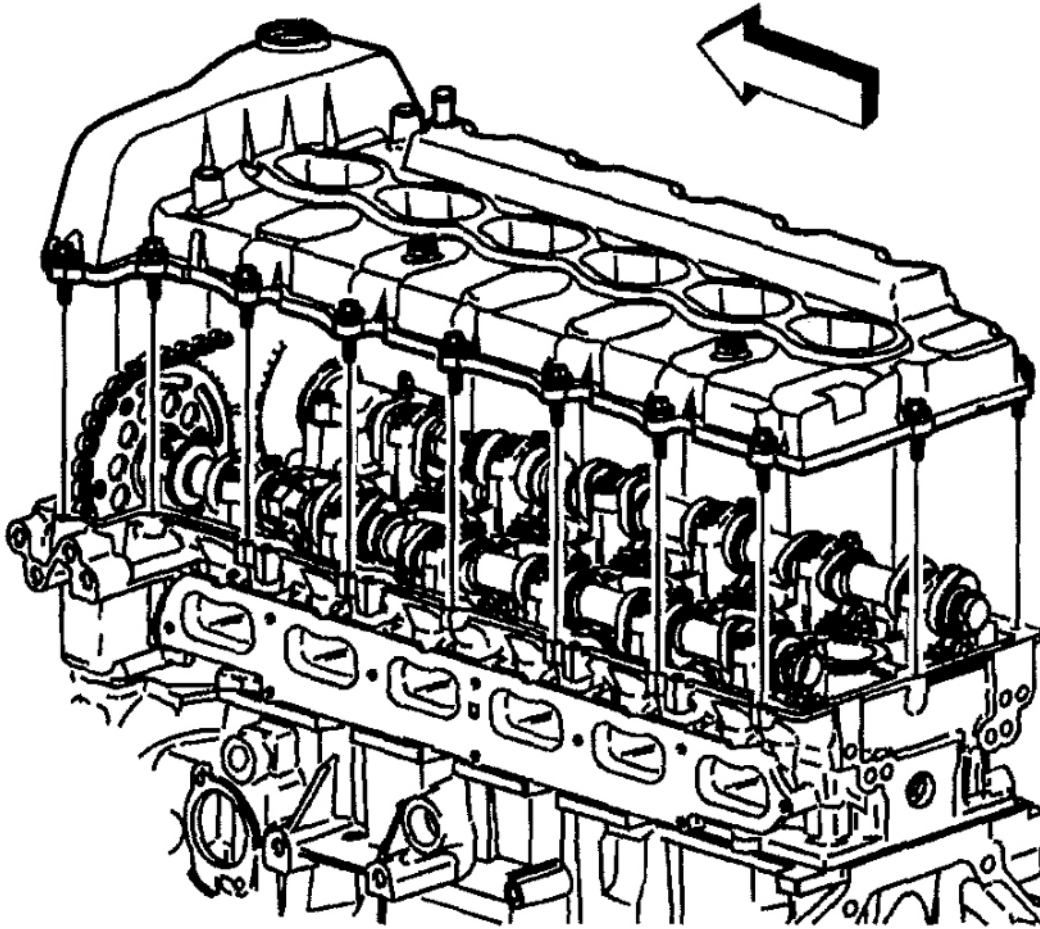
11. Disconnect the fuel injection harness electrical connector.
12. Loosen and remove the camshaft cover bolts.



G01706250

Fig. 77: Removing Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the camshaft cover.



G01706251

Fig. 78: Removing camshaft cover
Courtesy of GENERAL MOTORS CORP.

14. Clean and inspect the camshaft cover. Refer to Camshaft Cover Cleaning and Inspection in Engine Mechanical -4.2 L Unit Repair.

Installation Procedure

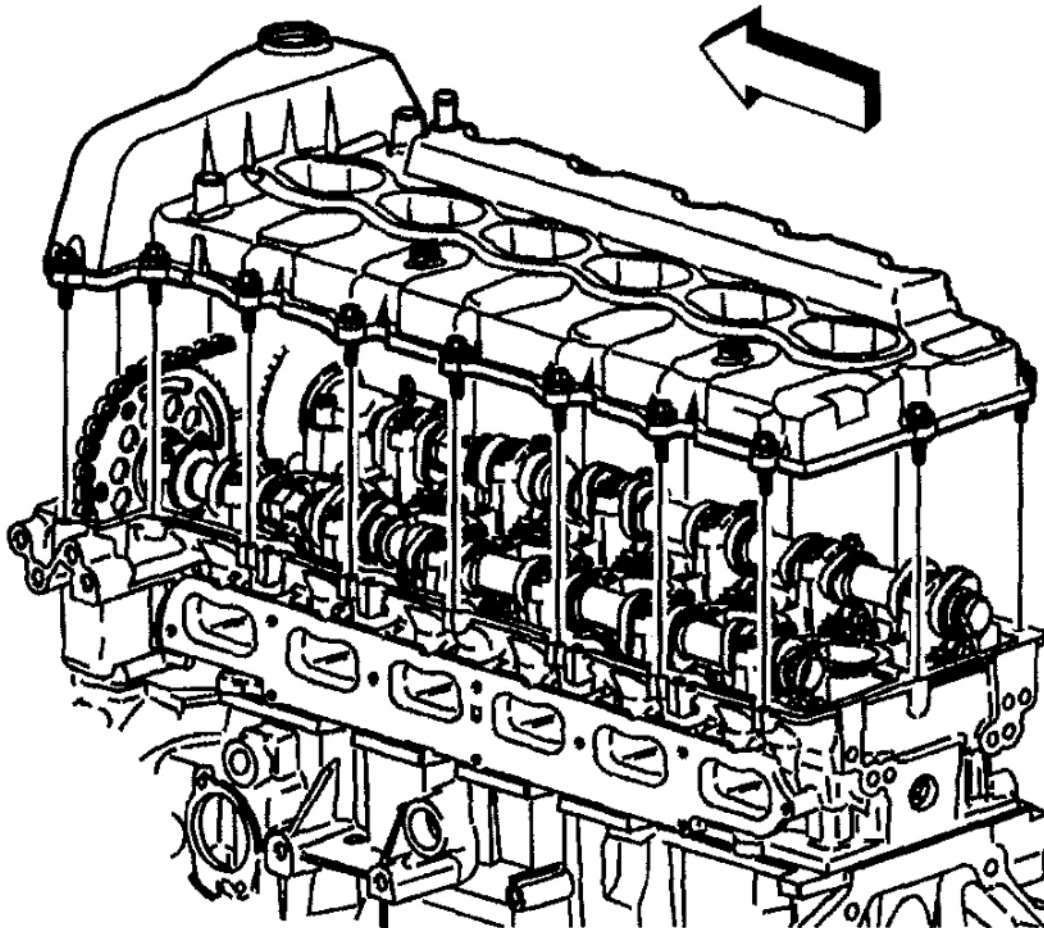
1. Install a new camshaft cover seal.
2. Install new rubber ignition control module seals.
3. Install the camshaft cover and secure with the cam cover bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or

sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

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



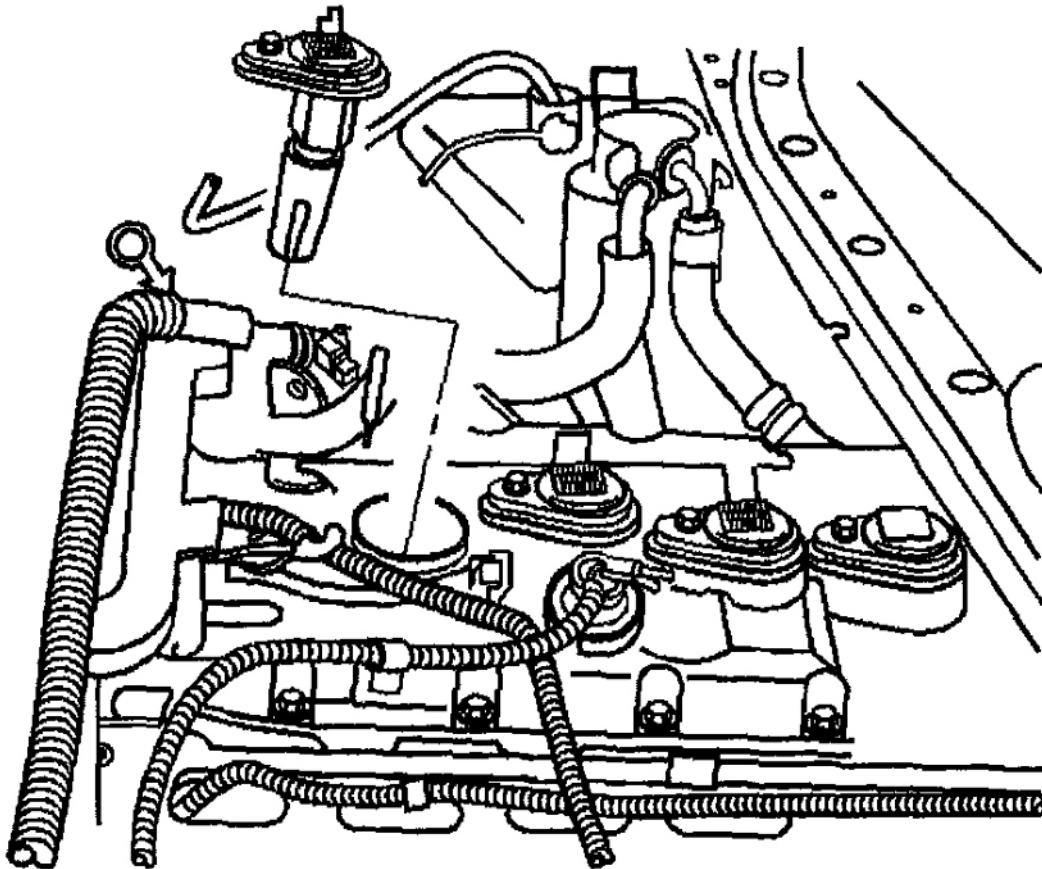
G01706252

Fig. 79: Installing Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the ignition control modules and secure the modules with bolts.

Tighten

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



G01706253

Fig. 80: Installing Ignition Control Modules
Courtesy of GENERAL MOTORS CORP.

5. Connect the ignition control module electrical connectors.
6. Install the fuel injector electrical connectors.
7. Install the engine electrical harness housing (1).

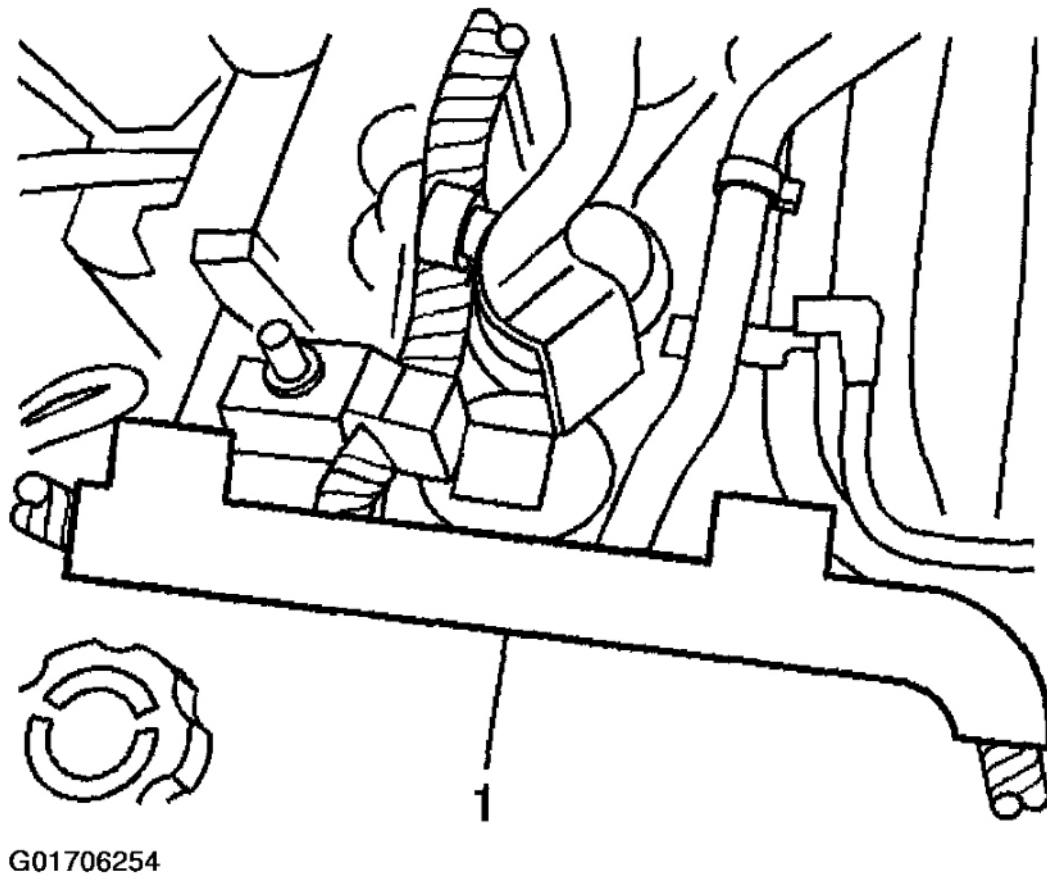


Fig. 81: Installing Engine Electrical Harness Housing
Courtesy of GENERAL MOTORS CORP.

8. Install the A/C line bracket to the oil level indicator tube stud and secure the bracket with the nut.

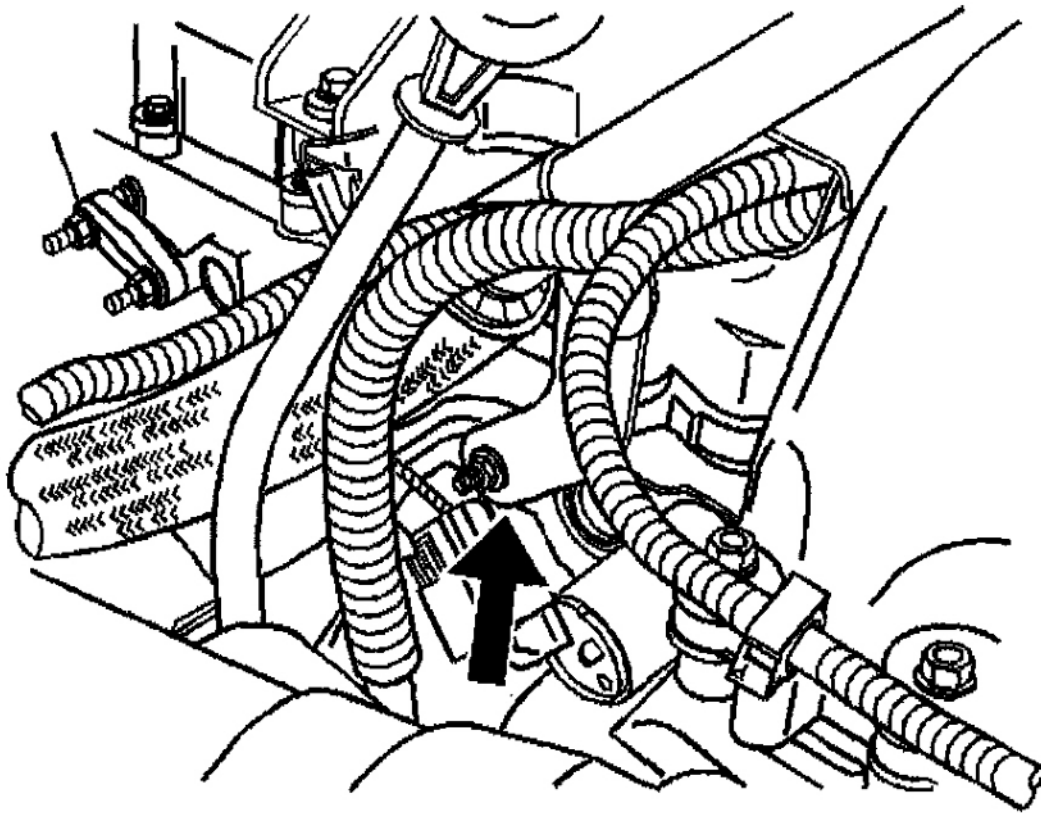
Tighten

Tighten the A/C line bracket nut to 7 N.m (62 lb in).

9. Install the engine lift bracket and secure the lift hook with the bolts.

Tighten

Tighten the lift bracket bolts to 50 N.m (37 lb ft).



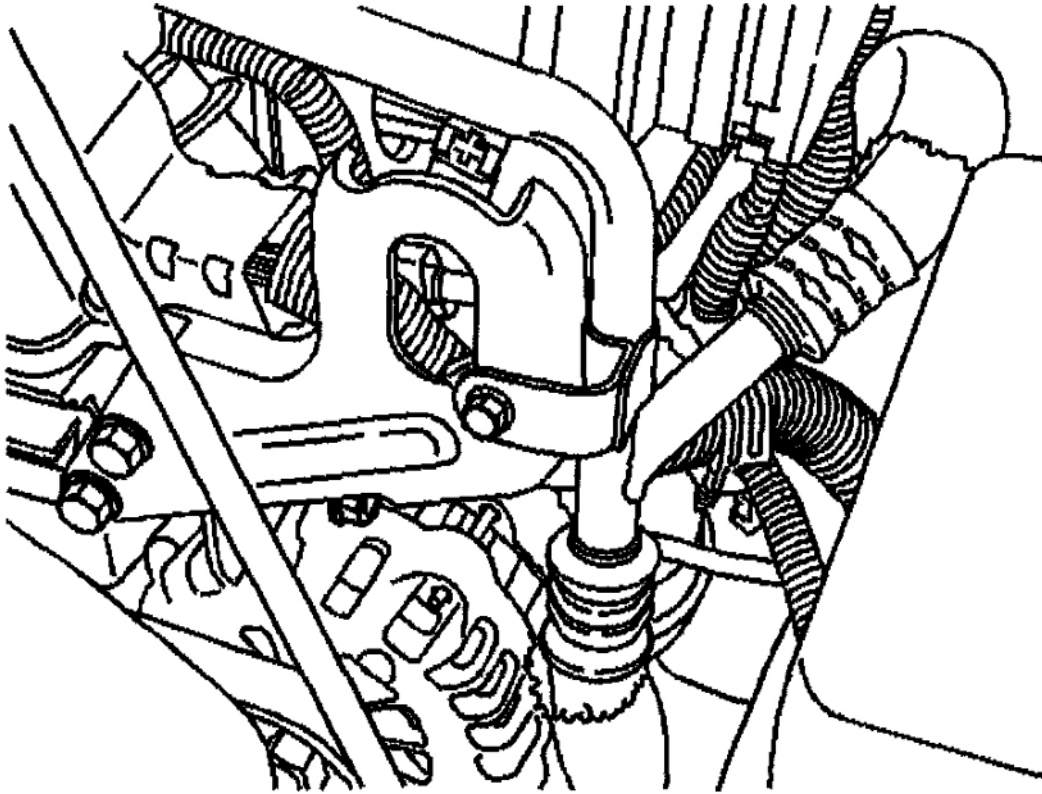
G01706255

Fig. 82: Installing Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

10. Install the A/C line bracket to the engine lift bracket and secure the A/C bracket with the bolt.

Tighten

Tighten the A/C bracket bolt to 10 N.m (89 lb in).



G01706256

Fig. 83: Installing A/C Line Bracket To Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

11. Install the intake manifold. Refer to **Intake Manifold Replacement**.
12. Recharge the A/C system. Refer to Refrigerant Recovery and Recharging in Heating, Ventilation and Air Conditioning.

VALVE ROCKER ARM AND VALVE LASH ADJUSTER REPLACEMENT

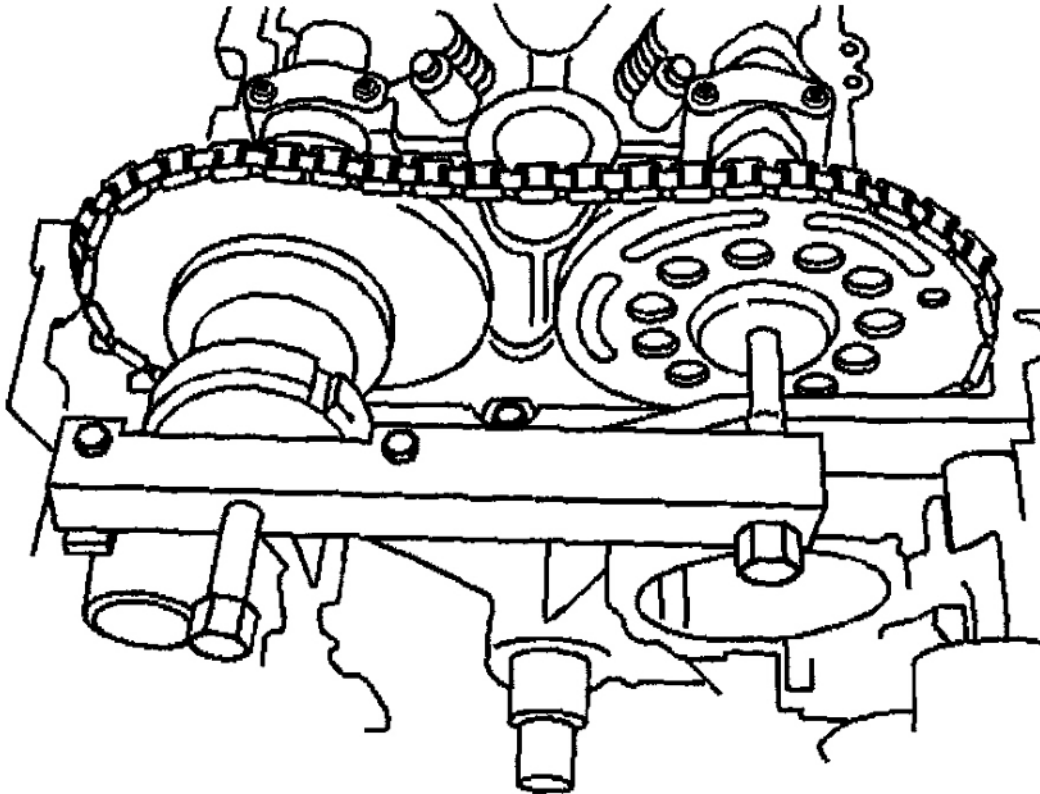
Tools Required

- **J 36660-A** Torque/Angle Meter
- **J 44222** Camshaft Sprocket Holding Tool

Removal Procedure

1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
2. Remove the exhaust and the intake sprocket bolts.

3. Install the J 44222 onto the cylinder head and adjust the horizontal bolts into the camshaft sprockets in order to maintain chain tension and keep from disturbing the timing chain components.



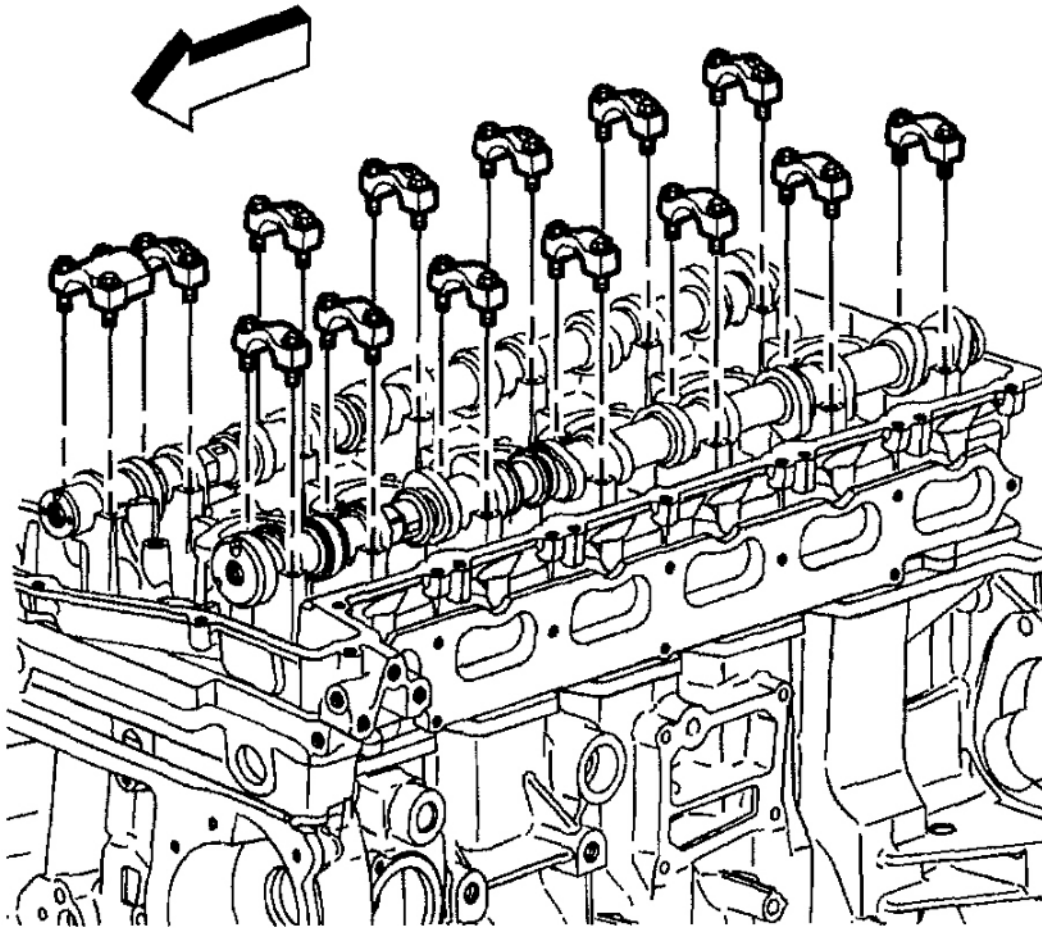
G01706257

Fig. 84: Installing J 44222 Onto Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Carefully move the sprockets with the timing chain off of the camshafts.

IMPORTANT: Place the camshaft caps in a rack to ensure the caps are installed in the same location from which they were removed.

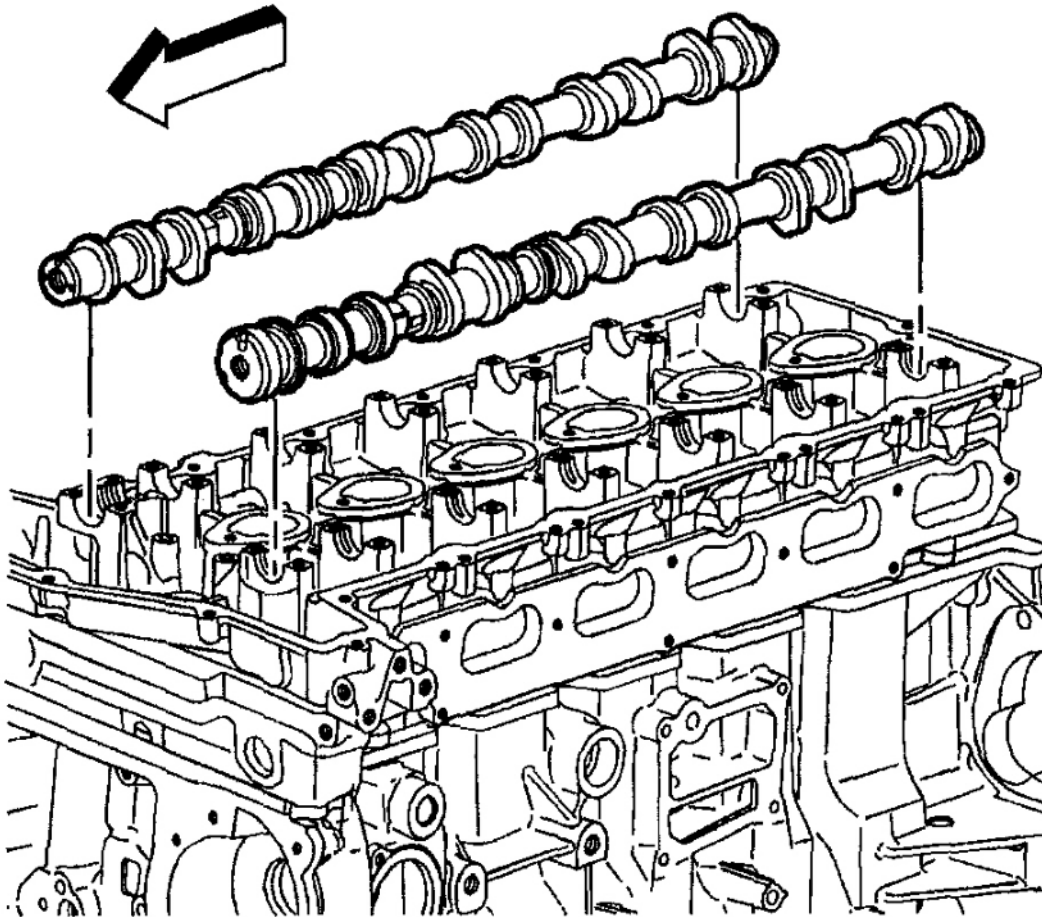
5. Remove the camshaft cap bolts.



G01706258

Fig. 85: Removing Camshaft Cap Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the camshaft caps.
7. Remove the camshafts.



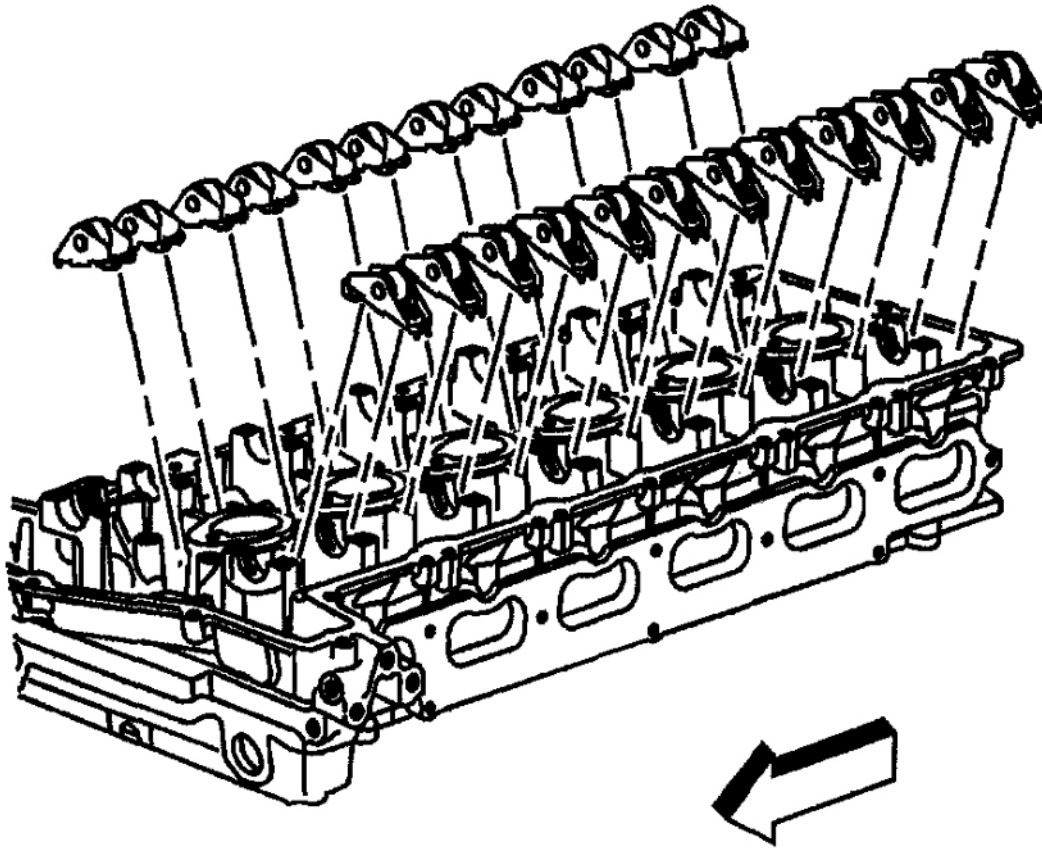
G01706259

Fig. 86: Removing Camshafts

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Once removed, place the valve rocker arms and valve lash adjusters in an organized order so the components can be installed into the original locations.

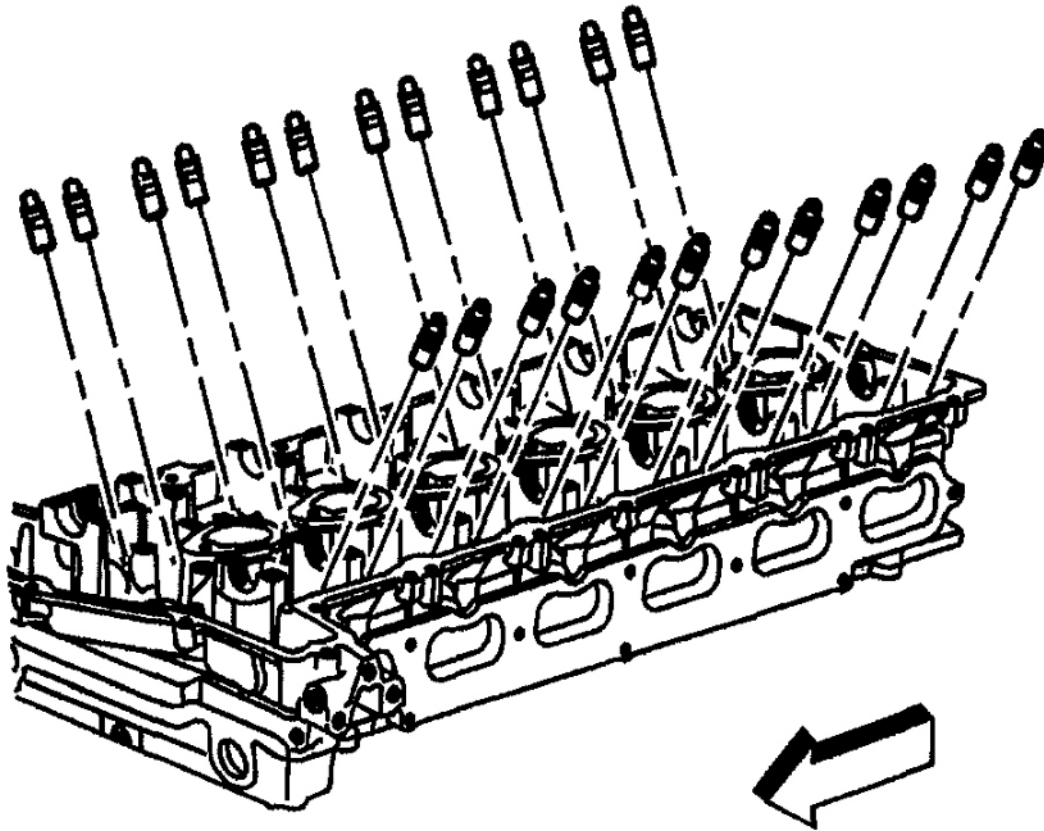
8. Remove the valve rocker arms.



G01706260

Fig. 87: Removing Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve lash adjusters.

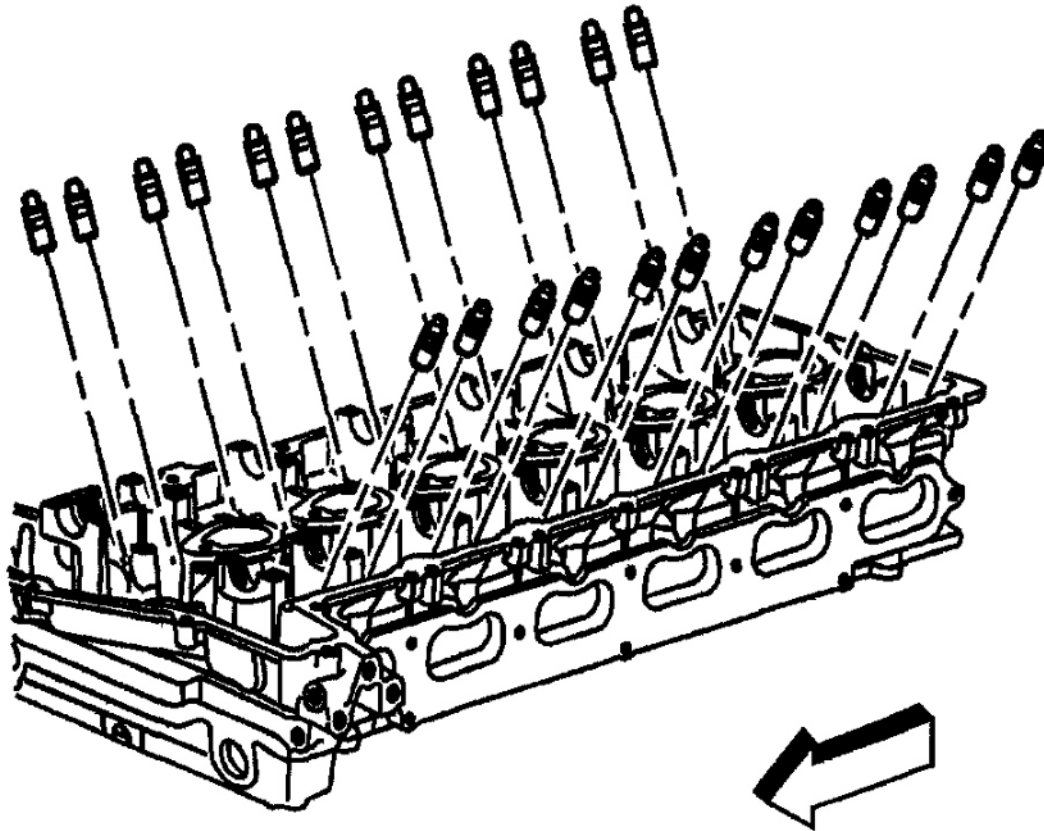


G01706261

Fig. 88: Removing Valve Lash Adjusters
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

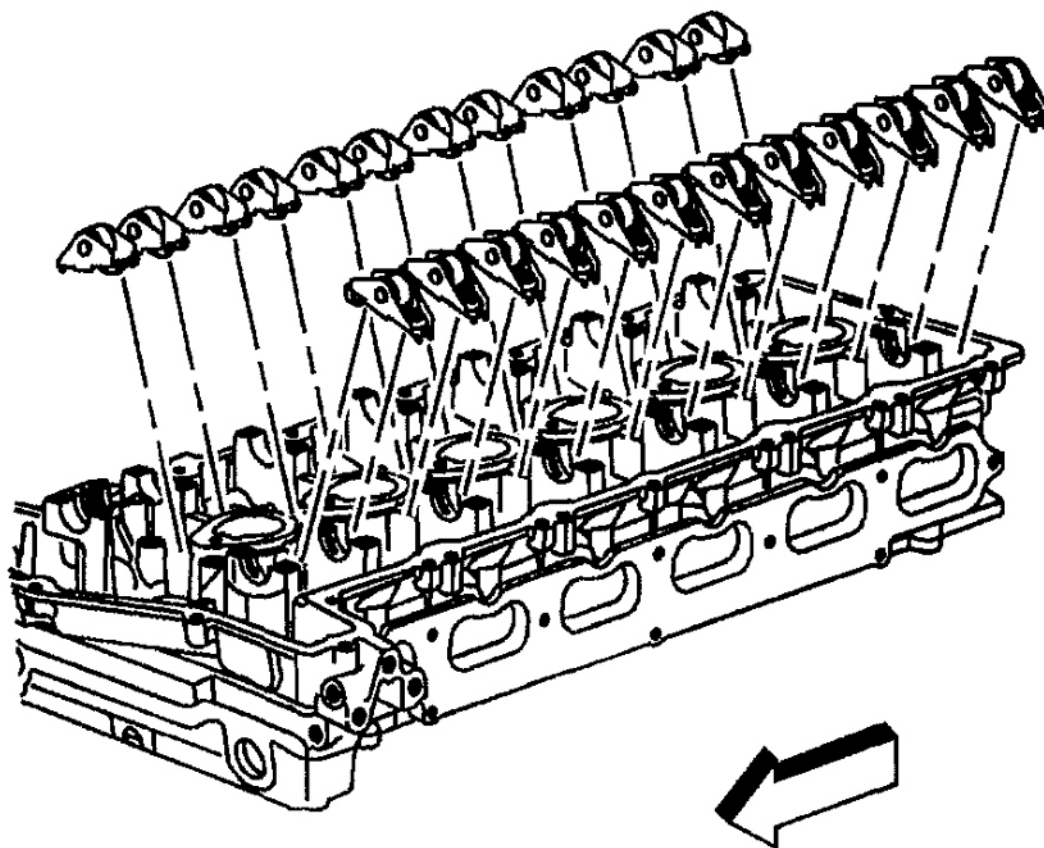
1. Lubricate and fill the valve lash adjusters with engine oil.
2. Install the valve lash adjusters in their original locations.



G01706262

Fig. 89: Installing Valve Lash Adjusters
Courtesy of GENERAL MOTORS CORP.

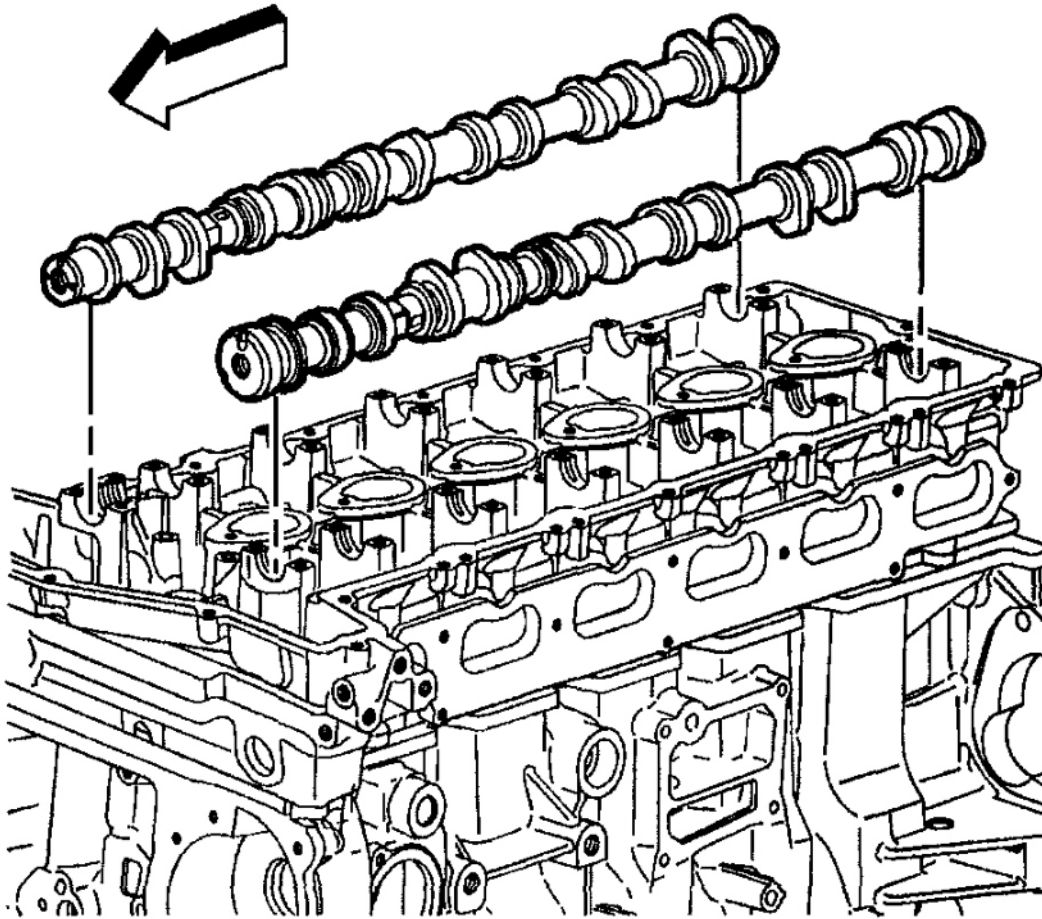
3. Lubricate the valve rocker arm roller.
4. Install the valve rocker arms in their original locations.



G01706263

Fig. 90: Installing Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

5. Coat the camshaft journals with engine oil.
6. Install the camshafts to their original position.



G01706264

Fig. 91: Installing Camshafts

Courtesy of GENERAL MOTORS CORP.

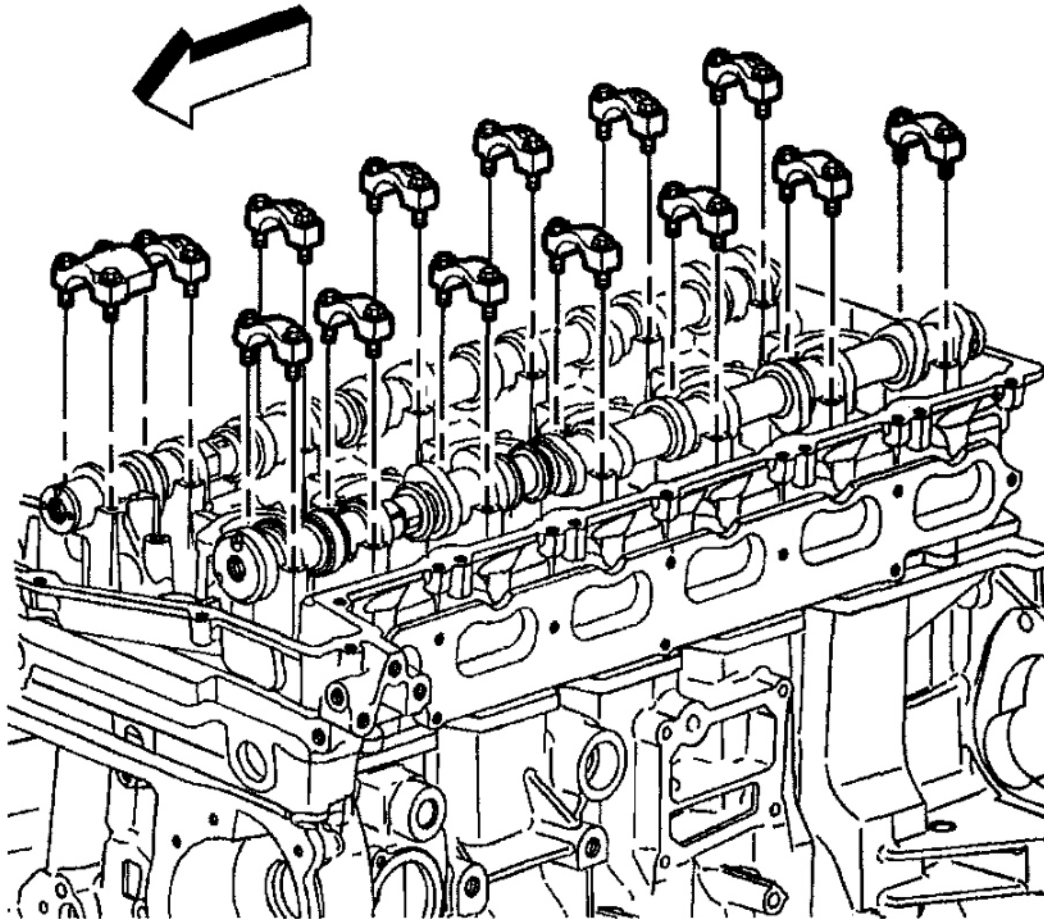
7. Install the camshaft caps onto their original journal.

NOTE:

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the camshaft cap bolts to 12 N.m (106 lb in).



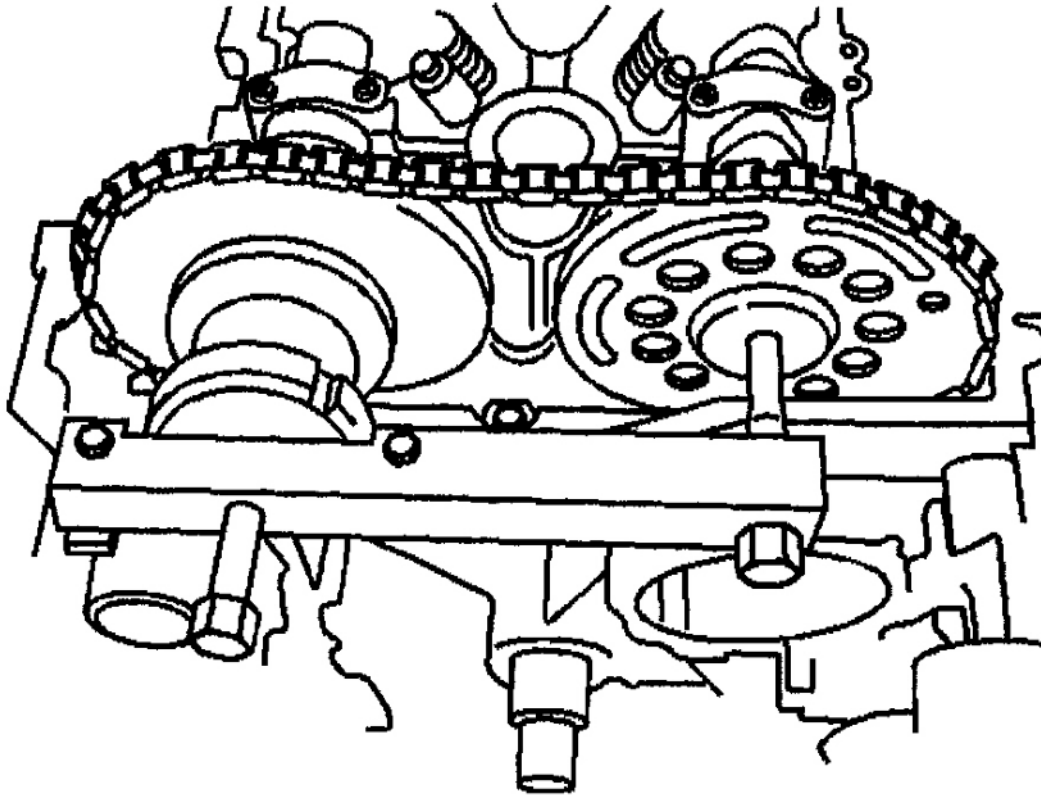
G01706265

Fig. 92: Installing Camshaft Caps
Courtesy of GENERAL MOTORS CORP.

8. Carefully move the camshaft sprockets back onto the camshafts and remove the J 44222.
9. Install the intake camshaft sprocket washer, and the bolt, and the exhaust camshaft actuator bolt.

Tighten

- Tighten the intake camshaft sprocket bolt the first pass 30 N.m (22 lb ft).
- Use the J 36660-A to tighten the intake camshaft sprocket bolt the final pass and additional 135 degrees.



G01706266

Fig. 93: Using J 36660-A To Tighten Intake Camshaft Sprocket Bolt
Courtesy of GENERAL MOTORS CORP.

- Tighten the exhaust camshaft actuator bolt the first pass to 25 N.m (18 lb ft).
- Use the J 36660-A to tighten the exhaust camshaft actuator bolt a final pass an additional 135 degrees.

10. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

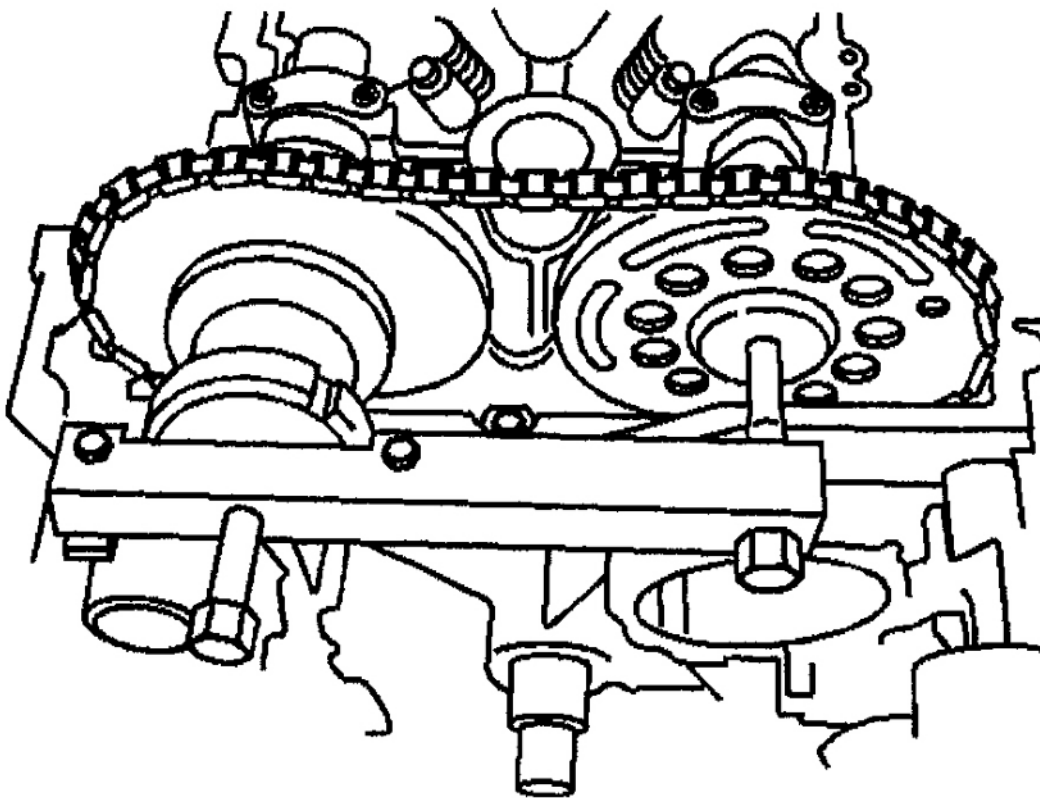
Tools Required

- **J 44222** Camshaft Sprocket Holding Tool
- **J 38820** Valve Stem Seal Installer
- **J 44228** Valve Spring Compressor

Removal Procedure

IMPORTANT: Organize the valve train components when disassembling so they can be reassembled in the same location and matched up with the same components, as previously installed.

1. Remove the cam cover. Refer to Camshaft Cover Replacement.
2. Remove the spark plugs. Refer to Spark Plug Replacement in Engine Controls-4.2 L.
3. Remove the exhaust and the intake sprocket bolts.
4. Install the J 44222 onto the cylinder head in order to keep from disturbing the timing chain components.



G01706267

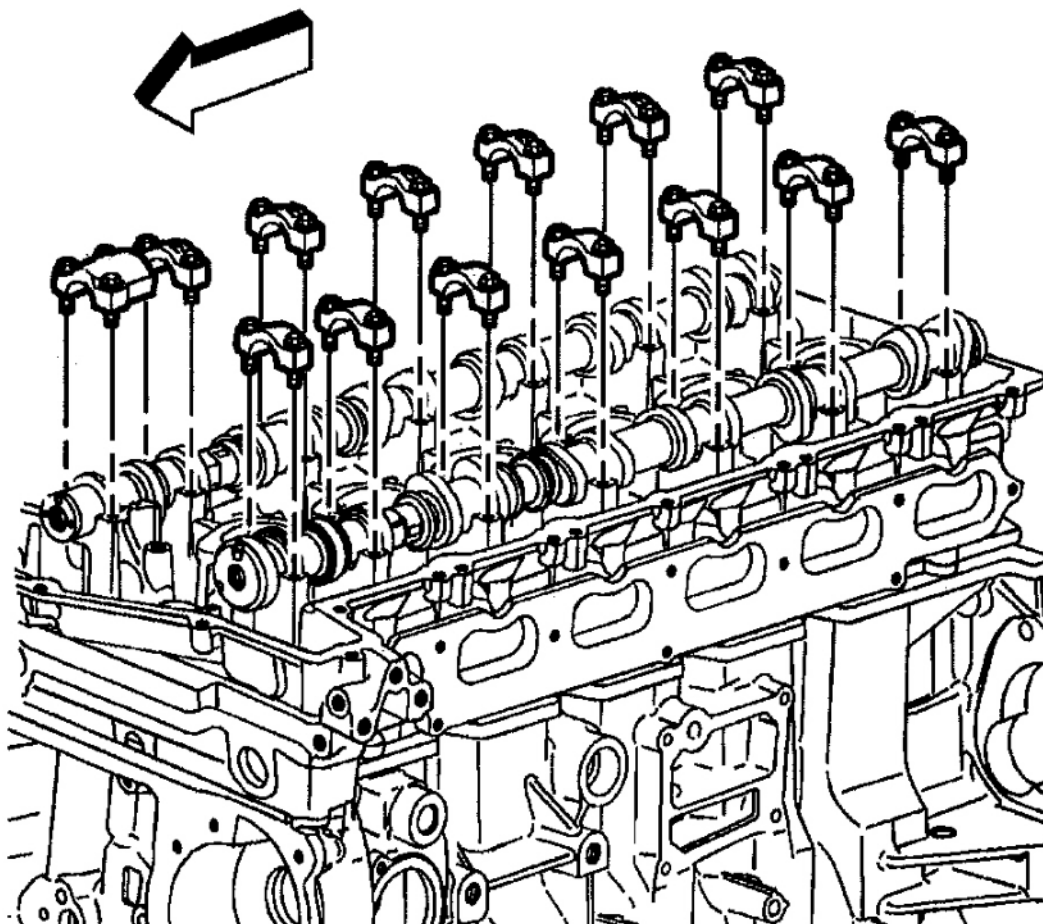
Fig. 94: Installing J 44222 Onto Cylinder Head
Courtesy of GENERAL MOTORS CORP.

5. Adjust the 2 horizontal bolts into the camshaft sprockets to maintain chain tension.
6. Carefully move the sprockets with the timing chain, off of the camshafts.
7. Remove the camshaft cap bolts.

IMPORTANT: Place the camshaft caps in a rack to ensure the caps are installed in the

same location from which they were removed.

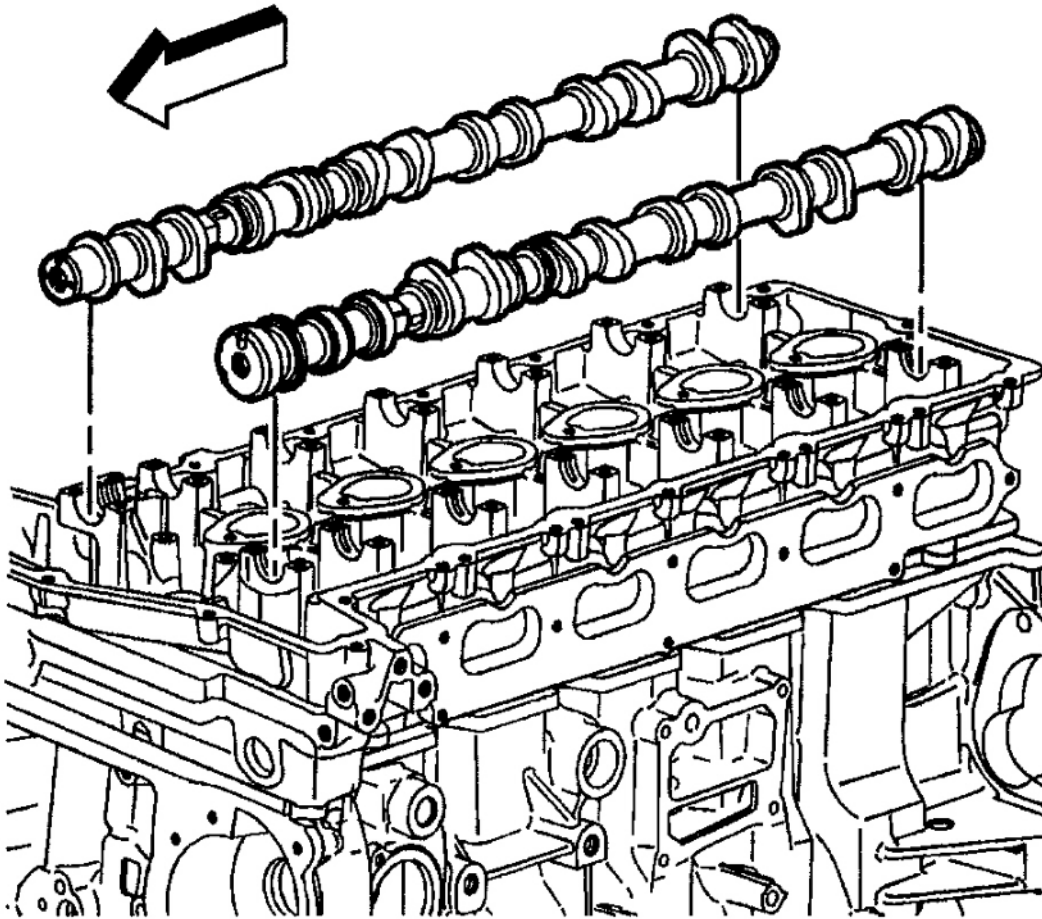
8. Remove the camshaft caps.



G01706268

Fig. 95: Removing Camshaft Caps
Courtesy of GENERAL MOTORS CORP.

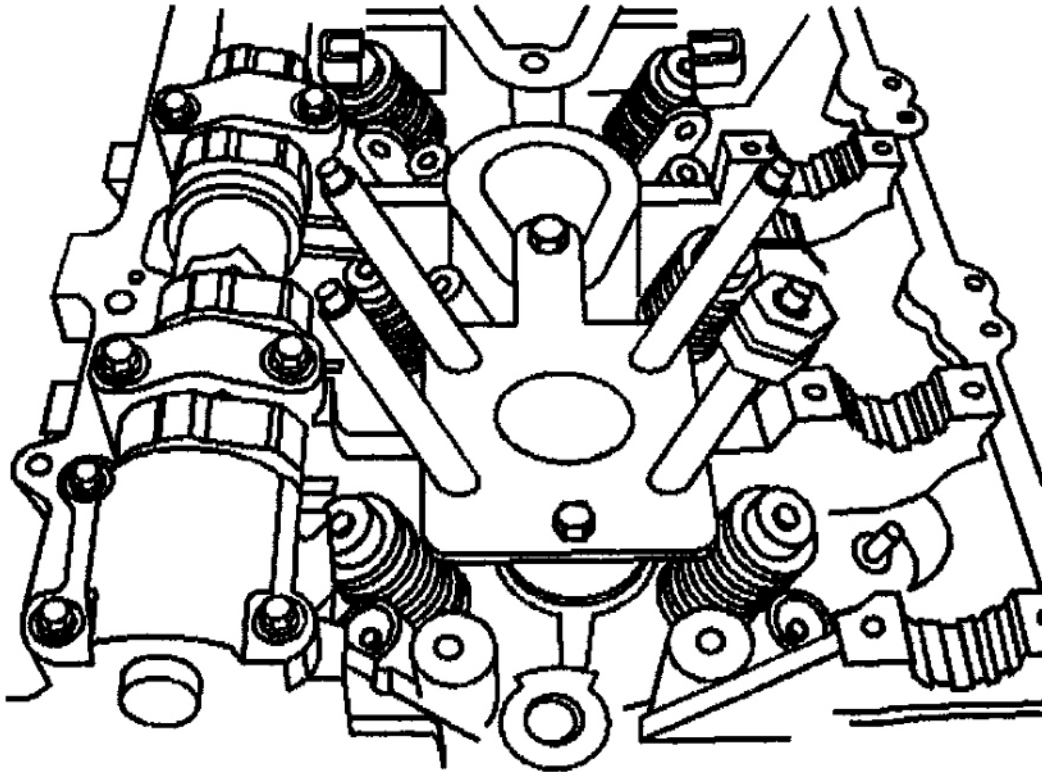
9. Remove the camshafts.



