

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

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Application	Specifications	
	Metric	English
A/C Compressor and Condenser at the Accumulator	48 N.m	36 lb ft
A/C Compressor and Condenser Hose Bolt at the Compressor	33 N.m	24 lb ft
A/C Compressor and Condenser Hose Nut	16 N.m	12 lb ft
Auto Left Side Trans Support to Engine Bolts	28 N.m	21 lb ft
Auto Left Side Trans Support to Transmission Bolt	8.5 N.m	75 lb in
Auto Left Side Trans Support Nut	80 N.m	59 lb ft
Auto Right Side Trans Support to Engine Bolts	50 N.m	75 lb in
Auto Right Side Trans Support to Trans Bolt	8.5 N.m	75 lb in
Battery Positive Cable Harness Nut	25 N.m	18 lb ft
Camshaft Sprocket Boll	100 N.m + 90 degrees	74 lb ft + 90 degrees
Camshaft Thrust Plate Bolt	15 N.m	11 lb ft
Coolant Pump Bolt	15 N.m + 80 degrees	11 lb ft + 80 degrees
Coolant Pump Pulley Bolt	13 N.m	116 lb in
Crankshaft Balancer Bolt	150 N.m + 114 degrees	111 lb ft + 114 degrees
Crankshaft Position Sensor Stud	30 N.m	22 lb ft
Crankshaft Rear Oil Seal Housing Bolt	15 N.m + 50 degrees	11 lb ft + 50 degrees
Cylinder Head Bolt	50 N.m + 120 degrees	37 lb ft + 120 degrees
Drive Belt Idler Pulley Bolt	50 N.m	37 lb ft
Drive Belt Tensioner Bolt	50 N.m	37 lb ft
EGR Valve Adapter Bolt	25 N.m	18 lb ft
EGR Valve Adapter Nut	50 N.m	37 lb ft
EGR Valve Nut	29 N.m	21 lb ft
EGR Valve Outlet Pipe Bolt/Nut	30 N.m	22 lb ft

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(Except Upper Intake Manifold)		
Engine Coolant Temperature Sensor	25 N.m	18 lb ft
Engine Flywheel Bolt	15 N.m + 50 degrees	11 lb ft + 50 degrees
Engine Front Cover Bolt/Stud	20 N.m + 40 degrees	15 lb ft + 40 degrees
Engine Ground Strap Bolt	25 N.m	18 lb ft
Engine Harness Clamp Bolt	6 N.m	53 lb in
Engine Lift Bracket Bolt/Nut/Stud	30 N.m	22 lb ft
Engine Mount Bolts	58 N.m	43 lb ft
Engine Mount Bracket Bolt	102 N.m	75 lb ft
Engine Mount Strut Bracket Stud at Engine, Left	87 N.m	64 lb ft
Engine Mount Strut Bracket Bolt at Engine, Right	50 N.m	37 lb ft
Engine Mount Through Bolt Nut	80 N.m	59 lb ft
Engine Wiring Harness Ground Bolt	25 N.m	18 lb ft
EVAP Canister Purge Valve Bolts	10 N.m	89 lb in
Flywheel Housing Inspection Cover Bolts	9 N.m	80 lb in
Fuel Pipe Heat Shield Nut	5 N.m	44 lb in
ICM Assembly Bolt	50 N.m	37 lb ft
Lower Intake Manifold Bolt	15 N.m	11 lb ft
Manifold Vacuum Source Screws	10 N.m	89 lb in
Manual Transmission to Engine Bolts	95 N.m	70 lb ft
Manual Transmission Support Brace Bolts to Transmission	50 N.m	37 lb ft
Manual Transmission Support Brace Bolts to Engine	28 N.m	21 lb ft
Oil Filter Adapter Bolt	15 N.m + 50 degrees	11 lb ft + 50 degrees
Oil Level Indicator Tube Nut	19 N.m	14 lb ft
Oil Pan Bolt	14 N.m	124 lb in
Oil Pan Drain Plug	30 N.m	22 lb ft
Oil Pressure Sensor	16 N.m	12 lb ft
Oil Pump Cover Screw	11 N.m	98 lb in
Oil Pump Screen Bolt	15 N.m	11 lb ft
Positive Crankcase Ventilation (PCV) Valve Cover Bolt	12 N.m	106 lb in
Right Side Transmission Support Nut	80 N.m	59 lb ft
Shock Absorber Bolts	65 N.m	48 lb ft
Throttle Body Bolt/Nut	10 N.m	89 lb in

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Timing Chain Dampener Bolt	22 N.m	16 lb ft
Transmission Oil Cooler Pipe Bracket Bolt	17 N.m	13 lb ft
Transmission Support Bolts	57 N.m	42 lb ft
Upper Ball Joint Nuts	53 N.m	39 lb ft
Upper Intake Manifold Bolts (Long)	30 N.m	22 lb ft
Upper Intake Manifold Bolts (Short)	15 N.m	11 lb ft
Valve Lifter Guide Retainer Bolt	30 N.m	22 lb ft
Valve Rocker Arm Bolt	15 N.m + 90 degrees	11 lb ft + 90 degrees
Valve Rocker Arm Cover Bolt	10 N.m	89 lb in
Wiring Harness Ground Bolt to Front Rail	12 N.m	106 lb in

ENGINE MECHANICAL SPECIFICATIONS**Engine Mechanical Specifications Table**

Application	Specification	
	Metric	English
General Data		
Engine Type	V6	
Regular Production Option (RPO)	L36	
Displacement	3.8 Liter	231 CID
Bore	96.52 mm	3.8 in
Stroke	86.36 mm	3.4 in
Compression Ratio	9.4:1	
Firing Order	1-6-5-4-3-2	
Lubrication System		
Oil Filter Type	PF47	
Oil Type (Recommended)	5W-30	
Oil Capacity (With Filter Change)	4.25 Liters	4.5 Quarts
Oil Capacity (Without Filter Change)	3.75 Liters	4.0 Quarts
Oil Pressure @ Normal Operating Temperature (Using 10W-30 Oil)		
At 1850 RPM (Revolutions Per Minute)	414 kPa	60 psig

SEALERS, ADHESIVES, AND LUBRICANTS

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Application	Type of Material	GM Part Number	
		United States	Canada
Crankshaft Position Sensor Stud Threads	Threadlock	12345382	10953489
Engine Front Cover Bolt Threads	Sealant	12346004	10953480
Intake Manifold Bolt Threads – Lower	Threadlock	12345493	10953488
Intake Manifold to Engine Block Mating Surfaces	Sealant	12345286	10953472
Valve Rocker Arm Bolt Threads	Threadlock	12345493	10953488
Valve Rocker Arm Cover Bolt Threads	Threadlock	12345382	10953489
Valvetrain Component Prelube	Lubricant	12345501	992704

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Fig. 1: Identifying 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** , **ENGINE COMPONENT DESCRIPTION** , **DRIVE BELT SYSTEM DESCRIPTION** , **LUBRICATION DESCRIPTION** , and **NEW PRODUCT INFORMATION** in Engine Mechanical. 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** , **ENGINE COMPONENT DESCRIPTION** , **DRIVE BELT SYSTEM DESCRIPTION** , **LUBRICATION DESCRIPTION** , and **NEW PRODUCT INFORMATION** in Engine Mechanical.

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**
- **Drive Belt Chirping Diagnosis**
- **Drive Belt Squeal Diagnosis**
- **Drive Belt Whine Diagnosis**
- **Drive Belt Rumbling Diagnosis**
- **Drive Belt Vibration Diagnosis**
- **Drive Belt Falls Off Diagnosis**
- **Drive Belt Excessive Wear Diagnosis**
- **Drive Belt Tensioner 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. Refer to <i>Drive Belt Replacement</i> .
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout 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. Refer to <i>Engine Flywheel Replacement</i> or <i>Crankshaft Balancer Replacement</i> .
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 heads or throttle body.	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
Worn or loose 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 or bent pushrods	Replace the pushrods.
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 lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump-up and loss of compression.	• 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 gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to - Engine Cooling Mechanical. Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. • Inspect the cylinder heads, engine block, and/or head gaskets. • 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.

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Fig. 2: Base Engine Misfire without Internal Engine Noises
Courtesy of GENERAL MOTORS CORP.

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. Refer to <i>Drive Belt Replacement</i> .
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. Refer to <i>Engine Flywheel Replacement</i> or <i>Crankshaft Balancer Replacement</i> .
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</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. 3: Base Engine Misfire With Abnormal Internal Lower Engine Noises
Courtesy of GENERAL MOTORS CORP.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Cause	Correction
Worn or loose 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. Refer to <i>Valve Rocker Arm And Push Rod Replacement</i> .
Worn or bent pushrods	Replace the pushrods. Refer to <i>Valve Rocker Arm And Push Rod Replacement</i> .
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. Refer to <i>Timing Chain And Sprockets Replacement</i> .
Worn camshaft lobes	Replace the camshaft and valve lifters. Refer to <i>Camshaft Replacement And/Or Valve Lifter Replacement</i> .
Sticking lifters	Replace as required.

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Fig. 4: Base Engine Misfire With Abnormal Valve Train Noise
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BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

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Cause	Correction
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages. Refer to <i>Engine Cooling Mechanical</i> .	• Inspect for spark plugs saturated by coolant. • Perform a cylinder leak down test.
Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder heads 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. 5: Base Engine Misfire With Coolant Consumption
Courtesy of GENERAL MOTORS CORP.

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. 6: 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.
High valve lifter leak down rate	Replace the lifters as required.

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Fig. 7: 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 <i>Oil Pressure Diagnosis and Testing</i>. • Repair or replace as required.
Loose and/or worn valve rocker arm attachments	• Inspect the valve rocker arm stud, nut, or bolt. • Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.
Bent or damaged push rod	Inspect the following components, and replace as required: • The valve rocker arm • The valve push rod • The valve lifter
Improper lubrication to the valve rocker arms	Inspect the following components, and repair or replace as required: • The valve rocker arm • The valve push rod • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn and/or damaged valve rotators	Replace the valve rotators as required.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched or broken timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn timing chain tensioner, if applicable	Replace the timing chain tensioners as required.

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Fig. 8: Upper Engine Noise, Regardless Of Engine Speed (1 Of 2)
Courtesy of GENERAL MOTORS CORP.

Cause	Correction
Worn engine camshaft lobes	• Inspect the engine camshaft lobes. • Replace the camshaft and valve lifters as required.
Damaged, broken, or dirty, balance shaft sprocket teeth, if applicable	Inspect the following components, and repair as required: • The balance shaft gear • The camshaft gear • The balance shaft rear bushing
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 (2 Of 2)
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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 Knock Sensor System. Refer to <i>Knock Sensor (KS) System Description</i> .
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.
Damaged oil pan, contacting the oil pump screen An oil pan that has been damaged may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	• Inspect the oil pan. • Inspect the oil pump screen • Repair or replace as required.
Oil pump screen loose, damaged or restricted	• Inspect the oil pump screen. • 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 Knock Sensor System. Refer to <i>Knock Sensor (KS) System Description</i> .
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.
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. 11: Engine Noise Under Load
Courtesy of GENERAL MOTORS CORP.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

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Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belt or belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket or gaskets. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or timing chain gears	1. Inspect timing chain and gears. 2. Repair as required.
Seized balance shaft bearing if equipped	1. Inspect balance shaft bearings. 2. Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearings. 2. Repair as required.
Bent or broken connecting rod	1. Inspect connecting rods. 2. Repair as required.
Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

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Fig. 12: Engine Will Not Crank - Crankshaft Will Not Rotate
Courtesy of GENERAL MOTORS CORP.

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.

1. Run the engine until it reaches normal operating temperature. The battery must be at or near full charge.
2. Turn the engine OFF.

Important: Remove the Powertrain Control Module (PCM) and the ignition fuses from the I/P fuse block. Refer to **FUSES & CIRCUIT BREAKERS** .

3. Disable the ignition.
4. Disable the fuel systems.
5. Remove the spark plugs from all the cylinders.
6. Remove the air duct from the throttle body.
7. Block the throttle plate in the open position.

8. Measure the engine compression, using the following procedure:
 - 8.1. Firmly install J 38722 to the spark plug hole.
 - 8.2. Have an assistant crank the engine through at least four compression strokes in the testing cylinder.
 - 8.3. Check and record the readings on J 38722 at each stroke.
 - 8.4. Disconnect J 38722.
 - 8.5. Repeat the compression test for each cylinder.

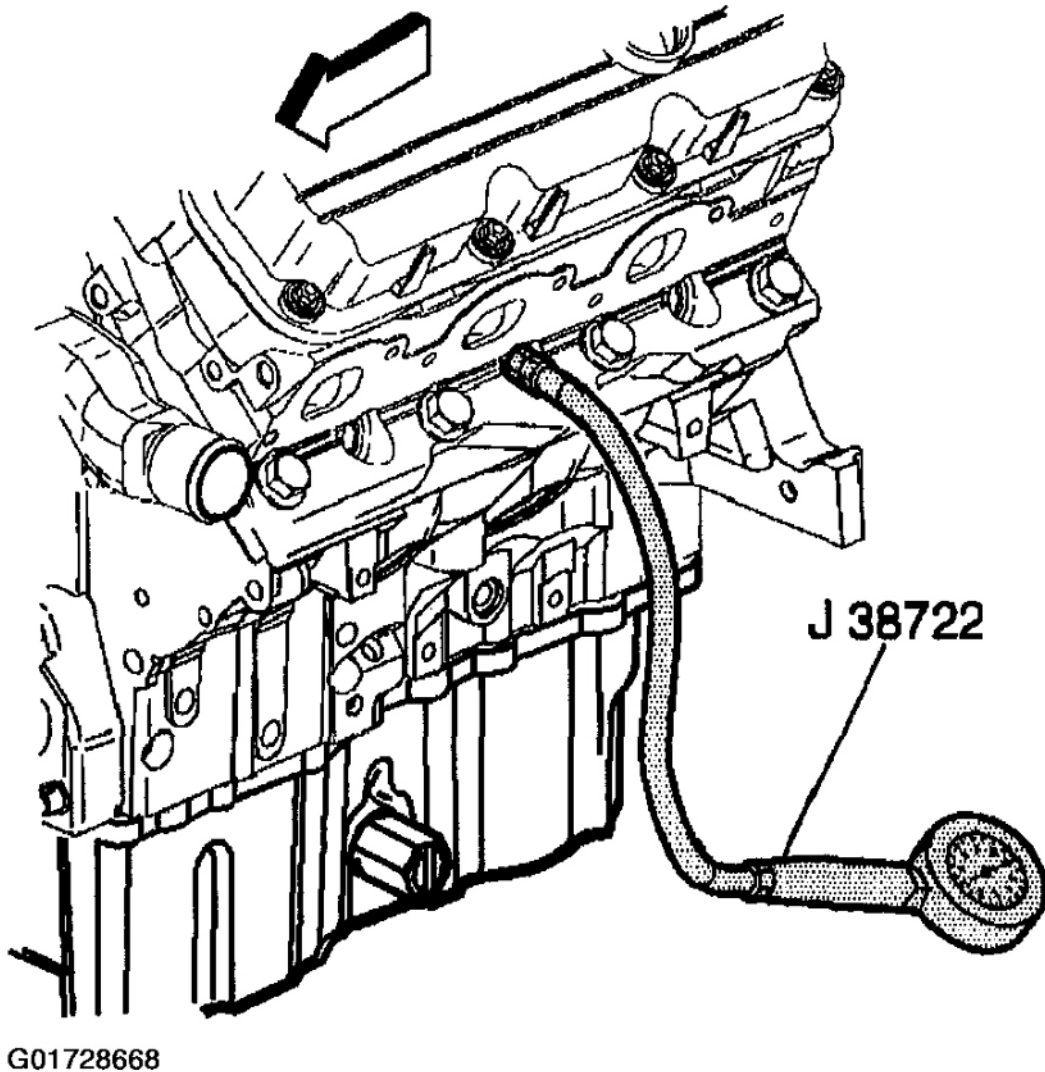


Fig. 13: Measuring The Engine Compression
Courtesy of GENERAL MOTORS CORP.

9. Record the compression readings from all of the cylinders.
 - The lowest reading should not be less than 70 percent of the highest reading.
 - No cylinder reading should be less than 689 kPa (100 psi).
10. 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.
11. Remove the block from the throttle plate.
12. Install the air duct to the throttle body.
13. Install the spark plugs.
14. Install the Powertrain Control Module (PCM) fuse.
15. Install the ignition fuse to the I/P fuse block.

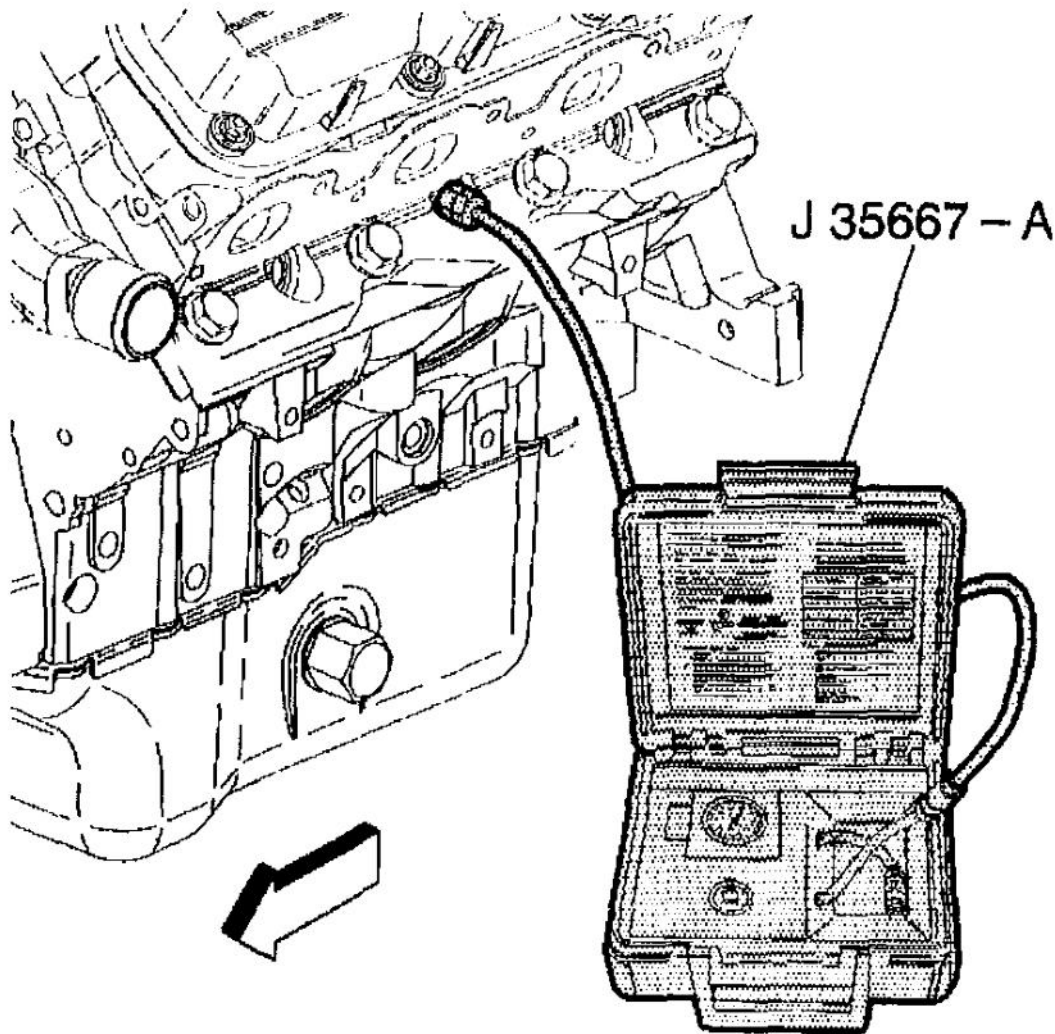
CYLINDER LEAKAGE TEST

Tools Required

J 35667-A Cylinder Head Leakdown Tester

With the use of air pressure, a cylinder leakage test will aid in the diagnosis. The cylinder leakage test may be used in conjunction with the engine compression test, to isolate the cause of leaking cylinders.

1. Remove the battery ground - negative cable.
2. Remove the spark plugs.
3. Install the J 35667-A.



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Fig. 14: Installing J 35667-A
Courtesy of GENERAL MOTORS CORP.

4. Measure each cylinder on the compression stroke, with both valves closed.

Important: It may be necessary to hold the crankshaft balancer bolt, to prevent piston movement.

5. Apply air pressure, using the J 35667-A. Refer to the manufacturer's instructions.
6. Record the cylinder leakage readings for each cylinder.

Important:

- Normal cylinder leakage is from 12-18 percent.
 - Make a note of any cylinder with more leakage than the other cylinders.
 - Any cylinder with 30 percent leakage or more requires service.
7. Inspect the four primary areas, to properly diagnose a leaking cylinder.
 8. If air is heard from the intake or exhaust system, perform the following procedure:
 - Remove the valve rocker arm cover of the suspect cylinder head.
 - Ensure that both valves are closed.
 - Inspect the cylinder head for a broken valve spring.
 - Remove the suspect cylinder head and inspect. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** .
 9. If air is heard from the crankcase system at the crankcase, oil filler tube, perform the following procedure:
 - Remove the piston from the suspect cylinder.
 - Inspect the piston and connecting rod assembly. Refer to **PISTON, CONNECTING ROD, AND BEARINGS CLEANING** .
 - Inspect the engine block. Refer to **ENGINE BLOCK CLEANING AND INSPECTION** .
 10. If bubbles are found in the radiator, perform the following procedure:
 - Remove both cylinder heads and inspect. Refer to **CYLINDER HEAD CLEANING AND INSPECTION** .
 - Inspect the engine block. Refer to **ENGINE BLOCK CLEANING AND INSPECTION** .
 11. Remove the J 35667-A.
 12. Install the spark plugs.
 13. Install the battery ground - negative cable.

OIL CONSUMPTION DIAGNOSIS

An engine that has excessive oil consumption uses 0.9 L (1 qt) of oil, or more, within 3 200 km (2,000 mi). The following list indicates the conditions and corrections of excessive oil consumption:

- An improperly read oil level indicator - dipstick
 - Inspect the oil level while the vehicle is parked on a level surface.
 - Allow adequate drain-down time.
- Improper oil viscosity
 - Use the recommended SAE viscosity for prevailing temperatures.
 - Refer to **SPECIFICATIONS** for the proper oil viscosity specifications.
- Continuous high-speed driving
- Severe hauling, such as a trailer. This causes decreased oil mileage.
- A malfunctioning crankcase ventilation system
- External oil leaks
 - Tighten the bolts, as needed.
 - Replace the gaskets and seals, as needed.

- Worn or omitted valve guides and/or valve stem seals
 - Ream the guides.
 - Install oversized service valves and/or new valve stem seals.
- Broken or worn piston rings
- Improperly installed or unseated piston rings
- Improperly installed or improperly fitted piston
- Plugged cylinder head gasket oil drain holes
- Damaged intake gaskets

OIL PRESSURE DIAGNOSIS AND TESTING

Low or No Oil Pressure

The following can cause low or no oil pressure:

- Low oil level - fill to the full mark on the oil level indicator.
- Slow idle speed
- Incorrect or malfunctioning oil pressure switch - replace the oil pressure switch.
- Incorrect or malfunctioning oil pressure gage - replace the oil pressure gage.
- Improper oil viscosity or diluted oil
 - Install oil of proper viscosity for expected temperature.
 - Install new oil if it is diluted.
- The oil pump is worn or dirty - clean or replace the oil pump.
- The oil filter is plugged - replace the oil filter.
- The oil pickup screen is loose or plugged - replace the oil pickup screen.
- A hole in the oil pickup tube - replace the oil pickup tube.
- Excessive bearing clearance - replace the bearings.
- Cracked, porous, or plugged oil galleries - repair or replace the engine block.
- The gallery plugs are missing or improperly installed - install or repair as necessary.
- The pressure regulator valve is stuck.
 - Check the pressure regulator valve for sticking in the bore.
 - Check the bore for scoring and burrs.
- The camshaft is worn or poorly machined - replace the camshaft.
- Worn valve guides - repair as needed.

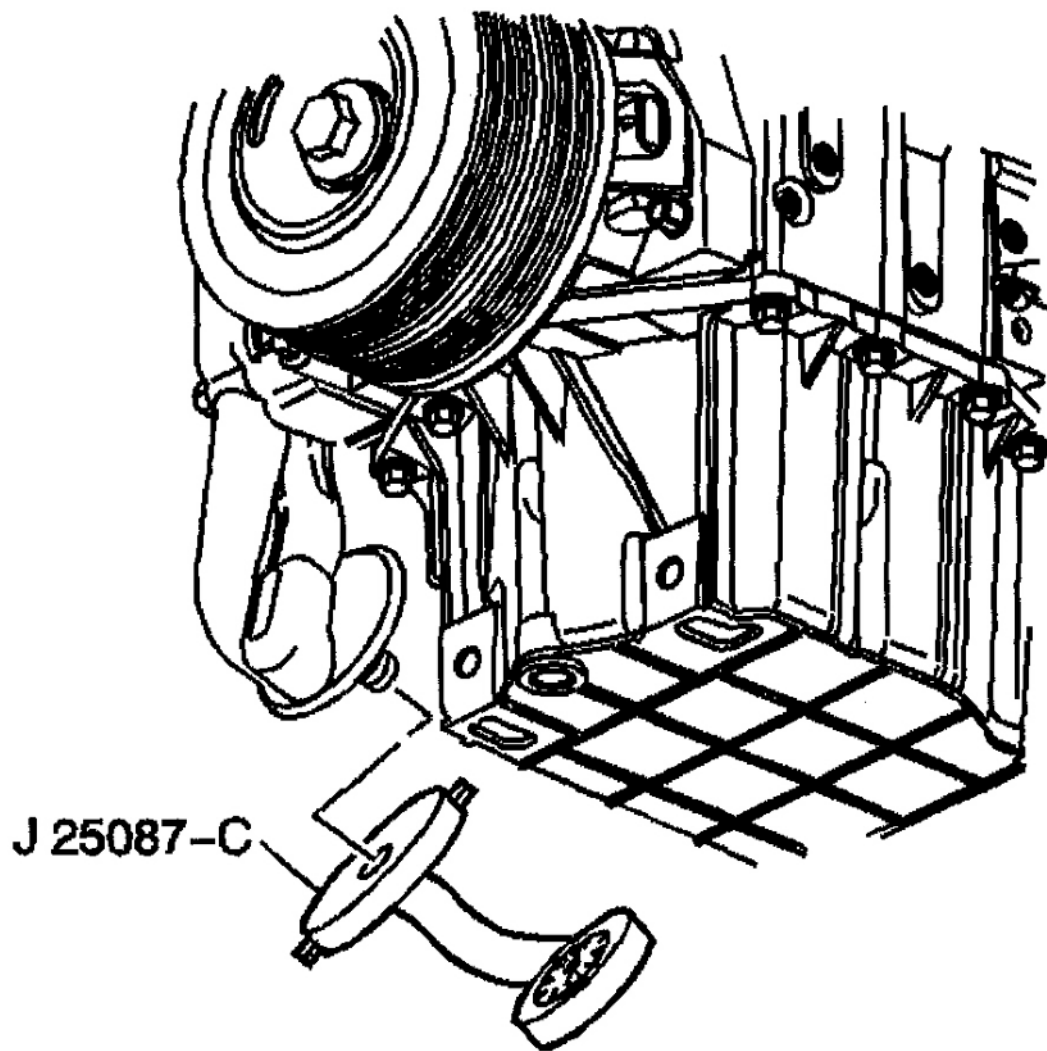
Oil Pressure Testing

Tools Required

J 25087-C Oil Pressure Tester

If the vehicle has low oil pressure perform the following tests.

1. Check the oil level.
2. Raise the vehicle and remove the oil filter.
3. Assemble the plunger valve in the large hole of J 25087-C base and the hose in the small hole of J 25087-C base. Connect the gage to the end of the hose.
4. Insert the flat side of the rubber plug in the bypass valve without depressing the bypass valve itself.
5. Install J 25087-C on the filter mounting pad.



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Fig. 15: Installing J 25087-C
Courtesy of GENERAL MOTORS CORP.

6. Start the engine and check the overall oil pressure, the oil pressure switch, and for noisy lifters. The engine should be at operating temperature before checking the oil pressure. The oil pressure should be approximately 414 kPa (60 psi) at 1850 RPM using 10W30 engine oil.
7. If adequate oil pressure is indicated, check the oil pressure switch.
8. If a low reading is indicated, press the valve on the tester base to isolate the oil pump and/or its components from the lubricating system. An adequate reading at this time indicates a good pump and the previous low pressure was due to worn bearings, etc. A low reading while pressing the valve would indicate a faulty pump.

OIL LEAK DIAGNOSIS

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

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 Step 2	System OK
2	Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 3
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 Step 10	Go to Step 4
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 Step 10	Go to Step 5
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 Step 10	Go to Step 6
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 Step 10	Go to Step 7

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Fig. 16: Oil Leak Diagnosis (1 Of 2)

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2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

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 High Intensity Black Light Kit 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. 17: Oil Leak Diagnosis (2 Of 2)
 Courtesy of GENERAL MOTORS CORP.

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Concern	Action
External oil leak	Inspect for any of the following conditions: • Plugged positive crankcase ventilation (PCV) valve. • Damaged or incorrectly installed PCV valve. • Excessive crankcase pressure.
Rough Idle, Stalling, or Low idle speed	Inspect for any of the following conditions: • Plugged PCV valve. • Leaking (damaged) PCV valve.
High idle speed	Inspect for a leaking (damaged) PCV valve.
Sludge in the engine	Inspect for a plugged PCV valve

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Fig. 18: Crankcase Ventilation System Inspection/Diagnosis
Courtesy of GENERAL MOTORS CORP.

DRIVE BELT CHIRPING DIAGNOSIS

Diagnostic Aids

The symptom may be intermittent due to moisture on the drive belt or the pulleys. It may be necessary to spray a small amount of water on the drive belt in order to duplicate the customers concern. If spraying water on the drive belt 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 item(s) on 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 verifies 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. Remove the drive belt and operate the engine for a brief period, verifying that the chirping noise is related to the drive belt. With the drive belt(s) removed the water pump may not operate and the engine may overheat. DTCs may set when the engine is operated with the drive belt removed.
4. Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills 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 may be bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to that accessory drive component for the proper installation procedure for that pulley.
10. Inspection 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 dents 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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2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

Step	Action	Yes	No
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. • Chirping may occur on cold damp startup conditions and will subside once the vehicle reaches normal operating temperature.			
1	Did you review the Symptoms - Drive Belt diagnostic information 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. 2. Operate the engine for no longer than 30 to 40 seconds. Does the chirping noise still exist?	Go to Engine Noise on Start-Up, but Only Lasting a Few Seconds or Upper Engine Noise, Regardless of Engine Speed or Lower Engine Noise, Regardless of Engine Speed	Go to Step 4
4	Inspect for severe belt 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. Were the drive belt pulleys cleaned?	Go to Step 15	Go to Step 6
6	Inspect for a misalignment of the pulleys. Are any of the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace and/or repair any misaligned pulleys. Were the misaligned pulleys repaired and/or replaced?	Go to Step 15	Go to Step 8
8	Inspect for bent and/or cracked brackets. Were there any bent and/or cracked brackets?	Go to Step 9	Go to Step 10
9	Replace any bent and/or cracked brackets. Refer to <i>Drive Belt Tensioner Replacement</i> . Were the bent and/or cracked brackets replaced?	Go to Step 15	Go to Step 10
10	Inspect for improper, missing and/or loose fasteners. Were there any improper, missing and/or loose fasteners?	Go to Step 11	Go to Step 12
11	1. Replace any improper and/or missing fasteners. 2. Tighten any loose 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. Was a bent pulley found?	Go to Step 13	Go to Step 14
13	Replace the bent pulley. Was the bent pulley replaced?	Go to Step 15	Go to Step 14
14	Replace the drive belt. Refer to <i>Drive Belt Replacement</i> . Was the drive belt replaced?	Go to Step 15	Go to Diagnostic Aids
15	Run the engine in order to verify the repair. Does the drive belt still chirp?	Go to Step 3	System OK

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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 on the vehicle

may cause the squeal noise.

If the noise is intermittent, verify that the accessory drive components are not the cause, by varying their loads making sure they are operating to their maximum capacity. An overcharged A/C system, a power steering system restriction, or incorrect fluid, or a failing generator 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. Remove the drive belt and operate the engine for a brief period, this will verify that the squeal noise is the drive belt or an accessory drive component. With the drive belt removed the water pump may not operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belt removed.
4. This test is to verify that an accessory drive component does not have a seized bearing. With the drive belt removed test the bearings in the accessory drive components for smooth operation. 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 belt squeal noise.
6. This test is to verify that the drive belt is not too long, which would prevent the drive belt tensioner from operating properly. Also if an incorrect length drive belt were 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 is bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned 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
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 Symptoms - Drive Belt diagnostic information and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Engine Mechanical
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. 2. Operate the engine for no longer than 30 to 40 seconds. Does the squeal noise still exist?	Go to Engine Noise on Start-Up, but Only Lasting a Few Seconds or Upper Engine Noise, Regardless of Engine Speed or Lower Engine Noise, Regardless of Engine Speed	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	Inspect the drive belt tensioner for proper operation. Refer to <i>Drive Belt Tensioner Diagnosis</i> . Did you find and correct the condition?	Go to Step 9	Go to Step 6
6	Check 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 Diagnostic Aids
9	Run the engine in order to verify the repair. Does the drive belt still squeal?	Go to Step 3	System OK

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

DRIVE BELT WHINE DIAGNOSIS

Diagnostic Aids

The drive belt will not cause the whine noise.

If the whine noise is intermittent, verify the accessory drive components are not the cause, by varying their loads making sure they are operating to their maximum capacity. An overcharged A/C system, a power steering system restriction or incorrect fluid, or a failing generator are suggested items to inspect.

Test Description

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

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3. This test is to verify that the noise is being caused by the drive belt or the accessory drive components. With the drive belt removed the water pump may not operate and the engine may overheat. Also DTCs may set when the engine is operated 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 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
DEFINITION: A high pitched continuous noise that may be caused by an accessory drive component failed bearing.			
1	Did you review the Symptoms - Drive Belt diagnostic information and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Engine Mechanical
2	Verify that there is a whine noise. Does the engine make the whine noise?	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the drive belt. 2. Operate the engine for no longer than 30 to 40 seconds. Does the whine noise still exist?	Go to Engine Noise on Start-Up, but Only Lasting a Few Seconds or Upper Engine Noise, Regardless of Engine Speed or Lower Engine Noise, Regardless of Engine Speed	Go to Step 4
4	Inspect for a failed accessory drive component bearing. Did you find and repair the condition?	Go to Step 5	Go to Diagnostic Aids
5	Run the engine in order to verify the repair. Does the drive belt still whine?	Go to Step 3	System OK

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

DRIVE BELT RUMBLING DIAGNOSIS

Diagnostic Aids

Vibration when the engine is operating may cause a body component or another part of the vehicle to produce rumbling noise.

The drive belt 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, and completing the diagnostic table, the noise is only heard when the drive belt is installed, there may be an accessory drive component failure. Varying the load on the accessory drive components may aid in identifying which accessory drive component is causing the rumbling noise.

Test Description

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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 is causing the rumbling noise. The 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. With the drive belt removed the water pump may not be operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belt removed.
4. Inspect the drive belt to ensure that the drive belt is not the cause of the noise. Small cracks across the ribs of the drive belt will not cause the rumbling noise. Belt separation is identified by the plies of the drive belt separating, this may be seen at the edge of the belt or 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.

Step	Action	Yes	No
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 Symptoms - Drive Belt diagnostic information 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. 2. Operate the engine for no longer than 30 to 40 seconds. Does the rumbling noise still exist?	Go to Engine Noise on Start-Up, but Only Lasting a Few Seconds or Upper Engine Noise, Regardless of Engine Speed or Lower Engine Noise, Regardless of Engine Speed	Go to Step 4
4	Inspect the drive belt 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	Run the engine in order to verify the repair. Does the drive belt still rumble?	Go to Diagnostic Aids	System OK

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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 may have an affect on engine vibration. An overcharged A/C system, a power steering system restriction, or incorrect fluid, or an extra load placed on the generator are some systems that should be inspected. 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 or accessory drive components may be causing the vibration. With the drive belt removed the water pump may not operate and the engine may overheat. Also DTCs may set when the engine is operated with the drive belt removed.
4. The drive belt may cause a vibration. With the drive belt removed inspect the condition of the drive belt.
6. Inspection 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 cooling fan is driven by the drive belt. Inspect the engine cooling fan for bent, twisted, loose, or cracked blades. Inspect the fan clutch for smooth operation. 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 smooth operation 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.

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Step	Action	Yes	No
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 Symptoms - Drive Belt diagnostic information 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. 2. Operate the engine for no longer than 30 to 40 seconds. Does the engine still make the vibration?	Go to Diagnostic Starting Point - Vibration Diagnosis and Correction	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	—
6	Inspect for improper, missing or loose fasteners. Did you find any of these conditions?	Go to Step 7	Go to Step 8
7	1. Tighten any loose fasteners. Refer to <i>Fastener Tightening Specifications</i> . 2. Replace improper or missing fasteners. Did you complete the repair?	Go to Step 11	—
8	Inspect for damaged fan blades or bent fan clutch shaft, if the fan is belt driven. Refer to <i>Cooling Fan Motor Replacement - Electric</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 (3.8L Engine)</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	Run the engine in order to verify the repair. Does the drive belt still vibrate?	Go to Step 3	System OK

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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 repeatedly falls off the drive belt pulleys, this may be caused by 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 that the accessory drive components operate properly.

If the drive belt is the incorrect length, the drive belt tensioner may not maintain 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 have occurred to the drive belt when the drive belt fell off the pulley. The drive belt may of been damaged in which case caused the drive belt to fall off the pulley. Inspect the drive 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 being bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.
5. Inspect the pulleys for dents, bends or other damage. Damage to the pulleys that would prevent the drive belt from seating properly in the pulley grooves. Damage would also prevent proper alignment of the drive belt pulley, when the smooth surface of the drive belt is required to drive the pulley.
6. Accessory drive component brackets that are bent or cracked will let the drive belt fall off.
7. Inspection of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing, loose, or the incorrect 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
DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys.			
1	Did you review the Symptoms - Drive Belt diagnostic information and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Engine Mechanical
2	Inspect for a damaged drive belt. Did you find the condition?	Go to Step 3	Go to Step 4
3	Install a new drive belt. Refer to <i>Drive Belt Replacement</i> . Does the drive belt continue to fall off?	Go to Step 4	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to Step 12	Go to Step 5
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to Step 12	Go to Step 6
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to Step 12	Go to Step 7
7	Inspect for improper, missing or loose fasteners. Did you find loose or missing fasteners?	Go to Step 8	Go to Step 9
8	1. Tighten any loose fasteners. Refer to <i>Fastener Tightening Specifications</i> . 2. Replace improper or missing fasteners. Does the drive belt continue to fall off?	Go to Step 9	System OK
9	Test the drive belt tensioner for operating correctly. Refer to <i>Drive Belt Tensioner Diagnosis</i> . Does the drive belt tensioner operate correctly?	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner. Refer to <i>Drive Belt Tensioner Replacement</i> . Does the drive belt continue to fall off?	Go to Step 11	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to Step 12	Go to Diagnostic Aids
12	Run the engine in order to verify the repair. Does the drive belt still fall off?	—	System OK

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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 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 to make a noise or to fall off the pulley(s).

Excessive misalignment of the drive belt pulleys will cause excessive wear and may also make the drive belt fall off the pulley.

Test Description

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

2. The inspection is to verify the drive belt(s) is correctly installed over all of the drive belt pulleys. Wear on the drive belt may be caused by mis-positioning the drive belt by one groove on a pulley.
3. The installation of a drive belt that is too wide or too 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 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 should not come in contact with an engine or a body component when snapping the throttle.

Step	Action	Yes	No
DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Symptoms - Drive Belt diagnostic information 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	Run the engine in order to verify the repair. Is there still excessive drive belt wear?	—	System OK

G01728680

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

DRIVE BELT TENSIONER DIAGNOSIS

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

Important: When the engine is operating, the belt tensioner arm will move. Do not replace the belt tensioner because of movement in the belt tensioner arm.

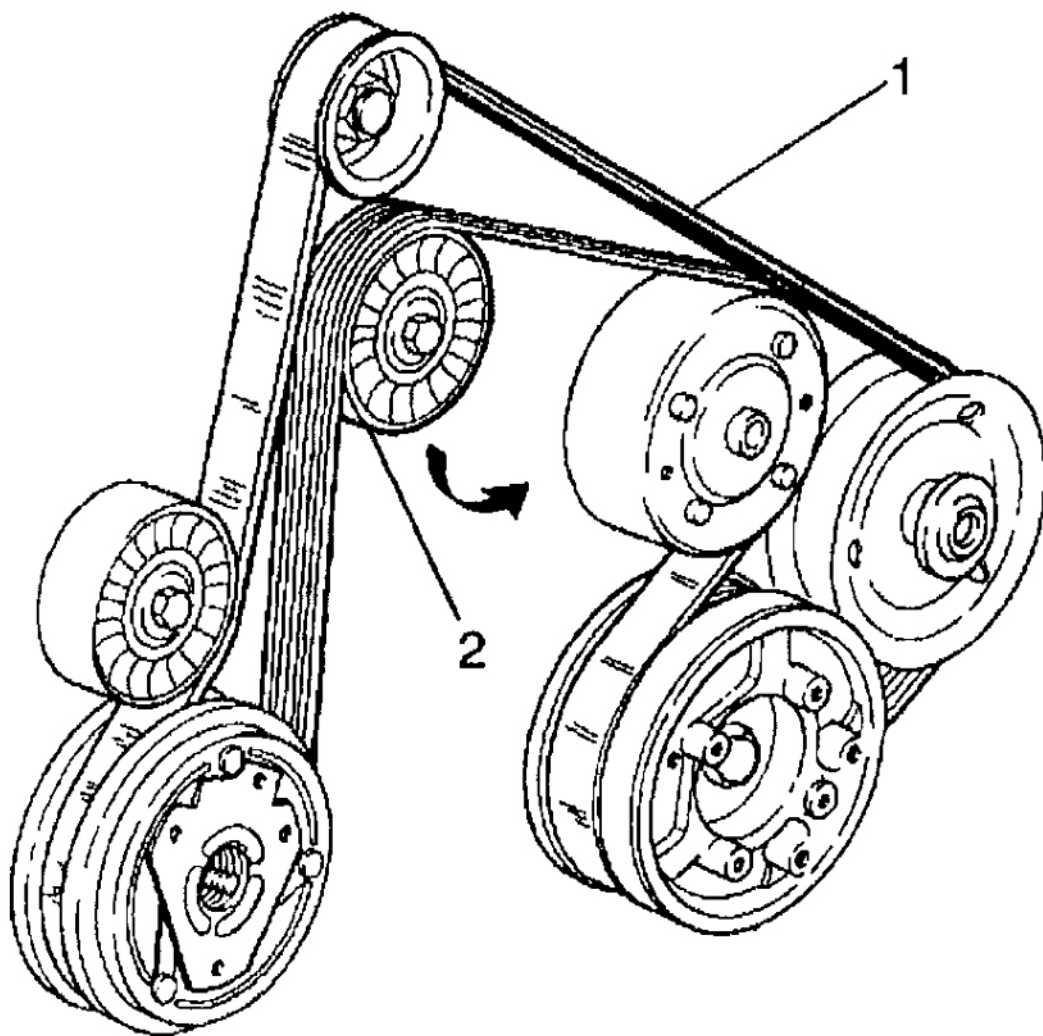
1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Position a hex-head socket on the drive belt tensioner arm and rotate the arm counterclockwise.
3. Move the drive belt tensioner through its full travel.
 - The movement should feel smooth
 - There should be no binding.
 - The tensioner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

REPAIR INSTRUCTIONS

DRIVE BELT REPLACEMENT

Removal Procedure

1. Position a hex-head socket on the belt tensioner pulley bolt.
2. Rotate the drive belt tensioner (2) clockwise to relieve the tension on the drive belt (1).



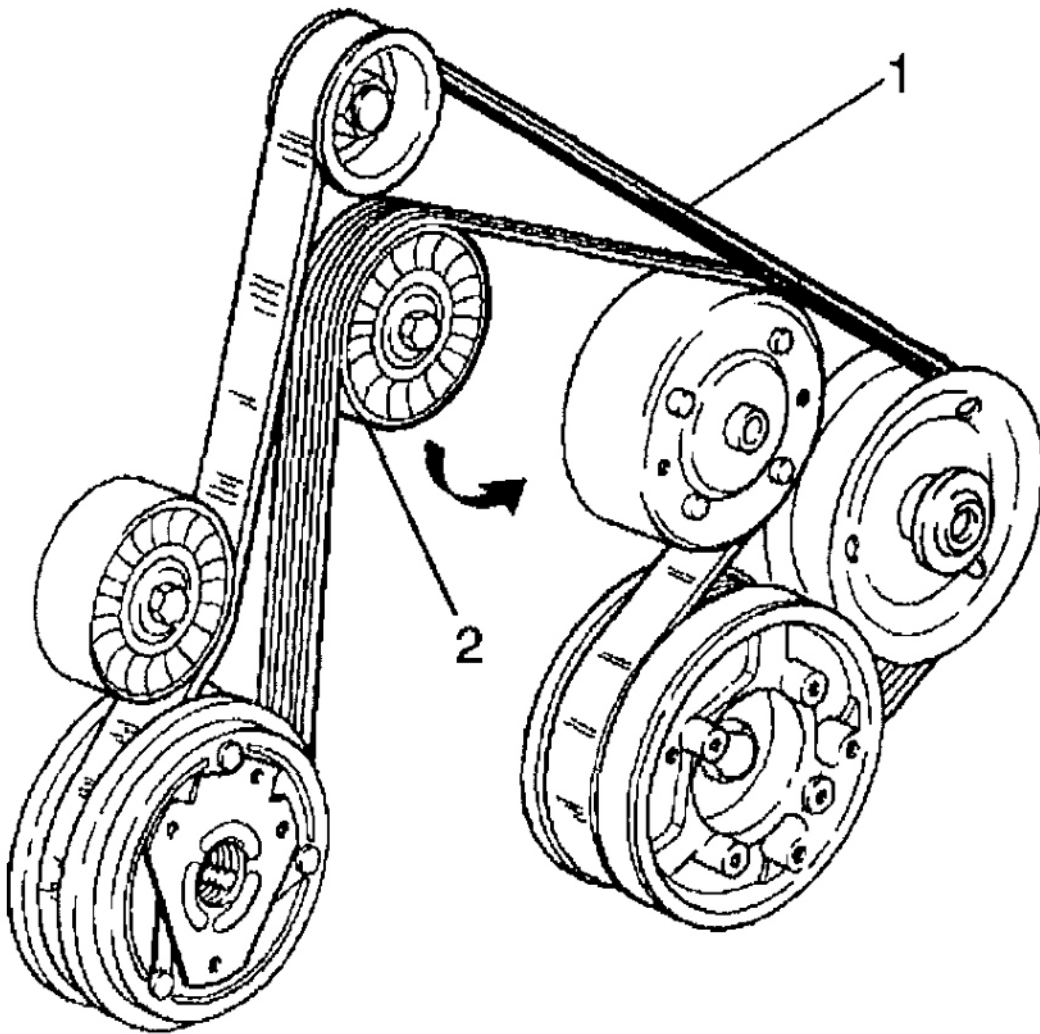
G01728681

Fig. 26: Drive Belt Routing
Courtesy of GENERAL MOTORS CORP.

3. Remove the drive belt (1) from the tensioner (2) and pulleys.
4. Clean and inspect the belt surfaces of all the pulleys.

Installation Procedure

1. Route the drive belt (1) around the pulleys.
2. Position a hex-head socket on the belt tensioner pulley bolt.
3. Rotate the drive belt tensioner (2) clockwise to relieve the tension.
4. Install the drive belt (1) onto the drive belt tensioner (2).
5. Inspect the drive belt (1) to ensure that the belt is properly aligned into the grooves of the pulleys.



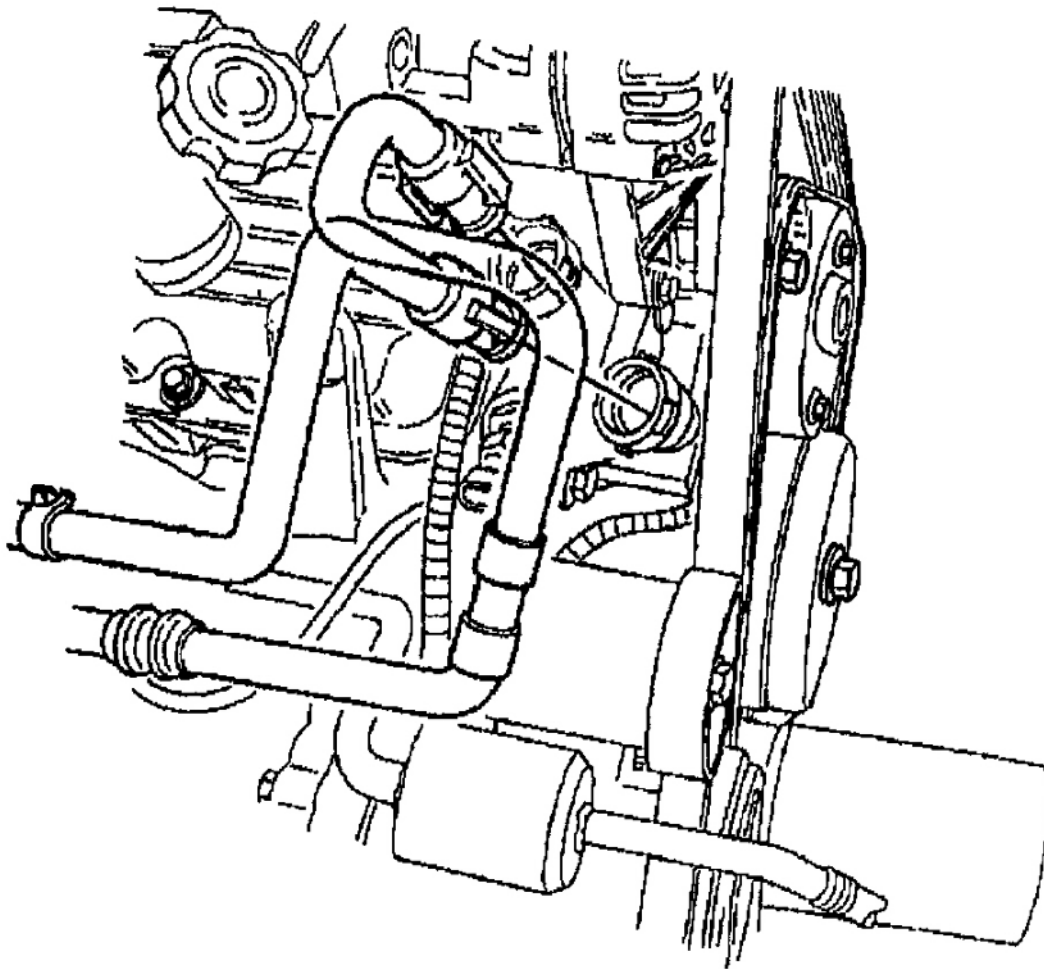
G01728682

Fig. 27: Installing Drive Belt

Courtesy of GENERAL MOTORS CORP.

DRIVE BELT TENSIONER REPLACEMENT**Removal Procedure**

1. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** in Engine Cooling.
2. Remove the drive belt. Refer to **Drive Belt Replacement**.
3. Remove the generator. Refer to **3.8L ENGINE** in Engine Electrical.
4. Remove the heater hoses from the drive belt tensioner.

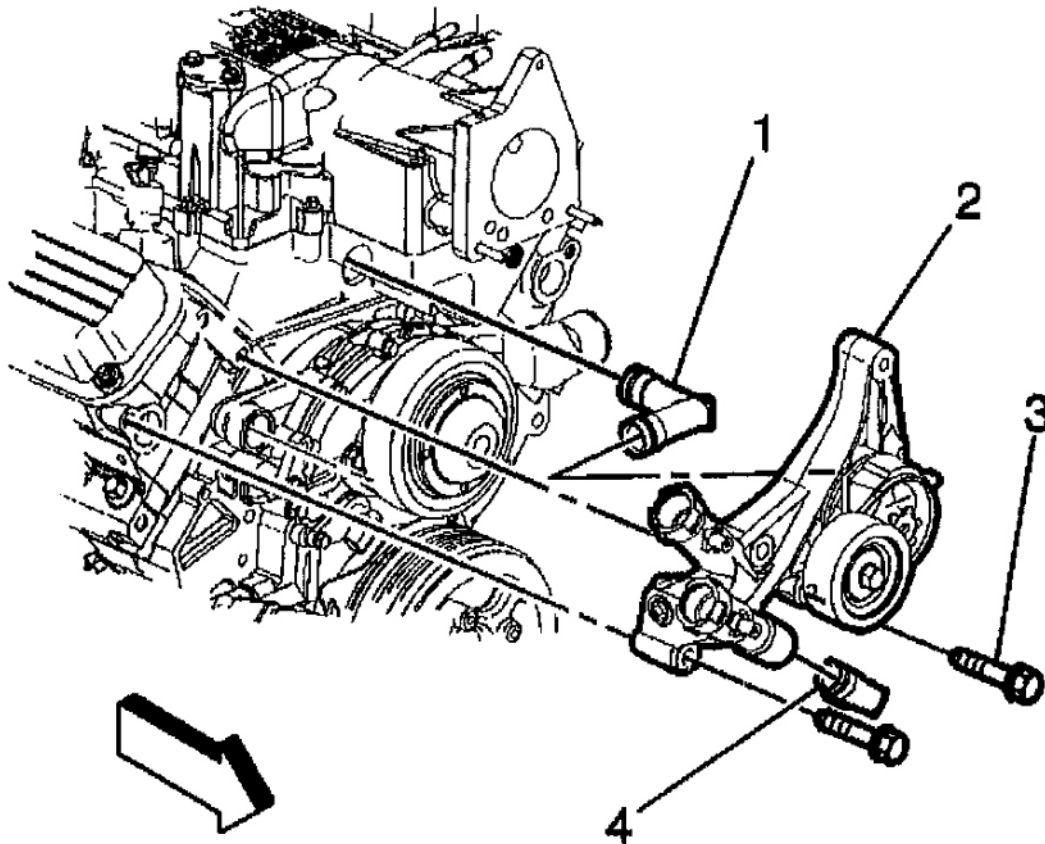


G01728683

Fig. 28: Removing Heater Hoses From The Drive Belt Tensioner

Courtesy of GENERAL MOTORS CORP.

5. Remove the drive belt tensioner bolts (3).



G01728684

Fig. 29: Removing Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

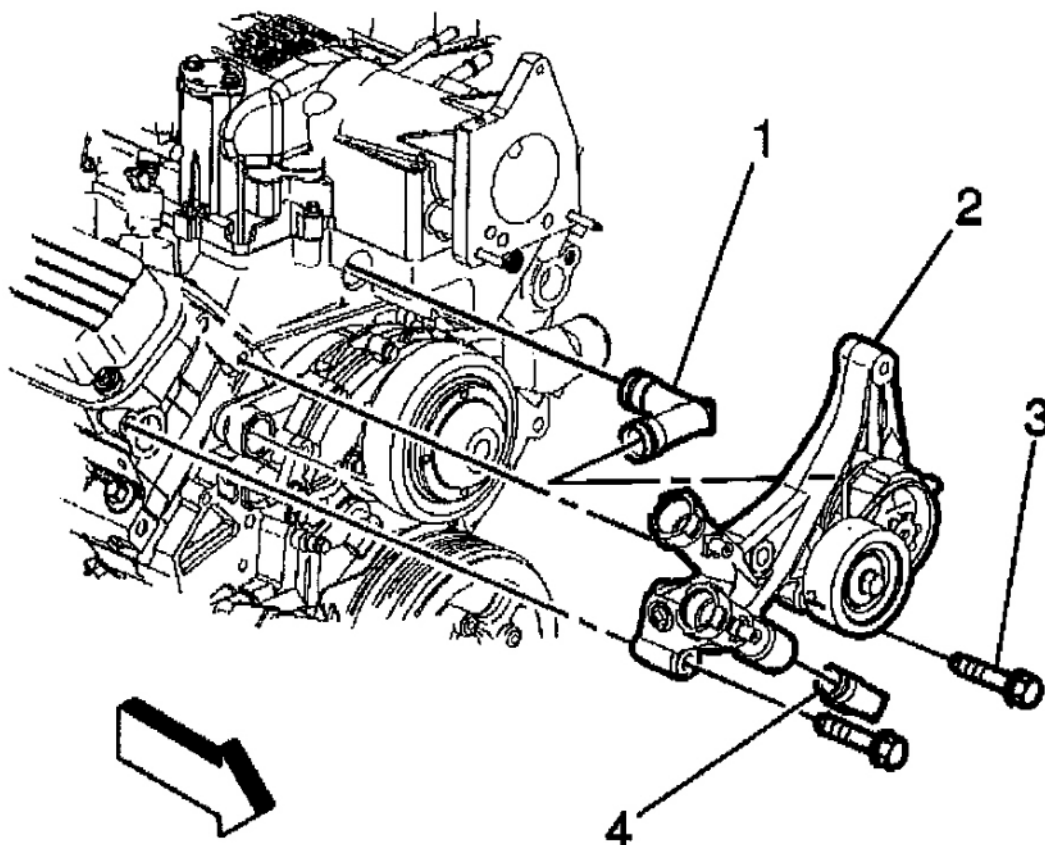
6. Remove the drive belt tensioner (2).
7. Remove the thermostat bypass pipes (1,4) from the tensioner (2), if necessary.

Installation Procedure

1. Install the thermostat bypass pipes (1,4) to the tensioner, if necessary.
2. Install the drive belt tensioner (2) to the engine.
3. Install the drive belt tensioner bolts (3).

Tighten

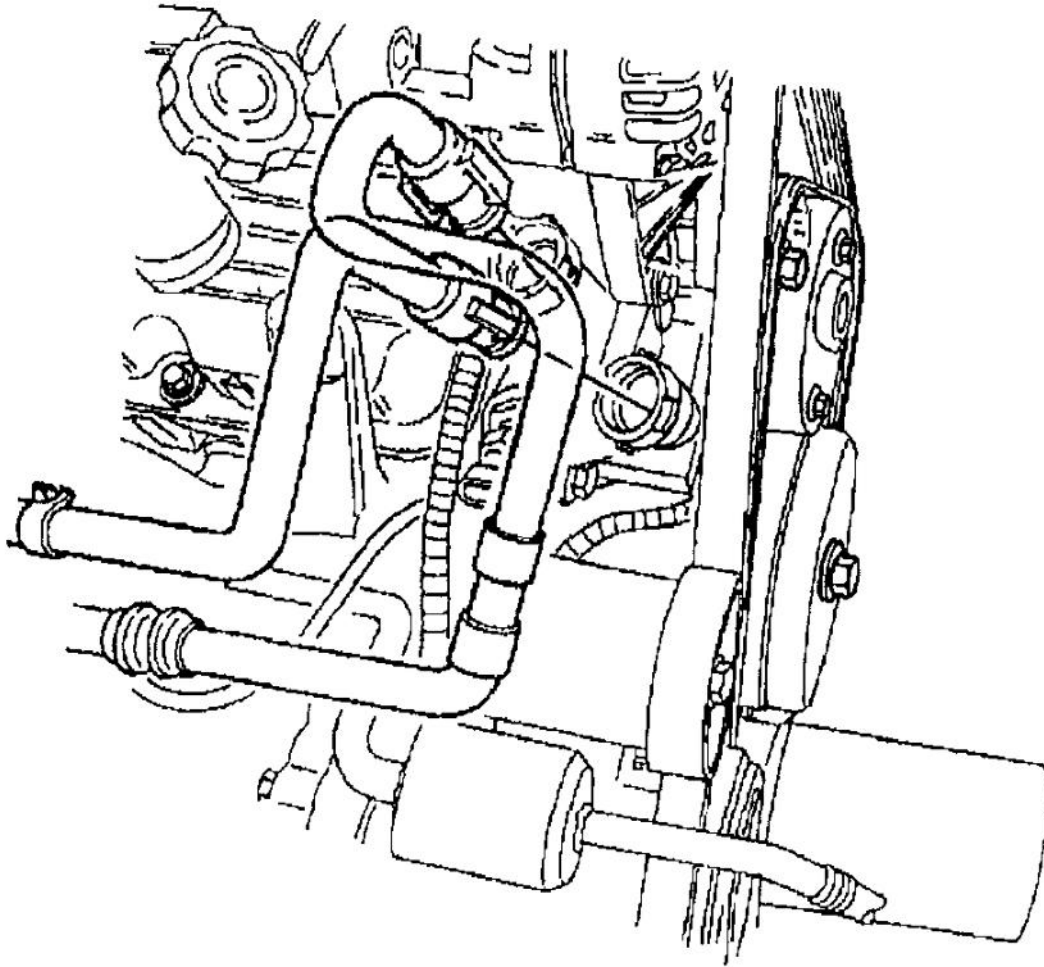
Tighten the drive belt tensioner bolts (3) to 50 N.m (37 lb ft).



G01728685

Fig. 30: Installing Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

4. Install the heater hoses to the drive belt tensioner.



G01728686

Fig. 31: Install Heater Hoses To Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

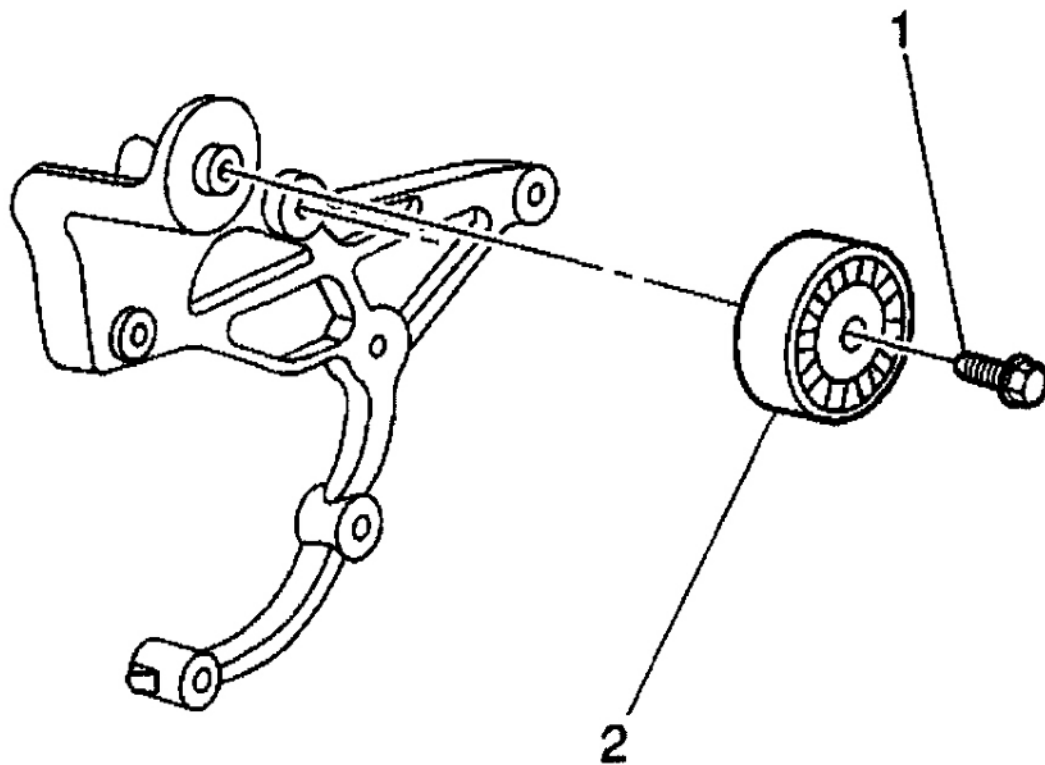
5. Install the generator. Refer to **3.8L ENGINE** in Engine Electrical.
6. Install the drive belt. Refer to **Drive Belt Replacement**.
7. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** in Engine Cooling.

DRIVE BELT IDLER PULLEY REPLACEMENT

Removal Procedure

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the drive belt idler pulley bolt (1).

3. Remove the drive belt idler pulley (2).

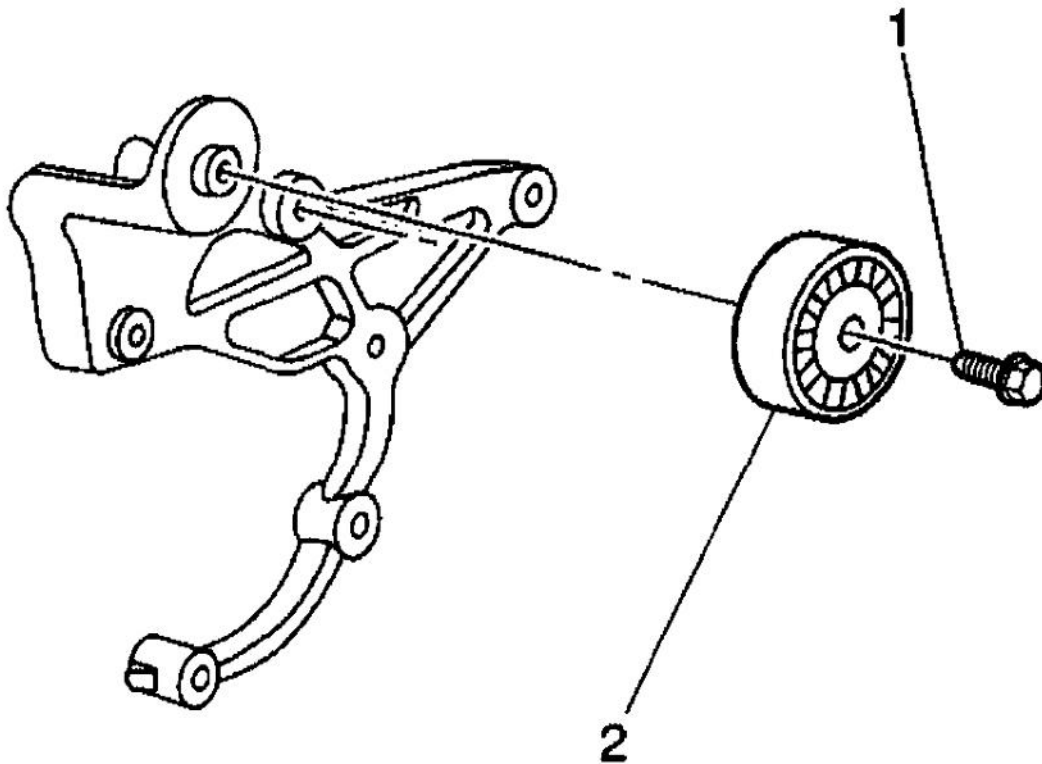


G01728687

Fig. 32: Removing Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the drive belt idler pulley (2).



G01728688

Fig. 33: Installing Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

2. Install the drive belt idler pulley bolt (1).

Tighten

Tighten the drive belt idler pulley bolt (1) to 50 N.m (37 lb ft).

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

ENGINE MOUNT INSPECTION

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. Lifting the engine in an

unapproved manner may cause component damage.

1. Measure the engine movement at the engine mounts in order to check for damage to the rubber portions of the mount.
 - 1.1. Apply the park brake.
 - 1.2. Start the engine.
 - 1.3. Firmly apply the primary brakes.
 - 1.4. Have an assistant stand to the side of the vehicle to observe for engine movement.
 - 1.5. Slightly load the engine in reverse and drive. If the engine moves more than 24 mm (0.945 in) from the at rest position, in either direction, check the engine mount attachment.
2. If the engine mount attachment is within specifications, replace the engine mount.
3. Replace the engine mount also if any of the following conditions exist:
 - Heat check cracks cover the hard rubber surface.
 - The rubber cushion is separated from the metal plate of the mount.
 - There is a split through the rubber cushion.
4. If the mount is loose, lower the engine and tighten the bolts or the nuts to the engine frame or the bracket. Refer to **Fastener Tightening Specifications**.

ENGINE SUPPORT FIXTURE**Tools Required**

- **J 28467-90A** Engine Support Adapters
 - **J 41044** Engine Support Adapters
 - **J 28467-B** Universal Engine Support Fixture
1. Remove 2 strut mounting nuts from the left and right side strut towers.
 2. Attach the engine support fixture adapters J 28467-90A to the strut tower studs.
 3. Install the engine support fixture adapters J 41044-1 and J 41044-2 onto the fixture adapters J 28467-90A on each strut tower.
 4. Secure with the wings nuts provided.

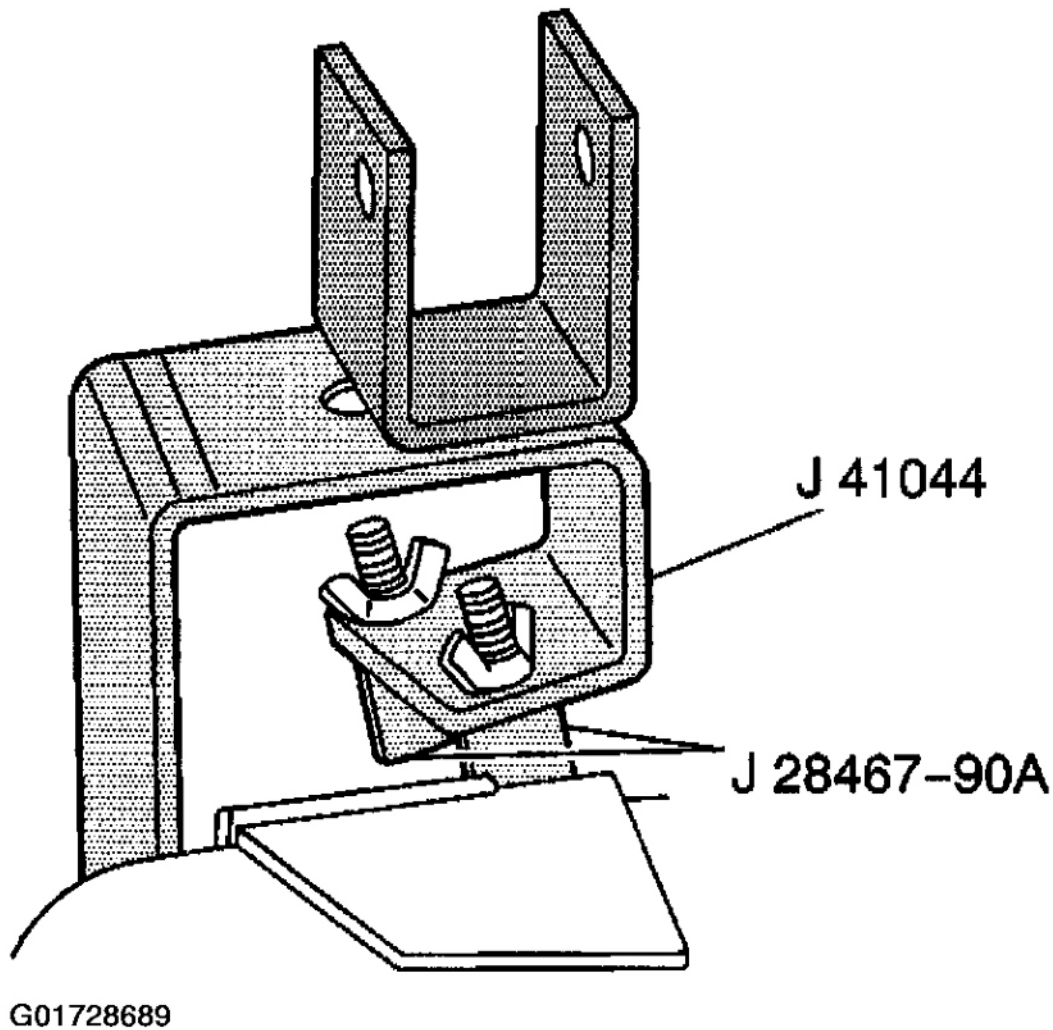
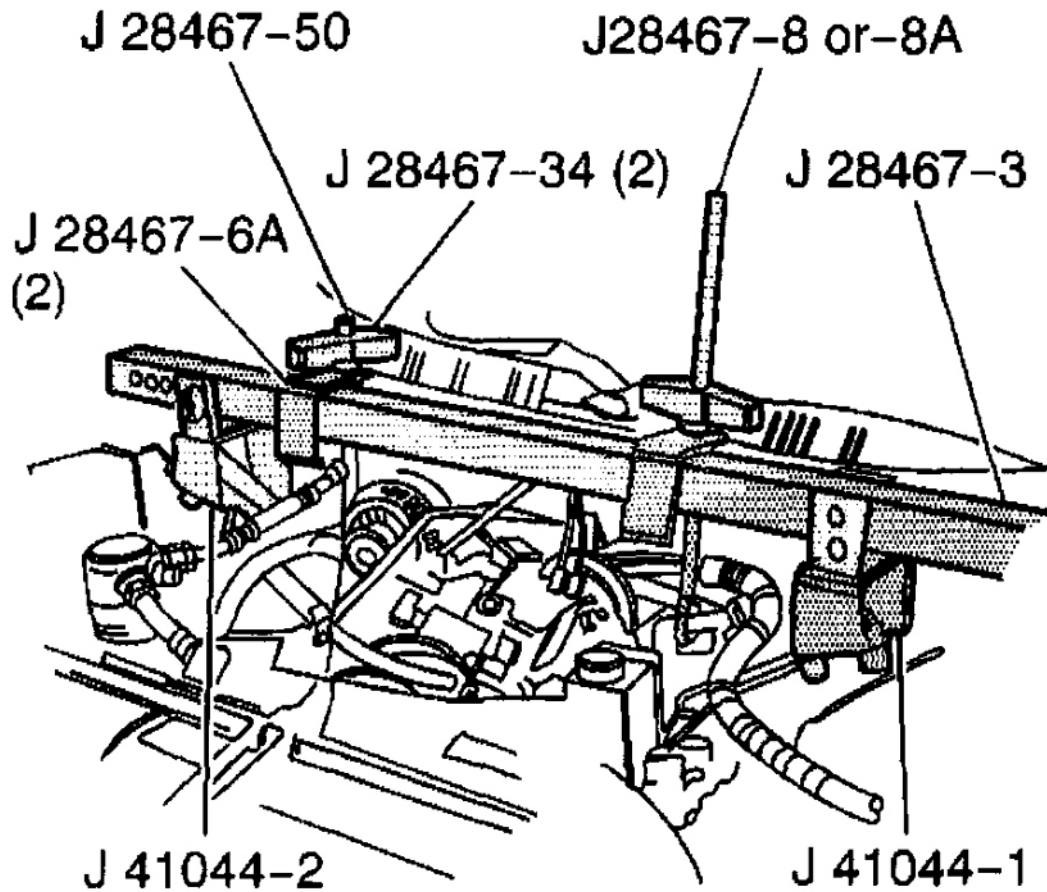


Fig. 34: Installing Engine Support Fixture Adapters
 Courtesy of GENERAL MOTORS CORP.

5. Place the cross bar J 28467-3 into the engine support adapters J 41044-1 and J 41044-2.
6. Install the quick release pins.
7. Thread the lift hooks J 28467-50 and J 28467-8 or J 28467-8A into the support hook brackets J 28467-6A.
8. Place the support hook brackets J 28467-6A over the cross bar J 28467-3 and connect the hooks to the engine lift brackets.
9. Tighten the large wing nuts J 28467-34.



G01728690

Fig. 35: Installing Engine Support Fixture
 Courtesy of GENERAL MOTORS CORP.

ENGINE MOUNT REPLACEMENT

Tools Required

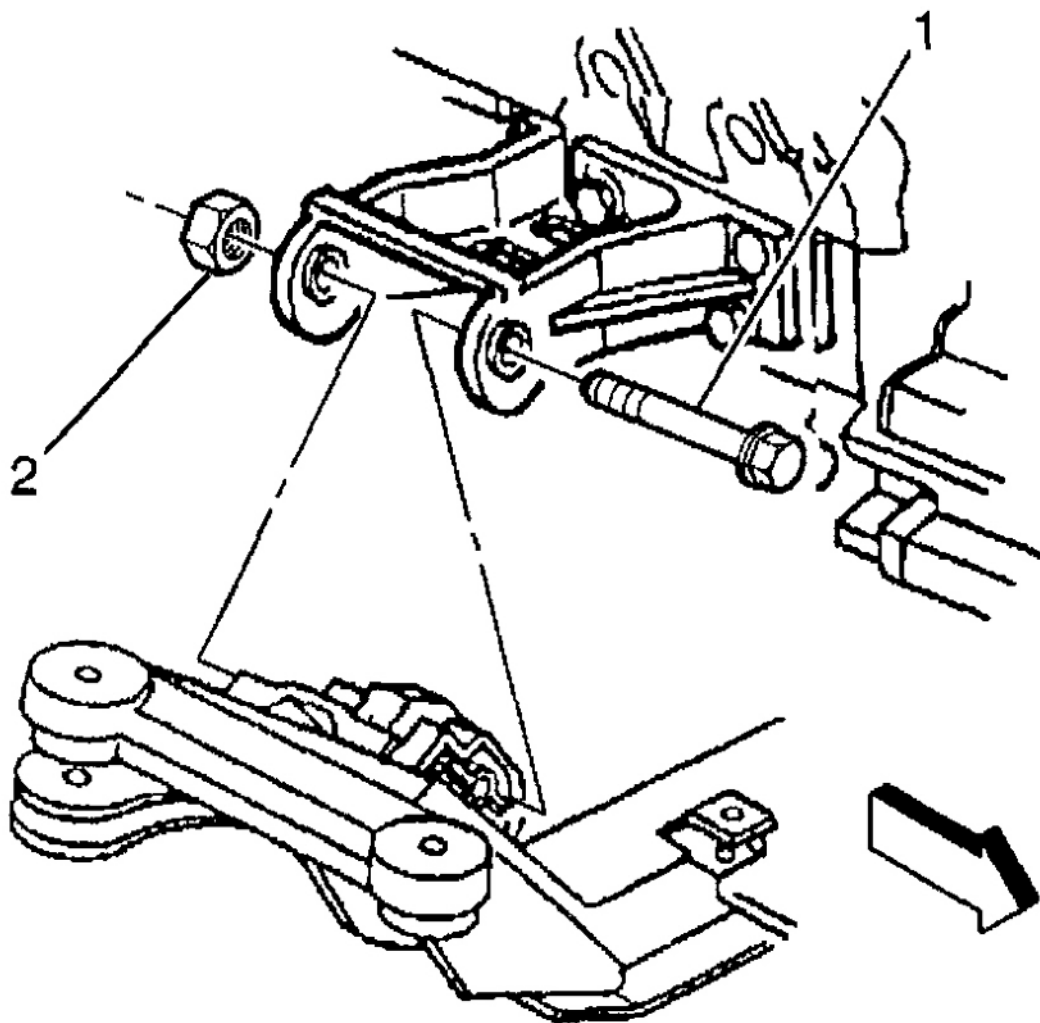
- J 41044 Engine support Adapters
- J 28467-B Universal engine Support Fixture

Removal Procedure

NOTE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, crankshaft balancer, or any sheet metal. Due to small clearances between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup

unit. Jacking against the crankshaft balancer may also cause oil seal and/or crankshaft bearing damage. Always use a J 28467-A (Universal Support Fixture) along with J 41044 (Engine Support Adapters) when raising or supporting the engine.

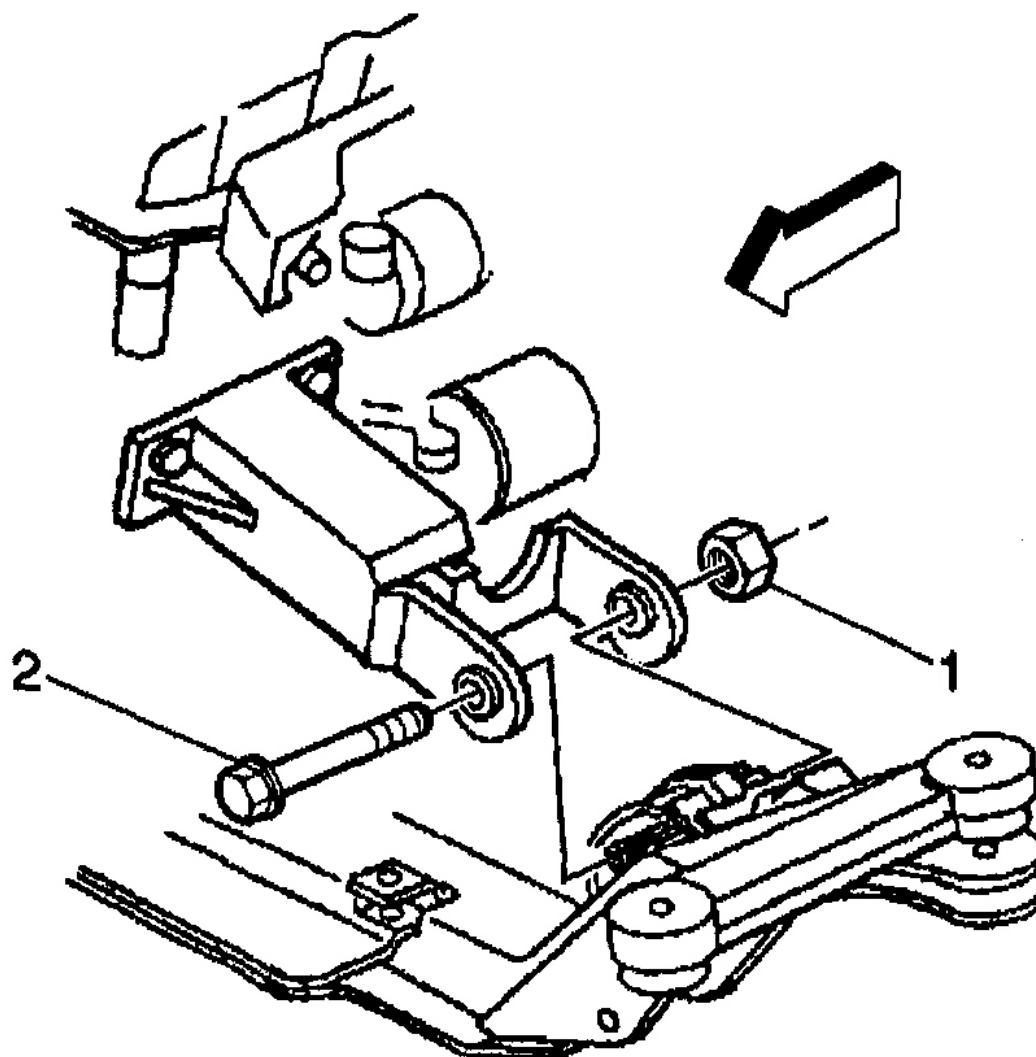
1. Remove the generator. Refer to **3.8L ENGINE** in Engine Electrical.
2. Remove the ignition control module. Refer to **IGNITION CONTROL MODULE** .
3. Install the engine support fixture to the engine. Refer to **Engine Support Fixture**.
4. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
5. Remove the 3-way catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT (3.8L ENGINE)** .
6. Remove the right side engine mount through bolt nut (2).



G01728691

Fig. 36: Removing Right Side Engine Mount Through Bolt Nut
Courtesy of GENERAL MOTORS CORP.

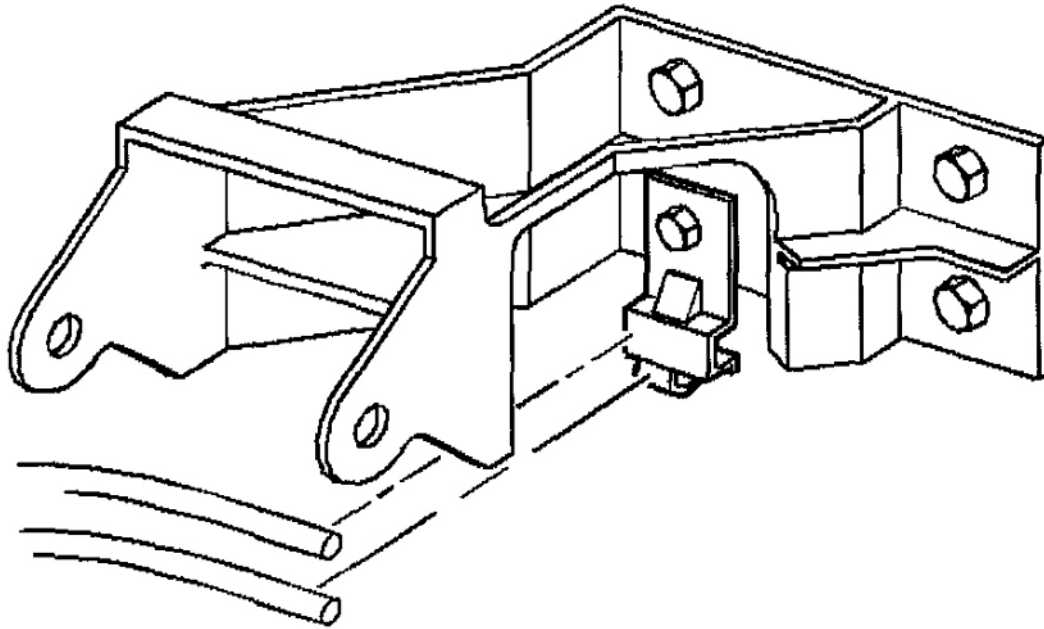
7. Remove the left side engine mount through bolt nut (1).



G01728692

Fig. 37: Remove Left Side Engine Mount Through Bolt Nut
 Courtesy of GENERAL MOTORS CORP.

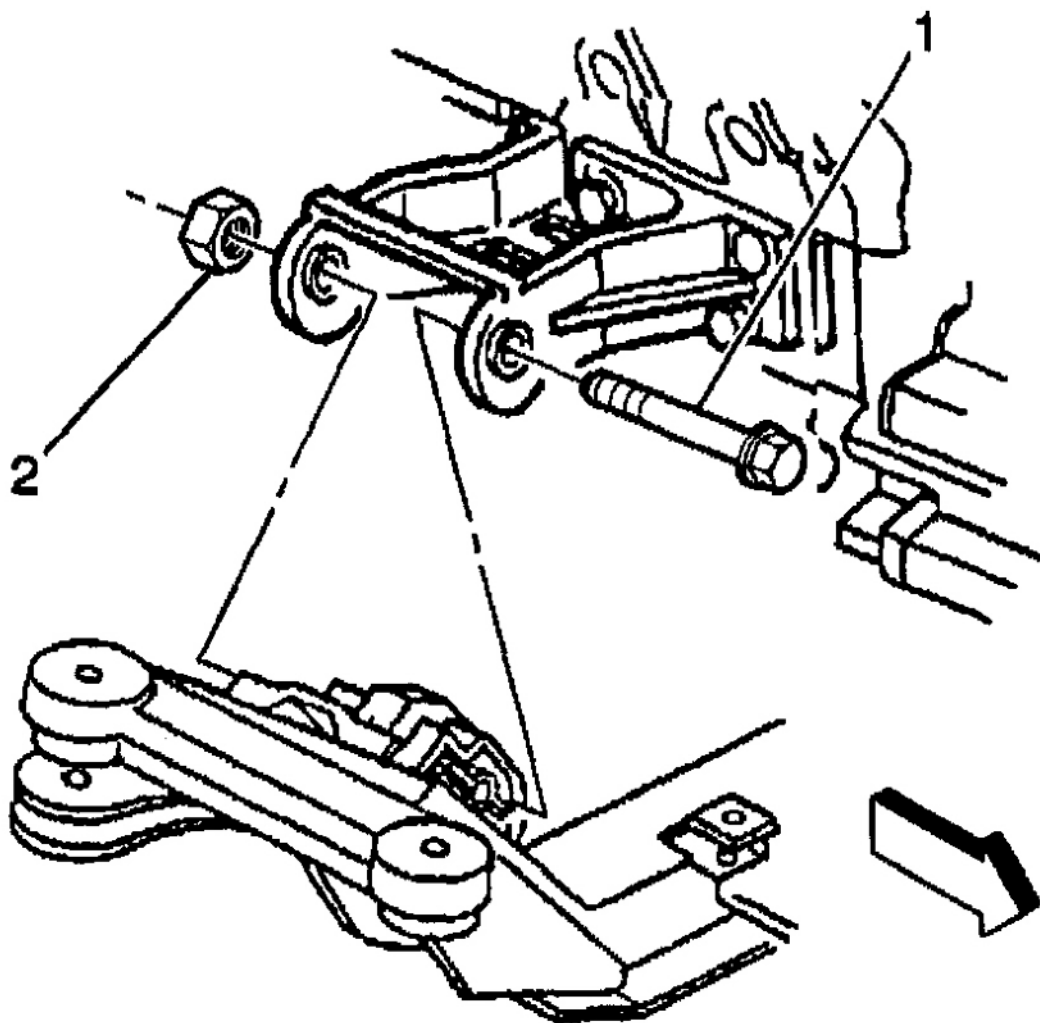
8. Remove the transmission oil cooler pipe bracket bolt and bracket.



G01728693

Fig. 38: Removing Transmission Oil Cooler Pipe Bracket Bolt And Bracket
Courtesy of GENERAL MOTORS CORP.

9. Lower the vehicle.
10. Remove the A/C compressor from the A/C compressor bracket without recovering the refrigerant. Refer to **COMPRESSOR** .
11. Raise the engine slightly in order to relieve tension on the through bolts.
12. Remove the right engine mount through bolt (1).



G01728694

Fig. 39: Removing Right Engine Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

13. Remove the left engine mount through bolt (2).

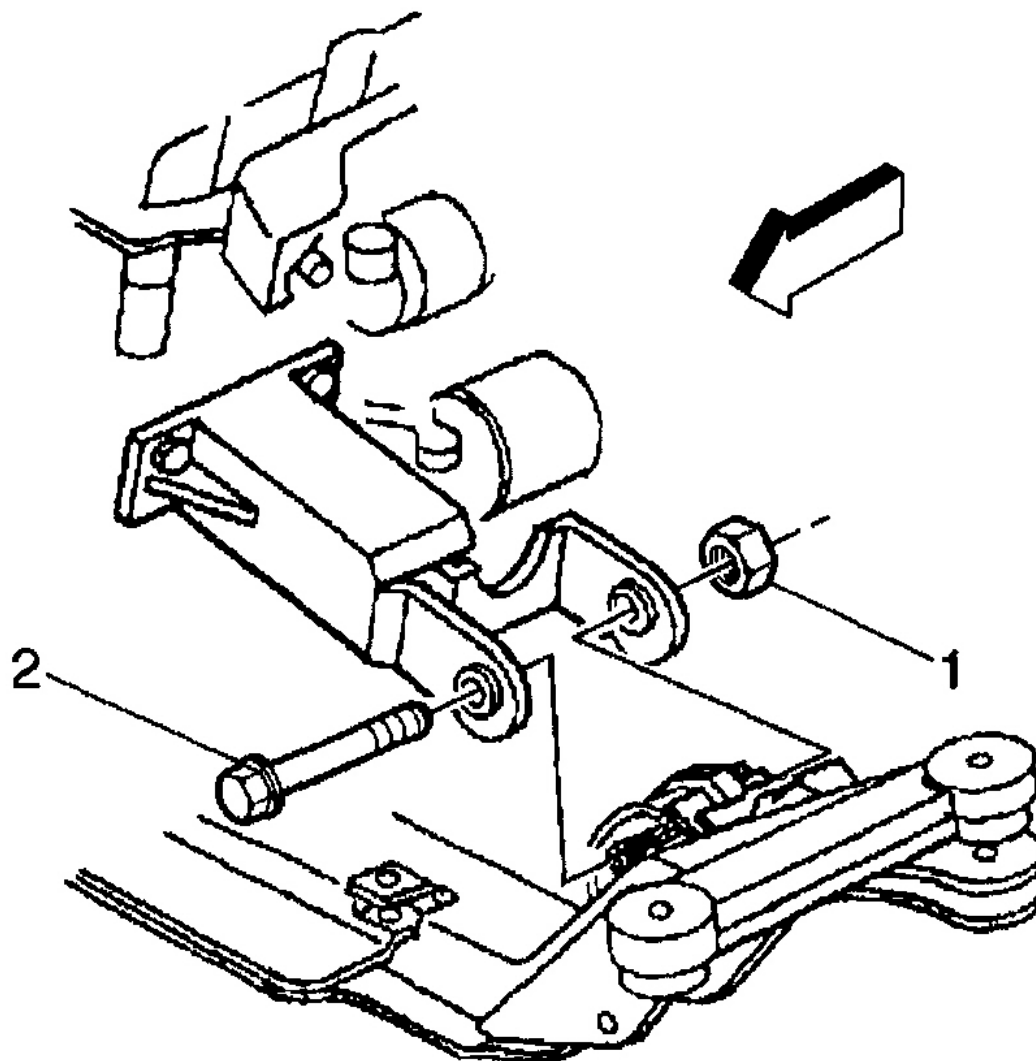
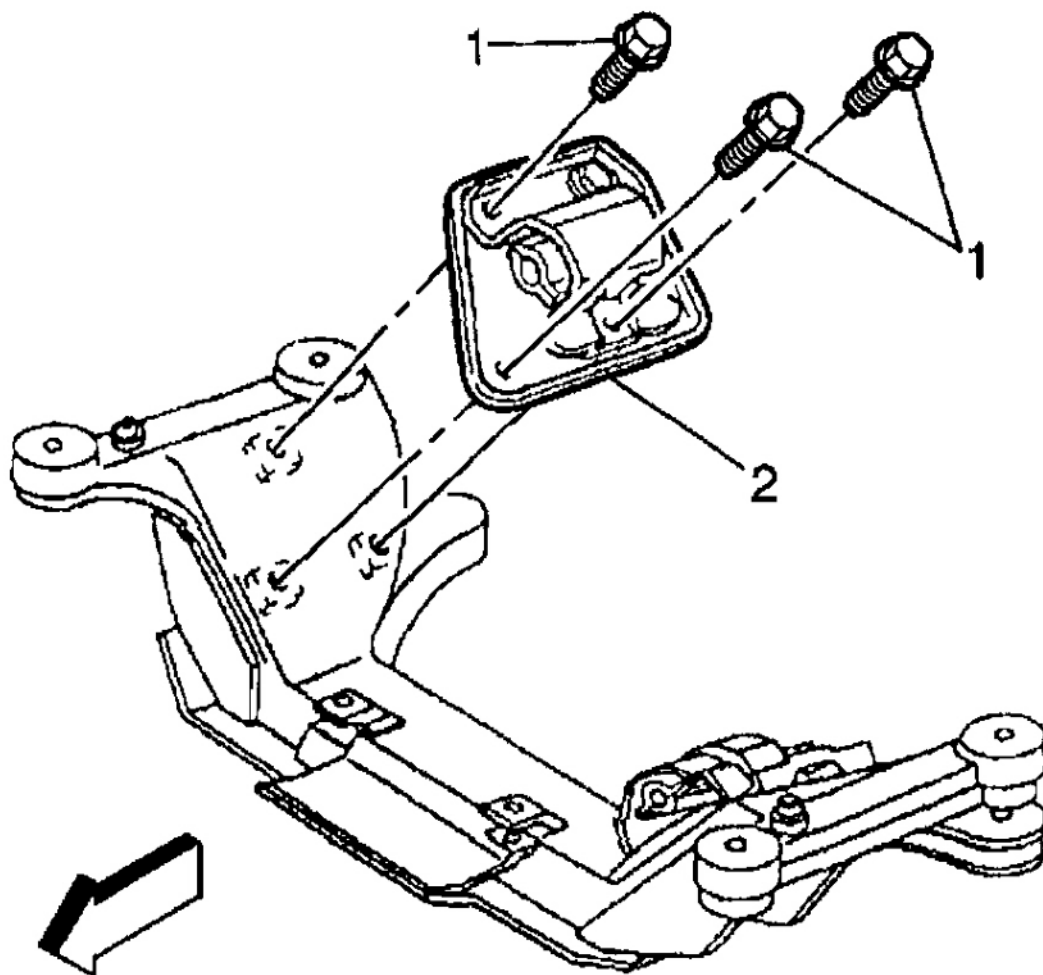


Fig. 40: Removing Left Engine Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

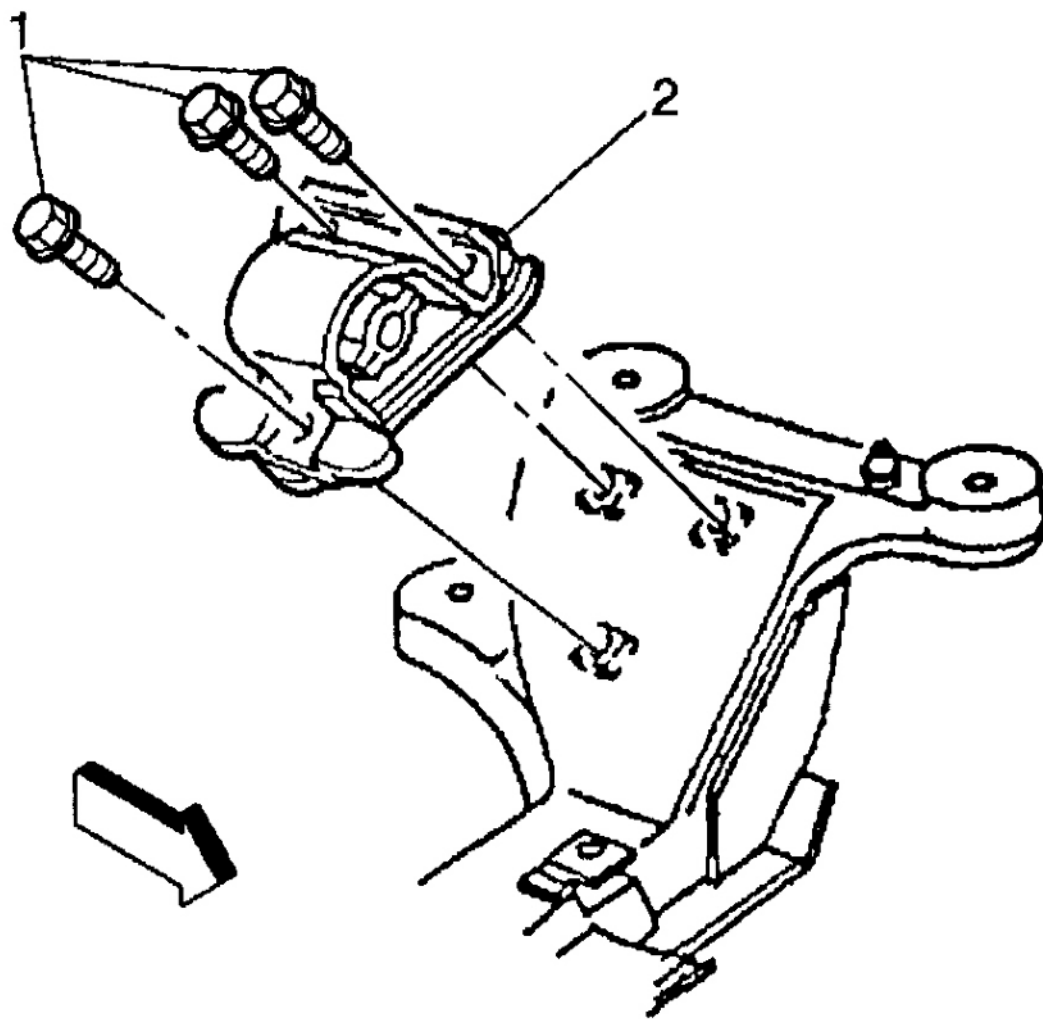
14. Raise the engine enough to remove the engine mounts.
15. Raise the vehicle.
16. Remove the right engine mount bolts (1) and the right engine mount (2).



G01728696

Fig. 41: Removing Right Engine Mount Bolts Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

17. Remove the left engine mount bolts (1) and the left engine mount (2).



G01728697

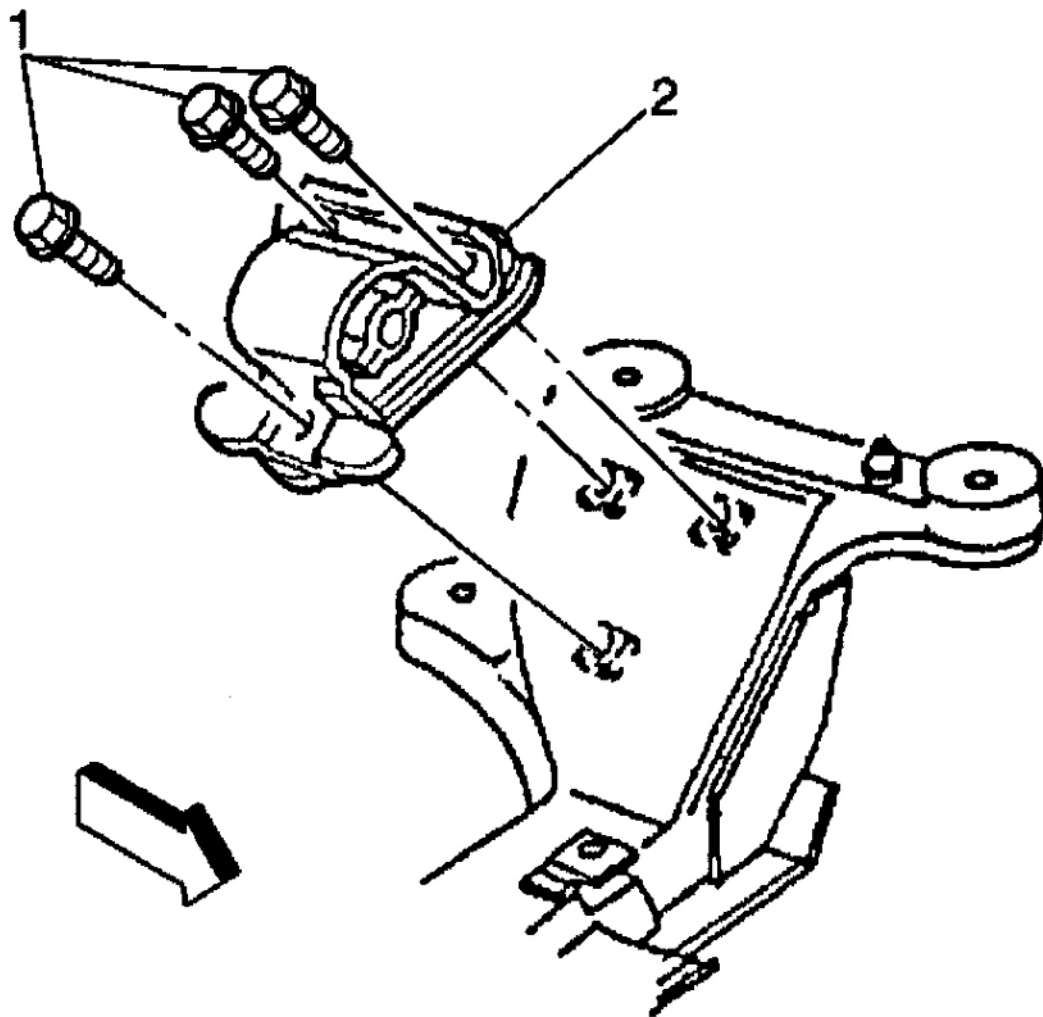
Fig. 42: Removing Left Engine Mount Bolts Left Engine Mount
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the left engine mount (2) and bolts (1) to the crossmember.

Tighten

Tighten the left engine mount bolts (1) to 58 N.m (43 lb ft).



G01728698

Fig. 43: Installing Left Engine Mount Bolts To Crossmember
Courtesy of GENERAL MOTORS CORP.

2. Install the right engine mount (2) and bolts (1) to the crossmember.

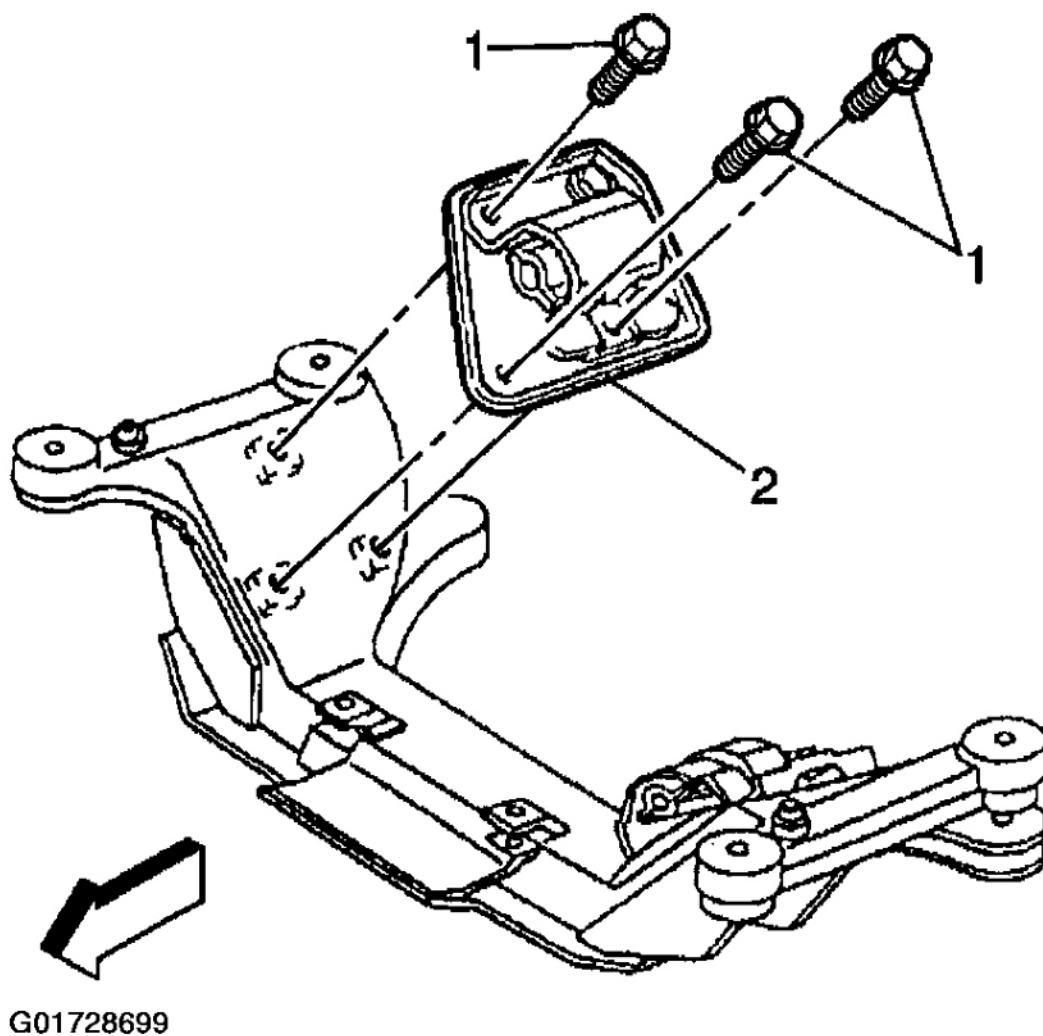
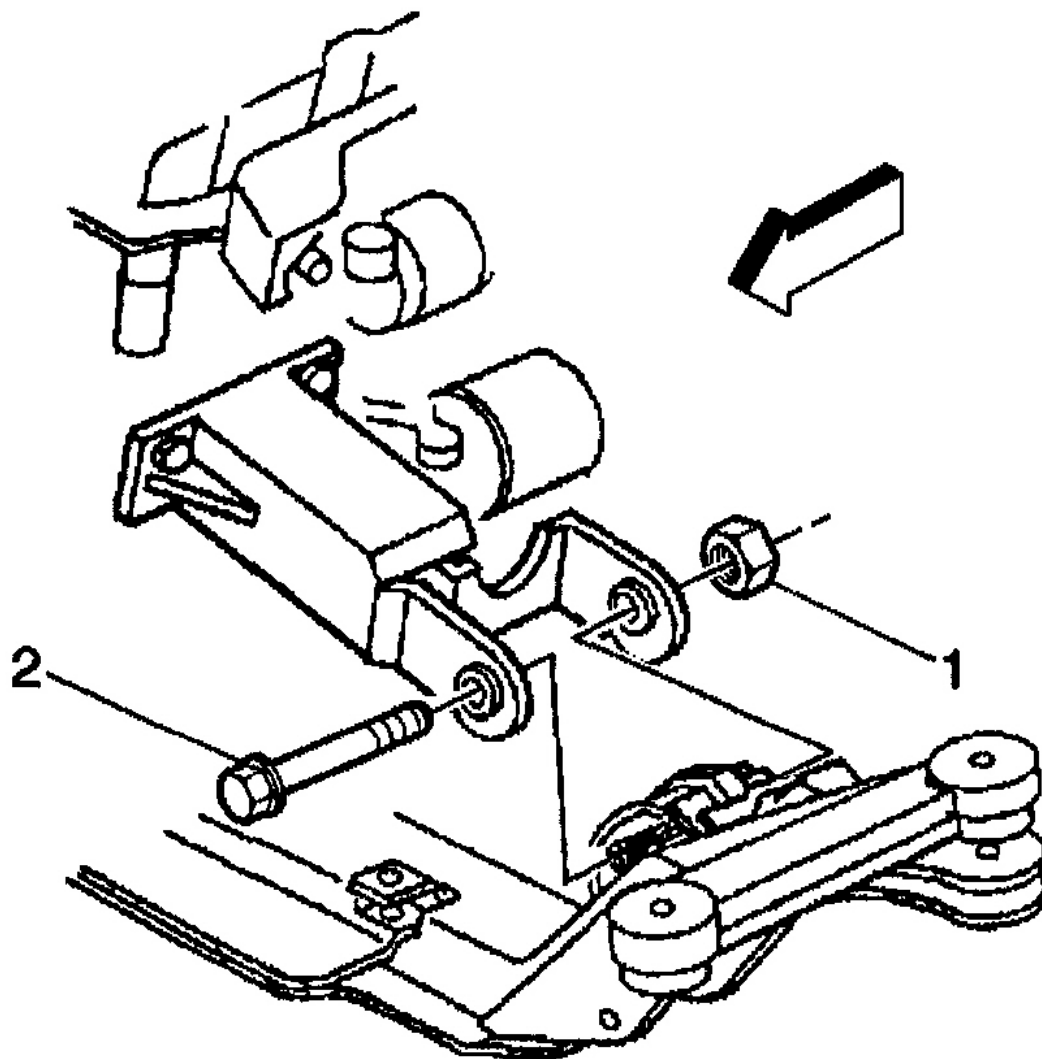


Fig. 44: Installing Right Engine Mount And Bolts To Crossmember
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the right engine mount bolts (2) to 58 N.m (43 lb ft).

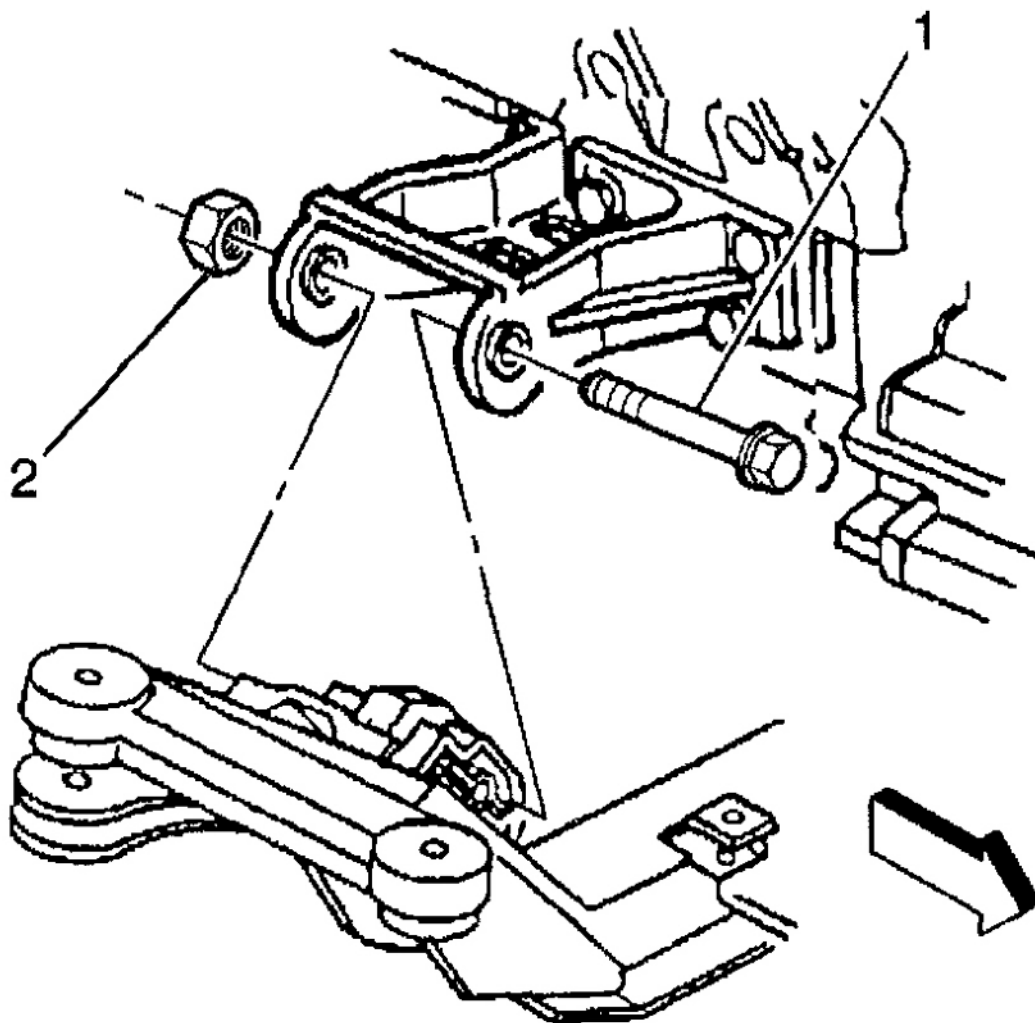
3. Lower the vehicle.
4. Lower the engine until the mount bracket and mount through holes line up together.
5. Install the left engine mount through bolt (2).



G01728700

Fig. 45: Installing Left Engine Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the right engine mount through bolt (1).



G01728701

Fig. 46: Install Right Engine Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the A/C compressor to the A/C compressor bracket. Refer to **COMPRESSOR**.
8. Raise the vehicle.
9. Install the transmission oil cooler pipe bracket and bolt.

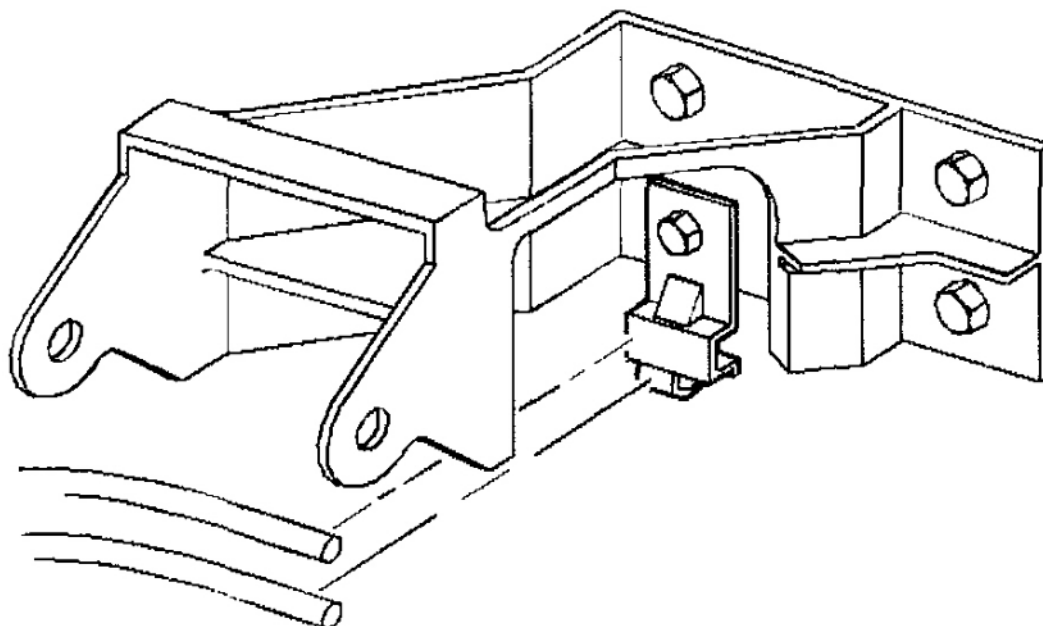
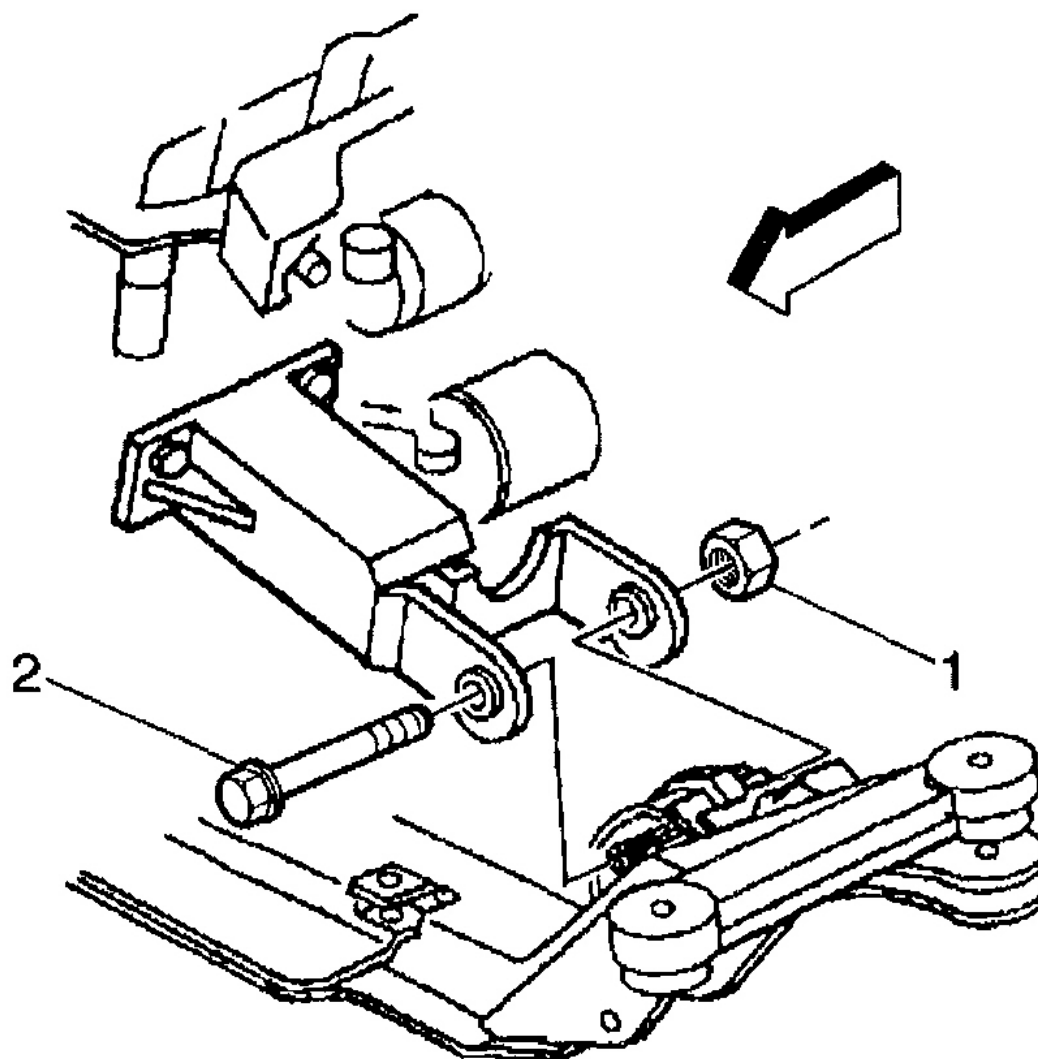
**G01728702**

Fig. 47: Installing Transmission Oil Cooler Pipe Bracket And Bolt
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the oil cooler pipe bracket to 17 N.m (13 lb ft).

10. Install the left side engine mount through bolt nut (1).



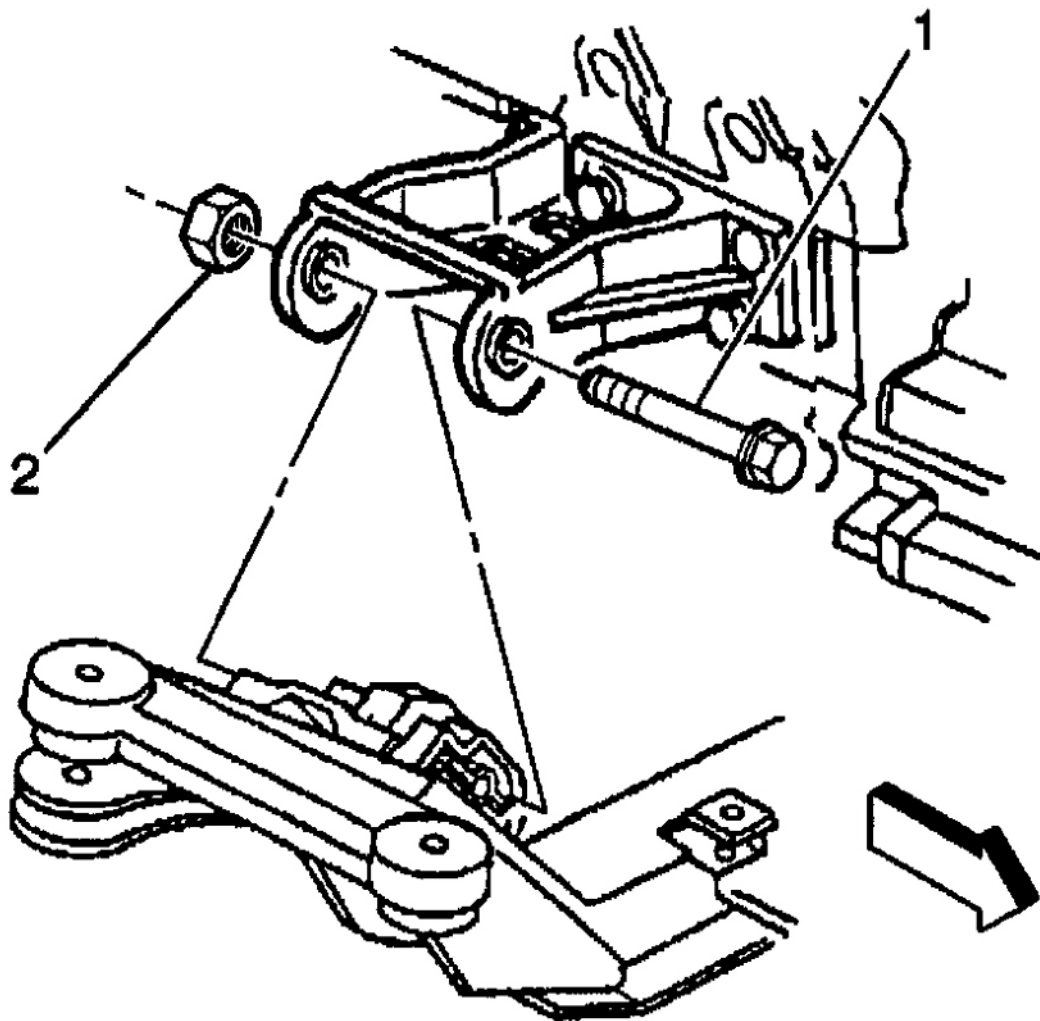
G01728703

Fig. 48: Installing Left Side Engine Mount Through Bolt Nut
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine mount through bolt nut (1) to 80 N.m (59 lb ft).

11. Install the right side engine mount through bolt nut (2).



G01728704

Fig. 49: Installing Right Side Engine Mount Through Bolt Nut
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine mount through bolt nut (2) to 80 N.m (59 lb ft).

