

2006 Chevrolet HHR LT

2006 ENGINE Engine Cooling - HHR

2006 ENGINE

Engine Cooling - HHR

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

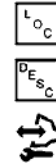
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Heater Bolt	10 N.m	89 lb in
Coolant Reservoir Bolt	9 N.m	80 lb in
Condenser Bolt (11516490)	20 N.m	15 lb ft
Exhaust Heat Shield Stud	22 N.m	167 lb ft
Radiator Bracket Upper Bolt	9 N.m	80 lb in
Radiator Support Lower Bolt	34 N.m	25 lb ft
Thermostat Housing Bolt	10 N.m	89 lb in
Thermostat Housing Cover Bolt	10 N.m	89 lb in
Water Pump Access Plate Bolt	10 N.m	89 lb in
Water Pump Bolt	25 N.m	18 lb ft
Water Pump Sprocket Bolt	10 N.m	89 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

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COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

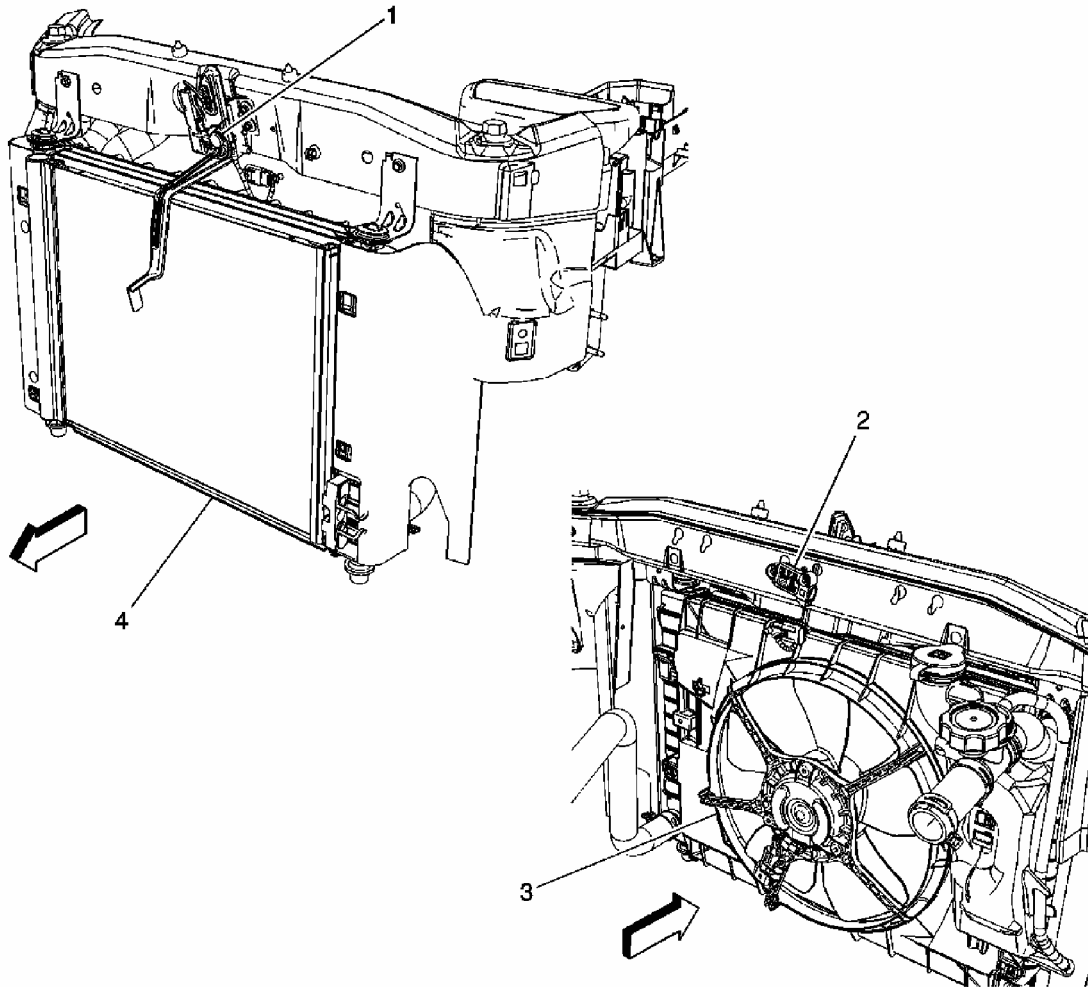


Fig. 2: Front of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Hood Ajar Switch (AP3)
2	Inflatable Restraint Front End Sensor
3	Engine Cooling Fan
4	Radiator

COOLING SYSTEM CONNECTOR END VIEWS

Engine Cooling Fan

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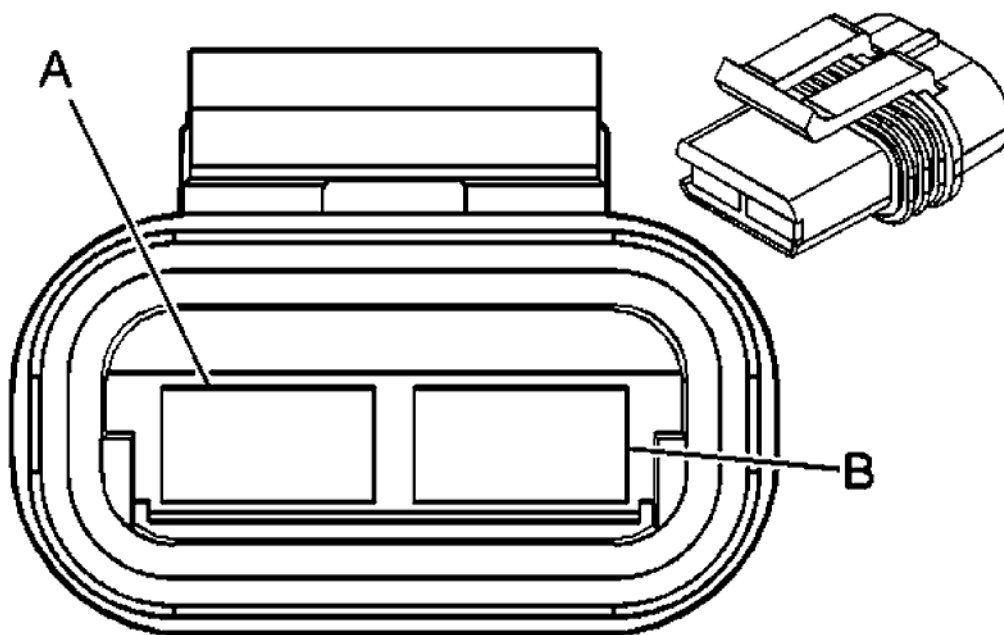


Fig. 3: Engine Cooling Fan Connector
Courtesy of GENERAL MOTORS CORP.

Cooling System Connector End Views

Connector Part Information

- OEM: 12033769
- Service: 12101917
- Description: 2-Way F Metri-Pack 630 Series, Sealed, Pull To Seat (BK)

Terminal Part Information

- Pins:
- Terminal:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Engine Cooling Fan

Pin	Wire Color	Circuit No.	Function
A	BK	1050	Ground
B	L-BU	409	Cooling Fan Motor Supply Voltage (1)

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DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0480 or P0481	** MULTIPLE VALUES **
DTC P1258	Engine Coolant Over Temperature - Fuel Disabled

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the diagnostic system check. Refer to **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check - Vehicle will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuits
- The identification of any stored DTCs and their status

The use of the Diagnostic System Check - Vehicle will identify the correct procedure for diagnosing the system and where the procedure is located.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls 2.2L L61 / 2.4L LE5

Scan Tool Output Control	Additional Menu Selections	Description
Cooling Fan Relay	Engine Output Controls	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the engine controller and activate or deactivate the cooling fan relay, manually turning the fan On and Off.

SCAN TOOL DATA LIST

Engine Control Module (ECM) 2.2L L61 / 2.4L LE5

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition Switch in RUN/Engine running/Automatic Transmission in PARK/Air Conditioner is OFF			
ECT	HVAC Data	°C/°F	Varies
FC Relay 1 Command	HVAC Data	ON/OFF	OFF

SCAN TOOL DATA DEFINITIONS

ECT

The scan tool displays -40 to +151°C (-40 to +304°F). The engine coolant temperature (ECT) sensor is mounted in the coolant stream. The engine control module (ECM) applies 5 volts to the ECT sensor signal circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold and the internal resistance is high, the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms and the internal resistance decreases, the voltage signal decreases and the ECM interprets the lower voltage as a warm engine.

FC Relay 1 Command

The cooling fan relay is commanded ON or OFF by the ECM.

DTC P0480 OR P0481

Circuit Description

Battery positive voltage is supplied to the cooling fan relay through the 30 A cooling fan fuse located in the underhood fuse block. The engine control module (ECM) controls the cooling fan relay by grounding the cooling fan relay control circuit through an internal solid state device called a driver. The primary function of the driver is to supply the ground for the component being controlled. Each driver has a fault line which is monitored by the ECM. When the ECM is commanding a component ON, the voltage potential of the control circuit should be low, near 0 volts. When the ECM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be high, near battery voltage. If the fault detection circuit senses a voltage other than what is expected, the DTC will set.

The ECM will monitor the control circuit for the following conditions:

- A short to ground
- A short to voltage
- An open circuit
- An open relay coil
- An internally shorted or excessively low resistance relay coil.

When the ECM detects any of the above conditions, the DTC will set and the affected driver will be disabled.

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- P0480 is for the low speed cooling fan relay control circuit.
- P0481 is for the high speed cooling fan relay control circuit.

Conditions for Running the DTC

- The ignition is ON.
- The battery voltage is more than 9 volts.

Conditions for Setting the DTC

- The ECM detects an open, a short to ground, or a short to voltage on the cooling fan relay control circuit.
- The condition must be present for a minimum of 6 seconds.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test has been run and failed.
- The ECM will store conditions which were present when the DTC set as Freeze Frame and Failure Records data.

Conditions for Clearing the MIL/DTC

- The ECM will turn OFF the MIL during the third consecutive trip in which the diagnostic has been run and passed.
- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool.

Diagnostic Aids

- If the condition is not present, refer to **Testing for Intermittent Conditions and Poor Connections**.
- Review the Freeze Frame/Failure Records vehicle mileage since the diagnostic test last failed. This may help determine how often the condition that caused the DTC to be set occurs.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- 2:** Listen for an audible click when the cooling fan relay operates. Command both the ON and OFF states. Repeat the commands as necessary.
- 3:** This step tests for voltage at the coil side of the cooling fan relay. The cool fan fuse supplies power to the cooling fan relay.
- 4:** This step verifies that the ECM is providing ground to the cooling fan relay.
- 5:** This step tests if ground is constantly being applied to the cooling fan relay.

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DTC P0480 or P0481

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Relay ON and OFF. Does the cooling fan relay turn ON and OFF with each command?	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the cooling fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the cooling fan relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Step 4	Go to Step 8
4	1. Connect a test lamp between the control circuit of the cooling fan relay and the battery positive voltage circuit of the cooling fan relay. 2. With a scan tool, command the Fan Relay ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to Step 10	Go to Step 5
5	Does the test lamp remain illuminated with each command?	Go to Step 7	Go to Step 6
6	Test the control circuit of the cooling fan relay for a short to voltage or an open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 14	Go to Step 9

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7	Test the control circuit of the cooling fan relay for a short to ground. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	Go to Step 14	Go to Step 9
8	Test the battery positive voltage circuit of the cooling fan relay for a short to ground or an open. Refer to Circuit Testing and Wiring Repairs . Did you complete the repair?	Go to Step 14	Go to Step 11
9	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	Go to Step 14	Go to Step 13
10	Inspect for poor connections at the cooling fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	Go to Step 14	Go to Step 12
11	Repair the cooling fan motor supply voltage circuit for a short to ground. Refer to Wiring Repairs . Did you complete the repair?	Go to Step 14	-
12	Replace the cooling fan relay. Did you complete the replacement?	Go to Step 14	-
13	Replace the ECM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	Go to Step 13	-
14	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	Go to Step 2	System OK

DTC P1258

Circuit Description

The engine control module (ECM) uses the engine coolant temperature (ECT) sensor to

monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 125°C (257°F). When an over temperature condition is present, DTC P1258 will set. The ECM will disable 2 groups of cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the ECM is able to reduce the temperature of the coolant.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1258 Engine Coolant Over Temperature - Fuel Disabled

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The ECM detects an engine metal over temperature.
- The above condition is present for at least 8 seconds.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The ECM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The body control module (BCM) may also signal the driver information center (DIC) to turn on the message HOT COOLANT TEMP.
- The ECM will alternately disable 2 groups of cylinders by turning OFF the fuel injectors.
- The ECM will store conditions which were present when the DTC set as Freeze Frame and File Records data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

- The ECM will turn the MIL OFF after 3 consecutive trips that the diagnostic has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

DTC P1258

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Step	Action	Yes	No
Connector End View Reference: <u>Cooling System Connector End Views</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Check the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to <u>Engine Overheating</u>	Go to <u>Symptoms - Engine Cooling</u>

SYMPTOMS - ENGINE COOLING

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions. Refer to Cooling System Description and Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to Checking Aftermarket Accessories .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the surge tank reservoir for the proper coolant level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .

Symptom List

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

- Cooling Fan Always On
- Cooling Fan Inoperative
- Engine Overheating
- Loss of Coolant
- Thermostat Diagnosis
- Coolant Heater Inoperative
- Engine Fails To Reach Normal Operating Temperature

COOLING FAN ALWAYS ON

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Cooling Fan Always On

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics Connector End View Reference: Cooling System Connector End Views DEFINITION: The engine cooling fan motor runs continuously.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Turn ON the ignition, with the engine OFF. Is the engine cooling fan running all the time?	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections
3	Remove the cooling fan relay. Did the cooling fan turn OFF?	Go to Step 5	Go to Step 4
4	Repair the short to B+ in the cooling fan motor supply voltage circuit. Refer to Wiring Repairs . Did you complete the repair?	Go to Step 7	-
5	Inspect for poor connections at the cooling fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	Go to Step 7	Go to Step 6
6	Replace the cooling fan relay. Did you complete the repair?	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

COOLING FAN INOPERATIVE**Cooling Fan Inoperative**

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics Connector End View Reference: Cooling System Connector End Views DEFINITION: The engine cooling fan motor does not operate.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
	1. Install a scan tool.		

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2	2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the cooling fan ON and OFF. Does the engine cooling fan turn ON and OFF with each command?	Go to Testing for Intermittent Conditions and Poor Connections	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the cooling fan relay. 3. Probe the battery positive voltage circuit of the cooling fan relay switch side with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Step 4	Go to Step 7
4	Connect a 20-amp fused jumper wire between the battery positive voltage circuit of the cooling fan relay and the cooling fan motor supply voltage circuit of the cooling fan relay. Does the cooling fan operate?	Go to Step 10	Go to Step 5
5	1. Disconnect the cooling fan connector. 2. Probe the cooling fan motor supply voltage circuit at the harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 8
6	Probe the harness connector of the cooling fan motor with a test lamp connected between the cooling fan motor supply voltage circuit and the ground circuit of the cooling fan motor. Does the test lamp illuminate?	Go to Step 11	Go to Step 9
7	Repair the battery positive circuit of the cooling fan relay. Refer to Circuit Testing and Wiring Repairs. Did you complete the repair?	Go to Step 14	-
8	Repair the supply voltage circuit of the cooling fan motor. Refer to Circuit Testing and Wiring Repairs.		

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	Did you complete the repair?	Go to Step 14	-
9	Repair the ground circuit of the cooling fan motor. Refer to Circuit Testing and Wiring Repairs . Did you complete the repair?	Go to Step 14	-
10	Inspect for poor connections at the cooling fan relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	Go to Step 14	Go to Step 12
11	Inspect for poor connections at the harness connector of the cooling fan motor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	Go to Step 14	Go to Step 13
12	Replace the cooling fan relay. Did you complete the repair?	Go to Step 14	-
13	Replace the cooling fan motor. Refer to Cooling Fan and Shroud Replacement . Did you complete the repair?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

ENGINE OVERHEATING**Engine Overheating**

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gage shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			
1	Check for a loss of coolant. Refer to Loss of Coolant . Is there a loss of coolant?	Go to Step 2	Go to Step 3
2	Fill the system to the specified level. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill) . Does the engine still overheat?	Go to Step 3	System OK
3	Check for kinked or pinched surge tank hoses, especially at the radiator.		

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	Are any surge tank hoses kinked or pinched?	Go to Step 4	Go to Step 5
4	1. Relieve any kinks by rerouting the hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to Step 5	System OK
5	Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors?	Go to Step 6	Go to Step 7
6	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to Step 7	System OK
7	Check the coolant concentration. Does the coolant concentration test correctly?	Go to Step 9	Go to Step 8
8	Replace the coolant, if necessary. Refer to <u>Draining and Filling Cooling System (Static Fill)</u> or <u>Draining and Filling Cooling System (GE 47716 Fill)</u> . Does the engine still overheat?	Go to Step 9	System OK
9	IMPORTANT: Use the correct pressure cap. Check the system for loss of pressure. Is there a loss of pressure?	Go to Step 10	Go to Step 11
10	Repair any leaks, as necessary. Does the engine still overheat?	Go to Step 11	System OK
11	Check for a faulty engine coolant temperature (ECT) sensor. Is the ECT sensor faulty?	Go to Step 12	Go to Step 13
12	Replace the ECT sensor. Refer to one of the following: • <u>Engine Coolant Temperature (ECT) Sensor Replacement</u> • <u>Engine Coolant Temperature (ECT) Sensor Replacement</u> Does the engine still overheat?	Go to Step 13	System OK
	Check the radiator for any air flow		

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13	obstructions or bent fins. Is there any airflow obstruction or bent fins?	Go to Step 14	Go to Step 15
14	1. Remove or relocate add-on parts that block air flow to the radiator. 2. Clean any debris from the radiator core. Does the engine still overheat?	Go to Step 15	System OK
15	Check for any blocked cooling system passages. Are there any blocked cooling system passages?	Go to Step 16	Go to Step 17
16	1. Remove any obstruction. 2. Flush the cooling system as required. Refer to Coolant System Flushing . 3. Refill the coolant. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill) . Does the engine still overheat?	Go to Step 17	System OK
17	Check for an inoperative cooling fan. Is the cooling fan inoperative?	Go to Step 18	Go to Step 19
18	Replace the cooling fan. Refer to Cooling Fan and Shroud Replacement . Does the engine still overheat?	Go to Step 19	System OK
19	Check for a thermostat that is stuck closed. Is the thermostat stuck closed?	Go to Step 20	Go to Step 21
20	Replace the thermostat. Refer to Thermostat Replacement (RPO L61) or Thermostat Replacement (RPO LE5) . Does the engine still overheat?	Go to Step 21	System OK
21	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to Step 22	-
22	Replace the water pump. Refer to Water Pump Replacement . Does the engine still overheat?	-	System OK

LOSS OF COOLANT

Loss of Coolant

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Step	Action	Yes	No
DEFINITION: The cooling system is loosing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill) . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 26
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 27	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 29	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 28	Go to Step 10
	With the engine idling, inspect the coolant recovery system.		

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10	Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • The coolant surge tank • The heater core • The radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 20	Go to Step 12
12	Visually inspect the following components: • The coolant pressure cap • The core plugs • The cylinder head gaskets • The engine block • The intake manifold • The radiator • The thermostat housing • The water pump Are any of the listed components leaking?	Go to Step 20	Go to Step 13
13	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 20	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 21
15	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 30	Go to Step 21
	Inspect for the following conditions: • A coolant smell inside of the vehicle		

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16	• Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering near the HVAC module Is coolant present?	Go to Step 22	Go to Step 17
17	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is a milky substance under the oil fill cap?	Go to Step 18	Go to Step 19
18	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is a milky substance on the engine oil fluid level indicator?	Go to Step 28	Go to Step 19
19	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 23	Go to Step 31
20	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 31	-
21	Replace the coolant pressure cap. Is the repair complete?	Go to Step 31	-
22	Replace the heater core. Refer to Heater Core Replacement. Is the repair complete?	Go to Step 31	-
23	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to Cooling System Leak Testing. 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to Step 24	Go to Step 25
24	1. Replace the radiator. Refer to Radiator Replacement. 2. Service the automatic transmission. Refer to Engine Coolant/Water in Transmission.		-

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	Is the repair complete?	Go to Step 31	
25	Install the cooler lines to the radiator. Is the action complete?	Go to Step 31	-
26	Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 2.2L (L61) engine or <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 2.4L (LE5) engine. Is the repair complete?	Go to Step 31	-
27	Repair the engine overheating condition. Refer to <u>Engine Overheating</u> . Is the repair complete?	Go to Step 31	-
28	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> or <u>Coolant in Engine Oil</u> for the 2.2L (L61) engine or <u>Coolant in Combustion Chamber</u> or <u>Coolant in Engine Oil</u> for the 2.4L (LE5) engine. Is the repair complete?	Go to Step 31	-
29	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 2.2L (L61) engine or <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 2.4L (LE5) engine. Is the repair complete?	Go to Step 31	-
30	Repair the combustion pressure in the cooling system problem. Refer to <u>Coolant in Combustion Chamber</u> for the 2.2L (L61) engine or <u>Coolant in Combustion Chamber</u> for the 2.4L (LE5) engine. Is the repair complete?	Go to Step 31	-
31	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS**Thermostat Test Procedure Using Glycol**

Inspect the operation of the thermostat by hanging the thermostat on a hook in a 33 percent glycol solution.

In order to inspect if the thermostat valve is opening properly, perform the following test:

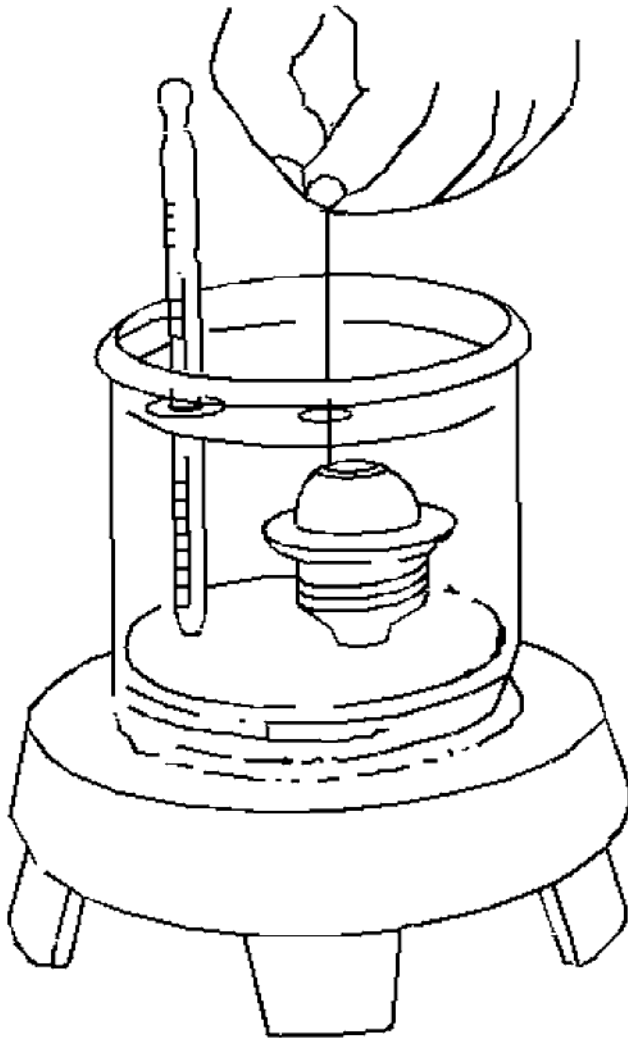


Fig. 4: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS CORP.

1. Completely submerge the thermostat in a glycol solution. The solution should be 11°C (22°F) above the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should open.

In order to inspect if the thermostat valve is closing properly, perform the following test:

1. Completely submerge the thermostat in a glycol solution. The solution should be 6°C (10°F) below the temperature indicated on the thermostat valve.

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2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should close completely.

COOLANT HEATER INOPERATIVE**Coolant Heater Inoperative**

Step	Action	Yes	No
1	Did you perform the necessary inspections?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Test the engine coolant heater power supply cord for an open or short to ground. Refer to Circuit Testing in Wiring Systems. Did you find a condition?	Go to Step 3	Go to Step 4
3	Replace the engine coolant heater power supply cord. Refer to Coolant Heater Cord Replacement . Did you complete the repair?	Go to Step 6	-
4	Inspect for poor connections at the harness connector of the engine coolant heater. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Replace the engine coolant heater. Refer to Coolant Heater Replacement . Did you complete the repair?	Go to Step 6	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE**Engine Fails To Reach Normal Operating Temperature**

Step	Action	Value(s)	Yes	No
1	Check the coolant level in the radiator surge tank. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill) . Is the coolant at the proper level?	-	Go to Step 3	Go to Step 2
	Add coolant to the radiator surge tank as necessary.			

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2	Does the engine still fail to reach normal operating temperatures?	-	Go to Step 3	System OK
3	Check for a blockage in the coolant passages. Are there any blockages in the coolant passages?	-	Go to Step 4	Go to Step 5
4	Flush the cooling system or flow check the radiator. Refer to Coolant System Flushing . Does the engine still fail to reach normal operating temperatures?	-	Go to Step 5	System OK
5	Check to see if the incorrect thermostat was installed or if it is stuck or sticks in the open position. Was the incorrect thermostat installed, or is it stuck or does it stick in the open position?	-	Go to Step 6	-
6	Replace the thermostat. Refer to Thermostat Replacement (RPO L61) or Thermostat Replacement (RPO LE5) . Does the engine still fail to reach normal operating temperature?	-	-	System OK

PRESSURE CAP TESTING**Tools Required**

- **J 24460-01** Cooling System Pressure Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.
- **J 46143** Intercooler Reservoir Cap Test Adapter

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. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

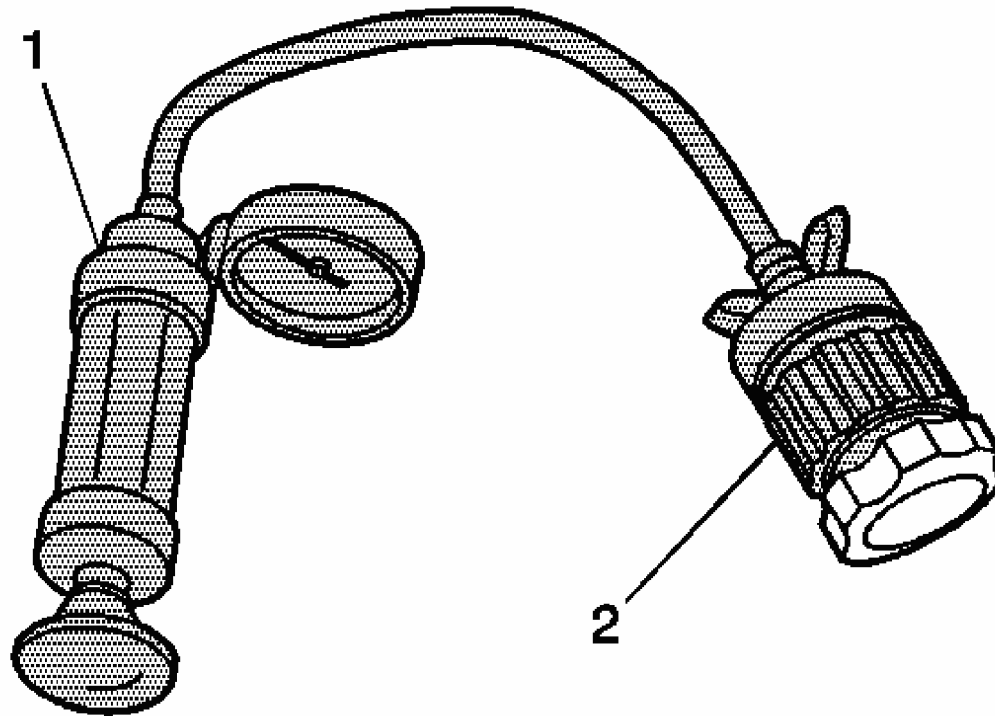


Fig. 5: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

3. Use **J 24460-01** (1) with one of the following attachments (2):. See **Special Tools**.
 - **J 42401** in order to test the radiator cap. See **Special Tools**.
 - **J 46143** in order to test the intercooler reservoir cap
4. Test the pressure cap for the following conditions:
 - Pressure the release when **J 24460-01** exceeds the pressure rating of the pressure cap. See **Special Tools**.
 - Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:
 - The pressure cap does not release the pressure which exceeds the rated pressure of the cap.
 - The pressure cap does not hold the rated pressure.

Tools Required

- **J 24460-01** Cooling System Pressure Tester. See **Special Tools**.
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools**.

Cooling System Leak Testing

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. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

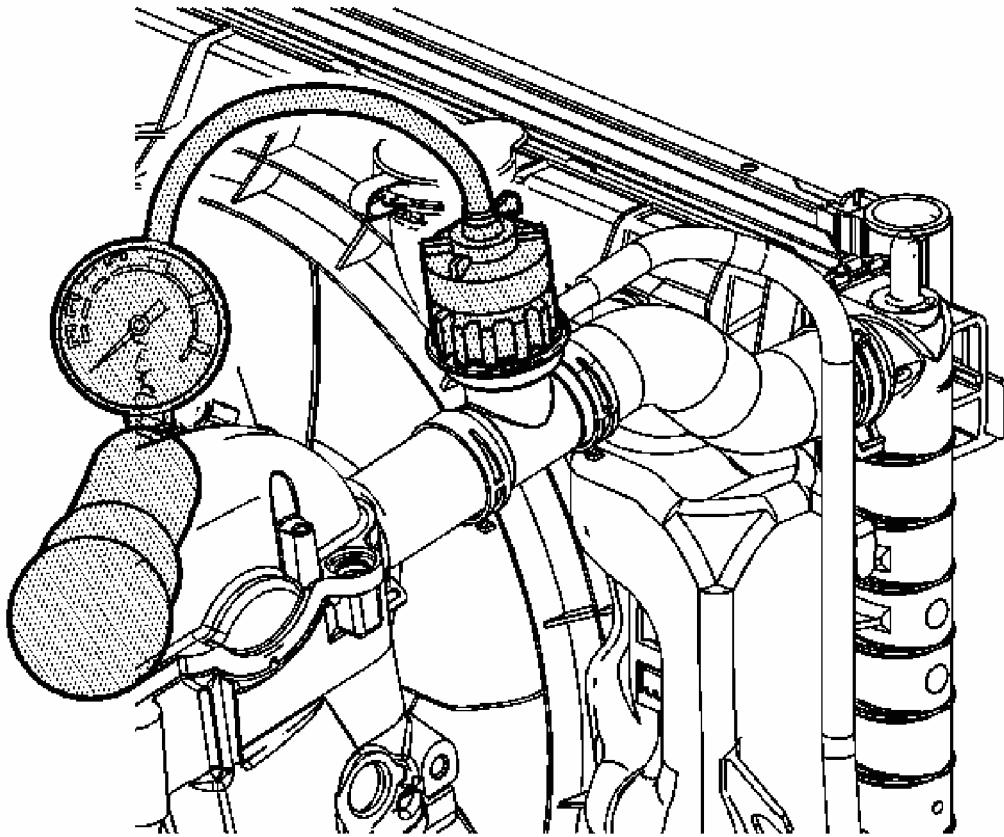


Fig. 6: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS CORP.

4. Use the J 24460-01 with J 42401 in order to apply pressure to the cooling system. See **Special Tools**.

Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

Observe the gage for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

DRAINING AND FILLING COOLING SYSTEM (STATIC FILL)

Tools Required

J 26568 Coolant and Battery Fluid Tester

Draining Procedure

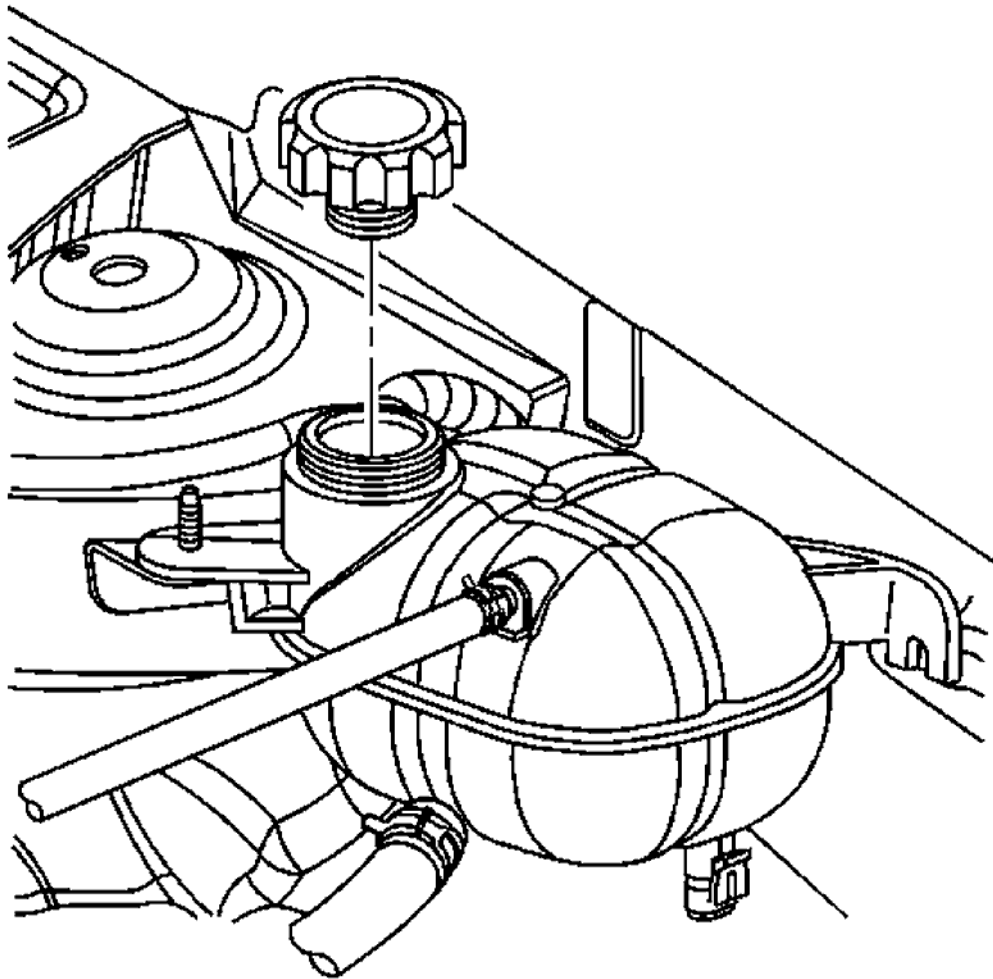


Fig. 7: View Of Surge Tank Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the coolant pressure cap.

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
3. Place a drain pan under the right side lower radiator mount.

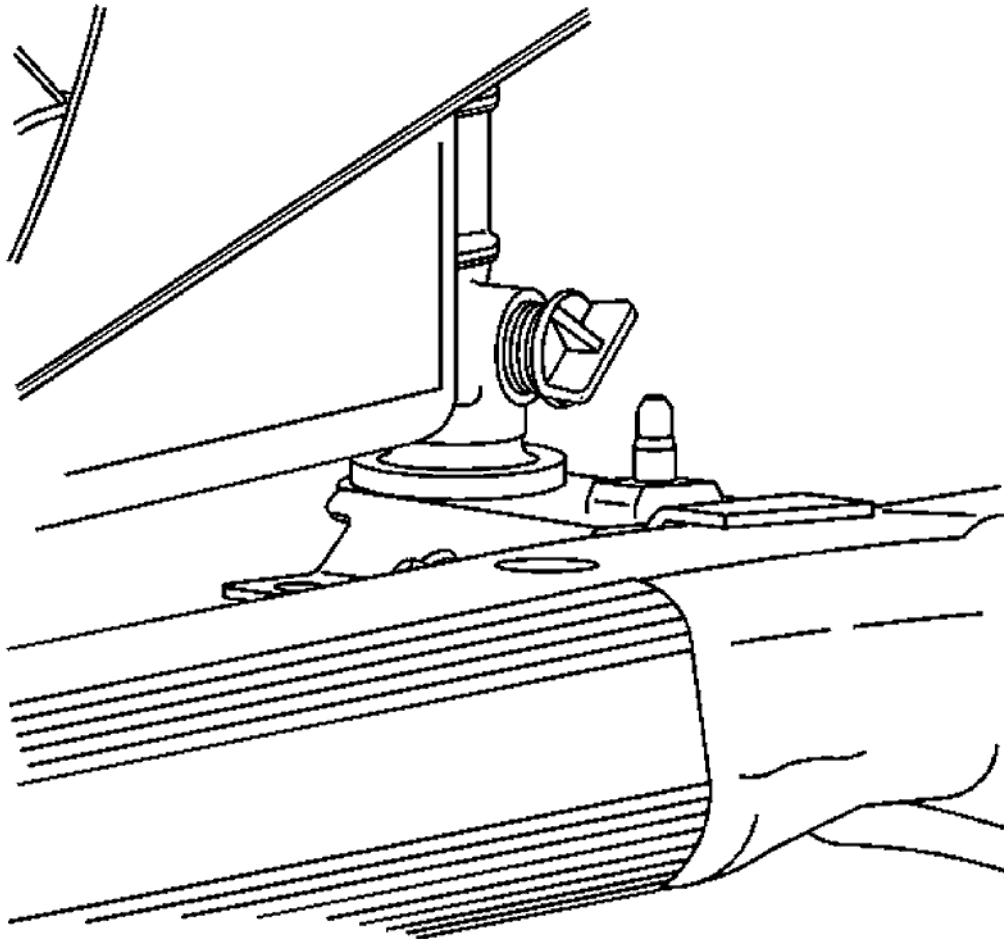


Fig. 8: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

4. Open the radiator drain cock.
5. Drain the cooling system.

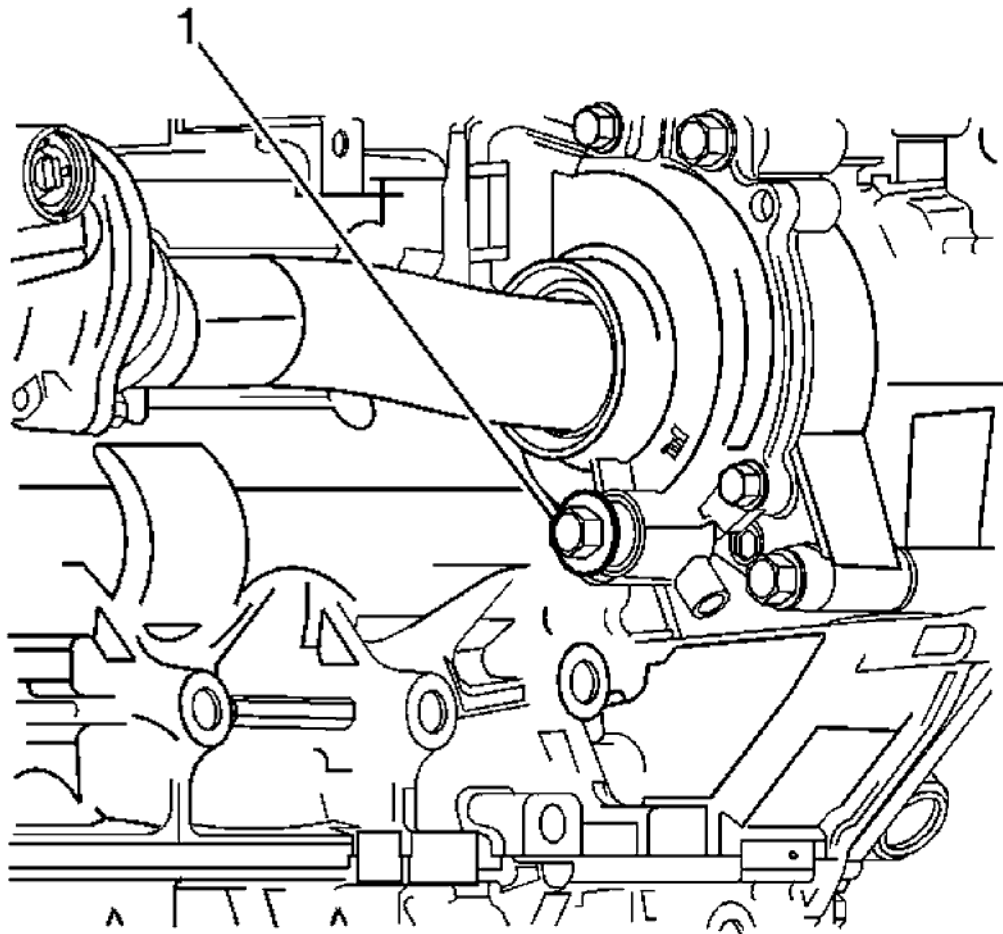


Fig. 9: Locating Water Pump Drain Plug/Bolt
Courtesy of GENERAL MOTORS CORP.

6. If a complete block drain is required, place a drain pan under the water pump drain.
7. Remove the water pump drain plug (1).
8. Drain the cooling system.
9. Inspect the appearance of the engine coolant for discoloration:
 - Discolored-Follow the flush procedure. Refer to **Coolant System Flushing**.
 - Normal in appearance-Follow the filling procedure.

Filling Procedure

NOTE: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition,

causing engine damage.

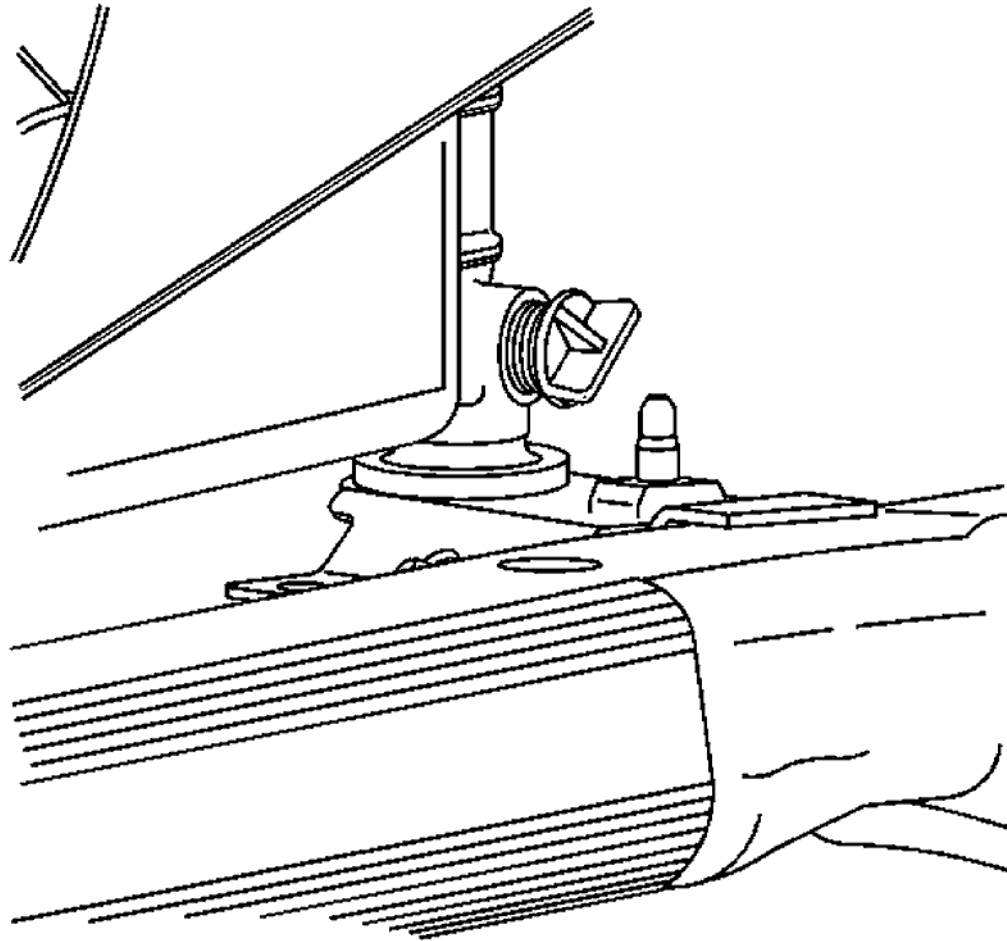


Fig. 10: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

1. Close the radiator drain cock by hand.

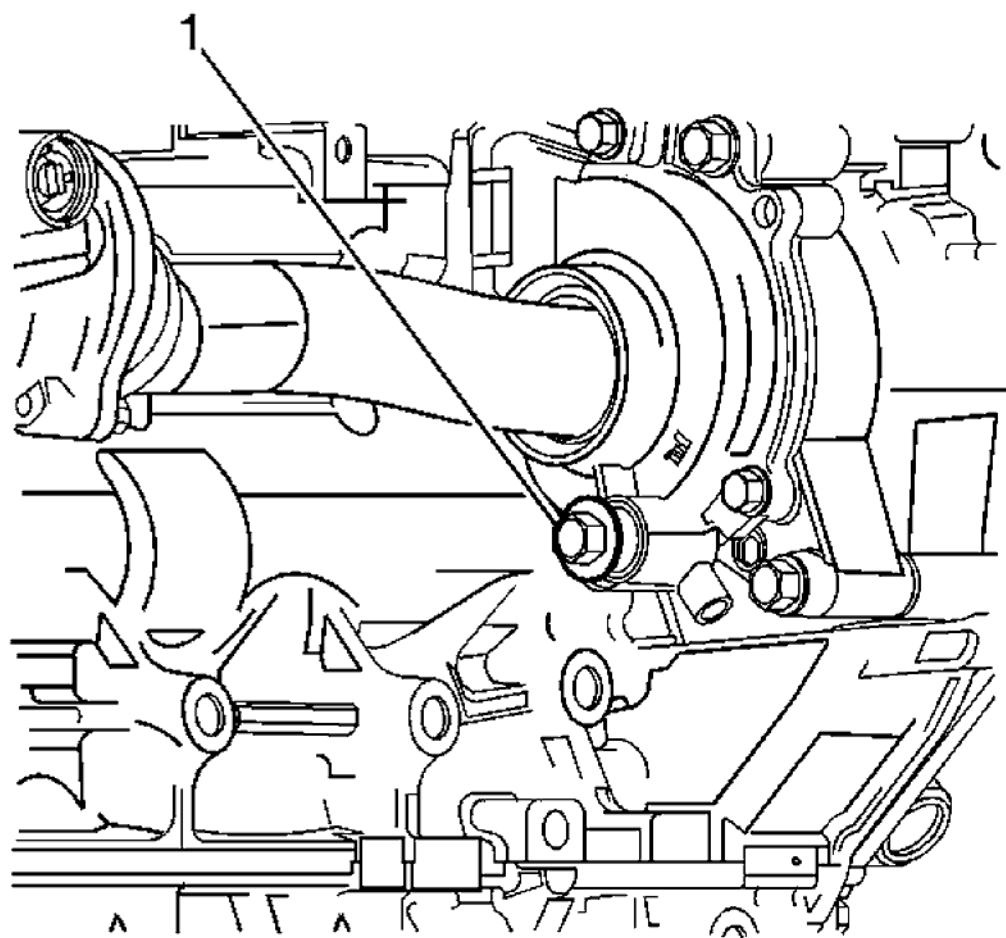


Fig. 11: Locating Water Pump Drain Plug/Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2. Install the water pump drain plug (1) if removed during the draining process.

