

2004 ENGINE

Engine Cooling - Vue

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Terminal Bolt	17 N.m	13 lb ft
Crossover Pipe Bolts-L66	22 N.m	16 lb ft
ECT Sensor	18 N.m	13 lb ft
Exhaust Manifold Heat Shield Bolts - L61	25 N.m	18 lb ft
Thermostat Housing Bolts - L66	12 N.m	106 lb in
Thermostat Housing Cover-to-Thermostat Housing Bolts - L61	10 N.m	89 lb in
Thermostat Housing-to-Block Bolts - L61	10 N.m	89 lb in
Thermostat Pipe Bracket-to-Cylinder Head Bolt - L61	8 N.m	71 lb in
Water Pump Access Bolts-to-Front Cover - L61	10 N.m	89 lb in
Water Pump Bolts - L66	12 N.m	106 lb in
Water Pump Sprocket-to-Water Pump Bolts - L61	10 N.m	89 lb in
Wheel Nuts	125 N.m	92 lb ft
Wiring Harness Ground Terminal Nut	12 N.m	106 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS (L61)

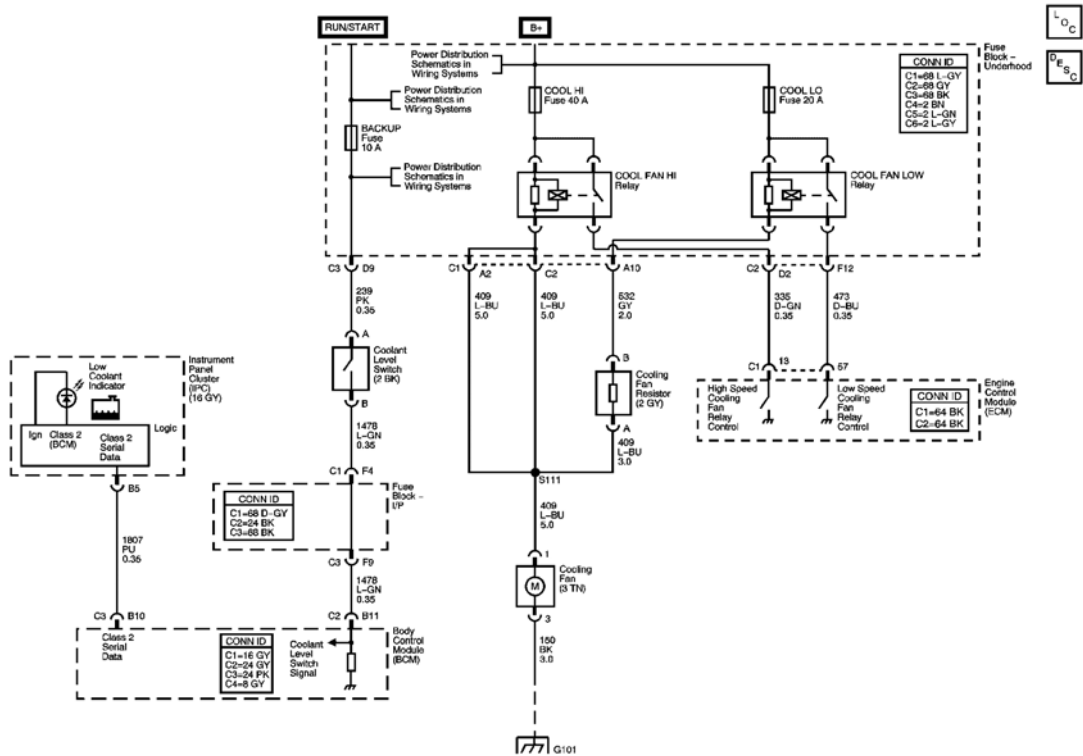


Fig. 1: Engine Cooling Fan Schematic (2.2L, L61)
 Courtesy of GENERAL MOTORS CORP.

ENGINE COOLING SCHEMATICS (L66)

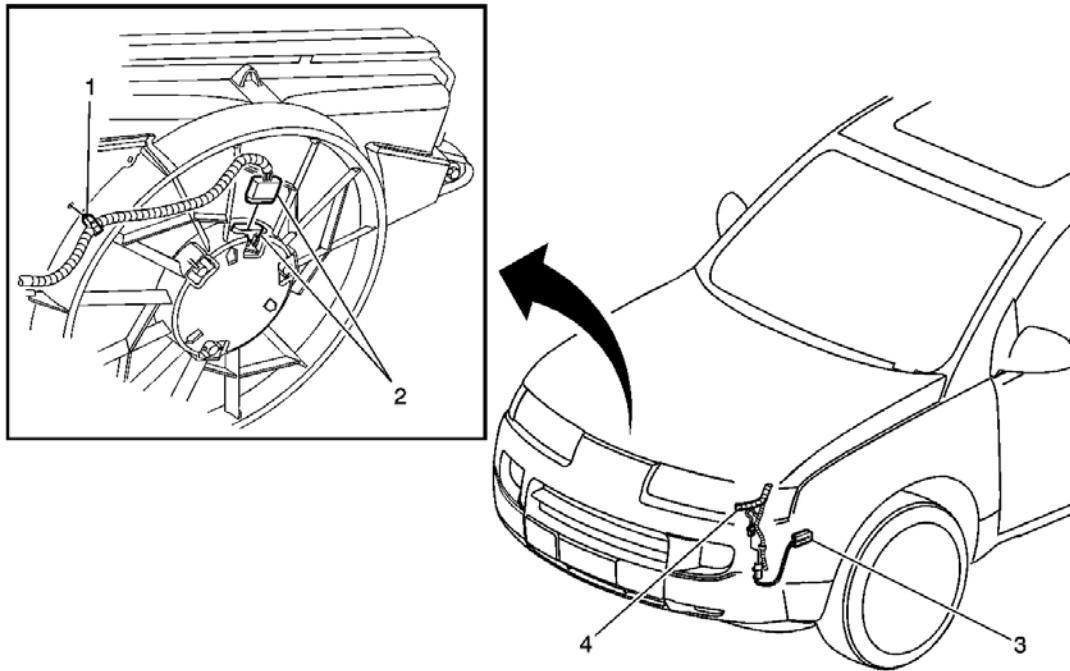


Fig. 3: Engine Cooling System Components (w/L61)
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3 Component View

Callout	Component Name
1	Forward Lamp Harness
2	Cooling Fan (3 TN)
3	Cooling Fan Resistor (2 GY)
4	Forward Lamp Harness

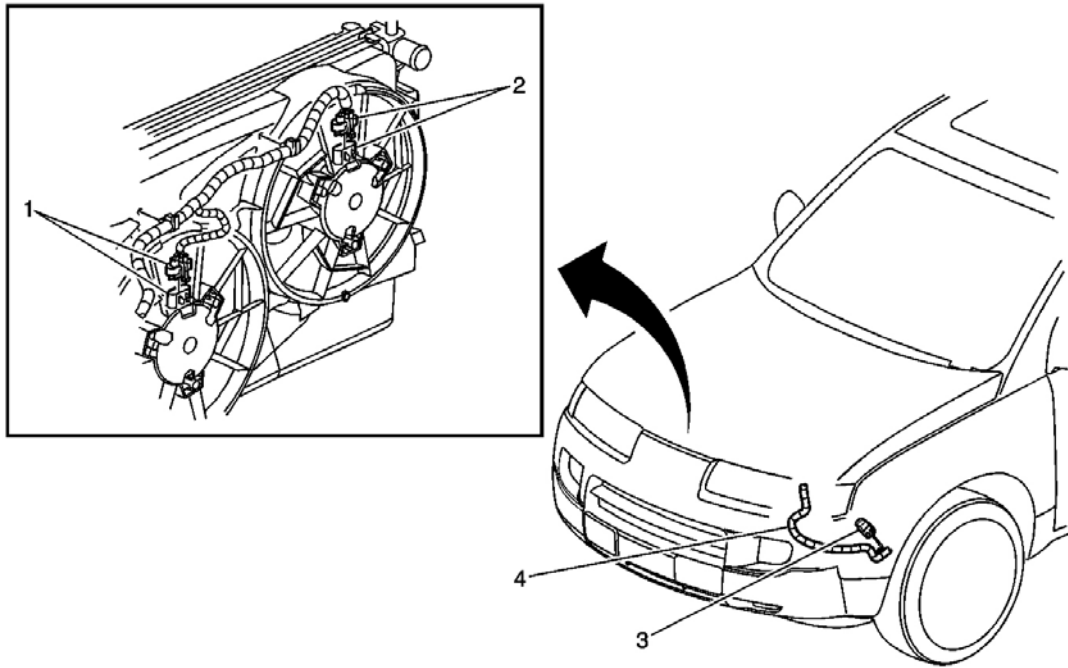


Fig. 4: Engine Cooling System Components (w/L66)
 Courtesy of GENERAL MOTORS CORP.

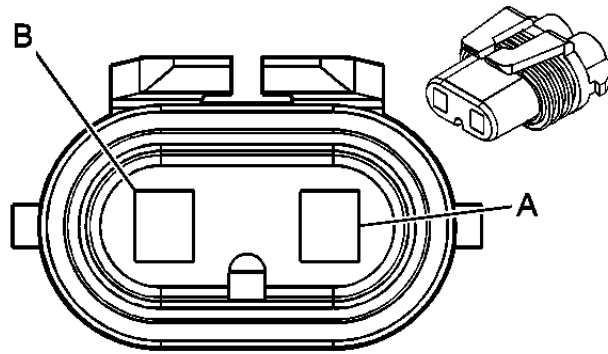
Callouts For Fig. 4 Component View

Callout	Component Name
1	Cooling Fan - Left (3 TN)
2	Cooling Fan - Right (3 TN)
3	Cooling Fan Relay 3 (5 BK)
4	Forward Lamp Harness

COOLING SYSTEM CONNECTOR END VIEWS

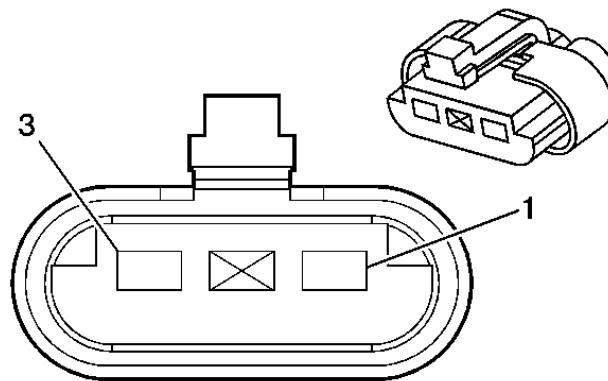
Cooling Fan Resistor (w/ L61) Connector End View





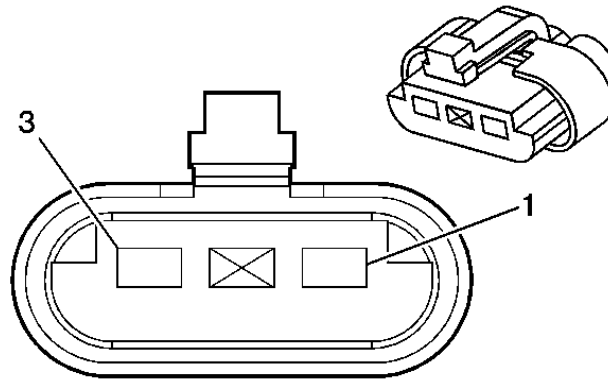
Connector Part Information		<ul style="list-style-type: none"> • 12059181 • 2-Way F Metri-Pack 280 Series Sealed (GY) 	
Pin	Wire Color	Circuit Number	Function
A	L-BU	409	Cooling Fan Motor Supply Voltage
B	GY	532	Cooling Fan Relay Supply Voltage

Cooling Fan (w/ L61) Connector End View



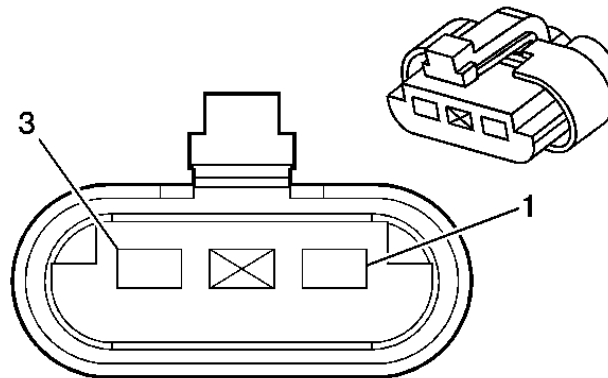
Connector Part Information		<ul style="list-style-type: none"> • F8ZB-14A464-DA • 3-Way F (TN w/ BK Case) 	
Pin	Wire Color	Circuit Number	Function
1	L-BU	409	Cooling Fan Motor Supply Voltage
2	-	-	Not Used
3	BK	150	Ground

Cooling Fan - Left (w/ L66) Connector End View



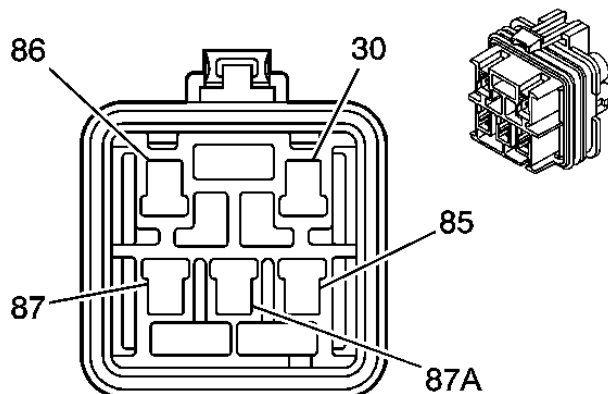
Connector Part Information		<ul style="list-style-type: none"> • F8ZB-14A464-DA • 3-Way F (TN w/ BK Case) 	
Pin	Wire Color	Circuit Number	Function
1	L-BU	409	Cooling Fan Motor Supply Voltage
2	-	-	Not Used
3	WH	504	Ground

Cooling Fan - Right (w/ L66) Connector End View



Connector Part Information		<ul style="list-style-type: none"> • F8ZB-14A464-DA • 3-Way F (TN w/ BK Case) 	
Pin	Wire Color	Circuit Number	Function
1	GY	532	Cooling Fan Motor Supply Voltage
2	-	-	Not Used
3	BK	150	Ground

Cooling Fan Relay 3 (w/ L66) Connector End View

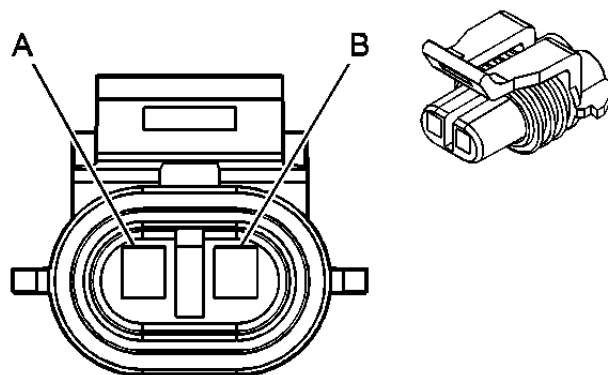


Connector Part Information

- 12110539
- 5-Way F Metri-Pack 280 Series Flex Lock (BK)

Pin	Wire Color	Circuit Number	Function
30	WH	504	Ground
85	OG	3040	Battery Positive Voltage
86	D-BU	473	High Speed Cooling Fan Relay Control
87	BK	150	Ground
87A	GY	532	Cooling Fan Motor Supply Voltage

Coolant Level Switch Connector End View



Connector Part Information

- 12052641
- 2-Way F Metri-Pack 150 Series (BK)

Pin	Wire Color	Circuit Number	Function
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A	PK	239	Ignition 1 Voltage
B	L-GN	1478	Coolant Level Switch Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the diagnostic system check. Refer to **Diagnostic System Check - Engine Cooling** . The Diagnostic System Check 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 Class 2 serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

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

DIAGNOSTIC SYSTEM CHECK - ENGINE COOLING

Test Description

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

2: Lack of communication may be due to a malfunction of the class 2. The specified procedure will determine the particular condition.

4: The presence of DTCs which begin with U indicate some other module is not communicating. The specified procedure will compile all the available information before tests are performed.

Diagnostic System Check - Engine Cooling

Step	Action	Yes	No
1	Install a scan tool. Does the scan tool power up?	Go to Step 2	Go to <u>Scan Tool Does Not Power Up</u> in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the engine control module (ECM) or powertrain control module (PCM). Does the scan tool communicate with the ECM/PCM?	Go to Step 3	Go to <u>Scan Tool Does Not Communicate with Class 2 Device</u> in Data Link Communications
	Select the ECM/PCM. Display DTCs		

3	function on the scan tool. Does the scan tool display any DTCs?	Go to Step 4	Go to Symptoms - Engine Cooling
4	Does the scan tool display any DTCs which begin with a U?	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications	Go to Diagnostic Trouble Code (DTC) List

SCAN TOOL OUTPUT CONTROLS

Engine Control Module (ECM) L61 Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
Fan Control 1 Command	General Info Outputs	The scan tool displays a commanded state of On or Off. This allows you to communicate with the ECM and activate or deactivate the cooling fan relay, manually turning the fans On and Off.
Fan Control 2 Command	General Info Outputs	The scan tool displays a commanded state of On or Off. This allows you to communicate with the ECM and activate or deactivate the cooling fan relay, manually turning the fans On and Off.

Powertrain Control Module (PCM) L66 Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
Fan Control 1 Command	General Info Outputs	The scan tool displays a commanded state of On or Off. This allows you to communicate with the PCM and activate or deactivate the cooling fan relay, manually turning the fan On and Off.
Fan Control 2 and 3 Command	General Info Outputs	The scan tool displays a commanded state of On or Off. This allows you to communicate with the PCM and activate or deactivate the cooling fan relays, manually turning the fans On and Off.

SCAN TOOL DATA LIST

Use the Scan Tool Data Display Values and Definitions Information in order to assist in diagnosing the HVAC Control Module problems. Compare the vehicles actual scan tool data with the typical data display value table information. Use the data information in order to aid in understanding the nature of the problem when the vehicle does not match with the typical data display values.

The scan tool data values were taken from a known good vehicle under the following conditions:

- The ignition switch is in the ON position.
- The engine is running at idle.
- The vehicle is in PARK.
- The doors are closed.

- The windows are closed.
- The A/C is ON.
- The ambient air temperatures are at 22-27°C (70-80°F).

Body Control Module (BCM) Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Engine idling, A/C ON, ambient air temperature between 22-27°C (70-80°F)			
Battery 1	HVAC Data	Volts	Battery Voltage
Low Coolant	Switch Inputs	Yes/No	No

Engine Control Module (ECM) Scan Tool Data List - L61/2.2L

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Engine idling, A/C ON, ambient air temperature between 22-27°C (70-80°F)			
Fan Control 1 Command	General Info Outputs	On/Off	Varies
Fan Control 2 Command	General Info Outputs	On/Off	Varies
ECT	Inputs/Outputs/Idle Speed Control	C/F	C/F

Powertrain Control Module (PCM) Scan Tool Data List - L66/3.5L

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Engine idling, A/C ON, ambient air temperature between 22-27°C (70-80°F)			
Fan Control 1 Command	General Info Outputs	On/Off	Varies
Fan Control 2 Command	General Info Outputs	On/Off	Varies
ECT	Inputs/Outputs/Idle Speed Control	C/F	C/F

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 powertrain control module (PCM) 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 PCM 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 PCM interprets the lower voltage as a warm engine.

F C 1, F C 2 Command

The scan tool displays On or Off. This parameter indicates the state of the driver circuit for this device.

Low Coolant Level, Switch Inputs

The scan tool displays YES or NO, determined by the state of the low coolant level switch.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module
P0125	DTC P0125 in Engine Controls - 2.2L (L61)	ECM
P0125	DTC P0125 in Engine Controls - 3.5L (L66)	PCM
P0128	DTC P0128 in Engine Controls - 2.2L (L61)	ECM
P0128	DTC P0128 in Engine Controls - 3.5L (L66)	PCM
P0480	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0481	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0691	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0692	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0693	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0694	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P1650	DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)	ECM/PCM
P0217	DTC P0217	ECM/PCM
B0936	DTC B0936	BCM

DTC B0936

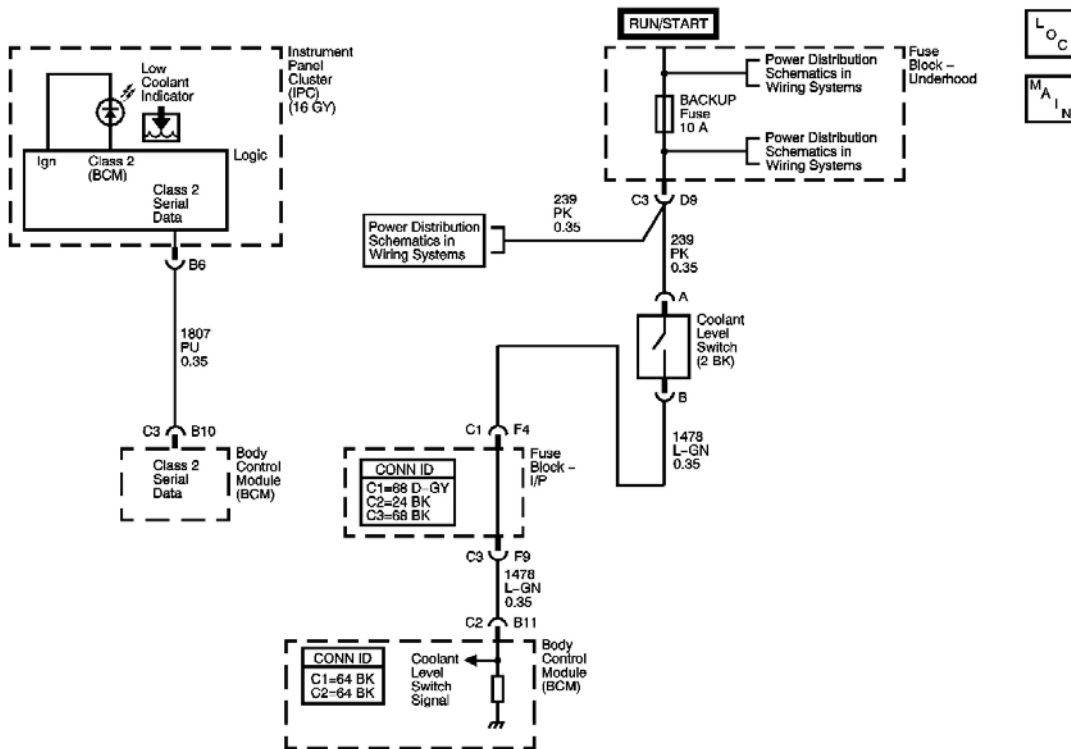


Fig. 5: DTC B0936 Circuit
 Courtesy of GENERAL MOTORS CORP.

Circuit Description

When the engine coolant is at the proper level in the surge tank, the low coolant level switch is closed. When in this condition, battery voltage is applied to the low coolant level signal circuit of the body control module (BCM). When coolant is below the proper level, the low coolant level switch opens. Because no voltage is applied to the low coolant level signal circuit, the BCM responds by sending a serial data message to the instrument panel cluster to turn on the low coolant level light. The BCM has an internal timer, which will not turn on the low coolant level light unless the coolant level is low for longer than 30 seconds. The timer avoids falsely turning on the light due to the movement of coolant within the surge tank.

Conditions for Running the DTC

- Ignition switch in RUN or Crank position.
- Low coolant warning light always ON with the ignition in Start.
- BACKUP fuse in underhood fuse block is open.

Conditions for Setting the DTC

- B0936 - The BCM detects a short to ground or an open on the coolant level signal circuit.

- The condition exists for longer than 30 seconds.

Conditions for Clearing the DTC

- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

- Check for poor connection at the BCM.
- Check for poor connection at the low coolant level switch.
- If the fault is suspected to be intermittent refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Test Description

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

2: Verifies the normal status of the signal circuit to the body control module.

3: Tests for voltage at the coolant level switch. The BACKUP fuse supplies power to the voltage side of the coolant level switch.

4: Verifies that the body control module is providing ground to the coolant.

DTC B0936 Circuit

Step	Action	Yes	No
Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the low coolant level switch input in the body control module (BCM), switch inputs data list. Does the scan tool display normal state?	Go to Diagnostic Aids	Go to Step 3
3	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the coolant level switch. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the coolant level switch with a test lamp that is connected to a good ground. 		

	Does the test lamp illuminate?	Go to Step 4	Go to Step 9
4	<ol style="list-style-type: none"> 1. Connect a test lamp between the coolant level switch signal of the coolant level switch and the ignition 1 voltage circuit of the coolant level switch. 2. With a scan tool, observe the low coolant switch input status. <p>Does the scan tool display normal state?</p>	Go to Step 7	Go to Step 5
5	<p>Test the switch signal of the coolant level switch for a short to voltage or an open. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 12	Go to Step 8
6	<p>Test the switch signal of the coolant level switch for a short to ground. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 12	Go to Step 8
7	<p>Inspect for poor connections at the coolant level switch. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 12	Go to Step 10
8	<p>Inspect for poor connections at the harness connector of the body control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 12	Go to Step 11
9	<p>Repair the ignition 1 voltage circuit of the coolant level switch. Refer to Wiring Repairs in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to Step 12	-
10	<p>Replace the coolant level switch. Refer to Surge Tank Replacement.</p> <p>Did you complete the replacement?</p>	Go to Step 12	-
11	<p>IMPORTANT: Perform the setup procedure for the body control module.</p> <p>Replace the body control module. Refer to Body Control Module Replacement in Body Control System. Did you complete the replacement?</p>	Go to Step 12	-
12	<ol style="list-style-type: none"> 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. <p>Does the DTC reset?</p>	Go to Step 2	System OK

DTC P0217

The coolant temperature telltale on the instrument panel (I/P) cluster has the ability to illuminate as a result of an engine over temperature condition. The engine control module (ECM) or powertrain control module (PCM) will send a message to the I/P cluster over the class 2 link to turn the coolant temperature telltale ON if the engine coolant temperature (ECT) exceeds the temperature calibration value listed under Conditions for Setting the DTC.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The engine coolant temperature (ECT) is greater than 117°C (242°F).
- No other ECT sensor DTCs have been set.
- The ECM/PCM will command the A/C relay OFF if the temperature of the engine coolant is greater than 117°C (242°F).

DTC P0217 diagnostic runs continuously once the above conditions have been met.

Conditions for Clearing the MIL/DTC

- The ECM/PCM will turn the malfunction indicator lamp (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.

Diagnostic Aids

- Cooling fan inoperative - Refer to **Cooling Fan Inoperative (L61)Cooling Fan Inoperative (L66)** .
- Engine cooling system overheated condition (thermostat, low engine coolant etc.) - Refer to **Engine Overheating** .
- Radiator or condenser air flow restricted
- Air dam missing or loose
- Overload due to trailer towing
- ECT sensor leaking engine coolant into ECT sensor harness connector causing elevated temperatures
- ECT sensor skewed

DTC P0217 Circuit

Step	Action	Yes	No
Schematic Reference:Engine Cooling Schematics (L61)Engine Cooling Schematics (L66)			
Connector End View Reference:Cooling System Connector End Views			
	Did you perform the Engine Cooling		Go to Diagnostic System Check -

1	Diagnostic System Check?	Go to Step 2	Engine Cooling
2	Check the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to Engine Overheating	Go to Symptoms - Engine Cooling

DTC P0480, P0481, P0691, P0692, P0693, P0694, OR P1650 (L61)

Circuit Description

The engine control module (ECM) controls the low speed cooling fan operation by grounding the low speed fan relay control circuit with an internal solid state device called a driver. For high speed cooling fan operation, the ECM grounds the high and low speed relay control circuit at the same time. Battery positive voltage is supplied to the low and high speed fan relays. When the ECM is commanding a fan relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM is commanding a fan relay OFF, the voltage potential of the control circuit should be high, near battery voltage.

The ECM monitors the relay control circuits for the following conditions:

- Short to ground
- Short to voltage
- An open circuit

If the ECM detects an improper voltage level on the low or high speed driver circuits, then code P0480, P0481, P0691, P0692, P0693, P0694 or P1650 will set and the effected driver will be disabled.

Conditions for Running the DTC

- The ignition voltage is between 8.0-18.0 volts
- The engine speed is more than 40 RPM
- The ECM driver transitions from ON to OFF or from OFF to ON

Conditions for Setting the DTC

- P0481 - The ECM detects an open circuit on the high speed cooling fan relay control circuit.
- P0693 - The ECM detects a short to ground on the high speed cooling fan relay control circuit.
- P0694 - The ECM detects a short to voltage on the high speed cooling fan relay control circuit.
- P0480 - The ECM detects an open on the low speed cooling fan relay control circuit.
- P0691 - The ECM detects a short to ground on the low speed cooling fan relay control circuit.
- P0692 - The ECM detects a short to voltage on the low speed cooling fan relay control circuit.
- The above condition is present for 5 seconds.
- P1650 - The ECM detects a short to voltage on both the low and high speed cooling fan relay control circuit.
- The above condition is present for 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.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

- If the condition is not present, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.
- Review the Freeze/Failure Records vehicle mileage since the diagnostic test failed. This may help determine how often the condition that caused the DTC to be set occurs.
- Allow engine coolant temperature to drop below 80°C (176°F).
- Set the A/C to the OFF position.
- Once the ECM has enabled a low or high fan speed, that speed must run for a minimum of 20 seconds.

Test Description

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

2: Listen for an audible click when the low speed fan relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

3: Listen for an audible click when the low and high speed fan relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61) Circuits

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics (L61) Engine Cooling Schematics (L66) Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control 1 ON and OFF.		

	Does the low speed fan relay turn ON and OFF with each command?	Go to Step 3	Go to Step 4
3	With a scan tool, command the Fan Control 2 ON and OFF. Do the low and the high speed fan relays turn ON and OFF with each command?	Go to Diagnostic Aids	Go to Step 6
4	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the low speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive circuit of the low speed fan relay with a test lamp that is connected to a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 5	Go to Step 14
5	<ol style="list-style-type: none"> 1. Connect a test lamp between the control circuit of the low speed fan relay and the battery positive voltage circuit of the low speed fan relay. 2. With a scan tool, command the Fan Control 1 ON and OFF. <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 11	Go to Step 8
6	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the high speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the high speed fan relay with a test lamp that is connected to a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 7	Go to Step 14
7	<ol style="list-style-type: none"> 1. Connect a test lamp between the control circuit of the high speed fan relay and the battery positive voltage circuit of the high speed fan relay. 2. With a scan tool, command the Fan Control 2 ON and OFF. <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 12	Go to Step 8
8	Does the test lamp remain illuminated with each command?	Go to Step 10	Go to Step 9
9	<p>Test the control circuit of the appropriate relay for a short to voltage or an open. Refer to Testing for Intermittent Conditions and Poor Connections and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 18	Go to Step 15

10	Test the control circuit of the appropriate relay for a short to ground. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 13
11	Inspect for poor connections at the low speed fan relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 15
12	Inspect for poor connections at the high speed fan relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 16
13	Inspect for poor connections at the harness connector of the ECM. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 17
14	Repair the battery positive voltage circuit for an open or high resistance. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 18	-
15	Replace the low speed fan relay. Did you complete the repair?	Go to Step 18	-
16	Replace the high speed fan relay. Did you complete the repair?	Go to Step 18	-
17	IMPORTANT: Perform the programming procedure for the ECM. Replace the ECM. Refer to <u>Engine Control Module (ECM) Replacement</u> in Engine Controls - 2.2L Did you complete the replacement?	Go to Step 18	-
18	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 P0480, P0481, P0691, P0692, P0693, P0694, OR P1650 (L66)

Circuit Description

Battery positive voltage is supplied to the cooling fan 1 relay from the COOL FAN #1 fuse. The powertrain control module (PCM) controls the cooling fan 1 relay by grounding the low speed cooling fan relay control circuit via an internal solid state device called a driver.

Battery positive voltage is supplied to the cooling fan 2 relay and the cooling fan 3 relay from the COOL FAN

#2 fuse. The powertrain control module (PCM) controls the relays by grounding the high speed cooling fan relay control circuit.

When the PCM is commanding a relay on, the voltage potential of the control circuit should be low, near 0 volts. When the PCM is commanding the control circuit to a relay, 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 PCM will monitor the control circuit for the following:

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

Conditions for Running the DTC

- The ignition is ON.
- System voltage is between 8-18 volts.
- The engine speed is more than 40 RPM
- The relay control circuit is transitioned from OFF to ON or ON to OFF.

Conditions for Setting the DTC

- P0481 - The PCM detects an open circuit on the high speed cooling fan relay control circuit.
- P0693 - The PCM detects a short to ground on the high speed cooling fan relay control circuit.
- P0694 - The PCM detects a short to voltage on the high speed cooling fan relay control circuit.
- P0480 - The PCM detects an open on the low speed cooling fan relay control circuit.
- P0691 - The PCM detects a short to ground on the low speed cooling fan relay control circuit.
- P0692 - The PCM detects a short to voltage on the low speed cooling fan relay control circuit.
- The above condition is present for 5 seconds.
- P1650 - The PCM detects a short to voltage on both the low and high speed cooling fan relay control circuit.
- The above condition is present for 6 seconds.

Action Taken When the DTC Sets

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

Records data.

- The Service Vehicle Soon (SVS) light may be illuminated.

Conditions for Clearing the MIL/DTC

- The PCM 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** in Wiring Systems.
- Review the Freeze/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 1 relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

3: Listen for an audible click when the cooling fan 2 and cooling fan 3 relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

4: Tests for voltage at the coil side of the cooling fan 1 relay. The COOL FAN #1 fuse supplies battery positive voltage to the coil side of the cooling fan 1 relay.

DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66) Circuits

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics (L61) Engine Cooling Schematics (L66) Connector End View Reference: Cooling System Connector End Views			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control 1 ON and OFF. Does the cooling fan 1 relay turn ON and OFF with each command?	Go to Step 3	Go to Step 4
	1. Install a scan tool.		

3	<ol style="list-style-type: none"> 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control 2 ON and OFF. <p>Do the cooling fan 2 and the cooling fan 3 relays turn ON and OFF with each command?</p>	Go to Diagnostic Aids	Go to Step 6
4	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the cooling fan 1 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the cooling fan 1 relay with a test lamp that is connected to a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 5	Go to Step 16
5	<ol style="list-style-type: none"> 1. Connect a test lamp between the control circuit of the cooling fan 1 relay and the battery positive voltage circuit of the cooling fan 1 relay. 2. With a scan tool, command the Fan Control 1 ON and OFF. <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 12	Go to Step 9
6	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the cooling fan 3 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the cooling fan 3 relay with a test lamp that is connected to a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 7	Go to Step 16
7	<ol style="list-style-type: none"> 1. Connect a test lamp between the control circuit of the cooling fan 3 relay and the battery positive voltage circuit of the cooling fan 3 relay. 2. With a scan tool, command the Fan Control 2 and 3 ON and OFF. <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 14	Go to Step 8
8	<ol style="list-style-type: none"> 1. Turn Off the ignition. 2. Disconnect the cooling fan 2 relay. 3. Turn ON the ignition with the engine OFF. 4. Connect a test lamp between the control circuit of the cooling fan 2 relay and the battery positive voltage 		

	<p>circuit of the cooling fan 2 relay.</p> <p>5. With a scan tool, command the Fans Control 2 and 3 ON and OFF.</p> <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 13	Go to Step 9
9	<p>Does the test lamp remain illuminated with each command?</p>	Go to Step 11	Go to Step 10
10	<p>Test the control circuit of the appropriate relay for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 15
11	<p>Test the control circuit of the appropriate relay for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 15
12	<p>Inspect for poor connections at the cooling fan 1 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 17
13	<p>Inspect for poor connections at the cooling fan 2 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 18
14	<p>Inspect for poor connections at the cooling fan 3 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 19
15	<p>Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 21	Go to Step 20
16	<p>Repair the battery positive voltage circuit. Refer to Wiring Repairs in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to Step 21	-
17	<p>Replace the cooling fan 1 relay.</p> <p>Did you complete the replacement?</p>	Go to Step 21	-
18	<p>Replace the cooling fan 2 relay.</p> <p>Did you complete the replacement?</p>	Go to Step 21	-
19	<p>Replace the cooling fan 3 relay.</p> <p>Did you complete the replacement?</p>	Go to Step 21	-
20	<p>IMPORTANT:</p> <p>Perform the programming procedure for the PCM.</p> <p>Replace the PCM. Refer to Powertrain Control Module</p>		

	(PCM) Replacement in Engine Controls - 3.5L. Did you complete the replacement?	Go to Step 21	-
21	<ol style="list-style-type: none"> 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. <p>Does the DTC reset?</p>	Go to Step 2	System OK

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** in Wiring Systems.
- 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** in Wiring Systems.

Symptom List

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

- **Low Engine Coolant Indicator Always On**
- **Cooling Fan Always On (L61)** or **Cooling Fan Always On (L66)**
- **Cooling Fan Inoperative (L61)** or **Cooling Fan Inoperative (L66)**
- **Engine Overheating**
- **Loss of Coolant**
- **Thermostat Diagnosis**
- **Coolant Heater Inoperative**
- **Engine Fails To Reach Normal Operating Temperature**

LOW ENGINE COOLANT INDICATOR ALWAYS ON

Low Engine Coolant Indicator Always On

Step	Action	Yes	No
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Schematic Reference: Engine Cooling Schematics (L61) Engine Cooling Schematics (L66)**Connector End View Reference: Cooling System Connector End Views**

DEFINITION: The low coolant indicator is always on when the key is in the ON position.

1	Did you perform the Instrument Cluster Diagnostic System Check?	Go to Step 2	Go to <u>Diagnostic System Check - Instrument Cluster</u> in Instrument Panel, Gages, and Console
2	1. Turn the ignition ON, with the engine OFF. 2. With a scan tool command the instrument cluster indicators ON and OFF. Does the low coolant indicator lamp turn ON and OFF with each command?	Go to Step 3	Go to Step 5
3	Disconnect the coolant level switch connector. Does the low coolant indicator turn off?	Go to Step 6	Go to Step 4
4	Test the signal circuit of the coolant level switch for a short to voltage. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 11	Go to Step 7
5	Inspect for poor connections at the harness connector of the instrument panel cluster (IPC). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 11	Go to Step 8
6	Inspect for poor connections at the harness connector of the coolant level switch. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 11	Go to Step 9
7	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 11	Go to Step 10
8	Replace the IPC. Refer to <u>Instrument Panel Cluster (IPC) Replacement</u> in Instrument Panel, Gages, and Console. Did you complete the repair?	Go to Step 11	-
9	Replace the coolant level switch. Refer to <u>Surge Tank Replacement</u> . Did you complete the replacement?	Go to Step 11	-
	IMPORTANT: Perform the recalibration procedure for the BCM. Refer to <u>Body Control Module (BCM) Programming/RPO Configuration</u> in Body Control System.		

10	Replace the BCM. Refer to Body Control Module Replacement in Body Control System. Did you complete the replacement?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

COOLING FAN ALWAYS ON (L61)

Cooling Fan Always On (L61)

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics (L61) Engine Cooling Schematics (L66)			
Connector End View Reference: Cooling System Connector End Views			
DEFINITION: The engine cooling fan motor runs continuously in high or low speed.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go To Diagnostic System Check - Engine Cooling
2	Turn the ignition ON, with the engine OFF. Is the cooling fan operating at low speed?	Go to Step 4	Go to Step 3
3	Is the cooling fan operating at high speed?	Go to Step 5	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
4	Remove the cool fan low relay. Did the fan turn OFF?	Go to Step 7	Go to Step 6
5	Remove the cool fan high relay. Did the cooling fan turn OFF?	Go to Step 8	Go to Step 6
6	Repair the cooling fan motor supply voltage circuit for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 11	-
7	Inspect for poor connections at the cool fan low relay. 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 11	Go to Step 9
8	Inspect for poor connections at the cool fan high relay. 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 11	Go to Step 10
9	Replace the cool fan low relay. Did you complete the replacement?	Go to Step 11	-
10	Replace the cool fan high relay. Did you complete the replacement?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

COOLING FAN ALWAYS ON (L66)

Cooling Fan Always On (L66)

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics (L61)</u> <u>Engine Cooling Schematics (L66)</u> , <u>HVAC Schematics</u> in HVAC Manual Connector End View Reference: <u>Cooling System Connector End Views</u> DEFINITION: One or both engine cooling fan motors run continuously in high or low speed.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go To Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans control 1 ON and OFF. Are one or both cooling fans ON?	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
3	Are both cooling fans running continuously?	Go to Step 4	Go to Step 6
4	Are both cooling fans running continuously in high speed?	Go to Step 5	Go to Step 7
5	Test the low reference circuit of the A/C refrigerant pressure sensor for an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 14
6	Remove the cool fan 3 relay. Did the right cooling fan turn OFF?	Go to Step 10	Go to Step 8
7	Remove the cool fan 1 relay. Did the cooling fans turn OFF?	Go to Step 12	Go to Step 9
8	Remove the cool fan 2 relay. Did the right cooling fan turn OFF?	Go to Step 13	Go to Step 11
9	Repair the short to voltage in the left cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 18	-
10	Repair the short to voltage in the left cooling fan low reference circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 18	-
11	Repair the short to voltage in the right cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 18	-
12	Inspect for poor connections at the cool fan 1 relay. Refer to Testing for Intermittent Conditions and Poor		

	Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 18	Go to Step 15
13	Inspect for poor connections at the cool fan 2 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 18	Go to Step 16
14	Inspect for poor connections at the A/C refrigerant pressure sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 18	Go to Step 17
15	Replace the cool fan 1 relay. Did you complete the replacement?	Go to Step 18	-
16	Replace the cool fan 2 relay. Did you complete the replacement?	Go to Step 18	-
17	Replace the A/C refrigerant pressure sensor. Refer to Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement . Did you complete the replacement?	Go to Step 18	-
18	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

COOLING FAN INOPERATIVE (L61)

Cooling Fan Inoperative (L61)

Step	Action	Yes	No
Schematic Reference:Engine Cooling Schematics (L61)Engine Cooling Schematics (L66) Connector End View Reference:Cooling System Connector End Views DEFINITION: The cooling fan motor is inoperative in either high or low speeds.			
1	Did you perform the Diagnostic System Check - Engine Cooling?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fan Control 1 ON and OFF. Does the cooling fan turn ON and OFF in low speed with each command?	Go to Step 3	Go to Step 4
3	IMPORTANT: A 3 second delay occurs before the engine control module (ECM)/powertrain control module (PCM) changes the cooling fan speed.	Go to Testing for	

	With a scan tool, command the Fan Control 2 Speed ON and OFF. Does the cooling fan turn ON and OFF in high speed with each command?	<u>Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 6
4	<p>IMPORTANT: Do NOT remove the jumper wire that you will be connecting until your testing is completed. If the low speed fan fuse opens when you connect the jumper wire, repair the cooling fan motor supply voltage circuit of the cooling fan motor for a short to ground.</p> <ol style="list-style-type: none"> 1. Disconnect the cool fan low relay. 2. Connect a jumper wire between the battery positive voltage circuit and the cooling fan motor supply voltage circuit of the low speed fan relay. <p>Does the cooling fan operate in low speed?</p>	Go to Step 11	Go to Step 5
5	<ol style="list-style-type: none"> 1. Disconnect the cool fan high relay. 2. With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the cooling fan resistor. <p>Does the test lamp illuminate?</p>	Go to Step 9	Go to Step 8
6	Does the cooling fan operate at high speed?	Go to Step 12	Go to Step 7
7	<p>Inspect the ground circuit of the cool fan high relay for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 18	Go to Step 12
8	<ol style="list-style-type: none"> 1. Install the cool fan high relay. 2. Disconnect the cooling fan electrical connector. 3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the cooling fan motor connector. <p>Does the test lamp illuminate?</p>	Go to Step 10	Go to Step 9
9	<p>Inspect the cooling fan motor supply voltage circuit for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 18	Go to Step 14
10	<p>Inspect the ground circuit of the cooling fan for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 18	Go to Step 13

11	Inspect for poor connections at the cool fan low relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 15
12	Inspect for poor connections at the cool fan high relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 13
13	Inspect for poor connections at the harness connector of the cooling fan. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 17
14	Inspect the battery positive voltage circuit for an open or high resistance. Refer to <u>Wiring Repairs</u> and <u>Circuit Testing</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 16
15	Replace the cool fan low relay. Did you complete the replacement?	Go to Step 18	-
16	Replace the cool fan high relay. Did you complete the replacement?	Go to Step 18	-
17	Replace the cooling fan. Refer to <u>Cooling Fan and Shroud Replacement (L61)</u> <u>Cooling Fan and Shroud Replacement (L66)</u> . Did you complete the replacement?	Go to Step 18	-
18	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

COOLING FAN INOPERATIVE (L66)

Cooling Fan Inoperative (L66)

Step	Action	Yes	No
Schematic Reference: Engine Cooling Schematics (L61) Engine Cooling Schematics (L66) Connector End View Reference: Cooling System Connector End Views DEFINITION: One or both cooling fan motors are inoperative in either high, low, or both speeds.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	Test the cool fan 1, cool fan 2 and cool fan 3 relay control circuits for an open. Did you find and correct the condition?	Go to Step 29	Go to Step 3
	1. Install a scan tool.		

3	<ol style="list-style-type: none"> 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Control 1 ON and OFF. <p>Do the low speed engine cooling fans turn ON and OFF with each command?</p>	Go to Step 4	Go to Step 5
4	<p>IMPORTANT: A 3 second delay occurs before the PCM changes the cooling fan speed.</p> <p>With a scan tool, command the Fans Control 2 and 3 ON and OFF. Do the high speed engine cooling fans turn ON and OFF with each command?</p>	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 12
5	<p>IMPORTANT: Do NOT remove the 20 A fused jumper wire connected during this step. Use a second 20 A fused jumper wire while performing the following steps.</p> <ol style="list-style-type: none"> 1. Disconnect the cooling fan 1 relay. 2. Connect the first 20 A fused jumper between the battery positive voltage circuit of the cooling fan 1 relay and the cooling fan motor supply voltage circuit of the cooling fan 1 relay. <p>Do both cooling fans operate in low speed?</p>	Go to Step 14	Go to Step 6
6	<ol style="list-style-type: none"> 1. Disconnect the cooling fan 3 relay 2. Connect the second 20 A fused jumper between the left cooling fan motor low reference circuit of the cooling fan 2 relay and the right cooling fan motor supply voltage circuit of the cooling fan 2 relay. <p>Do both cooling fans operate in low speed?</p>	Go to Step 15	Go to Step 7
7	<p>Reconnect the second 20 A fused jumper between the battery positive voltage circuit of the cooling fan 2 relay and the cooling fan motor supply voltage circuit of the cooling fan 2 relay.</p> <p>Does the right cooling fan operate in high speed?</p>	Go to Step 10	Go to Step 8
	<ol style="list-style-type: none"> 1. Install the cooling fan 2 relay. 2. Disconnect the right cooling fan electrical connector. 3. Reconnect the second 20-amp fused jumper wire from the cooling fan motor supply voltage 		

8	<p>circuit of the right cooling fan electrical connector to the cooling fan motor ground circuit of the right cooling fan electrical connector.</p> <p>Does the left cooling fan operate in high speed?</p>	Go to Step 17	Go to Step 9
9	<p>Reconnect the second 20-amp fused jumper wire from the cooling fan motor supply voltage circuit of the right cooling fan electrical connector to a good ground. Does the left cooling fan operate in high speed?</p>	Go to Step 21	Go to Step 22
10	<ol style="list-style-type: none"> 1. Install the cooling fan 2 relay. 2. Disconnect the left cooling fan electrical connector. 3. Reconnect the second 20 Amp fused jumper wire from cooling fan motor supply voltage circuit of the left cooling fan electrical connector to the cooling fan low reference circuit of the left cooling fan electrical connector. <p>Does the right cooling fan operate in high speed?</p>	Go to Step 18	Go to Step 11
11	<p>Reconnect the second 20-amp fused jumper wire from battery positive voltage to the left cooling fan low reference circuit of the left cooling fan electrical connector. Does the right cooling fan operate in high speed?</p>	Go to Step 19	Go to Step 23
12	<p>Does the right cooling fan operate in high speed?</p>	Go to Step 13	Go to Step 16
13	<ol style="list-style-type: none"> 1. Disconnect the cooling fan 2 relay 2. Connect a 20 A fused jumper between the left cooling fan low reference circuit of the cooling fan 2 relay and the ground circuit of the cooling fan 2 relay. <p>Does the left cooling fan operate properly in high speed?</p>	Go to Step 15	Go to Step 20
14	<p>Inspect for poor connections at the cooling fan 1 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?</p>	Go to Step 29	Go to Step 24
15	<p>Inspect for poor connections at the cooling fan 2 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?</p>	Go to Step 29	Go to Step 25

16	Inspect for poor connections at the cooling fan 3 relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 26
17	Inspect for poor connections at the harness connector of the right cooling fan. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 27
18	Inspect for poor connections at the harness connector of the left cooling fan. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 28
19	Repair the left cooling fan motor supply voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
20	Repair the left cooling fan motor ground circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
21	Repair the right cooling fan motor ground circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
22	Repair the right cooling fan motor supply voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
23	Repair the left cooling fan low reference circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
24	Replace the cooling fan 1 relay. Did you complete the replacement?	Go to Step 29	-
25	Replace the cooling fan 2 relay. Did you complete the replacement?	Go to Step 29	-
26	Replace the cooling fan 3 relay. Did you complete the replacement?	Go to Step 29	-
27	Replace the right cooling fan. Refer to <u>Cooling Fan Motor Replacement - Electric (L66)</u> . Did you complete the replacement?	Go to Step 29	-
28	Replace the left cooling fan. Refer to <u>Cooling Fan Motor Replacement - Electric (L66)</u> . Did you complete the replacement?	Go to Step 29	-
29	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

ENGINE OVERHEATING

Engine Overheating

Problem	Action
Coolant fan inoperative	Refer to Low Engine Coolant Indicator Always On .
Thermostat stuck closed	Replace the thermostat.
Radiator fins obstructed	<ul style="list-style-type: none"> • Remove or relocate add-on parts that block air to the radiator • Clean away bugs, leaves, etc. • In cold climates, clear away snow, etc. from the radiator core
Surge tank outlet hose pinched or kinked (at radiator)	<ul style="list-style-type: none"> • Relieve kinks by re-routing • Replace the hose if necessary
Incorrect radiator	Refer to the radiator usage chart in a parts catalog. If needed, replace with the correct radiator.
Loss of system pressure	<ul style="list-style-type: none"> • Pressure check the system and the surge tank cap • Ensure that the correct cap is being used
Damaged or missing air seals or deflector	Repair or replace as required.
Malfunctioning coolant pump	Replace the coolant pump. Refer to Water Pump Replacement (L61) Water Pump Replacement (L66) .
Air trapped in cooling system	Refill the cooling system.

LOSS OF COOLANT

Loss of Coolant

Step	Action	Yes	No
DEFINITION: The cooling system is losing 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 - Engine Cooling . 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 . 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	<p>Extended operation with a low coolant level can cause engine internal component failure.</p> <p>Is the engine knocking?</p>	Go to Step 29	Go to Step 8
8	<ol style="list-style-type: none"> 1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. <p>Is a heavy white smoke present from the exhaust pipe?</p>	Go to Step 9	Go to Step 10
9	<p>Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust.</p> <p>Condensation in the exhaust system can cause an odorless white smoke during engine warm up.</p> <p>Does the white smoke have a burning coolant type odor?</p>	Go to Step 28	Go to Step 10
10	<p>With the engine idling, inspect the coolant recovery system.</p> <p>Does the coolant recovery system discharge coolant while the engine is idling?</p>	Go to Step 15	Go to Step 11
11	<p>Visually inspect the hoses, pipes and hose clamps at the following locations:</p> <ul style="list-style-type: none"> • Coolant surge tank • Heater core • Radiator <p>Are any of the hoses, clamps or pipes leaking?</p>	Go to Step 20	Go to Step 12
12	<p>Visually inspect the following components:</p> <ul style="list-style-type: none"> • 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 <p>Are any of the listed components leaking?</p>	Go to Step 20	Go to Step 13
13	<ol style="list-style-type: none"> 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. 	Go to	

	Are any leaks present?	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
16	Inspect for the following conditions: <ul style="list-style-type: none"> • A coolant smell inside of the vehicle • 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 there a milky substance on 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 there 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 in Heating, Ventilation and Air Conditioning. 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 (L61) Radiator Replacement (L66) . 2. Service the automatic transmission. Refer to Engine Coolant/Water in Transmission in Automatic Transmission - 5AT or Engine Coolant/Water in Transmission in Automatic Transmission - VT25-E.		-

	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 Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical - 2.2L (L61) or Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical - 3.5L (L66). Is the repair complete?	Go to Step 31	-
27	Repair the engine overheating condition. Refer to Engine Overheating . Is the repair complete?	Go to Step 31	-
28	Repair the engine internal coolant leak. Refer to Coolant in Combustion Chamber in Engine Mechanical - 2.2L (L61) or Coolant in Combustion Chamber in Engine Mechanical - 3.5L (L66). Is the repair complete?	Go to Step 31	-
29	Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed in Engine Mechanical - 2.2L (L61) or Lower Engine Noise, Regardless of Engine Speed in Engine Mechanical - 3.5L (L66). Is the repair complete?	Go to Step 31	-
30	Repair the combustion pressure in the cooling system problem. Refer to Cylinder Leakage Test in Engine Mechanical-2.2L (L61). 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 Diagnosis

Step	Action	Yes	No
1	Pressure check the cooling system and the cap for leaks. Repair any leaks before proceeding with the diagnosis. Four cylinder engines use an 82°C (185°F) thermostat. Six cylinder engines use a 91°C (195°F) thermostat. Ambient temperatures should be between 13-38°C (55-100°F). Place the HVAC controls in the OFF position. Run a cold engine at idle 20-21°C (68-70°F) for 15-20 minutes before checking the engine temperature. Is the repair complete?	Go to Step 2	-
2	Verify the engine coolant temperature with a Scan Tool at idle. Is the engine temperature below 85°C (185°F)?	Go to Step 5	Go to Step 3
3	Verify the engine coolant temperature with a Scan Tool at idle. Is the engine coolant temperature between 85-96°C (185-205°F)?	System OK	Go to Step 4
	Verify the engine coolant temperature with a Scan Tool at idle.	Go to	

4	Is the engine coolant temperature over 96°C (205°F)?	Step 7	-
5	<p>Test the thermostat for the following conditions:</p> <ul style="list-style-type: none"> • Opening early • Seal is leaking <p>Are either of these conditions present?</p>	Go to Step 6	System OK
6	<p>Replace the thermostat. Refer to <u>Thermostat Replacement (L61)</u> <u>Thermostat Replacement (L66)</u> .</p> <p>Is the repair complete?</p>	System OK	-
7	Is the radiator inlet hot?	Go to Step 8	Go to Step 14
8	<ol style="list-style-type: none"> 1. Turn on the heater. 2. Check for hot air at the heater outlets. <p>Is the air hot?</p>	Go to Step 9	Go to Step 12
9	<p>Inspect for blockage in the radiator.</p> <p>Did you find any blockage?</p>	Go to Step 10	Go to Step 11
10	<ol style="list-style-type: none"> 1. Repair the blockage. 2. Reinspect the radiator with the Scan Tool . <p>Is the repair complete?</p>	System OK	-
11	<ol style="list-style-type: none"> 1. Replace thermostat. Refer to <u>Thermostat Replacement (L61)</u><u>Thermostat Replacement (L66)</u> . 2. Reinspect the radiator with the Scan Tool . <p>Is the repair complete?</p>	System OK	-
12	<ol style="list-style-type: none"> 1. Rev the engine several times to remove any air. 2. Inspect for blockage in the heater circuit. 3. Inspect for pinched or buckled hoses. <p>Did you find any blockage?</p>	Go to Step 13	Go to Heating Performance Diagnostic in HVAC
13	<ol style="list-style-type: none"> 1. Repair the blockage. 2. Reinspect the radiator with the Scan Tool . <p>Is the repair complete?</p>	System OK	-
14	<p>Air may be in the system.</p> <ol style="list-style-type: none"> 1. Add coolant to surge tank if low. 2. Reinspect the radiator inlet hose. 		

	Is the hose hot?	Go to Step 8	Go to Step 15
15	<p>Inspect for blockage in the following locations:</p> <ul style="list-style-type: none"> • The cylinder head • The radiator • The radiator hoses • The radiator nipples <p>Did you find any blockage?</p>	Go to Step 16	Go to Step 17
16	<ol style="list-style-type: none"> 1. Repair the blockage. 2. Reinspect the radiator with the Scan Tool . <p>Is the repair complete?</p>	System OK	-
17	<ol style="list-style-type: none"> 1. Repair the thermostat. 2. Reinspect the radiator with the Scan Tool . <p>Is the repair complete?</p>	System OK	-

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 (2.2L (L61))Coolant Heater Cord Replacement (L66) 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 (2.2L (L61))Coolant Heater Replacement (L66) 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

1. Verify that the cooling system is properly filled. Refer to **Draining and Filling Cooling System** .
2. If the complaint is a low temperature gauge reading, check the temperature gage for proper operation. Connect a scan tool to the vehicle and read the system temperature. Compare this reading to the temperature gauge. Replace the gauge or switch if necessary.
3. Refer to **Heating Performance Diagnostic** in Heating, Ventilation, and Air Conditioning if the complaint is no heat from the HVAC system.
4. Verify proper thermostat operation. Refer to **Thermostat Diagnosis** .

PRESSURE CAP TESTING

Tools Required

- **SA9141E** Cooling System Pressure Test Kit. See **Special Tools and Equipment** .
- **J 42401** Radiator Cap/Surge Tank Test Adapter. See **Special Tools and Equipment** .

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. Wash the pressure cap sealing surface with water.

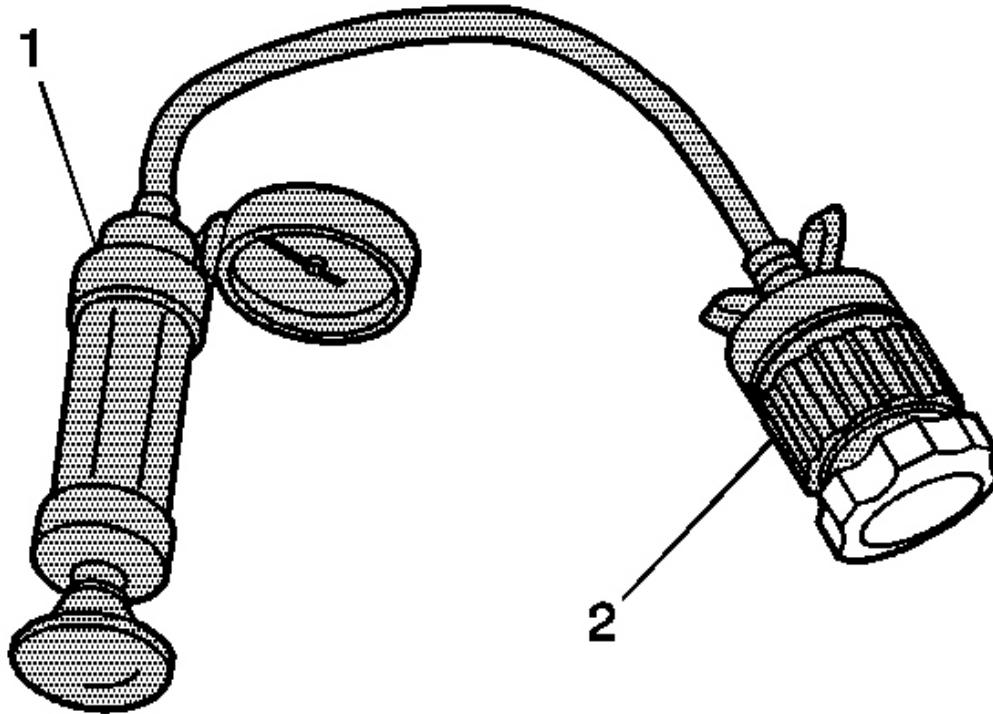


Fig. 6: Identifying J 24460-01 & J 42401
Courtesy of GENERAL MOTORS CORP.

3. Use the SA9141E (1) with J 42401 (2) in order to test the pressure cap. See **Special Tools and Equipment** .
4. Test the pressure cap for the following conditions:
 - Pressure release when the SA9141E exceeds the pressure rating of the pressure cap. See **Special Tools and Equipment** .
 - 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 pressure which exceeds the rated pressure of the cap.
 - The pressure cap does not hold the rated pressure.

Tools Required

- **SA9141E** Cooling System Pressure Test Kit. See **Special Tools and Equipment** .
- **J 42401** Radiator Cap / Surge Tank Test Adapter. See **Special Tools and Equipment** .

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.

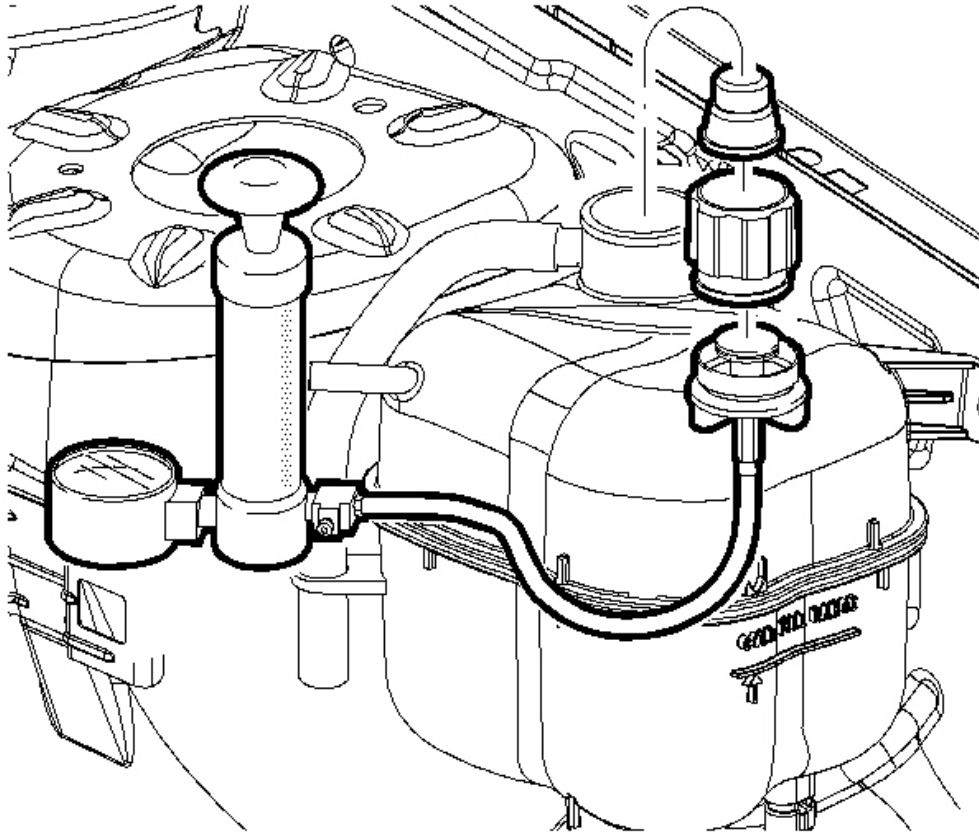


Fig. 7: View Of SA9141E & J 42401
Courtesy of GENERAL MOTORS CORP.

4. Use the SA9141E with J 42401 in order to apply pressure to the cooling system. See **Special Tools and Equipment**.
 - Wet the O-rings on the Surge Tank Pressure Test Adapter J42401-2 (insert) with water or clean coolant and insert into tank.
 - Wet the rubber gasket of the cap adapter J42401-3 (cap) and install on surge tank.

IMPORTANT: 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

Draining Procedure

CAUTION: In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.

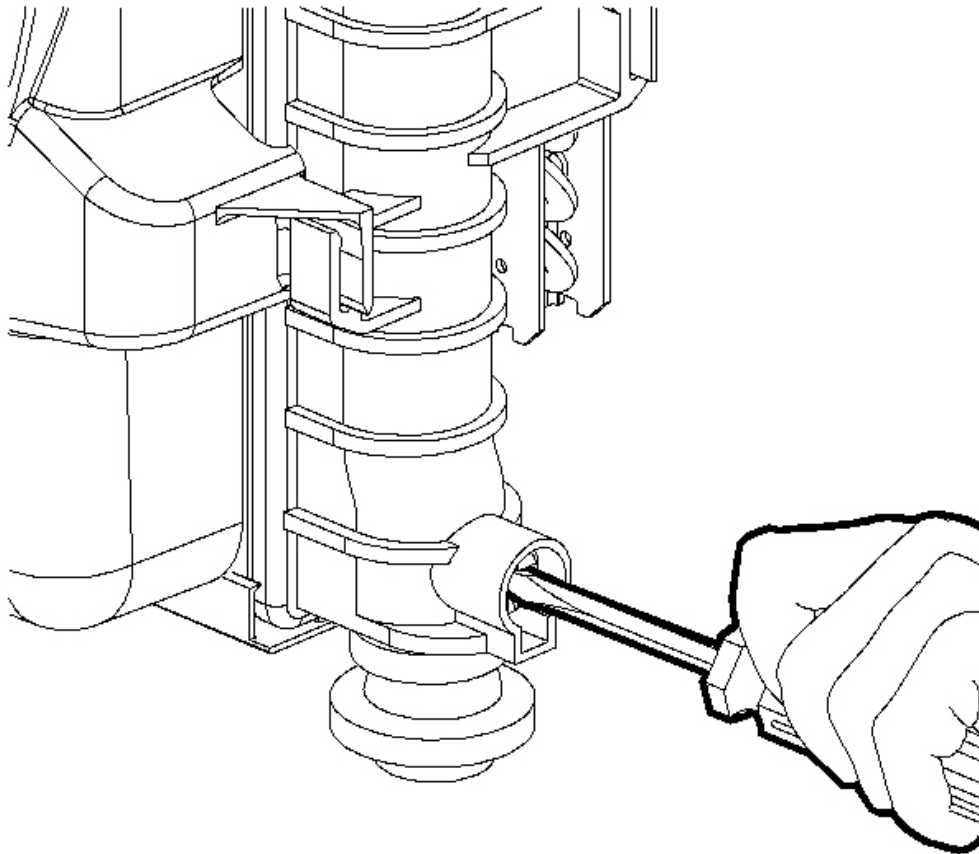


Fig. 8: View Of Drain Valve
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A 7.6 liter (8 qt) coolant container will be needed.