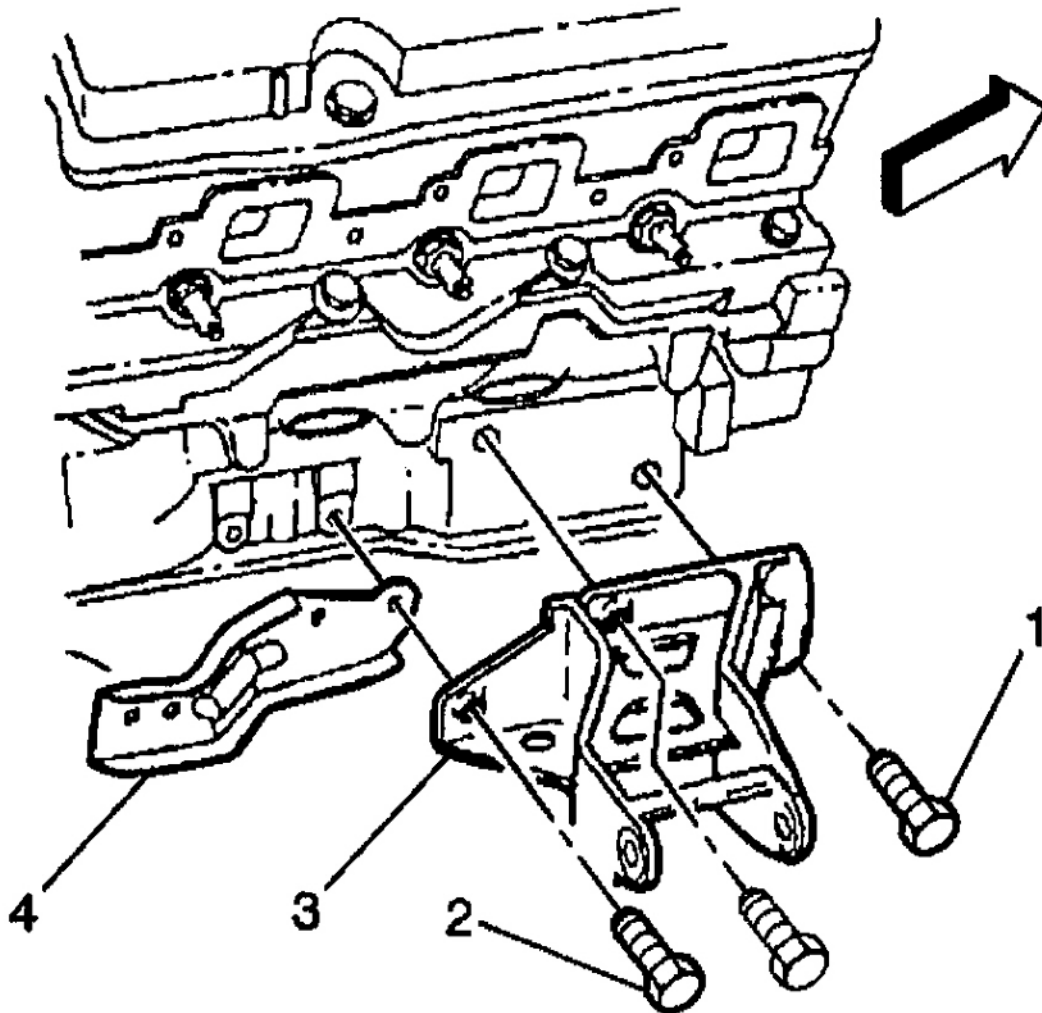
12. Install the 3-way catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT (3.8L ENGINE)**.
13. Lower the vehicle.
14. Remove the engine support fixture.
15. Install the ignition control module. Refer to **IGNITION CONTROL MODULE**.

16. Install the generator. Refer to **3.8L ENGINE** .

ENGINE MOUNT BRACKET REPLACEMENT

Removal Procedure

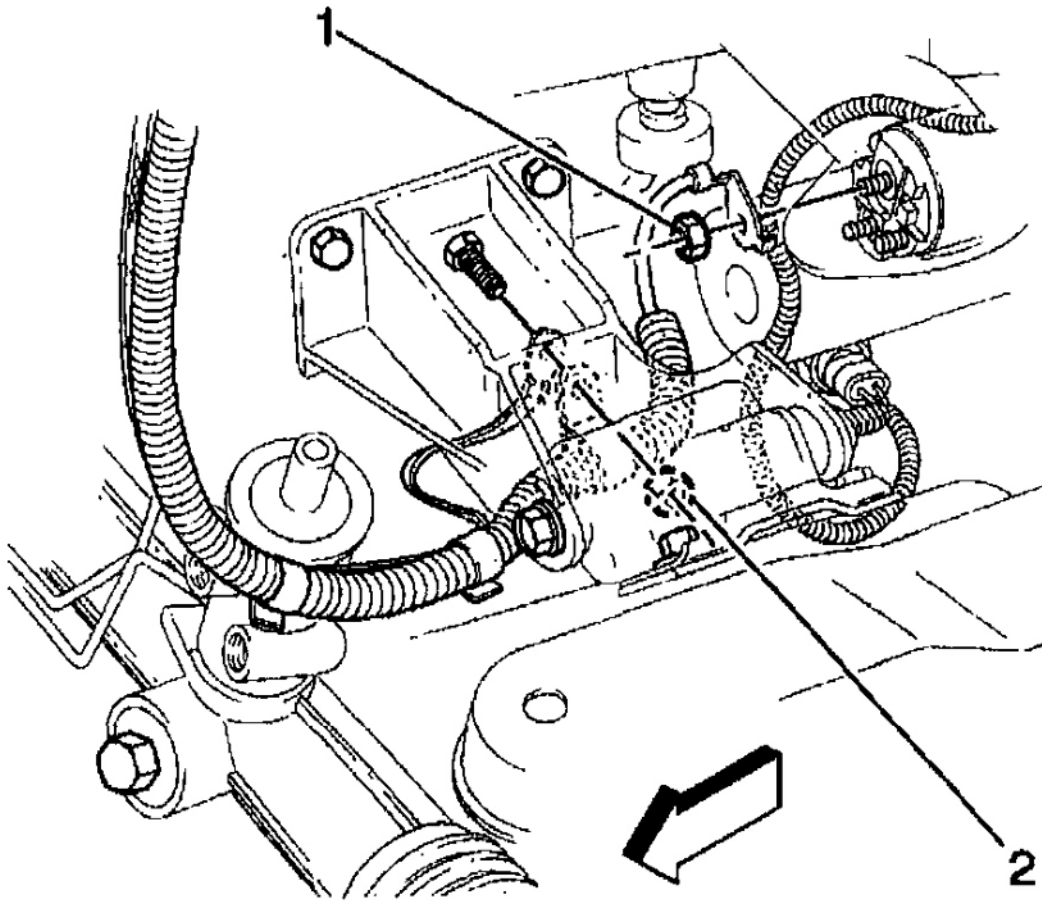
1. Remove the engine mount(s) Refer to **Engine Mount Replacement**.
2. Remove the right engine mount bracket bolts (1,2) and the right engine mount bracket (3).



G01728705

Fig. 50: Removing Right Engine Mount Bracket Bolts Right Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

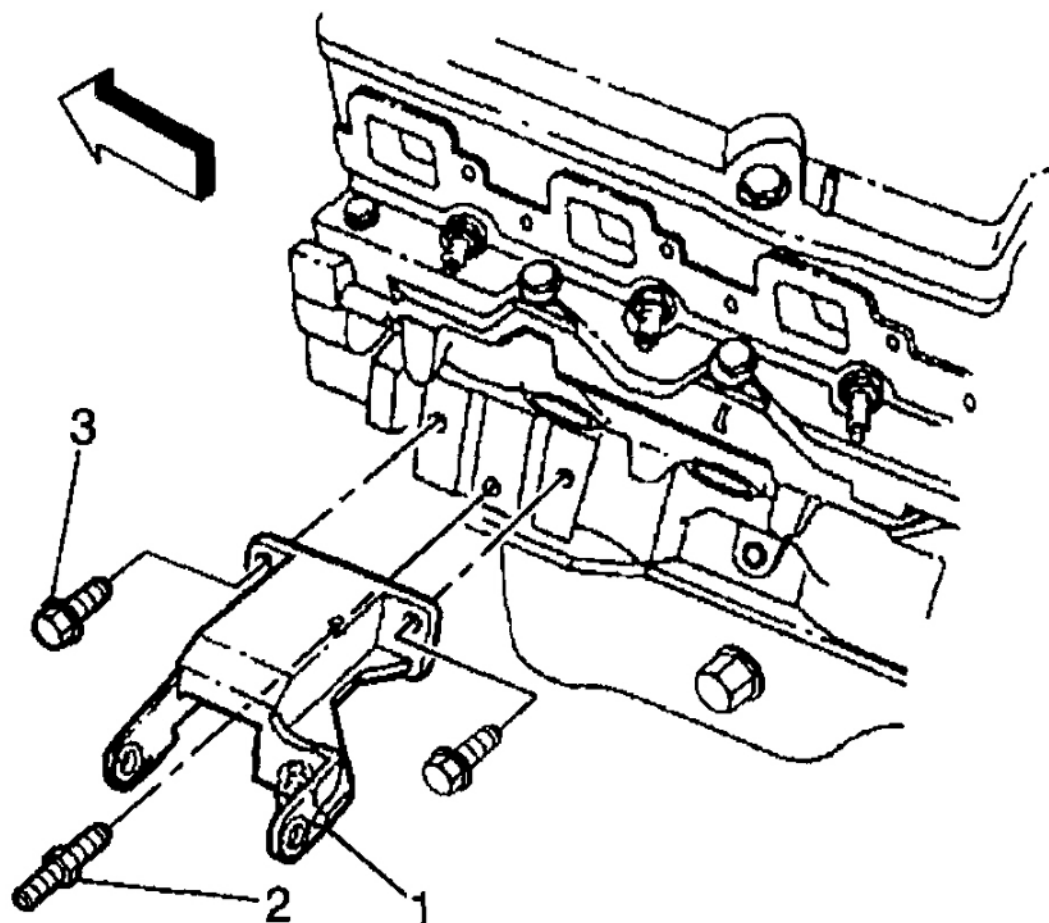
3. Remove the positive cable harness from the engine mount stud.
 - Remove the battery positive cable harness nut (2).
 - Remove the harness clamp from the stud.
 - Remove the RF (Radio Frequency) ground strap.



G01728706

Fig. 51: Remove Battery Positive Cable Harness Nut
Courtesy of GENERAL MOTORS CORP.

4. Remove the left engine mount bracket bolts (3).
5. Remove the left engine mount bracket stud (2) and the engine mount bracket (1).

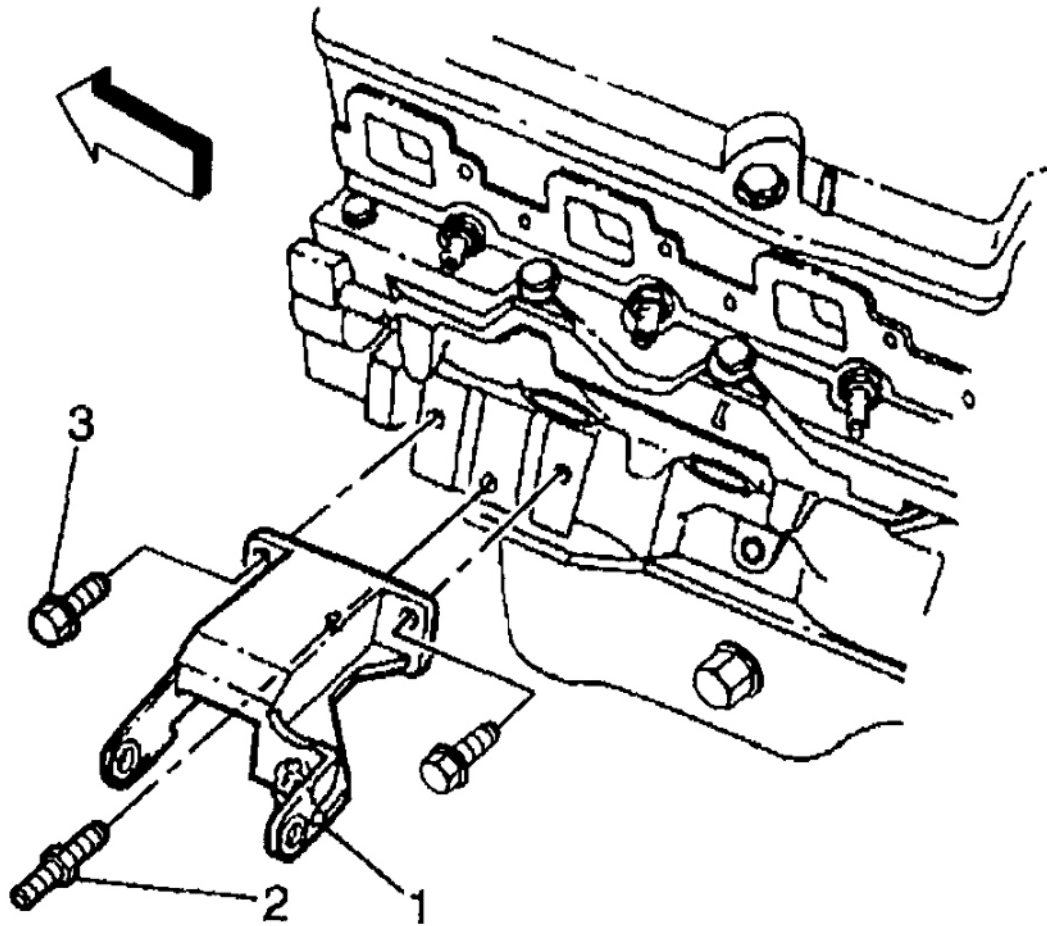


G01728707

Fig. 52: Removing Left Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the left engine mount bracket (1) and stud (2) to the engine block.



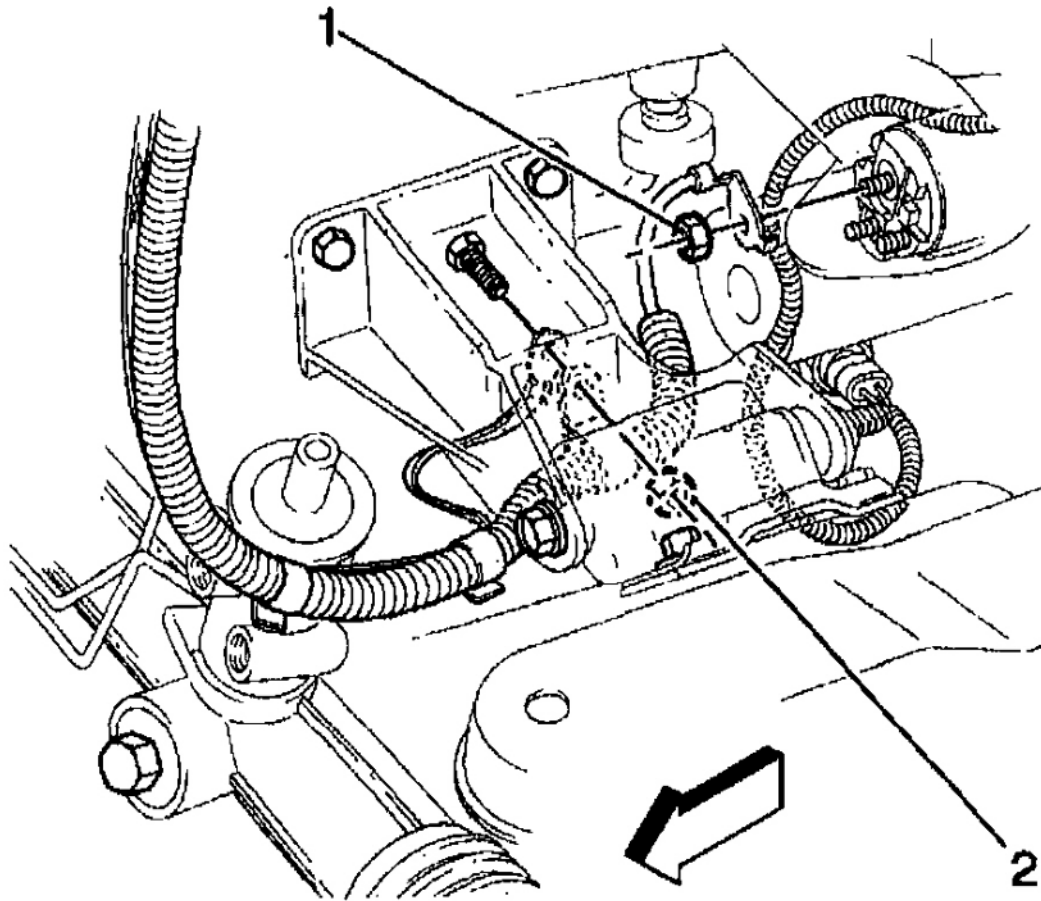
G01728708

Fig. 53: Install Left Engine Mount Bracket And Stud
Courtesy of GENERAL MOTORS CORP.

2. Install the left engine mount bracket bolts (3).

Tighten

- Tighten the engine mount bracket bolts (3) to 102 N.m (75 lb ft).
 - Tighten the engine mount bracket stud (2) to 87 N.m (64 lb ft).
3. Install the positive cable harness to the engine mount bracket stud.
 - Install the RF (Radio Frequency) ground strap.
 - Install the harness clamp to the stud.
 - Install the battery positive cable harness nut (2).



G01728709

Fig. 54: Install Battery Positive Cable Harness Nut
Courtesy of GENERAL MOTORS CORP.

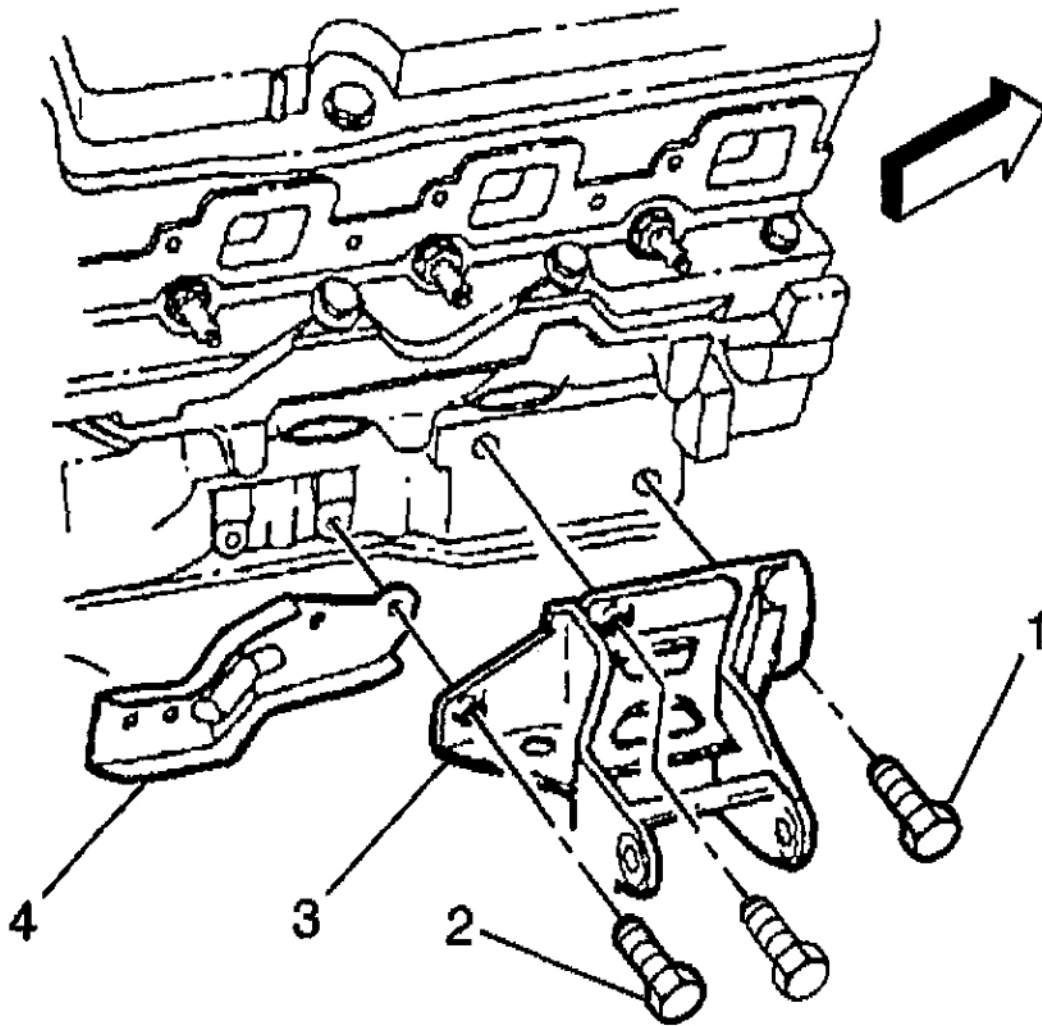
Tighten

Tighten the battery positive cable nut (2) to 25 N.m (18 lb ft).

4. Install the right engine mount bracket (3) and bolts (1,2) to the engine block.

Tighten

- Tighten the 2 engine mount bracket bolts (1) to 102 N.m (75 lb ft).
 - Tighten the engine mount bracket bolt (2) to 50 N.m (37 lb ft).
5. Install the engine mount(s). Refer to **Engine Mount Replacement**.



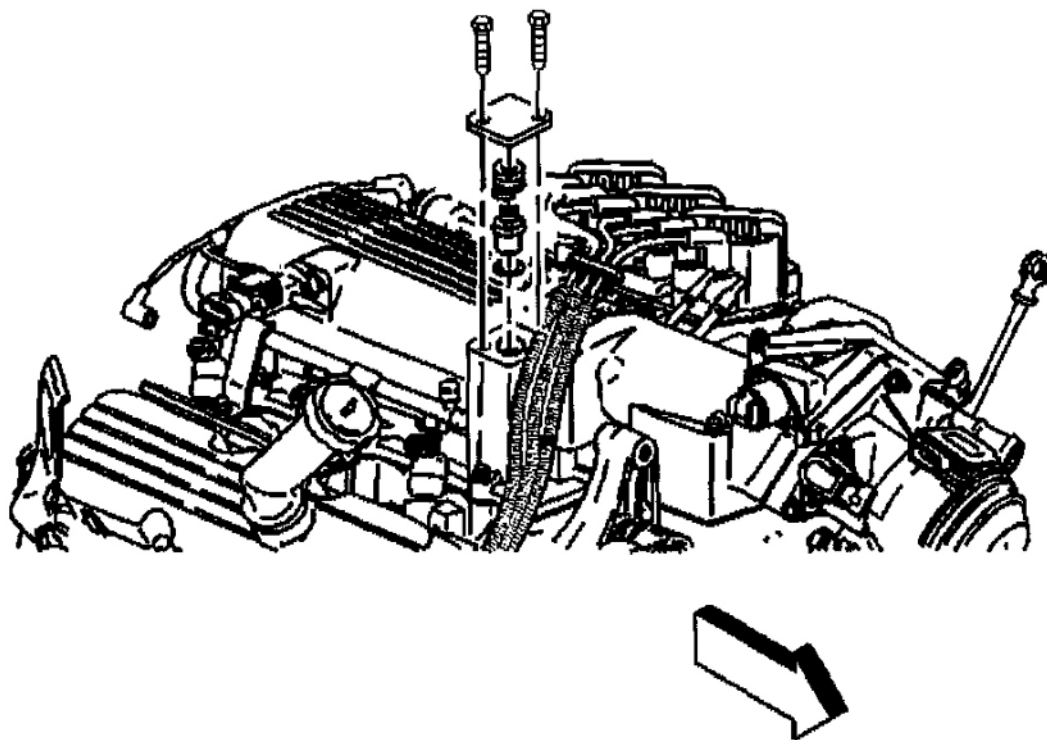
G01728710

Fig. 55: Installing Engine Mount(s)

Courtesy of GENERAL MOTORS CORP.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE REPLACEMENT**Removal Procedure**

1. While holding down the positive crankcase ventilation (PCV) valve cover, remove the cover bolts.
2. Remove the PCV valve cover.
3. Remove the PCV valve, spring, and O-ring.



G01728711

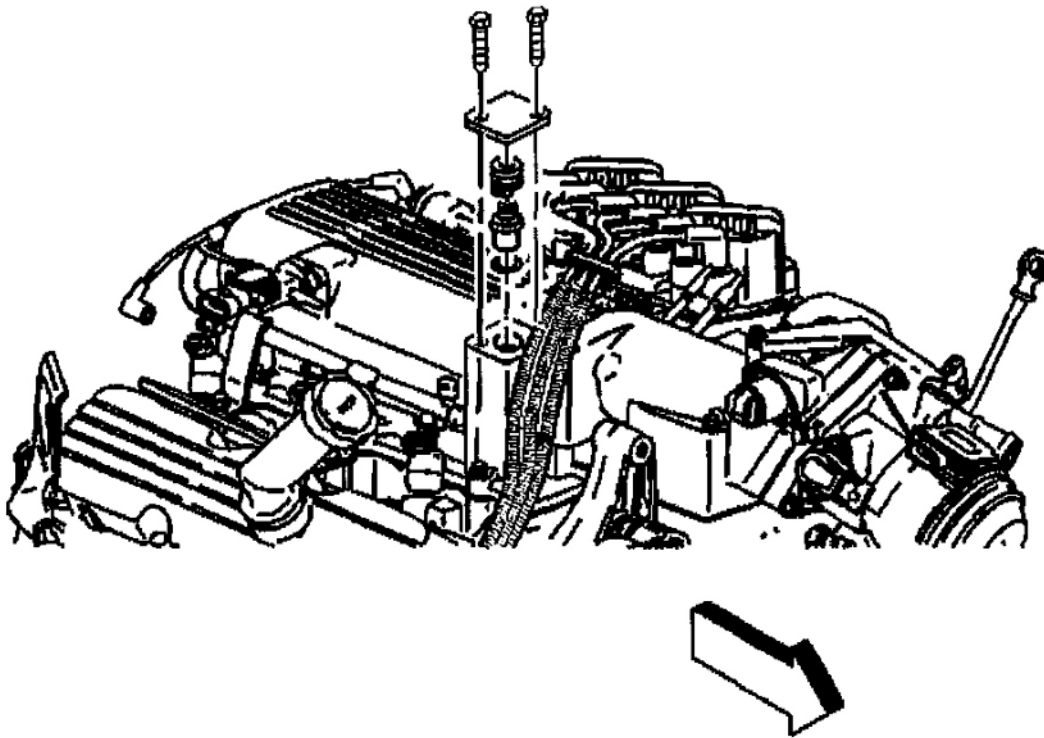
Fig. 56: Removing Cover Bolts
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the PCV valve O-ring, spring, and a NEW valve.
2. Install the PCV valve cover (using a NEW gasket, if necessary) and install the cover bolts.

Tighten

Tighten the PCV valve cover bolts to 12 N.m (106 lb in).



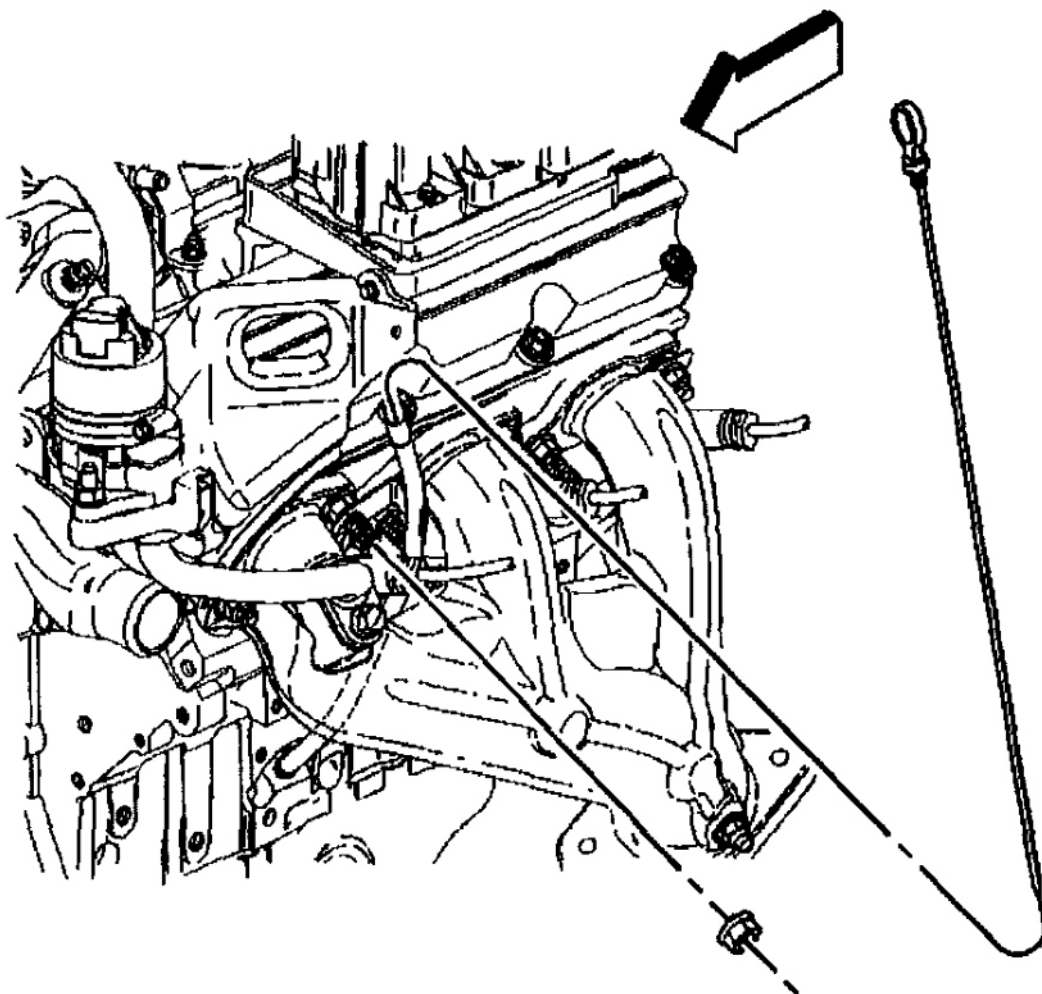
G01728712

Fig. 57: Installing PCV valve cover bolts
Courtesy of GENERAL MOTORS CORP.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

Removal Procedure

1. Remove the oil level indicator from the indicator tube.
2. Remove the oil level indicator tube nut.
3. Remove the oil level indicator tube from the engine block.



G01728713

Fig. 58: Remove Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

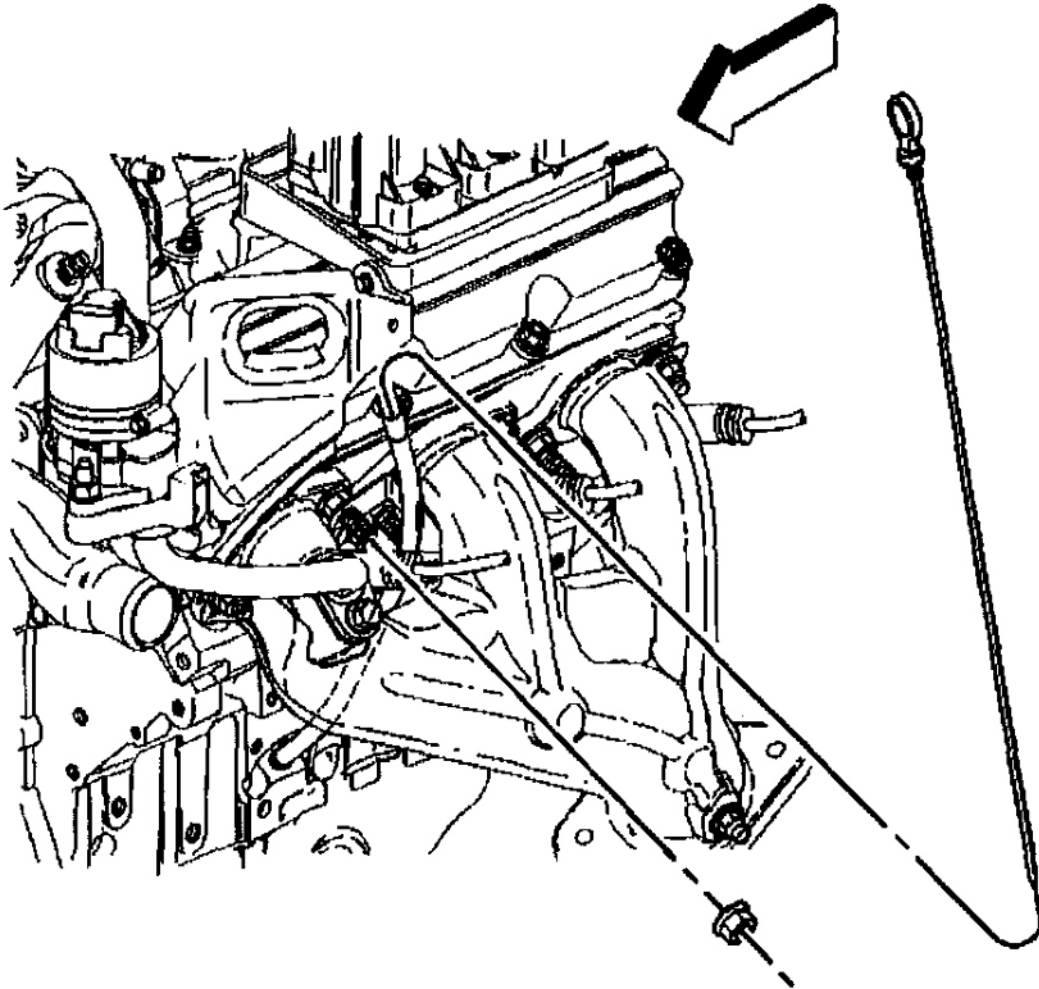
Installation Procedure

1. Replace the O-ring seal if necessary.
2. Install the oil level indicator tube to the engine block.
3. Install the oil level indicator tube nut.

Tighten

Tighten the oil level indicator tube nut to 19 N.m (14 lb ft).

4. Install the oil level indicator to the indicator tube.



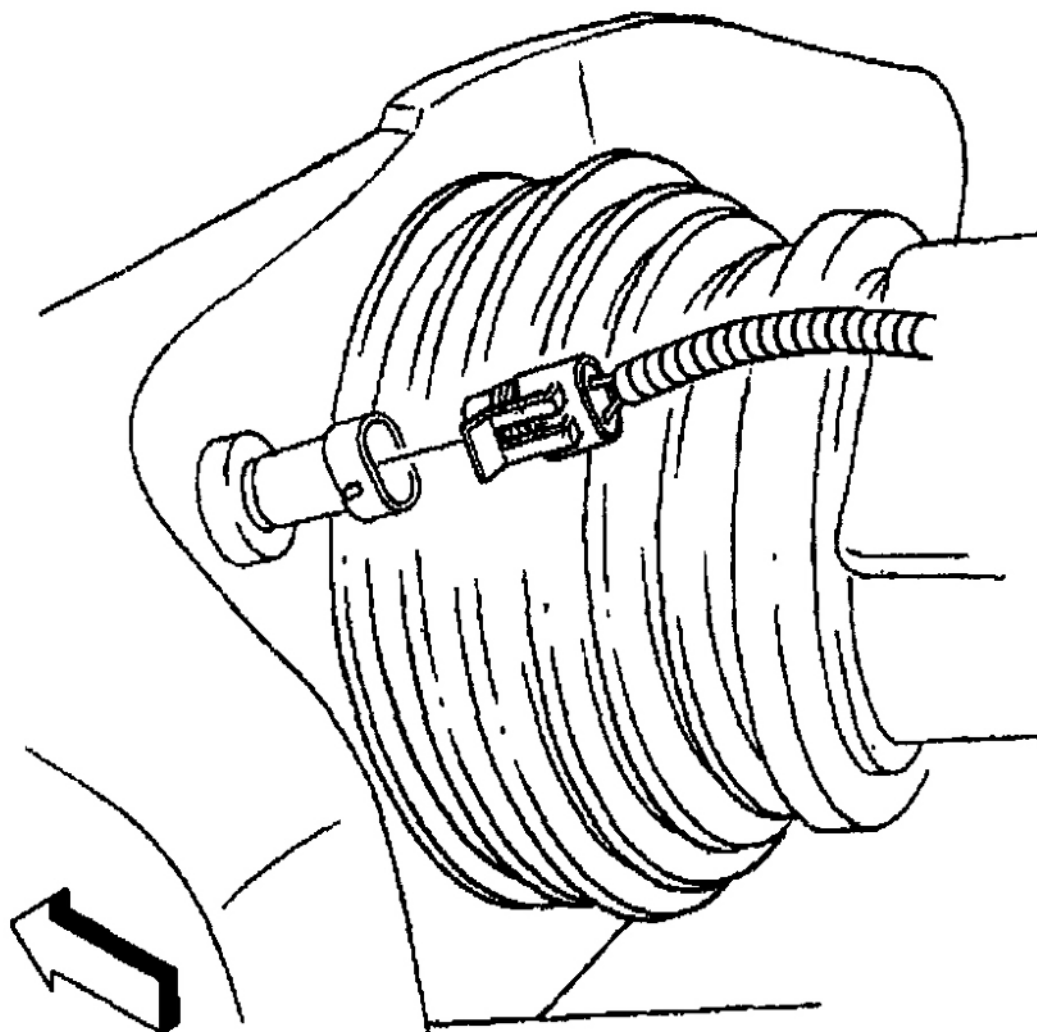
G01728714

Fig. 59: Installing Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

INTAKE MANIFOLD REPLACEMENT - UPPER

Removal Procedure

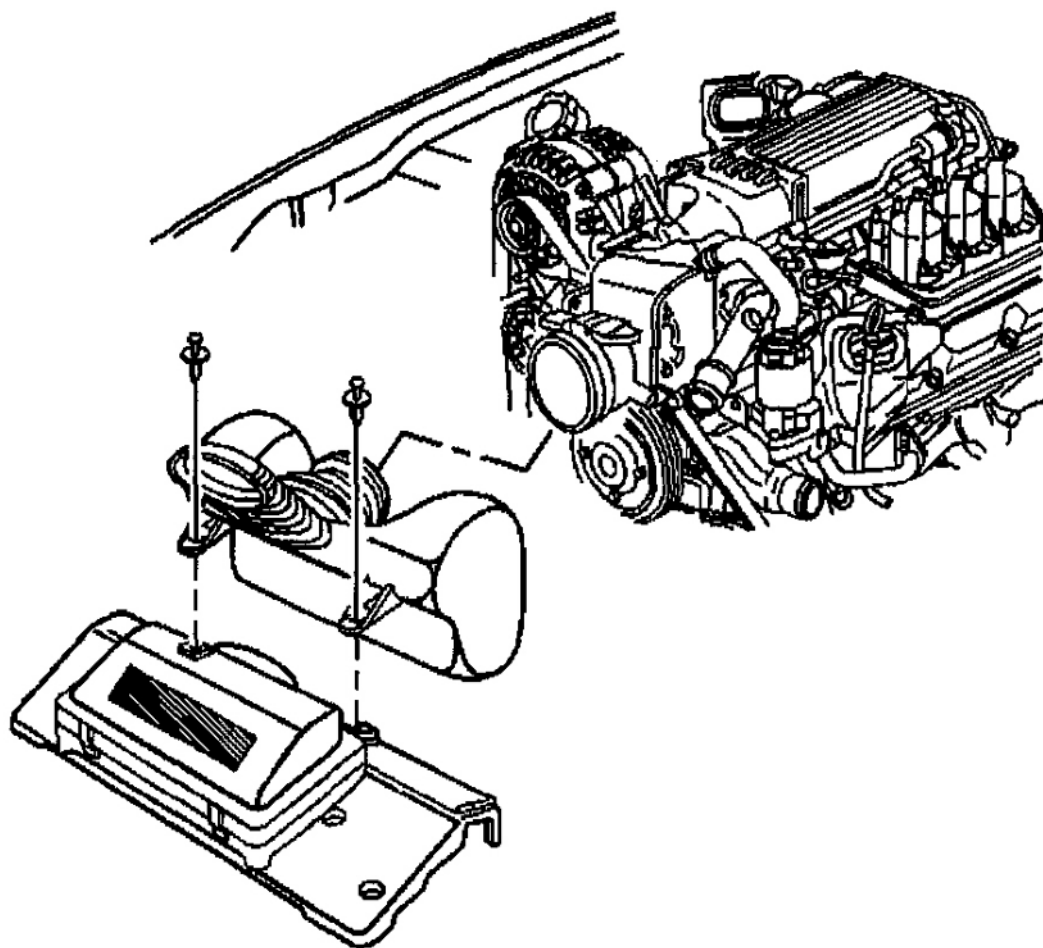
1. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Disconnect the intake air temperature (IAT) sensor electrical connector.



G01728715

Fig. 60: Disconnecting Intake Air Temperature (IAT) Sensor
Courtesy of GENERAL MOTORS CORP.

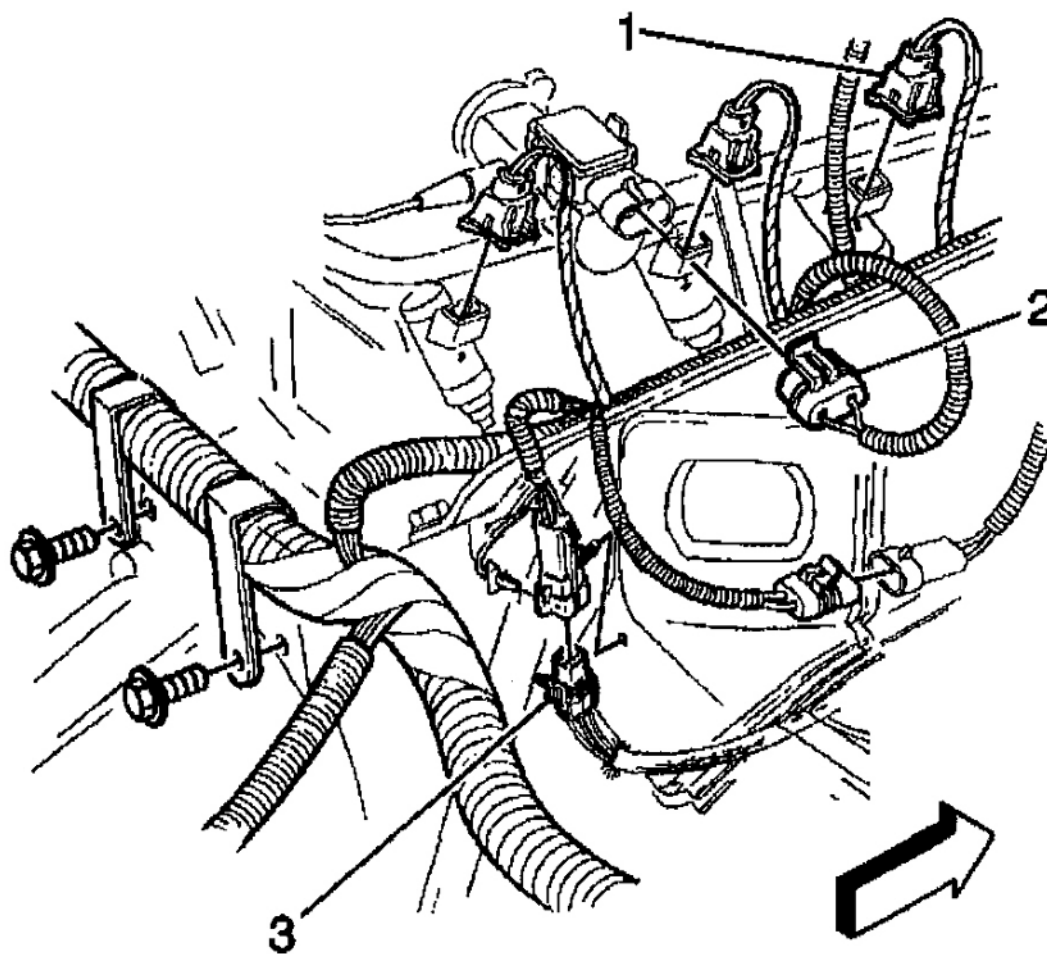
3. Remove the air intake duct.



G01728716

Fig. 61: Removing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

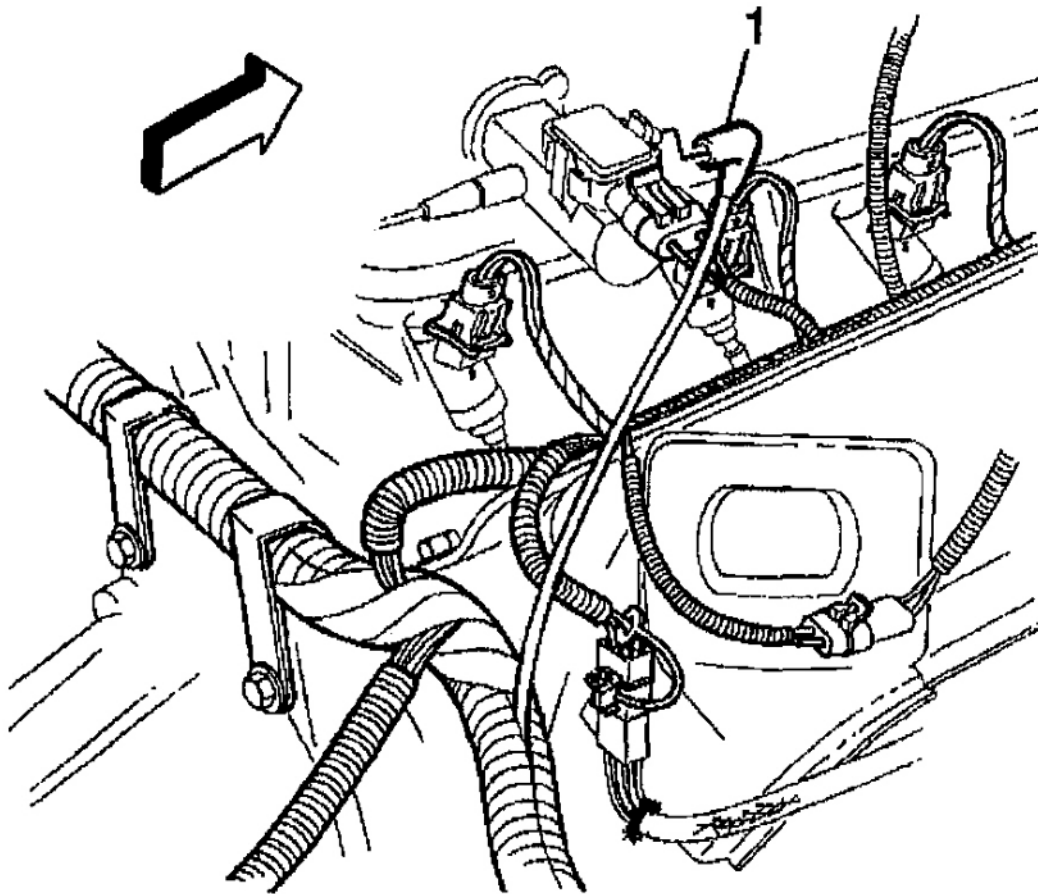
4. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
5. Disconnect the right side fuel injector electrical connectors (1) from the fuel injectors.



G01728717

Fig. 62: Disconnecting Right Side Fuel Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

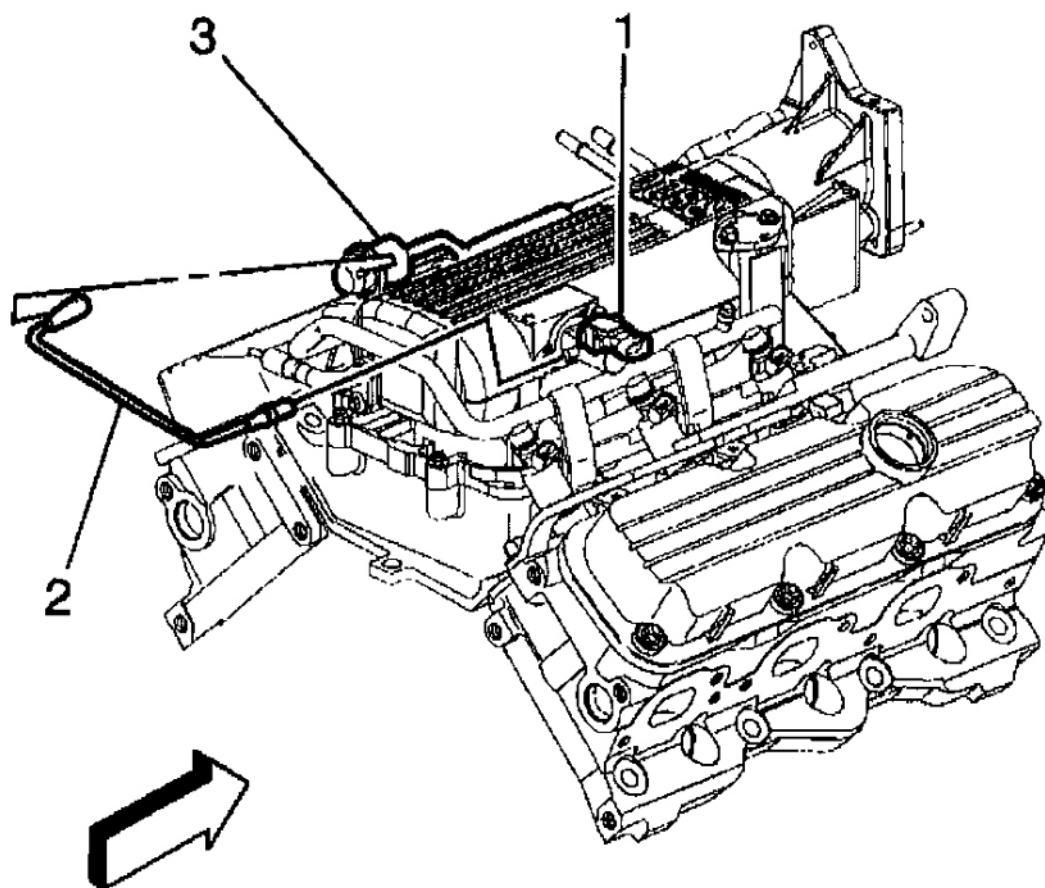
6. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (2).
7. Remove the engine harness vacuum tube (1) from the vacuum port.



G01728718

Fig. 63: Removing Engine Harness Vacuum Tube
Courtesy of GENERAL MOTORS CORP.

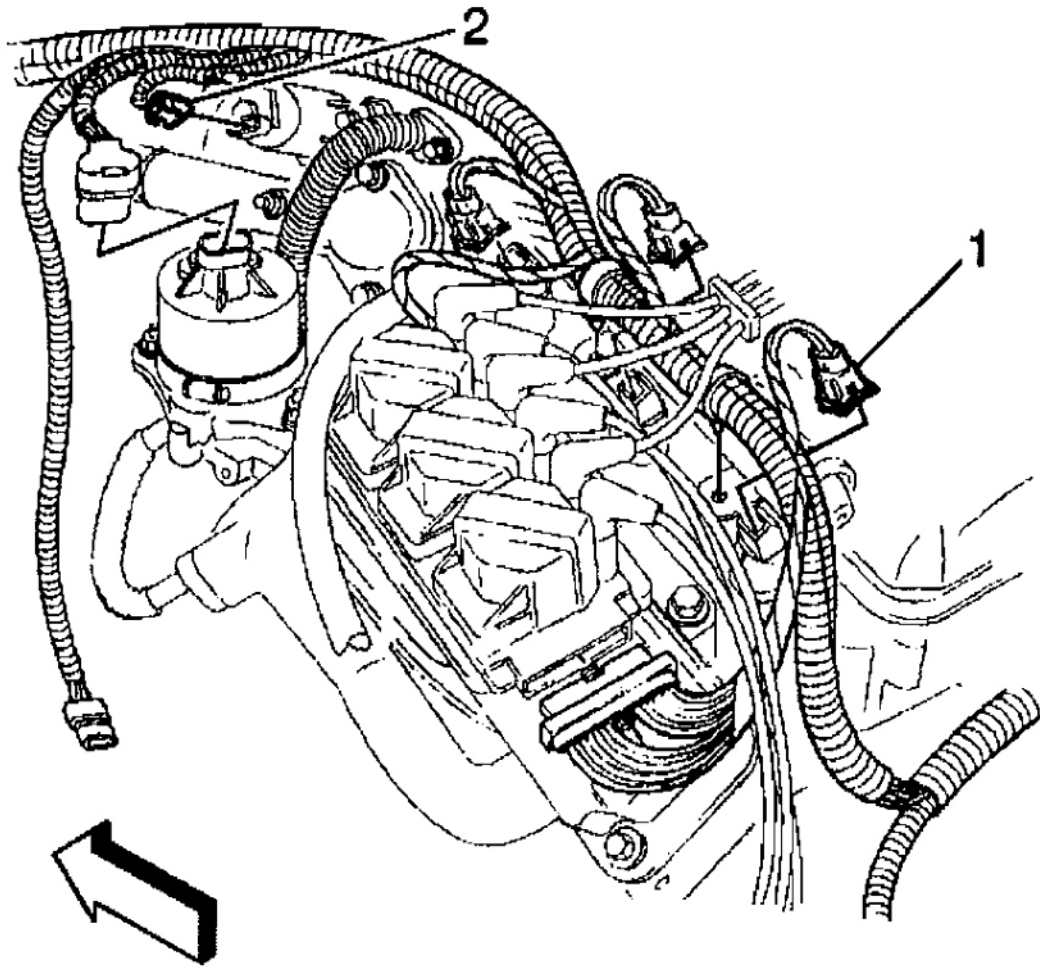
8. Remove the fuel pressure regulator tube (2) from the following components:
 - Manifold vacuum source (1)
 - Fuel pressure regulator valve (3)



G01728719

Fig. 64: Removing Fuel Pressure Regulator Tube
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the left side fuel injector electrical connectors (1) from the fuel injectors.

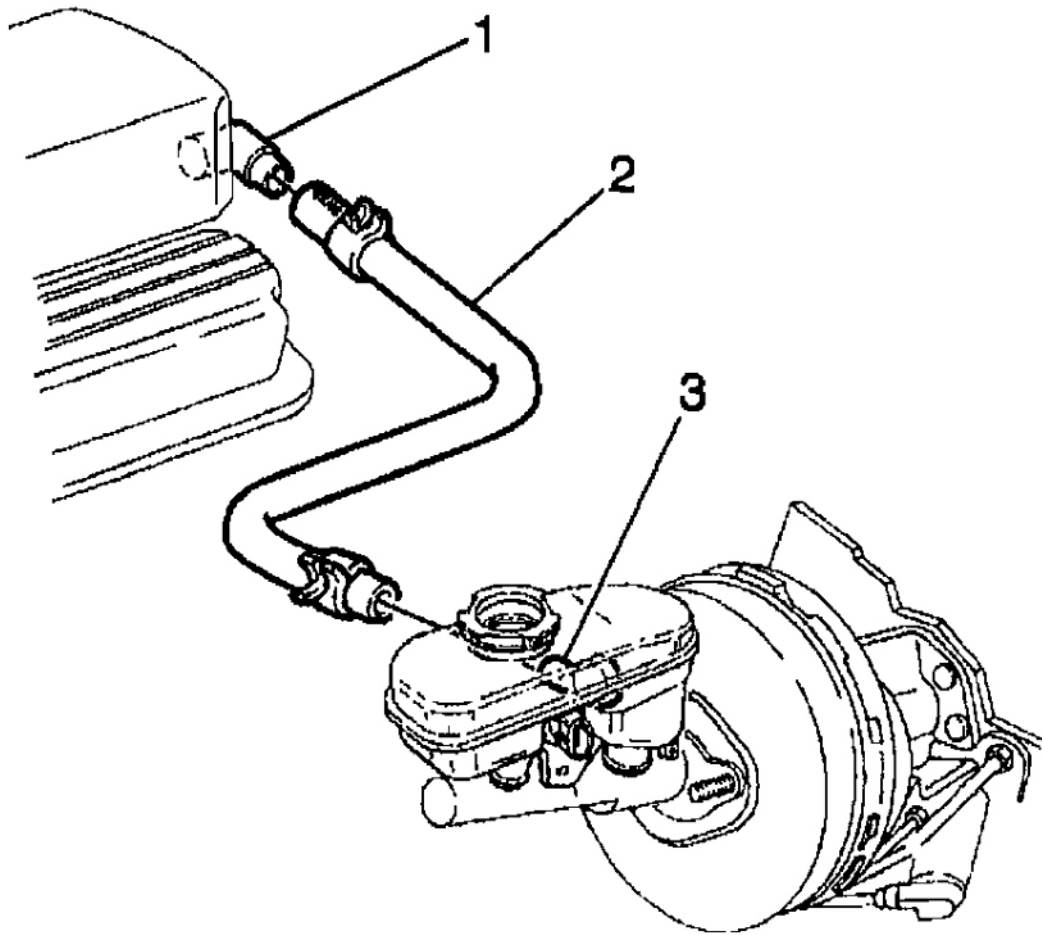


G01728720

Fig. 65: Disconnecting Left Side Fuel Injector Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

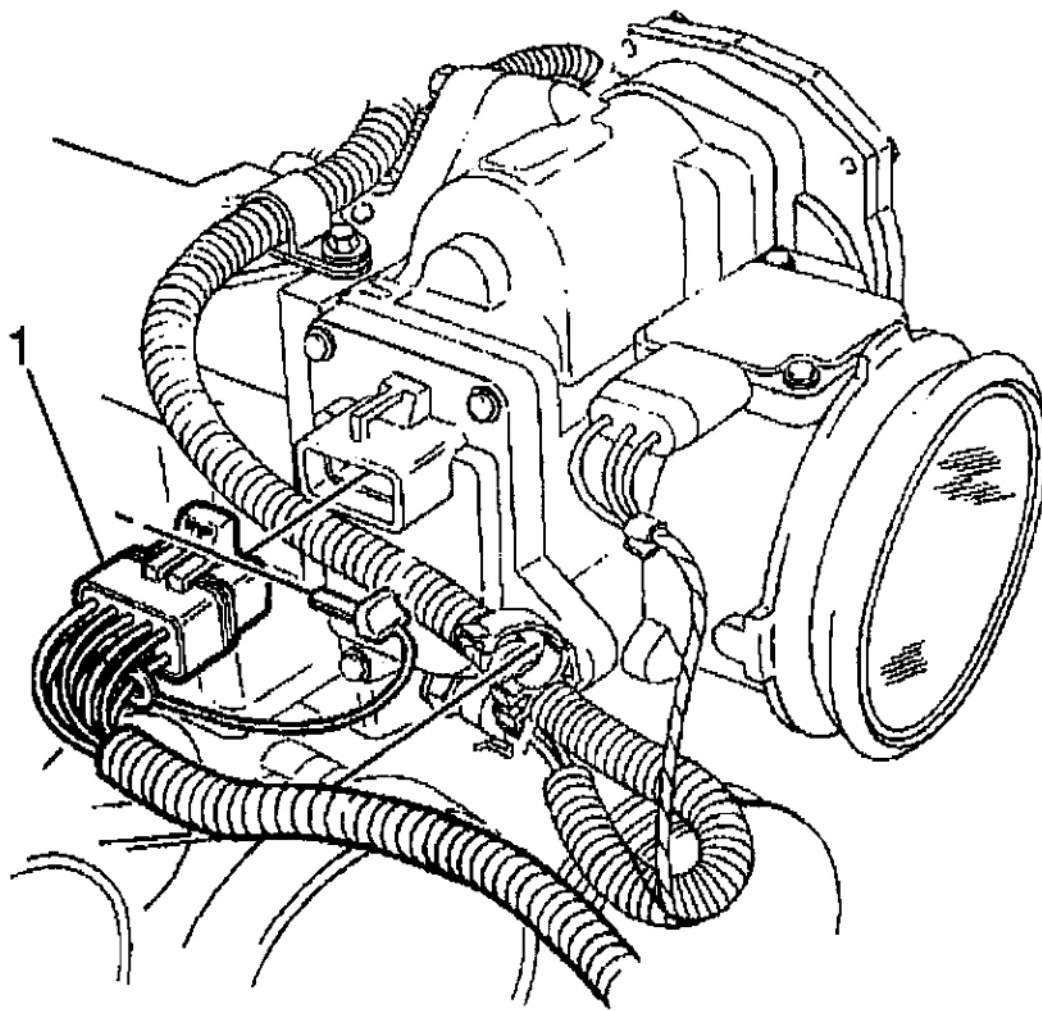
10. Disconnect the evaporative emission (EVAP) canister purge valve switch electrical connector (2).
11. Relieve the fuel pressure. Refer to **FUEL SYSTEM PRESSURE RELEASE**.
12. Disconnect the fuel lines from the fuel rail. Refer to **REMOVAL (QUICK-CONNECT FITTING - WITH METAL)**.
13. Disconnect the fuel vapor line from the EVAP canister purge valve. Refer to **REMOVAL (QUICK-CONNECT FITTING - WITH PLASTIC)**.
14. Remove the ignition control module. Refer to **IGNITION CONTROL MODULE**.
15. Reposition the brake booster hose clamp.
16. Remove the brake booster hose (2) from the upper intake manifold fitting (1).



G01728721

Fig. 66: Removing Brake Booster Hose
Courtesy of GENERAL MOTORS CORP.

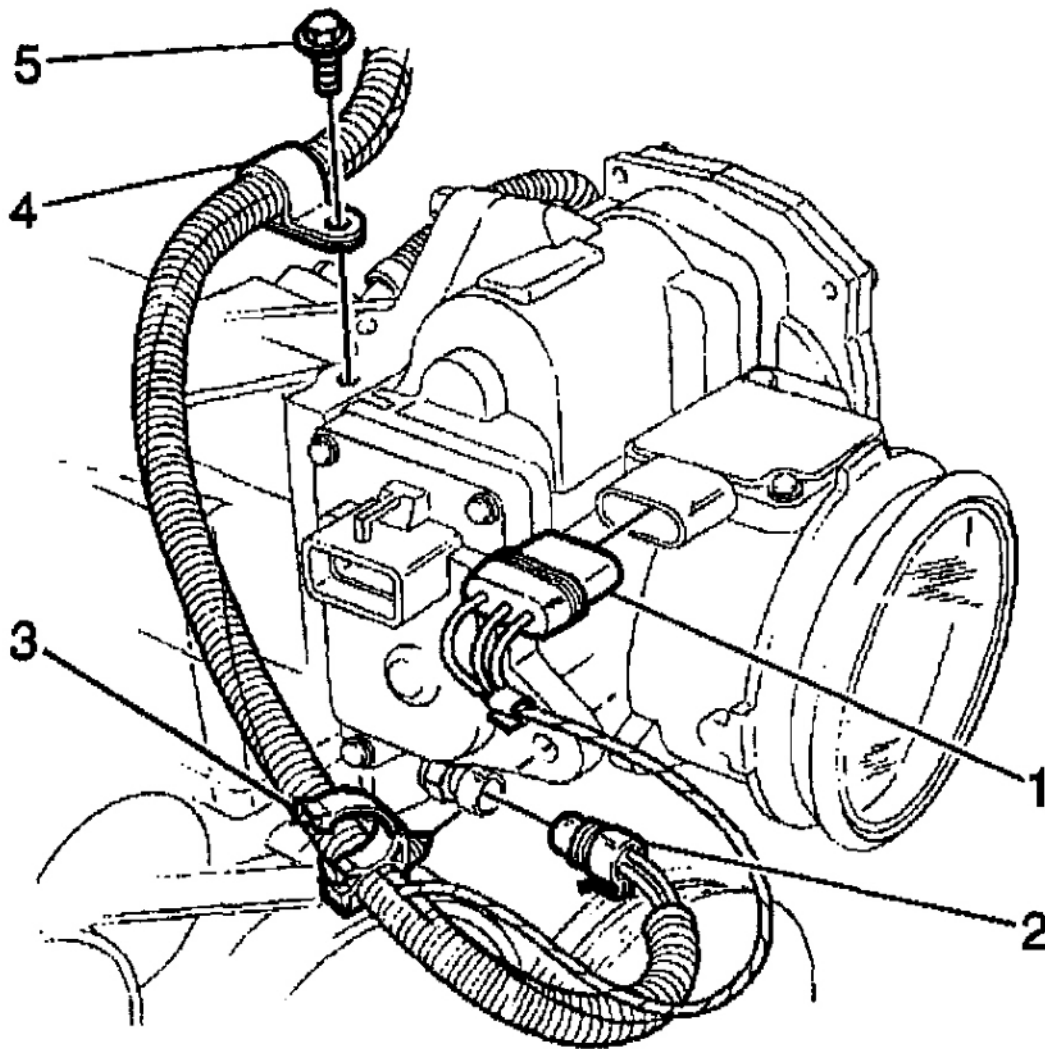
17. Disconnect the electronic throttle control (ETC) electrical connector (1).



G01728722

Fig. 67: Disconnecting Electronic Throttle Control (ETC) Electrical Connector
Courtesy of GENERAL MOTORS CORP.

18. Disconnect the following electrical connectors:
 - Mass airflow (MAF) sensor (1)

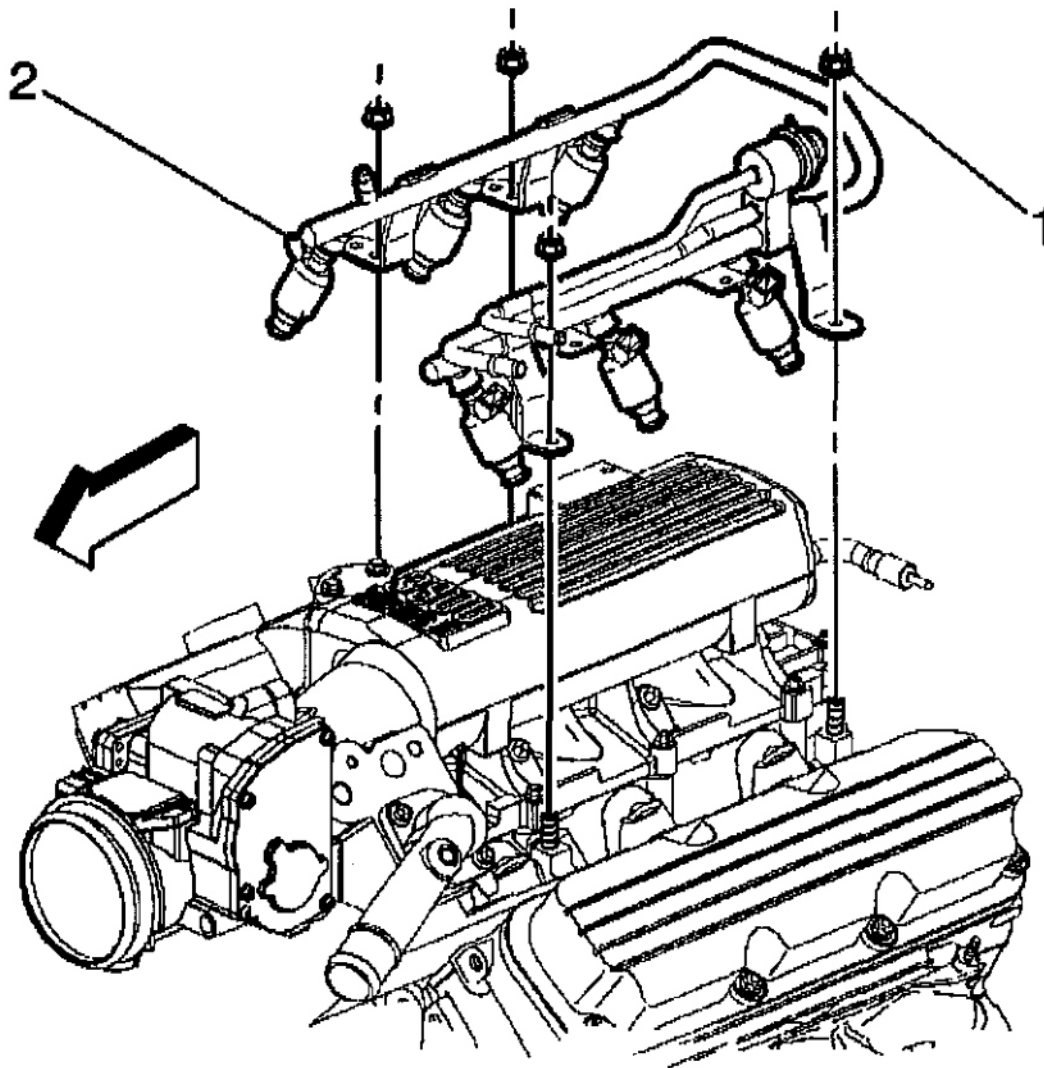


G01728723

Fig. 68: Disconnecting Mass Airflow (MAF) Sensor
Courtesy of GENERAL MOTORS CORP.

- Engine coolant temperature (ECT) sensor (2)
19. Remove the engine harness clip (3) from the throttle body.
 20. Remove the engine harness clamp bolt (5) and harness clamp (4).
 21. Reposition the engine wiring harness.
 22. Remove the thermostat housing. Refer to **THERMOSTAT HOUSING REPLACEMENT (3.8L ENGINE)**.
 23. Remove the wiring harness clips from the fuel rail.

24. Reposition the wiring harness.
25. Remove the fuel rail nuts (1).

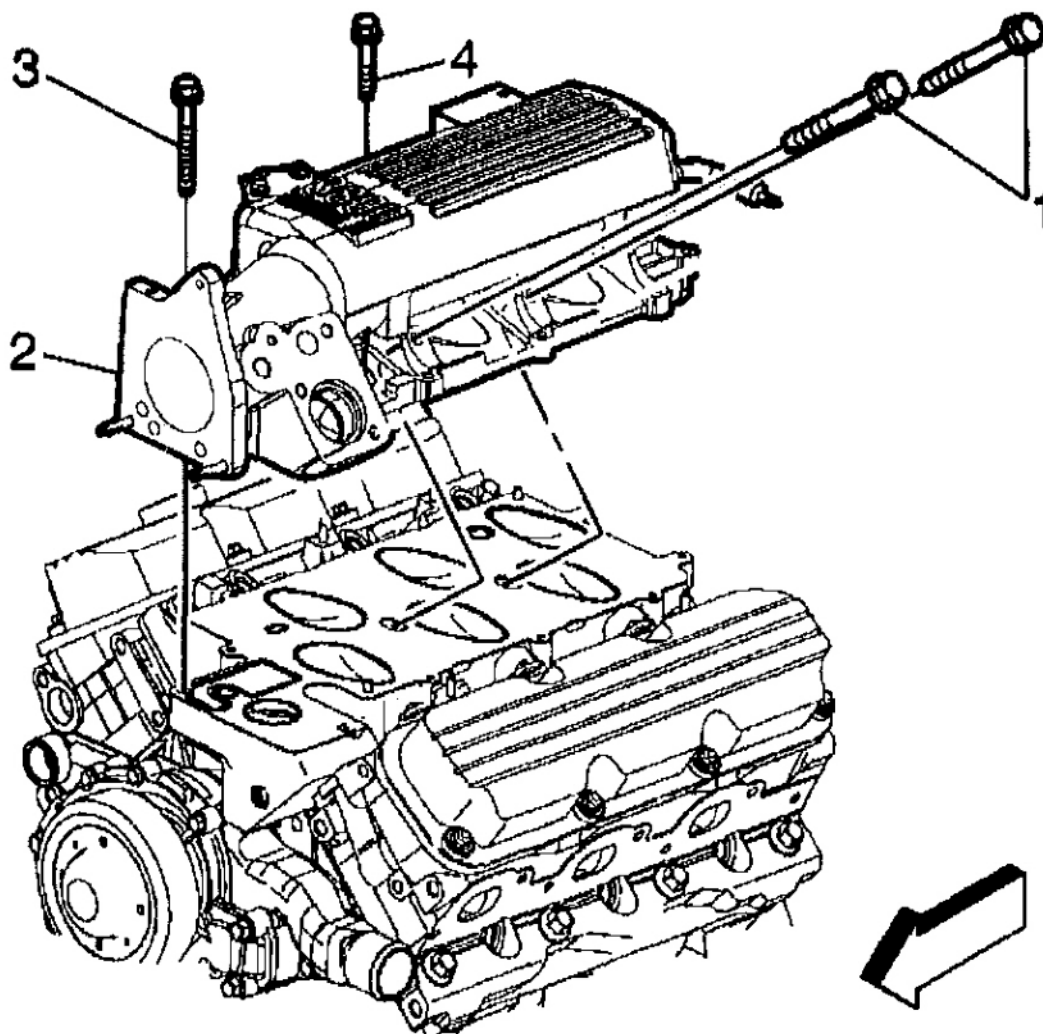


G01728724

Fig. 69: Removing Fuel Rail Nuts
Courtesy of GENERAL MOTORS CORP.

Important: Clean any dirt out of the injector bores with compressed air.

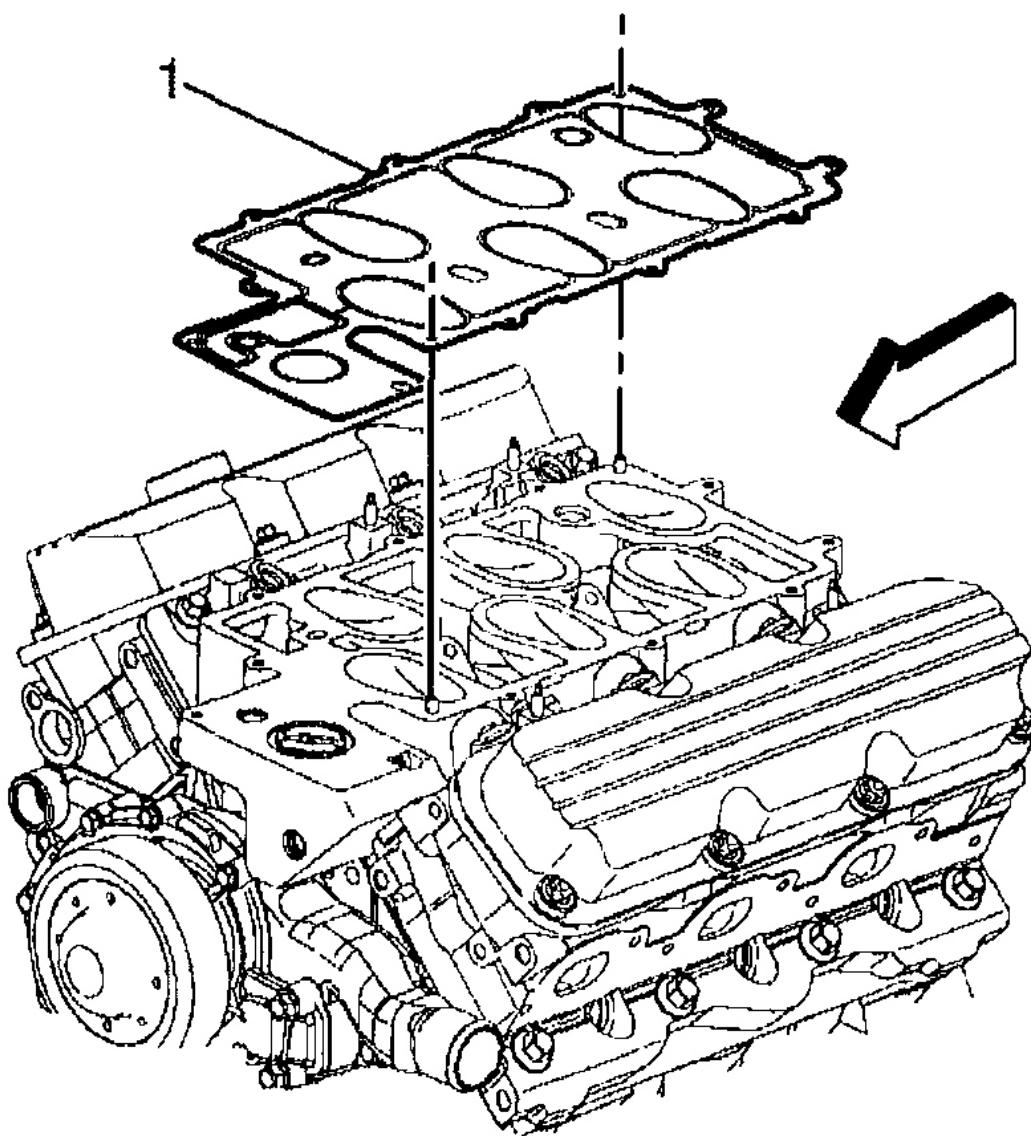
26. Remove the fuel rail (2) from the upper intake manifold.
27. Remove the upper intake manifold bolts (1, 3, 4).



G01728725

Fig. 70: Removing Upper Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

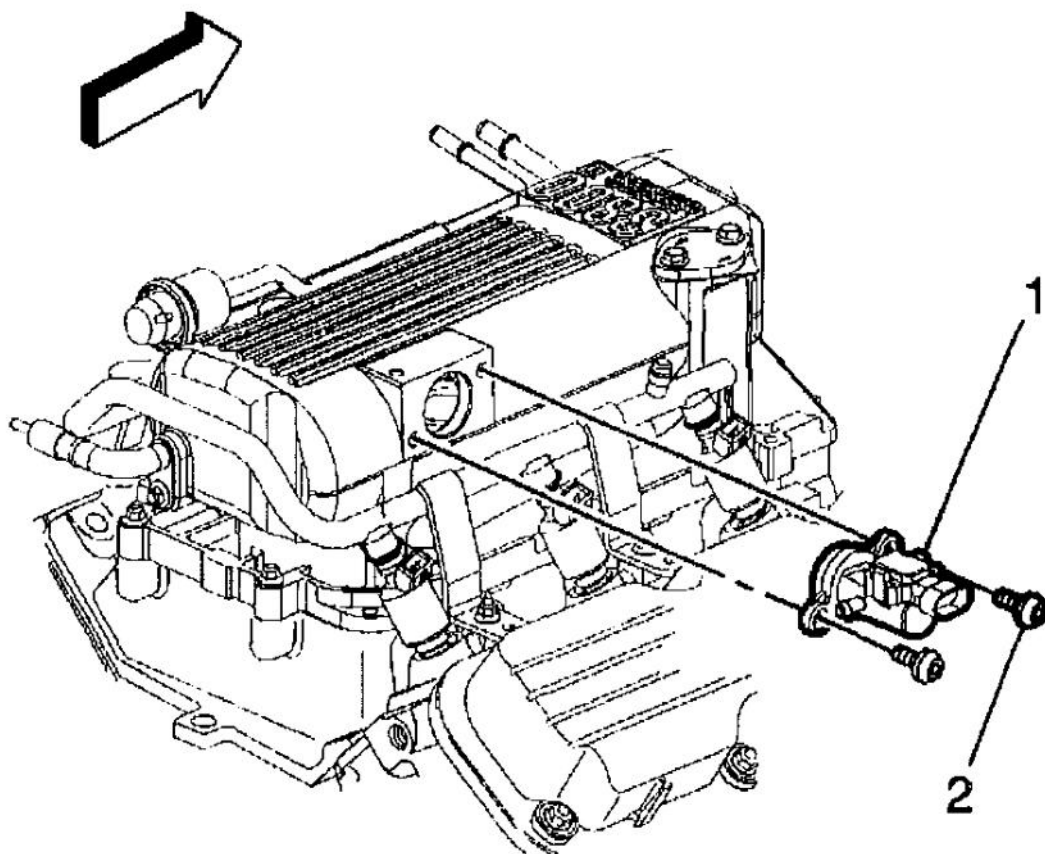
28. Remove the upper intake manifold (2).
29. Remove the upper intake manifold gasket (1).
30. Clean the upper and lower intake manifold mating surfaces.



G01728726

Fig. 71: Cleaning Upper And Lower Intake Manifold Mating Surfaces
Courtesy of GENERAL MOTORS CORP.

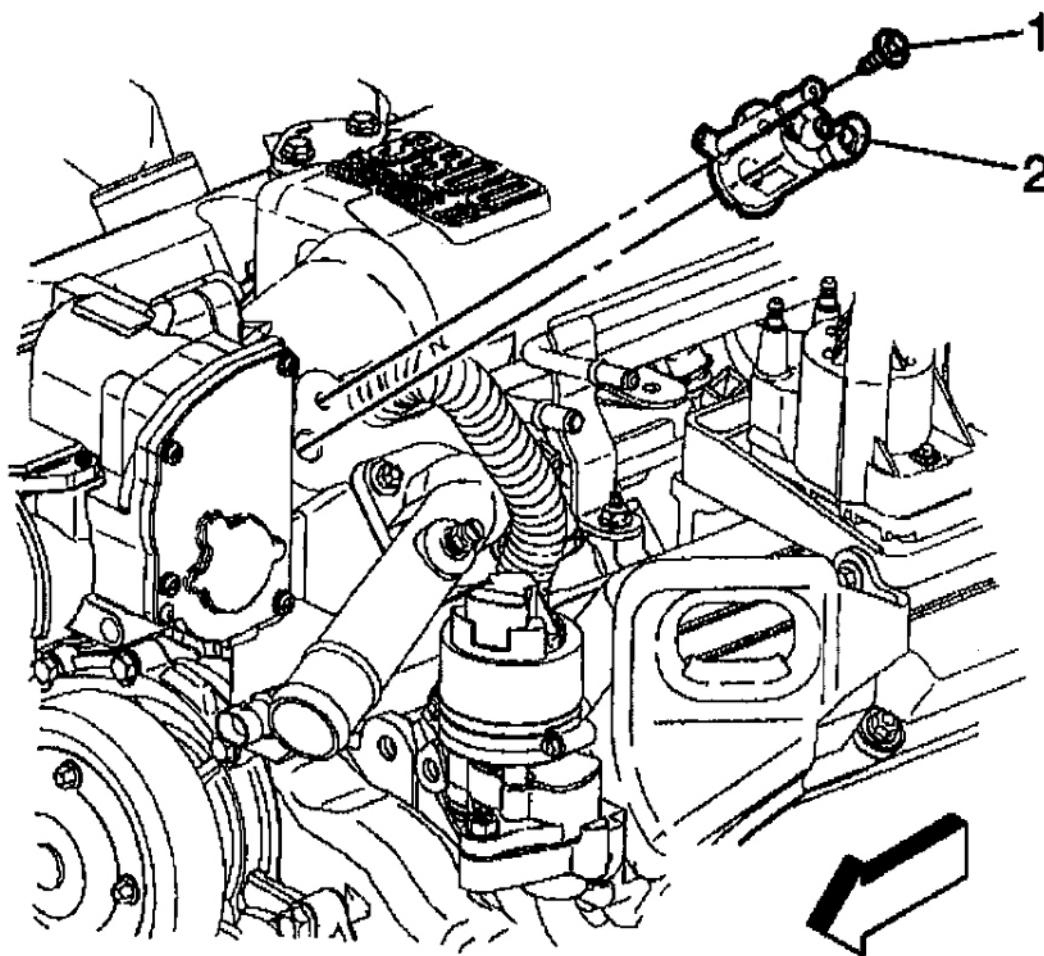
31. If replacing the manifold remove the manifold vacuum source screws (2) and manifold vacuum source (1).



G01728727

Fig. 72: Removing Manifold Vacuum Source Screws And Manifold Vacuum Source
Courtesy of GENERAL MOTORS CORP.

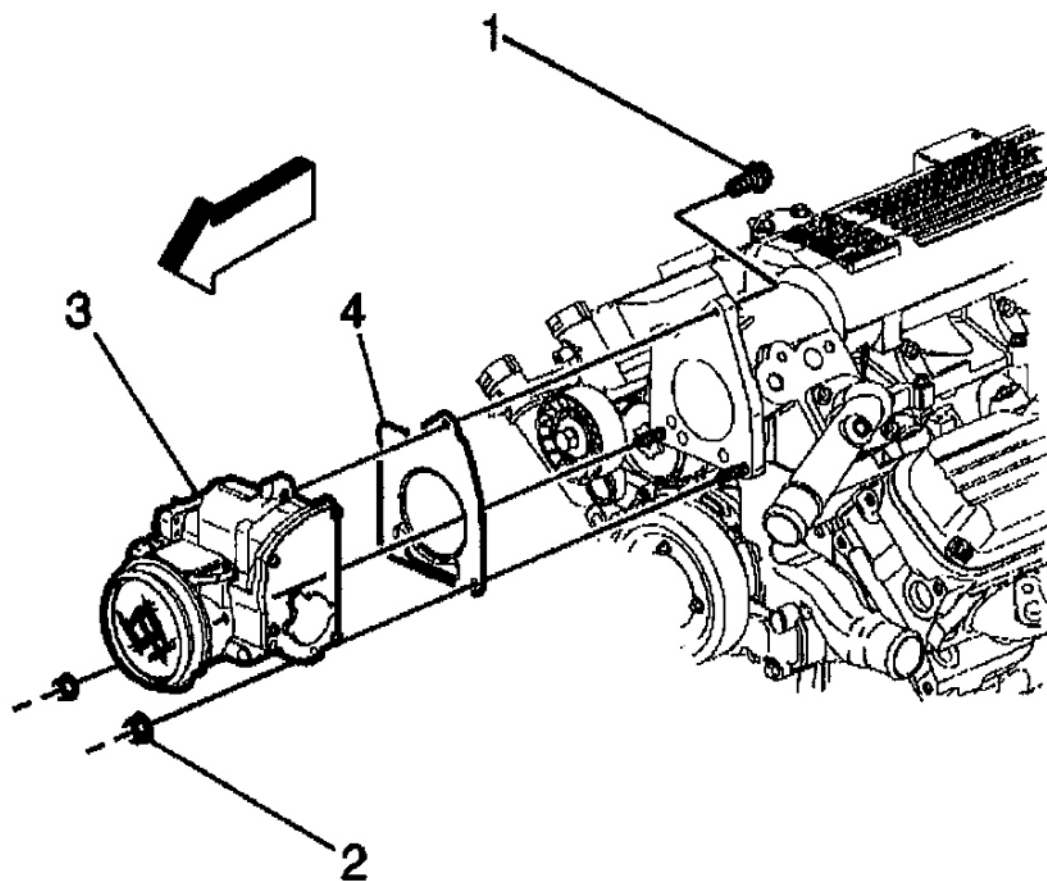
32. If replacing the manifold remove the EVAP purge valve bolts (1) and purge valve (2).



G01728728

Fig. 73: Removing EVAP Purge Valve Bolts
Courtesy of GENERAL MOTORS CORP.

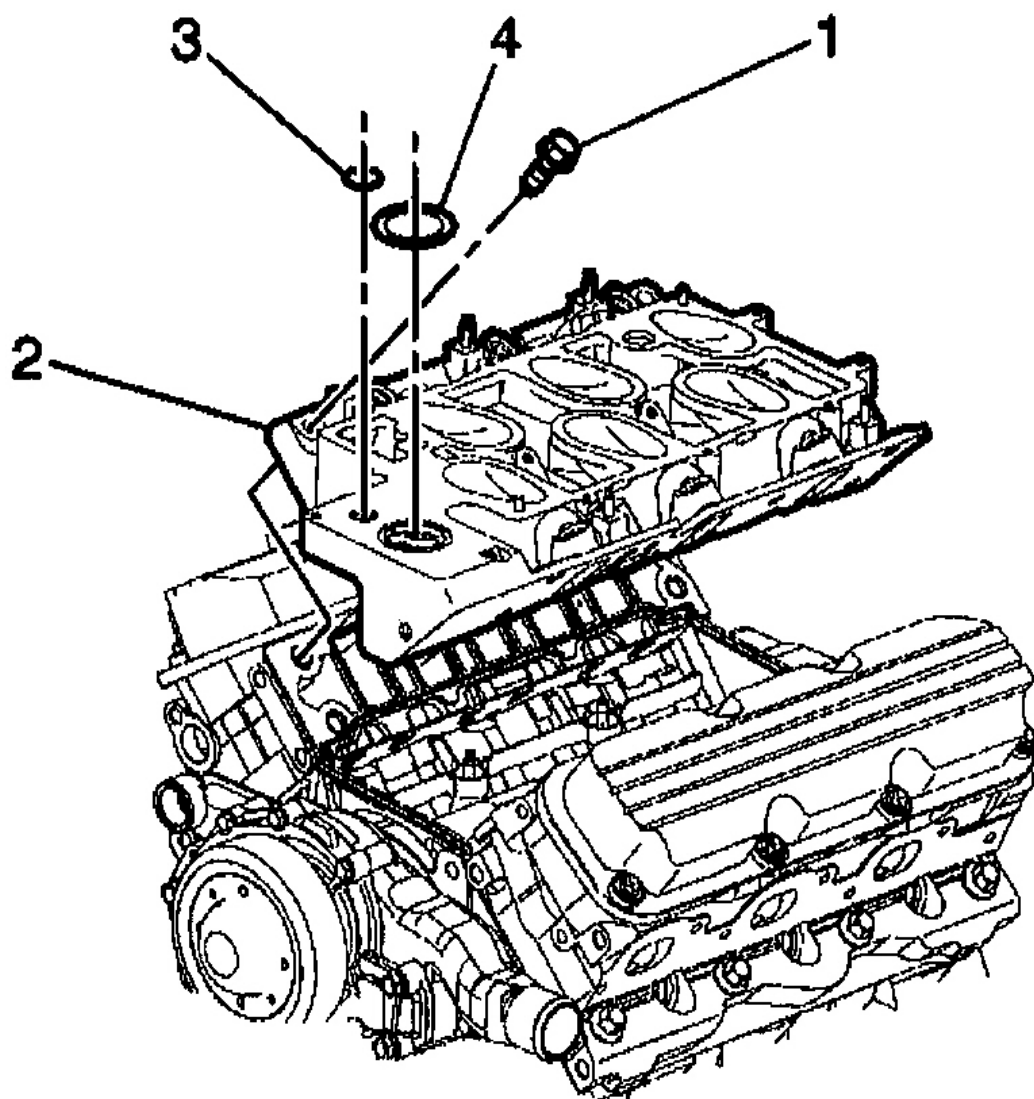
33. If replacing the manifold bolt (1), nuts (2), throttle body (3) and gasket (4).



G01728729

Fig. 74: Remove Throttle Body
 Courtesy of GENERAL MOTORS CORP.

34. Remove lower intake manifold O-rings seals (3, 4), if necessary.

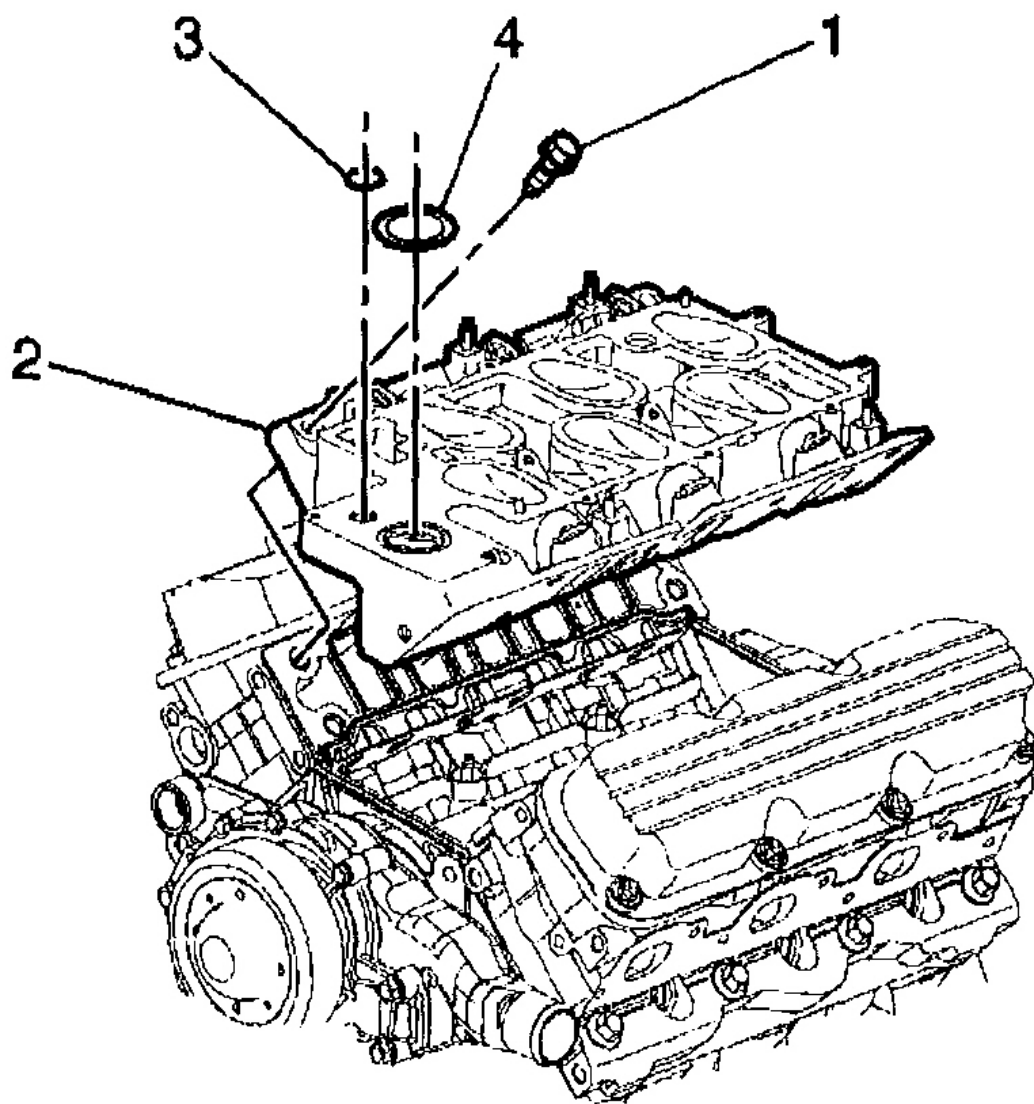


G01728730

Fig. 75: Removing Lower Intake Manifold O-Rings Seals
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

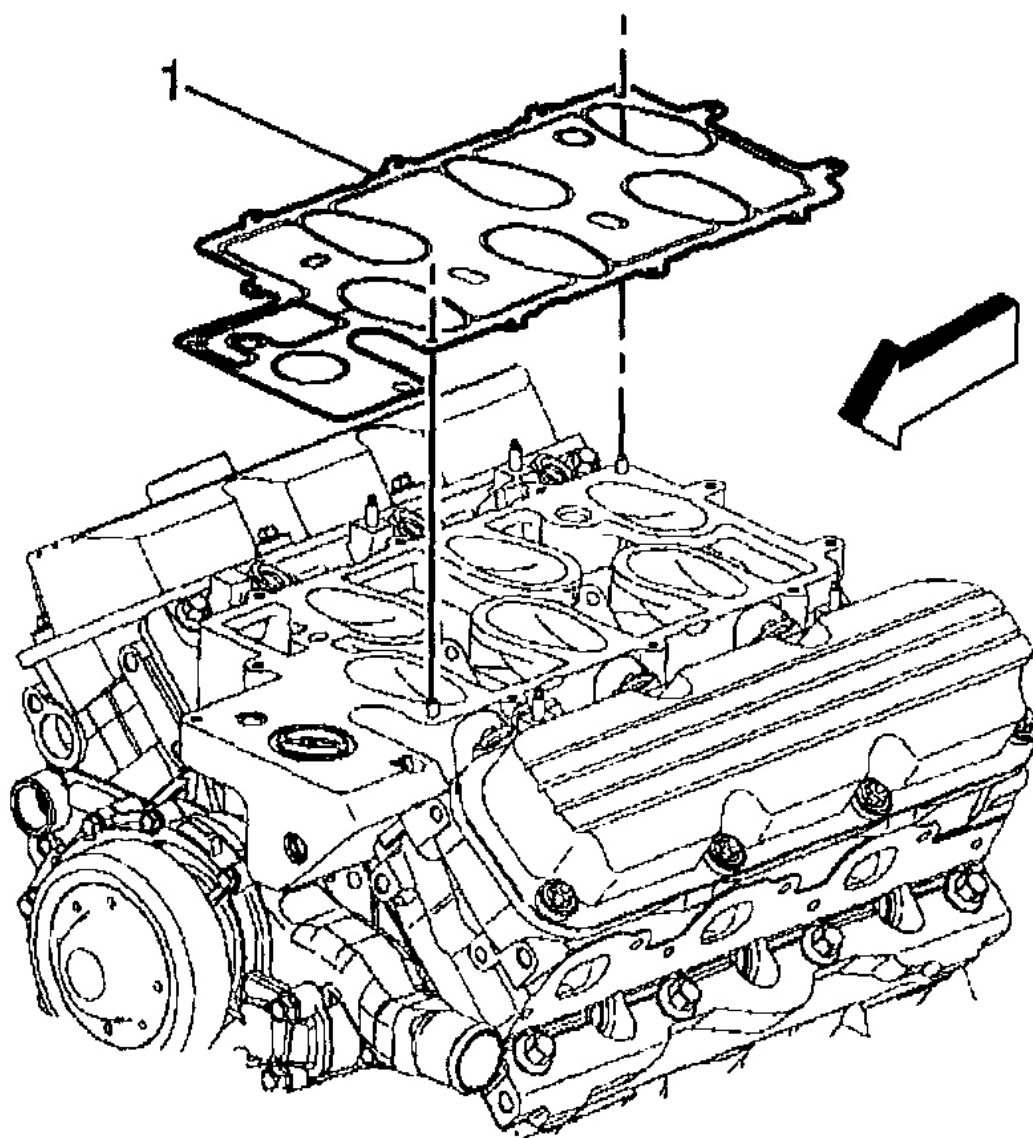
1. Install new lower intake manifold O-ring seal (3, 4), if removed.



G01728731

Fig. 76: Installing New Lower Intake Manifold O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

2. Install the upper intake manifold gasket (1).



G01728732

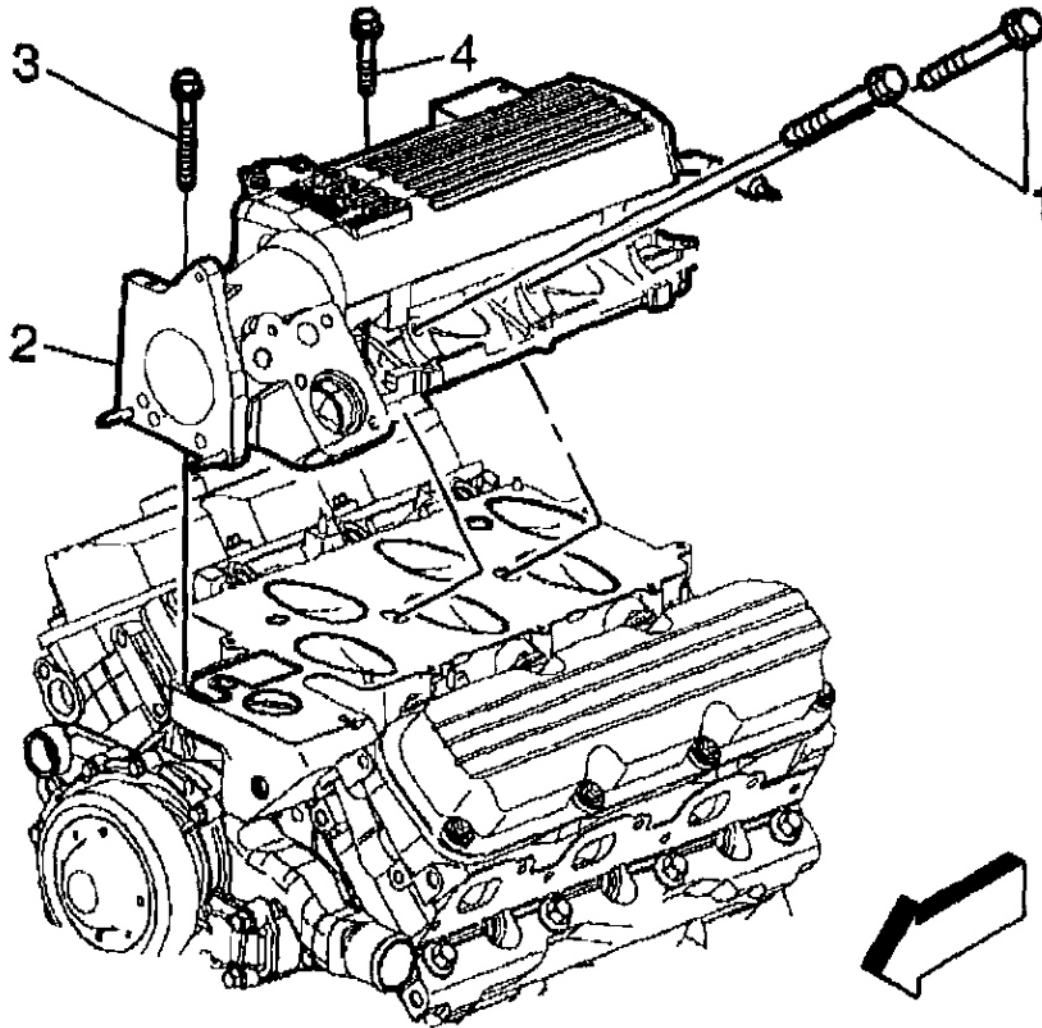
Fig. 77: Installing Upper Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install the upper intake manifold (2) onto the lower intake manifold.
4. Install the upper intake manifold bolts (1, 3, 4).

Tighten

- Tighten the 9 upper intake manifold bolts (4) to 15 N.m (11 lb ft).

- Tighten the 2 upper intake manifold bolts (1) to 30 N.m (22 lb ft).
- Tighten the upper intake manifold bolt (3) to 15 N.m (11 lb ft).



G01728733

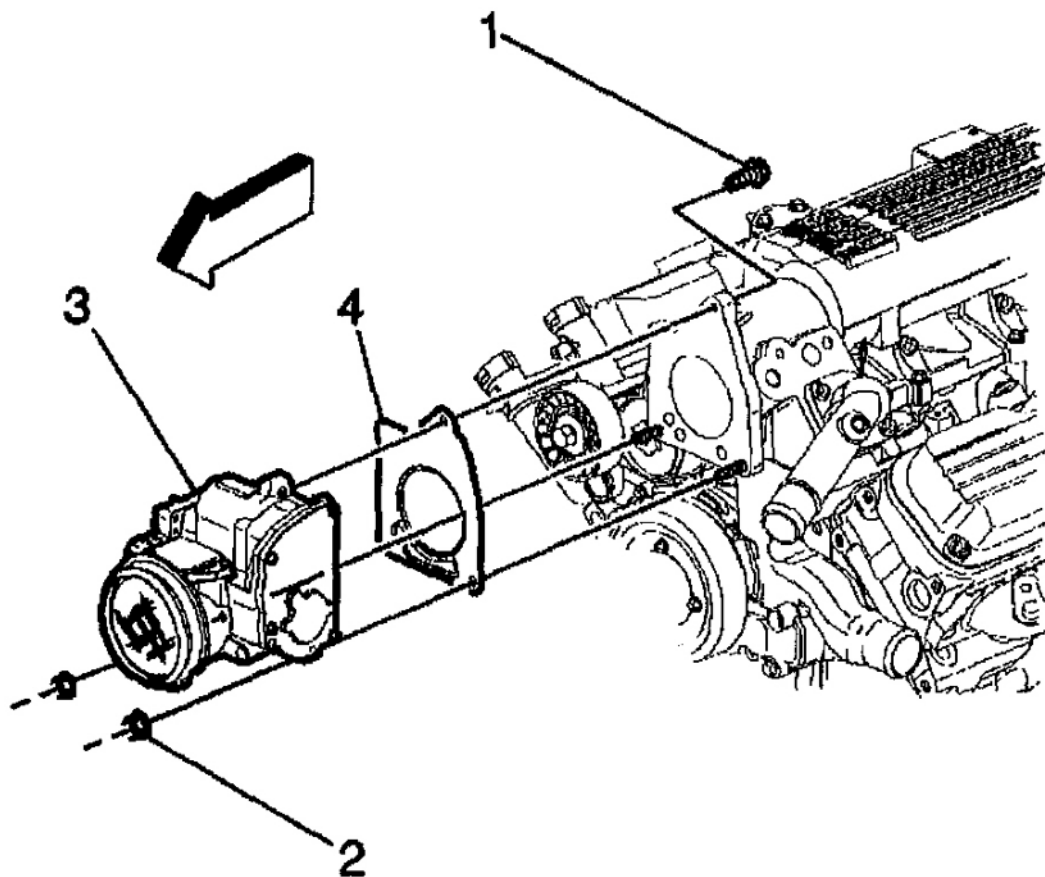
Fig. 78: Installing Upper Intake Manifold Bolts

Courtesy of GENERAL MOTORS CORP.

5. If the upper intake manifold was replaced install the throttle body gasket (4) and the throttle body (3).
6. Install the throttle body bolt (1) and nuts (2).

Tighten

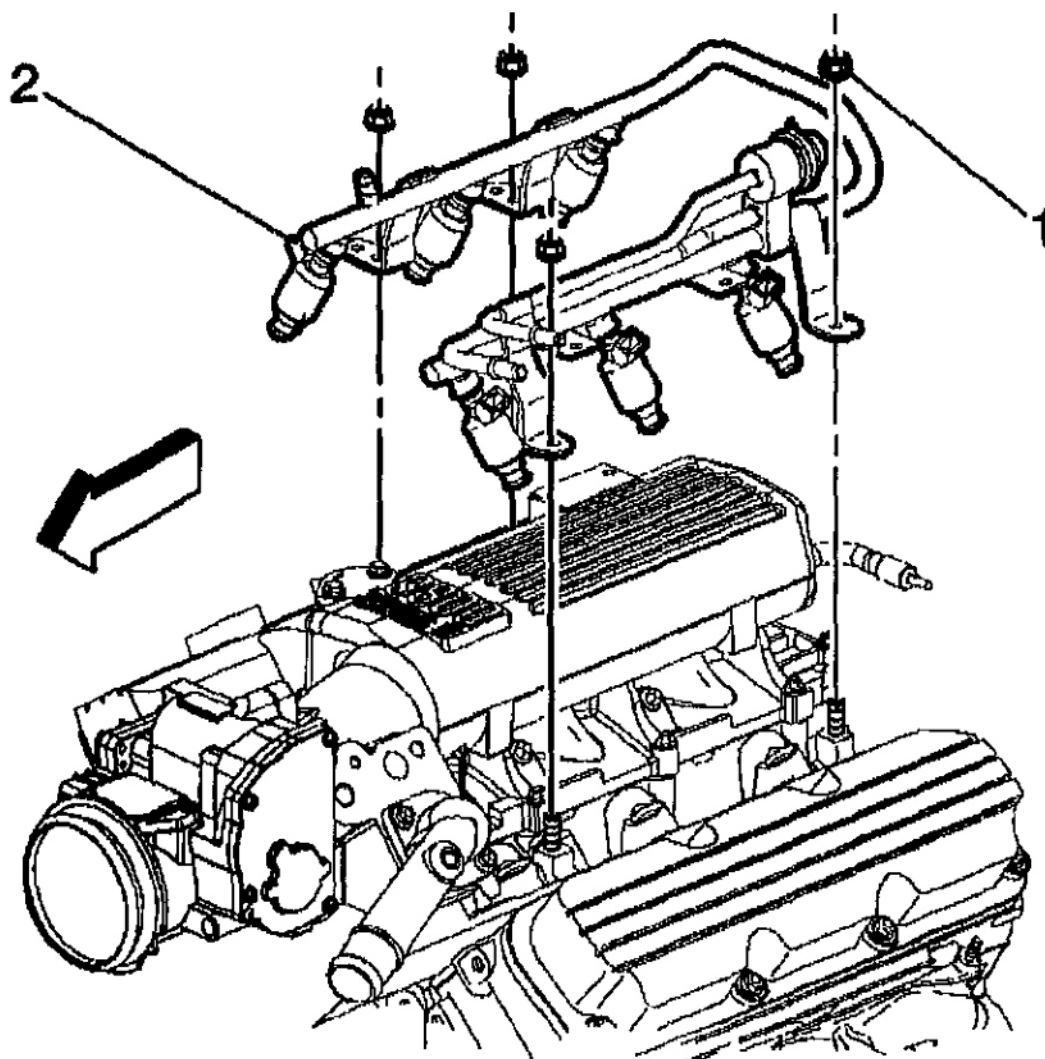
- Tighten the throttle body nuts (2) to 10 N.m (89 lb in).
- Tighten the throttle body bolt (1) to 10 N.m (89 lb in).



G01728734

Fig. 79: Installing Throttle Body Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the fuel rail (2) to the upper intake manifold.



G01728735

Fig. 80: Installing Fuel Rail

Courtesy of GENERAL MOTORS CORP.

8. Install the fuel rail nuts (1).

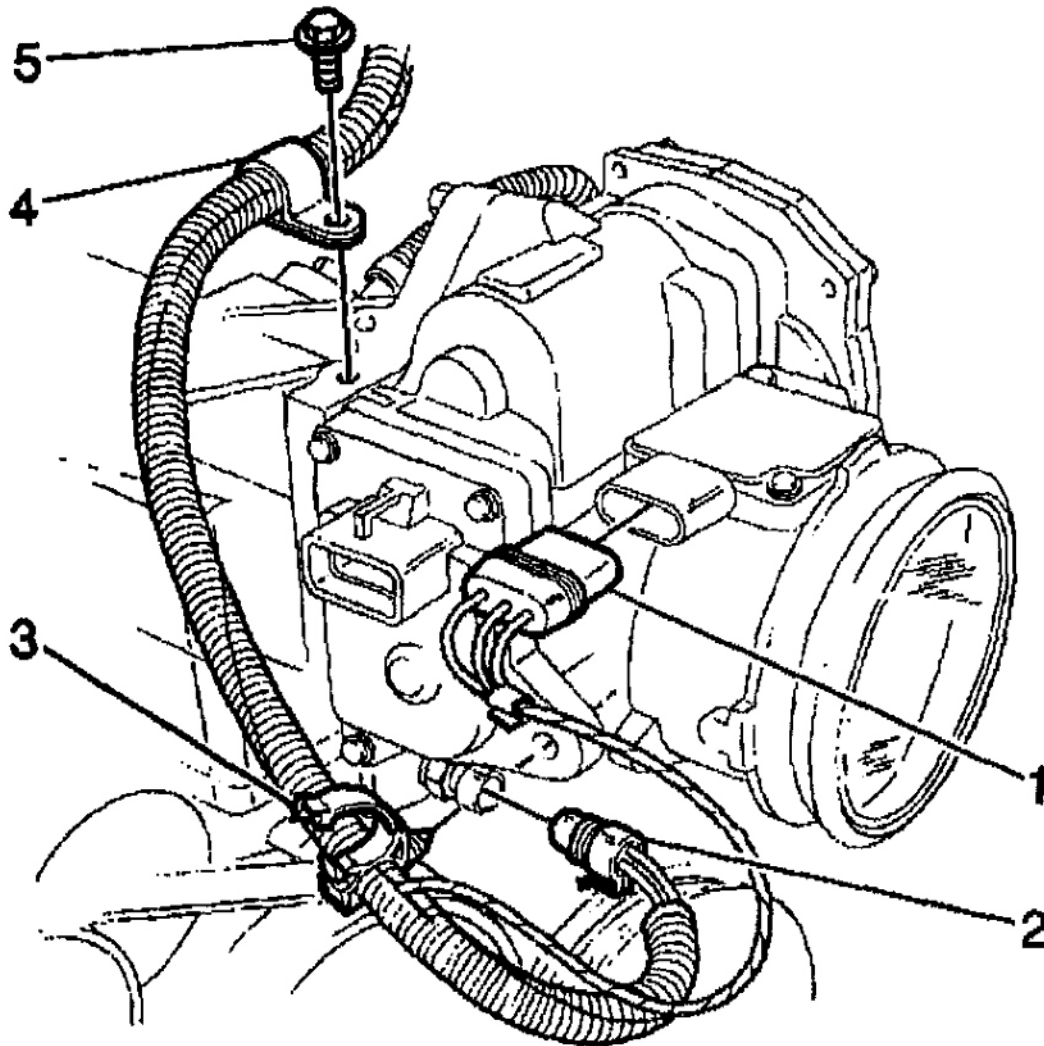
Tighten

Tighten the fuel rail nuts (1) to 9 N.m (80 lb in).

9. Install the wiring harness clips to the fuel rail.
10. Install the thermostat housing. Refer to **THERMOSTAT HOUSING REPLACEMENT (3.8L**

ENGINE)

11. Reposition the engine wiring harness.
12. Install the engine harness clamp (4) and harness clamp bolt (5).



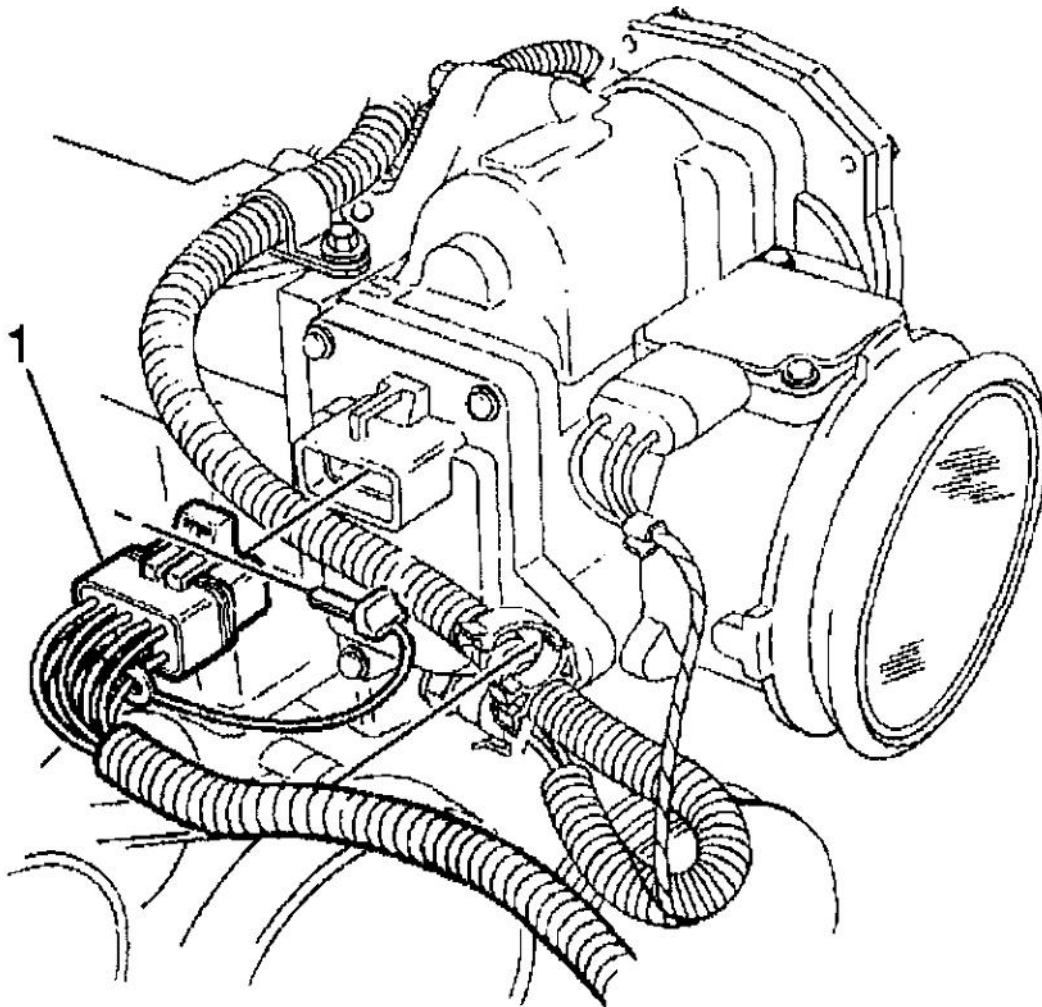
G01728736

Fig. 81: Installing Engine Harness Clamp And Harness Clamp Bolt
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the harness clamp bolt (5) to 6 N.m (53 lb in).

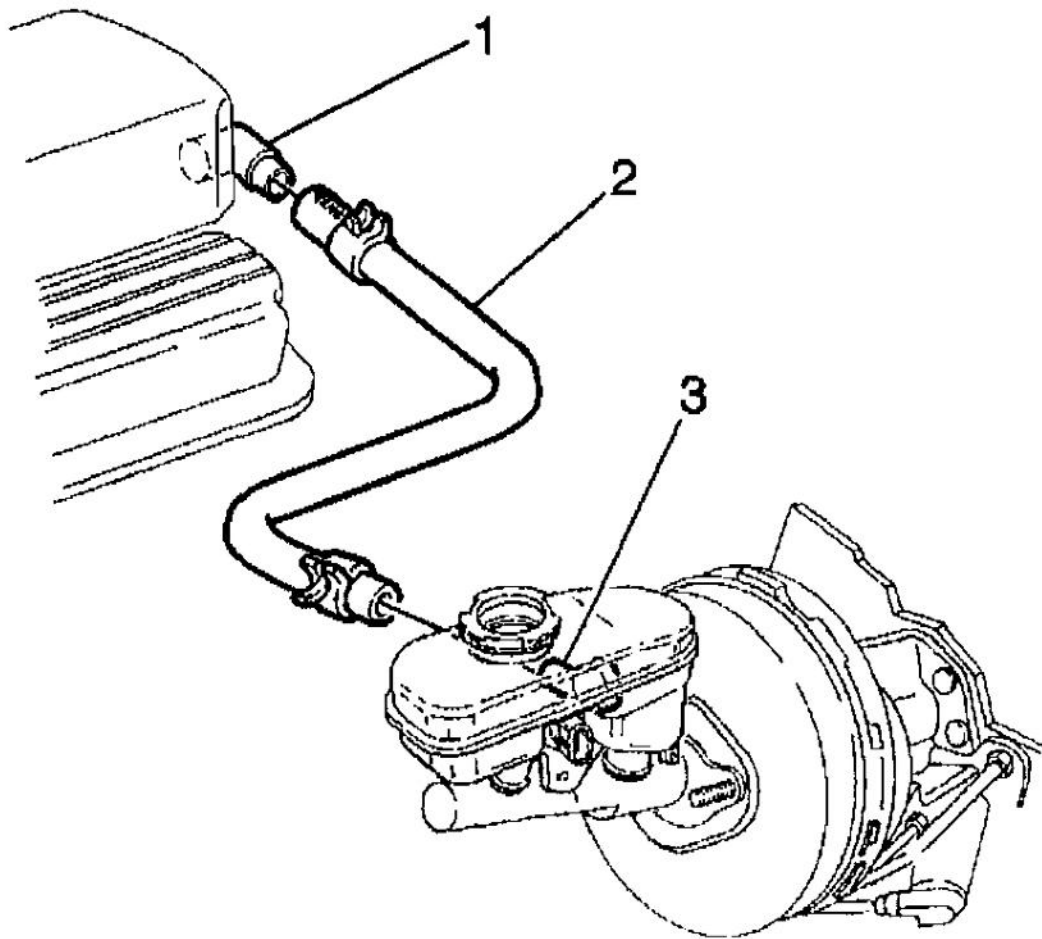
13. Install the engine harness clip (3) to the throttle body.
14. Connect the following electrical connectors:
 - MAF sensor (1)
 - ECT sensor (2)
15. Connect the ETC electrical connector (1).



G01728737

Fig. 82: Connecting ETC Electrical Connector
Courtesy of GENERAL MOTORS CORP.

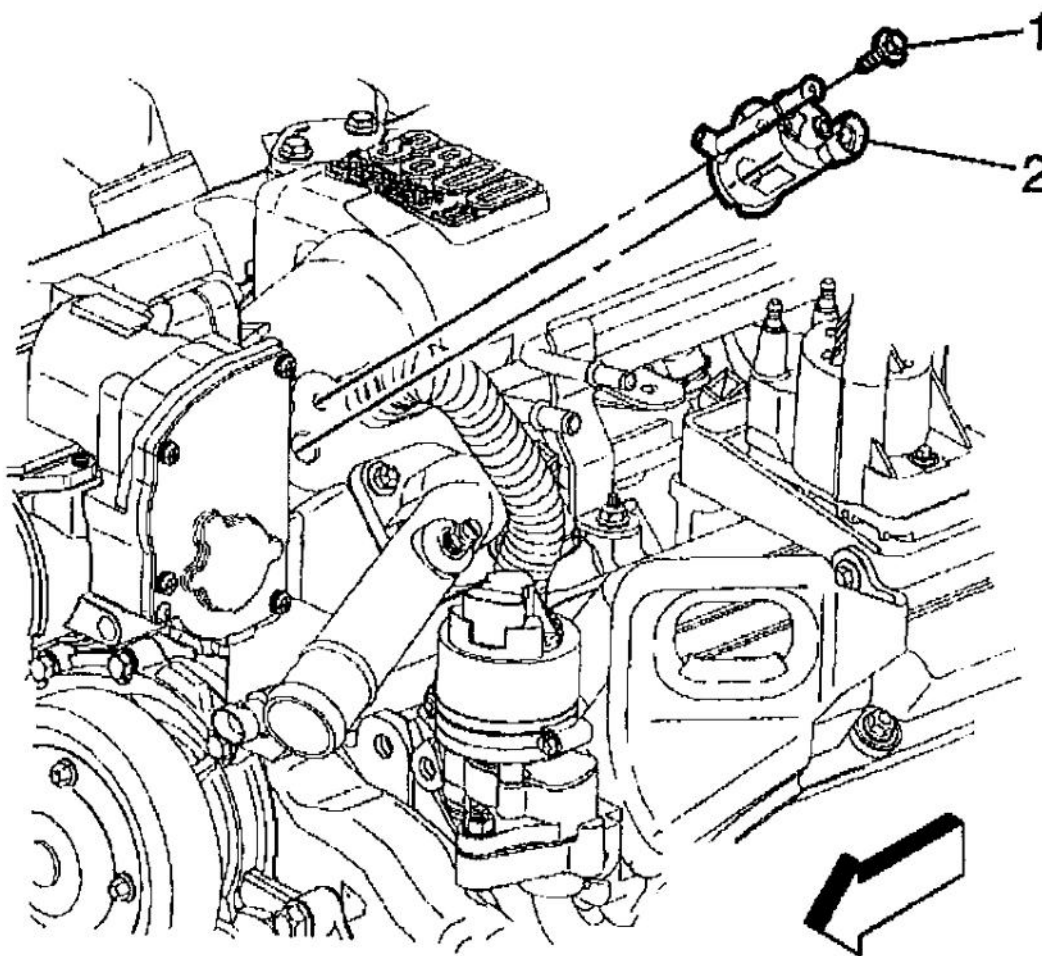
16. Install the brake booster hose (2) to the upper intake manifold fitting (1).



G01728738

Fig. 83: Installing Brake Booster Hose
 Courtesy of GENERAL MOTORS CORP.

17. Position the brake booster hose clamp.
18. Install the ignition control module. Refer to **IGNITION CONTROL MODULE** .
19. If the upper intake manifold was replaced install the EVAP canister purge valve (2) to the upper intake manifold.



G01728739

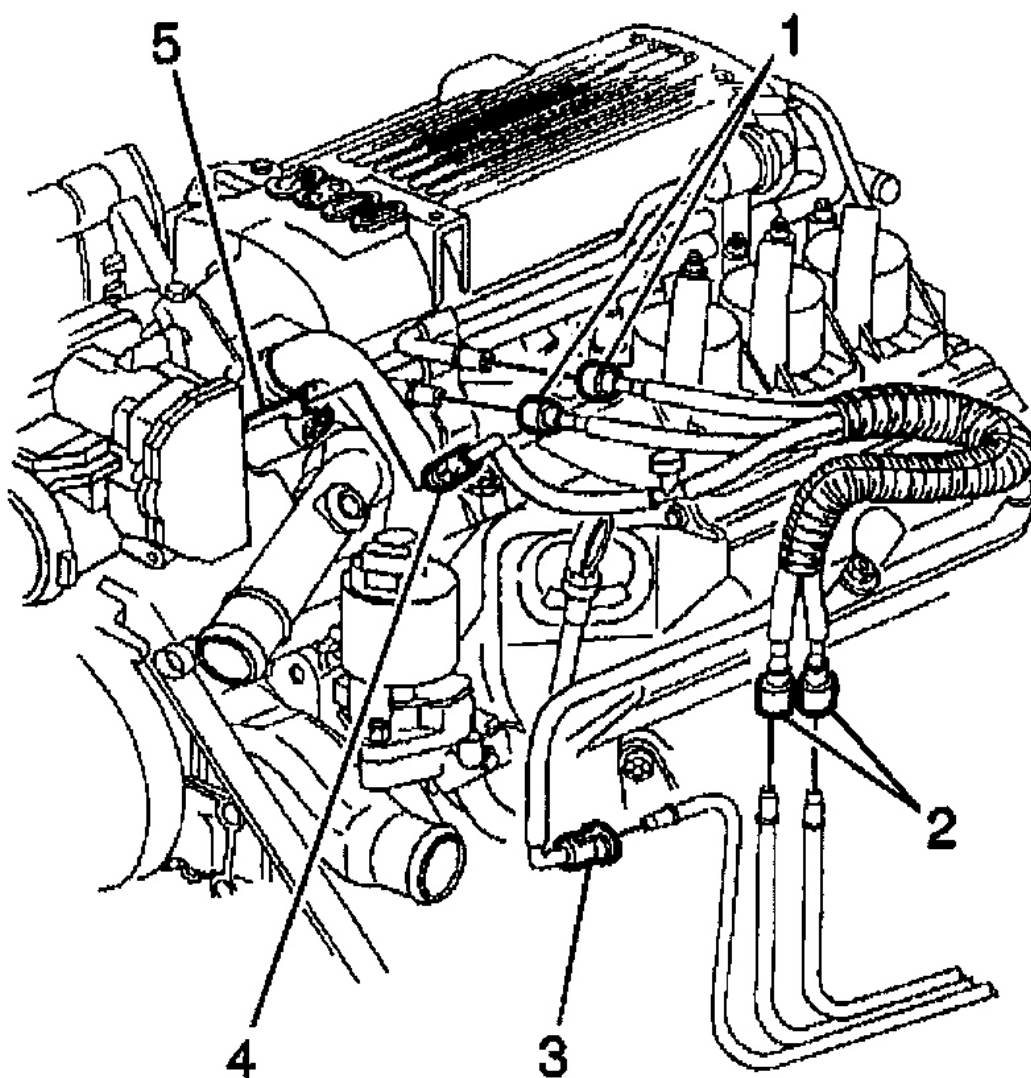
Fig. 84: Install EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

20. Install the EVAP canister purge valve bolts (1).

Tighten

Tighten the EVAP canister purge valve bolts (1) to 10 N.m (89 lb in).

