

2004 Cadillac SRX

2004 ENGINE Engine Cooling - SRX

2004 ENGINE**Engine Cooling - SRX****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS****Fastener Tightening Specifications**

Application	Specification	
	Metric	English
A/C Condenser Mounting Bolt	6.5 N.m	58 lb in
After-Boil Coolant Pump Nuts (LY7)	10 N.m	89 lb in
Auxiliary Electric Cooling-Fan-to-Condenser Mounting Bolts	6.5 N.m	58 lb in
Coolant Heater	60 N.m	44 lb ft
Coolant Heater Ground Lead Bolt	9 N.m	80 lb in
Coolant Inlet Pipe Bolt	20 N.m	15 lb ft
Coolant Inlet Pipe Support Bolt	20 N.m	15 lb ft
Electric Cooling Fan Blade Retaining Nut	7 N.m	62 lb in
Electric Cooling Fan Motor Mounting Screw	5 N.m	44 lb in
Electric Cooling-Fan-to-Radiator Mounting Bolt	6.5 N.m	58 lb in
Engine Coolant Temperature (ECT) Sensor	18 N.m	13 lb ft
Engine Driven Fan-Hub-Plate-to-Fan-Clutch Bolts	37 N.m	27 lb ft
Engine Driven Fan-to-Crankshaft Adapter Shaft	100 N.m	74 lb ft
Engine Rear Lift Bracket Bolt	20 N.m	15 lb ft
Heater Pipe Bracket Retaining Nuts	9 N.m	80 lb in
Manual Shift Shaft Nut	9 N.m	80 lb in
Oil Level Indicator Tube Bolt	20 N.m	15 lb ft
Radiator Support Bracket Bolt	9 N.m	80 lb in
Remote Power Steering Cooler-Line-to-Cooling-Fan Shroud Belts	6.5 N.m	58 lb in
Remote Power Steering Fluid Reservoir-to-Cylinder-Head Mounting Bolt	25 N.m	18 lb ft
Remote Power Steering Fluid Reservoir-to-Intake-Plenum Mounting Bolt	9 N.m	80 lb in
Surge Tank Outlet Hose Mounting Bracket Bolt	50 N.m	37 lb ft

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(LY7)		
Surge Tank Outlet Pipe Bracket Retaining Nuts	9 N.m	80 lb in
Surge Tank Outlet-Pipe-to-Vent-Housing Bolt	9 N.m	80 lb in
Surge Tank Retaining Bolt	9 N.m	80 lb in
Surge Tank Retaining Nut	9 N.m	80 lb in
Thermostat Housing Bolt	20 N.m	15 lb ft
Throttle Body Inlet Heater Hose Fitting	20 N.m	15 lb ft
Transmission Oil-Cooler-Line-to-Cooling-Fan-Shroud Bolts	6.5 N.m	58 lb in
Water Crossover Fitting	20 N.m	15 lb ft
Water Crossover Pipe Plug	5 N.m	44 lb in
Water Pump Bolt	25 N.m	18 lb ft
Water Pump Pulley Bolt	8 N.m	71 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

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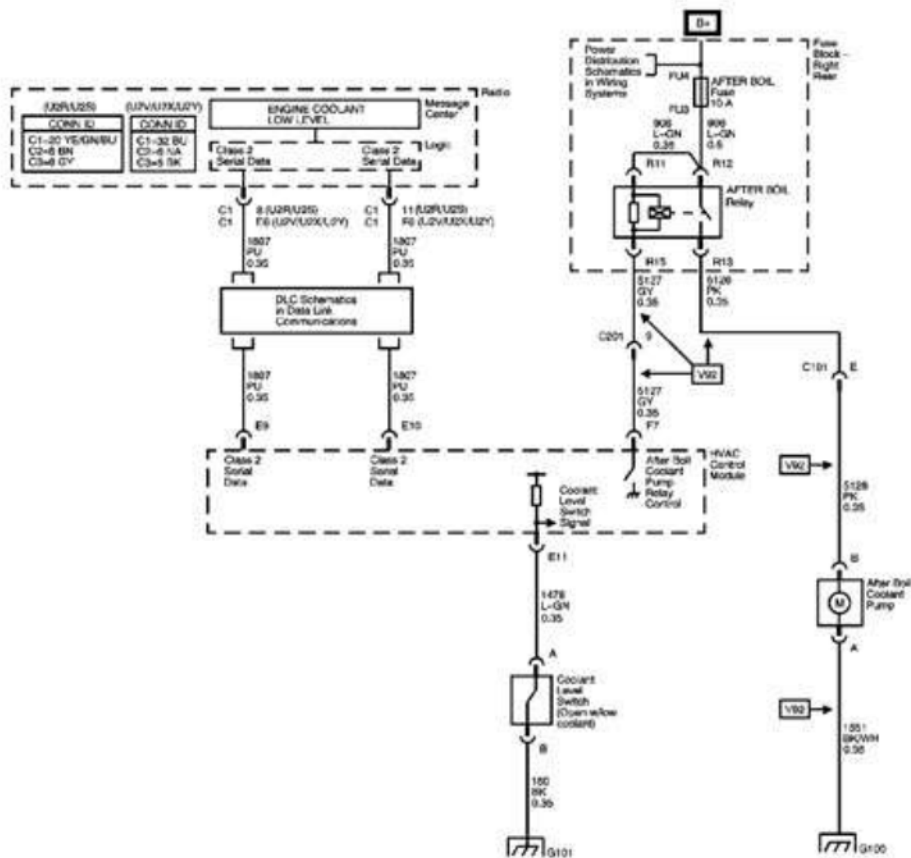


Fig. 1: Indicators & After Boil Coolant Pump Schematic
 Courtesy of GENERAL MOTORS CORP.

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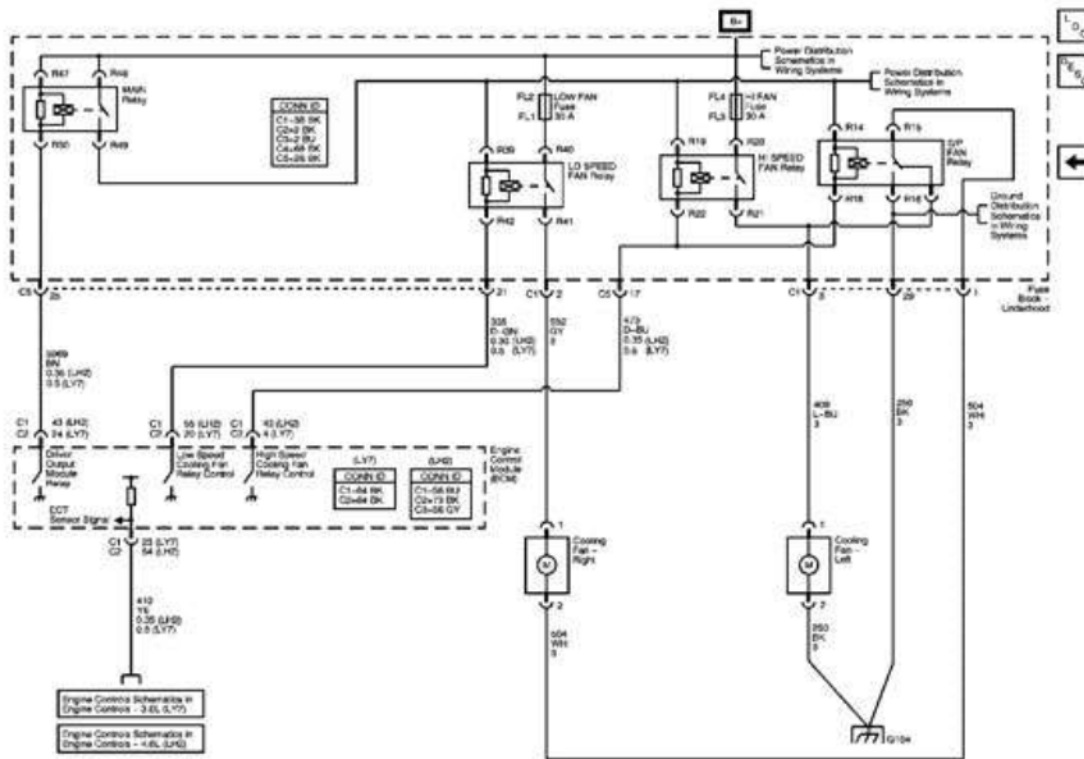


Fig. 2: Cooling Fans Schematic
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

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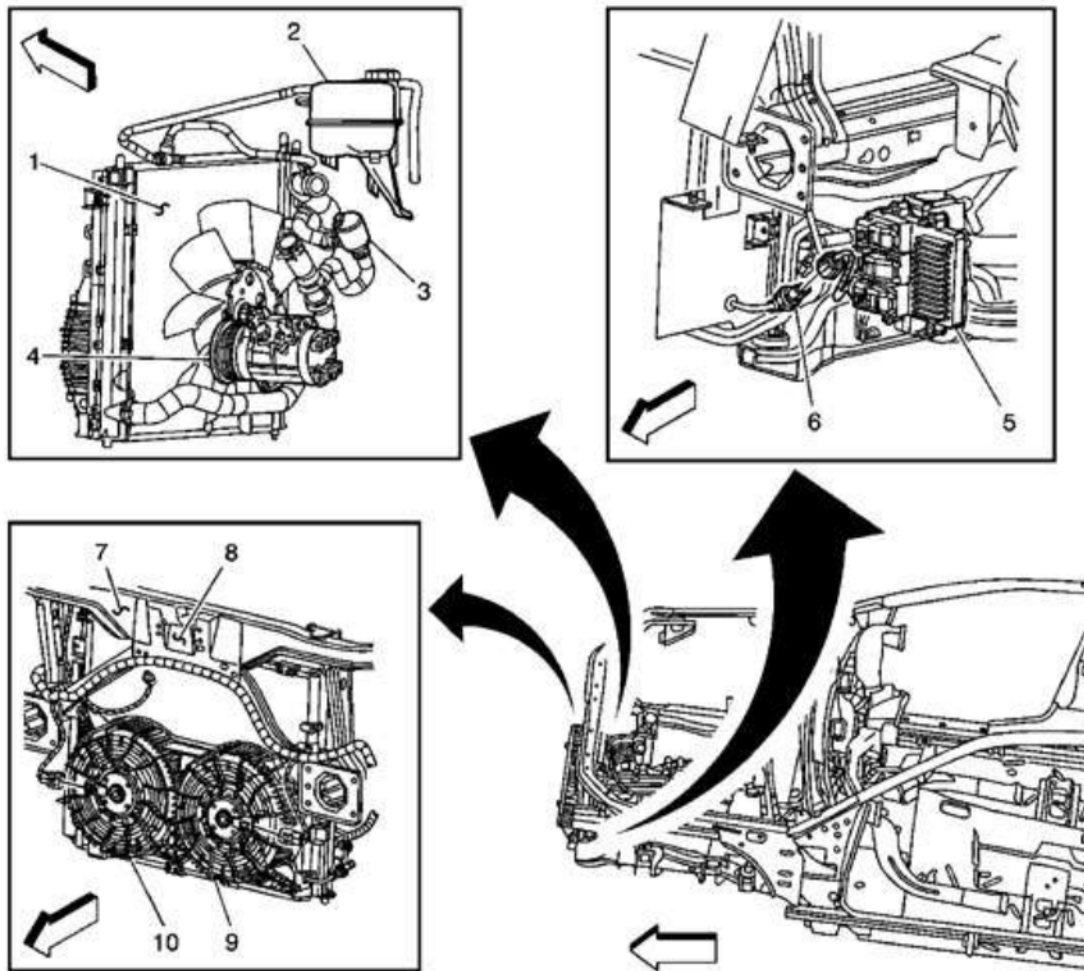


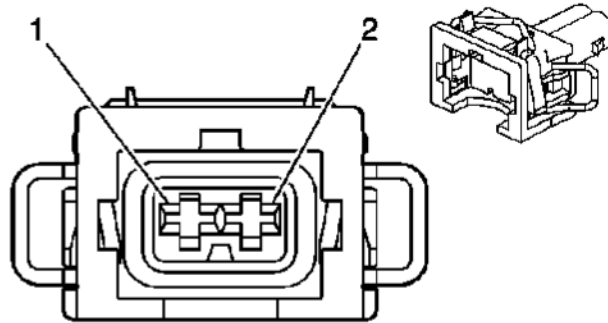
Fig. 3: Front Of Vehicle Component View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Radiator
2	Radiator Surge Tank
3	After Boil Coolant Pump (V92)
4	A/C Compressor Clutch
5	Engine Control Module (ECM) (LH2)
6	A/C Refrigerant Pressure Sensor
7	Condenser Assembly
8	Ambient Air Temperature Sensor
9	Cooling Fan - Left

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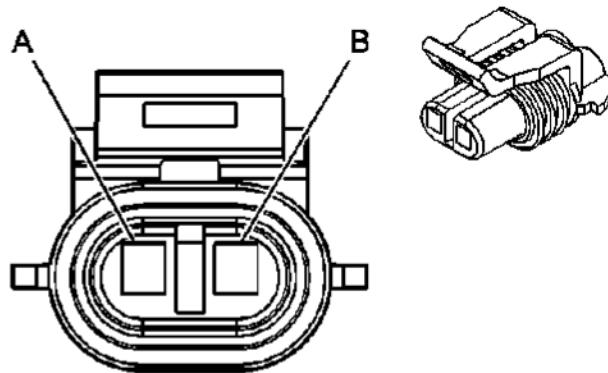


Connector Part Information

- 12131678
- 2-Way F Sealed (BK)

Pin	Wire Color	Circuit No.	Function
1	BK/WH	1551	Ground
2	PK	5126	Afterboil Coolant Pump Relay Control

Coolant Level Switch Terminal Identification



Connector Part Information

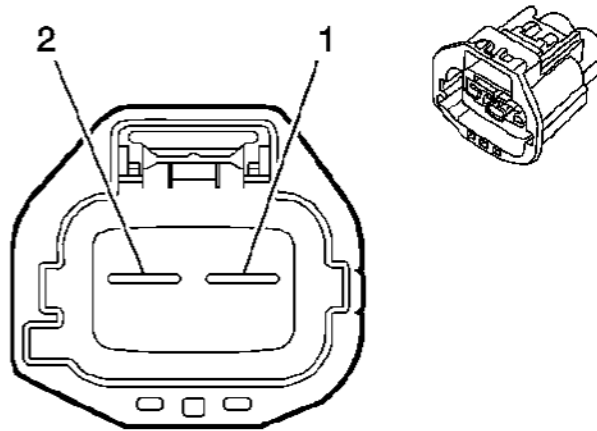
- 12052641
- 2-Way F Metri-Pack 150 Series Sealed (BK)

Pin	Wire Color	Circuit No.	Function
A	L-GN	1478	Coolant Level Switch Signal
B	BK	150	Ground

Cooling Fan Terminal Identification - Left

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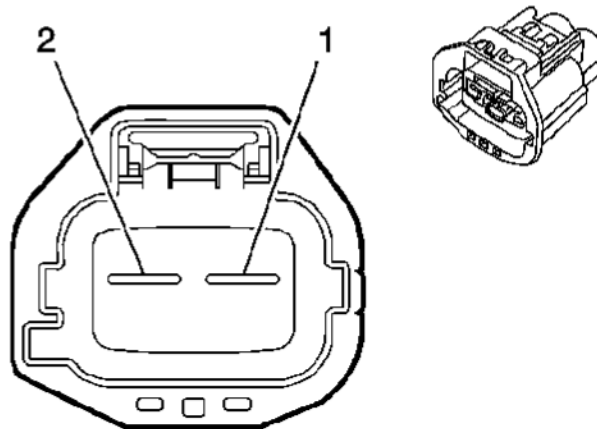


Connector Part Information

- 7283-5596-10
- 2-Way F Yazaki 6.3 Series (GY)

Pin	Wire Color	Circuit No.	Function
1	GY	532	Cooling Fan Motor Supply Voltage
2	WH	504	Cooling Fan Low Reference

Cooling Fan Terminal Identification - Right



Connector Part Information

- 7283-5596-10
- 2-Way F Yazaki 6.3 Series (GY)

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Pin	Wire Color	Circuit No.	Function
1	L-BU	409	Cooling Fan Motor Supply Voltage
2	BK	250	Ground

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the **Diagnostic System Check - Engine Cooling**. The Diagnostic System Check will provide the following information:

- The identification of the control module(s) which command the system.
- The ability of the control module(s) to communicate through the 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 partial malfunction of the class 2 serial data circuit or due to a total malfunction of the class 2 serial data circuit. The specified procedure will determine the particular condition.
- 3:** Determine if the instrument cluster or engine control modules have set DTCs which may affect engine cooling operation are present.
- 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

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2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the following control modules: • Instrument cluster • Engine control module Does the scan tool communicate with the control modules?	Go to Step 3	Go to <u>Data Link References</u> in Data Link Communications
3	Select the engine control module display DTCs function on the scan tool. Does the scan tool display any DTCs?	Go to Step 4	Go to <u>Symptoms - Engine Cooling</u>
4	Does the scan tool display any DTCs which begin with a "U"?	Go to <u>Scan Tool Does Not Communicate with Class 2 Device</u> in Data Link Communications	Go to <u>Diagnostic Trouble Code (DTC) List</u>

SCAN TOOL OUTPUT CONTROLS

Engine Control Module (ECM) Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Fan Relay 1	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the PCM and activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On and Off.
Fan Relay 2	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the PCM to activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On. After a 3 second delay the PCM will activate the cooling fan 2 relay and the cooling fan 3 relay. This turns the high speed fans On and Off.

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HVAC Control Module Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Water Pump Relay	Miscellaneous Tests	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the HVAC control module, and activate or deactivate the after-boil relay, manually turning the after-boil coolant pump On and Off.

SCAN TOOL DATA LIST**Scan Tool Data List**

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON, Engine OFF			
Cooling Fan After Run	Engine Data 2, Engine Data 3	Not Requested/Requested	Not Requested
ECT	Engine Data 1, Engine Data 2, Cooling/HVAC Data, EVAP Data, Fuel Trim Data	° C/° F	Varies
FC Relay 1 Command	Engine Data 2, Cooling/HVAC Data	On/Off	Varies
FC Relay 2 and 3 Command	Engine Data 2, Cooling/HVAC Data	On/Off	Varies
Low Coolant Status	HVAC System Data	OK/Low	OK
Low Coolant Switch	HVAC System Data	Open/Closed	Open
Water Pump Relay	Non-HVAC Data	On/Off	On

SCAN TOOL DATA DEFINITIONS**Cooling Fan After Run**

The scan tool displays Not Requested/Requested. If the engine coolant temperature is

greater than 101° C (214° F) when the engine is turned Off, the engine control module (ECM) will request low speed cooling fan operation, in conjunction with the after-boil coolant pump operation. If the engine coolant temperature is less than 101° C (214° F) after 60 seconds, the ECM will turn the cooling fans Off. Otherwise, the ECM will turn off the cooling fans and the after-boil coolant pump after 180 seconds on domestic vehicles, and 300 seconds on export vehicles.

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 ECM applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms and internal resistance decreases, the voltage signal decreases and the ECM interprets the lower voltage as a warm engine.

Engine Coolant Fan

The scan tool displays OFF, Level 1, Level 2, or Level 3. When the scan tool displays Level 1, the ECM is commanding the low speed fan control relay On. When the ECM commands the low speed fan relay On, the left and right cooling fans are enabled in low speed. When the scan tool displays Level 2, the ECM is commanding the low speed, high speed, and S/P fan relays On. When the low speed, high speed, and S/P fan relays are On, the left and right cooling fans are enabled in high speed. When the scan tool displays Level 3, the ECM is commanding all fan relays On. When all fan relays are activated, the left and right cooling fans are enabled in high speed, and the auxiliary cooling fan, if equipped, is enabled.

Low Coolant Status

The scan tool displays OK/Low. When the scan tool displays Low, a low voltage level has been detected on the coolant level switch signal circuit, indicating a low coolant level condition.

Low Coolant Switch

The scan tool displays Open/Closed. When the scan tool displays Open, the coolant level has fallen below a certain level, causing the low coolant level switch to open, and the check coolant level display should be activated.

Water Pump Relay

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The scan tool displays On/Off. The scan tool displays On when the HVAC control module has grounded the after-boil relay control circuit. Grounding the after-boil relay control circuit will turn on the after-boil relay, causing the after-boil coolant pump to turn on.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module(s)
P0480	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P0481	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P0691	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P0692	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P0693	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P0694	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	ECM
P1258	<u>DTC P1258</u>	ECM

DTC P0480, P0481, P0691, P0692, P0693, OR P0694

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 speed and S/P relay control circuit at the same time the low speed control circuit is grounded. Battery positive voltage is supplied to the low speed, high speed and S/P 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

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If the ECM detects an improper voltage level on the low or high speed driver circuits, then code P0480, P0481, P0691, P0692, P0693, or P0694, 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 one second.

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

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- 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.

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 S/P and high speed fan relays operate. Command both the ON and OFF states. Repeat the commands as necessary.

DTC P0480, P0481, P0691, P0692, P0693, or P0694

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u>			
Connector End View Reference: <u>Cooling System Connector End Views</u>			
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 Fans Low Speed 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 Fans High Speed ON and OFF. Do the S/P and the high speed fan relays turn ON and OFF with each command?	Go to Diagnostic Aids	Go to Step 6
4	1. Turn OFF the ignition. 2. Disconnect the low speed fan relay. 3. Turn ON the ignition, with the engine OFF.		

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	4. Probe the ignition 3 voltage circuit of the low speed fan relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Step 5	Go to Step 16
5	1. Connect a test lamp between the control circuit of the low speed fan relay and the ignition 3 voltage circuit of the low speed fan relay. 2. With a scan tool, command the Fans Low Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to Step 12	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the high speed fan relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 3 voltage circuit of the high speed fan relay with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to Step 7	Go to Step 16
7	1. Connect a test lamp between the control circuit of the high speed fan relay and the ignition 3 voltage circuit of the high speed fan relay. 2. With a scan tool, command the Fans High Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to Step 14	Go to Step 8
	1. Turn OFF the ignition. 2. Disconnect the S/P fan relay. 3. Turn ON the ignition with the engine OFF. 4. Connect a test lamp between the control		

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8	circuit of the S/P fan relay and the ignition 3 voltage circuit of the S/P fan relay. 5. With a scan tool, command the Fans High Speed ON and OFF. Does the test lamp turn ON and OFF with each command?	Go to Step 13	Go to Step 9
9	Does the test lamp remain illuminated with each command?	Go to Step 11	Go to Step 10
10	Test the control circuit of the appropriate relay for a short to voltage or an open. 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 21	Go to Step 15
11	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 21	Go to Step 15
12	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 21	Go to Step 17
13	Inspect for poor connections at the S/P 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 21	Go to Step 18
14	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 21	Go to Step 19
	Inspect for poor connections at the harness connector of the engine control module (ECM).		

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15	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 21	Go to Step 20
16	Repair the ignition 3 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 21	-
17	Replace the low speed fan relay. Did you complete the repair?	Go to Step 21	-
18	Replace the S/P fan relay. Did you complete the repair?	Go to Step 21	-
19	Replace the high speed fan relay. Did you complete the repair?	Go to Step 21	-
20	IMPORTANT: Perform the programming procedure for the ECM. Replace the ECM. Refer to <u>Engine Control Module (ECM) Replacement</u> in Engine Controls - 3.6L (L47) or <u>Engine Control Module (ECM) Replacement</u> in Engine Controls - 4.6L (LH2). Did you complete the replacement?	Go to Step 21	-
21	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	Go to Step 2	System OK

DTC P1258

Circuit Description

The engine control module (ECM) uses the ECT sensor to monitor the engine for an over temperature condition. This condition occurs when the coolant temperature is above 131° C (268° F). When an over temperature condition is present, DTC P1258 will set. The ECM will disable 2 groups of 4 cylinders by turning OFF the fuel injectors. By switching between the 2

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groups of cylinders, the ECM is able to reduce the temperature of the coolant.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The ECM detects an engine coolant temperature over 131° C (268° F).
- The above condition is present for at least 3 seconds.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The ECM will signal the IPC to turn ON the Service Engine Soon indicator.
- The ECM will alternately disable two groups of four cylinders by turning OFF the fuel injectors.
- The ECM will store conditions which were present when the DTC set in Freeze Frame Data.
- The ECM will command the fan on high speed.

Conditions for Clearing the MIL/DTC

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

DTC P1258

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

SYMPTOMS - ENGINE COOLING

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

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Cooling System. Refer to Checking Aftermarket Accessories 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 Inoperative
- Cooling Fan Always On
- Engine Overheating
- Loss of Coolant
- Thermostat Diagnosis (LS6)
- Engine Fails To Reach Normal Operating Temperature
- Pressure Cap Testing
- Cooling System Leak Testing

LOW ENGINE COOLANT INDICATOR ALWAYS ON**Low Engine Coolant Indicator Always On**

Step	Action	Yes	No
Schematic Reference: Body Control System Schematics in Body Control System			

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Connector End View Reference: Cooling System Connector End Views

DEFINITION: The check coolant level display 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, observe the low coolant switch parameter in the climate control panel HVAC system data list. Does the low coolant switch display open?	Go to Step 3	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems
3	1. Disconnect the coolant level switch connector. 2. Connect a 3-amp fused jumper wire between the coolant level switch signal circuit and the coolant level switch ground circuit, at the harness connector of the coolant level switch. Does the low coolant switch display closed on the scan tool?	Go to Step 7	Go to Step 4
4	Connect a 3-amp fused jumper wire from the coolant level switch signal circuit at the coolant level switch harness connector to a good ground. Does the low coolant switch display closed on the scan tool?	Go to Step 6	Go to Step 5
5	Test the signal circuit of the coolant level switch for an open. 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 8
	Repair the open or high resistance in the		

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6	coolant level switch ground circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 11	-
7	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
8	Inspect for poor connections at the harness connector of the HVAC control module. 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
9	Replace the coolant level switch. Refer to <u>Surge Tank Replacement</u> . Did you complete the replacement?	Go to Step 11	-
10	Replace the HVAC control module. Refer to <u>HVAC Control Module Replacement</u> in HVAC Systems - Automatic. Did you complete the repair?	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

Cooling Fan Always On

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u> 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 <u>Diagnostic System Check - Engine Cooling</u>
2	Turn ON the ignition, with the engine OFF.		

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	Are both cooling fans operating at low speed?	Go to Step 4	Go to Step 3
3	Is the left 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 low speed fan relay. Did the fans turn OFF?	Go to Step 8	Go to Step 6
5	Remove the high speed fan relay. Did the left cooling fan turn OFF?	Go to Step 9	Go to Step 7
6	Repair the cooling fan motor supply voltage circuit of the right cooling fan for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 12	-
7	Repair the cooling fan motor supply voltage circuit of the left cooling fan for a short to voltage Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 12	-
8	Inspect for poor connections at the low speed fan 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 12	Go to Step 10
9	Inspect for poor connections at the high speed fan 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 12	Go to Step 11
10	Replace the low speed fan relay. Did you complete the replacement?	Go to Step 12	-
11	Replace the high speed fan relay. Did you complete the replacement?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

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COOLING FAN INOPERATIVE

Cooling Fan Inoperative

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u> Connector End View Reference: <u>Cooling System Connector End Views</u> 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	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Low Speed ON and OFF. Do the low speed engine cooling fans turn ON and OFF with each command?	Go to Step 3	Go to Step 4
3	IMPORTANT: A 3-second delay occurs before the powertrain control module (PCM) changes the cooling fan speed. With a scan tool, command the Fans High Speed ON and OFF. Do the high speed engine cooling fans turn ON and OFF with each command?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 6
4	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 right cooling fan motor for a short to ground. 1. Disconnect the low speed fan relay. 2. Connect a jumper wire between the battery positive voltage circuit and the		

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	cooling fan motor supply voltage circuit of the low speed fan relay.		
	Do both cooling fans operate in low speed?	Go to Step 14	Go to Step 5
5	1. Disconnect the S/P fan relay. 2. With a test lamp connected to a good ground, probe the cooling fan low reference circuit at the S/P fan relay.		
	Does the test lamp illuminate?	Go to Step 9	Go to Step 8
6	Does the right cooling fan operate at high speed?	Go to Step 16	Go to Step 7
7	Inspect the ground circuit of the S/P fan relay for an open or high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 25	Go to Step 15
8	1. Install the S/P fan relay. 2. Disconnect the right cooling fan electrical connector. 3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the right cooling fan motor connector.		
	Does the test lamp illuminate?	Go to Step 12	Go to Step 13
9	1. Install the S/P fan relay. 2. Disconnect the left cooling fan motor connector. 3. With a test lamp connected to a good ground, probe the cooling fan motor supply voltage circuit at the left cooling fan connector.		
	Does the test lamp illuminate?	Go to Step 11	Go to Step 10
	Inspect the cooling fan motor supply voltage circuit for an open or high resistance. Refer to		

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10	<u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 25	Go to Step 15
11	Inspect the ground circuit of the left cooling fan for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 25	Go to Step 18
12	Inspect the cooling fan low reference circuit for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 25	Go to Step 17
13	Inspect the cooling fan motor supply voltage circuit of the right cooling fan for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 25	Go to Step 19
14	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 25	Go to Step 20
15	Inspect for poor connections at the S/P 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 25	Go to Step 21
16	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 25	Go to Step 22
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.		

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	Did you find and correct the condition?	Go to Step 25	Go to Step 23
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 25	Go to Step 24
19	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 25	-
20	Replace the low speed fan relay. Did you complete the replacement?	Go to Step 25	-
21	Replace the S/P fan relay. Did you complete the replacement?	Go to Step 25	-
22	Replace the high speed fan relay. Did you complete the replacement?	Go to Step 25	-
23	Replace the right cooling fan. Refer to <u>Cooling Fan Replacement - Electric (LH2 - Standard Cooling)</u> or <u>Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)</u> or <u>Cooling Fan Replacement - Electric (LY7)</u> . Did you complete the replacement?	Go to Step 25	-
24	Replace the left cooling fan. Refer to <u>Cooling Fan Replacement - Electric (LH2 - Standard Cooling)</u> or <u>Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)</u> or <u>Cooling Fan Replacement - Electric (LY7)</u> . Did you complete the replacement?	Go to Step 25	-
25	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

AFTER BOIL COOLANT PUMP INOPERATIVE

After Boil Coolant Pump Inoperative

Step	Action	Yes	No
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Schematic Reference: Engine Cooling Schematics

Connector End View Reference: Cooling System Connector End Views

DEFINITION: The after-boil coolant pump does not operate under certain conditions.

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 Water Pump Control ON in climate control panel (CCP) special functions, miscellaneous test. Does the after-boil coolant pump operate?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 3
3	1. Disconnect the after-boil relay. 2. Connect a test lamp between the control circuit of the after-boil relay and the coil supply voltage circuit of the after-boil relay. 3. With a scan tool command the Water Pump Control ON and OFF. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	Connect a 5-amp fused jumper wire between the battery positive voltage circuit of the after-boil relay and the after-boil coolant pump supply voltage circuit of the after-boil relay. Does the after-boil coolant pump operate?	Go to Step 12	Go to Step 8
5	Test the control circuit of the after-boil relay for an open or 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 13	Go to Step 6
6	Test the battery positive voltage circuit of the after-boil relay for an open or a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.		

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	Did you find and correct the condition?	Go to Step 13	Go to Step 7
7	Test the voltage supply circuit of the after-boil coolant pump for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 10
8	Test the voltage supply circuit of the after-boil coolant pump for an open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 9
9	Test the ground circuit of the after-boil coolant pump for an open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 11
10	Replace the HVAC Control Module. Refer to <u>HVAC Control Module Replacement</u> in HVAC Systems - Automatic. Did you complete the replacement?	Go to Step 13	-
11	Replace the after-boil coolant pump. Refer to <u>Afterboil Coolant Pump Replacement</u> . Did you complete the replacement?	Go to Step 13	-
12	Replace the after-boil relay. Did you complete the replacement?	Go to Step 13	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

ENGINE OVERHEATING

Diagnostic Aids

The engine may overheat due to an intermittent operation of one of the following components:

- The after boil heater pump
- The coolant bypass solenoid
- The coolant bypass valve
- The mechanical cooling fan
- The electric cooling fans

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- The thermostat

For electrical inspection of the cooling fans and the after boil heater pump, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Engine Overheating

Step	Action	Value(s)	Yes	No
DEFINITION: Engine temperature lamp comes ON and stays ON, or the temperature gage shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.				
1	Did you perform the Engine Cooling Diagnostic System Check?	-	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	Inspect the surge tank for low coolant. Is there a loss of coolant?	-	Go to <u>Loss of Coolant</u>	Go to Step 3
3	IMPORTANT: Do not allow the engine temperature to exceed the specified value. Start the engine and allow to reach normal operating temperature. Does the engine begin to exceed the specified value?	107° C (225° F)	Go to Step 4	Go to Diagnostic Aids
4	1. Inspect for loose, damaged, and/or missing of the following: • The A/C condenser seals • The front air deflector • The side seals 2. Repair the system as necessary. Does the engine still overheat?	-	Go to Step 5	Go to Step 18
5	Using the J 23688 Coolant and Battery Fluid Tester, test for insufficient coolant concentration. Is the coolant protection greater than the specified value?	-37° C (-34° F)	Go to Step 6	Go to Step 7

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6	Correct the coolant concentration as necessary. Does the engine still overheat?	-	Go to Step 7	Go to Step 18
7	Inspect for obstructed radiator air flow or bent radiator fins. Is the radiator air flow obstructed?	-	Go to Step 8	Go to Step 9
8	Clean the radiator. Refer to <u>Radiator Cleaning</u> . Does the engine still overheat?	-	Go to Step 9	Go to Step 18
9	Inspect the drive belt tensioner. Refer to <u>Drive Belt Tensioner Diagnosis</u> in Engine Mechanical - 3.6L or <u>Drive Belt Tensioner Diagnosis</u> in Engine Mechanical - 4.6L. Is the drive belt tensioner working properly and is the tension correct?	-	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner. Refer to <u>Drive Belt Tensioner Replacement - Generator and Water Pump</u> or <u>Drive Belt Tensioner Replacement - Power Steering and Air Conditioning</u> in Engine Mechanical - 3.6L or <u>Drive Belt Tensioner Replacement - Generator or Drive Belt Tensioner Replacement - Air Conditioning, Power Steering and Water Pump</u> in Engine Mechanical - 4.6L. Does the engine still overheat?	-	Go to Step 11	Go to Step 18
11	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis (LS6)</u> . Does the thermostat operate properly?	-	Go to Step 13	Go to Step 12
12	Replace the thermostat. Refer to <u>Thermostat Replacement (LH2)</u> or <u>Thermostat Replacement (LY7)</u> . Does the engine still overheat?	-	Go to Step 13	Go to Step 18
13	Inspect for an inoperative after boil coolant pump if equipped. Refer to <u>After</u>	-		

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	<u>Boil Coolant Pump Inoperative.</u> Does the engine still overheat?		Go to Step 14	Go to Step 18
14	Inspect for an inoperative cooling fan. Refer to <u>Cooling Fan Inoperative</u> or <u>Fan Clutch Diagnosis.</u> Does the engine still overheat?	-	Go to Step 15	Go to Step 18
15	Inspect for blocked cooling system passages. Are the cooling system passages blocked?	-	Go to Step 16	Go to Step 17
16	Replace the radiator. Refer to <u>Radiator Replacement (LH2 - Standard Cooling)</u> or <u>Radiator Replacement (LH2 - Heavy Duty Cooling)</u> or <u>Radiator Replacement (LY7 - Standard Cooling).</u> Does the engine still overheat?	-	Go to Step 17	Go to Step 18
17	Replace the engine water pump. Refer to <u>Water Pump Replacement (LH2)</u> or <u>Water Pump Replacement (LY7).</u> Did you complete the repair?	-	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

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 <u>Symptoms - Engine Cooling</u>
2	Repair any present DTCs. Refer to <u>Diagnostic System Check - Engine Cooling.</u> 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
	Fill the cooling system to the proper level.		

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4	Refer to <u>Draining and Filling Cooling System</u> . 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 cylinder. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 23
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 24	Go to Step 7
7	Extended engine operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 26	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	- Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. - Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 25	Go to Step 10
10	With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: - Afterboil pump - Engine - Heater		

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	• Radiator • Surge tank		
	Are any of the hoses, clamps or pipes leaking?	Go to Step 19	Go to Step 12
12	Visually inspect the following components: • Core plugs • Cylinder head gaskets • Engine block • Intake manifold • Radiator • Thermostat • Water pump • Surge tank • Surge tank cap		
	Are any of the listed components leaking?	Go to Step 19	Go to Step 13
13	1. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing</u>. 2. Visually inspect the components listed in steps 11 and 12 again.		
	Are any leaks present?	Go to Step 19	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to <u>Pressure Cap Testing</u>. Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 20
15	Pressure test the coolant pressure cap. Refer to <u>Pressure Cap Testing</u>. Does the coolant pressure cap hold pressure?	Go to Step 27	Go to Step 20
16	Inspect for the following conditions: • A coolant smell inside of the vehicle • Coolant in the HVAC module drain tube • Coolant on the vehicle floor covering		

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	under the HVAC module		
	Is coolant present?	Go to Step 21	Go to Step 17
17	Inspect the underside of the oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to Step 18	Go to Step 28
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 25	Go to Step 28
19	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 28	-
20	Replace the coolant pressure cap. Is the repair complete?	Go to Step 28	-
21	Replace the heater core. Refer to <u>Heater Core Replacement</u> in Heating, Ventilation and Air Conditioning. Is the repair complete?	Go to Step 28	-
22	Replace the radiator. Refer to <u>Radiator Replacement (LH2 - Standard Cooling)</u> or <u>Radiator Replacement (LH2 - Heavy Duty Cooling)</u> or <u>Radiator Replacement (LY7 - Standard Cooling)</u> . Is the repair complete?	Go to Step 28	-
23	Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> in Engine Mechanical - 4.6L (LH2) or <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> in Engine Mechanical - 3.6L (LY7). Is the repair complete?	Go to Step 28	-
24	Repair the engine overheating condition. Refer to <u>Engine Overheating</u> . Is the repair complete?	Go to Step 28	-
	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> or		

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25	Coolant in Engine Oil in Engine Mechanical - 4.6L (LH2) or Coolant in Combustion Chamber or Coolant in Engine Oil in Engine Mechanical - 3.6L (LY7). Is the repair complete?	Go to Step 28	-
26	Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed in Engine Mechanical - 4.6L (LH2) or Lower Engine Noise, Regardless of Engine Speed in Engine Mechanical - 3.6L (LY7). Is the repair complete?	Go to Step 28	-
27	Repair the combustion pressure in the cooling system problem. Refer to Cylinder Leakage Test in Engine Mechanical - 4.6L (LH2) or Cylinder Leakage Test in Engine Mechanical - 3.6L (LY7). Is the repair complete?	Go to Step 28	-
28	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS (LS6)**Tools Required**

- **J 24731** 188 Tempilstick. See **Special Tools and Equipment**.
- **J 24731** 206 Tempilstick. See **Special Tools and Equipment**.

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

1. Use a tempilstick in order to find the opening and the closing temperatures of the coolant thermostat.
 - J 24731-188 tempilstick melts at 87° C (188° F). The thermostat should begin to open at 90° C (194° F).
 - J 24731-206 tempilstick melts at 97° C (206° F). The thermostat should be fully open at 107° C (225° F).

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2. Replace the coolant thermostat if it does not operate properly between this temperature range.

COOLANT HEATER INOPERATIVE

Coolant Heater Inoperative

Step	Action	Yes	No
DEFINITION: The coolant heater does not warm the engine coolant properly.			
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 (LH2 (K05,KA3)) or Coolant Heater Cord Replacement (LY7 (K05)) . Did you complete the replacement?	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 (LH2 (K05)) or Coolant Heater Replacement (LH2 (KA3)) or Coolant Heater Replacement (LY7, K05) . Did you complete the replacement?	Go to Step 6	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Diagnostic Aids

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The engine may fail to reach normal operating temperature due to an intermittent operation of one of the following components:

- The thermostat
- The electric fan system
- The mechanical fan system

For electrical inspection of the electrical fan system, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

For mechanical fan system inspection refer to **Fan Clutch Diagnosis**.

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
DEFINITION: Normal coolant temperature readings will be expected to vary from 88-104° C (190-220° F).			
1	Did you perform the engine cooling diagnostic system check?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	Verify that the engine fails to reach normal operating temperature. Is the engine failing to reach normal operating temperature?	Go to Step 3	Go to Diagnostic Aids
3	Inspect the surge tank for low coolant. Is there a loss of coolant?	Go to <u>Loss of Coolant</u>	Go to Step 4
4	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis (LS6)</u> . Does the thermostat operate properly?	Go to Step 6	Go to Step 5
5	Replace the thermostat. Refer to <u>Thermostat Replacement (LH2)</u> or <u>Thermostat Replacement (LY7)</u> . 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

PRESSURE CAP TESTING

Tools required

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

Pressure Cap Testing

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.

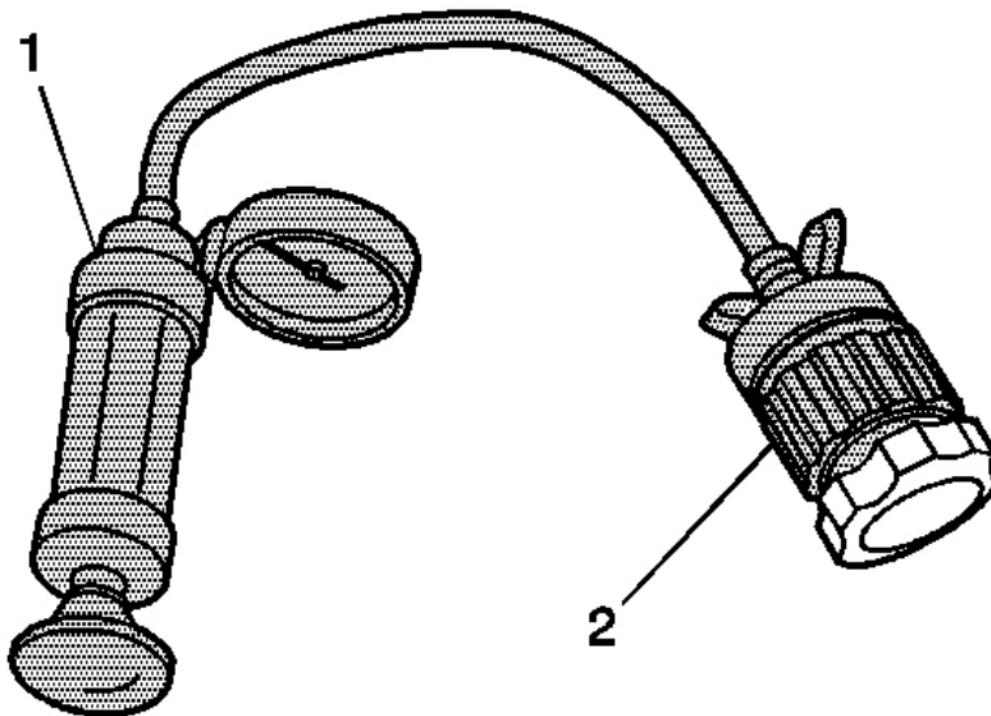


Fig. 5: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** (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 **J 24460-01** 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.

COOLING SYSTEM LEAK TESTING

Tools Required

- **J 24460-01** Cooling System Pressure Tester. 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.

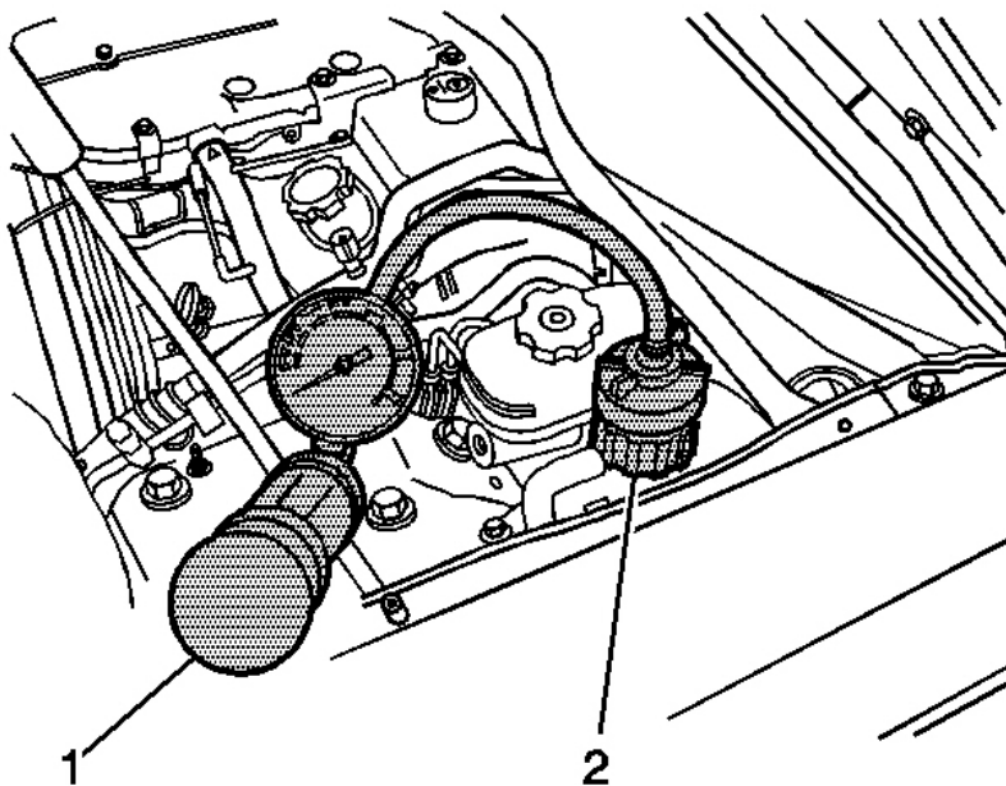


Fig. 6: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS CORP.

4. Use the J 24460-01 (1) with J 42401 (2) in order to apply pressure to the cooling system. See **Special Tools and Equipment**.

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.

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FAN CLUTCH DIAGNOSIS

Fan Clutch Diagnosis

Step	Action	Yes	No
DEFINITION: Testing the engagement and disengagement of the fan clutch.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Is there excessive fan air noise?	Go to Step 3	Go to Step 4
3	Fan air noise is normal during cold engine start up. Does the fan noise go away at normal engine operating temperature?	Go to Step 13	Go to Step 4
4	IMPORTANT: The engine must be turned OFF and the engine temperature should be cold. Rotate the fan clutch.Does the fan clutch rotate?	Go to Step 5	Go to Step 14
5	Visually inspect the fan blades for cracks, looseness or damage. Are the fan blades in good condition?	Go to Step 6	Go to Step 15
6	Visually inspect the fan clutch for signs of silicone leakage. - Slight silicone leakage may not effect the fan clutch engagement. - Excess leakage will prevent the fan clutch from engaging. Is the silicone fluid leakage excessive?	Go to Step 14	Go to Step 7
7	Inspect the fan clutch for proper installation. - Move the fan blade back and forth in a lateral motion. - Inspect for fan blade to fan clutch movement.		

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	Is the fan blade loose at the fan clutch?	Go to Step 10	Go to Step 8
8	Inspect the fan clutch for wear. 1. Move the fan blade back and forth in a lateral motion. IMPORTANT: Approximately 6.5 mm (1/4 in) movement at the tip of the fan blade is normal. 2. Inspect for fan clutch lateral movement. Is the fan clutch lateral movement excessive?	Go to Step 14	Go to Step 9
9	The fan clutch should have more turning resistance when the engine is at or above normal operating temperature. Does the fan clutch have more resistance when the engine temperature is raised?	Go to Step 11	Go to Step 14
10	Tighten the fan. Refer to <u>Fastener Tightening Specifications</u>. Is the repair complete?	Go to Step 15	-
11	Perform a fan clutch engagement test. 1. Ensure the engine coolant level is full. 2. Ensure the cooling fan drive belt tension is correct and not slipping. 3. Position and secure a thermometer between the fan clutch and the radiator. 4. Ensure the cooling fan is disengaged before starting this test. 5. Sufficiently cover the radiator grille to restrict the air flow. IMPORTANT: Do not allow engine temperature to exceed 121°C (250°F). 6. Start the engine.		

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	7. Turn the A/C ON. 8. Operate the engine at approximately 2,000 RPM. 9. Inspect the thermometer reading when the fan clutch engages. 10. Do not continue this test if the fan clutch does not engage between 85-96° C (185-205° F). Fan clutch engagement will be indicated by an increase in fan air noise, fan speed, and a drop of about 3-10° C (5-15° F) on the thermometer reading. Did the fan clutch engage between 85-96° C (185-205° F)?	Go to Step 12	Go to Step 14
12	Once the fan clutch engages, perform the following steps: 1. Uncover the radiator grille. 2. Turn the A/C OFF. 3. Operate the engine at approximately 2,500 RPM to reduce the engine operating temperature. 4. Remove the thermometer. Did the engine return to normal operating temperature?	Go to Step 13	-
13	As the engine temperature returns to normal, the fan clutch will disengage, indicated by a reduction in fan air noise and fan speed. Did the fan clutch disengage?	Go to Step 15	Go to Step 14
14	Replace the fan assembly. Refer to <u>Fan Replacement</u>. Is the repair complete?	Go to Step 15	-
15	Operate the fan clutch to verify proper operation.		

Did you find and correct the condition?	System OK	Go to Step 2
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REPAIR INSTRUCTIONS

DRAINING AND FILLING COOLING SYSTEM

Tools Required

J 26568 Coolant and Battery Fluid Tester. See Special Tools and Equipment.

Draining Procedure

CAUTION: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.

1. Park the vehicle on a level surface.
2. Remove the surge tank cap.
3. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
4. Remove the air deflector. Refer to Air Deflector Replacement - Front.
5. Place a drain pan under the radiator.
6. Insert a piece of clean flexible hose through the access hole in the cradle onto the radiator mounting pin.
7. Slowly loosen the drain cock and drain the coolant into the drain pan. Do not completely remove the drain cock.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance-Follow the flush procedure. Refer to Flushing.
 - Normal in appearance-Follow the Fill Procedure below.

Fill Procedure

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

engine damage.

1. Close the radiator drain cock.
2. Install the air deflector. Refer to **Air Deflector Replacement - Front** .
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean drinkable water to the cooling system through the top of the surge tank opening. Refer to **Capacities - Approximate Fluid** .
5. Slowly fill the cooling system until the coolant stabilizes at 25 mm (1 inch) above the FULL COLD mark on the surge tank.
6. Install the surge tank cap.
7. Start the engine.
8. Run the engine at 2,000-2,500 RPM until engine reaches normal operating temperature.
9. Allow the engine to idle for 3 minutes.
10. Shut the engine OFF.
11. Allow the engine to cool.
12. Add or remove coolant as necessary from the surge tank until the level is stabilized at the FULL COLD mark.
13. Inspect the cooling system for leaks.
14. Using **J 26568** inspect the concentration of the engine coolant. See **Special Tools and Equipment**.

FLUSHING**IMPORTANT: Do not use a chemical flush.**

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

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

1. Block the drive wheels.

2. Place the transmission in PARK (P).
3. Engage the park brake.
4. Run the engine until the thermostat opens.
5. Stop the engine.

CAUTION: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

6. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. Refer to Draining and Filling Cooling System.
7. Fill the cooling system when flushing is complete. Refer to Draining and Filling Cooling System.

RADIATOR CLEANING

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

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

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

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

SURGE TANK REPLACEMENT

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

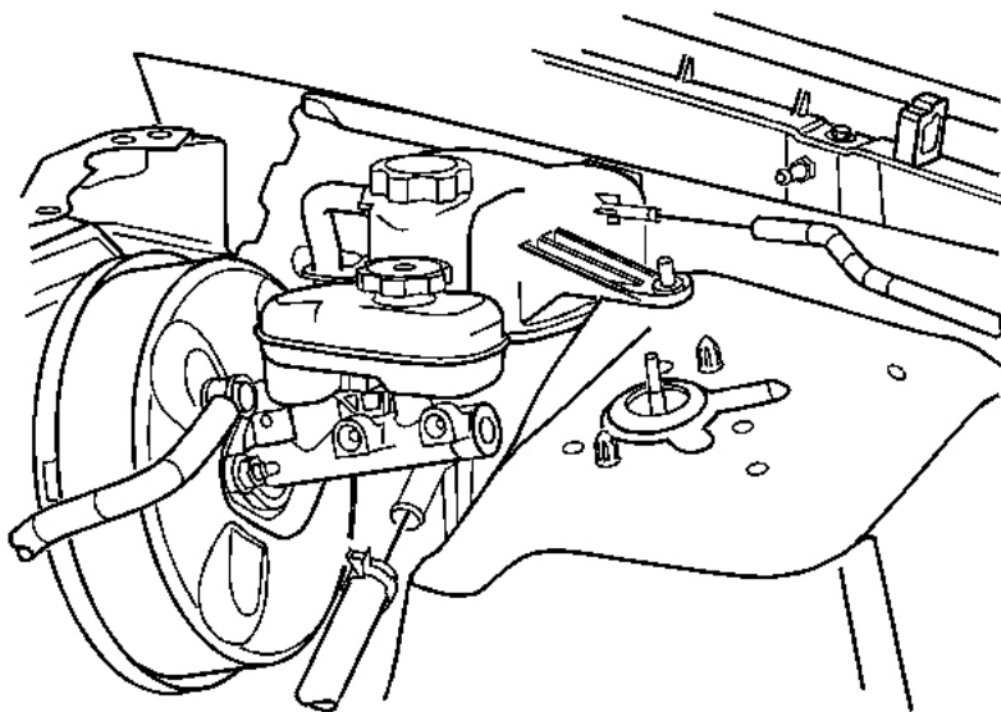


Fig. 7: View Of Surge Tank Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Disconnect the master cylinder fluid level sensor electrical connector and reposition aside.
3. Using the **J 38185** , disengage and reposition the surge tank outlet hose clamp.
4. Disconnect the surge tank outlet hose.
5. Using the **J 38185** , disengage and reposition the surge tank inlet hose clamp.
6. Disconnect the surge tank inlet hose.

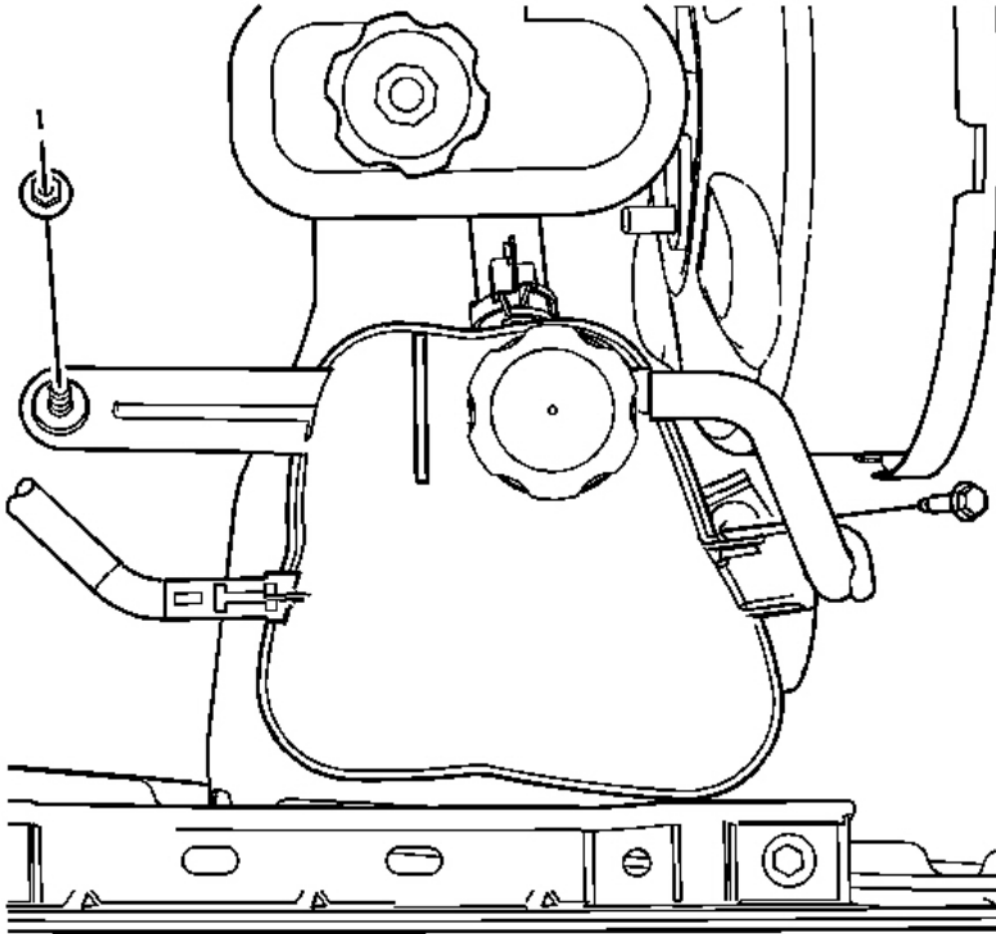


Fig. 8: View Of Surge Tank

Courtesy of GENERAL MOTORS CORP.

7. Remove the surge tank bolt.
8. Remove the surge tank nut.
9. Disconnect the low coolant sensor electrical connector.
10. Remove the surge tank.

Installation Procedure

1. Install the surge tank.

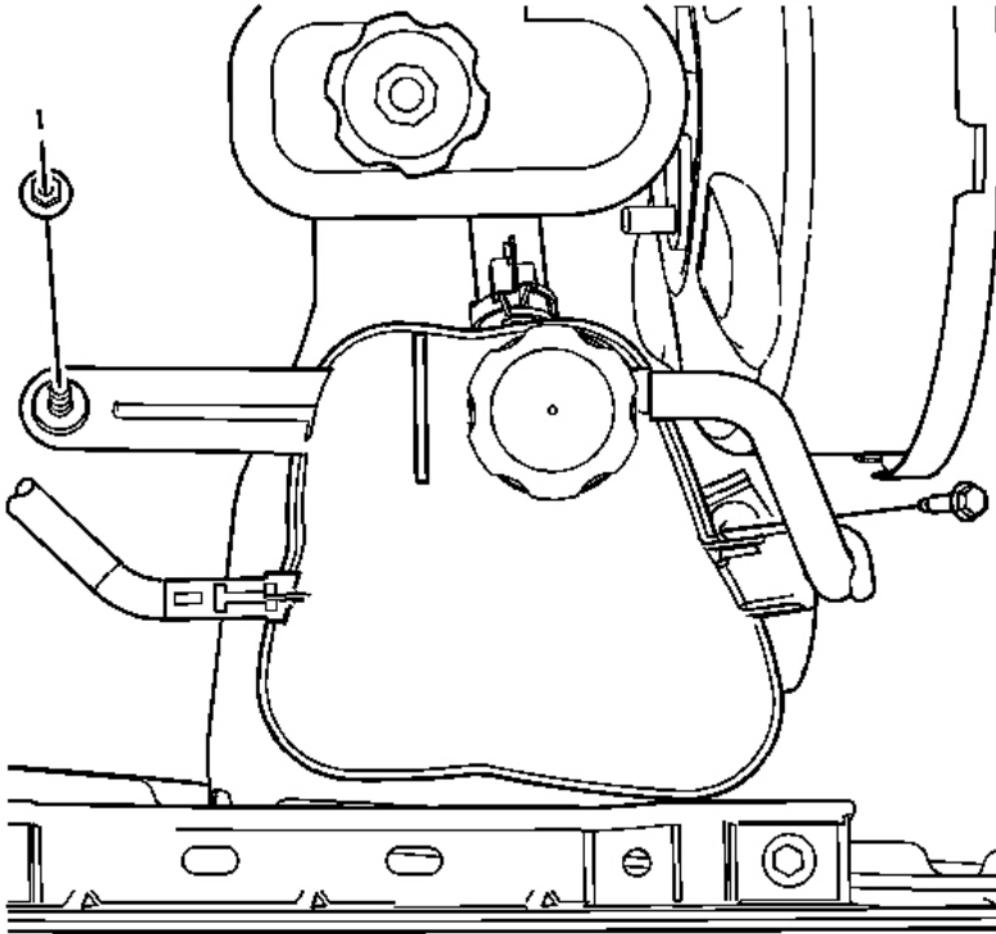


Fig. 9: View Of Surge Tank

Courtesy of GENERAL MOTORS CORP.

2. Connect the low coolant sensor electrical connector.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the surge tank nut.

Tighten: Tighten the nut to 9 N.m (80 lb in).

4. Install the surge tank bolt.

Tighten: Tighten the bolt to 9 N.m (80 lb in).

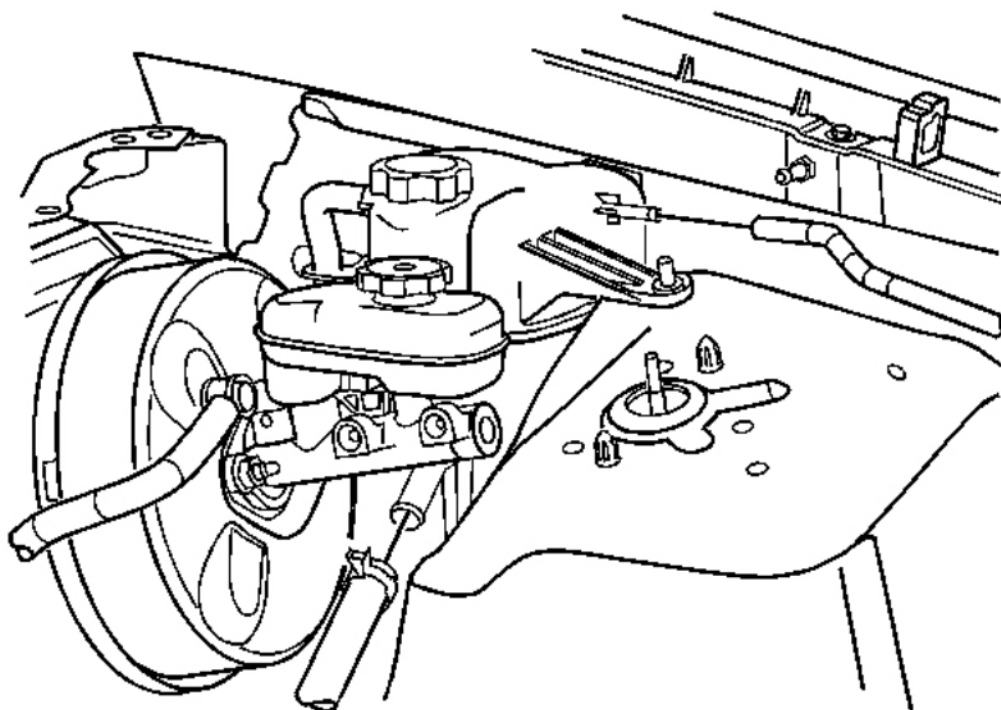


Fig. 10: View Of Surge Tank Hose
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

5. Connect the surge tank inlet hose to the surge tank.
6. Using the **J 38185** , reposition the hose clamp to secure the surge tank inlet hose.
7. Connect the surge tank outlet hose.
8. Using the **J 38185** , reposition the hose clamp to secure the surge tank outlet hose.
9. Connect the master cylinder fluid level sensor electrical connector.
10. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System**.

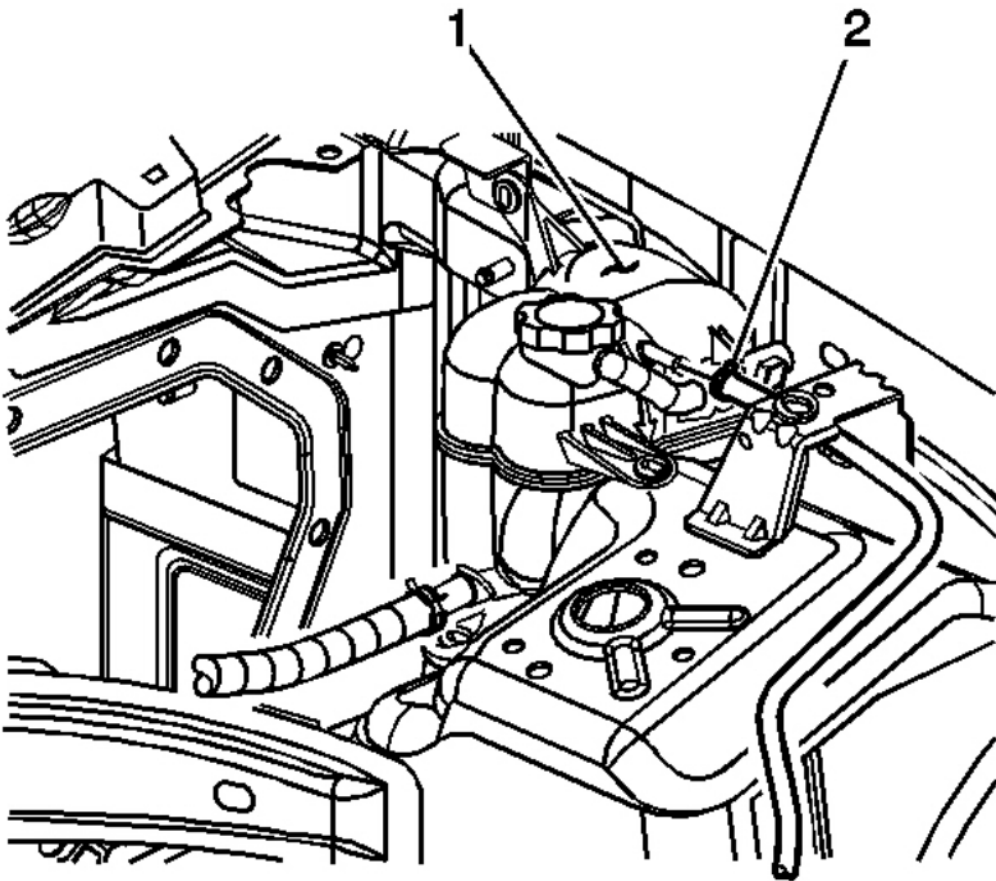


Fig. 11: Locating Surge Tank & Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to remove the surge tank inlet hose (2) from the surge tank (1).

