

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

2006 ENGINE

Engine Cooling - CTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

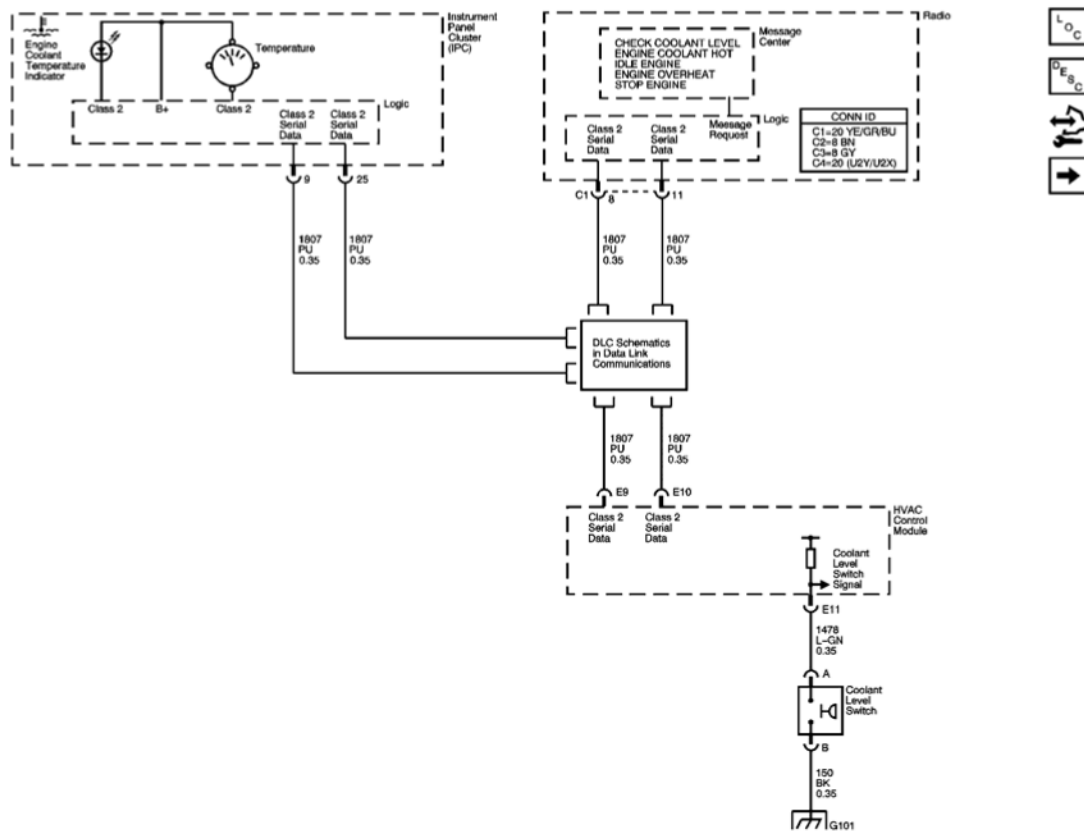
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning (A/C) Condenser Mounting Bolts	5.4 N.m	47 lb in
Auxiliary Cooling Fan to Condenser Bolts	5.4 N.m	47 lb in
Electric Cooling Fan Blade Nut	6.3 N.m	56 lb in
Electric Cooling Fan Motor Screws	3.9 N.m	35 lb in
Electric Cooling Fan Shroud to Radiator Bolts	5.4 N.m	47 lb in
Radiator Support Bracket Bolt	9 N.m	80 lb in
Surge Tank Bolt	9 N.m	80 lb in
Surge Tank Nut	9 N.m	80 lb in
Surge Tank Outlet Pipe Bracket to Cowl Nut (LS2)	9 N.m	80 lb in
Surge Tank Outlet Pipe Bracket to Engine Bolt (LP1, LY7)	50 N.m	37 lb ft

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

2006 ENGINE Engine Cooling - CTS



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2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

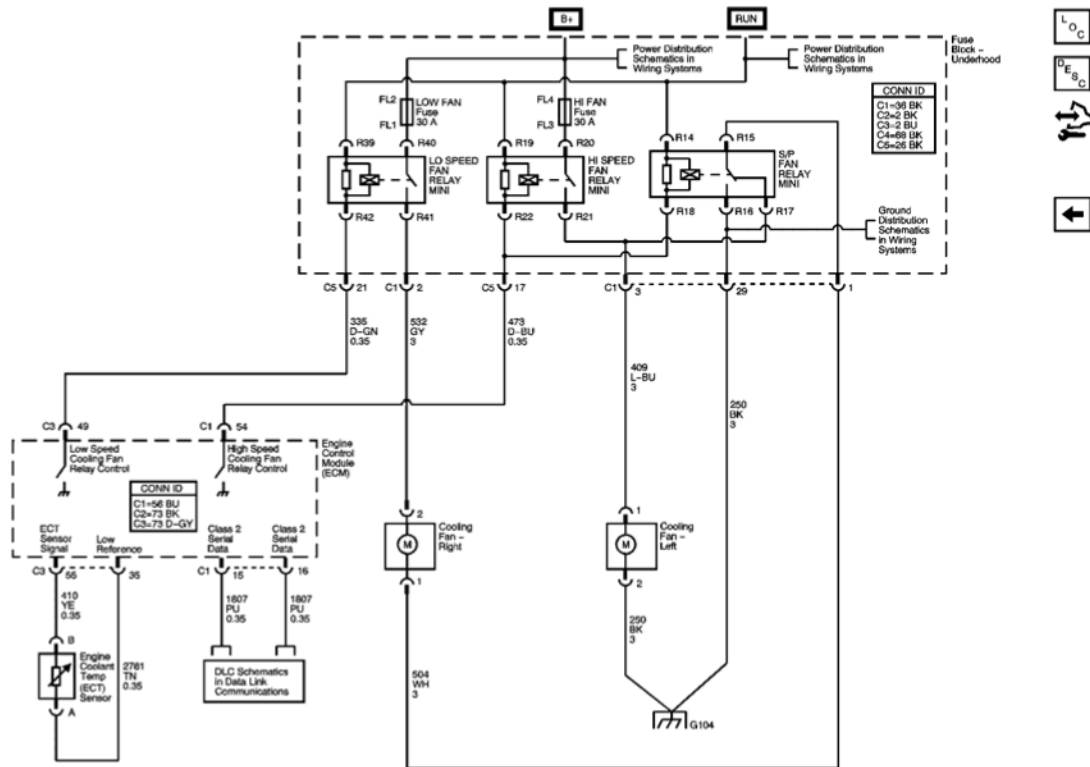


Fig. 3: Cooling Fans - 6.0L (LS2)

Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

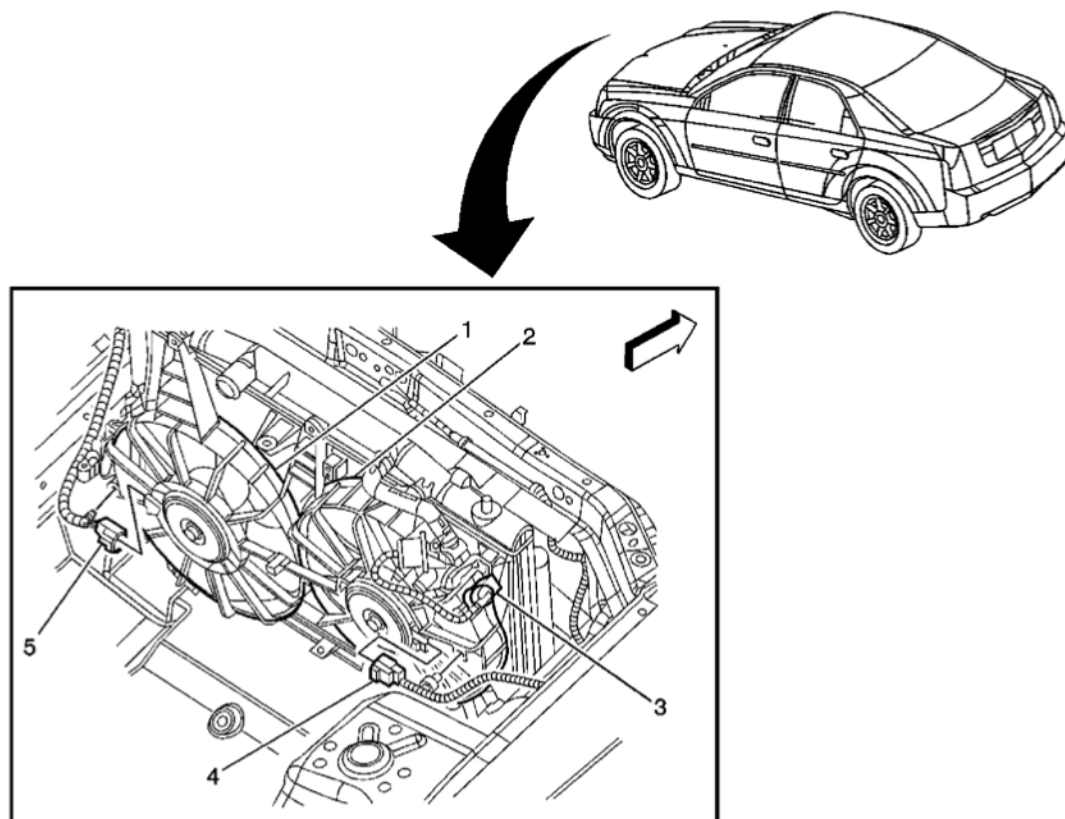


Fig. 4: Cooling Fans

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Cooling Fan - Left
2	Cooling Fan - Right
3	Cooling Fan - Right Connector (LS6)
4	Cooling Fan - Right Connector
5	Cooling Fan - Left Connector

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

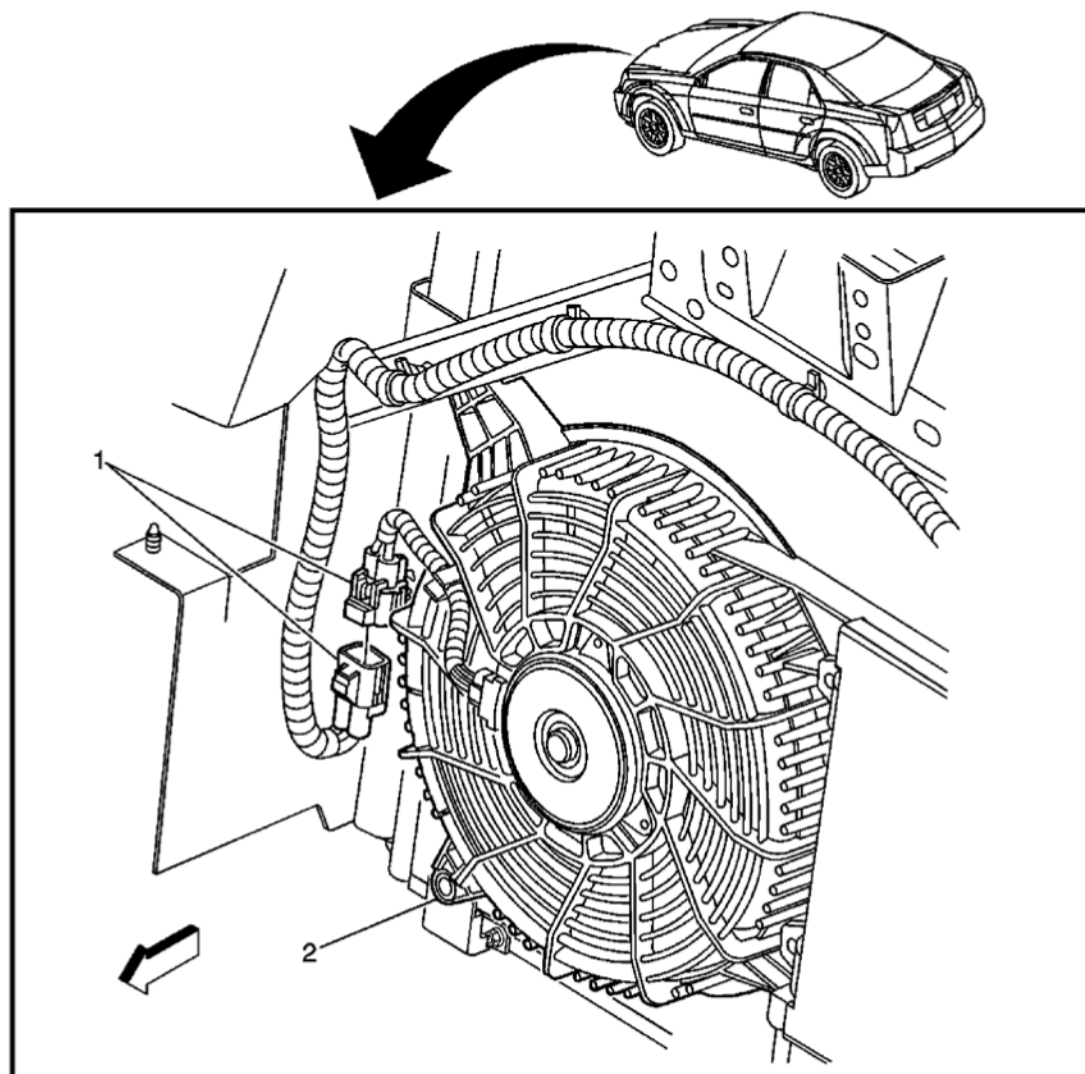


Fig. 5: Cooling Fan Component View - Auxiliary (Export w/V92)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Cooling Fan - Auxiliary Connector
2	Cooling Fan - Auxiliary

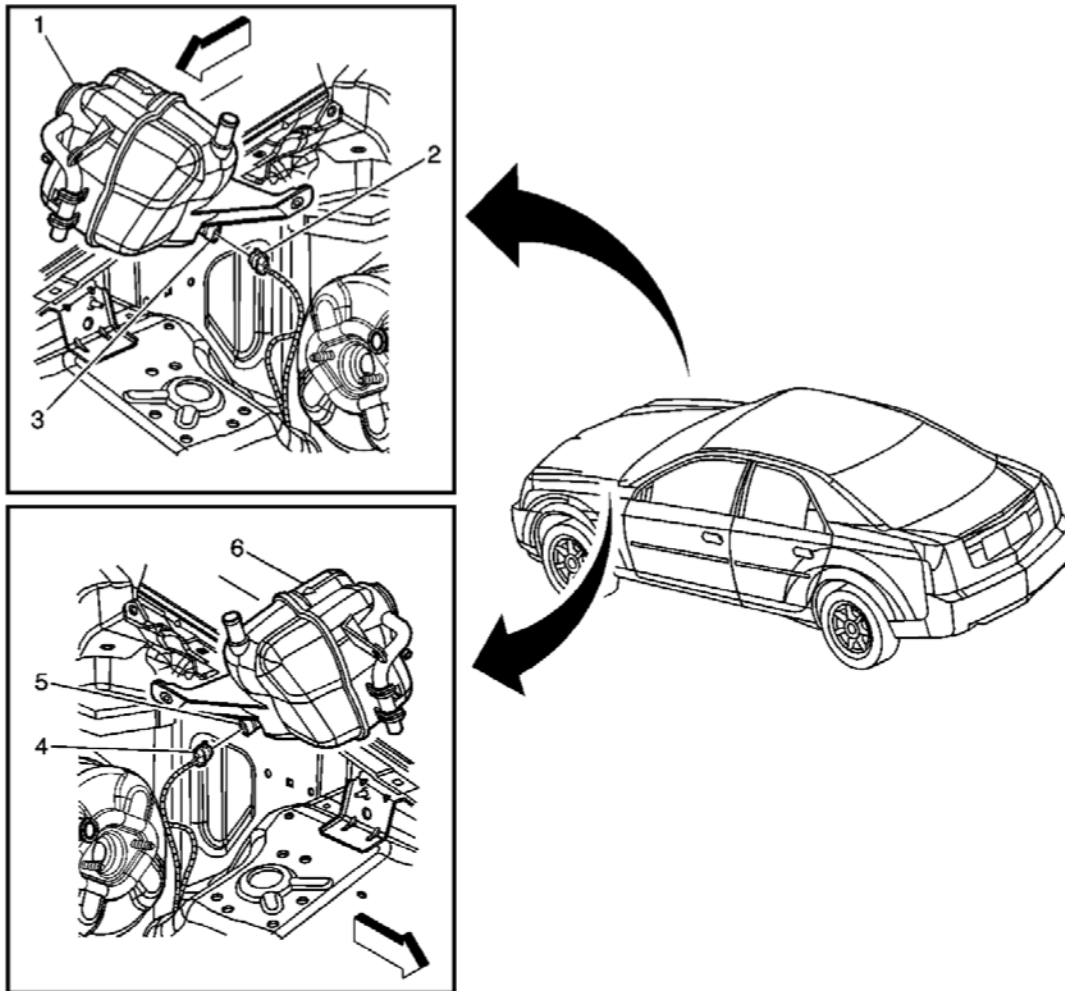


Fig. 6: Coolant Surge Tank Components View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

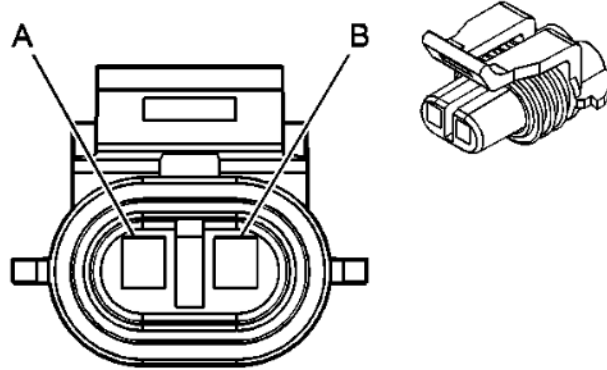
Callout	Component Name
1	Coolant Surge Tank (RHD)
2	Coolant Level Switch Connector (RHD)
3	Coolant Level Switch (RHD)
4	Coolant Level Switch Connector (LHD)
5	Coolant Level Switch (LHD)
6	Coolant Surge Tank (LHD)

COOLING SYSTEM CONNECTOR END VIEWS

Coolant Level Switch

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

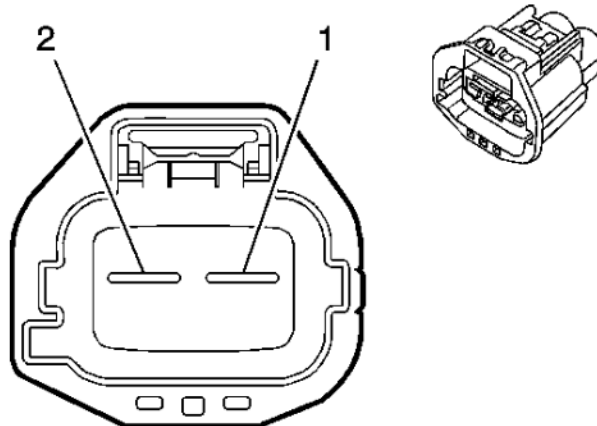


Connector Part Information

- 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 - Left

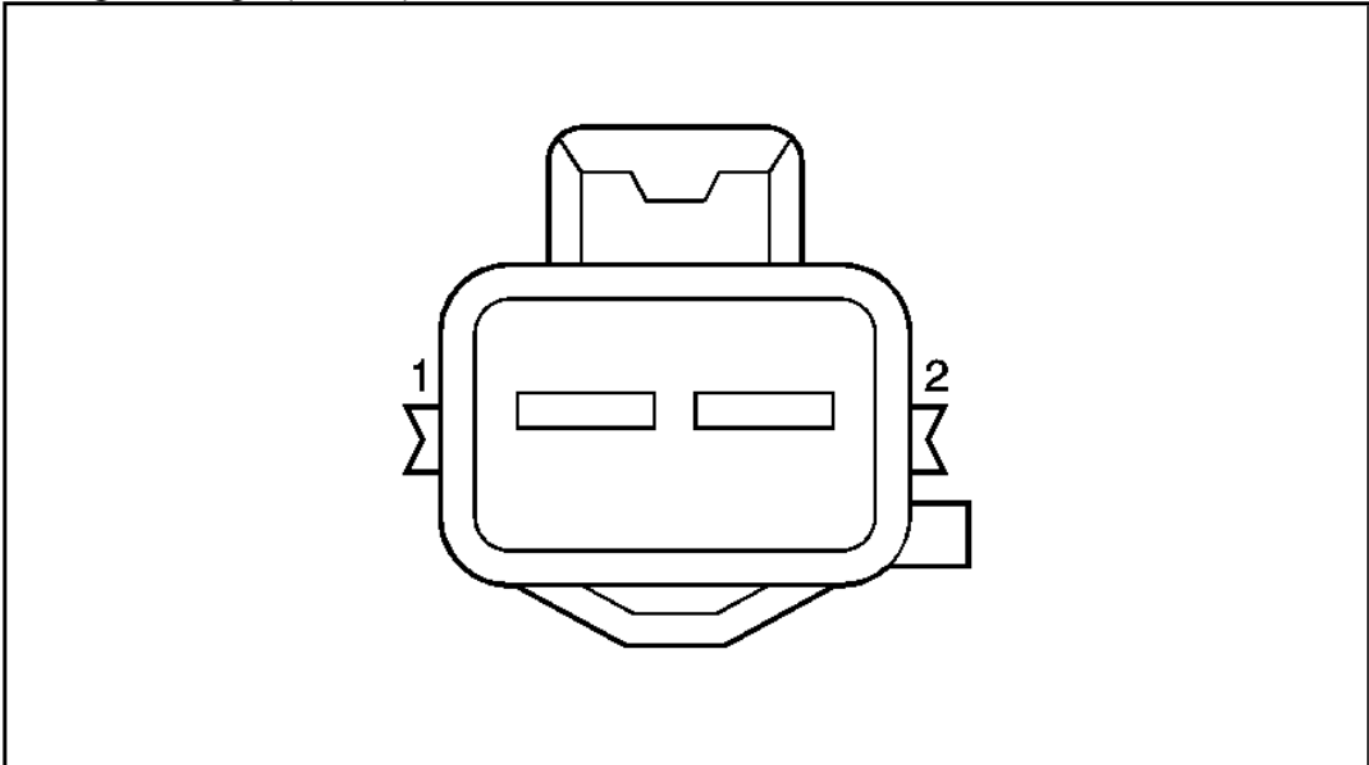


Connector Part Information

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

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

Cooling Fan - Right (w/o V92)



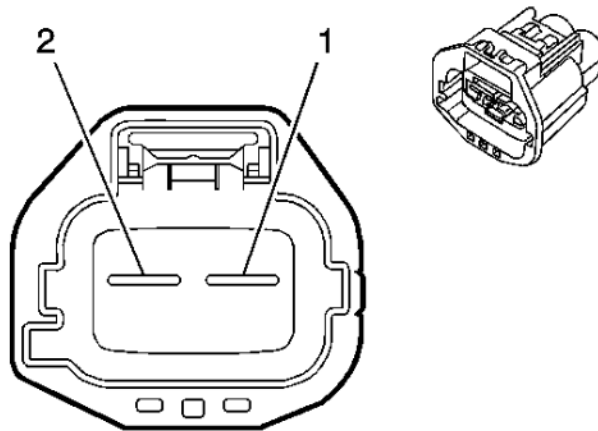
Connector Part Information		• 7282-5596-10 • 2-Way M 6.3 Series Weather Pack (GY)	
Pin	Wire Color	Circuit No.	Function
1	WH	504	Cooling Fan Low Reference
2	GY	532	Cooling Fan Motor Supply Voltage

Cooling Fan - Right (V92)



2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

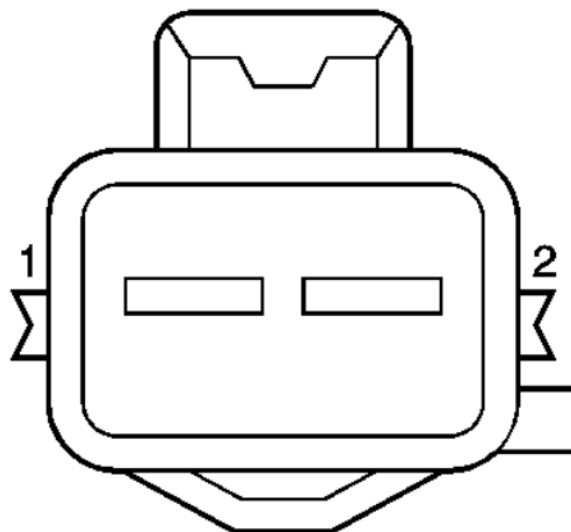


Connector Part Information

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

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

Cooling Fan - Auxiliary (V92)



2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

Connector Part Information		• 7282-5596-10 • 2-Way M 6.3 Series Weather Pack (GY)	
Pin	Wire Color	Circuit No.	Function
1	BK	250	Ground
2	YE	5358	Auxiliary Cooling Fan Motor Supply Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	** MULTIPLE VALUES **
<u>DTC P1258</u>	Engine Coolant Overtemperature-Protection Mode Active

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. 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.

SCAN TOOL OUTPUT CONTROLS

Engine Control Module (ECM) Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Aux Cooling Fan, Export vehicles only	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 auxiliary cooling fan relay, manually turning the auxiliary cooling fan On and Off.
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.
		The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the PCM to

2006 Cadillac CTS**2006 ENGINE Engine Cooling - CTS**

Fan Relays 1, 2 and 3	Fan Relays	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.
Fan Relays 2 and 3	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 2 relay and the cooling fan 3 relay. This turns On the left cooling fan only to high speed.

HVAC Control Module Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Display(s) Test	Output Control	the scan tool displays a Commanded State of None, Off, or On. This allows you to communicate with the Instrument Panel Cluster (IPC) and manually turn all segments and LEDs of the IPC On or Off.
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 afterboil relay, manually turning the afterboil 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
Commanded Cooling Fan	Engine Data 2, Engine Data 3	OFF/Level 1/Level 2/Level 3	varies
ECT	Engine Data 1, Engine Data 2, Engine Data 3, EVAP Data, Fuel Trim Data, HVAC System Data	°C/°F	varies
FC Relay 1 Command	Engine Data 2, Engine Data 3	On/Off	varies
FC Relay 2 and 3 Command	Engine Data 2, Engine Data 3	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 ECM will request low speed cooling fan operation, in conjunction with the afterboil 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 afterboil 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

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

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

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.

- Cooling fan relay 1 control circuit refers to the low speed cooling fan relay
- Cooling fan relay 2 control circuit refers to the high speed cooling fan relay

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0480 Cooling Fan Relay 1 Control Circuit
- DTC P0481 Cooling Fan Relay 2 Control Circuit
- DTC P0691 Cooling Fan Relay 1 Control Circuit Low Voltage
- DTC P0692 Cooling Fan Relay 1 Control Circuit High Voltage
- DTC P0693 Cooling Fan Relay 2 Control Circuit Low Voltage
- DTC P0694 Cooling Fan Relay 2 Control Circuit High Voltage

Conditions for Running the DTC

- The ignition voltage is between 8-18 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.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

- 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

- 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 Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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. 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		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	command?	Go to Step 14	Go to Step 8
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 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
15	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	Go to Step 20

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

16	Repair the ignition 3 voltage circuit for an open or high resistance. Refer to Wiring Repairs 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	Replace the ECM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. 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 engine coolant temperature (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 groups of cylinders, the ECM is able to reduce the temperature of the coolant.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1258 Engine Coolant Overtemperature-Protection Mode Active

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

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

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The ECM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The ECM will alternately disable 2 groups of 4 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 Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	Inspect the engine cooling fans for proper operation. Are the engine cooling fans operative?	Go to <u>Engine Overheating (LP1, LY7)</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.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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 Inoperative - Auxiliary
- Cooling Fan Always On
- Cooling Fan Always On - Auxiliary
- Engine Overheating (LP1, LY7)
- Loss of Coolant (w/Manual Transmission) or Loss of Coolant (w/Automatic Transmission)
- Thermostat Diagnosis (LP1, LY7) or 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: <u>Engine Cooling Schematics</u> Connector End View Reference: <u>Cooling System Connector End Views</u> DEFINITION: The check coolant level display is always on when the key is in the ON position.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Turn ON the ignition, 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>
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
	Connect a 3-amp fused jumper wire from the coolant		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

4	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
6	Repair the open or high resistance in the 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 (LP1, LY7)</u> or <u>Surge Tank Replacement (LS6)</u> . Did you complete the replacement?	Go to Step 11	-
10	Replace the HVAC control module. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. 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 Diagnostic System Check - Vehicle?	Go to Step 2	Go To <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	Turn ON the ignition, with the engine OFF.		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	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.	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.	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

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 Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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 Testing for Intermittent Conditions and Poor Connections 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 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.	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,		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	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
10	Inspect the cooling fan motor supply voltage circuit for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. 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
	Inspect for poor connections at the harness connector		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

17	of the right cooling fan. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 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 Motor Replacement - Electric</u> . Did you complete the replacement?	Go to Step 25	-
24	Replace the left cooling fan. Refer to <u>Cooling Fan Motor Replacement - Electric</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

COOLING FAN ALWAYS ON - AUXILIARY

Cooling Fan Always On - Auxiliary

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u> Connector End View Reference: <u>Cooling System Connector End Views</u> DEFINITION: The auxiliary cooling fan is always ON.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	Is the auxiliary cooling fan always ON?	Go to Step 3	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems
	Disconnect the pusher cooling fan relay located in the		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

3	left rear fuse block. Does the auxiliary cooling fan turn OFF?	Go to Step 5	Go to Step 4
4	Repair the short to voltage in the auxiliary cooling fan motor supply voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 11	-
5	Probe the control circuit of the auxiliary fan relay with a test lamp connected to battery positive voltage. Does the test lamp illuminate?	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the pusher cooling 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 11	Go to Step 9
7	Inspect the auxiliary cooling fan relay control circuit for a short to ground. Did you find and correct the condition?	Go to Step 11	Go to Step 7
8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 11	Go to Step 10
9	Replace the pusher cooling fan relay. Did you complete the replacement?	Go to Step 11	-
10	Replace the ECM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup and programming. Did you complete the replacement?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

COOLING FAN INOPERATIVE - AUXILIARY

Cooling Fan Inoperative - Auxiliary

Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u> Connector End View Reference: <u>Cooling System Connector End Views</u> DEFINITION: The auxiliary cooling fan is inoperative.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF.		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

2	3. With a scan tool, command the auxiliary cooling fan ON and OFF. Does the auxiliary cooling fan turn ON and OFF with each command?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 3
3	1. Disconnect the pusher fan relay. 2. Install a jumper wire between the battery positive voltage circuit and the auxiliary cooling fan motor supply voltage circuit on the switch side of the pusher fan relay. Does the fan operate?	Go to Step 7	Go to Step 4
4	Did the fuse open when the jumper was installed?	Go to Step 5	Go to Step 6
5	Inspect the auxiliary cooling fan supply voltage circuit 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 19	Go to Step 15
6	1. With the jumper wire still in place, unplug the auxiliary cooling fan. 2. With a test lamp connected to a good ground probe the auxiliary cooling fan motor supply voltage circuit at the pusher relay. Does the test lamp illuminate?	Go to Step 19	Go to Step 12
7	With a test lamp connected to a good ground probe the battery positive voltage circuits at the pusher relay. Does the test lamp illuminate?	Go to Step 8	Go to Step 9
8	1. With a test lamp connected to battery positive, probe the auxiliary cooling fan relay control circuit at the pusher relay. 2. With a scan tool command the auxiliary cooling fan ON. Does the test lamp illuminate?	Go to Step 13	Go to Step 10
9	Repair the battery positive voltage circuit of the auxiliary fan relay for a short to ground or 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 19	-
10	Inspect the control circuit of the auxiliary fan relay 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 19	Go to Step 17
	Repair the auxiliary cooling fan motor supply voltage		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

11	circuit for an open or high resistance. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 19	-
12	Inspect the auxiliary cooling fan motor ground 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 19	Go to Step 15
13	Inspect for poor connections at the auxiliary fan relay. Refer to <u>Circuit Testing</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 19	Go to Step 14
14	Replace the auxiliary fan relay. Did you complete the replacement?	Go to Step 19	-
15	Inspect for poor connections at the harness connector of the auxiliary cooling fan. Refer to <u>Circuit Testing</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 19	Go to Step 16
16	Replace the auxiliary cooling fan. Refer to <u>Cooling Fan and Motor Replacement - Auxiliary</u> . Did you complete the replacement?	Go to Step 19	-
17	Inspect for poor connections at the engine control module (ECM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 19	Go to Step 18
18	Replace the ECM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 19	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

ENGINE OVERHEATING (LP1, LY7)

Engine Overheating (LP1, LY7)

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition.			
- The engine temperature gage is in the red (overheat) zone and/or the engine temperature indicator is ON. - Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the ground while the engine is running.			
	1. Inspect and fill the cooling system, as necessary. Refer to <u>Draining and Filling Cooling System (LP1, LY7 Static Fill)</u> or <u>Draining and Filling</u>		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

1	<u>Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).</u> - Inspect the cooling system for leaks, as necessary. - Repair the cooling system leaks, as necessary. Has the inspection/repair been performed?	Go to Step 2	-
2	- Start the engine and allow the engine to run at approximately 1,200 RPM. - Use the Scan Tool in order to verify the overheat condition. Does the Scan Tool verify the engine overheat condition?	Go to Step 3	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
3	- Verify that the cooling fans are operating properly. - Repair the cooling fan system, as necessary. Does the engine still overheat?	Go to Step 4	System OK
4	Perform the following inspections: - Inspect the radiator and the A/C condenser cooling fins for debris or any other obstruction. - Inspect the drive belt system and the drive belt tensioner for proper operation in order to ensure that the coolant pump is rotating properly. - Inspect for loose, damaged and/or missing air deflector(s). - Check for a pinched or kinked cooling system hose. - Repair the systems as necessary. Does the engine still overheat?	Go to Step 5	System OK
5	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis (LP1, LY7)</u> or <u>Thermostat Diagnosis (LS6)</u>. Is the thermostat operating properly?	Go to Step 7	Go to Step 6
6	Replace the thermostat. Refer to <u>Thermostat Replacement (LP1, LY7)</u>. Does the engine still overheat?	Go to Step 7	System OK
	IMPORTANT: Excessive coolant freeze point protection MAY		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

7	cause the coolant to boil at low temperatures. 1. Inspect for the proper coolant concentration (mixture). Correct the coolant concentration as necessary. 2. Remove the radiator cap. 3. Start the engine and inspect for a constant flow of air bubbles in the engine coolant. Is there a constant flow of air bubbles in the engine coolant?	Go to Step 8	Go to Step 9
8	The probable cause of the engine overheat is combustion chamber gasses leaking into the cooling system. This condition is usually caused by the following: • A worn or damaged cylinder head gasket • A worn or damaged cylinder head • A worn and/or damaged engine block Verify this condition by inspecting the spark plug electrodes and porcelain surrounding the spark plug electrode for signs of coolant. Replace and/or repair the engine internal component(s), as necessary, in order to repair the engine internal coolant leak. Does the engine still overheat?	Go to Step 1	System OK
9	The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Refer to Flushing. Does the engine still overheat?	Go to Step 10	System OK
10	IMPORTANT: It is unlikely that the water pump is the cause of the overheat condition. If NONE of the cooling system passages are restricted, replace the coolant pump. Refer to Water Pump Replacement (LP1, LY7). Does the engine still overheat?	Go to Step 1	System OK

LOSS OF COOLANT (W/MANUAL TRANSMISSION)

Loss of Coolant (w/Manual Transmission)

Step	Action	Yes	No
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2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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 - Vehicle</u> . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level at the surge tank. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to <u>Draining and Filling Cooling System (LP1, LY7 Static Fill)</u> or <u>Draining and Filling Cooling System (LS2 Static Fill)</u> or <u>Draining and Filling Cooling System (GE 47716)</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 engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 22
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 23	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 25	Go to Step 8
8	Visually inspect the hoses, pipes and hose clamps at the following locations: • Surge Tank • Throttle Body • Water Pump • Heater Core • Radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 18	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant Pressure Cap • Core Plugs • Cylinder Head Gaskets • Cylinder Heads • Engine Block • Radiator • Thermostat housing		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	Water pump		
	Are any of the listed components leaking?	Go to Step 18	Go to Step 10
10	- Pressure test the cooling system. Refer to Cooling System Leak Testing. - With the cooling system pressurized, visually inspect the components listed in steps 8 and 9.		
	Are any leaks present?	Go to Step 18	Go to Step 11
11	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing .		
	Does the coolant pressure cap hold pressure?	Go to Step 12	Go to Step 19
12	- Apply the parking brake. - Ensure the vehicle is in PARK. - Start and idle the engine until it reaches normal operating temperature. - Inspect for heavy white smoke coming out of the exhaust pipe.		
	Is a heavy white smoke present from the exhaust pipe?	Go to Step 13	Go to Step 14
13	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 24	Go to Step 14
14	With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling?	Go to Step 26	Go to Step 15
15	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 near the HVAC module.		
	Is coolant present?	Go to Step 20	Go to Step 16
16	Inspect the engine oil for a gray/white milky substance. Is there a milky substance in the engine oil ?	Go to Step 24	Go to Step 17
17	Inspect the transmission oil fluid for a gray/white milky substance.		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	Does the transmission fluid contain a gray/white milky substance?	Go to Step 21	Go to Step 27
18	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 27	-
19	Replace the coolant pressure cap. Is the repair complete?	Go to Step 27	-
20	Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete?	Go to Step 27	-
21	1. Replace the radiator. Refer to <u>Radiator Replacement (LP1, LY7)</u> or <u>Radiator Replacement (LS6)</u> . 2. Service the transmission. Refer to <u>Engine Coolant/Water in Transmission</u> . Is the repair complete?	Go to Step 27	-
22	Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 3.6L engine or <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> 2.8L engine. Is the repair complete?	Go to Step 27	-
23	Repair the engine overheating condition. Refer to <u>Engine Overheating (LP1, LY7)</u> . Is the repair complete?	Go to Step 27	-
24	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> , <u>Coolant in Engine Oil</u> for the 3.6L engine or <u>Coolant in Combustion Chamber</u> , <u>Coolant in Engine Oil</u> for the 2.8L engine. Is the repair complete?	Go to Step 27	-
25	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 3.6L engine or <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 2.8L engine. Is the repair complete?	Go to Step 27	-
26	Repair the combustion pressure in the cooling system problem. Refer to <u>Cylinder Leakage Test</u> for the 3.6L engine or <u>Cylinder Leakage Test</u> for the 2.8L engine. Is the repair complete?	Go to Step 27	-
27	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

LOSS OF COOLANT (W/AUTOMATIC TRANSMISSION)

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

Loss of Coolant (w/Automatic Transmission)

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level at the surge tank. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Draining and Filling Cooling System (LP1, LY7 Static Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716) . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 20
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 21	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 23	Go to Step 8
8	Visually inspect the hoses, pipes and hose clamps at the following locations: • Surge Tank • Throttle Body • Water Pump • Heater Core • Radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 17	Go to Step 9
9	Visually inspect the following components: • Block heater • Coolant Pressure Cap • Core Plugs • Cylinder Head Gaskets • Cylinder Heads • Engine Block		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	• Radiator • Thermostat housing • Water pump		
	Are any of the listed components leaking?	Go to Step 17	Go to Step 10
10	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 8 and 9.		
	Are any leaks present?	Go to Step 17	Go to Step 11
11	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing .		
	Does the coolant pressure cap hold pressure?	Go to Step 12	Go to Step 18
12	1. Apply the parking brake. 2. Ensure the vehicle is in NEUTRAL. 3. Start and idle the engine until it reaches normal operating temperature. 4. Inspect for heavy white smoke coming out of the exhaust pipe.		
	Is a heavy white smoke present from the exhaust pipe?	Go to Step 13	Go to Step 14
13	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 22	Go to Step 14
14	With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling?	Go to Step 24	Go to Step 15
15	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 near the HVAC module.		
	Is coolant present?	Go to Step 19	Go to Step 16
16	Inspect the engine oil for a gray/white milky substance. Is there a milky substance in the engine oil ?	Go to Step 22	Go to Step 17

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

17	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 25	-
18	Replace the coolant pressure cap. Is the repair complete?	Go to Step 25	-
19	Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete?	Go to Step 25	-
20	Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 6.0L engine or <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 3.6L engine. Is the repair complete?	Go to Step 25	-
21	Repair the engine overheating condition. Refer to <u>Engine Overheating (LP1, LY7)</u> . Is the repair complete?	Go to Step 25	-
22	Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> , <u>Coolant in Engine Oil</u> for the 6.0L engine or <u>Coolant in Combustion Chamber</u> , <u>Coolant in Engine Oil</u> for the 3.6L engine. Is the repair complete?	Go to Step 25	-
23	Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 6.0L engine or <u>Lower Engine Noise, Regardless of Engine Speed</u> for the 3.6L engine. Is the repair complete?	Go to Step 25	-
24	Repair the combustion pressure in the cooling system problem. Refer to <u>Cylinder Leakage Test</u> for the 6.0L engine or <u>Cylinder Leakage Test</u> for the 3.6L engine. Is the repair complete?	Go to Step 25	-
25	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS (LP1, LY7)

Tools Required

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

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

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

1. Use a tempilstick in order to find the opening and the closing temperatures of the thermostat.
 - **J 24731** 188 tempilstick melts at 87°C (188°F). See **Special Tools**. The thermostat should begin to open at 90°C (194°F).
 - **J 24731** 206 tempilstick melts at 97°C (206°F). See **Special Tools**. The thermostat should be fully open at 107°C (225°F).
2. Replace the thermostat if it does not operate properly between this temperature range.

