

Engine Cooling

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator and Cruise Control Servo Cable Adjuster Bolt	8 N·m	71 lb in
Air Cleaner Bolt	12 N·m	106 lb in
Air Conditioning Condenser Tube Nut	16 N·m	12 lb ft
Coolant Heater Bolt (3.8 L)	2 N·m	18 lb in
Coolant Heater (5.7 L)	40 N·m	30 lb ft
Coolant Recovery Reservoir Bolt	12 N·m	106 lb in
Cooling Fan Blade Nut	6 N·m	53 lb in
Cooling Fan Motor Bolt	6 N·m	53 lb in
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
EGR Valve Outlet Pipe Bolt	29 N·m	21 lb ft
EGR Valve Outlet Pipe Nut	29 N·m	21 lb ft
Engine Block Coolant Drain Hole Plug (5.7 L)	60 N·m	44 lb ft
Engine Coolant Temperature Sensor (3.8 L)	25 N·m	18 lb ft
Engine Coolant Temperature Sensor (5.7 L)	20 N·m	15 lb ft
Evaporator Tube Bolt	16 N·m	12 lb ft
Knock Sensor (3.8 L)	19 N·m	14 lb ft
Radiator Air Lower Deflector Screw	10 N·m	89 lb in
Radiator Drain Cock	2 N·m	18 lb in
Transmission Oil Cooler Line Fitting (radiator end)	27 N·m	20 lb ft
Vapor Vent Pipe Stud/Bolts (5.7 L)	12 N·m	106 lb in
Water Outlet Bolt (3.8 L)	27 N·m	20 lb ft
Water Outlet Bolt (5.7 L)	10 N·m	89 lb in
Water Pump Bolt (3.8 L)	15 N·m + 80 degrees	11 lb ft + 80 degrees
Water Pump Bolt (5.7 L)	30 N·m	22 lb ft
Water Pump Pulley Bolt (3.8 L)	13 N·m	115 lb in

Engine Cooling System Specifications

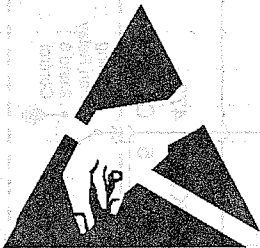
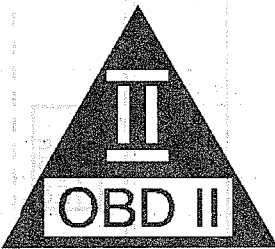
Application	Specification	
	Metric	English
3.8 L (VIN K)		
Manual Transmission	11.8 liters	12.5 quarts
Automatic Transmission	11.6 liters	12.3 quarts
5.7 L (VIN G)		
Manual Transmission	14.5 liters	15.3 quarts
Automatic Transmission	14.3 liters	15.1 quarts

GM SPO Group Numbers

Application	GM SPO Group Number
Coolant Radiator	1.000
Coolant Recovery Reservoir	1.000
Coolant Recovery Reservoir Hose	1.000
Electric Engine Cooling Fan Motor	1.000
Engine Coolant Thermostat	1.000
Engine Coolant Temperature Sensor (3.8 L)	1.000
Engine Coolant Temperature Sensor (5.7 L)	3.000
Engine Electric Coolant Fan	1.000
Engine Electric Cooling Fan Shroud Kit	1.000
Radiator Air Lower Baffle	1.000
Radiator Air Upper Baffle	1.000
Radiator Fill Cap	1.000
Radiator Inlet Hose	1.000
Radiator Outlet Hose	1.000
Vapor Vent Pipe (5.7 L)	1.000
Water Pump	1.000

Schematic and Routing Diagrams

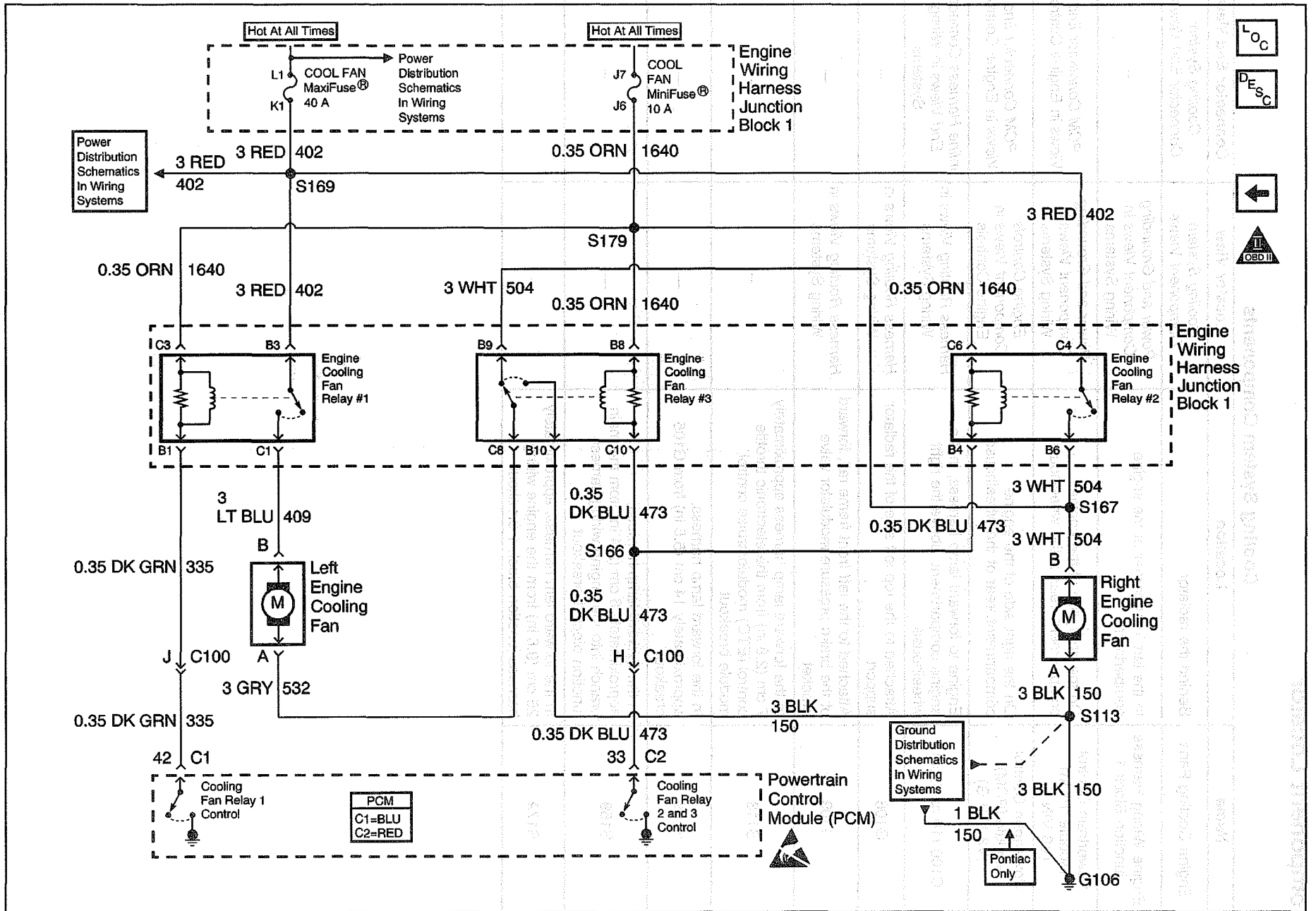
Cooling System Schematic Icons

Icon	Icon Definition
 19384	Refer to <i>ESD Notice</i> in Caution and Notices.
 19385	Refer to <i>OBD II Symbol Description Notice</i> in Caution and Notices.

6-596 Engine Cooling



Cooling Fan Schematics (V8 VIN G)



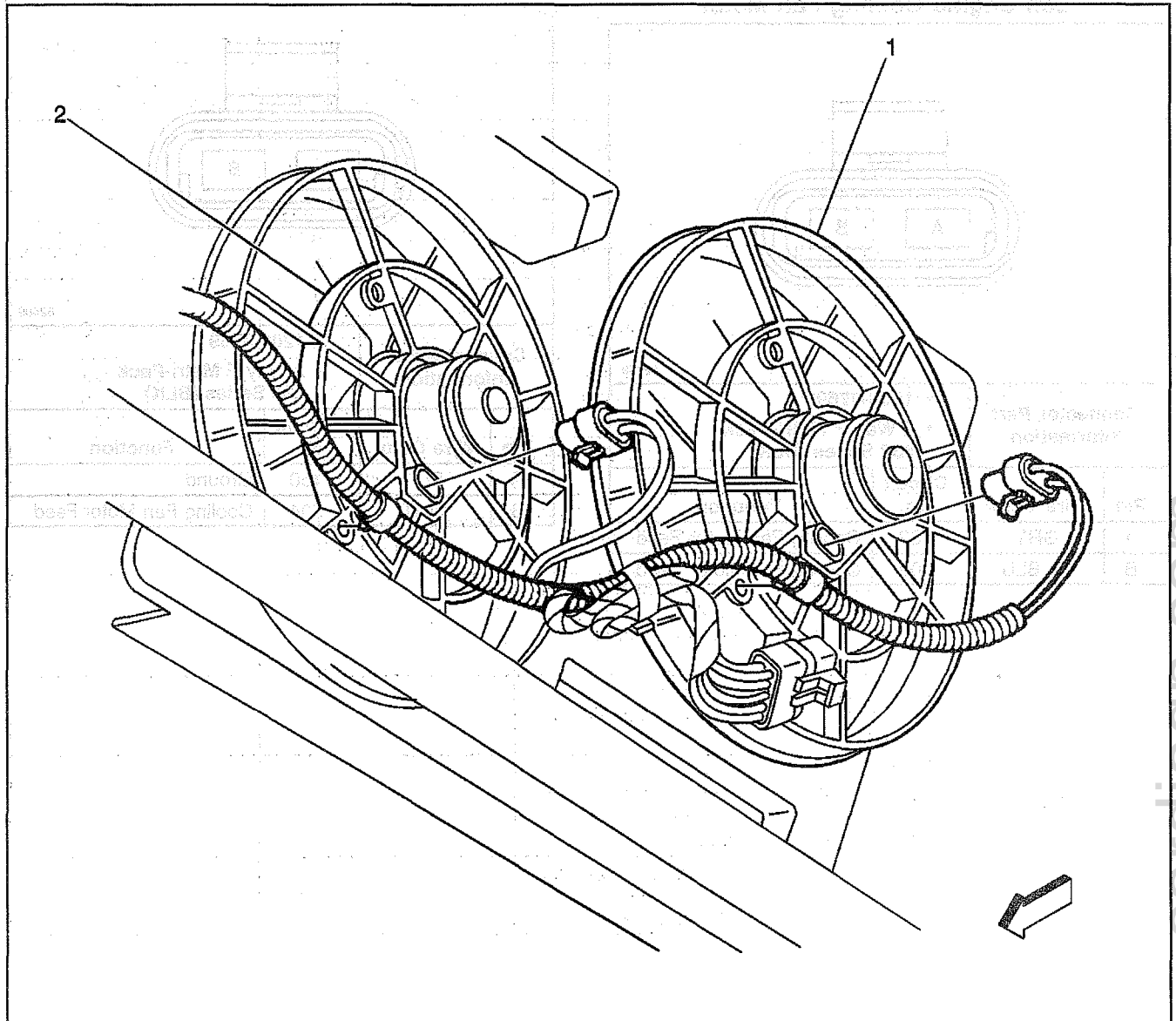
Component Locator

Cooling System Components

Name	Location	Locator View	Connector End View
Engine Cooling Fans	Behind the radiator	Cooling System Component Views	Cooling System Connector End Views
Engine Wiring Harness Junction Block 1	In the left front corner of the engine compartment	Power and Grounding Component Views in Wiring Systems	—
Powertrain Control Module (PCM) (V6 VIN K)	On the right side of the engine compartment, rear of the wheelhouse	Power and Grounding Component Views in Wiring Systems	PCM Connector End Views in Engine Controls
Powertrain Control Module (PCM) (V8 VIN G)	On the right side of the engine compartment, rear of the wheelhouse	Engine Controls Component Views in Engine Controls	PCM Connector End Views in Engine Controls
C100 (10 cavities)	Engine to forward lamp harness, in the engine compartment, above the right wheelhouse	Harness Routing Views in Wiring Systems	Inline Harness Connector End Views in Wiring Systems
G106	Attached to the top left side of the radiator support	Harness Routing Views in Wiring Systems	—
G109	Attached to the left front frame rail, forward of the brake pressure modulator valve bracket	Harness Routing Views in Wiring Systems	—
S113	In the forward lamp harness approximately 7 cm (2.8 in) from the electronic throttle control (ETC) module/cruise control module breakout	—	—
S166	In the forward lamp harness, approximately 14 cm (5.5 in) from G105 breakout	—	—
S169	In the forward lamp harness, approximately 6 cm (2.4 in) from the main branch into the engine wiring harness junction block 1 breakout	—	—
S179	In the forward lamp harness, approximately 25 cm (9.8 in) from the engine wiring harness junction block 1 breakout	—	—

Cooling System Component Views

Cooling Fans



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Legend

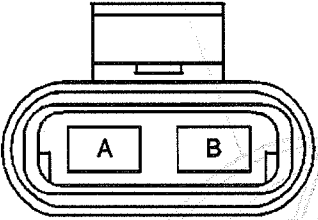
(1) Cooling Fan 2

(2) Cooling Fan 1

Cooling System Connector End Views

Right Engine Cooling Fan Motor

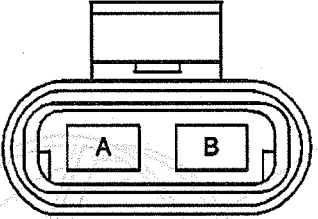
Left Engine Cooling Fan Motor



Connector Part Information

- 1203-3769
- 2 Way F Metri-Pack 630 Series (BLK)

Pin	Wire Color	Circuit No.	Function
A	GRY	532	Cooling Fan Motor Feed
B	LT BLU	409	Cooling Fan Motor Feed



Connector Part Information

- 1203-3769
- 2 Way F Metri-Pack 630 Series (BLK)

Pin	Wire Color	Circuit No.	Function
A	BLK	150	Ground
B	WHT	504	Cooling Fan Motor Feed

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Diagnostic Information and Procedures

Engine Overheating

Step	Action	Value	Yes	No
DEFINITION: Engine temperature lamp comes ON and stays ON, or the temperature gauge shows hot, or coolant overflows from the reservoir onto the ground while the engine is running.				
1	Check for a loss of coolant. Refer to <i>Loss of Coolant</i> . Is there a loss of coolant?	—	—	Go to Step 2
2	1. Check for weak engine coolant solution. 2. Perform a concentration test. Refer to <i>Coolant Concentration Testing</i> . Does the engine still overheat?	—	Go to Step 3	System OK
3	1. Check for obstructed radiator air flow or bent radiator fins. 2. If necessary, remove or relocate added-on parts that block air to the radiator. Clean away any bugs, leaves, or other debris. Does the engine still overheat?	—	Go to Step 4	System OK
4	1. Check for a loss of system pressure. 2. Perform a radiator fill cap pressure test. Refer to <i>Pressure Cap Testing</i> . Does the engine still overheat?	—	Go to Step 5	System OK
5	1. Check for a faulty Engine Coolant Temperature (ECT) sensor. Refer to one of the following procedures: • DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage in Engine Controls-3.8L. • DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage in Engine Controls-3.8L. • DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage in Engine Controls-5.7L. • DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage in Engine Controls-5.7L. 2. If necessary, replace the sensor. Does the engine still overheat?	—	Go to Step 6	System OK
6	1. Check for a damaged coolant recovery reservoir. 2. Check for a leaking or kinked reservoir hose. 3. If necessary, reroute the reservoir hose or replace the recovery reservoir. Refer to <i>Coolant Recovery Reservoir Replacement</i> . Does the engine still overheat?	—	Go to Step 7	System OK
7	1. Check for a loose accessory drive belt. 2. Check the tension of the drive belt. Refer to the following procedures: • Drive Belt Replacement in Engine Mechanical - 3.8L. • Drive Belt Replacement - Accessory in Engine Mechanical - 5.7L. Does the engine still overheat?	—	Go to Step 8	System OK
8	1. Check for advanced or retarded ignition timing. 2. If necessary, adjust the timing. Does the engine still overheat?	—	Go to Step 9	System OK

Engine Overheating (cont'd)

Step	Action	Value	Yes	No
9	1. Check for blocked cooling system passages.	—		
	2. Flush the cooling system. Refer to <i>Flushing</i> .			
10	3. If necessary, remove and inspect the cylinder head.			
	Does the engine still overheat?			
11	1. Check for an incorrect or damaged cooling fan blade(s).	—		
	2. Check for the correct fan blade(s) part number.			
12	3. If necessary, replace the fan blade(s). Refer to <i>Cooling Fan Replacement - Electric</i> .			
	Does the engine still overheat?			
13	1. Check for inoperative cooling fans. Refer to <i>Electric Cooling Fan Diagnosis (Description)</i> in Engine Controls - 3.8 L or <i>Electric Cooling Fan Diagnosis</i> in Engine Controls - 5.7 L.	—		
	2. If necessary, replace the cooling fan and motor. Refer to <i>Cooling Fan Replacement - Electric</i> .			
14	Does the engine still overheat?			
15	1. Check for a stuck closed thermostat. Refer to <i>Thermostat Diagnosis</i> .	—		
	2. If necessary, replace the thermostat.			
16	• For the 3.8 L engine, refer to <i>Thermostat Replacement (3.8 L)</i> .			
	• For the 5.7 L engine, refer to <i>Thermostat Replacement (5.7 L)</i> .			
17	Does the engine still overheat?			
18	1. Check for a faulty coolant pump.	—		
	2. If necessary, replace the coolant pump.			
19	• For the 3.8 L engine, refer to <i>Water Pump Replacement (3.8 L)</i> .			
	• For the 5.7 L engine, refer to <i>Water Pump Replacement (5.7 L)</i> .			
20	Does the engine still overheat?			
21	1. Check the radiator cooling capacity.	—		
	2. Check if the radiator is the proper size for the vehicle.			
22	3. If necessary, determine the proper radiator size and replace the radiator. Refer to <i>Radiator Replacement</i> .			
	Is the repair complete?			

Loss of Coolant

Step	Action	Value	Yes	No
1	1. Check for a wrong or defective radiator fill cap.	124 kPa (18 psi)		
	2. Perform a cap pressure test. Refer to <i>Pressure Cap Testing</i> . If necessary, replace the fill cap.			
2	Is there still a coolant loss?			
3	1. Check for a distorted radiator fill neck.	—		
	2. If the upper sealing area of the fill neck is distorted, use a wood block and a mallet to reshape the neck in order to fit the cap.			
4	Is there still a coolant loss?			
5	1. Check for a leaking coolant recovery reservoir.	—		
	2. Check for a loose or damaged reservoir hose.			
6	3. If the reservoir or hose is damaged, replace the reservoir or the hose. Refer to <i>Coolant Recovery Reservoir Replacement</i> .			
	Is there still a coolant loss?			

Loss of Coolant (cont'd)

Step	Action	Value	Yes	No
4	1. Check for any loose or damaged radiator hoses or heater hoses. 2. Re-seat the hoses and clamps. If necessary, replace the hoses and the clamps. Is there still a coolant loss?	—	Go to Step 5	System OK
5	1. Check for a water pump gasket leak. 2. If necessary, replace the water pump gasket. - For the 3.8 L engine, refer to <i>Water Pump Replacement (3.8 L)</i>. - For the 5.7 L engine, refer to <i>Water Pump Replacement (5.7 L)</i>. Is there still a coolant loss?	—	Go to Step 6	System OK
6	1. Check for a seal leak at the water pump. 2. If the seal is leaking, replace the water pump. - For the 3.8 L engine, refer to <i>Water Pump Replacement (3.8 L)</i>. - For the 5.7 L engine, refer to <i>Water Pump Replacement (5.7 L)</i>. Is there still a coolant loss?	—	Go to Step 7	System OK
7	1. Check if the cylinder head bolts are tightened to specification. Refer to the following procedures: <i>Fastener Tightening Specifications</i> in Engine Mechanical - 3.8L <i>Fastener Tightening Specifications</i> in Engine Mechanical - 5.7L 2. Tighten the cylinder head bolts to the specification. If necessary, replace the cylinder head gasket. Refer to one of the following procedures: <i>Cylinder Head Replacement (Left)</i> in Engine Mechanical 3.8L <i>Cylinder Head Replacement (Right)</i> in Engine Mechanical 3.8L <i>Cylinder Head Replacement (Left)</i> in Engine Mechanical-5.7L. <i>Cylinder Head Replacement (Right)</i> in Engine Mechanical-5.7L. Is there still a coolant loss?	—	Go to Step 8	System OK
8	1. Check for any coolant leaks at the radiator. 2. Inspect the radiator. 3. If necessary, replace the radiator. Refer to <i>Radiator Replacement</i> . Is there still a loss of coolant?	—	Go to Step 9	System OK
9	1. Check the following for leaks: - The intake manifold - The cylinder head gasket - The engine block coolant drain hole plug or the knock sensor - The heater core 2. Make the necessary repairs or replace the components as necessary in order to repair the leak. Is the repair complete?	—	System OK	

Thermostat Diagnosis

Thermostat Test

The coolant thermostat can be tested using a temperature (tempil) stick. The temperature stick is a pencil like device. It has a wax material containing certain chemicals which melt at a given temperature. Temperature sticks can be used to determine a thermostat's operating range, by rubbing 87°C (188°F) and 97°C (206°F) sticks on the thermostat housing.

Tools Required

- J 24731-188 188°F Tempilstick
 - J 24731-206 206°F Tempilstick
1. Use a tempilstick in order to find the opening and the closing temperatures of the coolant thermostat.
 - J 24731-188 tempilstick melts at 87°C (188°F). The thermostat should begin to open.
 - J 24731-206 tempilstick melts at 97°C (206°F). The thermostat should be fully open.
 2. Replace the coolant thermostat if it does not operate properly between this temperature range.

Engine Fails To Reach Normal Operating Temperature

Step	Action	Value(s)	Yes	No
1	Notice: When adding coolant, use DEX-COOL® coolant. If silicated coolant is added to the system, premature engine, heater core or radiator corrosion may result. In addition, the engine coolant will require change sooner-at 50,000 km (30,000 mi) or 24 months. 1. Check the level of the coolant in the coolant recovery reservoir. The coolant level should be at the FULL COLD mark. 2. Add engine coolant as necessary. Does the engine reach normal operating temperature now?	—	System OK	Go to Step 2
2	1. Check for a blockage in the coolant passages. 2. Flush the cooling system or flow check the radiator. Refer to <i>Flushing</i>. Does the engine reach normal operating temperature now?	—	System OK	Go to Step 3
3	1. Check to see if the correct type of thermostat was installed. 2. Check if the thermostat is stuck in the open position. Refer to <i>Engine Overheating</i>. 3. If necessary, replace the thermostat. • For the 3.8 L engine, refer to <i>Thermostat Replacement (3.8 L)</i>. • For the 5.7 L engine, refer to <i>Thermostat Replacement (5.7 L)</i>. Does the engine reach normal operating temperature?	—	System OK	—

Coolant Concentration Testing

Cleaning The Instruments

Tools Required

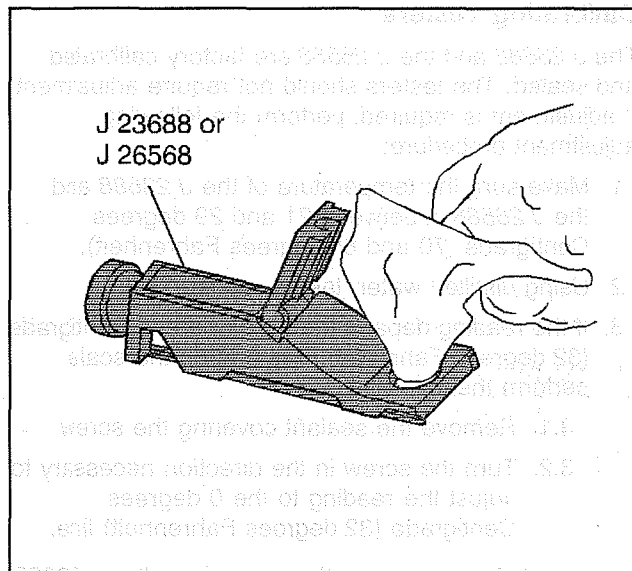
- J 23688 Coolant and Battery Fluid Tester (Fahrenheit Scale)
- J 26568 Coolant and Battery Fluid Tester (Centigrade Scale)

Some coolant manufacturers mix other types of glycol into their coolant formulations. Propylene glycol is the most common new ingredient.

A hydrometer does not always provide a correct measurement of freeze protection when anything other than ethylene glycol and water is being tested. The degree of inaccuracy varies depending on the proportion of other glycols present in the coolant.

All new GM vehicles are produced with coolant that can be accurately measured with a hydrometer; however, when the type and quality of coolant being measured is unknown, such as a customer vehicle that has accumulated mileage, the use of the refractometer is recommended.

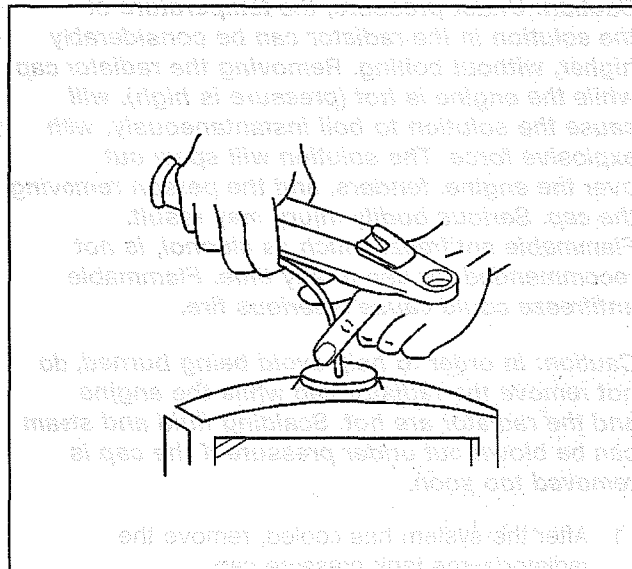
Coolant testers J 23688 (Fahrenheit Scale) or J 26568 (Centigrade Scale) can be used to check the antifreeze protection of the coolant. Make sure the refractometer markings are correct. Unless J 23688 or J 26568 has a provision for temperature correction, test the temperature at which J 23688 or J 26568 is calibrated. If the coolant is warmer or cooler, the reading may be incorrect. Follow the manufacturer's direction on using J 23688 or J 26568.



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1. To clean, swing back the plastic sample cover located at the slanted end of the J 23688 or J 26568.
2. Wipe clean both the prism and the bottom of the sample cover.
3. Dry them with a tissue or a clean soft cloth.
4. Close the sample cover.

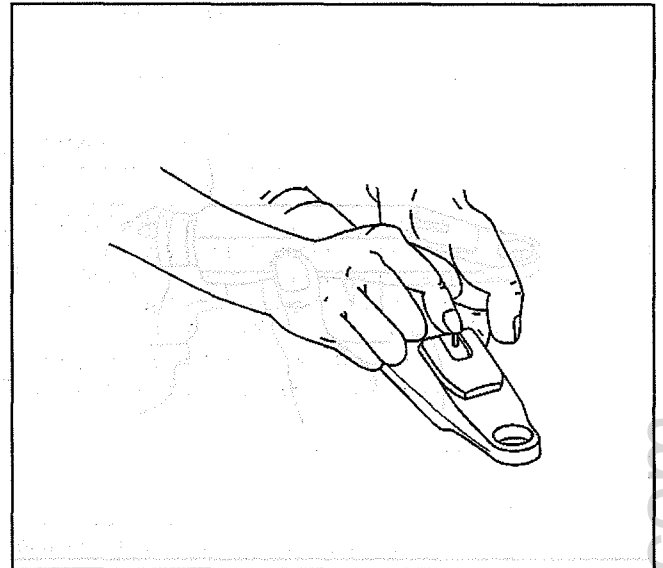
Testing Procedure



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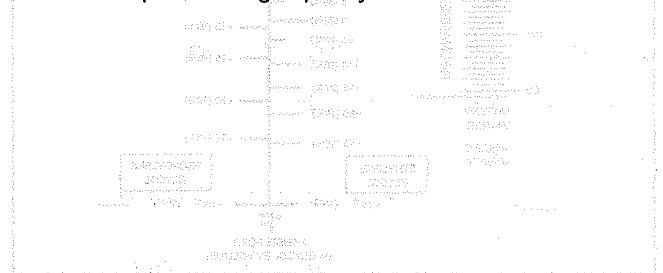
1. Release the clear plastic dropper, located on the side of the J 23688 or J 26568 should be used to draw the test sample.

2. Ensure that the dropper is free of any previous sample before starting the testing procedure.
3. Dip the end of the plastic dropper into the coolant without removing it from the tester. Be sure to insert the tube slightly below the fluid level.
4. Press and release the bulb to draw a sample of coolant.



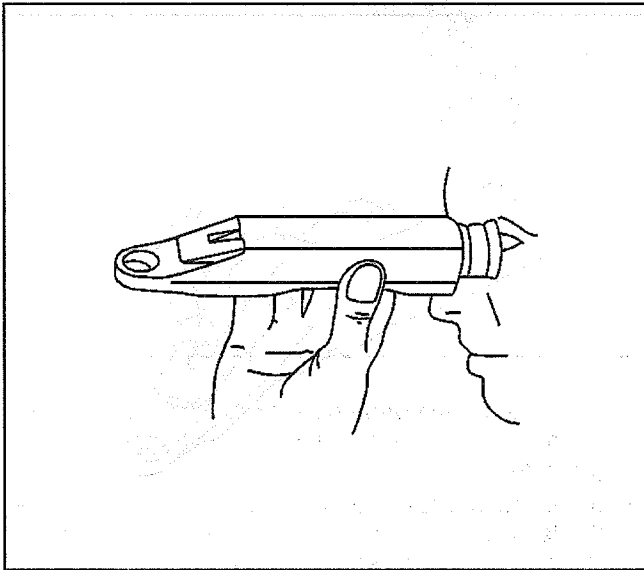
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5. Bend the plastic tube around the J 23688 or J 26568 so that the tip can be inserted in the sample cover opening.
6. Eject a few drops of the coolant onto the measuring prism by pressing the bulb. Take a reading.
7. The J 23688 and the J 26568 are equipped with an eyeguard that can be used in two positions. when wearing eyeglasses, the eyeguard should be folded back; when no eyewear is worn the eyeguard should be extended. Proper positioning of the eyeguard will help eliminate stray light and improve image quality.



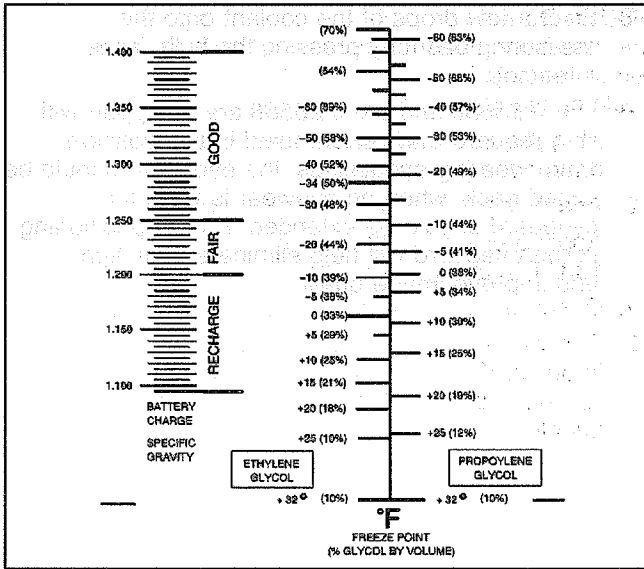
8. The coolant freeze point reading is taken where the dark and light portions of the scale meet. Take the coolant reading on the right-hand scale.
9. To obtain the best contrast between the light and dark portions of the scale, tilt the J 23688 or the J 26568 toward a light source. If the edge between the light and dark shadow is not sharp, the measuring prism was not sufficiently clean and dry or there was not enough fluid on the measuring prism.

Important: The temperature scale is reversed from a standard thermometer scale. Readings below 0 degrees are on the upper half of the scale. The scale is not visible until a sample is placed on the prism. If the concentration of the solution tested is greater than the limits of the scale, the shadow will not be visible.



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8. To take a reading, point the J 23688 or the J 26568 toward any light source and look into the eyepiece.



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9. The coolant freeze point reading is taken where the dark and light portions of the scale meet. Take the coolant reading on the right-hand scale.

10. To obtain the best contrast between the light and dark portions of the scale, tilt the J 23688 or the J 26568 toward a light source. If the edge between the light and dark shadow is not sharp, the measuring prism was not sufficiently clean and dry or there was not enough fluid on the measuring prism.

Calibrating Testers

The J 23688 and the J 26568 are factory calibrated and sealed. The testers should not require adjustment. If adjustment is required, perform the following adjustment procedure:

1. Make sure the temperature of the J 23688 and the J 26568 is between 21 and 29 degrees Centigrade (70 and 85 degrees Fahrenheit).
2. Using distilled water, take a reading.
3. If the reading departs from a 0 degrees Centigrade (32 degrees Fahrenheit) reading on the scale perform the following:
 - 3.1. Remove the sealant covering the screw.
 - 3.2. Turn the screw in the direction necessary to adjust the reading to the 0 degrees Centigrade (32 degrees Fahrenheit) line.

Important: Never remove the screw from the J 23688 or the J 26568.

- 3.3. Reseal the screw using silicone sealant.

Cooling System Leak Testing

Leak Testing Procedure (On Vehicle)

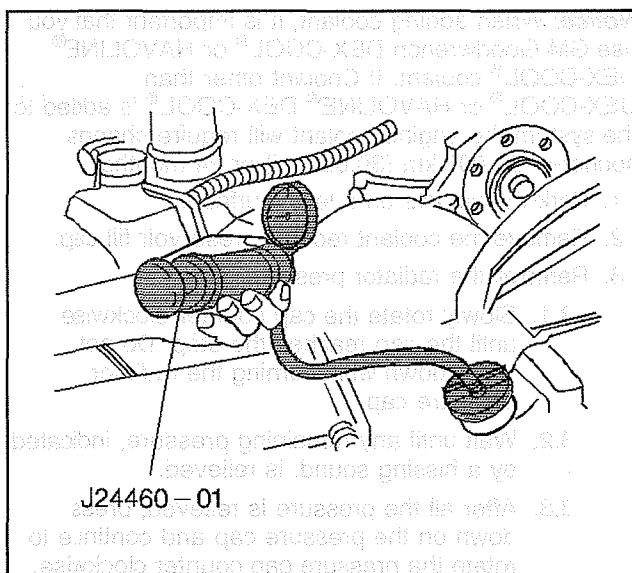
Tools Required

J 24460-01 Cooling System and Cap Pressure Tester

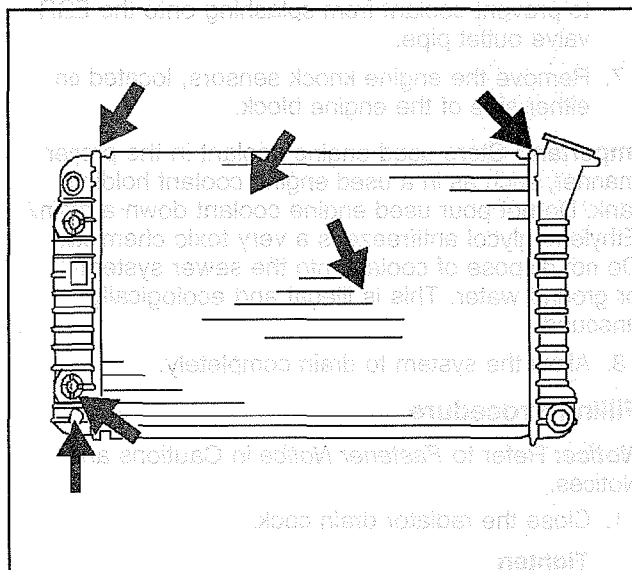
Caution: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

Caution: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

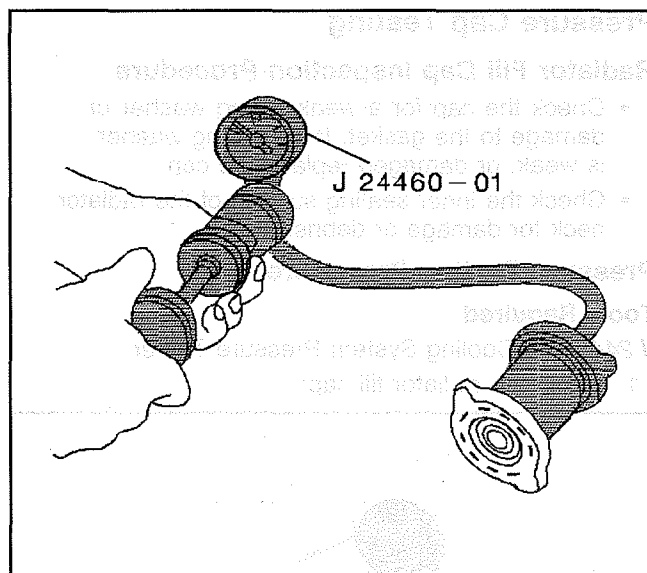
1. After the system has cooled, remove the radiator/surge tank pressure cap.



2. Connect the cooling system tester *J 24460-01* to the radiator/surge tank.
3. Apply normal system operating pressure. Do not exceed 138 kPa (20 psi).



4. Watch the gauge needle for an indication of a leak. Examine all cooling system connections and components, including the radiator and the heater core, for leaking coolant.
5. Tighten the hose connections or repair as required.



6. Check the radiator/surge tank cap with *J 24460-01* in order to ensure the cap maintains the correct pressure.
7. If the radiator leaks during the pressure test, mark the leak area so the leak can be located once the radiator has been removed from the vehicle.

Testing Procedure (Off Vehicle)

Tools Required

J 24460-01 Cooling System and Cap Pressure Tester

Notice: Do not use boil-out tanks or any other tank that has been used for copper or brass radiators. The remaining solutions or chemicals in these tanks could cause radiator failure.