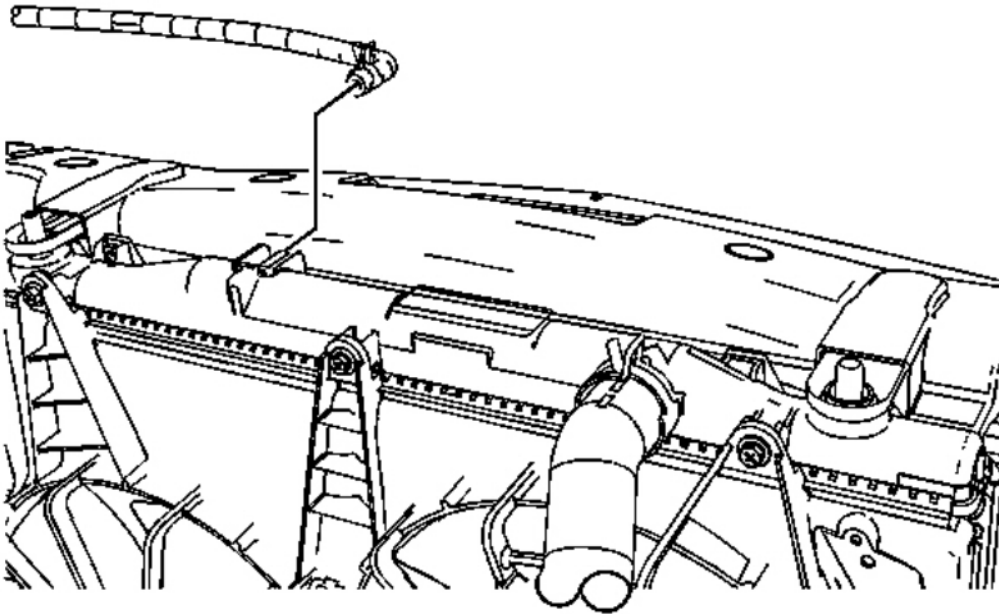


Fig. 12: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to remove the surge tank inlet hose from the radiator.
4. Position the **J 38185** to the clamp in order to remove the surge tank inlet hose from the throttle body assembly.
5. Remove the surge tank inlet hose from the vehicle.

Installation Procedure

1. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose to the throttle body assembly.

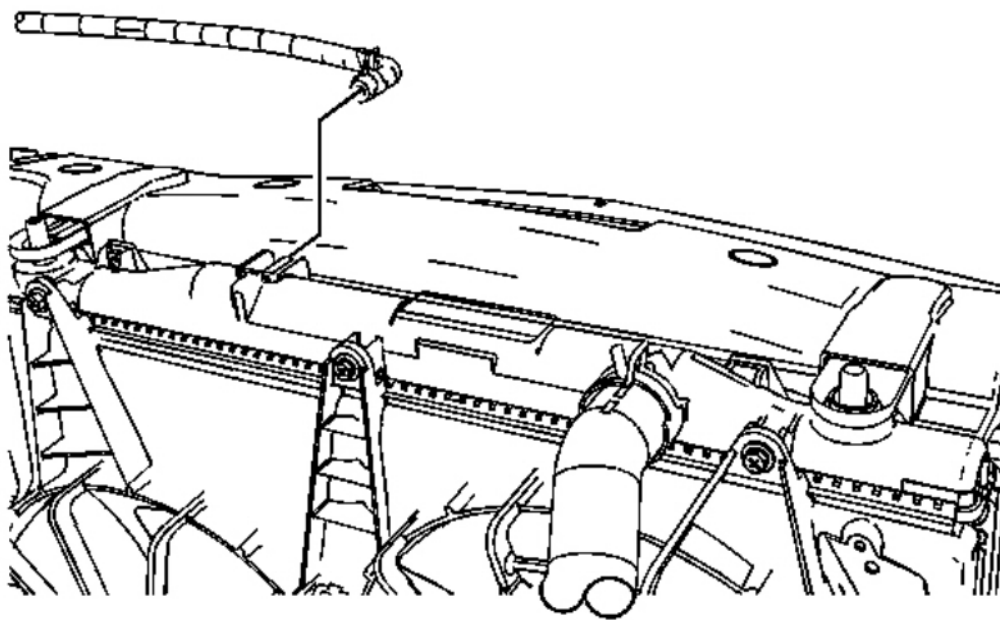


Fig. 13: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to connect the surge tank inlet hose to the radiator.

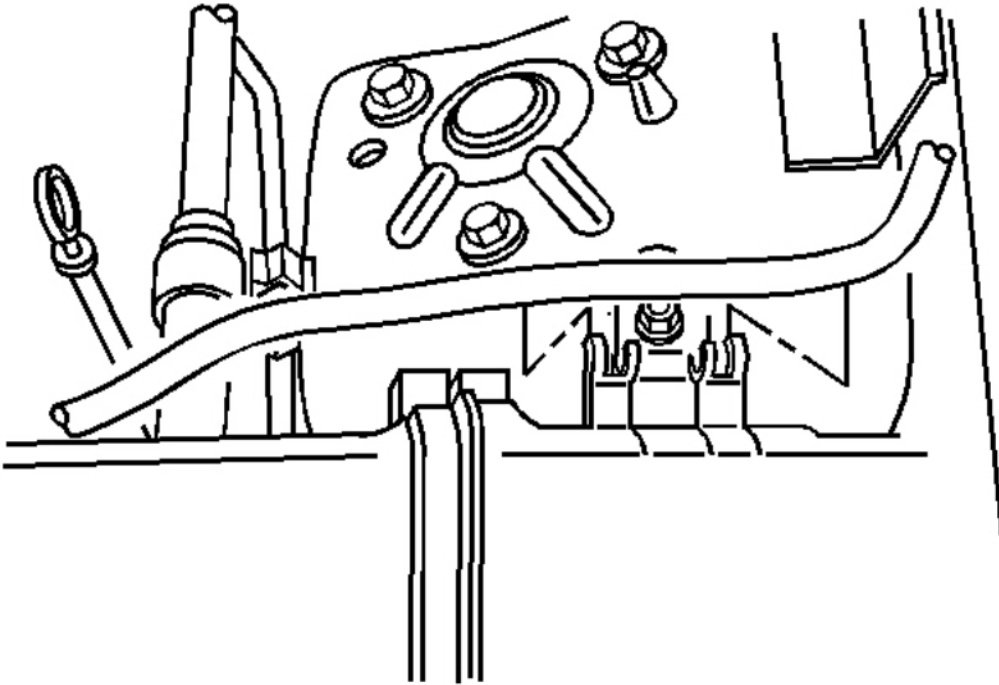


Fig. 14: View Of Surge Tank Inlet Hose & Retaining Feature
Courtesy of GENERAL MOTORS CORP.

3. Position the surge tank inlet hose to the retaining feature of the air cleaner assembly.

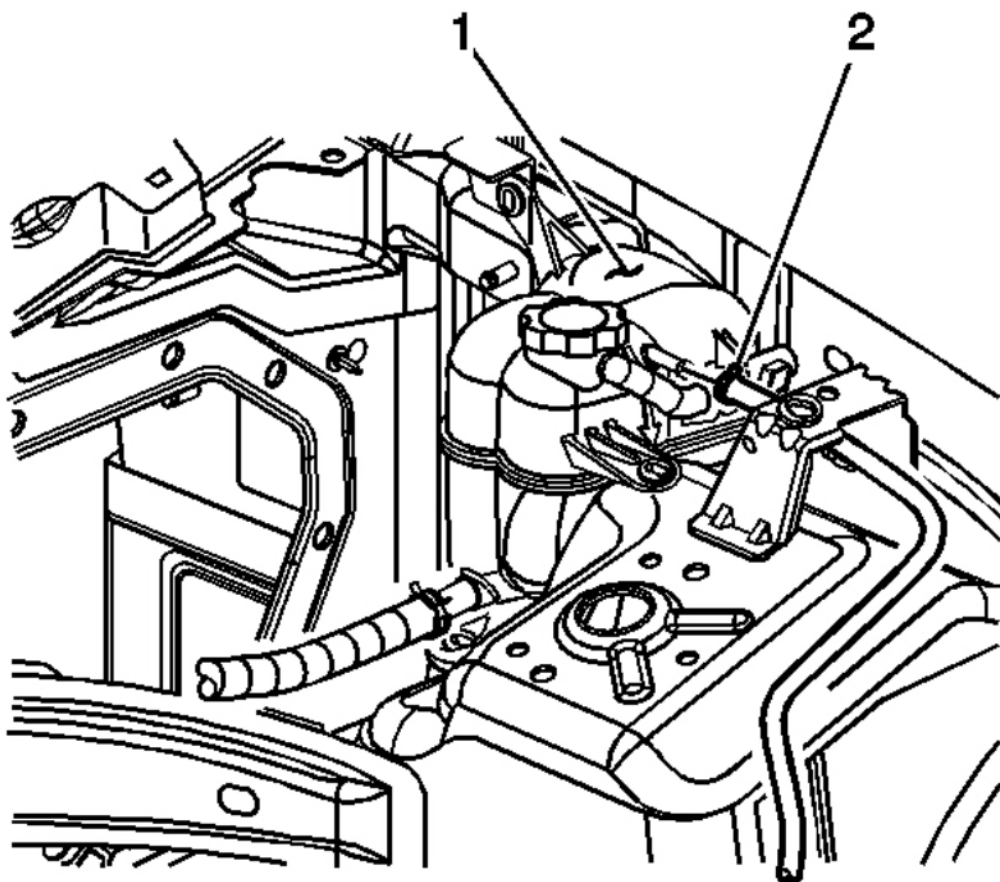


Fig. 15: Locating Surge Tank & Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Route the surge tank inlet hose under the hood assist rod support.
5. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose (2) to the surge tank (1).
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

SURGE TANK HOSE/PIPE REPLACEMENT - INLET (LH2)

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System**.

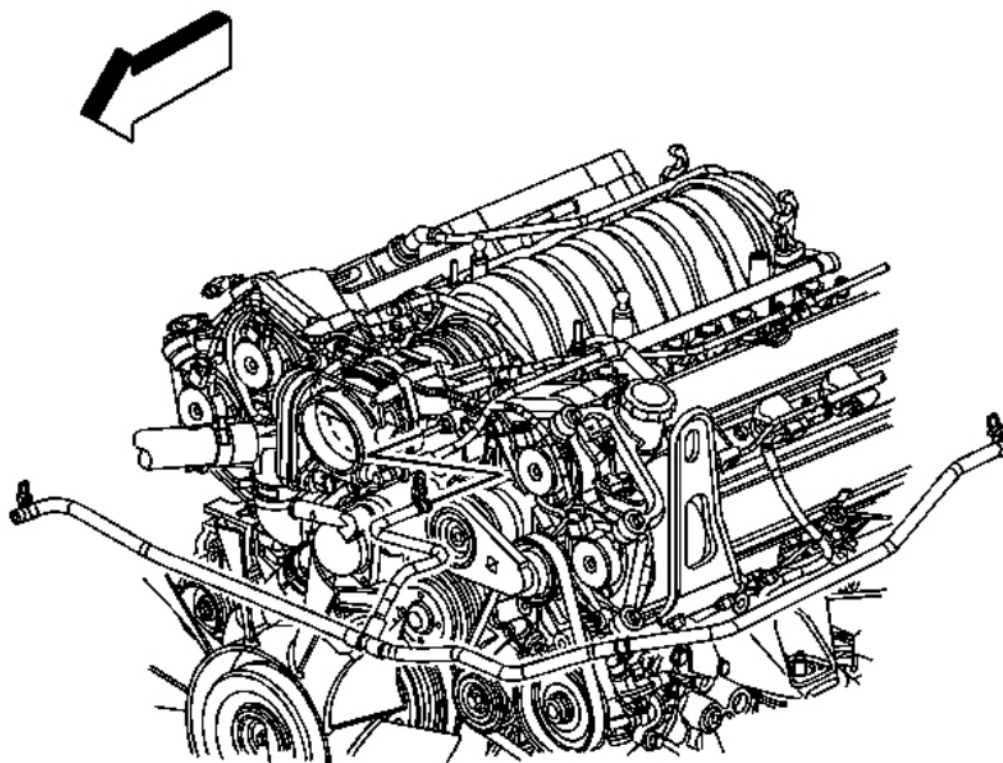


Fig. 16: View Of Surge Tank Inlet Hose - LH2
Courtesy of GENERAL MOTORS CORP.

2. Compress the clamp and remove the surge tank inlet hose from the surge tank.
3. Compress the clamp and remove the surge tank inlet hose from the radiator.
4. Remove the surge tank inlet hose from the retaining features on the fan shroud and the air cleaner assembly.
5. Compress the clamp and remove the surge tank inlet hose from the water housing assembly.
6. Remove the surge tank inlet hose from the vehicle.

Installation Procedure

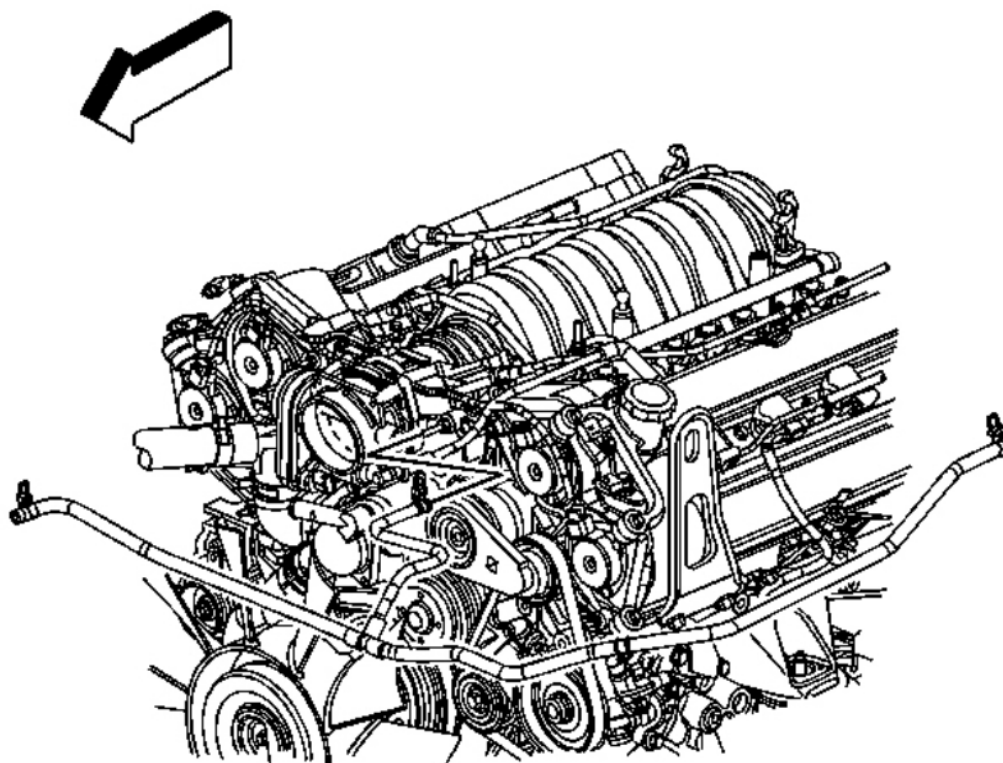


Fig. 17: View Of Surge Tank Inlet Hose - LH2
Courtesy of GENERAL MOTORS CORP.

1. Connect the surge tank inlet hose and clamp to the water housing assembly.
2. Insert the surge tank inlet hose into the retaining features on the fan shroud and the air cleaner housing assembly.
3. Connect the surge tank inlet hose and clamp to the radiator.
4. Connect the surge tank inlet hose and clamp to the surge tank.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LHD, LY7)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

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

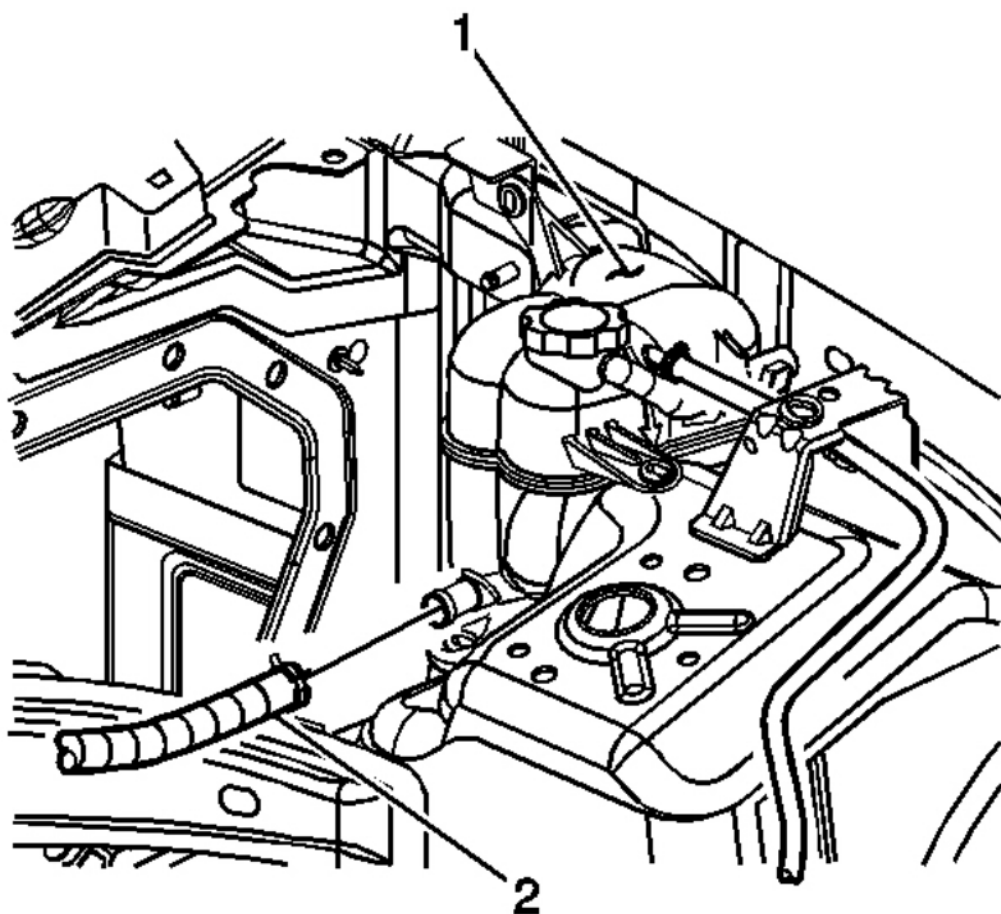


Fig. 18: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to remove the outlet hose (2) from the surge tank (1).
3. Loosen the bolt on the bracket which secures the surge tank outlet hose to the engine.
4. Position **J 38185** to the clamp in order to remove the surge tank outlet hose from the thermostat assembly.
5. Remove the surge tank outlet hose/pipe from the engine.

Installation Procedure

1. Position the surge tank outlet hose/pipe to the engine.
2. Position **J 38185** to the clamp in order to connect the surge tank outlet hose to the thermostat assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the bolt to the bracket securing the surge tank outlet pipe to the engine.

Tighten: Tighten the bolt to 9 N.m (80 lb in).

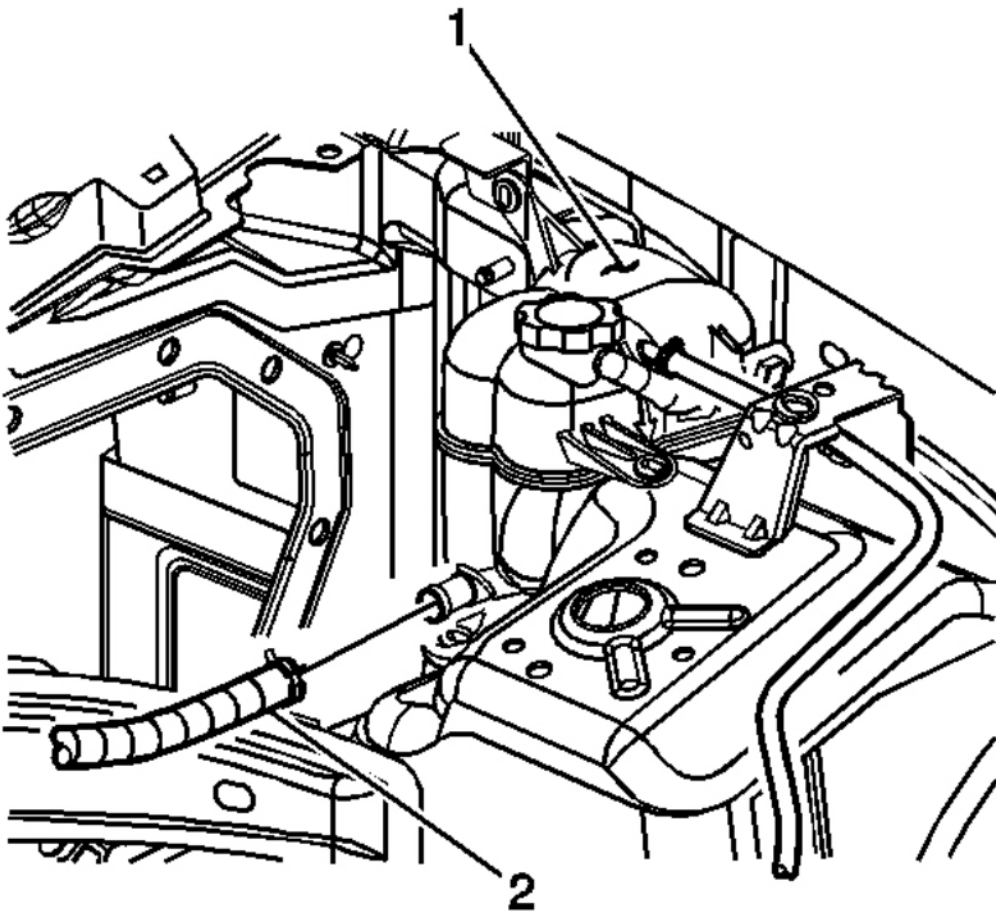


Fig. 19: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7

Courtesy of GENERAL MOTORS CORP.

4. Position **J 38185** to the clamp in order to connect the outlet hose (2) to the surge tank (1).
5. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LH2)

Removal Procedure

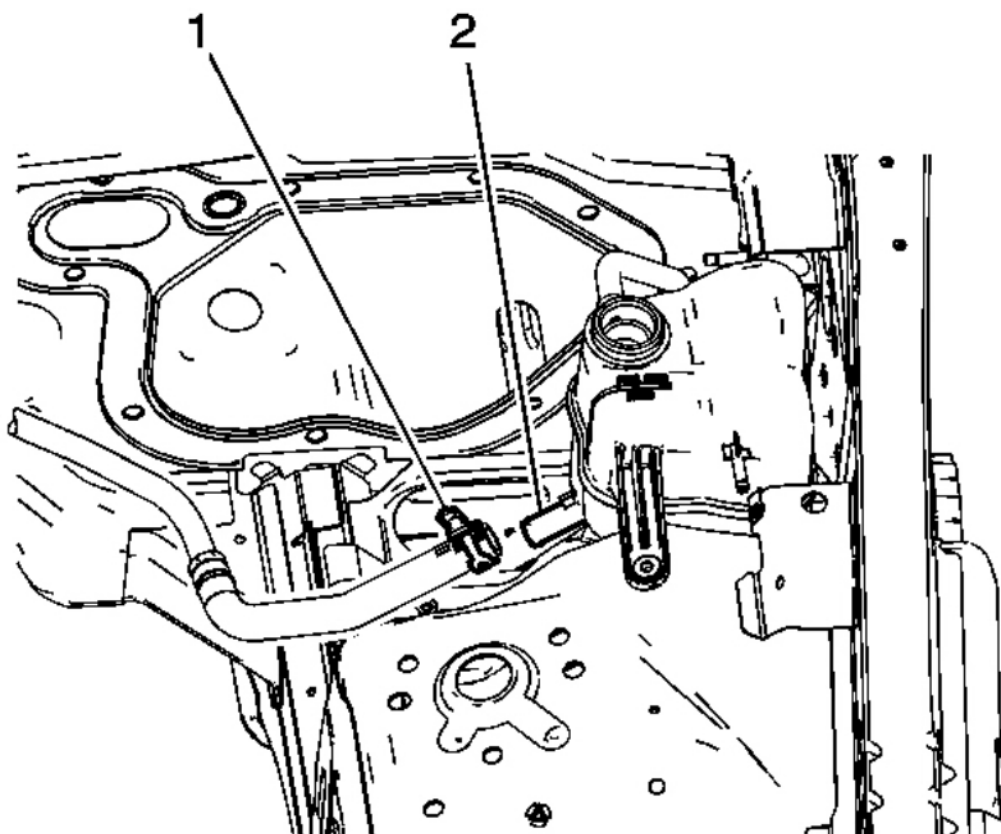


Fig. 20: View Of Surge Tank Outlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** in Engine Mechanical - 4.6L.

3. Compress the clamp (1) and remove the surge tank outlet hose from the surge tank (2).

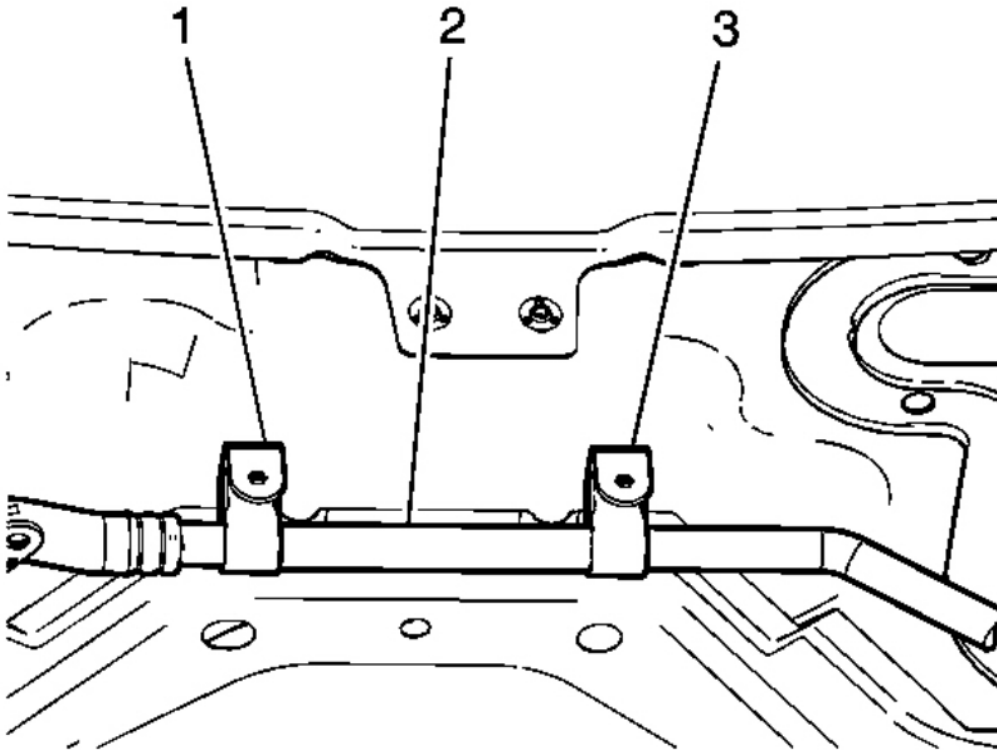


Fig. 21: View Of Outlet Hose & Retaining Features
Courtesy of GENERAL MOTORS CORP.

4. Separate the hose (2) from the retaining features (1 and 3) on the front of dash.

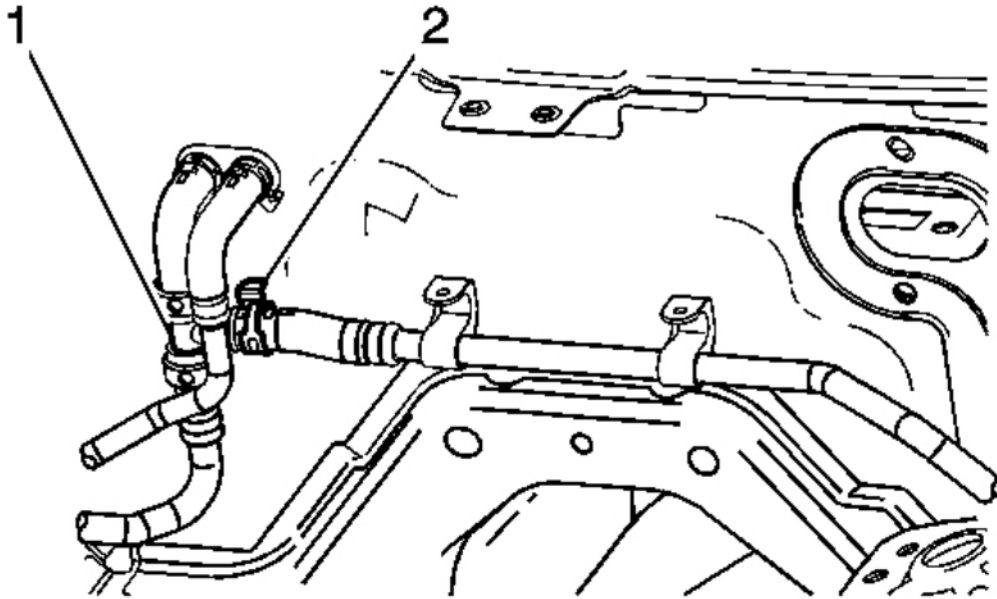


Fig. 22: View Of Surge Tank Outlet Hose At Heater Hose
Courtesy of GENERAL MOTORS CORP.

5. Compress the clamp (2) and remove the surge tank outlet hose from the heater hose (1).
6. Remove the surge tank outlet hose/pipe from the engine compartment.

Installation Procedure

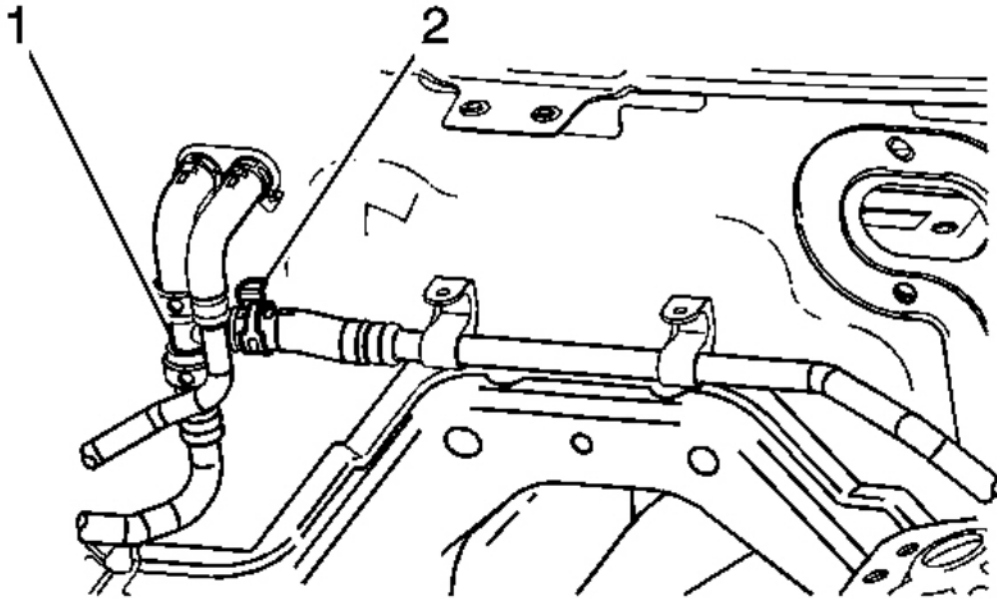


Fig. 23: View Of Surge Tank Outlet Hose At Heater Hose
Courtesy of GENERAL MOTORS CORP.

1. Position the surge tank outlet hose/pipe to the engine compartment.
2. Compress the clamp (2) and connect the surge tank outlet hose to the heater hose (1).

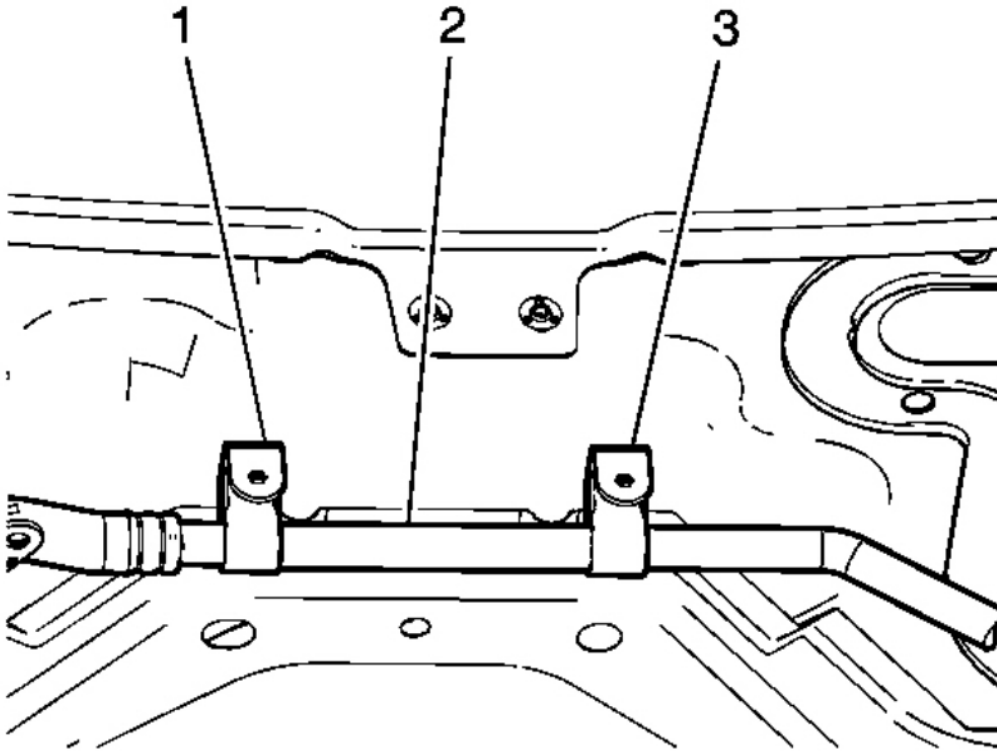


Fig. 24: View Of Outlet Hose & Retaining Features
Courtesy of GENERAL MOTORS CORP.

3. Install the hose (2) to the retaining features (1 and 3) on the front of dash.

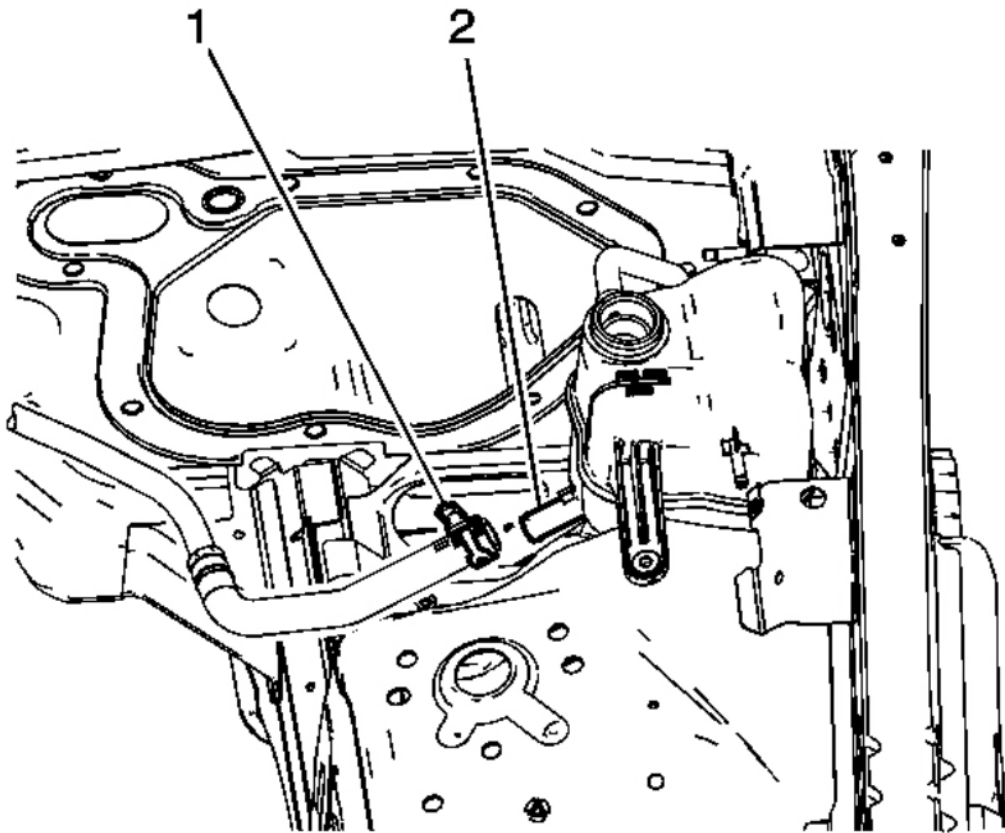


Fig. 25: View Of Surge Tank Outlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

4. Compress the clamp (1) and connect the surge tank outlet hose to the surge tank (2).
5. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** in Engine Mechanical - 4.6L.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - INLET (LH2)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

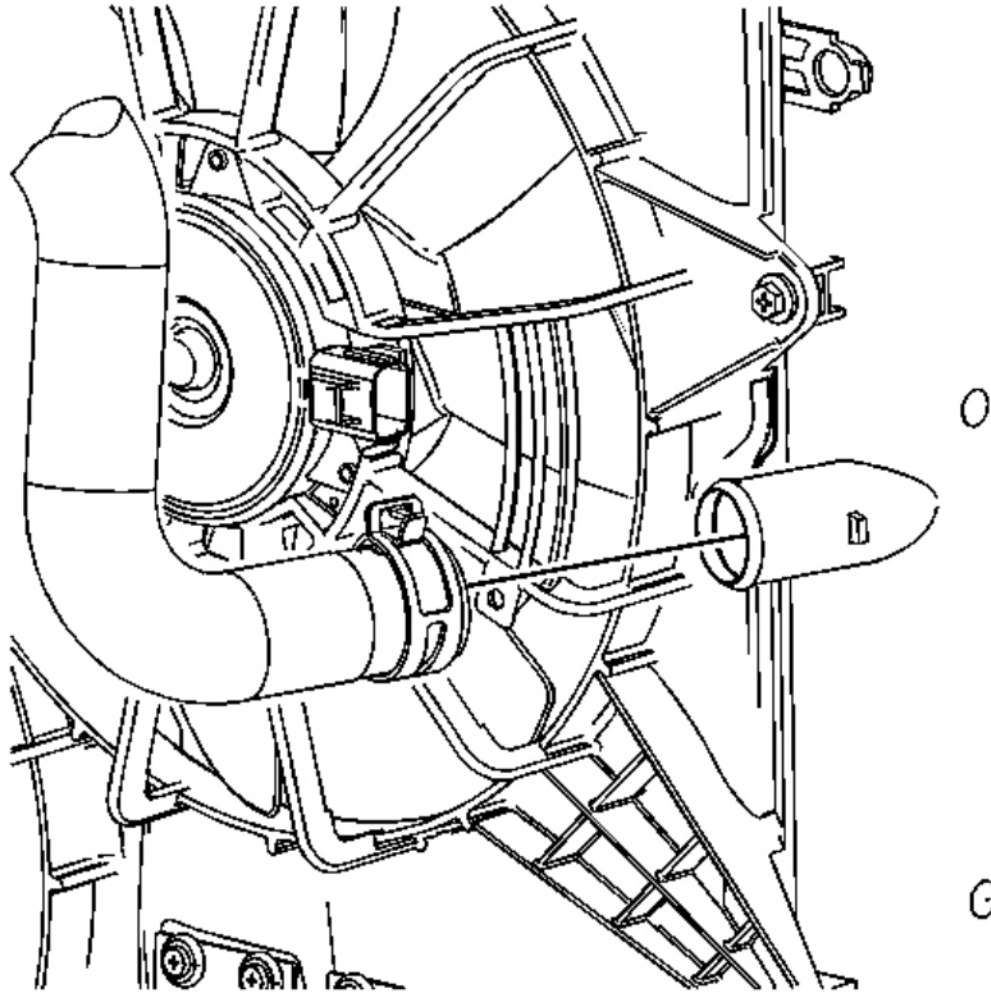


Fig. 26: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the throttle body housing.
3. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the radiator.
4. Remove the radiator inlet hose from the vehicle.

Installation Procedure

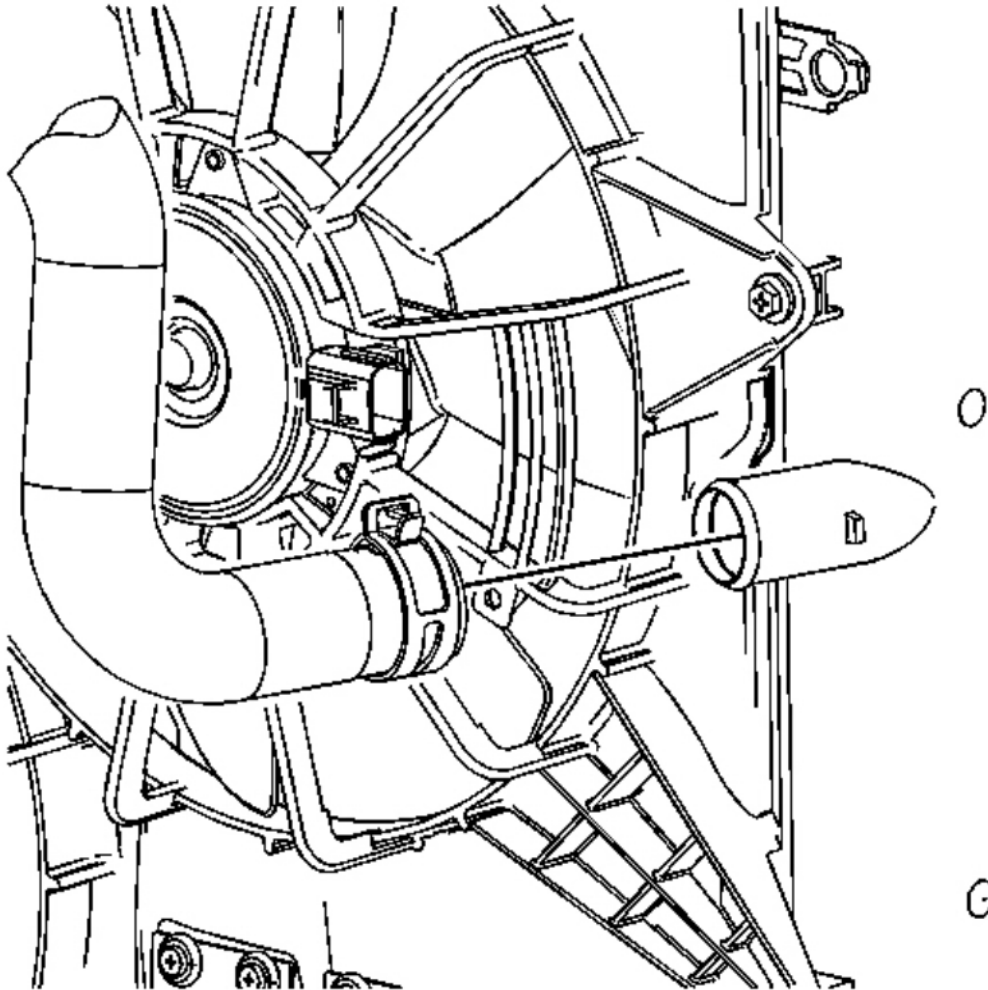


Fig. 27: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the inlet radiator hose into the vehicle.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

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2. Using the **J 38185** , disengage the tension on the hose clamp and Install the radiator inlet hose to the radiator.
3. Using the **J 38185** slide the clamp into the original position.
4. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator inlet hose to the throttle body housing.
5. Using the **J 38185** slide the clamp into the original position.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - INLET (LY7)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

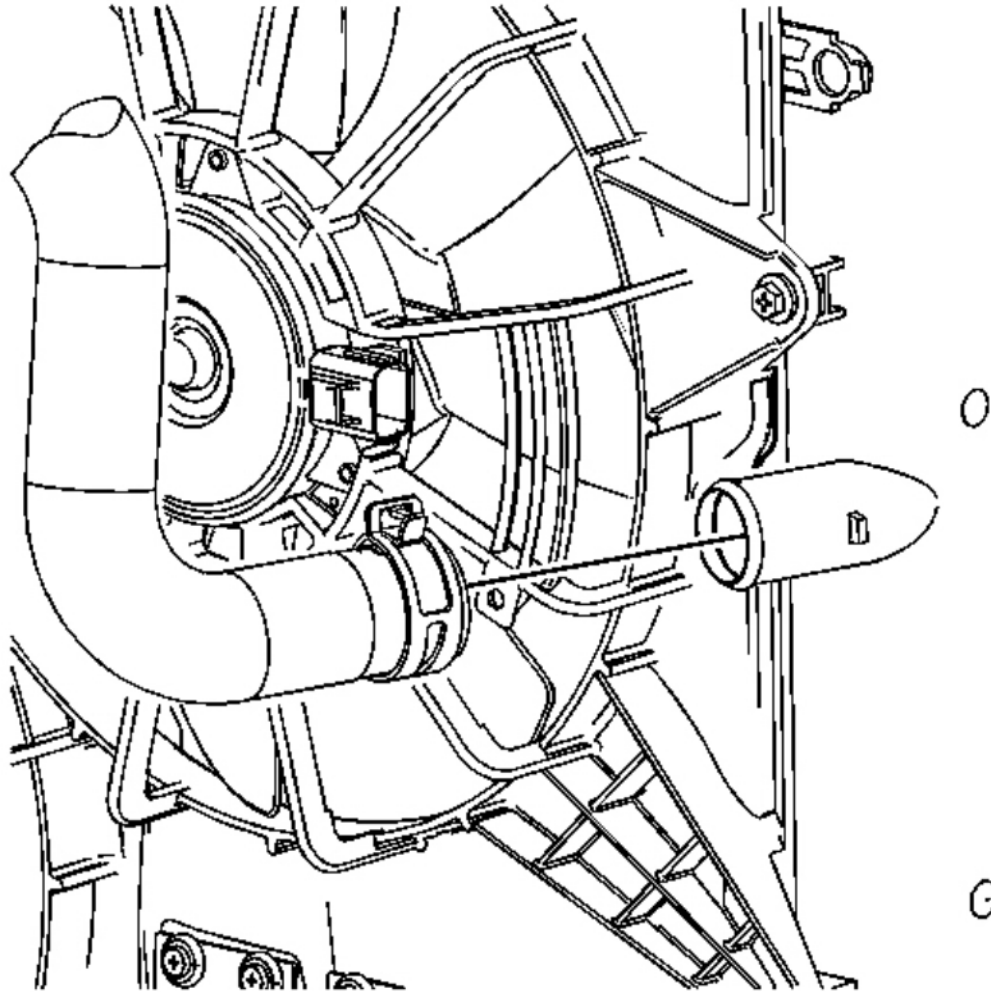


Fig. 28: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the thermostat housing.
3. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the radiator.
4. Remove the radiator inlet hose from the vehicle.

Installation Procedure

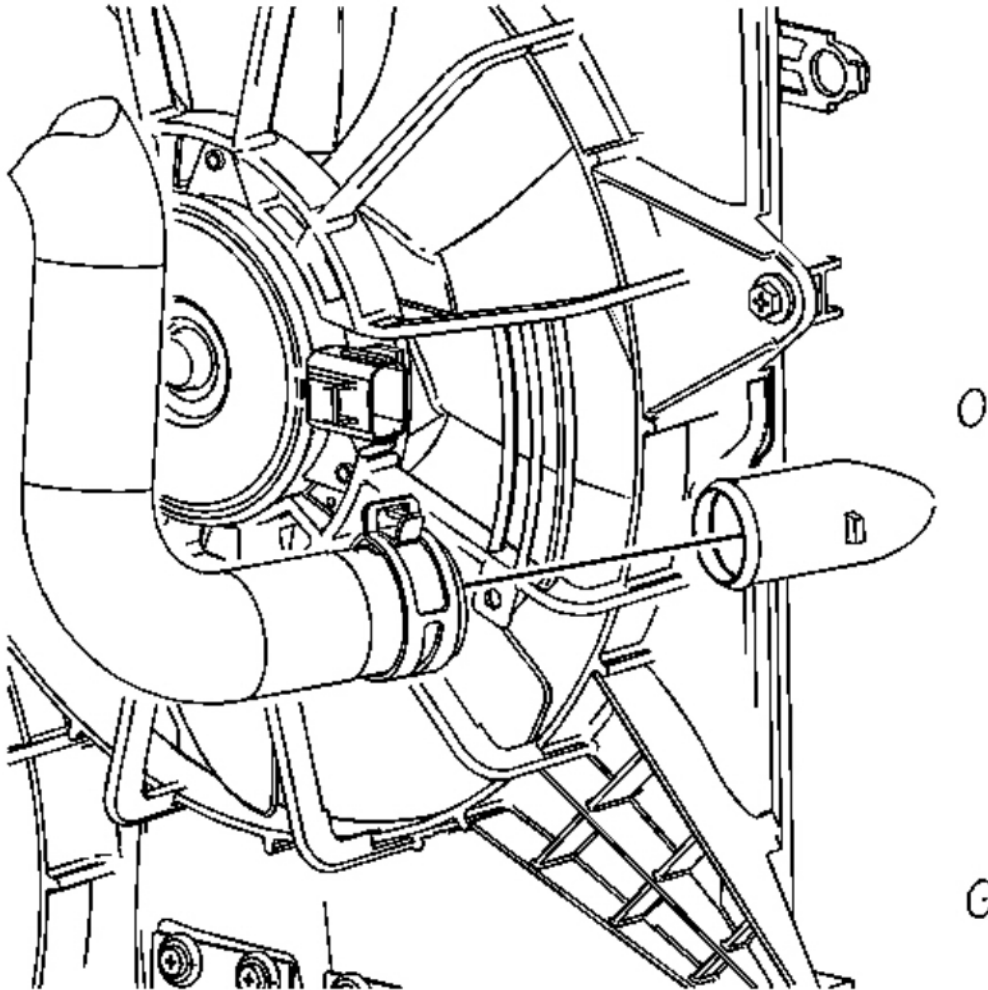


Fig. 29: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the inlet radiator hose into the vehicle.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

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2. Using the **J 38185** , disengage the tension on the hose clamp and Install the radiator inlet hose to the radiator.
3. Using the **J 38185** slide the clamp into the original position.
4. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator inlet hose to the thermostat housing.
5. Using the **J 38185** slide the clamp into the original position.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - OUTLET (LH2 - STANDARD COOLING)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

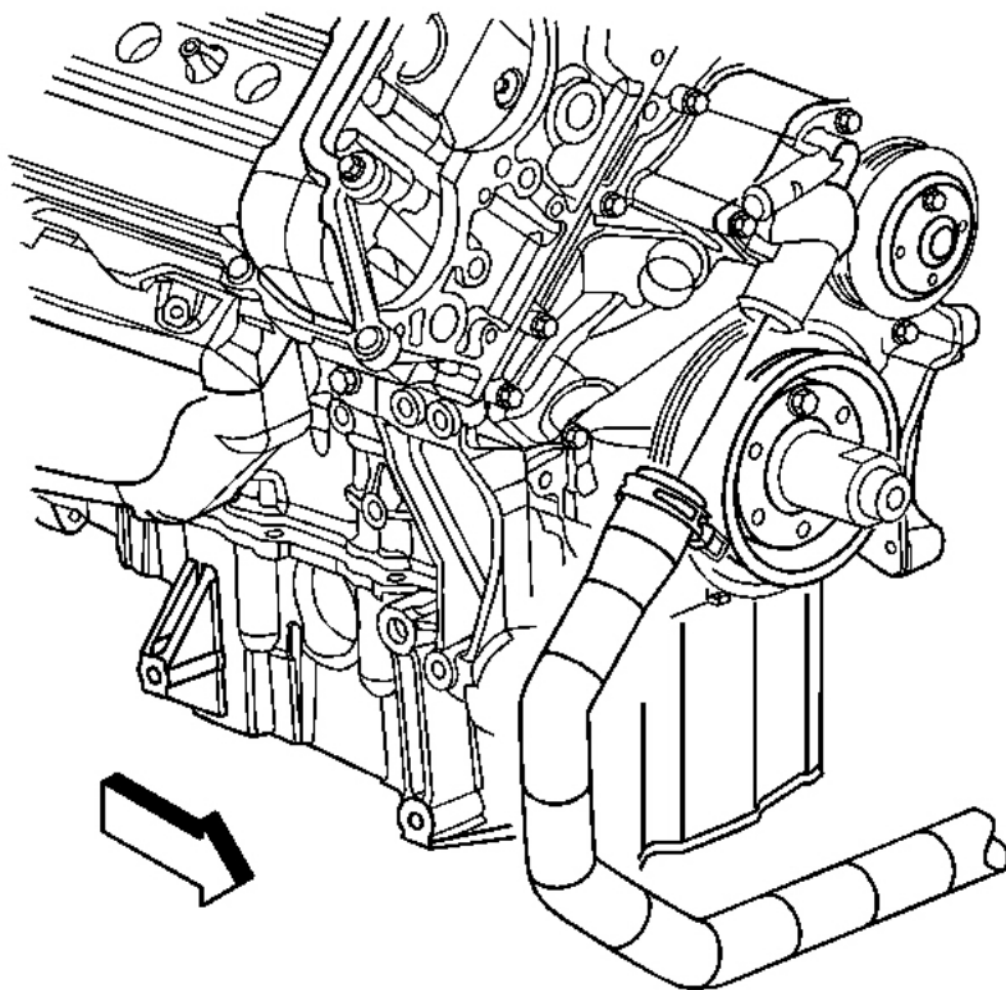


Fig. 30: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L.
3. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the thermostat housing.
4. Disconnect the radiator outlet hose from the support bracket.

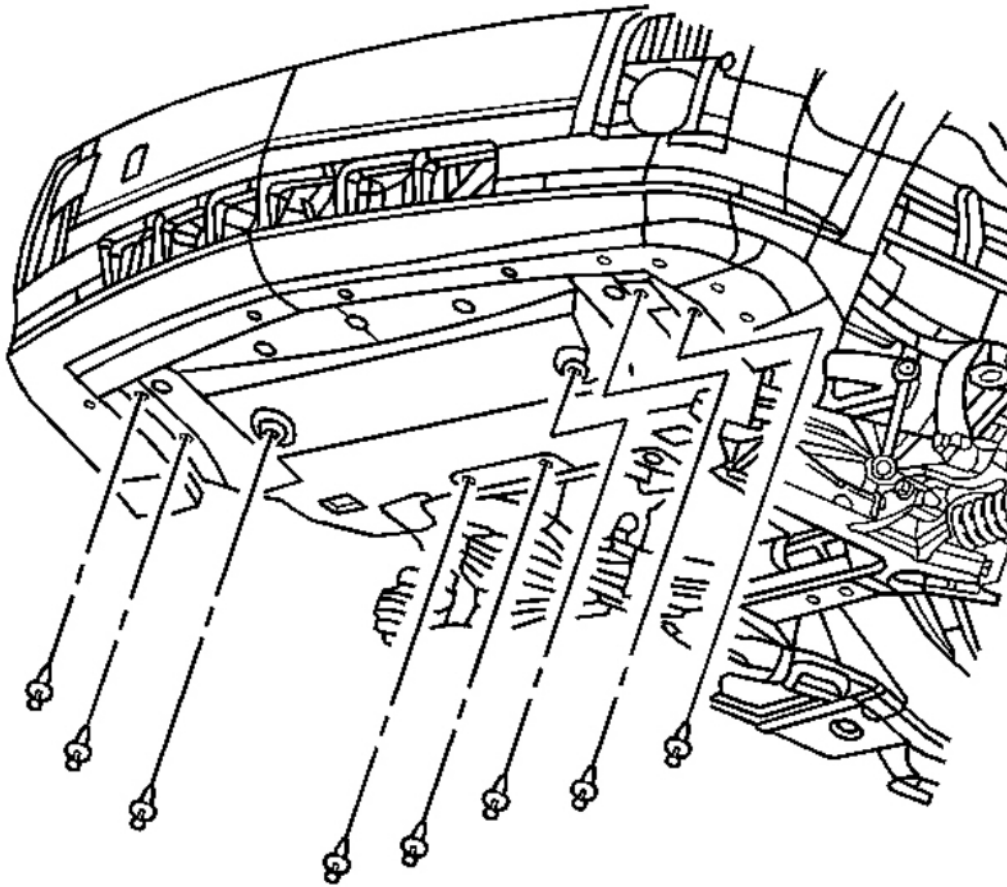


Fig. 31: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
6. Remove the front air deflector retainers.
7. Remove the front air deflector.

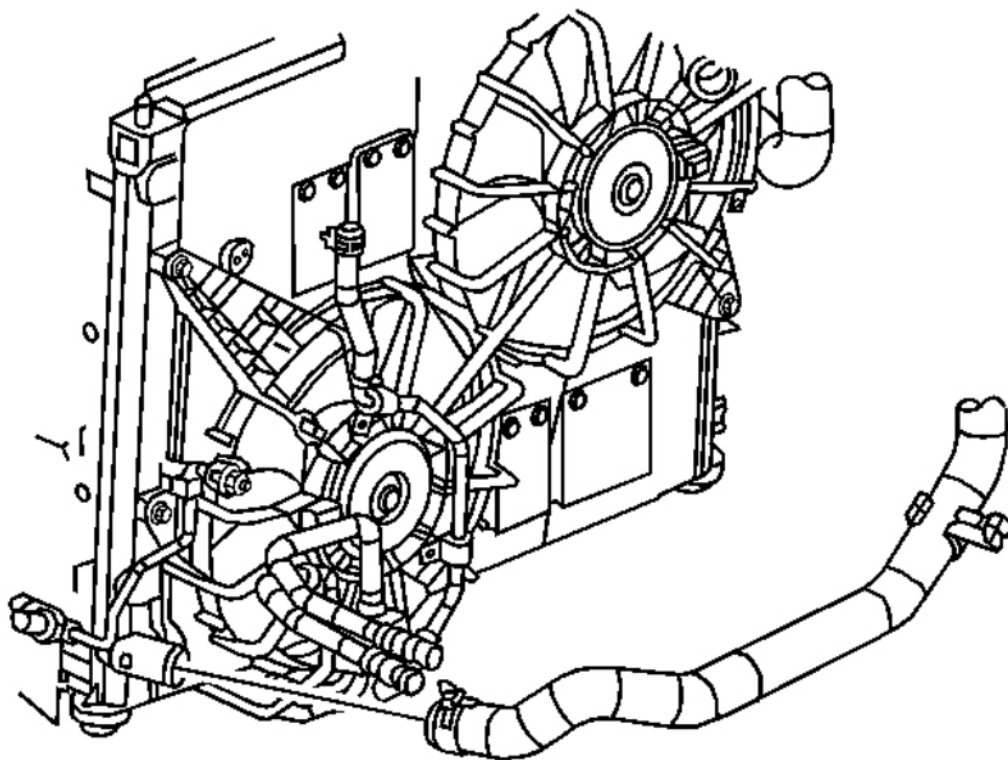


Fig. 32: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

8. Remove the ECM mounting nuts and reposition ECM aside.
9. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the radiator.
10. Lower the vehicle.
11. Remove the radiator outlet hose from the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the vehicle.
2. Raise the vehicle.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

3. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the radiator.
4. Using the **J 38185** slide the clamp into the original position.

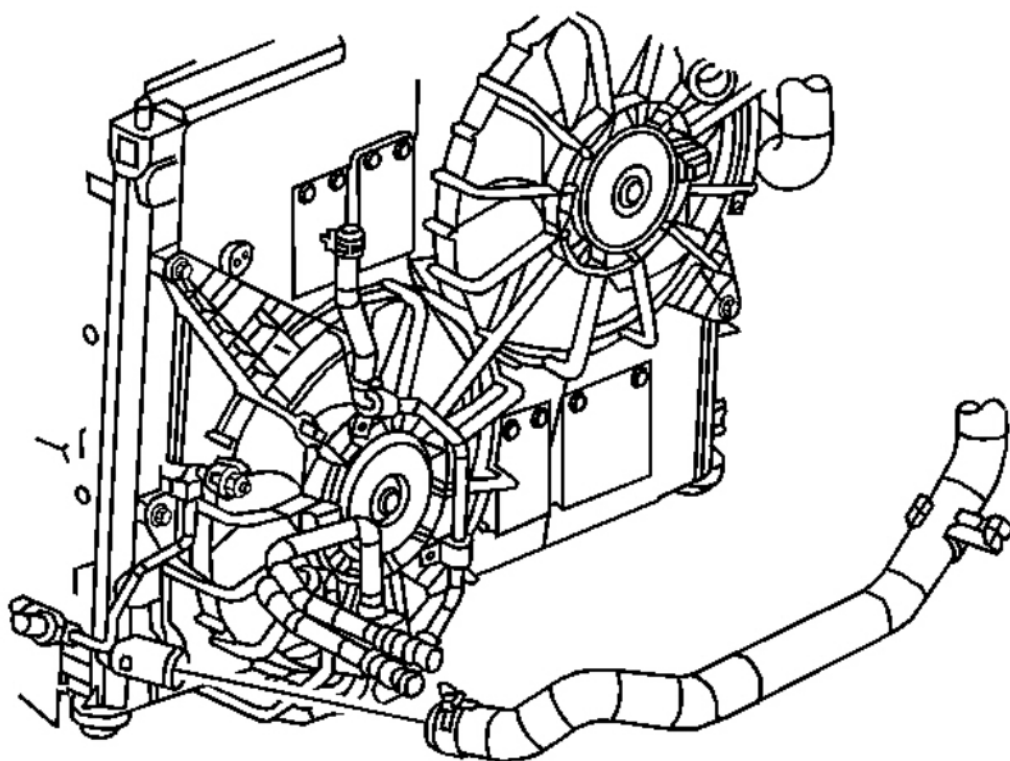


Fig. 33: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Position ECM on the mounting bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the ECM to mounting nuts.