THERMOSTAT DIAGNOSIS (LS6)

Tools Required

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

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).
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 (LP1, LY7) . 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		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

	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 (LP1, LY7) . 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

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
1	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine. 4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s). Is the electric cooling fan on?	Go to Step 2	Go to Step 3
2	1. Diagnose and repair the cooling fan system. Refer to Cooling Fan Always On and Cooling Fan Always On - Auxiliary. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 3	System OK
3	Install the Scan Tool to the DLC. Compare the Scan Tool coolant temperature reading to the I/P cluster coolant temperature. Is the I/P cluster coolant temperature close to the reading on the Scan Tool?	Go to Step 5	Go to Step 4
4	1. Diagnose and repair the coolant temperature gage system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 5	System OK
5	Inspect the thermostat for proper operation. Refer to Thermostat Diagnosis (LP1, LY7) or Thermostat Diagnosis (LS6). Is the thermostat operating properly?	Go to Step 1	Go to Step 6
	1. Replace the thermostat. Refer to Thermostat Replacement (LP1, LY7).		

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

6	2. Verify the customer complaint.		
	Does the engine still fail to reach normal operating temperature?	Go to Step 1	System OK

PRESSURE CAP TESTING

Tools required

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

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.

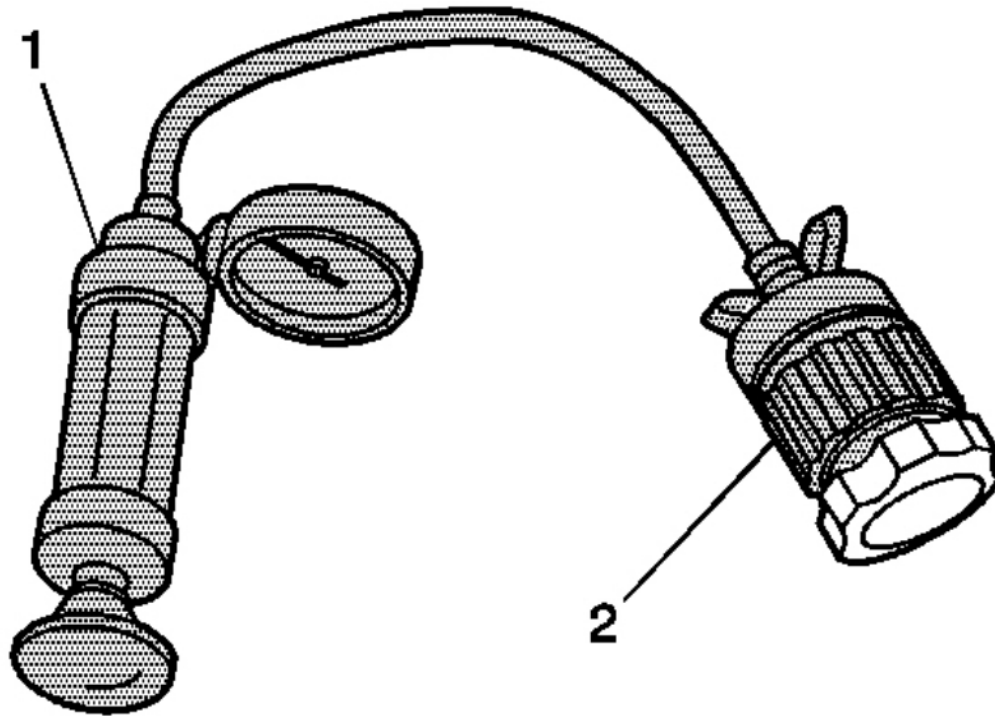


Fig. 7: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** (1) with **J 42401** (2) in order to test the pressure cap. See **Special Tools**.
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**.
 - 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

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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

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.

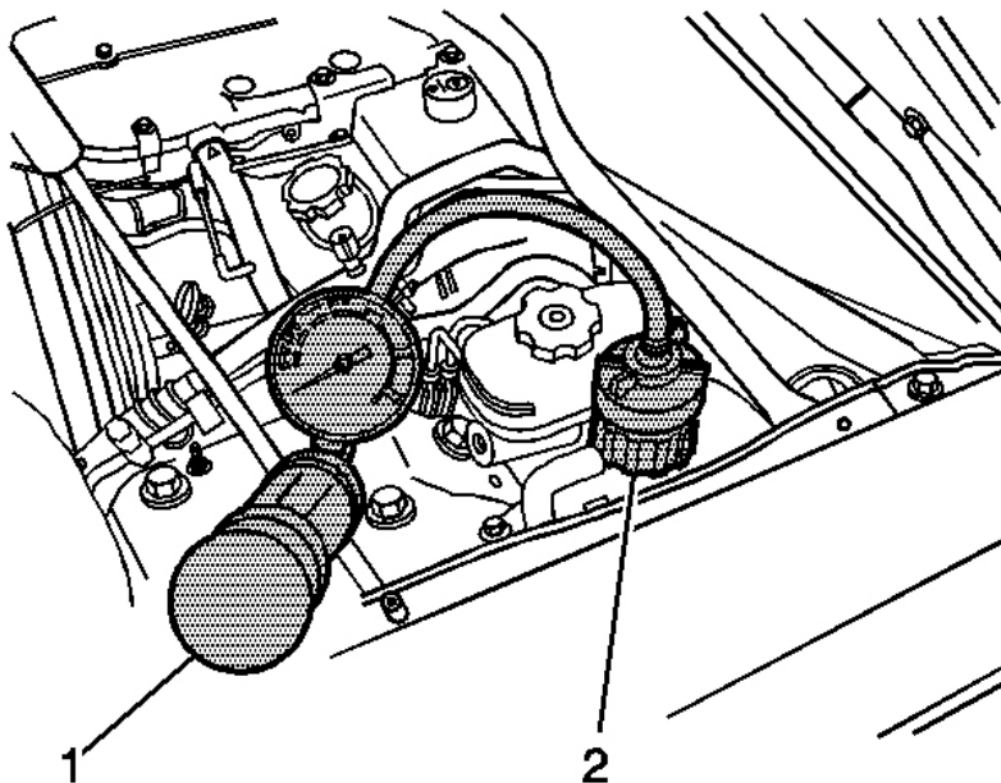


Fig. 8: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS CORP.

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

Do not exceed the pressure cap rating.

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

Observe the gage for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

DRAINING AND FILLING COOLING SYSTEM (LP1, LY7 STATIC FILL)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Draining Procedure

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** in General Information.
4. Remove the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
5. Place a drain pan under the lower radiator hose connection at the bottom of the radiator.
6. Using **J 38185** slide the hose clamp back on the hose. See **Special Tools**.
7. Slowly remove the lower radiator hose and drain the coolant into the drain pan.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance - follow the flush procedure. Refer to **Flushing**.
 - Normal in appearance - follow the filling procedure.

Filling Procedure

1. Install the lower radiator hose.
2. Using **J 38185** slide the clamp into the original position. See **Special Tools**.
3. Lower the vehicle.
4. Using **J 38185** remove the upper radiator hose from the radiator connection. See **Special Tools**.
5. Slowly add a mixture of 50/50 DEX-COOL antifreeze and deionized water to the cooling system through the top of the radiator opening. Refer to **Capacities - Approximate Fluid** in General Information.
6. Fill the upper radiator hose and engine with the 50/50 coolant mixture.
7. Connect the upper radiator hose to the engine.
8. Using **J 38185** slide the radiator hose clamp into the original position. See **Special Tools**.
9. Fill the surge tank to the FULL COLD level.
10. Install the surge tank cap.
11. Idle the engine for 2 minutes and occasionally raise the throttle to 3,000-3,500 RPM.
12. Shut off the engine and allow the engine to cool.
13. Repeat the steps 1-9.
14. Idle the engine for 2 minutes and occasionally raise the throttle to 3,000-3,500 RPM.
15. Inspect the surge tank for consistent flow.
16. If no flow occurs through the surge tank, repeat steps 1-9.
17. Install the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
18. Allow the engine to cool.
19. Remove the surge tank cap and fill to the FULL COLD level.

DRAINING AND FILLING COOLING SYSTEM (LS2 STATIC FILL)**Tools Required**

J 38185 Hose Clamp Pliers. See **Special Tools**.

Draining Procedure

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 lower radiator hose connection at the bottom of the radiator.
6. Using **J 38185** slide the hose clamp back on the hose. See **Special Tools**.
7. Slowly remove the lower radiator hose and drain the coolant into the drain pan.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance-Follow the flush procedure. Refer to **Flushing**.
 - Normal in appearance-Follow the filling procedure.

Filling Procedure

1. Install the lower radiator hose.
2. Using **J 38185** slide the clamp into the original position. See **Special Tools**.
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and deionized water to the cooling system. Refer to **Capacities - Approximate Fluid** .
5. Fill the surge tank to the FULL COLD level.
6. Install the surge tank cap.
7. Idle the engine for 2 minutes and occasionally raise the throttle to 3,000-3,500 RPM.
8. Shut off the engine and allow the engine to cool.
9. Repeat the steps 1-9.
10. Idle the engine for 2 minutes and occasionally raise the throttle to 3,000-3,500 RPM.
11. Inspect the surge tank for consistent flow.
12. If no flow occurs through the surge tank, repeat steps 1-9.
13. Install the air deflector. Refer to **Air Deflector Replacement - Front** .
14. Allow the engine to cool.
15. Remove the surge tank cap and fill to the FULL COLD level.

DRAINING AND FILLING COOLING SYSTEM (GE 47716)**Tools Required**

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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

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 lower radiator hose connection at the bottom of the radiator.
6. Using **J 38185** , slide the hose clamp back on the hose. See Special Tools.
7. Slowly remove the lower radiator hose and drain the coolant into the drain pan.
8. Inspect the engine coolant for the following conditions:
 - Discolored appearance-Follow the flush procedure. Refer to Flushing.
 - Normal in appearance-Follow the filling procedure.

Vac-N-Fill Procedure

1. Install the **J 42401** onto the coolant surge tank. See Special Tools.

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.

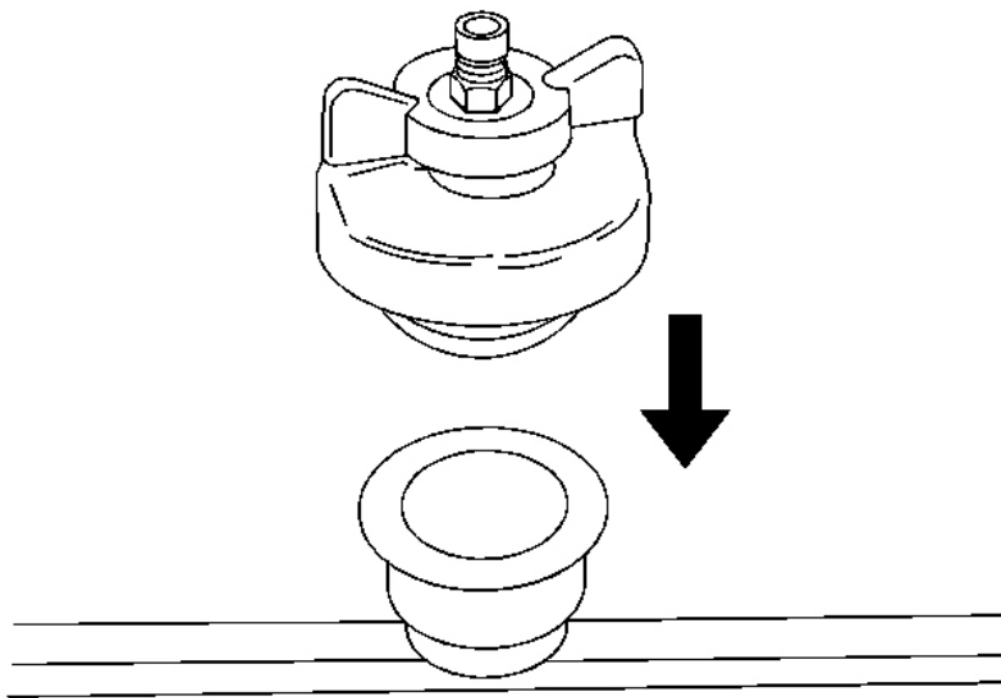


Fig. 9: Vac N Fill Cap

Courtesy of GENERAL MOTORS CORP.

2. Attach the Vac N Fill cap to the **J 42401** . See **Special Tools**.

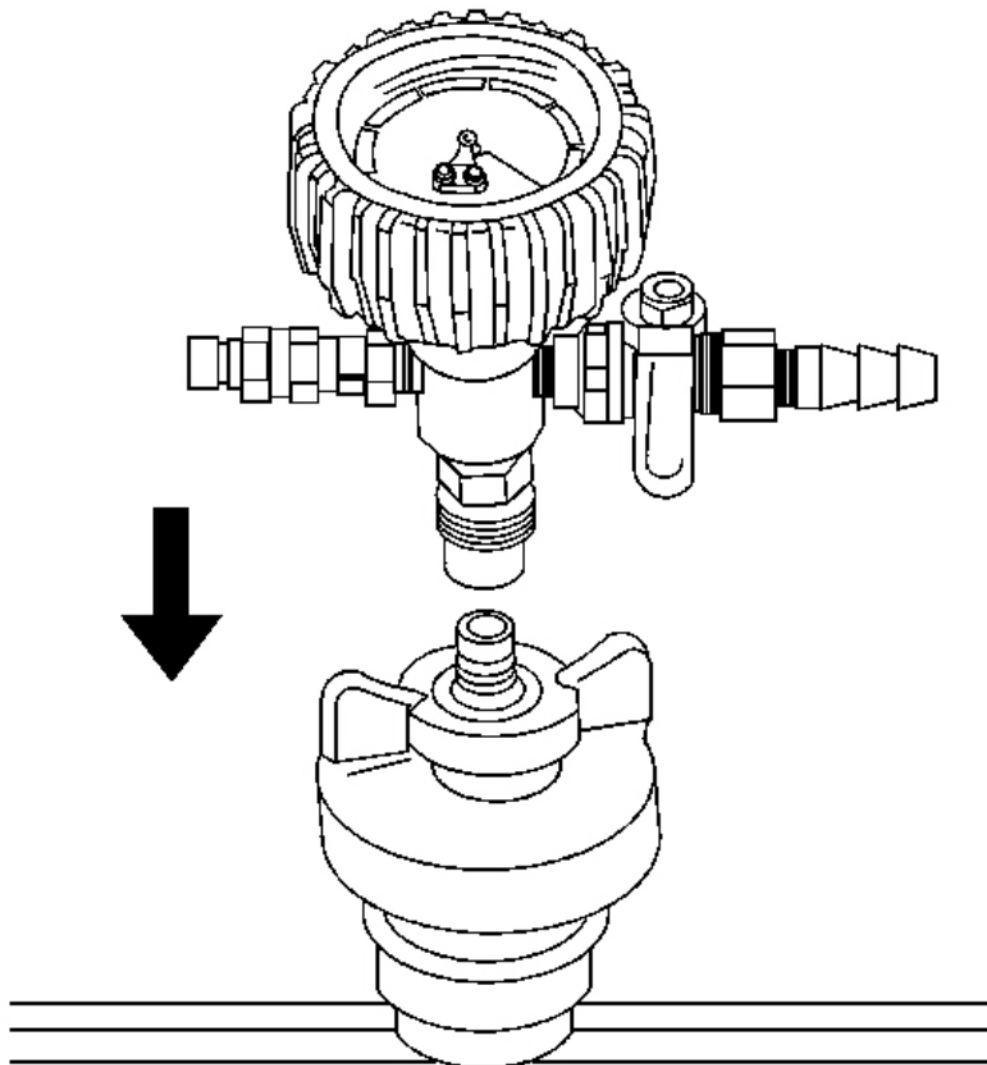


Fig. 10: Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

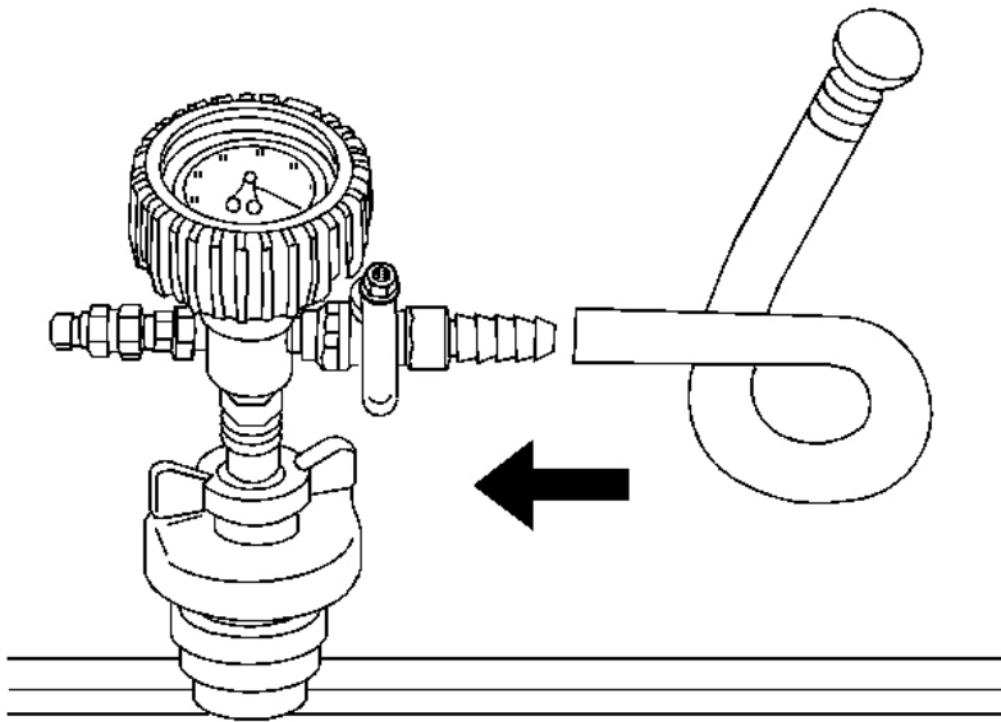


Fig. 11: Fill Hose

Courtesy of GENERAL MOTORS CORP.

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

Ensure that the valve is closed.

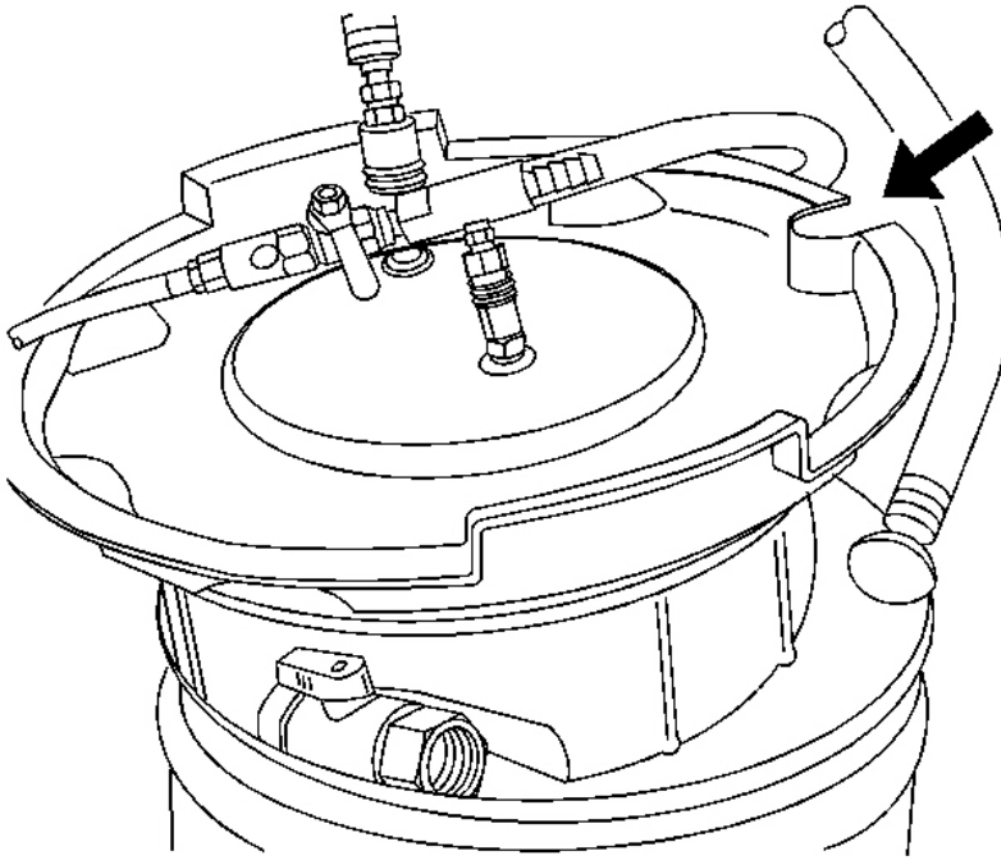


Fig. 12: Graduated Reservoir

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water. Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

5. Pour the coolant mixture into the graduated reservoir.
6. Place the fill hose in the graduated reservoir.

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

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

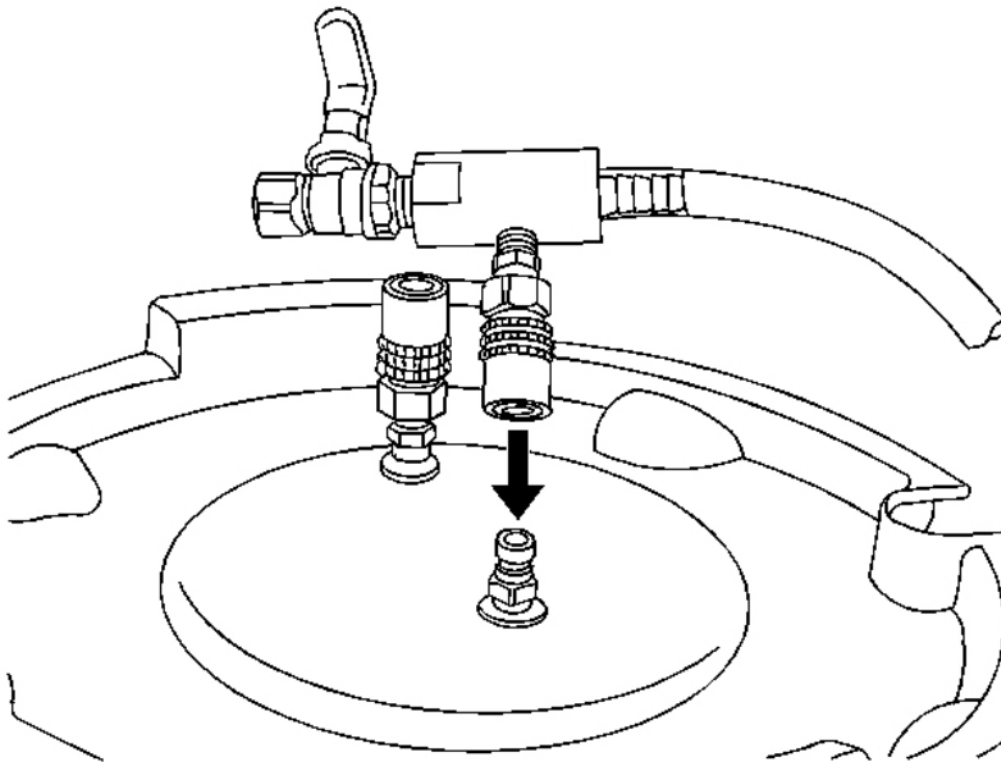


Fig. 13: Venturi Assembly

Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

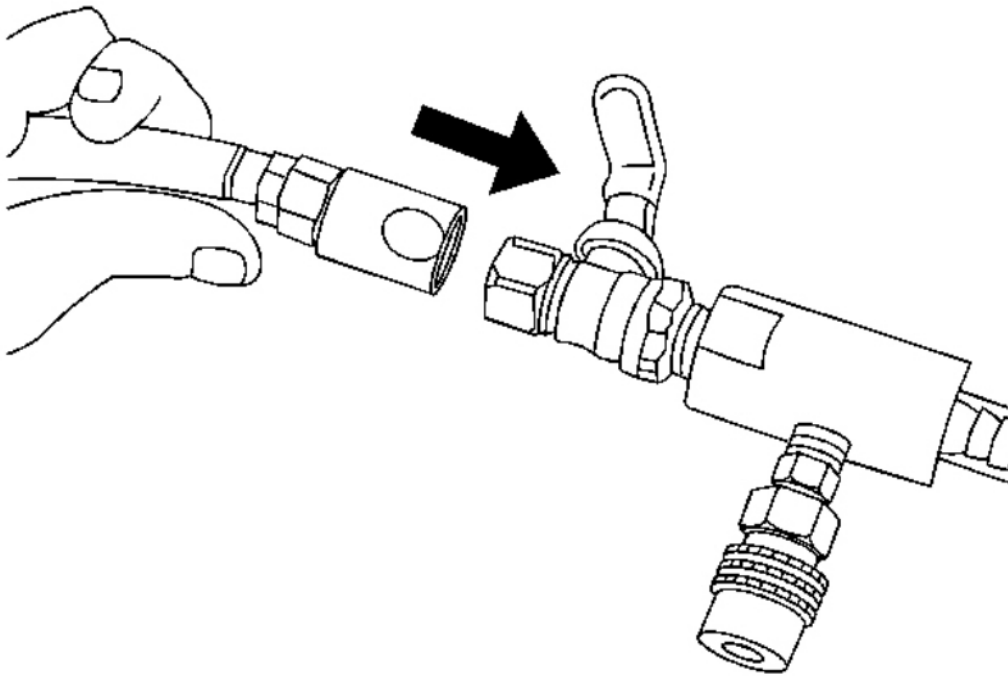


Fig. 14: Shop Air Hose

Courtesy of GENERAL MOTORS CORP.

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

Ensure the valve on the venturi assembly is closed.

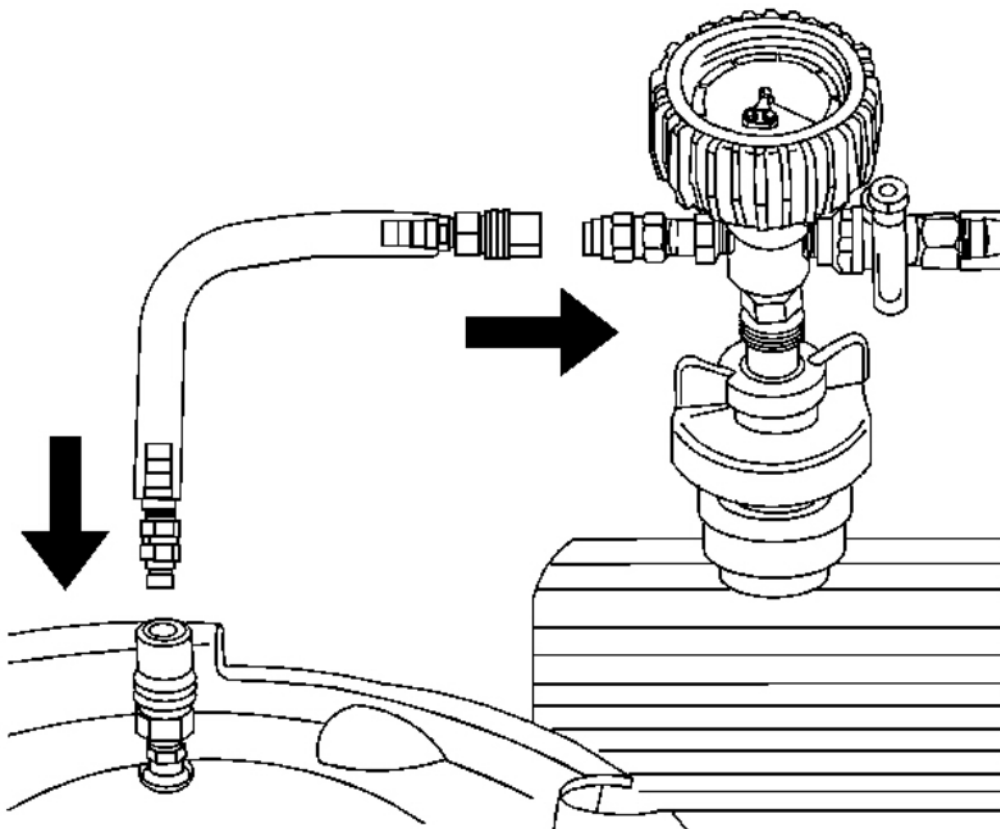


Fig. 15: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

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

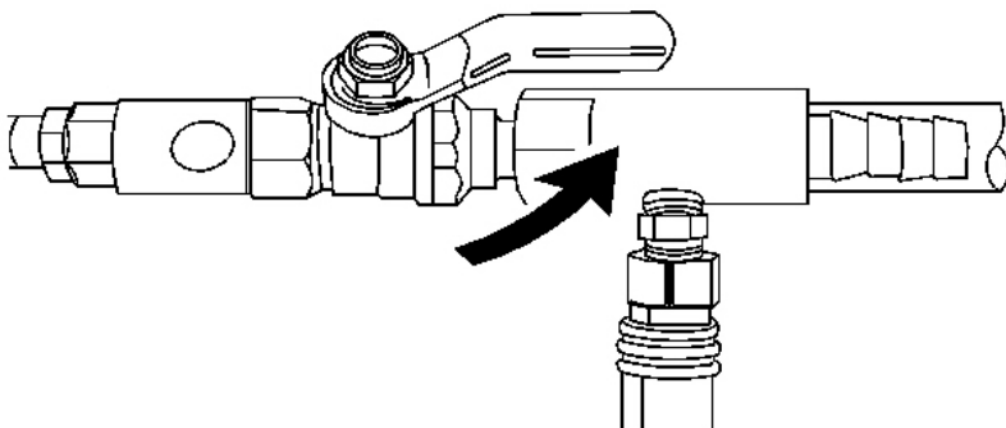


Fig. 16: Control Valve

Courtesy of GENERAL MOTORS CORP.

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

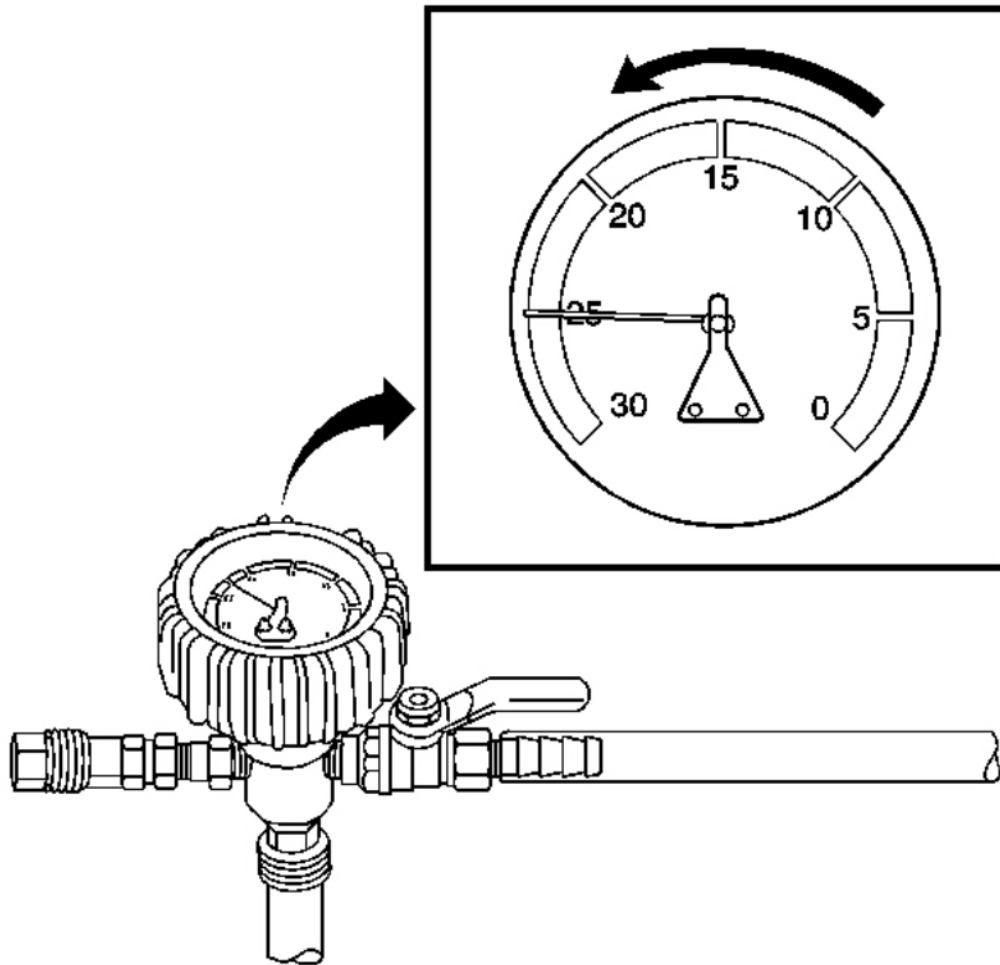


Fig. 17: Drawing Vacuum

Courtesy of GENERAL MOTORS CORP.

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

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

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

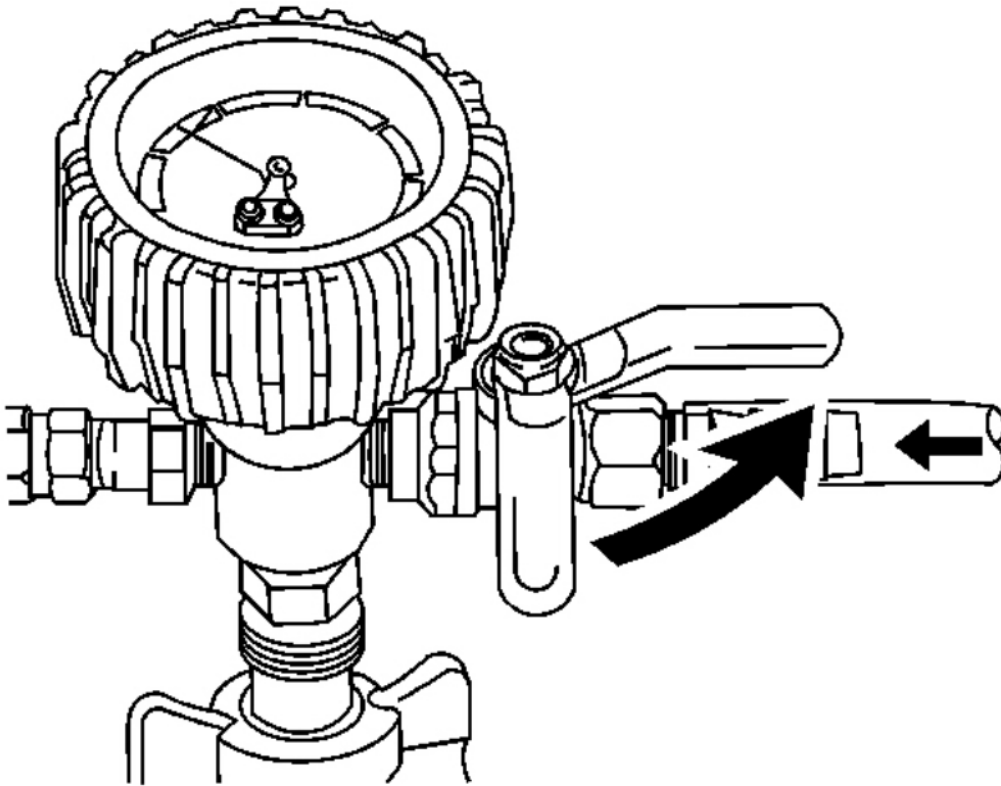


Fig. 18: Control Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

If vacuum loss is observed, refer to **Loss of Coolant (w/Manual Transmission)** or **Loss of Coolant (w/Automatic Transmission)**.