Tighten: Tighten the plug to 22 N.m (16 lb in).

3. Lower the vehicle.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water. It is necessary to maintain the coolant level near the cold fill line on the surge tank to insure all

the air has been purged from the cooling system.

4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and deionized water to the cooling system until the coolant level reaches and maintains slightly above the cold fill line on the surge tank. Refer to **Capacities - Approximate Fluid** .

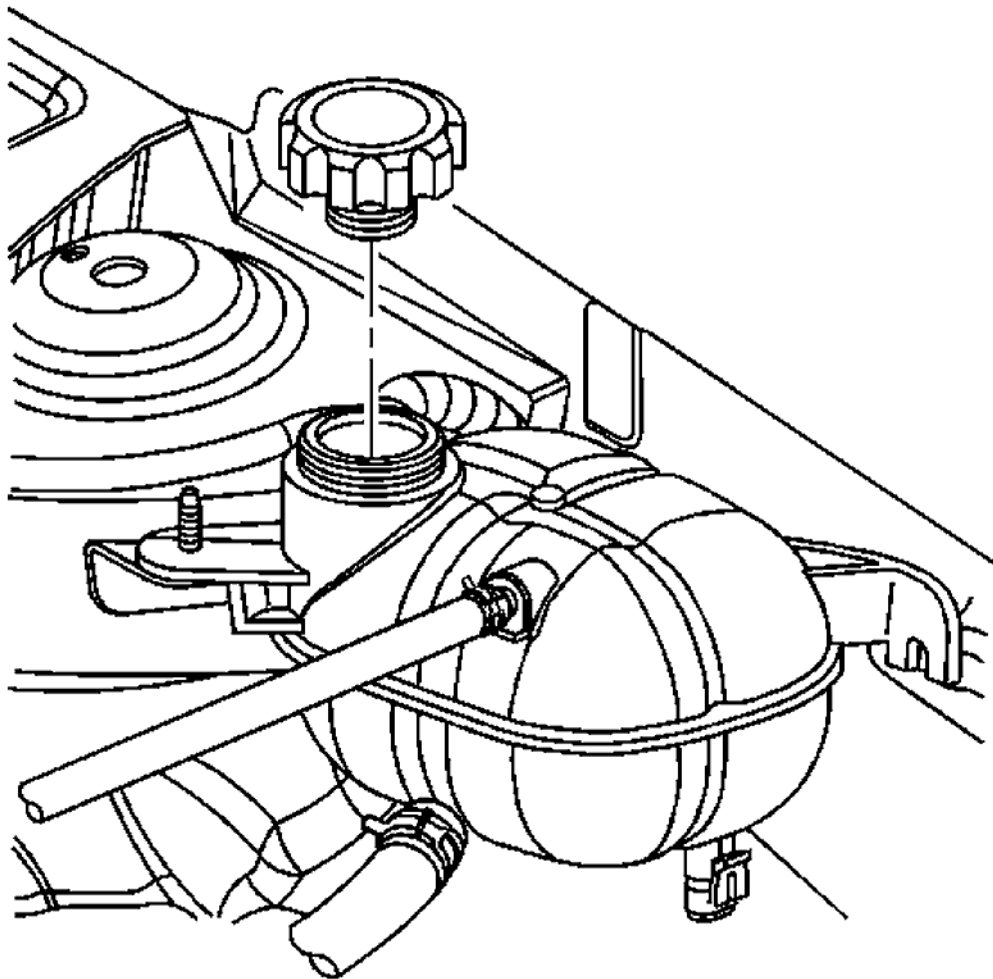


Fig. 12: View Of Surge Tank Cap
Courtesy of GENERAL MOTORS CORP.

5. Install surge tank cap.
6. Start the engine.
7. Run the engine at 2,000-2,500 RPM for 3 minutes.
8. Allow the engine to idle for 30 seconds.

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9. Shut the engine off.
10. Top off the coolant as necessary.
11. Fill the coolant reservoir to the cold fill line.
12. Inspect the cooling system for leaks.
13. Inspect the concentration of the coolant mixture using **J 26568** .
14. Rinse away any excess coolant from the engine and the engine compartment.

DRAINING AND FILLING COOLING SYSTEM (GE 47716 FILL)

Tools Required

- **J 26568** Coolant and Battery Fluid Tester
- **J 42401** Radiator Pressure Adapter. See **Special Tools**.
- **GE-47716** Vac N Fill Coolant Refill Tool

Draining Procedure

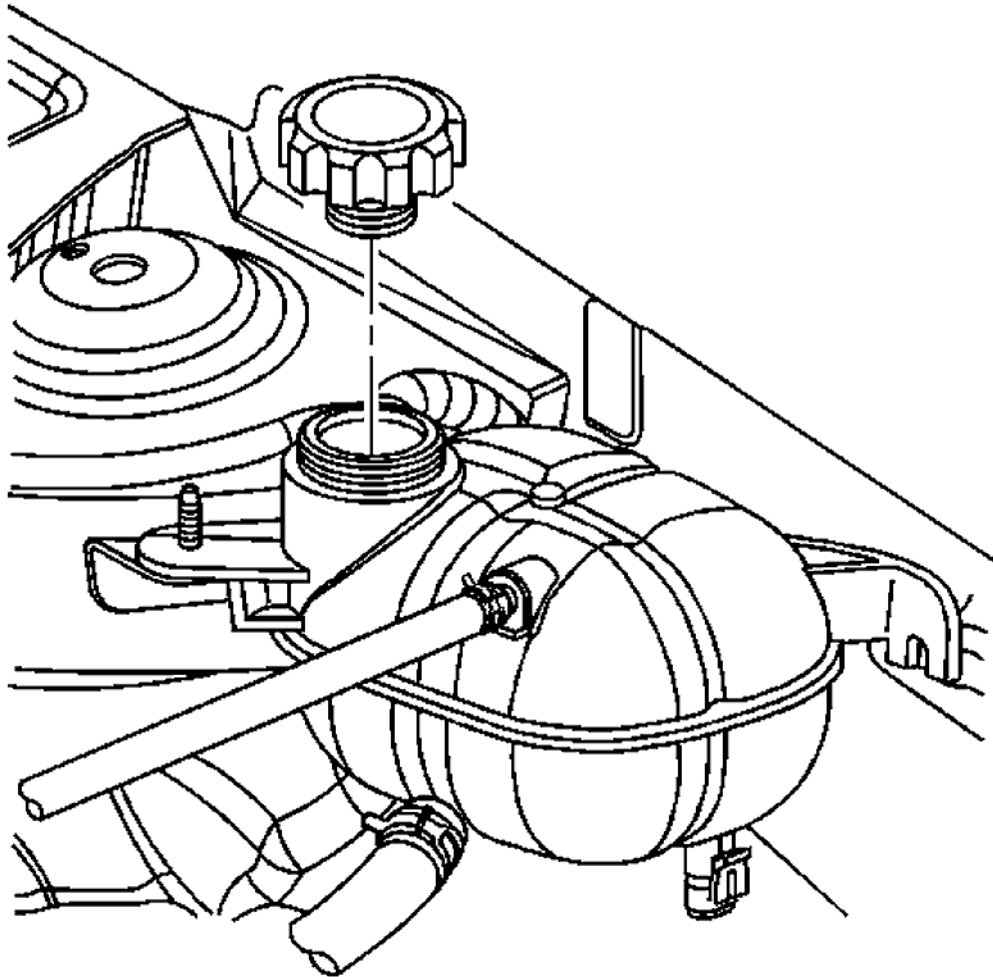


Fig. 13: View Of Surge Tank Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Place a drain pan under the right side lower radiator mount.

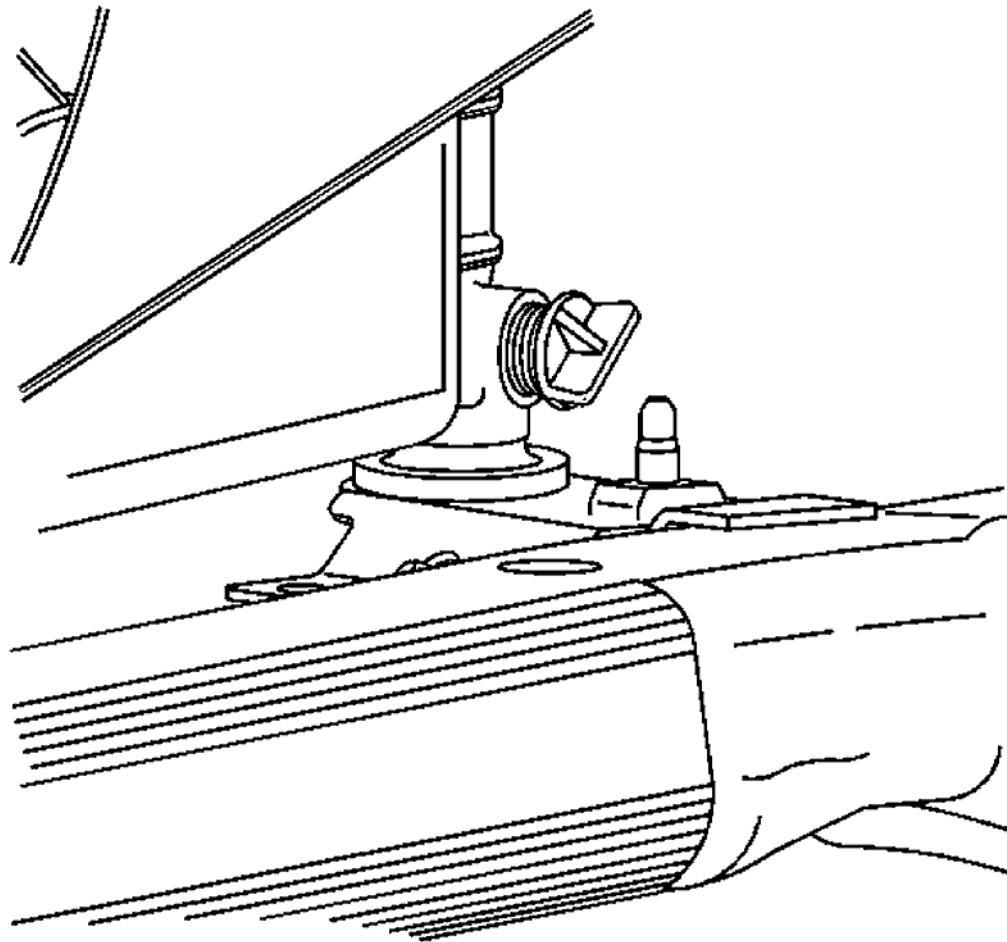


Fig. 14: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

4. Open the radiator drain cock.
5. Drain the cooling system.

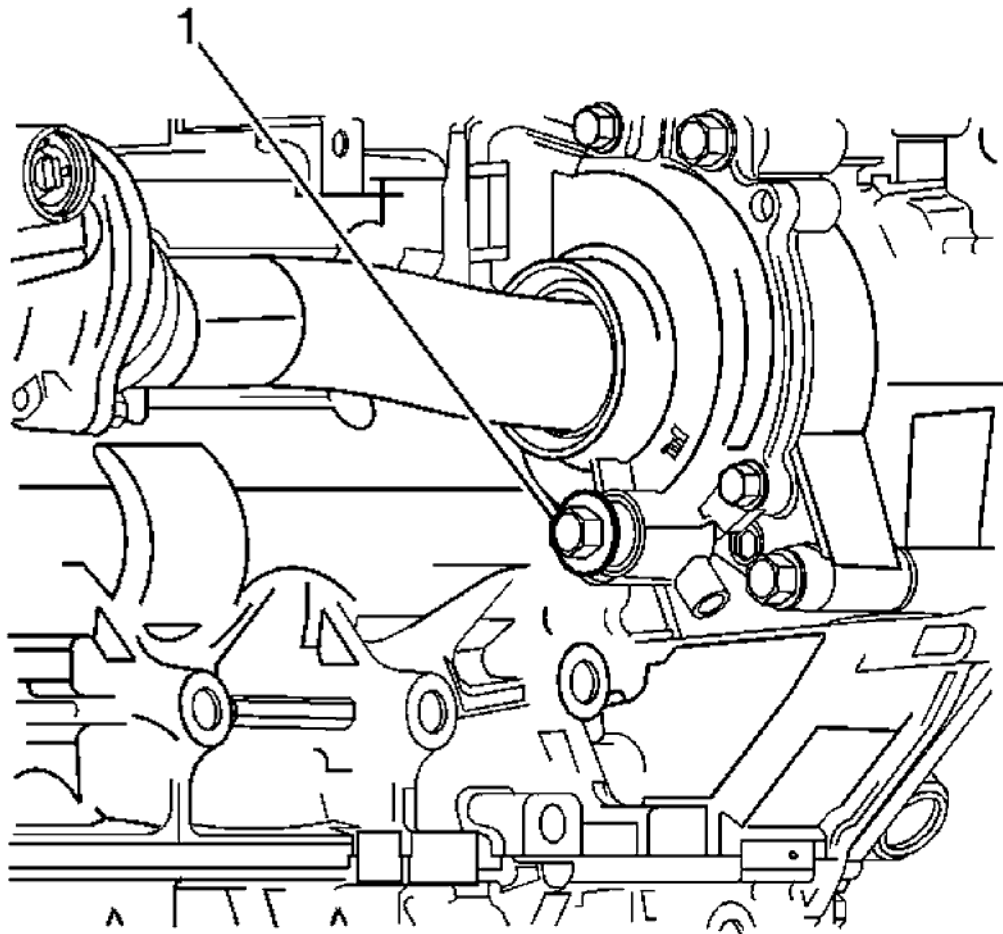


Fig. 15: Locating Water Pump Drain Plug/Bolt
Courtesy of GENERAL MOTORS CORP.

6. If a complete block drain is required, place a drain pan under the water pump drain.
7. Remove the water pump drain plug (1).
8. Drain the cooling system.
9. Inspect the appearance of the engine coolant for discoloration:
 - Discolored-Follow the flush procedure. Refer to **Coolant System Flushing**.
 - Normal in appearance-Follow the filling procedure.

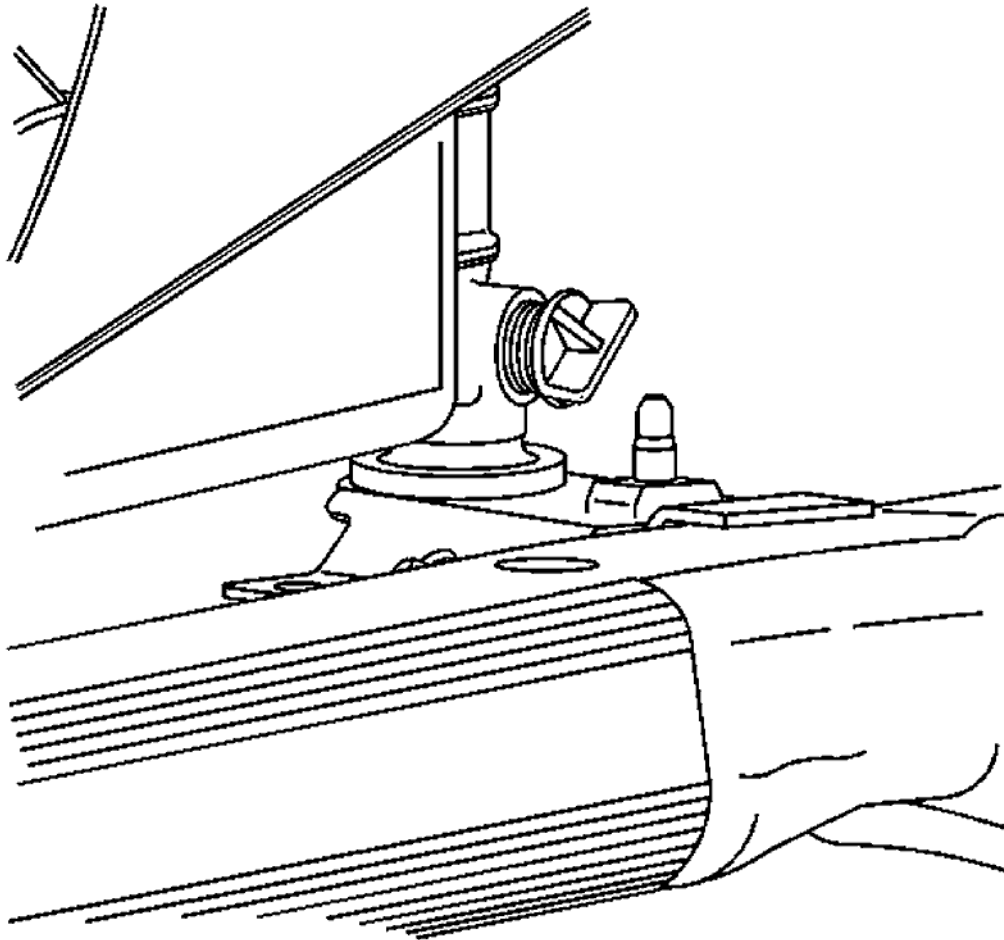


Fig. 16: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

NOTE: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

1. Close the radiator drain cock by hand.

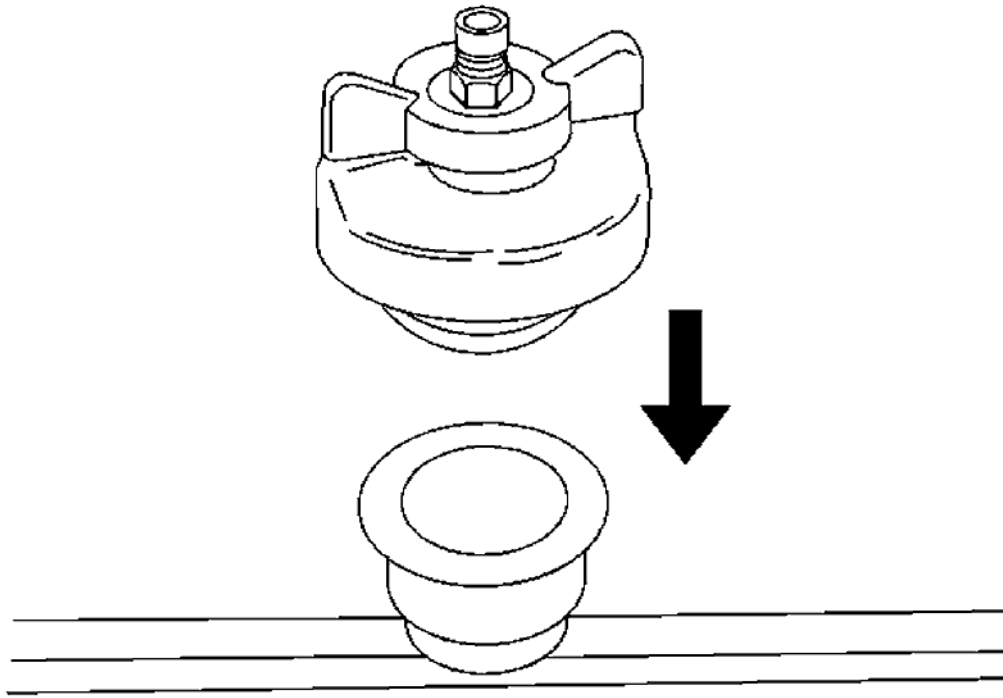


Fig. 17: Vac N Fill Cap

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: To prevent boiling of the coolant/water mixture in the vehicle's cooling system, do not apply vacuum to a cooling system above 49° C (120° F). The tool will not operate properly when the coolant is boiling.

2. Install J-42401-2 into the surge tank fill neck.
3. Install J-42401-3 to the surge tank fill neck.
4. Attach the Vac N Fill cap to the J-42401-3.

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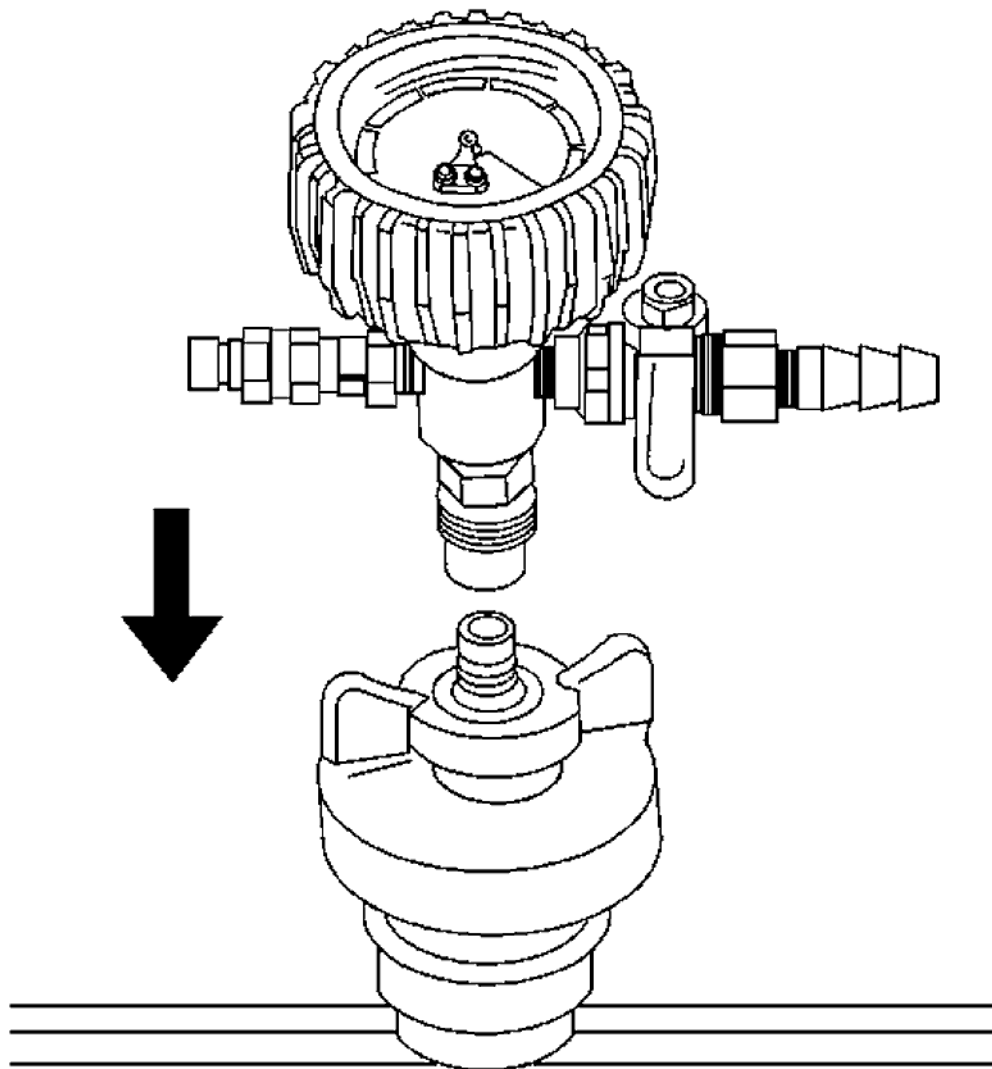


Fig. 18: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

5. Attach the vacuum gage assembly to the Vac N Fill cap.

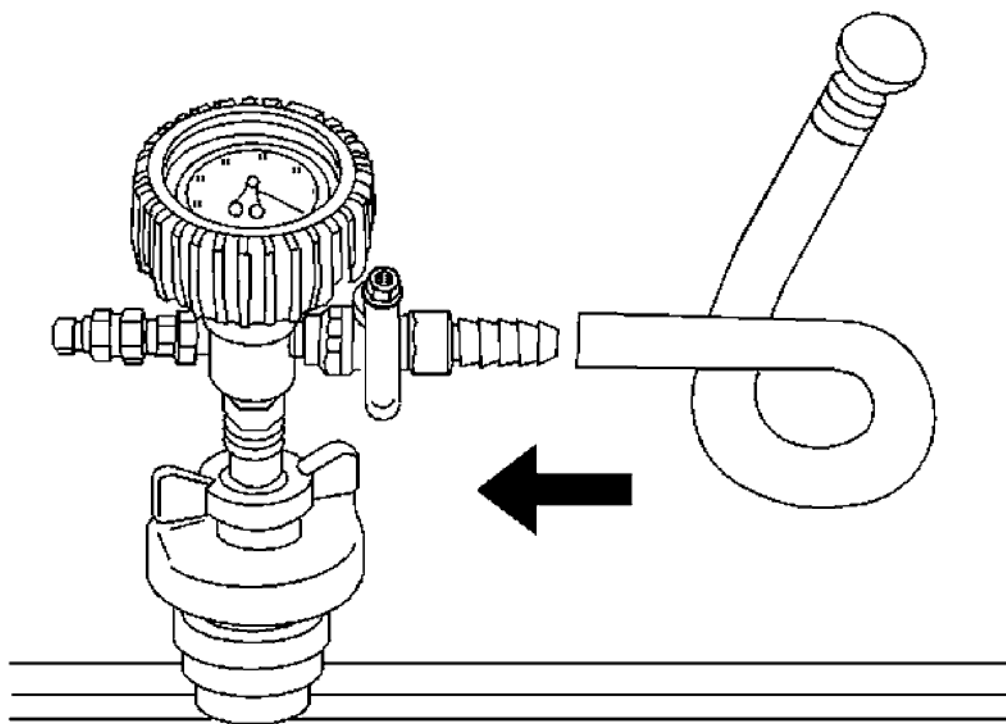


Fig. 19: Fill Hose

Courtesy of GENERAL MOTORS CORP.

6. Attach the fill hose to the barb fitting on the vacuum gage assembly.

Ensure that the valve is closed.

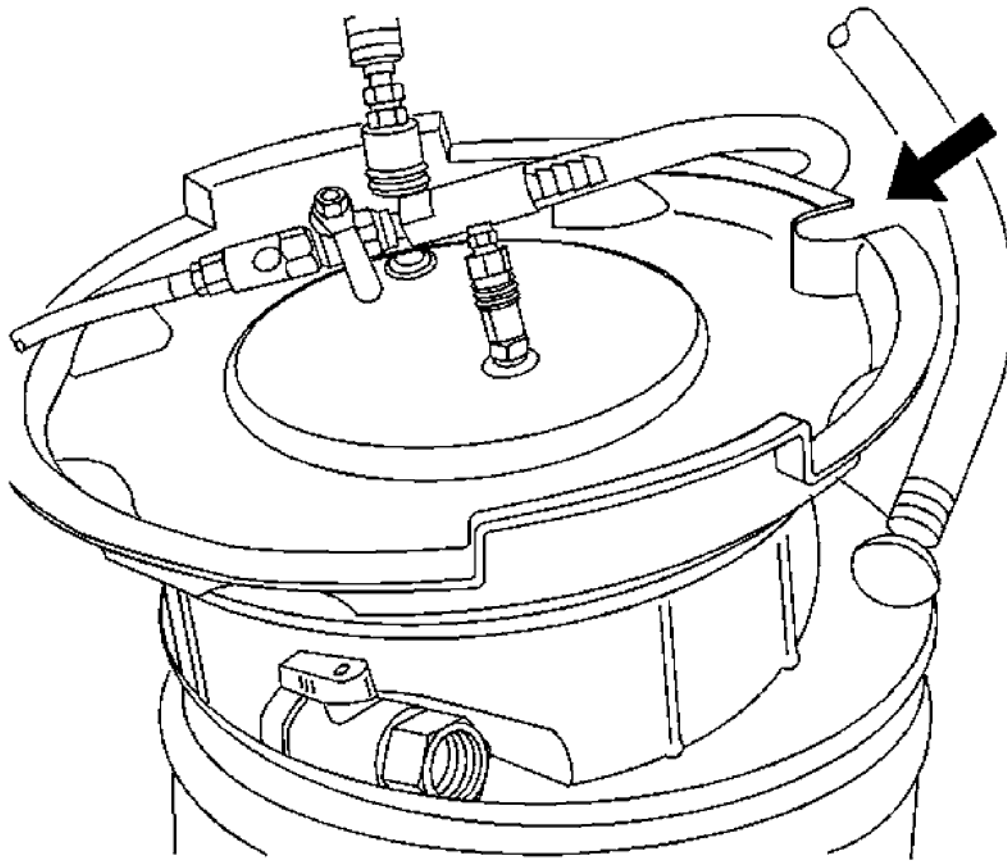


Fig. 20: Graduated Reservoir

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.

Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

7. Pour the coolant mixture into the graduated reservoir.
8. Place the fill hose in the graduated reservoir.

IMPORTANT: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

9. Install the vacuum tank on the graduated reservoir with the fill hose routed through the cut-out area in the vacuum tank.

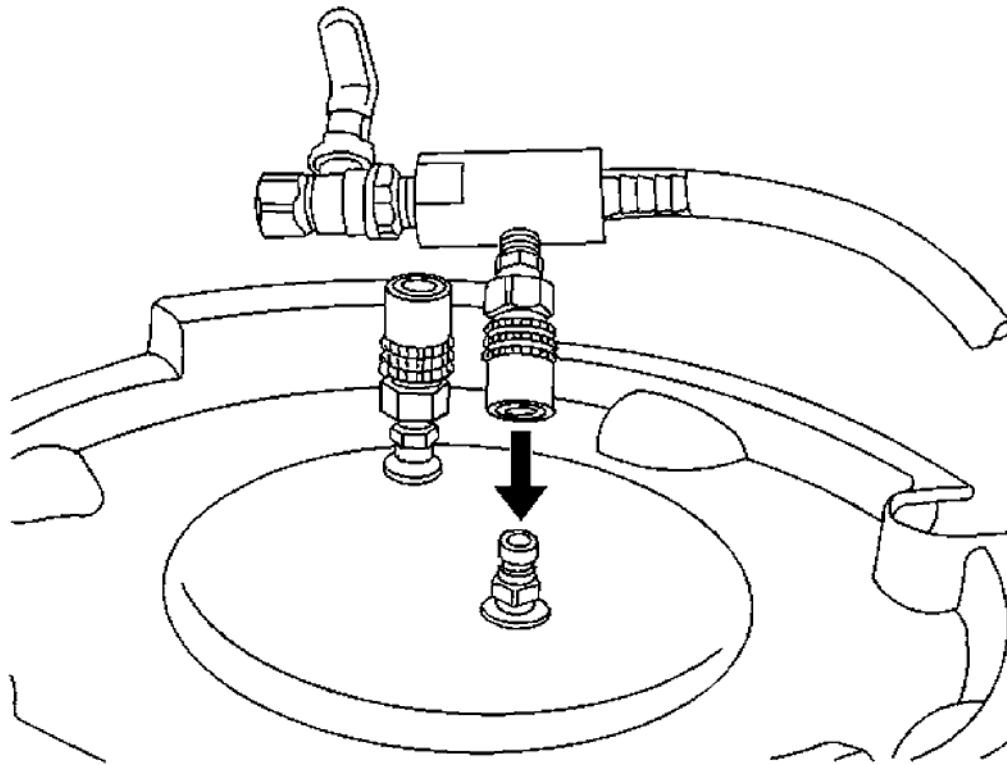


Fig. 21: Attaching Venturi Assembly To Vacuum Tank
Courtesy of GENERAL MOTORS CORP.

10. Attach the venturi assembly to the vacuum tank.

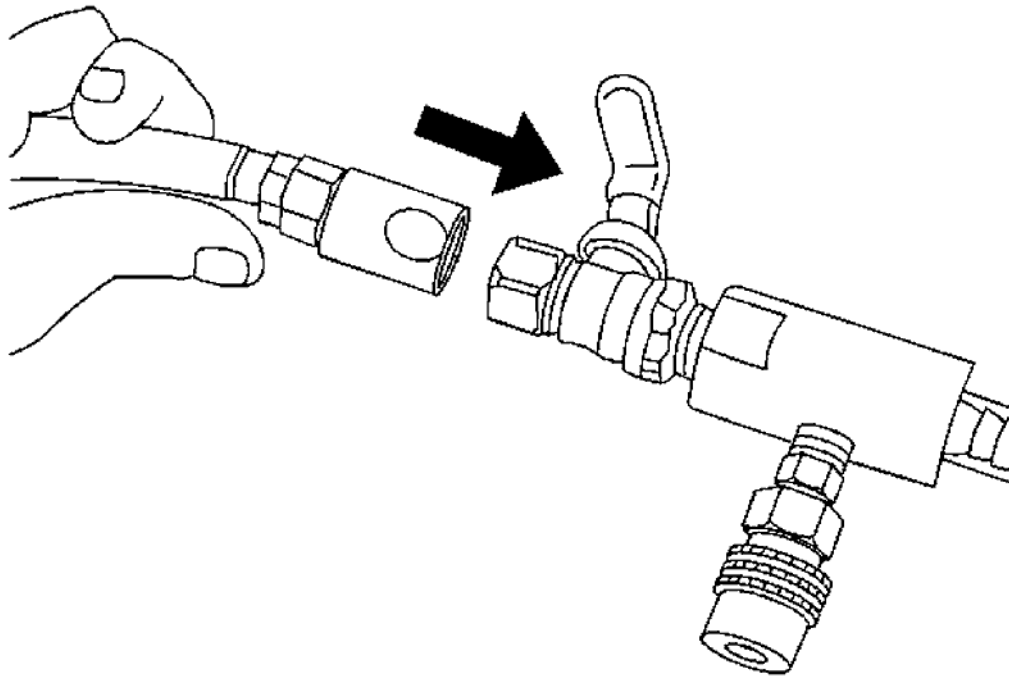


Fig. 22: Shop Air Hose

Courtesy of GENERAL MOTORS CORP.

11. Attach a shop air hose to the venturi assembly.

Ensure the valve on the venturi assembly is closed.

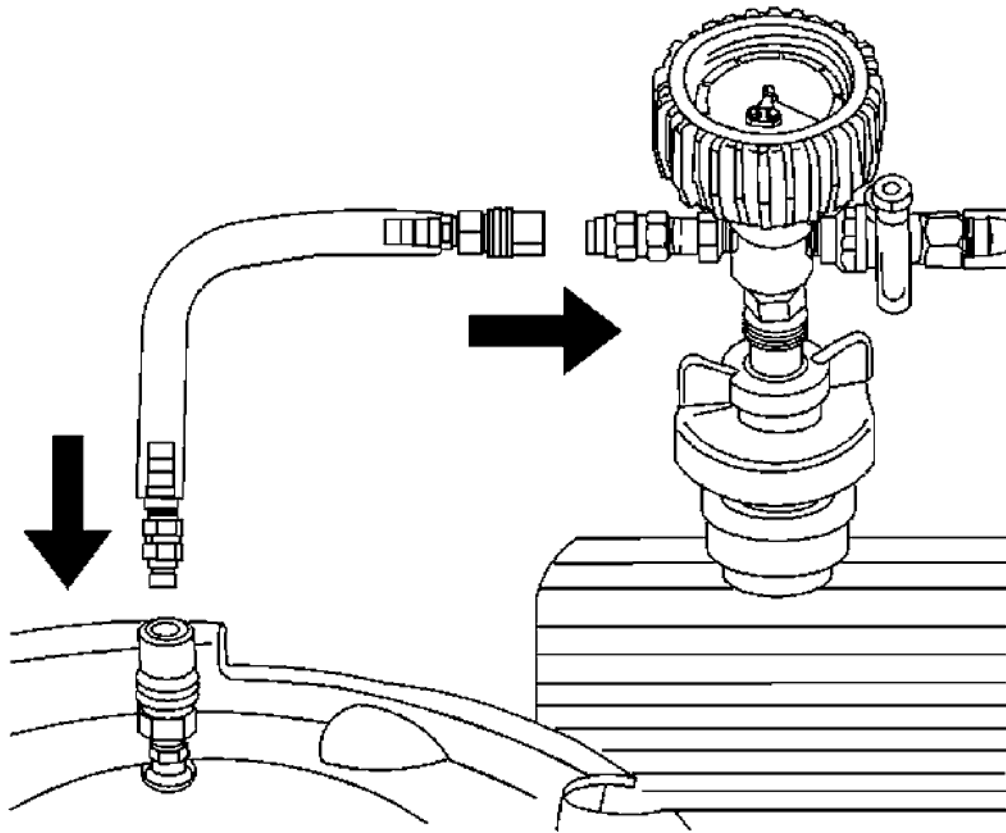


Fig. 23: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

12. Attach the vacuum hose to the vacuum gage assembly and the vacuum tank.

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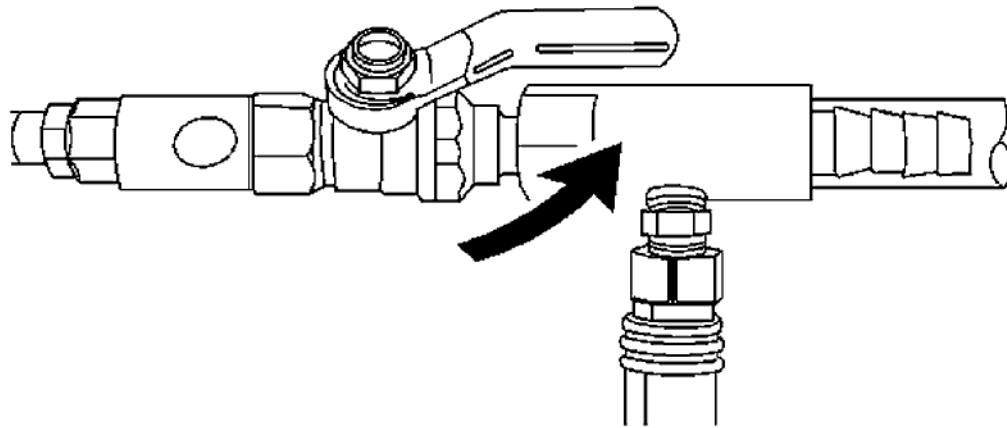


Fig. 24: Control Valve

Courtesy of GENERAL MOTORS CORP.

13. Open the valve on the venturi assembly. The vacuum gage will begin to rise and a hissing noise will be present.

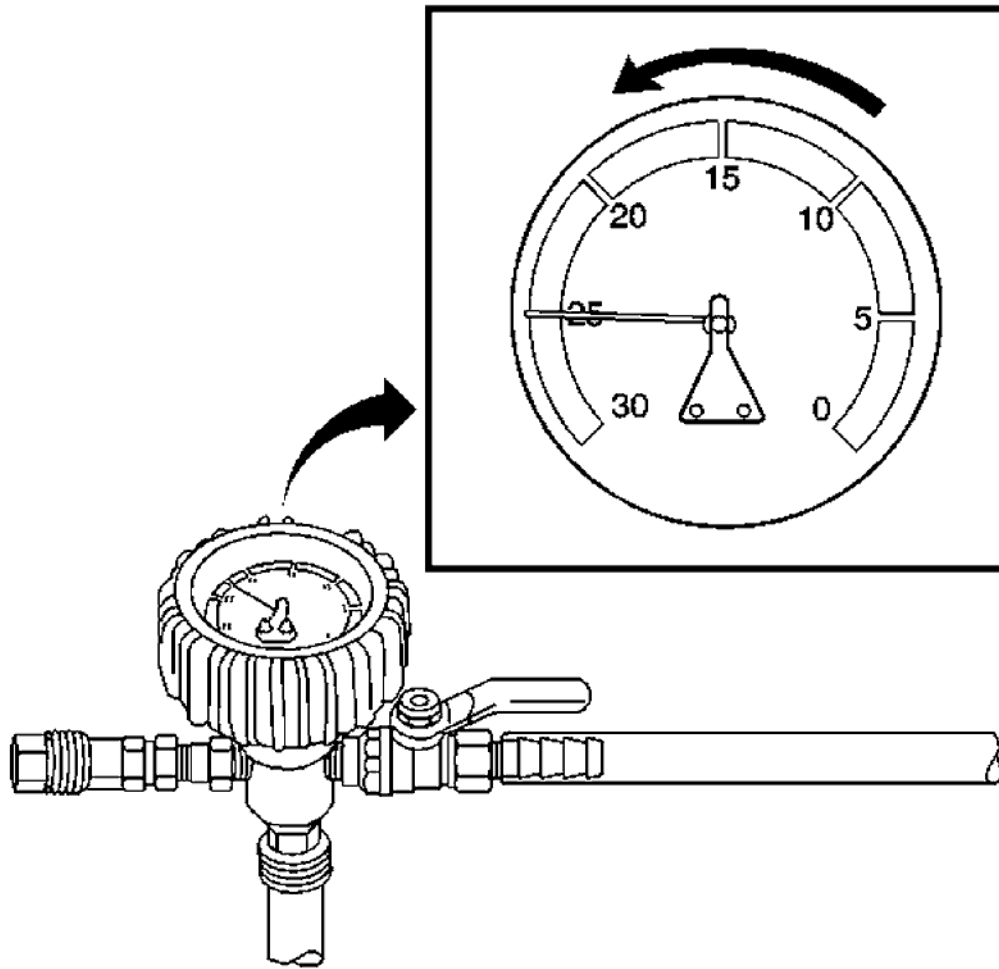


Fig. 25: Observing Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

14. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

Cooling hoses may start to collapse. This is normal due to vacuum draw.

15. To aid in the fill process, position the graduated reservoir above the coolant fill port.

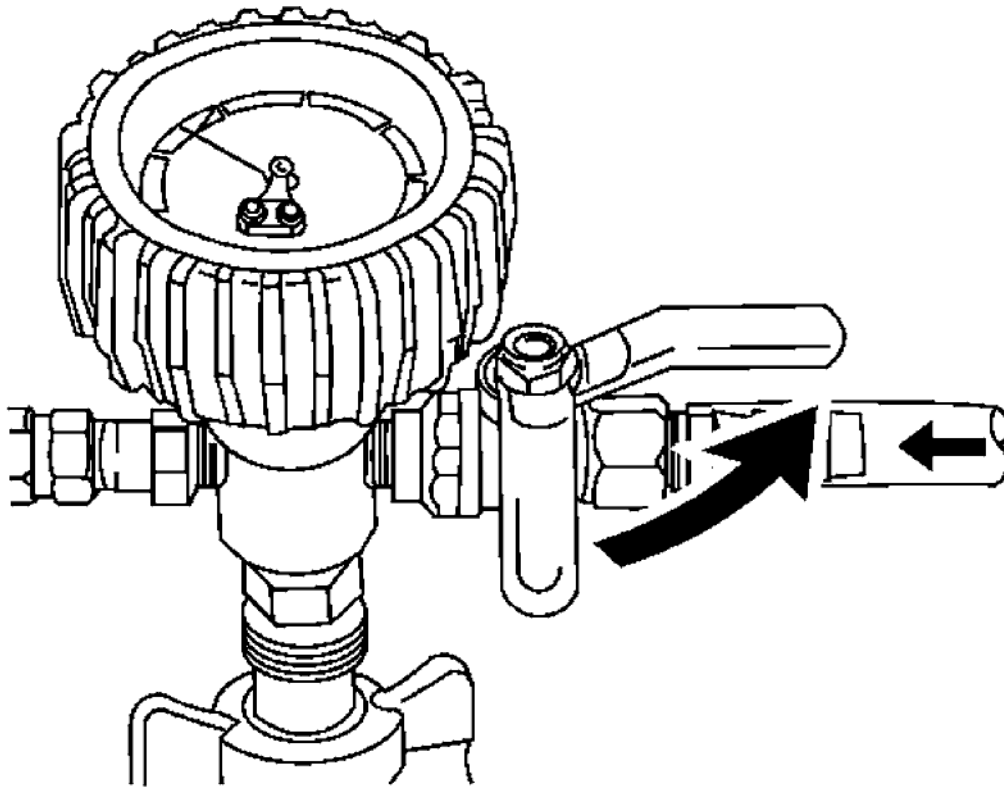


Fig. 26: Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

16. Slowly open the valve on the vacuum gage assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
17. Close the valve on the venturi assembly.
18. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

If vacuum loss is observed, refer to **Loss of Coolant**.