G01706269

Fig. 96: Removing Camshafts**Courtesy of GENERAL MOTORS CORP.**

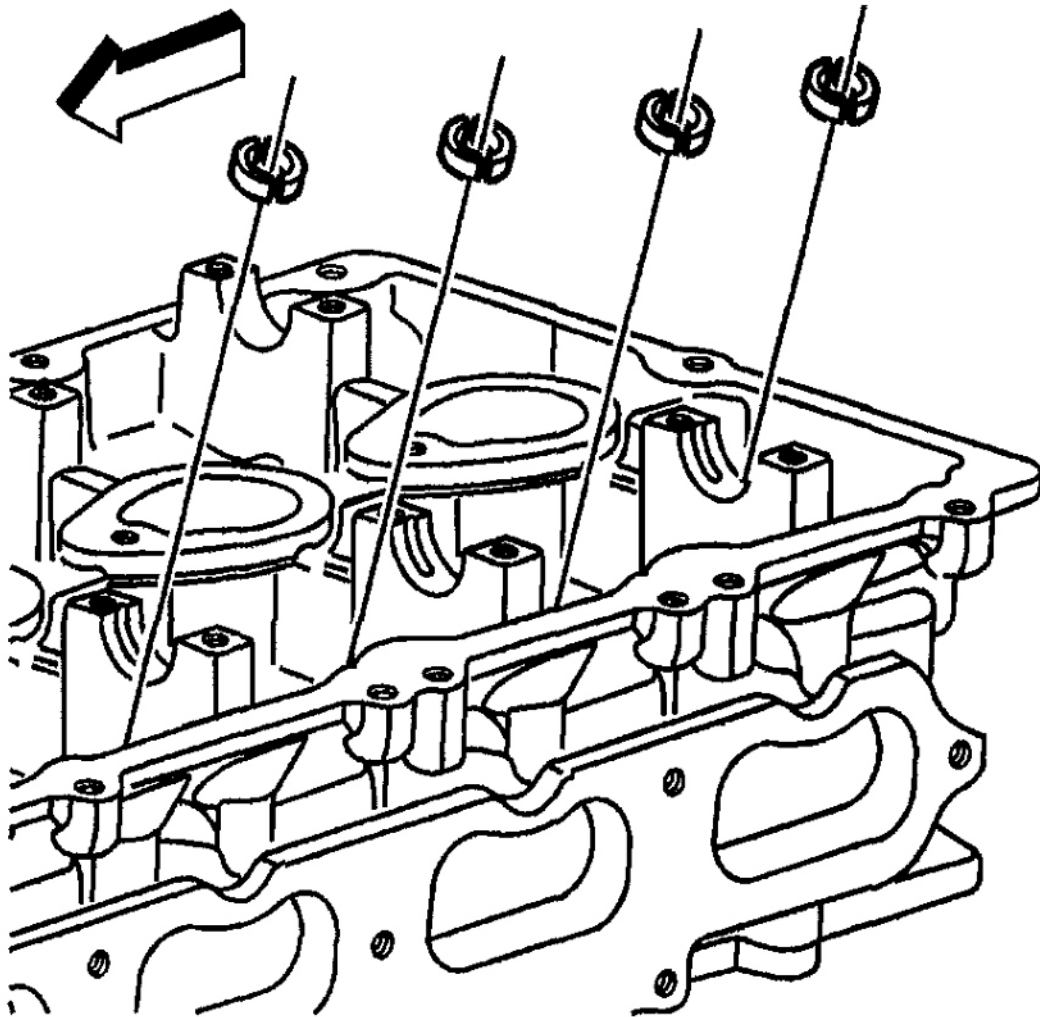
10. Using a suitable adapter, apply air pressure to the cylinder.
11. Install the J 44228 and compress the valve springs.



G01706270

Fig. 97: Installing J 44228 And Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

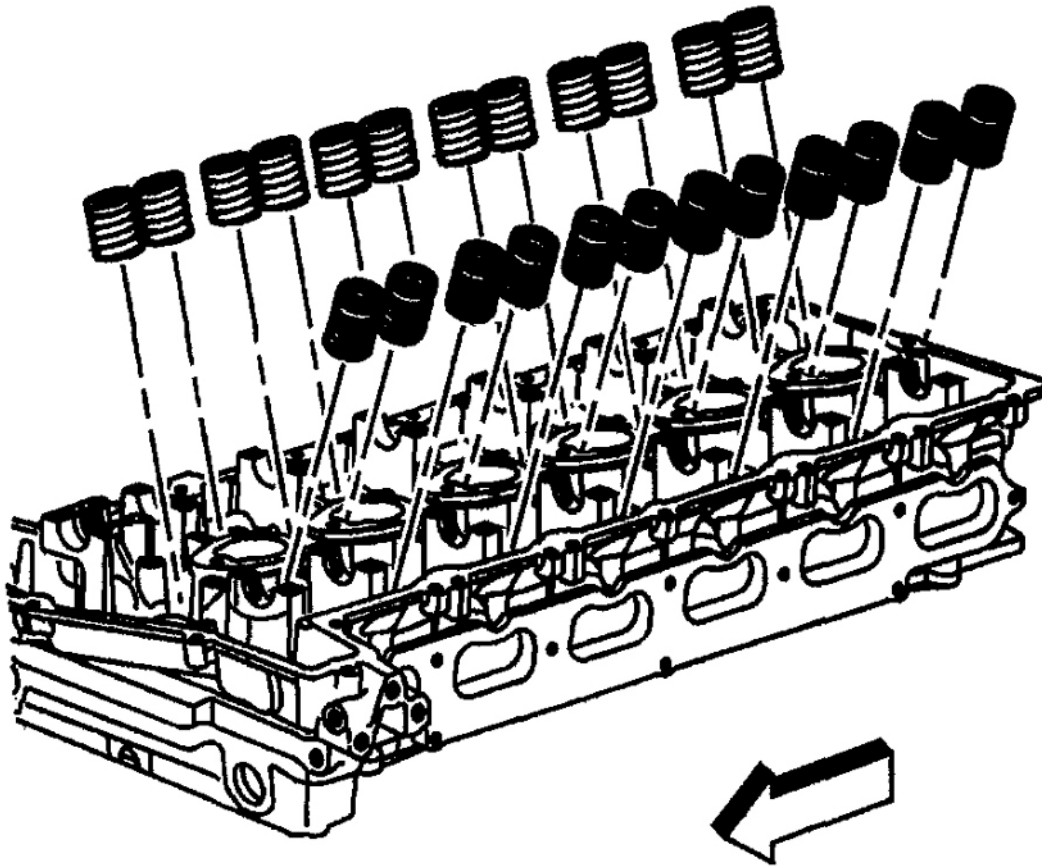
12. Remove the valve keys.



G01706271

Fig. 98: Removing Valve Keys
Courtesy of GENERAL MOTORS CORP.

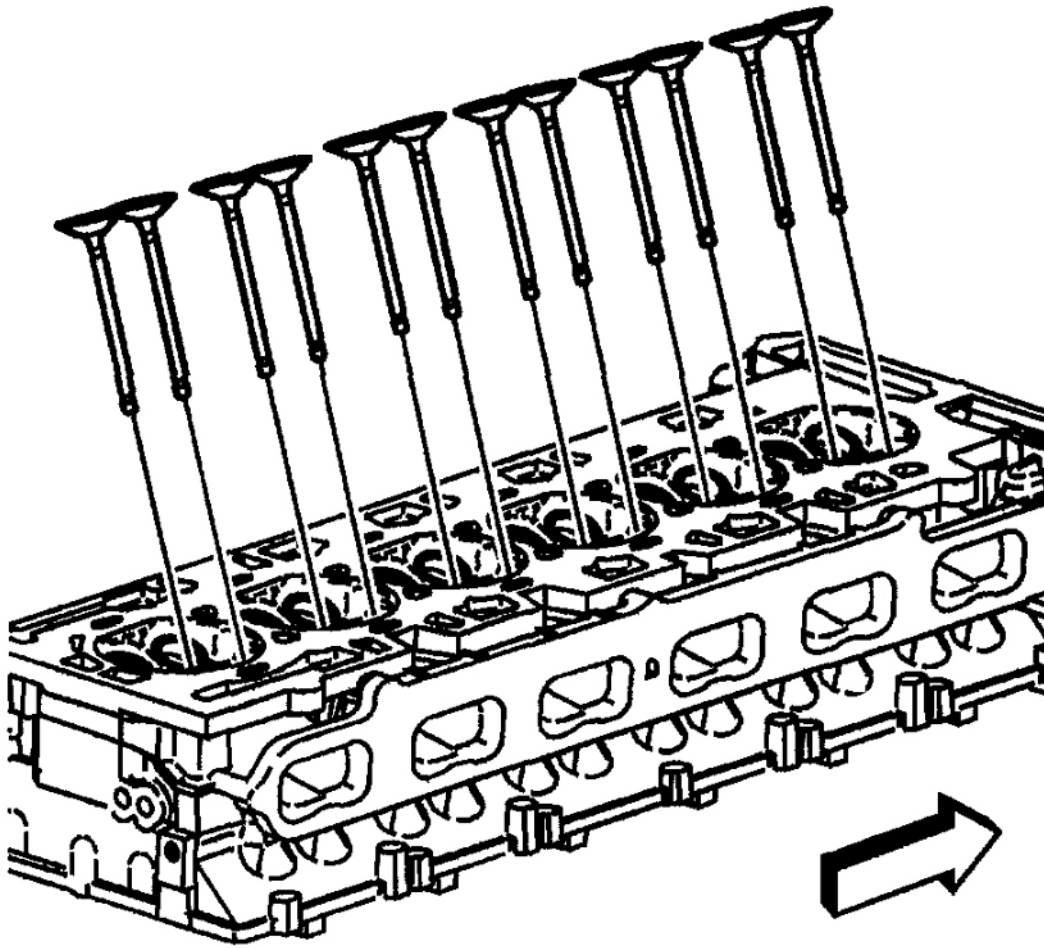
13. Remove the J 44228.
14. Remove the valve spring retainer and the valve spring.



G01706272

Fig. 99: Removing Valve Spring Retainer And Valve Spring
Courtesy of GENERAL MOTORS CORP.

15. Remove the valves.



G01706273

Fig. 100: Removing Valves

Courtesy of GENERAL MOTORS CORP.

16. Use the J 38820 and remove the seals.

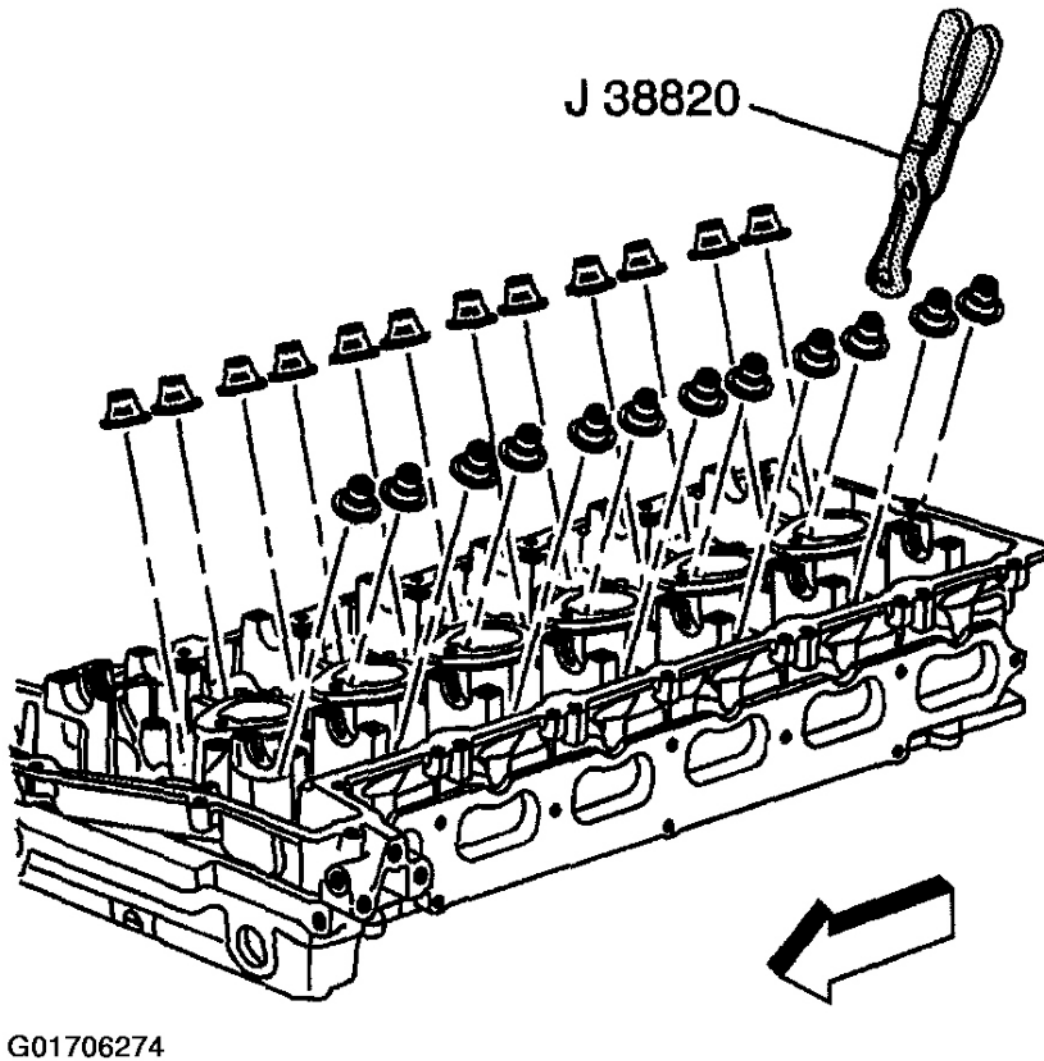


Fig. 101: Removing Seals

Courtesy of GENERAL MOTORS CORP.

17. Clean and inspect the cylinder head. Refer to Cylinder Head Cleaning and Inspection in Engine Mechanical - 4.2 L Unit Repair.

Installation Procedure

1. Use the J 38820 to install the valve seals. There is only one size seal.

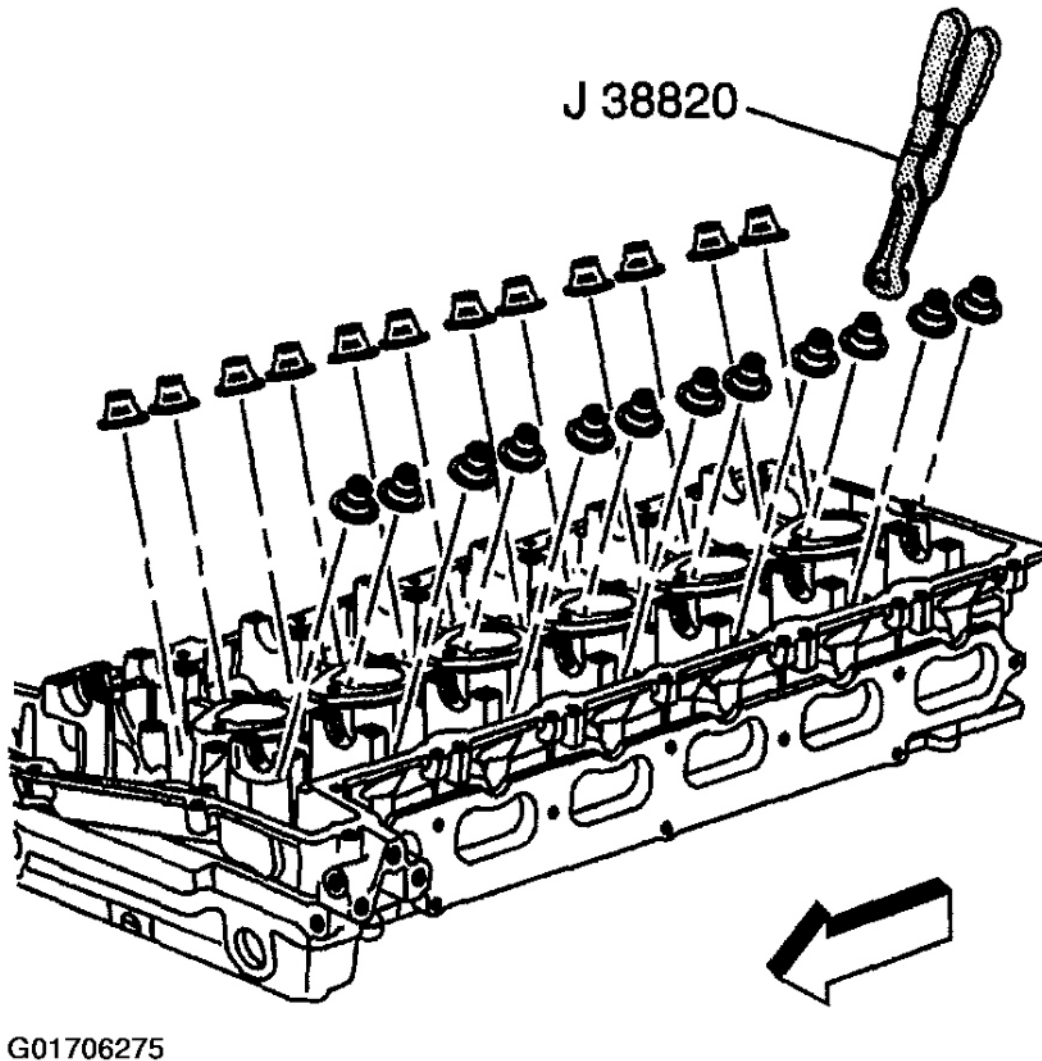
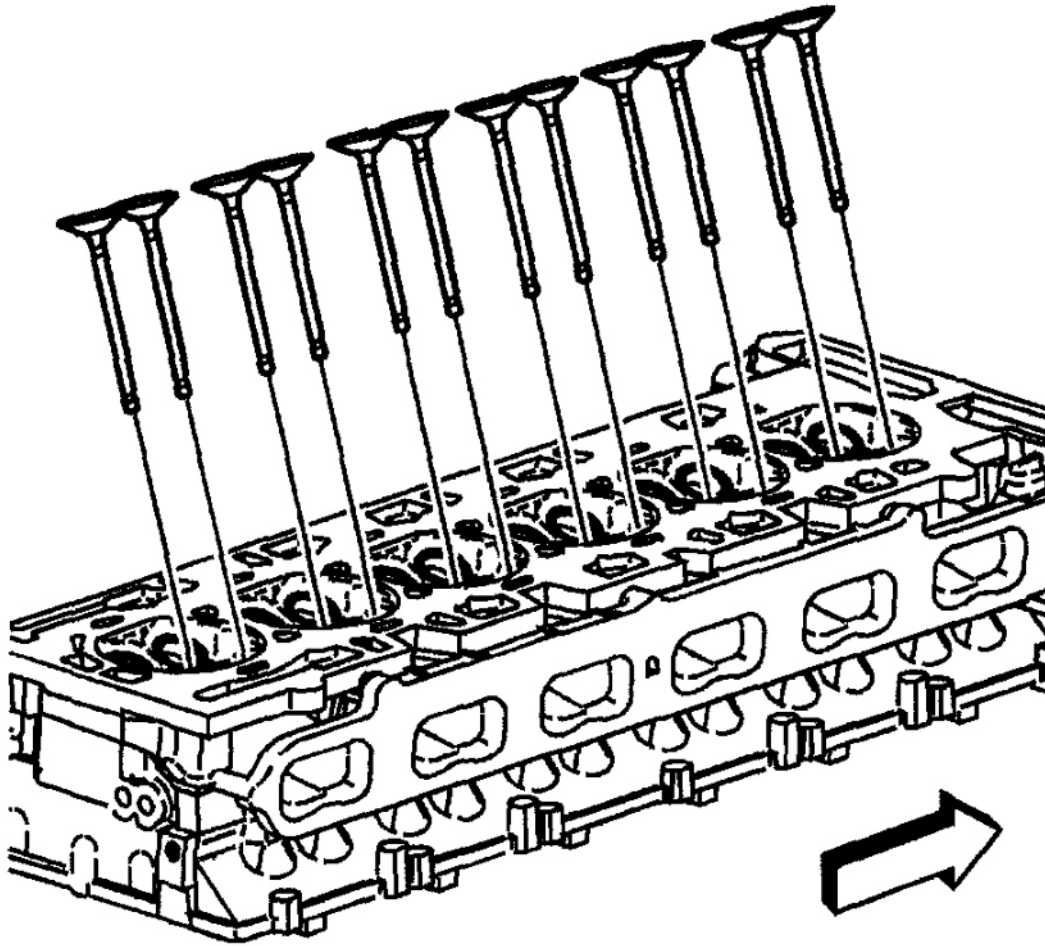


Fig. 102: Installing Valve Seals

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Lubricate the valve stems with clean engine oil before installing.

2. Install the valves. 0.075 mm (0.003 in) oversized valves are available if the valve guides need to be reamed. Use the same (original size) valve seal.

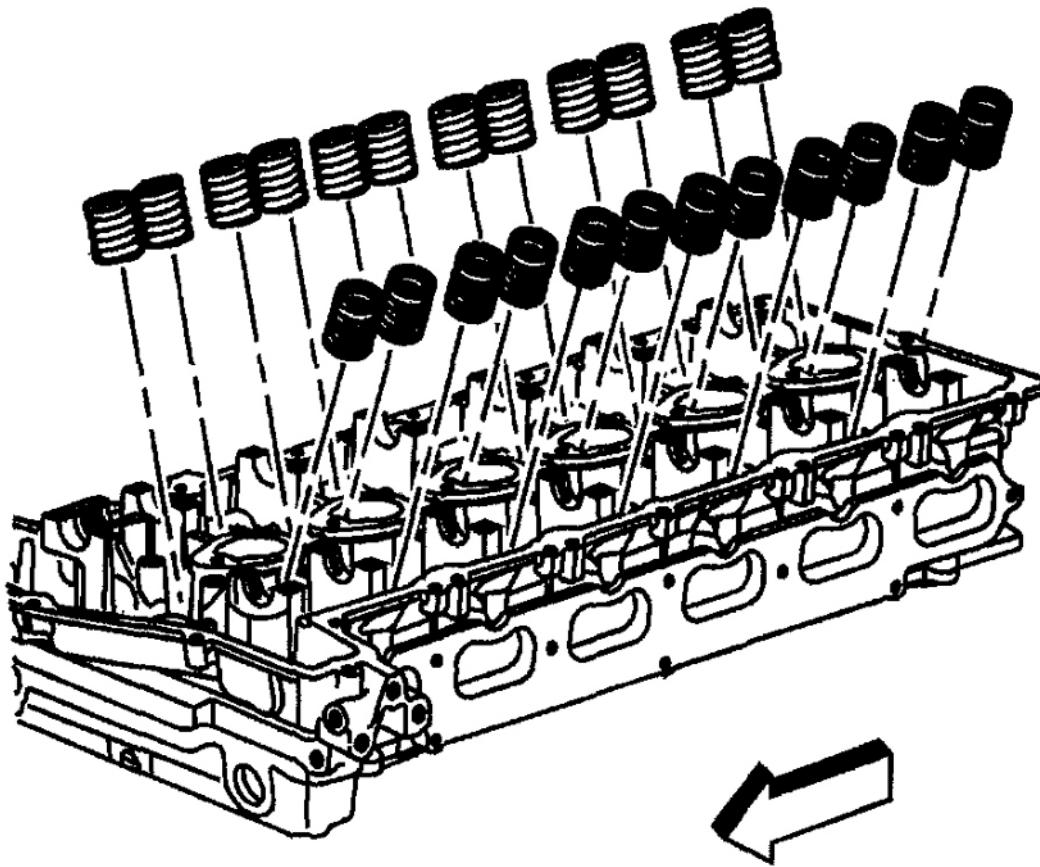


G01706276

Fig. 103: Installing Valves

Courtesy of GENERAL MOTORS CORP.

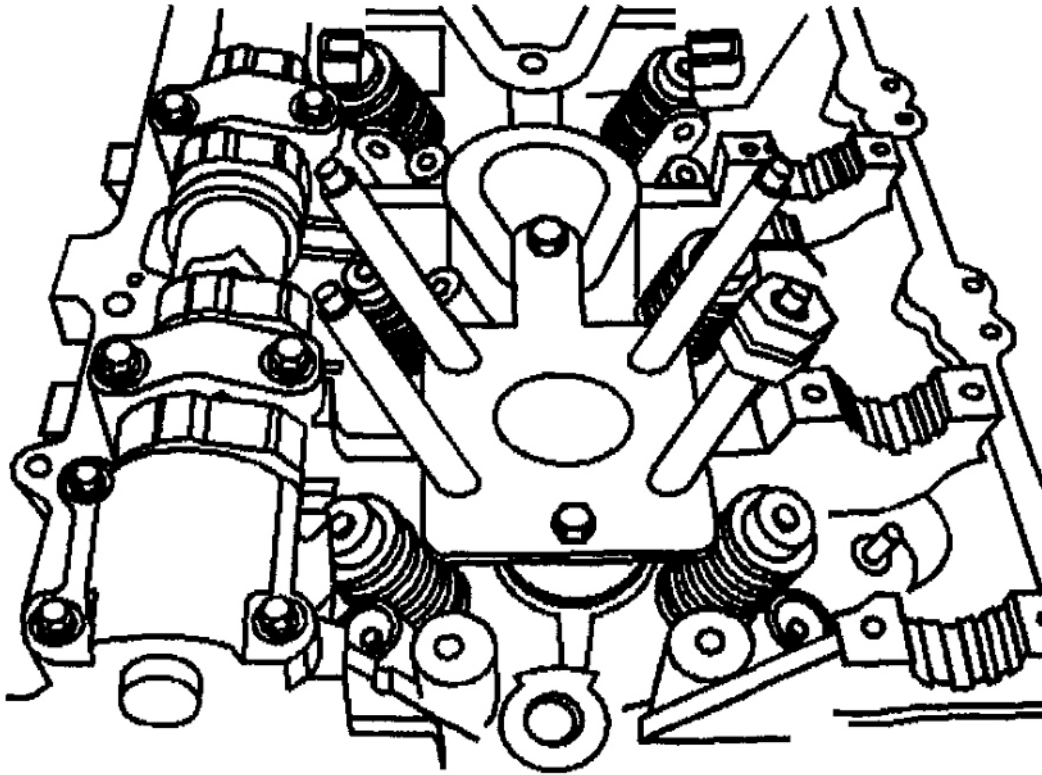
3. Install the valve spring and the valve spring retainer.



G01706277

Fig. 104: Installing Valve Spring And Retainer
Courtesy of GENERAL MOTORS CORP.

4. Use the J 44228 and compress the valve springs.

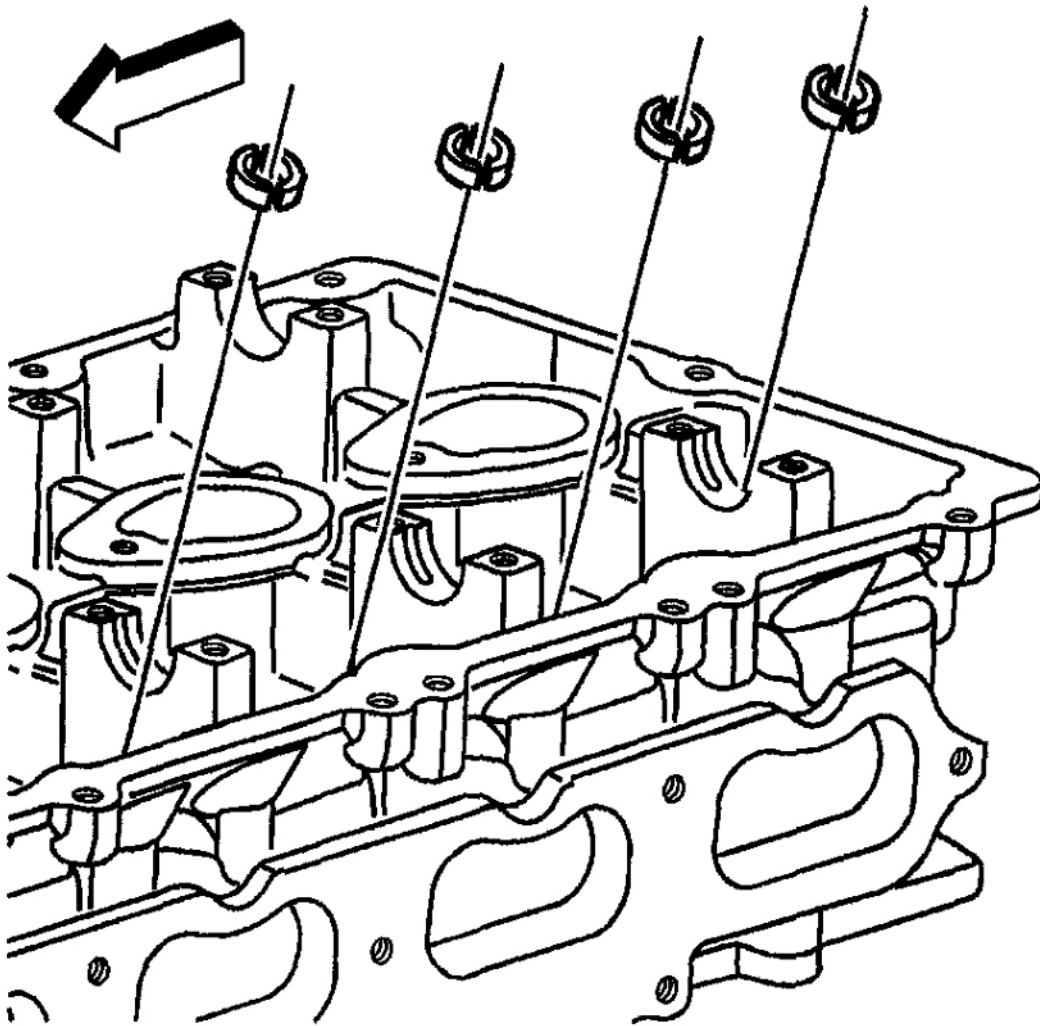


G01706278

Fig. 105: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

5. Install the valve keys.

Remove the J 44228.

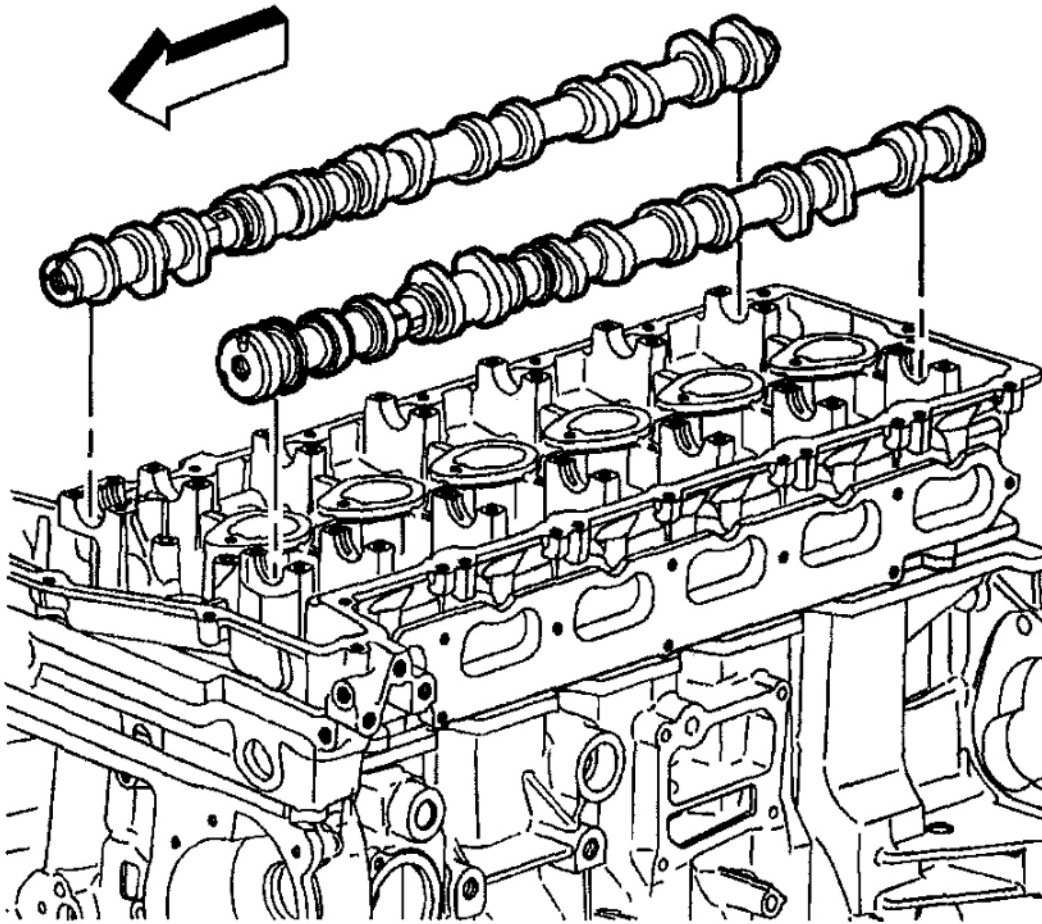


G01706279

Fig. 106: Installing Valve Keys

Courtesy of GENERAL MOTORS CORP.

6. Remove the air pressure to the cylinder.
7. Coat the camshaft journals, the camshaft journal thrust face, and the camshaft lobes with clean engine oil.
8. Install the camshafts to their original position.



G01706280

Fig. 107: Installing Camshafts

Courtesy of GENERAL MOTORS CORP.

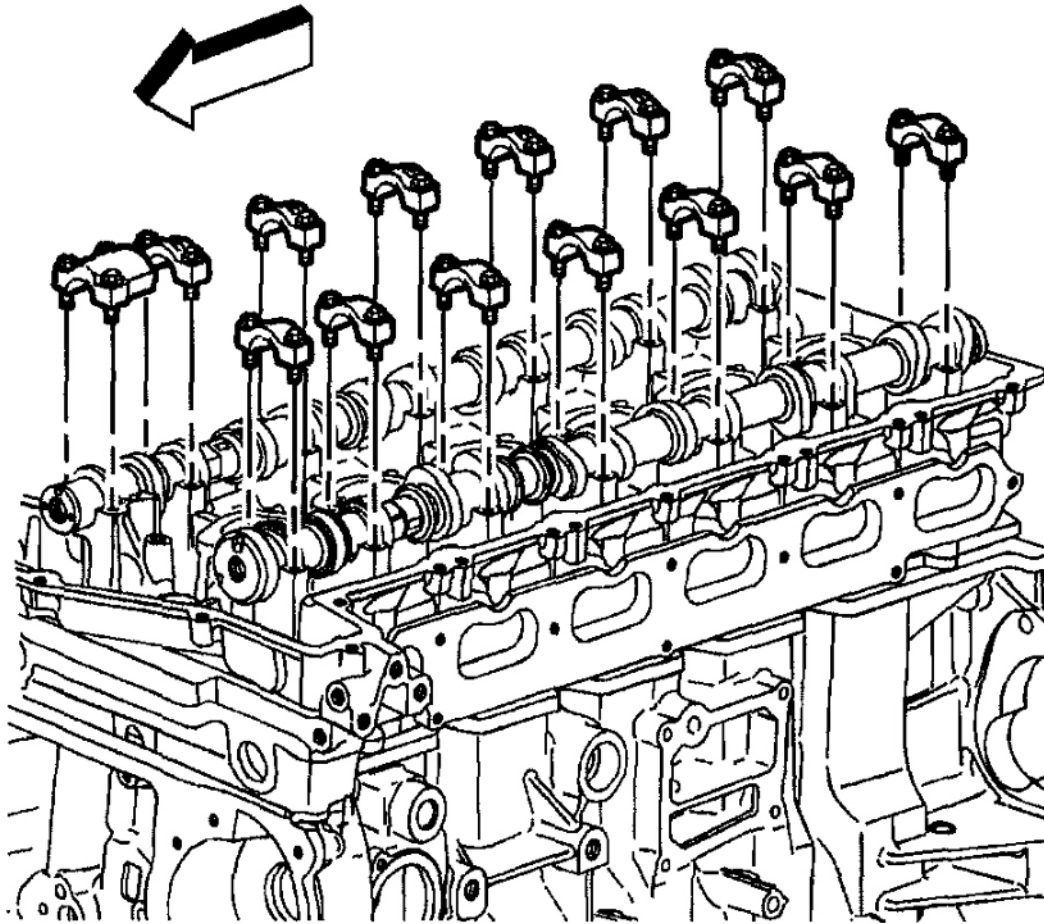
9. Install the camshaft caps onto their original journal.

NOTE:

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the camshaft cap bolts to 12 N.m (106 lb in).

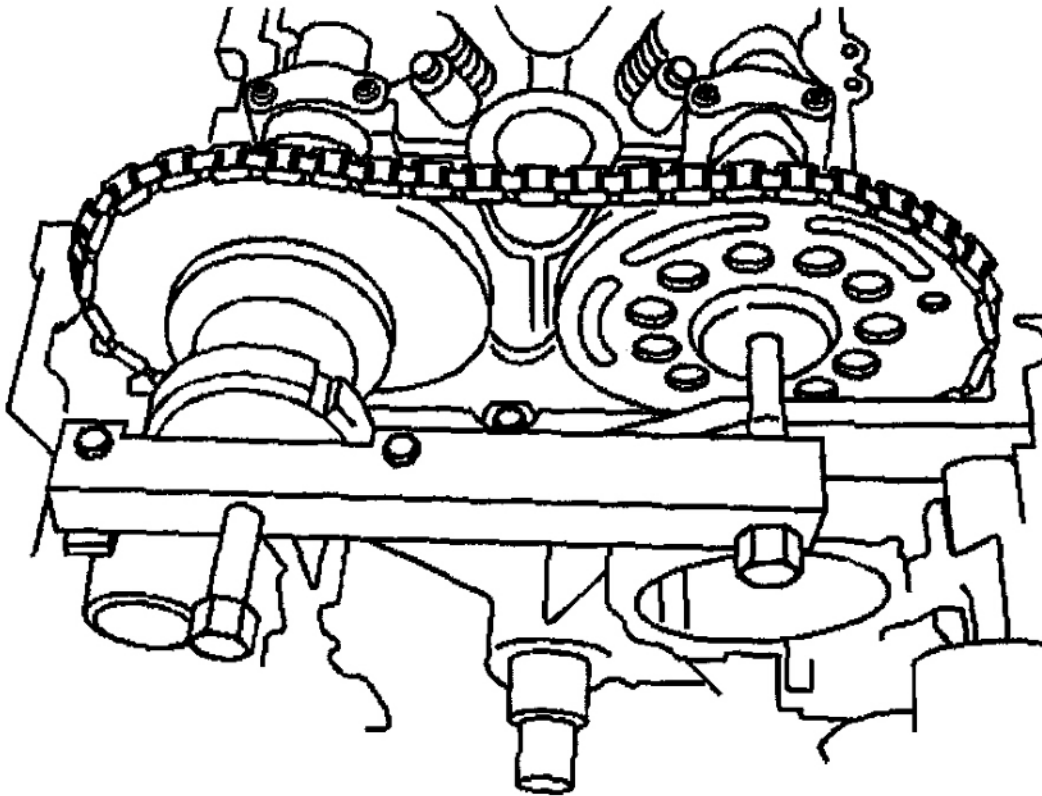


G01706281

Fig. 108: Installing Camshaft Caps

Courtesy of GENERAL MOTORS CORP.

10. Carefully move the camshaft sprockets back onto the camshafts and remove the J 44222.



G01706282

Fig. 109: Removing J 44222

Courtesy of GENERAL MOTORS CORP.

11. Install the intake camshaft sprocket washer and the bolt, and the exhaust camshaft actuator bolt.

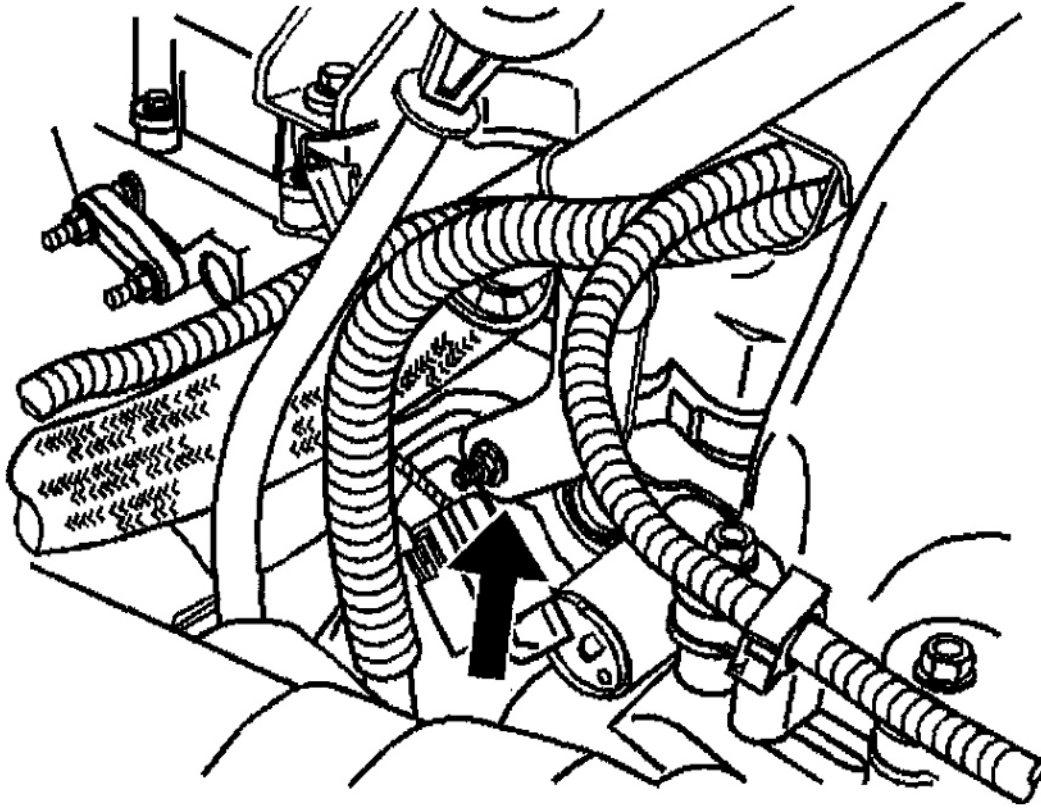
Tighten

- Tighten the intake camshaft sprocket bolt the first pass to 30 N.m (22 lb ft).
 - Use the J 36660-A to tighten the intake camshaft sprocket bolt the final pass and additional 135 degrees.
 - Tighten the exhaust camshaft actuator bolt the first pass to 25 N.m (18 lb ft).
 - Use the J 36660-A to tighten the exhaust camshaft actuator bolt a final pass an additional 135 degrees.
12. Install the spark plugs. Refer to Spark Plug Replacement in Engine Controls-4.2 L.
 13. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

Removal Procedure

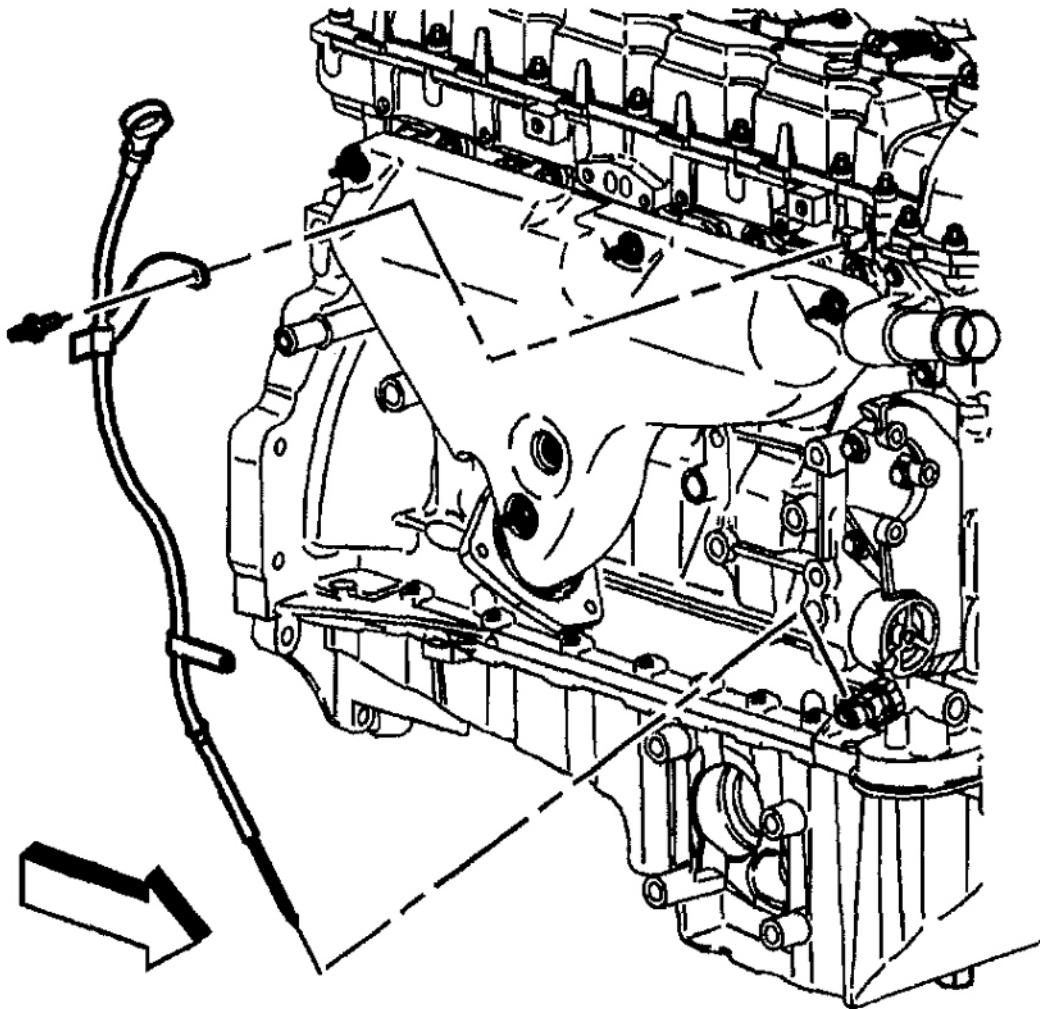
1. Remove the A/C line bracket nut.



G01706283

Fig. 110: Removing A/C Line Bracket Nut
Courtesy of GENERAL MOTORS CORP.

2. Remove the A/C line bracket from the oil level indicator tube stud.
3. Disconnect the O2 sensor electrical connector from the oil level indicator bracket.
4. Remove the oil level indicator tube stud.
5. Pull the indicator out of the tube.
6. Pull the tube out of the block.



G01706284

Fig. 111: Pulling Tube Out Of Block
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the oil level indicator tube into the engine block.
2. Add sealant GM P/N 12346004 to the oil level indicator tube stud threads.
3. Install the oil level indicator tube stud.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or

sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

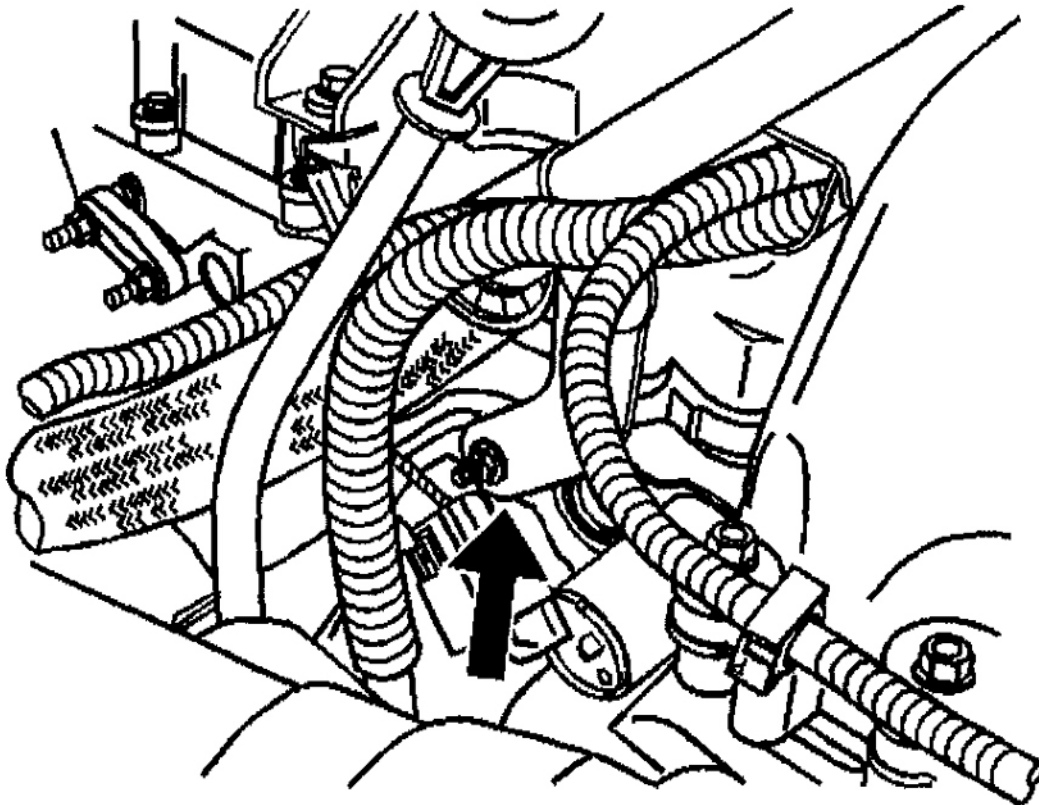
Tighten

Tighten the oil level indicator tube stud to 10 N.m (89 lb in).

4. Install the A/C line bracket to oil level indicator tube and secure with the nut.

Tighten

Tighten the A/C line bracket nut to 7 N.m (6 lb in).



G01706285

Fig. 112: Installing A/C Line Bracket To Oil Level Indicator Tube

Courtesy of GENERAL MOTORS CORP.

5. Connect the O2 sensor electrical connector.
6. Install the oil level indicator into the tube.

CYLINDER HEAD REPLACEMENT

CAUTION: Torque To Yield (TTY) bolts used on cylinder head and main bearing cap bolts may bend or break during removal. Interaction between TTY bolt and threads may cause bolt to bend or break during removal. To minimize this problem, prior to removing TTY bolts, perform the following:

- Using an appropriate size punch and hammer, rap head of each bolt. Vibration produced by this procedure will assist in a successful removal.
- If a bolt breaks during disassembly, a broken bolt Extractor Kit (EN-47702) has been released to assist in removal of remaining bolt segment. Many times the remaining bolt fragment will back out easily with a pick tool or reverse twist drill bit. NEVER reuse TTY bolts. Always make sure block threaded holes are clean and DO NOT place oil or threadlock on NEW bolts. See GM TSB 05-06-01-026B ON TORQUE TO YIELD BOLT BREAKAGE .

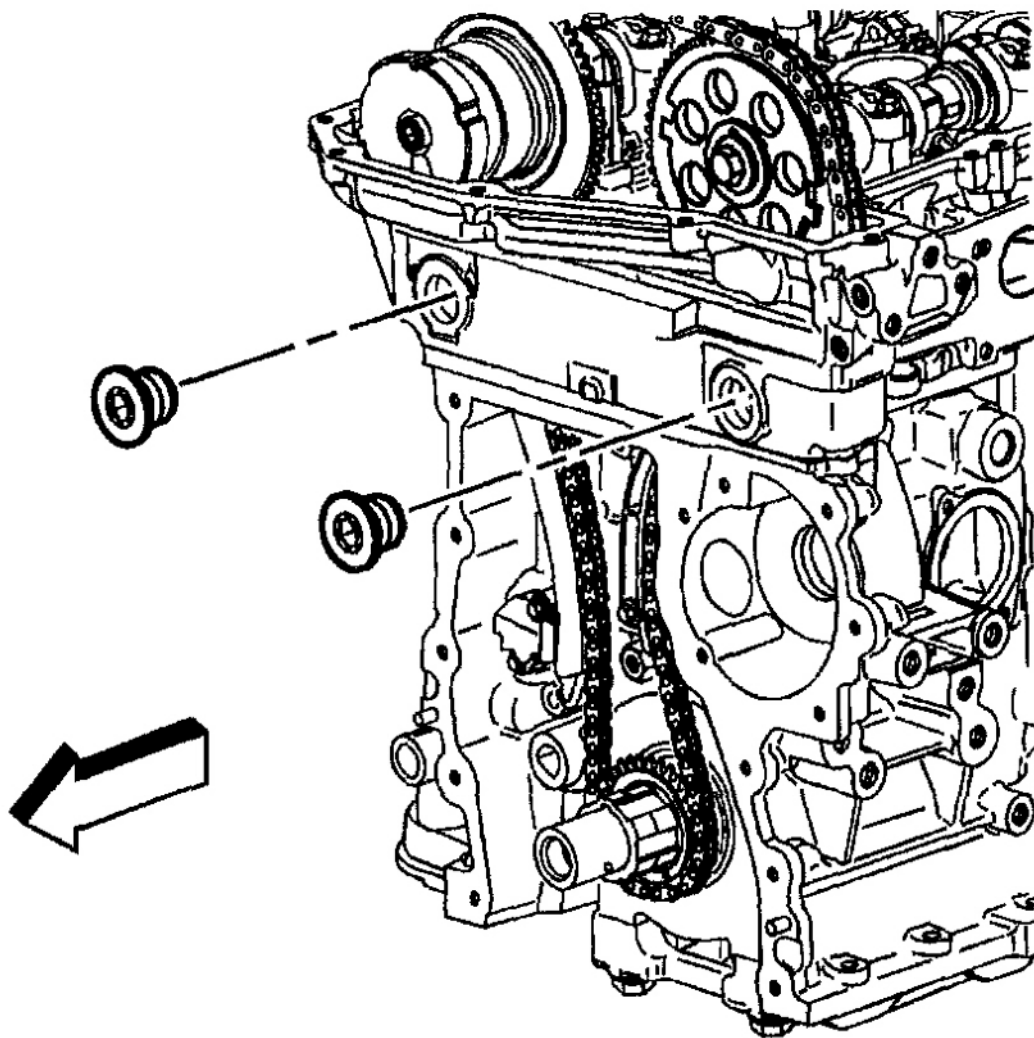
NOTE: General Motors has developed a procedure for removing the cylinder head without the removal of the front cover. The new procedure can be done in vehicle with the aid of a new special service tool. See **INFORMATION ON NEW IN-VEHICLE SERVICE PROCEDURE FOR REMOVAL/INSTALLATION OF LK5 OR L52 CYLINDER HEAD** .

Tools Required

J 36660-A Torque/Angle Meter

Removal Procedure

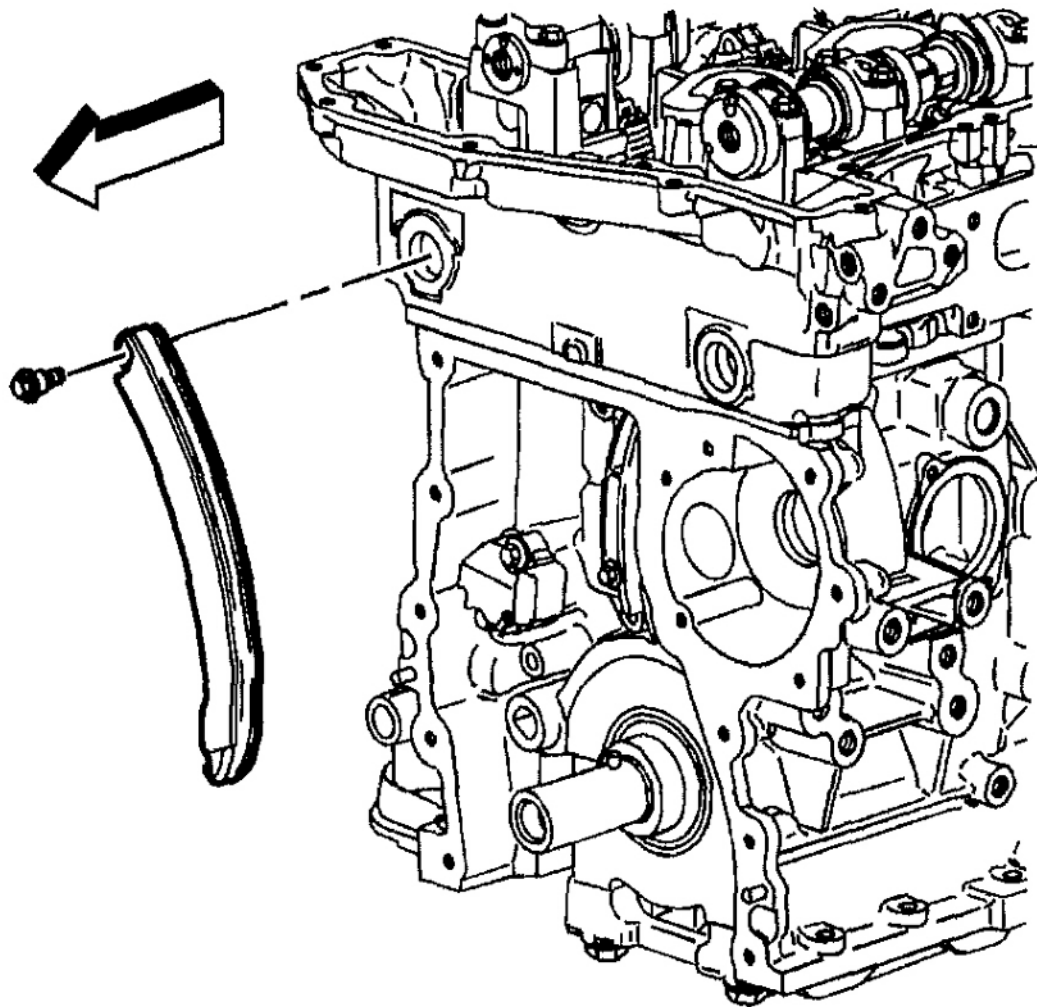
1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
2. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement** .
3. Remove the front cover. Refer to **Engine Front Cover Replacement**.
4. Remove the cylinder head access hole plugs.



G01706286

Fig. 113: Removing Cylinder Head Access Hole Plugs
Courtesy of GENERAL MOTORS CORP.

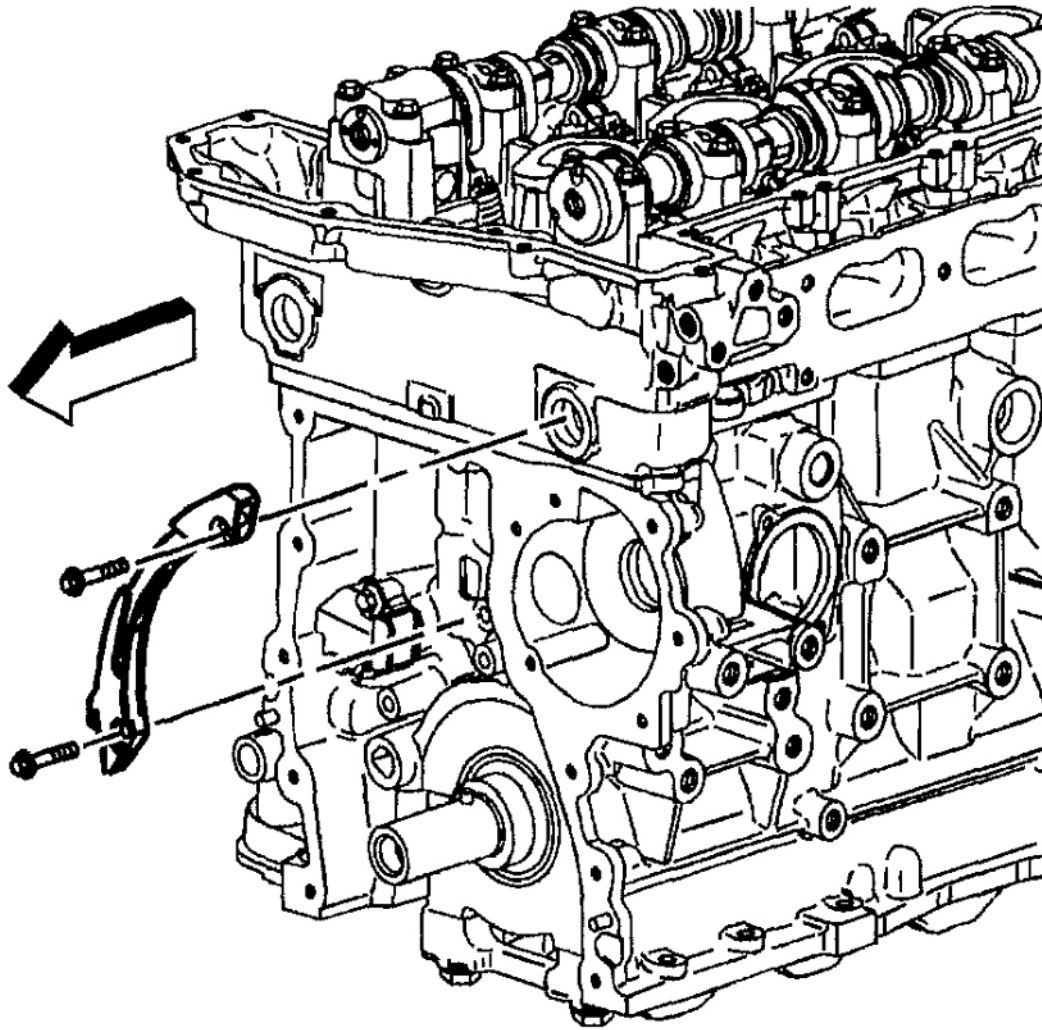
5. Remove the timing chain tensioner shoe bolt.