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

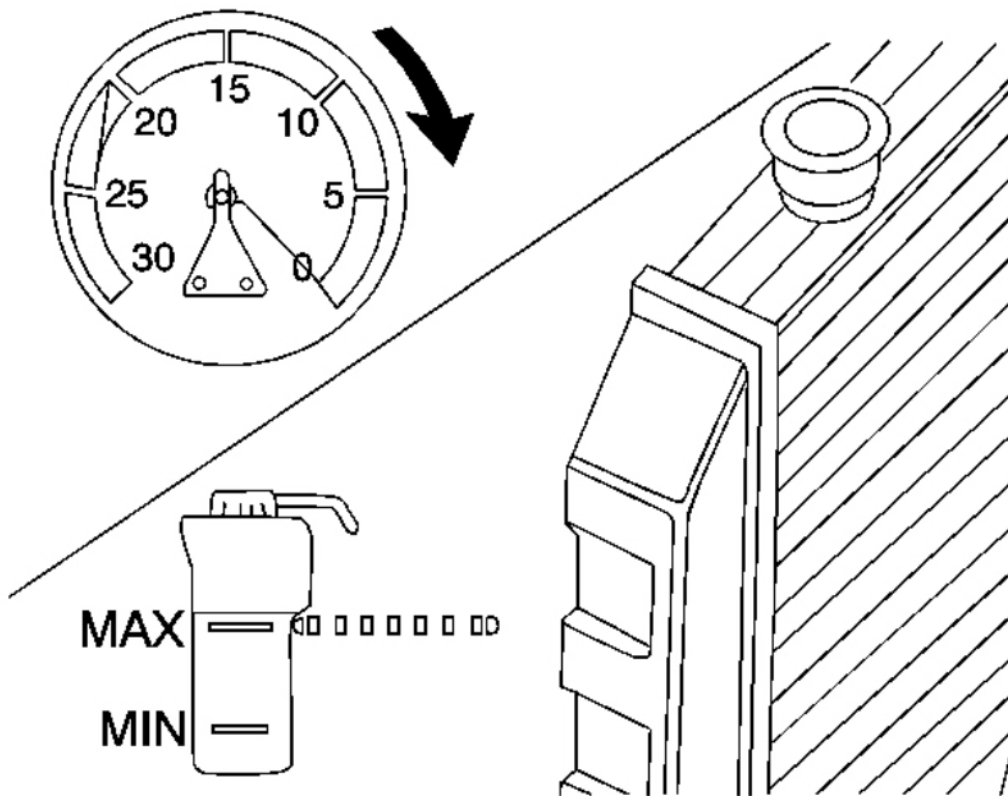


Fig. 19: Reading Vacuum Gage
Courtesy of GENERAL MOTORS CORP.

18. Once the vacuum gage reaches zero, close the valve on the vacuum gage assembly and repeat steps 11-17.
19. Detach the Vac N Fill cap from the **J 42401** . See **Special Tools**.
20. Remove the **J 42401** from the coolant surge tank. See **Special Tools**.
21. Add coolant to the system as necessary.
22. Inspect the concentration of the coolant mixture using **J 26568** . See **Special Tools**.

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

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

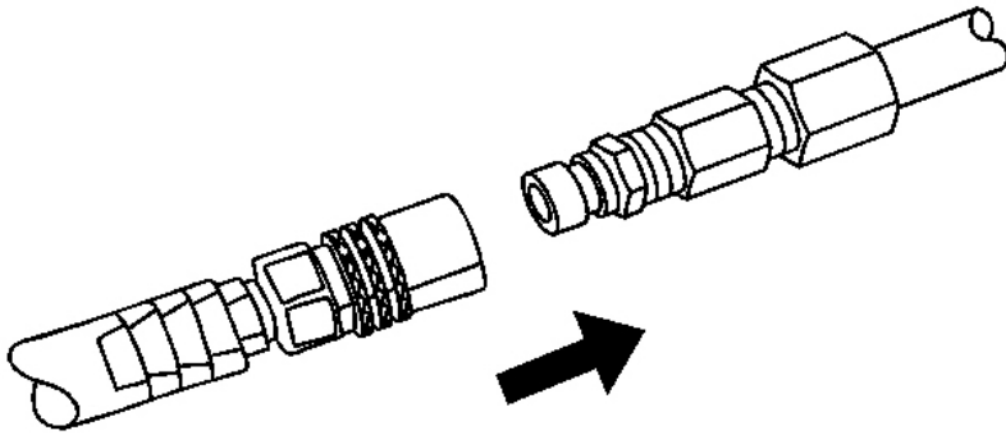


Fig. 20: Extraction Hose

Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

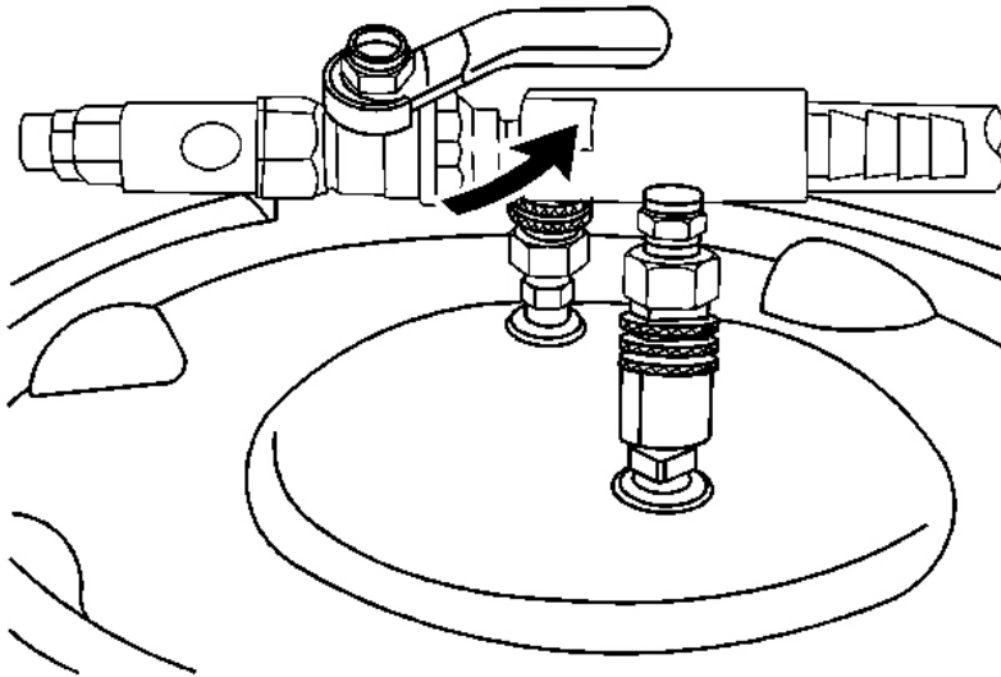


Fig. 21: Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

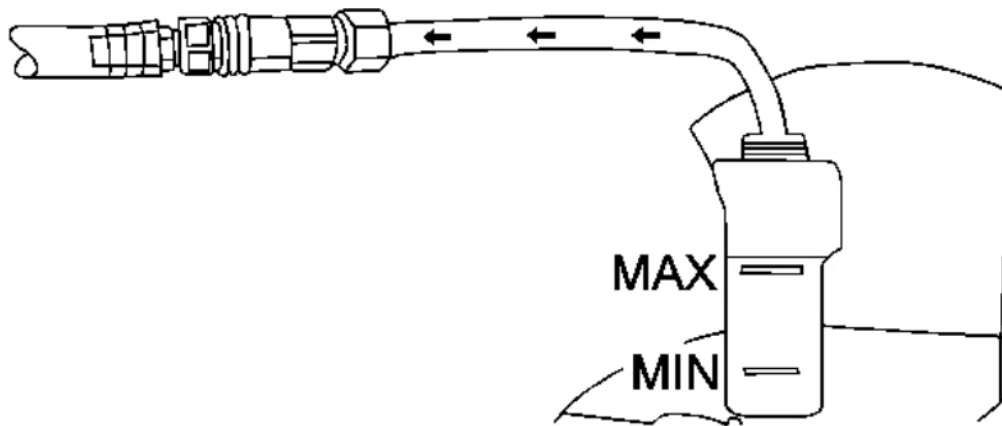


Fig. 22: Drawing Out Coolant
Courtesy of GENERAL MOTORS CORP.

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

FLUSHING

IMPORTANT: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound. Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction. However, always remove the thermostat before back flushing the system.

1. Block the drive wheels.
2. Place the transmission in PARK (P) or NEUTRAL (N).
3. Engage the park brake.
4. Run the engine until the thermostat opens.
5. Stop the engine.
6. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary,

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

until the fluid is nearly colorless. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

7. Fill the coolant reservoir to the FULL COLD mark.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

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 (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

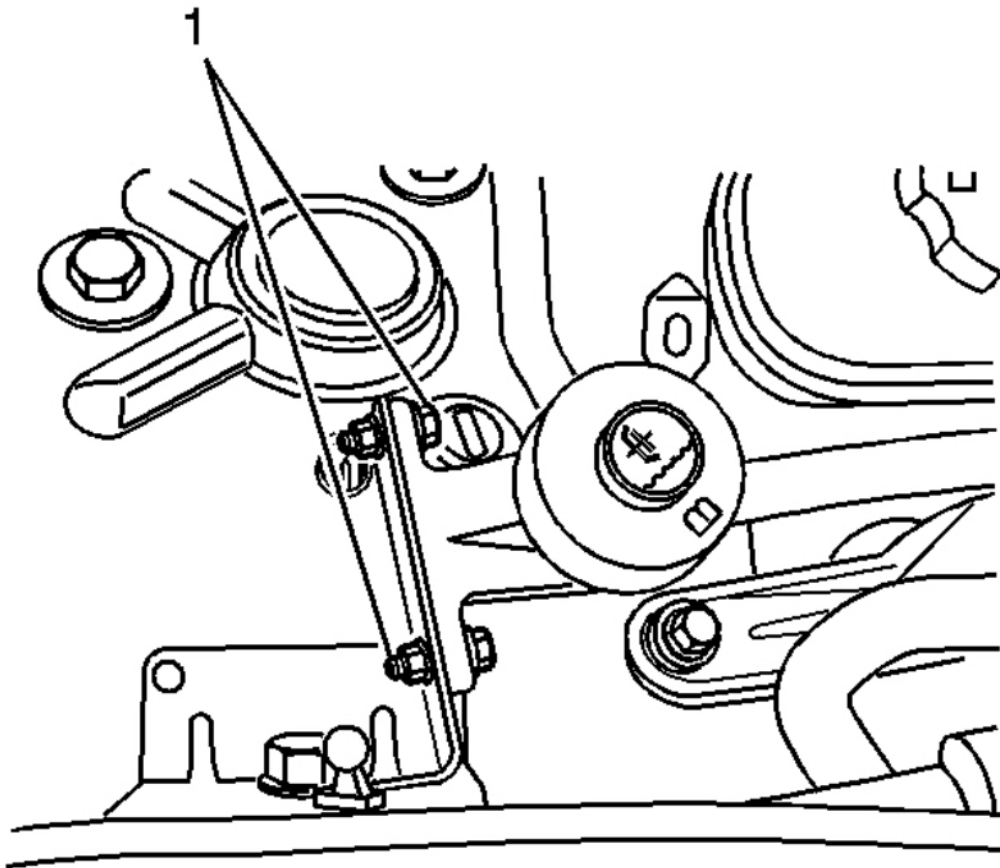


Fig. 23: Locating Clutch Master Cylinder Reservoir Bolts
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. If equipped with a manual transmission, remove the clutch master cylinder reservoir bolts (1).
3. Position the clutch master cylinder reservoir out of the way.

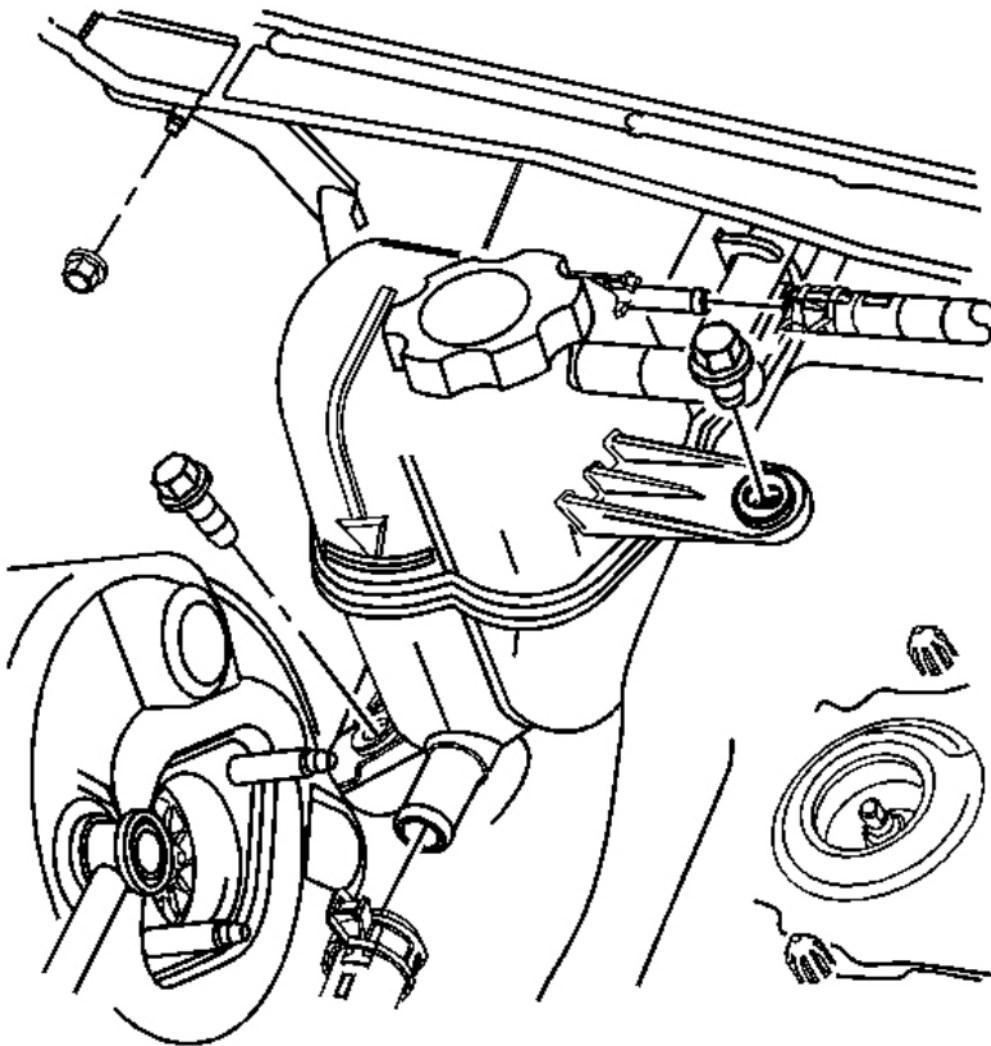


Fig. 24: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

4. Using **J 38185** , loosen and slide the clamp from the surge tank inlet hose. See **Special Tools**.
5. Disconnect the surge tank inlet hose.
6. Using **J 38185** , loosen and slide the clamp from the surge tank outlet hose. See **Special Tools**.
7. Disconnect the surge tank outlet hose.

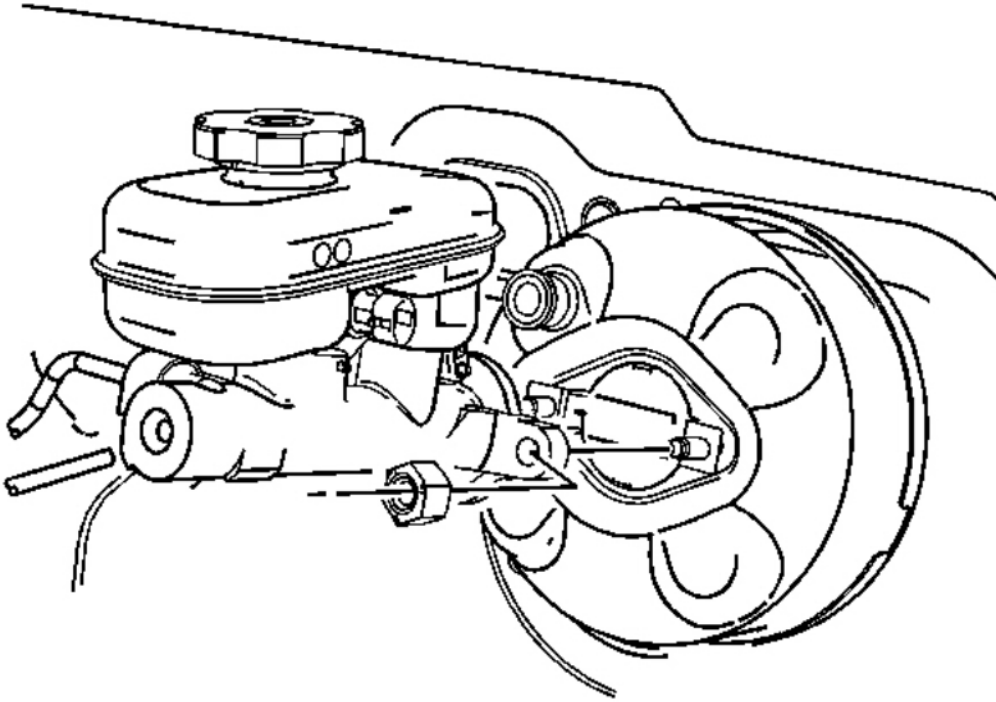


Fig. 25: Locating Master Cylinder To Vacuum Booster Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

8. Remove the master cylinder nuts.
9. Without disconnecting brake lines, separate the master cylinder from the brake booster.
10. Gently reposition the master cylinder out of the way.

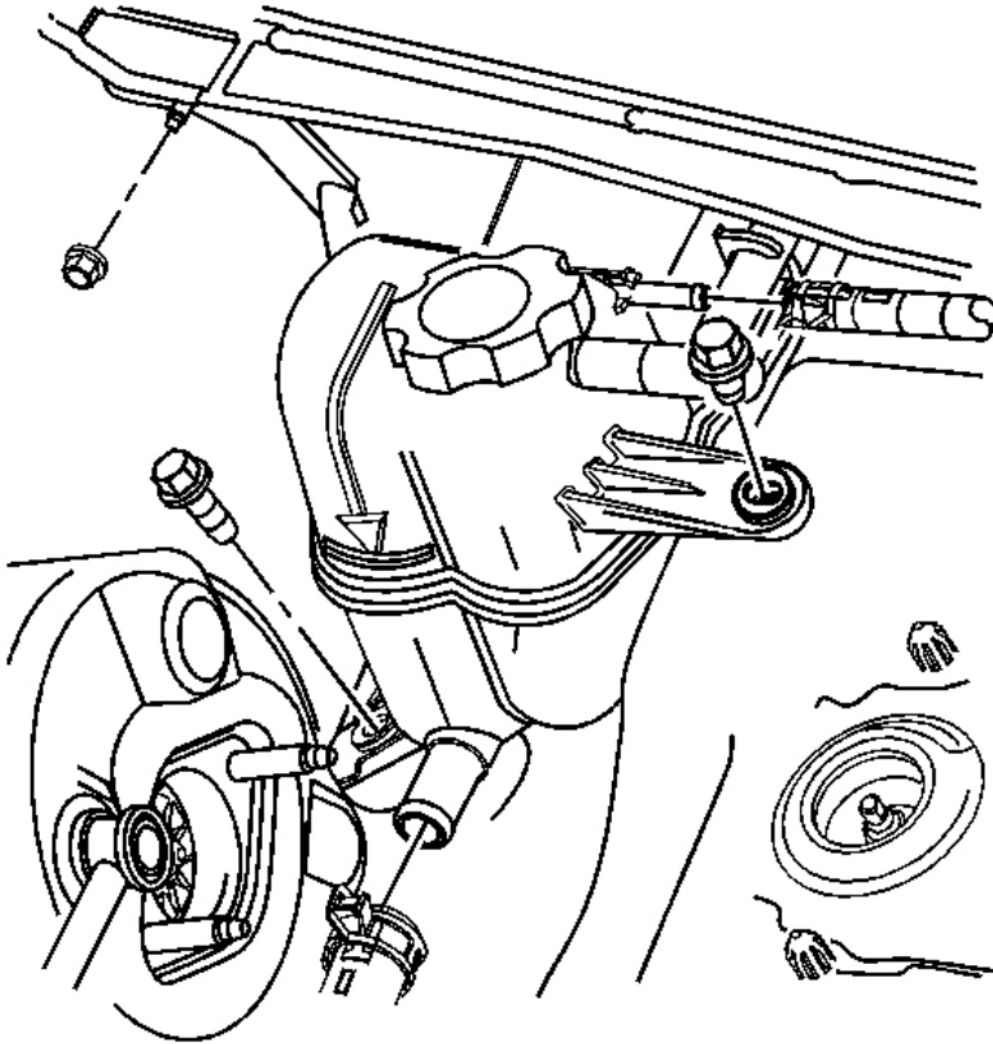


Fig. 26: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the 2 surge tank bolts.
12. Remove the surge tank nut.
13. Lift the air inlet grille panel partially out of the way to remove the surge tank.
14. Disconnect the low coolant sensor electrical connector.
15. Remove the surge tank.

Installation Procedure

1. Connect the low coolant sensor electrical connector.
2. Install the surge tank.
3. Position the surge tank tab behind the air inlet grille screen.
4. Reposition the air inlet grille.

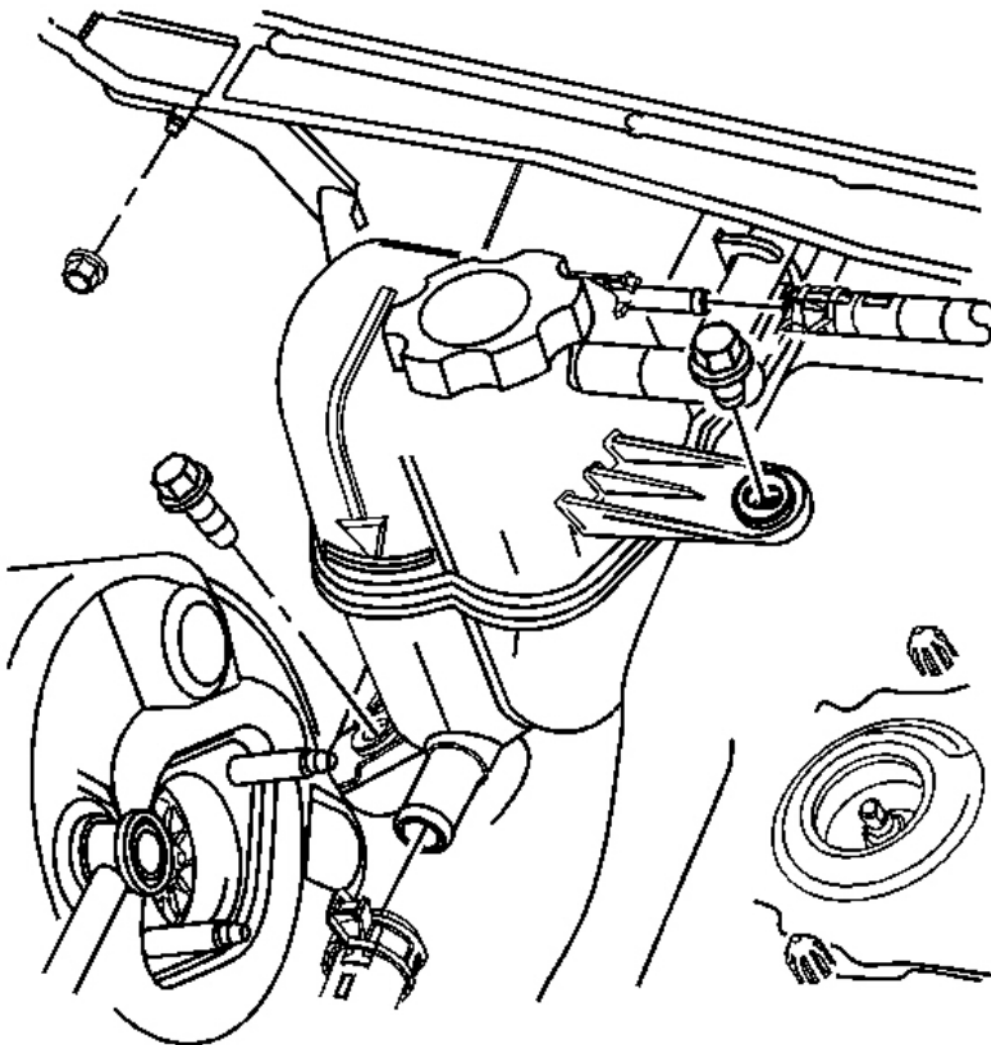


Fig. 27: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank outlet hose.
6. Using **J 38185** , reposition the clamp on the surge tank outlet hose. See **Special Tools**.

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

7. Install the surge tank nut.

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

8. Connect the surge tank inlet hose.
9. Using the **J 38185** , reposition the clamp on the surge tank inlet hose. See **Special Tools**.
10. Install the 2 surge tank bolts.

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

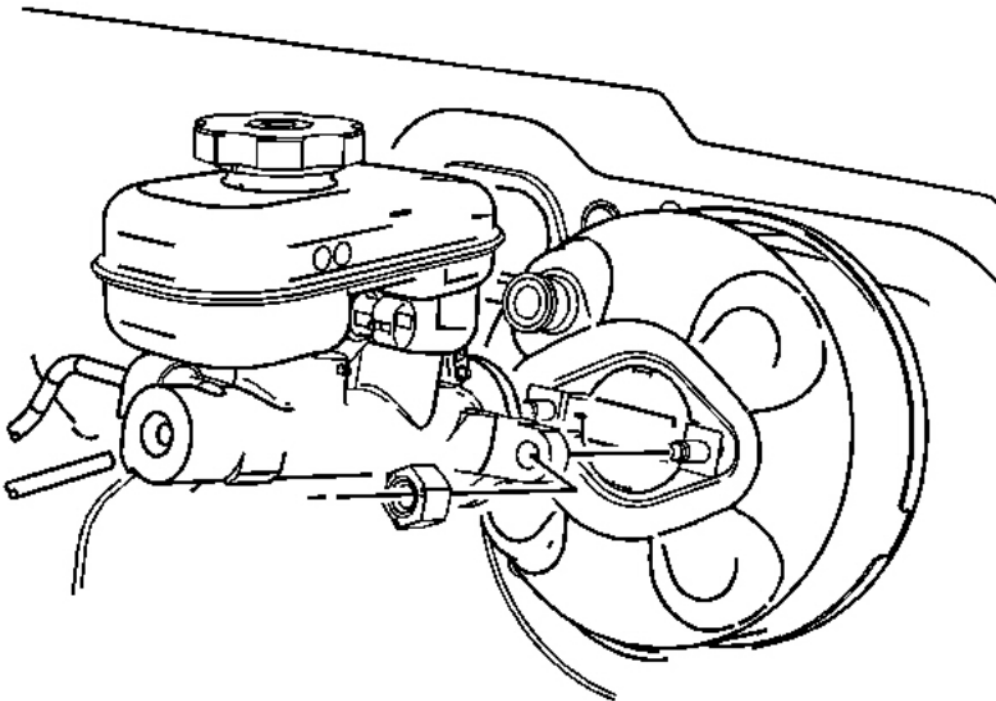


Fig. 28: Locating Master Cylinder To Vacuum Booster Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

11. Connect the master cylinder to the vacuum booster.

12. Install the master cylinder nuts.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

13. Fill the cooling system. Refer to [Draining and Filling Cooling System \(LP1, LY7 Static Fill\)](#) or [Draining and Filling Cooling System \(LS2 Static Fill\)](#) or [Draining and Filling Cooling System \(GE 47716\)](#).

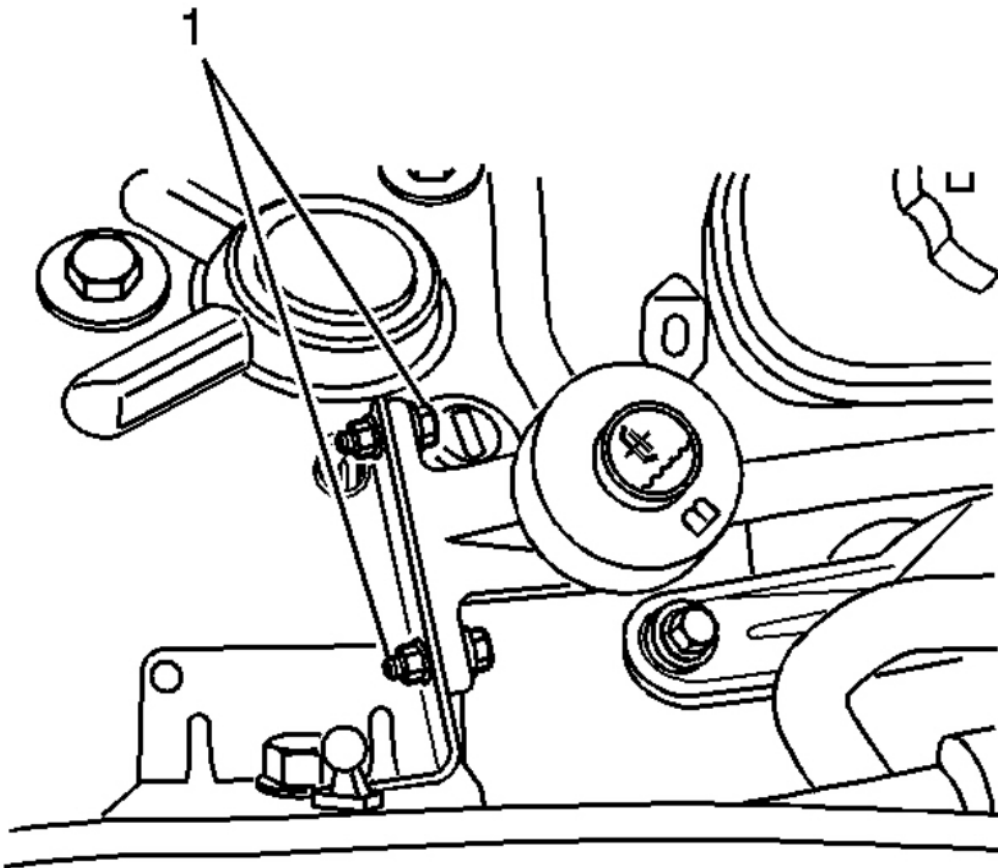


Fig. 29: Locating Clutch Master Cylinder Reservoir Bolts
Courtesy of GENERAL MOTORS CORP.

14. If equipped with a manual transmission, position the clutch master cylinder reservoir to the bracket.
15. Install the clutch master cylinder reservoir bolts (1).

Tighten: Tighten the bolts to 50 N.m (37 lb ft).

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

SURGE TANK REPLACEMENT (LS6)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Remove the left air inlet grille. Refer to **Air Inlet Grille Panel Replacement (LHD)** or **Air Inlet Grille Panel Replacement (RHD)** in Body Front End.

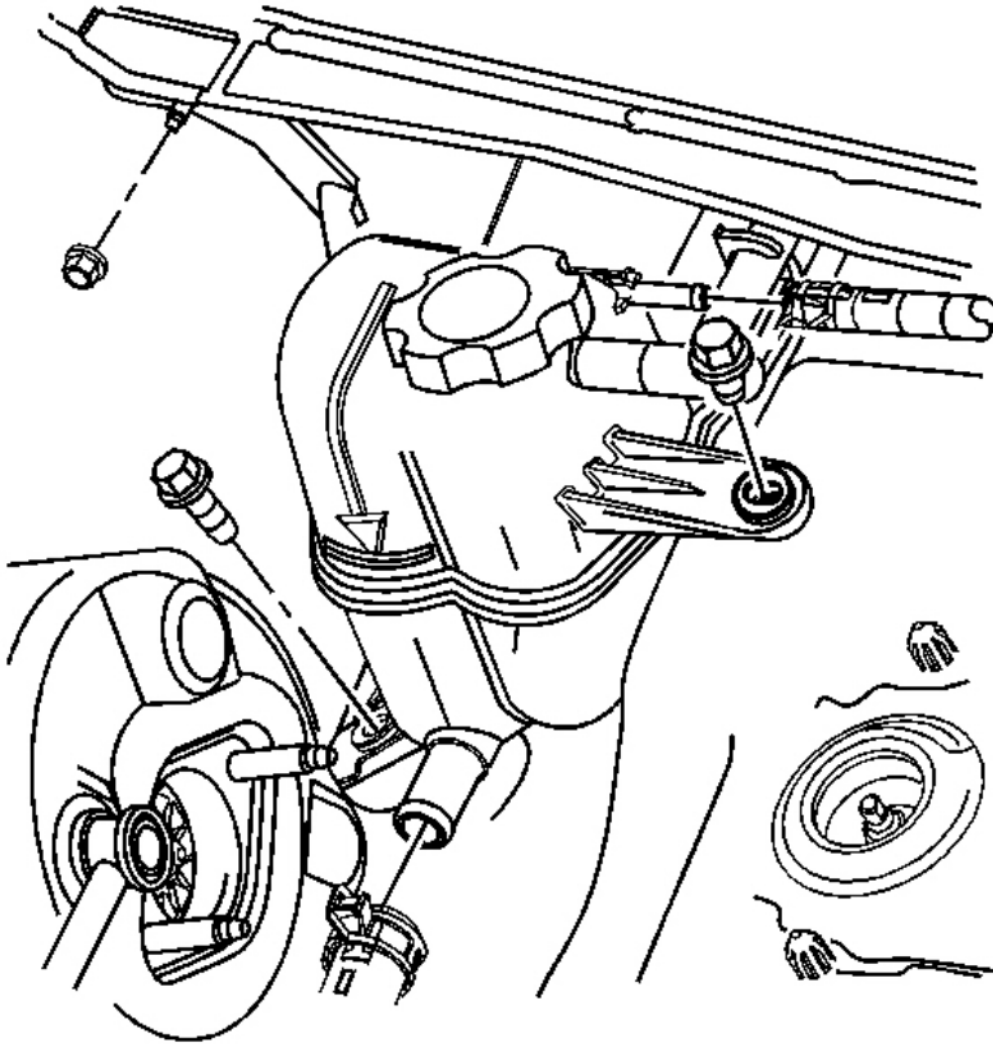


Fig. 30: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Using **J 38185** , loosen and slide the clamp from the surge tank inlet hose. See **Special Tools**.
4. Disconnect the surge tank inlet hose.
5. Using **J 38185** , loosen and slide the clamp from the surge tank outlet hose. See **Special Tools**.
6. Disconnect the surge tank outlet hose.

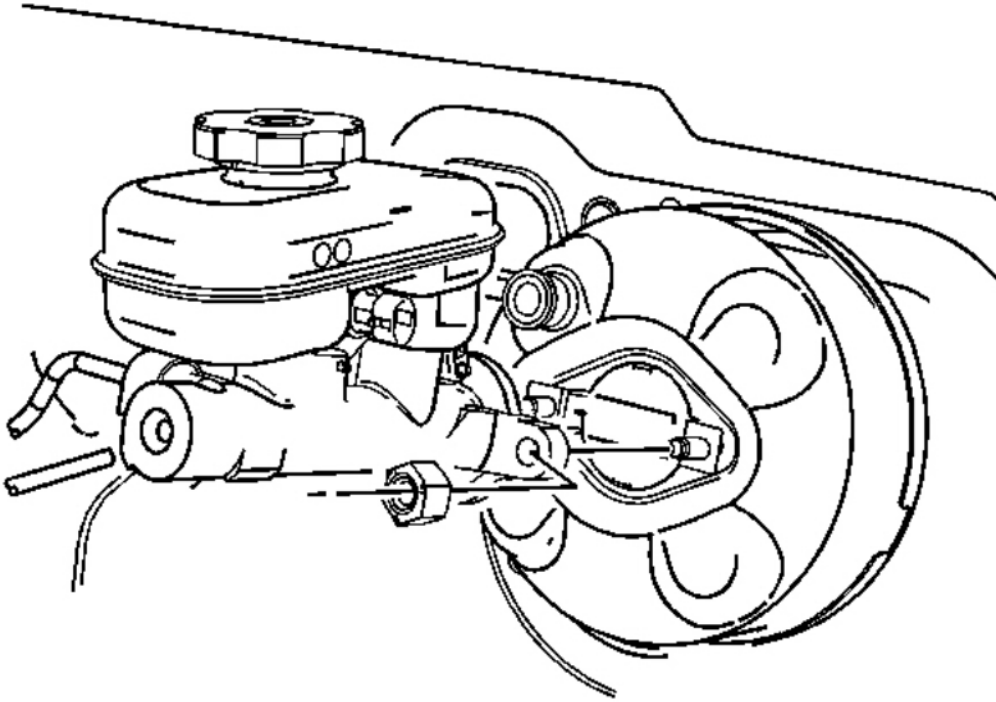


Fig. 31: Locating Master Cylinder To Vacuum Booster Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the master cylinder nuts.
8. Without disconnecting brake lines, separate the master cylinder from the brake booster.
9. Gently reposition the master cylinder out of the way.