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

7. Install the front air deflector.

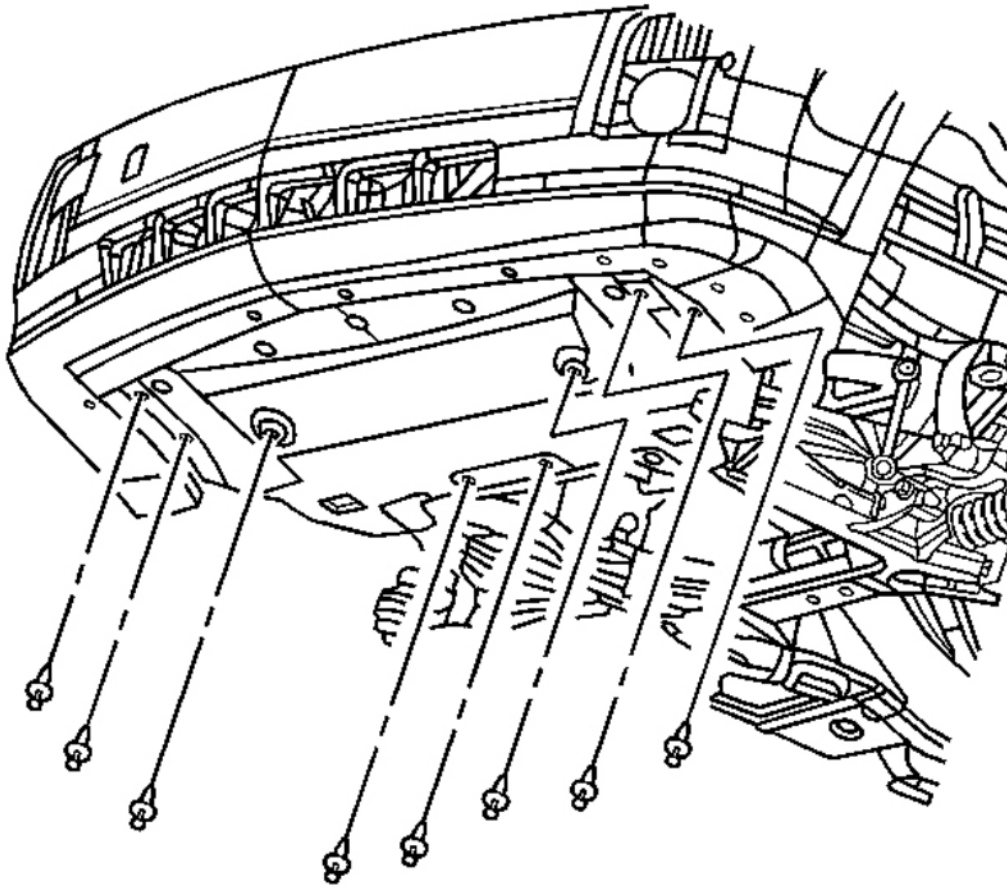


Fig. 34: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

8. Install the front air deflector retainers.
9. Lower the vehicle.

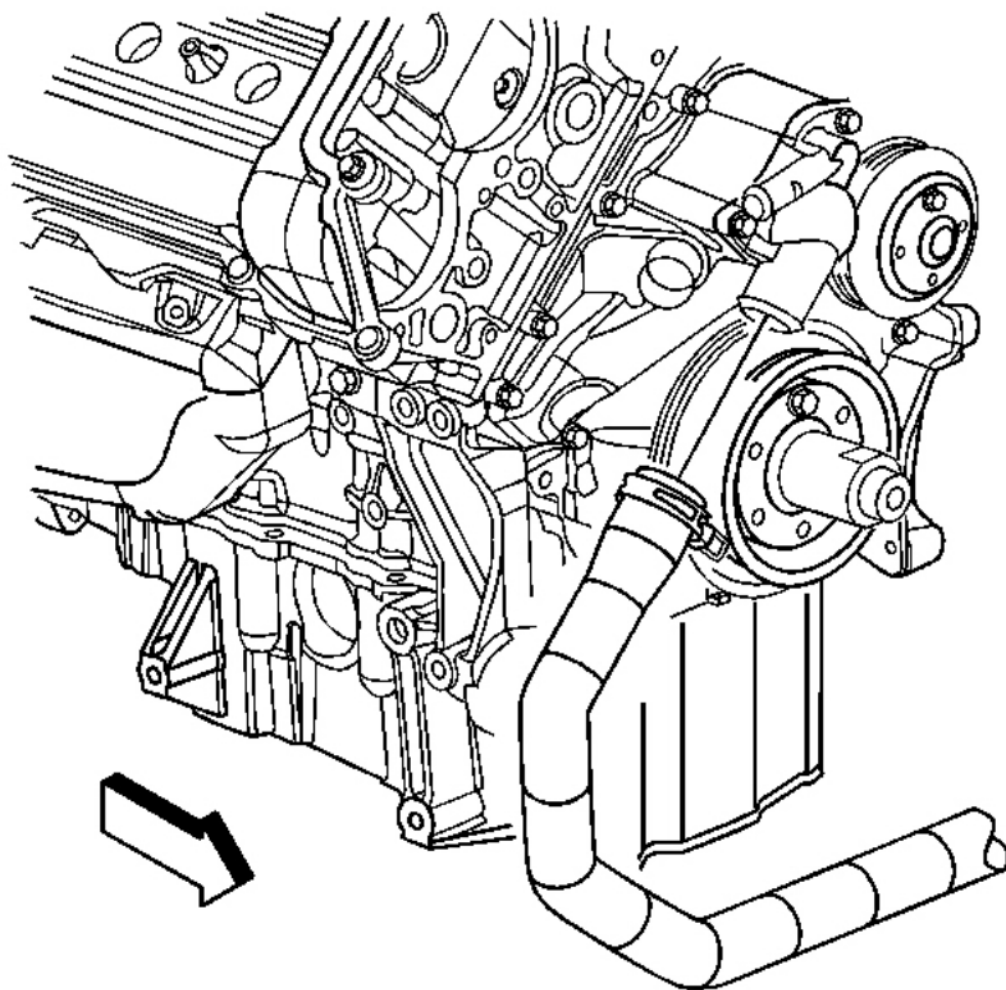


Fig. 35: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

10. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the thermostat housing.
11. Using the **J 38185** slide the clamp into the original position.
12. Install the radiator outlet hose to the support bracket.
13. Install the air intake duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L.
14. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - OUTLET (LH2 - HEAVY DUTY COOLING)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

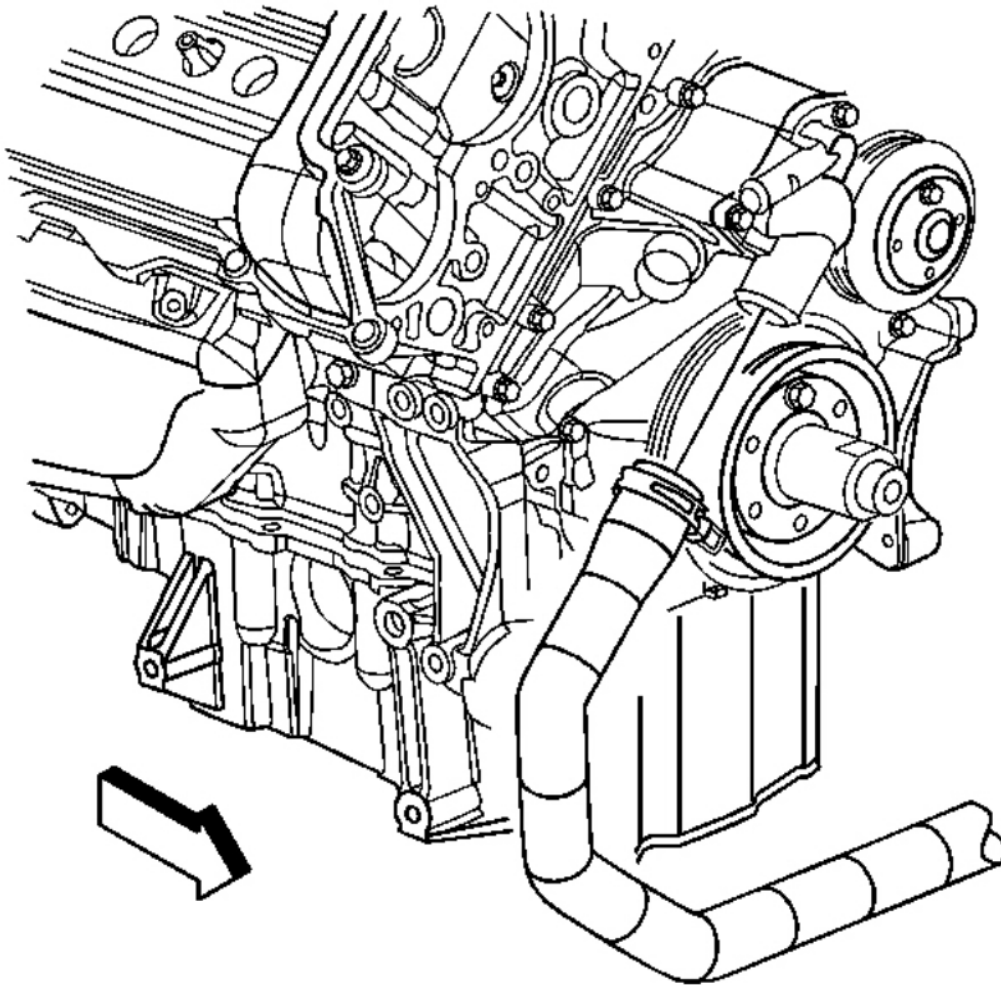


Fig. 36: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

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

2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L.
3. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the thermostat housing.
4. Disconnect the radiator outlet hose from the support bracket.

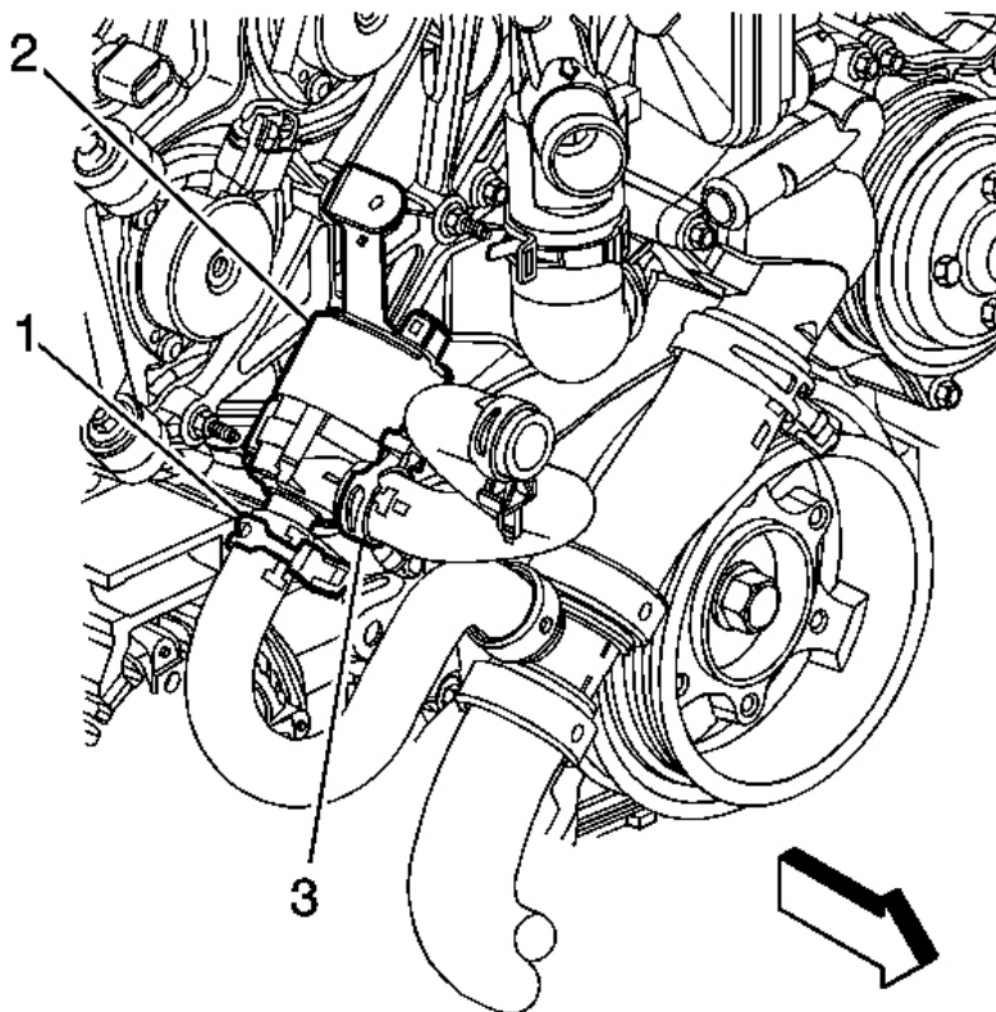


Fig. 37: View Of Afterboil Coolant Pump & Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Using the **J 38185** , disengage the tension on the radiator outlet hose (1) clamp.
6. Disconnect the radiator outlet hose (1) from the afterboil coolant pump.

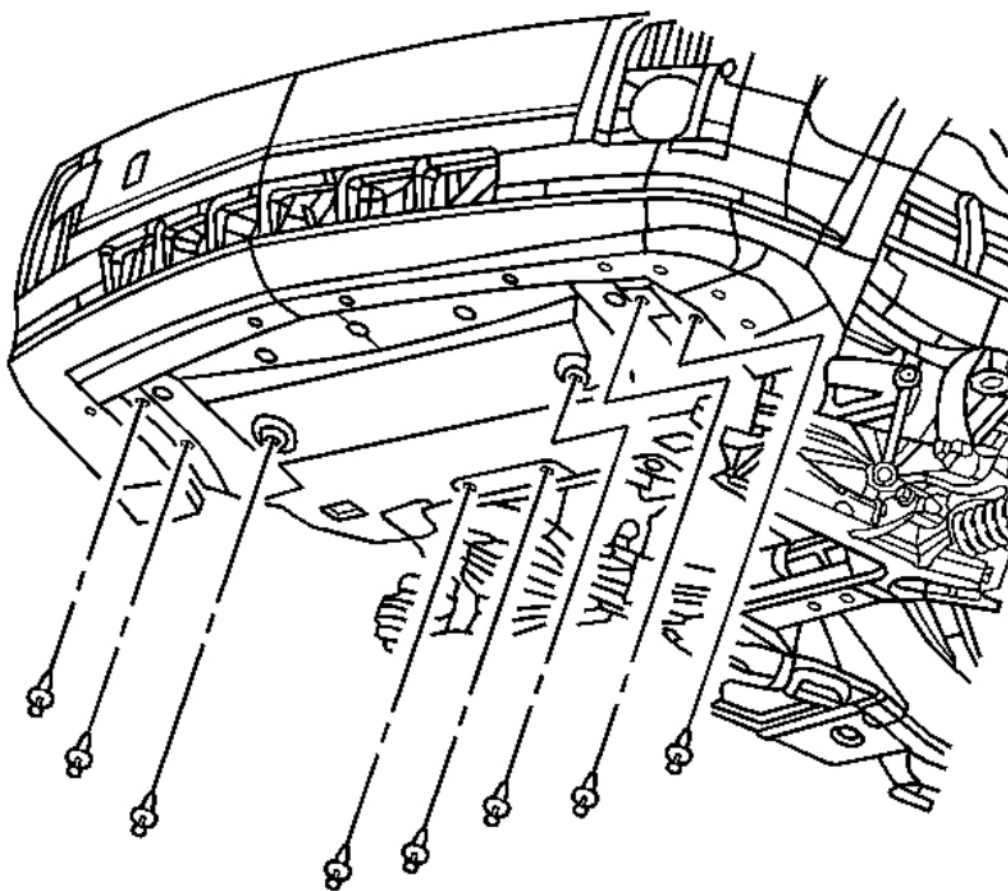


Fig. 38: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

7. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
8. Remove the front air deflector retainers.
9. Remove the front air deflector.
10. Remove the engine control module (ECM) mounting nuts and reposition ECM aside.
11. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the radiator.

12. Lower the vehicle.
13. Remove the radiator outlet hose from the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the vehicle.
2. Raise the vehicle.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

3. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the radiator.
4. Using the **J 38185** slide the clamp into the original position.
5. Position ECM on the mounting bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the ECM to mounting nuts.

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

7. Install the front air deflector.

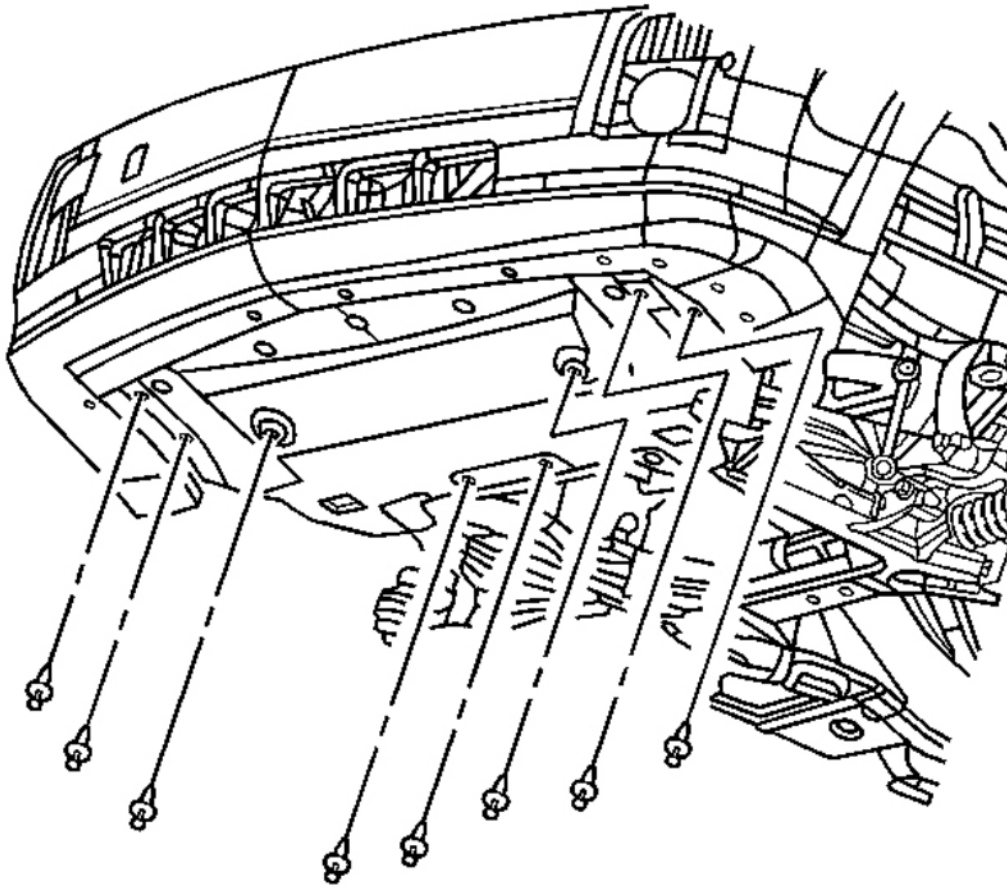


Fig. 39: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

8. Install the front air deflector retainers.
9. Lower the vehicle.
10. Connect the radiator outlet hose (1) to the afterboil coolant pump.

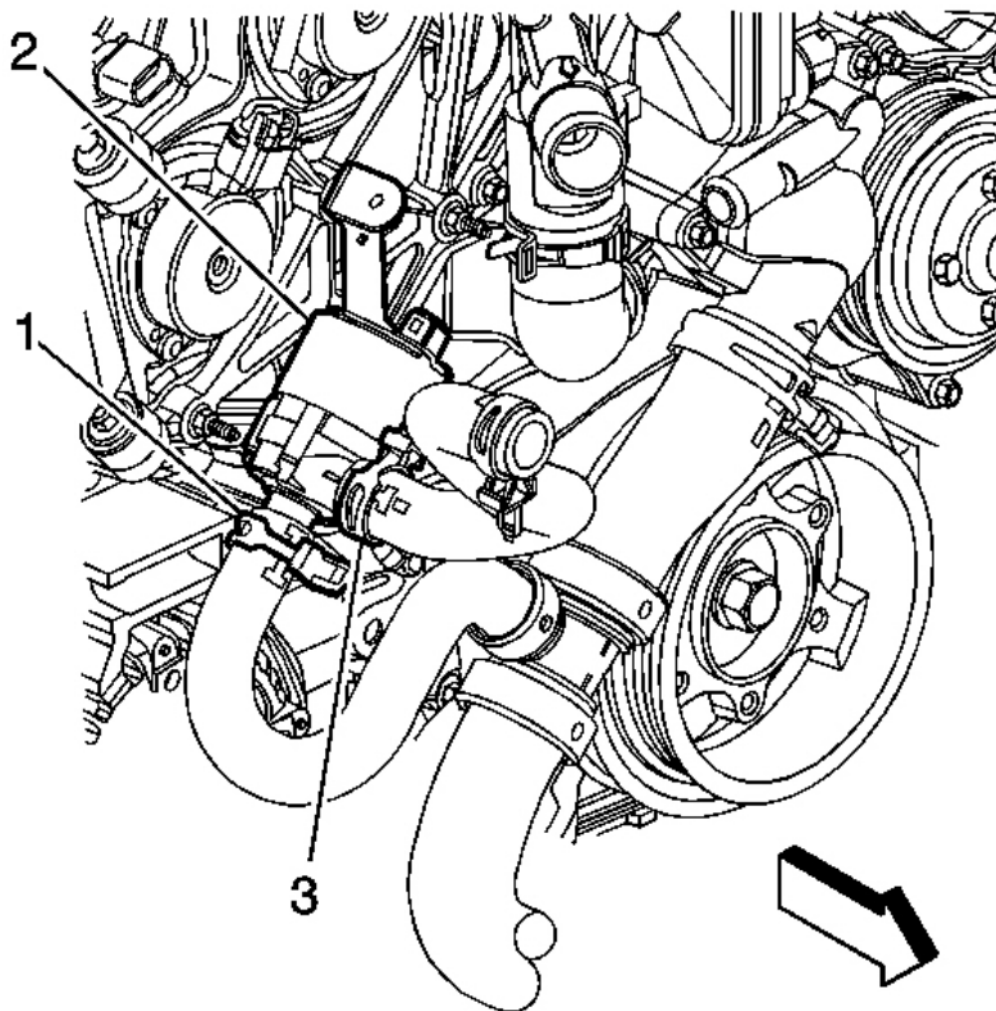


Fig. 40: View Of Afterboil Coolant Pump & Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

11. Using the **J 38185** , reposition the radiator outlet hose (1) clamp to secure the radiator outlet hose to the afterboil coolant pump.
12. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the thermostat housing.
13. Using the **J 38185** slide the clamp into the original position.
14. Install the radiator outlet hose to the support bracket.

15. Install the air intake duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - OUTLET (LY7)**Tools Required**

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Remove the radiator inlet hose. Refer to **Radiator Hose Replacement - Inlet (LH2)** or **Radiator Hose Replacement - Inlet (LY7)**.
3. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the thermostat housing.
4. Disconnect the radiator outlet hose from the engine support bracket.
5. Remove the air cleaner intake duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Control - 3.6L.

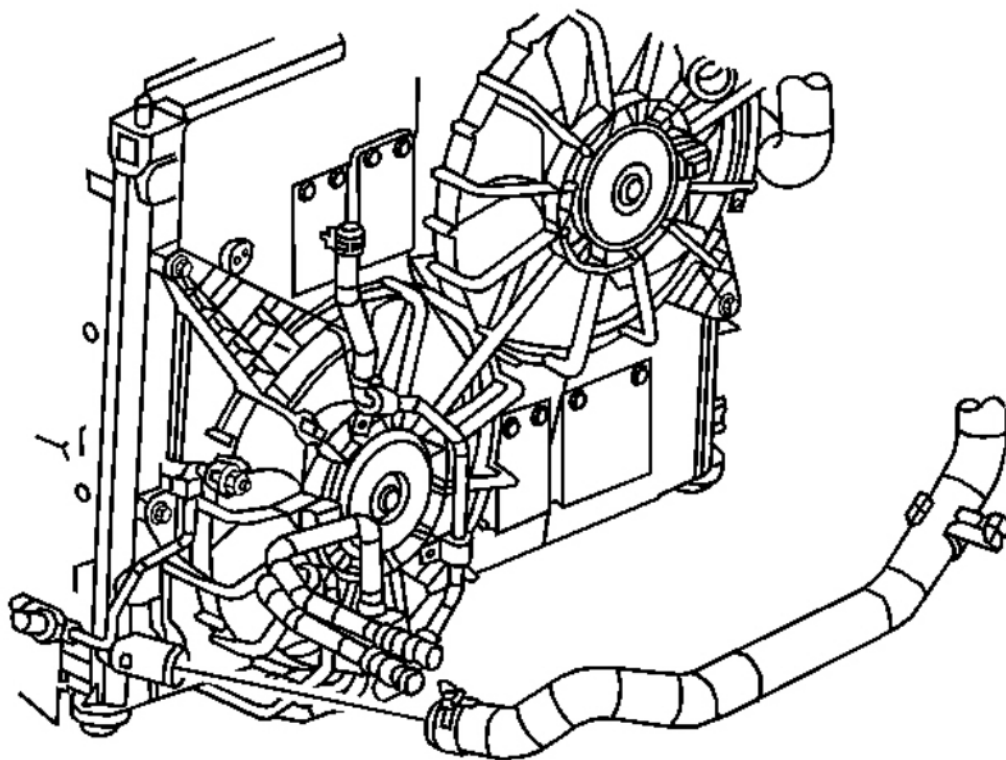


Fig. 41: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the radiator.
7. Remove the radiator outlet hose from the vehicle.

Installation Procedure

1. Install the radiator outlet hose to the vehicle.

IMPORTANT: Lubricate the inside diameters of the hoses with clean coolant prior to installation.

2. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the radiator.

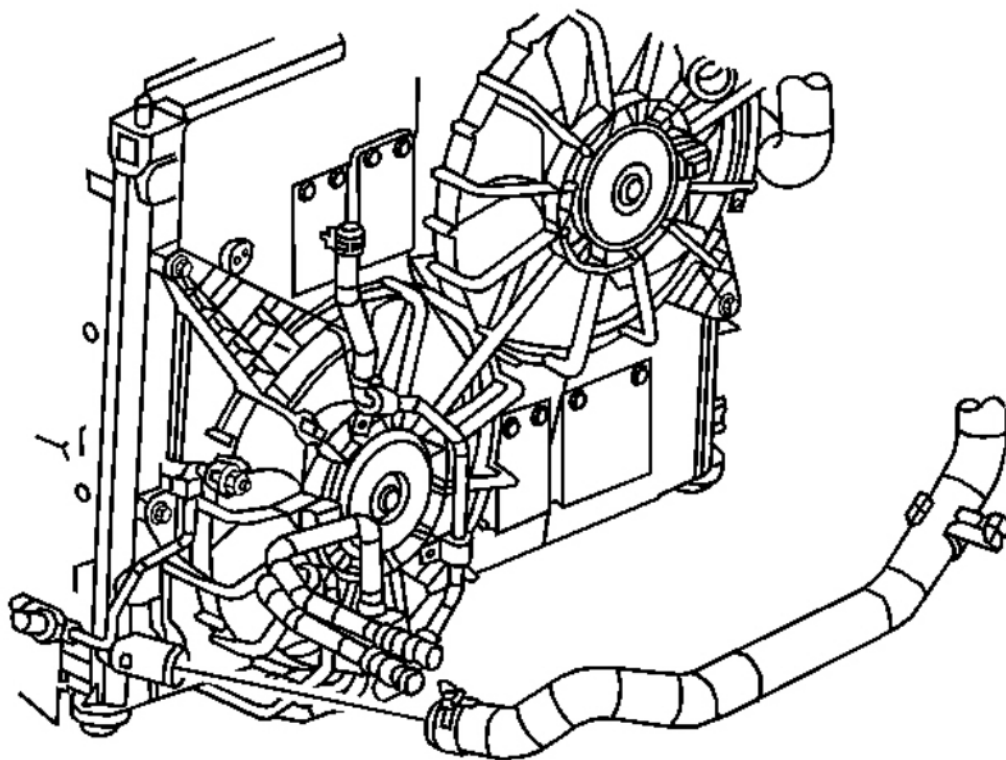


Fig. 42: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Using the **J 38185** slide the clamp into the original position.
4. Using the **J 38185** , disengage the tension on the hose clamp and install the radiator outlet hose to the thermostat housing.
5. Using the **J 38185** slide the clamp into the original position.
6. Install the radiator outlet hose to the engine support bracket.
7. Install the radiator inlet hose. Refer to **Radiator Hose Replacement - Inlet (LH2)** or **Radiator Hose Replacement - Inlet (LY7)**.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

FAN REPLACEMENT

Tools Required

J 41240-5A Fan Clutch Wrench. See Special Tools and Equipment.

Removal Procedure

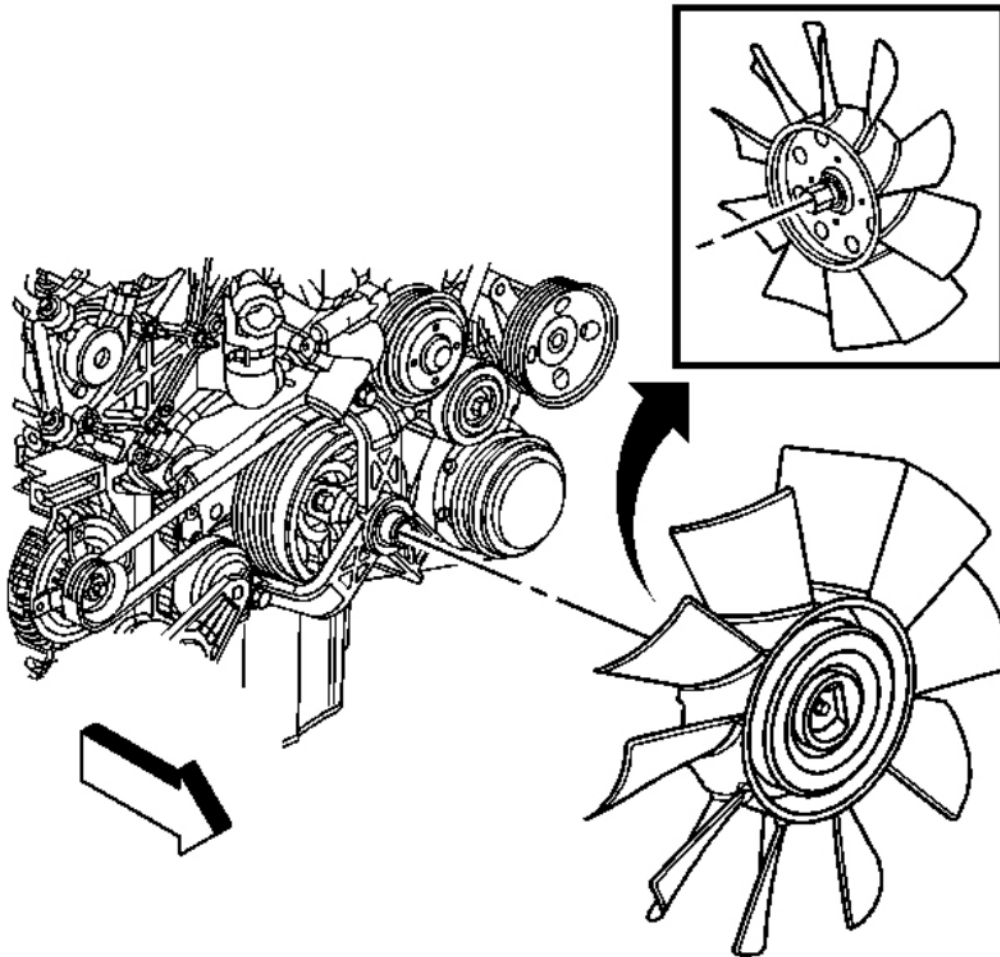


Fig. 43: View Of Fan

Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner intake duct. Refer to Air Cleaner Outlet Duct Replacement in Engine Controls - 4.6L.

IMPORTANT: Do not completely remove the fan from the crank adapter shaft.

2. Loosen the fan nut from the crank adapter shaft using **J 41240-5A** . See **Special Tools and Equipment**.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Disconnect the engine wiring harness from the engine frame and reposition aside.
5. Continue to loosen the fan nut and disconnect the fan from the crank adapter shaft.
6. Remove fan from vehicle.

Installation Procedure

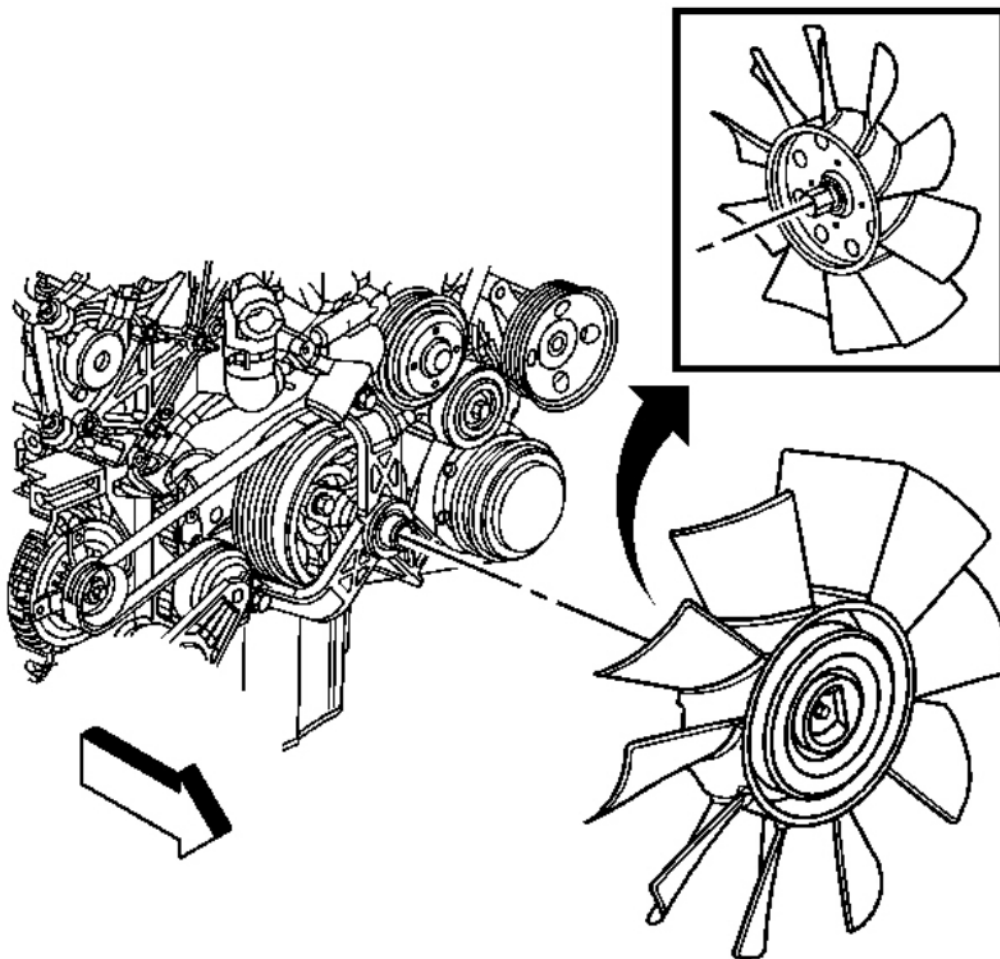


Fig. 44: View Of Fan

Courtesy of GENERAL MOTORS CORP.

1. Install fan from vehicle.
2. Connect the fan to the crank adapter shaft.
3. Connect the engine wiring harness to the engine frame.
4. Lower the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Tighten the fan nut to the crank adapter shaft using J 41240-5A . See Special Tools and Equipment.

Tighten: Tighten the nut to 100 N.m (74 lb ft).

6. Install the air cleaner intake duct. Refer to Air Cleaner Outlet Duct Replacement in Engine Controls - 4.6L.

COOLING FAN REPLACEMENT - ELECTRIC (LH2 - STANDARD COOLING)

Removal Procedure

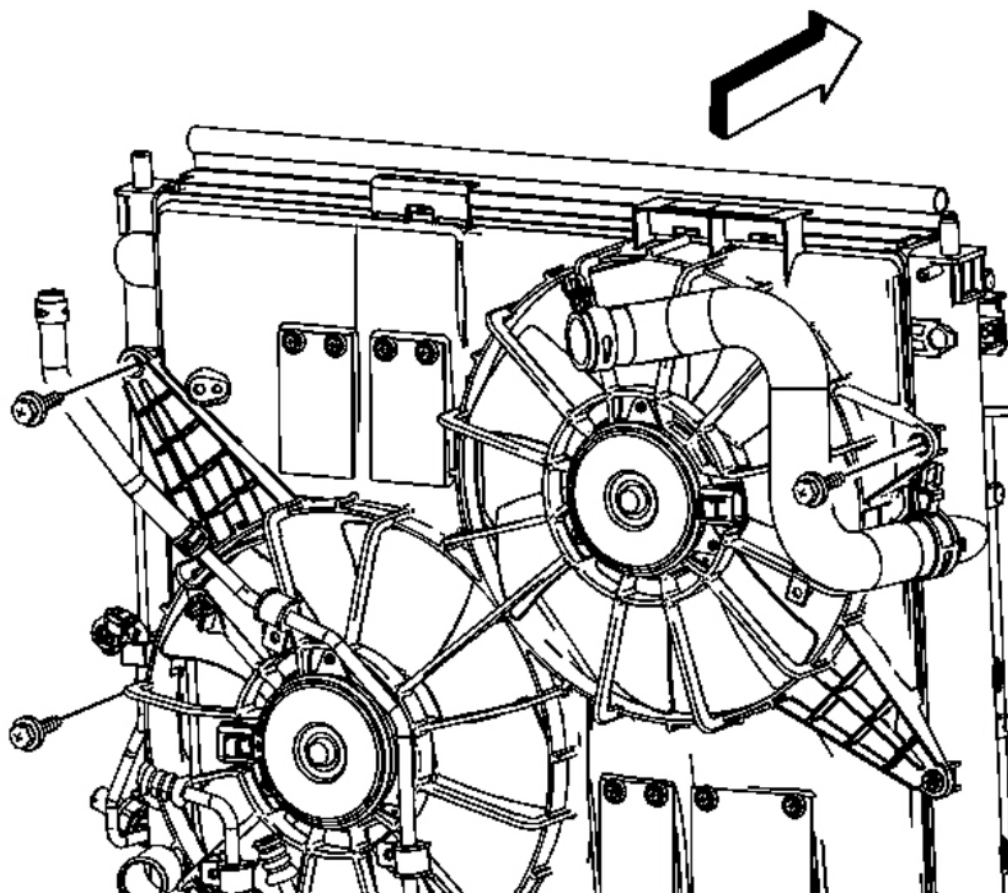


Fig. 45: View Of Fan Shroud To Radiator Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

CAUTION: To help avoid personal injury or damage to the vehicle, a bent, cracked, or damaged fan blade or housing should always be replaced.

1. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in

Engine Controls - 4.6L.

2. Disengage the surge tank inlet hose from the retaining features on the cooling fan shroud and reposition aside.
3. Remove the cooling fan shroud to radiator upper retaining bolts.
4. Remove the cooling fan shroud to radiator LH lower retaining bolt.
5. Disconnect the cooling fan electrical connectors.

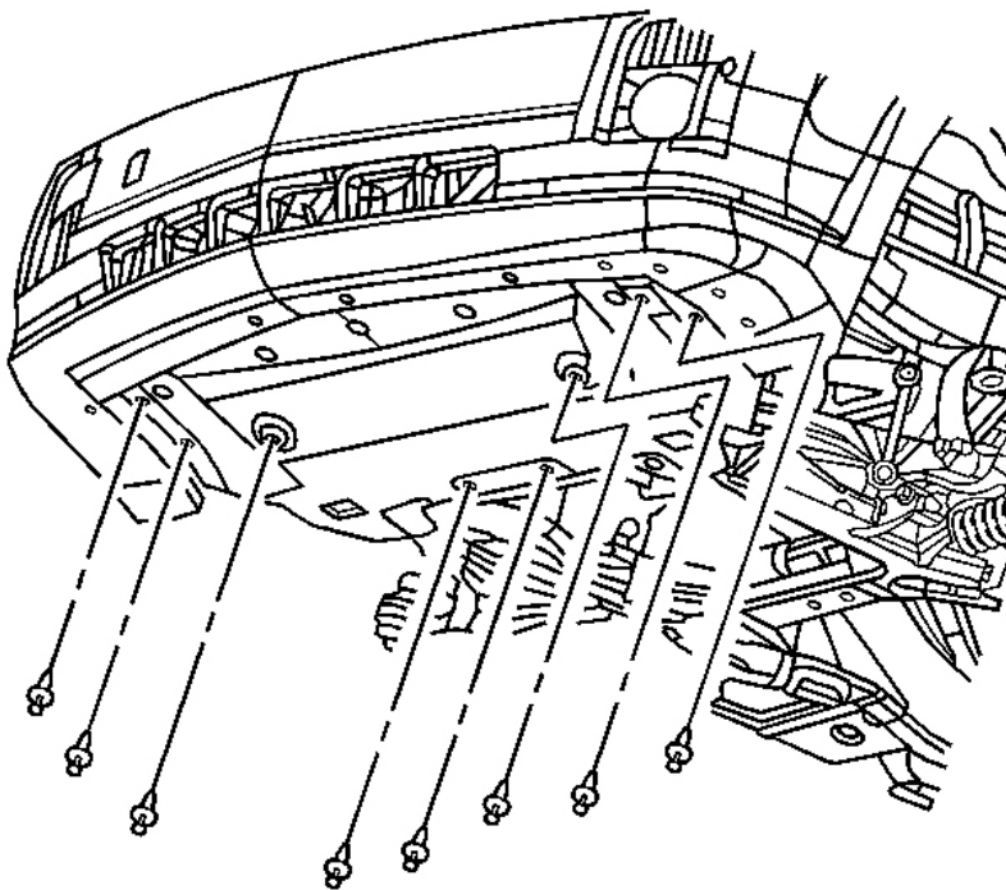


Fig. 46: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

6. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.

7. Remove the front air deflector retainers.
8. Remove the front air deflector.

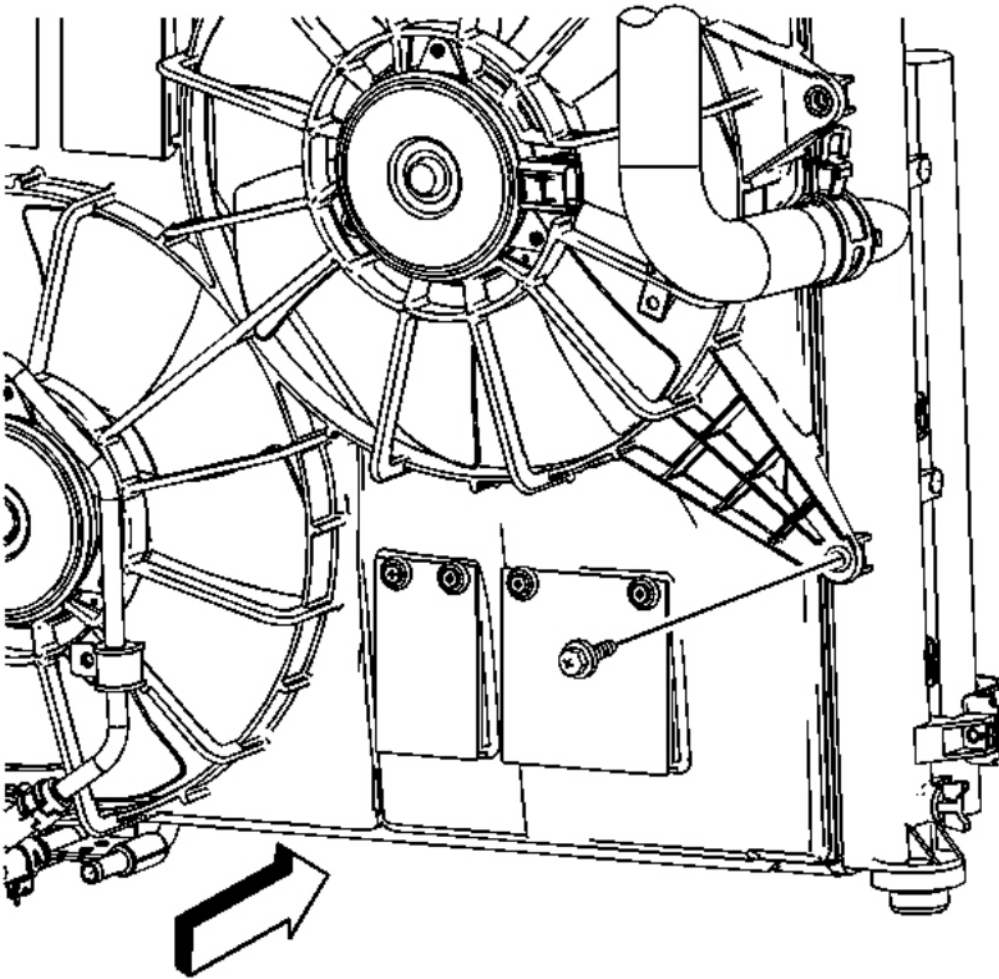


Fig. 47: View Of Cooling Fan Shroud To Radiator RH Lower Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

9. Remove the cooling fan shroud to radiator RH lower retaining bolt.

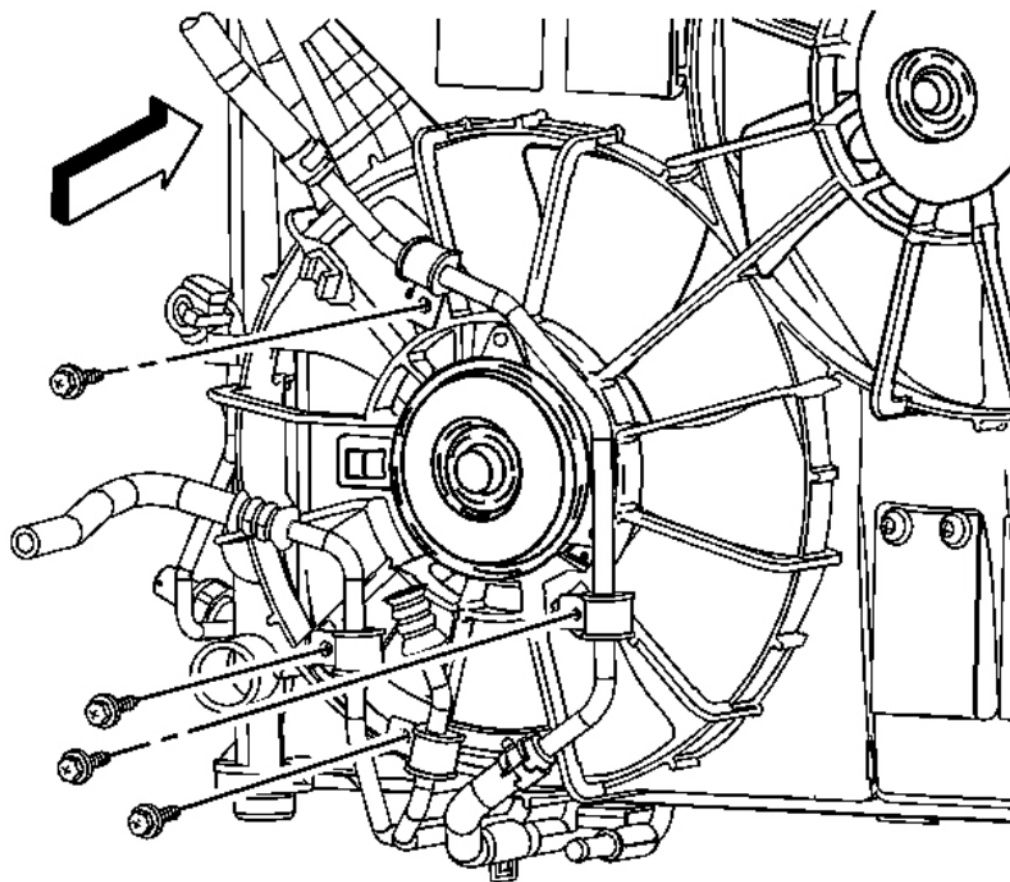


Fig. 48: View Of Power Steering & Transmission Oil Cooler Lines To Fan Shroud Retaining Bolts

Courtesy of GENERAL MOTORS CORP.

10. Disconnect and reposition the engine wiring harness from the engine frame and reposition.
11. Remove power steering line to cooling fan shroud retaining bolts.
12. Remove the transmission oil cooler lines to cooling fan shroud retaining bolts.
13. Lower the vehicle.
14. Remove the cooling fan assembly.

Installation Procedure

1. Install the cooling fan assembly.

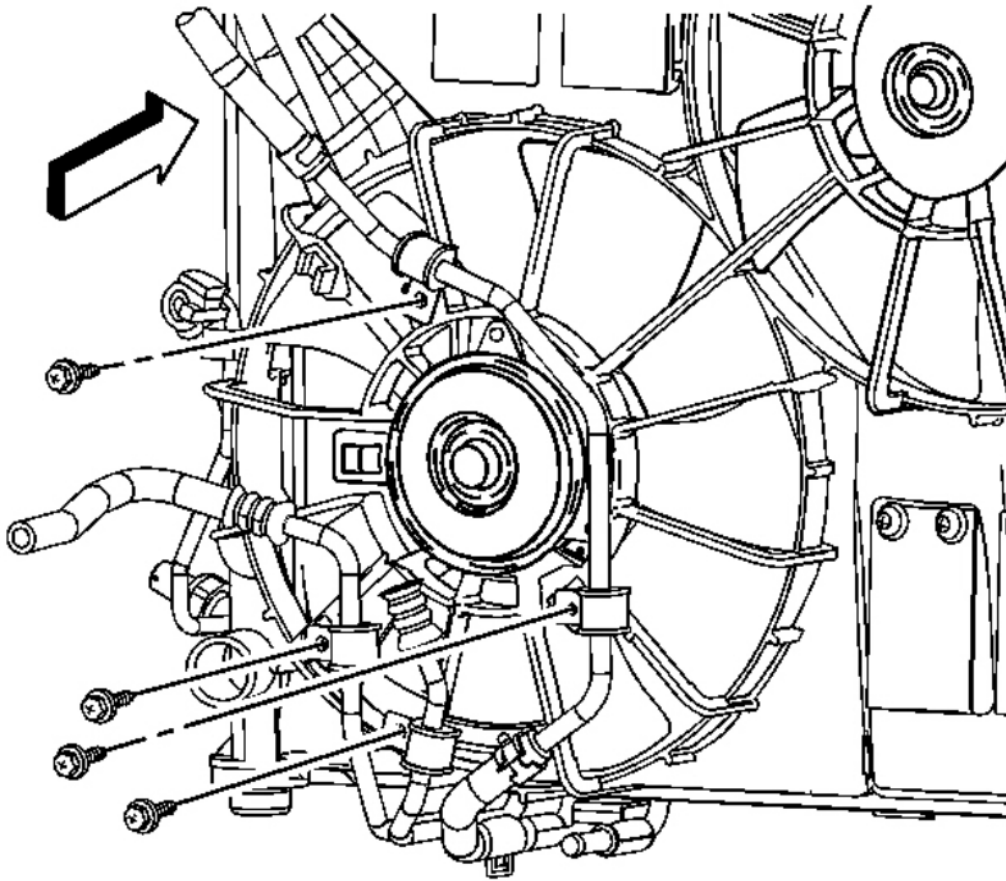


Fig. 49: View Of Power Steering & Transmission Oil Cooler Lines To Fan Shroud Retaining Bolts

Courtesy of GENERAL MOTORS CORP.

2. Raise the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the transmission oil cooler lines to cooling fan shroud retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

4. Install the power steering lines to cooling fan shroud retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

5. Connect the engine wiring harness to the engine frame.

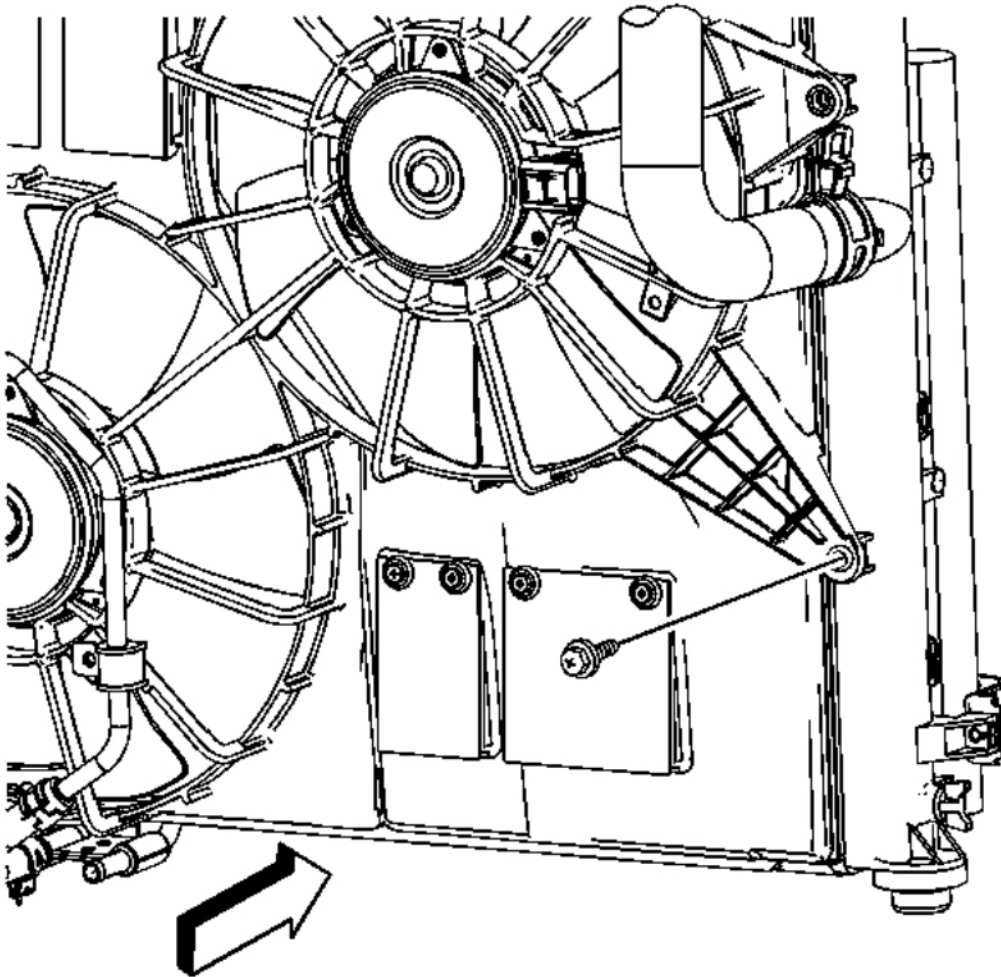


Fig. 50: View Of Cooling Fan Shroud To Radiator RH Lower Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the cooling fan shroud to radiator RH lower retaining bolt.

Tighten: Tighten the bolt to 6.5 N.m (58 lb in).

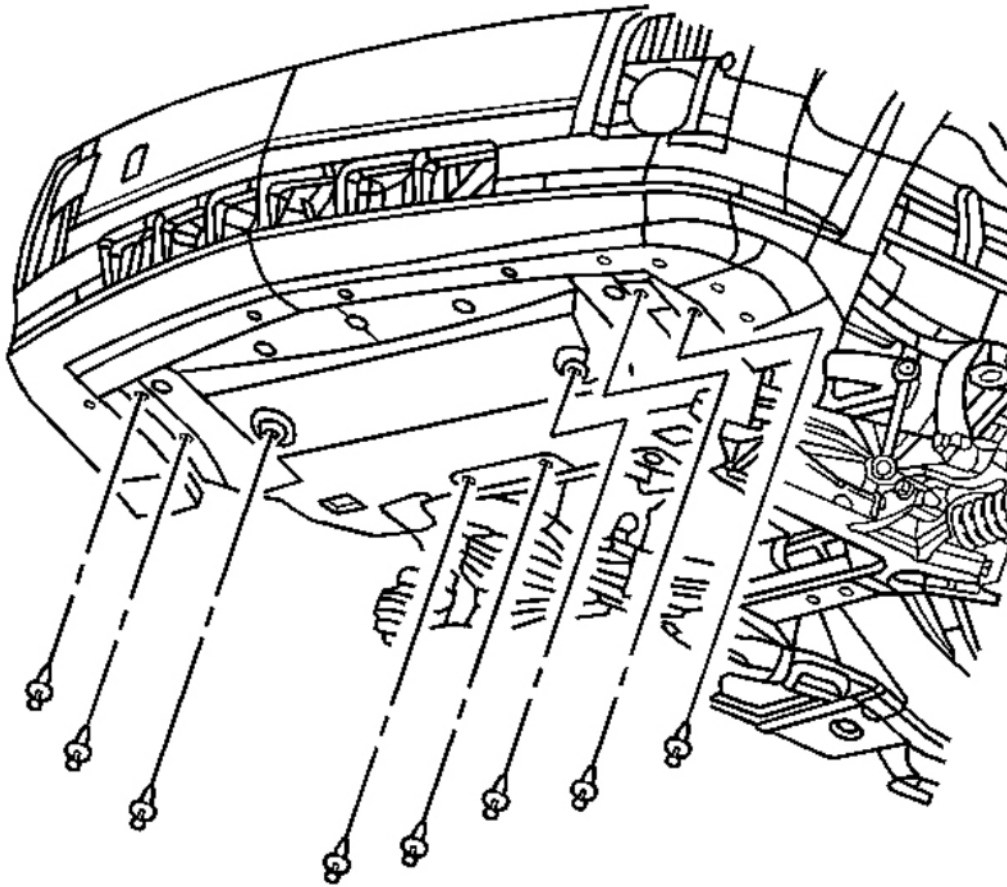


Fig. 51: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

7. Install the front air deflector.
8. Install the front air deflector retainers.
9. Lower the vehicle.
10. Connect the cooling fan electrical connectors.
11. Install the cooling fan shroud to radiator upper retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

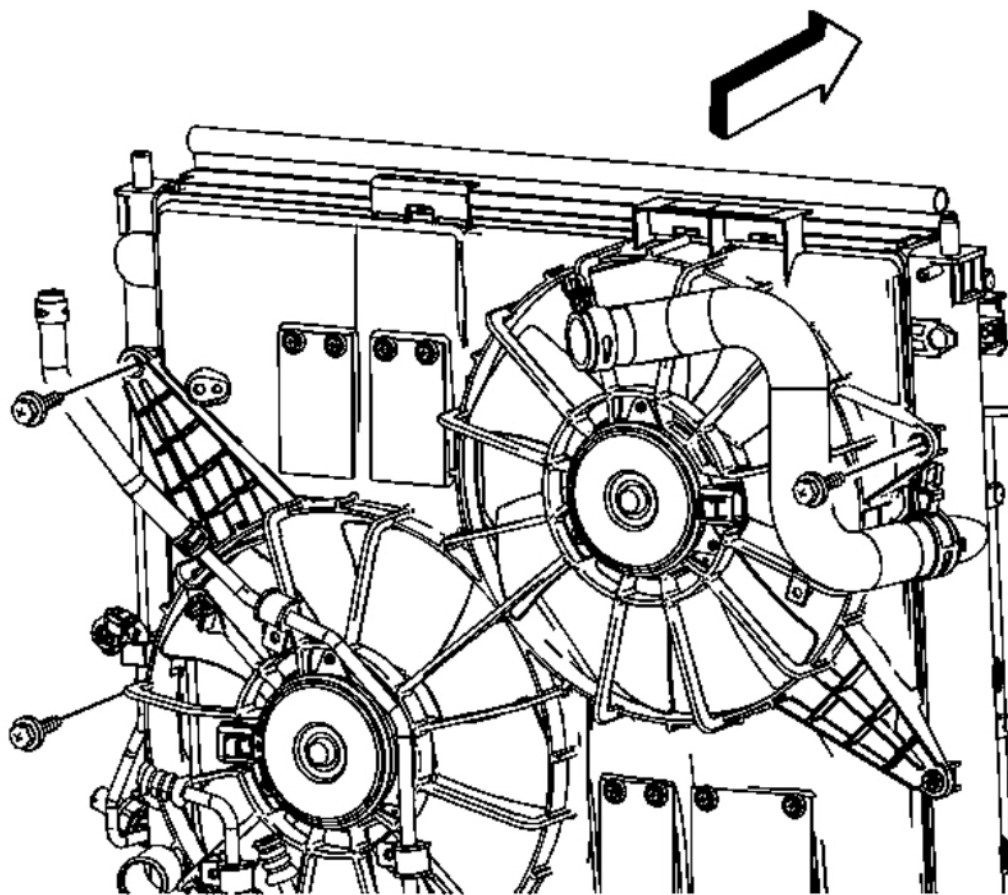


Fig. 52: View Of Fan Shroud To Radiator Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the cooling fan shroud to radiator left side lower retaining bolt.

Tighten: Tighten the bolt to 6.5 N.m (58 lb in).

13. Engage the surge tank inlet hose to the retaining features on the cooling fan shroud.
14. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L.

COOLING FAN REPLACEMENT - ELECTRIC (LH2 - HEAVY DUTY COOLING)

Removal Procedure

1. Remove the auxiliary cooling fan assembly to condenser upper mounting bolts.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

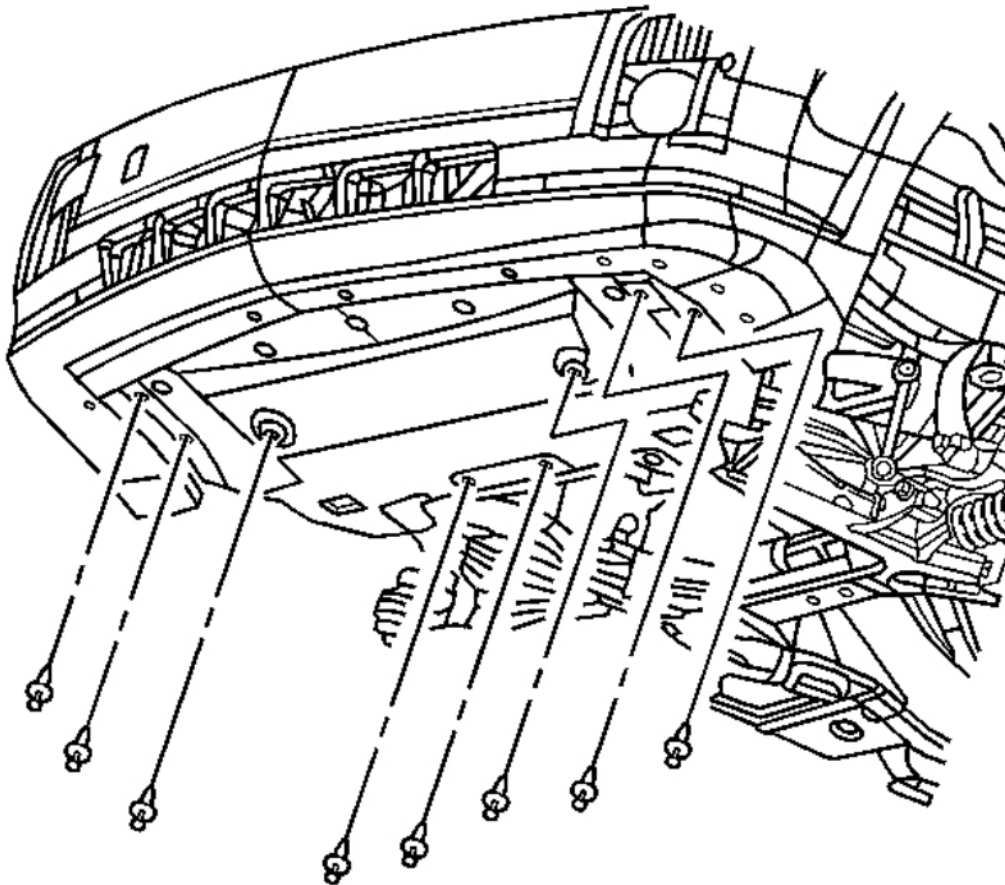


Fig. 53: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

3. Remove the front air deflector retainers.
4. Remove the front air deflector.

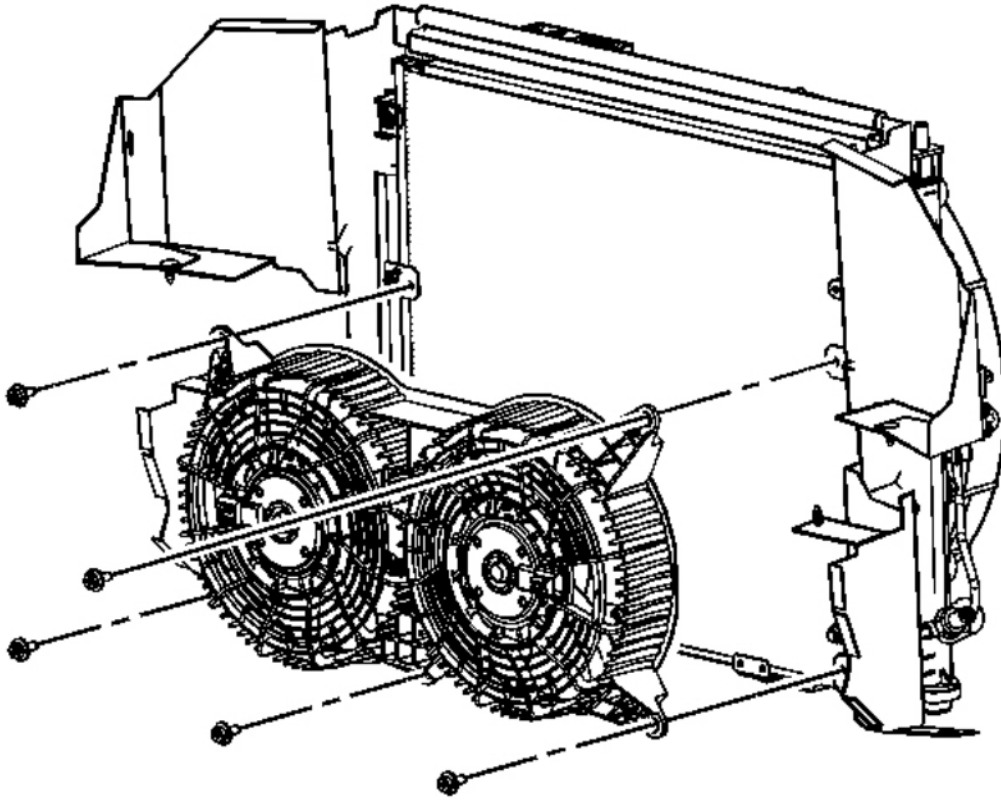


Fig. 54: View Of Auxiliary Cooling Fan Assembly
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the auxiliary cooling fan assembly electrical connectors.
6. Remove the auxiliary cooling fan assembly to condenser lower mounting bolts.
7. Remove the auxiliary cooling fan assembly.

Installation Procedure

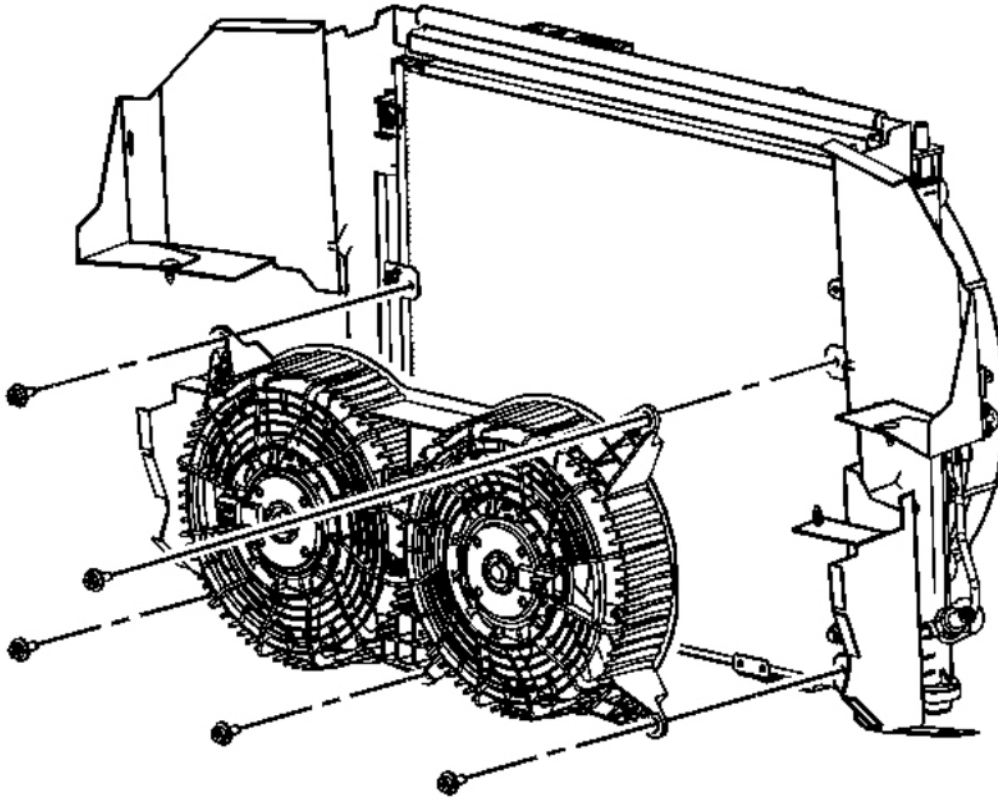


Fig. 55: View Of Auxiliary Cooling Fan Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the auxiliary cooling fan assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the auxiliary cooling fan assembly to condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

3. Connect the auxiliary cooling fan assembly electrical connectors.
4. Install the front air deflector.

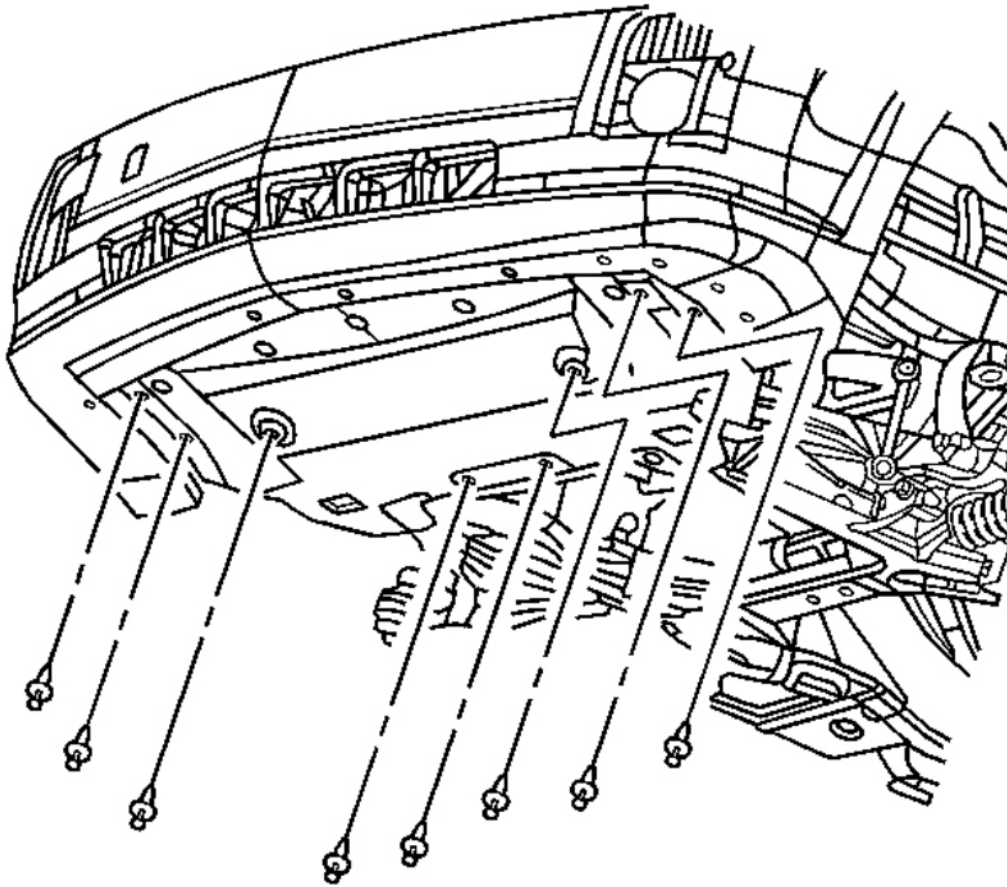


Fig. 56: Locating Front Air Deflector Retainers
Courtesy of GENERAL MOTORS CORP.