G01706287

Fig. 114: Removing Timing Chain Tensioner Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

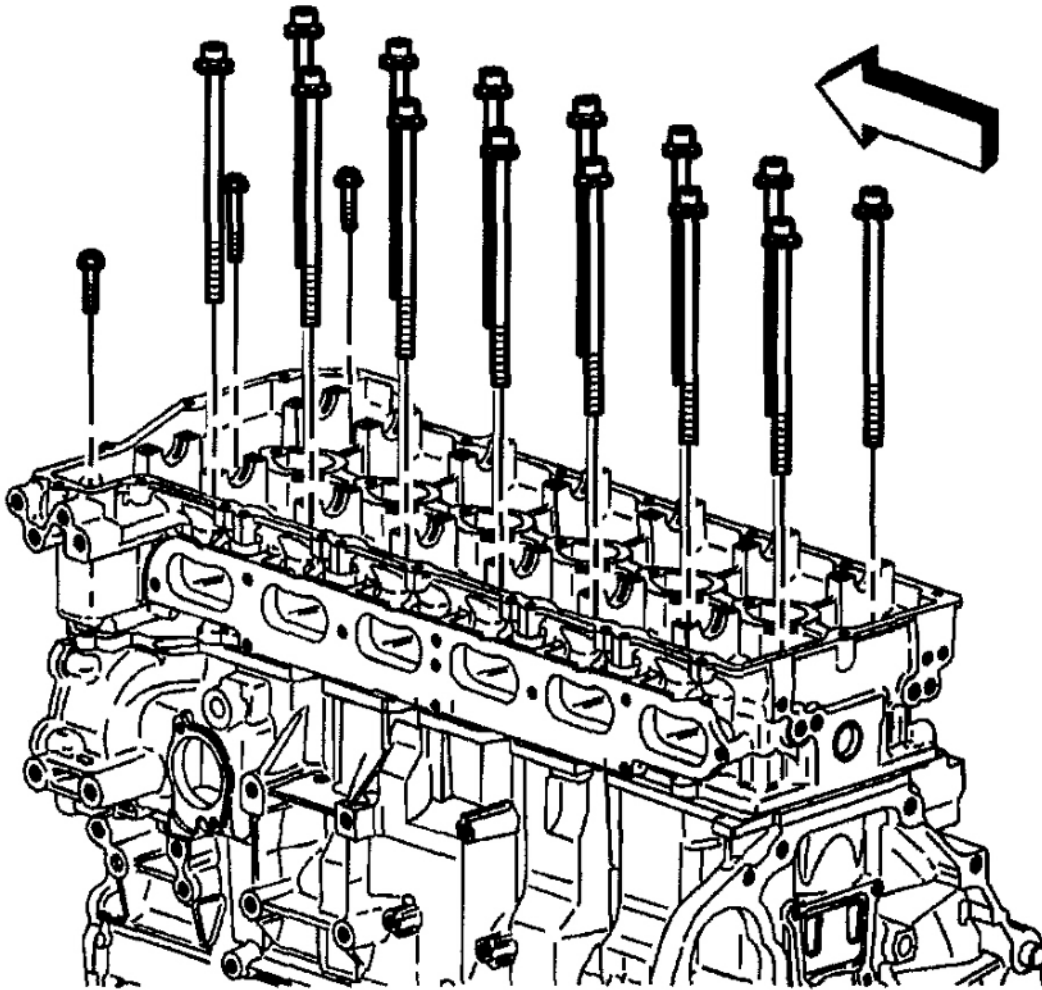
6. Remove the timing chain tensioner shoe.
7. Remove the timing chain tensioner guide bolts.



G01706288

Fig. 115: Removing Timing Chain Tensioner Guide Bolts
Courtesy of GENERAL MOTORS CORP.

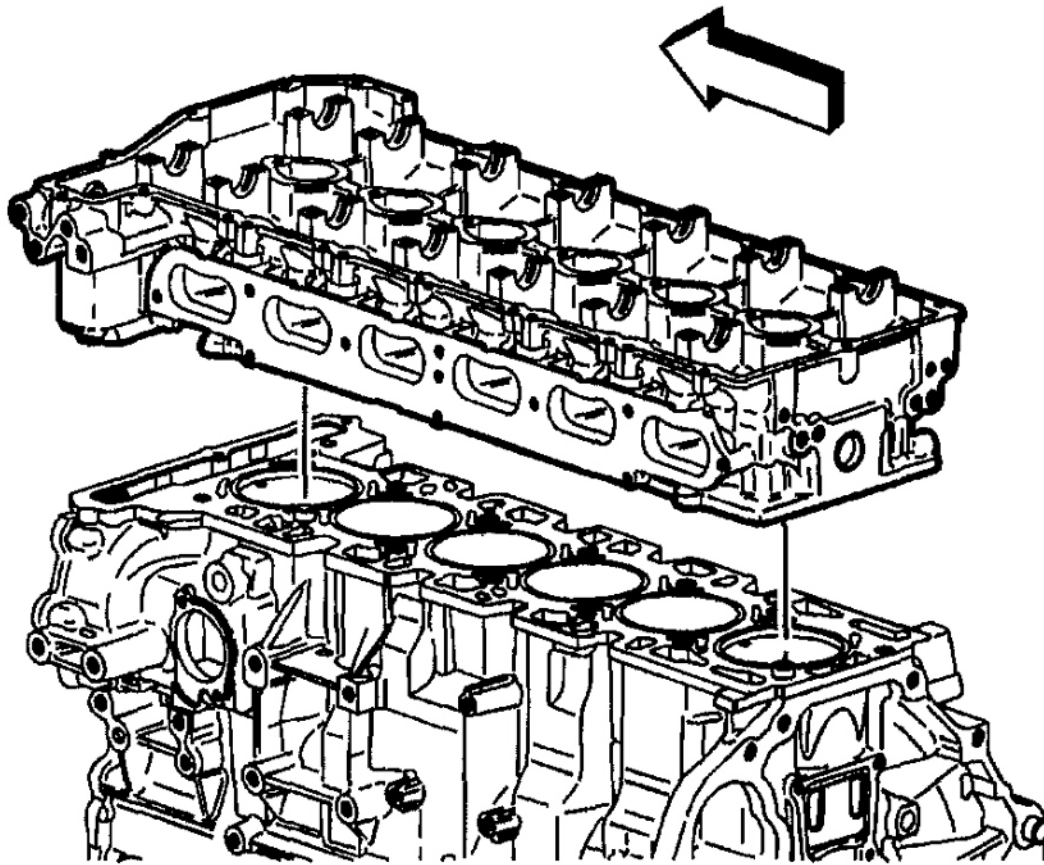
8. Remove the timing chain tensioner guide.
9. Remove the timing chain and the sprockets. Refer to **Timing Chain, Sprockets, and/or Tensioner Replacement**.
10. Loosen and remove the cylinder head bolts.



G01706289

Fig. 116: Removing Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

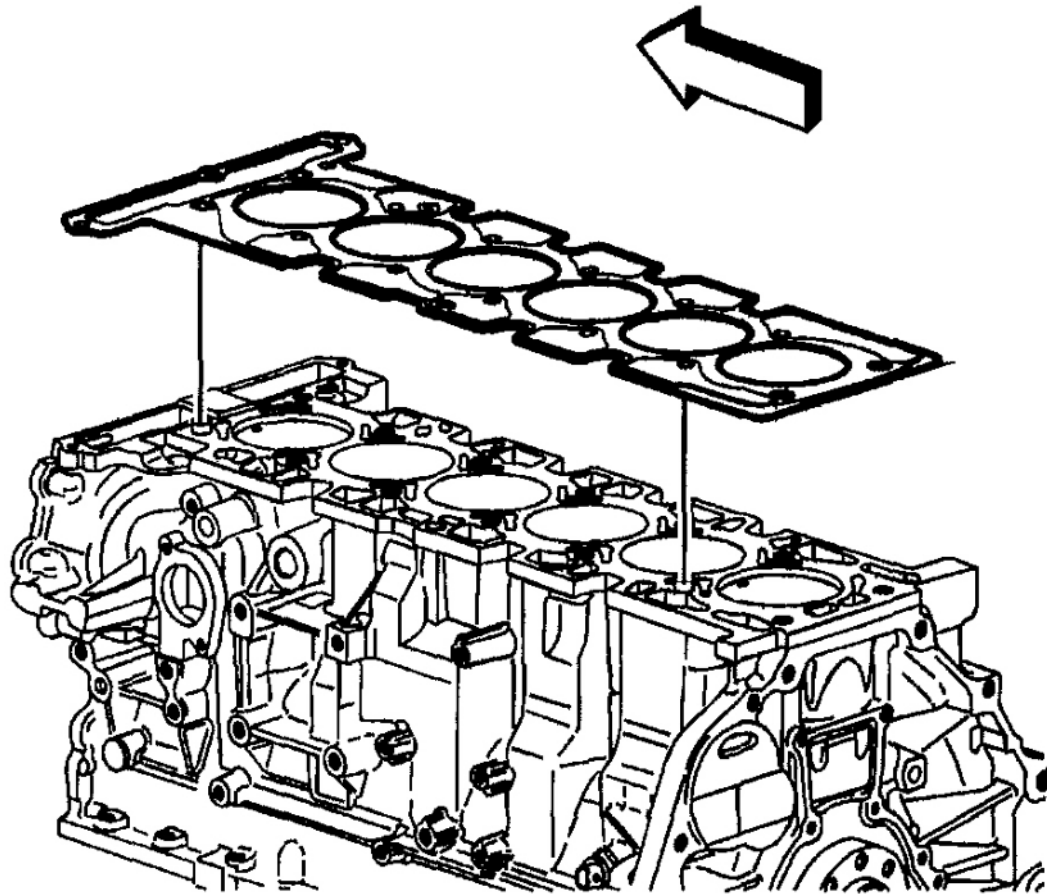
11. Remove the cylinder head.



G01706290

Fig. 117: Removing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

12. Remove the cylinder head gasket.



G01706291

Fig. 118: Removing Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

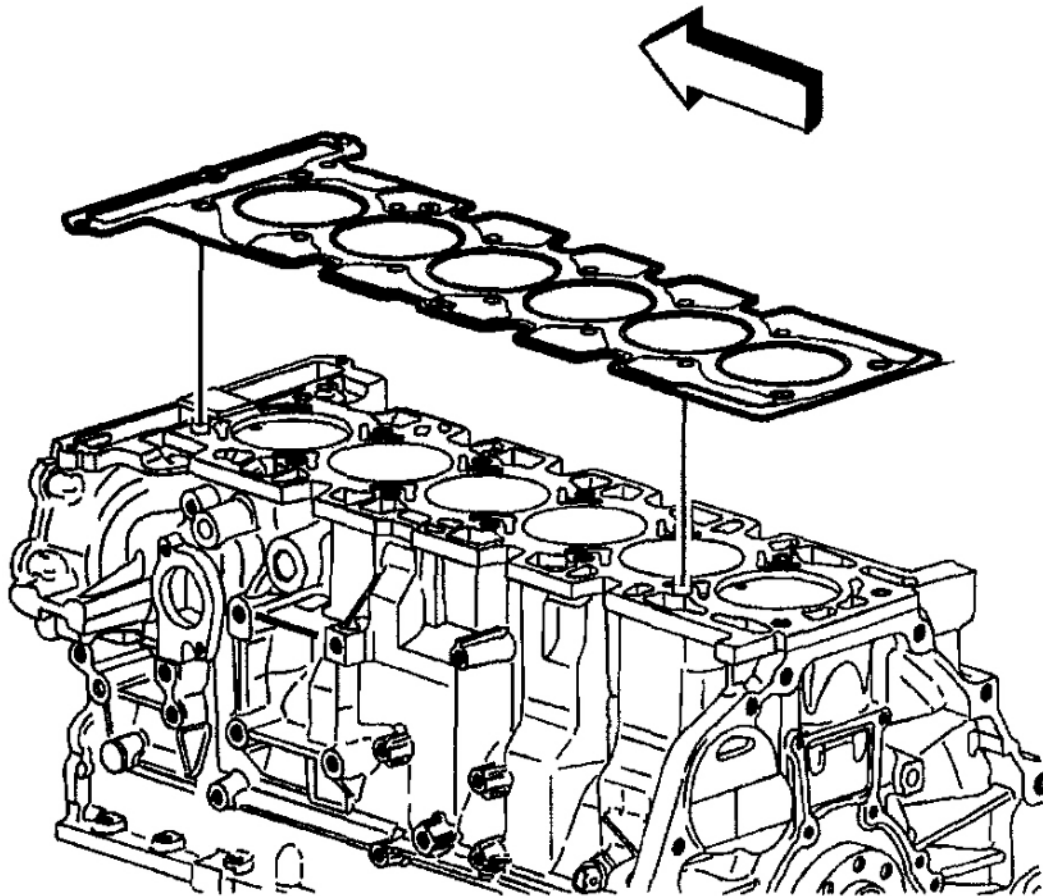
13. Place the cylinder head on a flat, clean surface with the combustion chambers face up, in order to prevent damage to the deck face.
14. If replacing cylinder head refer to Cylinder Head Disassemble in Engine Mechanical - 4.2 L Unit Repair.
15. Clean and inspect the cylinder head. Refer to Cylinder Head Cleaning and Inspection in Engine Mechanical - 4.2 L Unit Repair.

Installation Procedure

IMPORTANT: Ensure number 1 cylinder is at top dead center.

1. If replacing new cylinder head, refer to Cylinder Head Assemble in Engine Mechanical - 4.2 L Unit Repair.

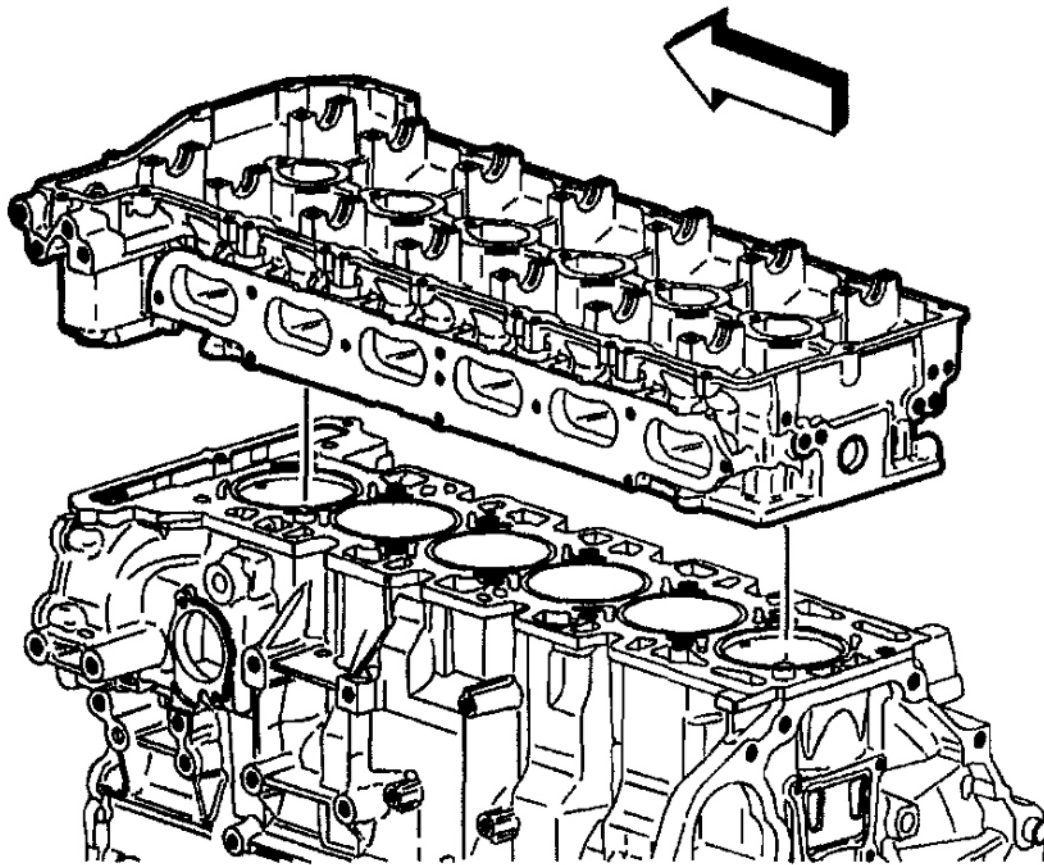
2. Install the dowel pins, cylinder head locator, if necessary.
3. Install the new cylinder head gasket.



G01706292

Fig. 119: Installing New Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

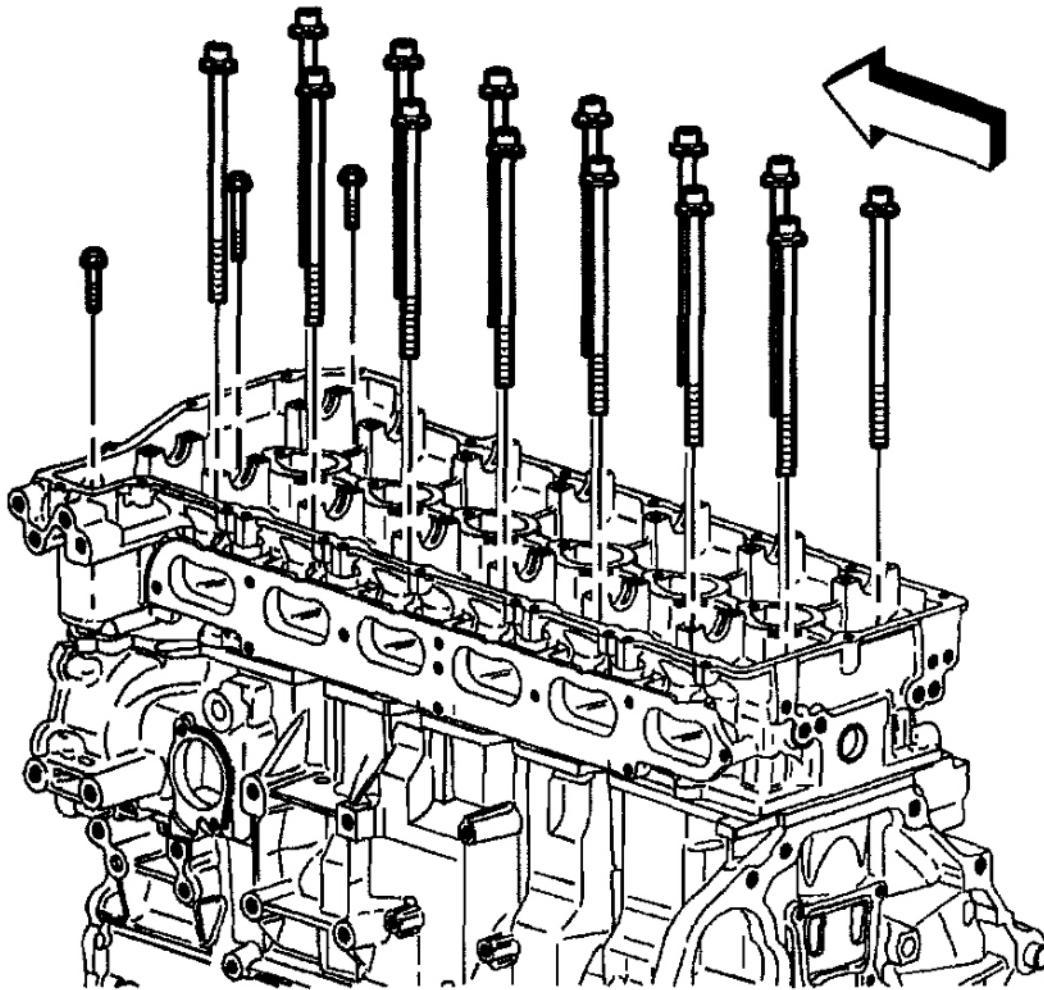
4. Install the cylinder head.



G01706293

Fig. 120: Installing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

5. Add threadlock GM P/N 12345493 to the cylinder head bolts.
6. Install the cylinder head bolts.



G01706294

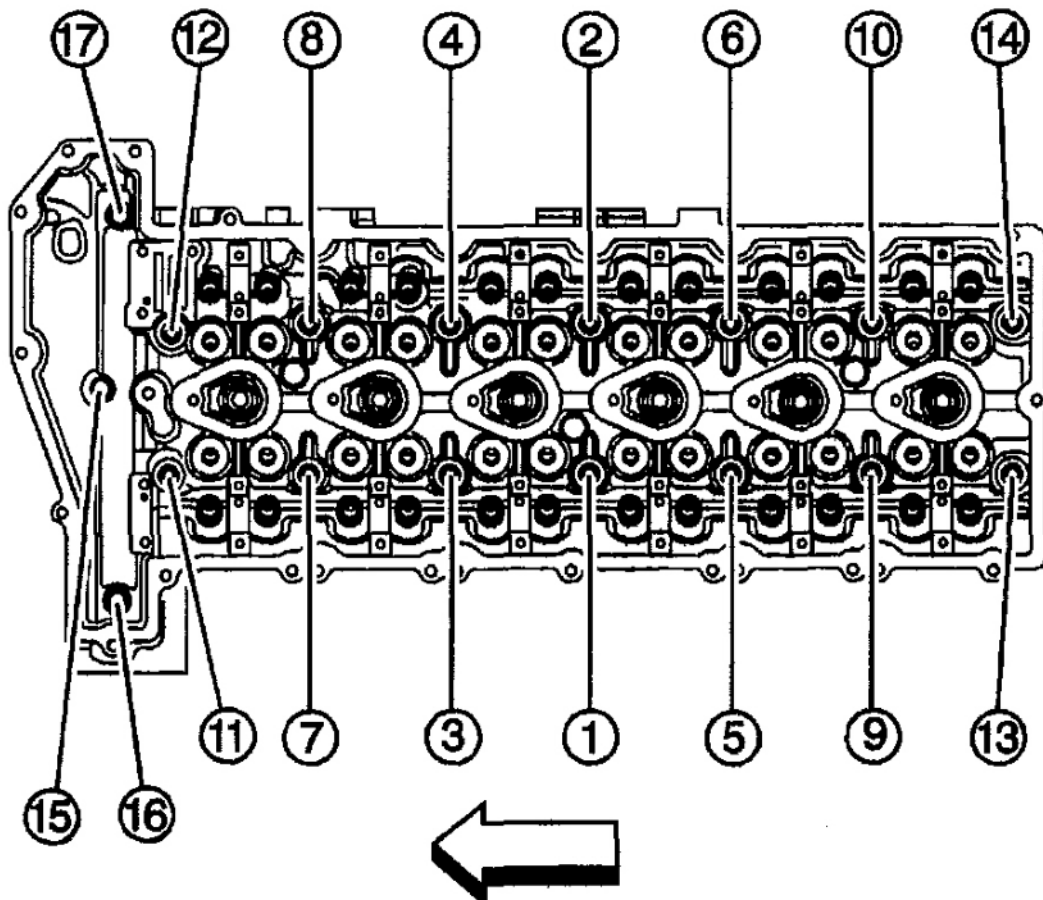
Fig. 121: Installing Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

7. Tighten the long cylinder head bolts (1 through 14) in sequence as shown.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to

parts and systems.**Tighten**

- 7.1. Tighten the bolts to 40 N.m (30 lb ft).
- 7.2. Use the J 36660-A in order to tighten the cylinder head bolts in sequence an additional 90 degrees.
- 7.3. Use the J 36660-A in order to tighten the cylinder head bolts in sequence an additional 60 degrees.
- 7.4. Tighten the 2 long end bolts to 20 N.m (89 lb in).
- 7.5. Tighten the 1 short end bolt to 18 N.m (13 lb ft).



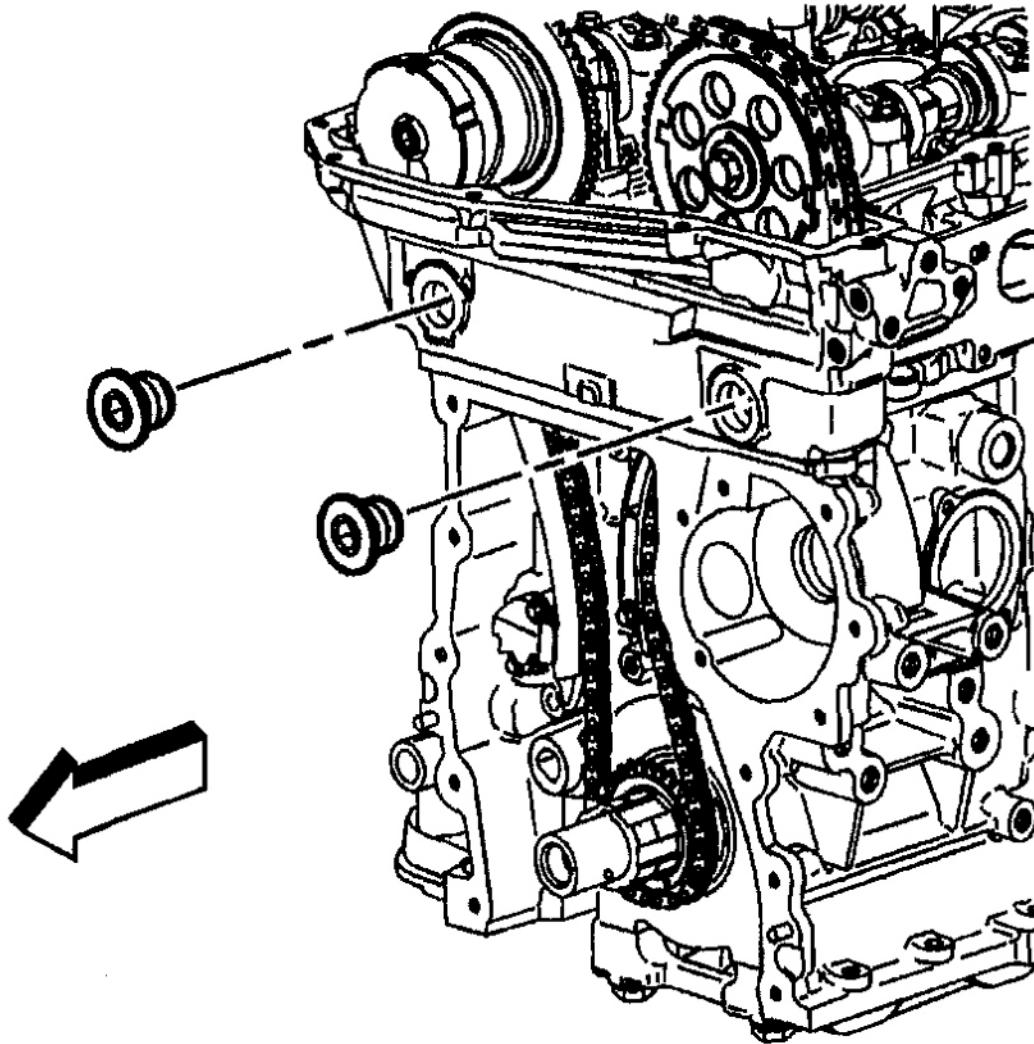
G01706295

Fig. 122: Tightening Long Cylinder Head Bolts In Sequence
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head access hole plugs.

Tighten

Tighten the plugs to 5 N.m (44 lb in).



G01706296

Fig. 123: Installing Cylinder Head Access Hole Plugs
Courtesy of GENERAL MOTORS CORP.

9. Install the timing chain and sprockets. Refer to **Timing Chain, Sprockets, and/or Tensioner Replacement**.

10. Install the front cover. Refer to **Engine Front Cover Replacement**.
11. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.
12. Install the exhaust manifold. Refer to Exhaust Manifold Replacement .

CRANKSHAFT BALANCER REPLACEMENT

Tools Required

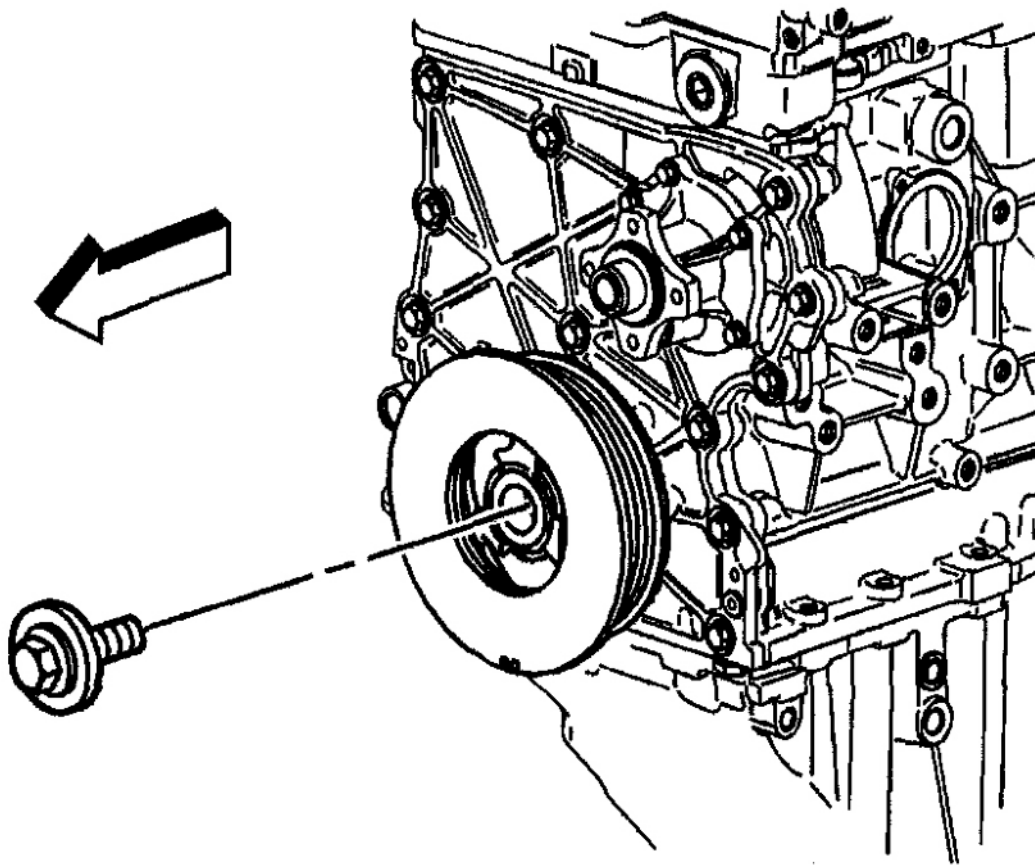
- **J 44226** Crankshaft Balancer Remover
- **J 41478** Crankshaft Front Oil Seal Installer
- **J 36660-A** Torque/Angle Meter

Removal Procedure

1. Remove the radiator intake baffle. Refer to Air Intake Baffle Replacement - Radiator in Body Front End.
2. Remove the grill. Refer to Grille Replacement (GMC) or Grille Replacement (Chevrolet) or Grille Replacement (Oldsmobile) in Exterior Trim.

IMPORTANT: When removing the diagonal brace, only remove the one bolt from the battery tray brace that is bolted to the radiator brace.

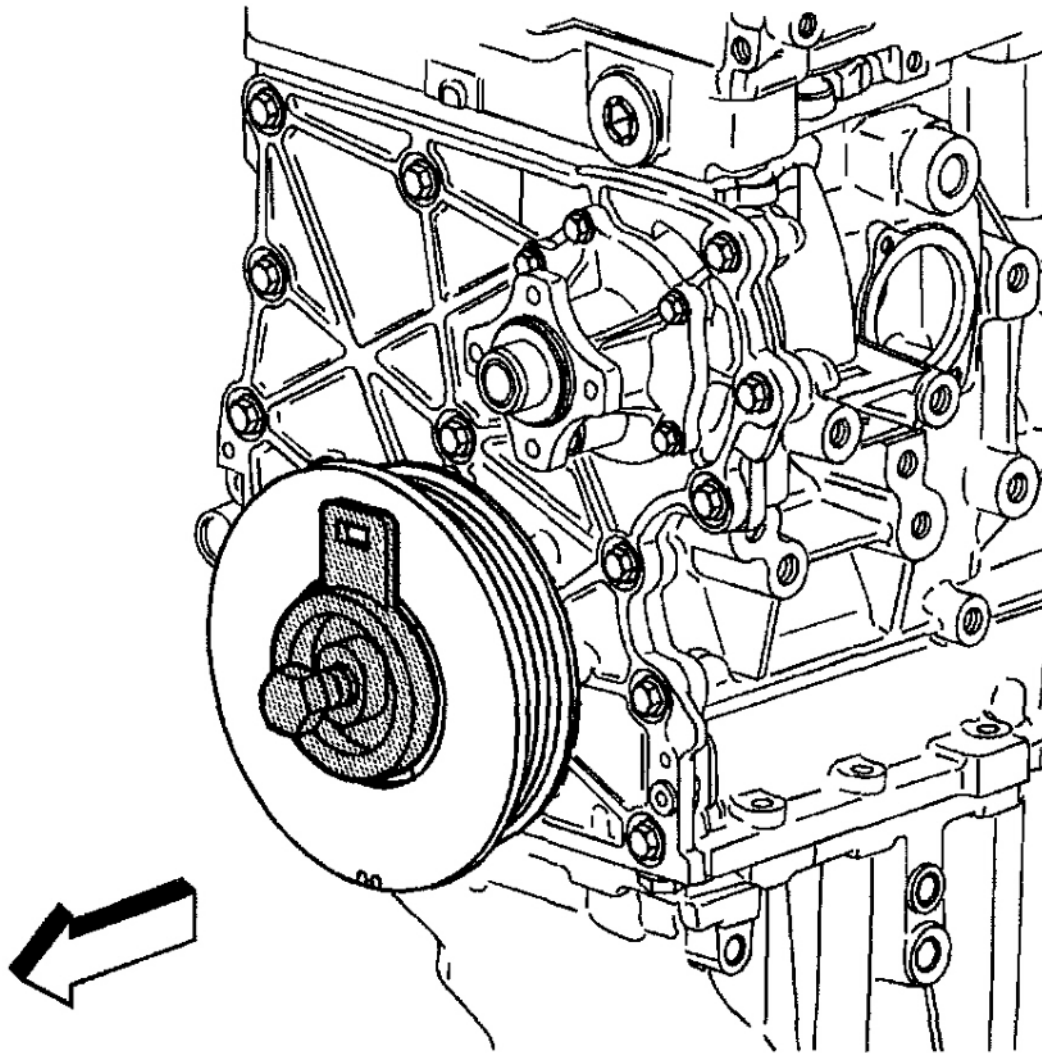
3. Remove the radiator support diagonal brace. Refer to Brace Replacement - Radiator Support Diagonal in Body Front End.
4. Remove the hood latch support. Refer to Hood Latch Support Replacement in Body Front End.
5. Remove the cooling fan and shroud. Refer to Cooling Fan and Shroud Replacement in Engine Cooling.
6. Remove the drive belt. Refer to **Drive Belt Replacement**.
7. Carefully loosen and remove the balancer bolt.



G01706297

Fig. 124: Removing Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

8. Using the J 44226 remove the balancer.



G01706298

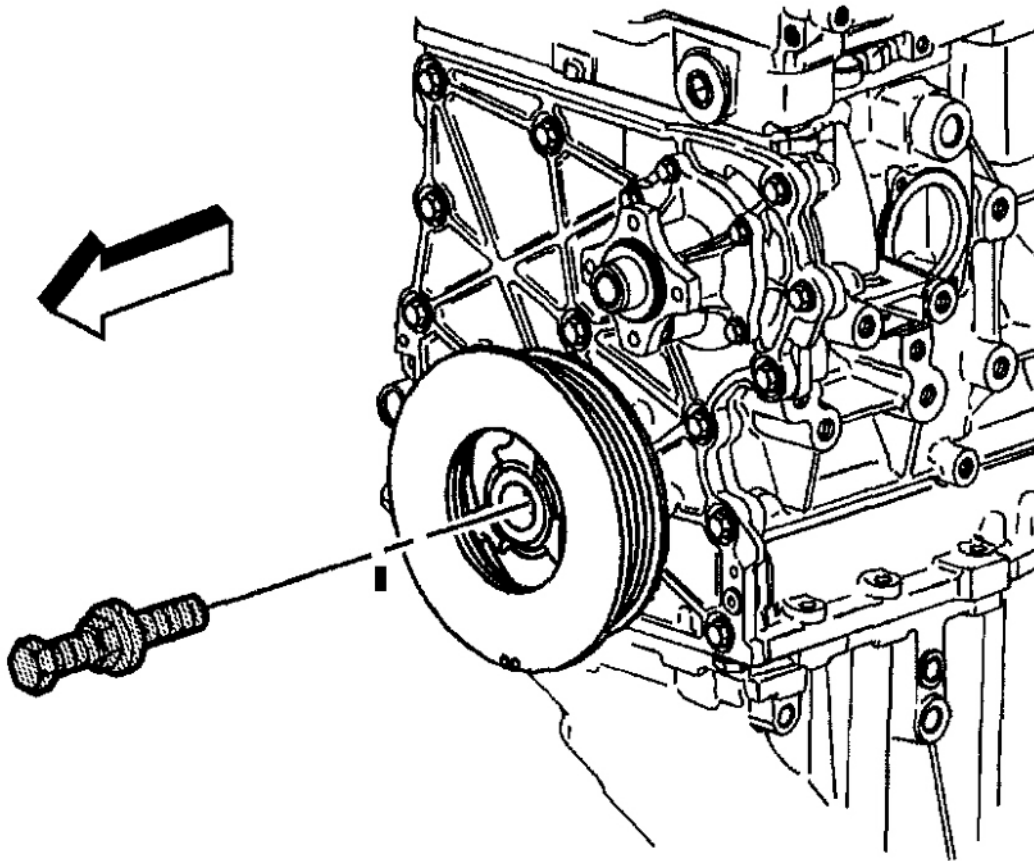
Fig. 125: Using J 44226 Remove Balancer
Courtesy of GENERAL MOTORS CORP.

9. Clean and inspect the crankshaft balancer. Refer to Crankshaft Balancer Cleaning and Inspection in Engine Mechanical - 4.2 L Unit Repair.

Installation Procedure

IMPORTANT: The crankshaft balancer does not have a key-way; so the crankshaft could turn when tightening, causing an improper torque. Make sure to follow the installation procedure to prevent damage.

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the torque converter access plug in the dry part of the oil pan.
3. Use the torque converter holding tool from the J 44226 kit and secure the torque converter while tightening the crankshaft balancer.



G01706299

Fig. 126: Installing And Seating Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

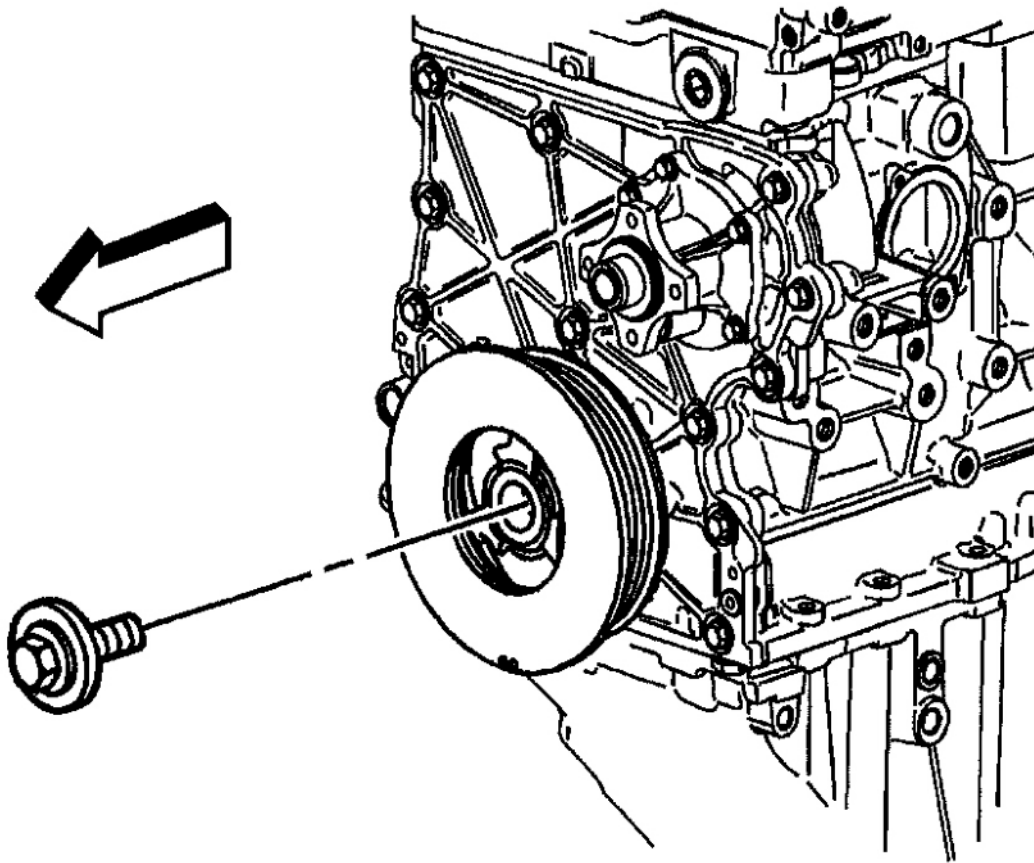
4. Using the J 41478 install and seat the crankshaft balancer.
5. Remove the J 41478.
6. While still holding the flywheel, install the balancer washer and the bolt.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or

sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the crankshaft balancer bolt to 150 N.m (111 lb ft). Use the J 36660-A in order to tighten the balancer bolt an additional 180 degrees.



G01706300

Fig. 127: Installing Balancer Washer And Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the torque converter holding tool.

8. Install the torque converter access plug into the oil pan.
9. Lower the vehicle.
10. Install the drive belt. Refer to **Drive Belt Replacement**.
11. Install the cooling fan and shroud. Refer to Cooling Fan and Shroud Replacement in Engine Cooling.
12. Install the hood latch support. Refer to Hood Latch Support Replacement in Body Front End.
13. Install the radiator diagonal brace. Refer to Brace Replacement - Radiator Support Diagonal in Body Front End.
14. Install the grill. Refer to Grille Replacement (GMC) or Grille Replacement (Chevrolet) or Grille Replacement (Oldsmobile) in Exterior Trim.
15. Install the radiator air intake baffle. Refer to Air Intake Baffle Replacement - Radiator in Body Front End.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

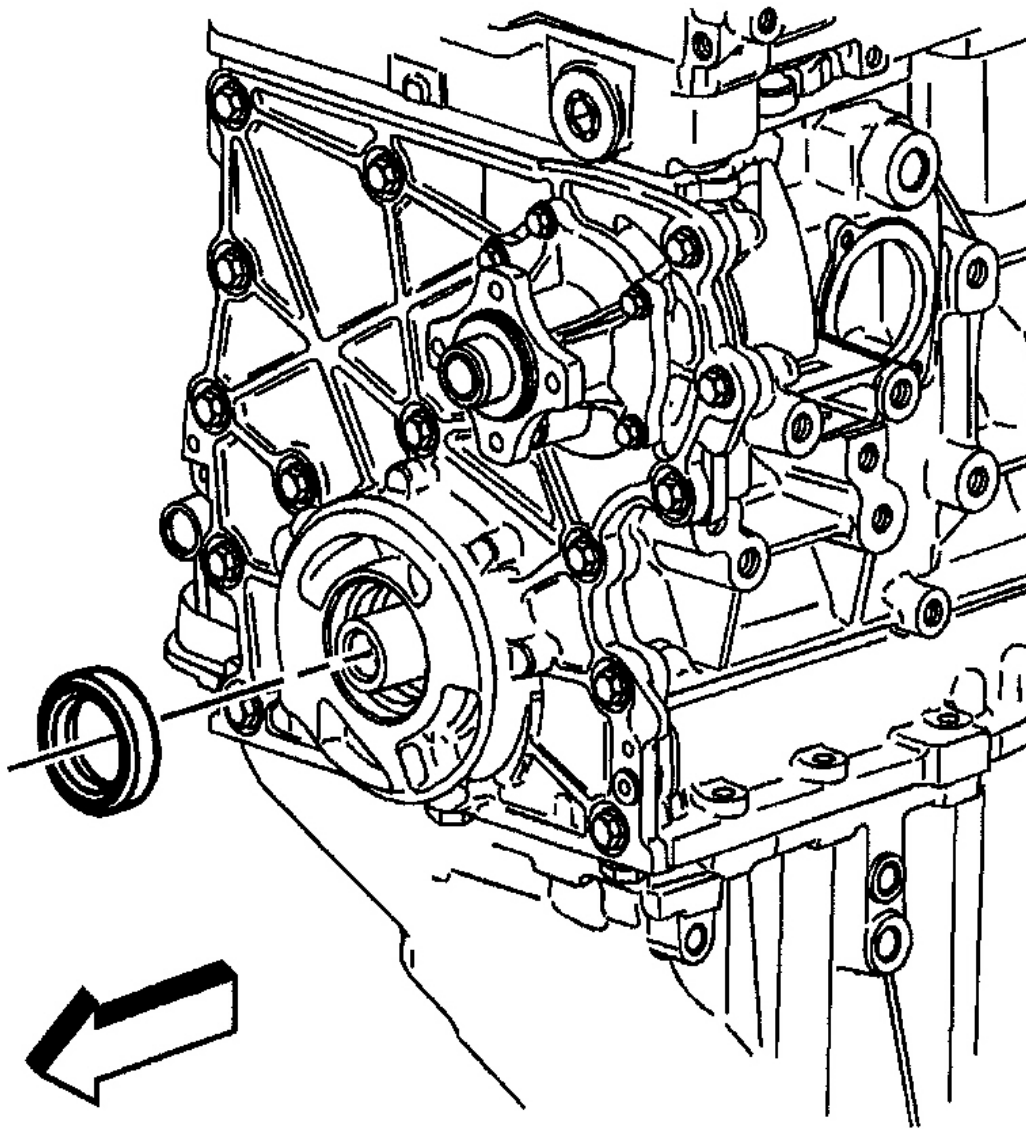
Tools Required

J 44218 Seal Installer

Removal Procedure

IMPORTANT: Do not damage the engine front cover or the crankshaft.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Pry out the crankshaft front oil seal using a suitable tool. Use the provided slots for prying out the seal.

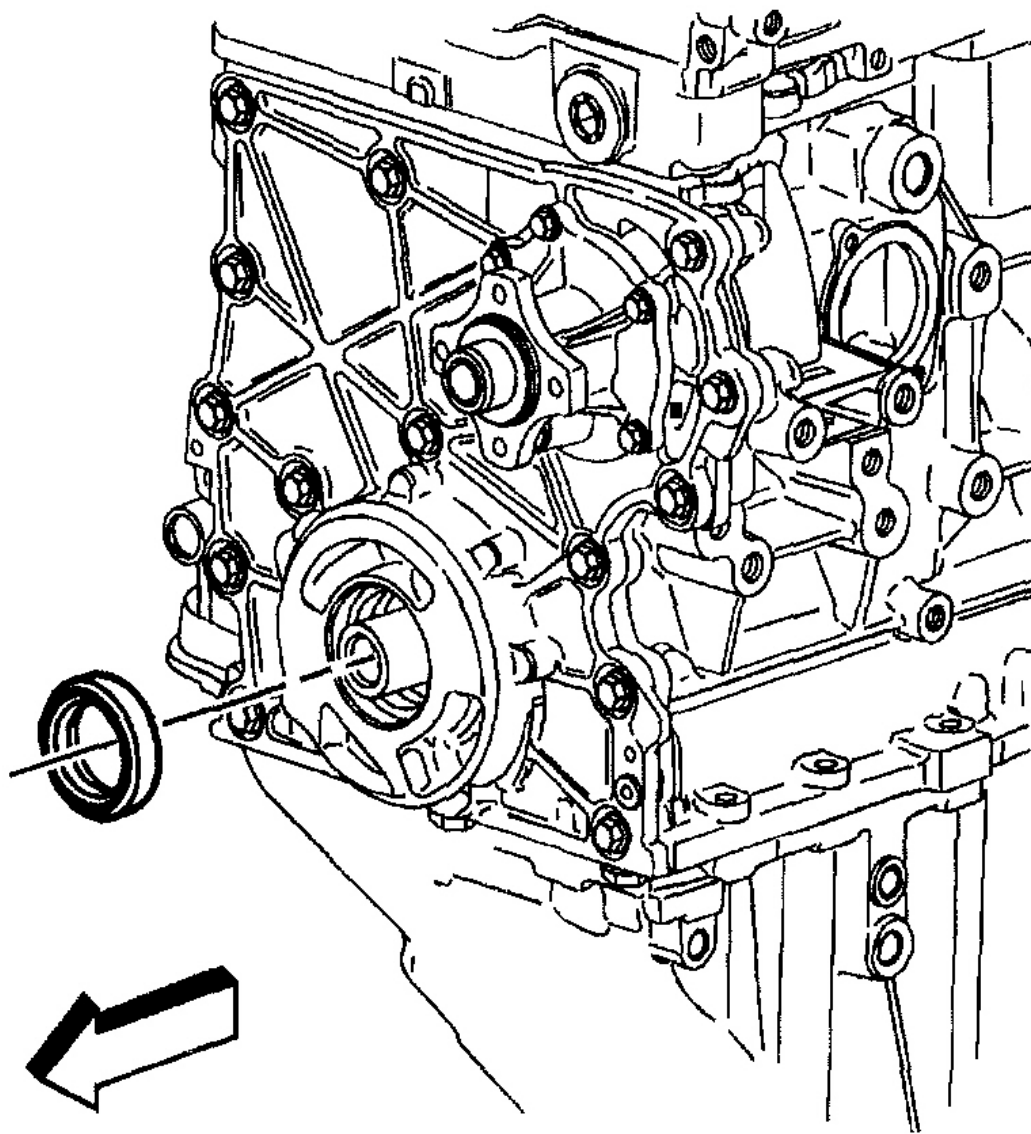


G01706301

Fig. 128: Prying Out Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

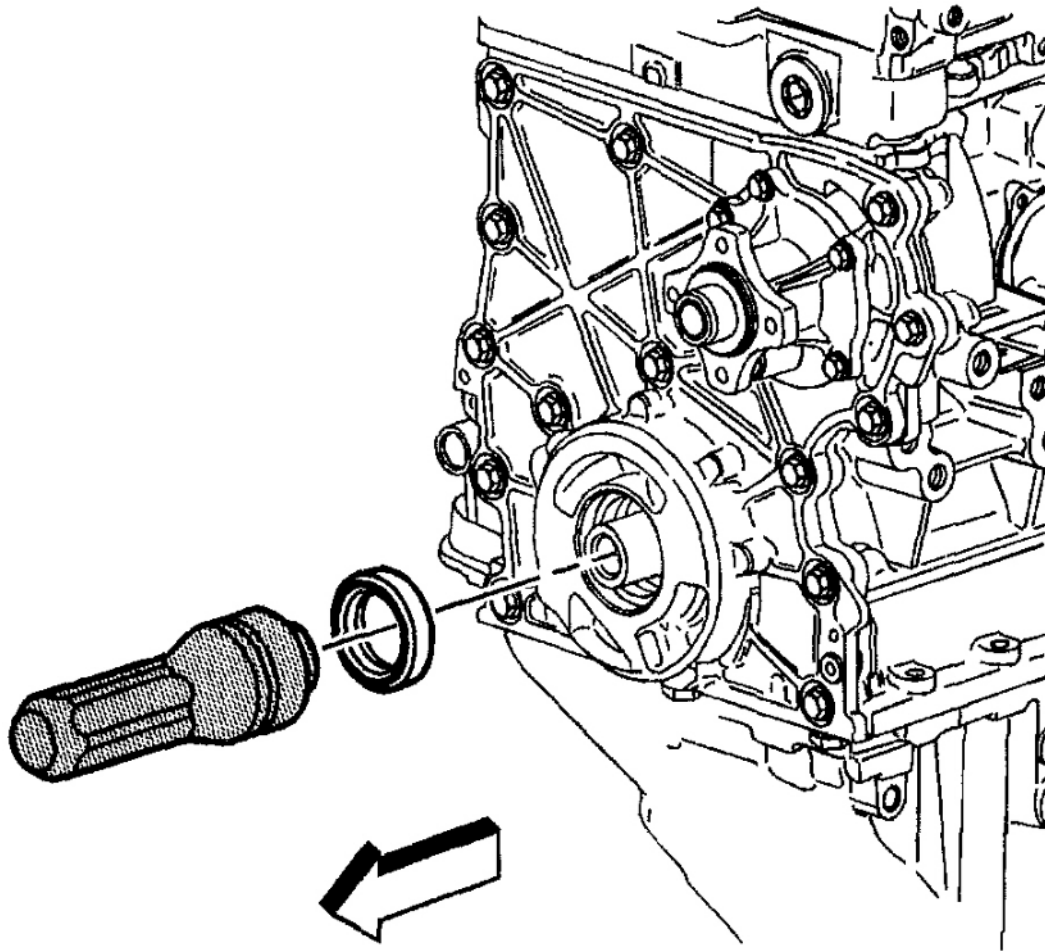
1. Apply the engine oil to the outside diameter of the crankshaft front oil seal.



G01706302

Fig. 129: Applying Engine Oil To Outside Diameter Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

2. Use the J 44218 to install the front oil seal.



G01706303

Fig. 130: Installing Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the J 44218.
4. Install the crank balancer shaft. Refer to **Crankshaft Balancer Replacement**.

ENGINE FRONT COVER REPLACEMENT

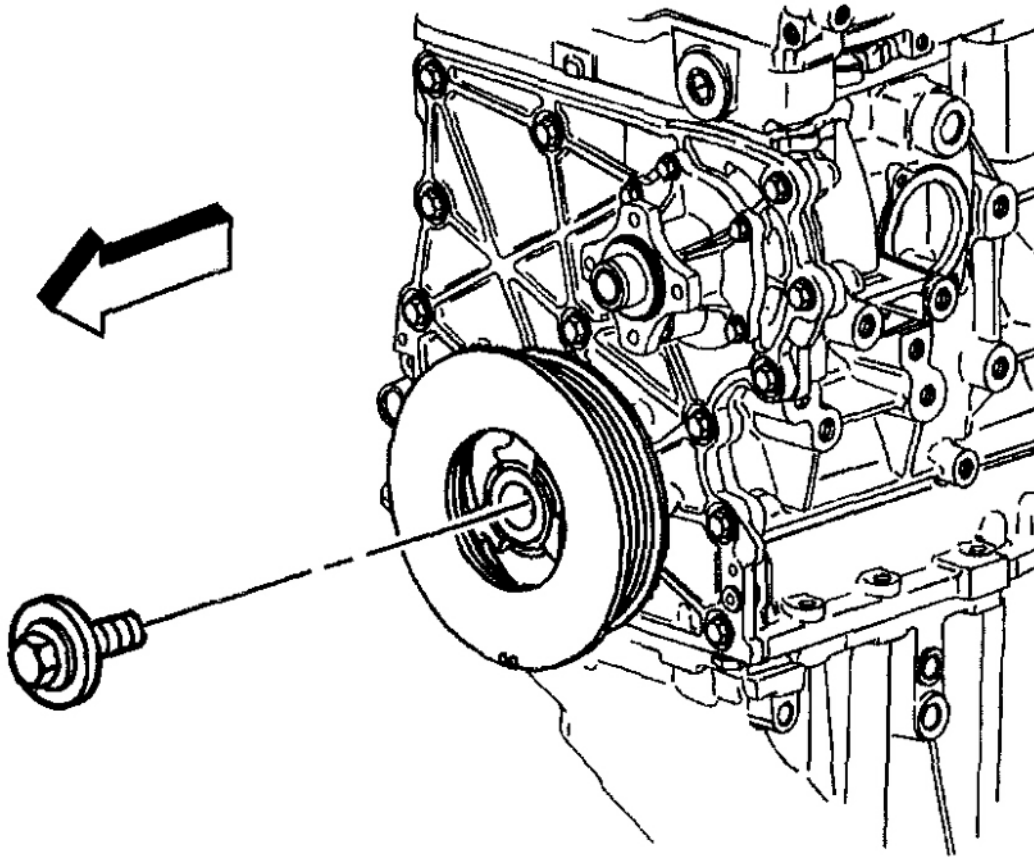
Tools Required

J 44219 Cover Alignment Pins

Removal Procedure

1. Drain the engine coolant. Refer to Draining and Filling Cooling System in Engine Cooling.

2. Remove the cooling fan and the shroud. Refer to [Cooling Fan and Shroud Replacement](#) in Engine Cooling.
3. Remove the drive belt. Refer to [Drive Belt Replacement](#).
4. Remove the water pump. Refer to [Water Pump Replacement](#) in Engine Cooling.
5. Remove the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).

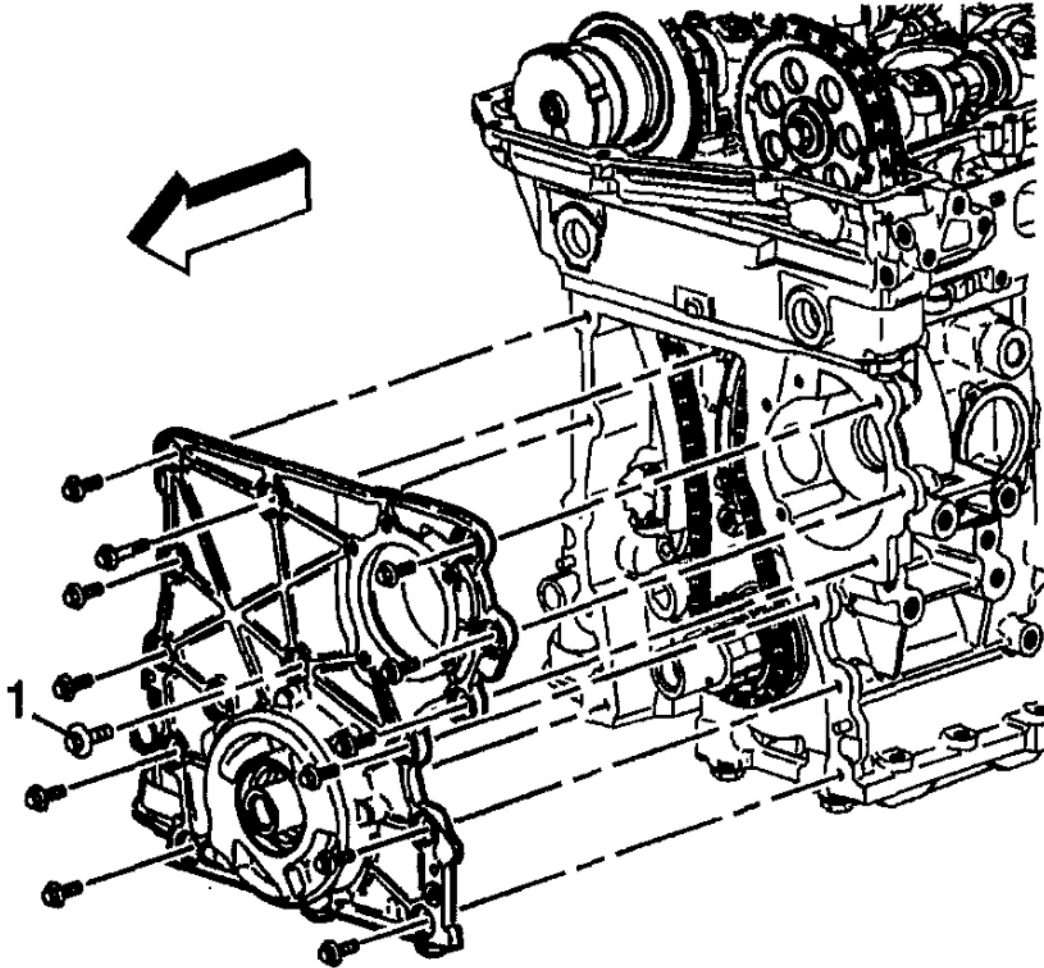


G01706304

Fig. 131: Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

6. Remove the power steering pump. Refer to [Power Steering Pump Replacement](#) in Power Steering System.
7. Repositioned A/C compressor on the side.
8. Raise the vehicle. Refer to [Lifting and Jacking the Vehicle](#) in General Information.
9. Remove the oil pan. Refer to [Oil Pan Replacement](#).
10. Lower the vehicle.

11. Remove the 7 mm center bolt (1).



G01706305

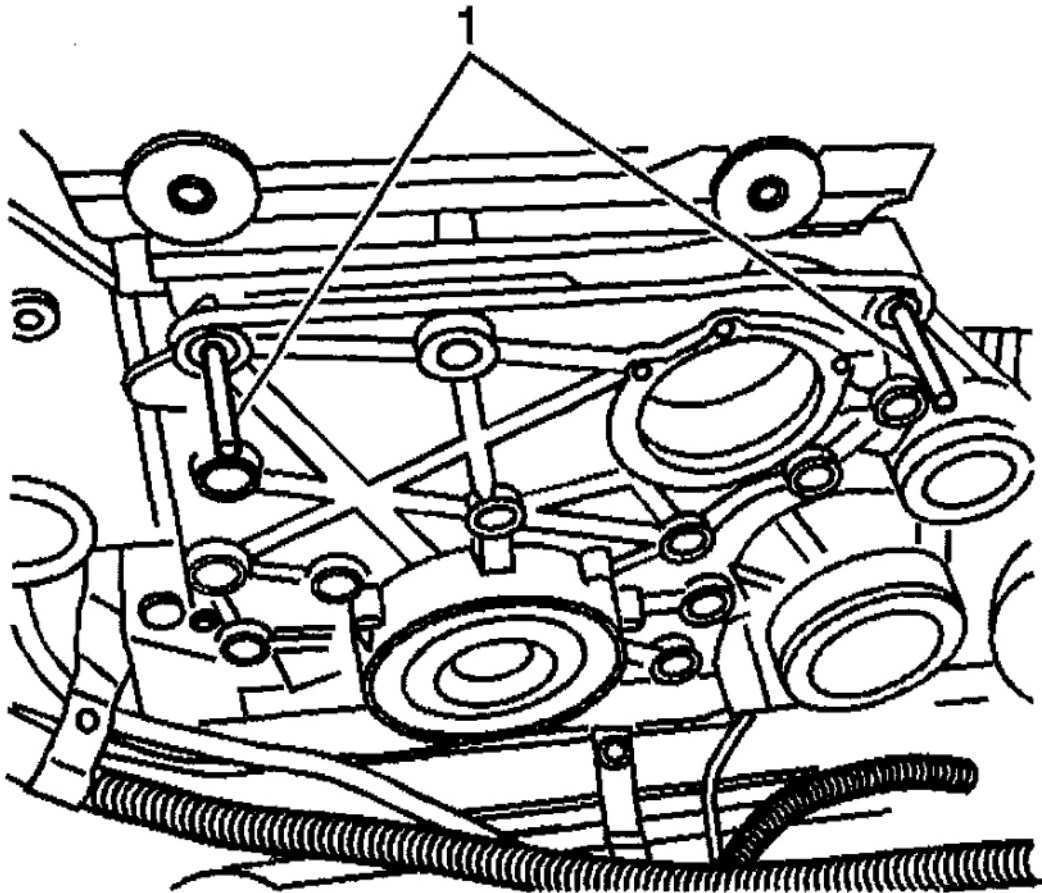
Fig. 132: Identifying 7 mm Center Bolt
Courtesy of GENERAL MOTORS CORP.