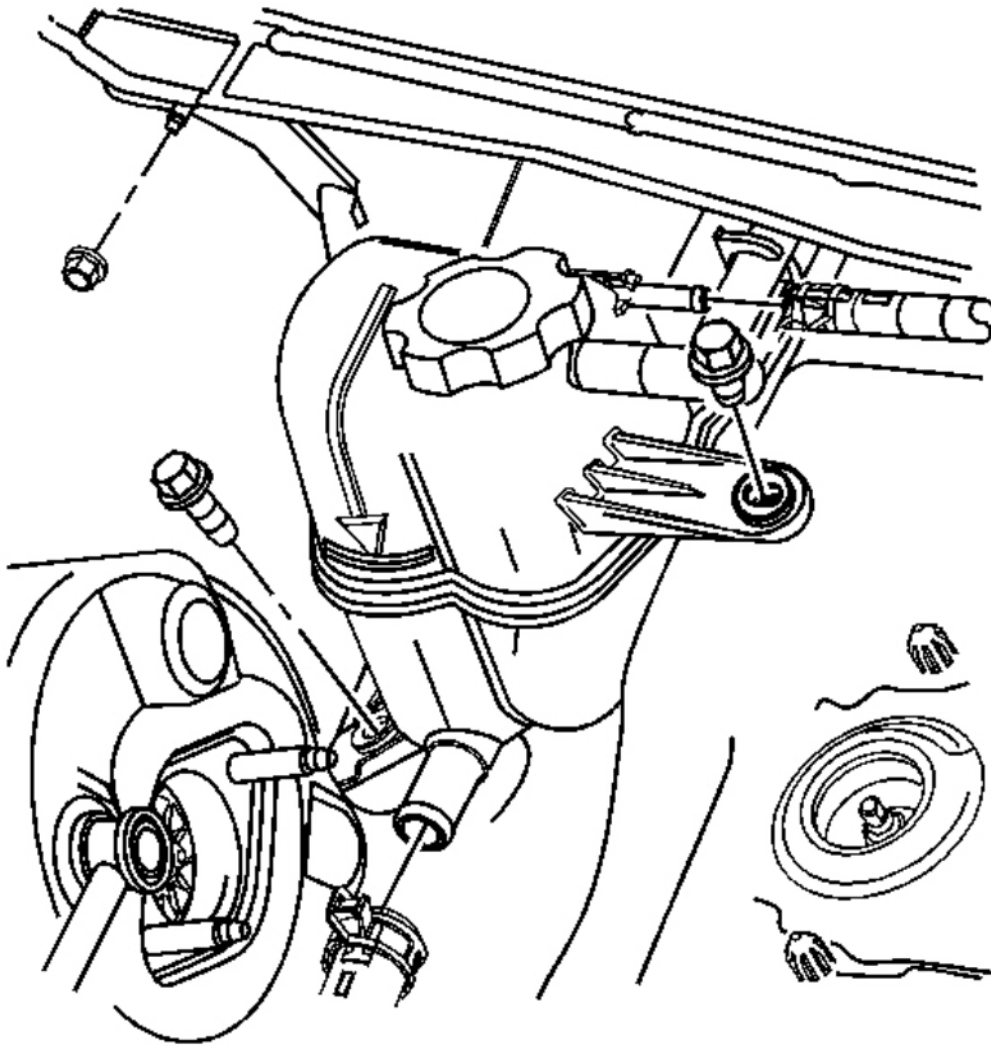


Fig. 32: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the 2 surge tank bolts.
11. Disconnect the low coolant sensor electrical connector.
12. Remove the surge tank.

Installation Procedure

1. Connect the low coolant sensor electrical connector.

2. Install the surge tank.

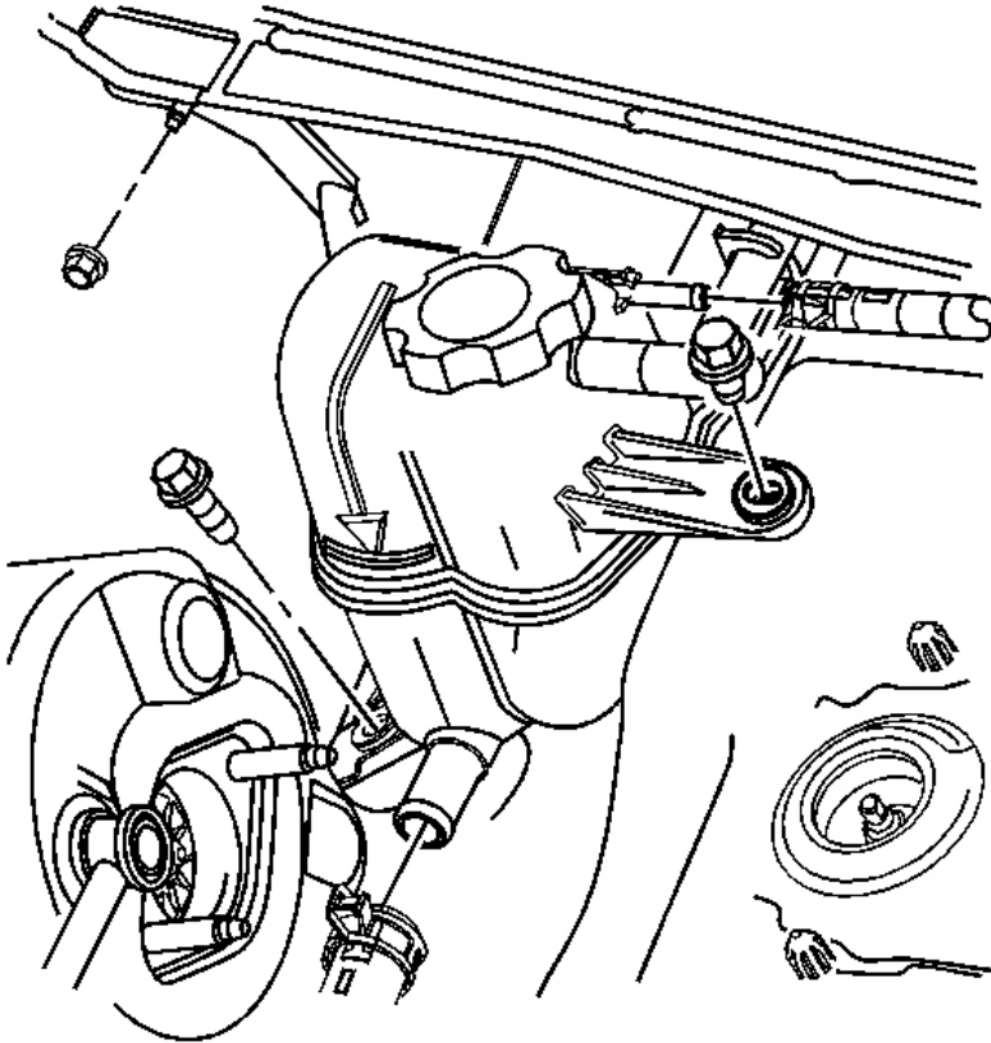


Fig. 33: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Connect the surge tank outlet hose.
4. Using **J 38185** , reposition the clamp on the surge tank outlet hose. See **Special Tools**.

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

5. Install the surge tank bolts.

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

6. Connect the surge tank inlet hose.
7. Using the **J 38185** , reposition the clamp on the surge tank inlet hose. See **Special Tools**.

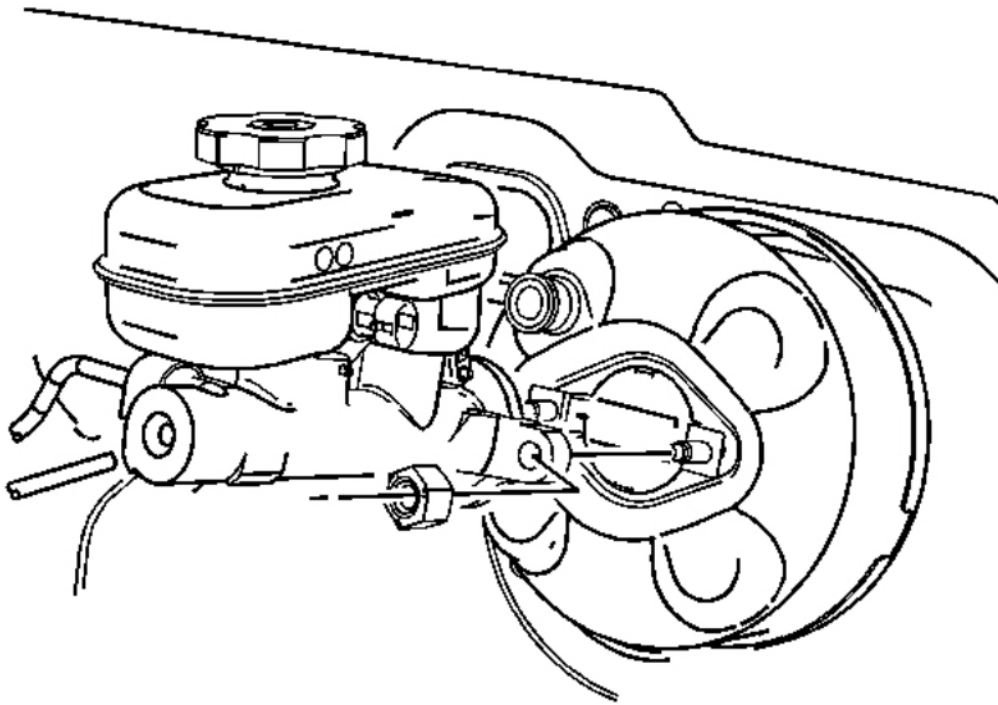


Fig. 34: Locating Master Cylinder To Vacuum Booster Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

8. Connect the master cylinder to the vacuum booster.
9. Install the master cylinder nuts.

Tighten: Tighten the nuts to 25 N.m (18 lb ft).

10. Install the left air inlet grille. Refer to **Air Inlet Grille Panel Replacement (LHD)** or **Air Inlet Grille Panel Replacement (RHD)** in Body Front End.
11. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE**

47716).

SURGE TANK HOSE/PIPE REPLACEMENT - INLET (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

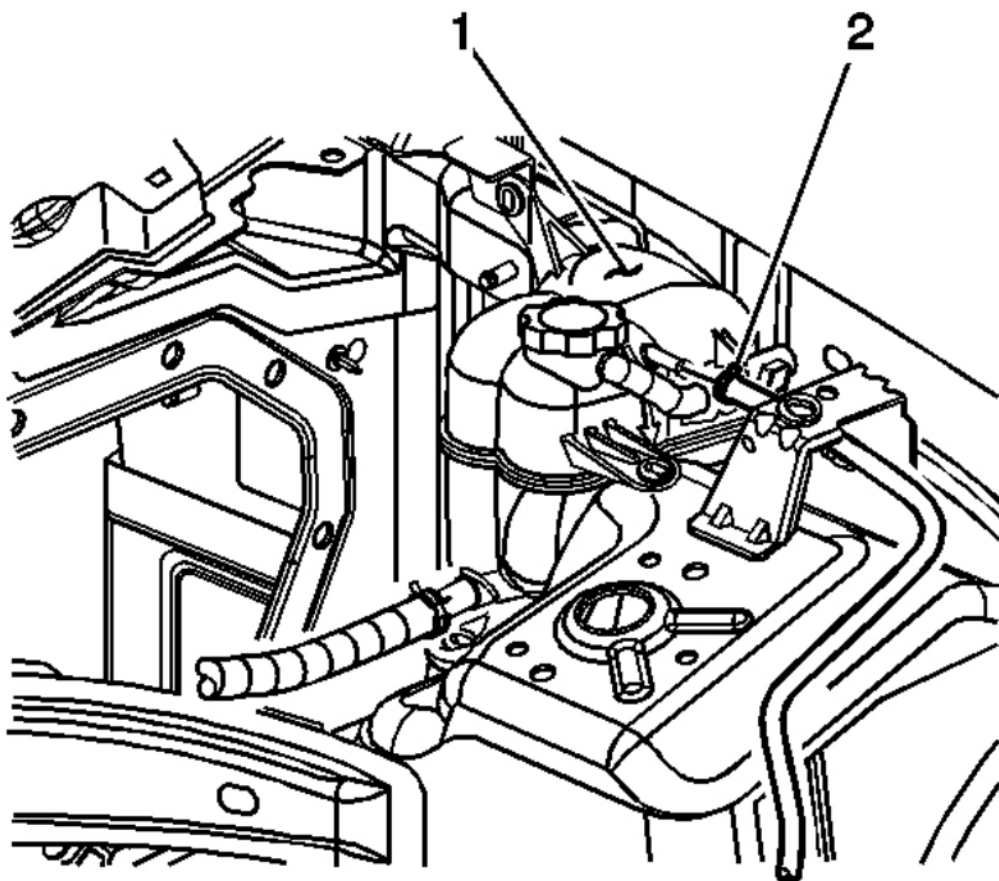


Fig. 35: Locating Surge Tank & Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

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

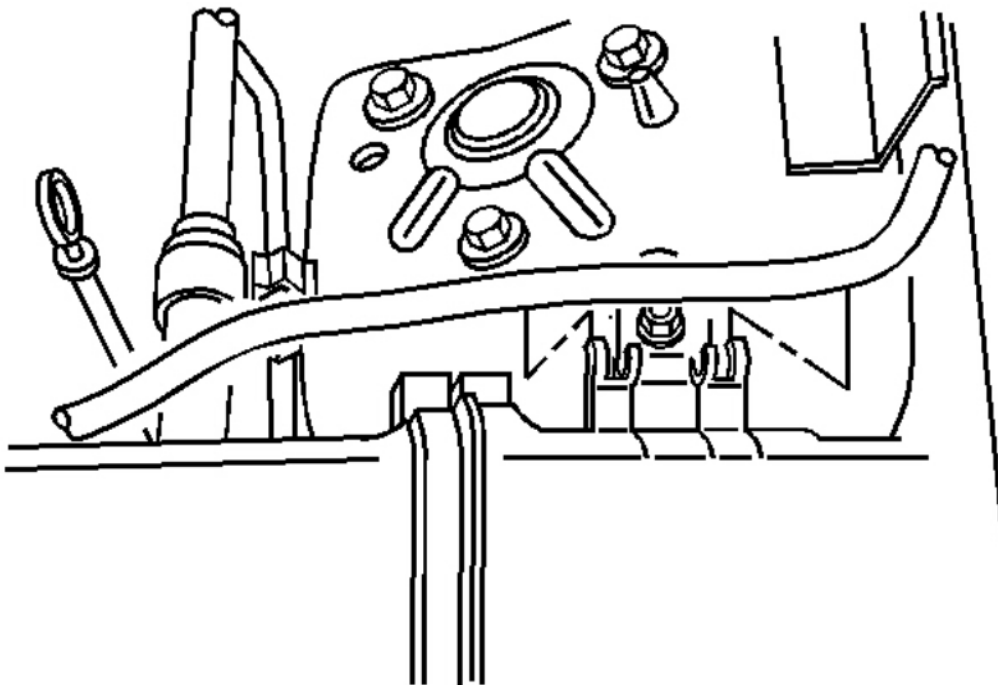


Fig. 36: View Of Surge Tank Inlet Hose & Retaining Feature
Courtesy of GENERAL MOTORS CORP.

2. Remove the inlet hose from the clips on the air cleaner housing.
3. Remove the inlet hose tee from the power steering fluid reservoir.

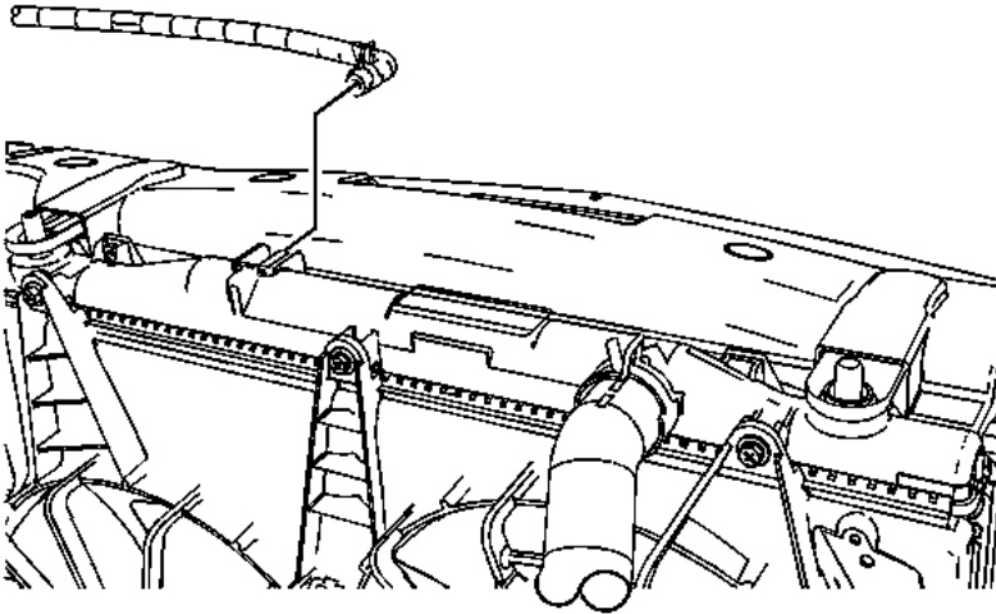


Fig. 37: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

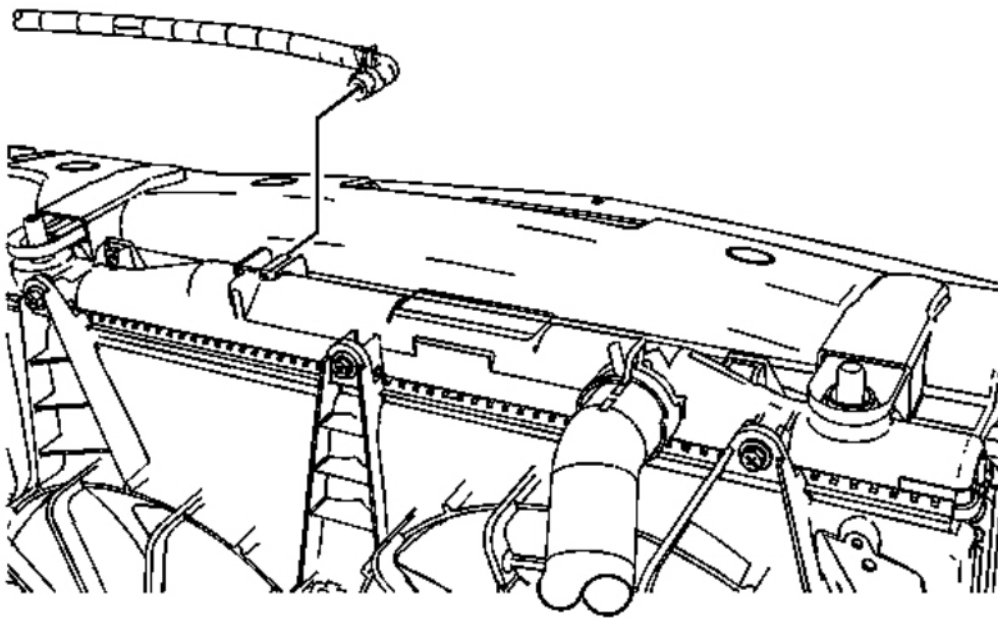


Fig. 38: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

1. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose to the throttle body assembly. See **Special Tools**.
2. Position **J 38185** to the clamp in order to connect the surge tank inlet hose to the radiator. See **Special Tools**.

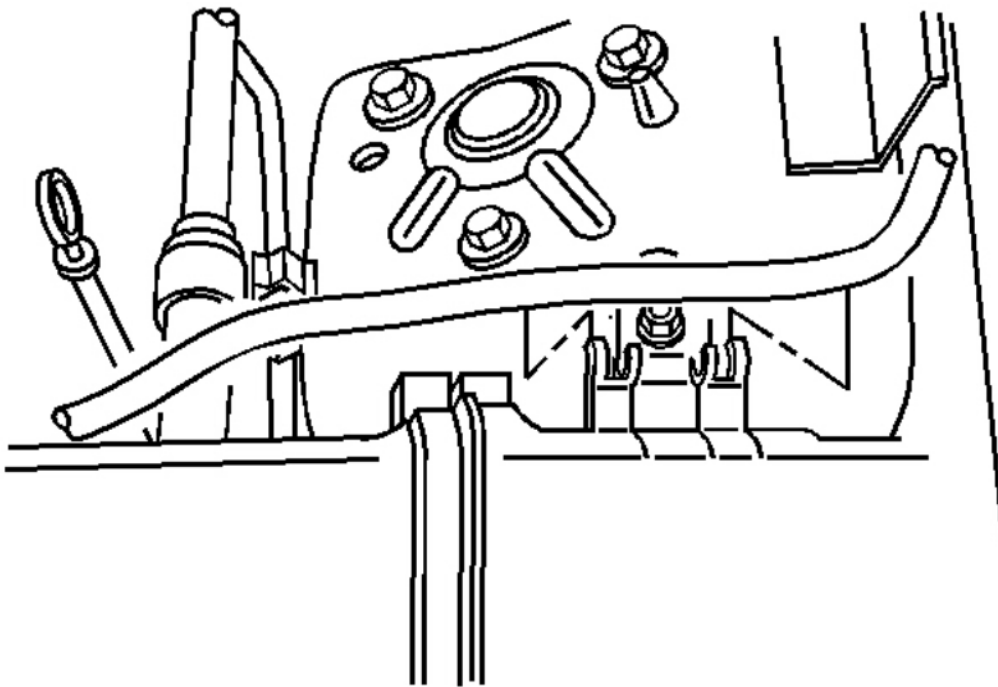


Fig. 39: View Of Surge Tank Inlet Hose & Retaining Feature
Courtesy of GENERAL MOTORS CORP.

3. Install the inlet hose tee to the power steering fluid reservoir.
4. Install the inlet hose to the clips on the air cleaner housing.

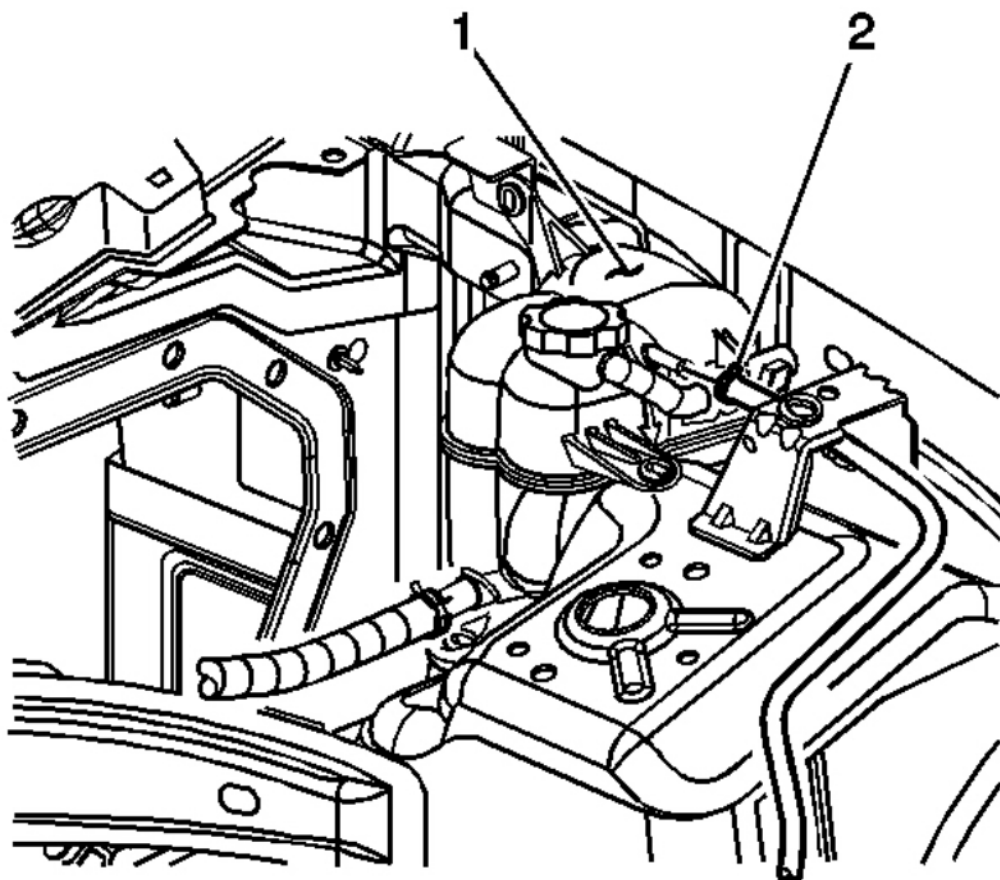


Fig. 40: Locating Surge Tank & Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Route the surge tank inlet hose under the hood assist rod support.
6. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose (2) to the surge tank (1). See **Special Tools**.

SURGE TANK HOSE/PIPE REPLACEMENT - INLET (LS6)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

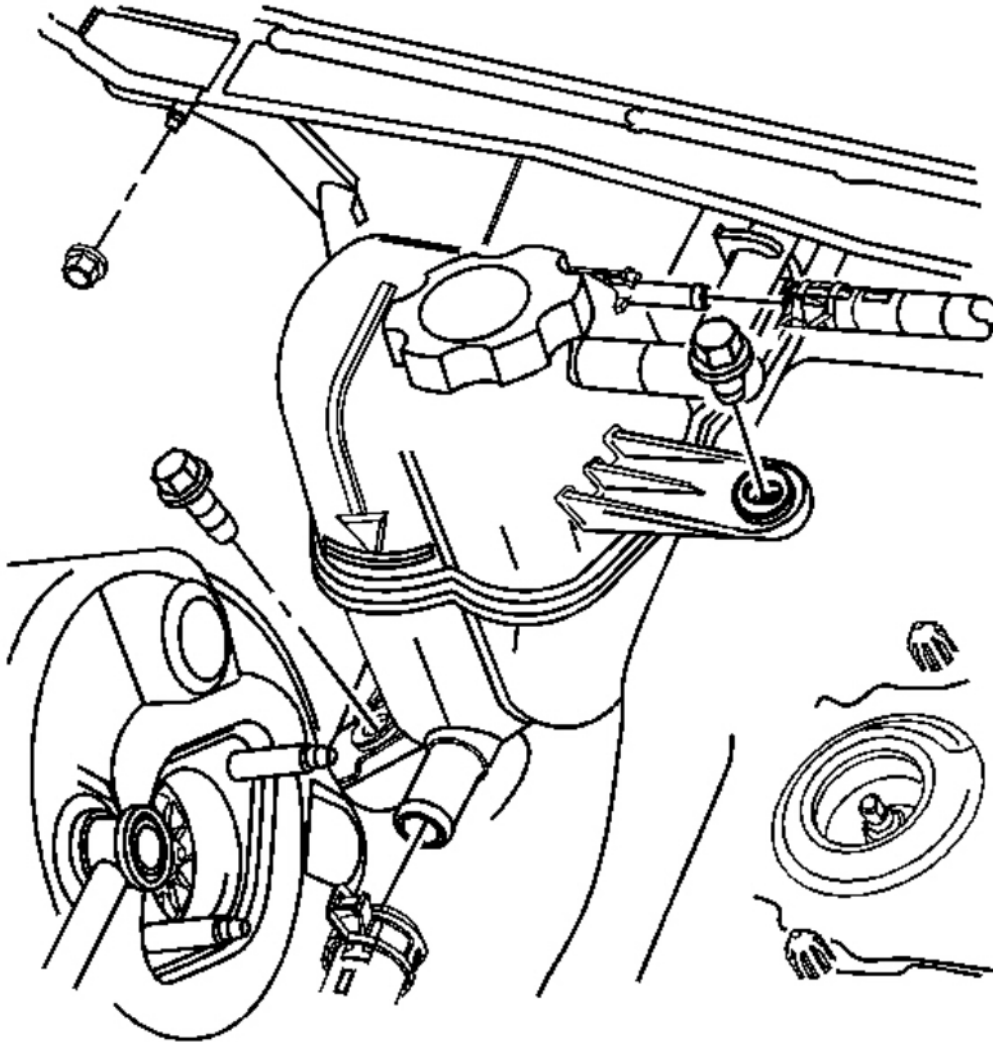


Fig. 41: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to remove the surge tank inlet hose from the surge tank. See **Special Tools**.

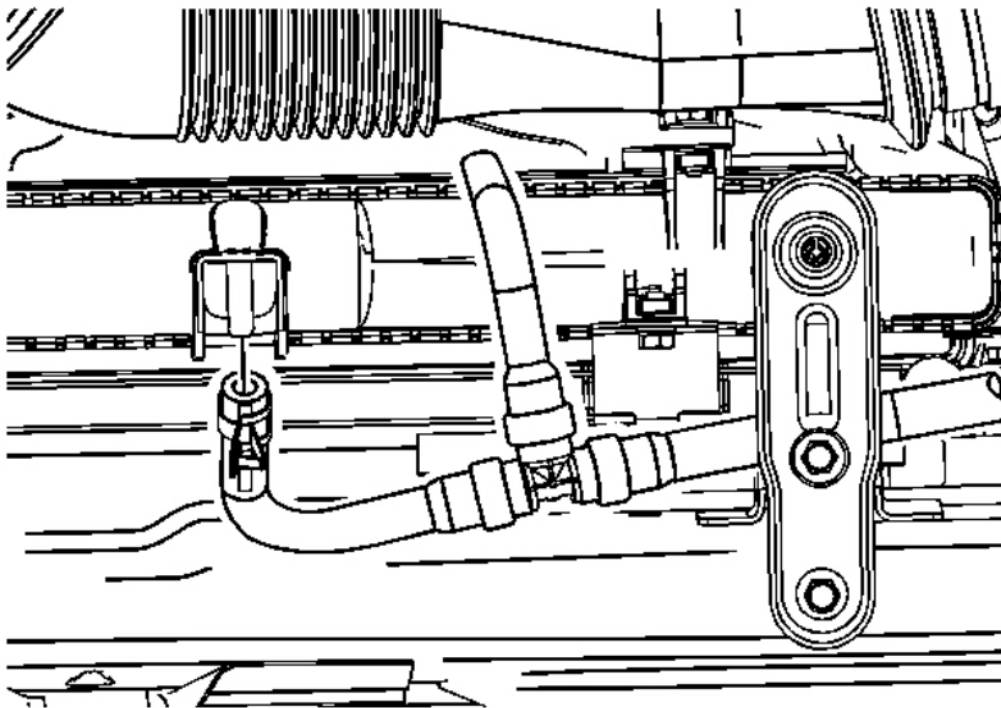


Fig. 42: View Of Surge Tank Inlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to remove the surge tank inlet hose from the radiator. See **Special Tools**.

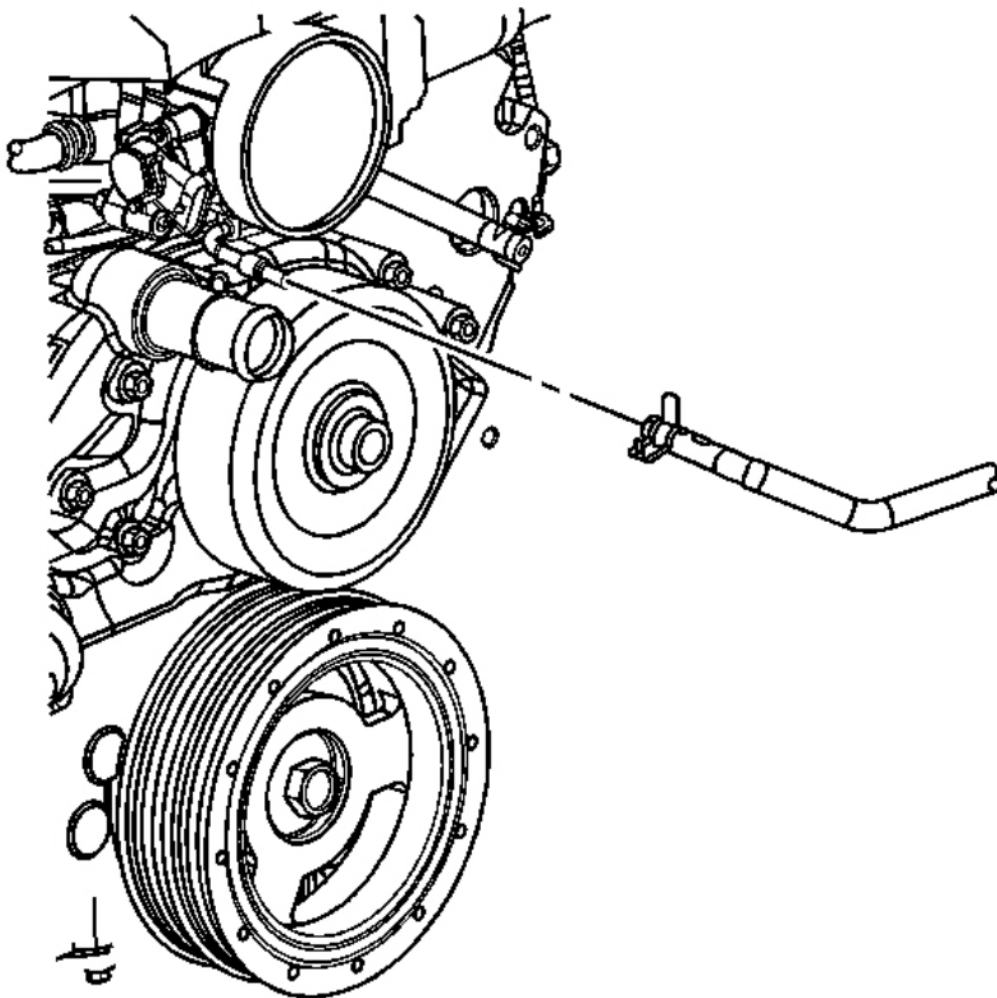


Fig. 43: Locating Surge Tank Inlet Hose To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

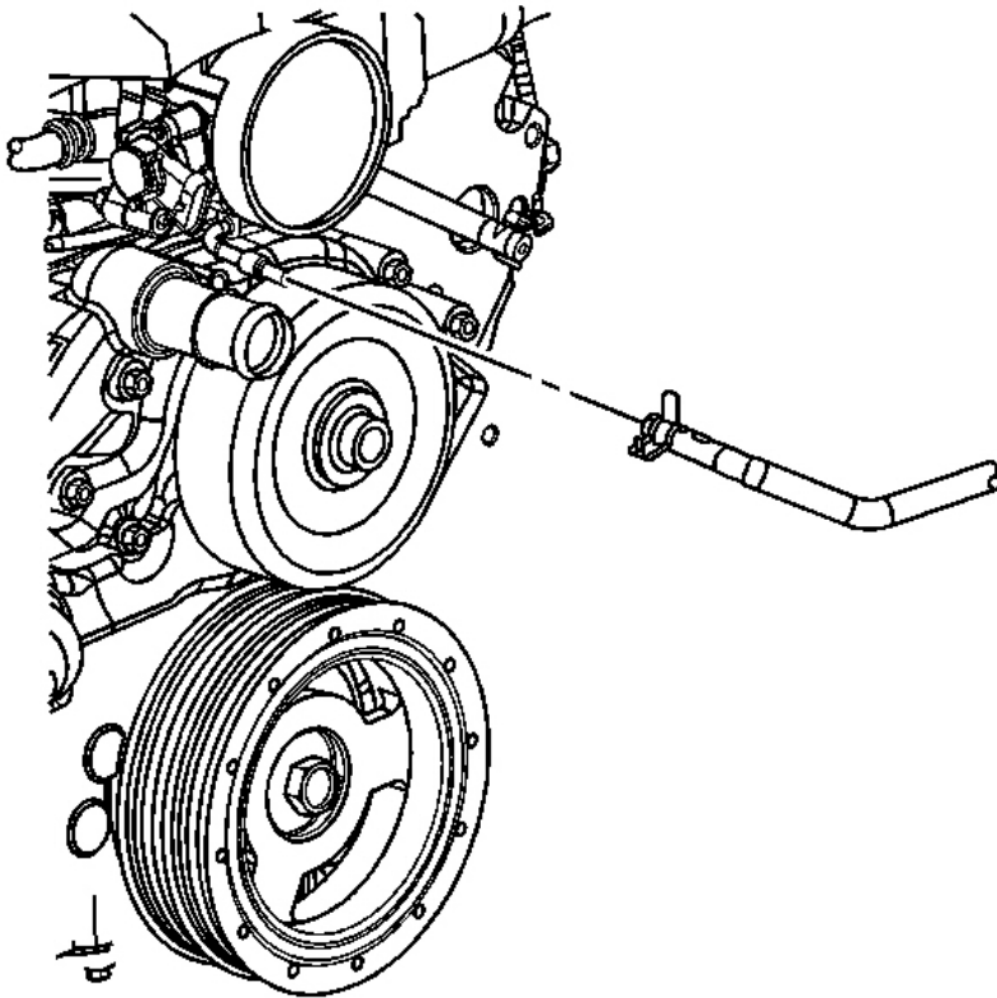


Fig. 44: Locating Surge Tank Inlet Hose To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

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

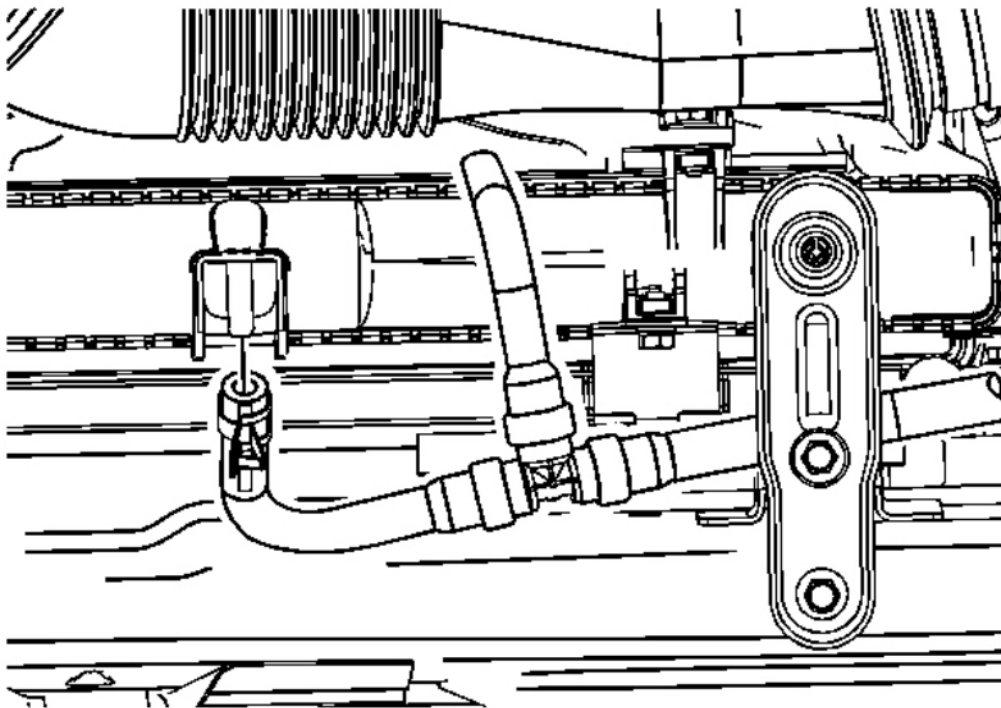


Fig. 45: View Of Surge Tank Inlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

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

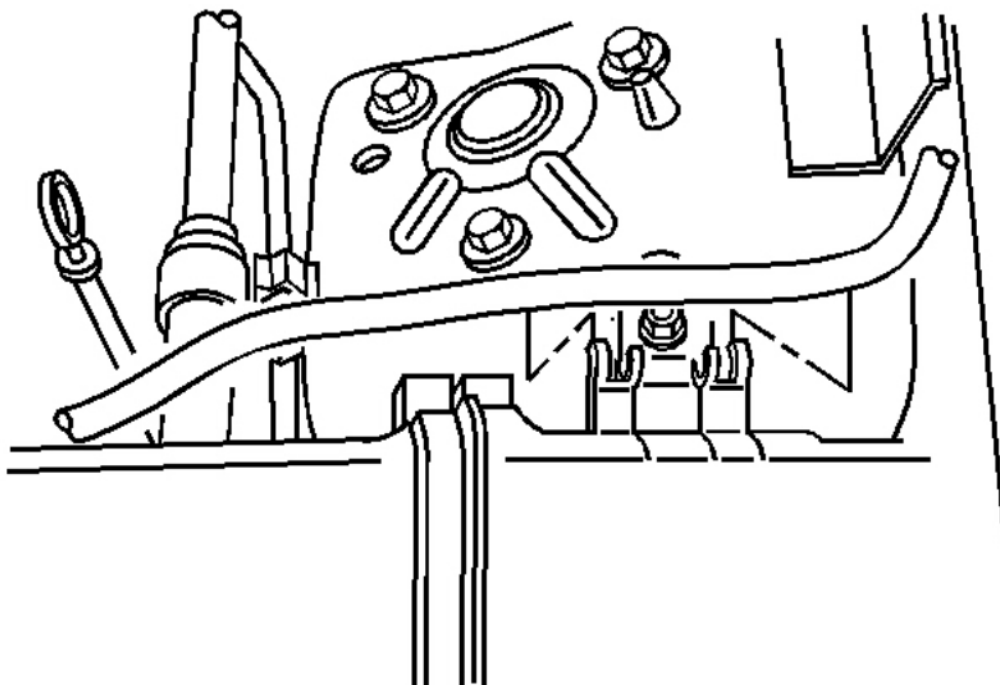


Fig. 46: View Of Surge Tank Inlet Hose & Retaining Feature
Courtesy of GENERAL MOTORS CORP.