19. Open the valve on the vacuum gage assembly. The vacuum gage will drop as coolant is drawn into the system.

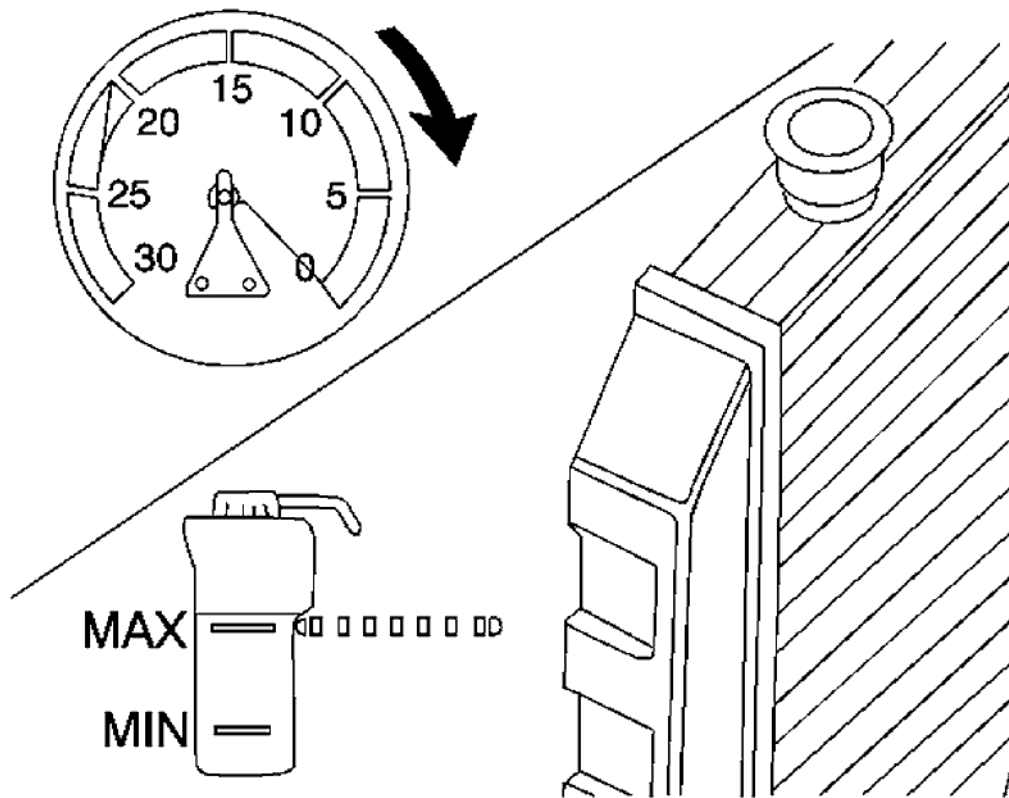


Fig. 27: Vacuum Gage Reading
Courtesy of GENERAL MOTORS CORP.

20. Once the vacuum gage reaches zero, close the valve on the vacuum gauge assembly and repeat steps 10-16.
21. Detach the Vac N Fill cap from the vehicle's coolant fill port.
22. Add coolant to the system as necessary.
23. Inspect the concentration of the coolant mixture using **J 26568** .

IMPORTANT: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

24. Detach the vacuum hose from the vacuum gage assembly.

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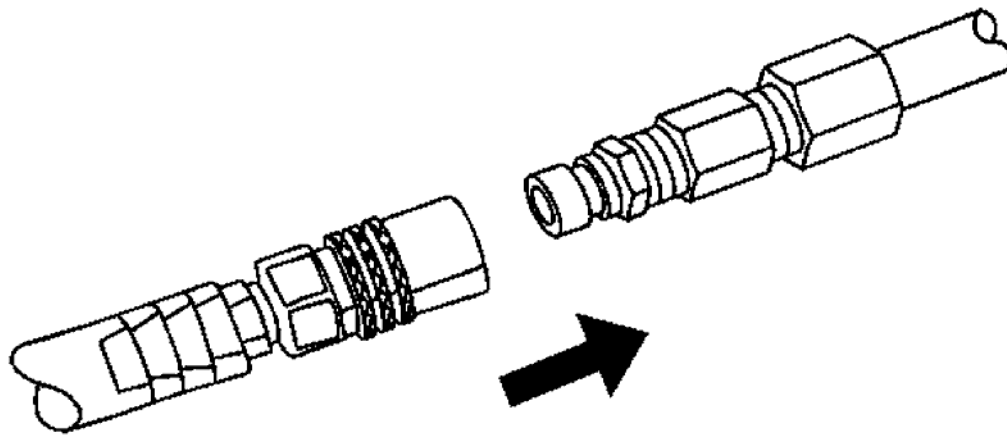


Fig. 28: Extraction Hose
Courtesy of GENERAL MOTORS CORP.

25. Attach the extraction hose to the vacuum hose.

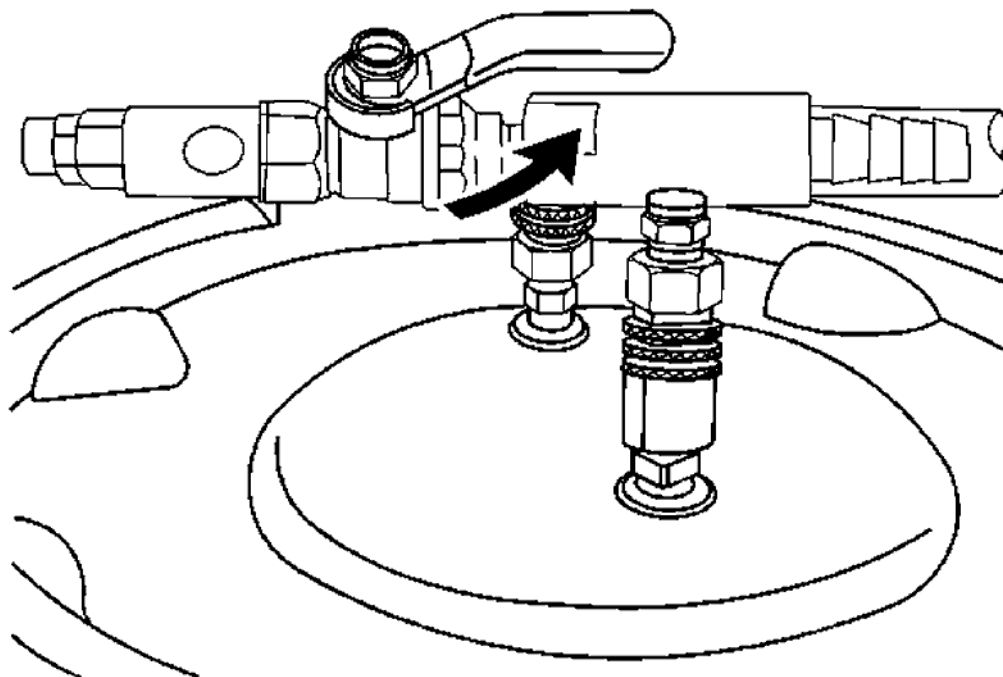


Fig. 29: Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

26. Open the valve on the venturi assembly to start a vacuum draw.

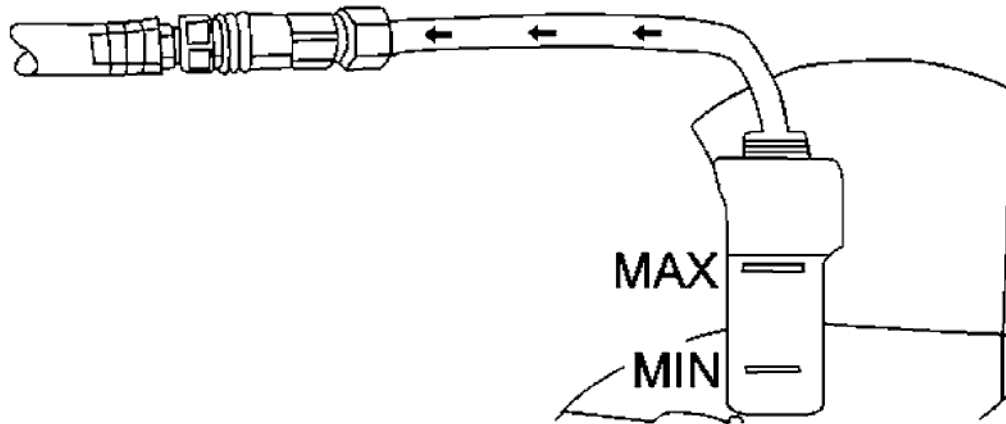


Fig. 30: Extraction Hose
Courtesy of GENERAL MOTORS CORP.

27. Use the extraction hose to draw out coolant to the proper level.
28. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

COOLANT SYSTEM FLUSHING

IMPORTANT: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used 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.

Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction. However, always remove the thermostat before back flushing the system.

1. Block the drive wheels.
2. Place the transmission in park (P) or neutral (N).

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3. Engage the park brake.
4. Run the engine until the thermostat opens.
5. Stop the engine.
6. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.
7. Fill the coolant reservoir to the FULL COLD mark.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

RADIATOR CLEANING

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

NOTE: 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: Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.

- Some conditions may require the use of warm water and a mild detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

COOLANT RECOVERY RESERVOIR REPLACEMENT

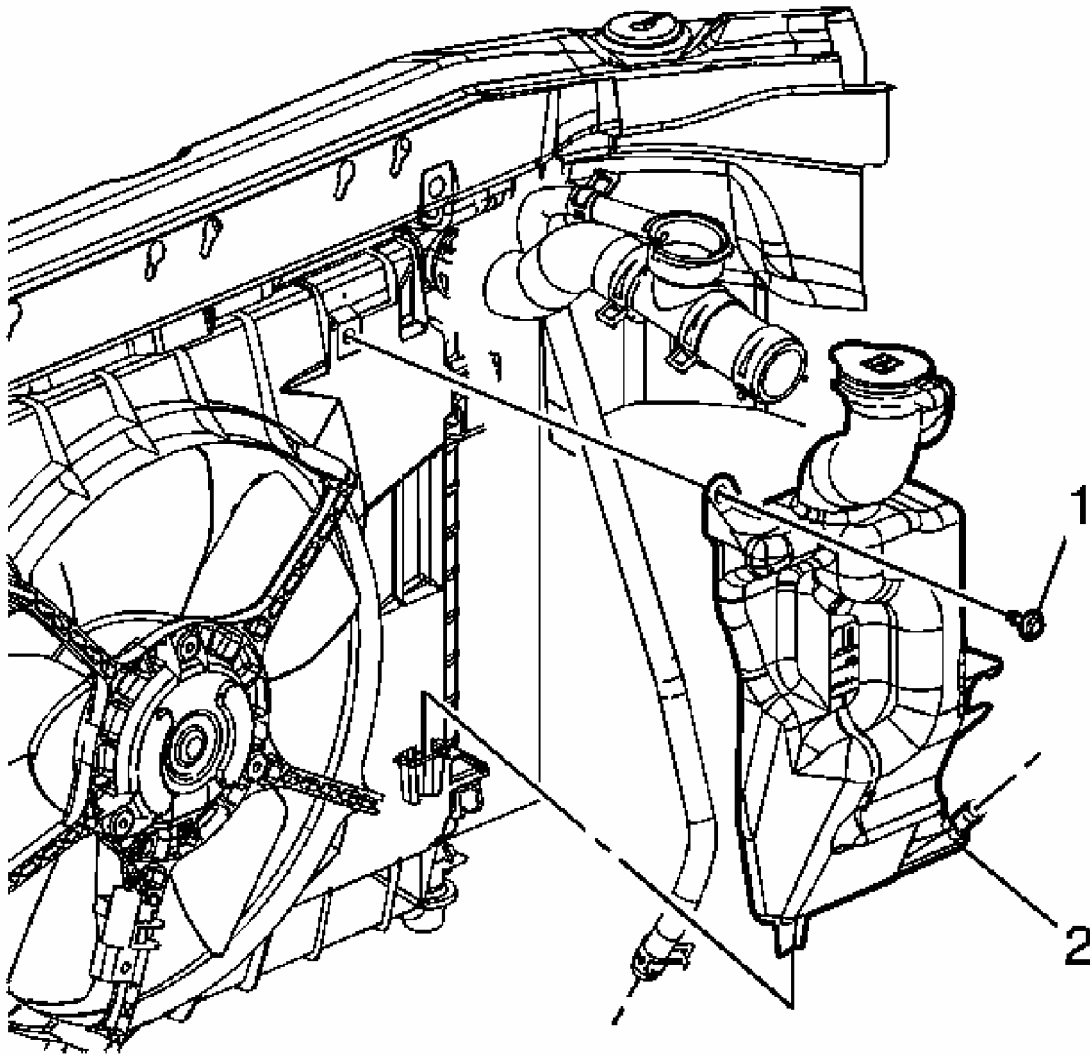


Fig. 31: Coolant Recovery Reservoir
 Courtesy of GENERAL MOTORS CORP.

Coolant Recovery Reservoir Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> . Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u>. Preliminary Procedure 1. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> for the 2.2L engine or <u>Air Cleaner Assembly Replacement</u> for the 2.4L engine. IMPORTANT:	

Drain only the fluid from the radiator coolant recovery expansion tank.

2. Drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

1	Coolant Recovery Reservoir Bolt Tighten: 9 N.m (80 lb in)
2	Coolant Recovery Expansion Tank Assembly Tip: Use J 38185 to remove the coolant recovery hose from the coolant recovery reservoir. See Special Tools .

RADIATOR HOSE REPLACEMENT - INLET

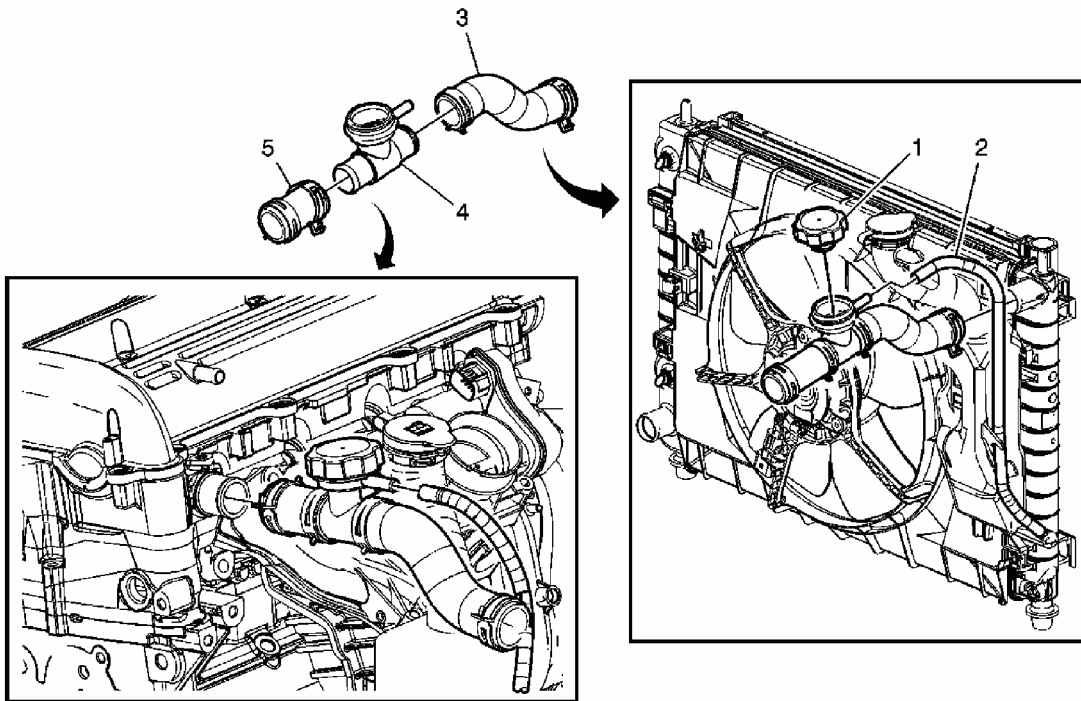


Fig. 32: Inlet Radiator Hose
Courtesy of GENERAL MOTORS CORP.

Radiator Hose Replacement - Inlet

Callout	Component Name
NOTE: Refer to Fastener Notice .	
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	

Preliminary Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 2.2L engine or **Air Cleaner Assembly Replacement** for the 2.4L engine.
2. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

1	Radiator Cap
2	Coolant Recovery Reservoir Hose Tip: Only remove the coolant recovery reservoir hose from the radiator fill neck tube.
3	Radiator Inlet - Front Hose Tip: Use J 38185 to reposition hose on the radiator inlet hose. See <u>Special Tools</u> .
4	Radiator Fill Tube Neck
5	Radiator Inlet - Rear Hose Tip: Use J 38185 to reposition hose on the radiator inlet hose. See <u>Special Tools</u> .

RADIATOR HOSE REPLACEMENT - OUTLET (RPO L61)

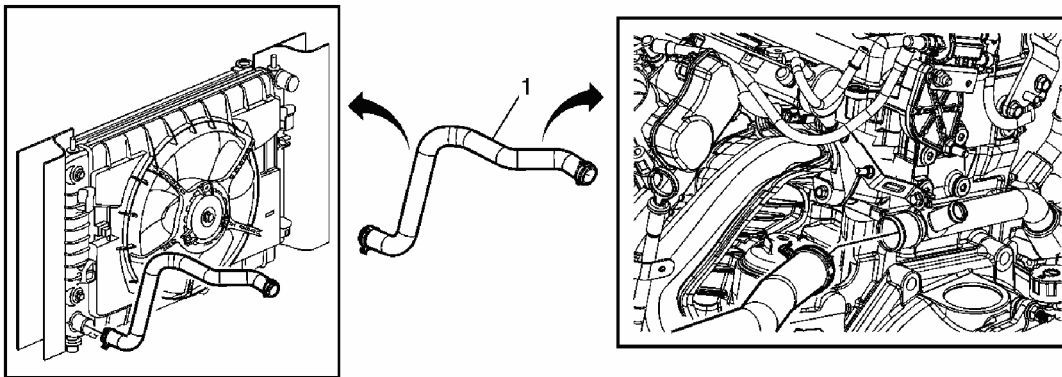


Fig. 33: Outlet Radiator Hose (RPO L61)
Courtesy of GENERAL MOTORS CORP.

Radiator Hose Replacement - Outlet (RPO L61)

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> .	

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Preliminary Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 2.2L engine or **Air Cleaner Assembly Replacement** for the 2.4L engine.
2. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

1	Radiator Outlet Hose Tip: Use J 38185 to reposition hose on the radiator outlet hose. See <u>Special Tools</u> .
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RADIATOR HOSE REPLACEMENT - OUTLET (RPO LE5)

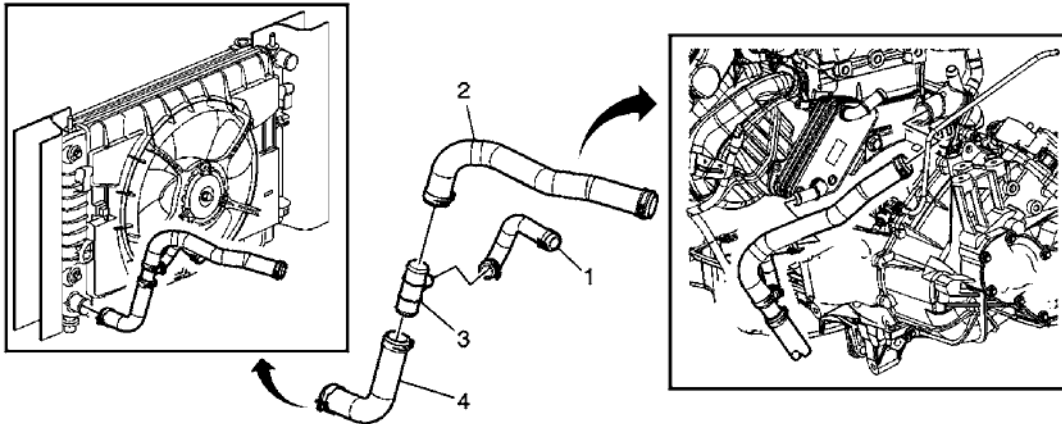


Fig. 34: Outlet Radiator Hose (RPO LE5)
Courtesy of GENERAL MOTORS CORP.

Radiator Hose Replacement - Outlet (RPO LE5)

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> .	
Preliminary Procedure	
1. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> for the 2.2L engine or <u>Air Cleaner Assembly Replacement</u> for the 2.4L engine.	

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2. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

1	Engine Oil Cooler Inlet Hose Tip: Use J 38185 to reposition the hose clamp. See Special Tools .
2	Radiator Outlet - Rear Hose Tip: Use J 38185 to reposition the hose clamp. See Special Tools .
3	Radiator Outlet Hose Tee
4	Radiator Outlet - Front Hose Tip: Use J 38185 to reposition the hose clamp. See Special Tools .

ENGINE OIL COOLER HOSE/PIPE REPLACEMENT

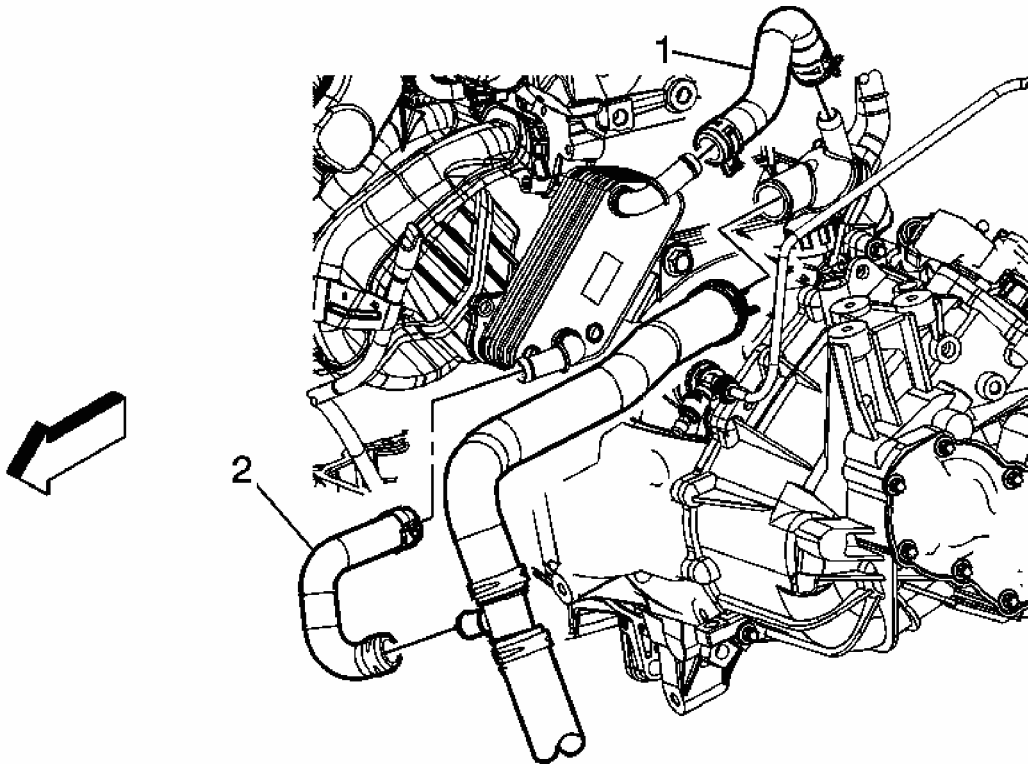


Fig. 35: Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

Engine Oil Cooler Hose/Pipe Replacement

Callout	Component Name
NOTE: Refer to Fastener Notice .	

Fastener Tightening Specifications: Refer to Fastener Tightening Specifications.

Preliminary Procedure

1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement for the 2.2L engine or Air Cleaner Assembly Replacement for the 2.4L engine.
2. Partially drain the cooling system. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill).

1	Engine Oil Cooler - Outlet Hose Tip: Use J 38185 to reposition hose clamps on the engine oil cooler outlet hose. See Special Tools .
2	Engine Oil Cooler - Inlet Hose Tip: Use J 38185 to reposition hose clamps on the engine oil cooler inlet hose. See Special Tools .

COOLING FAN AND SHROUD REPLACEMENT

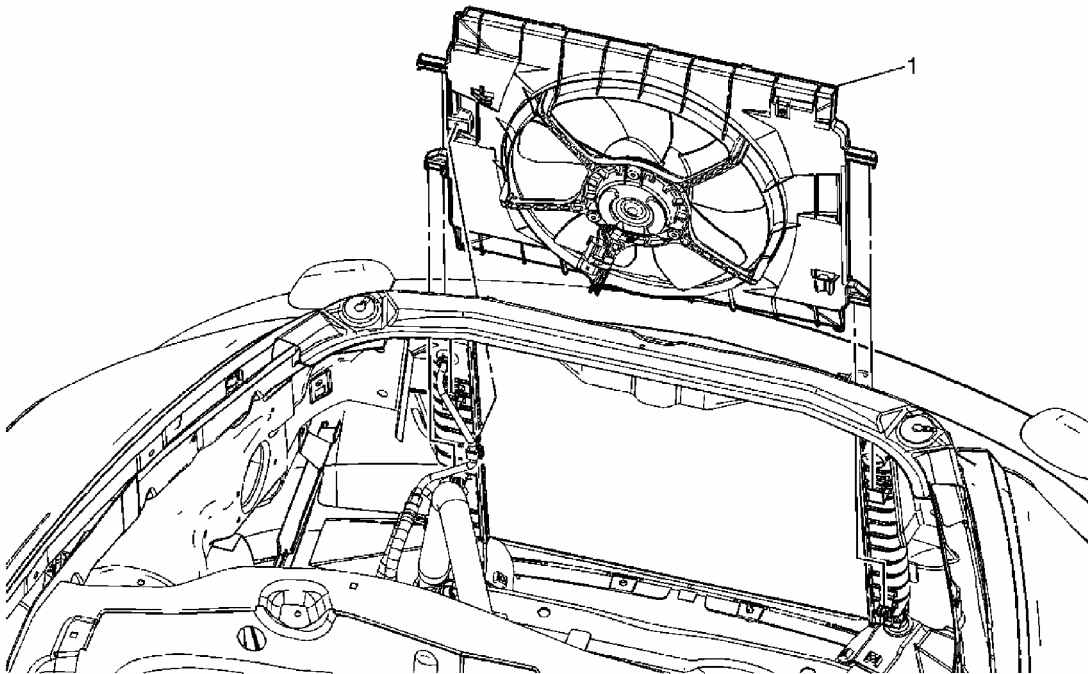


Fig. 36: Cooling Fan and Shroud
Courtesy of GENERAL MOTORS CORP.

Cooling Fan and Shroud Replacement

Callout	Component Name
NOTE: Refer to Fastener	

2006 Chevrolet HHR LT

2006 ENGINE Engine Cooling - HHR

Notice .

Fastener Tightening Specifications: Refer to **Fastener Tightening Specifications**.

Preliminary Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** for the 2.2L engine or **Air Cleaner Assembly Replacement** for the 2.4L engine.
2. Remove the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement**.
3. Remove the hood latch from the tie bar and set aside. Refer to **Hood Latch Replacement** .
4. Remove the radiator inlet hose from the radiator. Refer to **Radiator Hose Replacement - Inlet**.
5. Remove the upper radiator air baffle. Refer to **Radiator Air Baffle and Deflector Replacement - Upper**.

Fan Assembly, Engine Cooling - with Shroud

Tip:

1

1. Disconnect the cooling fan motor electrical connector.
2. Remove the transmission line connector from the fan shroud.
3. Lift the radiator out of the support bracket and pull toward the front of the vehicle.
4. Lift up on the fan shroud assembly to release from the radiator.

THERMOSTAT HOUSING REPLACEMENT (RPO L61)

Removal Procedure

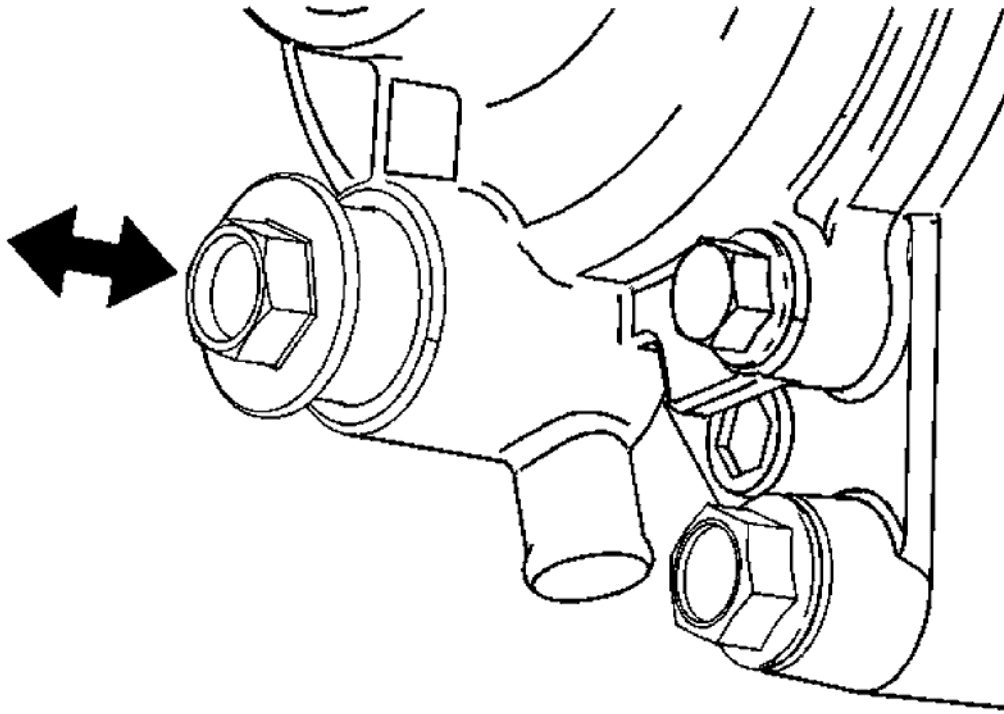


Fig. 37: Opening Water Pump Drain Plug (2.2L)
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

IMPORTANT: A drain has been provided at the bottom of the water pump for engine block coolant drainage.

2. Drain the coolant from the engine block at the water pump drain. After the coolant has drained, tighten the drain bolt.
3. Lower the vehicle.

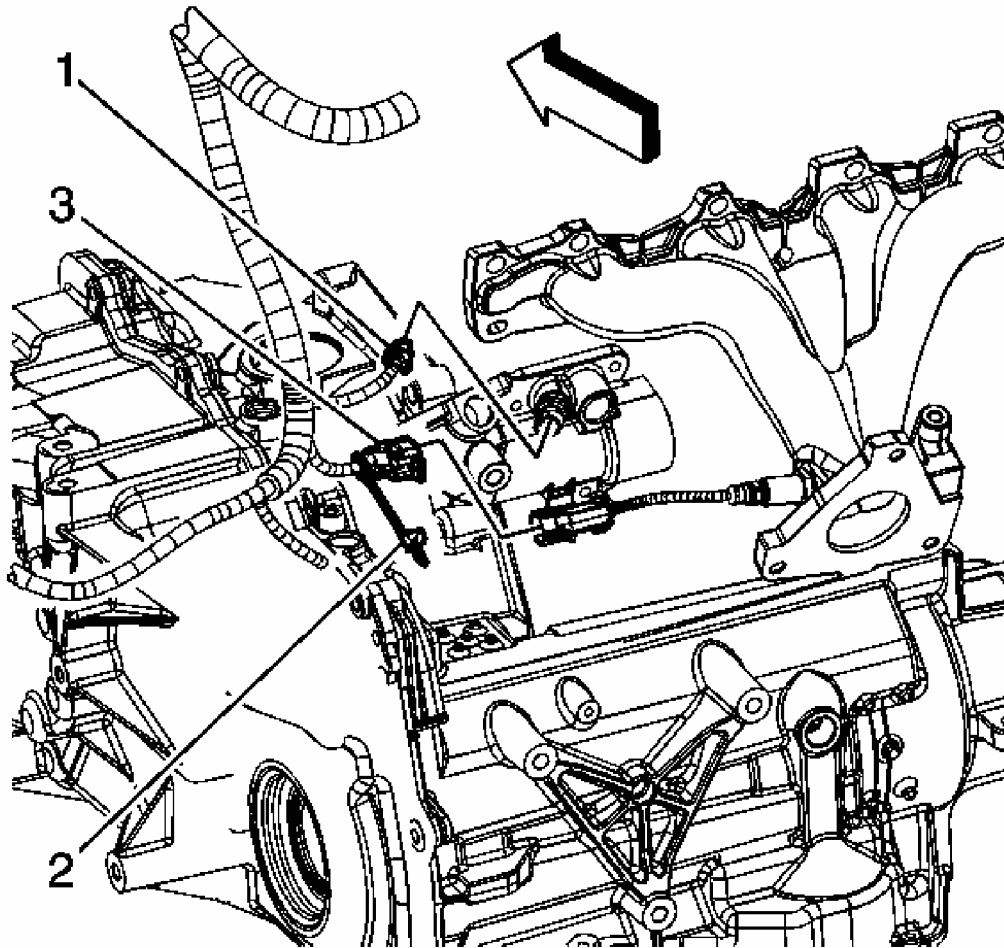


Fig. 38: ECT Sensor Connector (A/T)
Courtesy of GENERAL MOTORS CORP.

4. If equipped with a automatic transaxle, perform the following steps, disconnect the engine coolant temperature (ECT) sensor electrical connector (1).
5. Disconnect the heated oxygen sensor (HO2S) electrical connector clip from the thermostat housing.

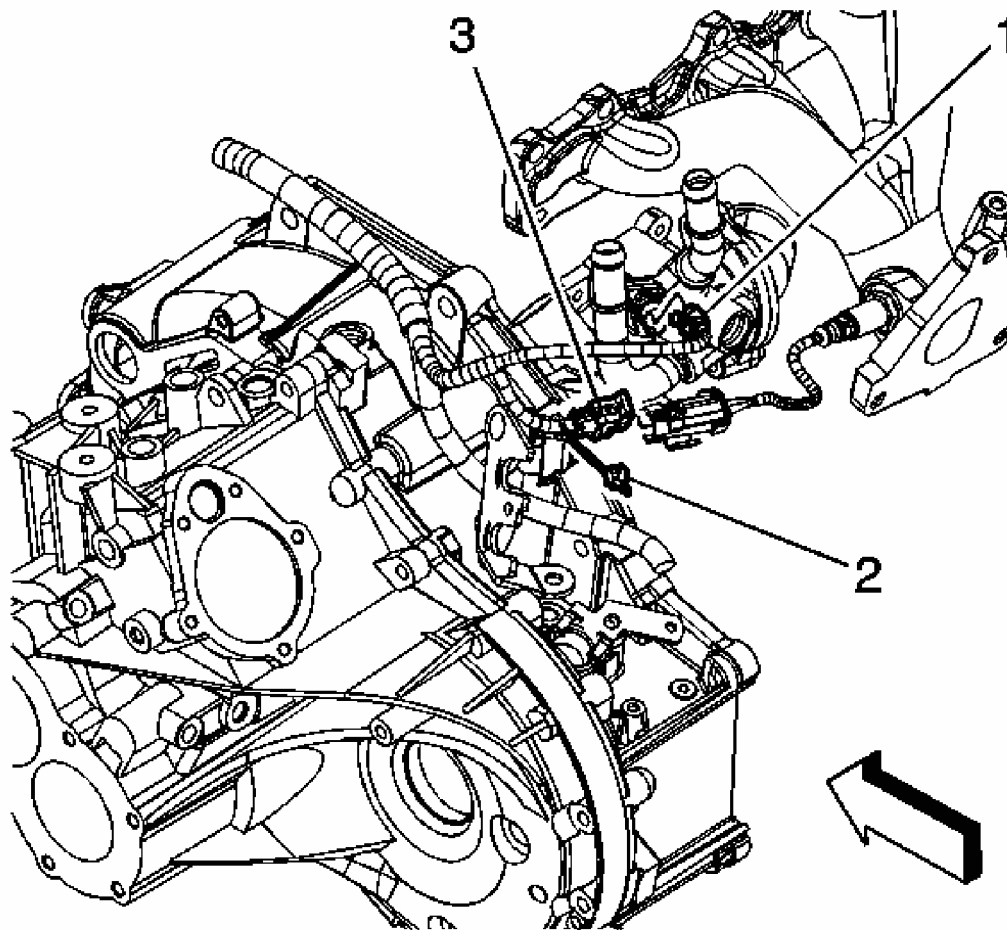


Fig. 39: ECT Sensor Electrical Connector (M/T)
Courtesy of GENERAL MOTORS CORP.

6. If equipped with a manual transaxle, disconnect the ECT sensor electrical connector (1).

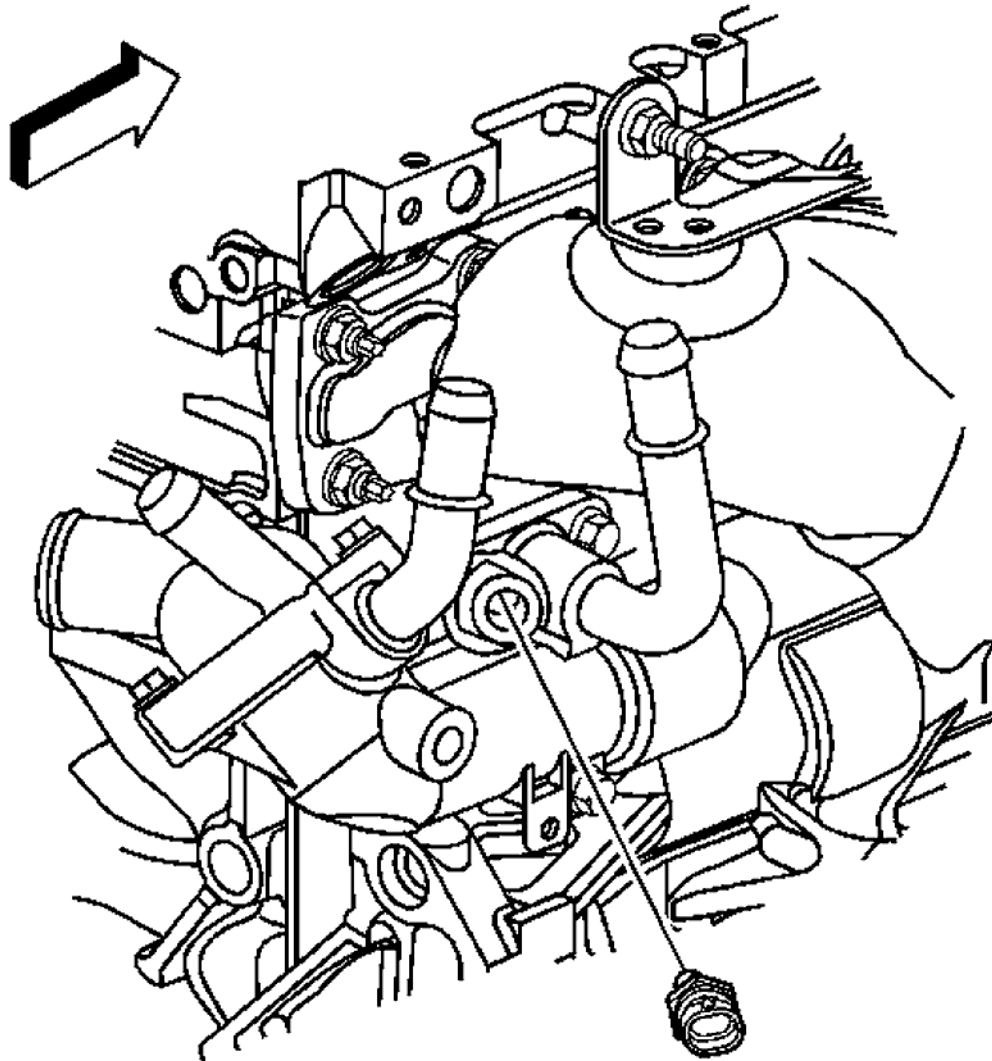


Fig. 40: ECT Sensor
Courtesy of GENERAL MOTORS CORP.

7. Remove the ECT sensor, if necessary.

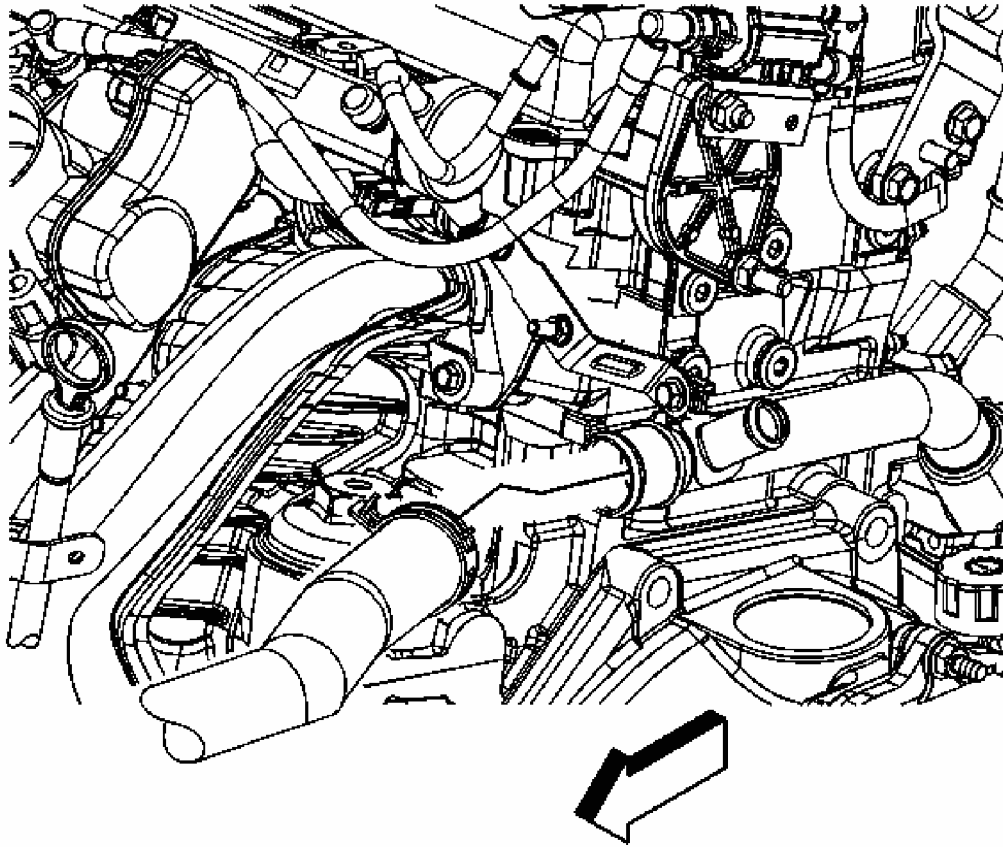


Fig. 41: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

8. Reposition the radiator outlet hose clamp at the thermostat housing.
9. Remove the radiator outlet hose from the thermostat housing.

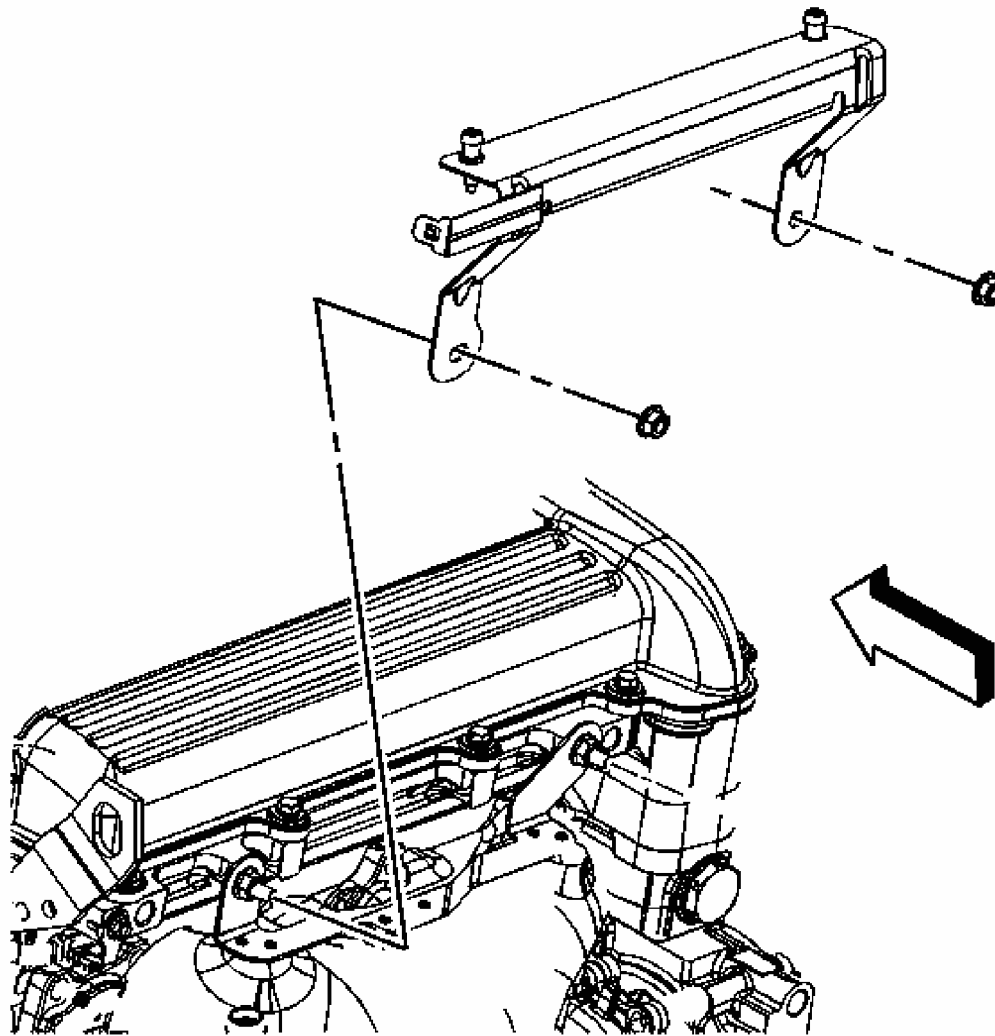


Fig. 42: Air Cleaner Bracket
Courtesy of GENERAL MOTORS CORP.