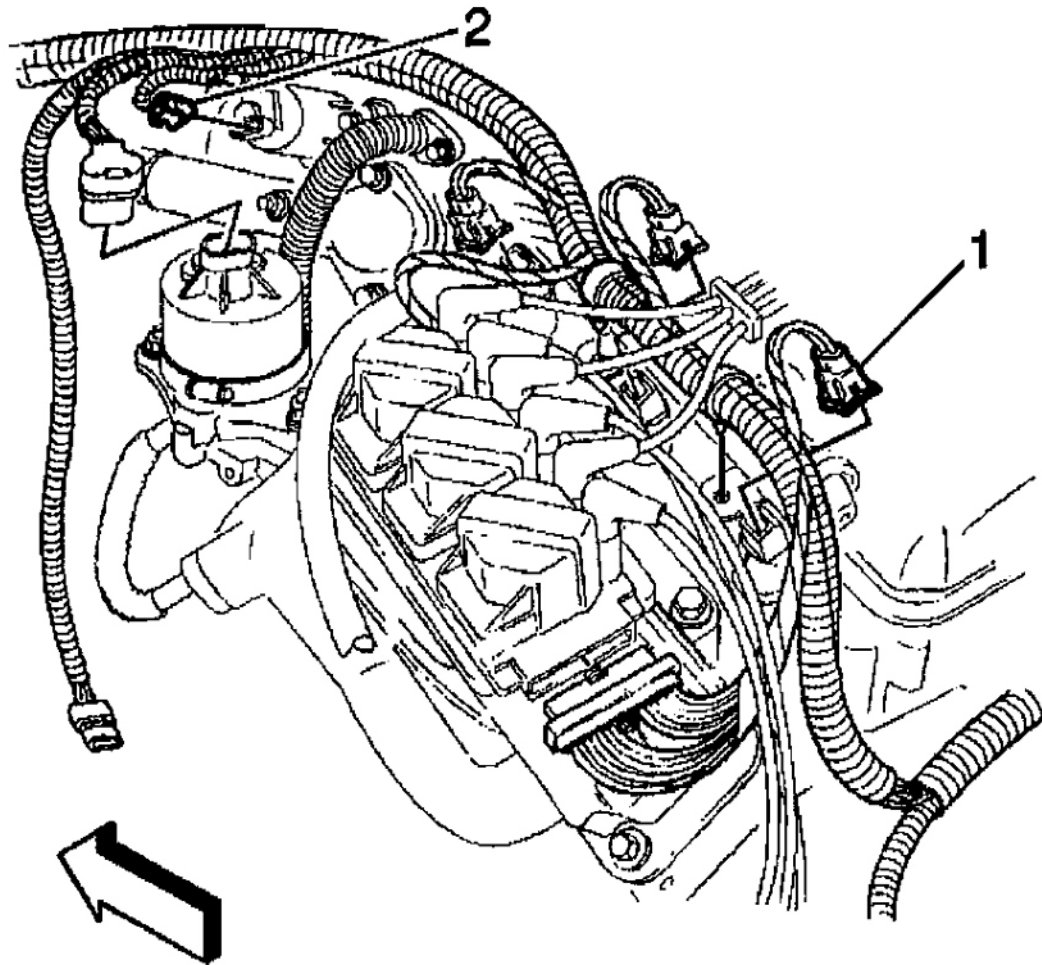
21. Install the fuel vapor line (4) to the EVAP canister purge valve (5).



G01728740

Fig. 85: Installing Fuel Vapor Line
Courtesy of GENERAL MOTORS CORP.

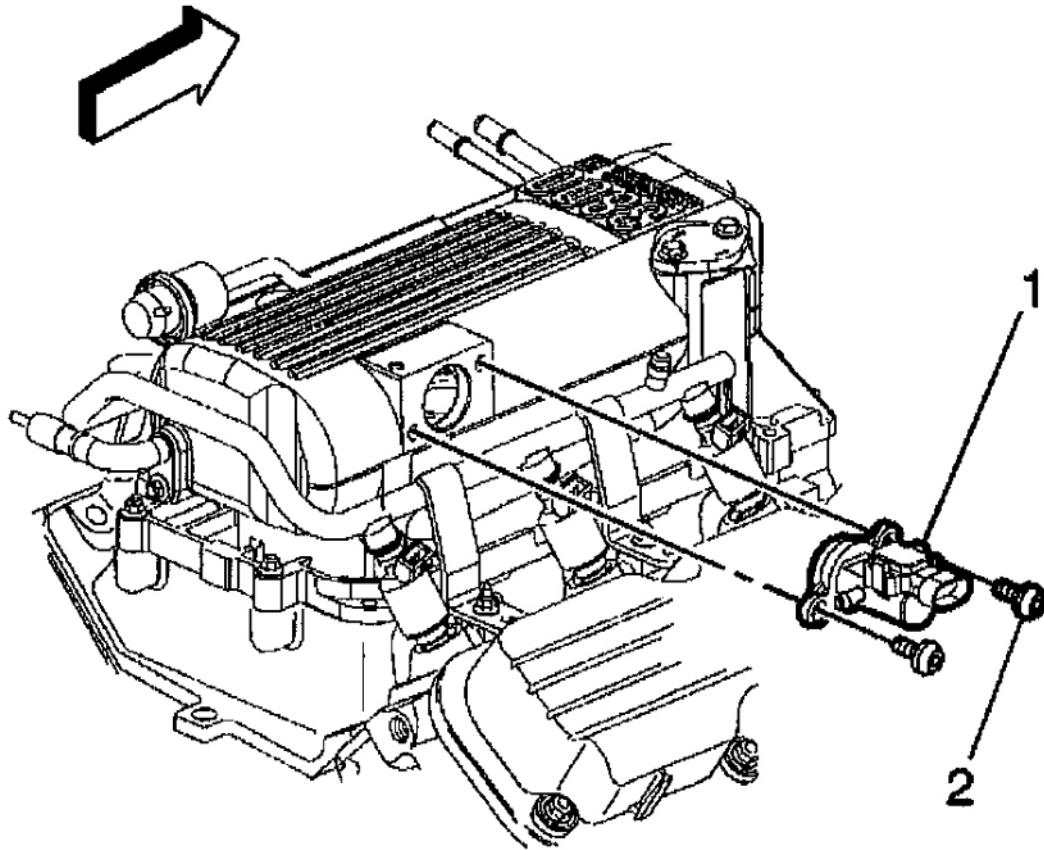
22. Install the fuel lines (1) to the fuel rail.
23. Connect the EVAP canister purge valve electrical connector (2).
24. Connect the left side fuel injector electrical connectors (1) to the fuel injectors.



G01728741

Fig. 86: Connecting EVAP Canister Purge Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

25. If the upper intake manifold was replaced install the manifold vacuum source (1) to the upper intake manifold.



G01728742

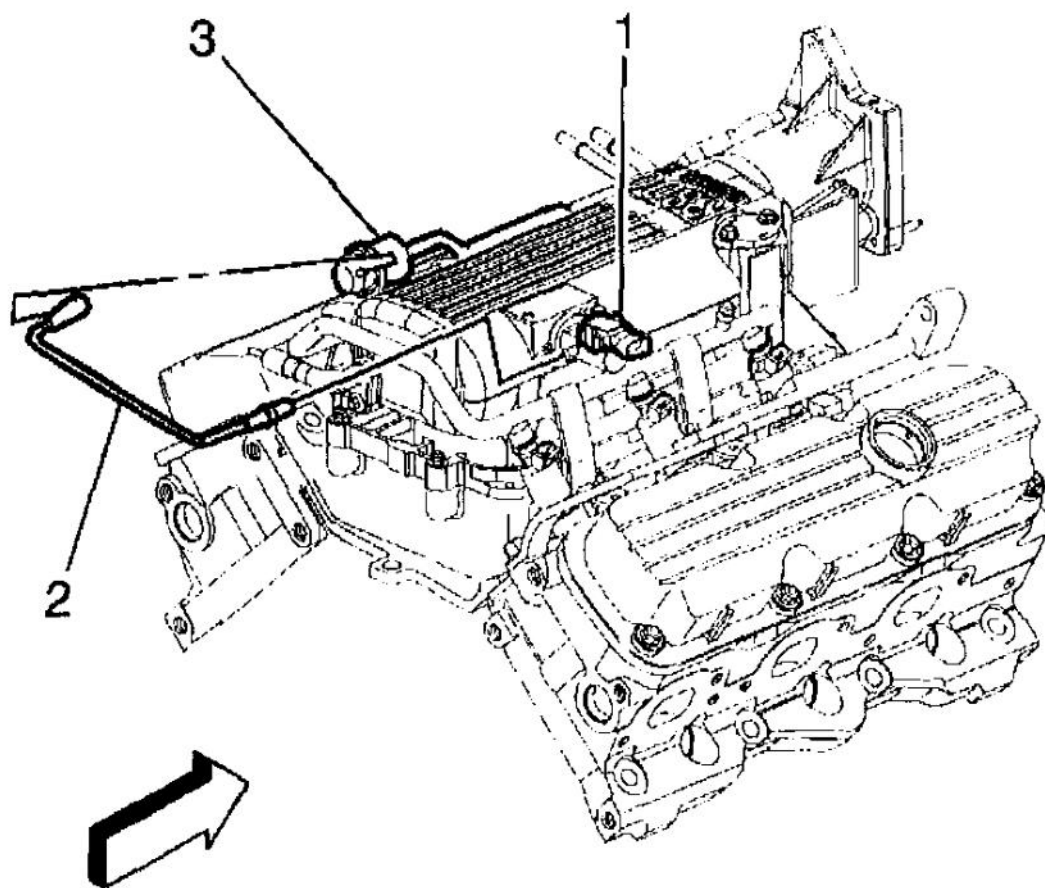
Fig. 87: Installing Manifold Vacuum Source
Courtesy of GENERAL MOTORS CORP.

26. Install the manifold vacuum source screws (2).

Tighten

Tighten the manifold vacuum source screws (2) to 10 N.m (89 lb in).

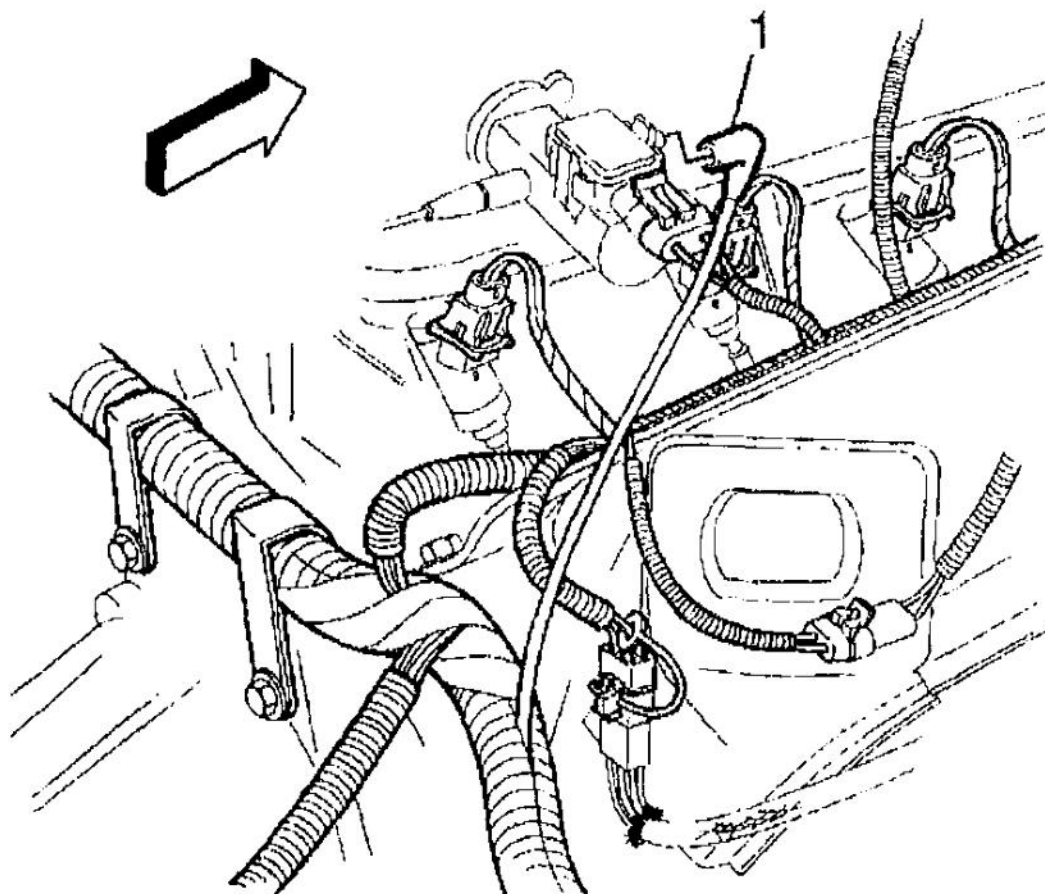
27. Install the fuel pressure regulator tube (2) to the following components:
 - Manifold vacuum source (1)
 - Fuel pressure regulator valve (3)



G01728743

Fig. 88: Install Fuel Pressure Regulator Tube
Courtesy of GENERAL MOTORS CORP.

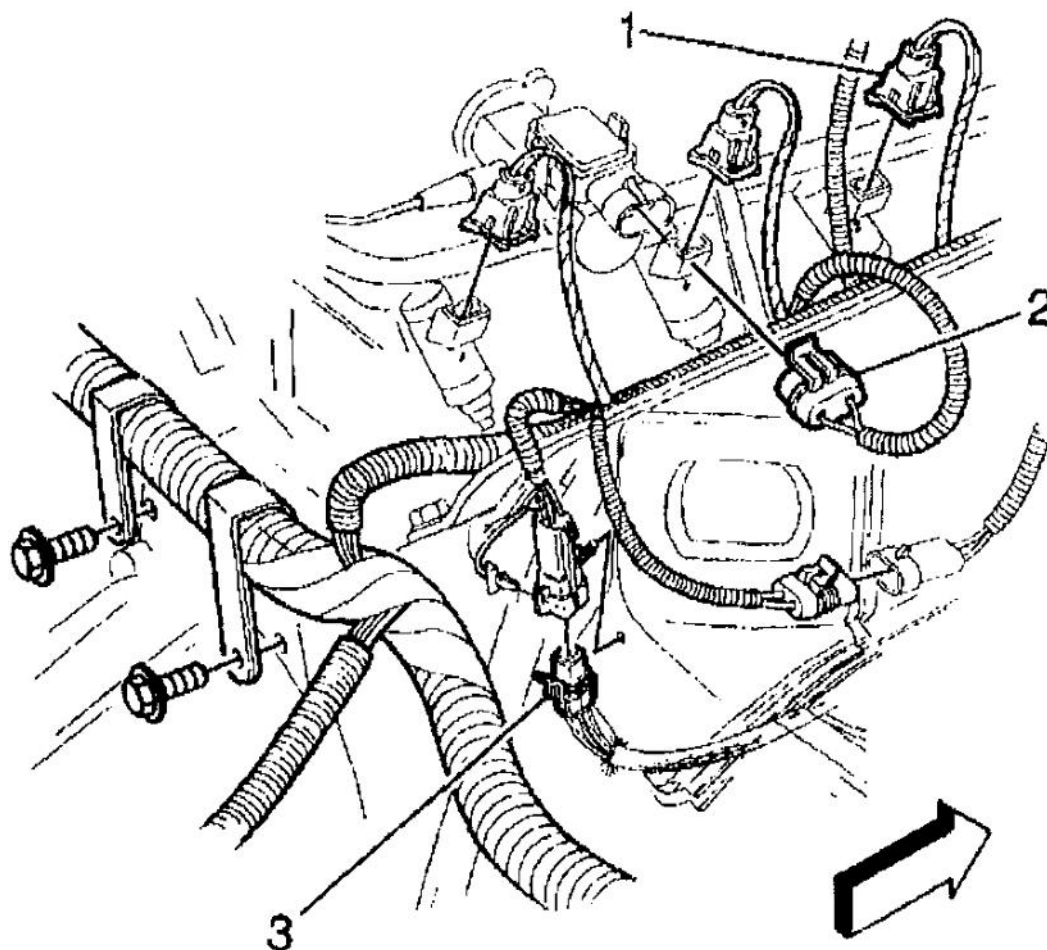
28. Install the engine harness vacuum tube (1) to the vacuum port.



G01728744

Fig. 89: Install Engine Harness Vacuum Tube
Courtesy of GENERAL MOTORS CORP.

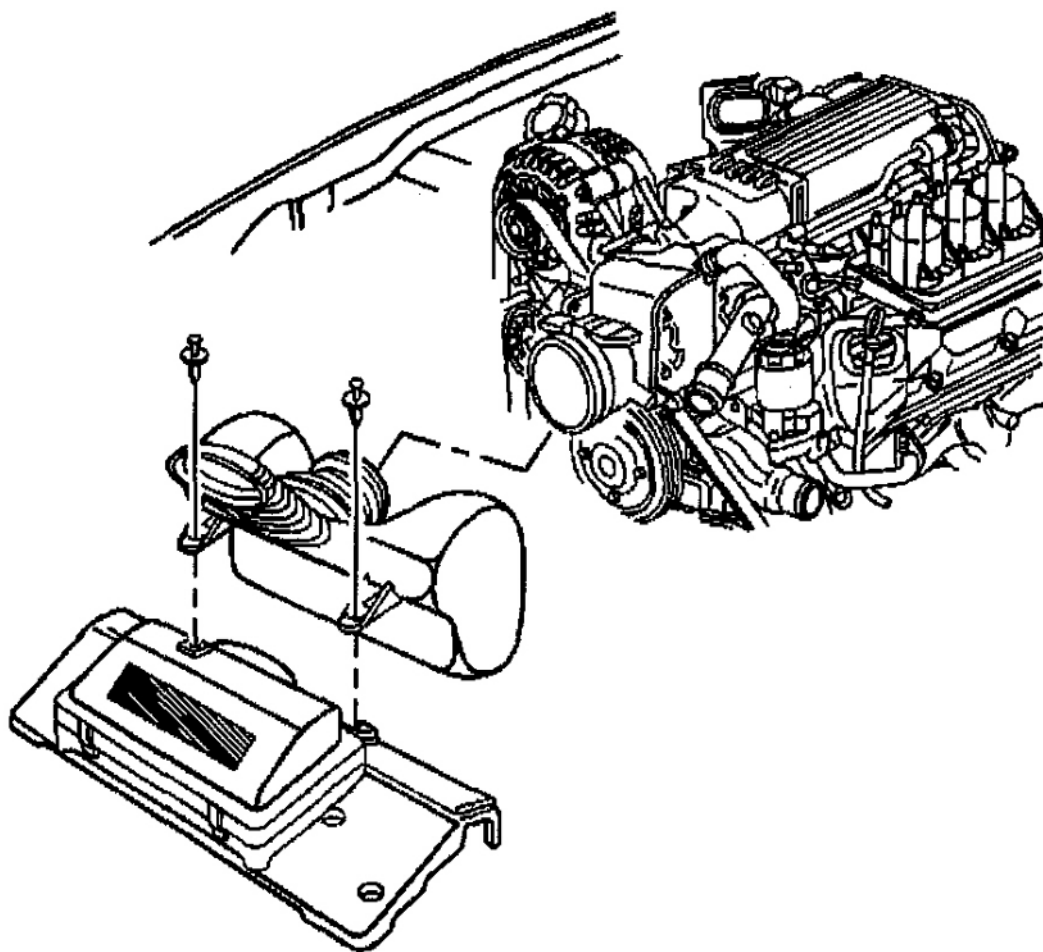
29. Connect the MAP sensor electrical connector (2).



G01728745

Fig. 90: Connecting MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

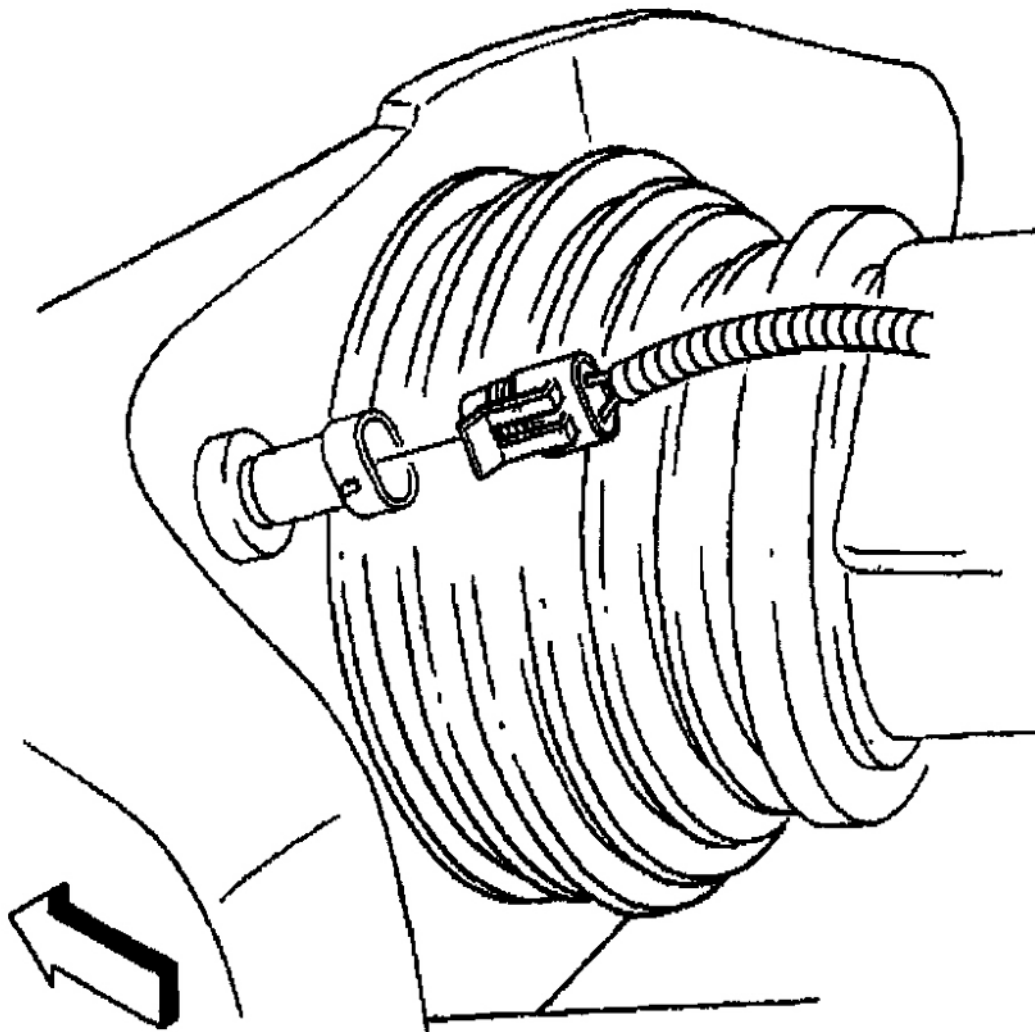
30. Connect the right side fuel injector electrical connectors (1) to the fuel injectors.
31. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
32. Install the air intake duct.



G01728746

Fig. 91: Installing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

33. Connect the IAT sensor electrical connector.
34. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .



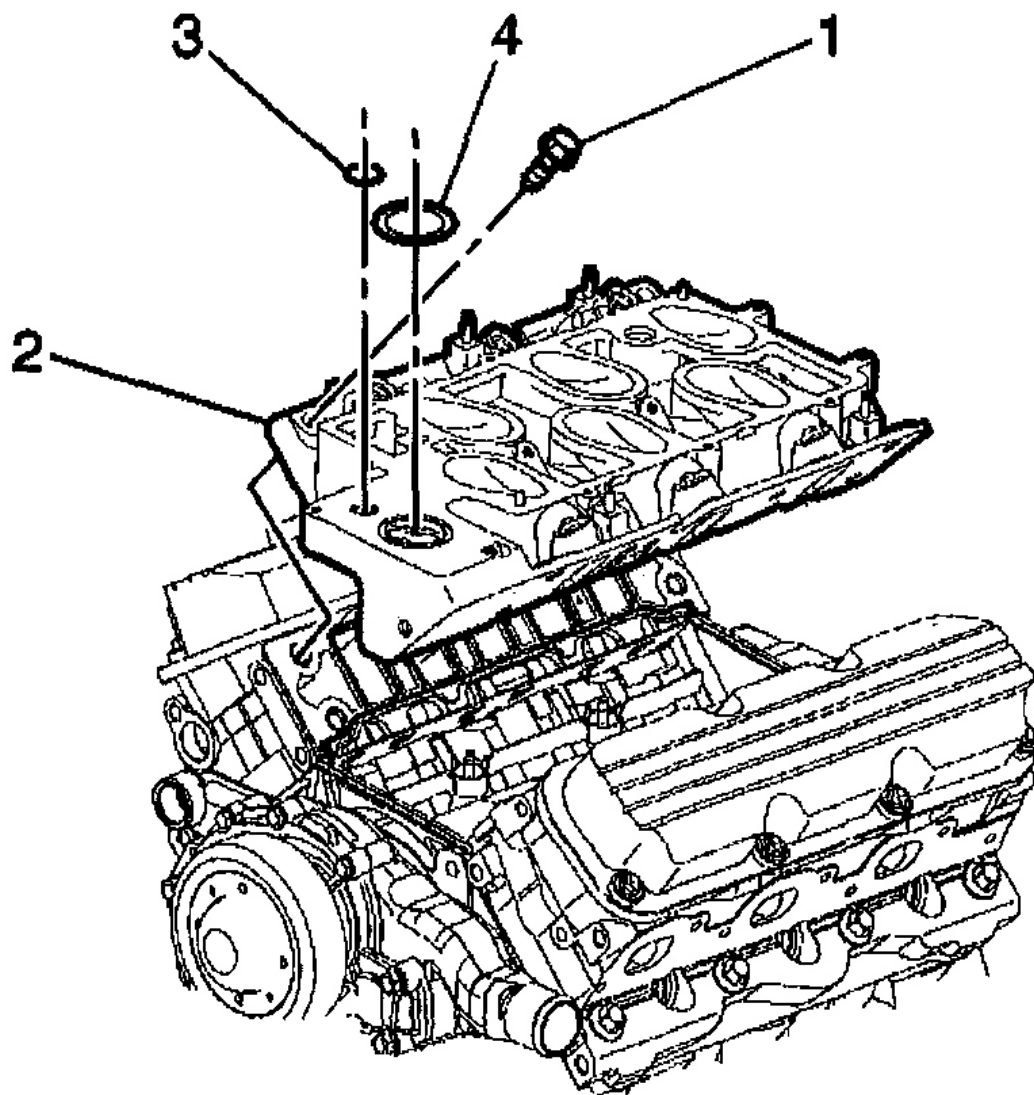
G01728747

Fig. 92: Connecting IAT Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

INTAKE MANIFOLD REPLACEMENT - LOWER

Removal Procedure

1. Remove the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.
2. Remove the O-ring seals (3, 4), if necessary.



G01728748

Fig. 93: Removing O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

3. Remove the lower intake manifold bolts (1).
4. Remove the lower intake manifold (2).
5. Remove the lower intake manifold seals (1).

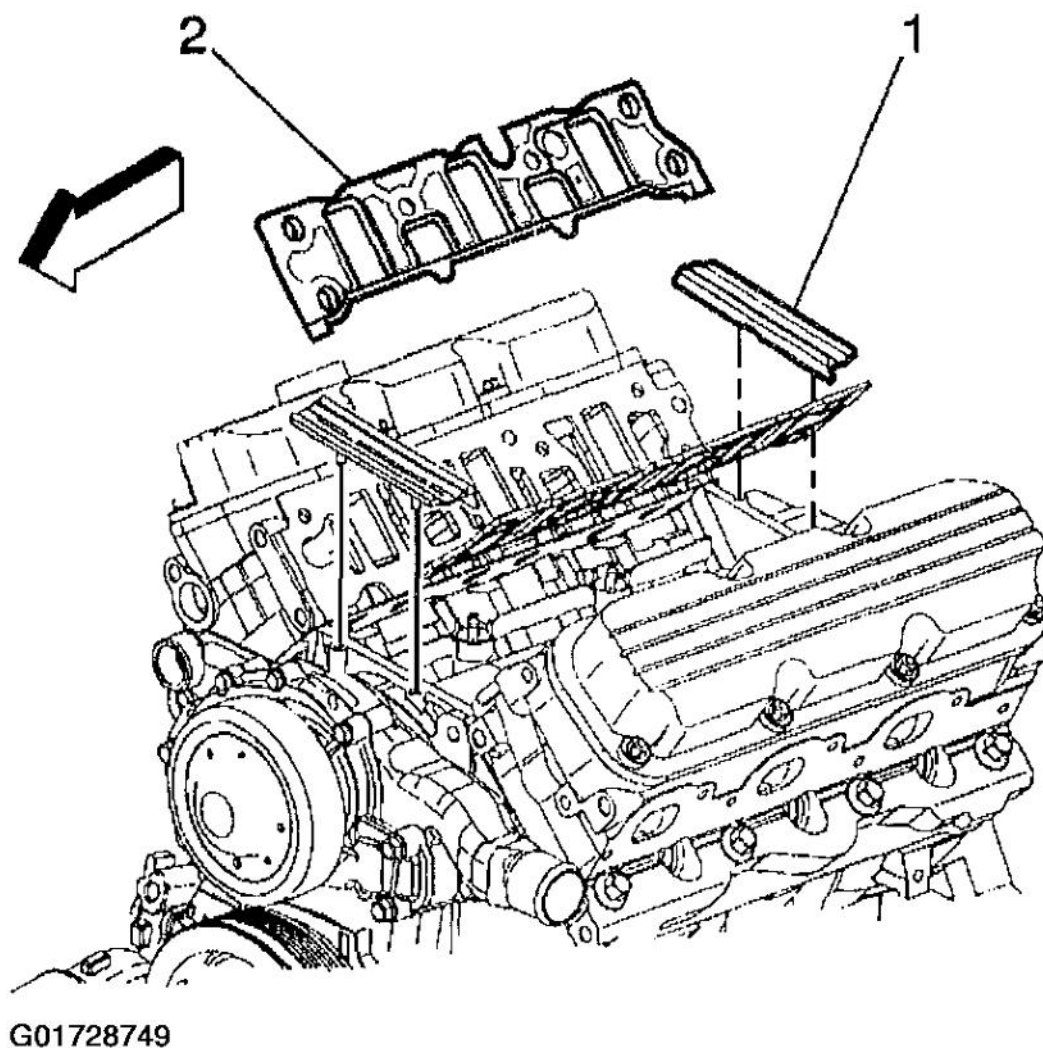
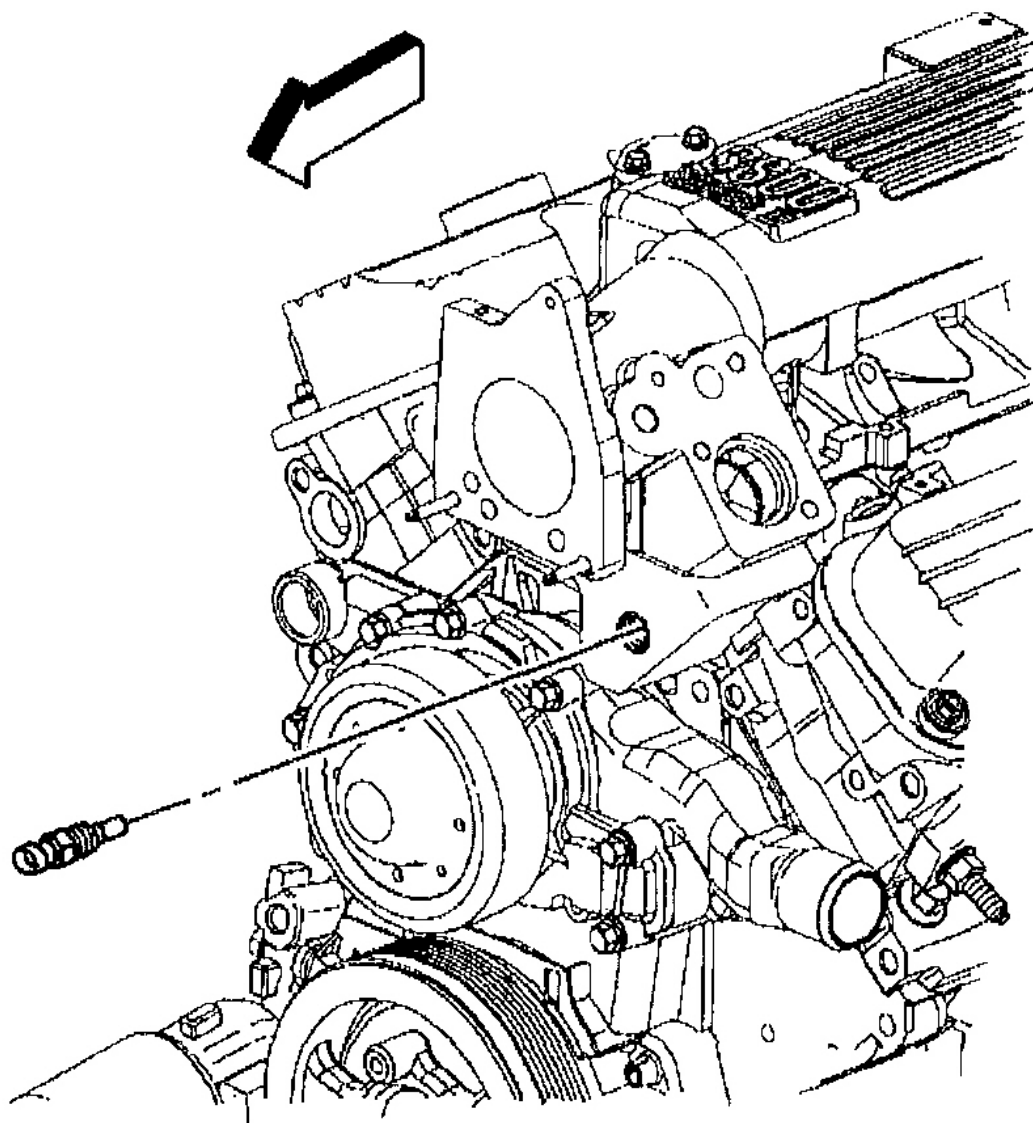


Fig. 94: Removing Lower Intake Manifold Seals
Courtesy of GENERAL MOTORS CORP.

6. Remove the lower intake manifold gaskets (2).
7. If replacing the manifold remove the coolant temperature sensor.



G01728750

Fig. 95: Remove Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the lower intake manifold gaskets (2).

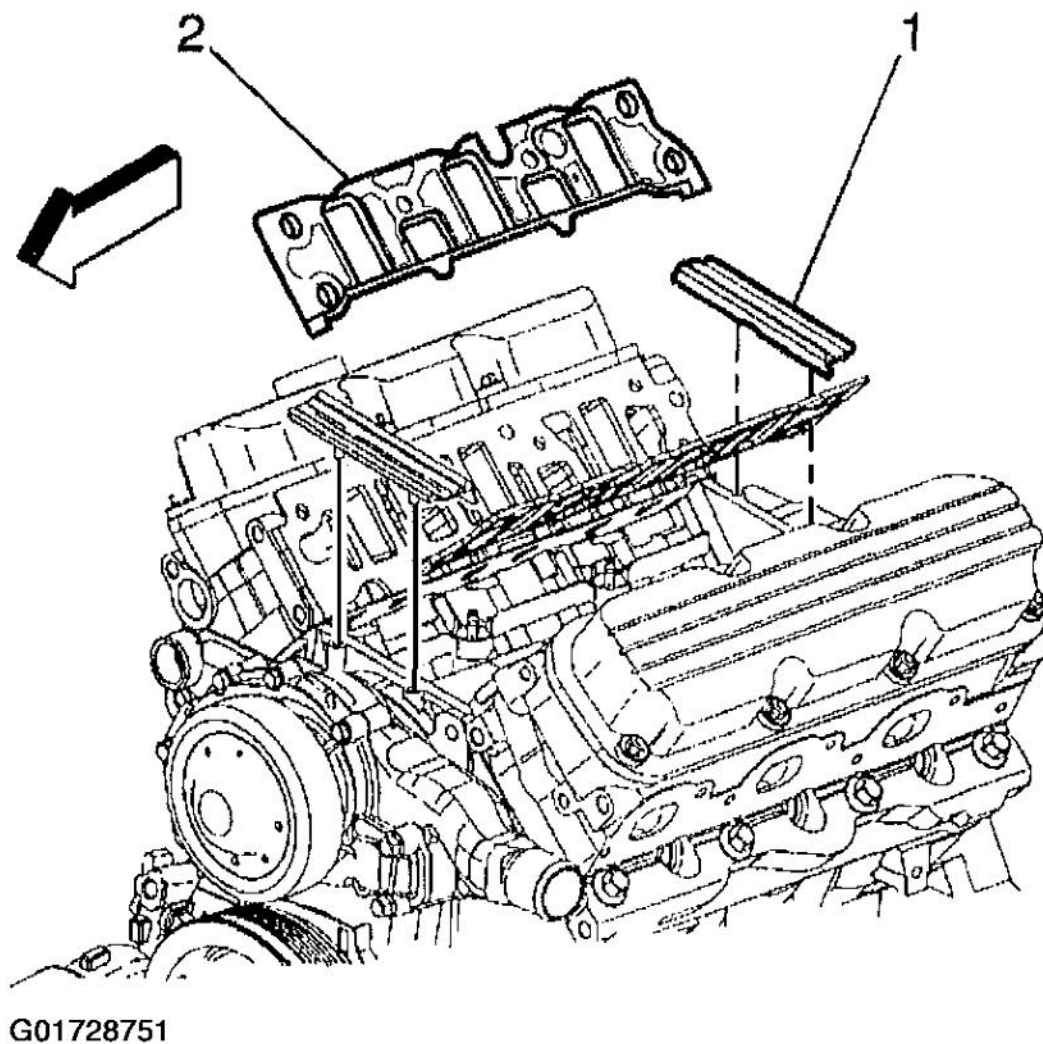
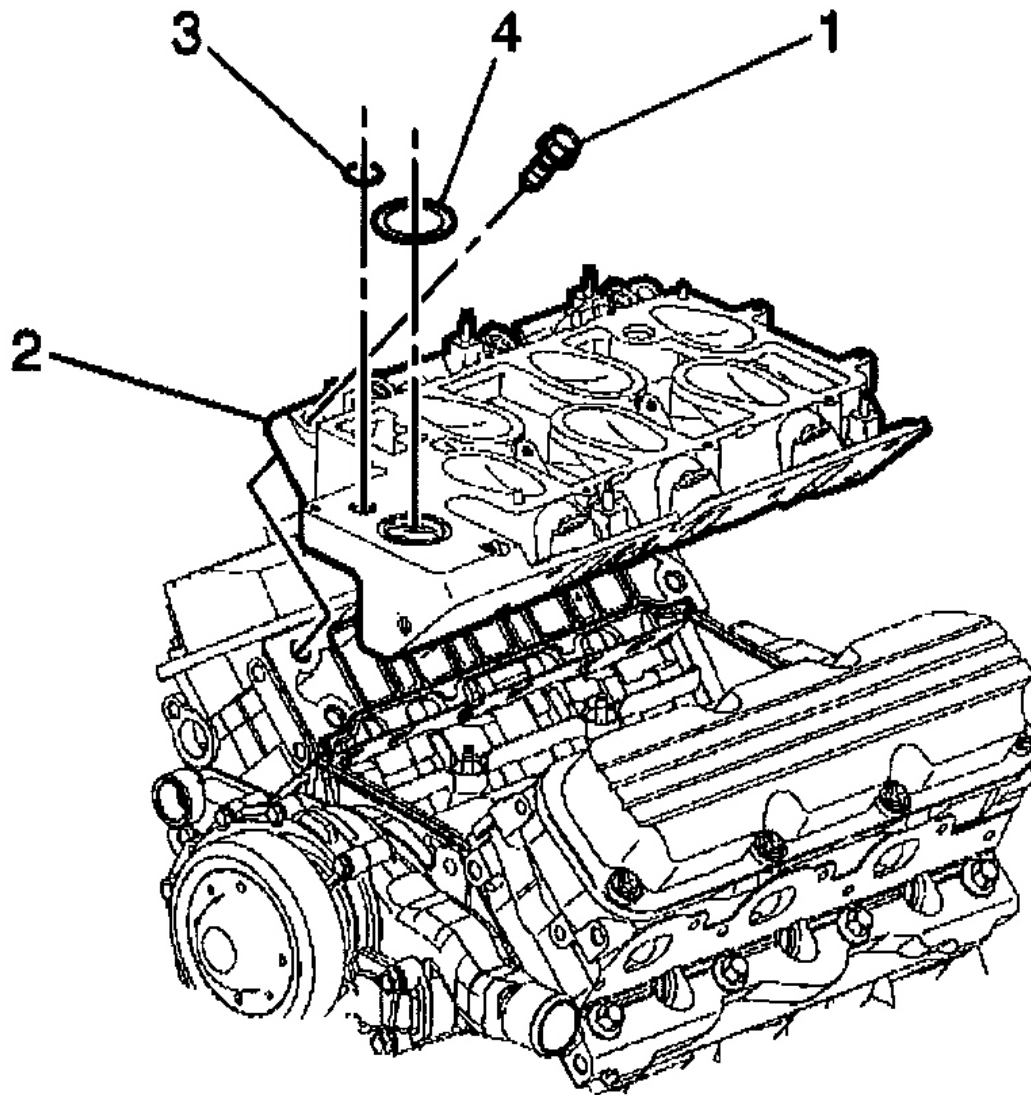


Fig. 96: Installing Lower Intake Manifold Gaskets
Courtesy of GENERAL MOTORS CORP.

2. Install the lower intake manifold seals (1).

Apply sealant GM P/N 12346286, Canada P/N 10953472, or equivalent to the ends for the manifold seals (2).

3. Install the lower intake manifold (2).



G01728752

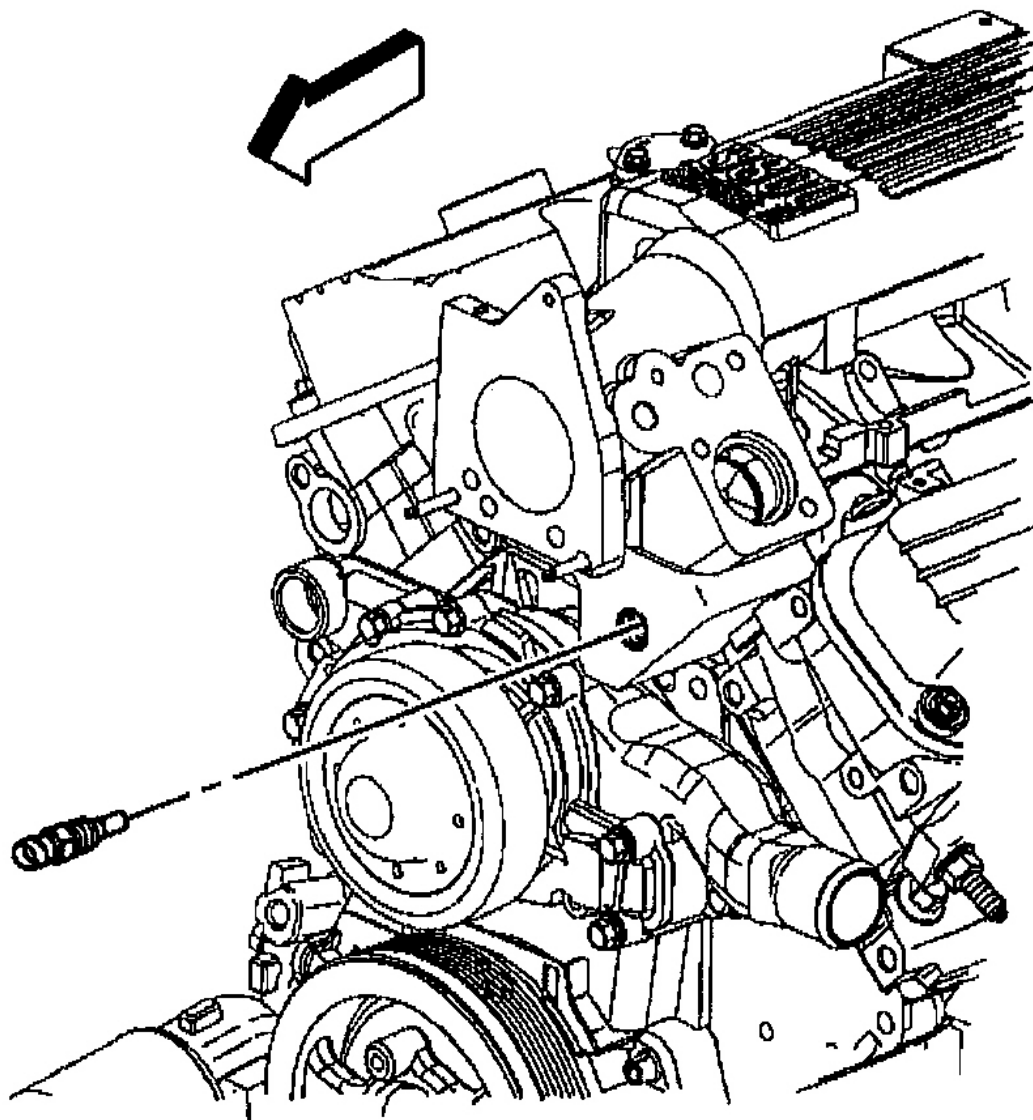
Fig. 97: Installing Lower Intake Manifold
 Courtesy of GENERAL MOTORS CORP.

4. Apply threadlock GM P/N 12345382, Canada P/N 10953488, or equivalent to the bolt threads before installing.
5. Install the lower intake manifold bolts (1).

Tighten

Tighten the lower manifold bolts (1) to 15 N.m (11 lb ft).

6. Install the coolant temperature sensor.



G01728753

Fig. 98: Installing Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

Tighten

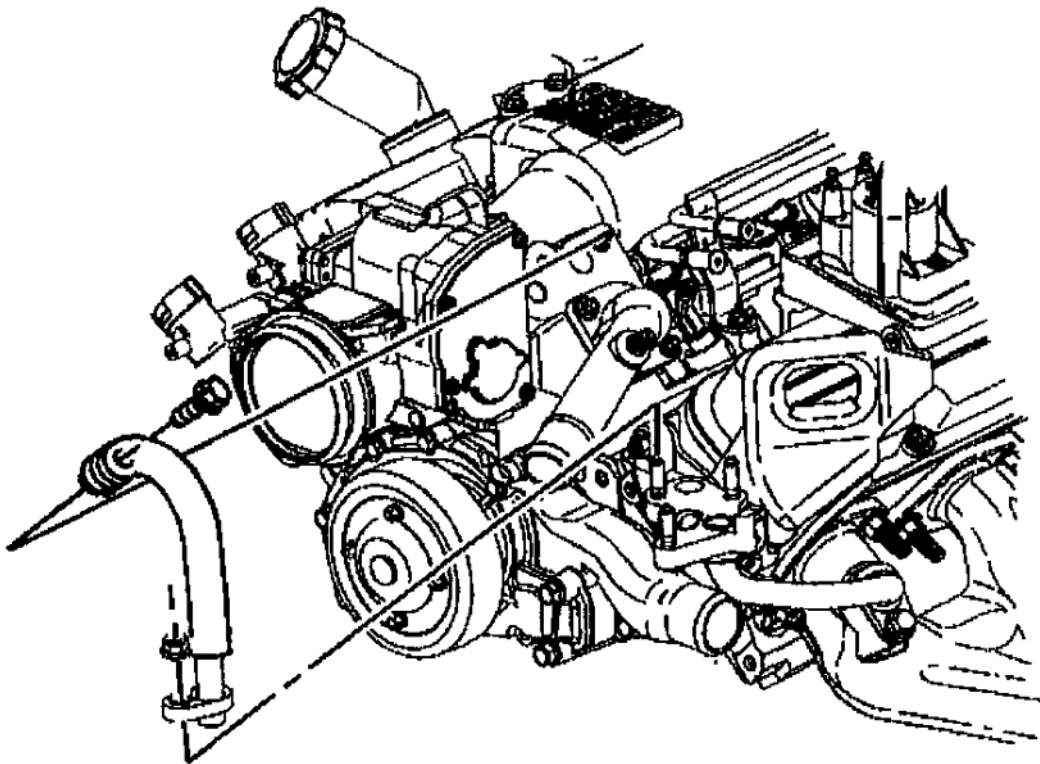
Tighten the coolant temperature sensor to 25 N.m (18 lb ft).

7. Install the upper intake manifold. Refer to **Intake Manifold Replacement - Upper**.

VALVE ROCKER ARM COVER REPLACEMENT - LEFT

Removal Procedure

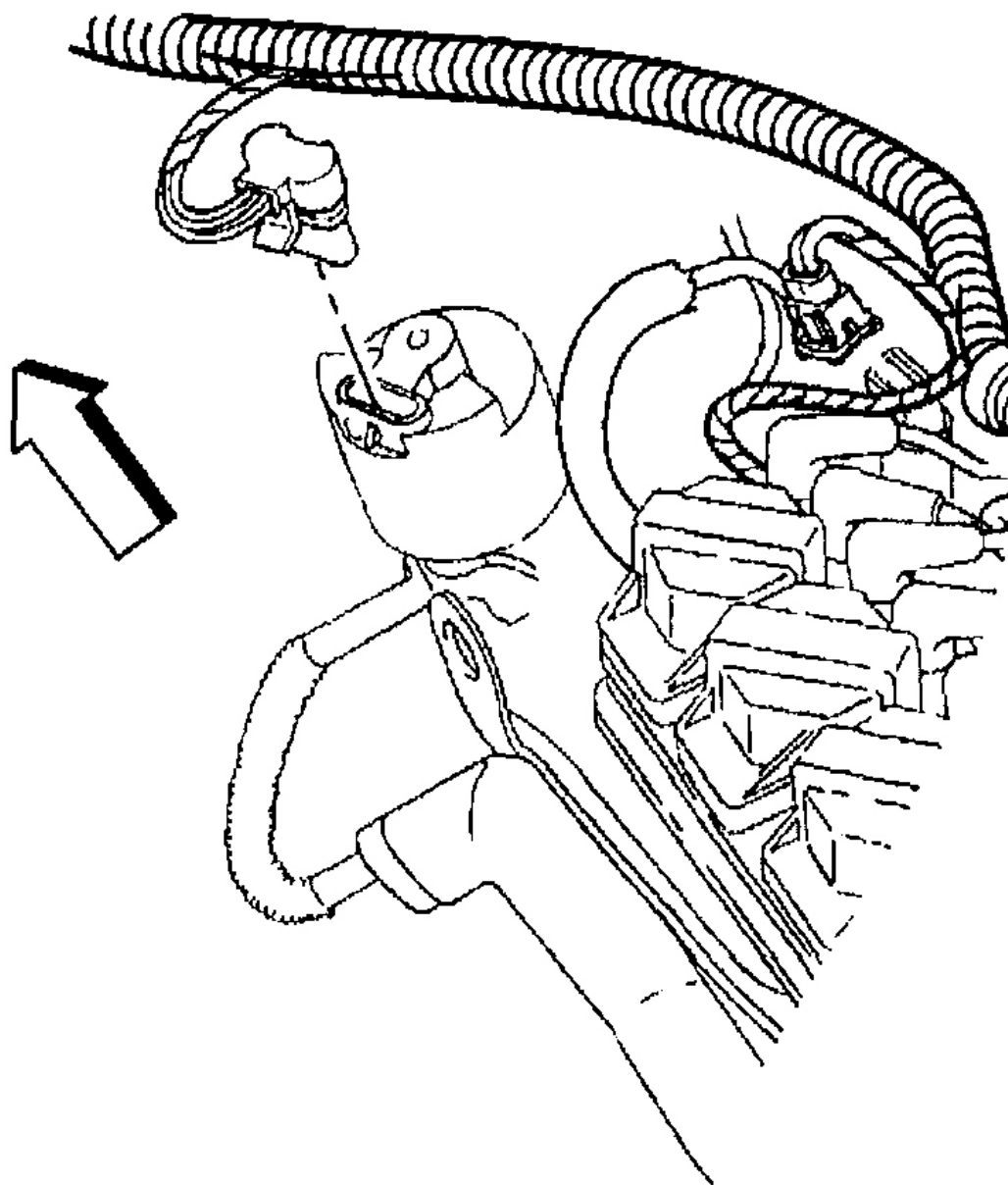
1. Remove the ignition control module. Refer to **IGNITION CONTROL MODULE**.
2. Remove the exhaust gas recirculation (EGR) valve outlet pipe bolt from the upper intake manifold.
3. Remove the EGR valve outlet pipe nut from the EGR valve adapter.
4. Remove the EGR valve outlet pipe.



G01728754

Fig. 99: Removing EGR Valve Outlet Pipe
Courtesy of GENERAL MOTORS CORP.

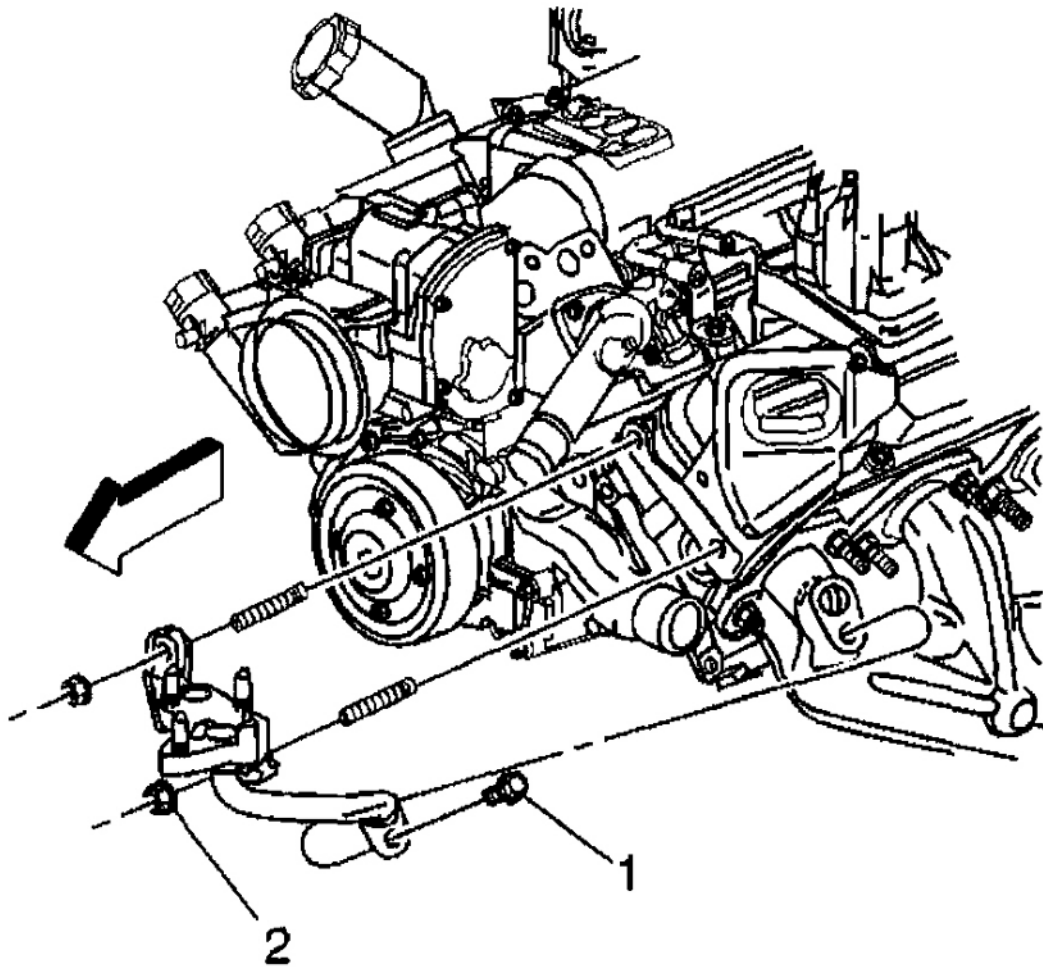
5. Disconnect the EGR valve electrical connector.



G01728755

Fig. 100: Disconnecting EGR Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Remove the EGR valve adapter nuts (2).



G01728756

Fig. 101: Removing EGR Valve Adapter Nuts
 Courtesy of GENERAL MOTORS CORP.

7. Remove the EGR valve adapter bolt (1).
8. Remove the EGR valve adapter from the cylinder head studs.
9. Remove the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
10. Remove the engine lift bracket from the cylinder head studs.
11. Remove the top ignition control module bracket bolt.
12. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
13. Remove the rear ignition control module bracket bolts.
14. Lower the vehicle.
15. Remove the ignition control module bracket.

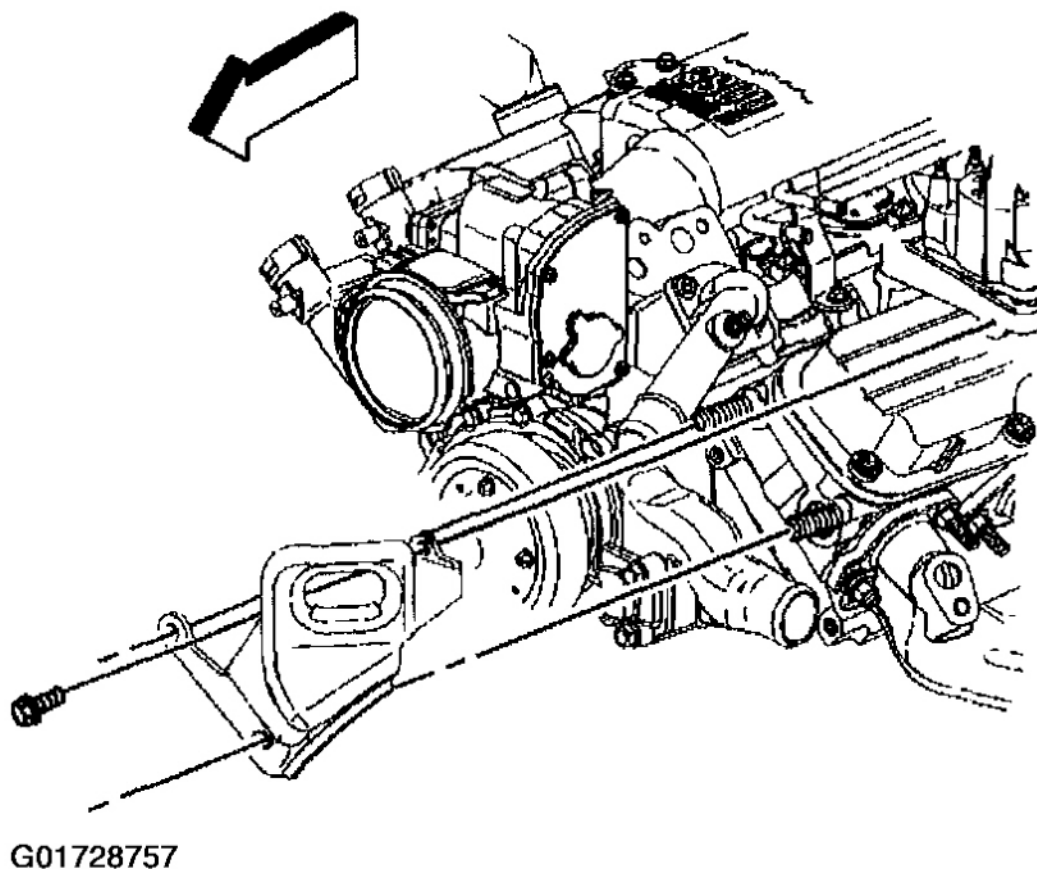
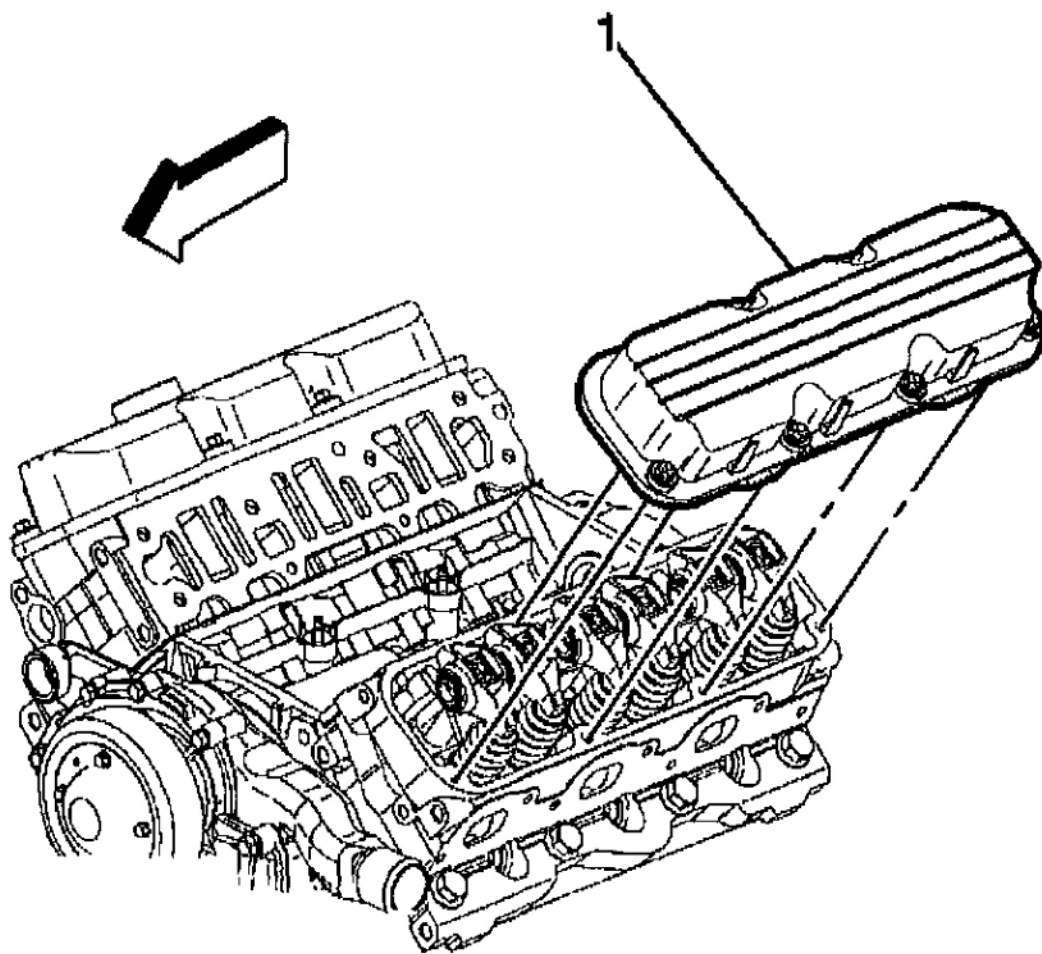


Fig. 102: Removing Ignition Control Module Bracket
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.
17. Remove the valve rocker arm cover (1).
18. Clean the following items:
 - Valve rocker arm cover
 - Cylinder head gasket surface
 - Valve rocker arm cover bolts

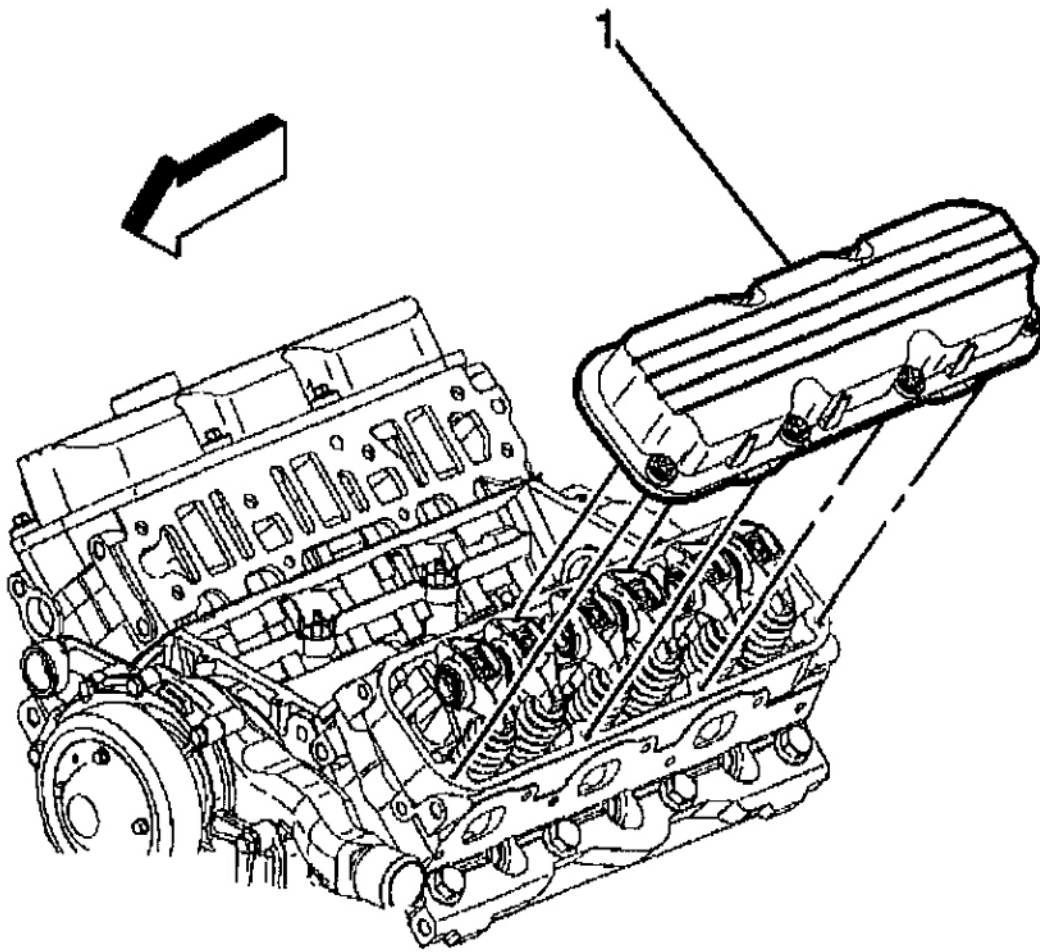


G01728758

Fig. 103: Removing Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Apply threadlock GM P/N 12345382, Canada P/N 10953489, or equivalent, to the valve rocker arm cover bolt threads.
2. Install the valve rocker arm cover (1).



G01728759

Fig. 104: Installing Valve Rocker Arm Cover

Courtesy of GENERAL MOTORS CORP.

3. Tighten the valve rocker arm cover bolts.

Tighten

Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

4. Install the ignition control module bracket.
5. Raise the vehicle.
6. Install the rear ignition control module bracket bolts.

Tighten

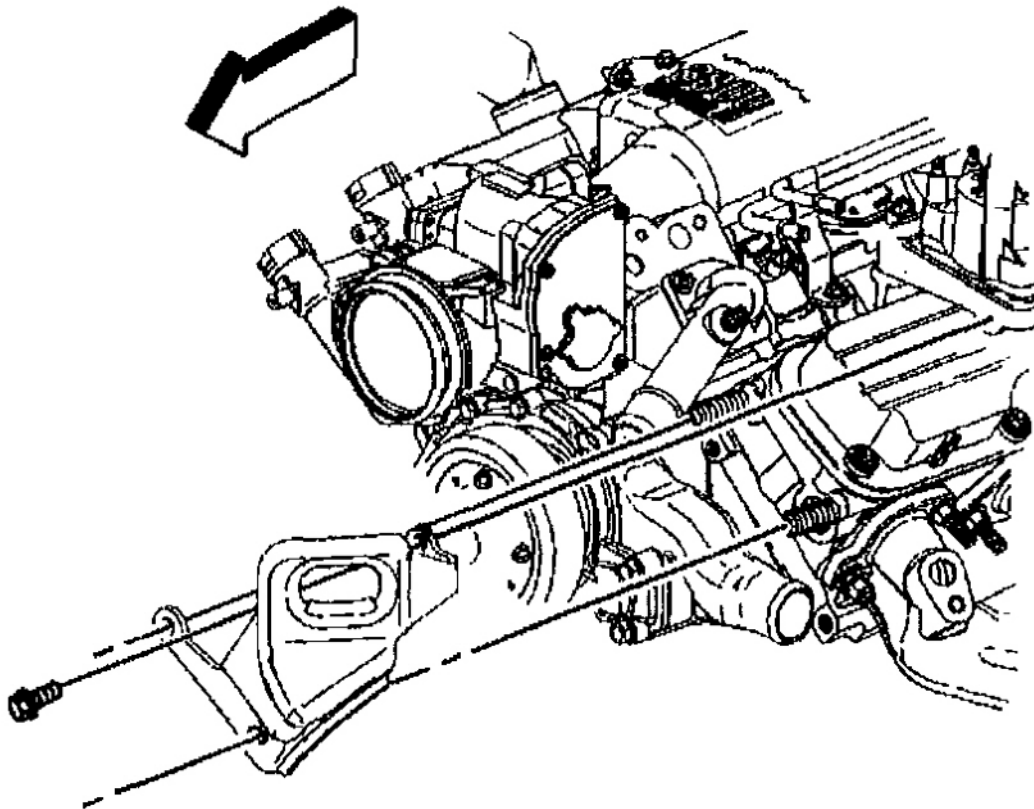
Tighten the rear ignition control module bracket bolts to 50 N.m (37 lb ft).

7. Lower the vehicle.
8. Install the top ignition control module bracket bolt.

Tighten

Tighten the top ignition control module bracket bolt to 50 N.m (37 lb ft).

9. Install the engine lift bracket to the cylinder head studs.



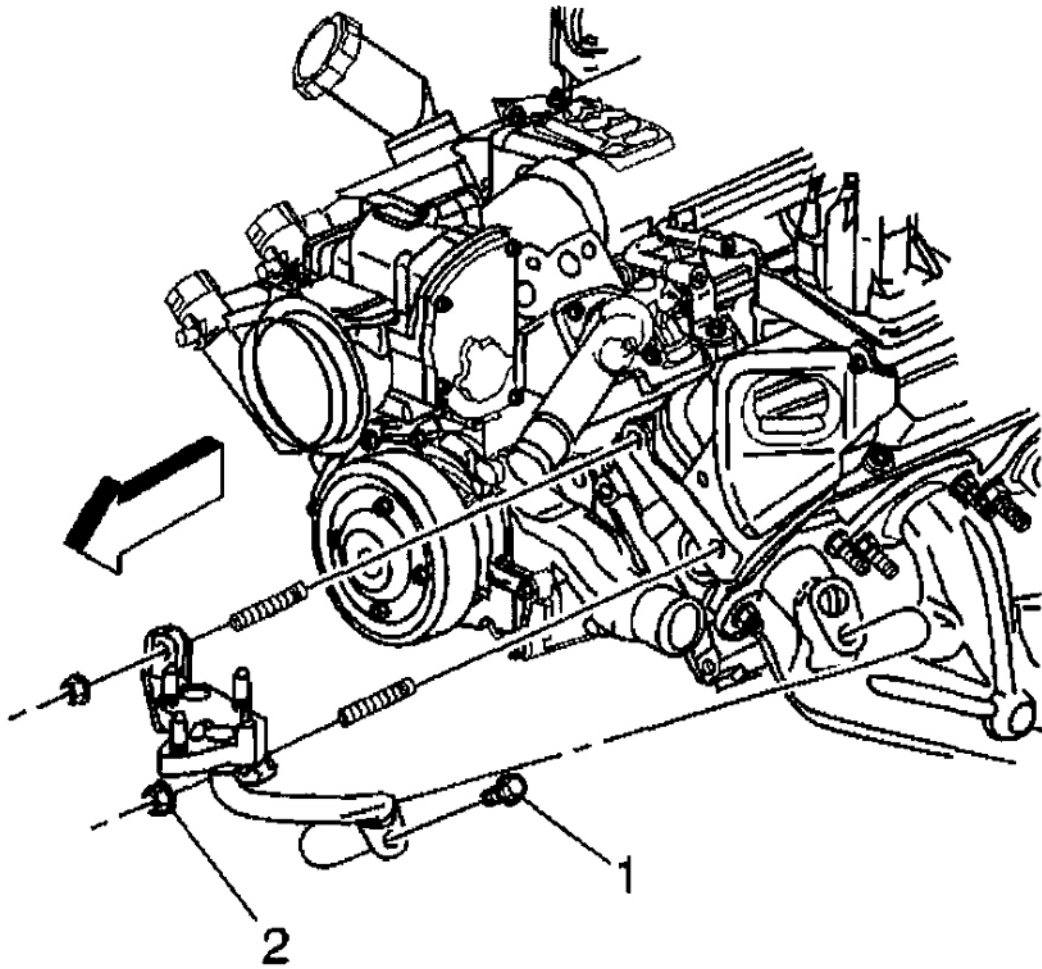
G01728760

Fig. 105: Installing Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine lift bracket to the cylinder head studs to 30 N.m (22 lb ft).

10. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
11. Install the EGR valve adapter to the cylinder head studs.
12. Install the EGR valve adapter bolt (1).



G01728761

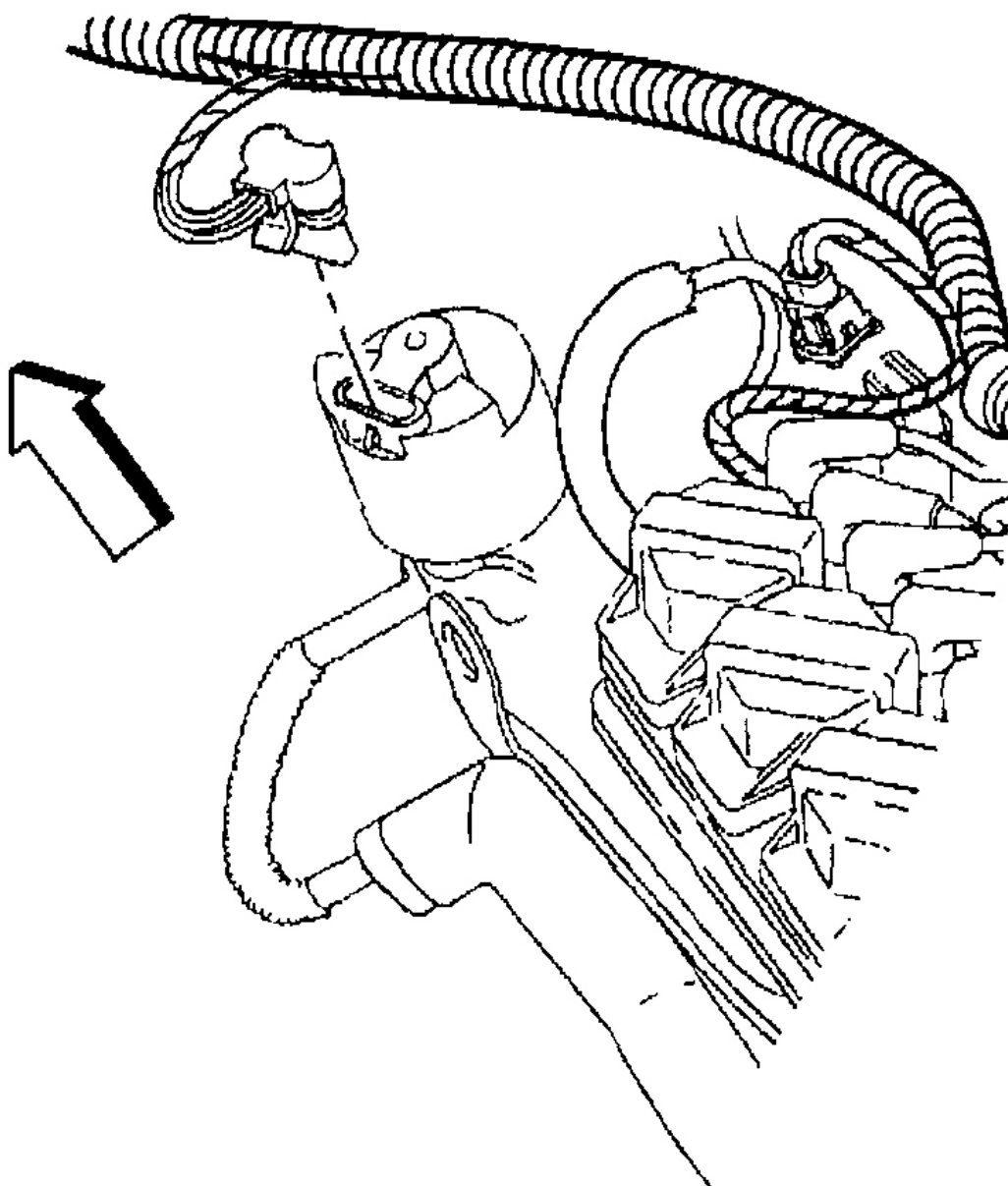
Fig. 106: Installing EGR Valve Adapter Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the EGR valve adapter nuts (2).

Tighten

- Tighten the EGR valve adapter nuts (2) to 50 N.m (37 lb ft).
- Tighten the EGR valve adapter bolt (1) to 25 N.m (18 lb ft).

14. Connect the EGR valve electrical connector.

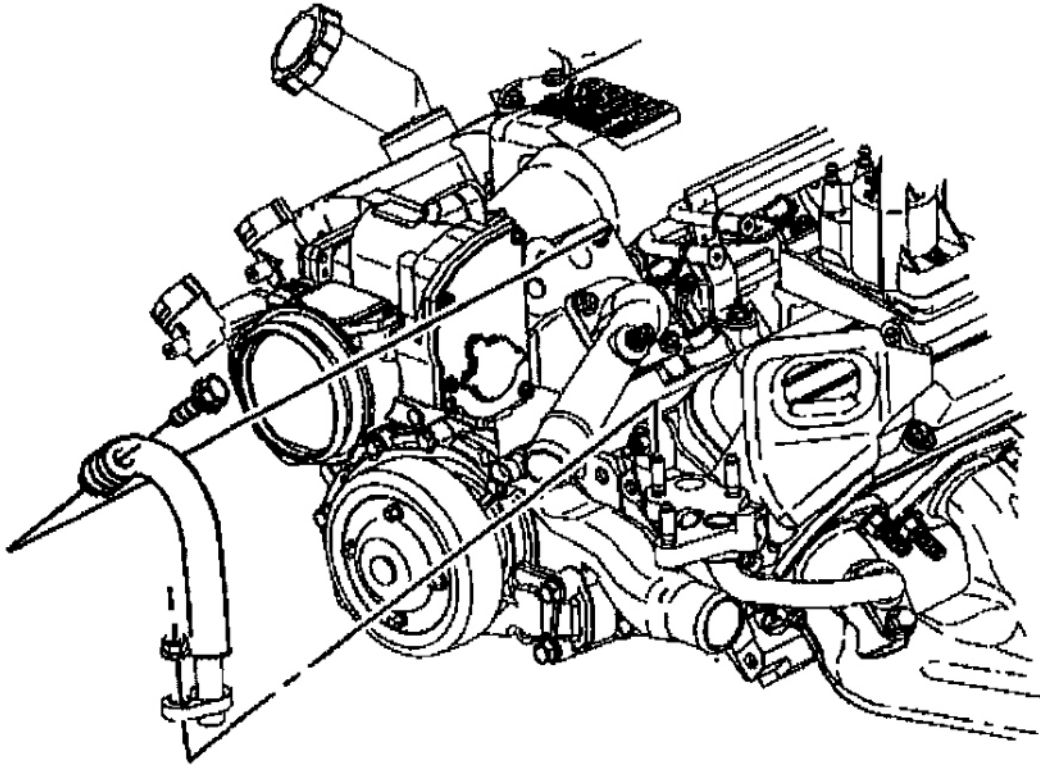


G01728762

Fig. 107: Connecting EGR Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

15. Install the EGR valve outlet pipe.

16. Install the EGR valve outlet pipe nut to the EGR valve adapter.
17. Install the EGR valve outlet pipe bolt to the upper intake manifold.



G01728763

Fig. 108: Installing EGR Valve Outlet Pipe Bolt
Courtesy of GENERAL MOTORS CORP.

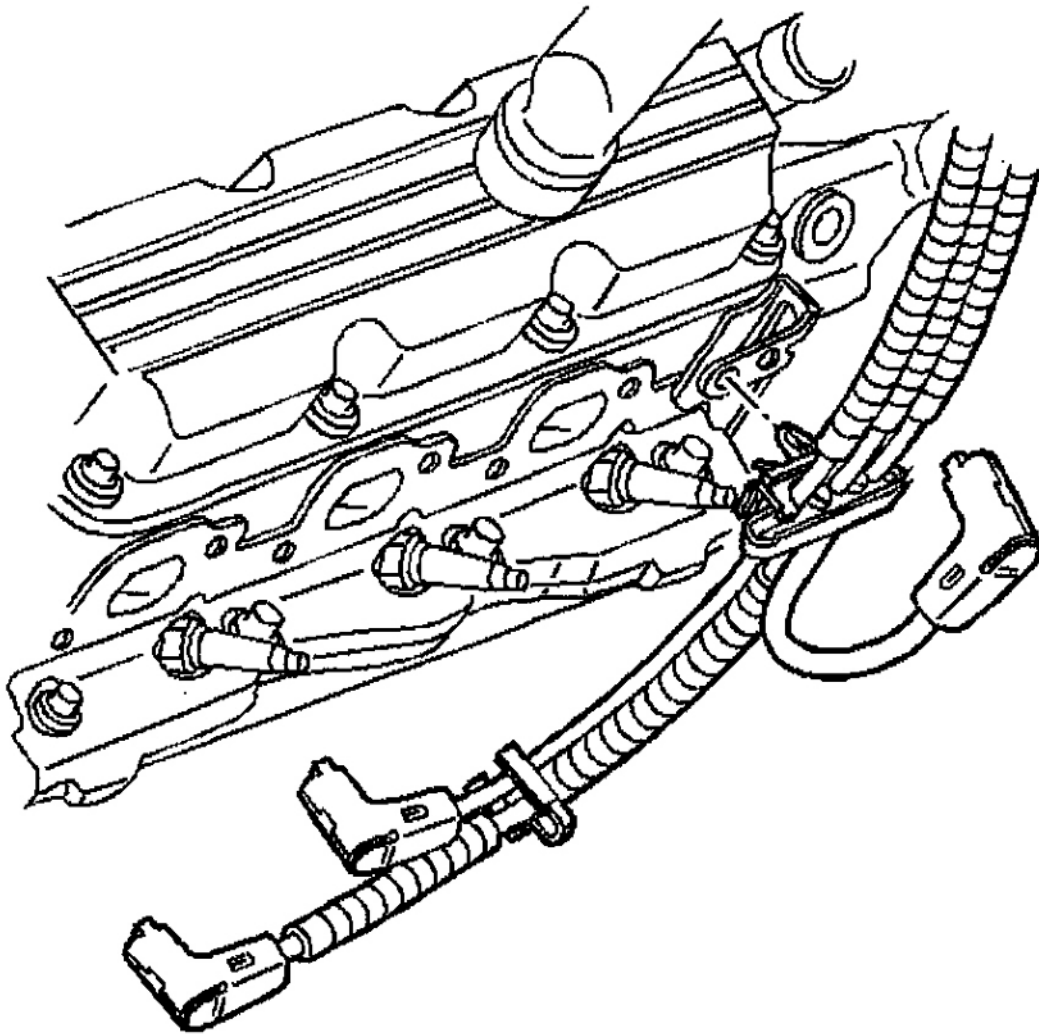
Tighten

- Tighten the EGR valve outlet pipe nut to 29 N.m (21 lb ft).
 - Tighten the EGR valve outlet pipe bolt to 29 N.m (21 lb ft).
18. Install the ignition control module. Refer to **IGNITION CONTROL MODULE** .

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT

Removal Procedure

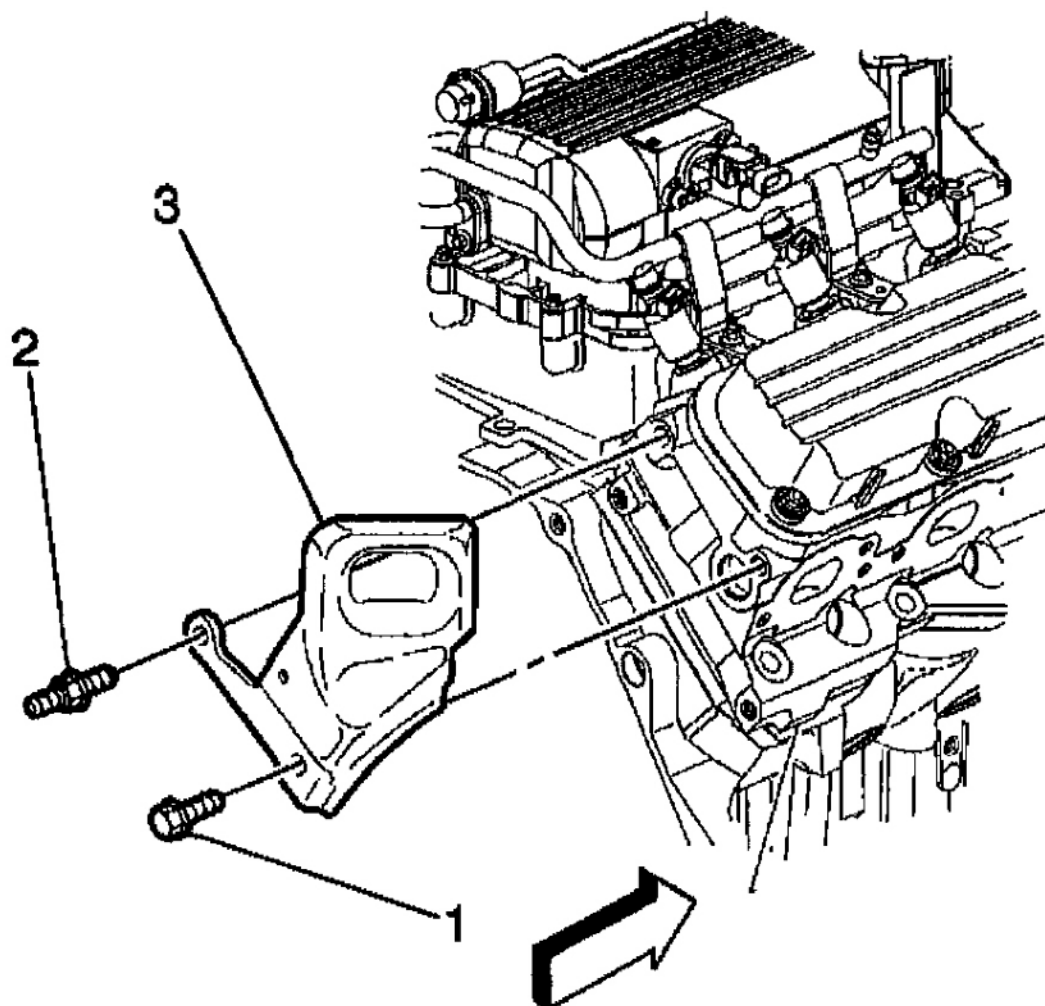
1. Remove the generator. Refer to **3.8L ENGINE** .
2. Remove the spark plug wires from the 1, 3 and 5 spark plugs.



G01728764

Fig. 109: Removing Spark Plug Wires
 Courtesy of GENERAL MOTORS CORP.

3. Remove the spark plug wiring harness from the clip and reposition the harness.
4. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
5. Remove the rear engine left bracket bolt (1) and stud (2).
6. Remove the rear engine lift bracket (3).
7. Lower the vehicle.



G01728765

Fig. 110: Removing Rear Engine Left Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

8. Loosen the valve rocker arm cover bolts.
9. Remove the valve rocker arm cover.

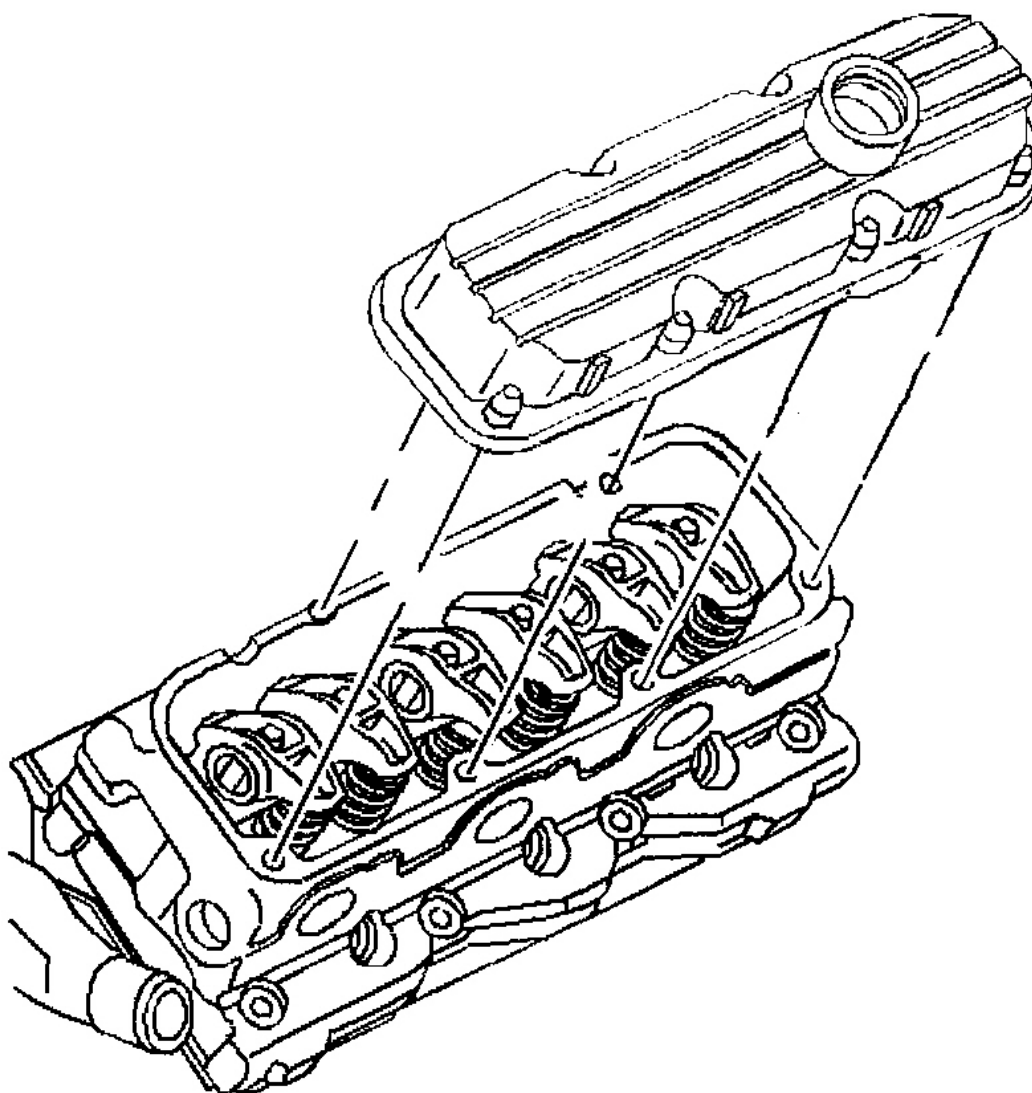
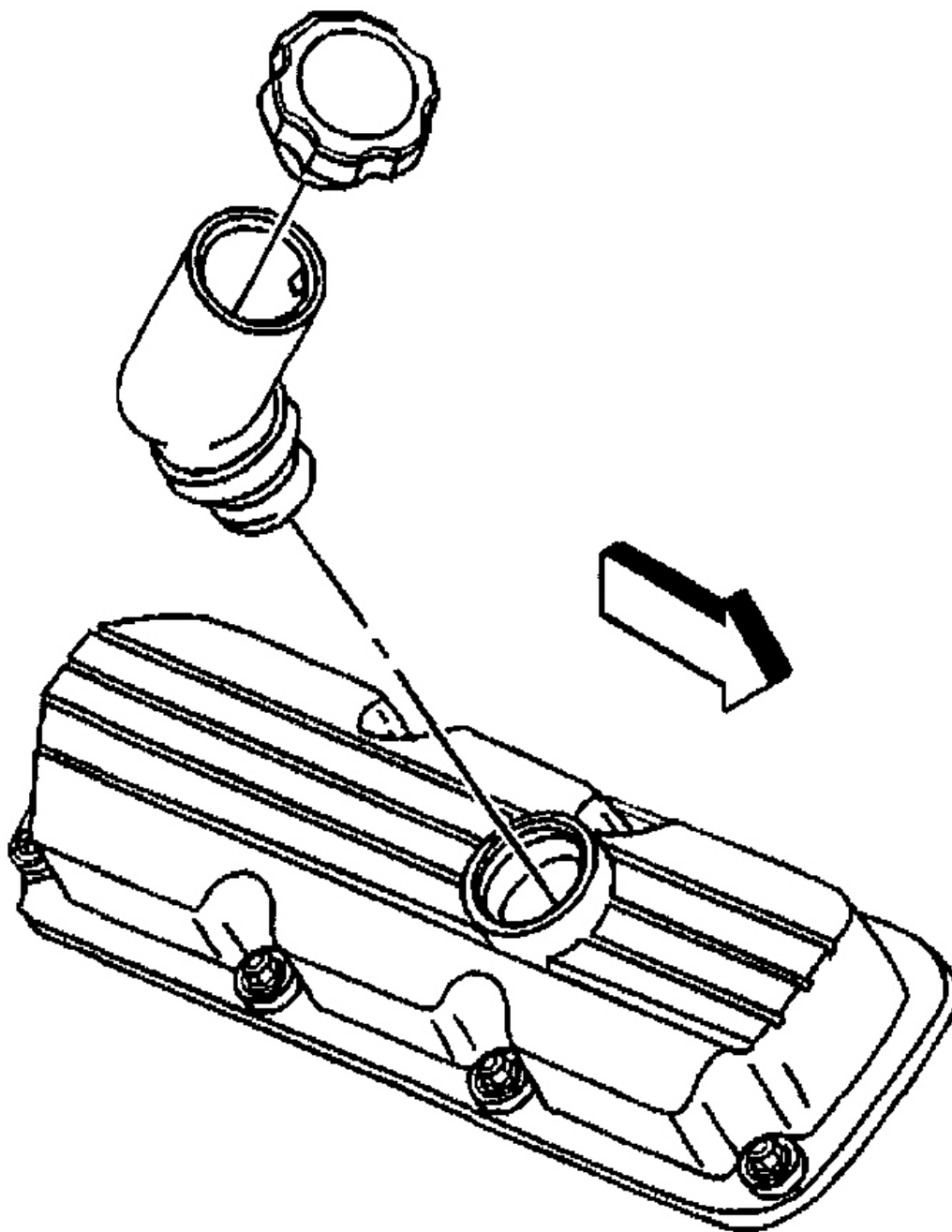
**G01728766**

Fig. 111: Removing Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil fill tube, if necessary.

To remove the fill tube press the tangs inside the tube in and twist the tube.



G01728767

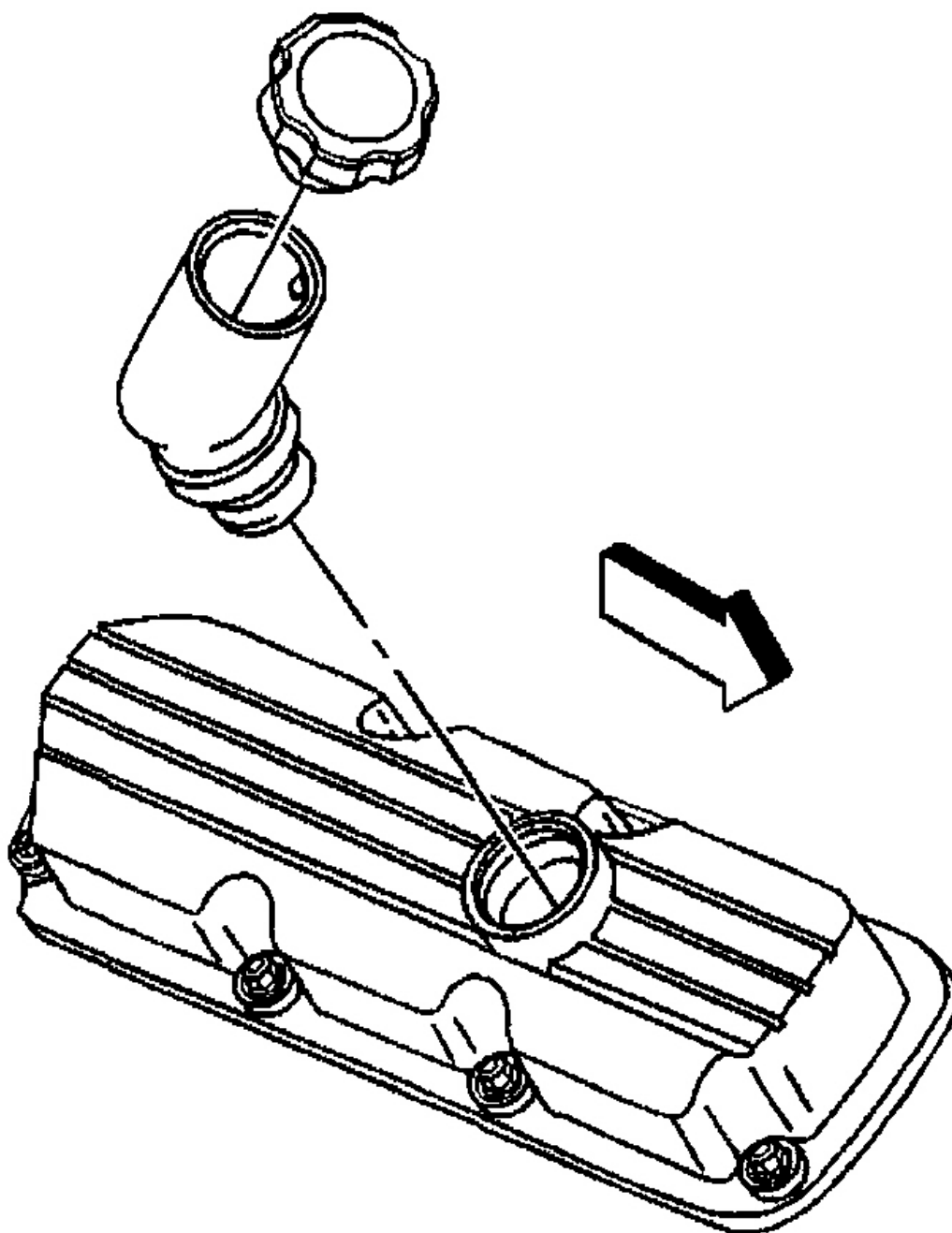
Fig. 112: Removing Oil Fill Tube
Courtesy of GENERAL MOTORS CORP.

11. Clean the following items:

- Valve rocker arm cover
- Cylinder head gasket surface
- Valve rocker arm cover bolts

Installation Procedure

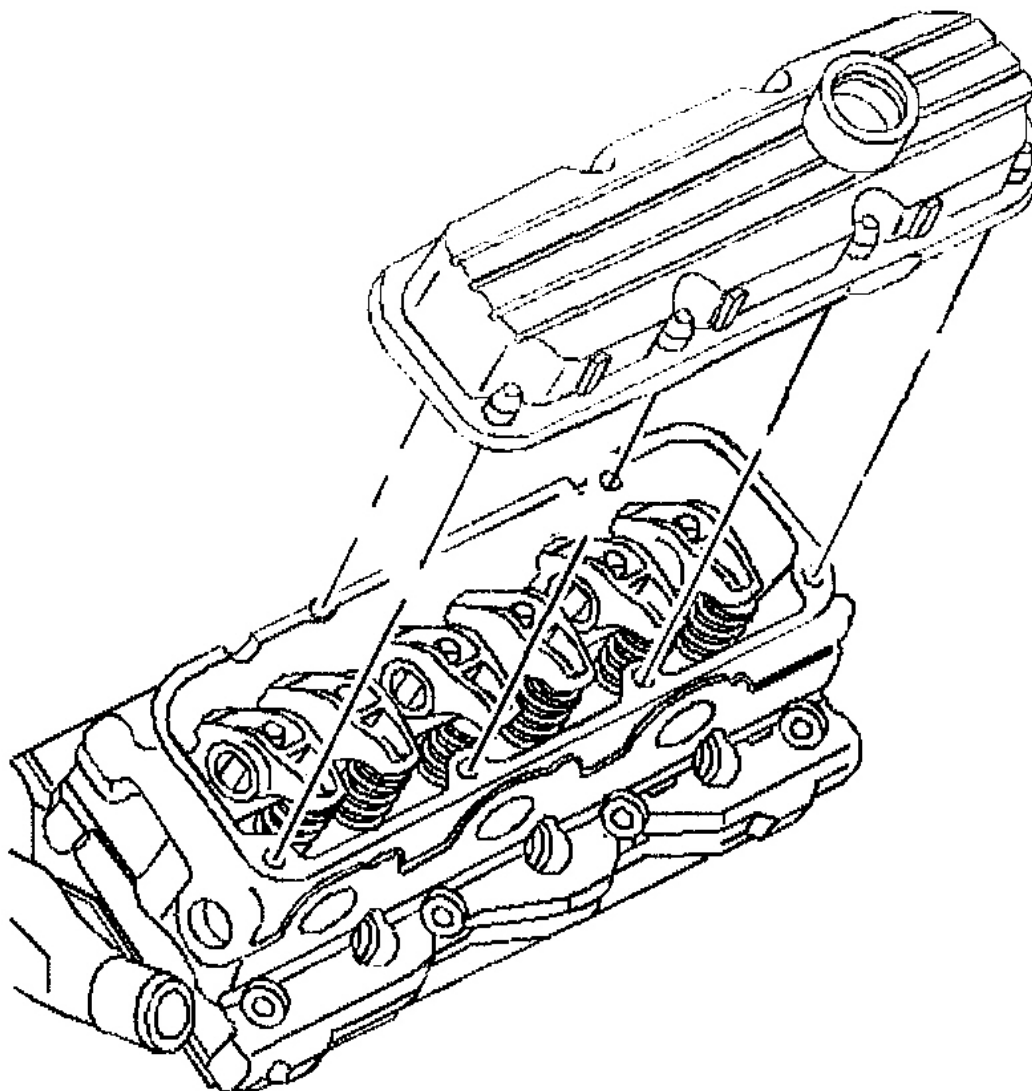
1. Install the oil fill tube to the valve rocker arm cover, if removed.



G01728768

Fig. 113: Installing Oil Fill Tube
Courtesy of GENERAL MOTORS CORP.

2. Apply threadlock GM P/N 12345382, Canada P/N 10953489, or equivalent to the valve rocker arm cover bolt threads.
3. Install the valve rocker arm cover.



G01728769

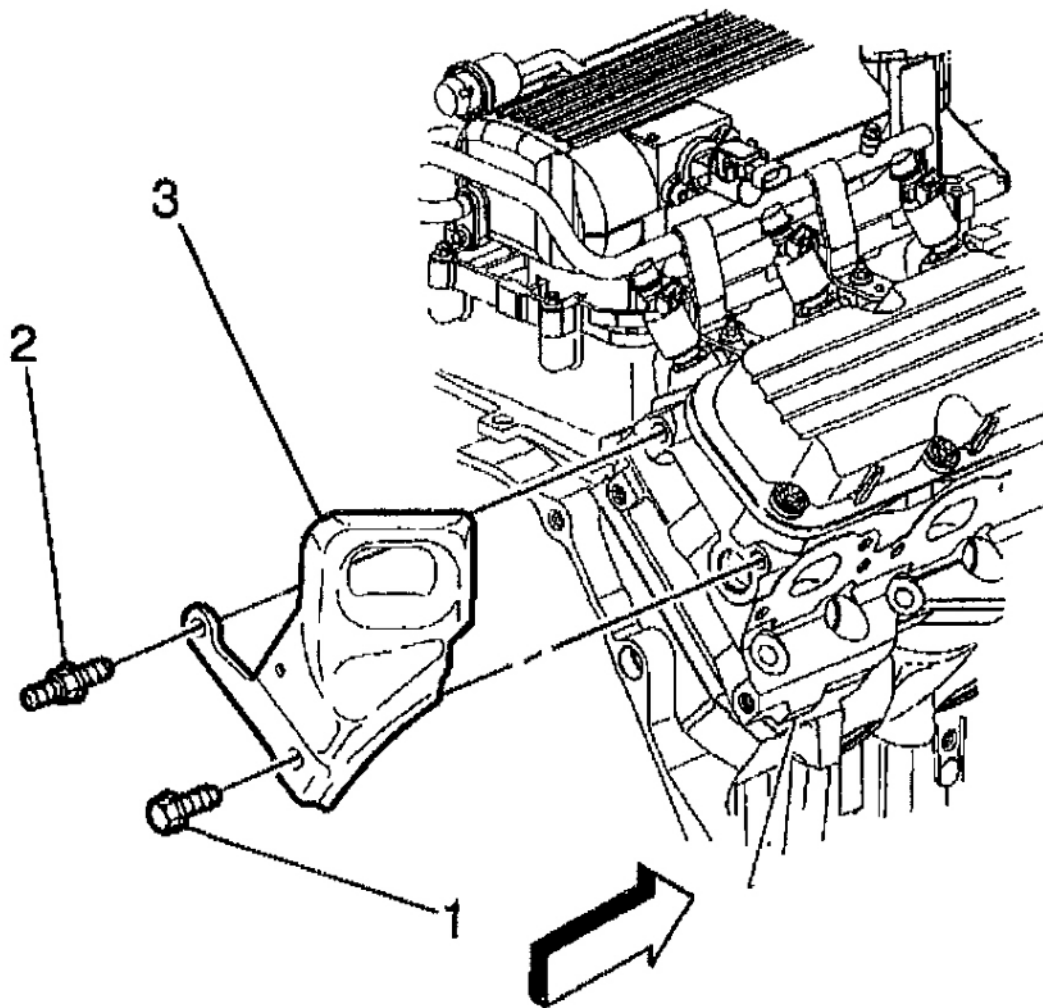
Fig. 114: Installing Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

4. Tighten the valve rocker arm cover bolts.

Tighten

Tighten the valve rocker arm cover bolts to 10 N.m (89 lb in).

5. Raise the vehicle. **LIFTING AND JACKING THE VEHICLE**
6. Install the rear engine lift bracket (3).



G01728770

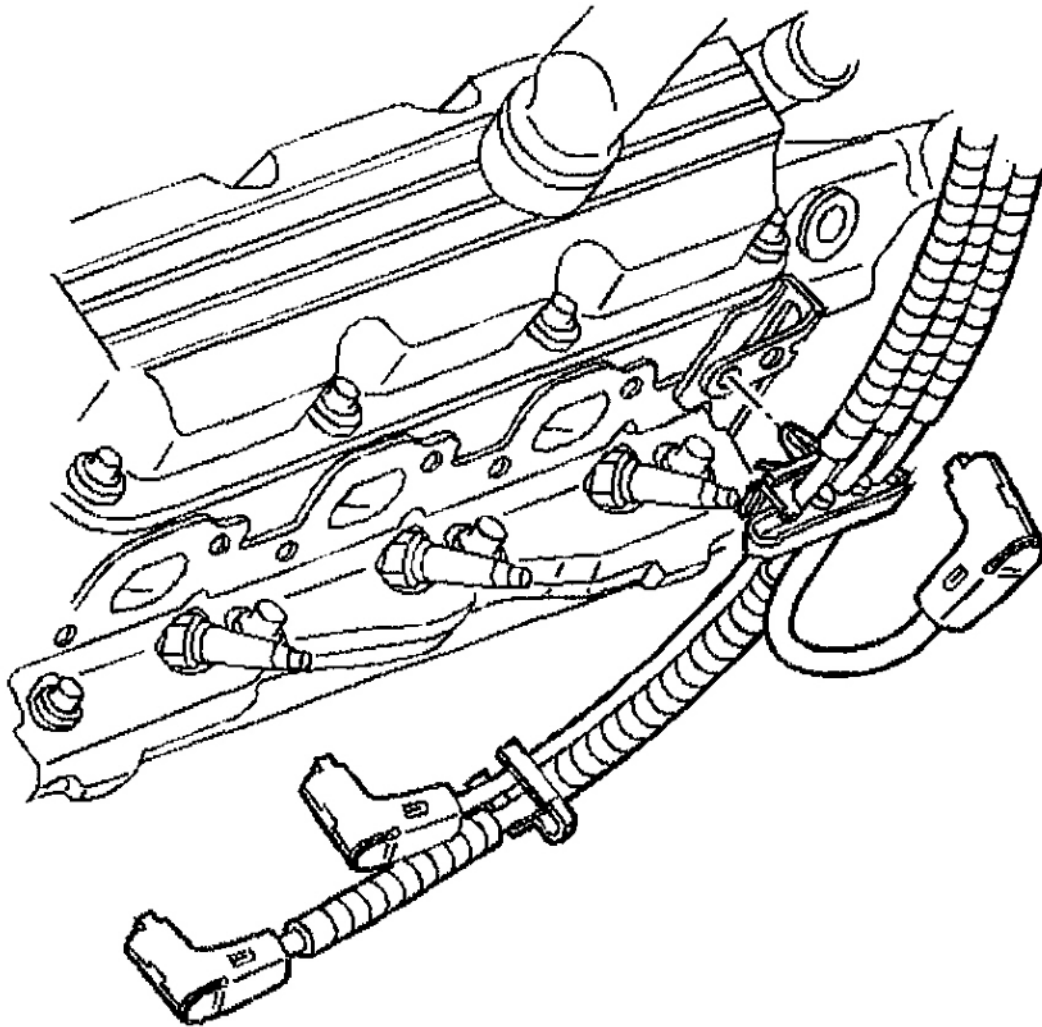
Fig. 115: Installing Rear Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

7. Install the rear engine lift bracket stud (2) and bolt (1).

Tighten

Tighten the rear engine lift bracket stud (2) and bolt (1) to 30 N.m (22 lb in).

8. Lower the vehicle.
9. Install the spark plug wiring harness to the clip.
10. Install the spark plug wires to the 1,3 and 5 spark plugs.



G01728771

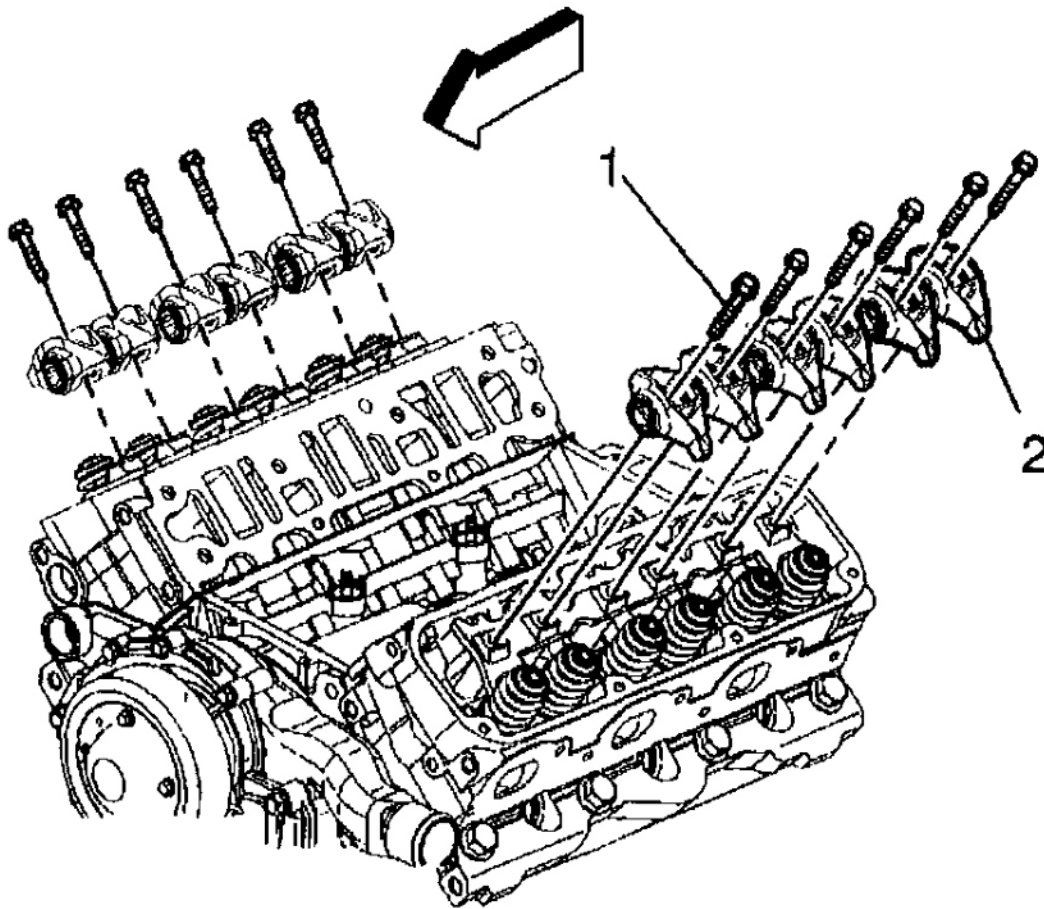
Fig. 116: Installing Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

11. Install the generator. Refer to **GENERATOR** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

Tools Required**J 36660-A** Torque Angle Meter**Removal Procedure**

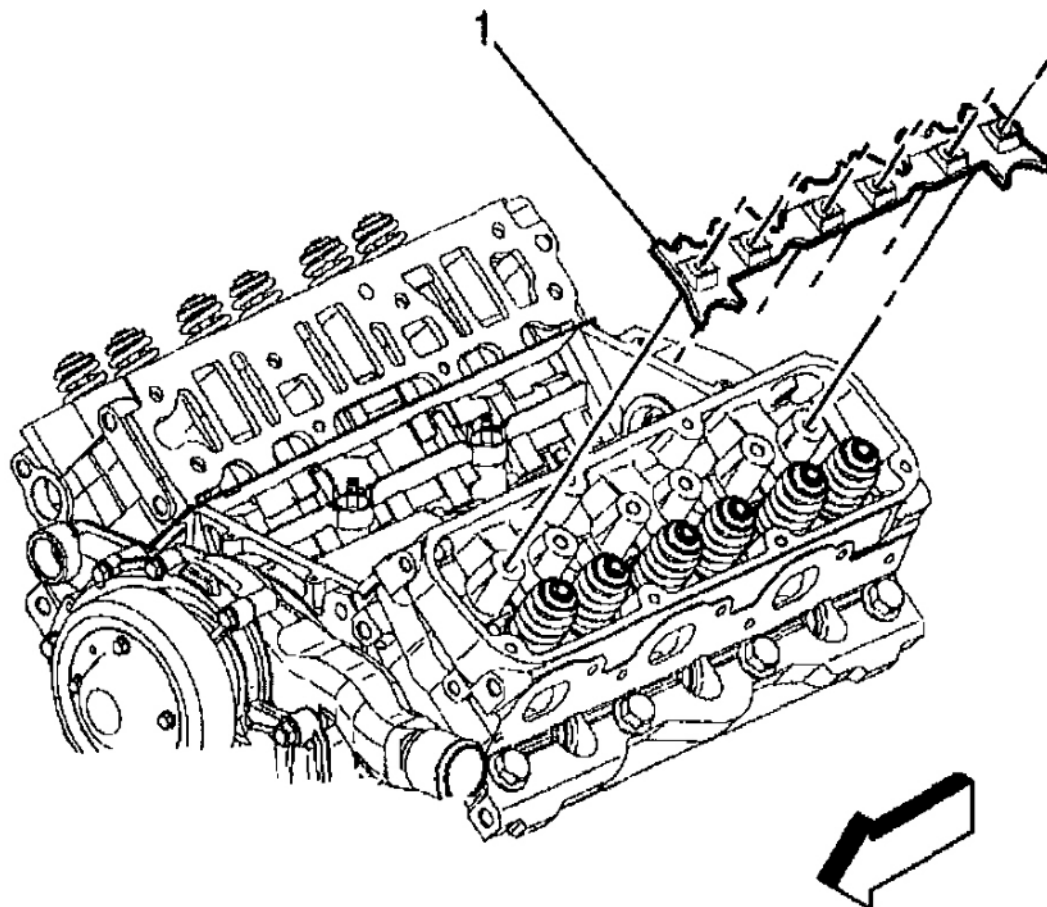
1. Remove the valve rocker arm covers. Refer the following procedures:
 - **Valve Rocker Arm Cover Replacement - Left**
 - **Valve Rocker Arm Cover Replacement - Right**
2. Remove the valve rocker arm bolts (1).
3. Remove the valve rocker arms (2).



G01728772

Fig. 117: Removing Valve Rocker Arm Bolts And Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

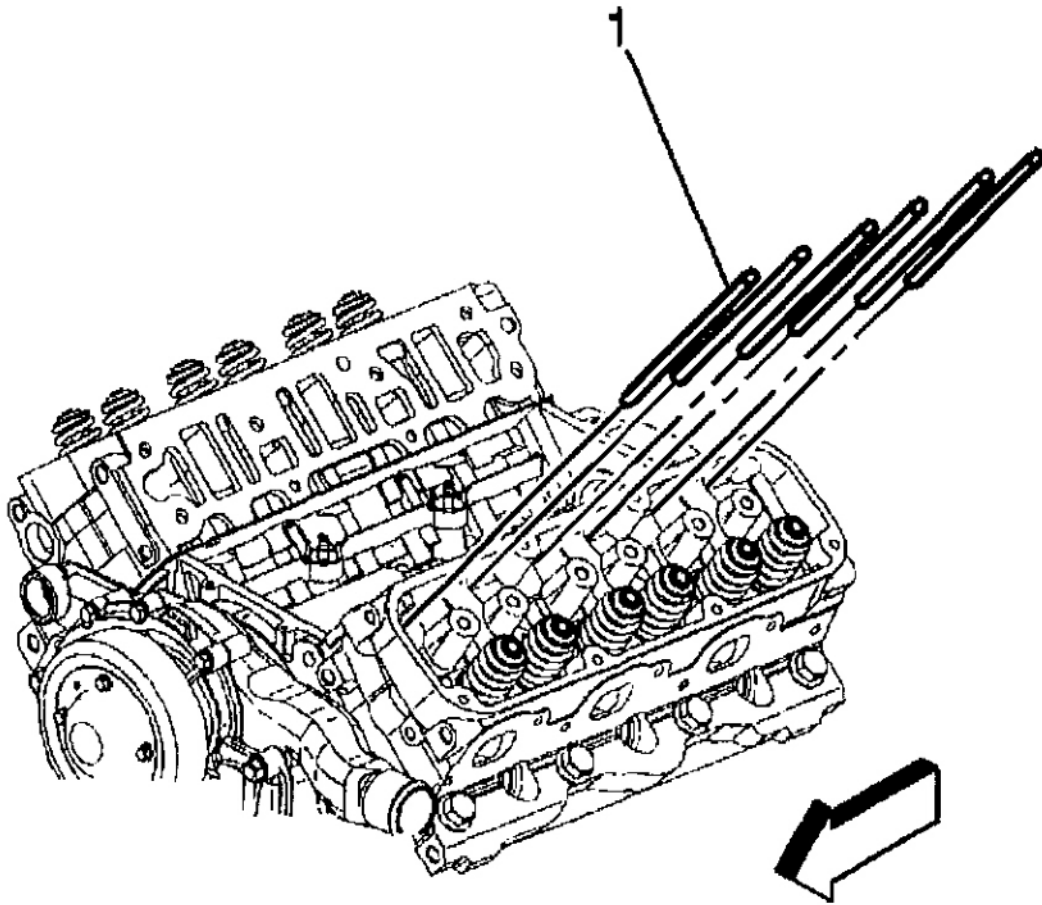
4. Remove the valve rocker arm retainer (1).



G01728773

Fig. 118: Removing Valve Rocker Arm Retainer
Courtesy of GENERAL MOTORS CORP.

5. Remove the pushrods (1).



G01728774

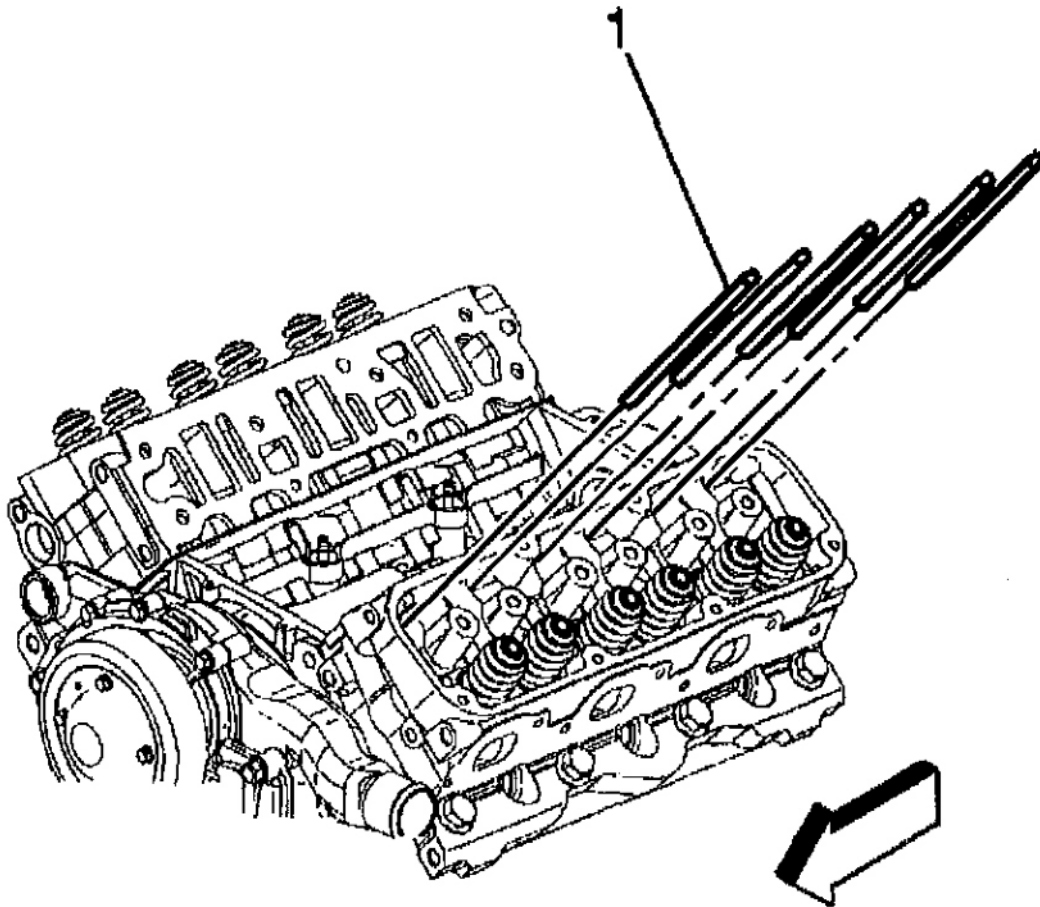
Fig. 119: Remove Pushrods

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

Important: When installing valve rocker arms and pushrods, coat the pushrods with lubricant GM P/N 12345501, Canada P/N 992704, or equivalent. Reinstall the rocker arms and pushrods in the same locations from which they were removed.

1. Install the pushrods (1).

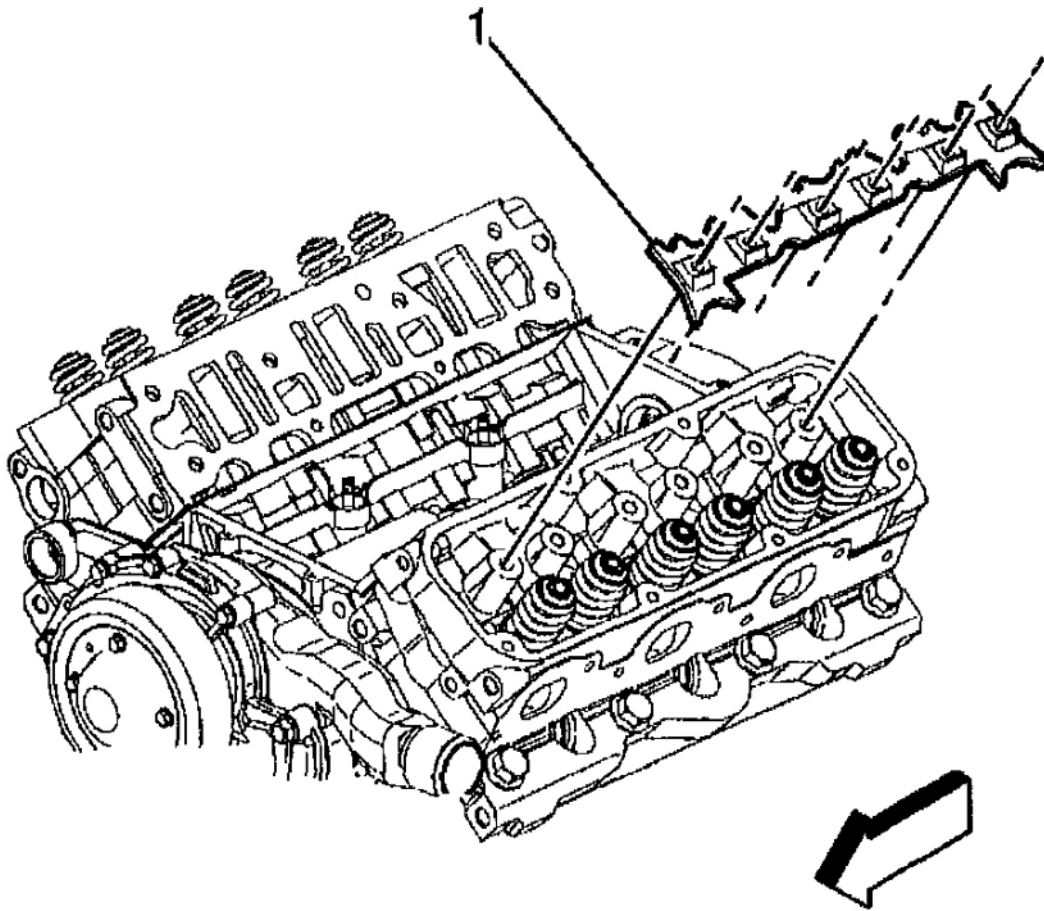


G01728775

Fig. 120: Installing Pushrods

Courtesy of GENERAL MOTORS CORP.