12. Loosen and remove the remaining engine front cover bolts.
13. Place two of the front cover bolts in the jack screw holes on the front cover and tighten the bolts evenly to release the front cover from the engine.
14. Remove the two bolts from the front cover.
15. Remove the oil pump. Refer to **Oil Pump Replacement**.
16. Clean and Inspect the front cover. Refer to Engine Front Cover Cleaning and Inspection in Engine Mechanical - 4.2L Unit Repair.

Installation Procedure

1. Install the J 44219 (aligning pins), onto the engine.

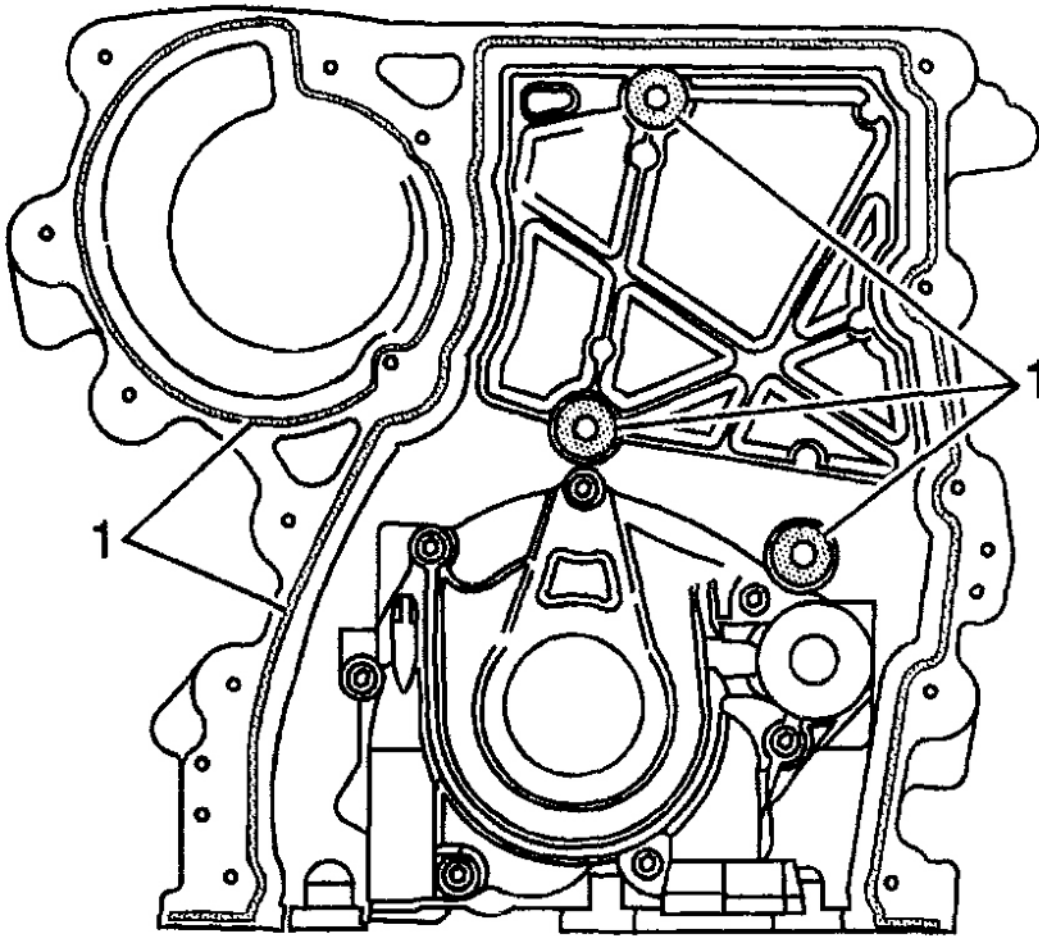
IMPORTANT: The engine front cover must be installed within 10 minutes from when the sealer was applied.



G01706306

Fig. 133: Identifying J 44219 Pins
Courtesy of GENERAL MOTORS CORP.

2. Apply a 3 mm (0.12 in) bead of sealer GM P/N 12378521 to the trace grooves on back side of the engine front cover (1).



G01706307

Fig. 134: Applying Sealer to Front Cover
Courtesy of GENERAL MOTORS CORP.

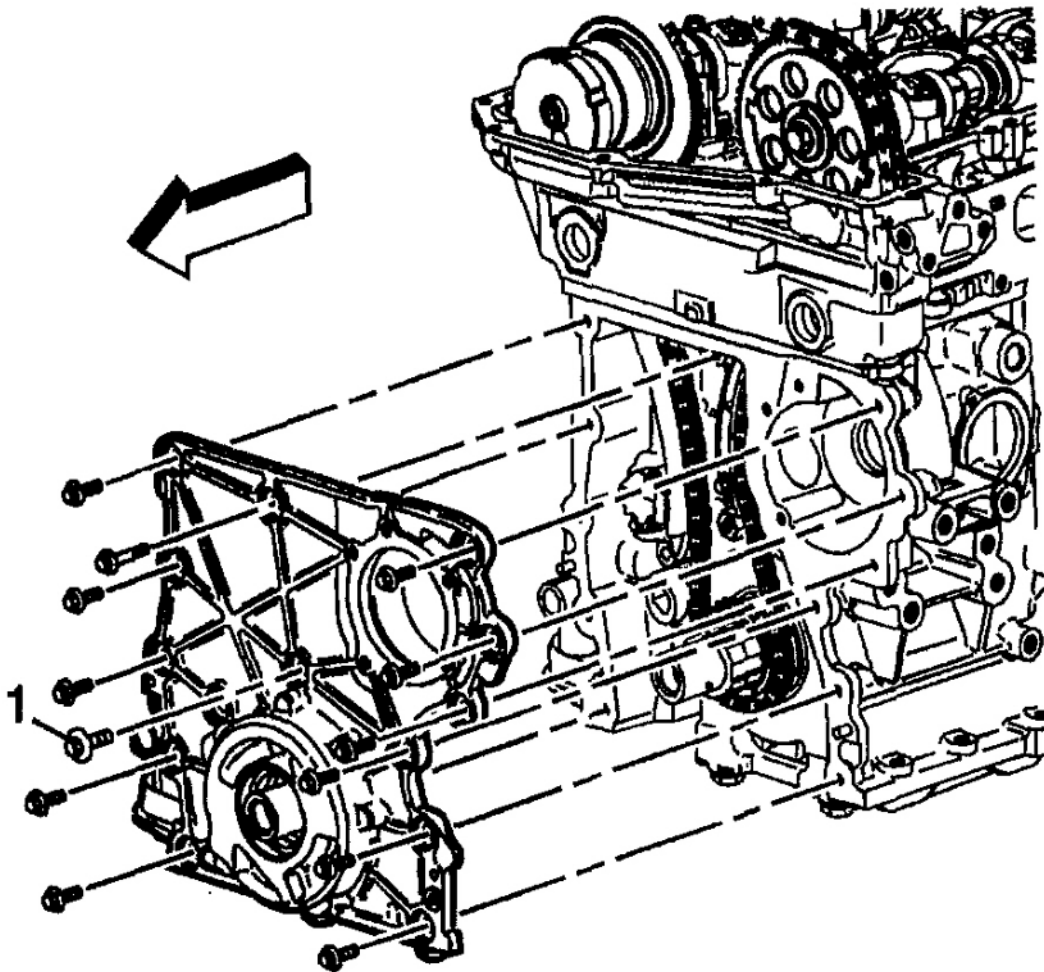
3. Also apply sealant on the inside three bolt hole bosses on the cover
4. Align the oil pump to the crankshaft sprocket splines.
5. Install the front cover.
6. Install the front cover bolts, tightening the center bolt last (1).

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping

force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

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



G01706305

Fig. 135: Identifying 7 mm Center Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the J 44219.
8. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.

9. Install the oil pan. Refer to **Oil Pan Replacement**.
10. Lower the vehicle.
11. Install the power steering pump. Refer to Power Steering Pump Replacement in Power Steering System.
12. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
13. Install the water pump. Refer to Water Pump Replacement in Engine Cooling.
14. Install the drive belt. Refer to **Drive Belt Replacement**.
15. Install the cooling fan and shroud. Refer to Cooling Fan and Shroud Replacement .
16. Fill the engine with coolant. Refer to Draining and Filling Cooling System in Engine Cooling.

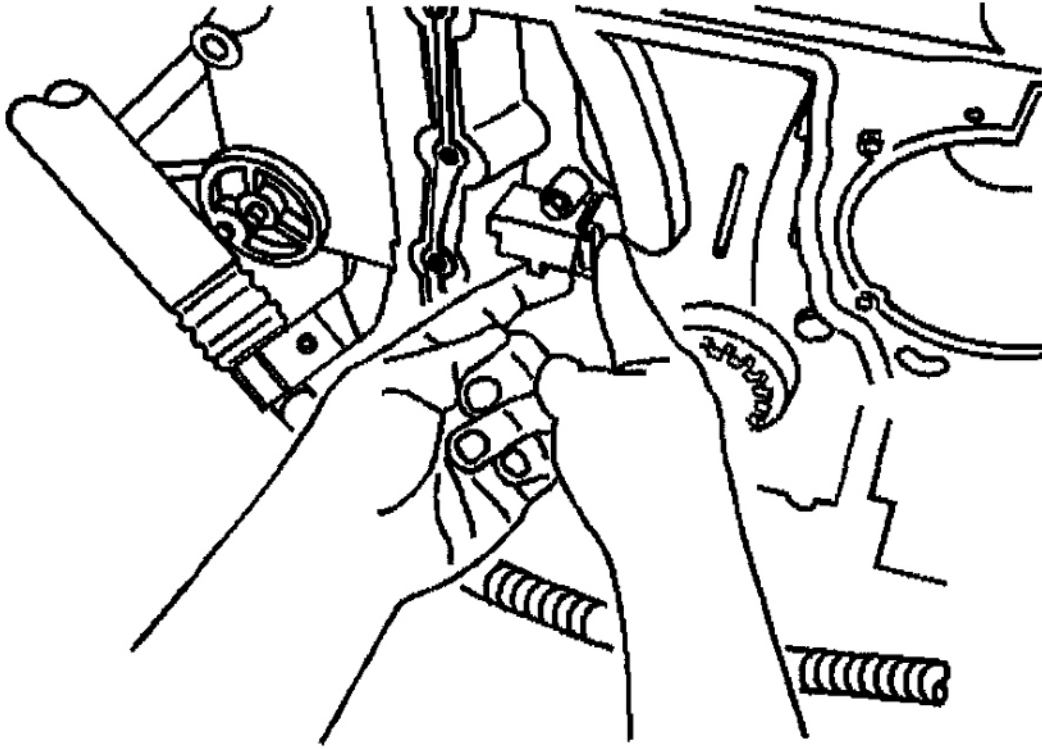
TIMING CHAIN, SPROCKETS, AND/OR TENSIONER REPLACEMENT

Tools Required

- **J 44221** Crankshaft Holding Tool
- **J 36660-A** Torque/Angle Meter

Removal Procedure

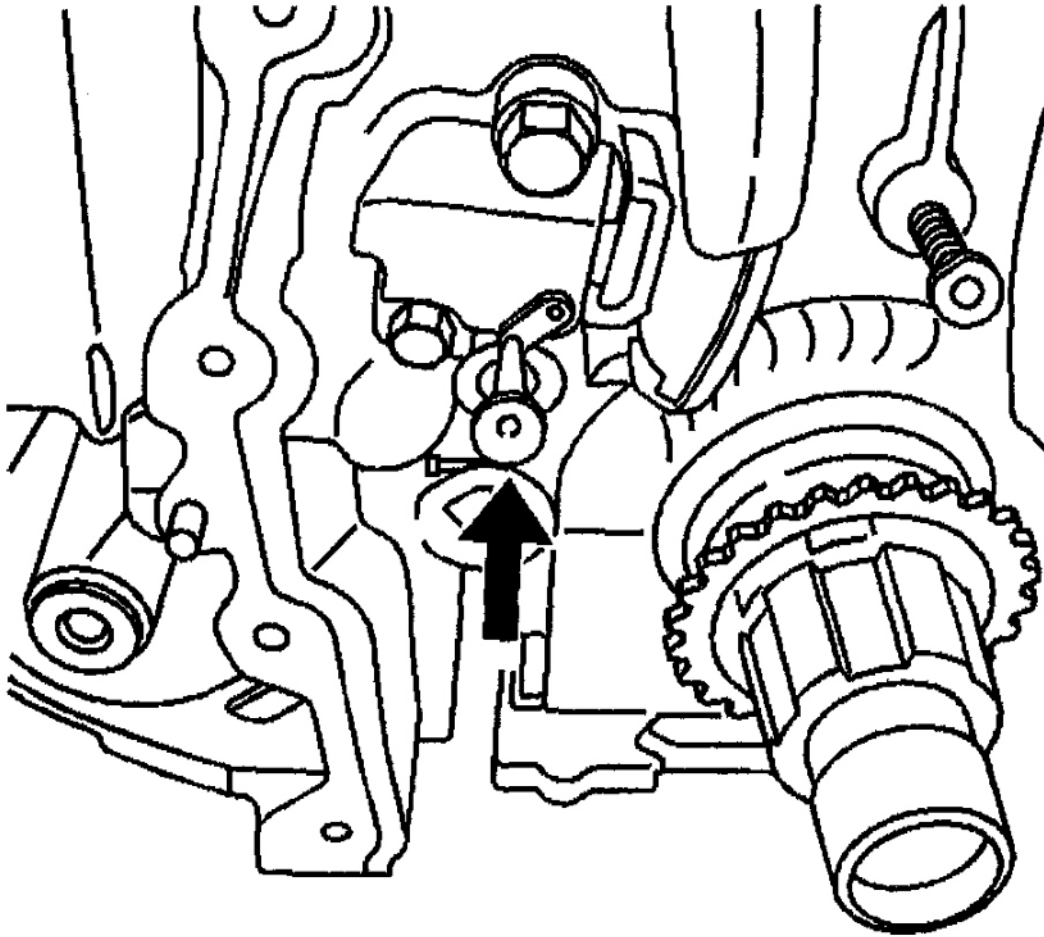
1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Release the tension on the timing chain by moving the tensioner shoe in.



G01706309

Fig. 136: Releasing Tension On Timing Chain
Courtesy of GENERAL MOTORS CORP.

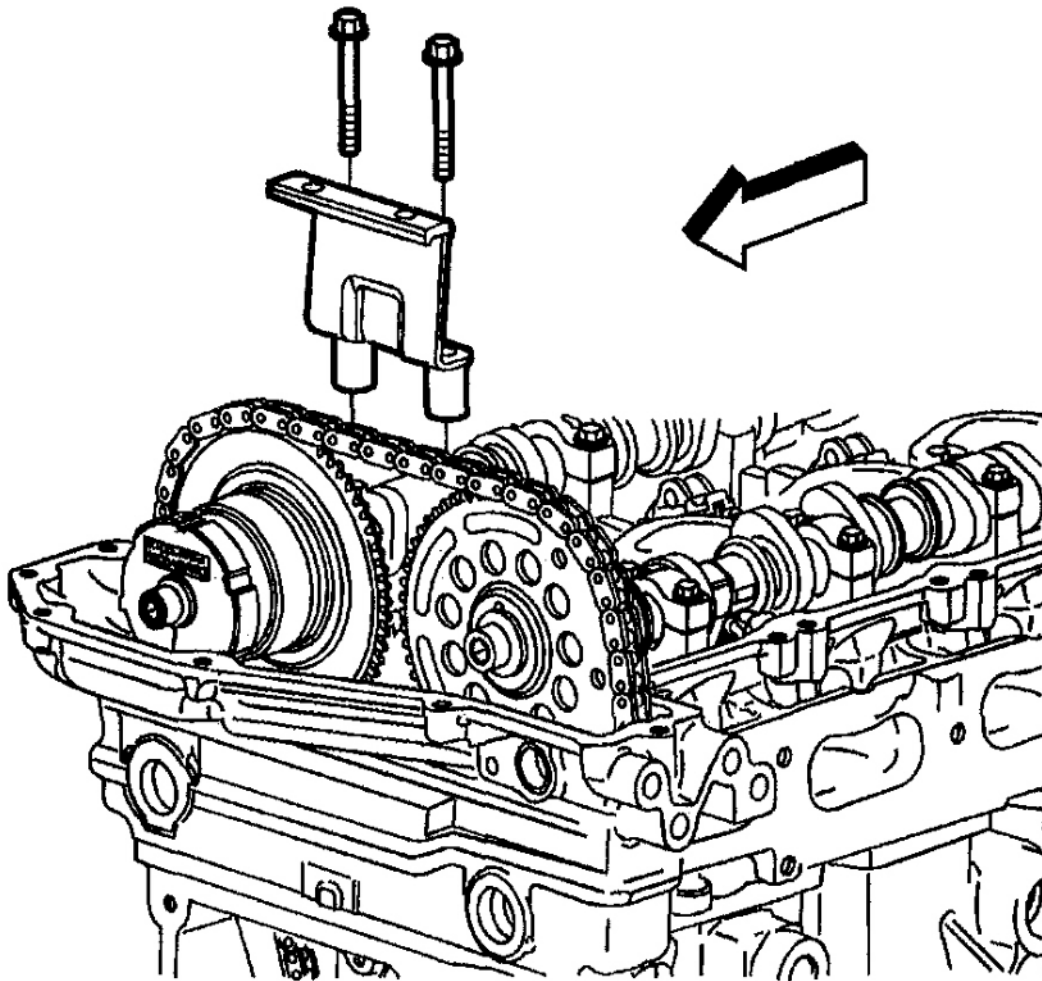
4. Place the tee into the tensioner to hold the shoe in place.



G01706310

Fig. 137: Placing Tee Into Tensioner
Courtesy of GENERAL MOTORS CORP.

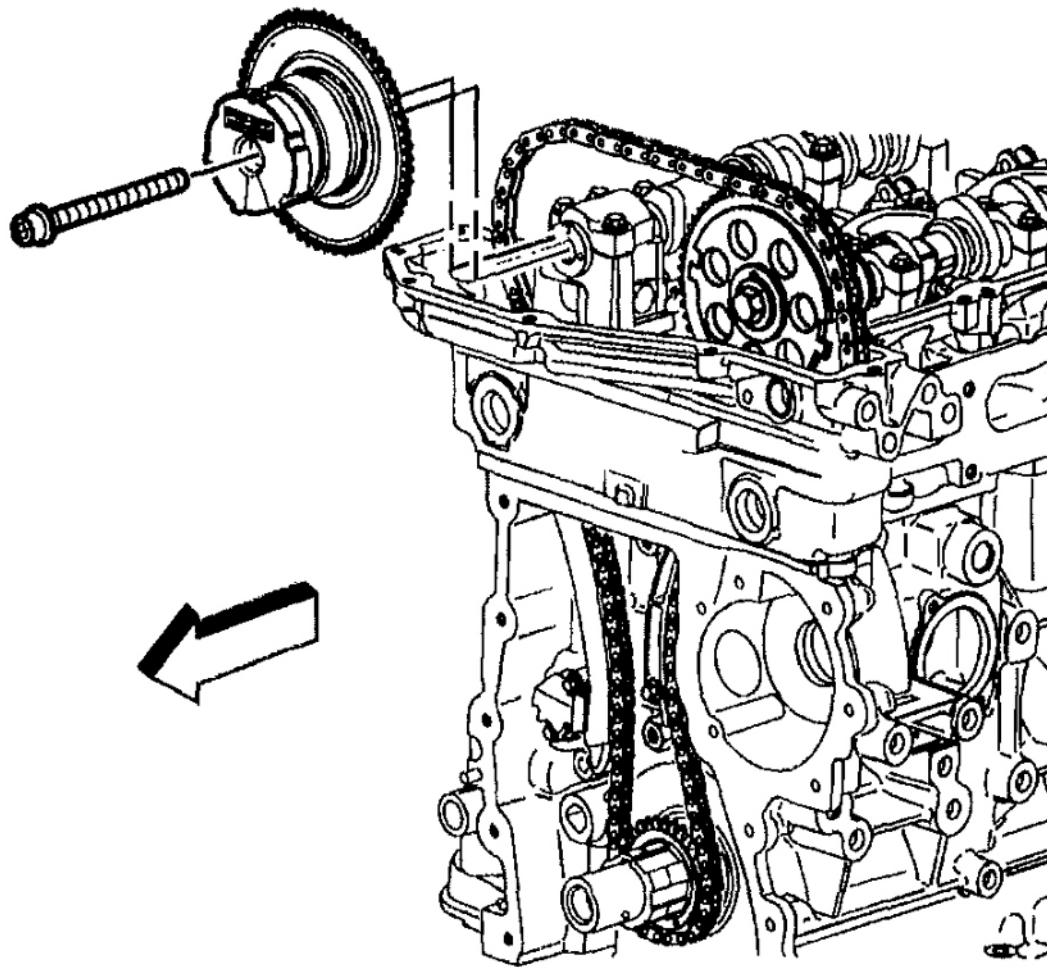
5. Remove the top chain guide bolts.



G01706311

Fig. 138: Removing Top Chain Guide Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the top chain guide.
7. Remove the exhaust camshaft position actuator bolt.



G01706312

Fig. 139: Removing Exhaust Camshaft Position Actuator Bolt
Courtesy of GENERAL MOTORS CORP.

8. Remove the exhaust camshaft position actuator.
9. Remove the intake camshaft sprocket bolt.

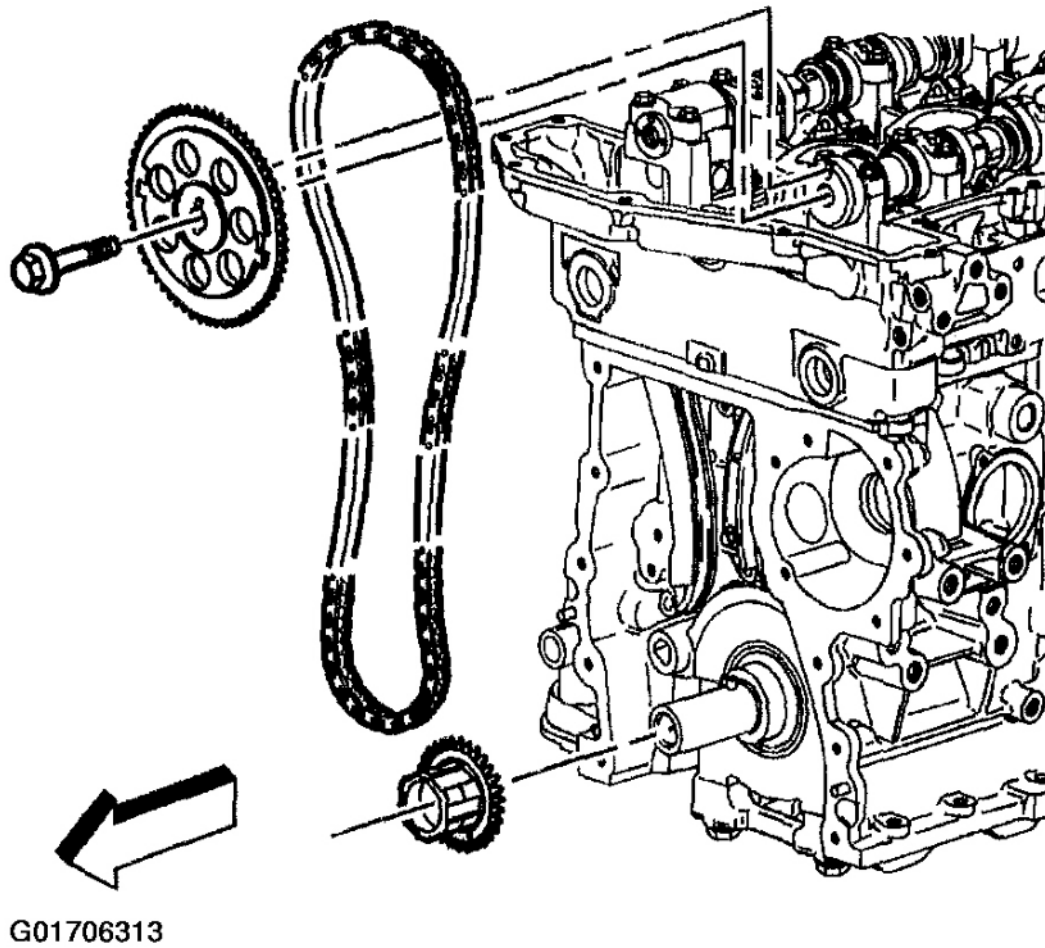
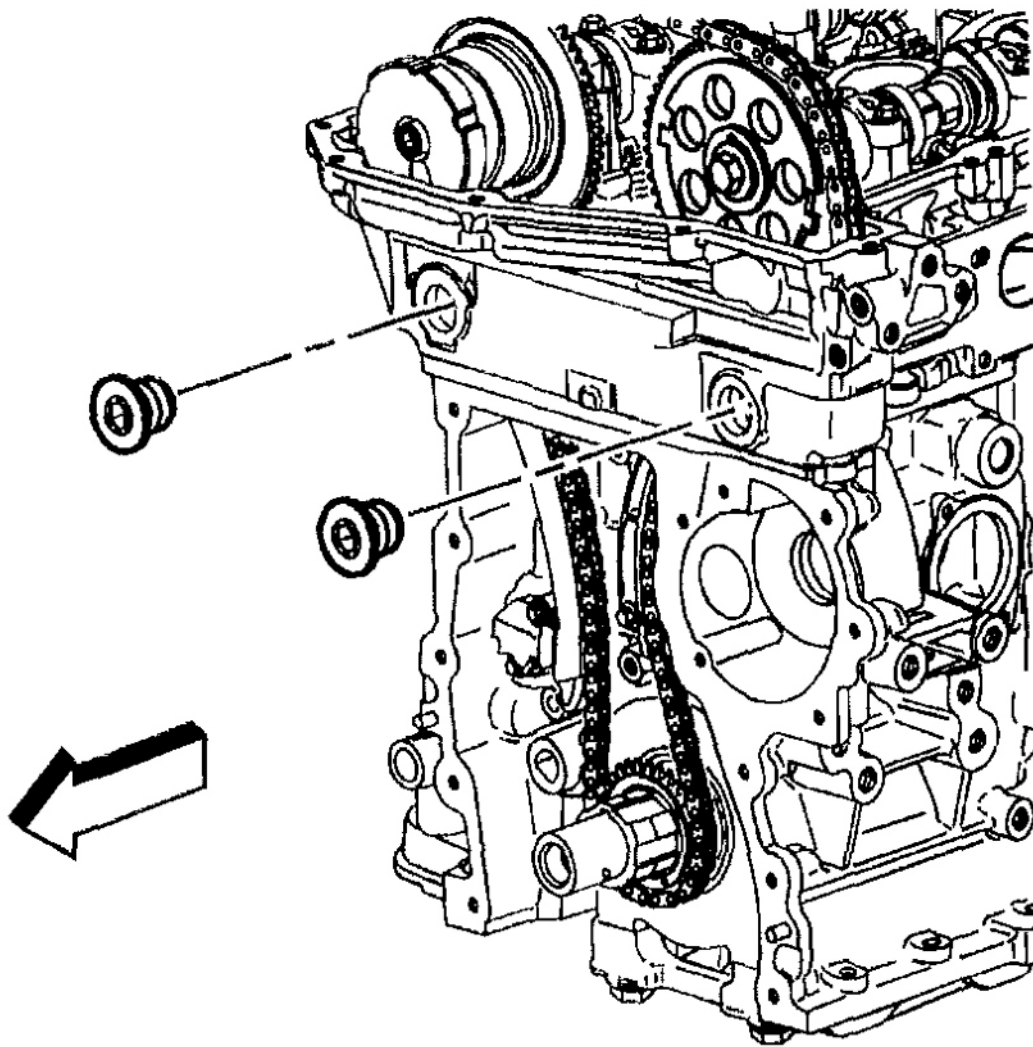


Fig. 140: Removing Intake Camshaft Sprocket Bolt
Courtesy of GENERAL MOTORS CORP.

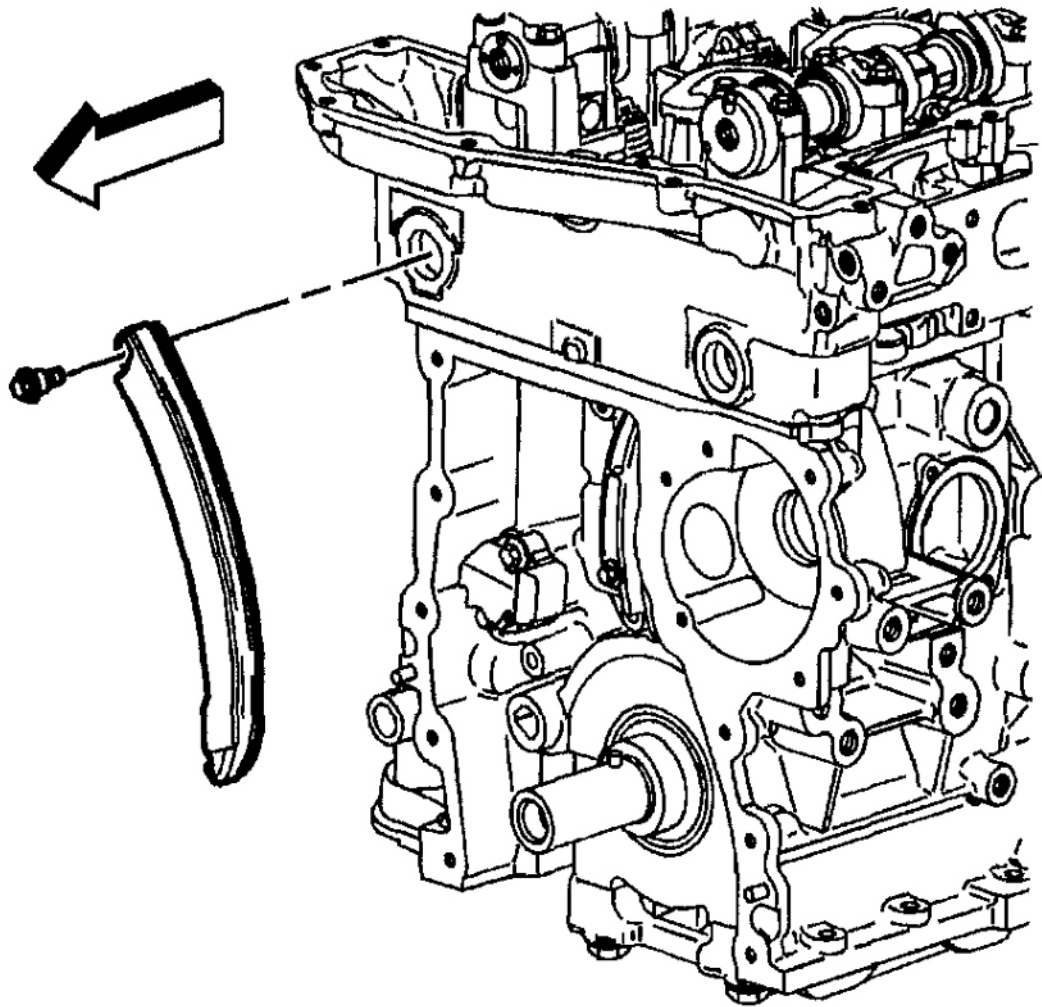
10. Remove the intake camshaft sprocket.
11. Remove the timing chain.
12. Remove the crankshaft sprocket.
13. Remove the cylinder head access hole plugs.



G01706314

Fig. 141: Removing Cylinder Head Access Hole Plugs
Courtesy of GENERAL MOTORS CORP.

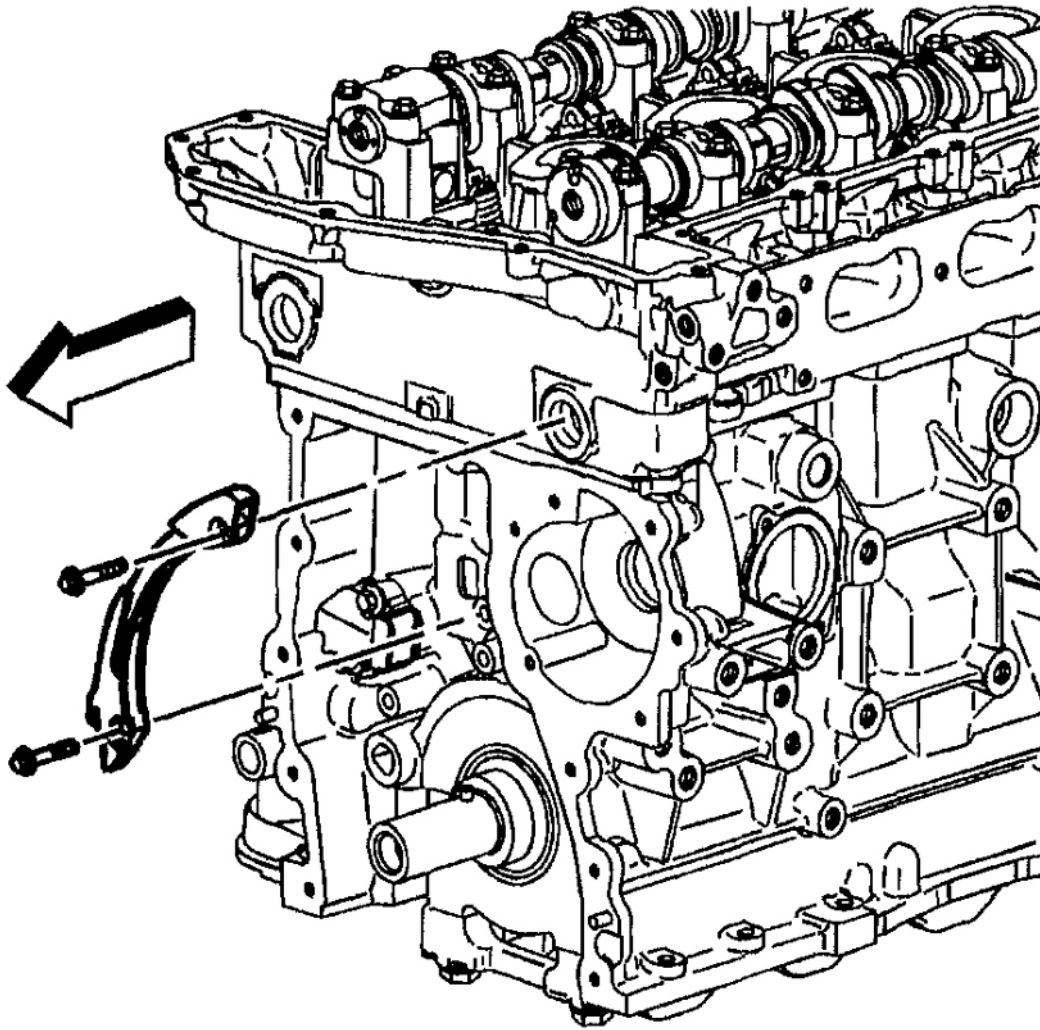
14. Remove the timing chain tensioner shoe bolt.



G01706315

Fig. 142: Removing Timing Chain Tensioner Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

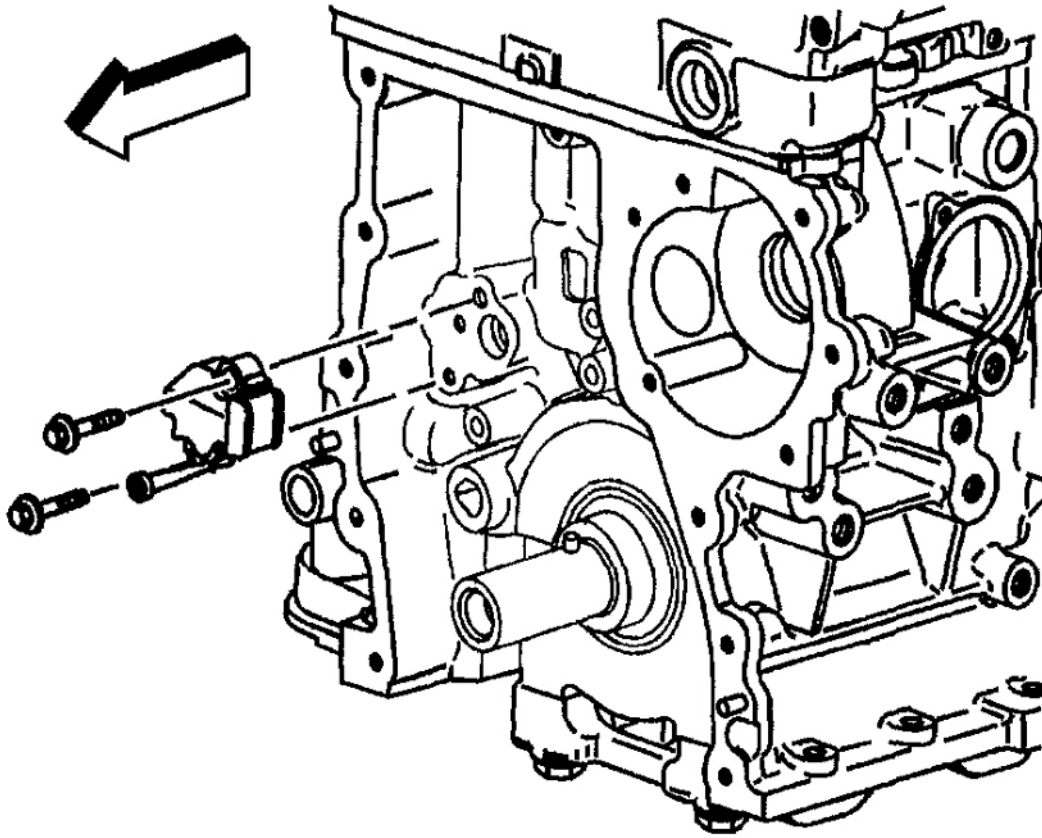
15. Remove the timing chain tensioner shoe.
16. Remove the timing chain tensioner guide bolts.



G01706316

Fig. 143: Removing Timing Chain Tensioner Guide Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the timing chain tensioner guide.
18. Remove the timing chain tensioner bolts.



G01706317

Fig. 144: Removing Timing Chain Tensioner Bolts
Courtesy of GENERAL MOTORS CORP.

19. Remove the timing chain tensioner.

Installation Procedure

IMPORTANT: Every seventh link of the timing chain is darkened to aid in aligning the timing marks.

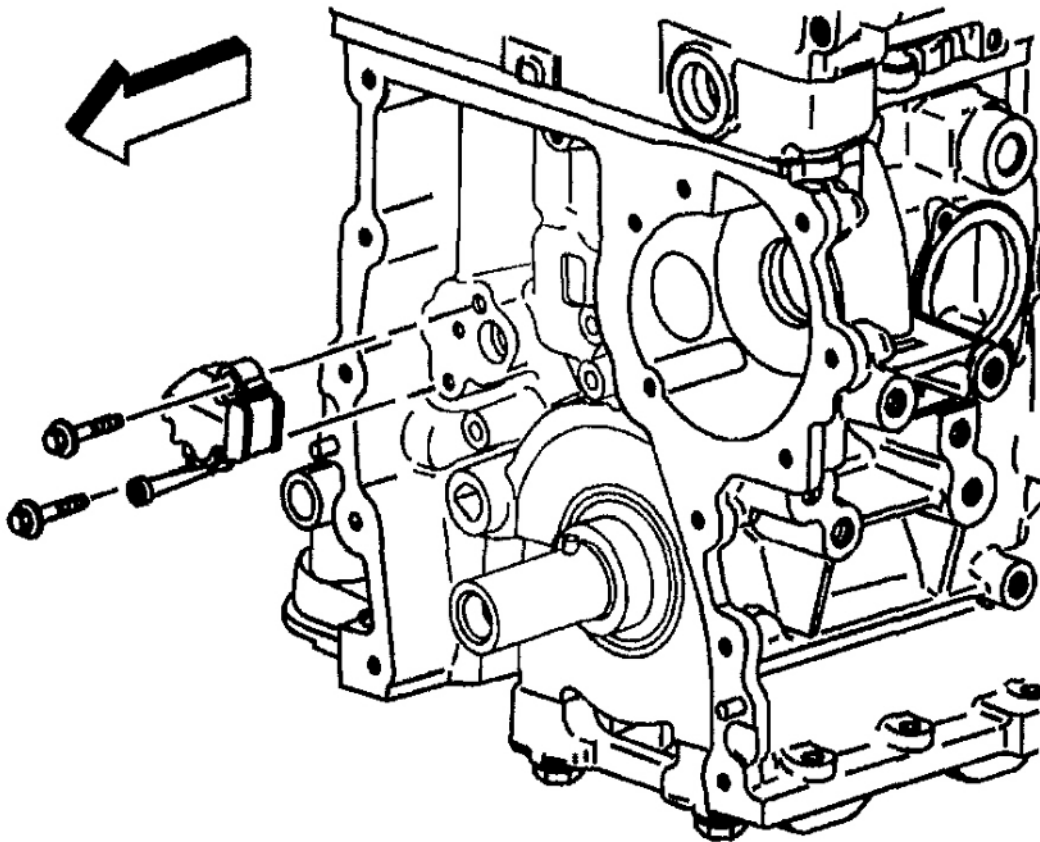
1. Install the timing chain tensioner and secure the tensioner with the bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces

unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the timing chain tensioner bolts to 25 N.m (18 lb ft).



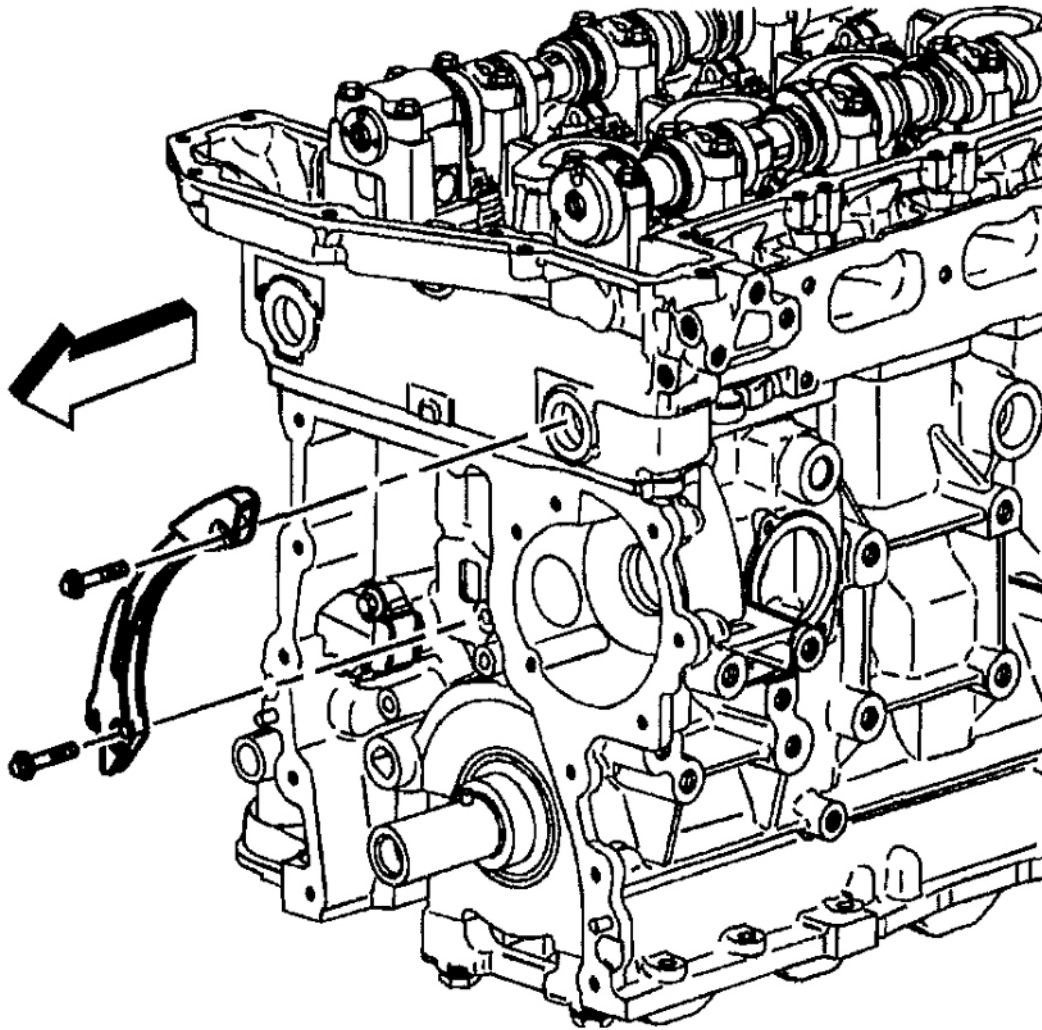
G01706318

Fig. 145: Installing Timing Chain Tensioner And Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the timing chain tensioner guide and secure the guide with the bolts.

Tighten

Tighten the timing chain tensioner guide to 10 N.m (89 lb in).



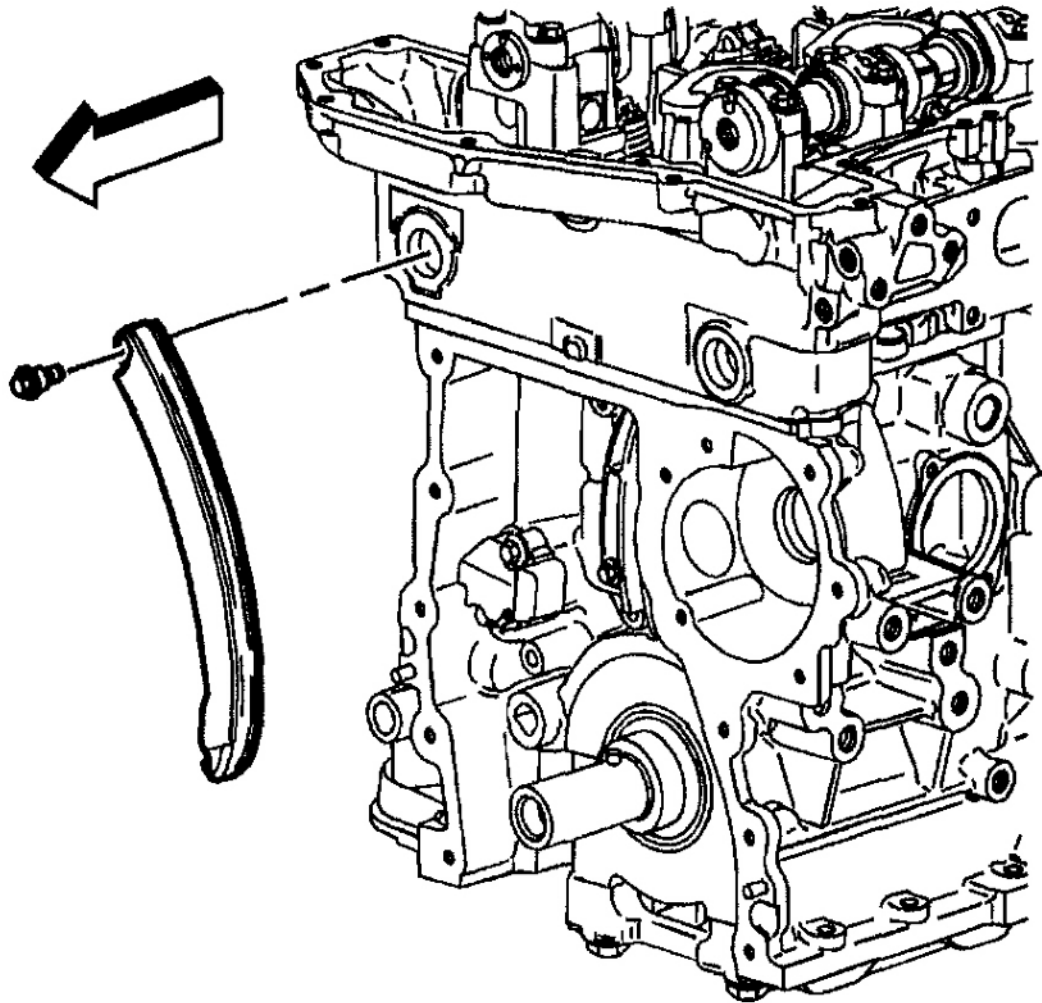
G01706319

Fig. 146: Installing Timing Chain Tensioner Guide And Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the timing chain tensioner shoe and secure the shoe with the bolt.

Tighten

Tighten the timing chain tensioner shoe bolt to 26 N.m (19 lb ft).



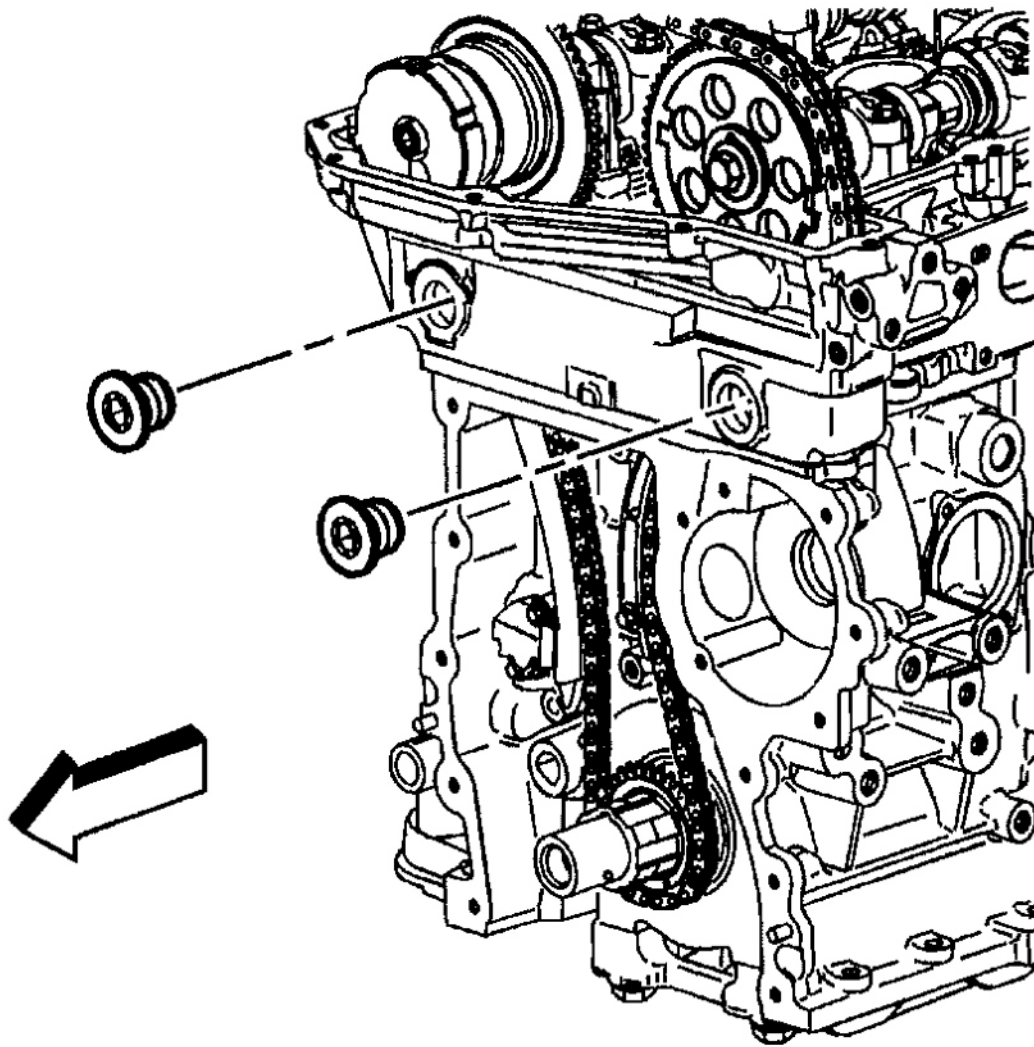
G01706320

Fig. 147: Installing Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head access hole plugs.

Tighten

Tighten the cylinder head access hole plugs to 5 N.m (44 lb in).



G01706321

Fig. 148: Installing Cylinder Head Access Hole Plugs
Courtesy of GENERAL MOTORS CORP.

5. Install the J 44221 with the camshaft flats up and the number 1 cylinder at top dead center.

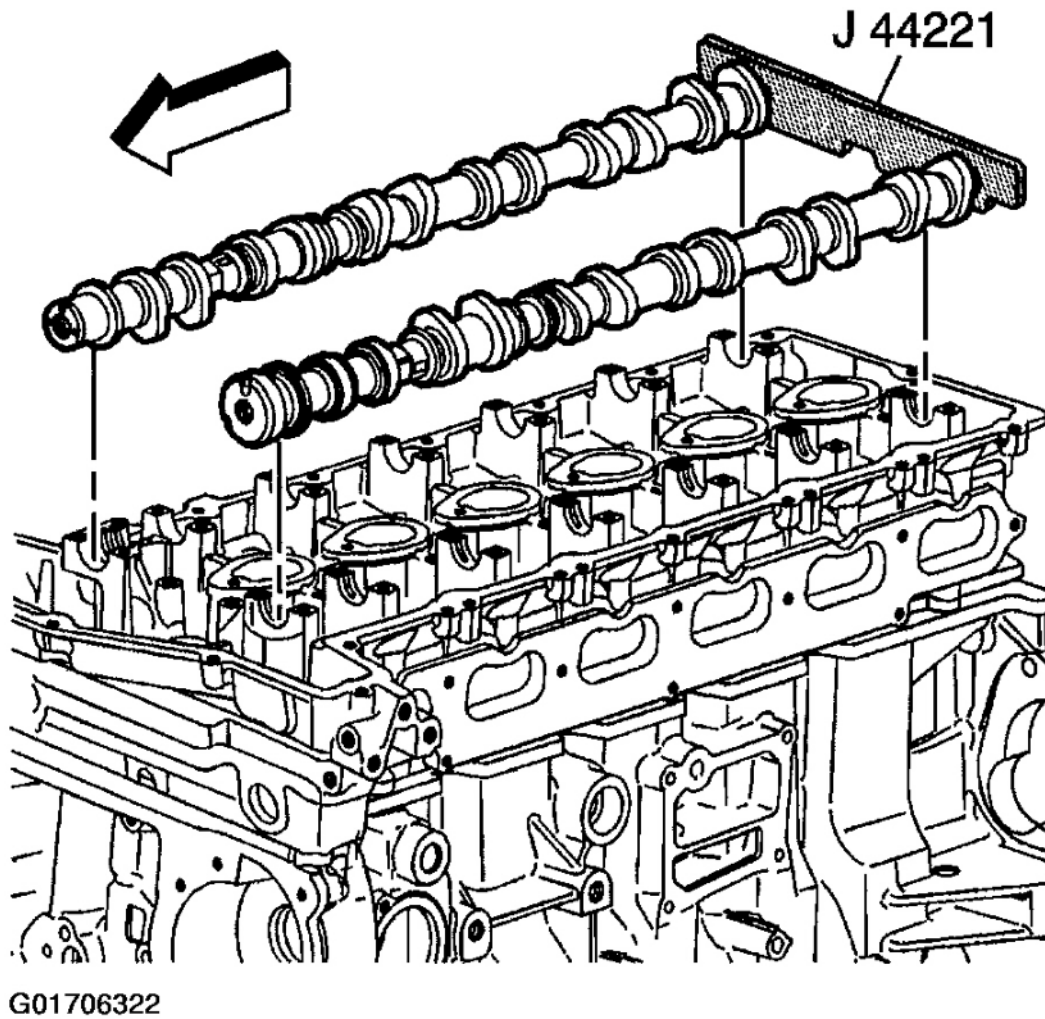
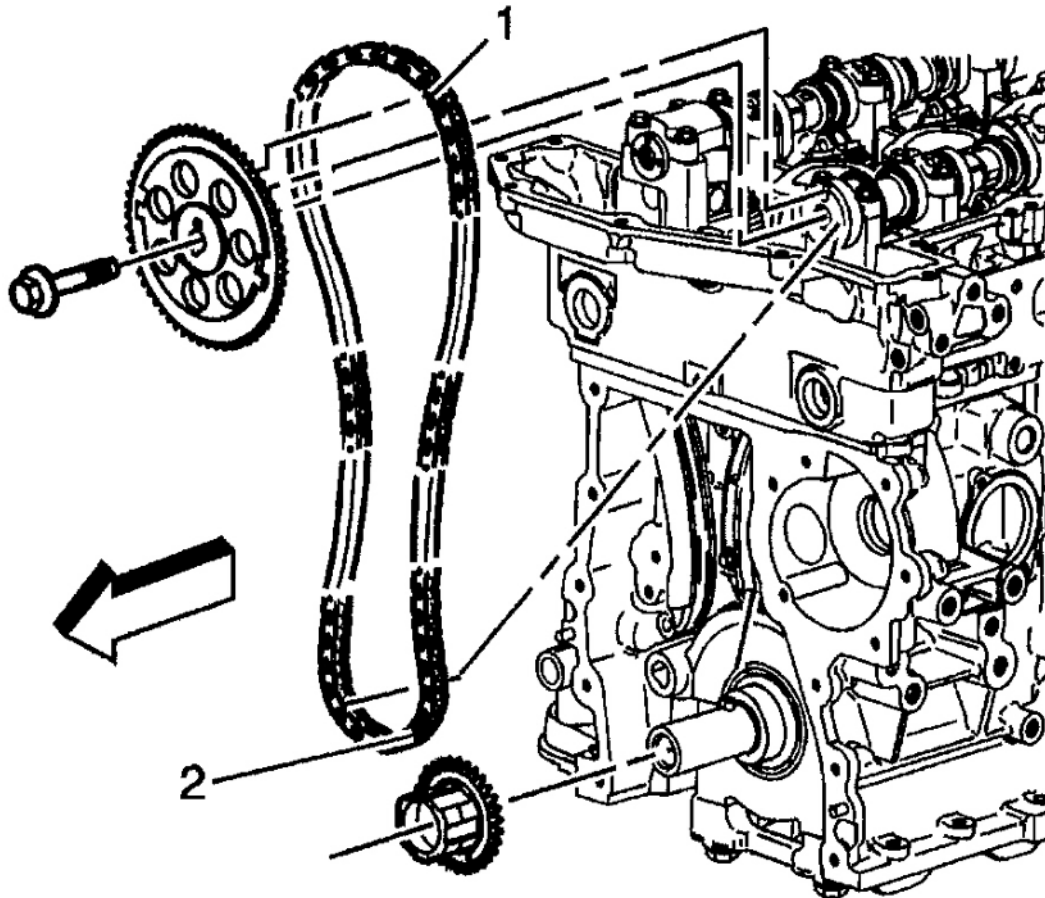


Fig. 149: Installing J 44221 With Camshaft Flats Up And Number 1 Cylinder At Top Dead Center
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft sprocket (1).



G01706323

Fig. 150: Installing Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

7. Install the intake camshaft sprocket into the timing chain.
8. Align the dark link of the timing chain with the timing mark on the intake camshaft sprocket (1).
9. Feed the timing chain down through the opening in the head.
10. Install the timing chain onto the crankshaft sprocket. Align the dark link of the timing chain with the timing mark on the crankshaft sprocket.

IMPORTANT: It may be necessary to remove J 44221 to rotate and hold the camshaft (hex) to align the pin to the camshaft sprocket.

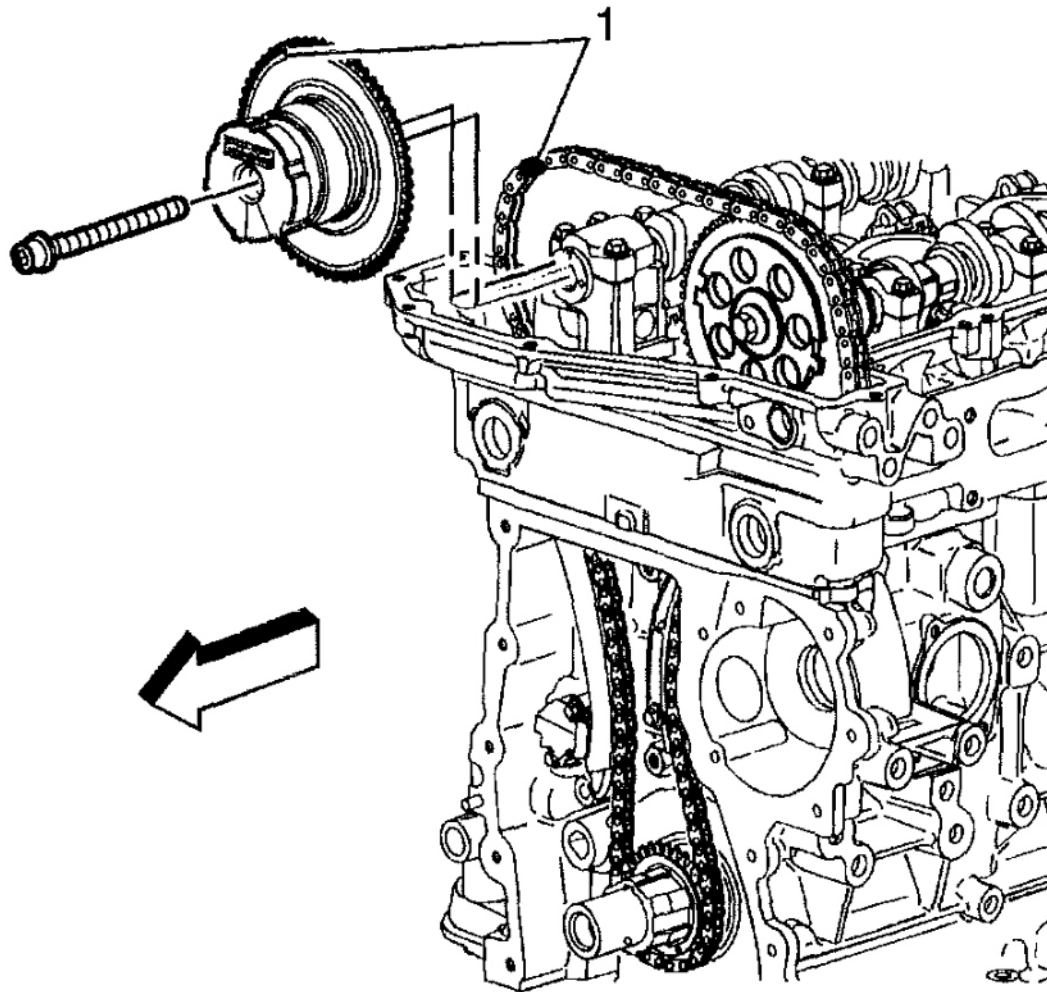
11. Install the intake camshaft sprocket onto the intake camshaft.