10. Remove the air cleaner bracket nuts.
11. Remove the air cleaner bracket.

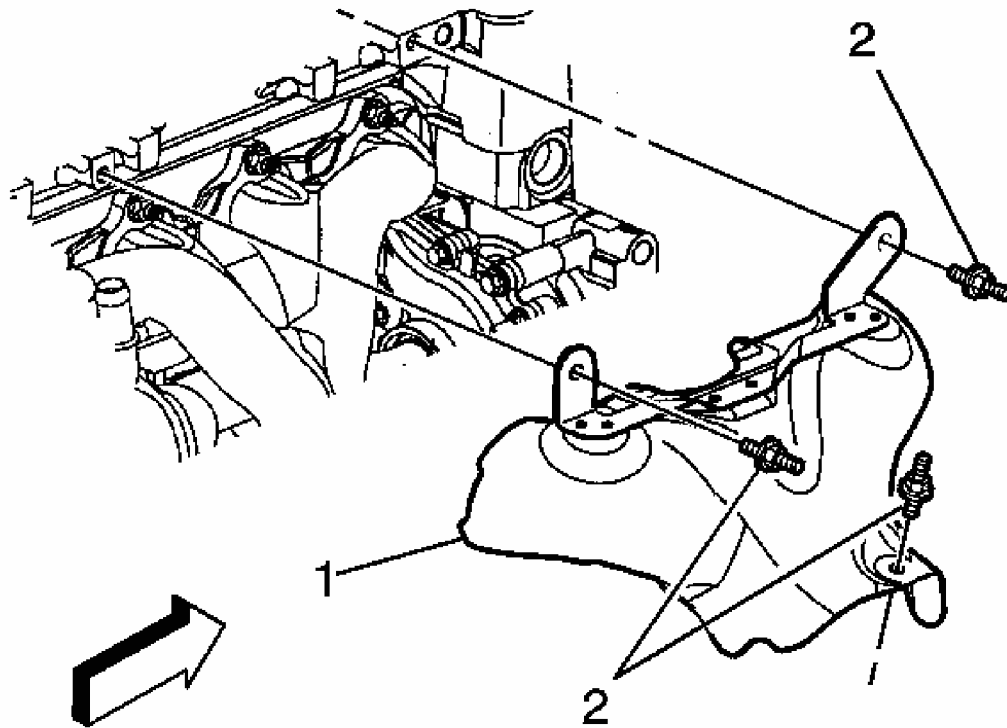


Fig. 43: Exhaust Heat Shield
Courtesy of GENERAL MOTORS CORP.

12. Remove the exhaust heat shield studs (2).
13. Remove the exhaust heat shield (1).

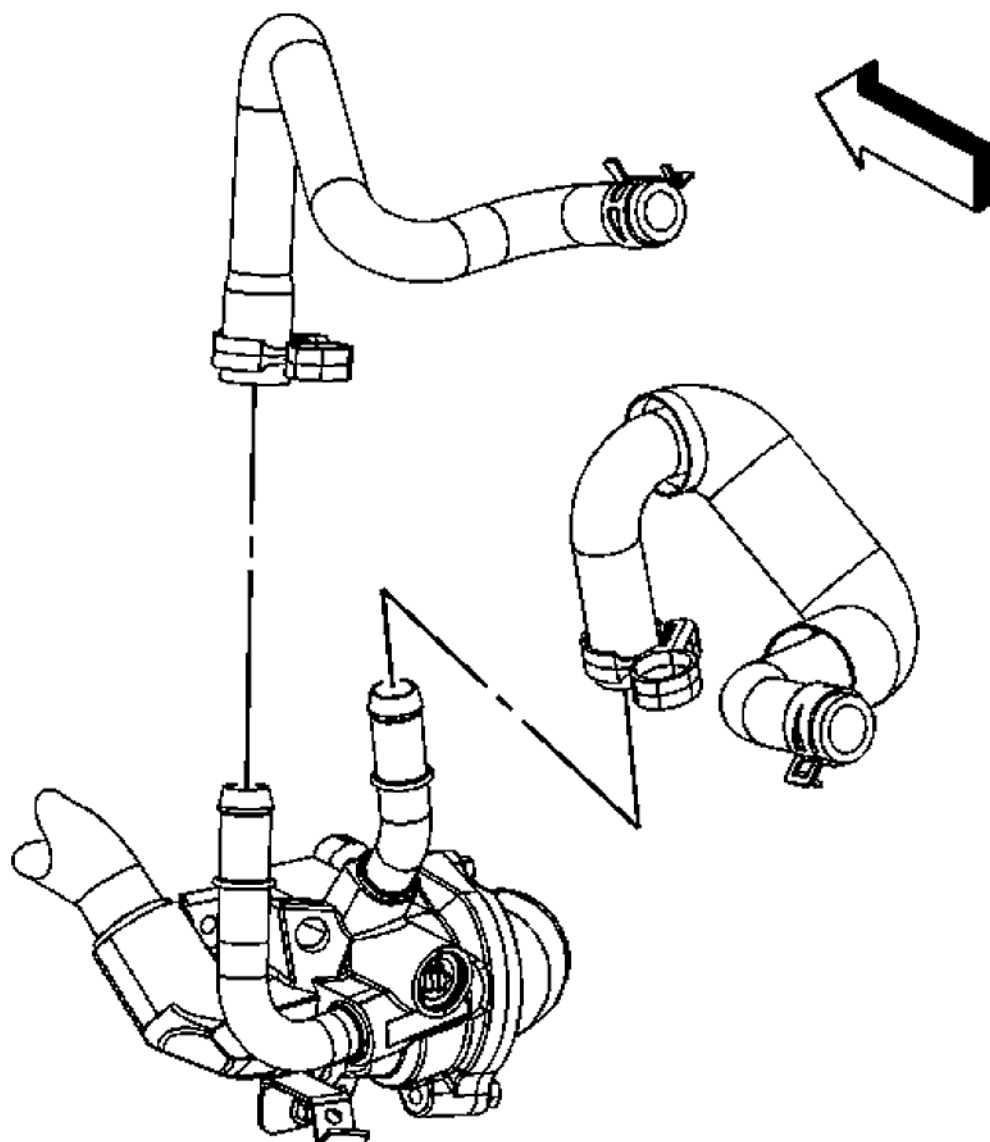


Fig. 44: Heater Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

14. Reposition the heater inlet and outlet hose clamps at the thermostat housing pipes.
15. Disconnect the heater inlet and outlet hoses from the thermostat housing pipes.
16. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
17. Remove the thermostat housing bolts (3, 4).

IMPORTANT: Twist the water transfer pipe while pulling in order to

remove it from the water pump.

18. Remove the thermostat housing (2) from the vehicle.

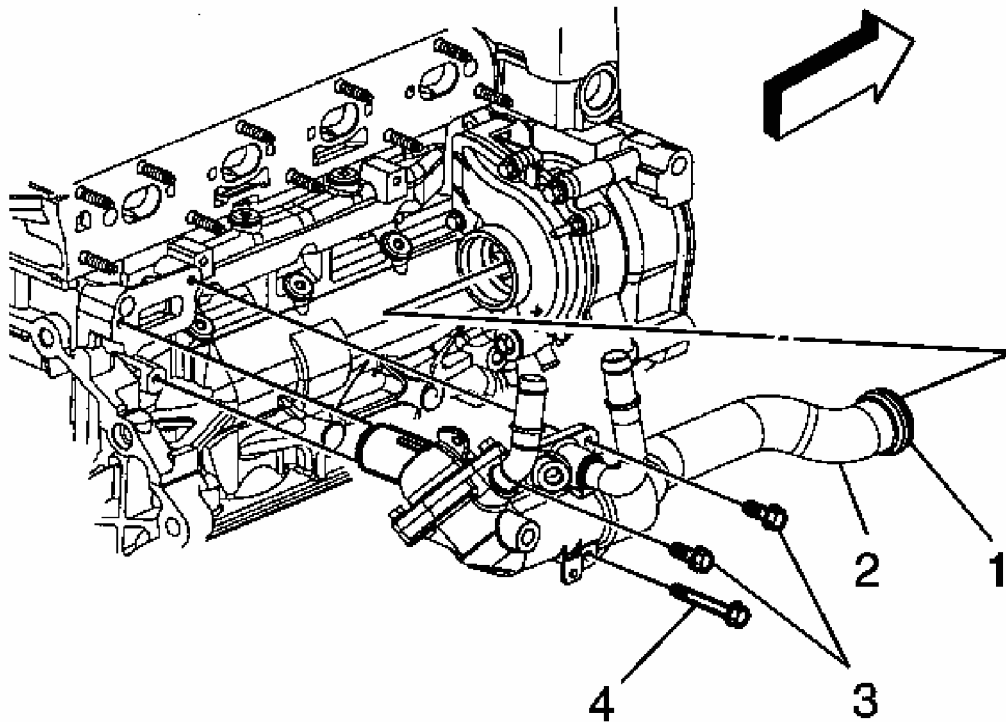


Fig. 45: Water Feed Pipe

Courtesy of GENERAL MOTORS CORP.

19. Remove the water transfer pipe from the thermostat housing, if necessary.
20. Remove and discard the water transfer pipe O-ring seals, if necessary.

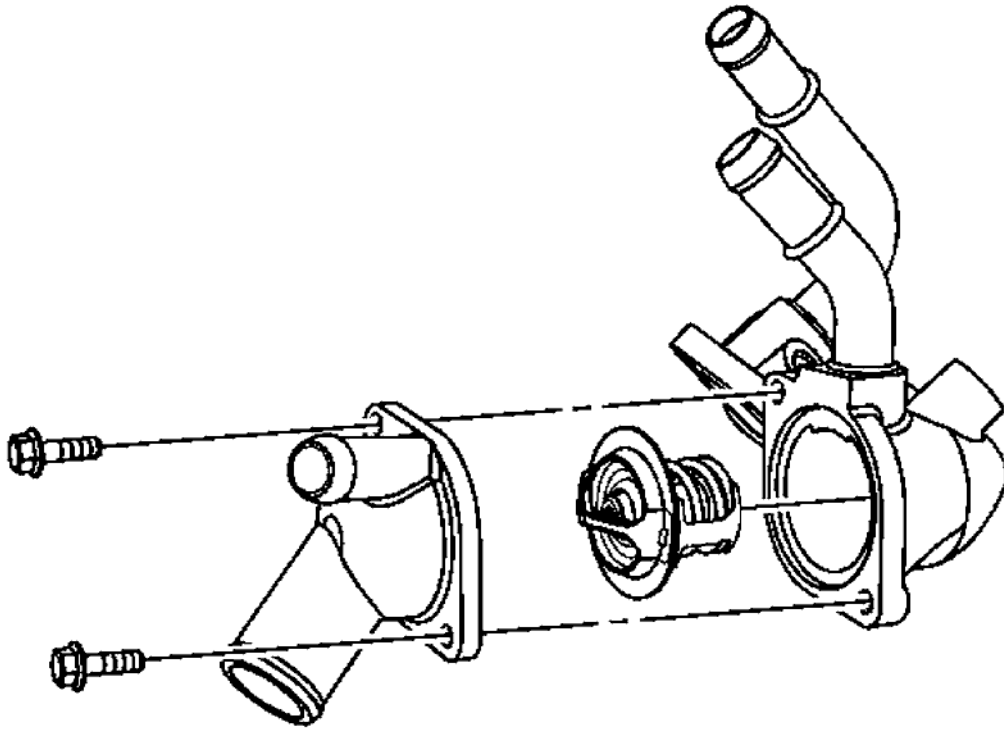


Fig. 46: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

21. Remove the thermostat housing cover bolts and cover, if necessary.
22. Remove the thermostat, if necessary.
23. Remove and discard the thermostat housing O-ring seal, if necessary.
24. Remove all debris and thread sealant from the engine coolant temperature sensor and bolt holes if the housing is being re-used.

Installation Procedure

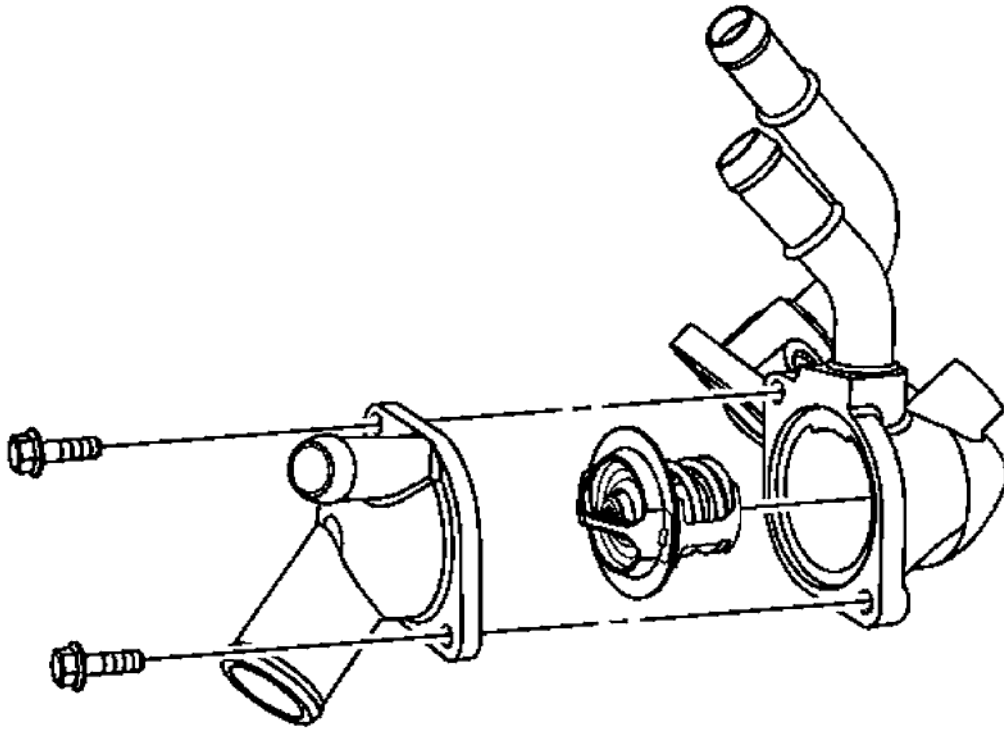


Fig. 47: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat housing cover O-ring seal into the recess groove.
2. Install the thermostat, if necessary.

NOTE: Refer to Fastener Notice .

3. Install the thermostat housing cover bolts, if necessary.

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

4. Install a NEW thermostat housing to engine gasket onto the thermostat housing.
5. Load the thermostat housing assembly into position.

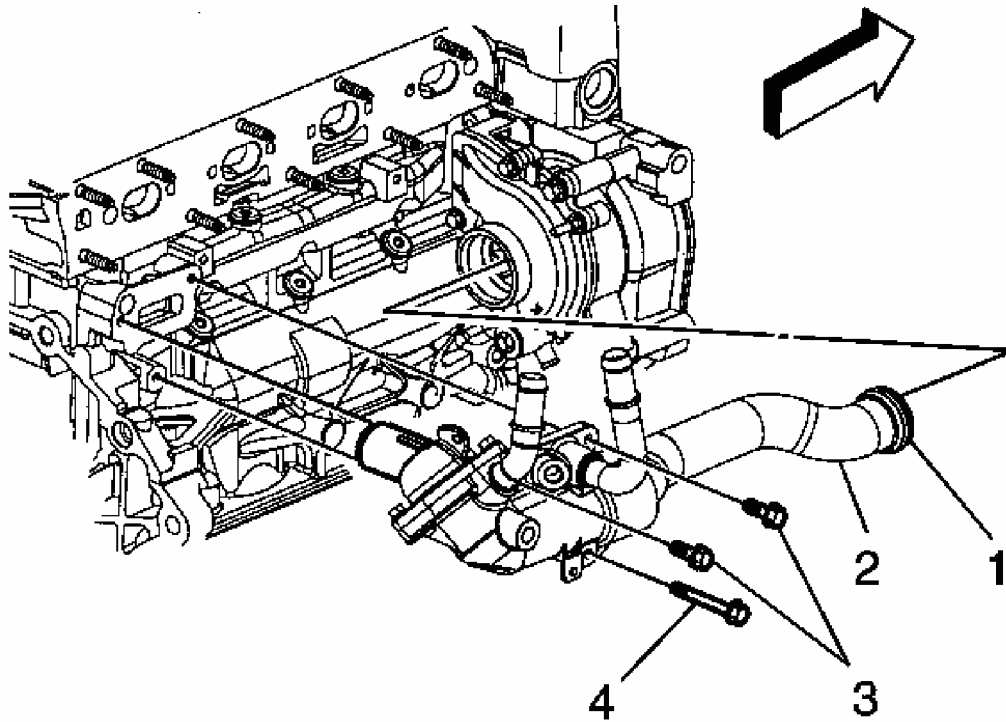


Fig. 48: Water Feed Pipe

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The water feed pipe seals can be lightly lubricated with coolant to aid during installation.

6. Install NEW O-ring seals onto the water feed pipe.

IMPORTANT: Lubricate the O-rings with coolant ONLY.

7. Install the water feed pipe into the thermostat housing aligning locator tab.
8. Align the water pipe to water pump.
9. Seat the water feed O-ring seal by pushing inward toward the water pump. Take care not to tear or damage the O-ring.
10. Position the thermostat housing (2) against the engine.
11. Install the thermostat housing bolts (3, 4).

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

12. Lower the vehicle.

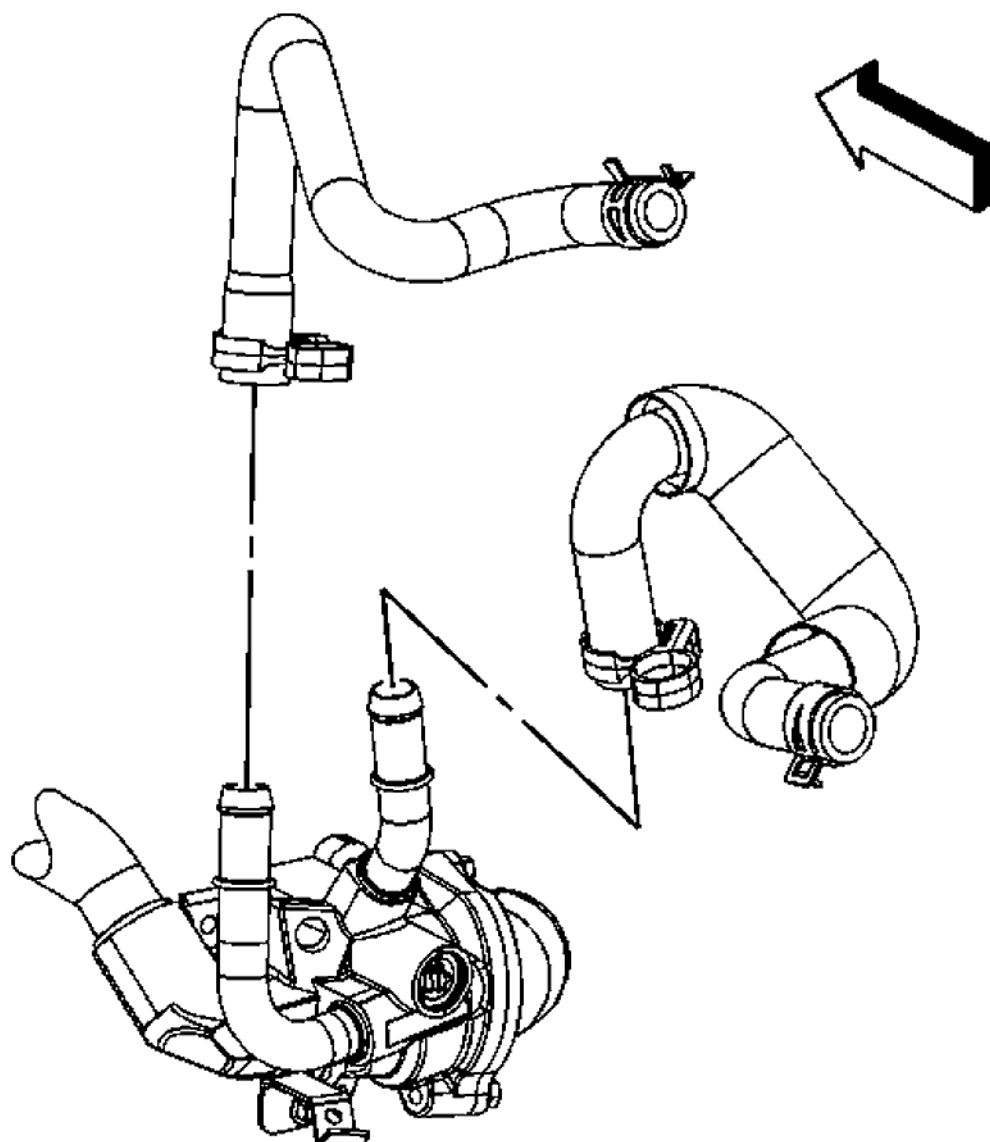


Fig. 49: Heater Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

13. Connect the heater inlet and outlet hoses to the thermostat housing pipes.
14. Position the heater inlet and outlet hose clamps at the thermostat housing pipes.

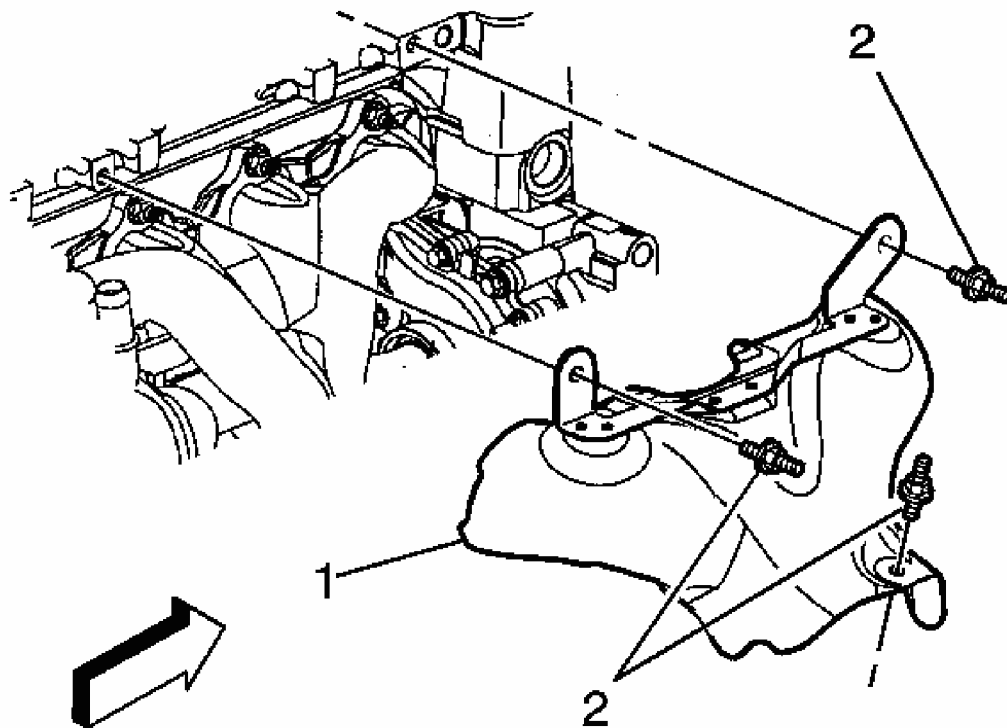


Fig. 50: Exhaust Heat Shield
Courtesy of GENERAL MOTORS CORP.

15. Install the exhaust heat shield (2).
16. Install the exhaust heat shield studs (1).

Tighten: Tighten the studs to 22 N.m (16 lb ft).

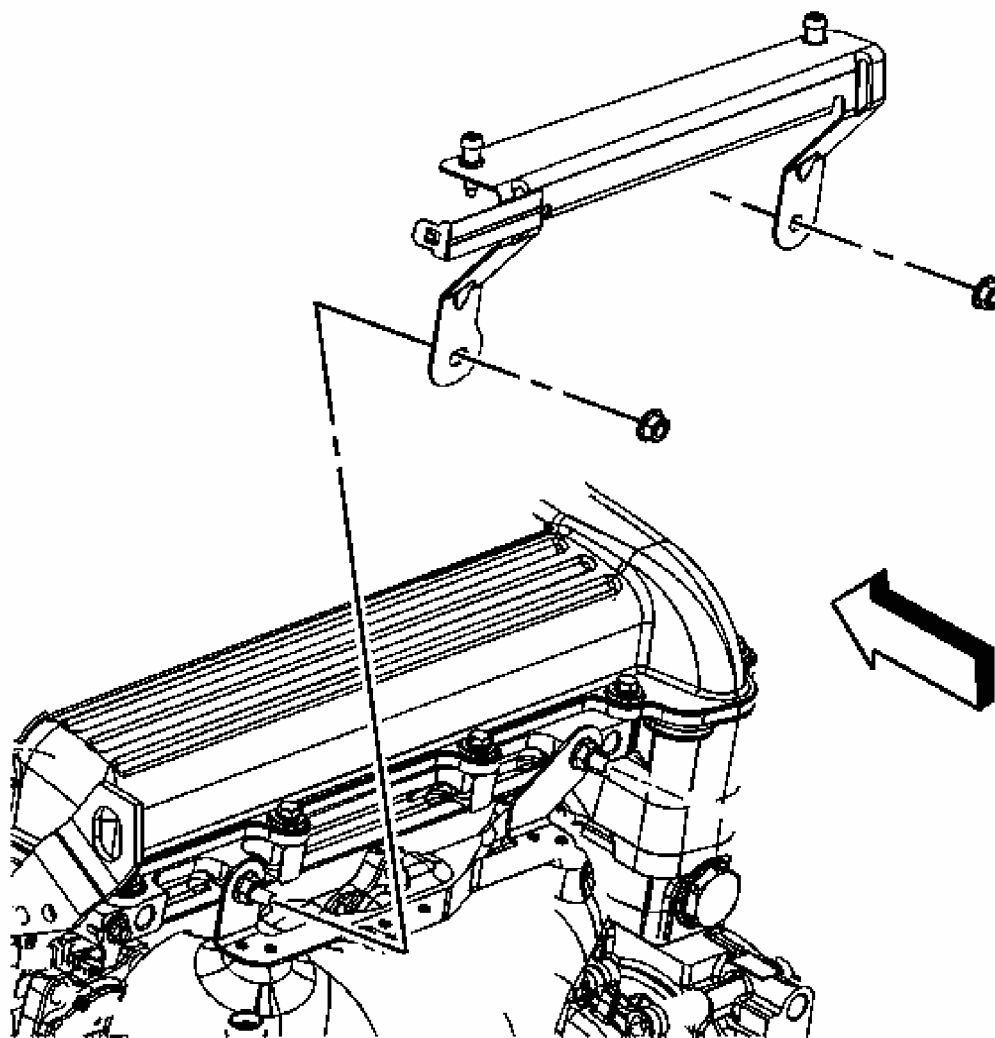


Fig. 51: Air Cleaner Bracket
Courtesy of GENERAL MOTORS CORP.

17. Install the air cleaner bracket.
18. Install the air cleaner bracket nuts.

Tighten: Tighten the nuts to 10 N.m (89 lb in).

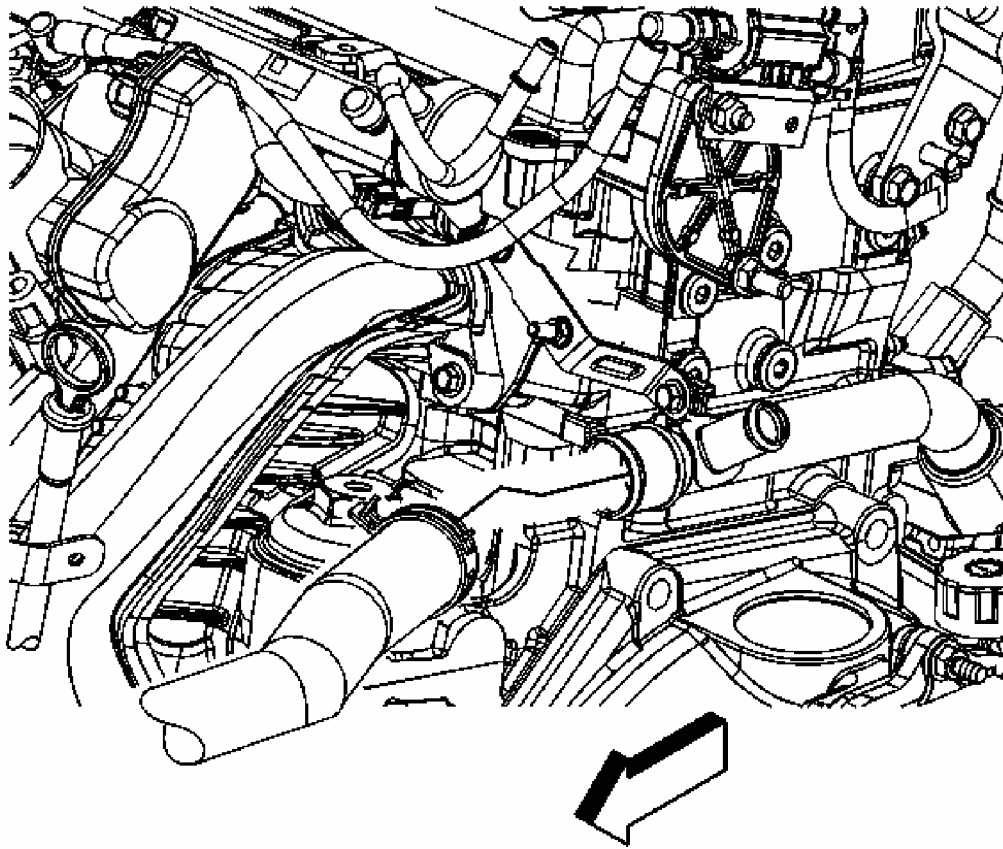


Fig. 52: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

19. Install the radiator outlet hose to the thermostat housing.
20. Position the radiator outlet hose clamp at the thermostat housing.

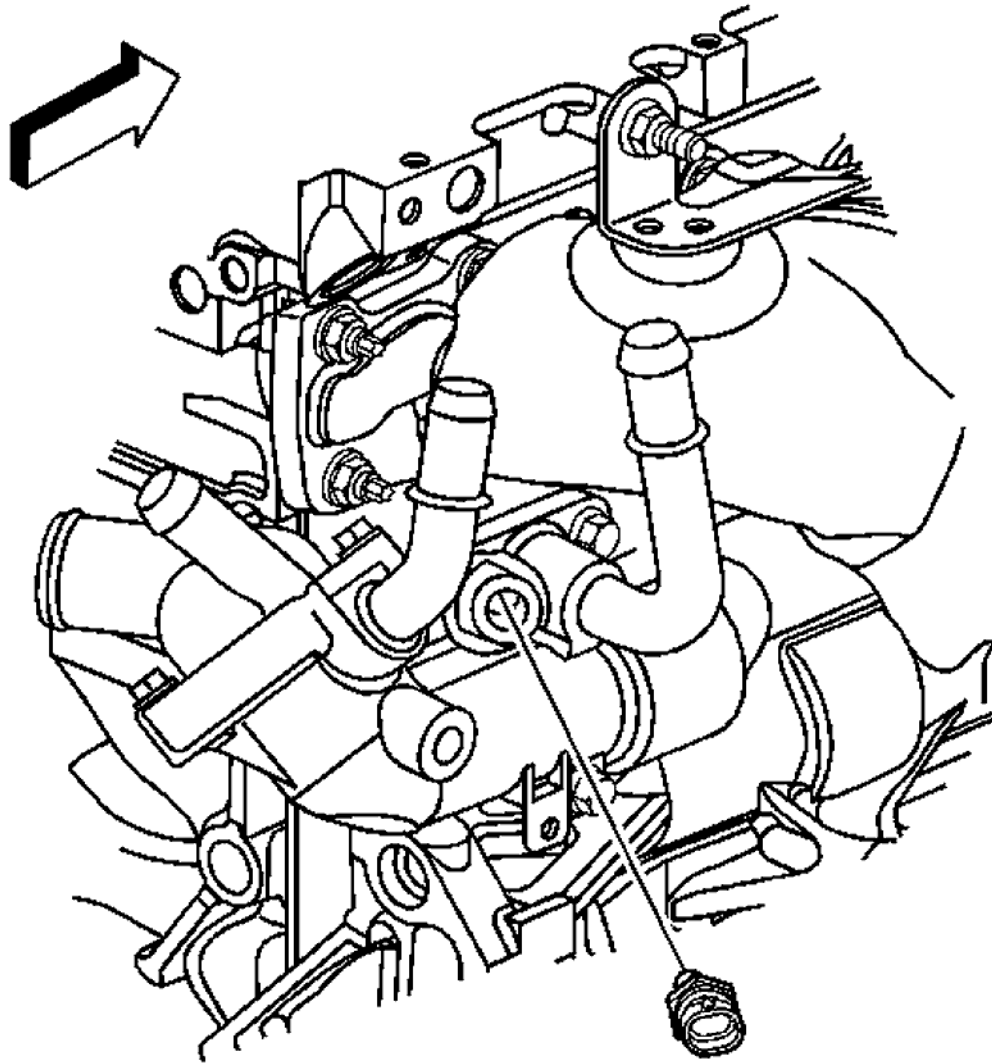


Fig. 53: ECT Sensor
Courtesy of GENERAL MOTORS CORP.

21. Install the ECT sensor, if necessary.

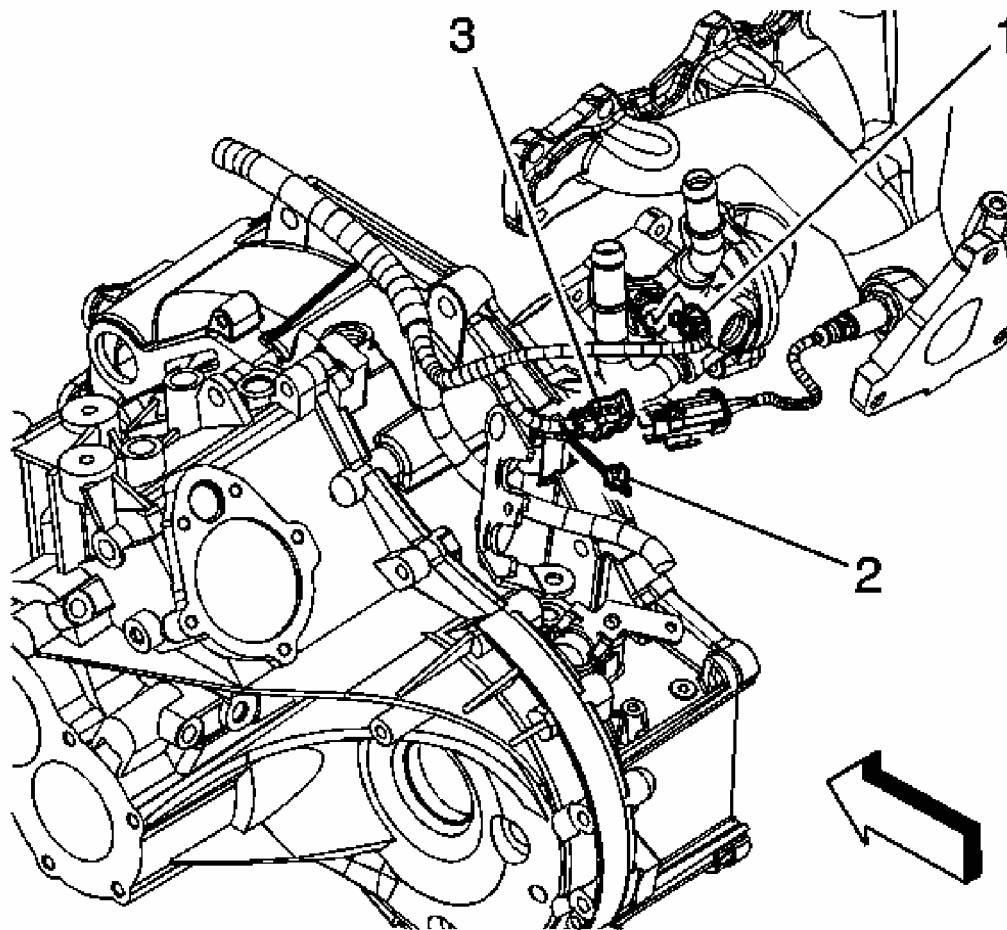


Fig. 54: ECT Sensor Electrical Connector (M/T)
Courtesy of GENERAL MOTORS CORP.

22. If equipped with a manual transaxle, connect the ECT sensor electrical connector (1).

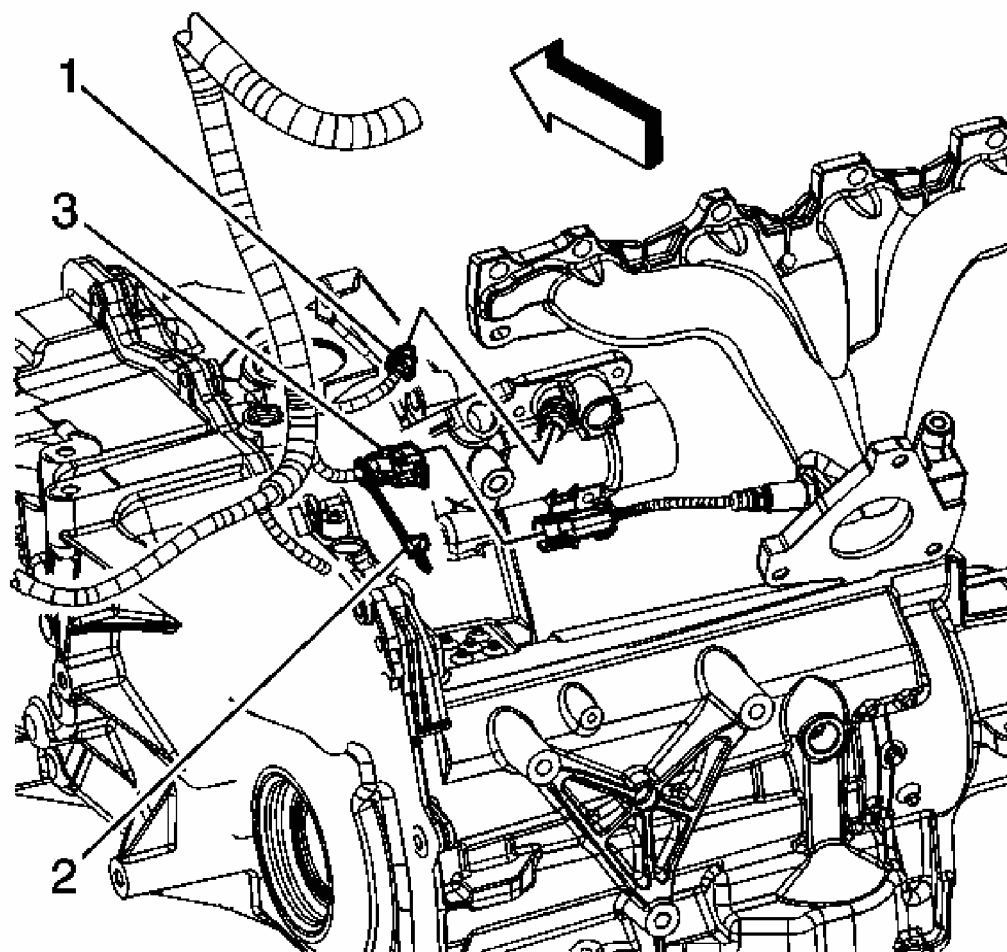


Fig. 55: ECT Sensor Connector (A/T)
Courtesy of GENERAL MOTORS CORP.

23. If equipped with a automatic transaxle, perform the following steps, connect the ECT sensor electrical connector (1).
24. Connect the HO2S electrical connector clip to the thermostat housing.

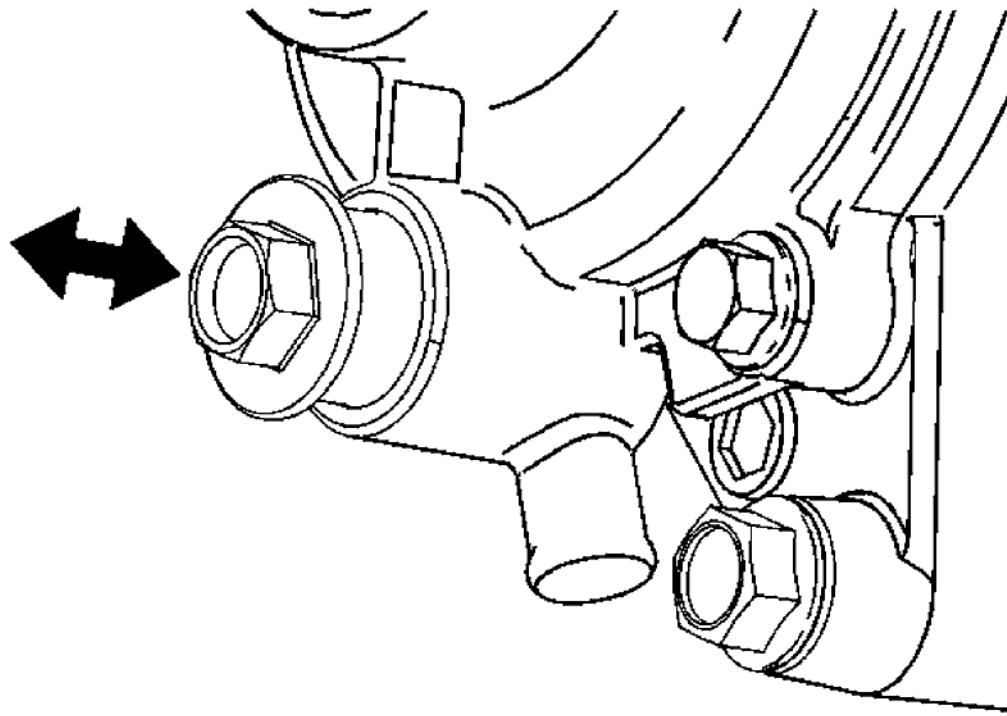


Fig. 56: Opening Water Pump Drain Plug (2.2L)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The vehicle must be level when filling the cooling system.

25. Verify the drain valves at the radiator and water pump are closed.
26. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.
27. Lower the vehicle.
28. Verify the repair and inspect for any leaks.

THERMOSTAT HOUSING REPLACEMENT (RPO LE5)

Removal Procedure

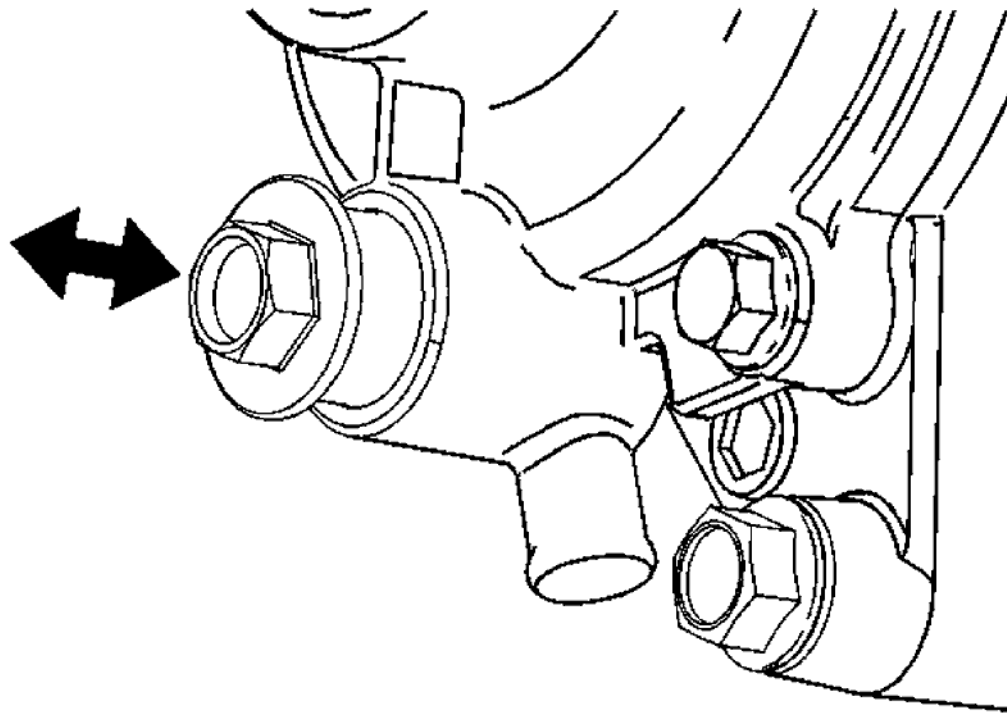


Fig. 57: Opening Water Pump Drain Plug (2.2L)
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

IMPORTANT: A drain has been provided at the bottom of the water pump for engine block coolant drainage.

2. Drain the coolant from the engine block at the water pump drain. After the coolant has drained, tighten the drain bolt.
3. Lower the vehicle.