1. Place the coolant container under the radiator drain cock located at the bottom of the right radiator end tank.
2. Using a flat-bladed tool, open the drain cock and drain the coolant. A small amount of coolant will drain from the system.

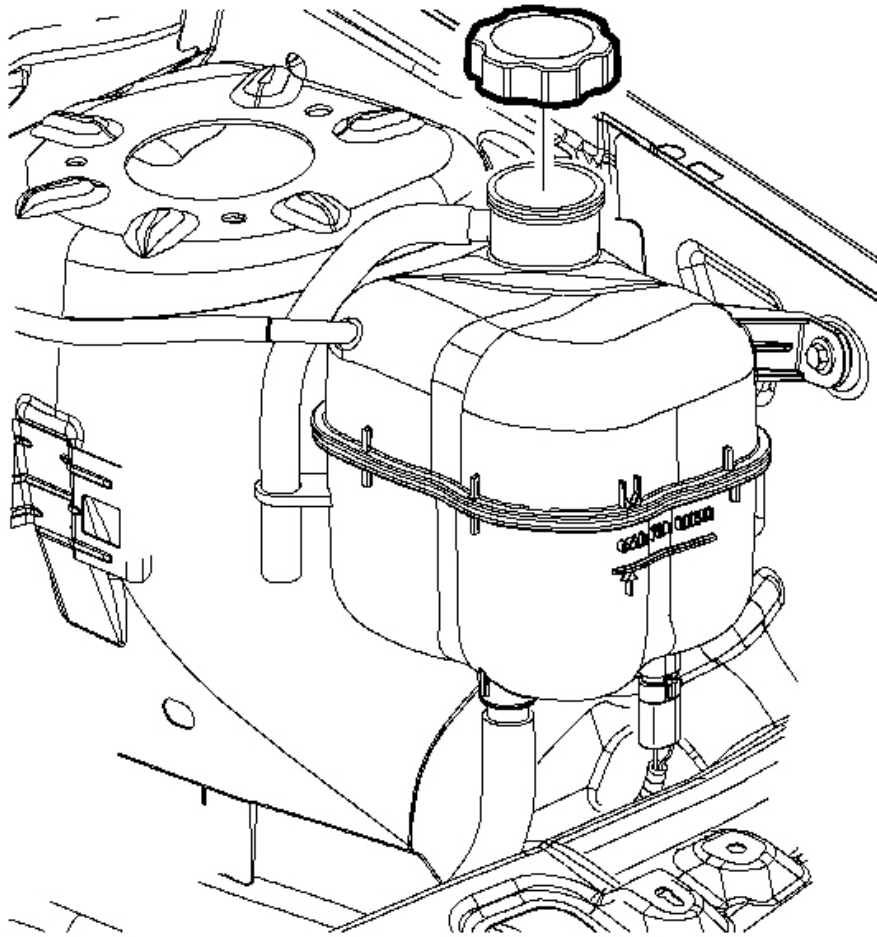


Fig. 9: View Of Surge Tank Cap
Courtesy of GENERAL MOTORS CORP.

3. Remove the surge tank cap from the surge tank and the coolant will drain from the system.

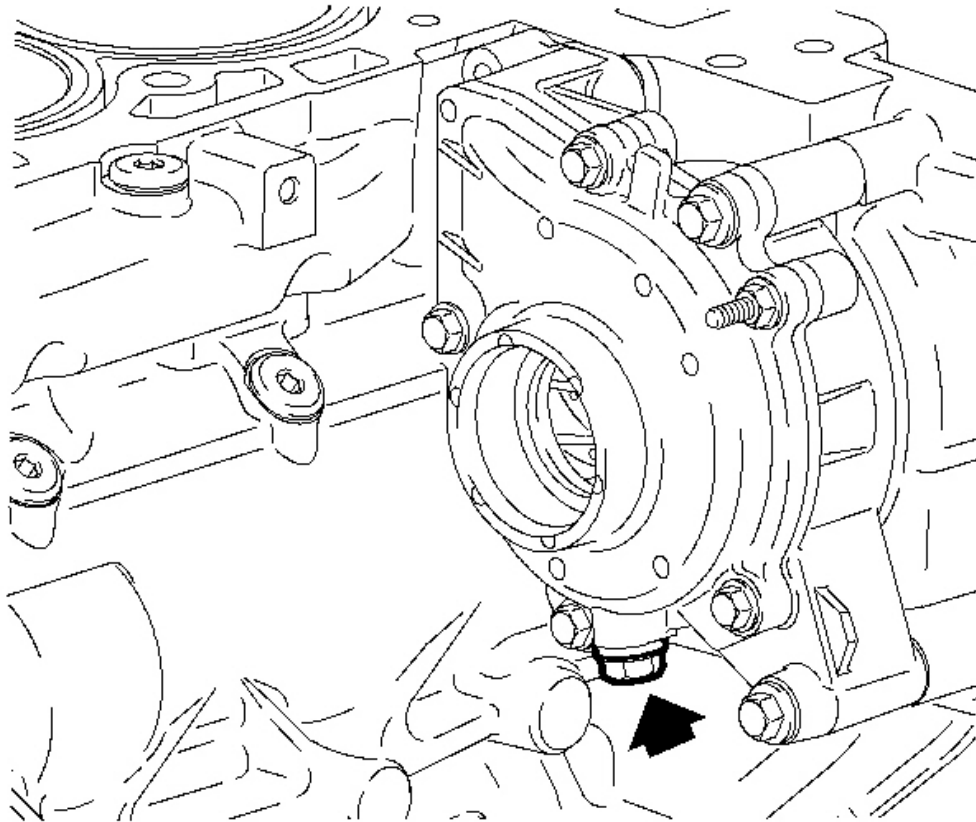


Fig. 10: View Of Drain Plug On The Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

4. For L61 vehicles, if the engine block needs to be drained, a drain bolt is located near the bottom of the water pump assembly.

Filling Procedure

NOTE: All entrapped air must be purged from the powertrain cooling system before the final coolant level can be determined. Proper coolant level is critical to avoid engine damage.

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

1. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean water to the coolant surge tank. Fill the cooling system as indicated below:
 - For L61 vehicles when the engine block is not drained, add 3.5 liters (3.7 qts)
 - For L61 vehicles when the engine block is drained, add 6 liters (6.3 qts)
 - For L66 vehicles, add 5 liters (5.3 qts)
2. Start the engine and check for leaks.
3. Run the engine and cycle the vehicle from idle to 3,000 RPM in 30 second intervals until the engine cooling fan comes ON, the engine cooling fan turns ON at approximately 102°C (216°F). Repeat this process twice before the engine is turned OFF.
4. Return the engine to idle, and idle for 30 seconds, then turn the engine OFF.
5. Allow the vehicle to cool, before adding additional coolant.

IMPORTANT: The level in the surge tank will return into the cold fill range once the vehicle cools.

6. Add additional coolant to the surge tank until the level is approximately 13 mm (0.5 in) above the surge tank seam.
7. Install the coolant surge tank cap.

COOLANT SYSTEM FLUSHING

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. Always remove the thermostat before flushing the cooling system.

When the cooling system becomes contaminated, the cooling system should be flushed thoroughly to remove the contaminants before the engine is seriously damaged.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
2. Remove the surge tank. Refer to **Surge Tank Replacement** .
3. Clean and flush the surge tank with clean, drinkable water.
4. Install the surge tank. Refer to **Surge Tank Replacement** .
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to **Draining and Filling Cooling System** .
6. Run the engine for 20 minutes.

7. Stop the engine.
8. Drain the cooling system. Refer to **Draining and Filling Cooling System** in Engine Cooling.
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

SURGE TANK REPLACEMENT

Removal Procedure

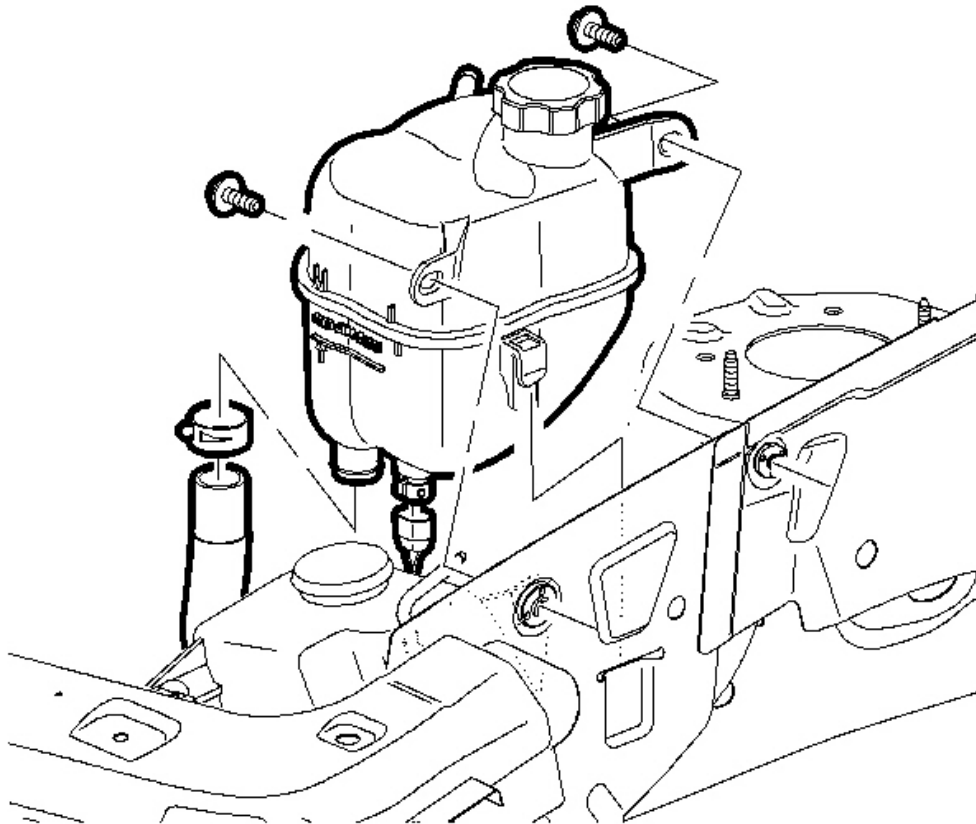


Fig. 11: View Of Surge Tank Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the surge tank inlet hose clamp from the surge tank.
3. Remove the surge tank inlet hose from the surge tank.
4. Remove the surge tank bolts from the vehicle.
5. Lift the surge tank to gain access to the bottom of the tank.
6. Disconnect the low coolant sensor from the surge tank.
7. Remove the surge tank outlet hose clamp from the bottom of the surge tank.
8. Remove the surge tank outlet hose from the bottom of the surge tank.

Installation Procedure

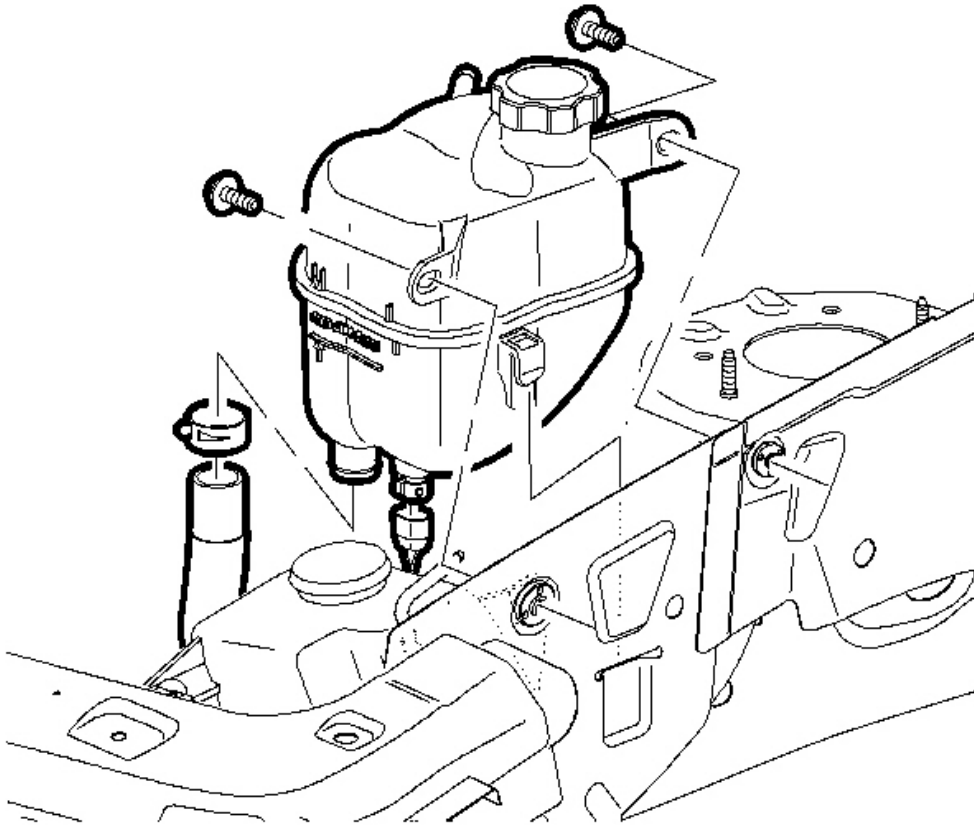


Fig. 12: View Of Surge Tank Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the surge tank outlet hose to the bottom of the surge tank.
2. Install the surge tank outlet hose clamp to the bottom of the surge tank.
3. Connect the low coolant sensor to the surge tank.
4. Align the surge tank retention tab and lower the surge tank into the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the surge tank bolts to the vehicle.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

6. Install the surge tank inlet hose to the surge tank.
7. Install the surge tank inlet hose clamp to the surge tank.
8. Fill the cooling system. Refer to Draining and Filling Cooling System .

SURGE TANK HOSE/PIPE REPLACEMENT - INLET (L61)

Removal Procedure

8. Remove the surge tank inlet hose from the vehicle.

Installation Procedure

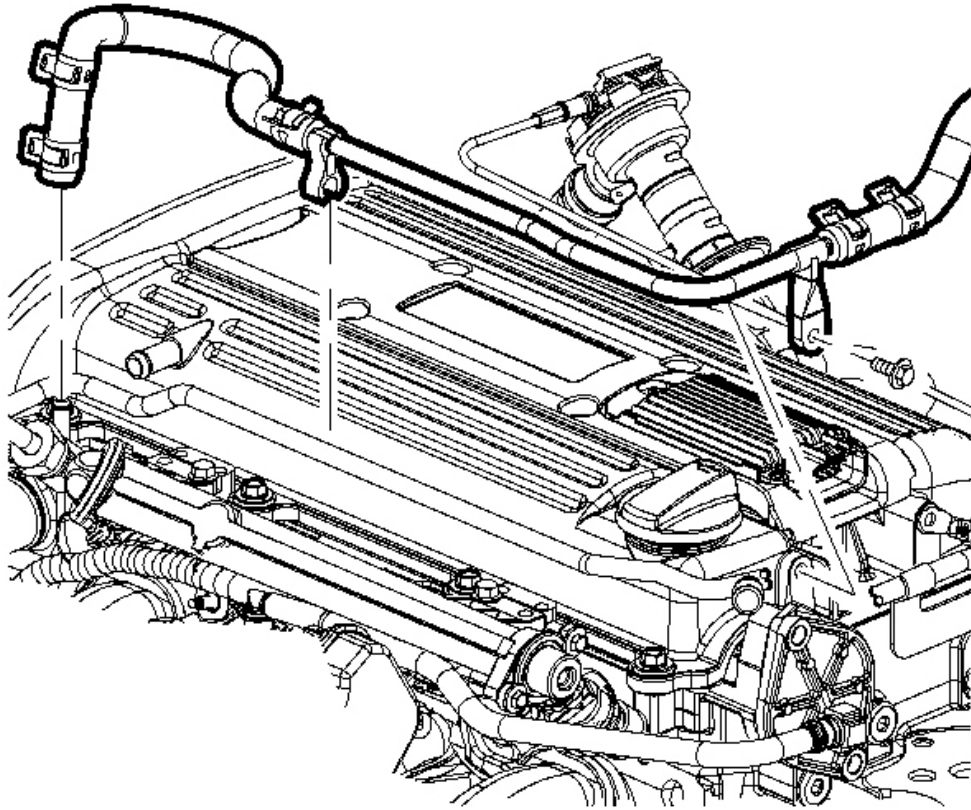


Fig. 14: View Of Surge Tank Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the surge tank inlet hose to the vehicle.
2. Connect the surge tank inlet hose retainers to the engine.
3. Install the surge tank inlet hose to the engine.
4. Install the surge tank inlet hose clamp to the engine.
5. Install the surge tank inlet hose to the surge tank.

6. Install the surge tank inlet hose clamp to the surge tank.
7. Install the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** in Engine Controls - 2.2L (L61).
8. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (L61)

Removal Procedure

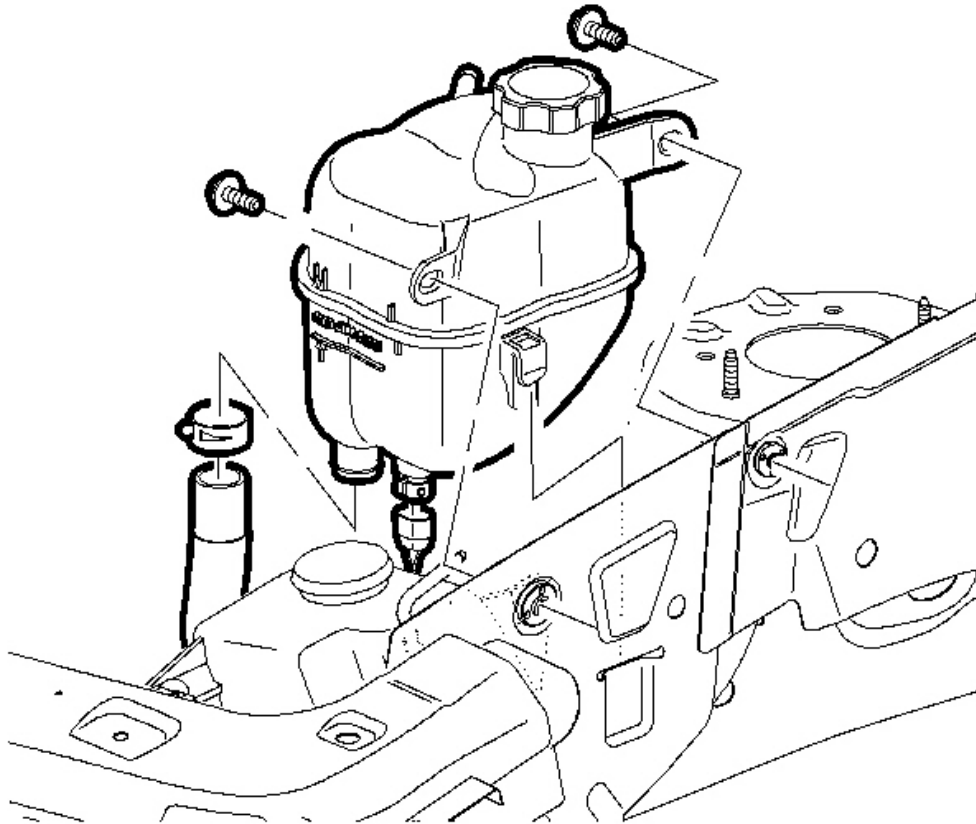


Fig. 15: View Of Surge Tank Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the surge tank. Refer to **Surge Tank Replacement** .
2. Remove the surge tank outlet hose clamp from the hose to aid in hose routing.

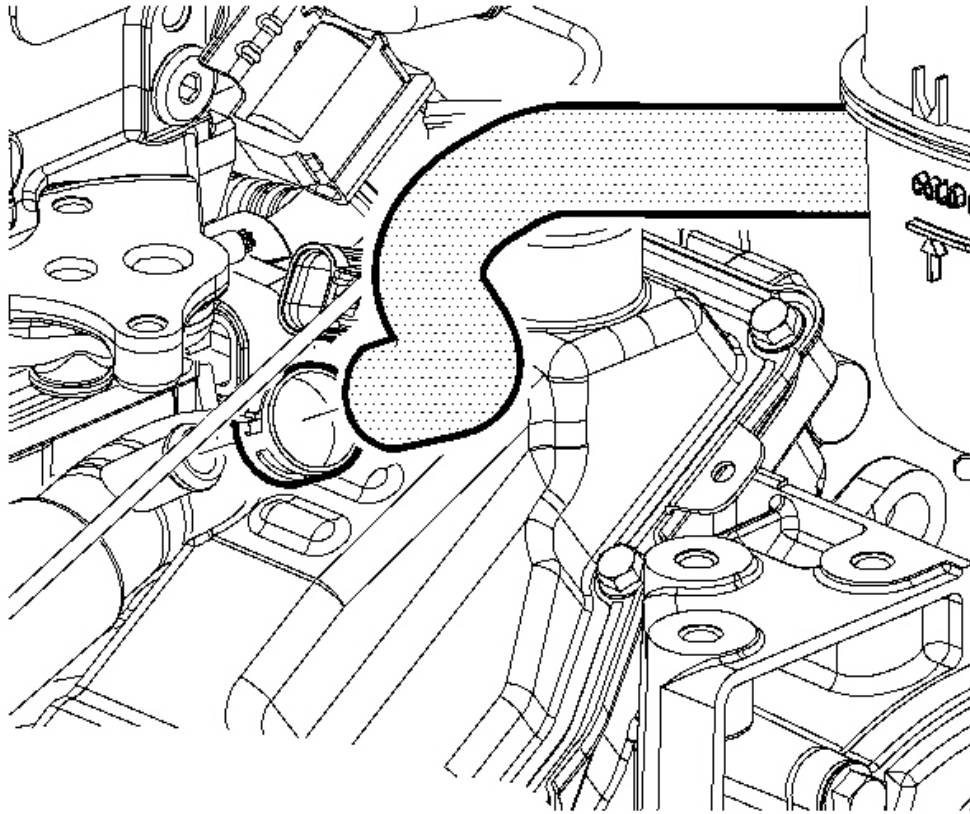


Fig. 16: View Of Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Remove the surge tank outlet hose clamp from the engine.
4. Remove the surge tank outlet hose from the engine.
5. Remove the surge tank outlet hose from the vehicle.

Installation Procedure

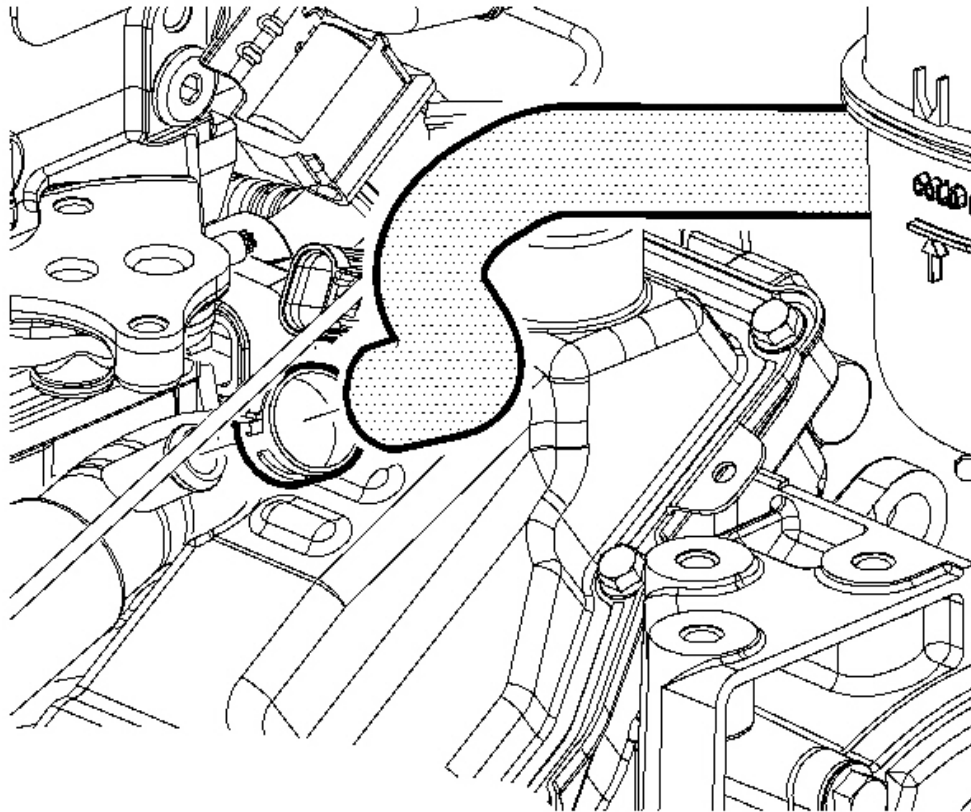


Fig. 17: View Of Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the surge tank outlet hose to the vehicle.
2. Install the surge tank outlet hose to the engine.
3. Install the surge tank outlet hose clamp to the engine.

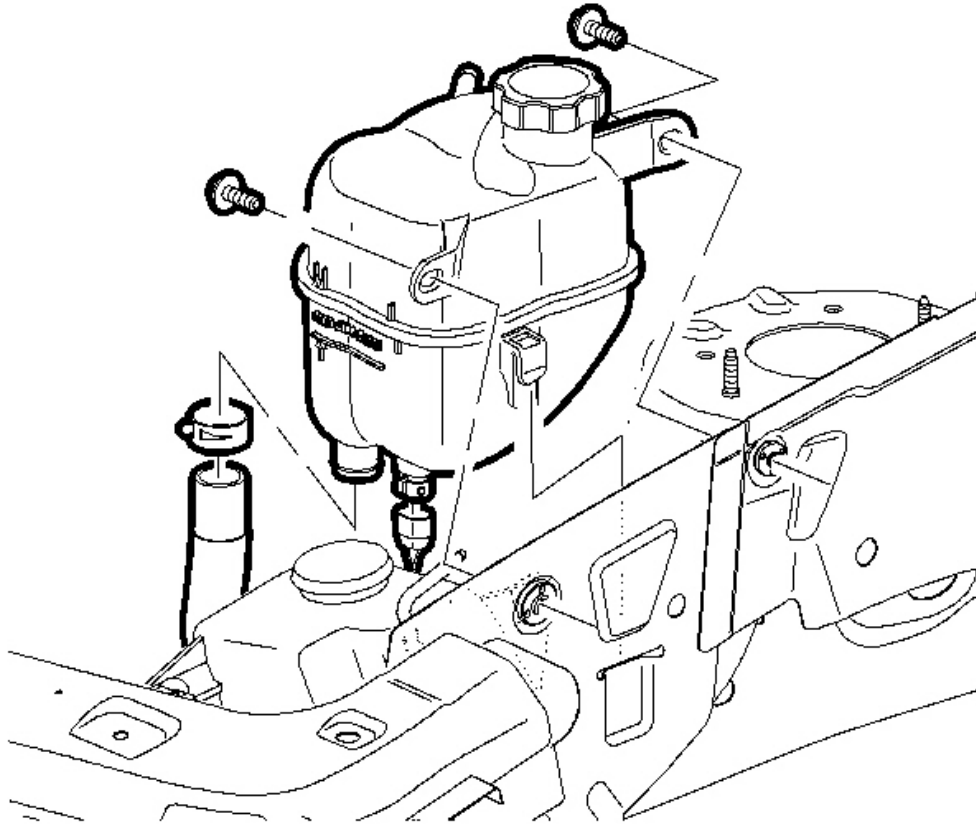


Fig. 18: View Of Surge Tank Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the surge tank outlet hose clamp to the hose.
5. Install the surge tank. Refer to **Surge Tank Replacement** .

RADIATOR HOSE REPLACEMENT - INLET (L66)

Removal Procedure

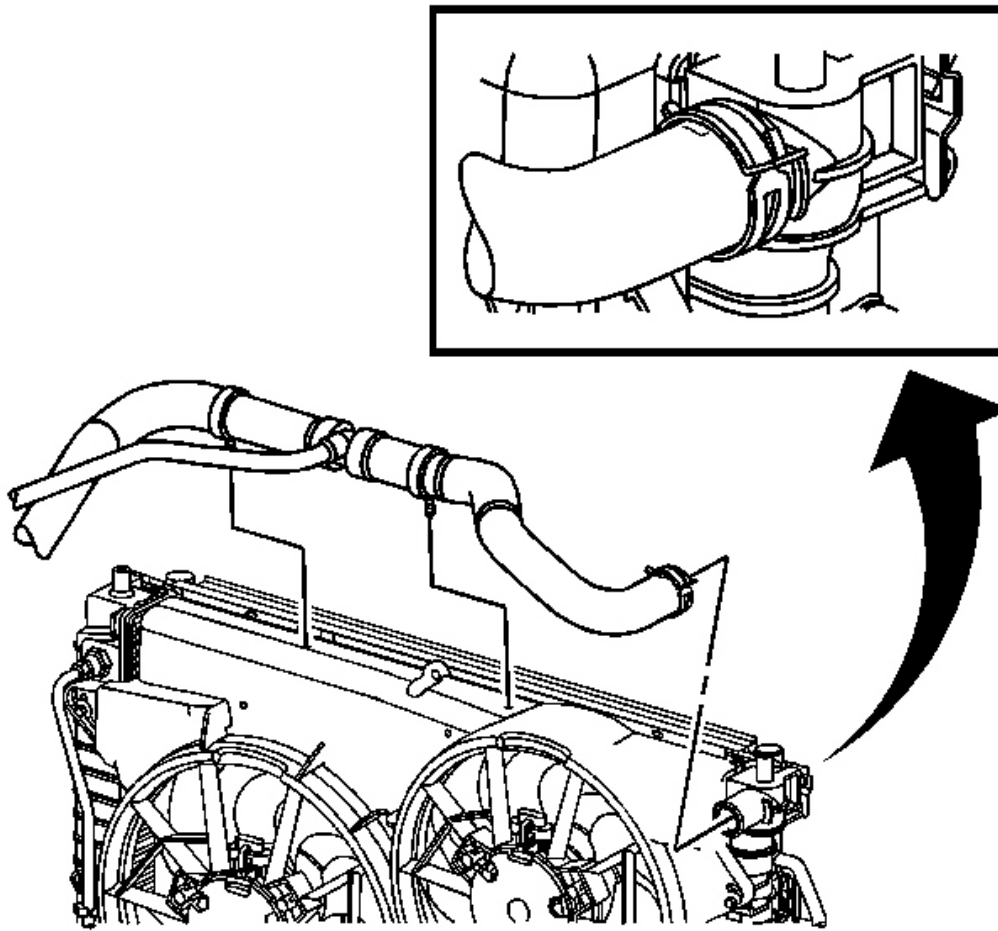


Fig. 19: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the radiator inlet hose clamp from the radiator.
3. Remove the radiator inlet hose from the radiator.
4. Remove the surge tank inlet hose from the surge tank.
5. Remove the radiator hose retaining straps from the radiator support.

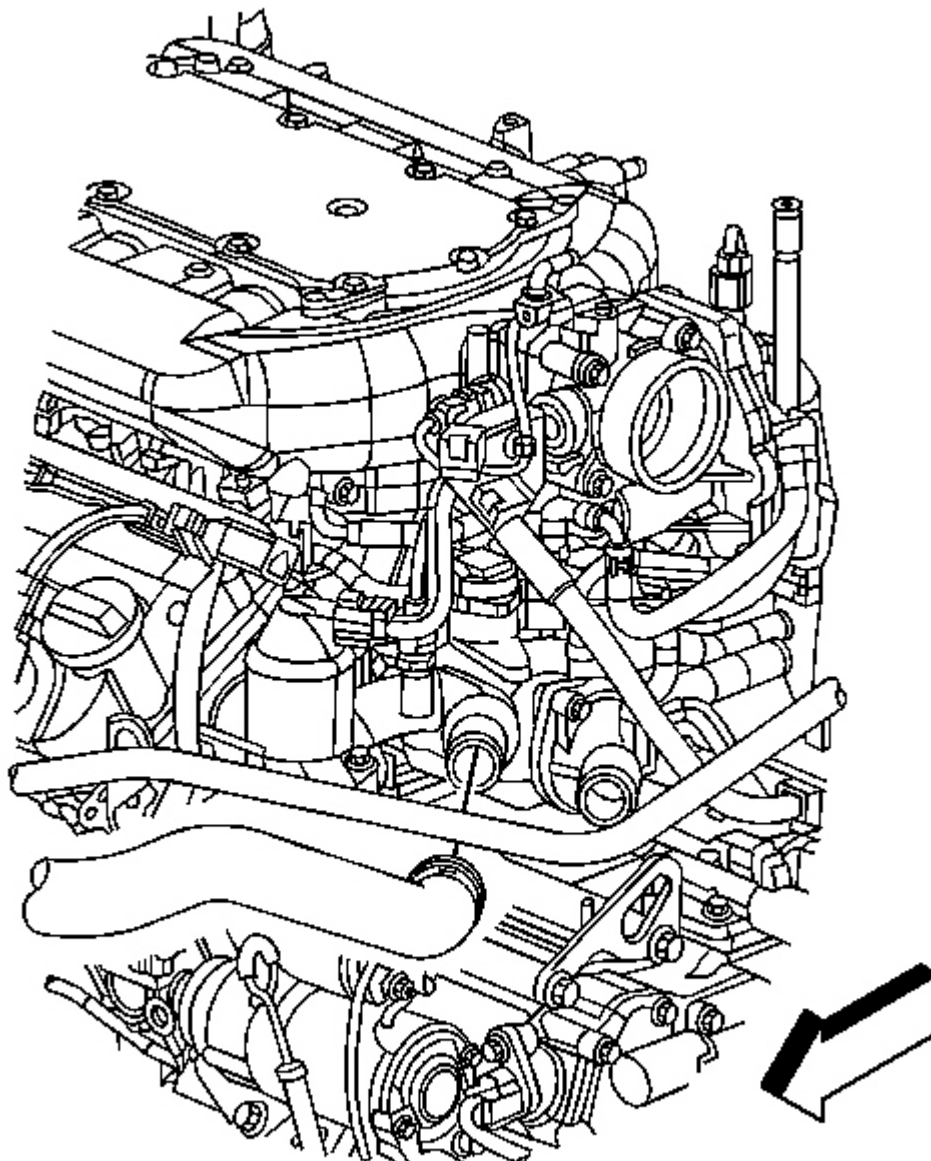


Fig. 20: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Remove the radiator inlet hose clamp from the engine.
7. Remove the radiator inlet hose from the engine.

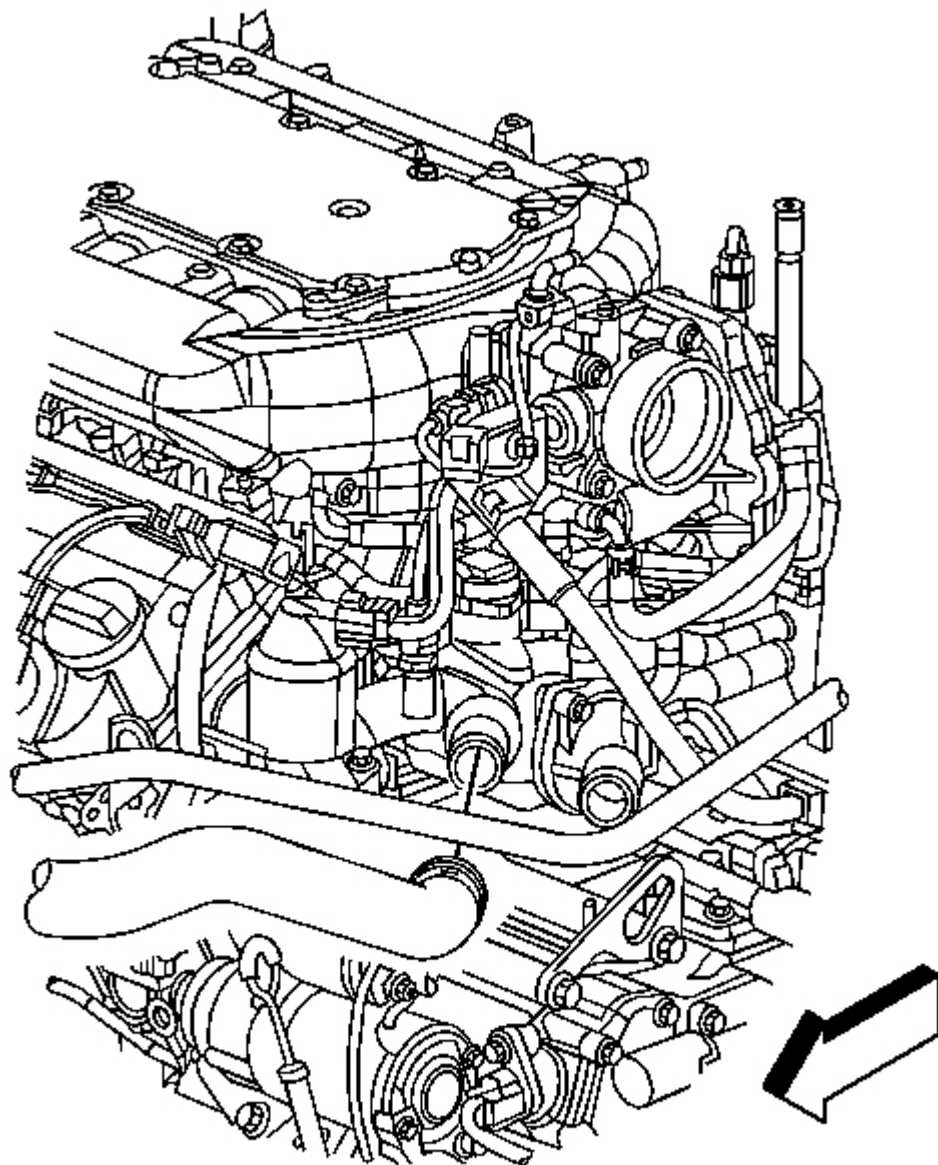


Fig. 21: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator inlet hose to the engine.

2. Install the radiator inlet hose clamp to the engine.

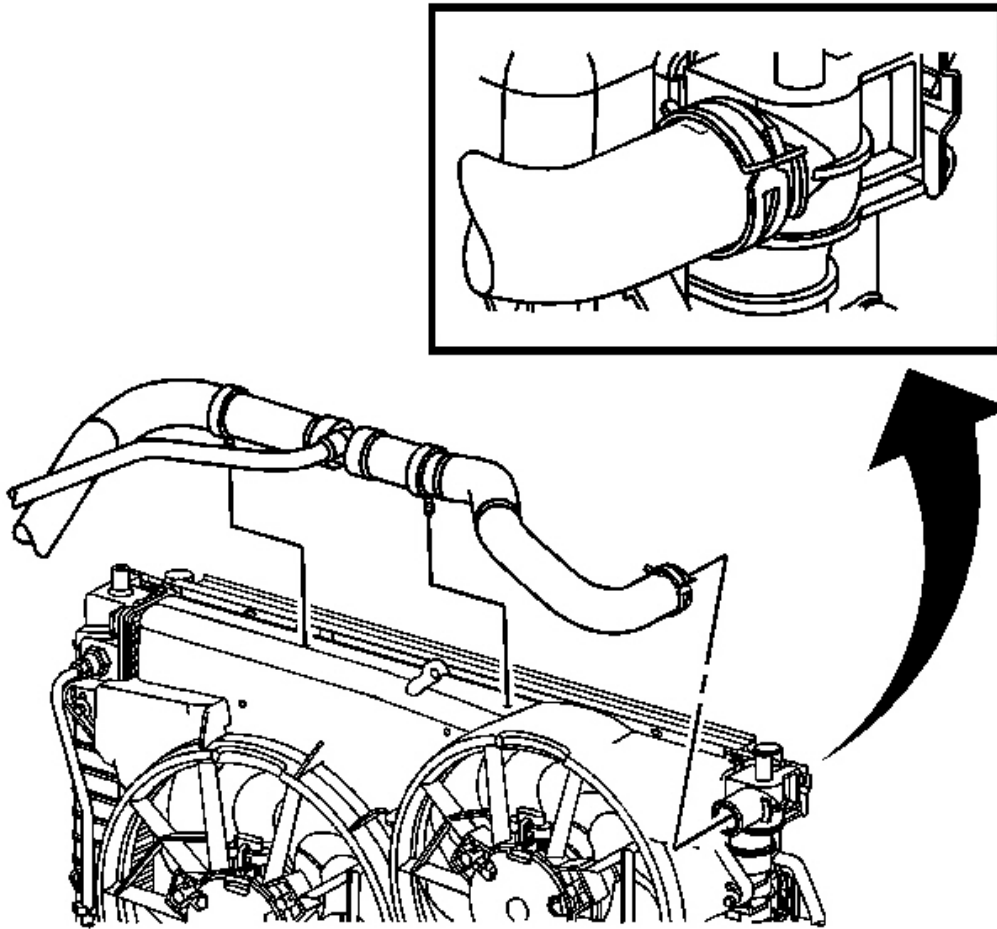


Fig. 22: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the surge tank inlet hose to the surge tank.
4. Install the radiator hose retaining straps to the radiator support.
5. Install the radiator inlet hose to the radiator.
6. Install the radiator inlet hose clamp to the radiator.
7. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

RADIATOR HOSE REPLACEMENT - INLET (L61)

Removal Procedure

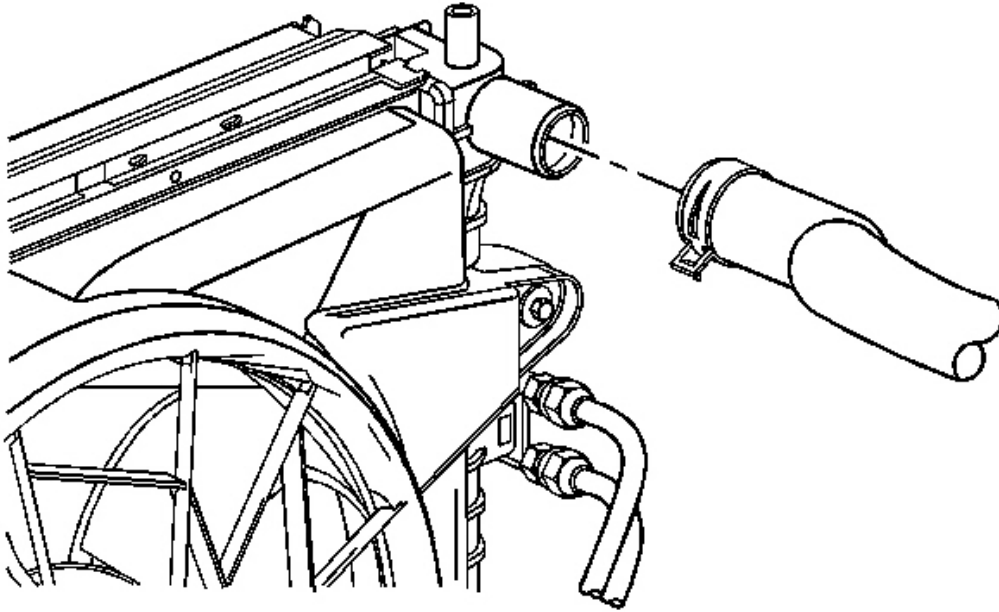


Fig. 23: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the radiator inlet hose clamp from the radiator.
3. Remove the radiator inlet hose from the radiator.

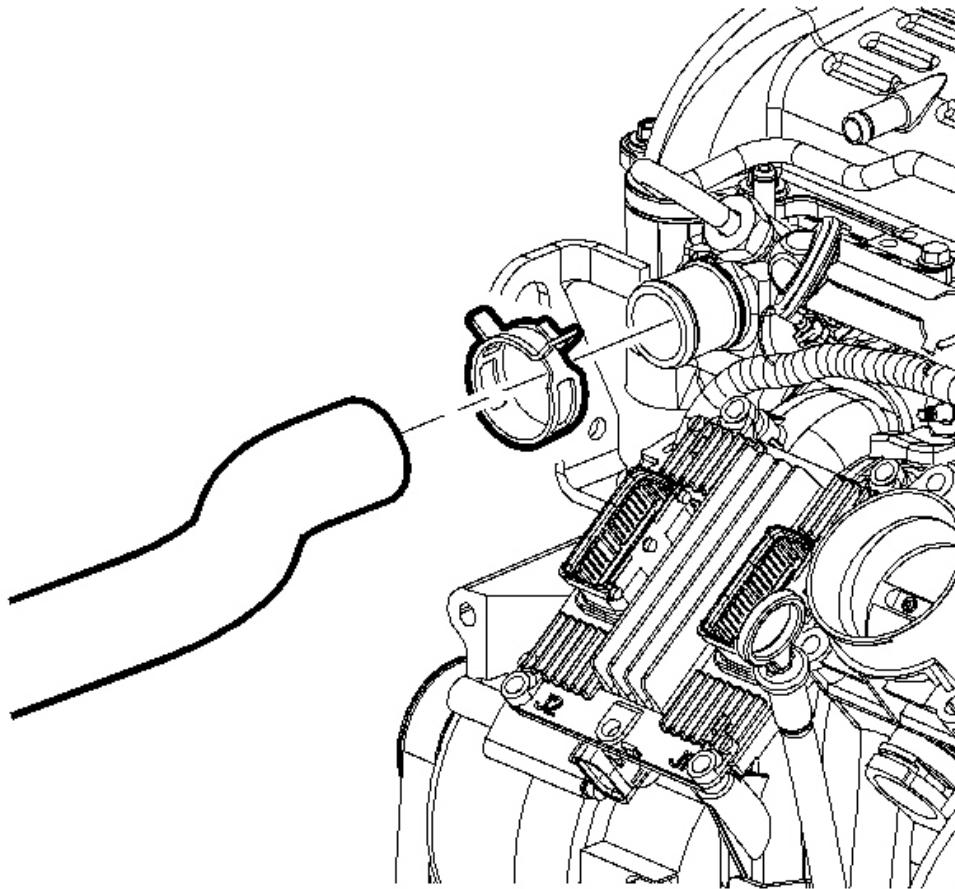


Fig. 24: View Of Radiator Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

4. Remove the radiator inlet hose clamp from the engine.
5. Remove the radiator inlet hose from the engine.

Installation Procedure

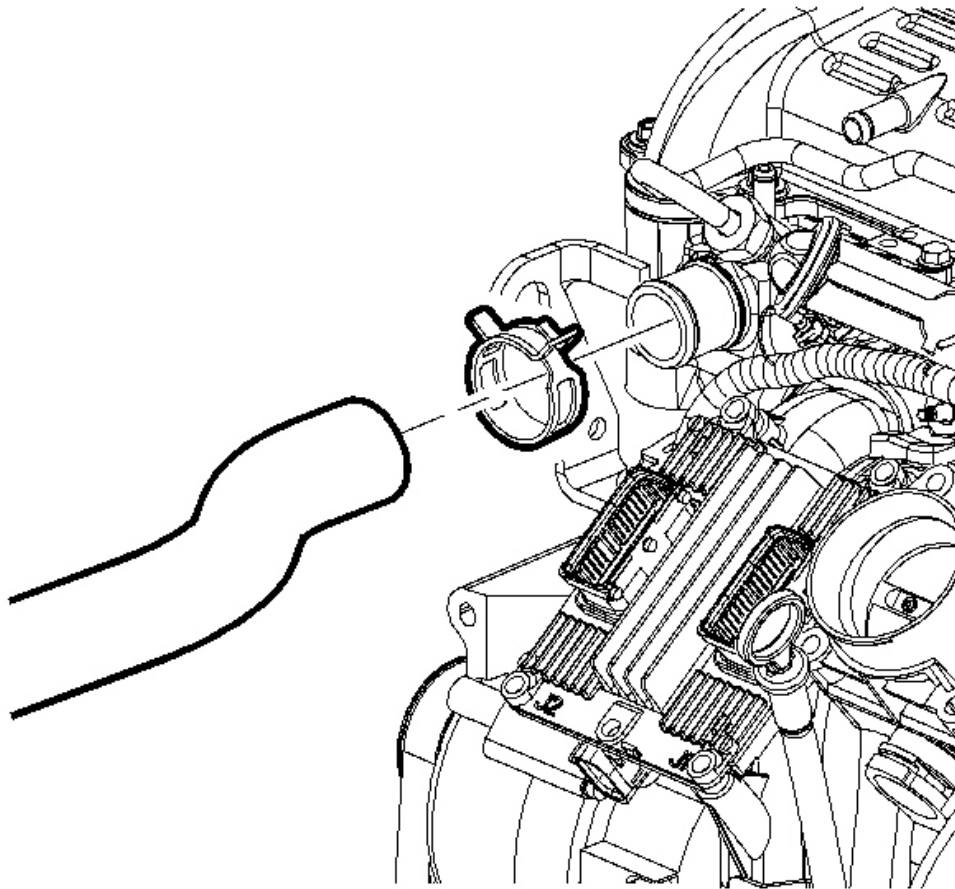


Fig. 25: View Of Radiator Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator inlet hose to the engine.
2. Install the radiator inlet hose clamp to the engine.

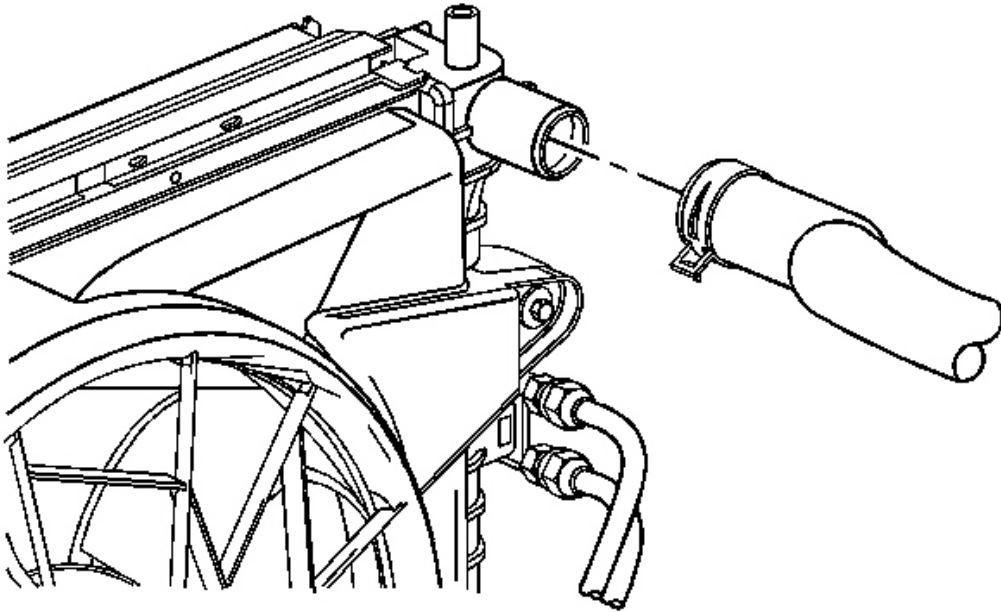


Fig. 26: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the radiator inlet hose to the radiator.
4. Install the radiator inlet hose clamp to the radiator.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

RADIATOR HOSE REPLACEMENT - OUTLET (L66)

Removal Procedure

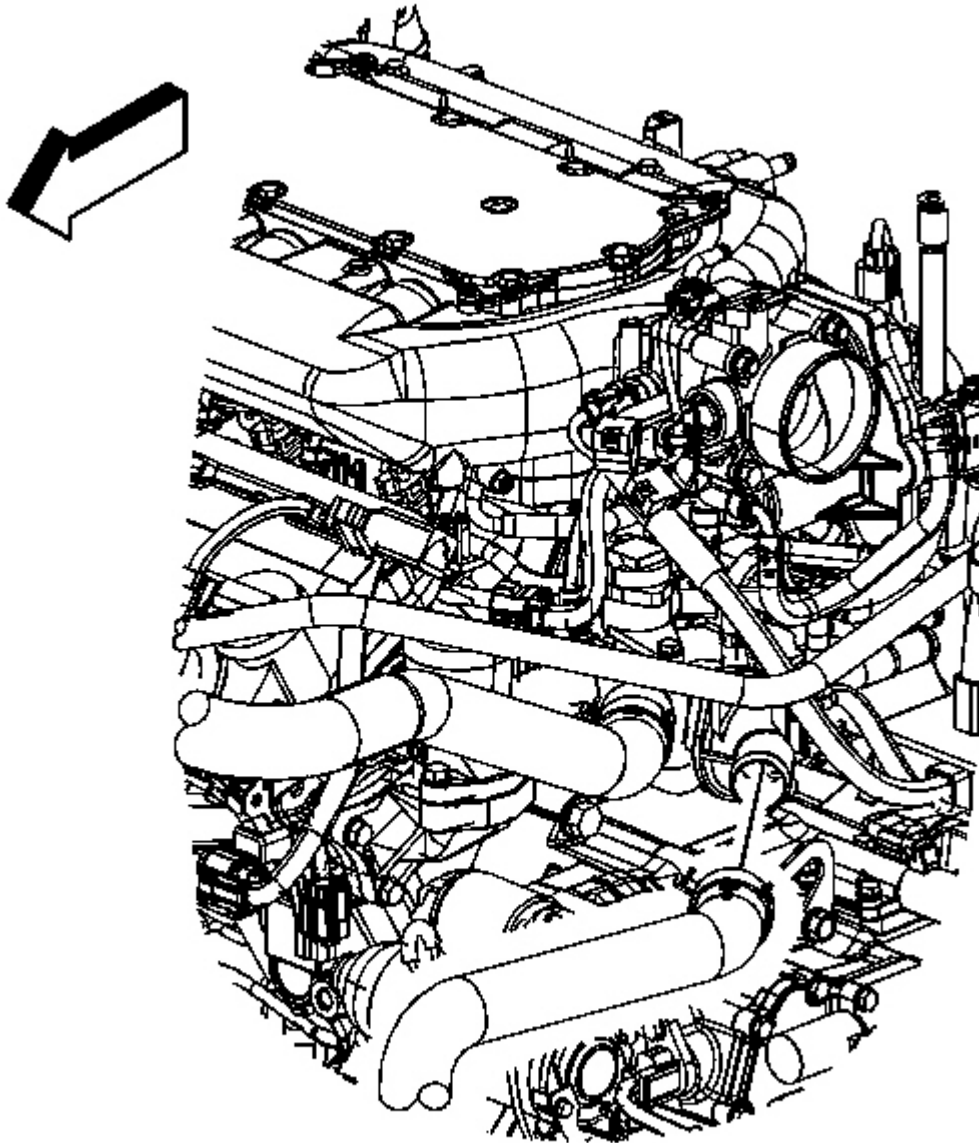


Fig. 27: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the radiator outlet hose clamp from the engine.
3. Remove the radiator outlet hose from the engine.

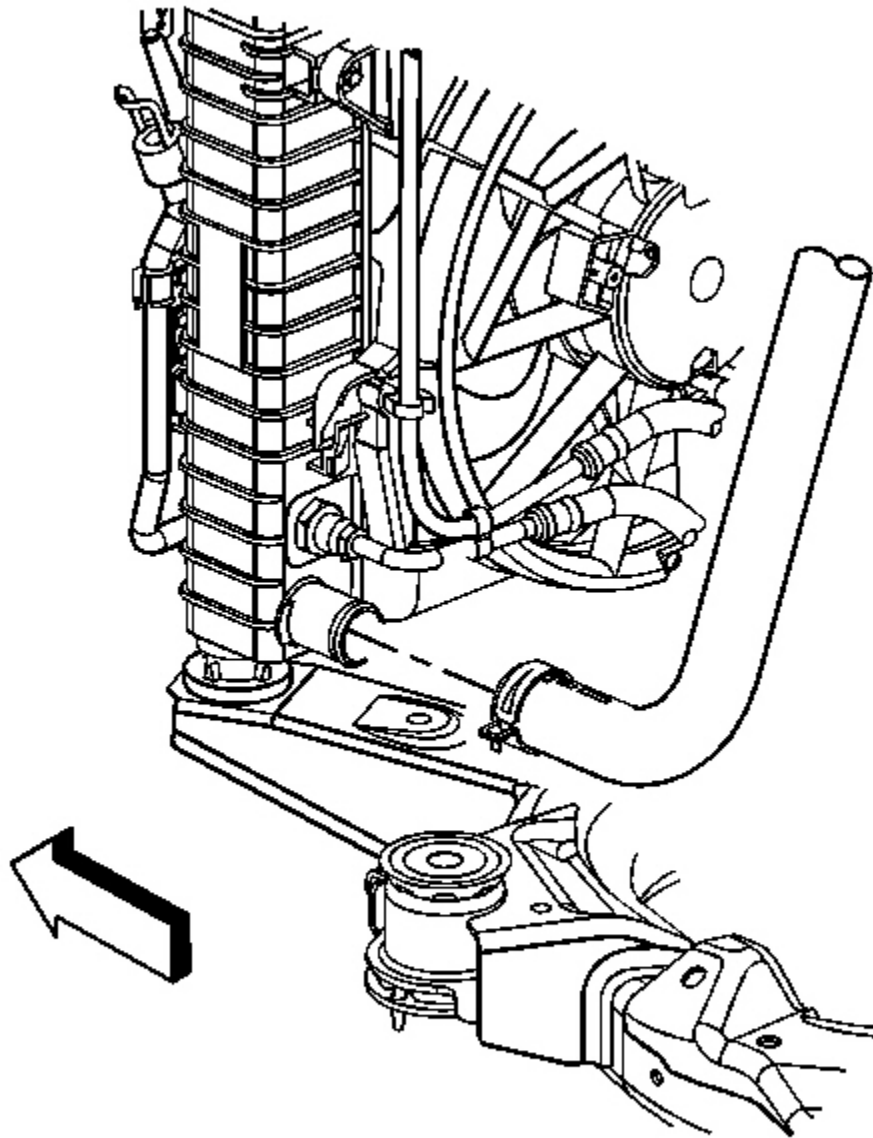


Fig. 28: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

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

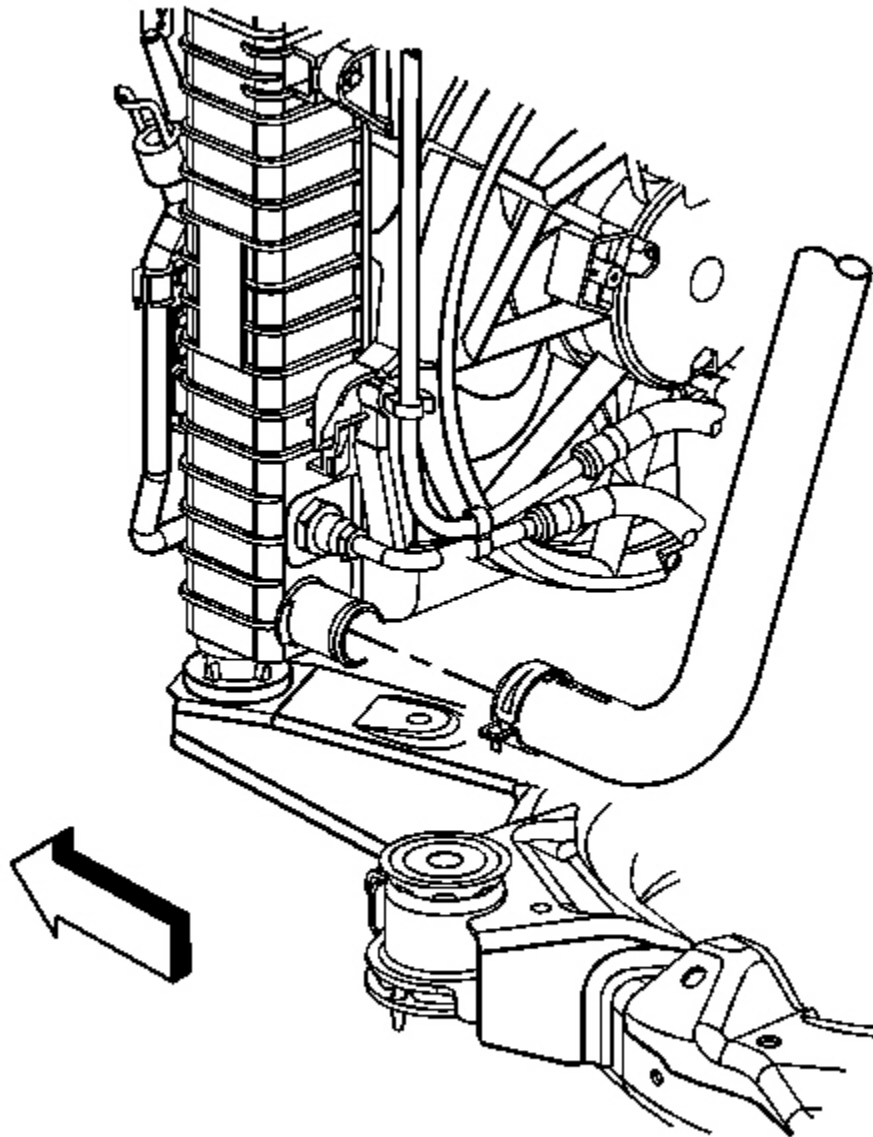


Fig. 29: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Route the radiator outlet hose into the vehicle.
2. Install the radiator outlet hose to the radiator.

3. Install the radiator outlet hose clamp to the radiator.

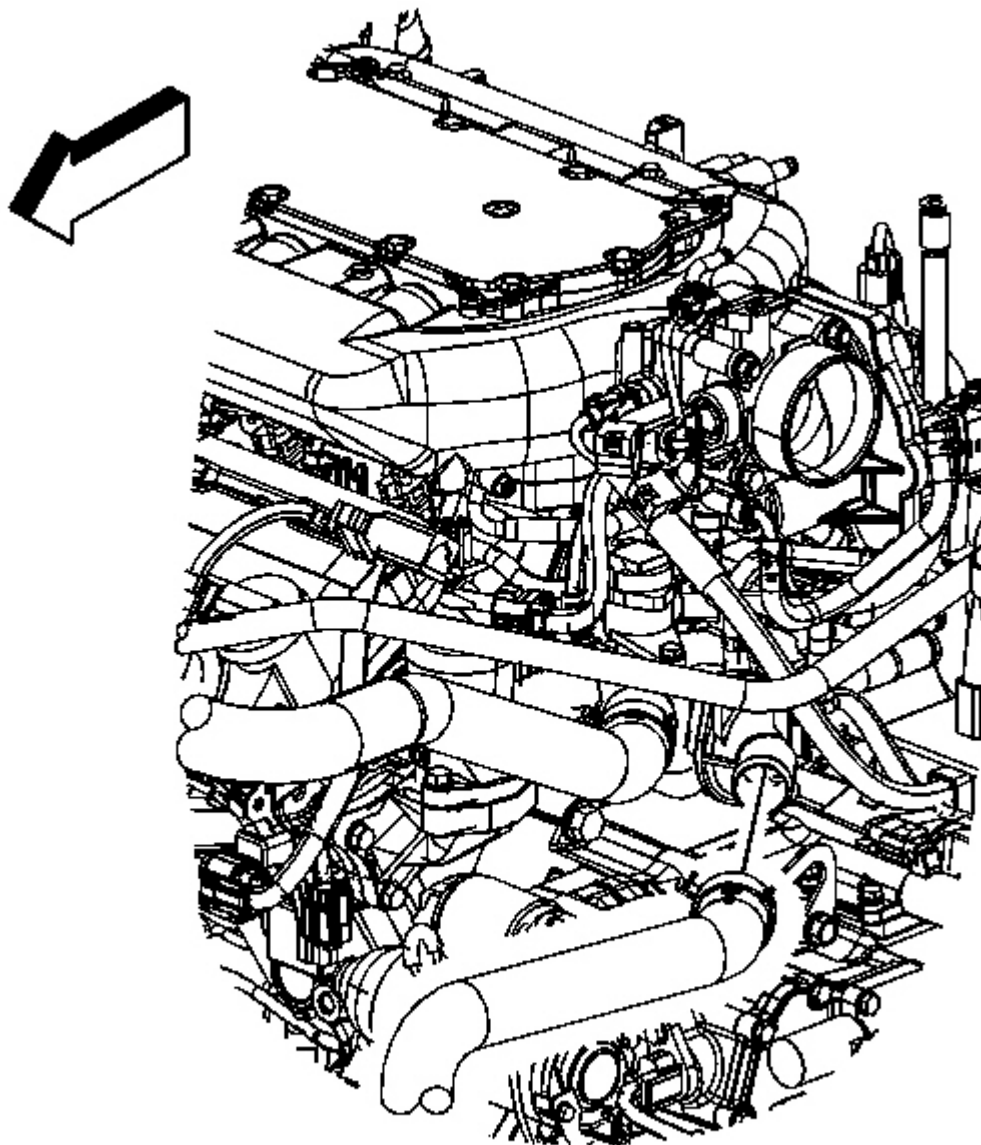


Fig. 30: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

4. Lower the vehicle.

5. Install the radiator outlet hose to the engine.
6. Install the radiator outlet hose clamp to the engine.
7. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

RADIATOR HOSE REPLACEMENT - OUTLET (L61)

Removal Procedure

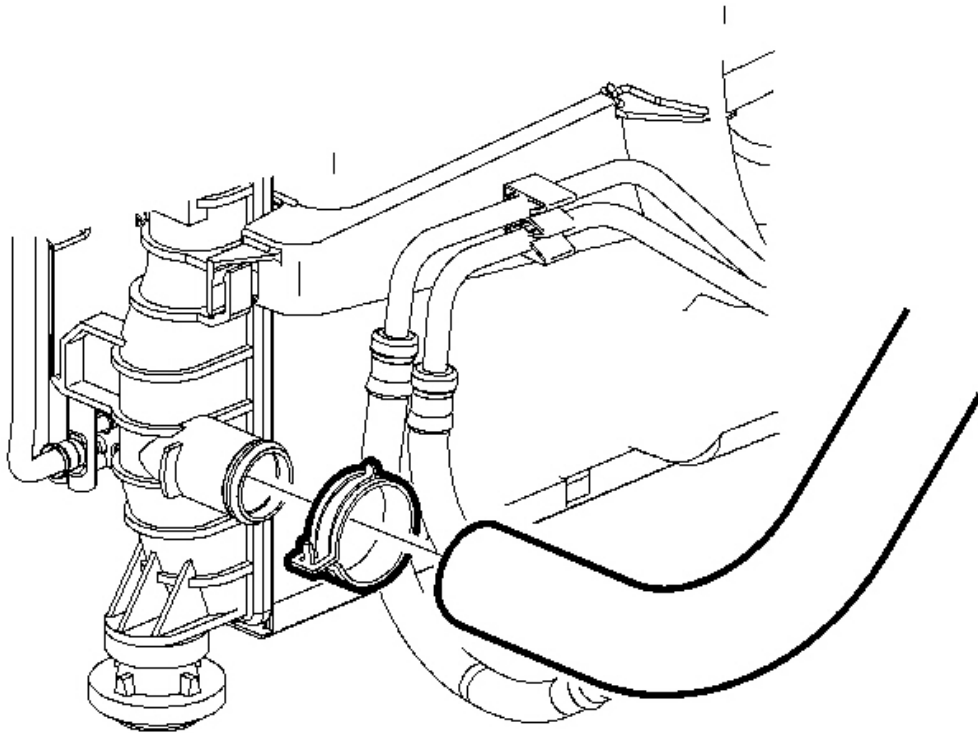


Fig. 31: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .

2. Remove the radiator outlet hose clamp from the radiator.
3. Remove the radiator outlet hose from the radiator.

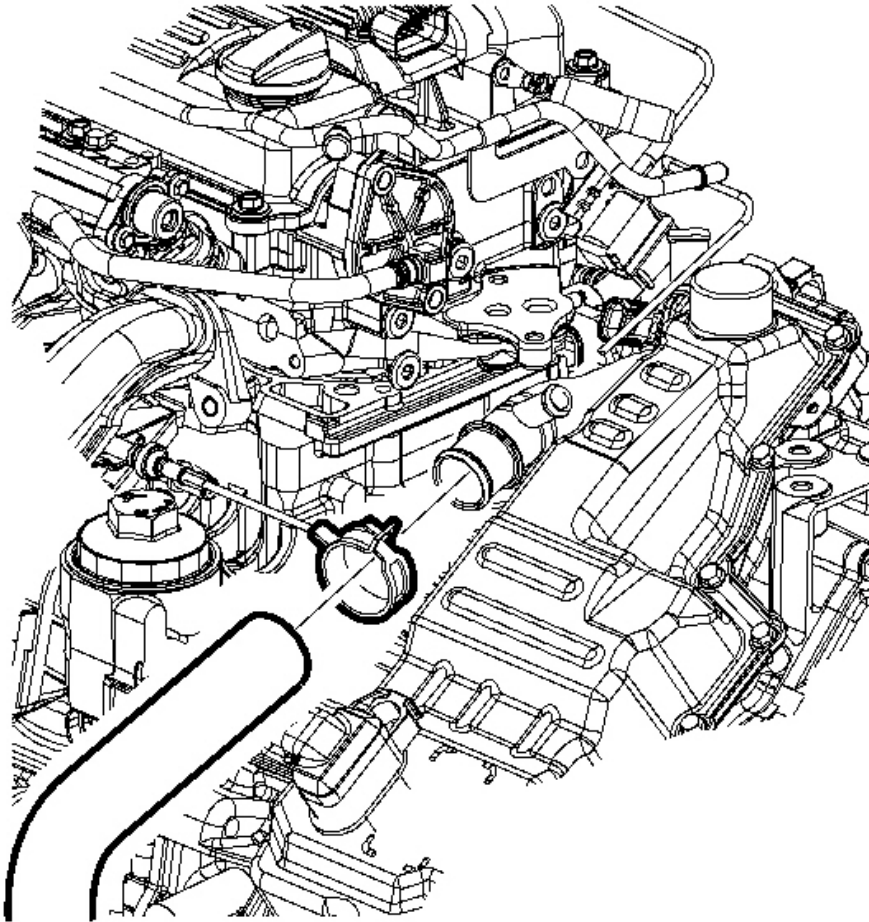


Fig. 32: View Of Radiator Outlet Hose Clamp From The Engine
Courtesy of GENERAL MOTORS CORP.

4. Remove the radiator outlet hose clamp from the engine.
5. Remove the radiator outlet hose from the engine.

Installation Procedure

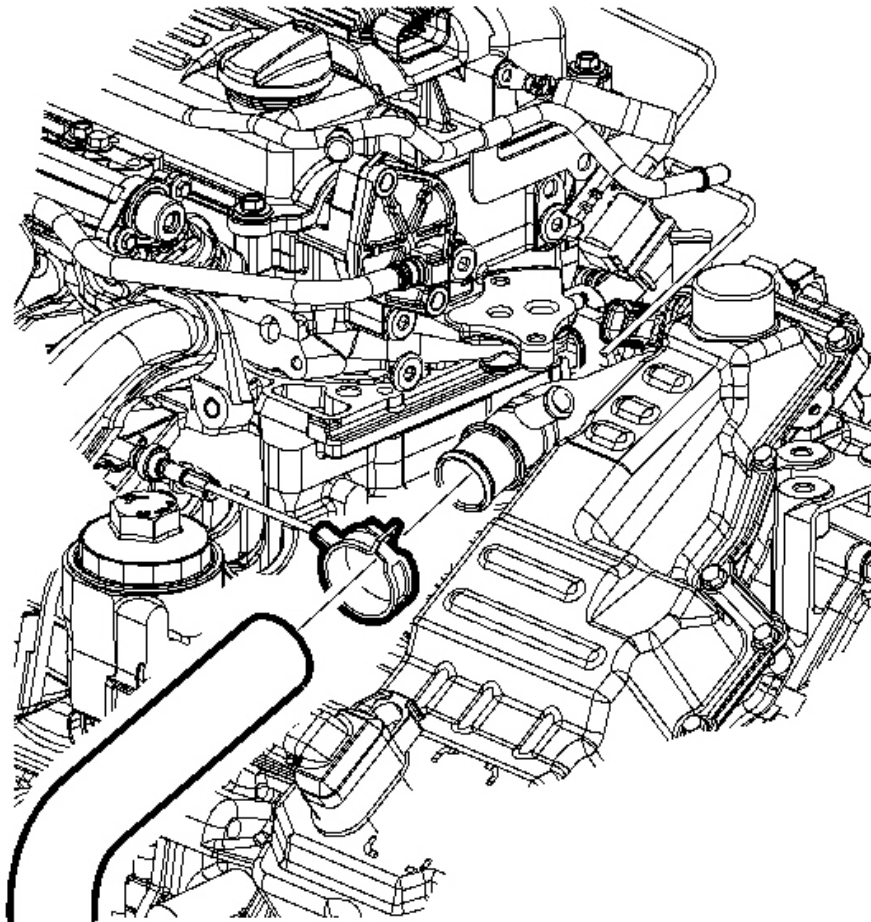


Fig. 33: View Of Radiator Outlet Hose Clamp From The Engine
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator outlet hose to the engine.
2. Install the radiator outlet hose clamp to the engine.

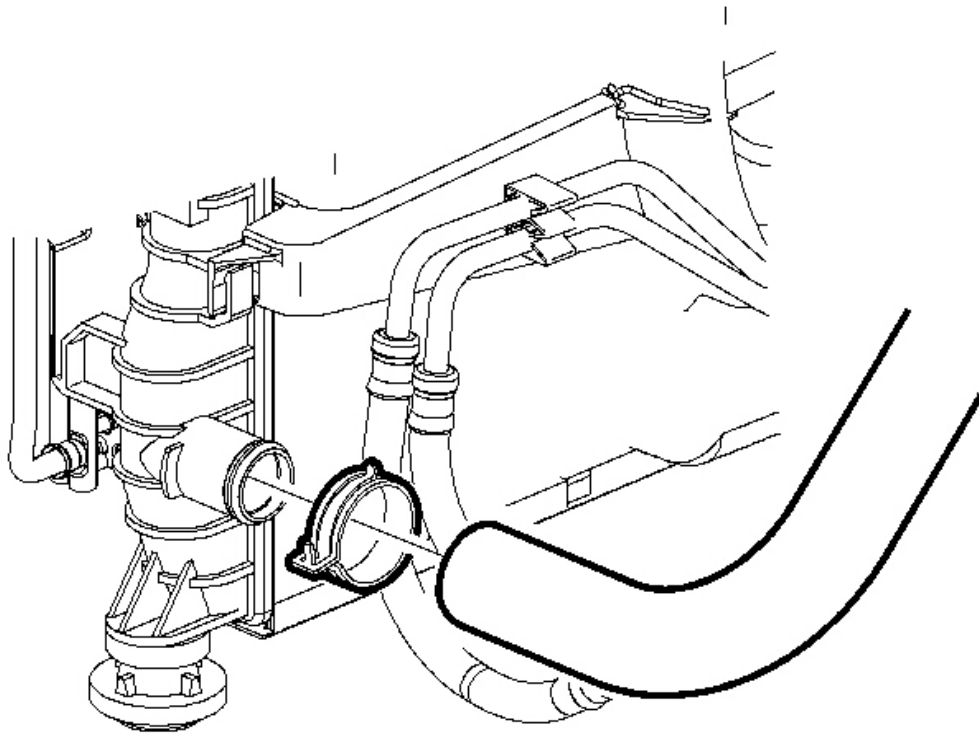


Fig. 34: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

3. Install the radiator outlet hose to the radiator.
4. Install the radiator outlet hose clamp to the radiator.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System**

THROTTLE BODY HEATER HOSE REPLACEMENT - INLET

Removal Procedure

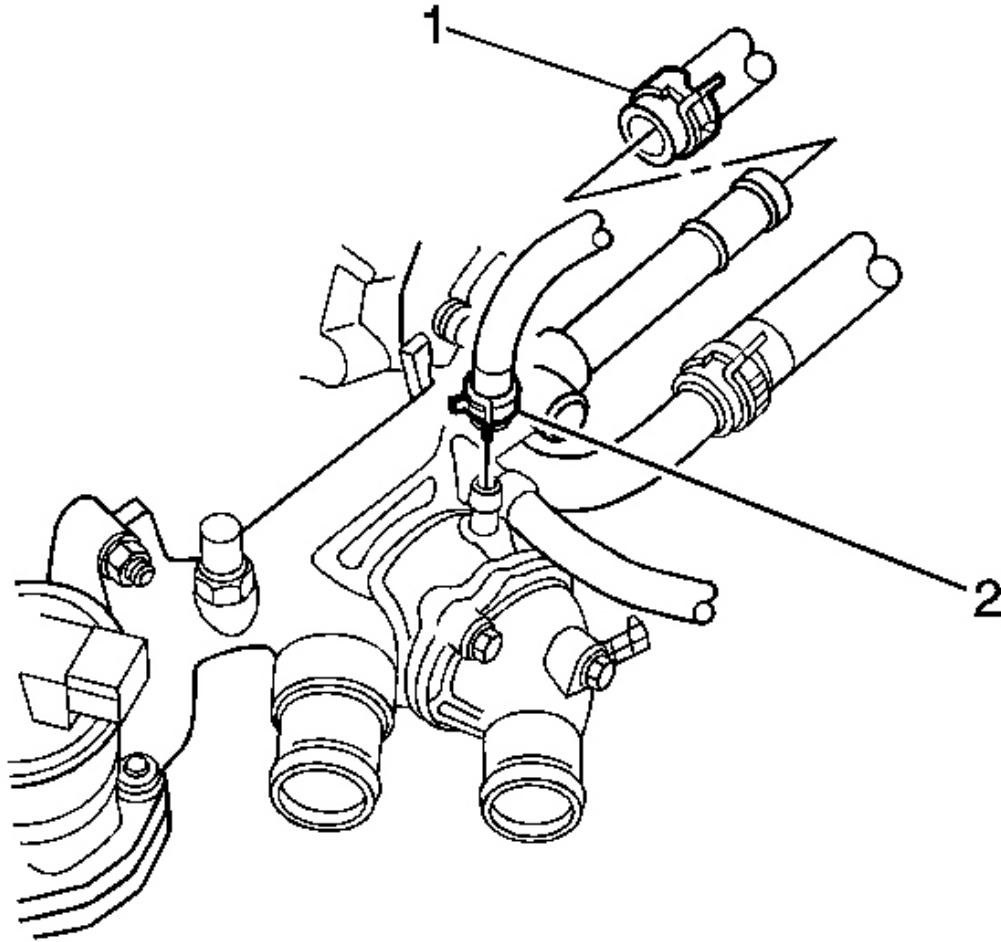


Fig. 35: View Of Throttle Body Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the throttle body air inlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 3.1L.
2. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
3. Remove the throttle body inlet hose clamp and the hose from the coolant pipe.
4. Remove the throttle body inlet hose clamp and the hose from the throttle body and the vehicle.

Installation Procedure

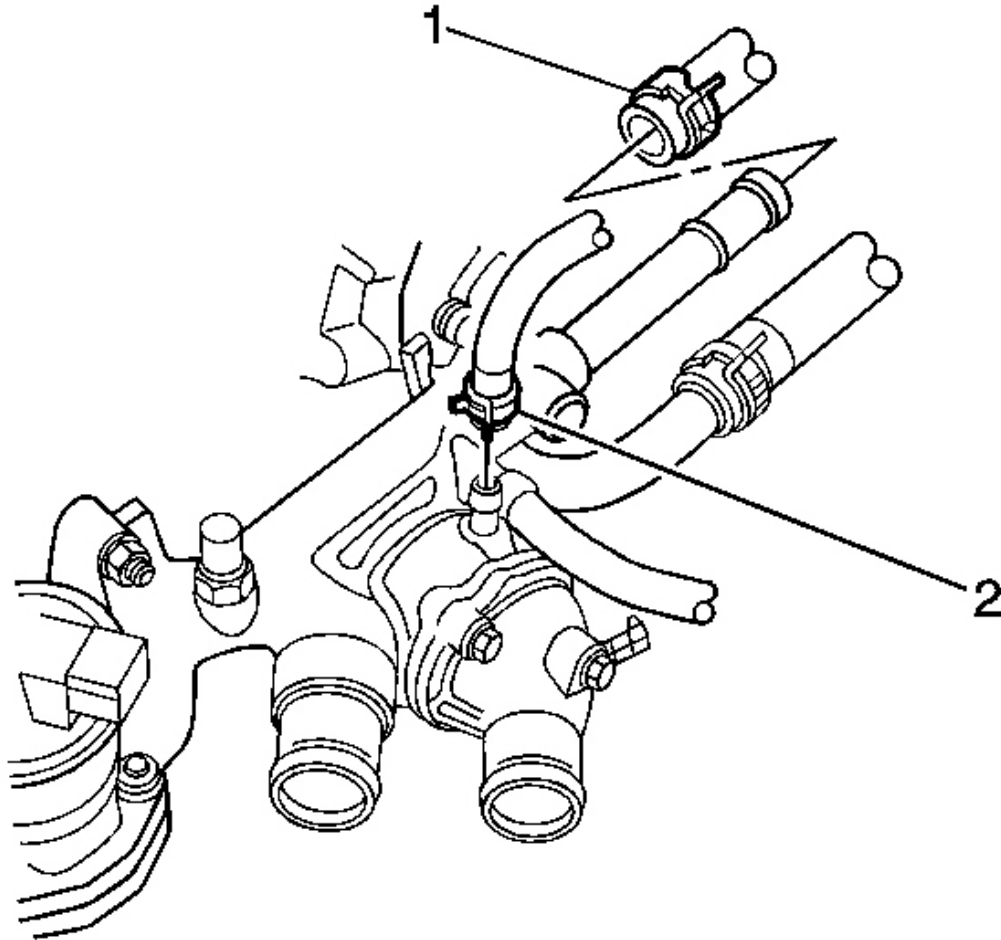


Fig. 36: View Of Throttle Body Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the throttle body inlet hose and the hose clamp to the throttle body.
2. Install the throttle body inlet hose and the hose clamp to the coolant pipe.
3. Install the throttle body air inlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 3.1L.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System** .
5. Inspect for leaks.

THROTTLE BODY HEATER HOSE REPLACEMENT - OUTLET

Removal Procedure

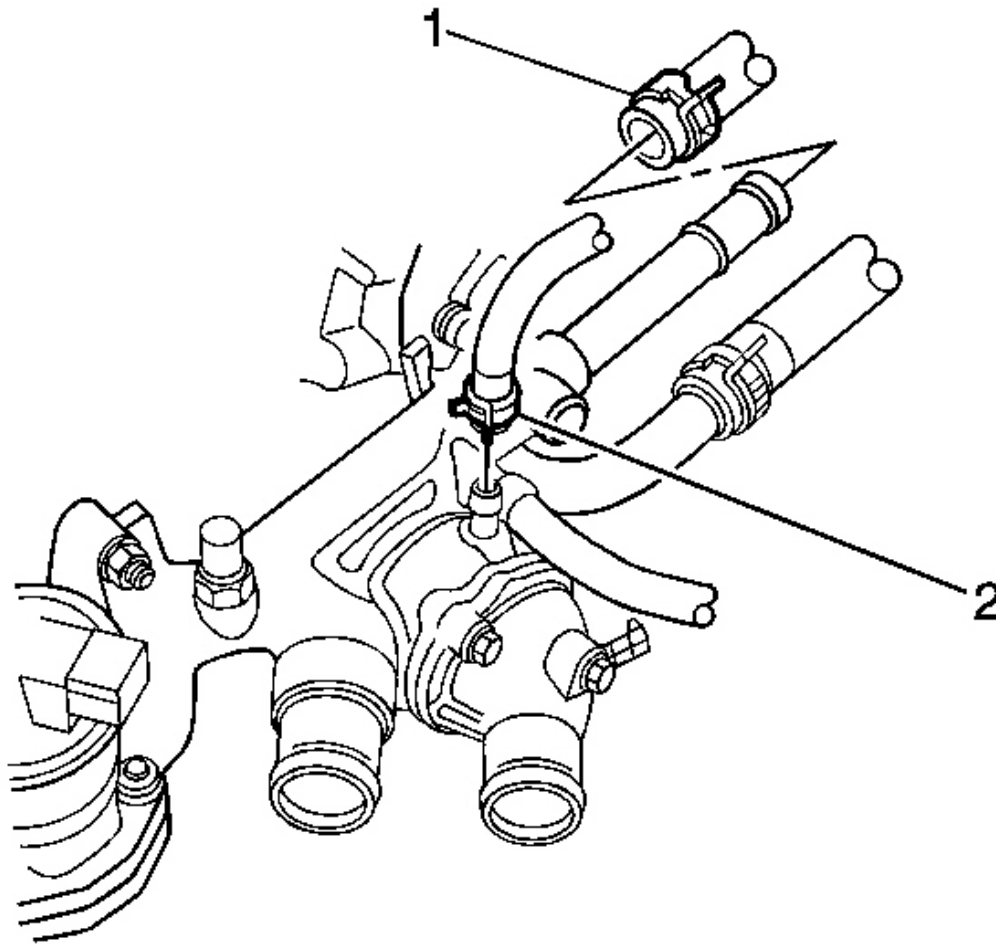


Fig. 37: View Of Throttle Body Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the throttle body air inlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 3.1L.
2. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
3. Remove the throttle body outlet hose clamp and the hose from the coolant pipe.
4. Remove the throttle body outlet hose clamp and the hose from the throttle body and the vehicle.

Installation Procedure

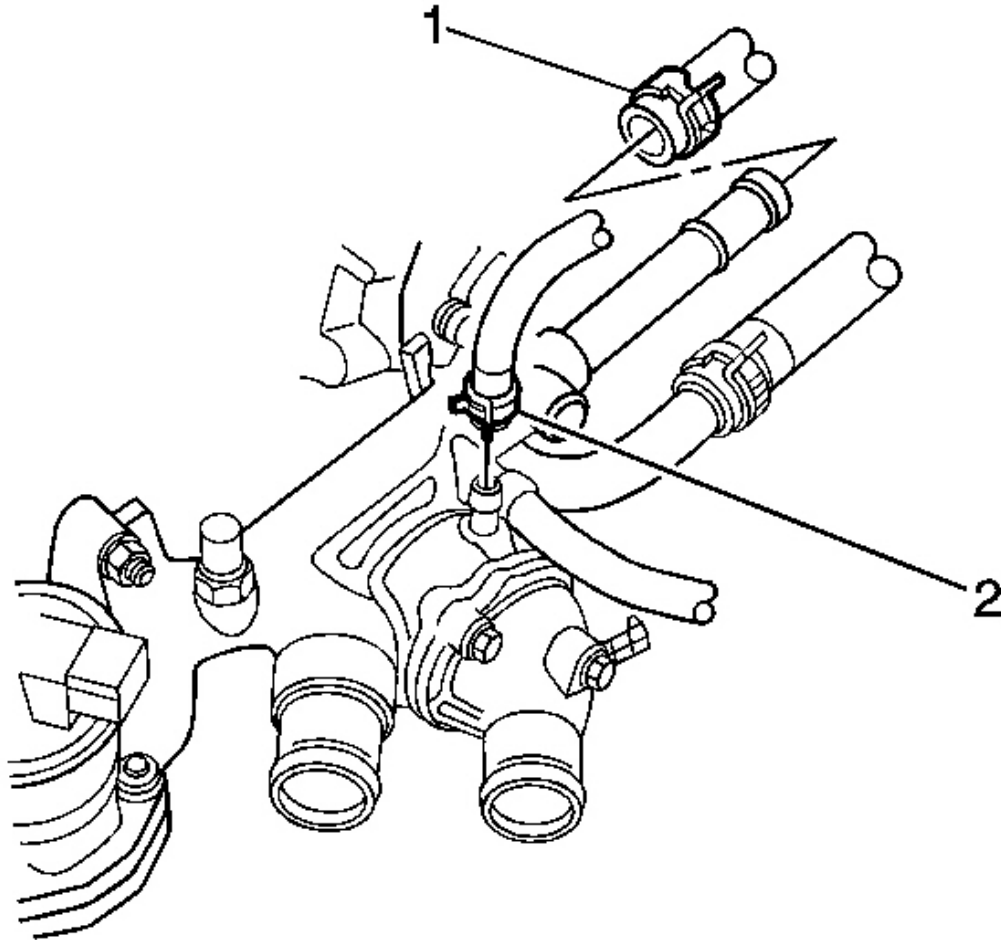


Fig. 38: View Of Throttle Body Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the throttle body outlet hose and the hose clamp to the throttle body.
2. Install the throttle body outlet hose and the hose clamp to the coolant pipe.
3. Install the throttle body air inlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 3.1L.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System** .
5. Inspect for leaks.

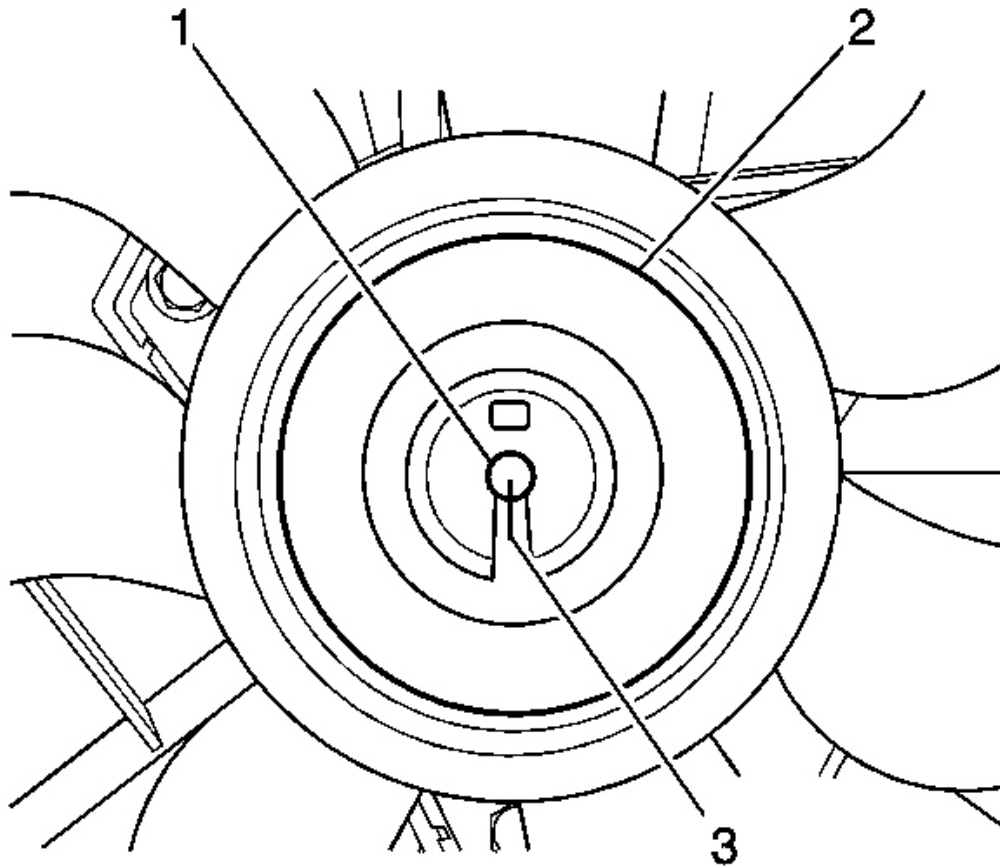


Fig. 39: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling fan and shroud from the vehicle. Refer to Cooling Fan and Shroud Replacement (L61) or Cooling Fan and Shroud Replacement (L66) .

IMPORTANT: The fan and motor assembly is a balanced assembly. Be sure to mark the relationship of the fan to the motor shaft to ensure the balance is maintained.

2. Place a scribe mark (3) on the fan (2) hub and the motor shaft (1).

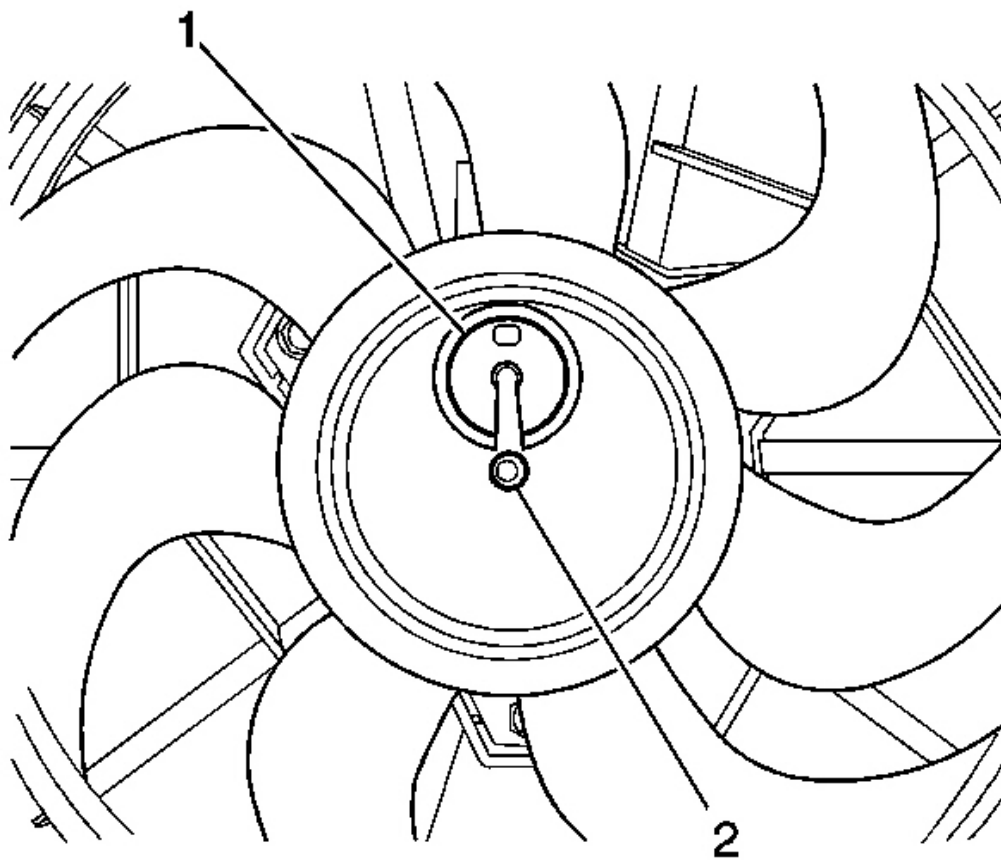


Fig. 40: View Of Fan Retaining Clip From The Motor Shaft
Courtesy of GENERAL MOTORS CORP.

3. Remove the fan retaining clip (1) from the motor shaft (2).
4. Discard fan retaining clip (1).

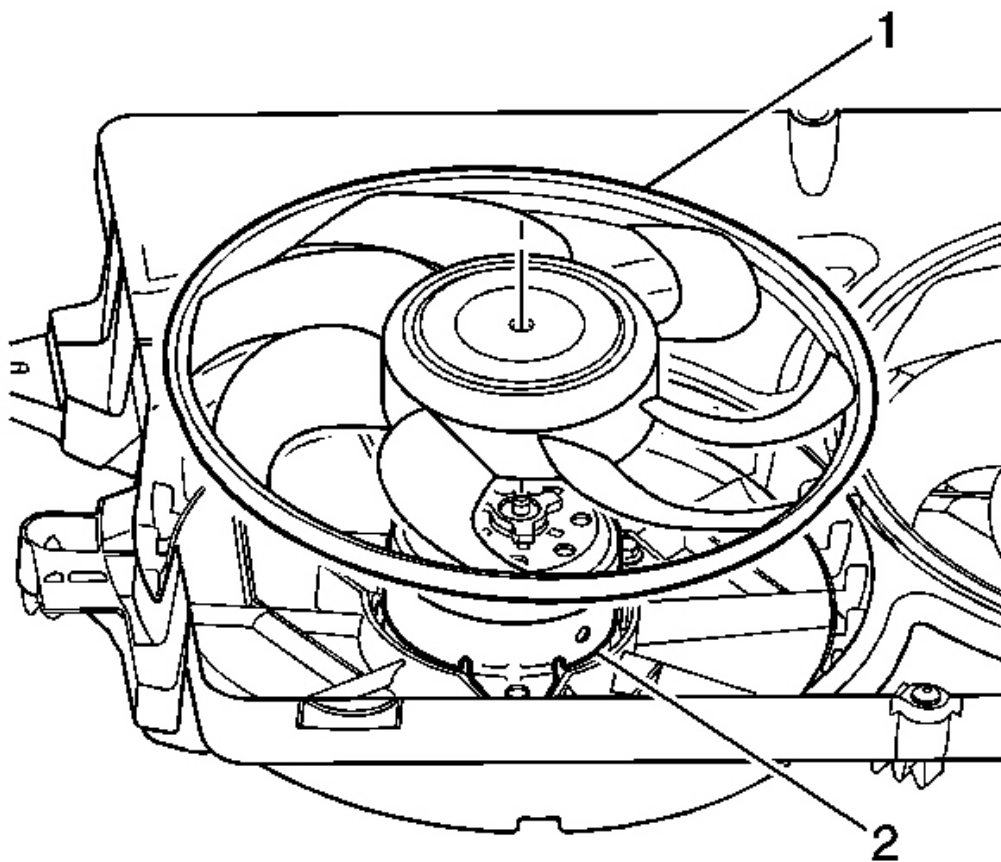


Fig. 41: View Of Fan From The Motor
Courtesy of GENERAL MOTORS CORP.

5. Remove the fan (1) from the motor (2).

Installation Procedure

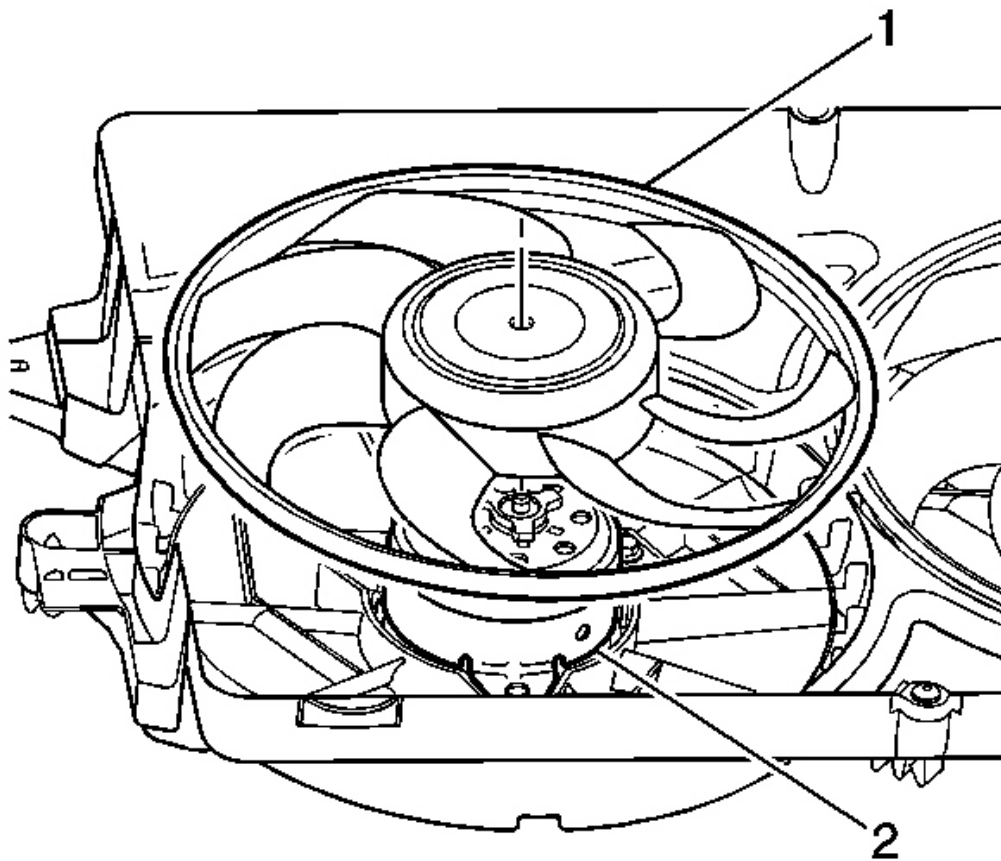


Fig. 42: View Of Fan From The Motor
Courtesy of GENERAL MOTORS CORP.

1. Install the fan (1) to the motor (2).

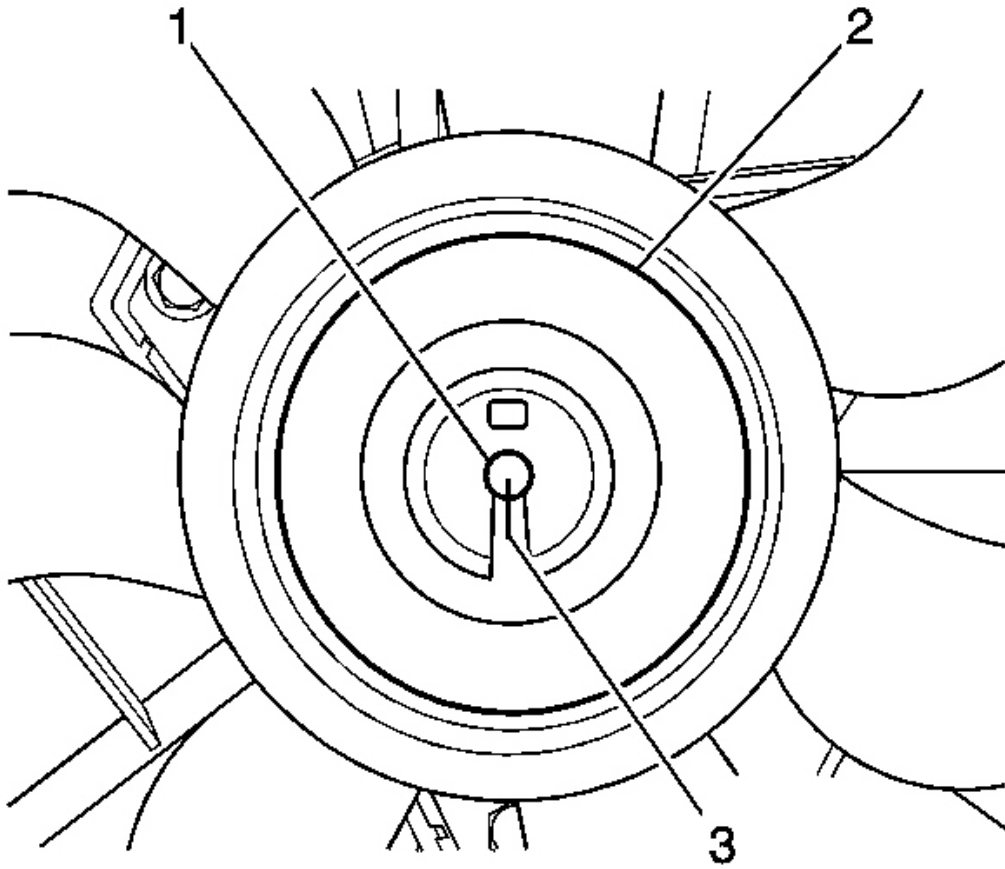


Fig. 43: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

2. Align the scribe marks (3) previously made on the fan (2) hub and the motor shaft (1).

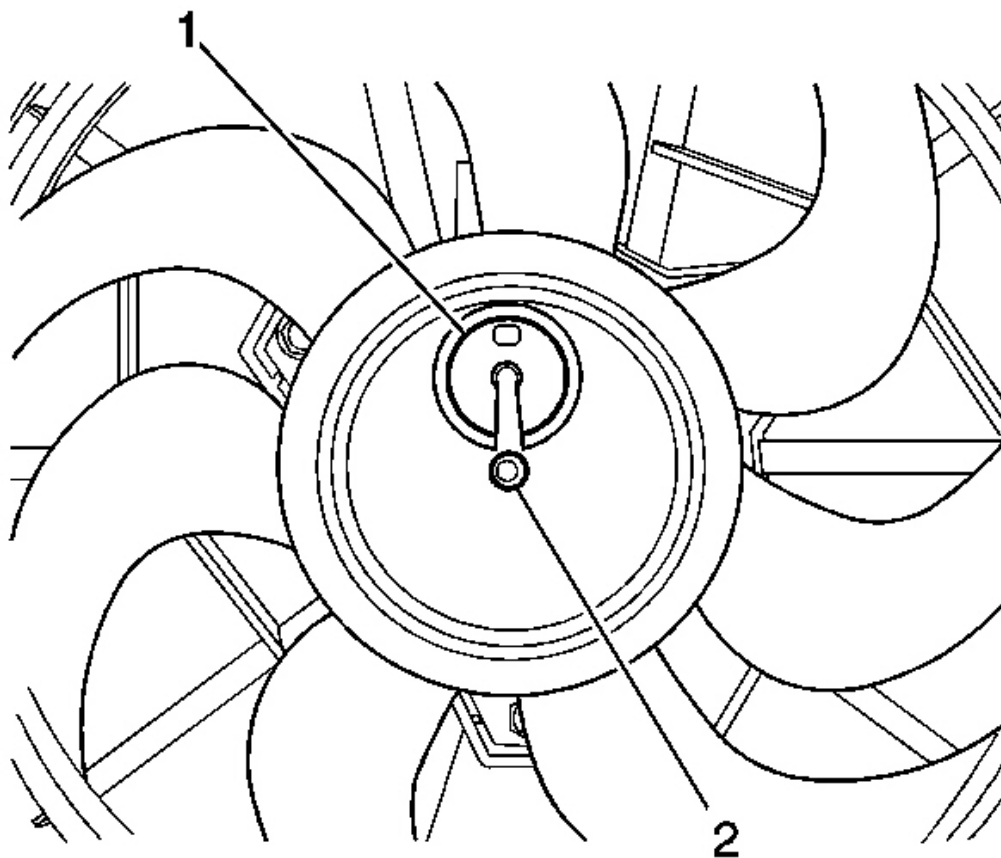


Fig. 44: View Of Fan Retaining Clip From The Motor Shaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the scribe marks remain aligned during fan retaining clip (1) installation.

3. Install a new fan retaining clip (1) to the motor shaft (2). Ensure the retaining clip (1) is fully seated.
4. Install the cooling fan and shroud to the vehicle. Refer to **Cooling Fan and Shroud Replacement (L61)** or **Cooling Fan and Shroud Replacement (L66)** .

COOLING FAN MOTOR REPLACEMENT - ELECTRIC (L66)

Removal Procedure

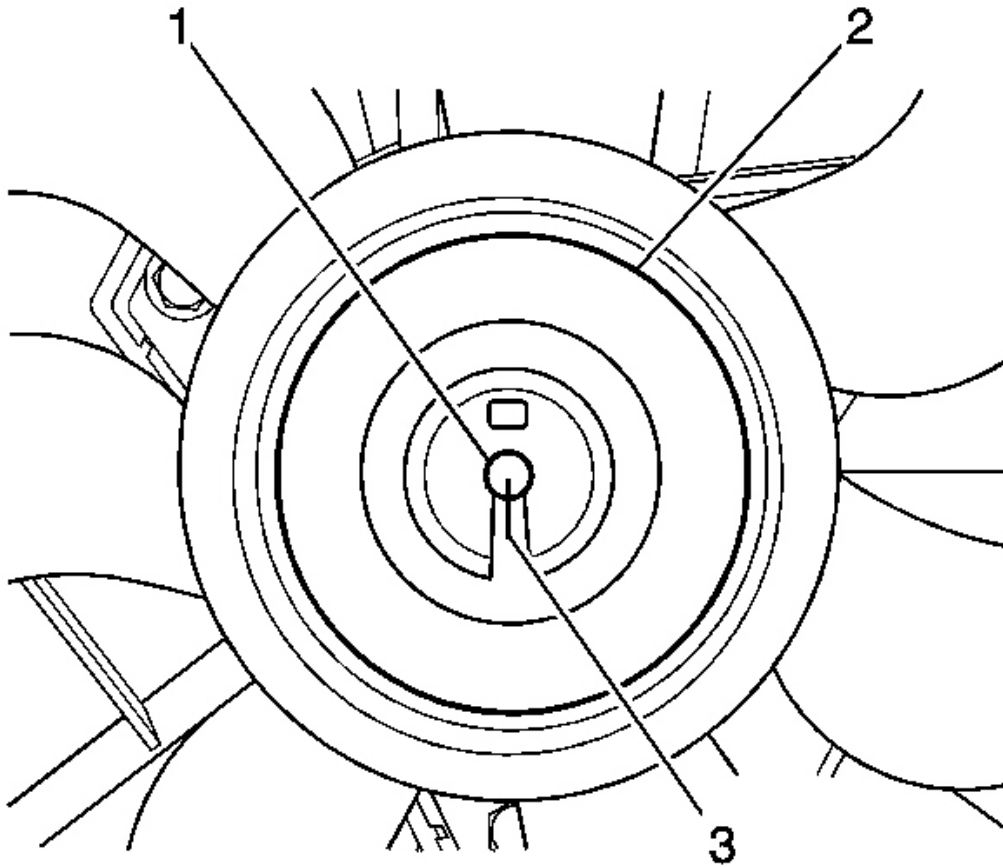


Fig. 45: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

1. Remove the cooling fan and shroud from the vehicle. Refer to **Cooling Fan and Shroud Replacement (L61)** or **Cooling Fan and Shroud Replacement (L66)** .

IMPORTANT: The fan and motor assembly is a balanced assembly. Be sure to mark the relationship of the fan to the motor shaft to ensure the balance is maintained.

2. Place a scribe mark (3) on the fan (2) hub and the motor shaft (1).

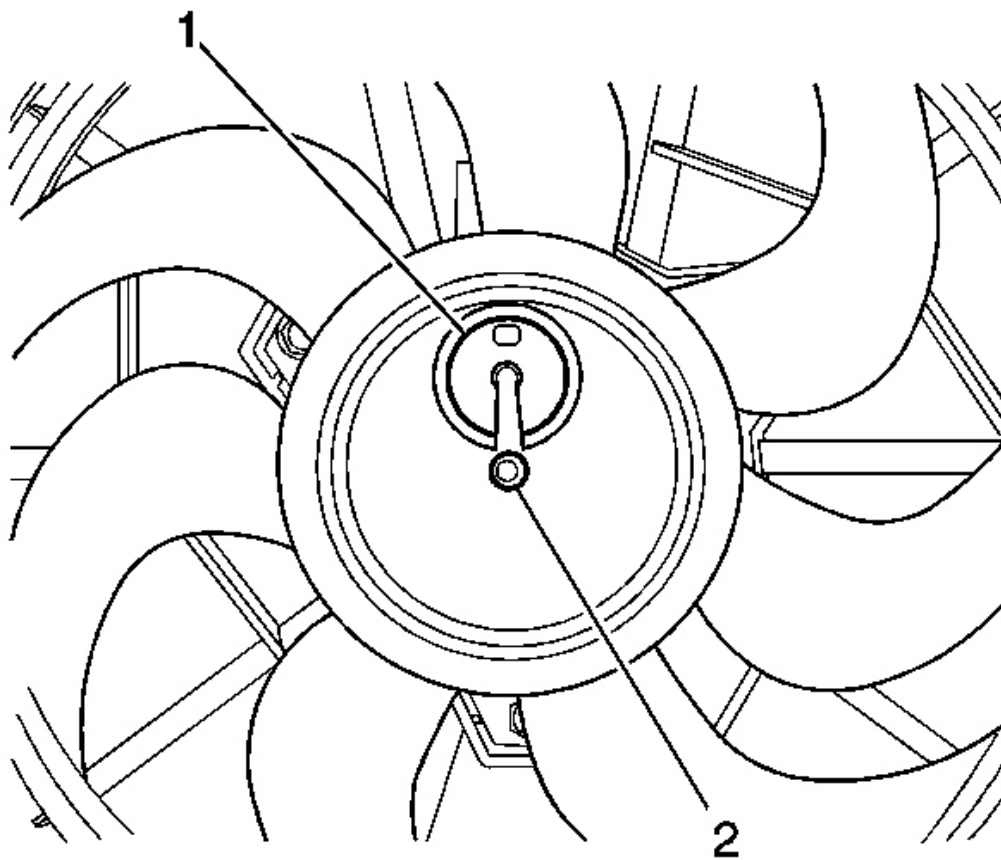


Fig. 46: View Of Fan Retaining Clip From The Motor Shaft
Courtesy of GENERAL MOTORS CORP.

3. Remove the fan retaining clip (1) from the motor shaft (2).
4. Discard fan retaining clip (1).

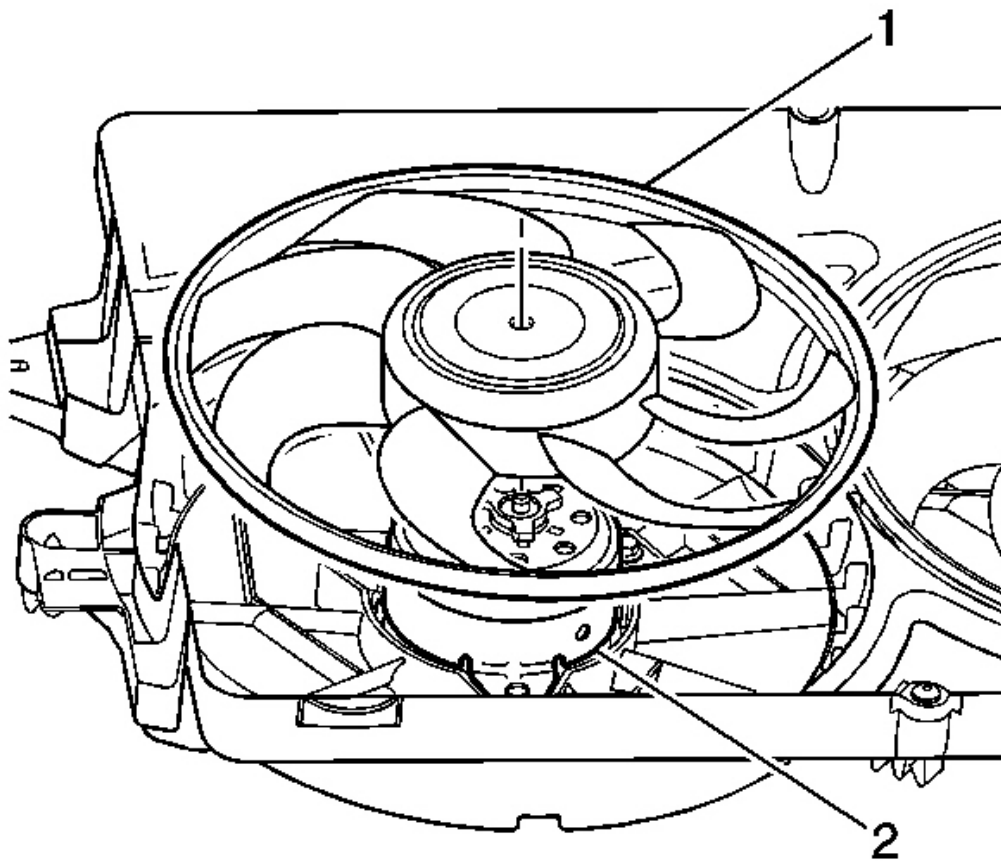


Fig. 47: View Of Fan From The Motor
Courtesy of GENERAL MOTORS CORP.

5. Remove the fan (1) from the motor (2).

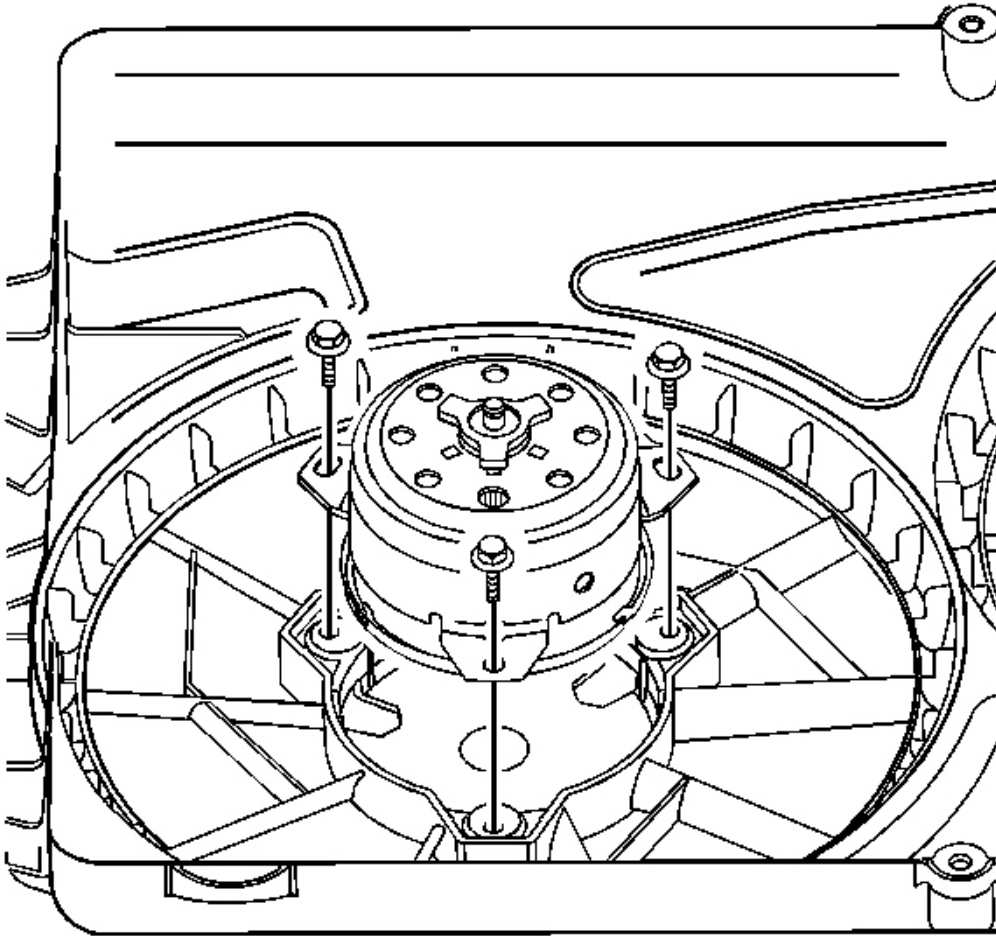


Fig. 48: View Of Fan Motor Screws From The Fan Shroud
Courtesy of GENERAL MOTORS CORP.

6. Remove the fan motor screws from the fan shroud.
7. Remove the fan motor from the fan shroud.

Installation Procedure

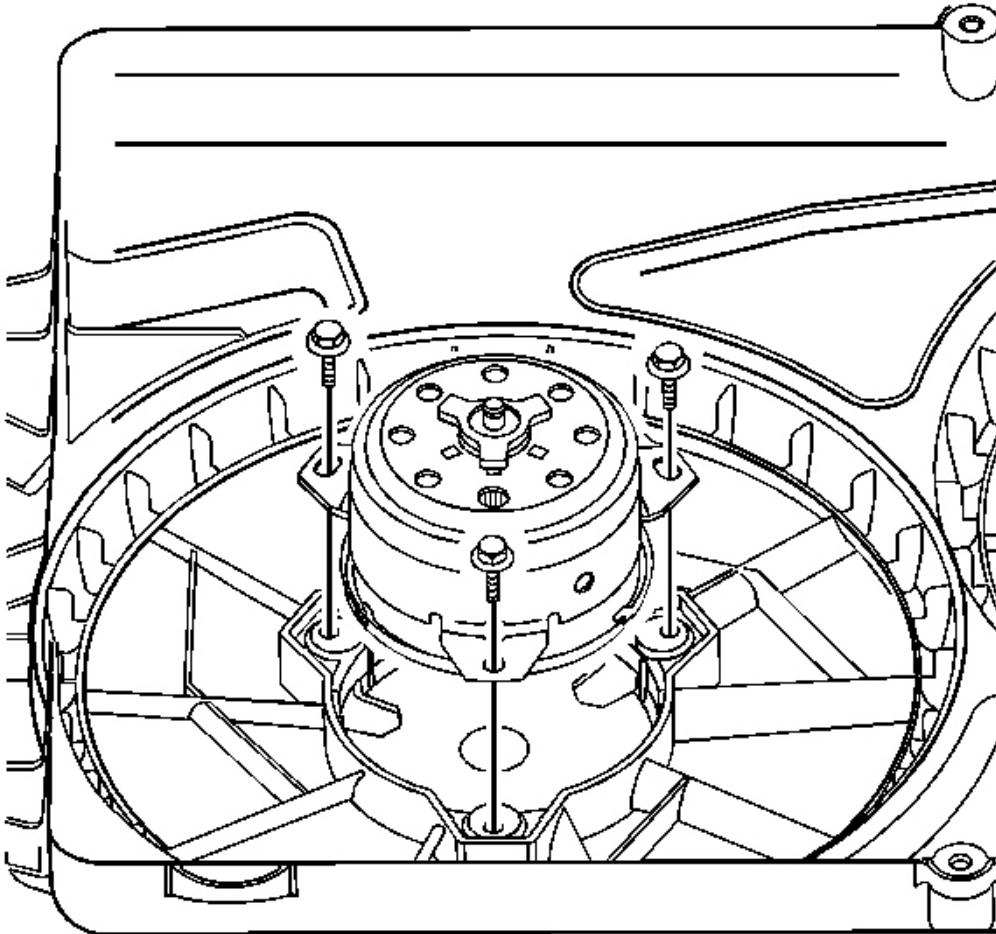


Fig. 49: View Of Fan Motor Screws From The Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the fan motor to the fan shroud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the fan motor screws to the fan shroud.

Tighten: Tighten the screws to 8 N.m (71 lb in).

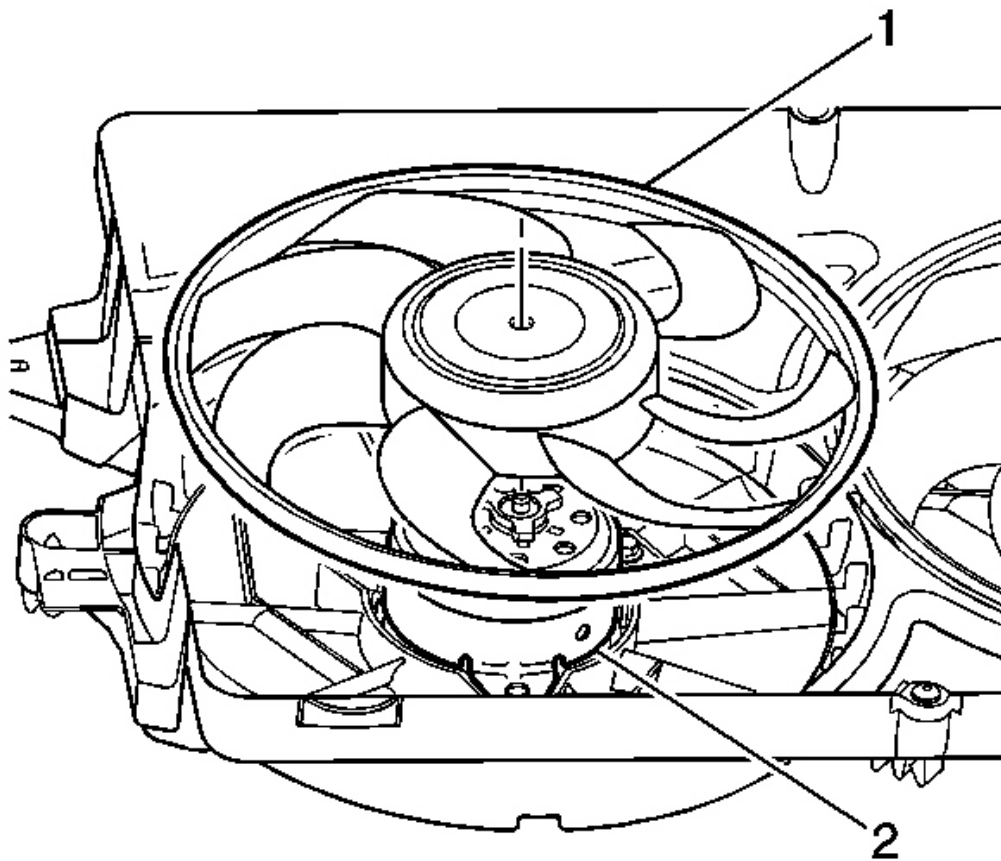


Fig. 50: View Of Fan From The Motor
Courtesy of GENERAL MOTORS CORP.

3. Install the fan (1) to the motor (2).

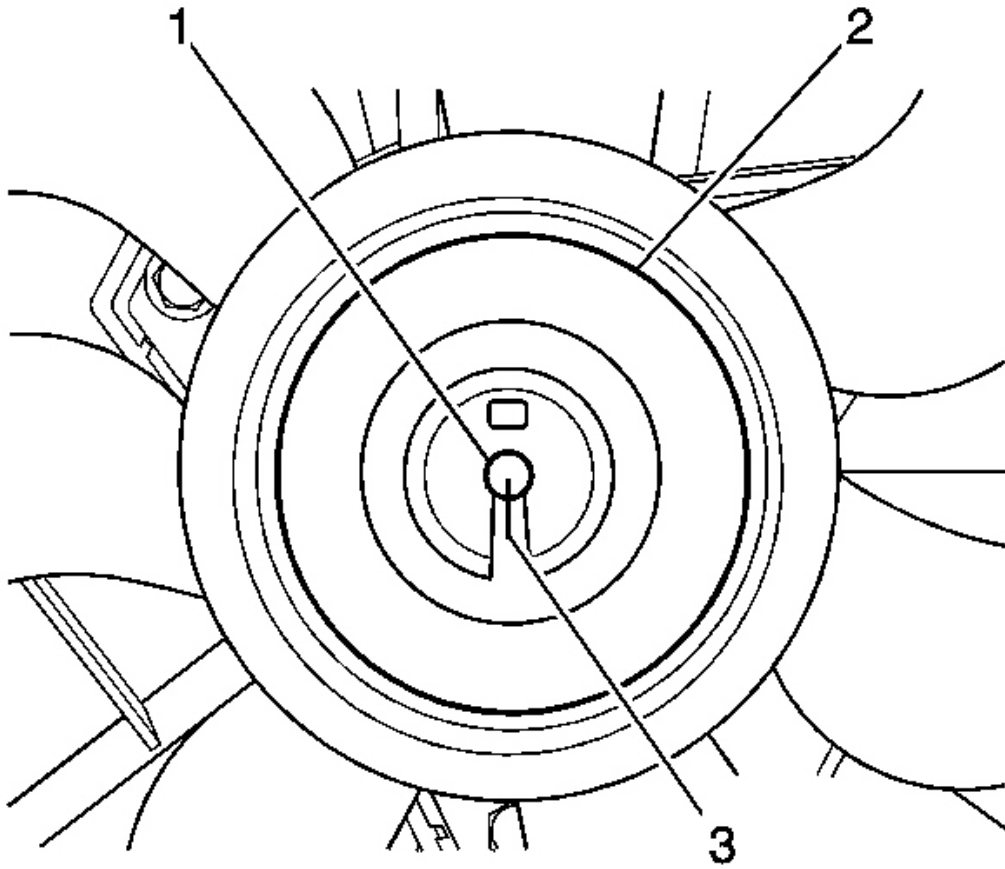


Fig. 51: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

4. Align the scribe marks (3) previously made on the fan (2) hub and the motor shaft (1).

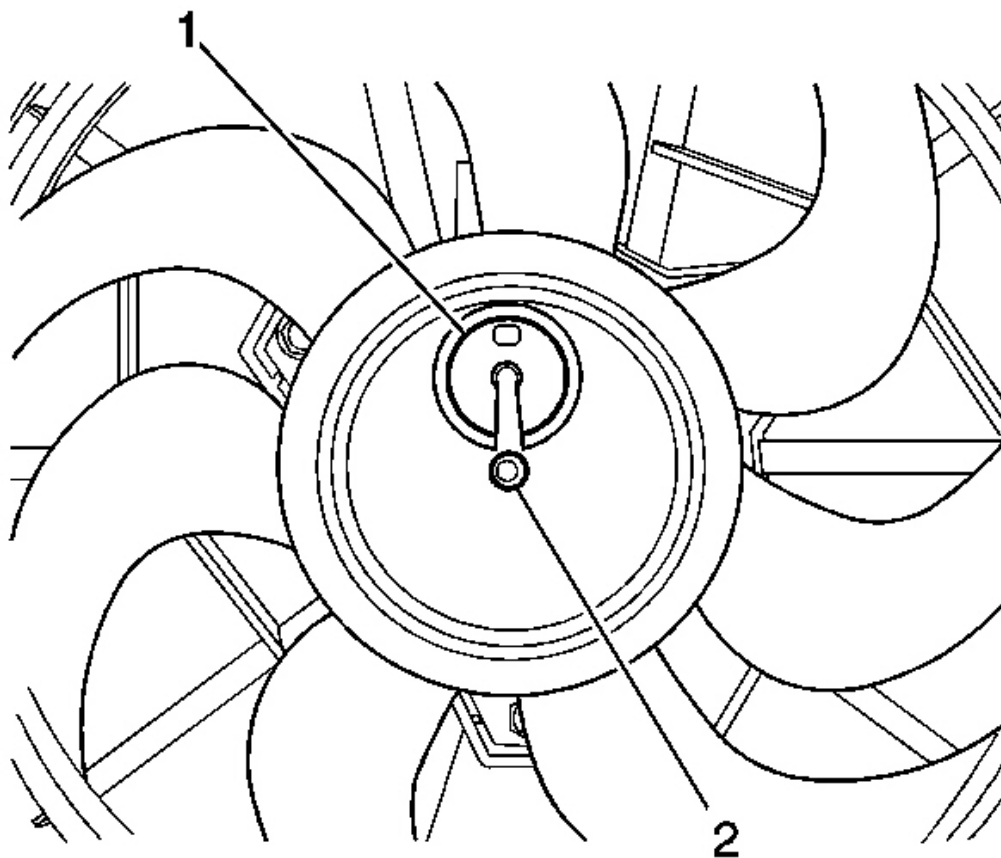


Fig. 52: View Of Fan Retaining Clip From The Motor Shaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the scribe marks remain aligned during fan retaining clip (1) installation.

5. Install a new fan retaining clip (1) to the motor shaft (2). Ensure the retaining clip (1) is fully seated.
6. Install the cooling fan and shroud to the vehicle. Refer to **Cooling Fan and Shroud Replacement (L61)** or **Cooling Fan and Shroud Replacement (L66)** .

COOLING FAN AND SHROUD REPLACEMENT (L61)

Removal Procedure

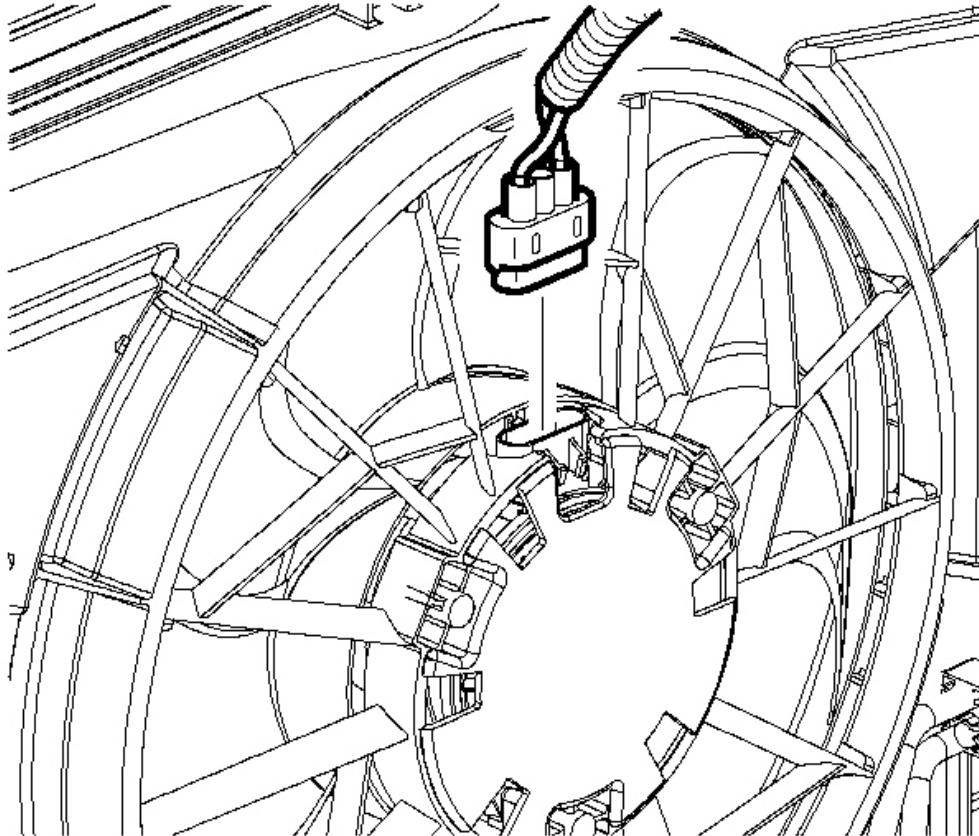


Fig. 53: View Of Cooling Fan & Shroud (L61)
Courtesy of GENERAL MOTORS CORP.