5. Install the front air deflector retainers.
6. Lower the vehicle.
7. Install the auxiliary cooling fan assembly to condenser upper mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

COOLING FAN REPLACEMENT - ELECTRIC (LY7)

Removal Procedure

CAUTION: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

CAUTION: To help avoid personal injury or damage to the vehicle, a bent, cracked, or damaged fan blade or housing should always be replaced.

1. Remove the air cleaner outlet duct. Refer to [Air Cleaner Intake Duct Replacement](#) in Engine Controls - 3.6L.

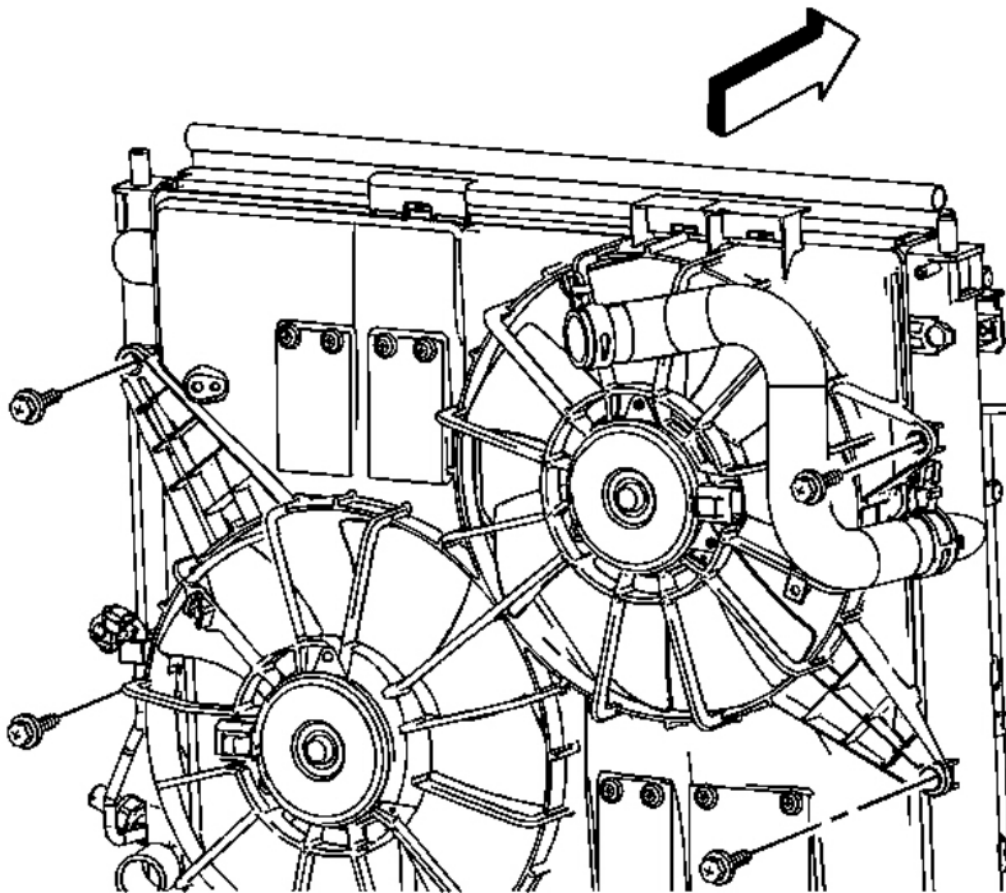


Fig. 57: View Of Cooling Fan Shroud To Radiator Retaining Bolts

Courtesy of GENERAL MOTORS CORP.

2. Disconnect the cooling fan electrical connectors.
3. Disconnect the condenser tube from the cooling fan shroud retainer clip.
4. Disengage the surge tank inlet hose from the retaining features on the cooling fan shroud and reposition aside.
5. Remove the cooling fan shroud to radiator retaining bolts.
6. Remove the cooling fan assembly.

Installation Procedure

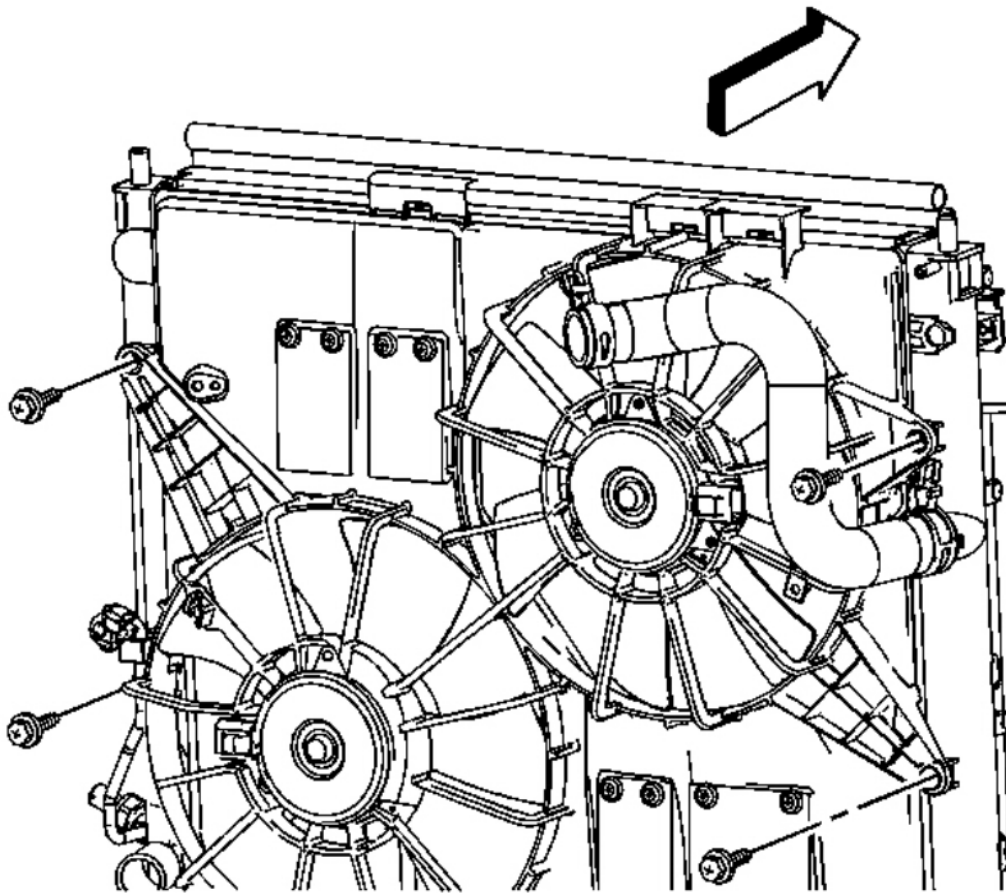


Fig. 58: View Of Cooling Fan Shroud To Radiator Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the cooling fan shroud to radiator retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

3. Engage the surge tank inlet hose to the retaining features on the cooling fan shroud.
4. Connect the condenser tube to the cooling fan shroud retainer clip.
5. Connect the cooling fan electrical connectors.
6. Install the air cleaner outlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.6L.

COOLING FAN MOTOR REPLACEMENT - ELECTRIC

Removal Procedure

1. Remove the cooling fan assembly. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.

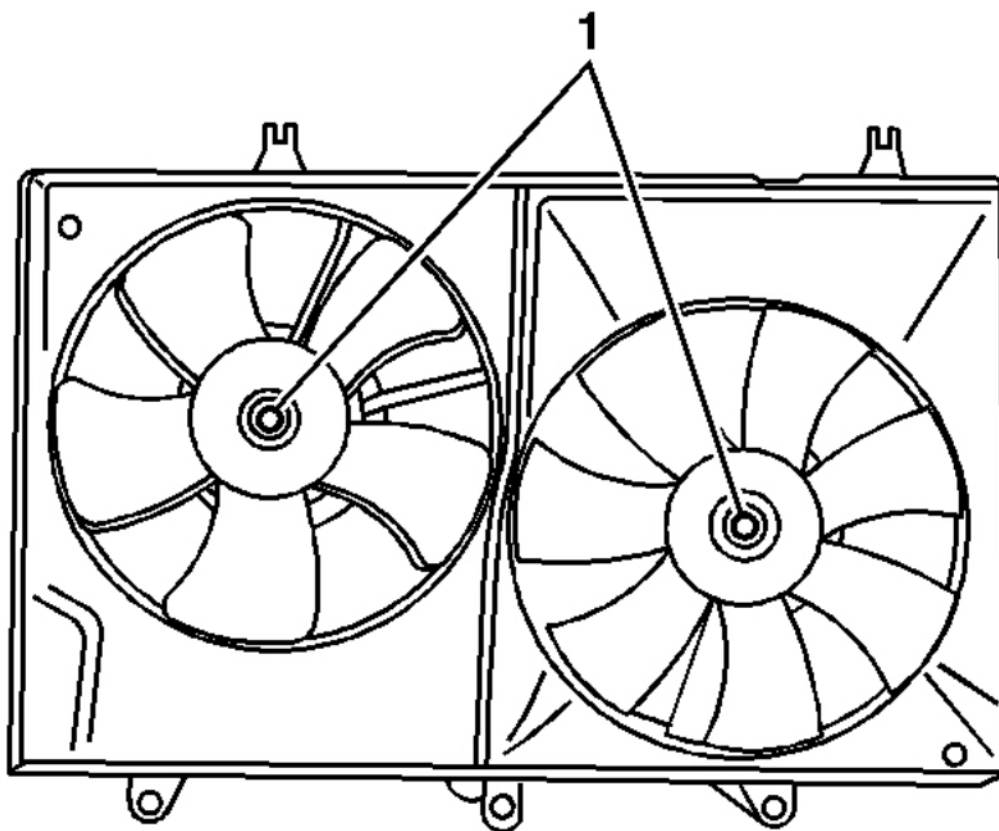


Fig. 59: Locating Fan Blade Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

2. Remove the fan blade retaining nut (1) from the motor.

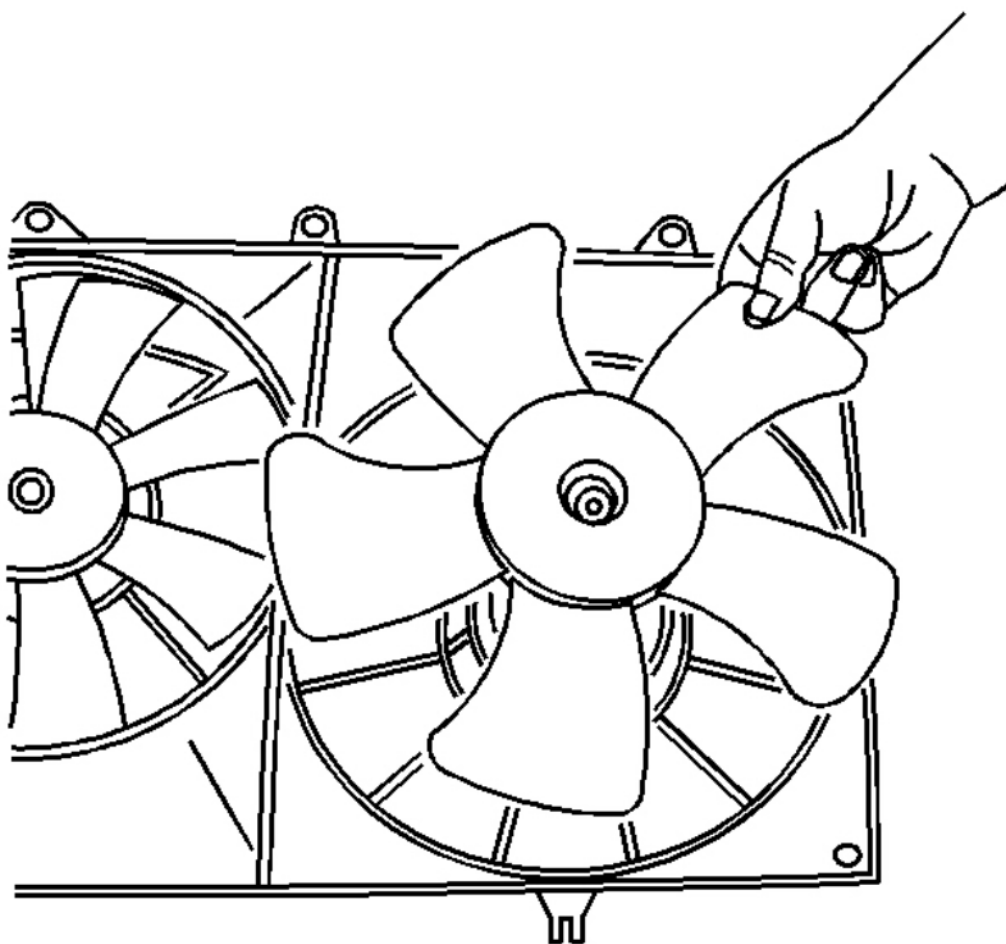


Fig. 60: View Of Motor Shaft Fan Blade
Courtesy of GENERAL MOTORS CORP.

3. Remove the fan blade from the motor shaft.

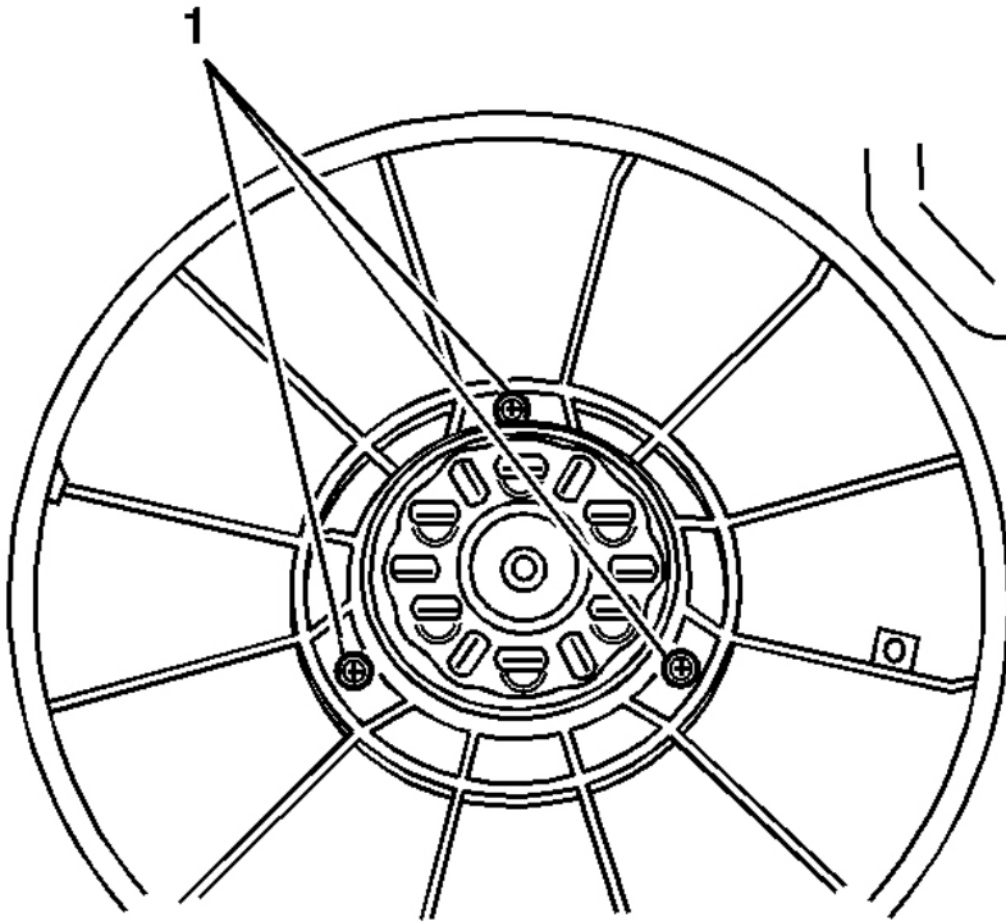


Fig. 61: Locating Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

4. Remove the motor retaining screws (1).

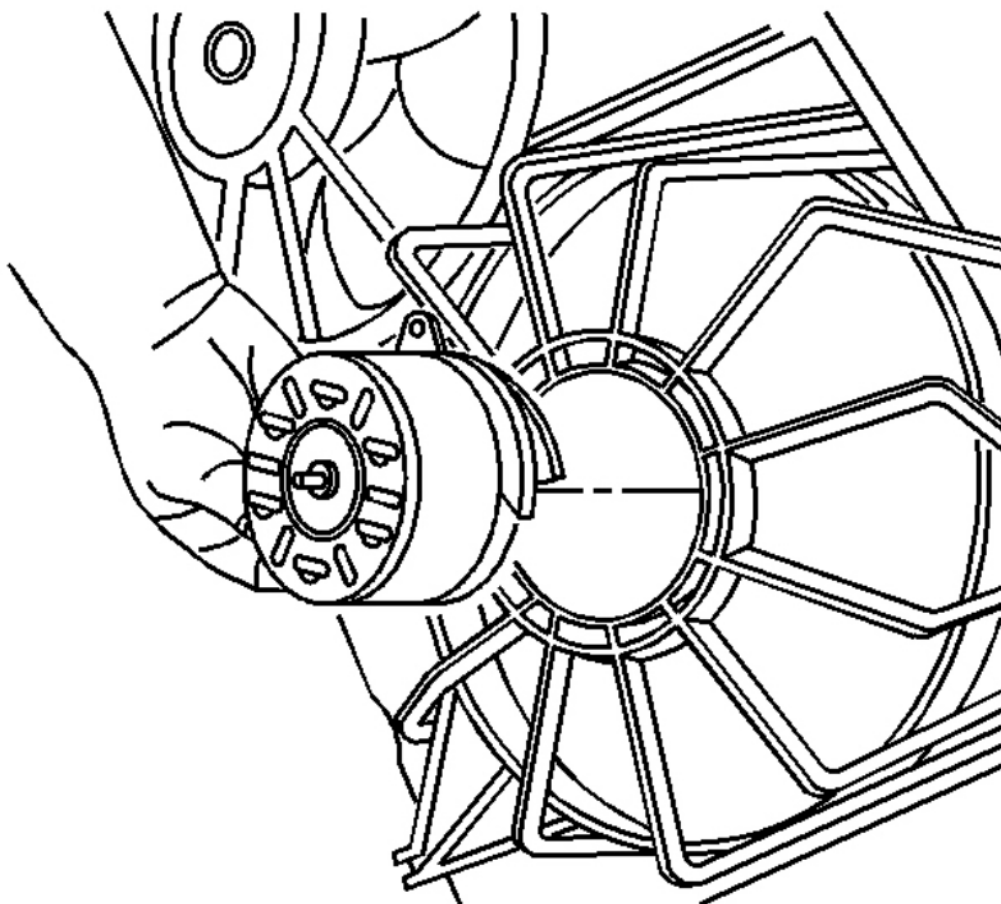


Fig. 62: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

5. Remove the motor from the shroud.

Installation Procedure

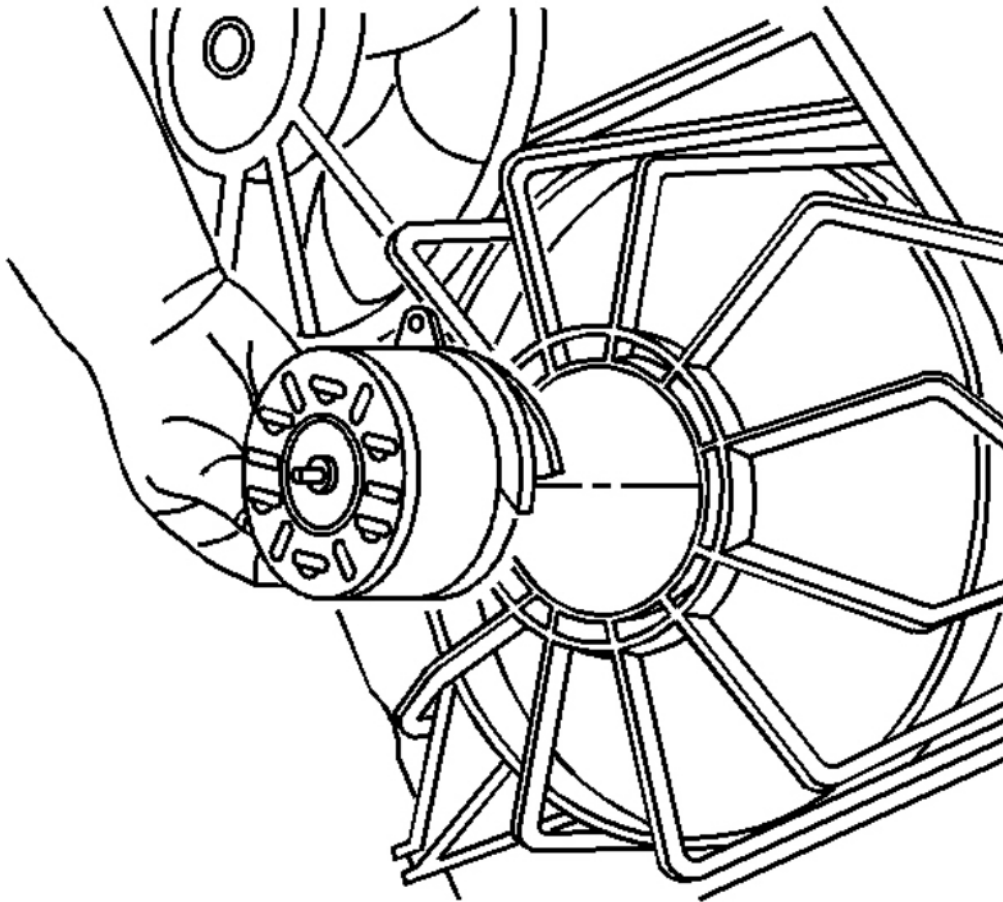


Fig. 63: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

1. Install the motor to the shroud.

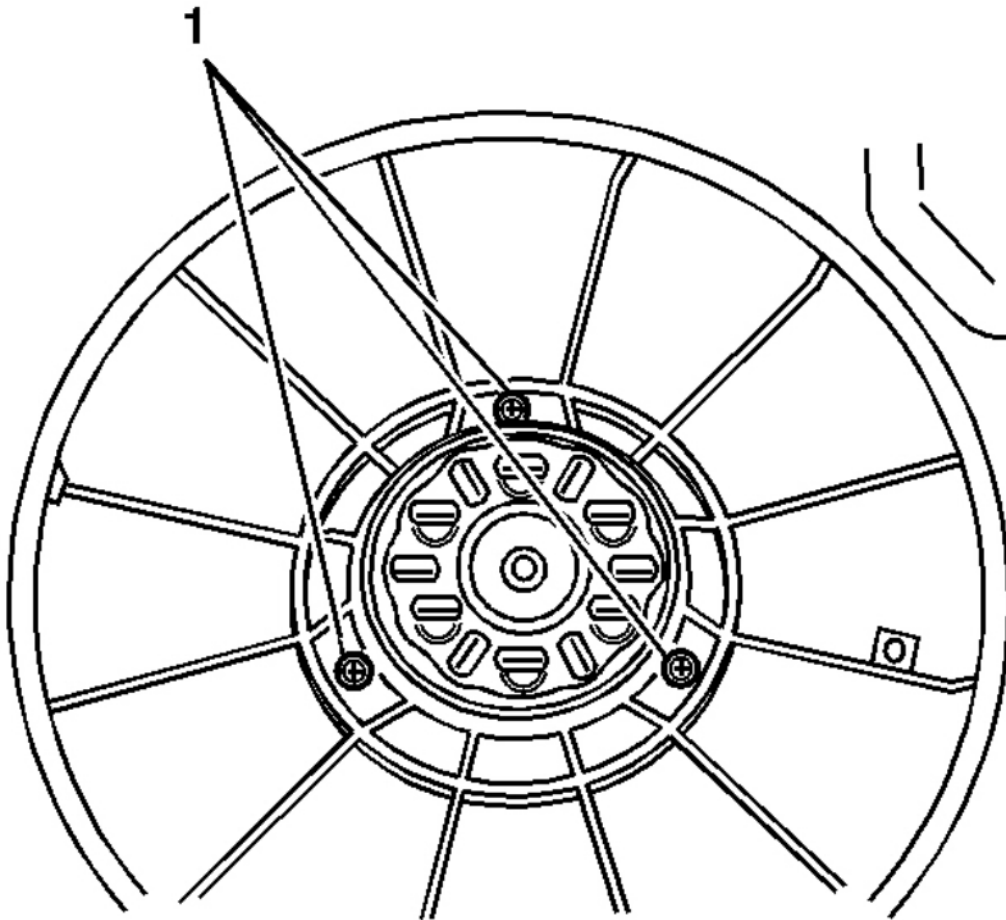


Fig. 64: Locating Motor Retaining Screws

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the cooling fan motor retaining screws (1).

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

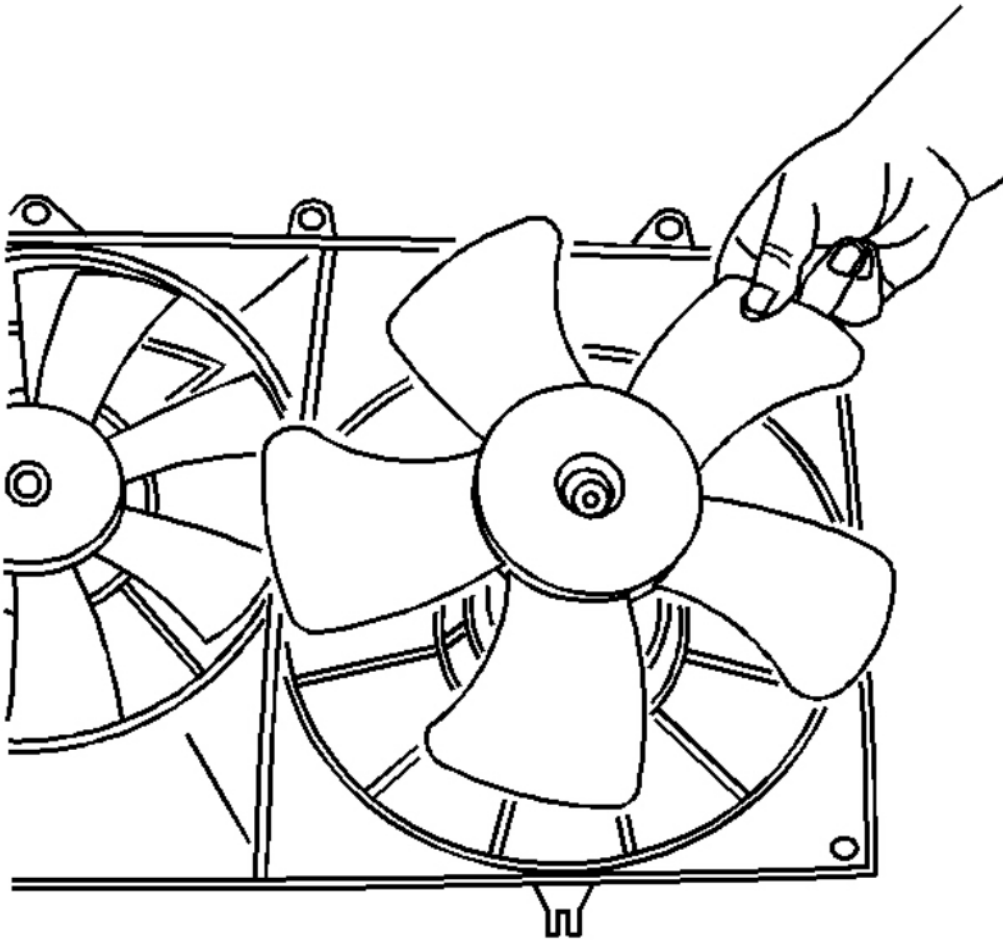


Fig. 65: View Of Motor Shaft Fan Blade
Courtesy of GENERAL MOTORS CORP.

3. Install the fan blade to the motor shaft.
4. Rotate the fan until the fan drops onto the shaft.

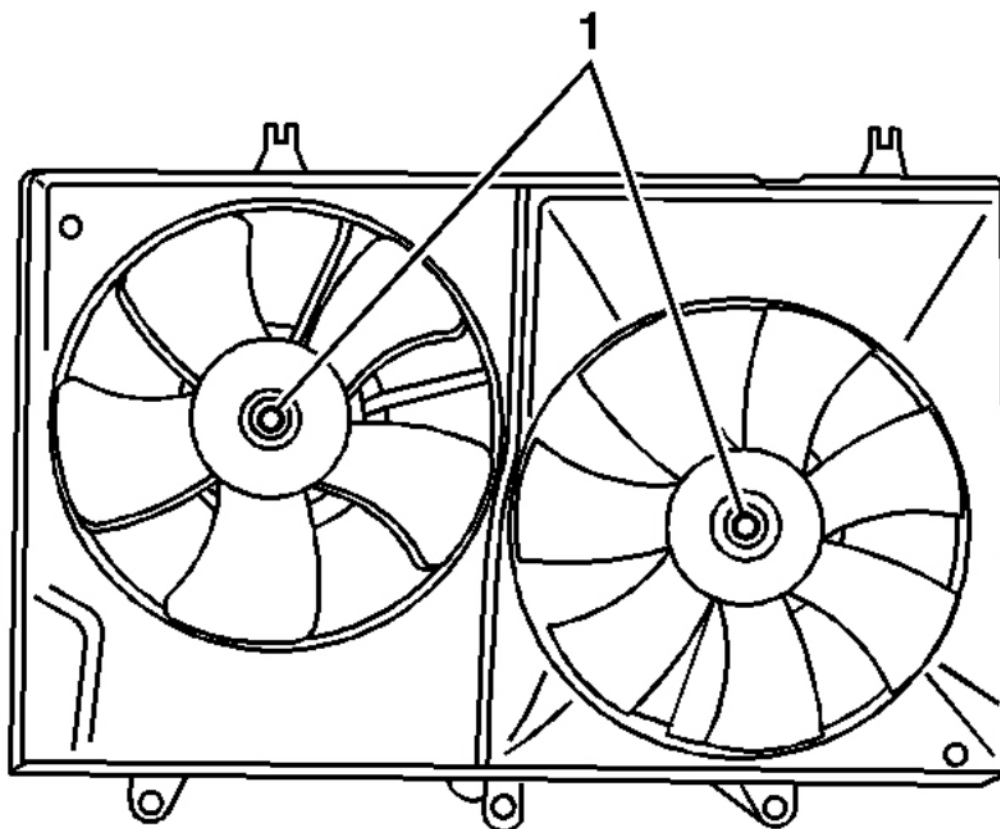


Fig. 66: Locating Fan Blade Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

5. Install the fan blade retaining nut (1) to the motor.

Tighten: Tighten the nut to 7 N.m (62 lb in).

6. Install the cooling fan assembly. Refer to Cooling Fan Replacement - Electric (LH2 - Standard Cooling) or Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling) or Cooling Fan Replacement - Electric (LY7).

THERMOSTAT HOUSING REPLACEMENT (LH2)

Removal Procedure

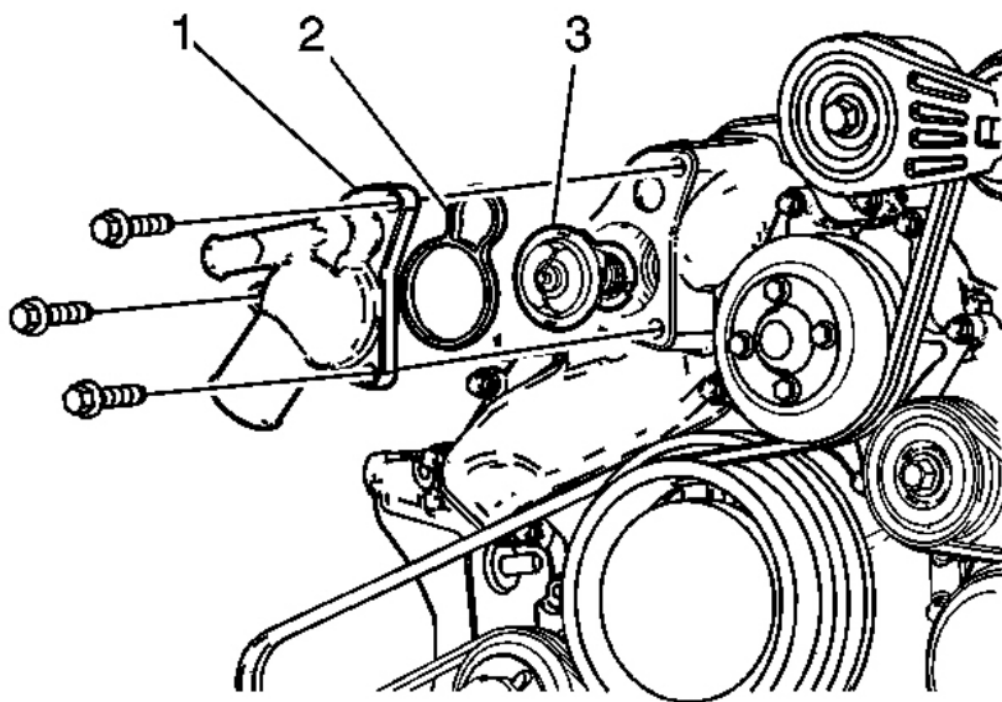


Fig. 67: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls-4.6L (LH2).
3. Remove the radiator hose from the thermostat housing. Refer to **Radiator Hose Replacement - Outlet (LH2 - Standard Cooling)** or **Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling)** or **Radiator Hose Replacement - Outlet (LY7)**.
4. Remove the heater hose from the thermostat housing. Refer to **Heater Hose Replacement - Outlet** in Heating, Ventilation and Air Conditioning.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing (1) with thermostat (3), from the water housing.
7. Remove and discard the seal ring (2).
8. Remove the thermostat from the thermostat housing.

Installation Procedure

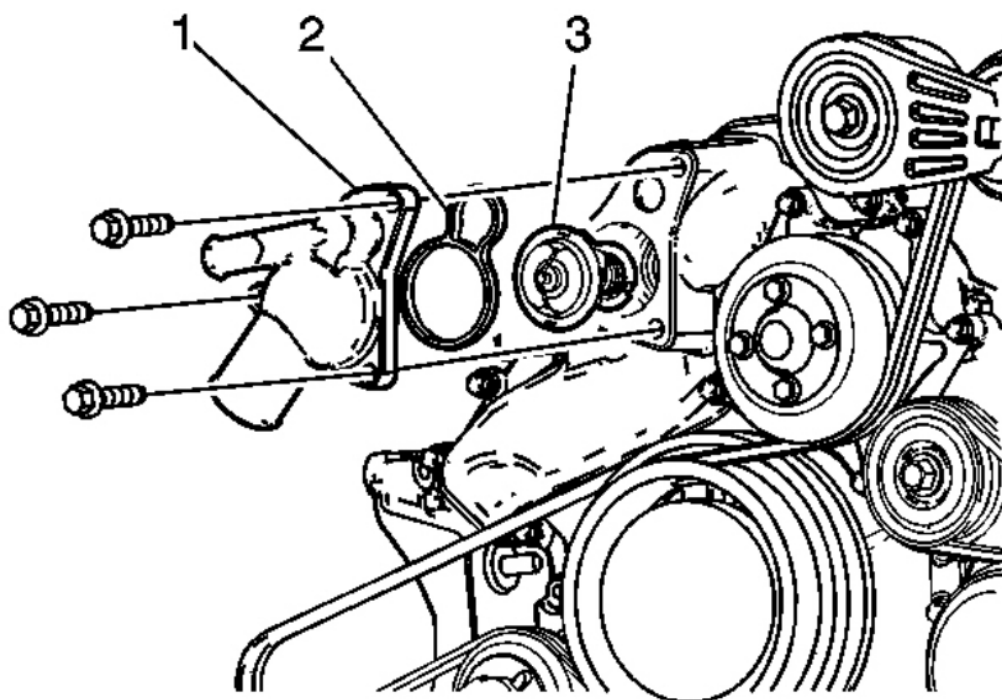


Fig. 68: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

1. Clean the thermostat housing and water housing sealing surfaces.
2. Install the thermostat to the thermostat housing.
3. Install the NEW seal (2) to the thermostat housing.
4. Install the thermostat housing (1) with the thermostat (3) and the seal (2) to the water housing.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the thermostat housing bolts.

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

6. Install the heater hose to the thermostat housing. Refer to **Heater Hose Replacement - Outlet** in Heating, Ventilation and Air Conditioning.
7. Install the radiator hose to the thermostat housing. Refer to **Radiator Hose Replacement - Outlet (LH2 - Standard Cooling)** or **Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling)** or **Radiator Hose Replacement - Outlet (LY7)**.
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls-4.6L (LH2).
9. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

THERMOSTAT HOUSING REPLACEMENT (LY7)

Removal Procedure

1. Disconnect the heater hoses from the heater core. Refer to **Heater Hose Replacement - Inlet** and **Heater Hose Replacement - Outlet** in Heating, Ventilation and Air Conditioning.
2. Remove the thermostat. Refer to **Thermostat Replacement (LH2)** or **Thermostat Replacement (LY7)**.

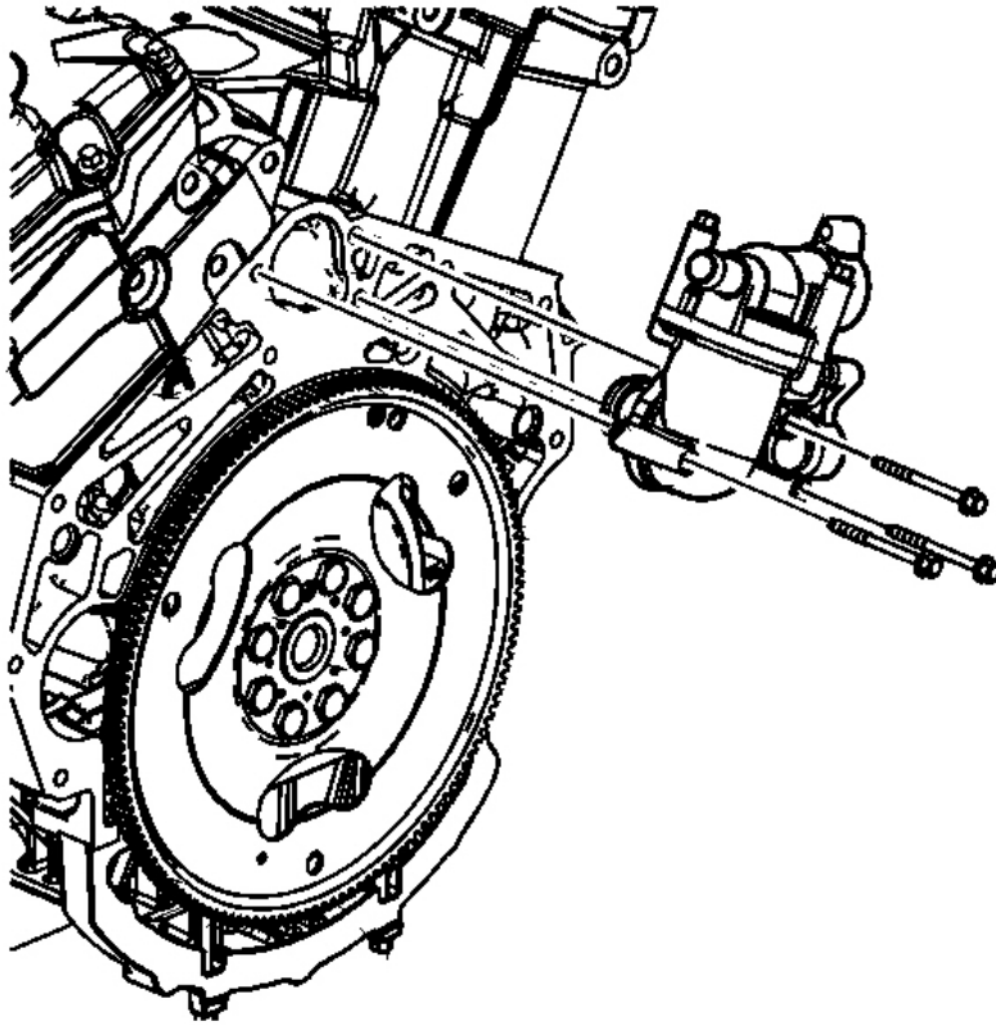


Fig. 69: View Of Thermostat Housing With Heater Pipes, Heater Hoses, Gasket & Bolts

Courtesy of GENERAL MOTORS CORP.

3. Remove the thermostat housing bolts.
4. Remove the thermostat housing with the heater pipes, hoses and bolts.
5. Carefully clean the sealing surfaces with a plastic gasket scraper such as **J 28410** or equivalent.

Installation Procedure

1. Assemble the heater pipes and hoses to the thermostat housing.
2. Install a new gasket to the thermostat housing.
3. Install the thermostat housing bolts to the thermostat housing.

Partially install the thermostat housing bolts in order to retain the gasket.

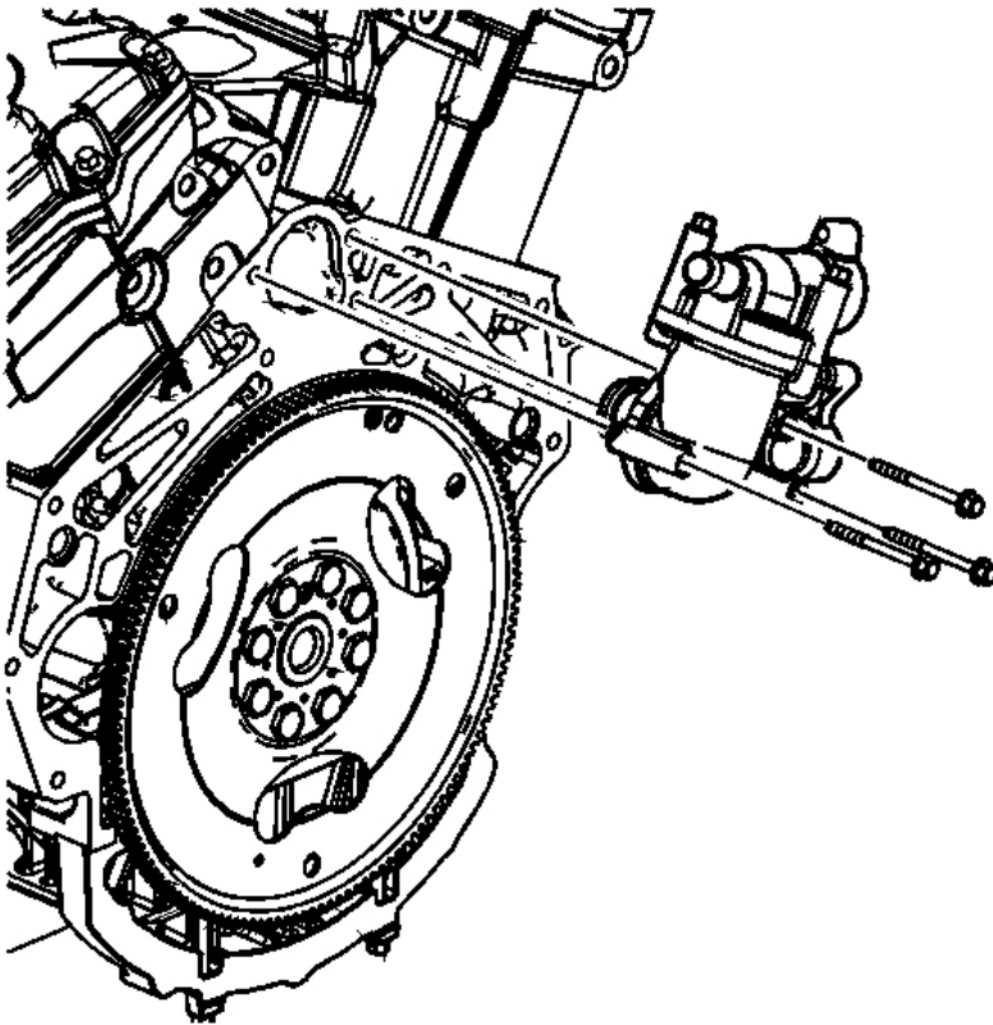


Fig. 70: View Of Thermostat Housing With Heater Pipes, Heater Hoses, Gasket & Bolts

Courtesy of GENERAL MOTORS CORP.

4. Install the thermostat housing with the heater pipes, heater hoses, gasket and bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the thermostat housing bolts.

Tighten: Tighten the thermostat housing bolts to 20 N.m (15 lb ft).

6. Install the thermostat. Refer to Thermostat Replacement (LH2) or Thermostat Replacement (LY7).
7. Connect the heater hoses to the heater core. Refer to Heater Hose Replacement - Inlet and Heater Hose Replacement - Inlet in Heating, Ventilation and Air Conditioning.

THERMOSTAT REPLACEMENT (LH2)

Removal Procedure

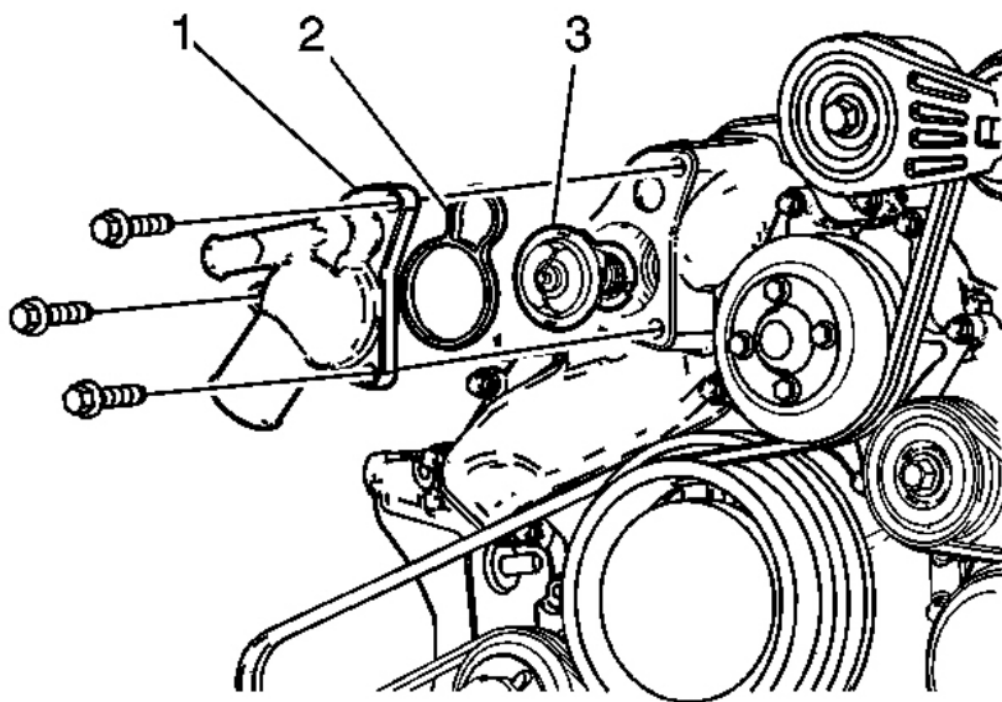


Fig. 71: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L (LH2).
3. Remove the radiator hose from the thermostat housing. Refer to **Radiator Hose Replacement - Outlet (LH2 - Standard Cooling)** or **Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling)** or **Radiator Hose Replacement - Outlet (LY7)**.
4. Remove the heater hose from the thermostat housing. Refer to **Heater Hose Replacement - Outlet** in Heating, Ventilation and Air Conditioning.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing (1) with thermostat (3), from the water housing.
7. Remove and discard the seal ring (2).
8. Remove the thermostat from the thermostat housing.

Installation Procedure

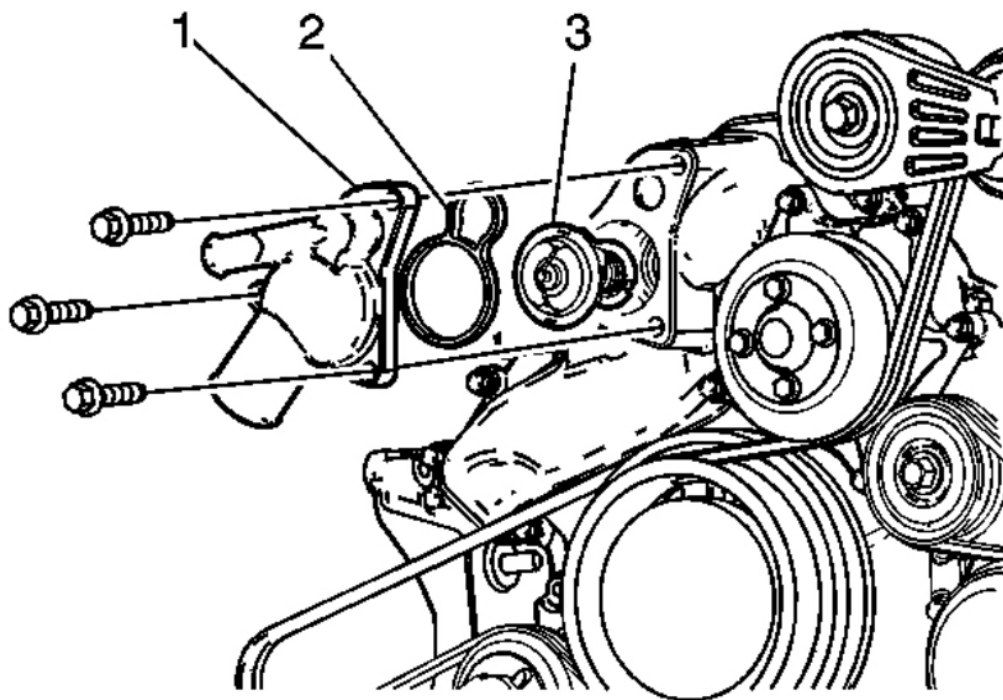


Fig. 72: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

1. Clean the thermostat housing and water housing sealing surfaces.
2. Install the new thermostat to the thermostat housing.
3. Install the NEW seal (2) to the thermostat housing.
4. Install the thermostat housing (1) with the thermostat (3) and the seal (2) to the water housing.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the thermostat housing bolts.

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

6. Install the heater hose to the thermostat housing. Refer to **Heater Hose Replacement - Outlet** in Heating, Ventilation and Air Conditioning.
7. Install the radiator hose to the thermostat housing. Refer to **Radiator Hose Replacement - Outlet (LH2 - Standard Cooling)** or **Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling)** or **Radiator Hose Replacement - Outlet (LY7)**.
8. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L (LH2).
9. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

THERMOSTAT REPLACEMENT (LY7)

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System**.

IMPORTANT: Do NOT separate the upper and lower intake manifolds.

2. Remove the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower** in Engine Mechanical - 3.6L (LY7).
3. Disconnect the surge tank hose from the thermostat.

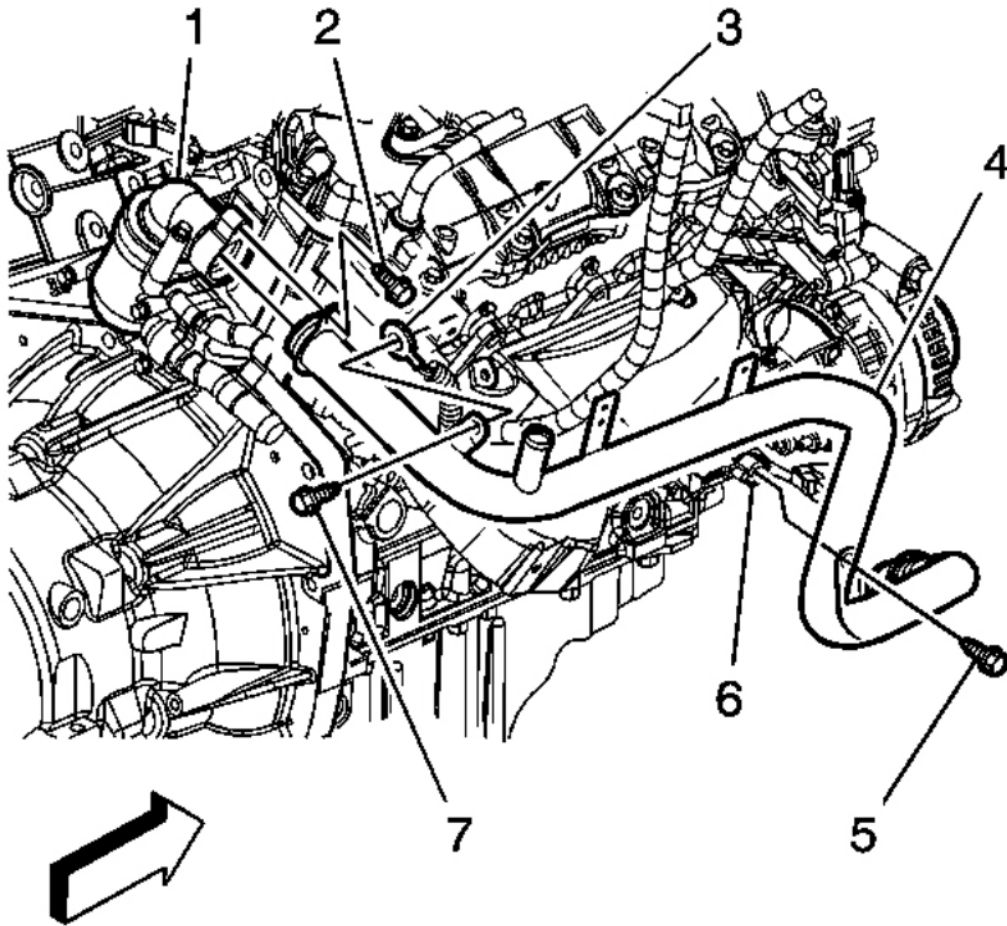


Fig. 73: View Of Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant pipe/thermostat housing bolt (2).
5. Remove the coolant pipe upper bolt (7).
6. Remove the coolant inlet pipe (4) from the thermostat.

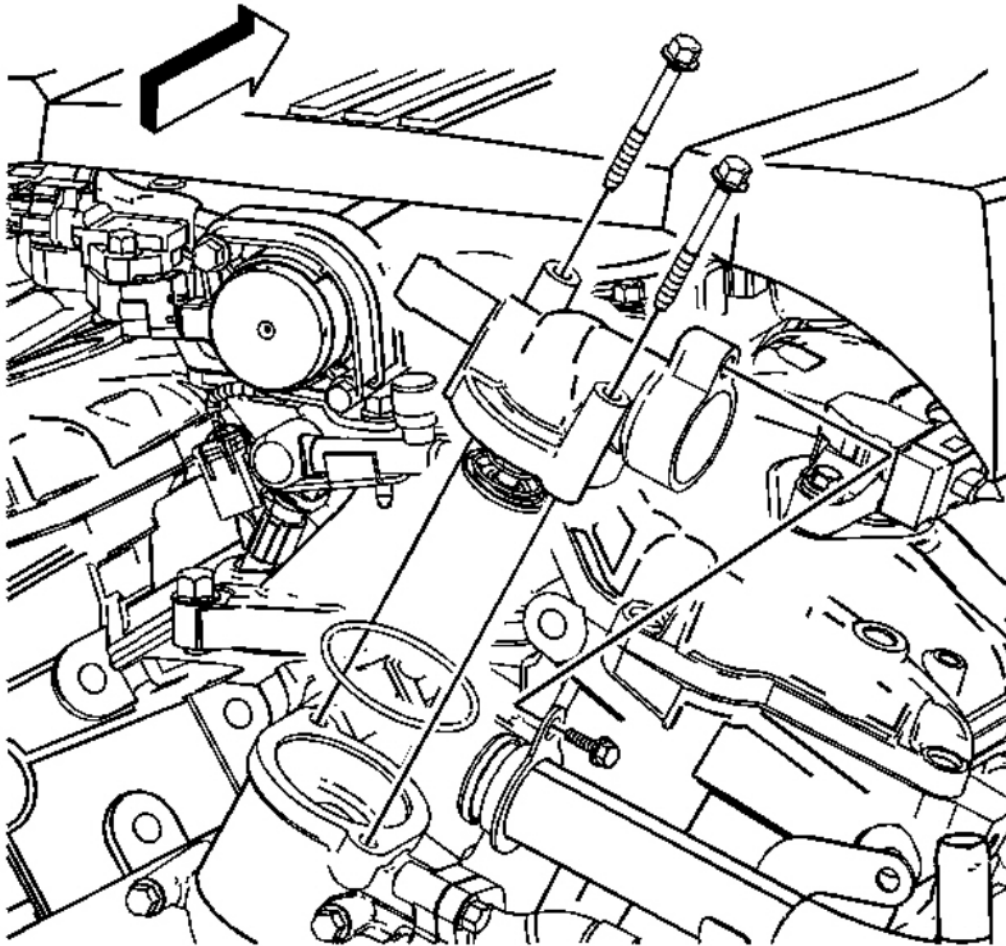


Fig. 74: View Of Thermostat
Courtesy of GENERAL MOTORS CORP.

7. Remove the thermostat bolts.
8. Remove the thermostat and discard the thermostat seal.

Installation Procedure

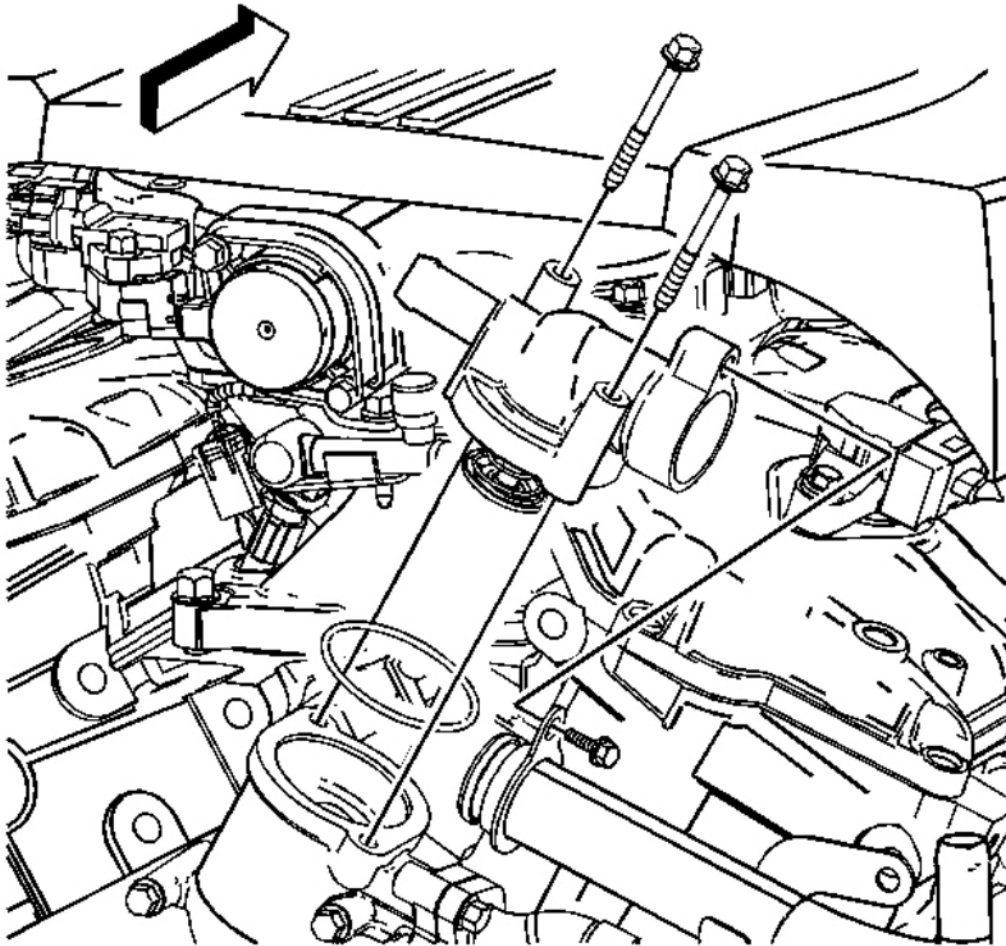


Fig. 75: View Of Thermostat
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat with a NEW thermostat seal.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the thermostat bolts.

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

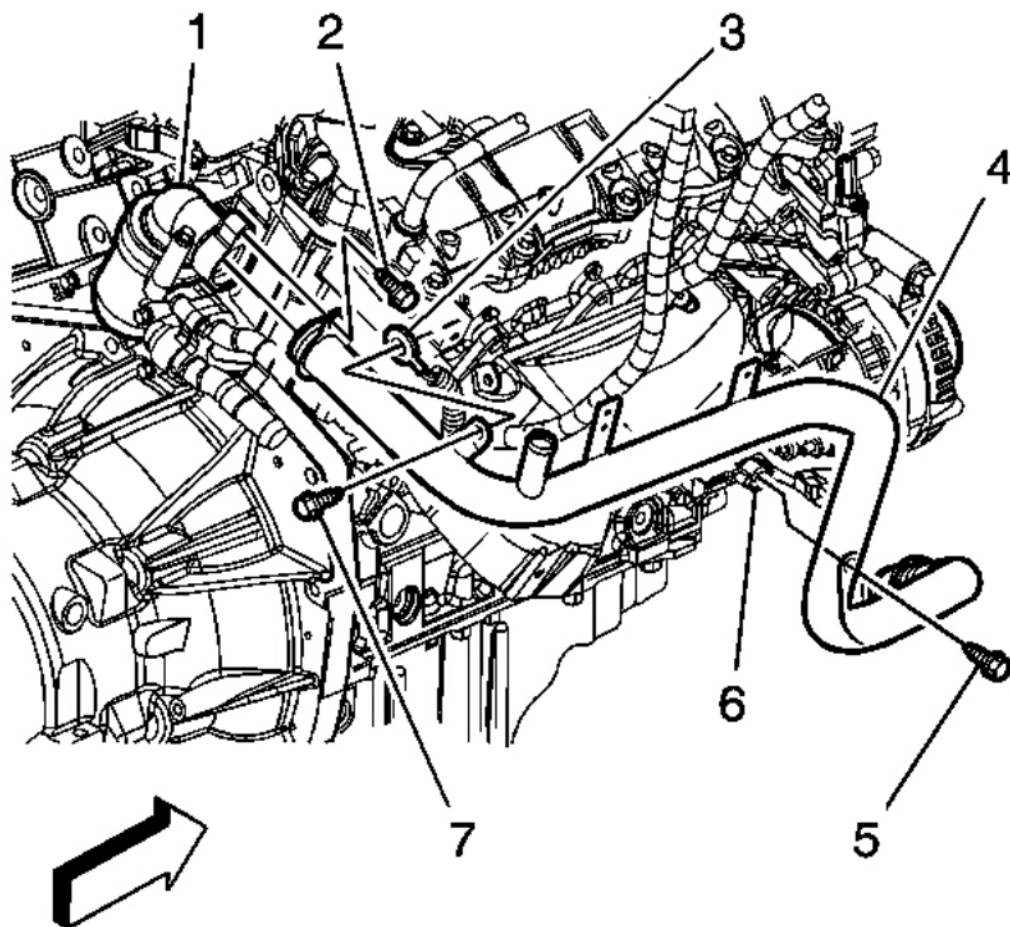


Fig. 76: View Of Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

3. Install the coolant pipe (4), NEW seal, and fasteners (2 and 7). Refer to **Coolant Pipe Replacement - Inlet (LY7)**.
4. Install the surge tank hose to the thermostat.
5. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower** in Engine Mechanical - 3.6L (LY7).
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

Removal Procedure

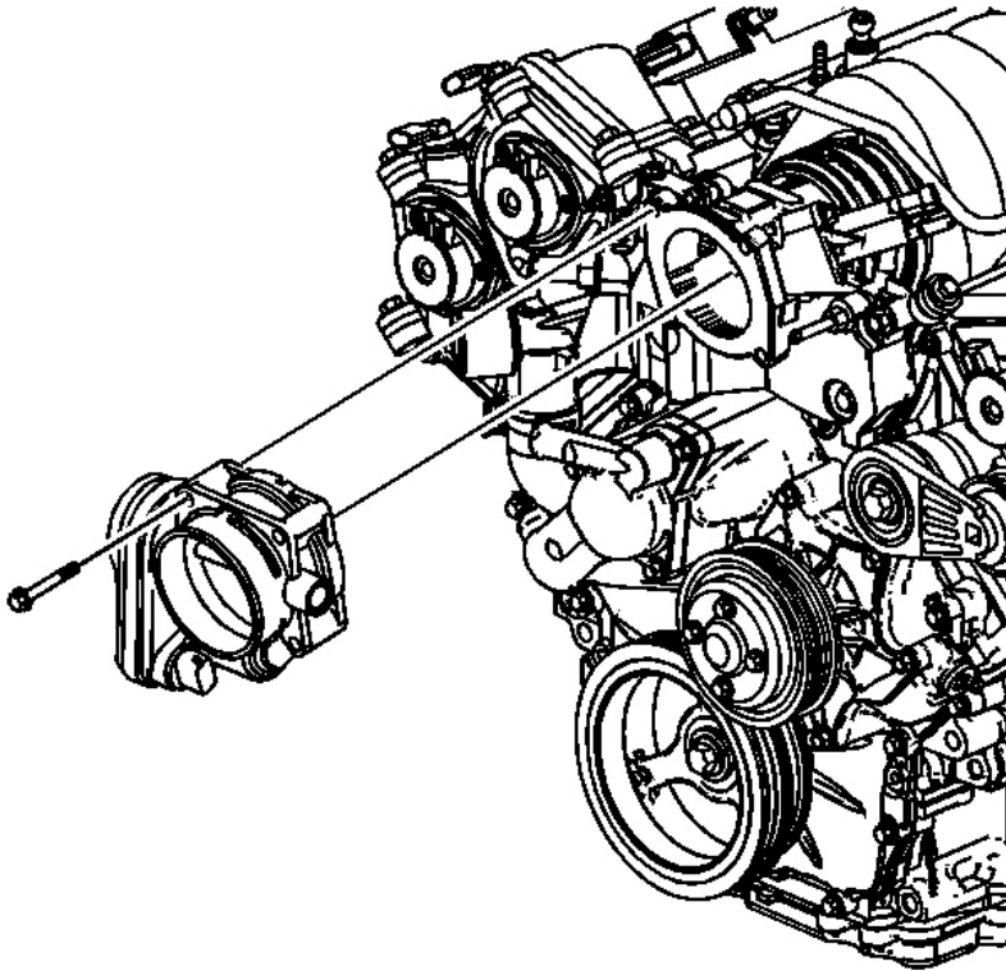


Fig. 77: View Of Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the throttle body. Refer to **Throttle Body Assembly Replacement** in Engine Controls - 4.6L (LH2).