2. Install the valve rocker arm retainer (1).



G01728776

Fig. 121: Installing Valve Rocker Arm Retainer
Courtesy of GENERAL MOTORS CORP.

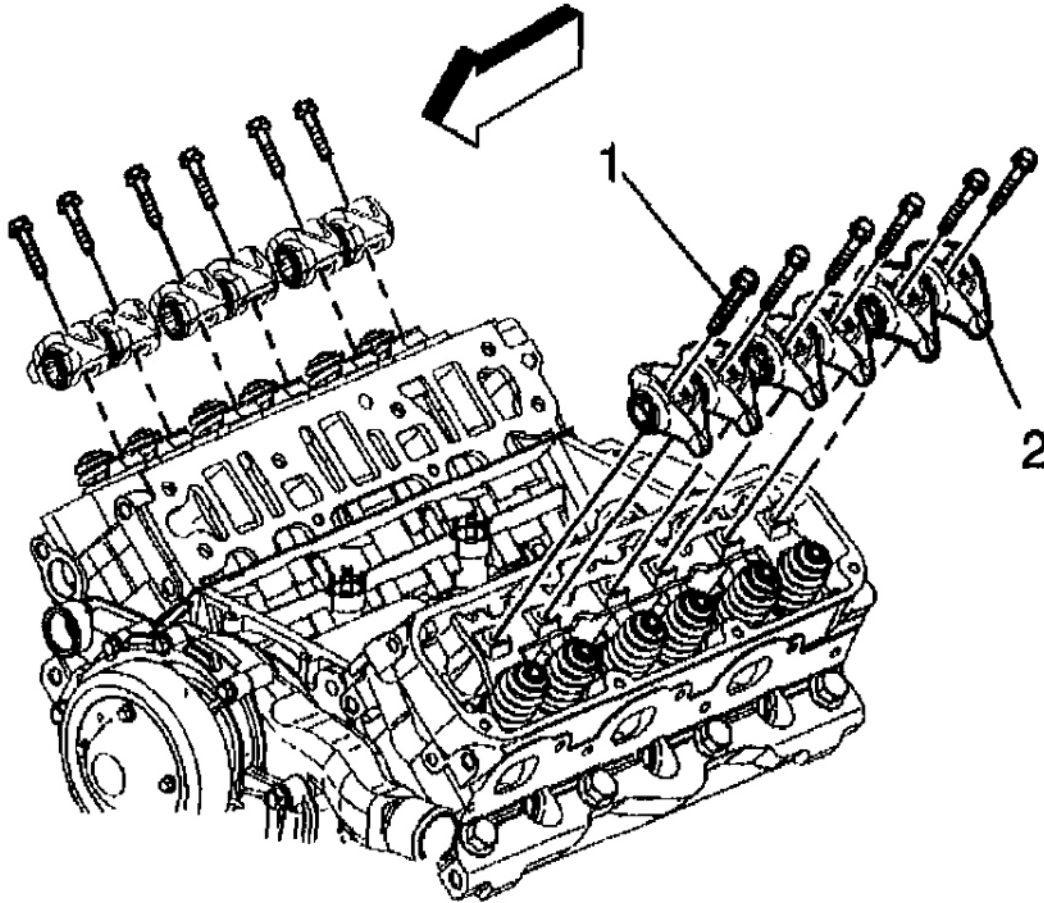
3. Install the valve rocker arms (2).
4. Apply threadlock GM P/N 12345493, Canada P/N 10953488, or equivalent to the rocker arm bolt threads before installing.
5. Install the valve rocker arm bolts (1).

Tighten

Tighten the valve rocker arm bolts to 15 N.m (11 lb ft). Use the J 36660-A in order to torque the bolts an additional 90 degrees.

6. Install the valve rocker arm covers. Refer to the following procedures:
 - **Valve Rocker Arm Cover Replacement - Left**

- Valve Rocker Arm Cover Replacement - Right



G01728777

Fig. 122: Installing Valve Rocker Arm Covers
Courtesy of GENERAL MOTORS CORP.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Tools Required

- **J 23590** Spark Plug Port Adapter
- **J 38606** Valve Spring Compressor
- **J 42863** Valve Seal Installer

Removal Procedure

1. Remove the valve rocker arm and push rod. Refer to Valve Rocker Arm and Push Rod Replacement.
2. Remove the spark plug.

Important: Rotate the engine so that the piston in the cylinder being worked on is at top dead center (TDC) before removing the valve keys. This will eliminate the possibility of the valve accidentally falling inside the cylinder.

3. Install the J 23590 to the spark plug port and apply compressed air in order to hold the valves closed.

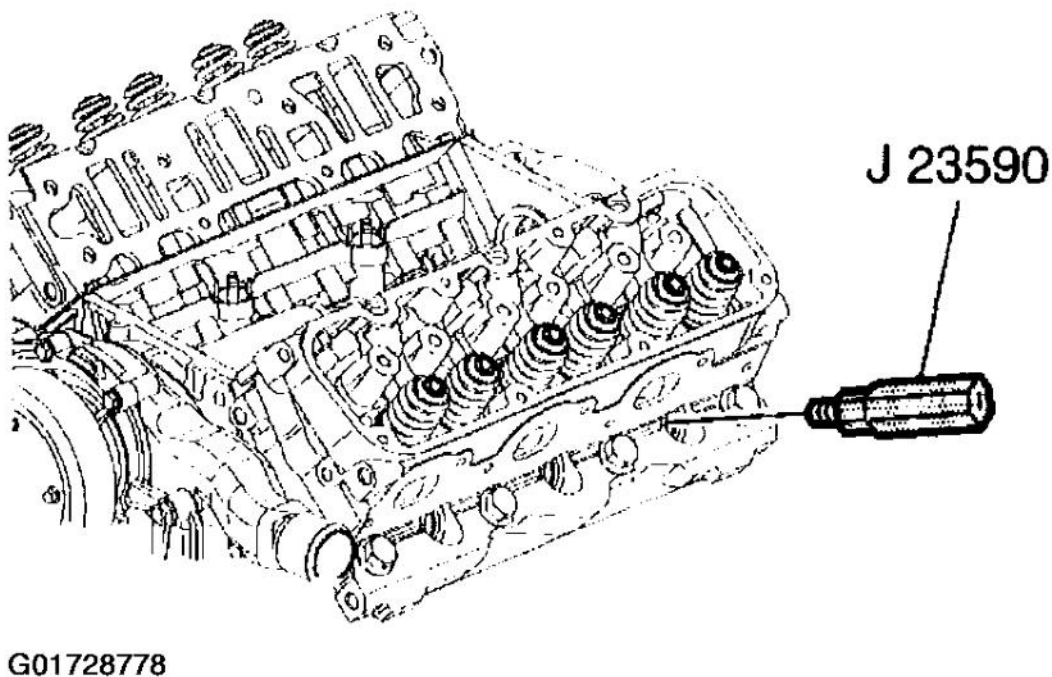
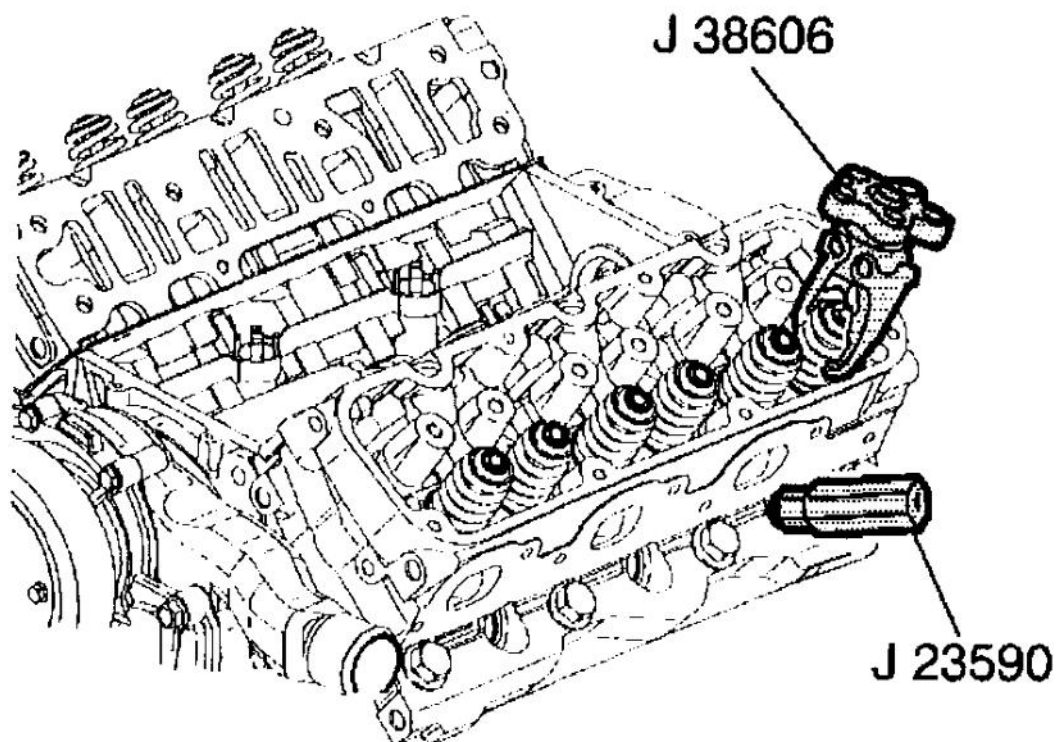


Fig. 123: Installing J 23590

Courtesy of GENERAL MOTORS CORP.

4. Install the J 38606 on the valve spring.



G01728779

Fig. 124: Installing J 38606

Courtesy of GENERAL MOTORS CORP.

5. Compress the valve spring using the J 38606.

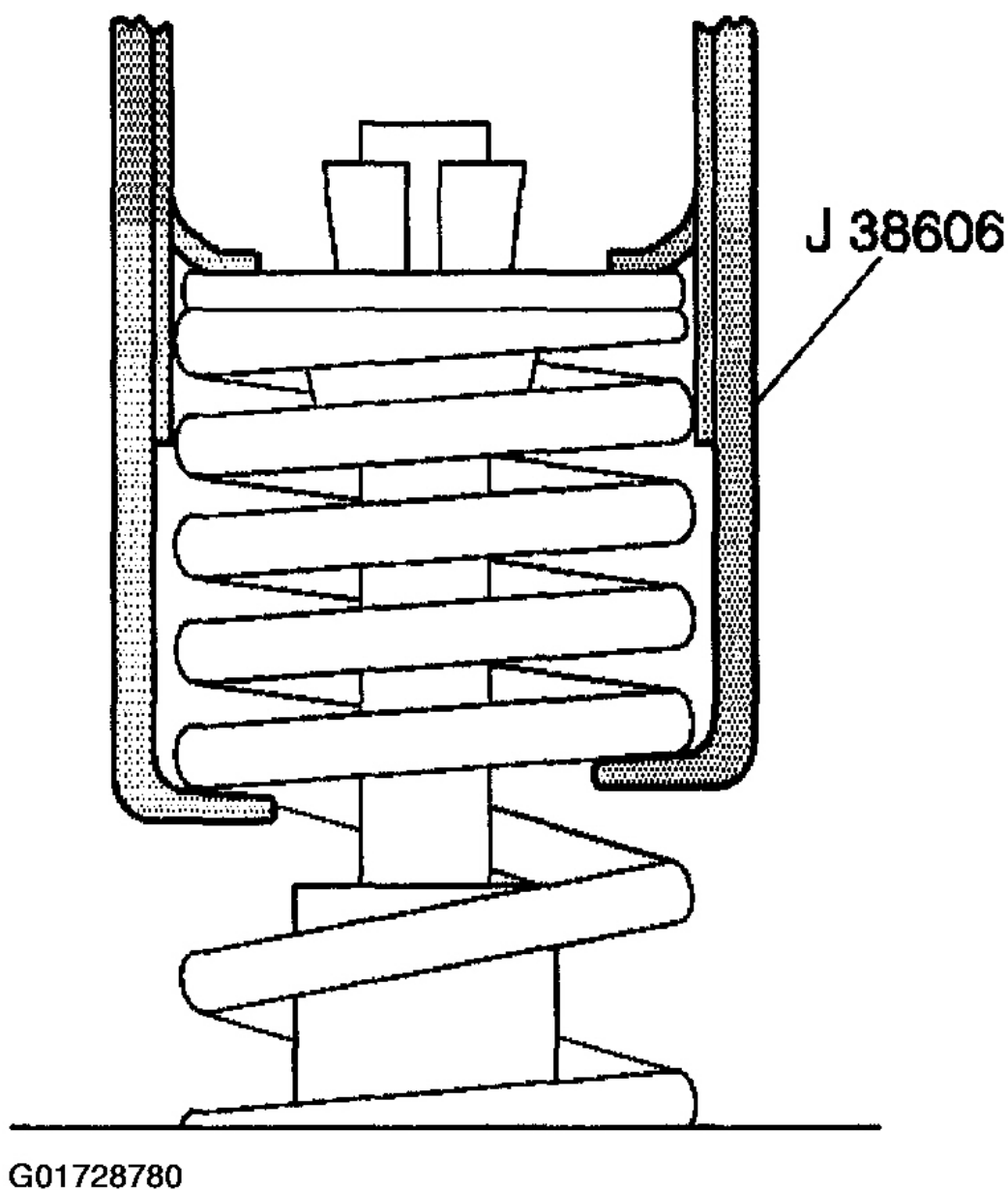
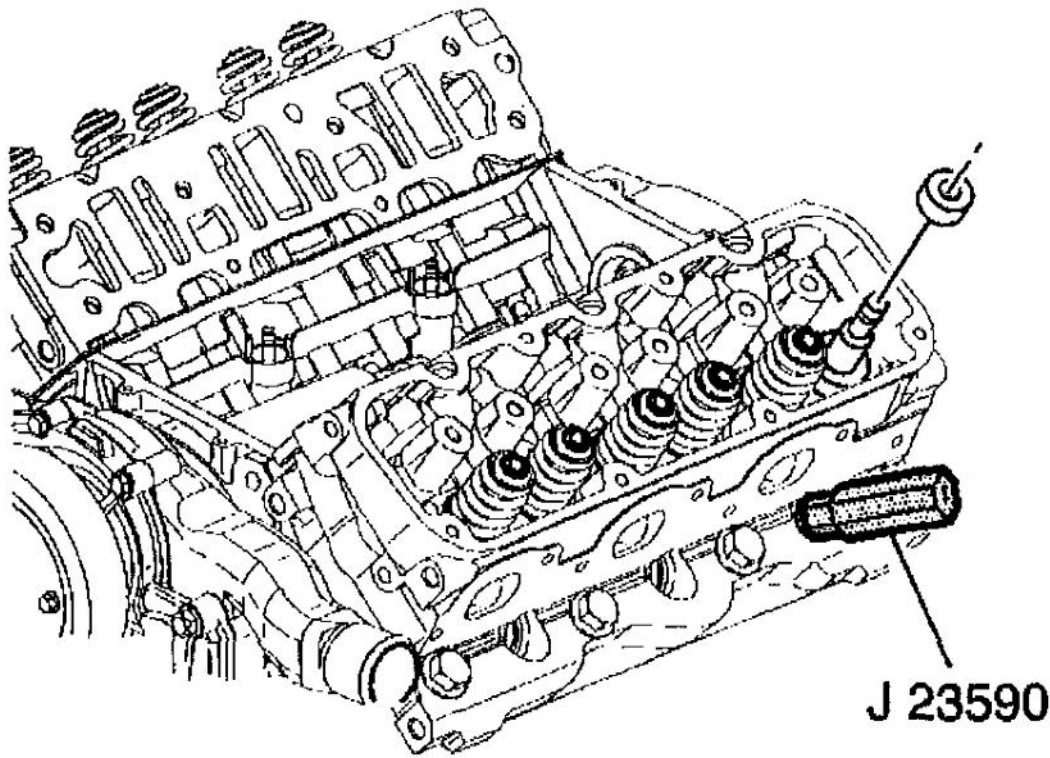


Fig. 125: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

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



G01728781

Fig. 126: Removing Valve Stem Oil Seal
Courtesy of GENERAL MOTORS CORP.

9. Inspect the valve spring for bent, cracked or broken parts. Replace it if damaged. Refer to **CYLINDER HEAD CLEANING AND INSPECTION**.

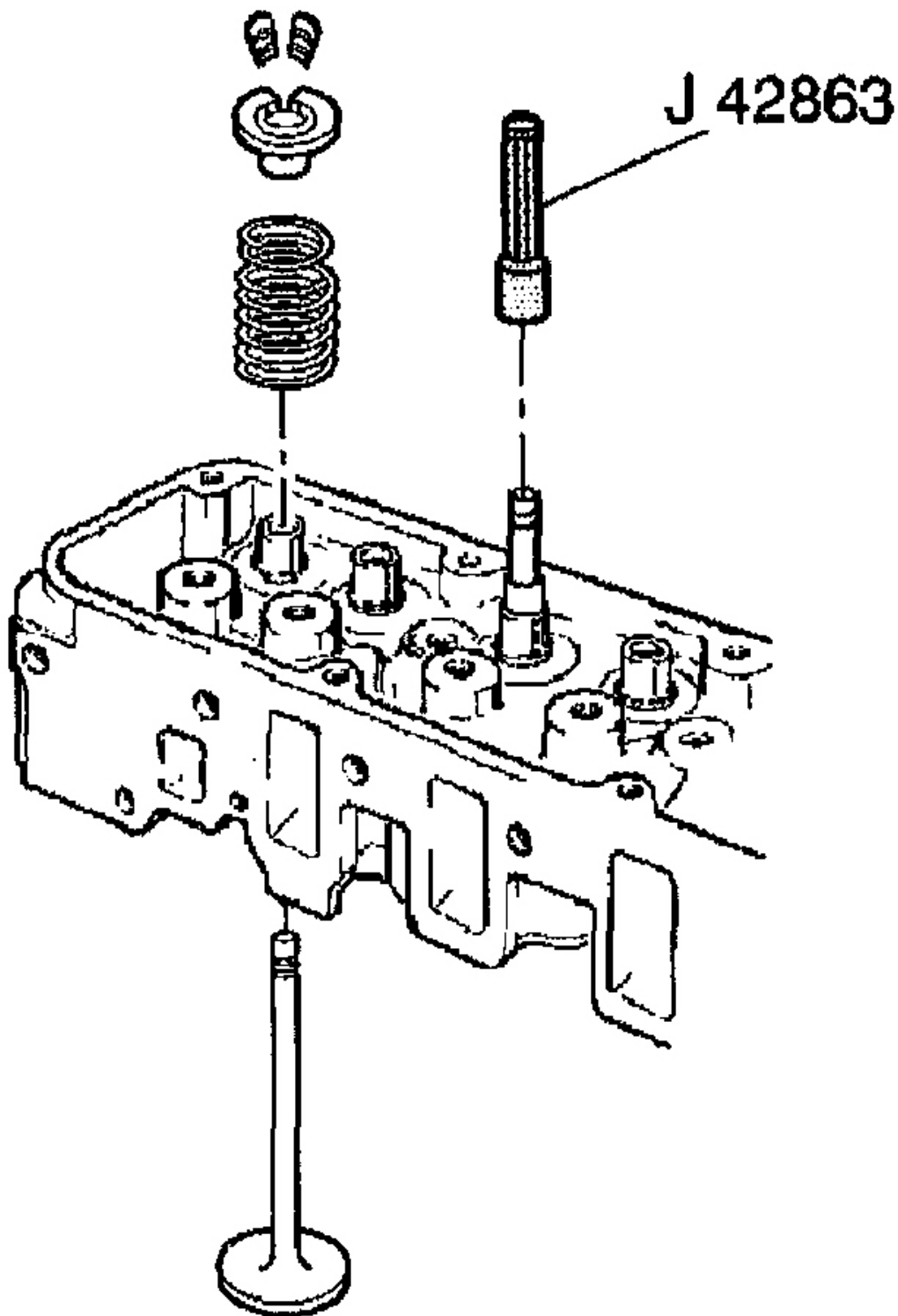
Installation Procedure

Important: The color of the replacement seal may not be the same color as the original seal. Install the seals in their correct location based on GM part and package description. Ensure that the seal is fully seated on the valve guide.

1. Place the valve stem oil seal over the valve stem so the seal begins to contact the valve guide.

Important: Use hand pressure only when installing the valve seal using J 42863. Using too much force may cause damage to the oil seal and possibly lead to excessive oil consumption.

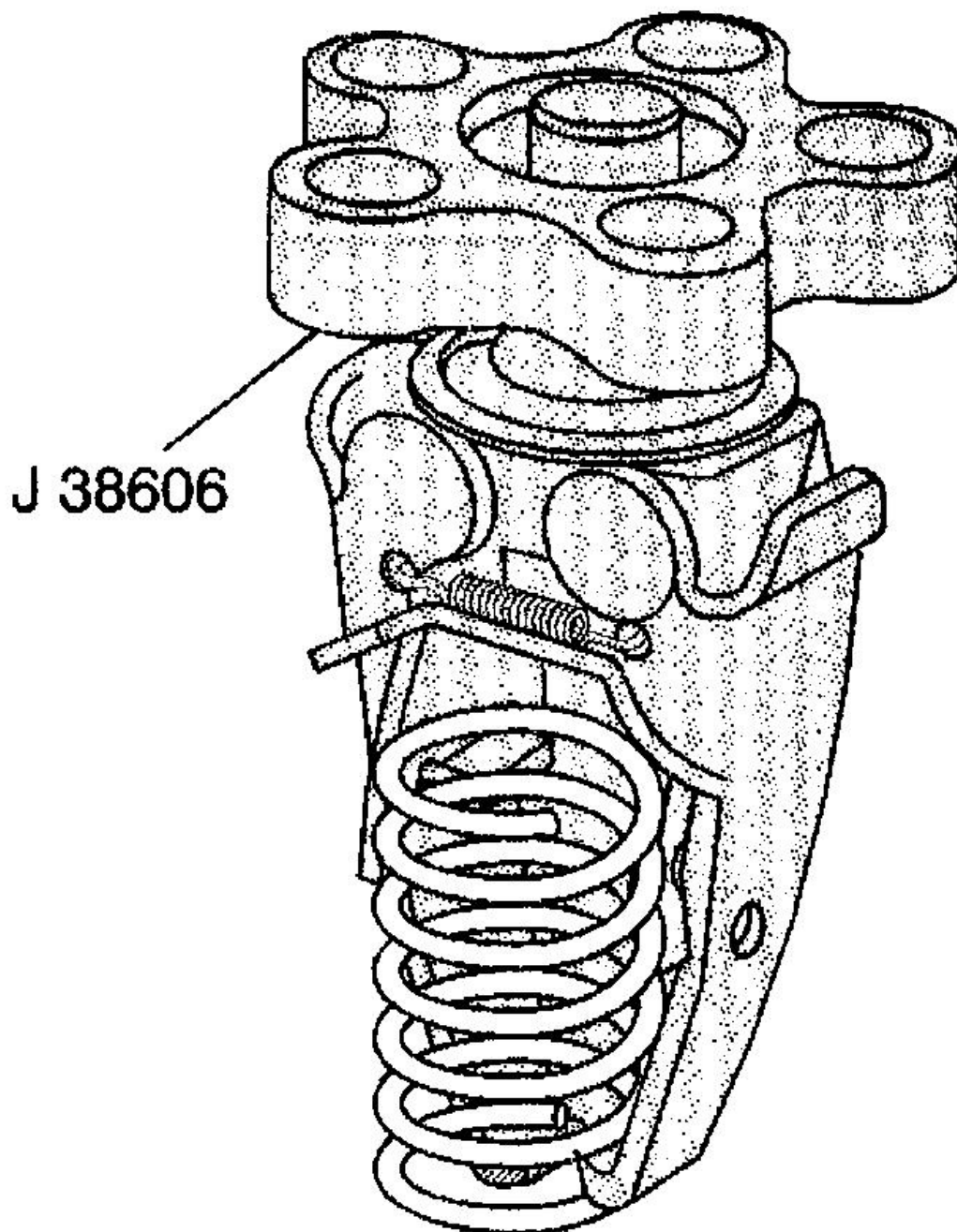
2. Using J 42863 push the valve stem oil seal over the valve guide.



G01728782

Fig. 127: Push Valve Stem Oil Seal Over The Valve Guide
Courtesy of GENERAL MOTORS CORP.

3. Install the J 38606 on the valve spring.



G01728783

Fig. 128: Installing J 38606
Courtesy of GENERAL MOTORS CORP.

4. Compress the valve spring using the J 38606.

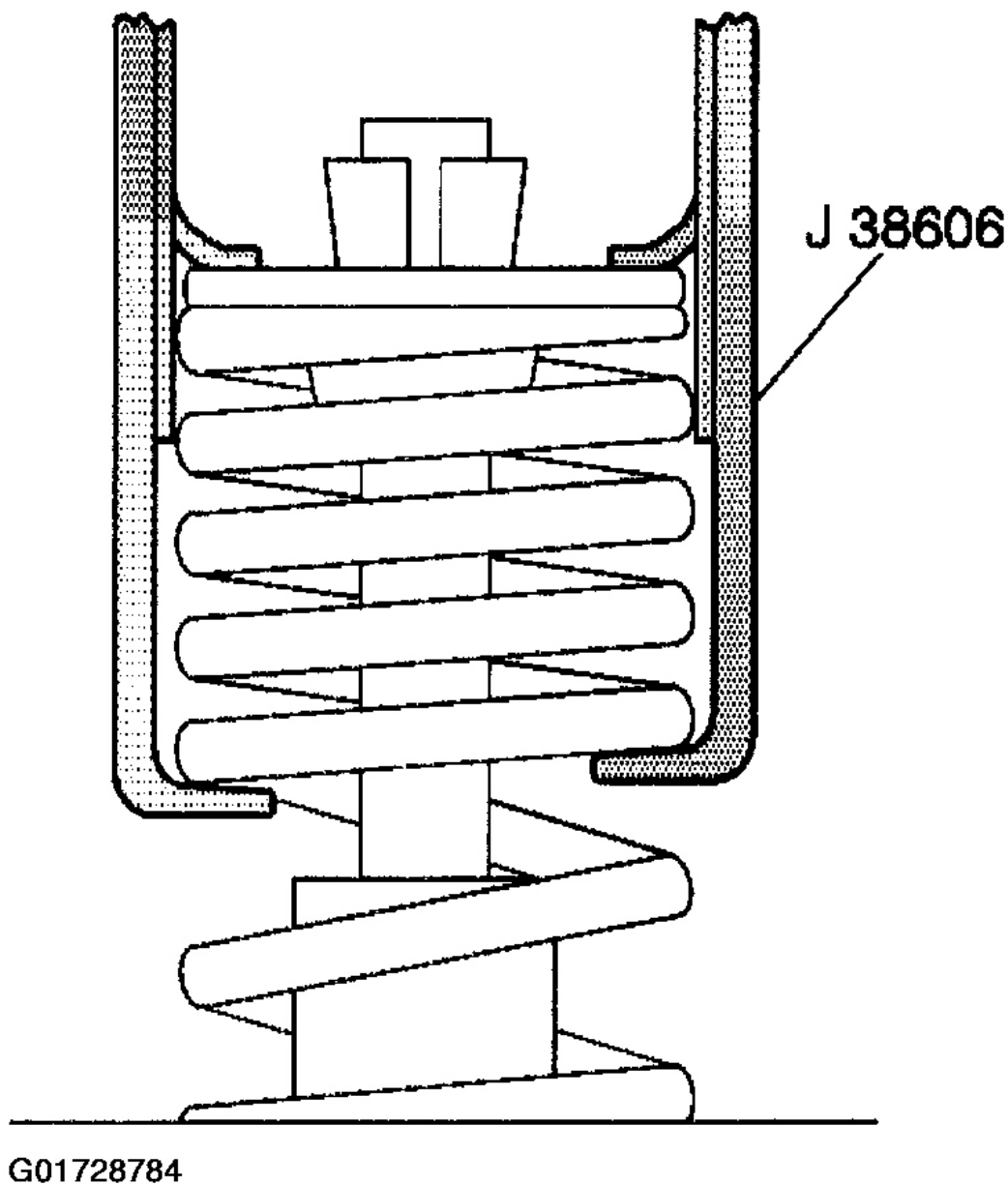
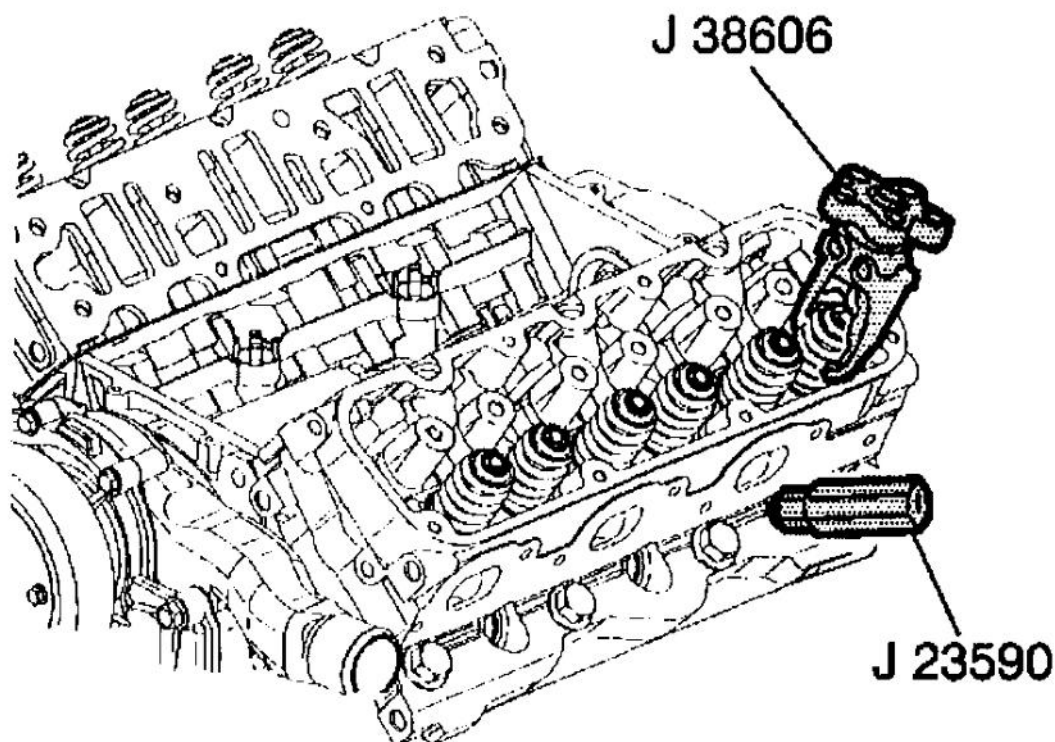


Fig. 129: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Using install the valve spring and the valve cap.
6. Install the valve keys.

7. Release the valve spring.
8. Ensure that the valve keys are seated.
9. Remove the J 38606.



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Fig. 130: Remove J 38606
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the air pressure, and remove the J 23590.

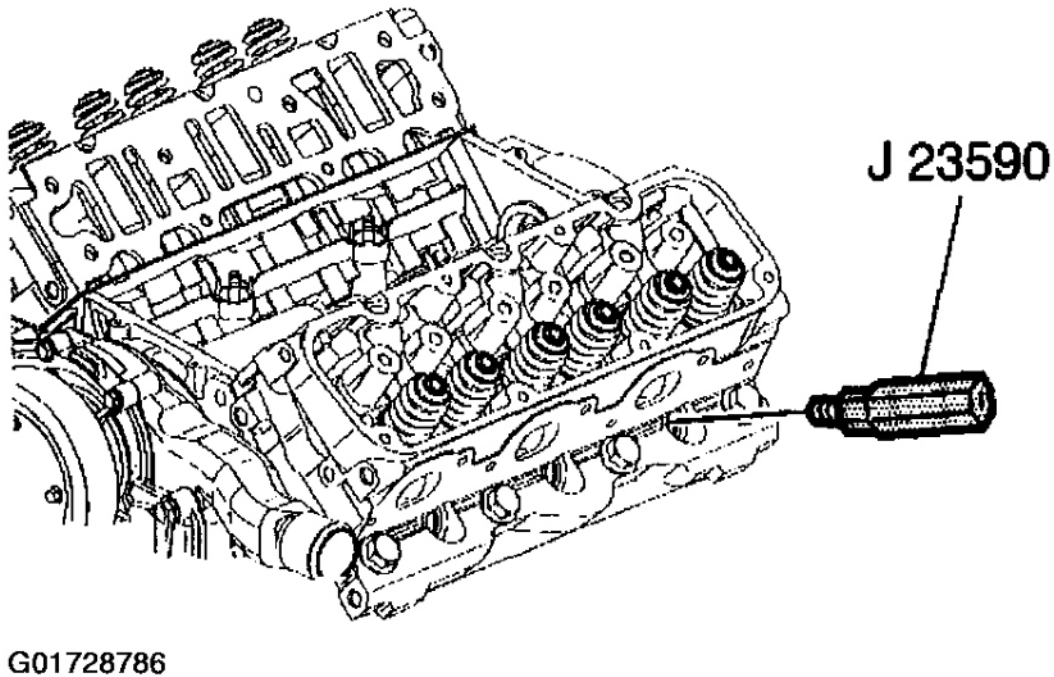


Fig. 131: Removing J 23590

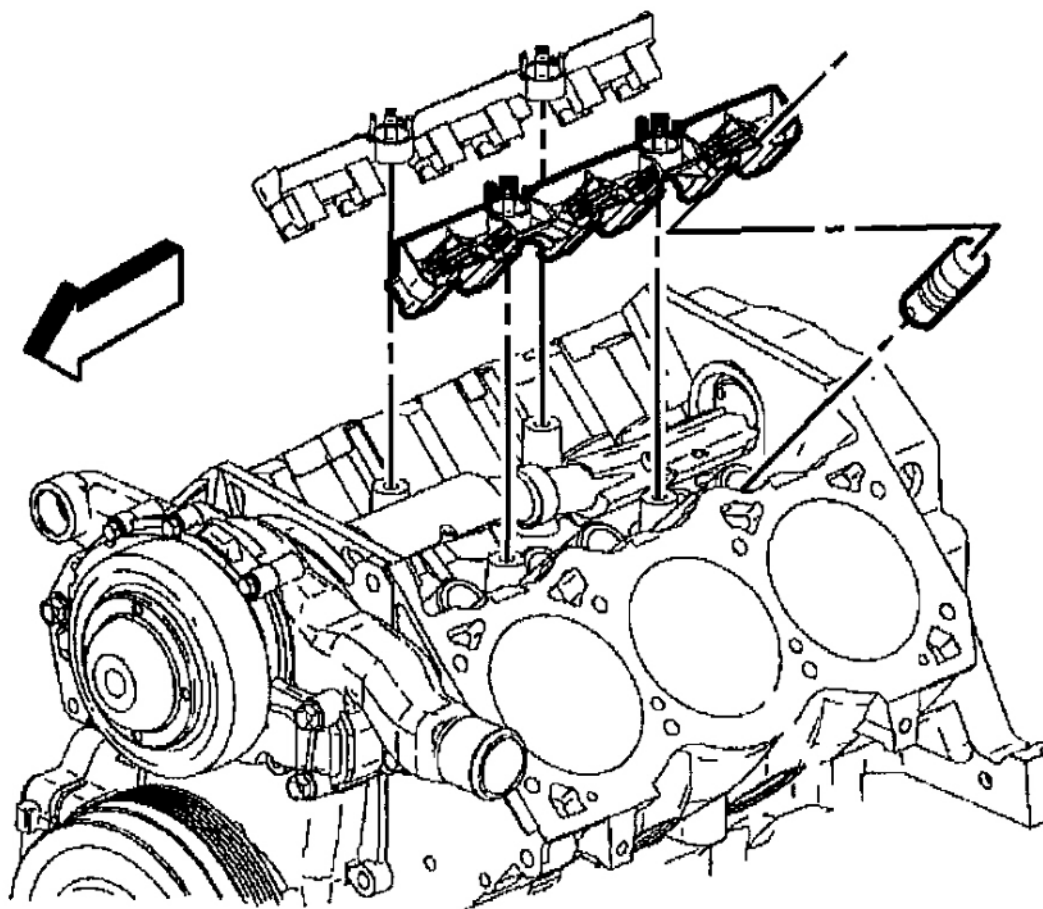
Courtesy of GENERAL MOTORS CORP.

11. Install the spark plug.
12. Install the push rod and valve rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.

VALVE LIFTER REPLACEMENT

Removal Procedure

1. Remove the lower intake manifold. Refer **Intake Manifold Replacement - Lower**.
2. Remove the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
3. Loosen the valve lifter guide bolts.
4. Remove the valve lifter guide.
5. Remove the valve lifters.

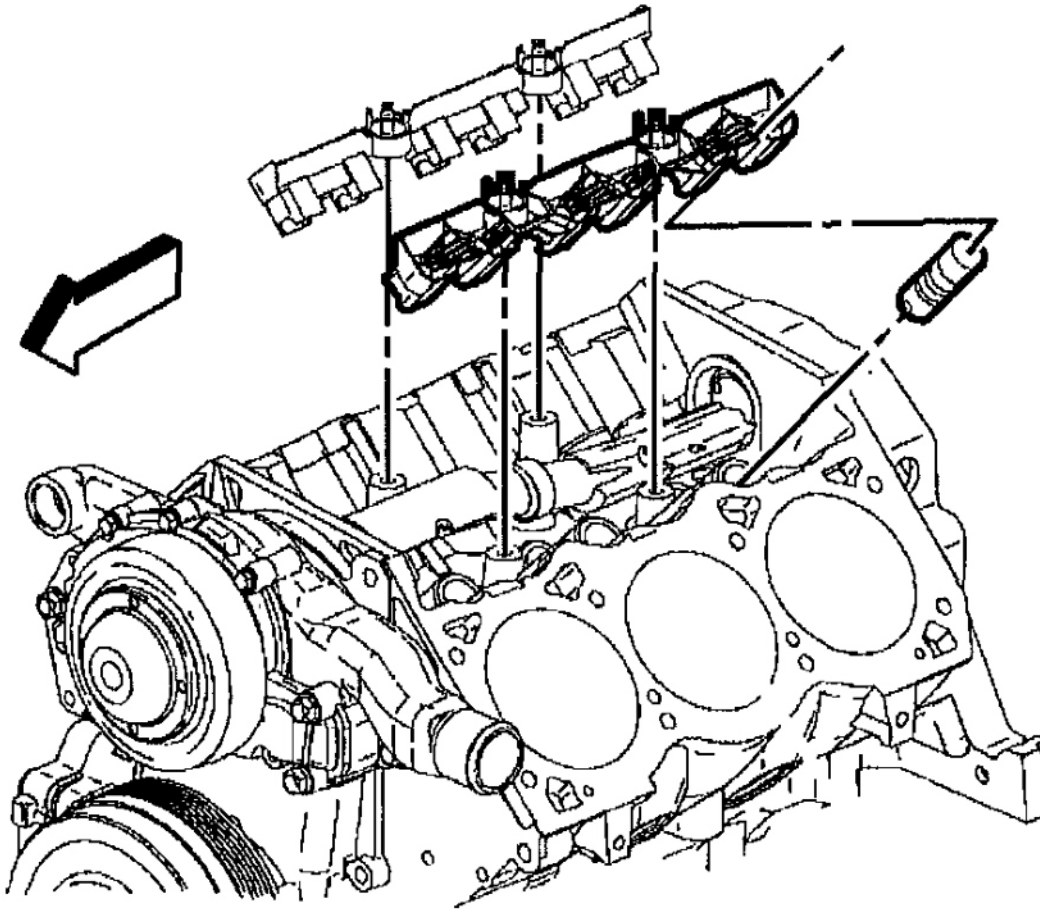


G01728787

Fig. 132: Removing Valve Lifters
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Coat the valve lifters with lubricant, GM P/N 12345501, Canada P/N 992704, or equivalent prior to installation.
2. Install the valve lifters.



G01728788

Fig. 133: Installing Valve Lifters
Courtesy of GENERAL MOTORS CORP.

3. Install the valve lifter guide.
4. Tighten the valve lifter guide bolts.

Tighten

Tighten the valve lifter guide bolts to 30 N.m (22 lb ft).

5. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

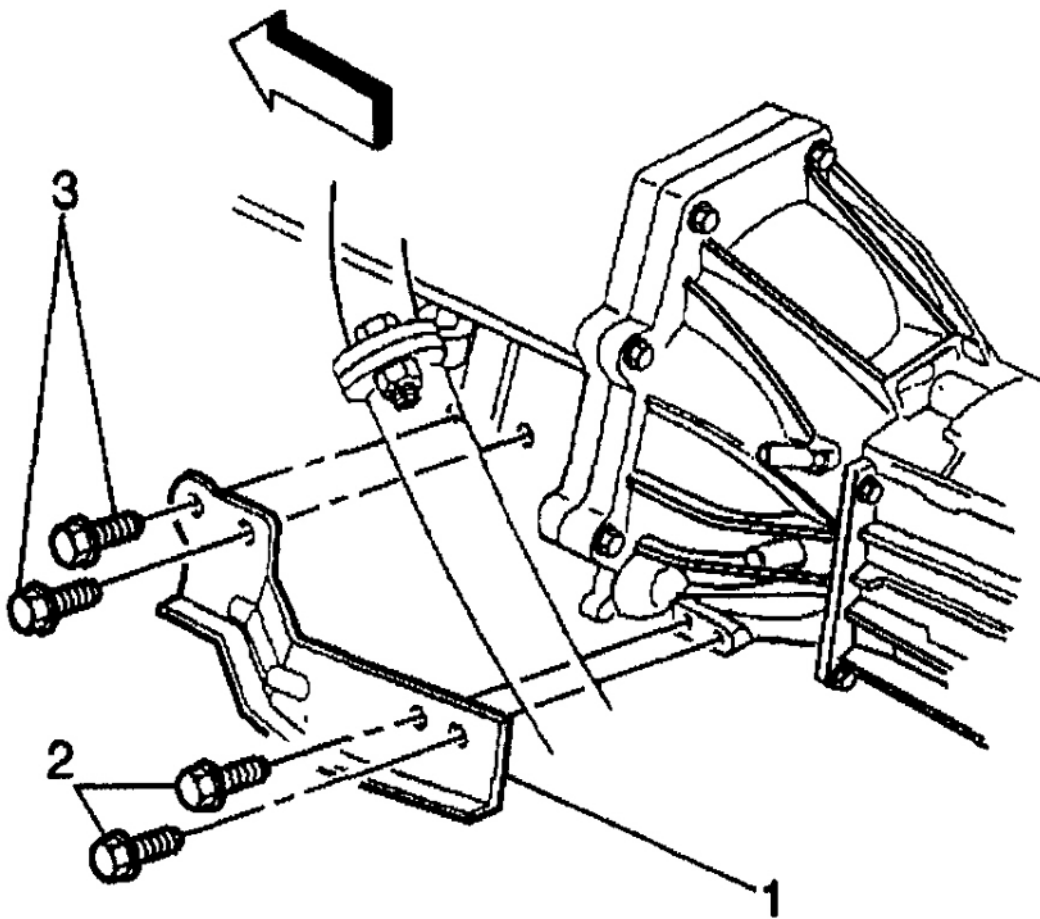
CRANKSHAFT BALANCER REPLACEMENT

Tools Required

- **J 38197-A** Crankshaft Balancer Puller
- **J 37096** Flywheel Holding Tool
- **J 36660-A** Torque Angle Meter

Removal Procedure

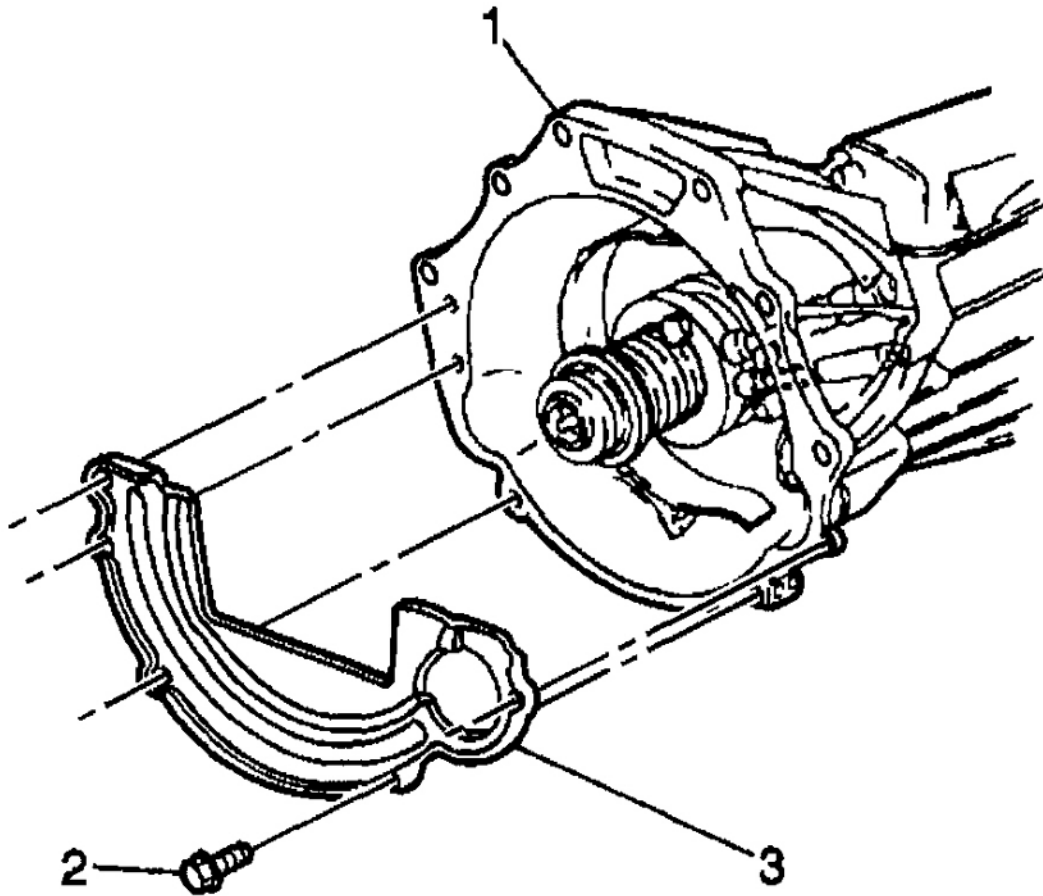
1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
3. Remove the starter motor. Refer to **STARTER MOTOR (3.8L)**.
4. If equipped with the M49 manual transmission remove the transmission brace bolts (2, 3).
5. Remove the transmission brace (1).



G01728789

Fig. 134: Removing Transmission Brace
Courtesy of GENERAL MOTORS CORP.

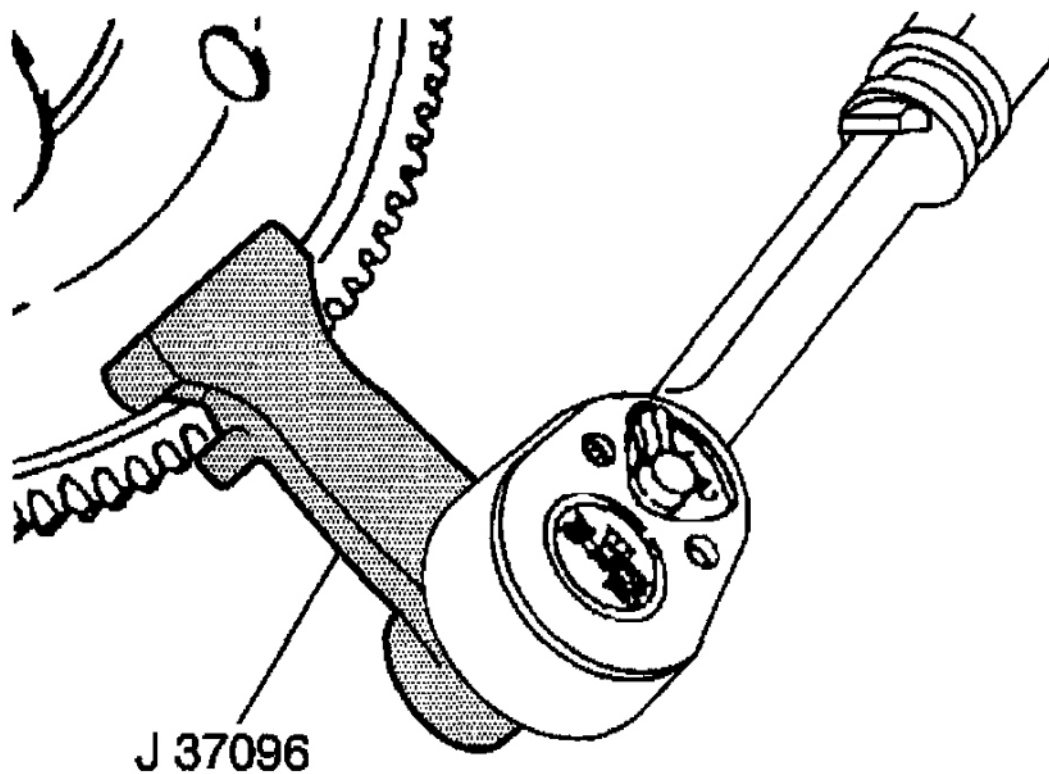
6. If equipped with the M49 manual transmission remove the flywheel housing inspection cover bolts (2).
7. Remove the flywheel housing inspection cover (3).



G01728790

Fig. 135: Remove Flywheel Housing Inspection Cover
Courtesy of GENERAL MOTORS CORP.

8. If equipped with the 4L60-E automatic transmission remove the torque converter cover. Refer to **TORQUE CONVERTER COVER**.
9. Use J 37096 in order to hold the flywheel.

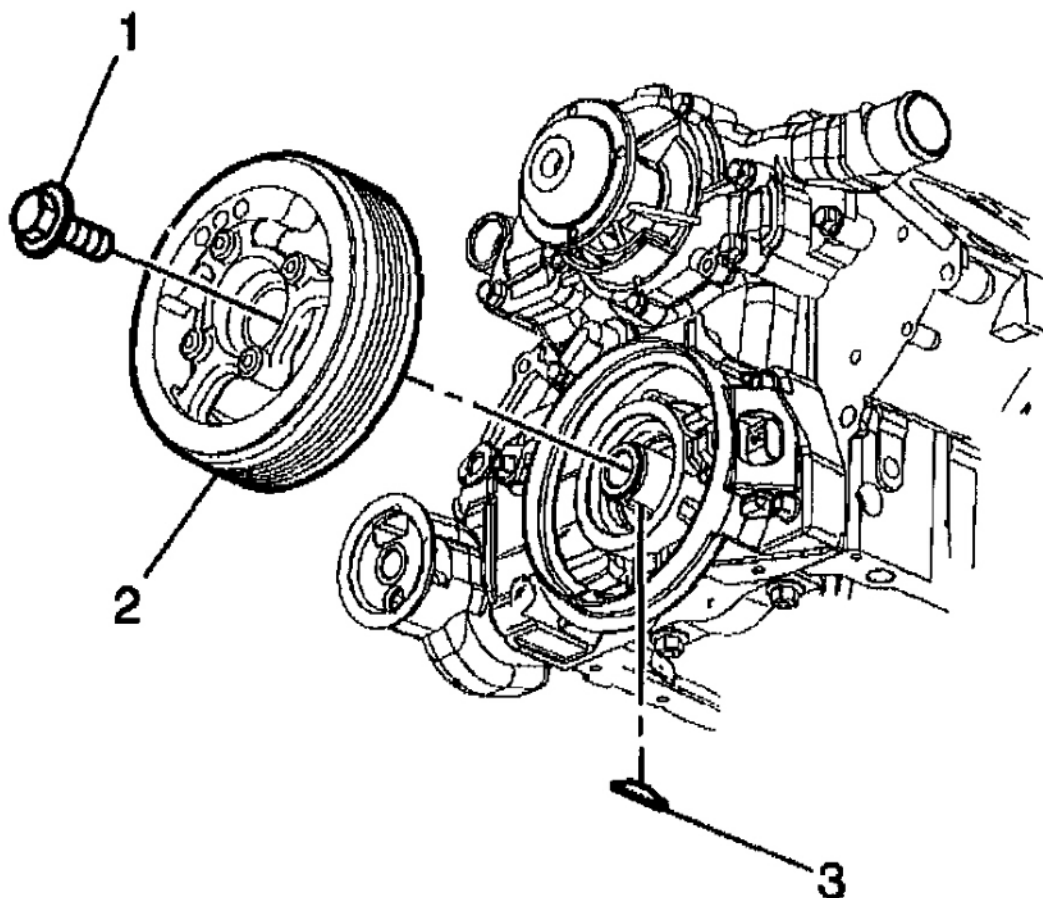


G01728791

Fig. 136: Using J 37096

Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt (1) from the balancer (2).



G01728792

Fig. 137: Removing Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

11. Remove the crankshaft balancer using the J 38197-A.

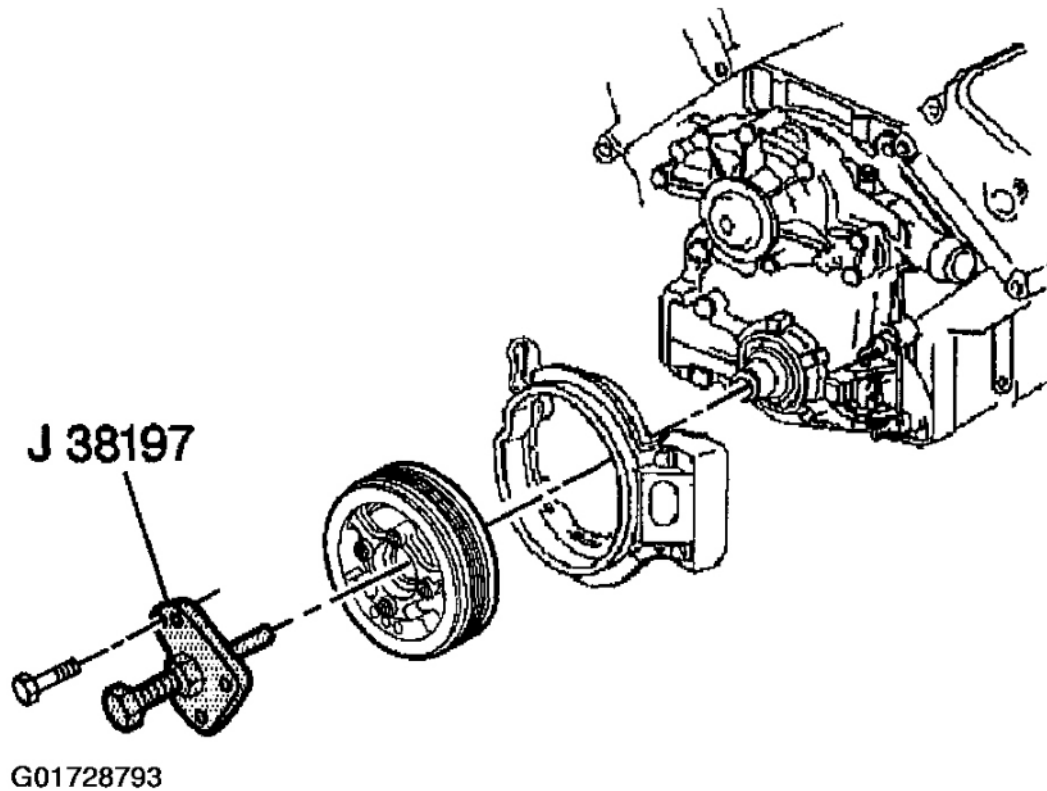
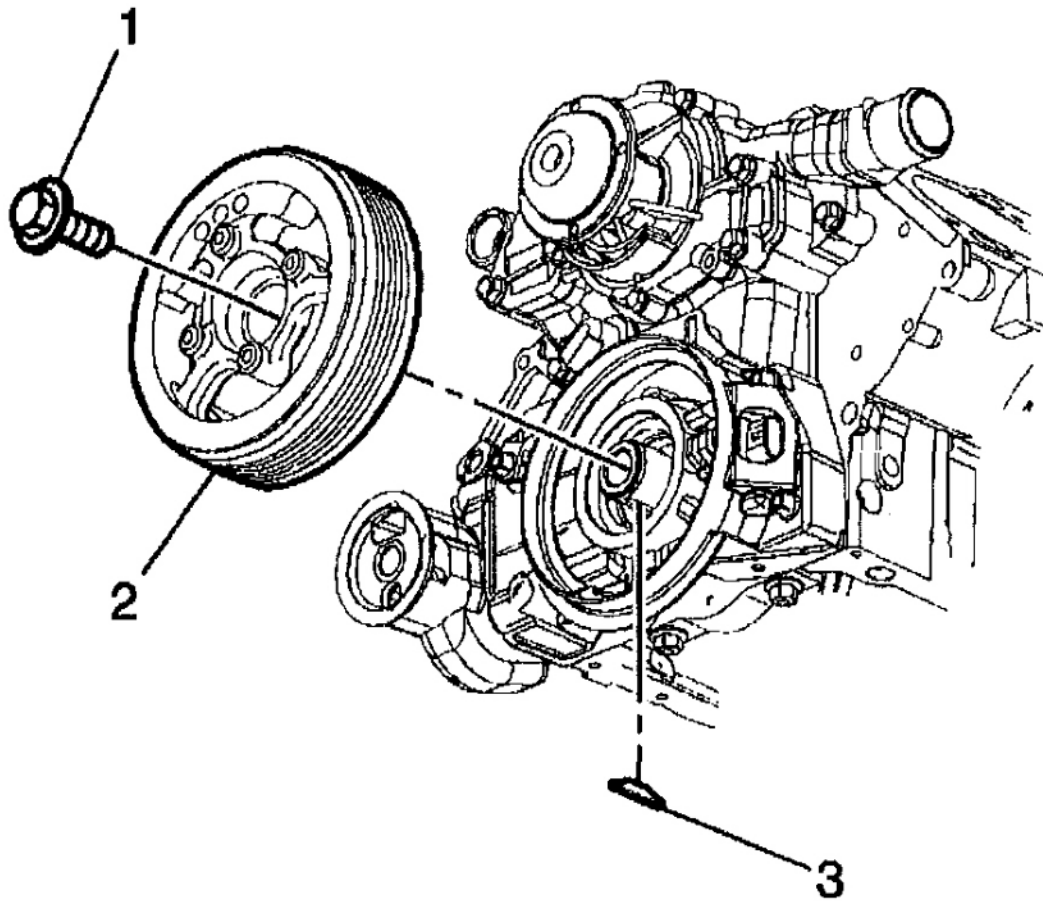


Fig. 138: Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

- 11.1. Invert J 38197-2 so the leg of the tool is facing away from the crankshaft balancer.
- 11.2. Install the bolts J 38197-4 to the crankshaft balancer.
- 11.3. Remove J 38197-1, J 38197-2, and J 38197-4 from the crankshaft balancer.
12. Remove the key from the crankshaft.

Installation Procedure

1. Lubricate the seal surface of the crankshaft balancer with engine oil.
2. Install the key (3)



G01728794

Fig. 139: Installing Key
Courtesy of GENERAL MOTORS CORP.

3. Align the key slot in the balancer (2) to the key slot in the crankshaft.
4. Install the crankshaft balancer (2).
5. Install the crankshaft balancer bolt (1).

Tighten

Tighten the crankshaft balancer bolt (1) to 150 N.m (111 lb ft). Use the J 36660-A to torque the crankshaft balancer bolt (1) an additional 114 degrees.

6. Remove the J 37096.
7. If equipped with the 4L60-E automatic transmission install the torque converter cover. Refer to **TORQUE CONVERTER COVER**.

8. If equipped with the M49 manual transmission install the flywheel housing inspection cover (3).
9. Install the flywheel housing inspection cover bolts (2).

Tighten

Tighten the flywheel housing inspection cover bolts (2) to 9 N.m (80 lb in).

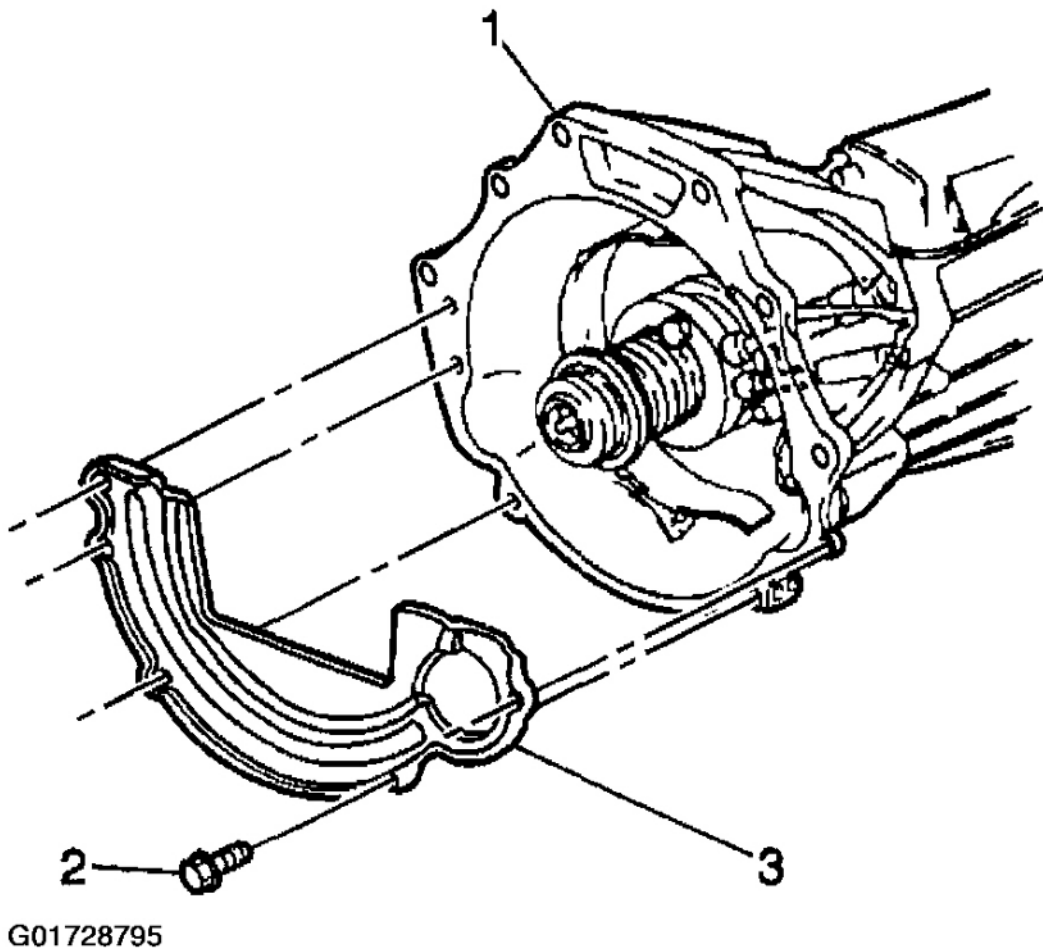
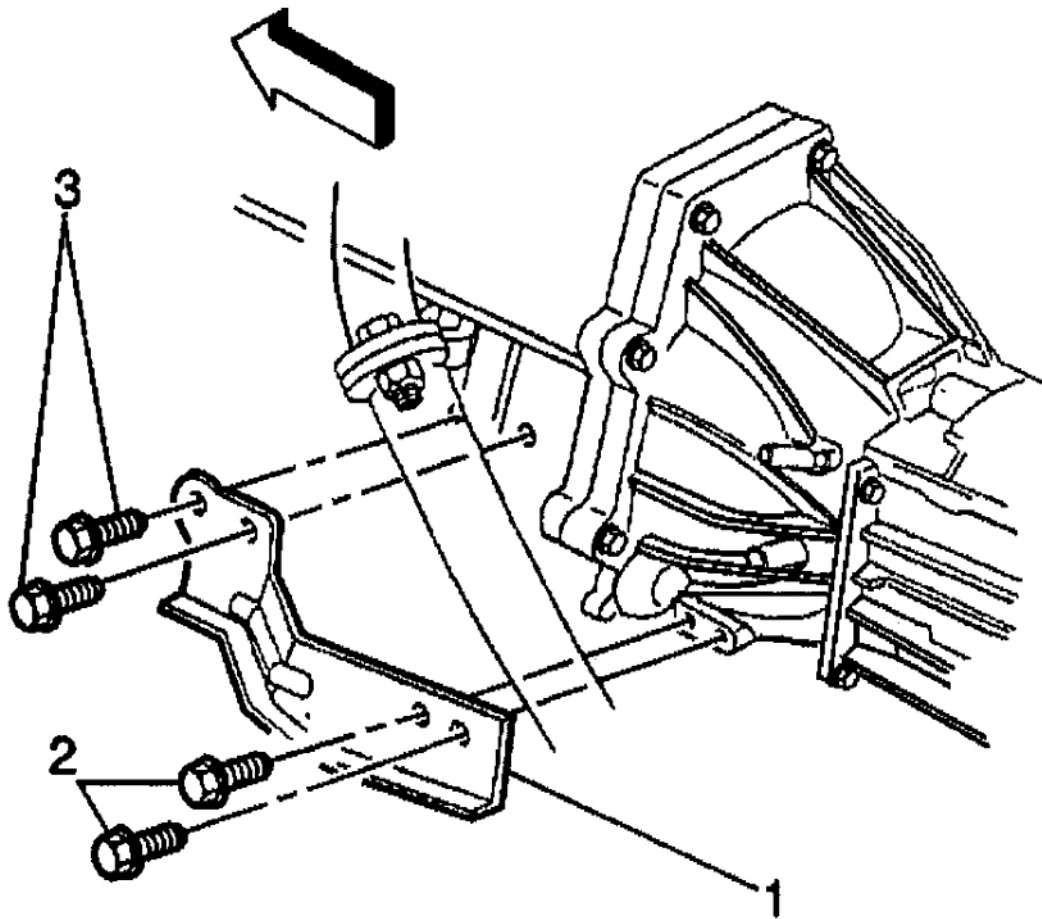


Fig. 140: Installing Flywheel Housing Inspection Cover
Courtesy of GENERAL MOTORS CORP.

10. If equipped with the M49 manual transmission install the transmission brace (1).
11. Install the transmission brace bolts (2, 3).



G01728796

Fig. 141: Installing Transmission Brace Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

- Tighten the brace bolts (3) to the engine block to 28 N.m (21 lb ft).
 - Tighten the brace bolts (2) to the transmission to 50 N.m (37 lb ft).
12. Install the starter motor. Refer to **STARTER MOTOR (3.8L)**
 13. Lower the vehicle.
 14. Install the drive belt. Refer to **Drive Belt Replacement**.
 15. Perform the crankshaft position (CKP) system variation learn procedure. Refer to **CRANKSHAFT POSITION SENSOR**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Tools Required**J 35354** Seal Installer**Removal Procedure**

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Use a screwdriver to pry out the crankshaft front oil seal. Use care in order to avoid damage to the seal bore or seal contact surfaces.

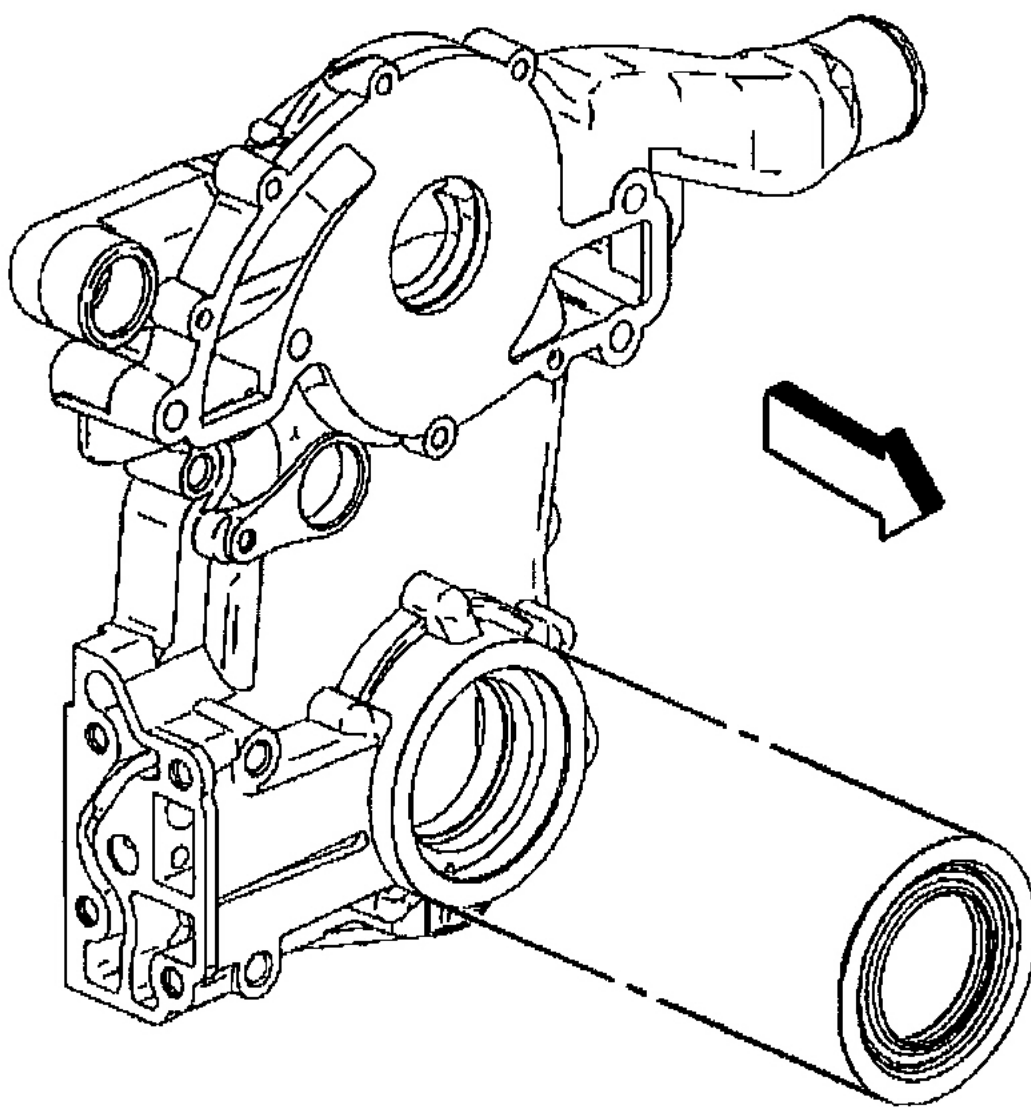
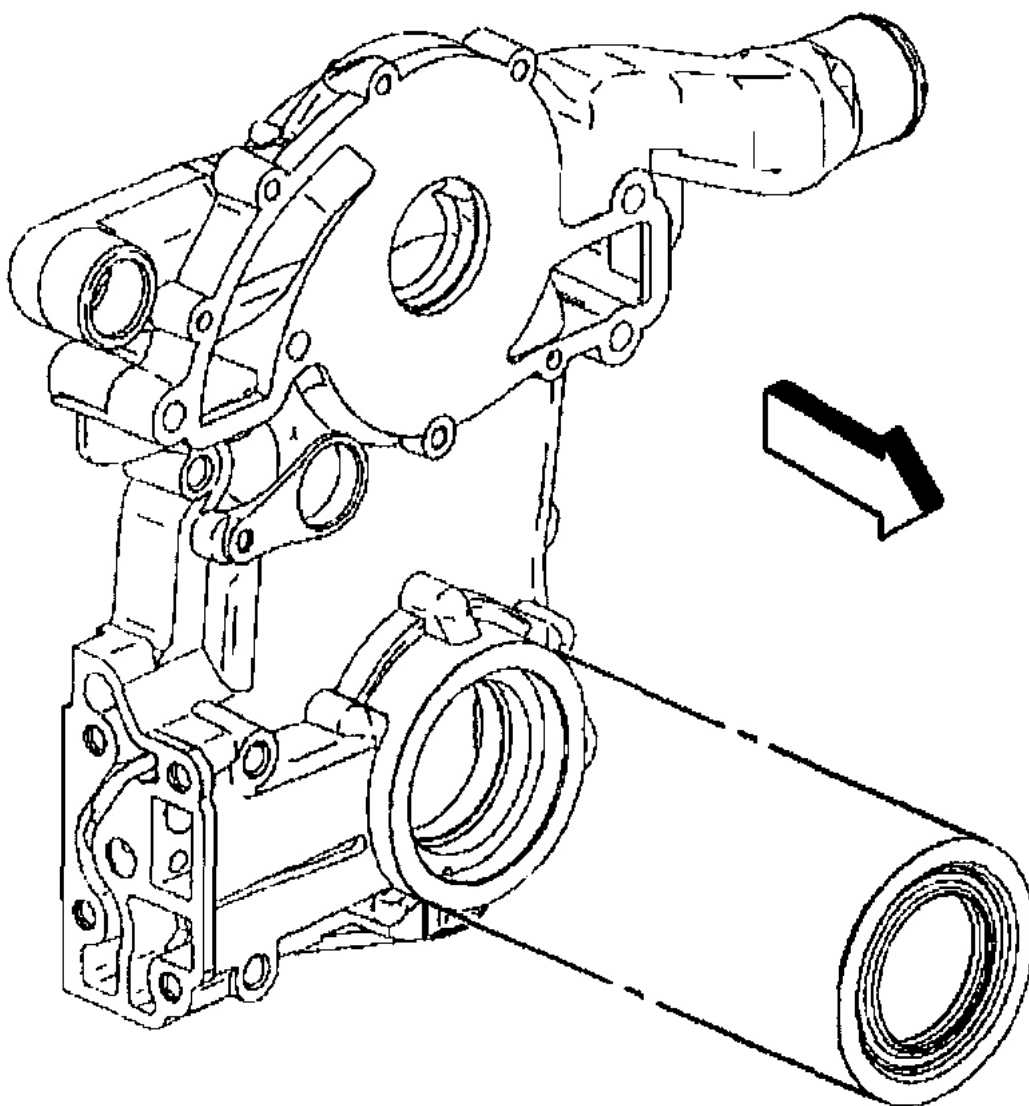
**G01728797**

Fig. 142: Prying Out The Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the crankshaft front oil seal. Use the J 35354.
2. Remove the J 35354.
3. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.



G01728798

Fig. 143: Installing Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

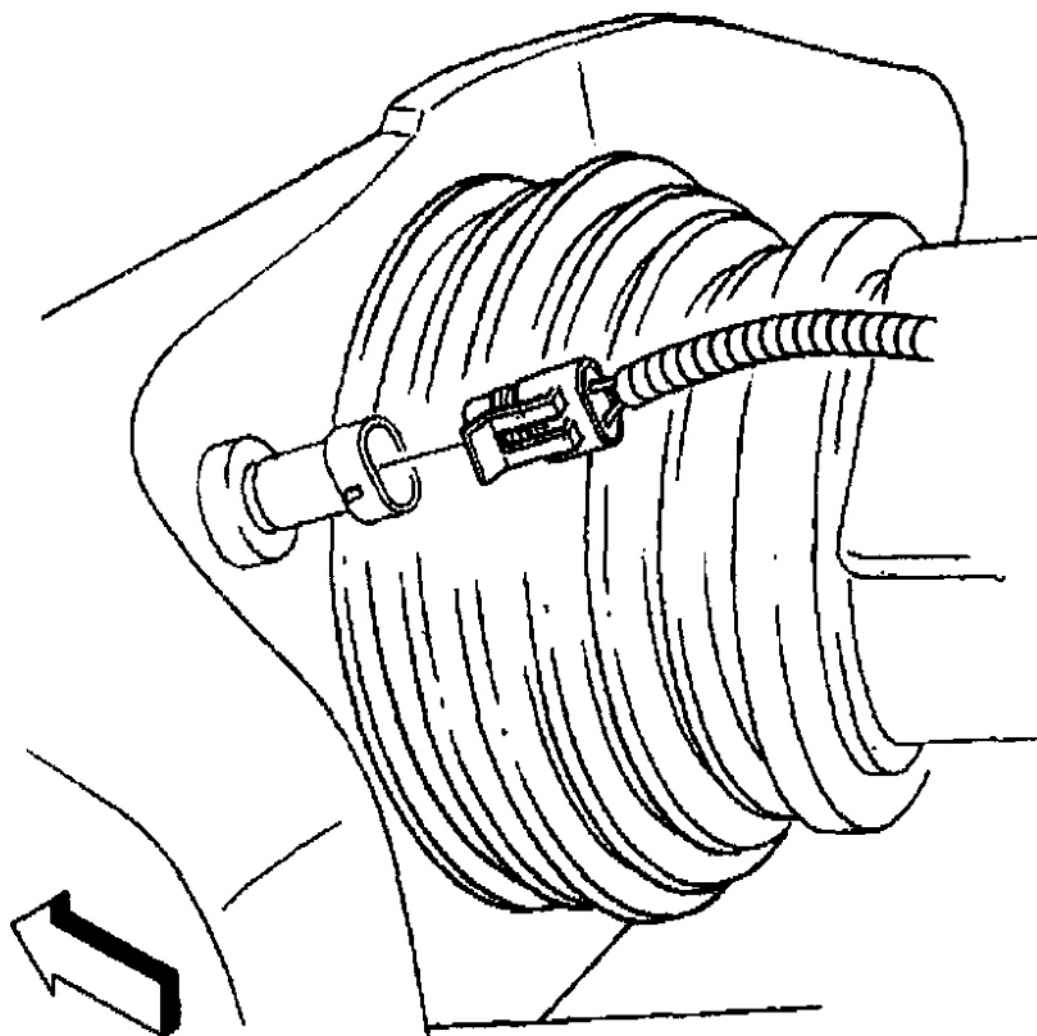
ENGINE FRONT COVER REPLACEMENT

Tools Required

- **J 36660-A** Torque Angle Meter
- **J 35354** Seal Installer

Removal Procedure

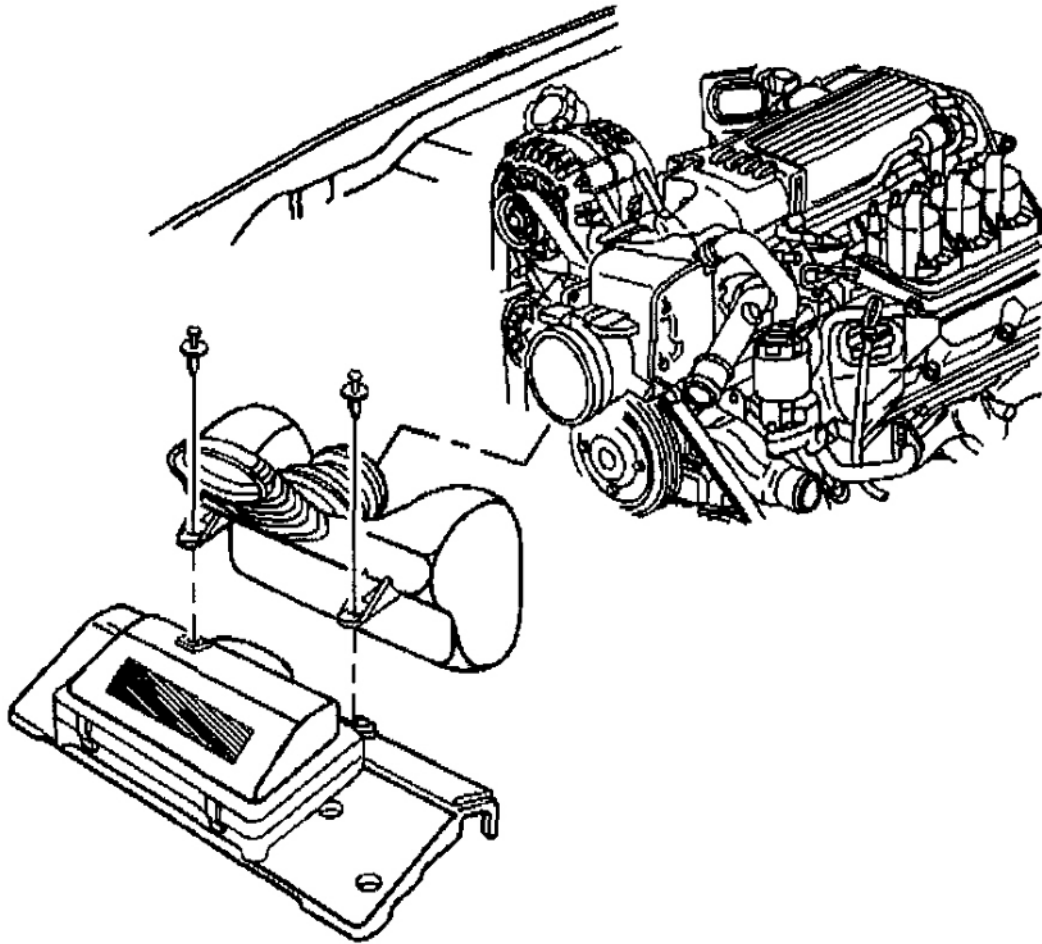
1. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
2. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
3. Disconnect the intake air temperature (IAT) sensor electrical connector.



G01728799

Fig. 144: Disconnecting Intake Air Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

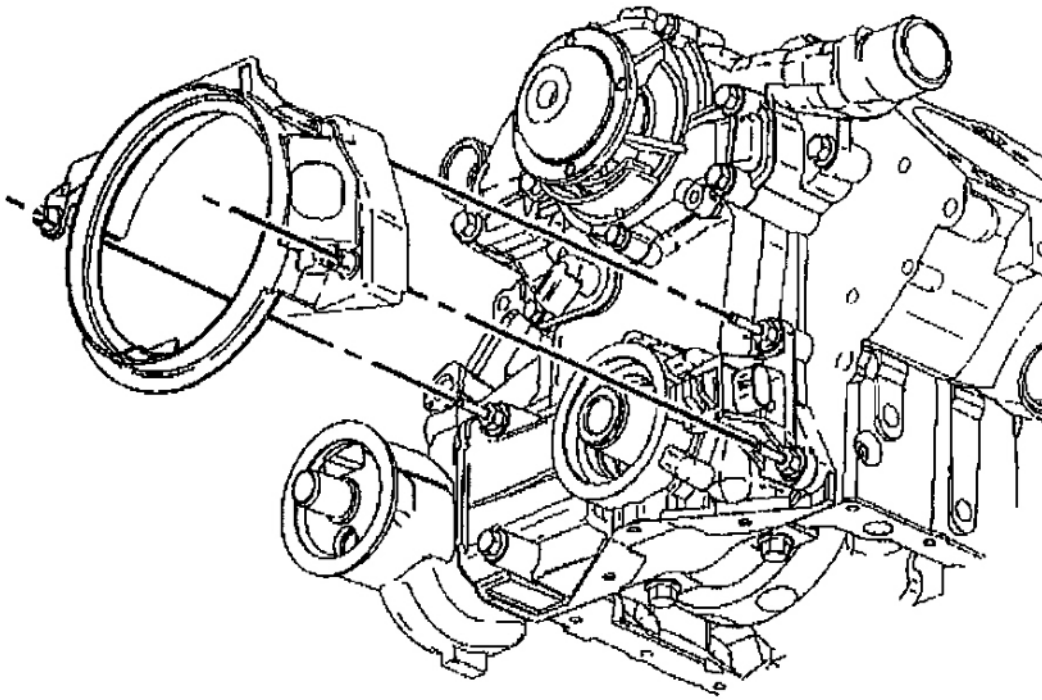
4. Remove the air intake duct.



G01728800

Fig. 145: Removing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

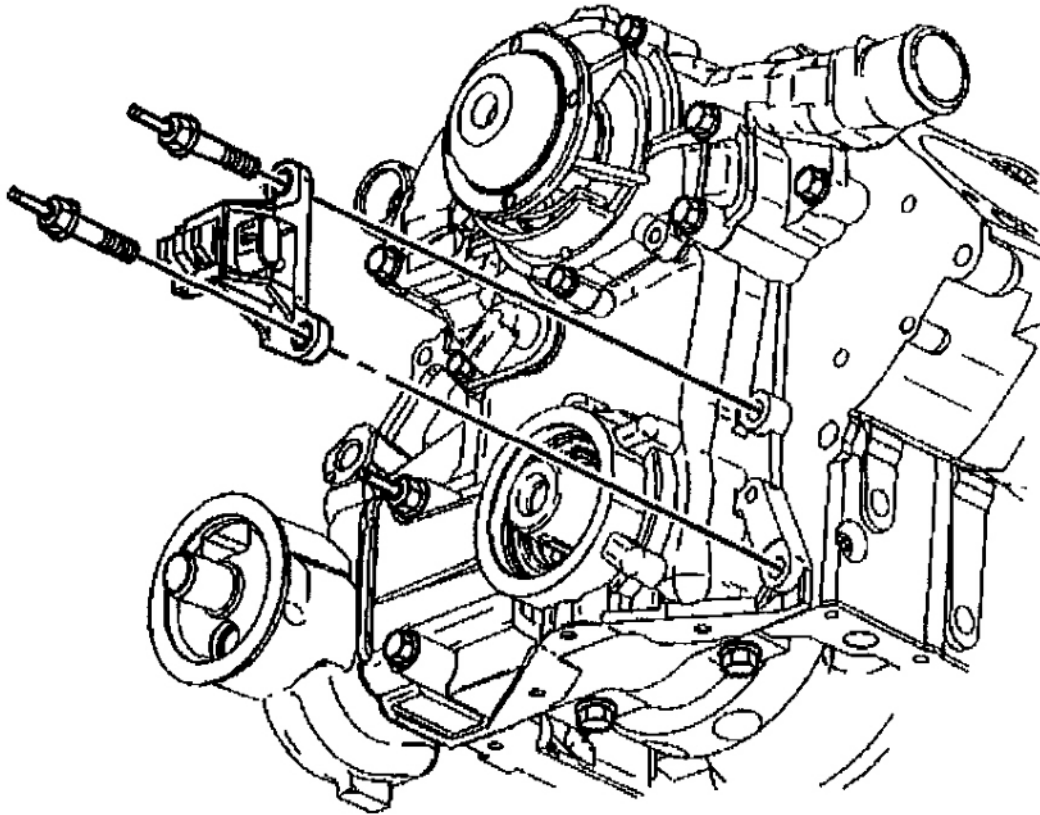
5. Loosen the coolant pump pulley bolts.
6. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
7. Remove the power steering pump.
8. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
9. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
10. Disconnect the oil pressure electrical connector.
11. Disconnect the crankshaft position sensor electrical connector.
12. Remove the crankshaft position sensor shield.



G01728801

Fig. 146: Removing Crankshaft Position Sensor Shield
Courtesy of GENERAL MOTORS CORP.

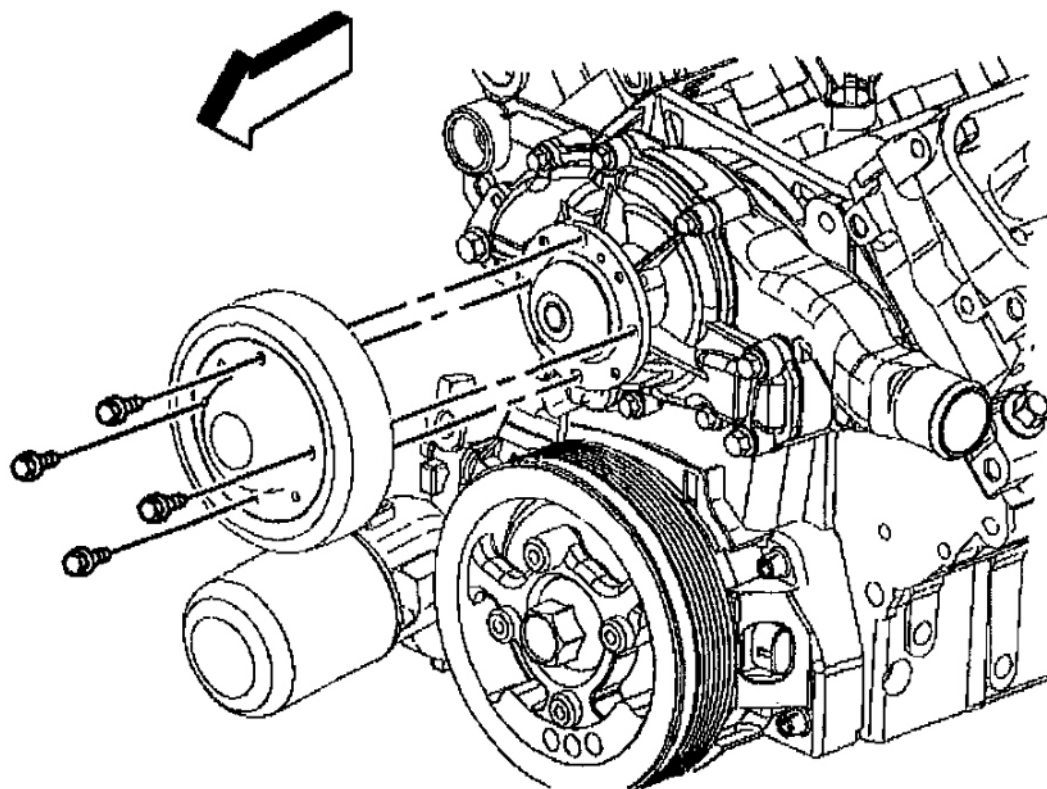
13. Remove the crankshaft position sensor studs.



G01728802

Fig. 147: Removing Crankshaft Position Sensor Studs
Courtesy of GENERAL MOTORS CORP.

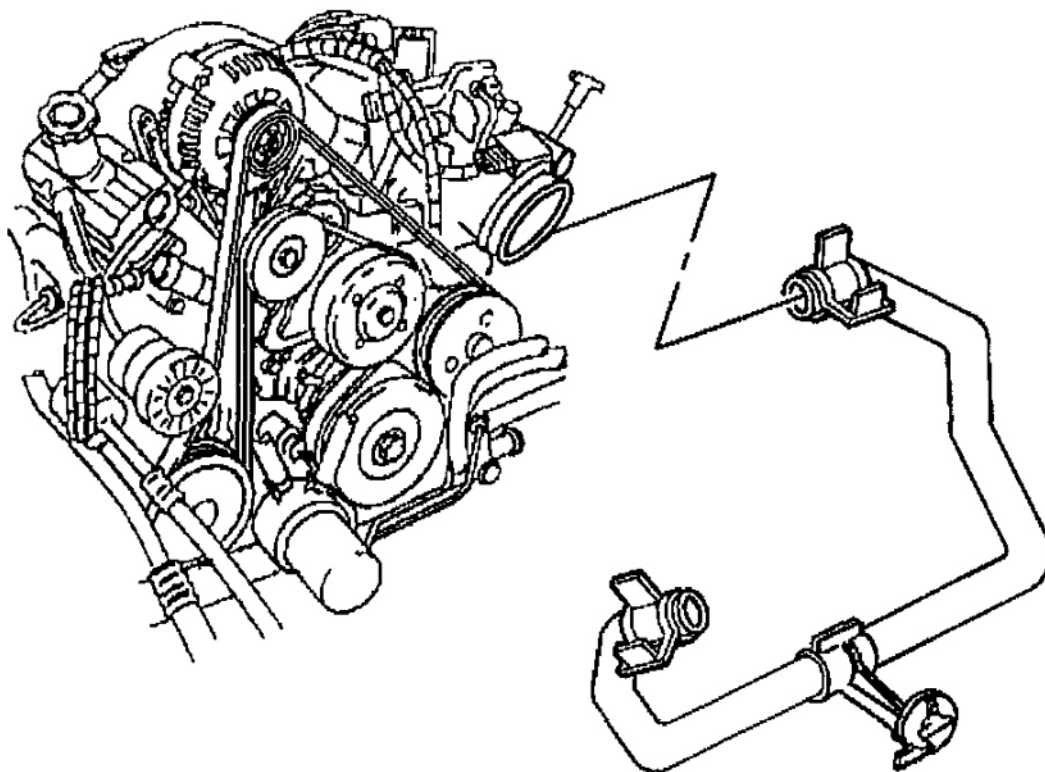
14. Remove the crankshaft position sensor.
15. Remove the oil pan to front cover bolts.
16. Loosen the oil pan bolts, to drop the oil pan slightly in order to add clearance for the front cover installation.
17. Lower the vehicle.
18. Remove the coolant pump pulley bolts.



G01728803

Fig. 148: Remove Coolant Pump Pulley Bolts
Courtesy of GENERAL MOTORS CORP.

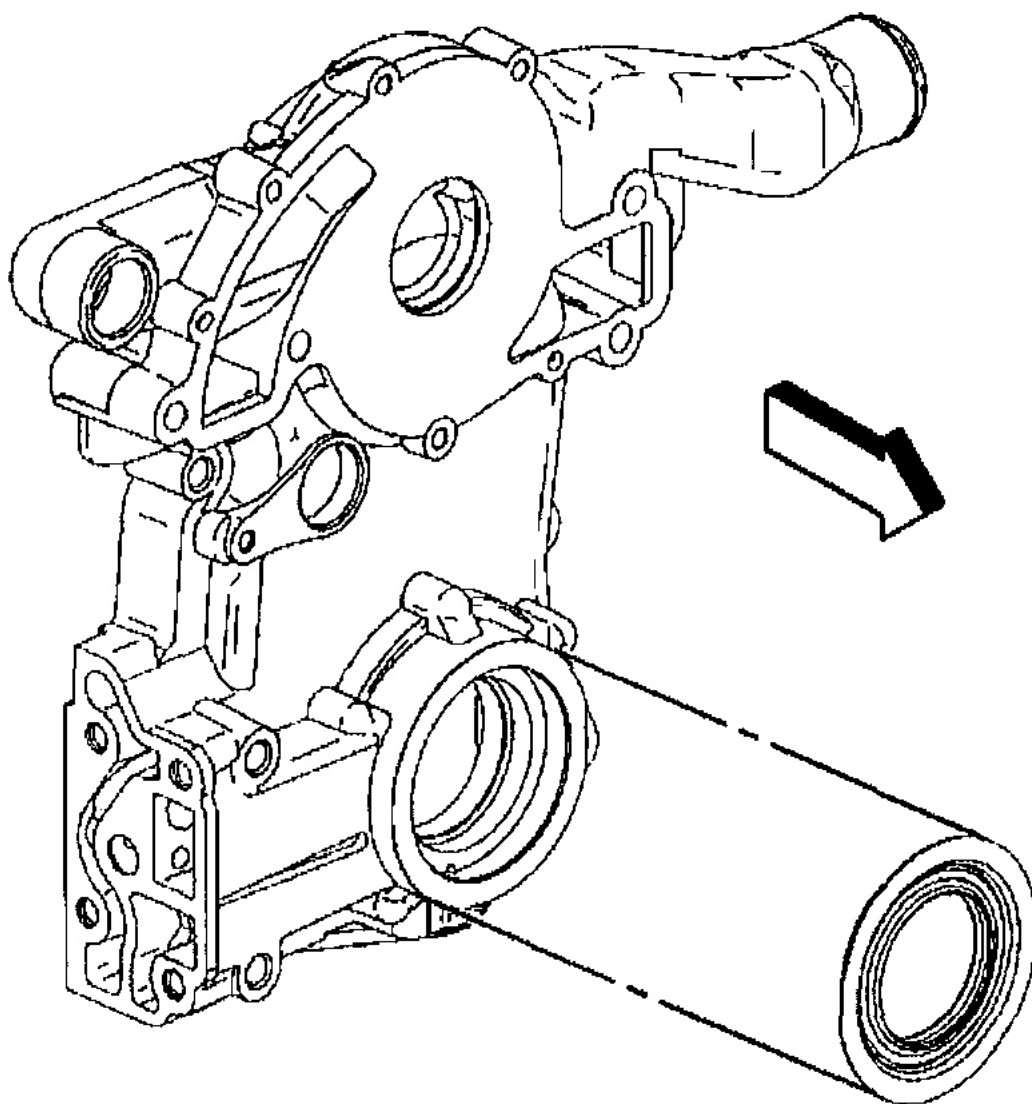
19. Remove the coolant pump pulley.
20. Remove the radiator outlet hose from the front cover.



G01728804

Fig. 149: Removing Radiator Outlet Hose From Front Cover
Courtesy of GENERAL MOTORS CORP.

21. Remove the crankshaft front oil seal. Use a screwdriver to pry out the crankshaft front oil seal. Use care in order to avoid damage to the seal bore or seal contact surfaces.



G01728805

Fig. 150: Removing Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

22. Remove the engine front cover studs and bolts (1).
23. Remove the engine front cover (2).

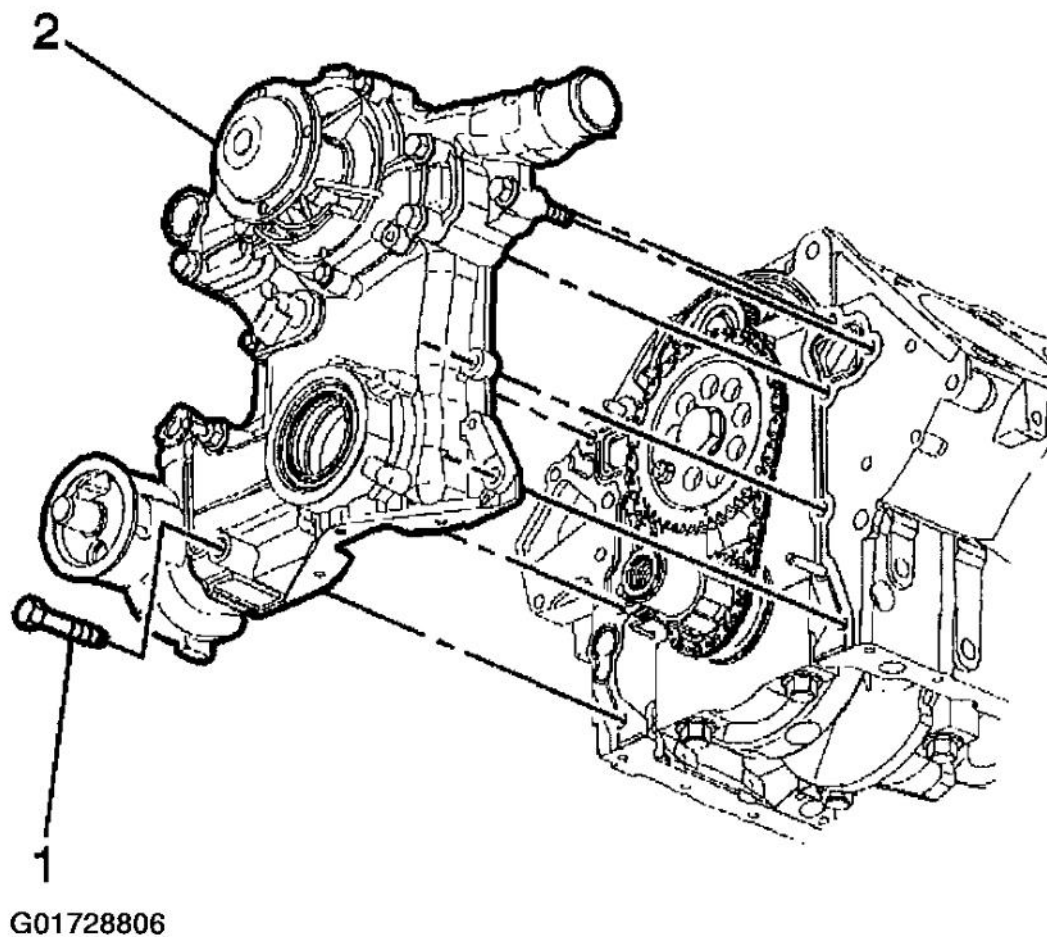
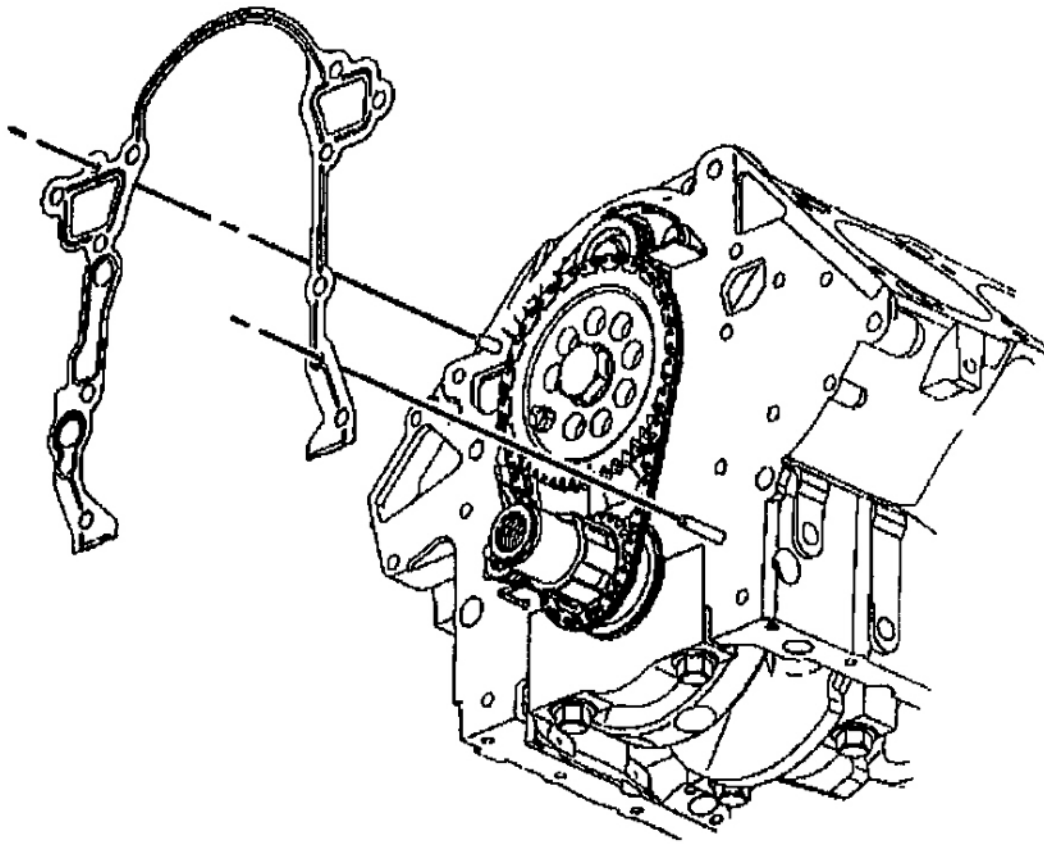


Fig. 151: Removing Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

24. Remove the engine front cover gasket from the engine block.

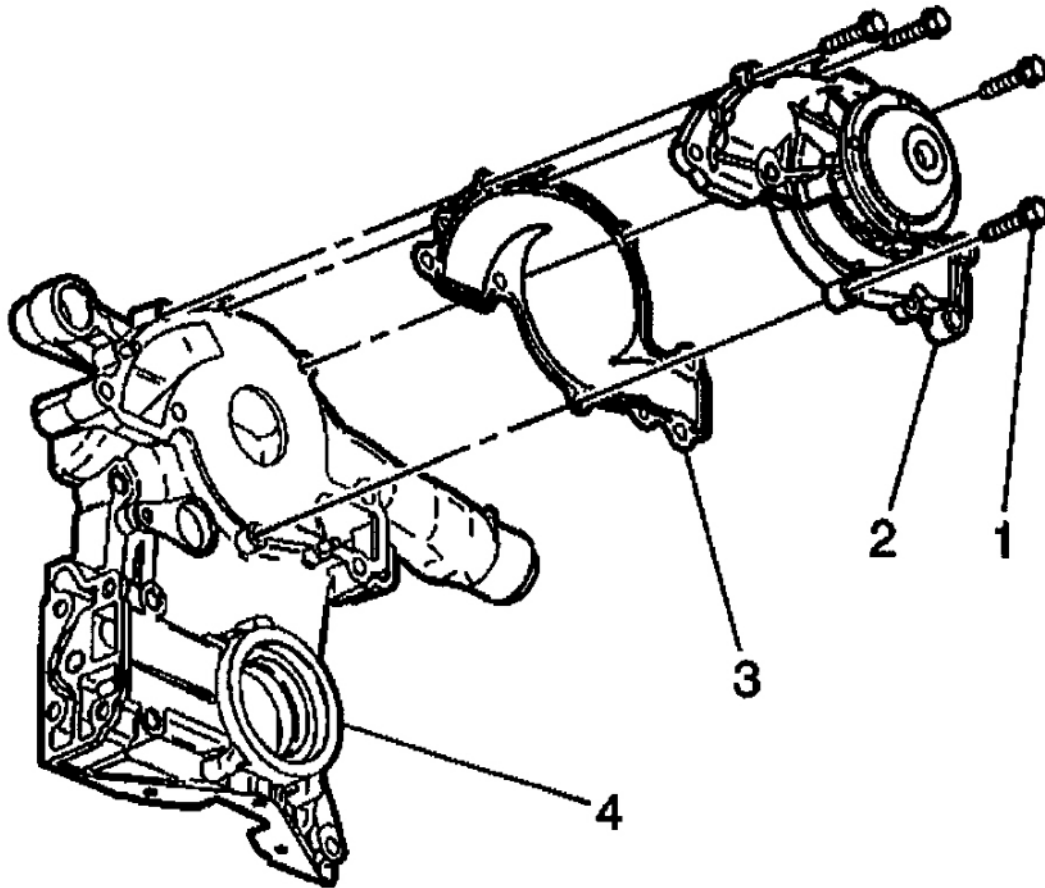


G01728807

Fig. 152: Removing Engine Front Cover Gasket
Courtesy of GENERAL MOTORS CORP.

25. If replacing the front cover remove the following:

- Remove the coolant pump bolts (1).
- Remove the coolant pump (2).
- Remove the coolant pump gasket (3) from the front cover (4).
- Remove the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
- Remove the camshaft position sensor. Refer to **CAMSHAFT POSITION SENSOR**.
- Remove the oil pump gear set. Refer to **Oil Pump Cover and Gear Set Replacement**.



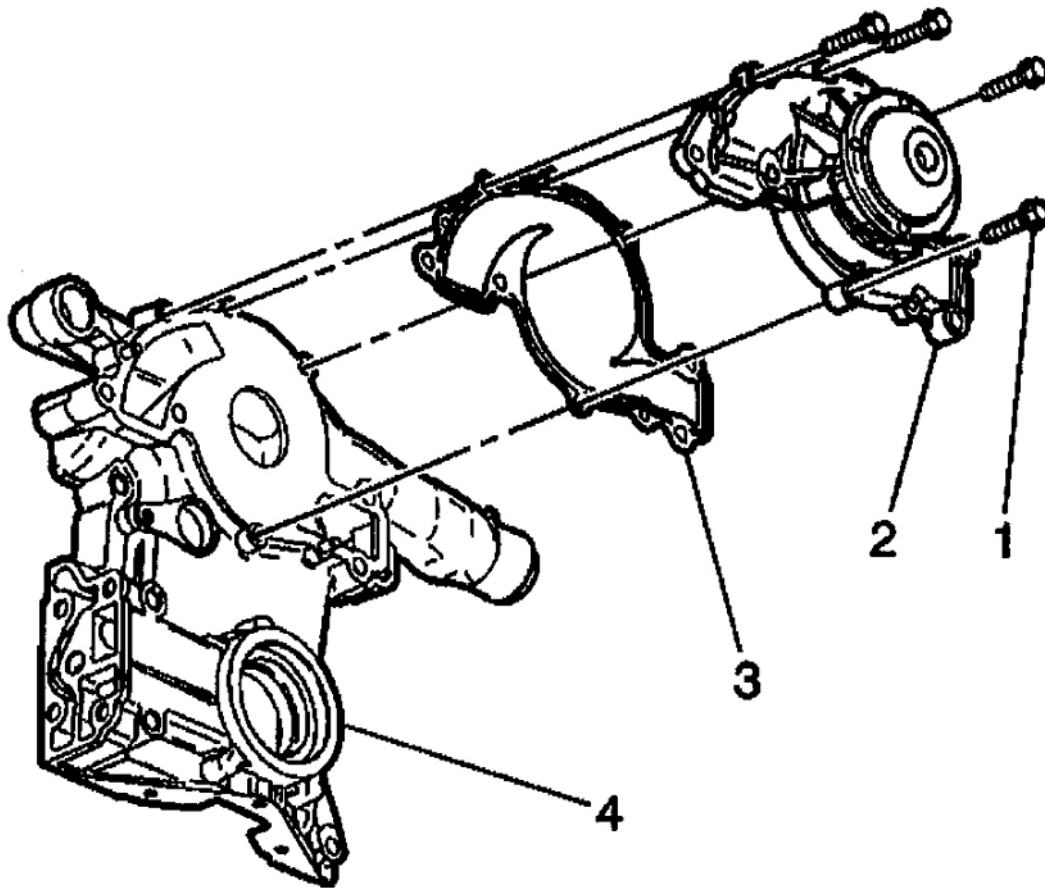
G01728808

Fig. 153: Replacing Front Cover
Courtesy of GENERAL MOTORS CORP.

26. Clean the engine front cover and engine block surfaces.

Installation Procedure

1. If the front cover was replaced, Install the following parts:
 - Install the oil pump gear set. Refer to **Oil Pump Cover and Gear Set Replacement**.
 - Install the camshaft position sensor. Refer to **CAMSHAFT POSITION SENSOR**.
 - Install the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
2. Install the coolant pump gasket (3) to the front cover (4).
3. Install the coolant pump (2).



G01728809

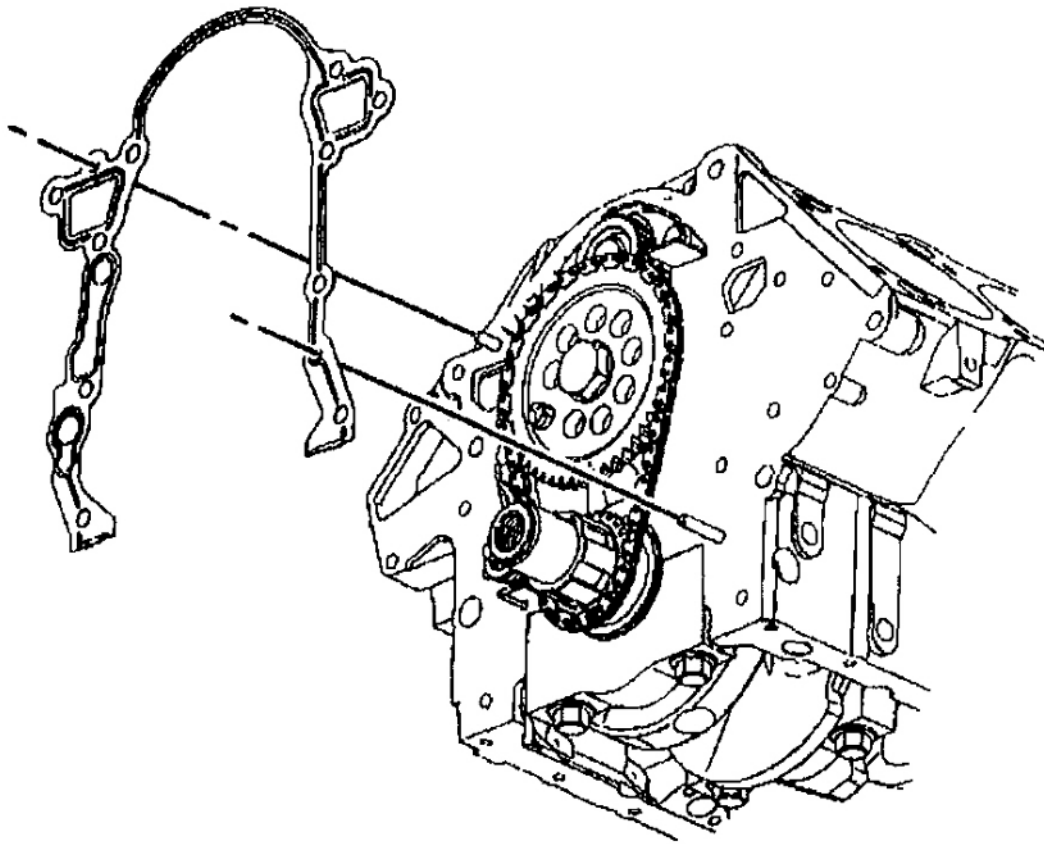
Fig. 154: Replacing Front Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the coolant pump bolts (1).

Tighten

Tighten the coolant pump bolts (1) to 15 N.m (11 lb ft). Use the J 36660-A to torque the coolant pump bolts (1) an additional 80 degrees.

5. Install a new engine front cover gasket to the engine block.



G01728810

Fig. 155: Installing New Engine Front Cover Gasket
Courtesy of GENERAL MOTORS CORP.

6. Install the engine front cover (2).

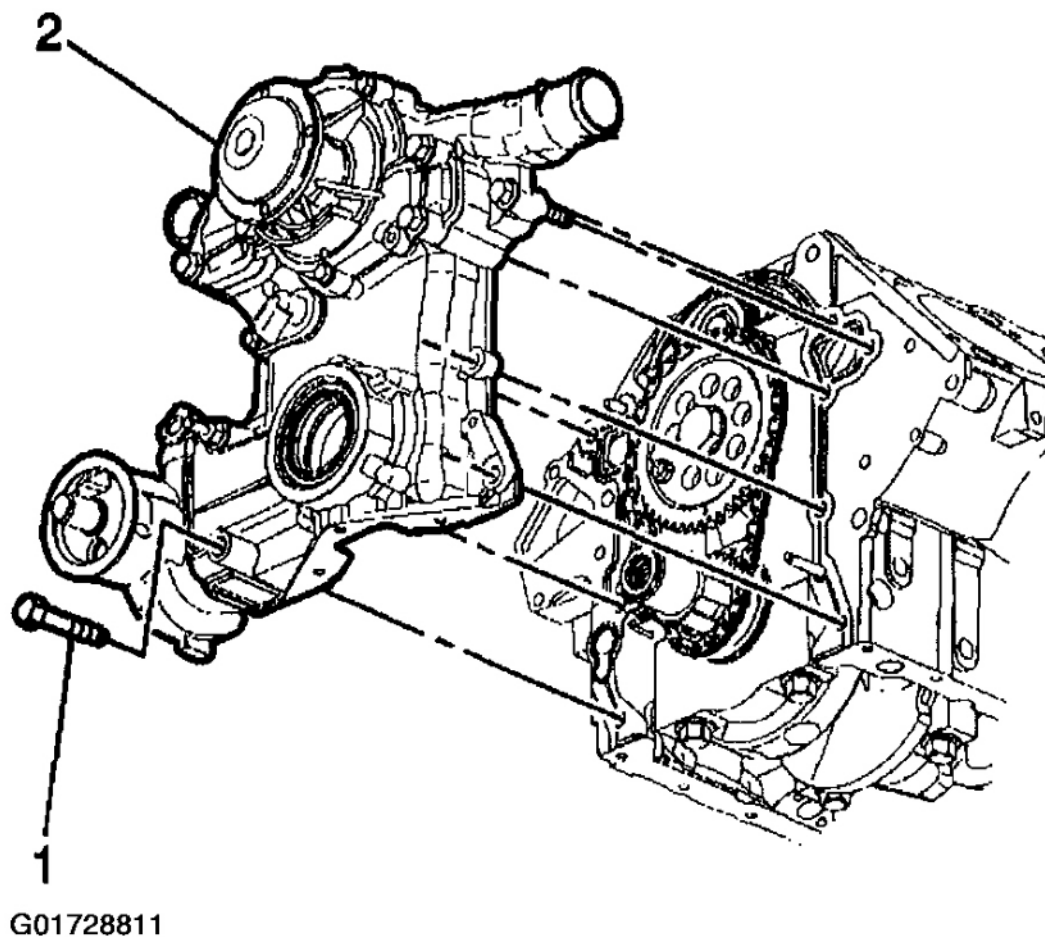
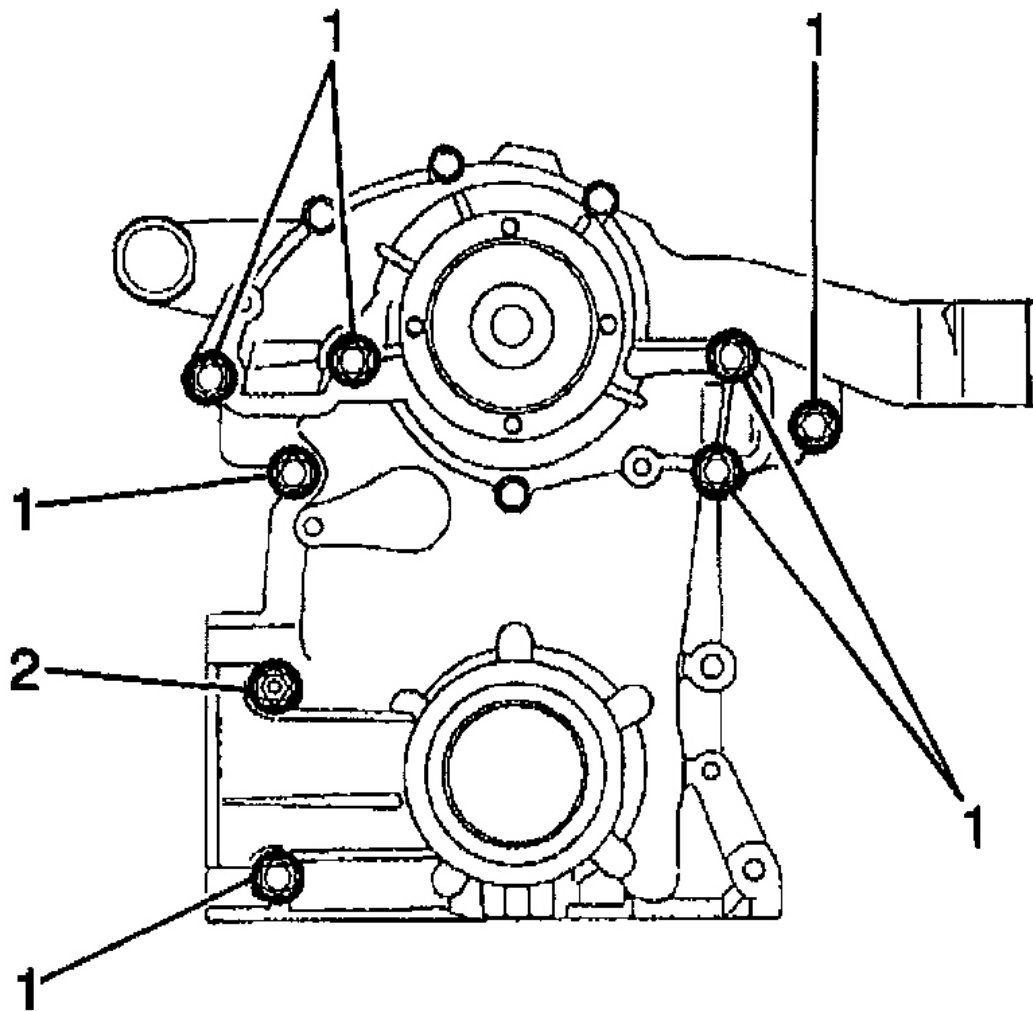


Fig. 156: Installing Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

7. Apply sealant GM P/N 12346004, Canada P/N 10953480, or equivalent to the engine front cover bolts (1) and stud (2).
8. Install the engine front cover bolts (1) and stud (2).



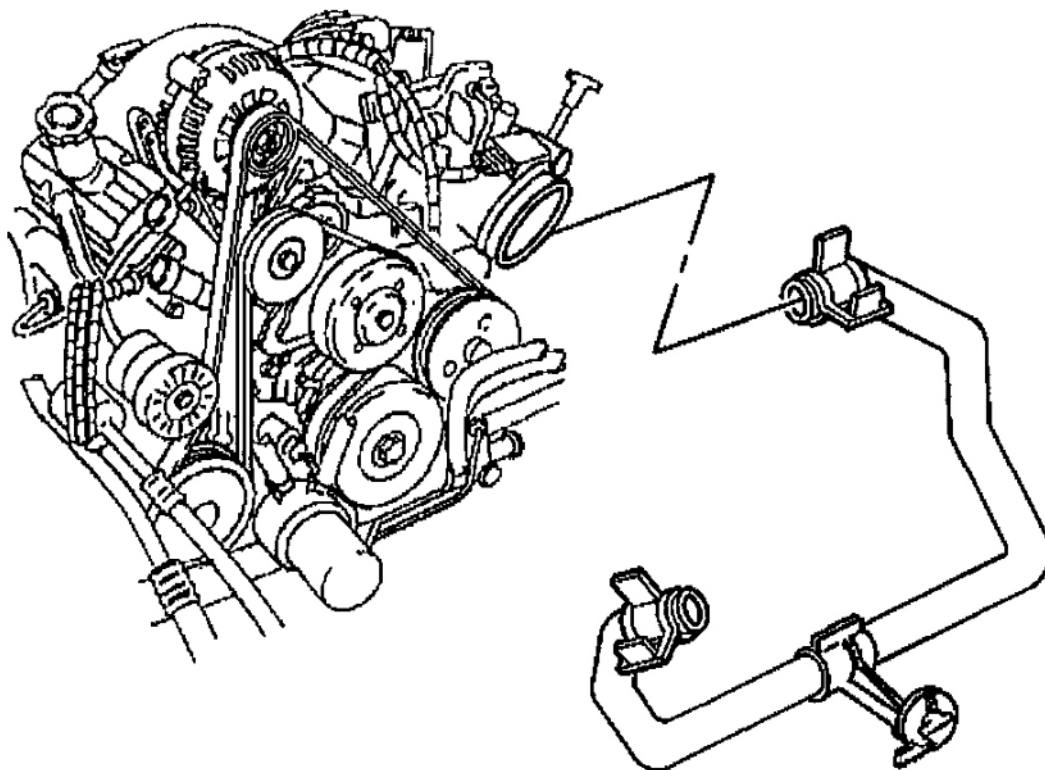
G01728812

Fig. 157: Installing Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the front cover bolts (1) and stud (2) to 20 N.m (15 lb ft). Use the J 36660-A to torque the front cover bolts (1) and stud (2) an additional 40 degrees.

9. Install the front crankshaft front oil seal using J 35354.
10. Install the radiator outlet hose to the front cover.



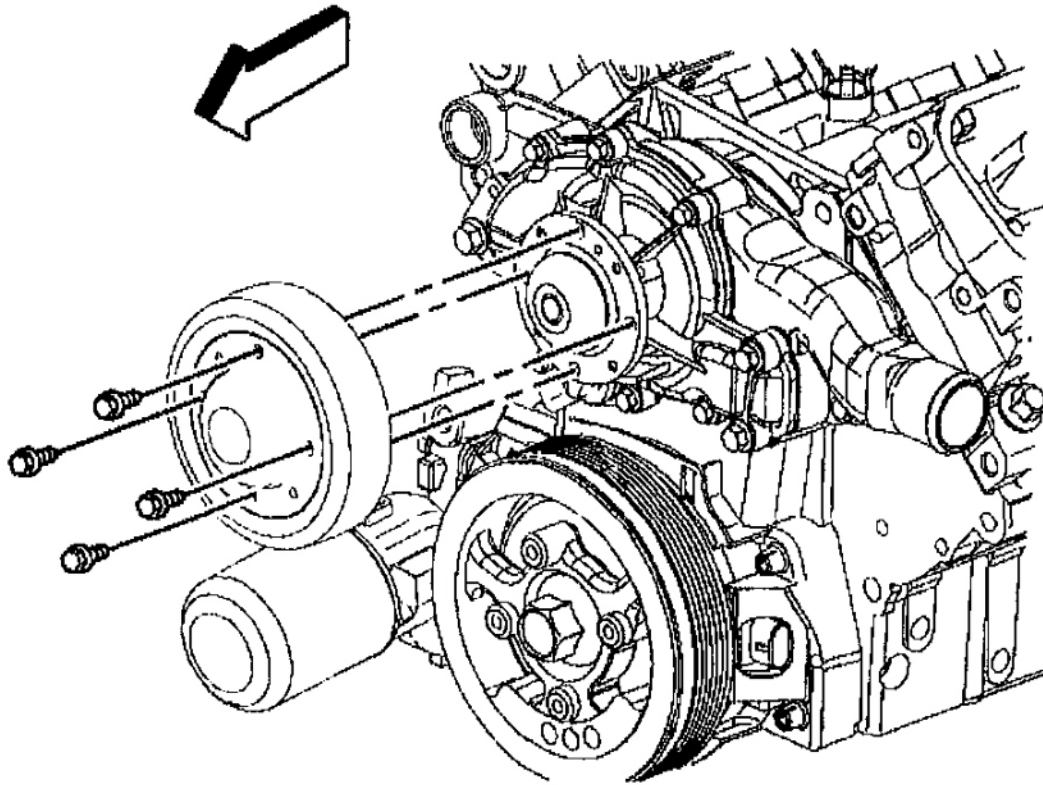
G01728813

Fig. 158: Installing Radiator Outlet Hose To Front Cover
Courtesy of GENERAL MOTORS CORP.

11. Install the coolant pump pulley.
12. Install the coolant pump pulley bolts.

Tighten

Tighten the coolant pump pulley bolts to 13 N.m (116 lb in).



G01728814

Fig. 159: Tightening Coolant Pump Pulley Bolts
Courtesy of GENERAL MOTORS CORP.