NOTE: Use the correct fastener in the correct location. Replacement fasteners

must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

12. Install the intake camshaft sprocket washer and bolt.
13. Install the exhaust camshaft actuator into the timing chain.
14. Align the dark link of the timing chain with the timing mark on the exhaust camshaft actuator (1).

IMPORTANT: It may be necessary to remove the J 44221 to rotate and hold the camshaft hex to align the pin to the camshaft sprocket.



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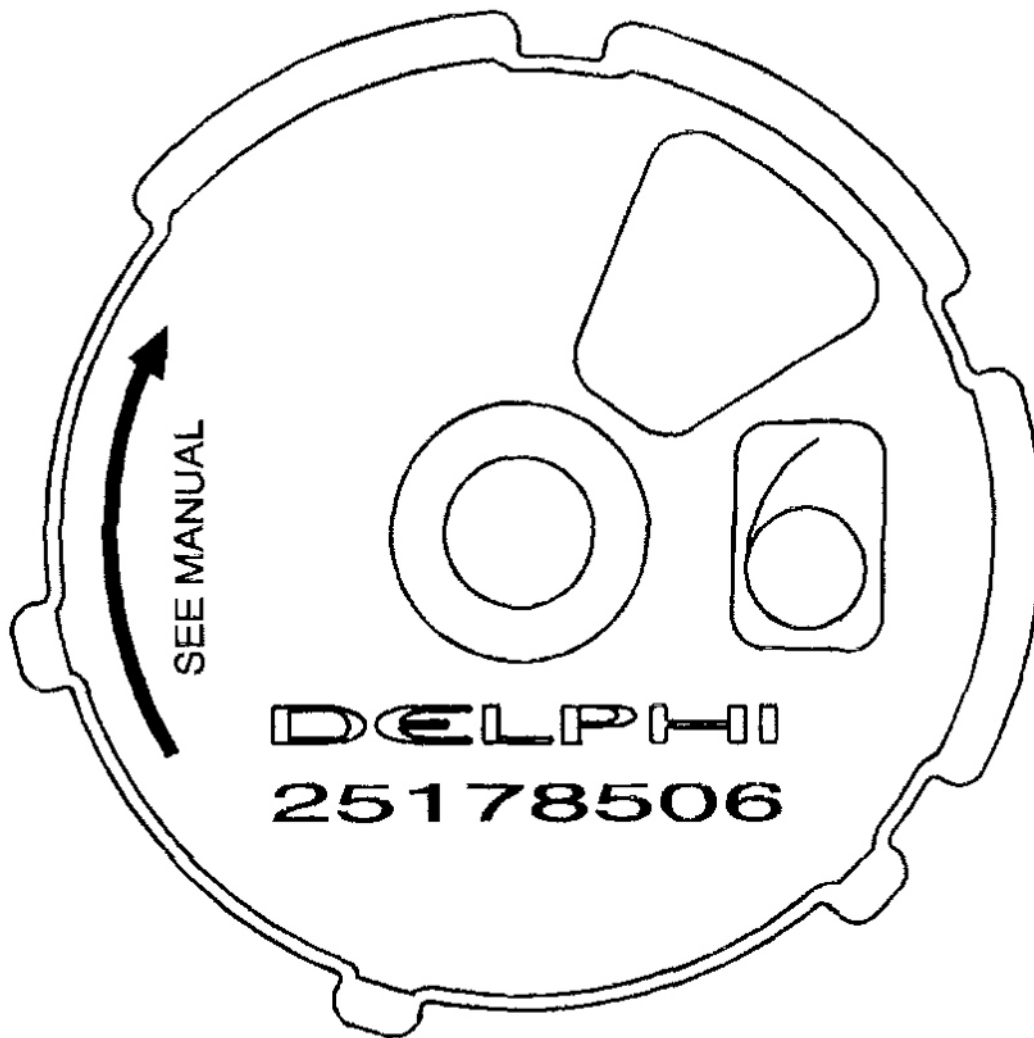
Fig. 151: Aligning Dark Link Of Timing Chain With Timing Mark On Exhaust Camshaft Actuator
Courtesy of GENERAL MOTORS CORP.

15. Install the exhaust camshaft actuator onto the exhaust camshaft.

IMPORTANT: Rotate the camshaft actuator clockwise relative to the camshaft prior to tightening the bolt.

16. Rotate the camshaft actuator clockwise (as seen from the front of the vehicle).

NOTE: The camshaft actuator must be fully advanced during installation. Engine damage may occur if the camshaft actuator is not fully advanced.



G01706325

Fig. 152: Rotating Camshaft Actuator Clockwise
Courtesy of GENERAL MOTORS CORP.

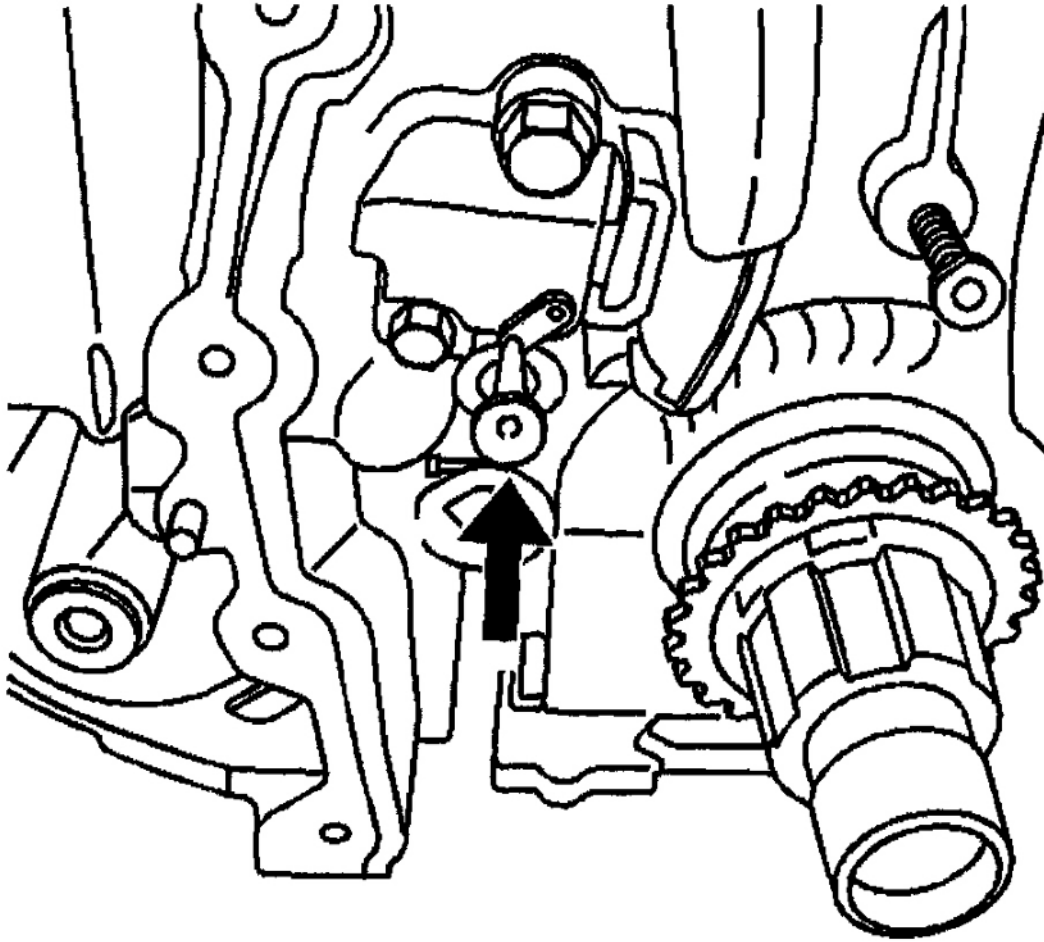
17. Install the exhaust camshaft actuator bolt.

Tighten

- Tighten the exhaust camshaft actuator bolt the first pass to 25 N.m (18 lb ft).
- Use J 36660-A to tighten the exhaust camshaft actuator bolt the final pass an additional 135 degrees.

18. **Tighten**

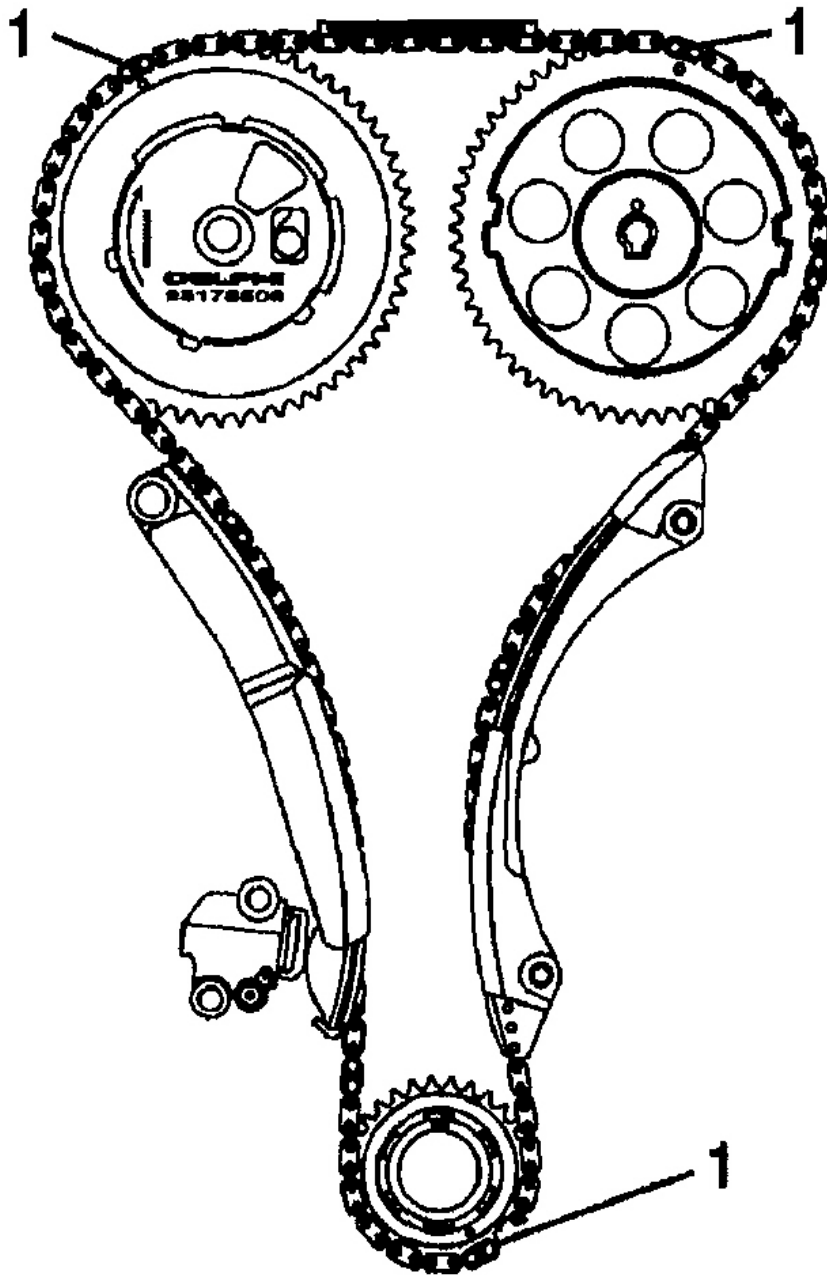
- Tighten the intake camshaft sprocket bolt the first pass to 30 N.m (22 lb ft).
 - Use J 36660-A to tighten the intake camshaft sprocket bolt the final pass an additional 135 degrees.
19. Remove the tee in the timing chain tensioner to regain tension on the timing chain.



G01706326

Fig. 153: Removing Tee In Timing Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

20. Remove the J 44221.
21. The dark lines (1) on the chain should be aligned with the marks on the sprockets as shown.



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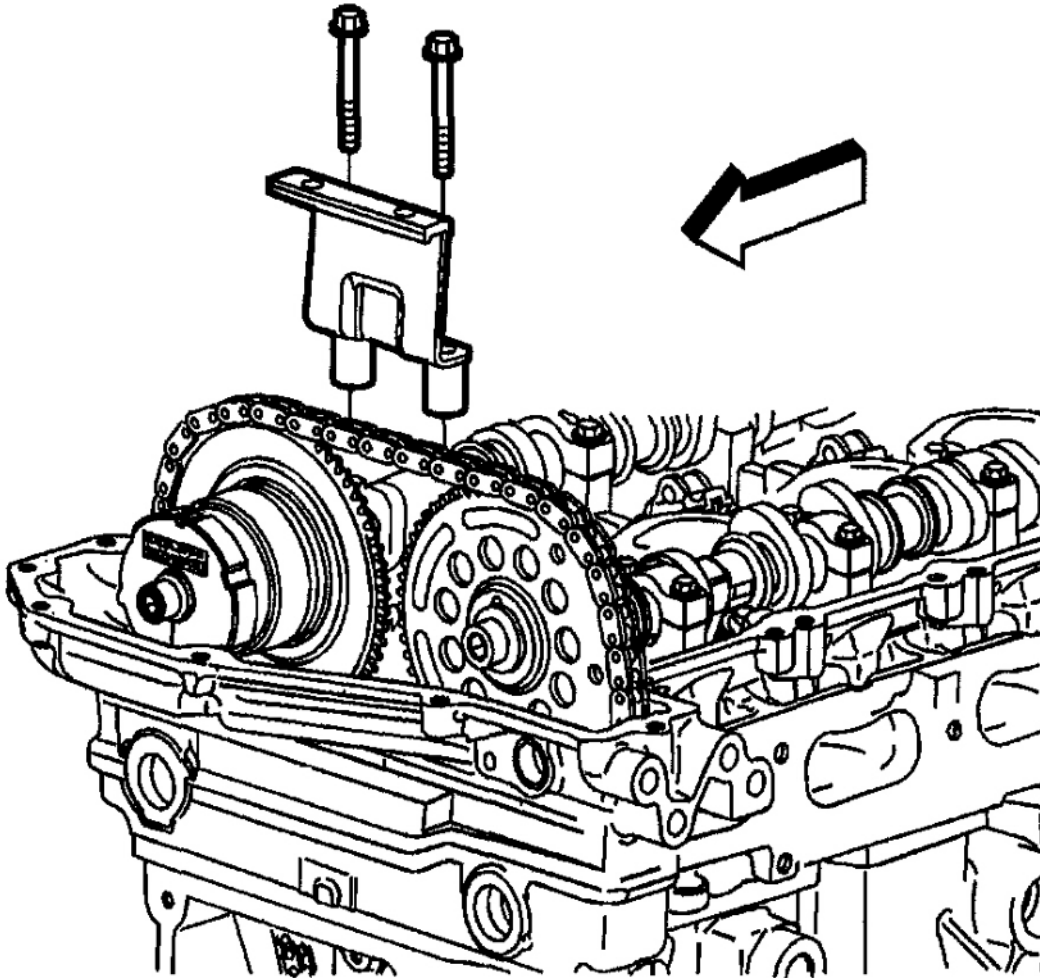
Fig. 154: Aligning Dark Lines On Chain With Marks On Sprockets
Courtesy of GENERAL MOTORS CORP.

22. Install the top chain guide.
23. Add threadlock GM P/N 12345493 to the top chain guide bolt threads.

24. Install the top chain guide bolts.

Tighten

Tighten the top chain guide bolts to 10 N.m (89 lb in).



G01706328

Fig. 155: Installing Top Chain Guide Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the engine front cover. Refer to **Engine Front Cover Replacement**.
26. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

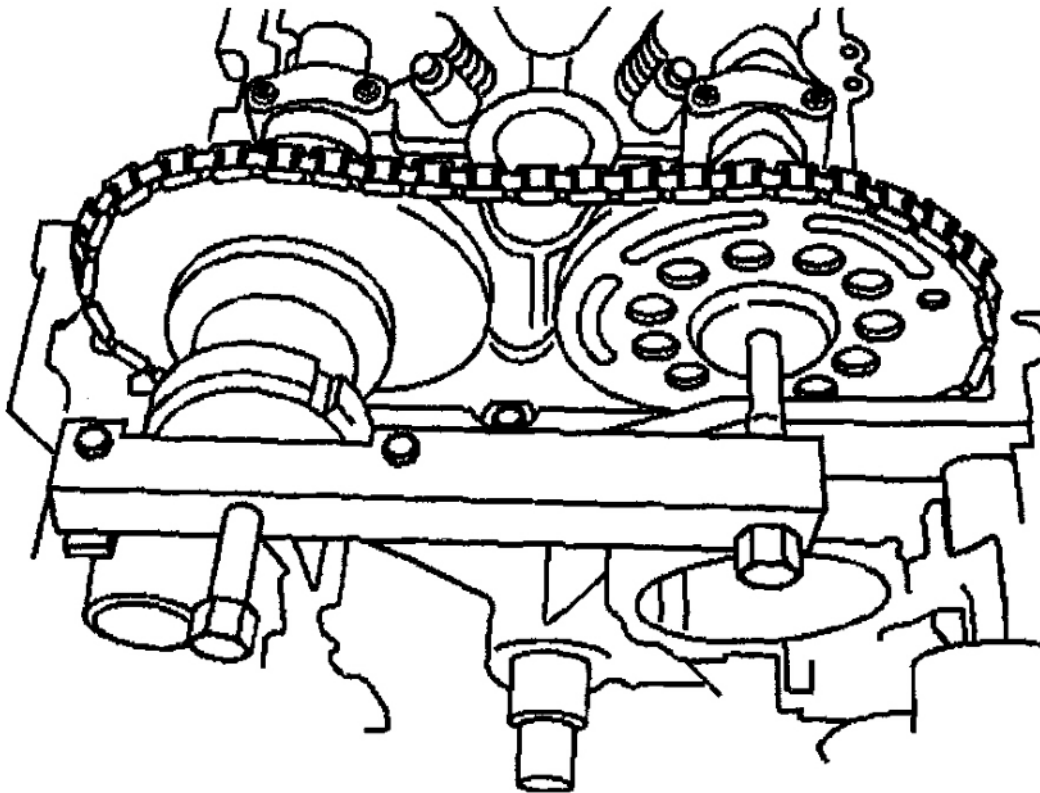
CAMSHAFT REPLACEMENT

Tools Required

- **J 44221** Camshaft Holding Tool
- **J 44222** Camshaft Sprocket Holding Tool
- **J 36660-A** Torque/Angle Meter

Removal Procedure

1. Remove the camshaft cover. Refer to **Camshaft Cover Replacement**.
2. Remove the intake and the exhaust camshaft sprocket bolts.
3. Install the J 44222 onto the cylinder head and adjust the horizontal bolts into the camshaft sprockets in order to maintain chain tension and keep from disturbing the timing chain components.



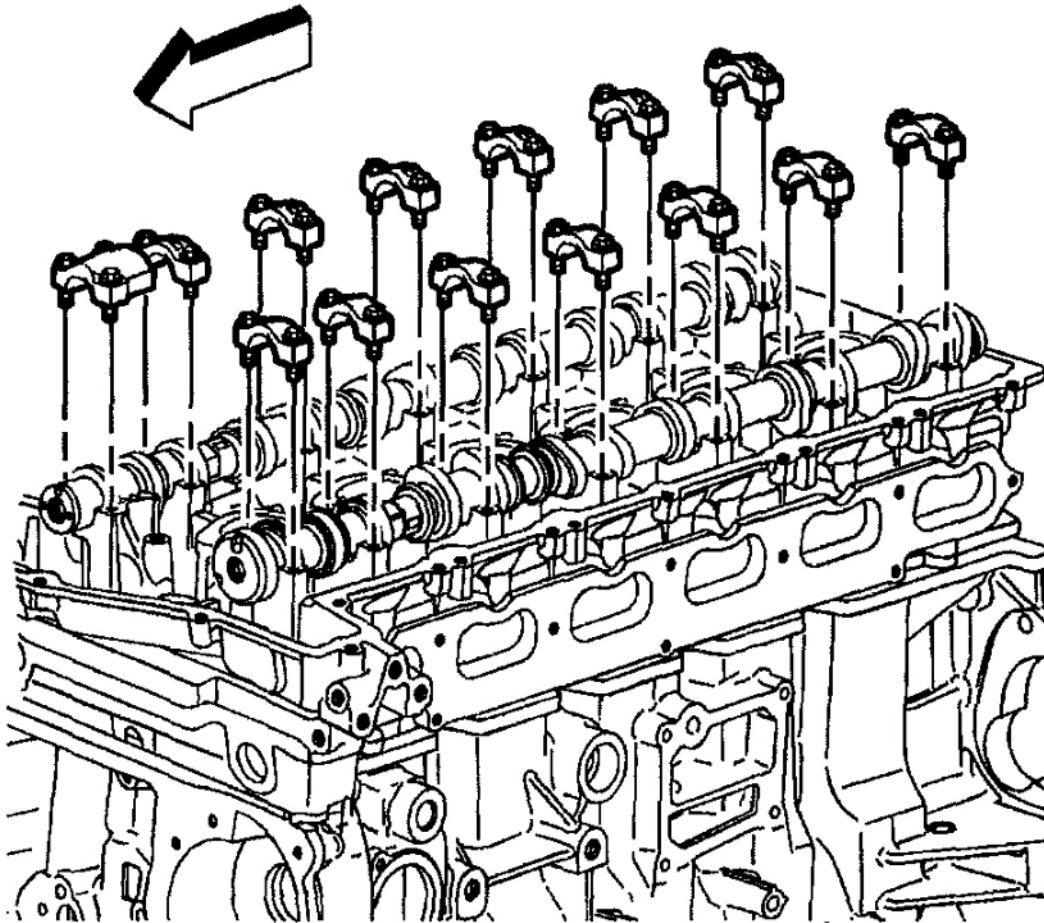
G01706329

Fig. 156: Installing J 44222 Onto Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Carefully move the sprockets with the timing chain, off of the camshafts.
5. Remove the camshaft cap bolts.

IMPORTANT: Place the camshaft caps in a rack to ensure the caps are installed in the same location from which they were removed.

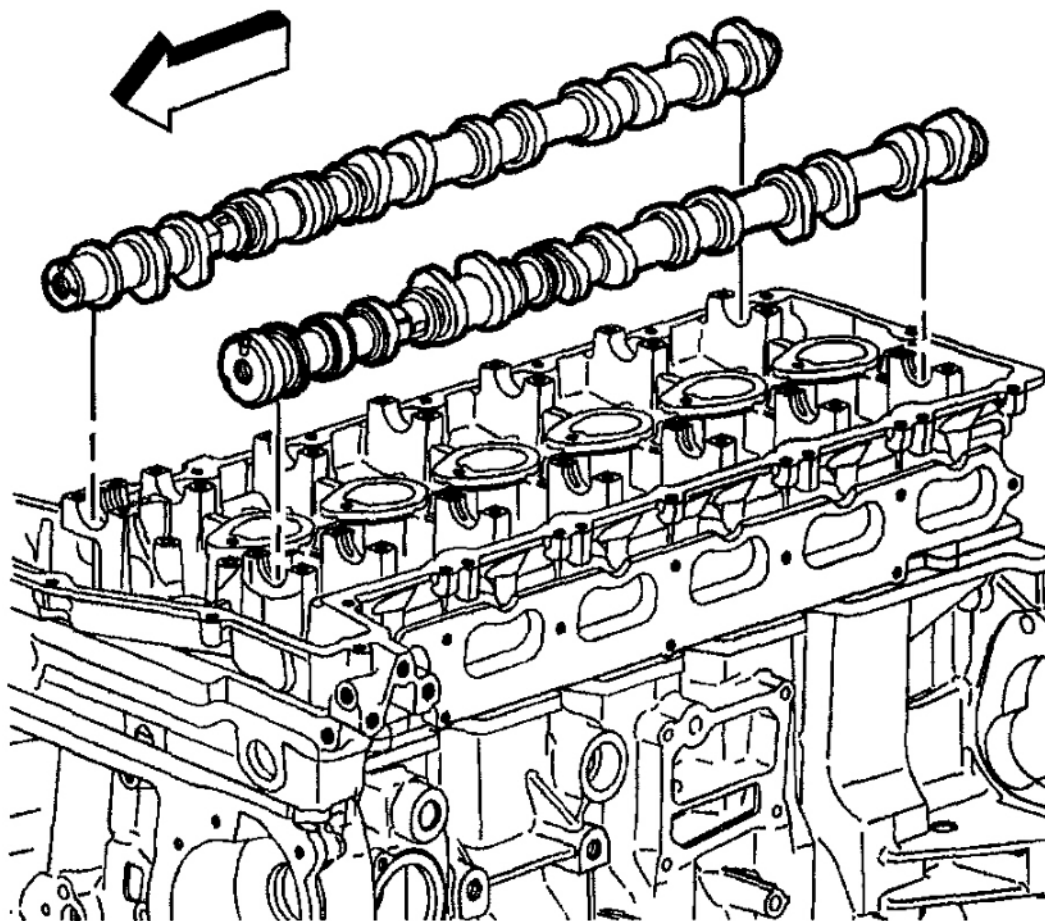
6. Remove the camshaft caps and store.



G01706330

Fig. 157: Removing Camshaft Caps
Courtesy of GENERAL MOTORS CORP.

7. Remove the camshafts.



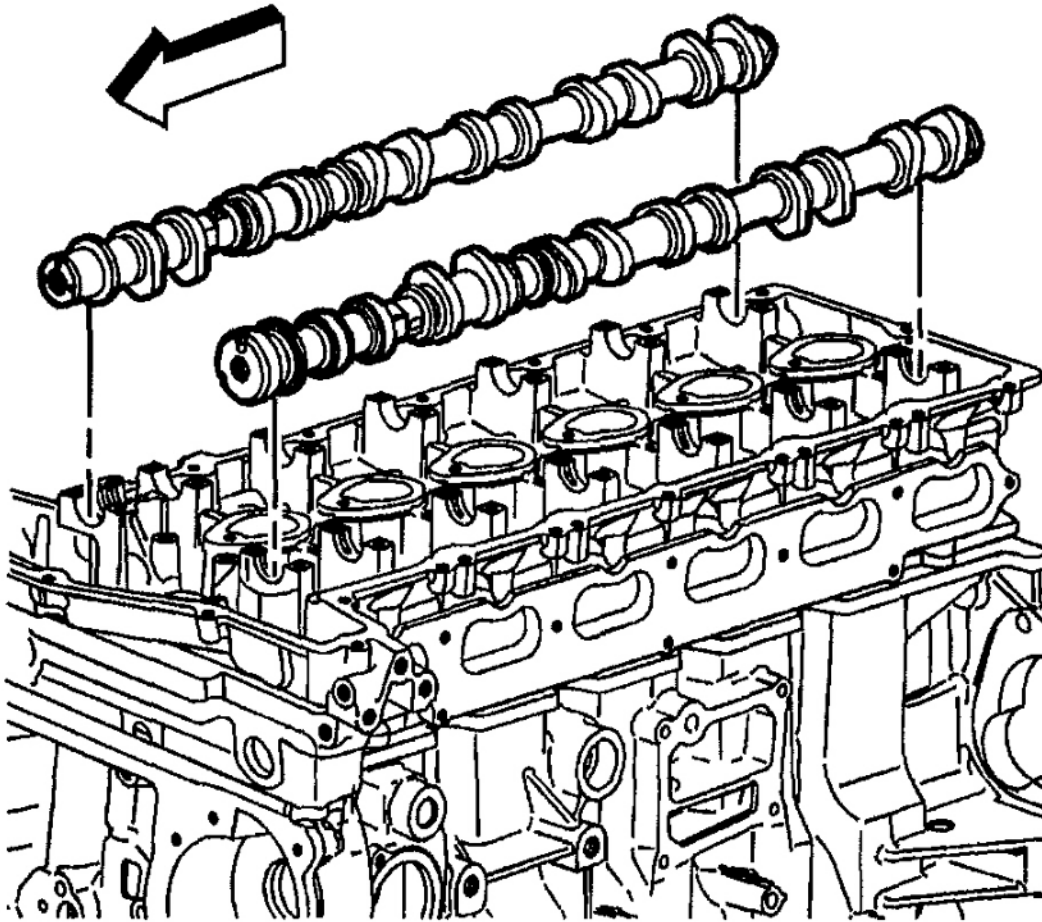
G01706331

Fig. 158: Removing Camshafts

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Coat the camshaft journals, camshaft journal thrust face, and camshaft lobes with clean engine oil.
2. Install the intake and exhaust camshafts to their original positions.



G01706332

Fig. 159: Installing Intake & Exhaust Camshafts

Courtesy of GENERAL MOTORS CORP.

3. Install the J 44221 with the camshaft flats up and the number 1 cylinder at top dead center.

IMPORTANT: Install the camshaft caps onto their original locations. The camshaft caps are pin stamped for direction and numerical order.

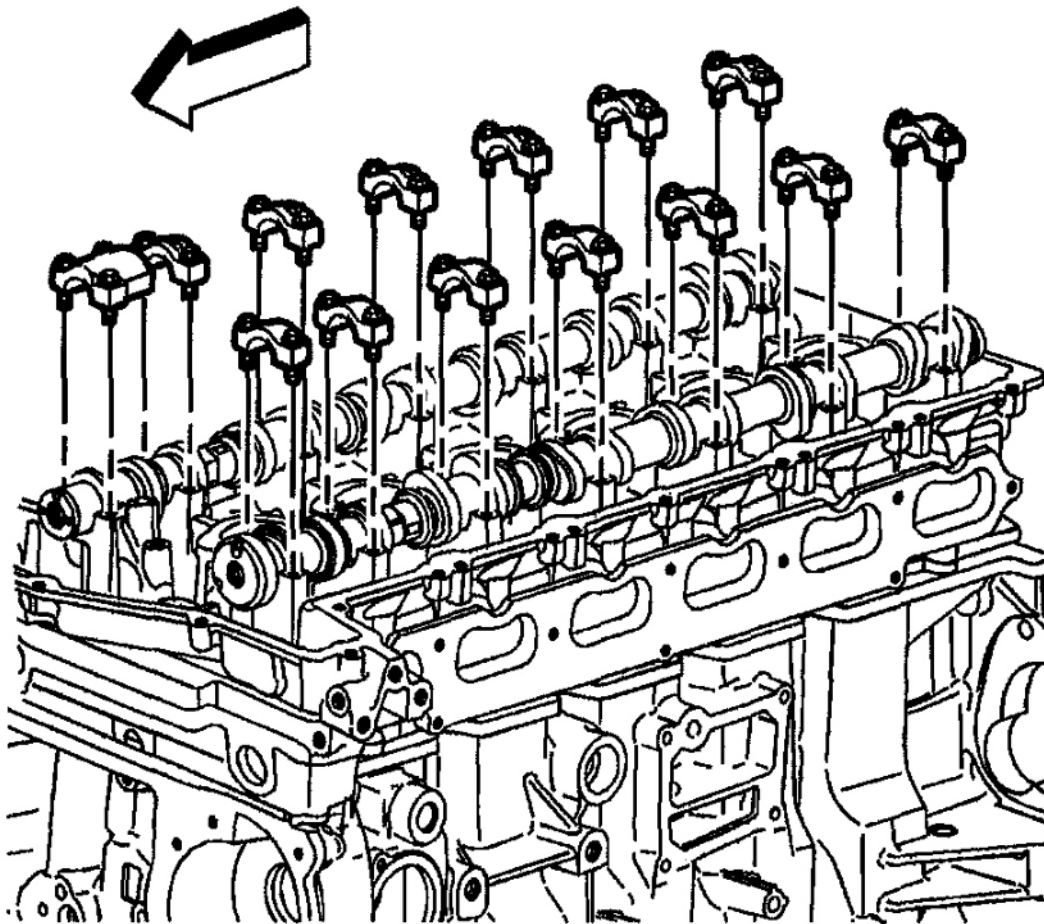
4. Install the camshaft caps and bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces

unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

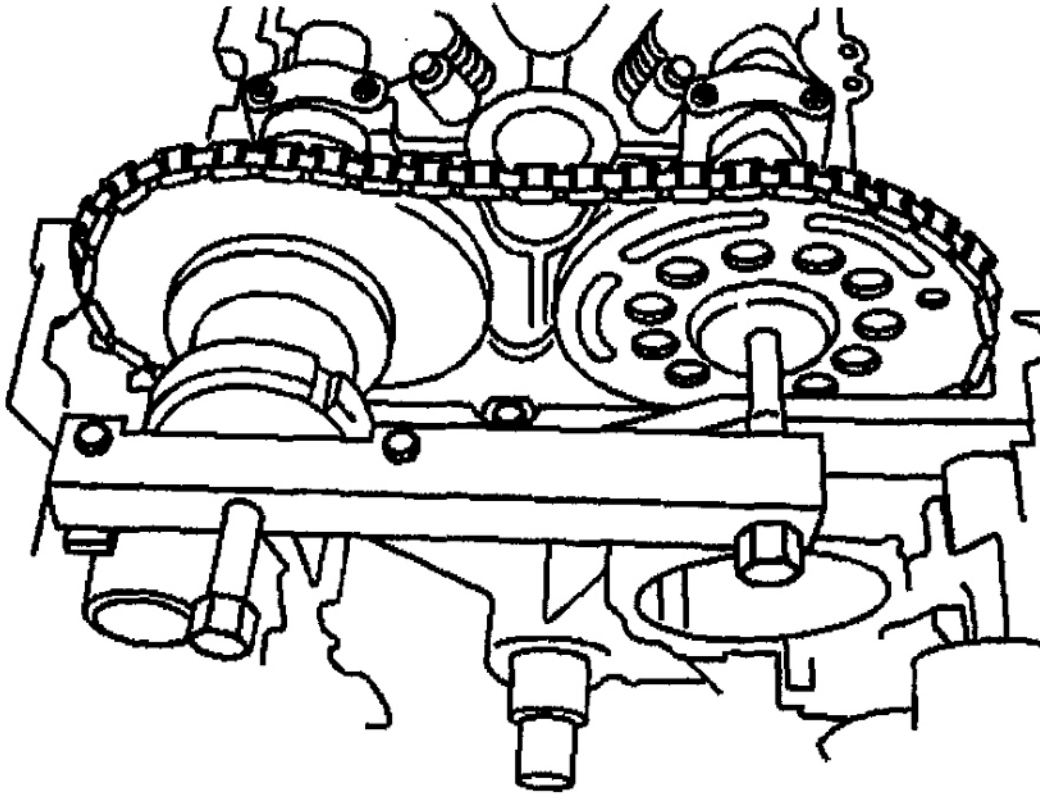
Tighten the camshaft cap bolts to 12 N.m (106 lb in).



G01706333

Fig. 160: Installing Camshaft Caps And Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the J 44221
6. Carefully move the sprockets back onto the camshafts and remove the J 44222.



G01706334

Fig. 161: Removing J 44222

Courtesy of GENERAL MOTORS CORP.

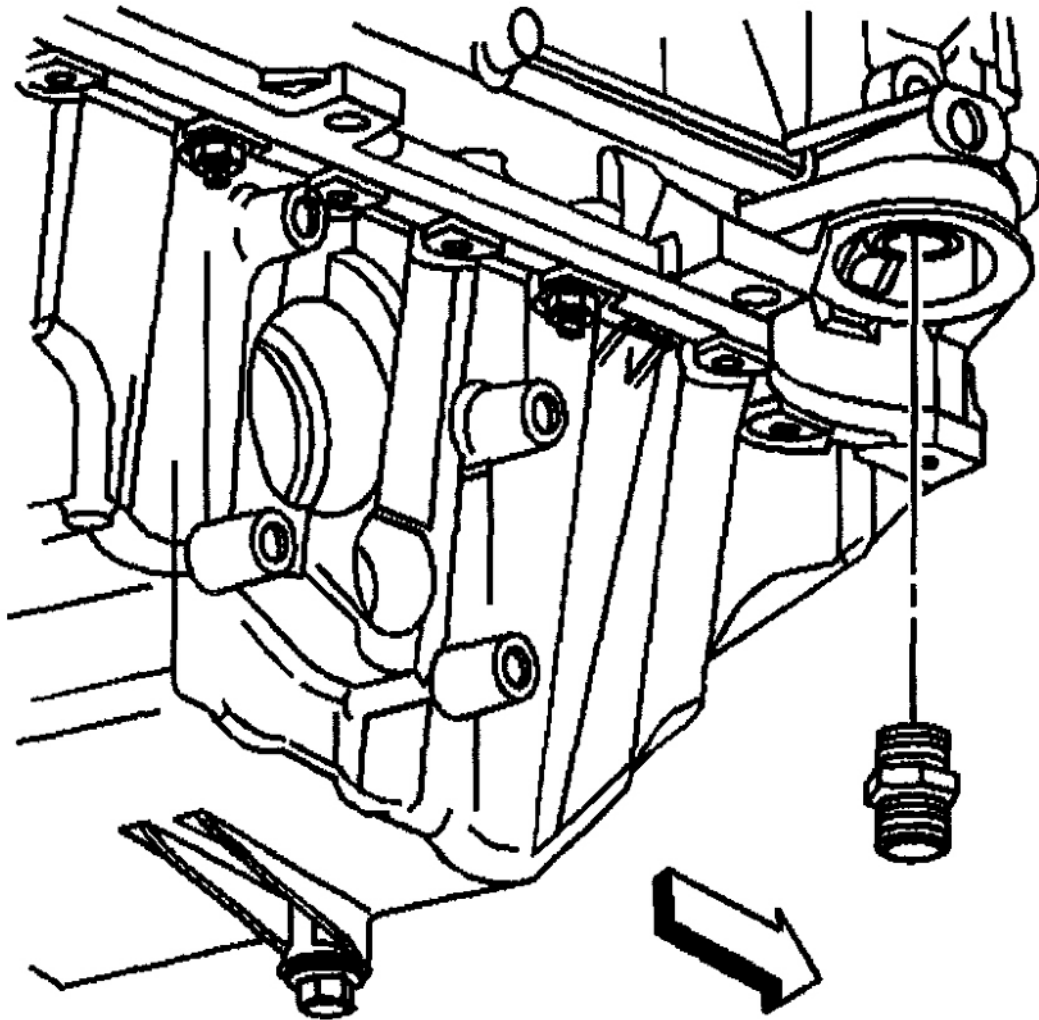
7. Install the intake camshaft sprocket washer and bolt, and the exhaust camshaft actuator bolt.

Tighten

- Tighten the intake camshaft sprocket bolt the first pass to 30 N.m (22 lb ft).
 - Use the J 36660-A to tighten the intake camshaft sprocket bolt the final pass an additional 135 degrees.
 - Tighten the exhaust camshaft actuator bolt the first pass to 25 N.m (18 lb ft).
 - Use the J 36660-A to tighten the exhaust camshaft actuator bolt a final pass an additional 135 degrees.
8. Install the camshaft cover. Refer to **Camshaft Cover Replacement**.

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT**Removal Procedure**

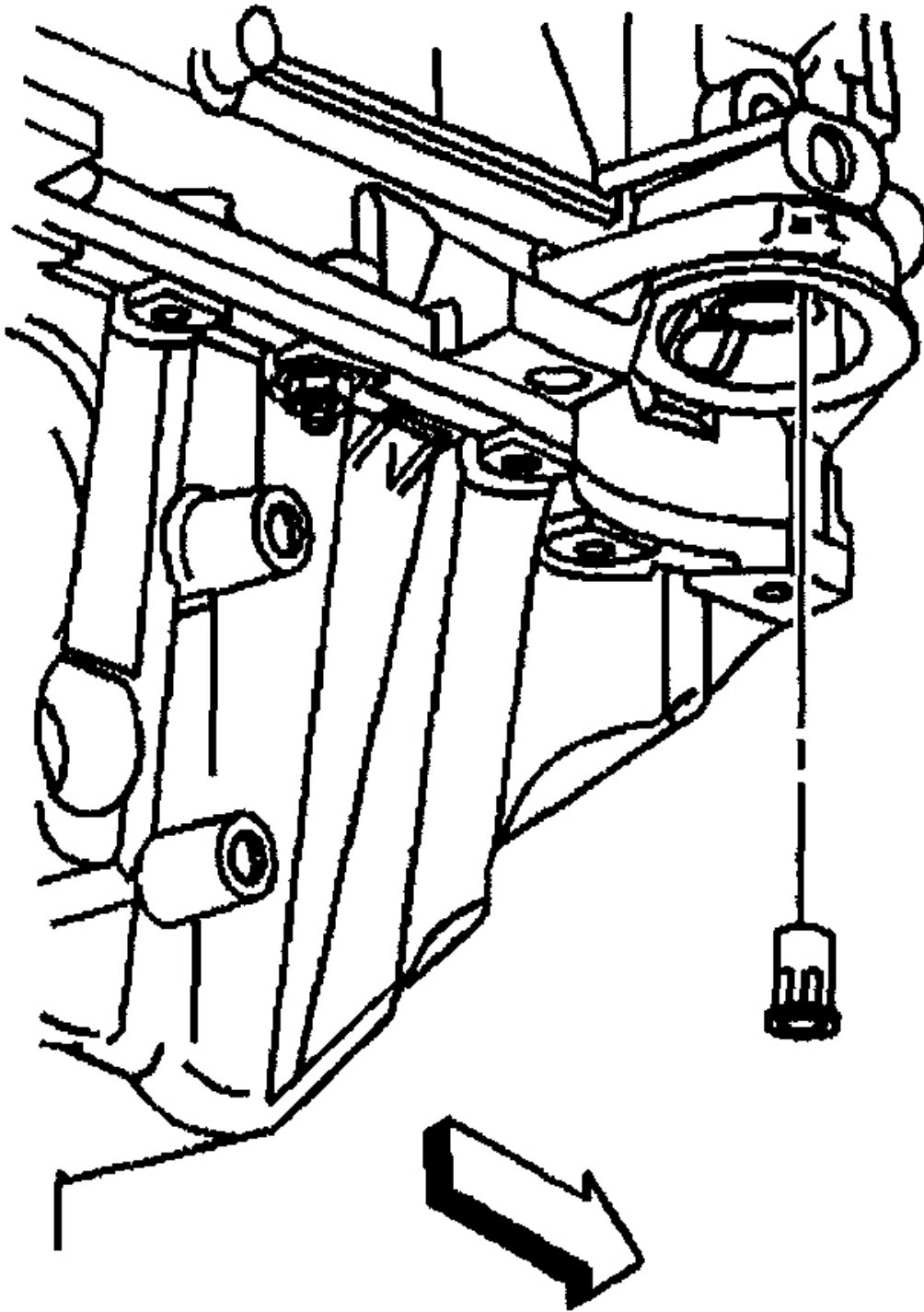
1. Remove the oil filter. Refer to Engine Oil and Oil Filter Replacement.
2. Remove the oil filter adapter.



G01706335

Fig. 162: Removing Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter bypass valve.

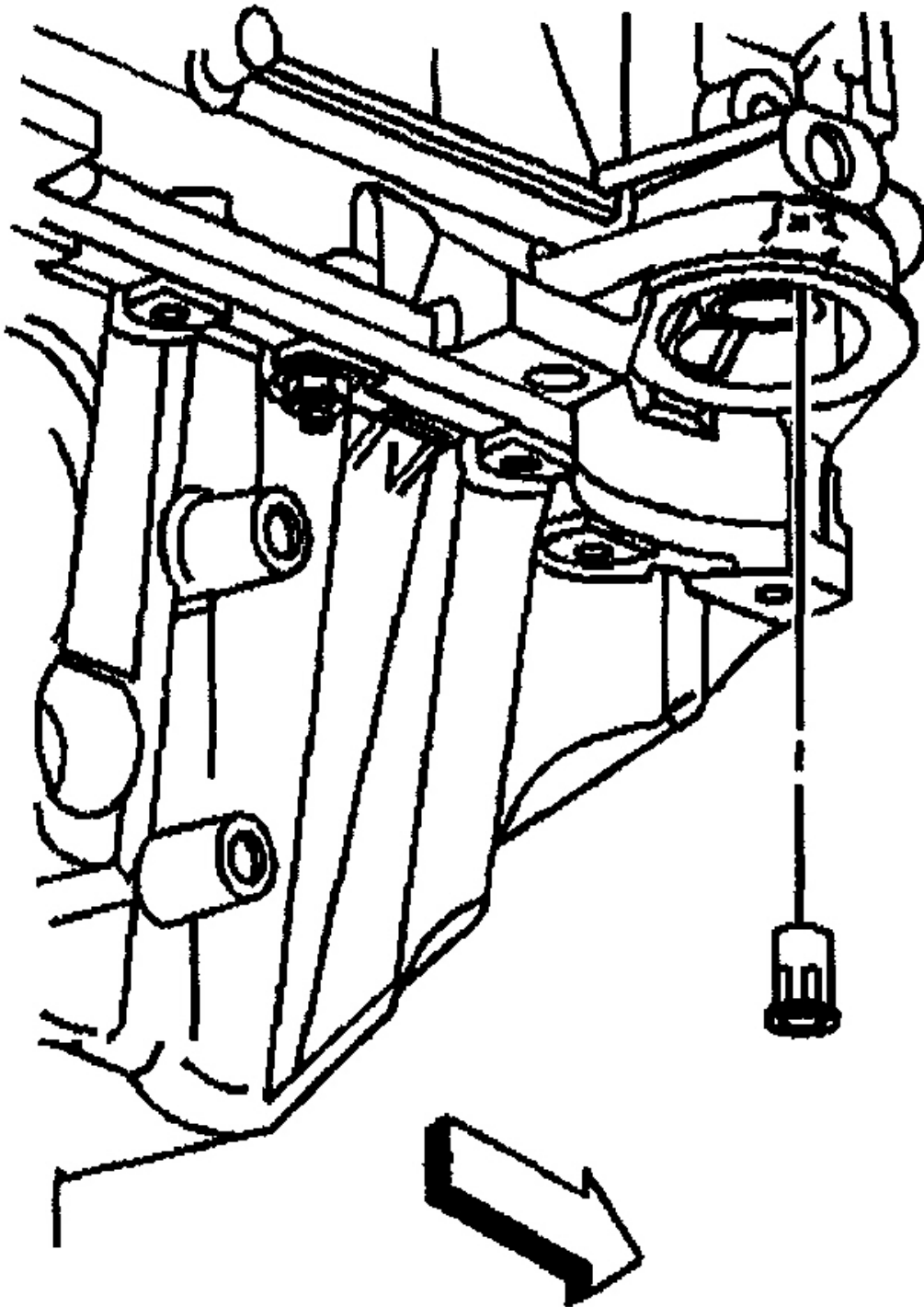


G01706336

Fig. 163: Removing Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the oil filter bypass valve.



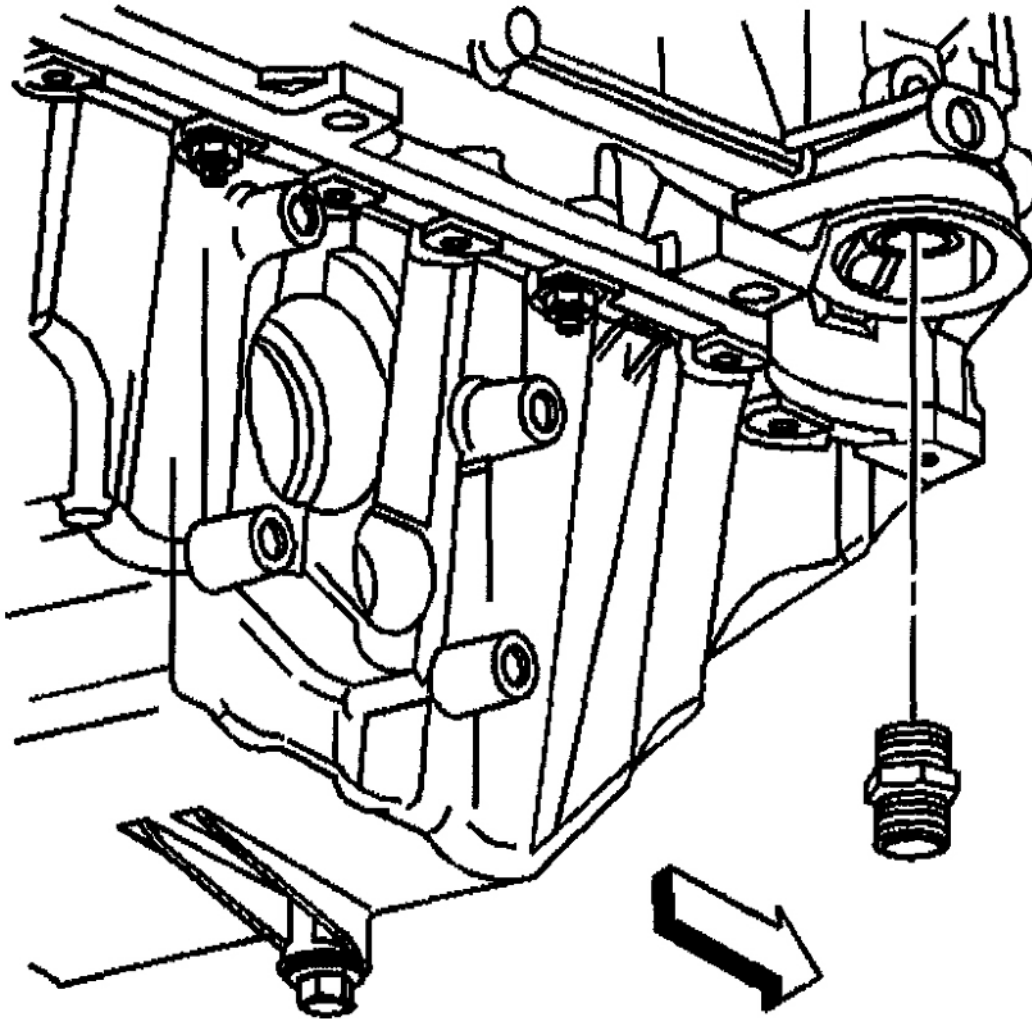
G01706337

Fig. 164: Installing Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

2. Install the oil filter adapter.

Tighten

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



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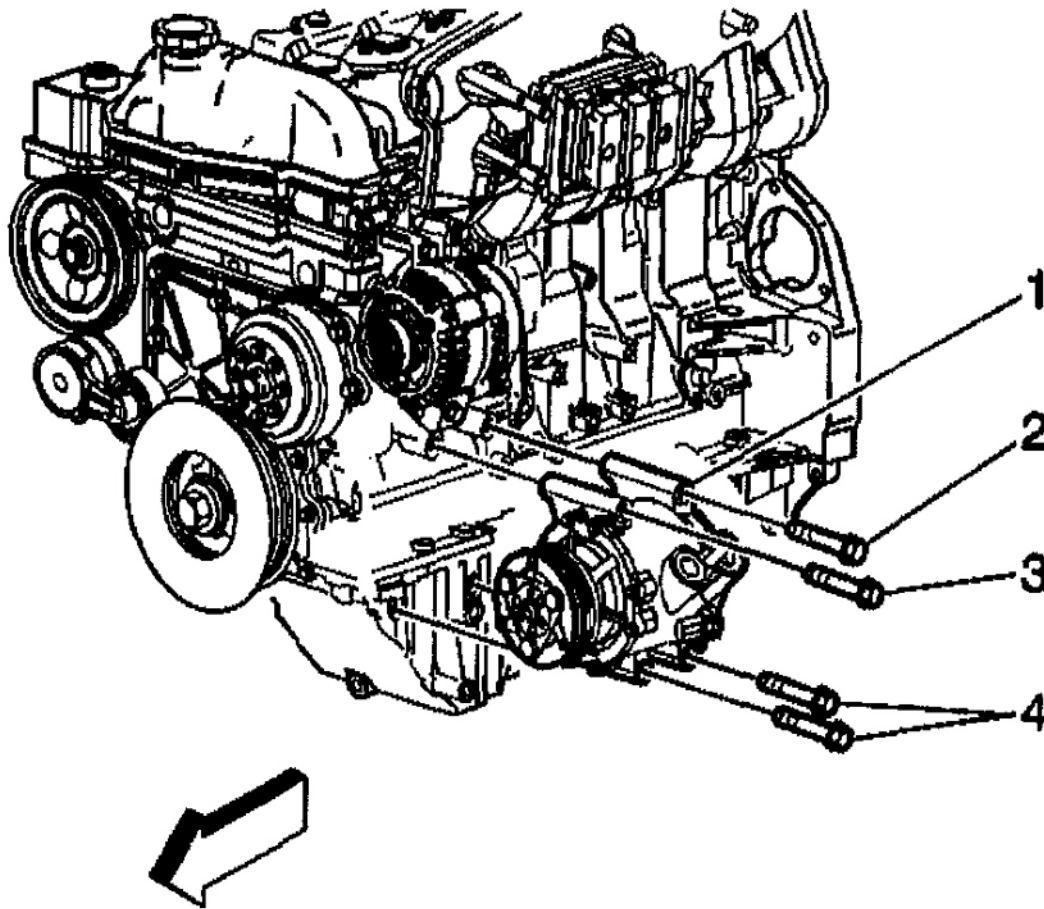
Fig. 165: Installing Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

3. Install the oil filter. Refer to **Engine Oil and Oil Filter Replacement**.

OIL PAN REPLACEMENT

Removal Procedure

1. Remove the A/C compressor bottom bolts (4) and loosen the top bolts (2, 3).

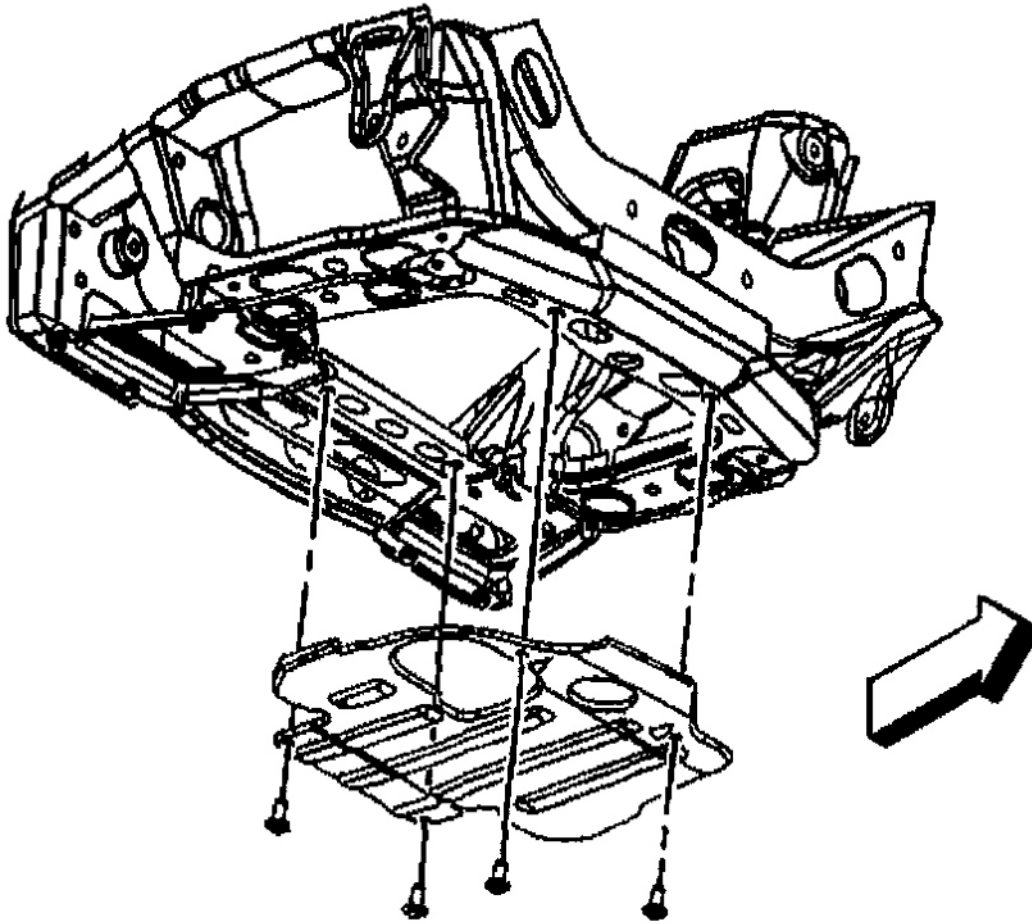


G01706339

Fig. 166: Removing A/C Compressor Bottom Bolts And Loosening Top Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Replacement**.
3. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
4. Remove left and right front tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

5. Remove the engine protection shield mounting bolts.

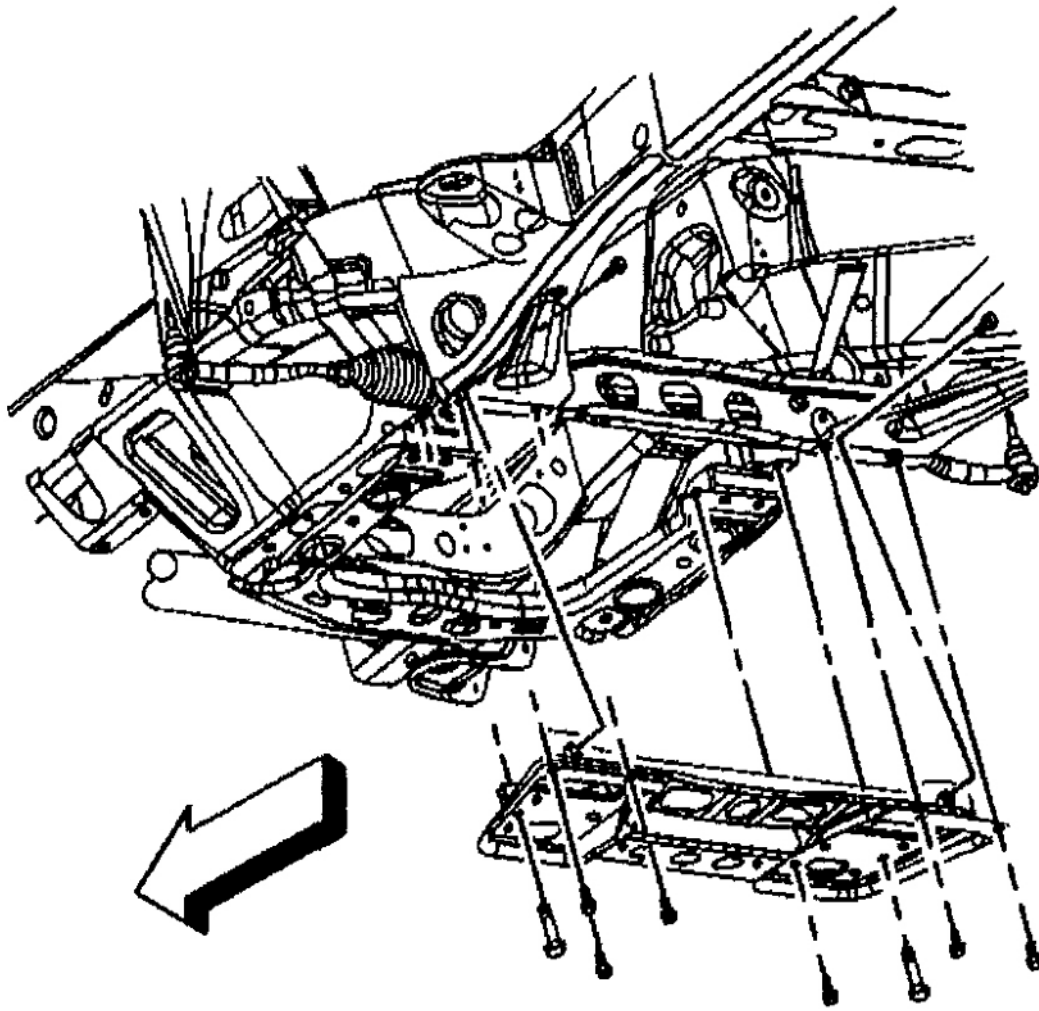


G01706340

Fig. 167: Removing Engine Protection Shield Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine protection shield.
7. Remove the steering gear crossmember, front.

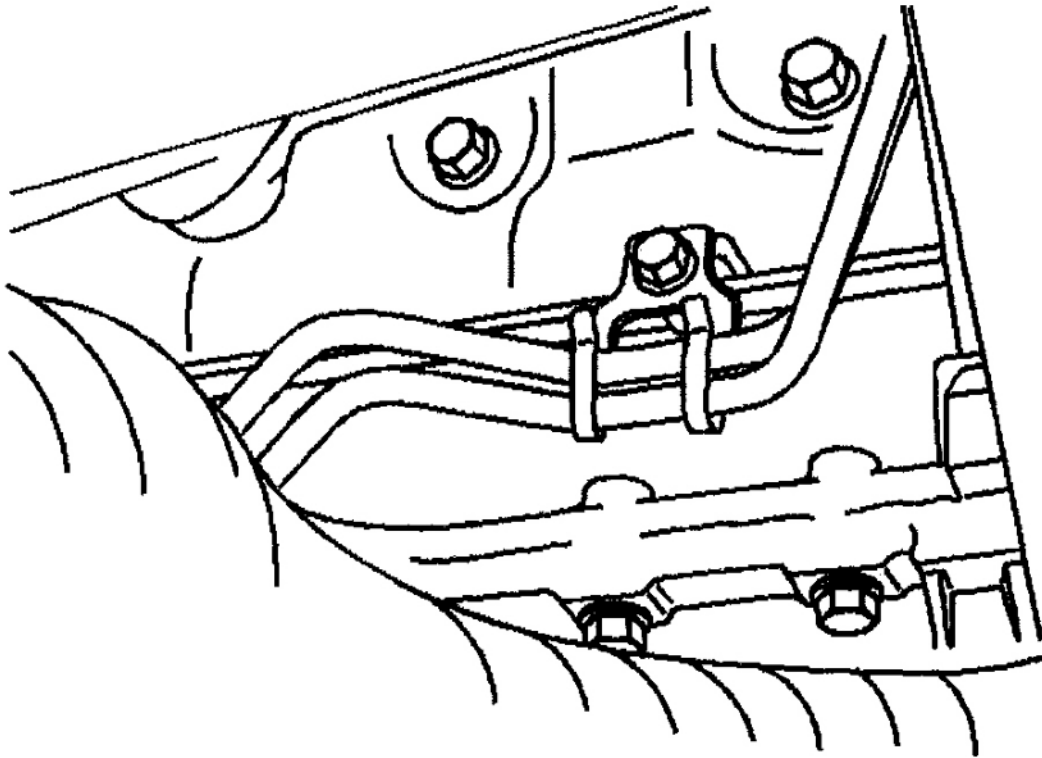
Refer to Steering Gear Crossmember Replacement - Front in Frame and Underbody.