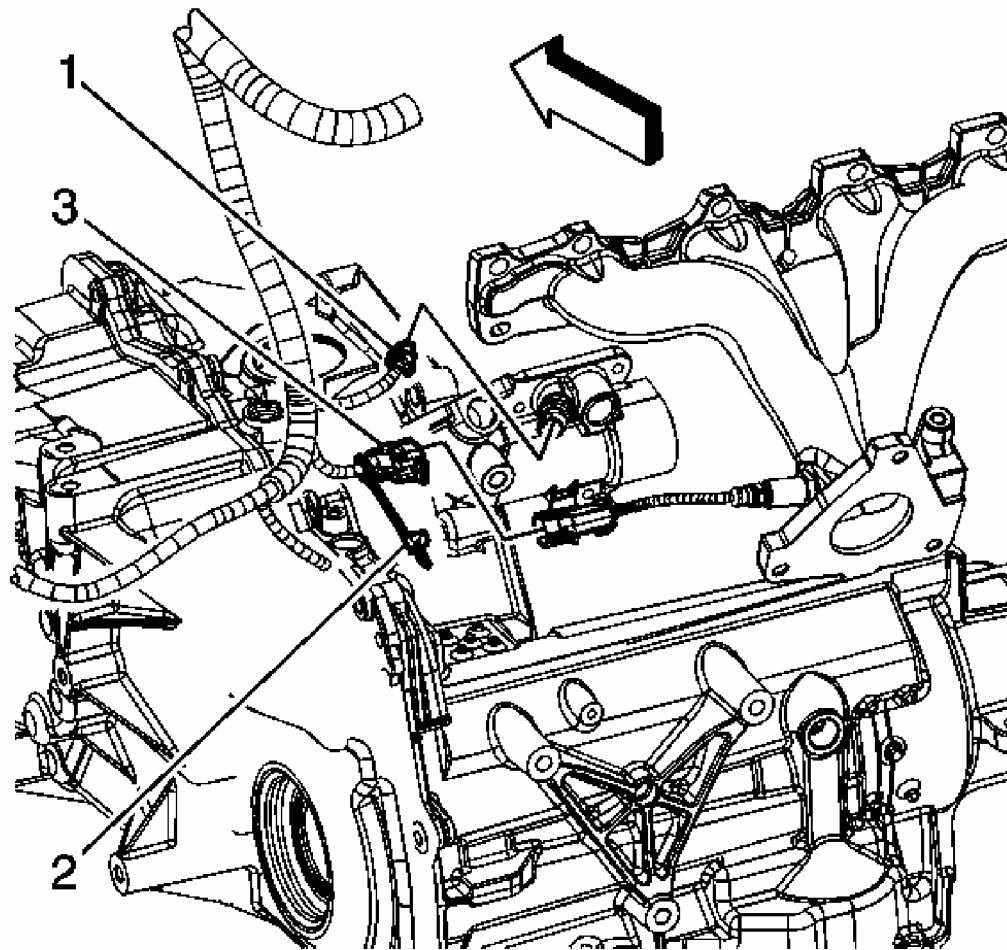


Fig. 58: ECT Sensor Connector (A/T)
Courtesy of GENERAL MOTORS CORP.

4. If equipped with a automatic transaxle, perform the following steps, disconnect the engine coolant temperature (ECT) sensor electrical connector (1).
5. Disconnect the heated oxygen sensor (HO2S) electrical connector clip from the thermostat housing.

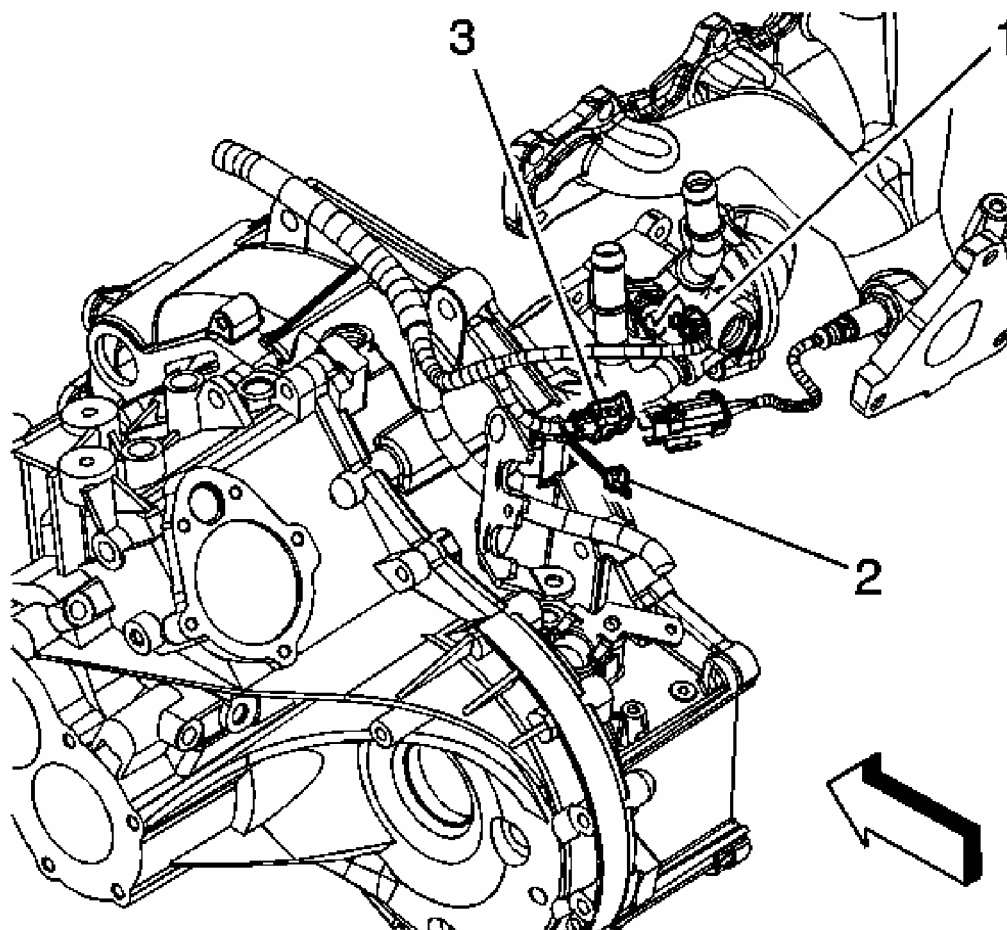


Fig. 59: ECT Sensor Electrical Connector (M/T)
Courtesy of GENERAL MOTORS CORP.

6. If equipped with a manual transaxle, disconnect the ECT sensor electrical connector (1).

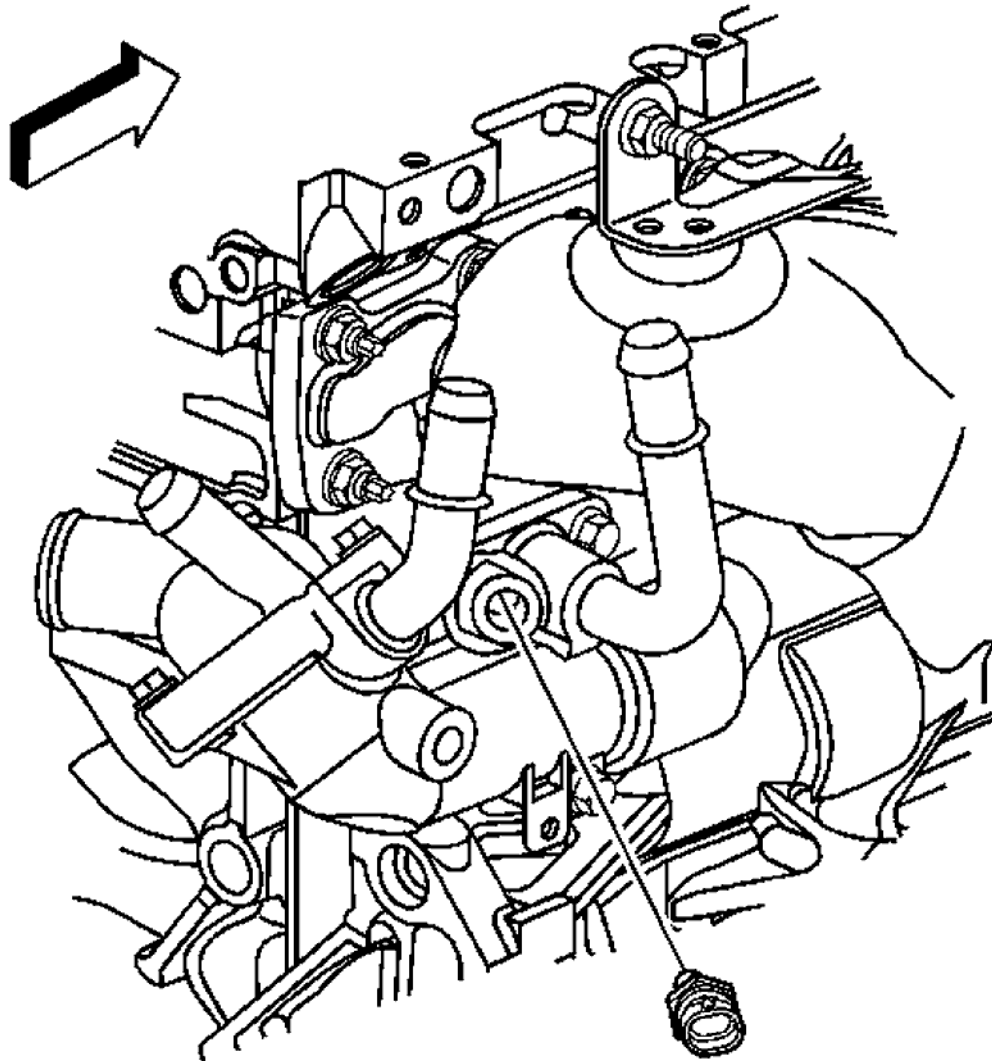


Fig. 60: ECT Sensor
Courtesy of GENERAL MOTORS CORP.

7. Remove the ECT sensor, if necessary.

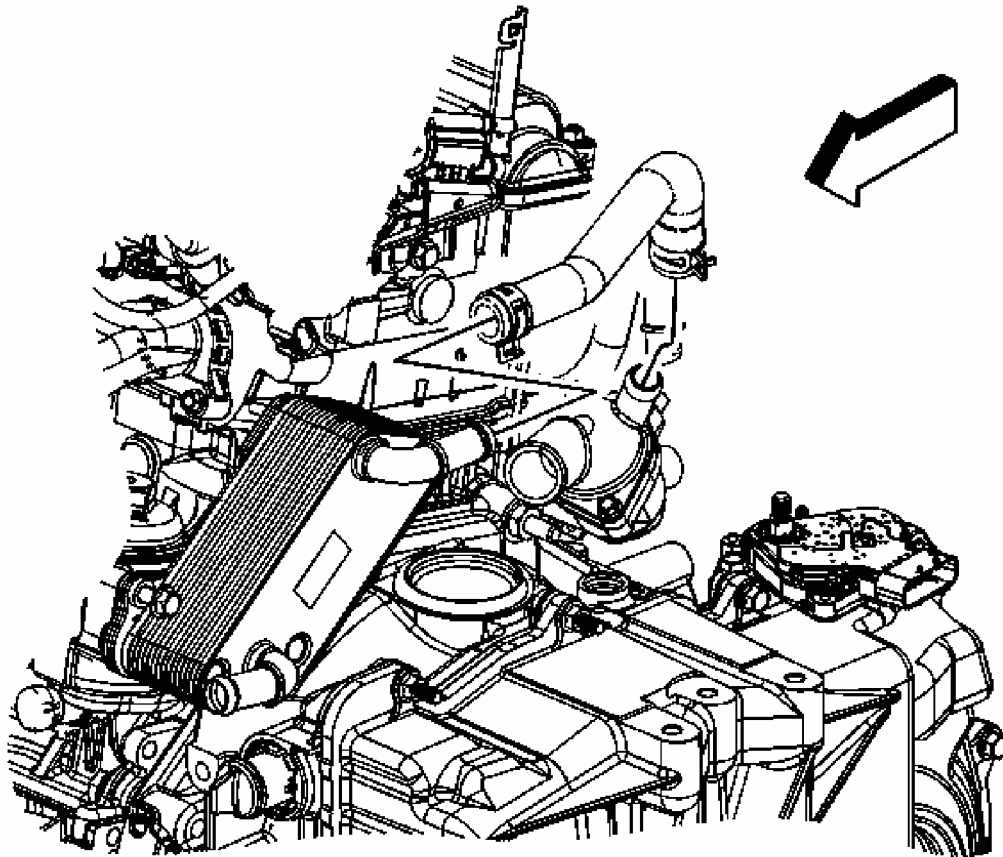


Fig. 61: Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

8. Reposition the oil cooler outlet hose clamp at the thermostat housing.
9. Remove the oil cooler outlet hose from the thermostat housing.

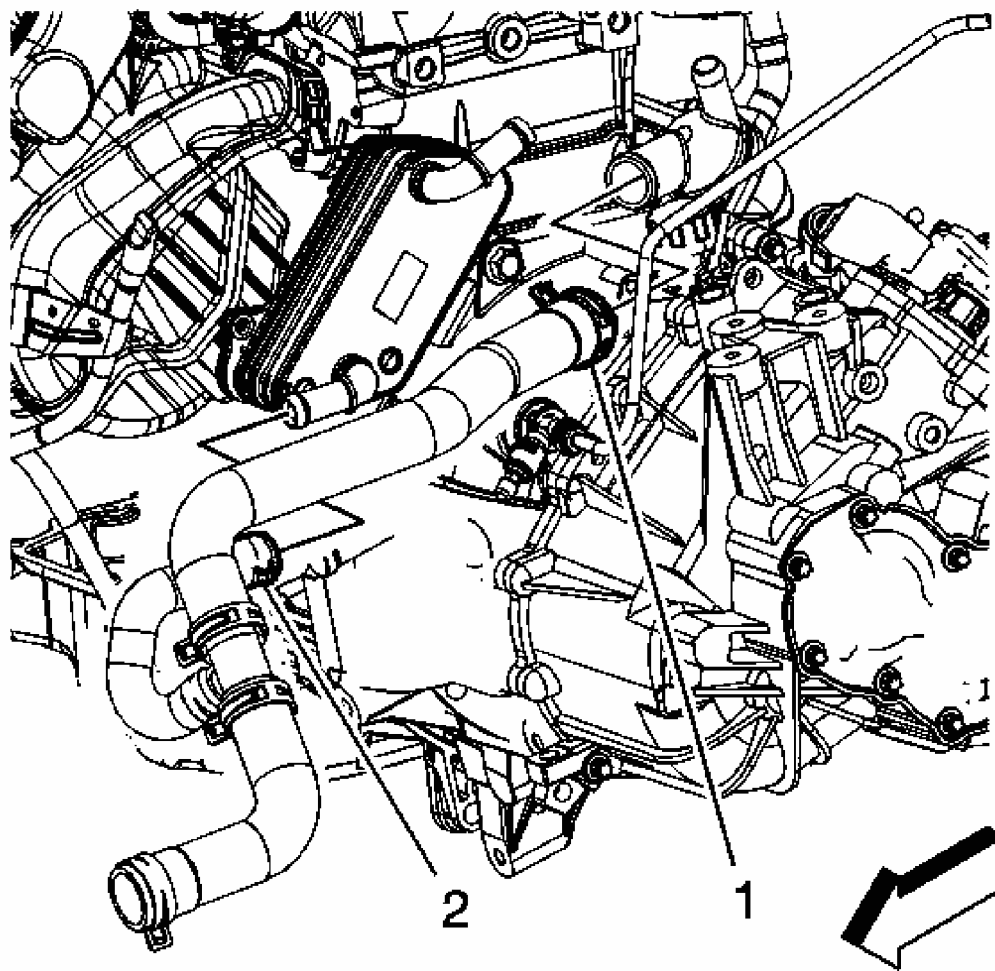


Fig. 62: Radiator Outlet Hose

Courtesy of GENERAL MOTORS CORP.

10. Reposition the radiator outlet hose clamp (1) at the thermostat housing.
11. Remove the radiator outlet hose from the thermostat housing.

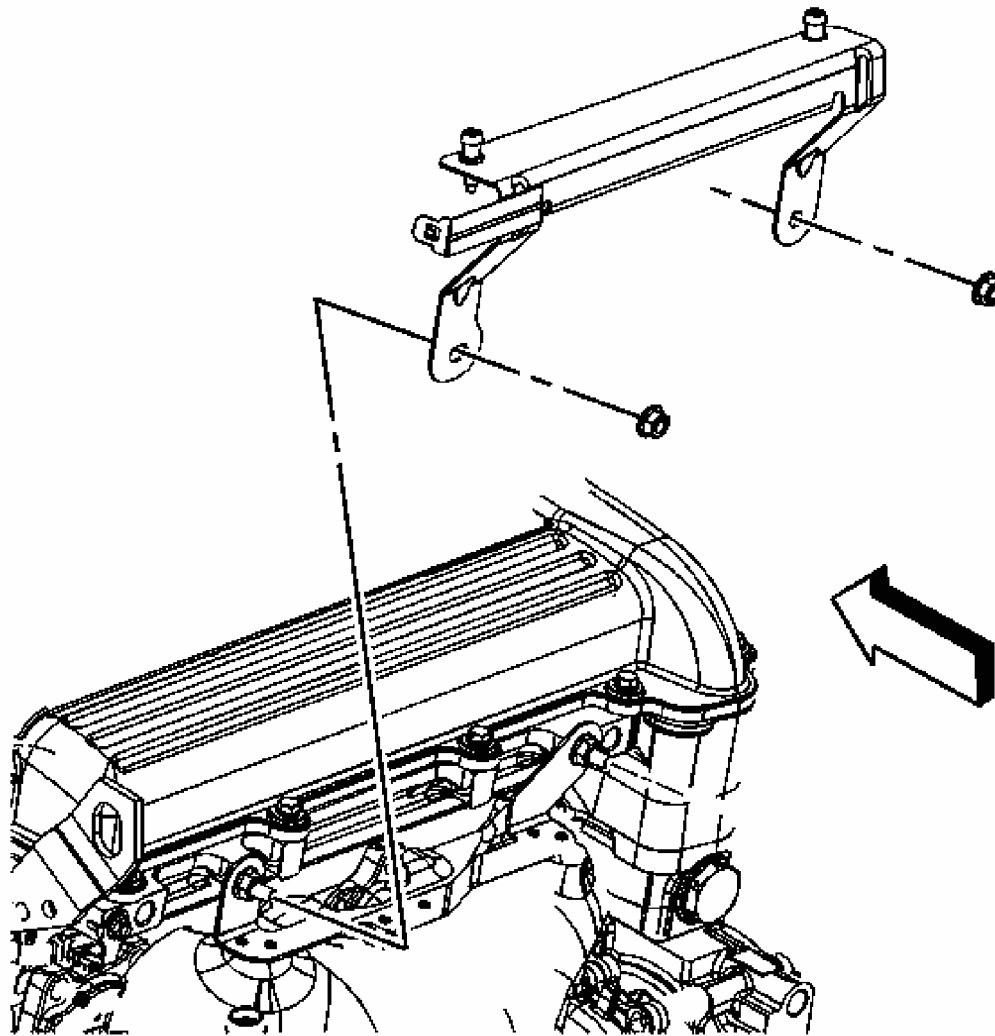


Fig. 63: Air Cleaner Bracket
Courtesy of GENERAL MOTORS CORP.

12. Remove the air cleaner bracket nuts.
13. Remove the air cleaner bracket.

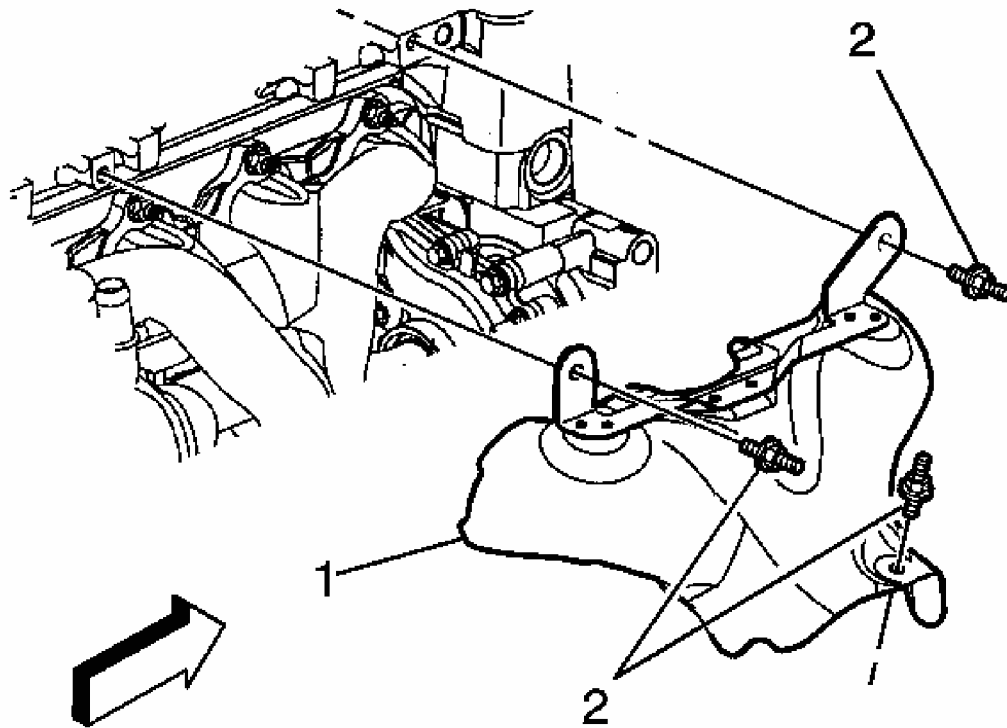


Fig. 64: Exhaust Heat Shield
Courtesy of GENERAL MOTORS CORP.

14. Remove the exhaust heat shield studs (2).
15. Remove the exhaust heat shield (1).

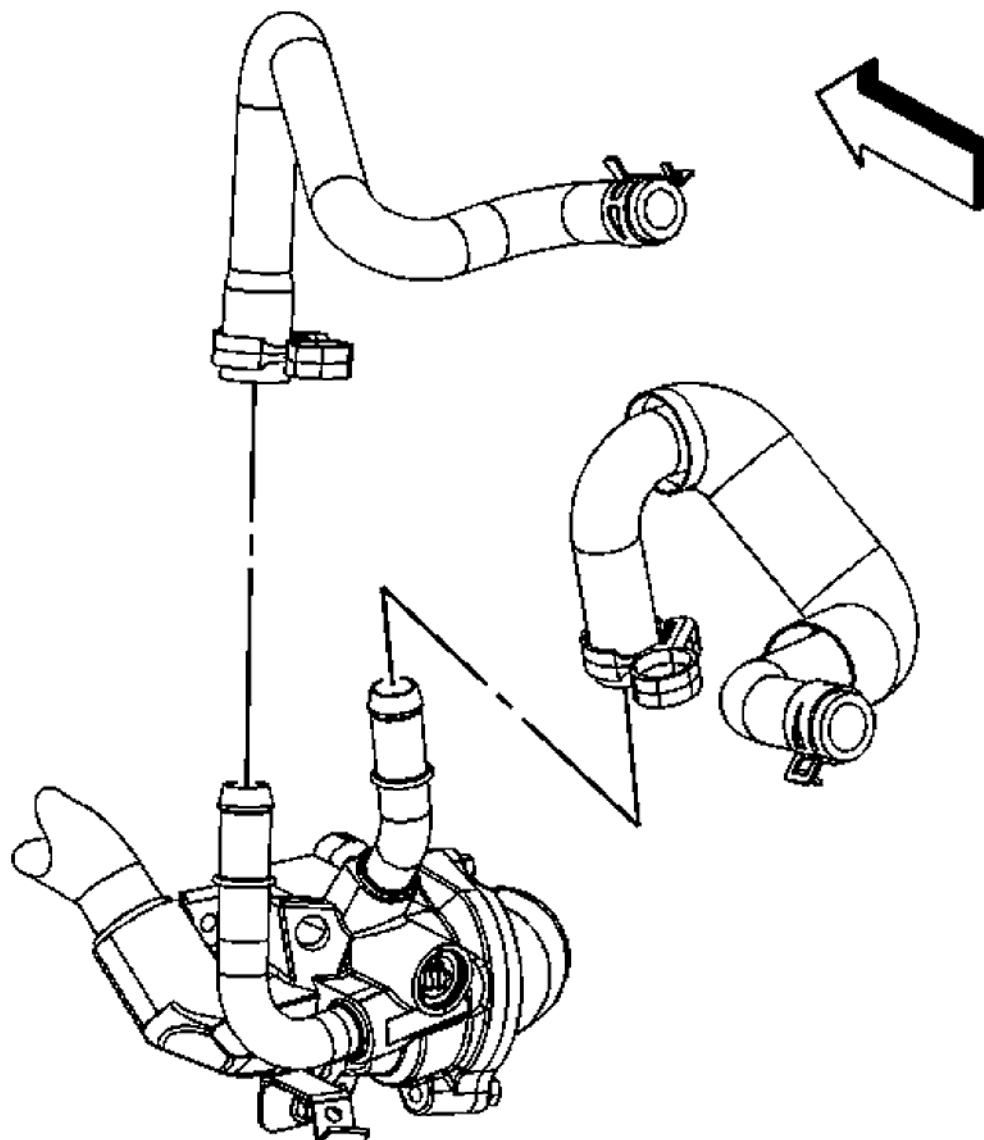


Fig. 65: Heater Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

16. Reposition the heater inlet and outlet hose clamps at the thermostat housing pipes.
17. Disconnect the heater inlet and outlet hoses from the thermostat housing pipes.
18. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

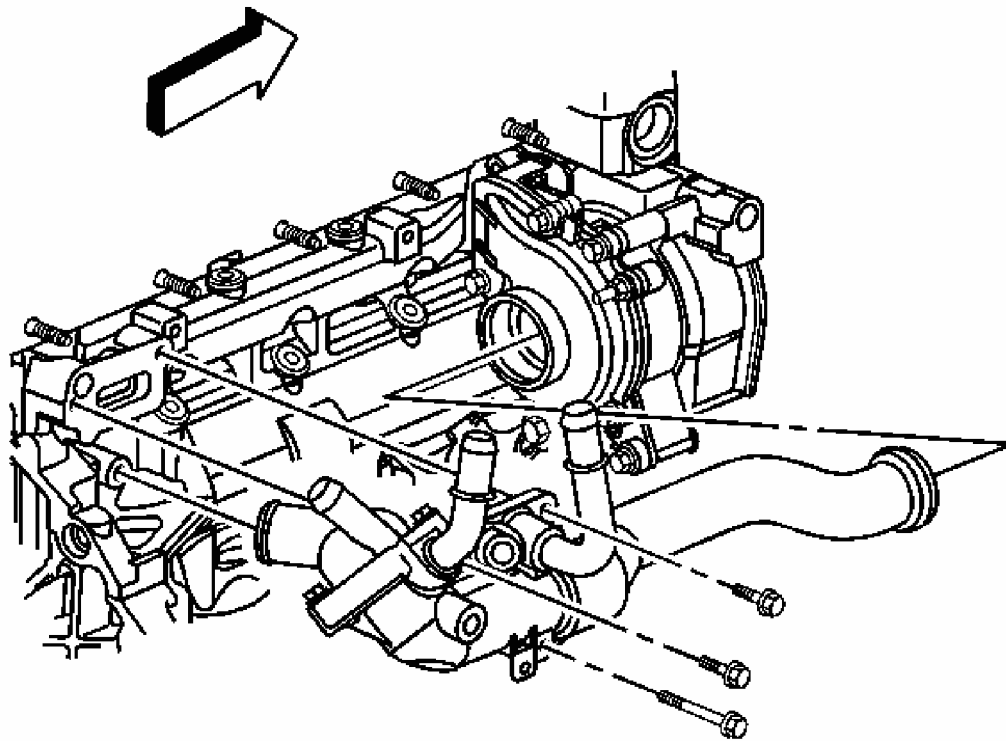


Fig. 66: Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

19. Remove the thermostat housing bolts.

IMPORTANT: Twist the water transfer pipe while pulling in order to remove it from the water pump.

20. Remove the thermostat housing from the vehicle.
21. Remove the water transfer pipe from the thermostat housing, if necessary.
22. Remove and discard the water transfer pipe O-ring seals, if necessary.

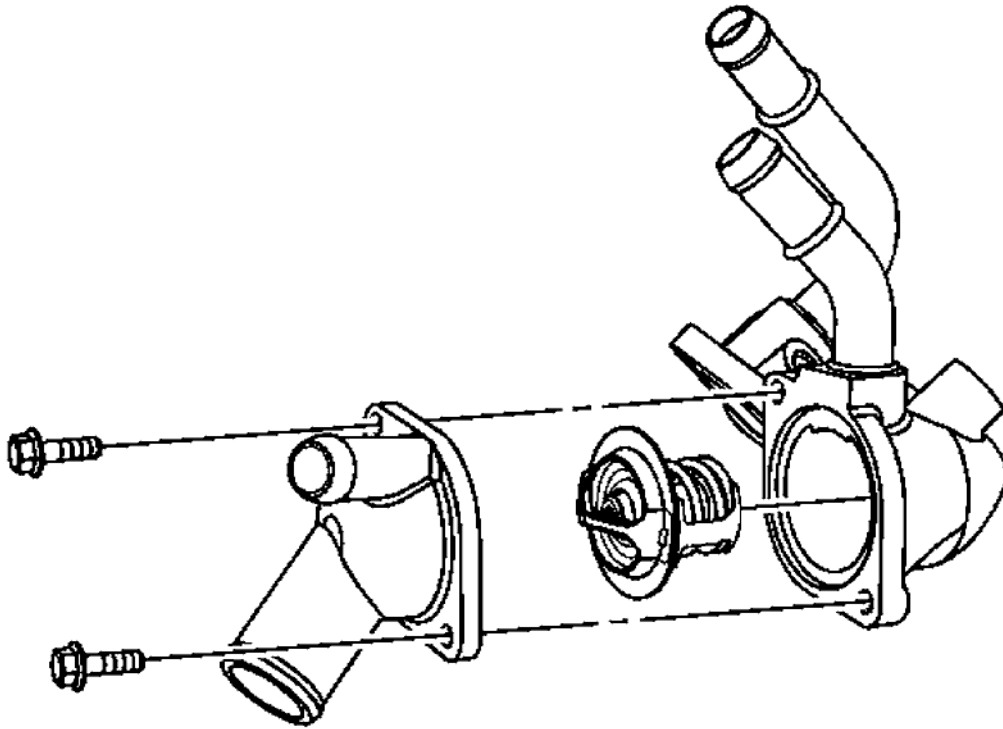


Fig. 67: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

23. Remove the thermostat housing cover bolts and cover, if necessary.
24. Remove the thermostat, if necessary.
25. Remove and discard the thermostat housing O-ring seal, if necessary.
26. Remove all debris and thread sealant from the engine coolant temperature sensor and bolt holes if the housing is being re-used.

Installation Procedure

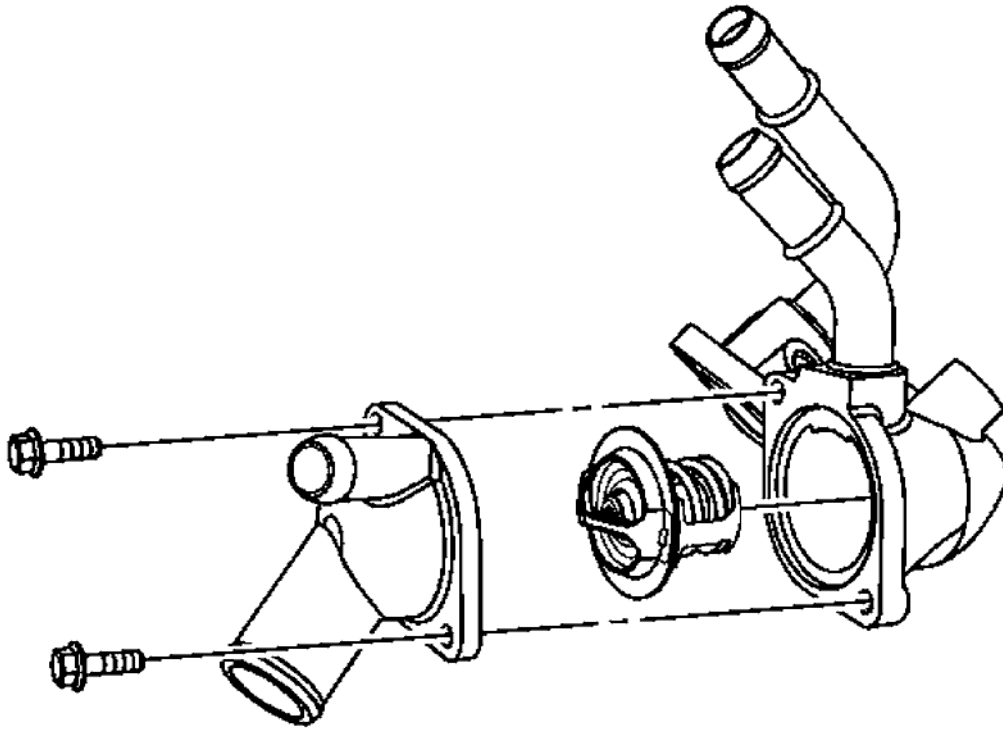


Fig. 68: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat housing cover O-ring seal into the recess groove.
2. Install the thermostat, if necessary.

NOTE: Refer to Fastener Notice .

3. Install the thermostat housing cover bolts, if necessary.

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

4. Install a NEW thermostat housing to engine gasket onto the thermostat housing.
5. Load the thermostat housing assembly into position.

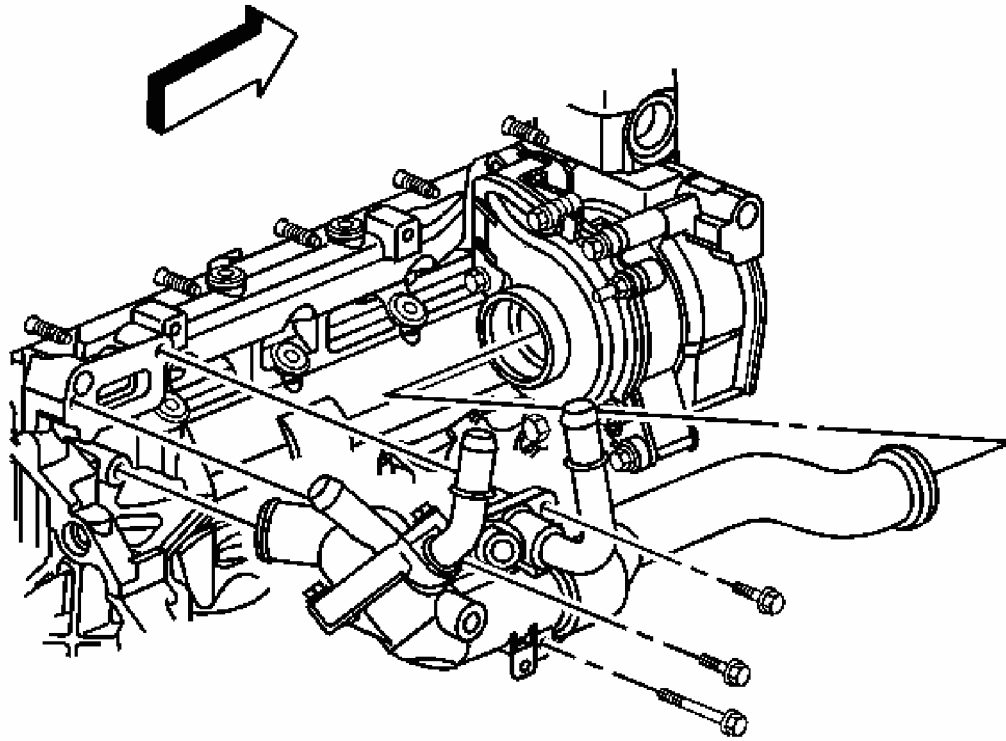


Fig. 69: Water Feed Pipe

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The water feed pipe seals can be lightly lubricated with coolant to aid during installation.

6. Install NEW O-ring seals onto the water feed pipe.

IMPORTANT: Lubricate the O-rings with coolant **ONLY**.

7. Install the water feed pipe into the thermostat housing aligning locator tab.
8. Align the water pipe to water pump.
9. Seat the water feed O-ring seal by pushing inward toward the water pump. Take care not to tear or damage the O-ring.
10. Position the thermostat housing against the engine.
11. Install the thermostat housing bolts.

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

12. Lower the vehicle.

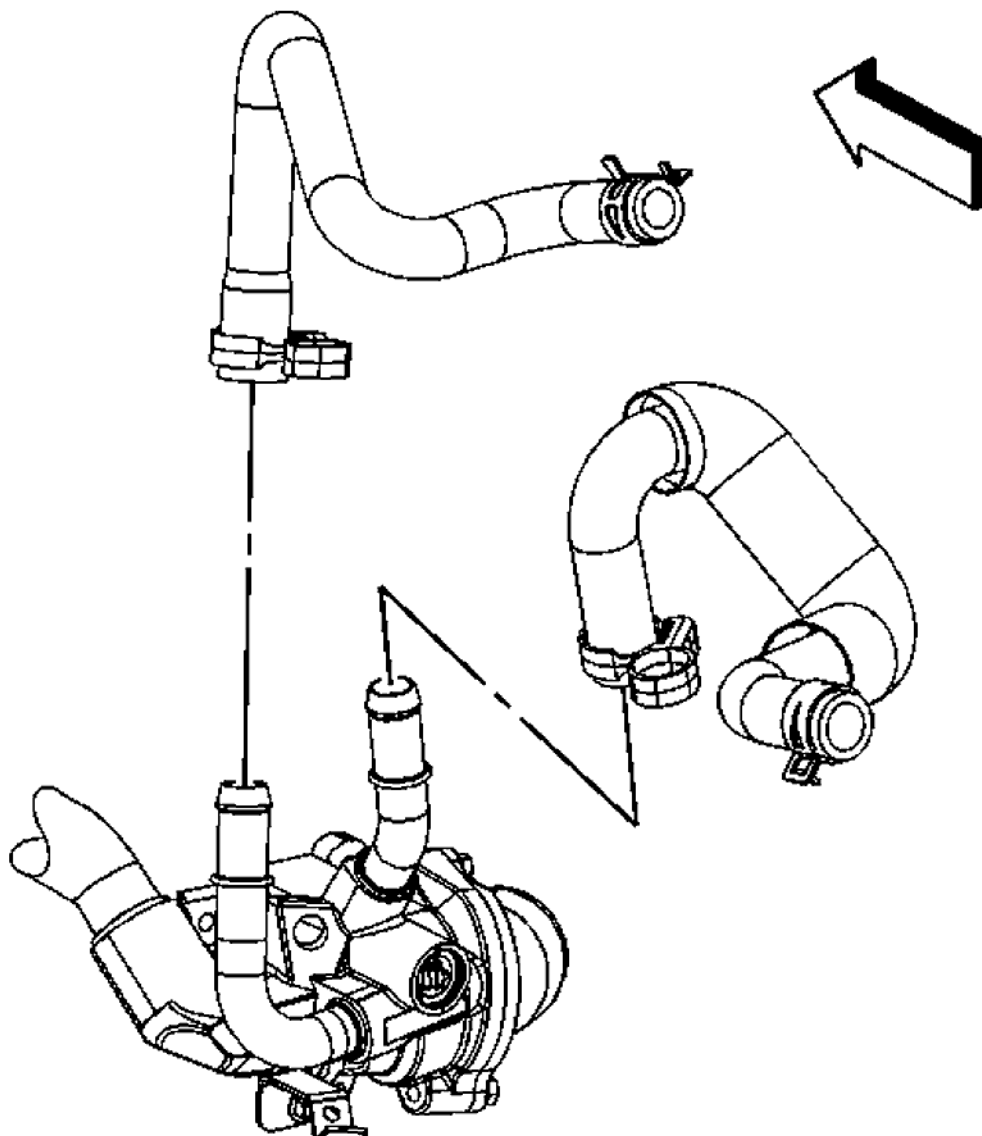


Fig. 70: Heater Inlet And Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

13. Connect the heater inlet and outlet hoses to the thermostat housing pipes.
14. Position the heater inlet and outlet hose clamps at the thermostat housing pipes.

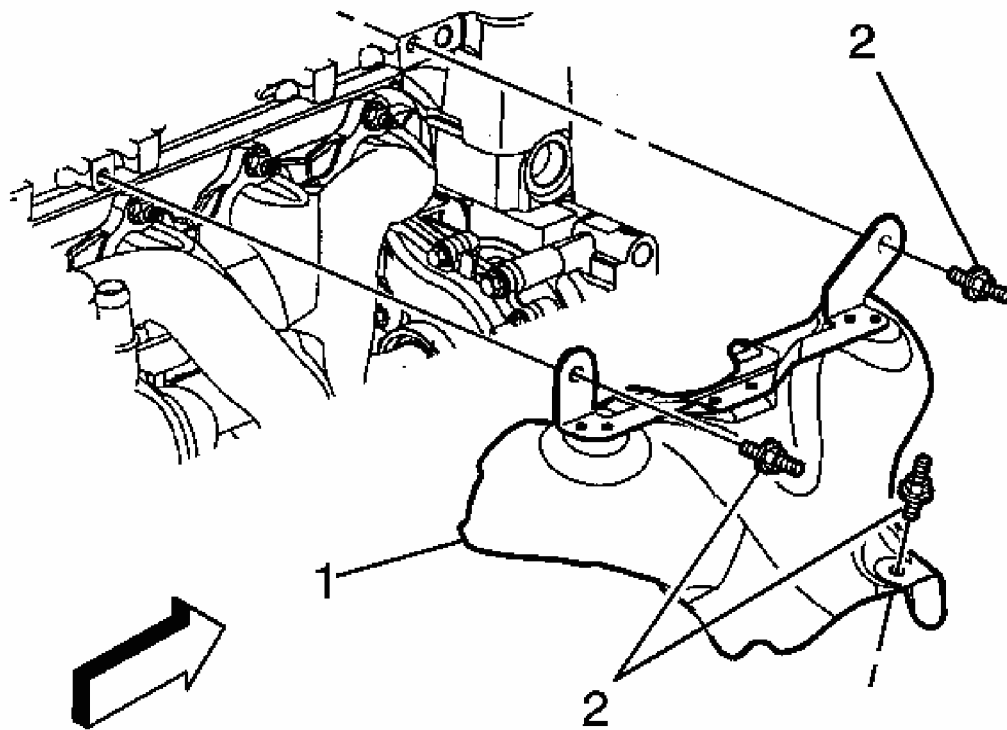


Fig. 71: Exhaust Heat Shield
Courtesy of GENERAL MOTORS CORP.

15. Install the exhaust heat shield (1).
16. Install the exhaust heat shield studs (2).

Tighten: Tighten the studs to 22 N.m (16 lb ft).

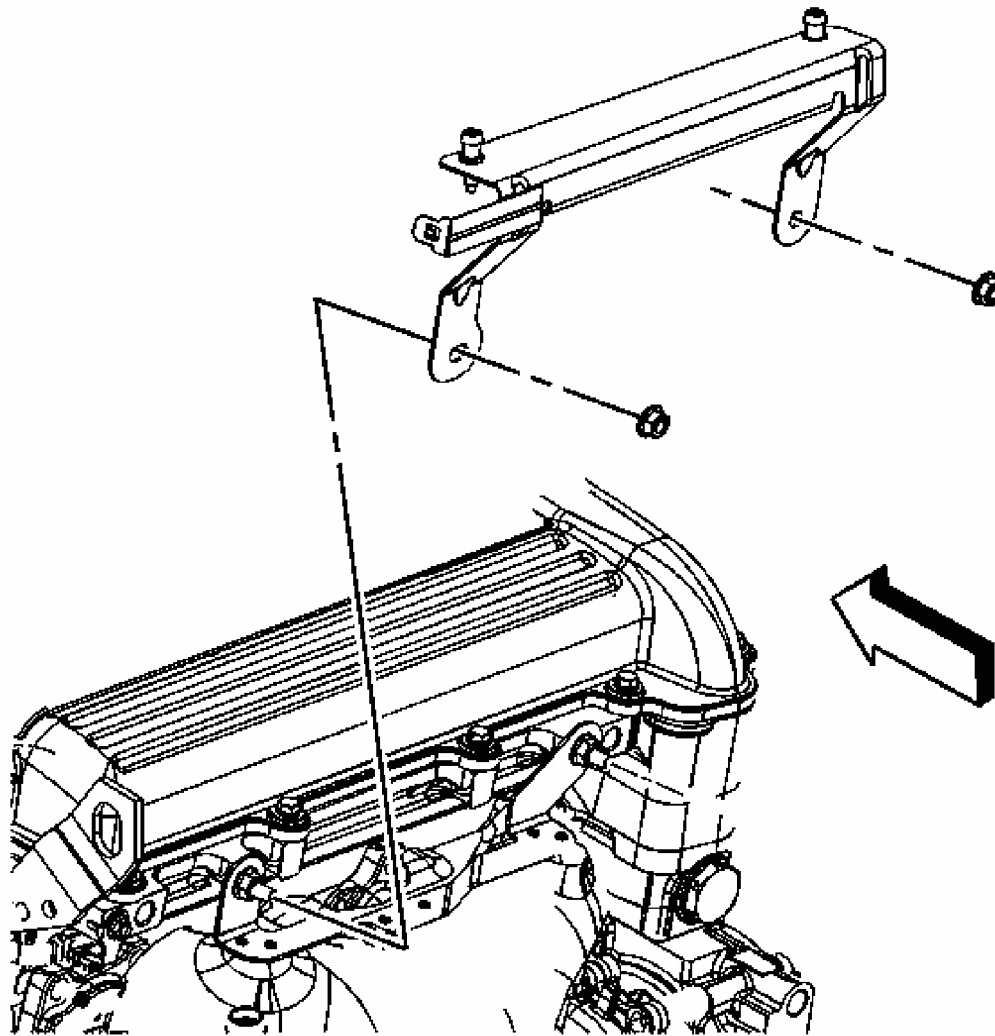


Fig. 72: Air Cleaner Bracket
Courtesy of GENERAL MOTORS CORP.