13. Raise the vehicle.
14. Install the oil pan to front cover bolts.

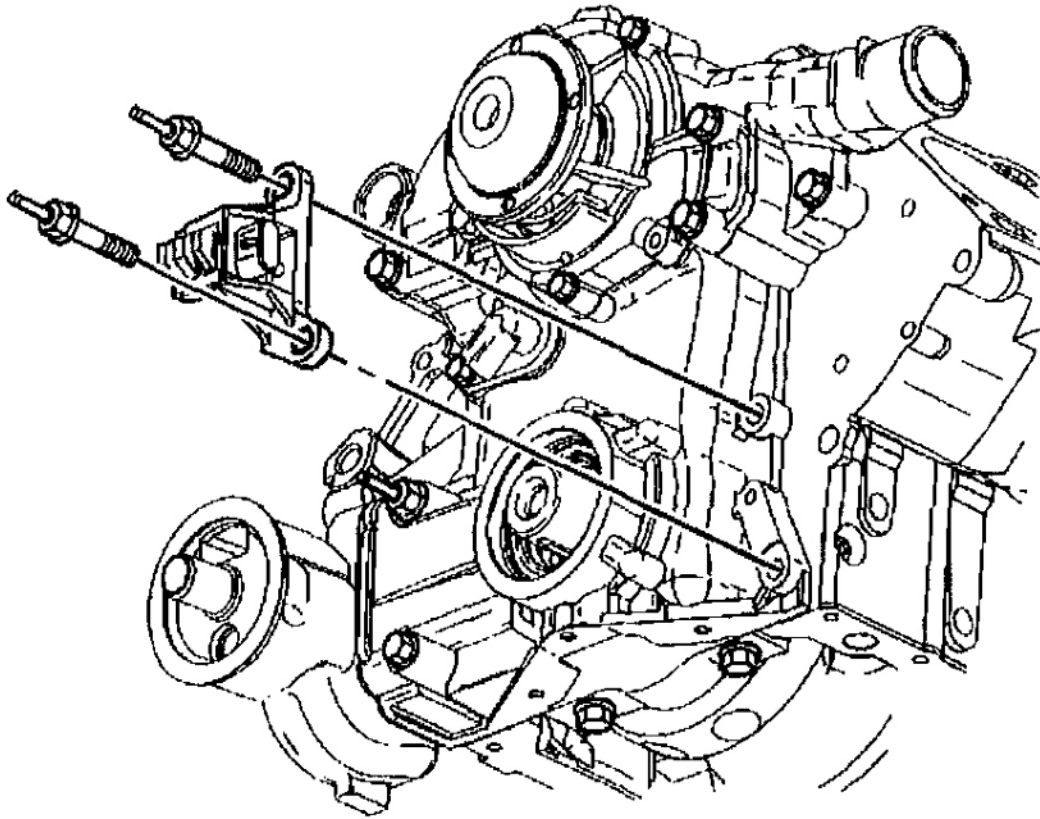
Tighten

Tighten the oil pan bolts to 14 N.m (124 lb in).

15. Install the crankshaft position sensor.
16. Apply threadlock GM P/N 12345382, Canada P/N 10953489, or equivalent to the crankshaft position sensor studs.
17. Install the crankshaft position sensor studs.

Tighten

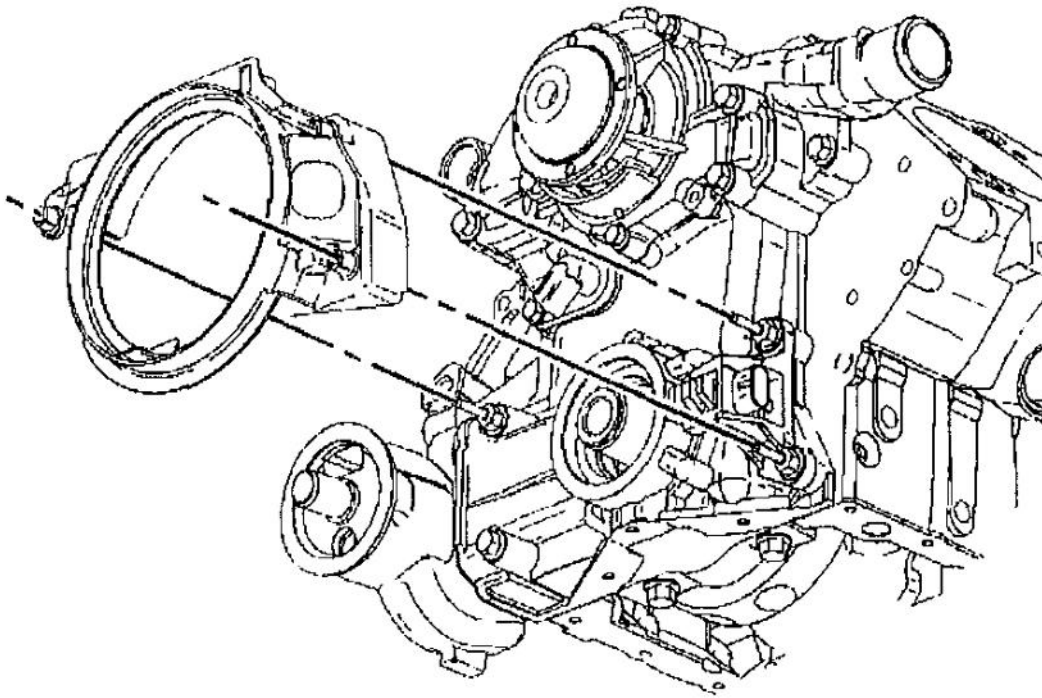
Tighten the crankshaft position sensor studs to 30 N.m (22 lb ft).



G01728815

Fig. 160: Tightening Crankshaft Position Sensor Studs
Courtesy of GENERAL MOTORS CORP.

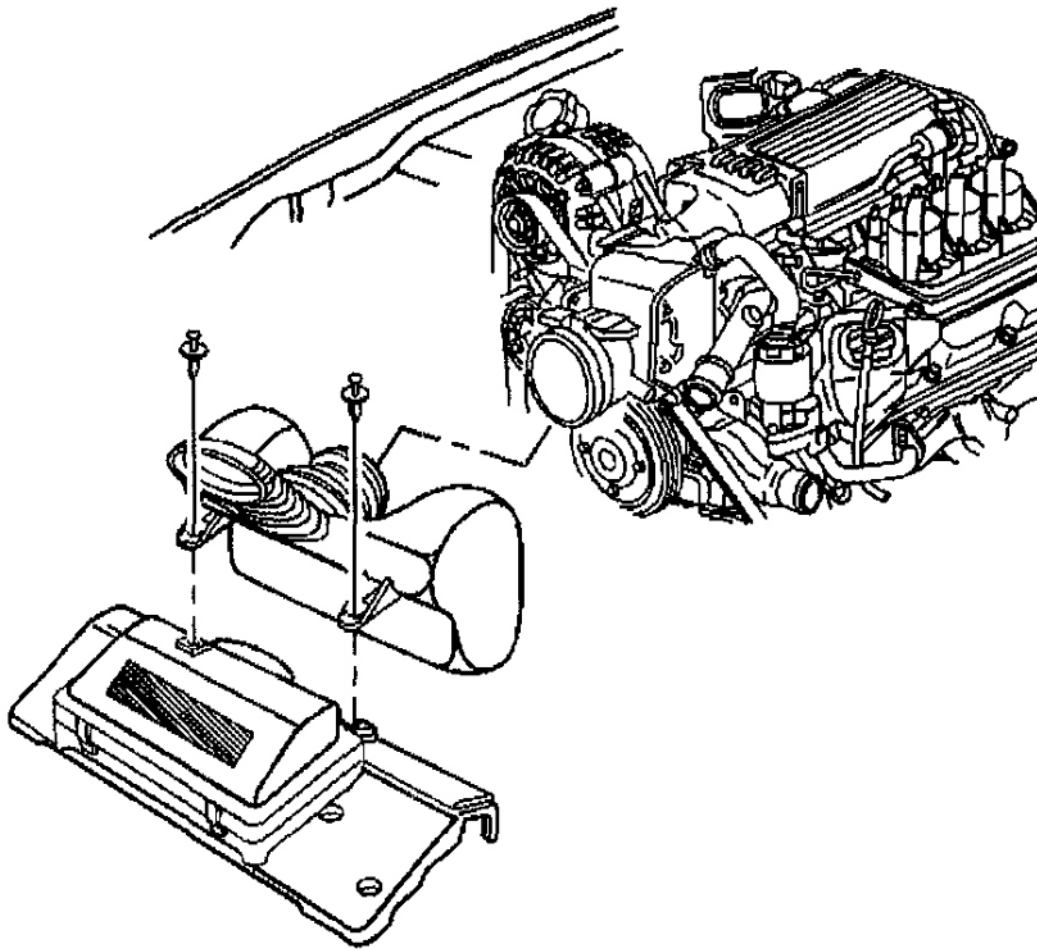
18. Install the crankshaft position sensor shield.



G01728816

Fig. 161: Installing Crankshaft Position Sensor Shield
Courtesy of GENERAL MOTORS CORP.

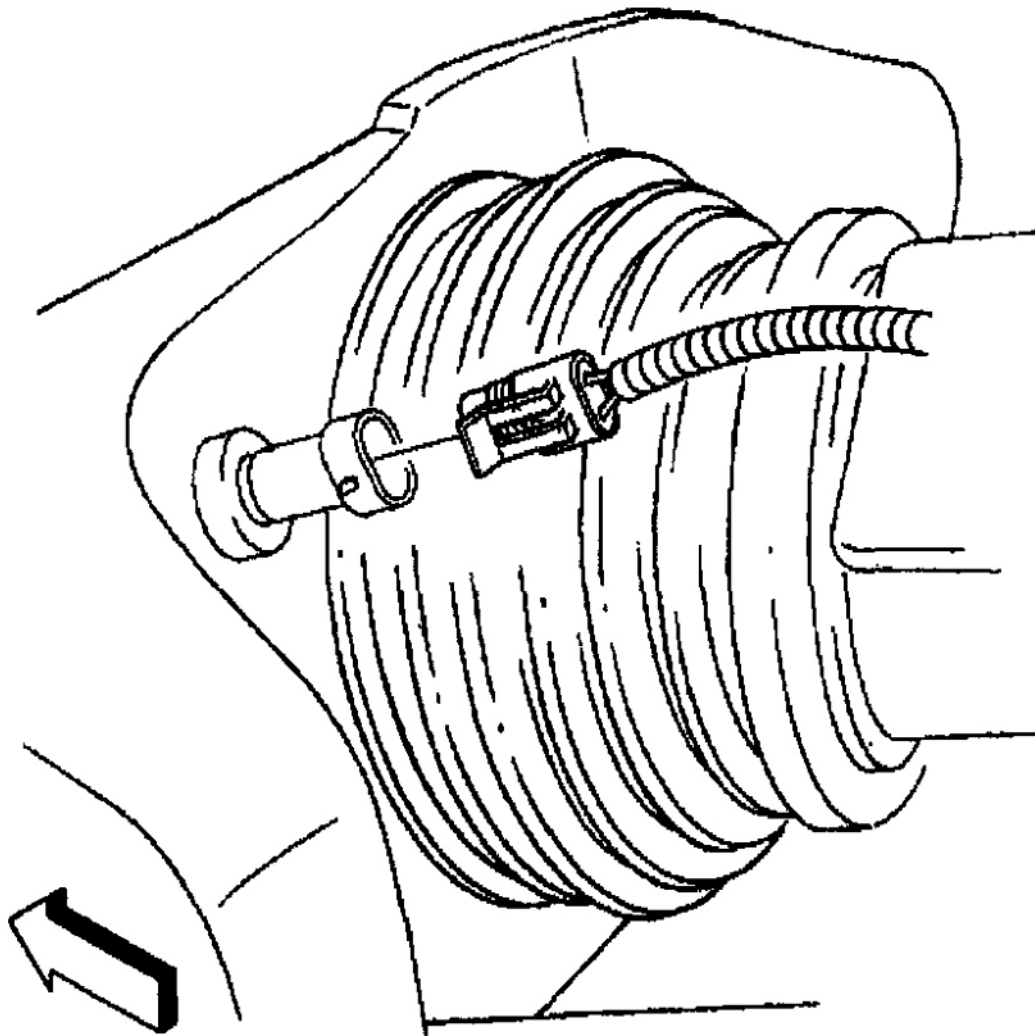
19. Connect the crankshaft position sensor electrical connector.
20. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
21. Connect the oil pressure sensor electrical connector.
22. Lower the vehicle.
23. Install the power steering pump.
24. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
25. Install the air intake duct.



G01728817

Fig. 162: Installing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

26. Connect the intake air temperature (IAT) sensor electrical connector.



G01728818

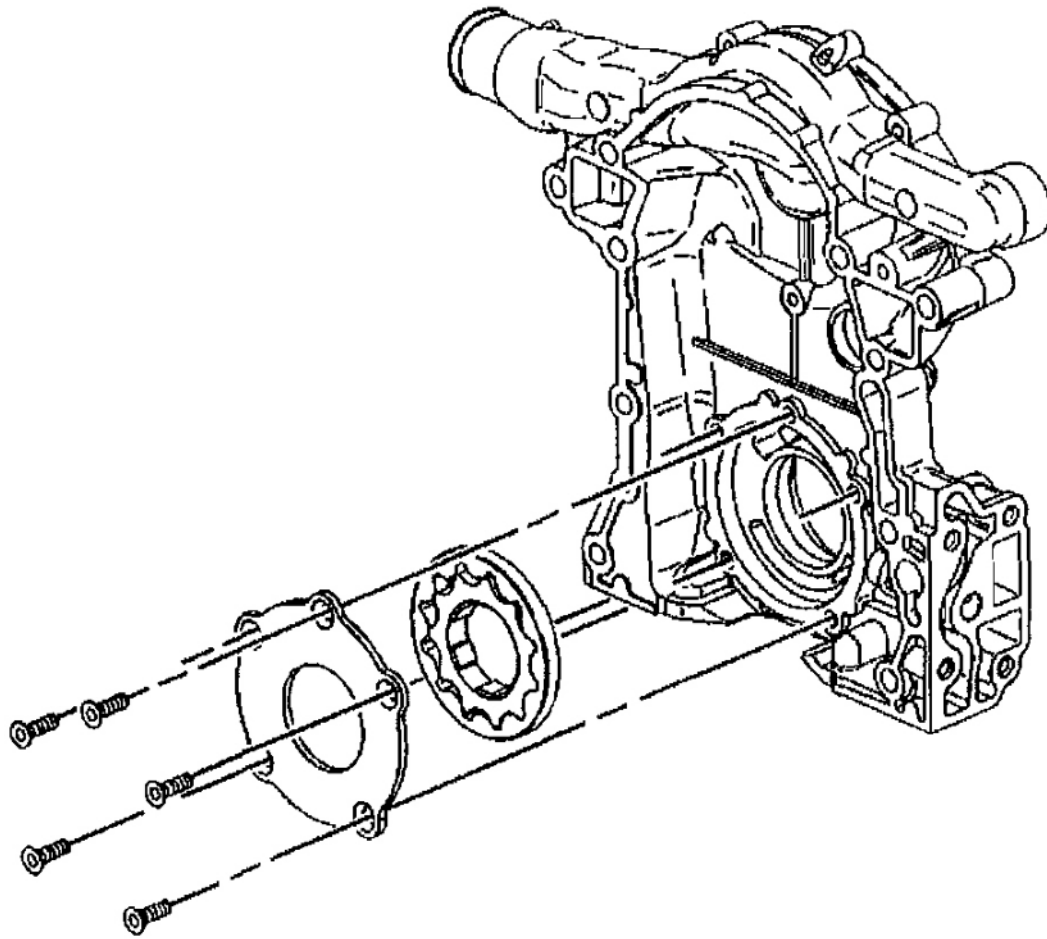
Fig. 163: Connecting Intake Air Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

27. Fill the crankcase with engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
28. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

OIL PUMP COVER AND GEAR SET REPLACEMENT

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Remove the oil pump cover attaching screws.



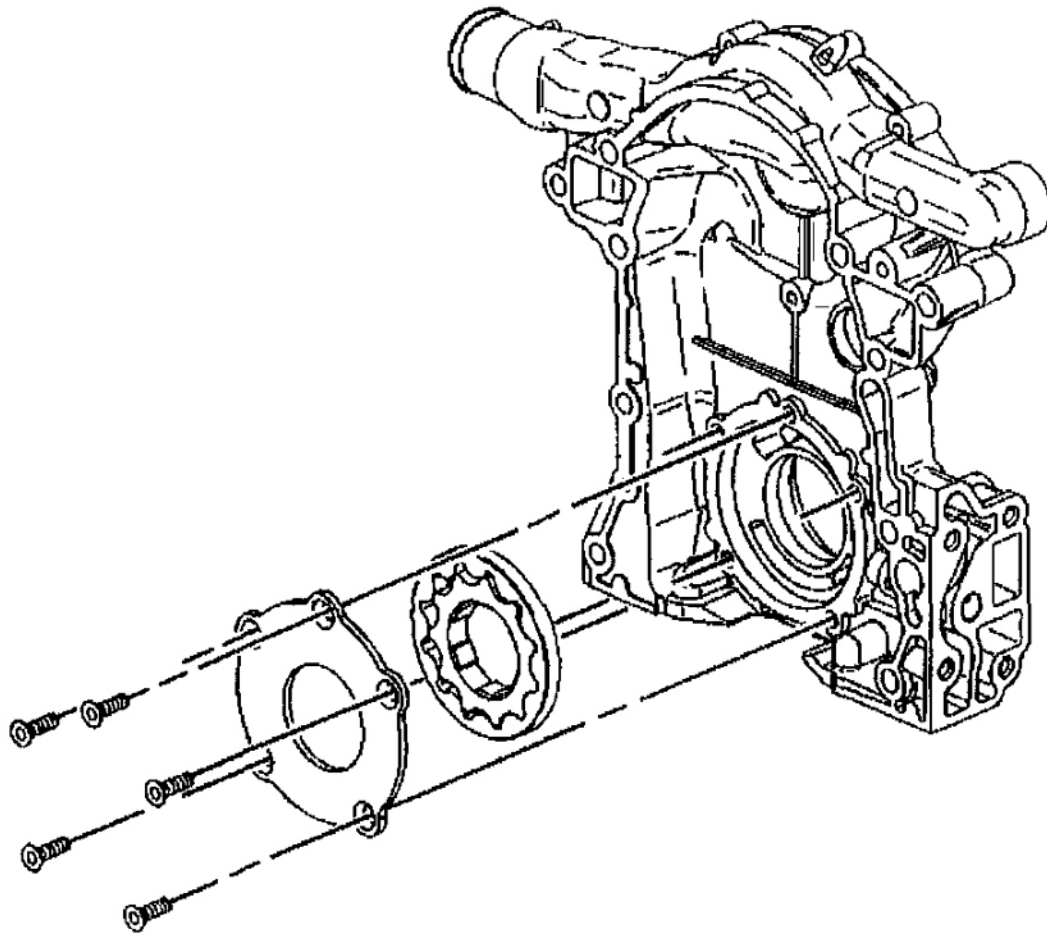
G01728819

Fig. 164: Removing Oil Pump Cover Attaching Screws
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pump cover.
4. Remove the oil pump gear set.
5. Inspect the oil pump gear set and housing. Refer to **OIL PUMP CLEANING AND INSPECTION** .

Installation Procedure

1. Lubricate the oil pump gear set with petroleum jelly.
2. Install the oil pump gear set.
3. Pack the oil pump cavity with petroleum jelly.
4. Install the oil pump cover.
5. Install the oil pump cover screws.



G01728820

Fig. 165: Installing Oil Pump Cover Screws
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the oil pump cover screws to 11 N.m (98 lb in).

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

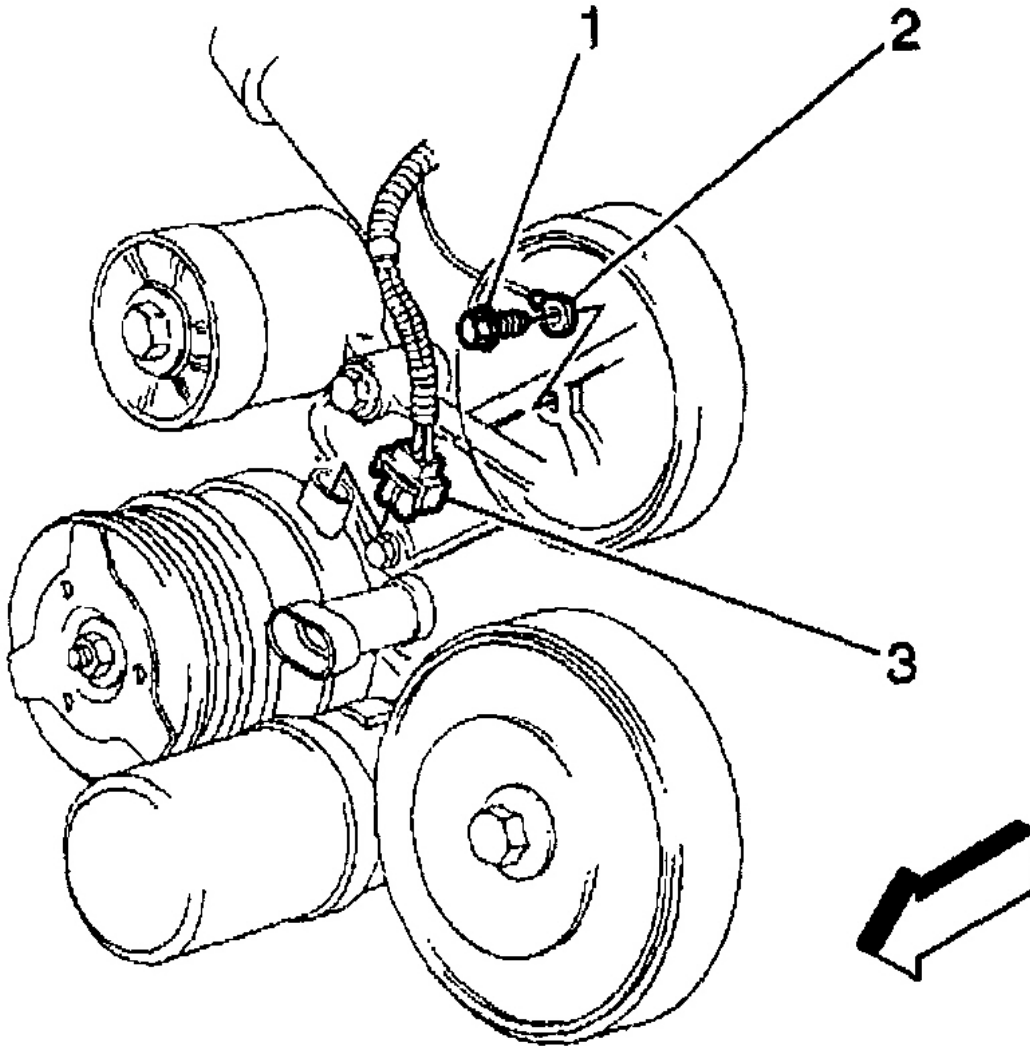
OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT

Tools Required

J 36660-A Torque Angle Meter

Removal Procedure

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the engine ground strap bolt (1) and ground strap (2).

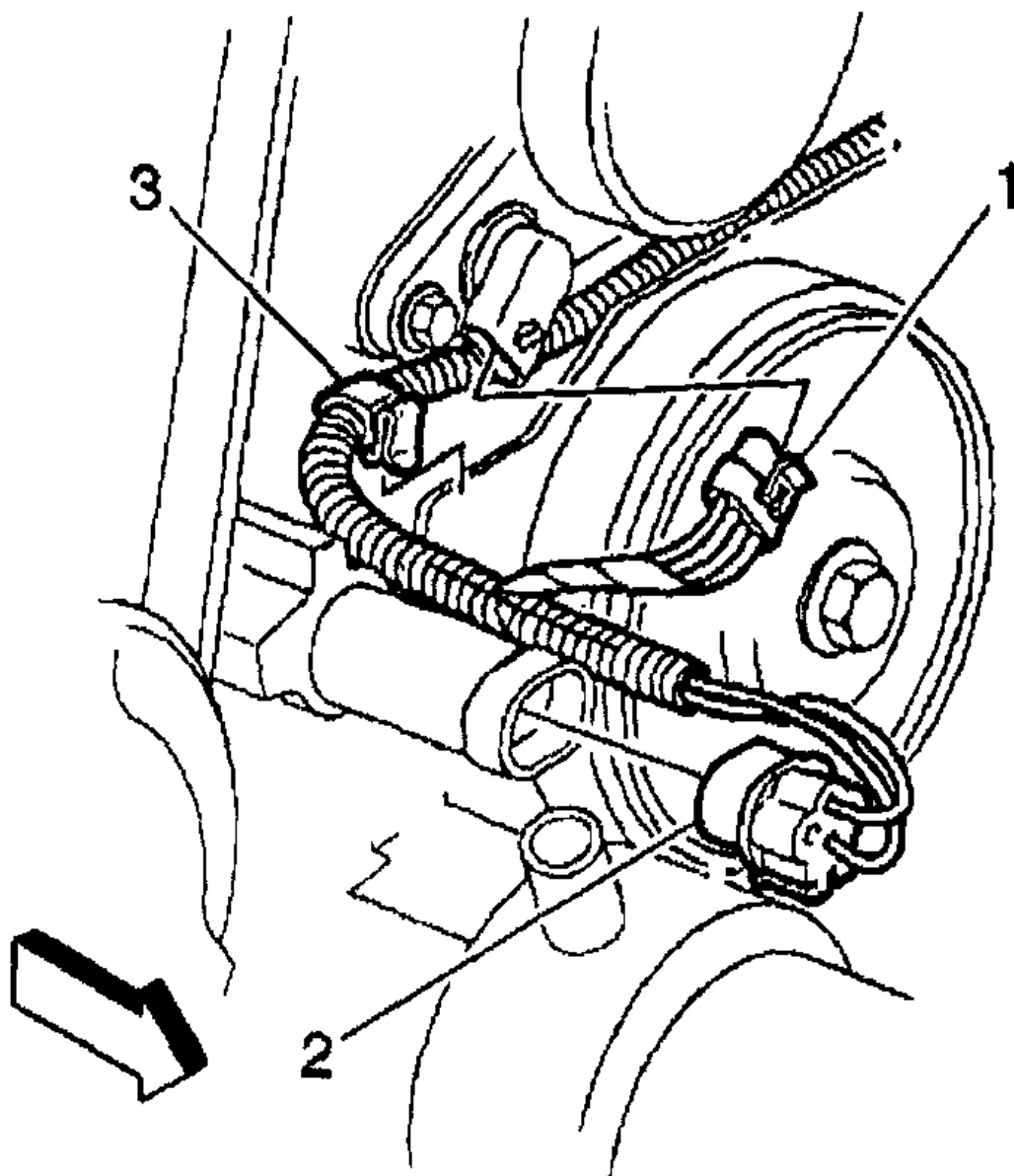


G01728821

Fig. 166: Removing Engine Ground Strap Bolt, ground strap And A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the A/C compressor electrical connector (3).
4. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
5. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.

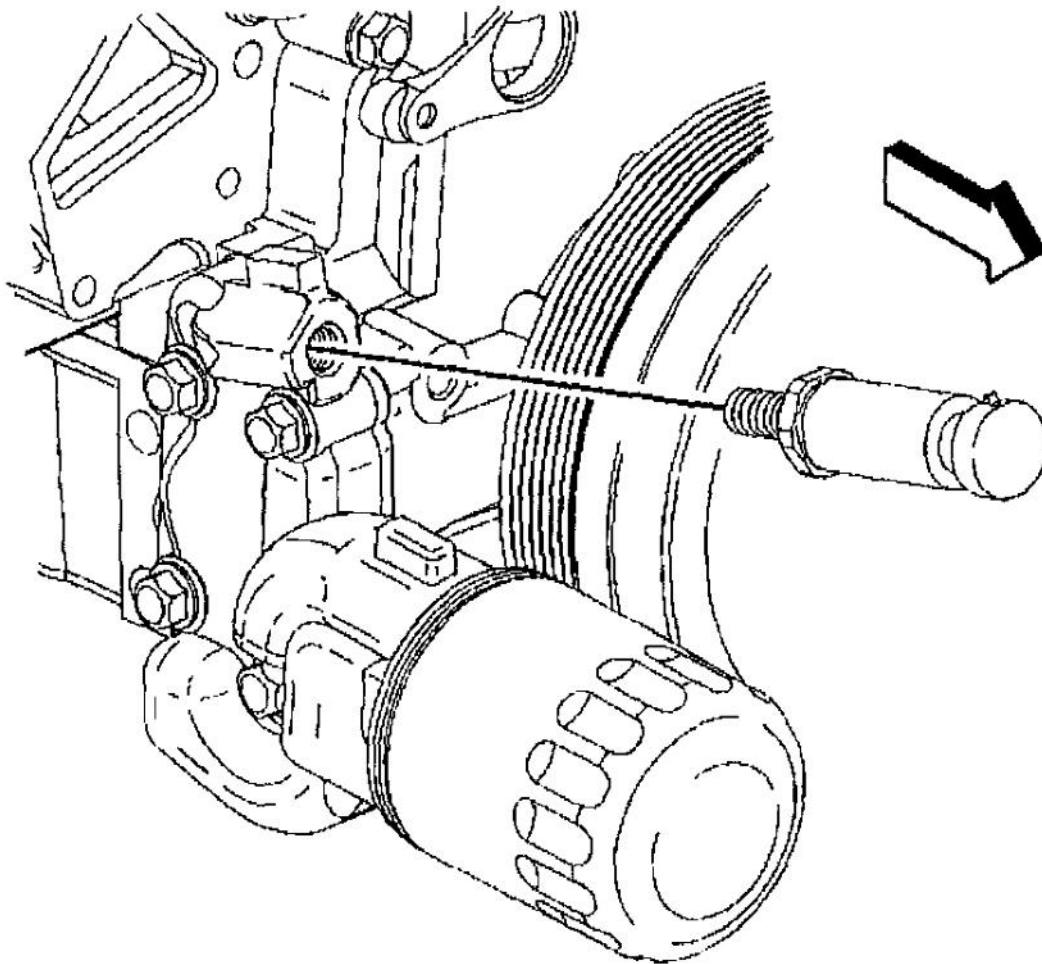
6. Remove the A/C compressor mounting bracket.
7. Disconnect the oil pressure sensor electrical connector (2).



G01728822

Fig. 167: Disconnect Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

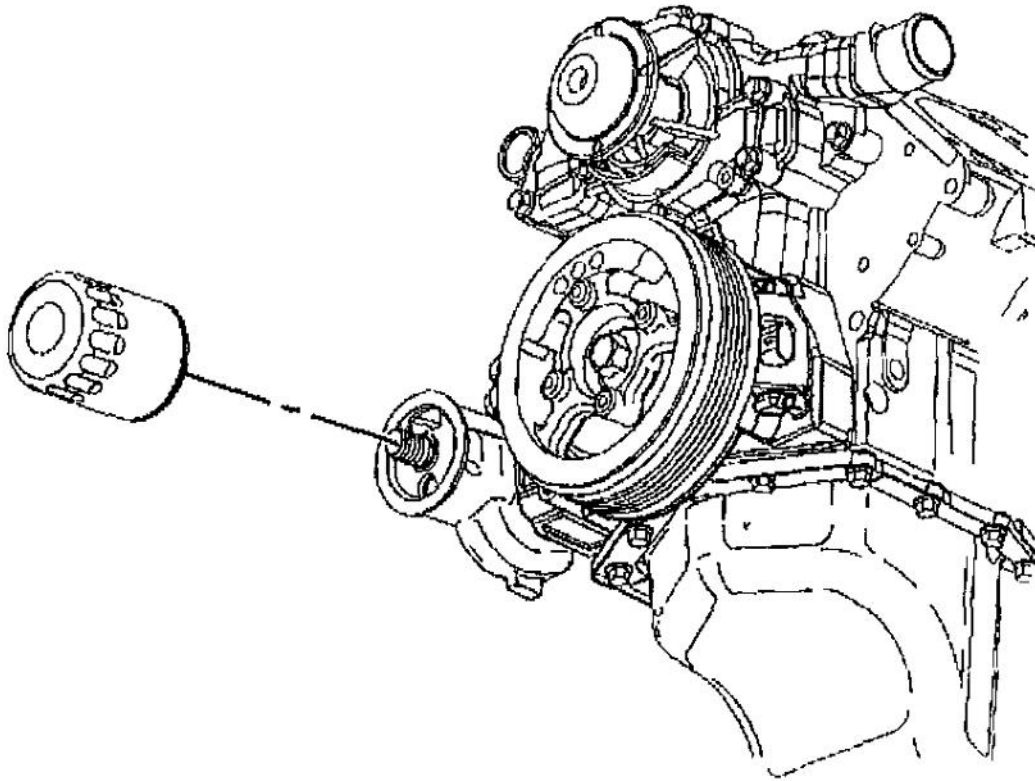
8. Remove the oil pressure sensor.



G01728823

Fig. 168: Removing Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

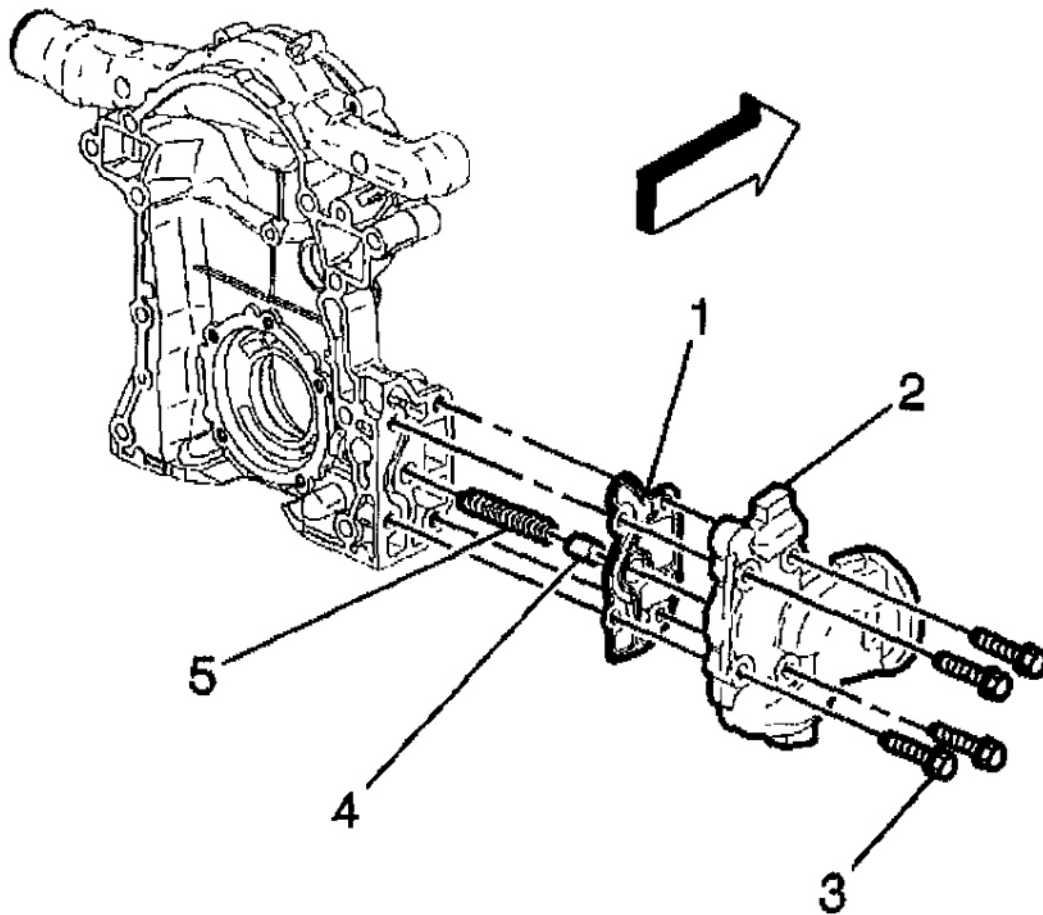
9. Remove the engine oil filter. Refer to **Engine Oil and Oil Filter Replacement**.



G01728824

Fig. 169: Removing Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil filter adapter bolts (3).



G01728825

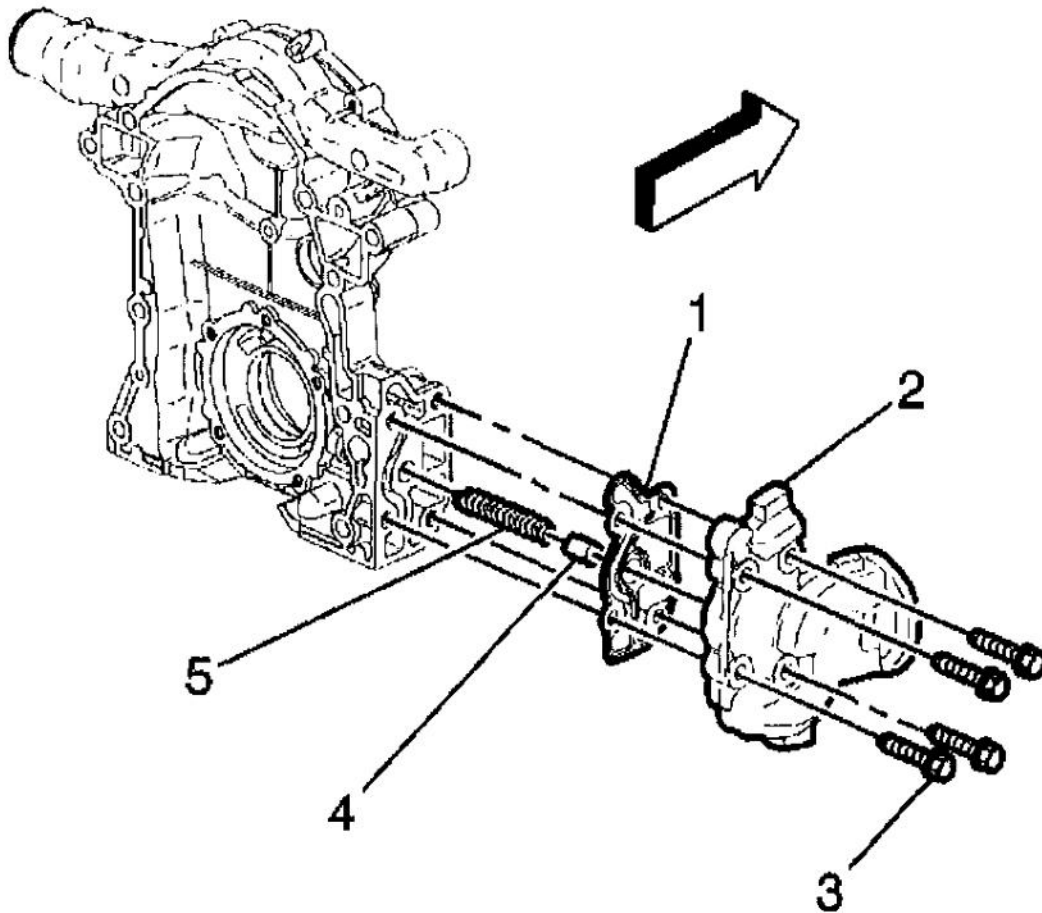
Fig. 170: Removing Oil Filter Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the oil filter adapter (2) and gasket (1).
12. Remove the pressure relief valve (4) and spring (5).
13. Clean the parts in a suitable solvent. Dry the parts.
14. Clean all of the gasket sealing surfaces.
15. Inspect the following areas:
 - The oil pressure relief valve (4) and the valve bore for burrs.
 - The spring (5) for loss of tension, replace the spring if necessary.

Installation Procedure

1. Install the pressure relief valve (4) and spring (5).

2. Install the oil filter adapter (2) and gasket (1).
3. Install the oil filter adapter bolts (3).



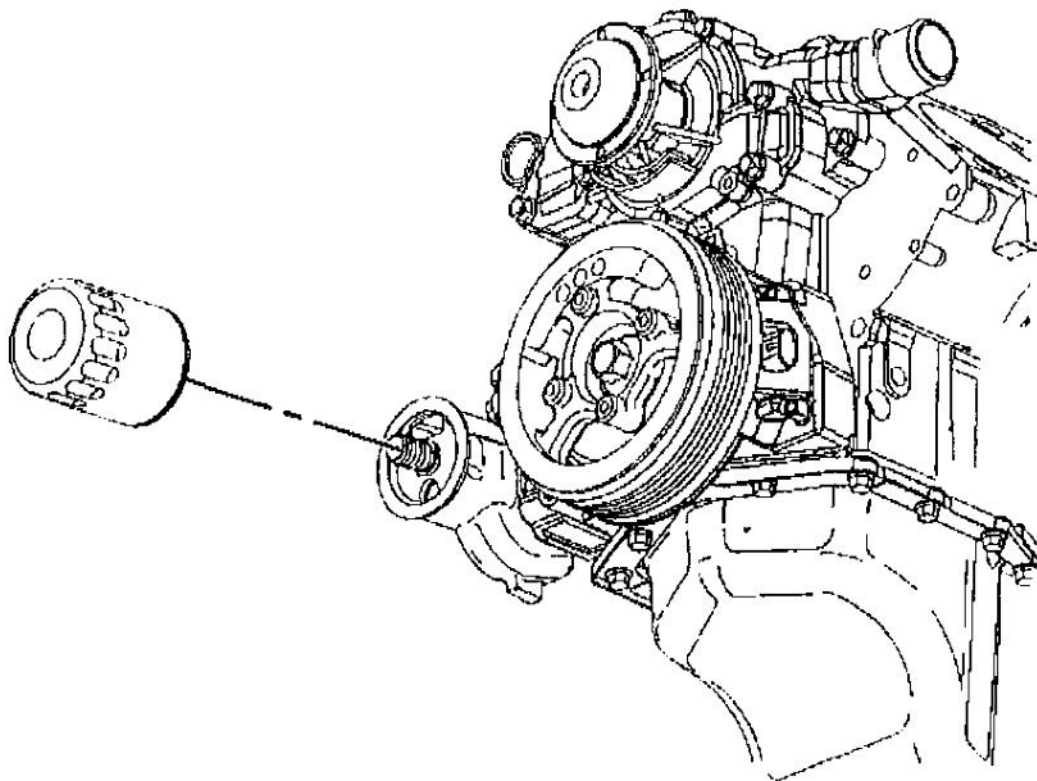
G01728826

Fig. 171: Installing Oil Filter Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the oil filter adapter bolts (3) to 15 N.m (11 lb ft). Use the J 36660-A to torque the oil filter adapter bolts (3) an additional 50 degrees.

4. Install a new oil filter. Refer to **Engine Oil and Oil Filter Replacement**.



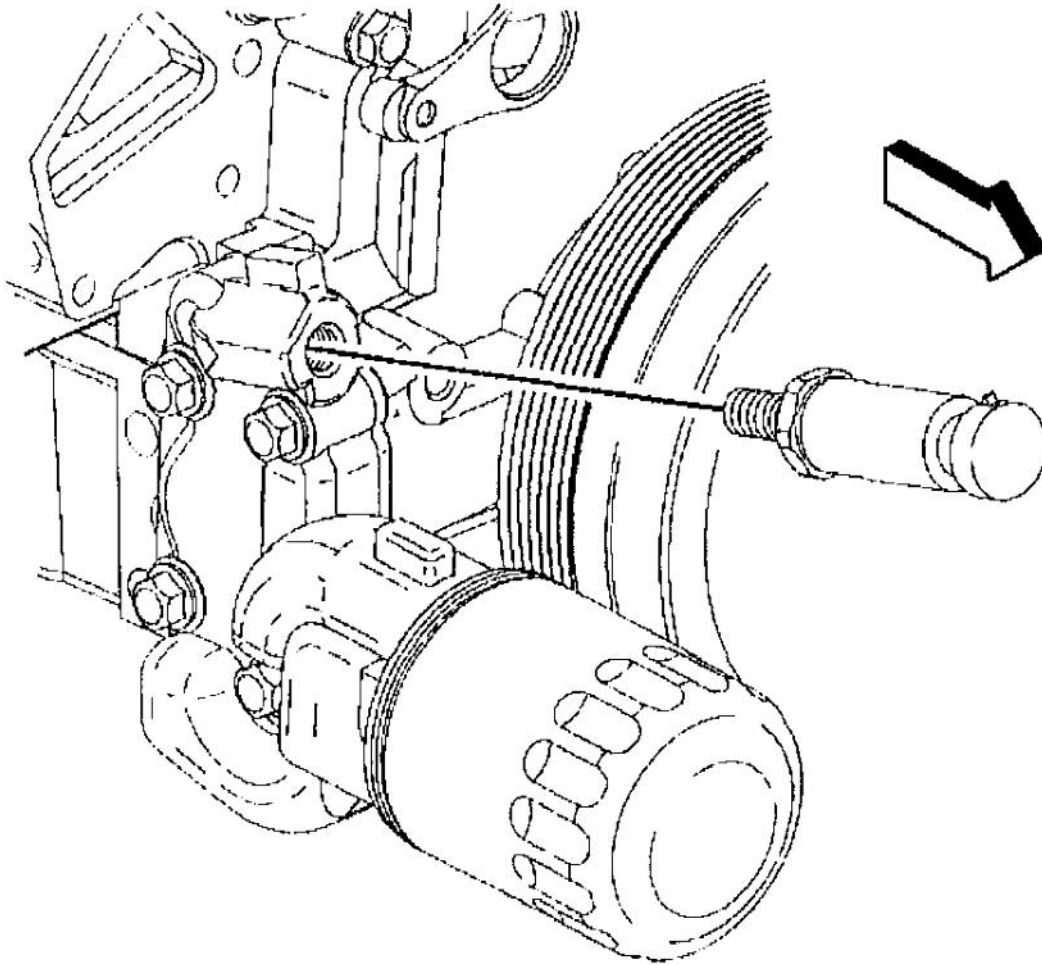
G01728827

Fig. 172: Installing New Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Install the oil pressure sensor.

Tighten

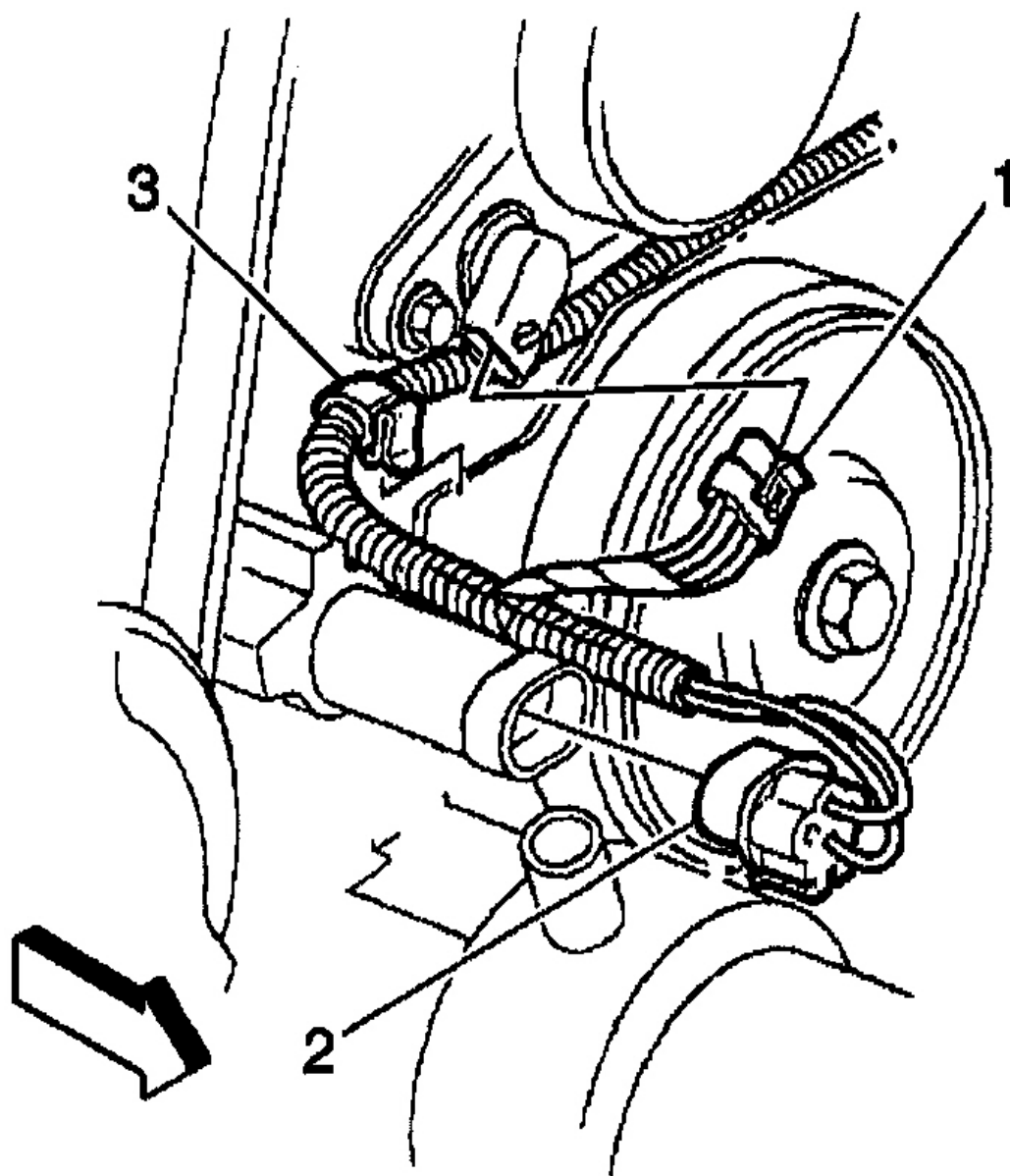
Tighten the oil pressure sensor to 16 N.m (12 lb ft).



G01728828

Fig. 173: Tightening Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

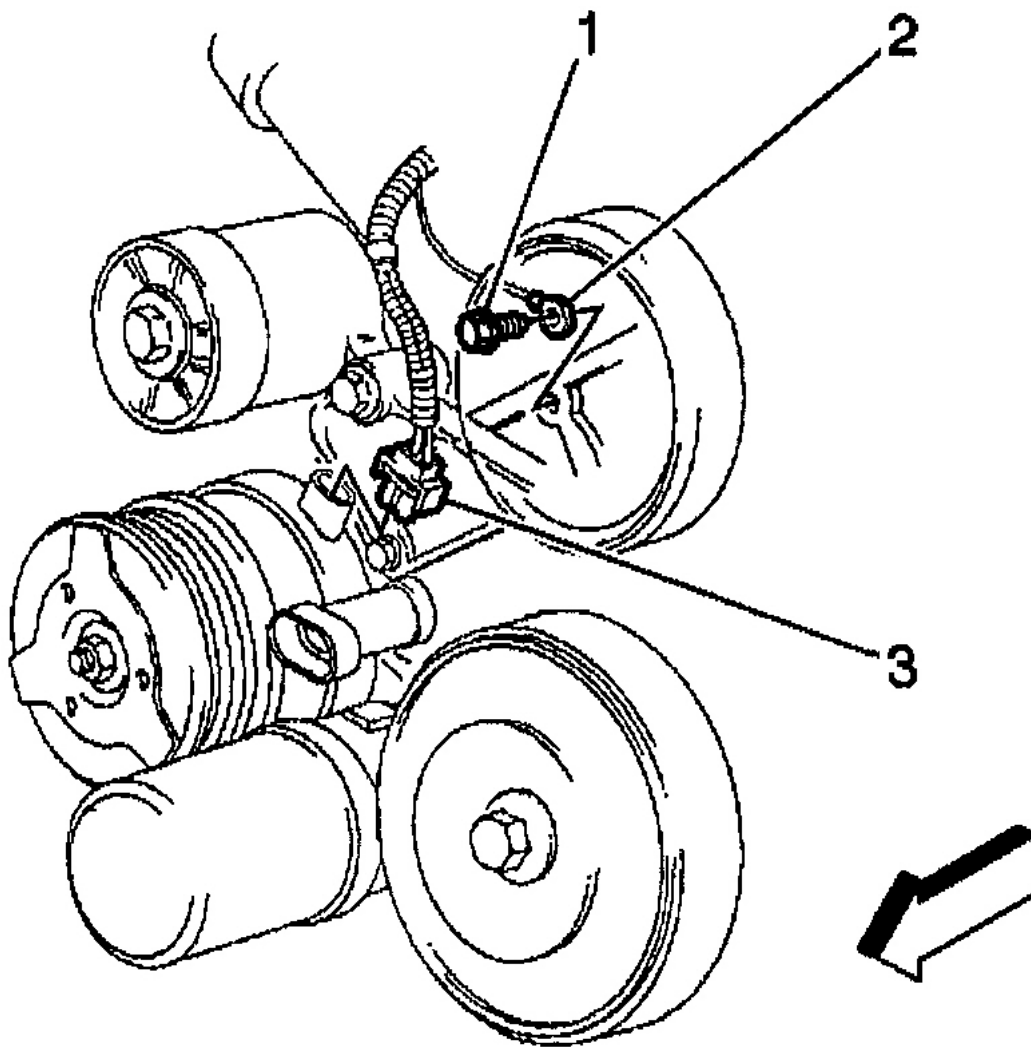
6. Connect the oil pressure sensor electrical connector (2).



G01728829

Fig. 174: Connecting Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Install the A/C compressor mounting bracket. Refer to **COMPRESSOR** .
8. Lower the vehicle.
9. Connect the A/C compressor electrical connector (3).



G01728830

Fig. 175: Connecting A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

10. Install the engine ground strap (2) and bolt (1).

Tighten

Tighten the engine ground strap bolt to 25 N.m (18 lb ft).

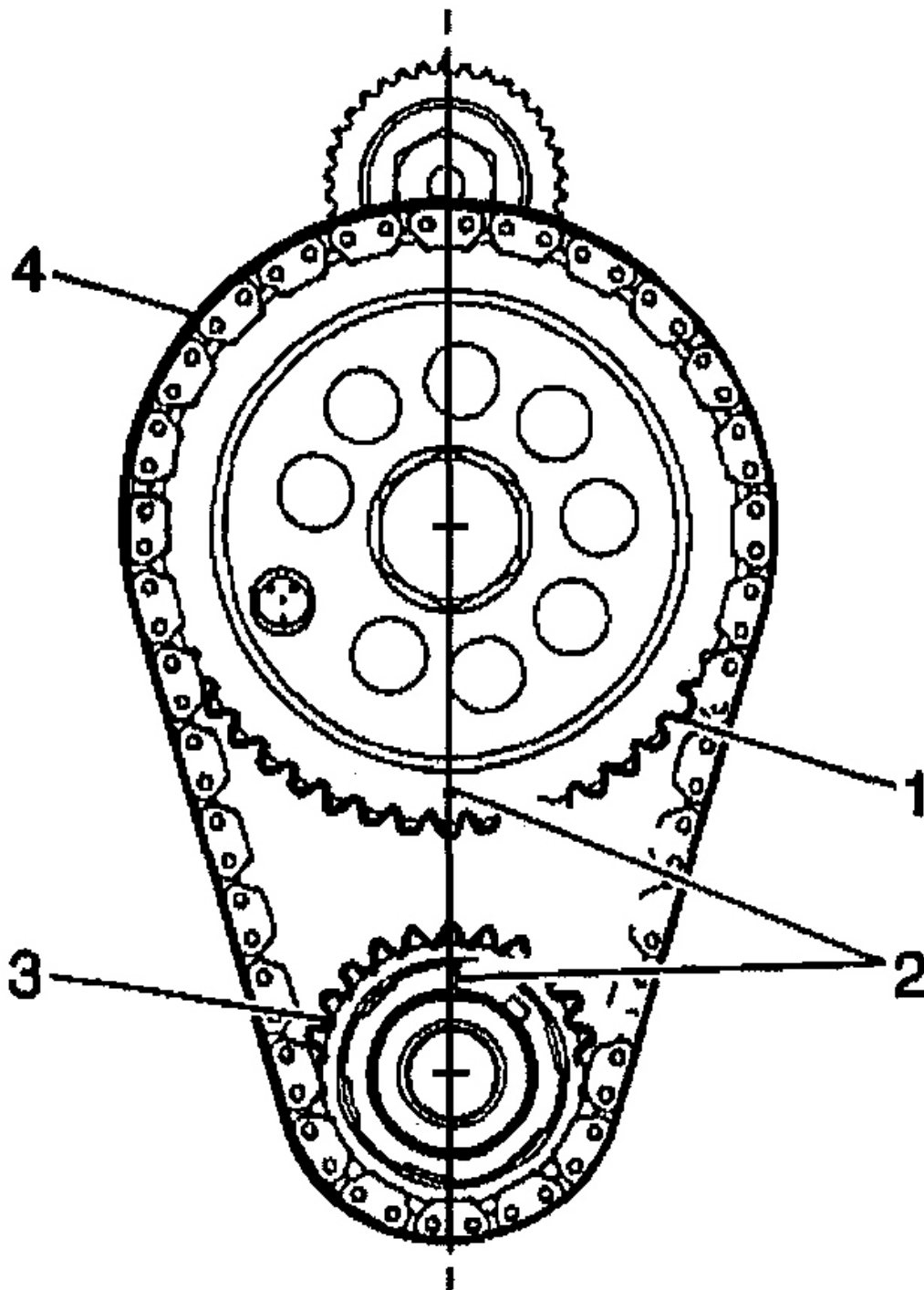
11. Install the drive belt. Refer to **Drive Belt Replacement**.
12. Fill the crankcase with engine oil. Refer to **Engine Oil and Oil Filter Replacement**.

TIMING CHAIN AND SPROCKETS REPLACEMENT**Tools Required**

J 36660-A Torque Angle Meter

Removal Procedure

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Align the timing marks (2) on the sprockets (1, 3) so that they are as close together as possible.

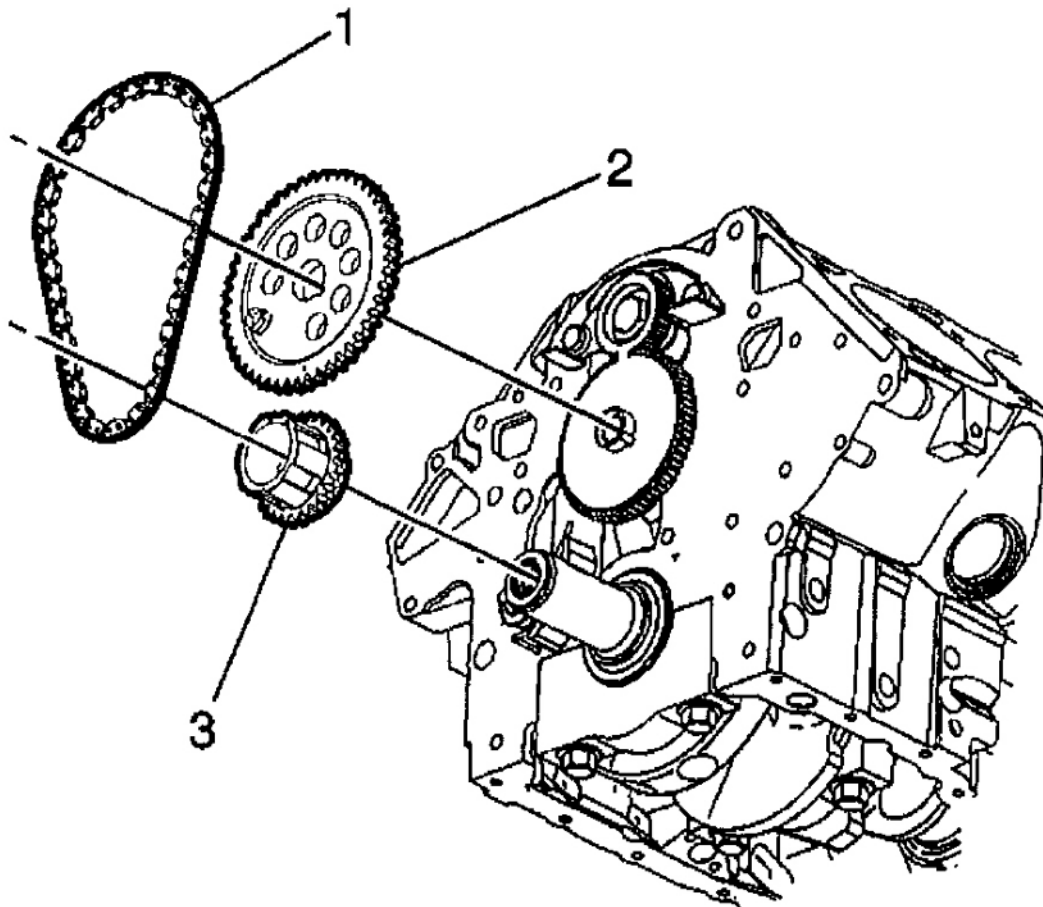


G01728831

Fig. 176: Aligning Timing Marks

Courtesy of GENERAL MOTORS CORP.

3. Remove the timing chain dampener.
4. Remove the camshaft sprocket bolt.
5. Remove the timing chain (1) and camshaft sprocket (2).



G01728832

Fig. 177: Removing Timing Chain And Camshaft Sprocket

Courtesy of GENERAL MOTORS CORP.

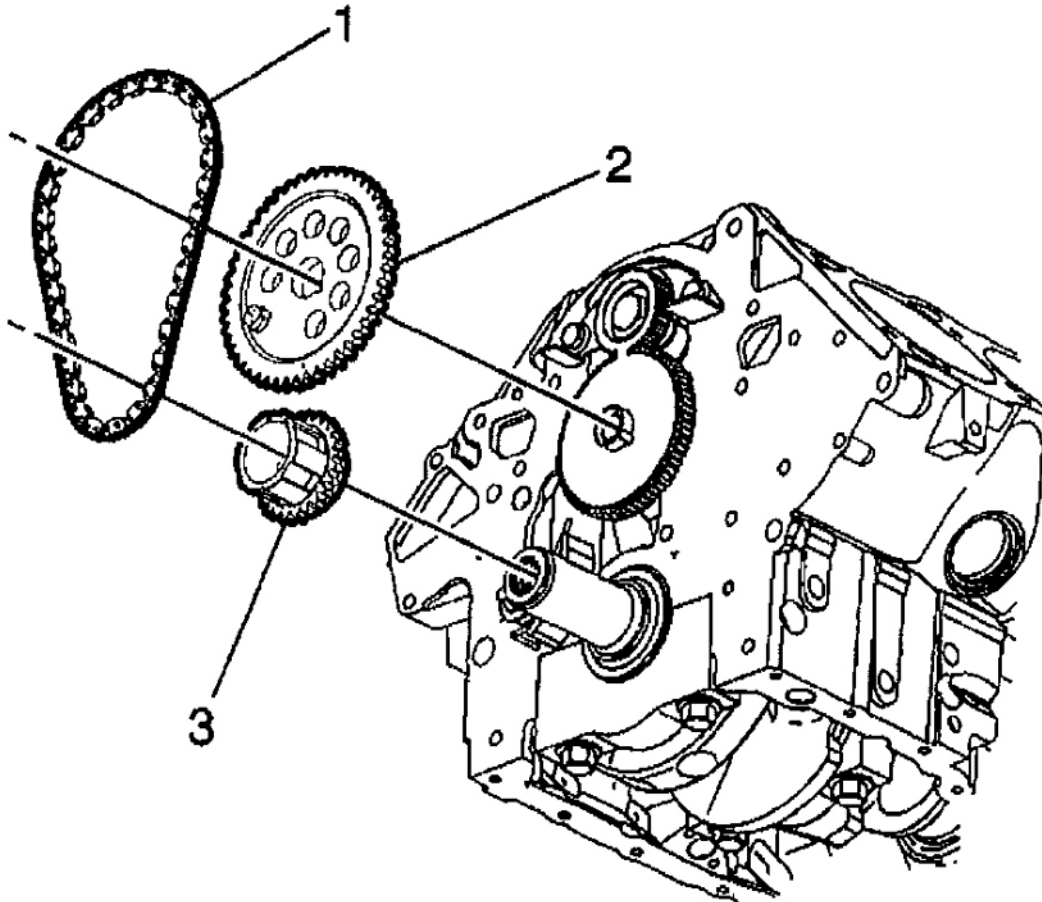
Important: If the crankshaft sprocket does not come off easily, a light blow on the edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

6. Remove the crankshaft sprocket (3).
7. Clean the timing chain.

8. Clean the sprockets.
9. Inspect all the components for wear or damage.
10. If the balance shaft timing has been disturbed. Refer to **BALANCE SHAFT REMOVAL** and **BALANCE SHAFT INSTALLATION**.
11. Use the following steps if the pistons have been moved in the engine:
 - 11.1. Turn the crankshaft in order to set the number one piston is at top dead center.
 - 11.2. With the sprocket installed, turn the camshaft in order to have the timing mark straight down.

Installation Procedure

1. Install the timing chain (1) onto the sprockets (2, 3) with the timing marks in their closest together position.



G01728833

Fig. 178: Installing Timing Chain

Courtesy of GENERAL MOTORS CORP.

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

Tighten

Tighten the camshaft sprocket bolt to 100 N.m (74 lb ft). Use the J 36660-A to torque the camshaft sprocket bolt an additional 90 degrees.

4. Install the timing chain dampener.
5. Install the timing chain dampener bolt.

Tighten

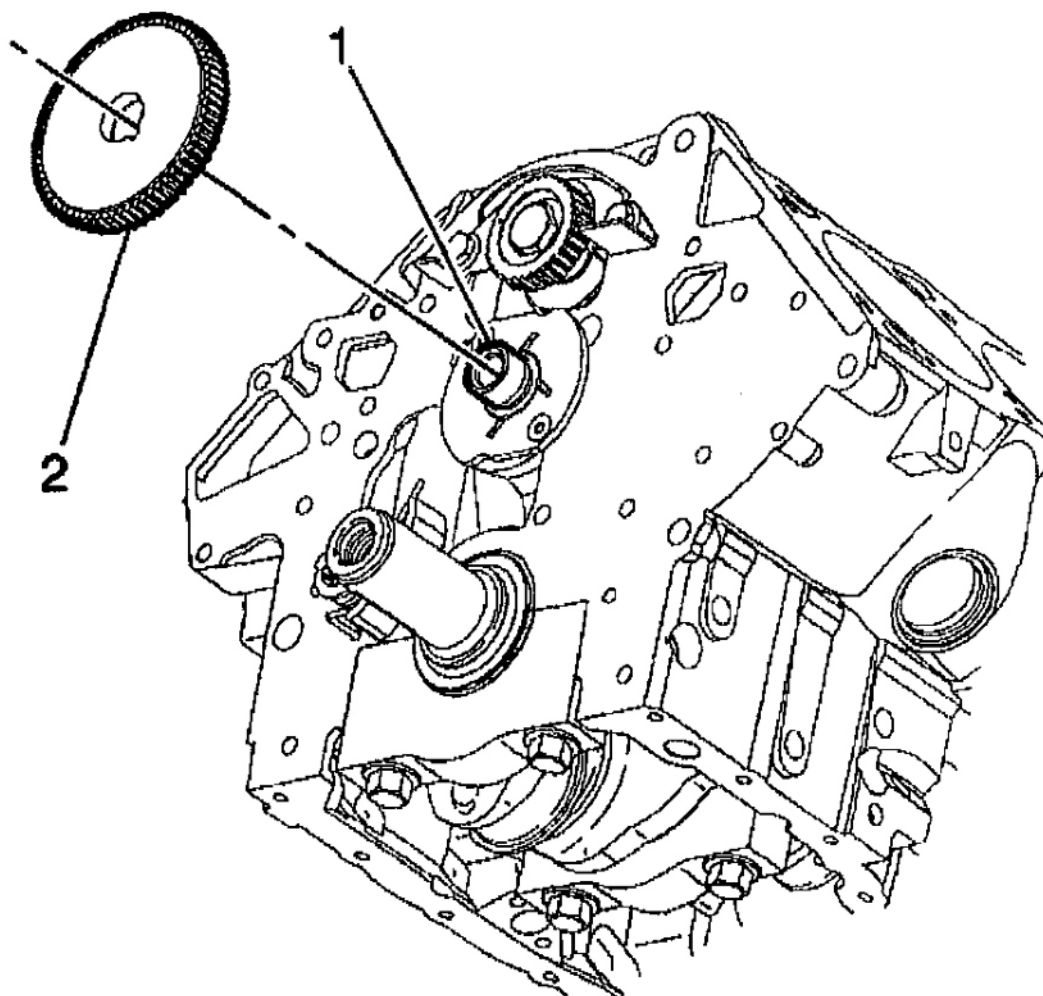
Tighten the dampener bolt to 22 N.m (16 lb ft).

Important: Rotate the engine two revolutions and check the timing marks. Ensure the marks are aligned.

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

CAMSHAFT REPLACEMENT**Removal Procedure**

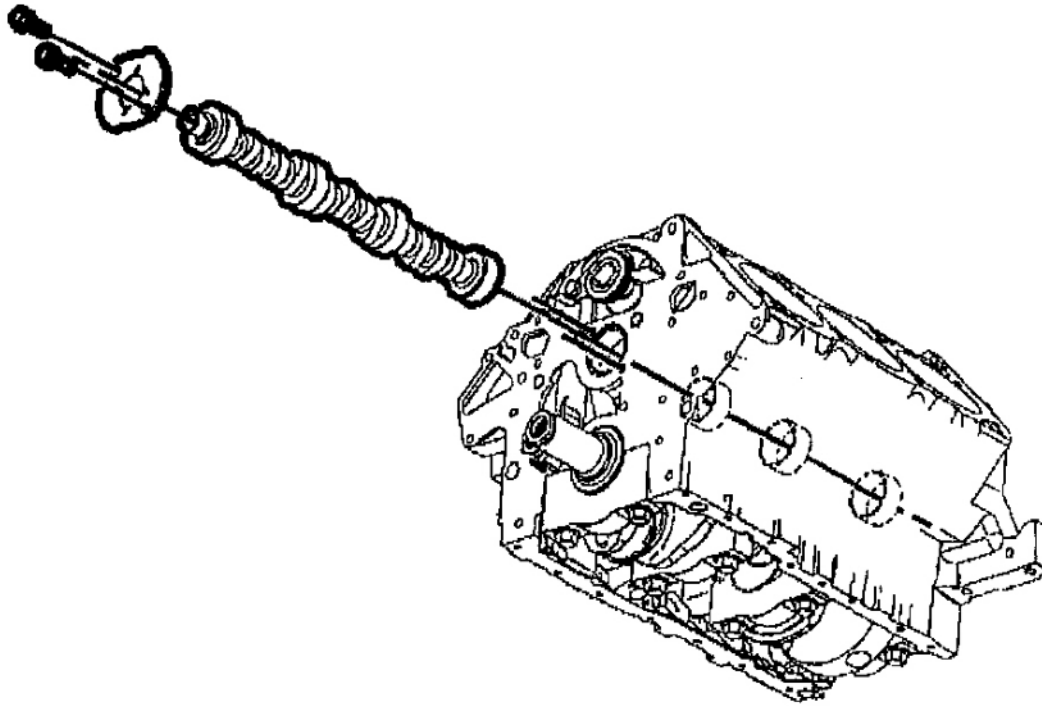
1. Remove the valve lifters. Refer to **Valve Lifter Replacement**.
2. Remove the timing chain and sprockets. Refer to **Timing Chain and Sprockets Replacement**.
3. Remove the balance shaft gear (2) from the camshaft (1).



G01728834

Fig. 179: Removing Balance Shaft Gear
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshaft thrust plate bolts.



G01728835

Fig. 180: Removing Camshaft Thrust Plate Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the camshaft thrust plate.
6. Remove the camshaft key.

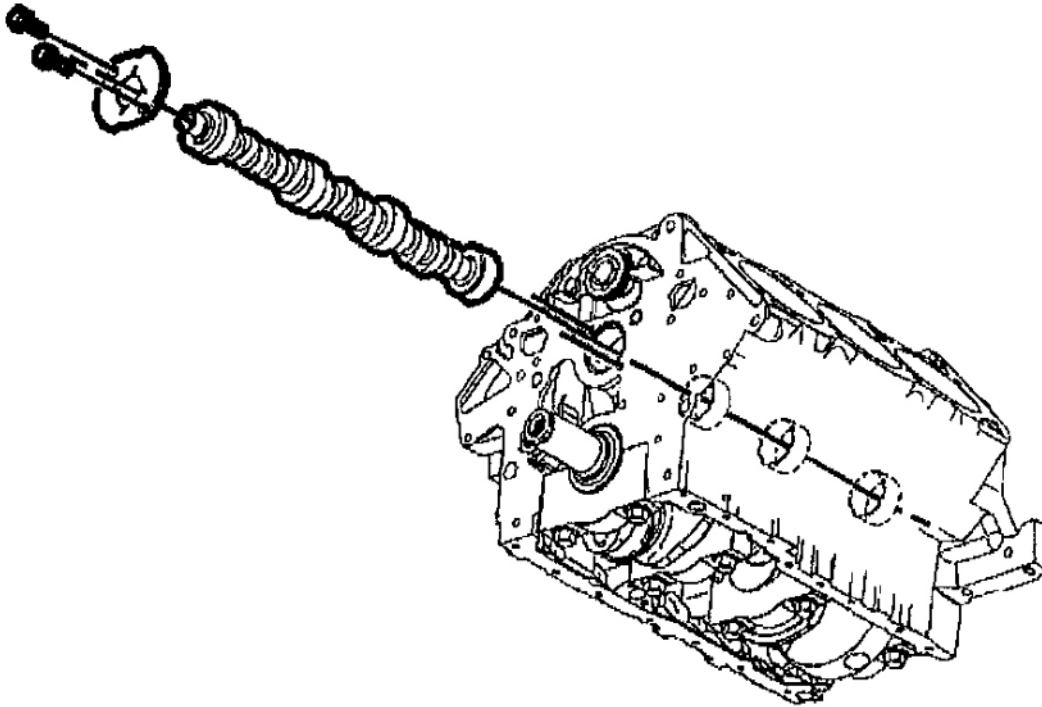
NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

7. Use the following procedure to remove the camshaft:
 - 7.1. Install three 5/16-18 x 4 in bolts in the camshaft bolt holes.
 - 7.2. Carefully rotate and pull the camshaft out.
8. Inspect the camshaft and bearings. Refer to **CAMSHAFT AND BEARINGS CLEANING AND INSPECTION**.

Installation Procedure

1. Coat the camshaft with lubricant GM P/N 12345501, Canada P/N 992704, or equivalent before installation.

2. Install the camshaft.
3. Install the camshaft key.
4. Install the camshaft thrust plate.



G01728836

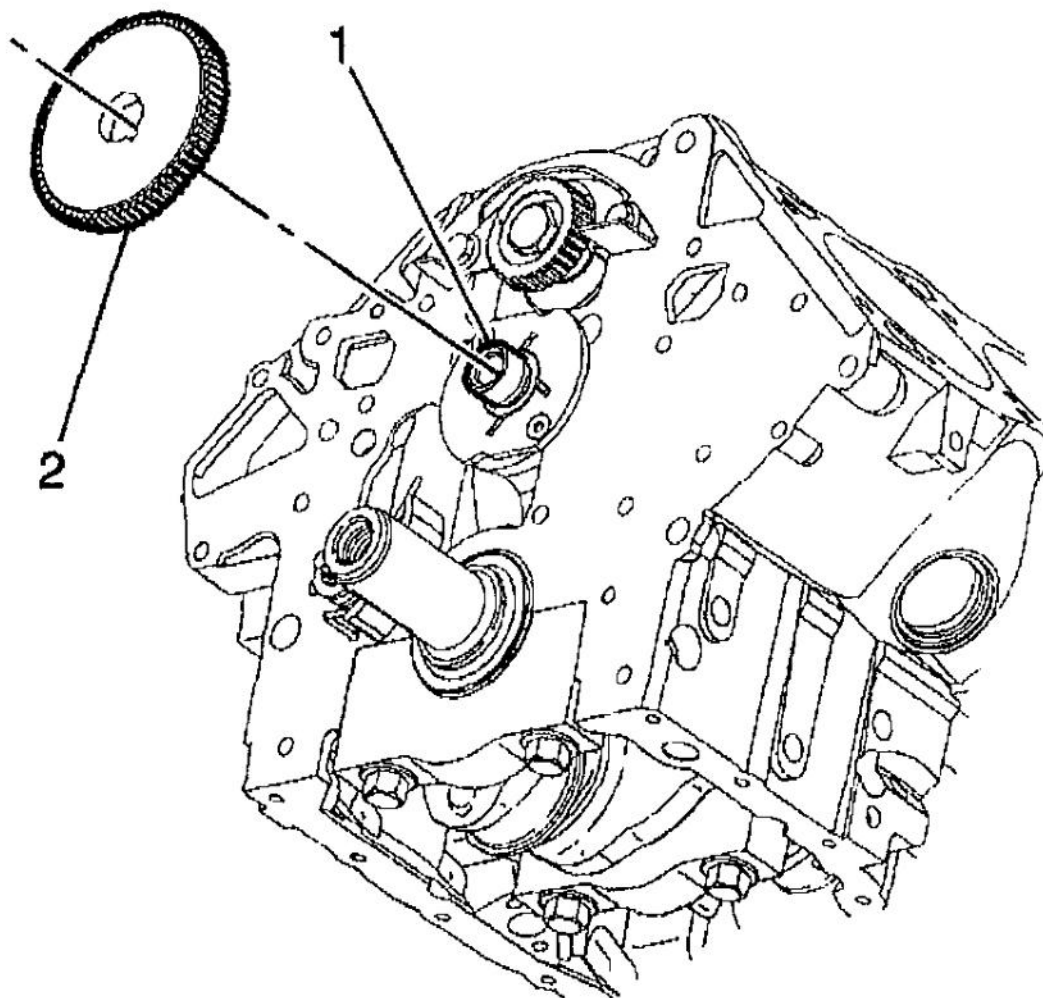
Fig. 181: Installing Camshaft Thrust Plate
Courtesy of GENERAL MOTORS CORP.

5. Install the camshaft thrust plate bolts.

Tighten

Tighten the camshaft thrust plate bolts to 15 N.m (11 lb ft).

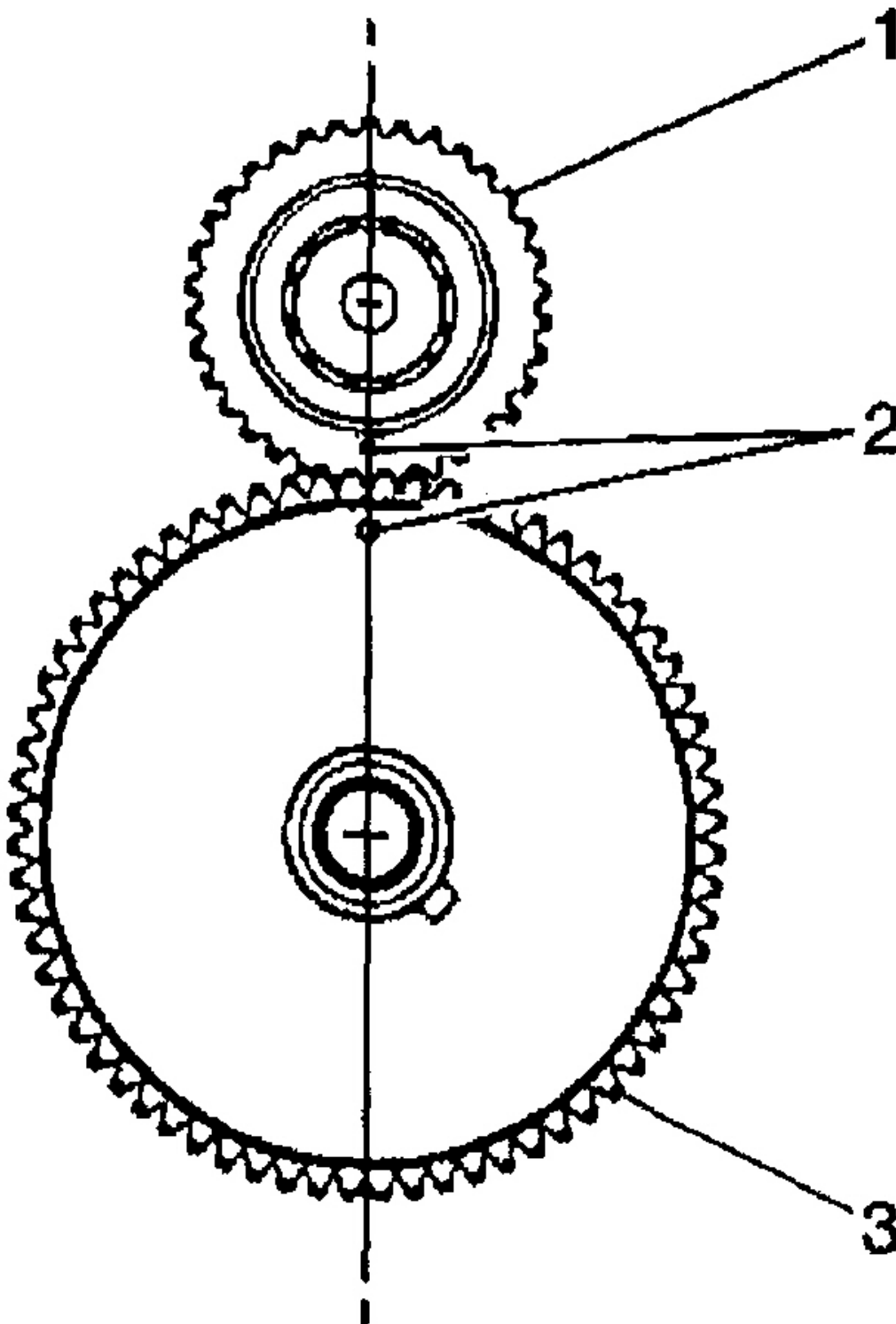
6. Install the balance shaft drive gear (2) to the camshaft (1).



G01728837

Fig. 182: Installing Balance Shaft Drive Gear
Courtesy of GENERAL MOTORS CORP.

7. Align the timing marks (2) on the balance shaft gear (1) and the balance shaft drive gear (3).



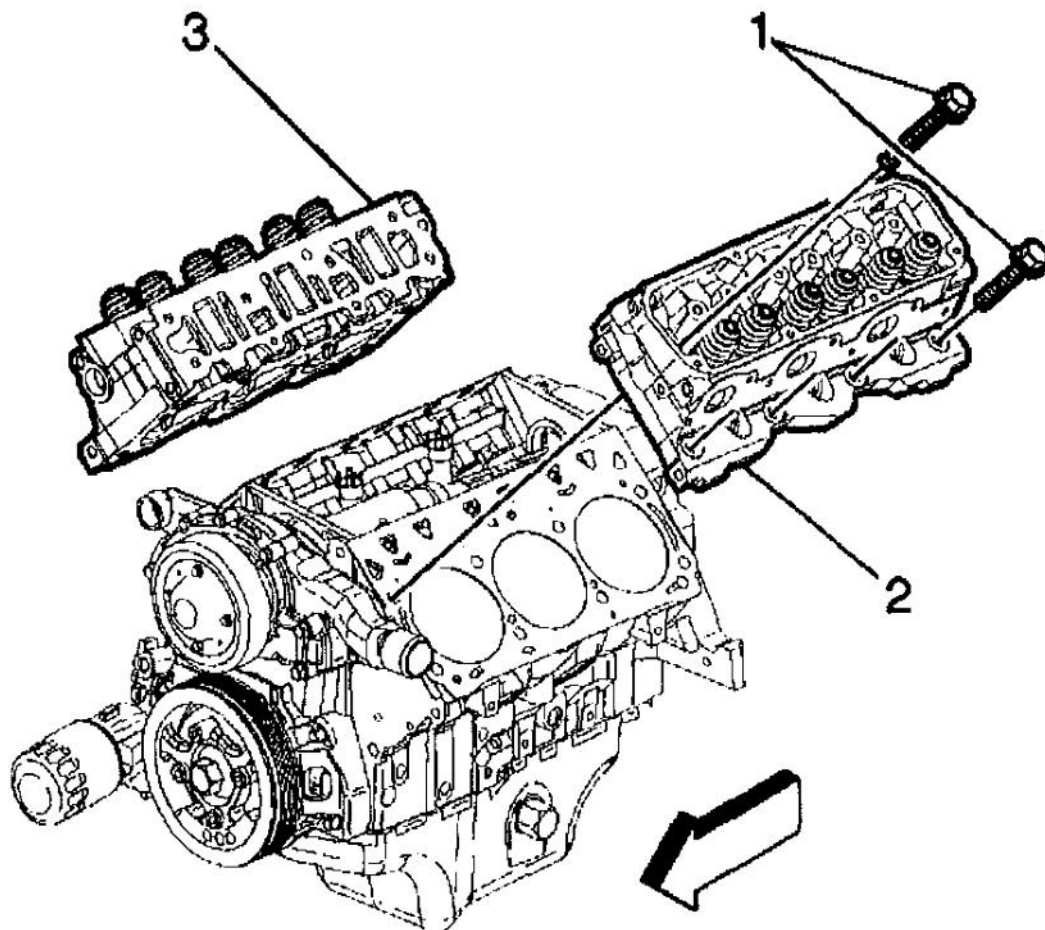
G01728838

Fig. 183: Aligning Timing Marks**Courtesy of GENERAL MOTORS CORP.**

8. Install the timing chain and sprockets. Refer to **Timing Chain and Sprockets Replacement**.
9. Install the valve lifters. Refer to **Valve Lifter Replacement**.

CYLINDER HEAD REPLACEMENT - LEFT**Tools Required****J 36660-A** Torque Angle Meter**Removal Procedure**

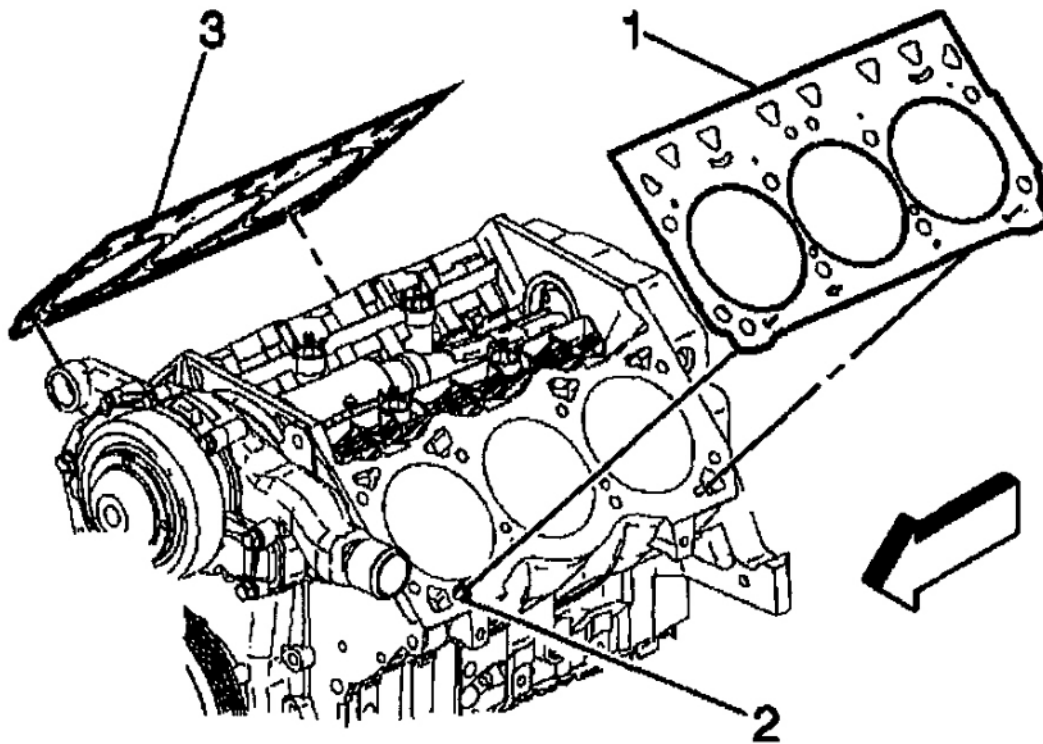
1. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
3. Remove the left exhaust manifold. Refer to **EXHAUST MANIFOLD REPLACEMENT - LEFT (3.8 L)**.
4. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
5. Remove the left cylinder head bolts (1).



G01728839

Fig. 184: Removing Left Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the left cylinder head (2).



G01728840

Fig. 185: Removing Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

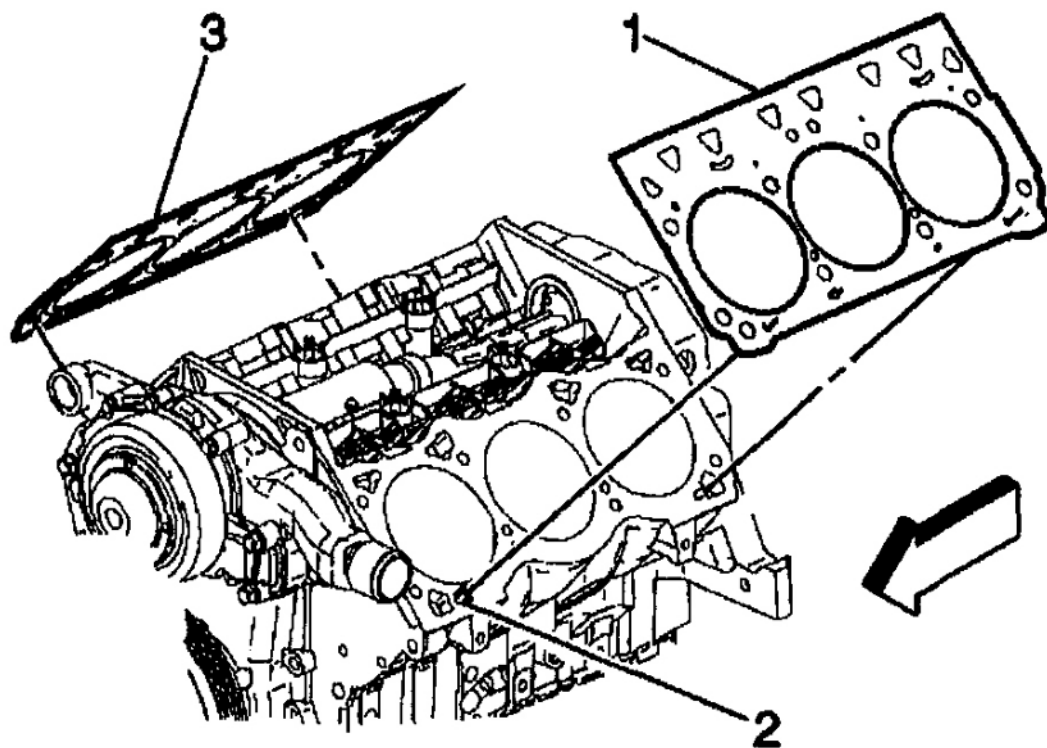
7. Remove the left cylinder head gasket (1).
8. Disassemble the left cylinder head. Refer to **CYLINDER HEAD REMOVAL - LEFT**.

Installation Procedure

1. Assemble the cylinder head. Refer to **CYLINDER HEAD ASSEMBLE**.

Important: The arrow on the gasket must point to the front of the engine. Failure to install the gasket properly will cause gasket failure and possible engine failure.

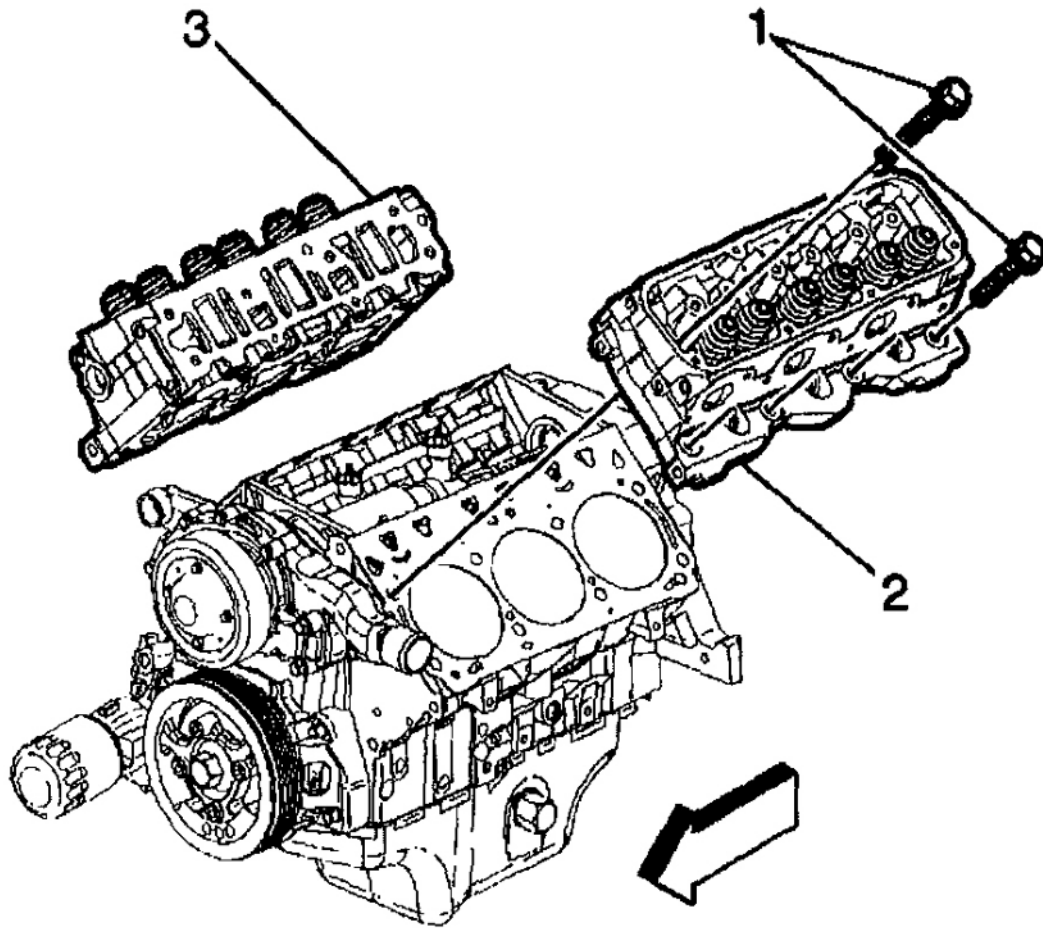
2. Install a new left cylinder head gasket (1) to the alignment pins (2).



G01728841

Fig. 186: Installing New Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install the left cylinder head (2).



G01728842

Fig. 187: Installing Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Torque the cylinder head bolts following the given sequence.
5. Install the cylinder head bolts.

Tighten

Tighten the cylinder head bolts to 50 N.m (37 lb ft) in sequence shown. Use the J 36660-A to torque the cylinder head bolts an additional 120 degrees.

6. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
7. Install the left exhaust manifold. Refer to **EXHAUST MANIFOLD REPLACEMENT - LEFT (3.8 L)**.

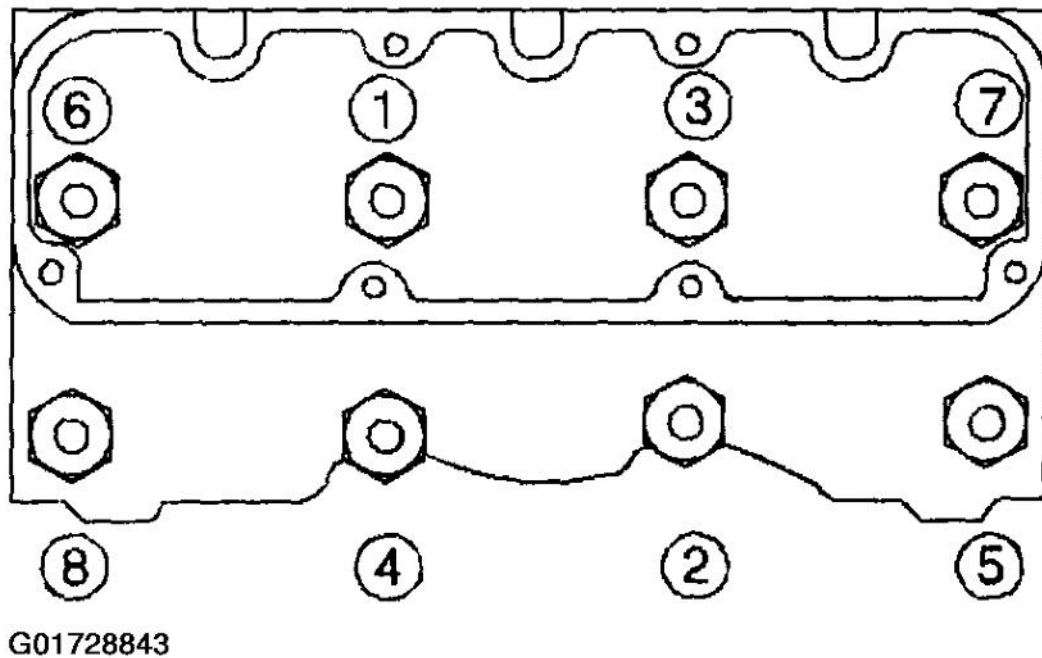


Fig. 188: Cylinder Head Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

8. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower.**
9. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM .**
10. Change the engine oil and filter. Refer to **Engine Oil and Oil Filter Replacement.**

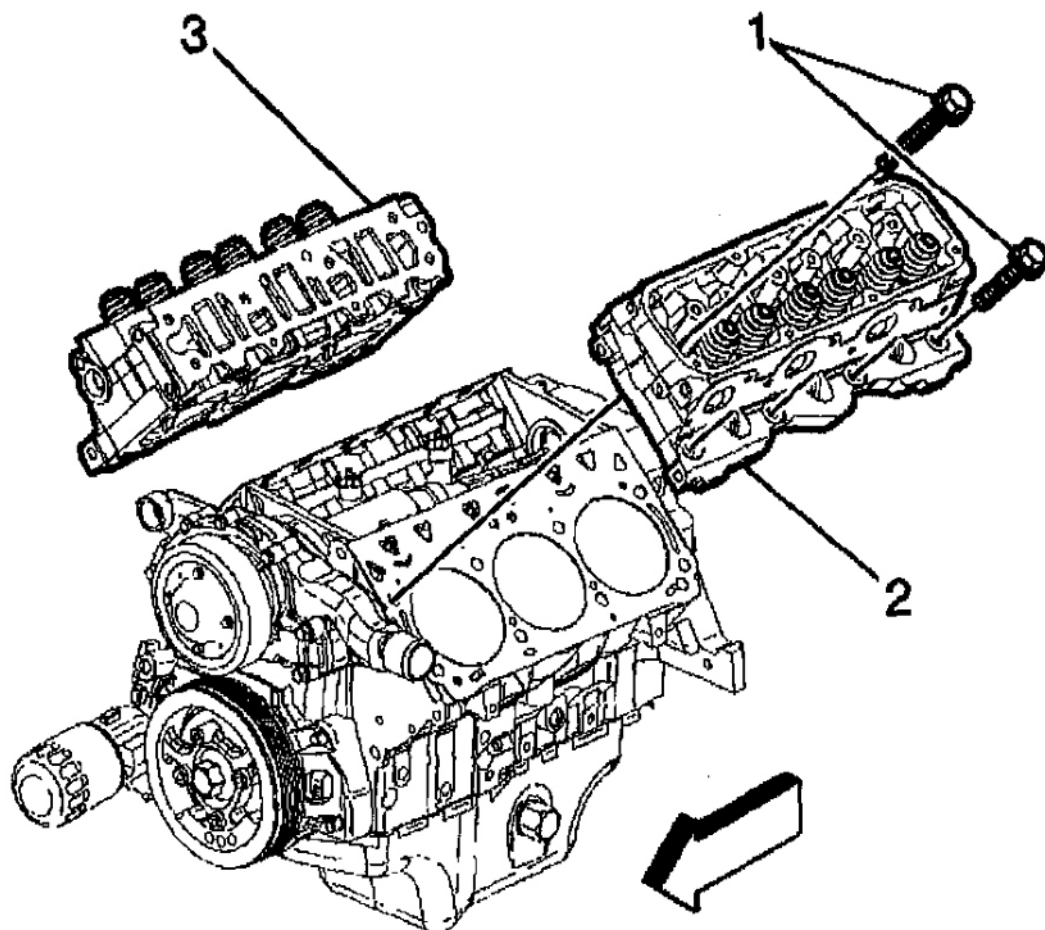
CYLINDER HEAD REPLACEMENT - RIGHT

Tools Required

J 36660-A Torque Angle Meter

Removal Procedure

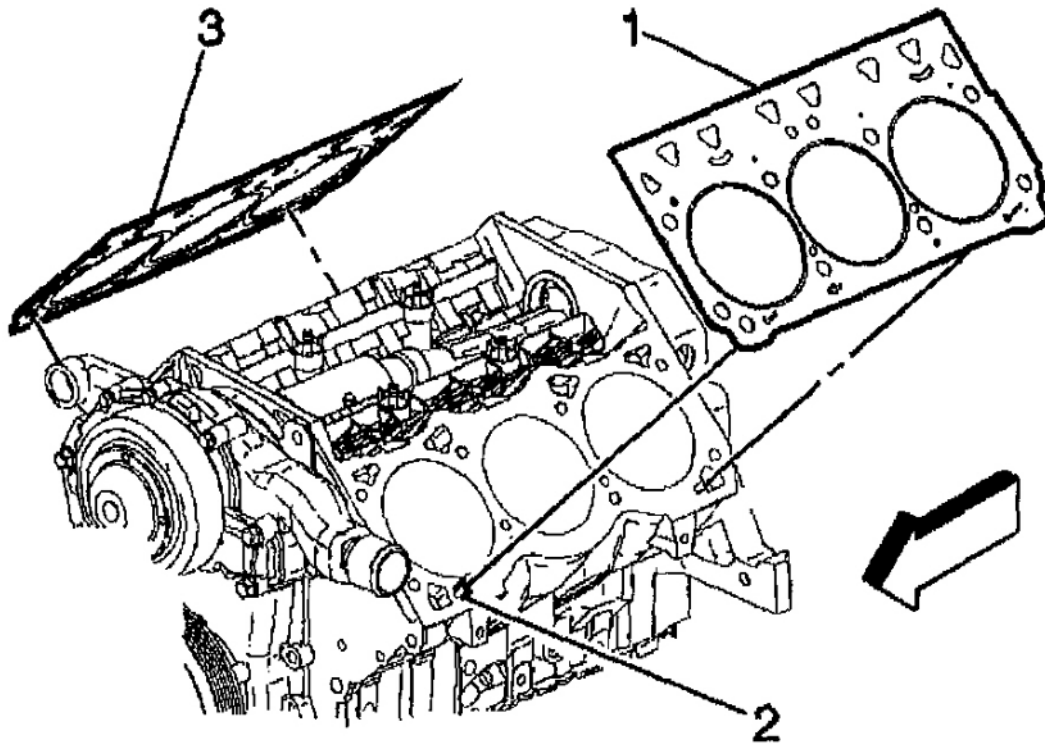
1. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM .**
2. Remove the lower intake manifold. Refer to **Intake Manifold Replacement - Lower.**
3. Remove the right exhaust manifold. Refer to **EXHAUST MANIFOLD REPLACEMENT - RIGHT (3.8L) .**
4. Remove the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement.**
5. Remove the cylinder head bolts (1).



G01728844

Fig. 189: Removing Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the right cylinder head (3).
7. Remove the right cylinder head gasket (3).



G01728845

Fig. 190: Removing Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

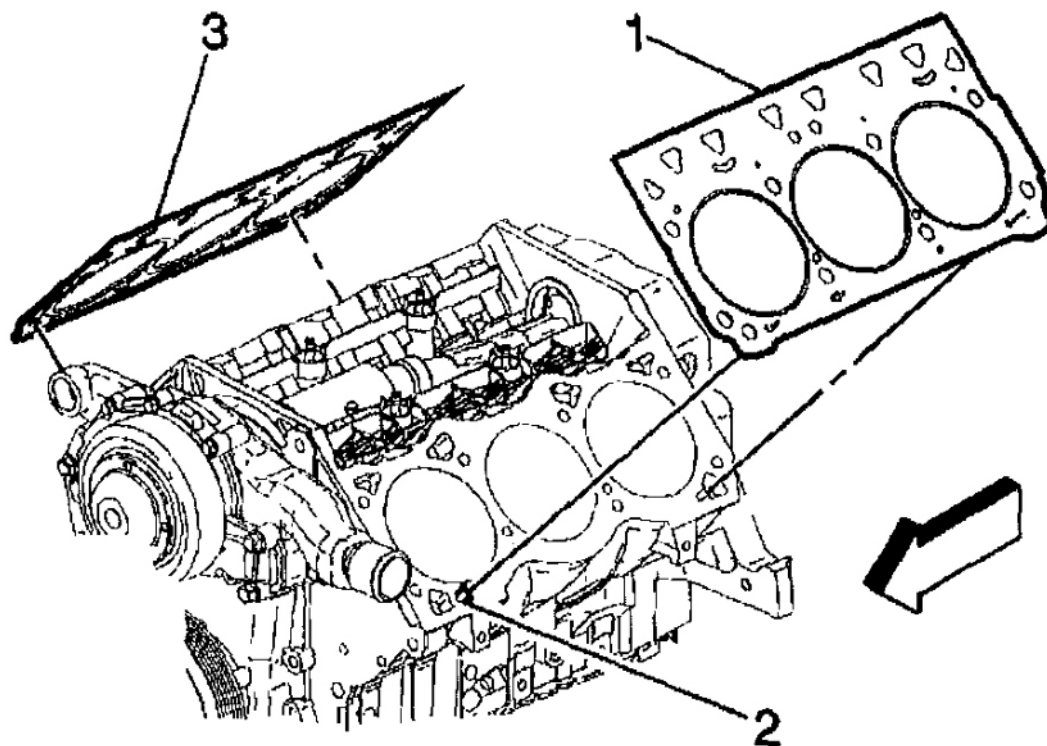
8. Disassemble the cylinder head. Refer to CYLINDER HEAD DISASSEMBLE .

Installation Procedure

1. Assemble the cylinder head. Refer to CYLINDER HEAD DISASSEMBLE .

Important: The arrow on the gasket must point to the front of the engine. Failure to install the gasket properly will cause gasket failure and possible engine damage.

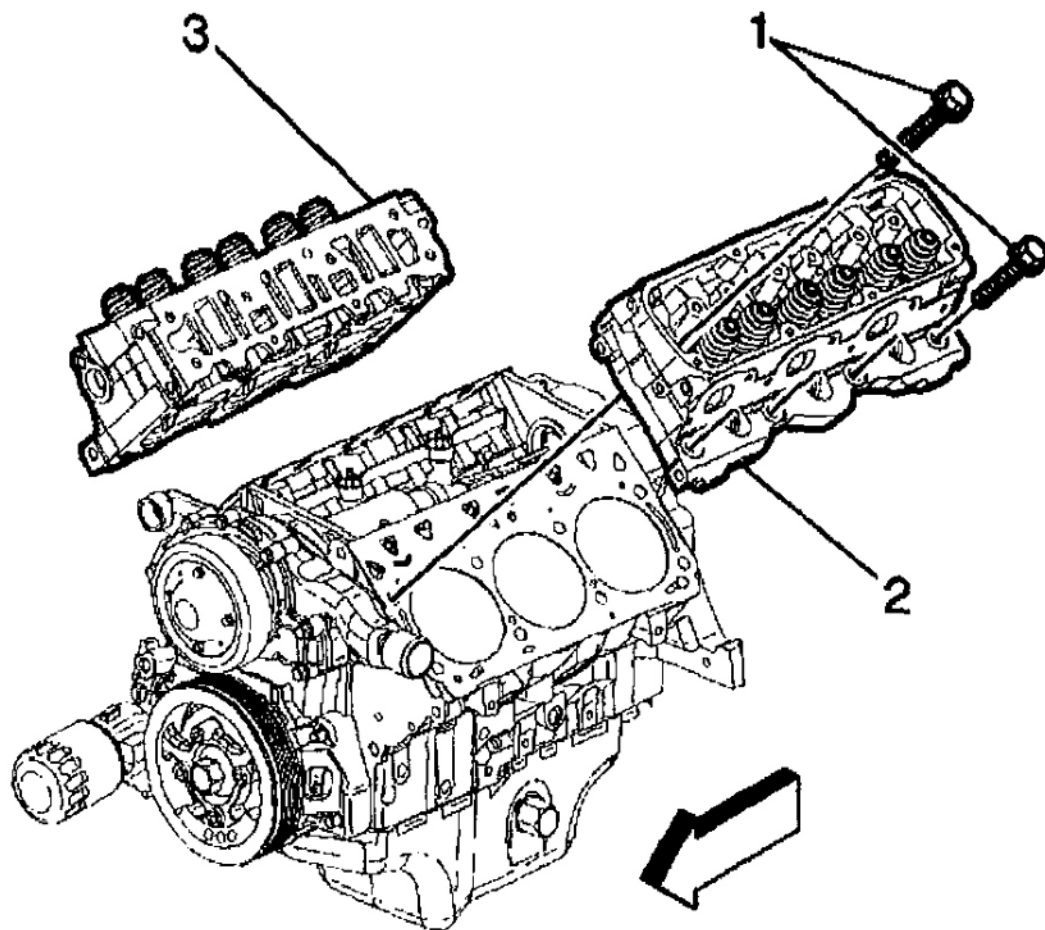
2. Install the new right cylinder head gasket (3) to the alignment pins (2).



G01728846

Fig. 191: Installing New Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

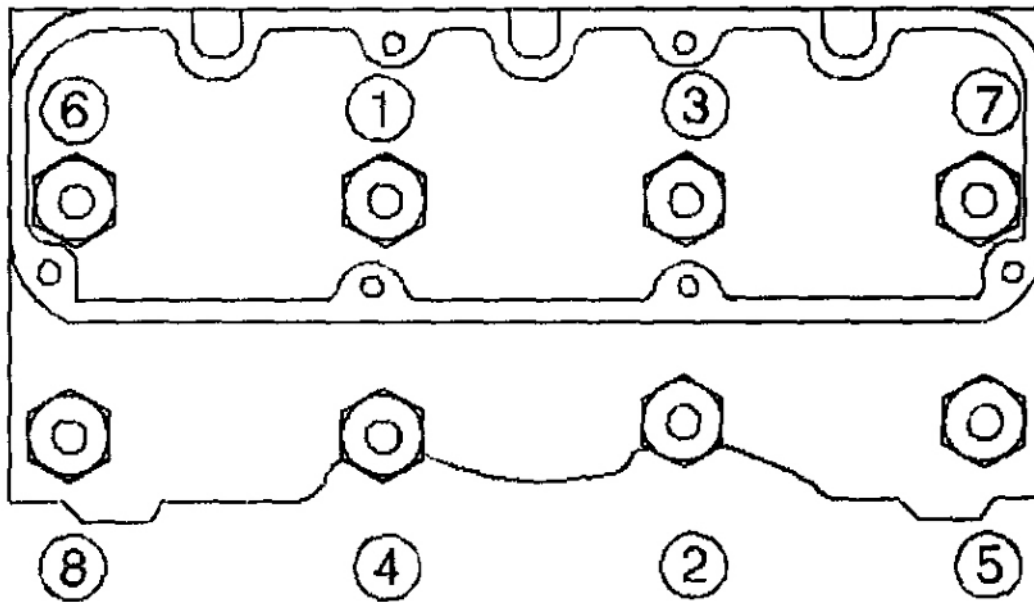
3. Install the right cylinder head (3).



G01728847

Fig. 192: Installing Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Tighten the cylinder head bolts following the given sequence.



G01728848

Fig. 193: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the cylinder head bolts to 50 N.m (37 lb ft) in sequence shown. Use the J 36660-A to torque the cylinder head bolts an additional 120 degrees.

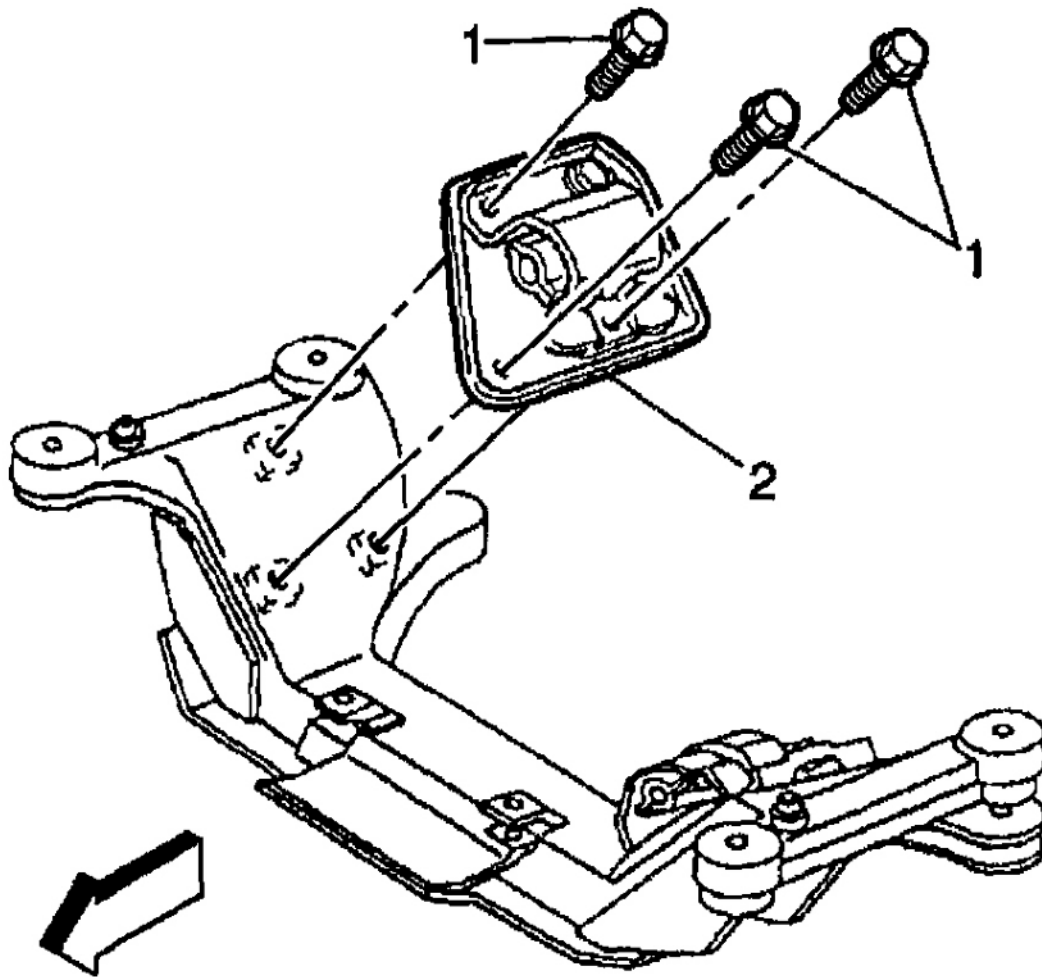
5. Install the pushrods and the valve rocker arms. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Install the right exhaust manifold. Refer to **EXHAUST MANIFOLD REPLACEMENT - RIGHT (3.8L)**.
7. Install the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
8. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
9. Change the engine oil and filter. Refer to **Engine Oil and Oil Filter Replacement**.

OIL PAN REPLACEMENT

Removal Procedure

1. Install the engine support fixture to the engine. Refer to **Engine Support Fixture**.
2. Disconnect the negative battery cable.
3. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**

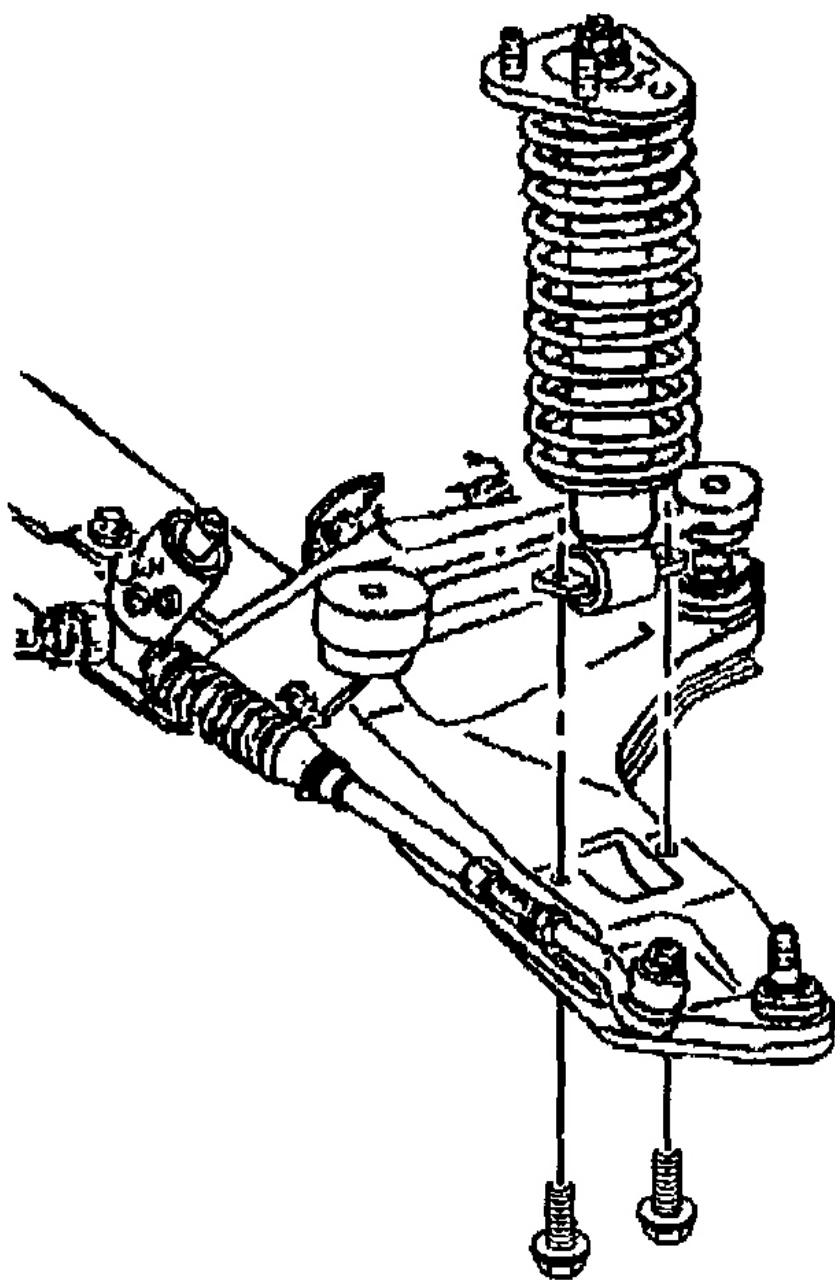
4. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
5. Remove the right side engine mount (2) to cradle bolts (1).



G01728849

Fig. 194: Removing Right Side Engine Mount
Courtesy of GENERAL MOTORS CORP.

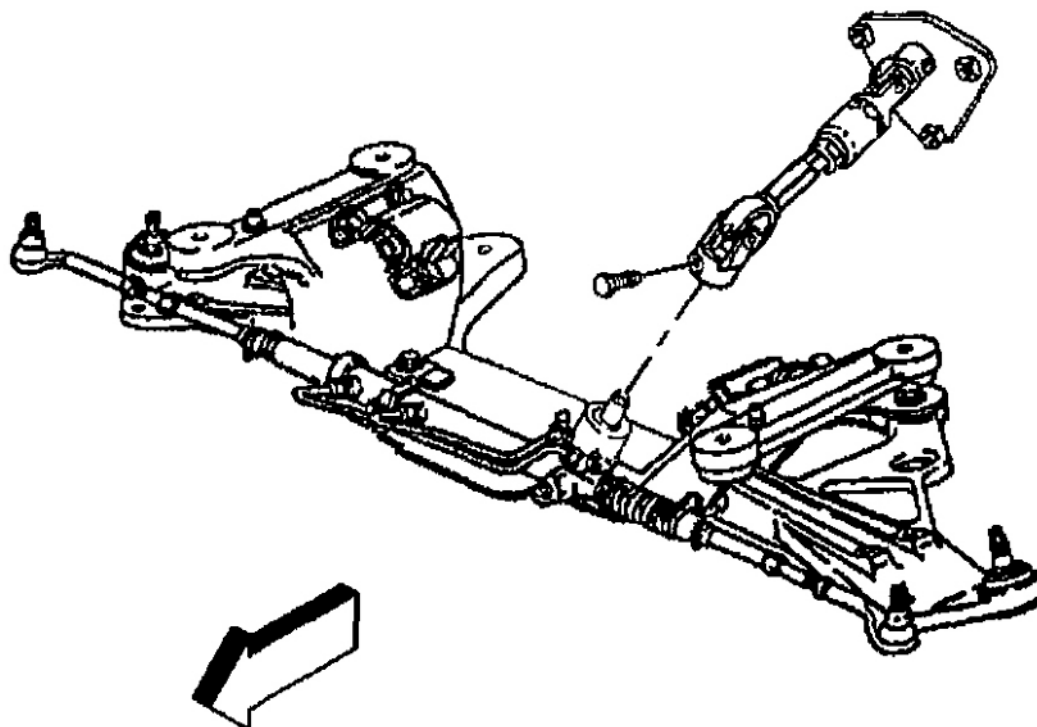
6. Remove exhaust crossover. Refer to **EXHAUST CROSSOVER PIPE REPLACEMENT**.
7. Remove the right side shock absorber lower mounting bolts.



G01728850

Fig. 195: Removing Right Side Shock Absorber Lower Mounting Bolt
Courtesy of GENERAL MOTORS CORP.

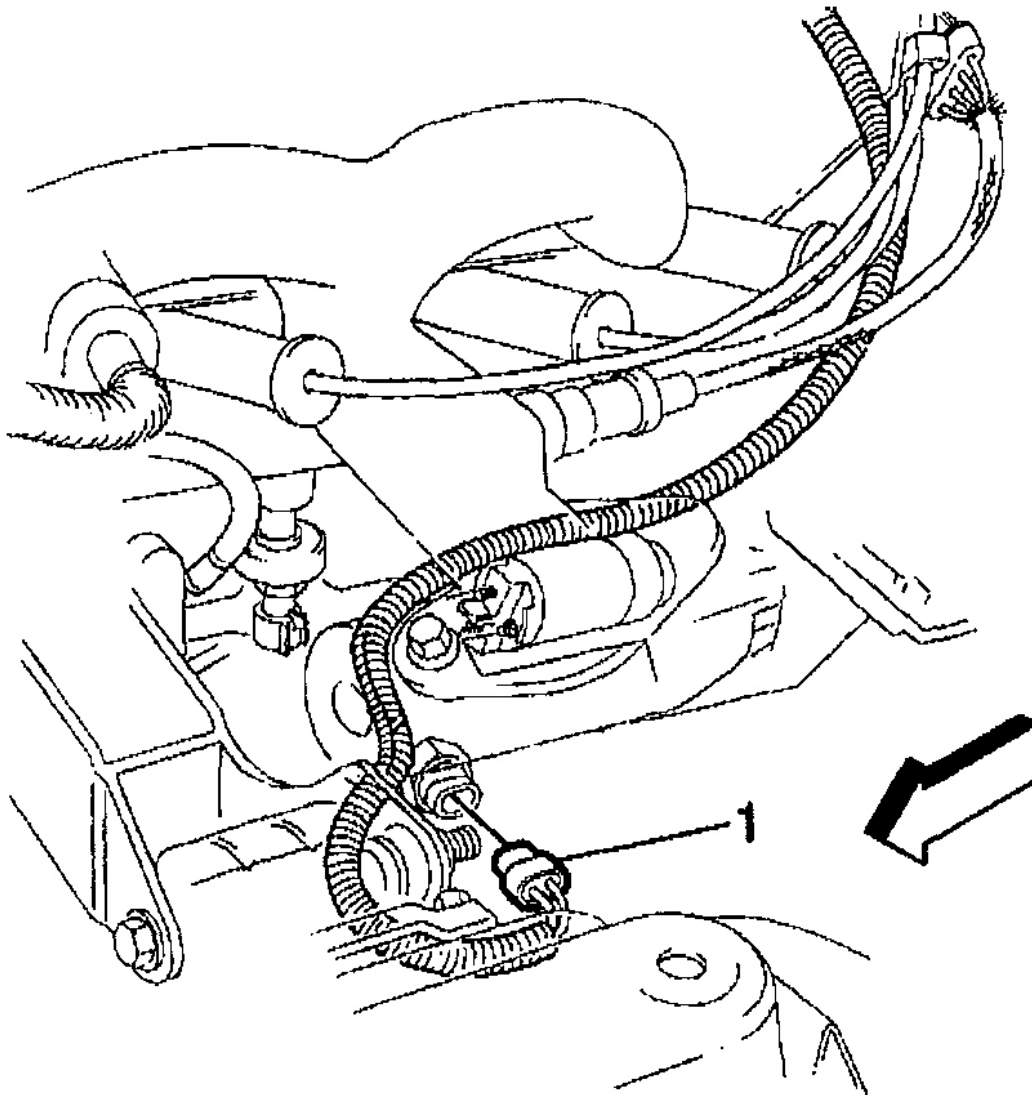
8. Remove the intermediate steering shaft bolt from the rack and pinion.



G01728851

Fig. 196: Removing Intermediate Steering Shaft Bolt From Rack And Pinion
Courtesy of GENERAL MOTORS CORP.