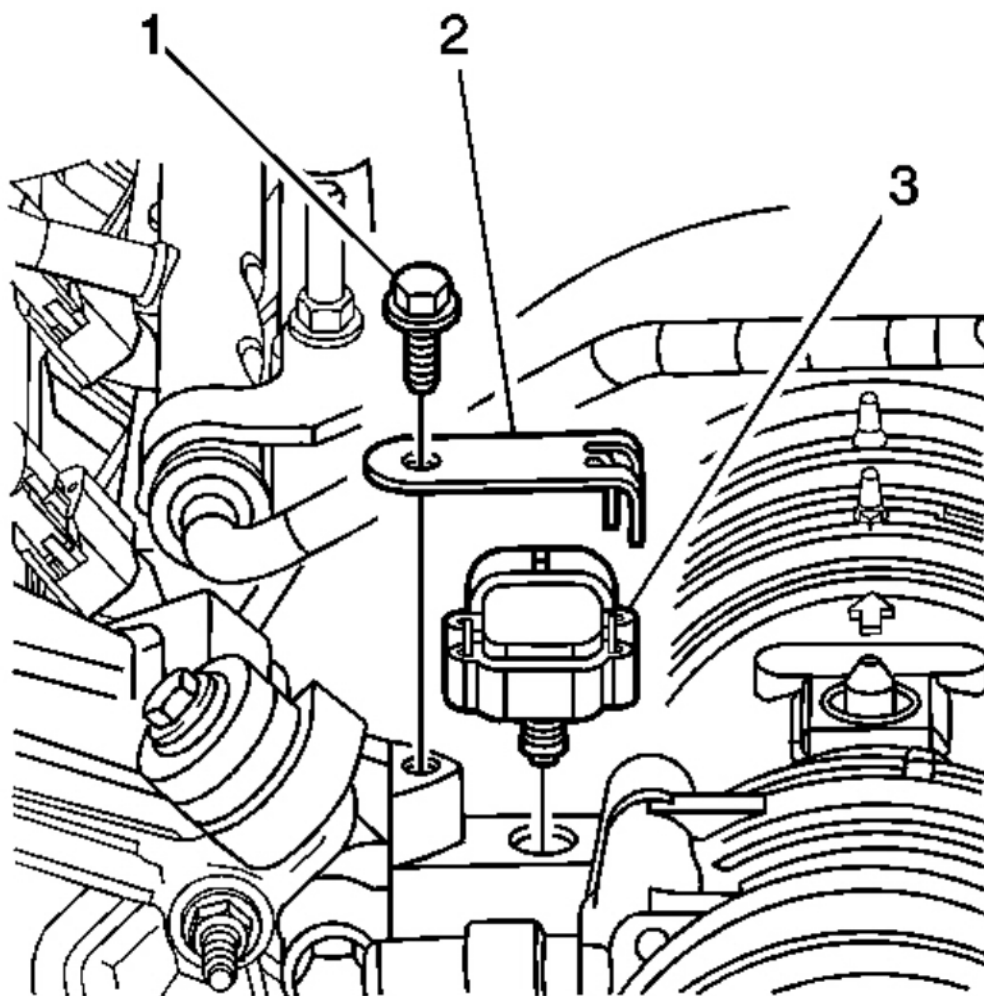


Fig. 78: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the manifold absolute pressure (MAP) sensor (3). Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** in Engine Controls - 4.6L (LH2).
4. Disconnect the evaporative emission (EVAP) canister purge solenoid valve hose and electrical connector. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** in Engine Controls - 4.6L (LH2).

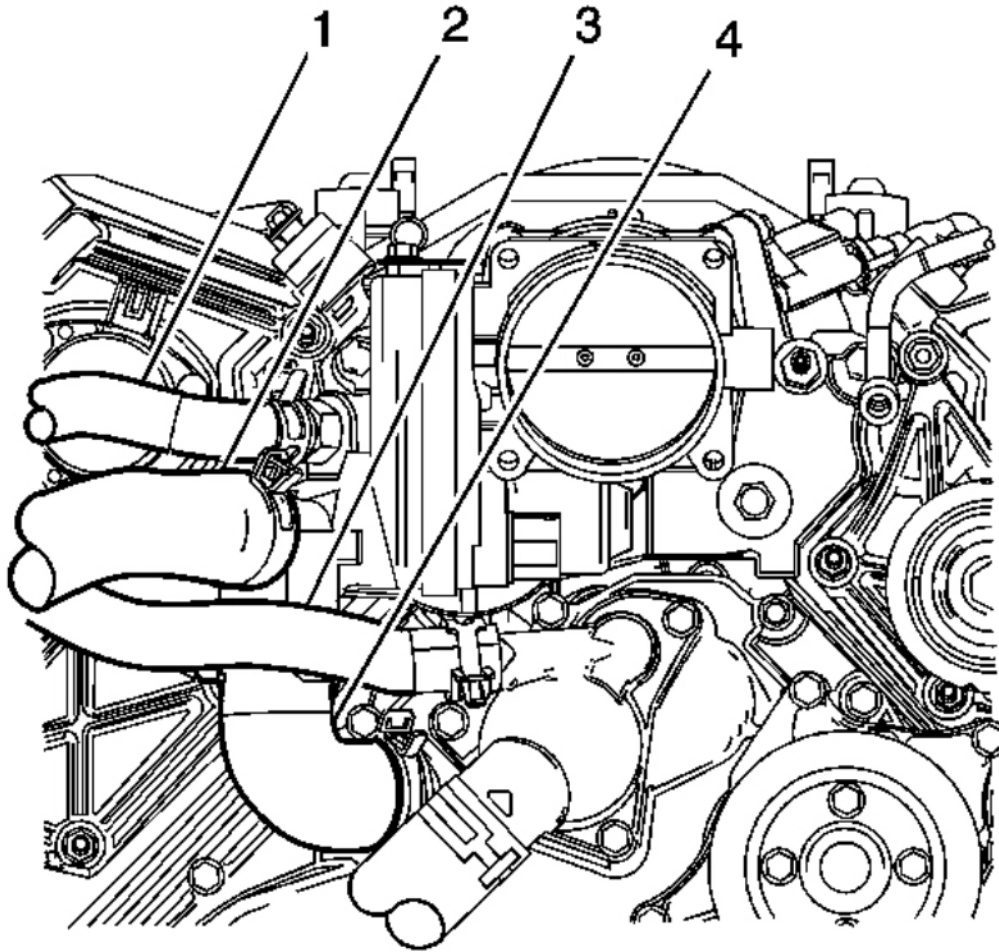


Fig. 79: View Of Radiator & Heater Hoses
Courtesy of GENERAL MOTORS CORP.

5. Compress the clamps and remove the following hoses from the thermostat and the water housing:
 - The heater inlet hose (1)
 - The radiator inlet hose (2)
 - The heater outlet hose (3)
 - The bypass hose (4)
 - The surge tank inlet hose

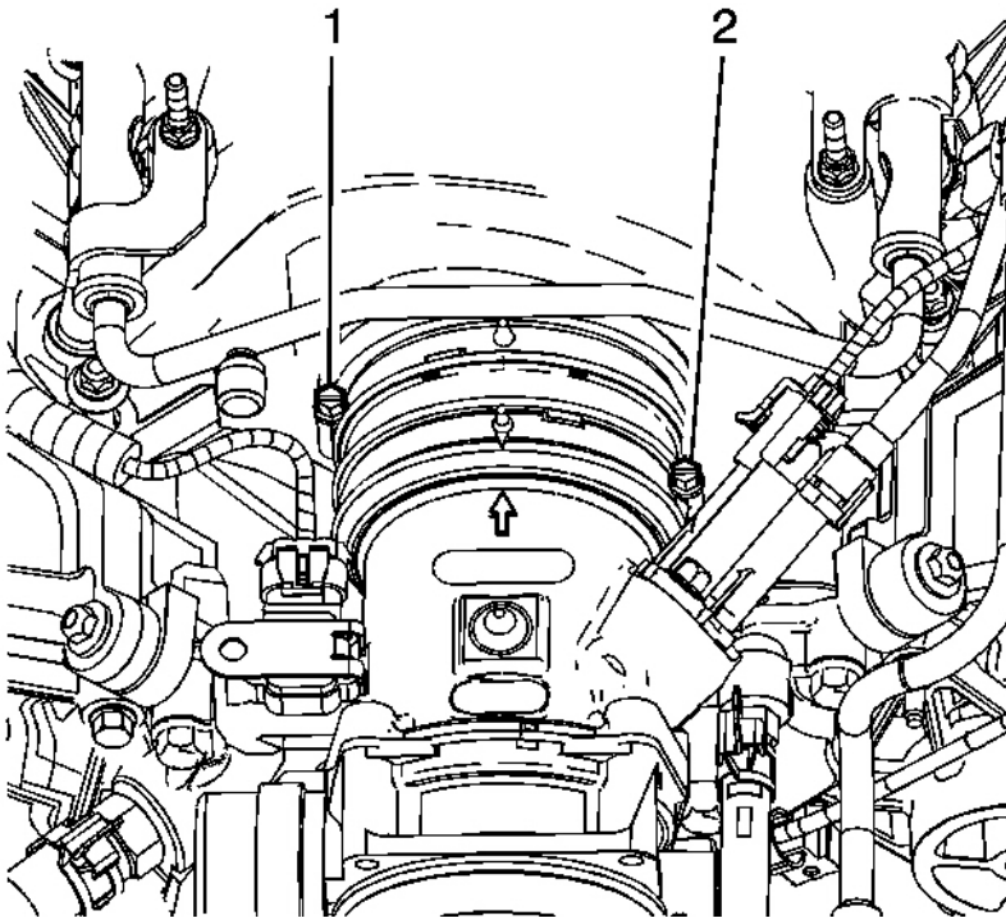


Fig. 80: Locating Intake Manifold Duct Clamp
Courtesy of GENERAL MOTORS CORP.

6. Loosen the intake manifold duct clamp (1).

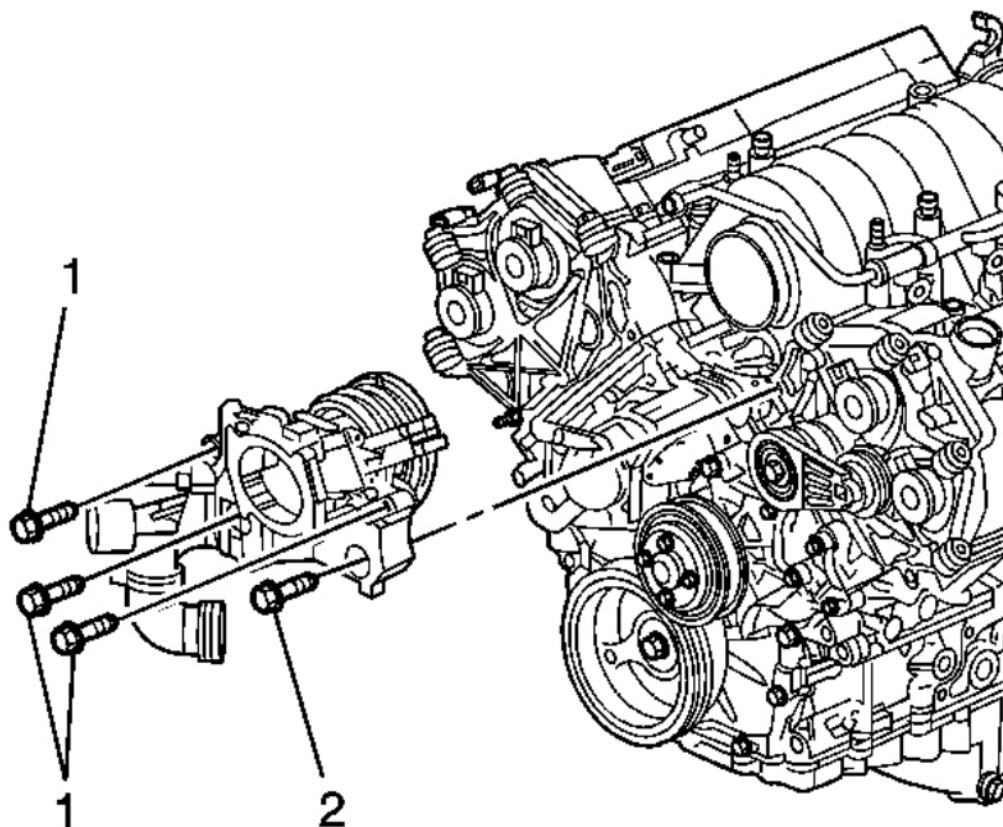


Fig. 81: View Of Water Outlet Housing Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the bolts (1, 2) securing the water outlet housing to the cylinder heads.
8. Remove the water outlet housing from the vehicle.
9. Discard the water outlet housing gaskets.
10. Clean and inspect the water outlet housing. Refer to **Water Outlet Housing Cleaning and Inspection** in Engine Mechanical - 4.6L.
11. Remove the following components from the water outlet housing if replacement is necessary:
 - The intake manifold inlet duct and clamp
 - The surge tank inlet hose fitting
 - The heater inlet hose fitting

- The evaporative emission (EVAP) canister purge solenoid valve-Refer to Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement in Engine Controls - 4.6L.

Installation Procedure

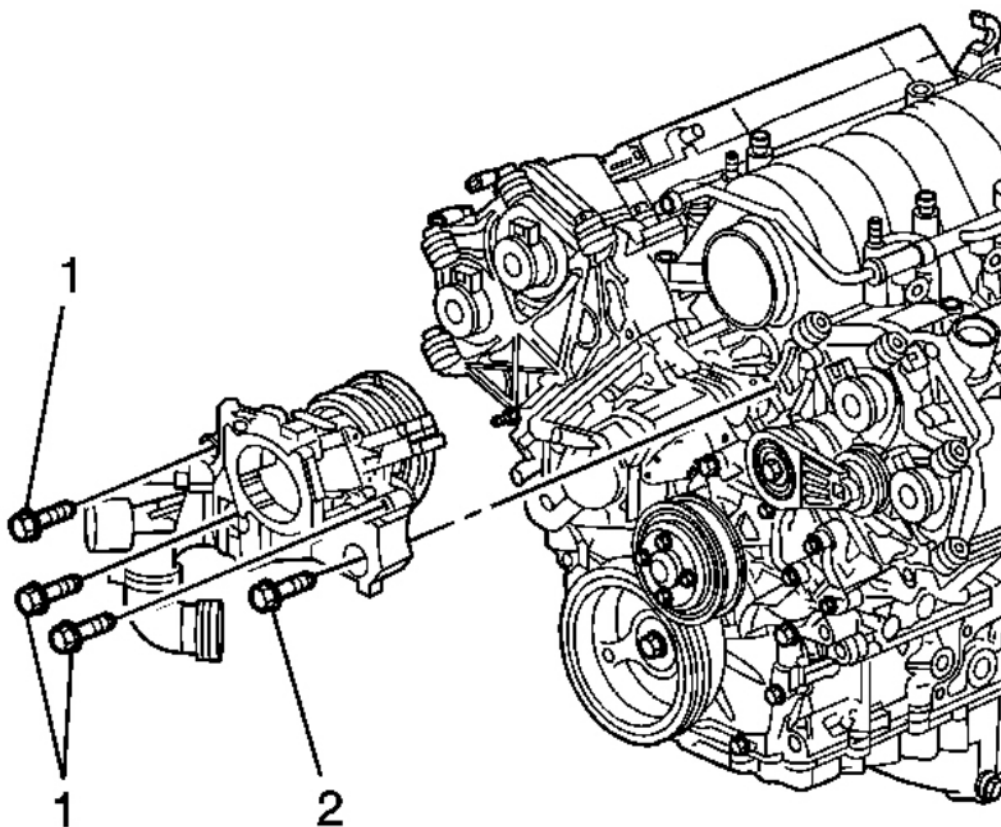


Fig. 82: View Of Water Outlet Housing Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the following components to the water outlet housing if previously removed:
 - The intake manifold inlet duct and clamp

Tighten: Tighten the manifold inlet duct clamp to 6 N.m (53 lb in).

- The surge tank inlet hose fitting

Tighten: Tighten the surge tank inlet hose fitting to 18 N.m (13 lb ft).

- The heater inlet hose fitting

Tighten: Tighten the heater inlet hose fitting to 20 N.m (15 lb ft).

- The (EVAP) canister purge solenoid valve

Tighten: Tighten the purge solenoid valve bolt to 12 N.m (106 lb in).

2. Install NEW water outlet housing gaskets.

IMPORTANT: The water outlet housing uses two different size bolts.

3. Bolt (2) is approximately 10 mm longer than the other three bolts (1).
4. Install the water outlet housing to the vehicle.
5. Install the water outlet housing bolts.

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

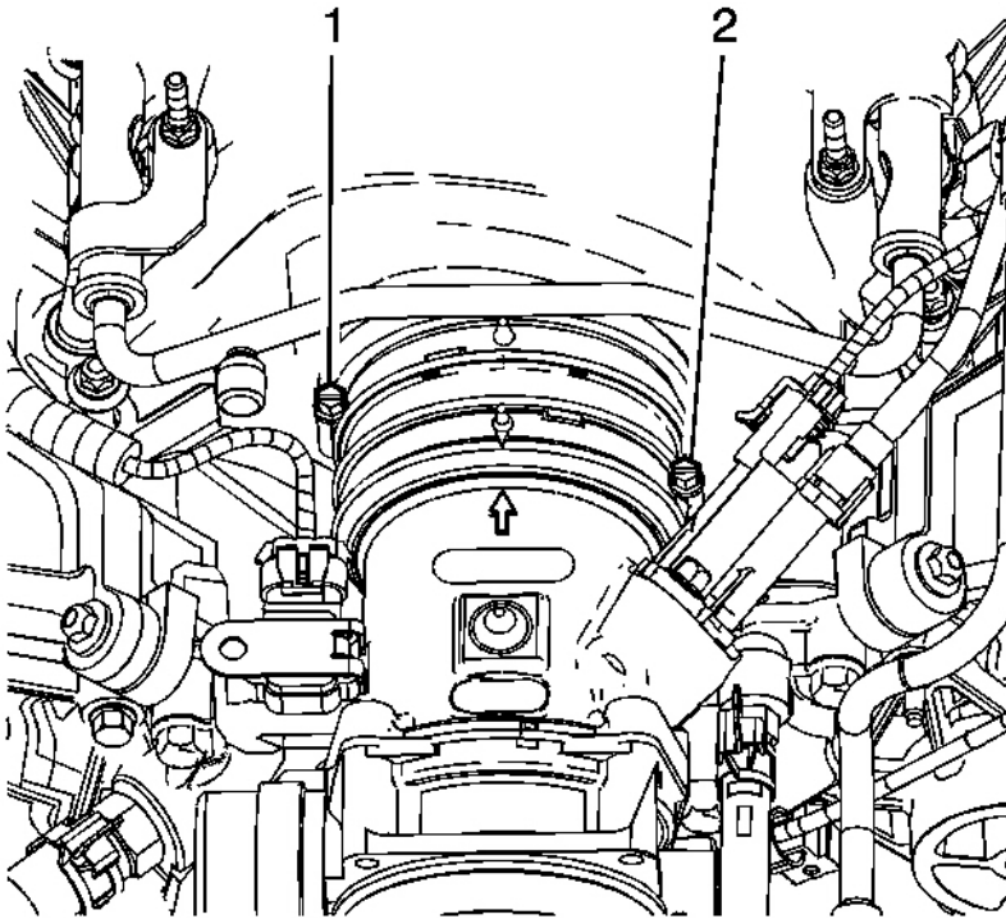


Fig. 83: Locating Intake Manifold Duct Clamp
Courtesy of GENERAL MOTORS CORP.

6. Tighten the intake manifold duct clamp (1).

Tighten: Tighten the intake manifold inlet duct clamp to 6 N.m (53 lb in).

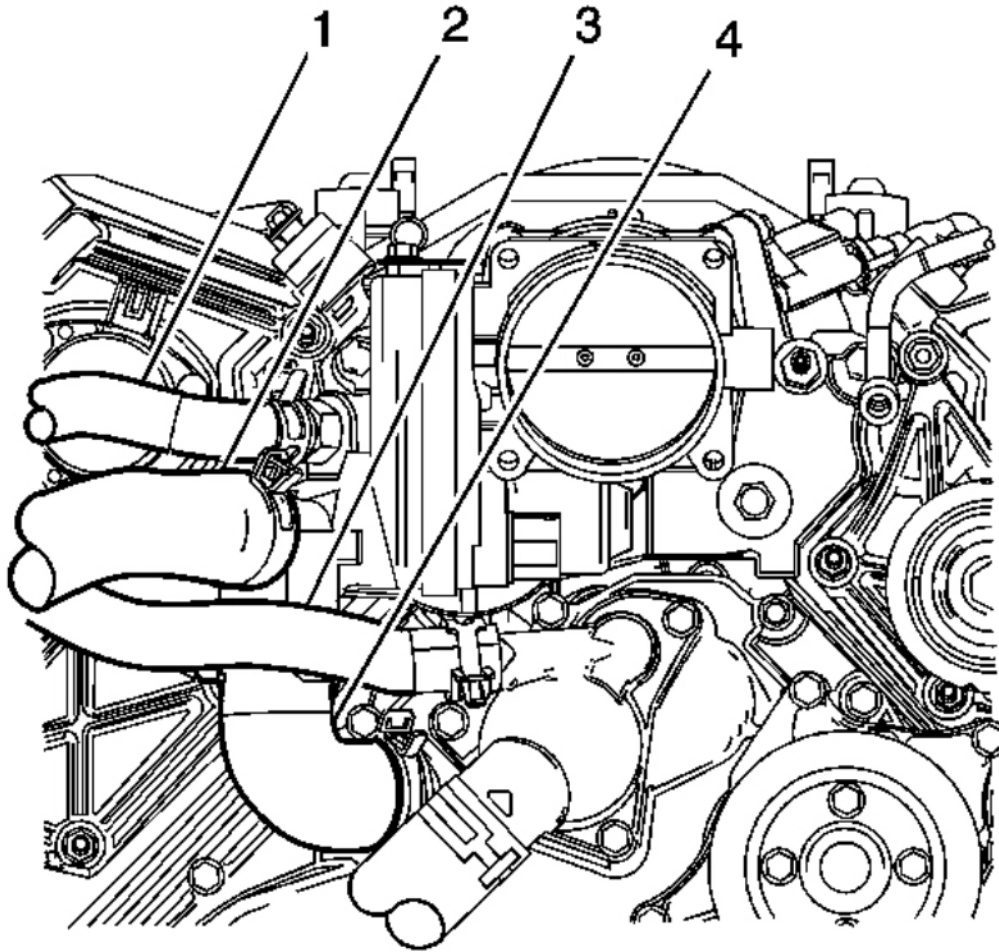


Fig. 84: View Of Radiator & Heater Hoses
Courtesy of GENERAL MOTORS CORP.

7. Compress the clamps and install the following hoses to the thermostat and the water housing:
 - The heater inlet hose (1)
 - The radiator inlet hose (2)
 - The heater outlet hose (3)
 - The bypass hose (4)
 - The surge tank inlet hose

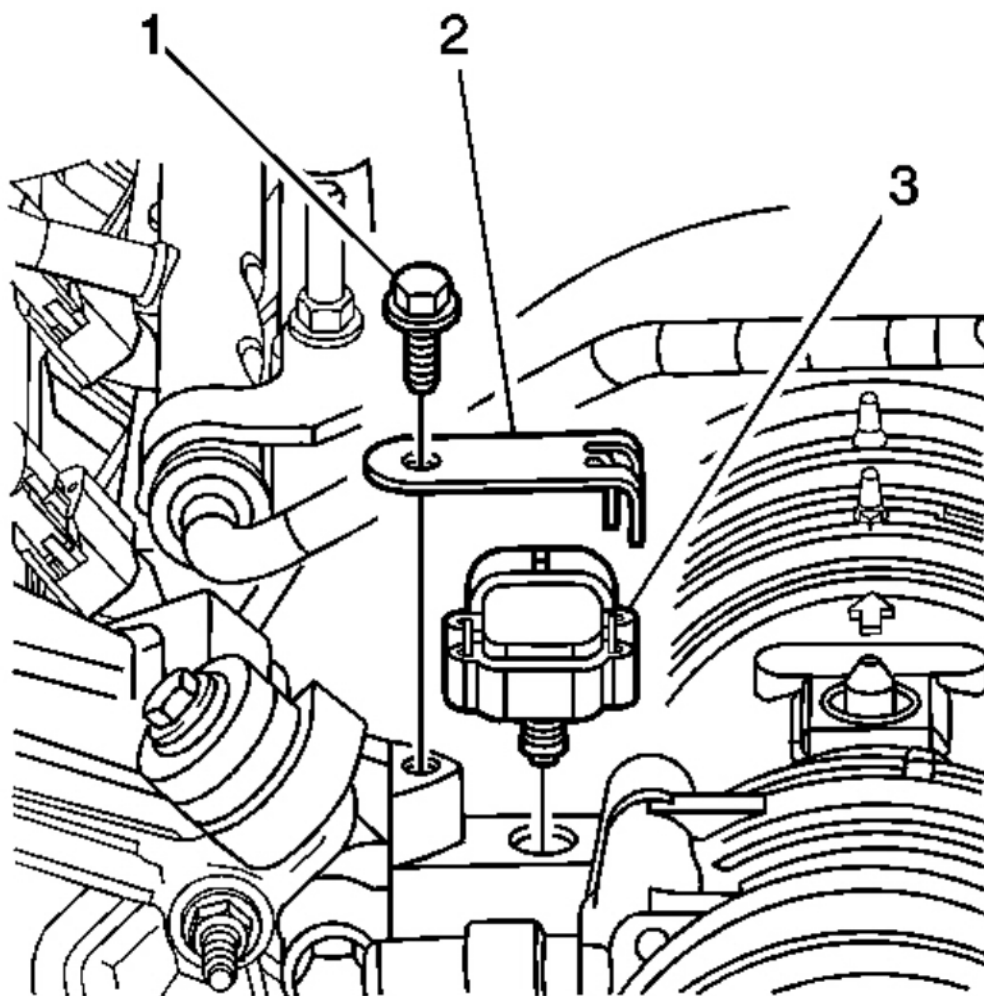


Fig. 85: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

8. Connect the evaporative emission (EVAP) canister purge solenoid valve hose and electrical connector. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** in Engine Controls - 4.6L (LH2).
9. Install the manifold absolute pressure (MAP) sensor (3). Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** in Engine Controls - 4.6L (LH2).

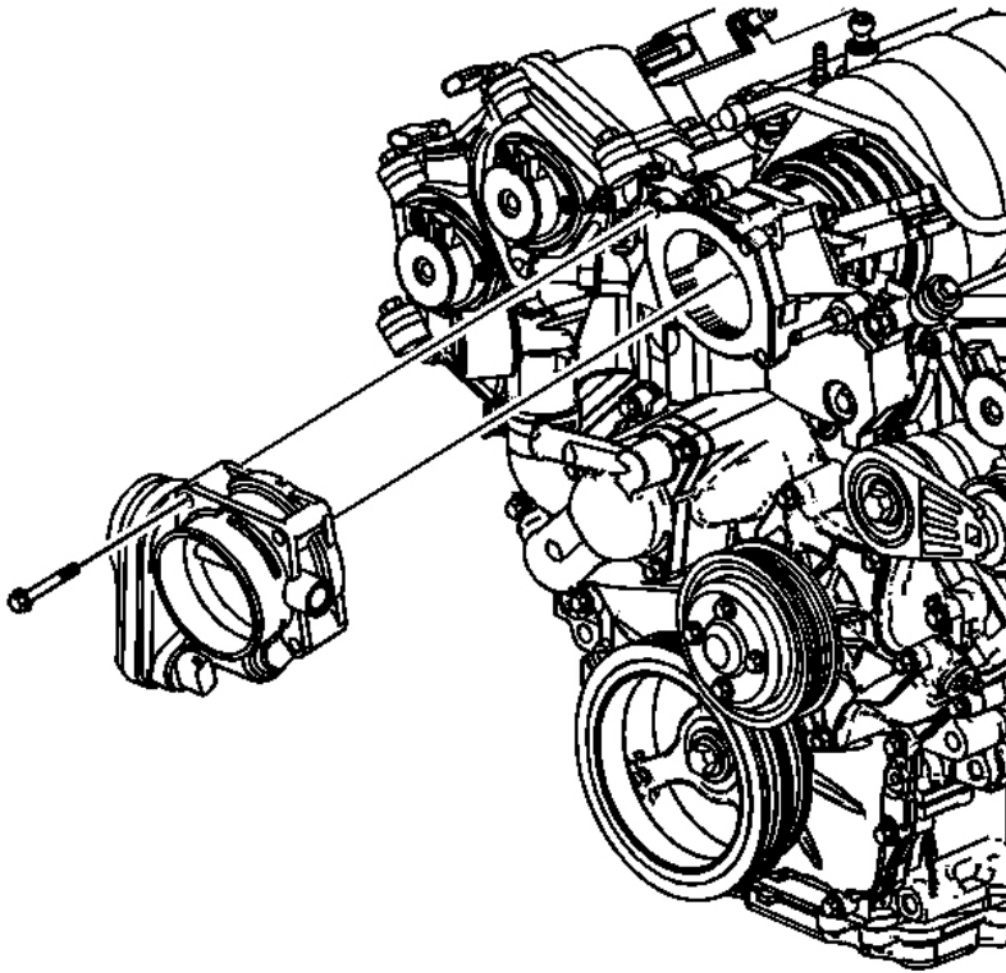


Fig. 86: View Of Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

10. Install the throttle body. Refer to **Throttle Body Assembly Replacement** in Engine Controls - 4.6L (LH2).
11. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER OUTLET HOUSING REPLACEMENT (LY7)

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System**.

2. Remove the radiator hose from the water outlet. Refer to **Radiator Hose Replacement - Inlet (LH2)** or **Radiator Hose Replacement - Inlet (LY7)**.

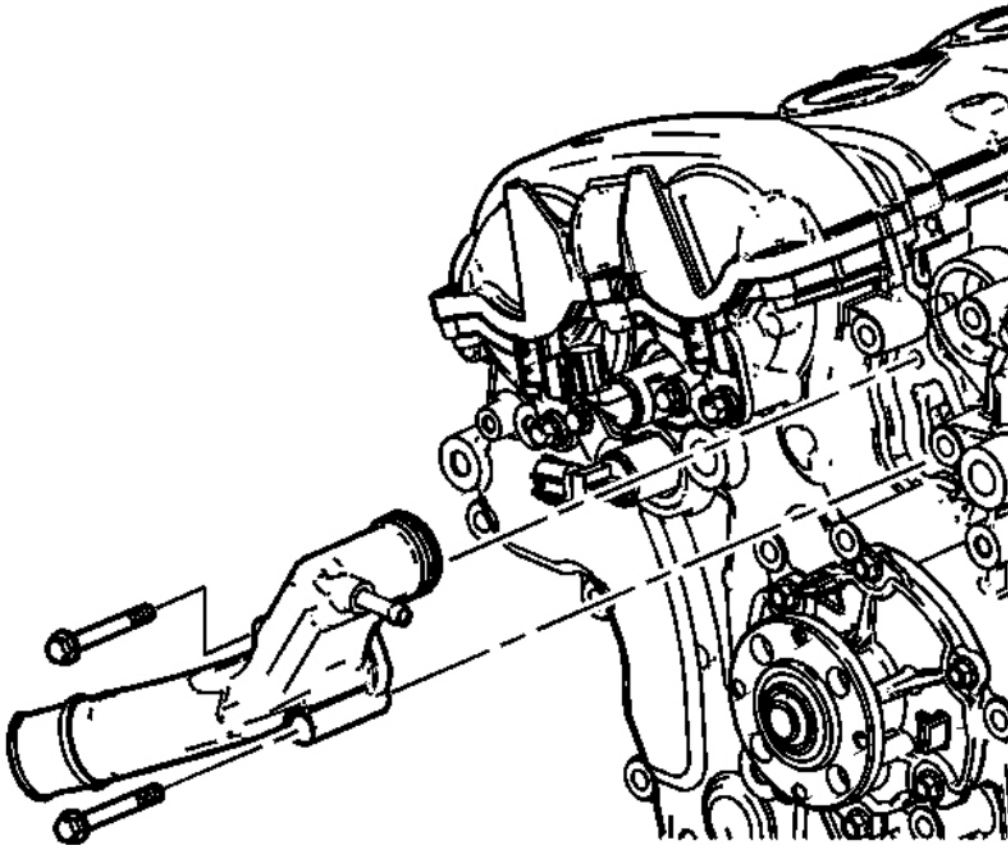


Fig. 87: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

3. Remove the water outlet housing bolts.
4. Remove the water outlet.
5. Remove and discard the water outlet seals.
6. Clean the water outlet housing sealing surfaces.

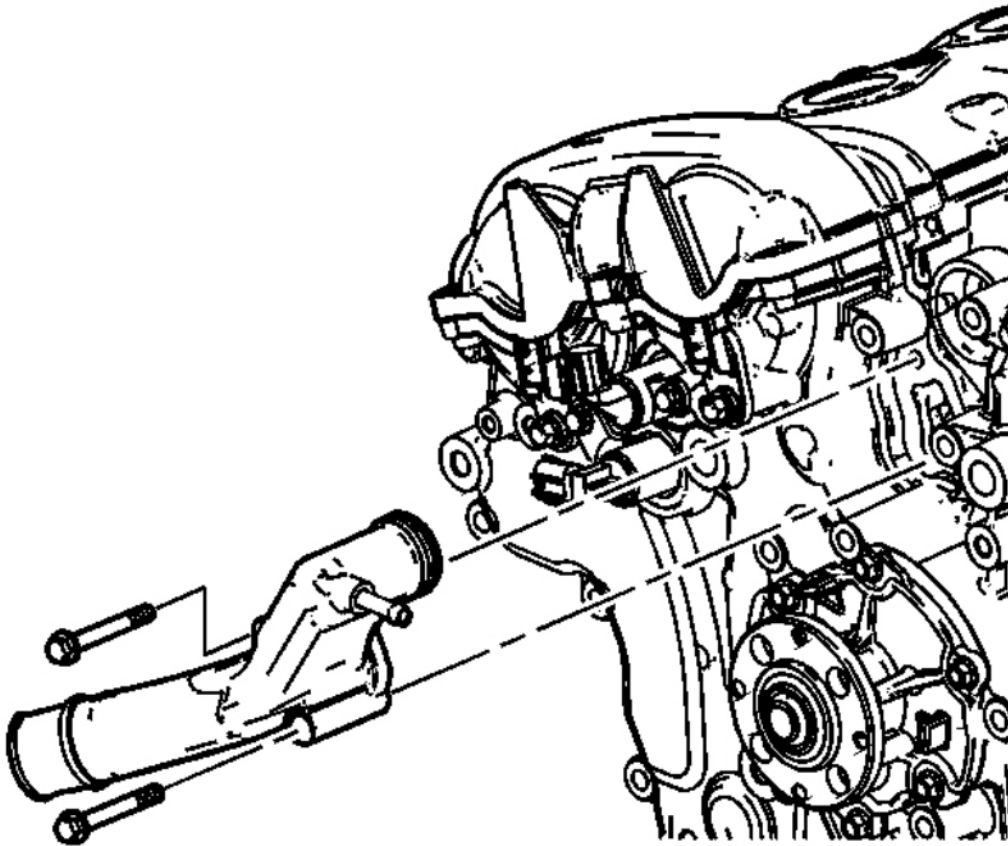


Fig. 88: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

1. Install NEW water outlet housing seals.
2. Install the water outlet.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the water outlet bolts.

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

4. Install the radiator hose to the water outlet. Refer to Radiator Hose Replacement - Inlet (LH2) or Radiator Hose Replacement - Inlet (LY7).

5. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

COOLANT PIPE REPLACEMENT - INLET (LY7)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

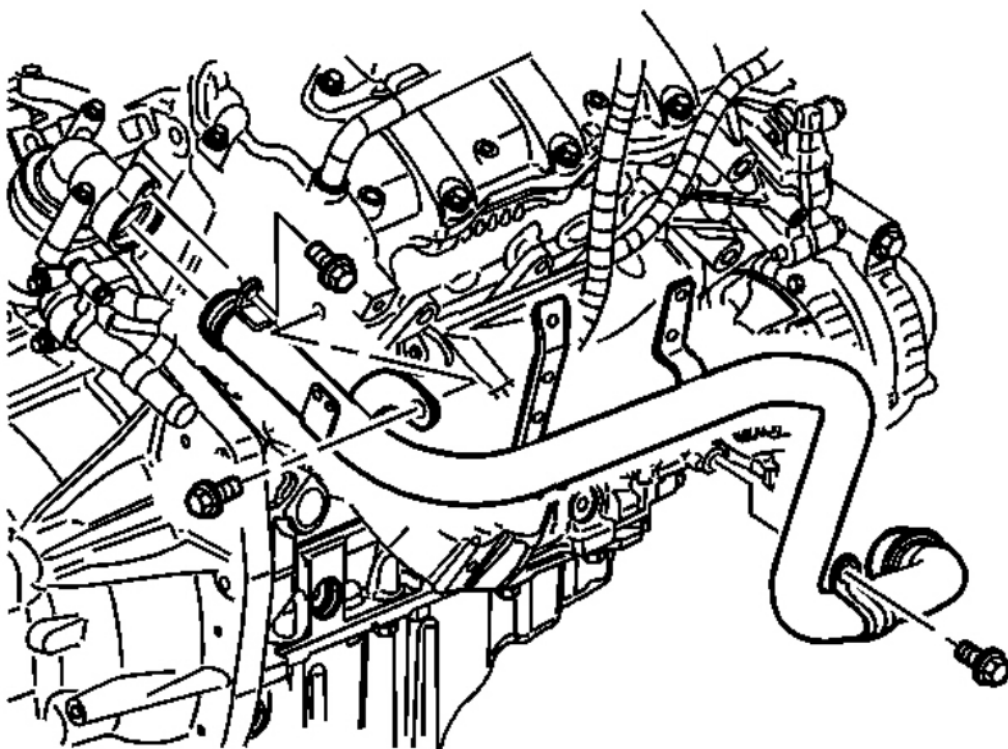


Fig. 89: View Of Radiator Outlet Pipe & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the coolant pipe to generator bracket bolt.
3. Lower the vehicle.
4. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
5. Disconnect the radiator outlet hose from the coolant pipe. Refer to **Radiator Hose**

Replacement - Outlet (LH2 - Standard Cooling) or Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling) or Radiator Hose Replacement - Outlet (LY7).

6. Remove the wiring harnesses from the coolant inlet pipe.
7. Remove the coolant pipe to thermostat bolt.
8. Remove the coolant pipe to cylinder head bolt.
9. Remove the coolant pipe.

Installation Procedure

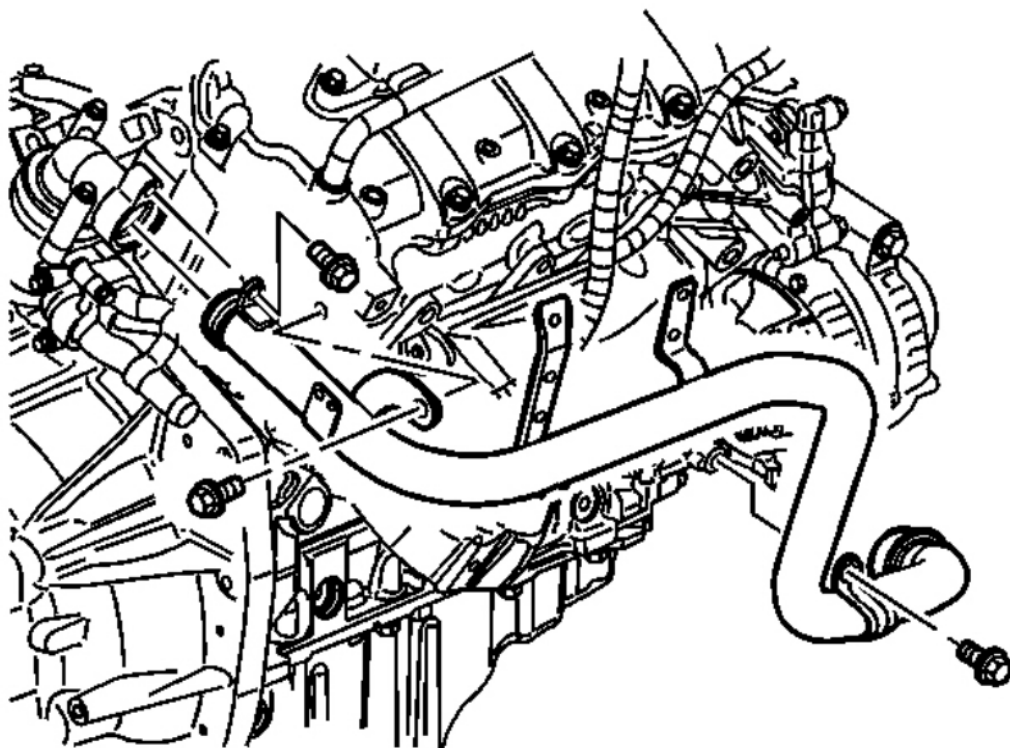


Fig. 90: View Of Radiator Outlet Pipe & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant pipe.
2. Loosely assemble all the coolant pipe bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the coolant pipe to thermostat bolt.

Tighten: Tighten the coolant pipe to thermostat bolt to 23 N.m (17 lb ft).

4. Install the coolant pipe to cylinder head bolt.

Tighten: Tighten the coolant pipe to cylinder head bolt to 50 N.m (37 lb ft).

5. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
6. Install the coolant pipe to generator bracket bolt.

Tighten: Tighten the coolant pipe to generator bracket bolt to 23 N.m (17 lb ft).

7. Connect the radiator outlet hose to the coolant pipe. Refer to Radiator Hose Replacement - Outlet (LH2 - Standard Cooling) or Radiator Hose Replacement - Outlet (LH2 - Heavy Duty Cooling) or Radiator Hose Replacement - Outlet (LY7).
8. Install the wiring harnesses to the coolant inlet pipe.
9. Fill the cooling system. Refer to Draining and Filling Cooling System.

COOLANT BYPASS HOSE REPLACEMENT (LH2)

Removal Procedure

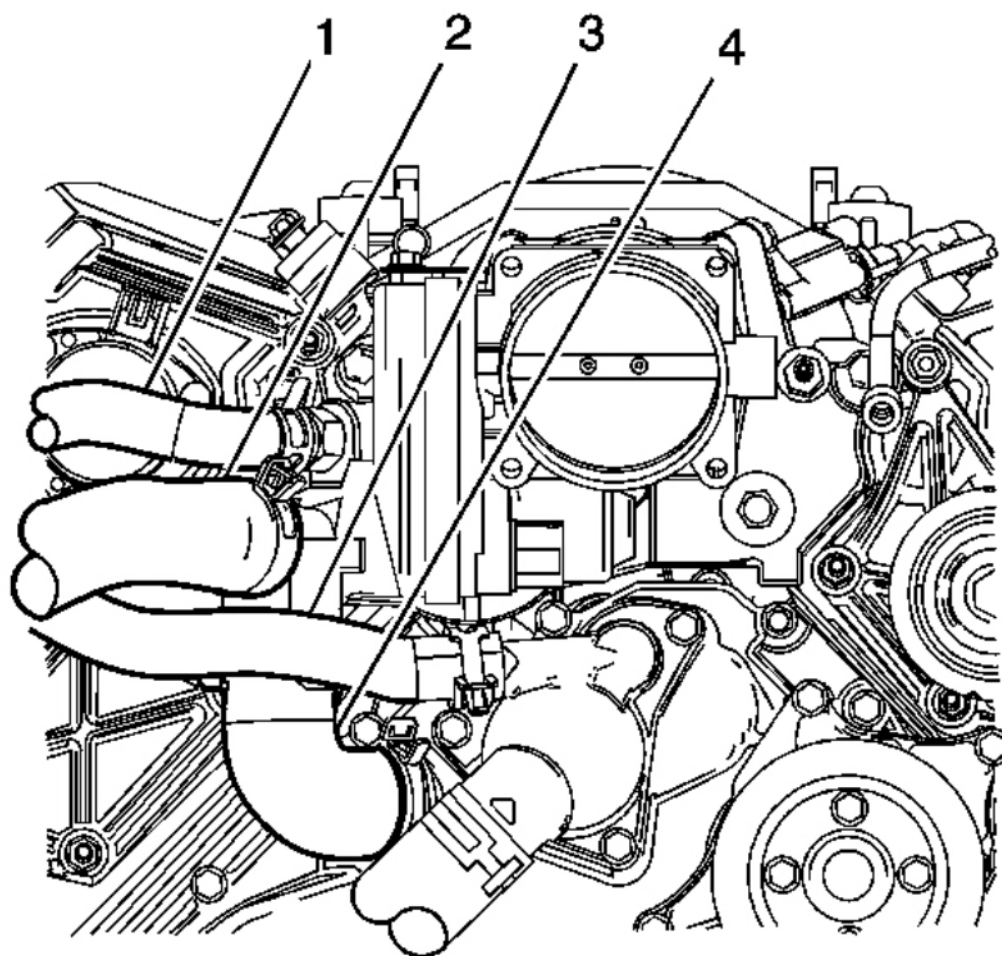


Fig. 91: View Of Radiator & Heater Hoses
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L (LH2).
3. Compress the clamp, and remove the heater outlet hose (3) from the thermostat housing in order to gain access to the bypass hose.

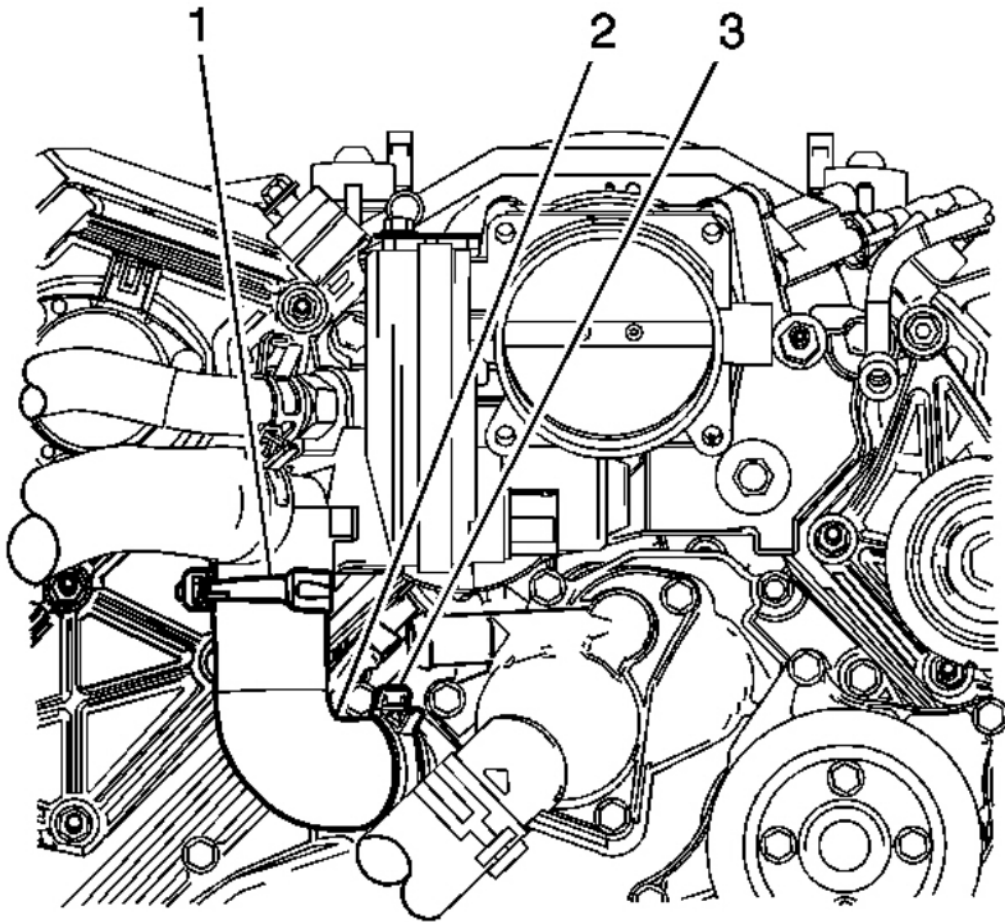


Fig. 92: View Of Coolant Bypass Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

4. Compress the clamps (1, 3) and remove the bypass hose (2) from the water outlet housing and the front cover.

Installation Procedure

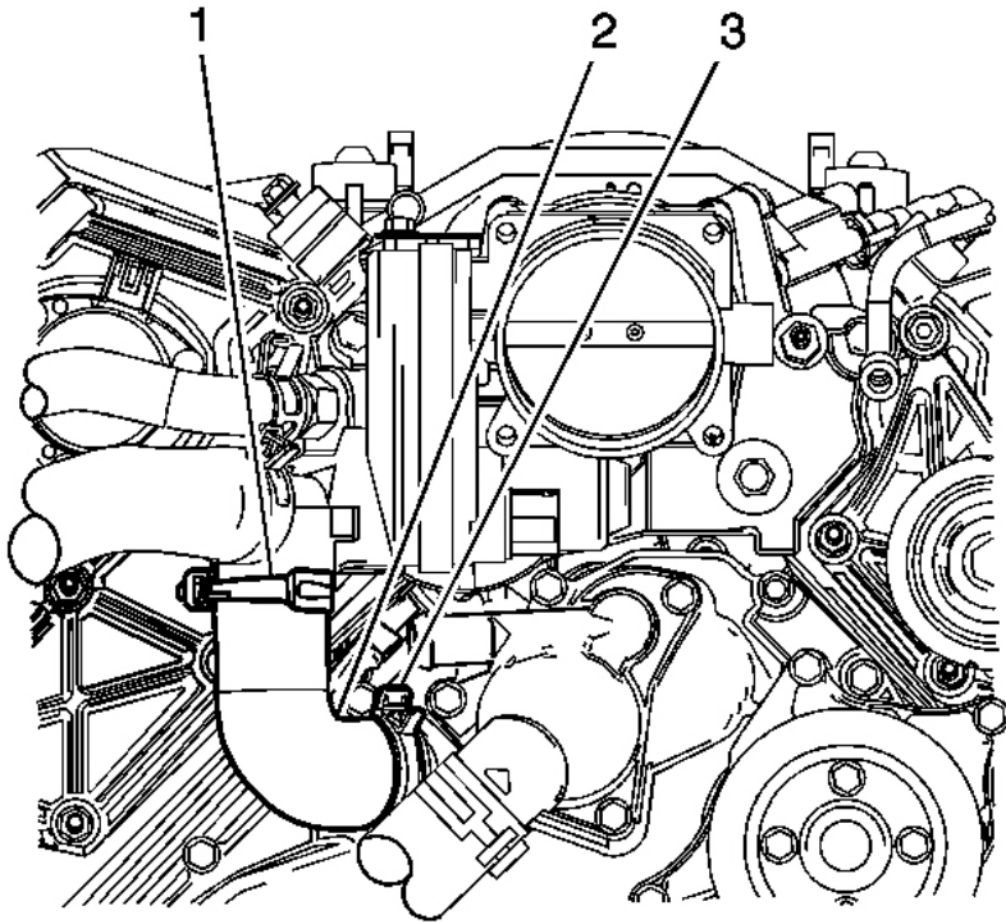


Fig. 93: View Of Coolant Bypass Hose & Clamps
Courtesy of GENERAL MOTORS CORP.

1. Compress the clamps (1, 3) and install the bypass hose (2) to the water outlet housing and the front cover.

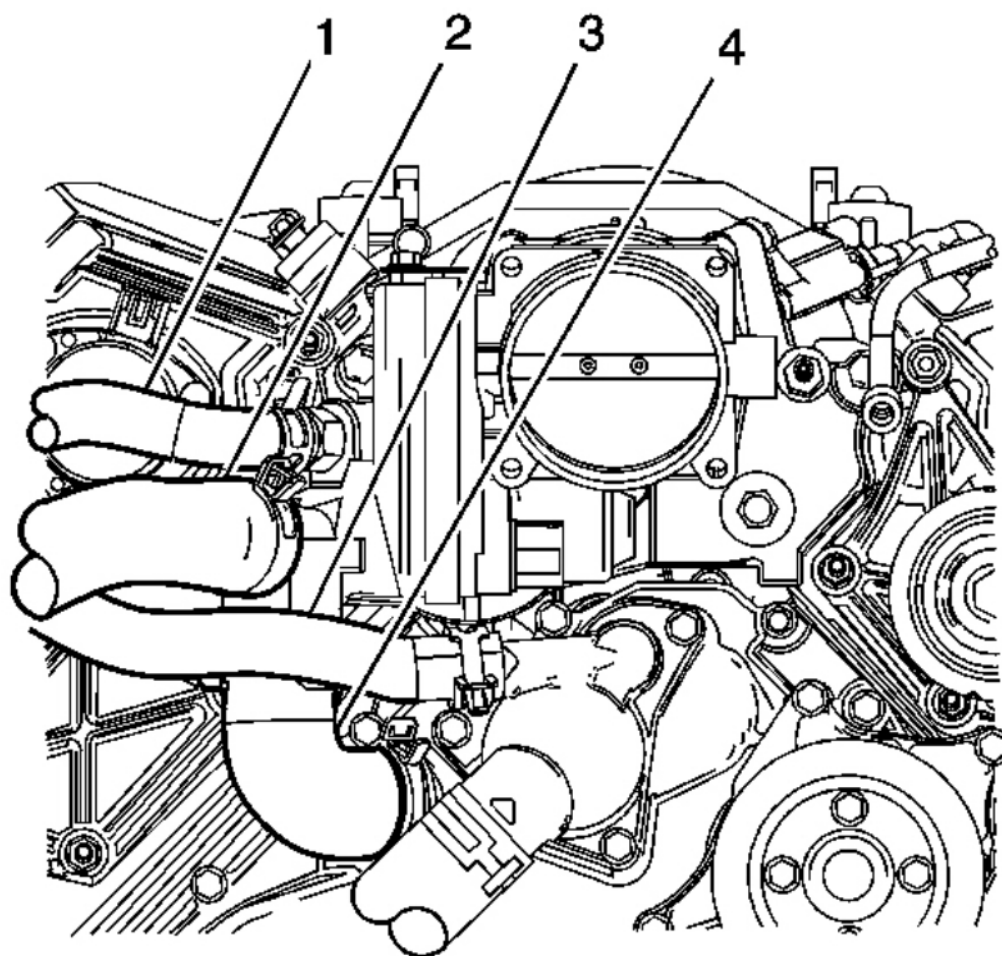


Fig. 94: View Of Radiator & Heater Hoses
Courtesy of GENERAL MOTORS CORP.

2. Compress the clamp, and install the heater outlet hose (3) to the thermostat housing.
3. Compress the clamp, and remove the heater outlet hose (3) from the thermostat housing in order to gain access to the bypass hose.
4. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** in Engine Controls - 4.6L (LH2).
5. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

Removal Procedure

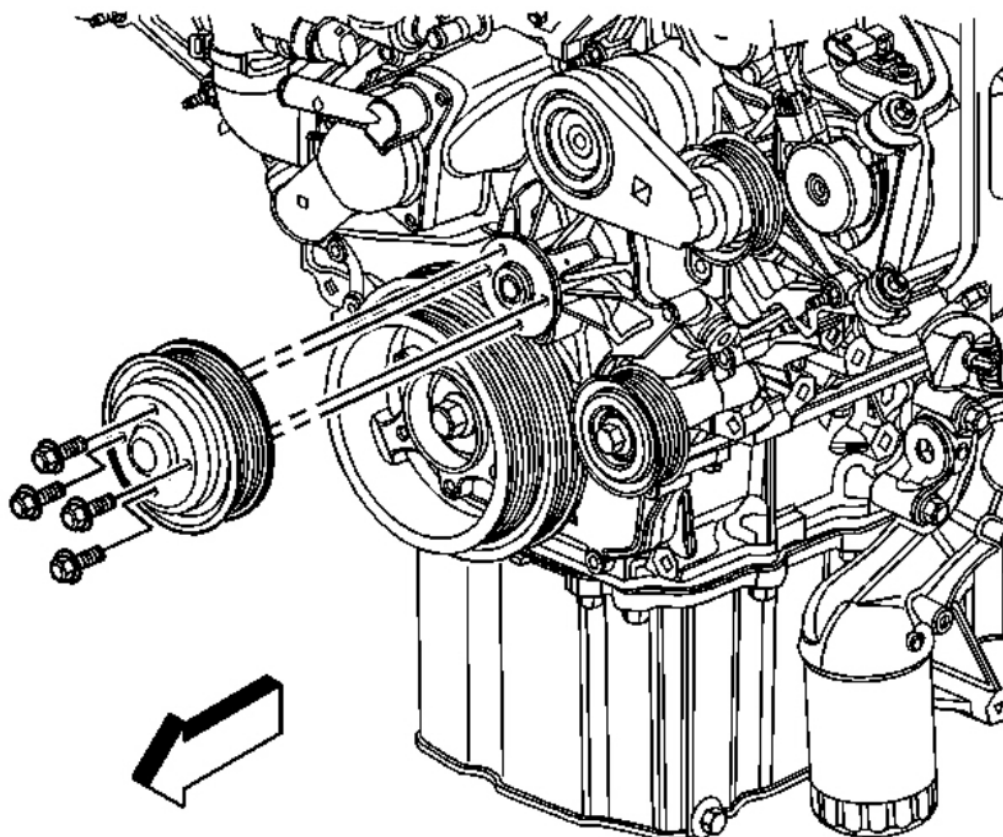


Fig. 95: View Of Water Pump Pulley Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the cooling fan. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)** or **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.
3. Remove the water pump drive belt. Refer to **Drive Belt Replacement - Air Conditioning, Power Steering and Water Pump** in Engine Mechanical - 4.6L (LH2).
4. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Air**

Conditioning, Power Steering and Water Pump in Engine Mechanical - 4.6L (LH2).

5. Remove the water pump pulley bolts.
6. Remove the water pump pulley from the water pump.

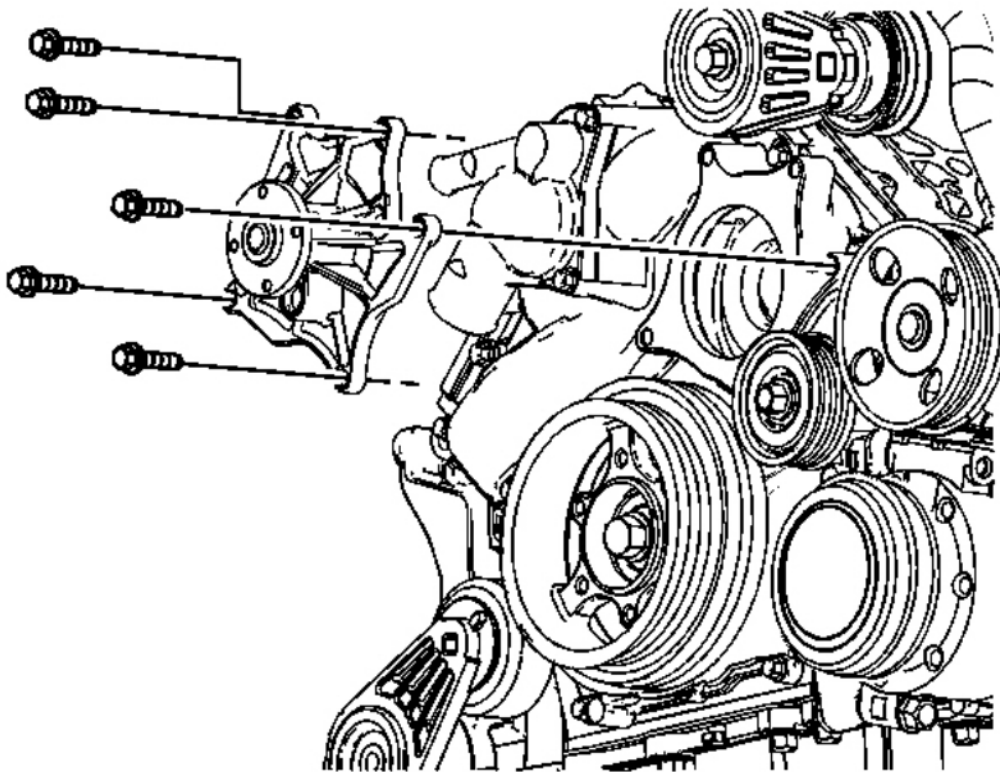


Fig. 96: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

7. Remove the water pump bolts.

IMPORTANT: Use a catch basin to collect escaping coolant.

8. Remove the water pump and seal.

Do not reuse the seal.

9. Clean the water pump mating surfaces.

10. Clean and inspect the water pump. Refer to Water Pump Cleaning and Inspection in Engine Mechanical - 4.6L (LH2).

Installation Procedure

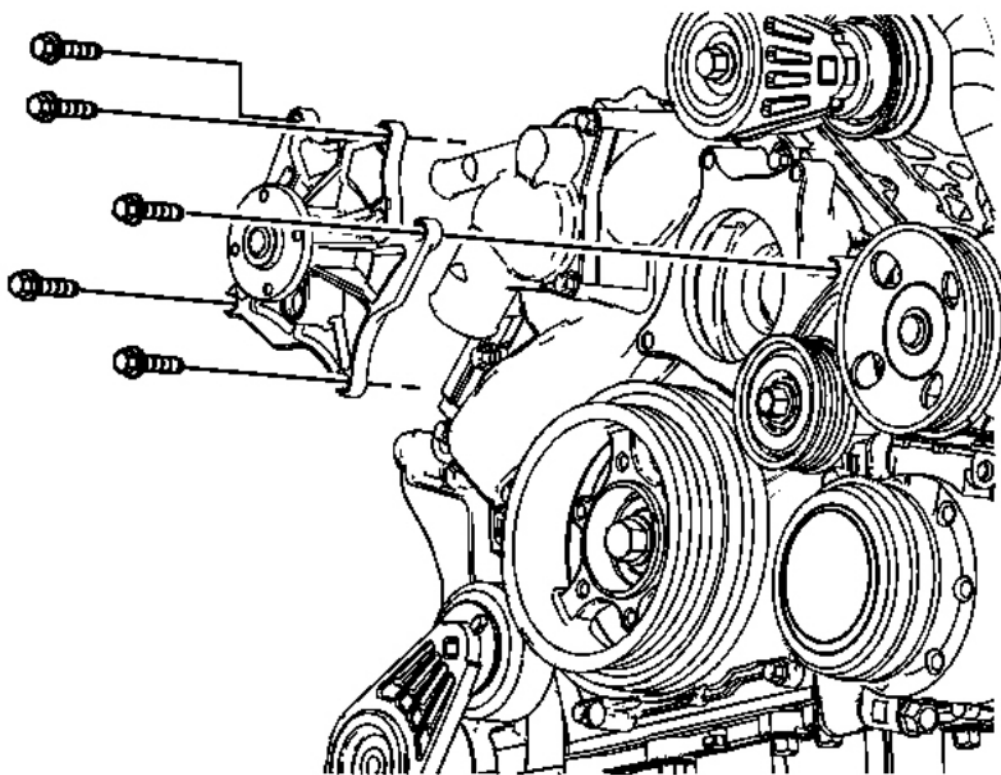


Fig. 97: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

1. Install the water pump and NEW seal to the engine front cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the water pump bolts.