1. Plug the inlet and outlet tubes. Make sure the drain cock is closed.
2. Attach the *J 24460-01* to the radiator.
3. Apply pressure to the radiator. Do not exceed 138 kPa (20 psi) of pressure.
4. Observe the gauge for any pressure loss.
5. Run water over the repair area and look for any bubbles. If a large tank is available, the radiator can be submerged in order to check for air bubbles.

Pressure Cap Testing

Radiator Fill Cap Inspection Procedure

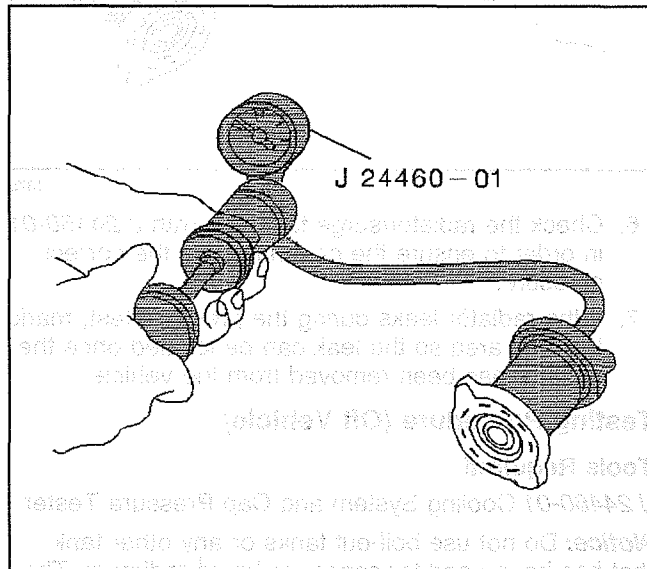
- Check the cap for a weak spring washer or damage to the gasket. If the spring washer is weak, or damaged replace the cap.
- Check the inner sealing surface of the radiator neck for damage or debris.

Pressure Testing Procedure

Tools Required

J 24460-01 Cooling System Pressure Tester

1. Clean the radiator fill cap.



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2. Install the cap on the J 24460-01.
3. In order to obtain the minimum holding pressure, slowly pump the J 24460-01.
 - If the cap fails to hold 83 kPa (12 psi) of pressure, replace the cap.
 - If a new cap is installed, coat the gasket with engine coolant.

Repair Instructions

Draining and Filling Cooling System (3.8 L)

Draining Procedure

Caution: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the pressure cap while the engine is hot and pressure is high will cause the solution to boil instantaneously — possibly with explosive force — spewing the solution over the engine, fenders and the person removing the cap.

Notice: When adding coolant, it is important that you use GM Goodwrench DEX-COOL® or HAVOLINE® DEX-COOL® coolant. If Coolant other than DEX-COOL® or HAVOLINE® DEX-COOL® is added to the system the engine coolant will require change sooner—at 50 000 km (30,000 mi) or 24 months.

1. Park the vehicle on a level surface.
2. Remove the coolant recovery reservoir fill cap.
3. Remove the radiator pressure cap.
 - 3.1. Slowly rotate the cap counter clockwise until the cap reaches the stop. Do not press down while turning the radiator pressure cap.
 - 3.2. Wait until any remaining pressure, indicated by a hissing sound, is relieved.
 - 3.3. After all the pressure is relieved, press down on the pressure cap and continue to rotate the pressure cap counter clockwise.
4. Open the radiator drain cock.
5. Open the air bleed vent located on top of the water outlet. Open the air bleed vent two or three turns.
6. Place a shop towel under the bleed valve in order to prevent coolant from splashing onto the EGR valve outlet pipe.
7. Remove the engine knock sensors, located on either side of the engine block.

Important: Store used engine coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used engine coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

8. Allow the system to drain completely.

Filling Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Close the radiator drain cock.

Tighten

Tighten the radiator drain cock to 2 N·m (18 lb in).

2. Install the engine knock sensors.

Tighten

Tighten the knock sensor to 19 N·m (14 lb ft).

3. Add enough water to fill the coolant system.
4. Run the engine until the thermostat opens.
5. Stop the engine. Repeat the draining procedure until the drained fluid is colorless.
6. Remove, clean, and then reinstall the coolant recovery reservoir. Refer to *Coolant Recovery Reservoir Replacement*.

7. Complete the following steps in order to fill the cooling system:
 - 7.1. Close the air bleed vent when the bubbles disappear and only the coolant is visible.
 - 7.2. Fill the radiator to below the fill neck.
 - 7.3. Fill the coolant recovery reservoir to the FULL HOT mark.
 - 7.4. Install the coolant recovery reservoir cap.
8. With the radiator pressure cap removed, run the engine until the engine reaches normal operating temperature. The radiator inlet hose will become hot.
9. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
10. Install the pressure cap. The arrows on the cap must line up with the vent tube.
11. After the engine reaches normal operating temperature, check for coolant leaks.

Draining and Filling Cooling System (5.7 L)

Draining Procedure

Caution: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the pressure cap while the engine is hot and pressure is high will cause the solution to boil instantaneously — possibly with explosive force — spewing the solution over the engine, fenders and the person removing the cap.

Notice: When adding coolant, it is important that you use GM Goodwrench DEX-COOL® or HAVOLINE® DEX-COOL® coolant. If Coolant other than DEX-COOL® or HAVOLINE® DEX-COOL® is added to the system the engine coolant will require change sooner—at 50 000 km (30,000 mi) or 24 months.

1. Park the vehicle on a level surface.
2. Follow the steps below to remove the radiator pressure cap:
 - Slowly rotate the cap counterclockwise until the cap reaches the stop. Do not press down while turning the radiator pressure cap.
 - Wait until any remaining pressure, indicated by a hissing sound, is relieved.
 - After all the pressure is relieved, press down on the cap and continue to rotate the pressure cap counterclockwise.
3. Open the radiator drain cock.
4. Remove the engine block coolant drain hole plugs.
5. Inspect the engine coolant:
 - Discolored — follow the flush procedure below.
 - Normal in appearance — Continue with the next step.
6. Allow the system to drain completely.

Filling Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Close the radiator drain cock.

Tighten

Tighten the radiator drain cock to 2 N·m (18 lb in).

2. Install the coolant drain hole plugs.

Tighten

Tighten the drain hole plugs to 60 N·m (44 lb ft).

3. Add enough water to fill the coolant system.
4. Run the engine until the thermostat opens.
5. Stop the engine. Repeat the draining procedure until the drained fluid is colorless.
6. Remove, clean, and reinstall the coolant recovery reservoir. Refer to *Coolant Recovery Reservoir Replacement*.
7. Complete the following steps in order to fill the coolant system:

- 7.1. Fill the radiator to below the fill neck.
- 7.2. Fill the coolant recovery reservoir to the FULL HOT mark.
- 7.3. Install the coolant recovery reservoir cap.
8. With the radiator pressure cap removed, run the engine until normal operating temperature is reached. The radiator inlet hose will become hot.
9. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the fill neck.
10. Install the pressure cap.
11. After the engine reaches normal operating temperature, check for coolant leaks.

Flushing

Important: Store used engine coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used engine coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

You can use various methods and equipment to flush the cooling system. If special equipment is used (such as a back flusher) follow the manufacturer's instructions. However, always remove the thermostat before flushing the system.

Engine Coolant Recycling

Whenever the cooling system needs maintenance or repairs, remove and replace the coolant with new coolant.

Important: Do not recycle coolant on vehicles manufactured with GM Goodwrench DEX-COOL®.

- Recover the used coolant.
- Store the coolant in a used coolant holding tank.
- Submit the used coolant for recycling on a regular basis.

Radiator Cleaning

Caution: NEVER spray water on a hot radiator. The resulting steam could cause personal injury.

Notice: The radiator fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

Important: Do not brush the radiator fins. The radiator fins are necessary for good heat transfer. Brushing damages the fins and reduces heat transfer.

Clean the front face of the radiator annually.

- Clean the front face of the condenser.
- Remove bugs, leaves, etc. by blowing compressed air through the radiator.

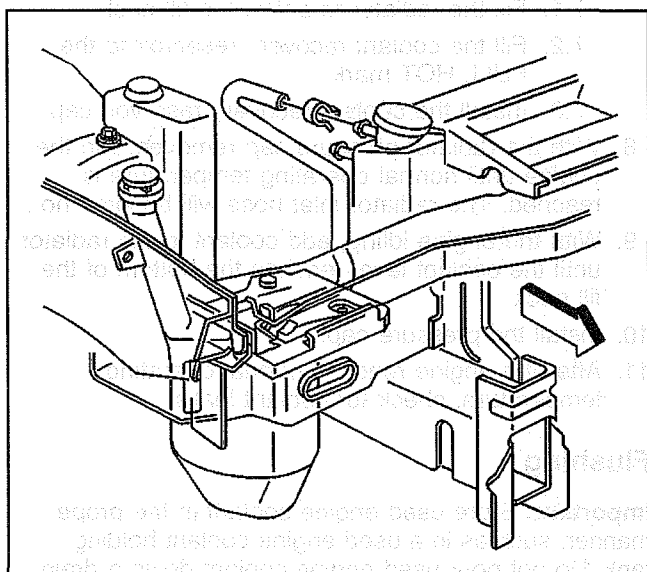
Blow the air from the rear toward the front. If compressed air is not available a water hose can be used to force water through the radiator.

Use water only with the engine not running and cool.

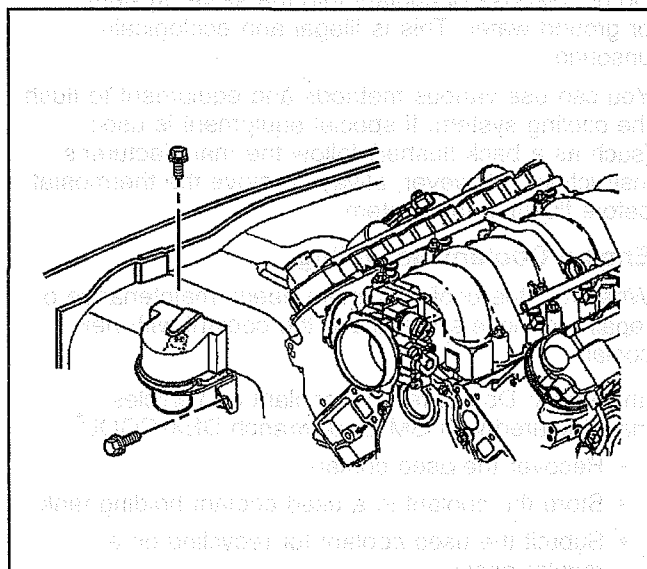
Coolant Recovery Reservoir Replacement

Removal Procedure

1. Remove the battery. Refer to *Battery Replacement* in Engine Electrical.
2. Remove the coolant recovery reservoir hose from the radiator.

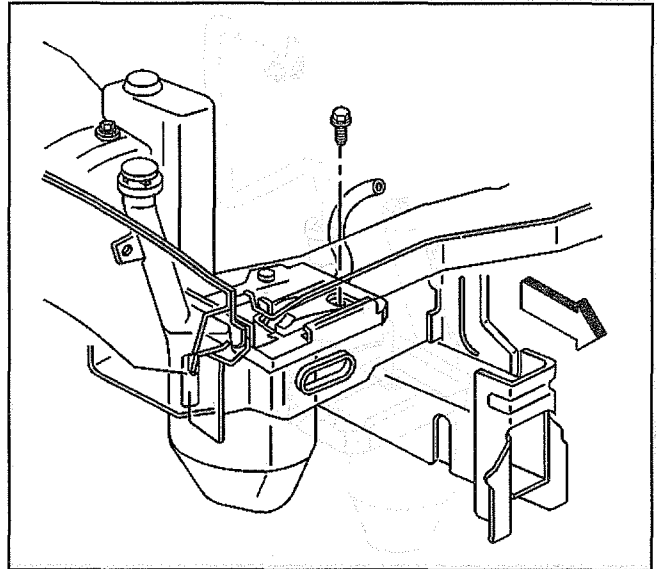


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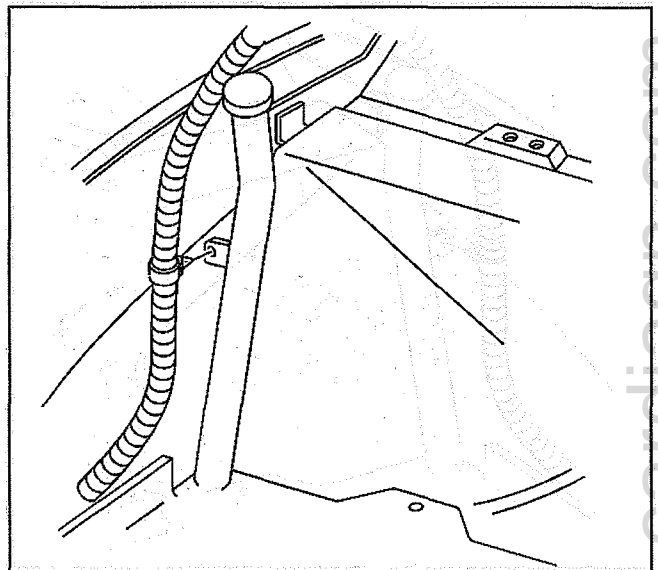
5. Remove the coolant recovery reservoir bolt.



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6. Remove the wiring harness rosebud clip from the reservoir neck.

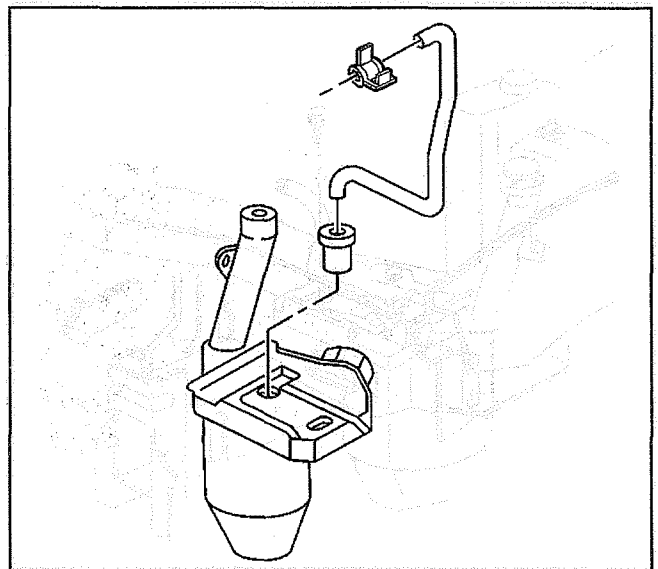
7. Remove the coolant recovery reservoir.



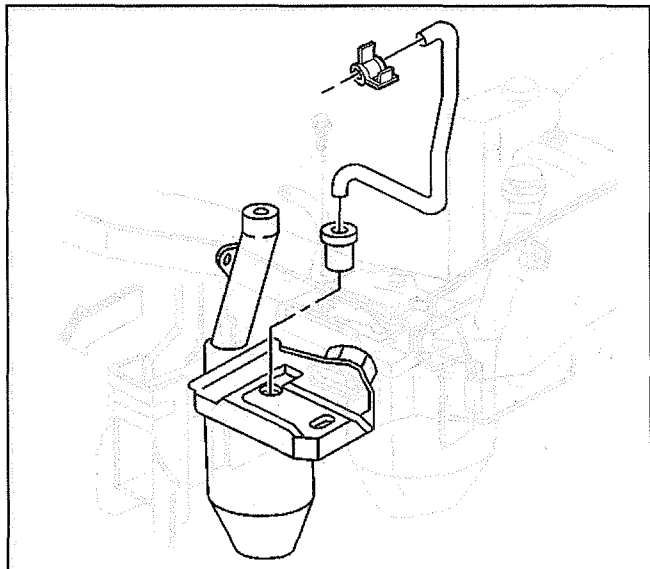
221650

8. Remove the coolant recovery reservoir hose from the reservoir.

9. Clean the coolant recovery reservoir with soap and water. Thoroughly rinse the reservoir.



221663

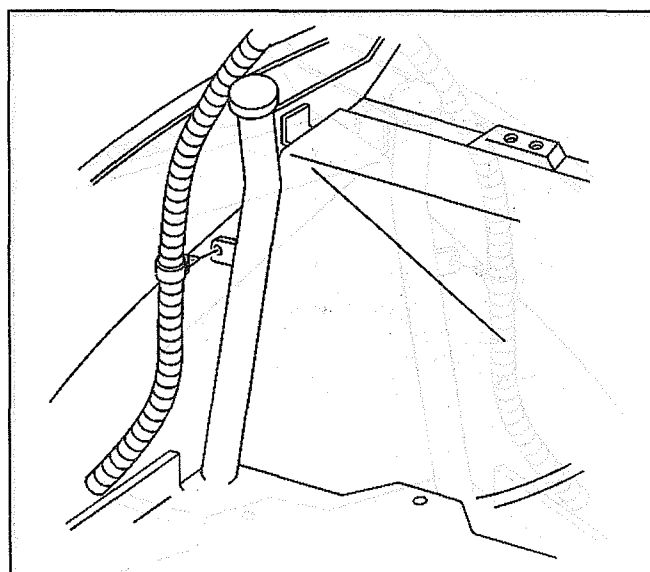


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Installation Procedure

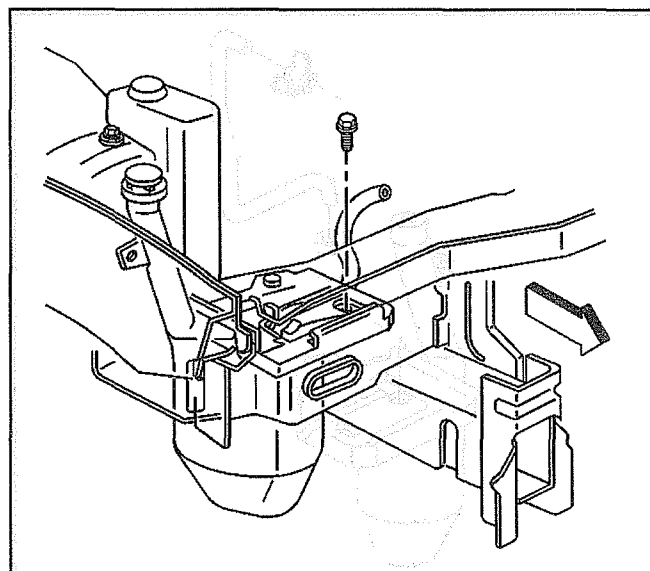
1. Install the coolant recovery reservoir hose to the reservoir.
2. Install the coolant recovery reservoir.



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3. Install the wiring harness rosebud clip to the reservoir neck.



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Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the coolant recovery reservoir bolt.

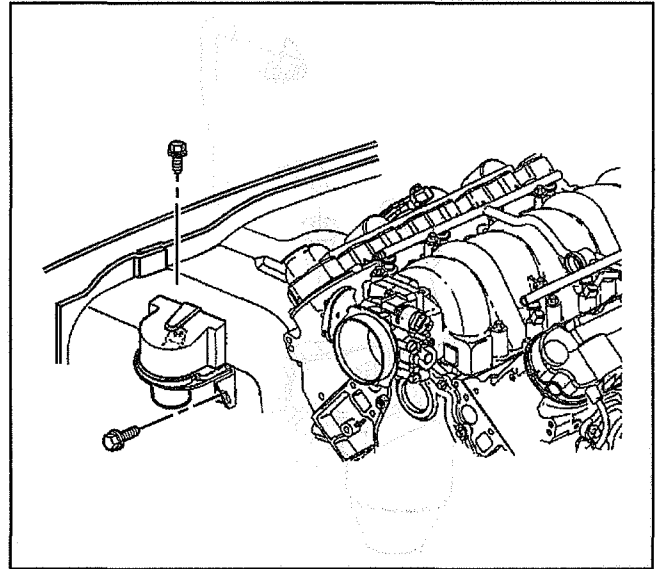
Tighten

Tighten the coolant recovery reservoir bolt to 12 N·m (106 lb in).

5. Position the accelerator and cruise control servo cable adjuster, if equipped with a 5.7 L engine.
6. Install the accelerator and cruise control servo cable bolts, if equipped with a 5.7 L engine.

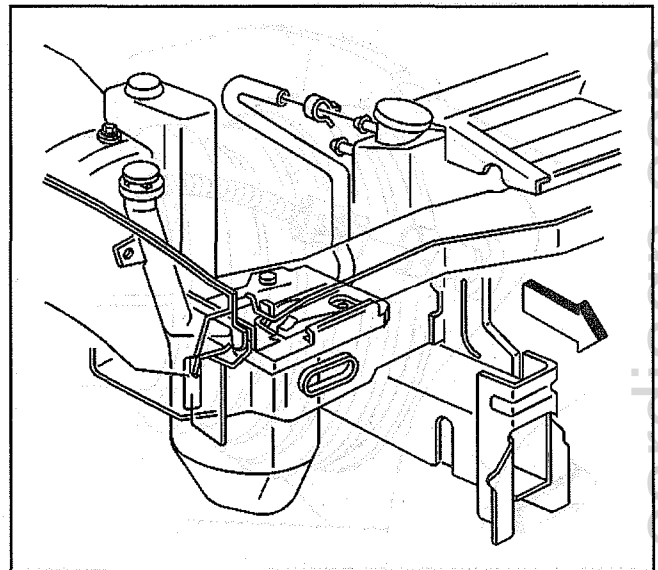
Tighten

Tighten the accelerator and cruise control servo cable adjuster bolts to 8 N·m (71 lb in).



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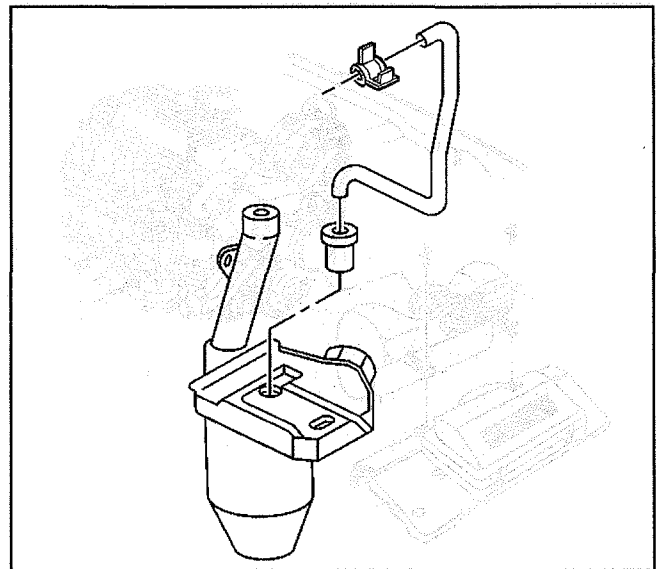
7. Install the coolant recovery reservoir hose to the radiator.
8. Install the battery. Refer to *Battery Replacement* in Engine Electrical.
9. Add engine coolant to the FULL COLD mark on the reservoir.



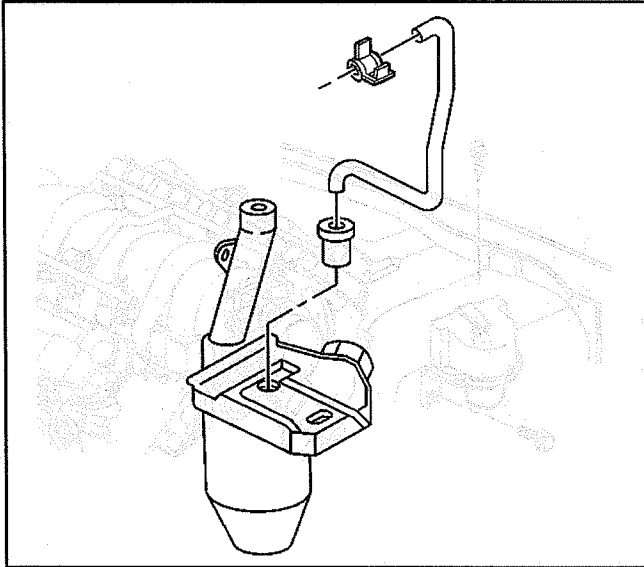
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Coolant Recovery Pipe Replacement**Removal Procedure**

1. Remove the coolant recovery reservoir. Refer to *Coolant Recovery Reservoir Replacement*.
2. Remove the coolant recovery hose and grommet from the reservoir.



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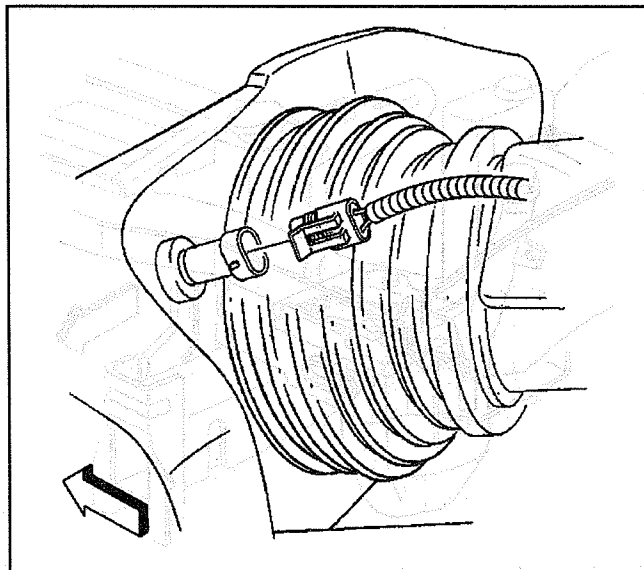
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221663

Installation Procedure

1. Install the coolant recovery hose and grommet to the reservoir.
2. Install the coolant recovery reservoir. Refer to *Coolant Recovery Reservoir Replacement*.

Tighten the accelerator and cruise control cable adjuster bolts to 8 N·m (7 lb ft).



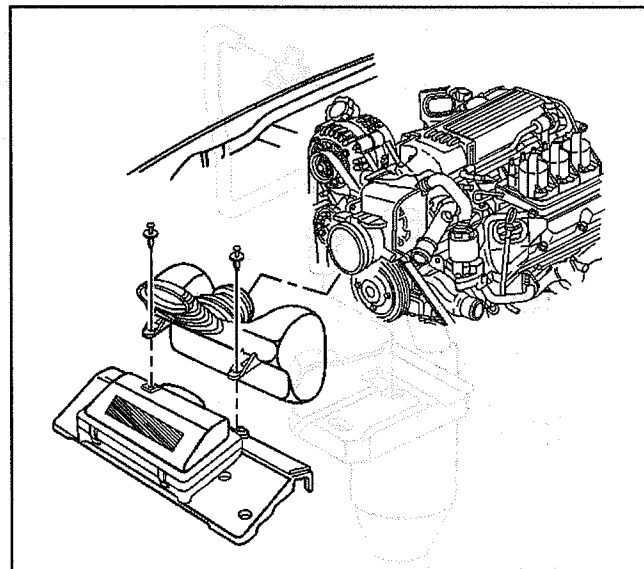
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Radiator Hose Replacement - Inlet (3.8 L)

Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.
2. Disconnect the intake air temperature (IAT) sensor electrical connector.



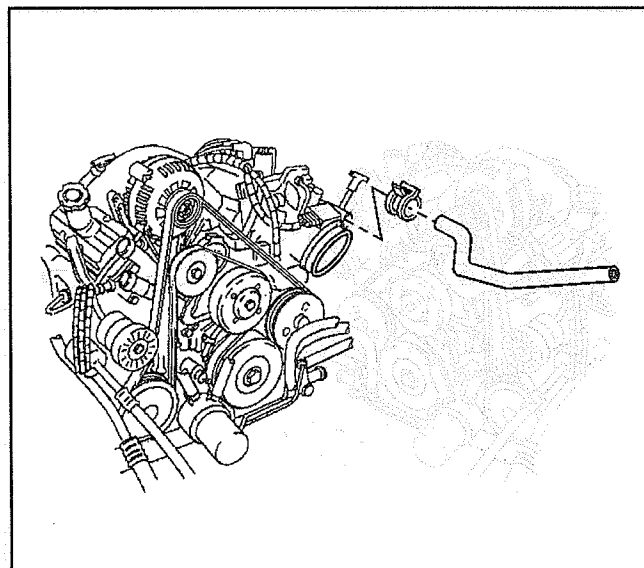
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3. Remove the air intake duct resonator.

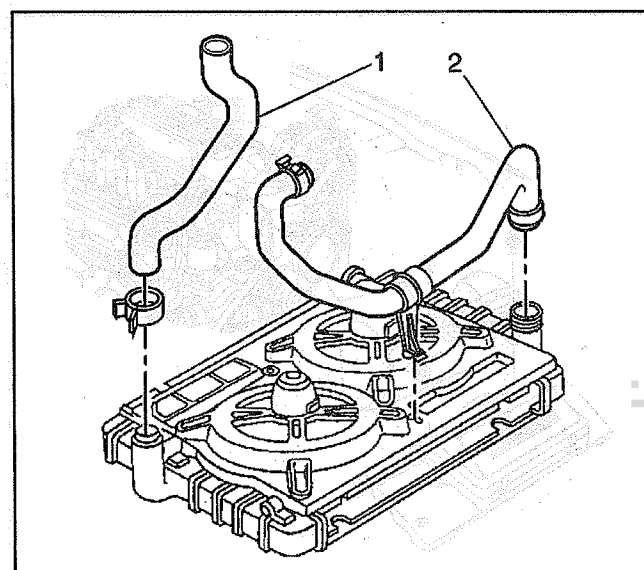
Removal Procedure
 1. Remove the coolant recovery reservoir. Refer to *Coolant Recovery Reservoir Replacement*.
 2. Remove the coolant recovery hose and grommet from the reservoir.

4. Remove the inlet hose from the water outlet.



221680

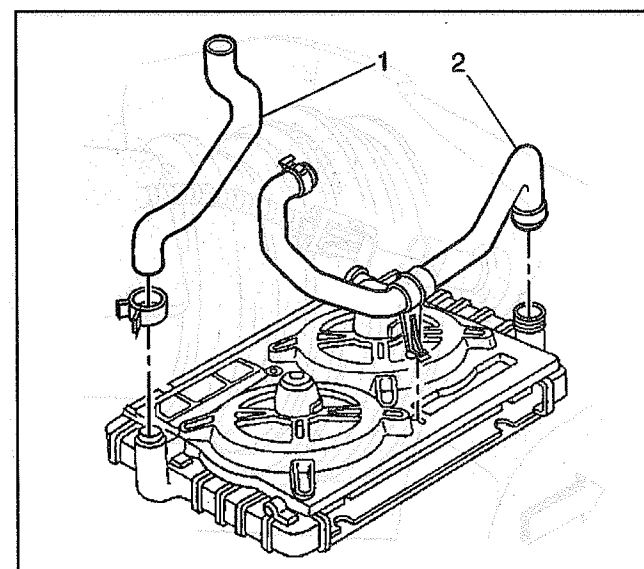
5. Remove the inlet hose (1) from the radiator.



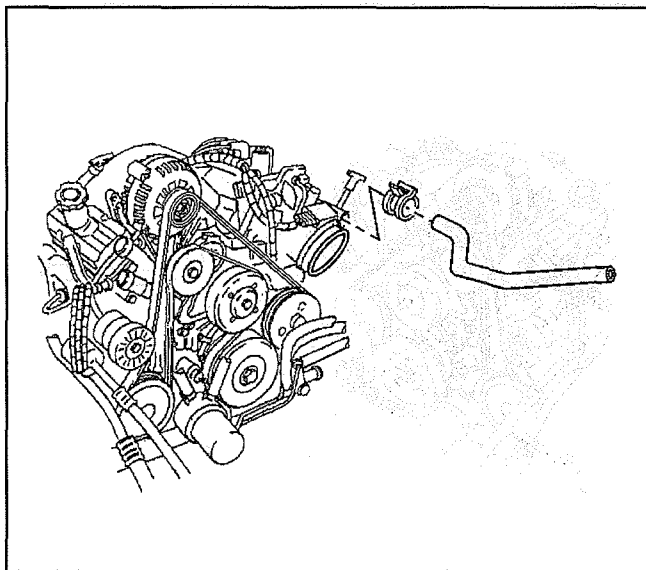
349794

Installation Procedure

1. Install the inlet hose (1) to the radiator.

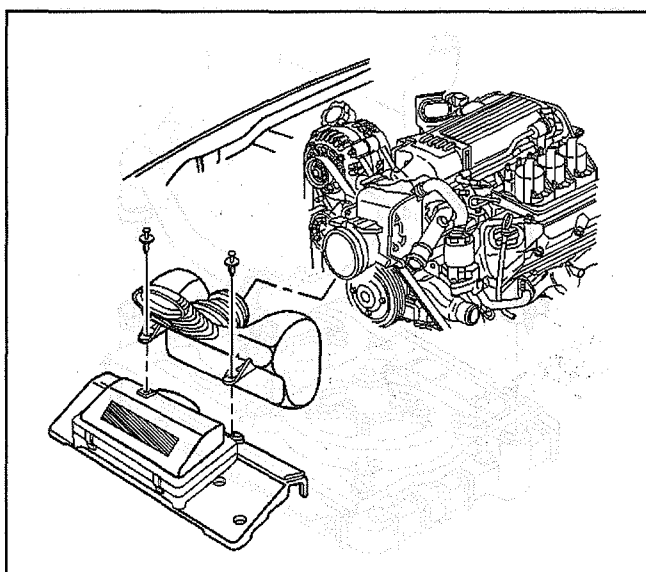


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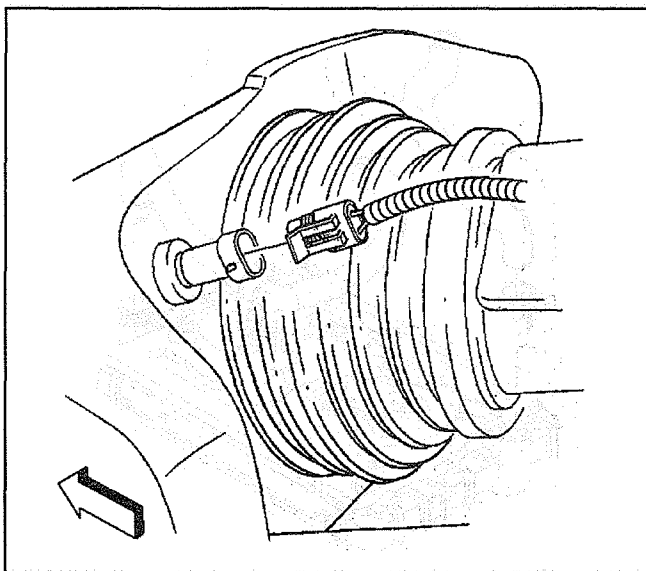
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2. Install the inlet hose to the water outlet.



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3. Install the air intake duct resonator.

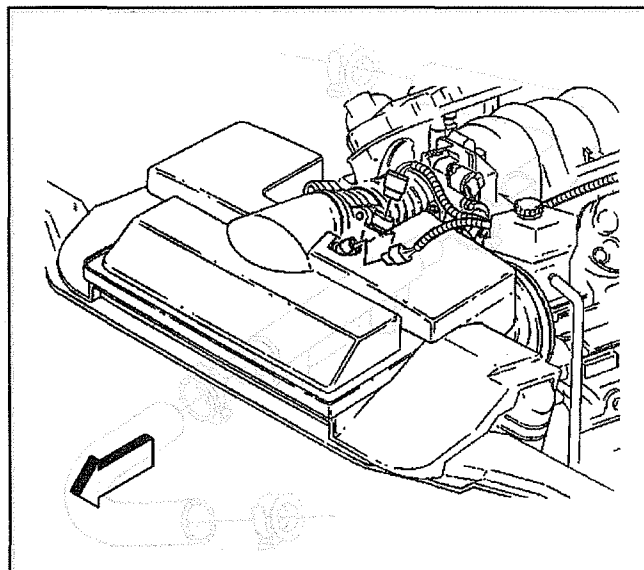


208554

4. Connect the IAT sensor electrical connector.
5. Fill the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.

Radiator Hose Replacement - Inlet (5.7 L)**Removal Procedure**

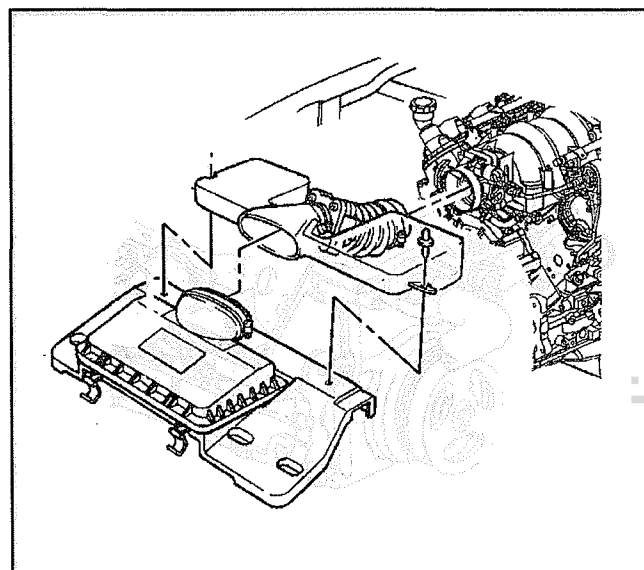
1. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
2. Disconnect the intake air temperature sensor (IAT) sensor electrical connector.
3. Disconnect the mass airflow (MAF) sensor electrical connector.



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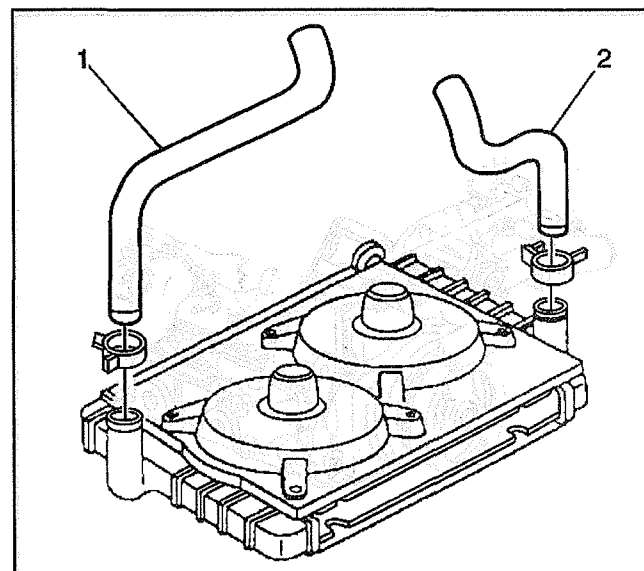
4. Remove the air intake duct resonator.