17. Install the air cleaner bracket.
18. Install the air cleaner bracket nuts.

Tighten: Tighten the nuts to 10 N.m (89 lb in).

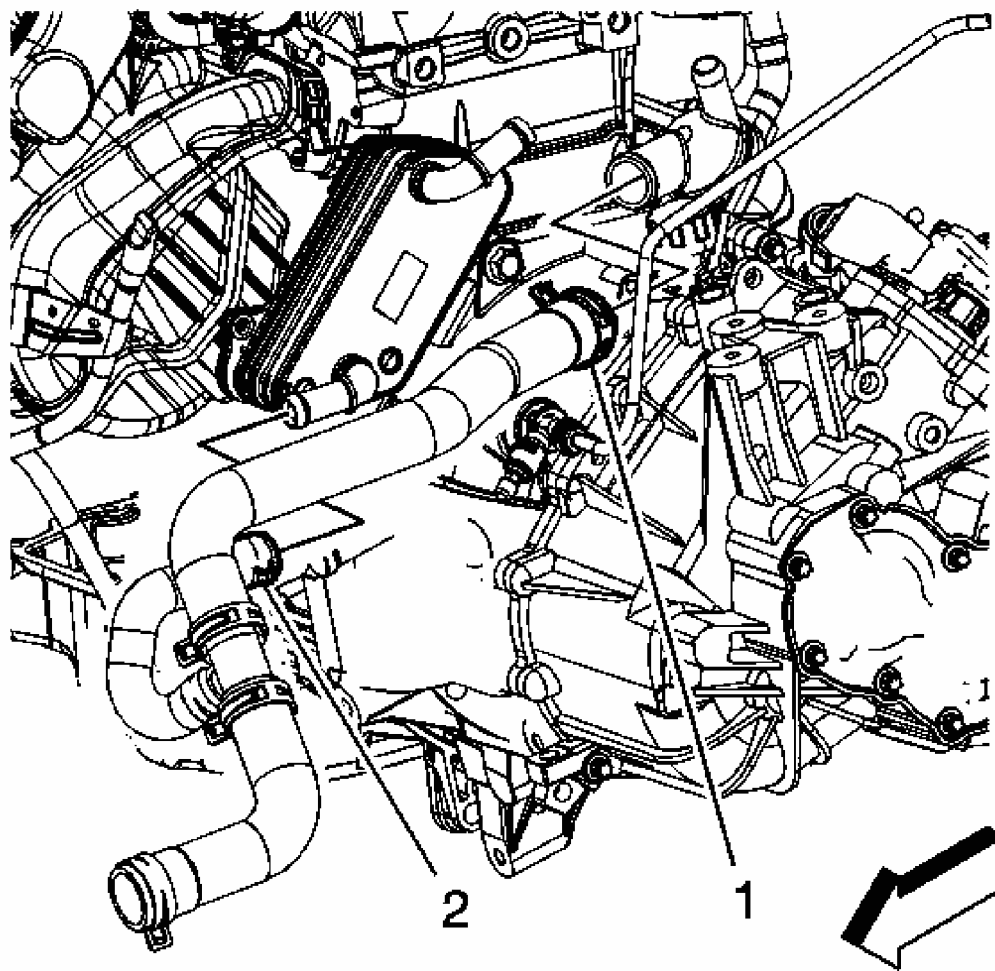


Fig. 73: Radiator Outlet Hose

Courtesy of GENERAL MOTORS CORP.

19. Install the radiator outlet hose to the thermostat housing.
20. Position the radiator outlet hose clamp (1) at the thermostat housing.

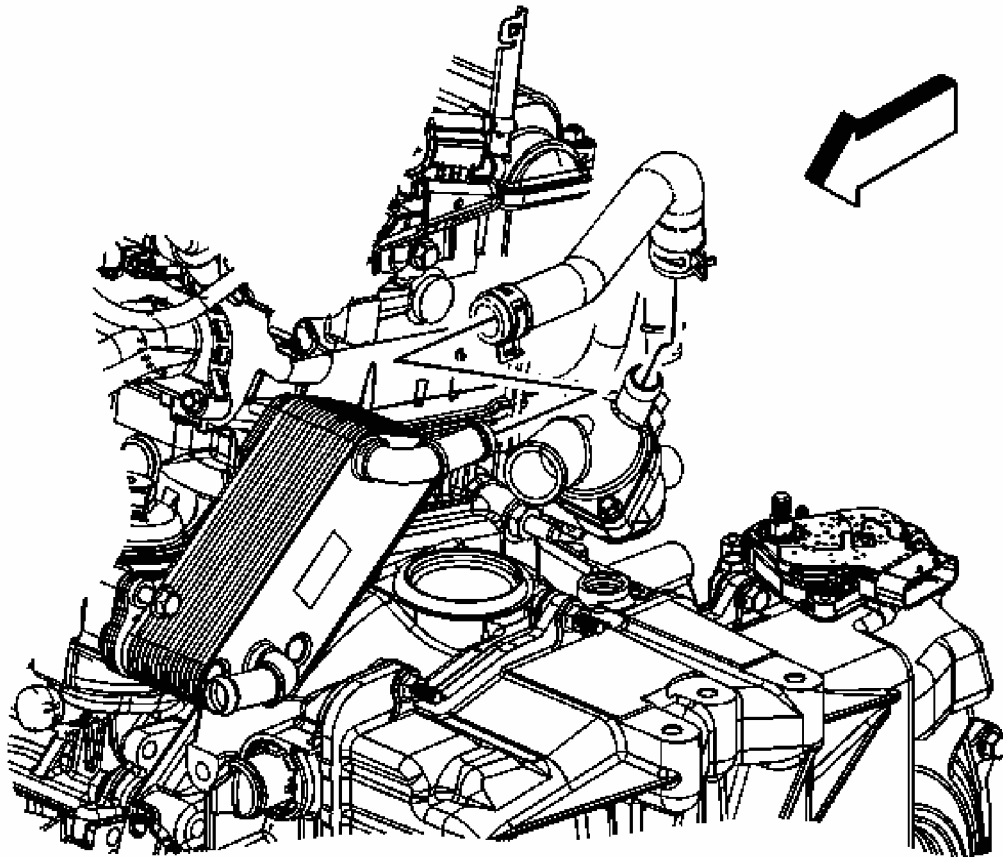


Fig. 74: Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

21. Install the oil cooler outlet hose to the thermostat housing.
22. Position the oil cooler outlet hose clamp at the thermostat housing.

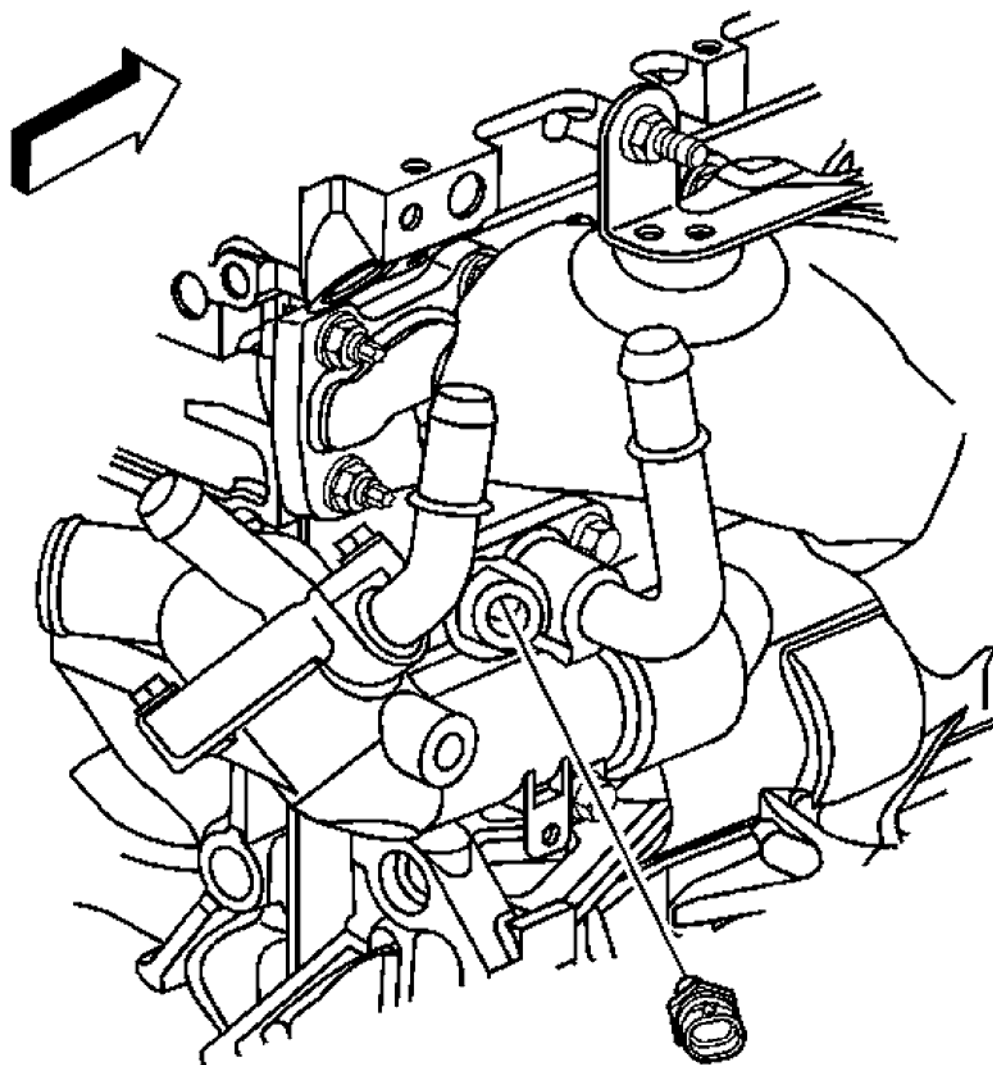


Fig. 75: ECT Sensor
Courtesy of GENERAL MOTORS CORP.

23. Install the ECT sensor, if necessary.

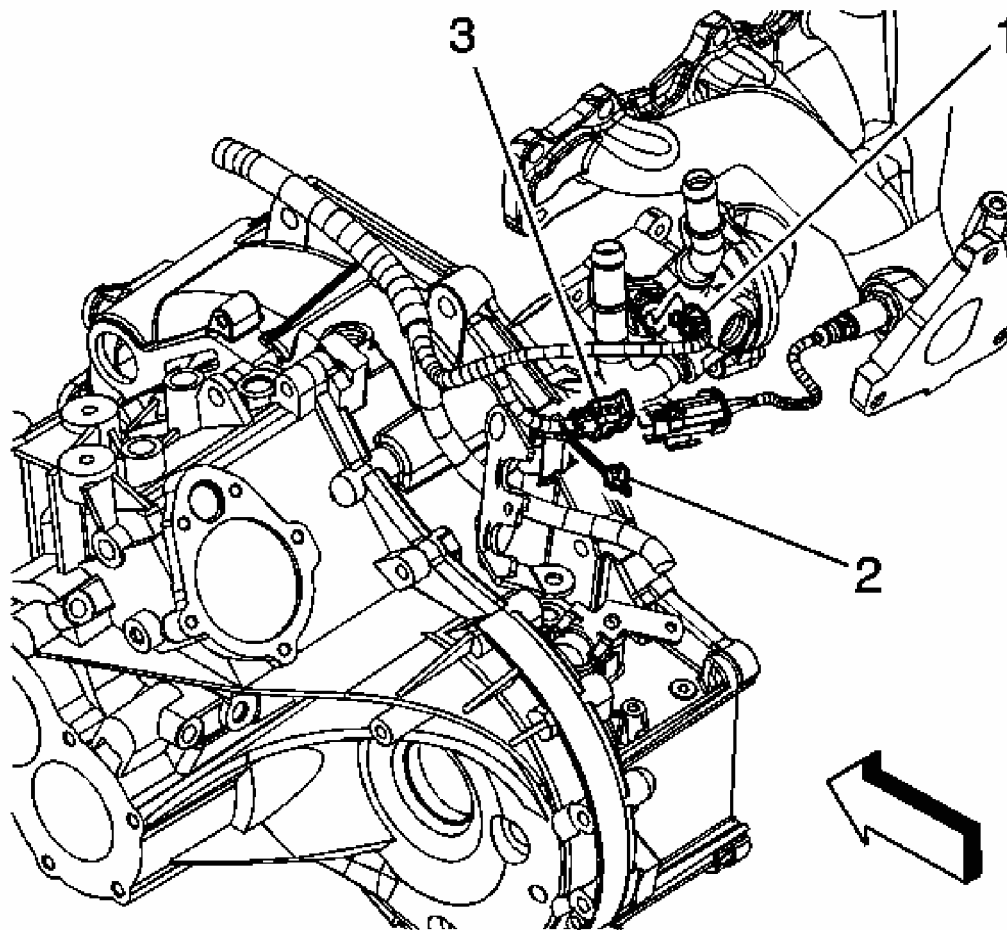


Fig. 76: ECT Sensor Electrical Connector (M/T)
Courtesy of GENERAL MOTORS CORP.

24. If equipped with a manual transaxle, connect the ECT sensor electrical connector (1).

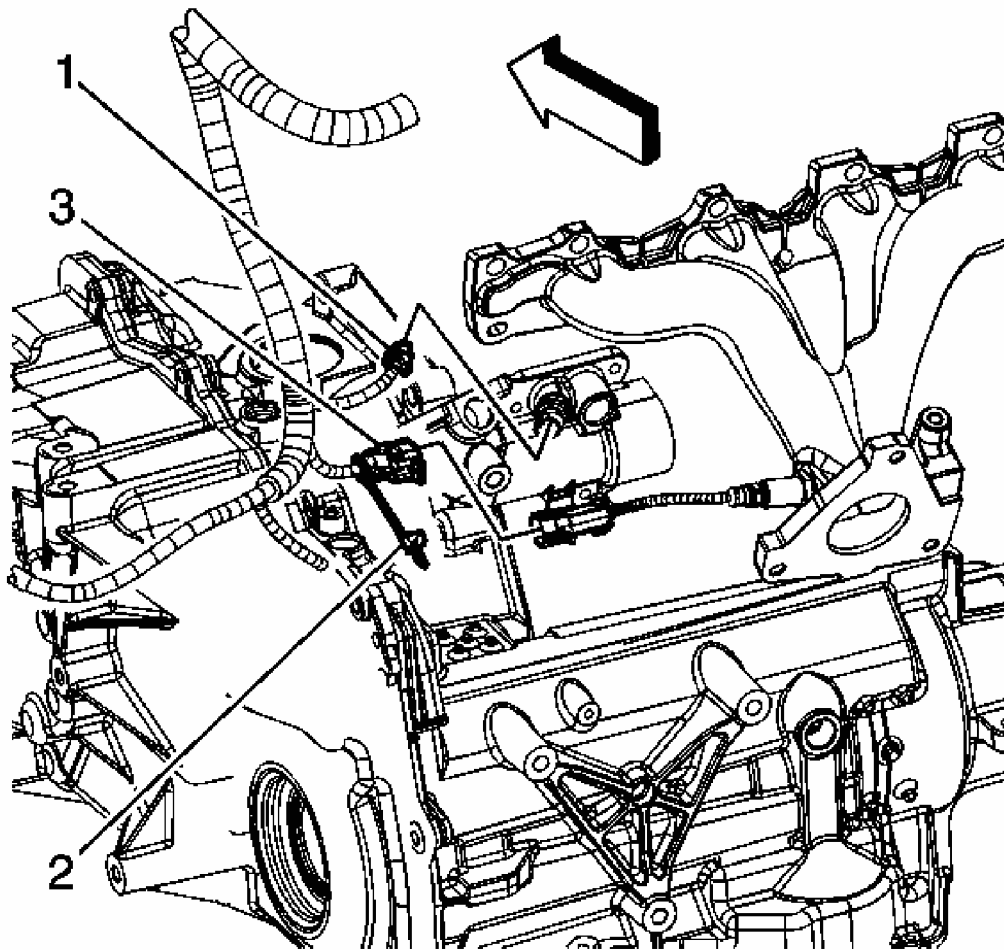


Fig. 77: ECT Sensor Connector (A/T)
Courtesy of GENERAL MOTORS CORP.

25. If equipped with a automatic transaxle, perform the following steps, connect the ECT sensor electrical connector (1).
26. Connect the HO2S electrical connector clip to the thermostat housing.

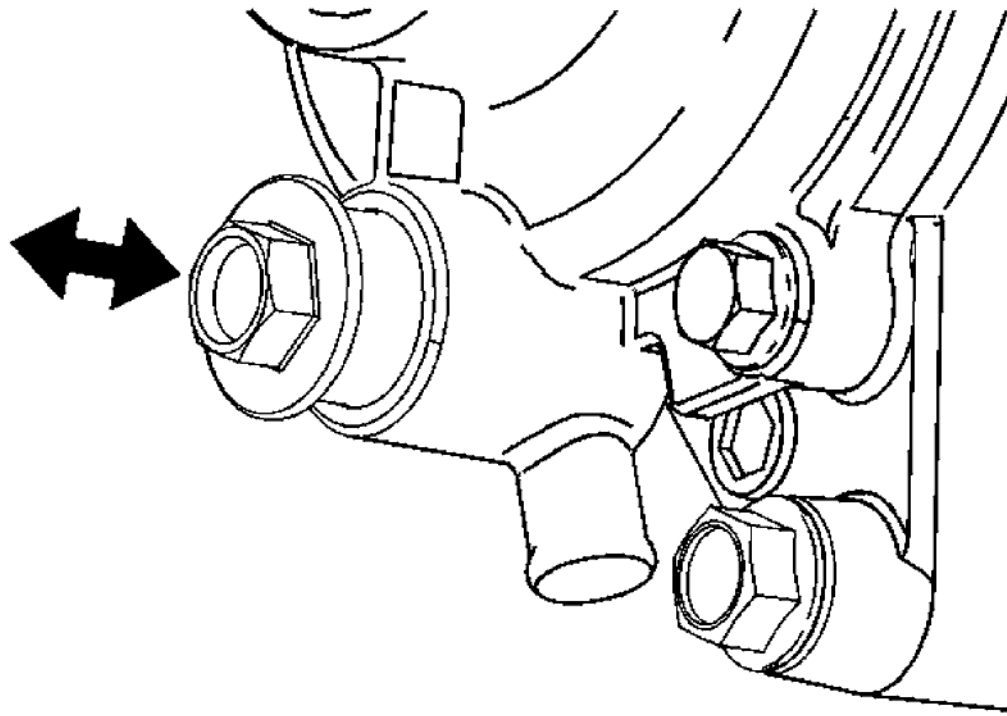


Fig. 78: Opening Water Pump Drain Plug (2.2L)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The vehicle must be level when filling the cooling system.

27. Verify the drain valves at the radiator and water pump are closed.
28. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.
29. Lower the vehicle.
30. Verify the repair and inspect for any leaks.

THERMOSTAT REPLACEMENT (RPO L61)

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

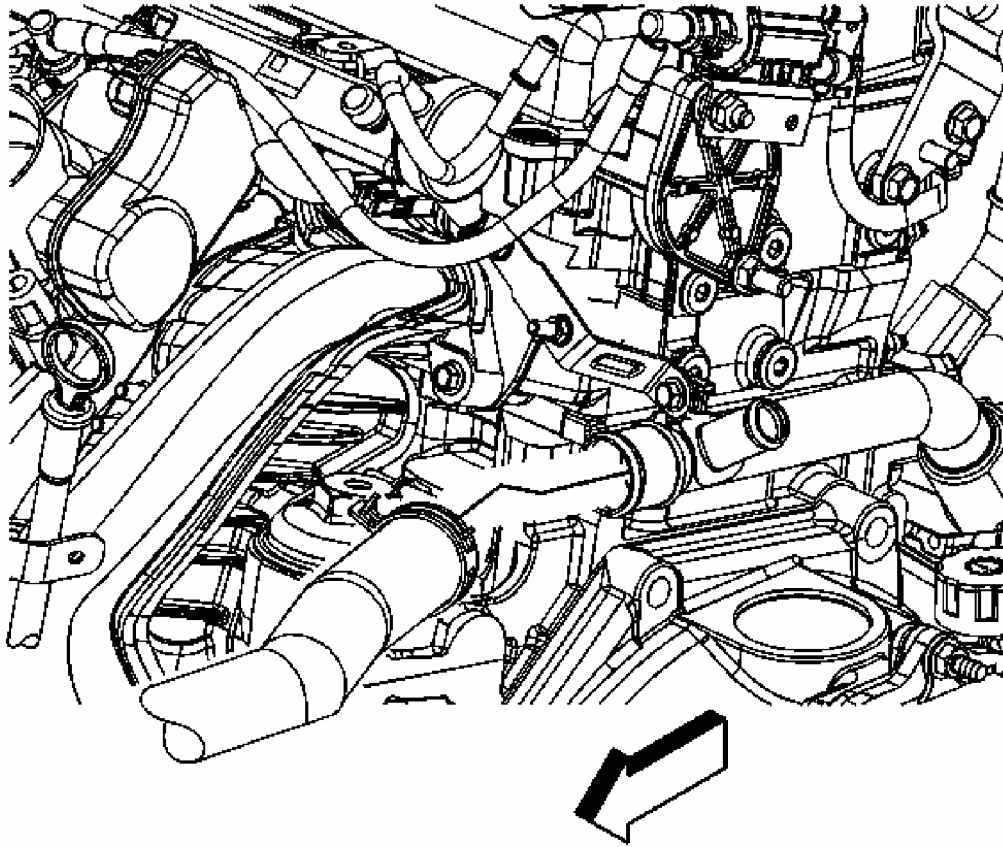


Fig. 79: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Reposition the radiator outlet hose clamp at the thermostat housing.
3. Remove the radiator outlet hose from the thermostat housing.

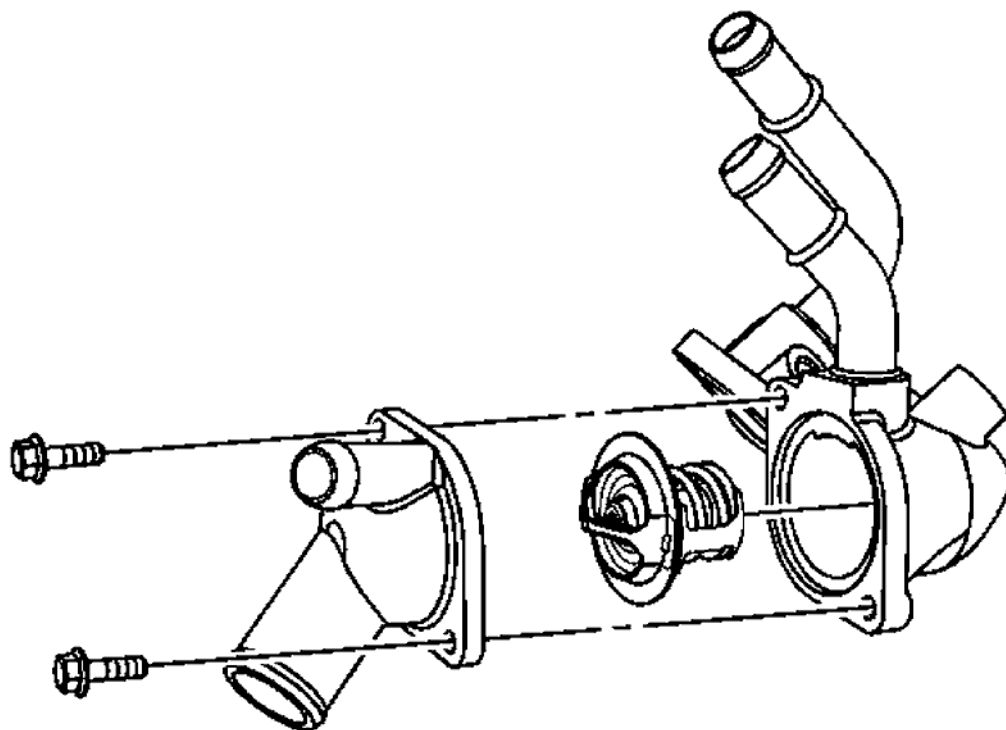


Fig. 80: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the thermostat housing cover bolts and cover.
5. Remove the thermostat.
6. Remove and discard the thermostat housing O-ring seal.

Installation Procedure

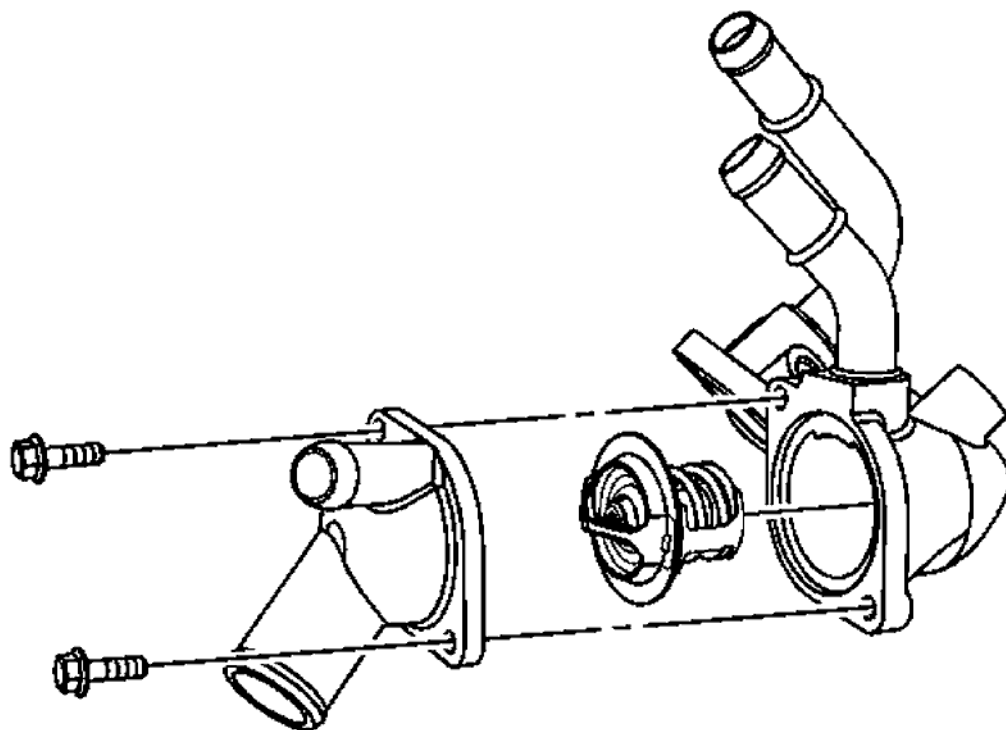


Fig. 81: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat housing cover O-ring seal.
2. Install the thermostat.

NOTE: Refer to Fastener Notice .

3. Install the thermostat housing cover bolts.

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

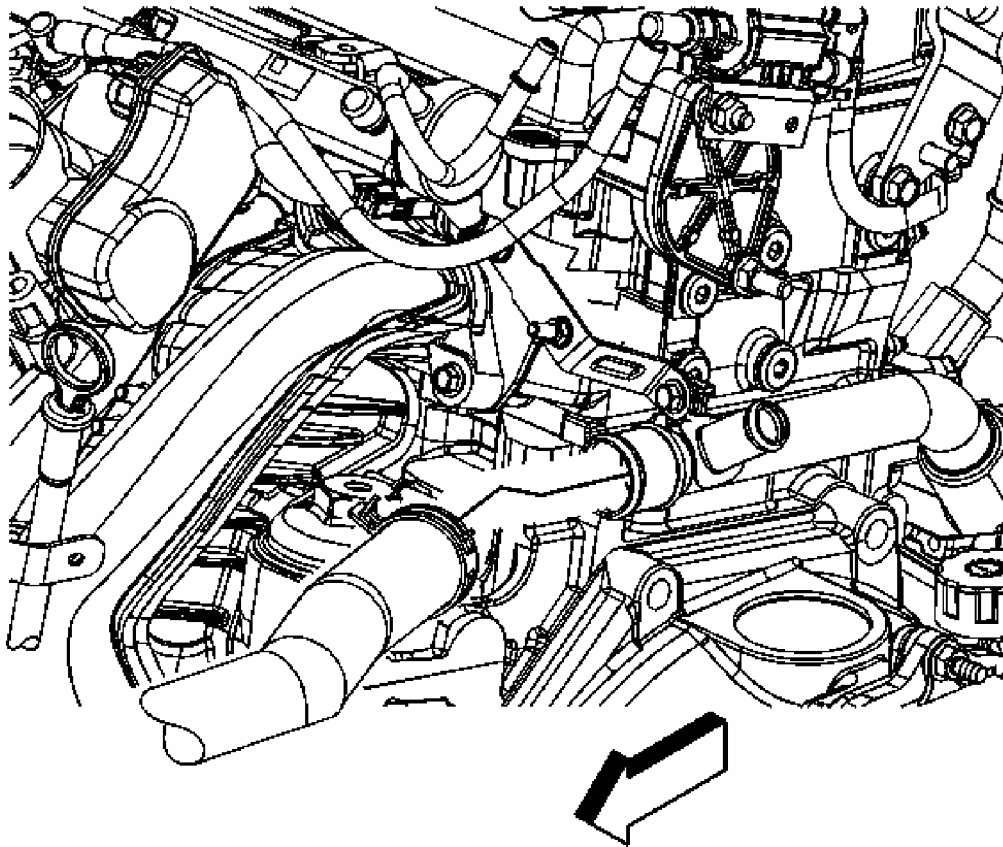


Fig. 82: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator outlet hose to the thermostat housing.
5. Position the radiator outlet hose clamp at the thermostat housing.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

THERMOSTAT REPLACEMENT (RPO LE5)

Removal Procedure

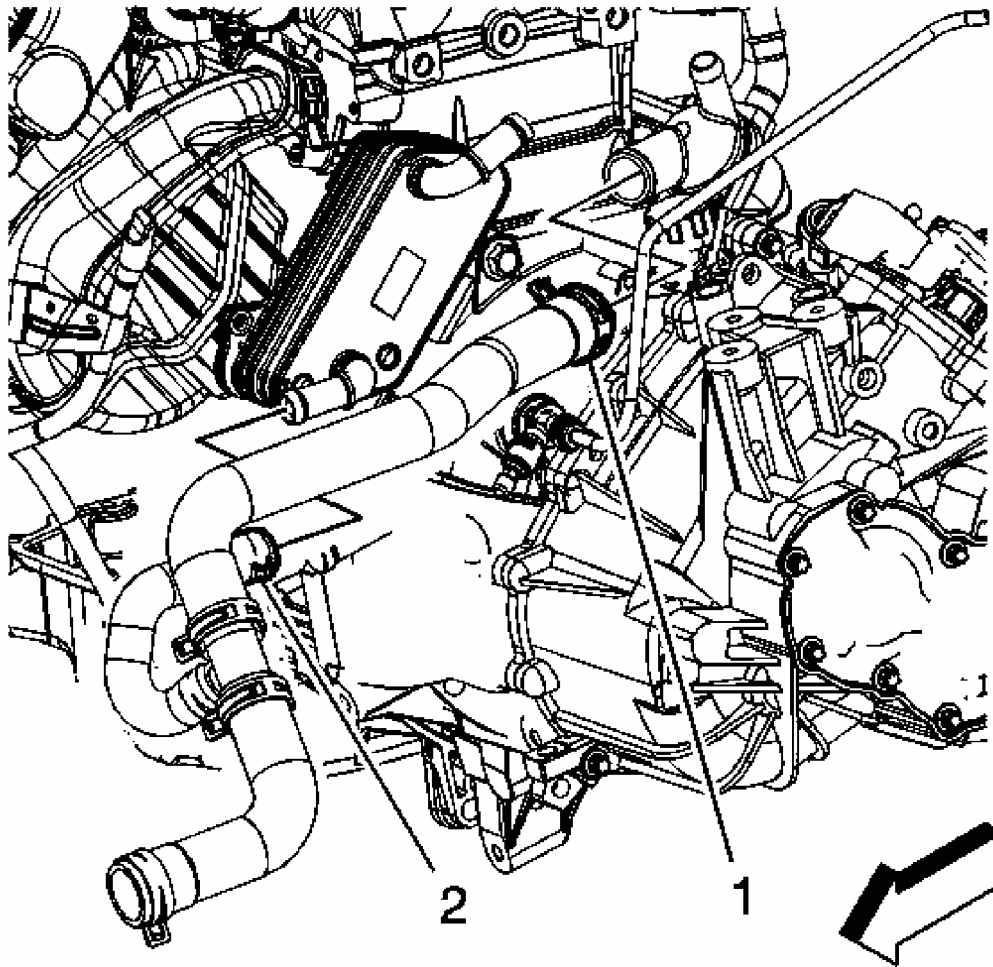


Fig. 83: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.
2. Reposition the radiator outlet hose clamp (1) at the thermostat housing.
3. Remove the radiator outlet hose from the thermostat housing.

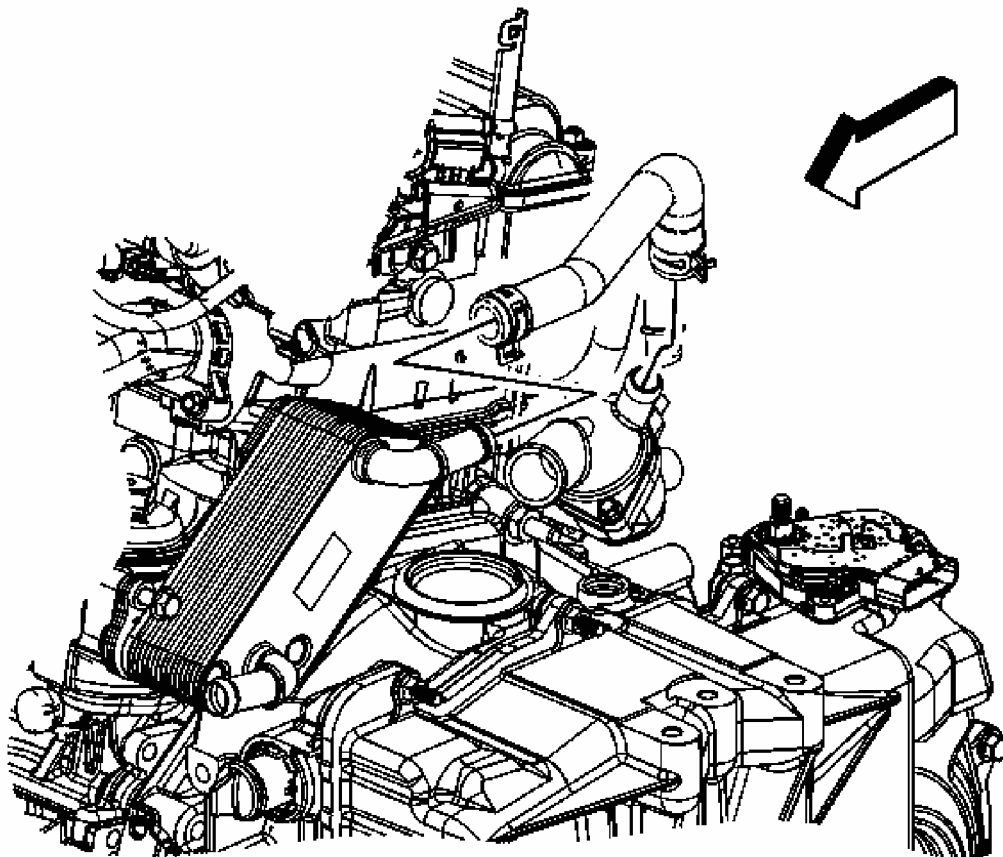


Fig. 84: Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Reposition the oil cooler outlet hose clamp at the thermostat housing.
5. Remove the oil cooler outlet hose from the thermostat housing.

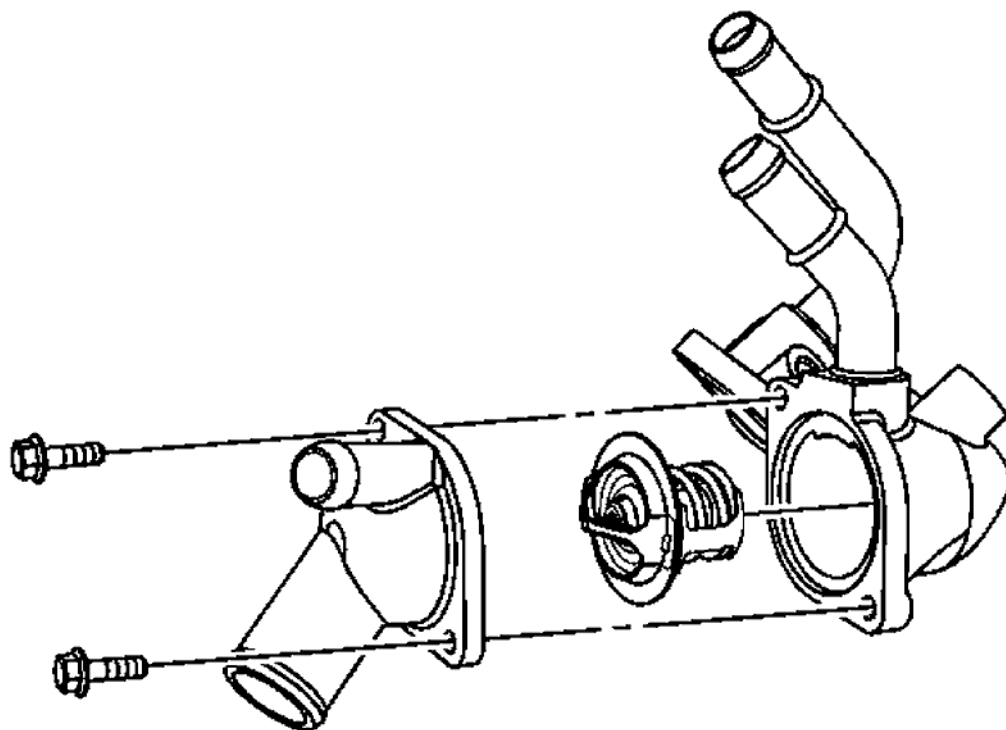


Fig. 85: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the thermostat housing cover bolts and cover.
7. Remove the thermostat.
8. Remove and discard the thermostat housing O-ring seal.

Installation Procedure

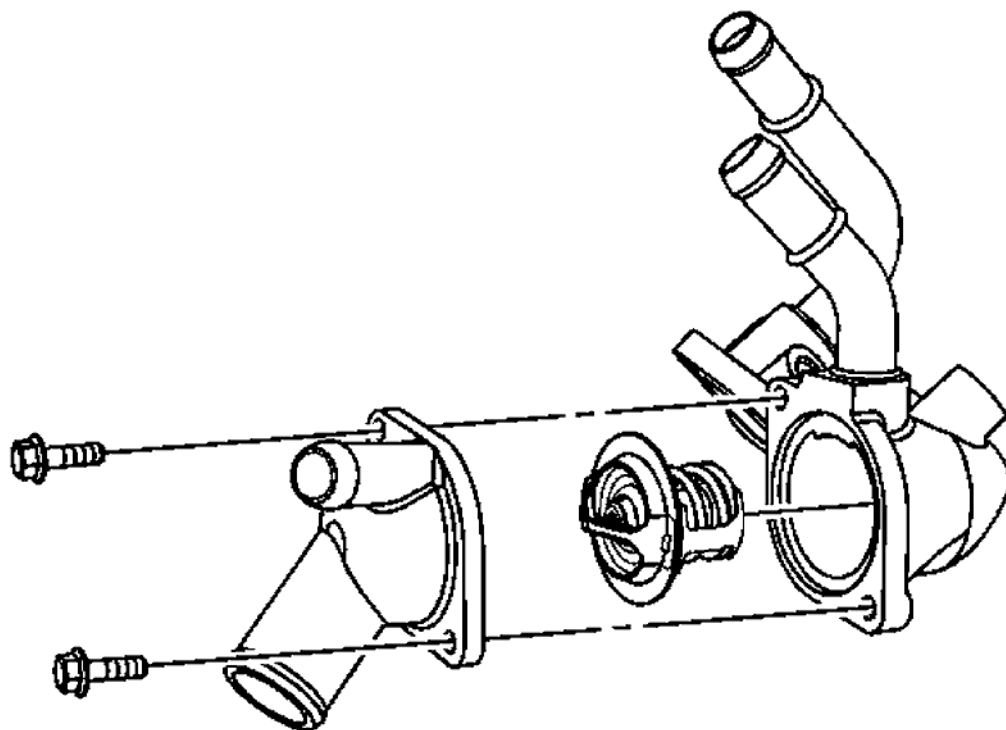


Fig. 86: Thermostat Housing Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat housing cover O-ring seal.
2. Install the thermostat.

NOTE: Refer to Fastener Notice .

3. Install the thermostat housing cover bolts.

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

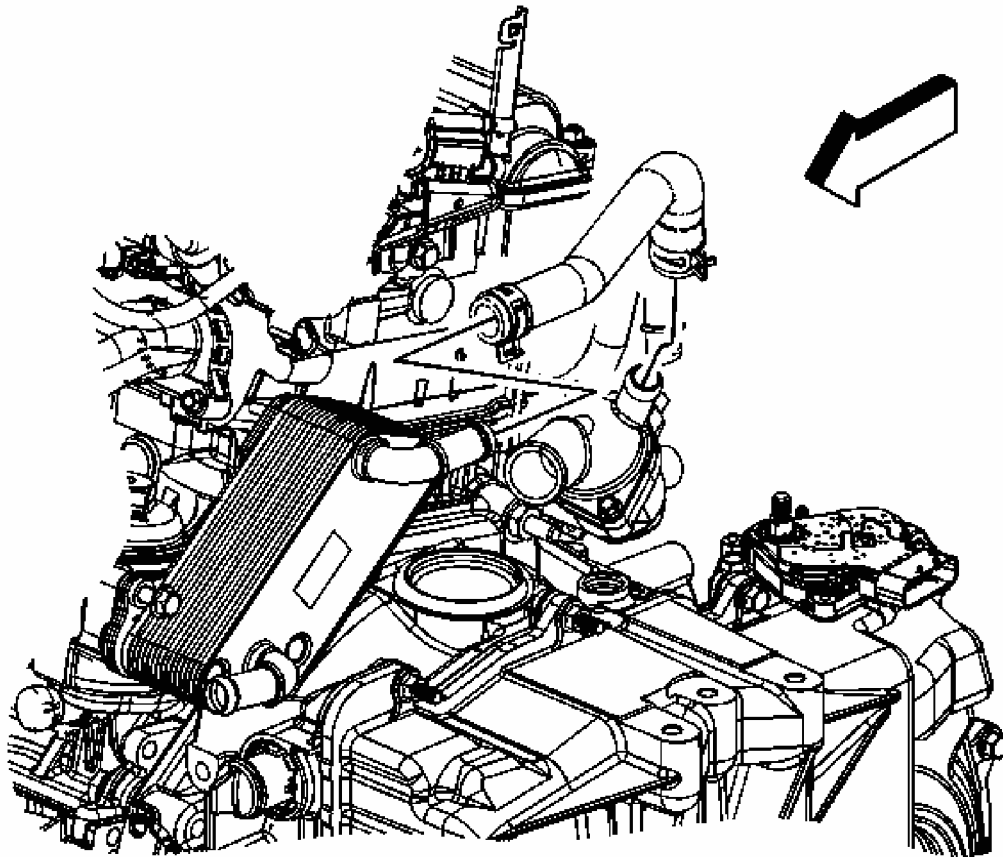


Fig. 87: Oil Cooler Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the oil cooler outlet hose to the thermostat housing.
5. Position the oil cooler outlet hose clamp at the thermostat housing.