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

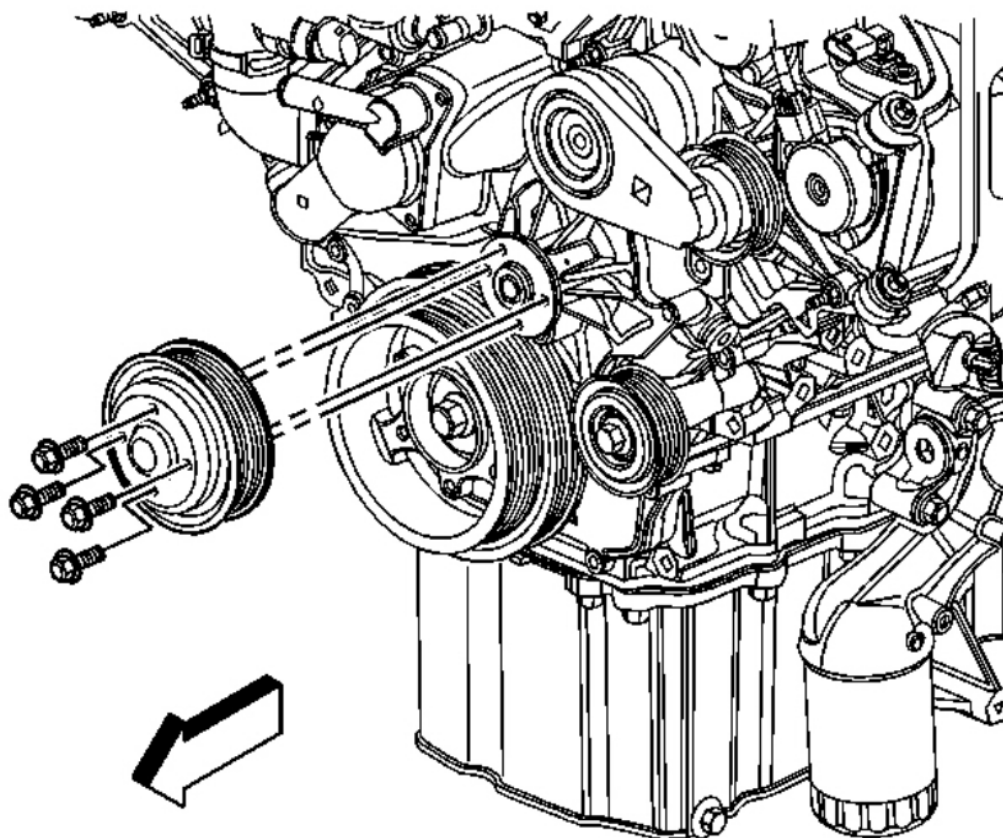


Fig. 98: View Of Water Pump Pulley Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the water pump pulley to the water pump.
4. Install the water pump pulley bolts.

Tighten: Tighten the water pump pulley bolts to 12 N.m (106 lb in).

5. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Air Conditioning, Power Steering and Water Pump** in Engine Mechanical - 4.6L (LH2).
6. Install the water pump drive belt. Refer to **Drive Belt Replacement - Air Conditioning, Power Steering and Water Pump** in Engine Mechanical - 4.6L (LH2).
7. Install the cooling fan. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or

Cooling Fan Replacement - Electric (LY7) or **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.

8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER PUMP REPLACEMENT (LY7)

Tools Required

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the generator drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump** in Engine Mechanical - 3.6L (LY7).

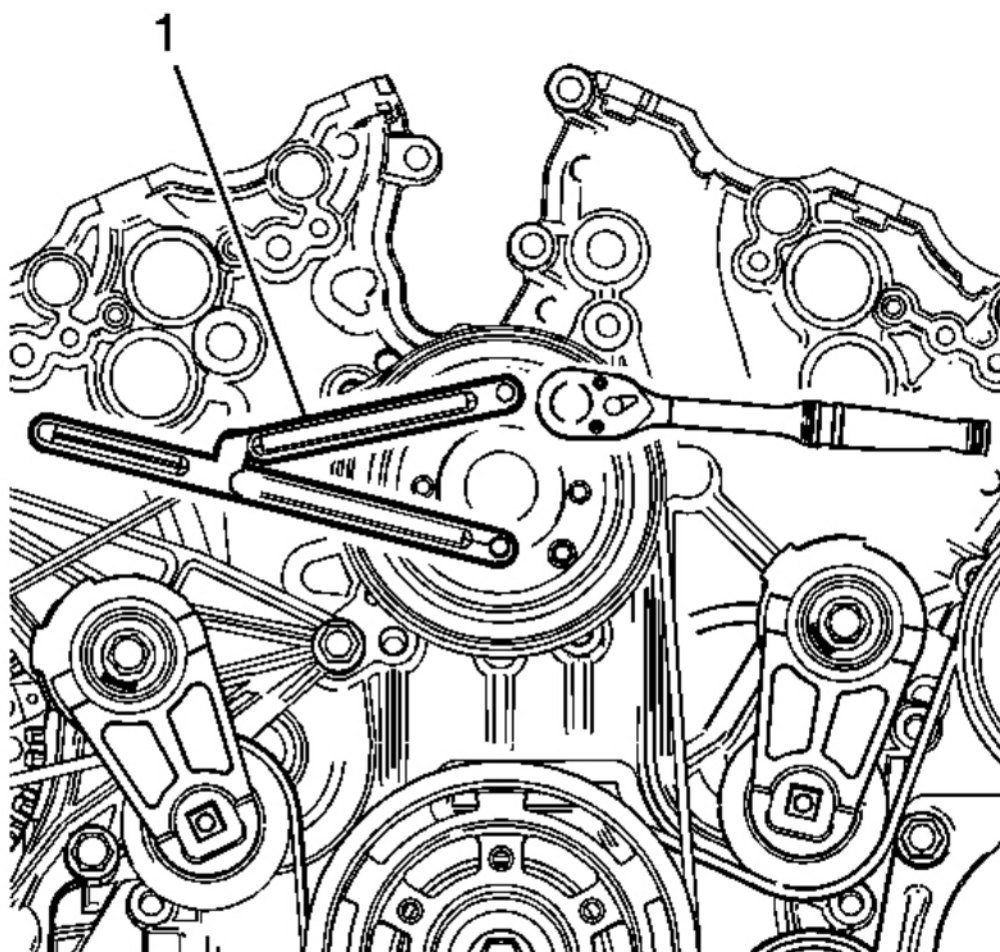


Fig. 99: View Of EN 46104

Courtesy of GENERAL MOTORS CORP.

3. Use the **EN 46104** (1) in order to retain the water pump pulley.

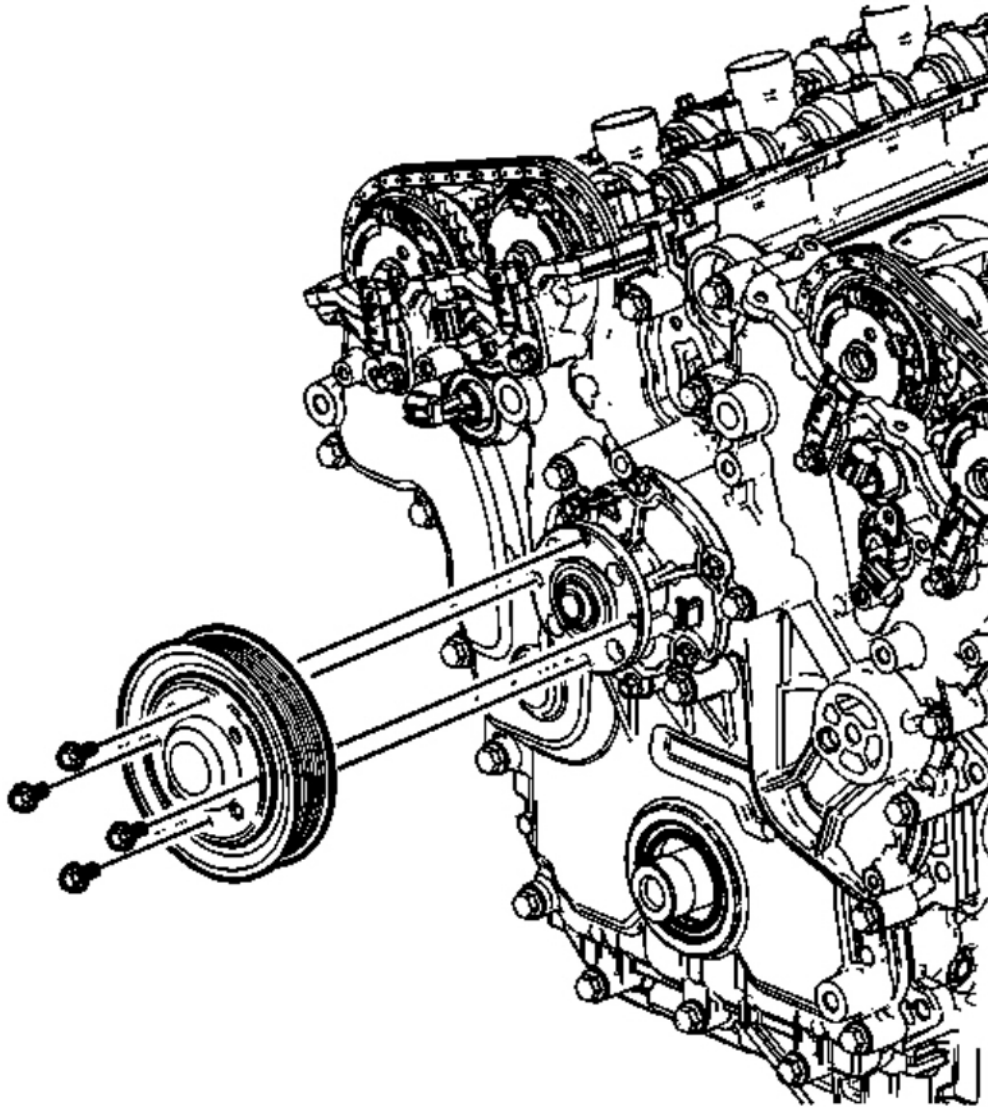


Fig. 100: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Remove the water pump pulley bolts.
5. Remove the water pump pulley.

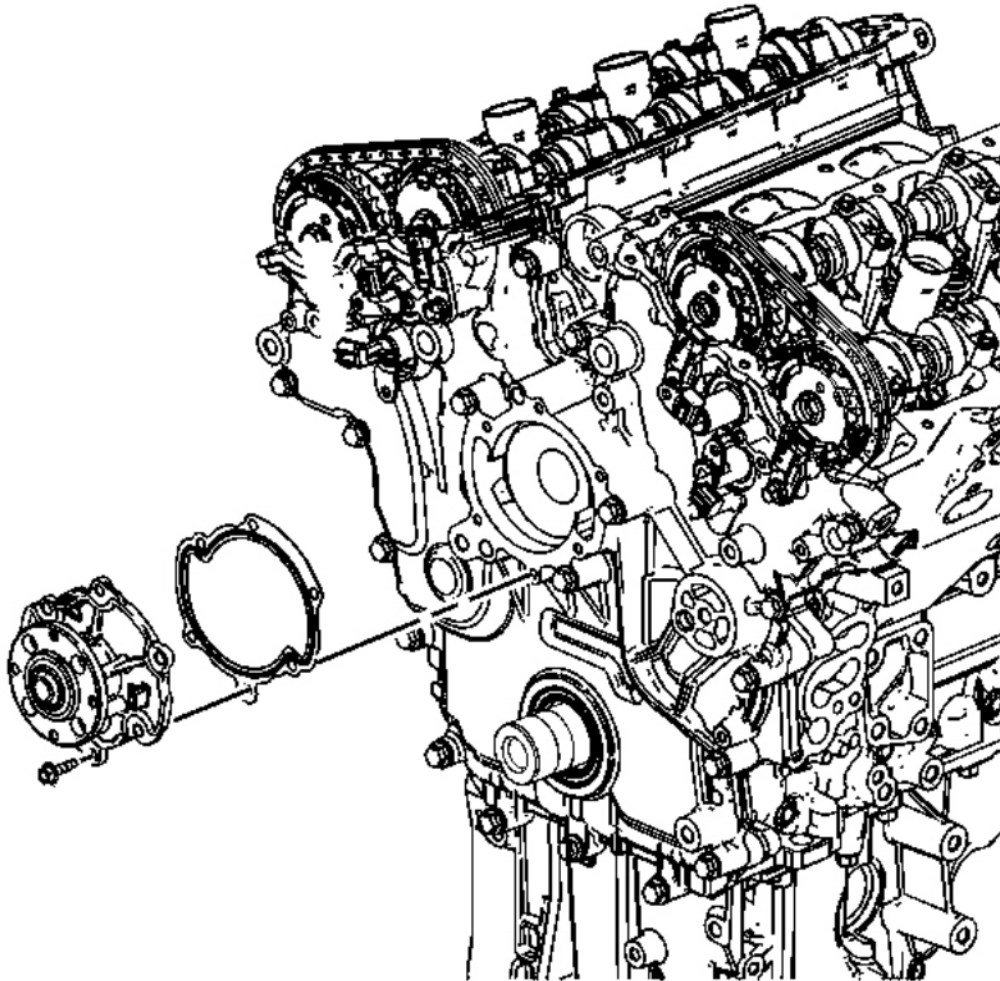


Fig. 101: View Of Water Pump & Seal
Courtesy of GENERAL MOTORS CORP.

6. Remove the water pump bolts.
7. Remove the water pump.
8. Remove and DISCARD the water pump seal.
9. Carefully clean the water pump sealing surfaces.

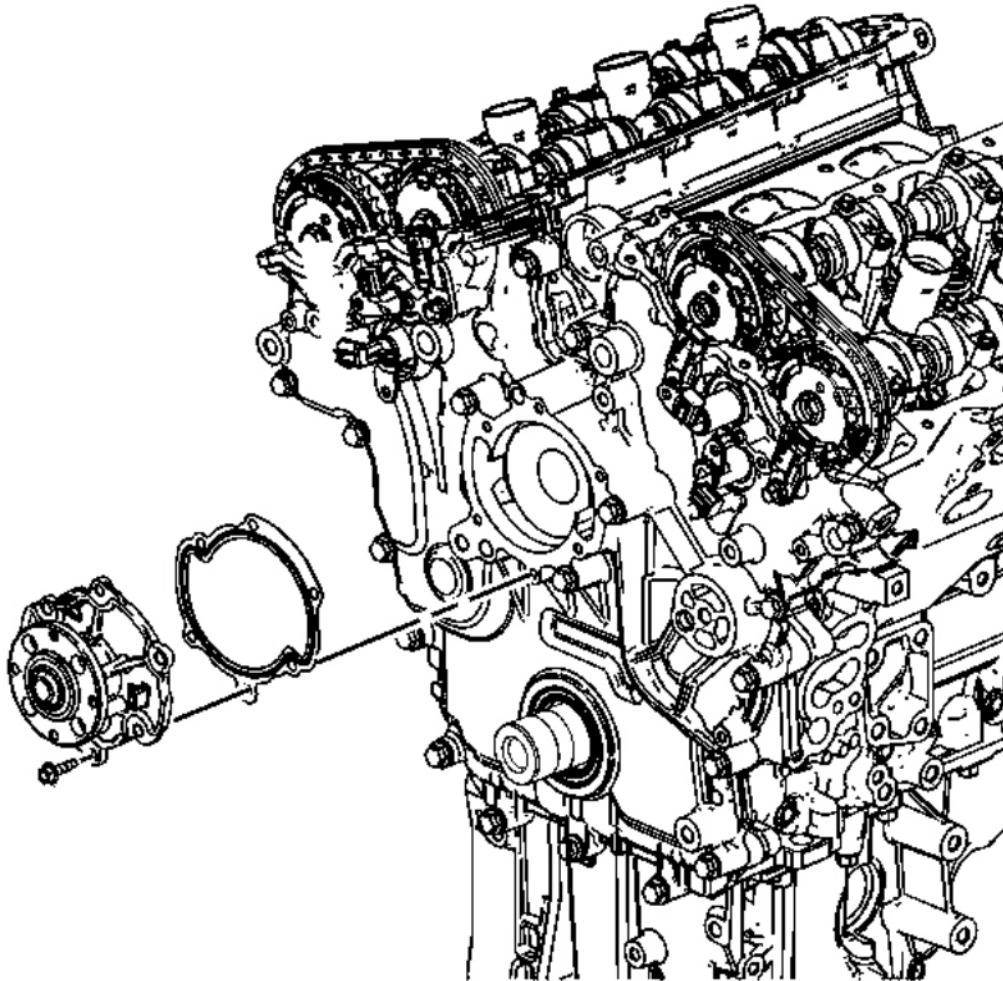


Fig. 102: View Of Water Pump & Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW water pump seal.
2. Install the water pump.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the water pump bolts.

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

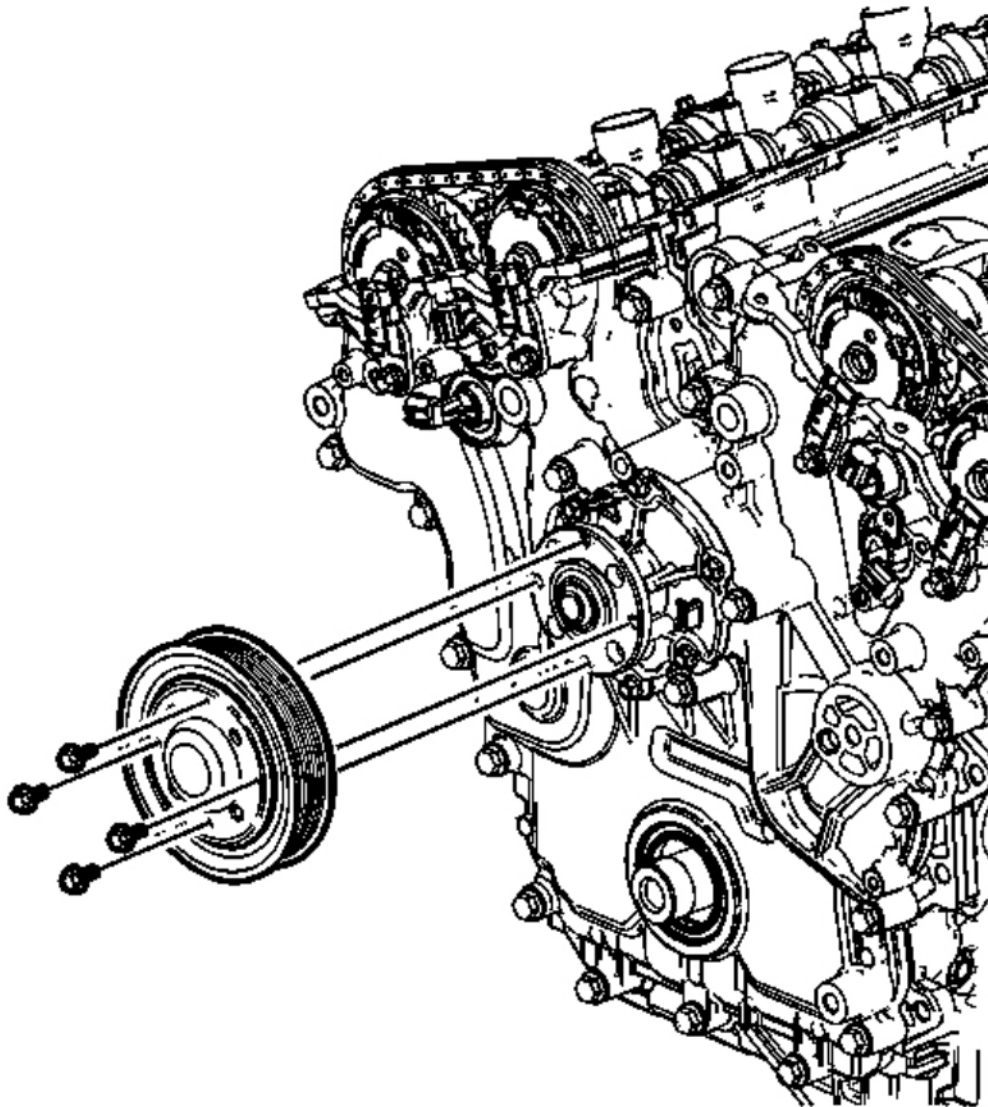


Fig. 103: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley and the water pump pulley bolts.

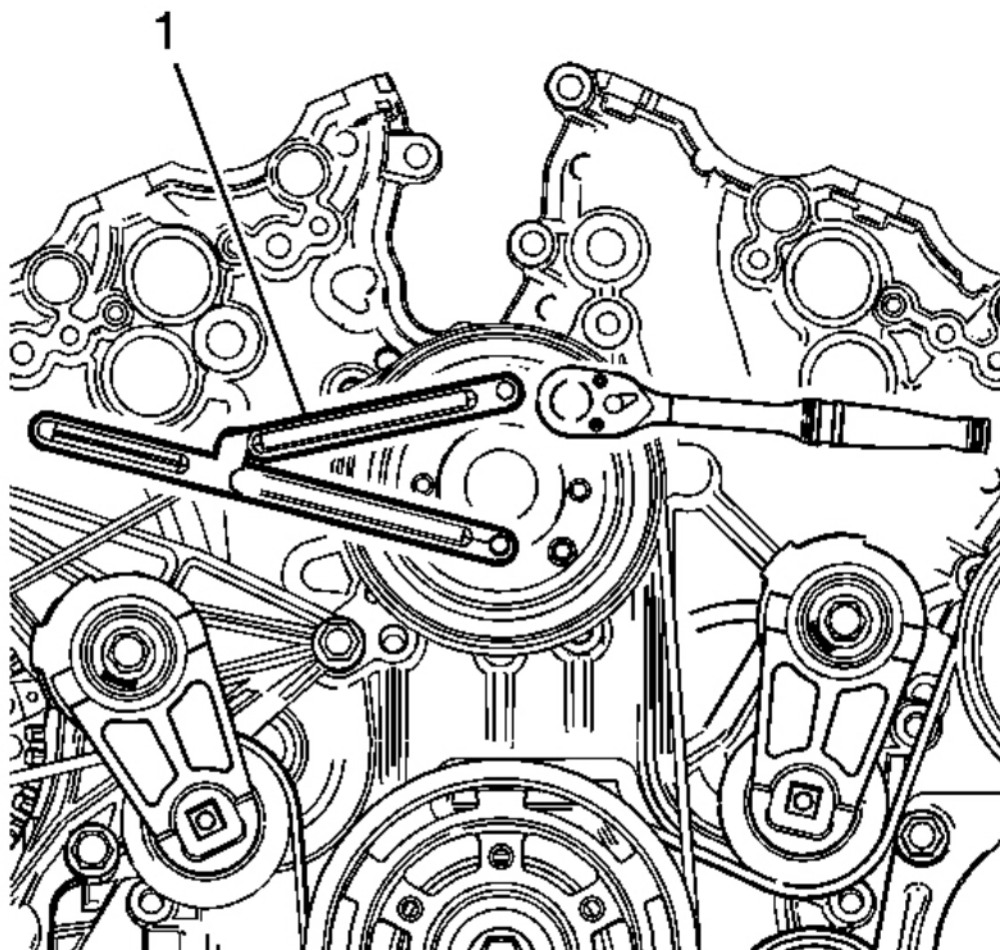


Fig. 104: View Of EN 46104

Courtesy of GENERAL MOTORS CORP.

5. Use the **EN 46104** (1) in order to retain the water pump pulley.
6. Install the water pump pulley bolts.

Tighten: Tighten the water pump pulley bolts to 12 N.m (106 lb in).

7. Install the generator drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump** in Engine Mechanical - 3.6L (LY7).
8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

AFTERBOIL COOLANT PUMP REPLACEMENT

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

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

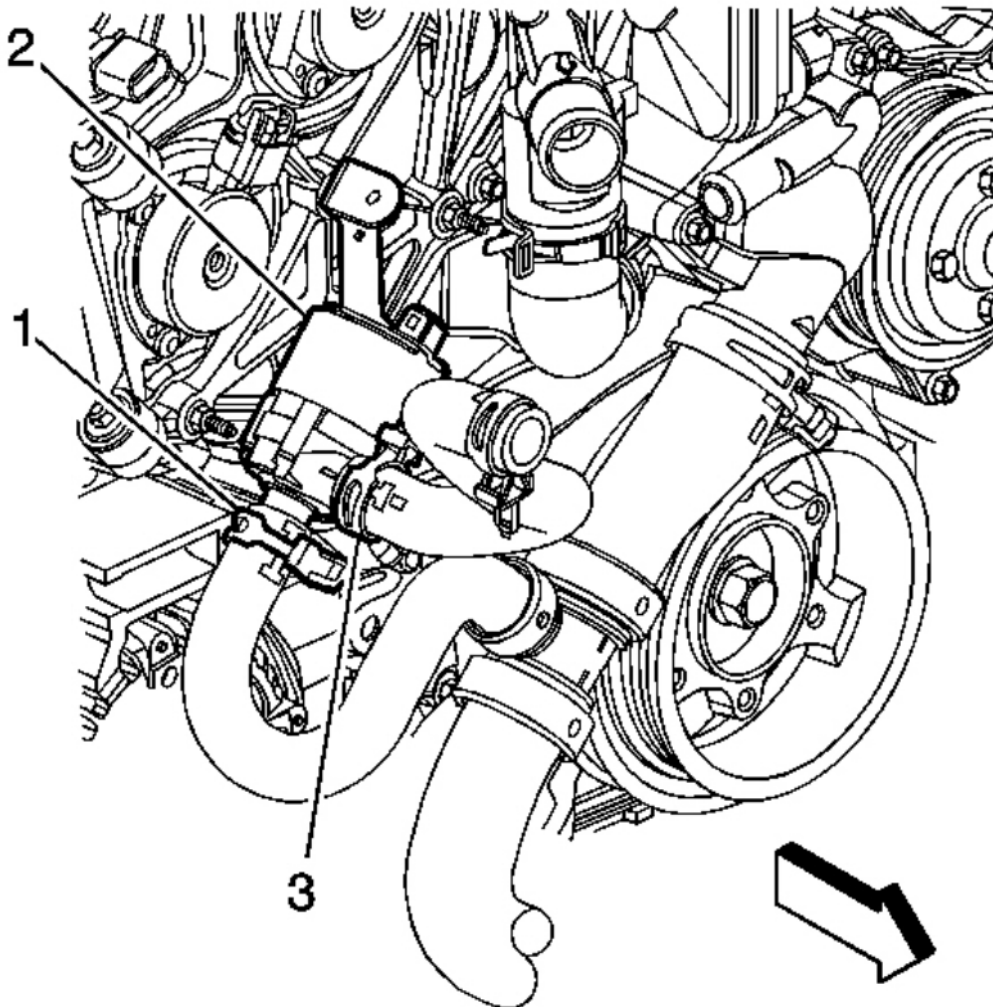


Fig. 105: View Of Afterboil Coolant Pump & Radiator Outlet Hose

Courtesy of GENERAL MOTORS CORP.

2. Using the **J 38185** slide the hose clamp down on the hose (3).
3. Disconnect the hose from the afterboil coolant pump.
4. Using the **J 38185** slide the hose clamp back on the hose (1).
5. Disconnect the hose from the afterboil coolant pump.
6. Disconnect the afterboil coolant pump electrical connector from the afterboil coolant pump.

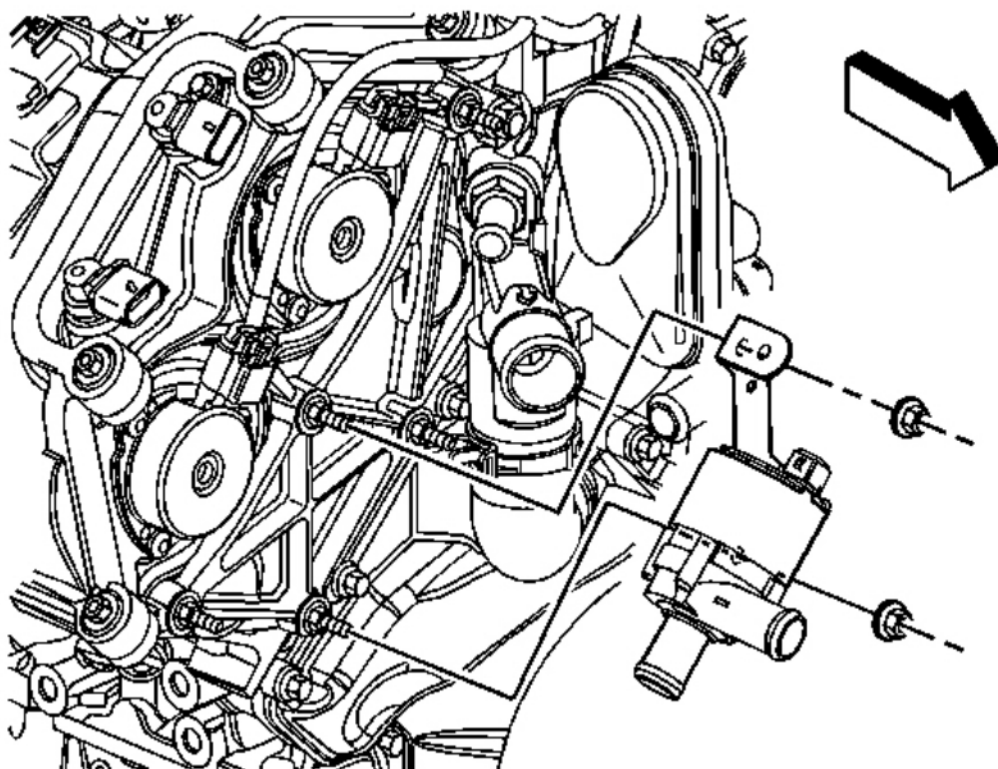


Fig. 106: View Of Afterboil Coolant Pump
Courtesy of GENERAL MOTORS CORP.

7. Remove the afterboil coolant pump nuts.
8. Remove the afterboil coolant pump.

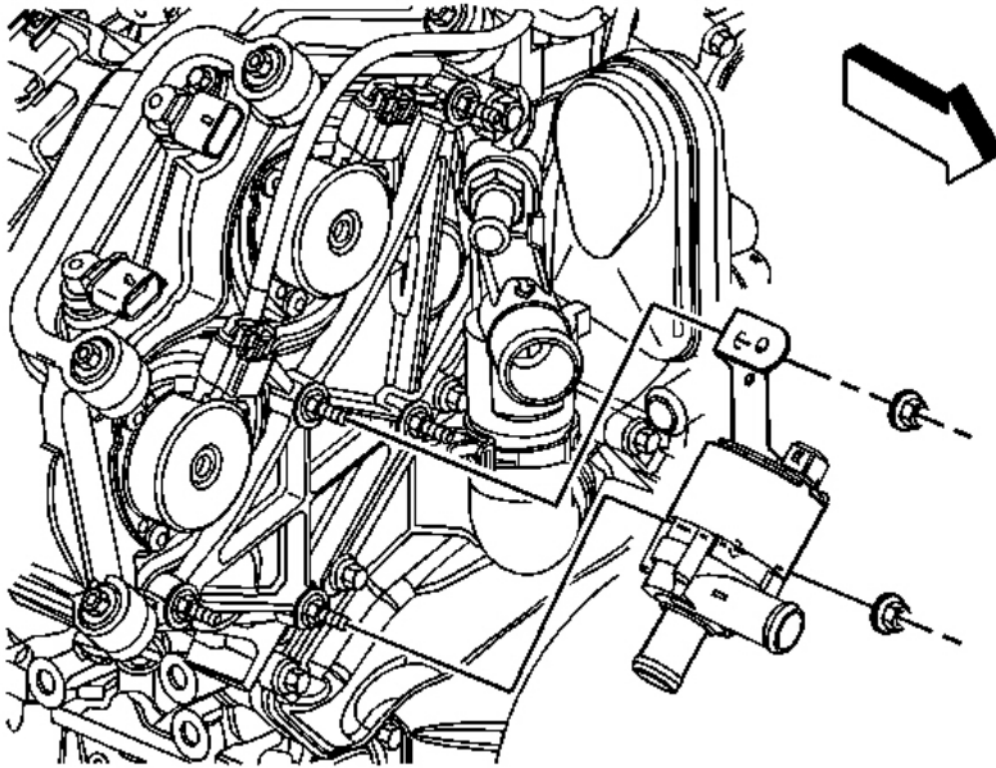


Fig. 107: View Of Afterboil Coolant Pump
Courtesy of GENERAL MOTORS CORP.

1. Install the afterboil coolant pump.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the afterboil coolant pump nuts.

Tighten: Tighten the nuts to 9 N.m (80 lb in).

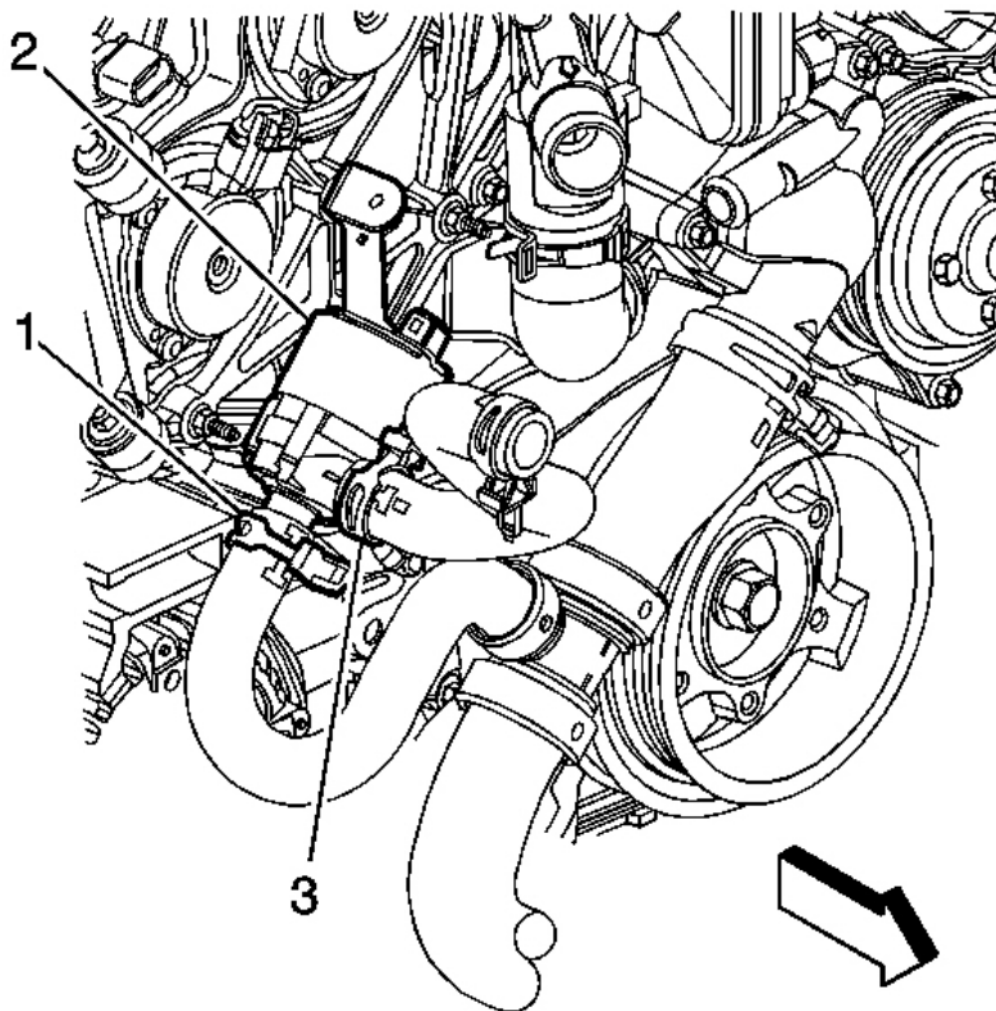


Fig. 108: View Of Afterboil Coolant Pump & Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Connect the afterboil coolant pump electrical connector to the afterboil coolant pump.
4. Connect the hose (3) to the afterboil coolant pump.
5. Using the **J 38185** slide the hose clamp back into the original position on the hose.
6. Connect the hose (1) to the afterboil coolant pump.
7. Using the **J 38185** slide the hose clamp back to the original position on the hose.

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

FAN SHROUD REPLACEMENT (LH2)

Removal Procedure

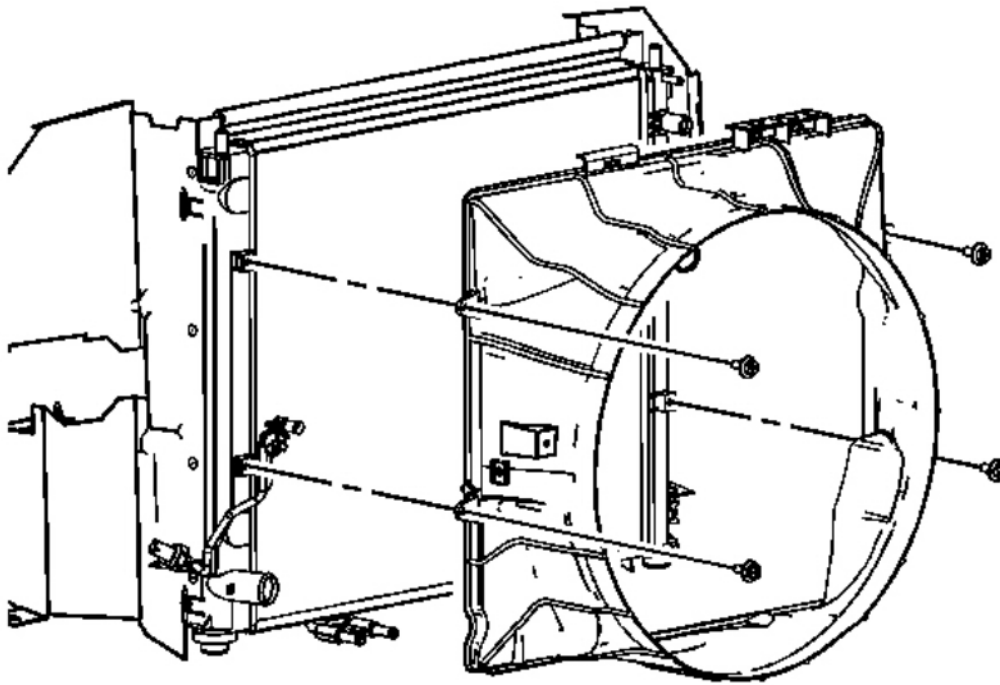


Fig. 109: View Of Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Remove the fan. Refer to **Fan Replacement**.
2. Lower the vehicle.
3. Disconnect the condenser tube from the fan shroud retainer clip.
4. Remove the cooling fan shroud retaining bolts.
5. Remove the cooling fan shroud.

Installation Procedure

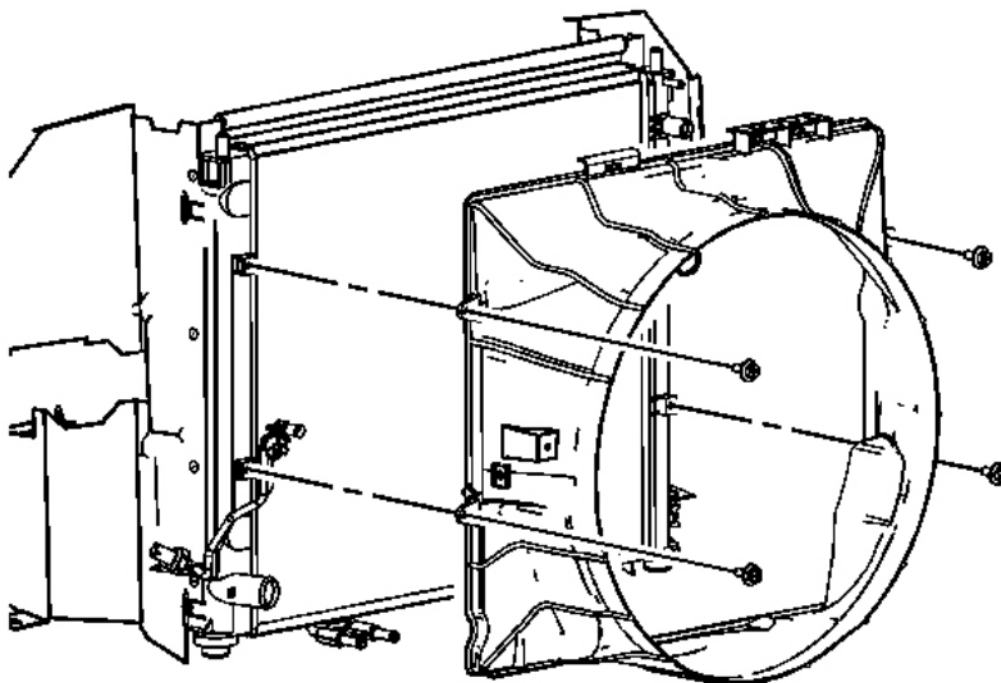


Fig. 110: View Of Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan shroud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the cooling fan shroud retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

3. Connect the condenser tube to the fan shroud retainer clip.
4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
5. Install the fan. Refer to Fan Replacement.

FAN SHROUD REPLACEMENT (LY7)

Removal Procedure

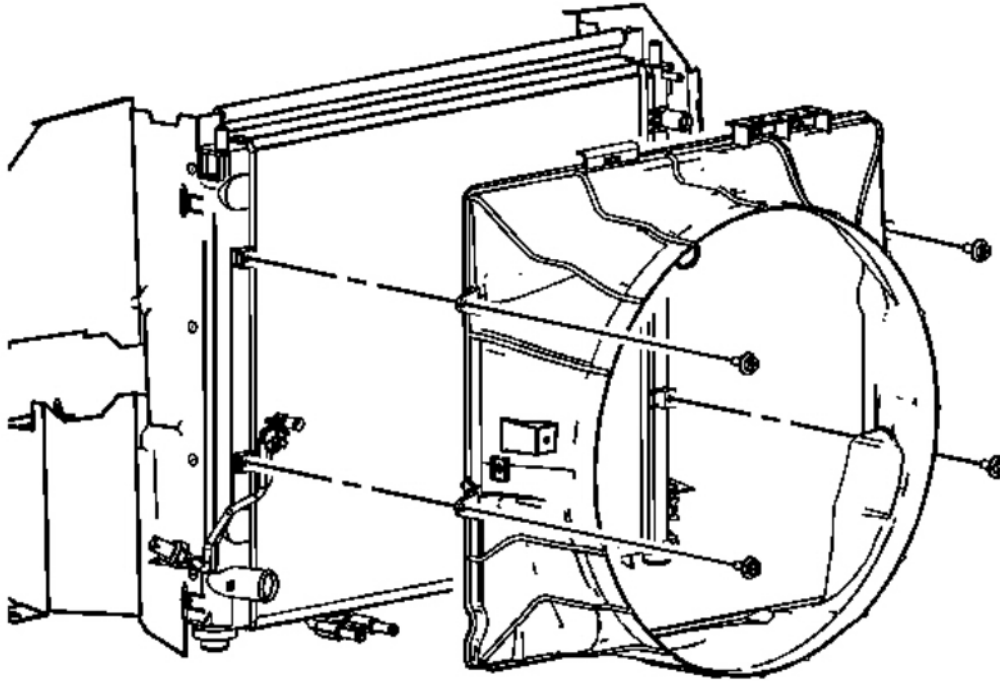


Fig. 111: View Of Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Remove the fan. Refer to **Fan Replacement**.
2. Disconnect the condenser tube from the fan shroud retainer clip.
3. Remove the cooling fan shroud retaining bolts.
4. Remove the cooling fan shroud.

Installation Procedure

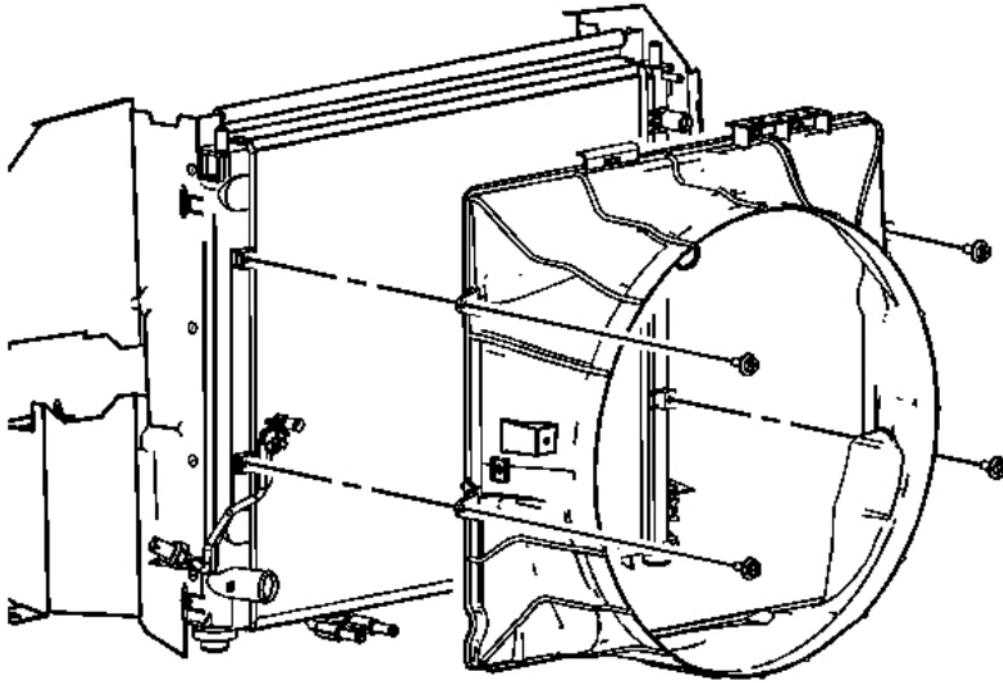


Fig. 112: View Of Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan shroud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the cooling fan shroud retaining bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

3. Connect the condenser tube to the fan shroud retainer clip.
4. Install the fan. Refer to Fan Replacement.

RADIATOR REPLACEMENT (LH2 - STANDARD COOLING)

Tools Required

J 38185 Hose Clamp Pliers**Removal Procedure**

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Remove the electric cooling fan. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.

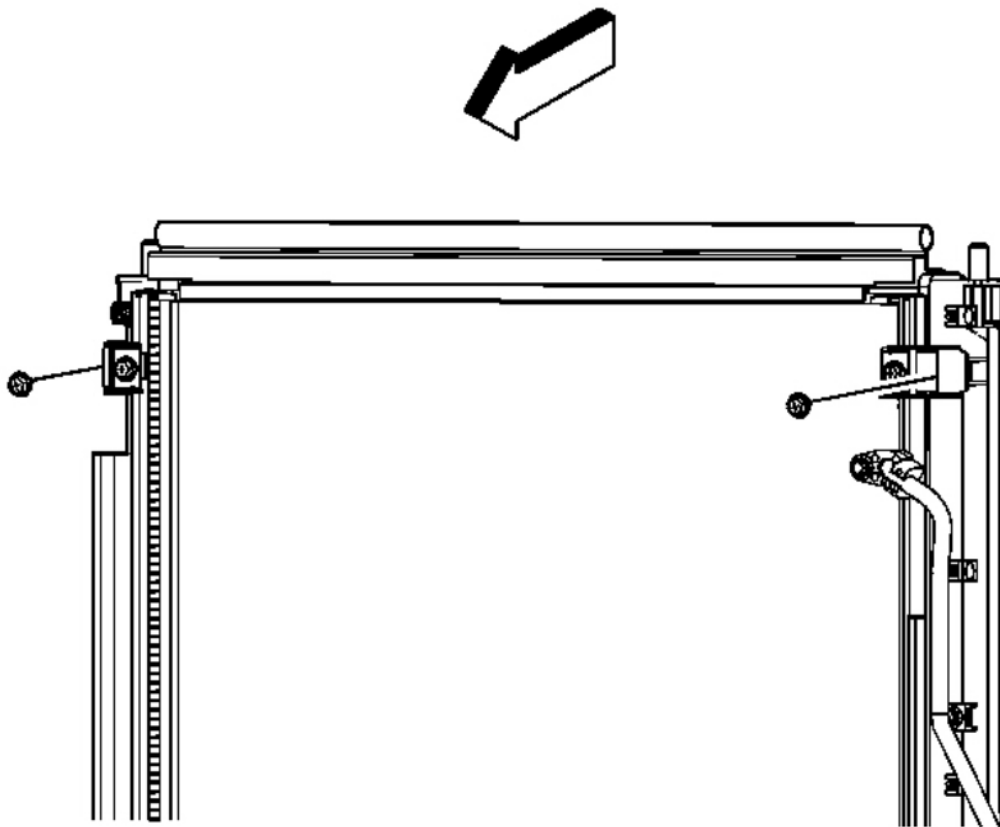


Fig. 113: View Of Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the upper condenser mounting bolts.

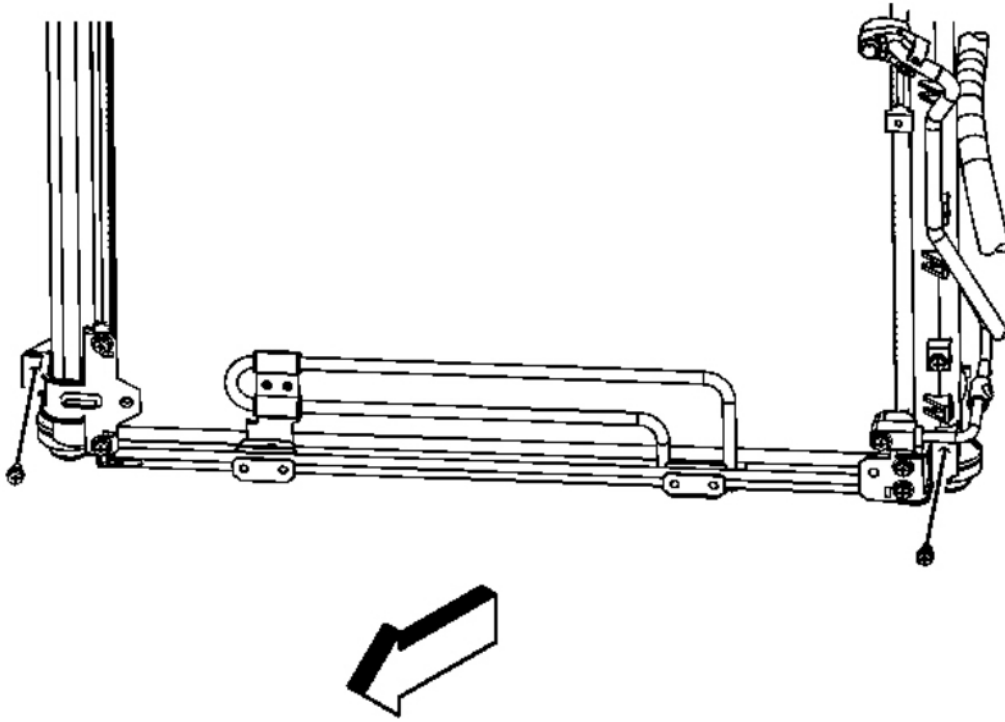


Fig. 114: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower condenser mounting bolts.

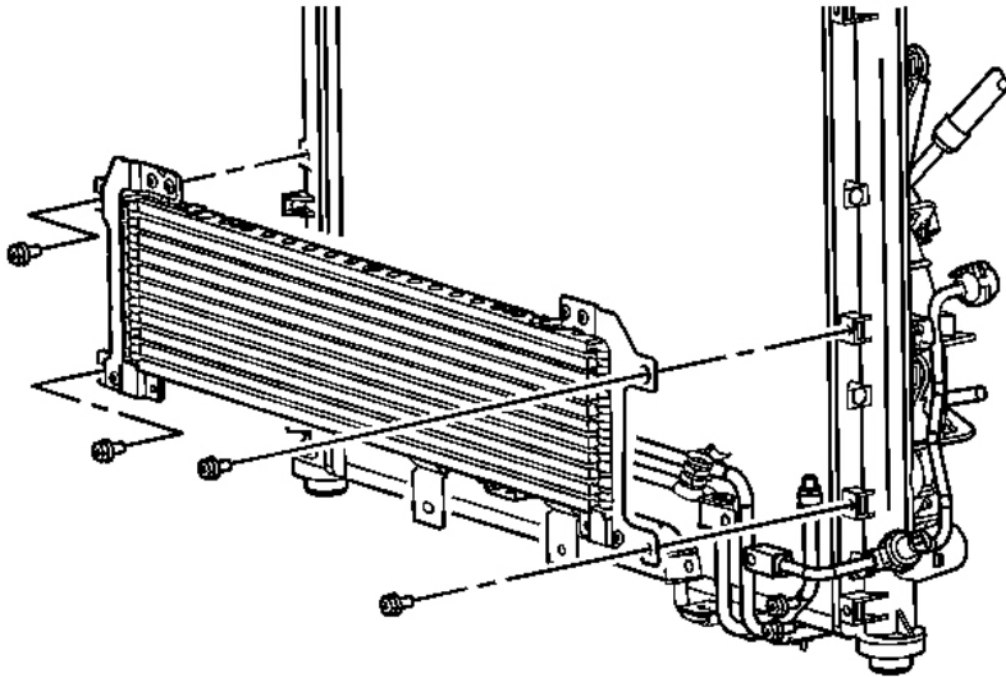


Fig. 115: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the side air baffle lower retaining pins from the radiator.

IMPORTANT: Reposition the condenser to access the transmission oil cooler mounting bolts.

6. Remove the transmission oil cooler (TOC) mounting bolts.
7. Lower the vehicle.

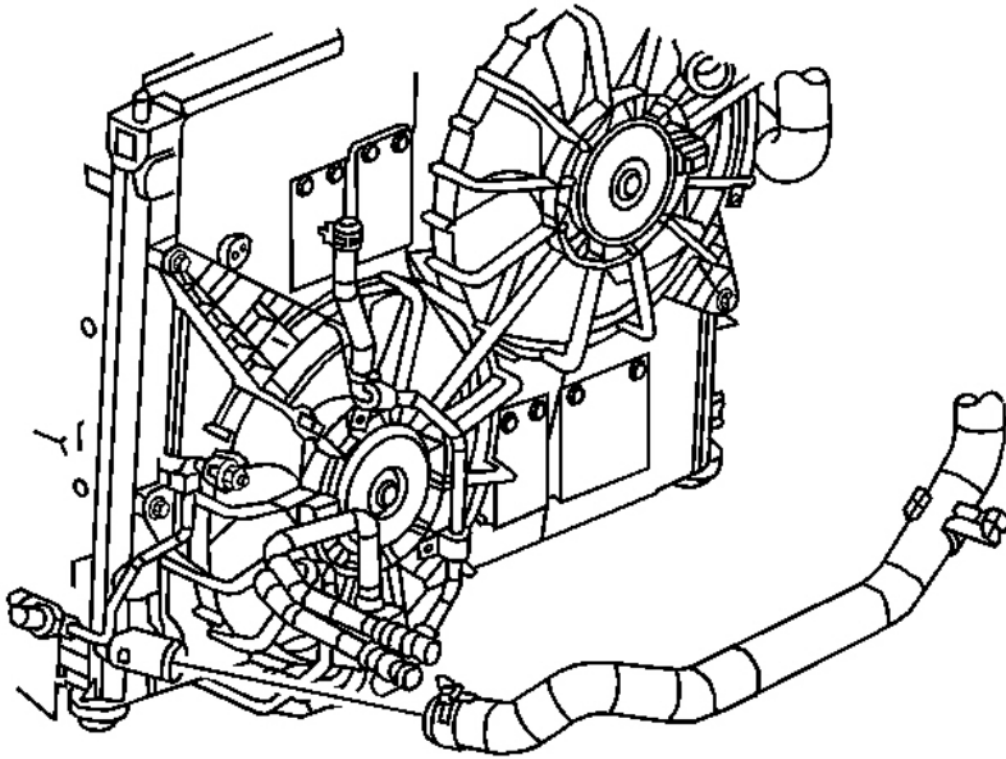


Fig. 116: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

8. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the radiator.

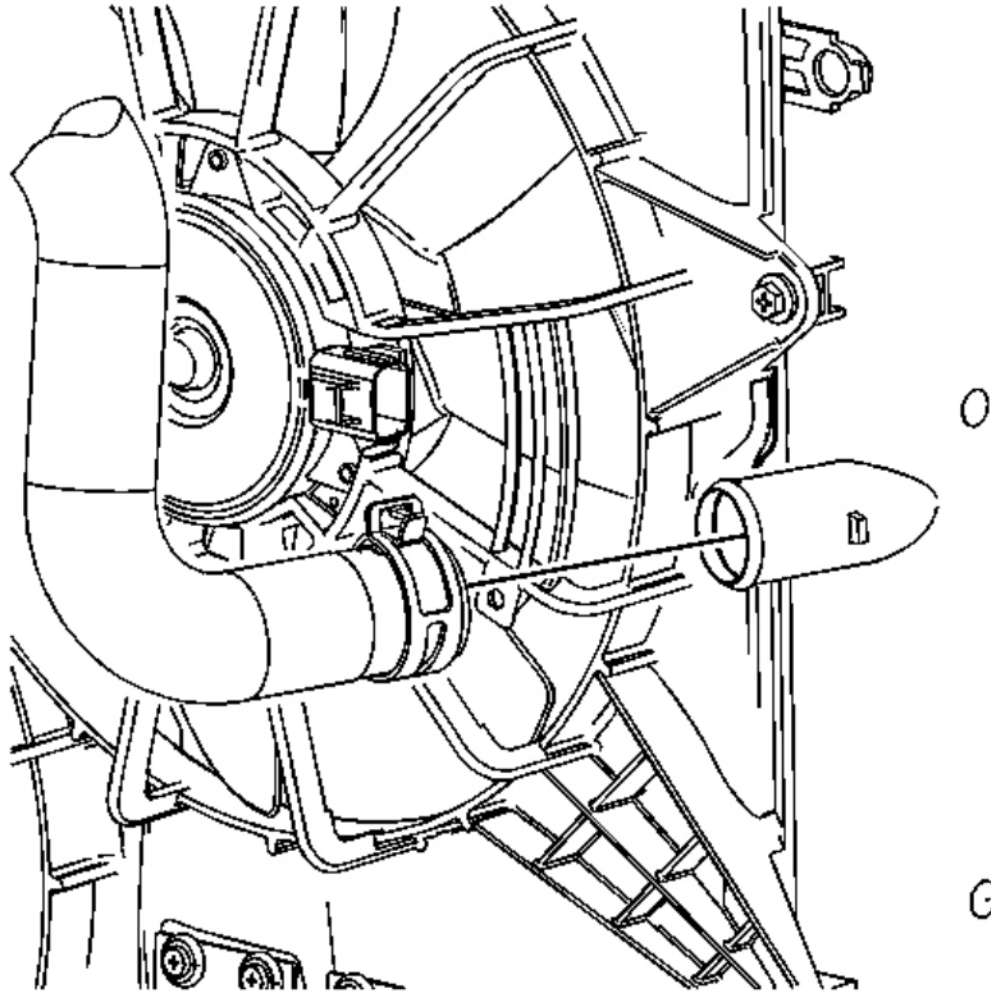


Fig. 117: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the radiator.

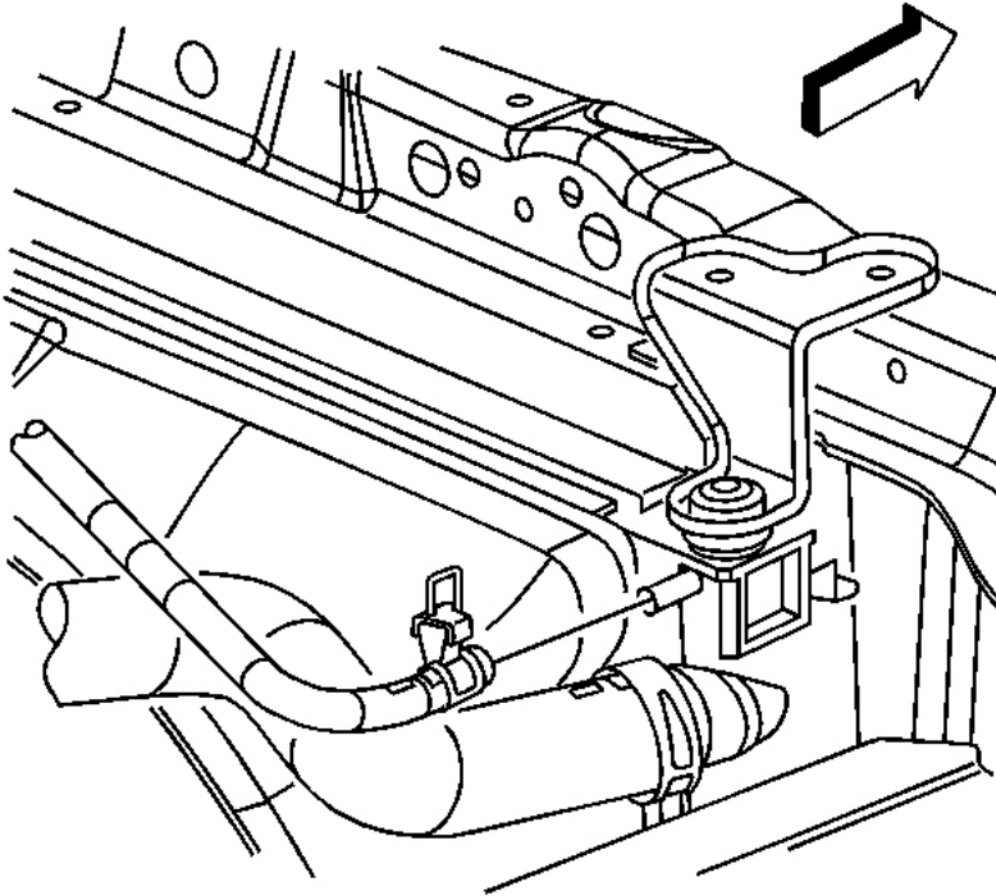


Fig. 118: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

10. Using the **J 38185** , disengage the tension on the hose clamp and remove the surge tank inlet hose from the radiator.

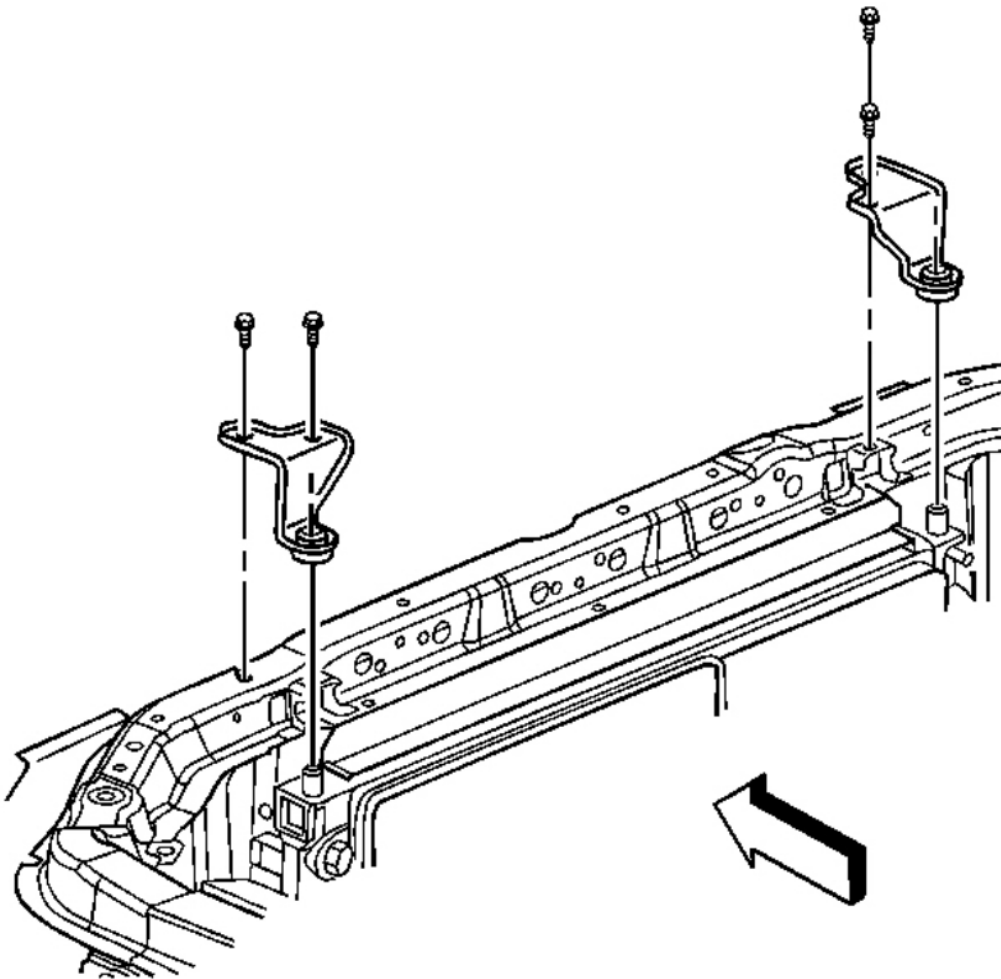


Fig. 119: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

11. Remove the radiator support bracket bolts.
12. Remove the radiator support brackets.
13. Disconnect the upper air baffle retaining pins from the radiator.
14. Remove the radiator.

Installation Procedure

1. Install the radiator.

2. Connect the upper air baffle retaining pins to the radiator.
3. Install the radiator support brackets.

NOTE: Refer to Fastener Notice in Cautions and Notices.