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

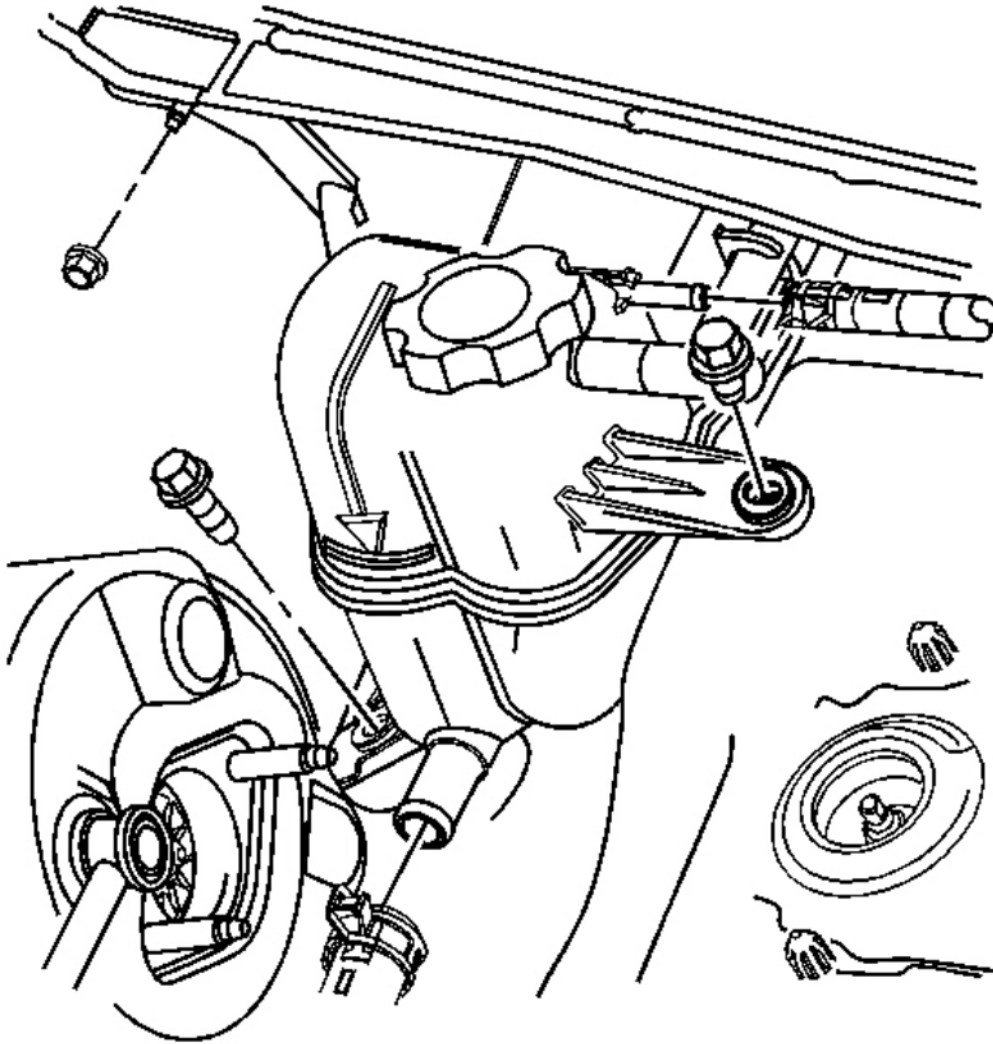


Fig. 47: View Of Surge Tank Inlet/Outlet Hoses & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

4. Route the surge tank inlet hose under the hood assist rod support.
5. Position **J 38185** to the clamp in order to connect the surge tank inlet hose to the surge tank. See **Special Tools**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LP1, LY7)**Tools Required**

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

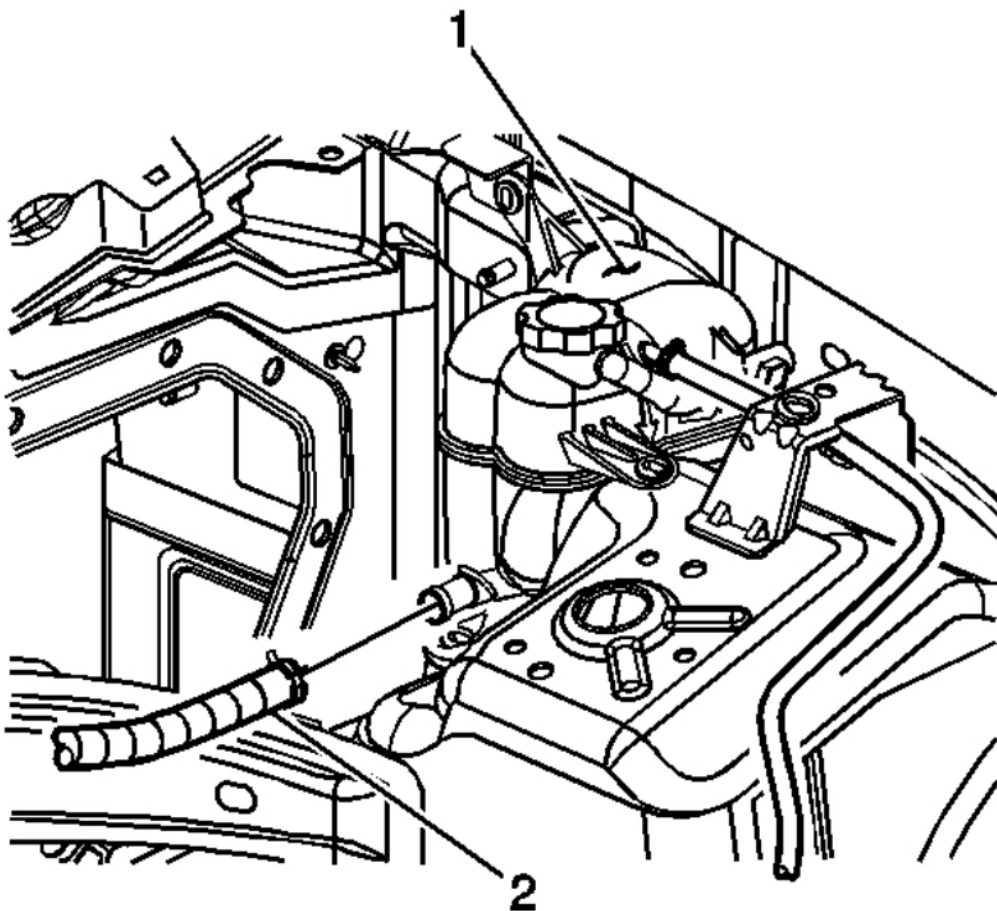


Fig. 48: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

2. Position **J 38185** to the clamp in order to remove the outlet hose (2) from the surge tank (1). See **Special Tools**.
3. Loosen the bolt on the bracket which secures the surge tank outlet hose to the engine.
4. Remove the windshield wiper transmission. Refer to **Wiper Transmission Replacement** in Wipers/Washer System.
5. Position **J 38185** to the clamp in order to remove the surge tank outlet hose from the thermostat assembly. See **Special Tools**.
6. 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. See **Special Tools**.
3. Install the windshield wiper transmission. Refer to **Wiper Transmission Replacement** in Wipers/Washer System.

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

4. 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).

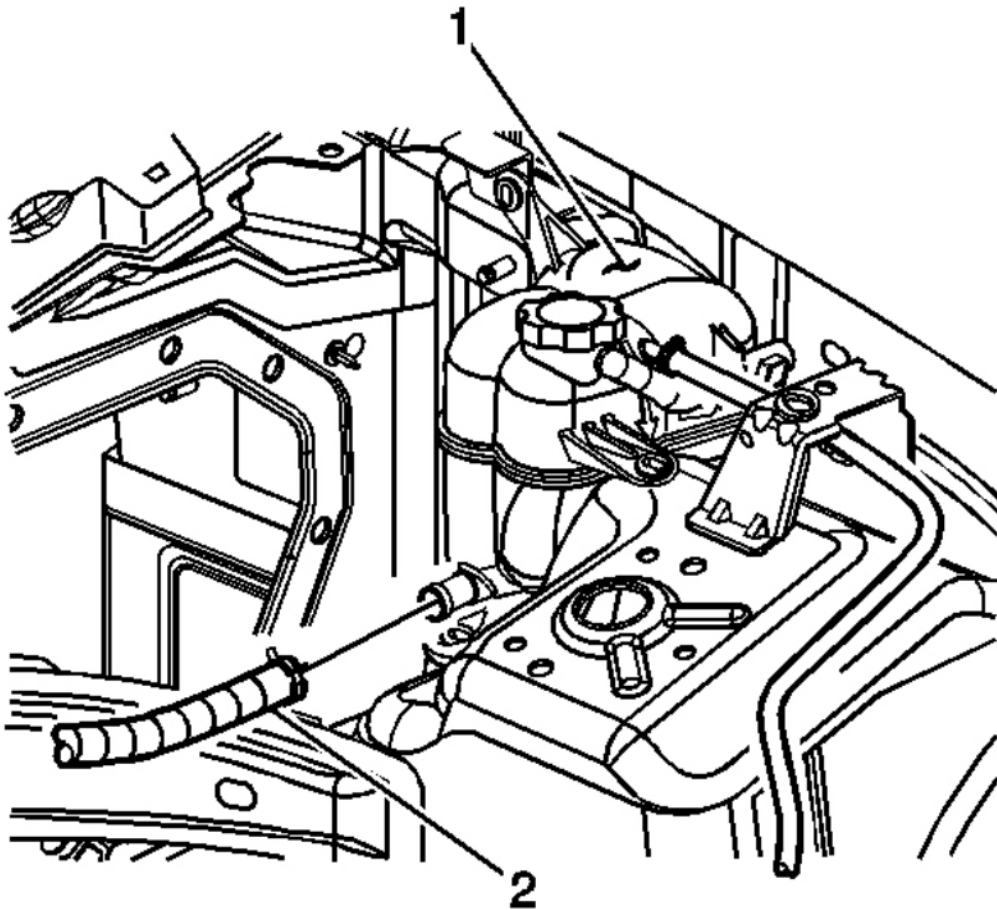


Fig. 49: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

5. Position **J 38185** to the clamp in order to connect the outlet hose (2) to the surge tank (1). See **Special Tools**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LS6)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

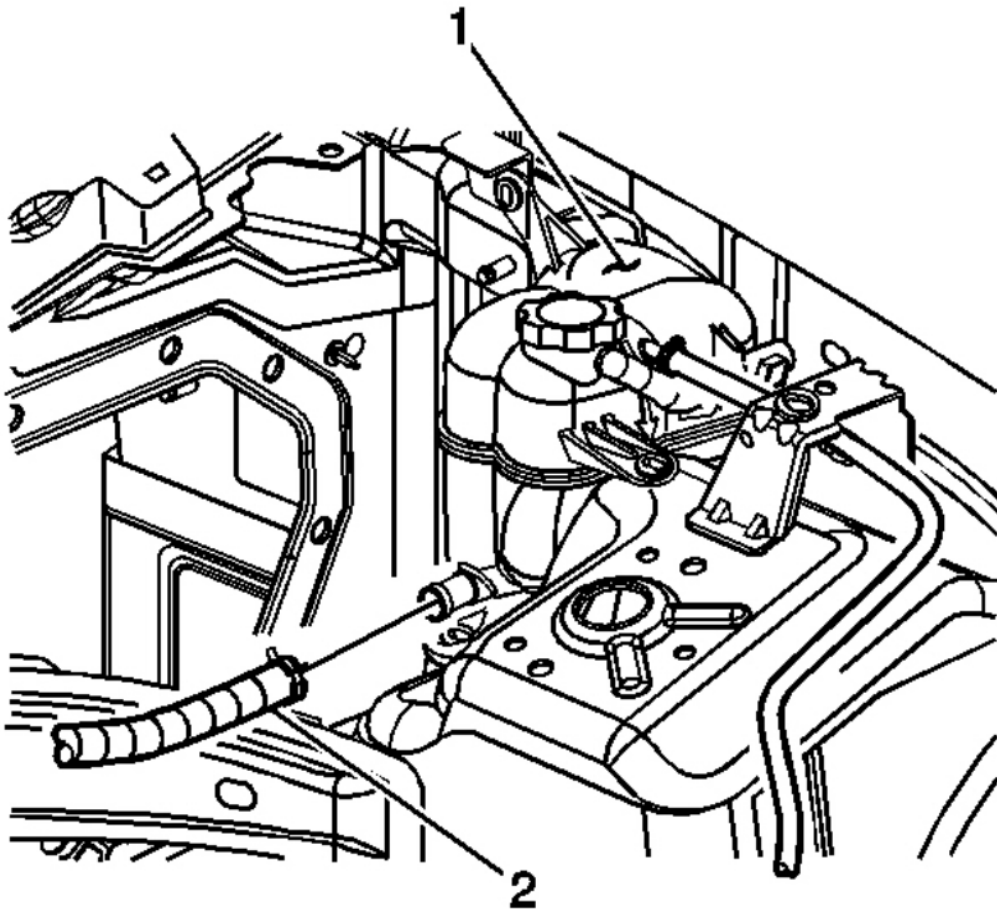


Fig. 50: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to remove the outlet hose (2) from the surge tank (1). See **Special Tools**.
3. Remove the nuts on the bracket which secures the surge tank outlet hose to the cowl.
4. Position **J 38185** to the clamp in order to remove the surge tank outlet hose from the heater hose pipe. See **Special Tools**.

5. Remove the surge tank outlet hose from the pipe.

Installation Procedure

1. Position the surge tank outlet hose to the heater hose pipe.
2. Position **J 38185** to the clamp in order to connect the surge tank outlet hose to the heater hose pipe. See **Special Tools**.

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

3. Install the nut to the bracket securing the surge tank outlet pipe to the cowl.

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

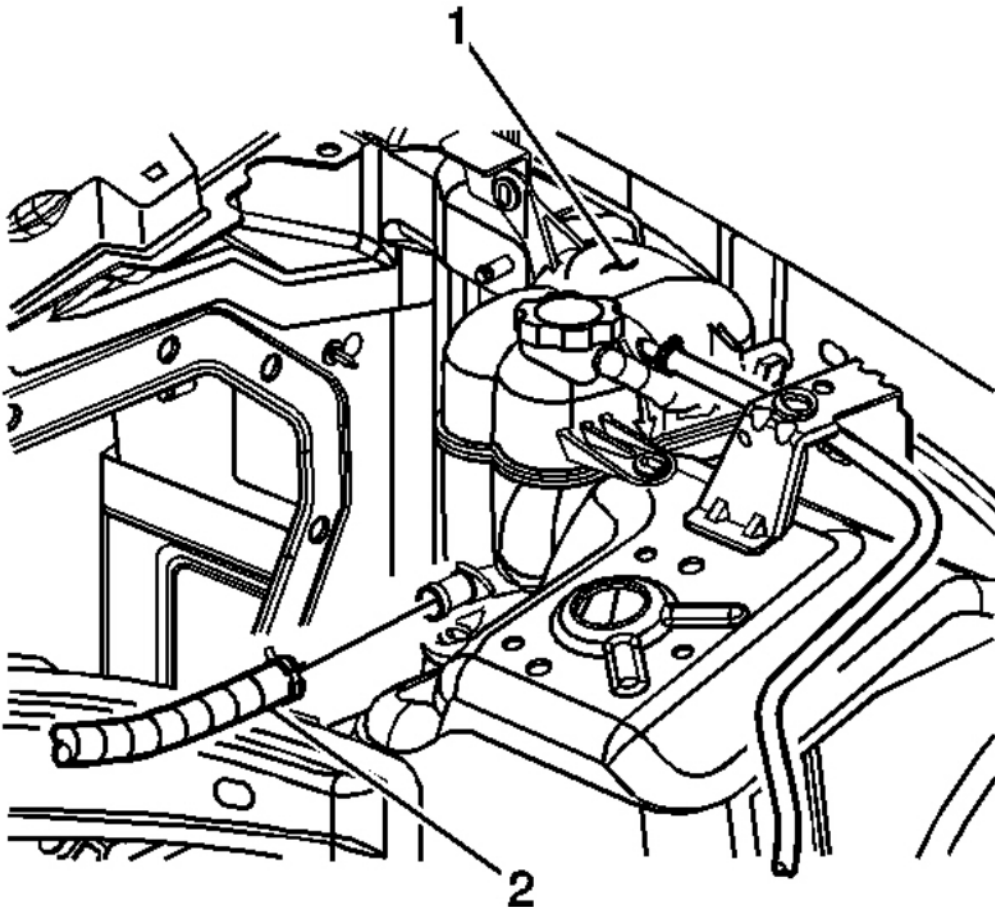


Fig. 51: Locating Surge Tank & Surge Tank Outlet Hose - LHD, LY7

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). See **Special Tools**.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

RADIATOR HOSE REPLACEMENT - INLET (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

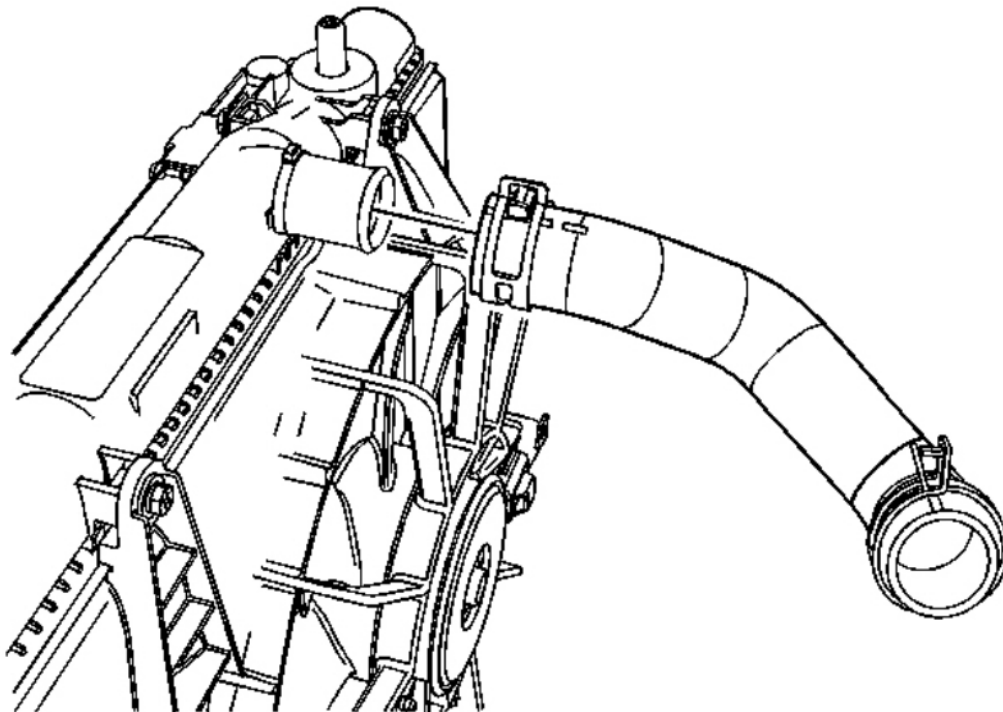


Fig. 52: View Of Radiator Inlet Hose & Clamp

Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Position **J 38185** to the clamp in order to remove the inlet hose from the radiator. See **Special Tools**.

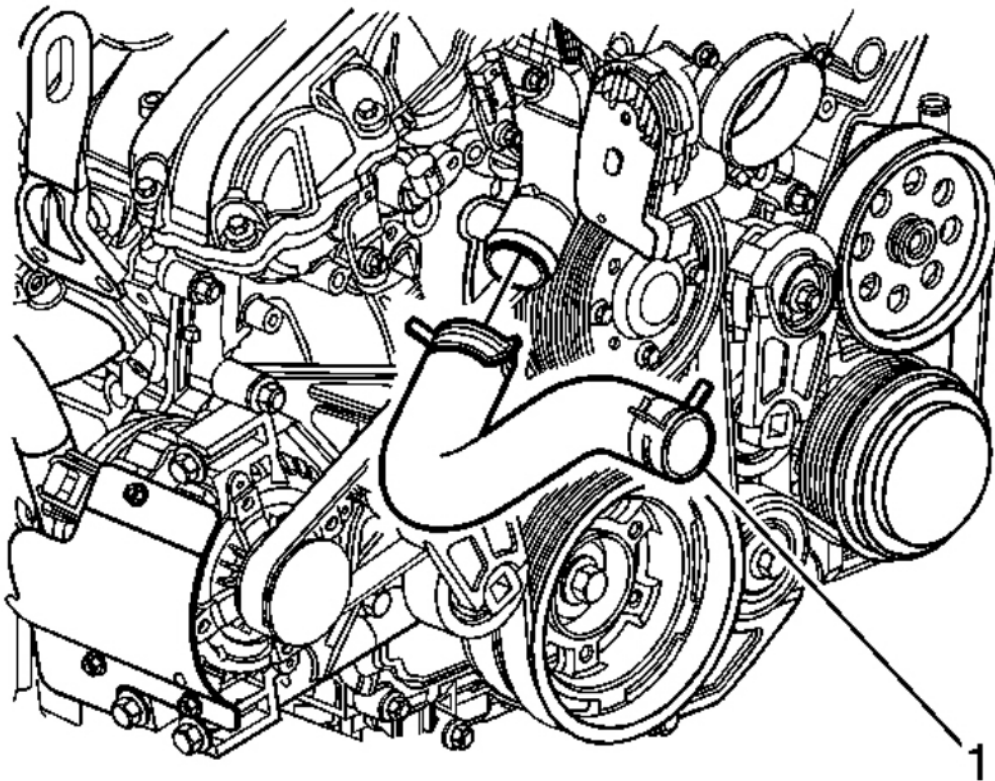


Fig. 53: Locating Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to remove the hose (1) from the engine. See **Special Tools**.
4. Remove the inlet hose.

Installation Procedure

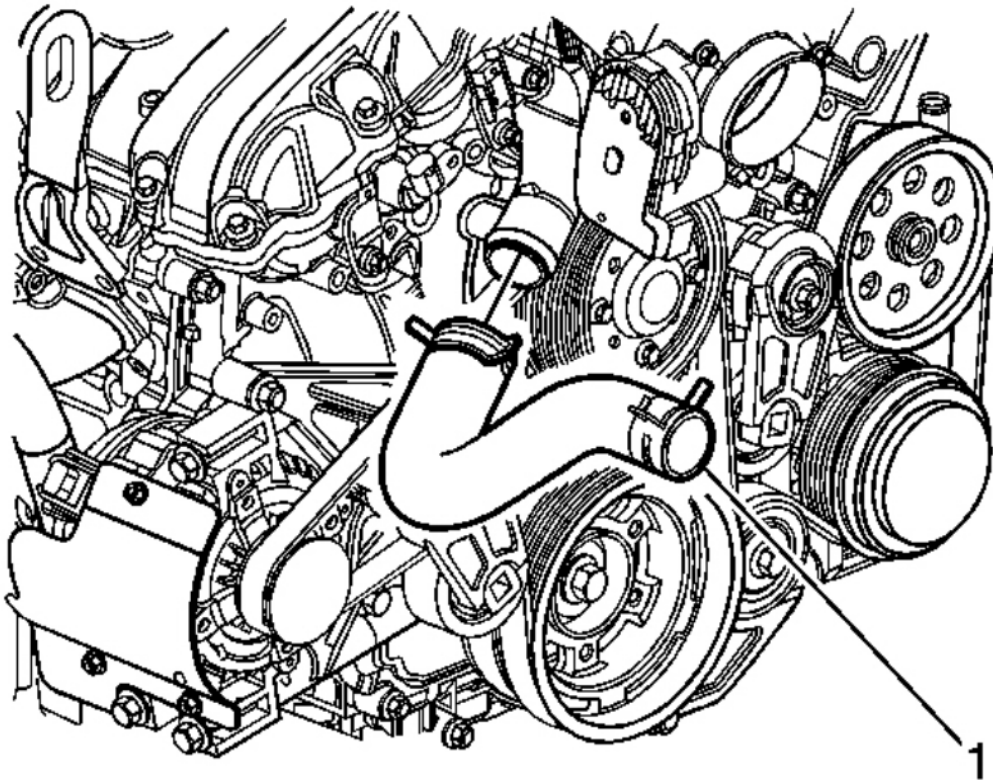


Fig. 54: Locating Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator inlet hose into the vehicle with the mark in the top position.
2. Position **J 38185** to the clamp in order to connect the hose (1) to the engine. See **Special Tools**.

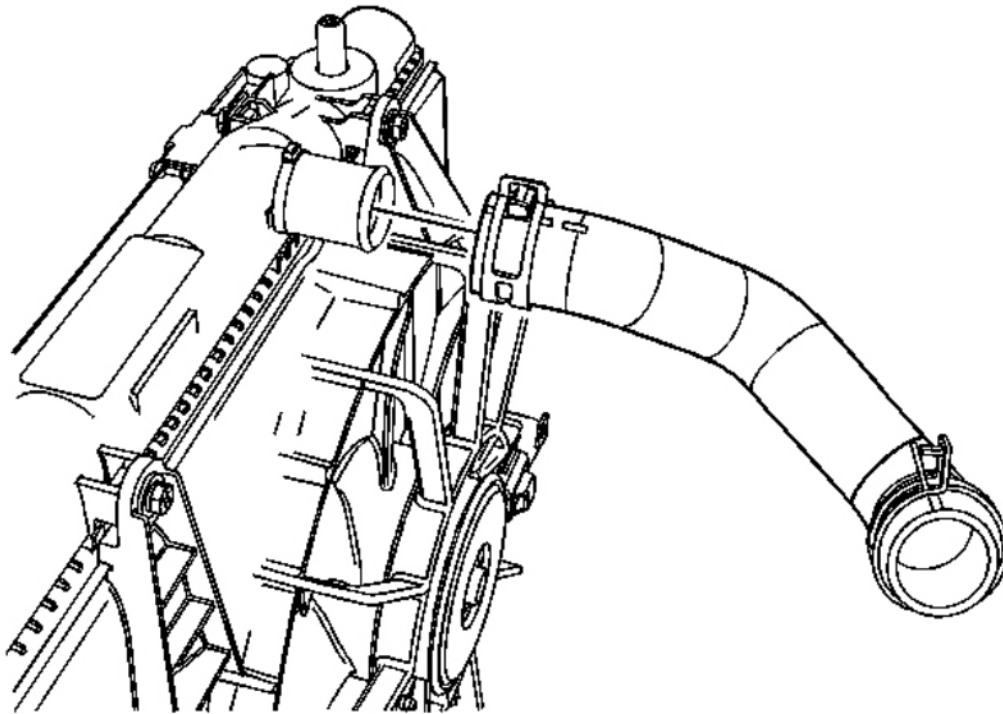


Fig. 55: View Of Radiator Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Position the **J 37097-A** to the clamp in order to connect the hose to the radiator. See **Special Tools**.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

RADIATOR HOSE REPLACEMENT - INLET (LS6)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

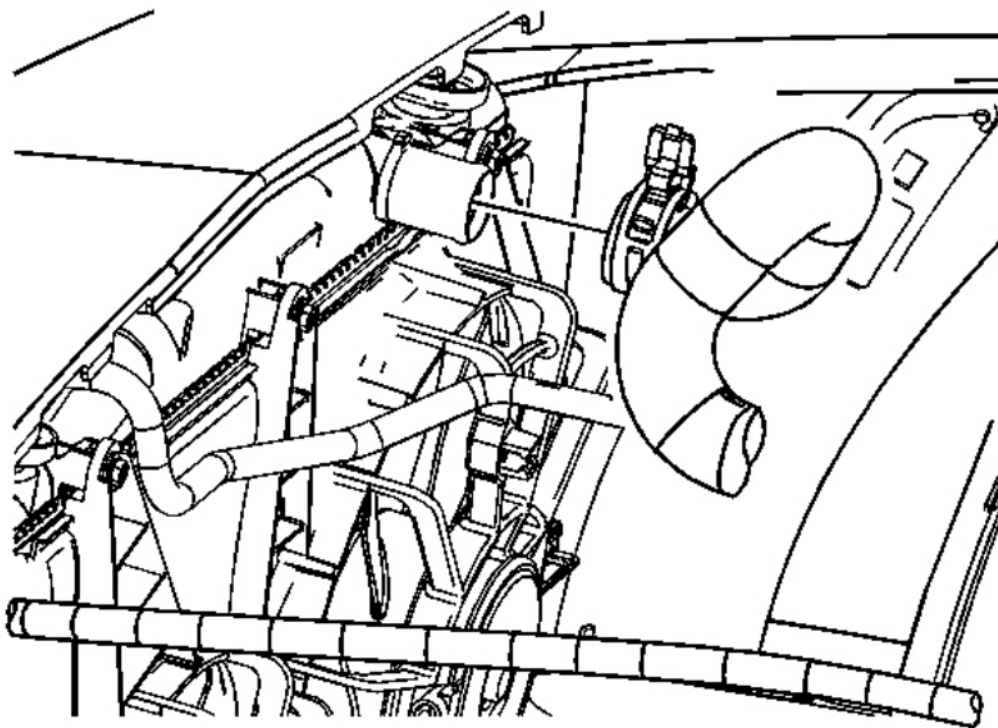


Fig. 56: Identifying Radiator Hose To Radiator & Clamp
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Position **J 38185** to the clamp in order to remove the inlet hose from the radiator. See **Special Tools**.

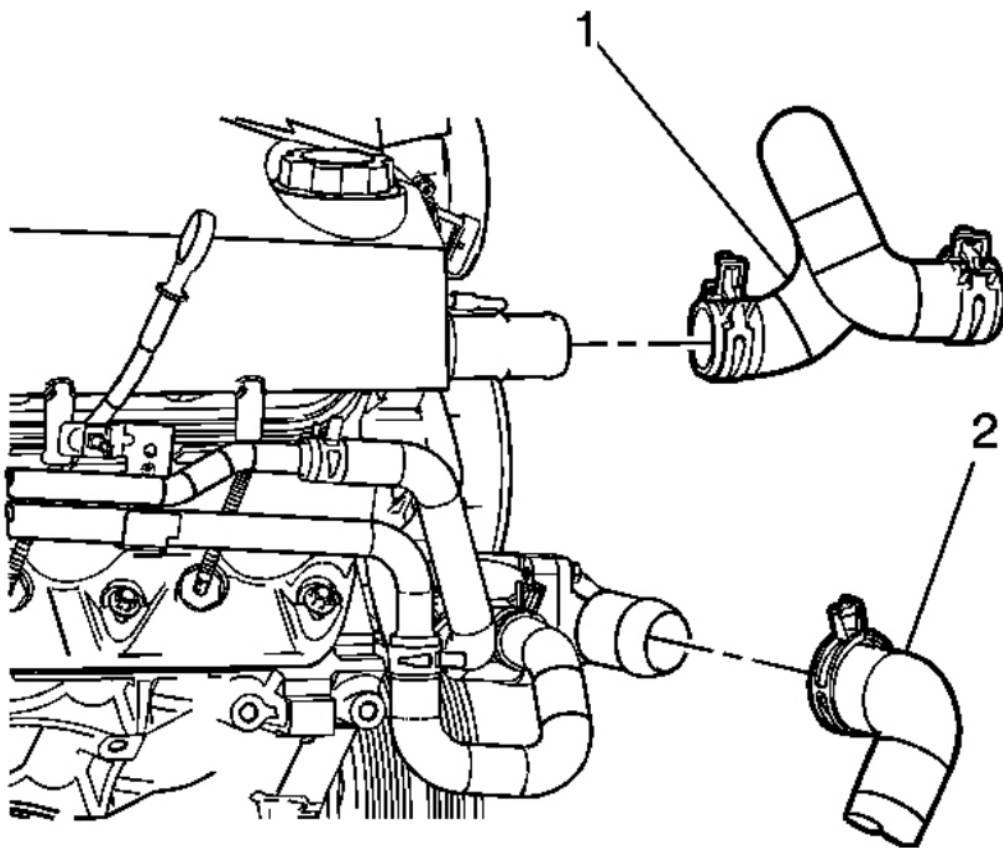


Fig. 57: View Of Radiator Inlet & Outlet Hoses At Engine
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to remove the hose (1) from the engine. See **Special Tools**.
4. Remove the inlet hose.

Installation Procedure

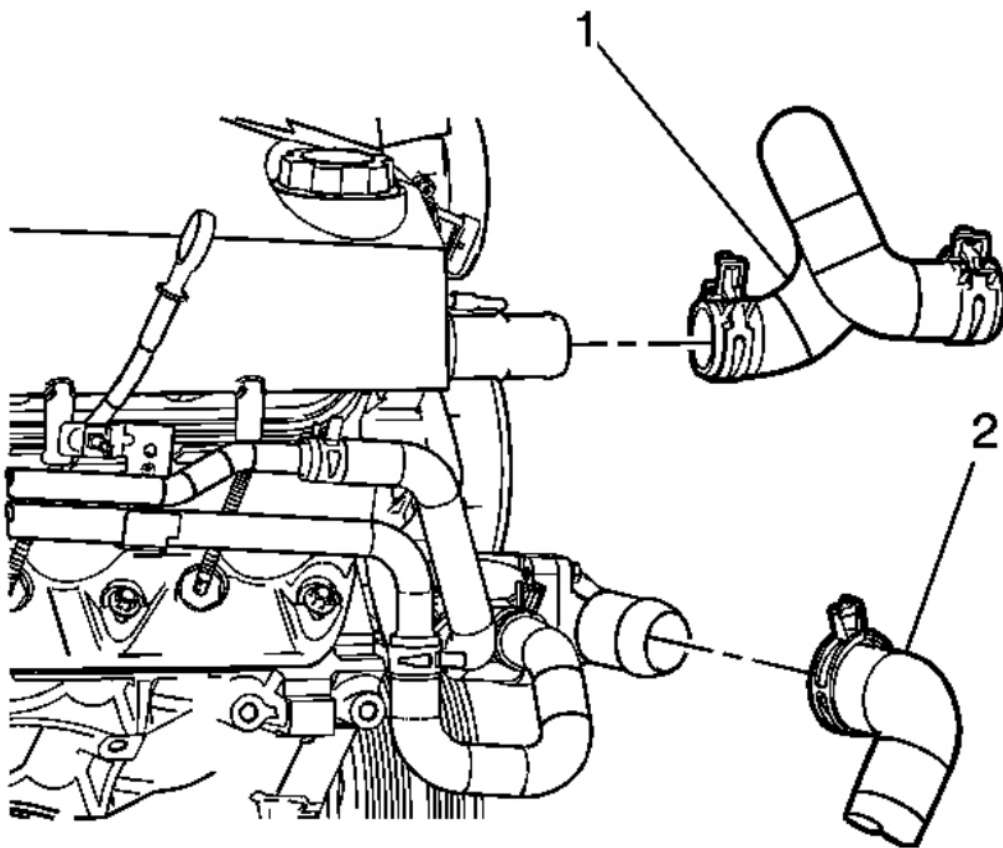


Fig. 58: View Of Radiator Inlet & Outlet Hoses At Engine
Courtesy of GENERAL MOTORS CORP.