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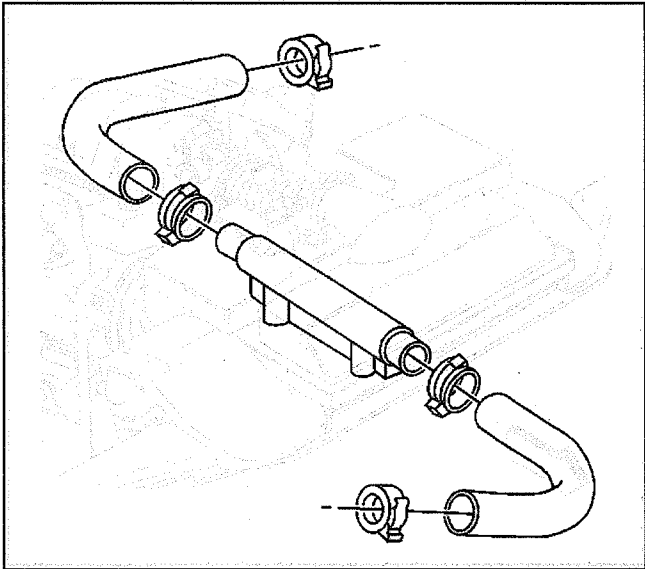
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5. Remove the inlet hose (1) from the radiator.



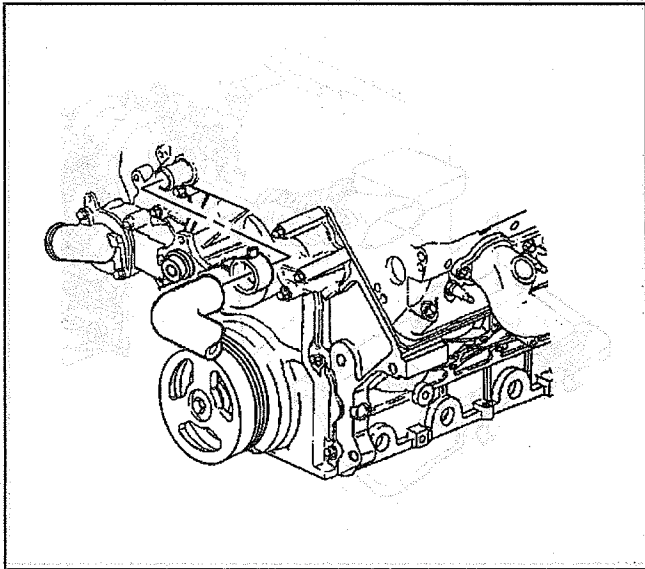
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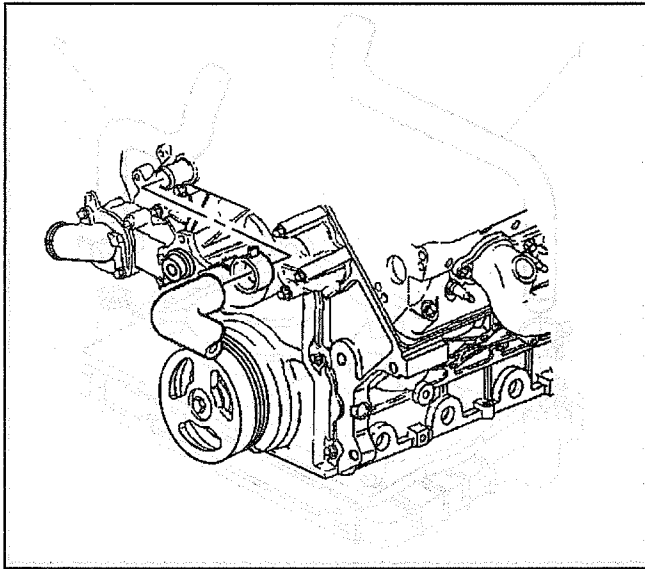
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6. Remove the inlet hose from the power steering cooler, if equipped.



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7. Remove the inlet hose from the water pump.

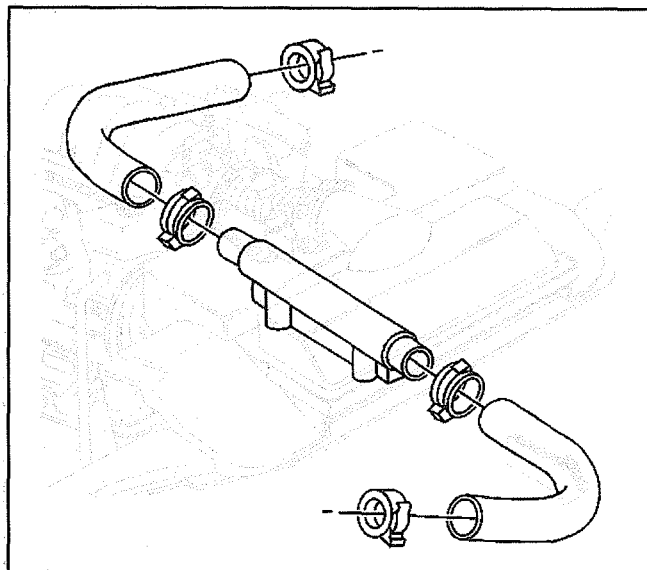


221676

Installation Procedure

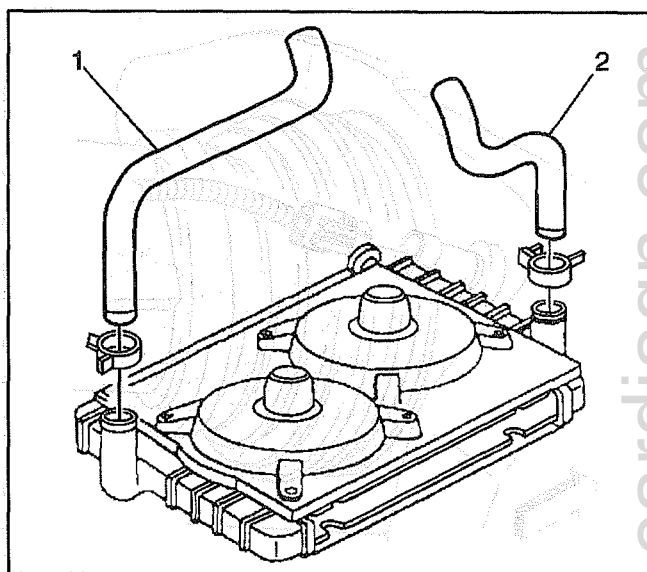
1. Install the inlet hose to the water pump.

2. Install the inlet hose to the power steering cooler, if equipped.



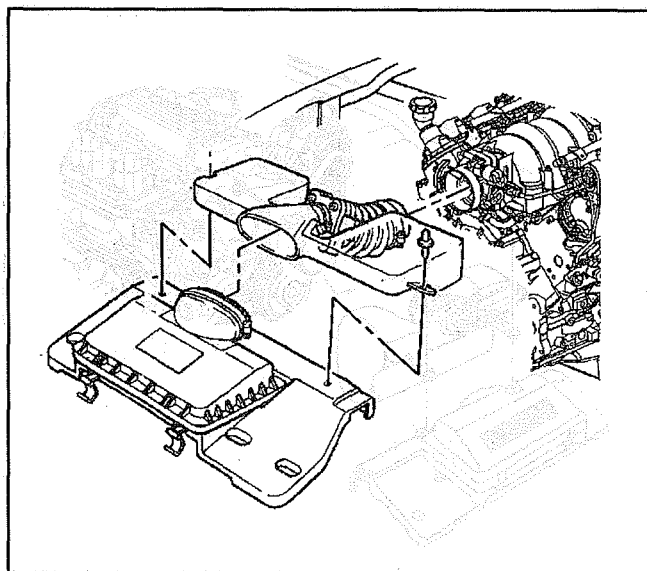
221666

3. Install the inlet hose (1) to the radiator.

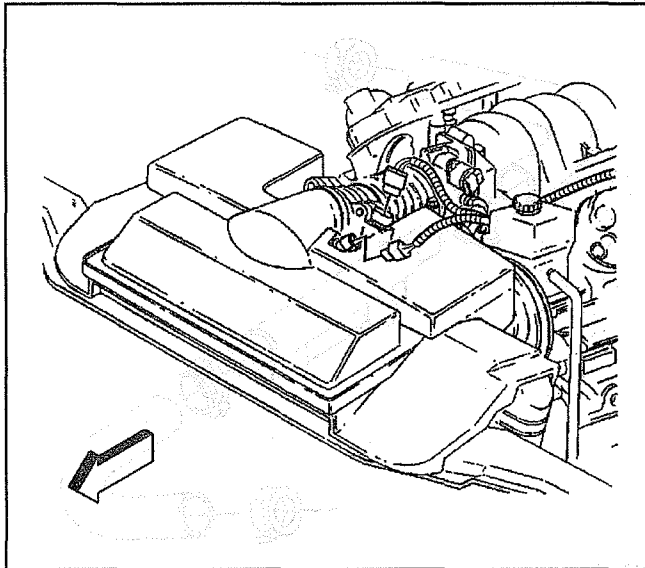


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4. Install the air intake duct resonator.



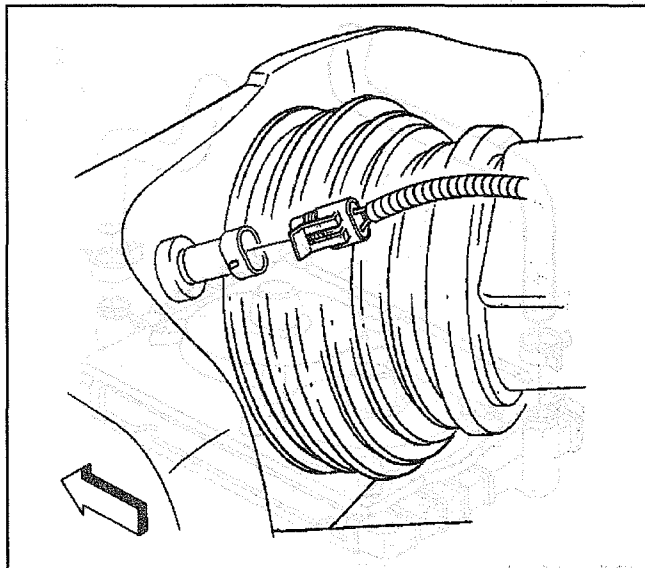
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5. Connect the IAT sensor electrical connector.
6. Connect the MAF sensor electrical connector.
7. Refill the cooling system. Refer to *Draining and Filling Cooling System* (5.7 L).



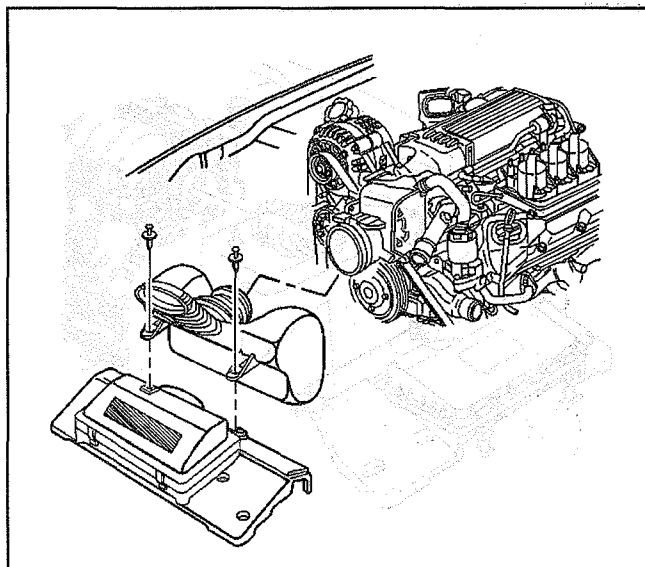
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Radiator Hose Replacement - (3.8 L)

Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System* (3.8 L).
2. Disconnect the intake air temperature (IAT) sensor electrical connector.

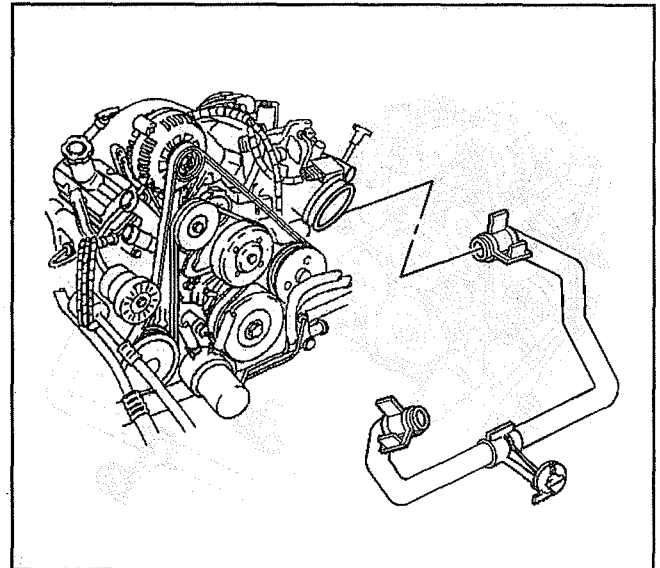


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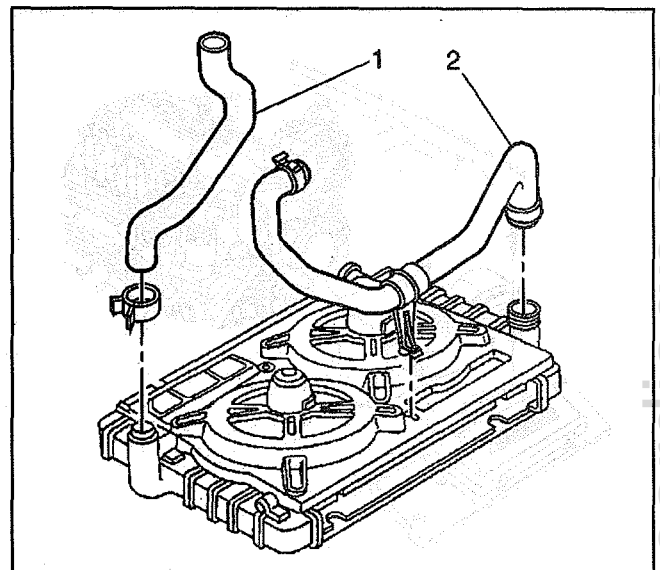
3. Remove the air intake duct resonator.

4. Remove the outlet hose from the water pump.
5. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.



221689

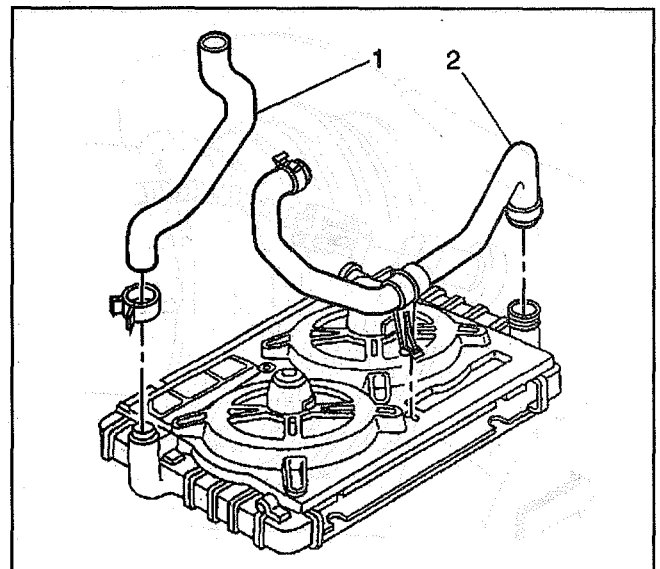
6. Remove the outlet hose (2) from the radiator.
7. Remove the hose support from the fan shroud.



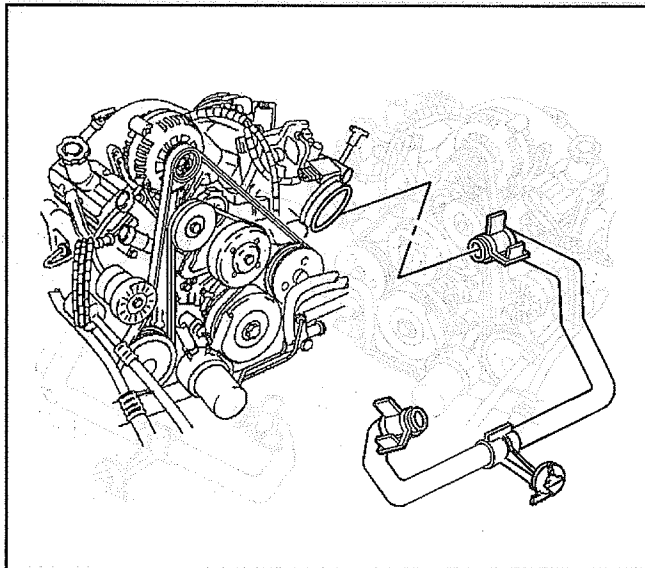
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Installation Procedure

1. Install the outlet hose support to the fan shroud.
2. Install the outlet hose (2) to the radiator.
3. Lower the vehicle.

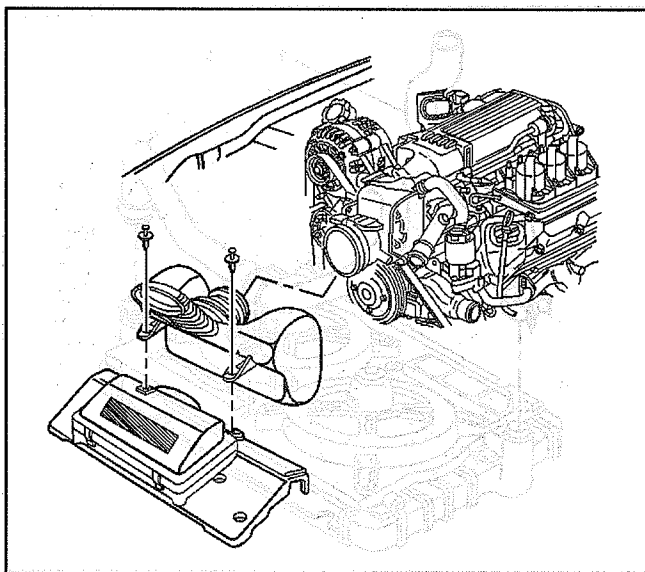


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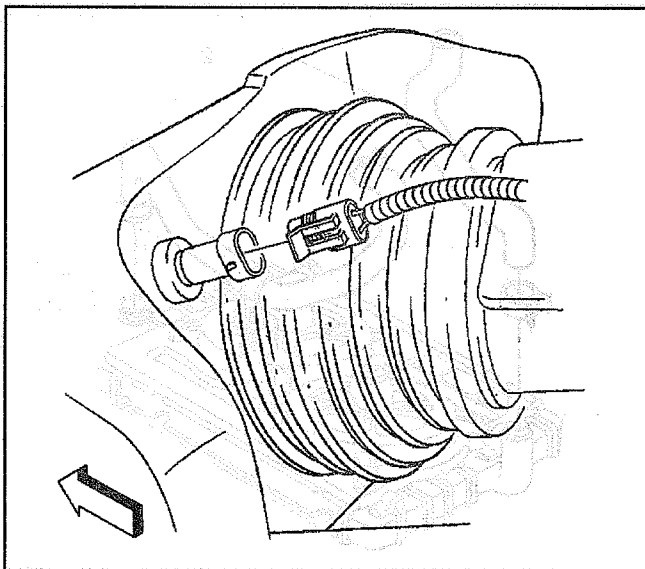
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4. Install the outlet hose to the water pump.



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5. Install the air intake duct resonator.



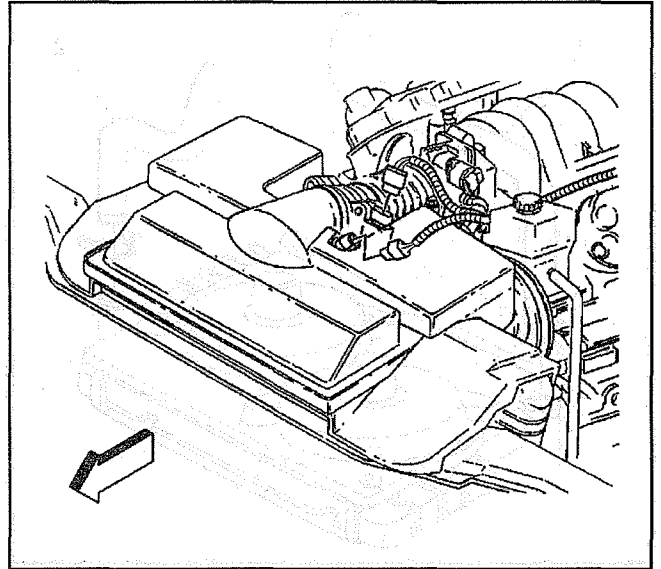
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6. Connect the IAT sensor electrical connector.
7. Refill the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.

Radiator Hose Replacement - Outlet (5.7 L)

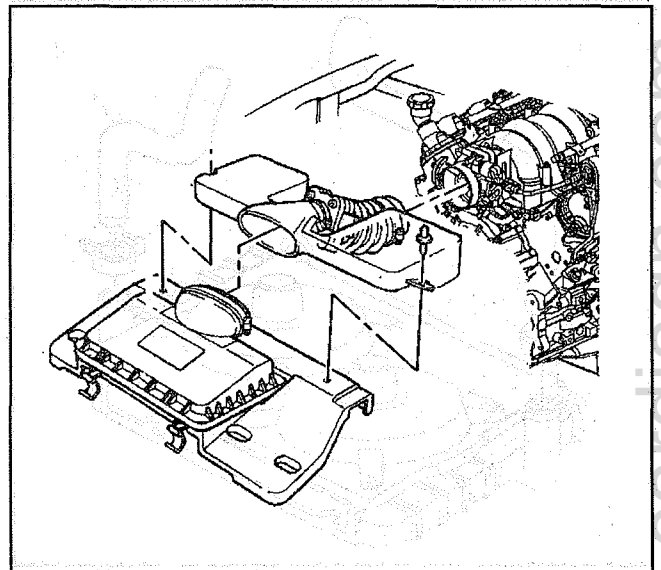
Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
2. Disconnect the intake air temperature (IAT) sensor electrical connector.
3. Disconnect the mass airflow (MAF) sensor electrical connector.



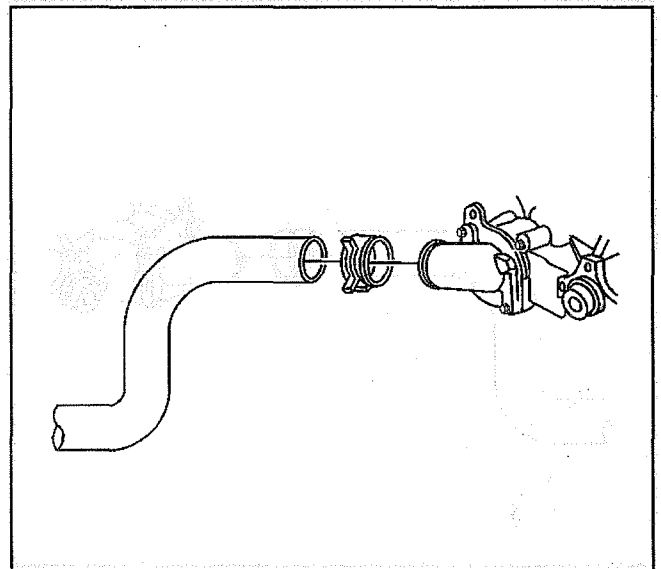
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4. Remove the air intake duct resonator.

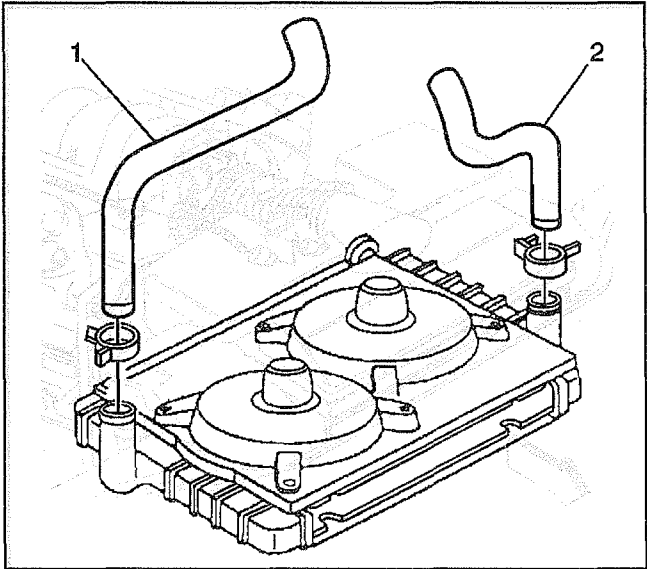


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5. Remove the outlet hose from the water outlet.
6. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

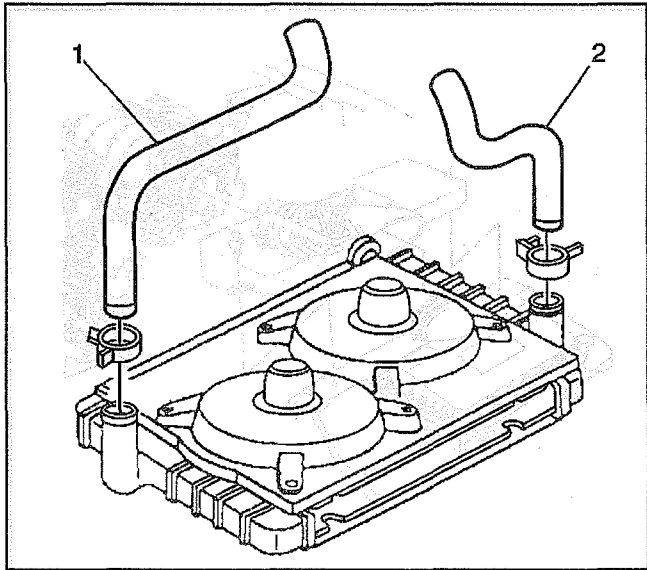


221671



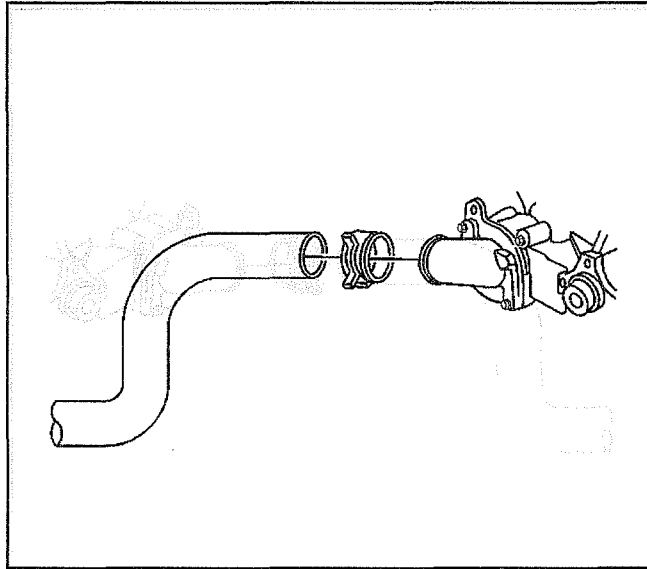
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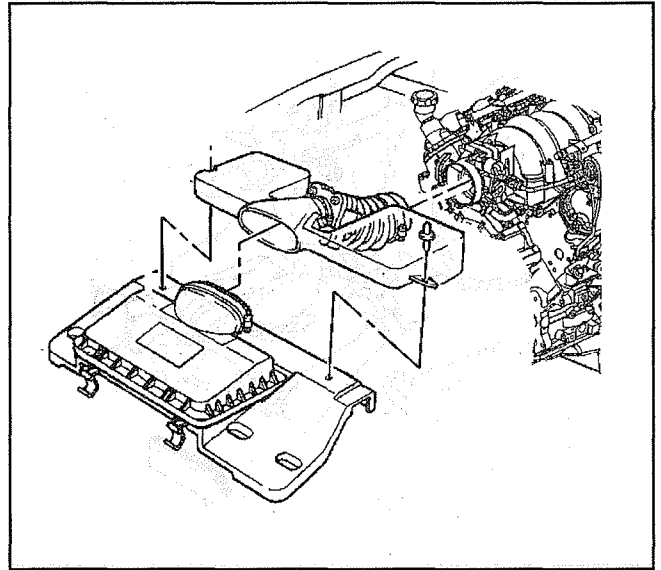
7. Remove the outlet hose (2) from the radiator.

Installation Procedure

1. Install the outlet hose (2) to the radiator.
2. Lower the vehicle.

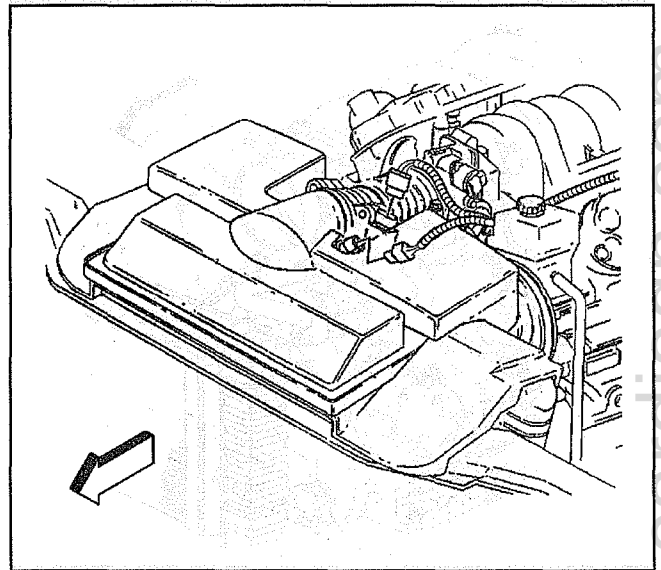
3. Install the outlet hose to the water outlet.

4. Install the air intake duct resonator.



208569

5. Connect the IAT sensor electrical connector.
6. Connect the MAF sensor electrical connector.
7. Refill the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.

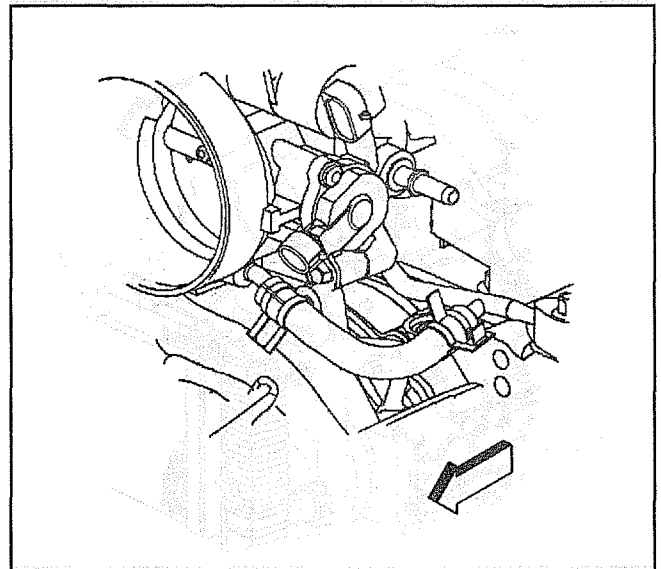


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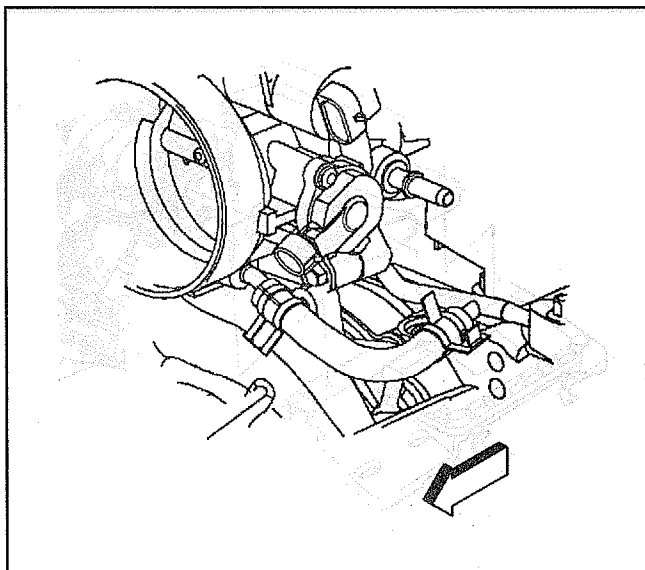
Throttle Body Heater Hose Replacement - Inlet (5.7 L)

Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
2. Disconnect the throttle position sensor (TPS) electrical connector, if necessary.
3. Reposition the hose clamps at the throttle body and engine coolant air bleed pipe.
4. Remove the throttle body heater inlet hose from the throttle body.
5. Remove the throttle body inlet hose from the engine coolant air bleed pipe.



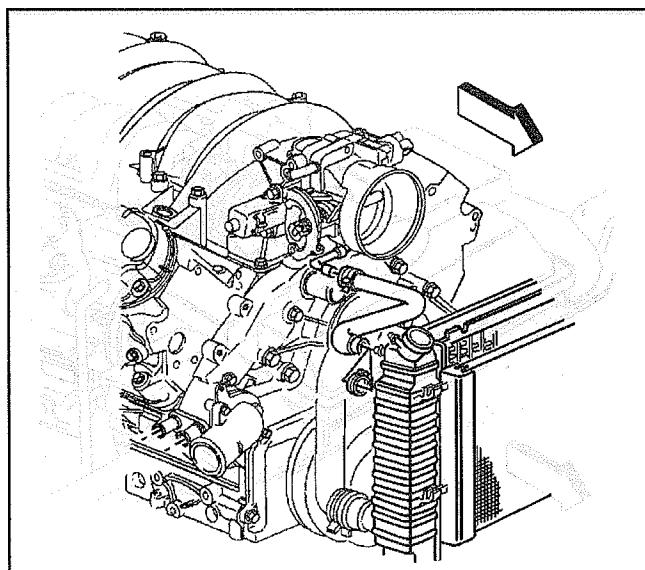
220621



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Installation Procedure

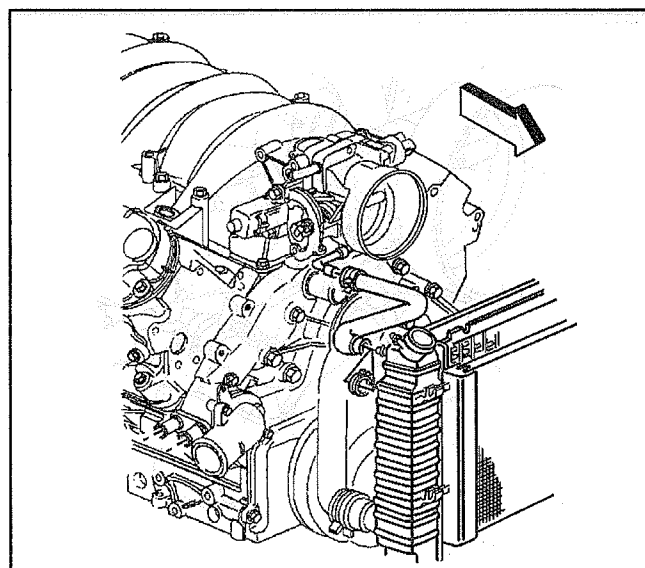
1. Install the throttle body inlet hose to the engine coolant air bleed pipe.
2. Install the throttle body heater inlet hose to the throttle body.
3. Reposition the hose clamps at the throttle body and engine coolant air bleed pipe.
4. Connect the TPS electrical connector, if necessary.
5. Refill the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.



220620

Throttle Body Heater Hose Replacement - Outlet (5.7 L)**Removal Procedure**

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
2. Reposition the hose clamps at the throttle body and radiator.
3. Remove the throttle body heater outlet hose from the throttle body.
4. Remove the throttle body outlet hose from the radiator.



220620

Installation Procedure

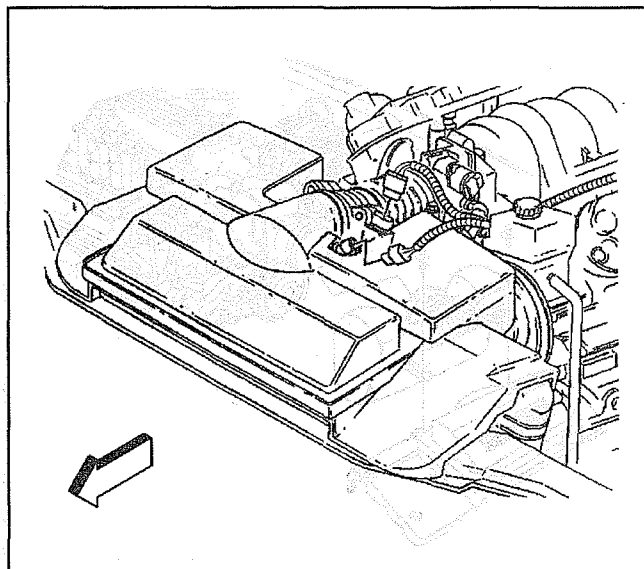
1. Install the throttle body outlet hose to the radiator.
2. Install the throttle body heater outlet hose to the throttle body.
3. Reposition the hose clamps at the throttle body and radiator.
4. Refill the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.