9. Support the crossmember with suitable support.
10. Disconnect the oil level sensor electrical connector (1).

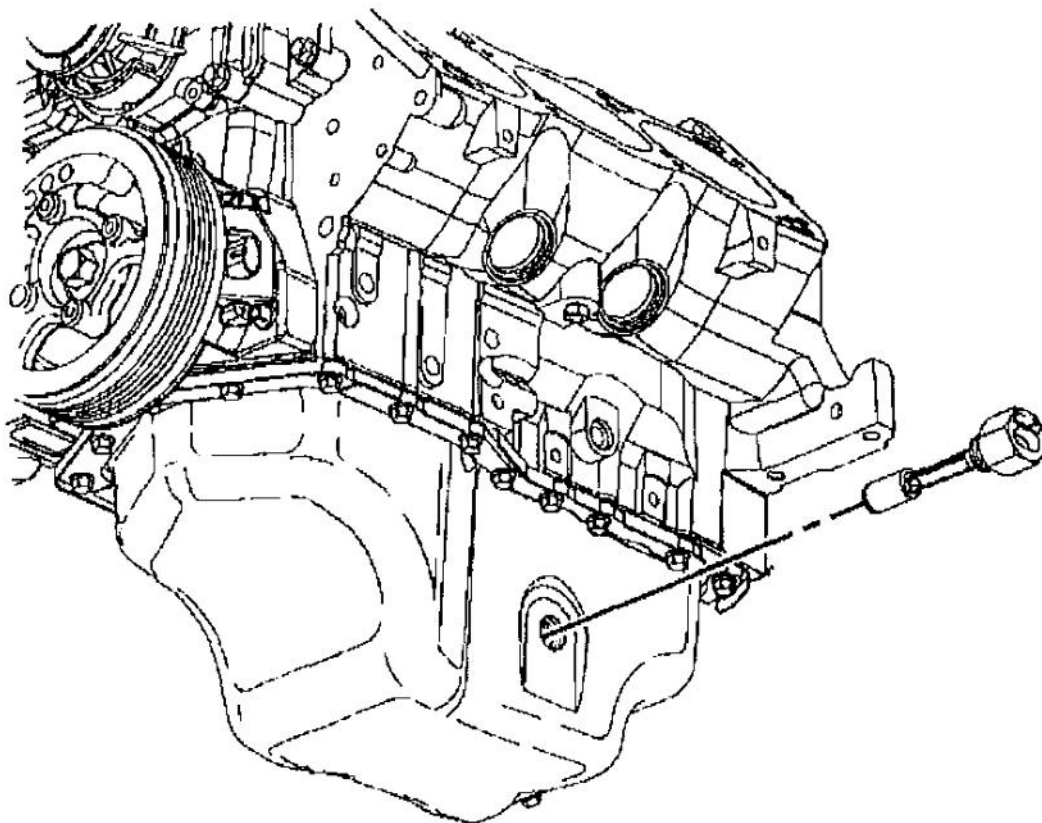


G01728852

Fig. 197: Disconnecting Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Remove the oil level sensor, located in the oil pan, before the oil pan is removed. The sensor may be damaged if the oil pan is removed first.

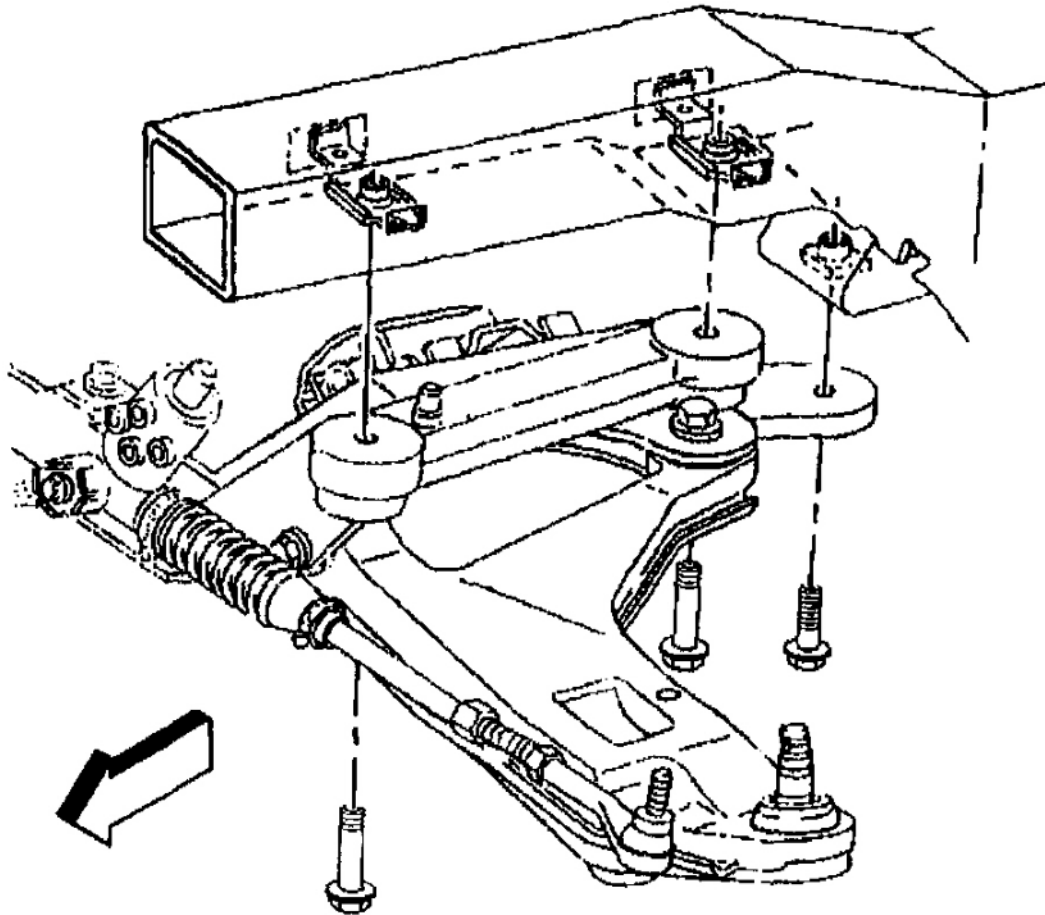
11. Remove the oil level sensor from the oil pan.



G01728853

Fig. 198: Removing Oil Level Sensor From Oil Pan
Courtesy of GENERAL MOTORS CORP.

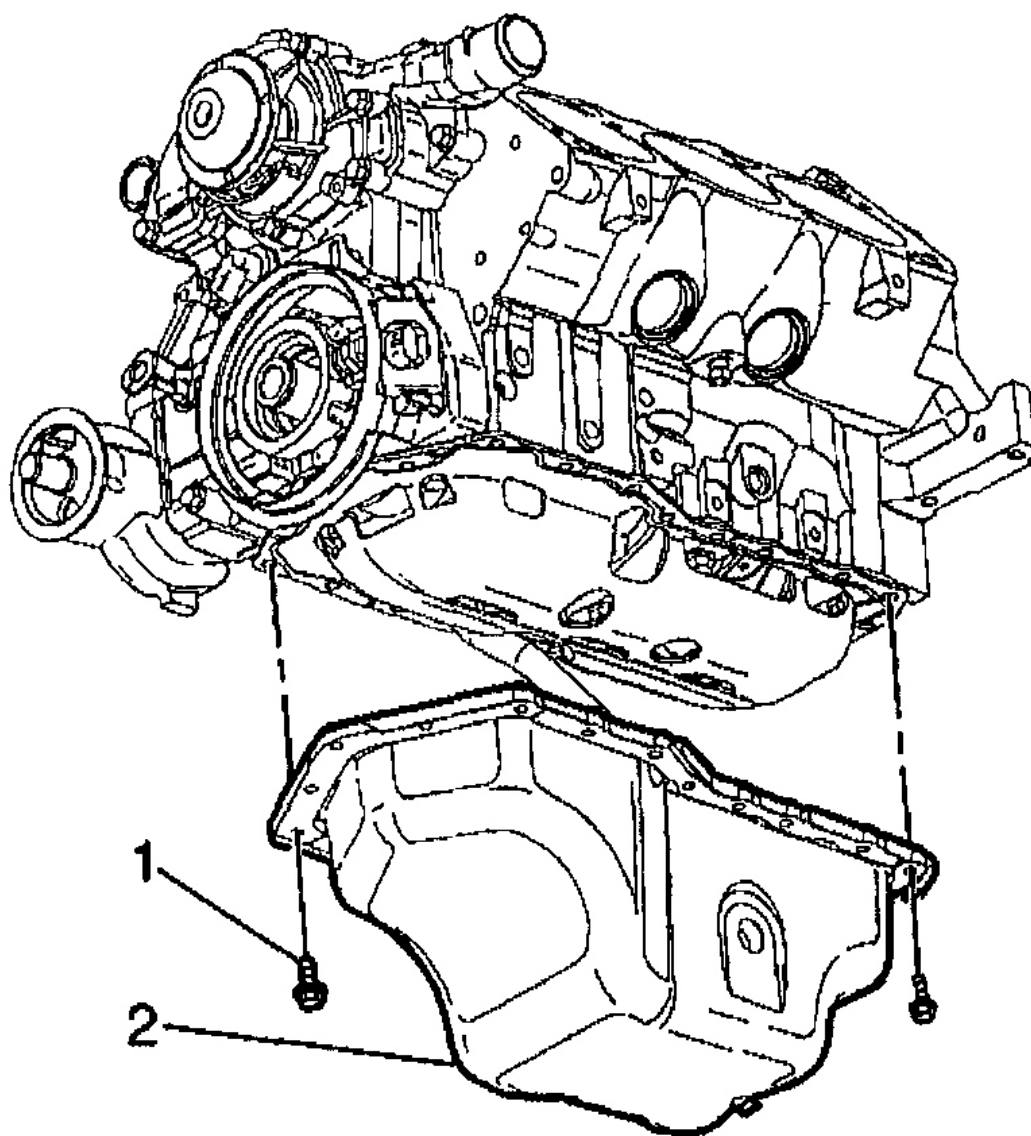
12. Remove the starter motor. Refer to **STARTER MOTOR (3.8L)** .
13. Remove the right front crossmember bolts.
14. Remove left engine mount through bolt.



G01728854

Fig. 199: Removing Left Engine Mount Through Bolt
 Courtesy of GENERAL MOTORS CORP.

15. Loosen left crossmember bolts 2 turns.
16. Lower vehicle and raise the engine with the engine support fixture.
17. Raise the vehicle. **LIFTING AND JACKING THE VEHICLE**
18. Adjust crossmember to gain access to the oil pan.
19. Remove the oil pan bolts (1).



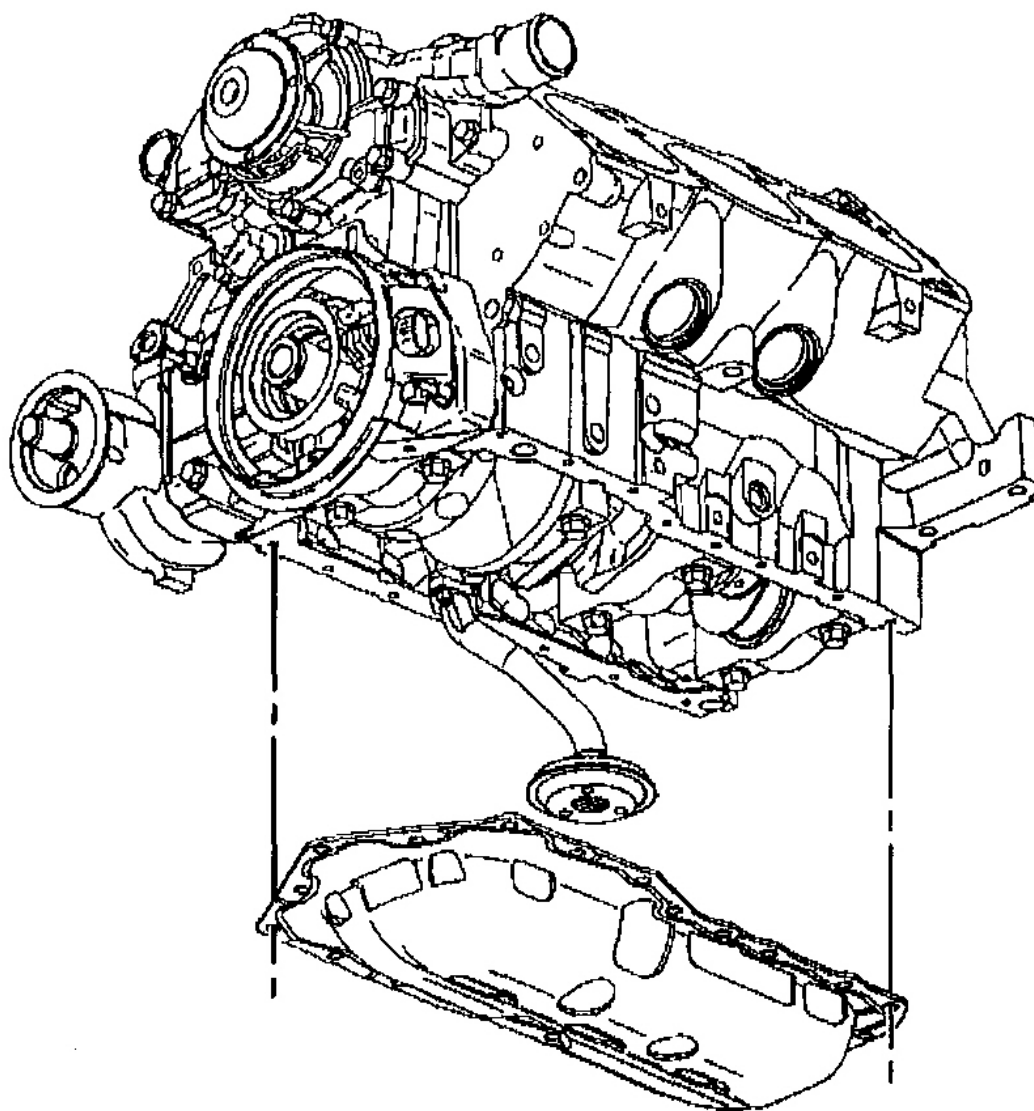
G01728855

Fig. 200: Removing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

20. Hold the oil pan gasket against the engine block while removing the oil pan.
21. Lower the rear of the oil pan while rotating the pan outward.

Remove the oil pan (2).

22. Remove the oil pan gasket.



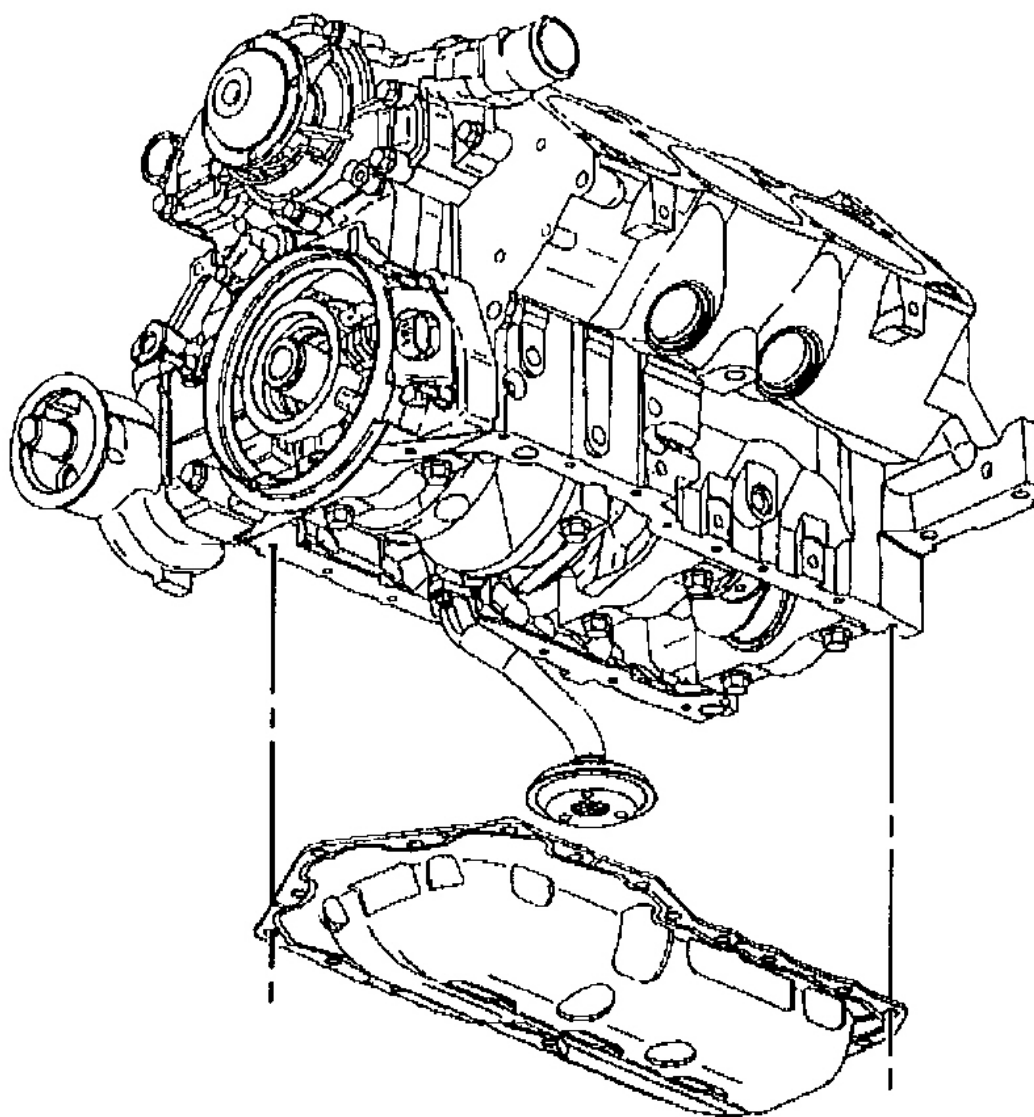
G01728856

Fig. 201: Removing Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

23. Clean the oil pan gasket mating surface.

Installation Procedure

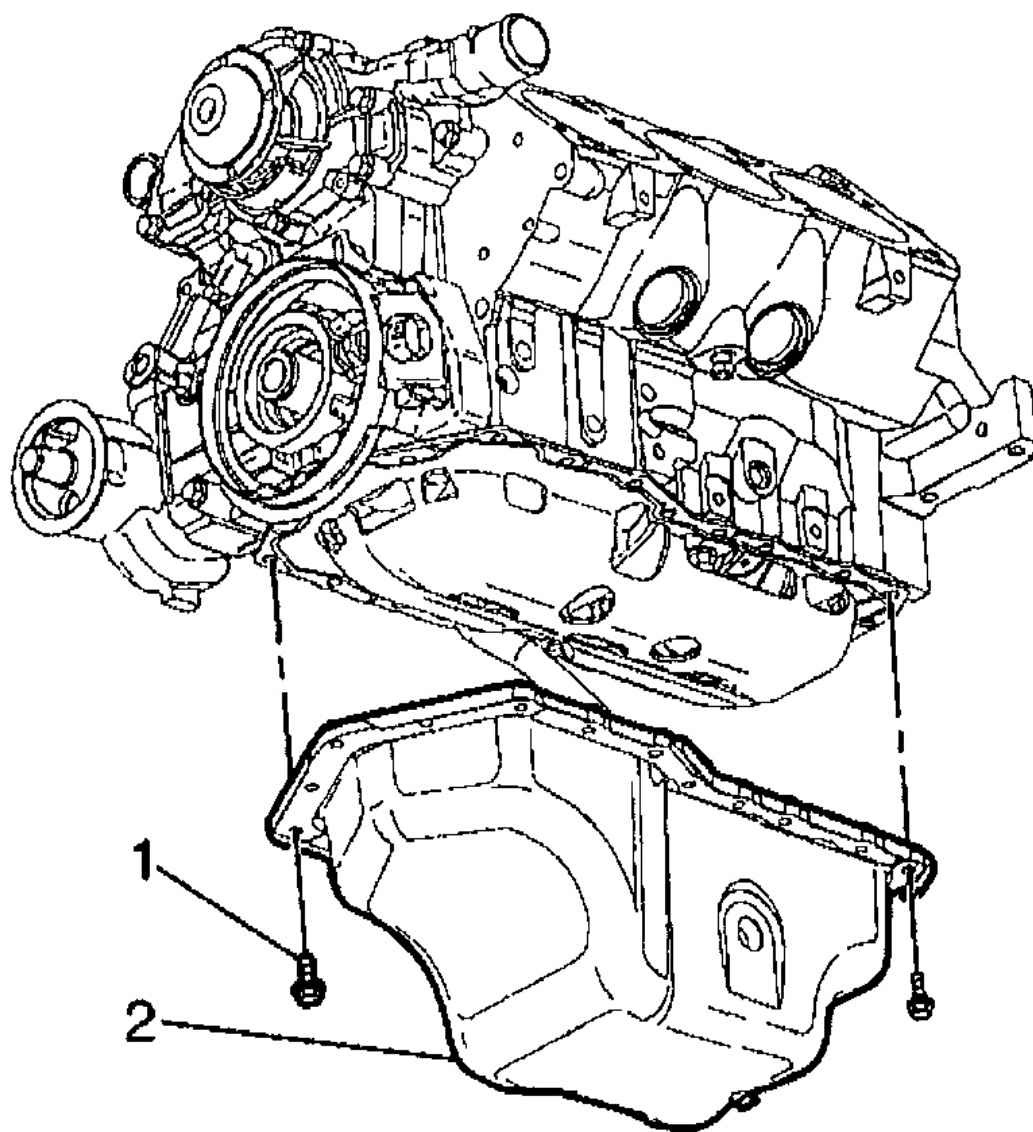
1. Install the oil pan gasket.



G01728857

Fig. 202: Installing Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan (2).
3. Install the oil pan bolts (1).



G01728858

Fig. 203: Installing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

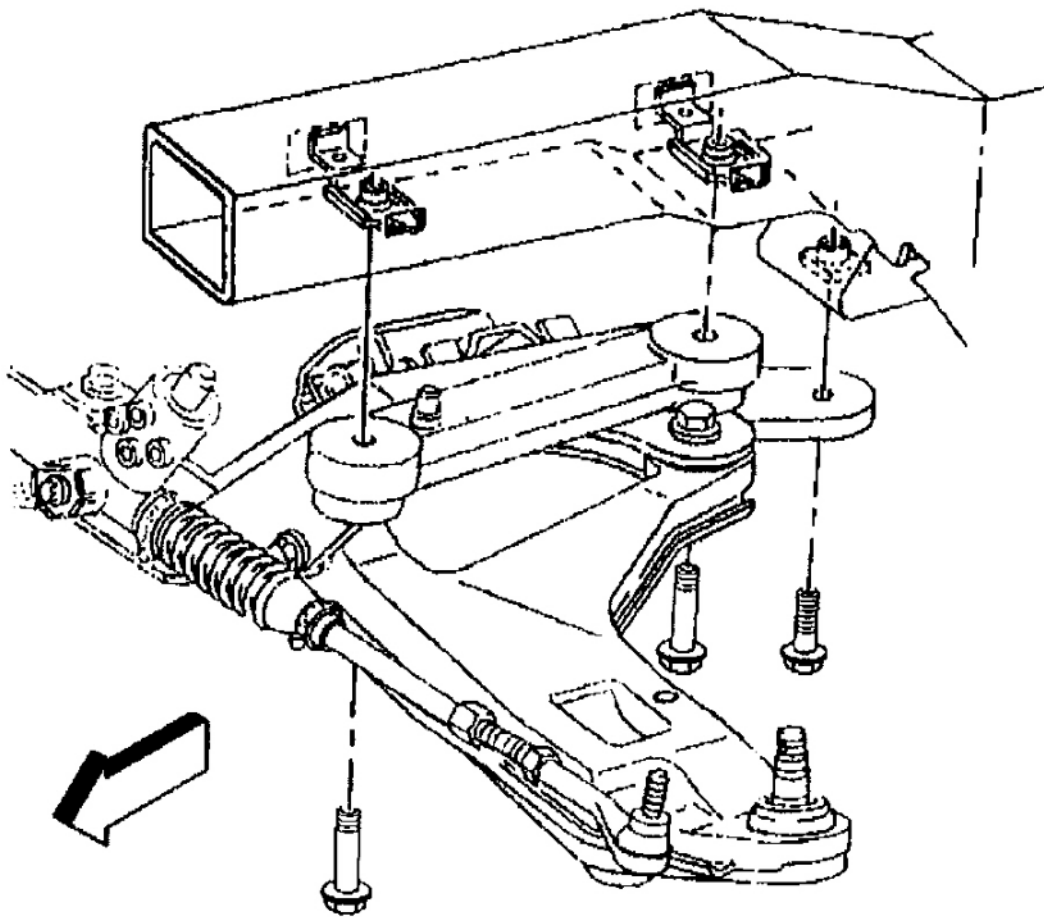
Tighten

Tighten the oil pan bolts to 14 N.m (10 lb ft).

4. Install the right crossmember bolts.

Tighten

- Tighten the 2 upper right crossmember bolts to 125 N.m (92 lb ft).
 - Tighten the lower right crossmember bolt to 145 N.m (107 lb ft).
5. Lower the vehicle.
 6. Lower the engine with the engine support fixture.
 7. Raise the vehicle. **LIFTING AND JACKING THE VEHICLE**
 8. Install the left engine mount through bolt.



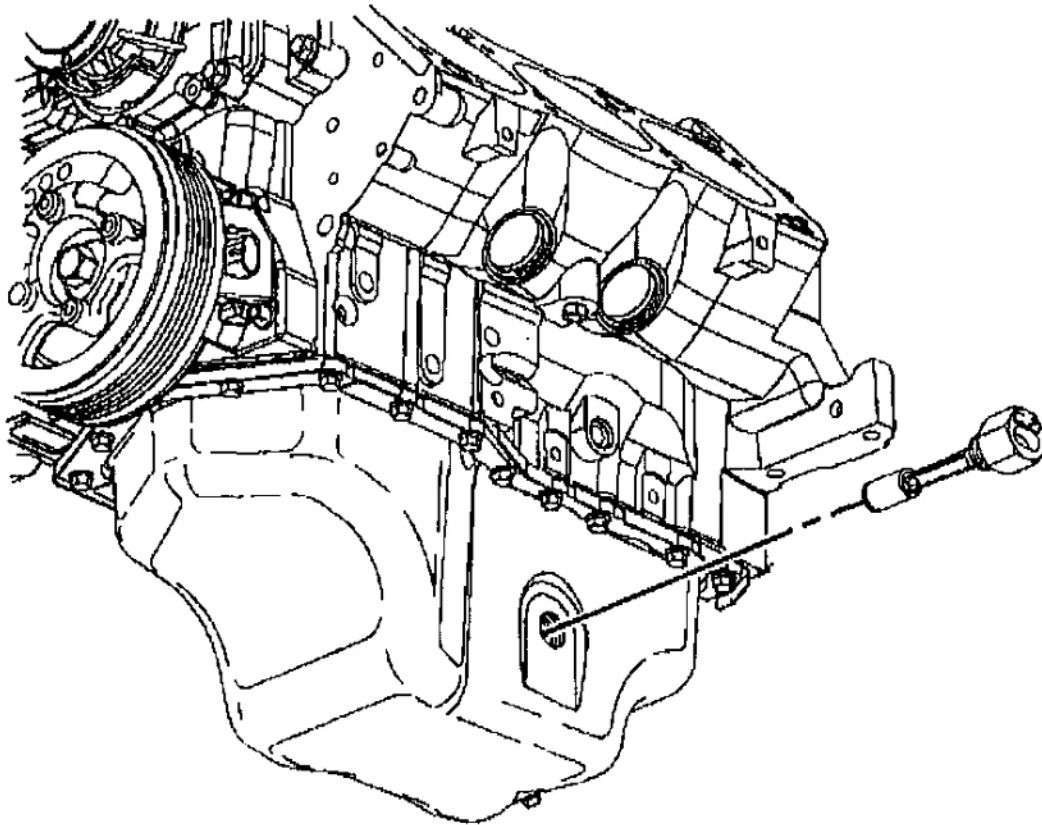
G01728859

Fig. 204: Installing Left Engine Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

9. Install the starter motor. Refer to **STARTER MOTOR (3.8L)** .
10. Install the oil level sensor to the oil pan.

Tighten

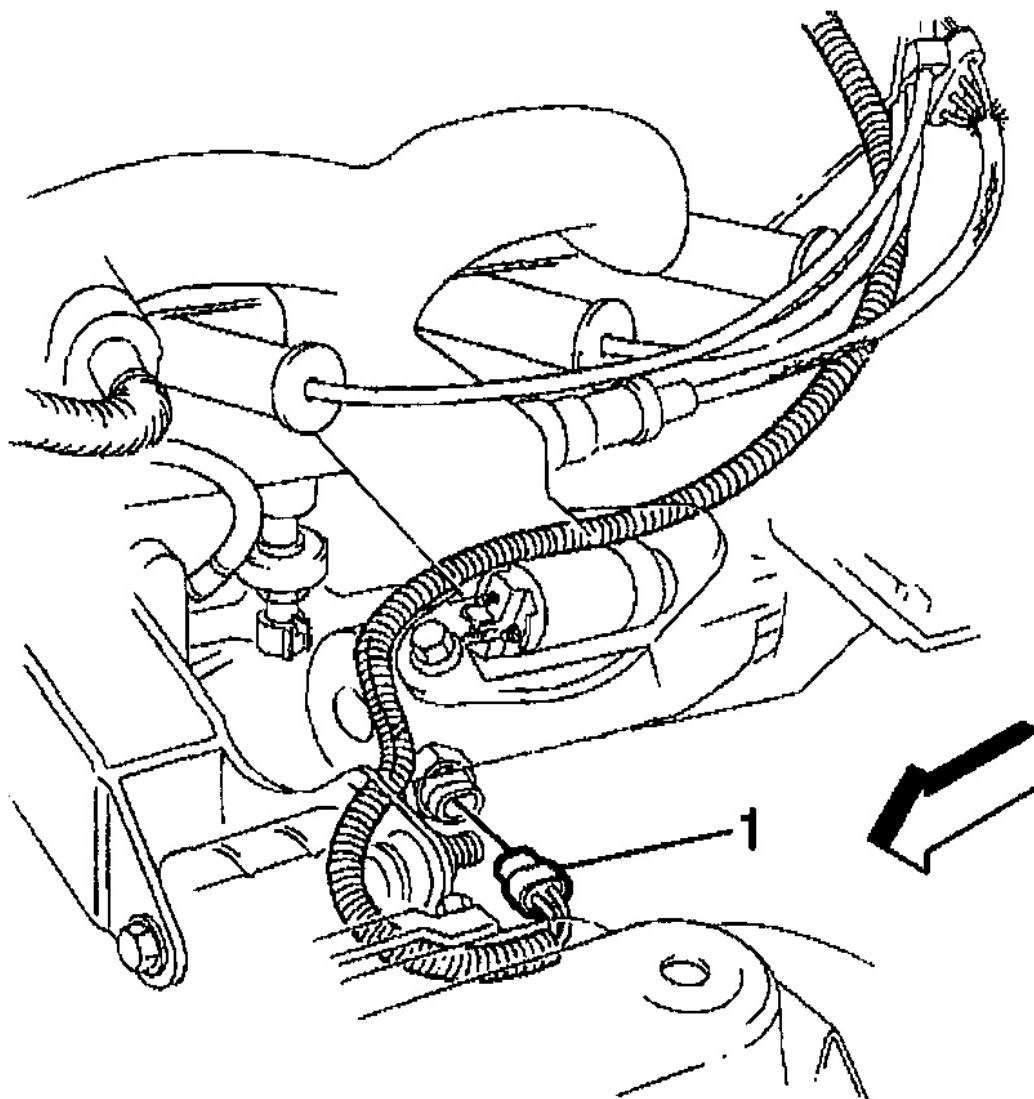
Tighten the oil level sensor to 20 N.m (15 lb ft).



G01728860

Fig. 205: Installing Oil Level Sensor To Oil Pan
Courtesy of GENERAL MOTORS CORP.

11. Connect the oil level sensor electrical connector (1).



G01728861

Fig. 206: Connecting Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Remove the support from the crossmember.
13. Install the intermediate steering shaft from the rack and pinion.

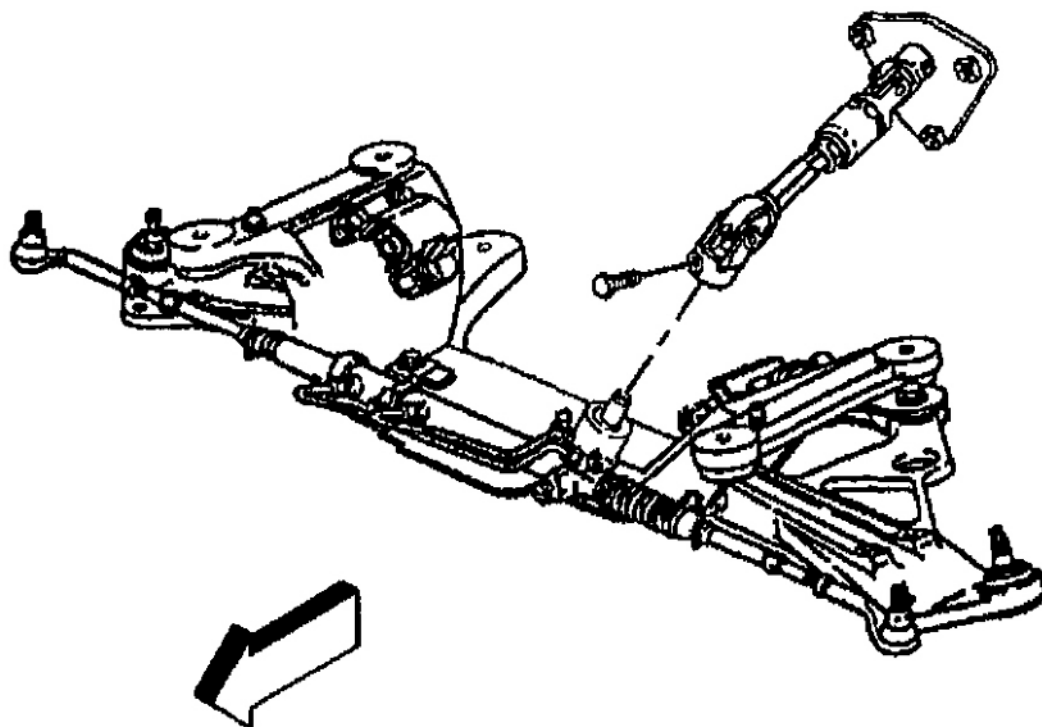
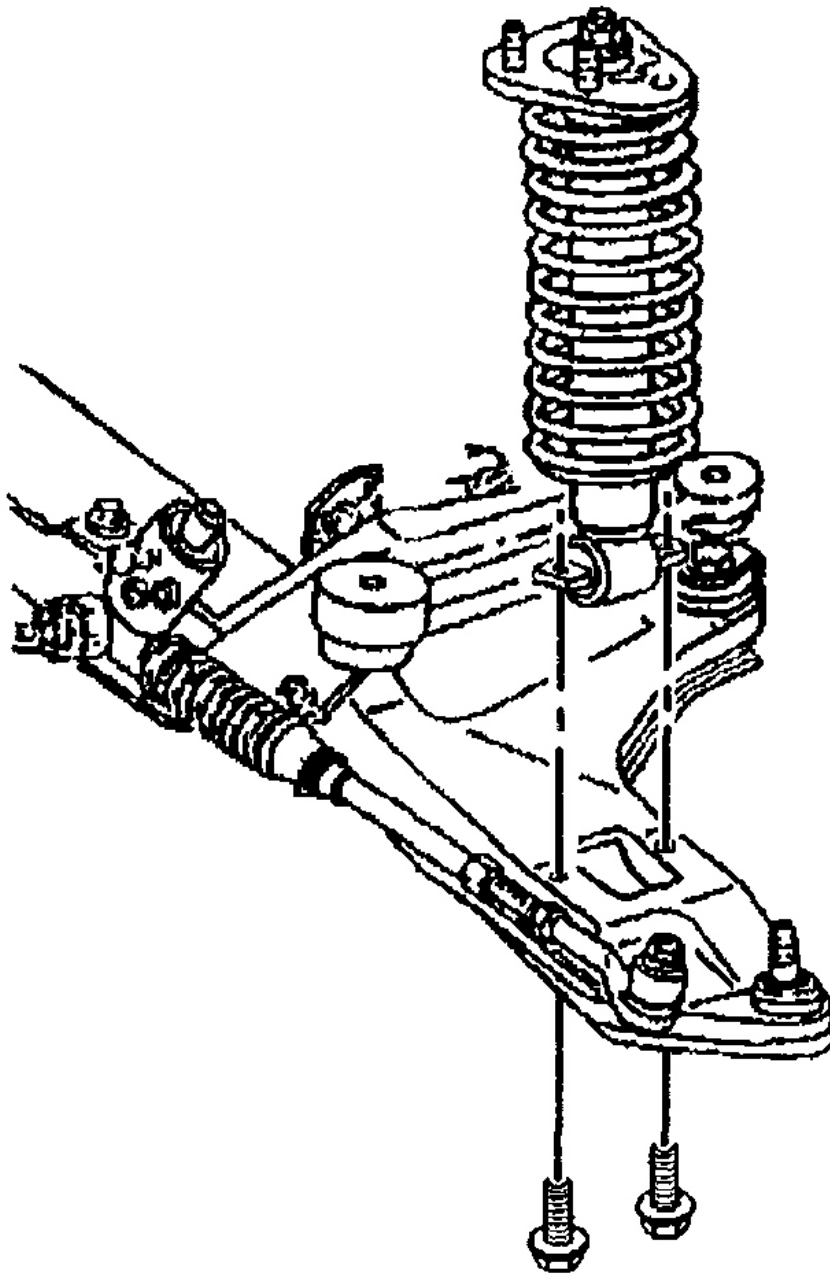
**G01728862**

Fig. 207: Installing Intermediate Steering Shaft From The Rack And Pinion
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the intermediate shaft bolt to 47 N.m (35 lb ft).

14. Install the right side shock absorber lower mounting bolts.



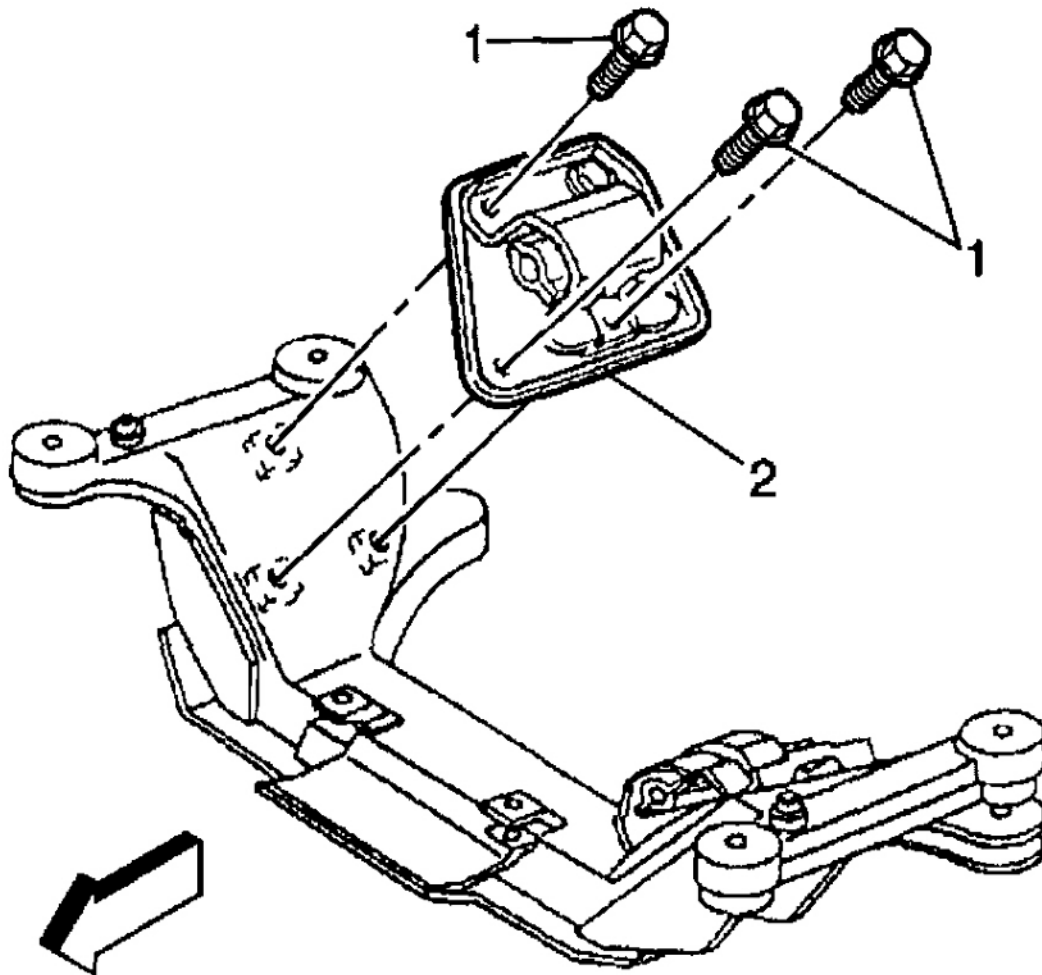
G01728863

Fig. 208: Installing Right Side Shock Absorber Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the shock bolts to 65 N.m (48 lb ft).

15. Install the right side engine mount (2) to cradle bolts (1).



G01728864

Fig. 209: Installing Right Side Engine Mount
Courtesy of GENERAL MOTORS CORP.

Tighten

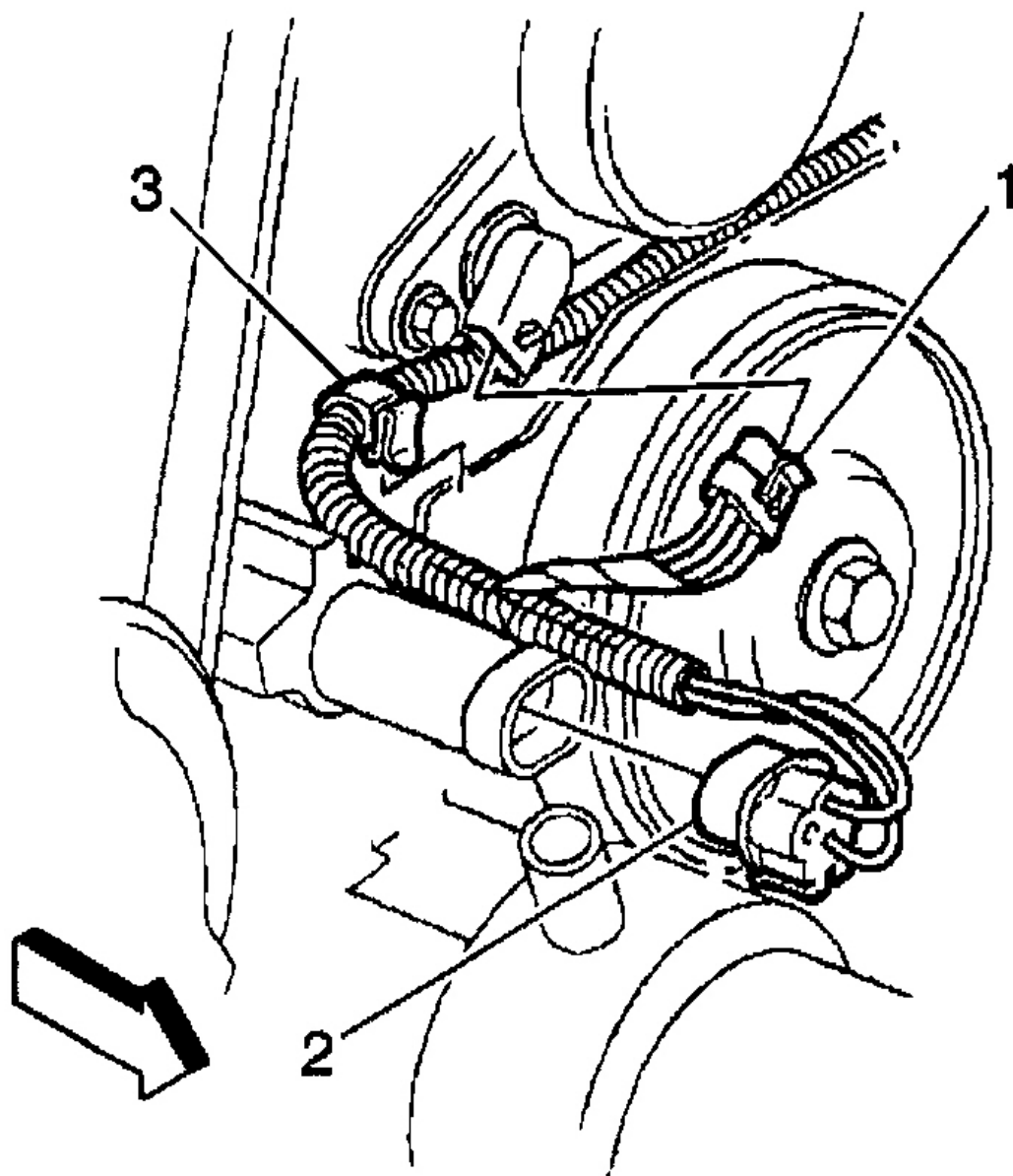
Tighten the right side engine mount to cradle bolts (1) to 58 N.m (43 lb ft).

16. Lower the vehicle.
17. Remove the engine support fixture.

18. Connect the negative battery cable.
19. Change the engine oil and filter. Refer to **Engine Oil and Oil Filter Replacement**.

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT**Removal Procedure**

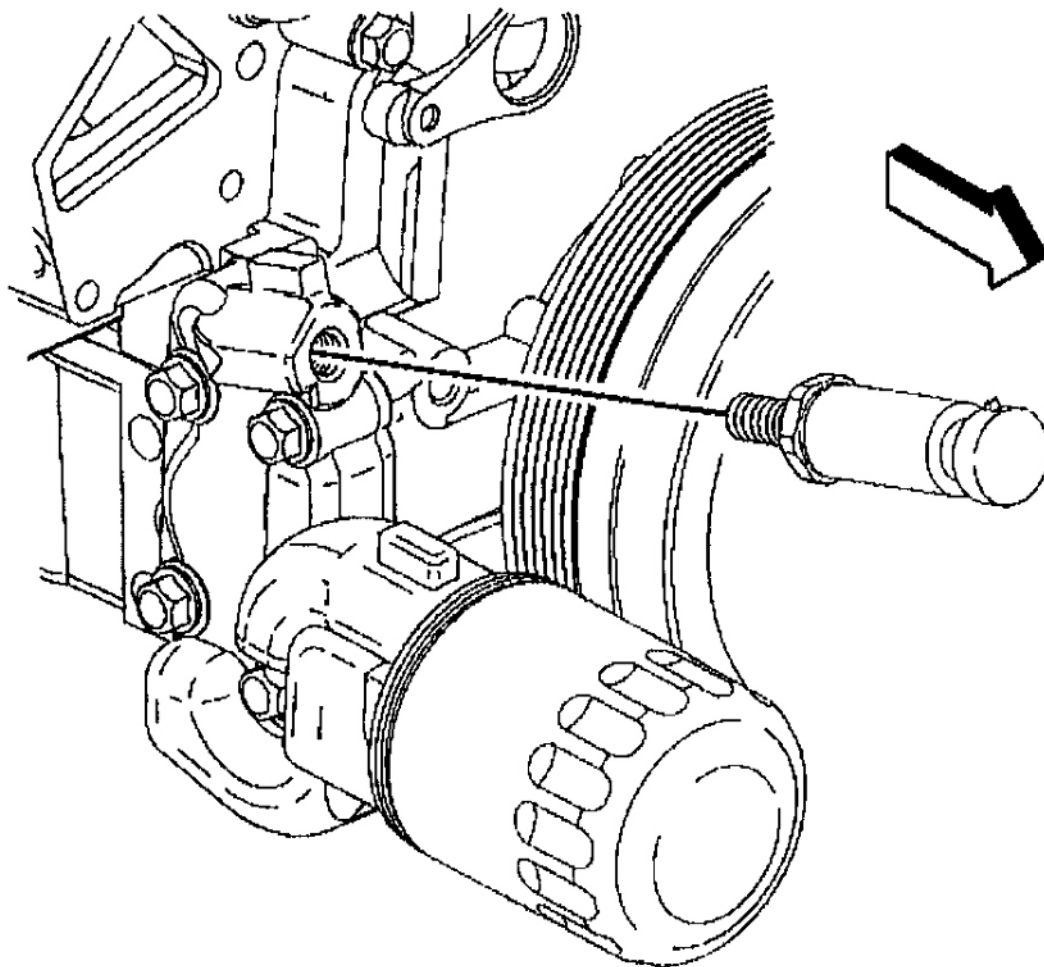
1. Disconnect oil pressure sensor electrical connector (2).



G01728865

Fig. 210: Disconnecting Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil pressure sensor.

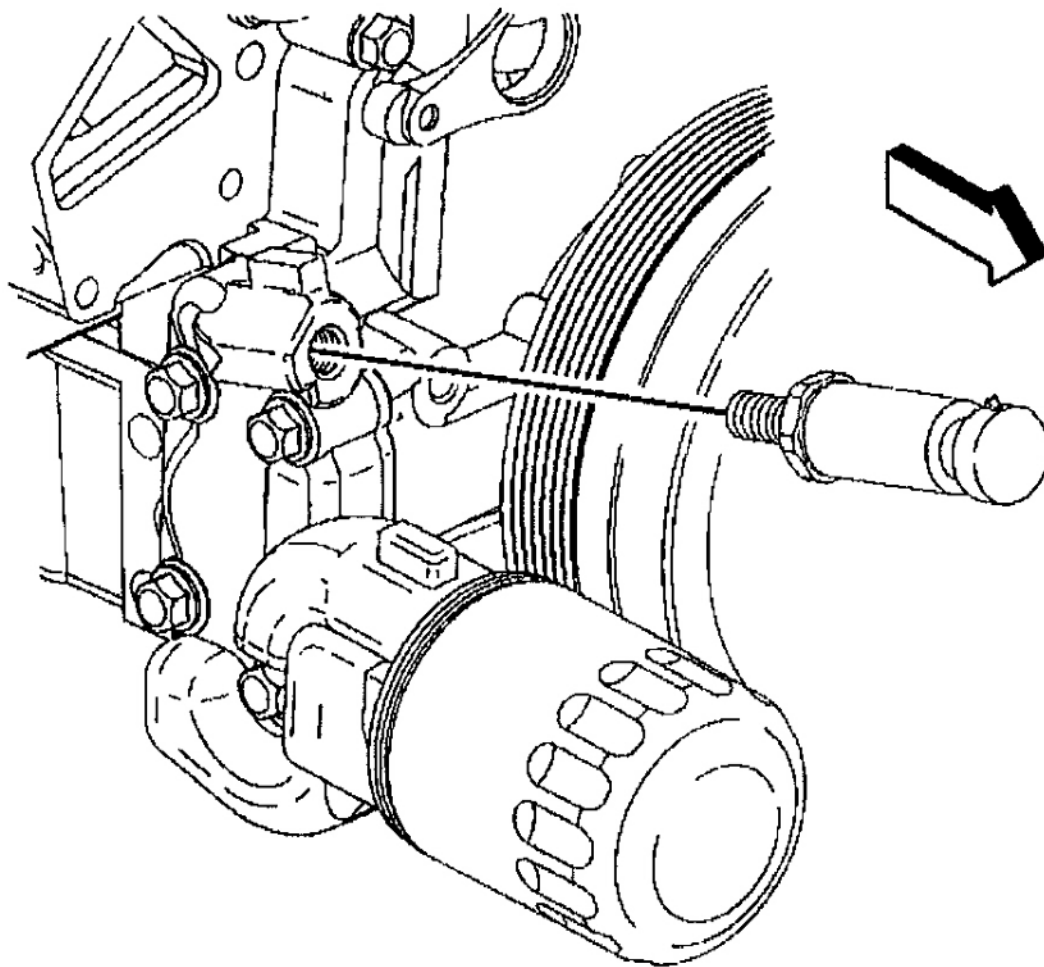


G01728866

Fig. 211: Removing Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the oil pressure sensor.



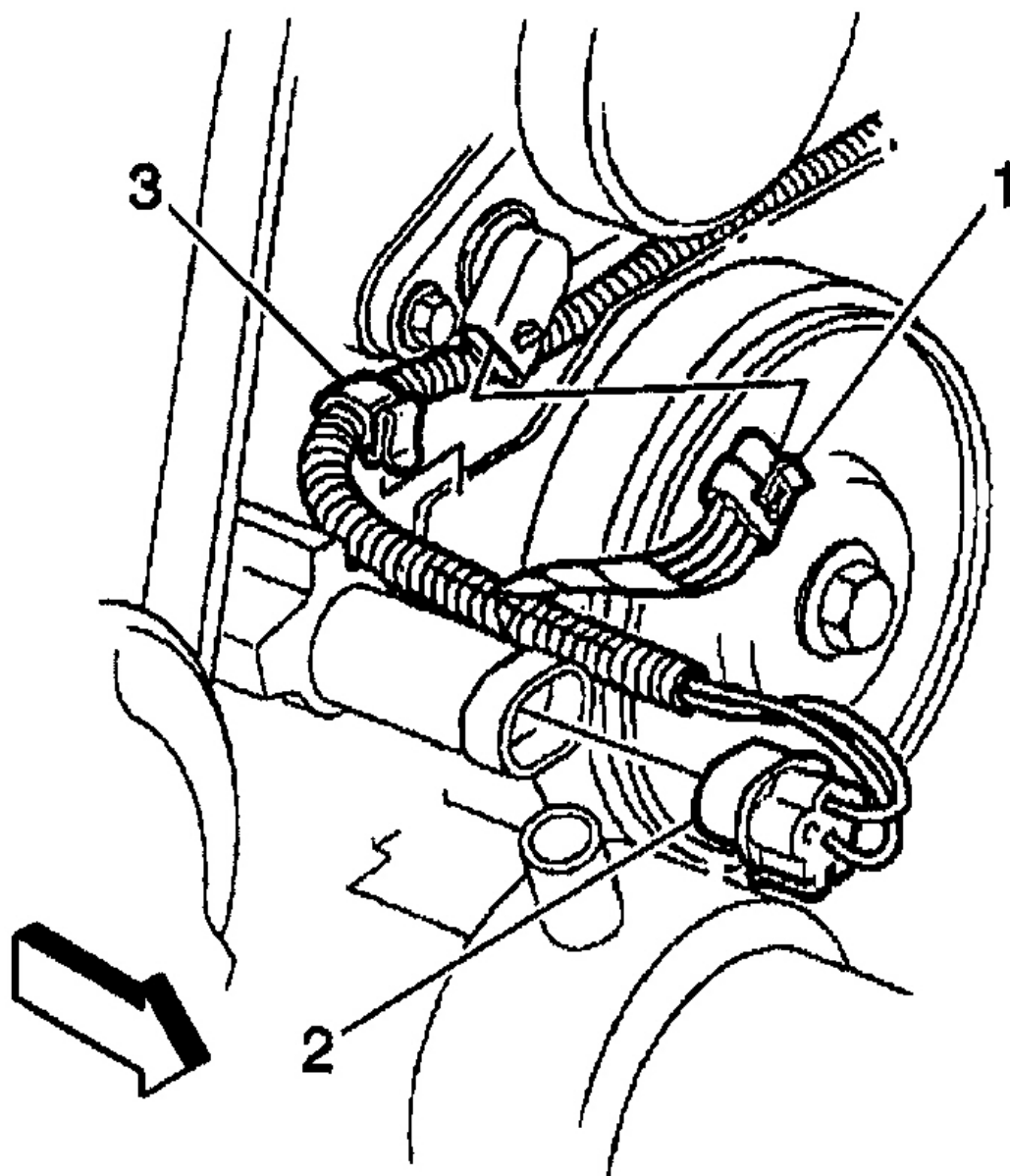
G01728867

Fig. 212: Installing Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the oil pressure sensor to 16 N.m (12 lb ft).

2. Connect oil pressure sensor electrical connector (2).



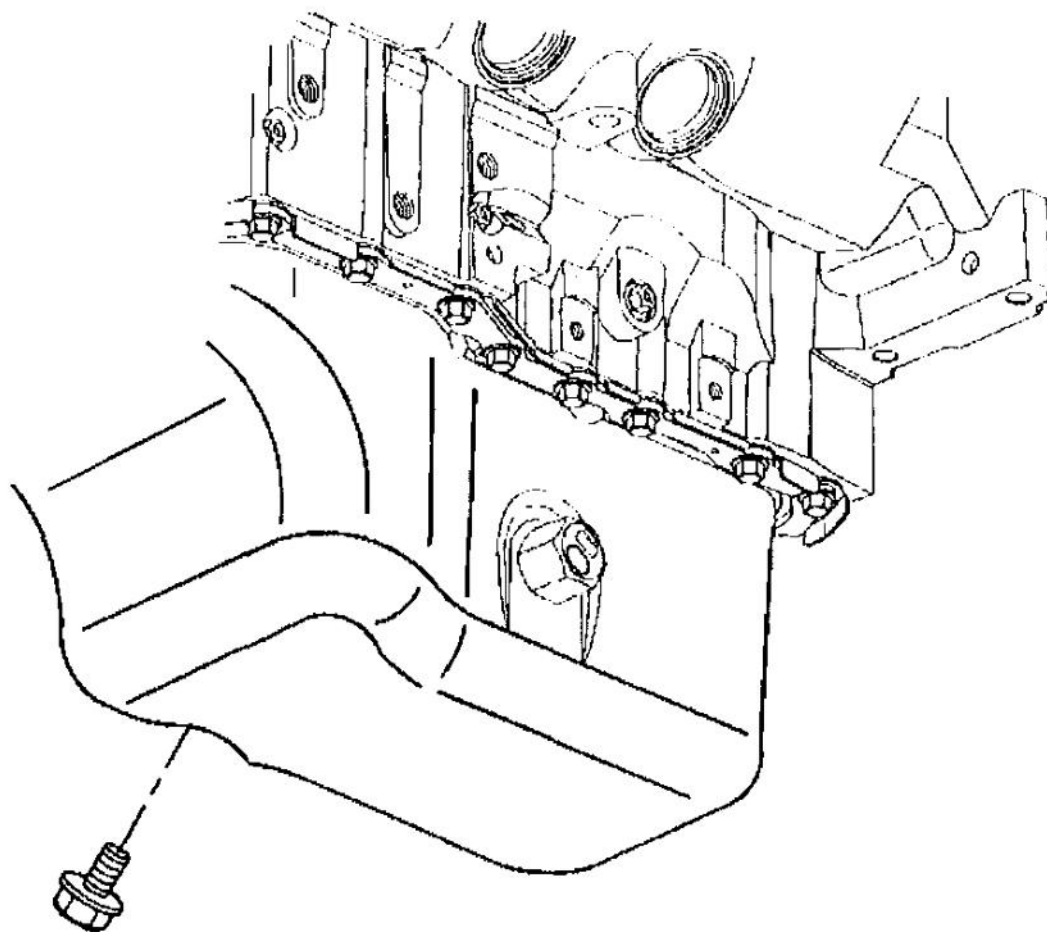
G01728868

Fig. 213: Connecting Oil Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

Removal Procedure

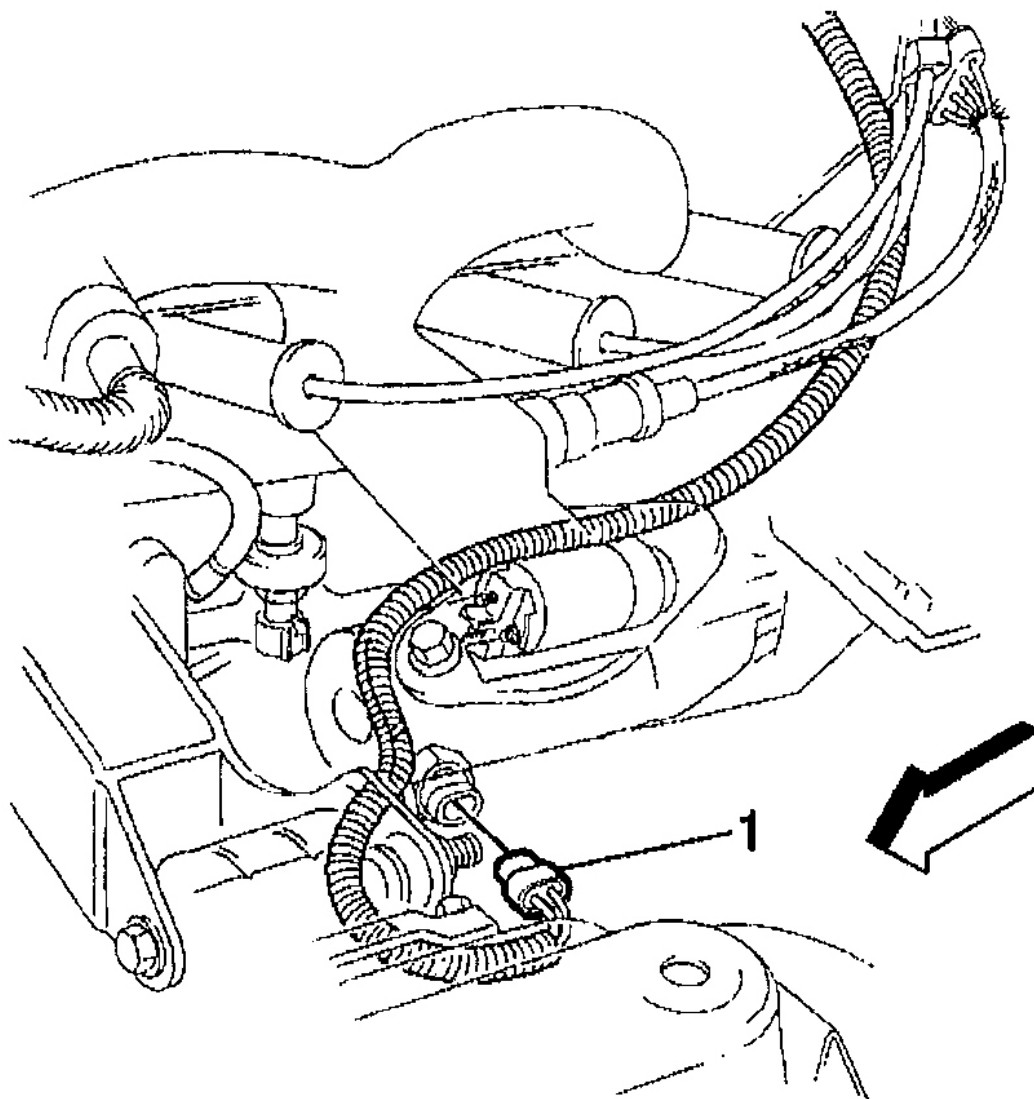
1. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
2. Remove the engine oil drain plug in order to drain the engine oil.



G01728869

Fig. 214: Removing Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

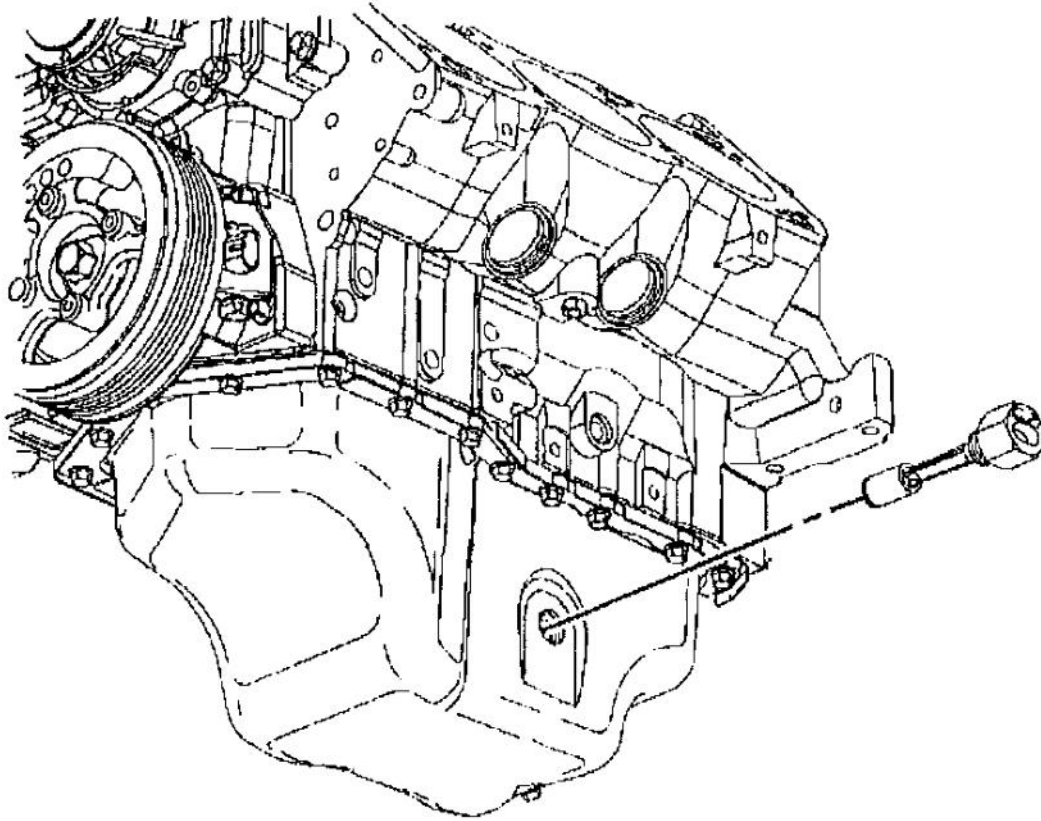
3. Disconnect the oil level sensor electrical connector (1).



G01728870

Fig. 215: Disconnecting Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil level sensor from the oil pan.

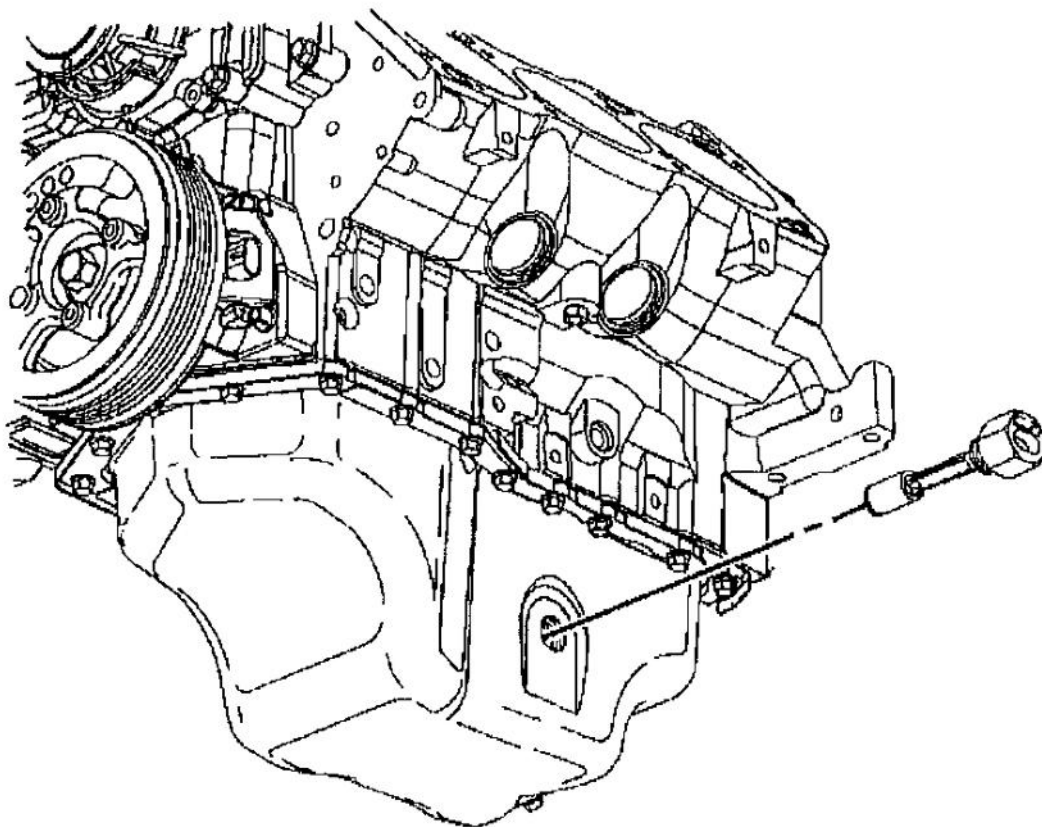


G01728871

Fig. 216: Removing Oil Level Sensor
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the oil level sensor from the oil pan.



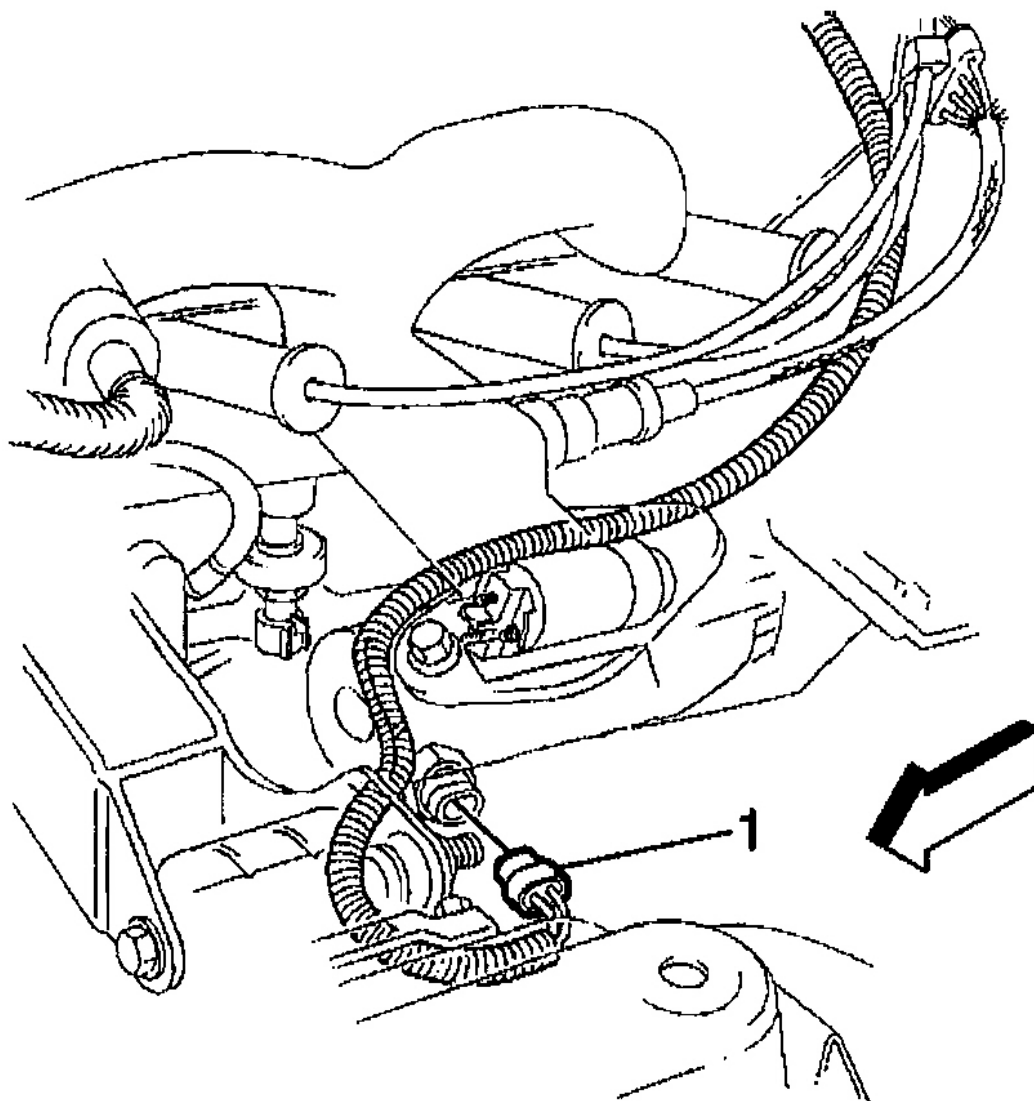
G01728872

Fig. 217: Installing Oil Level Sensor From Oil Pan
Courtesy of GENERAL MOTORS CORP.

Tighten

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

2. Connect the oil level sensor electrical connector (1).



G01728873

Fig. 218: Connecting Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Install the engine oil drain plug.

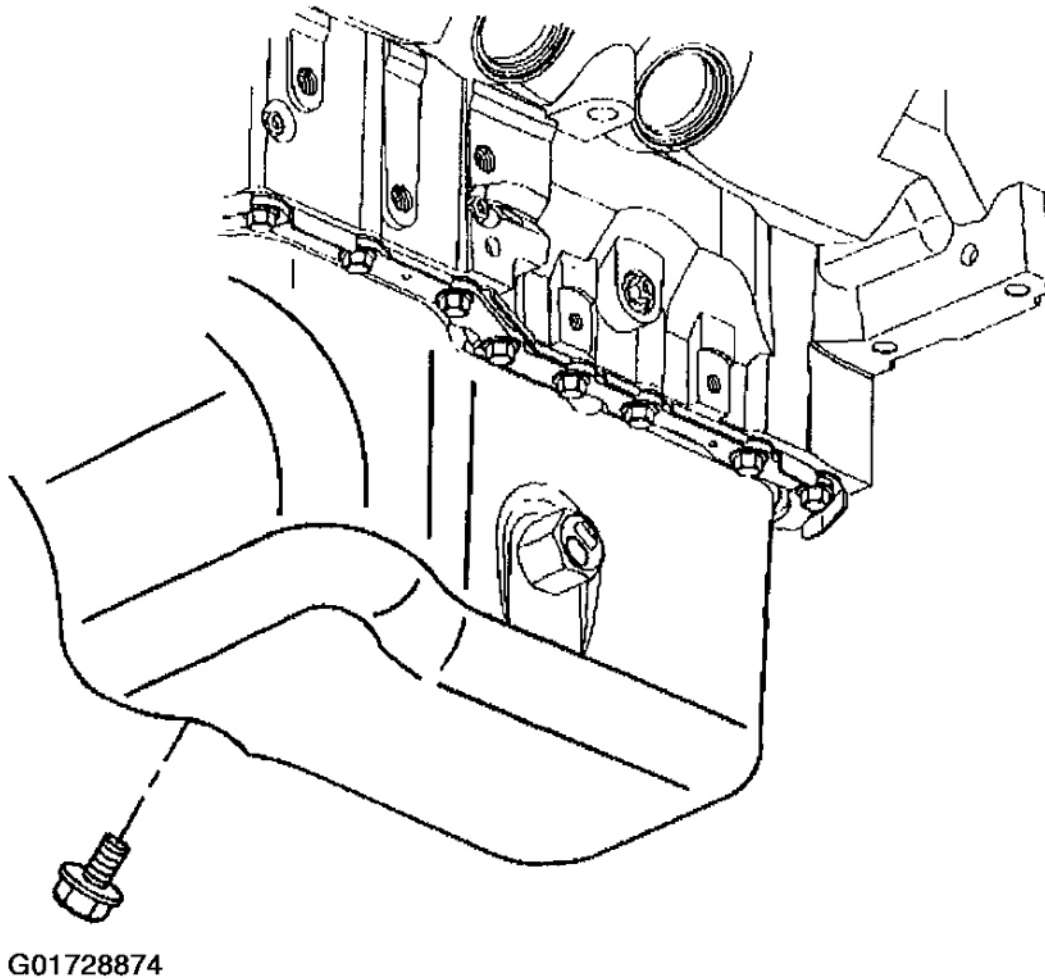


Fig. 219: Installing Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine oil drain plug to 30 N.m (22 lb ft).

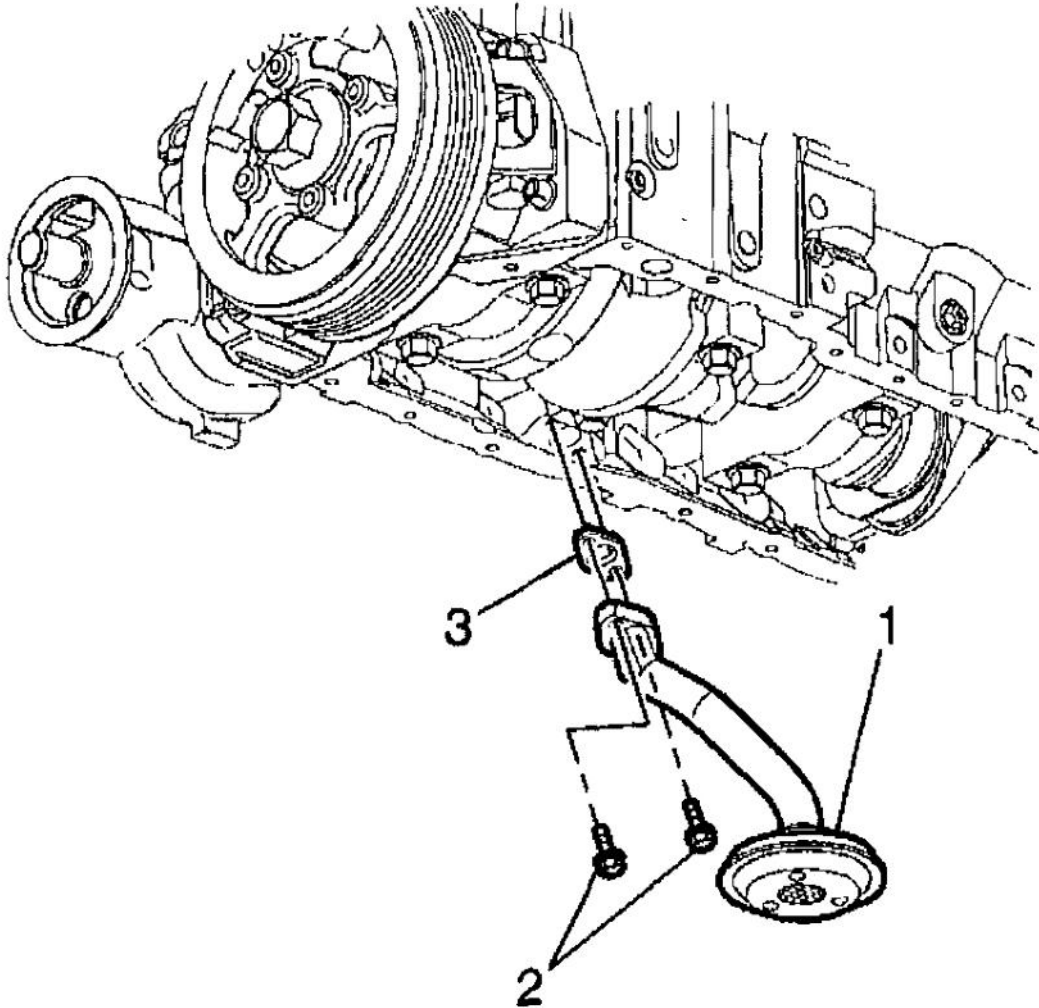
4. Refill the engine with oil.
5. Lower the vehicle.

OIL PUMP PIPE AND SCREEN ASSEMBLY REPLACEMENT

Removal Procedure

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

2. Remove the oil pump screen attaching bolts (2).



G01728875

Fig. 220: Removing Oil Pump Screen Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pump screen (1).
4. Remove the oil pump screen gasket (3).
5. Clean the screen and housing with solvent and blow dry with compressed air.
6. Clean the gasket mating surfaces on the pipe flange and cylinder block.

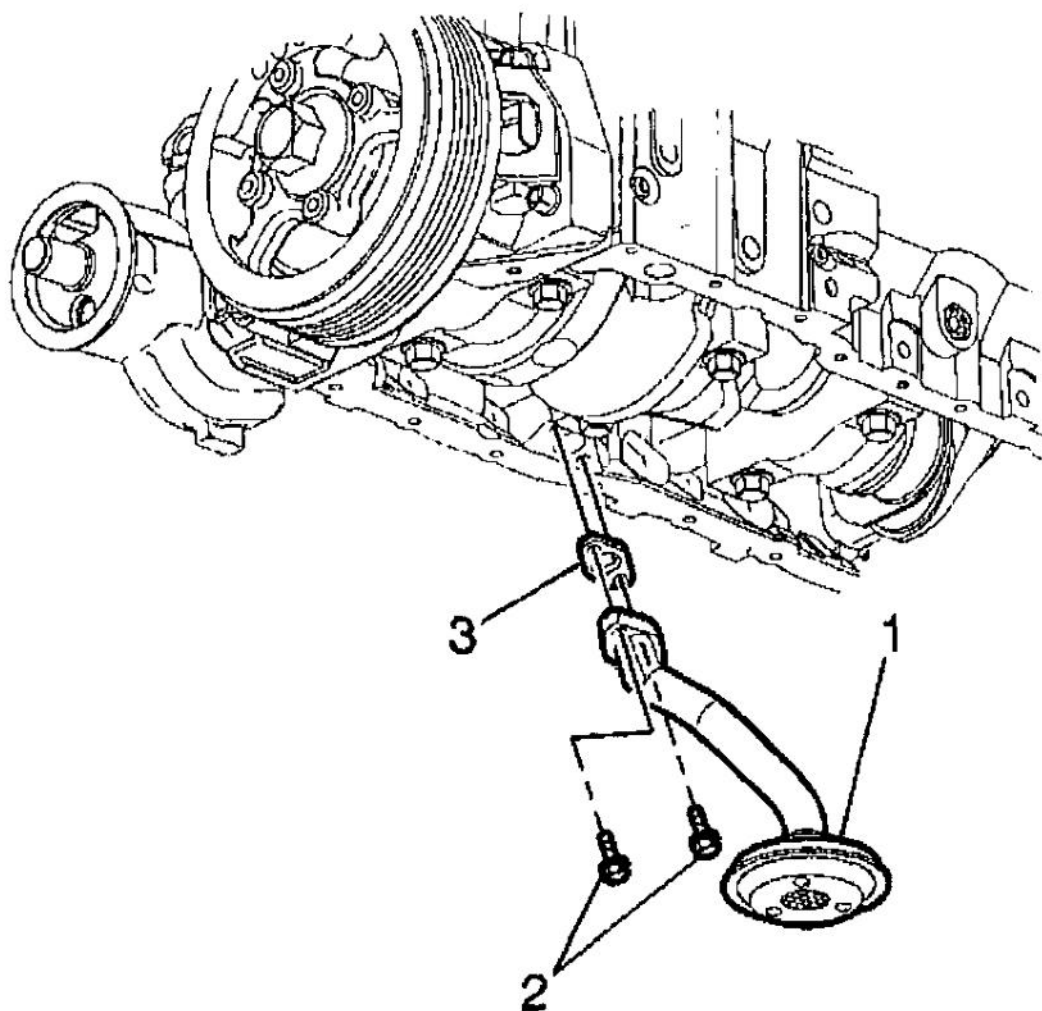
Installation Procedure

1. Install the oil pump screen gasket (3).
2. Install the oil pump screen (1).
3. Install the oil pump screen bolts (2).

Tighten

Tighten the oil pump screen bolts (2) to 15 N.m (11 lb ft).

4. Install the oil pan. Refer to Oil Pan Replacement.



G01728876

Fig. 221: Installing Oil Pump
Courtesy of GENERAL MOTORS CORP.

ENGINE FLYWHEEL REPLACEMENT

Tools Required

- **J 37096** Flywheel Holding Tool
- **J 36660-A** Torque Angle Meter

Removal Procedure

1. Remove the clutch, if equipped with a manual transmission. Refer to **CLUTCH ASSEMBLY** .
2. Remove the automatic transmission, if equipped. Refer to **REMOVAL & INSTALLATION** and/or **SERVICING - M/T** .
3. Use the J 37096 to hold the flywheel to loosen the flywheel bolts.

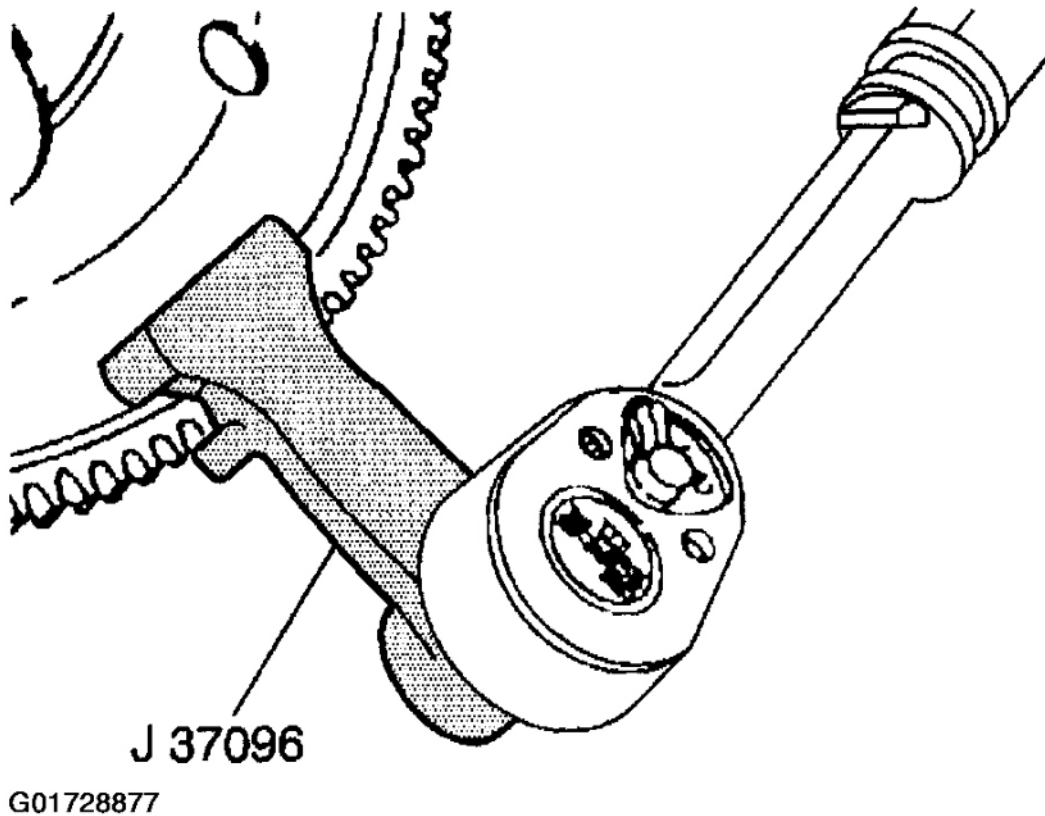
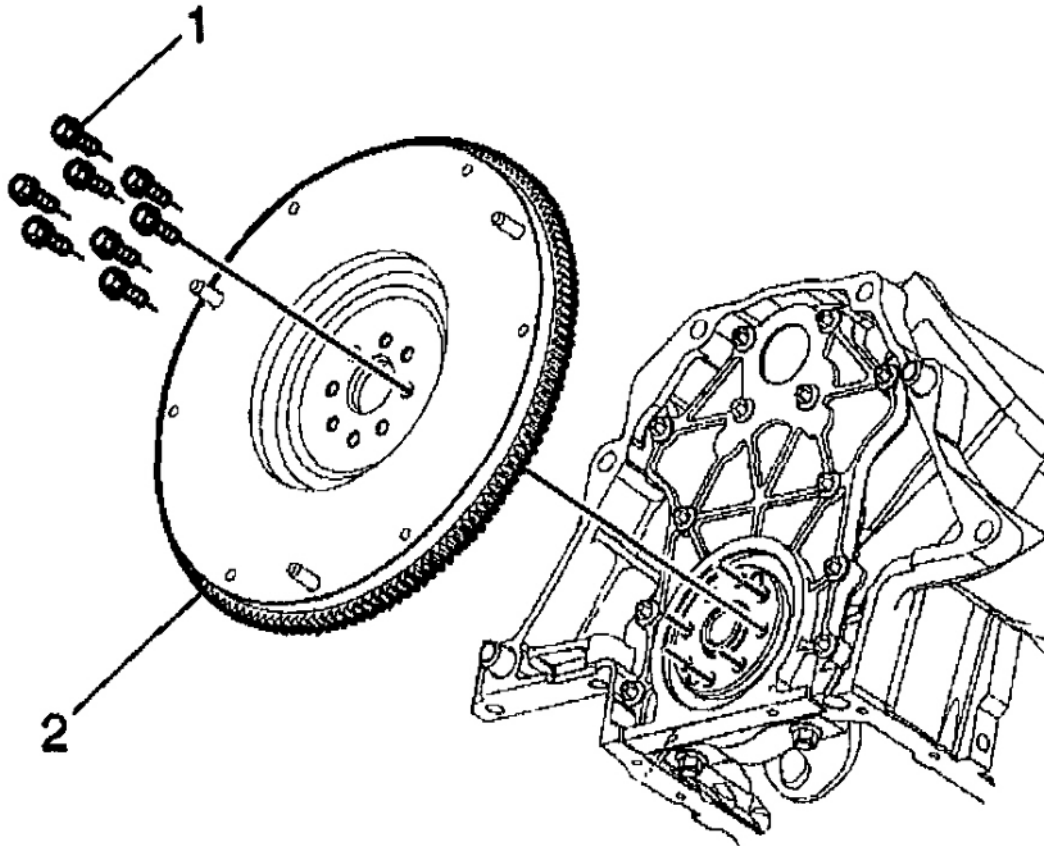


Fig. 222: Using J 37096
Courtesy of GENERAL MOTORS CORP.

4. If equipped with the manual transmission, remove the following components:
 - 4.1. Remove the flywheel bolts (1).

4.2. Remove the flywheel (2).



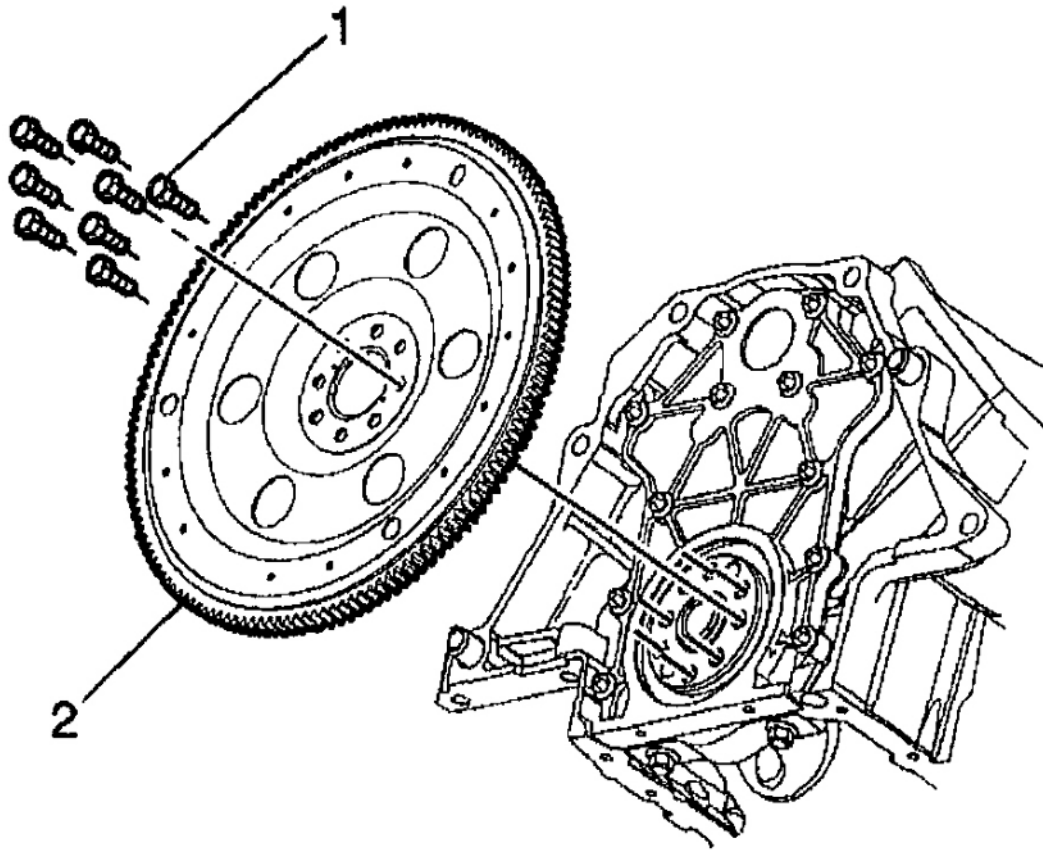
G01728878

Fig. 223: Removing/Installing Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

5. If equipped with the automatic transmission, remove the following components:
 - 5.1. Remove the flywheel bolts (1).
 - 5.2. Remove the flywheel (2).

Installation Procedure

1. If equipped with the automatic transmission, install the following components:
 - 1.1. Install the flywheel (2).
 - 1.2. Install the flywheel bolts (1) finger tight.



G01728880

Fig. 224: Installing Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

2. If equipped with the manual transmission, install the following components:
 - 2.1. Install the flywheel (2).
 - 2.2. Install the flywheel bolts (1) finger tight.
3. Using J 37096, hold the flywheel when tightening the flywheel bolts.
4. Tighten the flywheel bolts.

Tighten

Tighten the flywheel bolts to 15 N.m (11 lb ft). Using the J 36660-A to torque the flywheel bolts an additional 50 degrees.

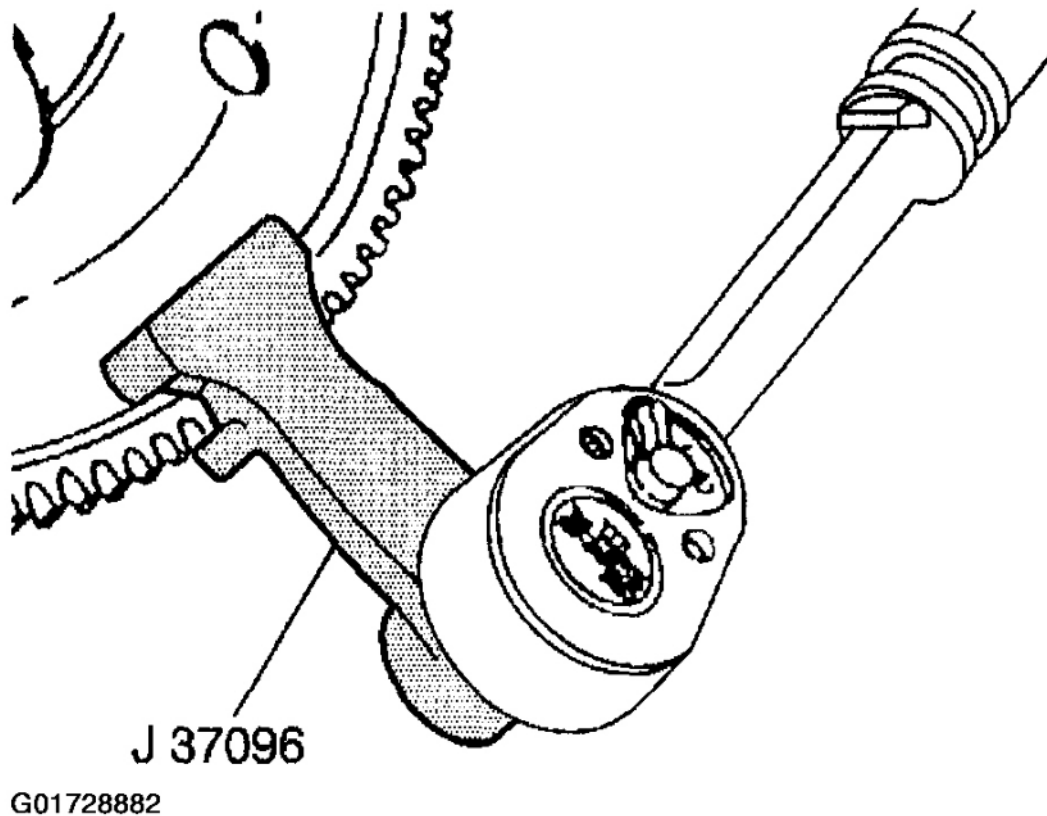


Fig. 225: Using the J 36660-A
Courtesy of GENERAL MOTORS CORP.

5. Install the automatic transmission, if equipped. Refer to **REMOVAL & INSTALLATION - A/T** .
6. Install the clutch, if equipped with a manual transmission. Refer to **CLUTCH ASSEMBLY** .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Tools Required

J 38196 Crankshaft Rear Oil Seal Installer

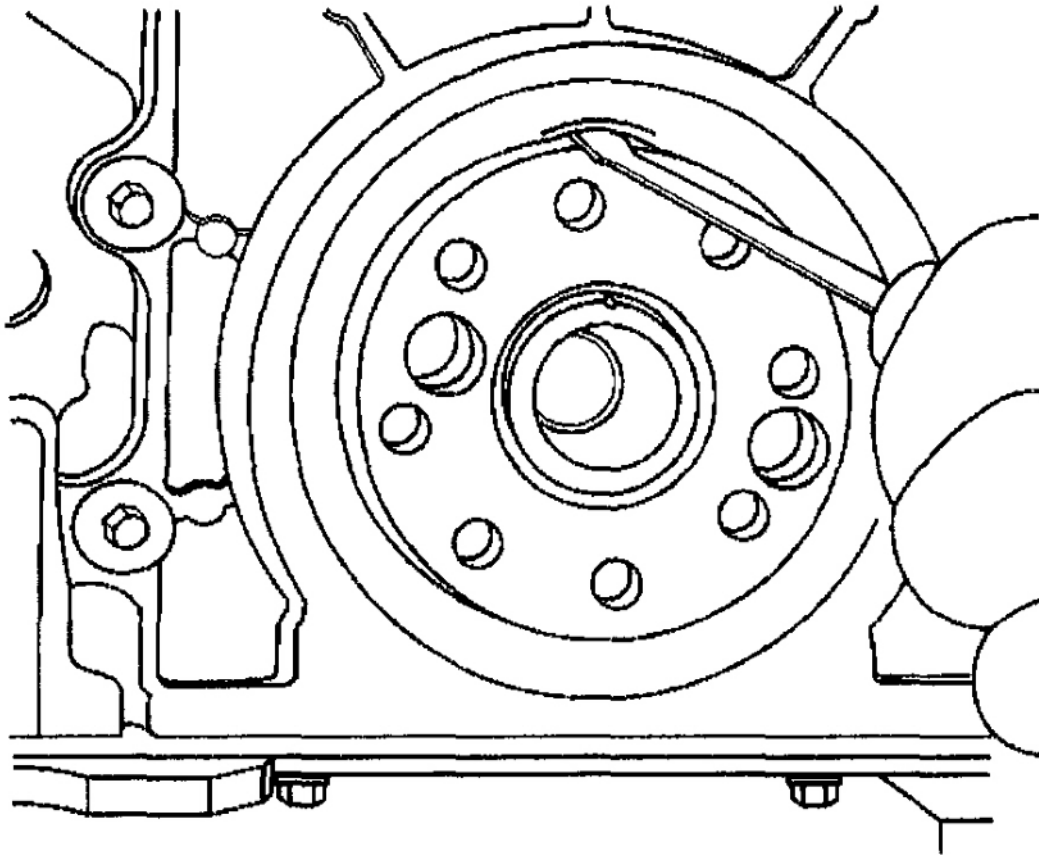
Removal Procedure

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.

Important: Make sure not to damage the crankshaft outside diameter surface or the inside diameter of the crankshaft rear oil seal housing.

2. Remove the crankshaft rear oil seal. Insert a flat-bladed tool through the dust lip at an angle. Pry out the

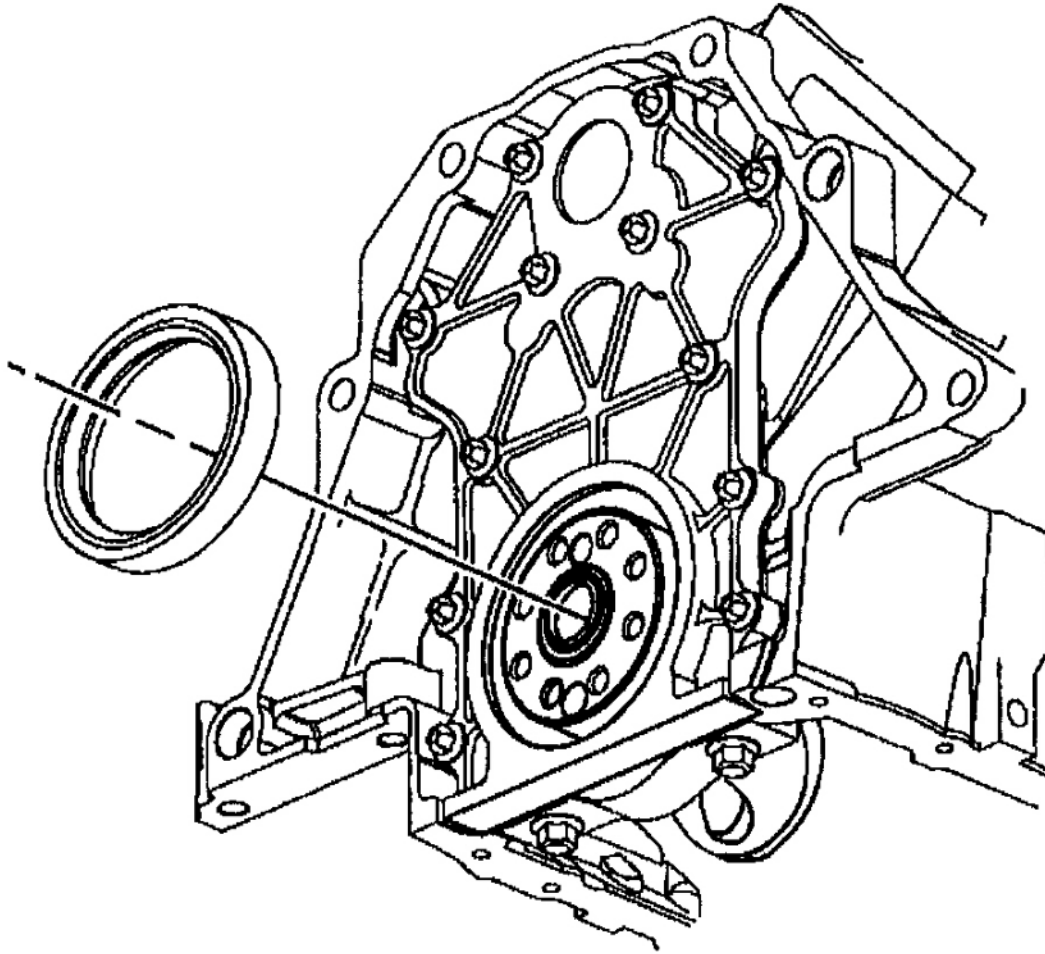
crankshaft rear oil seal by moving the handle of the tool towards the end of the crankshaft. Repeat as necessary around the crankshaft rear oil seal.



G01728883

Fig. 226: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Inspect the inside diameter of the bore. Repair or replace the crankshaft rear oil seal housing if necessary.



G01728884

Fig. 227: Inspecting Inside Diameter Of The Bore
Courtesy of GENERAL MOTORS CORP.

4. Inspect the crankshaft for nicks or burrs on the surface that contacts the crankshaft rear oil seal.
5. Repair or replace the crankshaft if necessary.

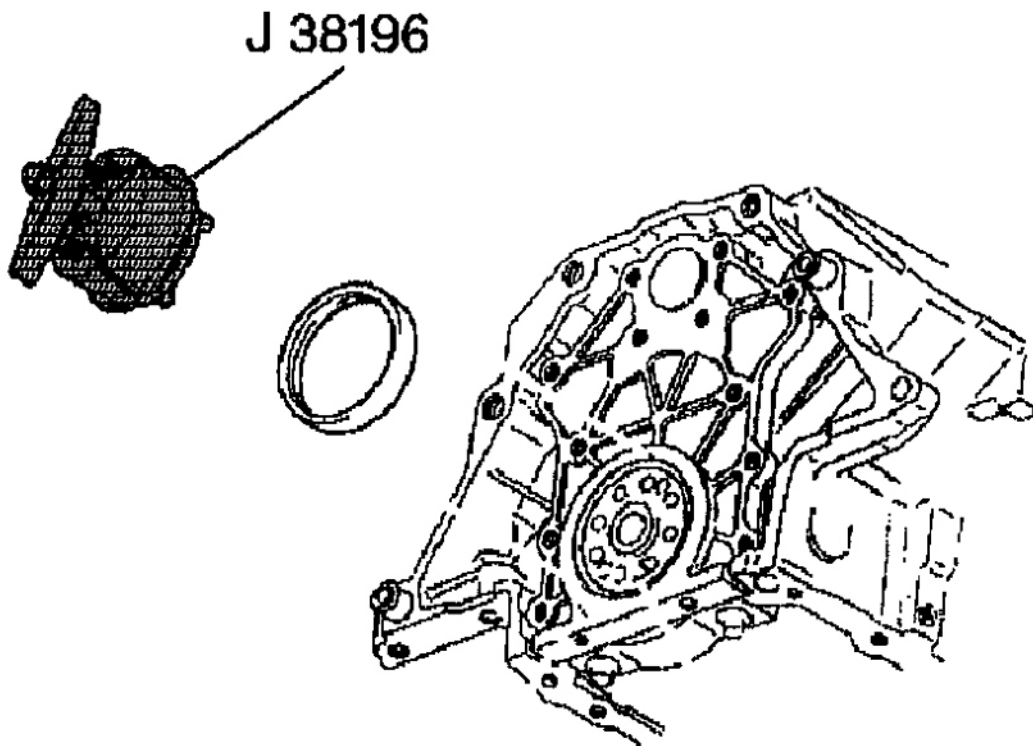
Installation Procedure

1. Apply engine oil to the inside diameter of the new crankshaft rear oil seal. Slide the new crankshaft rear oil seal over the mandrel until the back of the crankshaft rear oil seal bottoms squarely against the collar of the J 38196.
2. Install the crankshaft rear oil seal using the following steps:
 - Attach the J 38196 to the crankshaft by hand, or tighten the attaching screws.

Tighten

Tighten the screws to 5 N.m (54 lb in).

- Turn the T-handle of the J 38196 so that the collar pushes the seal into the bore. Turn the handle until the collar is tight against the case. This will ensure that the crankshaft rear oil seal is seated properly between the crankshaft and the crankshaft rear oil seal housing.
- Remove the attaching screws.



G01728885

Fig. 228: Installing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the engine flywheel. Refer to Engine Flywheel Replacement.
4. Inspect for leaks.

CRANKSHAFT REAR OIL SEAL AND HOUSING REPLACEMENT

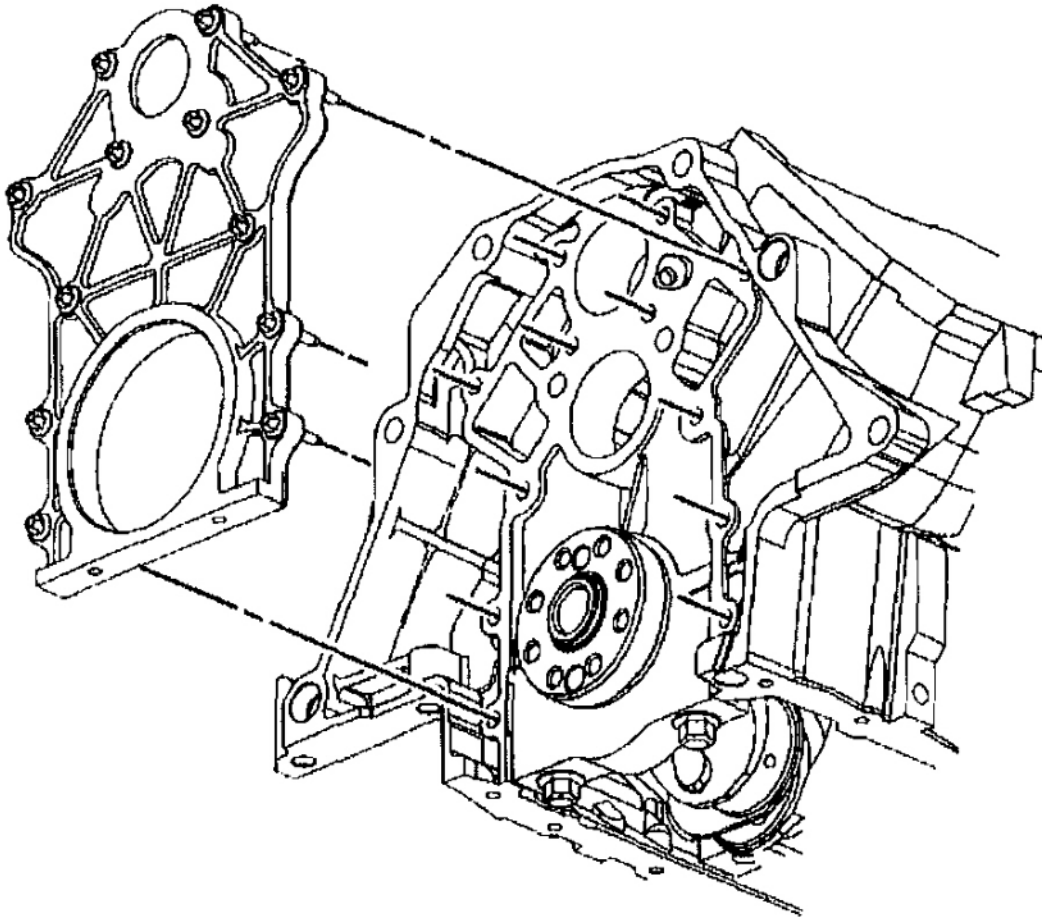
Tools Required

- J 36660-A Torque Angle Meter

- **J 41349** Crankshaft Rear Oil Seal Housing Aligning Tool

Removal Procedure

1. Drain the engine coolant from the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** in Engine Cooling.
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Remove the crankshaft rear oil seal. Refer to **Crankshaft Rear Oil Seal Replacement**.
4. Loosen all of the oil pan bolts.
5. Remove the crankshaft rear oil seal housing bolts.
6. Remove the crankshaft rear oil seal housing.



G01728886

Fig. 229: Removing Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear oil seal housing gasket.
8. Clean the gasket surfaces of the oil seal housing and the engine block.
9. Inspect the inside diameter of the oil seal housing bore. Replace the crankshaft rear oil seal housing as required.
10. Inspect the crankshaft for nicks or burrs on the surface that contacts the seal.
11. Repair or replace the crankshaft if necessary.

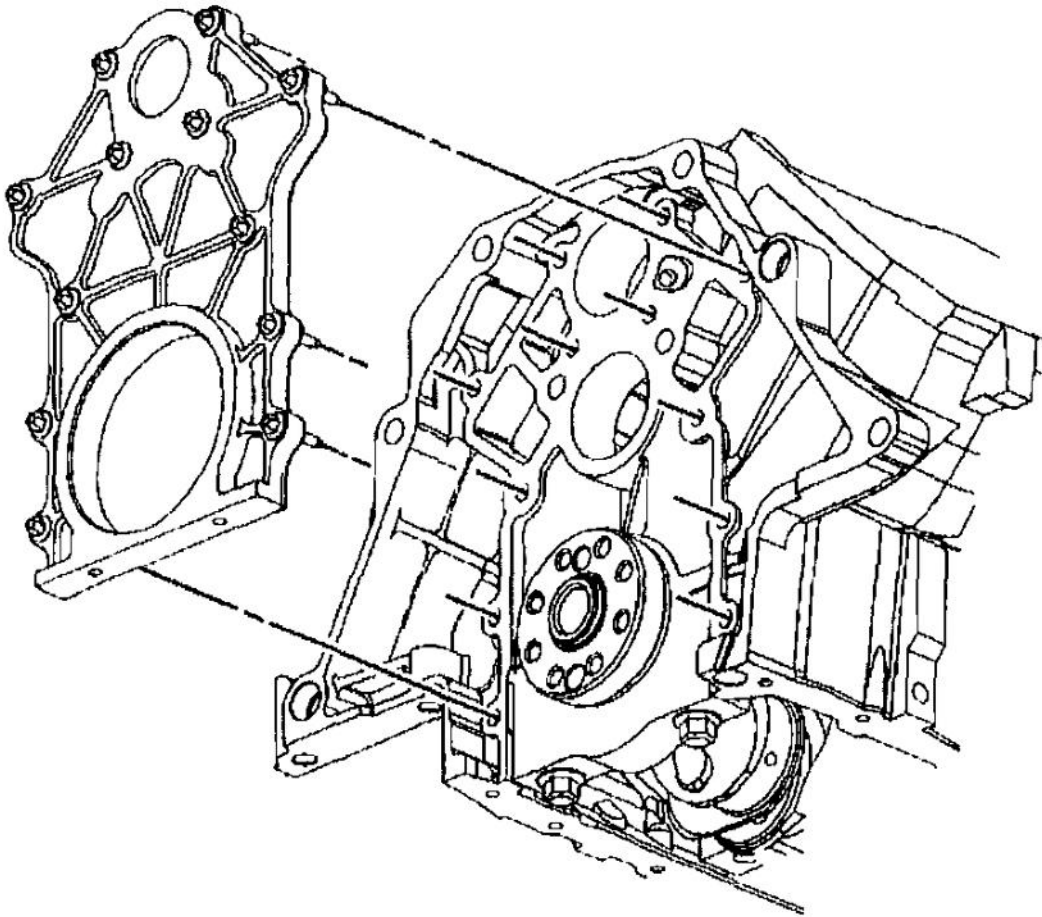
Installation Procedure

NOTE: Do not use a sealant or adhesive when installing this component. Use of a sealant or adhesive can cause improper sealing. A component that is not sealed properly can leak leading to extensive engine damage.

1. Install the crankshaft rear oil seal housing gasket over the bolts for alignment.

Important: The plastic inserts in the crankshaft rear oil seal housing are used to aid assembly only. The inserts are not required for service.

2. Finger tighten the crankshaft rear oil seal housing bolts.



G01728887

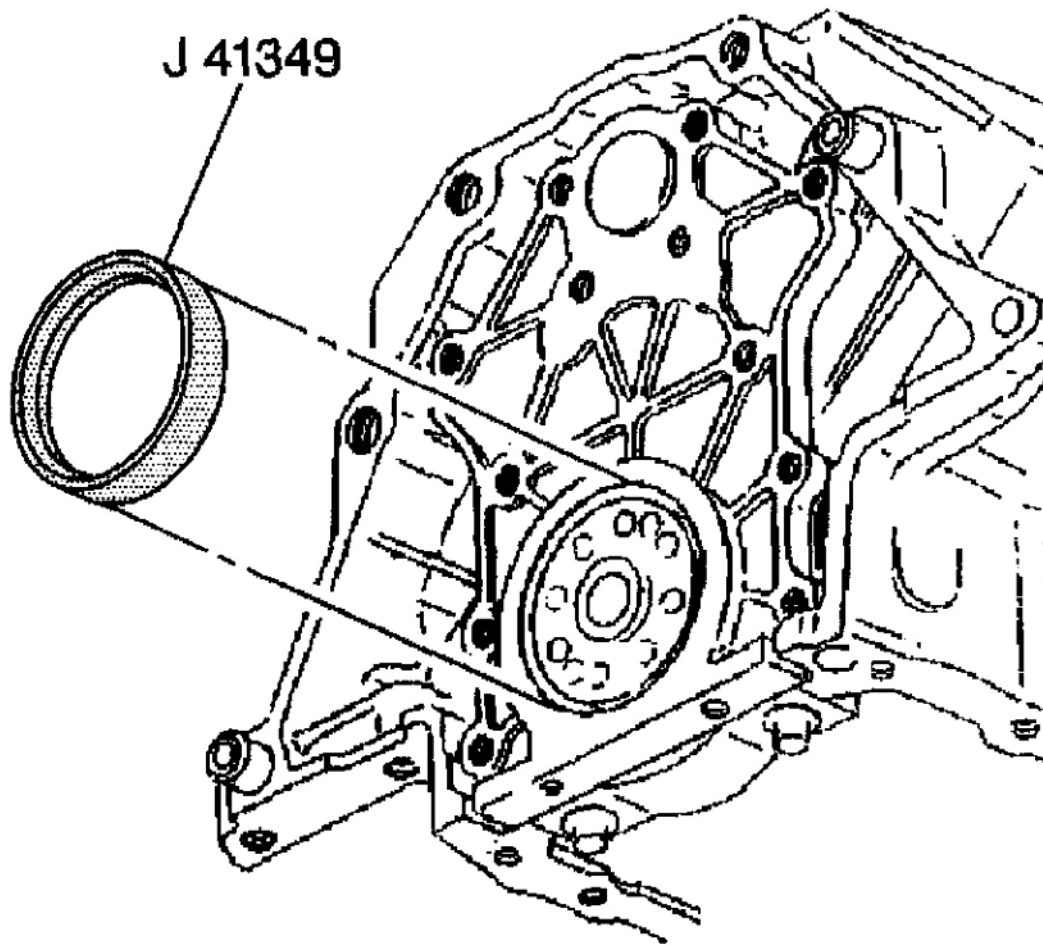
Fig. 230: Installing Crankshaft Rear Oil Seal Housing

Courtesy of GENERAL MOTORS CORP.

3. Apply engine oil to both sides of the J 41349.

NOTE: Sealability of the rear main oil seal depends on the correct alignment of the rear main oil seal housing and the oil pan. Incorrect alignment may cause oil leaks.

4. Install the J 41349 over the crankshaft. Twist the tool to aid in sliding the tool over the crankshaft.



G01728888

Fig. 231: Installing J 41349

Courtesy of GENERAL MOTORS CORP.

5. Raise the oil pan and finger tighten the oil pan bolts.
6. Tighten the crankshaft rear oil seal housing bolts.

Tighten

Tighten the crankshaft rear oil seal housing bolts to 15 N.m (11 lb ft). Use the J 36660-A to torque the crankshaft rear oil seal housing bolt an additional 50 degrees.

7. Remove the J 41349.
8. Tighten the oil pan bolts.

Tighten

Tighten the oil pan bolts to 14 N.m (10 lb ft).

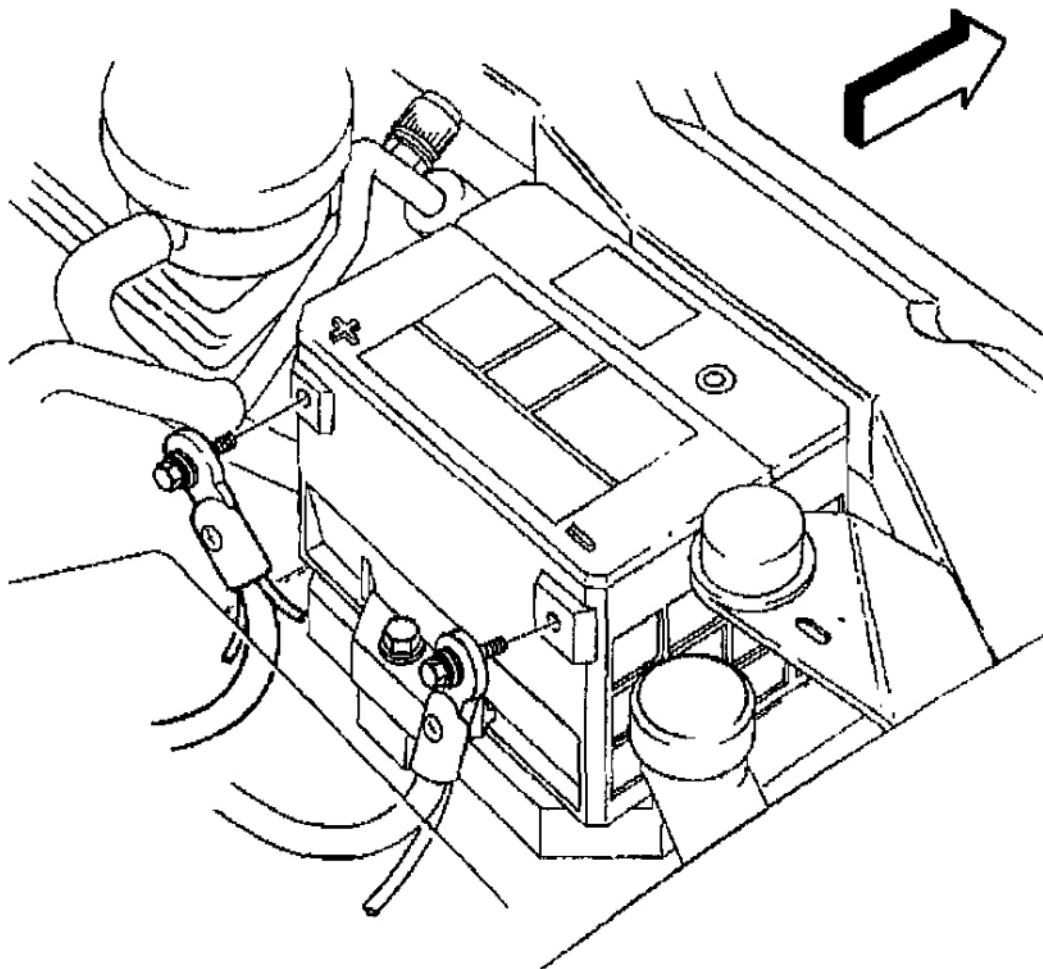
9. Install the crankshaft rear oil seal. Refer to **Crankshaft Rear Oil Seal Replacement**.
10. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
11. Fill the crankcase with engine oil. Refer to **Engine Oil and Oil Filter Replacement**.

ENGINE REPLACEMENT**Tools Required**

- **J 21366** Converter Holding Strap
- **J 36221** Hydraulic Clutch Line Separator
- **J 39549** Ball Joint/Tie Rod End Separator
- **J 39580** Engine Support Table

Removal Procedure

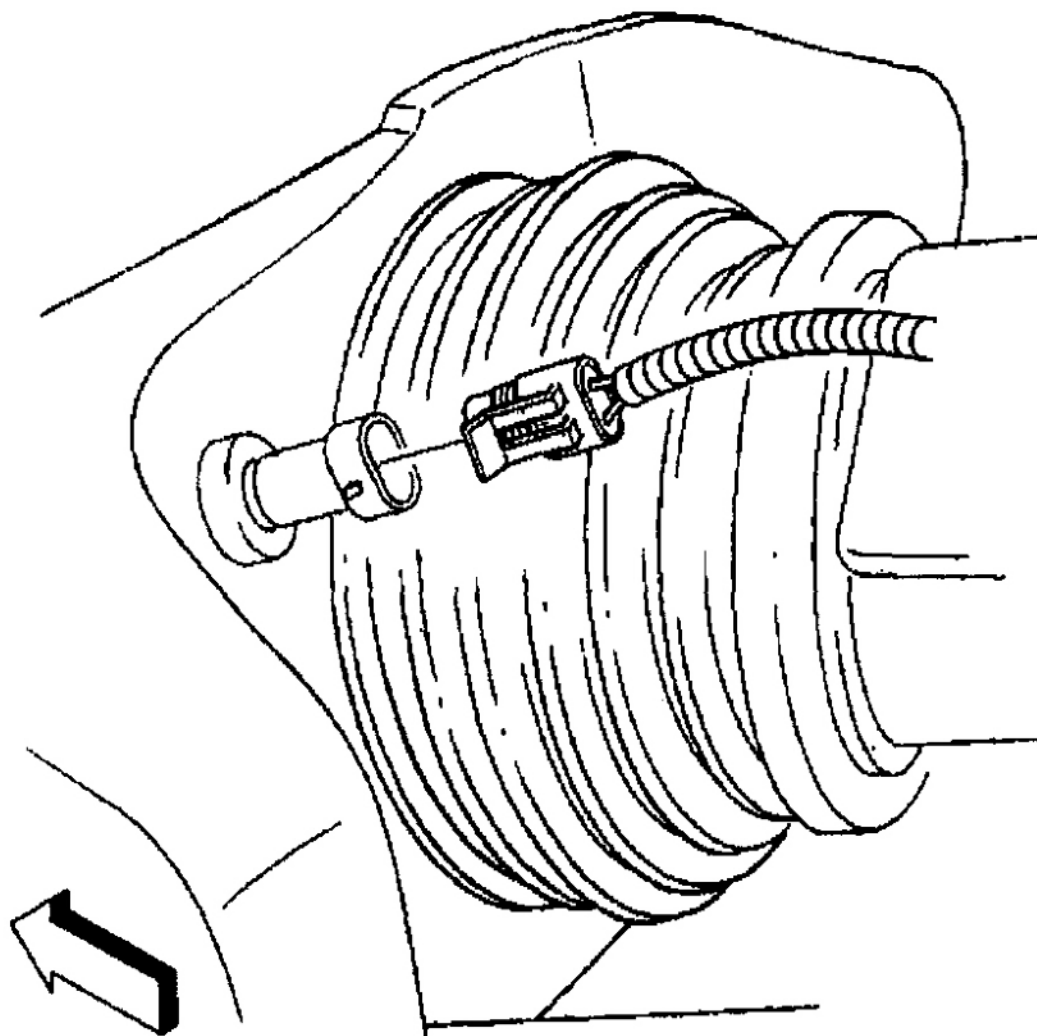
1. Disconnect the negative battery cable.
2. Disconnect the positive battery cable.