G01706341

Fig. 168: Removing Front Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

8. Remove the left and right wheel drive shaft. Refer to **FRONT DRIVE AXLE - 4WD** article.
9. Remove the front drive axle clutch fork assembly. Refer to Intermediate Shaft Bearing Assembly Replacement - Front Drive Axle (S4WD) or Intermediate Shaft Bearing Assembly Replacement - Front Drive Axle (A4WD) in Front Drive Axle.
10. Disconnect the prop shaft from the front axle pinion yoke. Refer to **PROPELLER SHAFT REPLACEMENT - FRONT** in Propeller Shaft.
11. Remove the oil pan drain plug and drain the oil.
12. Unclip the transmission cooler lines from the engine block.



G01706342

Fig. 169: Unclipping Transmission Cooler Lines From Engine Block
Courtesy of GENERAL MOTORS CORP.

13. Remove the front differential bolts and set aside the front differential.
14. Remove 4 transmission bell housing bolts that are attached to the oil pan.
15. Remove the remaining oil pan bolts.
16. Place 2 oil pan bolts in the jack screws on the oil pan and tighten evenly to release the oil pan from the engine.
17. Clean and inspect the oil pan. Refer to **OIL PAN CLEANING AND INSPECTION** in Engine Mechanical - 4.2L Unit Repair.

Installation Procedure

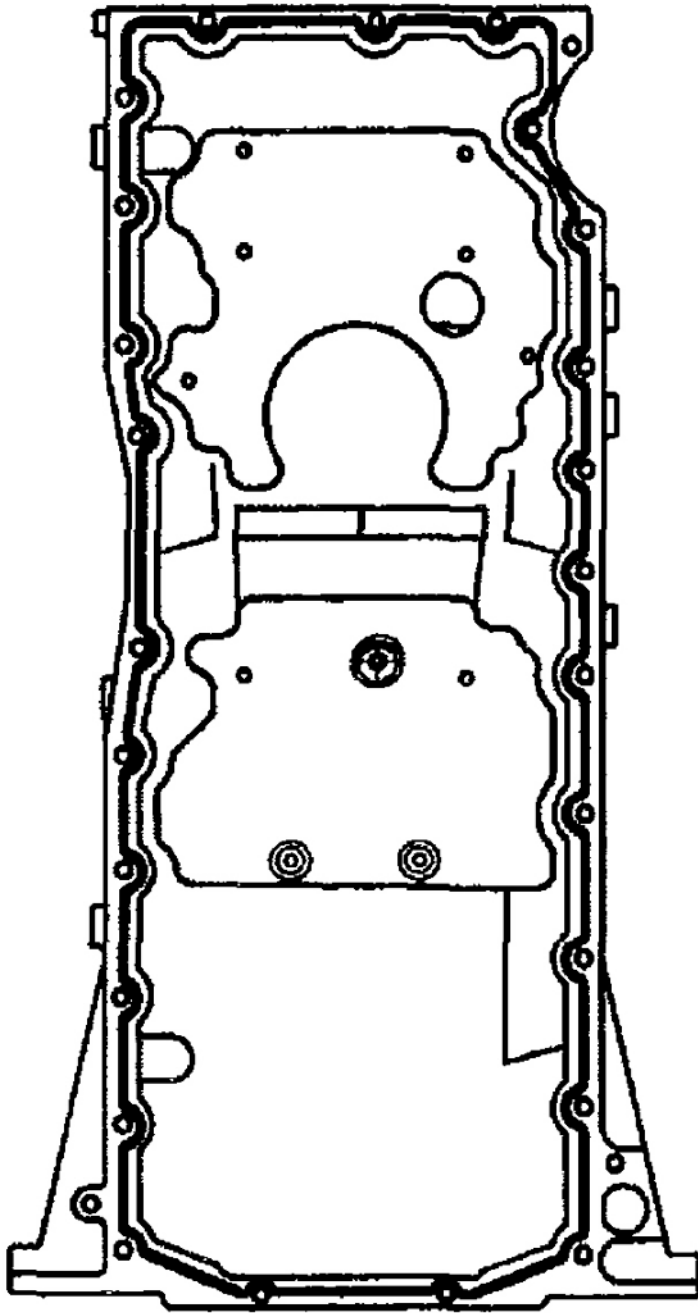
IMPORTANT: The oil pan must be installed within 10 minutes from when sealer was applied.

1. Apply a 3 mm (0.12 in) bead of sealer GM PN 12378521 to the block, rather than the oil pan.

IMPORTANT: When you install the oil pan, it could be shifted front or back a little which could cause a transmission alignment problem. The back of the oil pan

needs to be flush with the block.

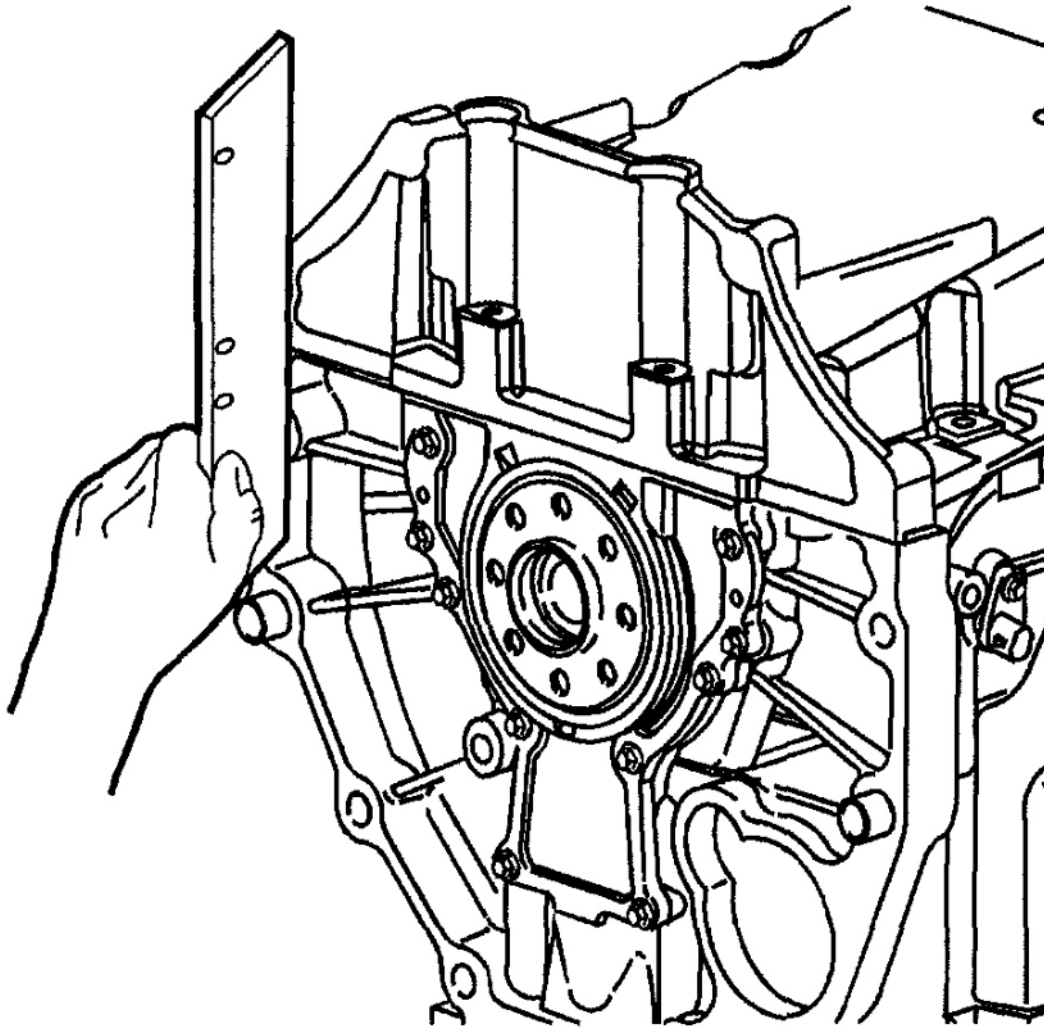
2. Install the oil pan, maneuvering the oil pan to clear the oil pump and screen assembly.
3. Install the oil pan bolts.



G01706343

Fig. 170: Installing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

4. Inspect the oil pan alignment. Use a straight edge on the back of the back and the oil pan transmission mounting surface.



G01706344

Fig. 171: Inspecting Oil Pan Alignment
Courtesy of GENERAL MOTORS CORP.

5. Install the oil pan bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence

and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

- Tighten the oil pan side bolts to 25 N.m (18 lb ft).
 - Tighten the oil pan end bolts to 10 N.m (89 lb in).
6. Install the 4 transmission bell housing bolts that attach to the oil pan.

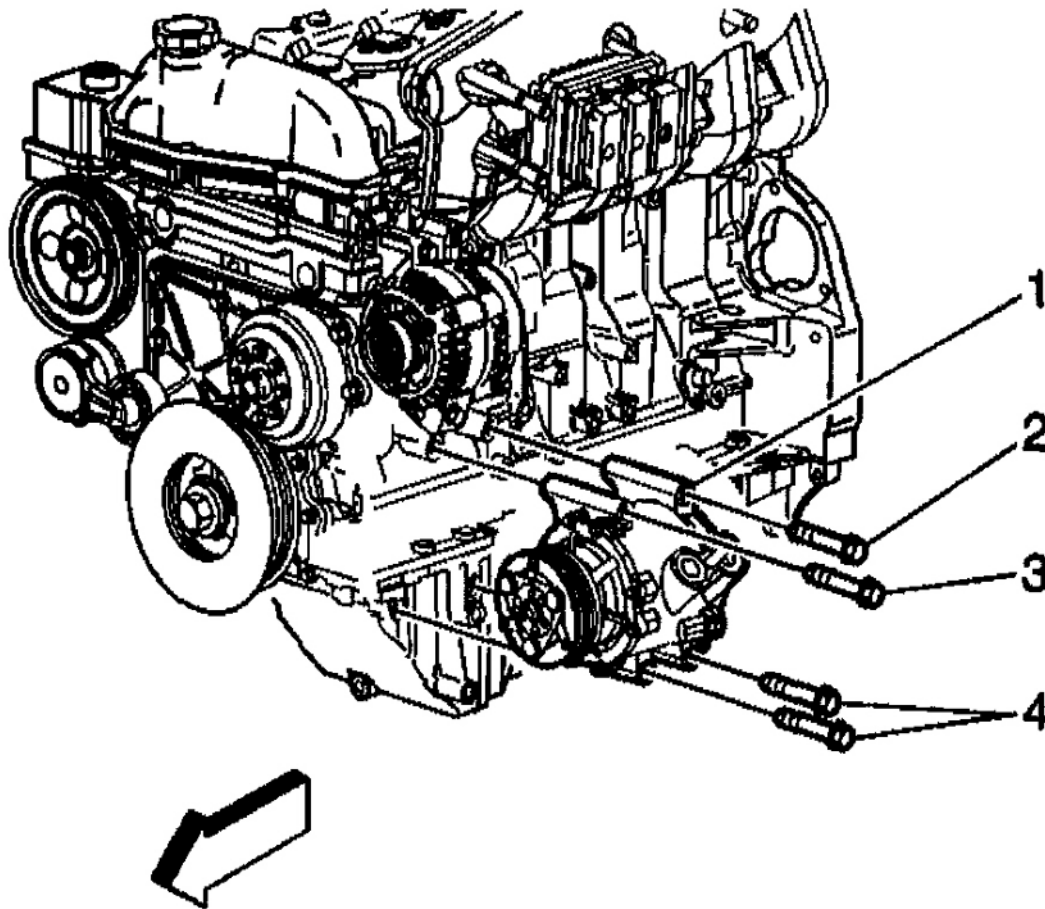
Tighten

Tighten bolts to 47 N.m (35 lb ft).

7. Install the A/C compressor 2 bottom bolts (4).

Tighten

Tighten all 4 bolts to 50 N.m (37 lb ft).



G01706345

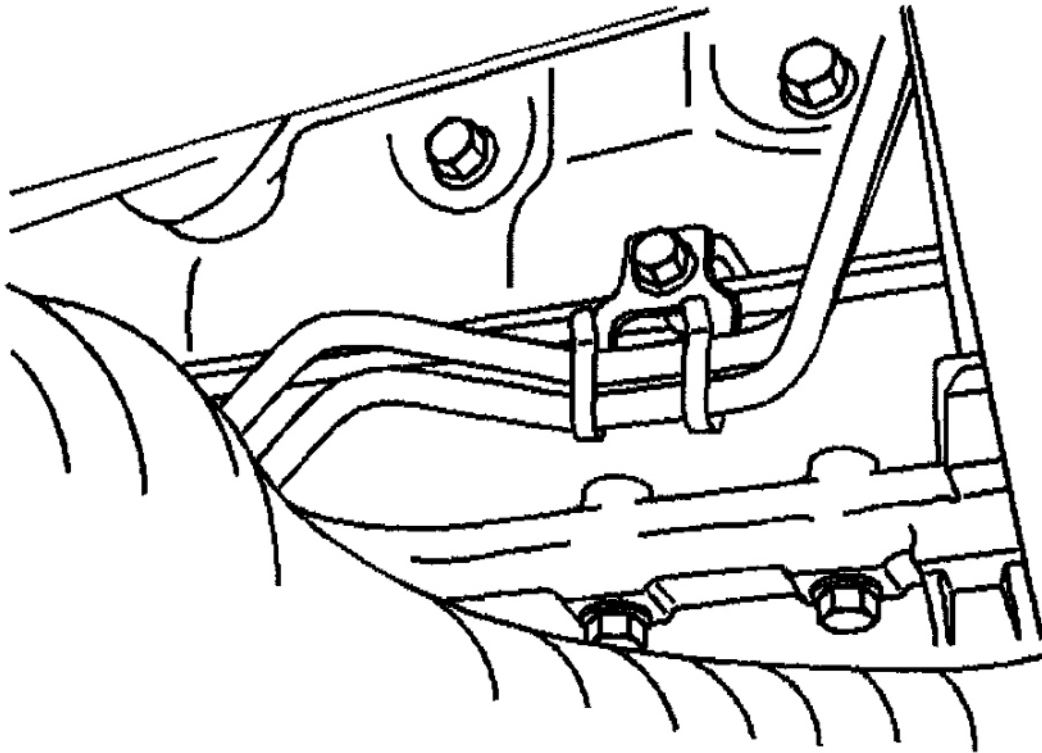
Fig. 172: Installing A/C Compressor
Courtesy of GENERAL MOTORS CORP.

8. Install the front differential bolts.

Tighten

Tighten the front differential bolts to 85 N.m (63 lb ft).

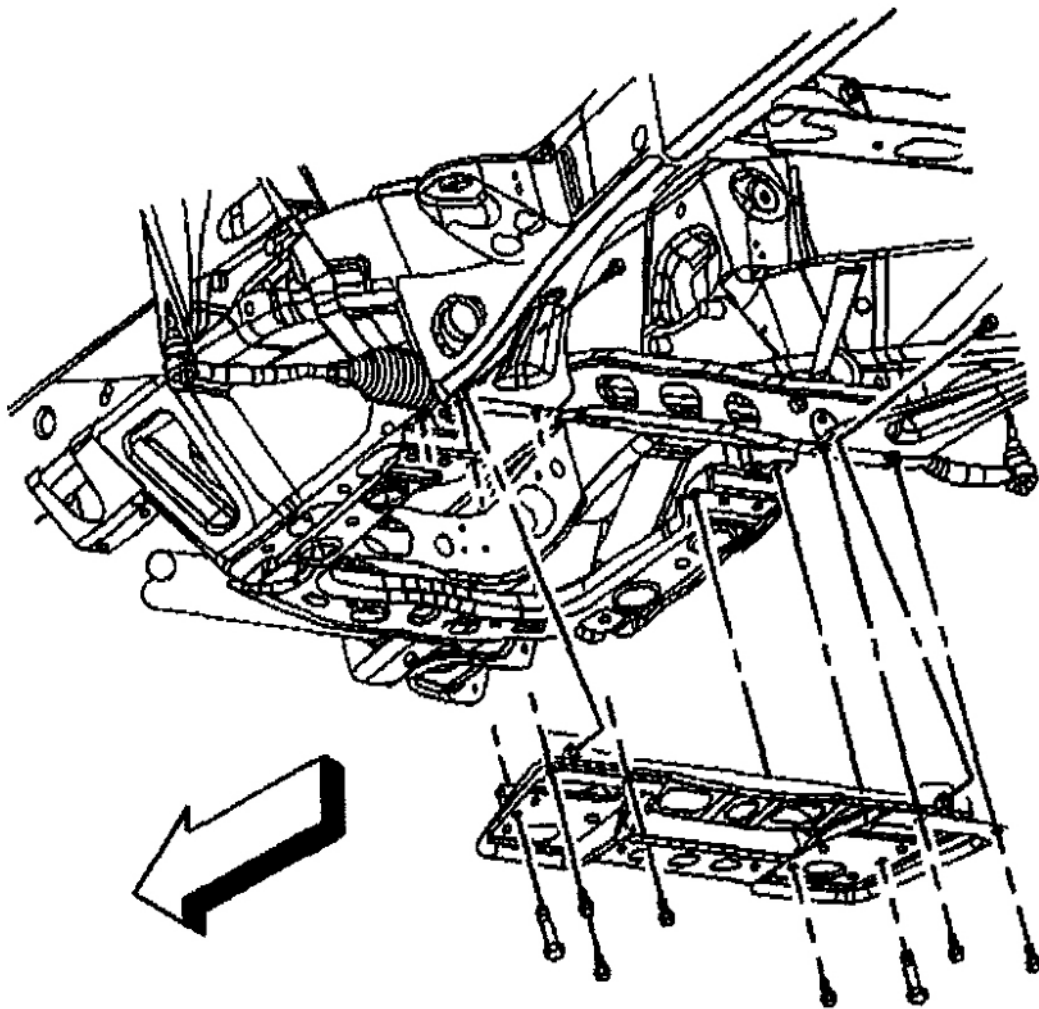
9. Install the front drive axle, clutch fork assembly. Refer to **INTERMEDIATE SHAFT BEARING ASSEMBLY REPLACEMENT - FRONT DRIVE AXLE (S4WD)** or **INTERMEDIATE SHAFT BEARING ASSEMBLY REPLACEMENT - FRONT DRIVE AXLE (A4WD)** in Front Drive Axle.
10. Clip transmission cooler lines to block.



G01706346

Fig. 173: Clipping Transmission Cooler Lines Block
Courtesy of GENERAL MOTORS CORP.

11. Connect prop shaft to front differential.
12. Install the steering gear crossmember. Refer to Steering Gear Crossmember Replacement - Front in Frame and Underbody.



G01706347

Fig. 174: Installing Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

13. Install the left and right wheel drive shaft. Refer to **FRONT DRIVE AXLE - 4WD** article.
14. Install the oil pan drain plug.

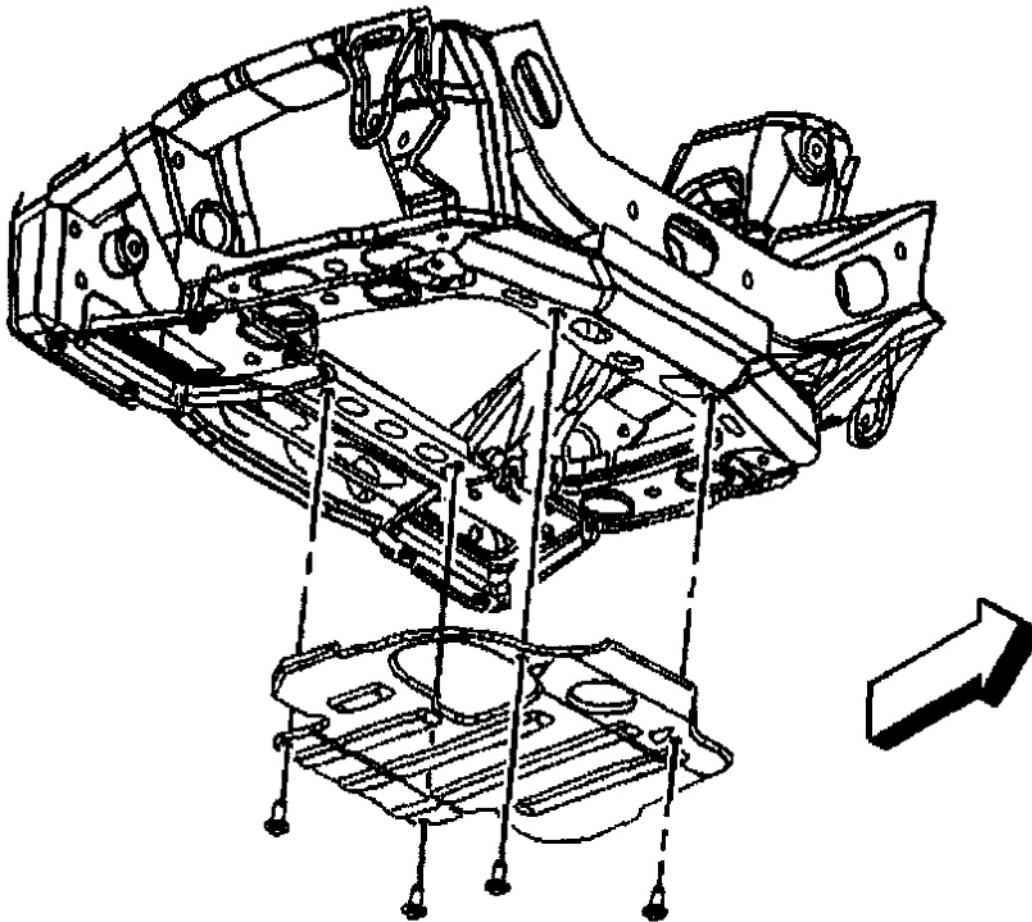
Tighten

Torque the oil pan drain plug to 26 N.m (19 lb ft).

15. Install the engine protection shield and secure with the bolts.

Tighten

Tighten the engine protection shield bolts to 25 N.m (18 lb ft).



G01706348

Fig. 175: Installing Engine Protection Shield
Courtesy of GENERAL MOTORS CORP.

16. Install the left and the right front tires. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
17. Lower the vehicle.

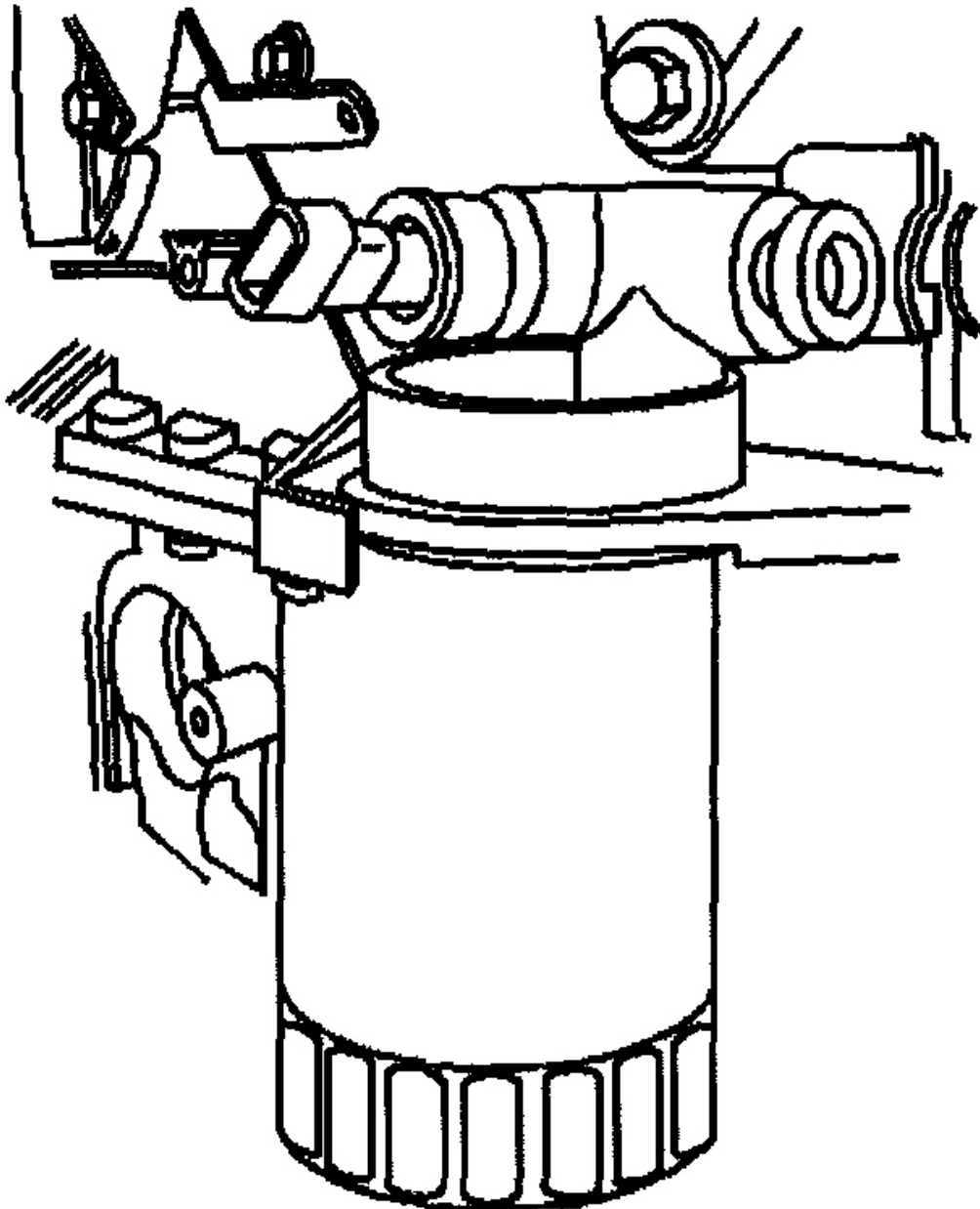
IMPORTANT: Inspect the engine for oil leaks in order to ensure all sealing surfaces are sealed.

18. Service the engine with oil.

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the engine shield. Refer to Engine Protection Shield Replacement in Frame and Underbody.
3. Remove the electrical connector from the oil pressure switch.
4. Remove the oil pressure switch.



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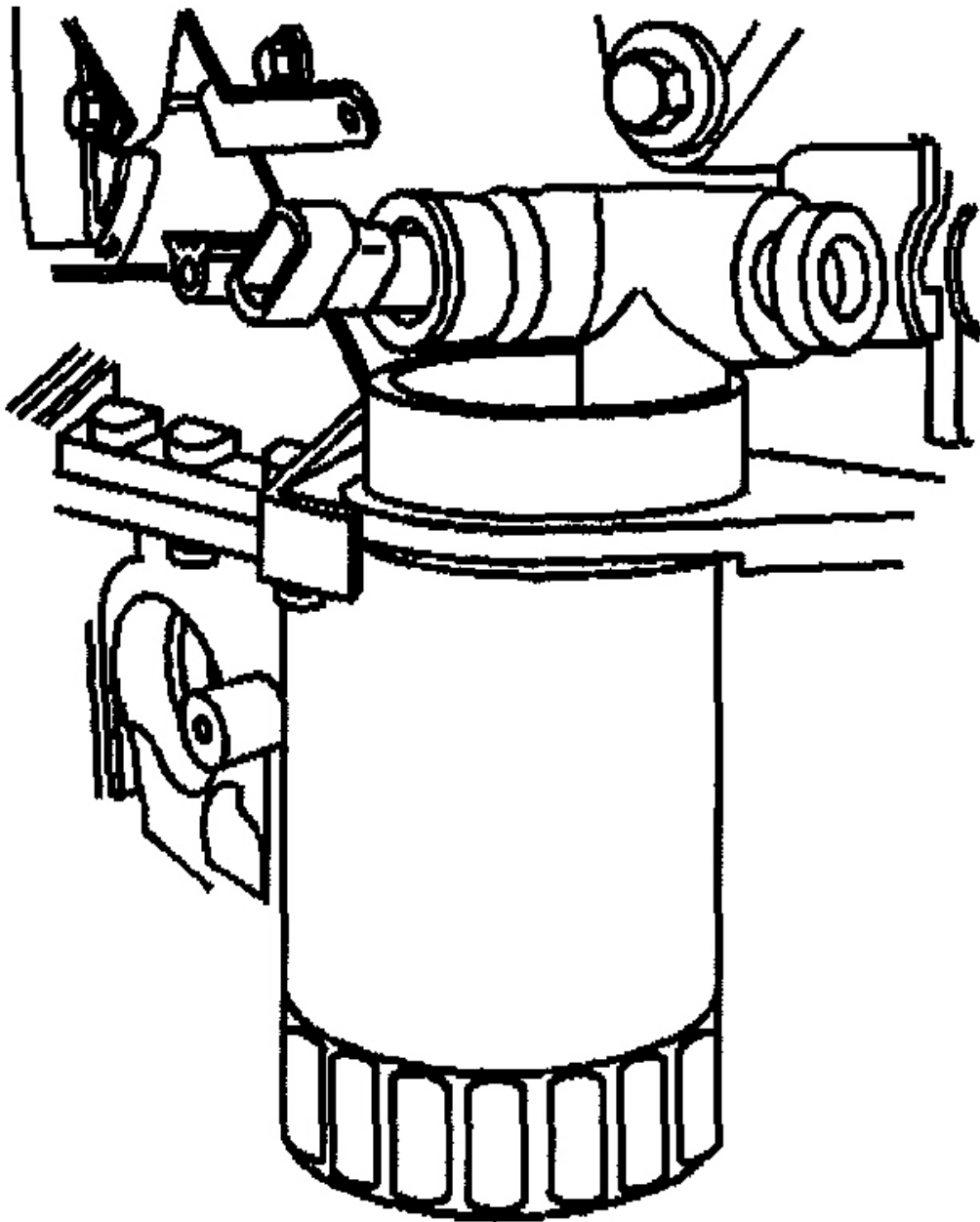
Fig. 176: Removing Oil Pressure Switch
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the oil pressure switch.

Tighten

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



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Fig. 177: Installing Oil Pressure Switch
Courtesy of GENERAL MOTORS CORP.

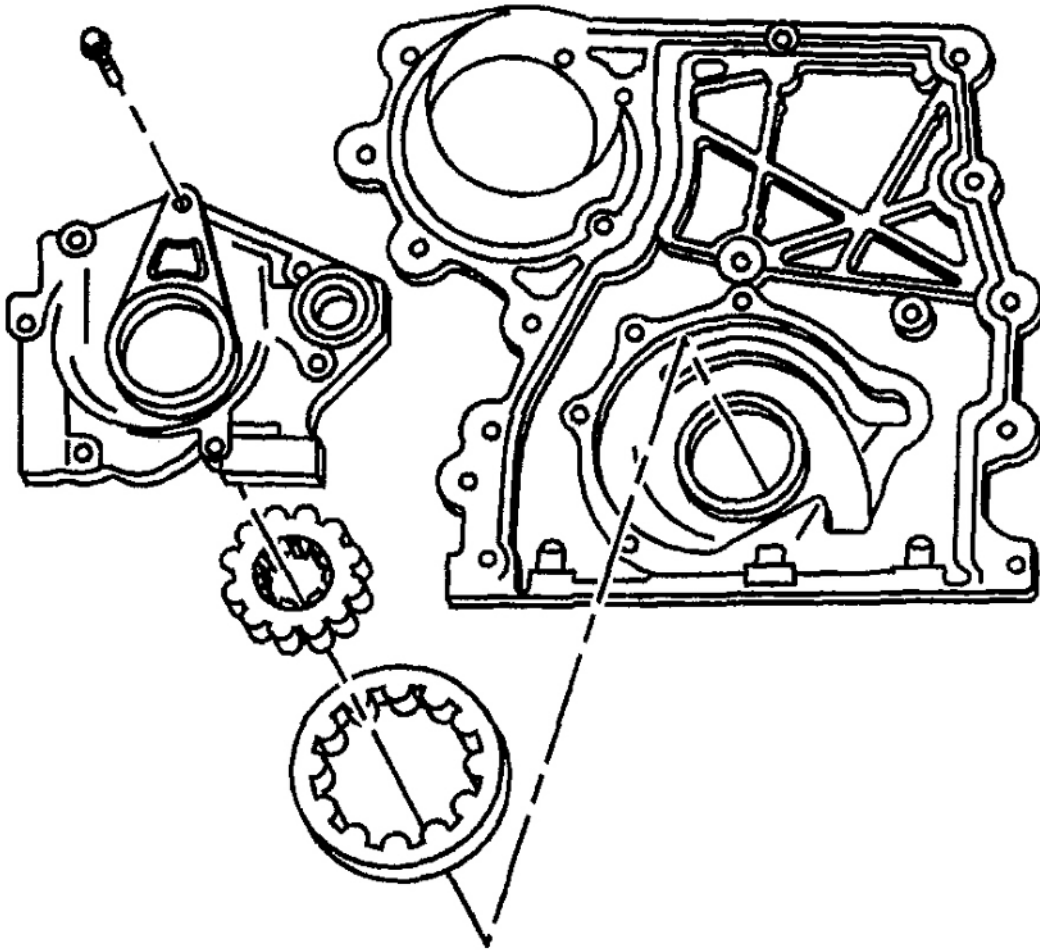
2. Install the electrical connector to the oil pressure switch.

3. Install the engine shield. Refer to Engine Protection Shield Replacement in Frame and Underbody.
4. Lower the vehicle.

OIL PUMP REPLACEMENT

Removal Procedure

1. Remove the engine front cover. Refer to Engine Front Cover Replacement.
2. Remove the oil pump cover bolts.
3. Remove the oil pump cover.
4. Mark the inner and the outer gears in relation to the oil pump housing.
5. Remove the inner and the outer oil pump gears.



G01706351

Fig. 178: Removing Inner And Outer Oil Pump Gears
Courtesy of GENERAL MOTORS CORP.

6. Remove the oil pump pressure relief valve plug.
7. Remove the oil pump pressure relief valve and the spring.

Installation Procedure

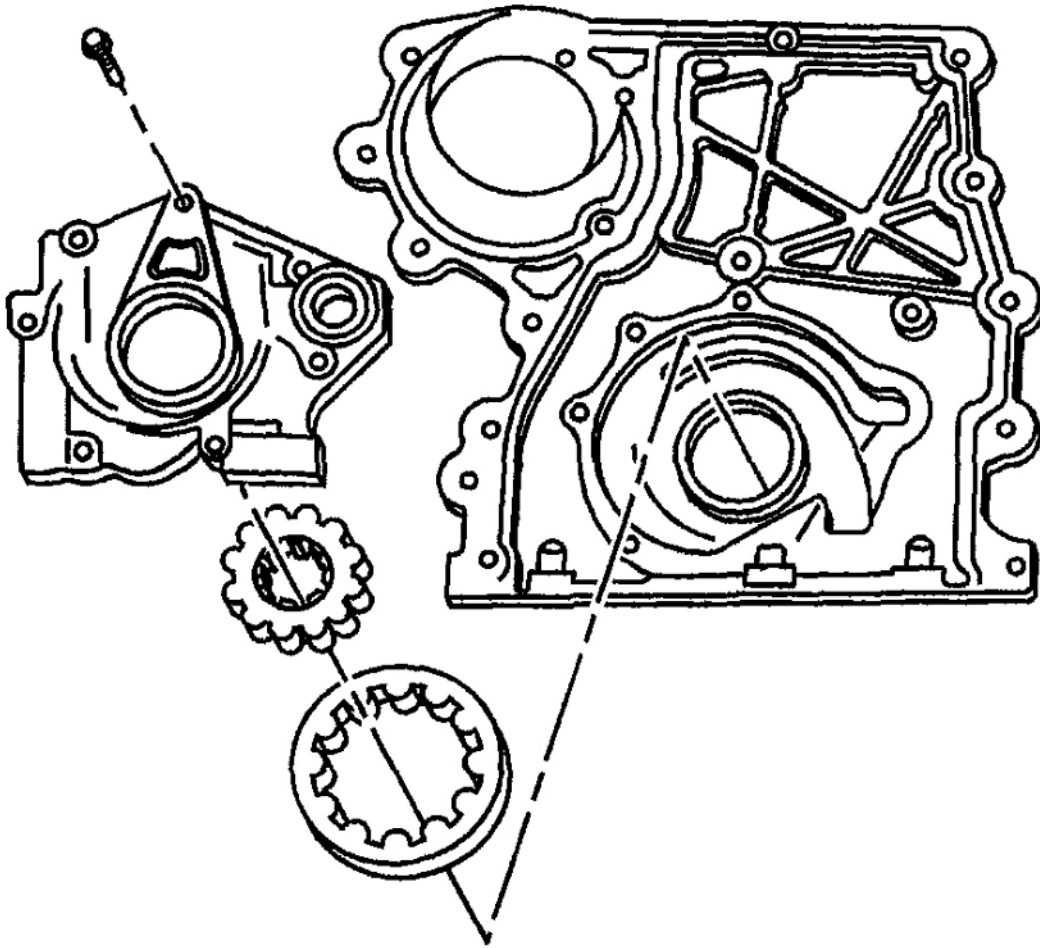
1. Install the oil pump pressure relief valve and the spring.
2. Install the oil pump pressure relief valve plug.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the oil pump pressure relief valve to 14 N.m (124 lb in).

3. Install the oil pump outer and inner gears as removed.



G01706352

Fig. 179: Installing Oil Pump Outer And Inner Gears
Courtesy of GENERAL MOTORS CORP.

4. Install the oil pump cover.
5. Install the oil pump cover bolts.

Tighten

Tighten the oil pump cover bolts to 10 N.m (89 lb in).

6. Install the front cover. Refer to **Engine Front Cover Replacement**.

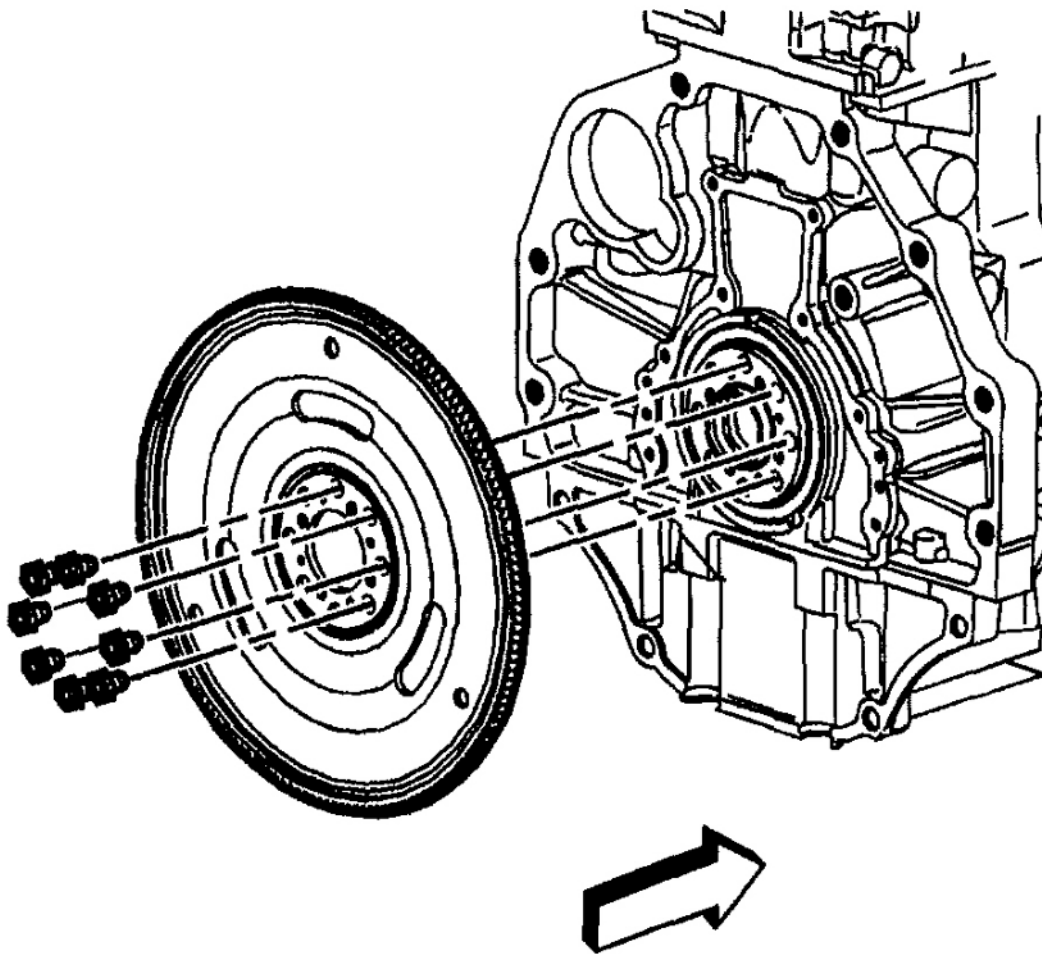
CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

Tools Required

- **J 36660-A** Torque Angle Meter
- **J 44219** Cover Alignment Pins
- **J 44227** Rear Seal Installer

Removal Procedure

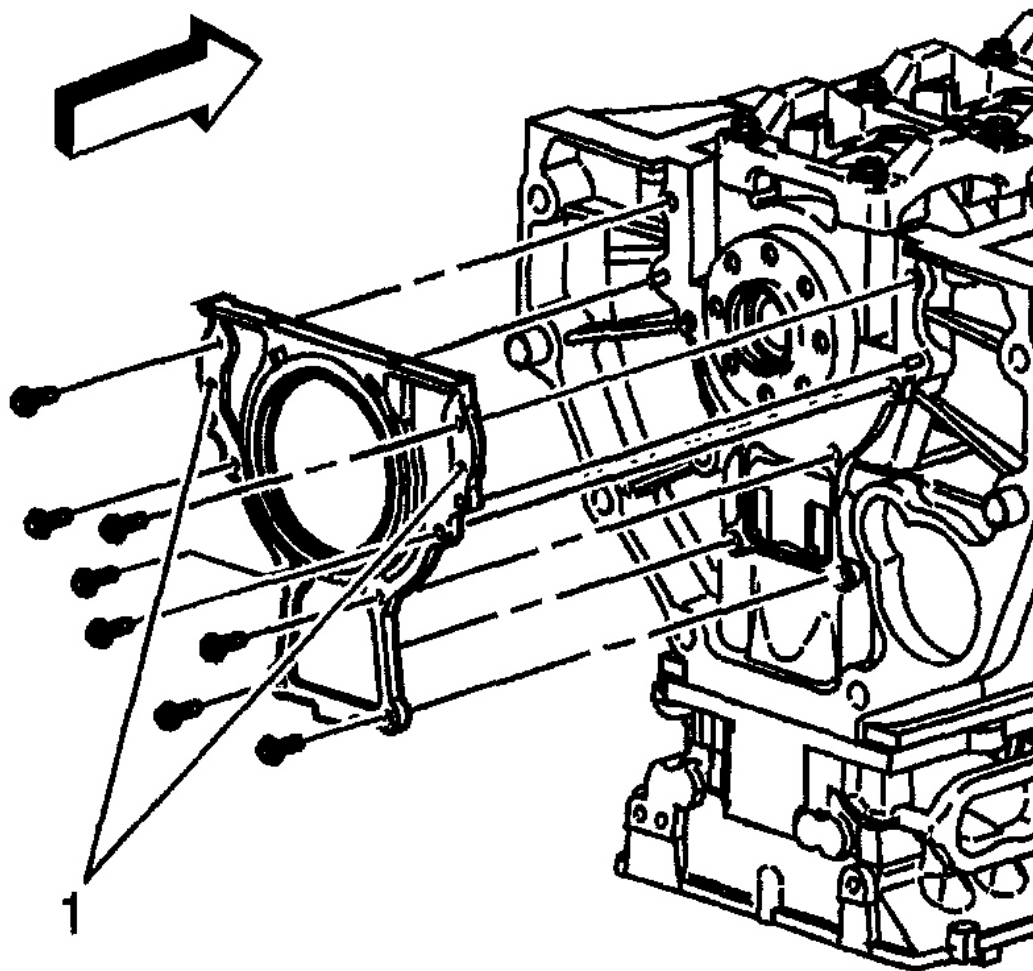
1. Remove the transmission. Refer to **REMOVAL & INSTALLATION - A/T** in Automatic Transmission.
2. Remove the fly wheel bolts and remove the fly wheel.



G01706353

Fig. 180: Removing Fly Wheel Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the crankshaft rear oil seal housing bolts.
4. Install two bolts into the jackscrew holes (1) to release the cover from the block.



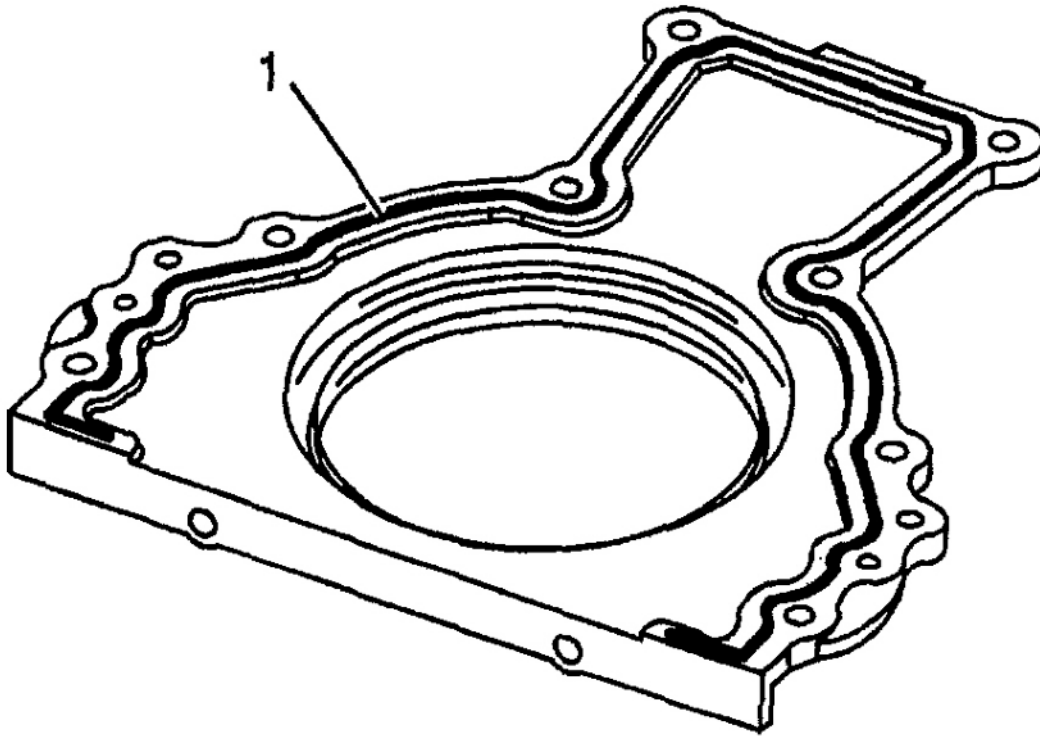
G01706354

Fig. 181: Releasing Cover From Block
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft and rear oil seal housing.
6. Remove the oil seal from the crankshaft snout.

Installation Procedure

1. Use the J 44227 to install the crankshaft rear oil seal.
2. Remove the J 44227.
3. Apply a 3 mm (0.12 in) bead of GM P/N 12378521 to the rear oil seal housing (1).



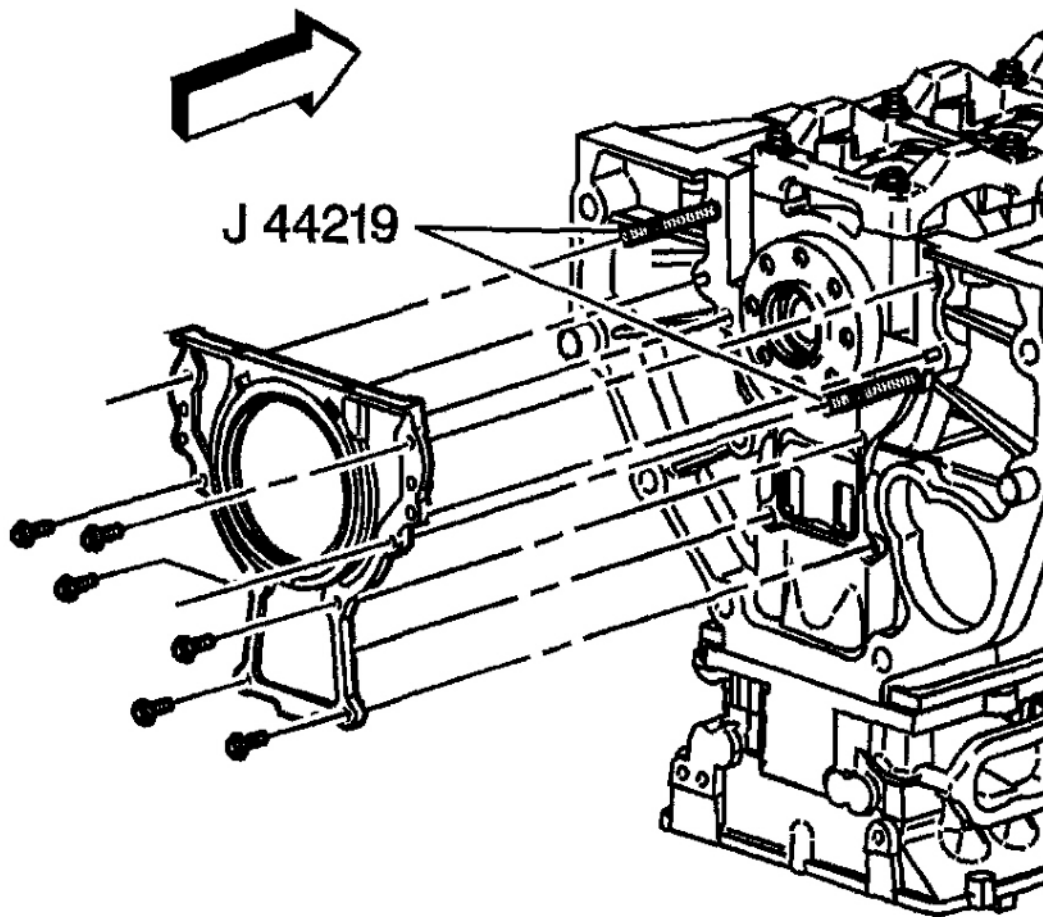
G01706355

Fig. 182: Rear Oil Seal Housing
Courtesy of GENERAL MOTORS CORP.

4. Install the J 44219 guide pins into the block.

IMPORTANT:

- When installing a new seal, use the plastic installation sleeve supplied with the new seal.
- The seal installation sleeve should come off after the seal is installed. Disregard the sleeve.



G01706356

Fig. 183: Installing J 44219 Guide Pins Into Block
Courtesy of GENERAL MOTORS CORP.

5. Slide the crankshaft rear oil seal housing over the alignment pins J 44219 and crankshaft.
6. Install the crankshaft rear oil seal housing bolts, except the two in place of the guide pins.
7. Remove the J 44219 guide pins.
8. Install the remaining two crankshaft rear oil seal housing bolts.

Tighten

Tighten all the oil seal housing bolts to 10 N.m (89 lb in).

9. Wipe off any excess material from the bottom of the oil pan sealing area (1).

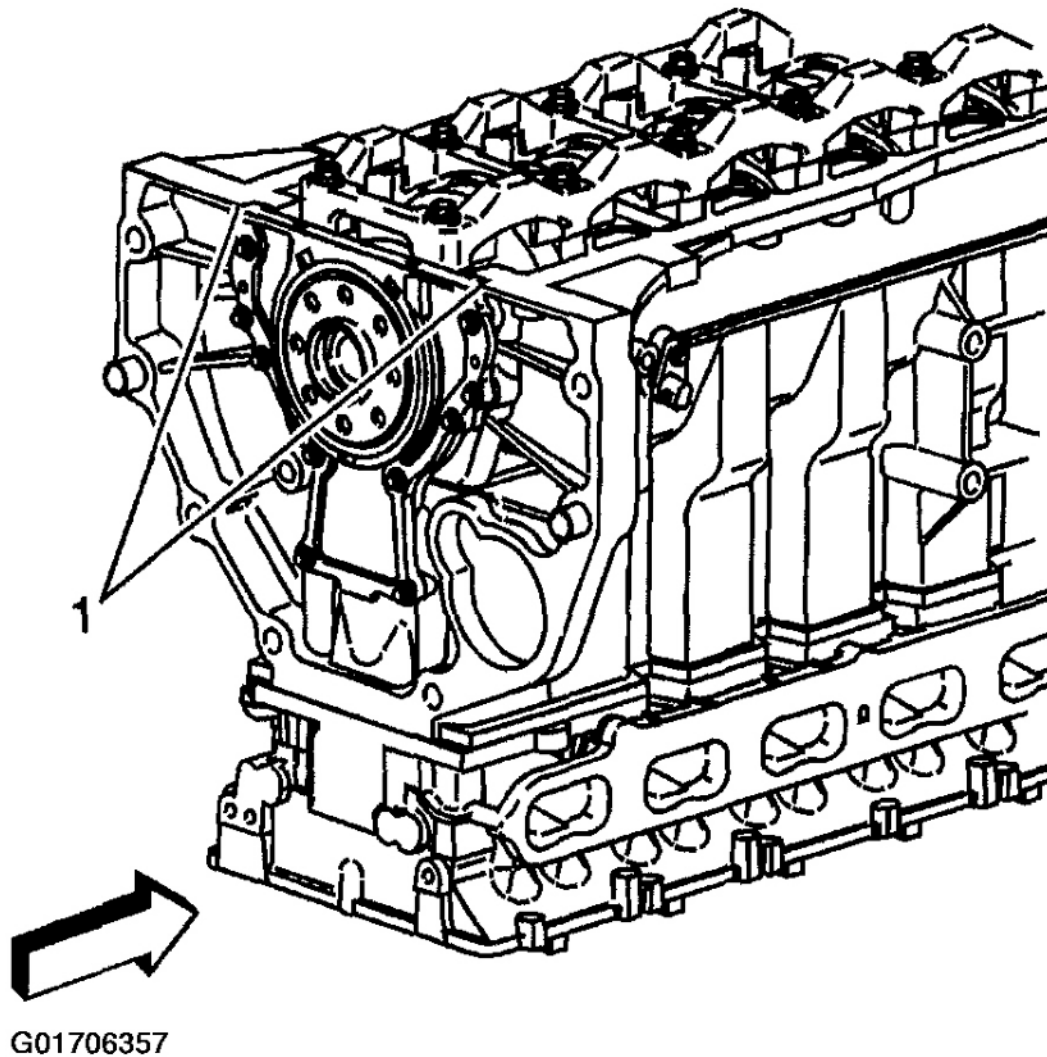
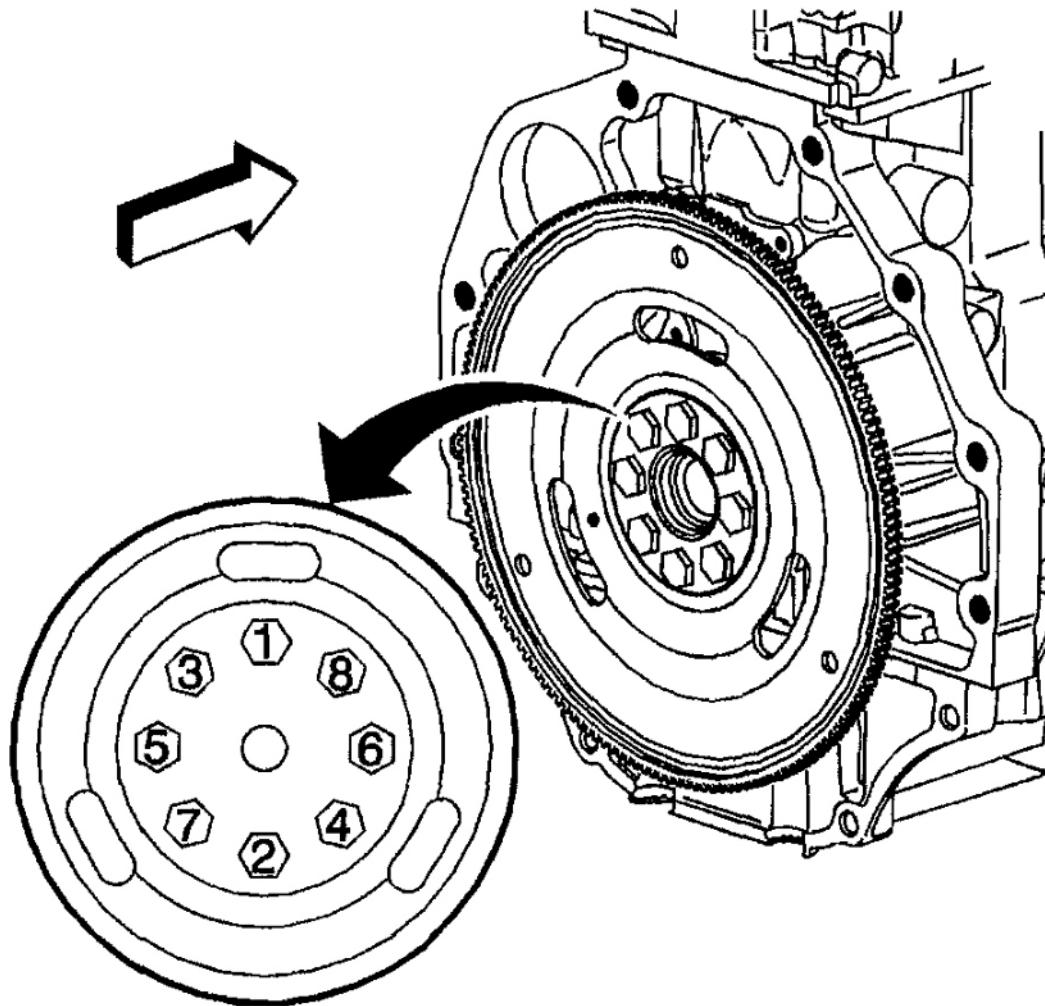


Fig. 184: Bottom Of Oil Pan Sealing Area
Courtesy of GENERAL MOTORS CORP.

10. Install the fly wheel and secure with the bolts.

Tighten

Tighten the fly wheel bolts in sequence to 25 N.m (18 lb ft).



G01706358

Fig. 185: Installing Fly Wheel

Courtesy of GENERAL MOTORS CORP.

11. Use the J 36660-A to tighten the bolts an additional 50 degrees.
12. Install the transmission. Refer to **REMOVAL & INSTALLATION - A/T** in Automatic Transmission.

ENGINE FLYWHEEL REPLACEMENT

Tools Required

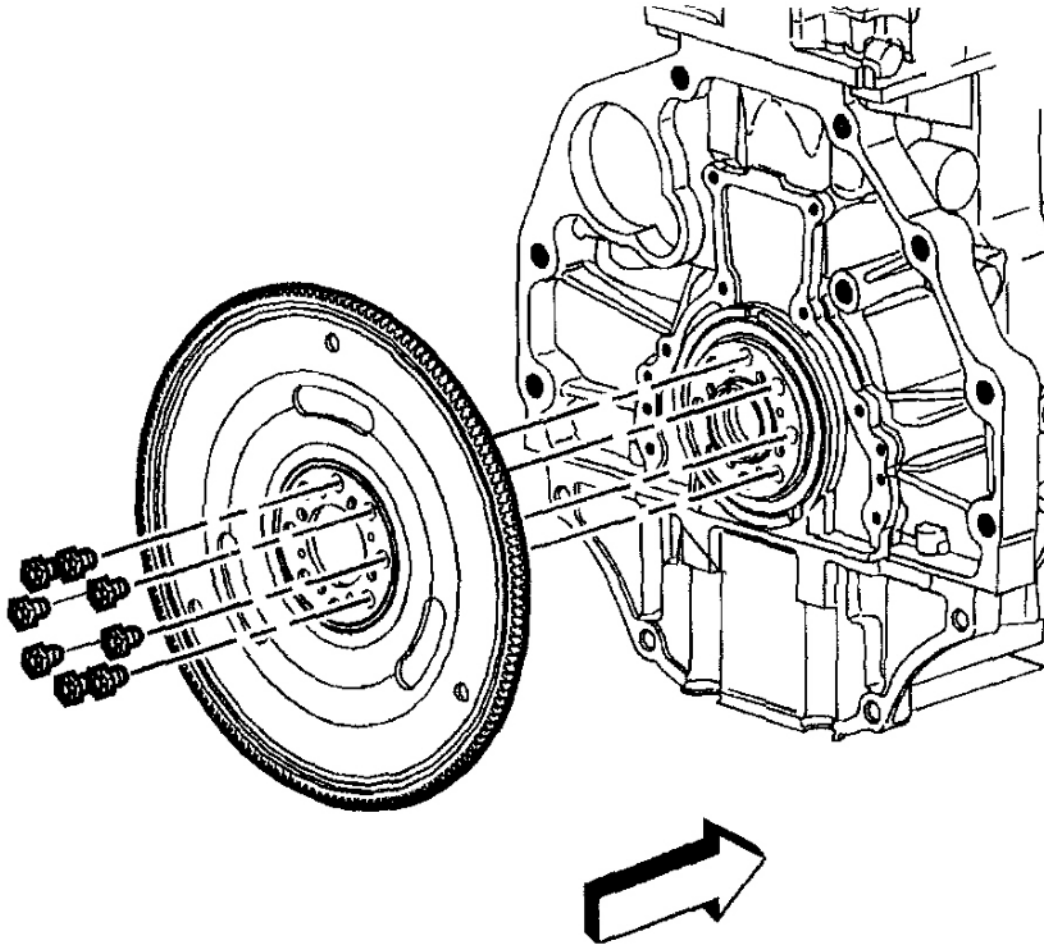
J 36660-A Torque/Angle Meter

Removal Procedure

1. Remove the transmission. Refer to **REMOVAL & INSTALLATION - A/T** in Automatic Transmission.

IMPORTANT: Note the position and the direction of the engine flywheel before removal.

2. Remove the flywheel bolts.



G01706359

Fig. 186: Removing flywheel bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the flywheel.
4. Clean and Inspect the flywheel. Refer to **ENGINE FLYWHEEL CLEANING AND INSPECTION** in Engine Mechanical - 4.2L Unit Repair.