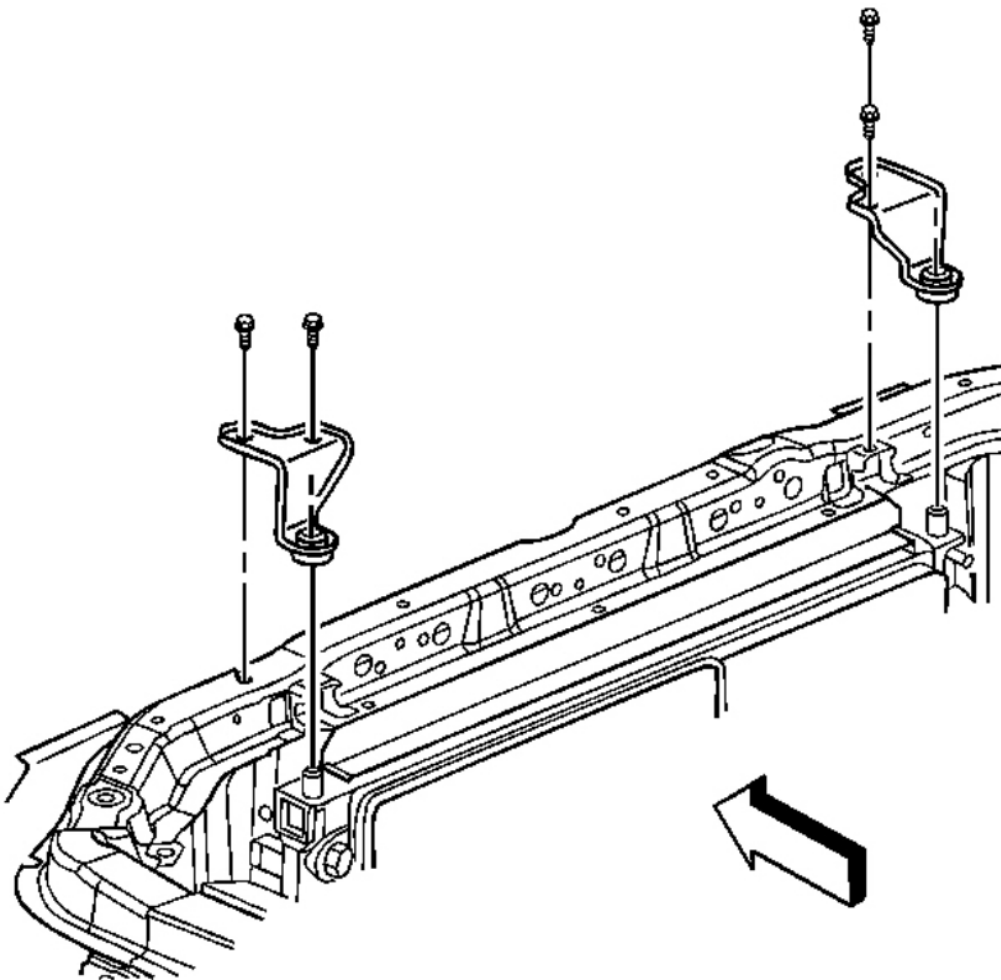


Fig. 120: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator support bracket bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

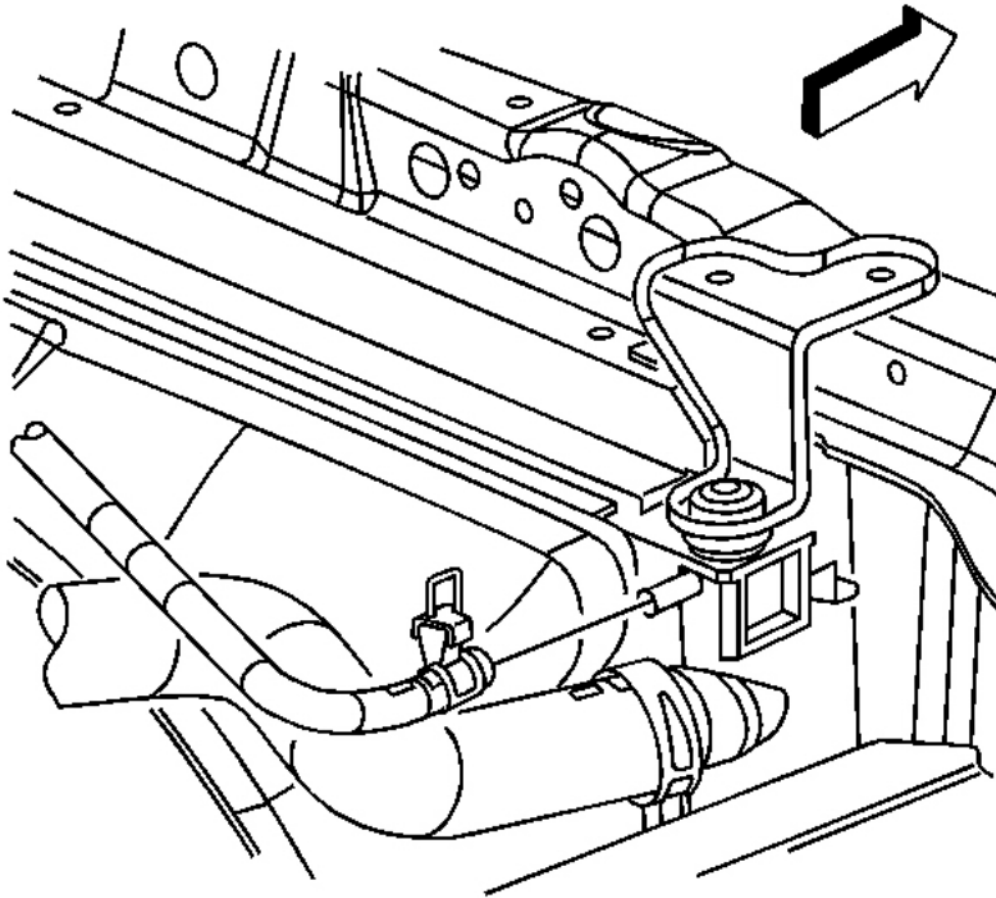


Fig. 121: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank inlet hose to the radiator and using the **J 38185** , position the surge tank inlet hose clamp to secure the hose.

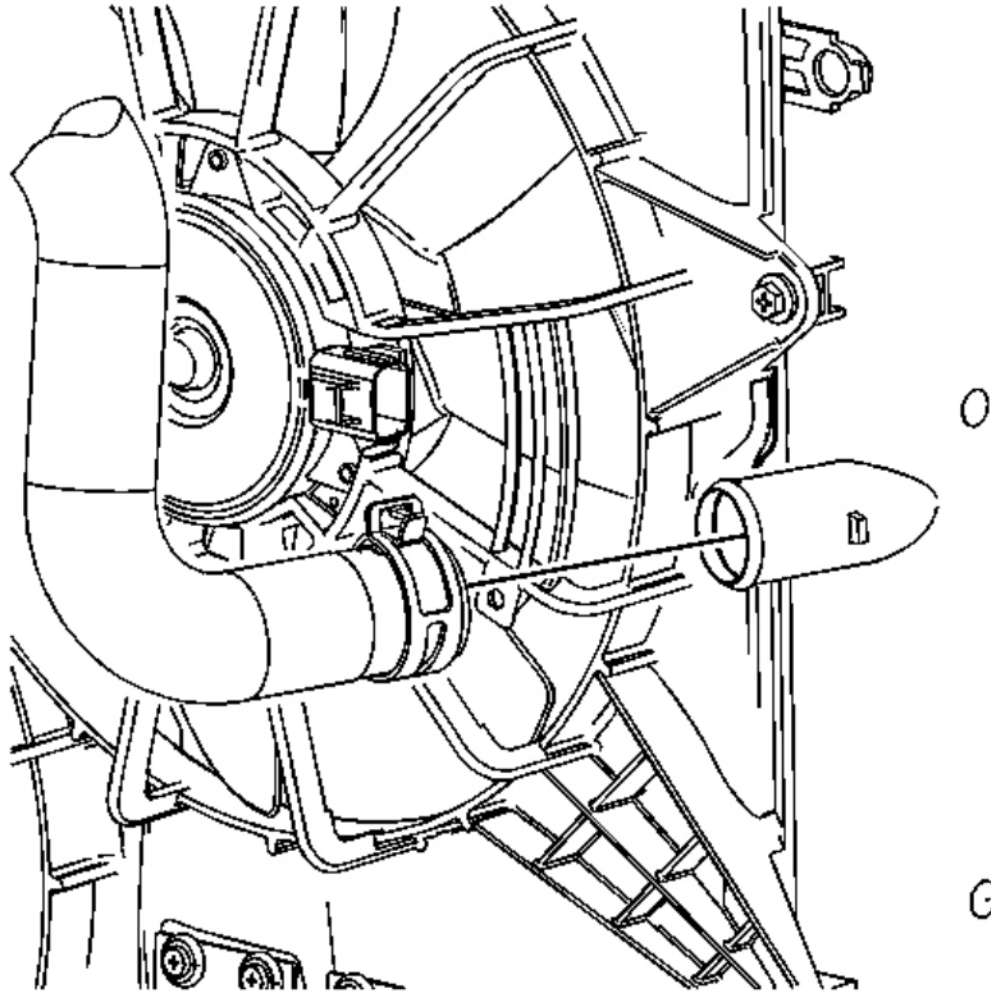


Fig. 122: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Connect the radiator inlet hose to the radiator and using the **J 38185** , position the radiator inlet hose clamp to secure the hose.

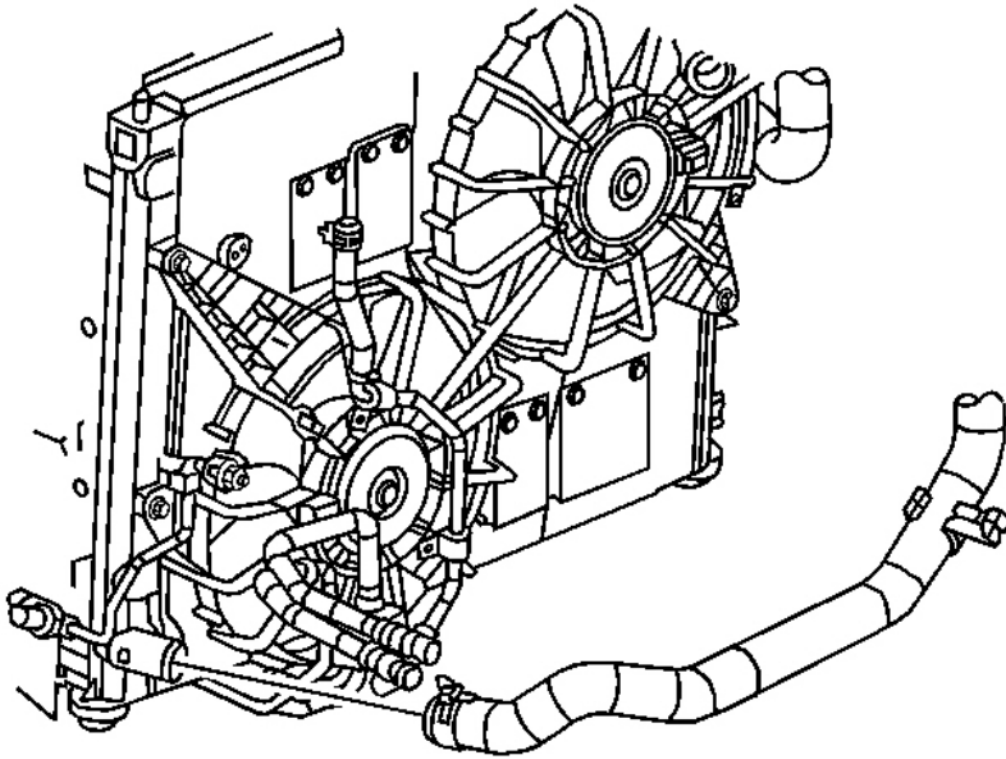


Fig. 123: Identifying Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Connect the radiator outlet hose to the radiator and using the **J 38185** , position the radiator outlet hose clamp to secure the hose.
8. Raise and support the vehicle.
9. Install the TOC mounting bolts.

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

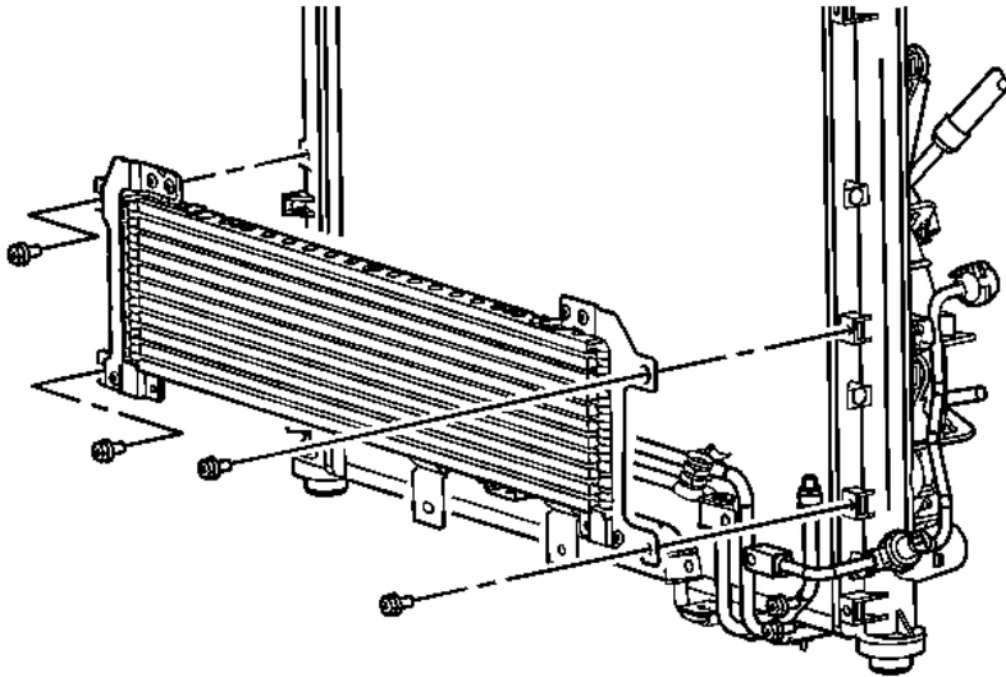


Fig. 124: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

10. Connect the side air baffle lower retaining pins to the radiator.

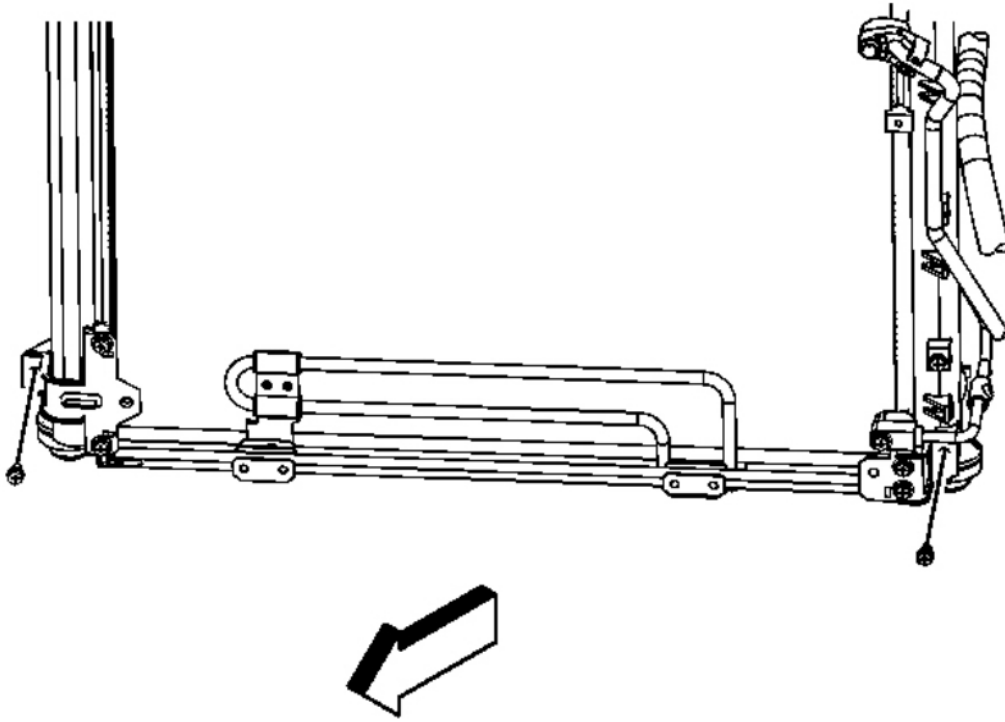


Fig. 125: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the lower condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

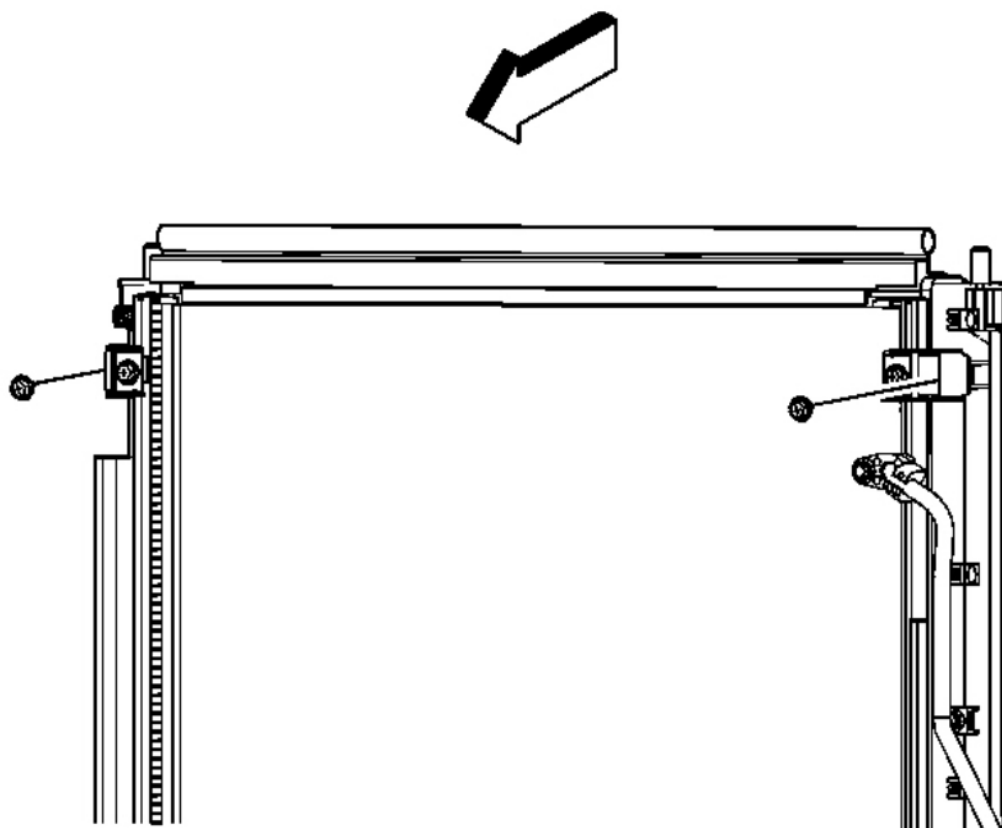


Fig. 126: View Of Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the upper condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

13. Install the electric cooling fan. Refer to Cooling Fan Replacement - Electric (LH2 - Standard Cooling) or Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling) or Cooling Fan Replacement - Electric (LY7).
14. Fill the cooling system. Refer to Draining and Filling Cooling System.

RADIATOR REPLACEMENT (LH2 - HEAVY DUTY COOLING)

Tools Required

J 38185 Hose Clamp Pliers**Removal Procedure**

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Remove the electric cooling fan. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.

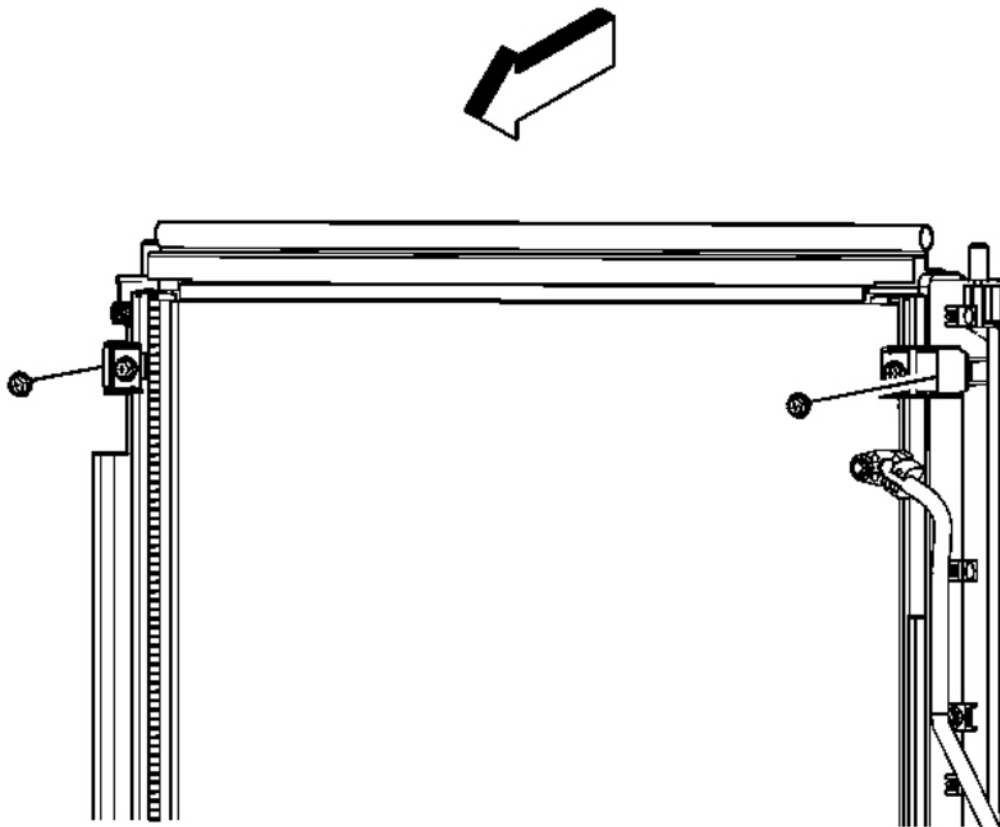


Fig. 127: View Of Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the upper condenser mounting bolts.

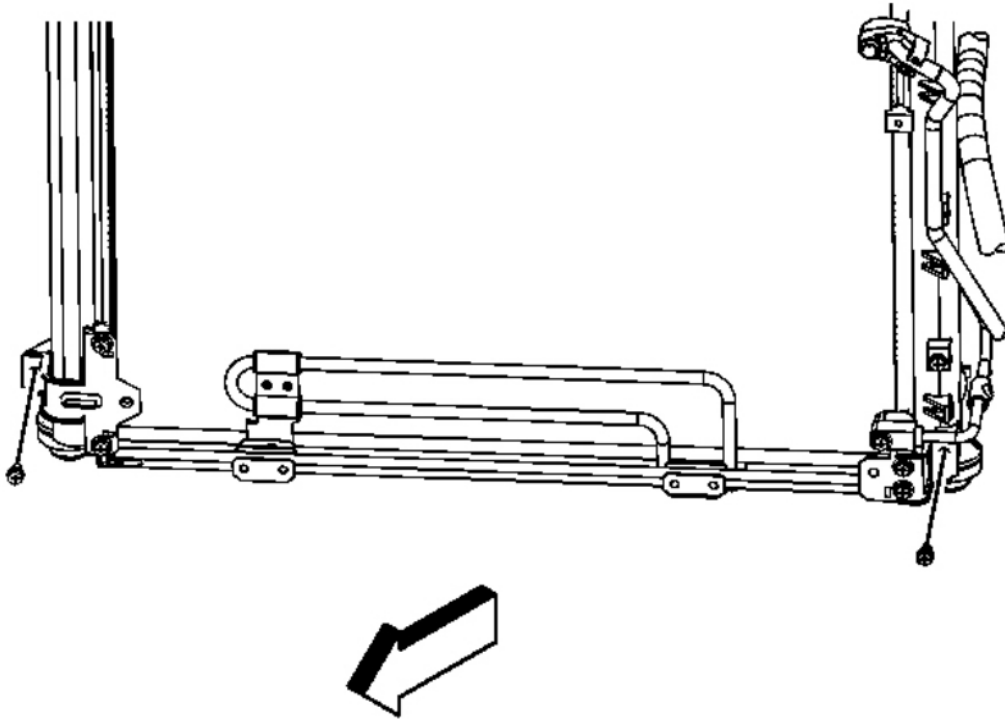


Fig. 128: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower condenser mounting bolts.

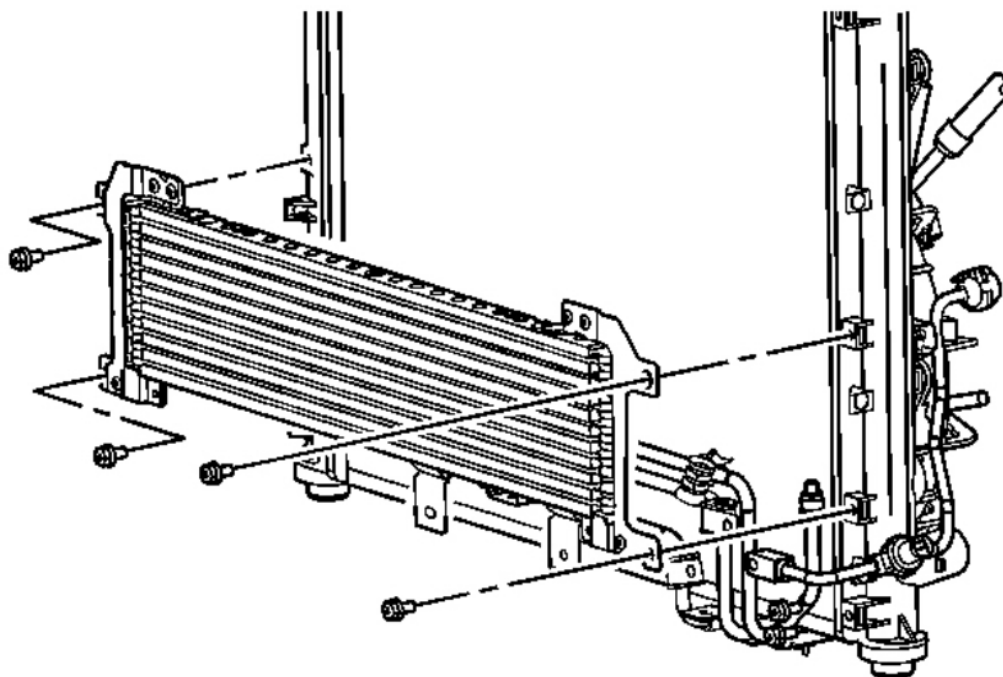


Fig. 129: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the side air baffle lower retaining pins from the radiator.

IMPORTANT: Reposition the condenser to access the transmission oil cooler mounting bolts.

6. Remove the transmission oil cooler (TOC) mounting bolts.
7. Lower the vehicle.
8. Remove the fan shroud. Refer to **Fan Shroud Replacement (LH2)** or **Fan Shroud Replacement (LY7)**.
9. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator outlet hose from the radiator.

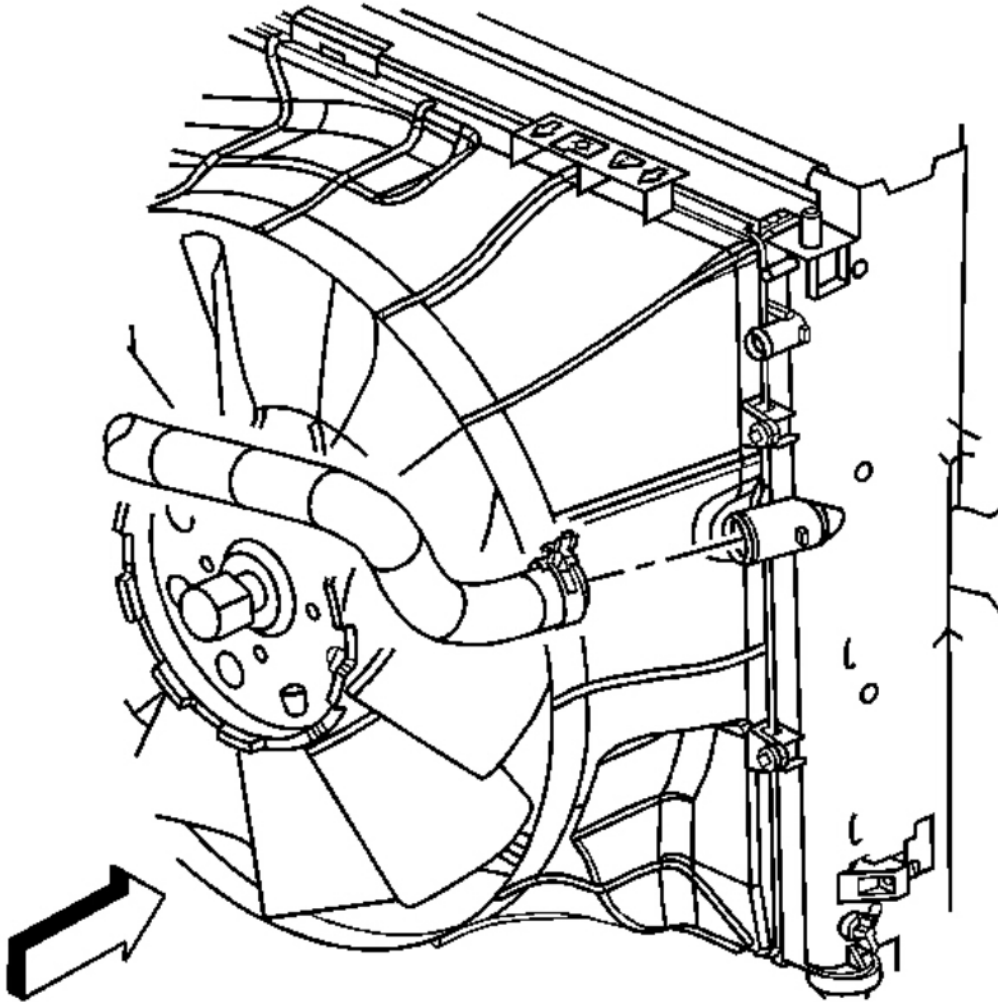


Fig. 130: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

10. Using the **J 38185** , disengage the tension on the hose clamp and remove the radiator inlet hose from the radiator.

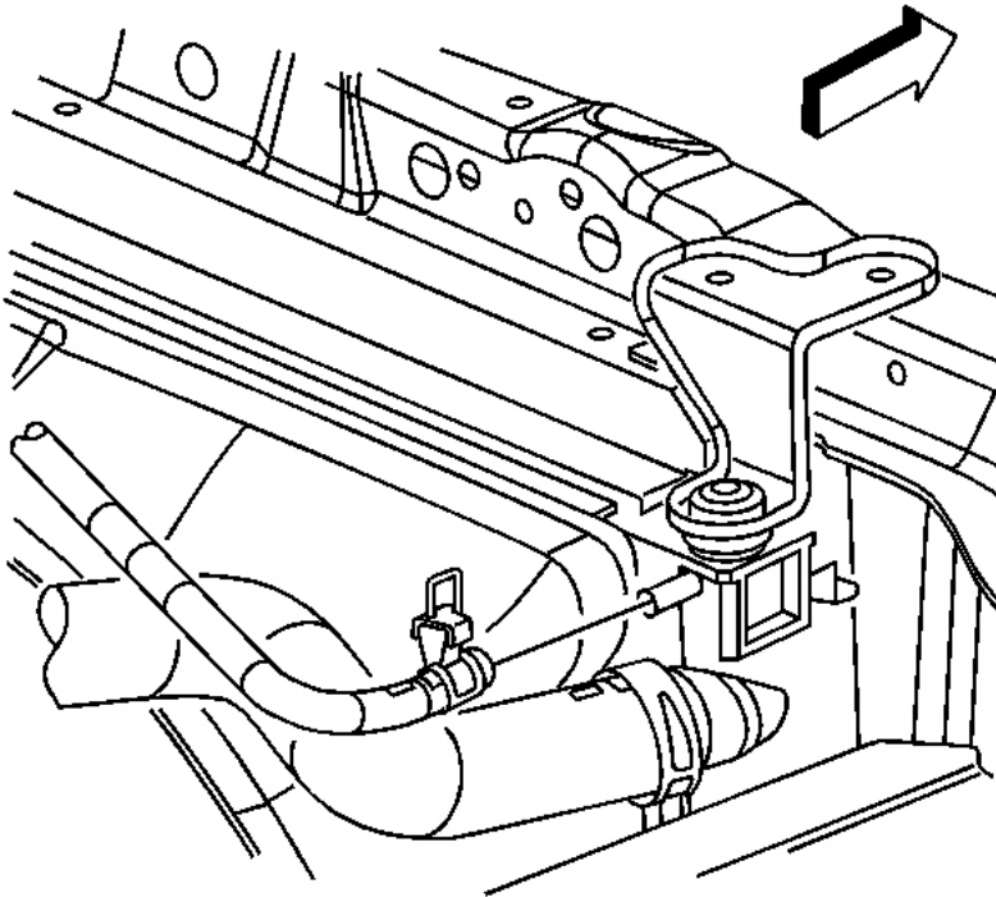


Fig. 131: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

11. Using the **J 38185** , disengage the tension on the hose clamp and remove the surge tank inlet hose from the radiator.

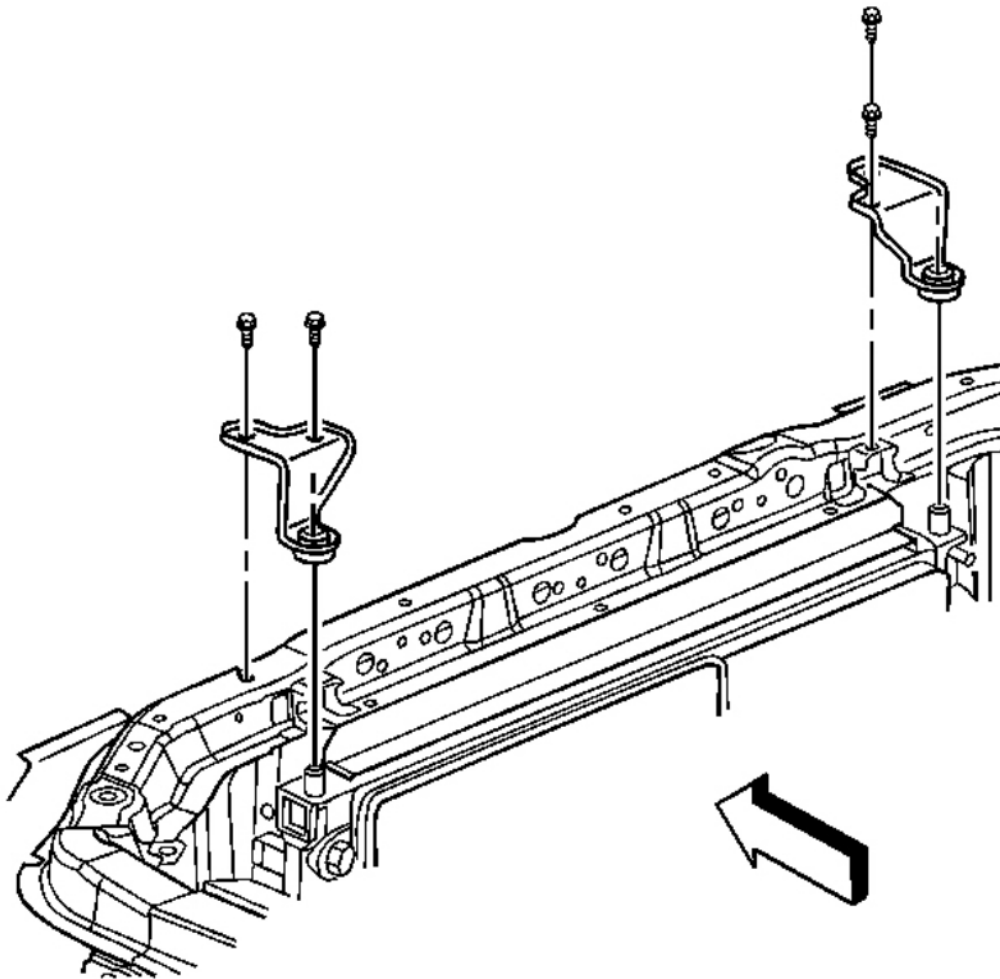


Fig. 132: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

12. Remove the radiator support bracket bolts.
13. Remove the radiator support brackets.
14. Disconnect the upper air baffle retaining pins from the radiator.
15. Remove the radiator.

Installation Procedure

1. Install the radiator.

2. Connect the upper air baffle retaining pins to the radiator.
3. Install the radiator support brackets.

NOTE: Refer to Fastener Notice in Cautions and Notices.

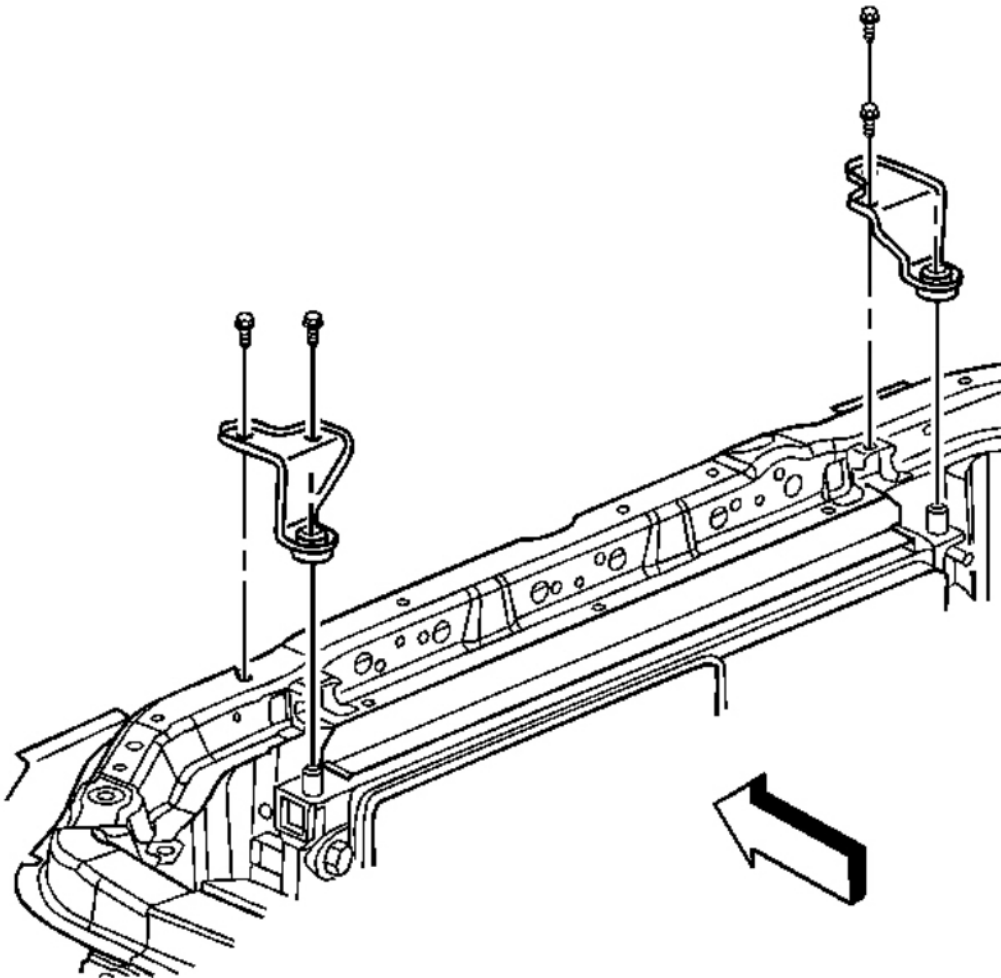


Fig. 133: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

4. Install the radiator support bracket bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

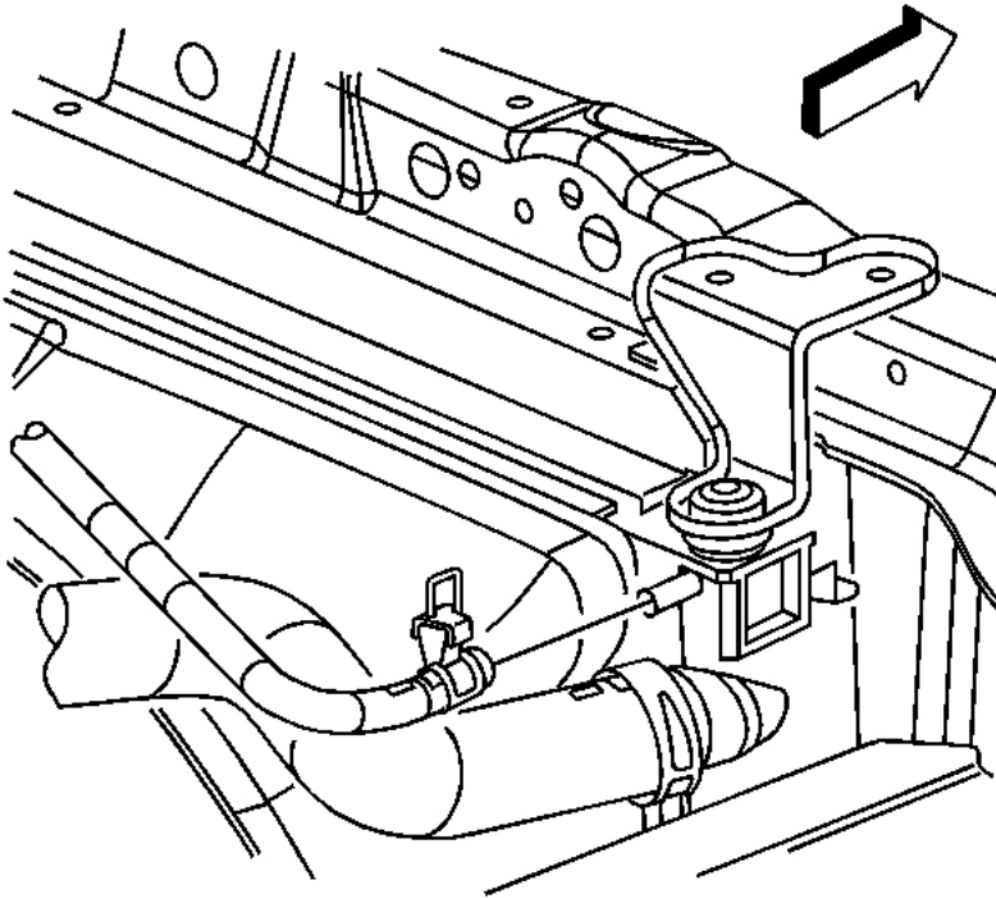


Fig. 134: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank inlet hose to the radiator and using the **J 38185** , position the surge tank inlet hose clamp to secure the hose.

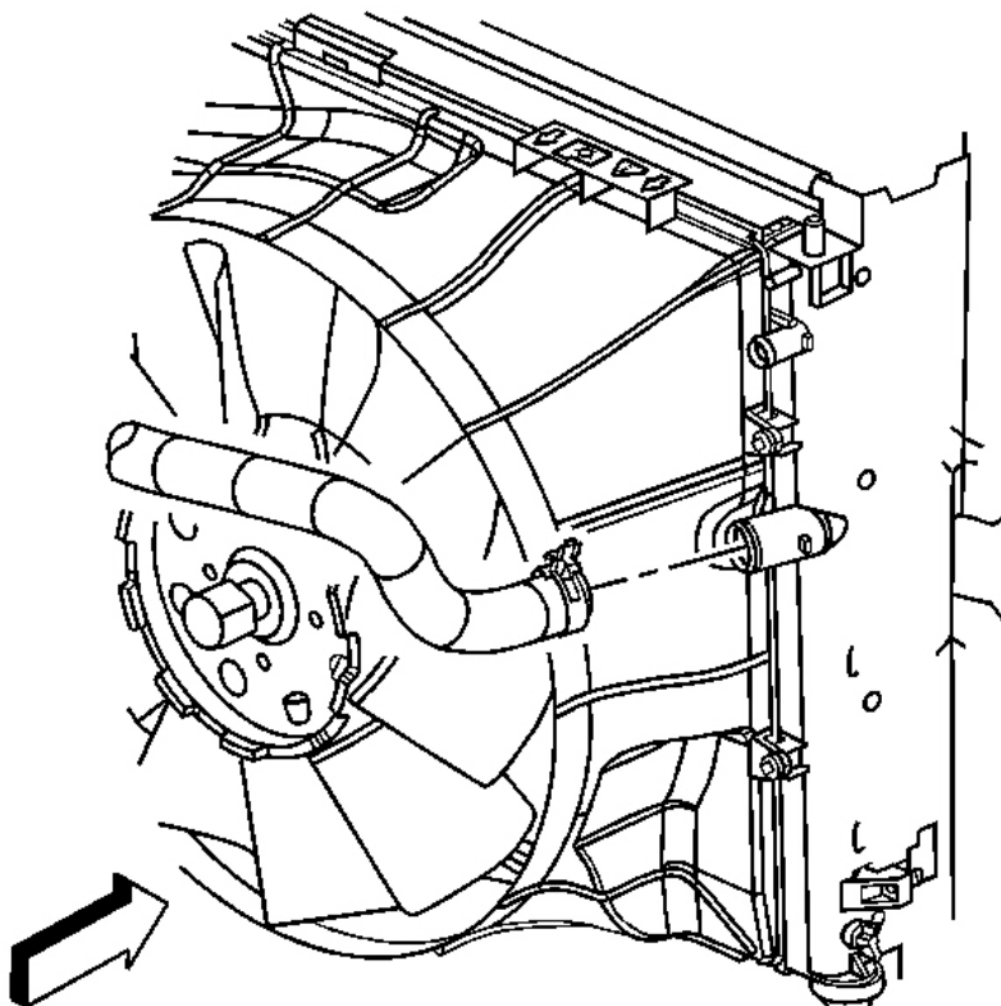


Fig. 135: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Connect the radiator inlet hose to the radiator and using the **J 38185** , position the radiator inlet hose clamp to secure the hose.
7. Connect the radiator outlet hose to the radiator and using the **J 38185** , position the radiator outlet hose clamp to secure the hose.
8. Install the fan shroud. Refer to **Fan Shroud Replacement (LH2)** or **Fan Shroud Replacement (LY7)**.

9. Raise and support the vehicle.
10. Install the TOC mounting bolts.

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

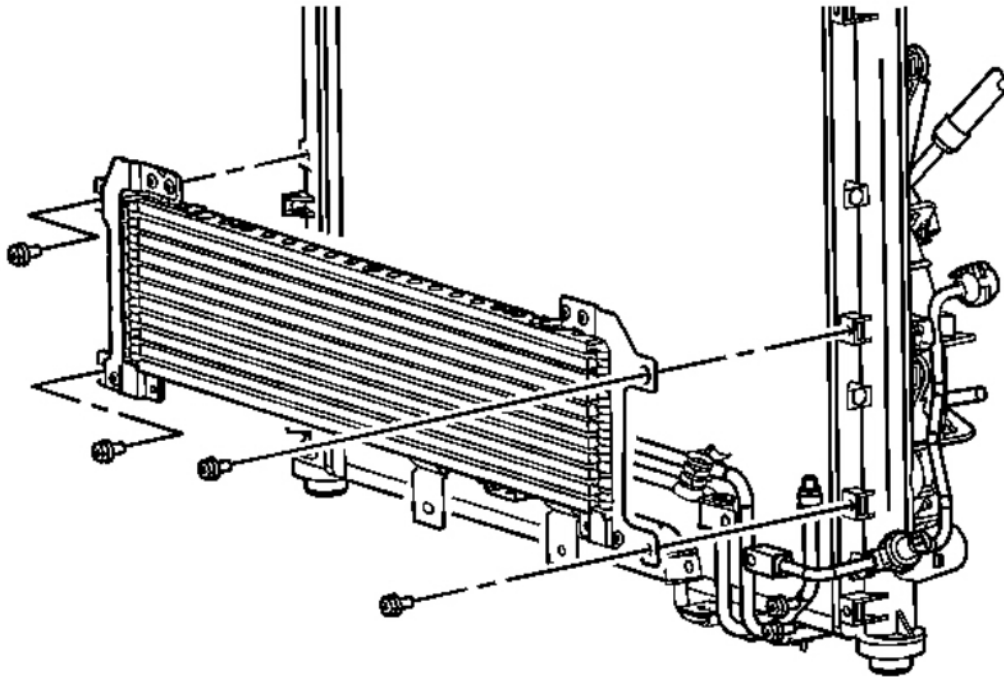


Fig. 136: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

11. Connect the side air baffle lower retaining pins to the radiator.

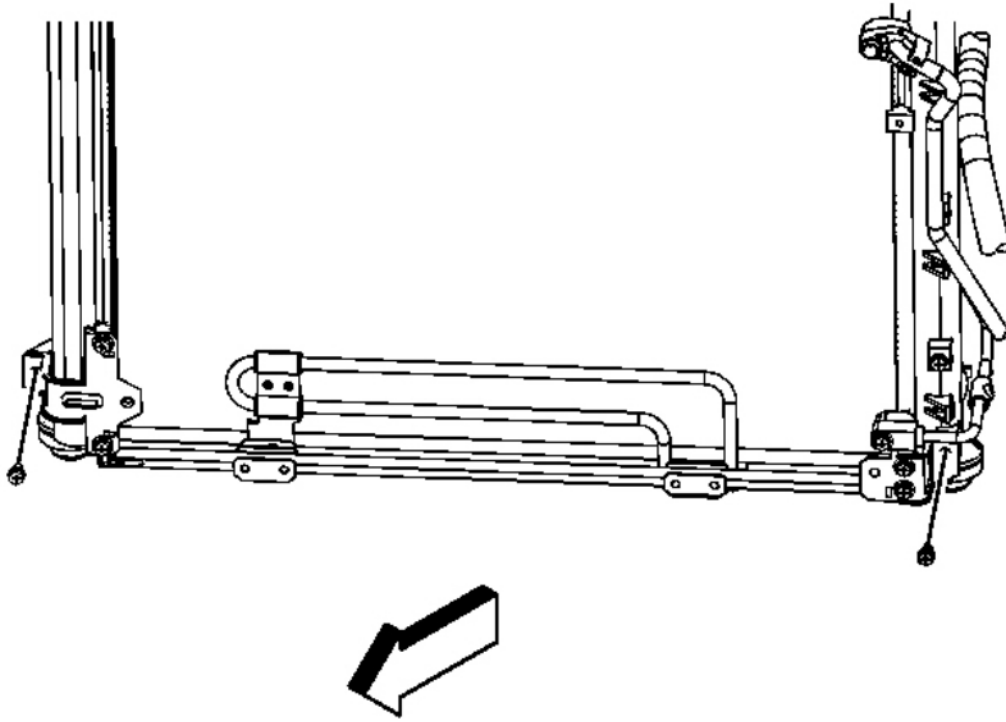


Fig. 137: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the lower condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

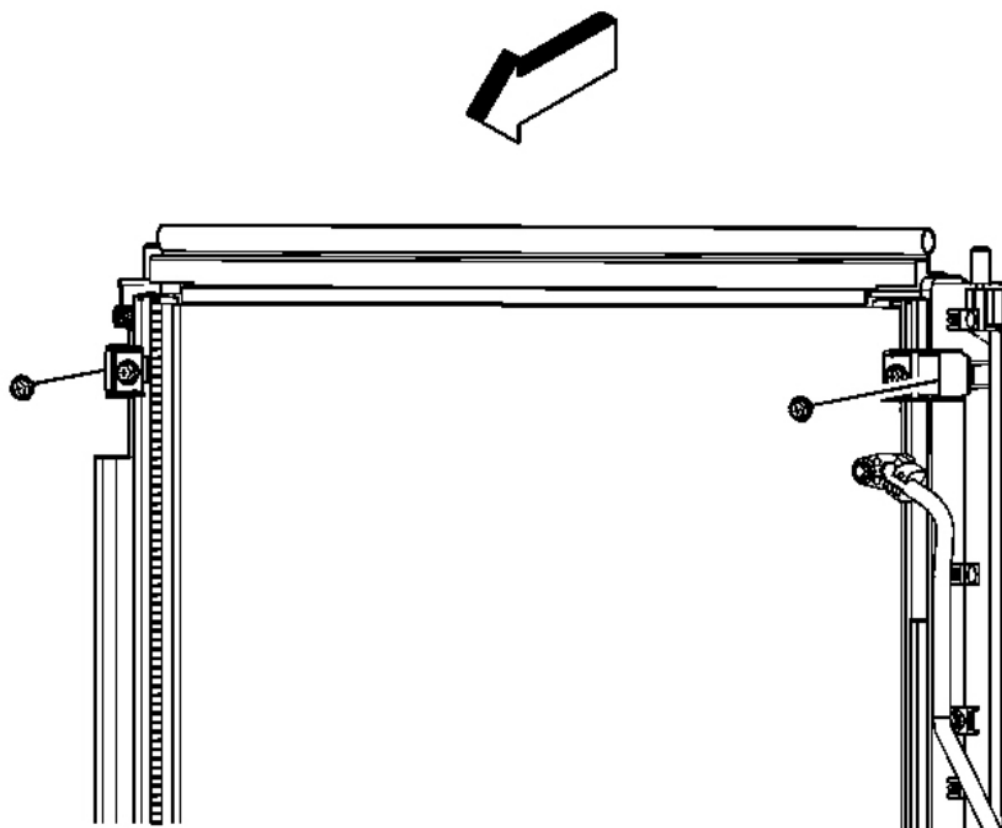


Fig. 138: View Of Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the upper condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

14. Install the electric cooling fan. Refer to Cooling Fan Replacement - Electric (LH2 - Standard Cooling) or Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling) or Cooling Fan Replacement - Electric (LY7).
15. Fill the cooling system. Refer to Draining and Filling Cooling System.

RADIATOR REPLACEMENT (LY7 - STANDARD COOLING)

Tools Required

- **J 38185** Hose Clamp Pliers
- **J 38778** Door Trim Pad Clip Remover

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System**.
2. Remove the electric cooling fan assembly. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

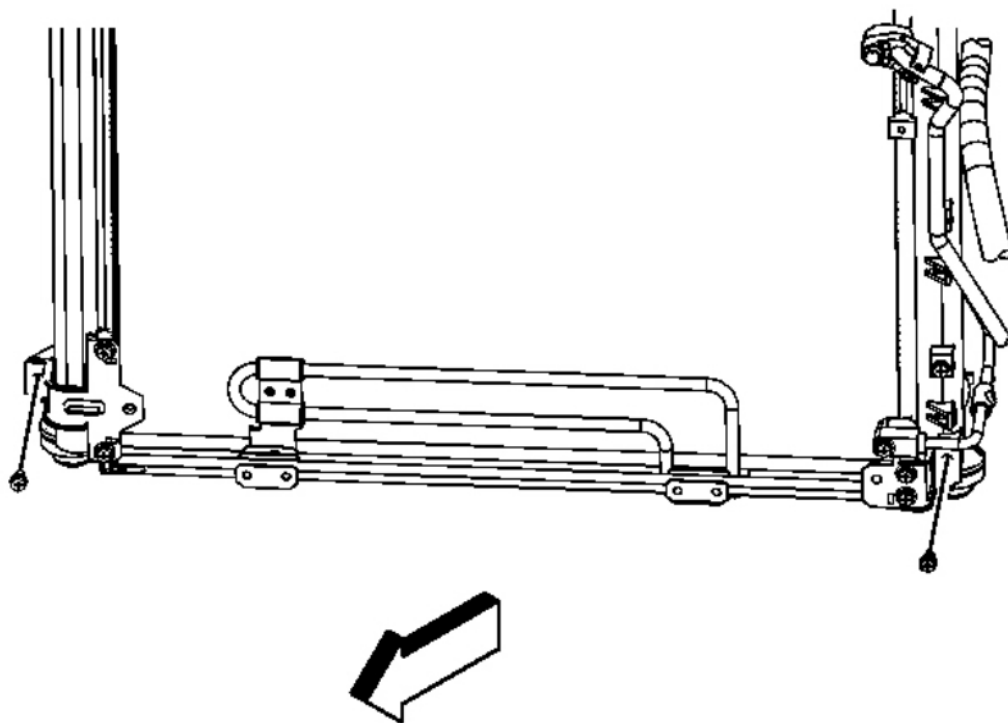


Fig. 139: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the lower condenser mounting bolts.

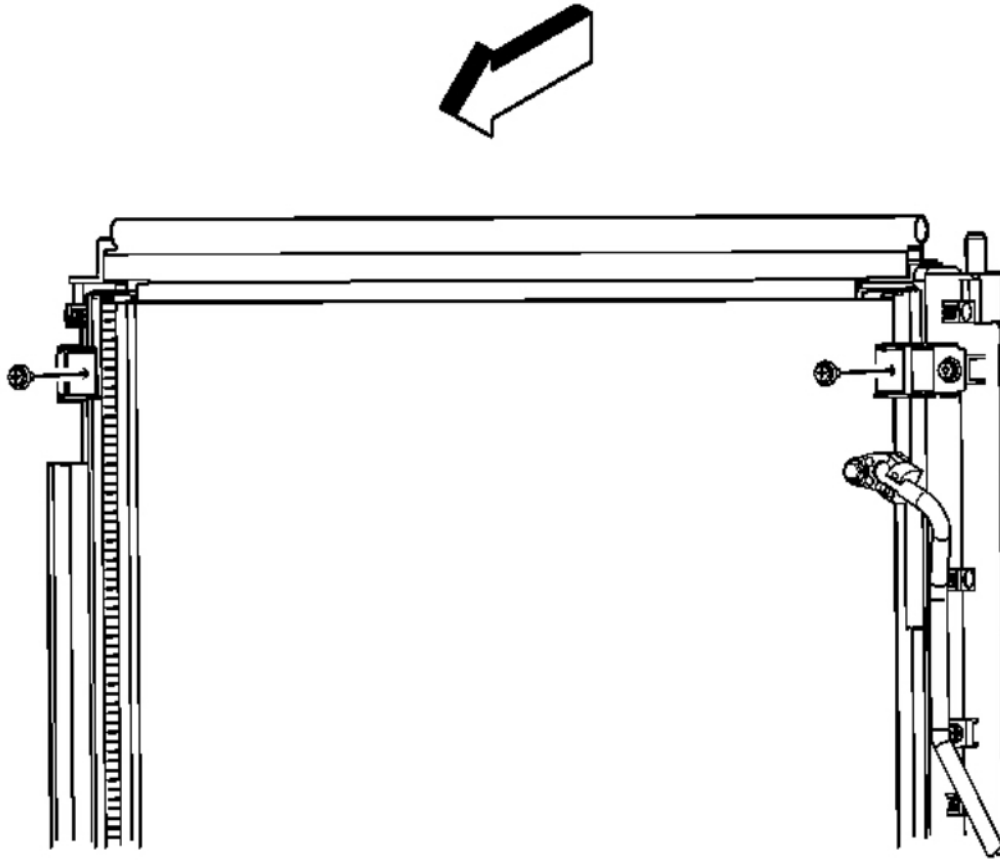


Fig. 140: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper condenser mounting bolts.

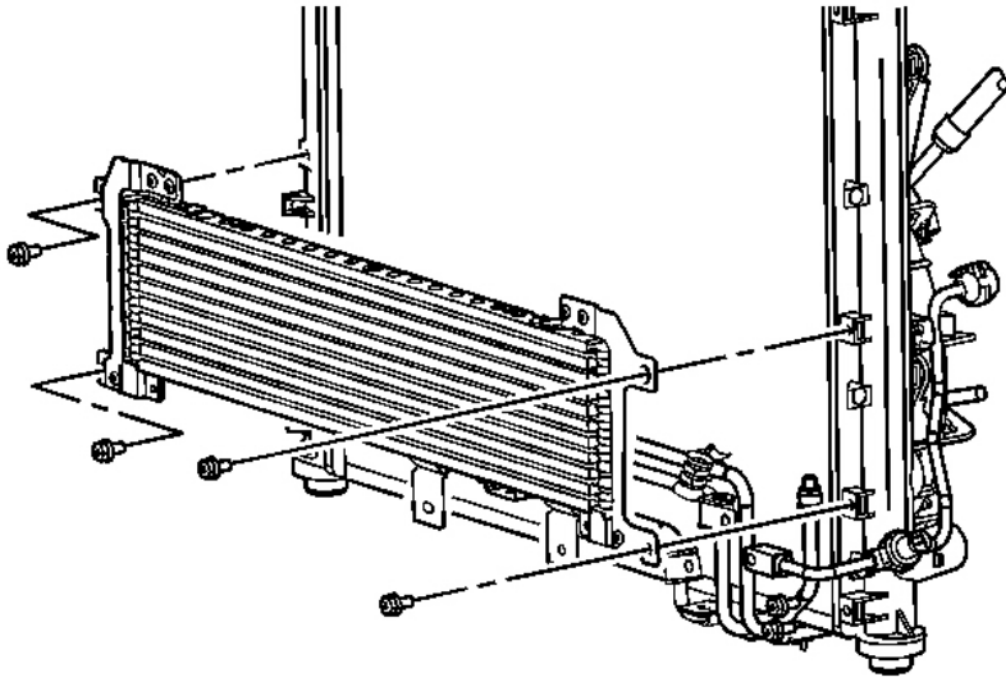


Fig. 141: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Reposition the condenser to access the transmission oil cooler mounting bolts.

6. Remove the transmission oil cooler mounting bolts.

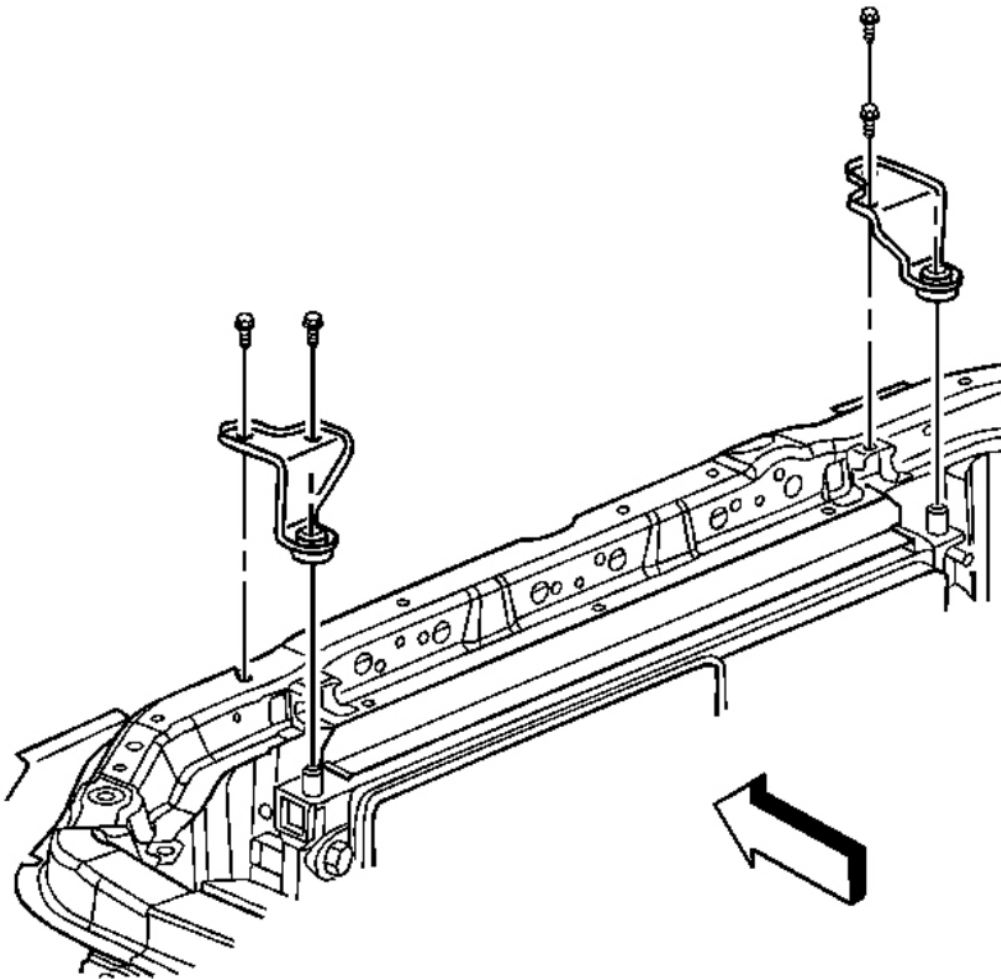


Fig. 142: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the side air baffle lower retainer pins from the radiator.
8. Lower the vehicle.
9. Remove the radiator support bracket bolts.
10. Remove the radiator support brackets.
11. Remove the radiator/condenser upper support using **J 38778**.

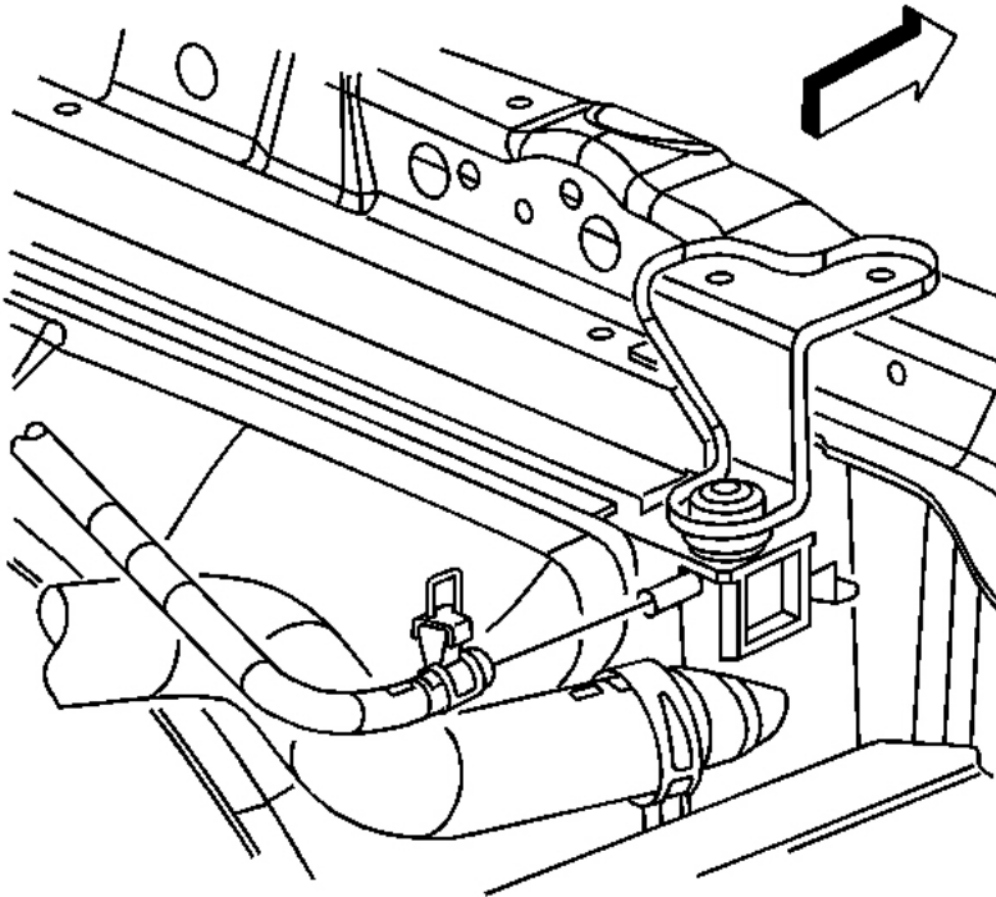


Fig. 143: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the surge tank inlet hose from the radiator using the **J 38185** and reposition aside.