Cooling Fan Replacement - Electric

Removal Procedure

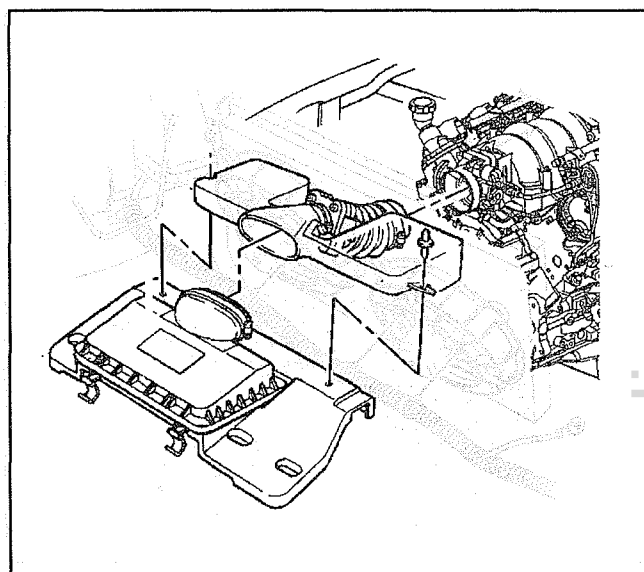
Caution: Keep hands, tools, and clothing away from the electric engine coolant fans in order to help prevent personal injury. These fans are electric and can turn on whether or not the engine is running. The fans can start automatically with the ignition in the ON position.

1. Disconnect the intake air temperature (IAT) and mass airflow (MAF) sensors electrical connectors, if equipped with the 5.7 L engine.



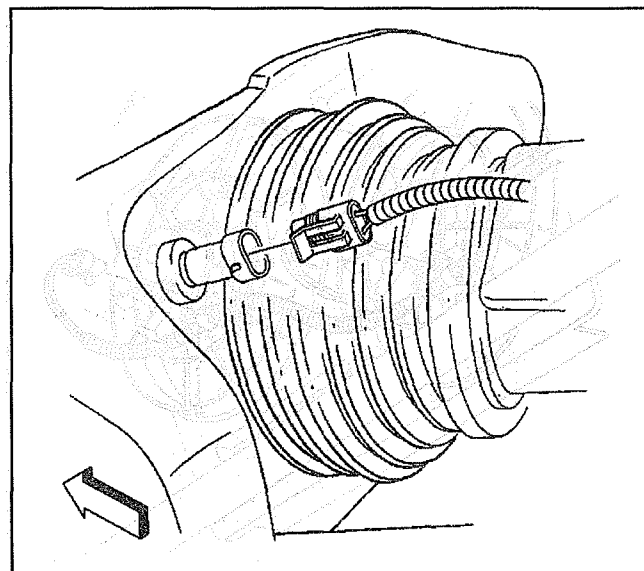
208553

2. Remove the air intake duct resonator, if equipped with the 5.7 L engine.

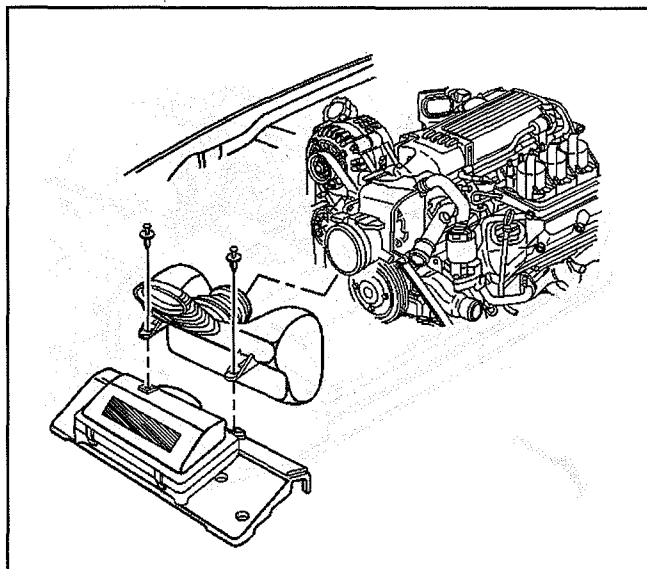


208569

3. Disconnect the electrical connector from the intake air temperature (IAT) sensor, if equipped with the 3.8 L engine.

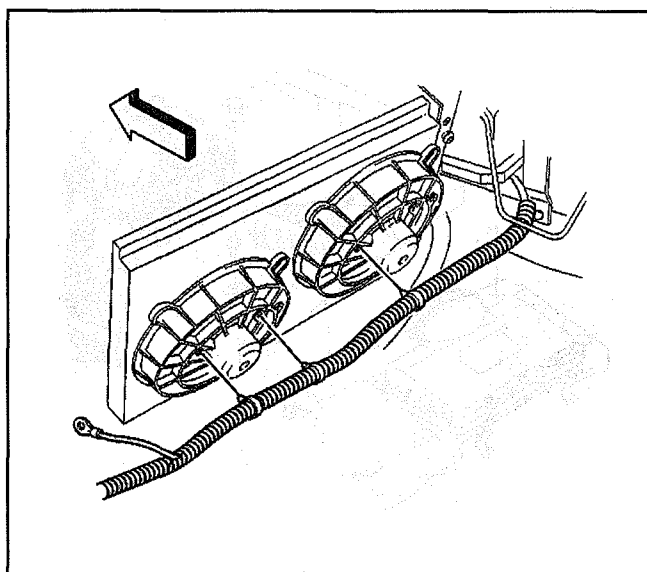


208554



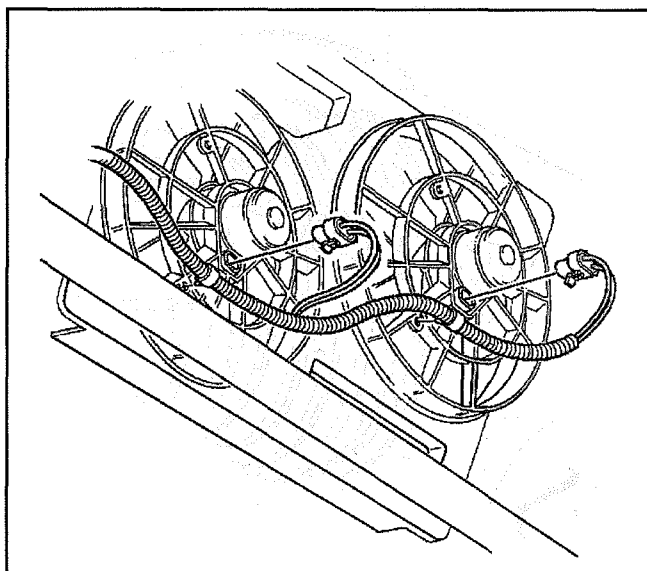
554755

4. Remove the air intake duct resonator, if equipped with the 3.8 L engine.



211602

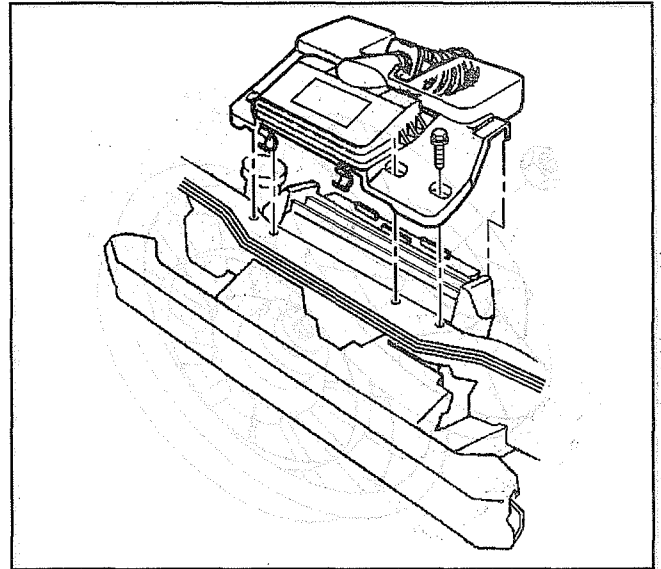
5. Disconnect the rosebud clips from the fans.



221692

6. Disconnect the coolant fan electrical connectors from the fans.

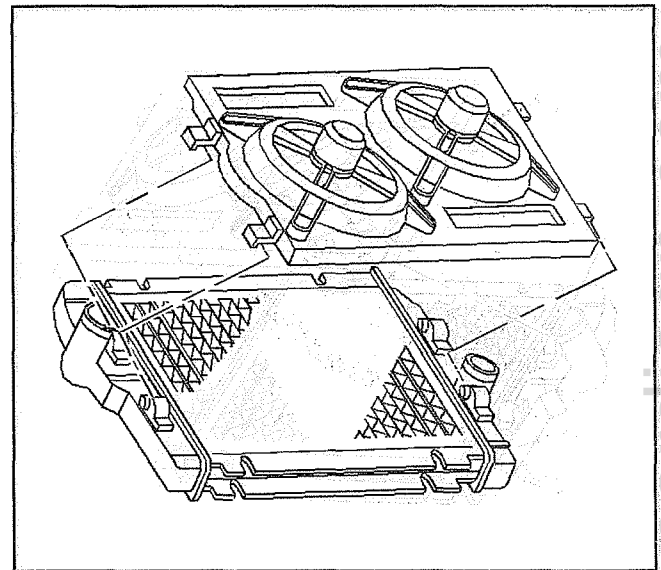
7. Remove the air cleaner bolts.
8. Remove the air cleaner.



221697

221697

9. Remove the electric engine coolant fan. The fan will slide off of the radiator.

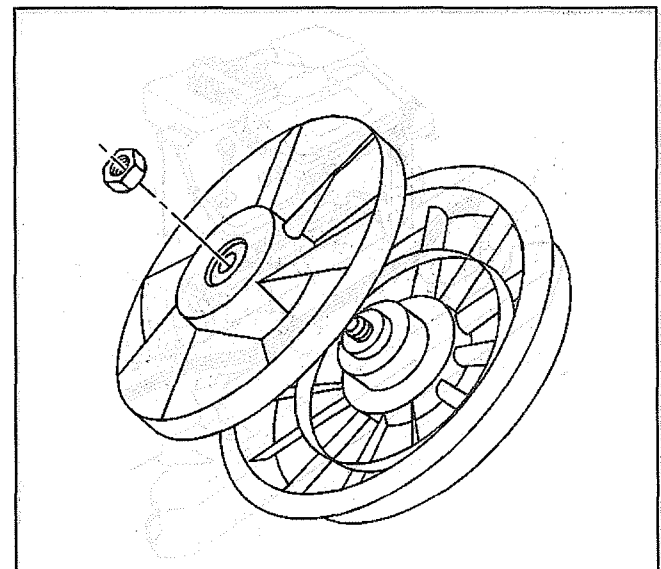


41692

41692

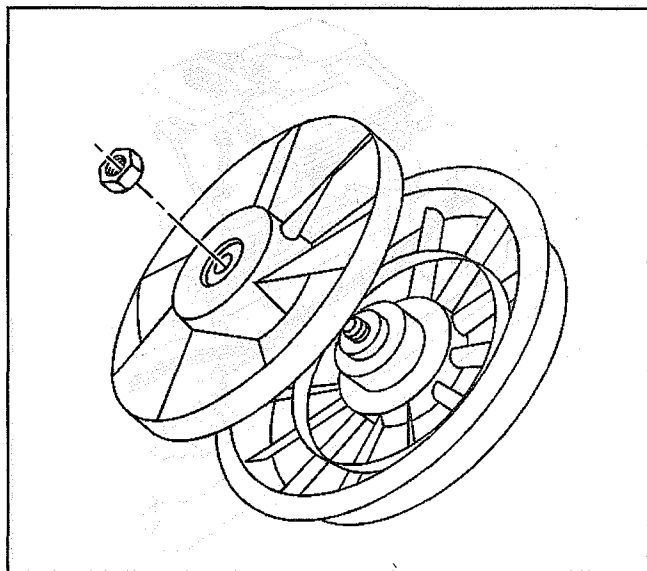
10. Remove the fan blade nut.
- Caution:** If a fan blade is bent or damaged in any way, do not repair or reuse the damaged part. Always replace a bent or damaged fan blade. Fan blades that have been damaged can not be assured of proper balance and could fail and fly apart during subsequent use. This creates an extremely dangerous situation.
- The fan blades must remain in proper balance. You cannot assure fan blade balance once a fan blade has been bent or damaged. A fan blade that is not in proper balance could fail and fly apart during use, creating an extremely dangerous situation.

11. Remove the fan blade.
12. Inspect for the following conditions:
 - Bent or cracked fan blades
 - Smoothness of the fan blade mating surfaces
 - Remove burrs or other imperfections as necessary



342281

342281



342281

Installation Procedure

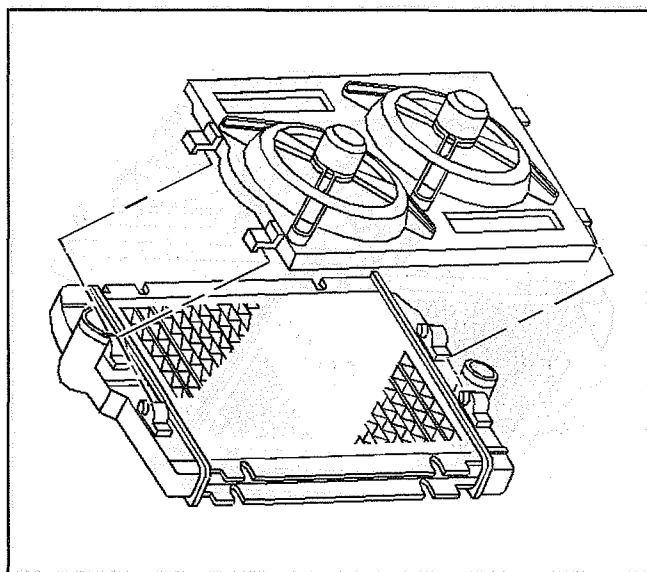
1. Install the fan blade.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the fan blade nut.

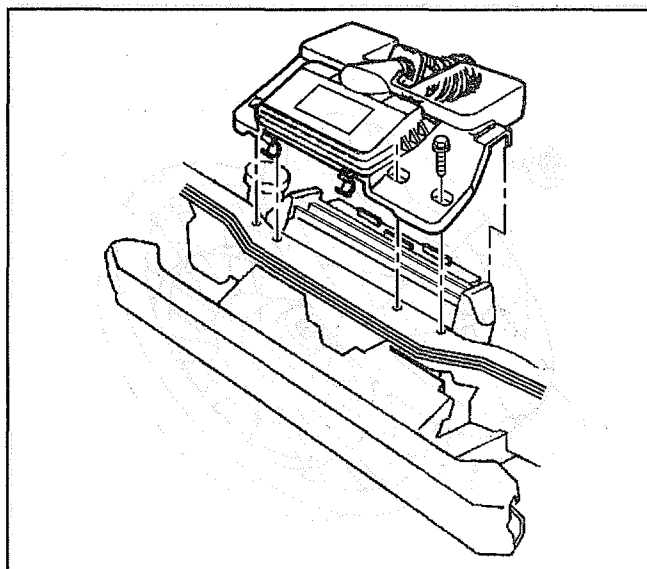
Tighten

Tighten the fan blade nut to 6 N·m (53 lb in).



41692

3. Install the electric engine coolant fan. The fan will slide into place on the radiator.



221697

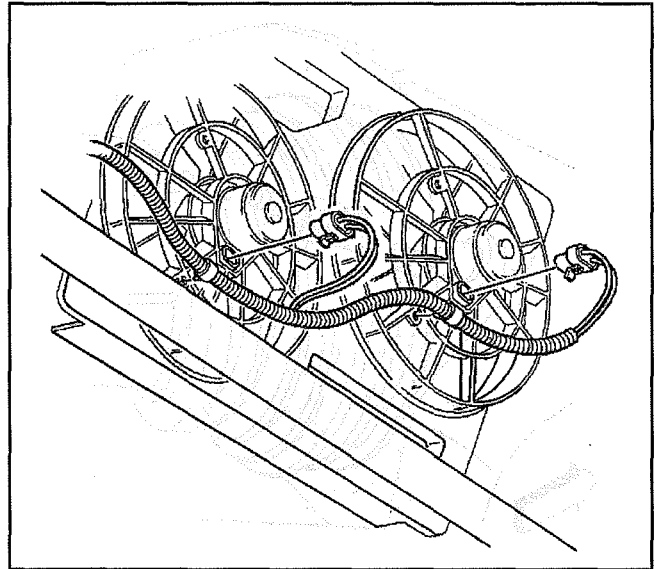
4. Install the air cleaner.

5. Install the air cleaner bolts.

Tighten

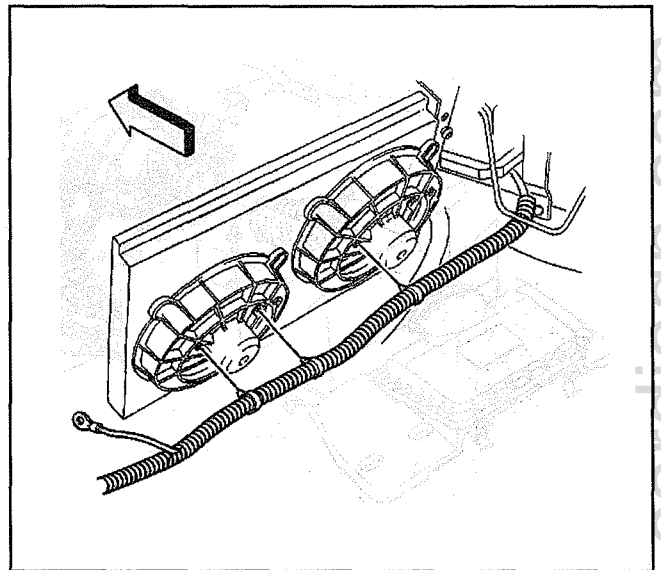
Tighten the air cleaner bolts to 12 N·m (106 lb in).

6. Connect the coolant fan electrical connectors to the fans.



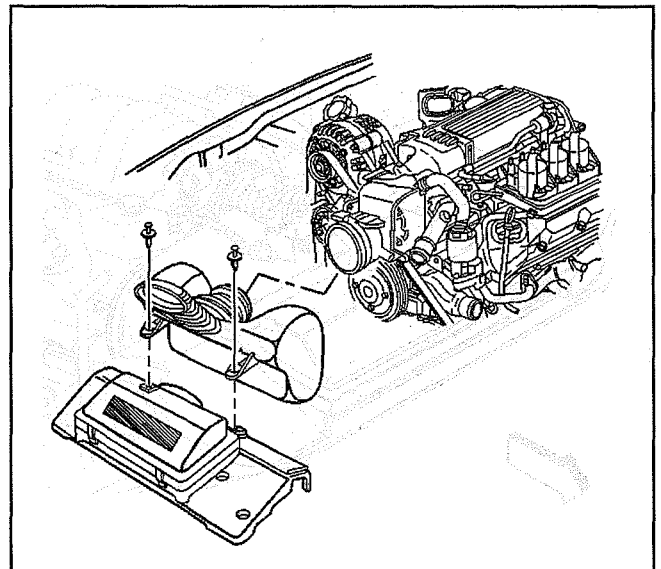
221692

7. Connect the rosebud clips to the fans.

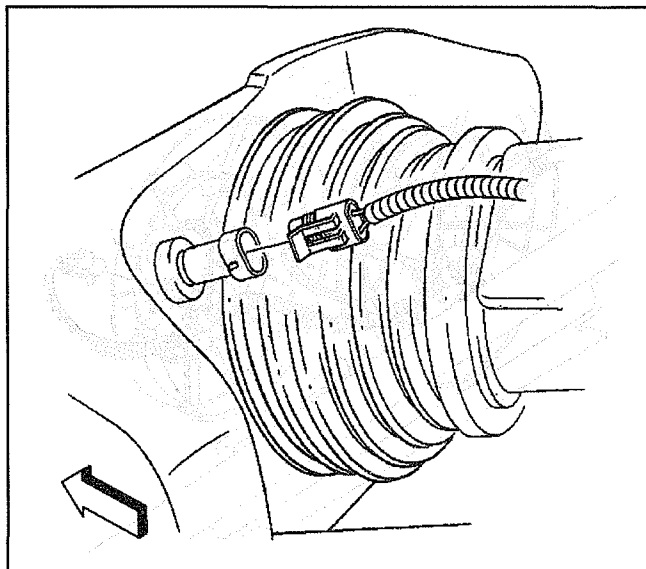


211602

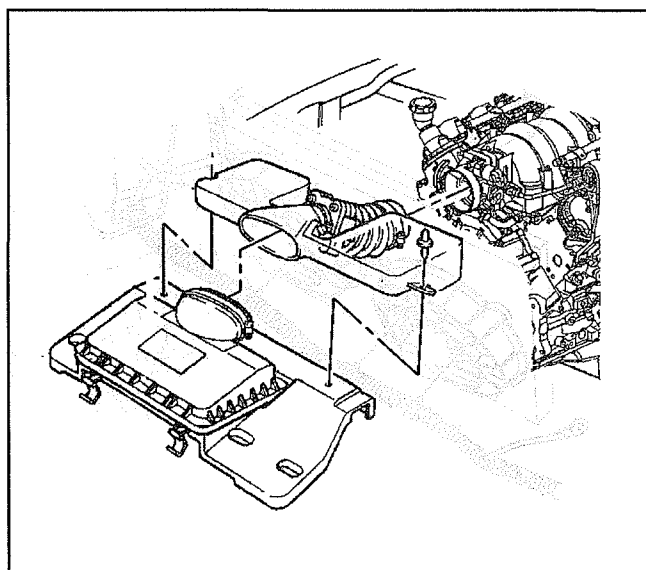
8. Install the air intake duct resonator, if equipped with the 3.8 L engine.



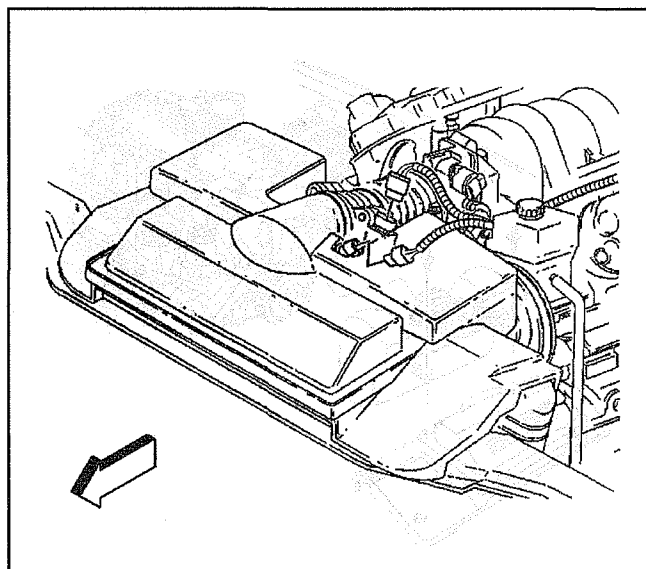
554755



9. Connect the electrical connector to the IAT sensor, if equipped with the 3.8 L engine.



10. Install the air intake duct resonator, if equipped with the 5.7 L engine.

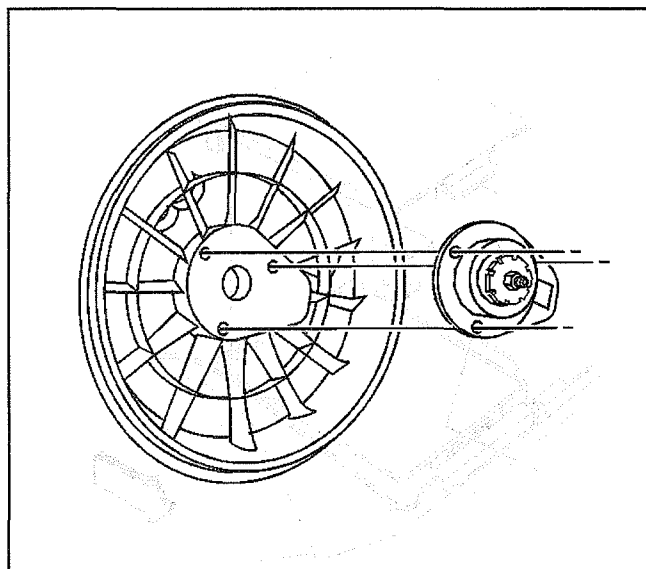


11. Connect the IAT and the MAF sensors electrical connectors, if equipped with the 5.7 L engine.

Cooling Fan Motor Replacement - Electric

Removal Procedure

1. Remove the cooling fan. Refer to *Cooling Fan Replacement - Electric*.
2. Remove the cooling fan motor.



342295

Installation Procedure

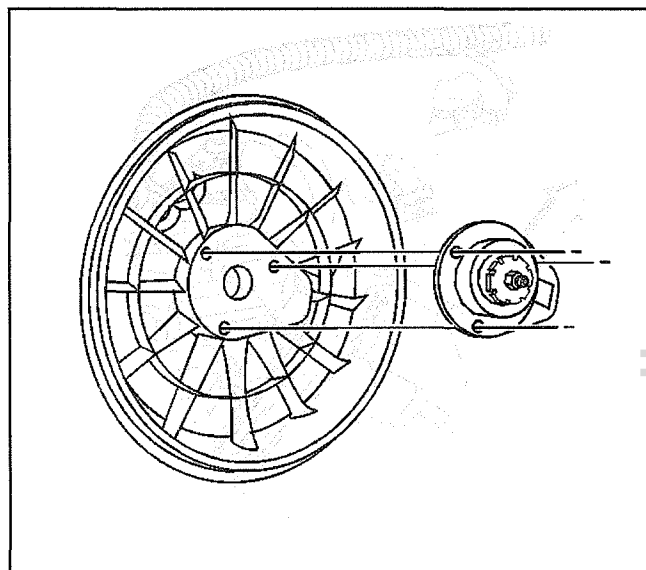
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the cooling fan motor.

Tighten

Tighten the cooling fan motor bolts to 6 N·m (53 lb in).

2. Install the cooling fan. Refer to *Cooling Fan Replacement - Electric*.

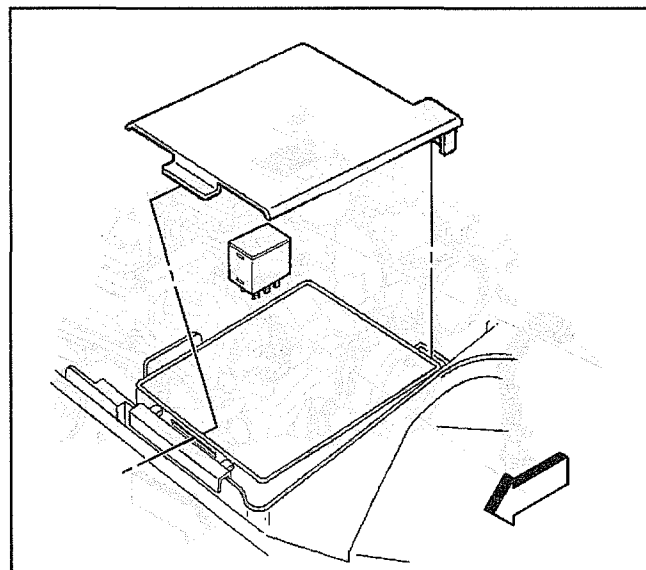


342295

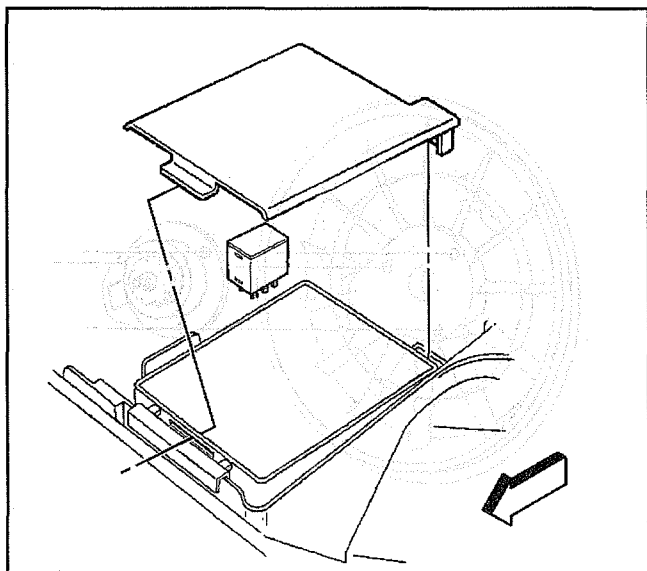
Cooling Fan Relay Replacement

Removal Procedure

1. Remove the cover from the number 1 underhood electrical center.
2. Remove the cooling fan relay from the underhood electrical center. Refer to *Electrical Center Identification Views* in Wiring Systems.



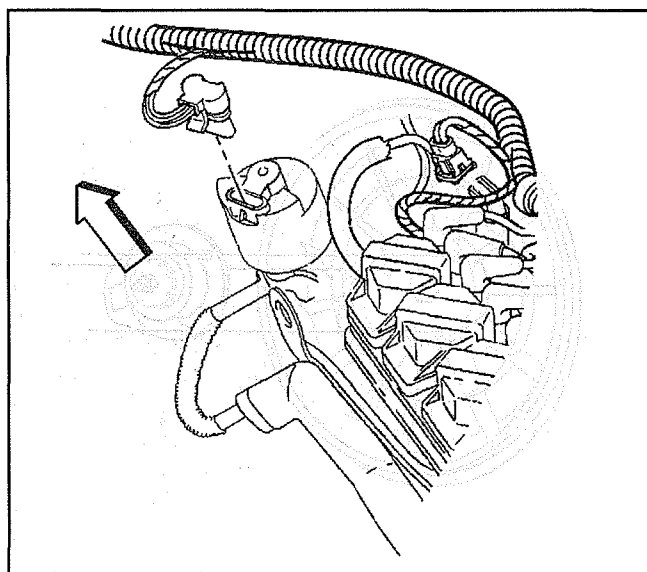
401242



401242

Installation Procedure

1. Install the cooling fan relay to the underhood electrical center. Refer to *Electrical Center Identification Views* in Wiring Systems.
2. Install the cover to the number 1 underhood electrical center.



221704

Thermostat Housing Replacement (3.8 L)**Removal Procedure**

1. Open the radiator drain cock.
2. Drain the engine coolant to a level below the thermostat.

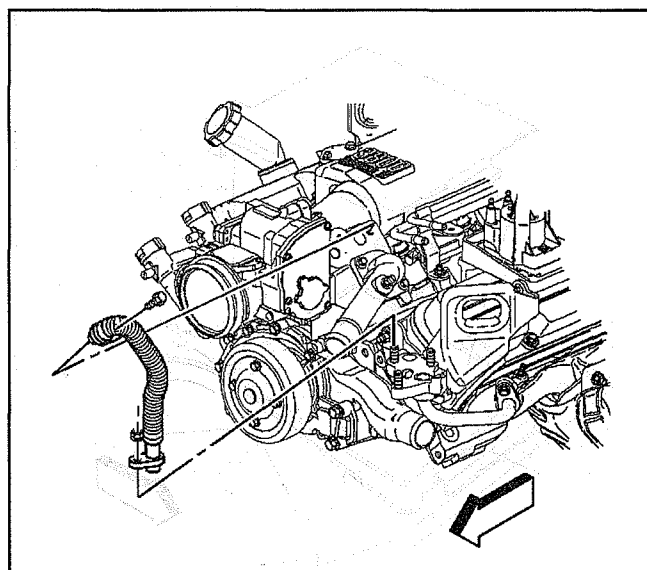
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Close the radiator drain cock.

Tighten

Tighten the radiator drain cock to 2 N·m (18 lb in).

4. Disconnect the exhaust gas recirculation (EGR) valve electrical connector.



221706

5. Remove the EGR valve outlet pipe bolt from the upper intake manifold.
6. Remove the EGR valve outlet pipe nut from the EGR valve adapter.
7. Remove the EGR valve pipe.

8. Remove the inlet hose from the water outlet.

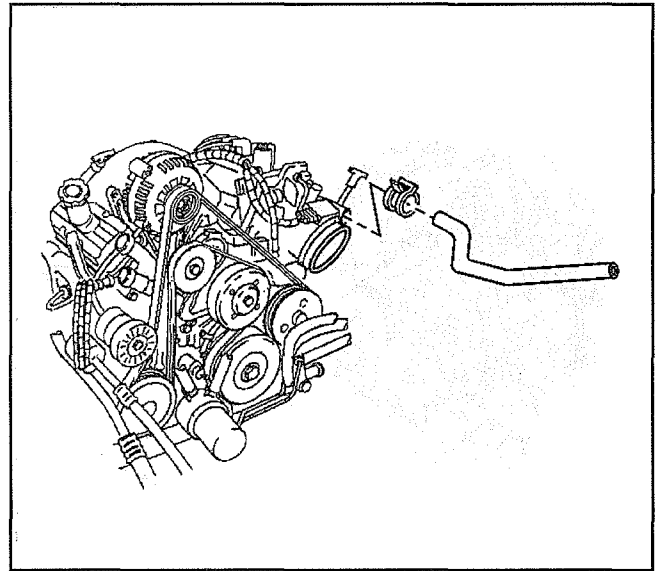


Figure 1

221680

9. Remove the water outlet bolts (1).
10. Remove the water outlet (2).

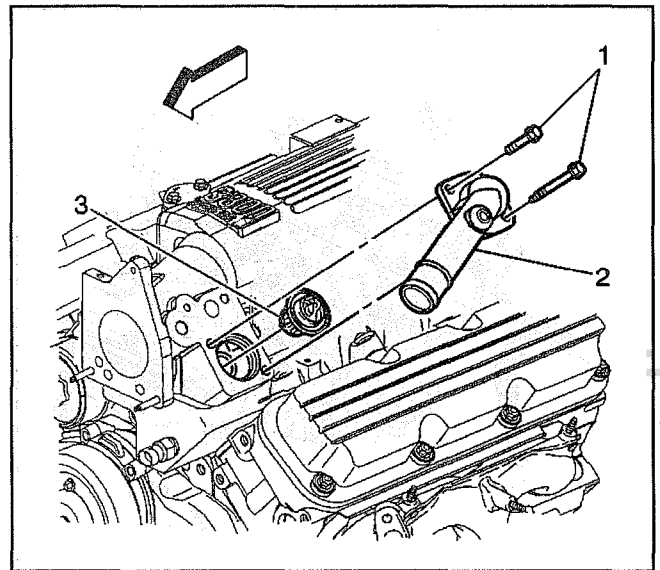


Figure 2

349798

Installation Procedure

1. Install the water outlet (2).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the water outlet bolts (1).

Tighten

Tighten the water outlet bolts (1) to 27 N·m (20 lb ft).

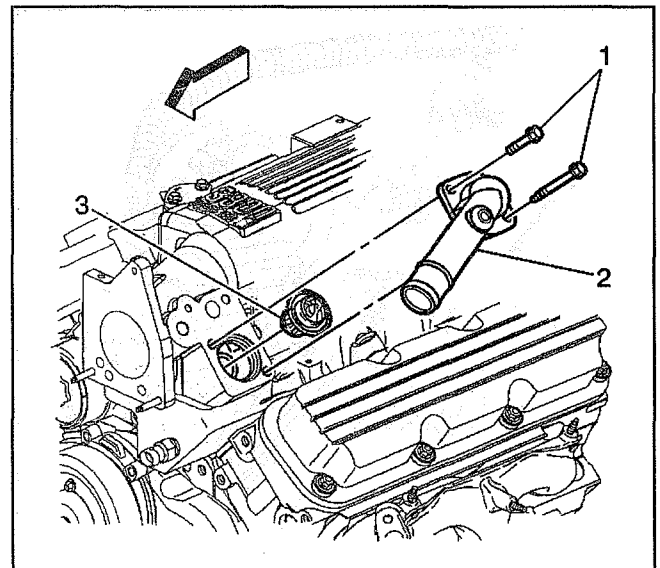
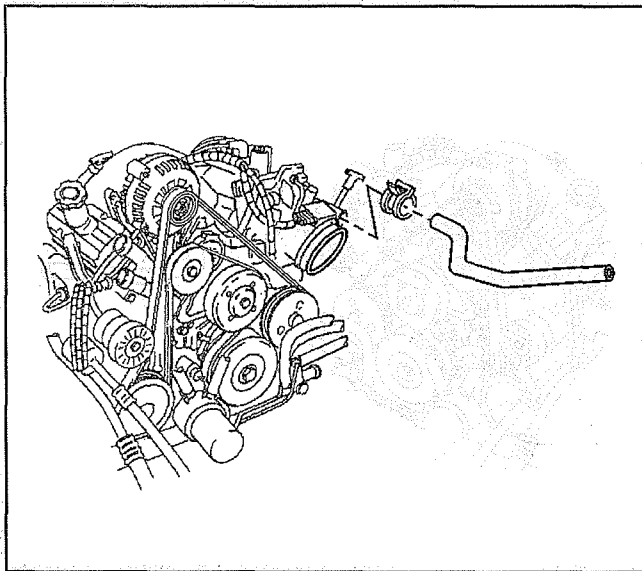


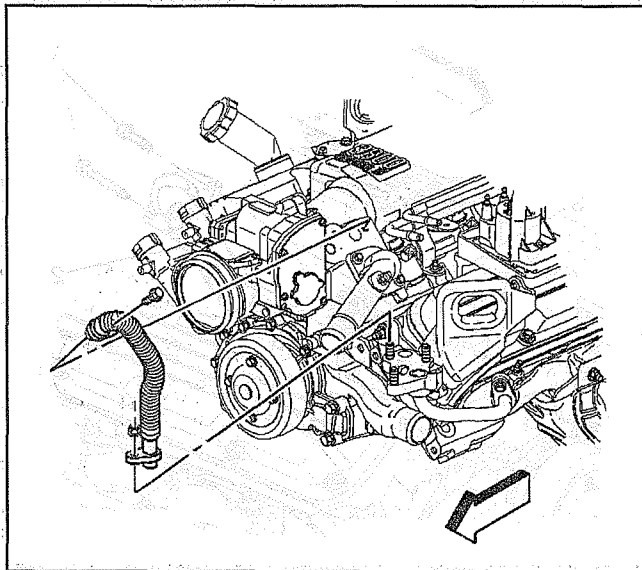
Figure 3

349798



221680

3. Install the inlet hose to the water outlet.



221706

4. Install the EGR valve pipe.
5. Install the EGR valve outlet pipe nut from the EGR valve adapter.

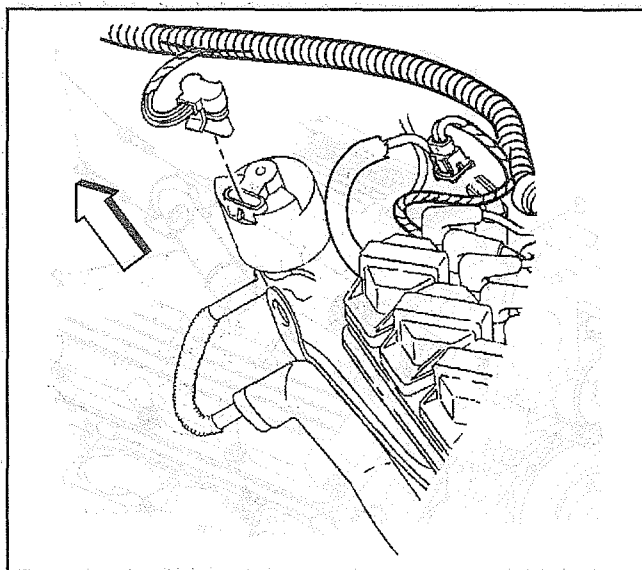
Tighten

Tighten the EGR valve outlet pipe nut to 29 N·m (21 lb ft).