1. Remove the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
2. Drain the coolant. Refer to **Draining and Filling Cooling System** .
3. Disconnect the electrical connector from the fan motor.

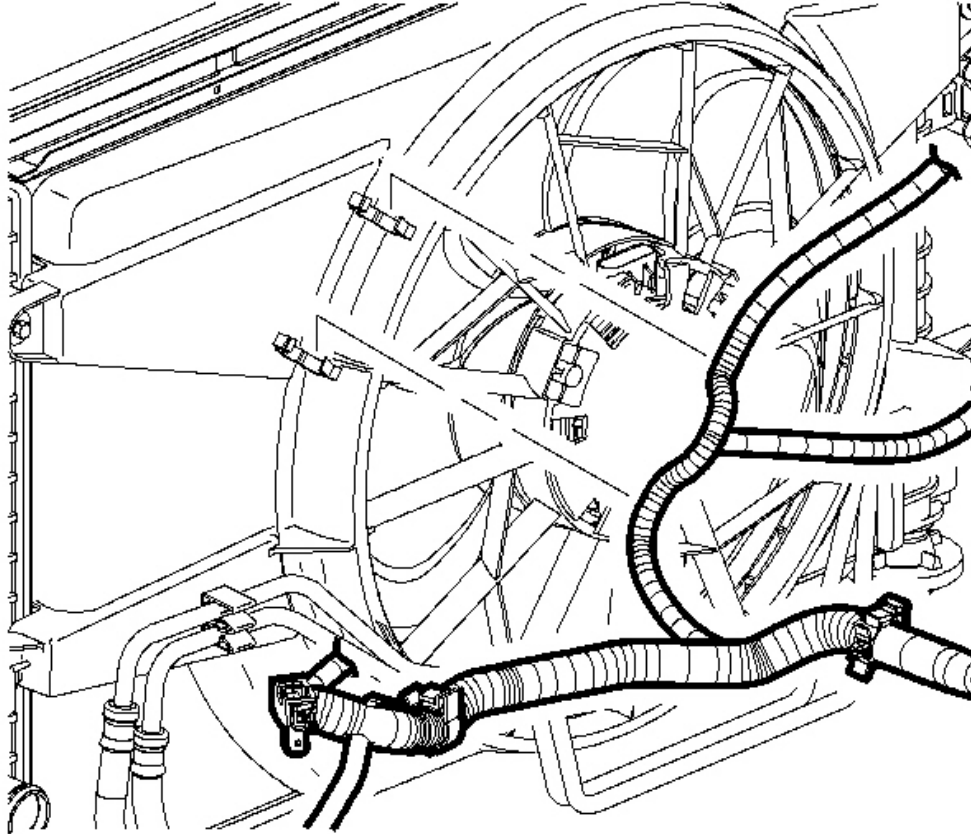


Fig. 54: View Of Clip Wire Harness From The Fan Assembly
Courtesy of GENERAL MOTORS CORP.

4. Unclip the wire harness from the fan assembly.

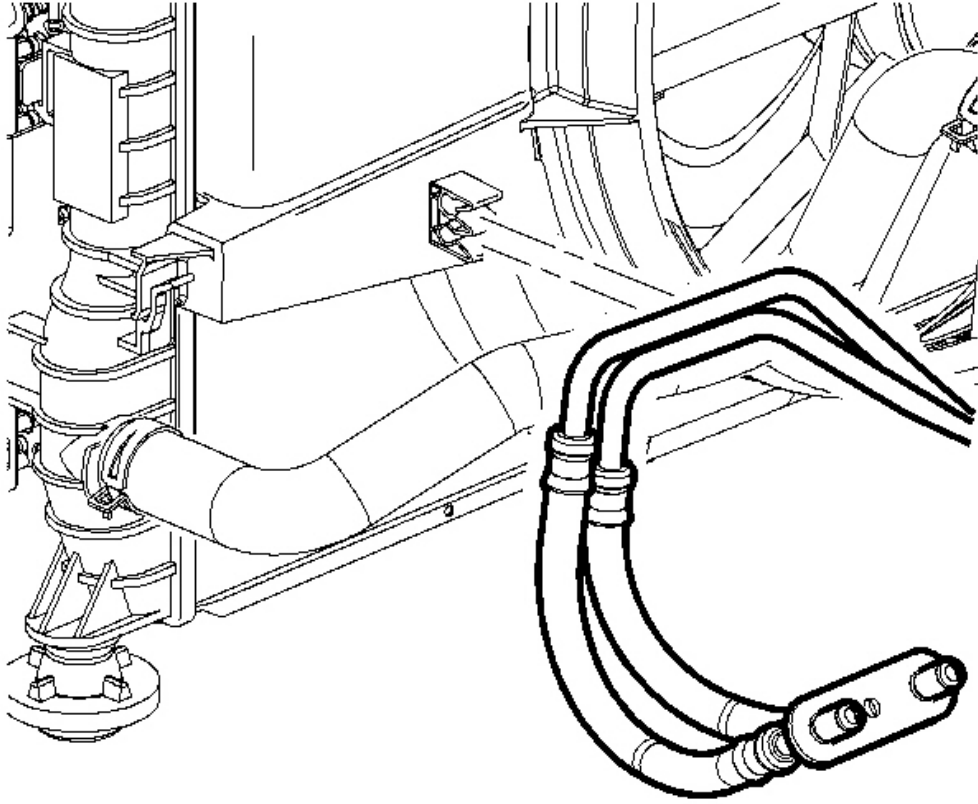


Fig. 55: View Of Unclip Transmission Cooler Lines From The Fan Assembly
Courtesy of GENERAL MOTORS CORP.

5. Unclip the transmission cooler lines from the fan assembly.

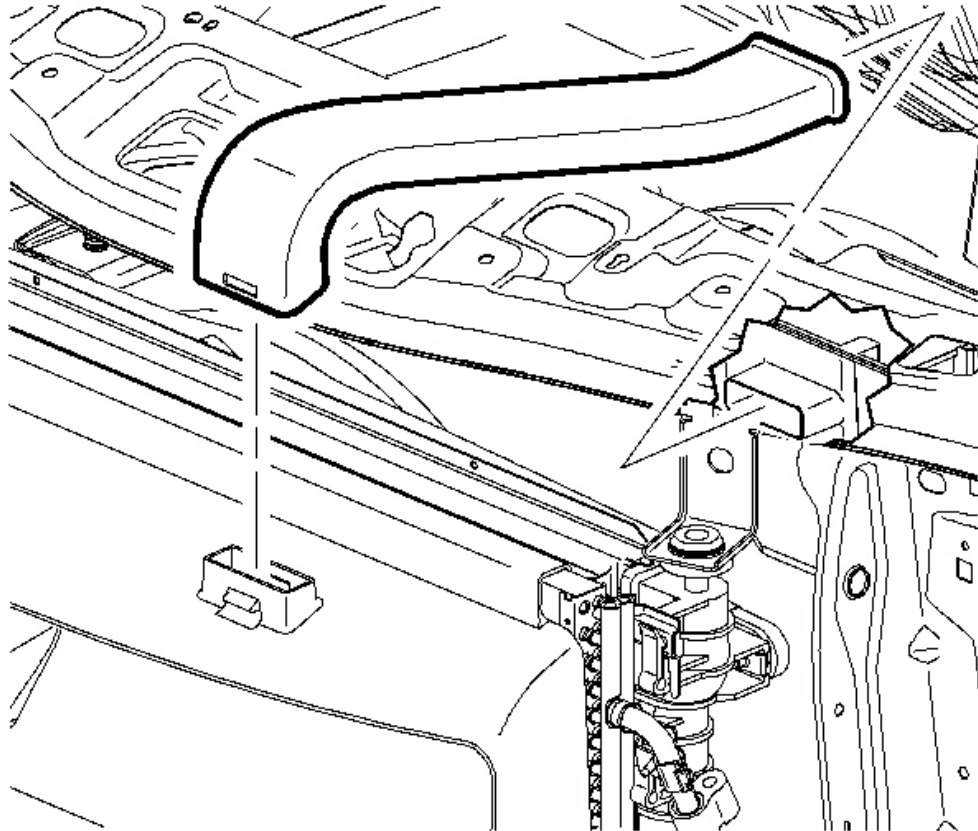


Fig. 56: View Of Battery Box Inlet Air Duct
Courtesy of GENERAL MOTORS CORP.

6. Remove the battery box inlet air duct.

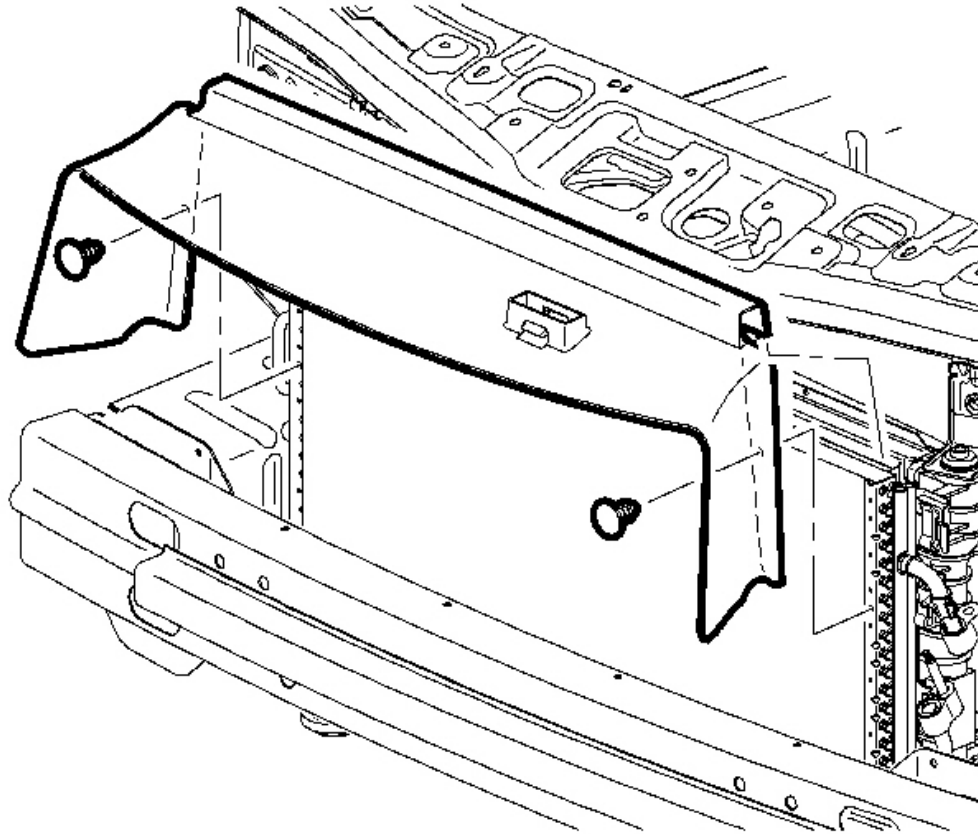


Fig. 57: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

7. Remove the condenser radiator fan module (CRFM) closeout panel retainers from the condenser.
8. Remove the CRFM closeout panel from the condenser.

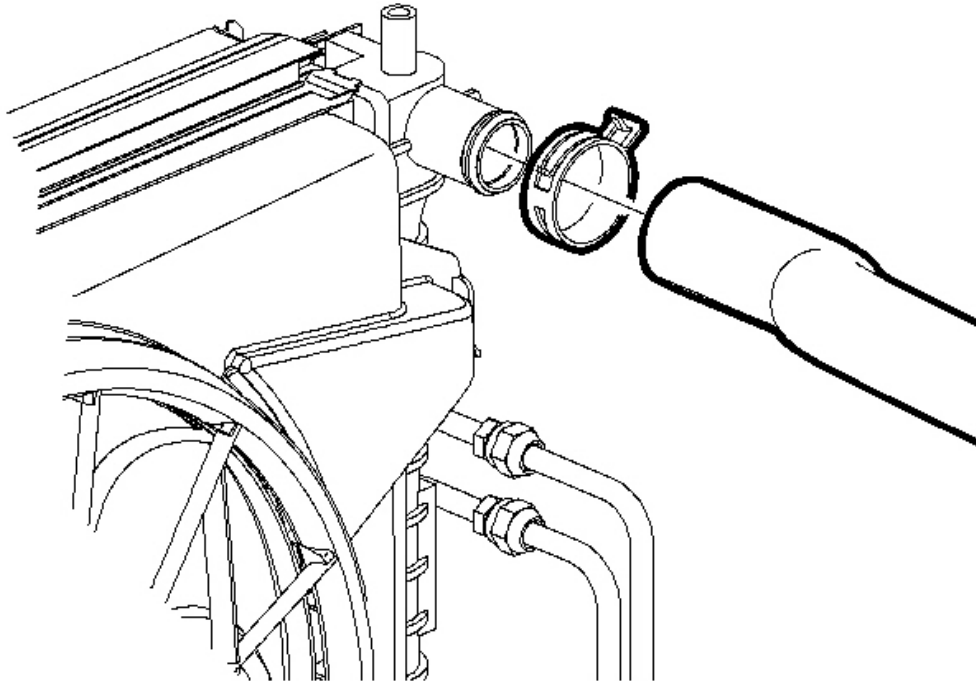


Fig. 58: View Of Radiator Inlet Hose To The Radiator
Courtesy of GENERAL MOTORS CORP.

9. Remove the radiator inlet hose clamp from the radiator.
10. Remove the radiator inlet hose from the radiator.

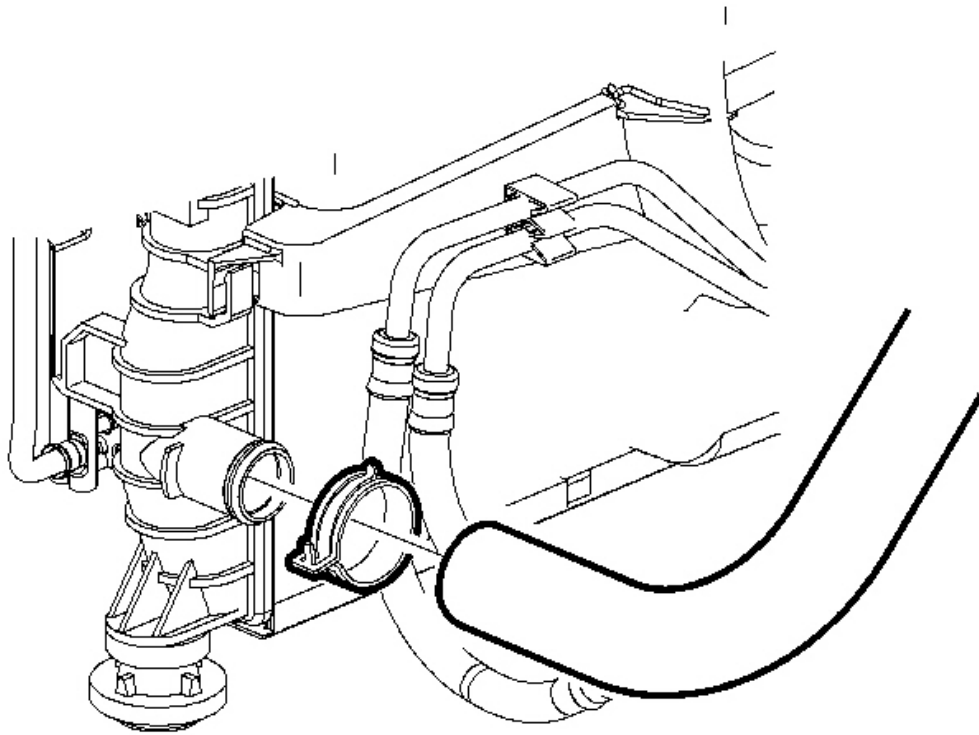


Fig. 59: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

11. Remove the radiator outlet hose clamp from the radiator.
12. Remove the radiator outlet hose from the radiator.

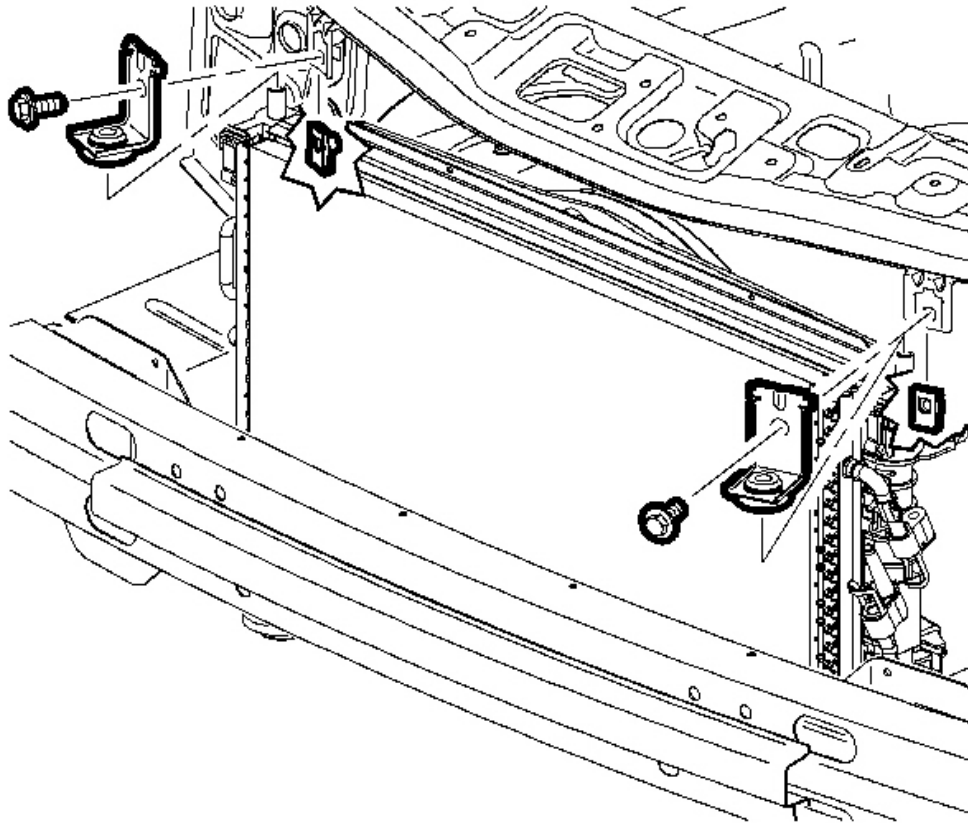


Fig. 60: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

13. Remove the CRFM mounting bracket bolts from the radiator support.
14. Remove the CRFM mounting brackets from the radiator support.

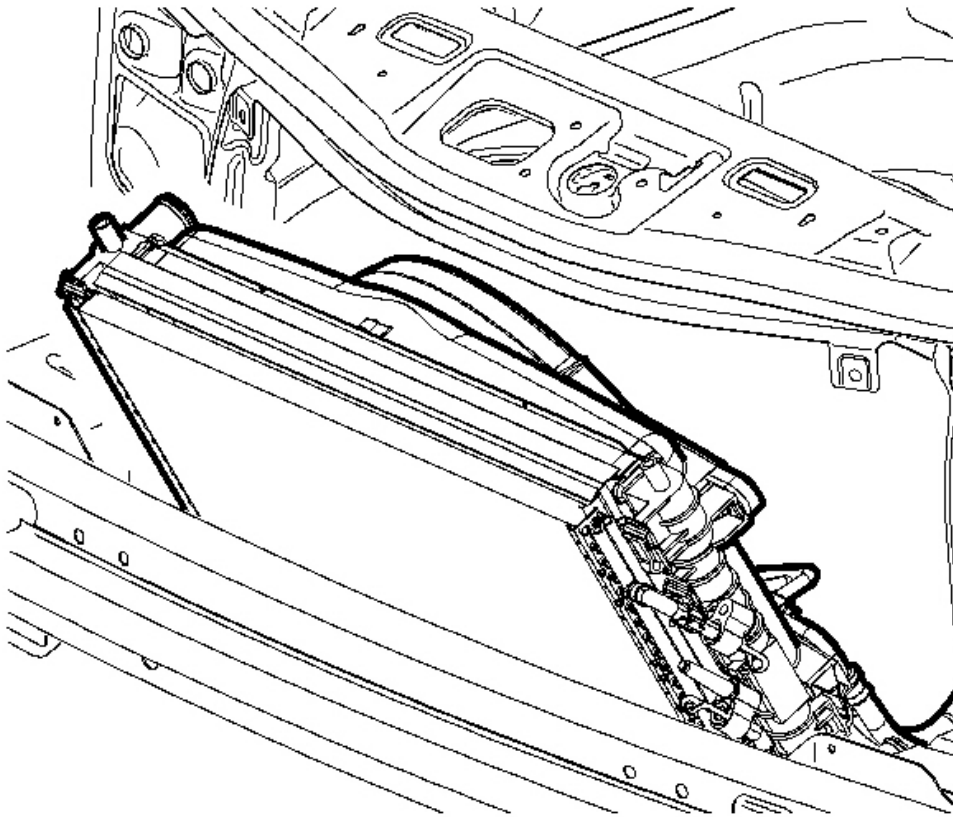


Fig. 61: View Of CRFM Assembly From The Lower Mounts
Courtesy of GENERAL MOTORS CORP.

15. Lift the CRFM assembly from the lower mounts and carefully move the bottom of the assembly rearward while tilting the top forward.

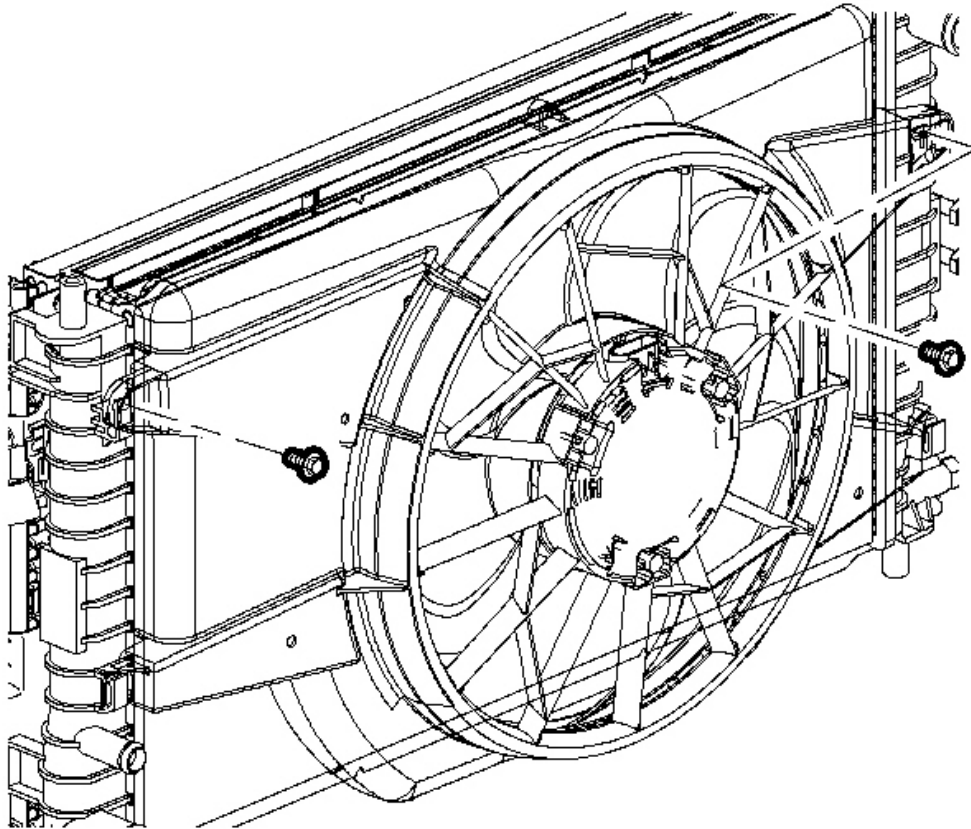


Fig. 62: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

16. Remove the fan assembly bolts from the radiator.

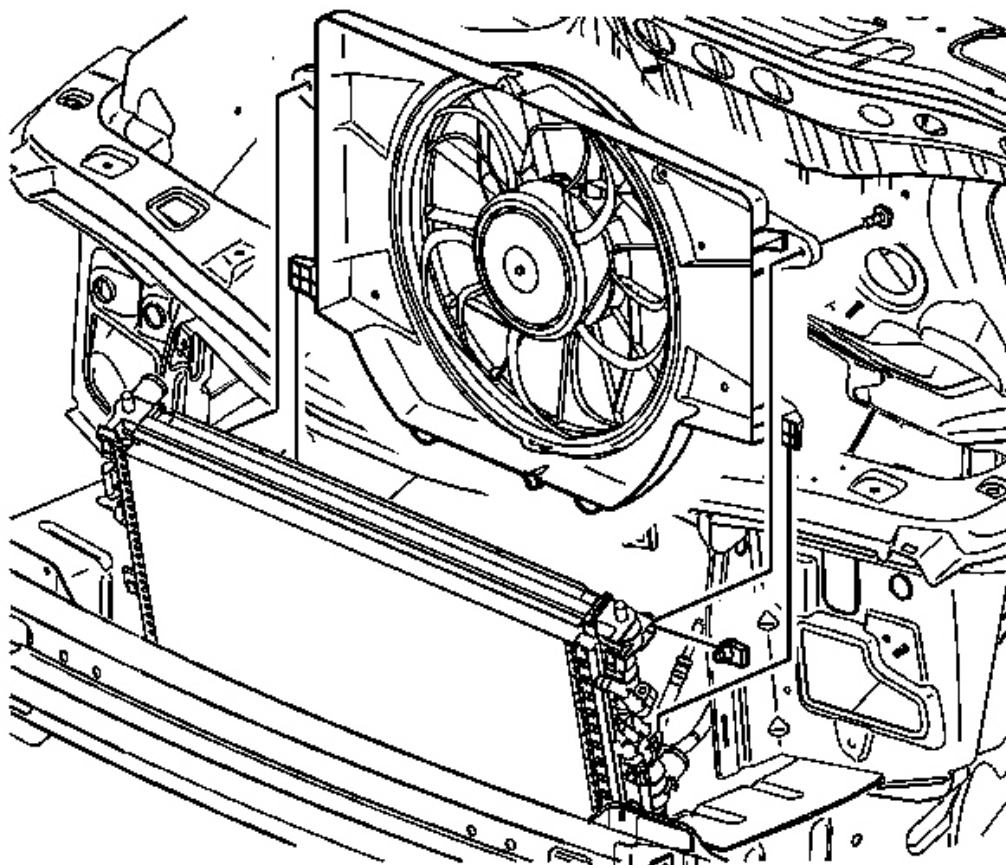


Fig. 63: View Of Fan Assembly From The Radiator
Courtesy of GENERAL MOTORS CORP.

17. Remove the fan assembly from the radiator.

Installation Procedure

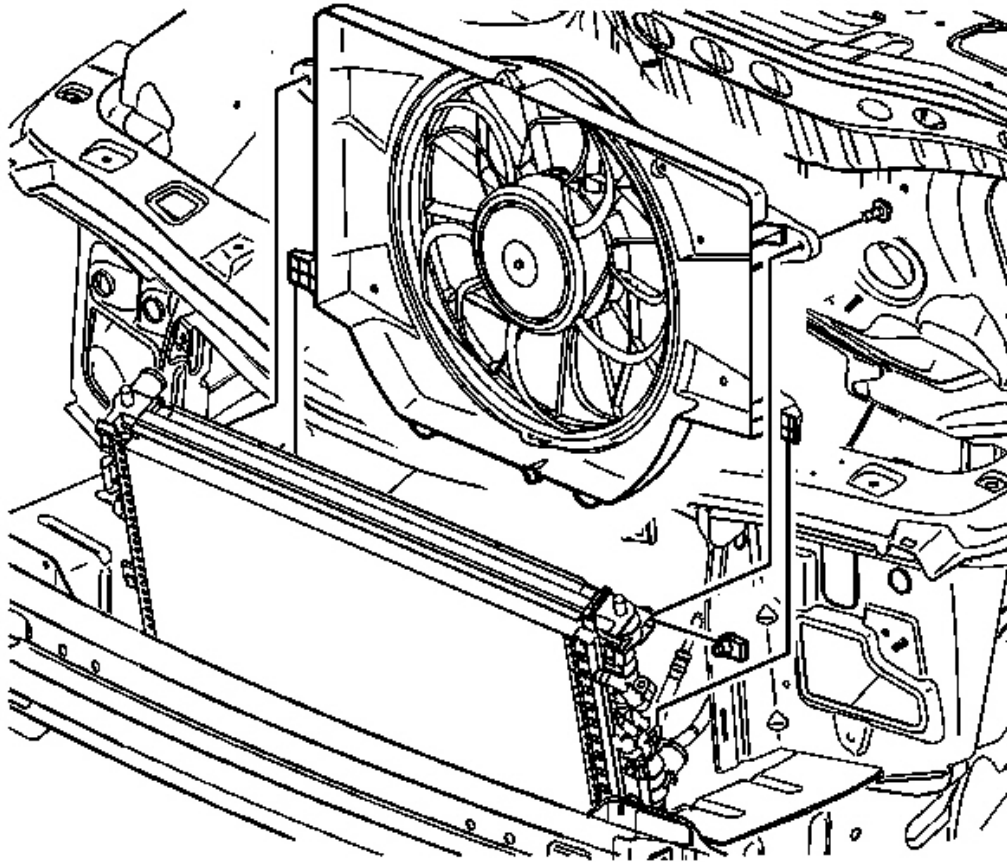


Fig. 64: View Of Fan Assembly From The Radiator
Courtesy of GENERAL MOTORS CORP.

1. Install the fan assembly to the radiator by guiding the lower tabs into the corresponding hooks on the radiator.

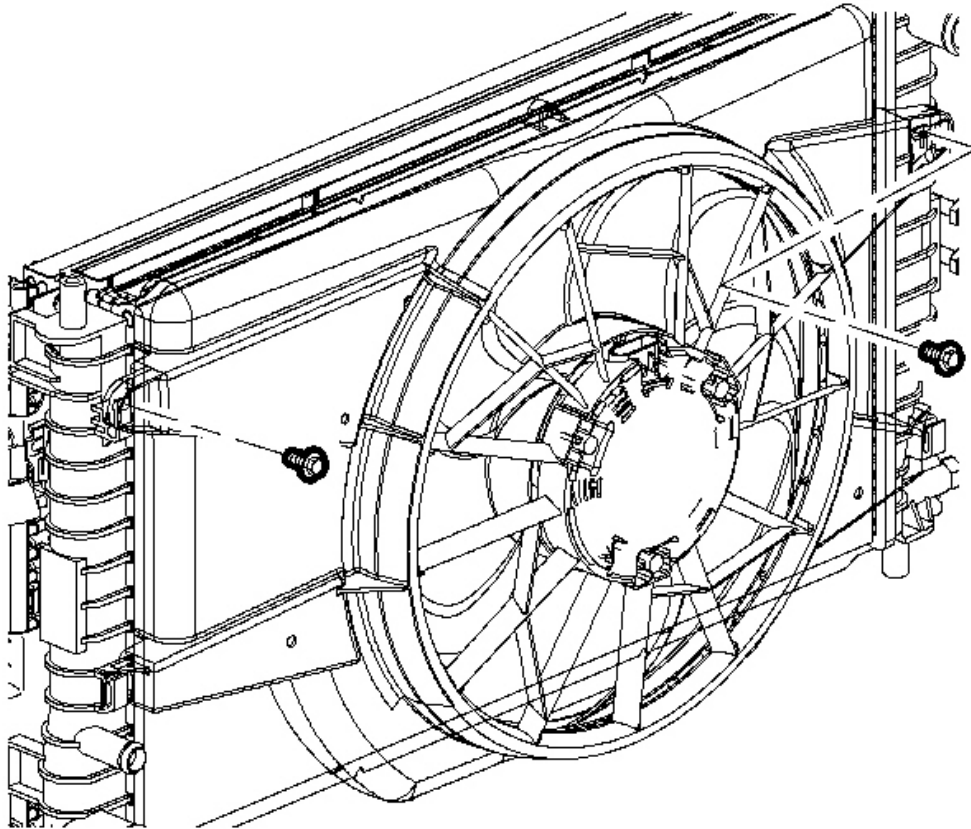


Fig. 65: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the fan assembly bolts to the radiator.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

3. Position the CRFM assembly onto the lower mounts.

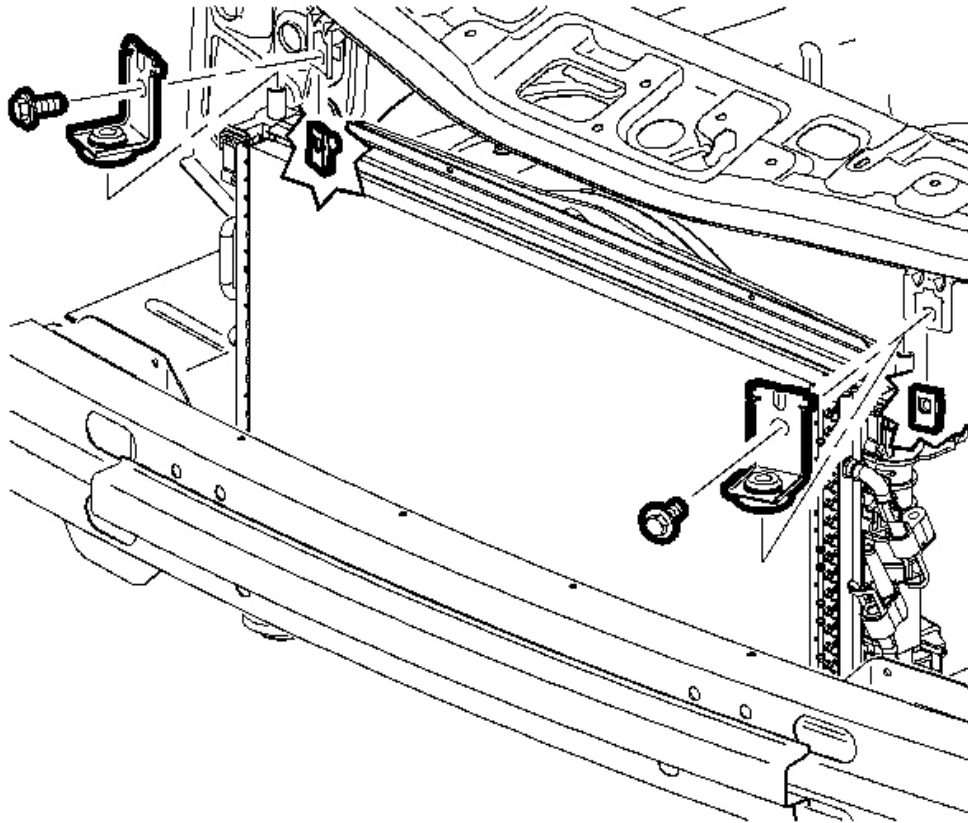


Fig. 66: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

4. Install the CRFM mounting brackets to the radiator support.
5. Install the CRFM mounting bracket bolts to the radiator support.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

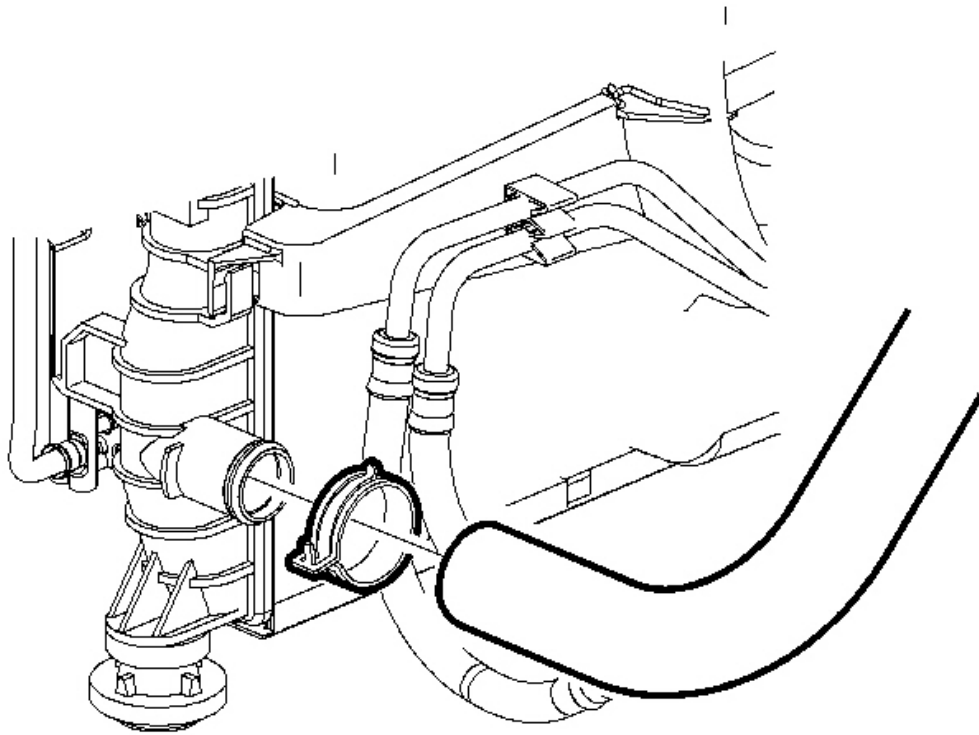


Fig. 67: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the radiator outlet hose to the radiator.
7. Install the radiator outlet hose clamp to the radiator.

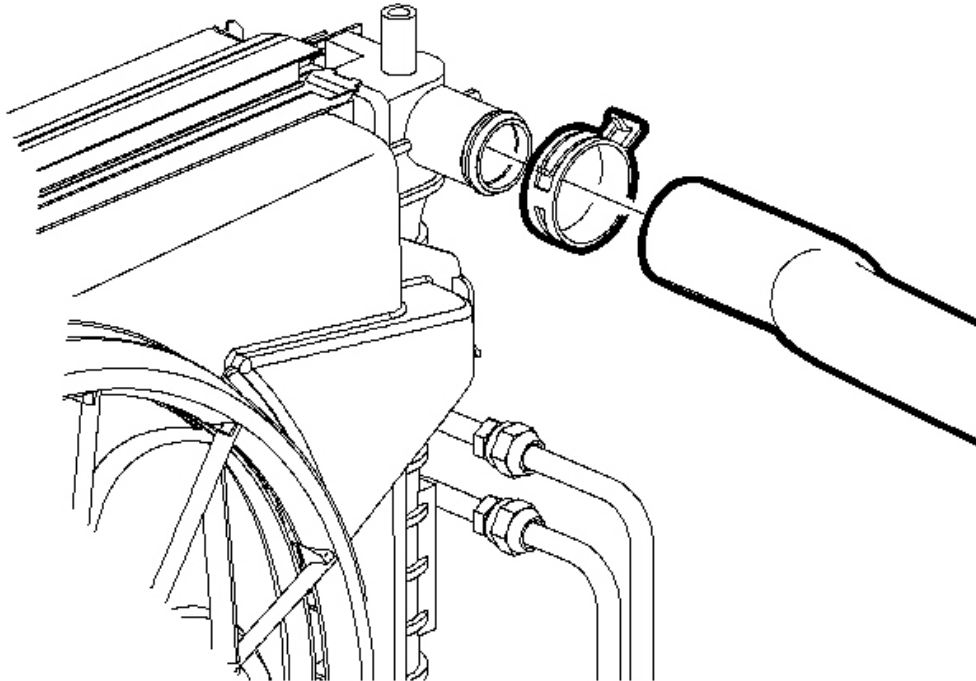


Fig. 68: View Of Radiator Inlet Hose To The Radiator
Courtesy of GENERAL MOTORS CORP.

8. Install the radiator inlet hose to the radiator.
9. Install the radiator inlet hose clamp to the radiator.

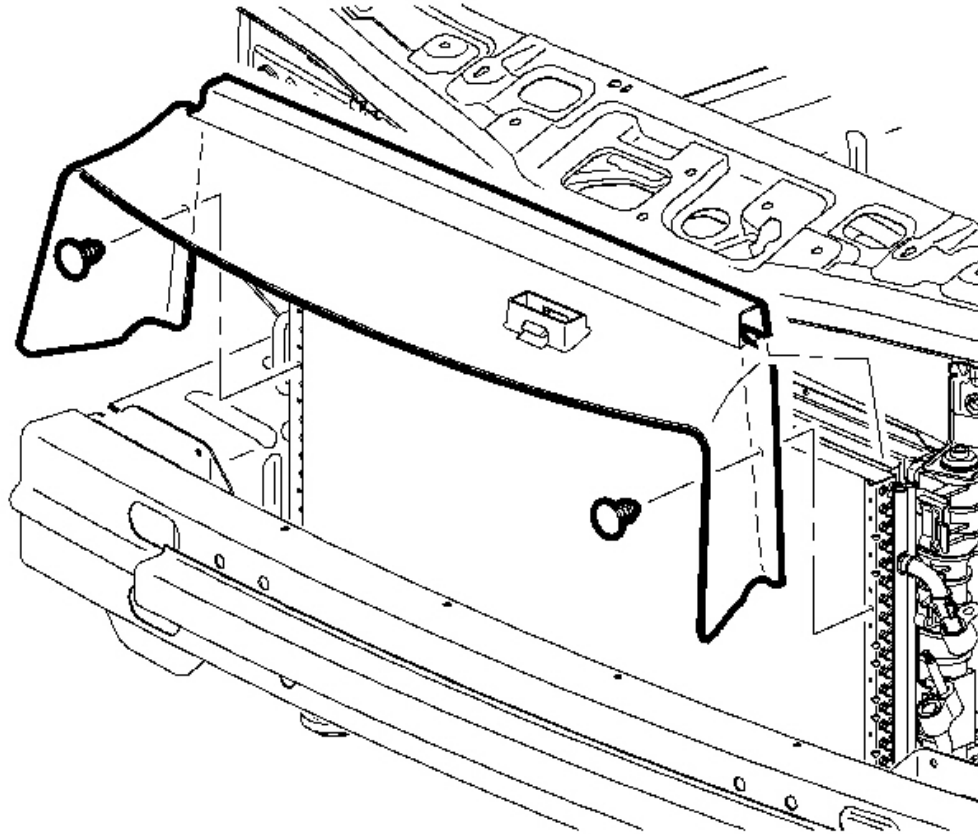


Fig. 69: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

10. Install the CRFM closeout panel to the condenser.
11. Install the CRFM closeout panel retainers to the condenser.

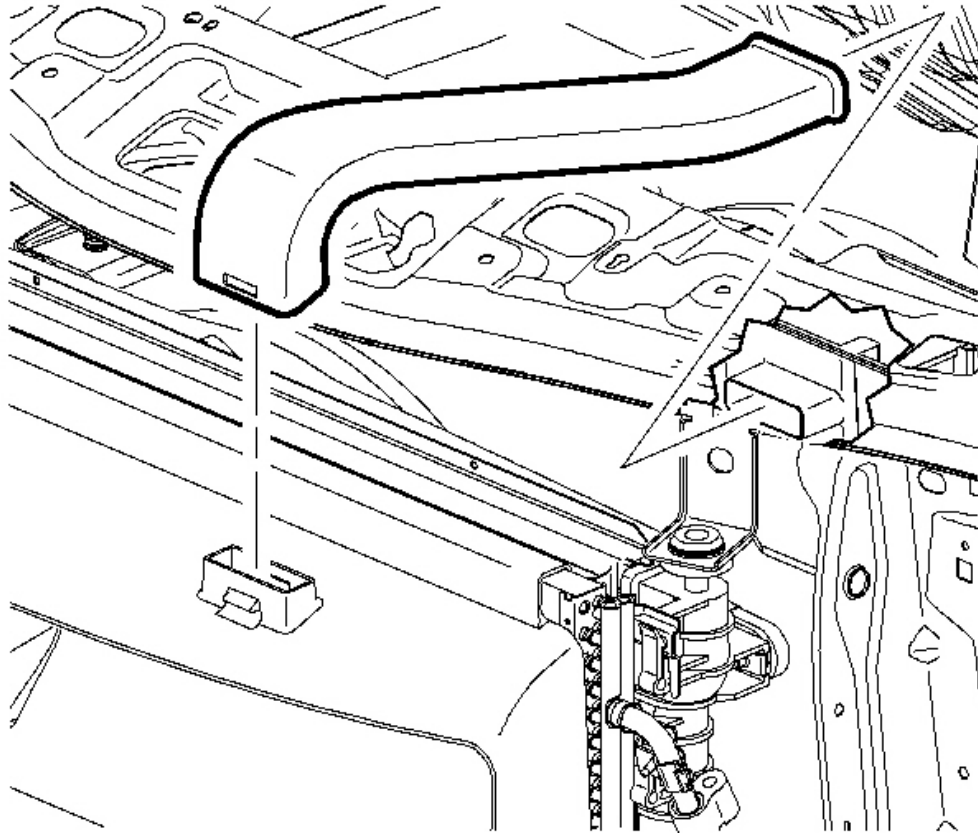


Fig. 70: View Of Battery Box Inlet Air Duct
Courtesy of GENERAL MOTORS CORP.

12. Install the battery box inlet air duct.

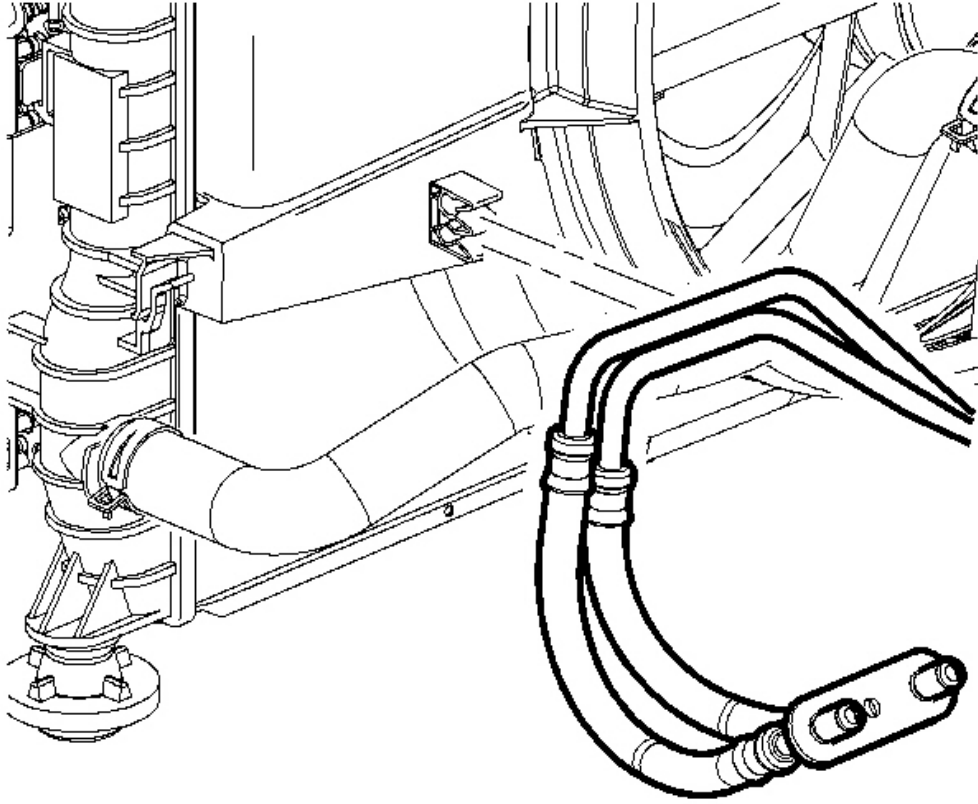


Fig. 71: View Of Unclip Transmission Cooler Lines From The Fan Assembly
Courtesy of GENERAL MOTORS CORP.

13. Clip the transmission cooler lines to the fan assembly.

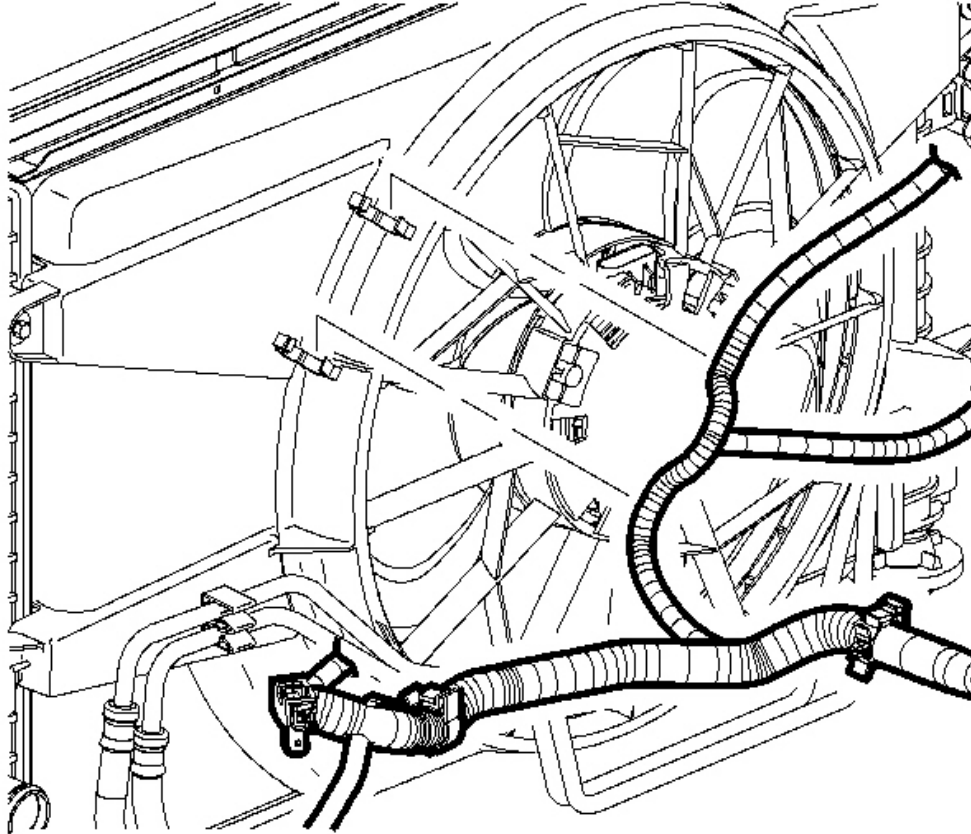


Fig. 72: View Of Clip Wire Harness From The Fan Assembly
Courtesy of GENERAL MOTORS CORP.

14. Clip the engine wire harness to fan assembly.

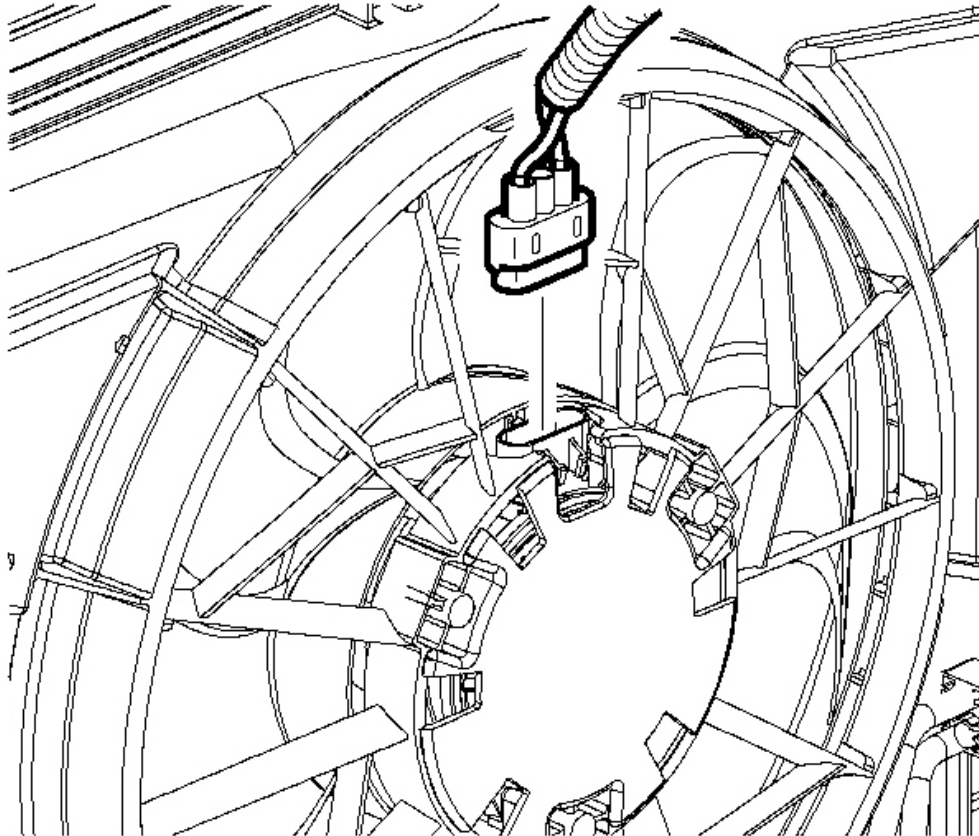


Fig. 73: View Of Electrical Connector To The Fan Motor
Courtesy of GENERAL MOTORS CORP.

15. Install the electrical connector to the fan motor.
16. Install the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
17. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

COOLING FAN AND SHROUD REPLACEMENT (L66)

Removal Procedure

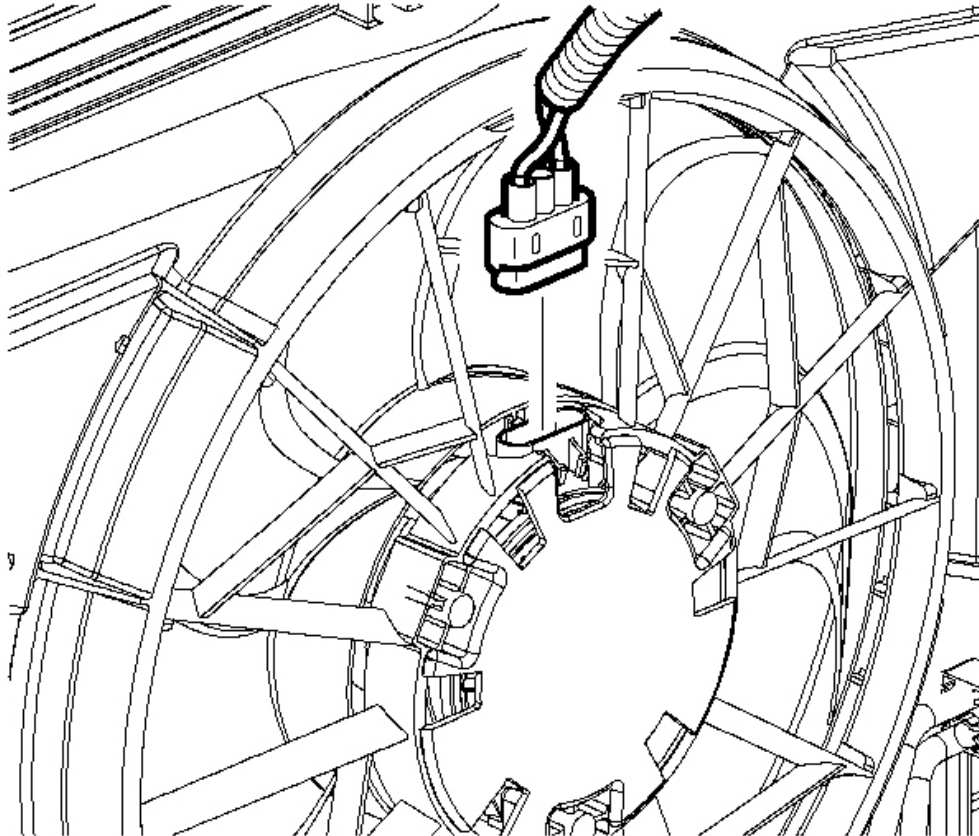


Fig. 74: View Of Cooling Fan & Shroud (L66)
Courtesy of GENERAL MOTORS CORP.

1. Remove the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
2. Drain the coolant. Refer to **Draining and Filling Cooling System** .
3. Disconnect the electrical connectors from the fan motors.
4. Unclip the wire harness from the fan assembly.
5. Unclip the transmission cooler lines from the fan assembly.

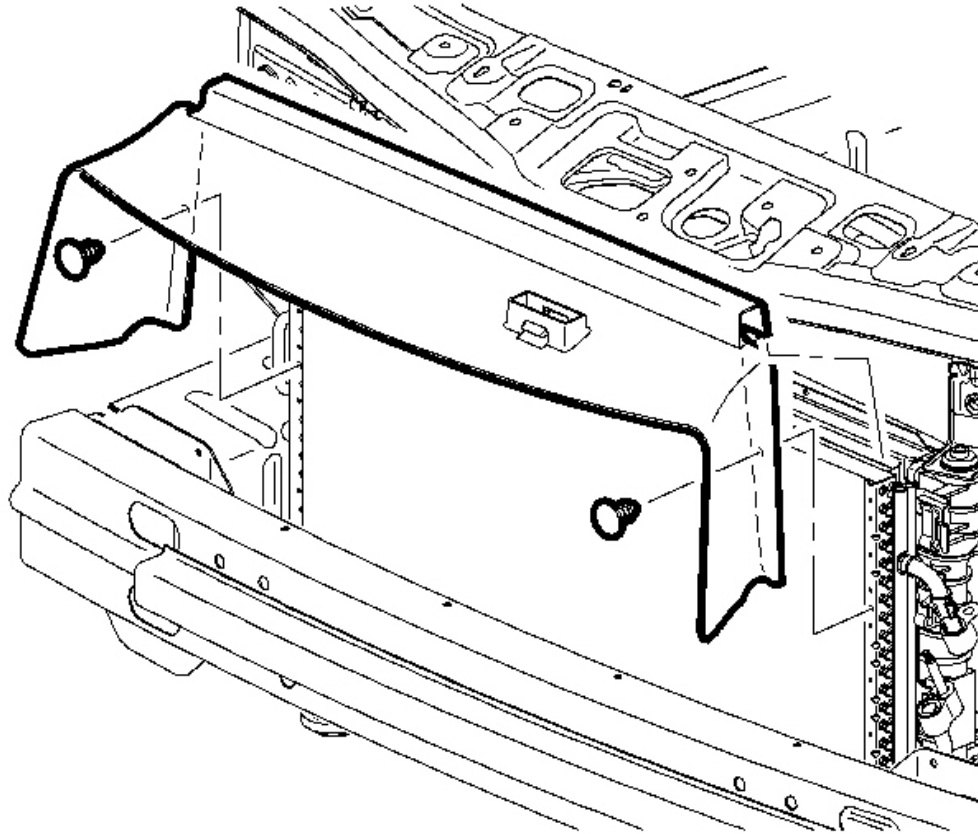


Fig. 75: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

6. Remove the condenser radiator fan module (CRFM) closeout panel retainers from the condenser.
7. Remove the CRFM closeout panel from the condenser.

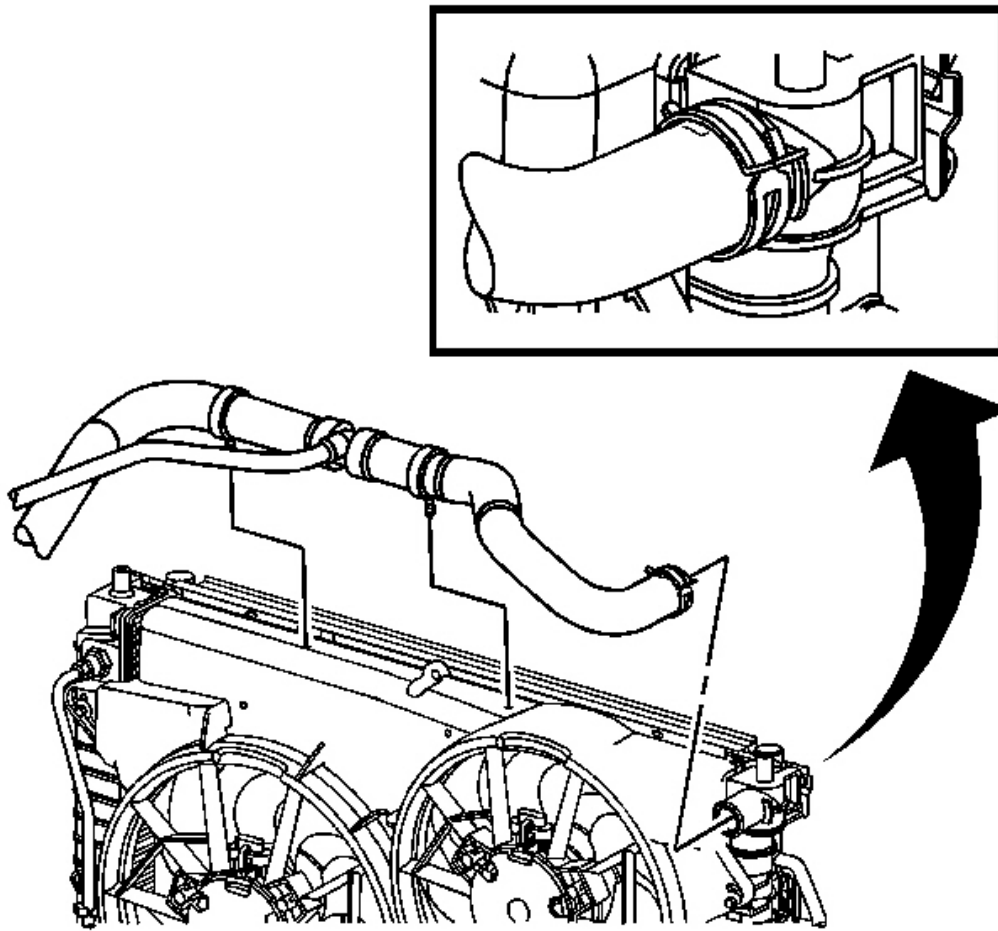


Fig. 76: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

8. Remove the radiator inlet hose clamp from the radiator.
9. Remove the radiator inlet hose from the radiator.
10. Remove the radiator inlet hose retaining straps from the radiator support.

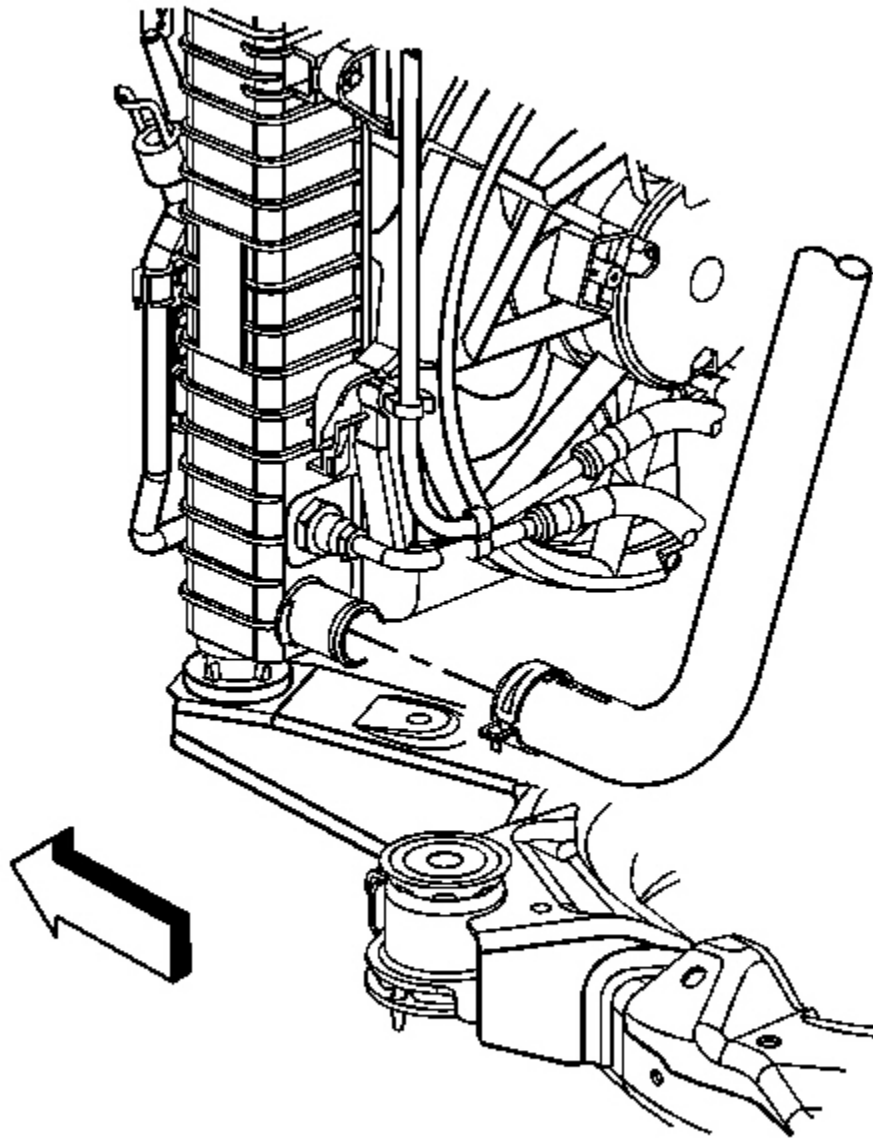


Fig. 77: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

11. Remove the radiator outlet hose clamp from the radiator.
12. Remove the radiator outlet hose from the radiator.

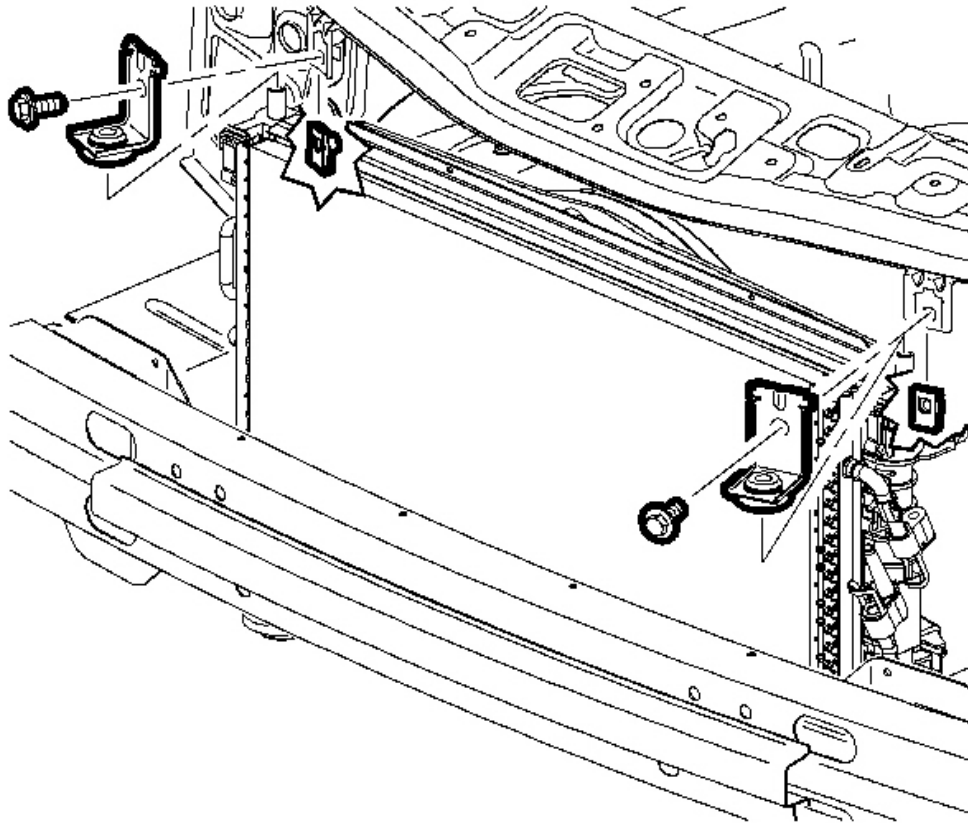


Fig. 78: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

13. Remove the CRFM mounting bracket bolts from the radiator support.
14. Remove the CRFM mounting brackets from the radiator support.