1. Position the radiator inlet hose (1) into the vehicle.
2. Position **J 38185** to the clamp in order to connect the hose to the engine. See **Special Tools**.

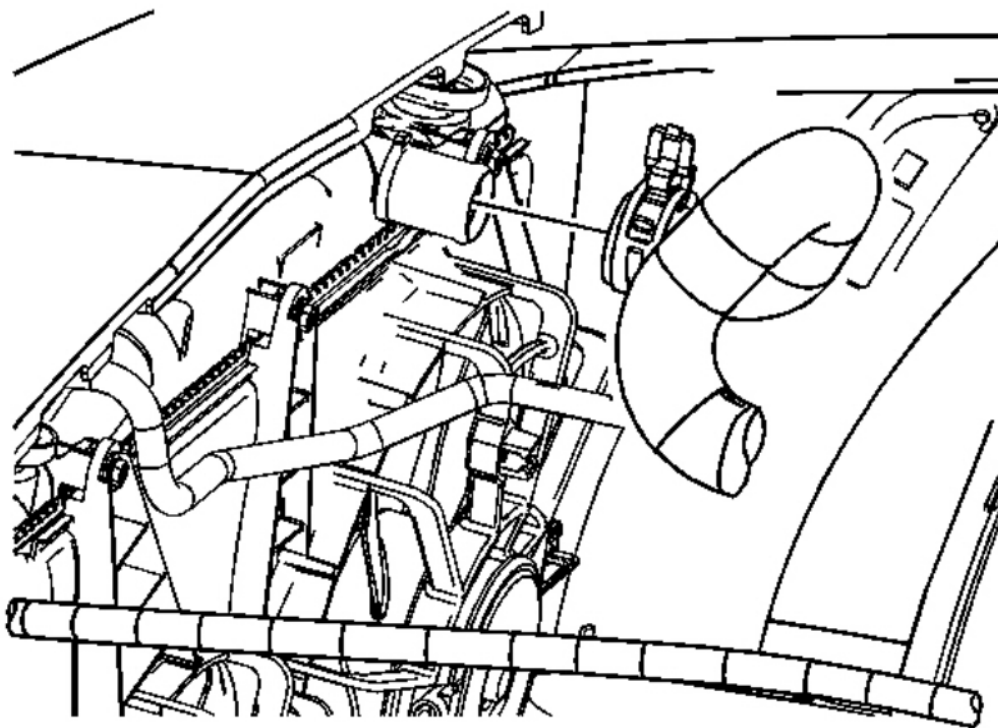


Fig. 59: Identifying Radiator Hose To Radiator & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Position the **J 38185** to the clamp in order to connect the hose to the radiator. See **Special Tools**.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

RADIATOR HOSE REPLACEMENT - OUTLET (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

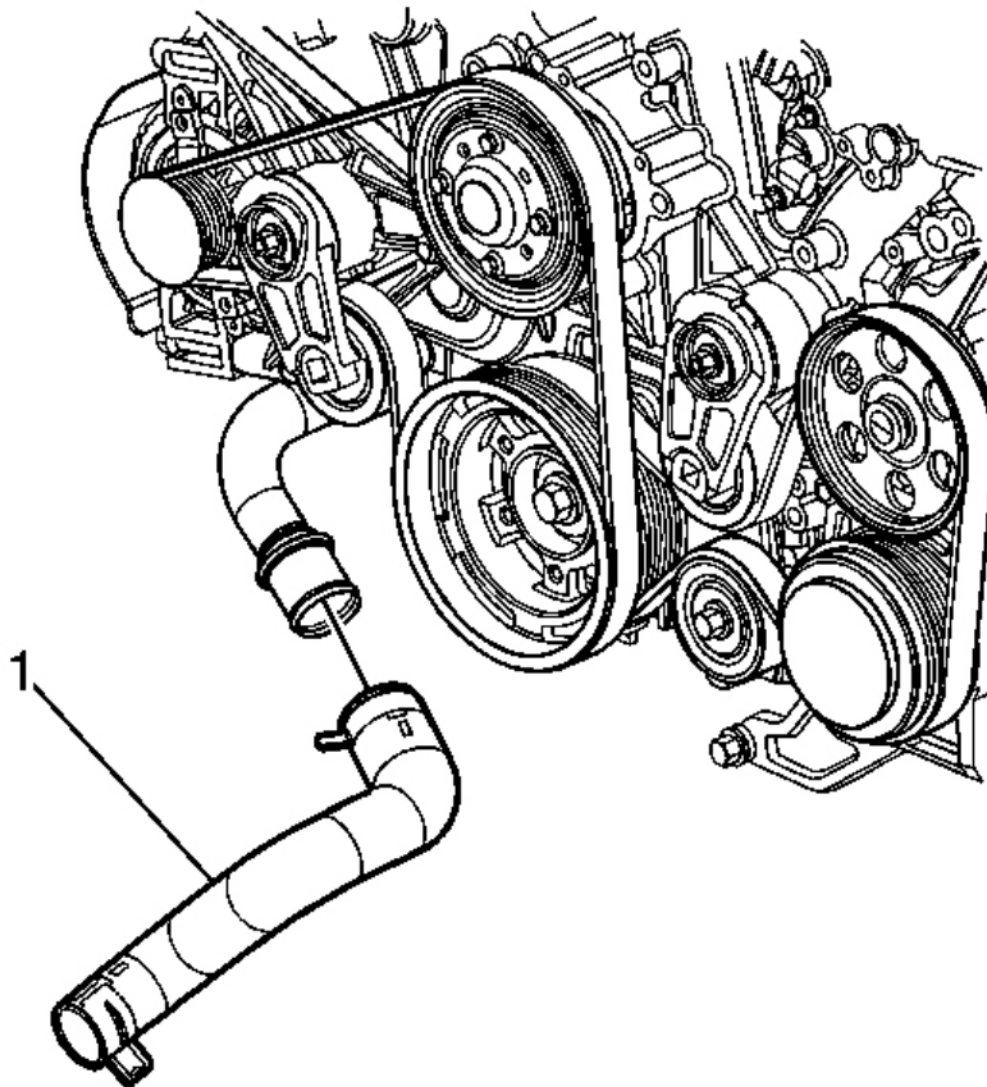


Fig. 60: View Of Radiator Hose To Cooling Pipe
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Position **J 38185** to the clamp in order to remove the radiator outlet hose (1) from the cooling pipe. See **Special Tools**.

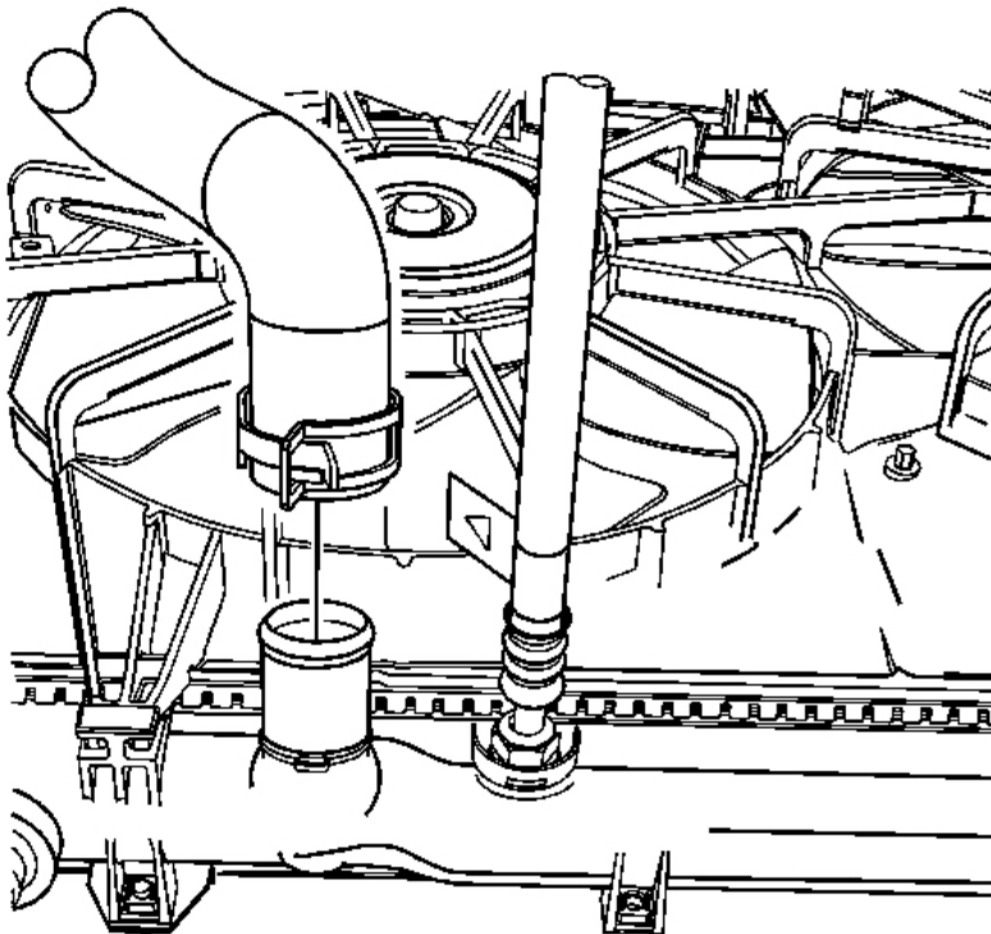


Fig. 61: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

3. Remove the hose from the vehicle.

Installation Procedure

1. Position the radiator output hose into the vehicle.

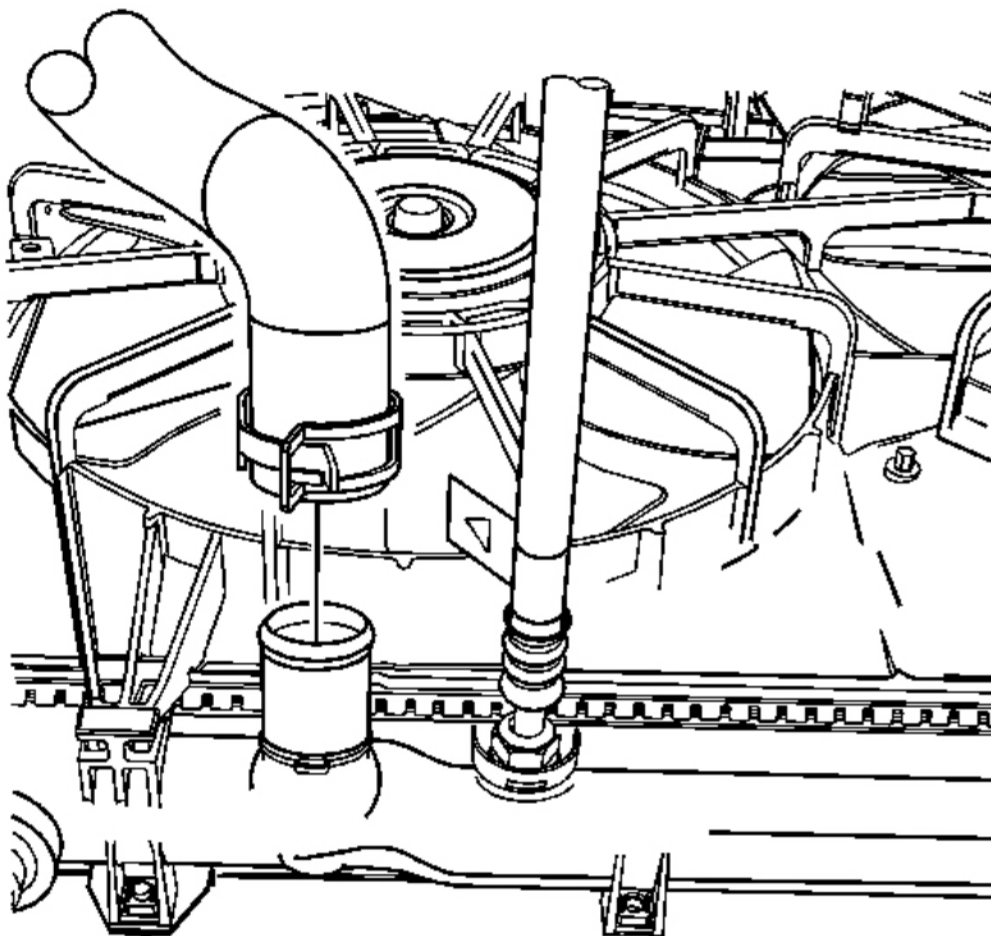


Fig. 62: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to connect the hose to the radiator. See **Special Tools**.

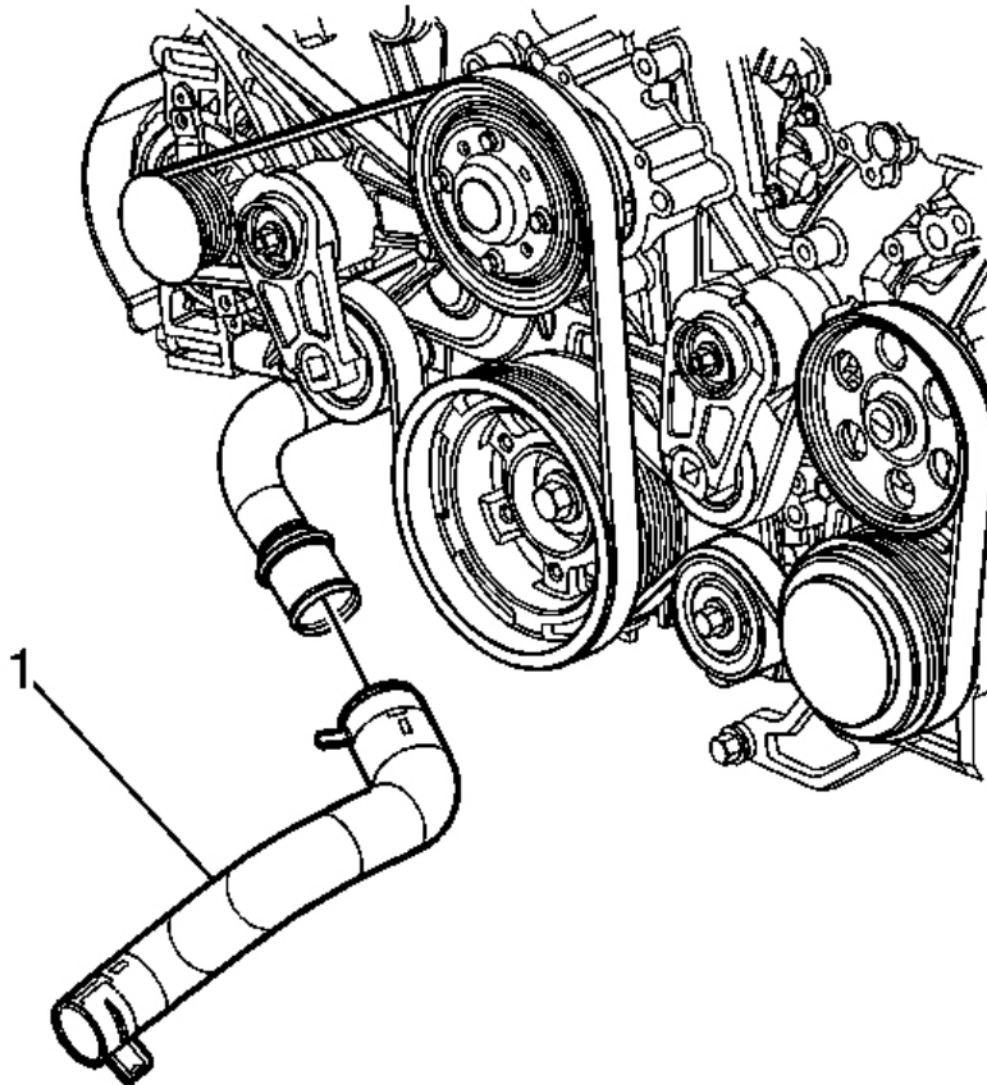


Fig. 63: View Of Radiator Hose To Cooling Pipe
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to connect the hose (1) to the cooling pipe. See **Special Tools**.
4. Install the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

RADIATOR HOSE REPLACEMENT - OUTLET (LS6)**Tools Required**

J 38185 Hose Clamp Pliers. See **Special Tools**.

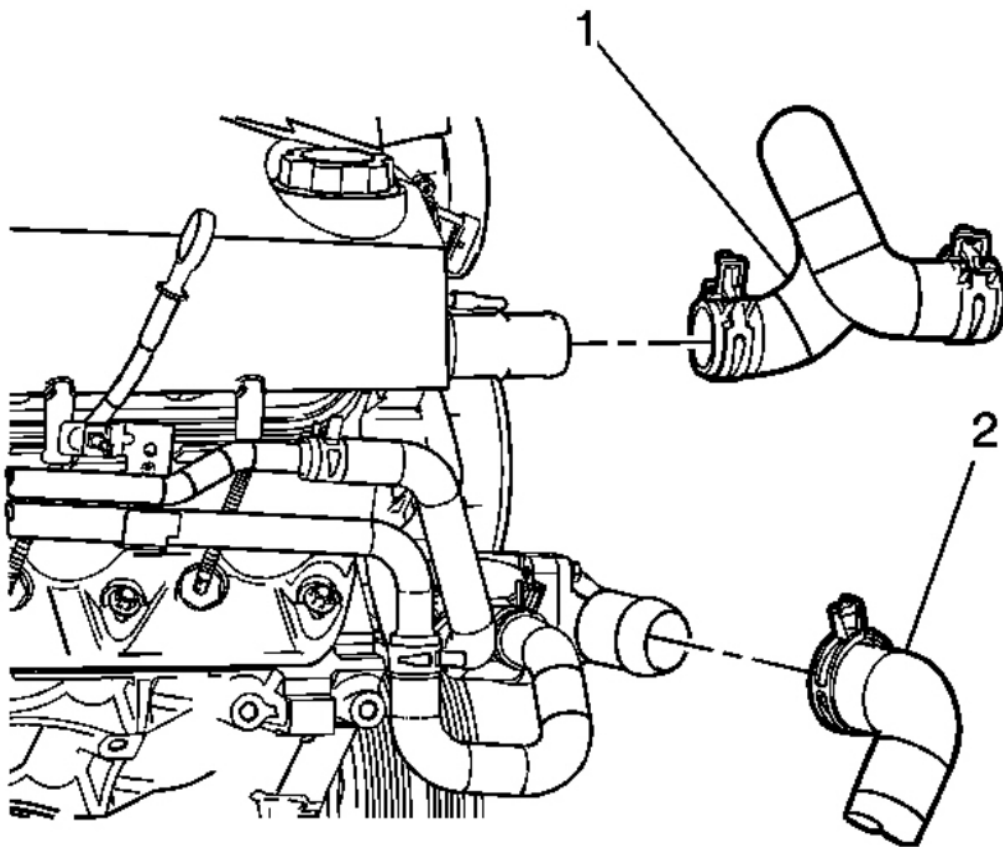
Removal Procedure

Fig. 64: View Of Radiator Inlet & Outlet Hoses At Engine
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Position **J 38185** to the clamp in order to remove the radiator outlet hose (2) from the engine. See **Special Tools**.

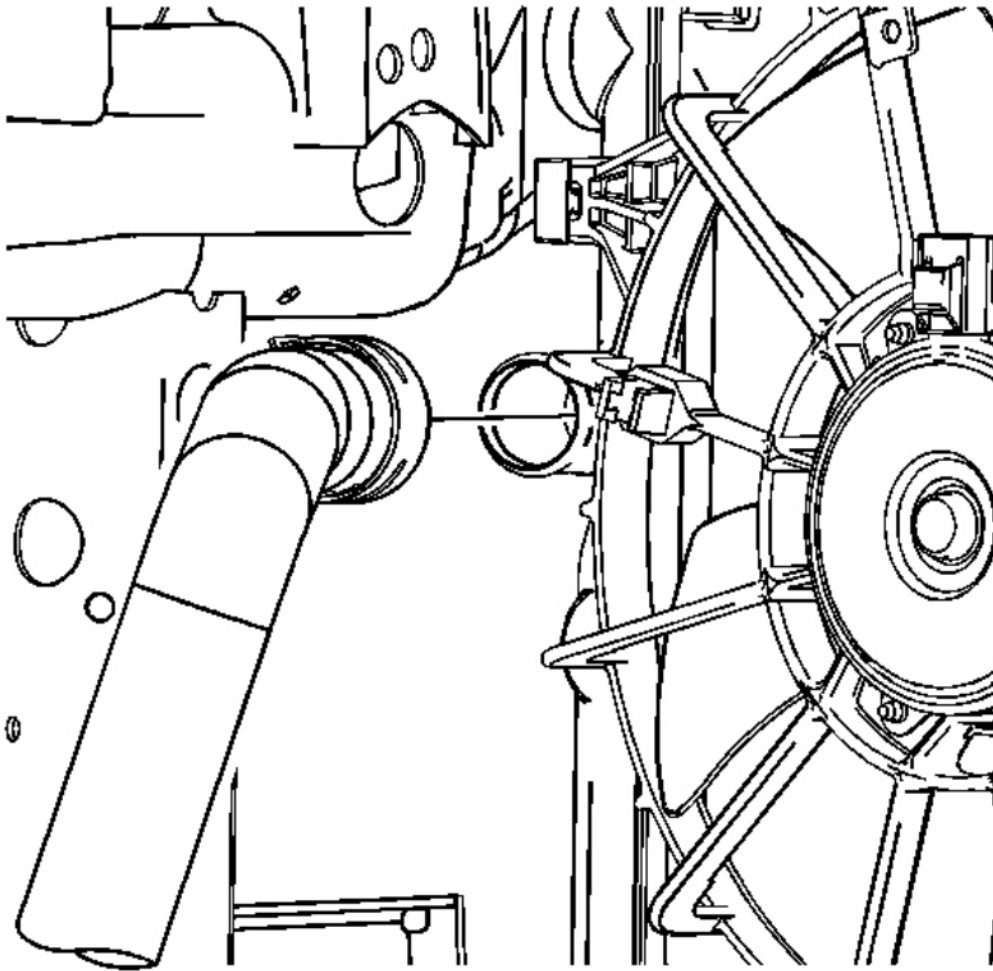


Fig. 65: Identifying Outlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to remove the radiator outlet hose from the radiator. See **Special Tools**.
4. Remove the hose from the vehicle.

Installation Procedure

1. Position the radiator output hose into the vehicle.

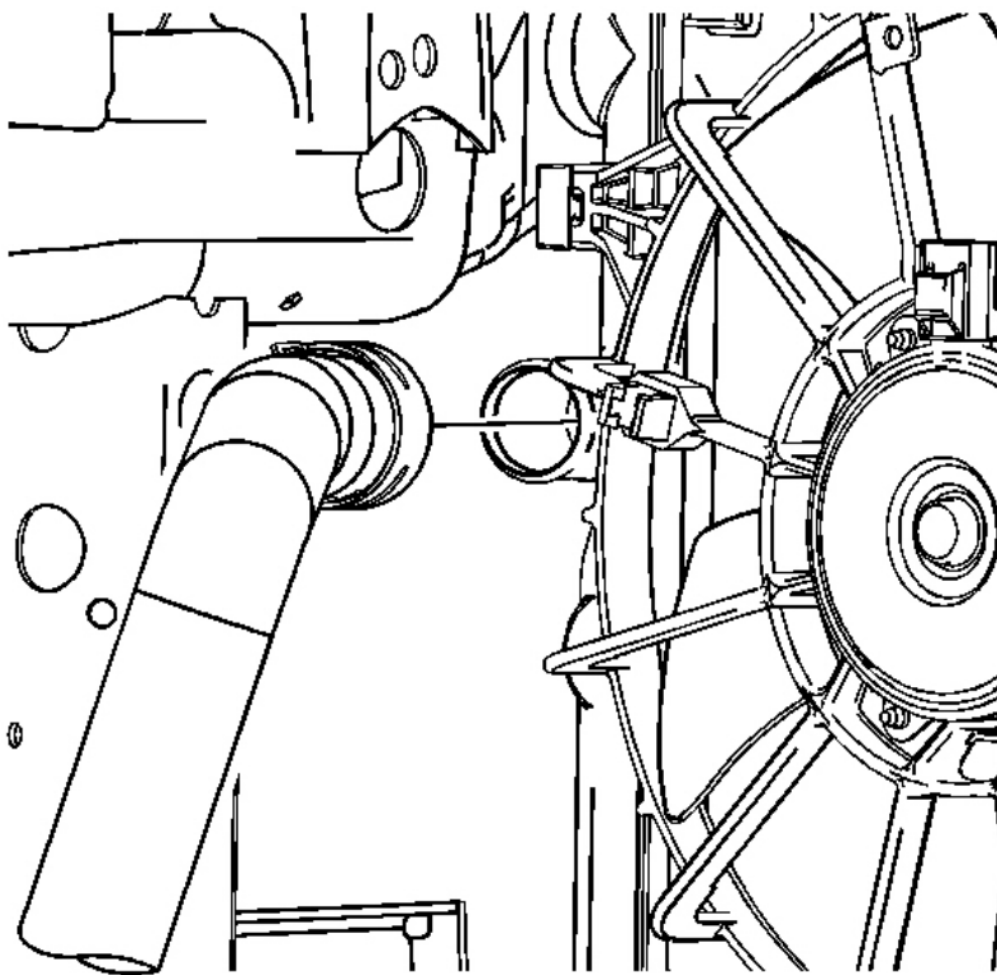


Fig. 66: Identifying Outlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

2. Position **J 38185** to the clamp in order to connect the hose to the radiator. See **Special Tools**.

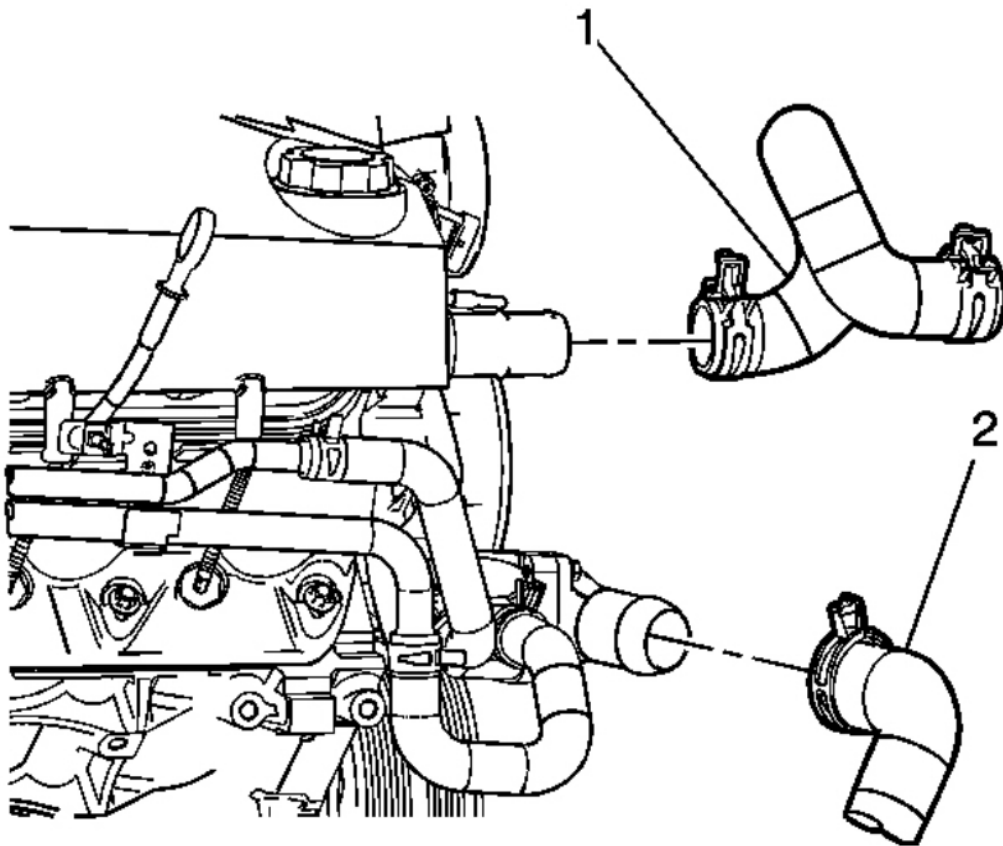


Fig. 67: View Of Radiator Inlet & Outlet Hoses At Engine
Courtesy of GENERAL MOTORS CORP.

3. Position **J 38185** to the clamp in order to connect the hose (2) to the engine. See **Special Tools**.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

THROTTLE BODY HEATER HOSE/PIPE REPLACEMENT - INLET (LS6)

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

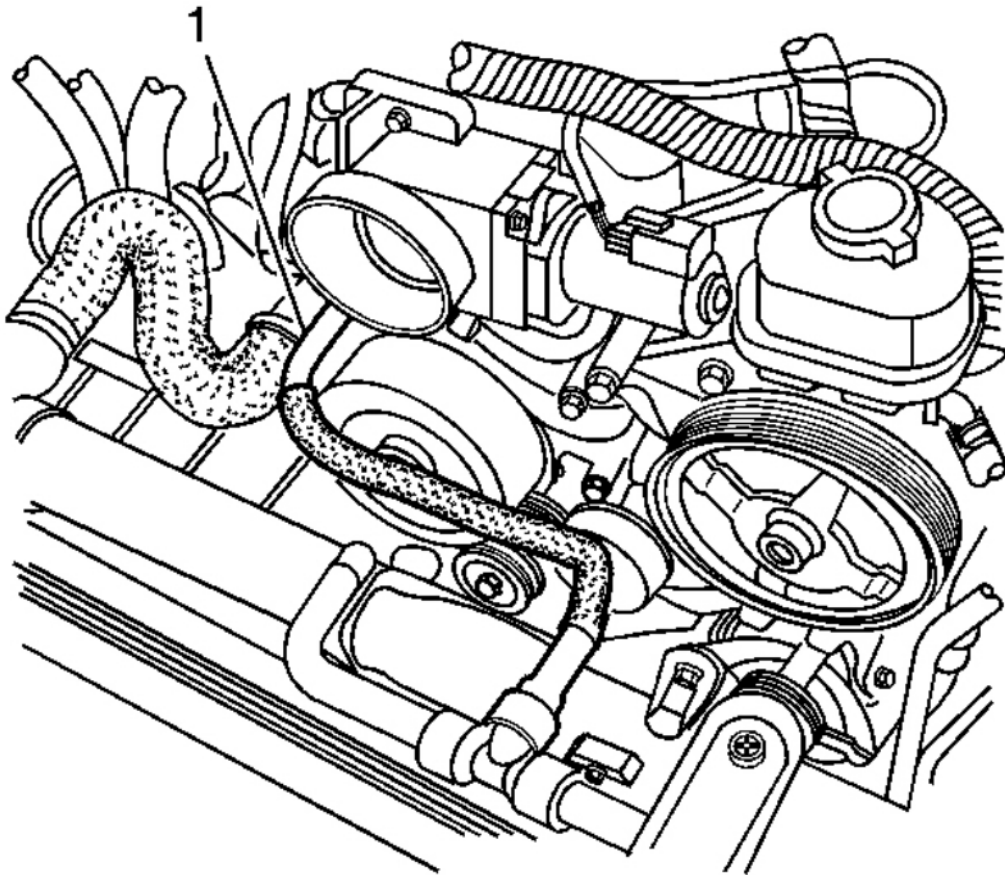


Fig. 68: View Of Throttle Body Heater Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Compress the clamp and remove the surge tank inlet hose from the surge tank.
3. Remove the radiator shelf cover.
4. Compress the clamp and remove the surge tank inlet hose from the radiator.
5. Remove the surge tank inlet hose from the retaining features on the fan shroud and the air cleaner assembly.
6. Compress the clamp and remove the surge tank inlet hose from the throttle body.
7. Remove the surge tank inlet hose from the vehicle.

Installation Procedure

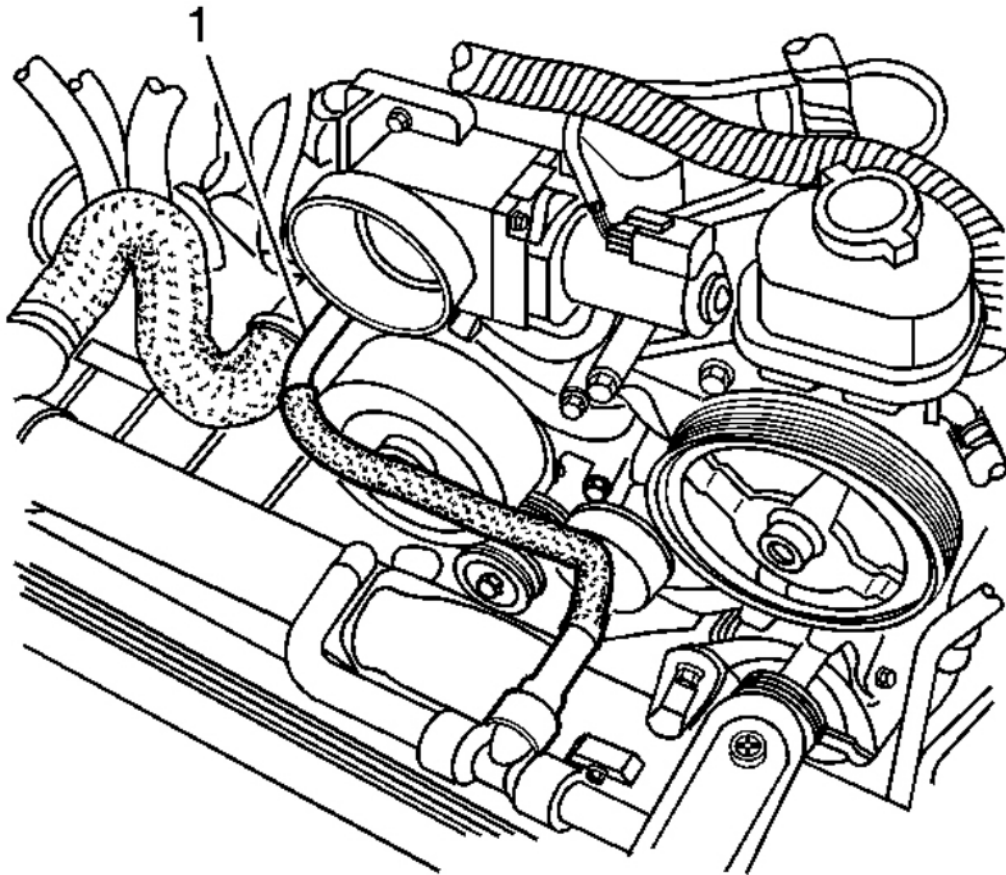


Fig. 69: View Of Throttle Body Heater Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Connect the surge tank inlet hose and clamp to the throttle body.
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. Install the radiator shelf cover.
5. Connect the surge tank inlet hose and clamp to the surge tank.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

Tools Required

J 38185 Hose Clamp Pliers. See Special Tools.

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. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnect/Connect Procedure in Engine Electrical.
2. Drain the cooling system. Refer to Draining and Filling Cooling System (LP1, LY7 Static Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).

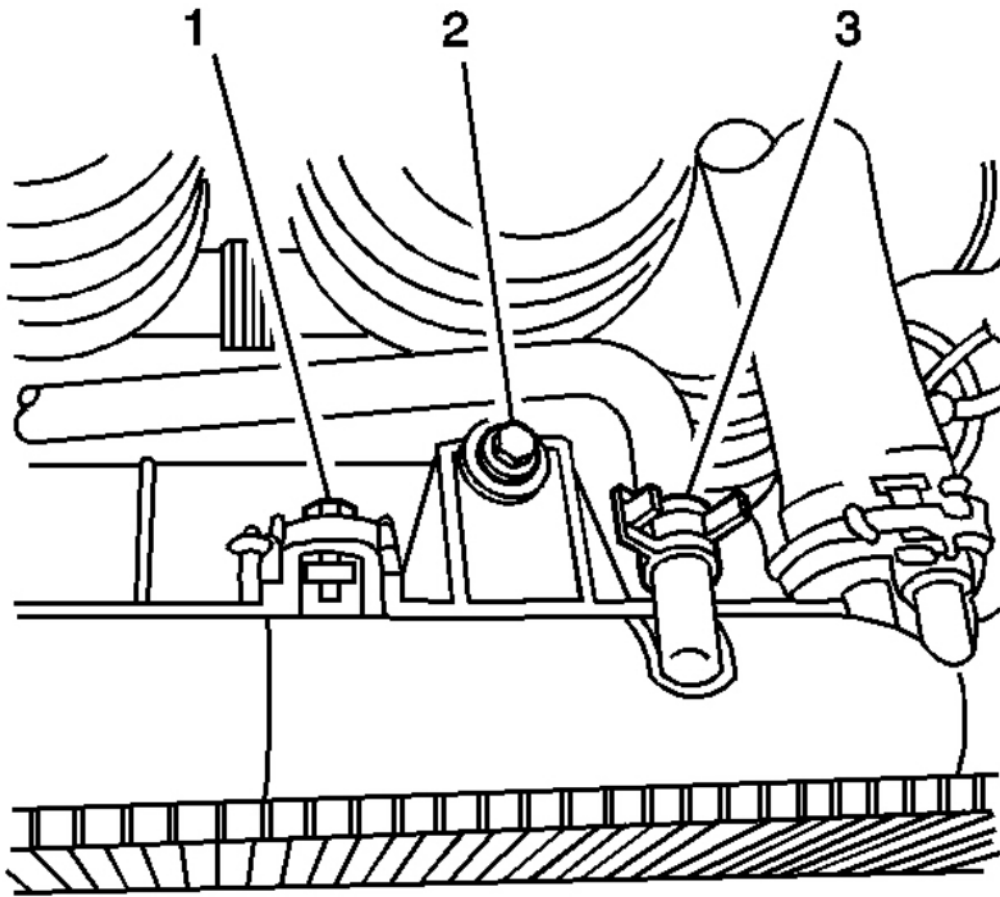


Fig. 70: View Of Surge Tank Hose & Fan Shroud To Radiator Bolts
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the surge tank hose (3).
4. Remove the fan shroud to radiator bolt (1).
5. Remove the fan shroud to air plenum bolt (2).
6. Remove remaining fan shroud to radiator bolts.