G01728889

Fig. 232: Disconnecting Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

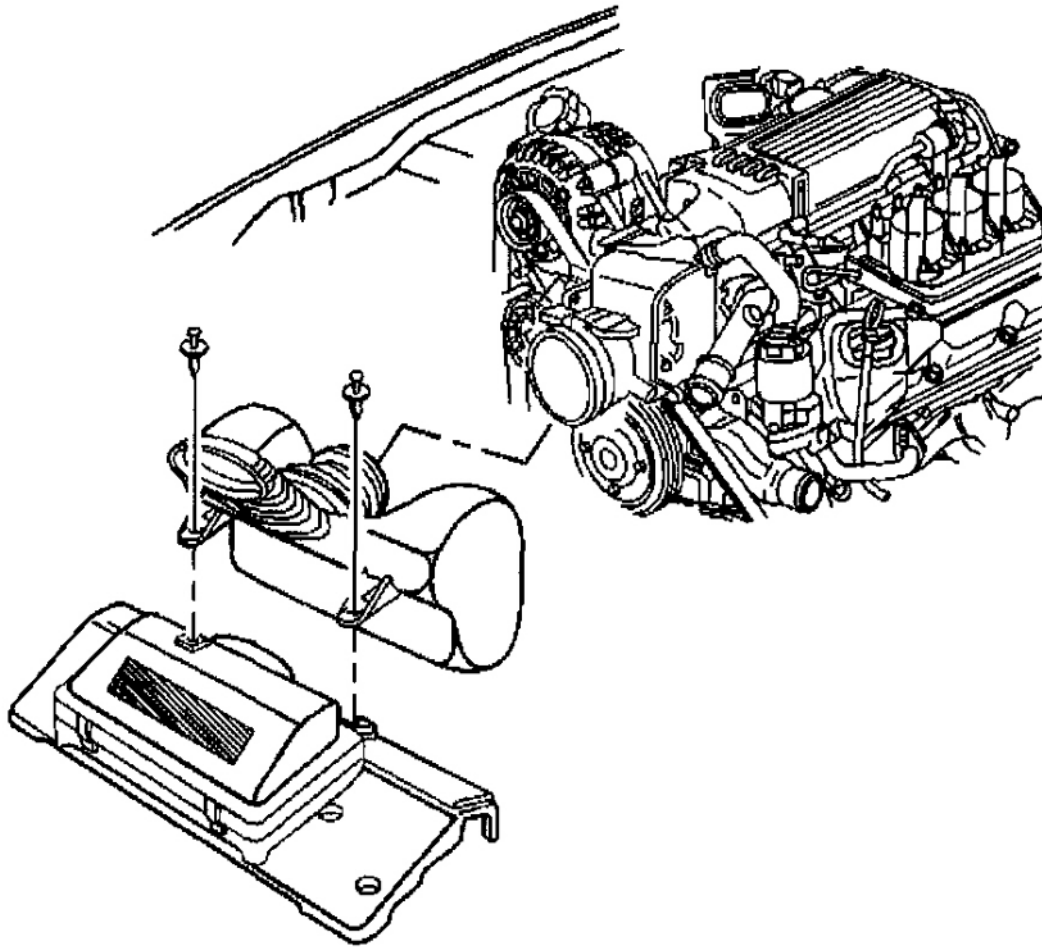
3. Disconnect the intake air temperature (IAT) sensor electrical connector.



G01728890

Fig. 233: Disconnecting Intake Air Temperature (IAT) Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Remove the air intake duct.

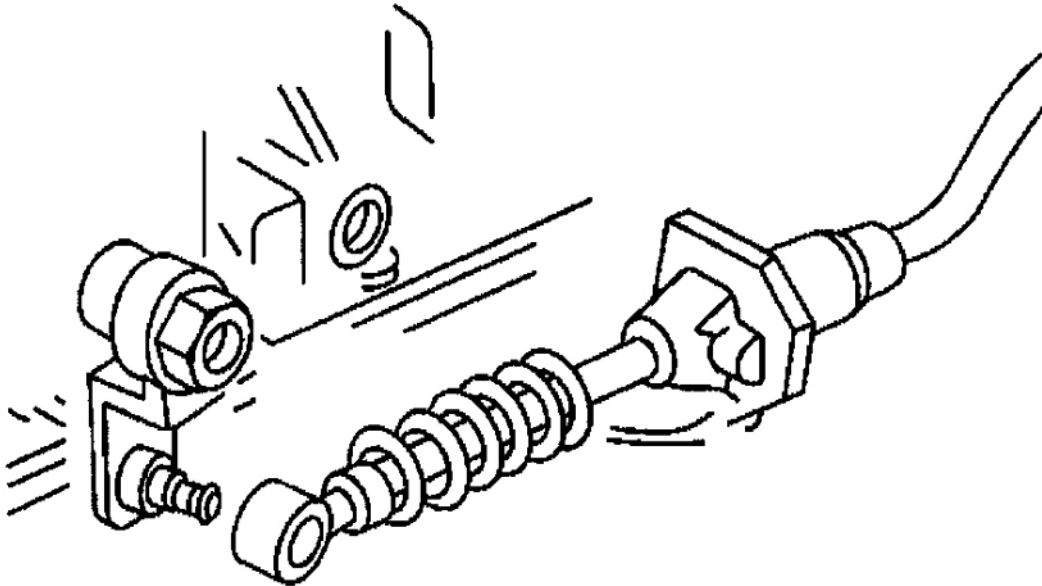


G01728891

Fig. 234: Removing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

5. Recover the refrigerant. Refer to **COOLANT RECOVERY RESERVOIR REPLACEMENT** .
6. Raise and support the vehicle. **LIFTING AND JACKING THE VEHICLE**
7. Remove the starter motor. Refer to **STARTER MOTOR (3.8L)** .
8. If equipped, remove the torque converter to flywheel bolts.
9. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
10. Remove the front wheels. Refer to Tire and Wheel Removal and Installation in Tires and Wheels .
11. Drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
12. Remove the 3-way catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT (3.8L ENGINE)** .
13. Remove the propeller shaft.

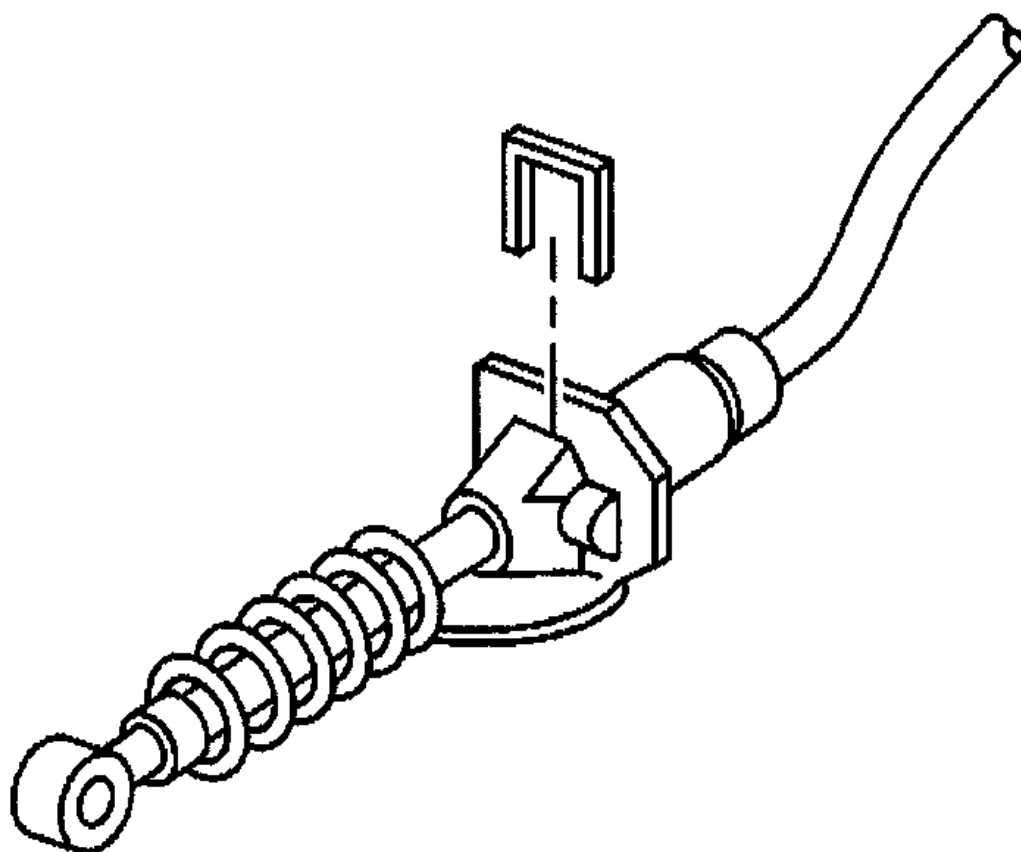
14. Remove the torque arm. Refer to **TORQUE ARM REPLACEMENT** .
15. If equipped with an automatic transmission, remove the transmission range selector lever cable from the range selector lever.



G01728892

Fig. 235: Removing Transmission Range Selector Lever Cable From Range Selector Lever
Courtesy of GENERAL MOTORS CORP.

16. Remove the retainer from the range selector lever cable.



G01728893

Fig. 236: Removing Retainer From Range Selector Lever Cable
Courtesy of GENERAL MOTORS CORP.

17. Remove the range selector lever cable from the cable bracket.

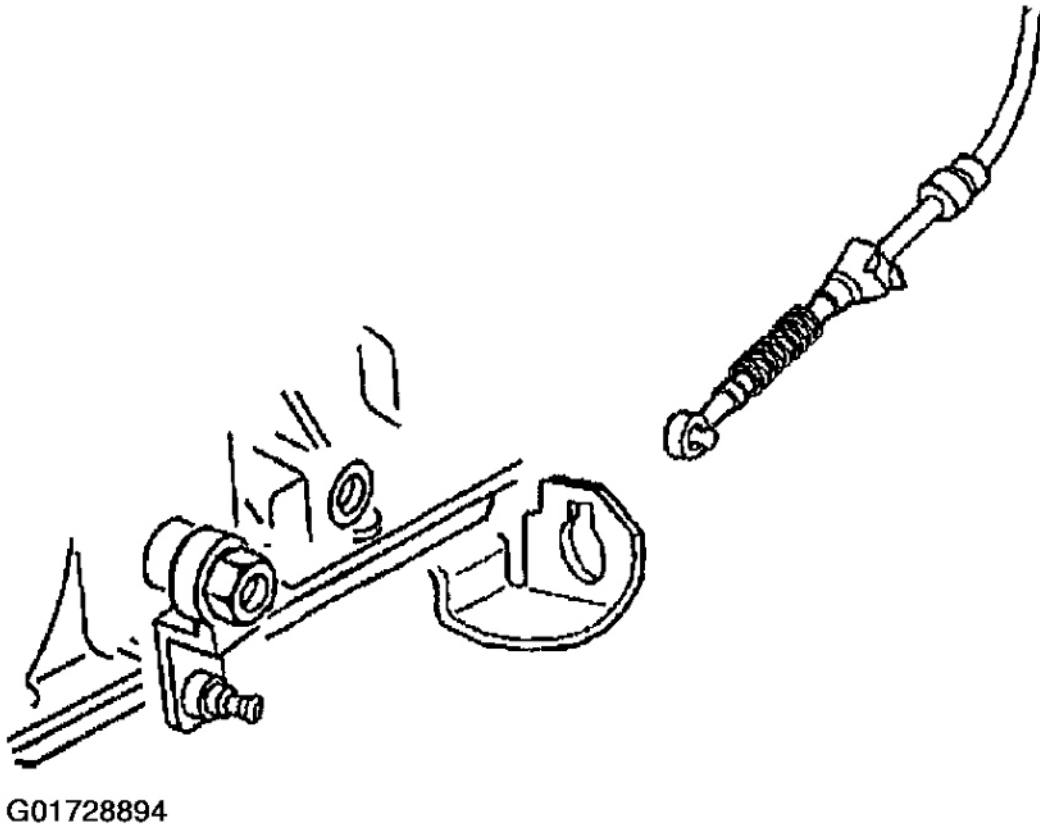
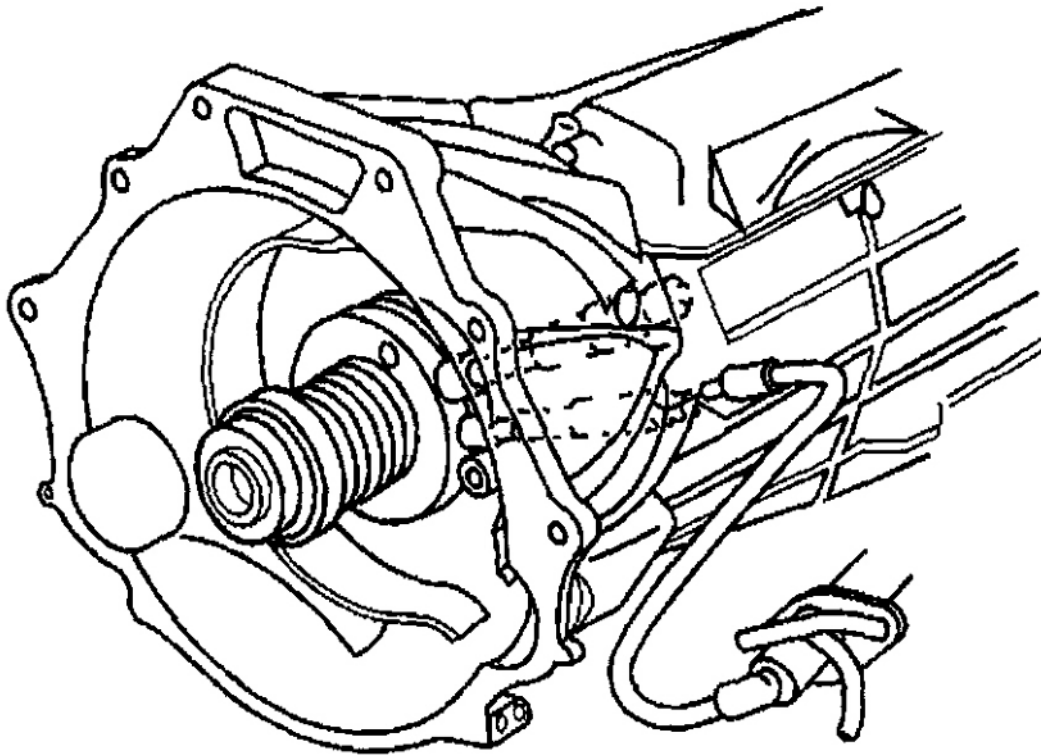


Fig. 237: Removing Range Selector Lever Cable From Cable Bracket
Courtesy of GENERAL MOTORS CORP.

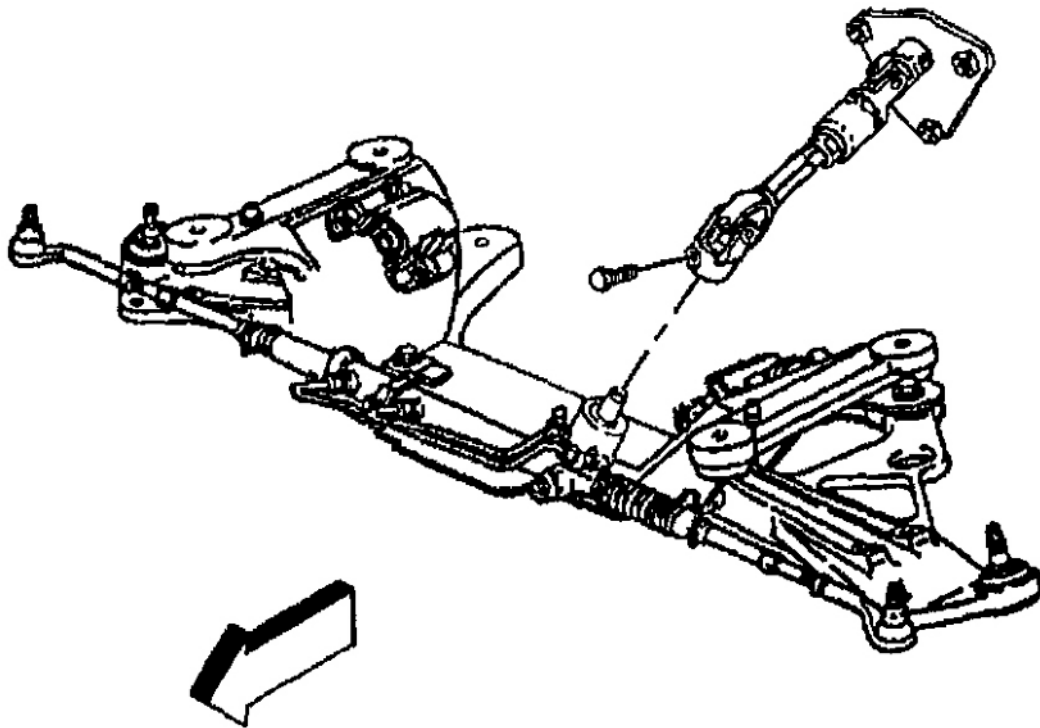
18. If equipped with a manual transmission, disconnect the clutch actuator cylinder line from the actuator cylinder using the J 36221.



G01728895

Fig. 238: Disconnecting Clutch Actuator Cylinder Line From The Actuator Cylinder
Courtesy of GENERAL MOTORS CORP.

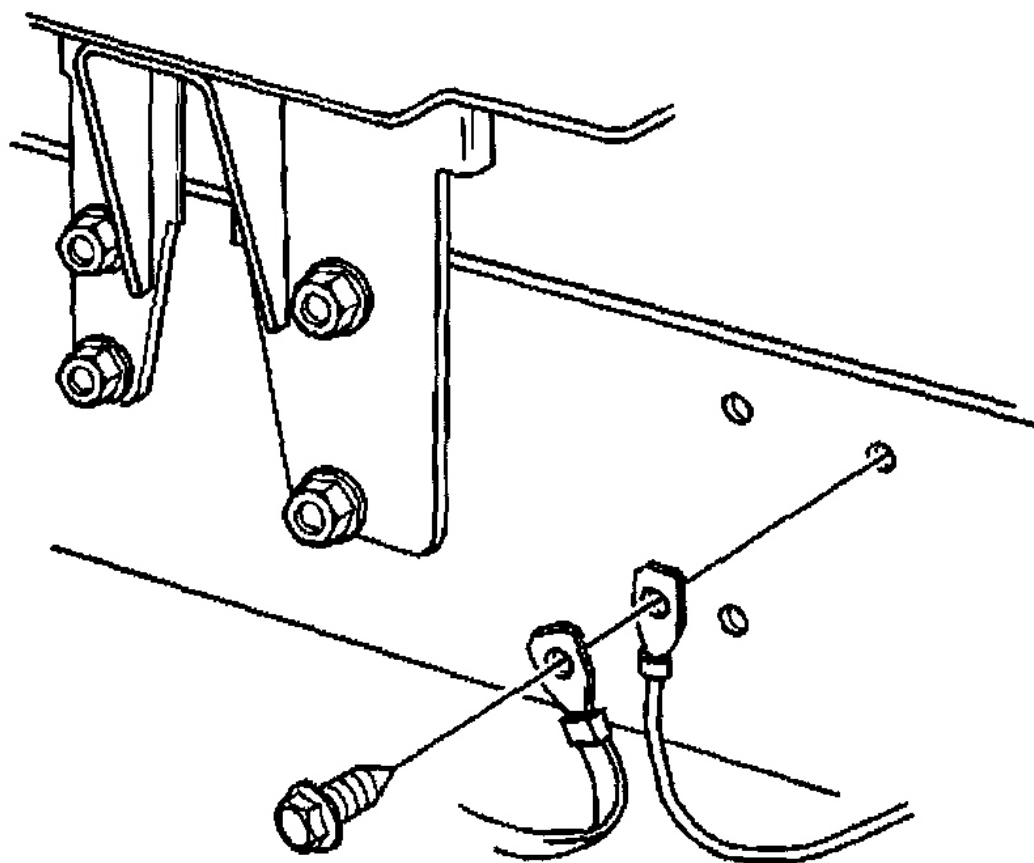
19. Remove the left side front air deflector.
20. Remove the stabilizer bar brackets. Refer to **STABILIZER SHAFT INSULATOR REPLACEMENT** .
21. Remove the intermediate steering shaft bolt and shaft from the rack. Refer to Intermediate Steering Shaft Replacement in Steering Wheel and Column .



G01728896

Fig. 239: Removing Intermediate Steering Shaft Bolt And Shaft From Rack
Courtesy of GENERAL MOTORS CORP.

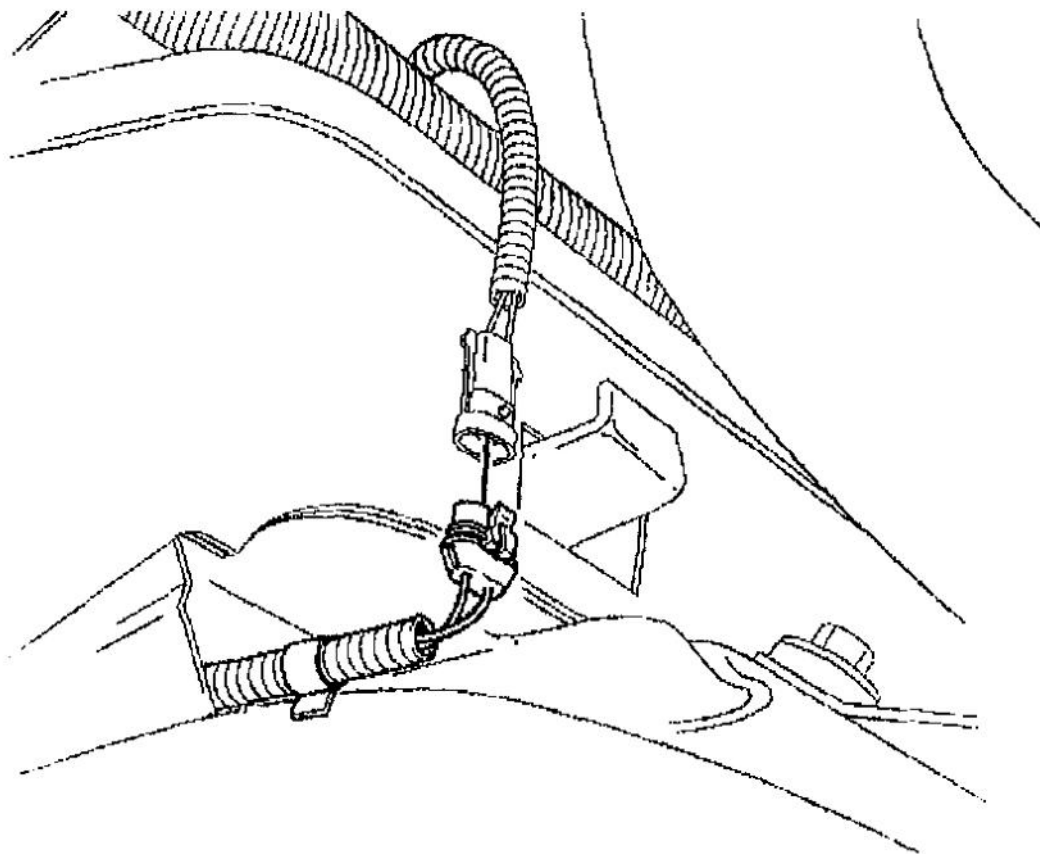
22. Remove the wiring harness ground bolt and RF (Radio Frequency) ground strap and cruise control ground lead from the front rail.



G01728897

Fig. 240: Removing Wiring Harness Ground Bolt, RF (Radio Frequency) Ground Strap And Cruise Control Ground Lead From Front Rail
 Courtesy of GENERAL MOTORS CORP.

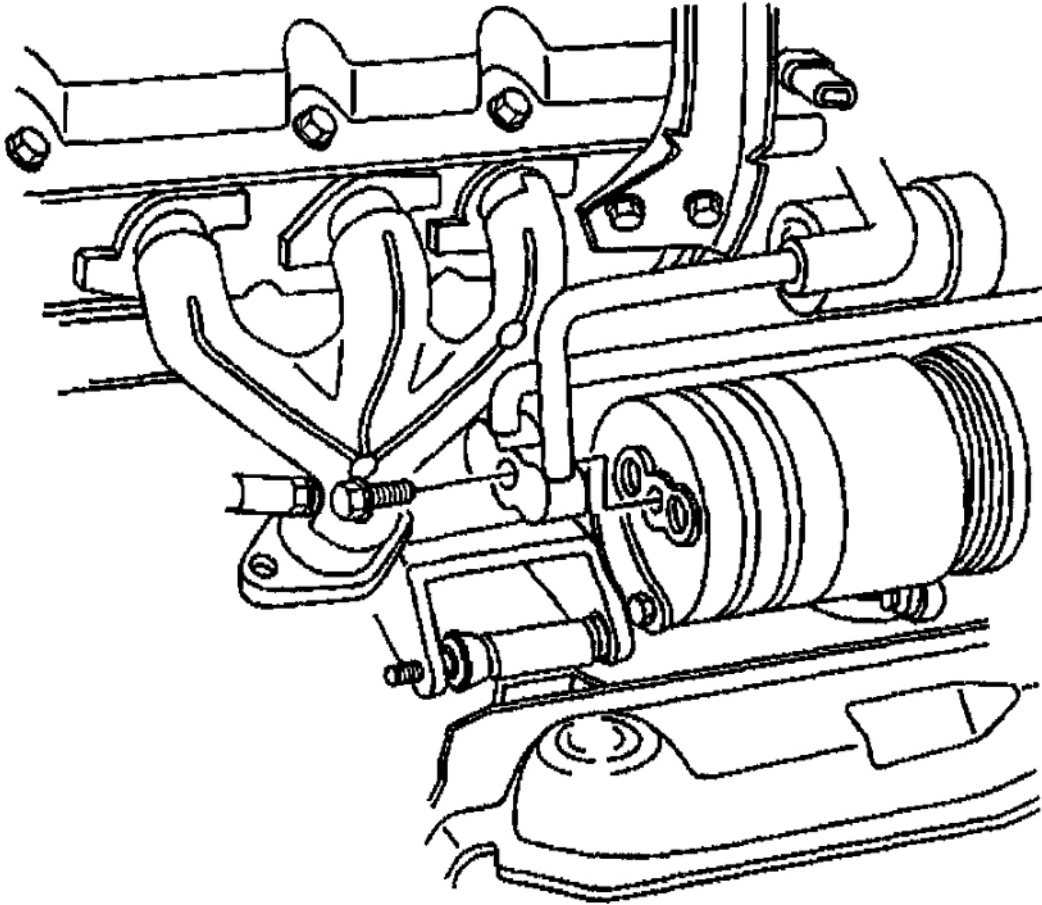
23. Disconnect the knock sensor electrical connectors.
24. Disconnect the wheel speed sensors electrical connectors.



G01728898

Fig. 241: Disconnecting Wheel Speed Sensors Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

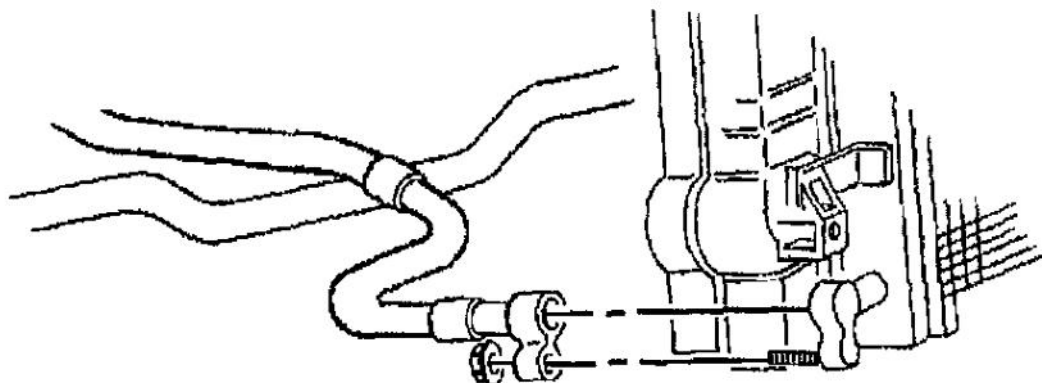
25. Remove the A/C compressor and condenser hose bolt from the compressor.



G01728899

Fig. 242: Removing A/C Compressor And Condenser Hose Bolt From The Compressor
Courtesy of GENERAL MOTORS CORP.

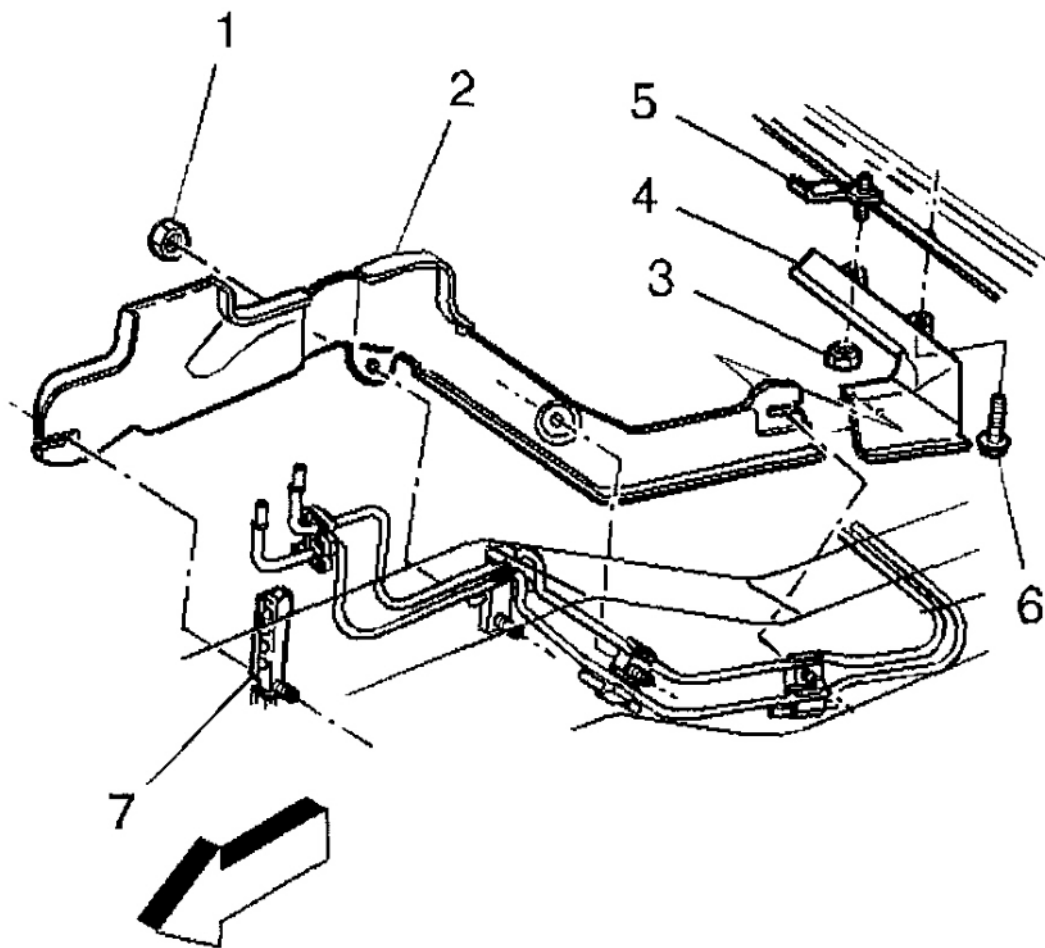
26. Discard the O-ring.
27. Remove the A/C compressor and condenser hose nut from the condenser.
28. Discard the O-ring.



G01728900

Fig. 243: Removing A/C Compressor And Condenser Hose Nut From The Condenser
Courtesy of GENERAL MOTORS CORP.

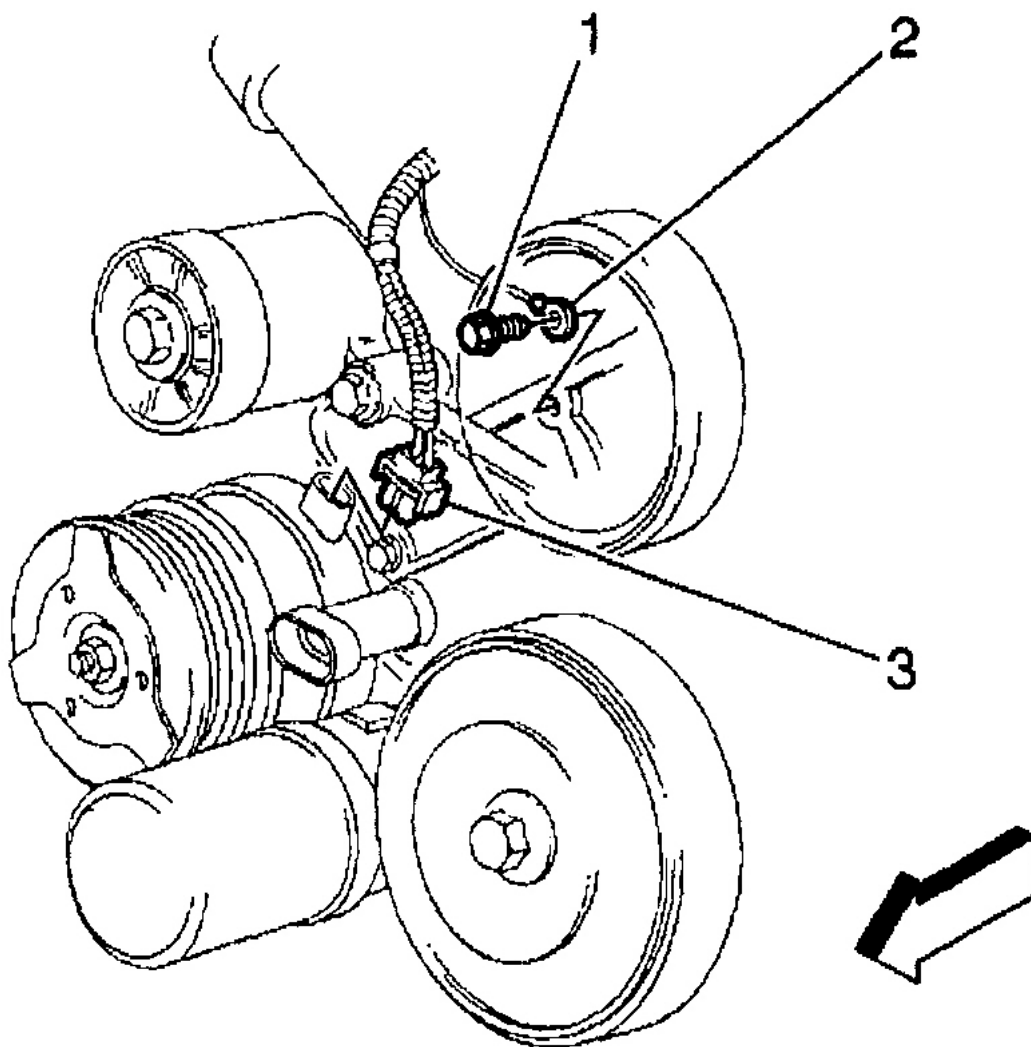
29. Remove the front fuel pipe heat shield nuts (1).
30. Remove the front fuel pipe heat shield (2).
31. Remove the brake lines from the brake pipe clip.
32. Lower the vehicle.



G01728901

Fig. 244: Removing Front Fuel Pipe Heat Shield Nuts
 Courtesy of GENERAL MOTORS CORP.

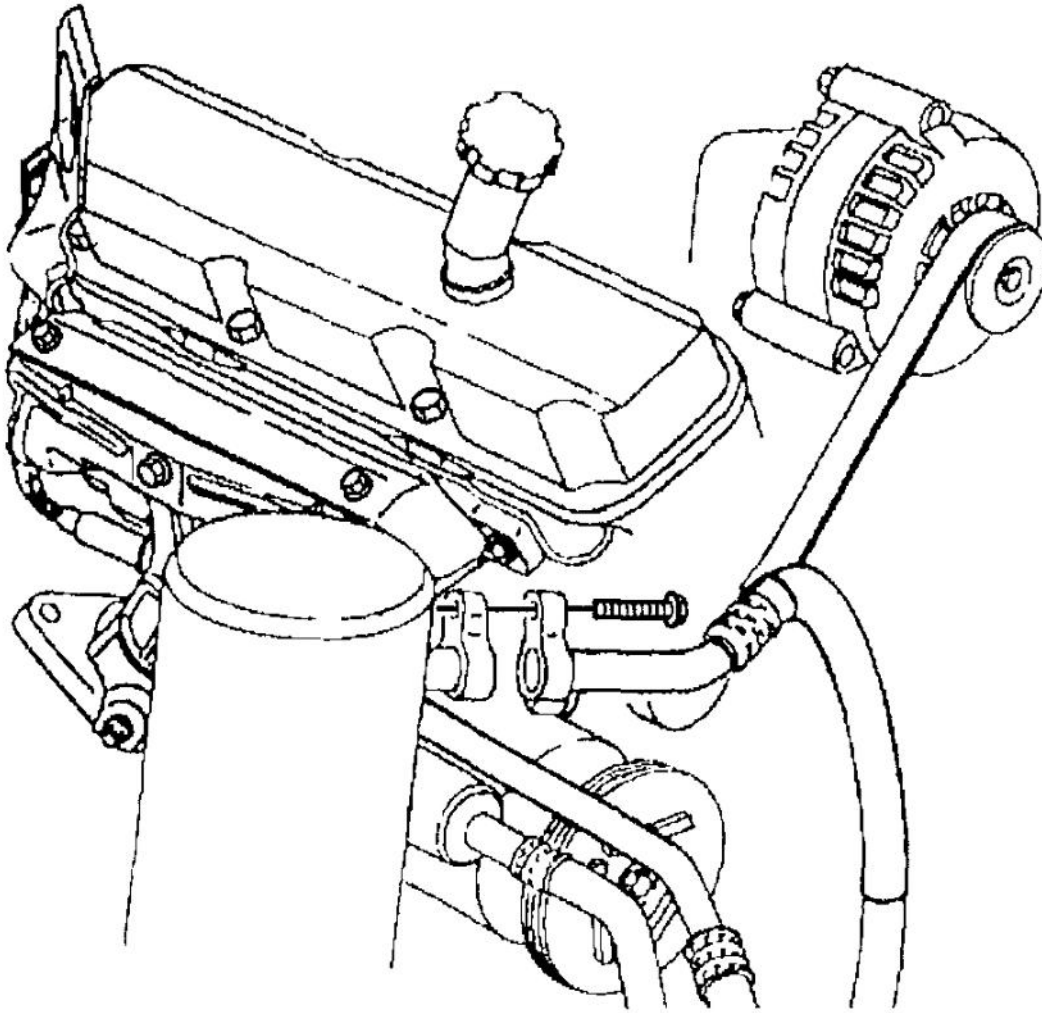
33. Remove the engine wiring harness ground bolt (1).



G01728902

Fig. 245: Removing Engine Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

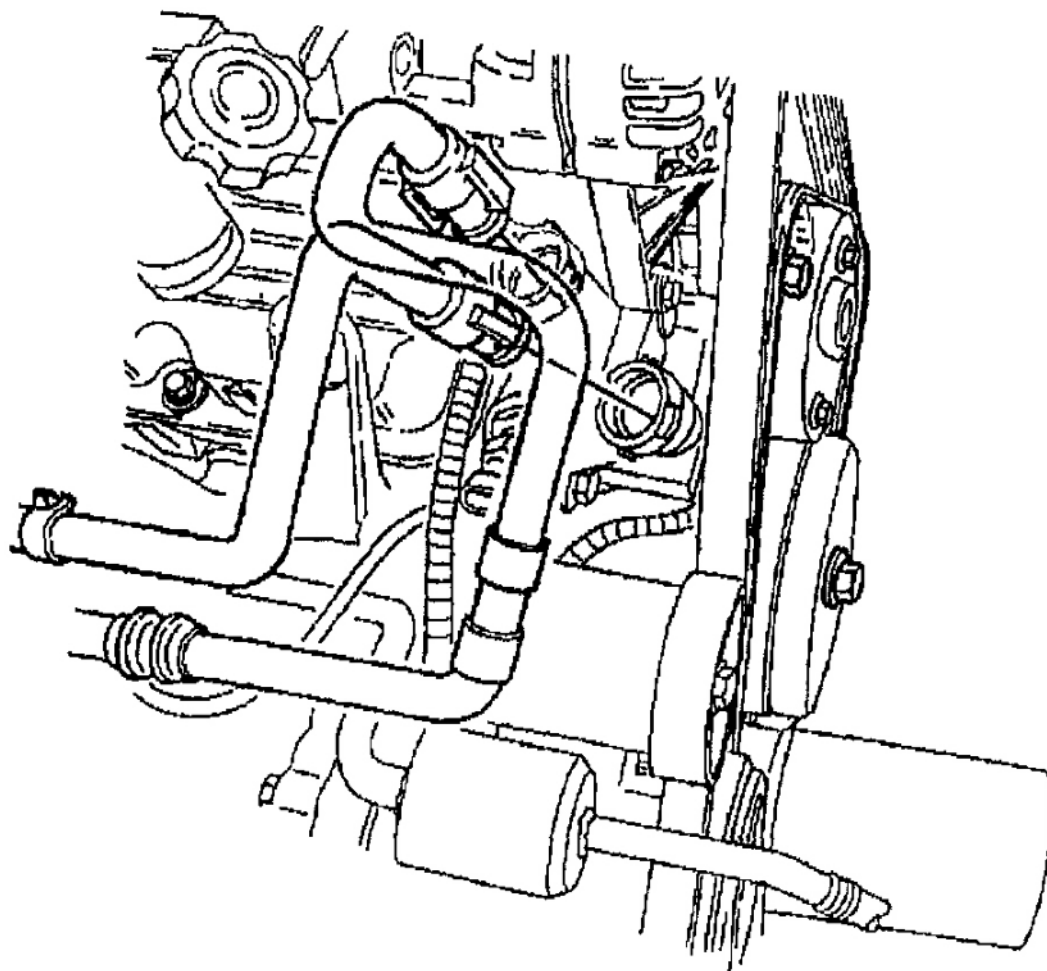
34. Remove the engine ground.
35. Remove the A/C compressor and condenser hose bolt from the accumulator.



G01728903

Fig. 246: Removing A/C Compressor And Condenser Hose Bolt From Accumulator
Courtesy of GENERAL MOTORS CORP.

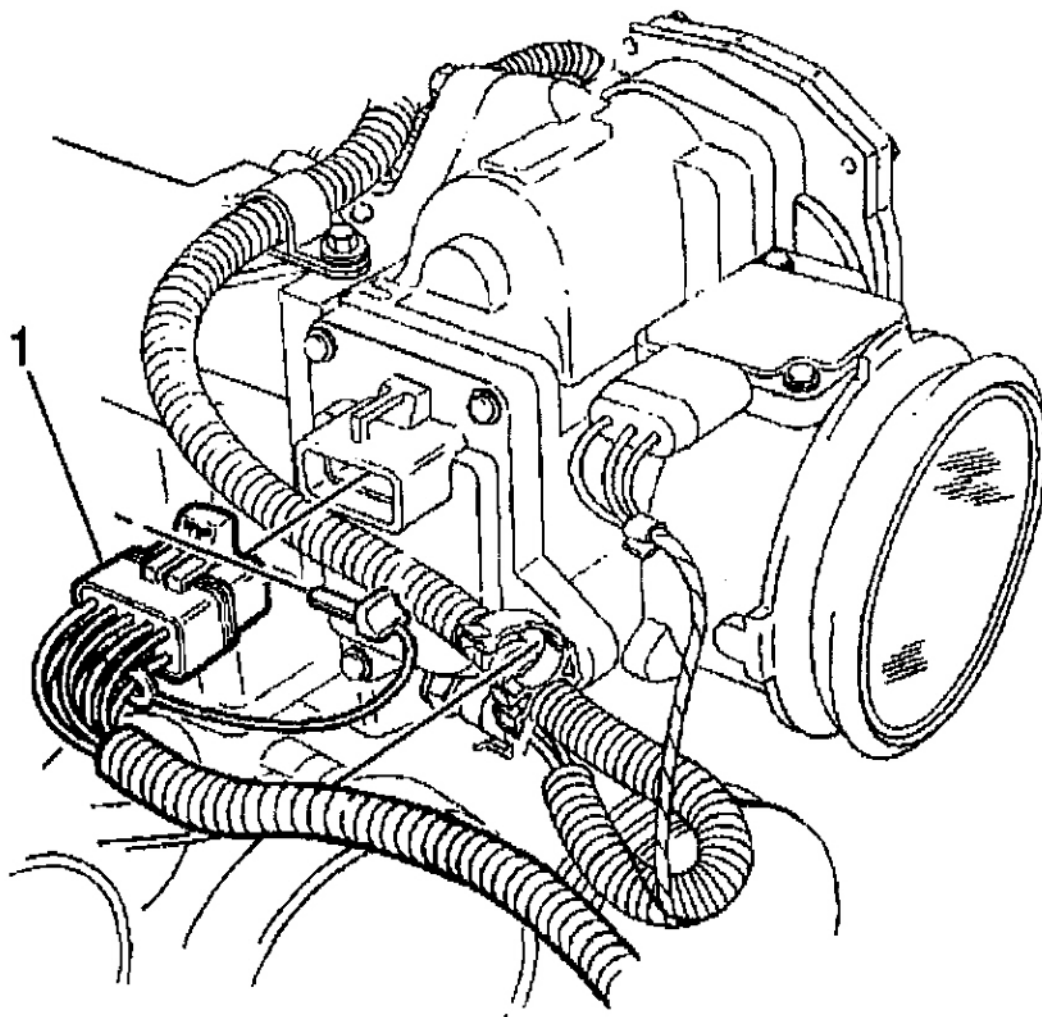
36. Discard the O-ring.
37. Remove the heater hoses from the drive belt tensioner.
38. Relieve the fuel pressure. Refer to **FUEL SYSTEM PRESSURE RELEASE** .
39. Disconnect the fuel lines from the fuel rail. Refer to **REMOVAL (QUICK-CONNECT FITTING - WITH METAL)** .
40. Disconnect the fuel vapor line from the EVAP canister purge valve. Refer to **REMOVAL (QUICK-CONNECT FITTING - WITH PLASTIC)** .



G01728904

Fig. 247: Disconnecting Fuel Vapor Line From EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

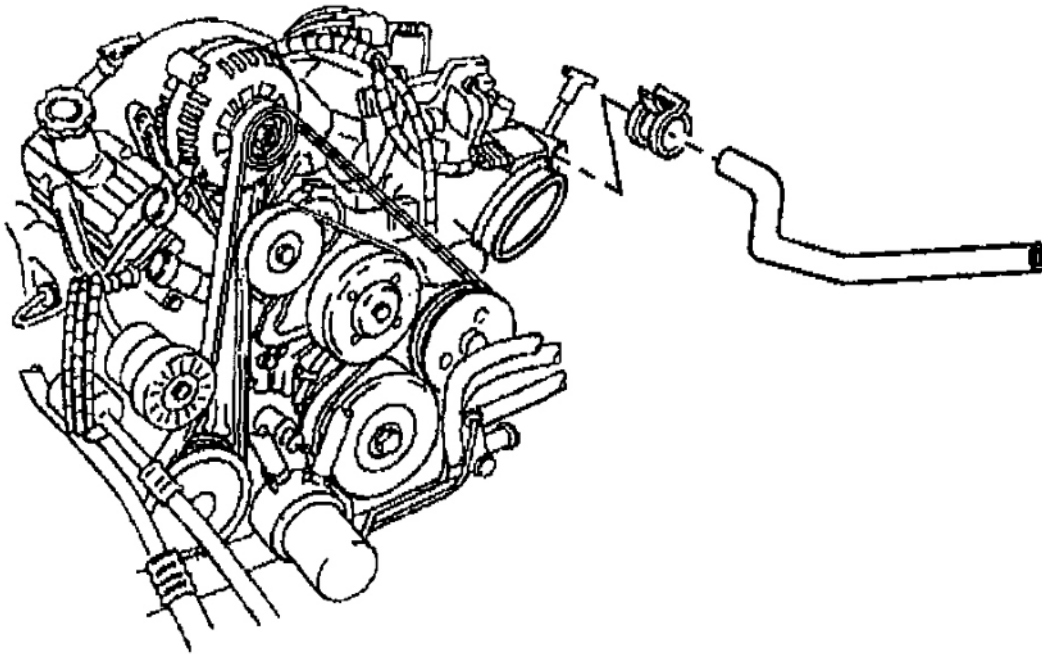
41. Disconnect the electronic throttle control (ETC) electrical connector (1).



G01728905

Fig. 248: Disconnecting Electronic Throttle Control (ETC) Electrical Connector
Courtesy of GENERAL MOTORS CORP.

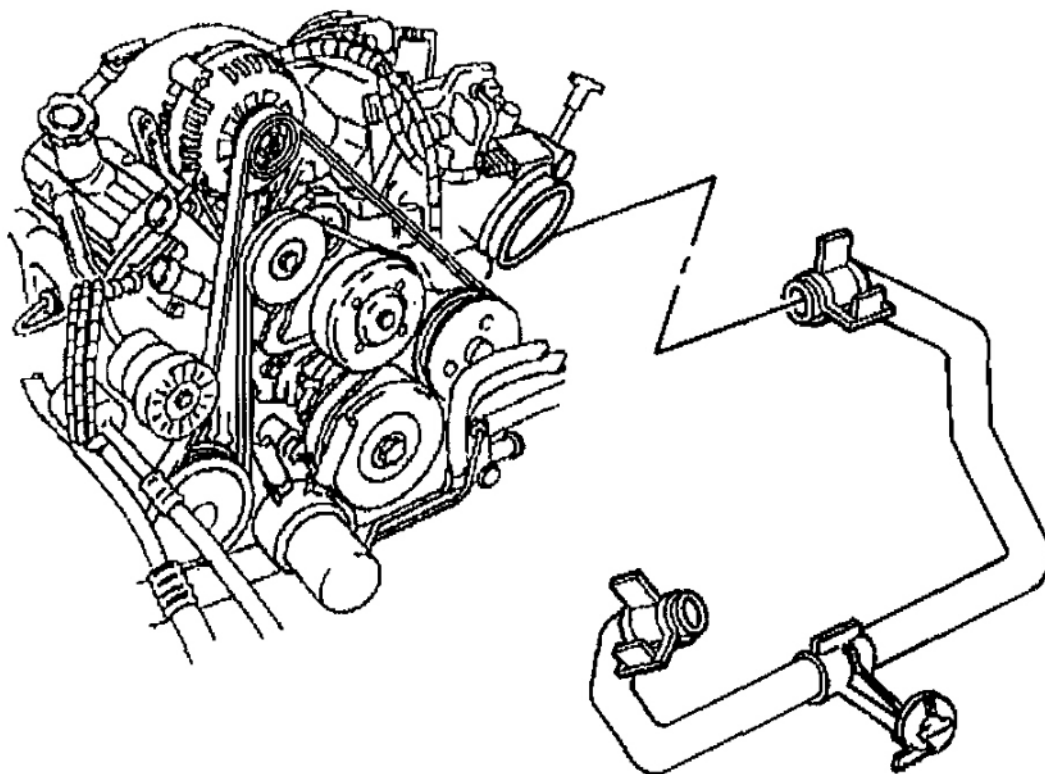
42. Remove the forward lamp harness branch from the wire harness clip.
43. Remove the inlet hose from the water outlet.



G01728906

Fig. 249: Removing Inlet Hose From The Water Outlet
Courtesy of GENERAL MOTORS CORP.

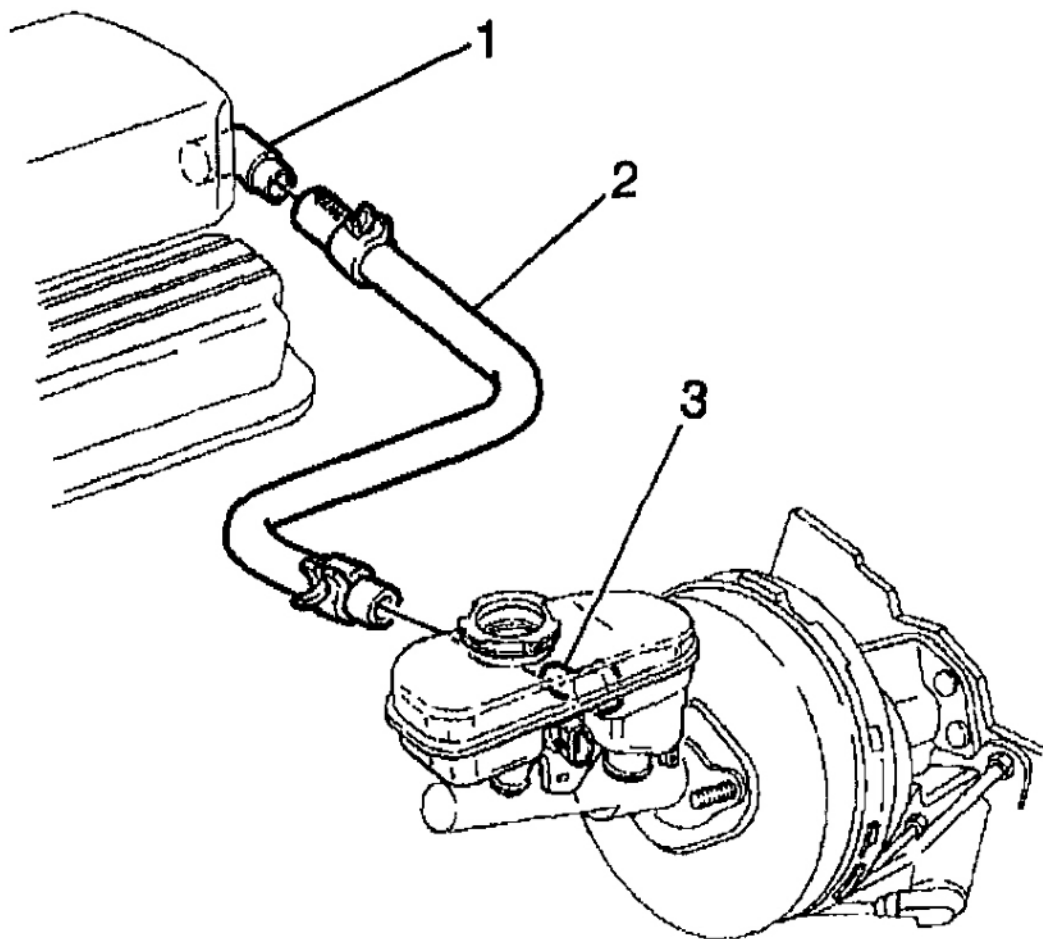
44. Remove the outlet hose from the coolant pump.



G01728907

Fig. 250: Removing Outlet Hose From The Coolant Pump
Courtesy of GENERAL MOTORS CORP.

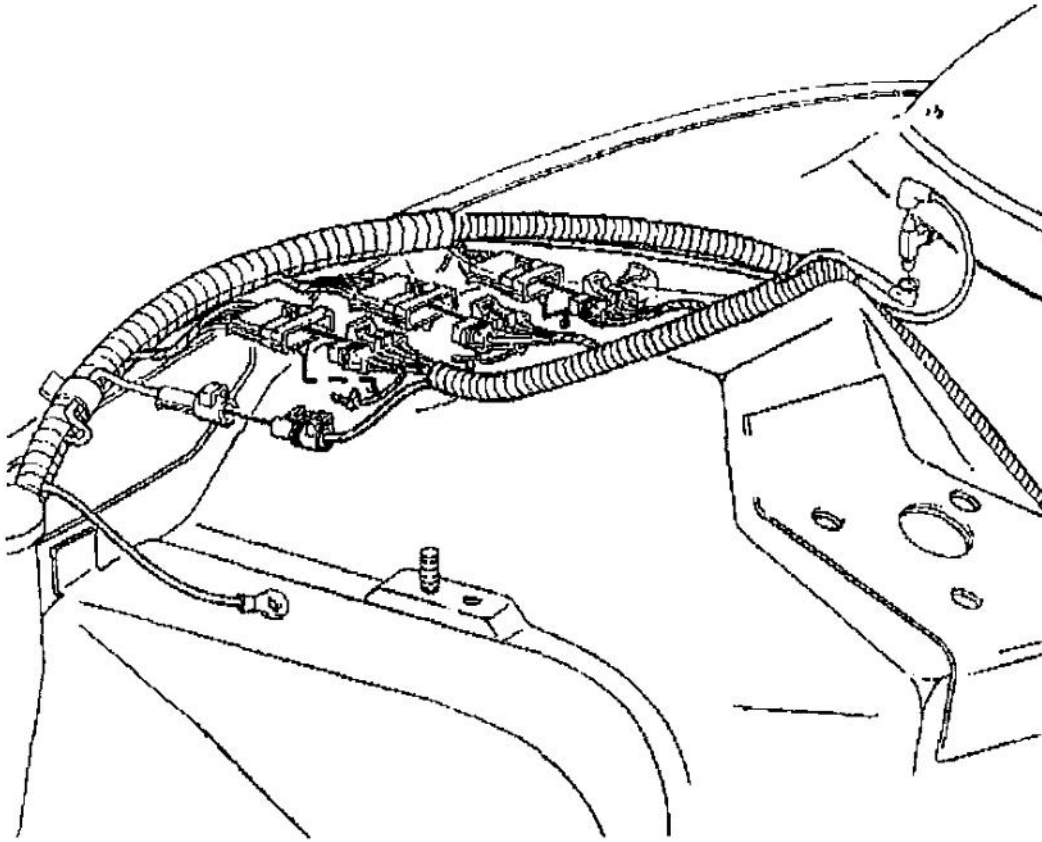
45. Remove the brake booster vacuum hose (2) from the intake manifold fitting (1).



G01728908

Fig. 251: Remove Brake Booster Vacuum Hose From Intake Manifold Fitting
Courtesy of GENERAL MOTORS CORP.

46. Remove the front 2 brake pipes from the brake modulator.
47. Disconnect the forward lamp harness from the engine harness.
48. Disconnect the engine harness vacuum tube from the bottom of the vacuum check valve.



G01728909

Fig. 252: Disconnecting Engine Harness Vacuum Tube
Courtesy of GENERAL MOTORS CORP.

49. Remove the PCM from the vehicle. Refer to **POWERTRAIN CONTROL MODULE** .
50. Remove the right side insulator panel.
51. Remove the hinge pillar trim panel.
52. Disconnect the engine wiring harness from the instrument panel wiring harness.

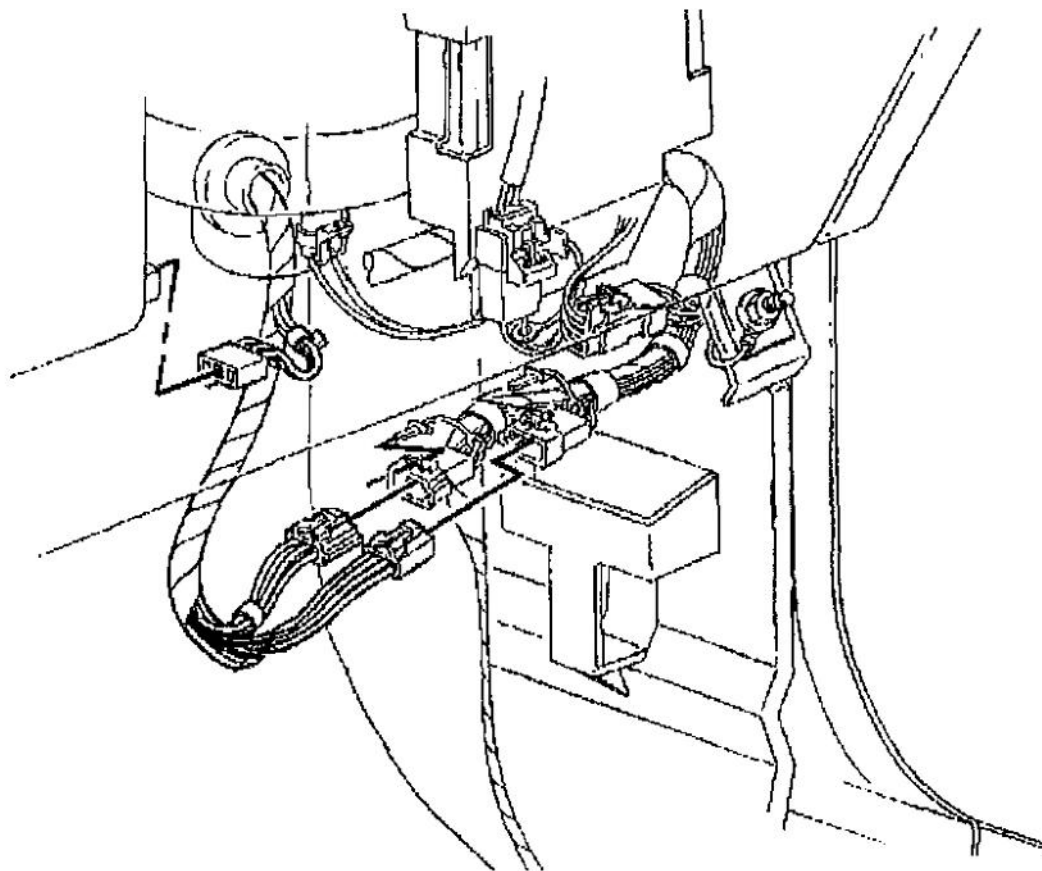
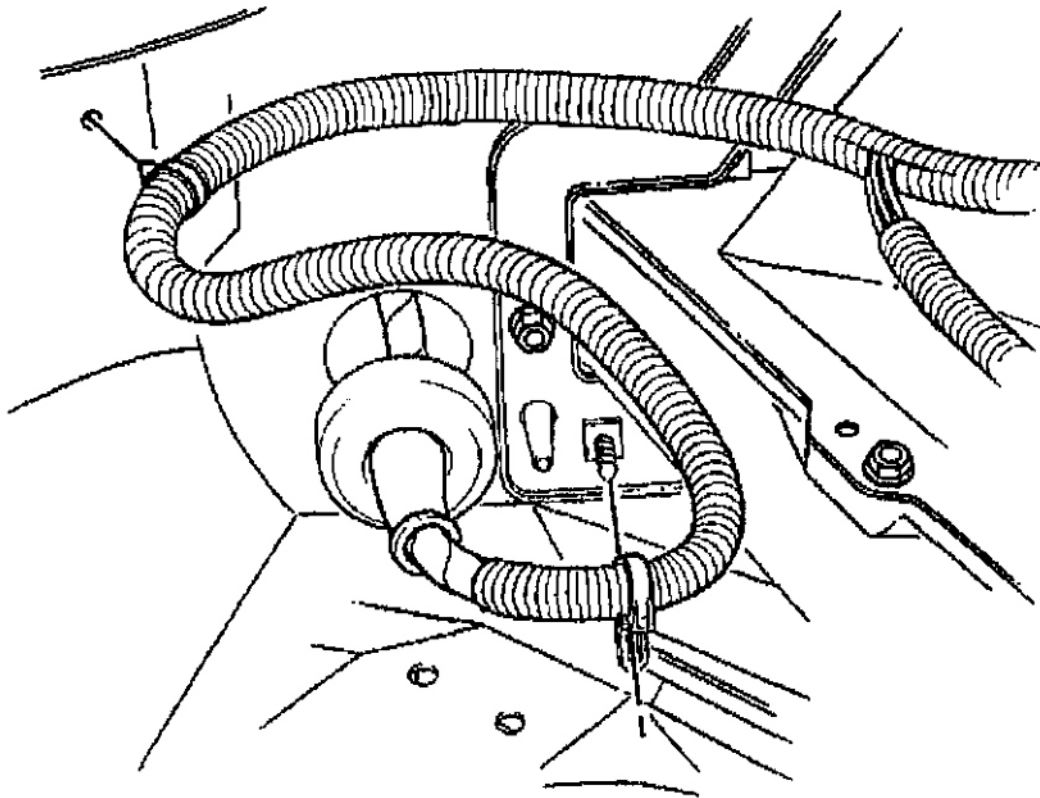
**G01728910**

Fig. 253: Disconnecting Engine Wiring Harness From Instrument Panel Wiring Harness
Courtesy of GENERAL MOTORS CORP.

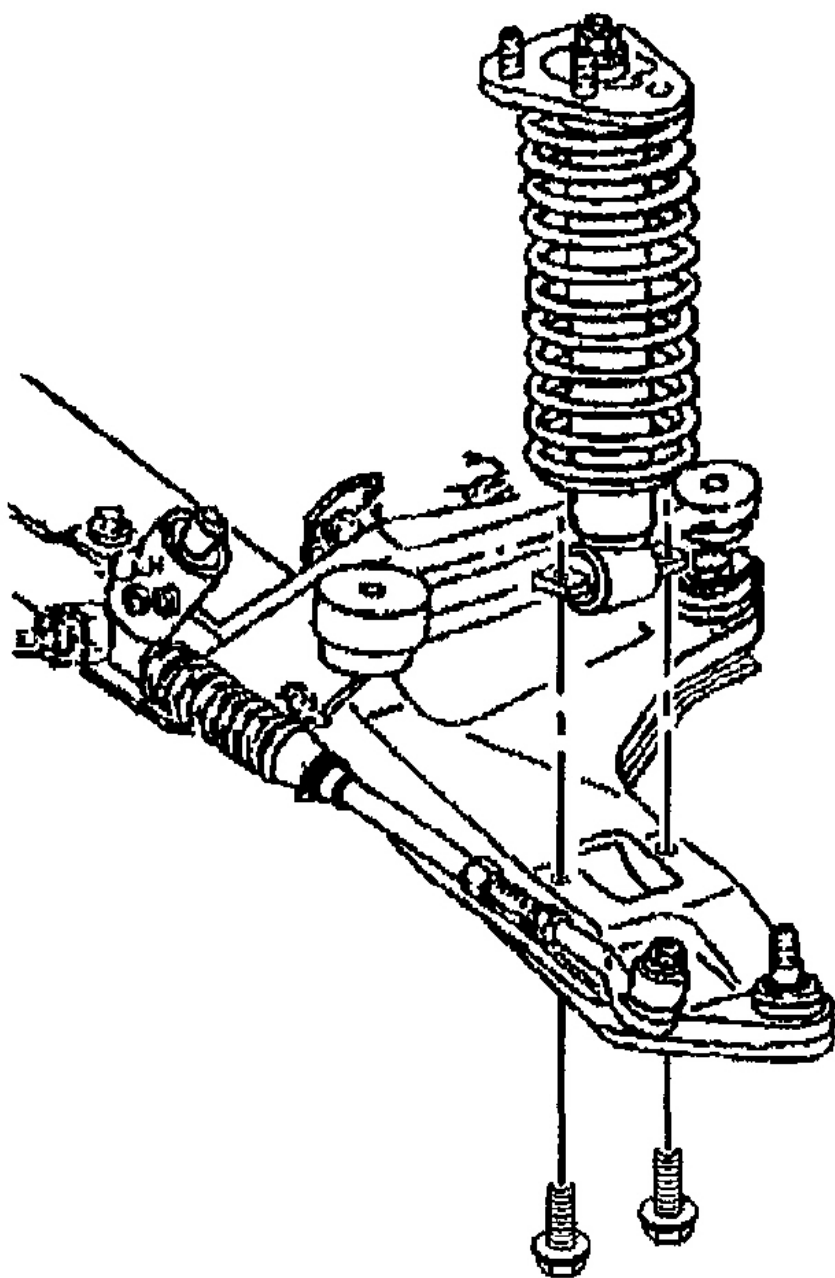
53. Remove the engine wire harness through the front of the cowl. Place the harness on top of the engine.
54. If equipped with the manual transmission remove the transmission shift control.



G01728911

Fig. 254: Remove Transmission Shift Control
Courtesy of GENERAL MOTORS CORP.

55. Raise the vehicle.
56. Remove the right and left side shock absorber lower mounting bolts.

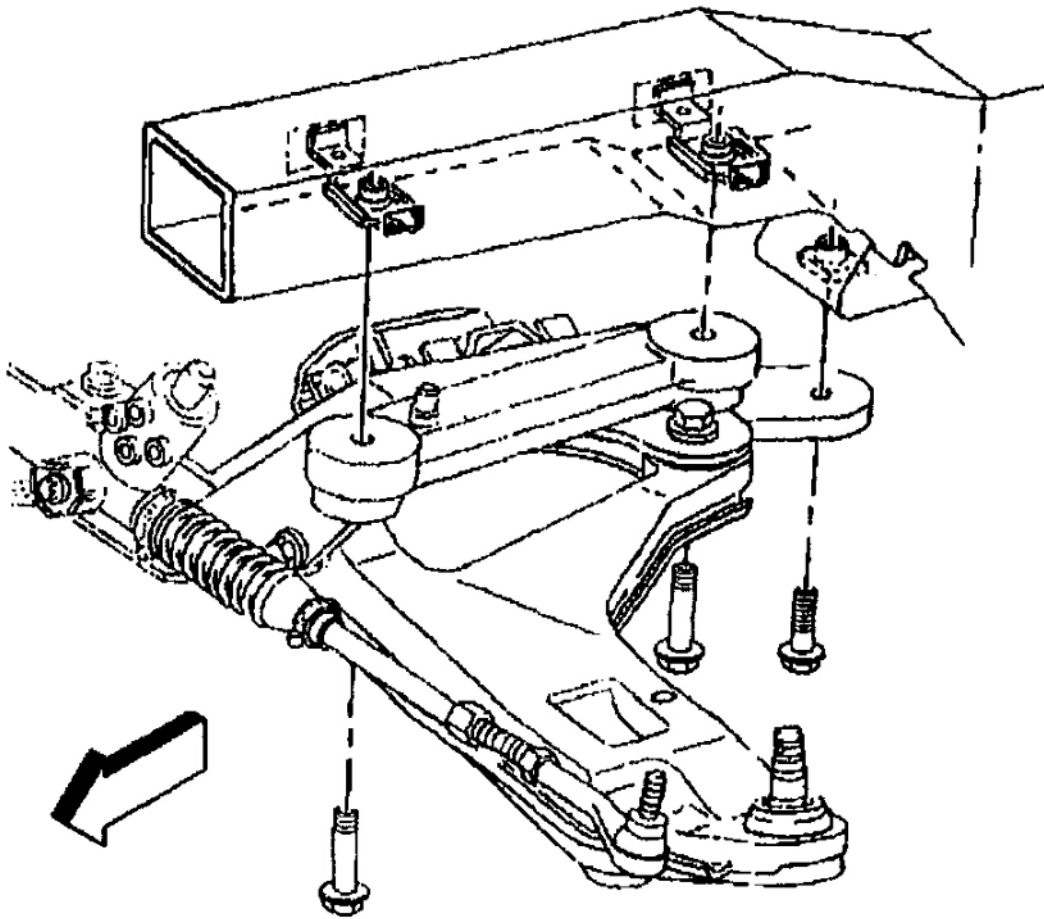


G01728912

Fig. 255: Removing Right And Left Side Shock Absorber Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

57. Remove the cotter pins and nuts from the left and right upper ball joints.
58. Remove the left and right upper ball joints from the steering knuckles using the J 39549.

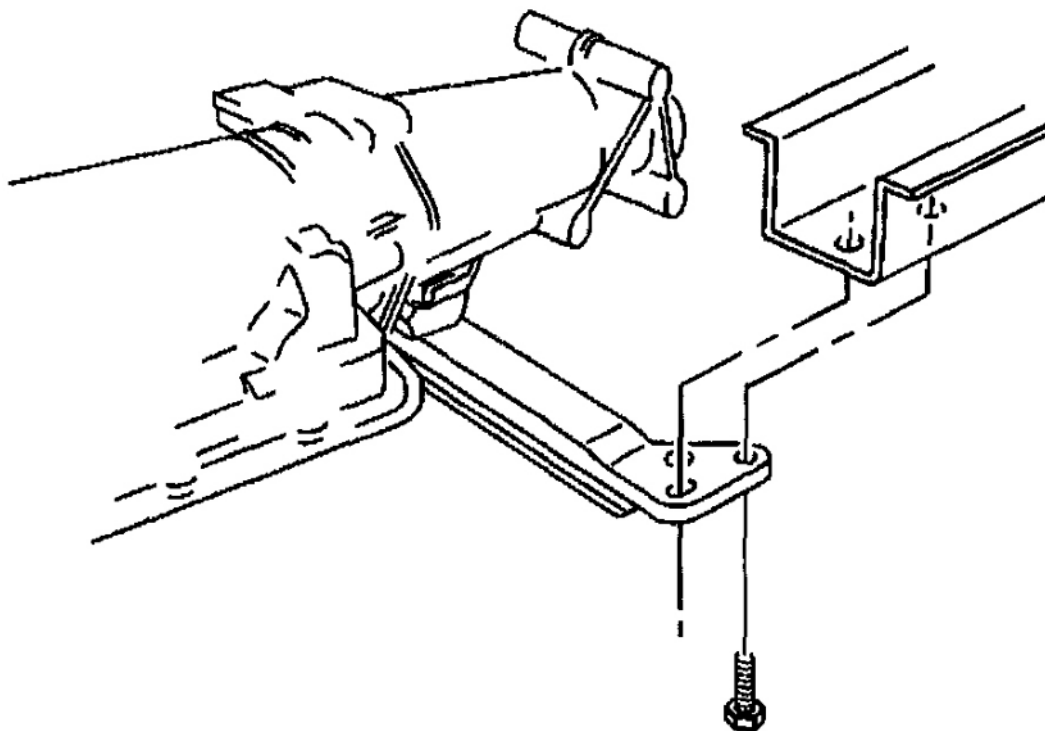
59. Support the left and right steering knuckles.
60. Position the J 39580 under the vehicle.
61. Lower the vehicle on the J 39580.
62. Remove the crossmember bolts.



G01728913

Fig. 256: Removing Crossmember Bolts
Courtesy of GENERAL MOTORS CORP.

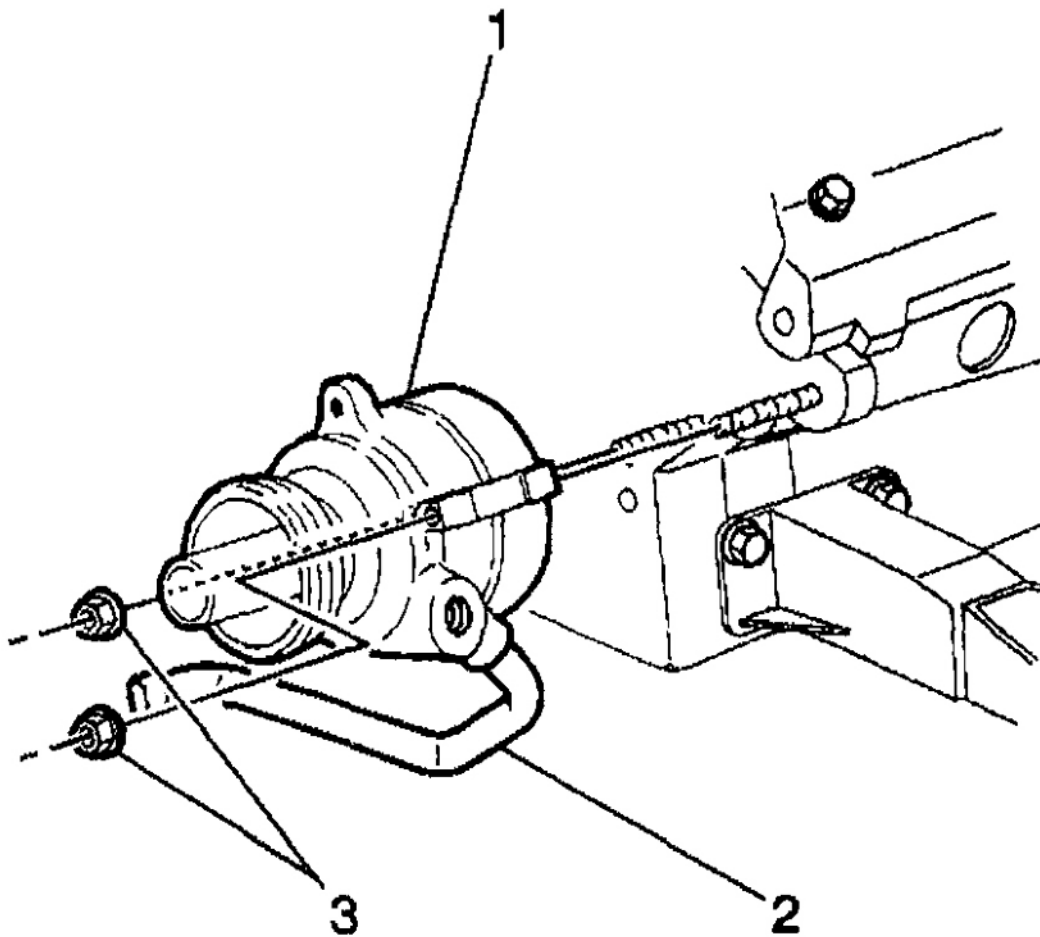
63. Remove the transmission support bolts.
64. Raise the vehicle and remove the engine and transmission from the vehicle.
65. Secure the crossmember to the J 39580.
66. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
67. Remove the A/C compressor and the A/C compressor mounting bracket. Refer to **COMPRESSOR**.



G01728914

Fig. 257: Removing A/C Compressor And A/C Compressor Mounting Bracket
Courtesy of GENERAL MOTORS CORP.

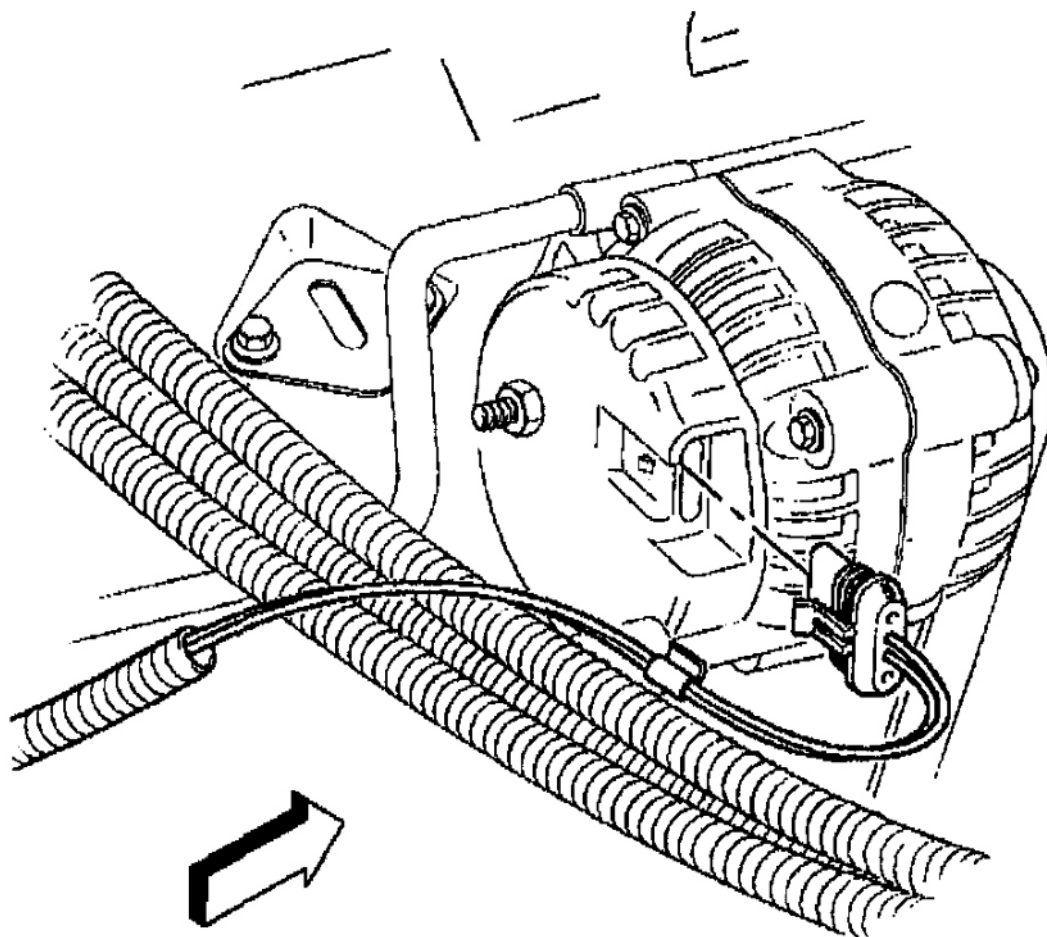
68. Remove the power steering pump nuts (3).



G01728915

Fig. 258: Removing Power Steering Pump Nuts
Courtesy of GENERAL MOTORS CORP.

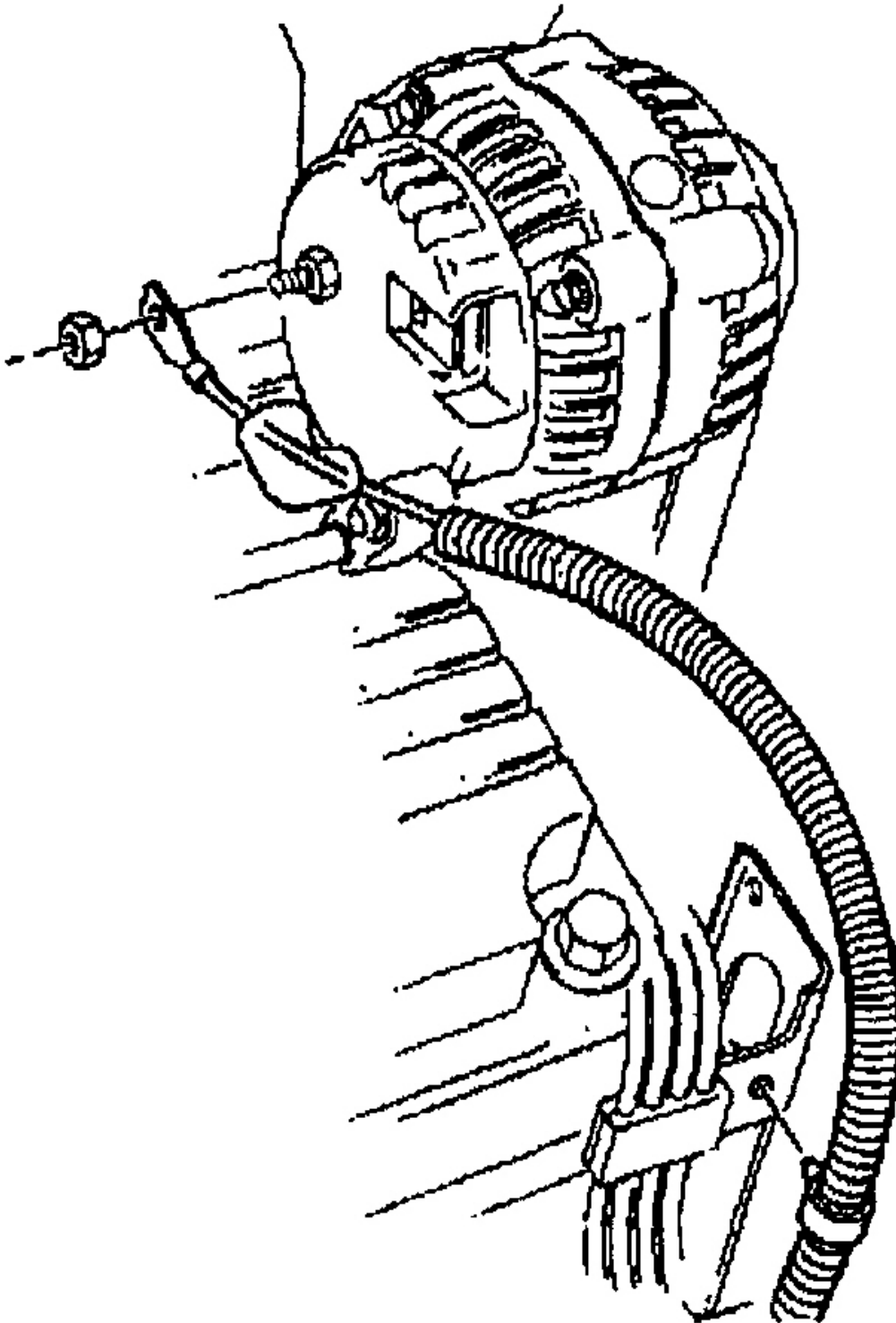
69. Reposition the power steering pump to crossmember.
70. Disconnect the generator electrical connector.



G01728916

Fig. 259: Disconnecting Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

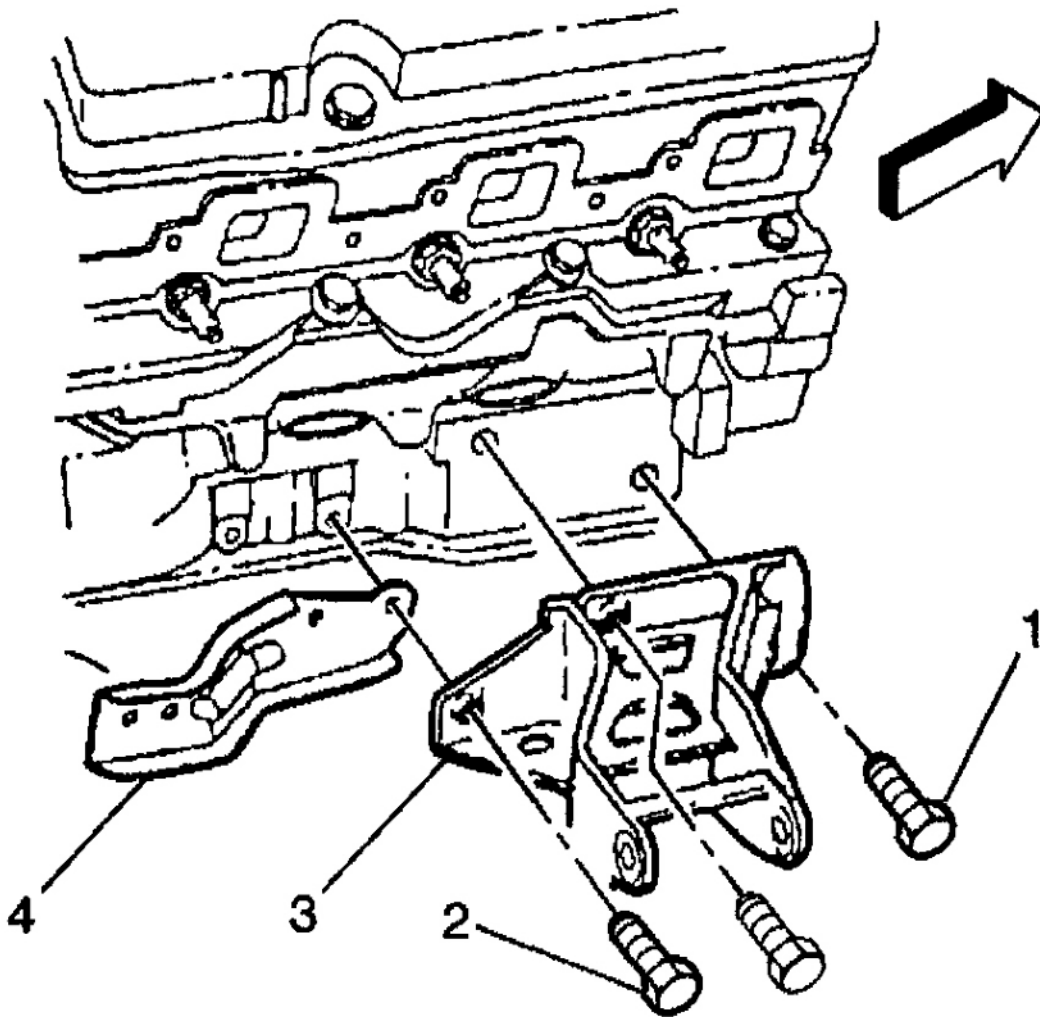
71. Remove the positive cable nut from the generator terminal.



G01728917

Fig. 260: Removing Positive Cable Nut From Generator Terminal
Courtesy of GENERAL MOTORS CORP.

72. Remove the generator from the engine.
73. Install a lifting device to the engine.
74. Remove the right engine mount bracket bolts (1, 2) and the right engine mount bracket (3).



G01728918

Fig. 261: Removing Right Engine Mount Bracket Bolts And Right Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

75. Remove the left engine mount bracket bolts (3).
76. Remove the left engine mount bracket stud (2) and the left engine mount bracket (1).

77. With the aide of an assistant, raise the engine and transmission from the crossmember.

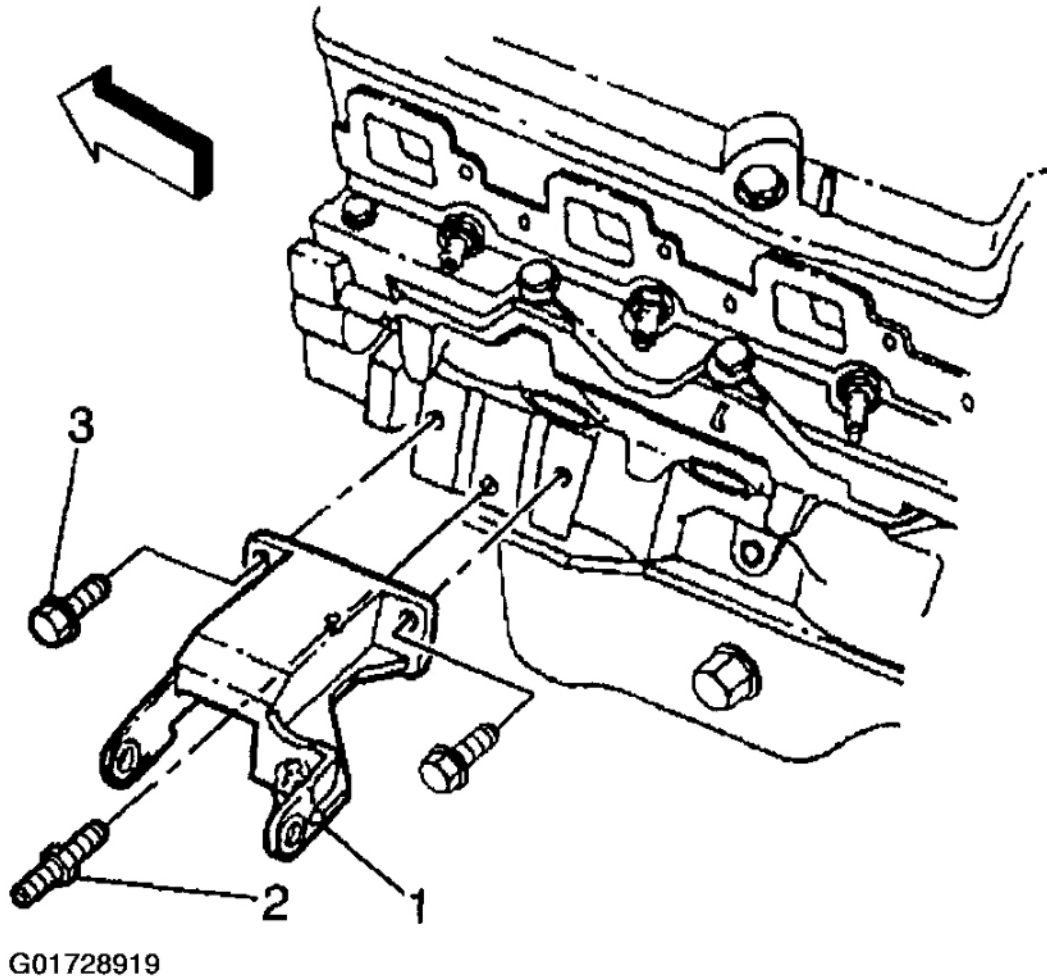
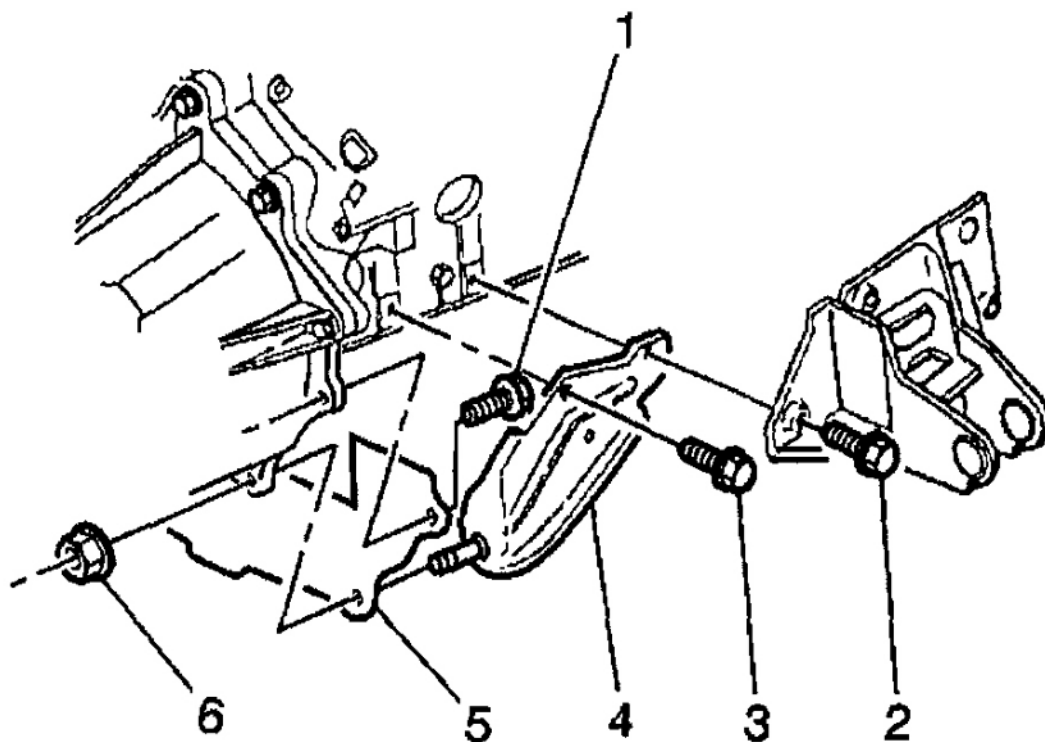


Fig. 262: Removing Left Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

78. If equipped with the automatic transmission remove the following from the right side:
- The transmission support brace bolts (1, 2, 3)
 - The transmission support nut (6)
 - The transmission support (4)



G01728920

Fig. 263: Removing Transmission Support Brace Bolts
Courtesy of GENERAL MOTORS CORP.

79. If equipped with the automatic transmission remove the following from the left side:
- The transmission support brace bolts (3, 5)
 - The transmission support nut (1)
 - The transmission support (4)

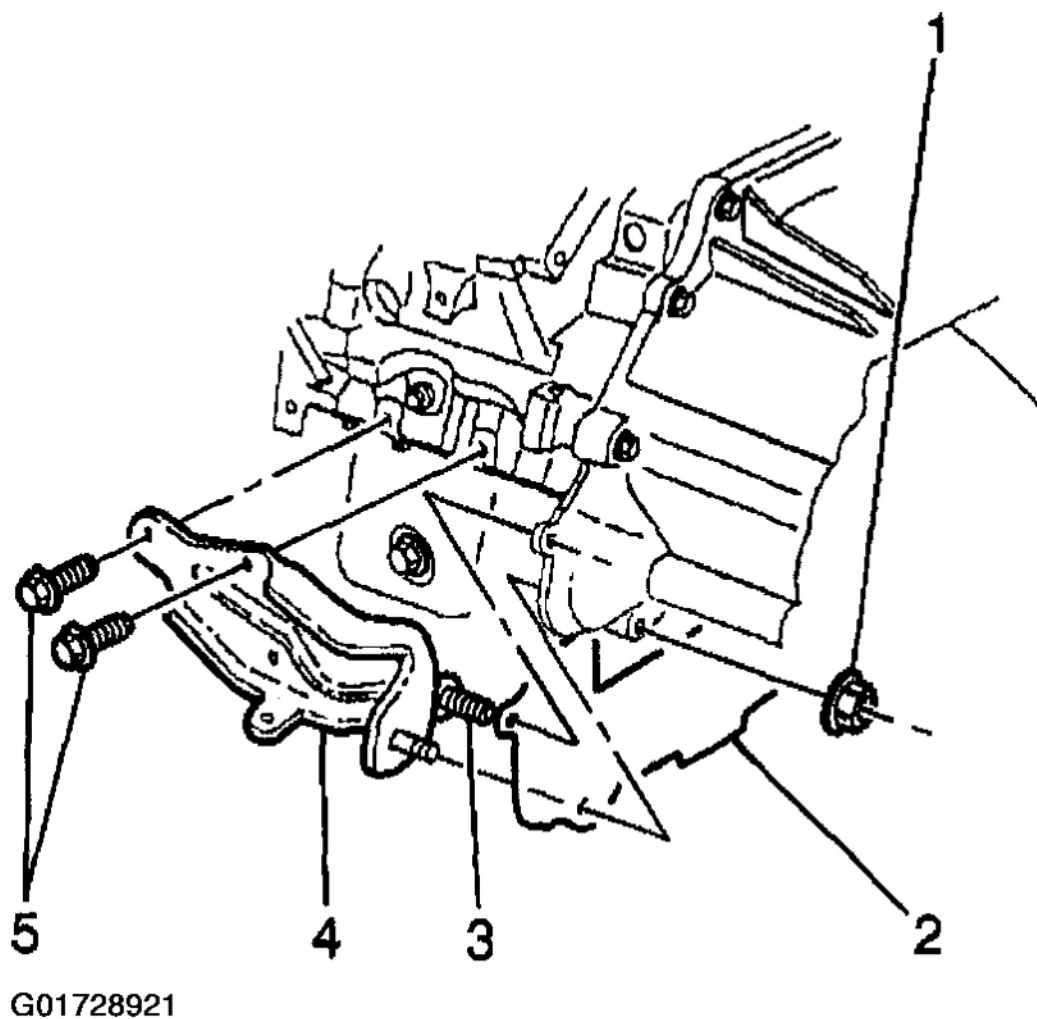
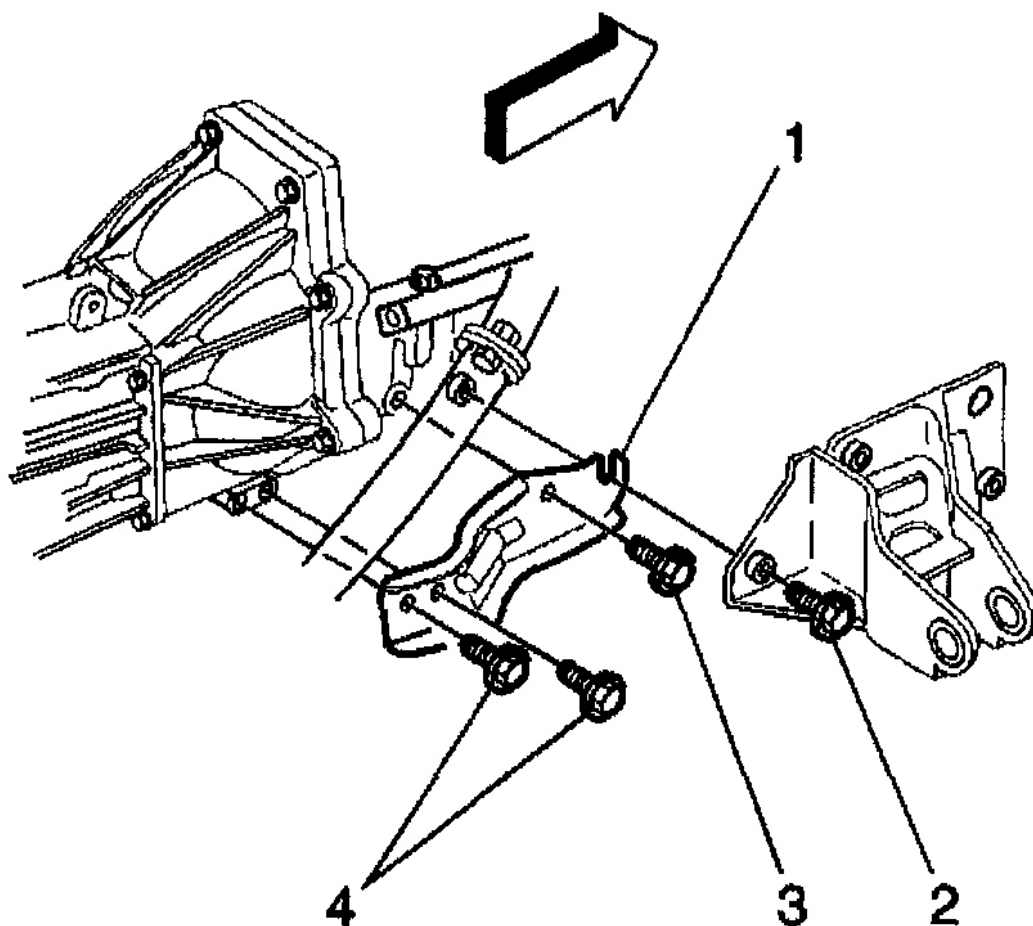


Fig. 264: Removing Transmission Support Brace Bolts
Courtesy of GENERAL MOTORS CORP.

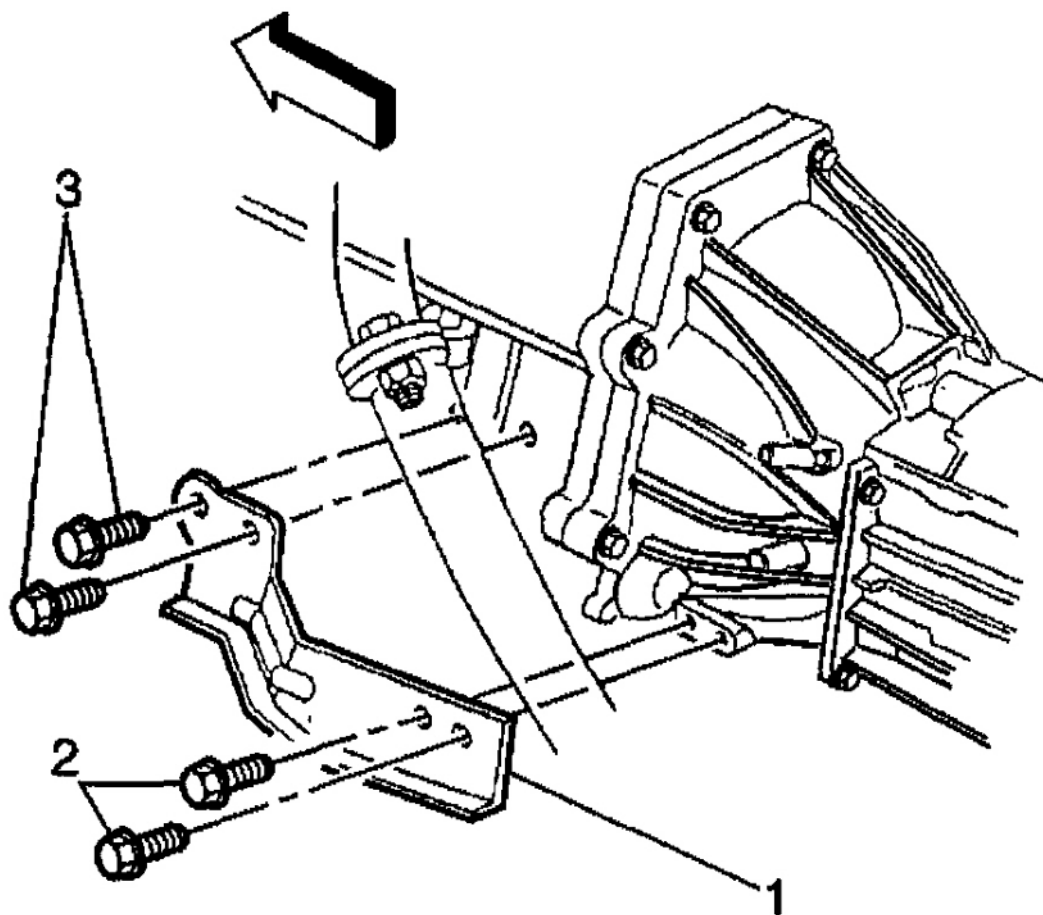
80. If equipped with the manual transmission remove the following from the right side:
- The transmission support bolts (3, 4)
 - The transmission support (1)



G01728922

Fig. 265: Removing Transmission Support Bolts
Courtesy of GENERAL MOTORS CORP.

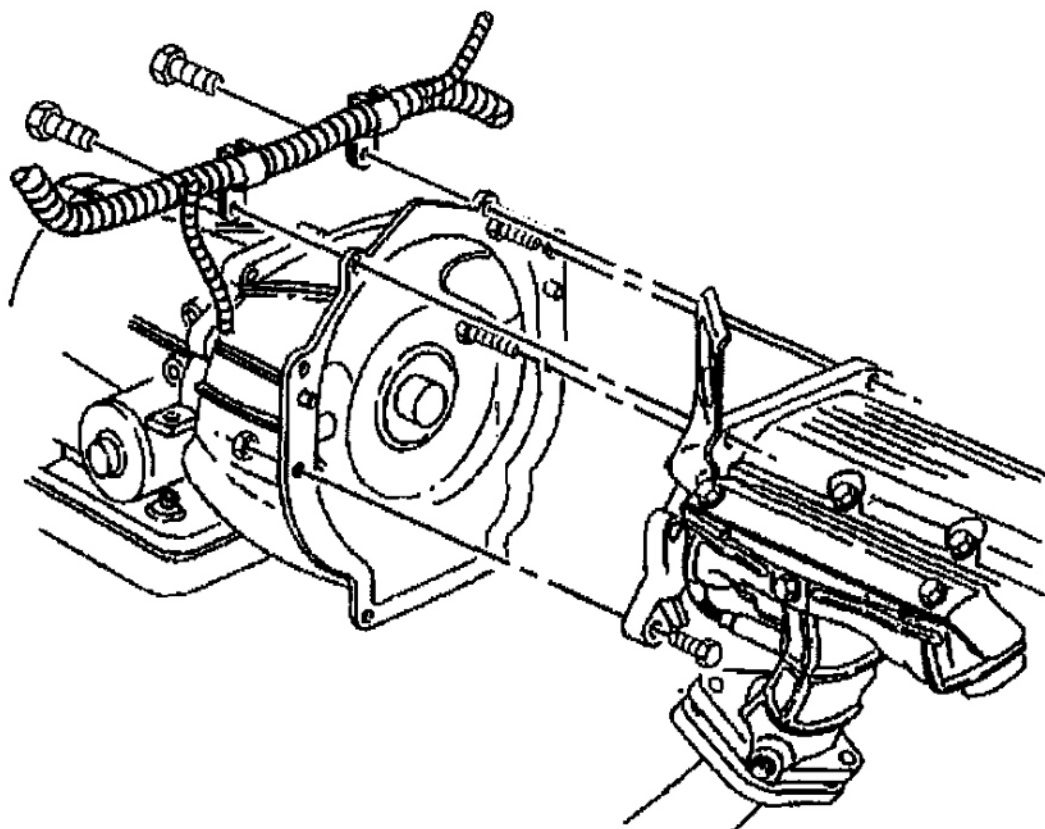
81. If equipped with the manual transmission remove the following from the left side:
- The transmission support bolts (2, 3)
 - The transmission support (1)



G01728923

Fig. 266: Removing Transmission Support Bolts
Courtesy of GENERAL MOTORS CORP.

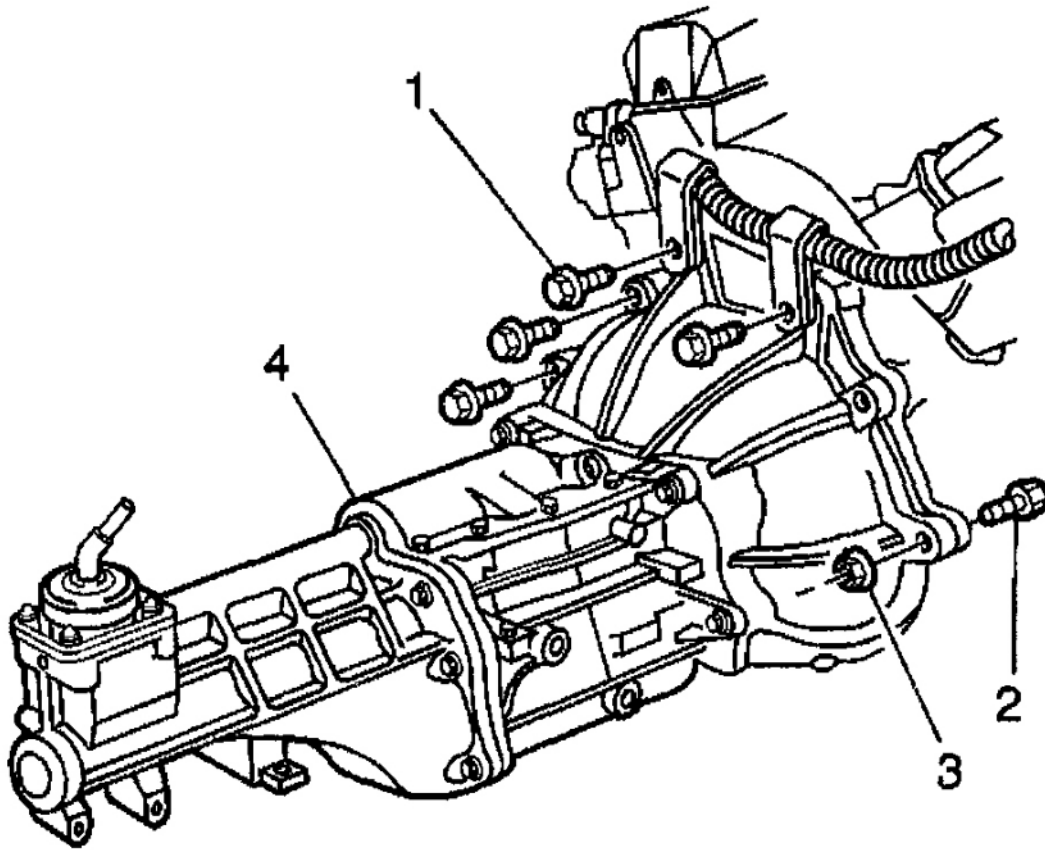
82. Disconnect the electrical connectors from the transmission.
83. Place the transmission on a suitable table.
84. For the automatic transmission, remove the transmission to engine bolts and nut.
85. Separate the engine from the transmission.
86. Attach the J 21366 to the transmission to secure the torque converter.



G01728924

Fig. 267: Removing Transmission To Engine Bolts And Nut (A/T)
Courtesy of GENERAL MOTORS CORP.

87. For the manual transmission, remove the transmission to engine bolts (1, 2) and nuts (3).



G01728925

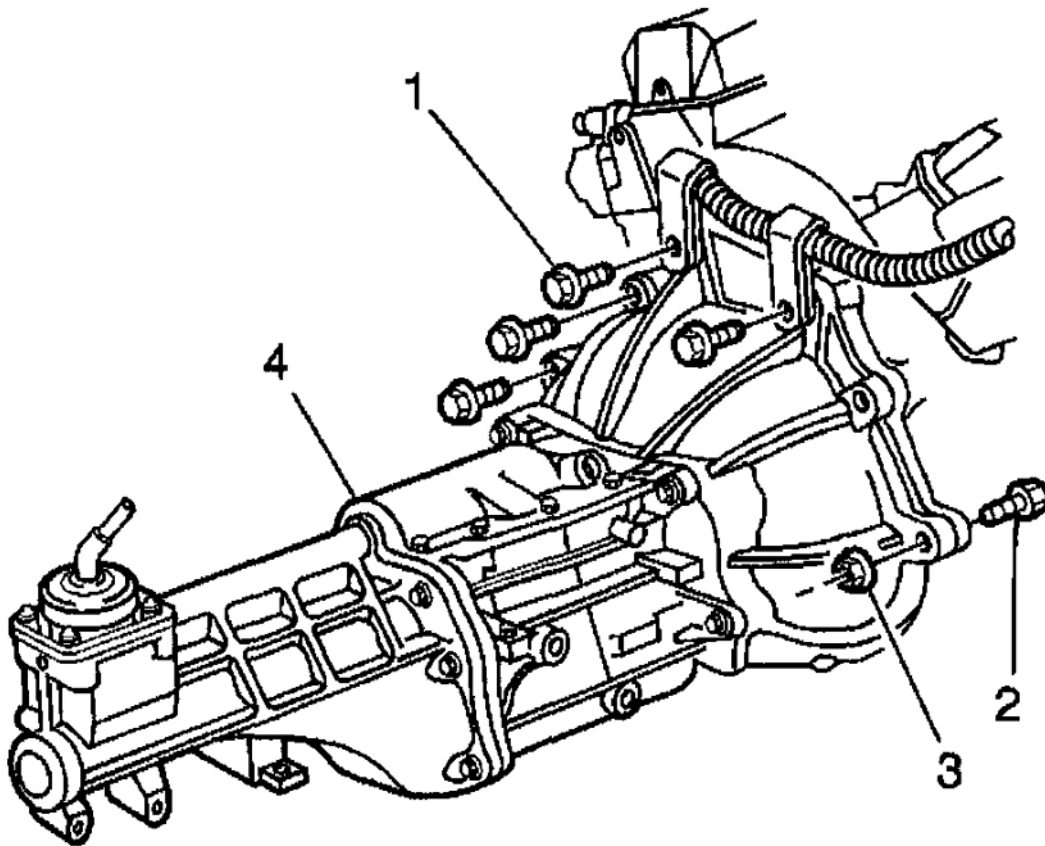
Fig. 268: Removing The Transmission To Engine Bolts And Nuts
Courtesy of GENERAL MOTORS CORP.

88. Separate the engine from the transmission.
89. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
90. Install the engine to an engine stand.
91. Remove the lifting device from the engine.
92. Disconnect and remove the engine wiring harness from the engine.
93. Remove the left and right exhaust manifolds. Refer to **EXHAUST MANIFOLD REPLACEMENT - LEFT (3.8 L)** and **EXHAUST MANIFOLD REPLACEMENT - RIGHT (3.8L)**.

Installation Procedure

1. Install the left and right exhaust manifolds. Refer to **EXHAUST MANIFOLD REPLACEMENT - LEFT (3.8 L)** or **EXHAUST MANIFOLD REPLACEMENT - RIGHT (3.8L)**.
2. Install and connect the engine wiring harness to the engine.

3. Install the lifting device to the engine.
4. Remove the engine from the engine stand.
5. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.
6. Install the engine to the transmission.



G01728926

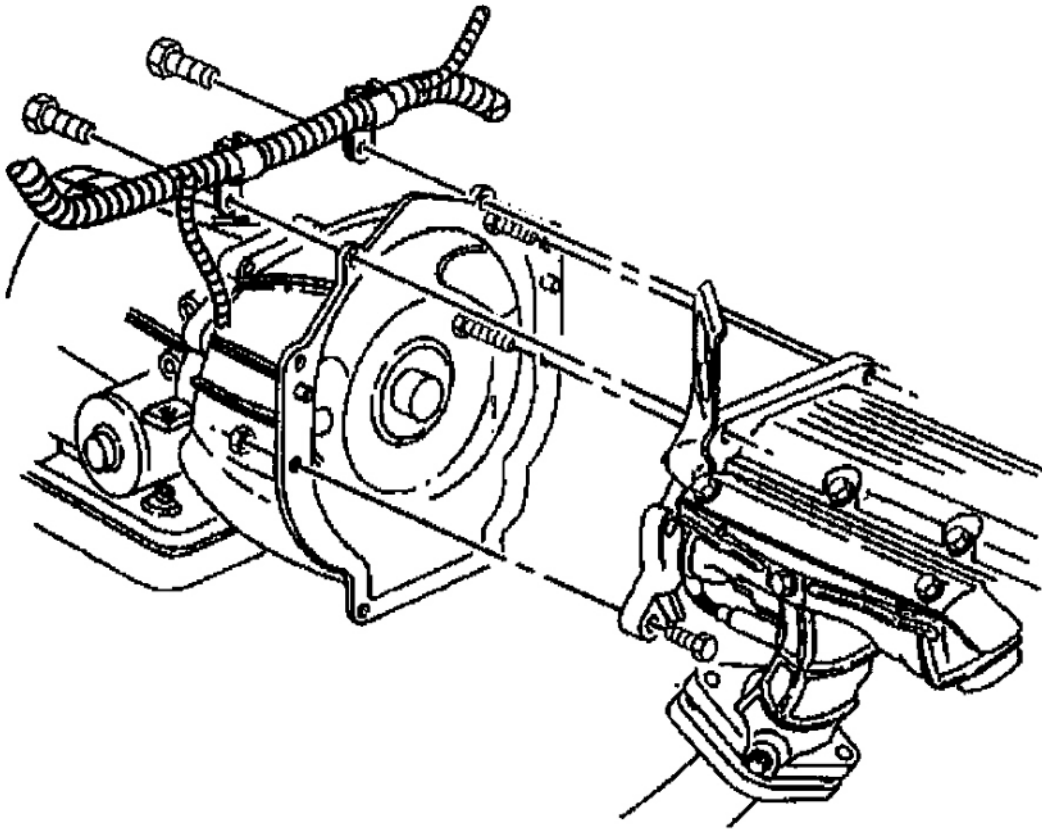
Fig. 269: Installing Engine To The Transmission
Courtesy of GENERAL MOTORS CORP.

7. For the manual transmission, install the flywheel housing to engine bolts (1, 2) and nuts (3).

Tighten

Tighten the flywheel housing to engine bolts (1, 2) and nuts (3) to 95 N.m (70 lb ft).

8. If equipped with an automatic transmission remove the J 21366 from the transmission.
9. For the automatic transmission, install the transmission to engine bolts and nut.



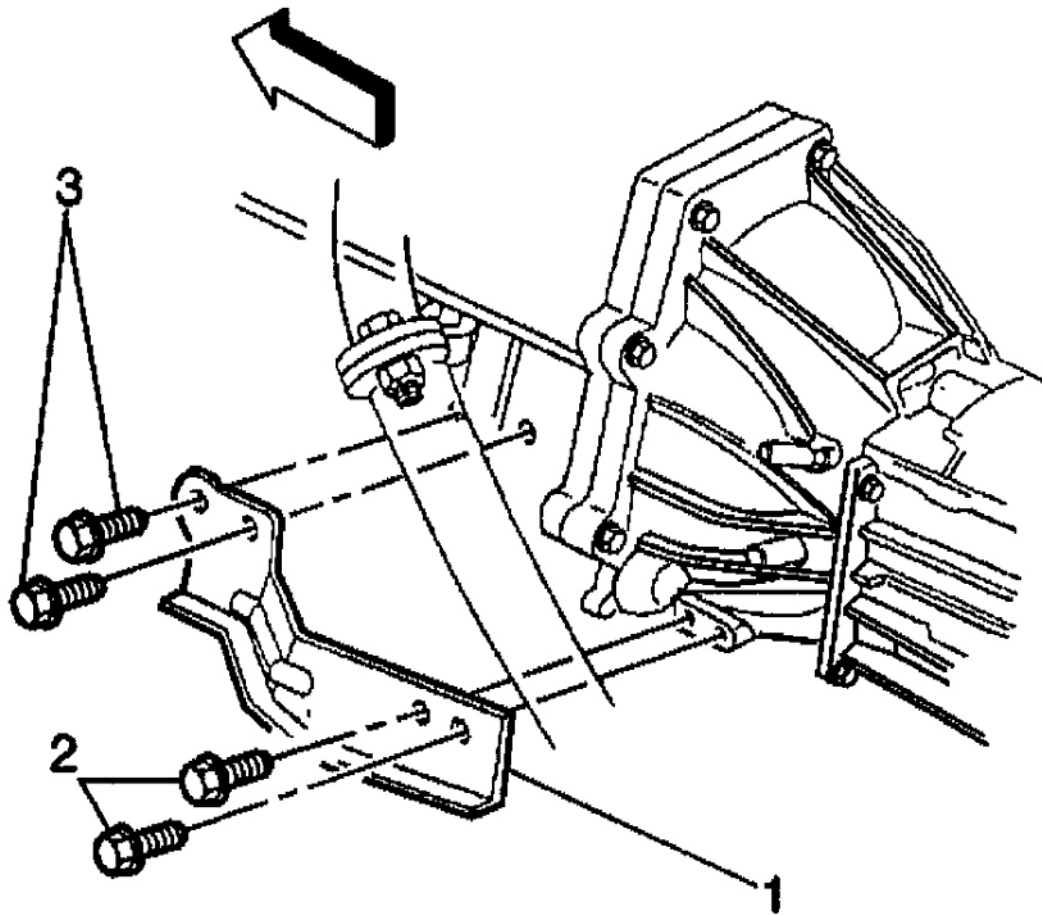
G01728927

Fig. 270: Installing The Transmission To Engine Bolts And Nut
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the transmission to engine bolts and nut to 95 N.m (70 lb ft).

10. Connect the electrical connectors to the transmission.
11. If equipped with the manual transmission install left side transmission support (1).



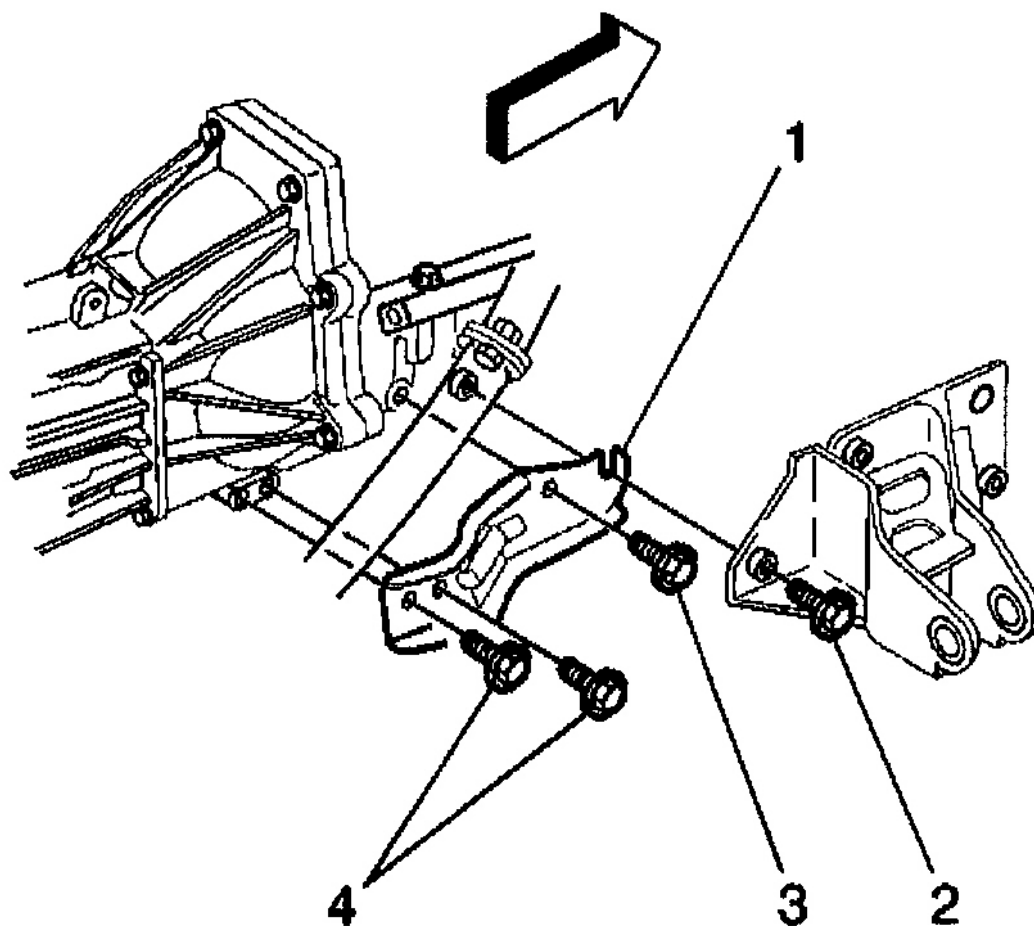
G01728928

Fig. 271: Installing Left Side Transmission Support
Courtesy of GENERAL MOTORS CORP.

12. Install the left side transmission support brace bolts (2, 3).

Tighten

- Tighten the left side transmission support brace bolts (2) to the transmission to 50 N.m (37 lb ft).
 - Tighten the left side transmission support brace bolts (3) to the engine to 28 N.m (21 lb ft).
13. If equipped with the manual transmission install right side transmission support (1).