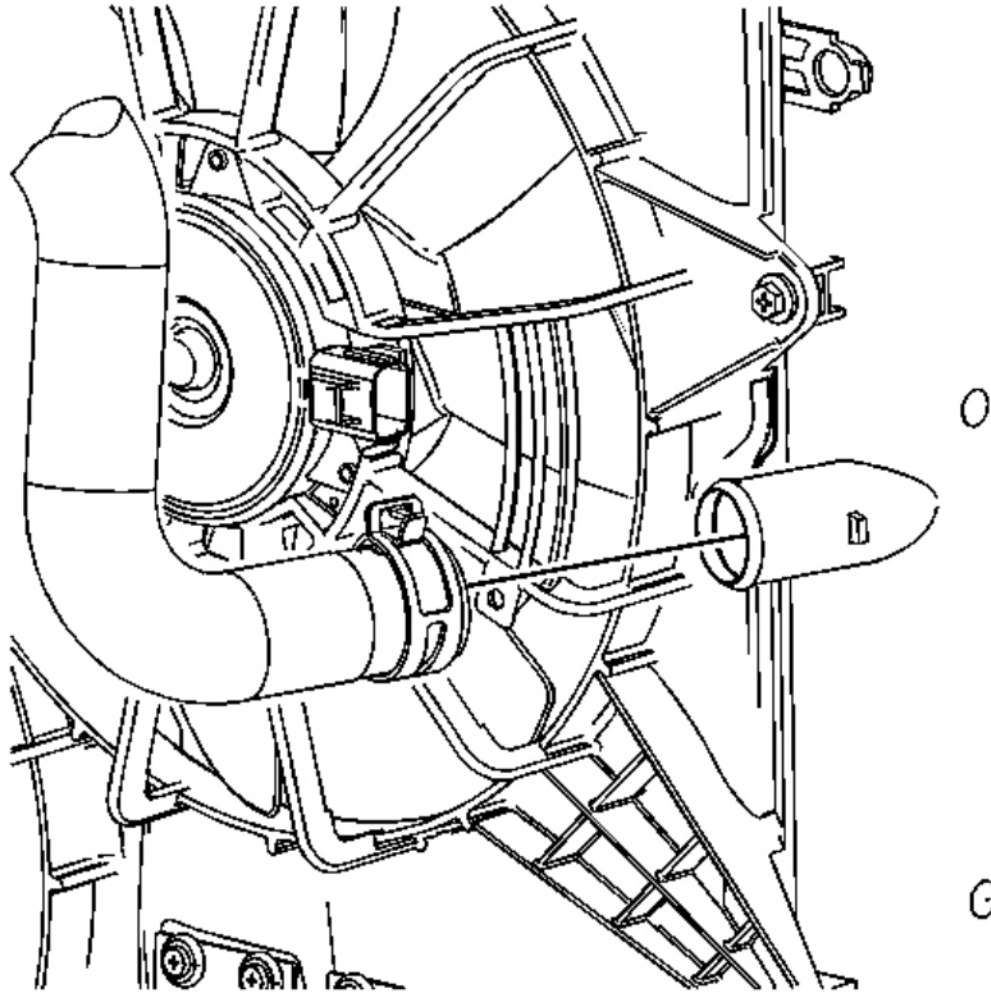


Fig. 144: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

13. Using the **J 38185** disengage tension on the radiator inlet hose clamp and disconnect from the radiator.
14. Using the **J 38185** disengage tension on the radiator outlet hose clamp and disconnect from the radiator.
15. Disconnect the side air baffle upper retainer pins from the radiator.
16. Remove the radiator.

Installation Procedure

1. Install the radiator.
2. Connect the side air baffle upper retainer pins to the radiator.
3. Connect the radiator outlet hose to the radiator and using the **J 38185** , position the radiator outlet hose clamp to secure the hose.

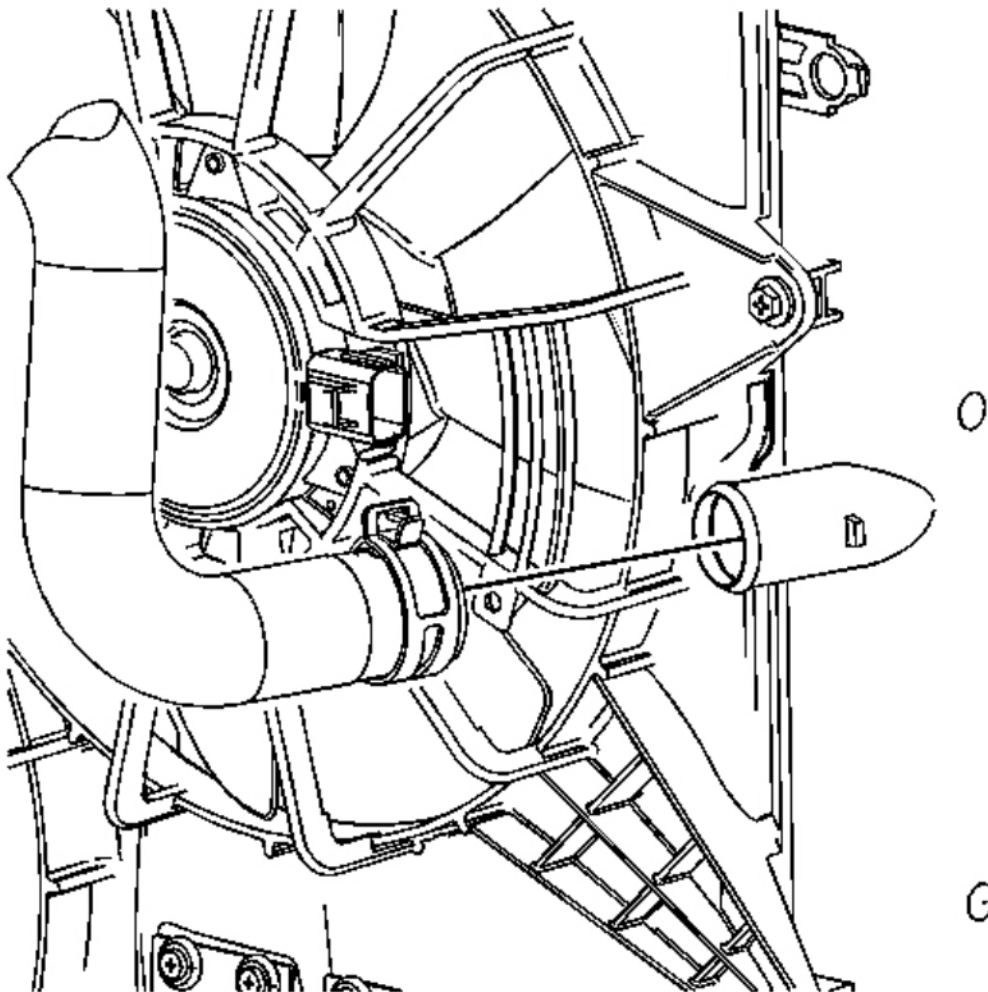


Fig. 145: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Connect the radiator inlet hose to the radiator and using the **J 38185** , position the radiator inlet hose clamp to secure the hose.

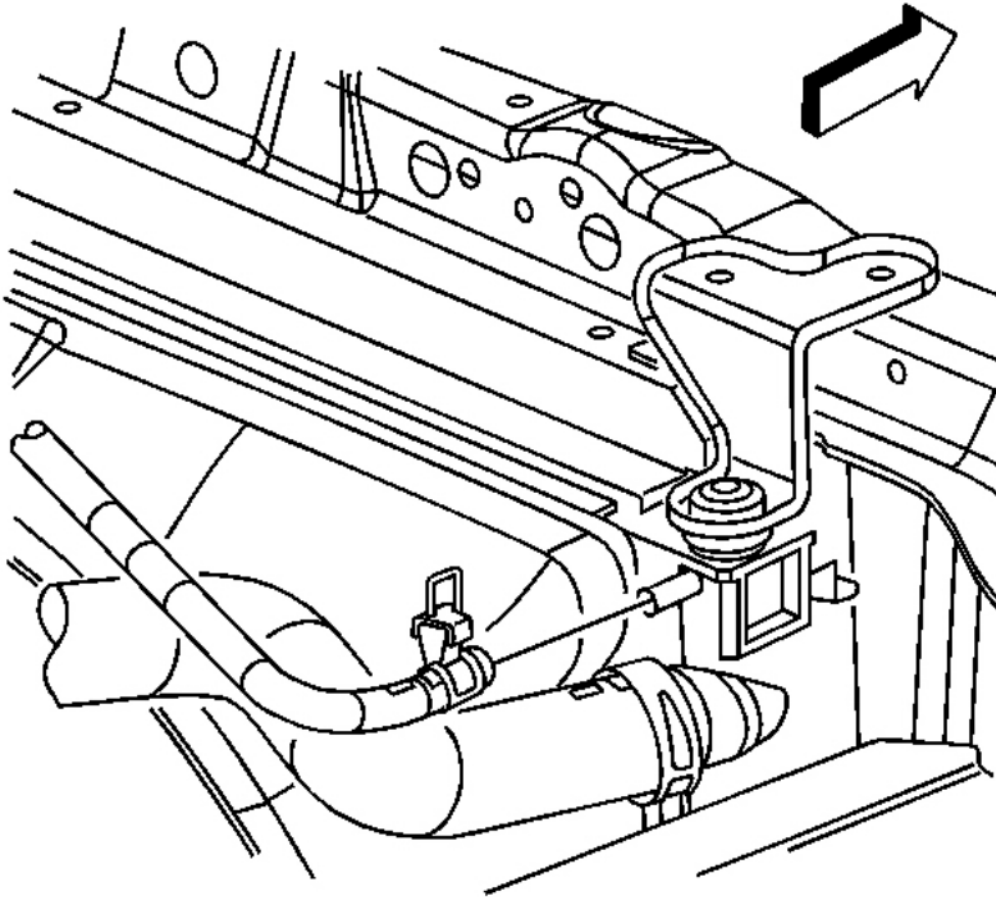


Fig. 146: Identifying Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank inlet hose to the radiator and using the **J 38185** , position the hose clamp to secure the hose.
6. Install the radiator/condenser upper support.
7. Install the radiator support brackets.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the radiator support bracket bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

9. Raise and support the vehicle.

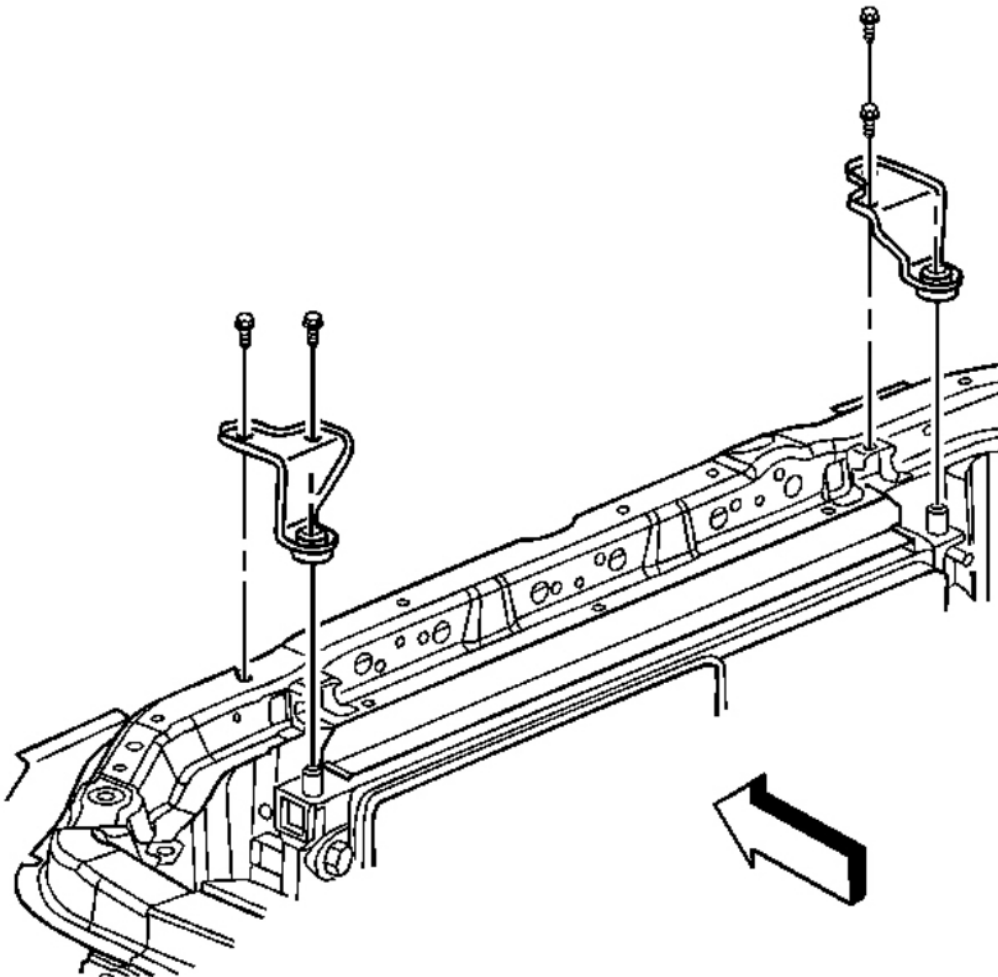


Fig. 147: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

10. Connect the side air baffle lower retainer pins to the radiator.

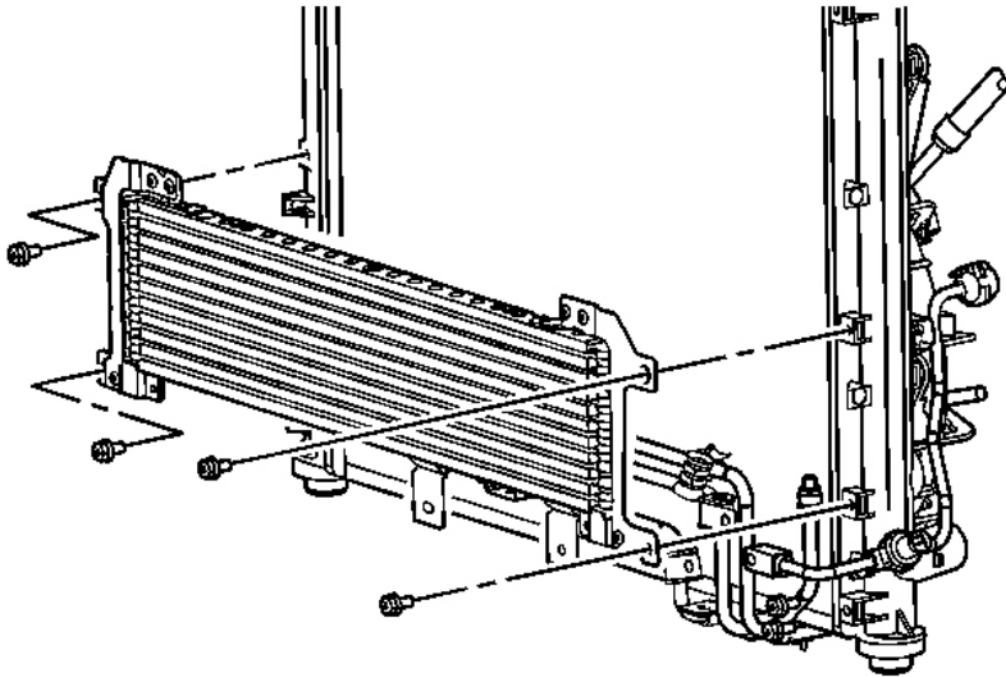


Fig. 148: View Of Transmission Oil Ccooler (TOC) Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the transmission oil cooler mounting bolts.

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

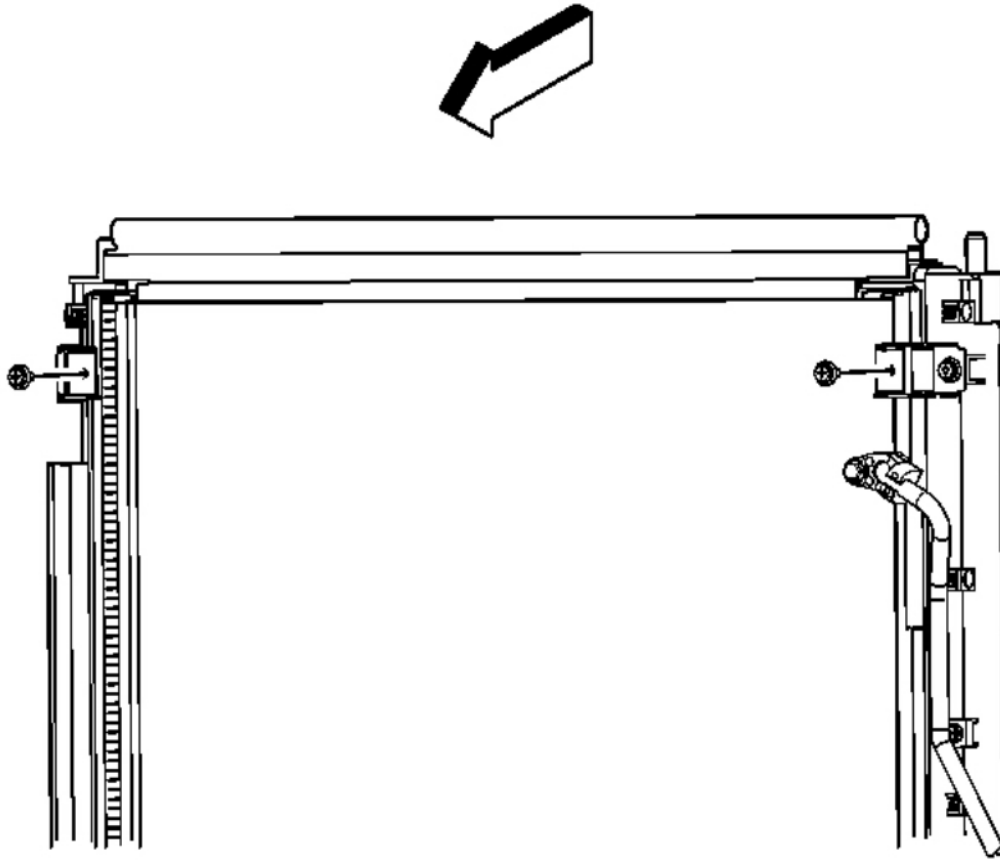


Fig. 149: Locating Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the upper condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

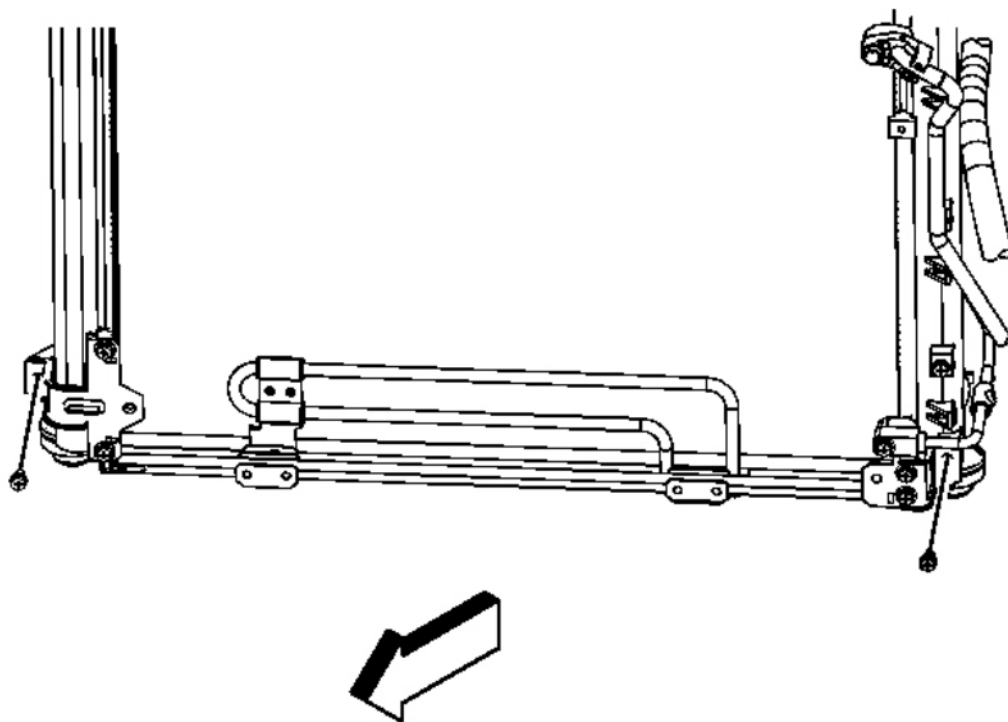


Fig. 150: View Of Condenser Lower Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the lower condenser mounting bolts.

Tighten: Tighten the bolts to 6.5 N.m (58 lb in).

14. Lower the vehicle.
15. Install the electric cooling fan assembly. Refer to **Cooling Fan Replacement - Electric (LH2 - Standard Cooling)** or **Cooling Fan Replacement - Electric (LH2 - Heavy Duty Cooling)** or **Cooling Fan Replacement - Electric (LY7)**.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR SUPPORT BRACKET REPLACEMENT

Removal Procedure

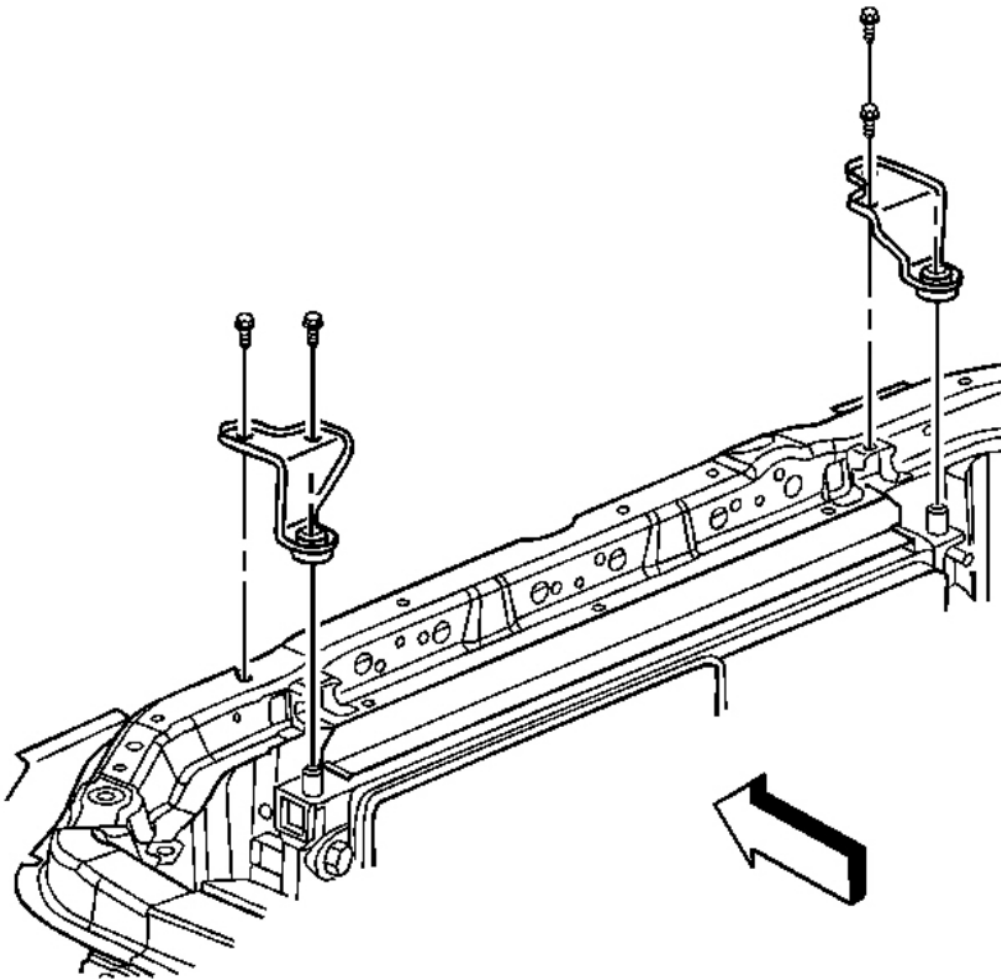


Fig. 151: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

1. Remove the radiator support bolts.
2. Remove the radiator support brackets.

Installation Procedure

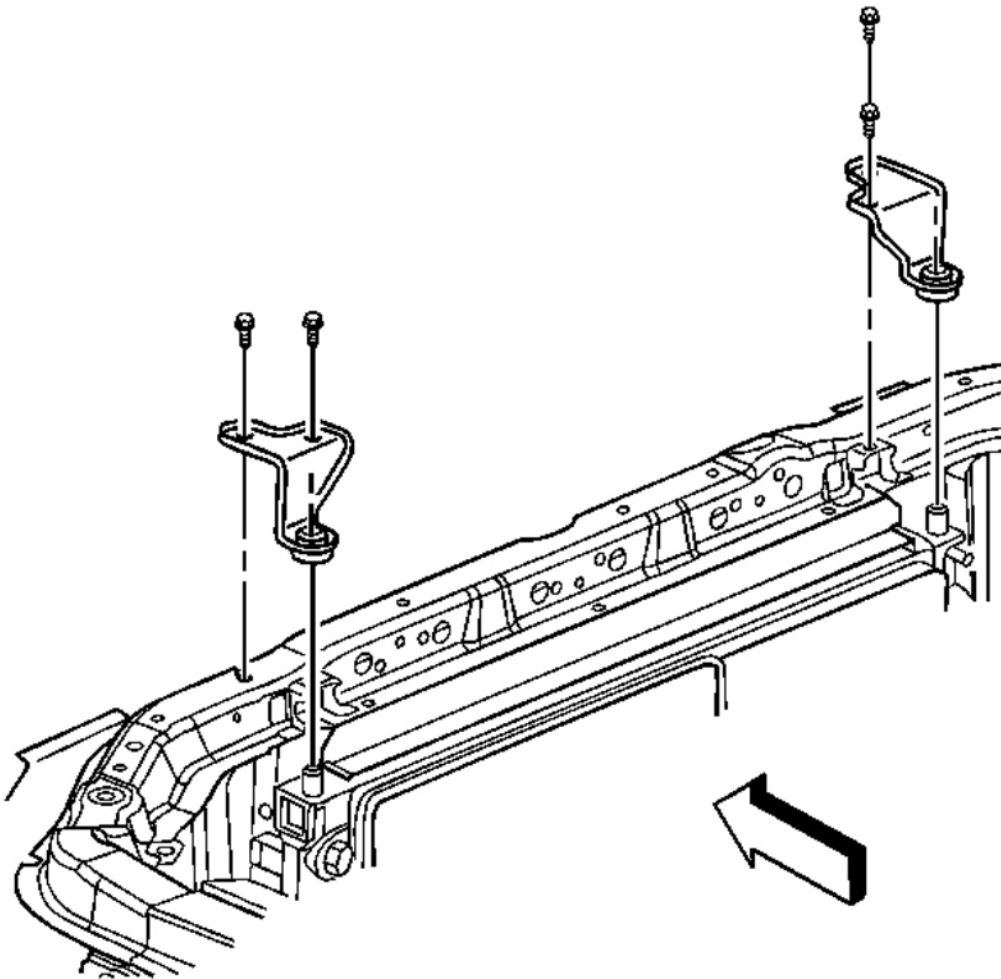


Fig. 152: View Of Radiator Support Brackets
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator support brackets.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the radiator support bolts.

Tighten: Tighten the bolts to 9 N.m (80 lb in).

COOLANT HEATER REPLACEMENT (LH2 (KO5))

Removal Procedure

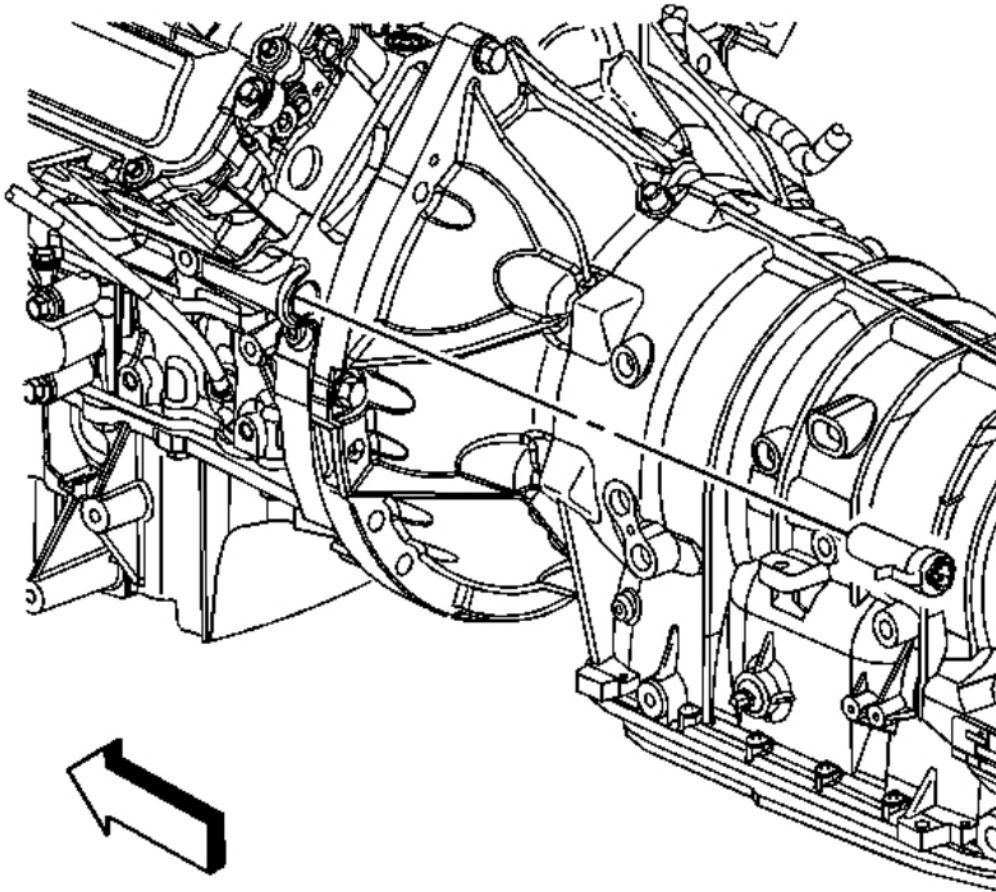


Fig. 153: View Of Coolant Heater - LH2 (KO5)
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect the coolant heater power supply cord from the coolant heater.
3. Complete the following in order to remove the coolant heater from the engine block:
 1. Pry outward on the retaining clip.

2. Pull the coolant heater from the engine block.

Installation Procedure

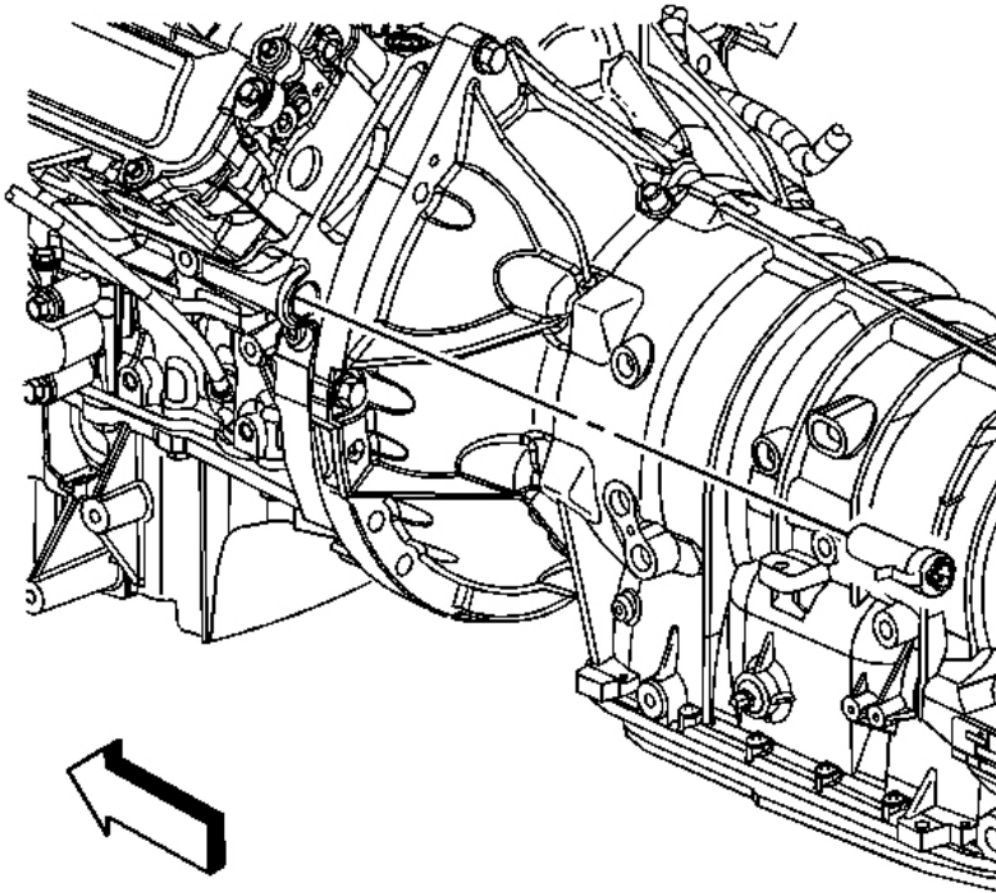


Fig. 154: View Of Coolant Heater - LH2 (K05)
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater into the engine block until the retaining clip is fully engaged.
2. Connect the coolant heater power cord to the coolant heater.
3. Lower the vehicle.

COOLANT HEATER REPLACEMENT (LH2 (KA3))

Removal Procedure

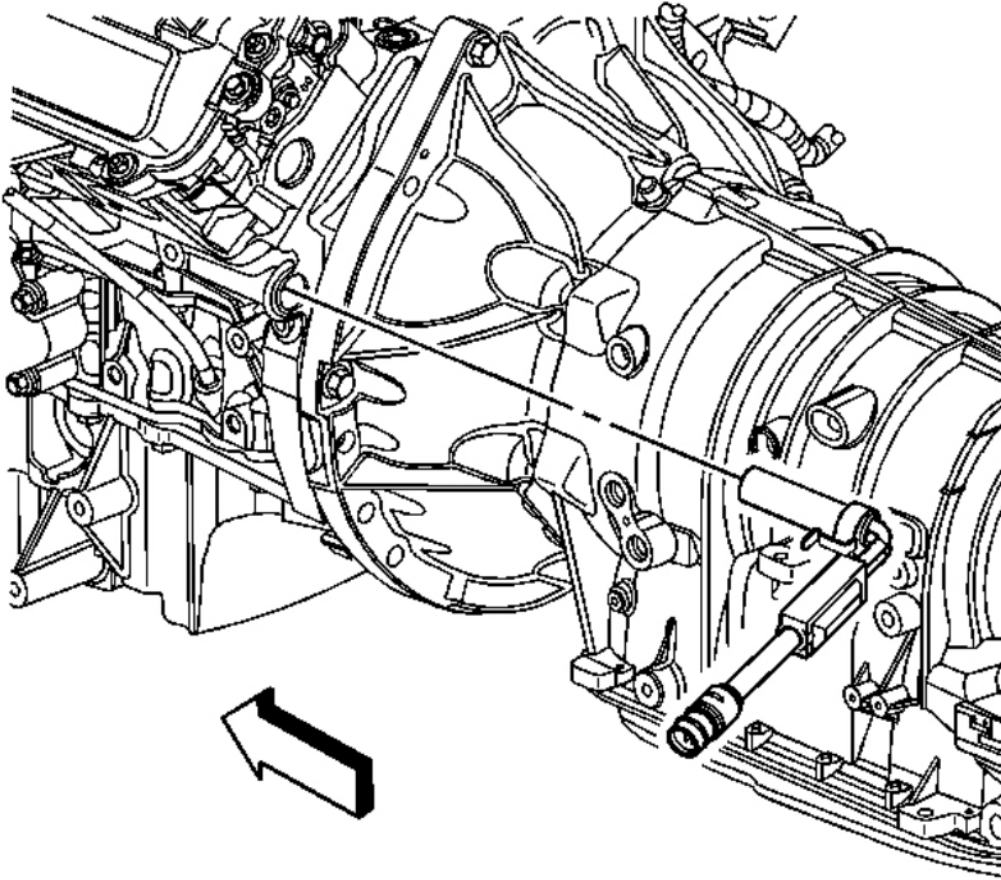


Fig. 155: View Of Coolant Heater - LH2 (KA3)
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect the coolant heater power supply cord from the coolant heater.
3. Complete the following in order to remove the coolant heater from the engine block:
 1. Pry outward on the retaining clip.
 2. Pull the coolant heater from the engine block.

Installation Procedure

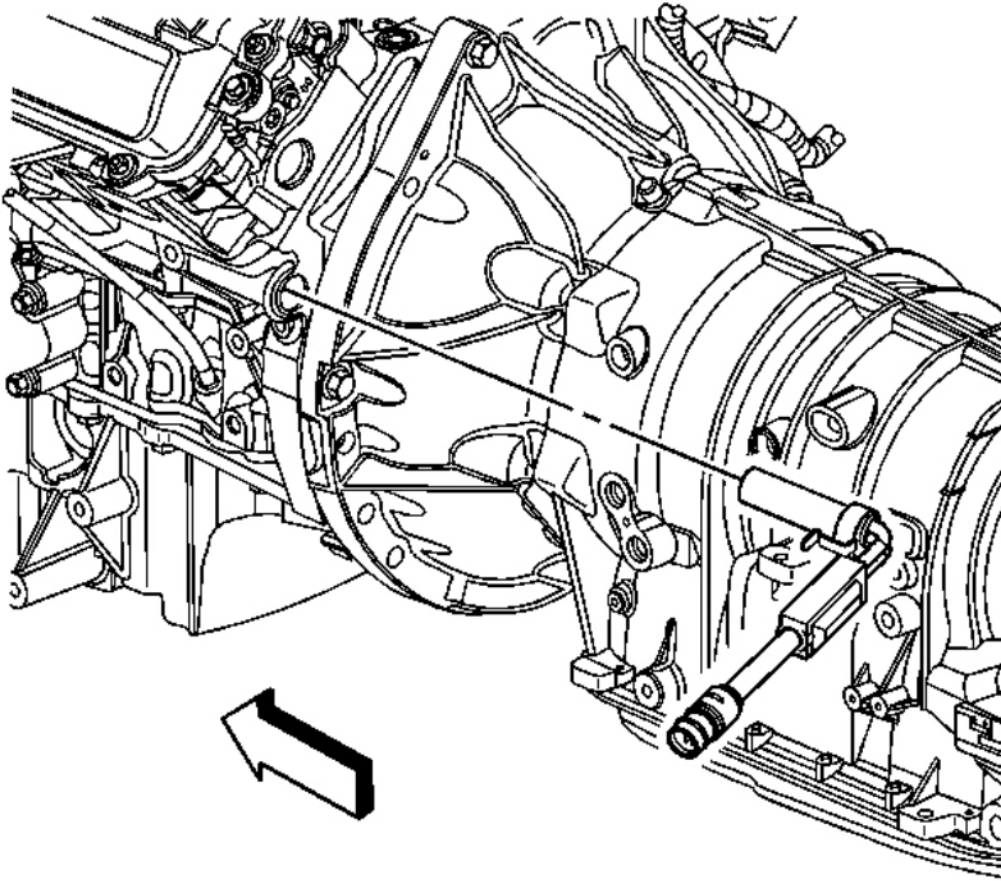


Fig. 156: View Of Coolant Heater - LH2 (KA3)
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater into the engine block until the retaining clip is fully engaged.
2. Connect the coolant heater power cord to the coolant heater.
3. Lower the vehicle.

COOLANT HEATER REPLACEMENT (LY7, KO5)

Removal Procedure

1. Turn the ignition OFF.
2. Raise and support the vehicle.

3. Disconnect the coolant heater cord from the coolant heater.

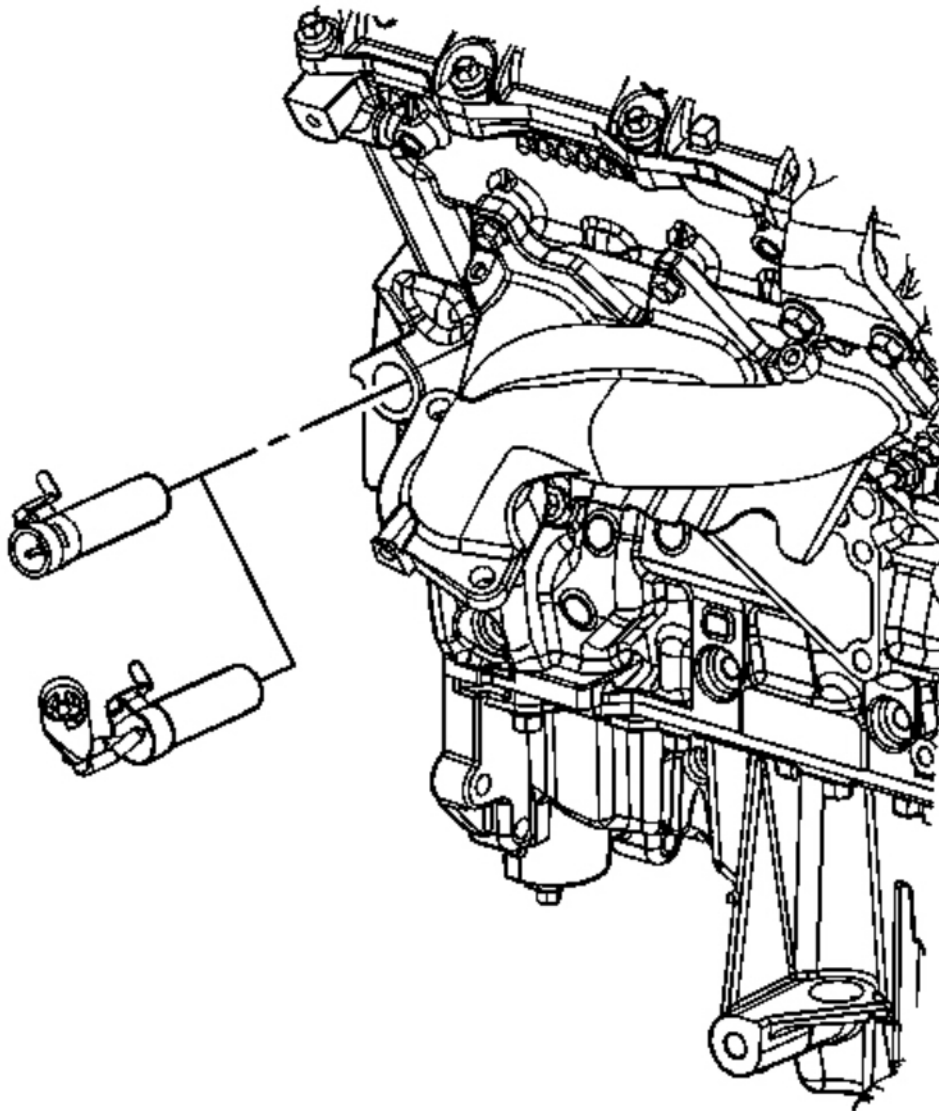


Fig. 157: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater.

Installation Procedure

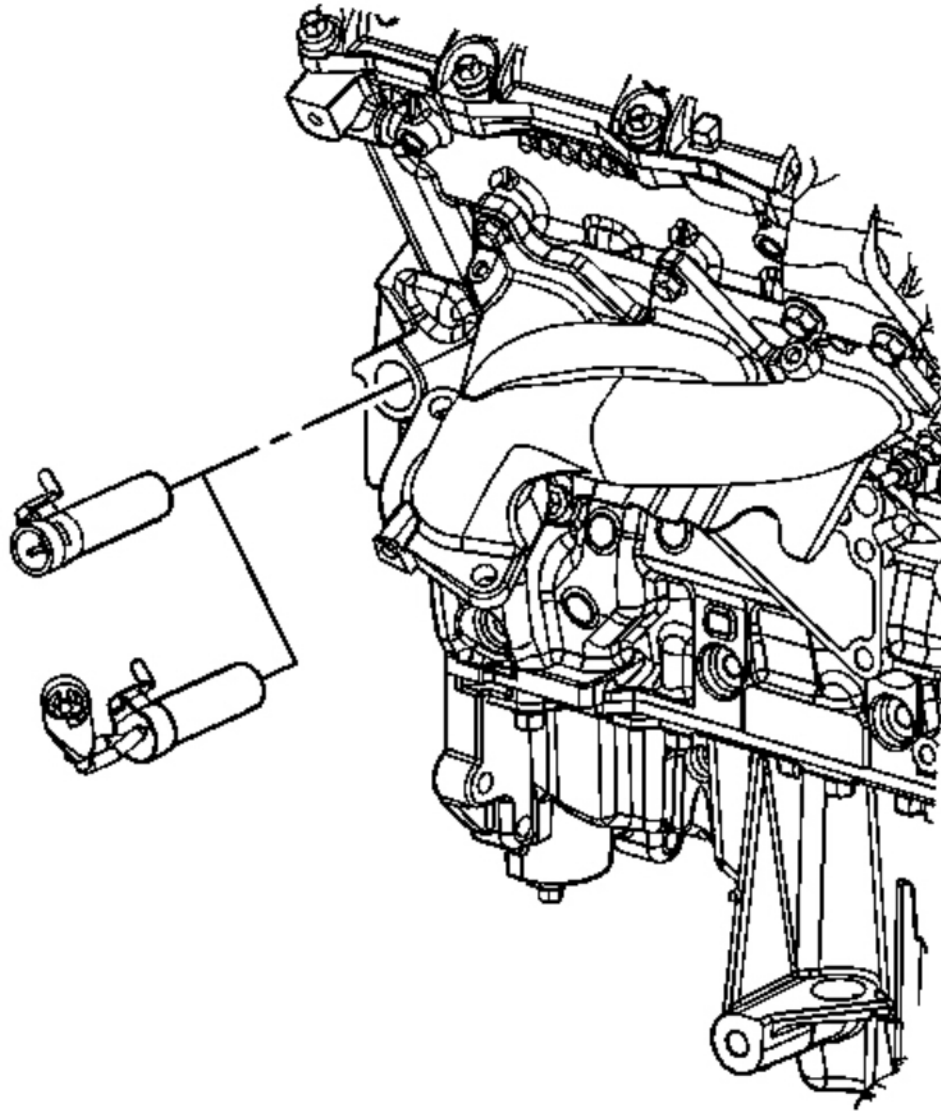


Fig. 158: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater.
2. Connect the coolant heater cord to the coolant heater.

3. Lower the vehicle.

COOLANT HEATER CORD REPLACEMENT (LH2 (K05,KA3))**Removal Procedure**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect the coolant heater power supply cord from the coolant heater.
3. Lower the vehicle.
4. Disconnect the coolant heater cord clips from the following:
 - The engine wiring harness conduit
 - The engine oil level indicator tube
5. Remove the coolant heater cord from the vehicle.

Installation Procedure

1. Position the coolant heater power supply cord to the engine.
2. Route the coolant heater cord along the engine wiring harness conduit.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Connect the coolant heater cord to the coolant heater.
5. Secure the coolant heater cord clip to the coolant heater cord.
6. Lower the vehicle.
7. Secure the coolant heater cord clips to the following:
 - The engine wiring harness conduit
 - The engine oil level indicator tube

COOLANT HEATER CORD REPLACEMENT (LY7 (K05))**Removal Procedure**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

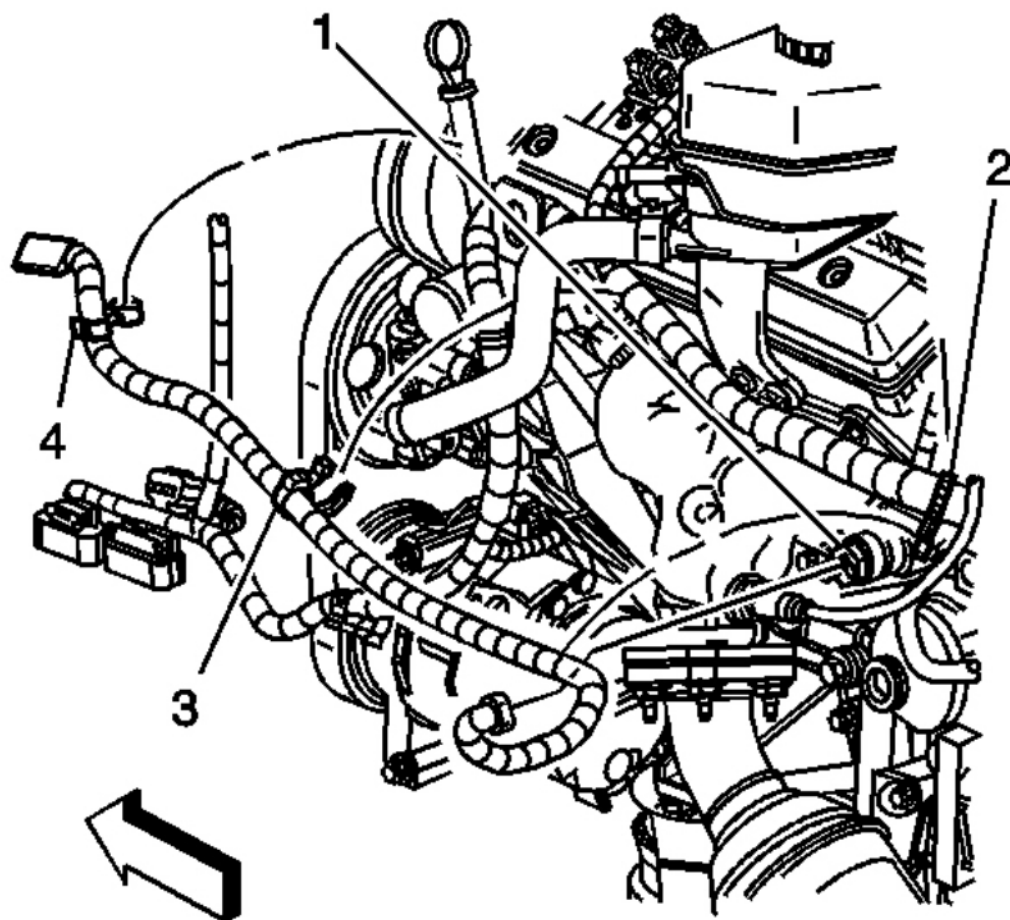


Fig. 159: View Of Coolant Heater Cord - LY7 (KO5)
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the coolant heater power supply cord from the coolant heater (1).
3. Disconnect the coolant heater cord clip (2) from the coolant heater cord.
4. Lower the vehicle.
5. Disconnect the coolant heater cord clips (3, 4) from the following:
 - The engine wiring harness conduit
 - The engine oil level indicator tube
6. Remove the coolant heater cord from the vehicle.

Installation Procedure

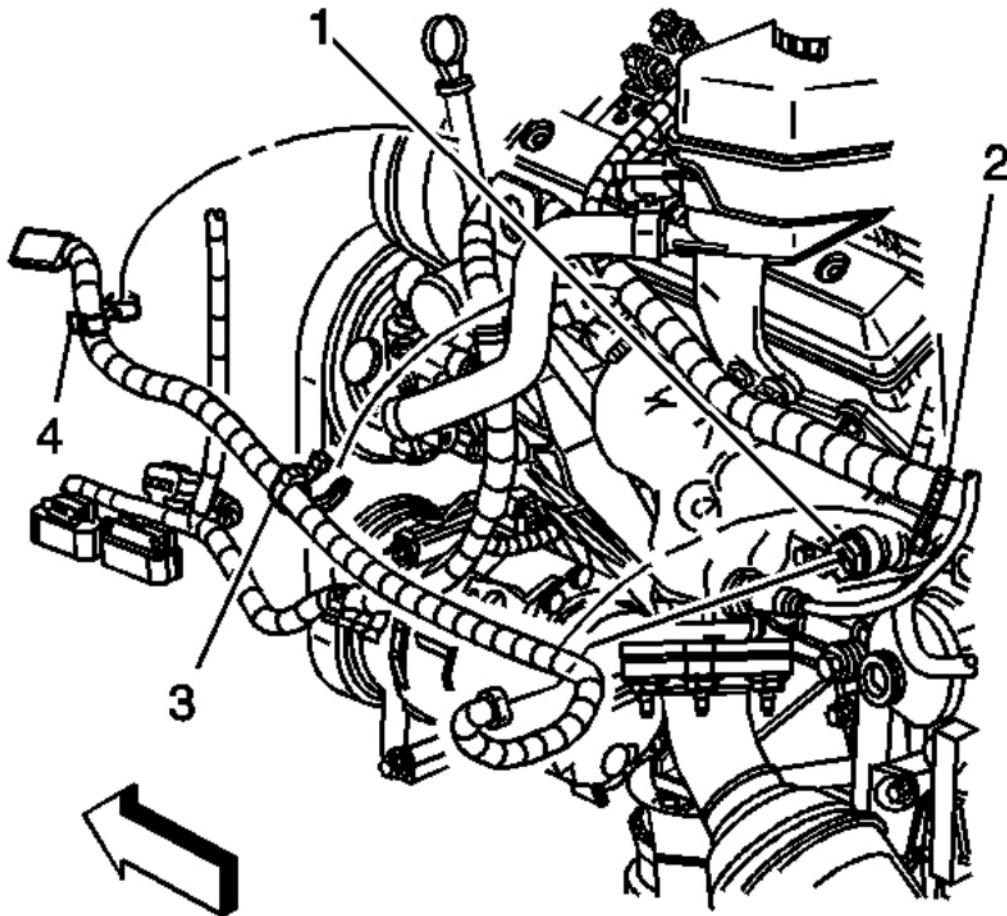


Fig. 160: View Of Coolant Heater Cord - LY7 (KO5)

Courtesy of GENERAL MOTORS CORP.

1. Position the coolant heater power supply cord to the engine.
2. Route the coolant heater cord along the engine wiring harness conduit.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Connect the coolant heater cord to the coolant heater (1).
5. Secure the coolant heater cord clip (2) to the coolant heater cord.

6. Lower the vehicle.
7. Secure the coolant heater cord clips (3, 4) to the following:
 - The engine wiring harness conduit
 - The engine oil level indicator tube

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control - Two Fan System

The engine cooling fan system consists of 2 puller type electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the engine control module (ECM) to operate both fans together at low or high speeds. The cooling fans and the fan relays receive battery positive voltage from the underhood fuse block. The ground path is provided at G104.

During low speed operation, the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts, and supplies battery positive voltage from the low fan fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan s/p relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. After a 3-second delay, the ECM supplies a ground path for the high speed fan relay and the cooling fan s/p relay through the high speed cooling fan relay control circuit. This energizes the cooling fan s/p relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the high speed fan relay coil is energized closing the relay contacts and provides battery positive voltage from the high fan fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have there own ground path. The result is a parallel circuit with both fans running at high speed.

The ECM commands the low speed cooling fans ON under the following conditions:

- Engine coolant temperature exceeds approximately 94.5° C (202° F).
- A/C refrigerant pressure exceeds 1447 kPa (210 psi).
- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 101° C (214° F) the low speed fans will run for a minimum of 60 seconds After 60 seconds,

if the coolant temperature drops below 101° C (214° F) the fans will shut OFF. The fans will automatically shut OFF after 3 minutes regardless of coolant temperature.

The ECM commands the high speed fans ON under the following conditions:

- Engine coolant temperature exceeds 104° C (220° F).
- A/C refrigerant pressure exceeds 1824 kPa (265 psi).
- When certain DTCs set.

At idle and very low vehicle speeds the cooling fans are only allowed to increase in speed if required. This insures idle stability by preventing the fans from cycling between high and low speed.

Cooling Fan Control - Three Fan System

The engine cooling fan system consists of a mechanical fan, 2 electrical pusher type cooling fans and 3 fan relays. The low speed, high speed, and S/P relays are arranged in a series/parallel configuration that allows the ECM to operate the left cooling fan and right cooling fan together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood fuse block. The ground path is provided at G104.

During low speed operation, the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the low speed fan relay coil, closes the relay contacts, and supplies battery positive voltage from the low fan fuse through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan S/P relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. After a 3-second delay, the ECM supplies a ground path for the high speed fan relay and the cooling fan S/P relay through the high speed cooling fan relay control circuit. This energizes the cooling fan S/P relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the high speed fan relay coil is energized closing the relay contacts and provides battery positive voltage from the high fan fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have there own ground path. The result is a parallel circuit with both fans running at high speed.

The ECM commands the low speed fans on under the following conditions:

- Engine coolant temperature exceeds 94.5° C (202° F).

- A/C refrigerant pressure exceeds 1447 kPa (210 psi).
- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 101° C (214° F) the low speed fans will run for a minimum of 60 seconds. After 60 seconds, if the coolant temperature drops below 101° C (214° F) the fans will shut OFF. The fans will automatically shut OFF after 4 minutes regardless of the coolant temperature.

The ECM commands the high speed fans ON under the following conditions:

- Engine coolant temperature exceeds 104° C (220° F).
- A/C refrigerant pressure exceeds 1824 kPa (265 psi).
- When certain DTCs set.

At idle and very low vehicle speeds the cooling fans are only allowed to increase in speed if required. This ensures idle stability by preventing the fans from cycling between high and low speed.

Engine Coolant

Engine coolant is the key element of the heating system. The engine thermostat controls the normal engine operating coolant temperature. Coolant pumped out of the engine block enters the heater core through the inlet heater hose. The air flowing through the HVAC module absorbs the heat of the coolant flowing through the heater core. The coolant then exits the heater core through the heater outlet hose. To prevent the coolant from boiling after the engine is turned off an after-boil/heater coolant pump is used.

The HVAC control module will command the after-boil/heater coolant pump on when the engine is off under the following conditions:

- The engine is OFF.
- The engine coolant temperature is greater than 101° C (214° F).

The above coolant flow circuits are designed to show the coolant flow related to the coolant bypass valve positions only. The thermostat function and thermostat coolant flow paths are not shown.

Coolant Warning Messages

The radio will display the following messages if the following conditions exist in the cooling system.

- Engine hot - A/C OFF, is displayed if the coolant temperature is greater than 117° C (243°

F) for domestic vehicles or 115° C (239° F) for imports.

- Engine coolant hot - idle engine, is displayed if the coolant temperature is greater than 118° C (245° F).
- Engine overheated - stop engine, is displayed if the coolant temperature is greater than 123° C (253° F).

Coolant Level Control

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the HVAC control module detects an open, or a high voltage level, on the coolant level indicator control circuit for at least 10 seconds, the control module sends a class 2 message to the radio requesting display of the low coolant level message. A 10-second delay occurs before the HVAC control module sends the class 2 message, to prevent the message from being displayed due to coolant sloshing in the surge tank.

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 system cools slowly or not at all. This allows the engine to warm quickly.

Cooling Cycle

The thermostat is located between the radiator outlet and the water pump inlet. At normal operating temperature, coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. In cold conditions, the thermostat will bypass the radiator, and the pump will draw coolant directly from the engine outlet.

Coolant is then pumped through 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.

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The coolant is then forced 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.

Coolant is also directed to the throttle body. There it circulates through passages in the casting. During initial warm-up, the coolant assists in warming the throttle body. During normal operating temperatures, the coolant assists in keeping the throttle body cool.

From the cylinder heads, the coolant is then forced to the engine outlet. Coolant leaves the engine through four different routes: 1) Through the engine outlet fitting to the radiator. This path is blocked at cold conditions by the thermostat at the engine inlet fitting. 2) Through the radiator bypass. 3) To the heater core for passenger compartment heat and defrost. 4) Through the vent hose to the surge tank, providing continuous direction of the cooling system.

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 clean drinkable 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 crossflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire core assembly is then brazed forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. 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 which is located in the bottom of the passenger side tank. The drain cock includes the drain cock and drain cock seal.

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

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. Coolant without bubbles absorbs heat much better than coolant with bubbles.

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Pressure Cap

The pressure cap is a cap that seals and pressurizes 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 and protects the radiator by relieving pressure if it exceeds 18 psi. 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, could cause the radiator hoses to collapse.

The pressure cap allows pressure in the cooling system to build up. As the pressure builds, the boiling point of the coolant goes up as well. Therefore, the coolant can be safely run at a temperature higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat moves from the radiator to the cooler passing air. However, if the pressure exceeds the strength of the spring, the pressure valve rises so that the excess pressure can escape. When 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 cooling system. This equalizes the pressure in the cooling system with atmospheric pressure, thus preventing the radiator hoses from collapsing.

Surge Tank

The surge tank is a plastic tank with a pressure cap mounted to it. 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 system cooling. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle to flow through the radiator and increase cooling. Air baffles are also used to direct airflow into the radiator and increase cooling. Air seals prevent air from bypassing the radiator and A/C condenser. Air seals also prevent recirculation of the 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 and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved

blades or vanes. When the impeller rotates, the coolant between the 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 drive belt.

Thermostat

The thermostat is a coolant flow control component. Its purpose is to regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a piston. When the element is heated, it expands and exerts pressure against a rubber diaphragm. 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 quickly. After the coolant temperature reaches 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, even 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.

Engine Oil Heat Exchanger

The engine oil heat exchanger is mounted to the top of the engine block, under the intake manifold flange. Oil is pumped through the oil cooler inlet pipe to the heat exchanger, back through the oil cooler outlet pipe, and then to the oil passages in the engine for lubrication. The exchanger provides the following 2 functions:

- Engine coolant warms up faster than the engine oil. During cold operation, the coolant warms the oil and provides better flow during cold engine operation.
- After the engine reaches normal operating temperature, the engine oil temperature will exceed the engine coolant temperature. The coolant flowing through the engine oil cooler will absorb heat from the engine oil. Cooling the engine oil extends oil life and helps reduce internal engine wear.

Transmission Oil Cooler-Two Fan System

NOTE: The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission, and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

The transmission oil cooler is a heat exchanger located in the bottom tank of the radiator. The transmission oil temperature is regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the cooler and back to the transmission.

Transmission Oil Cooler-Three Fan System

NOTE: The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission, and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

There are 2 transmission oil coolers in a series in the heavy duty transmission oil cooler system. The initial transmission oil cooler is a heat exchanger located in the bottom tank of the radiator. The transmission oil temperature is partially regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the cooler. The oil out of the cooler is plumbed to an air-to-oil cooler in front of the A/C condenser. This cooler provides additional cooling for heavy duty trailering. The transmission oil is then directed back to the transmission.

Transmission Oil Cooler Lines

NOTE: The transmission oil cooler system uses quick connect fittings throughout the system. Use a special tool to disconnect these quick connect fittings. Removing the transmission oil cooler lines without this tool will result in damage to the radiator, the transmission, and the transmission oil cooler caused by mixing the transmission oil and coolant or due to transmission oil loss.

The transmission oil cooler lines use quick connect fittings on the transmission oil cooler lines near the A/C compressor. The quick connect fittings must be removed using a special tool. The

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transmission oil cooler is an oil-to-air heat exchanger located between the A/C condenser and the radiator. The transmission oil temperature is regulated by the temperature of the air leaving the A/C condenser and passing over the heat exchanger. Lines from the transmission bring oil pumped at a high pressure to the cooler and back to the transmission. A thermal bypass valve is located external to the transmission where the transmission oil cooler lines connect to the transmission. This provides uninterrupted transmission oil flow for low ambient temperature conditions.

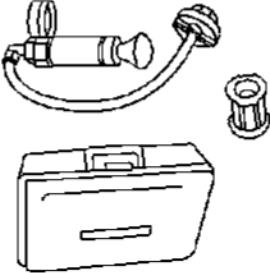
Power Steering Oil Cooler

Some vehicles are equipped with a power steering oil cooler located either between the radiator and condenser (Heavy Duty) or in front of the engine. This cooler transfers heat from the power steering system to the air passing through the condenser and radiator. The cooler uses constant tension clamps on the hose connections to the cooler.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Special Tools

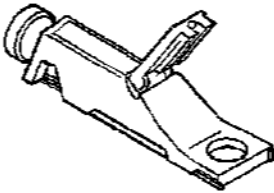
Illustration	Tool Number / Description
	J 24460-01 Cooling System Pressure Tester
	J 24731 Tempilstick 188

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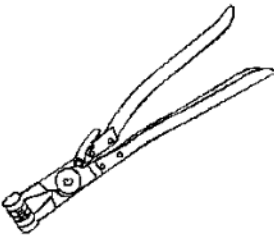
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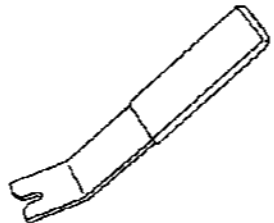
J 24731
Tempilstick 206



J 26568
Coolant and Battery Fluid Tester



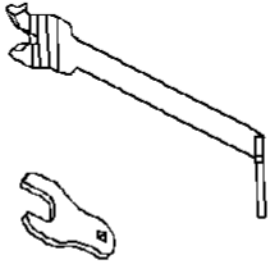
J 38185
Hose Clamp Pliers



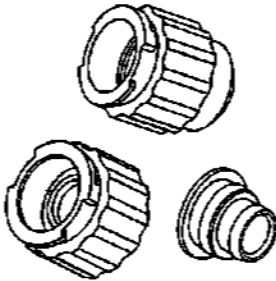
J 38778
Door Trim Pad Clip Remover

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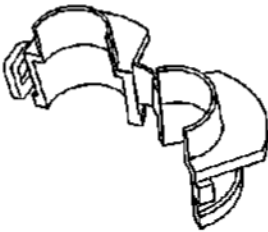
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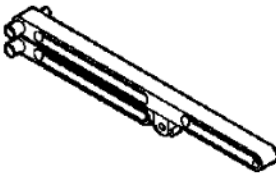
J 41240
Fan Clutch Remover and Installer



J 42401
Radiator Cap / Surge Tank Test Adapter



J 44827
Transmission Cooler Quick Disconnect



EN 46104
Water Pump Pulley Holding Tool