6. Install the EGR valve outlet pipe bolt from the upper intake manifold.

Tighten

Tighten the EGR valve outlet pipe bolt to 29 N·m (21 lb ft).



221704

7. Connect the EGR valve electrical connector.
8. Add engine coolant.

Thermostat Housing Replacement (5.7 L)

Removal Procedure

1. Open the radiator drain cock. Drain the engine coolant to a level below the thermostat.

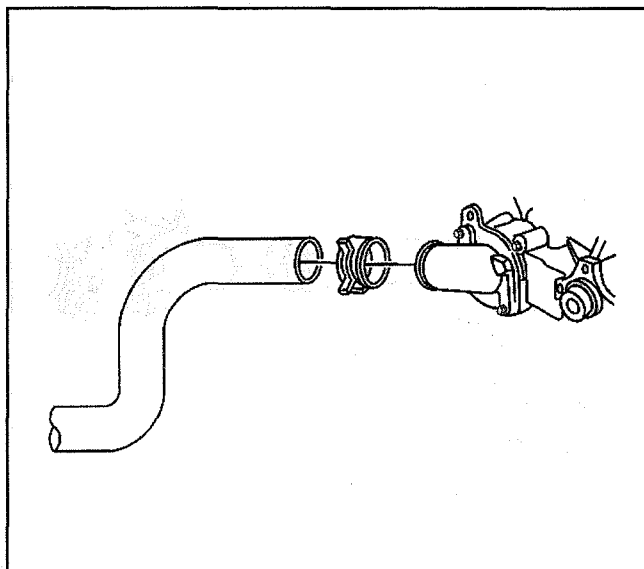
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Close the radiator drain cock.

Tighten

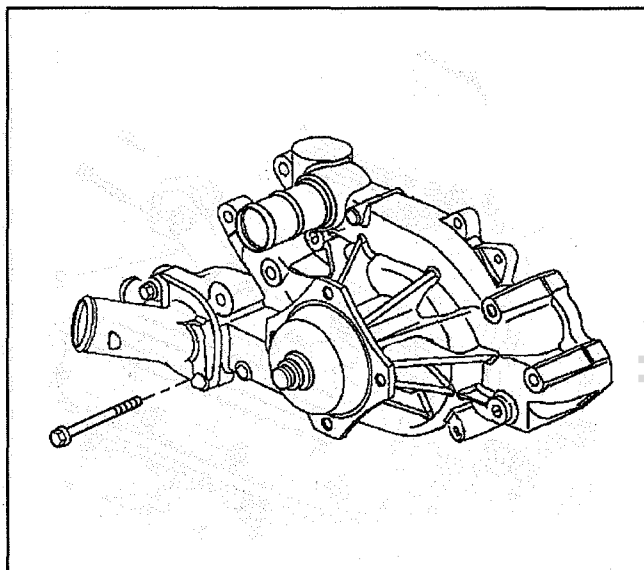
Tighten the radiator drain cock to 2 N·m (18 lb in).

3. Remove the radiator outlet hose from the water outlet.



221671

4. Remove the water outlet housing bolts.
5. Remove the water outlet.



221708

Installation Procedure

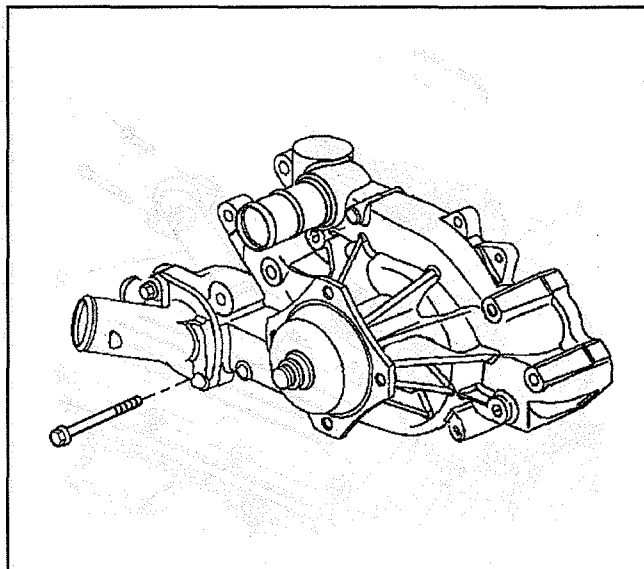
1. Thoroughly clean the water outlet and water pump surfaces.
2. Install the water outlet.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

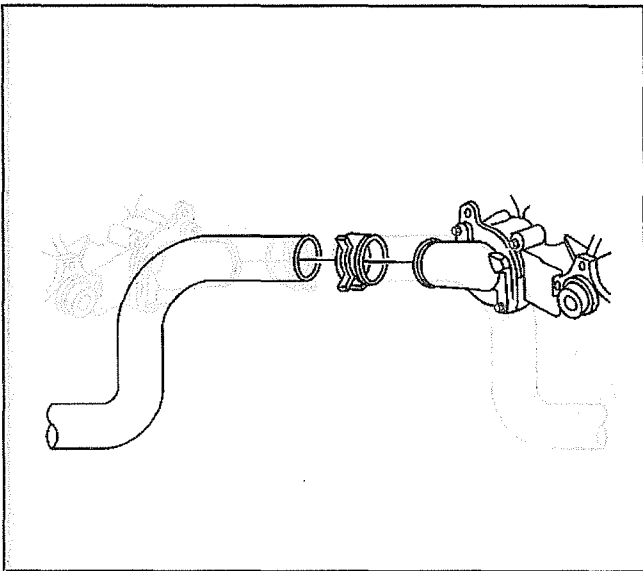
3. Install the water outlet bolts.

Tighten

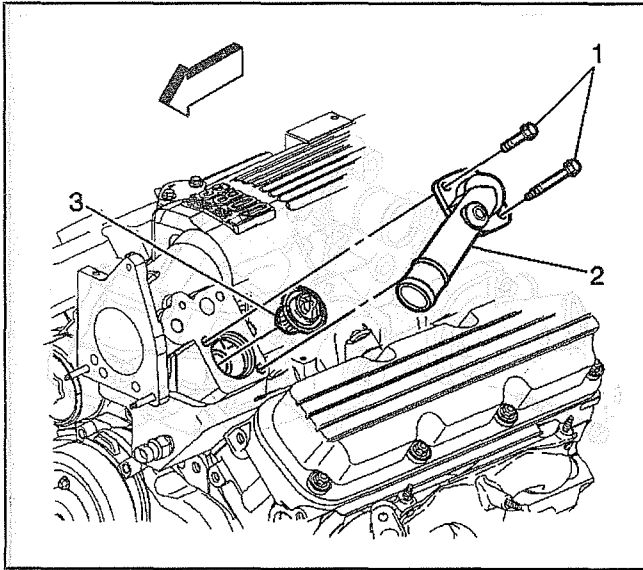
Tighten the water outlet bolts to 10 N·m (89 lb in).



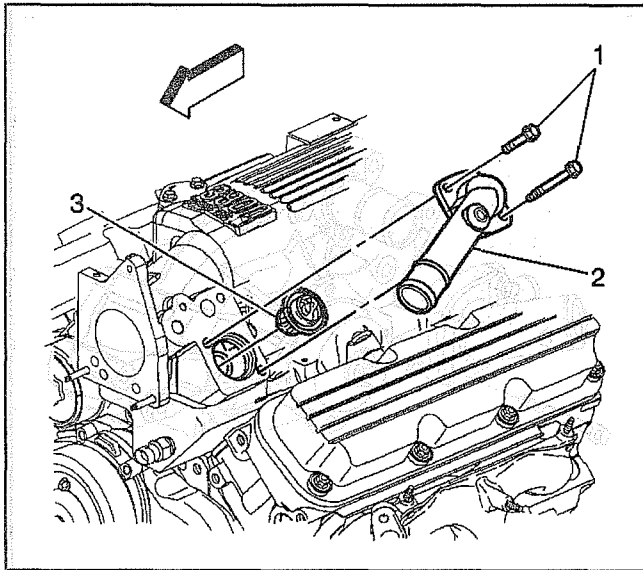
221708



221671



349798



349798

4. Install the radiator outlet hose to the water outlet.
5. Add engine coolant.

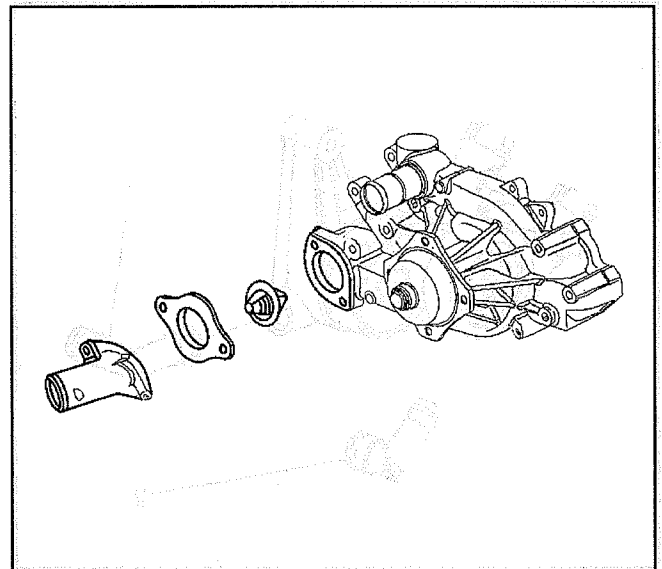
Thermostat Replacement (3.8 L)

- Removal Procedure**
1. Remove the water outlet (2). Refer to *Thermostat Housing Replacement (3.8 L)*.
 2. Remove the engine coolant thermostat (3).

- Installation Procedure**
1. Install the engine coolant thermostat (3).
 2. Install the water outlet (2). Refer to *Thermostat Housing Replacement (3.8 L)*.

Thermostat Replacement (5.7 L)**Removal Procedure**

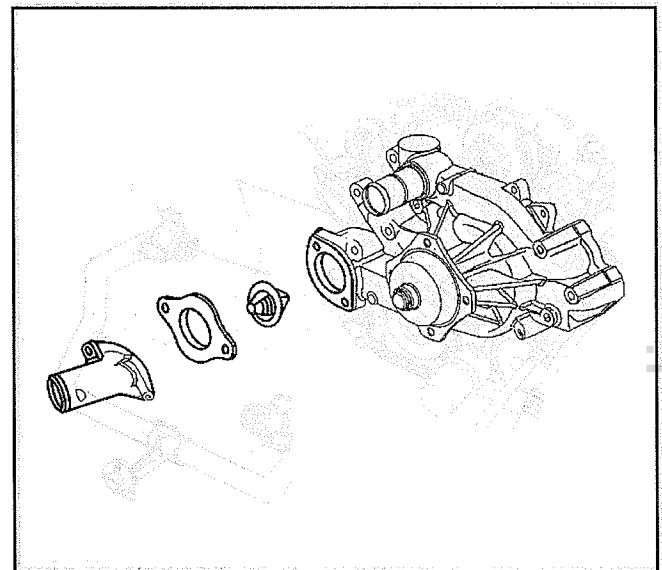
1. Remove the water outlet. Refer to *Thermostat Housing Replacement (5.7 L)*.
2. Remove the thermostat.



221709

Installation Procedure

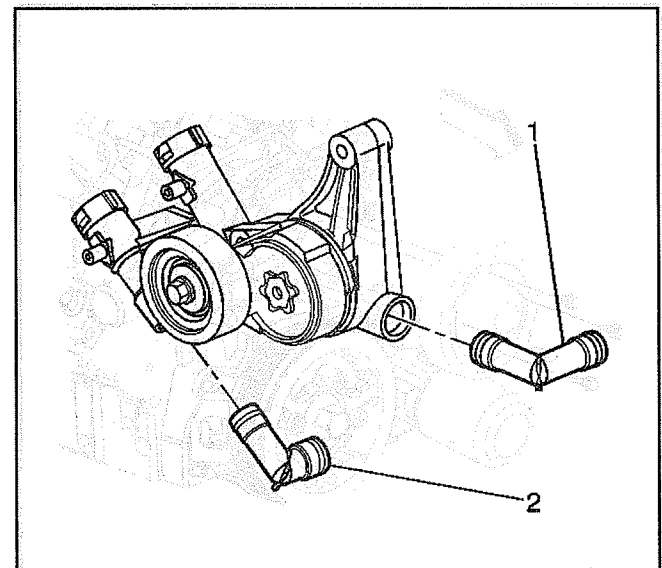
1. Install the thermostat.
2. Install the water outlet. Refer to *Thermostat Housing Replacement (5.7 L)*.



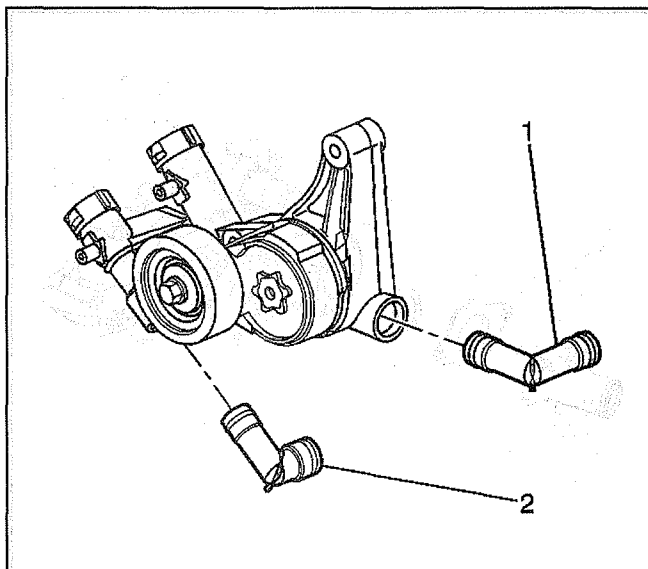
221709

Thermostat Bypass Pipes Replacement (3.8 L)**Removal Procedure**

1. Remove the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement* in Engine Mechanical - 3.8 L.
2. Remove the thermostat bypass upper (1) and/or lower (2) pipe.



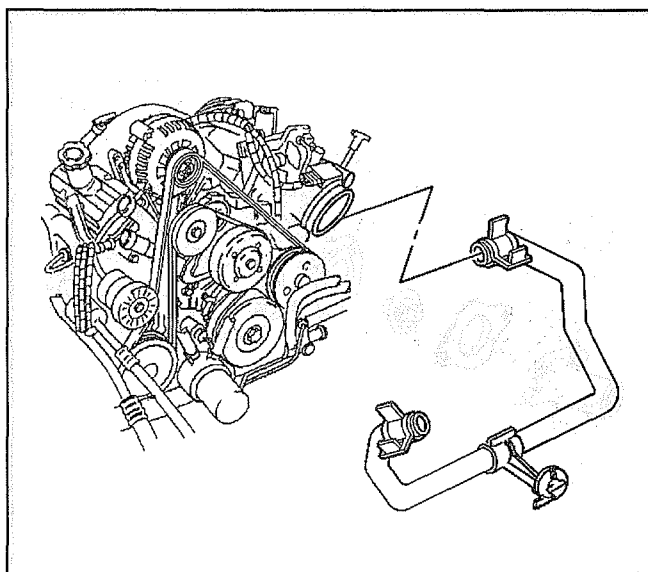
500325



500325

Installation Procedure

1. Install the thermostat bypass upper (1) and/or lower (2) pipe.
2. Install the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement* in Engine Mechanical - 3.8 L.



221689

Water Pump Replacement (3.8 L)

Removal Procedure

1. Open the radiator drain cock. Drain the engine coolant to a level below the thermostat.

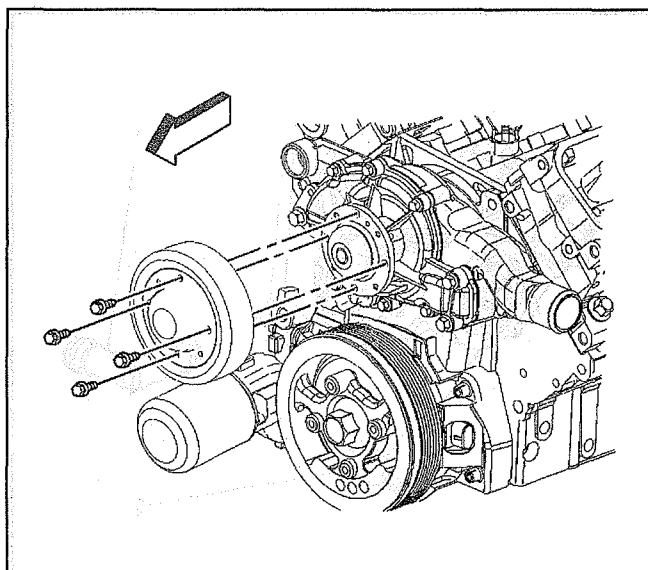
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Close the radiator drain cock.

Tighten

Tighten the radiator drain cock to 2 N·m (18 lb in).

3. Loosen the water pump pulley bolts.
4. Remove the accessory drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
5. Remove the radiator inlet hose from the water pump.

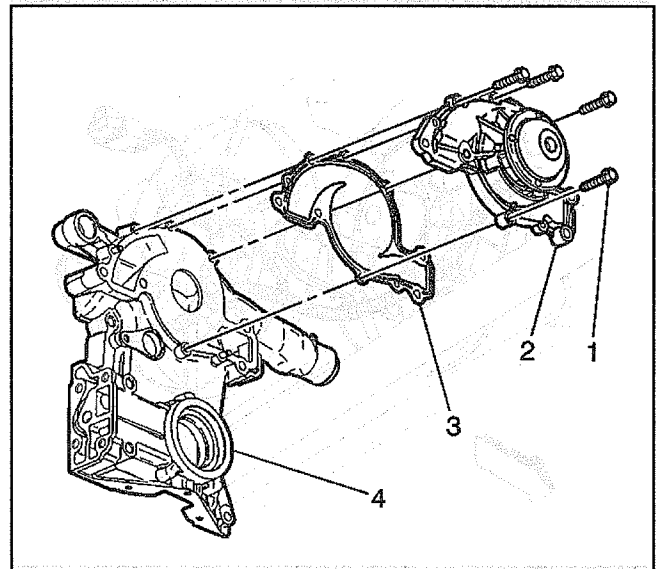


221711

6. Remove the water pump pulley bolts.

7. Remove the water pump pulley.

8. Remove the water pump bolts (1).
9. Remove the water pump (2).
10. Remove the water pump gasket (3).
11. Clean all of the gasket mating surfaces, including the water pump bolts.



11687

Installation Procedure

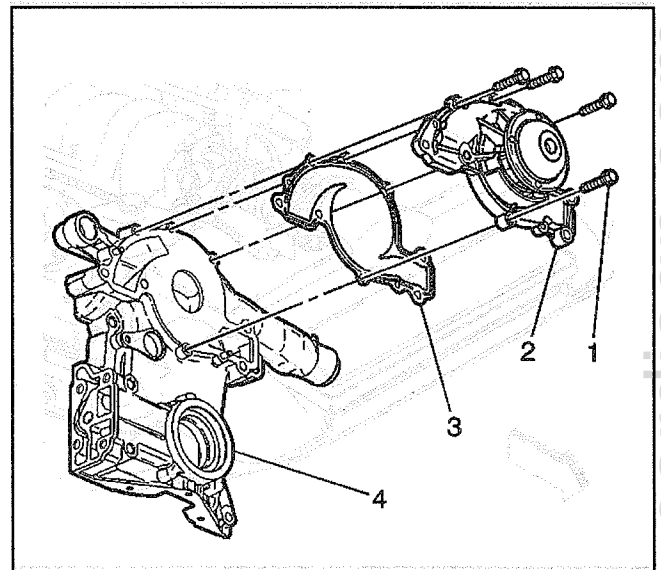
Tools Required

J 36660-A Torque Angle Meter

1. Install a new water pump gasket (3).
2. Install the water pump (2).
3. Install the water pump bolts (1).

Tighten

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



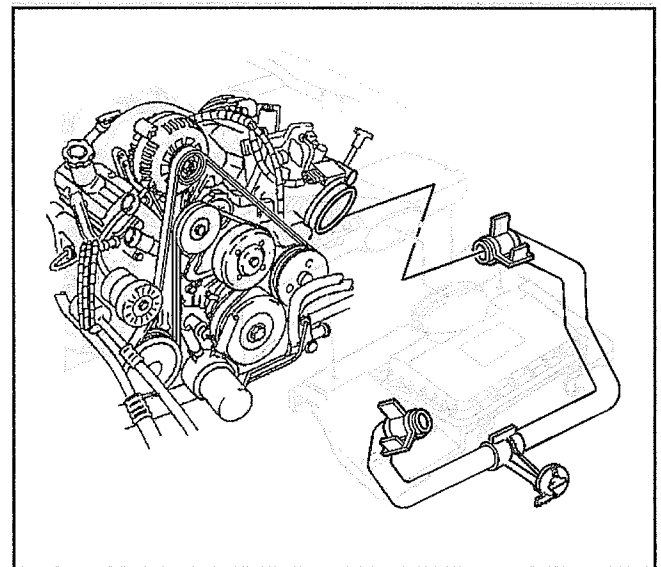
11687

4. Connect the radiator inlet hose to the water pump.
5. Install the water pump pulley and the bolts.

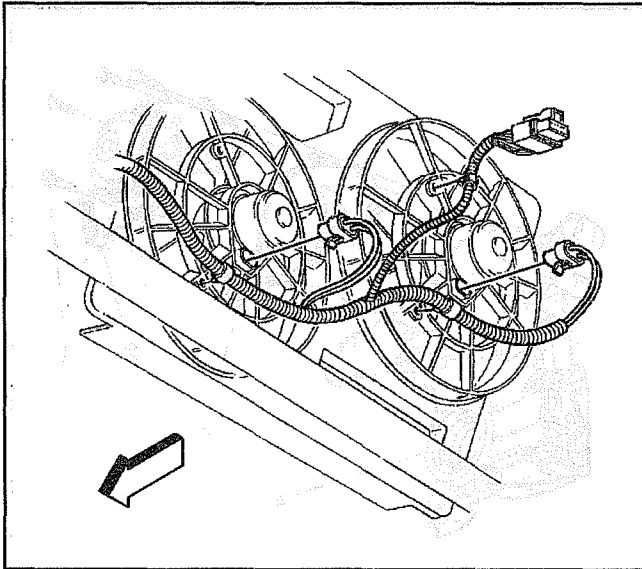
Tighten

Tighten the water pump pulley bolts to 13 N·m (115 lb in).

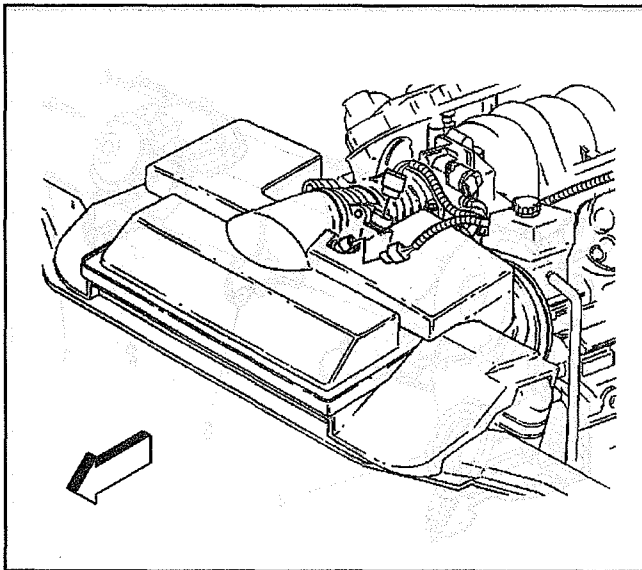
6. Install the accessory drive belt. Refer to *Drive Belt Replacement* in Engine Mechanical - 3.8 L.
7. Add the engine coolant.
8. Start the engine. After the engine reaches normal operating temperature, check for coolant leaks.



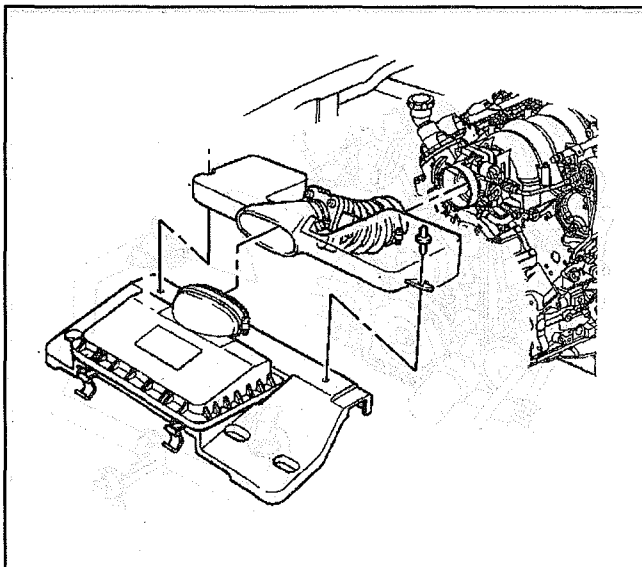
221689



550332



208553



208569

Water Pump Replacement (5.7 L)

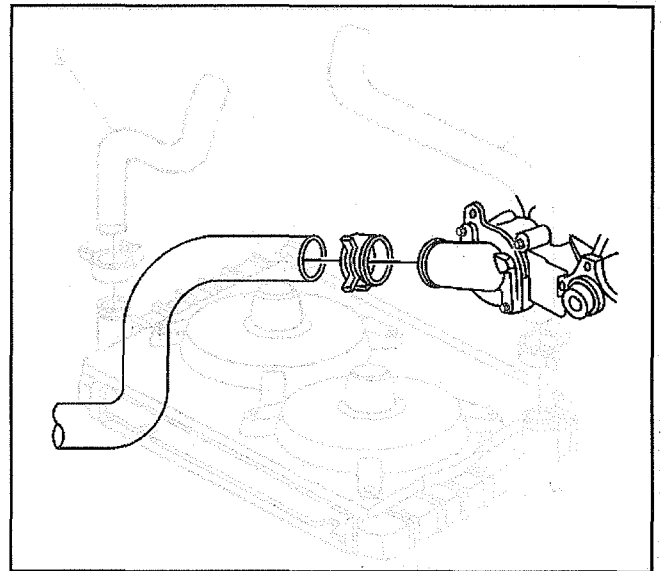
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Disconnect the coolant fan electrical connectors.
3. Drain the cooling system. Refer to *Draining and Filling Cooling System* (5.7 L).
4. Lower the vehicle.

5. Disconnect the intake air temperature (IAT) sensor electrical connector.
6. Disconnect the mass airflow (MAF) sensor electrical connector.

7. Remove the air intake duct resonator.

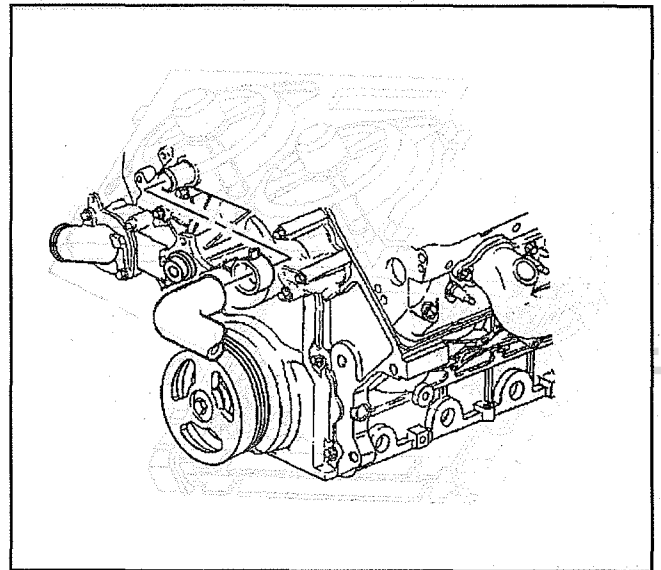
8. Remove the outlet hose from the water outlet.



221671

221671

9. Remove the inlet hose from the coolant pump.

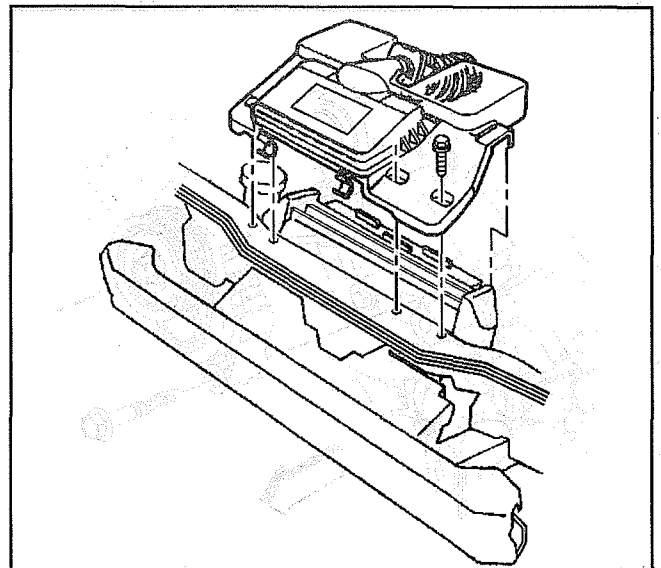


221676

221676

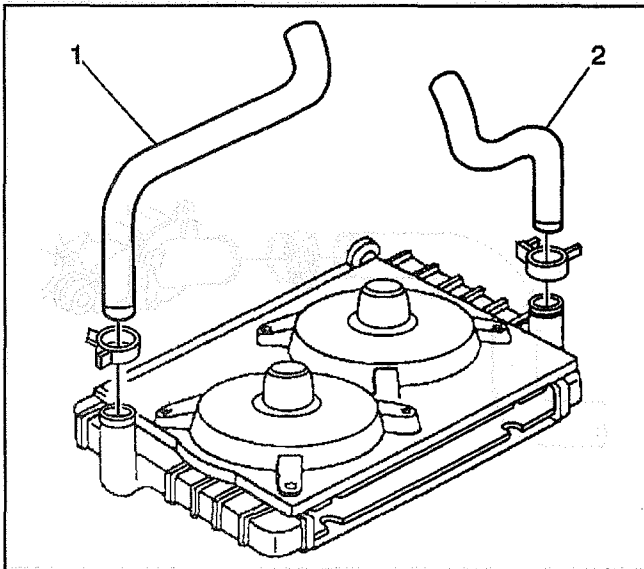
10. Remove the air cleaner bolts.

11. Remove the air cleaner / upper radiator support.



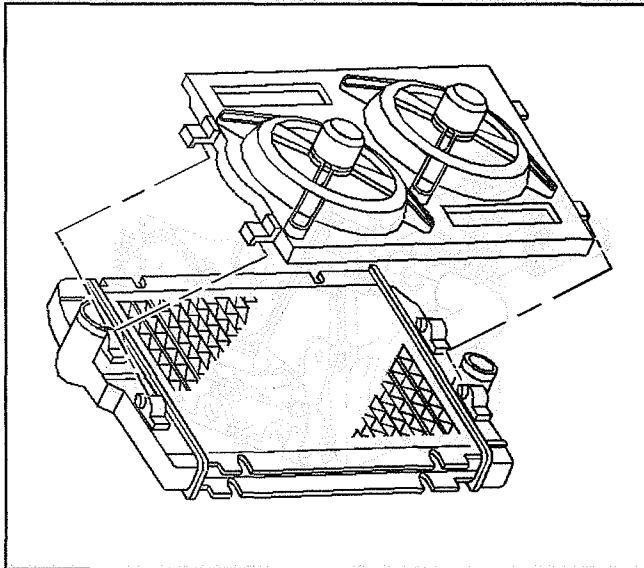
221697

221697



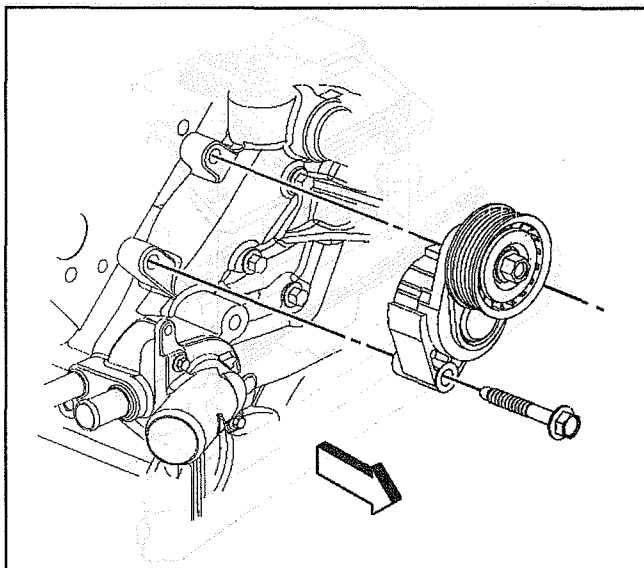
349797

12. Remove the inlet hose (1) from the radiator.



41692

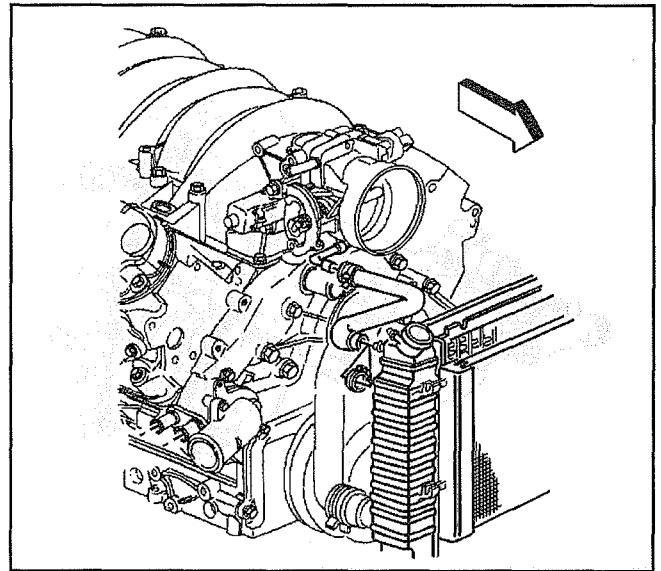
13. Remove the electric engine coolant fans.
14. Remove the accessory drive belt. Refer to *Drive Belt Replacement - Accessory* in Engine Mechanical - 5.7 L.



220581

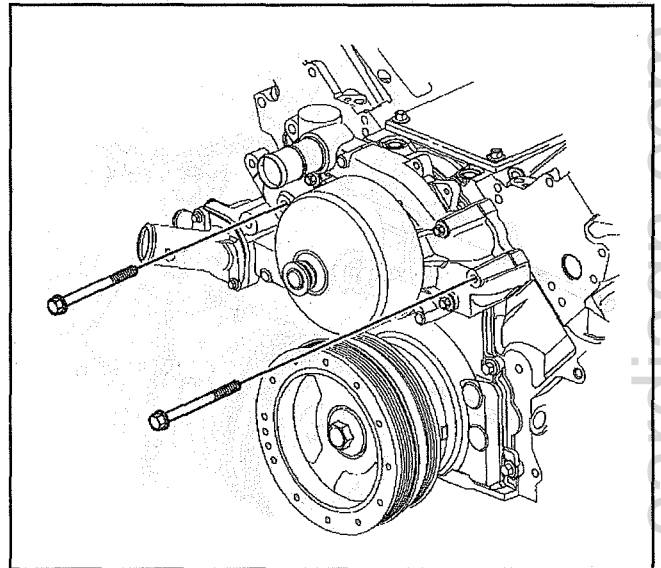
15. Remove the drive belt tensioner pulley from the coolant pump.

16. Remove the throttle body heater outlet hose from the radiator.



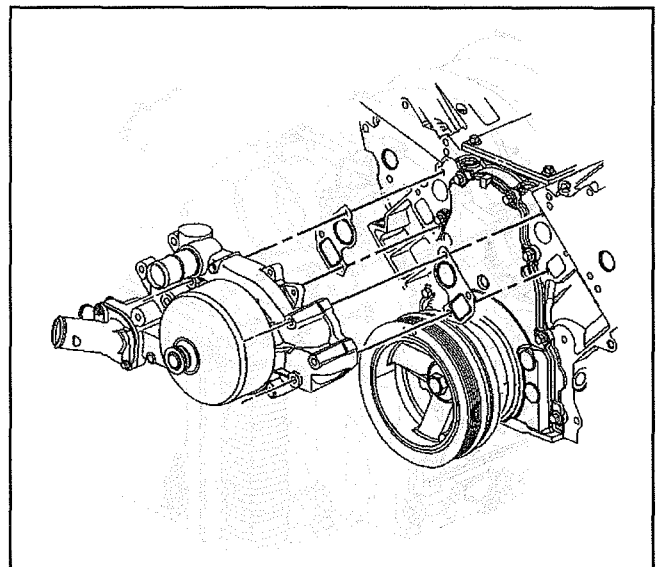
220620

17. Remove the coolant pump bolts.

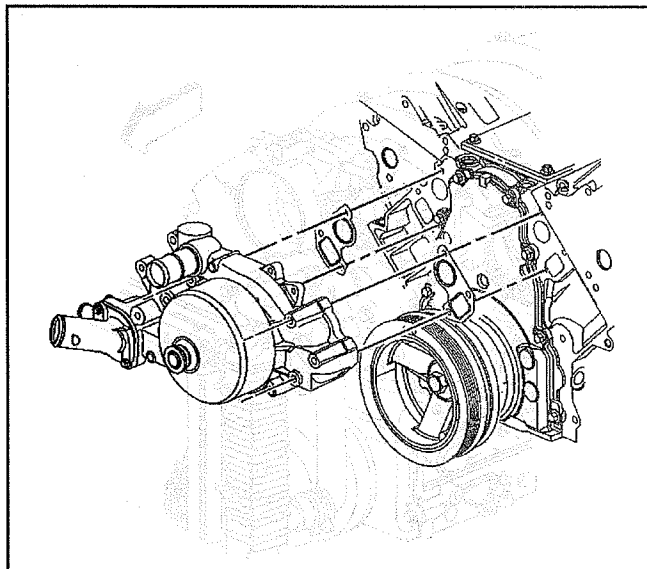


550333

18. Remove the coolant pump.
19. Remove the coolant pump gaskets.
20. Clean all gasket mating surfaces, also clean the water pump bolts.