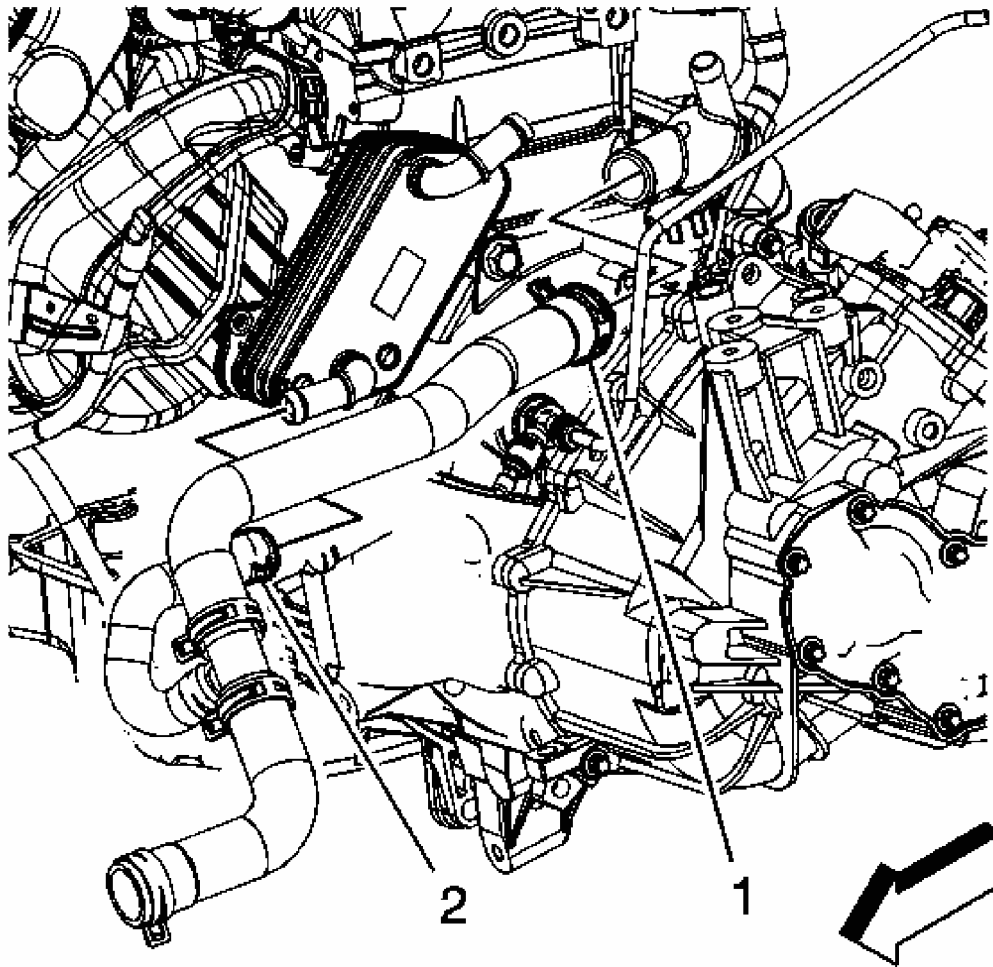


Fig. 88: Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Install the radiator outlet hose to the thermostat housing.
7. Position the radiator outlet hose clamp (1) at the thermostat housing.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

WATER PUMP REPLACEMENT

Tools Required

J 43651 Water Pump Holding Tool. See **Special Tools**.

Removal Procedure

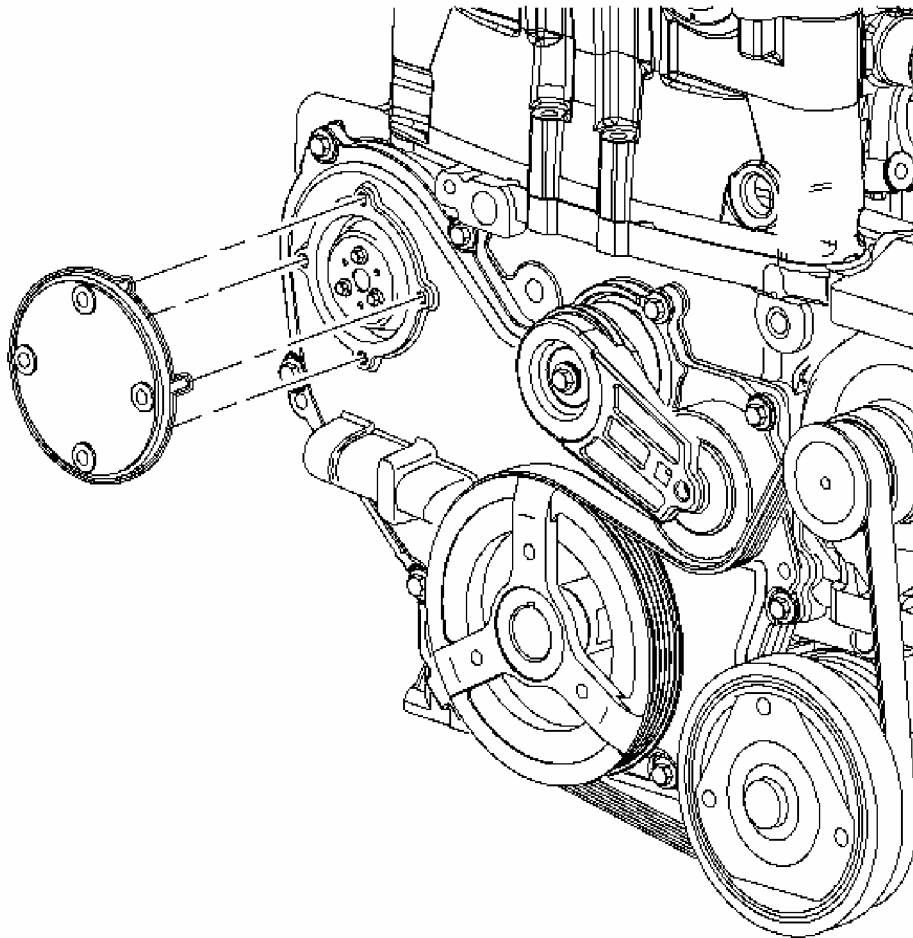


Fig. 89: View Of Water Pump Access Plate At Front Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the thermostat housing. Refer to Thermostat Housing Replacement (RPO L61) or Thermostat Housing Replacement (RPO LE5).
2. Remove the water pump access plate from the front cover.
3. Remove the right hand fender liner. Refer to Wheelhouse Liner Replacement - Front .

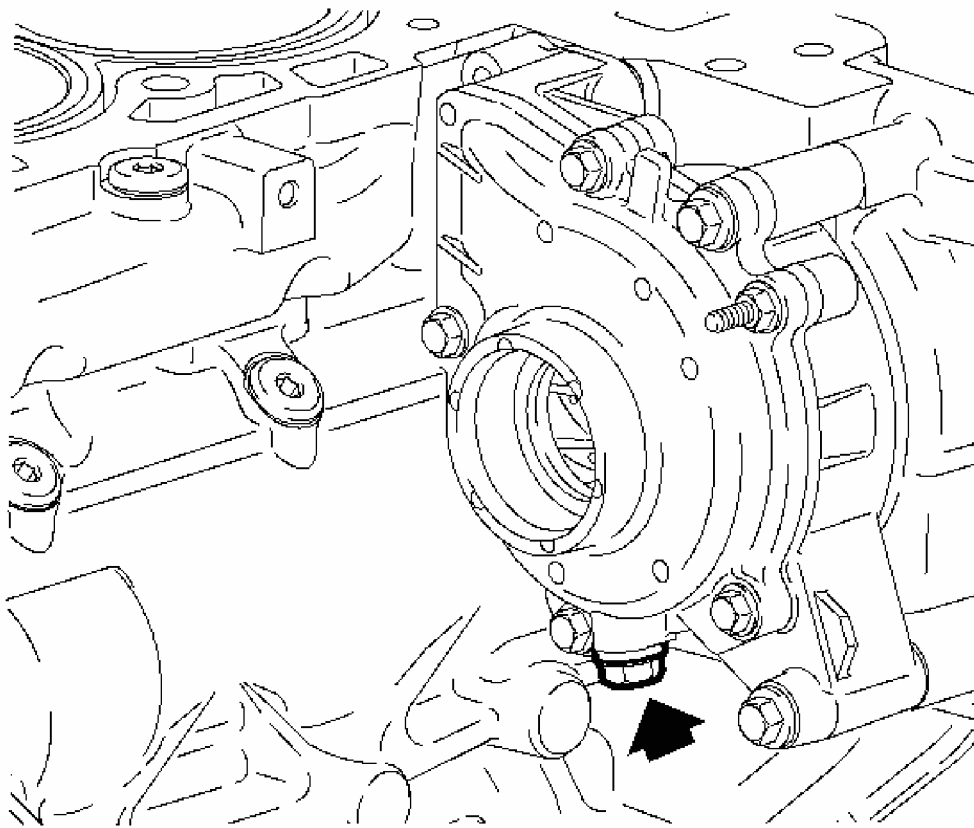


Fig. 90: Locating Water Pump Drain Plug (L61)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A drain plug has been provided at the bottom of the water pump assembly for additional coolant drainage from the engine block and water pump.

4. Drain the coolant from the water pump using the plug at the bottom of the pump.

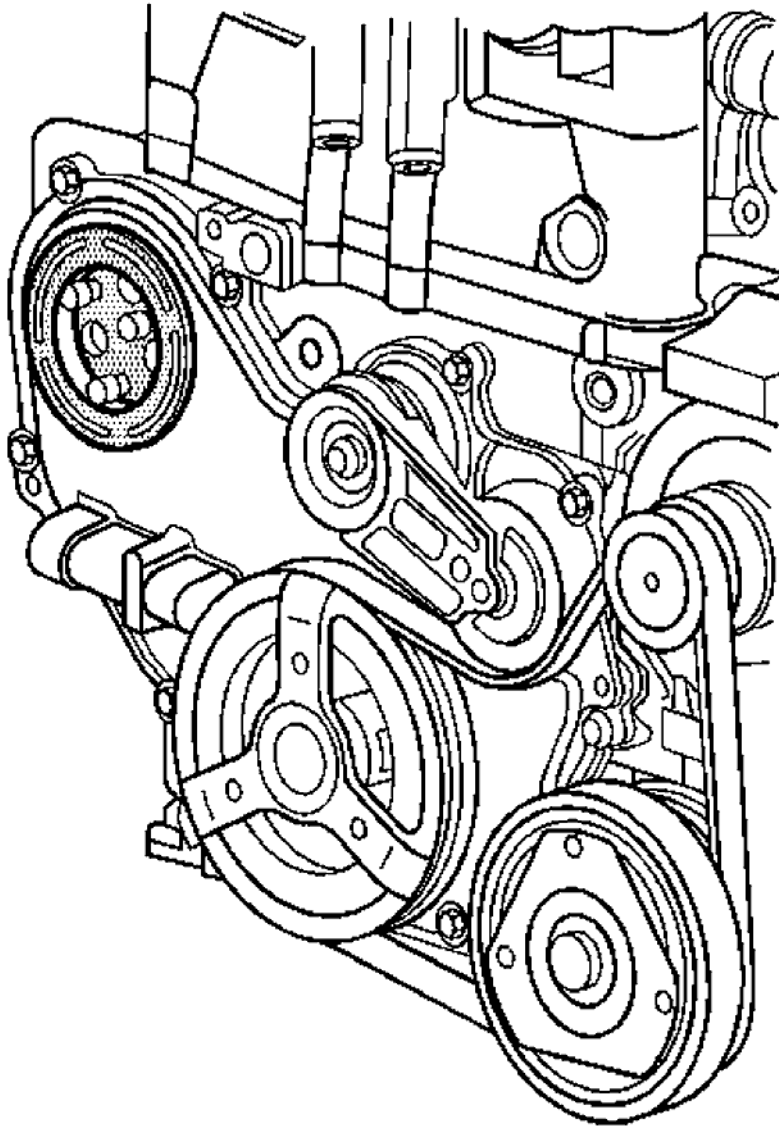


Fig. 91: View Of Water Pump Holding Tool
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The water pump holding tool supports the sprocket and chain during water pump service. The tool must be used or the balance shaft must be re-timed.

5. Install the **J 43651** into position. See **Special Tools**.
6. Tighten the bolts on the water pump holding tool into the threads on the water pump

sprocket.

7. Install the access cover bolts that were removed earlier to secure the water pump holding tool to the front cover assembly.
8. Remove the 3 inner water pump sprocket to water pump bolts.

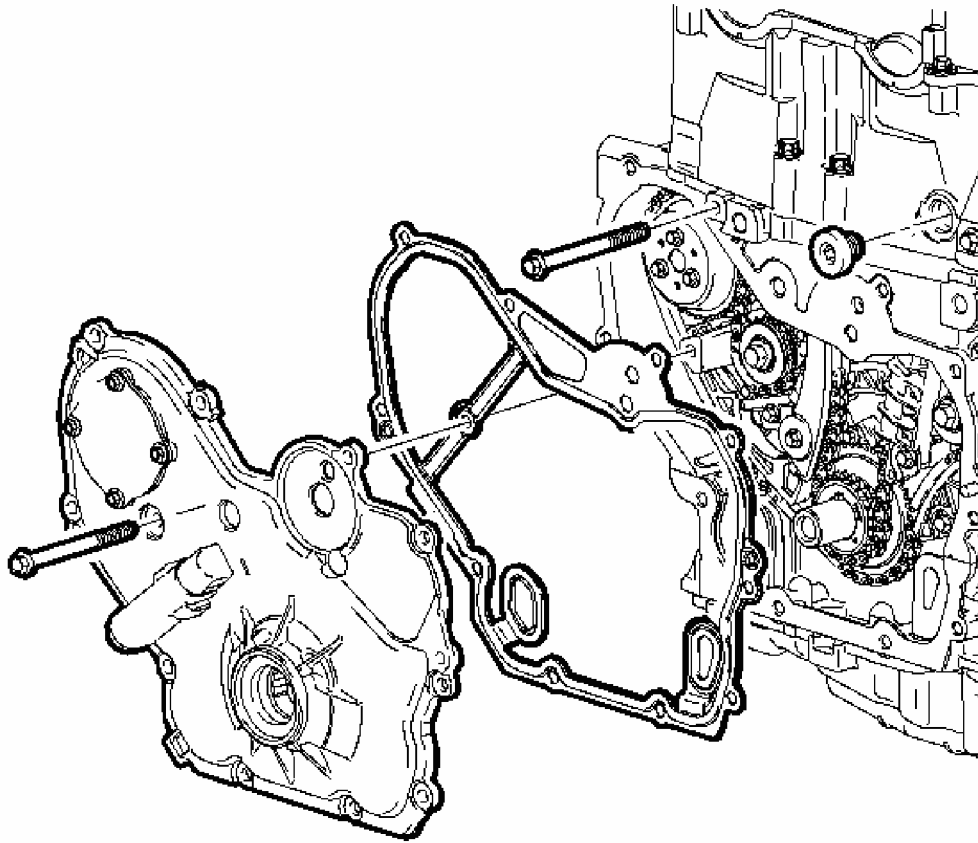


Fig. 92: View Of Water Pump Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be sure to remove both water pump bolts from the front of the engine block.

9. Remove the 2 water pump bolts.

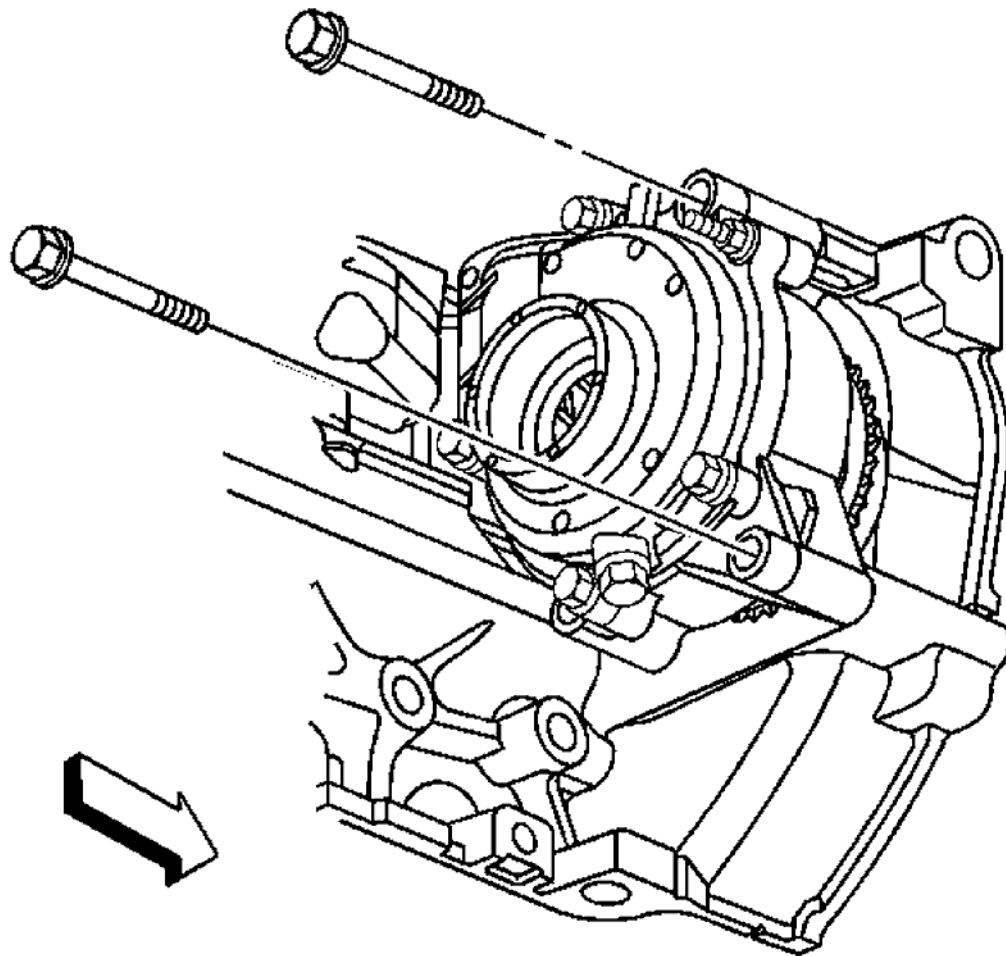


Fig. 93: Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the rear 2 water pump bolts.

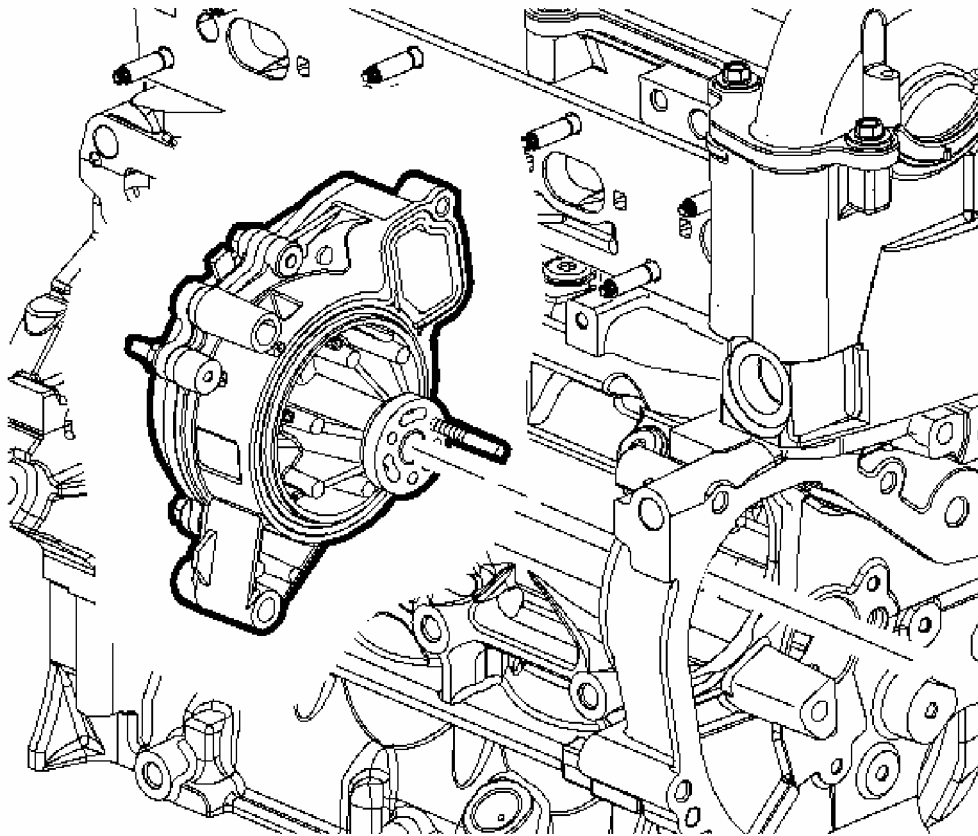


Fig. 94: View Of Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

11. Remove the water pump.
12. Remove and discard the water pump O-ring seal.

Installation Procedure

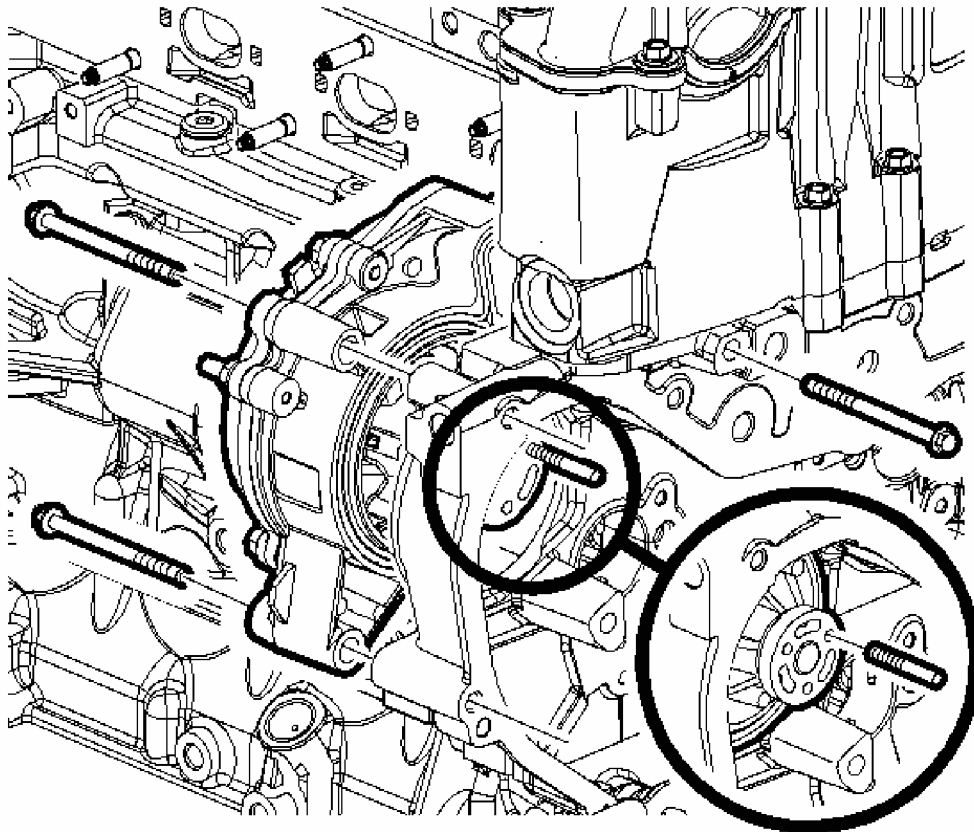


Fig. 95: View Of Water Pump Bolts (L61)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Prior to installing the water pump, read the entire procedure. This will help avoid balance shaft chain re-timing and ensure proper sealing.

1. Install a NEW water pump O-ring seal.

IMPORTANT: A guide pin can be created to aid in water pump alignment. Use a M6 m x 6 mm stud. Thread the pin into the water pump sprocket.

2. Using the guide pin, align the pin with the water pump holding tool.

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3. Position the water pump against the engine block and hand tighten the water pump bolts.

NOTE: Refer to Fastener Notice .

4. Install the inner water pump sprocket bolts. After 2 are snug, remove the guide pin and install the 3rd bolt.

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

5. Tighten the water pump sprocket bolts last.

Tighten: Tighten the water pump sprocket bolts to 10 N.m (89 lb in).

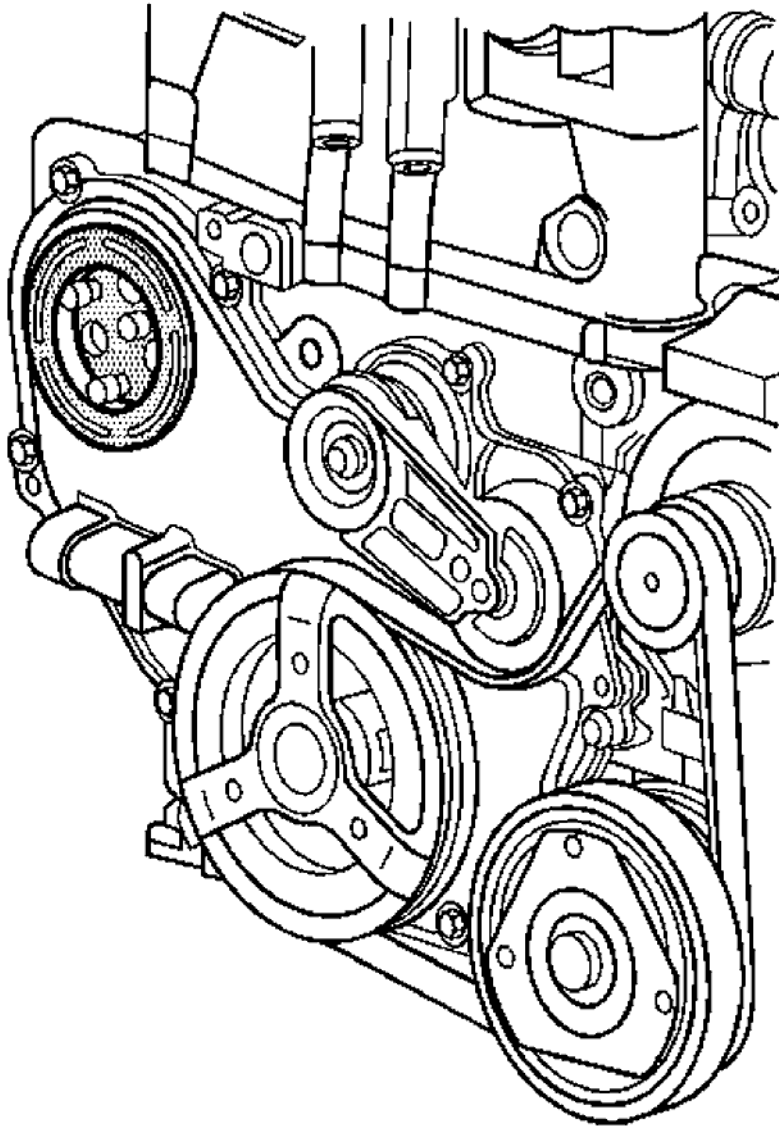


Fig. 96: View Of Water Pump Holding Tool
Courtesy of GENERAL MOTORS CORP.

6. Remove the **J 43651** . See Special Tools.

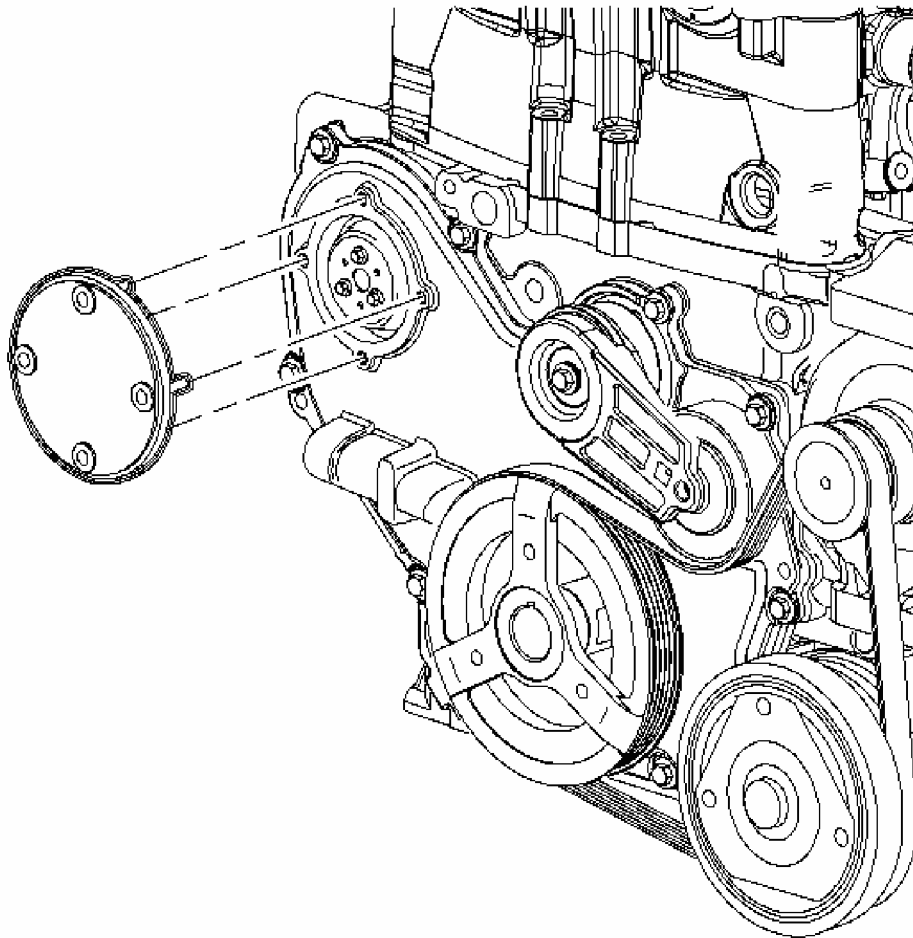


Fig. 97: View Of Water Pump Access Plate At Front Cover
Courtesy of GENERAL MOTORS CORP.

7. Install the water pump access plate and bolts.

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

8. Install the right hand fender liner. Refer to Wheelhouse Liner Replacement - Front.
9. Install the thermostat housing. Refer to Thermostat Housing Replacement (RPO L61) or Thermostat Housing Replacement (RPO LE5).

DRAIN COCK REPLACEMENT

CAUTION: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling

point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Place a drain pan under the right side lower radiator mount.

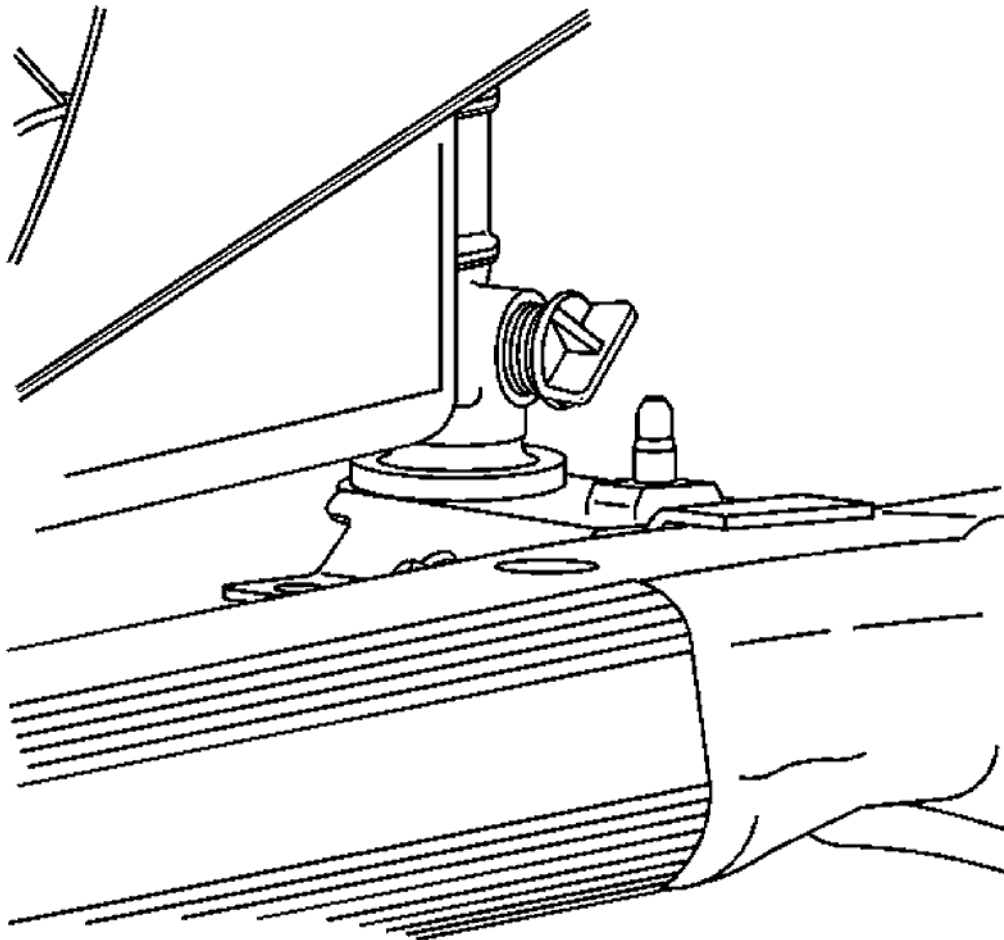


Fig. 98: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

3. Remove the radiator drain cock.

Installation Procedure

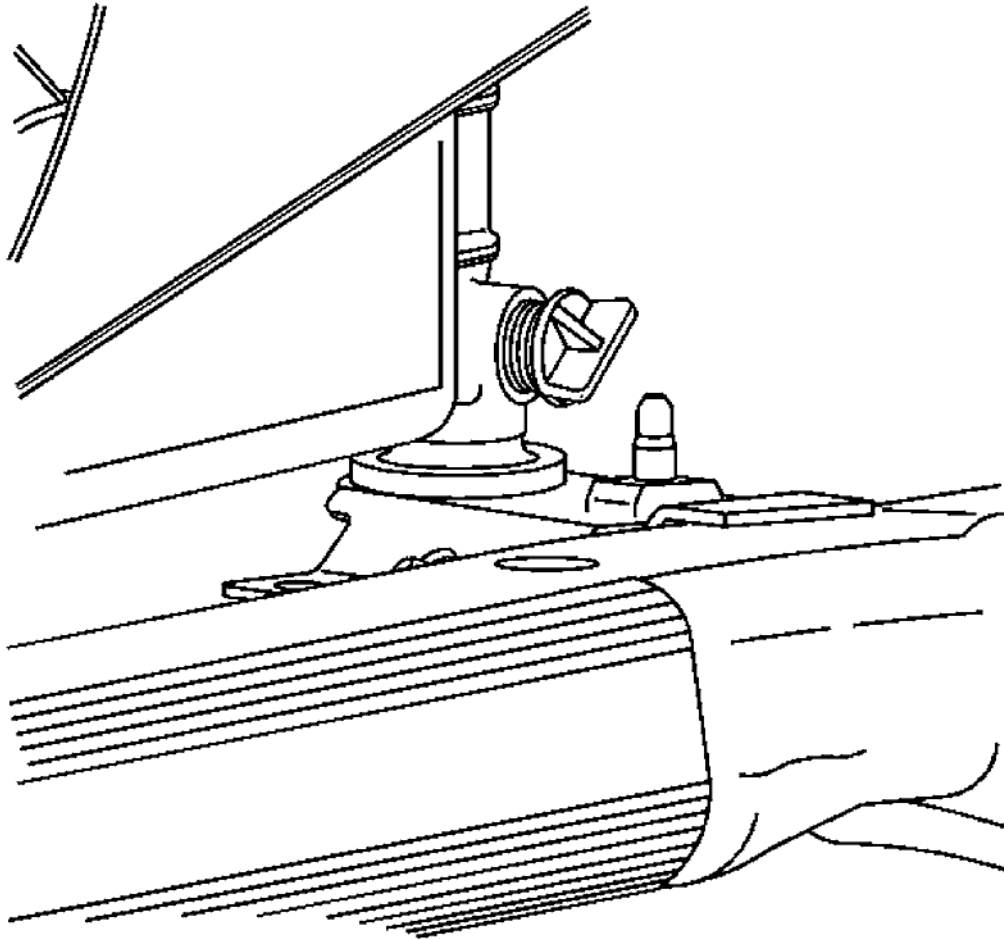


Fig. 99: View Of Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator drain cock. Tighten the radiator drain cock by hand only.
2. Lower the vehicle.
3. Fill the cooling system. Refer to **Draining and Filling Cooling System (Static Fill)** or **Draining and Filling Cooling System (GE 47716 Fill)**.

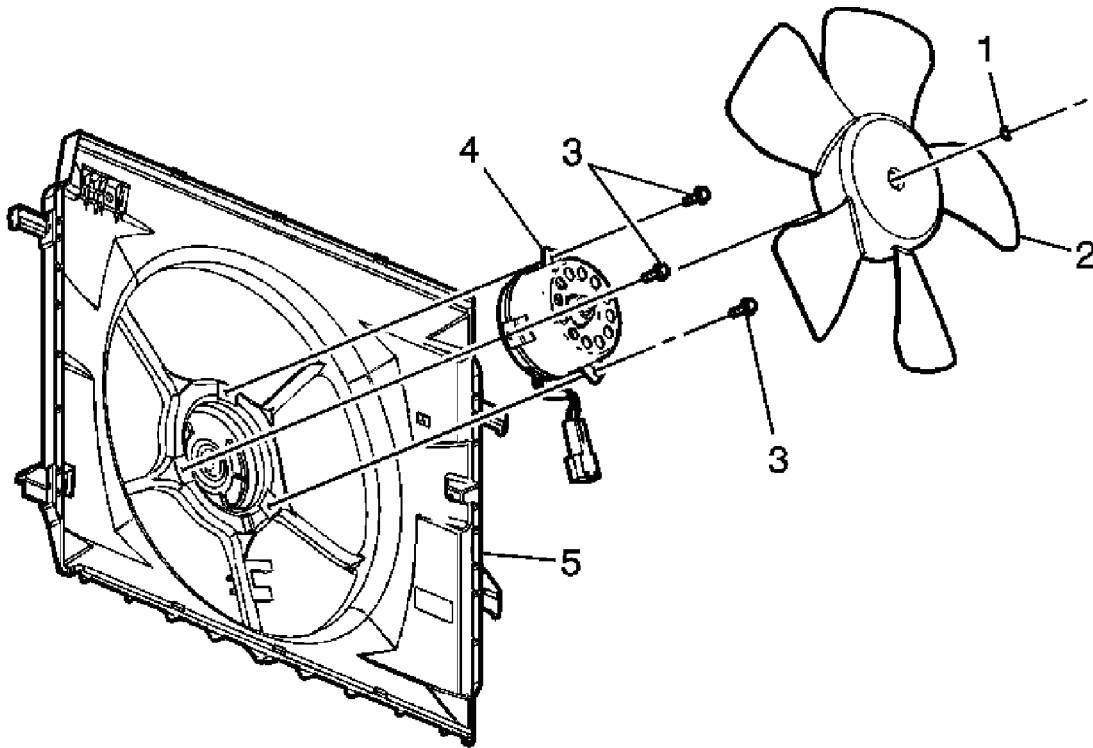
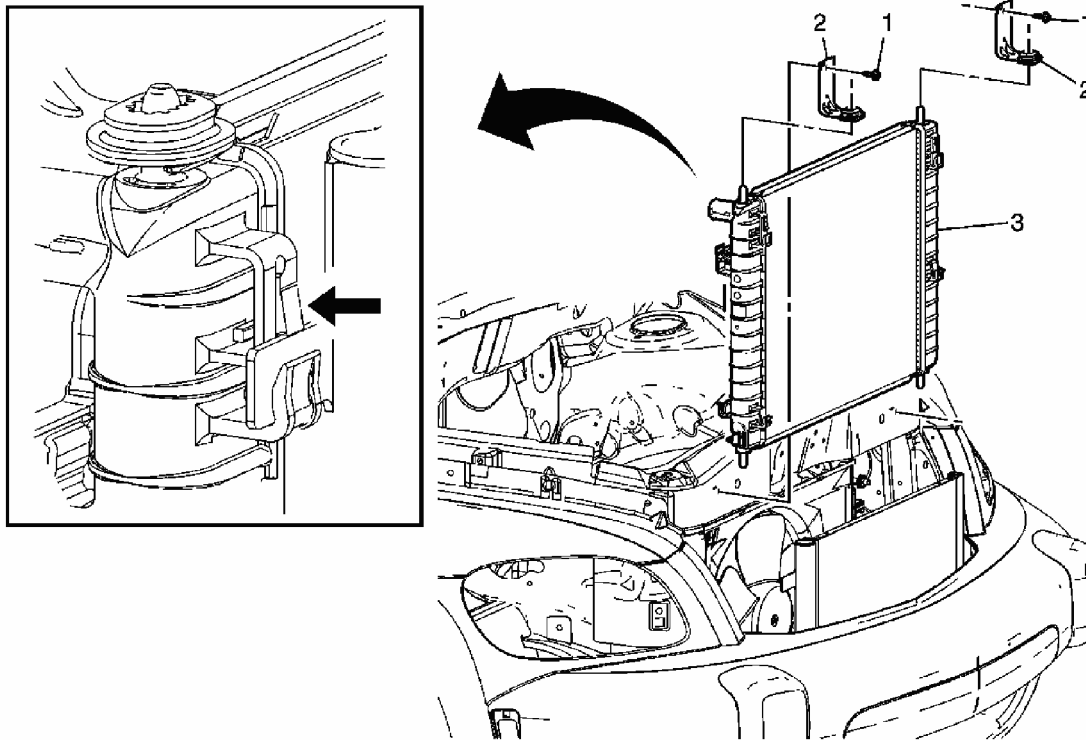


Fig. 100: Radiator Fan & Shroud
 Courtesy of GENERAL MOTORS CORP.

Fan Shroud Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> . Preliminary Procedure: Remove the fan shroud assembly. Refer to <u>Cooling Fan and Shroud Replacement</u> .	
1	Nut, Engine Cooling Fan Blade Tighten: 6 N.m (53 lb in)
2	Blade, Fan
3	Bolt, Engine Cooling Fan Motor (Qty: 3) Tighten: 6 N.m (53 lb in)
4	Motor Assembly, Engine Cooling Fan
5	Shroud, Engine Cooling Fan

RADIATOR REPLACEMENT

**Fig. 101: Radiator**

Courtesy of GENERAL MOTORS CORP.

Radiator Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> . Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u>. Preliminary Procedure 1. Partially drain the cooling system. Refer to Draining and Filling Cooling System (Static Fill) or Draining and Filling Cooling System (GE 47716 Fill). 2. Remove the air cleaner assembly. Refer to <u>Air Cleaner Assembly Replacement</u> for the 2.2L engine or <u>Air Cleaner Assembly Replacement</u> for the 2.4L engine. 3. Remove the hood latch from the tie bar and set aside. Refer to <u>Hood Latch Replacement</u> . 4. Remove the transmission lines from the radiator. Refer to <u>Automatic Transmission Oil Cooler Pipes Replacement</u> . 5. Remove the radiator inlet hose from the radiator. Refer to Radiator Hose	

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Replacement - Inlet.

6. Remove the radiator outlet hose from the radiator. Refer to **Radiator Hose Replacement - Outlet (RPO L61)** or **Radiator Hose Replacement - Outlet (RPO LE5)**.

1	Bolt, Radiator Bracket Assembly Tighten: 9 N.m (80 lb in)
2	Bracket Assembly, Radiator
3	Radiator Assembly Tip: • Lift up on the fan assembly and remove from the radiator and set a side. • Push in on the retaining tabs to release the condenser from the radiator and set aside.

RADIATOR SUPPORT BRACKET REPLACEMENT

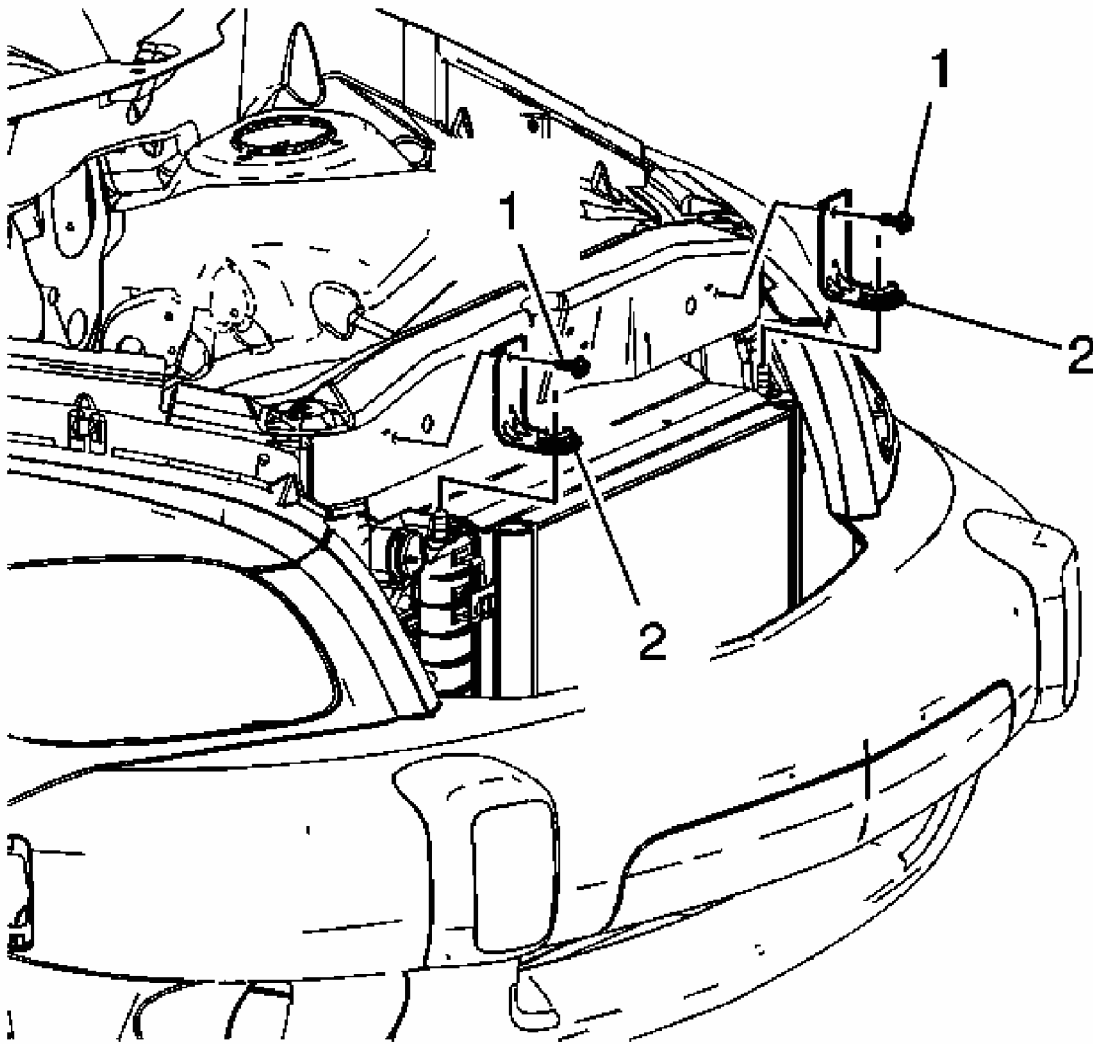


Fig. 102: Radiator Support Bracket
Courtesy of GENERAL MOTORS CORP.