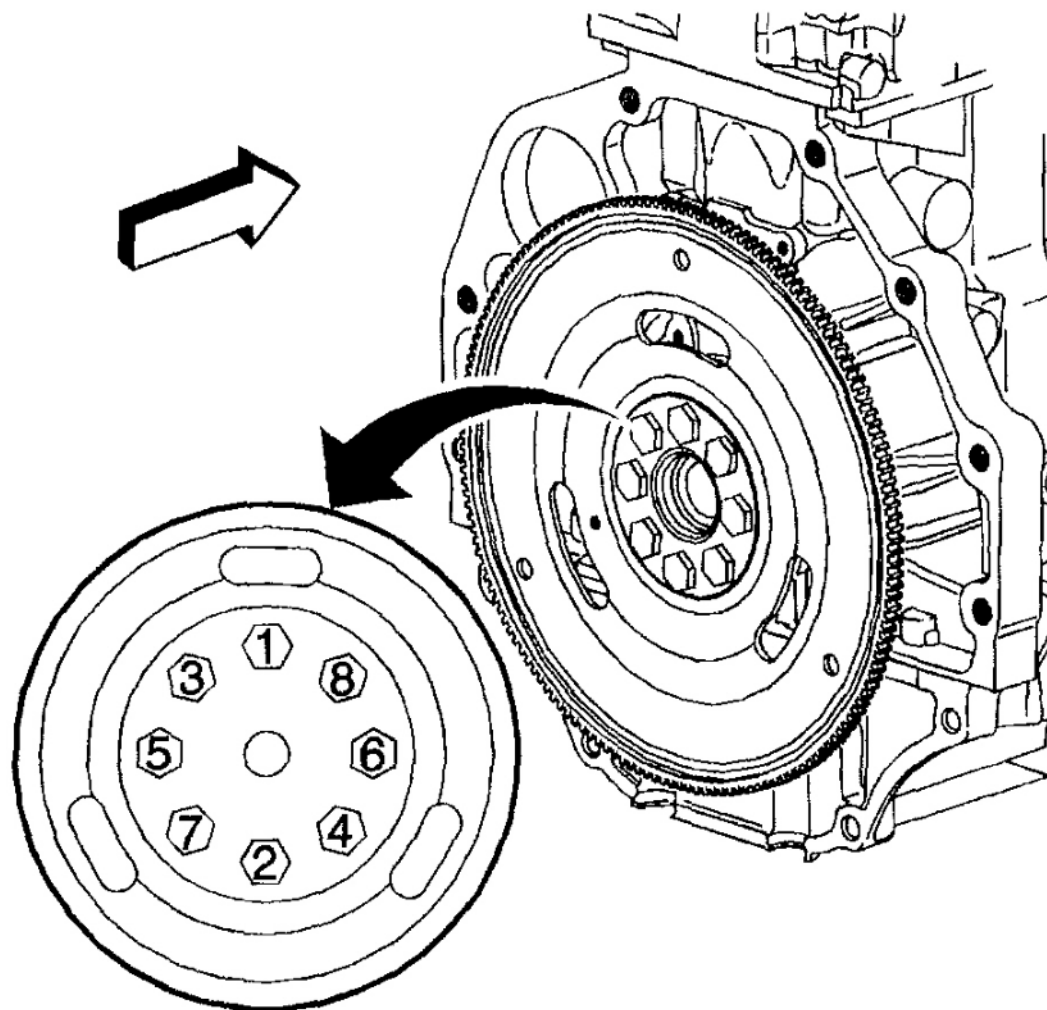
Installation Procedure

1. Add threadlock GM P/N 12345493 to the new flywheel bolts.
2. Install the flywheel and secure the flywheel with the new bolts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

- 2.1. Tighten the bolts in sequence to 25 N.m (18 lb ft).
- 2.2. Use the J 36660-A in order to tighten the bolts an additional 50 degrees.



G01706360

Fig. 187: Installing Flywheel

Courtesy of GENERAL MOTORS CORP.

3. Install the transmission. Refer to **REMOVAL & INSTALLATION - A/T** in Automatic Transmission.

ENGINE REPLACEMENT

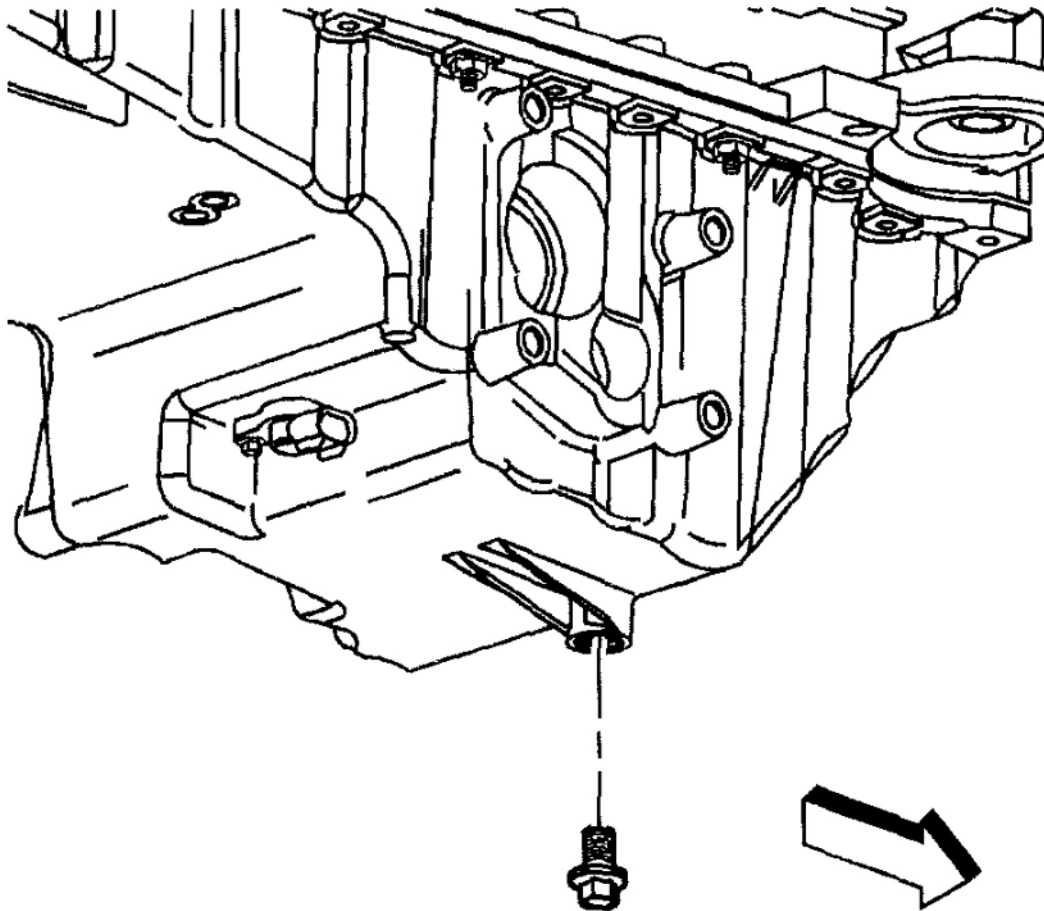
Tools Required

J 44220 Engine Lift Bracket

Removal Procedure

1. Remove the hood. Refer to Hood Replacement in Body Front End.
2. Disconnect the negative battery cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Electrical.
3. Drain engine coolant. Refer to Draining and Filling Cooling System in Engine Cooling.
4. Recover the refrigerant. Refer to **RECOVERY/EVACUATION & RECHARGING** in Heating, Ventilation and Air Conditioning.
5. Remove the oil pan drain plug and drain the oil.

IMPORTANT: Keep drain plug removed during engine removal and installation.



G01706361

Fig. 188: Removing Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

6. Install a suitable plug into the oil pan after draining to prevent any oil leakage during the rest of the

procedure.

7. Remove the air cleaner assembly.
8. Remove the throttle body. Refer to **THROTTLE BODY** in Engine Controls - 4.2 L
9. Remove the map sensor. Refer to **MANIFOLD ABSOLUTE PRESSURE SENSOR** in Engine Controls - 4.2L
10. Remove the washer solvent container. Refer to **WASHER SOLVENT CONTAINER REPLACEMENT** in Wipers/Washer Systems.
11. Remove the air intake baffle. Refer to Air Intake Baffle Replacement - Radiator in Body Front End.
12. Remove the grill. Refer to Grille Replacement (GMC) or Grille Replacement (Chevrolet) or Grille Replacement (Oldsmobile) in Body Exterior.
13. Remove the headlamp housing. Refer to Headlamp Housing Panel Replacement (Chevy, GMC) or Headlamp Housing Panel Replacement (Olds) in Body Front End.
14. Remove the radiator support brace. Refer to Brace Replacement - Radiator Support Diagonal in Body Front End.
15. Remove the hood latch. Refer to Hood Latch Support Replacement in Body Front End.
16. Disconnect A/C lines at the condenser.
17. Disconnect the transmission cooler lines at the engine, not the radiator.
18. Remove the cooling fan and the shroud tilting the radiator forward, and the cooling fan and the shroud rearward for clearance. Refer to Cooling Fan and Shroud Replacement in Engine Cooling.
19. Remove the radiator with condenser and transmission cooler lines. Refer to Radiator Replacement in Engine Cooling.
20. Remove the drive belt. Refer to **Drive Belt Replacement**.
21. Remove the power steering pump bolts and lay the pump aside.
22. Ensure the heater hoses at the heater core are disconnected.

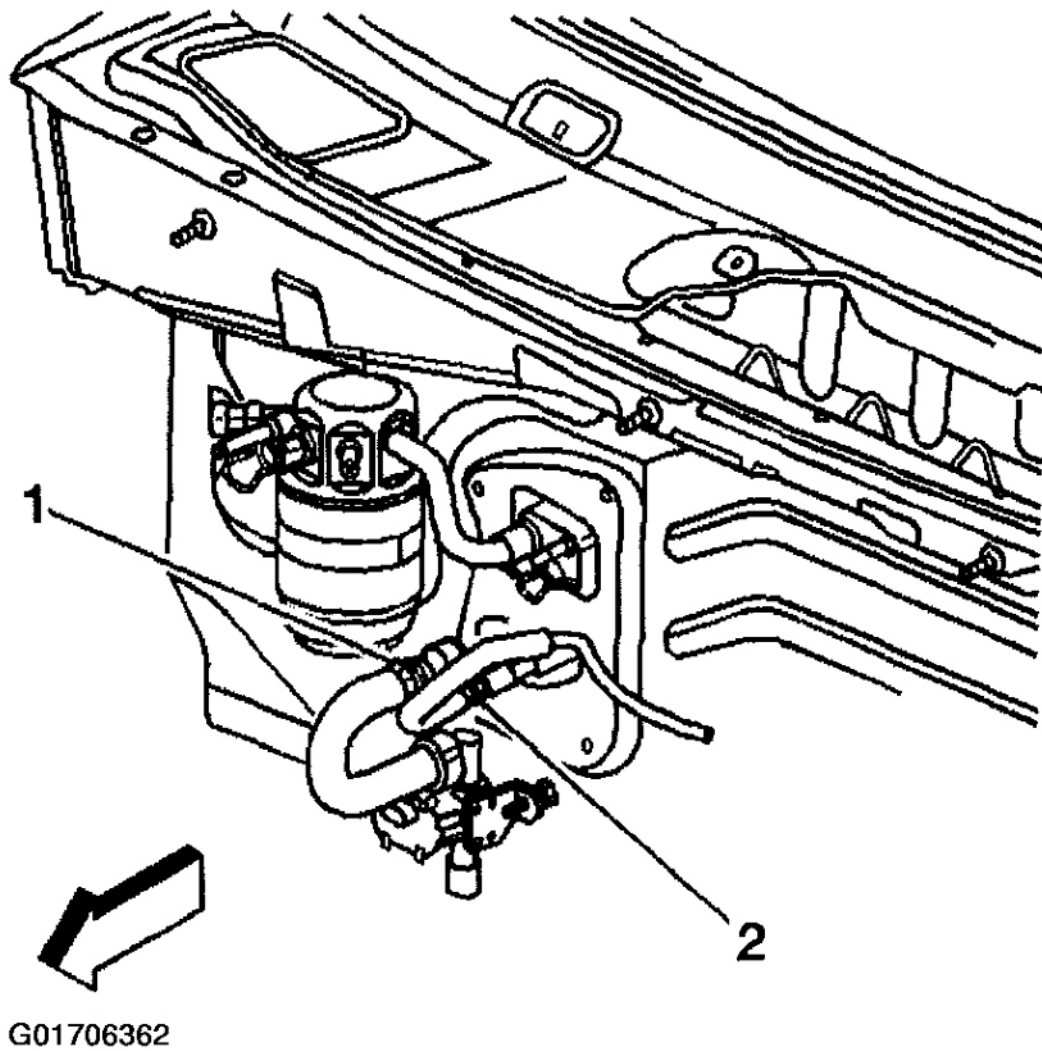
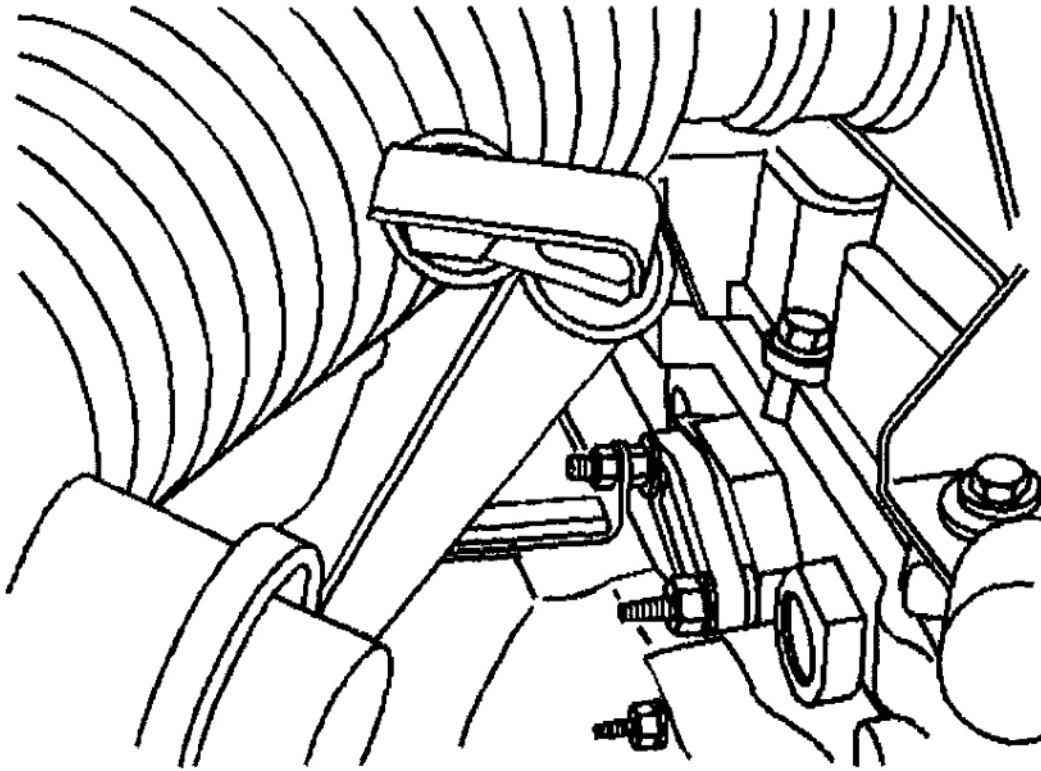


Fig. 189: Ensuring Heater Hoses At Heater Core Are Disconnected
Courtesy of GENERAL MOTORS CORP.

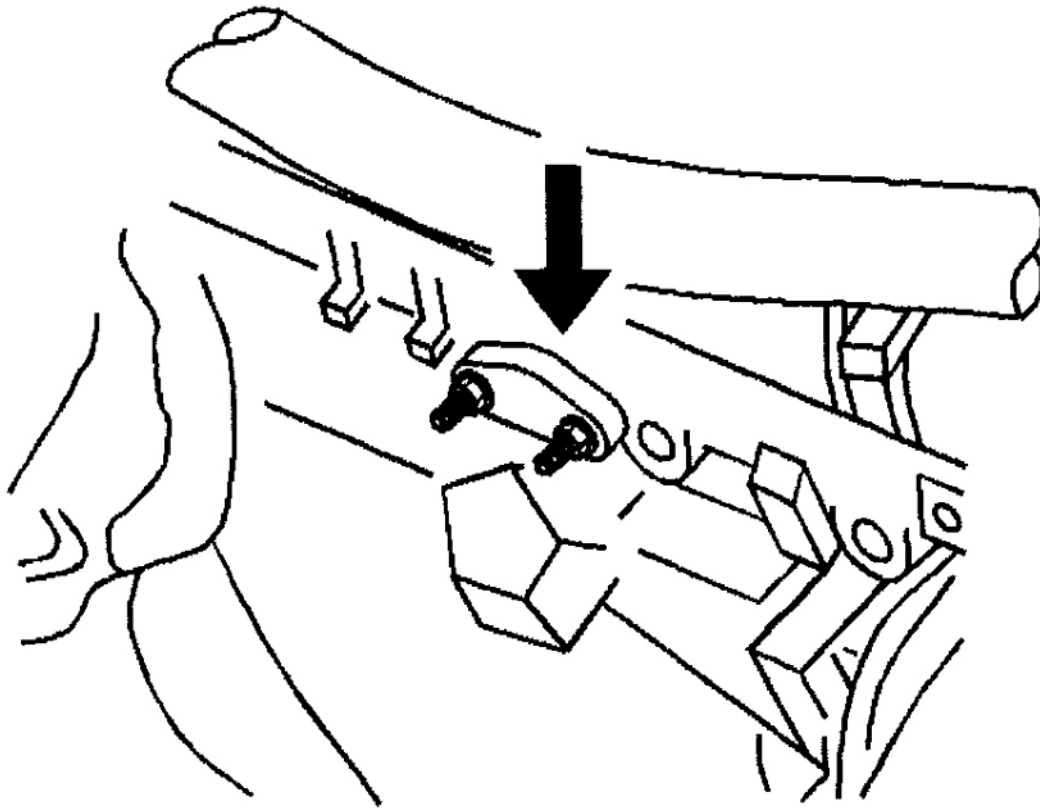
23. Disconnect the transmission filler tube bracket nut from the AIR adapter.



G01706363

Fig. 190: Disconnecting Transmission Filler Tube Bracket Nut From AIR Adapter
Courtesy of GENERAL MOTORS CORP.

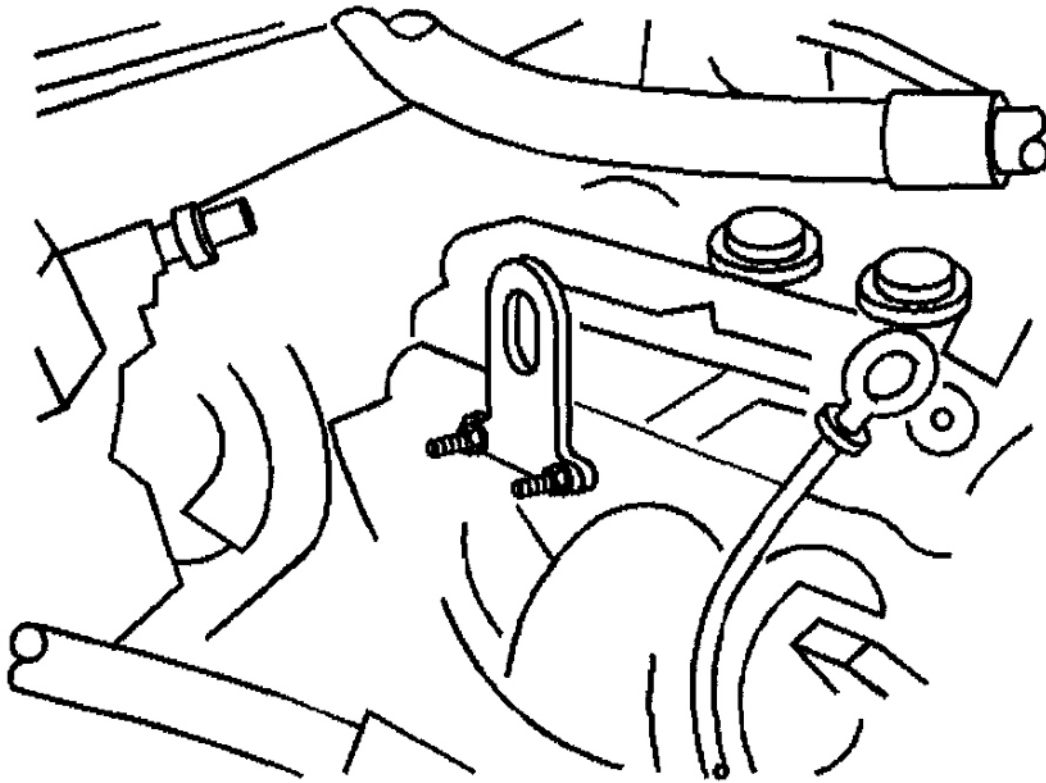
24. Remove the AIR adapter.



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Fig. 191: Removing AIR Adapter
Courtesy of GENERAL MOTORS CORP.

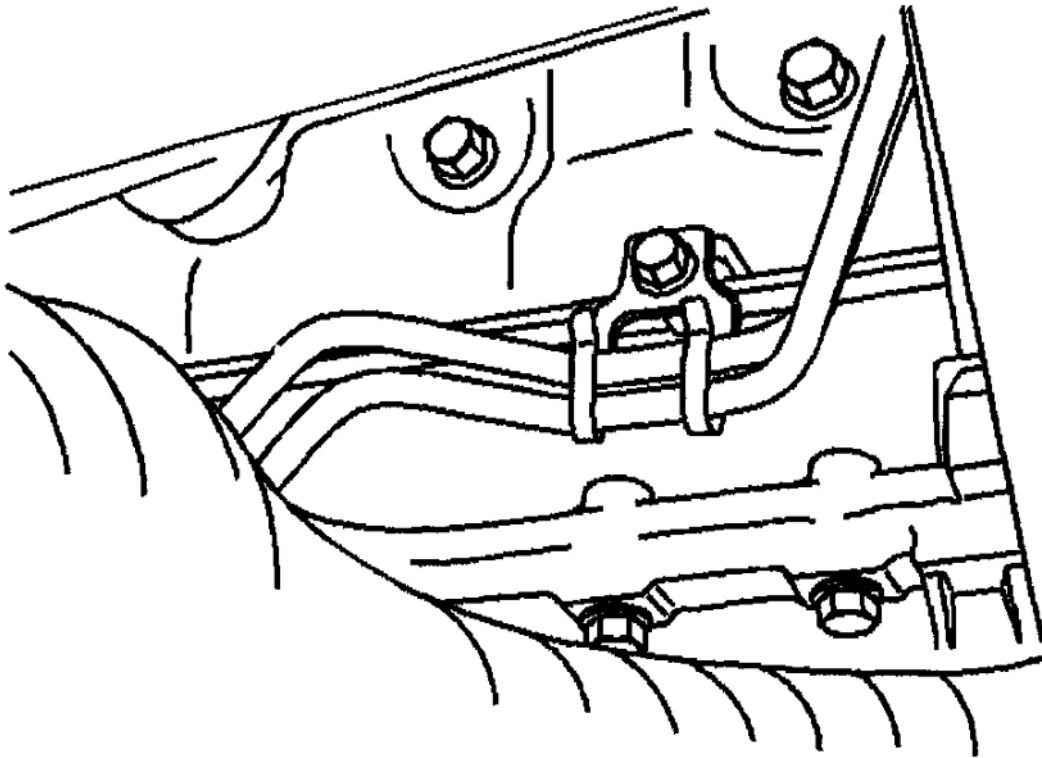
25. Install the lift hook J 44220 to the AIR adapter.



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Fig. 192: Installing Lift Hook To AIR Adapter
Courtesy of GENERAL MOTORS CORP.

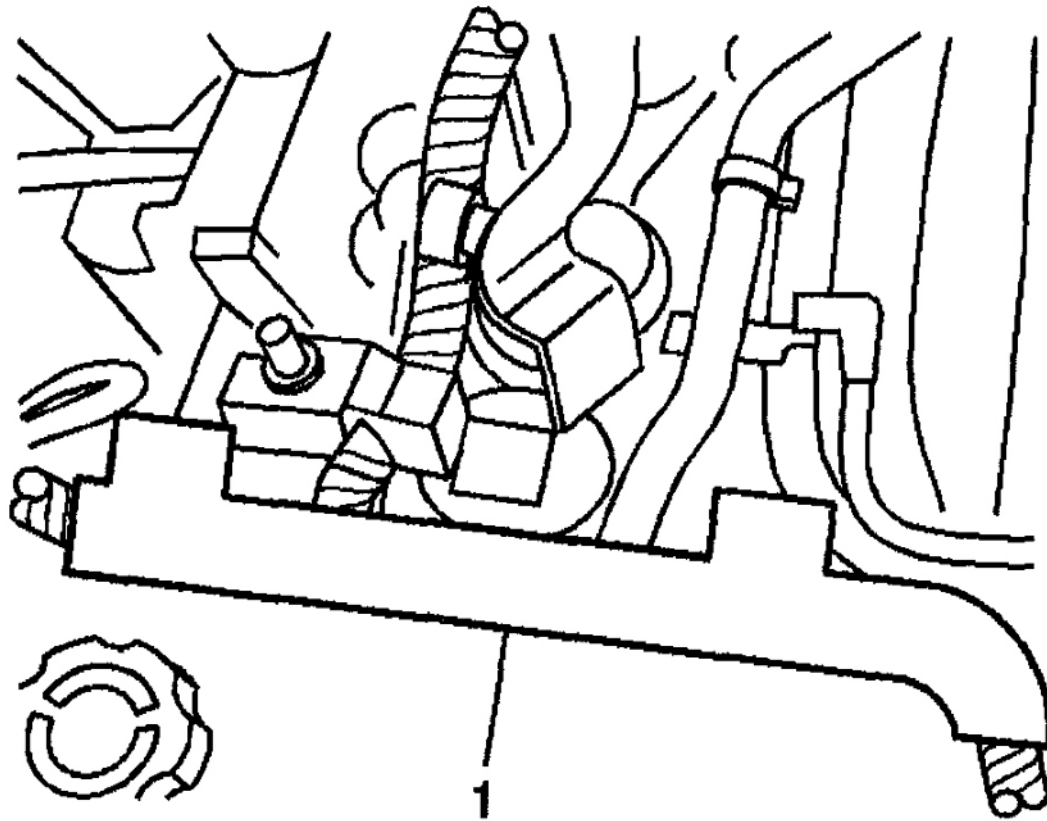
26. Disconnect the oxygen sensor electrical connector.
27. Disconnect the A/C line at the accumulator.
28. Disconnect the front axle actuator electrical connector.
29. Disconnect the camshaft phaser actuator valve electrical connector.
30. Unclip the transmission cooler lines from right side of the engine block.



G01706366

Fig. 193: Unclipping Transmission Cooler Lines From Right Side Of Engine Block
Courtesy of GENERAL MOTORS CORP.

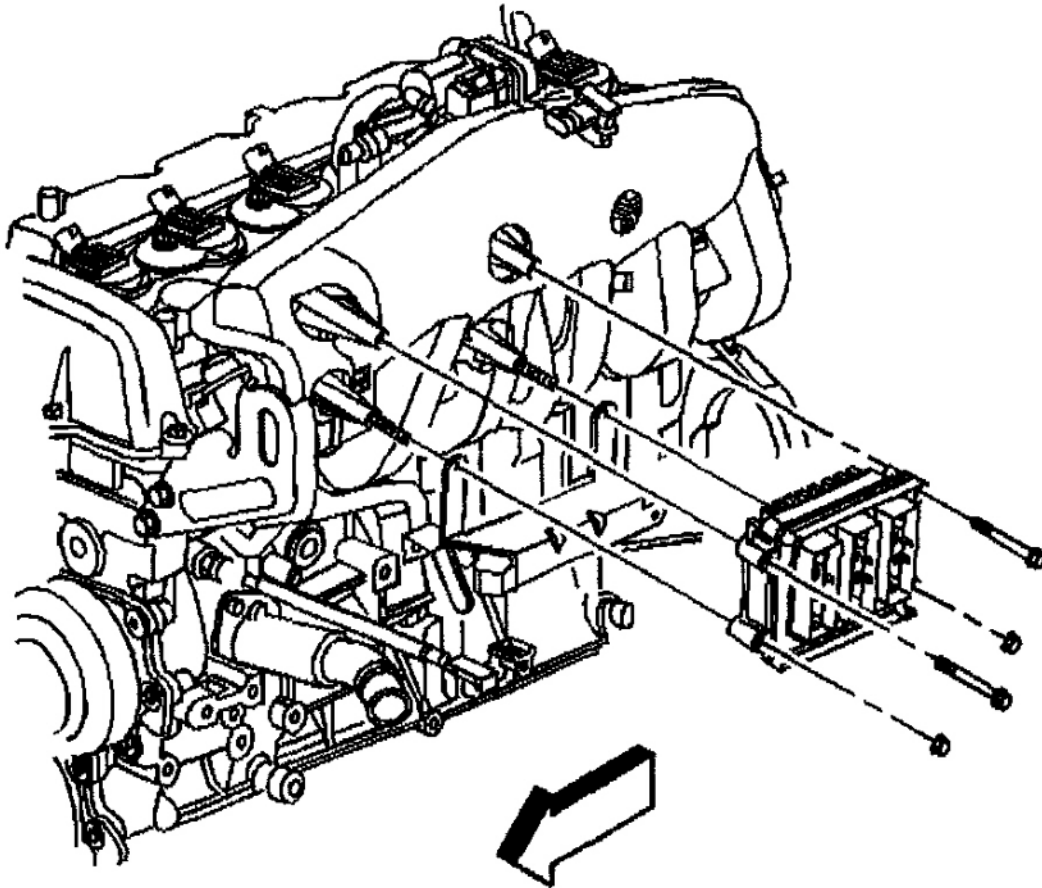
31. Disconnect the ignition coil harness connectors.
32. Carefully disconnect harness retainer at clips (1) and remove.



G01706367

Fig. 194: Disconnecting Harness Retainer At Clips
Courtesy of GENERAL MOTORS CORP.

33. Remove power brake hose at booster.
34. Remove the PCM. Refer to **POWERTRAIN CONTROL MODULE** in Engine Controls - 4.2 L.

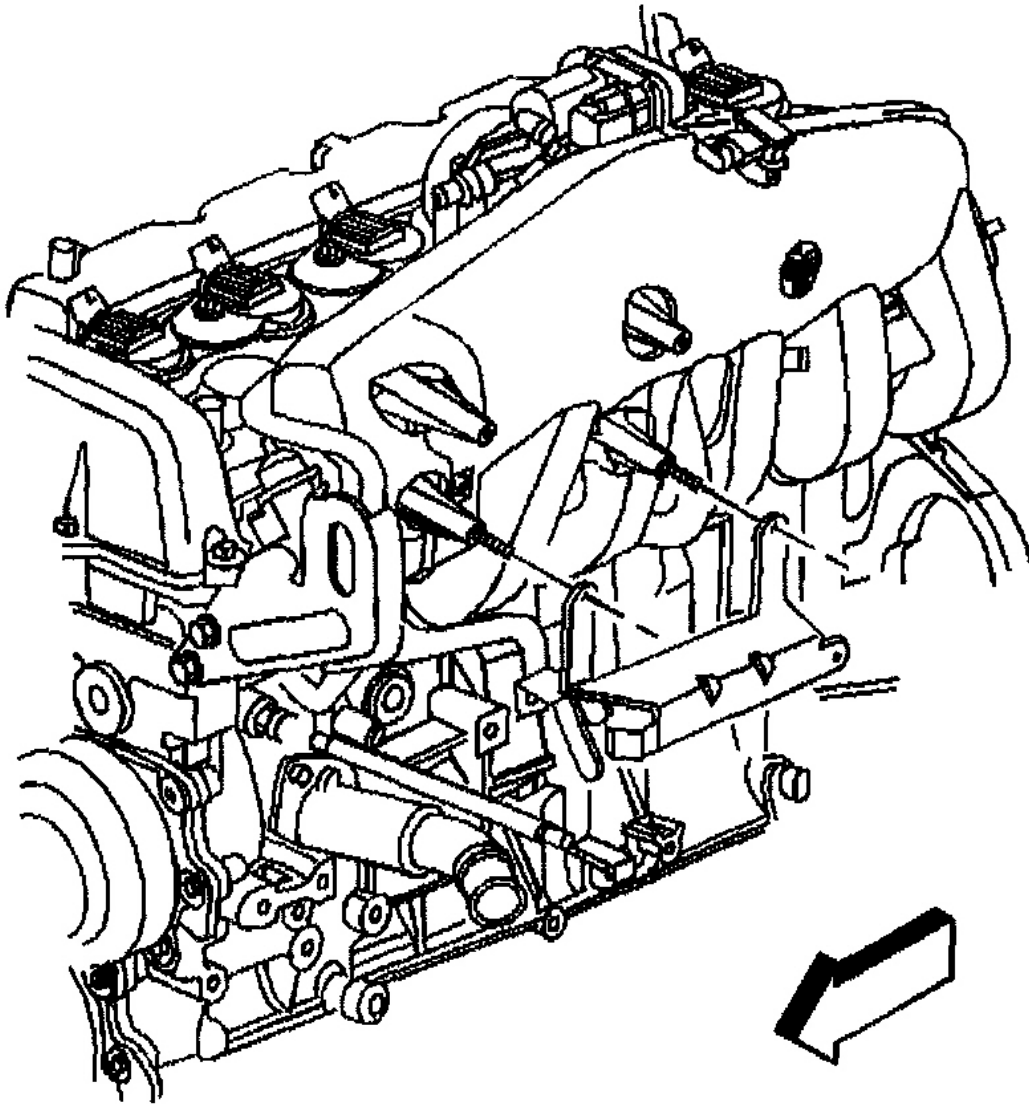


G01706368

Fig. 195: Removing PCM

Courtesy of GENERAL MOTORS CORP.

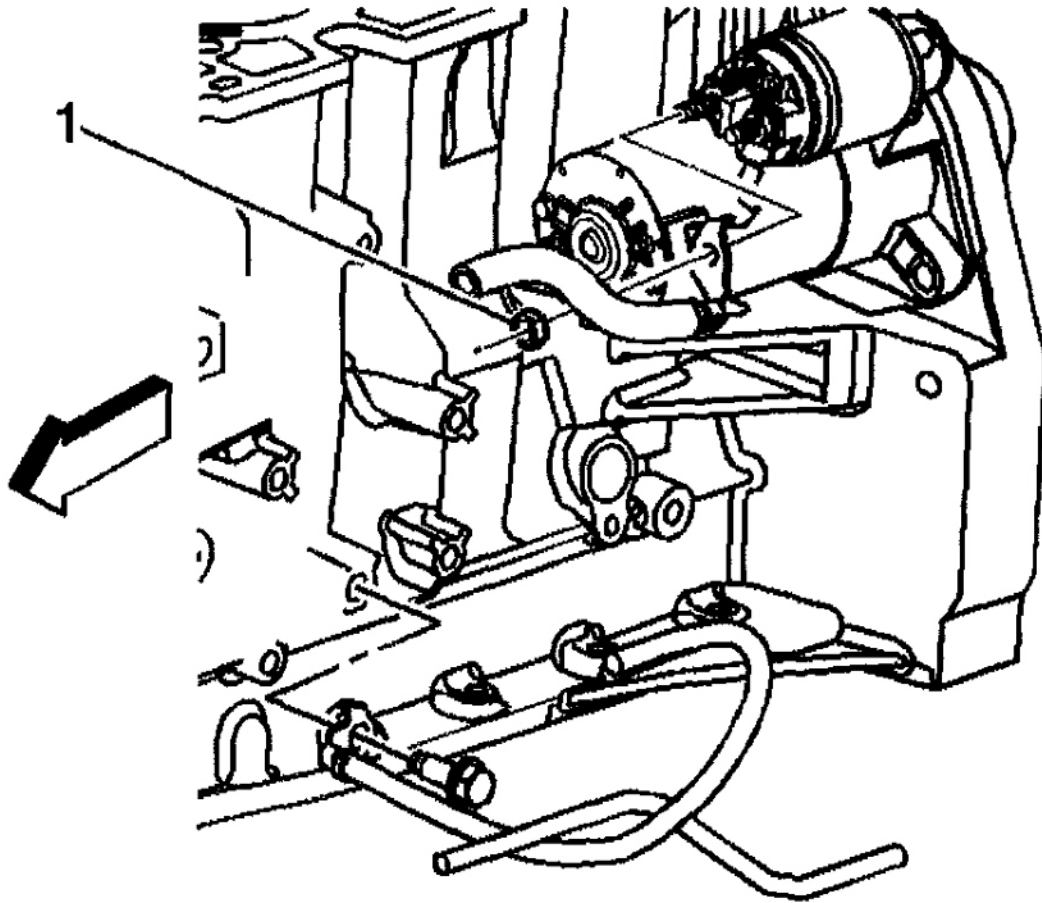
35. Disconnect the full lines at the fuel pressure regulator and cap lines. Refer to **FUEL PRESSURE REGULATOR** in Engine Controls - 4.2 L.
36. Remove all harnesses from the engine harness bracket.
37. Disconnect the front differential vent hose from the engine harness bracket.
38. Remove the engine harness bracket bolt and remove bracket.



G01706369

Fig. 196: Removing Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

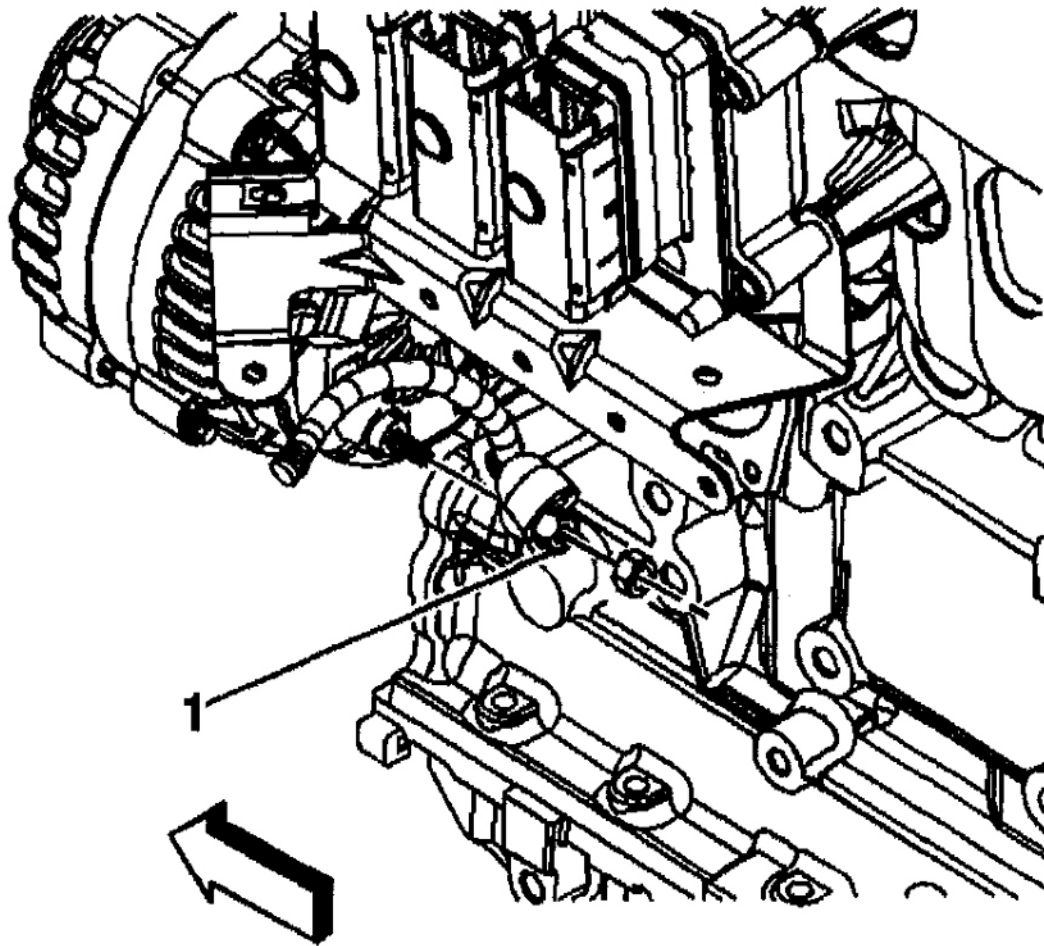
39. Disconnect starter electrical connections (1).



G01706370

Fig. 197: Disconnect Starter Electrical Connections
Courtesy of GENERAL MOTORS CORP.

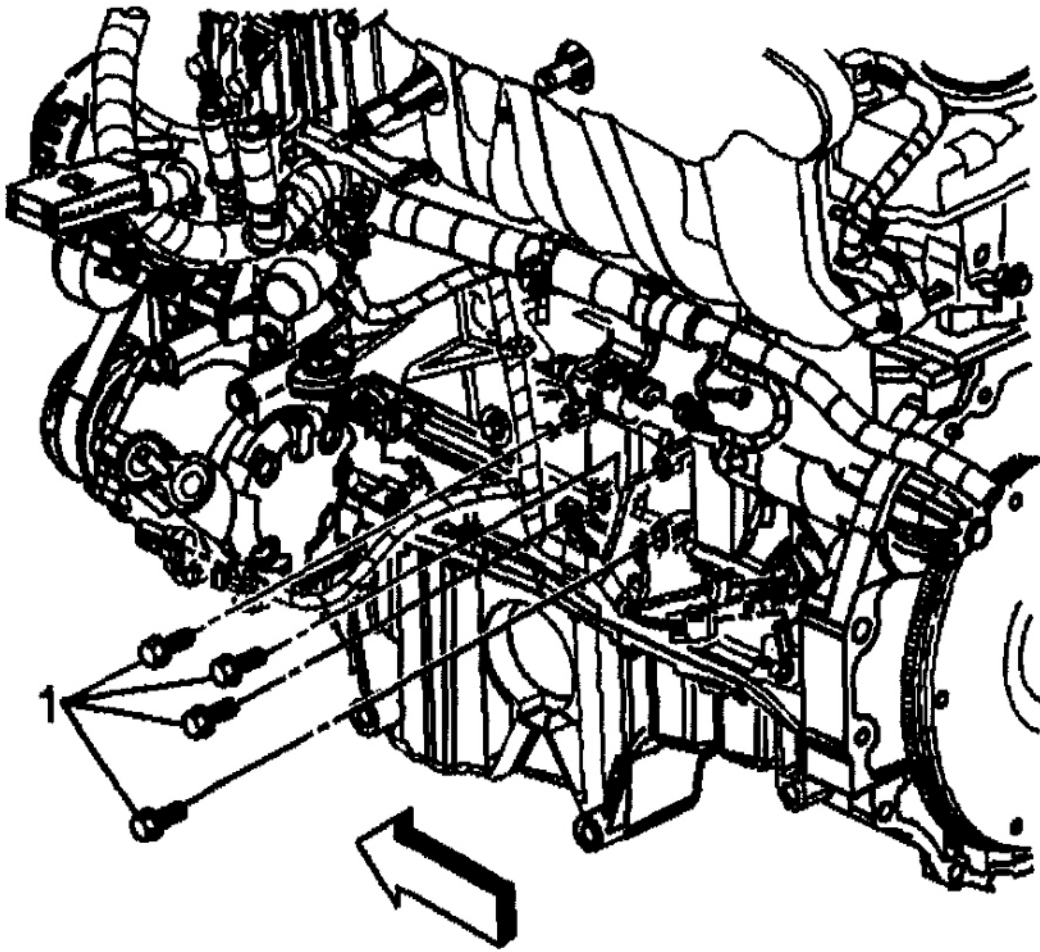
40. Disconnect the A/C pressure sensor and clutch electrical connector.
41. Disconnect generator electrical connector and battery lead.



G01706371

Fig. 198: Disconnecting Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

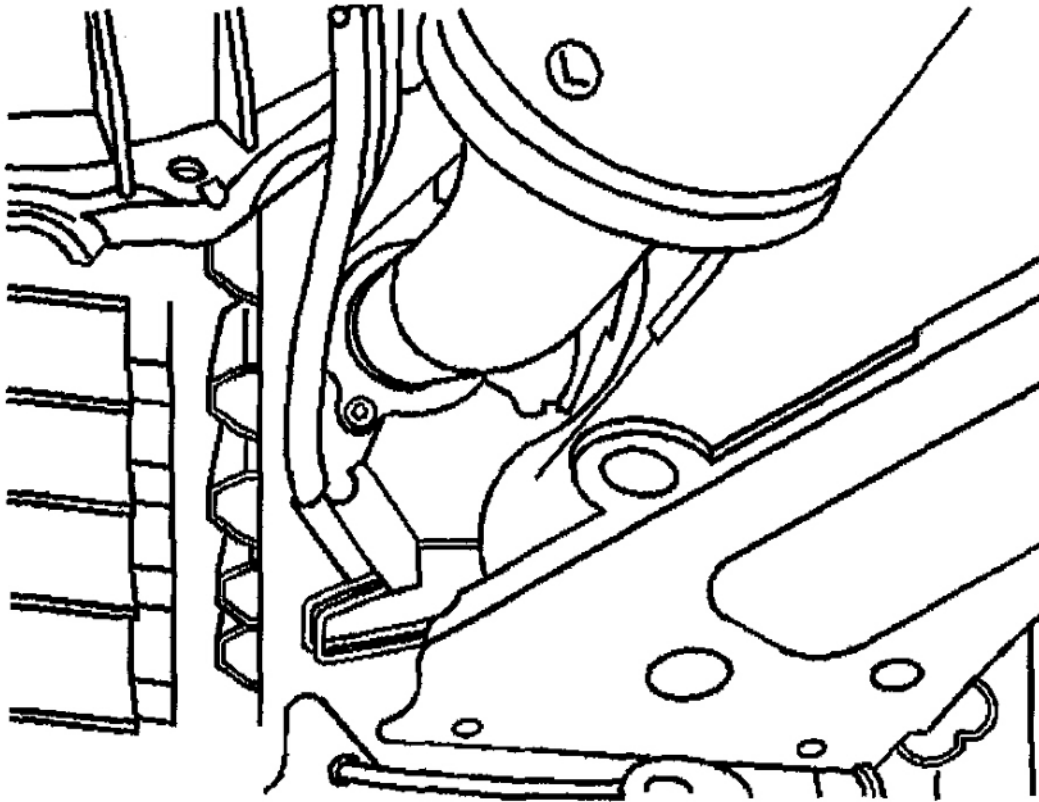
42. Disconnect the knock sensor electrical connector.
43. Disconnect the crankshaft sensor electrical connector.
44. Disconnect the camshaft sensor electrical connector.
45. Remove 4 grounds on the left side of the block (1).



G01706372

Fig. 199: Removing 4 Grounds On Left Side Of Block
Courtesy of GENERAL MOTORS CORP.

46. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
47. Remove the wheel drive shafts, left and right. Refer to **FRONT DRIVE AXLE - 4WD** article.
48. Remove the propeller shaft from the front axle pinion yoke. Refer to **PROPELLER SHAFT REPLACEMENT - FRONT** in Propeller Shaft.
49. Remove the engine protection shield. Refer to Engine Protection Shield Replacement in Body Front End.
50. Disconnect the exhaust pipe from the exhaust manifold and slide the exhaust pipe backward slightly.

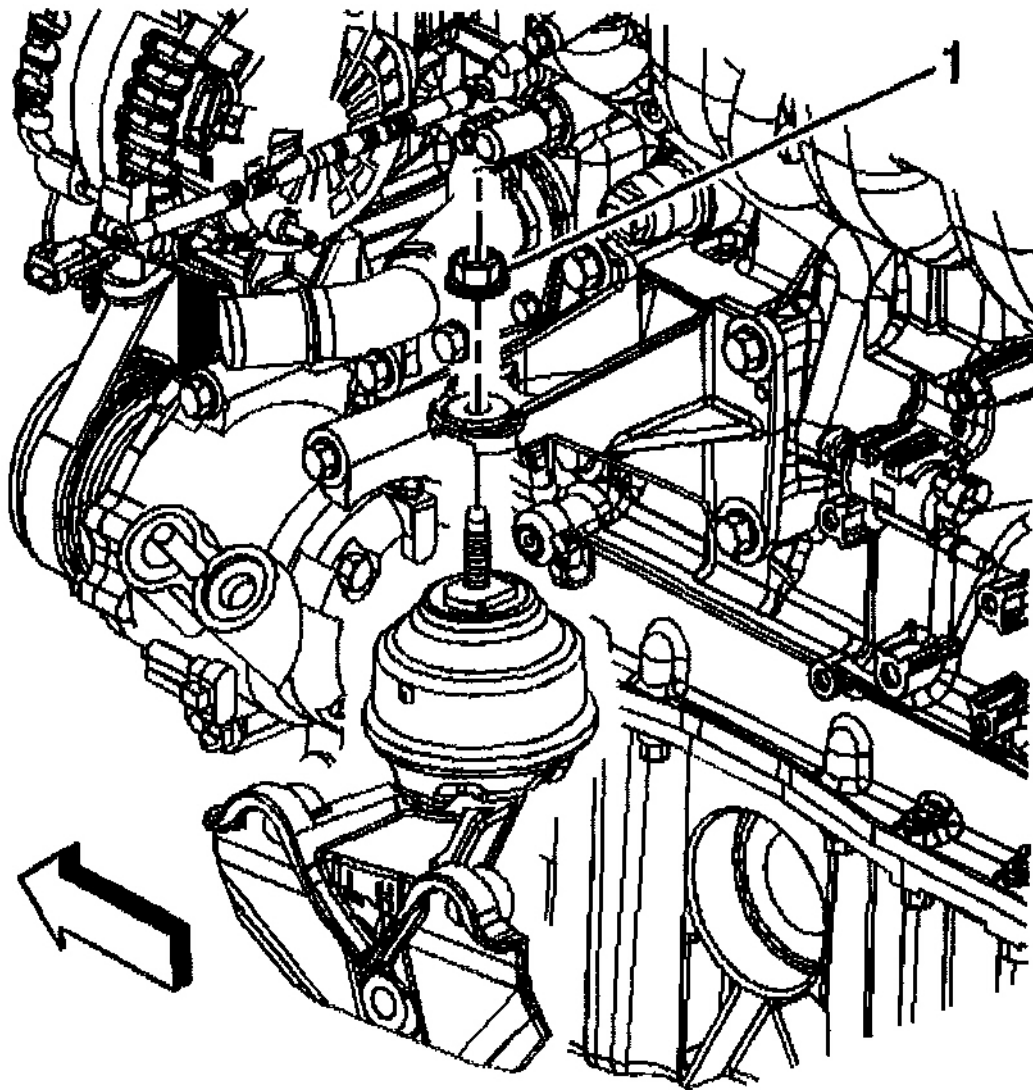


G01706373

Fig. 200: Disconnecting Exhaust Pipe From Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

51. Remove the fuel tank shield, if equipped. Refer to Fuel Tank Shield Replacement in Frame and Underbody.
52. Remove the torque converter bolt access cover.
53. Remove the torque converter bolts.
54. Place a jack on the transmission oil pan for support.
55. Remove the transmission support. Refer to Transmission Support Replacement in Frame and Underbody.
56. Lower the transmission enough to reach the top bell housing bolts.
57. Remove the top 4 bell housing bolts, there may be 2 harness clips that will need to be removed in order to have access to 2 of the top bolts.
58. Raise the transmission.
59. Reinstall the transmission support using only 2 through bolts.
60. Remove the remaining bell housing bolts, for a total of 11 bolts.
61. Remove the left and right engine lower mount nuts.

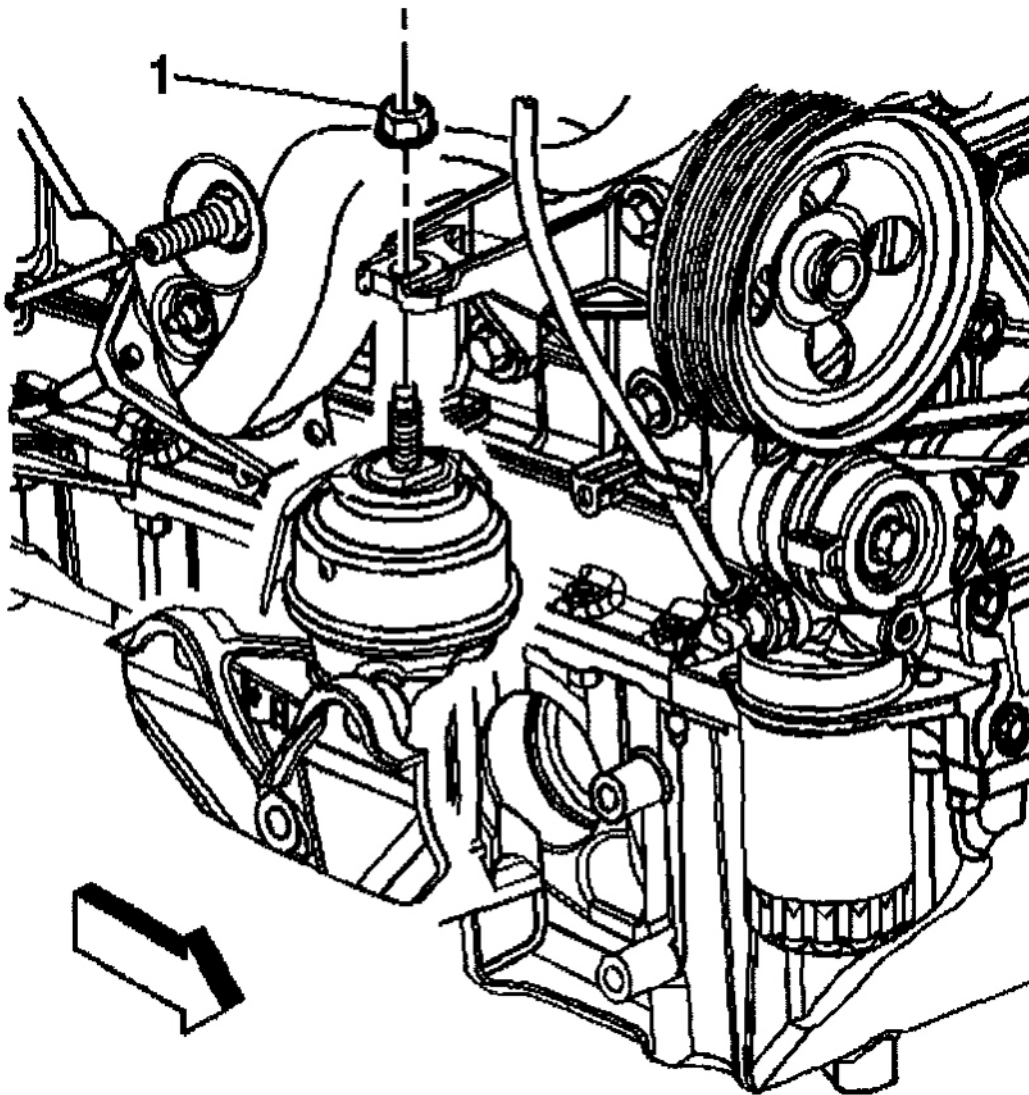
62. Disconnect the oil level sensor electrical connector.
63. Disconnect the oil pressure switch electrical connector.
64. Lower the vehicle.
65. Remove the left upper engine mount nut.



G01706374

Fig. 201: Removing Left Upper Engine Mount Nut
Courtesy of GENERAL MOTORS CORP.

66. Remove the right upper engine mount nut.



G01706375

Fig. 202: Removing Right Upper Engine Mount Nut
Courtesy of GENERAL MOTORS CORP.

67. Install the engine hoist.
68. Raise the engine out of the compartment slowly keeping the transmission supported.
69. Remove both engine mount for clearance.
70. Continue raising the engine out of the vehicle.
71. Install the engine to the engine stand.

Installation Procedure

1. Remove the engine from the engine stand.
2. Slowly install the engine into the engine compartment aligning the engine mounts with the brackets.
3. When the engine mounts are aligned, install the engine mounts, putting the mount up through the engine mount brackets before inserting into the chassis mount brackets.
4. Lower the engine onto the mounts and install the upper engine mount nuts.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the nuts to 70 N.m (51 lb ft).

5. Remove the engine hoist.
6. Lay the radiator into the radiator support, but do not install the radiator completely.
7. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
8. Install all of the lower bell housing bolts, excluding the top four.
9. Remove the two through bolts securing the transmission support.
10. Lower the transmission.
11. Install the top four bell housing bolts.

Tighten

Tighten all eleven bell housing bolts to 50 N.m (37 lb ft).

12. Raise the transmission.
13. Install the transmission support. Refer to Transmission Support Replacement in Frame and Underbody.
14. Install the 3 torque converter bolts.

Tighten

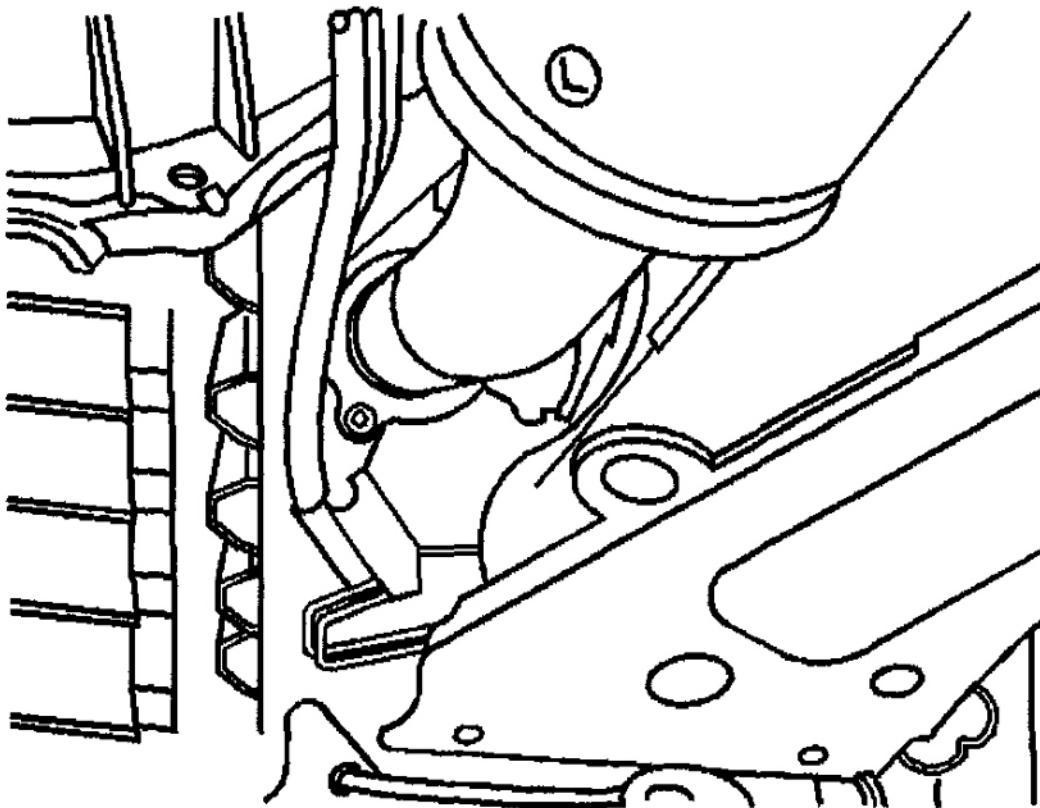
Tighten the torque converter bolts to 60 N.m (44 lb ft).

15. Install the torque converter bolt cover.
16. Install the fuel tank shield, if removed. Refer to Fuel Tank Shield Replacement in Frame and Underbody.

17. Install the engine protection shield. Refer to Engine Protection Shield Replacement .
18. Install the propeller shaft to the front axle pinion yoke. Refer to **PROPELLER SHAFT REPLACEMENT - FRONT** in Propeller Shaft.
19. Connect the exhaust pipe to the manifold and secure the pipe with the bolts.

Tighten

Tighten the exhaust pipe bolts to 50 N.m (37 lb ft).



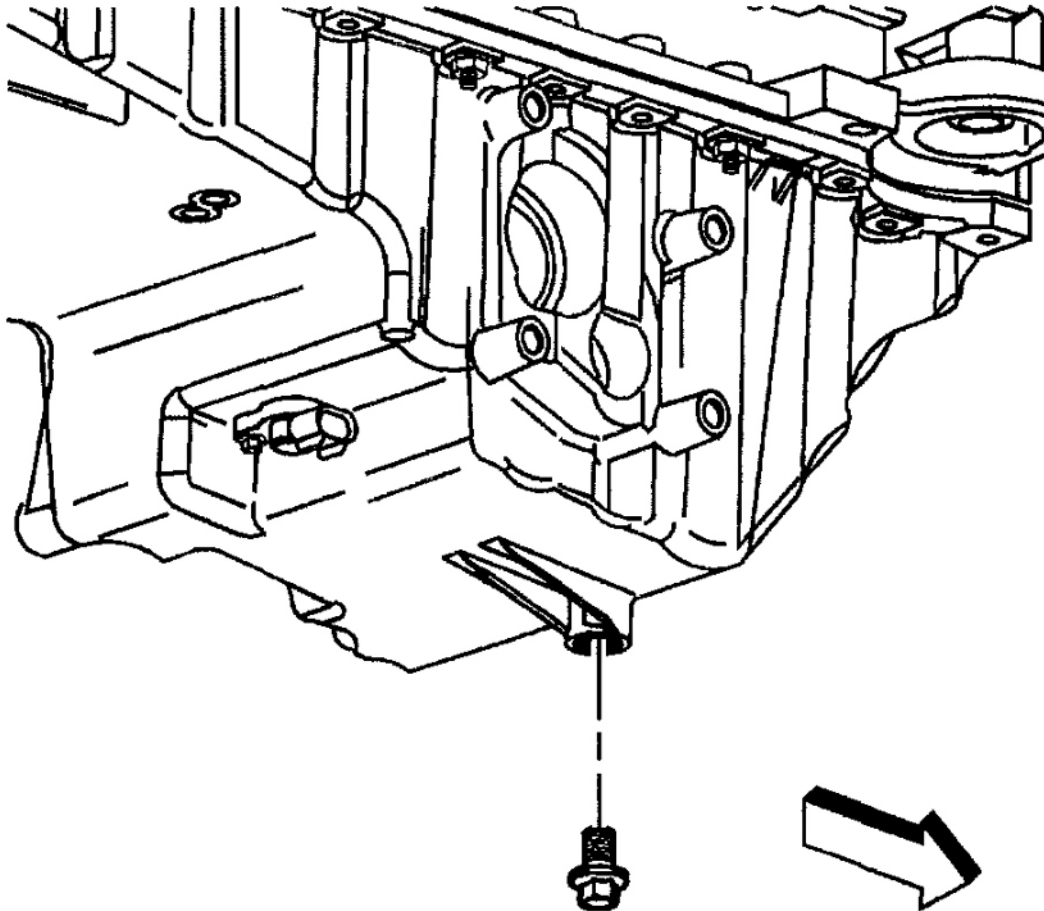
G01706376

Fig. 203: Connecting Exhaust Pipe To Manifold
Courtesy of GENERAL MOTORS CORP.