550334



550334

Installation Procedure

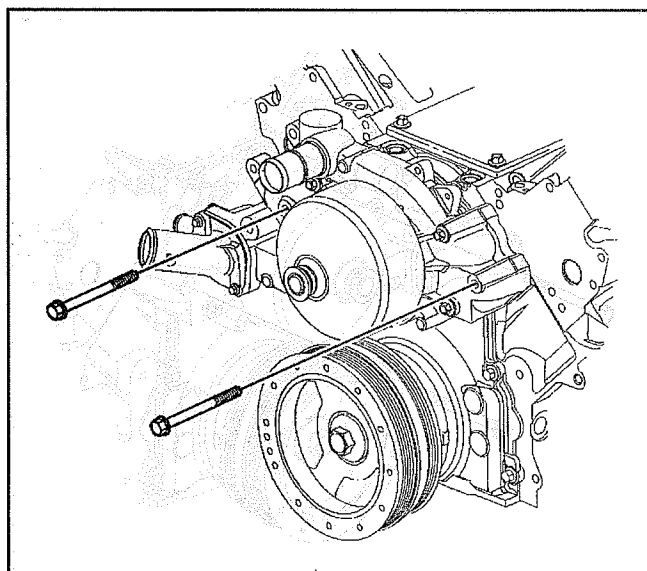
1. Install the coolant pump and gaskets to the engine block.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

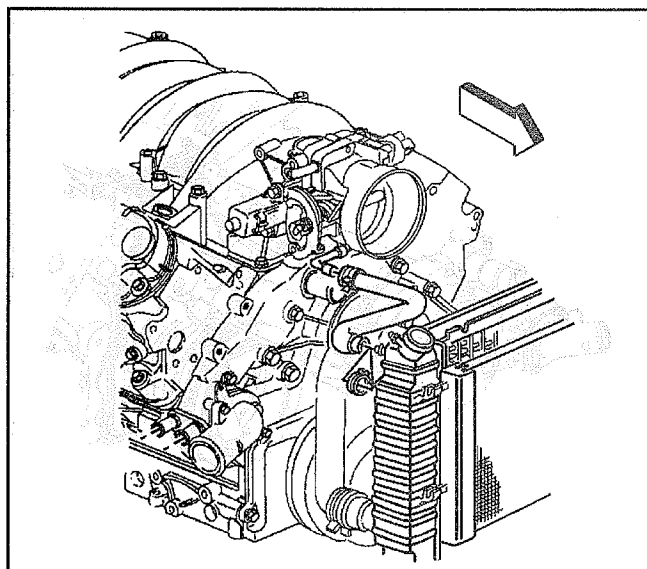
2. Install the coolant pump bolts.

Tighten

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



550333



220620

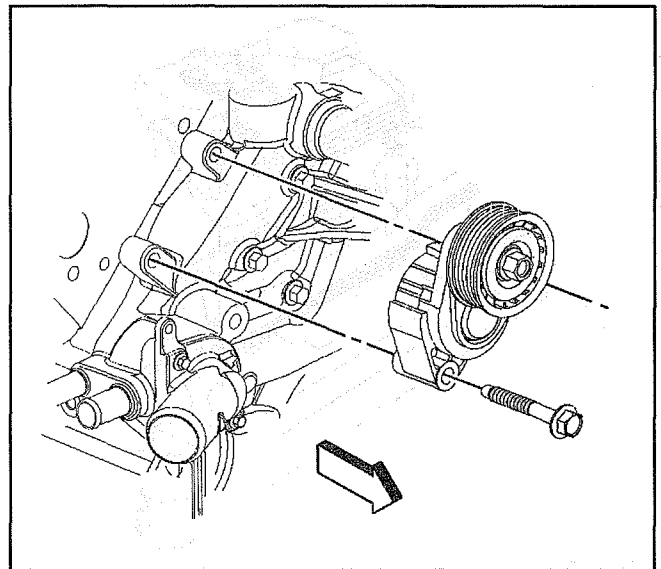
3. Install the throttle body heater outlet hose to the radiator.

4. Install the drive belt tensioner to the coolant pump.

Tighten

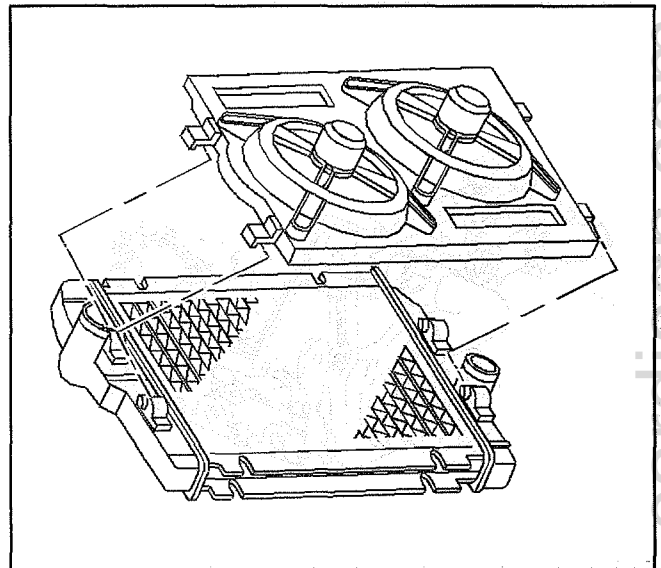
Tighten the drive belt tensioner bolt to 50 N·m (37 lb ft).

5. Install the accessory drive belt. Refer to *Drive Belt Replacement - Accessory* in Engine Mechanical - 5.7 L.



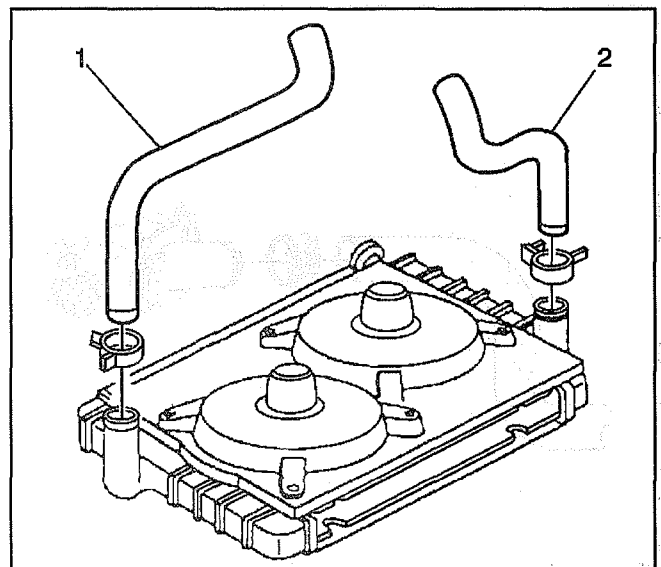
220581

6. Install the electric engine cooling fans.

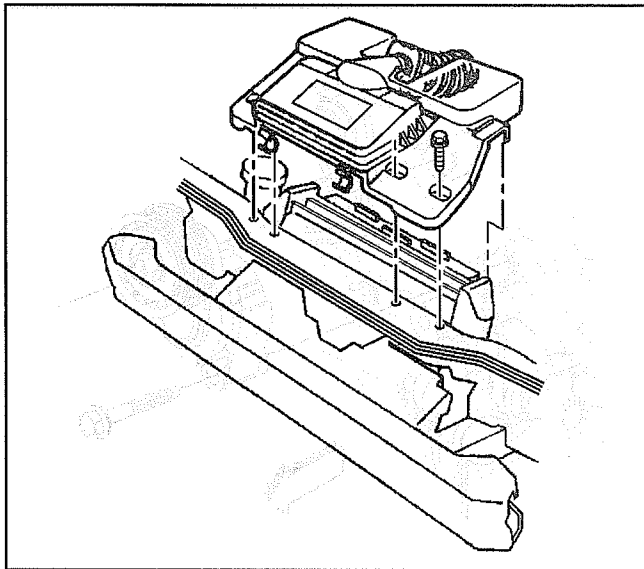


41692

7. Install the inlet hose (1) to the radiator.



349797



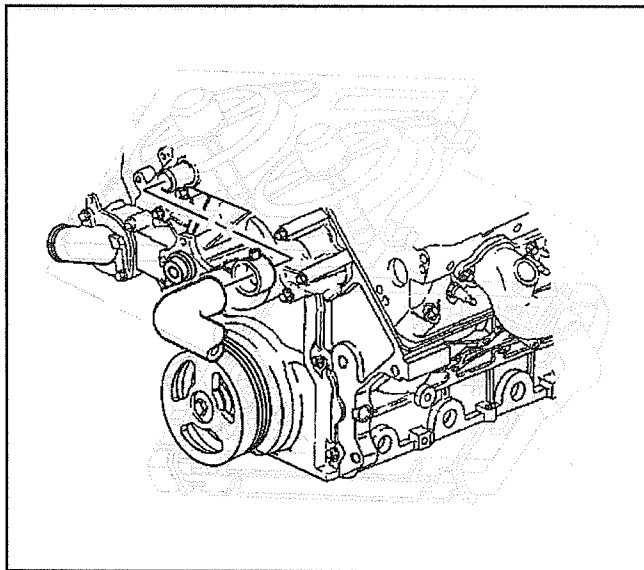
221697

8. Install the air cleaner / upper radiator support.

9. Install the air cleaner bolts.

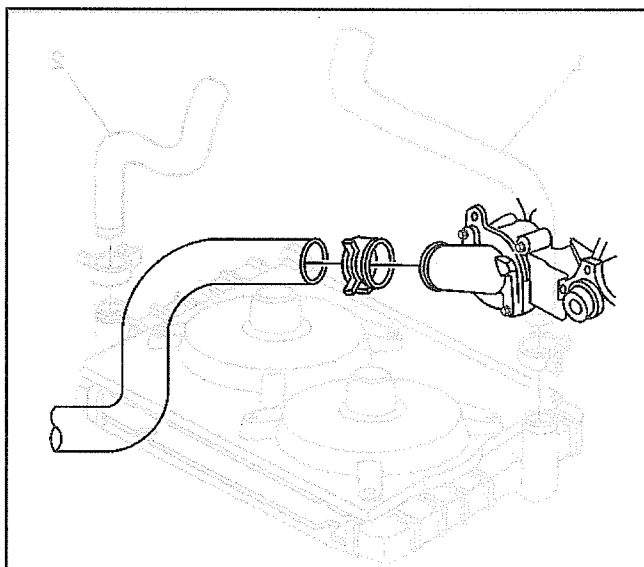
Tighten

Tighten the air cleaner bolts to 12 N·m (106 lb in).



221676

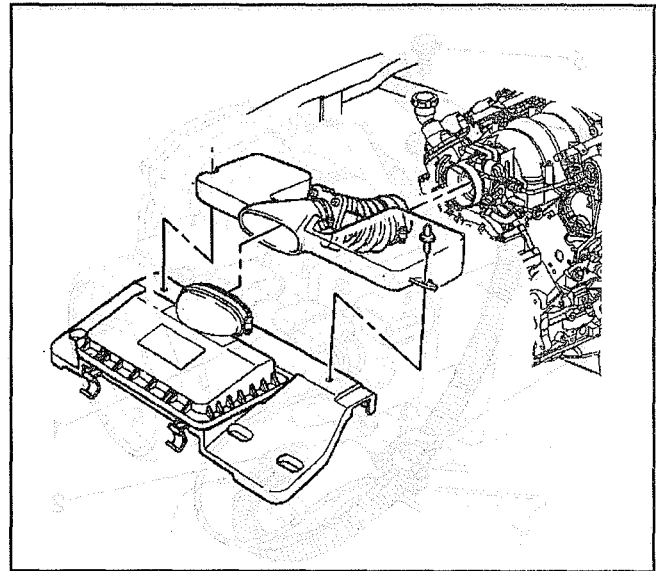
10. Install the inlet hose to the coolant pump.



221671

11. Install the outlet hose to the water outlet.

12. Install the air intake duct resonator.

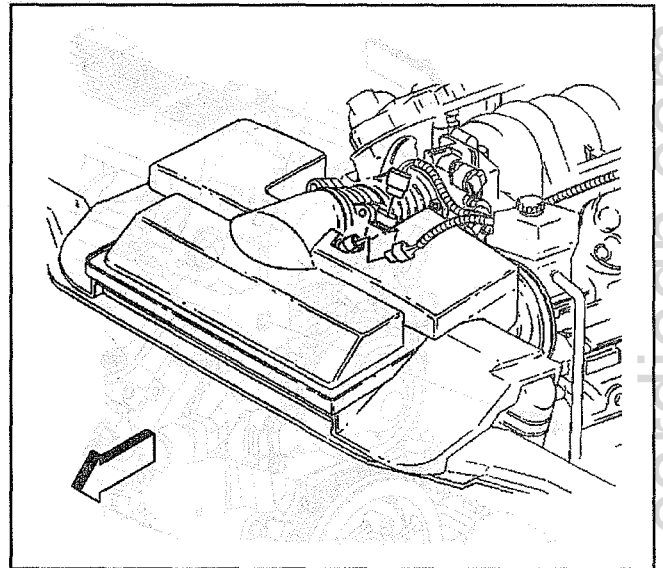


208569

208569

13. Connect the IAT sensor electrical connector.

14. Connect the MAF sensor electrical connector.

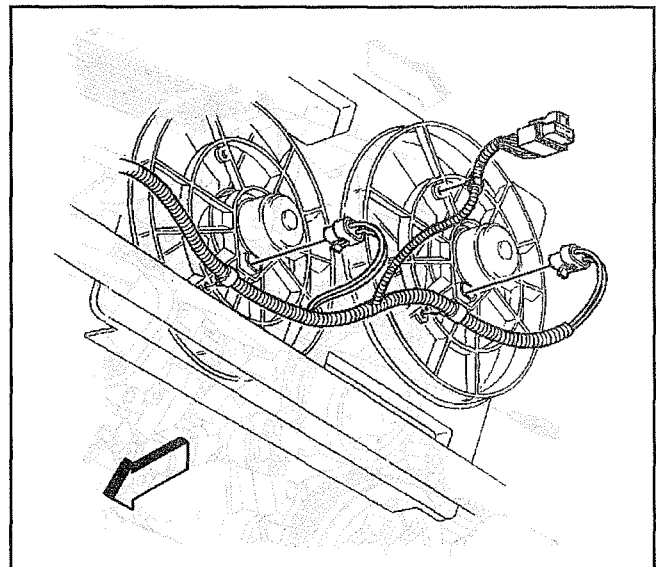


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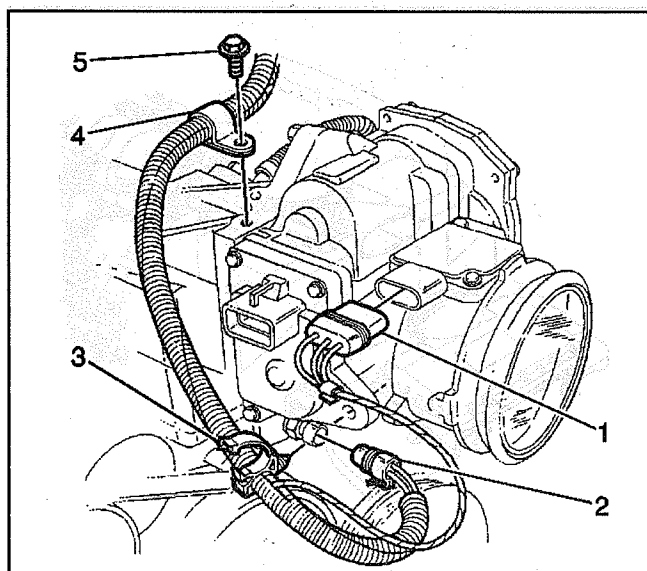
15. Connect the coolant fan electrical connectors.

16. Refill the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.



550332

550332

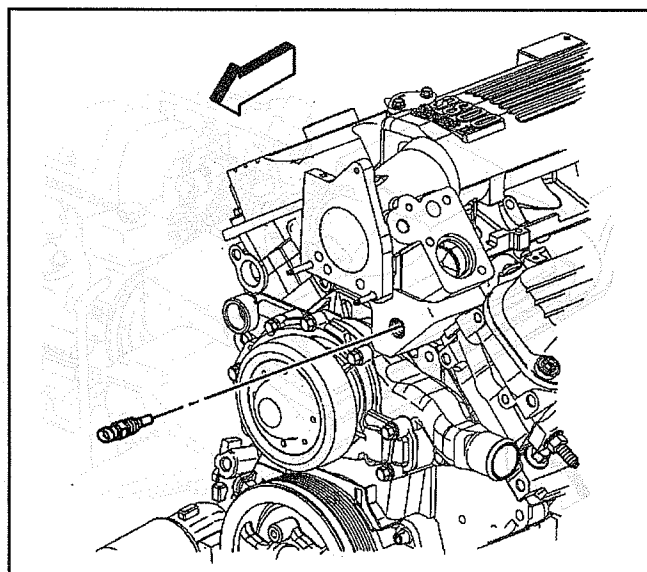


439428

Engine Coolant Temperature Sensor Replacement (3.8 L)

Removal Procedure

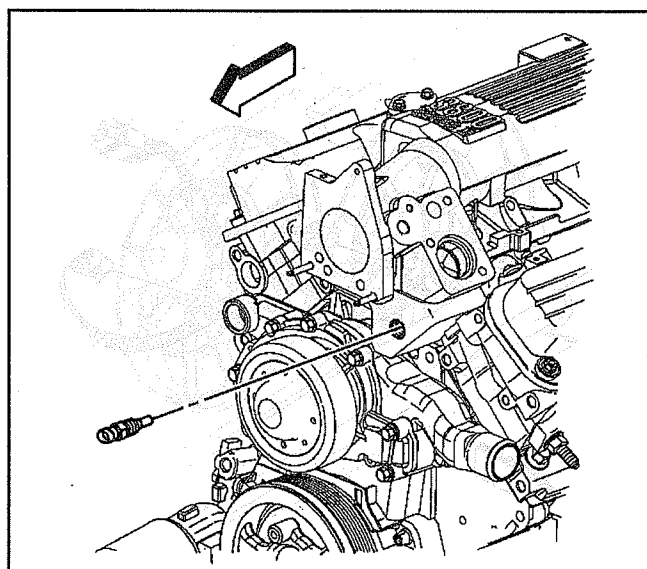
1. Drain the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.
2. Disconnect the engine coolant temperature (ECT) sensor electrical connector (2).



349800

Important: Care must be taken when handling the ECT sensor. damage to the sensor will affect proper operation of the fuel injection system.

3. Remove the ECT sensor.



349800

Installation Procedure

1. Coat the ECT sensor threads with sealer GM P/N 12346004 or equivalent.
2. Install the ECT sensor into the engine.

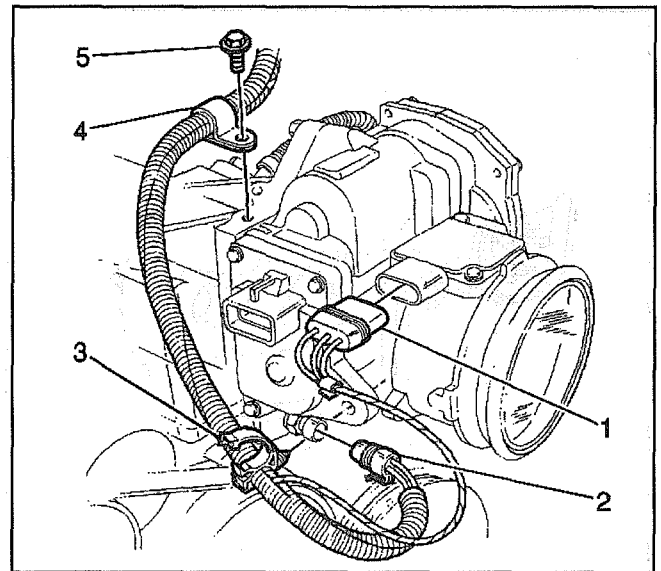
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Tighten the ECT sensor.

Tighten

Tighten the ECT sensor to 25 N·m (18 lb ft).

4. Connect the ECT sensor electrical connector (2).
5. Refill the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.



439428

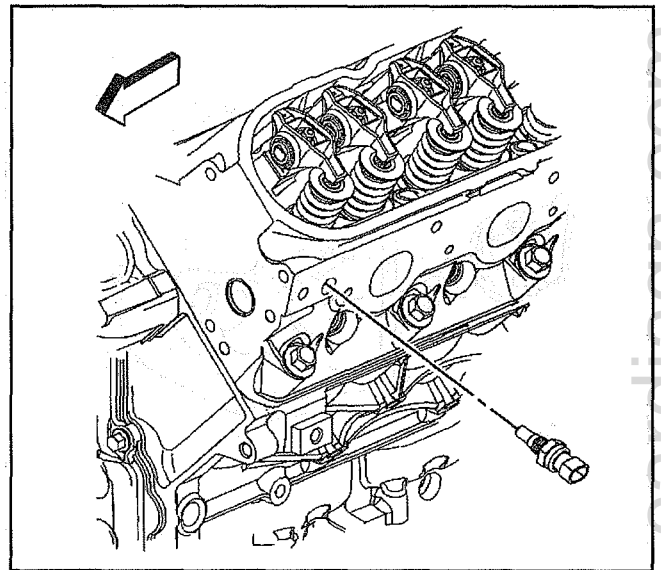
Engine Coolant Temperature Sensor Replacement (5.7 L)

Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
2. Disconnect the engine coolant temperature (ECT) sensor electrical connector.
3. Remove the number 1 spark plug wire.

Important: Care must be taken when handling the ECT sensor. Damage to the sensor will affect proper operation of the fuel injection system.

4. Remove the ECT sensor.



550336

Installation Procedure

1. Coat the ECT sensor threads with sealer GM P/N 12346004 or equivalent.
2. Install the ECT sensor.

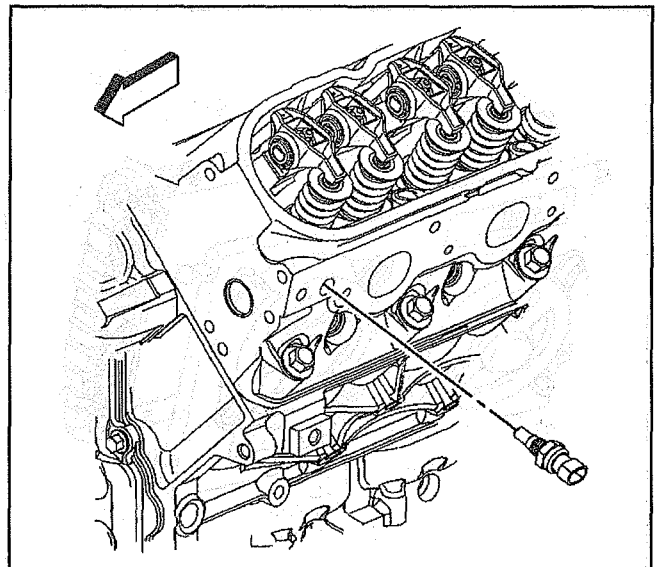
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the ECT sensor.

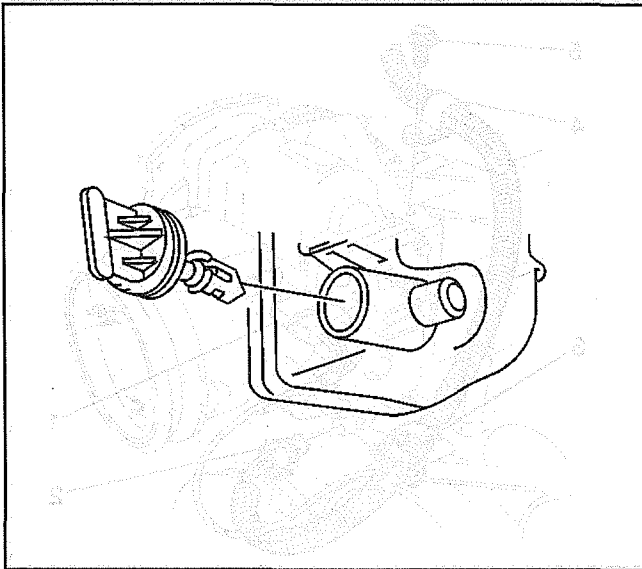
Tighten

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

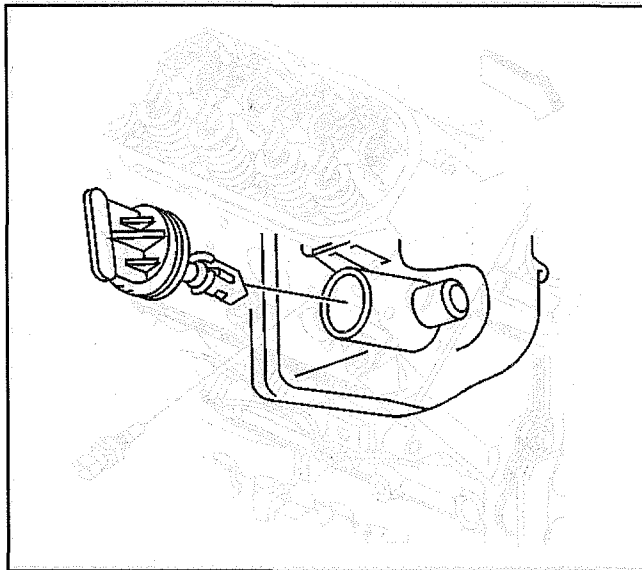
4. Install the number 1 spark plug wire.
5. Connect the ECT sensor electrical connector.
6. Refill the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.



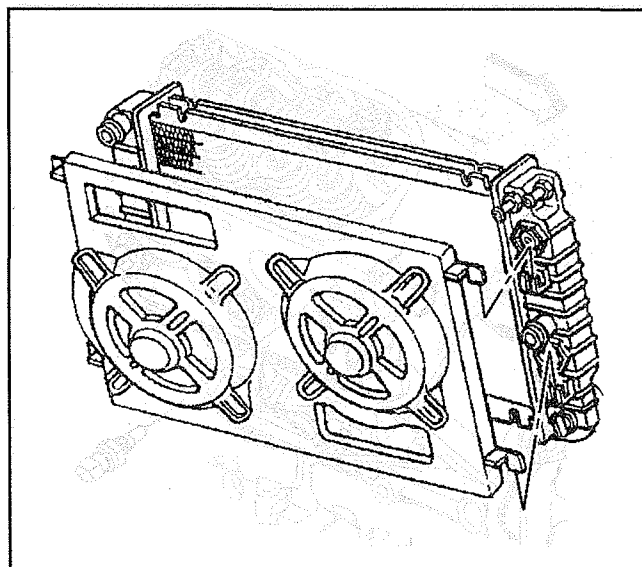
550336



457901



457901



185073

Drain Cock Replacement

Removal Procedure

1. Drain the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)*.
2. Remove the radiator drain cock.

Installation Procedure

1. Install the radiator drain cock.
2. Refill the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)* or *Draining and Filling Cooling System (5.7 L)*.

Fan Shroud Replacement

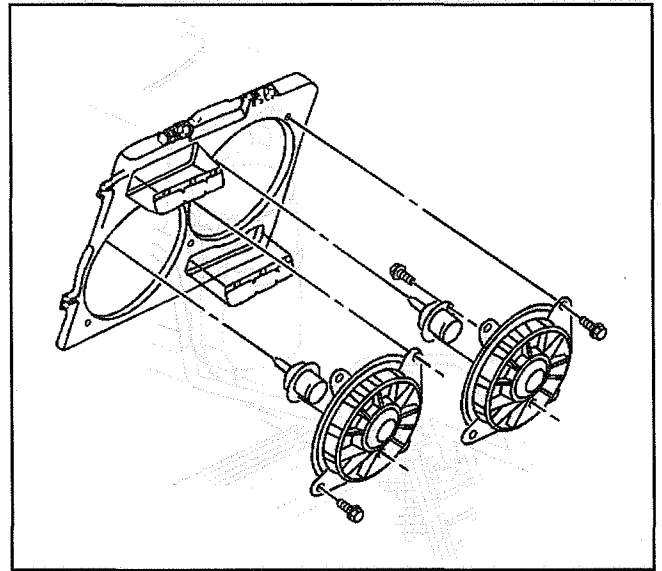
Removal Procedure

1. Remove the radiator upper support. Refer to *Radiator Support Replacement*.
2. Remove the fan shroud:
 - Move the fan shroud up in order to clear the four mounts.
 - Move the fan shroud down in order to remove it from the vehicle.

3. Remove the cooling fan brackets from the fan shroud.

Removal Procedure

1. Recover the air conditioning system. Refer to HVAC System Recovery and Recharging in HVAC Systems with A/C - Manual.
2. Drain the engine coolant. Refer to Draining and Filling Cooling System (5.8 L) or to Draining and Filling Cooling System (5.7 L).
3. Remove the radiator inlet hose. Refer to Radiator Hose Replacement - Inlet (5.8 L) or to Radiator Hose Replacement - Inlet (5.7 L).
4. Remove the radiator outlet hose. Refer to Radiator Hose Replacement - Outlet (5.8 L) or to Radiator Hose Replacement - Outlet (5.7 L).
5. Remove the evaporator tube bolt.
6. Remove the evaporator tube from the condenser.



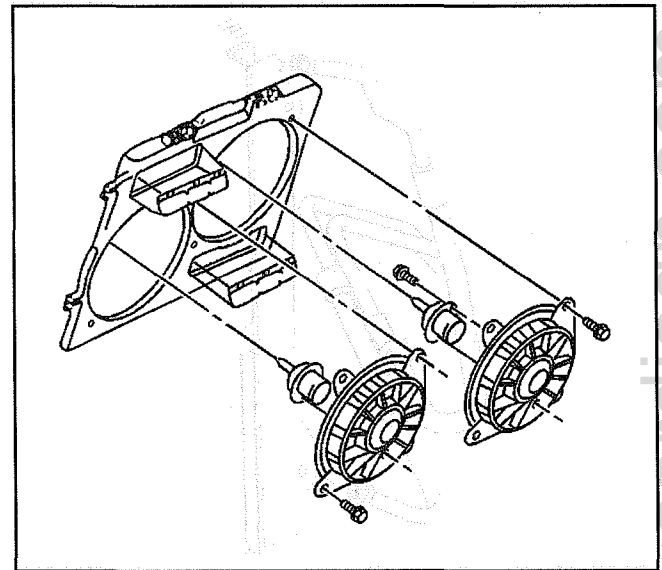
349792

349792

Installation Procedure

1. Install the cooling fan brackets to the fan shroud.

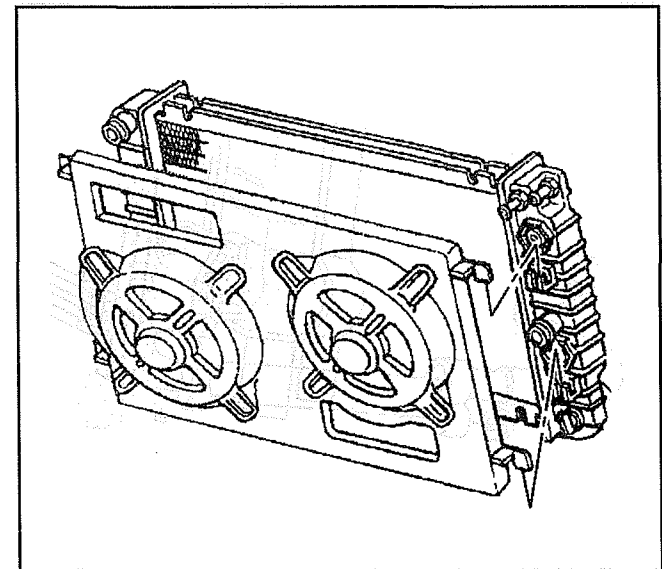
2. Remove the lower oil cooler line from the radiator.



349792

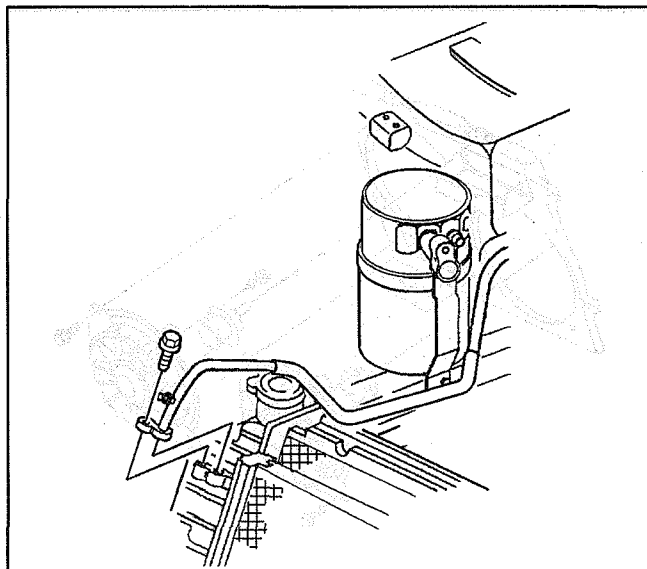
349792

2. Install the fan shroud into the four retaining tabs on the radiator.
3. Install the radiator upper support. Refer to Radiator Support Replacement.



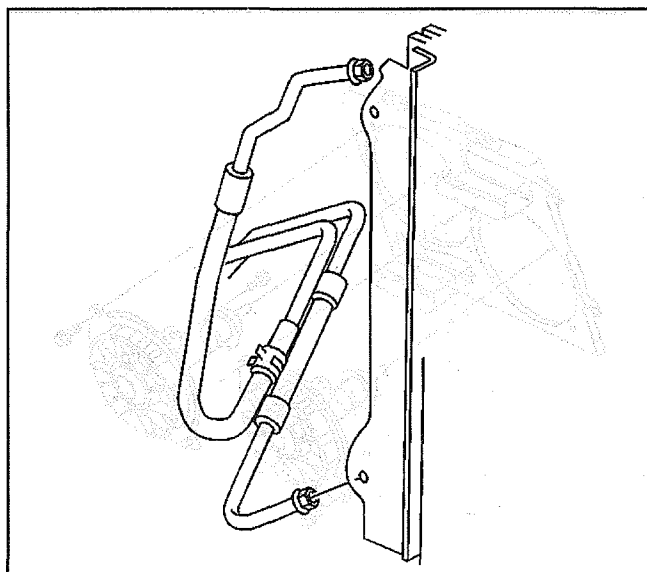
185073

185073



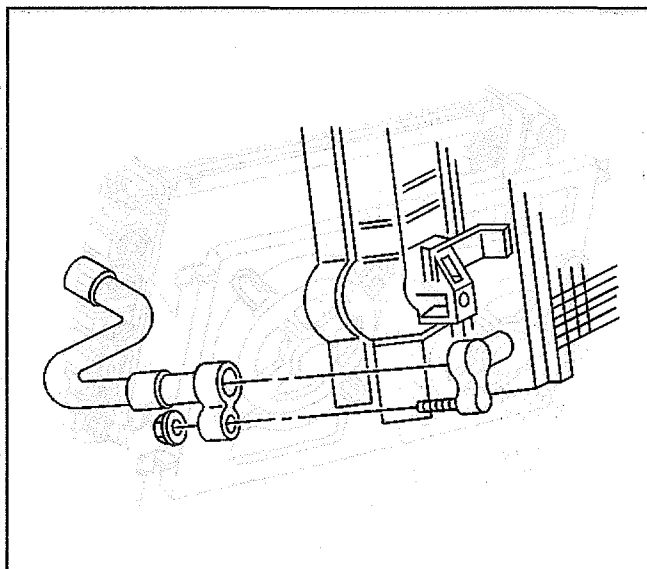
221720

221720



208321

208321



221721

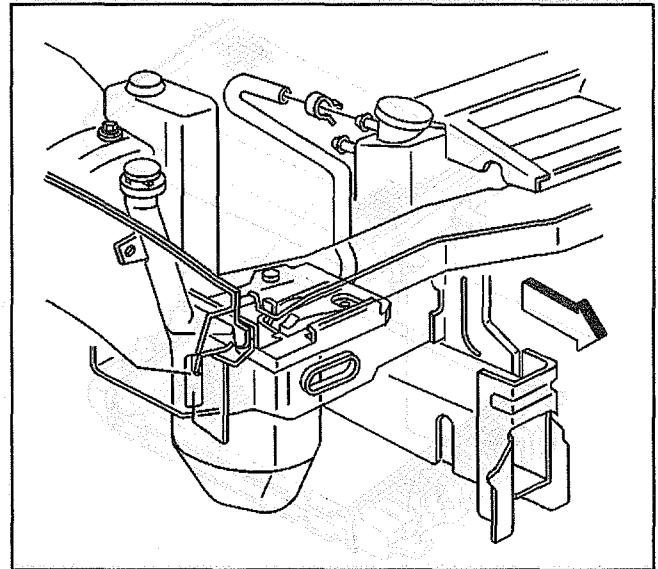
221721

Radiator Replacement

Removal Procedure

1. Recover air conditioning system. Refer to *Refrigerant Recovery and Recharging in HVAC Systems with A/C - Manual*.
2. Drain the engine coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or to *Draining and Filling Cooling System (5.7 L)*.
3. Remove the radiator inlet hose. Refer to *Radiator Hose Replacement - Inlet (3.8 L)* or to *Radiator Hose Replacement - Inlet (5.7 L)*.
4. Remove the radiator outlet hose. Refer to *Radiator Hose Replacement - Outlet (3.8 L)* or to *Radiator Hose Replacement - Outlet (5.7 L)*.
5. Remove the evaporator tube bolt.
6. Remove the evaporator tube from the condenser.
7. Remove the upper oil cooler line from the radiator.
8. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
9. Remove the lower oil cooler line from the radiator.
10. Remove the air conditioning condenser tube nut.
11. Remove the condenser tube from the condenser.
12. Lower the vehicle.