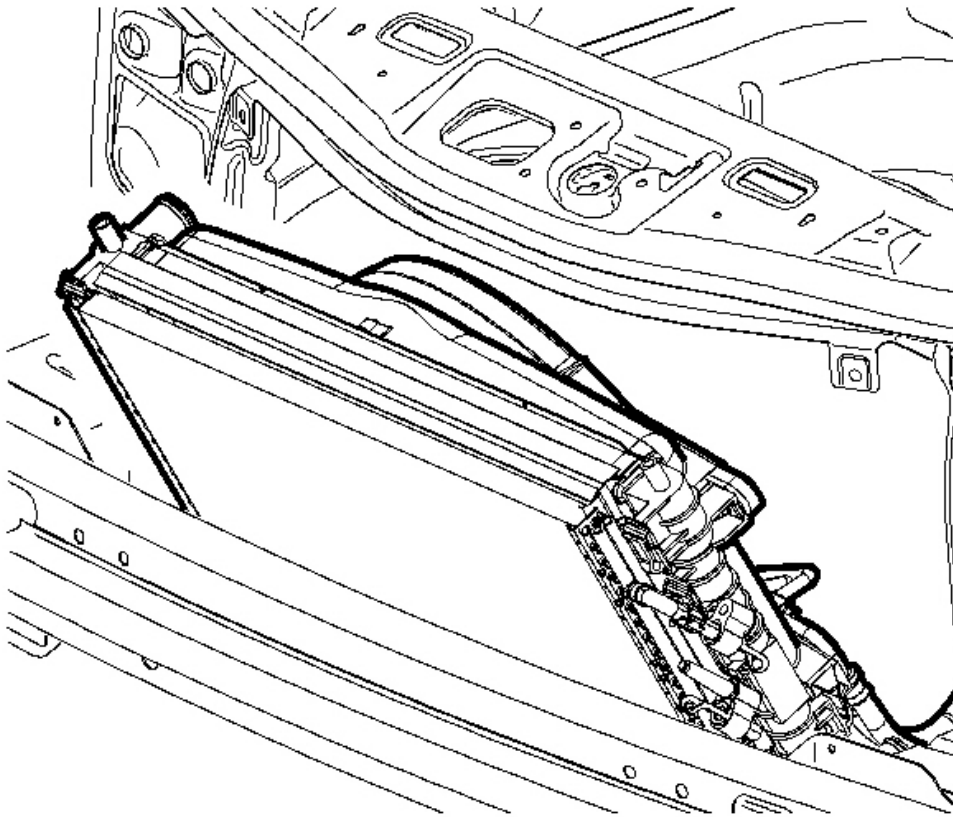


Fig. 79: View Of CRFM Assembly From The Lower Mounts
Courtesy of GENERAL MOTORS CORP.

15. Lift the CRFM assembly from the lower mounts and carefully move the bottom of the assembly rearward while tilting the top forward.

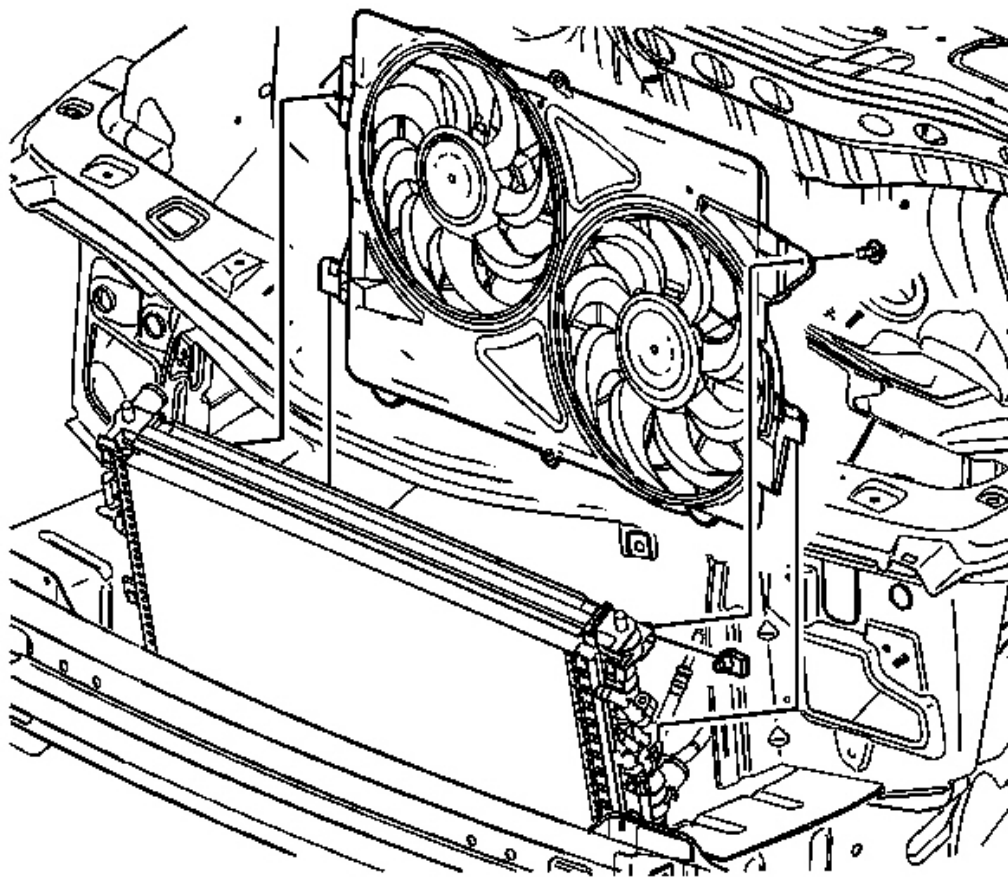


Fig. 80: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

16. Remove the fan assembly bolts from the radiator.
17. Remove the fan assembly from the radiator.

Installation Procedure

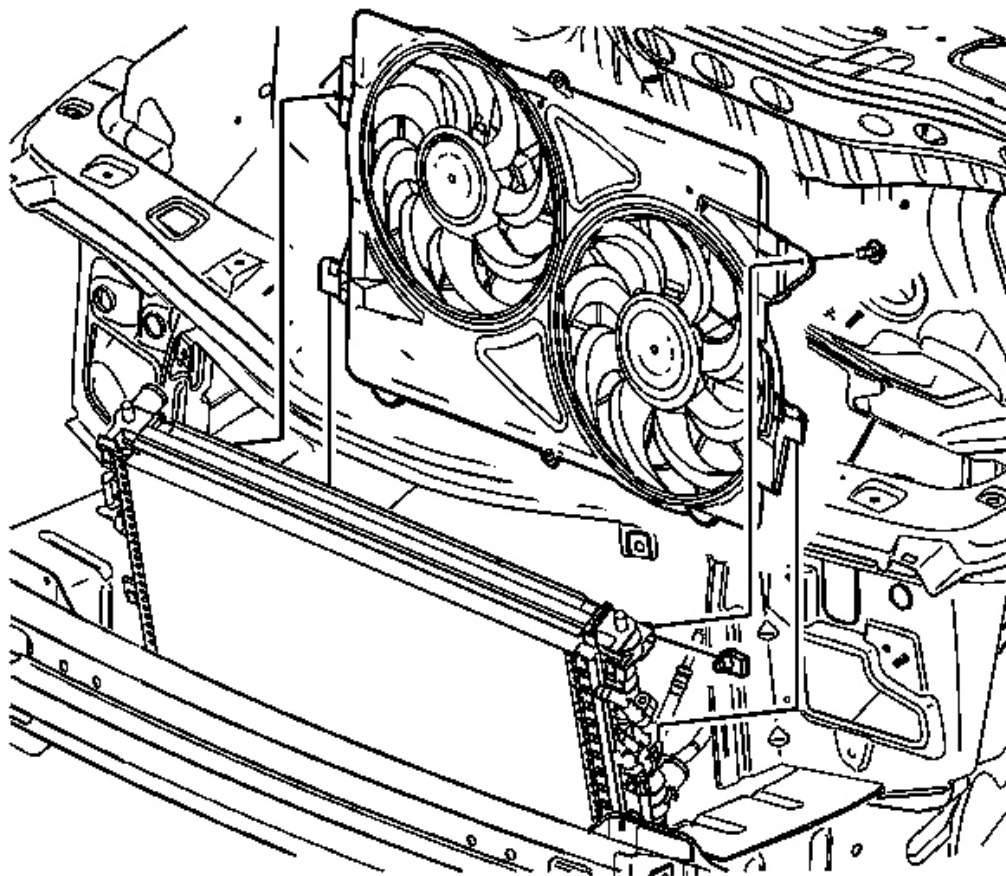


Fig. 81: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the fan assembly to the radiator by guiding the lower tabs into the corresponding hooks on the radiator.

Install the fan assembly bolts to the radiator.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

2. Position the CRFM assembly onto the lower mounts.

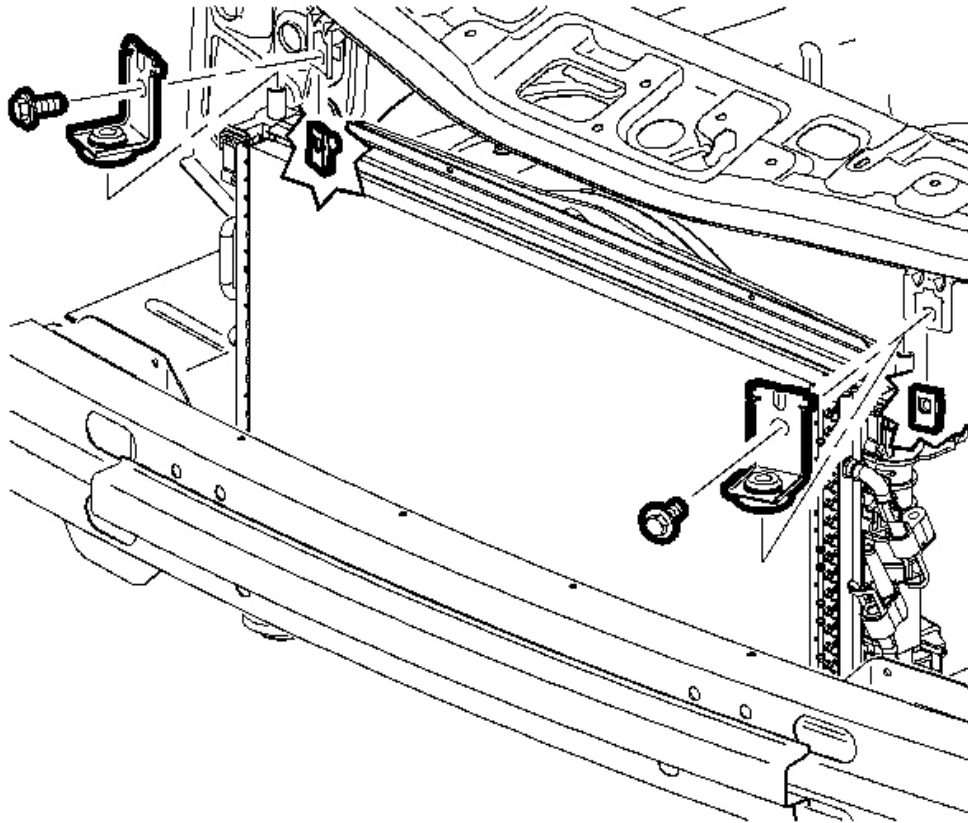


Fig. 82: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

3. Install the CRFM mounting brackets to the radiator support.
4. Install the CRFM mounting bracket bolts to the radiator support.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

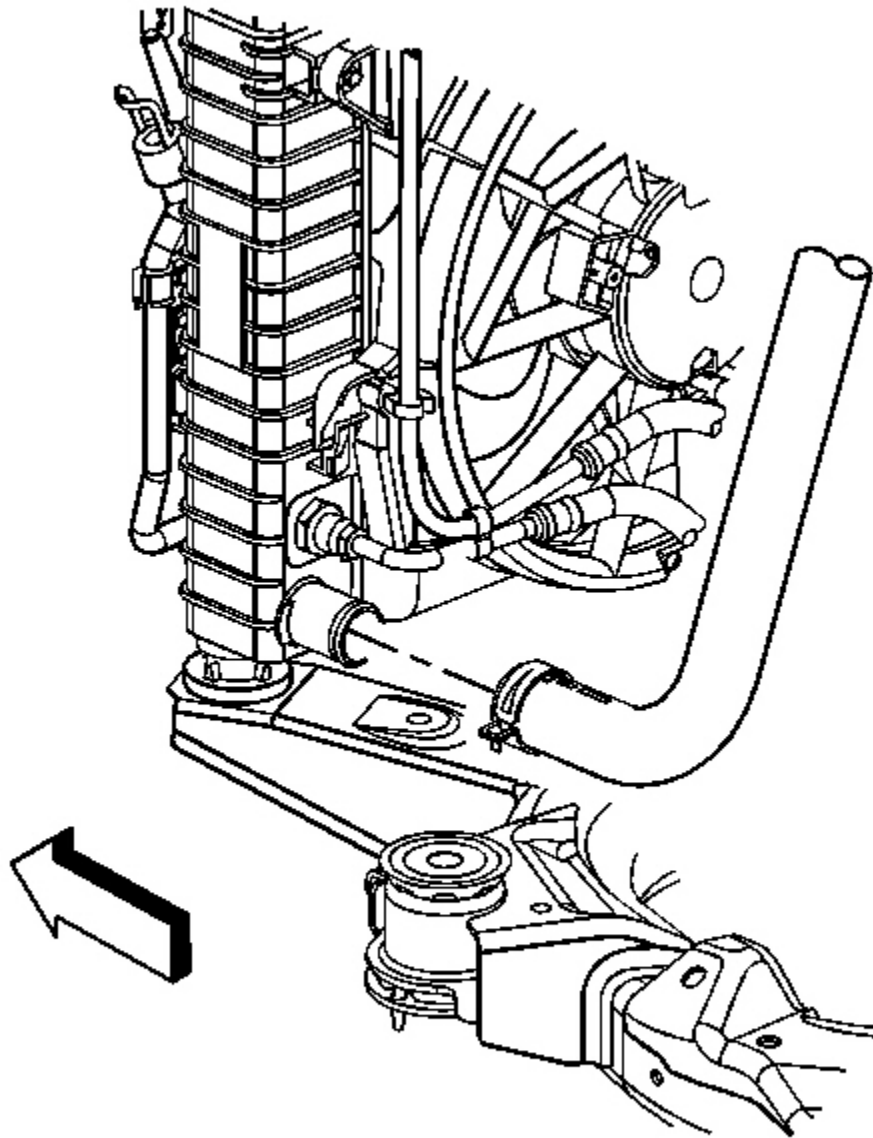


Fig. 83: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Install the radiator outlet hose to the radiator.
6. Install the radiator outlet hose clamp to the radiator.

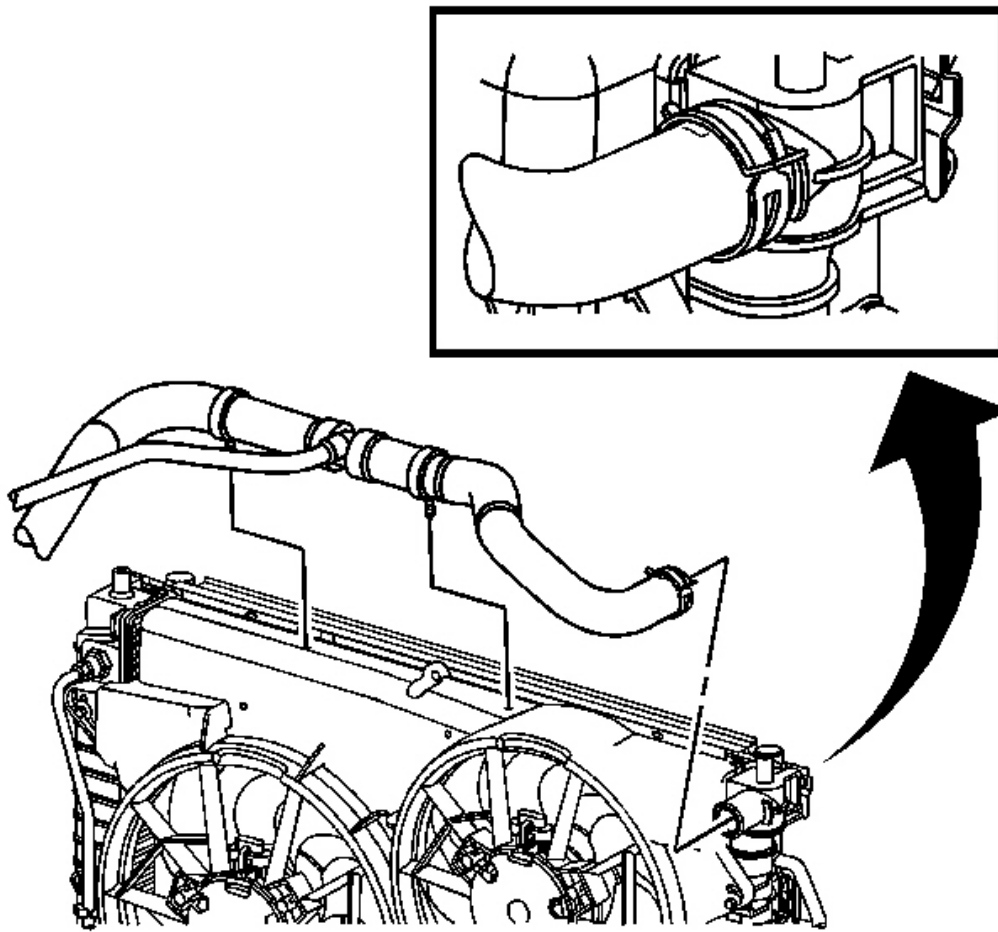


Fig. 84: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

7. Install the radiator inlet hose to the radiator.
8. Install the radiator inlet hose clamp to the radiator.

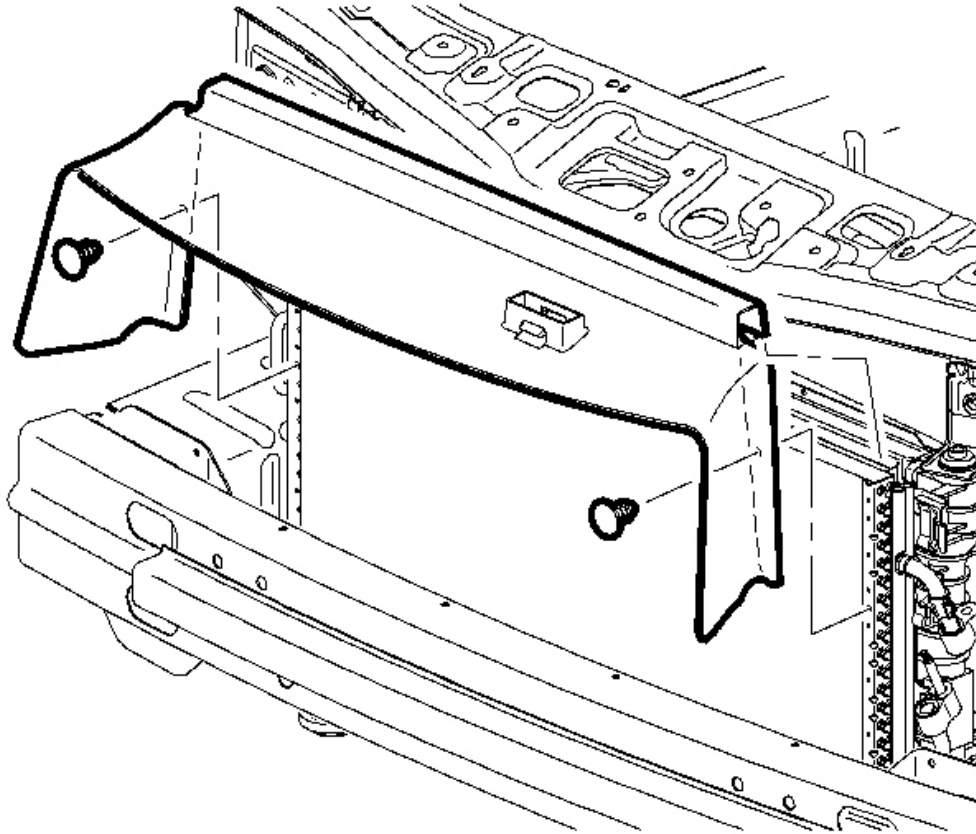


Fig. 85: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

9. Install the CRFM closeout panel to the condenser.
10. Install the CRFM closeout panel retainers to the condenser.

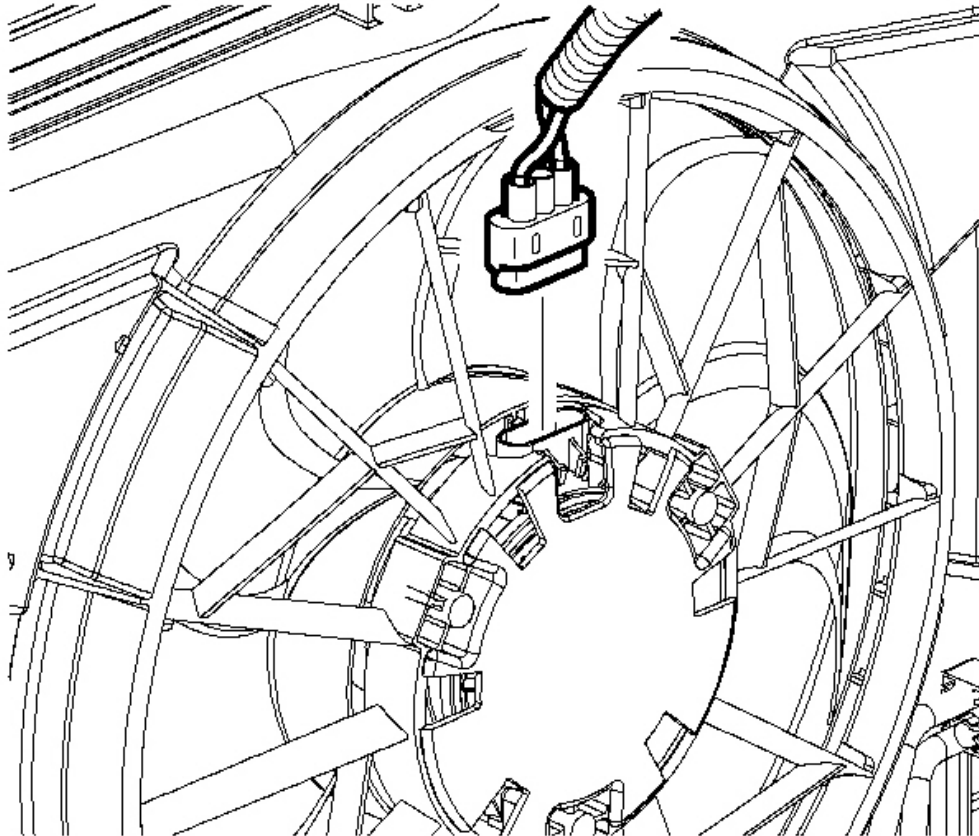


Fig. 86: View Of Electrical Connector To The Fan Motor
Courtesy of GENERAL MOTORS CORP.

11. Clip the transmission cooler lines to the fan assembly.
12. Clip the engine wire harness to fan assembly.
13. Install the electrical connectors to the fan motors.
14. Install the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
15. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

THERMOSTAT REPLACEMENT (L61)

Removal Procedure

NOTE: The thermostat will not function correctly once it is contacted by oil. If oil is found in the cooling system, it must be flushed and the thermostat's cartridge replaced.

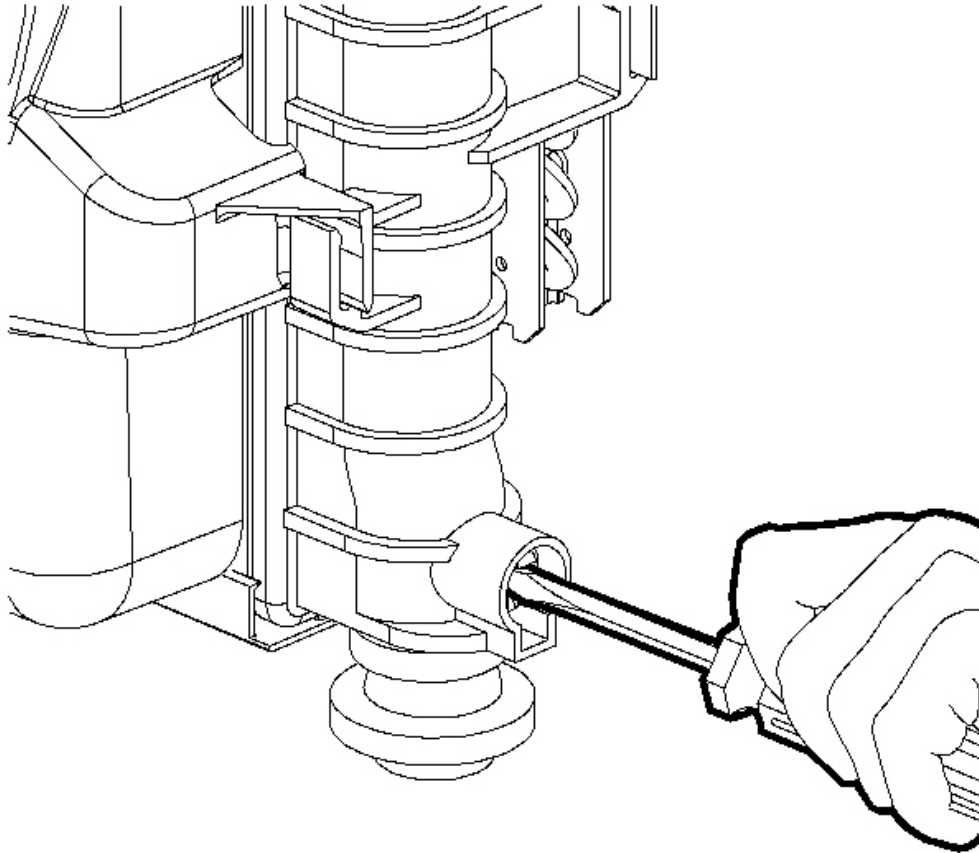


Fig. 87: View Of Thermostat (L61)
Courtesy of GENERAL MOTORS CORP.

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

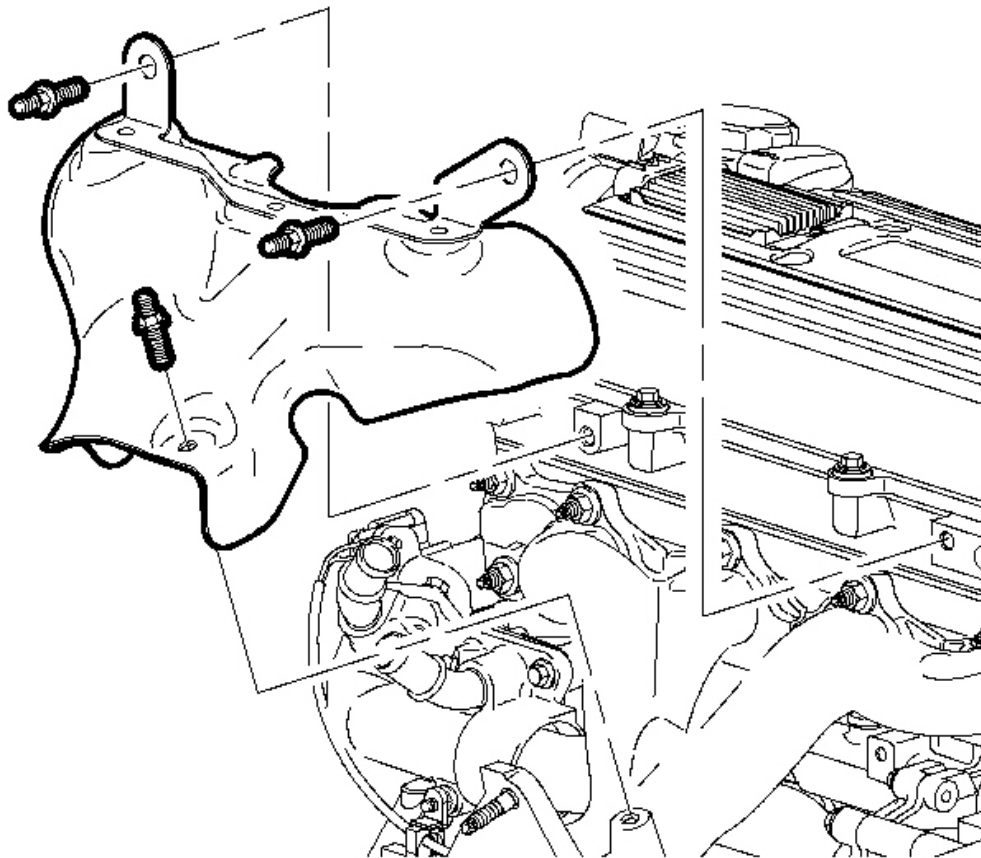


Fig. 88: View Of Exhaust Manifold Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the exhaust heat shield bolts.
3. Remove the exhaust heat shield.
4. Raise the vehicle.

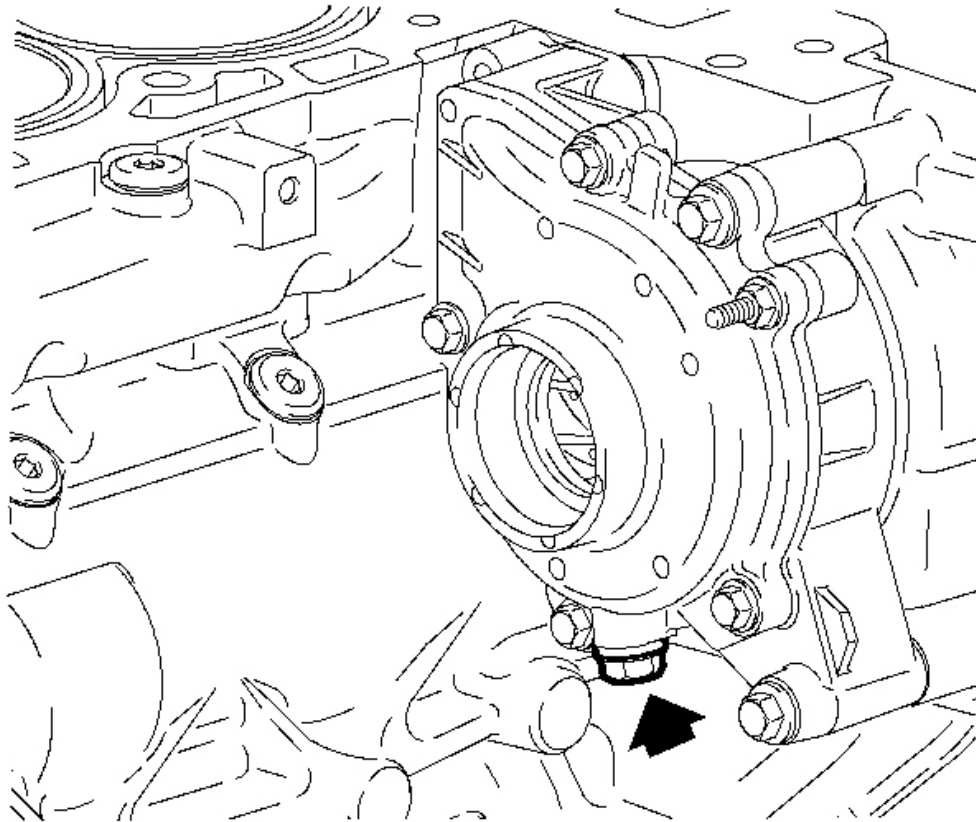


Fig. 89: View Of Drain Plug On The Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

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.

5. Drain the coolant from the water pump drain plug.

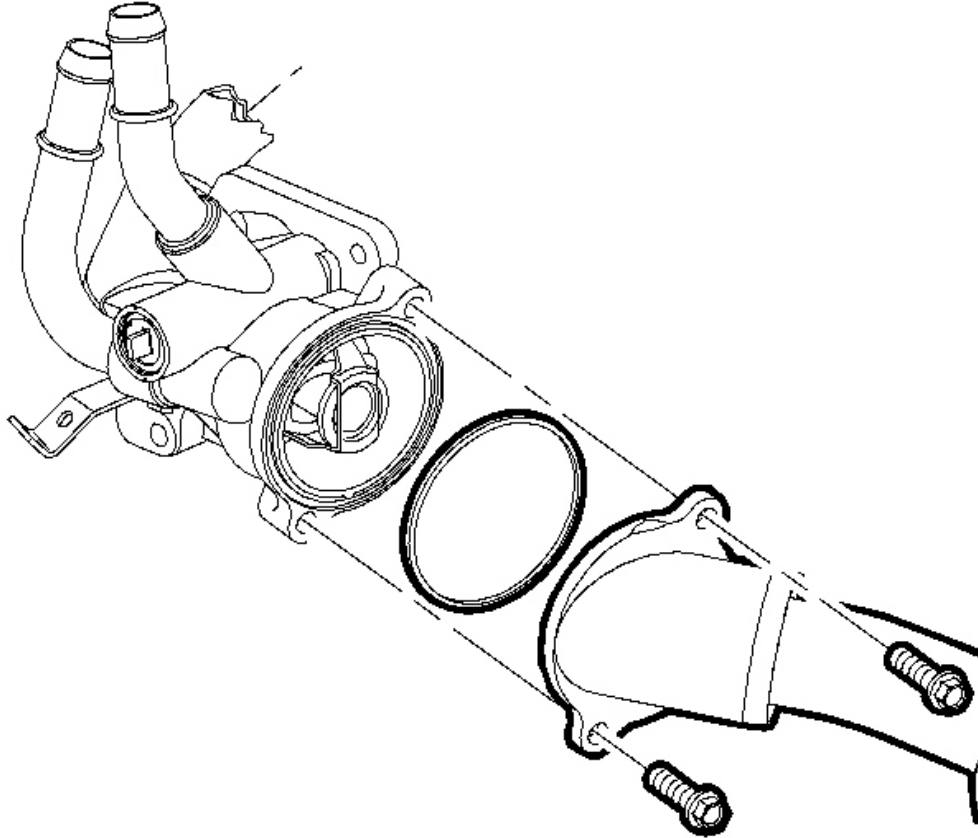


Fig. 90: View Of Thermostat Cover Bolts
Courtesy of GENERAL MOTORS CORP.

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

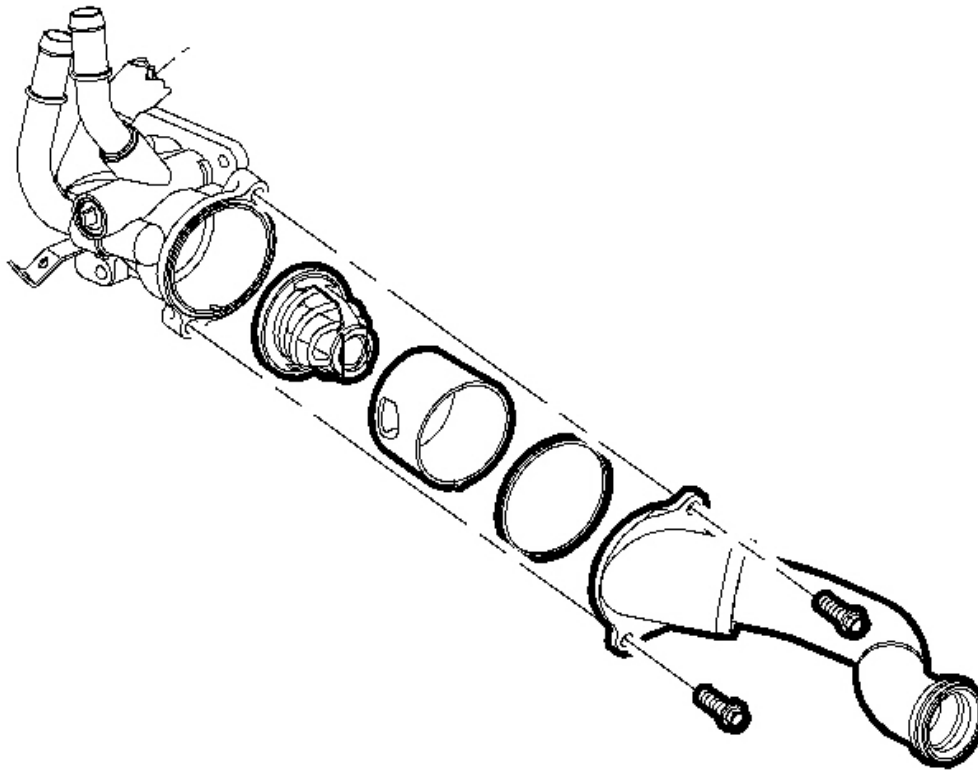


Fig. 91: View Of Water Pipe From The Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Twist the water feed pipe while pulling to remove it from the water pump.

8. Remove the water pipe from the water pump assembly.
9. Remove and discard the seals from the water pipe.
10. Remove the inner thermostat sleeve.
11. Remove the thermostat assembly.

Installation Procedure

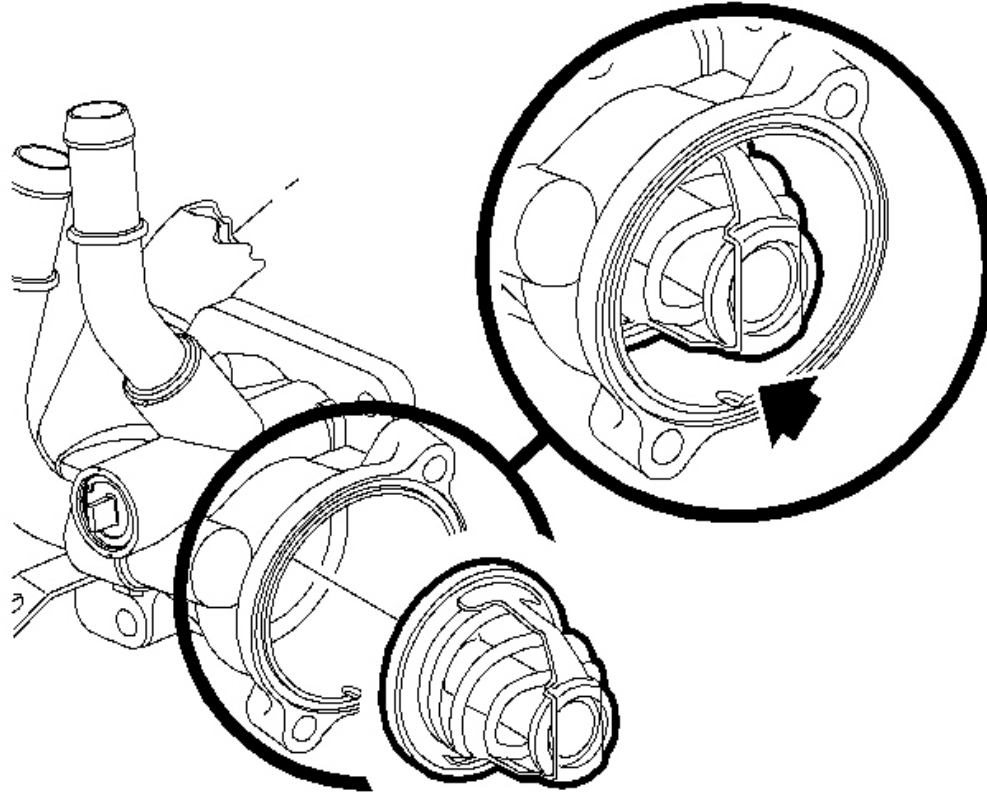


Fig. 92: Exploded View Of Thermostat
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat cartridge into the thermostat housing while aligning the cartridge tangs up with the thermostat housing bolt holes. This will assure the inner sleeve can be completely installed.

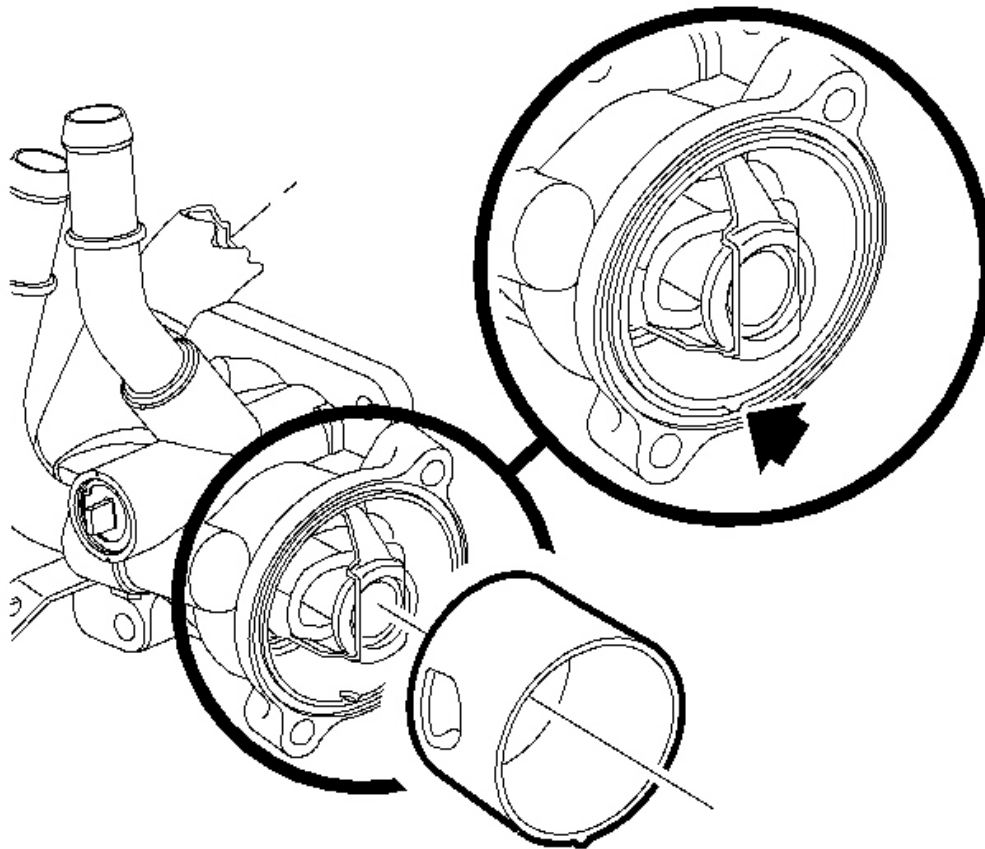


Fig. 93: View Of Thermostat
Courtesy of GENERAL MOTORS CORP.

2. Align and insert the inner sleeve notch into the thermostat housing. If the inner sleeve notch is not properly positioned, the sleeve will not completely seat into the housing.

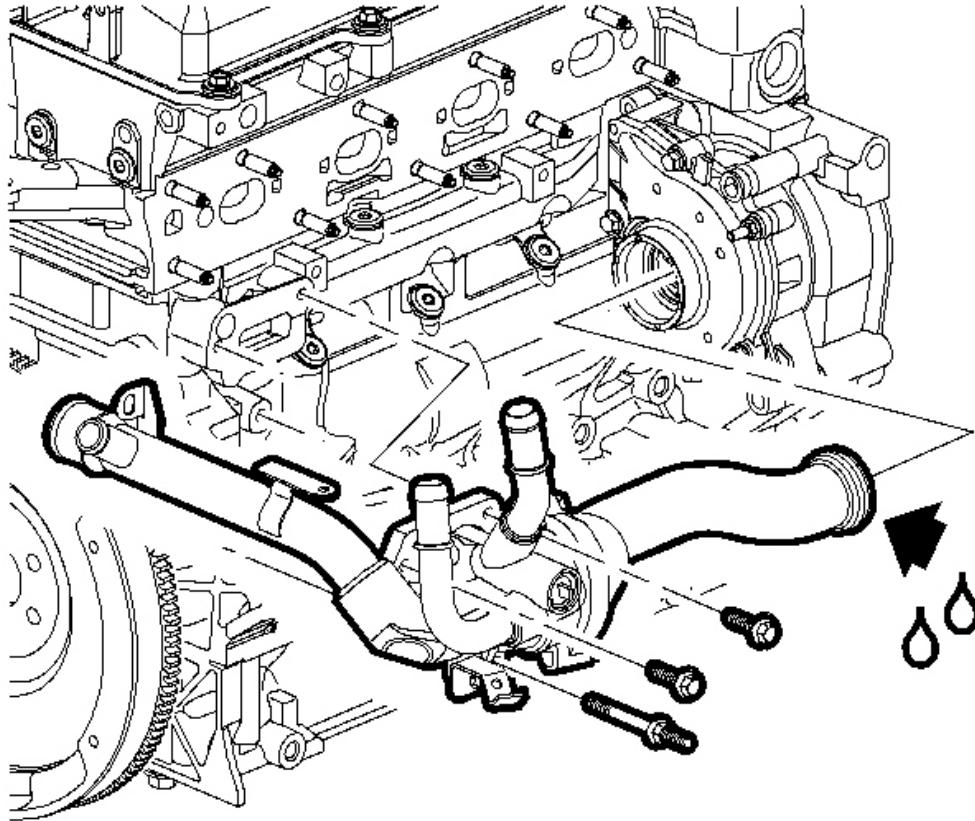


Fig. 94: View Of Thermostat Housing To Block Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The water feed pipe seals can be slightly lubricated with silicone gel to aid during installation.

3. Install a new O-seal on the water pipe.
4. Position the water pipe into the water pump assembly.
5. Seat the water feed O-seal by pushing and twisting toward the water pump. Take care not to tear or damage the O-ring.

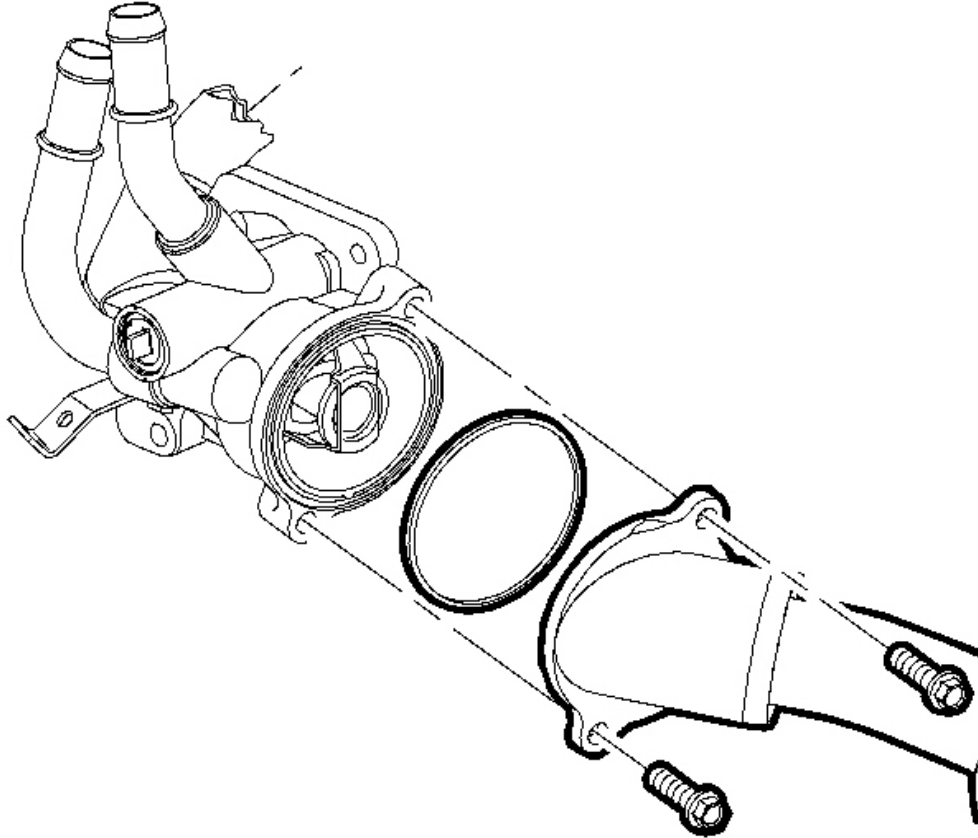


Fig. 95: View Of Thermostat Cover Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the thermostat housing cover to the water pipe. The water feed pipe has a locating tab to assure proper alignment.
7. Install a new thermostat housing cover seal into the recess groove.
8. Position the thermostat housing cover into position.

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

9. Install the thermostat housing cover bolts.

Tighten: Tighten the thermostat housing cover-to-thermostat housing bolts to 10 N.m (89 lb in).

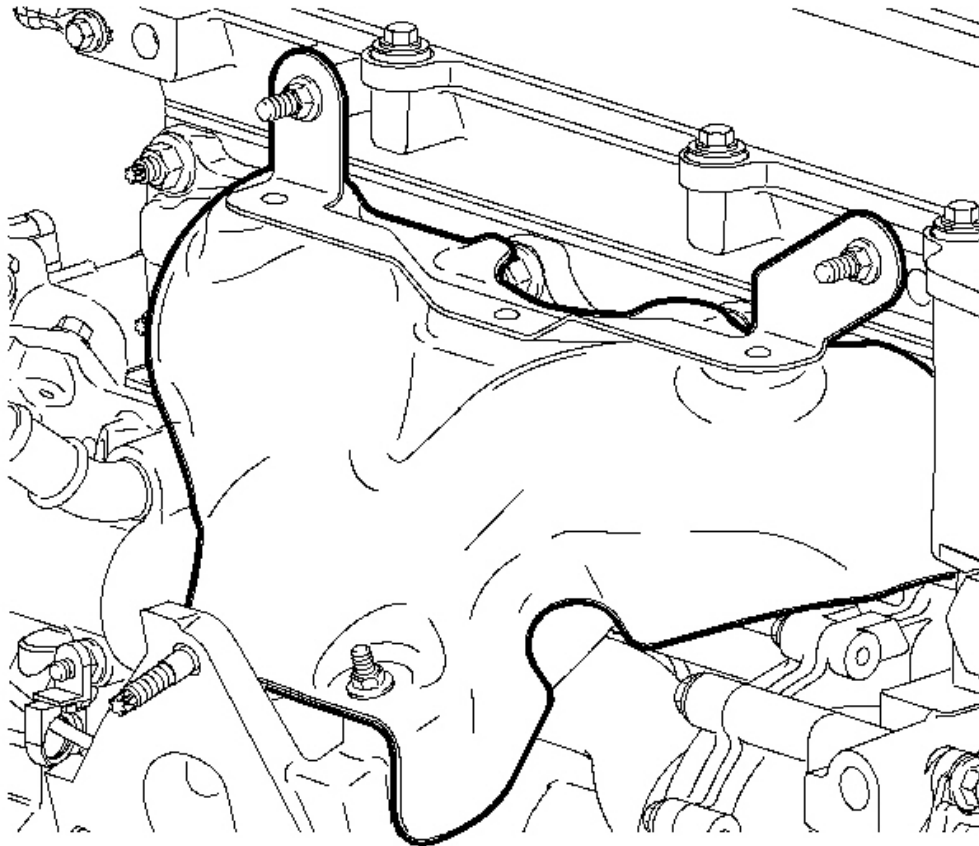


Fig. 96: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

10. Lower the vehicle.
11. Install the exhaust manifold heat shield.
12. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 23 N.m (17 lb ft).

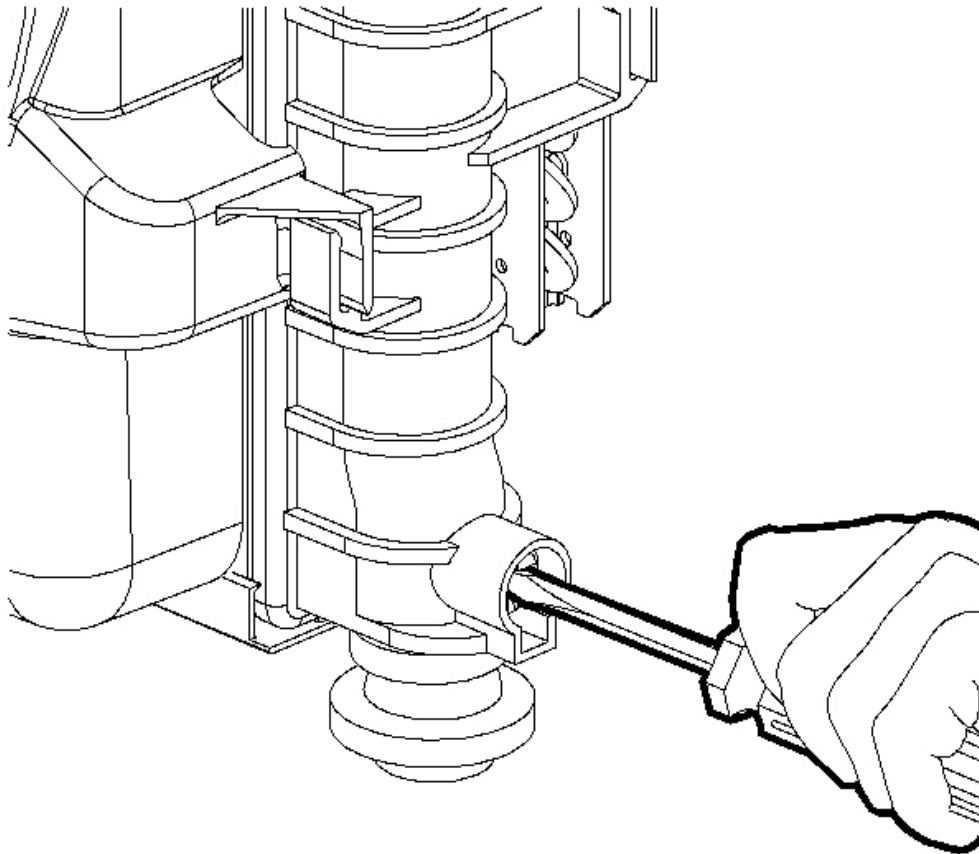


Fig. 97: View Of Drain Valve
Courtesy of GENERAL MOTORS CORP.

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

13. Verify the drain valve at the radiator and the water pump are closed.

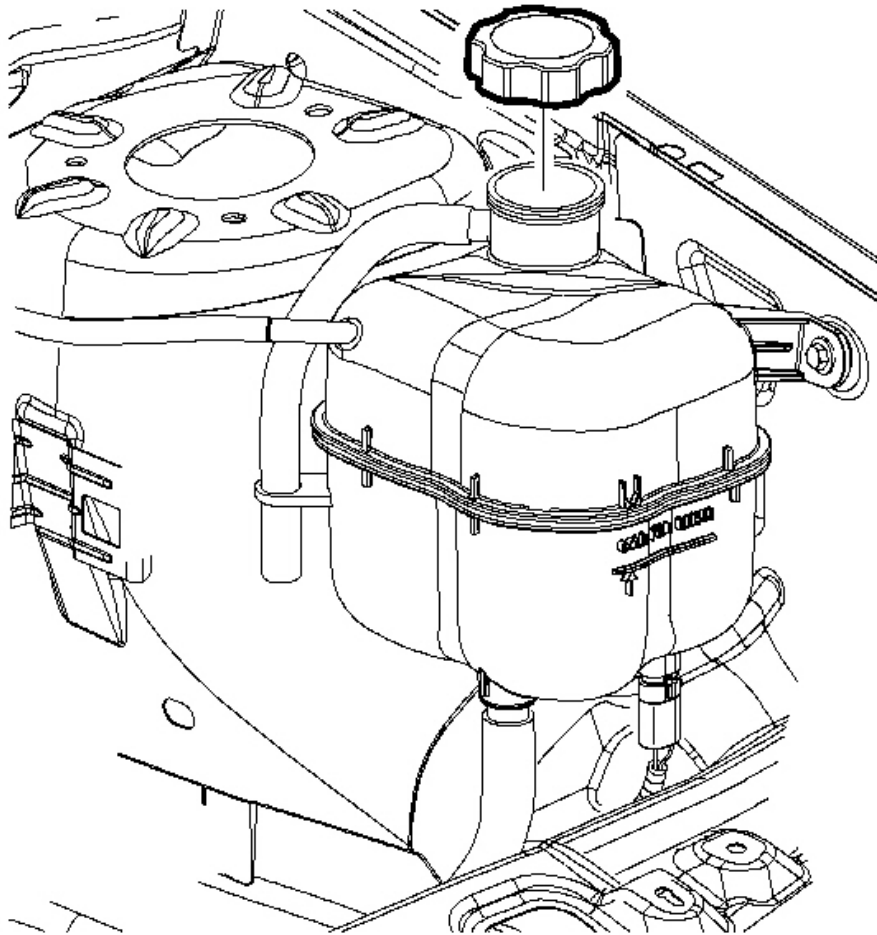


Fig. 98: View Of Surge Tank Cap
Courtesy of GENERAL MOTORS CORP.

14. Fill the engine coolant. Refer to **Draining and Filling Cooling System** .
15. Verify the repair and inspect for any leaks.

THERMOSTAT REPLACEMENT (L66)

Removal Procedure

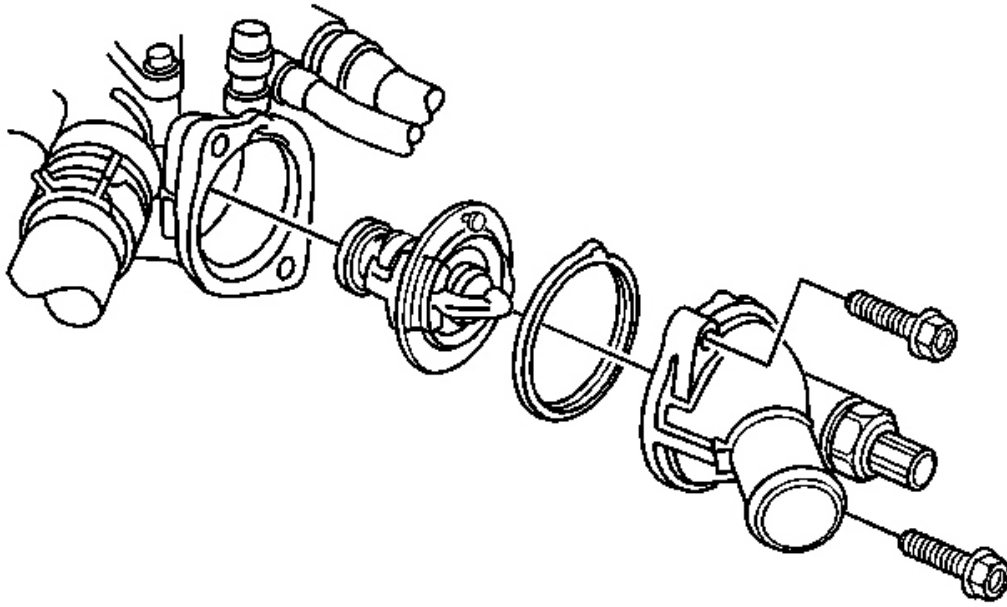


Fig. 99: Exploded View Of Thermostat (L66)
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the battery. Refer to **Battery Replacement** in Engine Electrical.
3. Remove the thermostat housing.
4. Remove the thermostat.

Installation Procedure

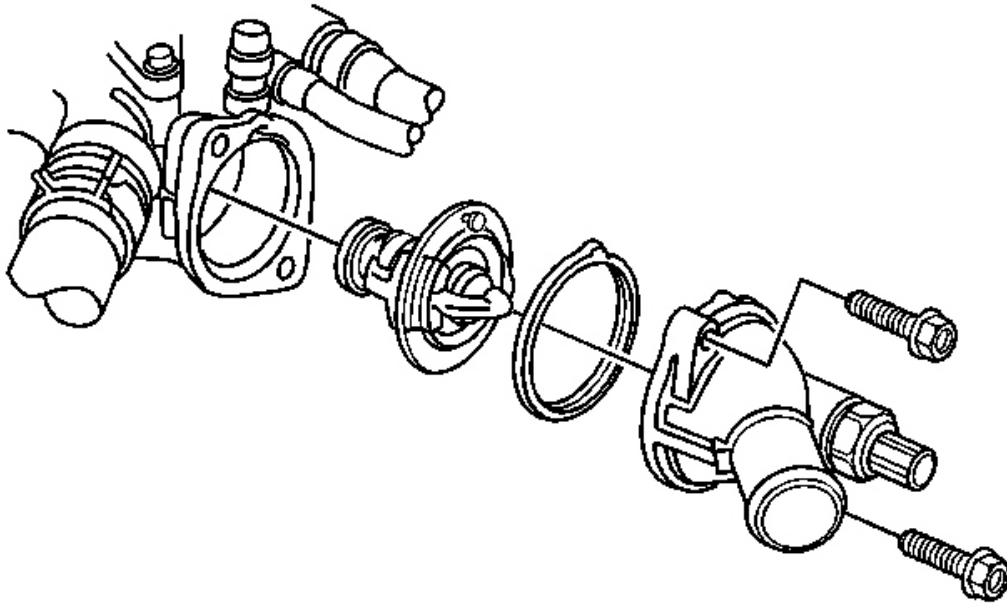


Fig. 100: View Of Thermostat With Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat with housing.
 1. Install a new gasket.
 2. Position the thermostat with the housing.
 3. Apply thread sealant PST 565(R) to the bolt threads.

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

4. Install the housing bolts.

Tighten: Tighten the thermostat housing bolts 12 N.m (106 lb in).

2. Install the battery. Refer to **Battery Replacement** in Engine Electrical.
3. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

COOLANT CROSSOVER PIPE REPLACEMENT

Removal Procedure

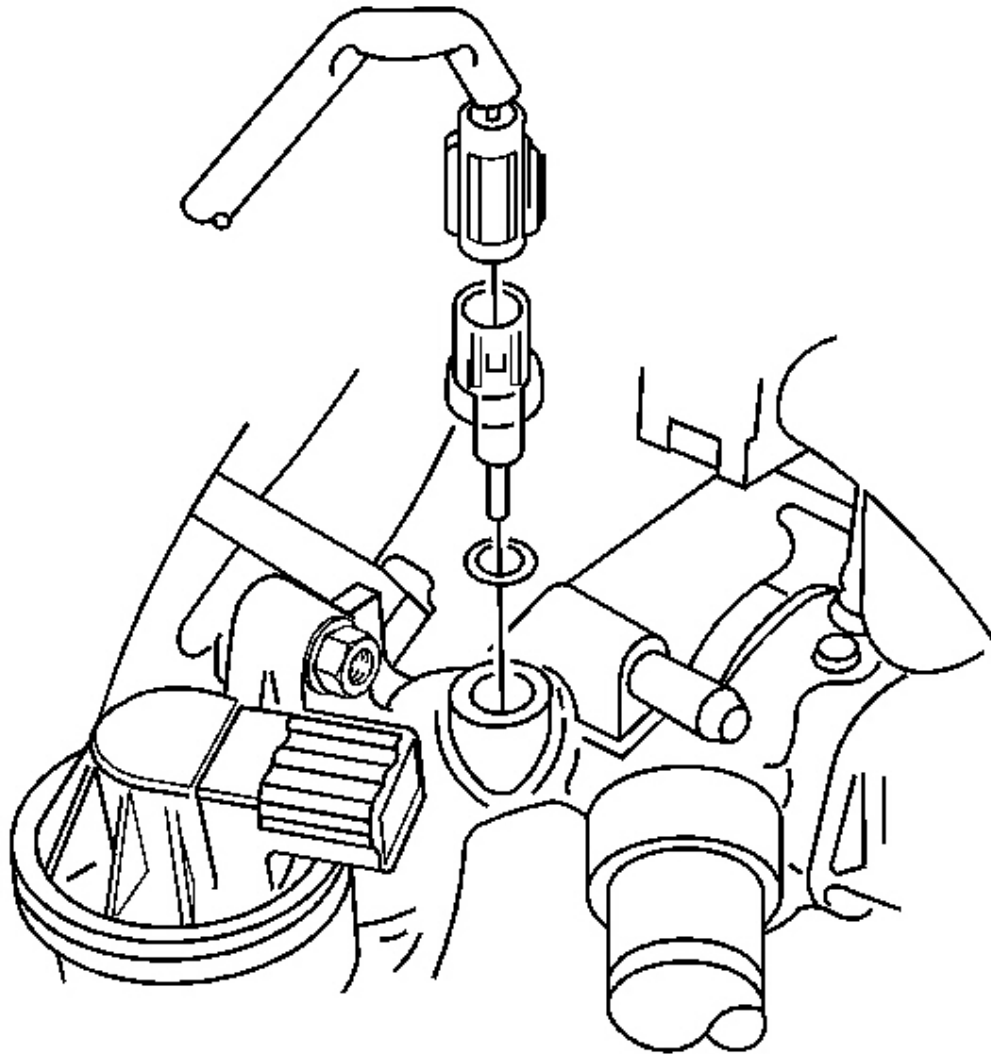


Fig. 101: View Of Crossover Pipe
Courtesy of **GENERAL MOTORS CORP.**

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.
2. Remove the battery. Refer to **Battery Replacement** in Engine Electrical.
3. Drain the engine coolant. Refer to **Draining and Filling Cooling System** .
4. Disconnect the engine coolant temperature (ECT) sensor electrical connector.
5. Remove the ECT sensor.