20. Connect the oil level switch electrical connector.
21. Connect the oil pressure sensor electrical connector.
22. Install the oil pan drain plug.

Tighten

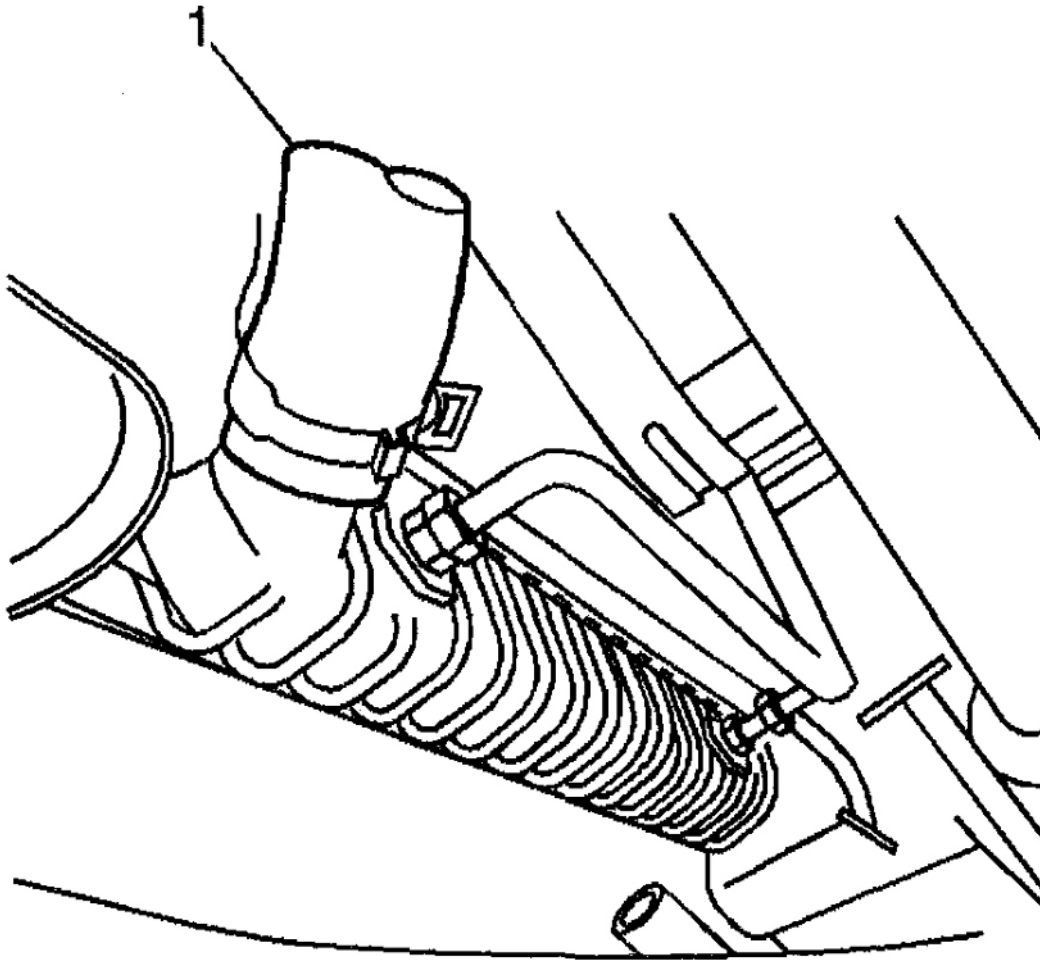
Tighten the plug to 26 N.m (19 lb ft).



G01706377

Fig. 204: Installing Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

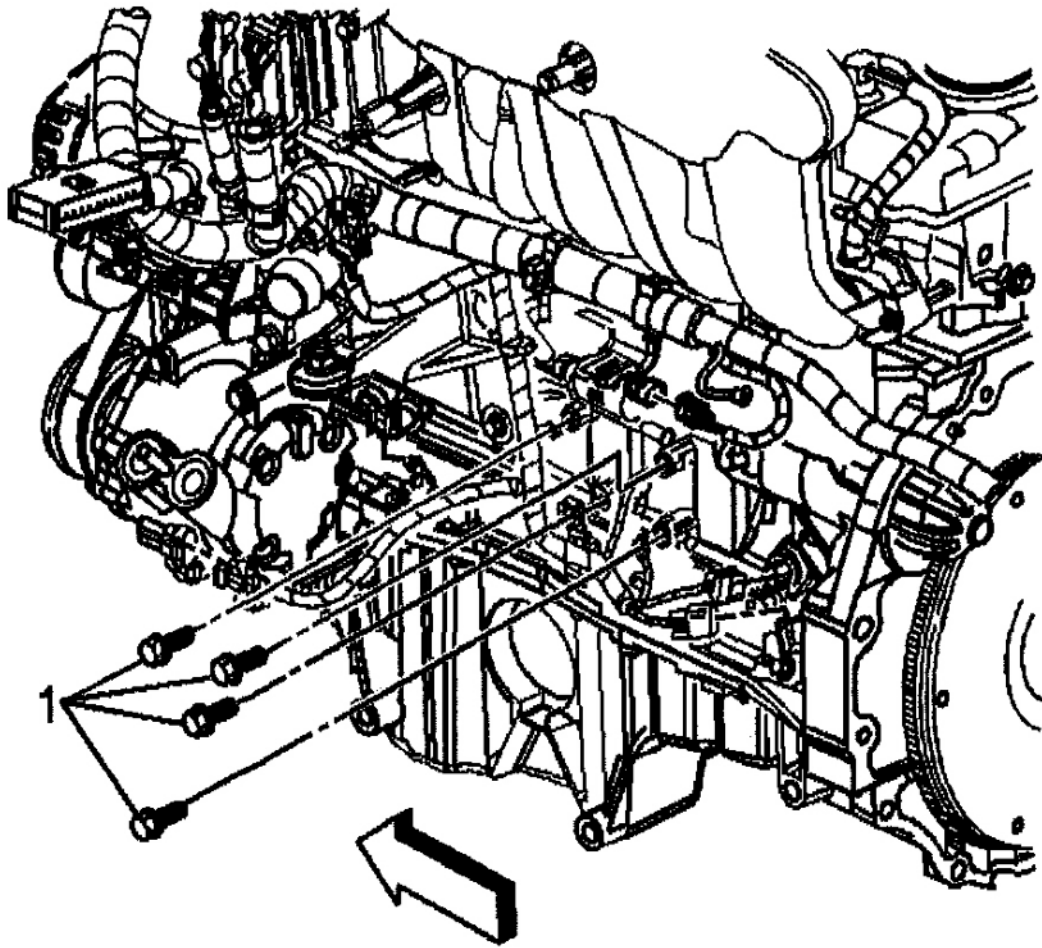
23. Install the lower radiator hose (1).



G01706378

Fig. 205: Installing Lower Radiator Hose
Courtesy of GENERAL MOTORS CORP.

24. Install the left and right wheel drive shafts. Refer to **FRONT DRIVE AXLE - 4WD** article.
25. Lower the vehicle.
26. Install the 4 grounds on the left side of the block (1).



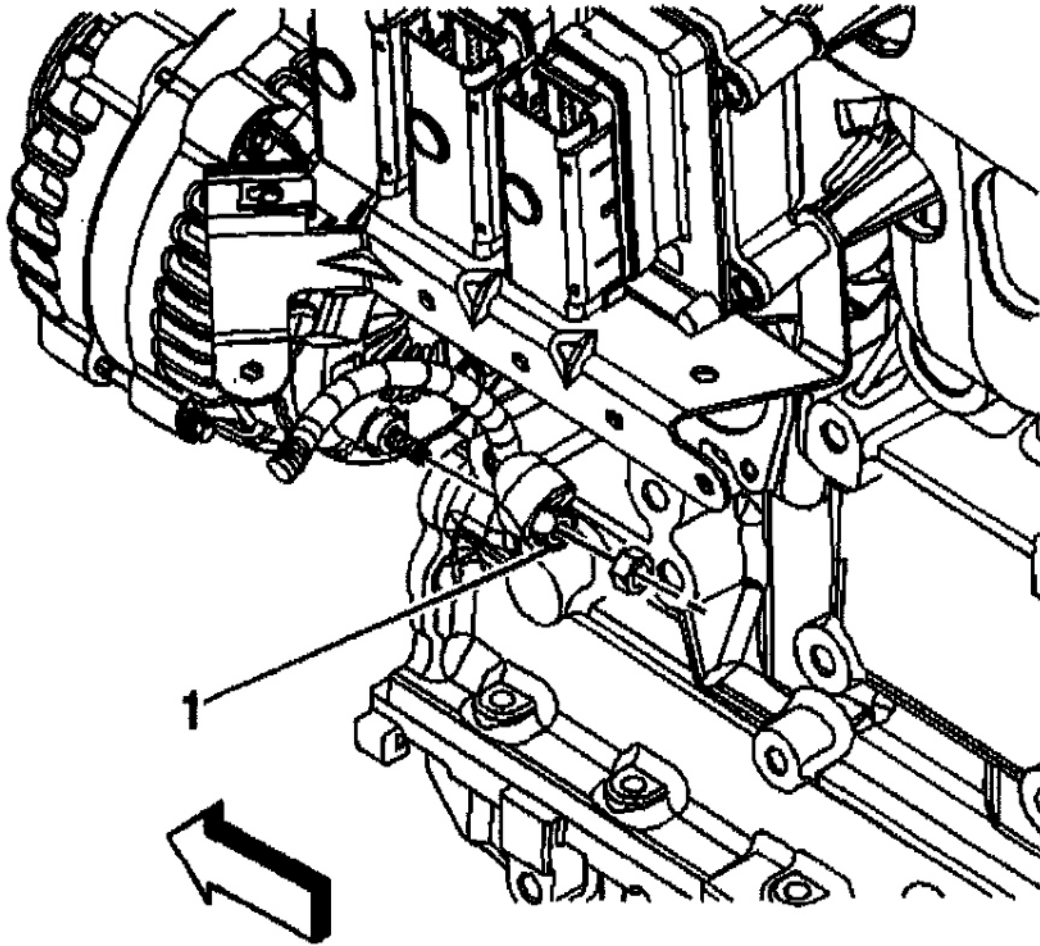
G01706379

Fig. 206: Installing 4 Grounds On Left Side Of Block
Courtesy of GENERAL MOTORS CORP.

27. Install the camshaft sensor electrical connectors.
28. Install the crankshaft sensor electrical connector.
29. Install the knock sensor electrical connector.
30. Install the generator electrical connector and battery lead (1).

Tighten

Tighten the generator battery lead nut to 9 N.m (80 lb in).



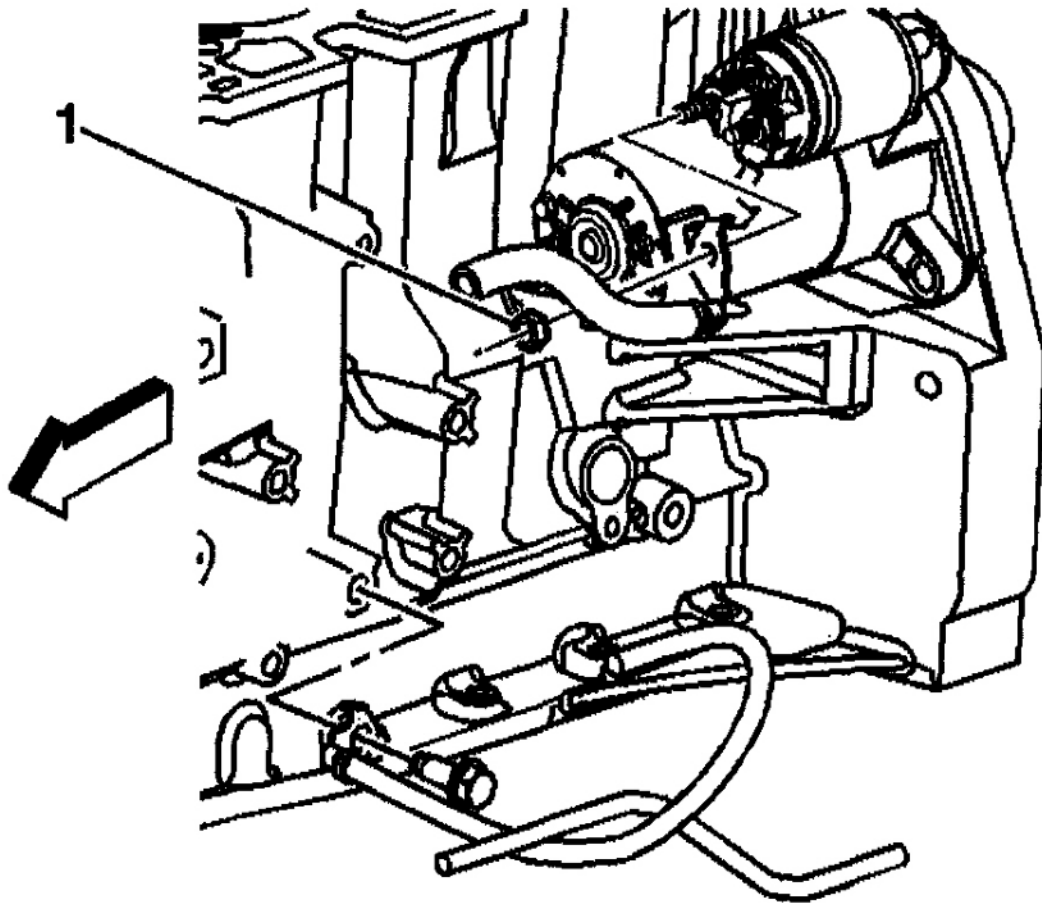
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Fig. 207: Installing Generator Electrical Connector And Battery Lead
Courtesy of GENERAL MOTORS CORP.

31. Install the A/C pressure sensor and clutch electrical connector.
32. Install starter electrical connectors and battery lead (1).

Tighten

Tighten the starter battery lead to 9 N.m (80 lb in).



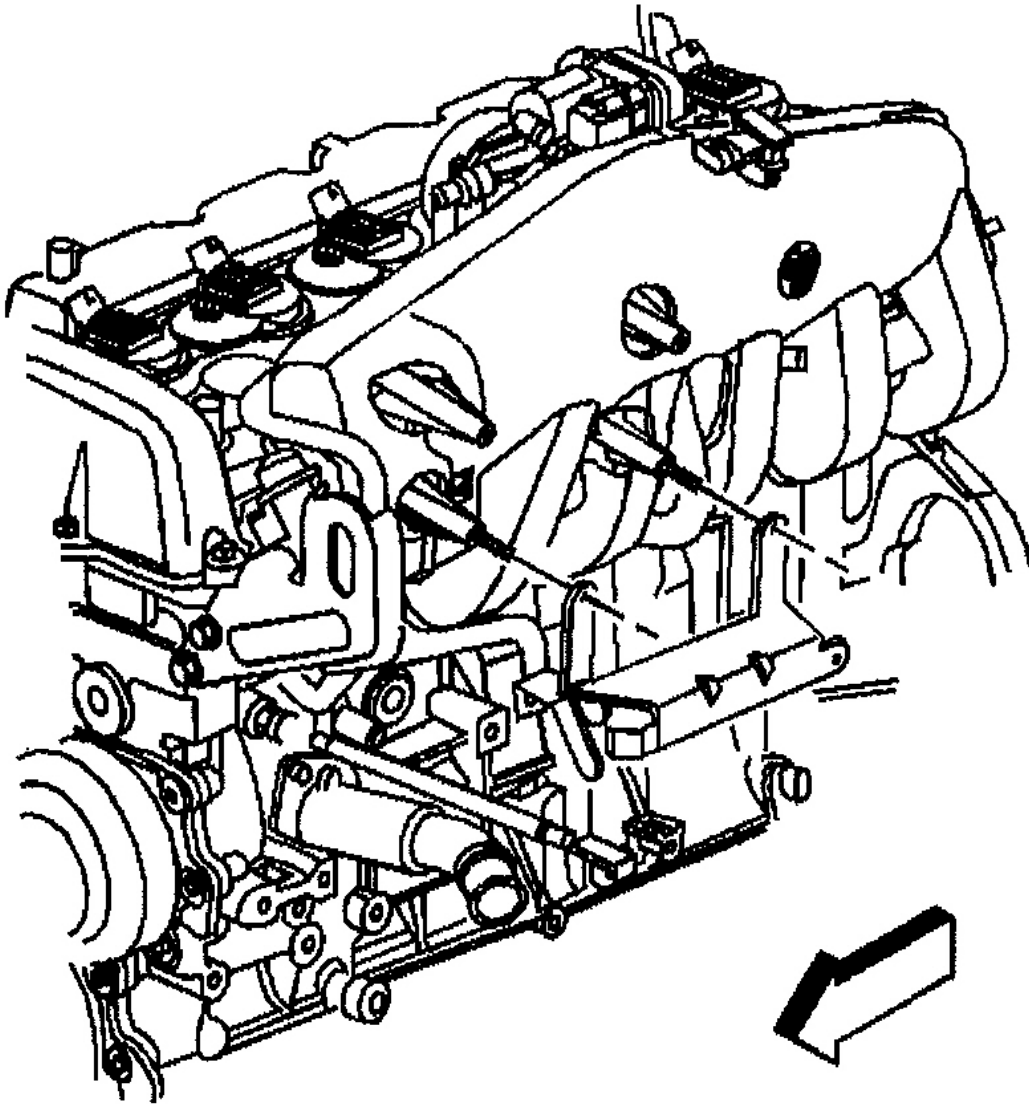
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Fig. 208: Installing Starter Electrical Connectors And Battery Lead
Courtesy of GENERAL MOTORS CORP.

33. Install the fuel lines at the fuel pressure regulator. Refer to **FUEL PRESSURE REGULATOR** in Engine Controls - 4.2L.
34. Install the engine harness bracket and bolt.

Tighten

Tighten the engine harness bracket bolt to 50 N.m (37 lb ft).



G01706382

Fig. 209: Installing Engine Harness Bracket
Courtesy of GENERAL MOTORS CORP.

35. Install the front differential vent hose, to the engine harness bracket.
36. Install all the harnesses to the engine harness bracket.
37. Install the PCM. Refer to **POWERTRAIN CONTROL MODULE** in Engine Controls - 4.2 L.
38. Install the power brake hose at booster
39. Install the harness retainer to the original location.

40. Install the ignition coil harness electrical connectors.

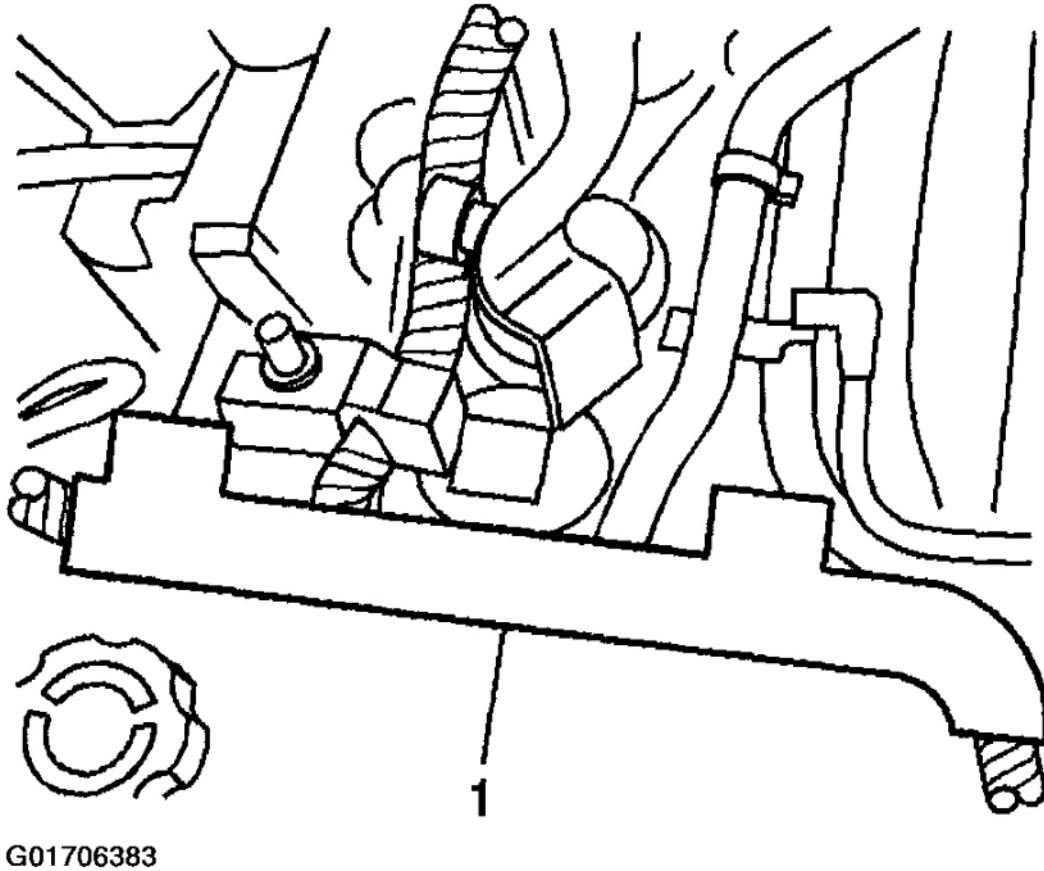
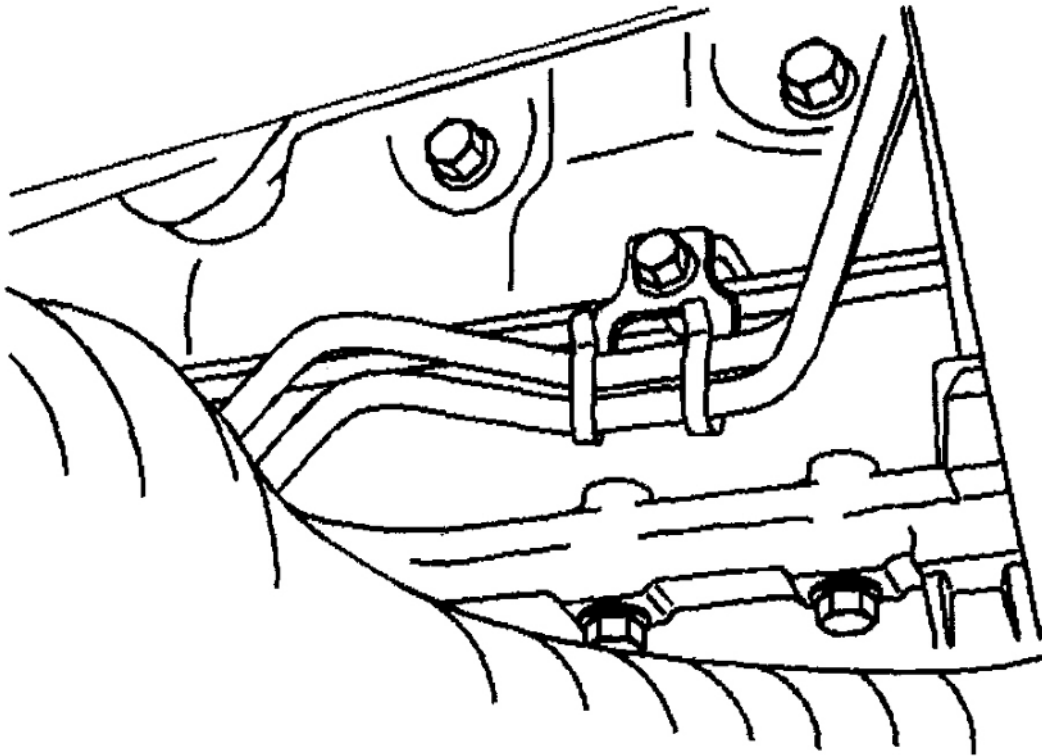


Fig. 210: Installing Ignition Coil Harness Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

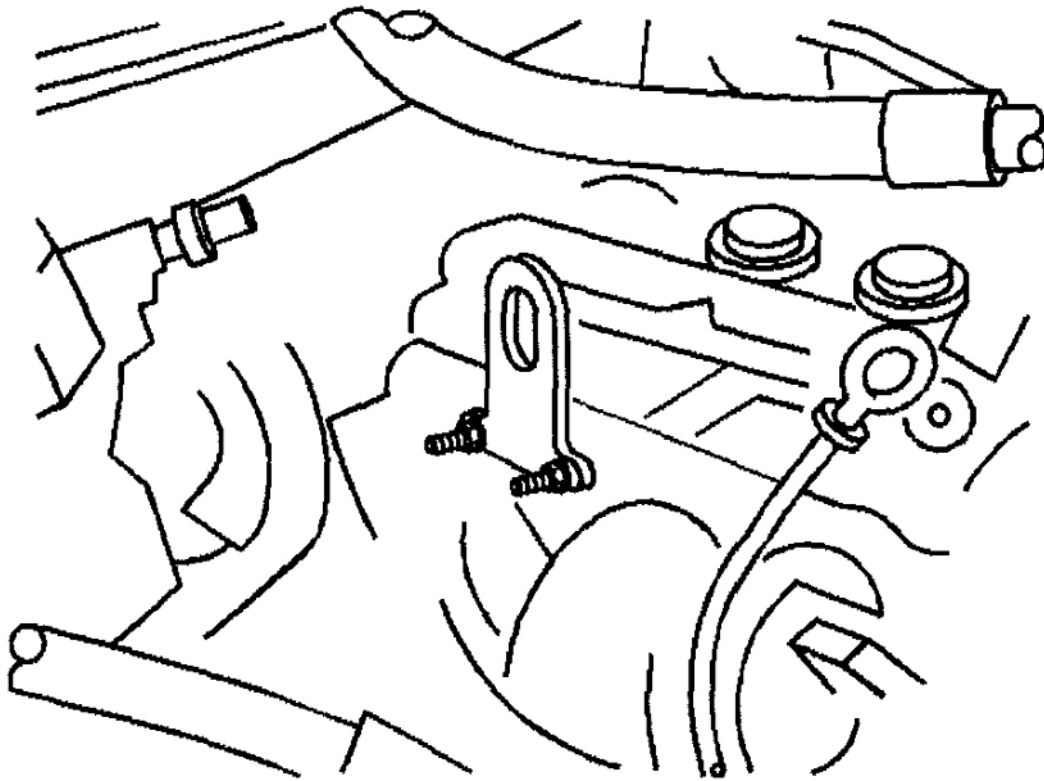
41. Clip the transmission cooler lines to the right side of the engine block.



G01706384

Fig. 211: Clipping Transmission Cooler Lines To Right Side Of Engine Block
Courtesy of GENERAL MOTORS CORP.

42. Connect the camshaft phaser actuator valve electrical connector.
43. Connect the front axle actuator electrical connector.
44. Connect the A/C line at the accumulator.
45. Install the oxygen sensor electrical connector.
46. Remove the lift hook J 44220.



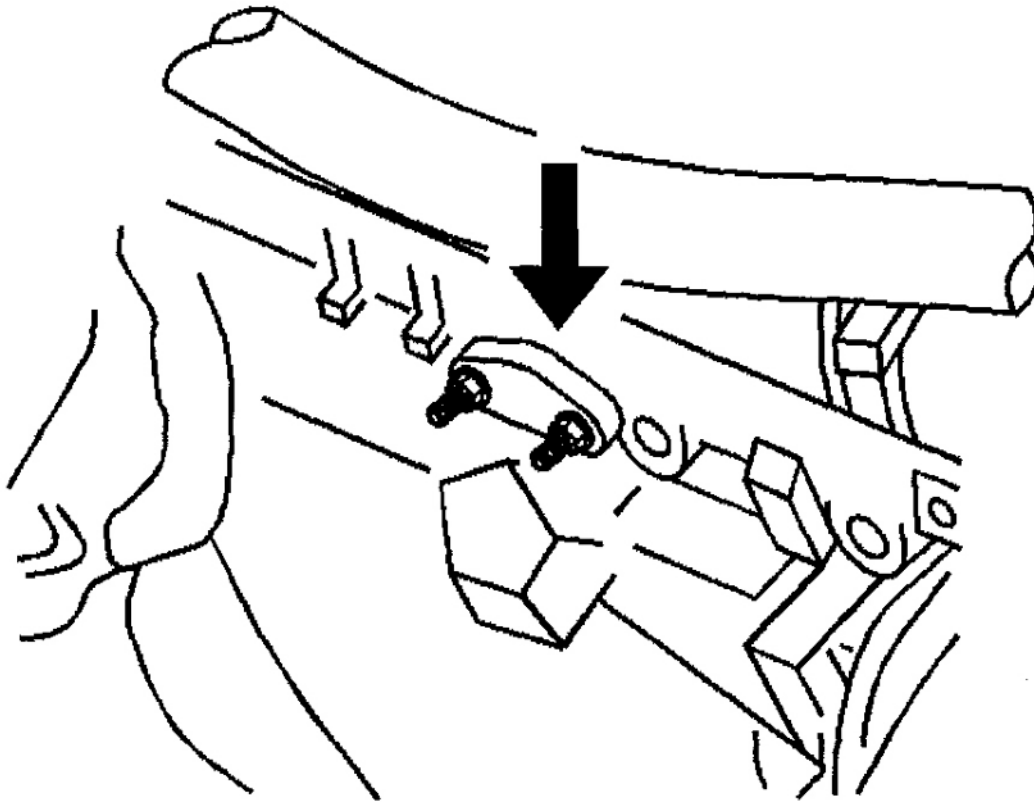
G01706385

Fig. 212: Removing Lift Hook
Courtesy of GENERAL MOTORS CORP.

47. Install the AIR adapter and secure the adapter with the studs.

Tighten

Tighten the AIR adapter studs to 25 N.m (18 lb ft).



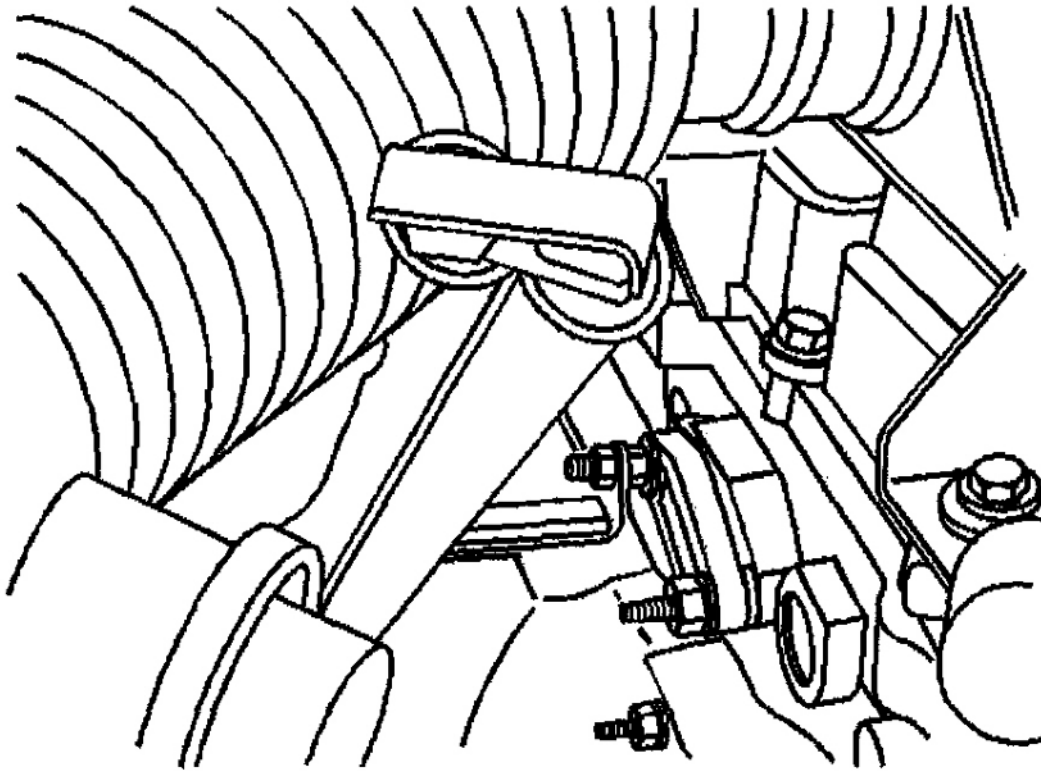
G01706386

Fig. 213: Installing AIR Adapter
Courtesy of GENERAL MOTORS CORP.

48. Install the transmission filler tube bracket to AIR adapter stud and secure the bracket with the nut.

Tighten

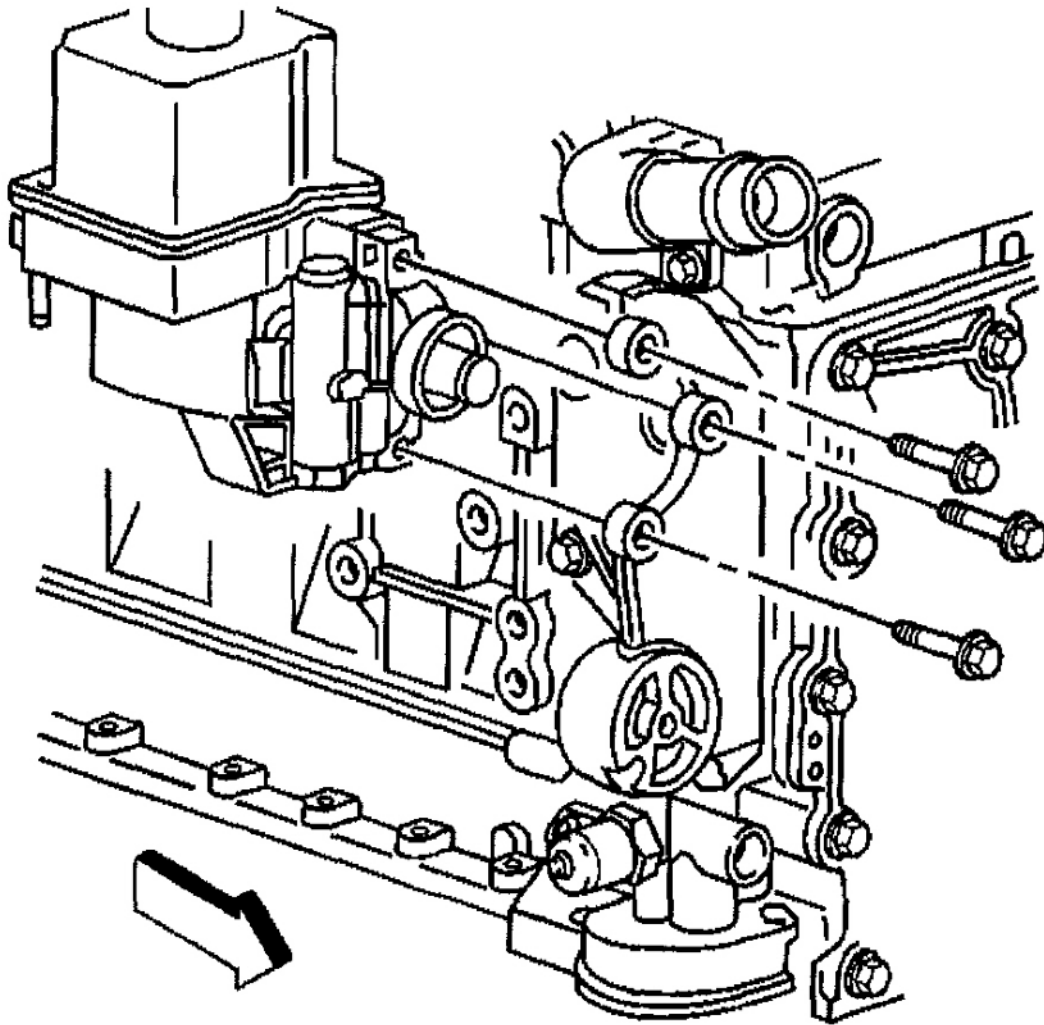
Torque nut to 10 N.m (89 lb in).



G01706387

Fig. 214: Installing Transmission Filler Tube Bracket
Courtesy of GENERAL MOTORS CORP.

49. Install the heater hoses to the heater core.
50. Install the power steering pump.



G01706388

Fig. 215: Installing Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

51. Install the power steering pump bolts.

Tighten

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

52. Install the drive belt. Refer to **Drive Belt Replacement**.
53. Install cooling fan and shroud, tilting the radiator forward for clearance.
54. Finish installing the radiator. Refer to Radiator Replacement in Engine Cooling.

55. Install transmission cooler lines together.
56. Install map Sensor. Refer to **MANIFOLD ABSOLUTE PRESSURE SENSOR** in Engine Controls - 4.2L.
57. Install the throttle body. Refer to **THROTTLE BODY** in Engine Controls -4.2 L.
58. Install the hood latch. Refer to Hood Latch Support Replacement in Body Front End.
59. Install the head lamp housing. Refer to Headlamp Housing Panel Replacement (Chevy, GMC) or Headlamp Housing Panel Replacement (Olds) in Body Front End.
60. Install the grill. Refer to Grille Replacement (GMC) or Grille Replacement (Chevrolet) or Grille Replacement (Oldsmobile) in Exterior Trim.
61. Install the air intake baffle. Refer to Air Intake Baffle Replacement - Radiator in Engine Controls - 4.2 L.
62. Install the washer solvent container. Refer to Washer Solvent Container Replacement in Wipers/Washer Systems.
63. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement in Engine Controls - 4.2 L.
64. Connect the negative battery cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Engine Electrical.
65. Install the hood. Refer to Hood Replacement .
66. Service the engine oil.
67. Fill the cooling system. Refer to Draining and Filling Cooling System in Engine Cooling.
68. Recharge the refrigerant. Refer to Refrigerant Recovery and Recharging in Heating, Ventilation and Air Conditioning.
69. Perform the CKP system variation learn procedure. Refer to CKP System Variation Learn Procedure in Engine Controls - 4.2 L, 5.3 L, and 6.0 L.

IMPORTANT: After an overhaul, the engine should be tested. Use the following procedure after the engine is installed in the vehicle.

- Disable the ignition system.
 - Crank the engine several times. Listen for unusual noises or evidence that parts are binding.
 - Enable the ignition system.
 - Start the engine and listen for unusual noises.
 - Check the vehicle oil pressure gauge or light and confirm that the engine has acceptable oil pressure.
 - Run the engine speed at about 1000 RPM until the engine has reached normal operating temperature.
 - Listen for a sticking lifter and other unusual noises.
 - Inspect for fuel, oil and/or coolant leaks while the engine is running.
 - Perform a final inspection for the proper engine oil and coolant levels.
70. Close the hood.

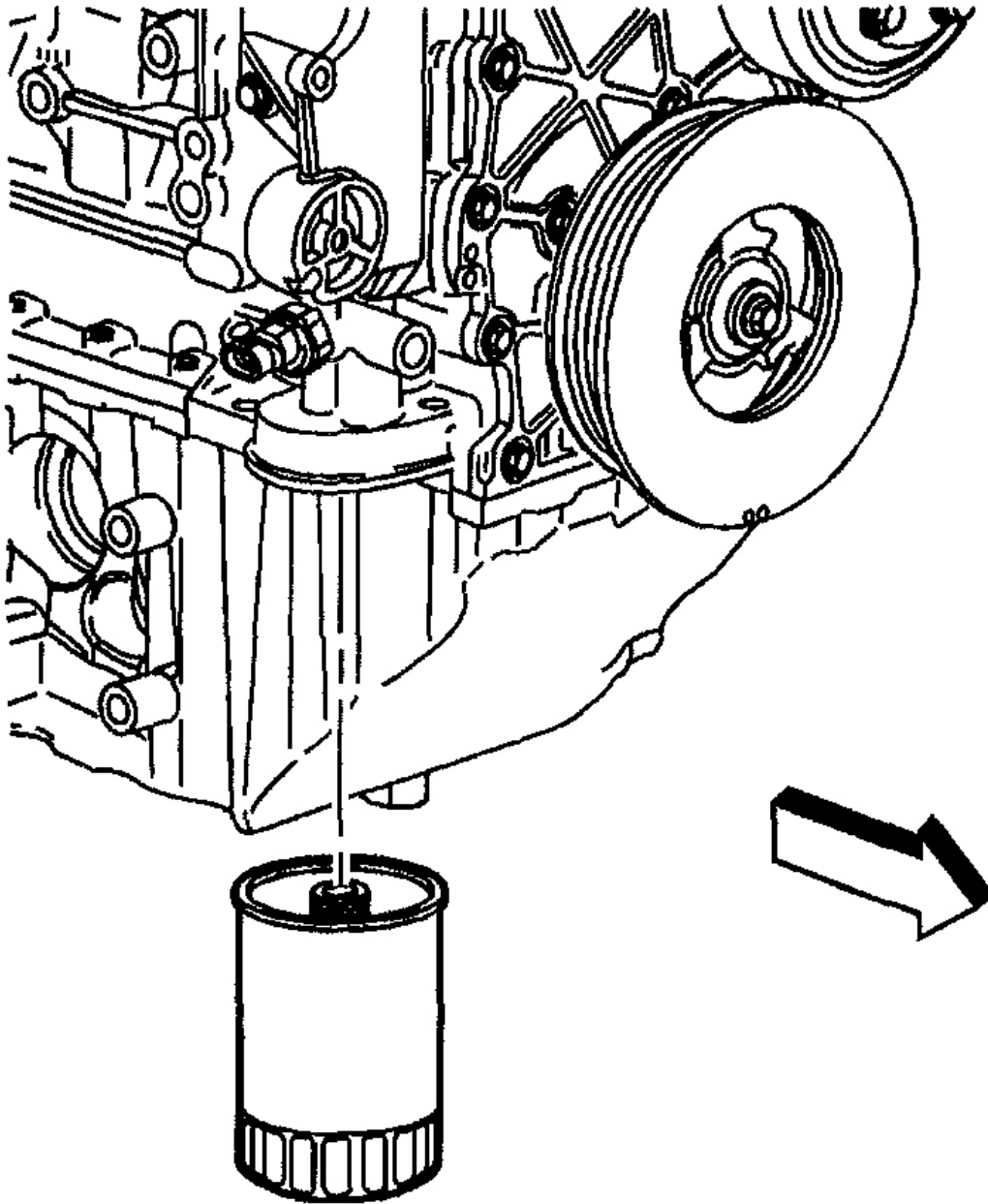
ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Remove the oil fill cap.
2. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
3. Remove the oil pan drain plug and drain the oil into a suitable container.

IMPORTANT: Check the old oil filter to ensure the filter seal is not left on the engine block.

4. Remove the oil filter using a suitable wrench.



G01706389

Fig. 216: Removing Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Wipe the excess oil from the oil filter housing.

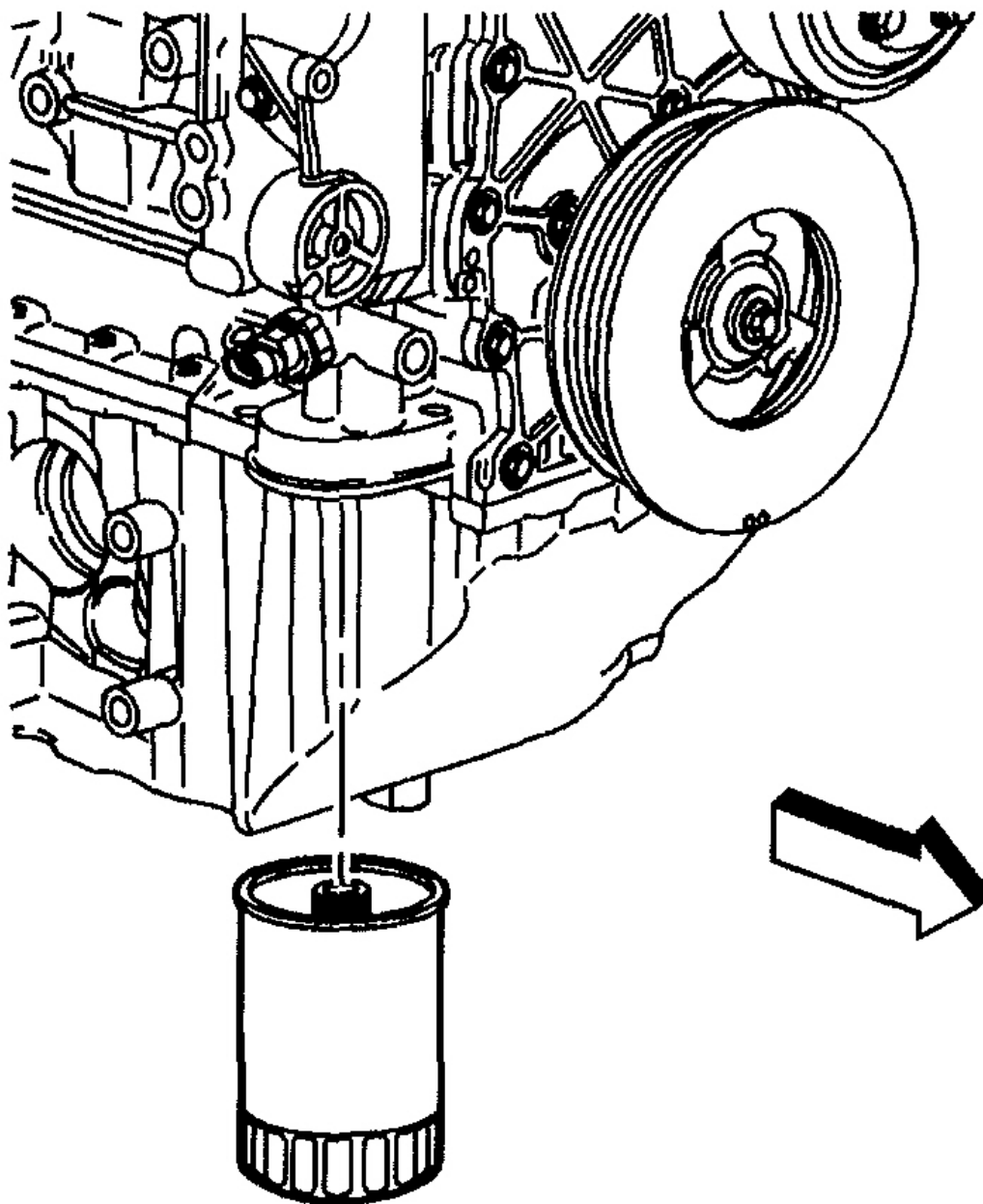
Installation Procedure

1. Lubricate the oil filter seal with clean engine oil.
2. Install the new oil filter.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.

Tighten

Tighten the oil filter to 17 N.m (22 lb ft) plus 150 degrees.



G01706390

Fig. 217: Installing New Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pan drain plug.

Tighten

Tighten the oil pan drain plug to 26 N.m (19 lb ft).

4. Lower the vehicle.
5. Fill the crankcase with the proper quantity of engine oil.
6. Remove the oil level indicator.
7. Wipe the indicator with a clean cloth.
8. Install the oil level indicator.
9. Remove the oil level indicator and check the oil level.
10. Add oil if necessary.
11. Check for any oil leaks.

DESCRIPTION AND OPERATION**CRANKCASE VENTILATION SYSTEM DESCRIPTION**

A closed crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation pipe/passage into the intake manifold.

Results of Incorrect Operation

A plugged PCV Pipe/passage way may cause:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

DRIVE BELT SYSTEM DESCRIPTION

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The drive belt idler pulley
- The crankshaft balancer pulley
- The accessory drive component mounting brackets
- The accessory drive components
 - The power steering pump, if belt driven
 - The generator

- The A/C compressor, if equipped
- The engine cooling fan, if belt driven
- The water pump, if belt driven
- The vacuum pump, if equipped
- The air compressor, if equipped

The drive belt system may use one belt or two belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. There also may be a V-belt style belt used to drive certain accessory drive components. The drive belts are made of different types of rubbers (chloroprene or EPDM) and have different layers or plies containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

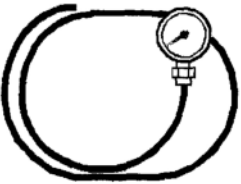
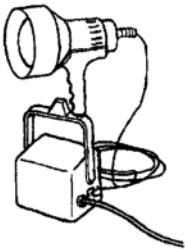
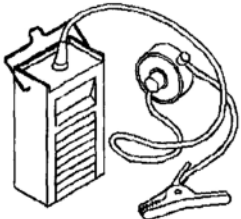
The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

SPECIAL TOOLS AND EQUIPMENT

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2002 ENGINES 4.2L 6-Cylinder - Bravada, Envoy & Trailblazer

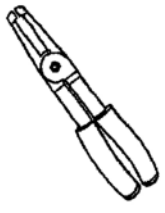
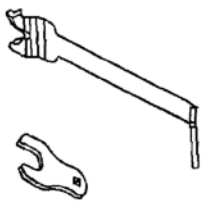
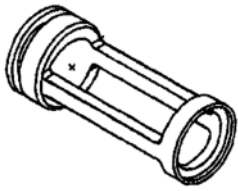
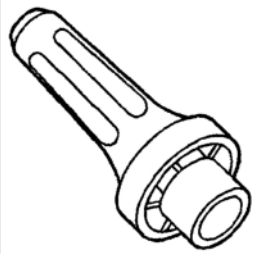
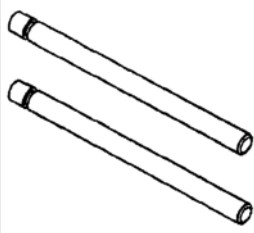
Illustration	Tool Number/Description
	J 21867 Pressure Gage
	J 25087-C Oil Pressure Tester and Pump Primer
	J 28428-E High Intensity Black Light Kit
	J 36660-A Torque/Angle Meter
	J 38722 Compression Tester

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Fig. 218: Special Tools And Equipment (1 Of 4)
Courtesy of GENERAL MOTORS CORP.

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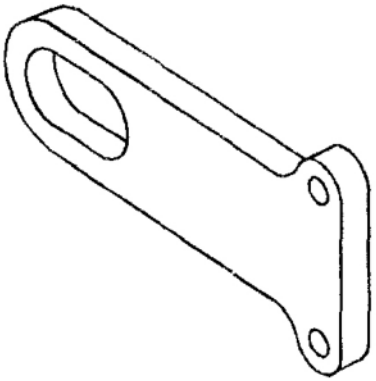
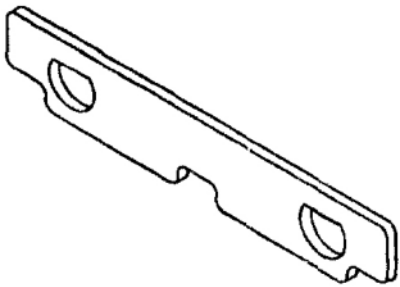
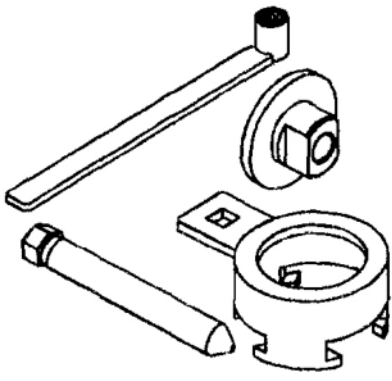
Illustration	Tool Number/Description
	J 38820 Valve Stem Seal Installer
	J 41240 Fan Clutch Remover and Installer
	J 42037 Valve Spring Compressor Adapter
	J 44218 Seal Installer
	J 44219 Cover Alignment Pins

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Fig. 219: Special Tools And Equipment (2 Of 4)
Courtesy of GENERAL MOTORS CORP.

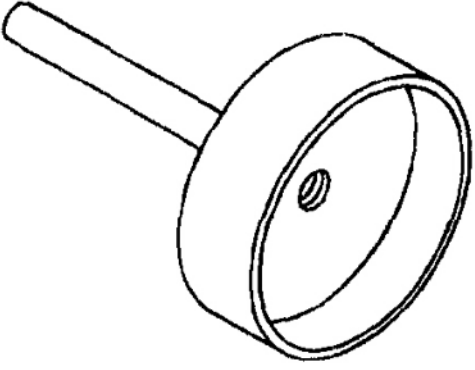
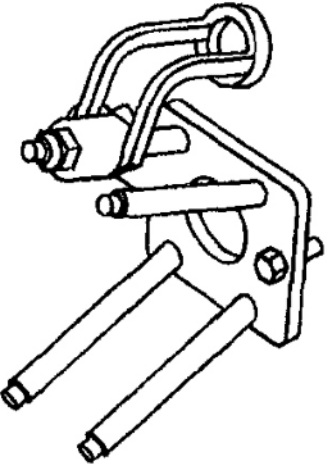
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Illustration	Tool Number/Description
	J 44220 Engine Lift Bracket
	J 44221 Camshaft Holding Tool
	J 44226 Crankshaft Balancer Remover

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Fig. 220: Special Tools And Equipment (3 Of 4)
Courtesy of GENERAL MOTORS CORP.

Illustration	Tool Number/Description
	J 44227 Rear Seal Installer
	J 44228 Valve Spring Compressor

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Fig. 221: Special Tools And Equipment (4 Of 4)
 Courtesy of GENERAL MOTORS CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lb. (N.m)
A/C Compressor Bolts	37 (50)
A.I.R. Cover Stud	18 (25)

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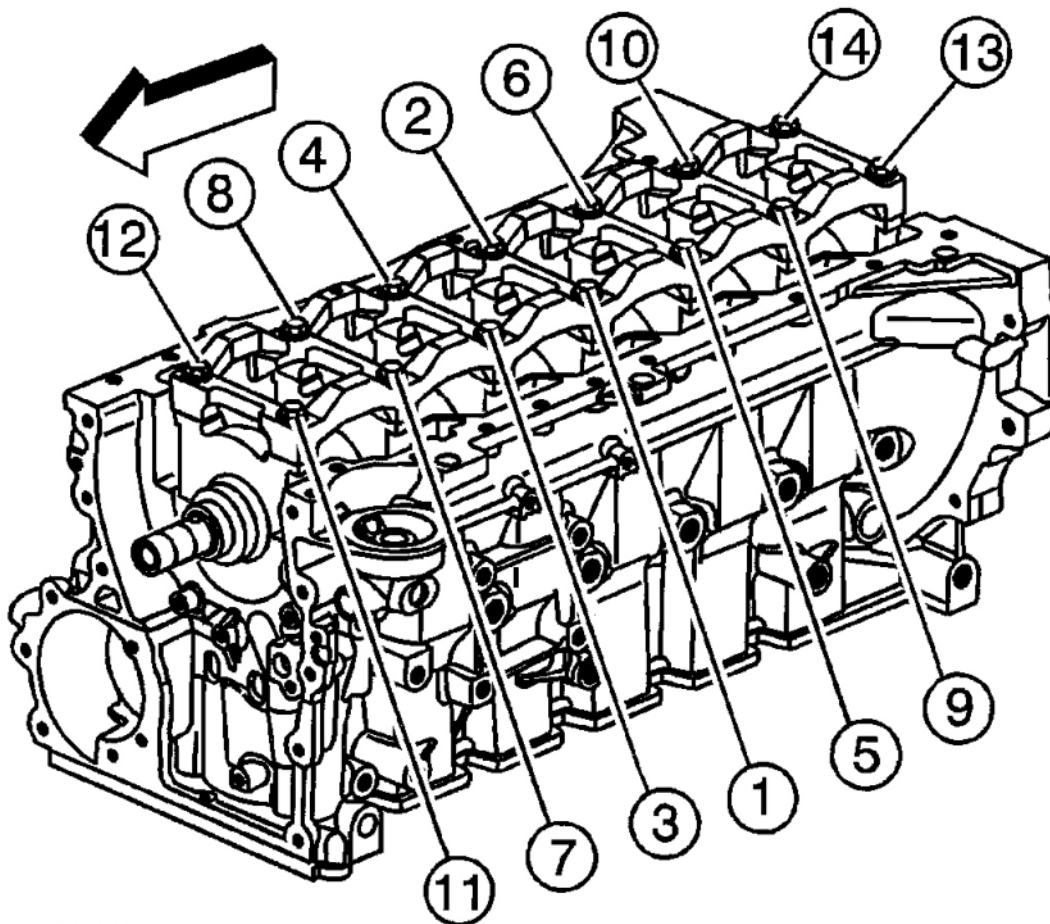
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Cooling Fan Hub Nut	41 (56)
Crankshaft Balancer Bolt	
First Pass	110 (150)
Final Pass	180 Degrees
Cylinder Head Bolt (14)	
First Pass	22 (30)
Final Pass	155 Degrees
Drive Belt Idler Pulley Bolt	37 (50)
Drive Belt Tensioner Bolt	37 (50)
Engine Flywheel Bolt	
First Pass	18 (25)
Final Pass	50 Degrees
Engine Front Lift Bracket Bolt	37 (50)
Engine Harness Bracket Bolt	37 (50)
Engine Mount Bracket Bolt	
Engine	37 (50)
Frame	110 (81)
Engine Mount Nuts (Upper and Lower)	52 (70)
Exhaust Camshaft Actuator Bolt	
First Pass	18 (25)
Final Pass	135 Degrees
Exhaust Pipe Bolts	37 (50)
Front Differential Bolts	63 (85)
Heater Inlet Fitting	33 (45)
Heater Outlet Fitting	33 (45)
Intake Camshaft Sprocket Bolt	
First Pass	15 (20)
Final Pass	100 Degrees
Oil Filter (PF 58)	
First Pass	13 (17)
Final Pass	150 Degrees
Oil Filter Adapter	22 (30)
Oil Pan Bolt (Sides)	18 (25)
Oil Pan Nut	18 (25)
Oil Pressure Sensor	15 (20)
Oil Pump Pressure Relief Valve	124 (14)
Power Steering Pump Bolt	18 (25)
Timing Chain Tensioner Bolt	18 (25)
Timing Chain Tensioner Shoe Bolt	18 (25)
Torque Converter Bolts	44 (60)
Transmission Bell Housing Bolts	37 (50)
INCH Lbs (N m)	

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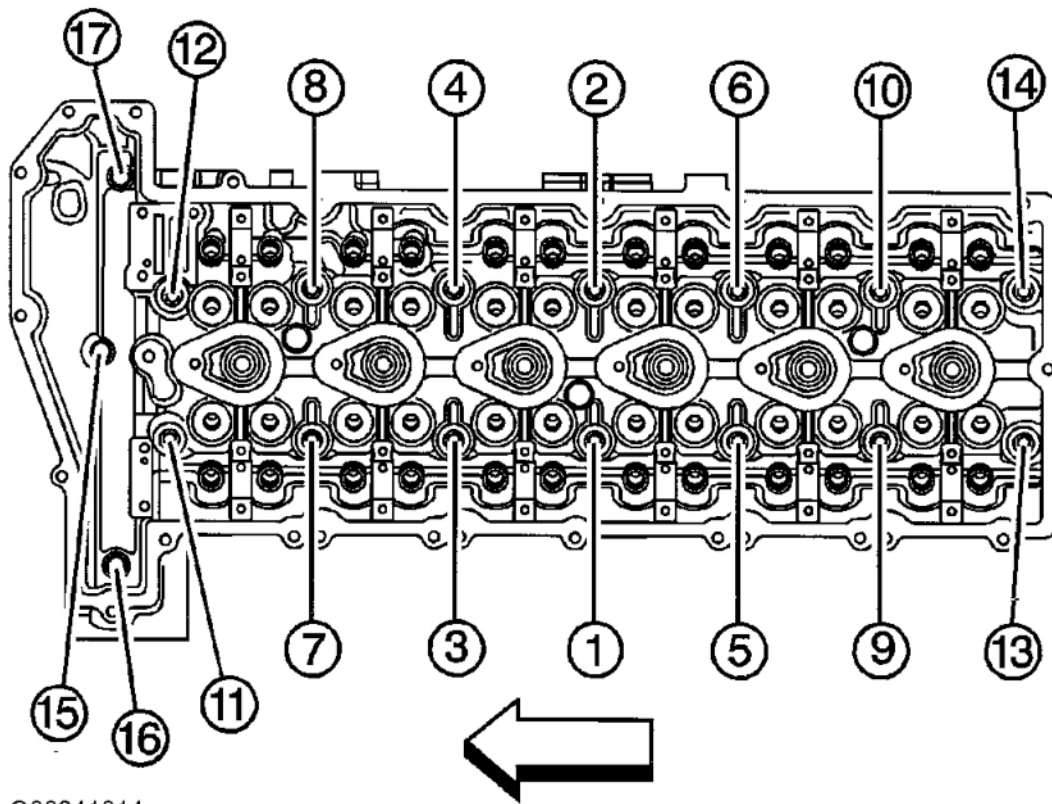
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A/C Line Bracket Nut at Oil Level Indicator Tube	61 (7)
A/C Line Bracket Bolt at Engine Lift Bracket	89 (10)
Camshaft Cap Bolts	106 (12)
Camshaft Cover Bolt ⁽¹⁾	89 (10)
Crankshaft Rear Housing Bolt	89 (10)
Cylinder Head Access Hole Plug (Plastic)	44 (5)
Cylinder Head End Bolts (2 Short) ⁽²⁾	
First Pass	62 (7)
Final Pass	60 Degrees
Cylinder Head End Bolts (1 Long)	
First Pass	62 (7)
Final Pass	120 Degrees
Engine Front Cover Bolt	89 (10)
Engine Front Cover Spacer Bolt	89 (10)
Generator Battery Lead Nut	80 (9)
Intake Manifold Bolt	89 (10)
Oil Level Indicator Tube Stud	89 (10)
Oil Pan Bolt (Ends)	89 (10)
Oil Pan Stud	97 (11)
Oil Pump Cover Bolt	89 (10)
Timing Chain Tensioner Guide Bolt	124 (14)
Timing Chain Top Guide Bolt	89 (10)
Transmission Fluid Tube to Air Adapter Nut	89 (10)
(1) Tighten in sequence. See Fig. 222 .	
(2) Tighten in sequence. See Fig. 223 .	



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Fig. 222: Camshaft Main Bearing Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.



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Fig. 223: Cylinder Head Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.