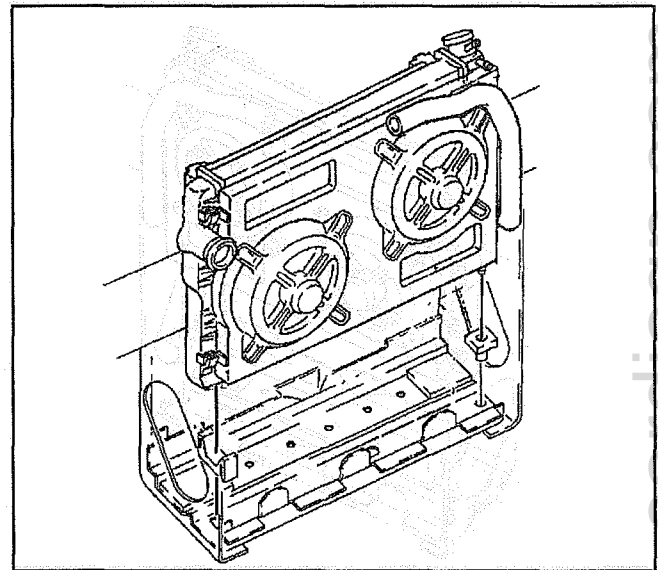
13. Remove the coolant recovery reservoir hose from the radiator.
14. Remove the electric engine coolant fans. Refer to *Cooling Fan Replacement - Electric*.



221645

221645

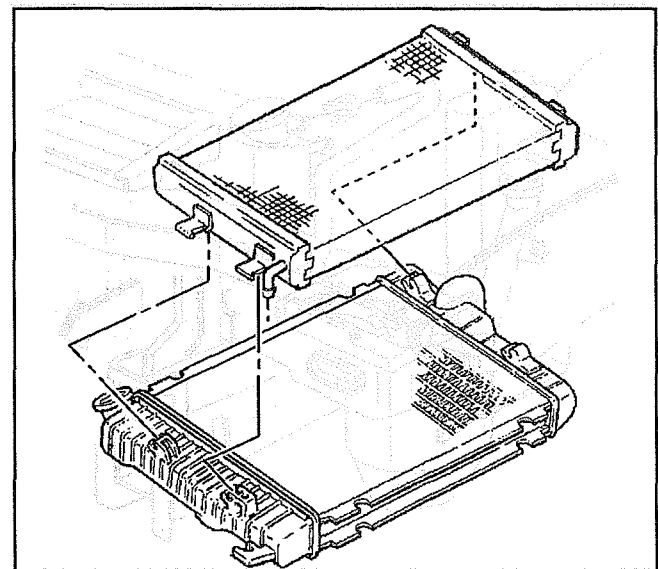
15. Remove the radiator from the vehicle.



221724

221724

16. Remove the condenser from the radiator.



221726

221726

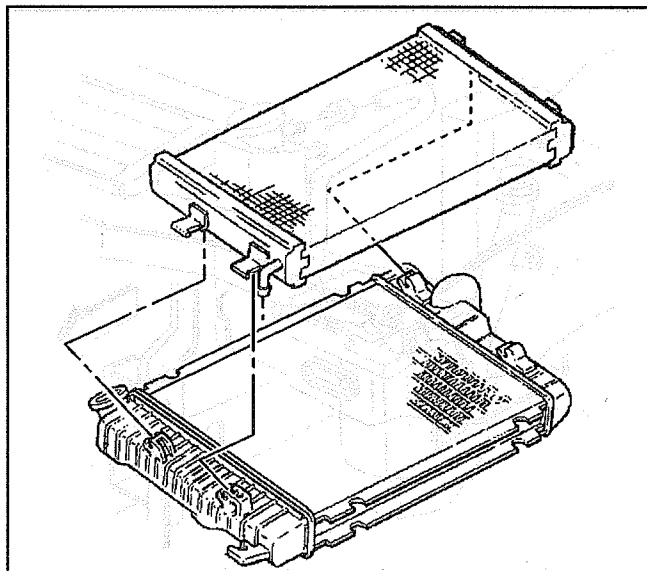


FIGURE 221726

221726

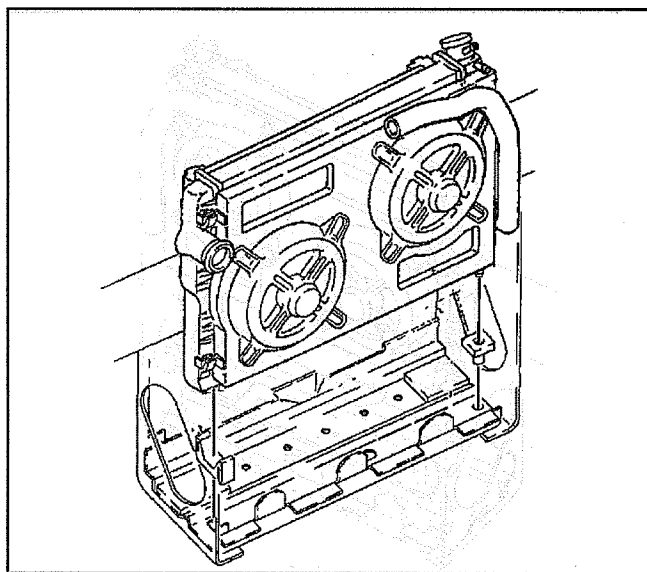


FIGURE 221724

221724

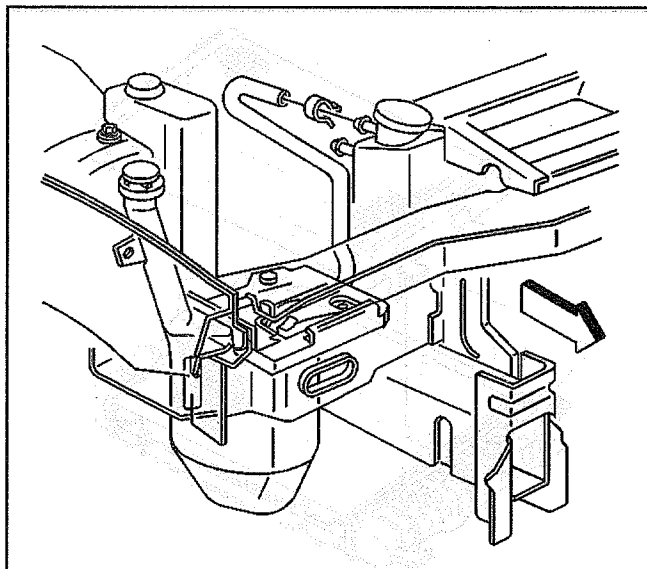


FIGURE 221645

221645

Installation Procedure

1. Install the condenser to the radiator.
2. Install the radiator to the vehicle.
3. Install the electric engine coolant fans. Refer to *Cooling Fan Replacement - Electric*.
4. Install the coolant recovery reservoir hose to the radiator.
5. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.

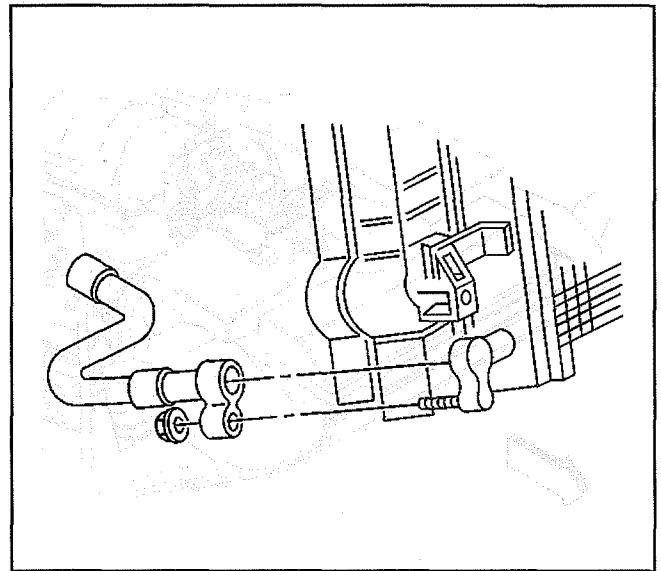
6. Install the condenser tube to the condenser.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the condenser tube nut.

Tighten

Tighten the A/C condenser tube nut to 16 N·m (12 lb ft).



221721

8. Install the lower oil cooler line to the radiator.

Tighten

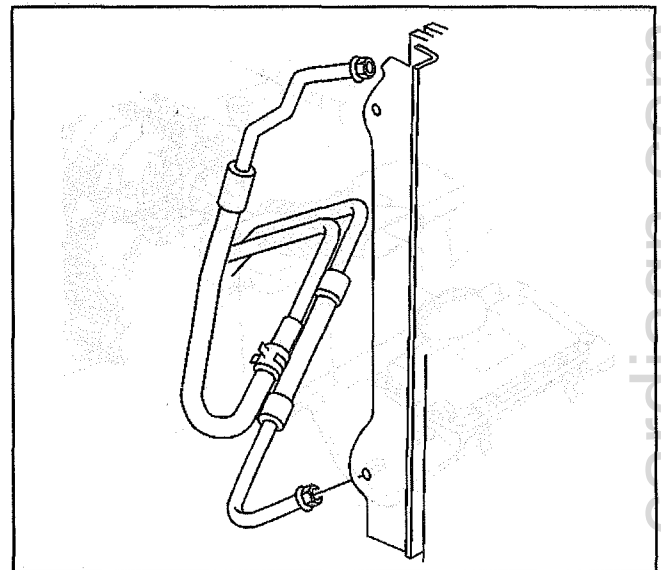
Tighten the lower oil cooler line to 27 N·m (20 lb ft).

9. Lower the vehicle.

10. Install the upper oil cooler line to the radiator.

Tighten

Tighten the upper oil cooler line to 27 N·m (20 lb ft).



208321

11. Install the evaporator tube to the condenser.

12. Install the evaporator tube bolt.

Tighten

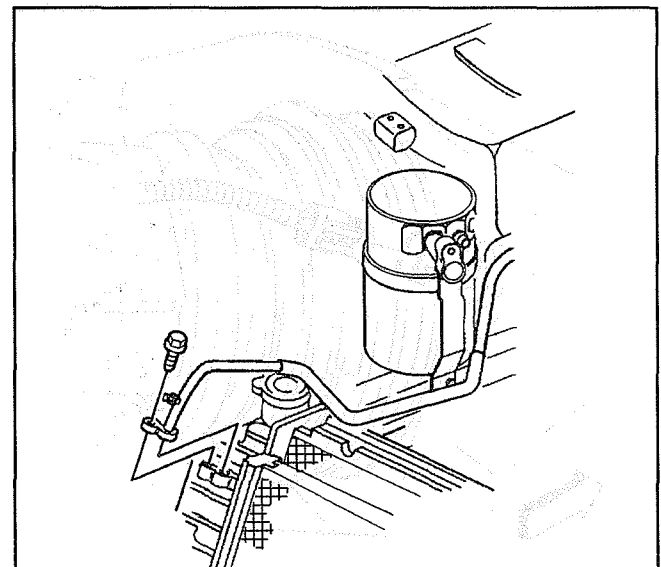
Tighten the evaporator tube bolt to 16 N·m (12 lb ft).

13. Install the radiator outlet hose. Refer to *Radiator Hose Replacement - Outlet (3.8 L)* or to *Radiator Hose Replacement - Outlet (5.7 L)*.

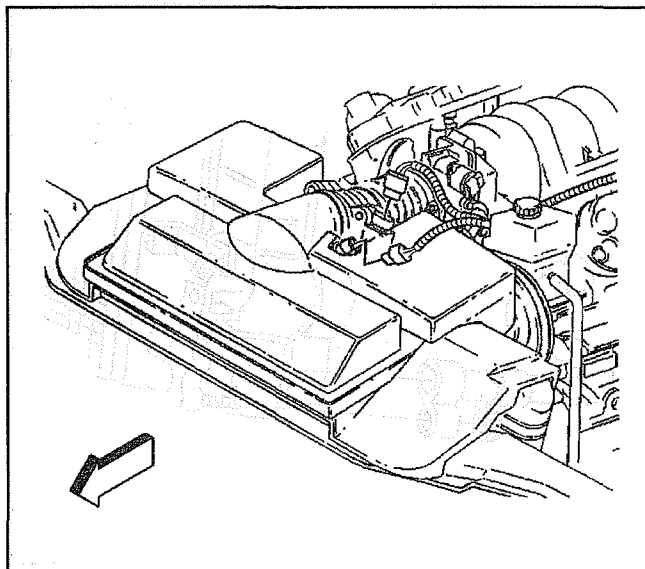
14. Install the radiator inlet hose. Refer to *Radiator Hose Replacement - Inlet (3.8 L)* or to *Radiator Hose Replacement - Inlet (5.7 L)*.

15. Drain the engine coolant. Refer to *Draining and Filling Cooling System (3.8 L)* or to *Draining and Filling Cooling System (5.7 L)*.

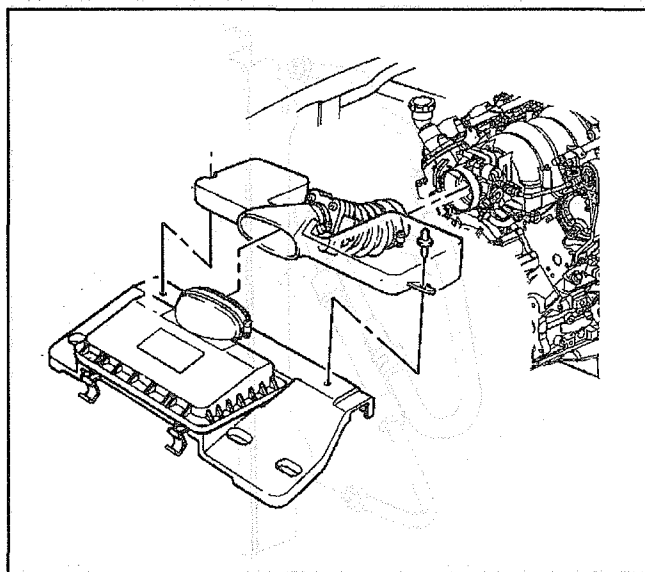
16. Recharge the air conditioning system. Refer to *Refrigerant Recovery and Recharging in HVAC Systems with A/C - Manual*.



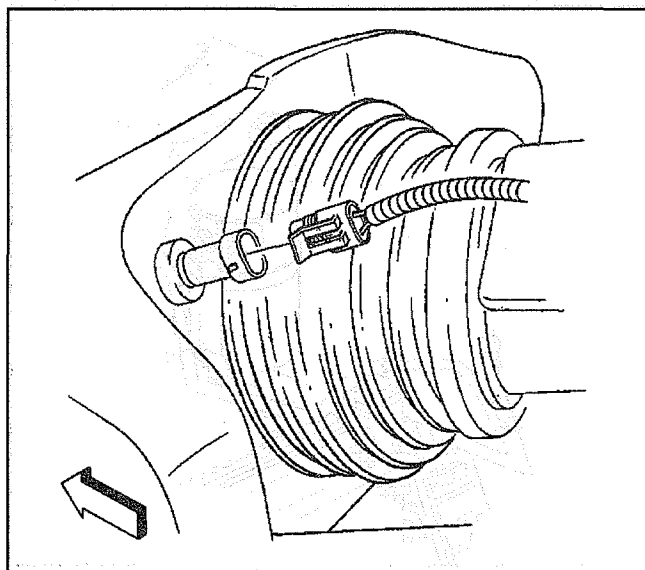
221720



208553



208569



208554

Radiator Support Replacement

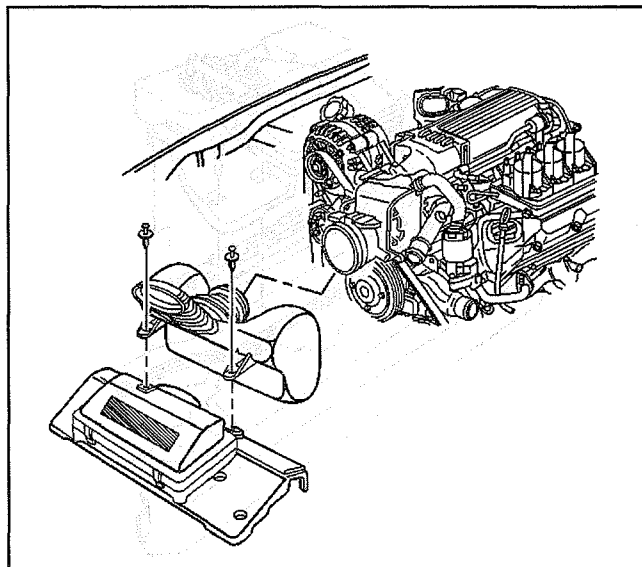
Removal Procedure

1. Disconnect the intake air temperature (IAT) and mass airflow (MAF) sensors electrical connectors, if equipped with the 5.7 L engine.

2. Remove the air intake duct resonator, if equipped with the 5.7 L engine.

3. Disconnect the intake air temperature (IAT) sensor electrical connector, if equipped with the 3.8 L engine.

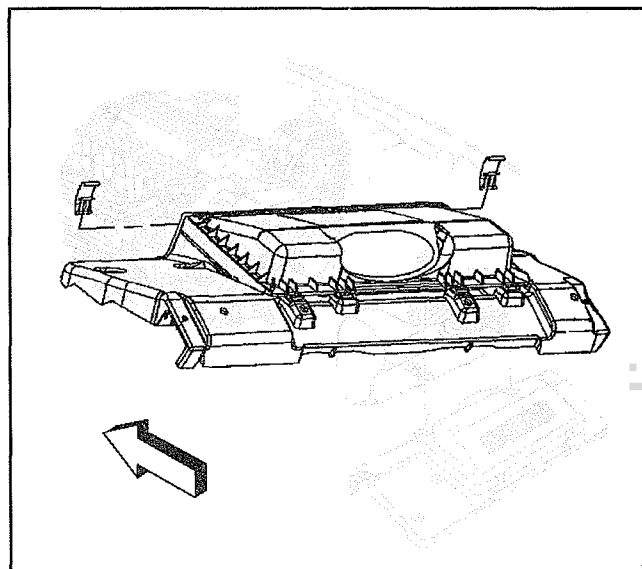
4. Remove the air intake duct resonator, if equipped with the 3.8 L engine.



554755

554755

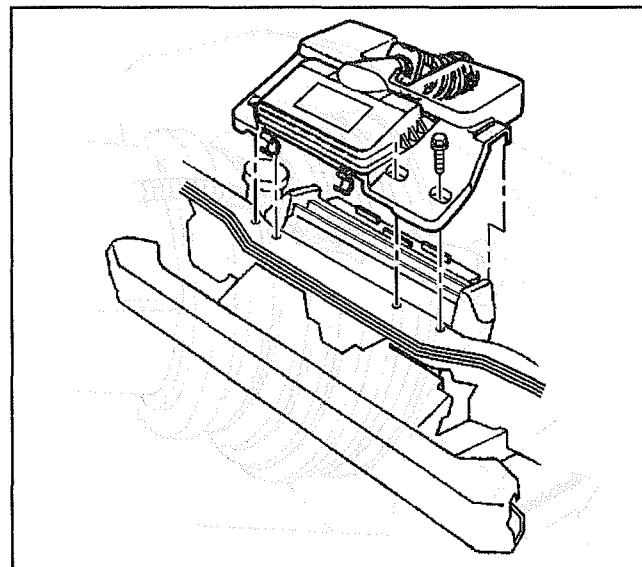
5. Release the retaining strap latches.
6. Lift the top of the air cleaner housing off.
7. Remove the air filter element.



245337

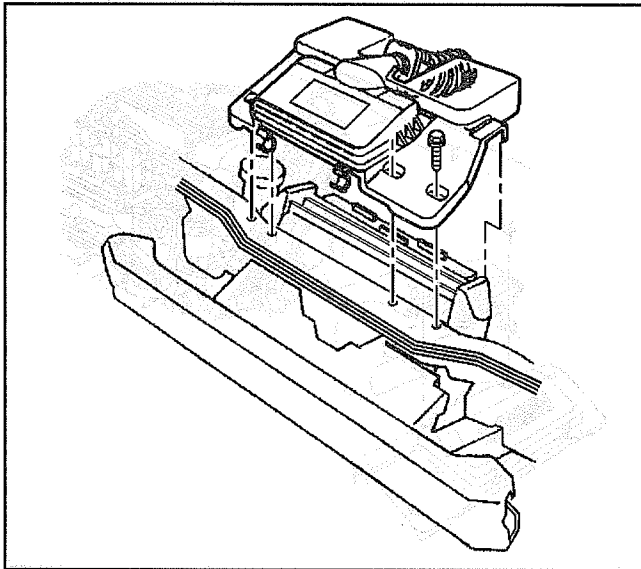
245337

8. Remove the air cleaner / radiator support bolts.
9. Remove the radiator support.



221697

221697



527443

221697

Installation Procedure

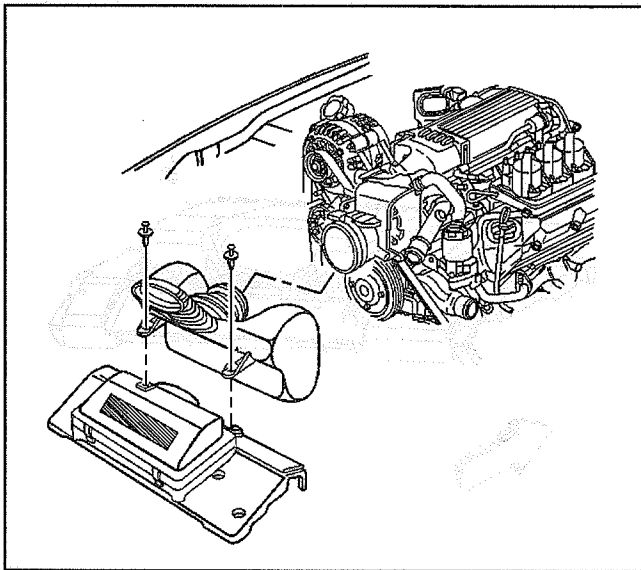
1. Install the radiator support.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the air cleaner / radiator support bolts

Tighten

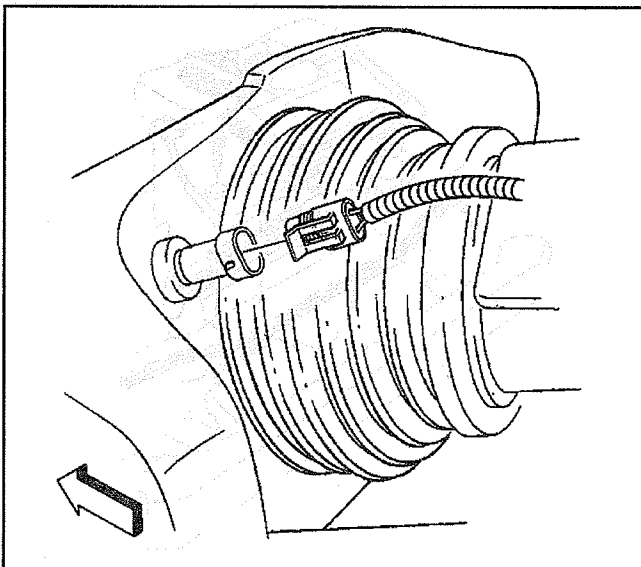
Tighten the air cleaner bolts to 12 N·m (106 lb in).



554755

554755

3. Install the air intake duct resonator, if equipped with the 3.8 L engine.

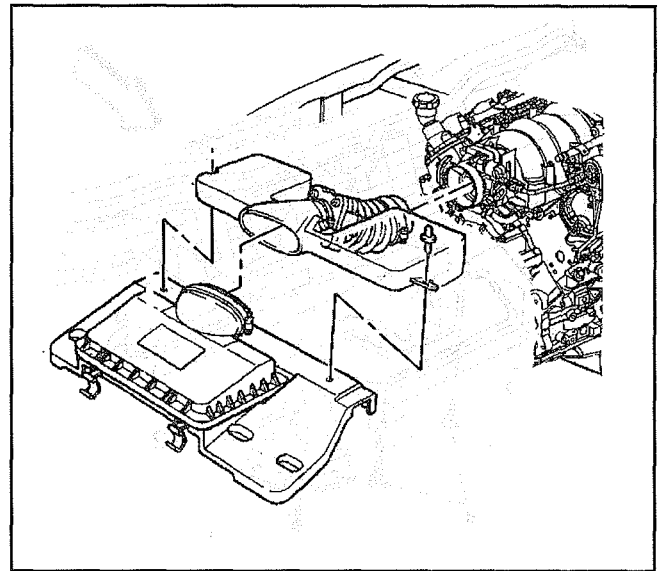


208554

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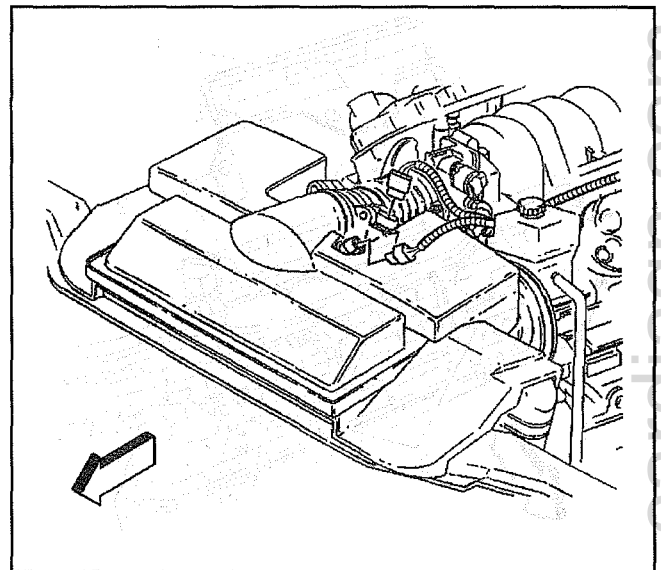
4. Connect the IAT sensor electrical connector, if equipped with the 3.8 L engine.

5. Install the air intake duct resonator, if equipped with the 5.7 L engine.



208569

6. Connect the IAT and the MAF sensors electrical connectors, if equipped with the 5.7 L engine.

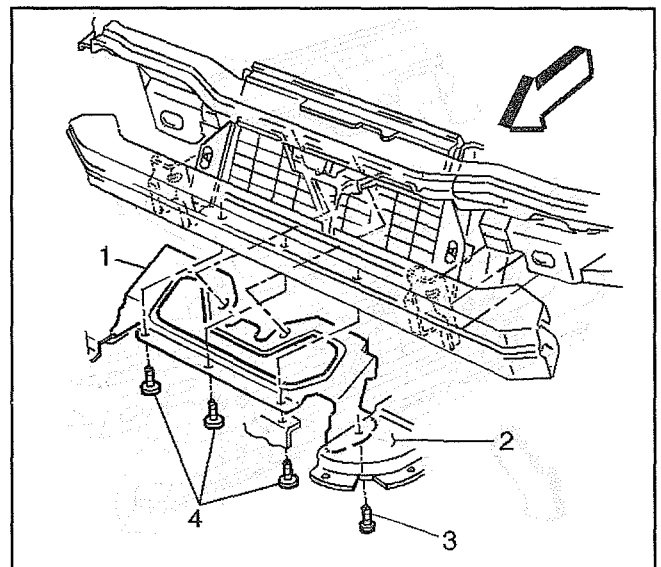


208553

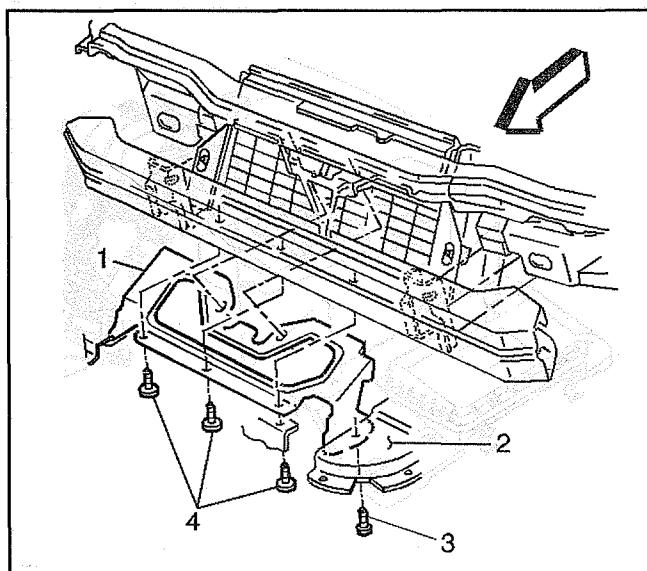
Radiator Air Baffle Assemblies and Deflectors (Lower)

Removal Procedure

1. Remove the air lower deflector screws (3).
2. Remove the radiator air lower baffle retainers (4).
3. Remove the radiator air lower baffle (1).
4. Inspect for any component damage.



11689



11689

Installation Procedure

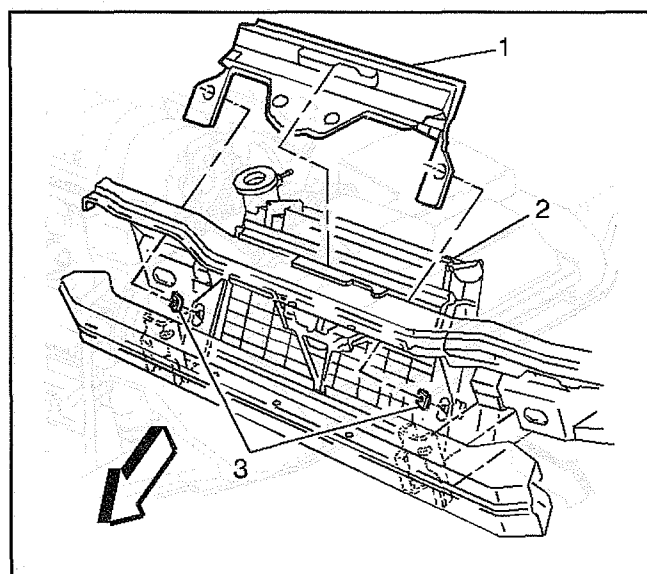
1. Install the radiator air lower baffle (1).
2. Install the radiator air lower baffle retainers (4).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the radiator air lower deflector screws (3).

Tighten

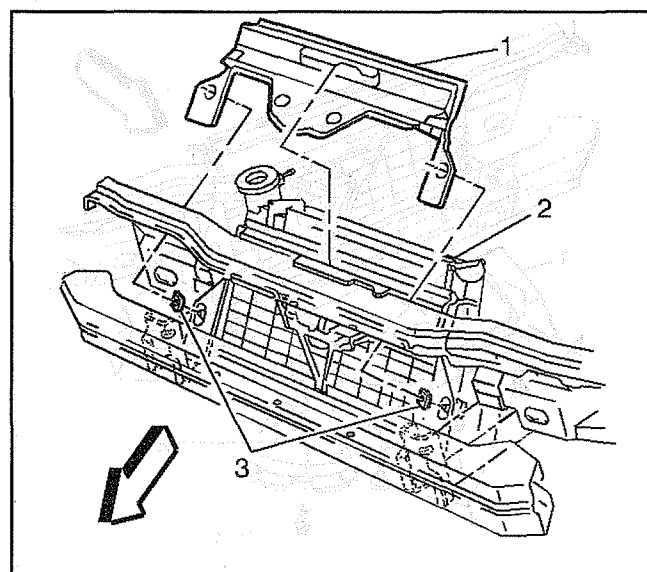
Tighten the radiator air lower deflector screws to 10 N·m (89 lb in).



11690

Radiator Air Baffle Assemblies and Deflectors (Upper)**Removal Procedure**

1. Remove the radiator air upper baffle from the retainers (3).
2. Remove the radiator air upper baffle (1) from the radiator (2).



11690

Installation Procedure

1. Install the radiator air upper baffle (1) to the radiator (2).
2. Install the radiator air upper baffle to the retainers (3).

Coolant Heater Replacement (3.8 L)

Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Drain the cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.
3. Disconnect the electrical cord from the coolant heater.

4. Loosen the coolant heater bolt.

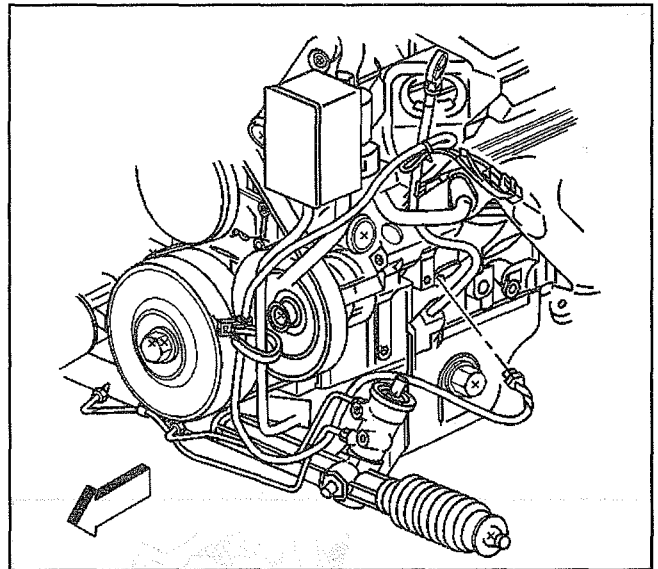
Important: When removing the engine coolant heater from the engine block, be careful not to score the machined surface of the plug hole.

5. Remove the coolant heater from the engine block.
6. Clean the engine coolant heater hole. Remove any burrs, sealer, paint or other rough spots.

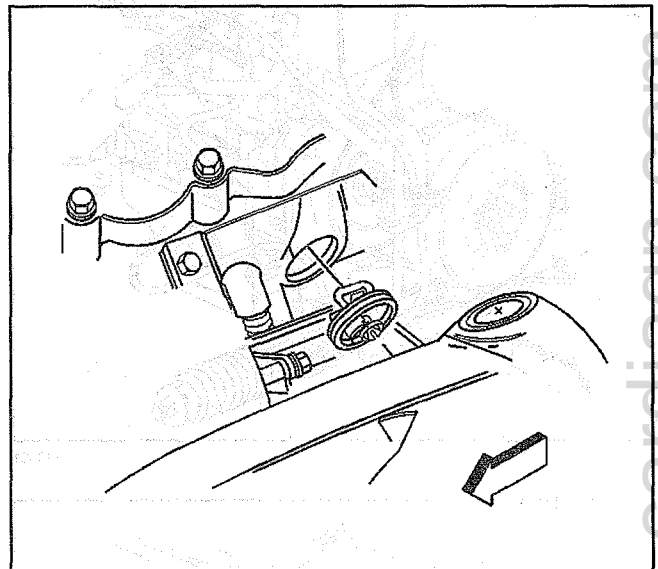
Installation Procedure

Important: The heater element must not touch the engine block inner wall in the installed position or damage to the engine block and coolant heater could result.

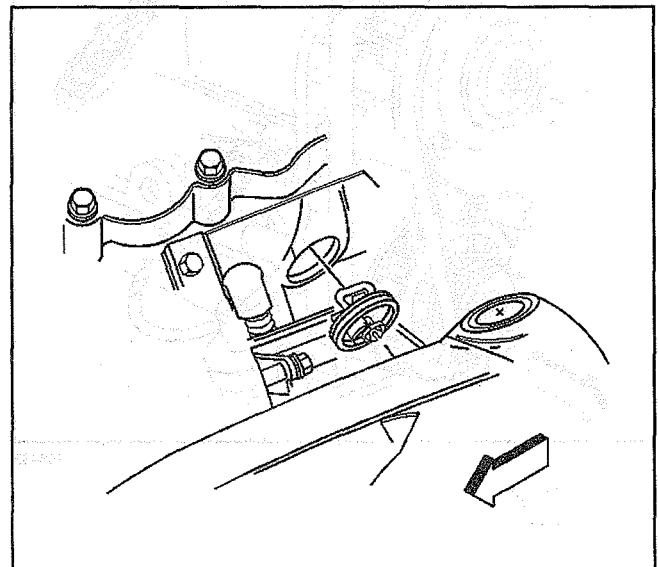
1. Apply a coat of engine coolant heater lubricant, GM P/N 12345996 or equivalent, to the O-ring and walls of the coolant heater hole.