G01728929

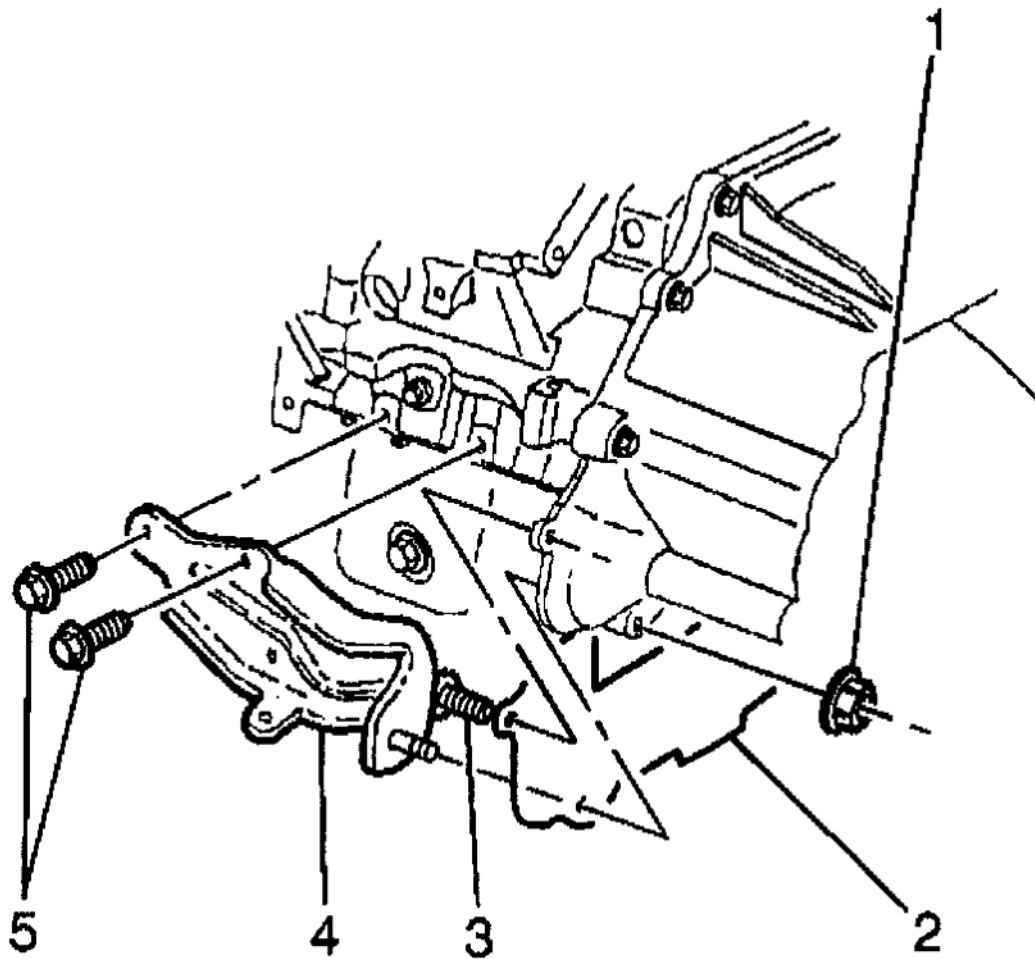
Fig. 272: Installing Right Side Transmission Support
Courtesy of GENERAL MOTORS CORP.

14. Install the right side transmission support brace bolts (3, 4).

Tighten

Tighten the right side transmission support brace bolts (3, 4) to 50 N.m (37 lb ft).

15. If equipped with the automatic transmission install left side transmission support (4).



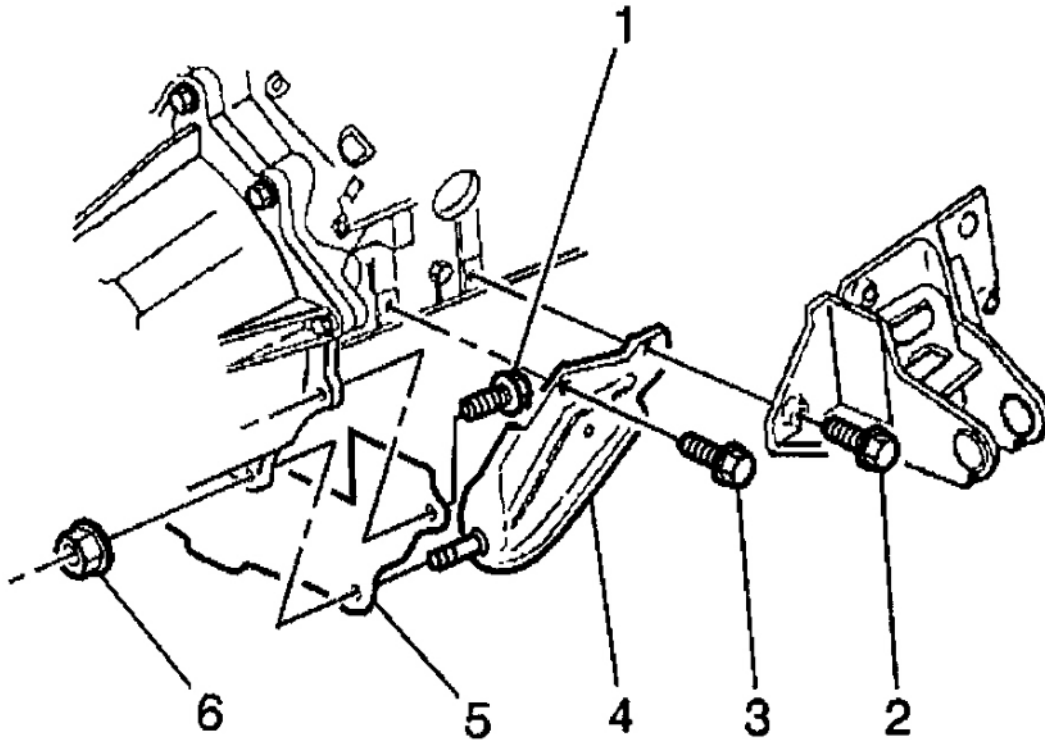
G01728930

Fig. 273: Installing Left Side Transmission Support
 Courtesy of GENERAL MOTORS CORP.

16. Install the left side transmission support bolts (3, 5).
17. Install the left side transmission support nut (1).

Tighten

- Tighten the left side transmission support bolt (3) to 8.5 N.m (75 lb in).
 - Tighten the left side transmission support bolt (5) to 28 N.m (21 lb ft).
 - Tighten the left side transmission support nut (1) to 80 N.m (59 lb ft).
18. If equipped with the automatic transmission install right side transmission support (4).



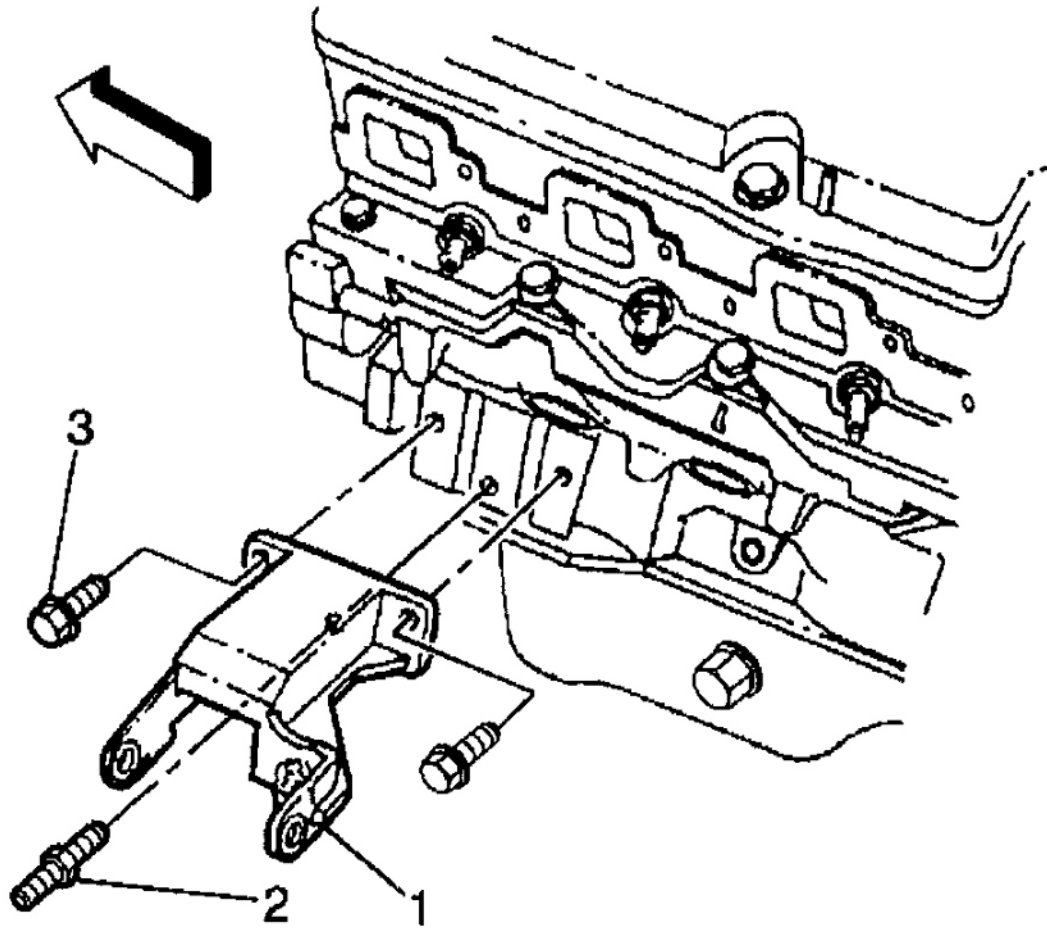
G01728931

Fig. 274: Installing Right Side Transmission Support
Courtesy of GENERAL MOTORS CORP.

19. Install the right side transmission support brace bolts (1, 2, 3).
20. Install the right side transmission support nut (6).

Tighten

- Tighten the right side transmission support brace bolt (1) to 8.5 N.m (75 lb in).
 - Tighten the right side transmission support bolts (2,3) to 50 N.m (37 lb ft).
 - Tighten the right side transmission support nut (6) to 80 N.m (59 lb ft).
21. With the aide of an assistant, lower the engine and transmission to the crossmember.
 22. Install the left engine mount bracket (1) and mount bracket stud (2).



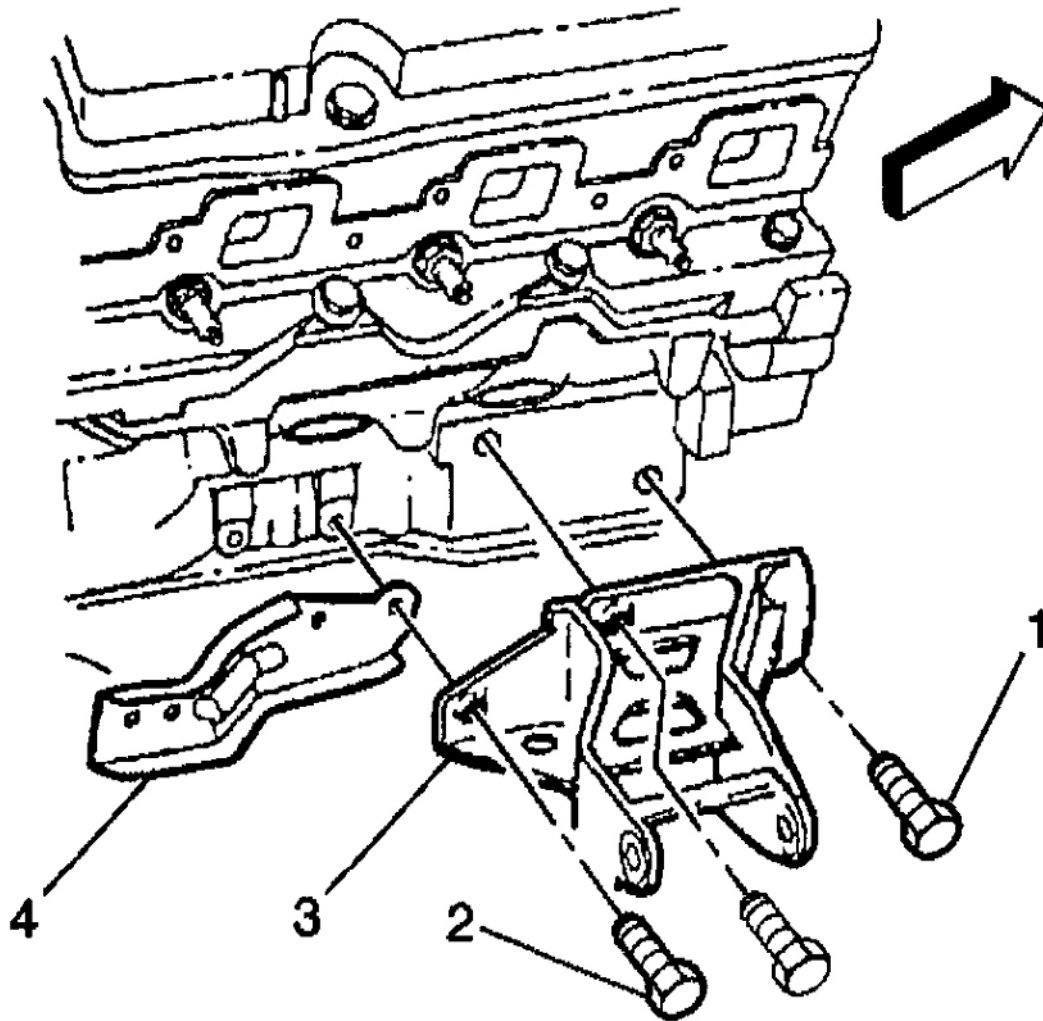
G01728932

Fig. 275: Installing Left Engine Mount Bracket And Mount Bracket Stud
Courtesy of GENERAL MOTORS CORP.

23. Install the left engine mount bracket bolts (3).

Tighten

- Tighten the left engine mount bracket bolt (3) to 102 N.m (75 lb ft).
 - Tighten the left engine mount bracket stud (2) to 87 N.m (64 lb ft).
24. Install the right engine mount bracket (3) and the engine mount bracket bolts (1, 2).



G01728933

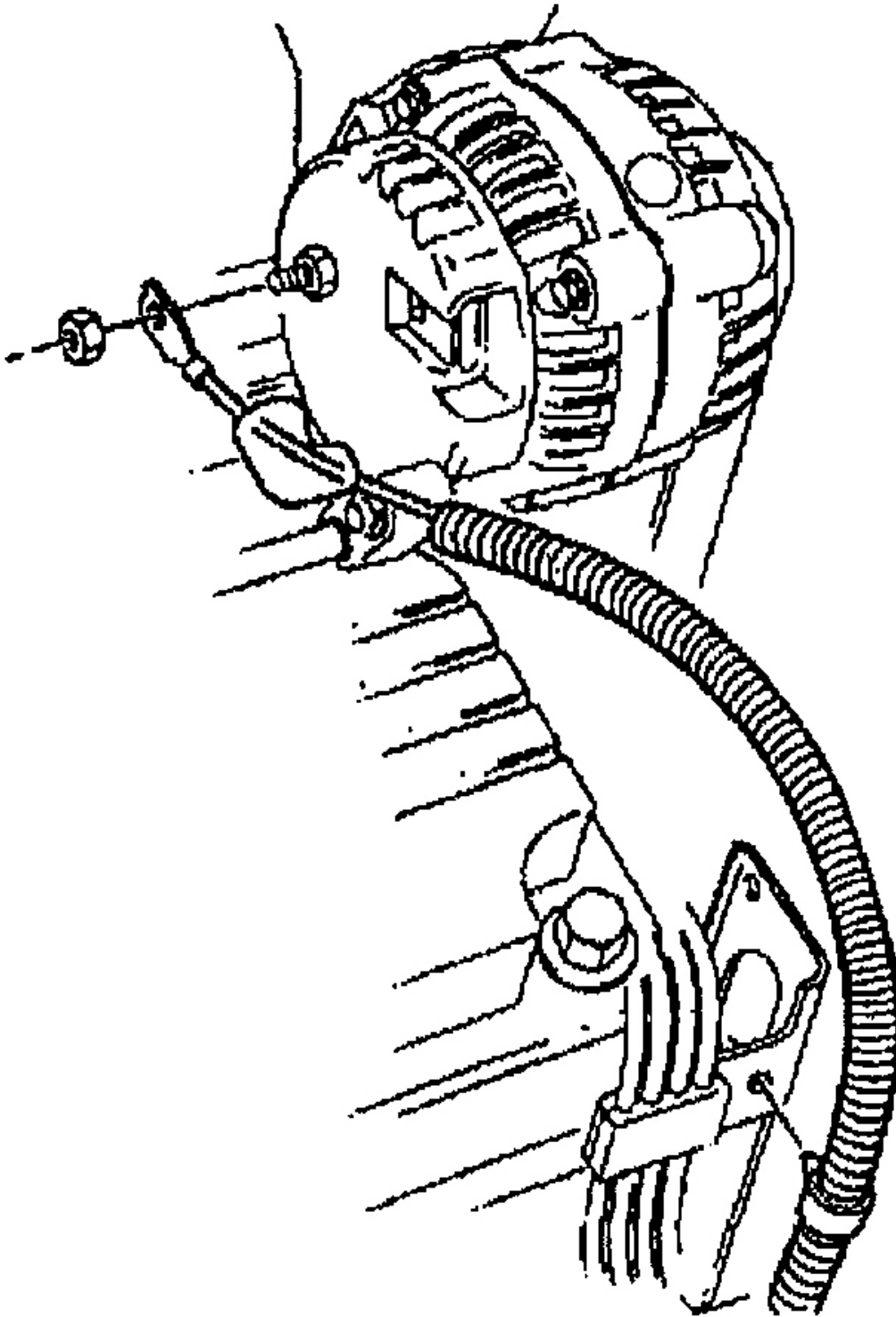
Fig. 276: Installing Right Engine Mount Bracket And Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

- Tighten the two right engine mount bracket bolts (1) to 102 N.m (75 lb ft).
- Tighten the right engine mount bracket bolt (2) to 50 N.m (37 lb ft).

25. Remove the lifting device from the engine.

26. Install the generator to the engine.



G01728934

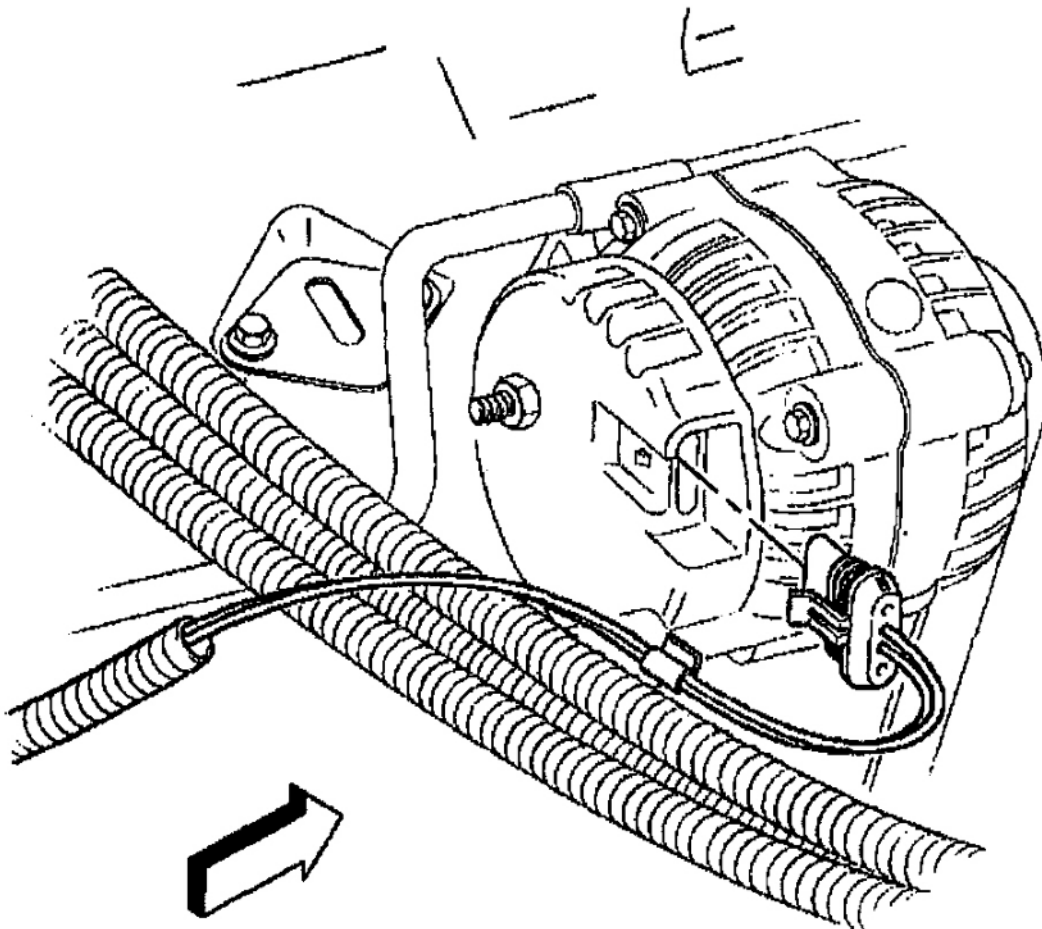
Fig. 277: Installing Generator To Engine
Courtesy of GENERAL MOTORS CORP.

27. Install the positive cable nut to the generator terminal.

Tighten

Tighten the positive cable nut to generator terminal to 22 N.m (16 lb ft).

28. Connect the generator electrical connector.

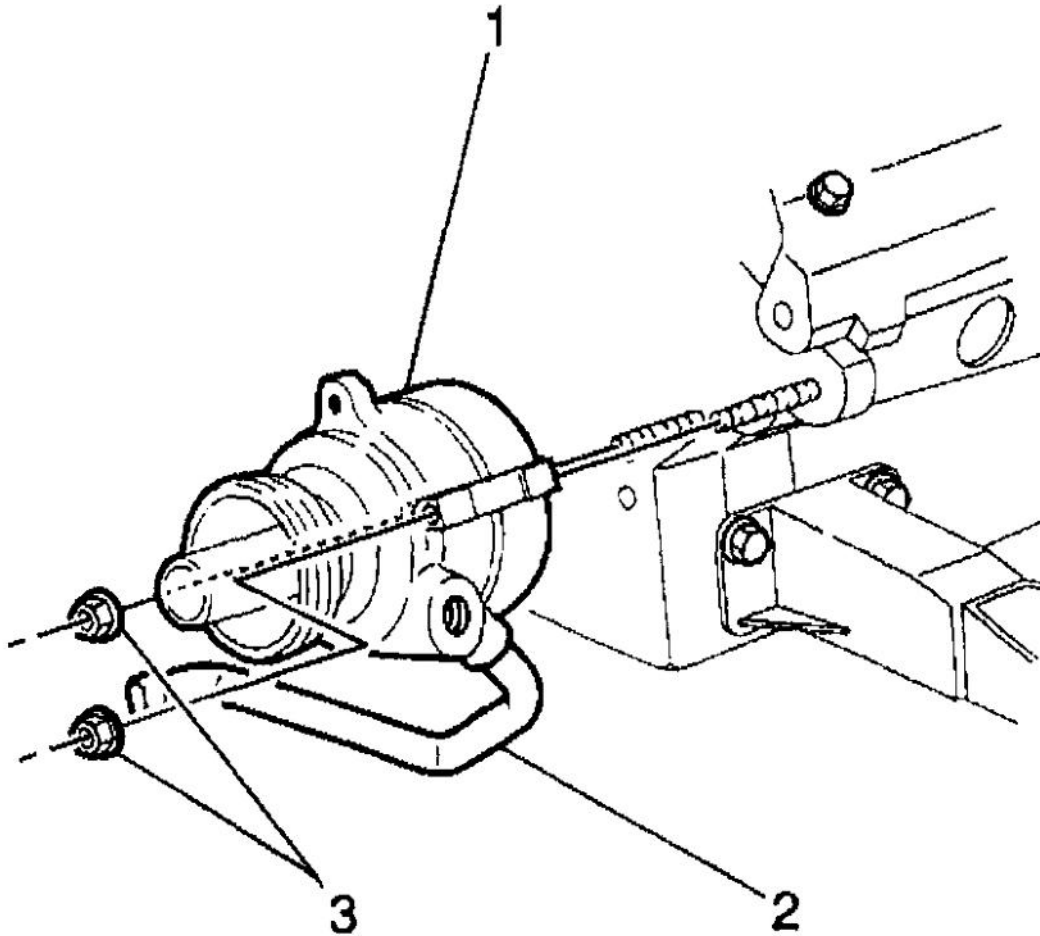


G01728935

Fig. 278: Connecting Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

29. Install the power steering pump.

30. Install the power steering pump nuts (3).



G01728936

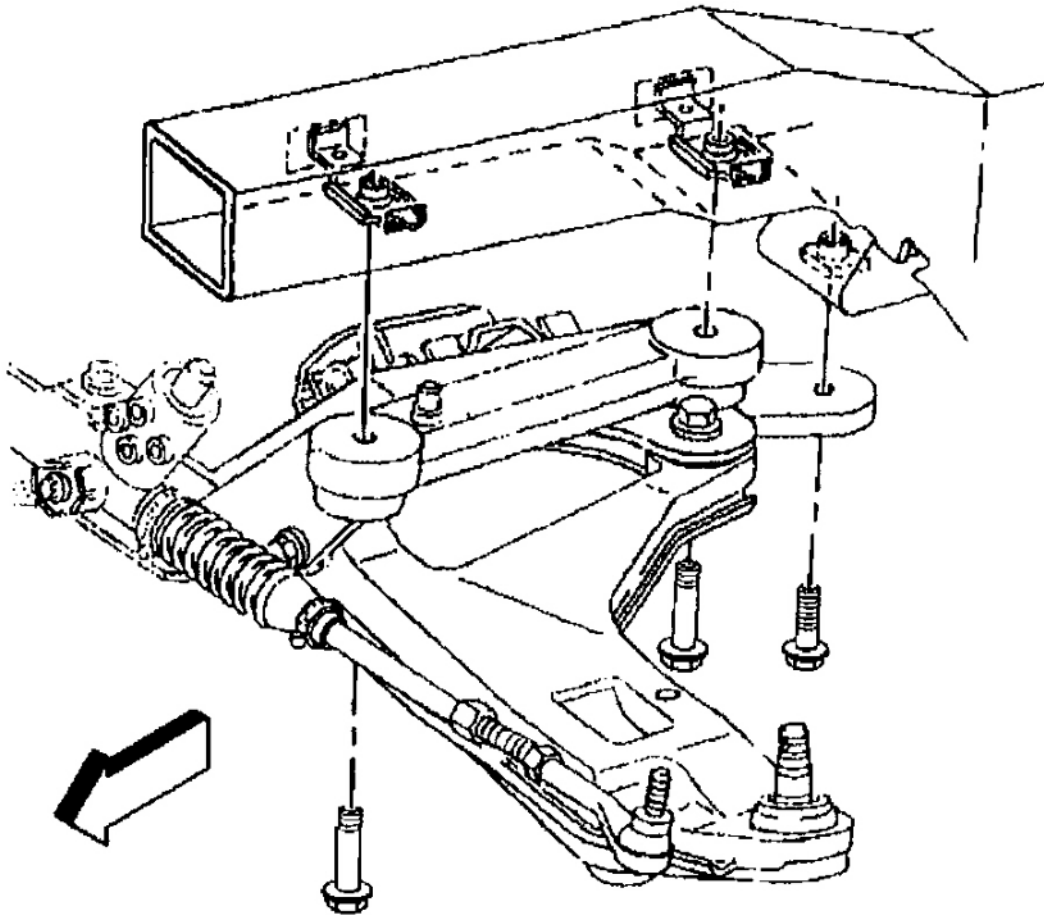
Fig. 279: Installing Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the power steering nuts (3) to 30 N.m (22 lb ft).

31. Install the A/C compressor bracket and compressor. Refer to **COMPRESSOR** .
32. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
33. Remove the safety straps from the crossmember and J 39580.
34. Lower the vehicle and install the engine and transmission to the vehicle.

35. Align the crossmember to the vehicle body.
36. Install the front crossmember bolts.

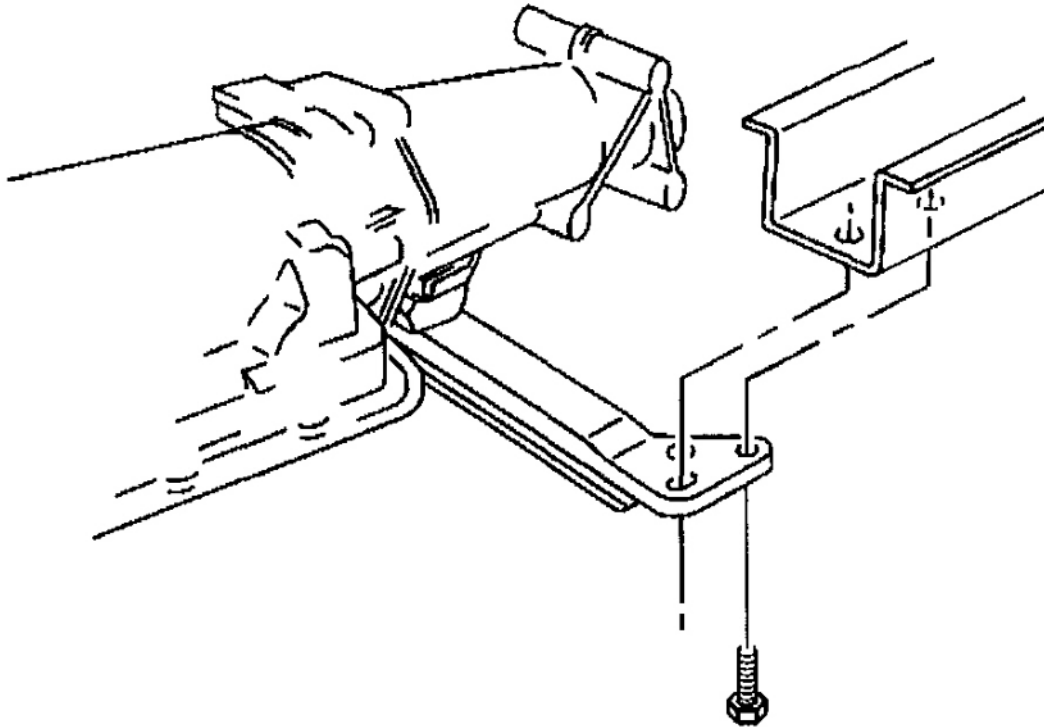


G01728937

Fig. 280: Installing Front Crossmember Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

- Tighten the four crossmember bolts to 125 N.m (92 lb ft).
 - Tighten the two crossmember bolts to 145 N.m (107 lb ft).
37. Install the transmission support bolts.



G01728938

Fig. 281: Installing Transmission Support Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

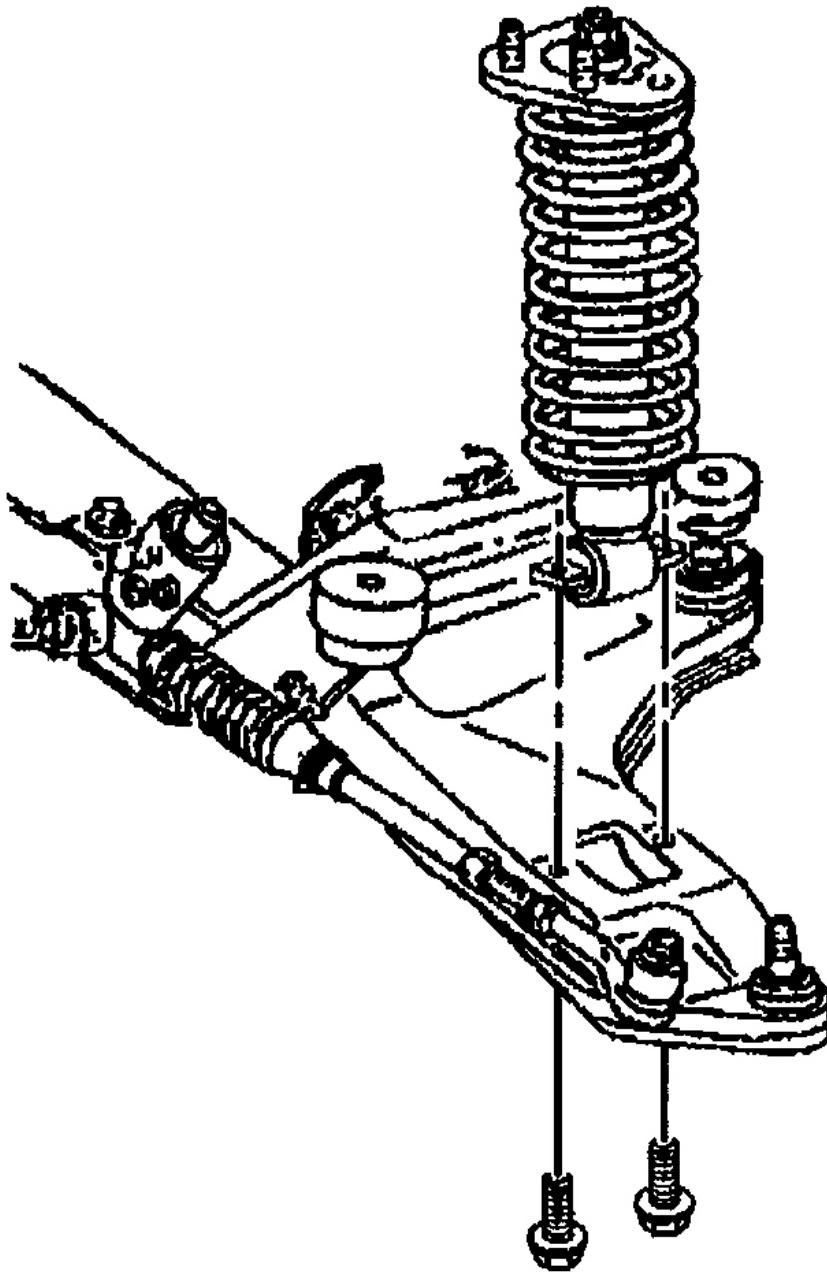
Tighten the transmission support bolts to 57 N.m (42 lb ft).

38. Raise the vehicle.
39. Remove the J 39580 from under the vehicle.
40. Install the ball joints to the steering knuckles.
41. Install the left and right upper ball joint nuts.

Tighten

Tighten the upper ball joint nuts to 53 N.m (39 lb ft).

42. Install the cotter pins to the left and right upper ball joints.
43. Install the right and left side shock absorber lower mounting bolts.



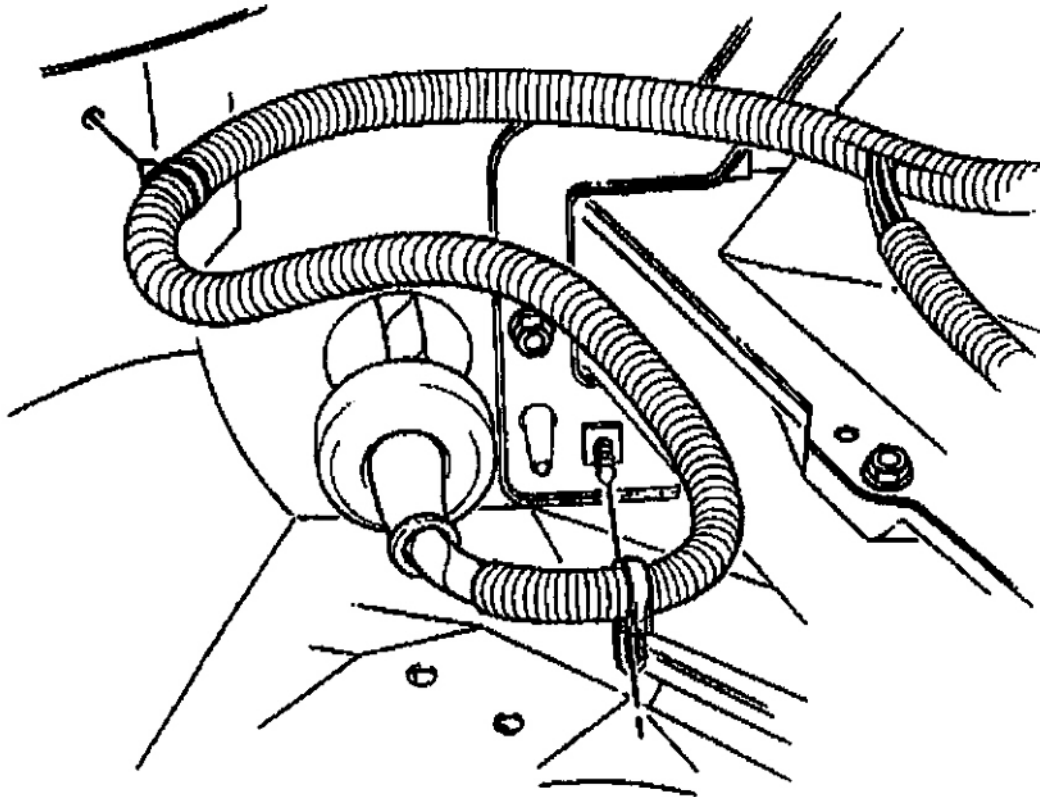
G01728939

Fig. 282: Installing Right And Left Side Shock Absorber Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the shock absorber lower mounting bolts to 65 N.m (48 lb ft).

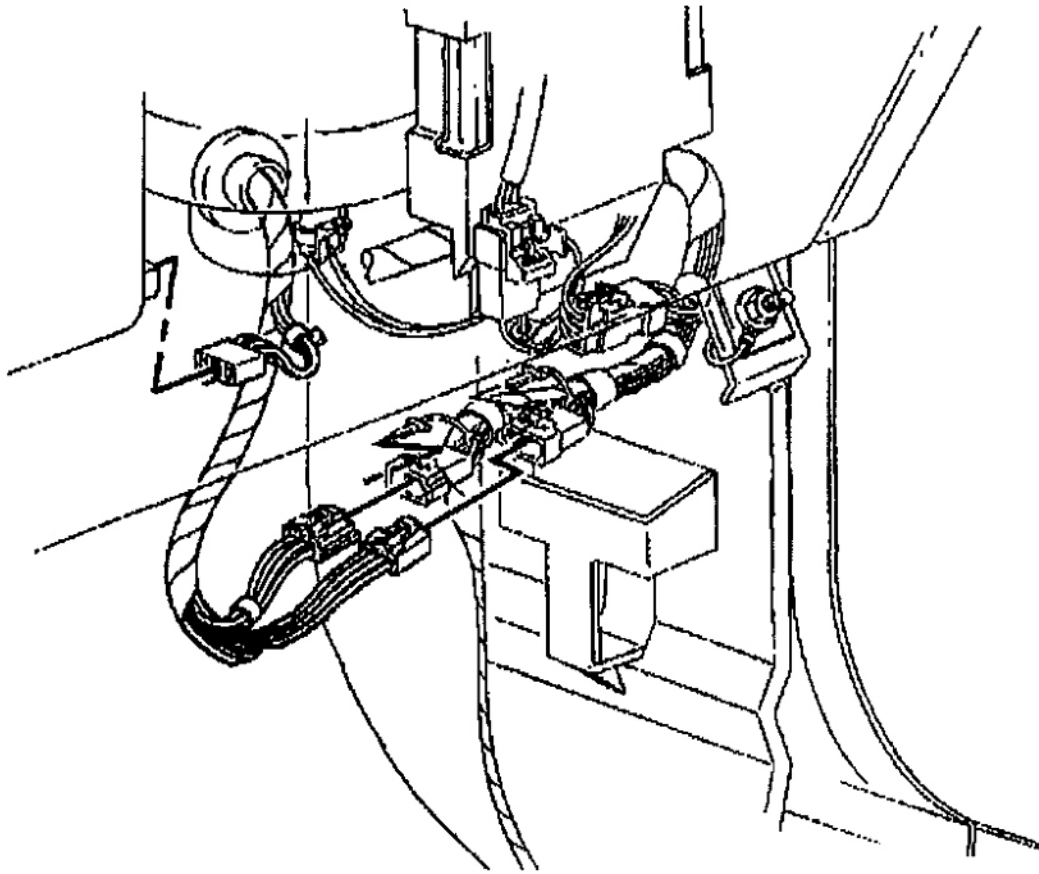
44. Lower the vehicle.
45. If equipped with the manual transmission Install the transmission control.
46. Install the engine wire harness through the front of the cowl.



G01728940

Fig. 283: Installing Engine Wire Harness
Courtesy of GENERAL MOTORS CORP.

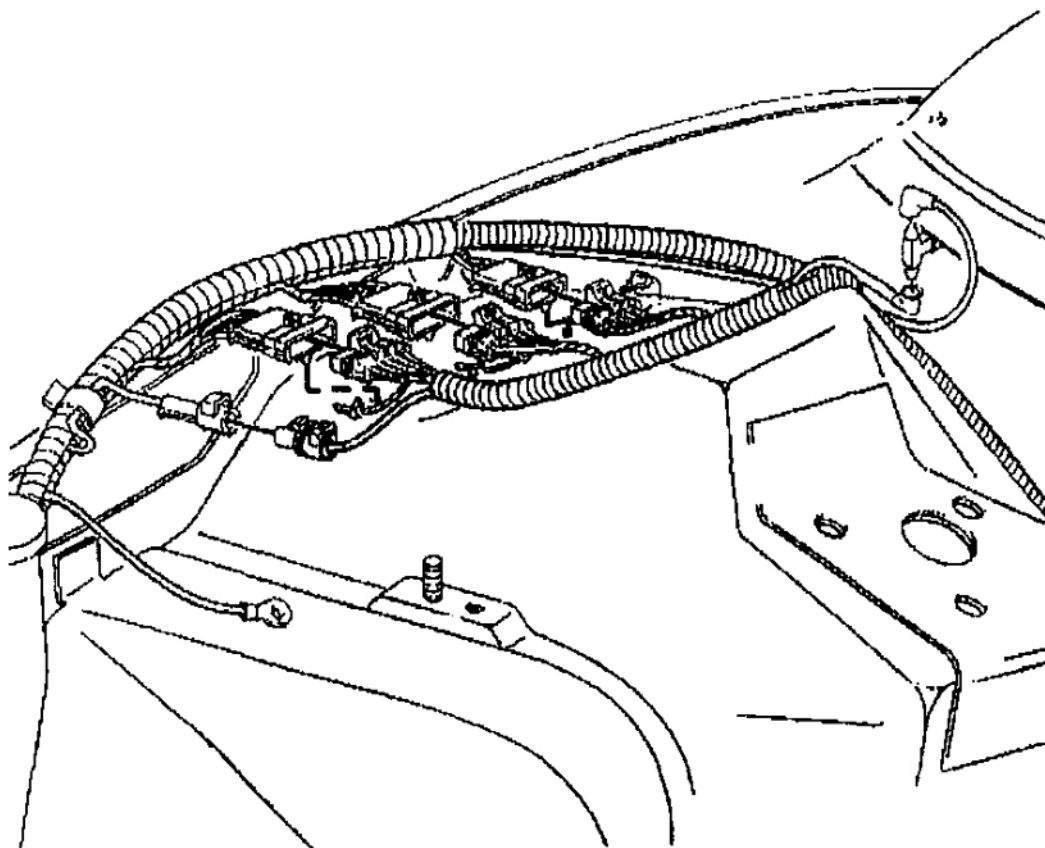
47. Connect the engine wiring harness to the instrument panel wiring harness.



G01728941

Fig. 284: Connecting Engine Wiring Harness To Instrument Panel Wiring Harness
Courtesy of GENERAL MOTORS CORP.

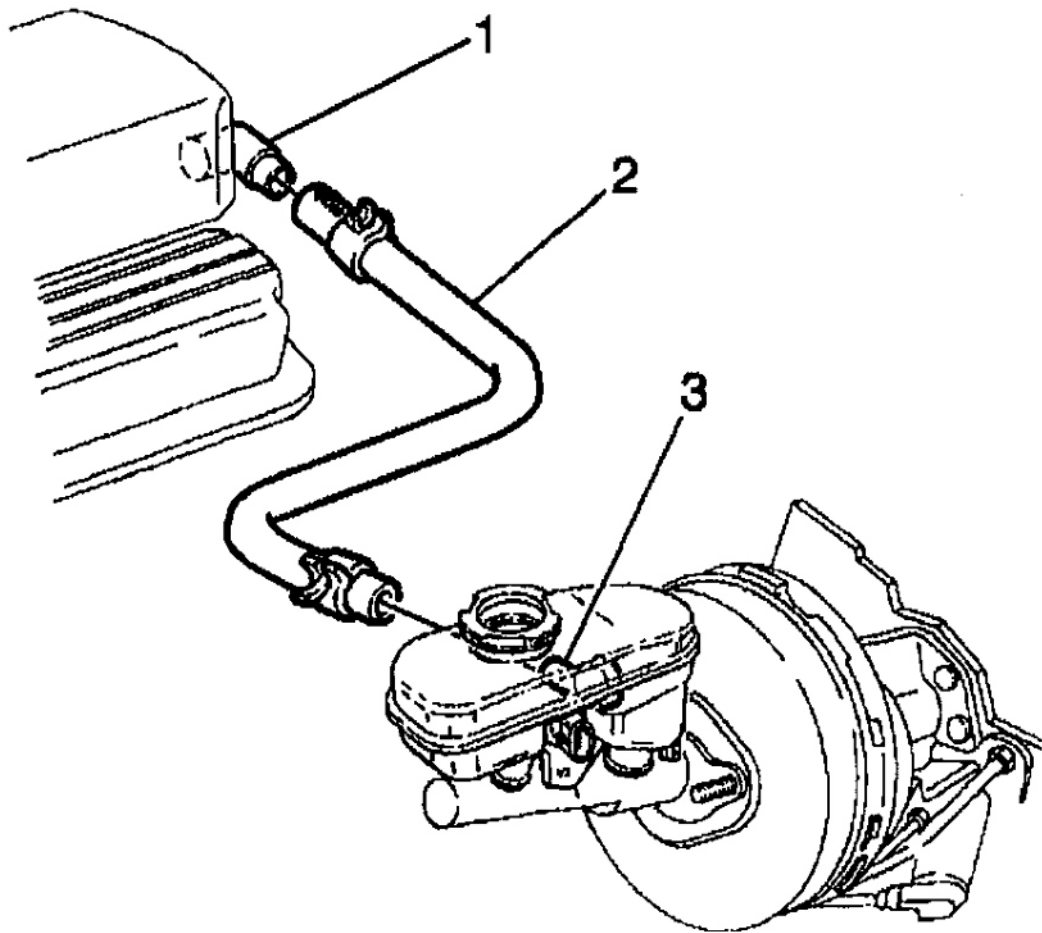
48. Install the hinge pillar trim panel.
49. Install the right side insulator panel.
50. Install the PCM. Refer to **POWERTRAIN CONTROL MODULE** .
51. Install the engine harness vacuum tube to the bottom of the vacuum check valve.



G01728942

Fig. 285: Installing Engine Harness Vacuum Tube
Courtesy of GENERAL MOTORS CORP.

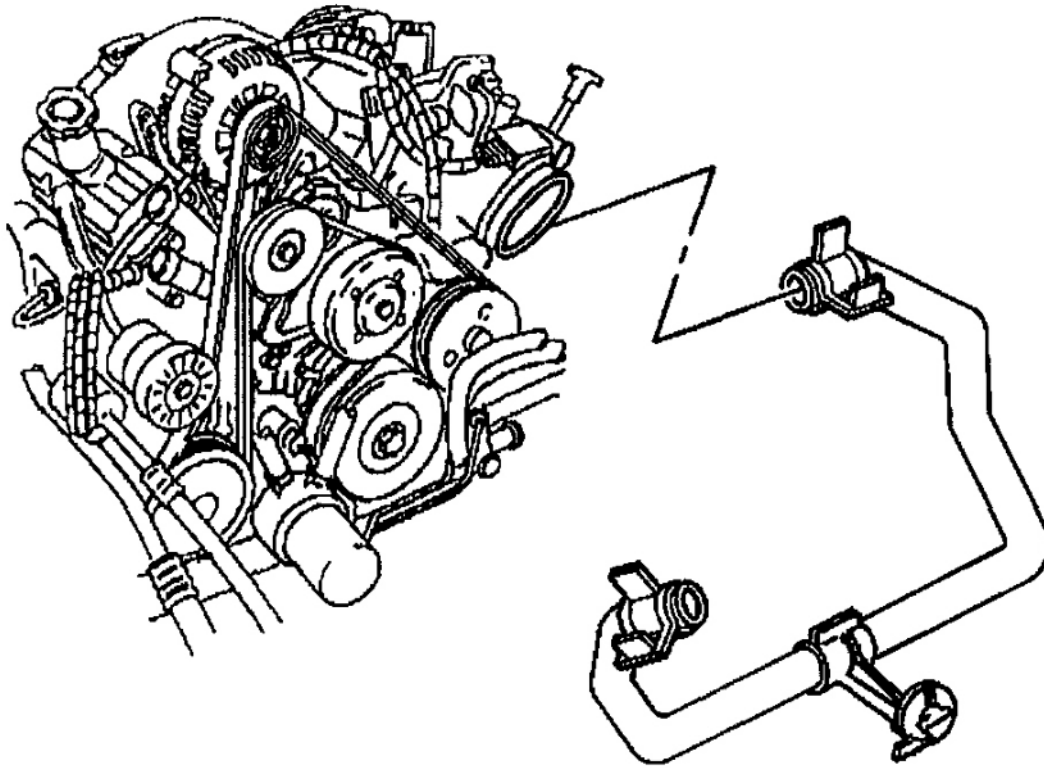
52. Connect the forward lamp harness to the engine harness.
53. Install the front 2 brake pipes to the brake modulator.
54. Install the brake booster vacuum hose (2) to the intake manifold fitting (1).



G01728943

Fig. 286: Installing Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

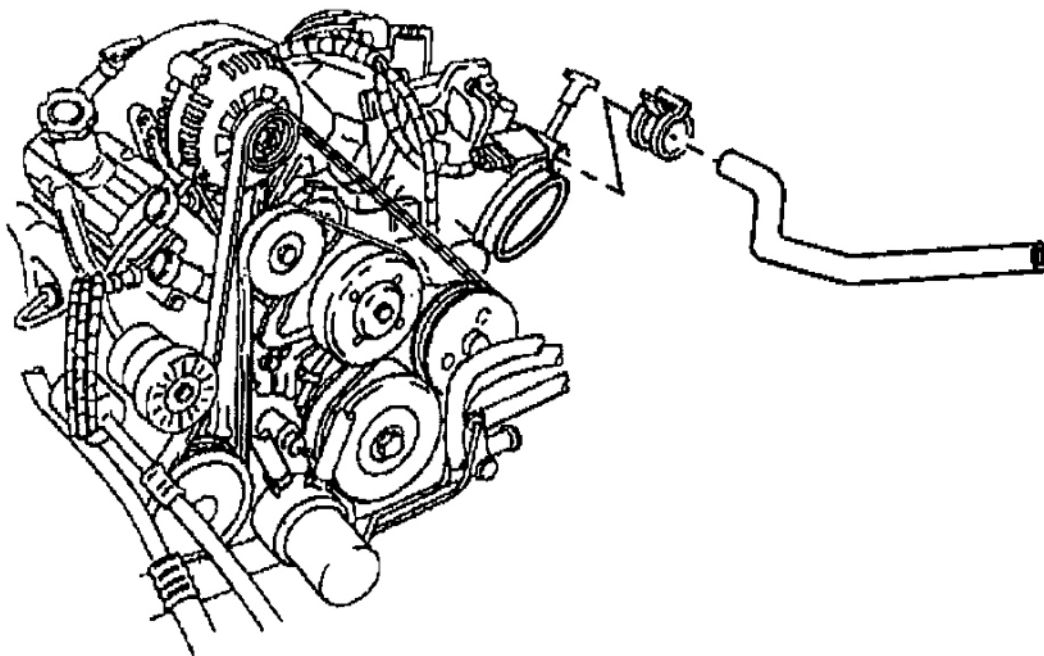
55. Install the outlet hose to the coolant pump.



G01728944

Fig. 287: Installing Outlet Hose To Coolant Pump
Courtesy of GENERAL MOTORS CORP.

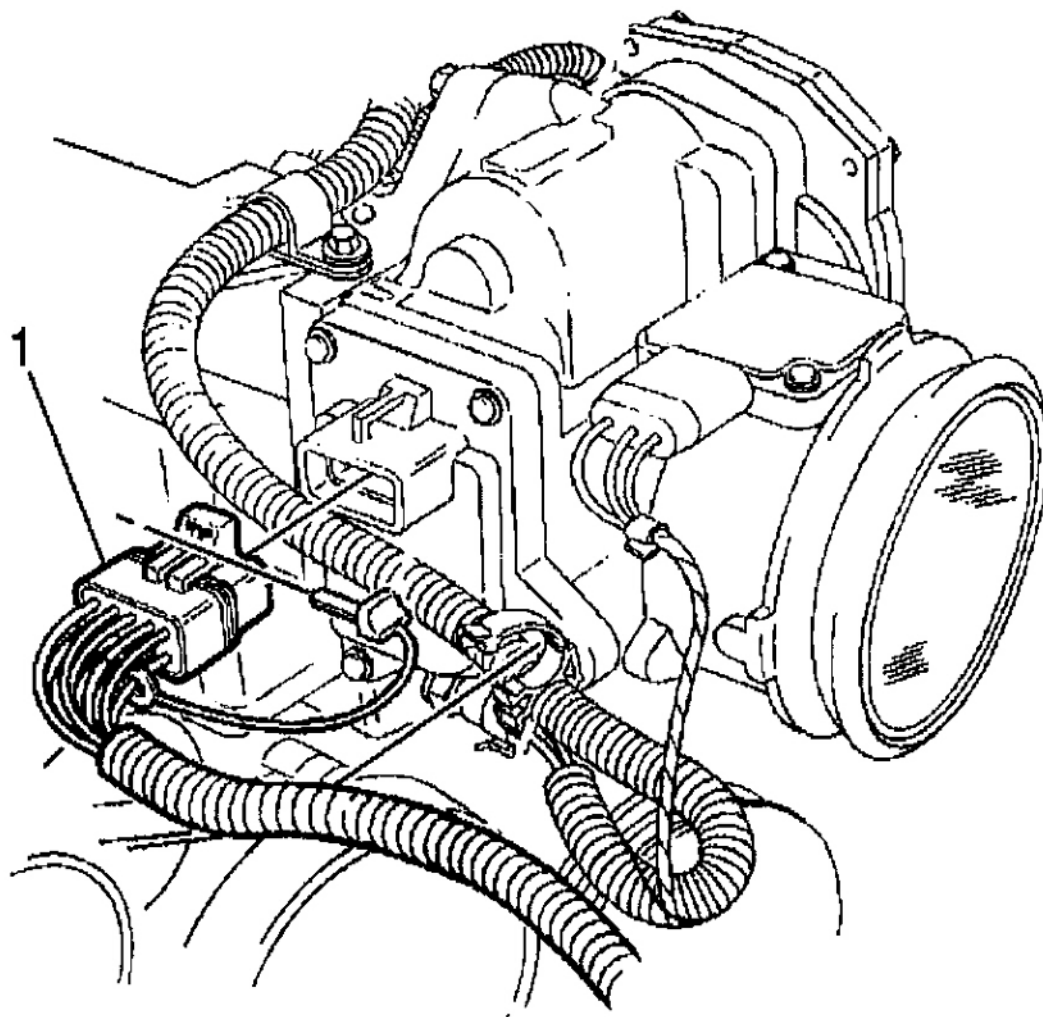
56. Install the inlet hose to the water outlet.



G01728945

Fig. 288: Installing Inlet Hose To Water Outlet
Courtesy of GENERAL MOTORS CORP.

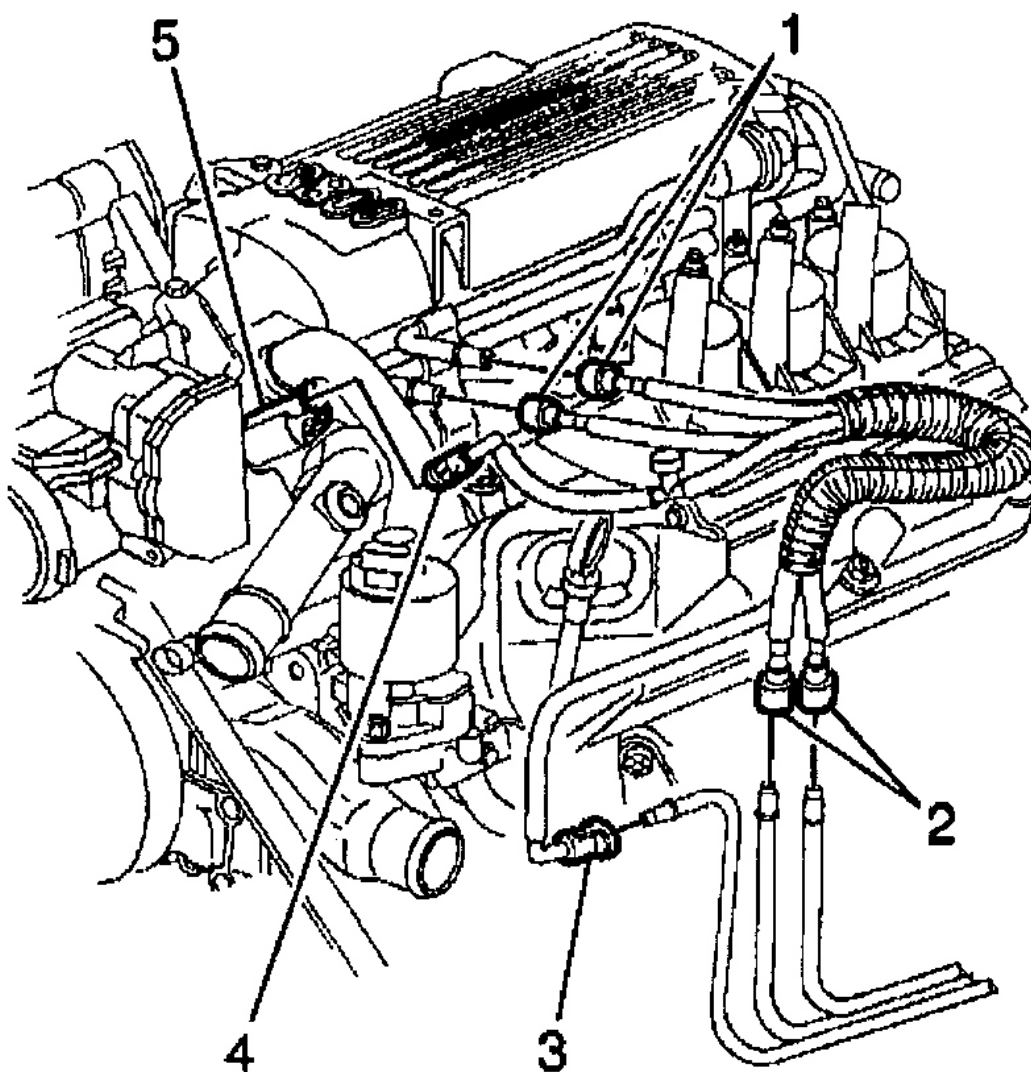
57. Install the forward lamp harness to the wiring harness clip.
58. Connect the electronic throttle control (ETC) electrical connector (1).



G01728946

Fig. 289: Connecting Electronic Throttle Control (ETC) Electrical Connector
Courtesy of GENERAL MOTORS CORP.

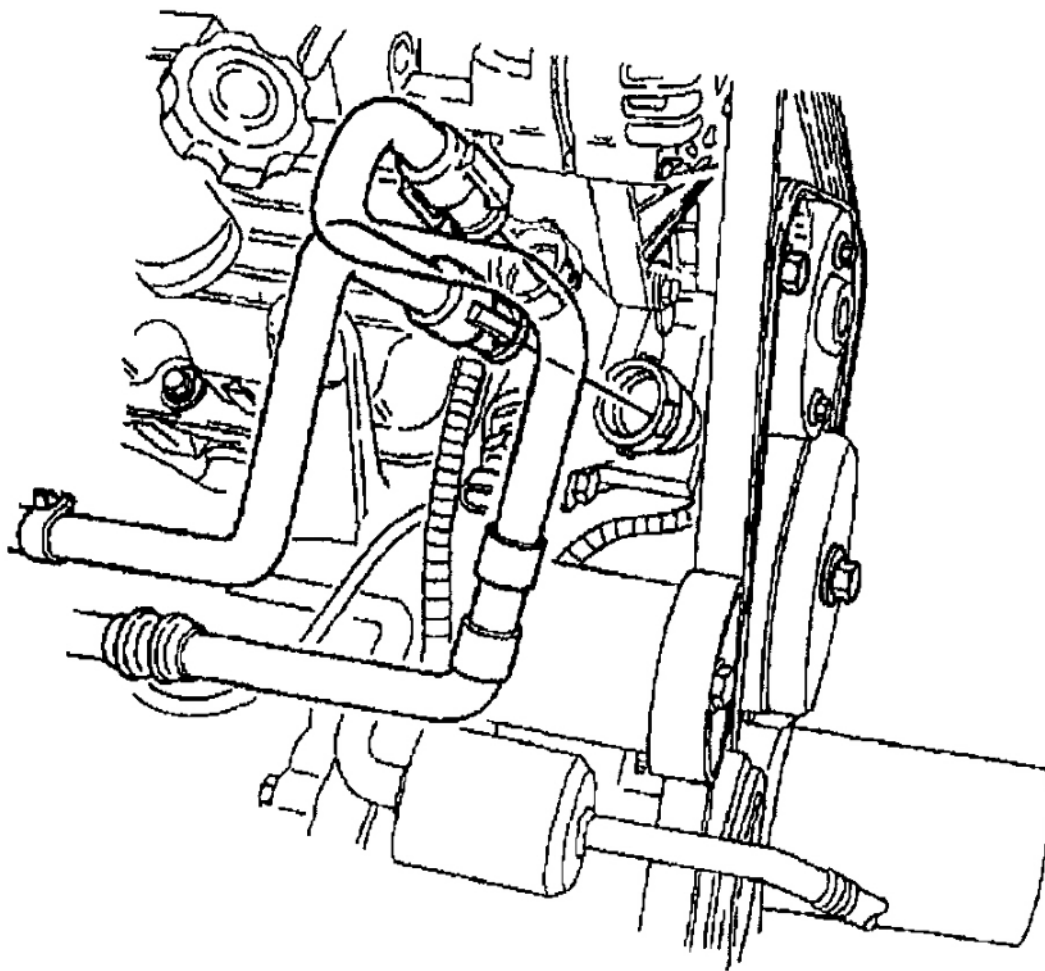
59. Install the fuel vapor line (4) to the EVAP canister purge valve (5).



G01728947

Fig. 290: Installing Fuel Vapor Line To EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

60. Install the fuel pipes (2) to the fuel rail.
61. Install the heater hoses to the drive belt tensioner.



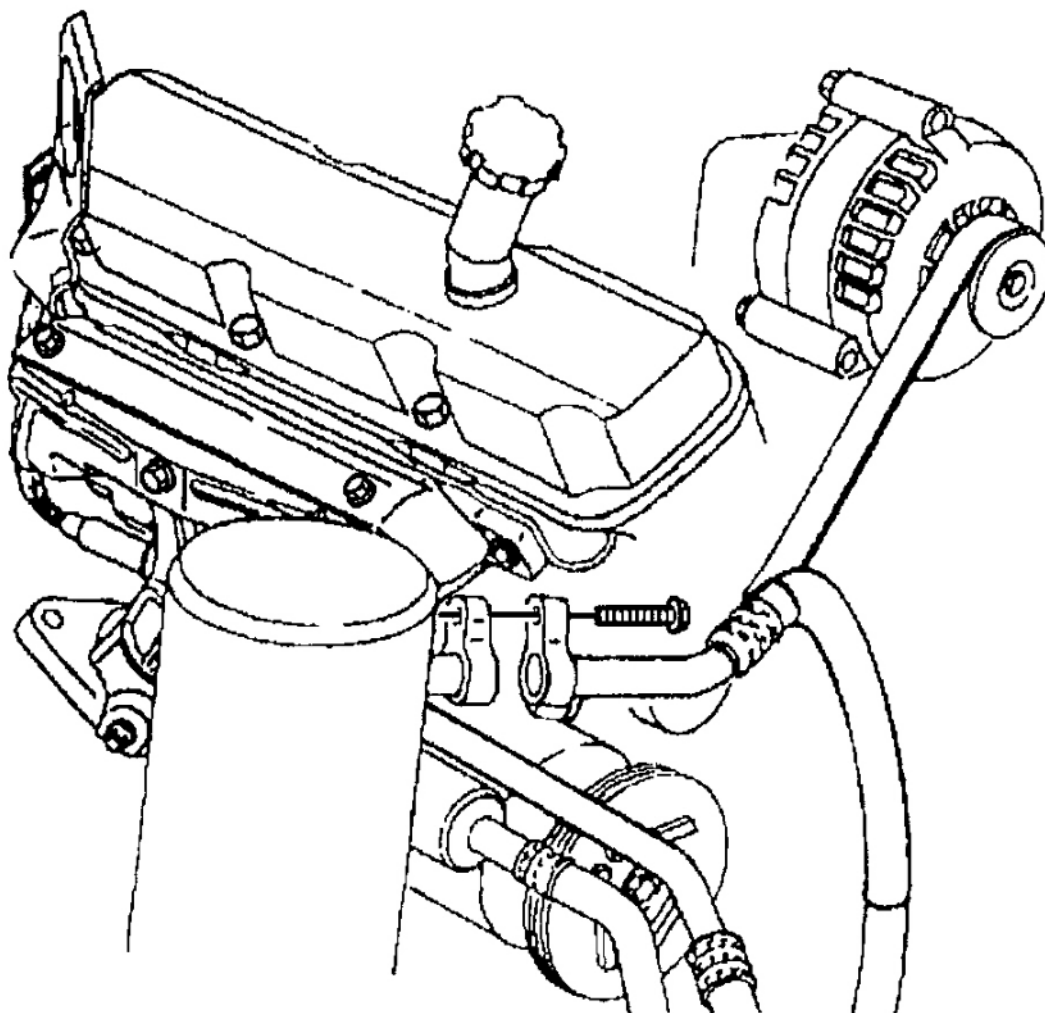
G01728948

Fig. 291: Installing Heater Hoses To Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

62. Install a new O-ring.
63. Install the A/C compressor and condenser hose bolt to the accumulator.

Tighten

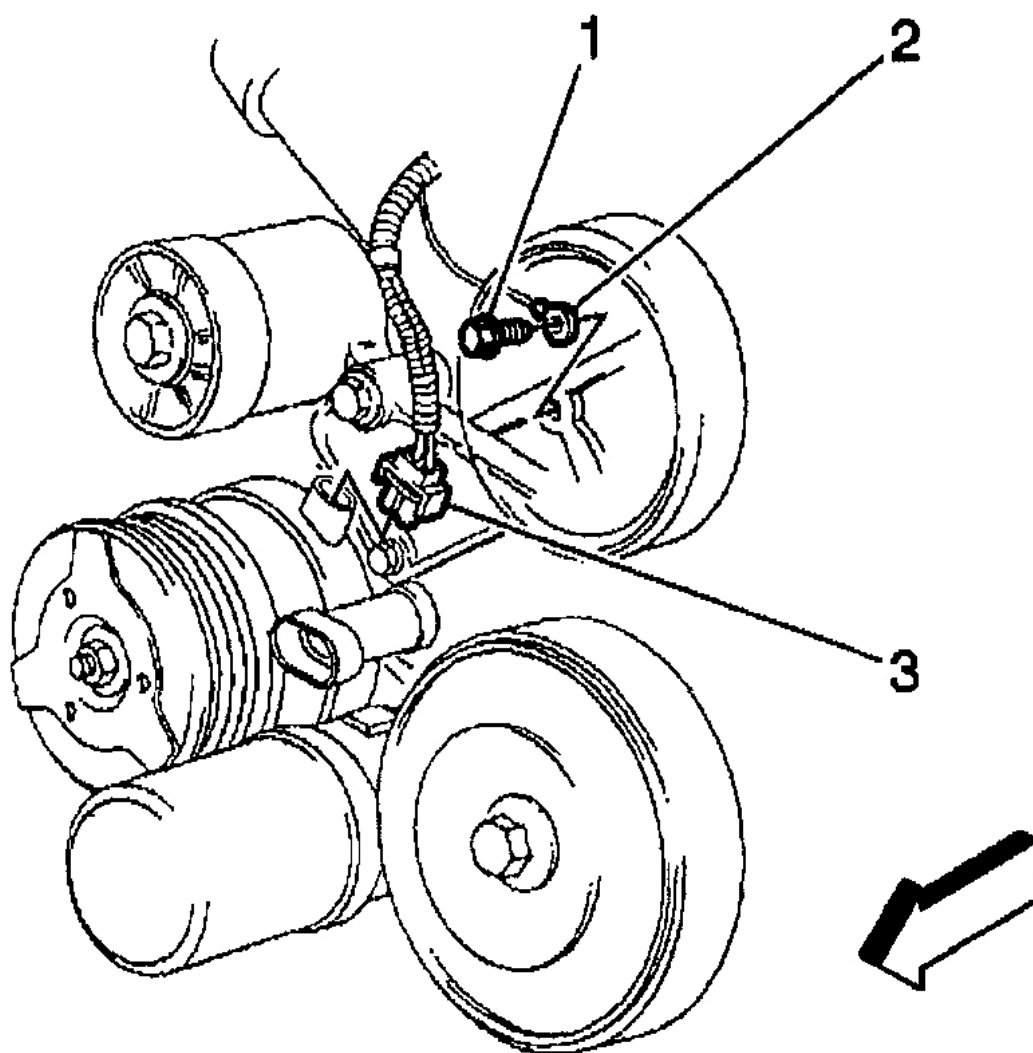
Tighten A/C compressor and condenser hose bolt at the accumulator to 48 N.m (36 lb ft).



G01728949

Fig. 292: Installing A/C Compressor And Condenser Hose Bolt To Accumulator
Courtesy of GENERAL MOTORS CORP.

64. Install the engine ground.
65. Install the engine wiring harness ground bolt (1).



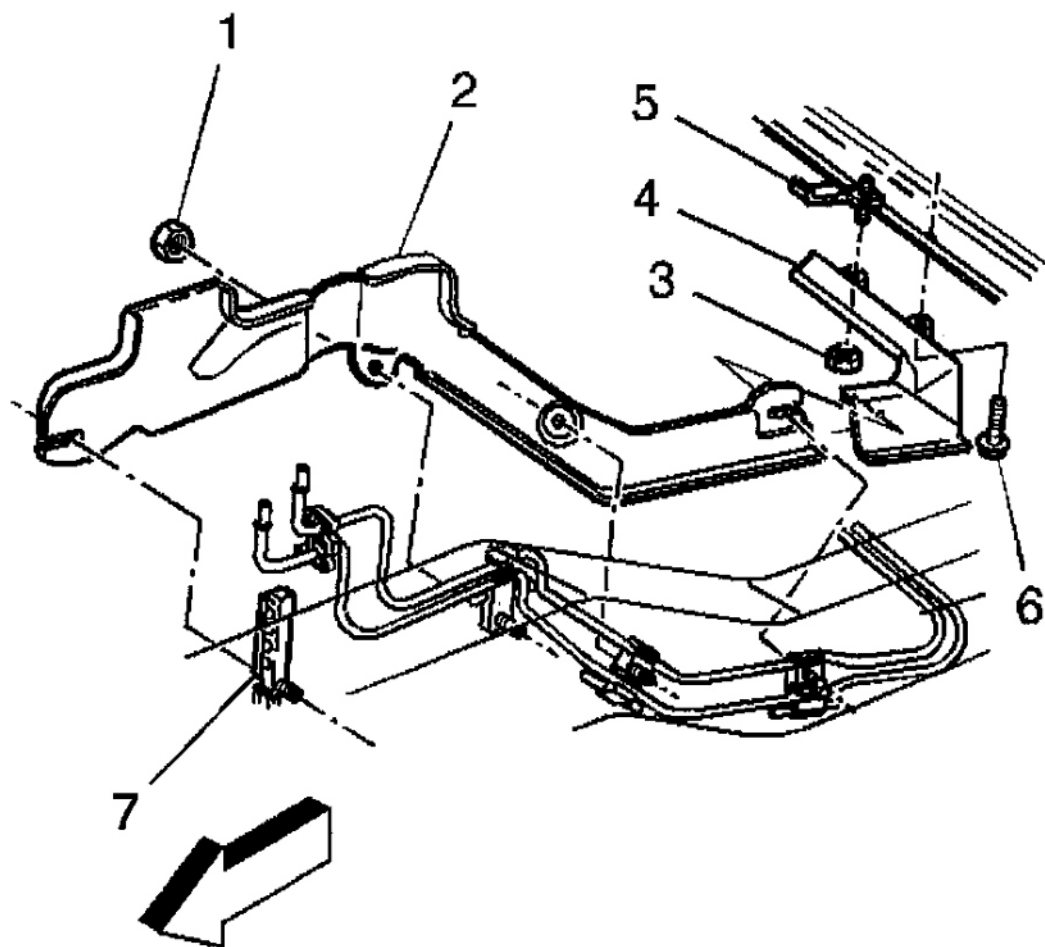
G01728950

Fig. 293: Installing Engine Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine wiring harness ground bolt to 25 N.m (18 lb ft).

66. Raise the vehicle.
67. Install the brake lines to the brake pipe clip.
68. Install the front fuel pipe heat shield (2).



G01728951

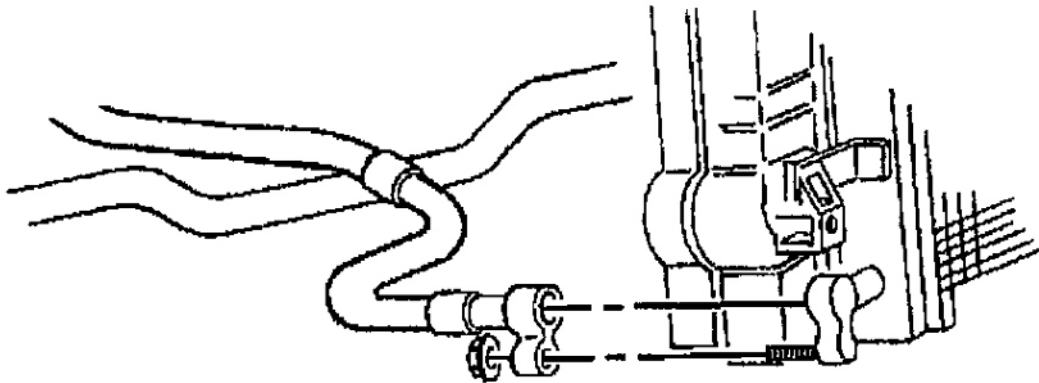
Fig. 294: Installing Front Fuel Pipe Heat Shield
Courtesy of GENERAL MOTORS CORP.

69. Install the front fuel pipe heat shield nuts (1).

Tighten

Tighten the front fuel pipe heat shield nuts (1) to 5 N.m (44 lb in).

70. Install a new O-ring.
71. Install the A/C compressor and condenser hose nut to the condenser.



G01728952

Fig. 295: Installing A/C Compressor And Condenser Hose Nut To Condenser
Courtesy of GENERAL MOTORS CORP.

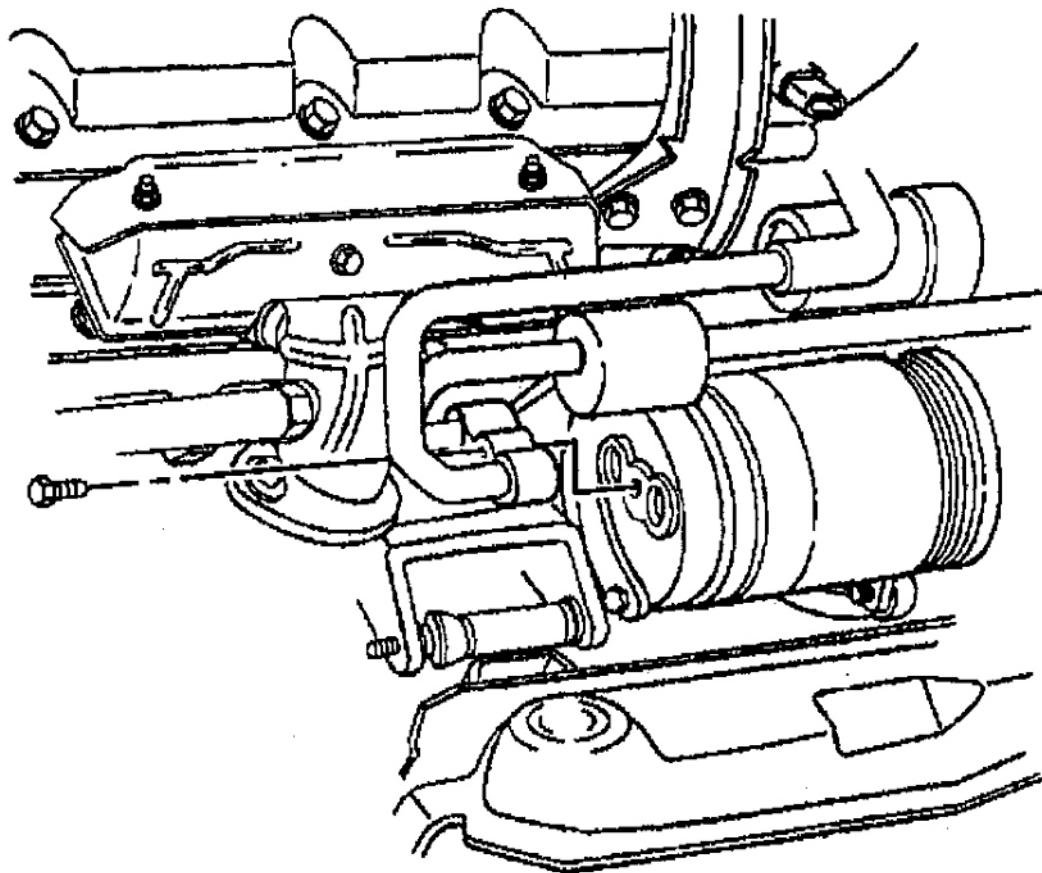
Tighten

Tighten the A/C compressor and condenser hose nut to the condenser to 16 N.m (12 lb ft).

72. Install a new O-ring.
73. Install the A/C compressor and condenser hose bolt to the compressor.

Tighten

Tighten the A/C compressor and condenser hose bolt to 33 N.m (24 lb ft).



G01728953

Fig. 296: Installing A/C Compressor And Condenser Hose Bolt To Compressor
Courtesy of GENERAL MOTORS CORP.

74. Connect the wheel speed sensors electrical connectors.

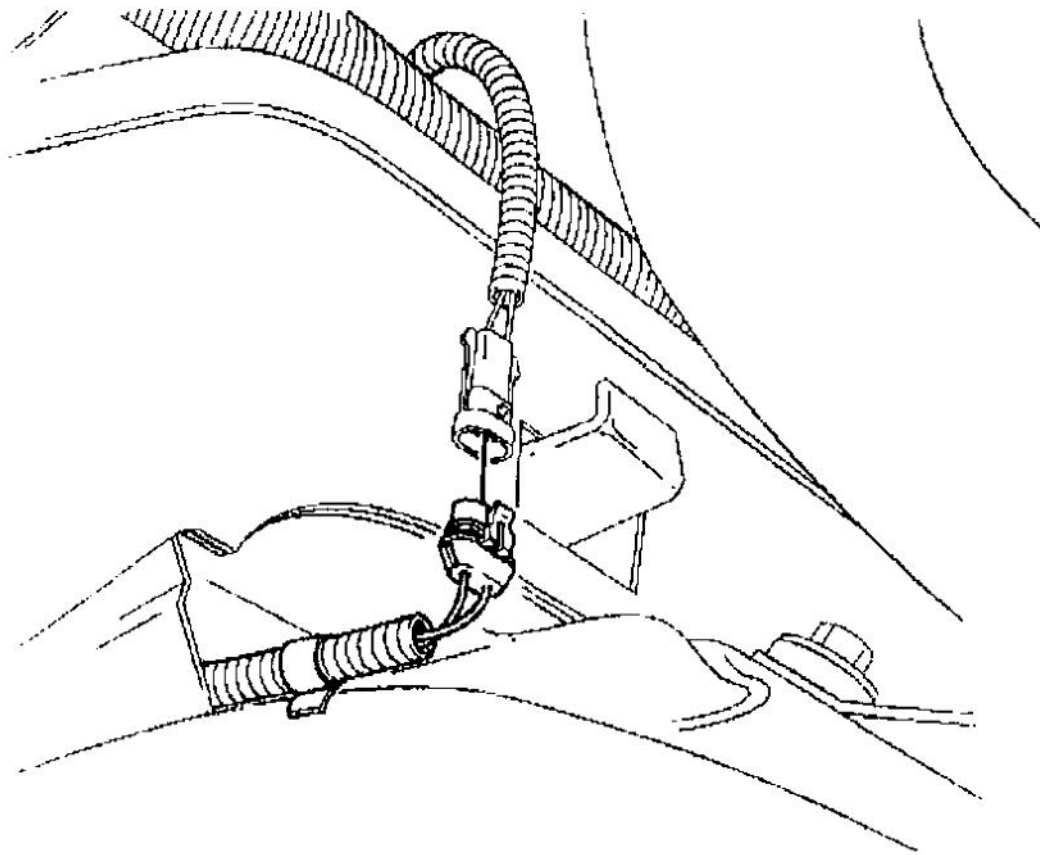
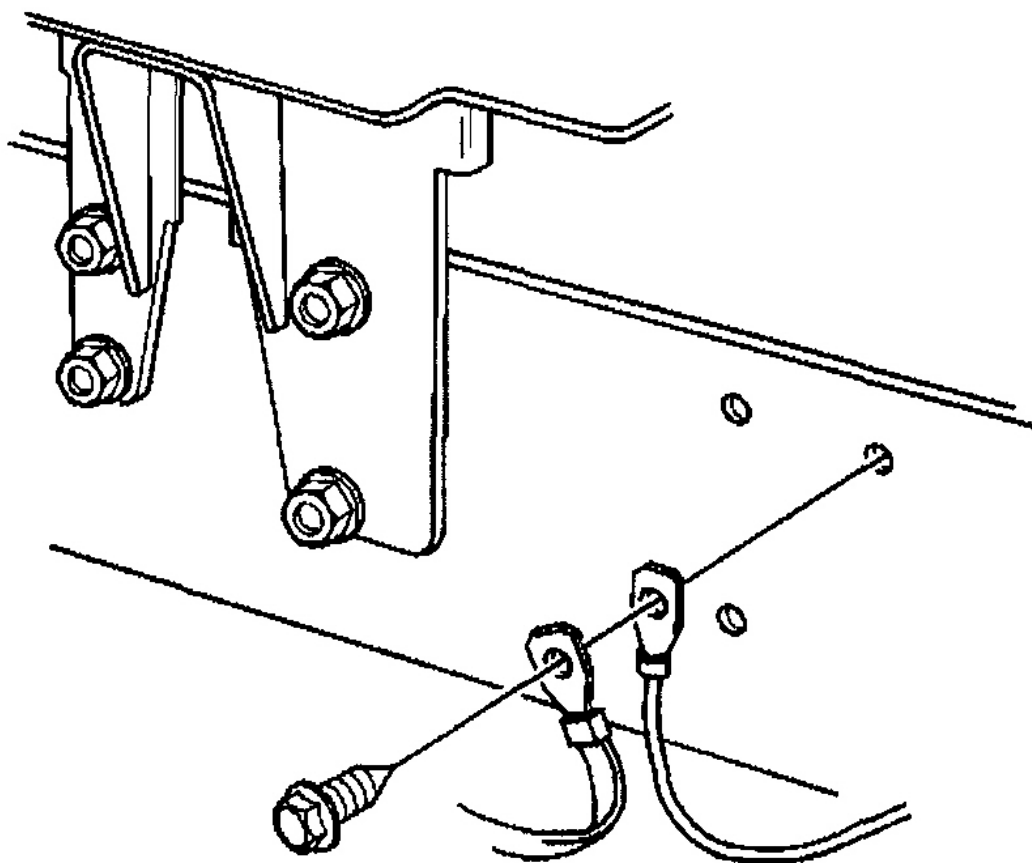
**G01728954**

Fig. 297: Connecting Wheel Speed Sensors Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

75. Connect the knock sensors electrical connectors.
76. Install the RF ground strap, cruise control lead and wiring harness ground bolt to the front rail.



G01728955

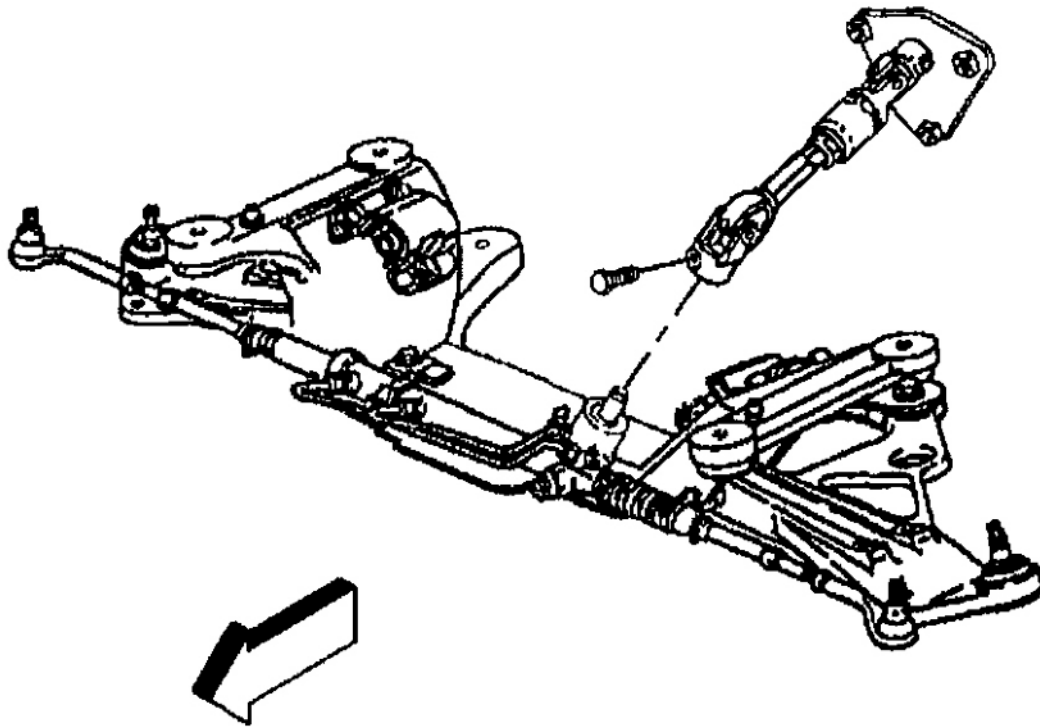
Fig. 298: Installing RF Ground Strap, Cruise Control Lead And Wiring Harness Ground Bolt To Front Rail

Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the wiring harness ground bolt to 12N.m (106 lb in).

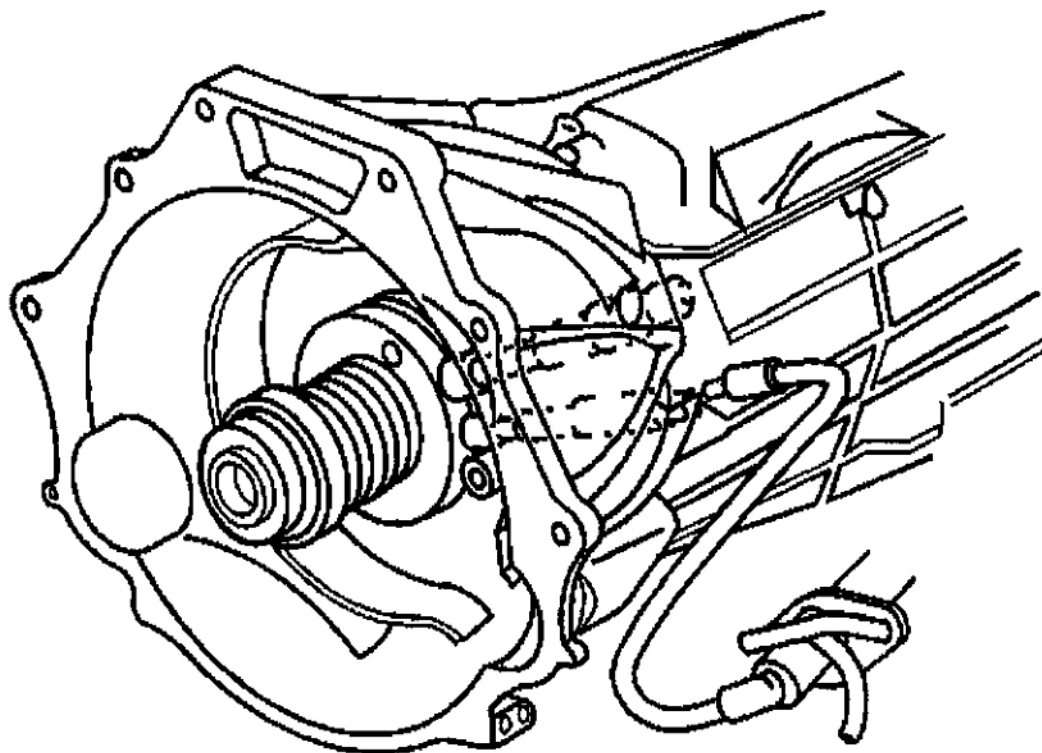
77. Install the intermediate steering shaft and bolt to the rack.



G01728956

Fig. 299: Installing Intermediate Steering Shaft And Bolt To Rack
Courtesy of GENERAL MOTORS CORP.

78. Install the stabilizer bar brackets. Refer to **STABILIZER SHAFT INSULATOR REPLACEMENT** .
79. Install the left side front air deflector.
80. On vehicles equipped with a manual transmission, install the clutch actuator cylinder line to the actuator cylinder.



G01728957

Fig. 300: Installing Clutch Actuator Cylinder Line To Actuator Cylinder
Courtesy of GENERAL MOTORS CORP.

81. If equipped with a automatic transmission, install the range selector lever cable to the cable bracket.

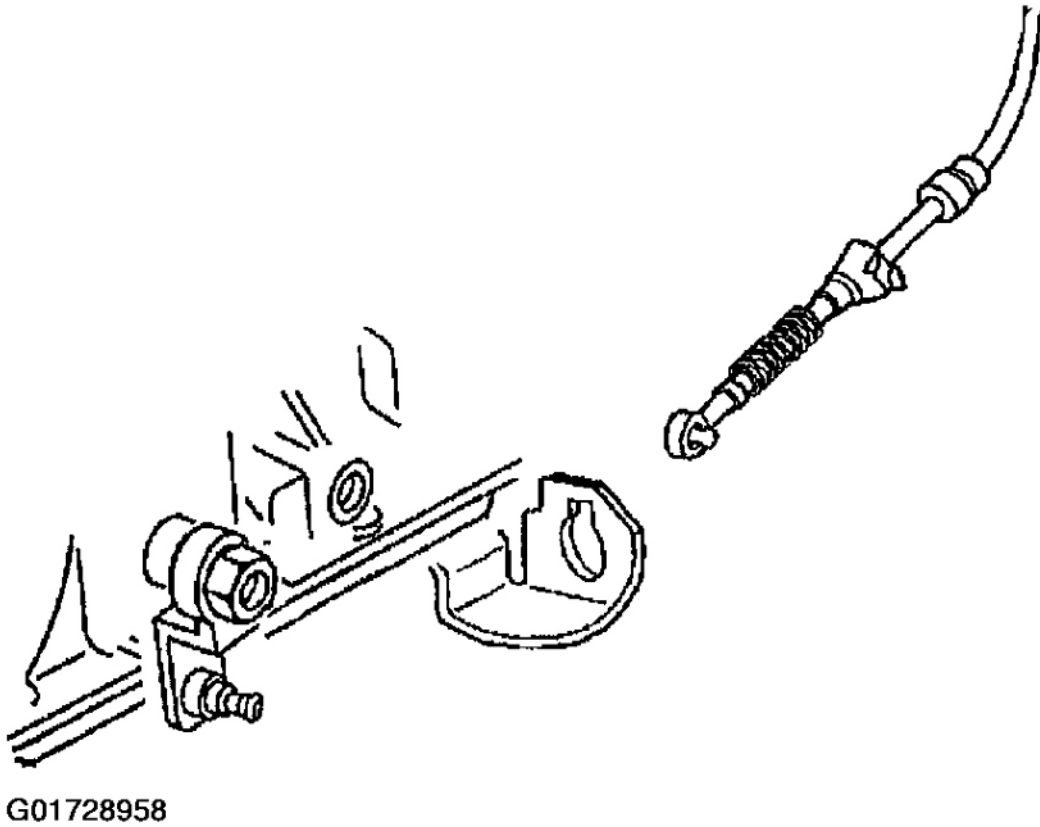
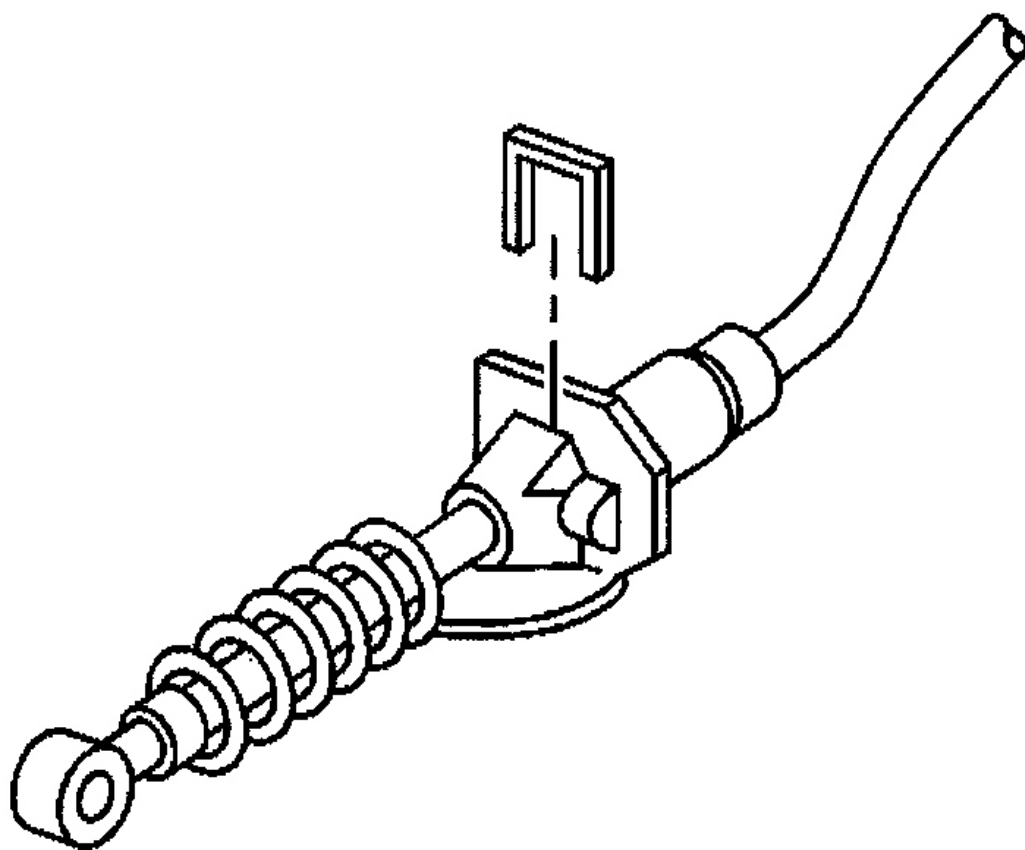


Fig. 301: Installing Range Selector Lever Cable To Cable Bracket.
Courtesy of GENERAL MOTORS CORP.

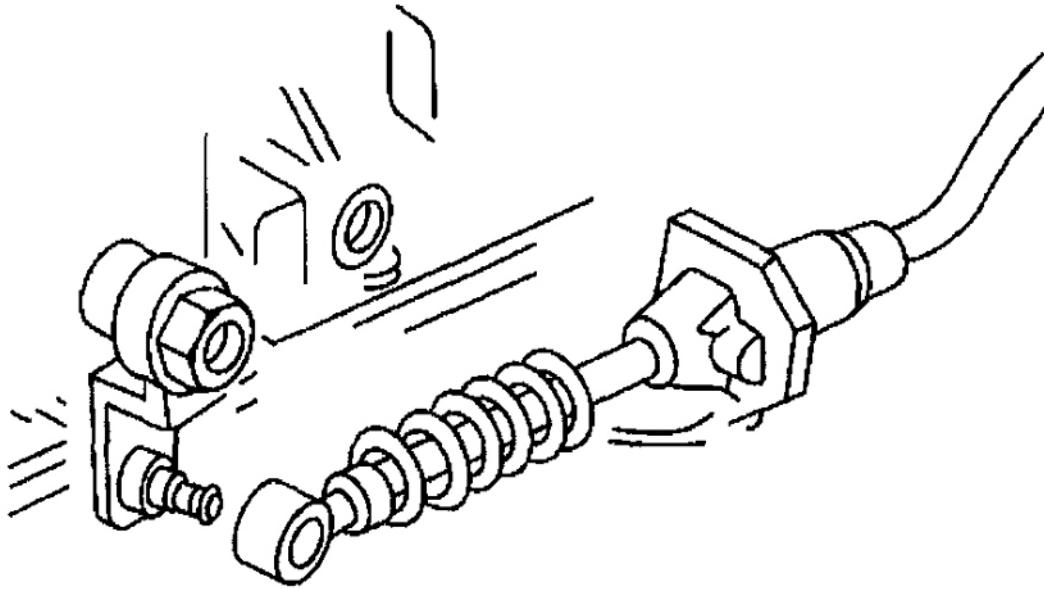
82. Install the retainer to the range selector lever cable.



G01728959

Fig. 302: Installing Retainer To Range Selector Lever Cable
Courtesy of GENERAL MOTORS CORP.

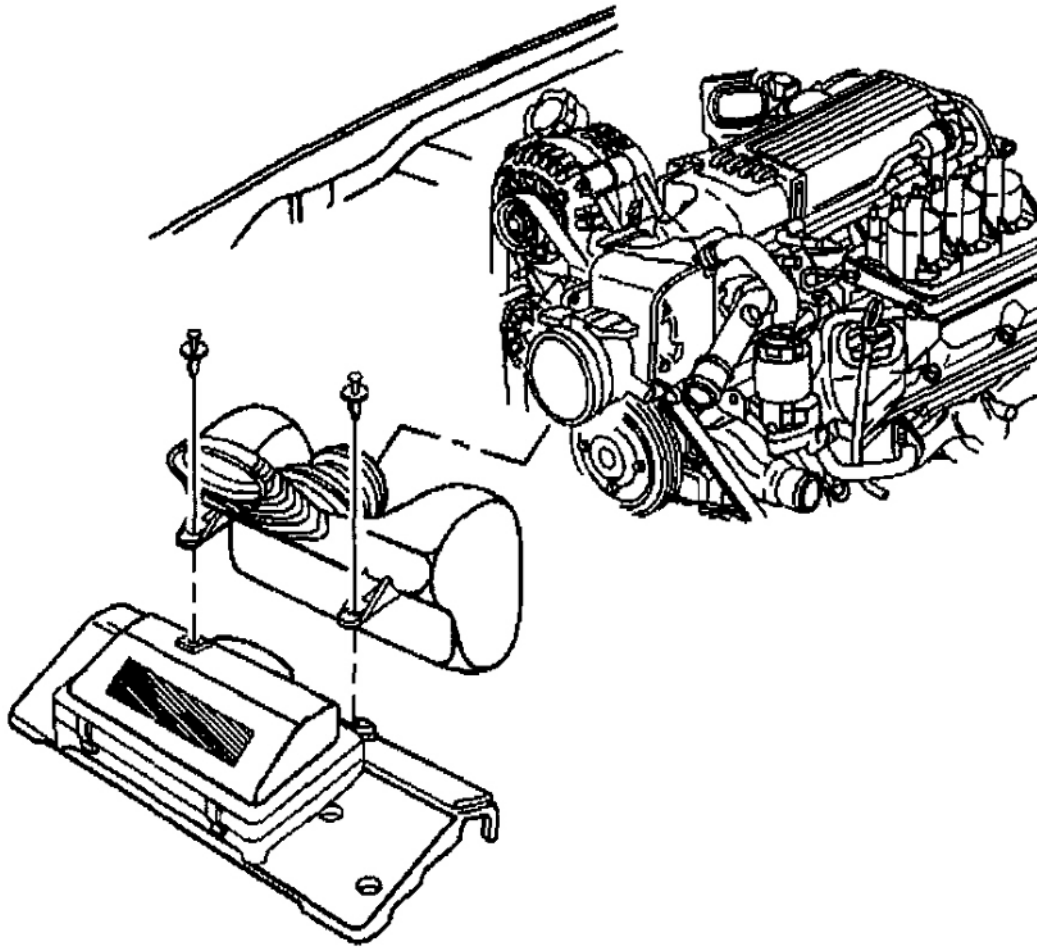
83. Install the transmission range selector lever cable to the transmission range selector.



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Fig. 303: Installing Transmission Range Selector Lever Cable To Transmission Range Selector
Courtesy of GENERAL MOTORS CORP.

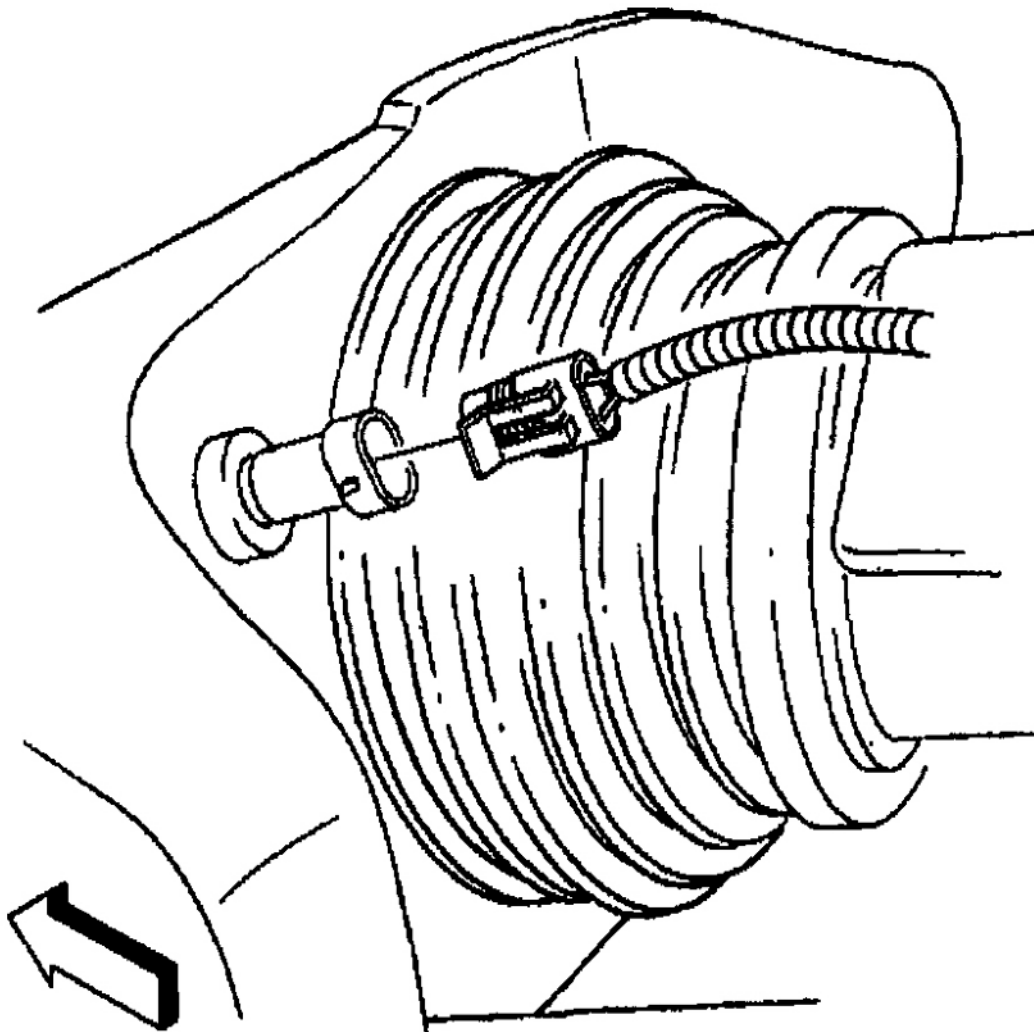
84. Install the torque arm. Refer to **TORQUE ARM REPLACEMENT** .
85. Install the propeller shaft.
86. Install the 3-way catalytic converter. Refer to **CATALYTIC CONVERTER REPLACEMENT (3.8L ENGINE)** .
87. Install the front wheels. Refer to Tire and Wheel Removal and Installation in Tires and Wheels .
88. If equipped, install the torque converter to flywheel bolts.
89. Install the starter motor. Refer to **STARTER MOTOR (3.8L)** .
90. Lower the vehicle.
91. Install the air intake duct.



G01728961

Fig. 304: Installing Air Intake Duct
Courtesy of GENERAL MOTORS CORP.

92. Connect the intake air temperature (IAT) sensor electrical connector.



G01728962

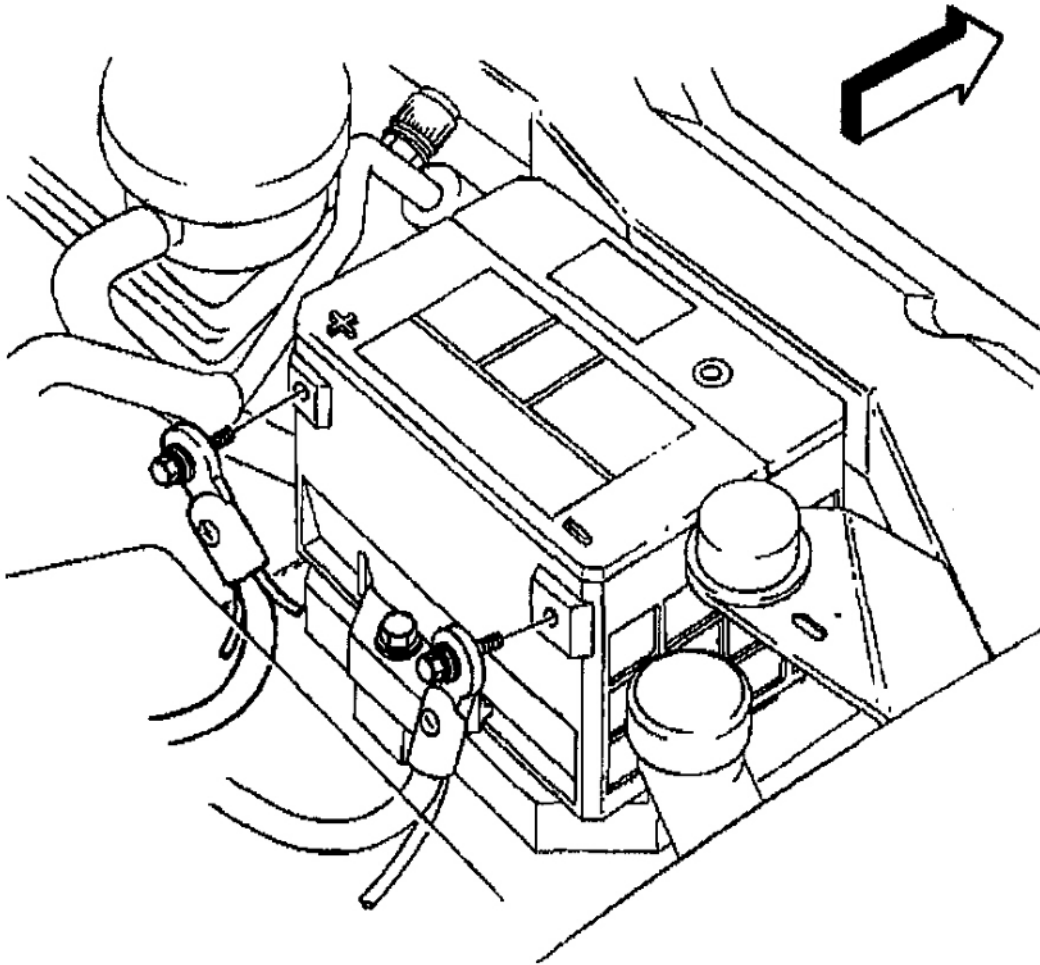
Fig. 305: Connecting Intake Air Temperature (IAT) Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

93. Install the positive battery cable to the battery.

Tighten

Tighten the positive battery terminal to 15 N.m (11 lb ft).

94. Install the negative battery cable to the battery.



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Fig. 306: Installing Negative Battery Cable To Battery
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the negative battery terminal to 15 N.m (11 lb ft).

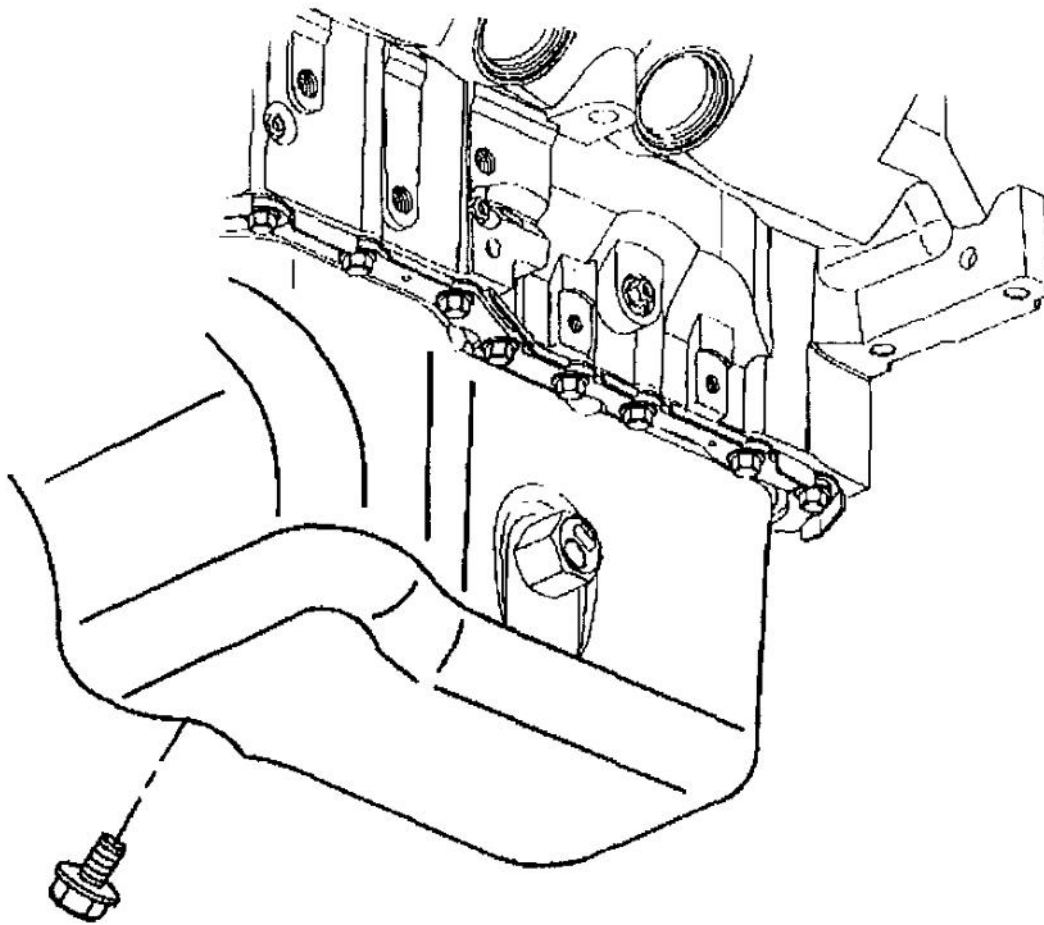
95. Fill the crankcase with engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
96. Check and fill the transmission fluid as necessary.
97. Refill the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
98. Recharge the A/C system. Refer to **COOLANT RECOVERY RESERVOIR REPLACEMENT**.
99. Bleed the brakes. Refer to **BLEEDING BRAKE SYSTEM**.
100. Bleed the clutch hydraulic system. Refer to **BLEEDING**.

101. Perform the crankshaft position (CKP) system variation learn procedure.

ENGINE OIL AND OIL FILTER REPLACEMENT

Removal Procedure

1. Raise and suitably support the vehicle. **LIFTING AND JACKING THE VEHICLE**
2. Position the oil drain pan under the engine oil drain plug.
3. Remove the engine oil drain plug.

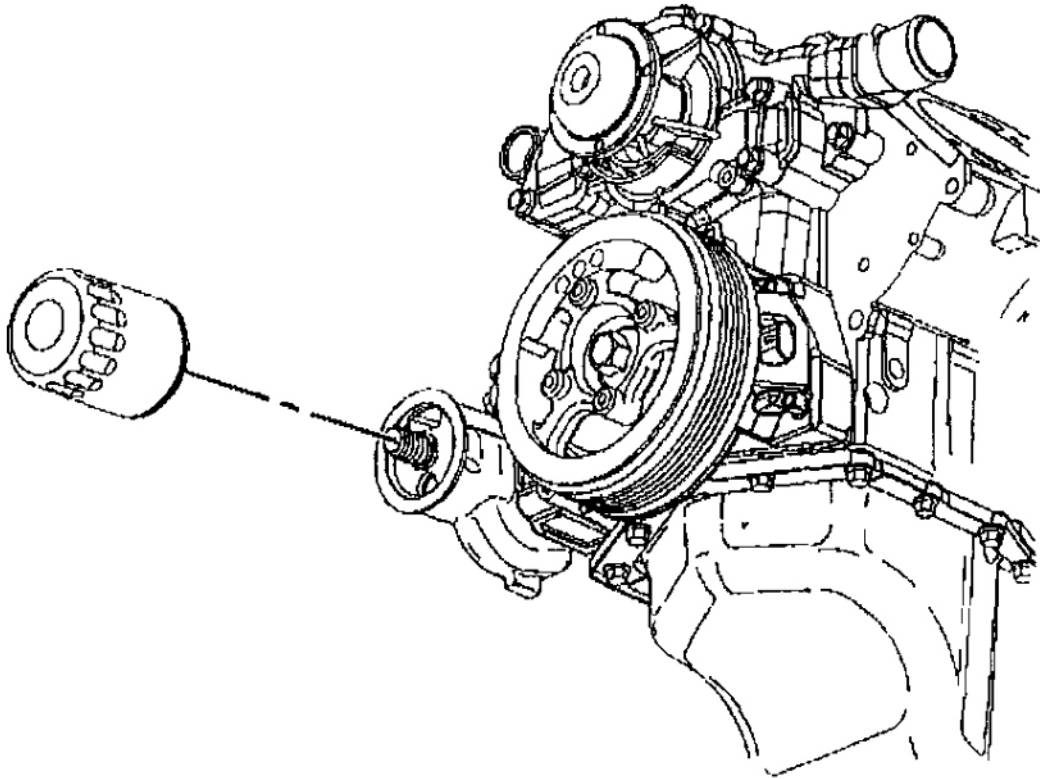


G01728964

Fig. 307: Removing Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

4. Clean and inspect the engine oil drain plug, replace if necessary.
5. Clean and inspect the engine oil drain plug sealing surface on the oil pan, replace the oil pan if necessary.

6. Remove the oil filter.
7. Clean and inspect the oil filter sealing area on the oil filter adapter, replace if necessary. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.

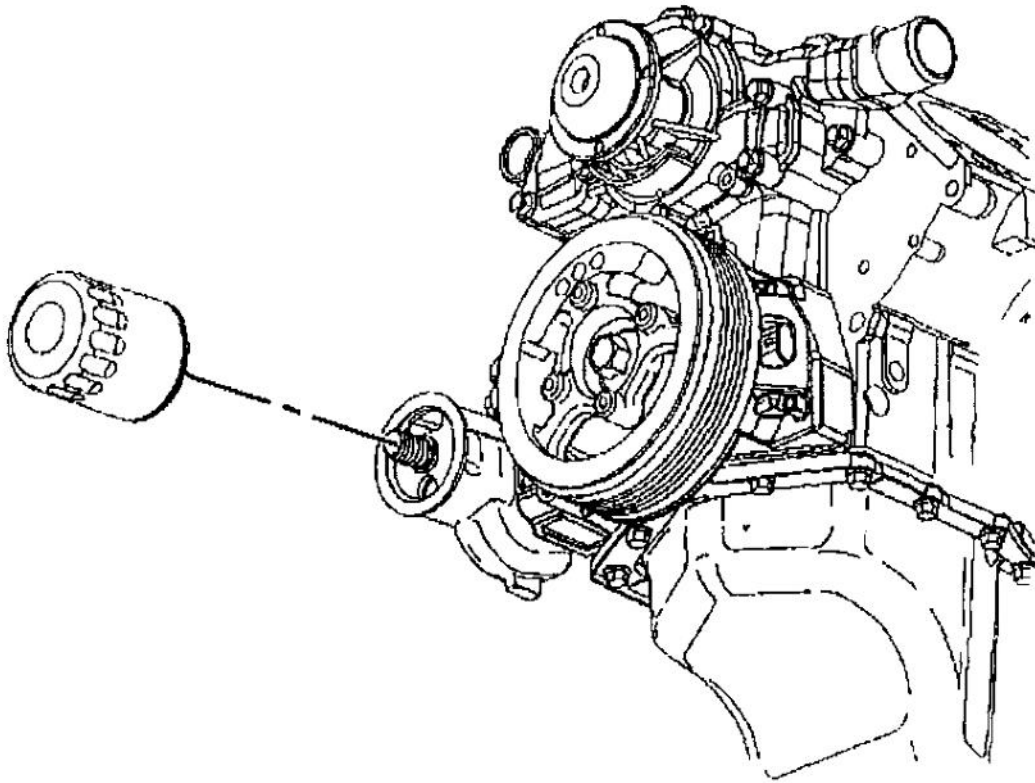


G01728965

Fig. 308: Removing Oil Filter
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Lightly oil the replacement oil filter gasket with clean engine oil.
2. Install a new engine oil filter. Tighten the new oil filter to 3/4 to 1 full turn, after the filter gasket contacts the oil filter mounting surface.



G01728966

Fig. 309: Installing New Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

3. Install the engine oil drain plug.

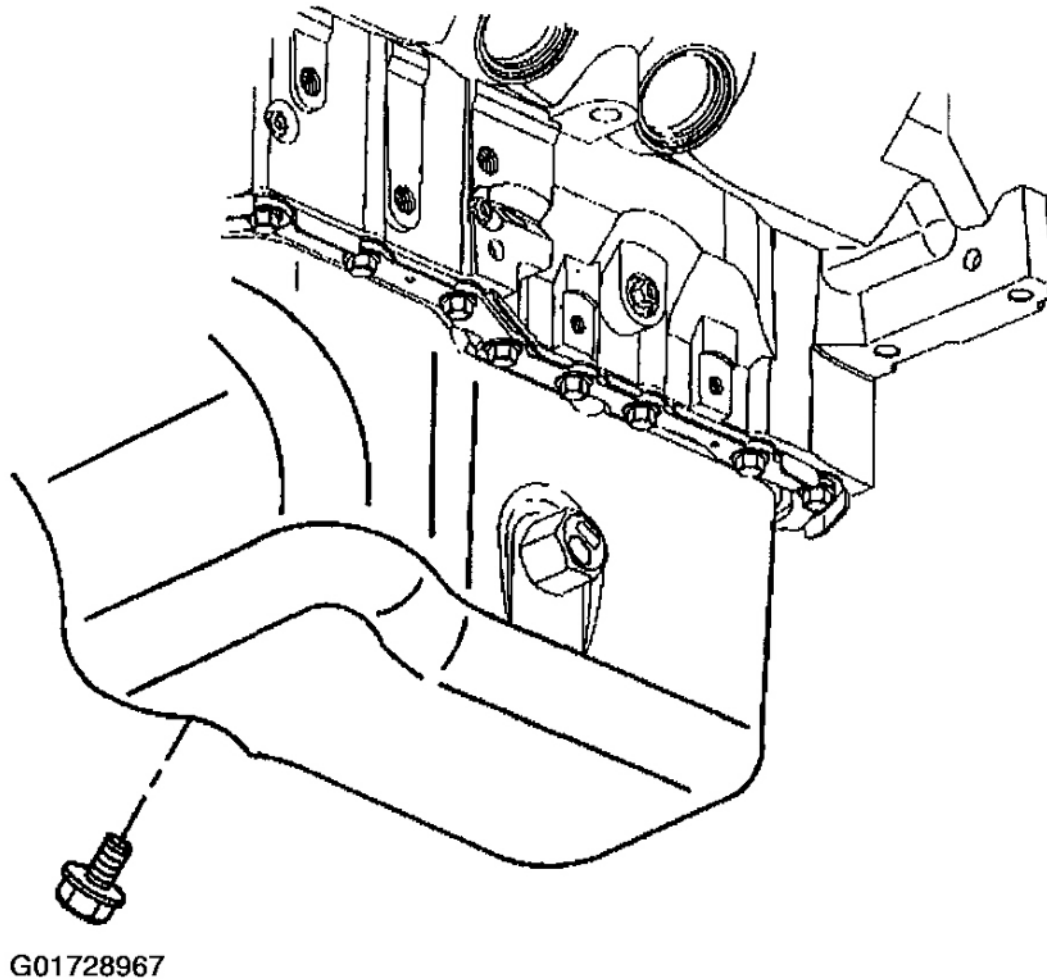


Fig. 310: Installing Engine Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

Tighten

Tighten the engine oil drain plug to 30 N.m (22 lb ft).

4. Remove the oil drain pan.
5. Lower the vehicle.
6. Fill the engine with new engine oil.
7. Start the engine.
8. Inspect for oil leaks after engine start up.
9. Turn off the engine and allow the oil a few minutes to drain back into the oil pan.
10. Remove the oil level indicator from the oil indicator tube.

11. Clean off the indicator end of the oil level indicator with a clean paper towel or cloth.
12. Install the oil level indicator into the oil level indicator tube until the oil level indicator handle contacts the top of the oil level indicator tube.
13. Again, remove the oil level indicator from the oil level indicator tube keeping the tip of the oil level indicator down.
14. Check the level of the engine oil on the oil level indicator.
15. If needed add or drain the engine oil to the correct level.

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM INSPECTION/DESCRIPTION

A crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting them to the atmosphere. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases and then passed through a crankcase ventilation valve into the intake manifold.

The primary control is through the crankcase ventilation valve which meters the flow at a rate depending on inlet vacuum. To maintain idle quality, the crankcase ventilation valve restricts the flow when inlet vacuum is high.

If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent into the throttle body to be consumed by normal combustion.

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 1 belt or 2 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.

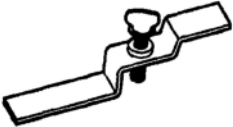
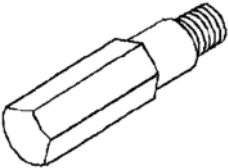
The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive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

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

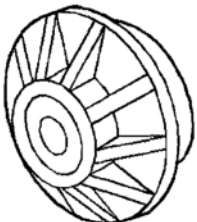
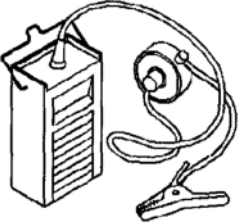
Illustration	Tool Number/Description
	J 21366 Converter Holding Strap
	J 23590 Spark Plug Port Adapter
	J 25087-C Oil Pressure Tester and Pump Primer
	J 28428-E High Intensity Black Light
	J 28467-B Universal Engine Support Fixture

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Fig. 311: Identifying Special Tools And Equipment (1 Of 4)
Courtesy of GENERAL MOTORS CORP.

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

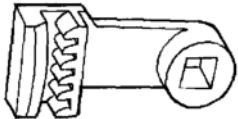
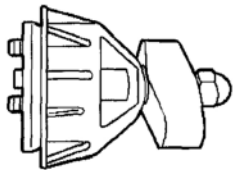
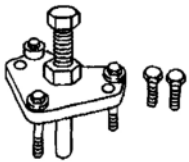
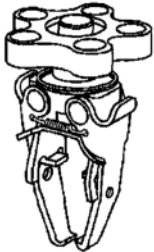
Illustration	Tool Number/Description
	J 28467-90A Engine Support Adapters
	J 35354 Seal Installer
	J 35667-A Cylinder Leakdown Tester
	J 36221 Hydraulic Line Separator
	J 36660-A Torque Angle Meter

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Fig. 312: Identifying Special Tools And Equipment (2 Of 4)
Courtesy of GENERAL MOTORS CORP.

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

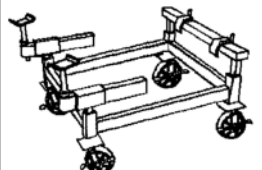
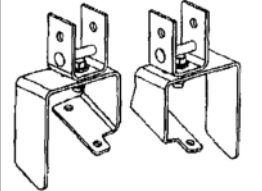
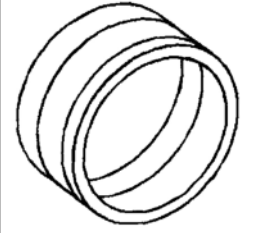
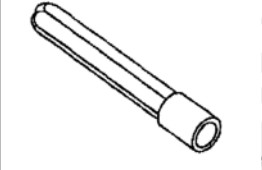
Illustration	Tool Number/Description
	J 37096 Flywheel Holding Tool
	J 38196 Crankshaft Rear Oil Seal Installer
	J 38197-A Crankshaft Balancer Puller
	J 38606 Valve Spring Compressor
	J 38722 Compression Tester

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Fig. 313: Identifying Special Tools And Equipment (3 Of 4)
Courtesy of GENERAL MOTORS CORP.

2002 Pontiac Firebird

2002 ENGINES Engine Mechanical - 3.8L - Camaro & Firebird

Illustration	Tool Number/Description
	J 39549 Ball Joint and Tie Rod End Separator
	J 39580 Universal Engine Support Table
	J 41044 Engine Support Adapters
	J 41349 Crankshaft Rear Oil Seal Housing Alignment Tool
	J 42863 Valve Seal Installer

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Fig. 314: Identifying Special Tools And Equipment (4 Of 4)
Courtesy of GENERAL MOTORS CORP.