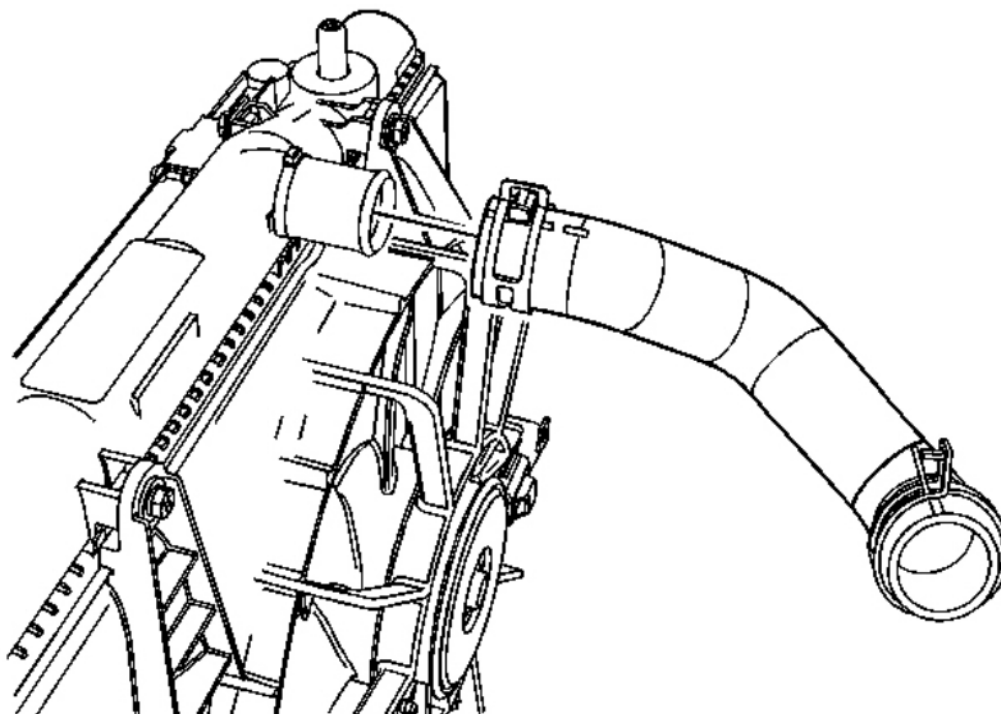


Fig. 71: View Of Radiator Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

7. Using **J 38185** disconnect the upper radiator hose at the radiator. See **Special Tools**.
8. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 2.8L or **Air Cleaner Assembly Replacement** in Engine Controls - 3.6L (LY7).

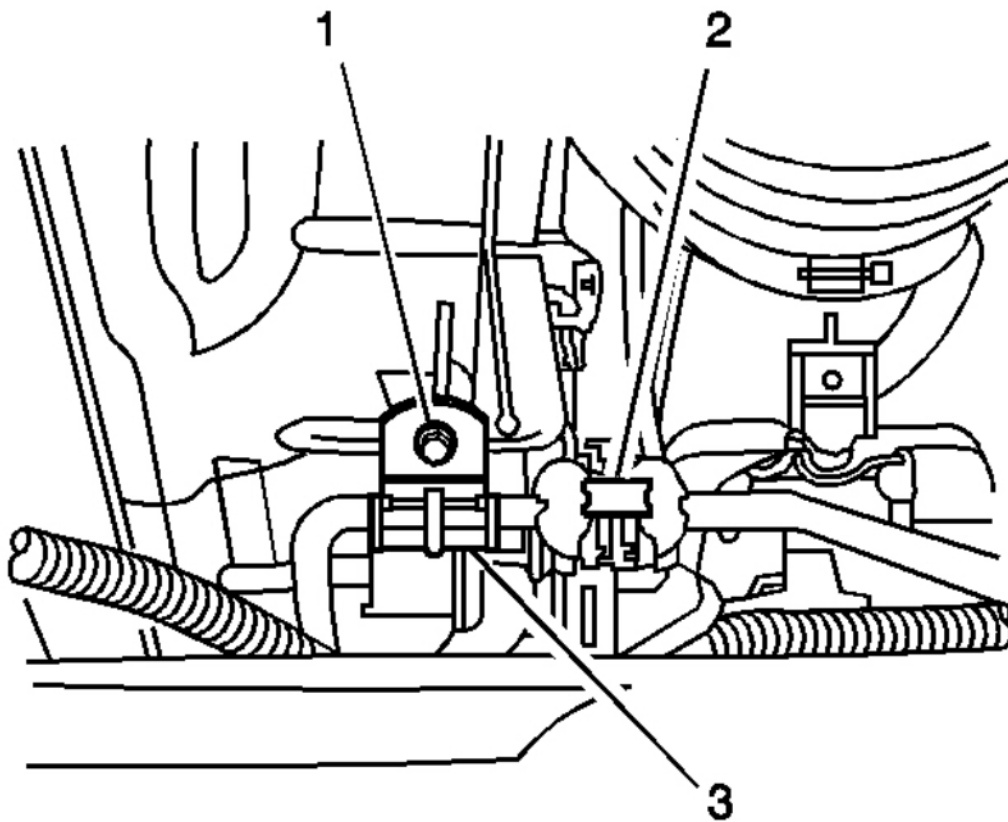


Fig. 72: Locating A/C Line Retaining Clip Screw
Courtesy of GENERAL MOTORS CORP.

9. Remove the screw (1) from the A/C line retaining clip (3).
10. Rotate the retaining clip.

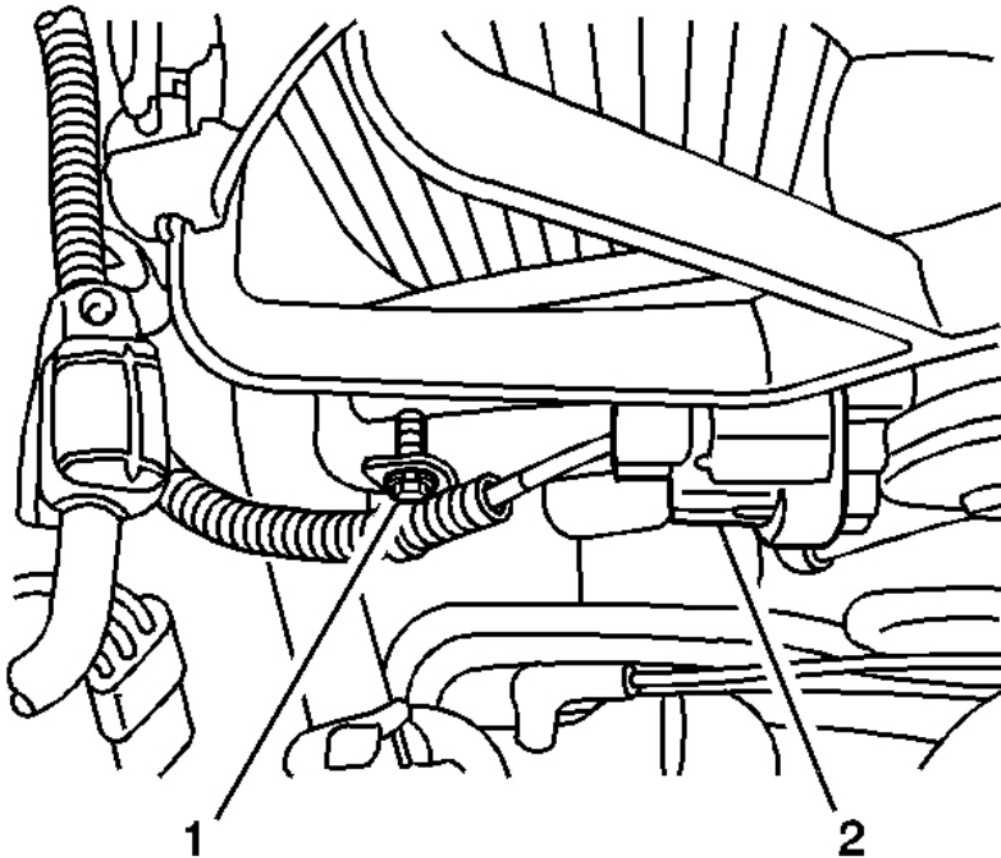


Fig. 73: View Of Fan Electrical Harness Retainers
Courtesy of GENERAL MOTORS CORP.

11. Remove the electric fan harness clip (1).
12. Disconnect the fan motor electrical connectors (2).
13. Separate the wiring harness from the fan shroud.
14. Remove the right fan shroud bolt.
15. Remove the left fan shroud bolt.

IMPORTANT: Carefully remove the electric cooling fan assembly from the vehicle, to protect the radiator core.

16. Pull upward on the fan assembly, removing the assembly from the vehicle.

IMPORTANT: Carefully install the electric cooling fan assembly into the vehicle, to protect the radiator core.

1. Install the cooling fan assembly to the vehicle.
2. Ensure that the electric cooling fan is in the lower attaching points.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the upper fan shroud to radiator mounting bolts.

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

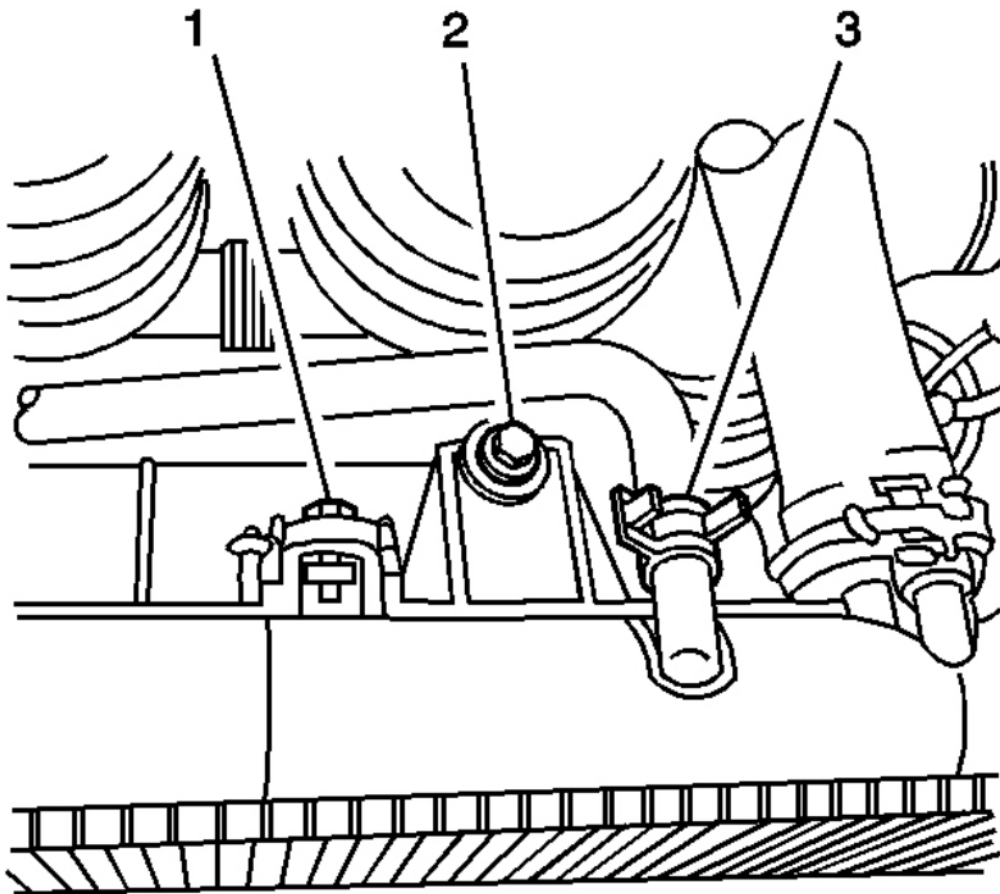


Fig. 74: View Of Surge Tank Hose & Fan Shroud To Radiator Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the electric cooling fan shroud to plenum mounting bolt (2).

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

5. Connect the surge tank hose to radiator (3).

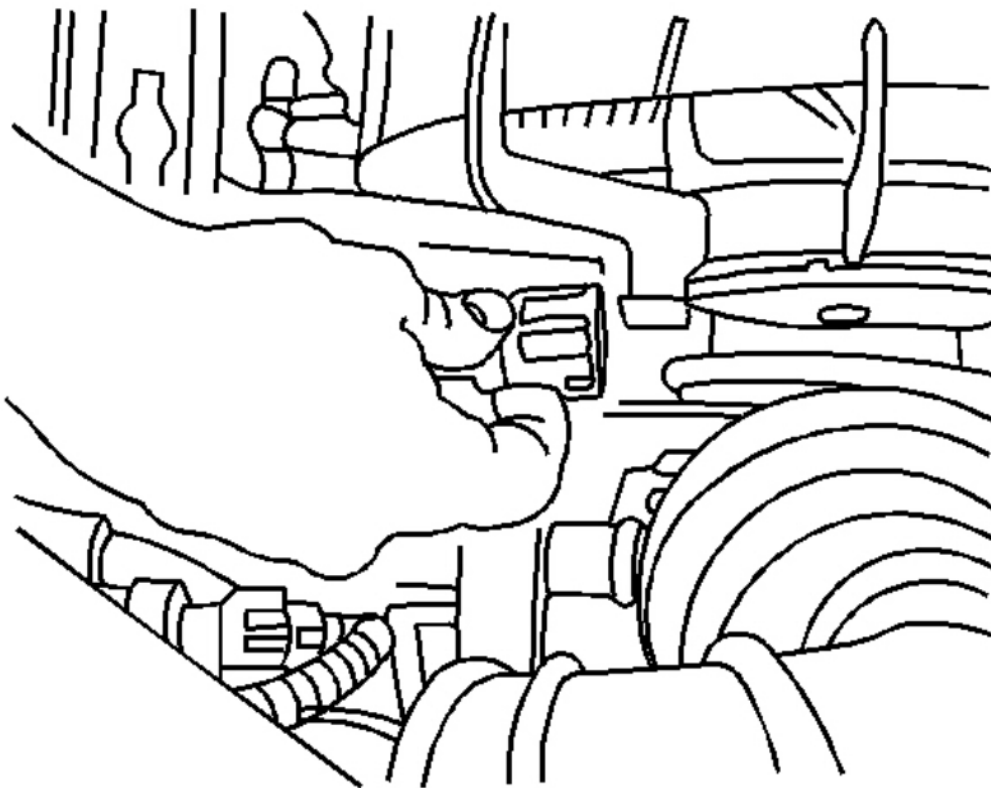


Fig. 75: View Of Cooling Fan Assembly Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the wiring harness electrical connectors to the cooling fan motors.

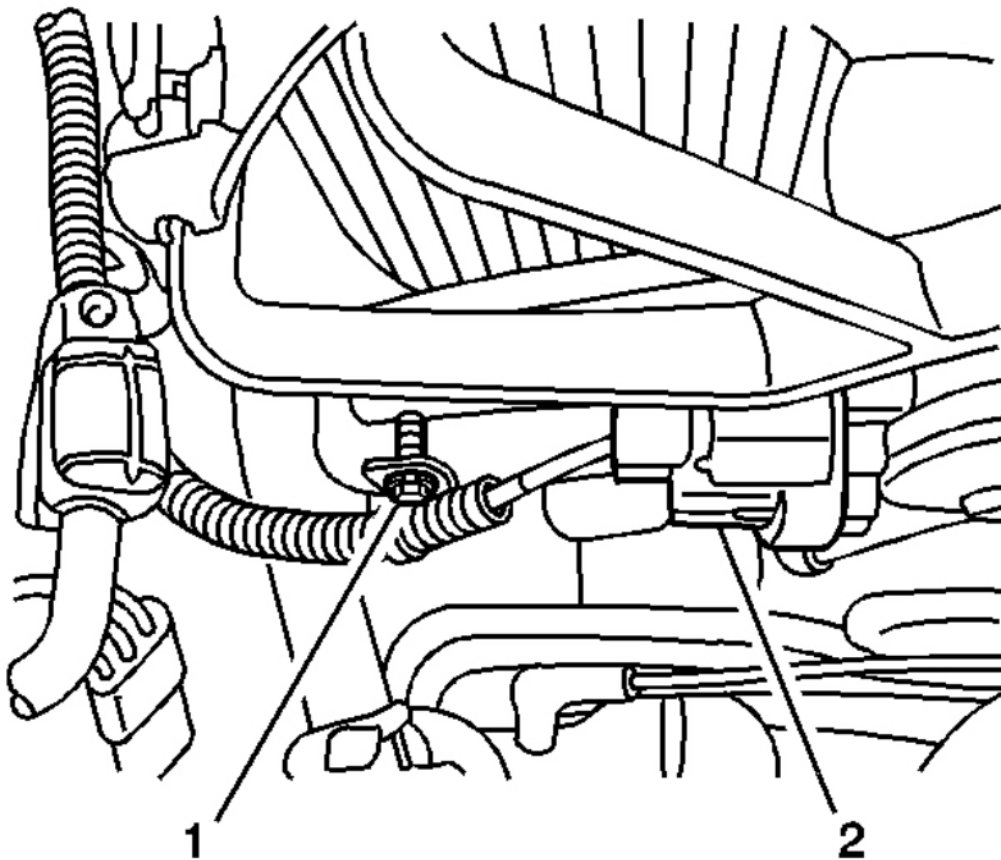


Fig. 76: View Of Fan Electrical Harness Retainers
Courtesy of GENERAL MOTORS CORP.

7. Connect the fan electrical harness retainers (1) to the fan assembly.
8. Attach the remaining wiring harness retaining clips to the fan shroud.

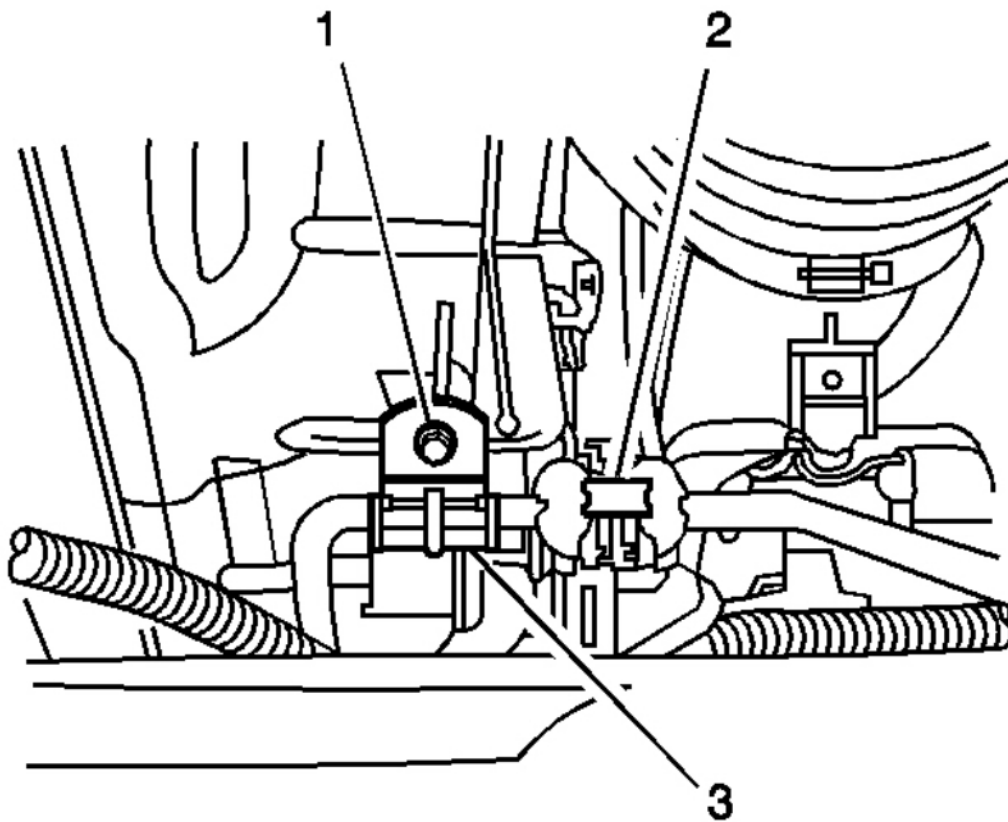


Fig. 77: Locating A/C Line Retaining Clip Screw
Courtesy of GENERAL MOTORS CORP.

9. Install the A/C line retaining clip screw (1) to the fan shroud.

Tighten: Tighten the screw to 1 N.m (9 lb in).

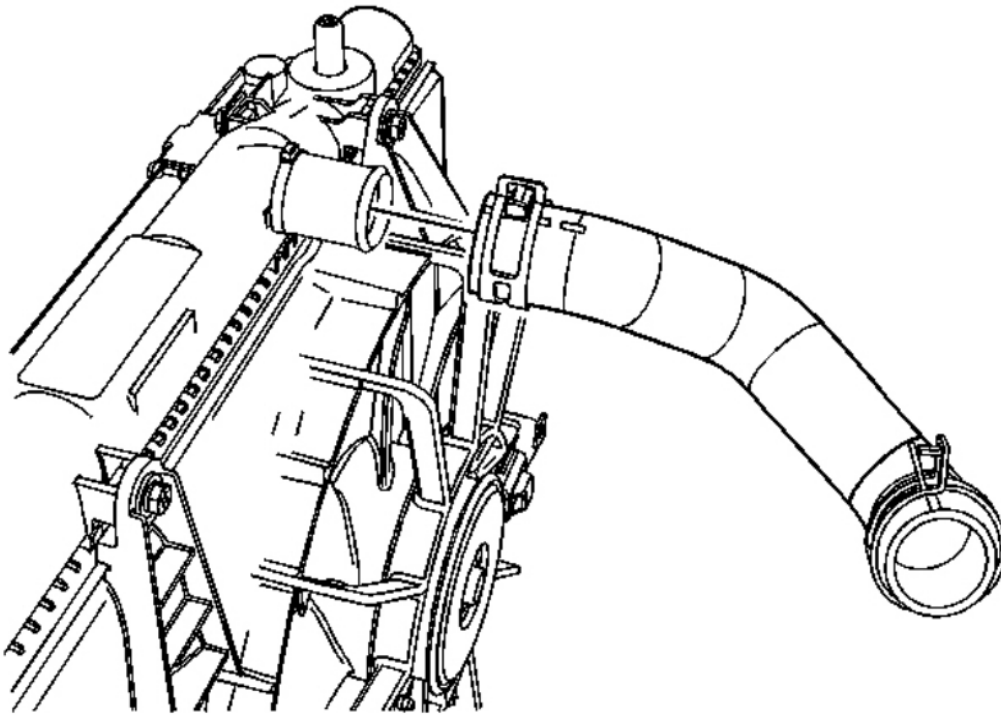


Fig. 78: View Of Radiator Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

10. Position the radiator hose with the mark facing up.
11. Position **J 38185** to the clamp and position the clamp on the radiator hose. See **Special Tools**.
12. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
13. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 2.8L or **Air Cleaner Assembly Replacement** in Engine Controls - 3.6L (LY7).
14. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.

COOLING FAN MOTOR REPLACEMENT - ELECTRIC

Removal Procedure

1. Remove the cooling fan assembly. Refer to **Cooling Fan Replacement - Electric (LP1, LY7)**.

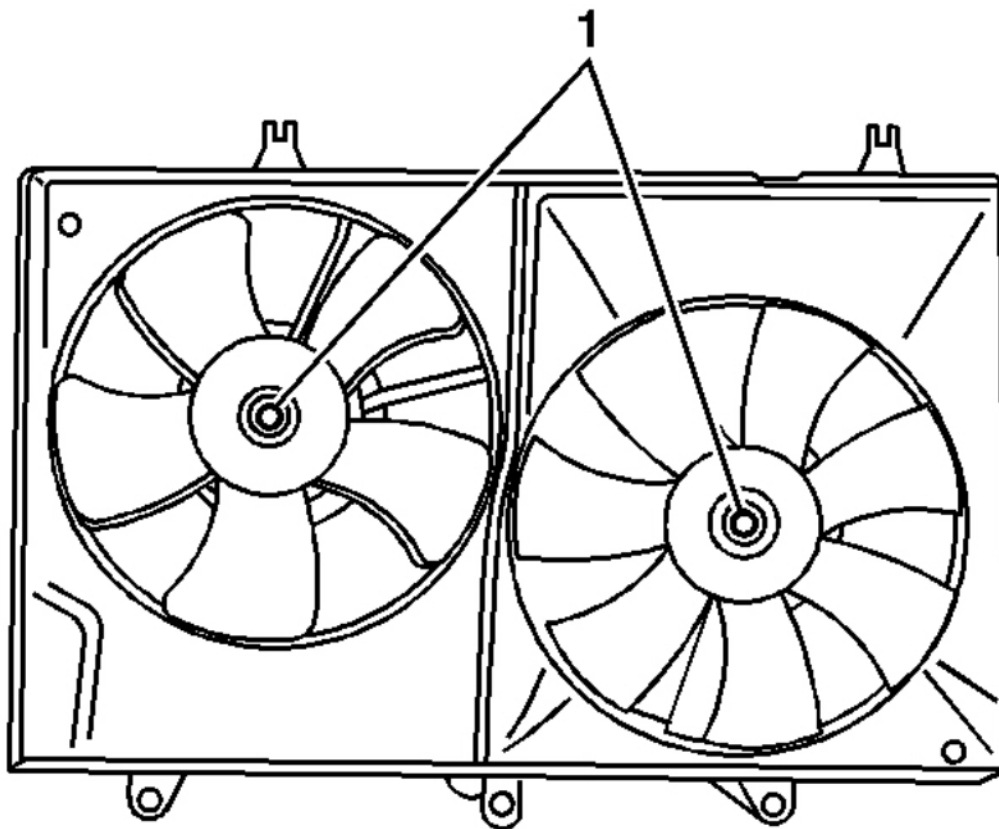


Fig. 79: Locating Fan Blade Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

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

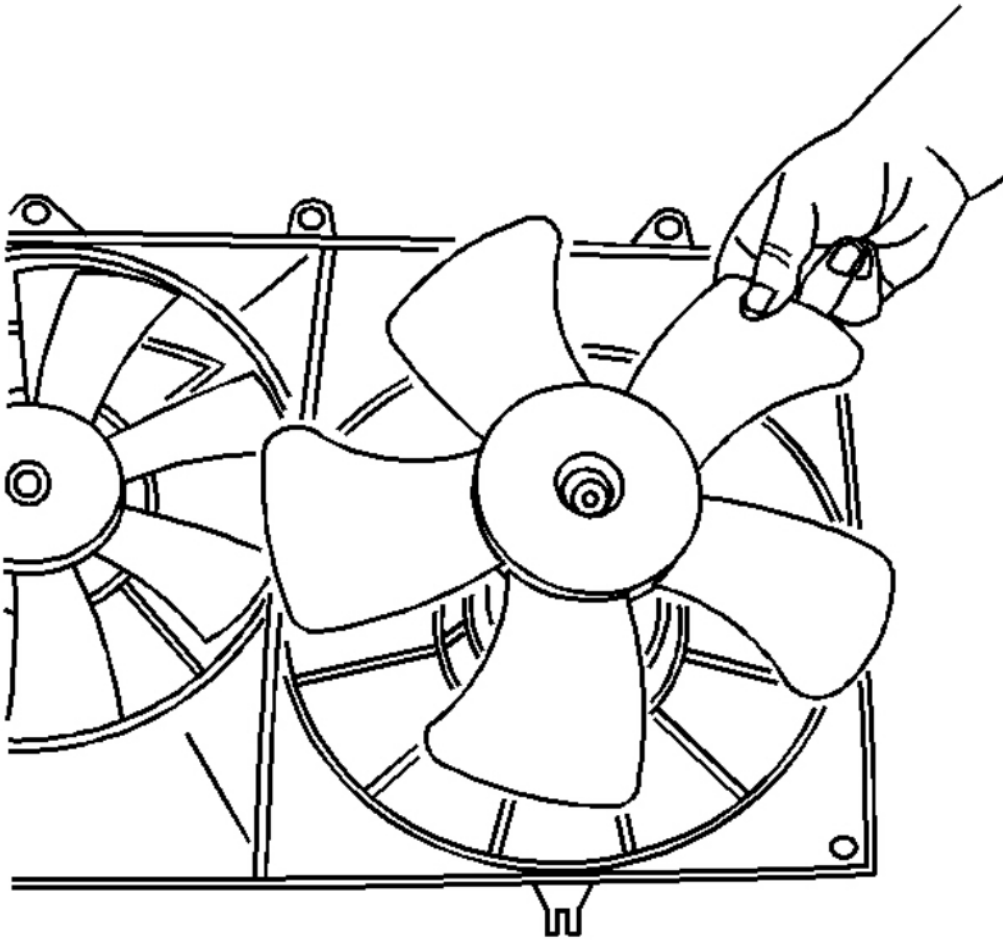


Fig. 80: View Of Motor Shaft Fan Blade
Courtesy of GENERAL MOTORS CORP.

3. Remove the fan blade from the motor shaft.

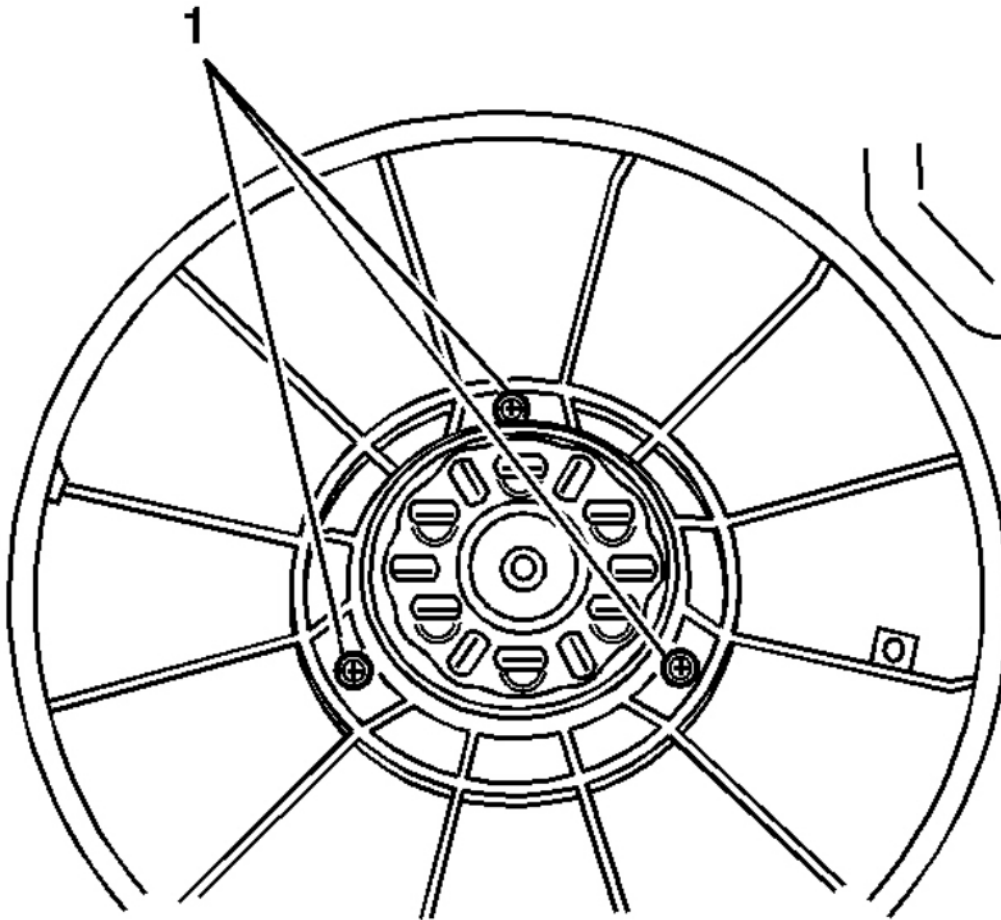


Fig. 81: Locating Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

4. Remove the motor retaining screws (1).

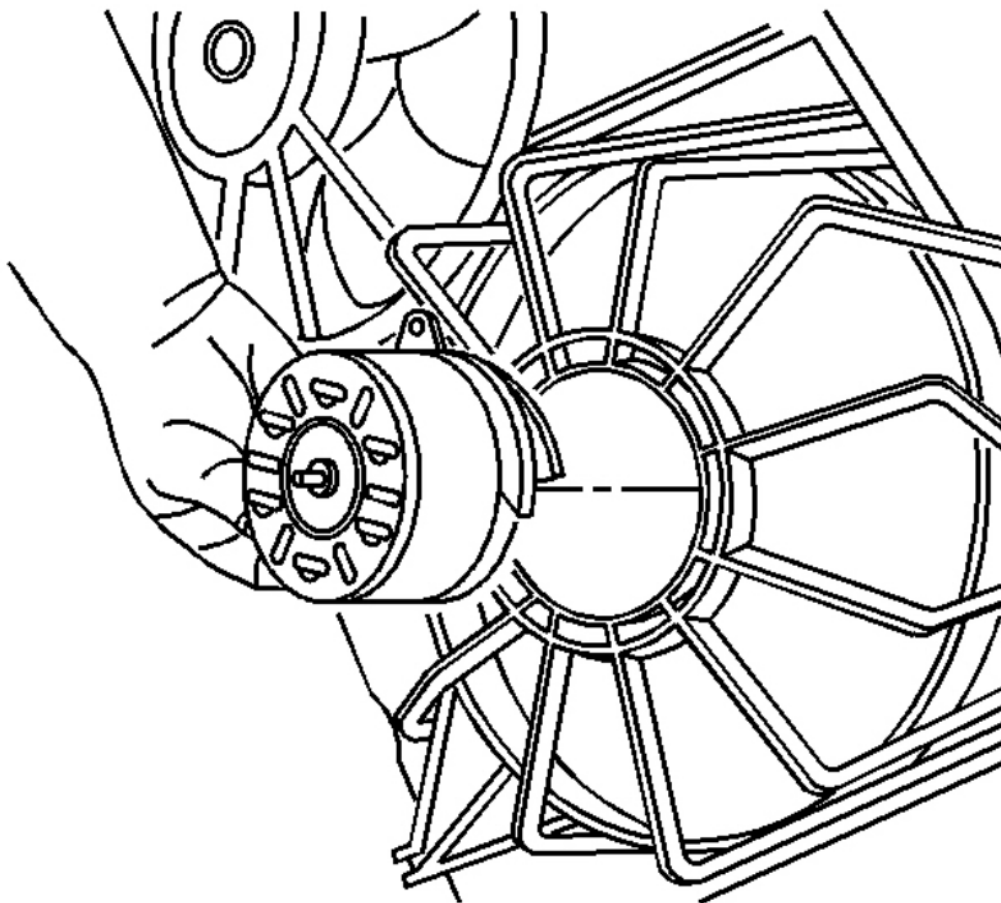


Fig. 82: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

5. Remove the motor from the shroud.

Installation Procedure

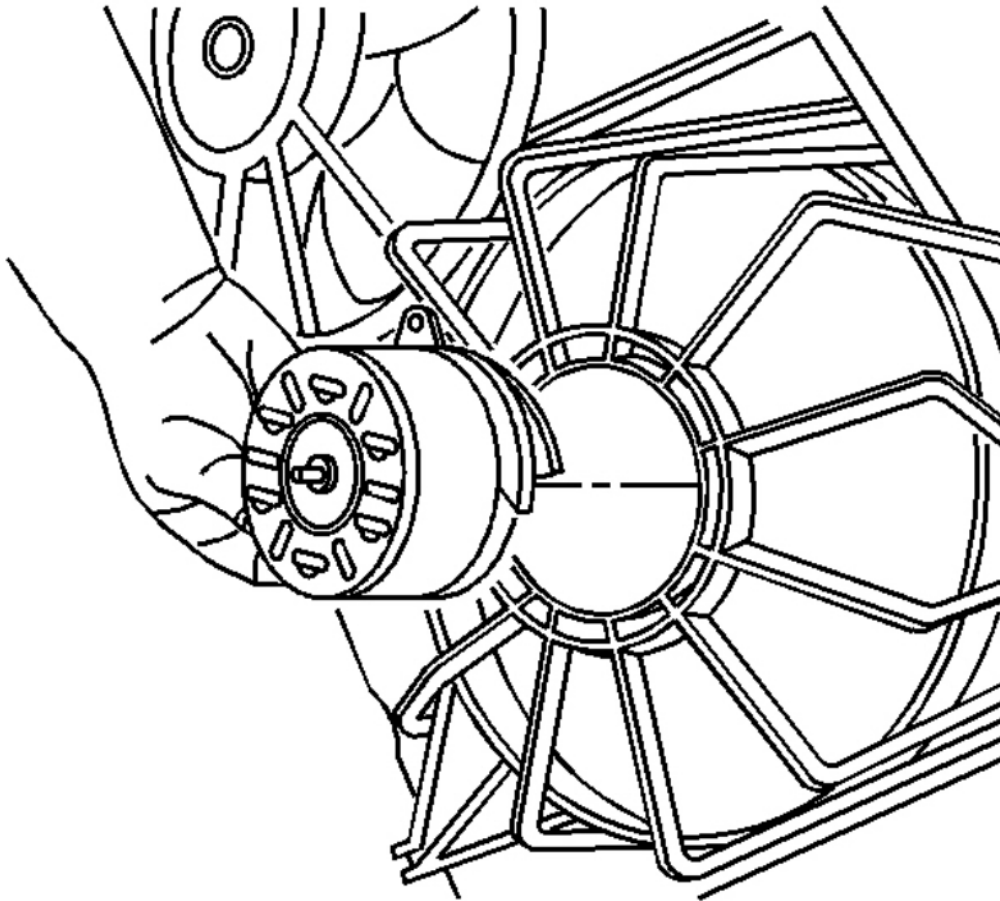


Fig. 83: View Of Cooling Fan Motor
Courtesy of GENERAL MOTORS CORP.