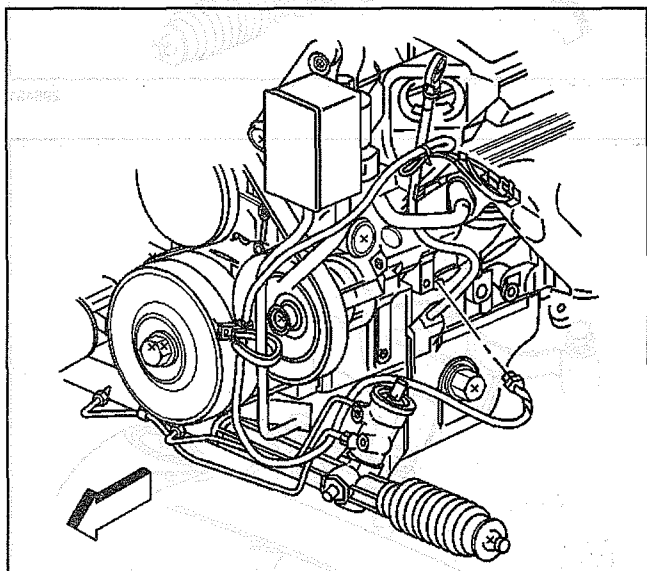
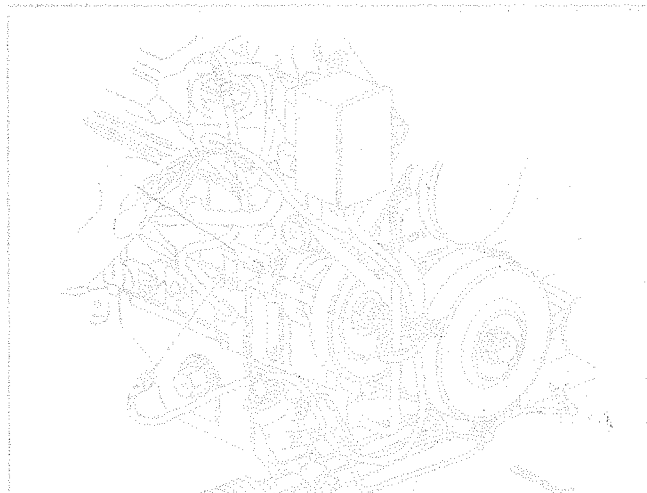
298431



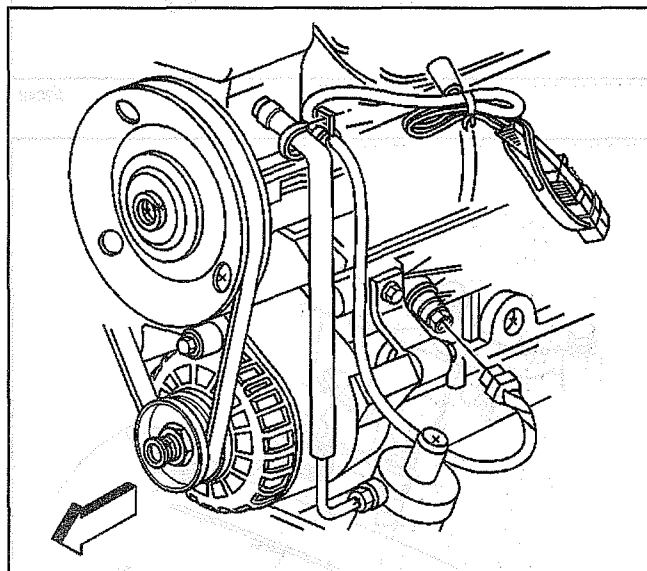
298427



298427



298431



298433

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the coolant heater into the coolant hole using the following steps:
 - Insert the heating element end of the heater into the engine block.
 - Line up the heater with the plug hole and push it straight into place.
 - Rotate the heater so that the center electrical contact and bolt are in line horizontally.
 - Tighten the bolt so that the yoke presses against the engine block inner wall.

Tighten

Tighten the coolant heater bolt to 2 N·m (18 lb in).

3. Connect the coolant heater electrical cord to the heater.
4. Lower the vehicle.
5. Refill the engine cooling system. Refer to *Draining and Filling Cooling System (3.8 L)*.

Important: When removing the engine coolant heater from the engine block, be careful not to score the machined surface of the plug hole.

6. Remove the coolant heater from the engine block. Clean the engine coolant heater hole. Remove any burr, sealant, paint or other foreign matter.

Coolant Heater Replacement (5.7 L)

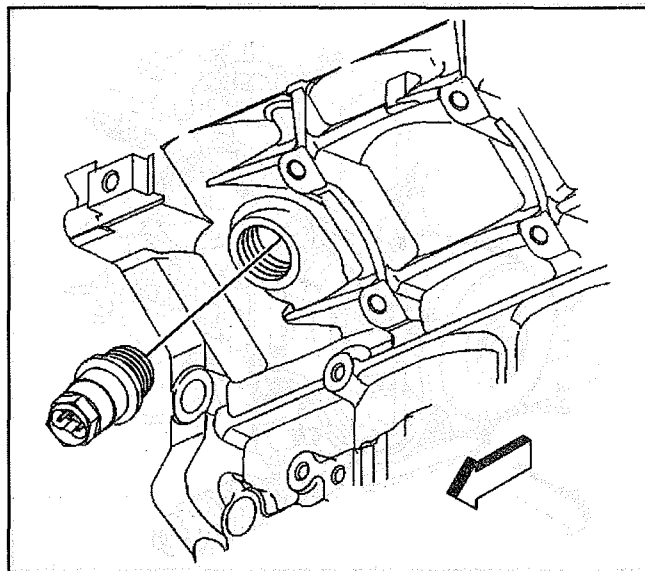
Removal Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Drain the cooling system. Refer to *Draining and Filling Cooling System (5.7 L)*.
3. Disconnect the electrical cord from the coolant heater.

4. Apply a coat of engine coolant heater lubricant (GM Part 12342999 or equivalent) to the O-ring and the wall of the coolant heater hole.

Important: When removing the engine coolant heater from the engine block, be careful not to score the machined surface of the plug hole.

4. Remove the coolant heater from the engine block.
5. Clean the engine coolant heater hole. Remove any burrs, sealer, paint or other rough spots.



550337

Installation Procedure

Important: The heater element must not touch the engine block inner wall in the installed position or damage to the engine block and coolant heater could result.

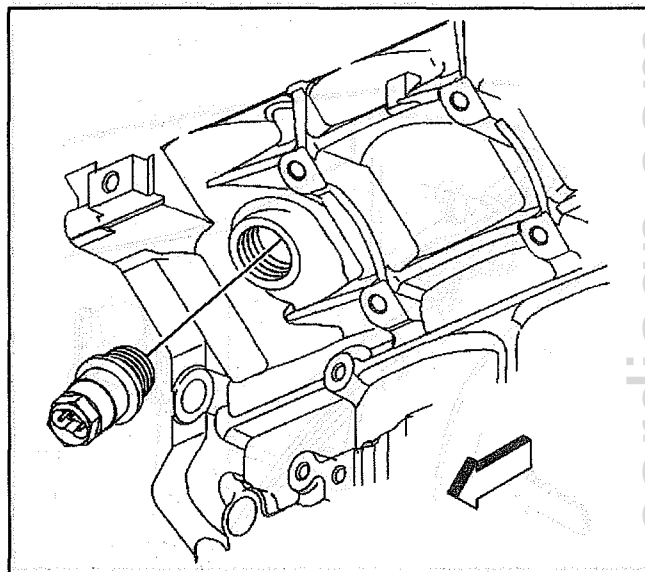
1. Apply a coat of engine coolant heater lubricant, GM P/N 12345996 or equivalent, to the O-ring and walls of the coolant heater hole.
2. Finger start the coolant heater to the engine block.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Tighten the coolant heater.

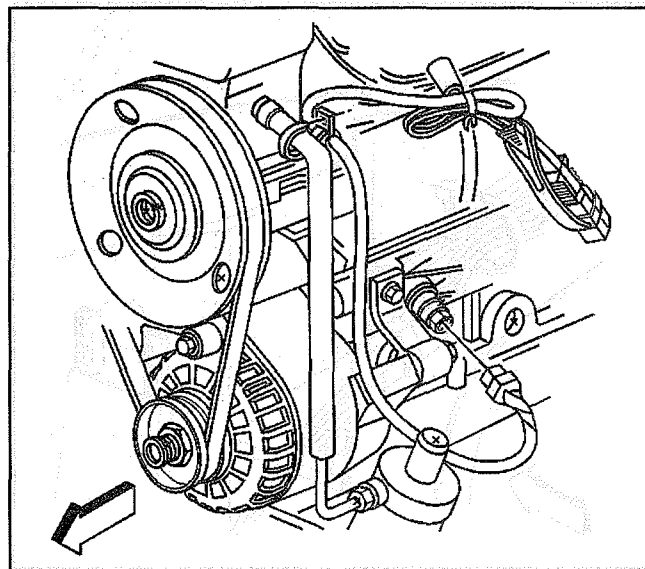
Tighten

Tighten the coolant heater to 40 N·m (30 lb ft).

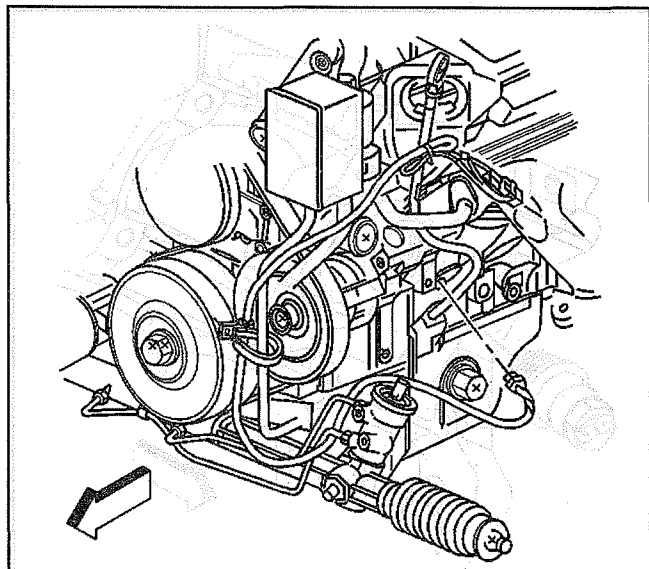


550337

4. Install the coolant heater electrical cord to the heater.
5. Lower the vehicle.
6. Refill the cooling system. Refer to *Draining and Filling Cooling System* (5.7 L).



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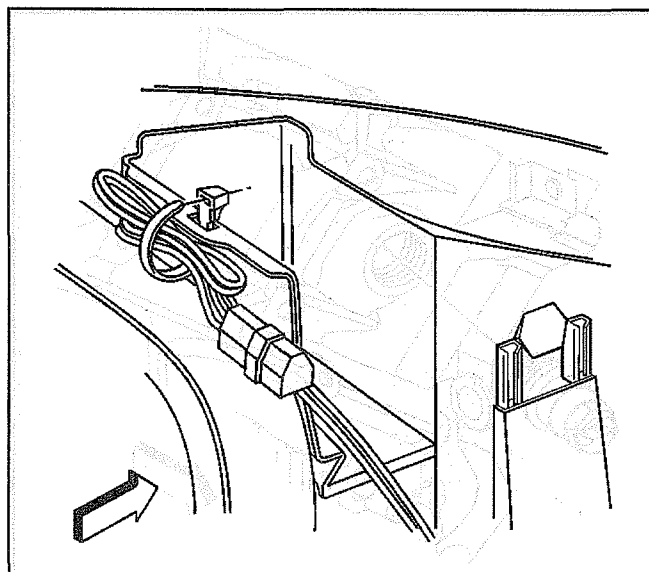


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Coolant Heater Cord Replacement (3.8 L)

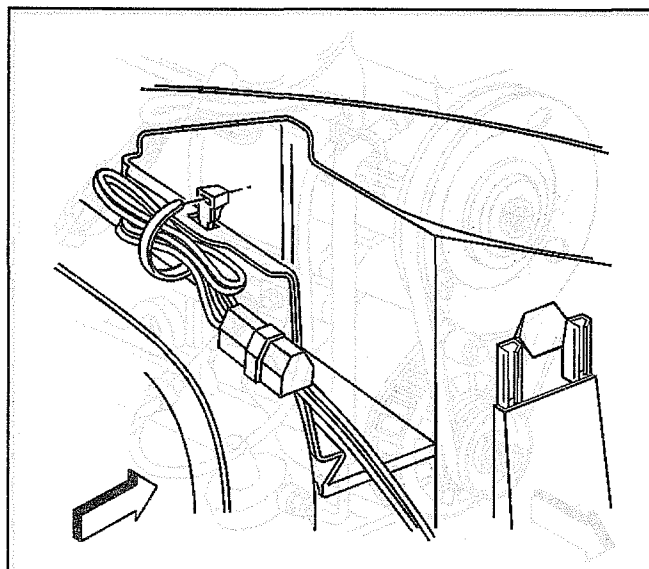
Removal Procedure

1. Disconnect the heater cord from the block heater.
2. Route the block heater end of the cord under the power steering rack lines.
3. Cut the heater cord strap at the power steering reservoir.



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4. Cut the heater cord strap at the fuse block center.
5. Remove the heater cord from the vehicle.

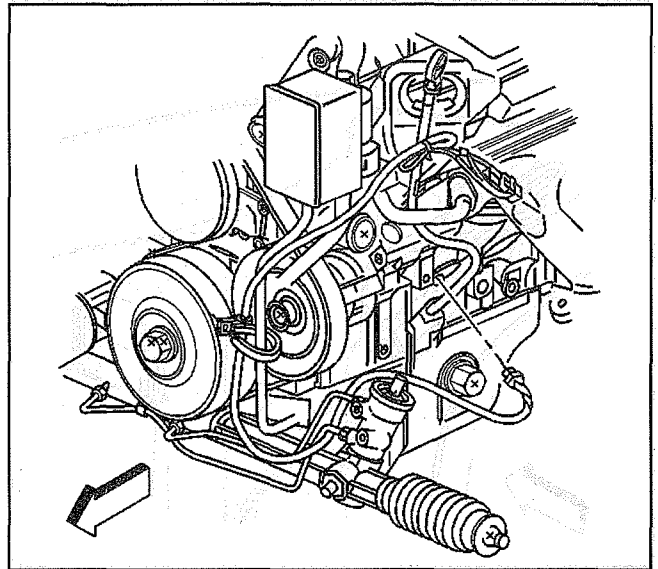


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Installation Procedure

1. Install the heater cord and a new strap to the fuse block center.

2. Route the cord up under the power steering rack lines.
3. Install a new heater cord strap to the power steering reservoir.
4. Connect the heater cord to the coolant heater.

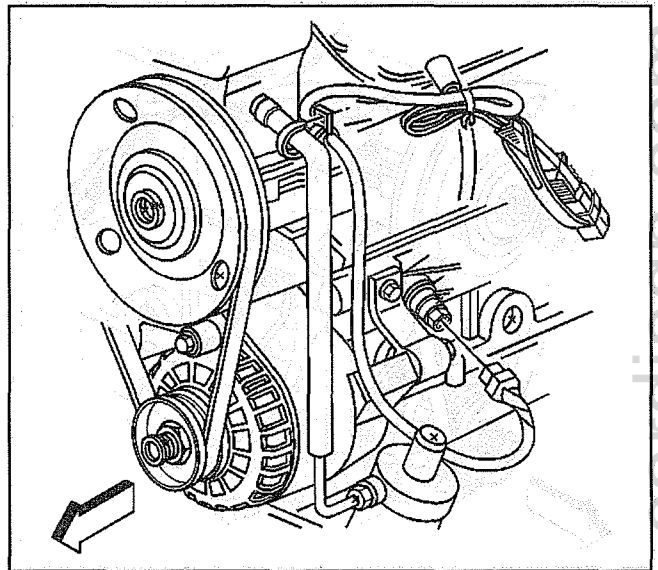


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Coolant Heater Cord Replacement (5.7 L)

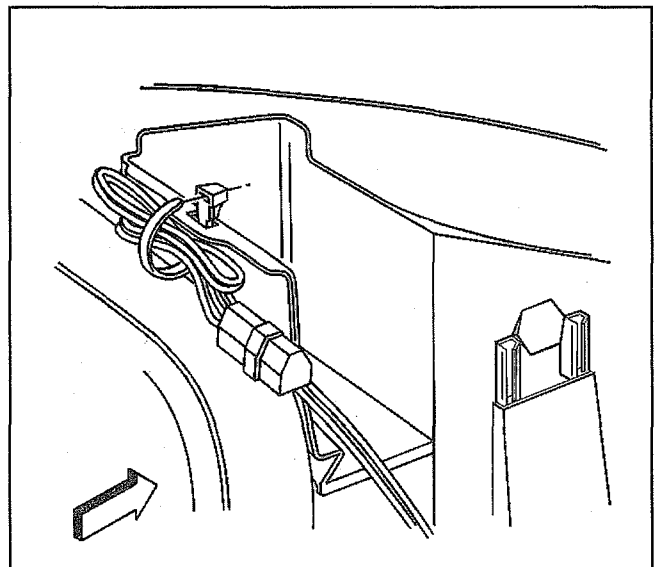
Removal Procedure

1. Disconnect the heater cord from the block heater.
2. Cut the heater cord strap at the power steering line.

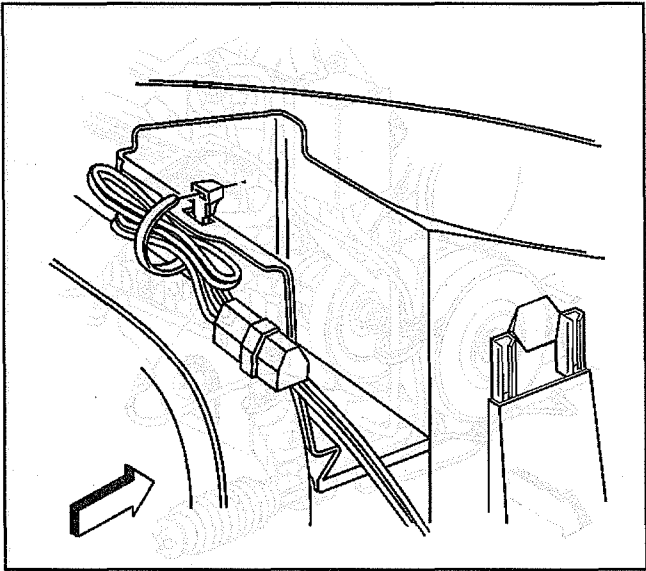


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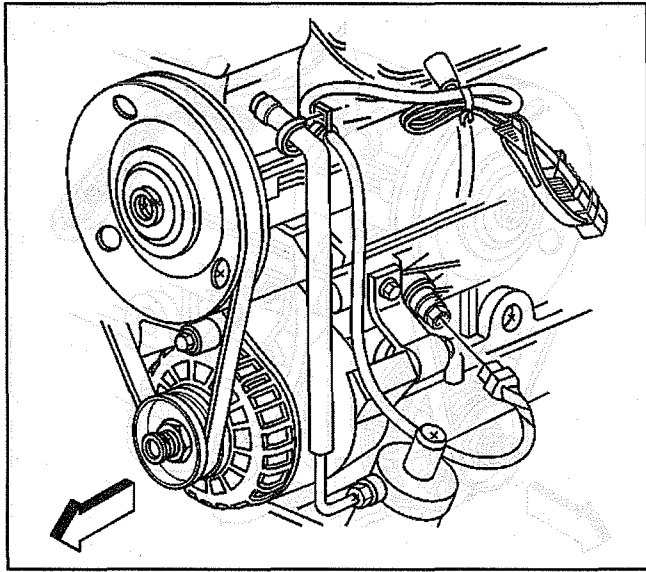
3. Cut the heater cord strap at the fuse block center.
4. Remove the heater cord from the vehicle.



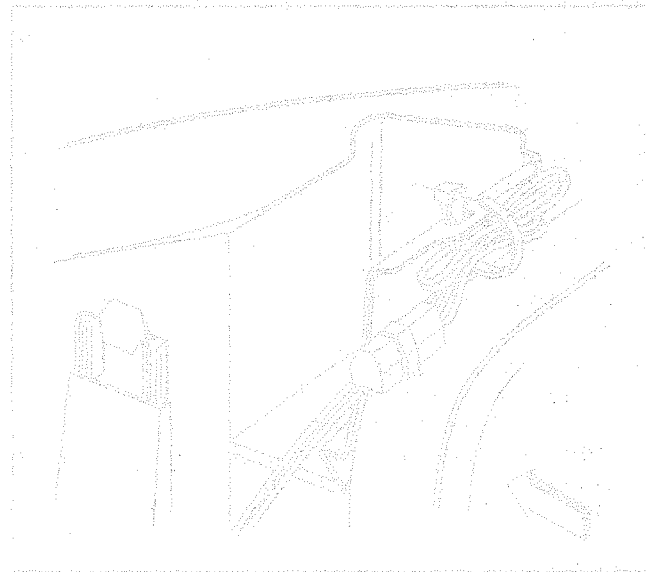
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Installation Procedure

1. Install the heater cord to the vehicle.
2. Install the heater cord and a new strap to the fuse block center.

3. Install the heater cord and a new strap to the power steering line.
4. Connect the heater cord to the coolant heater.

Description and Operation

Cooling System Description

The cooling system consists of the following major components:

- Radiator
- Coolant recovery reservoir
- Cooling fans
- Thermostat
- Water pump
- Engine coolant air bleed pipe
- Engine coolant temperature (ECT) sensor
- Transmission oil cooler
- All related hoses
- Fan shroud
- Fan motor/blade

The cooling systems functions is to maintain an efficient engine operating temperature during all speeds and under all operating conditions. Cooling systems are designed to remove about one-third (30 to 35 percent) of the heat produced in the combustion chambers by the burning of the air-fuel mixture. The engine is very inefficient while cold. Therefore the cooling system includes a device (thermostat) that prevents normal cooling action during engine warm-up. The thermostat allows the engine parts to reach their normal operating temperature more quickly. This shortens the inefficient cold-operating time. When the engine reaches its normal operating temperature, the cooling system begins to function. The cooling system removes excess heat when the engine is hot, and slowly or not at all when the engine is cold or warming up.

The coolant absorbs heat as it passes through the engine. Then the hot coolant flows through a radiator in which the heat in the coolant is passed on to the air that is flowing through the radiator. The cooled coolant then flows back through the engine. This circulation of the coolant continually removes heat from the engine. The coolant is kept in circulation by the water pump.

Water jackets are designed to keep the cylinder block and cylinder heads cool. The water jackets are open spaces between the outside wall of the cylinder and the inside of the cylinder block and head. The coolant can circulate freely around the engine hot spots. These hot spots include the following:

- Valve guides
- Valve seats
- Upper parts of the cylinder walls

When the engine is running at the normal operating temperature, coolant flows into the block and through the water jackets surrounding the cylinders. Vapor is vented off through the engine coolant air bleed pipe. Then coolant is forced through the head gasket openings and into the cylinder head water jackets. In the heads, the coolant flows around the combustion chambers and valve seat, picking up additional heat. From the heads, the coolant flows through the

upper hose into the radiator. There, the coolant temperature is lowered, and the coolant is drawn again into the engine by the water pump to provide passenger compartment heat and defrost. The coolant recovery reservoir provides a coolant fill point. The reservoir is translucent for coolant level viewing.

Coolant Description

This vehicle has a newly developed engine coolant. GM Goodwrench® DEX-COOL® was developed to last for 240 000 km (150,000 mi) or 5 years, whichever occurs first. Follow the instructions in Draining and Filling Cooling System. Make sure only GM Goodwrench® DEX-COOL® (silicate-free) or Havoline® DEX-COOL® is used when coolant is added or changed.

A 50/50 mixture of DEX-COOL® and clean drinkable water will provide the following protection:

Notice: Pure coolant can be added to raise the boiling point of the coolant, but too much will affect the freezing point. Do not use a solution stronger than 70 percent, as the freeze level rises rapidly after this point. Pure coolant will freeze at -22°C (-8°F).

- Give freezing protection down to -37°C (-34°F).
- Give boiling protection up to 129°C (260°F).
- Protect against rust and corrosion.
- Help keep the proper engine temperature.
- Let the warning lights and gauges work correctly.

Coolant Recovery System Description

The cooling system has a separate plastic, translucent coolant recover reservoir. The reservoir, also called a recovery tank or expansion tank, is partly filled with coolant and is connected to the overflow tube on the radiator fill neck to the reservoir by the overflow tube. The coolant in the engine expands as the engine heats up. Instead of dripping out the overflow tube onto the ground and being lost from the cooling system completely, the coolant flows into the reservoir.

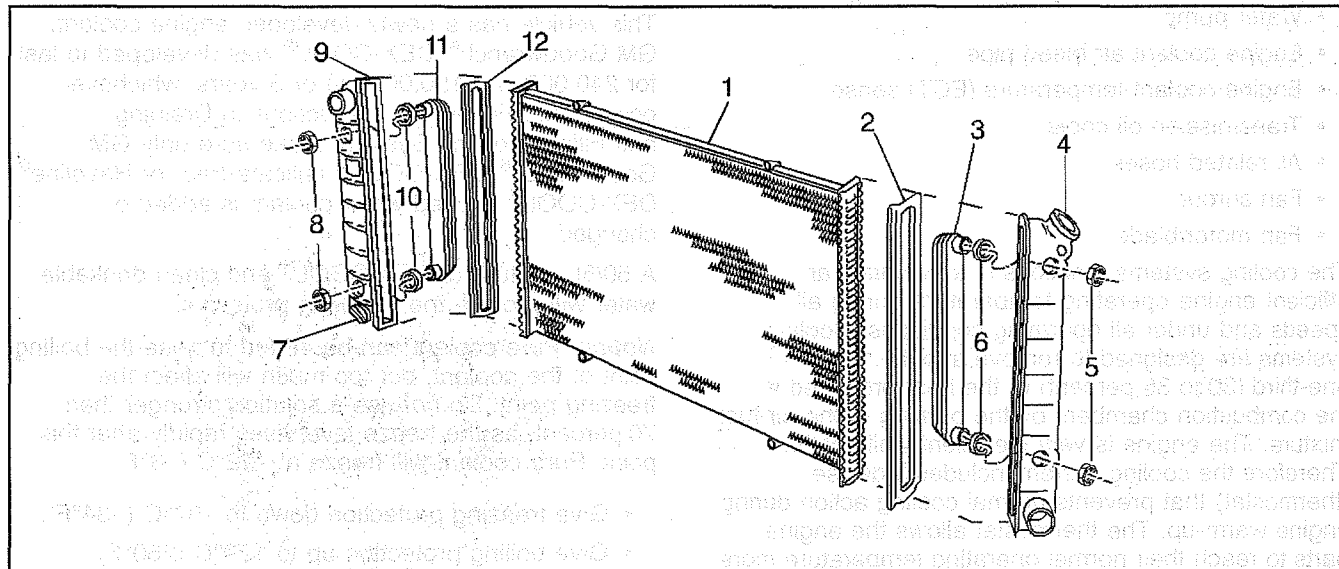
When the engine cools, a vacuum is created in the cooling system. The vacuum siphons some of the coolant back into the radiator from the reservoir. In effect, a cooling system with a recovery reservoir is a closed system. Coolant can flow back and forth between the radiator and the reservoir. This occurs as the coolant expands and contracts from heating and cooling. Under normal conditions, no coolant is lost.

An advantage to the use of a coolant recovery reservoir is that it eliminates almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles in it. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. This results in maximum cooling efficiency.

Throttle Body Coolant System Description

The fuel injection system has coolant passages in the throttle body. The heated coolant flow through these passages improves the cold weather driveability of the vehicle.

Radiator Assembly Description



The radiator is a heat exchanger that removes heat from the coolant passing through it. The radiator holds a large volume of coolant in close contact with a large volume of air so that heat will transfer from the coolant to the air. The radiator core is divided into two separate compartments coolant passes through one, and air passes through the other. The aluminum radiator core (1) is a crossflow tube and fin design. A tube and fin radiator consists of a series of tubes extending from side to side on the radiator core. The tubes run from the inlet tank (4) to the outlet tank (9). Fins are placed around the outside of the tubes to improve heat transfer. Air passes between the fins. As the air passes by, it absorbs heat from the fins which have, in turn, absorbed heat from the coolant.

Coolant Heater Description

The engine coolant heater is used to heat the engine coolant prior to vehicle start up, making it easier to start the engine in very cold climates. It is installed into the engine block at a water jacket plug location. An engine coolant heater cord is routed inside the engine compartment. The heater is rated at 600 watts and uses a 110 volt ac power supply.

In a typical radiator, there are five fins per inch. Radiators used in vehicles that have factory installed air conditioning have seven fins per inch. This provides the additional cooling surface required to handle the additional heat load imposed by air conditioning.

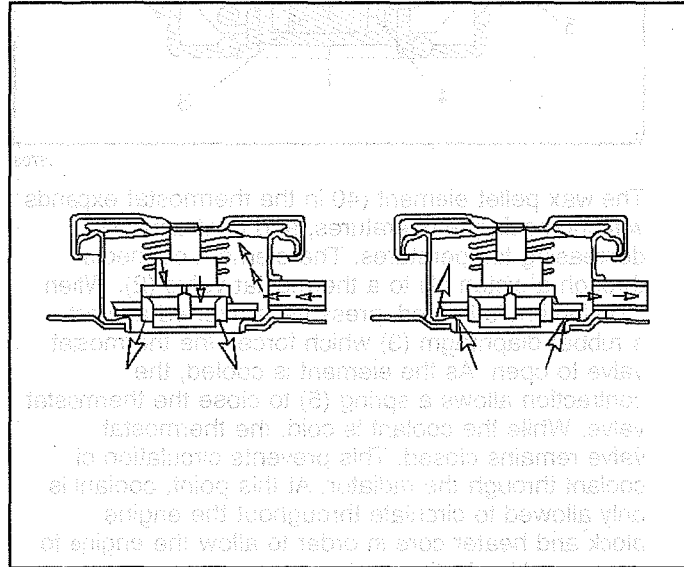
The inlet (4) and outlet (9) tanks are molded with high temperature nylon-reinforced plastic. A high temperature rubber gasket (2, 12) seals the tank flange edge. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core (1). A plastic serviceable drain cock (7) and rubber seal is used.

The integral transmission oil cooler (3) is housed inside the outlet (4) tank. The cooler provides the automatic transmission fluid cooling capacity. This maintains a fairly constant temperature under all operating conditions.

Pressure Cap Description

Radiator Fill Cap

Caution: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

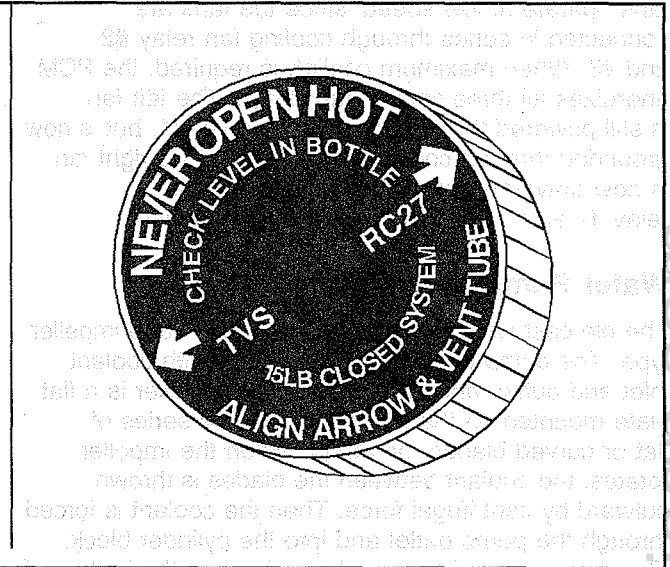


The cooling system is sealed and pressurized by a radiator pressure cap. There are two advantages to sealing and pressurizing the cooling system.

- Increased pressure raises the boiling point of the coolant. This increases the efficiency of the cooling system.
- Sealing the cooling system reduces coolant losses from evaporation and permits the use of the recovery reservoir.

As the pressure goes up, the boiling point goes up. Therefore, the coolant can be safely run at a temperature higher than 212 degrees F (100 degrees C) without boiling. The higher the coolant temperature, the greater the difference between it and the outside air temperature. This difference in temperature is what causes the cooling system to work. The hotter the coolant, the faster the heat moves from the radiator to the cooler passing air. This means that the pressurized, sealed cooling system can take heat away from the engine faster. Therefore, the cooling system works more efficiently when the coolant is under higher pressure.

However, the cooling system can be pressurized too much. If the pressure in the system gets too high, it can damage the radiator and blow off the hoses. To prevent this the radiator cap has a pressure relief



valve. When the pressure gets too high, it raises the valve so that the excess pressure can escape into the recovery reservoir.

The radiator pressure cap also has a vacuum vent valve. This valve protects the system from developing a vacuum that could collapse the radiator. When the engine is shut off and cools, the coolant volume is reduced. Cold coolant takes up less space than hot coolant. As the temperature of the coolant drops, a vacuum develops in the cooling system. To prevent excessive vacuum from developing, the vacuum valve opens to allow outside air or coolant from the recovery reservoir to flow into the cooling system. This relieves the vacuum that could otherwise cause outside air pressure to collapse the radiator.

Engine Cooling Fan Description - Electric

The cooling fans are located behind the radiator. The cooling fans are driven by an electric motor. The cooling fan motors both have five blades that are each 312 mm (12.3 in) in diameter. One cooling fan will start and run and then both cooling fans will run depending on the amount of cooling the radiator needs.

The advantage of the electric fan is less power drain on the engine and less fan noise. Also, there is no fan belt to inspect, adjust, or replace. This means less cooling system maintenance.

The engine cooling fan relays provide the current required for the motors based on a low current signal received from the powertrain control module (PCM).

Cooling Fan Relay Description

The cooling fan relays are used to control the high current flow to power the cooling fan motors. Both fans operate together. When minimum cooling is required, the PCM energizes cooling fan relay #1 and both fans operate at low speed, since the fans are connected in series through cooling fan relay #2 and #3. When maximum cooling is required, the PCM energizes all three cooling fan relays. The left fan is still powered through cooling fan relay #1, but is now grounded through cooling fan relay #3. The right fan is now powered directly through cooling fan relay #2 and both fans operate at high speed.

Water Pump Description

The die-cast water pump is a centrifugal vane impeller type. The pump consists of a housing, with coolant inlet and outlet, and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades, or vanes. When the impeller rotates, the coolant between the blades is thrown outward by centrifugal force. Then the coolant is forced through the pump outlet and into the cylinder block. The pump inlet is connected by a hose to the bottom of the radiator. Coolant from the radiator is drawn into the pump to replace the coolant forced through the outlet.

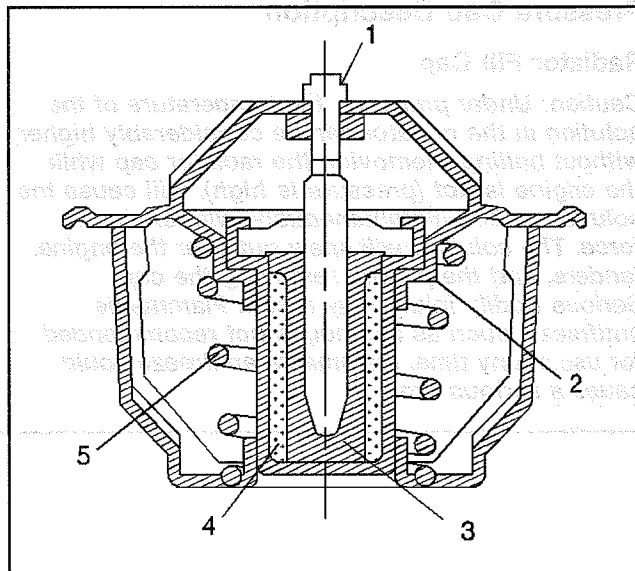
The impeller shaft is supported on one or more bearings. A seal prevents coolant from leaking out around the bearings. The water pump uses sealed bearings, which never need lubrication. With a sealed bearing, grease cannot leak out, and dirt and water cannot get in.

Thermostat Description

The thermostat is a coolant flow control components that utilizes a temperature sensitive wax-pellet element (4). Its purpose is to close off the coolant passage when the engine is cold. Now coolant circulation is restricted, causing the engine to reach normal operating temperature more quickly. Also, after warm-up, the thermostat keeps the engine running at a higher temperature than it would without a thermostat. The higher operating temperature improves engine efficiency and reduces exhaust emissions.

The thermostat performs the following functions:

- Controls the flow of coolant through the radiator
- Enables controlled engine warm up
- Assists in coolant temperature control



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The wax pellet element (40 in the thermostat) expands with increasing temperatures, and contracts with decreasing temperatures. The element connects through a piston (1) to a thermostat valve (2). When the element is heated, pressure is exerted against a rubber diaphragm (3) which forces the thermostat valve to open. As the element is cooled, the contraction allows a spring (5) to close the thermostat valve. While the coolant is cold, the thermostat valve remains closed. This prevents circulation of coolant through the radiator. At this point, coolant is only allowed to circulate throughout the engine block and heater core in order to allow the engine to warm quickly. As the engine warms, the element expands and the thermostat valve opens. This permits coolant to flow through the radiator, where the heat dissipates to the atmosphere.

Engine Coolant Temperature Sensor Description

The engine coolant temperature (ECT) sensor is a variable resistance device. The ECT sensor resistance determines the position of the temperature gauge. As the temperature increases, the ECT sensor resistance decreases. This allows for more current to flow through the gauge, causing a higher temperature reading.

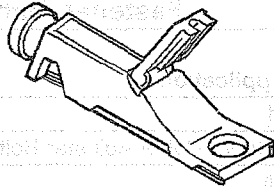
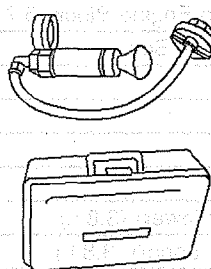
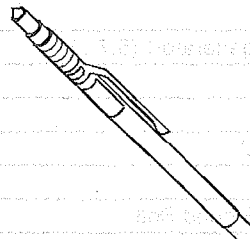
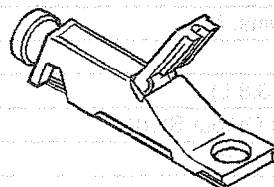
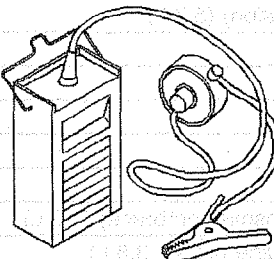
Air Baffles and Seals Description

A deflector redirects air flow. Deflectors are installed under the vehicle and redirects the air flow beneath the vehicle to flow through the cooling system. The deflectors perform the following functions:

- Reduce drag
- Prevent front end lift
- Increase radiator cooling

Air baffles are used to direct air into the radiator and A/C condenser. Air seals ensure that air passes through, and does not bypass, the radiator and the A/C condenser. A missing, damaged, or incorrectly installed baffle or seal may cause the engine to overheat.

Special Tools and Equipment

Illustration	Tool Number/ Description
 1409	J 23688 Coolant Tester (Fahrenheit Scale)
 1405	J 24460-01 Cooling System and Cap Pressure Tester
 23570	J 24731 Tempil Stick
 12869	J 26568 Coolant Tester (Celsius Scale)
 3413	J 36660 Torque Angle Meter