6. Remove the radiator inlet and outlet hoses from the crossover pipe.
7. Disconnect the wiring harness ground terminal from the crossover pipe.

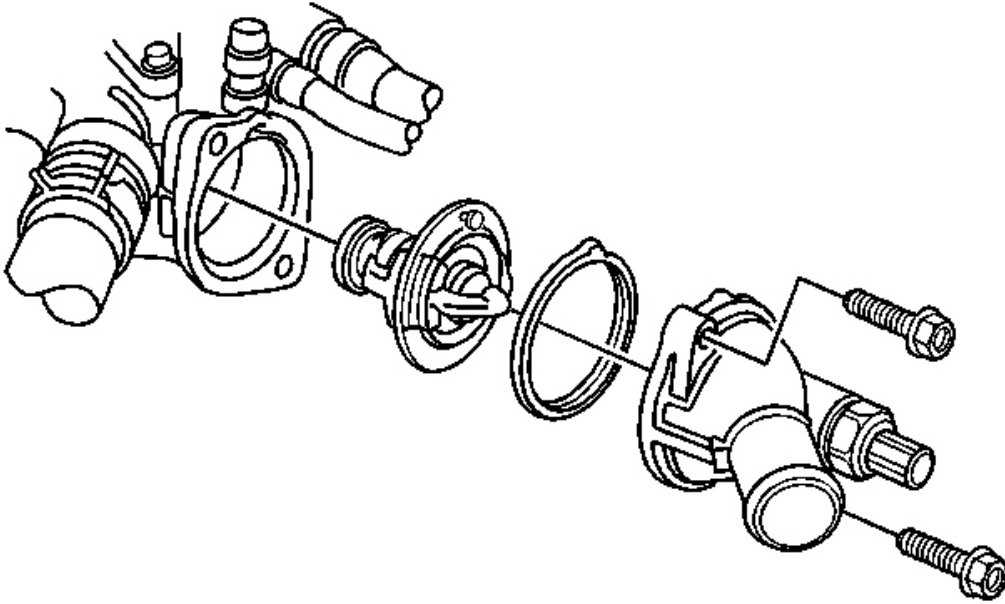


Fig. 102: View Of Thermostat With Housing
Courtesy of GENERAL MOTORS CORP.

8. Remove the thermostat housing and thermostat from the crossover pipe.

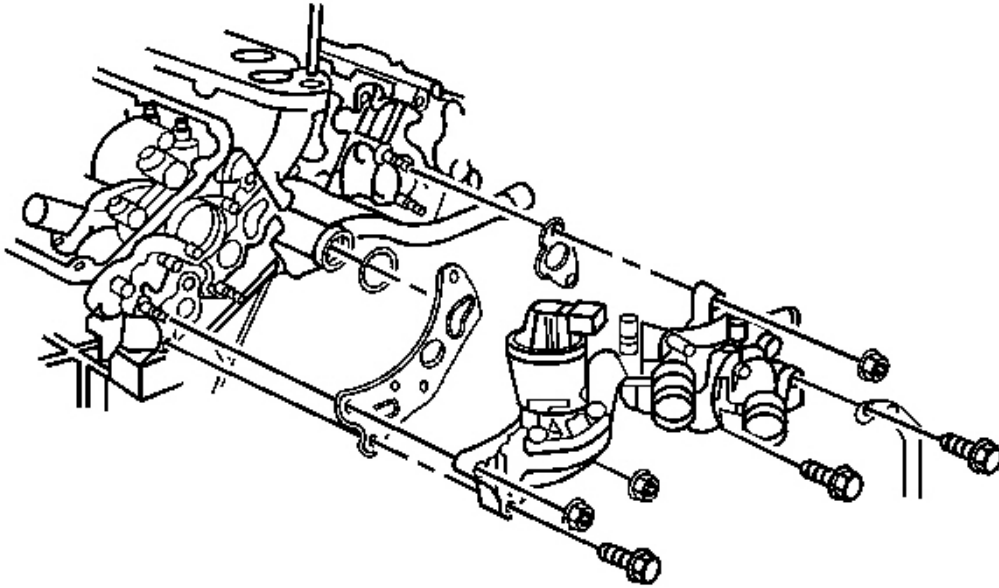


Fig. 103: View Of Crossover Pipe & Crossover Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the crossover pipe bolts and crossover pipe.

Installation Procedure

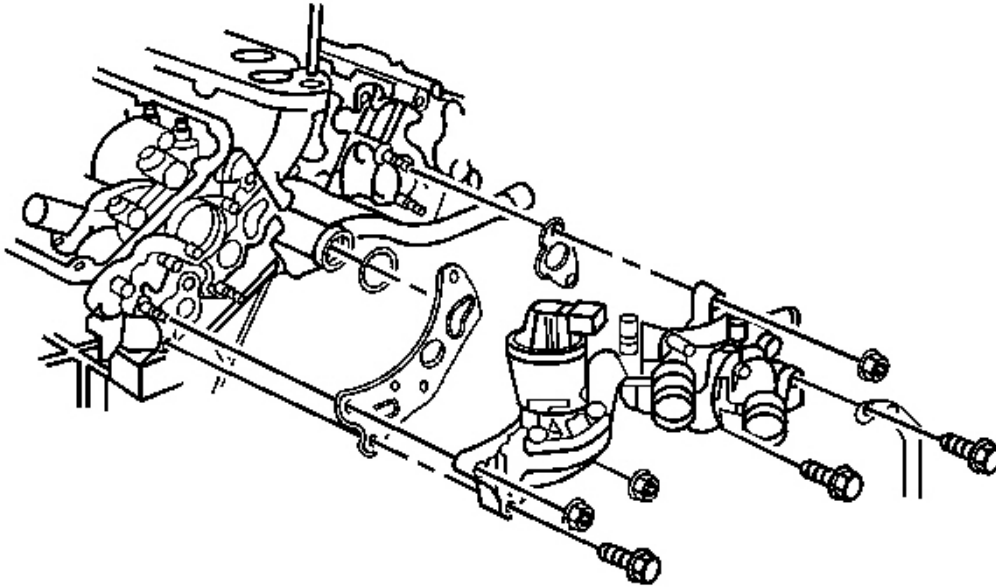


Fig. 104: View Of Crossover Pipe & Crossover Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

1. Clean and dry the area before installing new seals.
2. Install the crossover pipe.

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

3. Install the crossover pipe bolts.

Tighten: Tighten the crossover pipe bolts to 22 N.m (16 lb ft).

4. Install the thermostat and thermostat housing.

Tighten: Tighten the thermostat housing bolts to 12 N.m (106 lb in).

5. Connect the coolant hoses at the crossover pipe.
6. Connect the wiring harness ground terminal to the crossover pipe.

Tighten: Tighten the nut to 12 N.m (106 lb in).

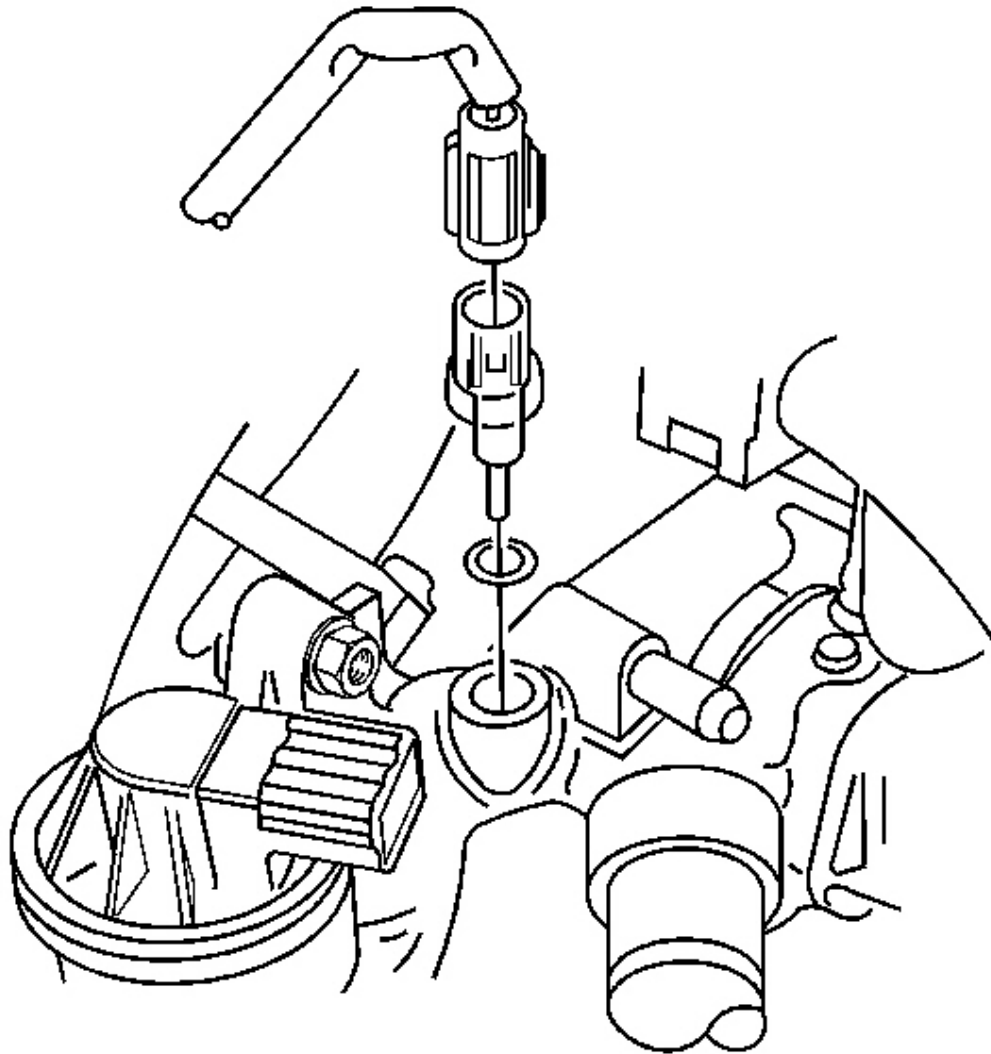


Fig. 105: View Of Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

7. Apply thread sealant (Saturn P/N 21485277) Loctite(tm) 242 threadlocker, or equivalent, to sensor threads.
8. Install the ECT sensor.

Tighten: Tighten the ECT sensor to 18 N.m (13 lb ft).

9. Connect the ECT sensor harness connector. Push in the connector until a click is heard, then pull back to confirm a positive engagement.
10. Install the battery. Refer to **Battery Replacement** in Engine Electrical.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.

Tighten: Tighten the battery terminal bolt to 17 N.m (13 lb ft).

12. Fill the coolant. Refer to **Draining and Filling Cooling System** .

WATER PUMP REPLACEMENT (L61)

Tools Required

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

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the thermostat housing pipe-to-cylinder bolt near the front of the engine.

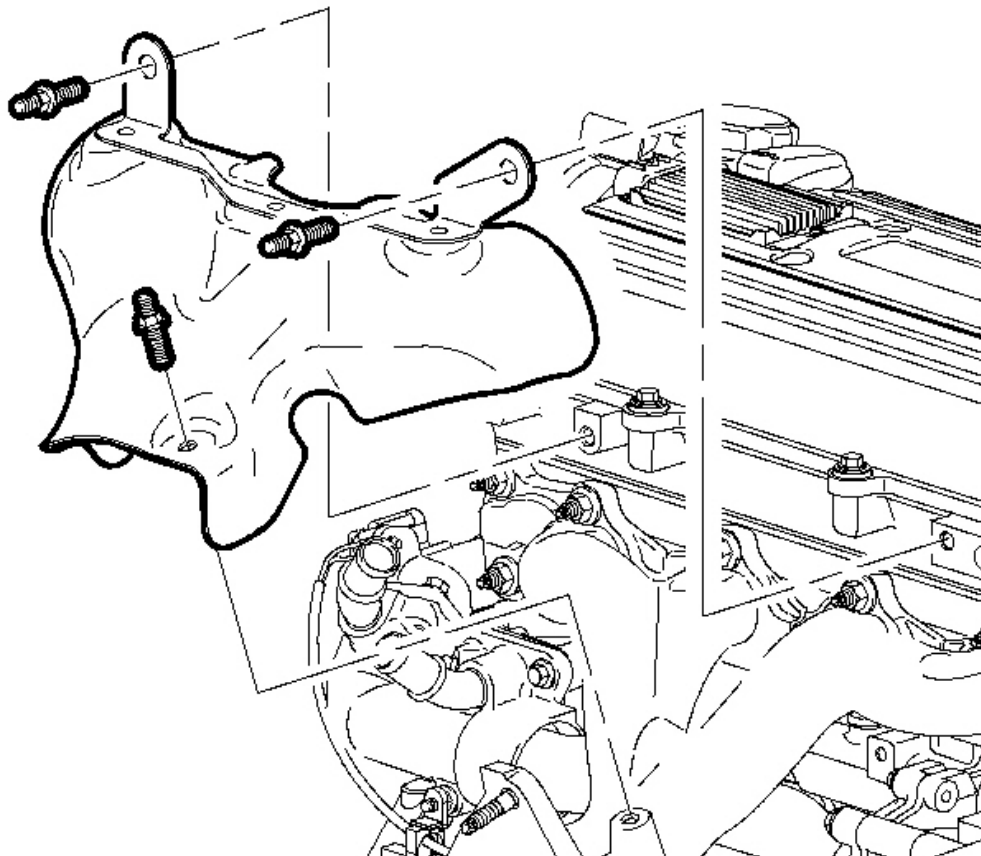


Fig. 106: View Of Exhaust Manifold Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the exhaust manifold heat shield and bolts.

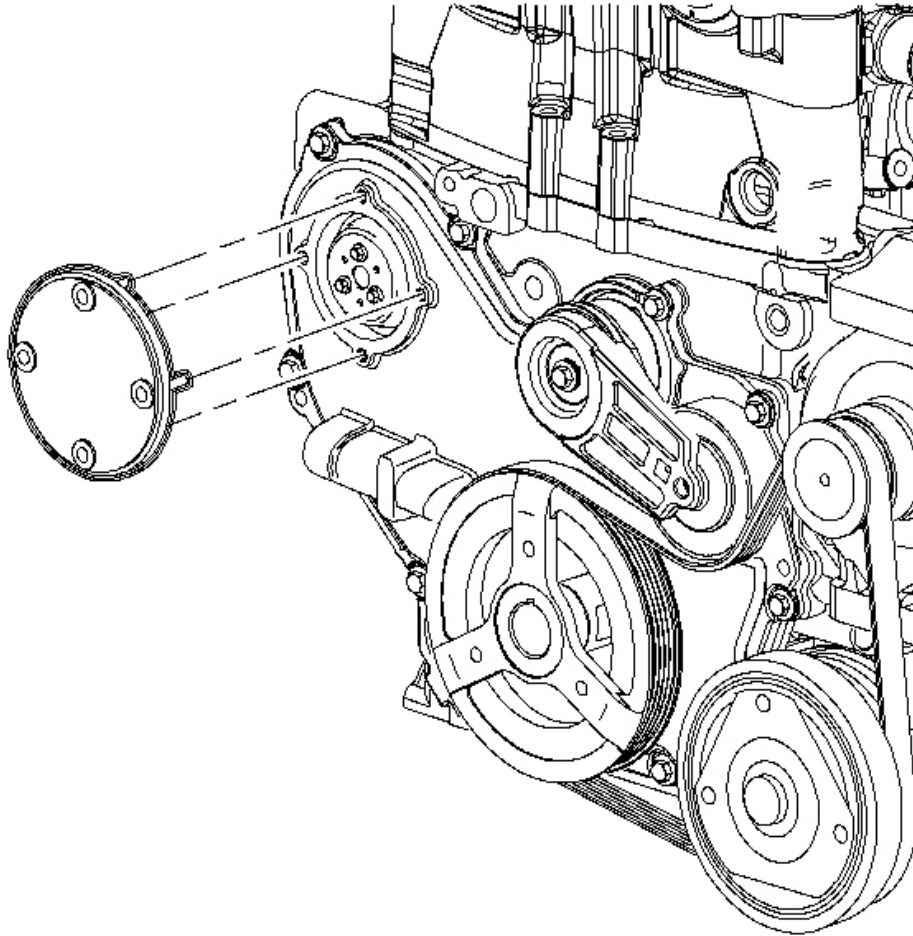


Fig. 107: View Of Water Pump Access Plate From The Front Cover
Courtesy of GENERAL MOTORS CORP.

4. Remove the water pump access plate from the front cover.
5. Remove the right hand wheel nuts and wheel assembly.
6. Remove the right hand inner push-pins and splash shield.

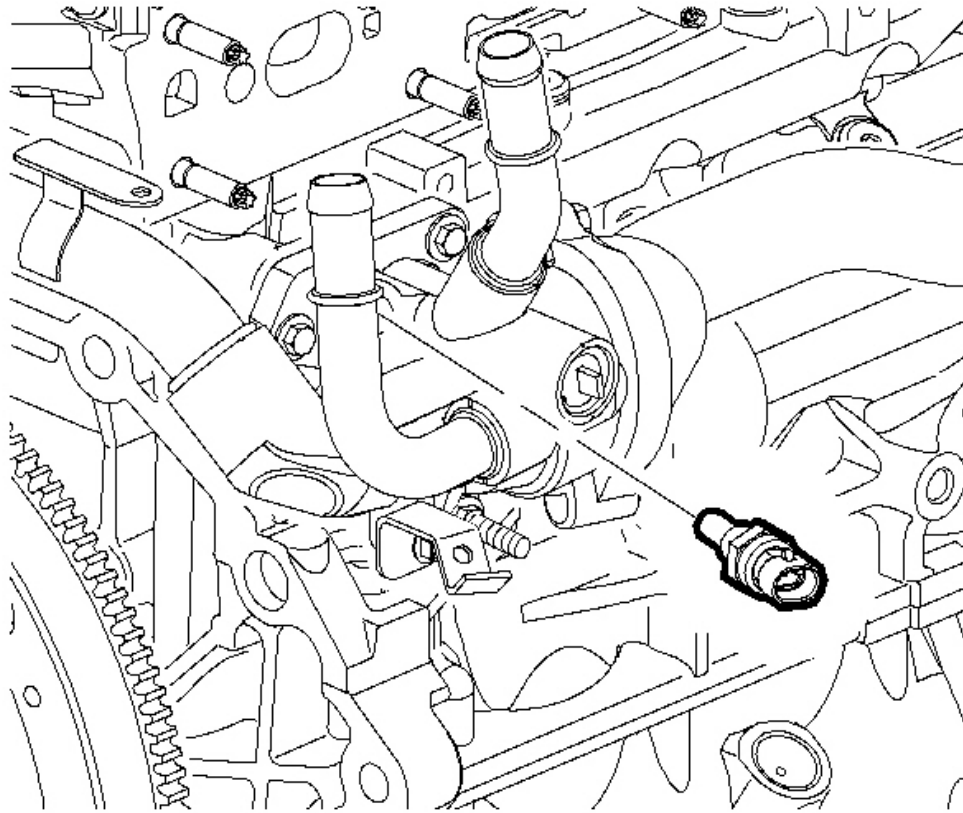


Fig. 108: View Of Electrical Connector To Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

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.

7. Drain the coolant from the plug at the bottom of the water pump.
8. Disconnect the engine coolant temperature sensor electrical connector.

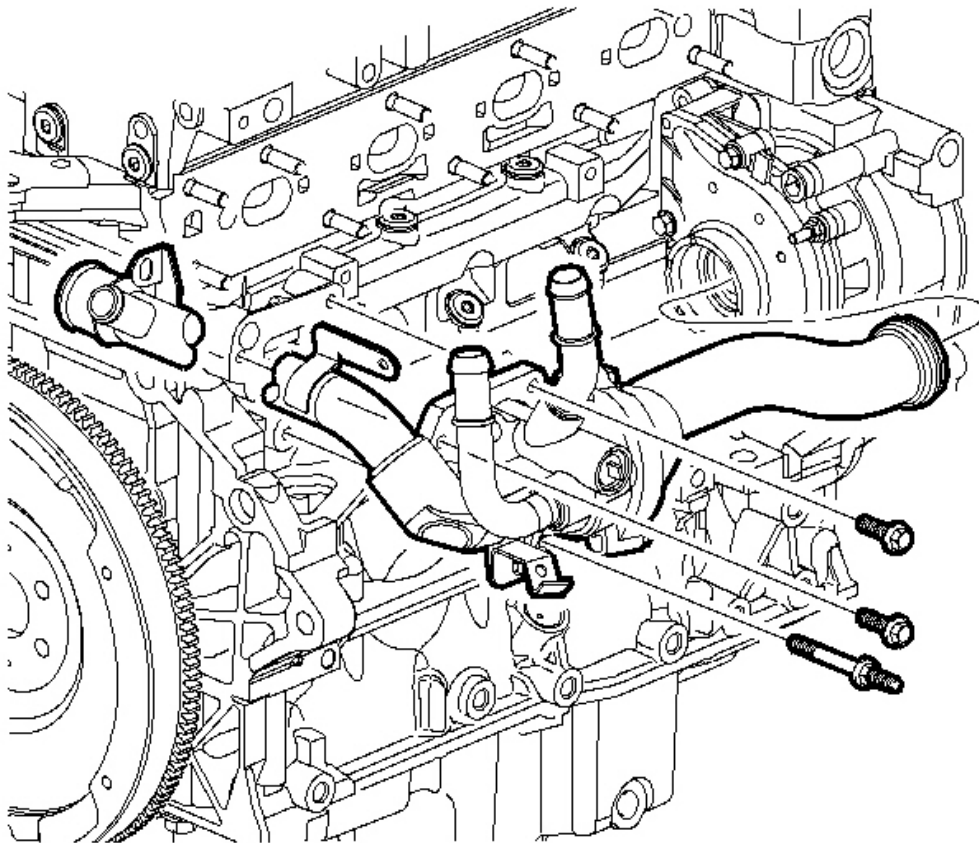


Fig. 109: View Of Thermostat Housing Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the thermostat housing bolts.
10. Move the thermostat housing toward the left hand side of the vehicle while twisting the water feed pipe from the rear of the water pump assembly. Leave the coolant hoses and thermostat housing cover connected.
11. Remove the water feed pipe.
12. Discard the water pipe seals.

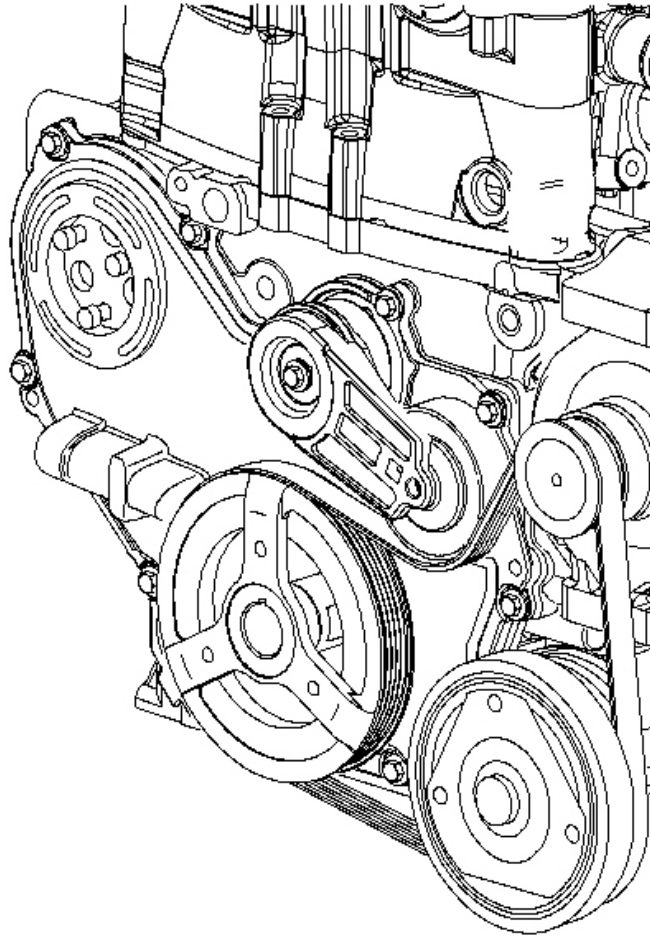


Fig. 110: Positioning J 43651
Courtesy of GENERAL MOTORS CORP.

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.

13. Install the **J 43651** into position. See **Special Tools and Equipment** .
14. Tighten the bolts on the water pump holding tool into the threads on the water pump sprocket.
15. Install the access cover bolts that were removed earlier to secure the water pump holding tool to the front cover assembly.
16. Remove the 3 inner water pump sprocket to water pump blots.

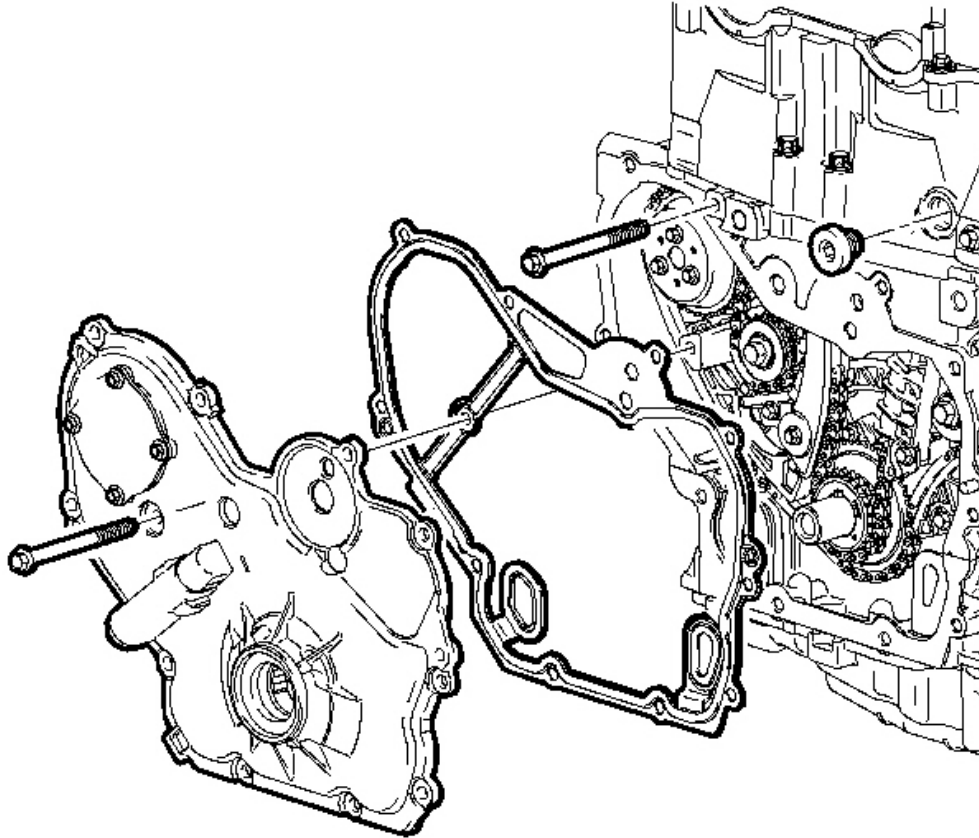


Fig. 111: View Of Both Water Pump Retaining Bolts From The Front Of The Engine Block
Courtesy of GENERAL MOTORS CORP.

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

17. Remove the 2 water pump assembly bolts.

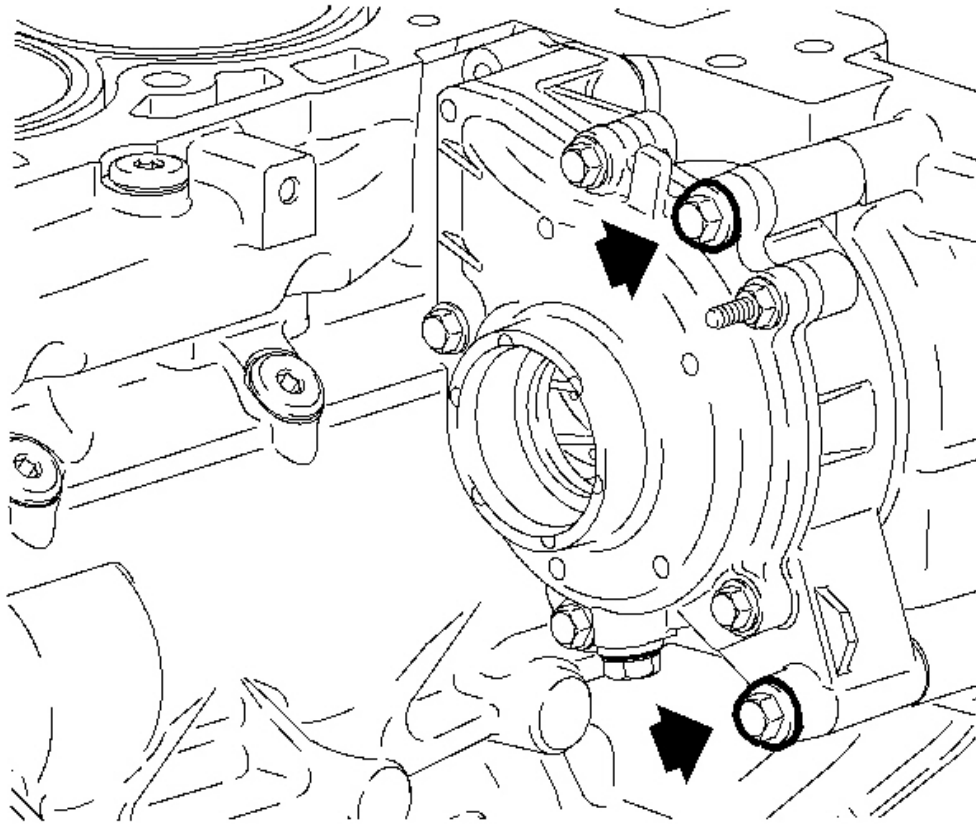


Fig. 112: View Of 2 Rear Water Pump Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

18. Remove the rear 2 water pump assembly bolts.
19. Remove the water pump assembly and water pump O-seal.

Installation Procedure

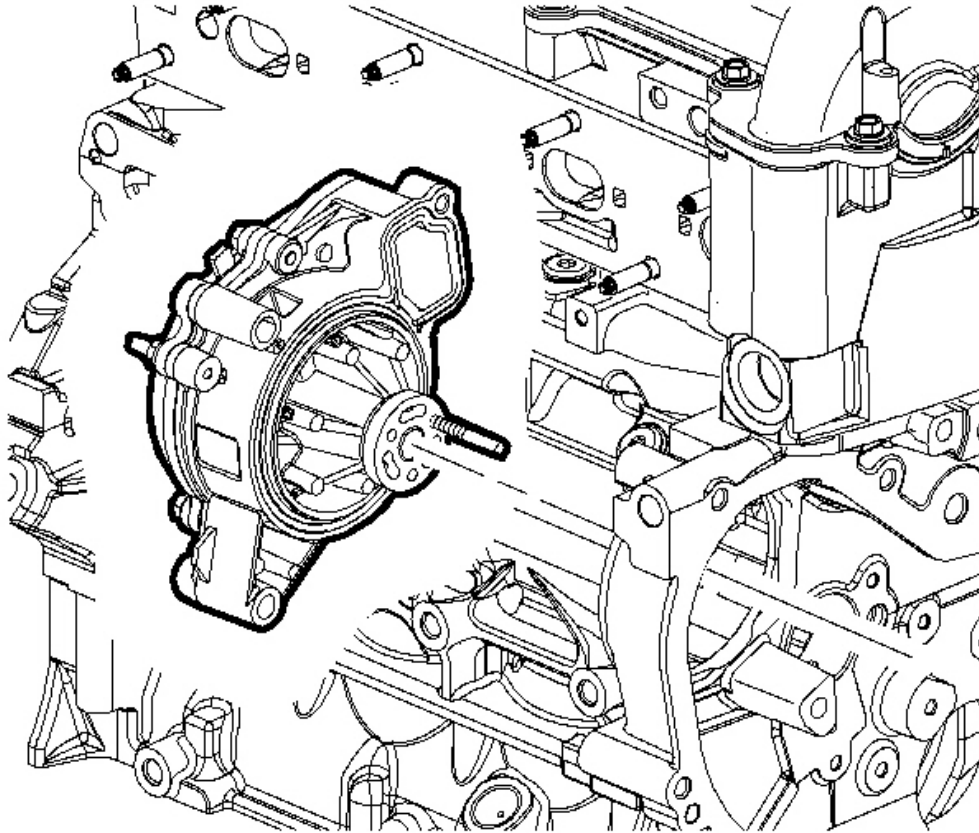


Fig. 113: View Of Water Pump Assembly
Courtesy of GENERAL MOTORS CORP.

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

1. Install a new water pump assembly seal.

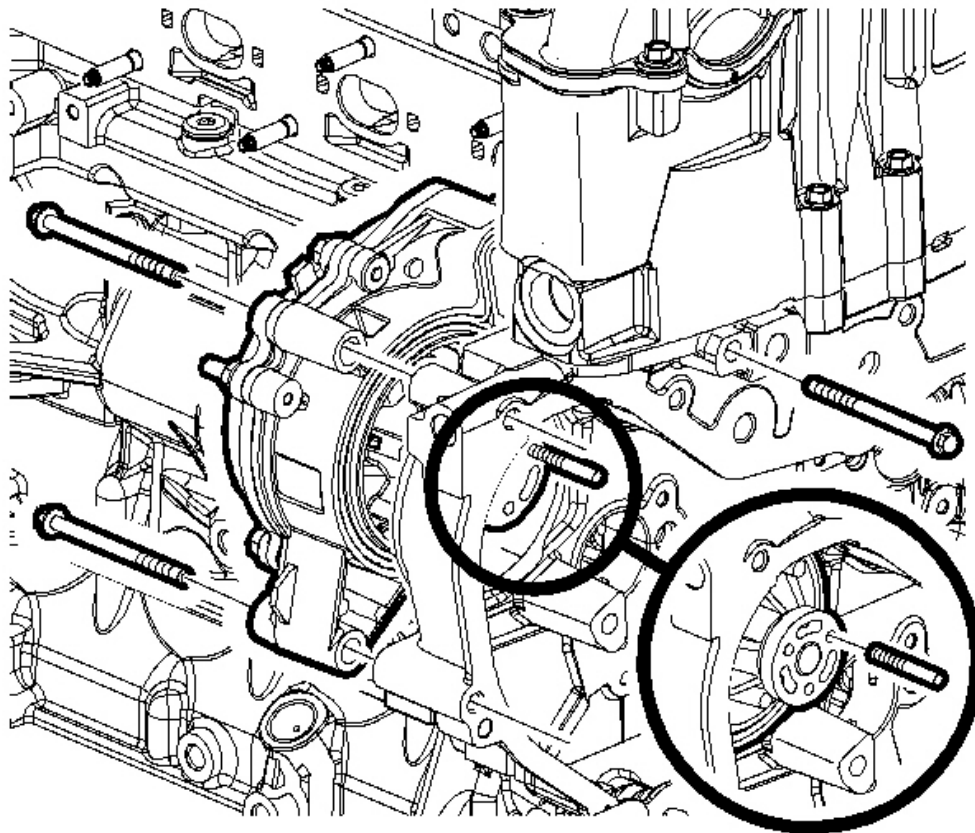


Fig. 114: View Of Water Pump Sprocket Bolts
Courtesy of GENERAL MOTORS CORP.

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

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

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

bolt.

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

5. Tighten the water pump bolts.

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

6. Remove the **J 43651** . See **Special Tools and Equipment** .
7. Install the water pump access plate and bolts.

Tighten: Tighten the water pump access bolts-to-front cover to 10 N.m (89 lb in).

IMPORTANT: The water feed pipe seals can be lightly lubricated with silicone gel to aid in assembly.

8. Install a new O-ring seal on the water feed pipe.

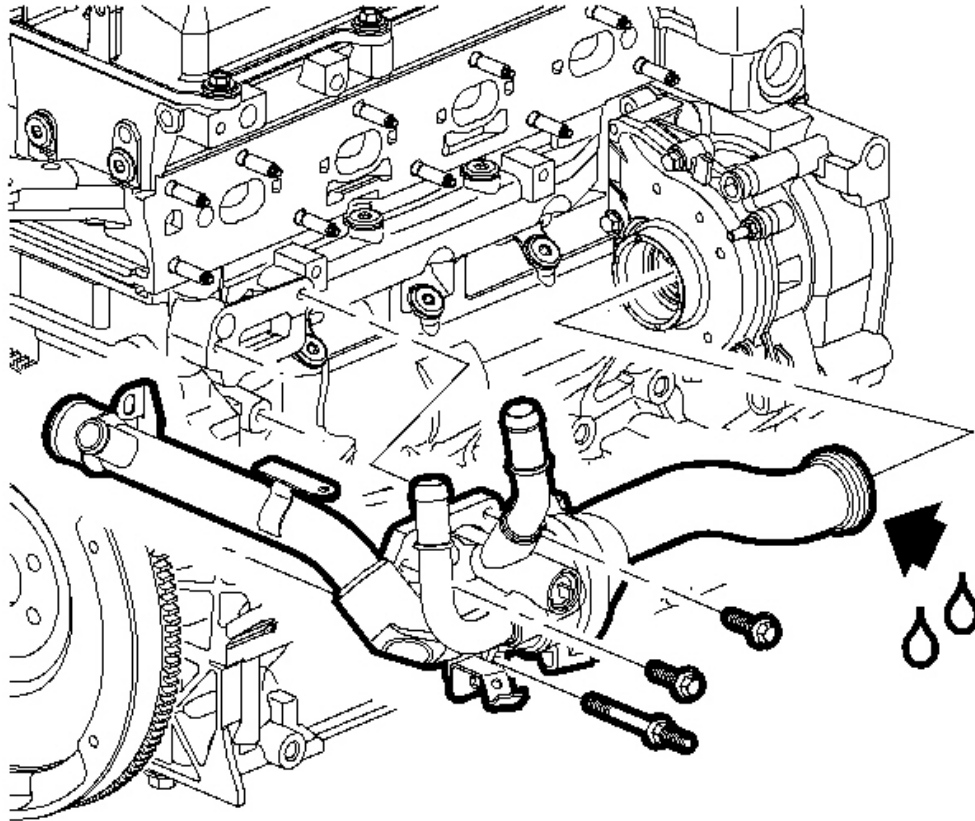


Fig. 115: View Of Thermostat Housing To Block Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the thermostat housing to block seal onto the thermostat housing, if damaged.
10. Install the water feed pipe into the water pump assembly.
11. Align the water feed pipe to the thermostat housing assembly.
12. Seat the water feed O-ring seal by pushing and twisting toward the water pump. Take care not to tear or damage the O-ring.
13. The water feed pipe has a locating tab to assure proper alignment.
14. Position the thermostat housing against the engine. Be sure that the thermostat housing pipe is properly positioned against the support bracket near the front of the engine.
15. Install the thermostat housing to block bolts.

Tighten: Tighten the thermostat housing-to-block bolts to 10 N.m (89 lb in).

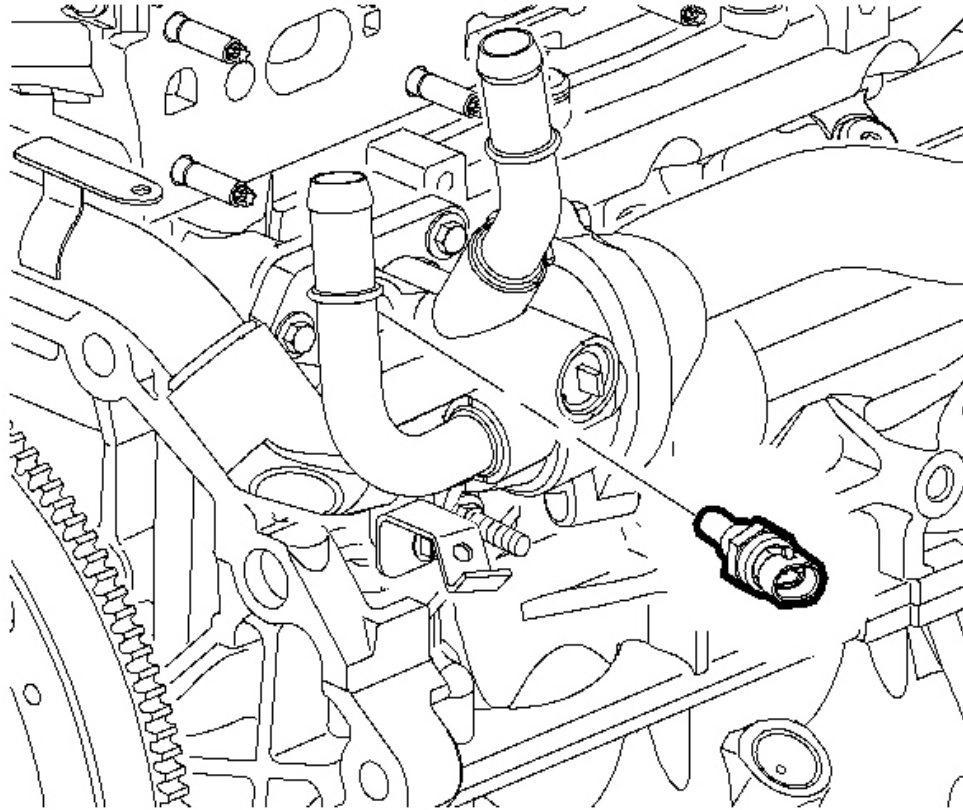


Fig. 116: View Of Electrical Connector To Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

16. Connect the electrical connector to coolant temperature sensor.
17. Install the right hand inner splash shield and push pins.
18. Install the right hand tire assembly and wheel nuts.

Tighten: Tighten the wheel nuts to 125 N.m (92 lb ft).

19. Lower the vehicle.

20. Install the thermostat pipe bracket to cylinder head bolt.

Tighten: Tighten the thermostat pipe bracket-to-cylinder head bolt to 8 N.m (71 lb in).

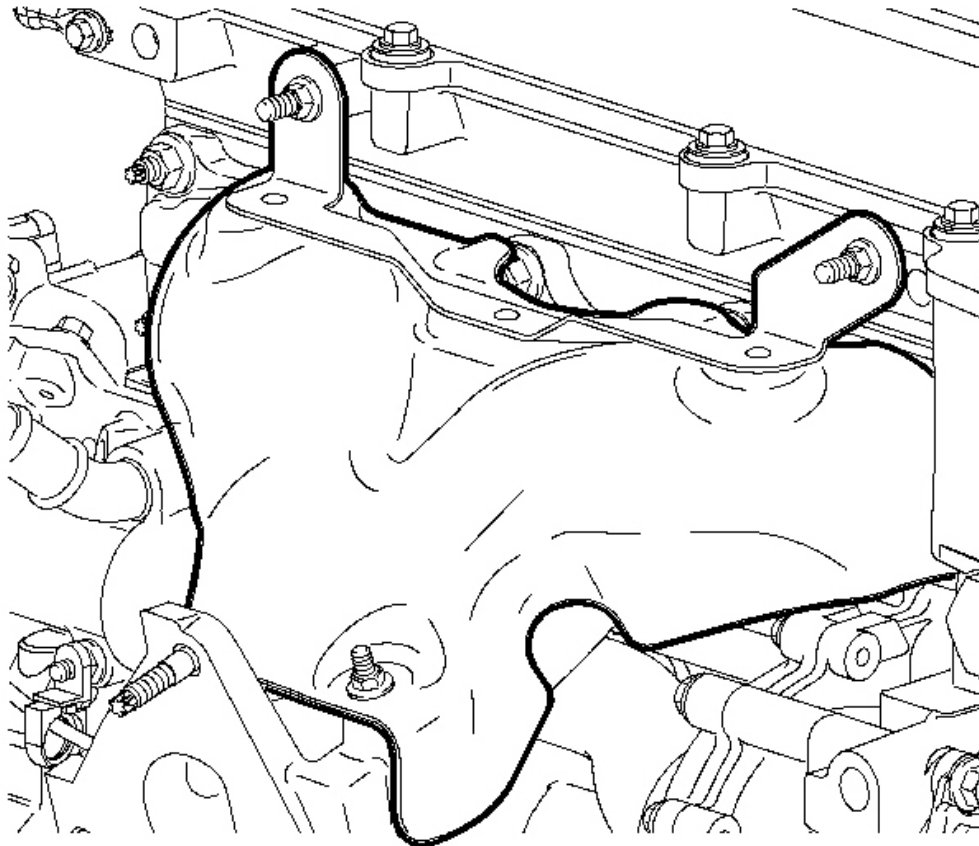


Fig. 117: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

21. Install the exhaust manifold heat shield.

22. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 23 N.m (17 lb ft).

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

23. Verify the drain valves at the radiator and water pump are closed.
24. Fill the engine coolant. Refer to **Draining and Filling Cooling System** .
25. Verify the repair and inspect for any leaks.

WATER PUMP REPLACEMENT (L66)

Removal Procedure

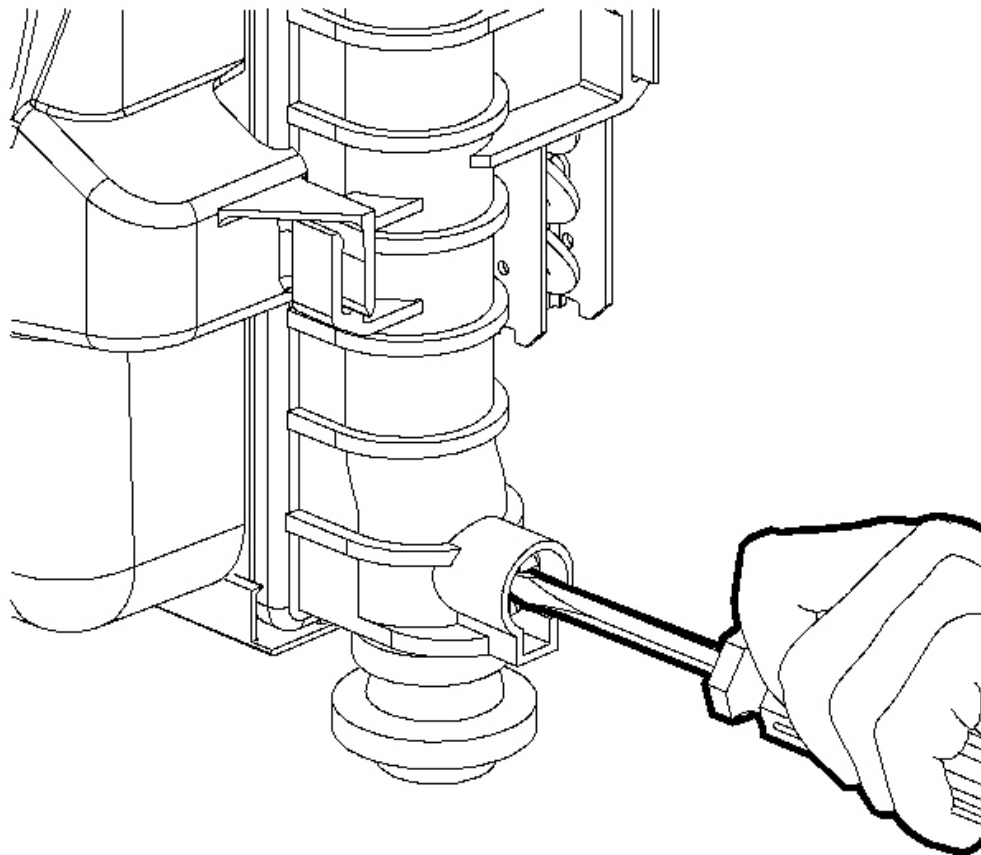


Fig. 118: View Of Water Pump (L66)
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System** .
2. Remove the timing belt cover. Refer to **Timing Belt Cover Replacement** in Engine Mechanical - 3.5L.

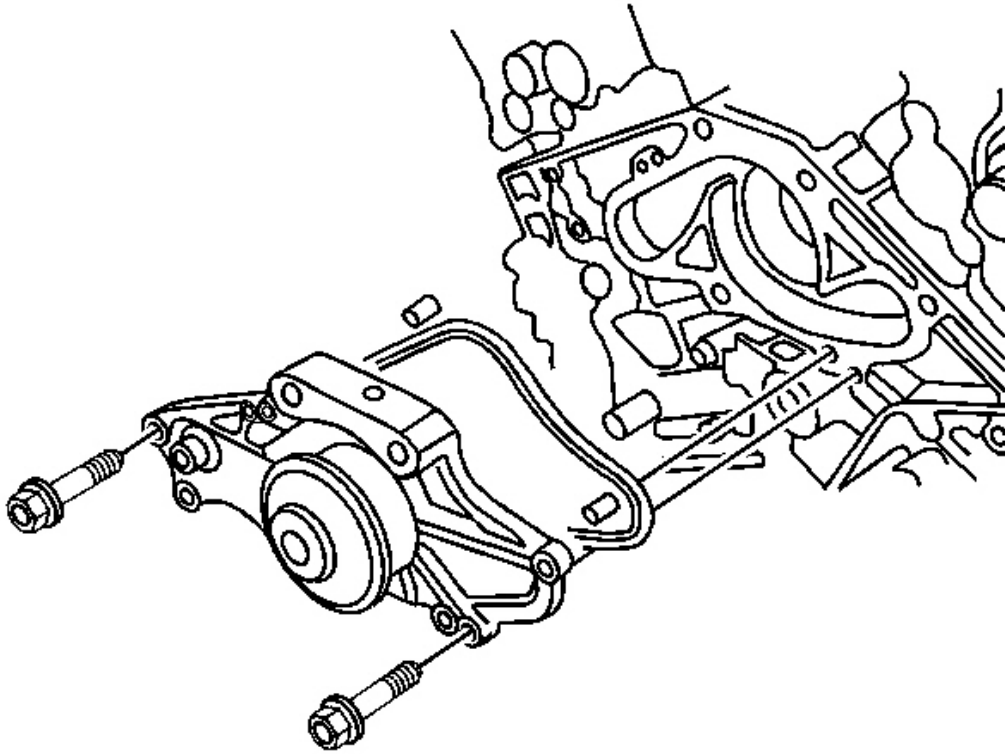


Fig. 119: View Of Water Pump Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- When a vehicle is diagnosed to have coolant leaking inside the timing belt cover, a visual inspection of the timing belt should be completed. If there is any indication that coolant has leaked onto the timing belt (i.e. wetness, staining, etc.), the timing belt should be replaced.
- When replacing the water pump, coolant will be spilled onto the timing belt. Replacement of the timing belt due to coolant spillage on the belt is not necessary.

3. Remove the water pump assembly bolts.
4. Remove the water pump and O-ring.

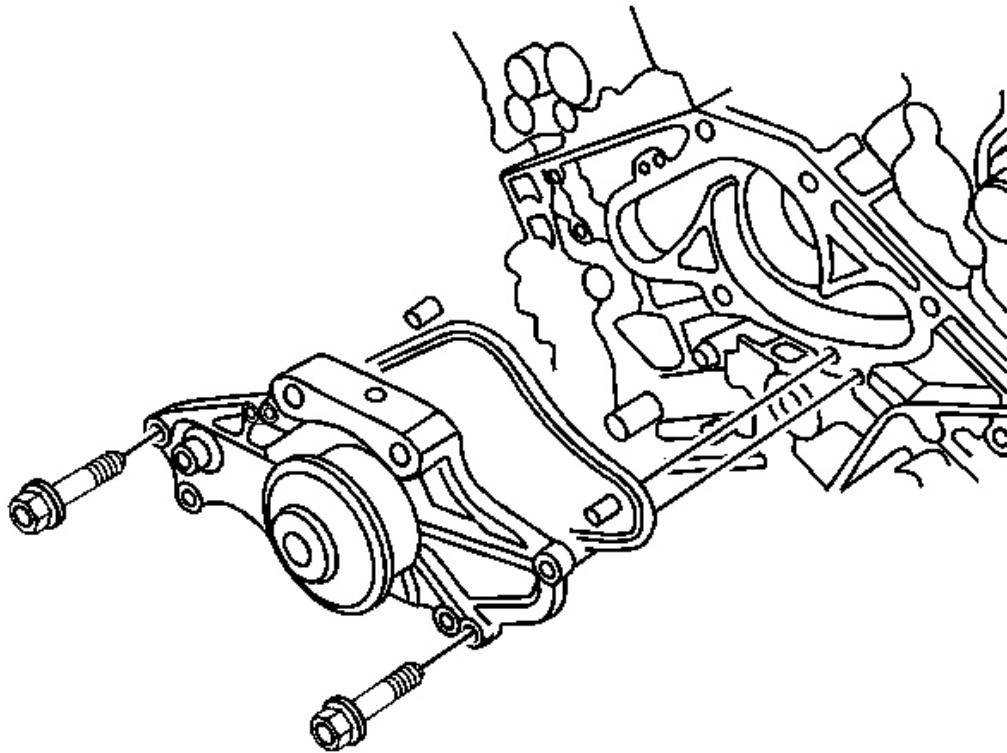


Fig. 120: View Of Water Pump Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

1. Clean and block at the water pump mating surface.
2. Install a new water pump O-seal to the water pump.
3. Install the water pump assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the water pump bolts.

Tighten: Tighten the water pump bolts to 12 N.m (18 lb in).

5. Install the timing belt cover. Refer to Timing Belt Cover Replacement in Engine Mechanical - 3.5L.
6. Fill the coolant system. Refer to Draining and Filling Cooling System .

DRAIN COCK REPLACEMENT

Removal Procedure

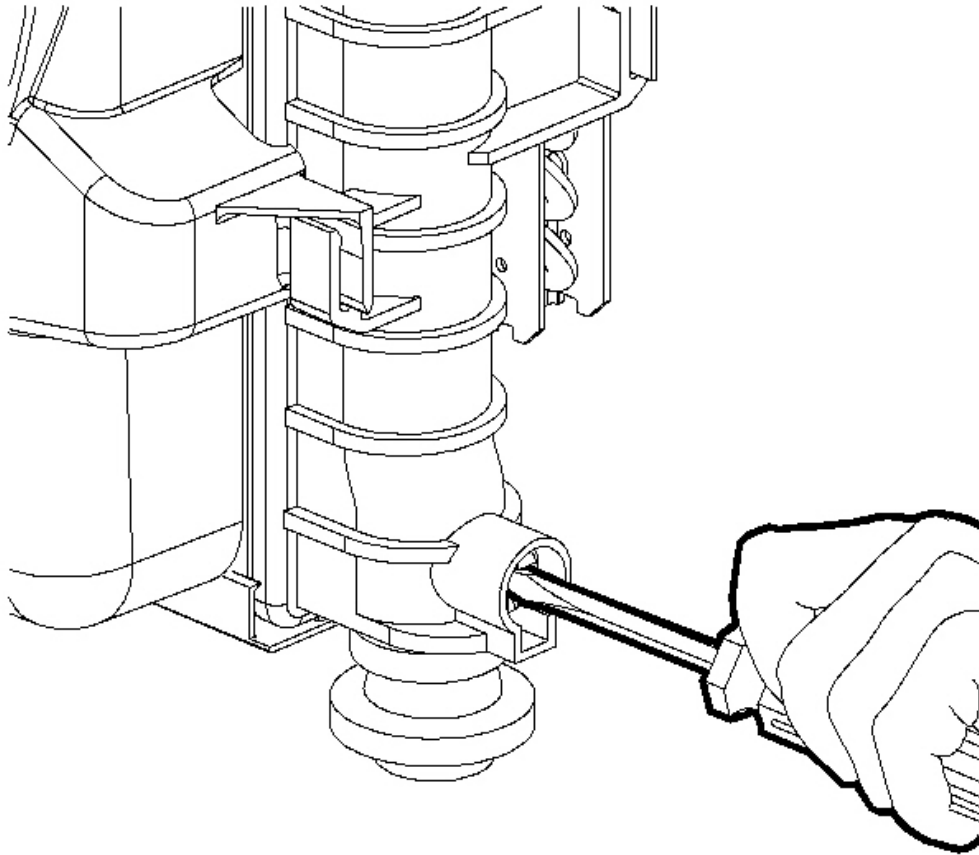


Fig. 121: View Of Drain Valve
Courtesy of GENERAL MOTORS CORP.

1. Drain the radiator. Refer to **Draining and Filling Cooling System** .
2. Unscrew the drain plug from the radiator end tank. Then using a flat-bladed tool, gently pry the plug from the end tank.

Installation Procedure

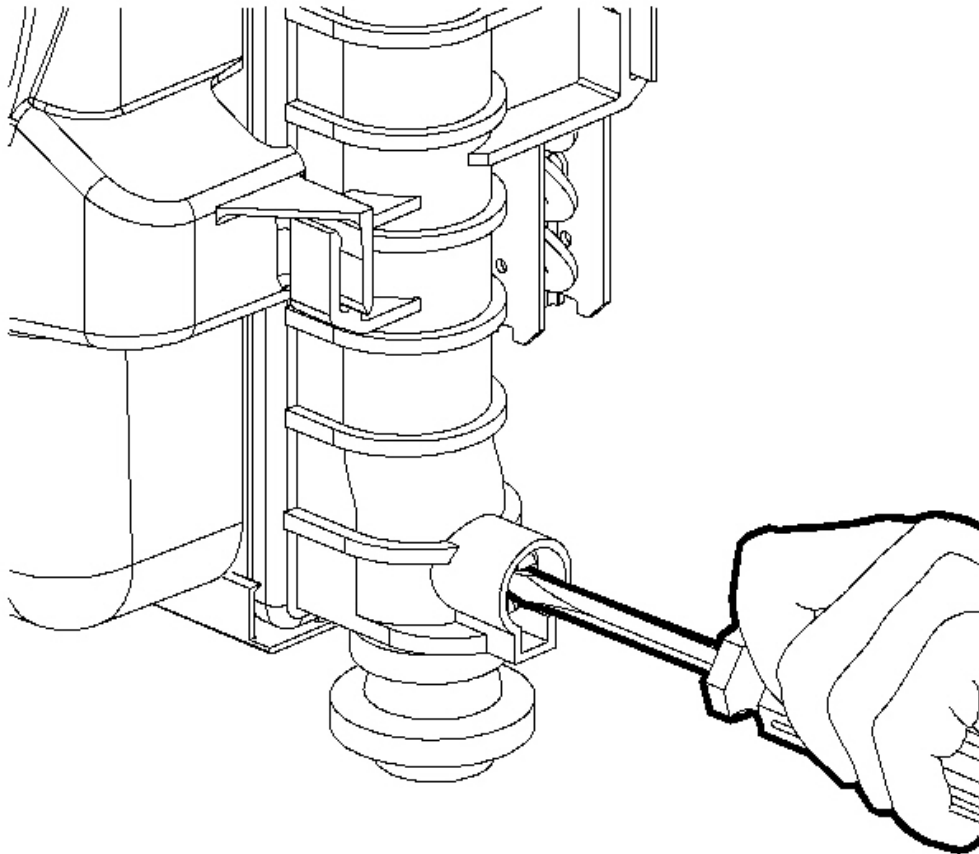


Fig. 122: View Of Drain Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the drain plug into the end tank drain hole by snapping into place. Tighten using a flat-bladed tool.
2. Fill the radiator. Refer to **Draining and Filling Cooling System** .

RADIATOR REPLACEMENT (L61)

Removal Procedure

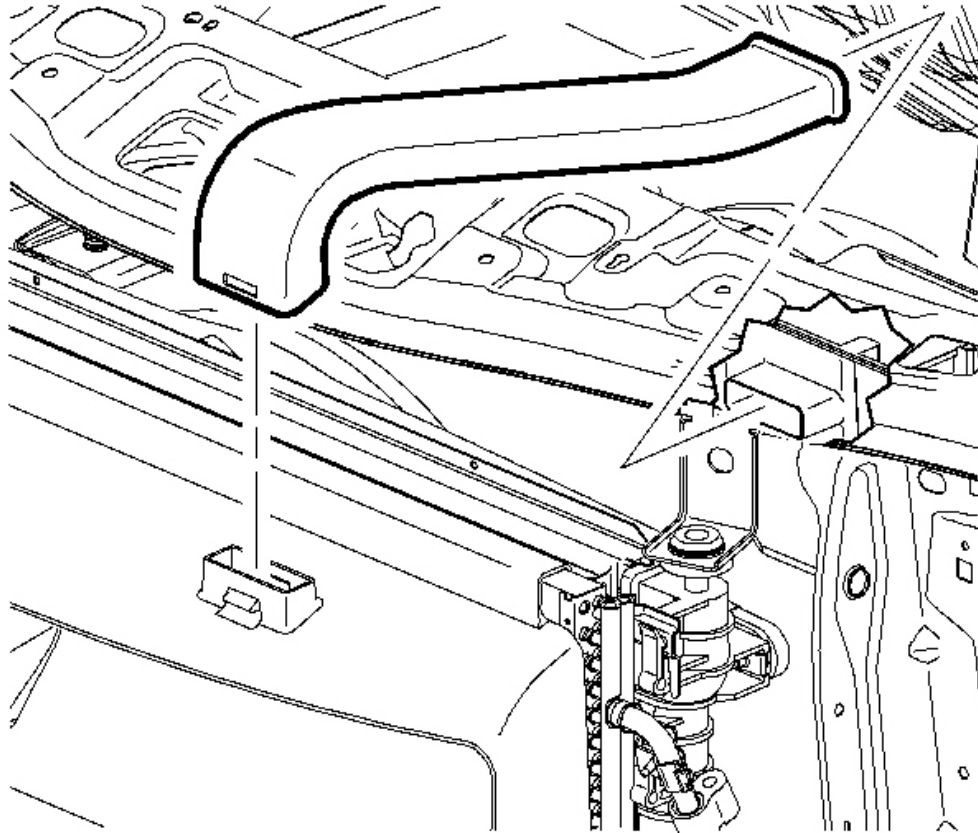


Fig. 123: View Of Radiator (L61)
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
2. Remove the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
3. Remove the battery box inlet air duct.

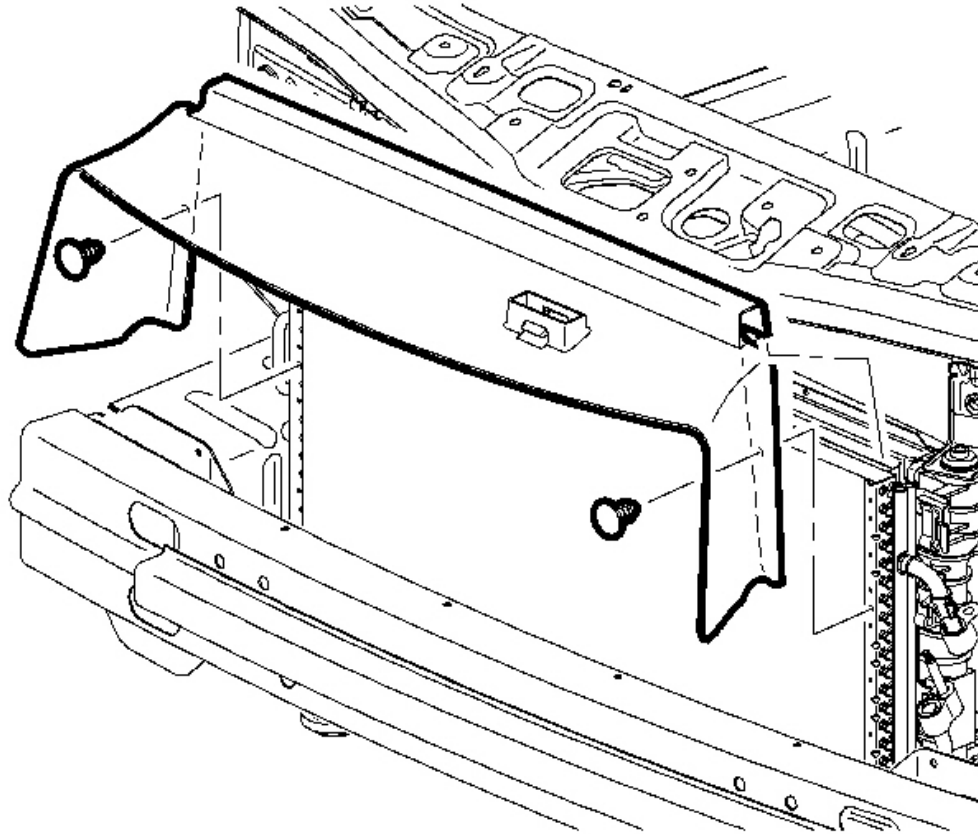


Fig. 124: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

4. Remove the condenser radiator fan module (CRFM) closeout panel retainers from the condenser.
5. Remove the CRFM closeout panel from the condenser.