Radiator Support Bracket Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> .	
1	Bolt, Radiator Bracket Assembly - Upper Tighten: 9 N.m (80 lb in)
2	Bracket Asm, Radiator - Upper

RADIATOR SUPPORT REPLACEMENT

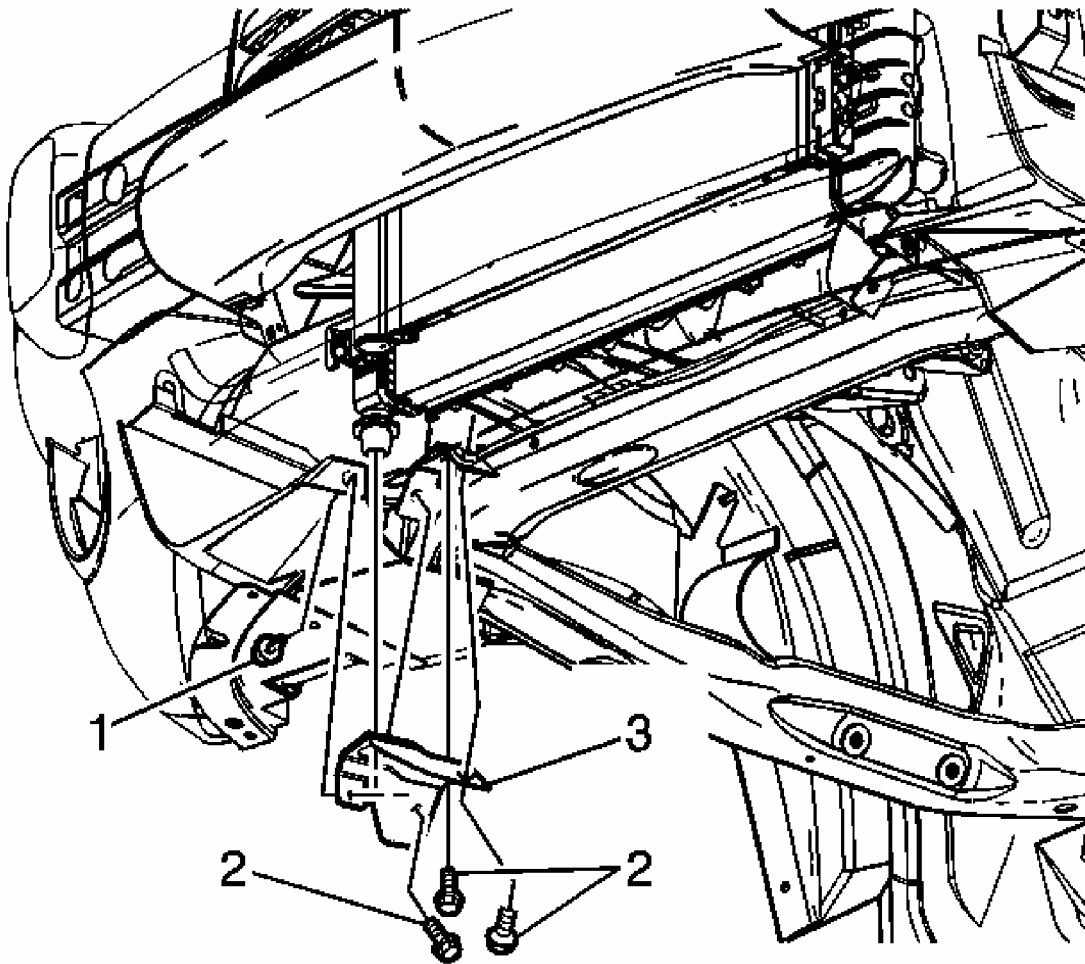


Fig. 103: Radiator Support
 Courtesy of GENERAL MOTORS CORP.

Radiator Support Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> . Preliminary Procedure: Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Retainer, Front Bumper Fascia Lower Deflector - Push In
2	Bolt, Radiator Support - Lower Tighten: 34 N.m (25 lb ft)
3	Support, Radiator - Lower

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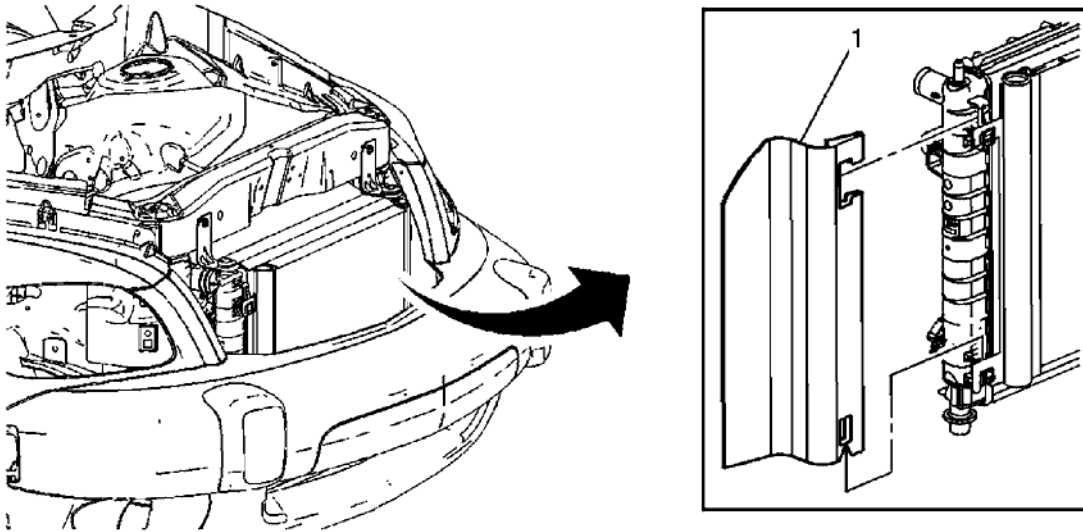


Fig. 104: Radiator Air Baffle and Deflector - Side
Courtesy of GENERAL MOTORS CORP.

Radiator Air Baffle and Deflector Replacement - Side

Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Radiator Air Baffle and Deflector- Side Tip: • Pull up and the out to release the radiator air seal from the radiator. • Right side shown left similar.

RADIATOR AIR BAFFLE AND DEFLECTOR REPLACEMENT - UPPER

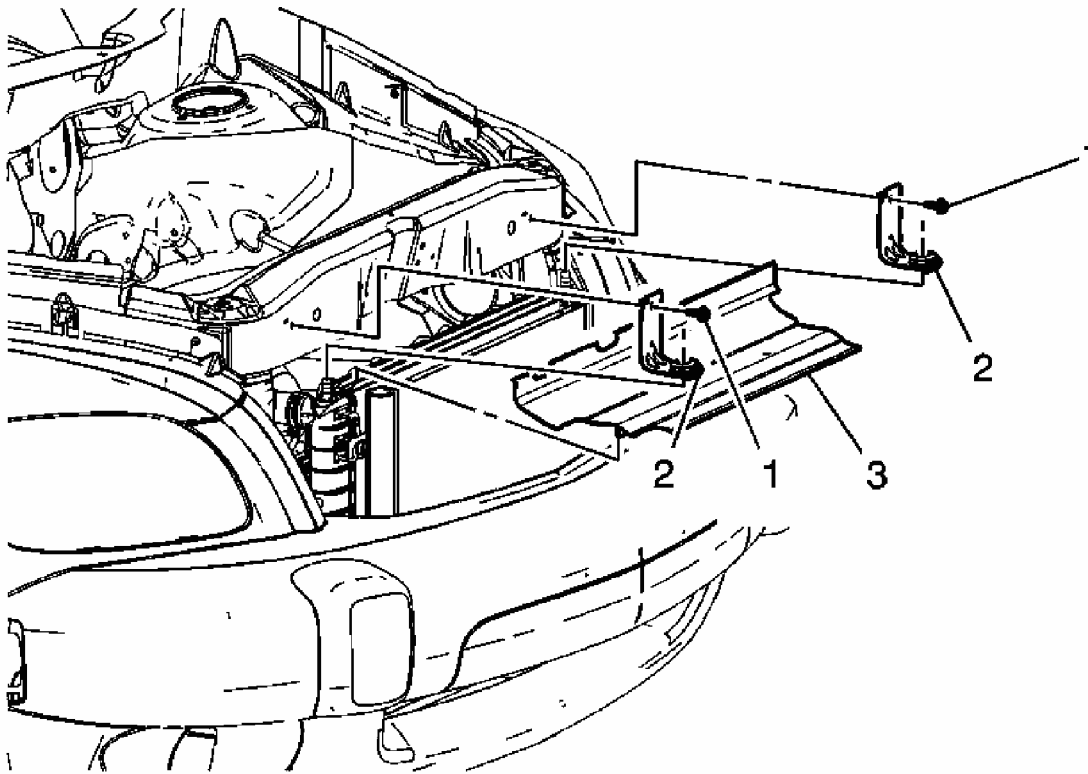


Fig. 105: Radiator Air Baffle and Deflector - Upper
Courtesy of GENERAL MOTORS CORP.

Radiator Air Baffle and Deflector Replacement - Upper

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> .	
1	Radiator Bracket Assembly- Upper Bolt Tighten: 9 N.m (80 lb in)
2	Radiator - Upper Bracket Assembly
3	Radiator Air Baffle and Deflector- Upper

COOLANT HEATER REPLACEMENT

Removal Procedure

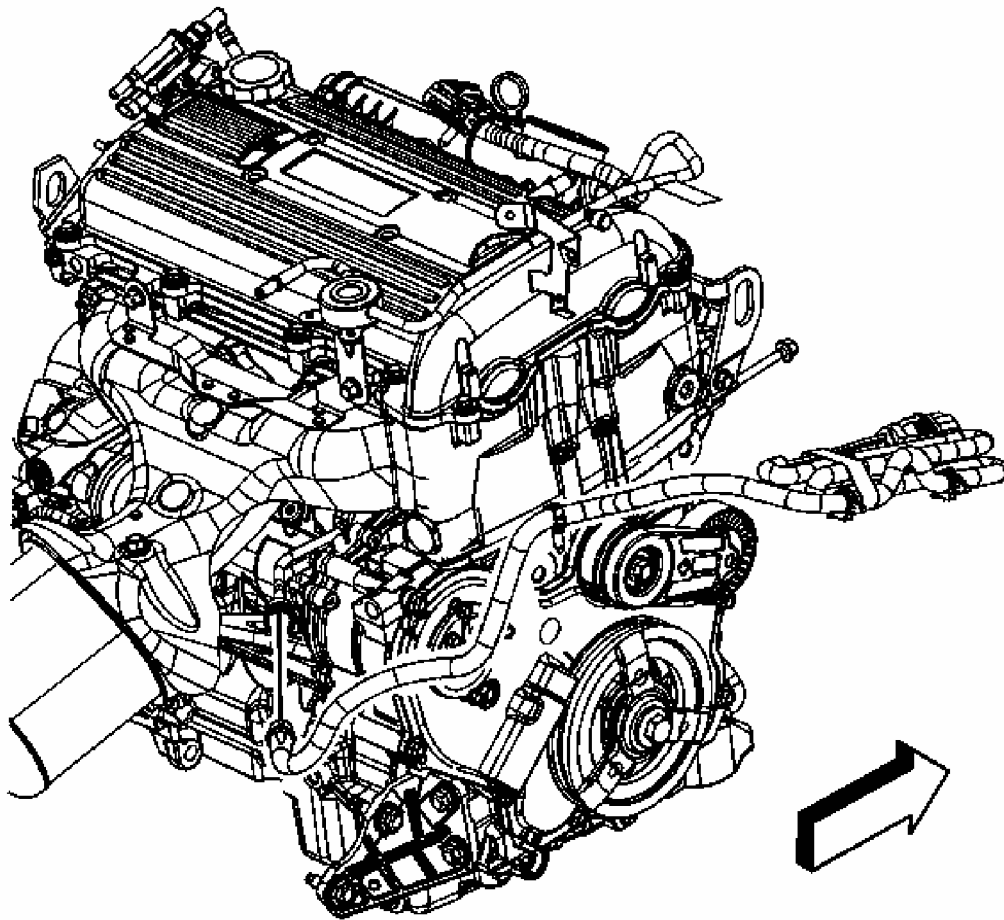


Fig. 106: Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the coolant heater cord.

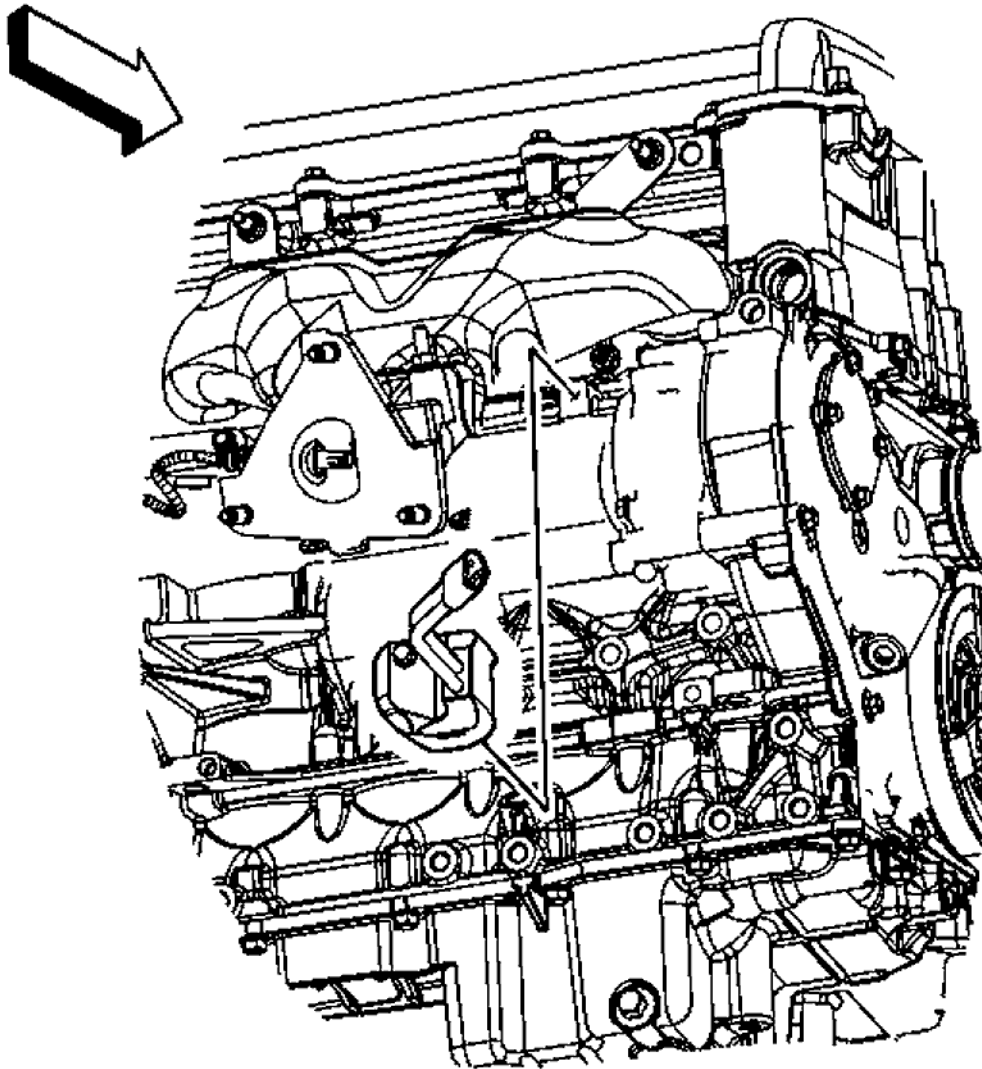


Fig. 107: Coolant Heater
Courtesy of GENERAL MOTORS CORP.

2. Remove the coolant heater bolt.
3. Remove the coolant heater.

Installation Procedure

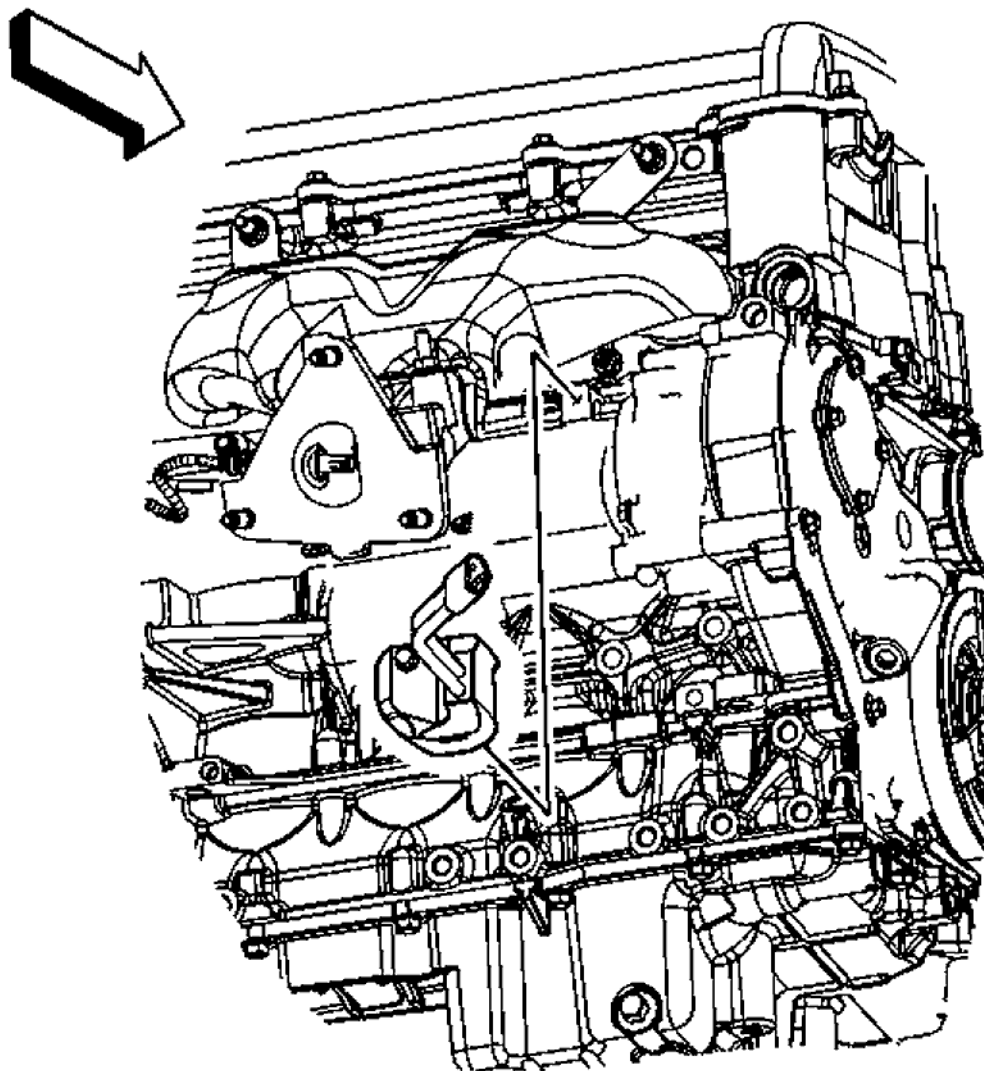


Fig. 108: Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater.

NOTE: Refer to Fastener Notice .

2. Install the coolant heater bolt.

Tighten: Tighten the bolt to 10 N.m (89 lb in).

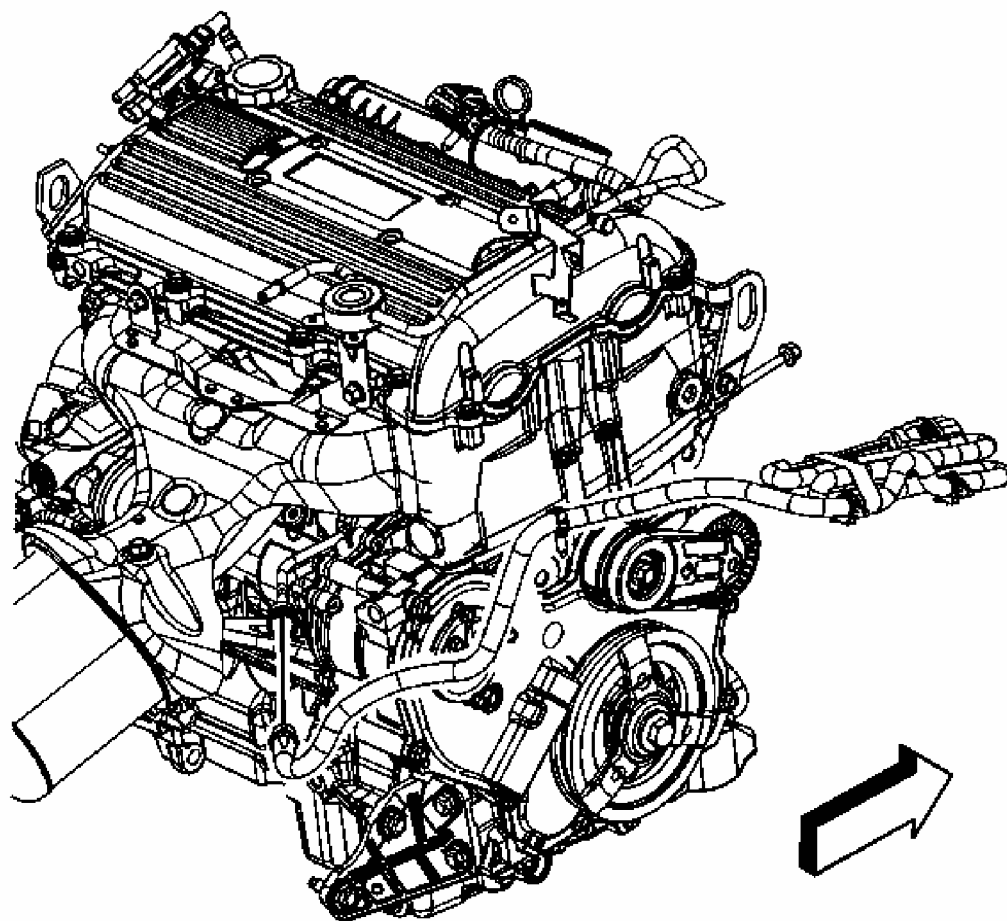


Fig. 109: Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Connect the coolant heater cord.

COOLANT HEATER CORD REPLACEMENT

Removal Procedure

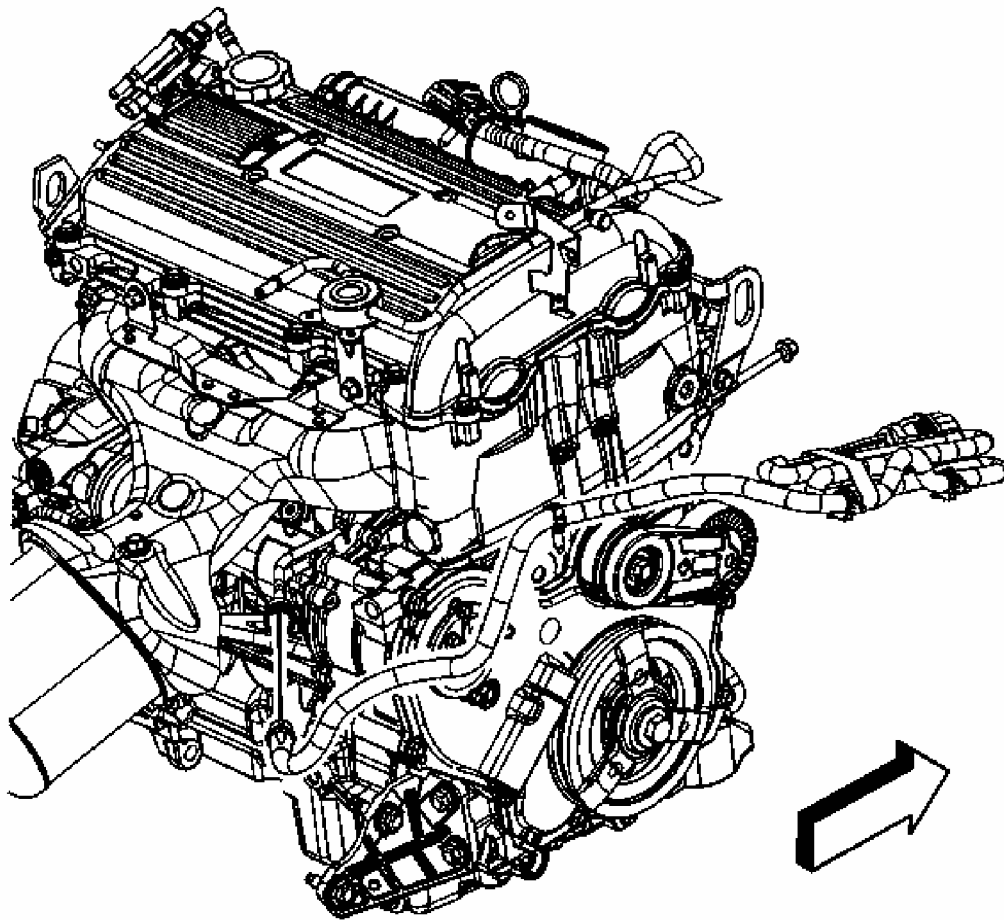


Fig. 110: Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine coolant heater cord.

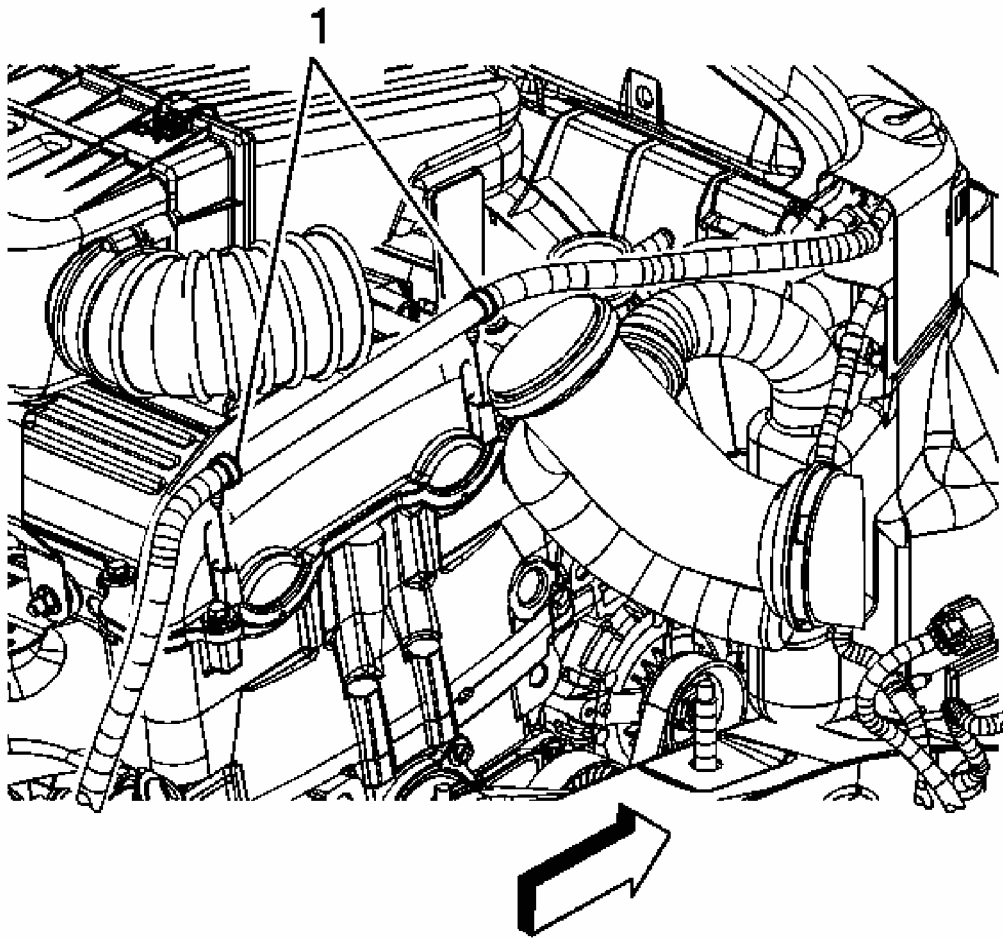


Fig. 111: Coolant Heater Cord Clips
Courtesy of GENERAL MOTORS CORP.

2. If equipped with regular production option (RPO) L61 and a manual transaxle, remove the cord clips (1) from the camshaft cover.

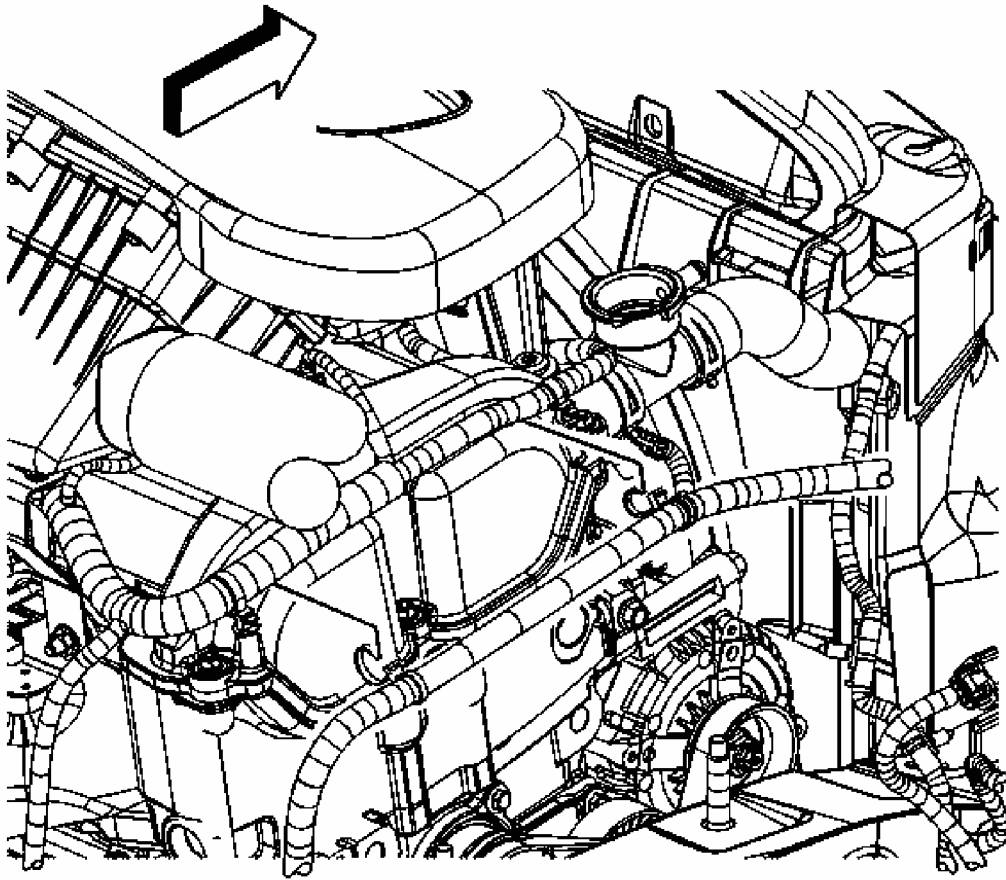


Fig. 112: Engine Harness Straps
Courtesy of GENERAL MOTORS CORP.

3. If equipped with RPO LE5, or RPO L61 and a automatic transaxle, disconnect the straps from the engine harness.
4. Disconnect the strap from the right front headlamp harness.
5. Remove the heater cord.

Installation Procedure

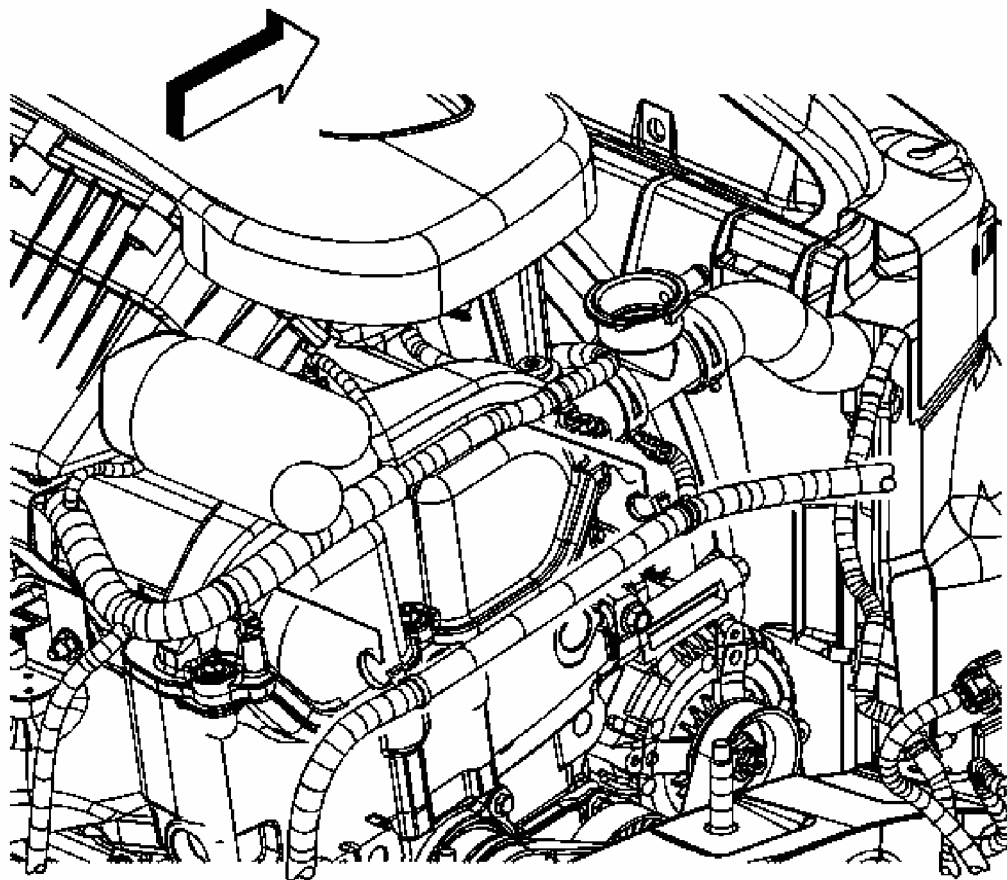


Fig. 113: Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

1. Install the heater cord.
2. Connect the strap to the right front headlamp harness.
3. If equipped with RPO LE5, or RPO L61 and a automatic transaxle, connect the straps to the engine harness.

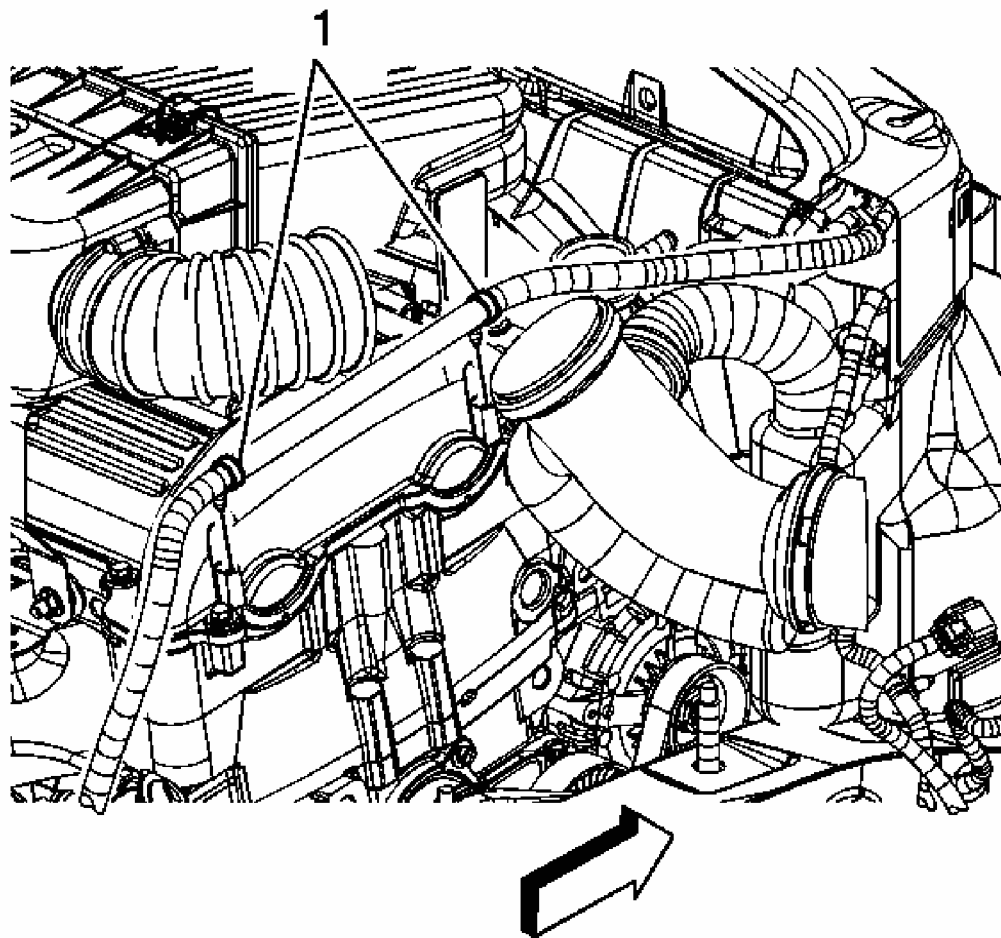


Fig. 114: Coolant Heater Cord Clips
Courtesy of GENERAL MOTORS CORP.

4. If equipped with RPO L61 and a manual transaxle, install the cord clips (1) to the camshaft cover.

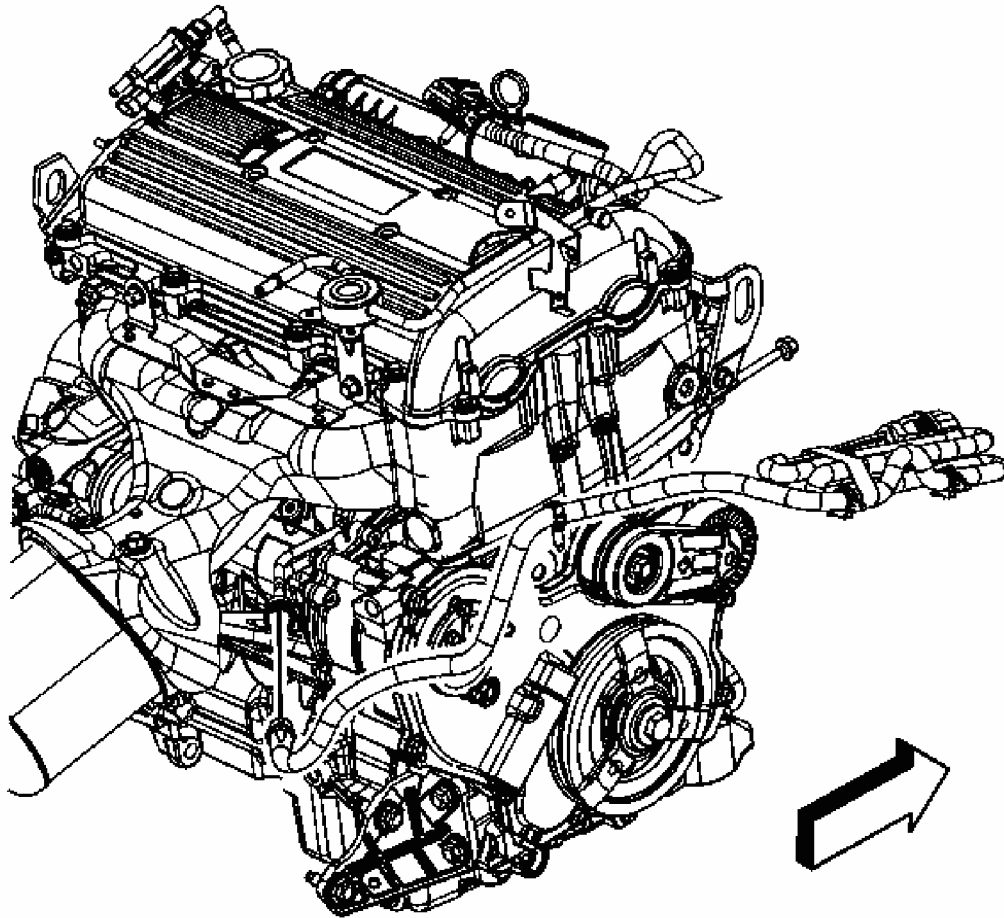


Fig. 115: Coolant Heater
Courtesy of GENERAL MOTORS CORP.

5. Connect the engine coolant heater cord.

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system consists of one cooling fan and one relay. The relay is powered by the battery positive voltage circuit and controlled by a switched ground from the engine control module (ECM).

During operation, the ECM supplies the ground path for the cooling fan relay through the cooling fan relay control circuit. This energizes the cooling fan relay coil, closes the relay

contacts, and supplies battery positive voltage from the cooling fan fuse through the cooling fan motor supply voltage circuit to the cooling fan. The cooling fan motor is grounded through its own ground circuit.

The ECM commands the fan on under the following conditions:

- Engine coolant temperature exceeds approximately 106°C (223°F).
- A/C refrigerant pressure exceeds 1302 kPa (189 psi).
- A/C is requested and vehicle speed is below 100 km/h (62 mph) with A/C pressure above 1413 kPa (205 psi).
- AF23-5 Transmission fluid temperature exceeds 130°C (266°F).
- VT25-E Transmission fluid temperature exceeds 140°C (284°F).
- When the engine coolant temperature exceeds 125°C (257°F) at key off, the fan will run for up to 108 seconds.

The ECM commands the fan off under the following conditions:

- Engine coolant temperature drops below approximately 125°C (257°F).
- Throttle position is greater than 95 percent.
- Vehicle speed exceeds 113 km/h (70 mph)

Coolant Heater

The optional engine coolant heater (RPO K05) operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather -29°C (-20°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant flows from the radiator outlet and into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine

block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

The coolant then flows through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where it absorbs additional heat.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature, or it will flow through the thermostat and into the radiator where it is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and suitable drinking water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator also has a drain cock located in the bottom of the right hand tank. The drain cock unit includes the drain cock and drain cock seal.

The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Pressure Cap

The pressure cap seals the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling system pressure. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, might cause the radiator

and/or coolant hoses to collapse.

The pressure cap allows cooling system pressure to build up as the temperature increases. As the pressure builds, the boiling point of the coolant increases. Engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat transfers from the radiator to the cooler, passing air.

The pressure in the cooling system can get too high. When the cooling system pressure exceeds the rating of the pressure cap, it raises the pressure valve, venting the excess pressure.

As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Coolant Recovery System

The coolant recovery system consists of a plastic coolant recovery reservoir and overflow tube. The recovery reservoir is also called a recovery tank or expansion tank. This tank is partially filled with coolant and is connected to the radiator fill neck with the overflow tube. Coolant can flow back and forth between the radiator and the reservoir.

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure within the cooling system gets too high, the pressure valve in the pressure cap will open. This allows the coolant, which has expanded due to heat, to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is the elimination of almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle and through the radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser, and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is mounted on the pump shaft and consists of a series of flat or curved blades or vanes on a flat plate. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force.

The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The purpose of the water pump is to circulate coolant throughout the cooling system. The water pump is driven by the crankshaft via the timing chain.

Thermostat

The thermostat is a coolant flow control component. Its purpose is to help regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a small piston. When the element is heated, it expands and exerts pressure against the small piston. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up. After the coolant temperature reaches the rated thermostat opening temperature, the thermostat valve will open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the left side end tank of the radiator. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator.

The transmission oil pump, pumps the fluid through the transmission oil cooler line to the transmission oil cooler. The fluid then flows through the cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

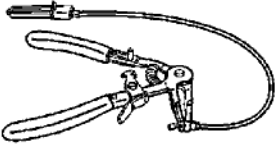
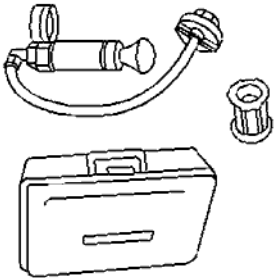
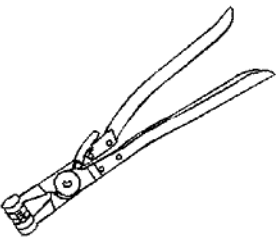
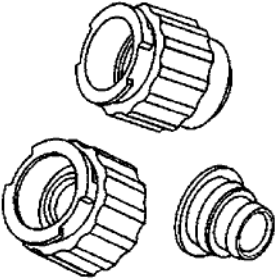
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

2006 Chevrolet HHR LT

2006 ENGINE Engine Cooling - HHR

Illustration	Tool Number/Description
	GE-47622 Hose Clamp Pliers
	J-24460-01 Cooling System Pressure Tester
	J-38185 Hose Clamp Pliers
	J-42401 Radiator Cap/Surge Tank Tester
	J-43651 Water Pump Holding Tool

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