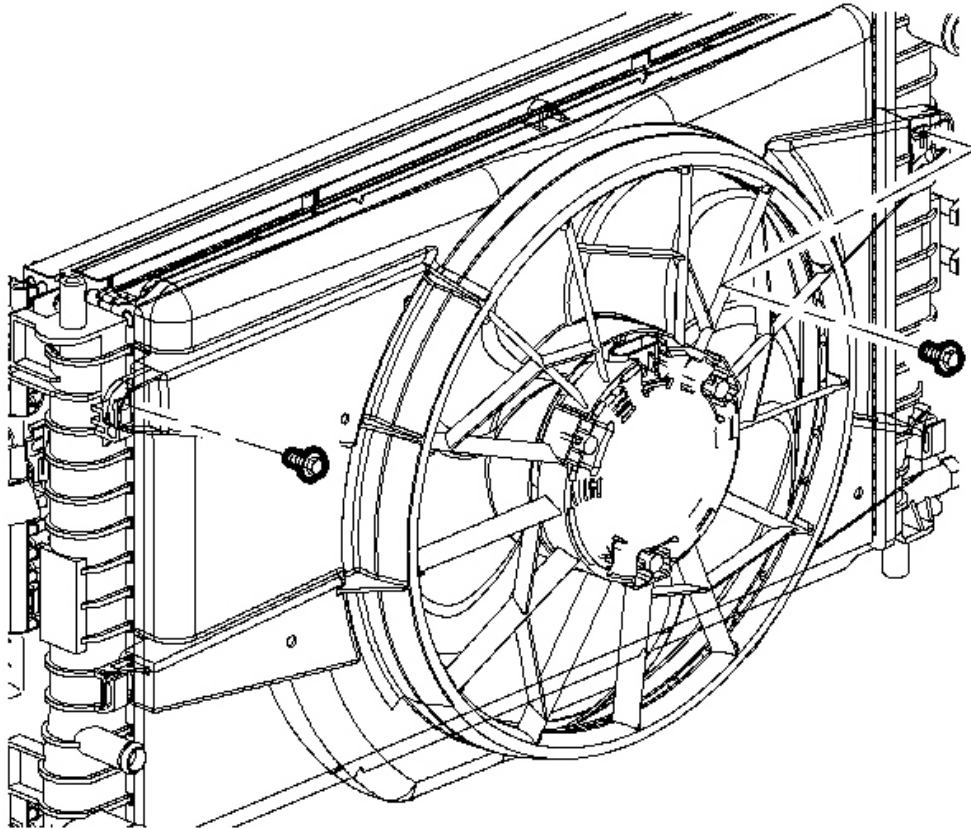


Fig. 125: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

6. Remove the fan assembly bolts from the radiator.
7. Lift the fan assembly to disengage the lower retention tabs.
8. Position the fan assembly away from the radiator.

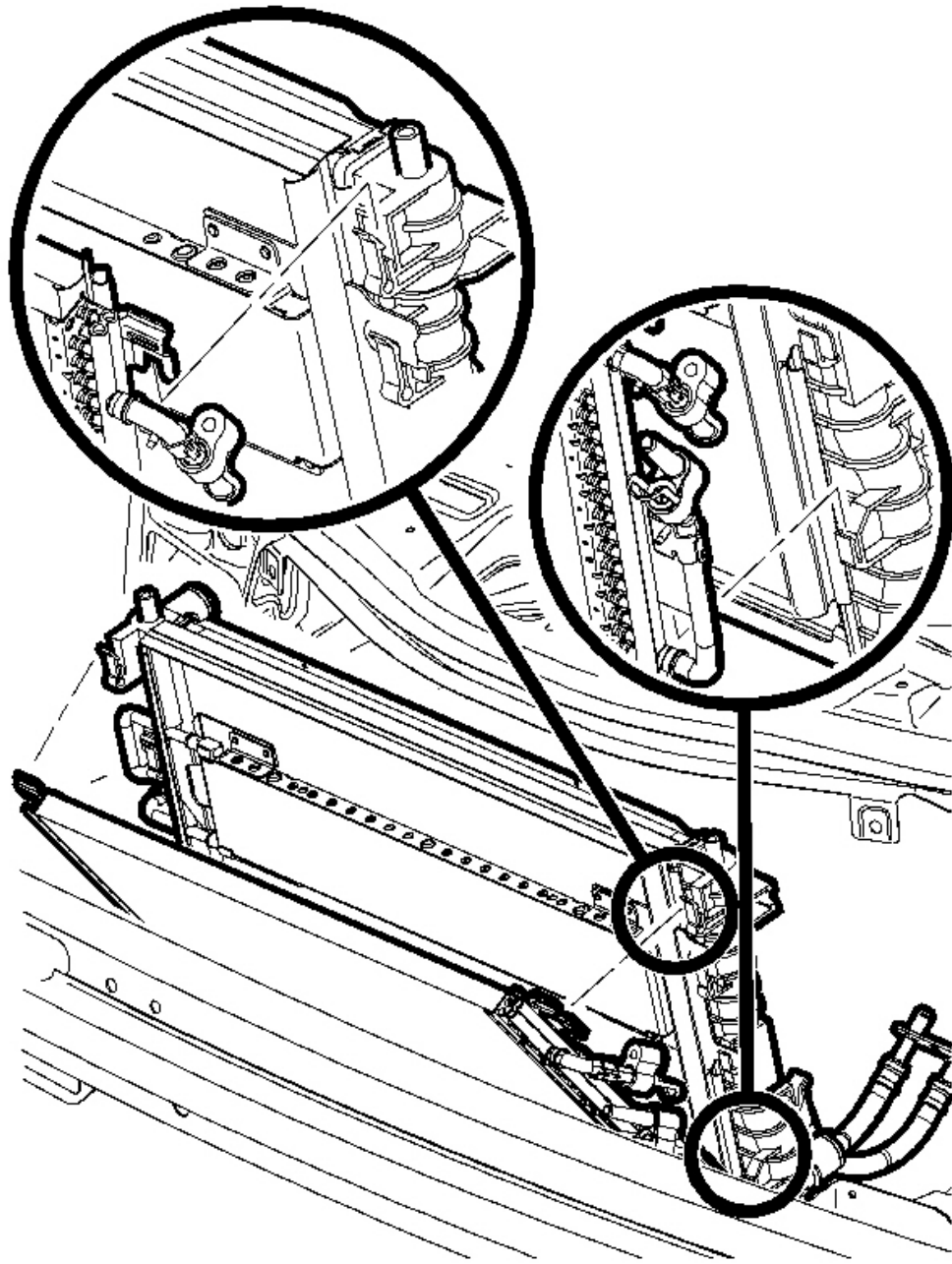


Fig. 126: View Of Condenser To The Radiator
Courtesy of GENERAL MOTORS CORP.

9. Lift the condenser while holding the upper retention tabs forward.
10. Position the condenser away from the radiator.

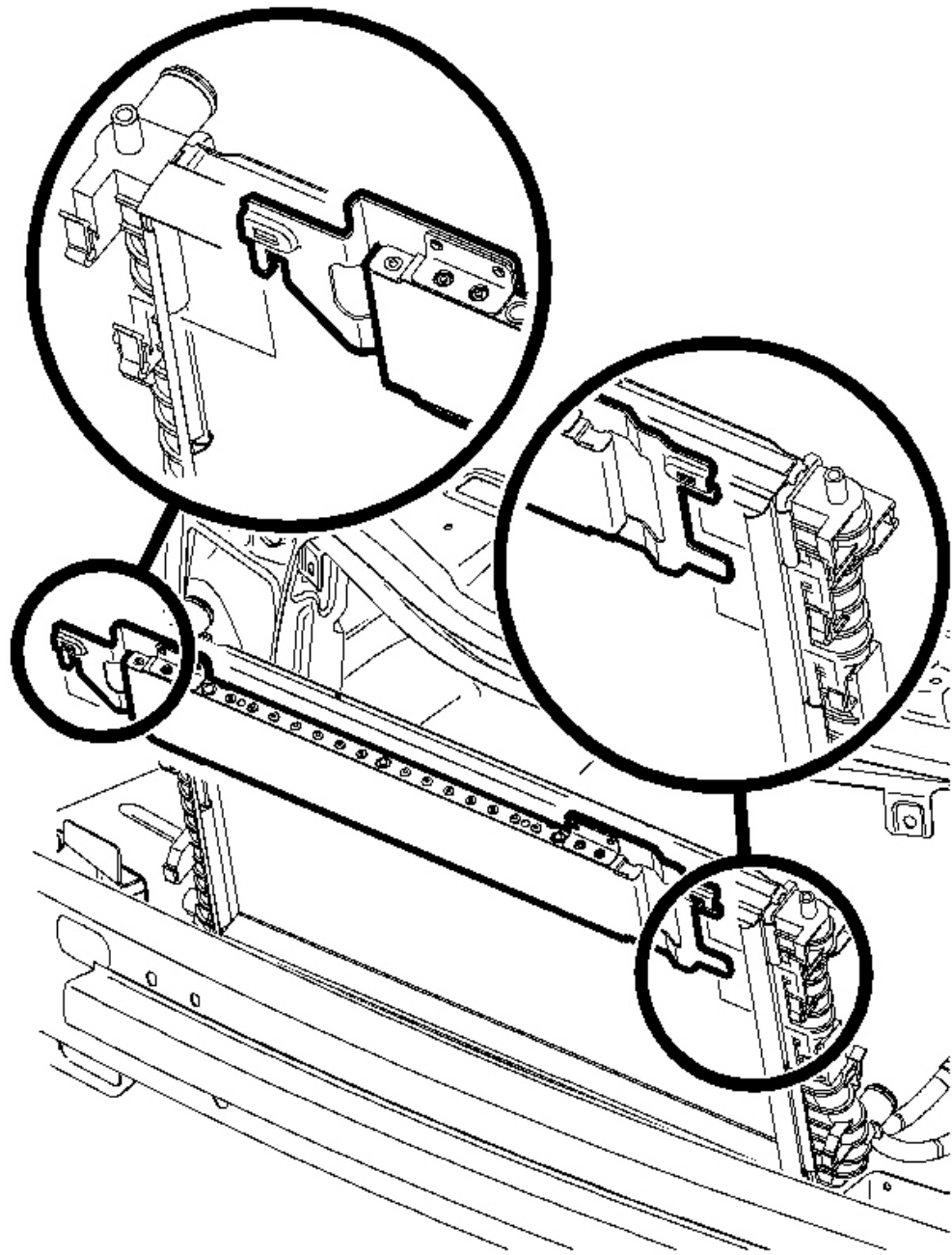


Fig. 127: View Of Transmission Cooler Liners To The Vehicle
Courtesy of GENERAL MOTORS CORP.

11. Disconnect the transmission cooler liners from the transmission cooler, if equipped.
12. Remove the transmission cooler bolt from the radiator, if equipped.
13. Lift the transmission cooler while holding the upper retention tabs forward, if equipped.
14. Remove the transmission cooler from the vehicle.

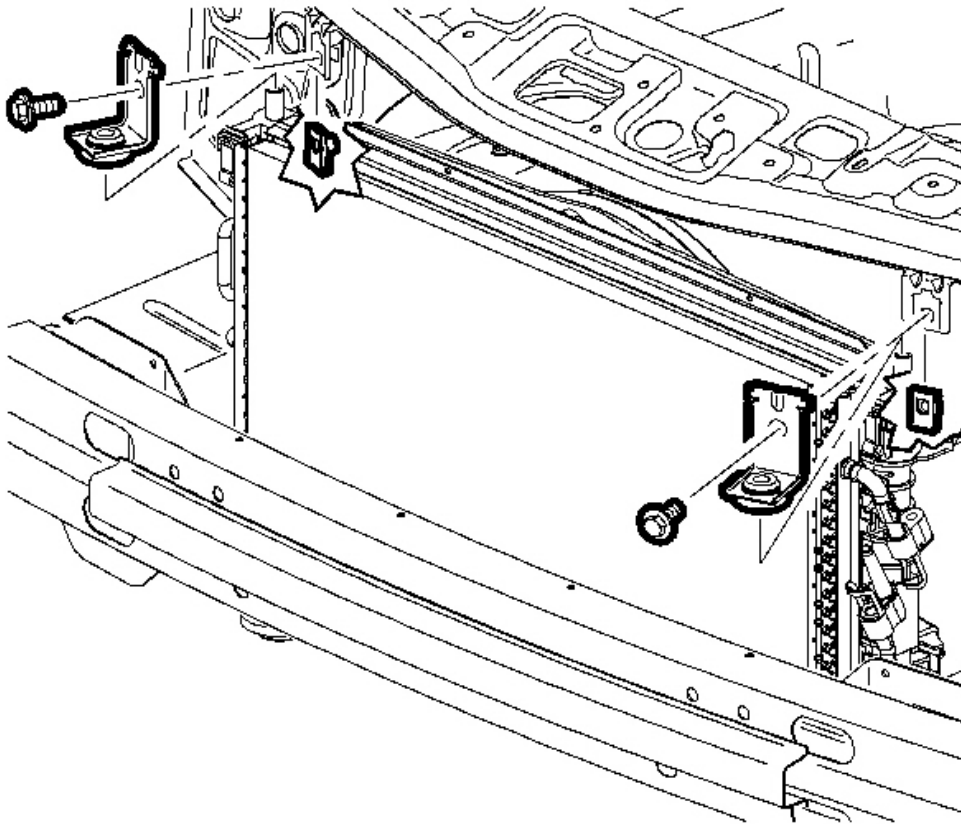


Fig. 128: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

15. Remove the CRFM bracket bolts from the radiator support.

16. Remove the CRFM brackets from the radiator.

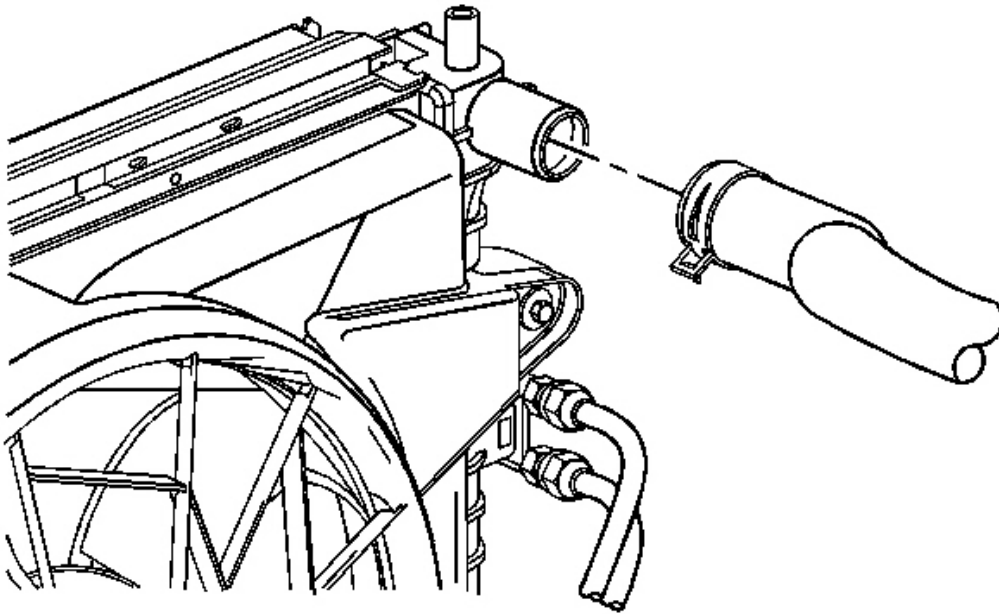


Fig. 129: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

17. Remove the radiator inlet hose clamp from the radiator.
18. Remove the radiator inlet hose from the radiator.

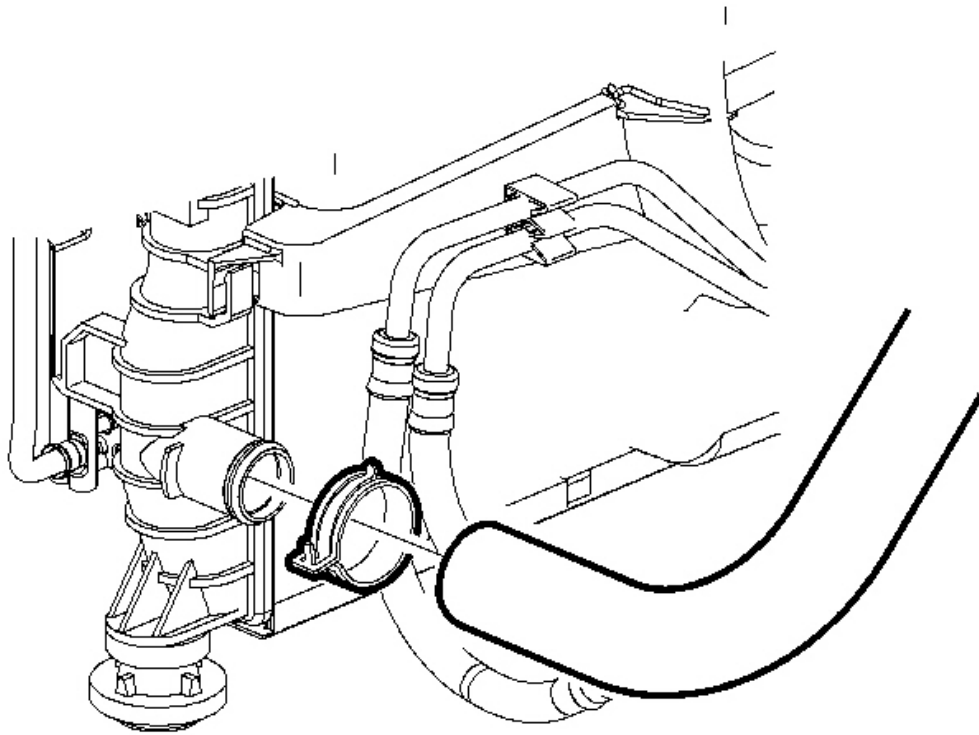


Fig. 130: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

19. Remove the radiator outlet hose clamp from the radiator.
20. Remove the radiator outlet hose from the radiator.

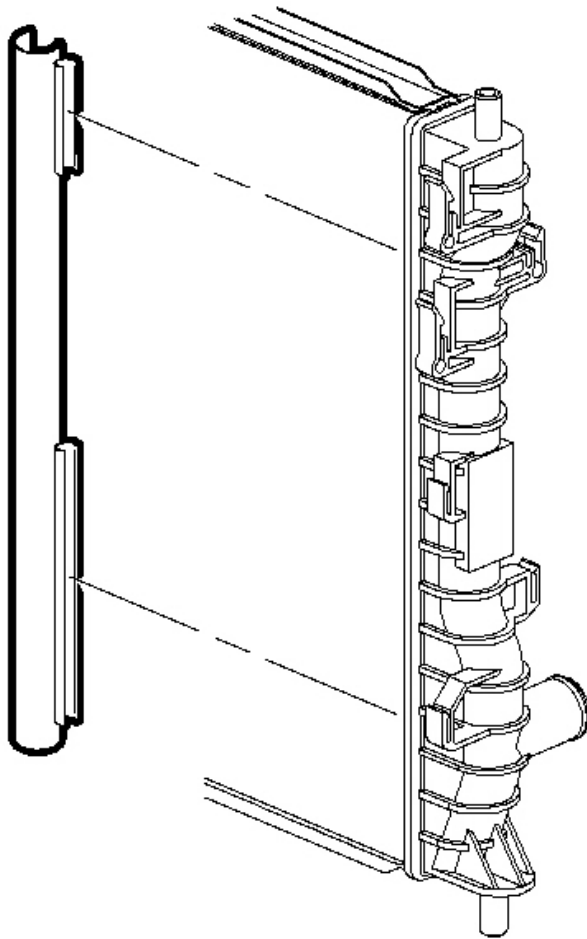


Fig. 131: View Of Radiator Seals
Courtesy of GENERAL MOTORS CORP.

21. Remove the radiator from the vehicle.
22. Remove the radiator seals from the radiator.

Installation Procedure

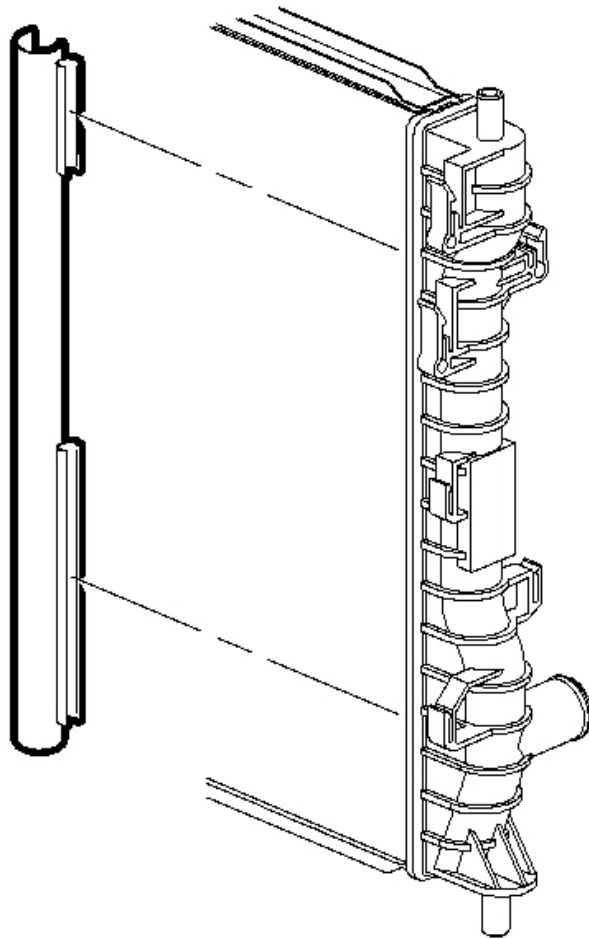


Fig. 132: View Of Radiator Seals
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator seals to the radiator.
2. Install the radiator to the vehicle.

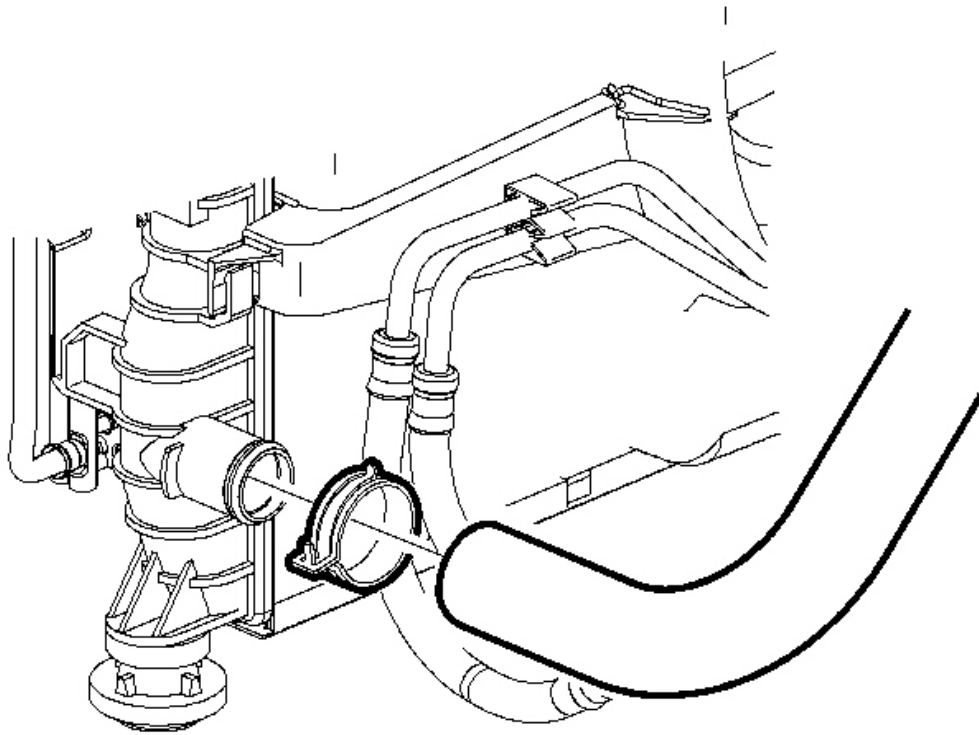


Fig. 133: View Of Radiator Outlet (L61) Hose Clamp
Courtesy of GENERAL MOTORS CORP.

3. Install the radiator outlet hose to the radiator.
4. Install the radiator outlet hose clamp to the radiator.

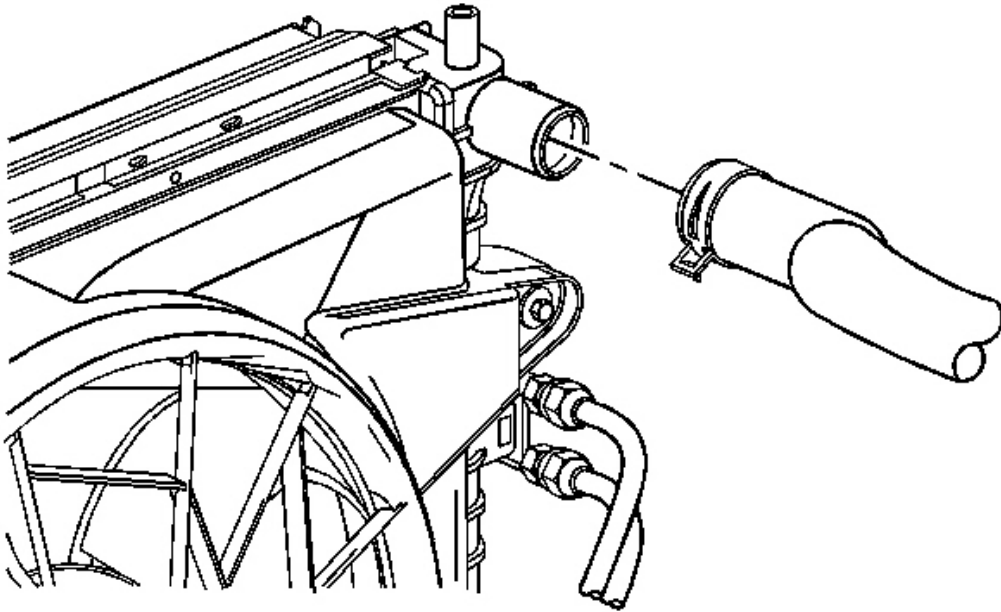


Fig. 134: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Install the radiator inlet hose to the radiator.
6. Install the radiator inlet hose clamp to the radiator.

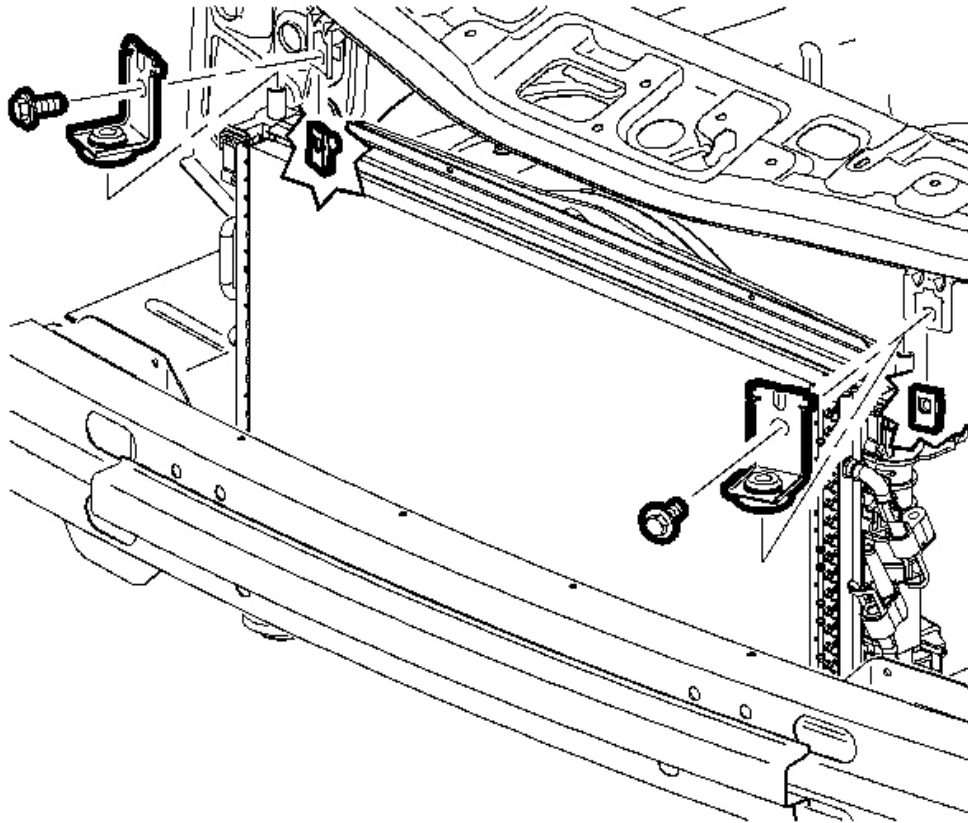


Fig. 135: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

7. Install the CRFM bracket to the radiator support.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the CRFM brackets bolts to the radiator.

Tighten: Tighten the bolt to 8 N.m (71 lb in).

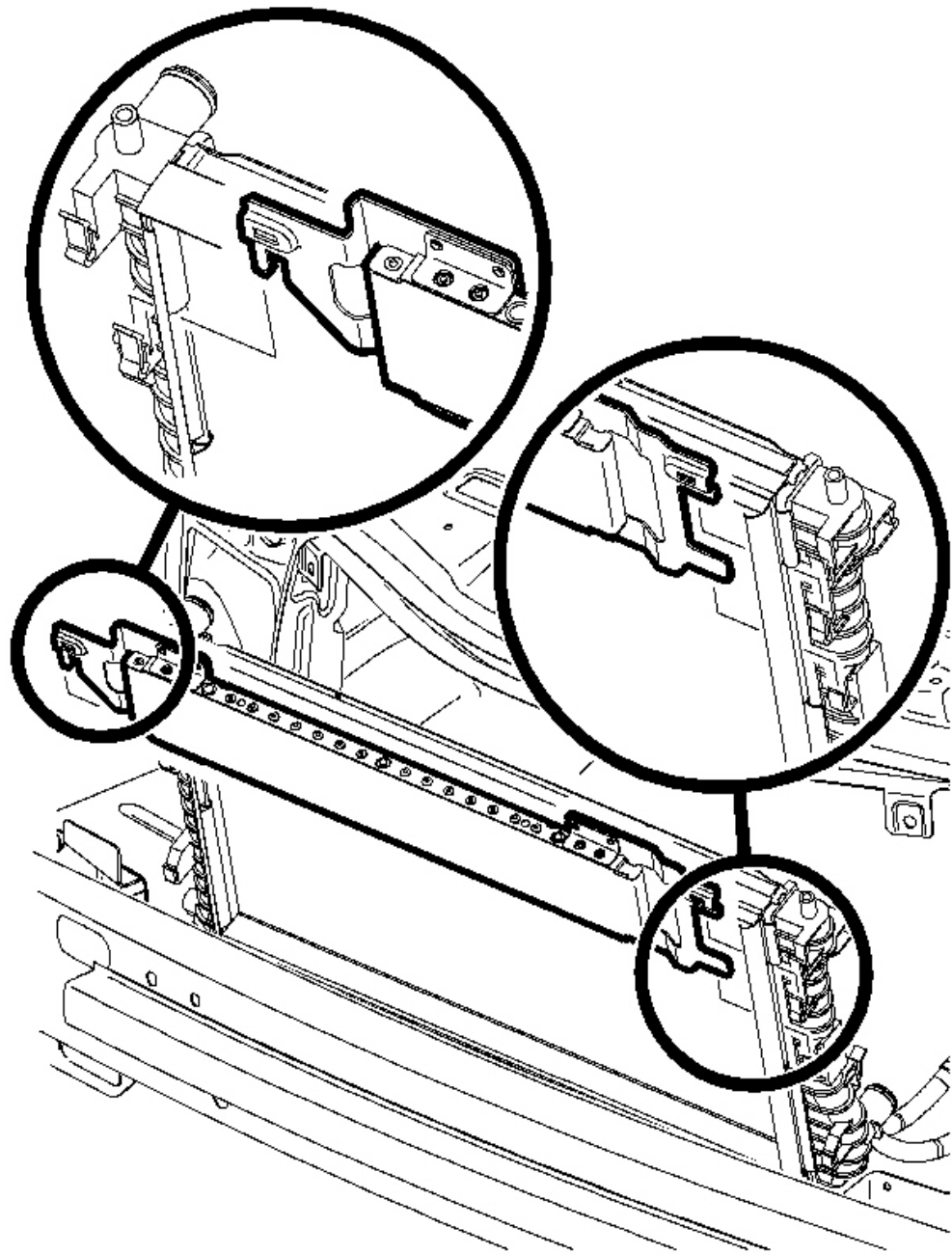


Fig. 136: View Of Transmission Cooler Liners To The Vehicle
Courtesy of GENERAL MOTORS CORP.

9. Install the transmission cooler to the vehicle, if equipped. Press down to engage the upper retention tabs.
10. Install the transmission cooler bolt to the radiator, if equipped.

Tighten: Tighten the bolt to 8 N.m (71 lb in).

11. Connect the transmission cooler liners to the transmission cooler, if equipped.

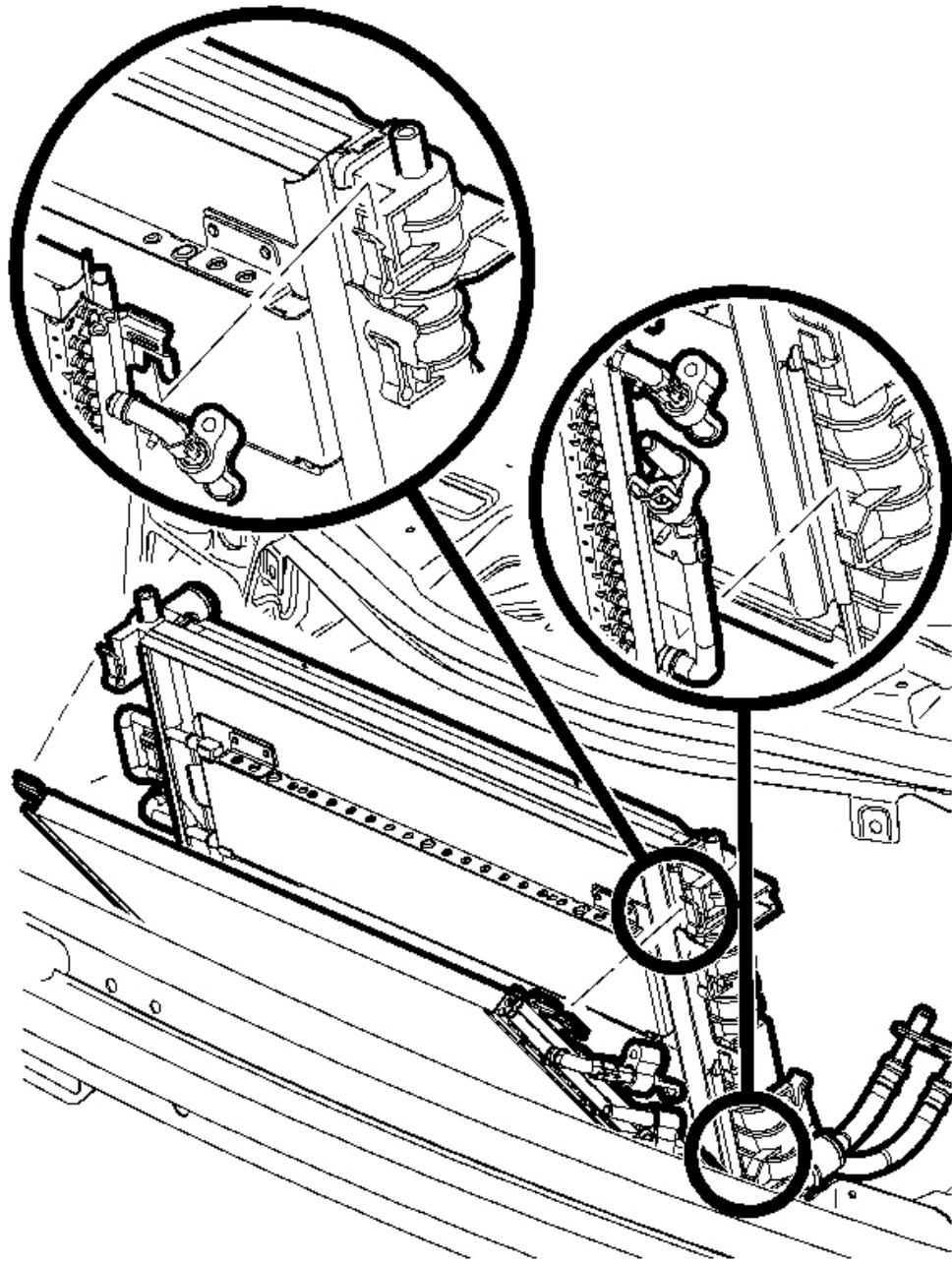


Fig. 137: View Of Condenser To The Radiator
Courtesy of GENERAL MOTORS CORP.

12. Install the condenser to the radiator. Press down to engage the upper retention tabs.

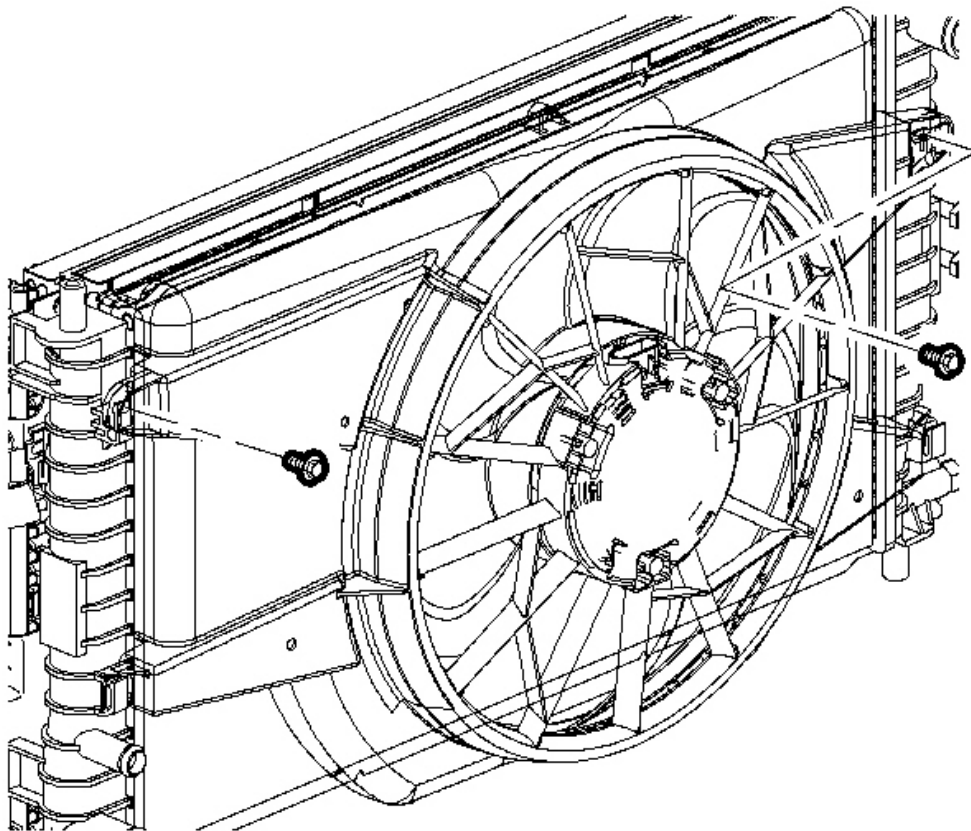


Fig. 138: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

13. Install the fan assembly to the radiator.
14. Install the fan assembly bolts to the radiator.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

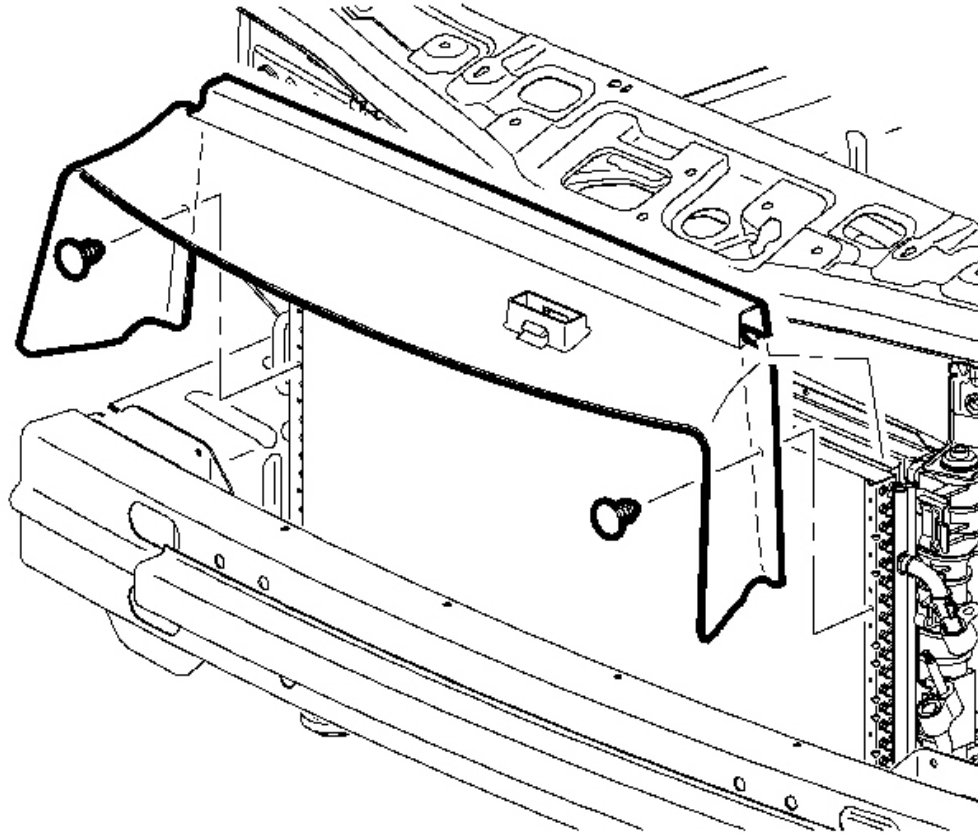


Fig. 139: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

15. Install the CRFM closeout panel to the condenser.
16. Install the CRFM closeout panel retainers to the condenser.

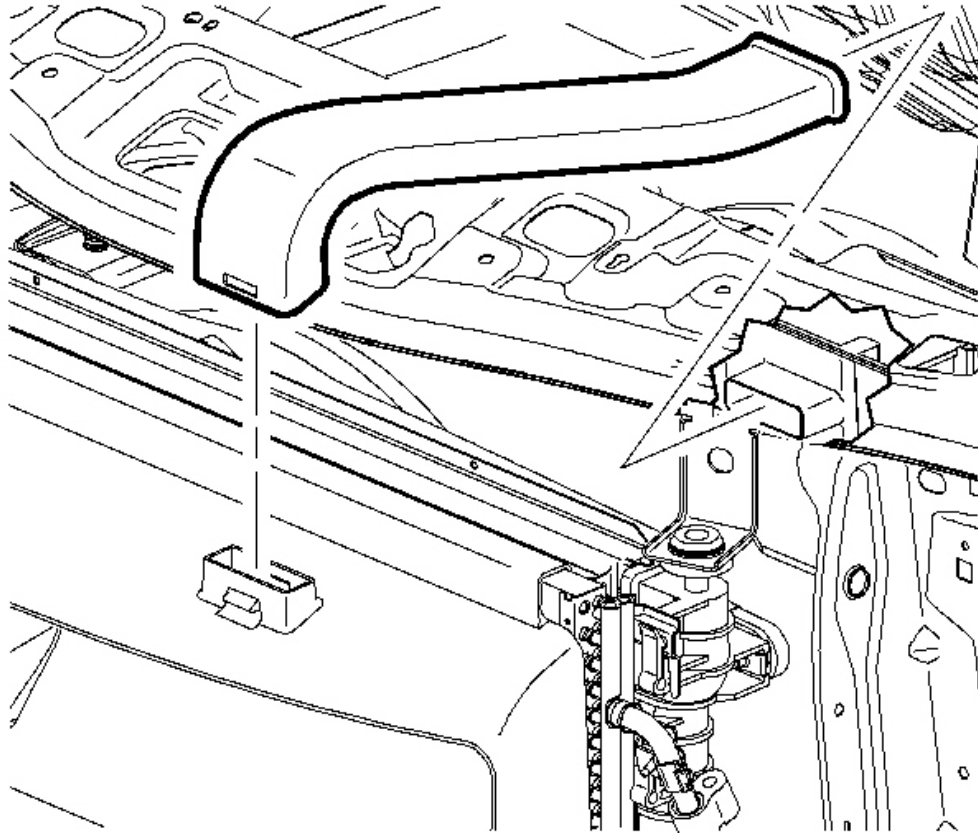


Fig. 140: View Of Battery Box Inlet Air Duct
Courtesy of GENERAL MOTORS CORP.

17. Install the battery box inlet air duct.
18. Install the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
19. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

RADIATOR REPLACEMENT (L66)

Removal Procedure

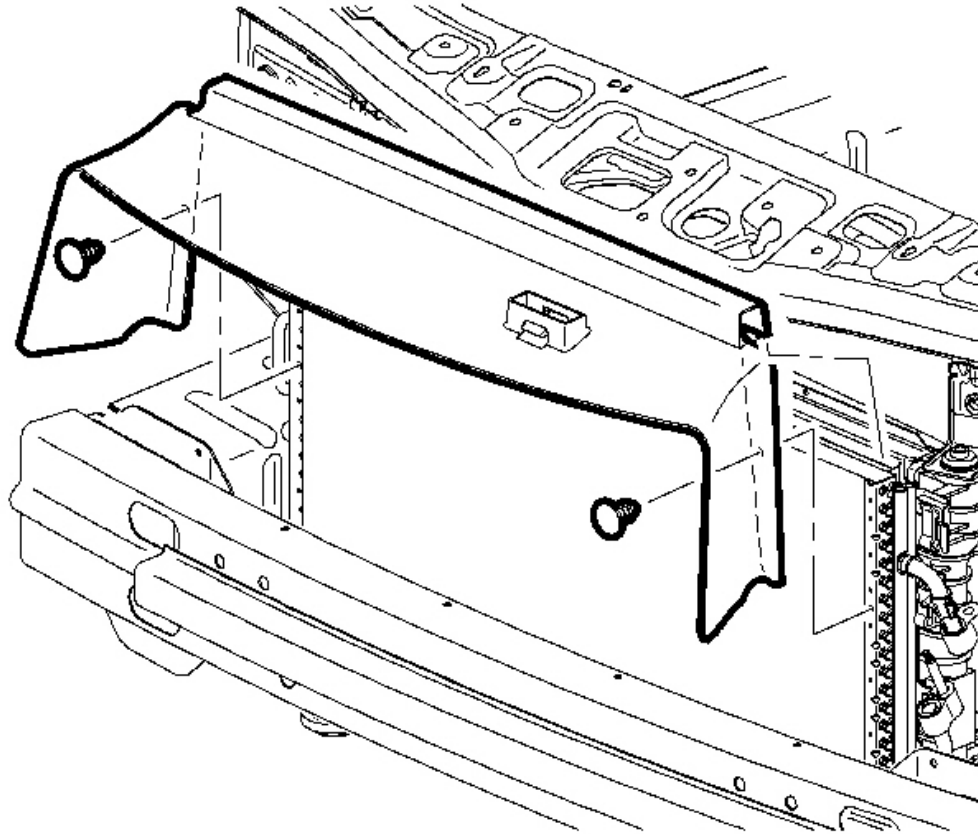


Fig. 141: View Of Radiator (L66)
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
2. Remove the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
3. Remove the condenser radiator fan module (CRFM) closeout panel retainers from the condenser.
4. Remove the CRFM closeout panel from the condenser.

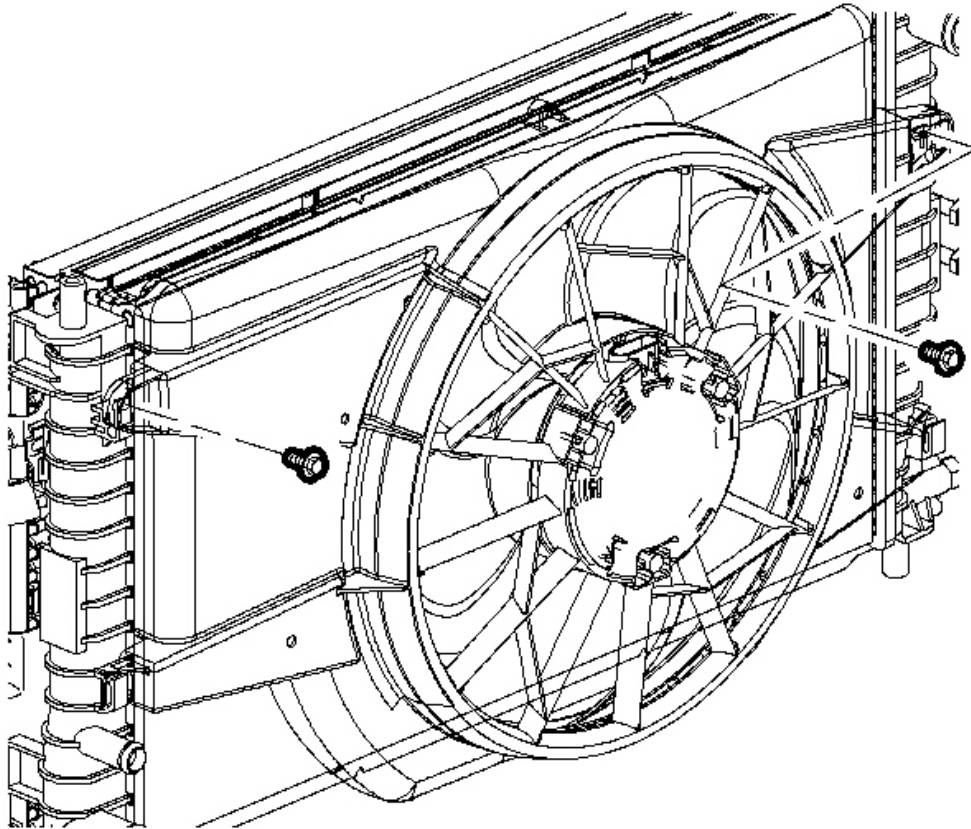


Fig. 142: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

5. Remove the fan assembly bolts from the radiator.
6. Lift the fan assembly to disengage the lower retention tabs.
7. Position the fan assembly away from the radiator.

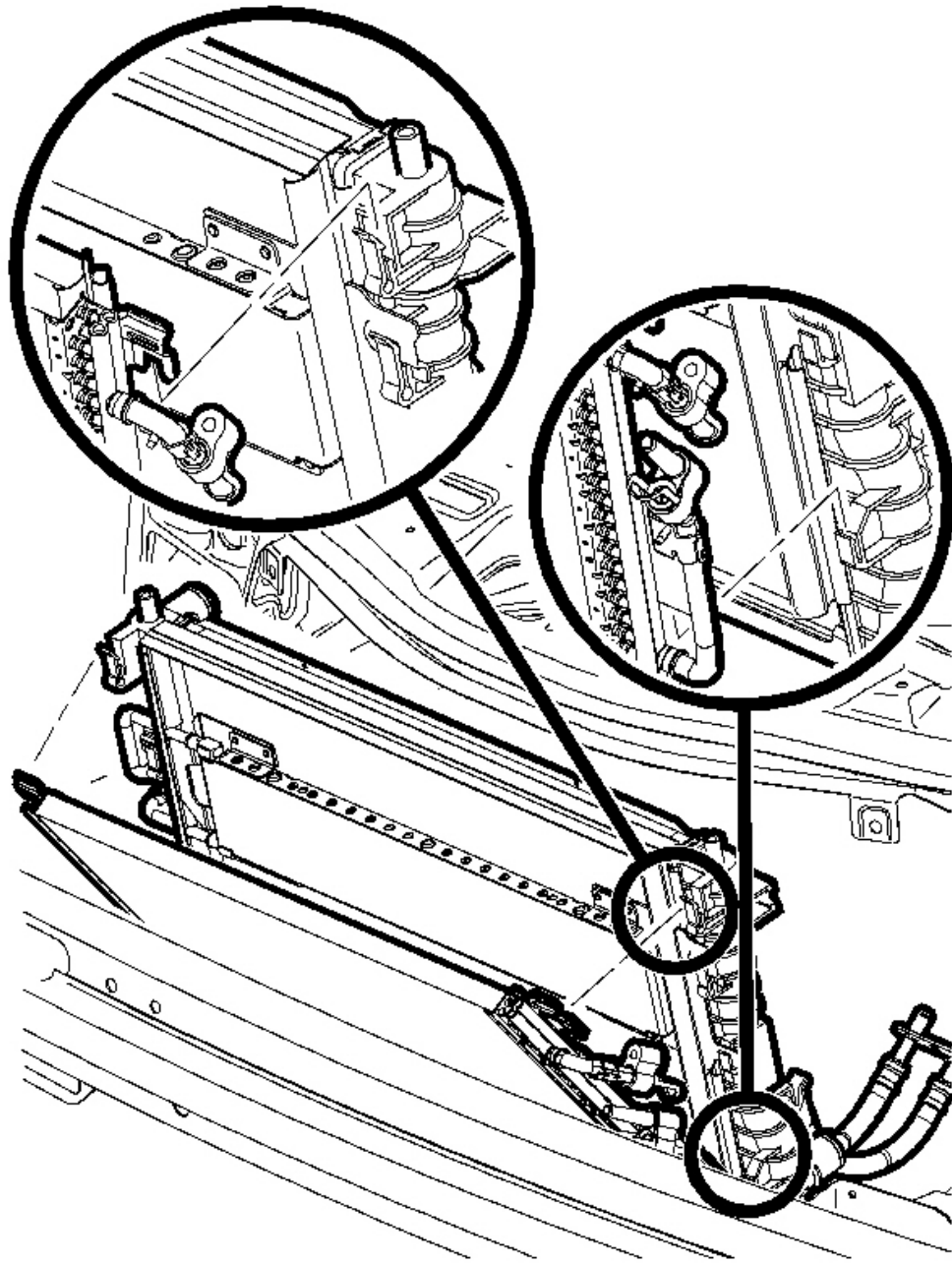


Fig. 143: View Of Condenser To The Radiator
Courtesy of GENERAL MOTORS CORP.

8. Lift the condenser while holding the upper retention tabs forward.
9. Position the condenser away from the radiator.

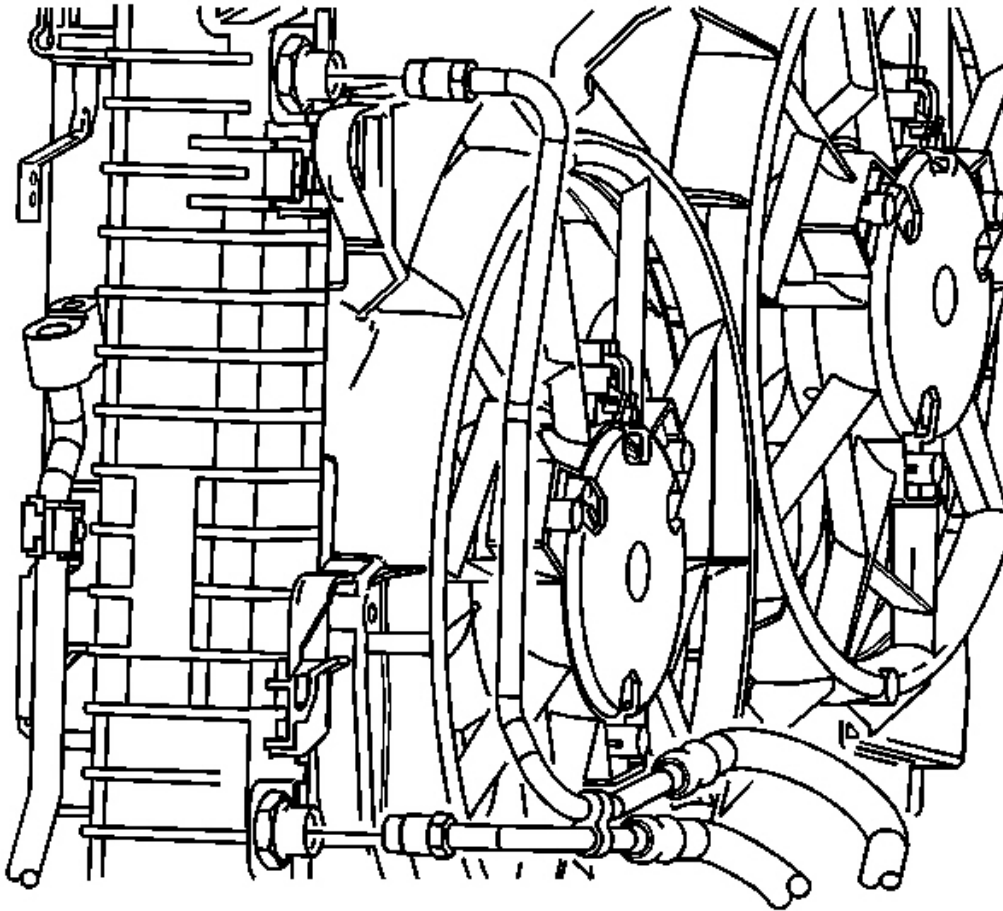


Fig. 144: View Of Transmission Cooler Liners To The Radiator
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the transmission cooler liners from the radiator.

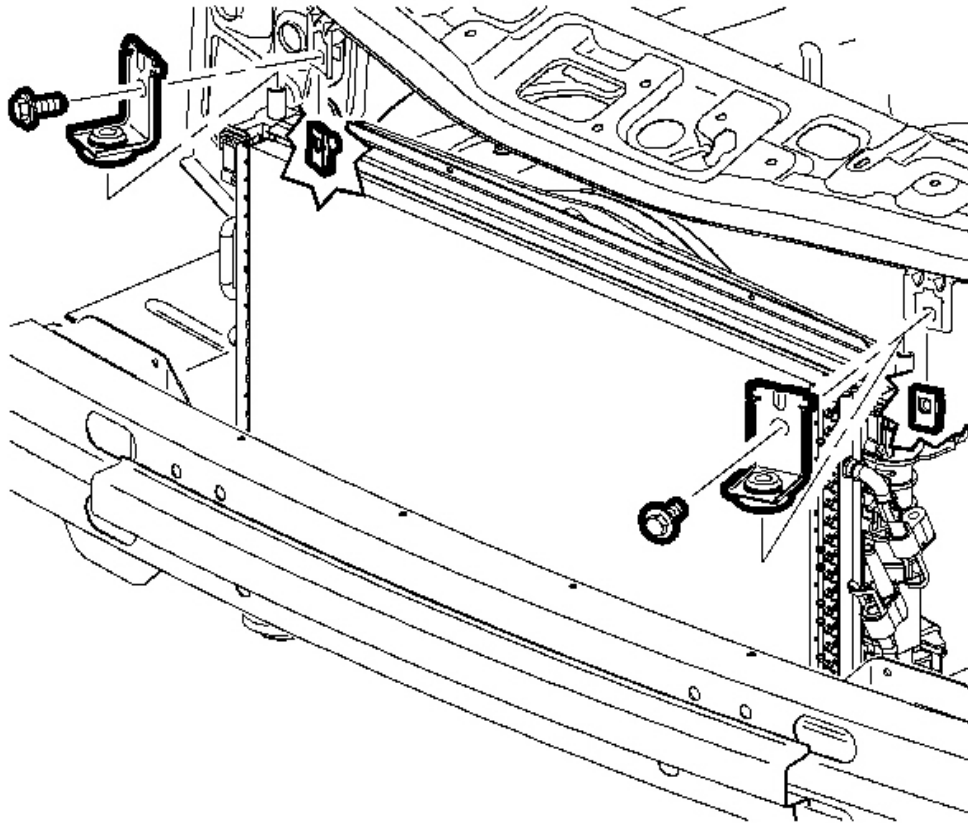


Fig. 145: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

11. Remove the CRFM bracket bolts from the radiator support.
12. Remove the CRFM brackets from the radiator.

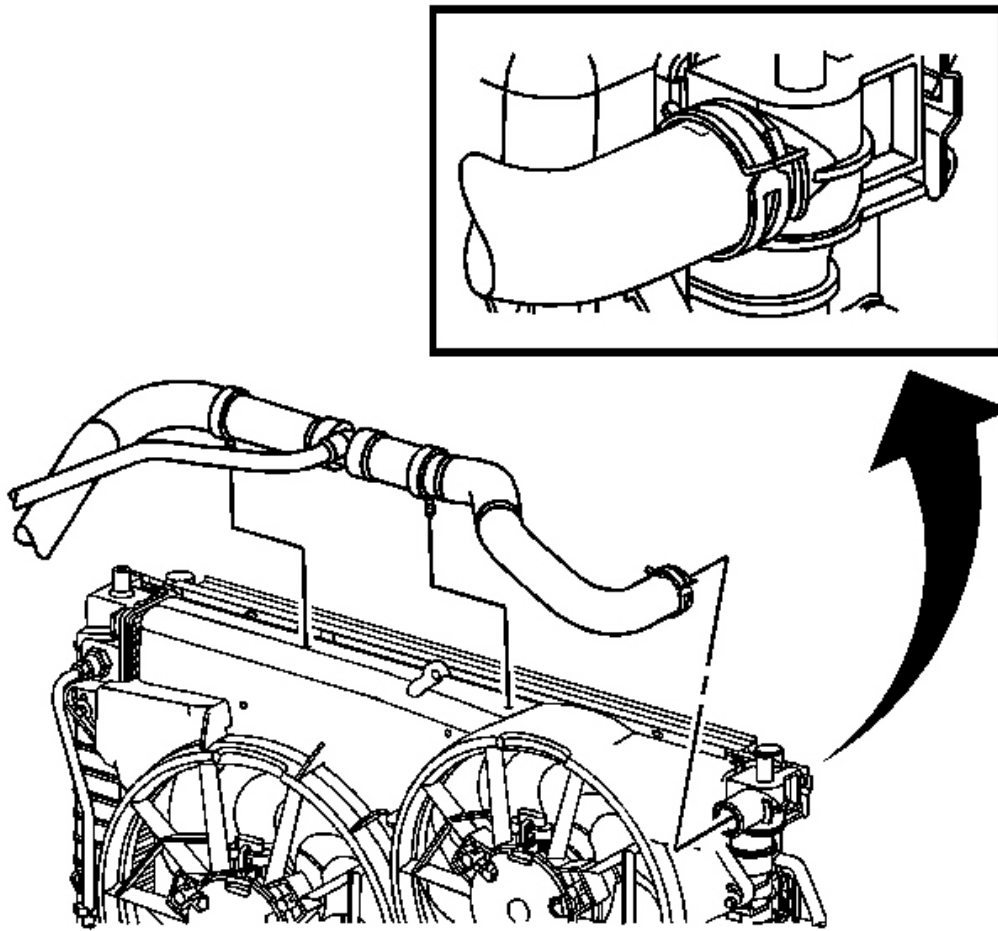


Fig. 146: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

13. Remove the radiator inlet hose clamp from the radiator.
14. Remove the radiator inlet hose from the radiator.

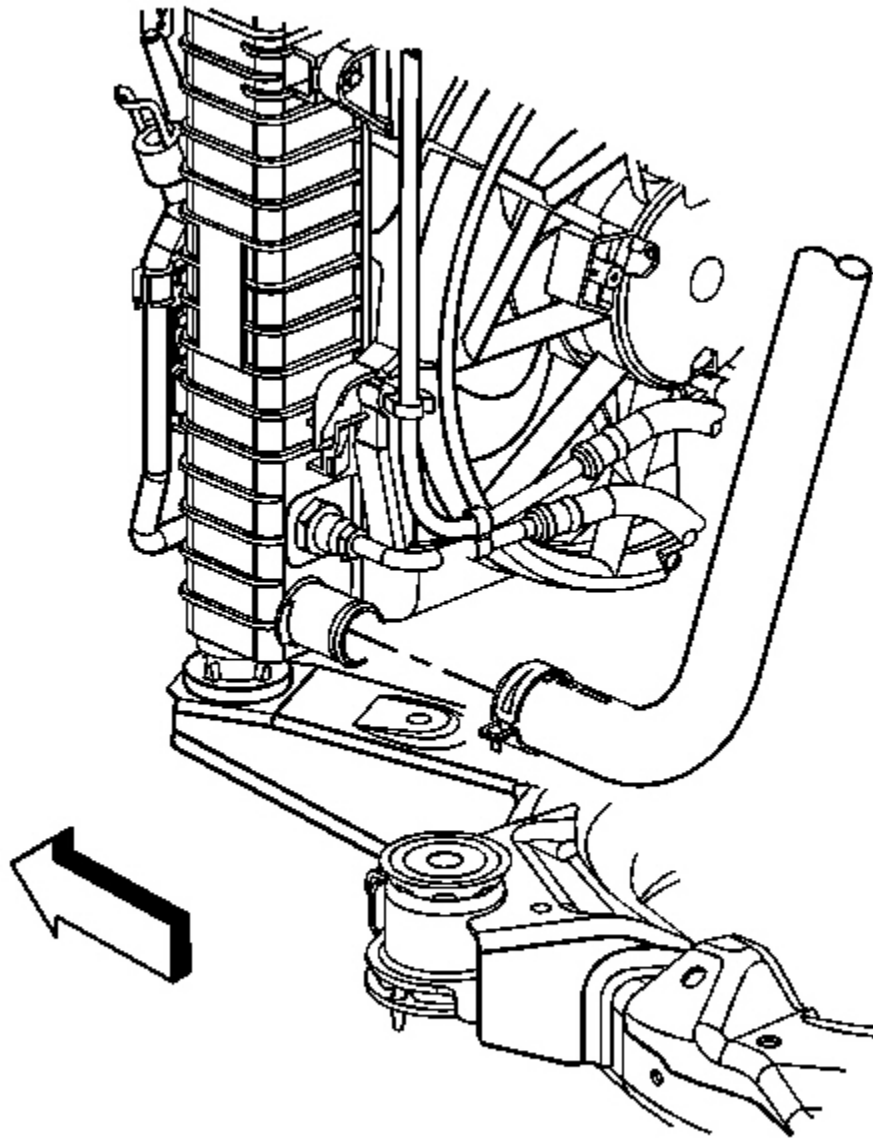


Fig. 147: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

15. Remove the radiator outlet hose clamp from the radiator.
16. Remove the radiator outlet hose from the radiator.

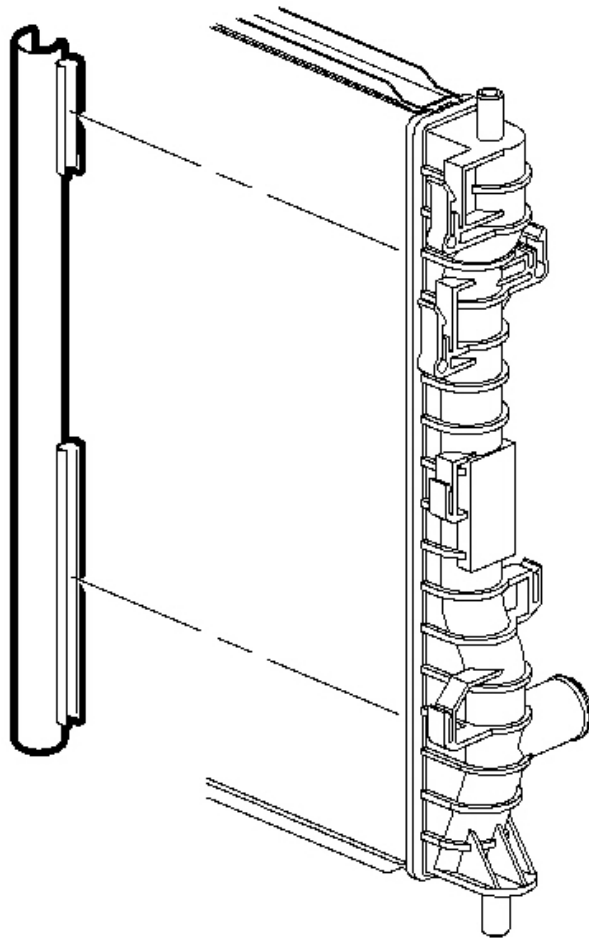


Fig. 148: View Of Radiator Seals
Courtesy of GENERAL MOTORS CORP.

17. Remove the radiator from the vehicle.
18. Remove the radiator seals from the radiator.

Installation Procedure

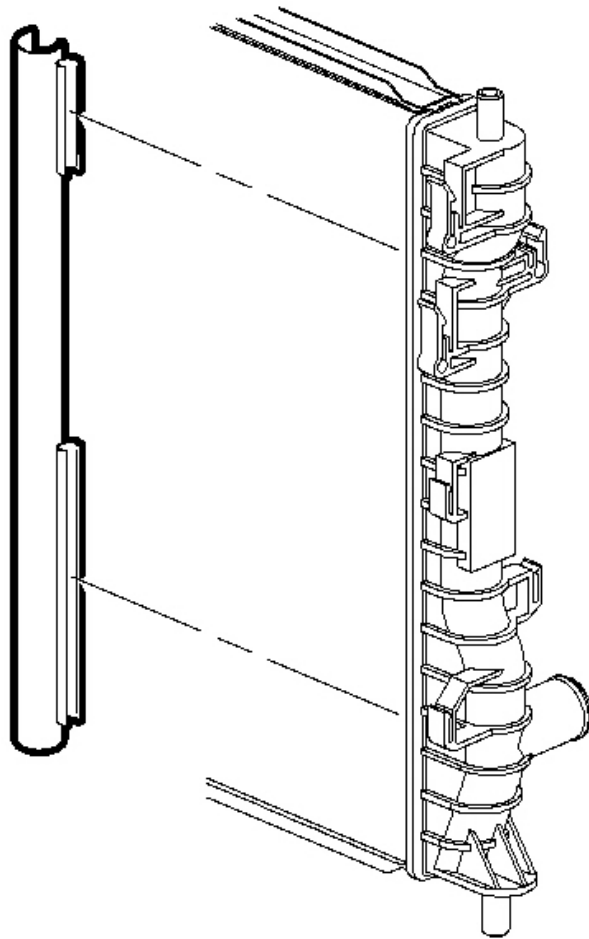


Fig. 149: View Of Radiator Seals
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator seals to the radiator.
2. Install the radiator to the vehicle.

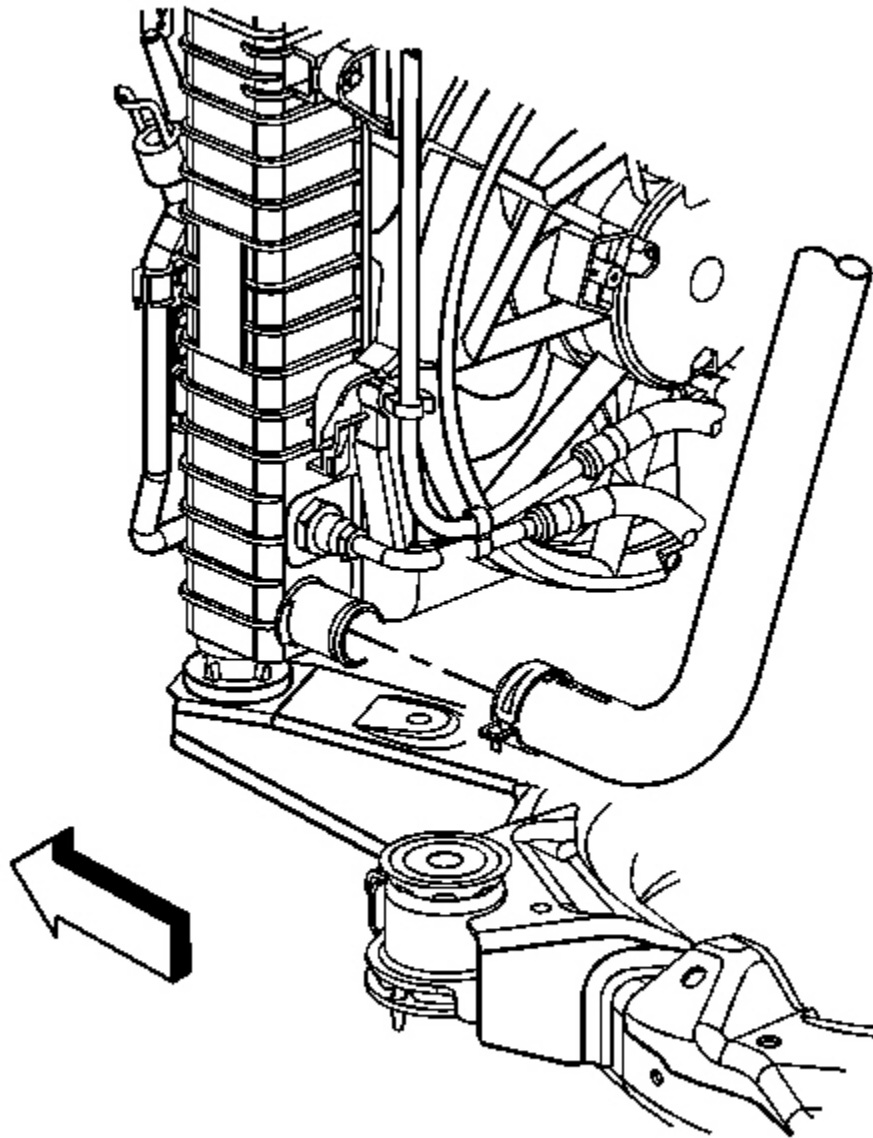


Fig. 150: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the radiator outlet hose to the radiator.
4. Install the radiator outlet hose clamp to the radiator.

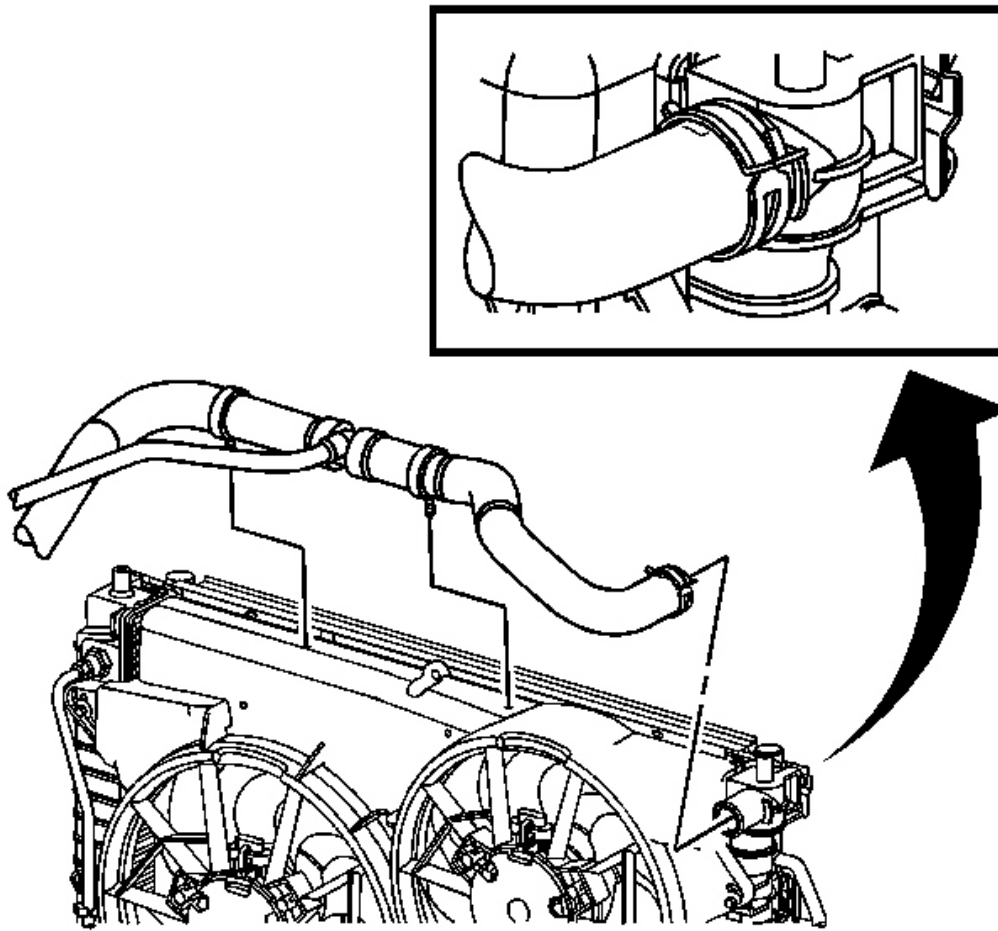


Fig. 151: View Of Radiator Hose
Courtesy of GENERAL MOTORS CORP.

5. Install the radiator inlet hose to the radiator.
6. Install the radiator inlet hose clamp to the radiator.

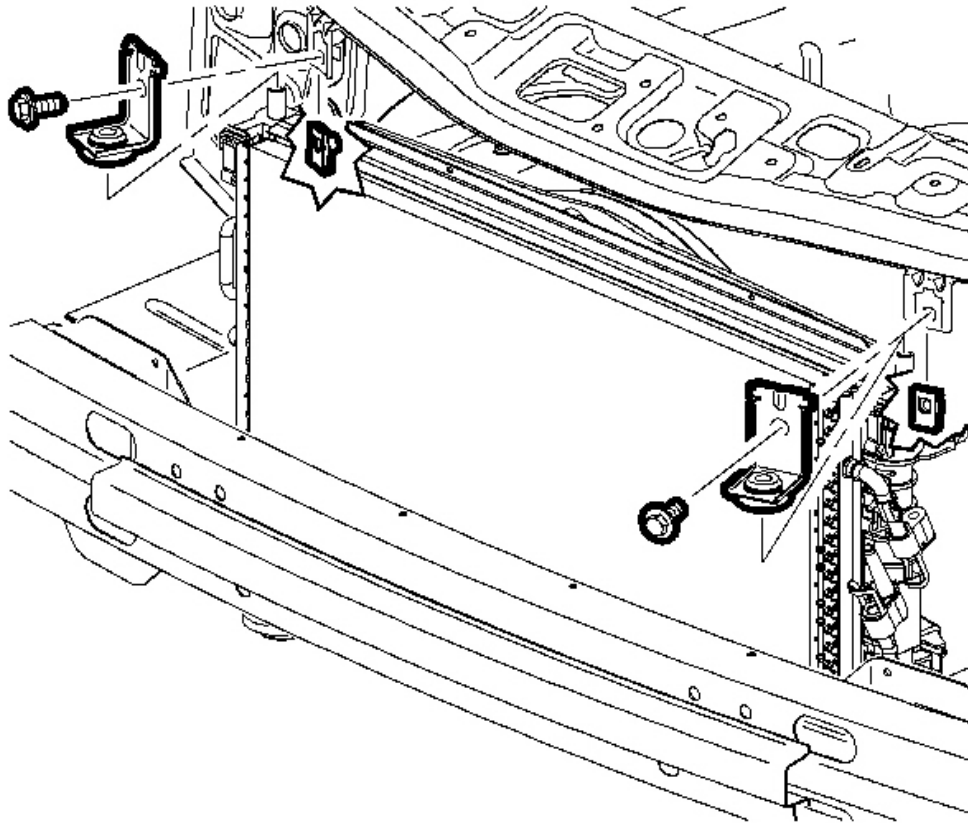


Fig. 152: View Of CRFM Mounting Brackets To The Radiator Support
Courtesy of GENERAL MOTORS CORP.

7. Install the CRFM bracket to the radiator support.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the CRFM brackets bolts to the radiator.

Tighten: Tighten the bolt to 8 N.m (71 lb in).

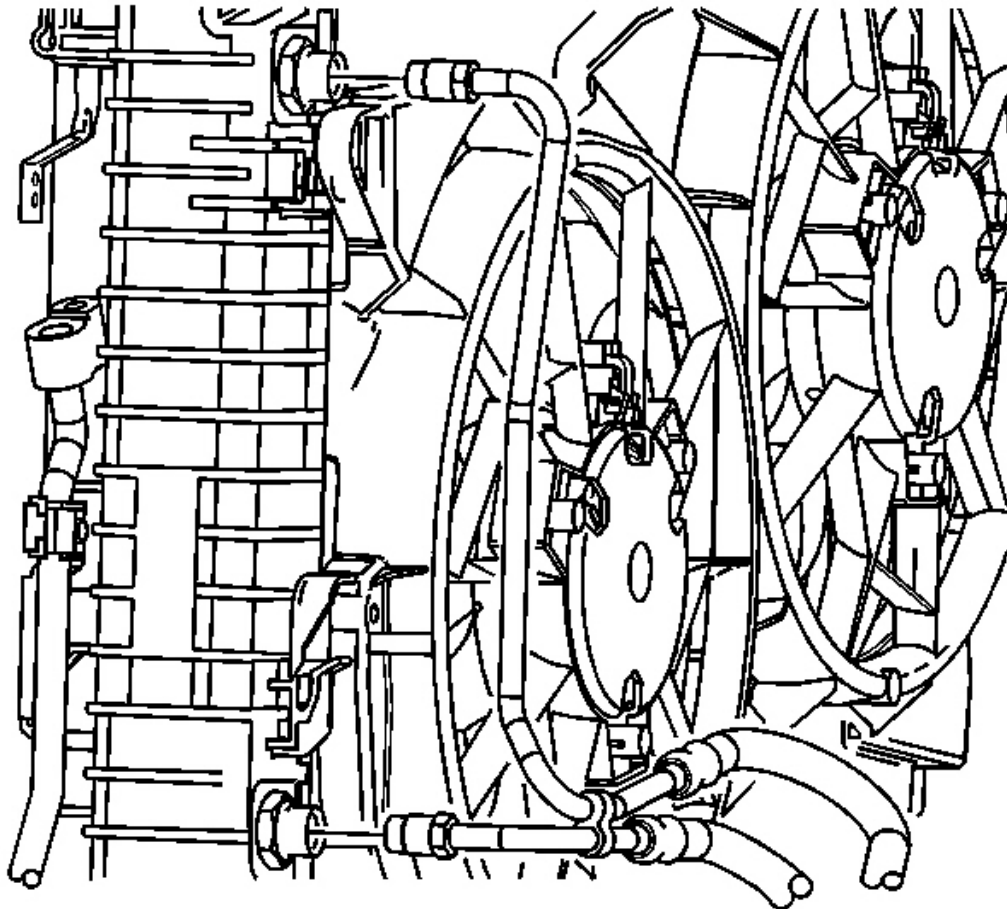


Fig. 153: View Of Transmission Cooler Liners To The Radiator
Courtesy of GENERAL MOTORS CORP.

9. Connect the transmission cooler liners to the radiator.

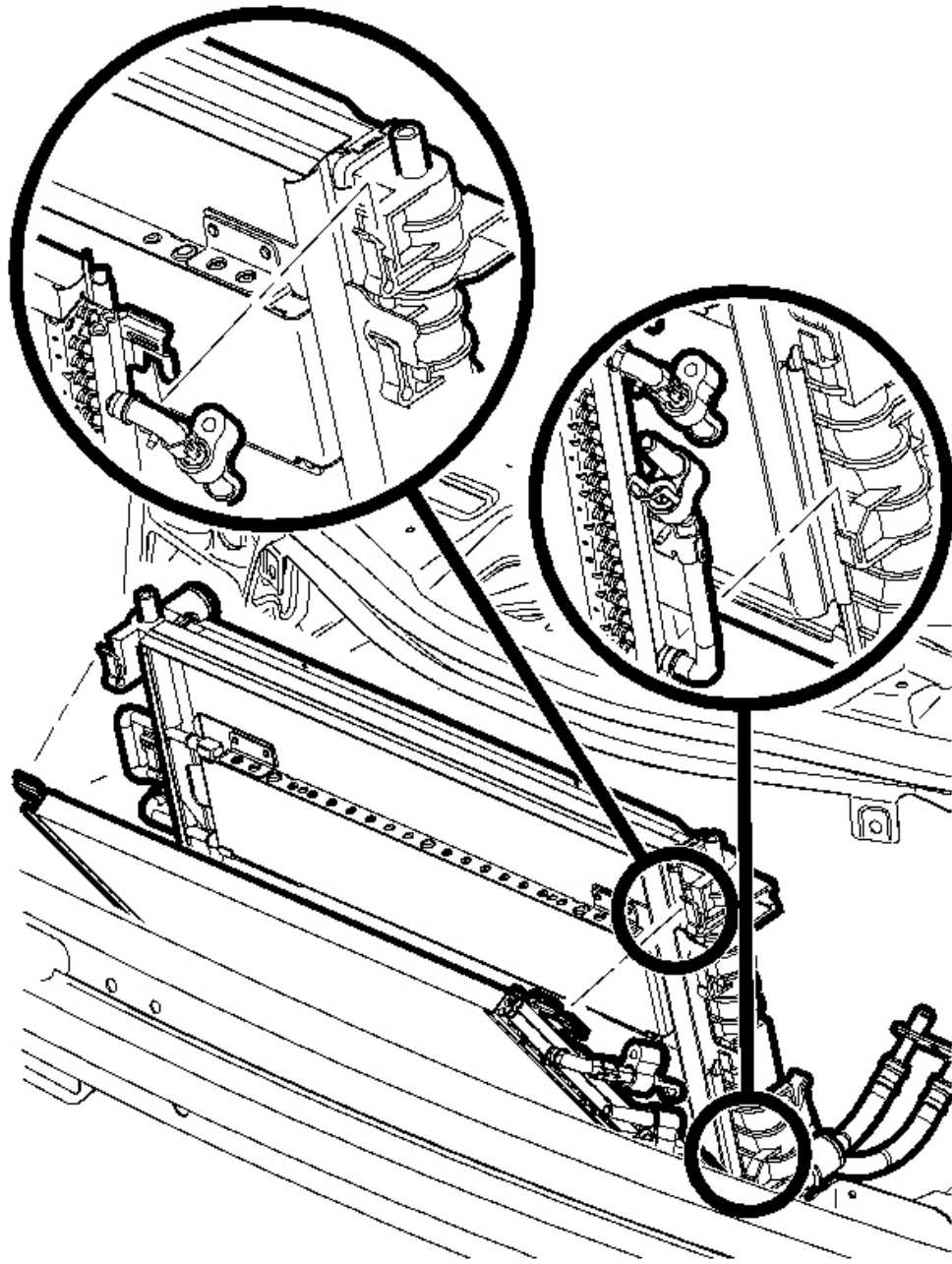


Fig. 154: View Of Condenser To The Radiator
Courtesy of GENERAL MOTORS CORP.

10. Install the condenser to the radiator. Press down to engage the upper retention tabs.

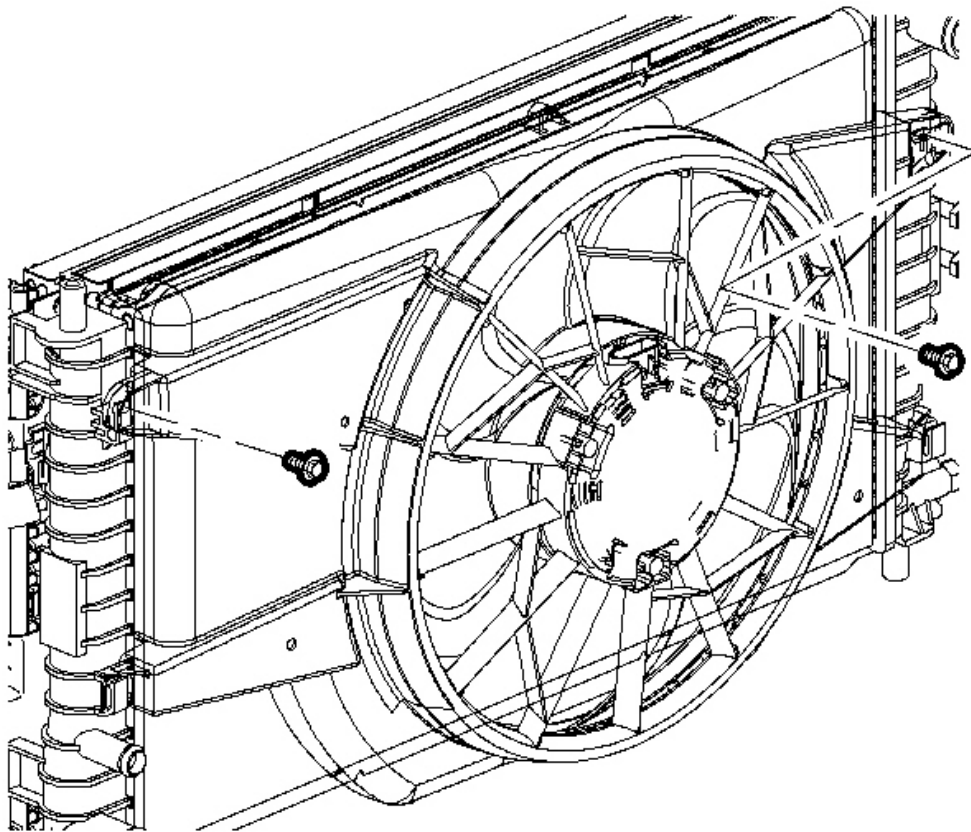


Fig. 155: View Of Fan Assembly Bolts From The Radiator
Courtesy of GENERAL MOTORS CORP.

11. Install the fan assembly to the radiator.
12. Install the fan assembly bolts to the radiator.

Tighten: Tighten the bolts to 8 N.m (71 lb in).

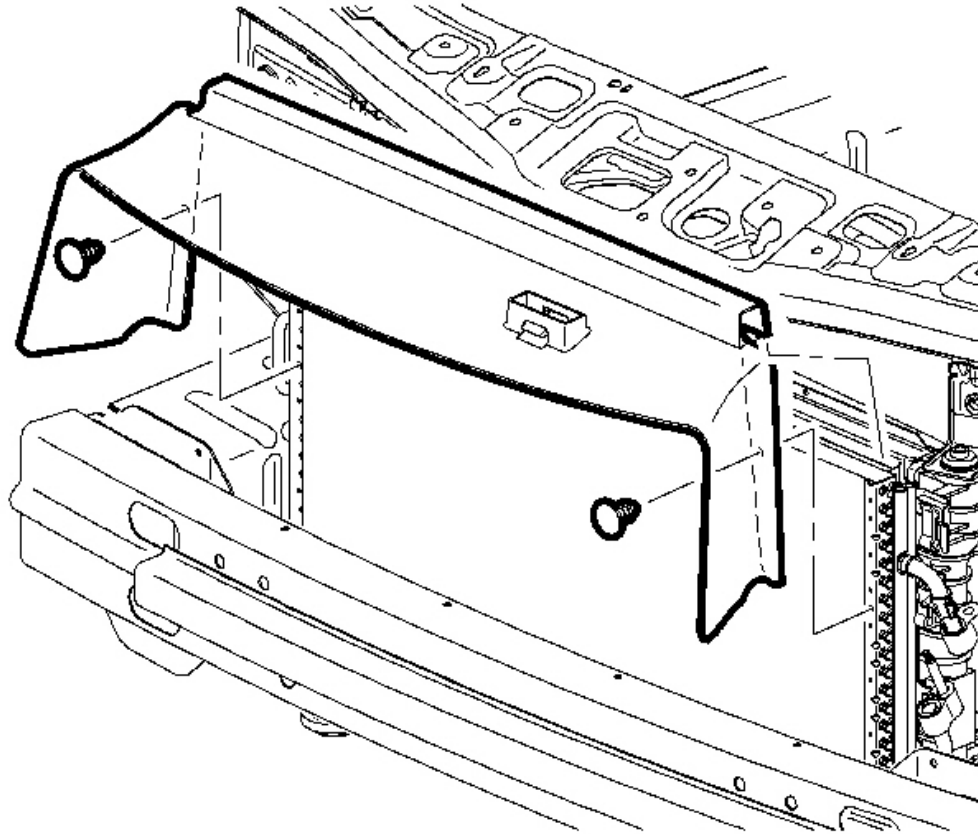


Fig. 156: View Of CRFM Closeout Panel To The Condenser
Courtesy of GENERAL MOTORS CORP.

13. Install the CRFM closeout panel to the condenser.
14. Install the CRFM closeout panel retainers to the condenser.
15. Install the front fascia. Refer to **Fascia Replacement - Front Bumper** in Bumpers.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System** .

COOLANT HEATER REPLACEMENT (2.2L (L61))

Removal Procedure

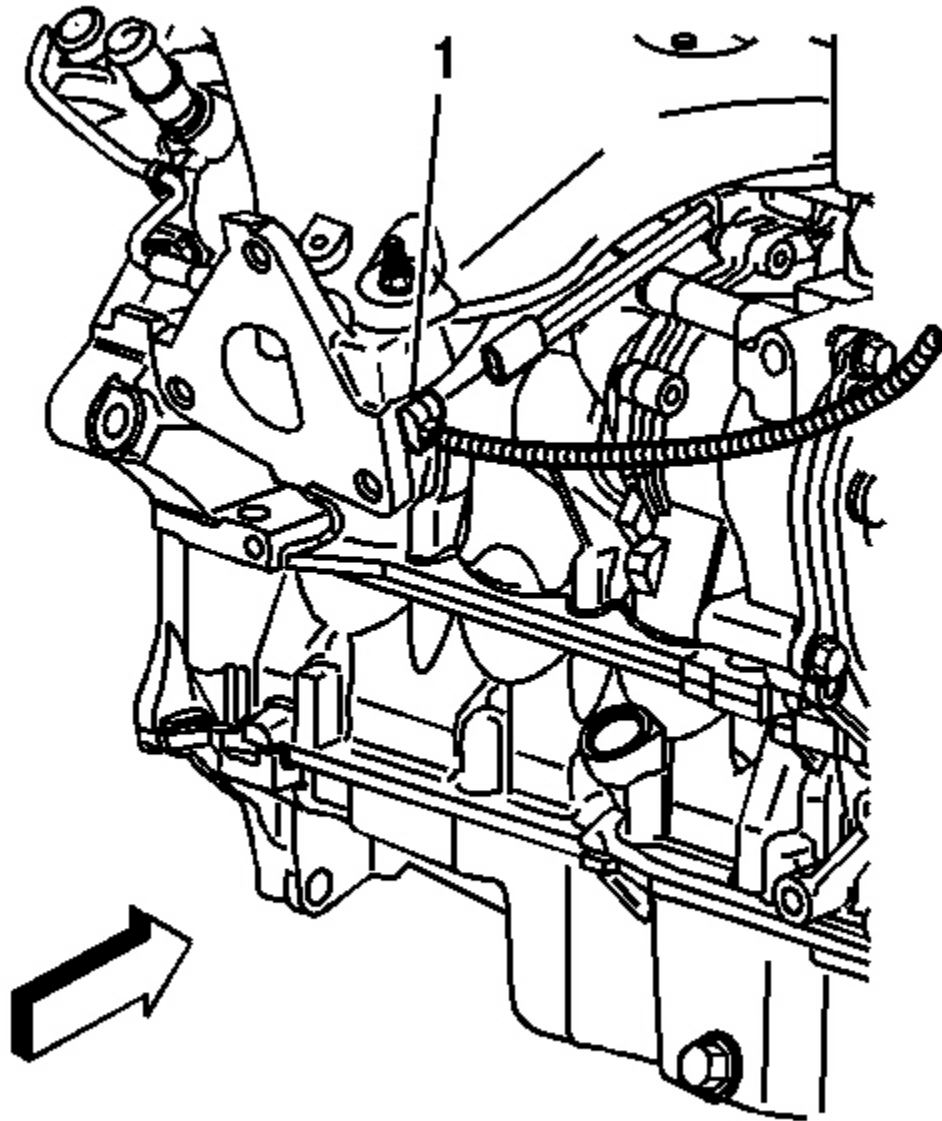


Fig. 157: Coolant Heater View
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the coolant heater cord (1).

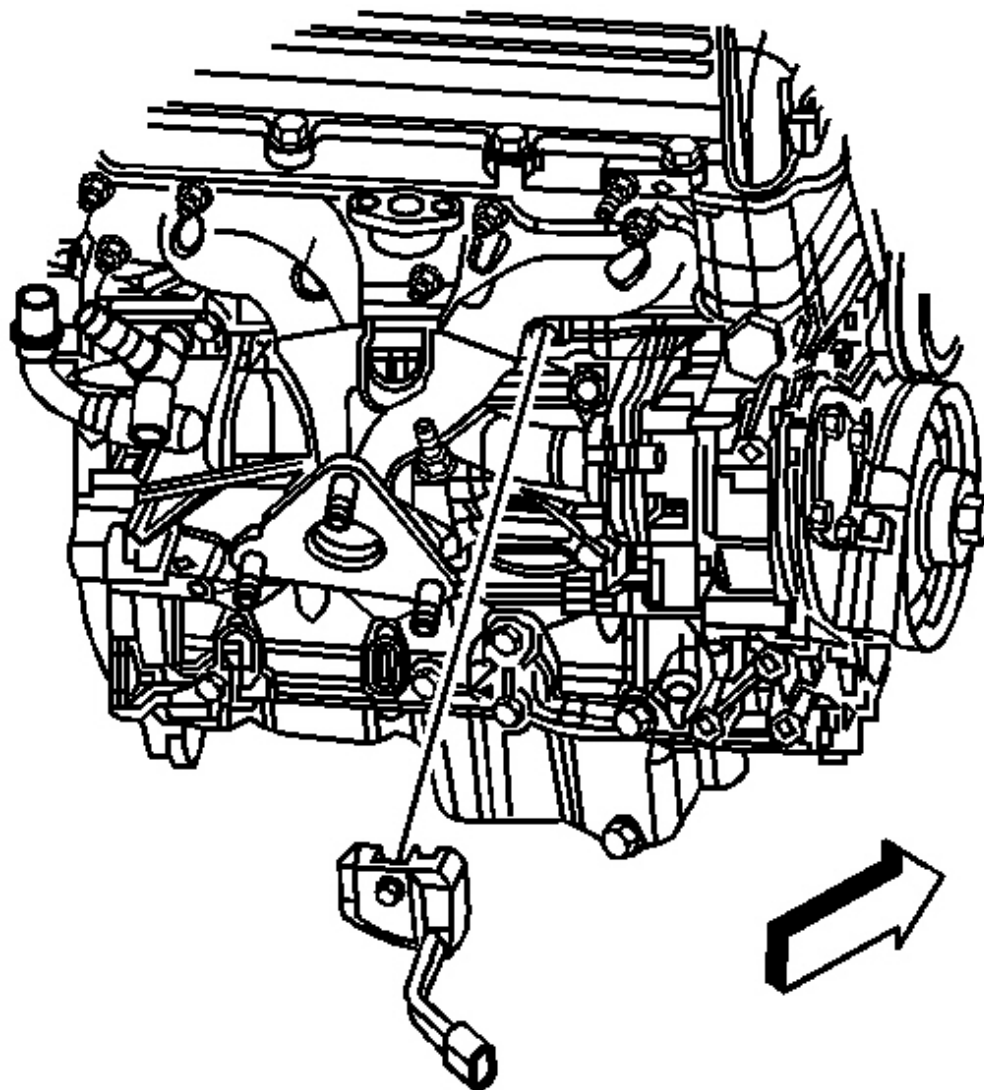


Fig. 158: View Of Coolant Heater
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

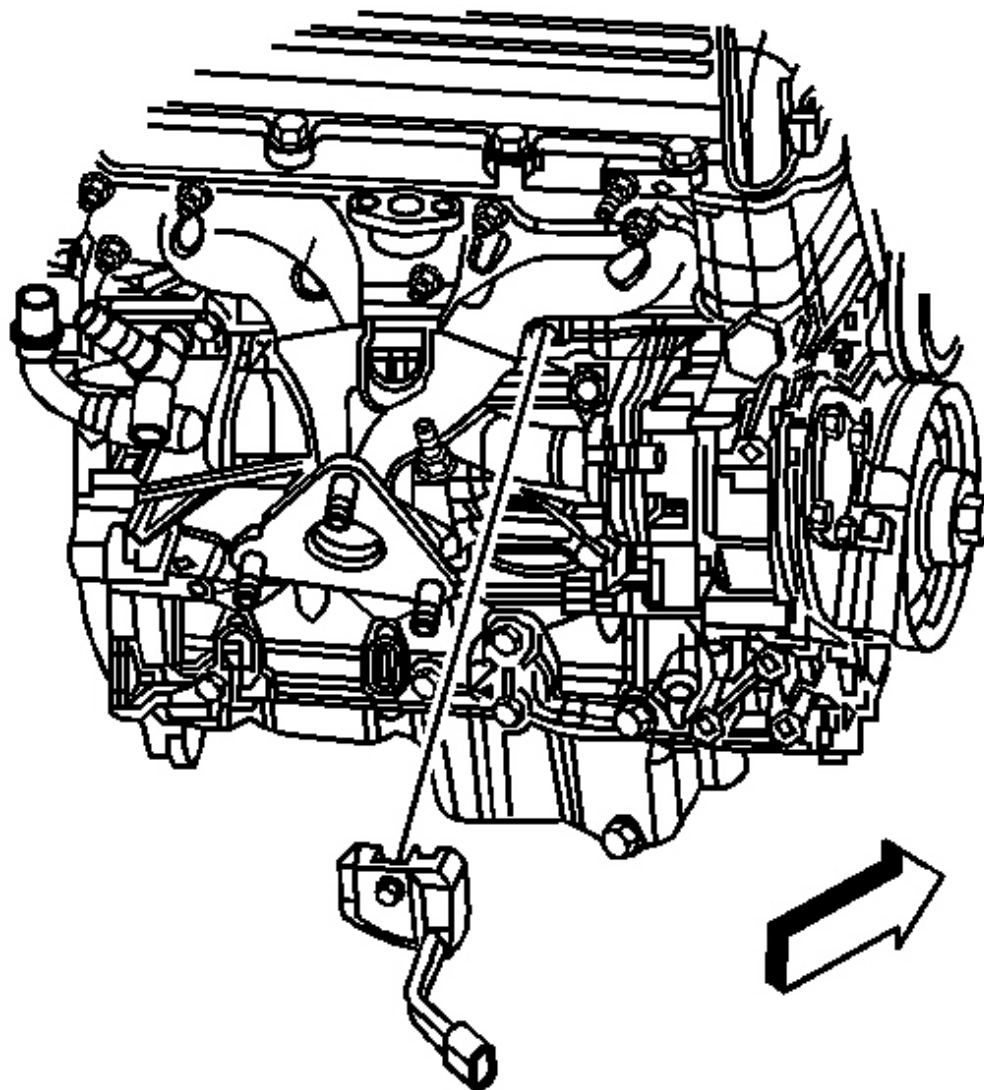


Fig. 159: View Of Coolant Heater
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the coolant heater bolt.

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

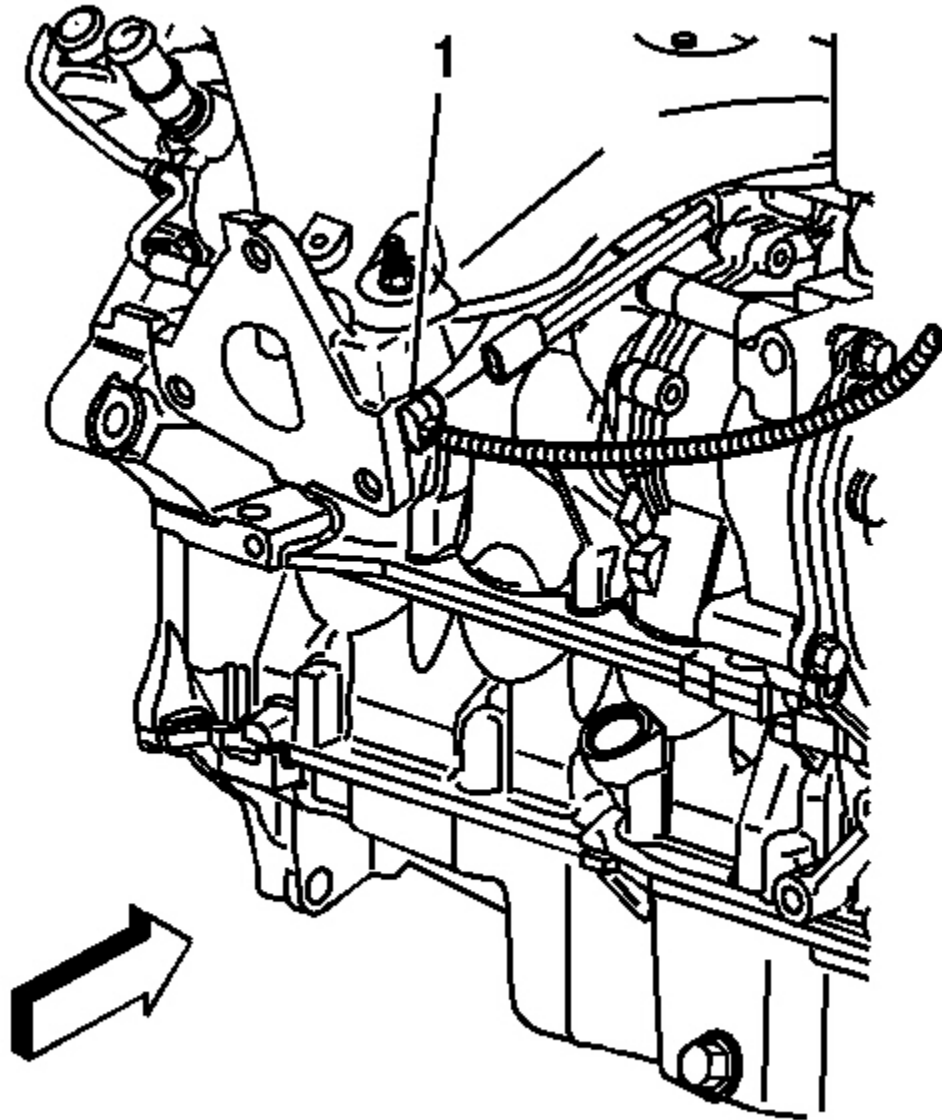


Fig. 160: Coolant Heater View
Courtesy of GENERAL MOTORS CORP.

3. Connect the coolant heater cord (1).

COOLANT HEATER REPLACEMENT (L66)

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System** .
2. Disconnect the coolant heater power supply cord from the coolant heater.

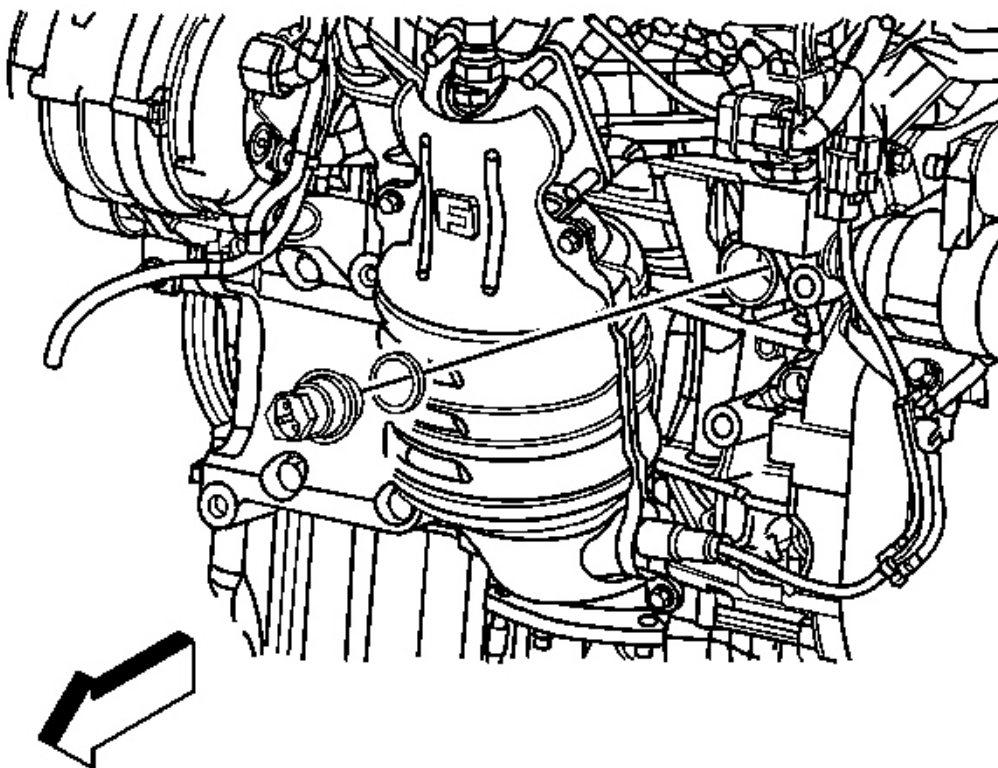


Fig. 161: View Of Coolant Heater (L66)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A residual amount of coolant will drain from the engine block.

3. Remove the coolant heater and washer from the engine block.

Installation Procedure

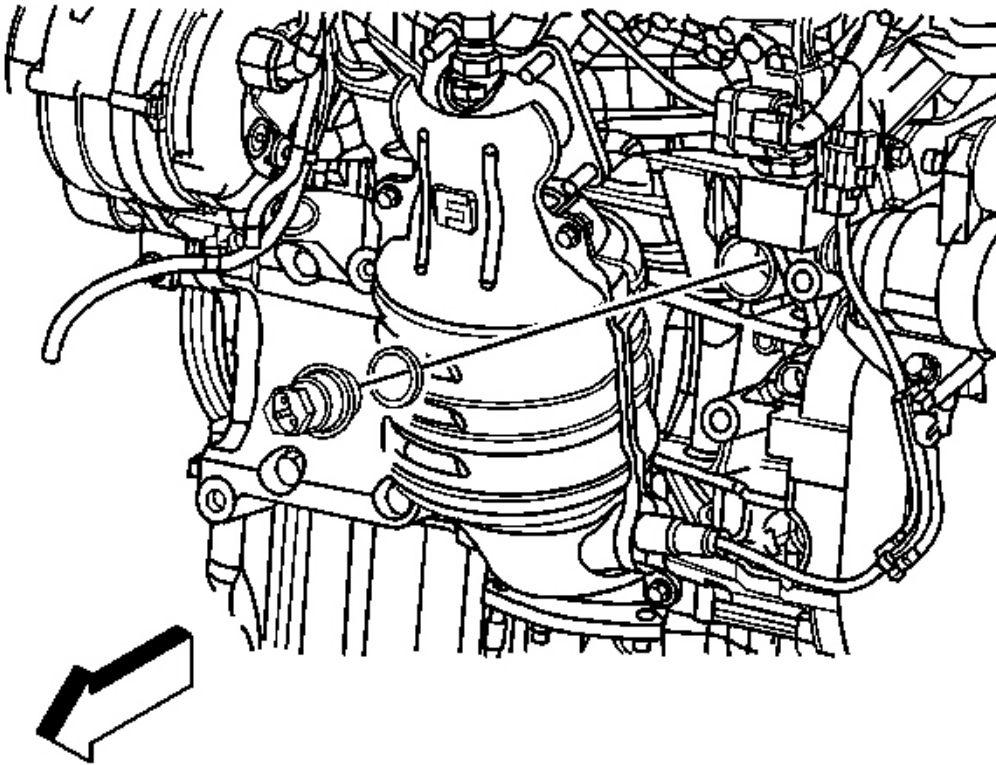


Fig. 162: View Of Coolant Heater (L66)
Courtesy of GENERAL MOTORS CORP.

1. Install the washer to the coolant heater.

NOTE: Refer to Component Fastener Tightening Notice in Cautions and Notices.

2. Install the coolant heater into the engine block.

Tighten: Tighten the coolant heater to 60 N.m (44 lb ft).

3. Connect the coolant heater power supply cord to the coolant heater.
4. Fill the cooling system. Refer to Draining and Filling Cooling System .

COOLANT HEATER CORD REPLACEMENT (2.2L (L61))

Removal Procedure

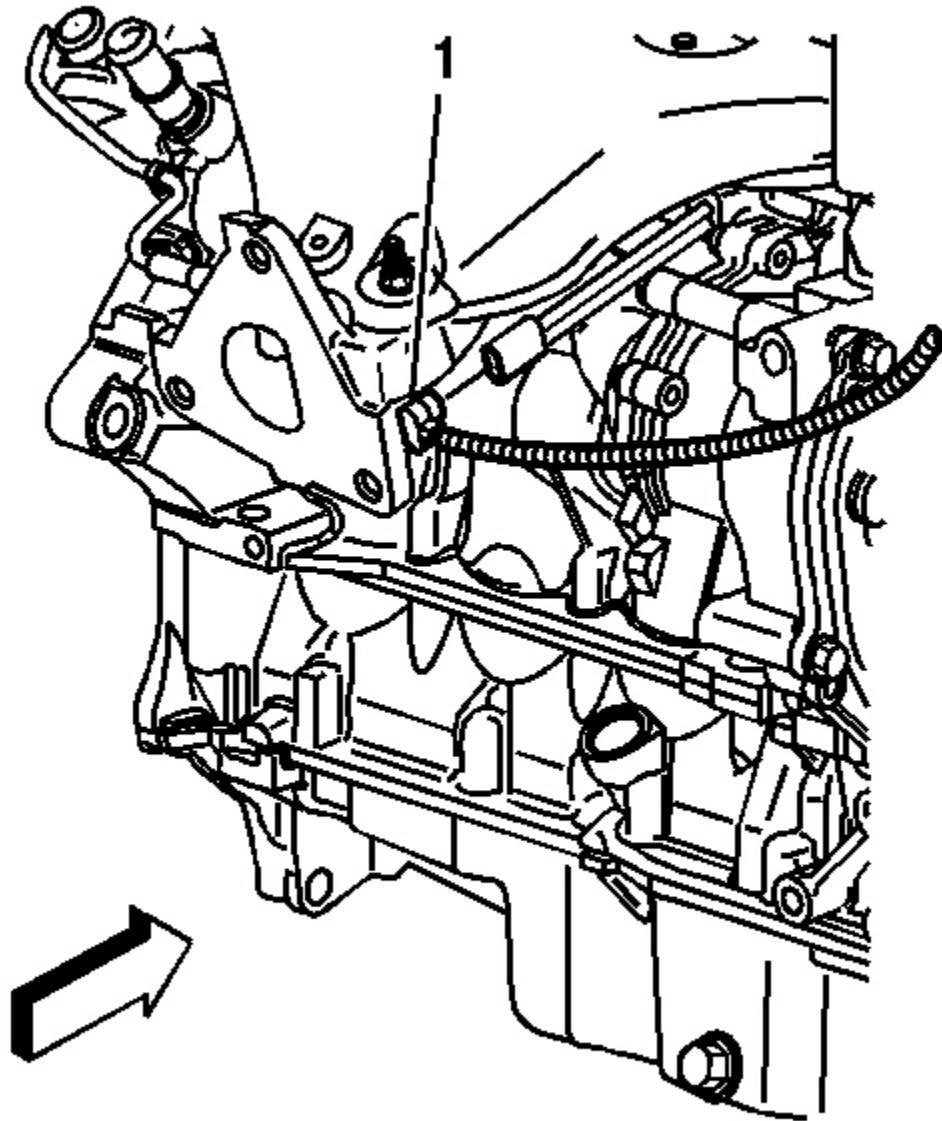


Fig. 163: Coolant Heater View
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the engine coolant heater cord (1).
2. Remove the clips from the engine mount and surge tank.

1. Install the clips from the engine mount and surge tank.

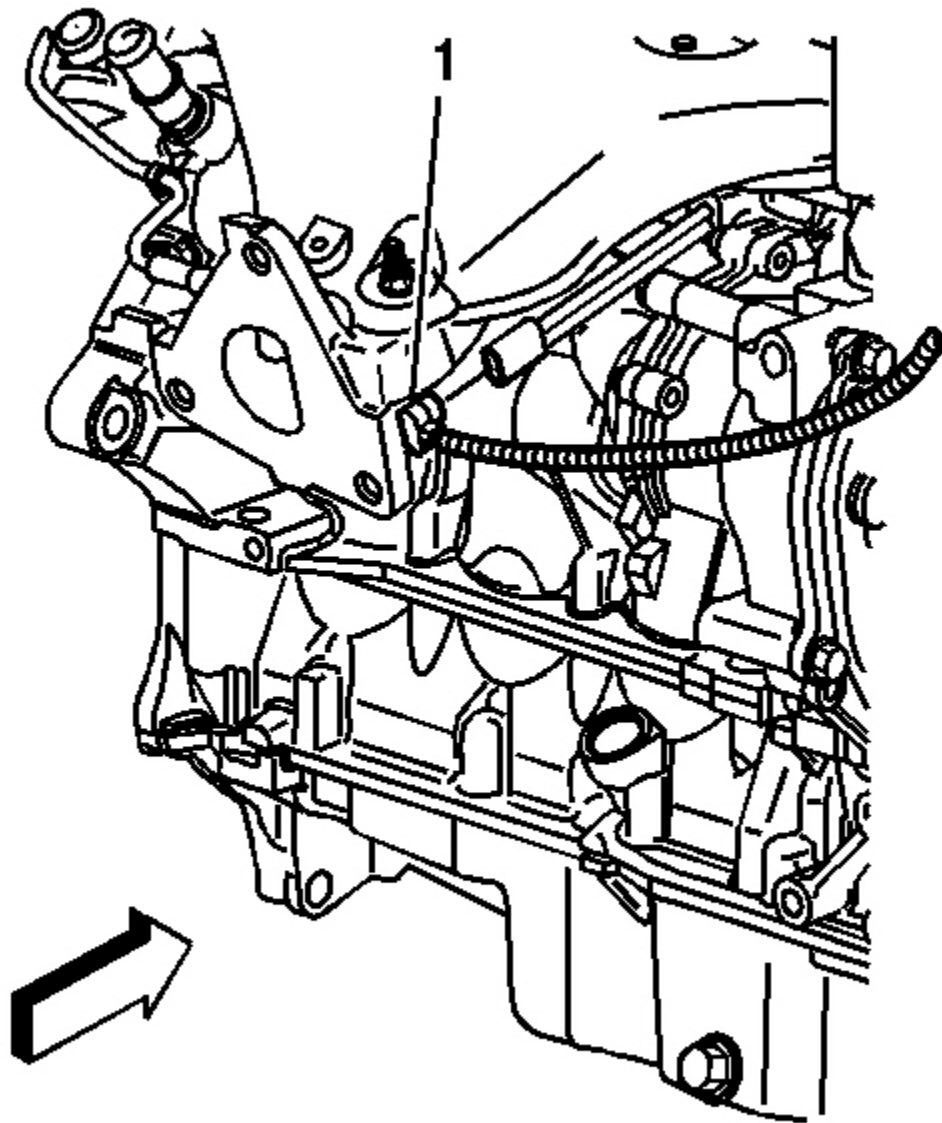


Fig. 164: Coolant Heater View
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine coolant heater cord (1).

COOLANT HEATER CORD REPLACEMENT (L66)

Removal Procedure

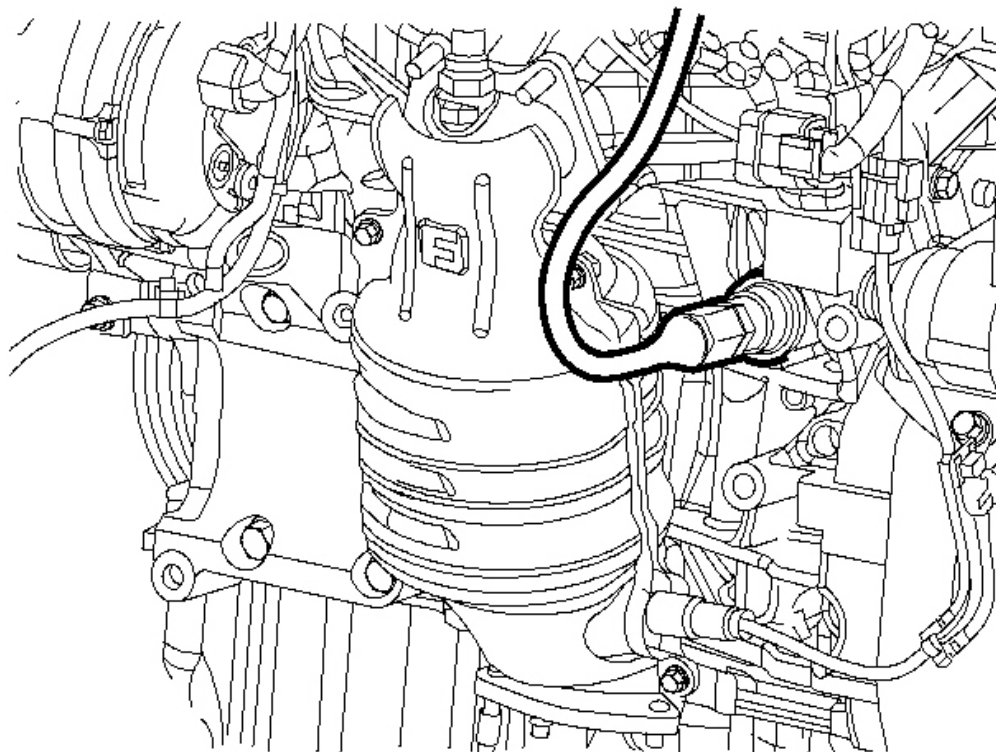


Fig. 165: View Of Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the coolant heater power supply cord from the coolant heater (2).
2. Disconnect the coolant heater cord clip (1) from the engine.

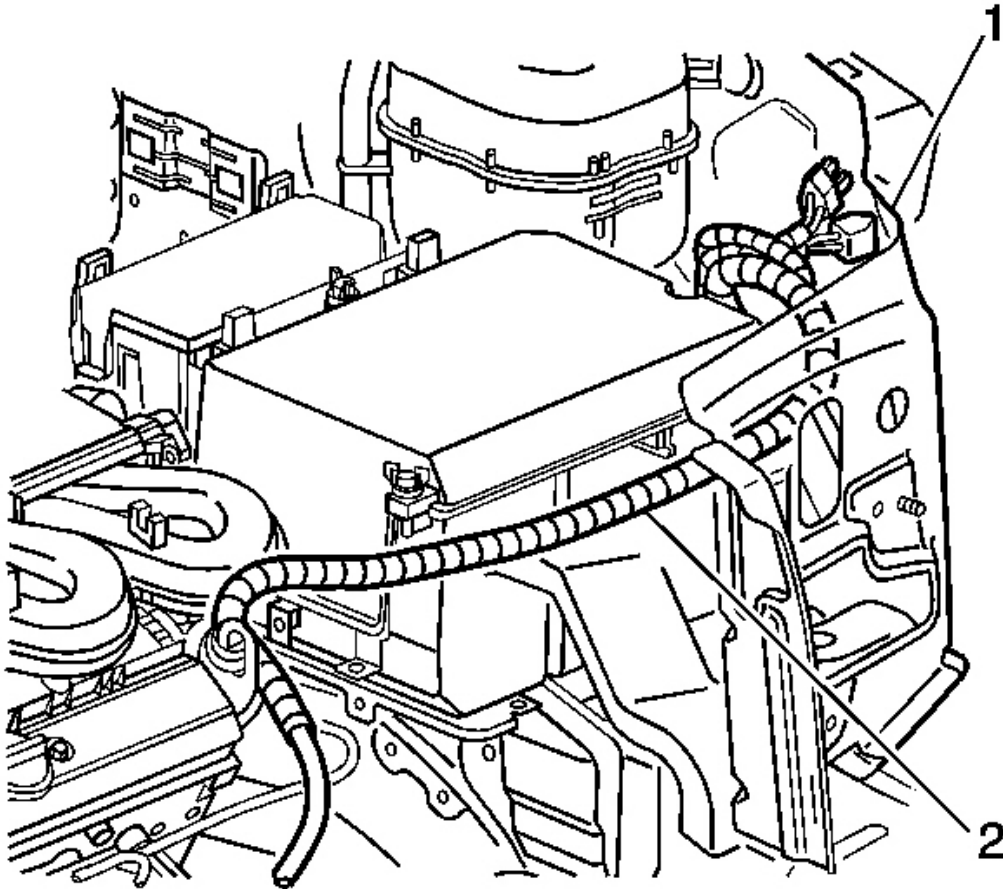


Fig. 166: View Of Coolant Heater Cord From The Washer Bottle & The Coolant Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant heater cord from between the washer bottle and the coolant reservoir (1).
4. Remove the coolant heater cord from the vehicle.

Installation Procedure

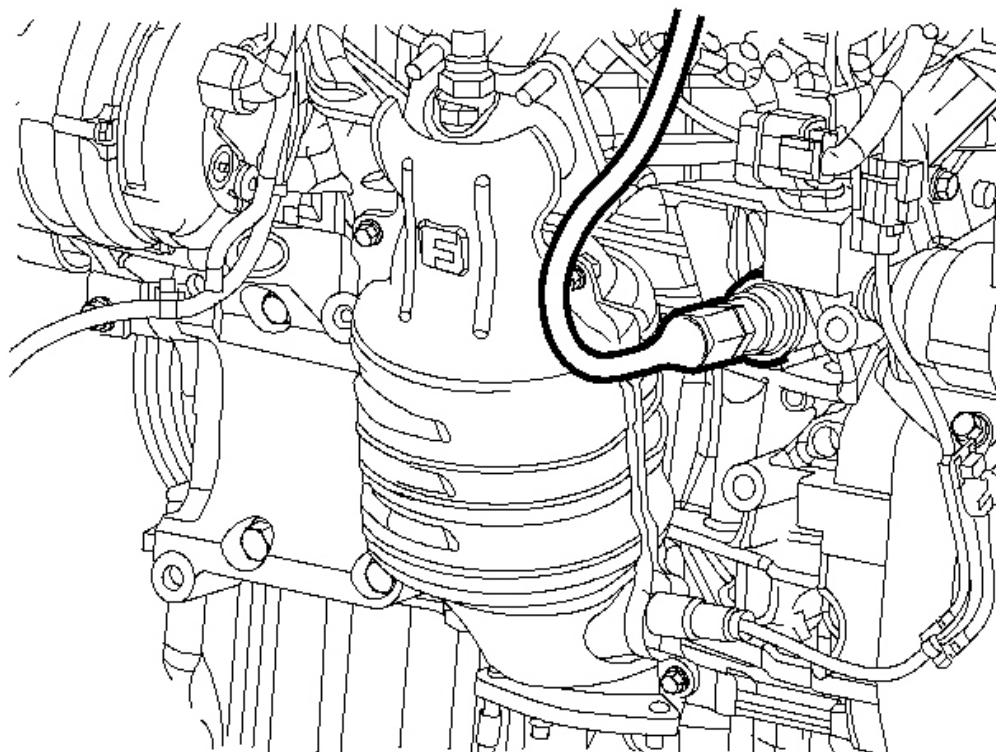


Fig. 167: View Of Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

1. Connect the coolant heater cord to the coolant heater (2).
2. Secure the coolant heater cord clip (1) to the engine.

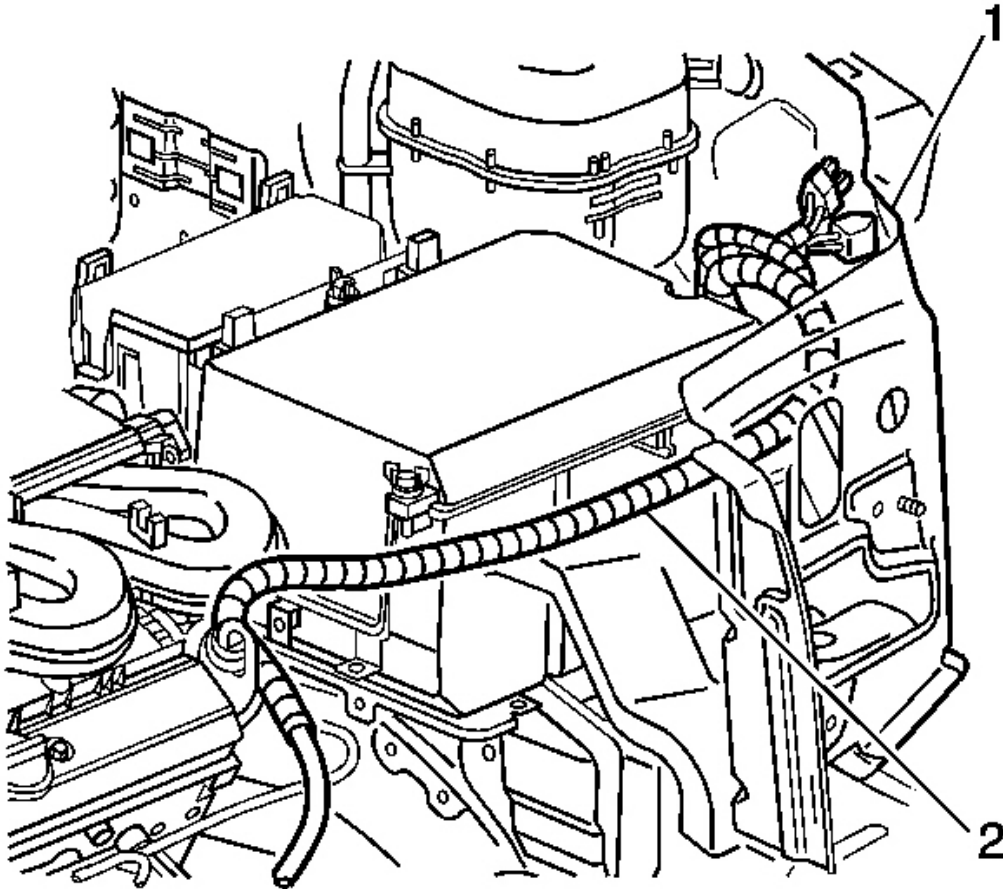


Fig. 168: View Of Coolant Heater Cord From The Washer Bottle & The Coolant Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Route the coolant heater cord along the battery (2).
4. Secure the coiled power cord between the washer fluid bottle and the coolant reservoir (1).

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system consists of one cooling fan and two relays with the L61 4 cylinder engine and two cooling fans and three relays with the L66 V6 engine. The relays are powered by the battery positive

voltage circuit and controlled by a switched ground from the engine control module (ECM) or powertrain control module (PCM).

During operation, the ECM/PCM supplies the ground path for the cooling fan relays 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/PCM commands the fan on under the following conditions:

- Engine coolant temperature exceeds approximately 114°C (237°F) - L61/2.2L.
- Engine coolant temperature exceeds approximately 98°C (208°F) Low Fan Speed - L66/3.5L.
- Engine coolant temperature exceeds approximately 102°C (216°F) High Fan Speed - L66/3.5L.
- A/C refrigerant pressure exceeds 2,945 kPa (427 psi) - L61/2.2L.
- A/C refrigerant pressure exceeds 361 kPa (52 psi) Low Fan Speed - L66/3.5L.
- A/C refrigerant pressure exceeds 2100 kPa (300 psi) High Fan Speed - L66/3.5L.
- With the L66 V6 engine, when the engine coolant temperature exceeds 112°C (234°F) at key off, the fan high speed will run for up to 300 seconds. If within that time frame 102°C (216°F) is reached then fan speed will change from high to low speed. If within that time frame 99°C (210°F) is reached then fan speed will change from low to off.

The ECM/PCM commands the fan off under the following conditions:

- A/C is requested and engine speed exceeds 6,250 RPM - L61/2.2L.
- A/C is requested and engine speed exceeds 6,240 RPM - L66/3.5L.
- Engine coolant temperature exceeds approximately 99°C (210°F) turns the cooling fans from low to off - L66/3.5L

Engine Coolant Indicator(s)

LOW COOLANT LEVEL

The IPC illuminates the low coolant warning indicator when any of the following occur:

- The BCM detects a low coolant level condition for at least 30 seconds. The IPC receives a class 2 message from the BCM requesting illumination.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.

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.

Surge Tank

The surge tank is a plastic tank that the pressure cap mounts onto. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system. The air space allows the coolant to expand and contract. The surge tank also provides a coolant fill point and a central air bleed location. During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. This is an advantage to 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.

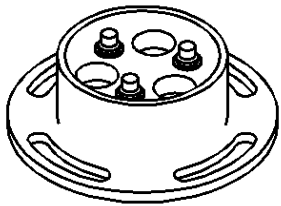
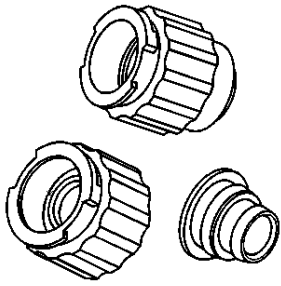
The transmission oil pump, pumps the fluid through the transmission oil cooler line to the transmission oil cooler. The fluid then flows through the cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

SPECIAL TOOLS AND EQUIPMENT

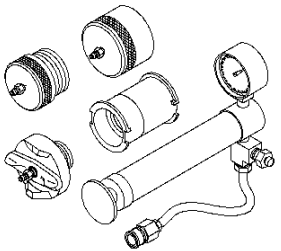
SPECIAL TOOLS

Special Tools

Illustration	Tool Number / Description
	<p>J 42401 Radiator Cap and Surge Tank Test Adapter</p>



J 43651
Water Pump Holding Tool



SA 9141E
Cooling System Pressure Test Kit