1. Install the motor to the shroud.

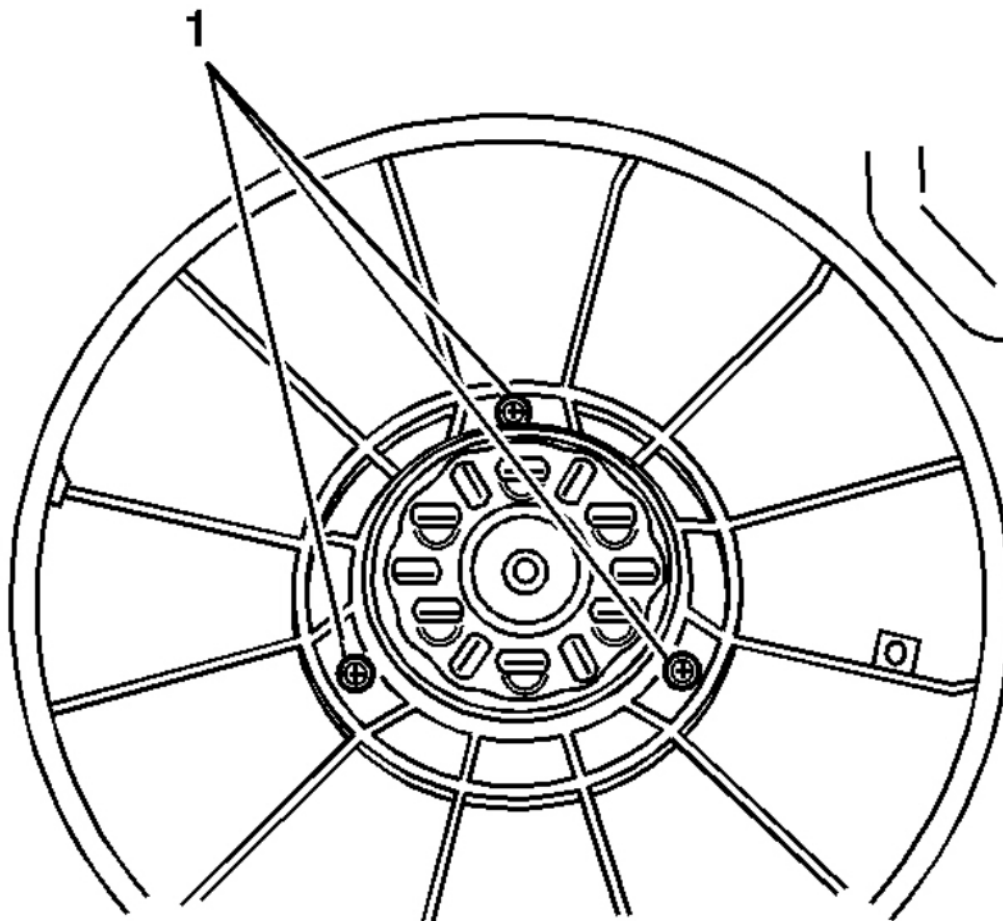


Fig. 84: Locating Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

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).

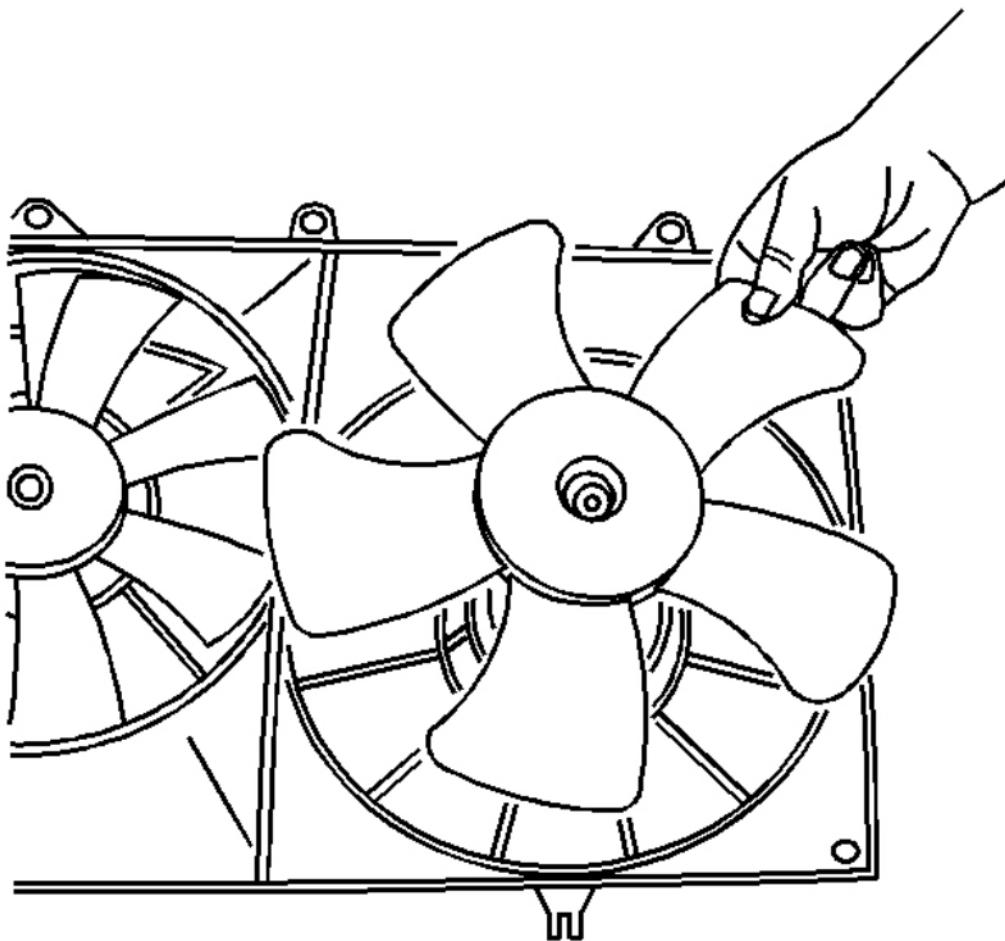


Fig. 85: View Of Motor Shaft Fan Blade
Courtesy of GENERAL MOTORS CORP.

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

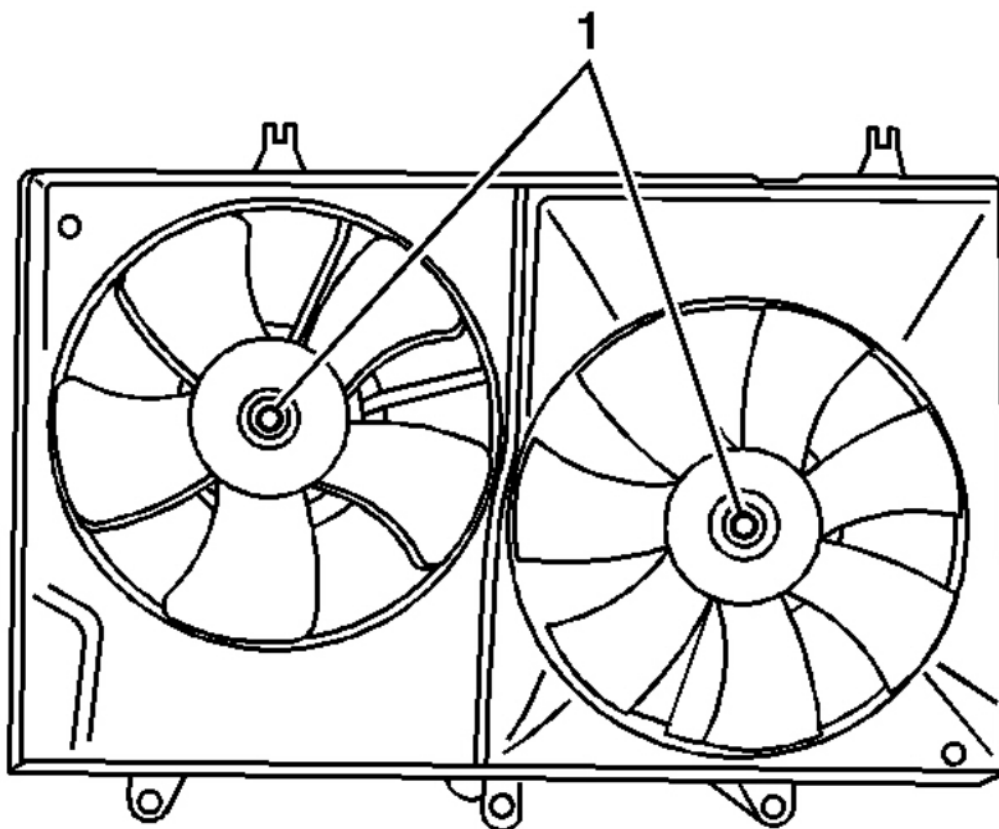


Fig. 86: Locating Fan Blade Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

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 (LP1, LY7)**.

COOLING FAN AND MOTOR REPLACEMENT - AUXILIARY

Tools Required

J 44827 Transmission Cooler Quick Disconnect. See **Special Tools**.

Removal Procedure

1. Remove the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.

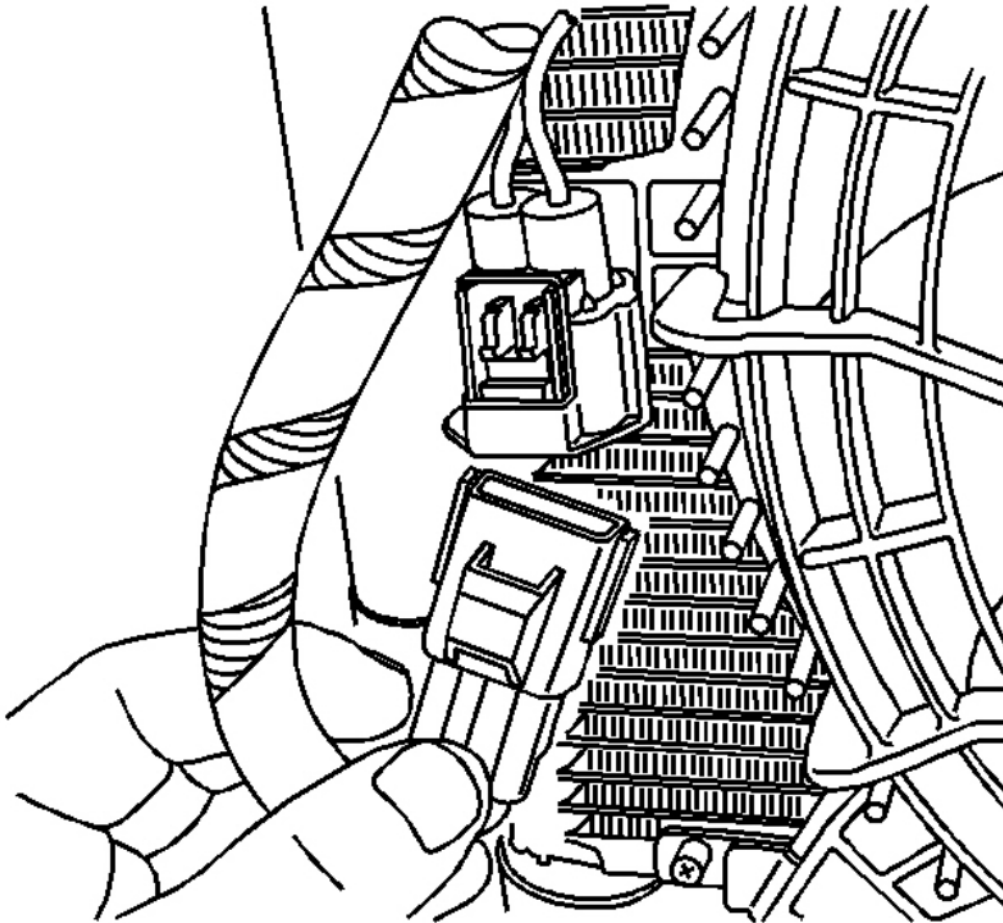


Fig. 87: Identifying Auxiliary Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the auxiliary cooling fan electrical connector.

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.

3. Using the **J 44827** disconnect the auxiliary transmission cooler lines from the auxiliary cooler. See **Special Tools**.
4. Position the auxiliary cooler lines out of the way.

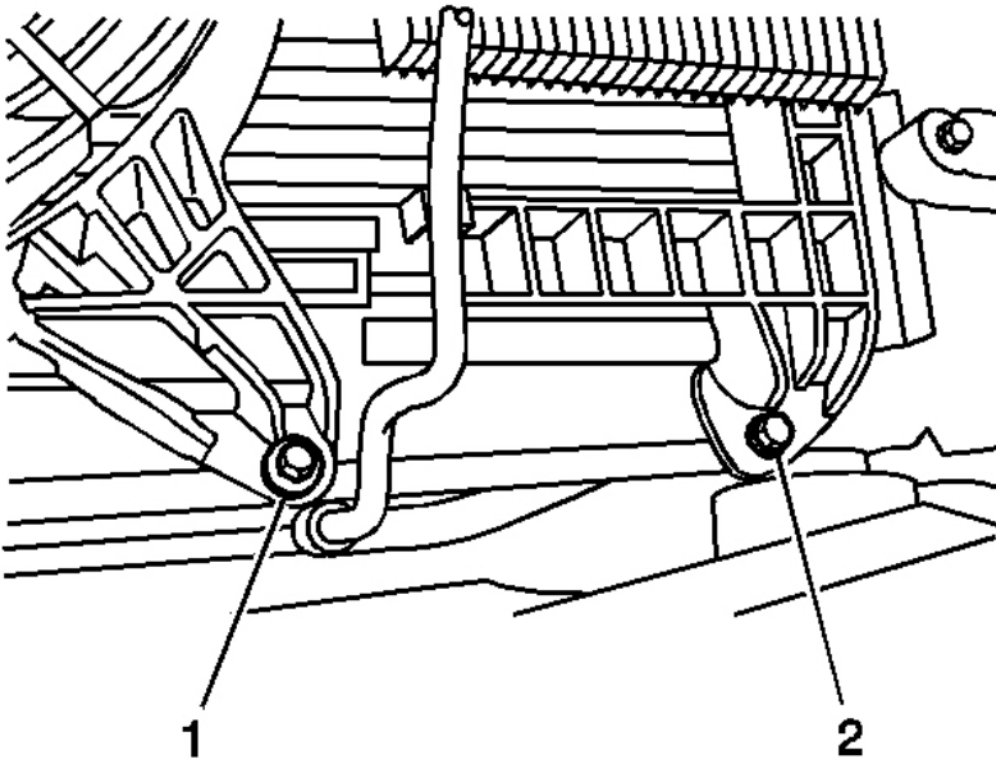


Fig. 88: Identifying Auxiliary Cooling Fan Lower Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the auxiliary cooling fan assembly bolts (1, 2).
6. Remove the lower left auxiliary cooling fan bolt.

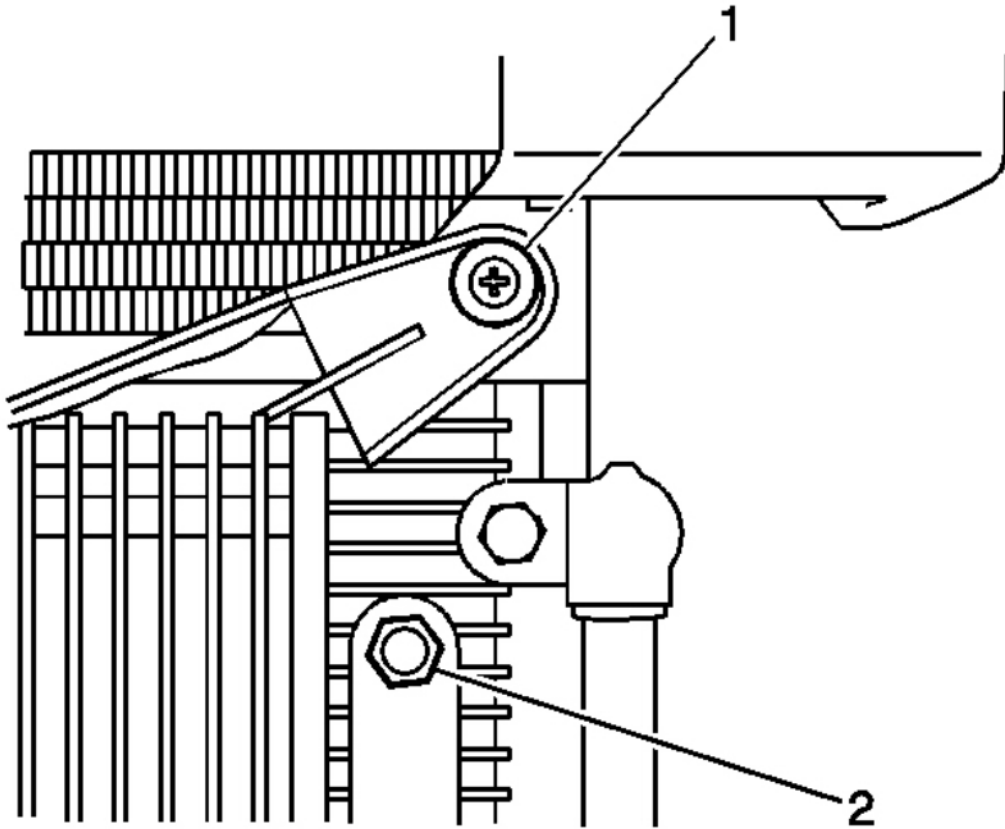


Fig. 89: View Of Fan Assembly Bolt & Auxiliary Cooling Fan Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the auxiliary cooling fan assembly bolt (1).
8. Remove the upper left auxiliary cooling fan bolt.
9. Remove the auxiliary cooling fan assembly from the vehicle.

Installation Procedure

1. Position the auxiliary fan assembly into the vehicle.

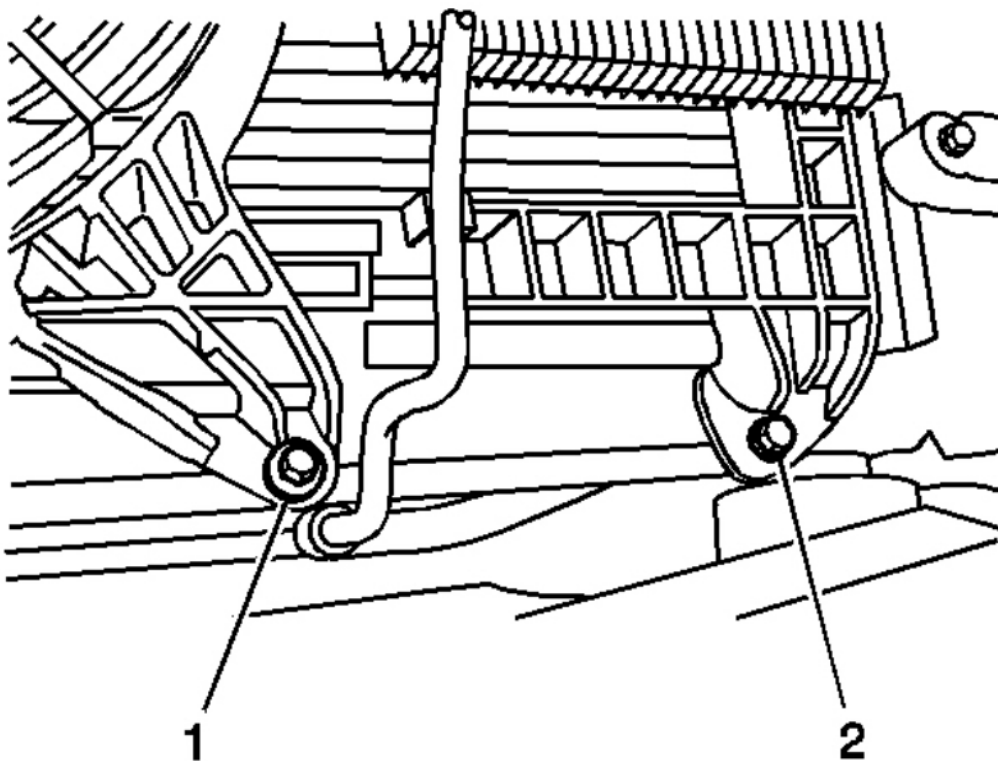


Fig. 90: Identifying Auxiliary Cooling Fan Lower Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the auxiliary cooling fan lower bolts (1,2).

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

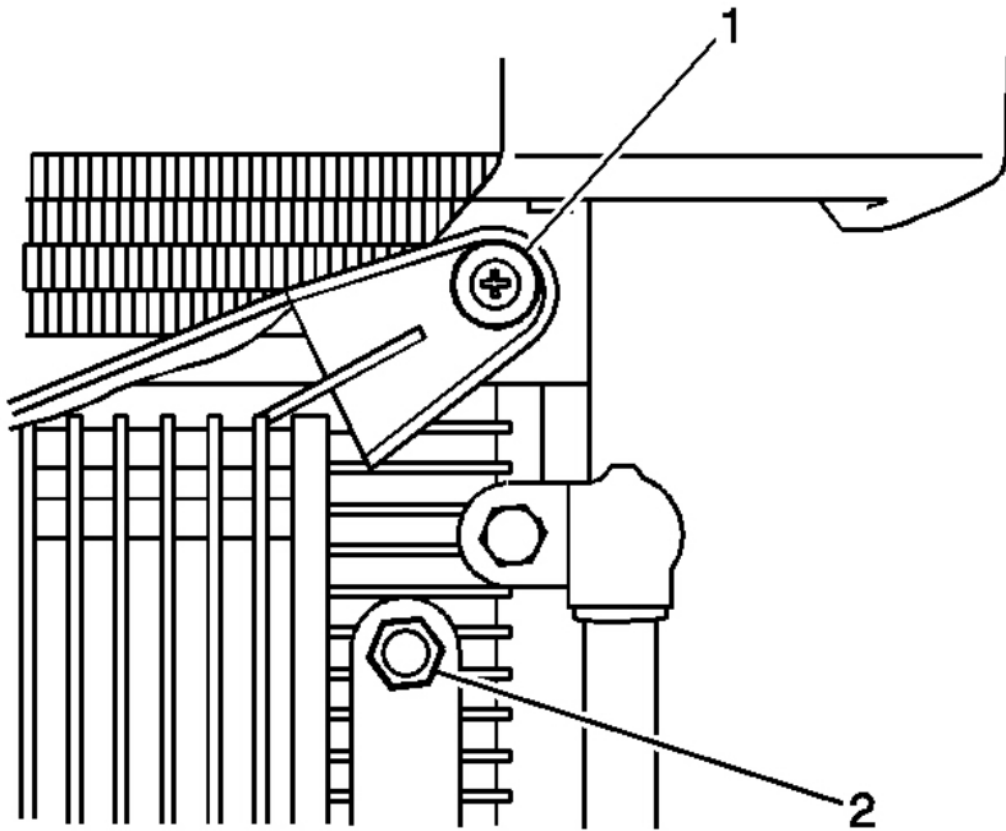


Fig. 91: View Of Fan Assembly Bolt & Auxiliary Cooling Fan Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the fan assembly bolt (1).

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

4. Install the remaining auxiliary cooling fan bolts.

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

5. Push the auxiliary transaxle oil cooler line into the cooler until you hear it engage.
6. Gently tug out on the transmission oil cooler line to verify that the line is engaged into position.

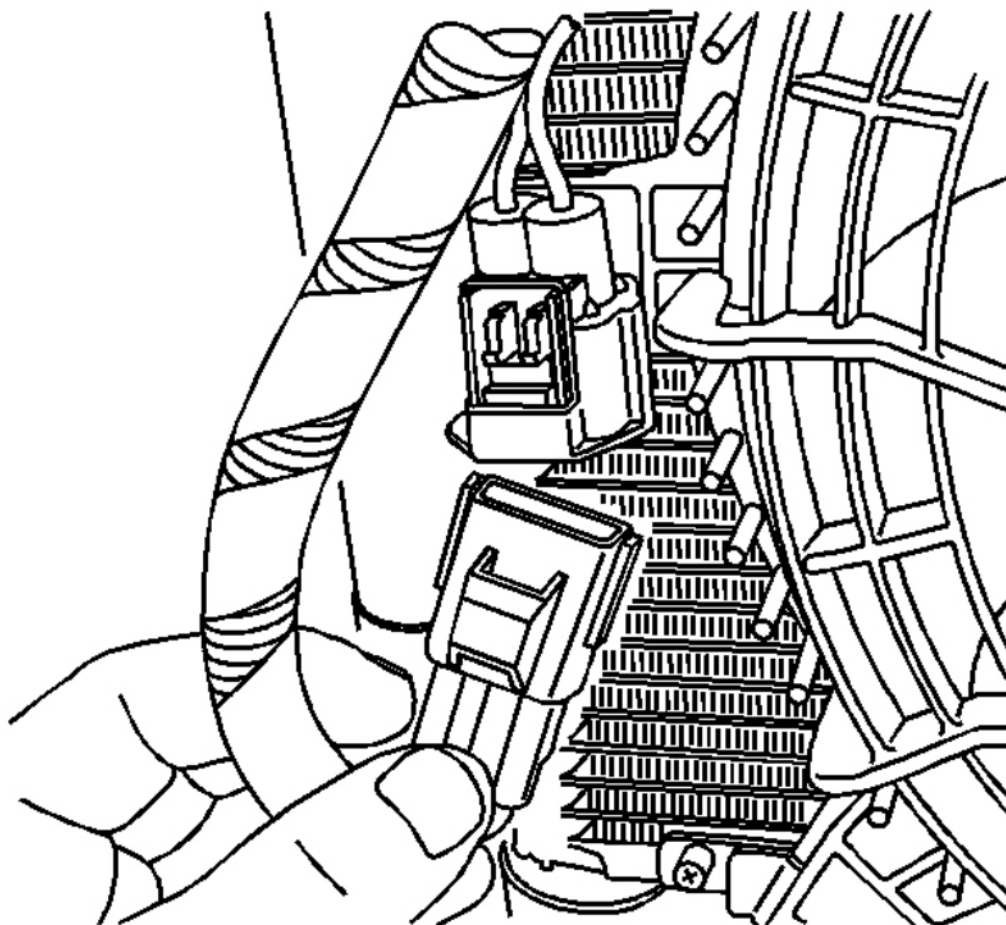


Fig. 92: Identifying Auxiliary Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect the auxiliary fan electrical connector.
8. Install the air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
9. Inspect the transmission fluid level. Refer to **Transmission Fluid Checking Procedure** in Automatic Transmission - 5L40-E/5L50-E.

THERMOSTAT HOUSING REPLACEMENT (LP1, LY7)

Tools Required

J 28410 Gasket Remover

Removal Procedure

1. Disconnect the heater hoses from the heater core. Refer to **Heater Hose Replacement - Inlet (LY7)** and **Heater Hose Replacement - Outlet (LY7)** in Heating, Ventilation and Air Conditioning.
2. Remove the thermostat. Refer to **Thermostat Replacement (LP1, LY7)**.

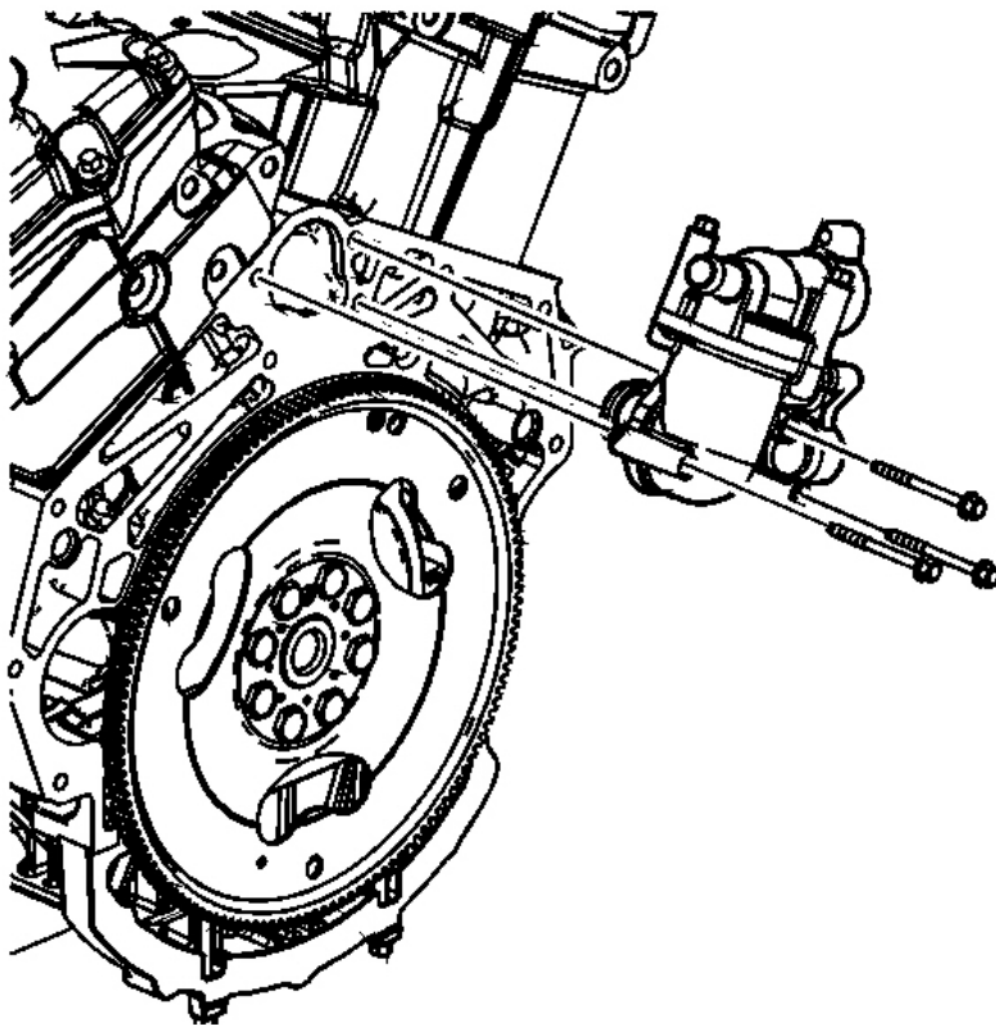


Fig. 93: View Of Thermostat Housing With Heater Pipes, Heater Hoses, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

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.

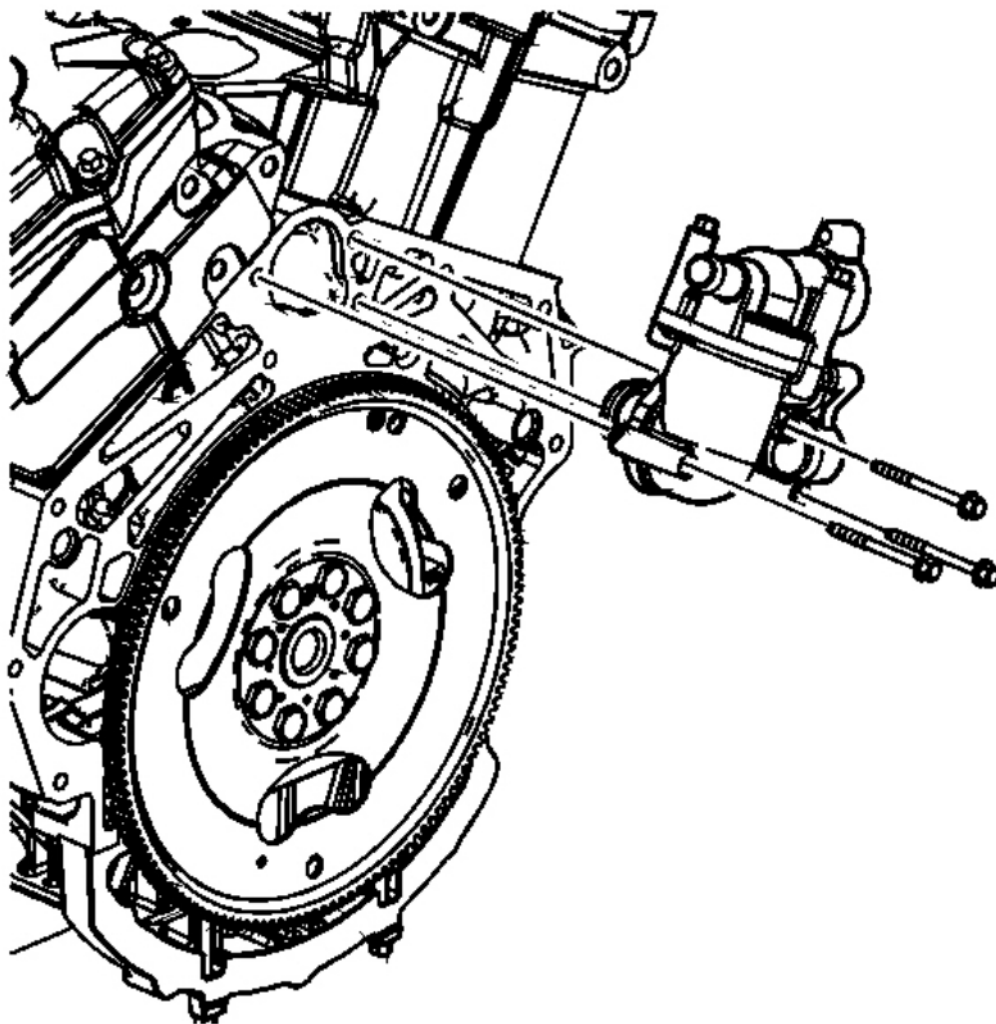


Fig. 94: View Of Thermostat Housing With Heater Pipes, Heater Hoses, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

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 (LP1, LY7)**.
7. Connect the heater hoses to the heater core. Refer to **Heater Hose Replacement - Inlet (LY7)** and **Heater Hose Replacement - Inlet (LY7)** in Heating, Ventilation and Air Conditioning.

THERMOSTAT REPLACEMENT (LP1, LY7)

Removal Procedure

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

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 - 2.8L (LP1), or **Intake Manifold Replacement - Lower** in Engine Mechanical - 3.6L (LY7).
3. Disconnect the surge tank hose from the thermostat.

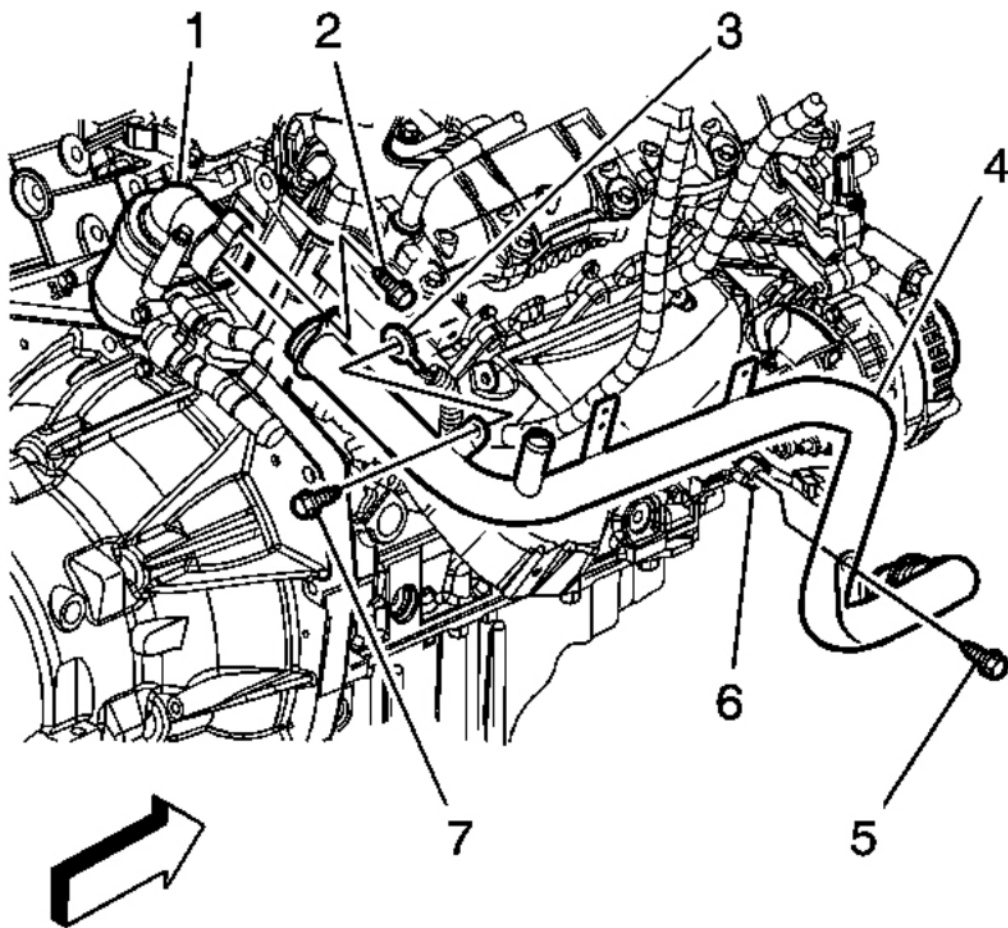


Fig. 95: View Of Coolant Inlet Pipe

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.

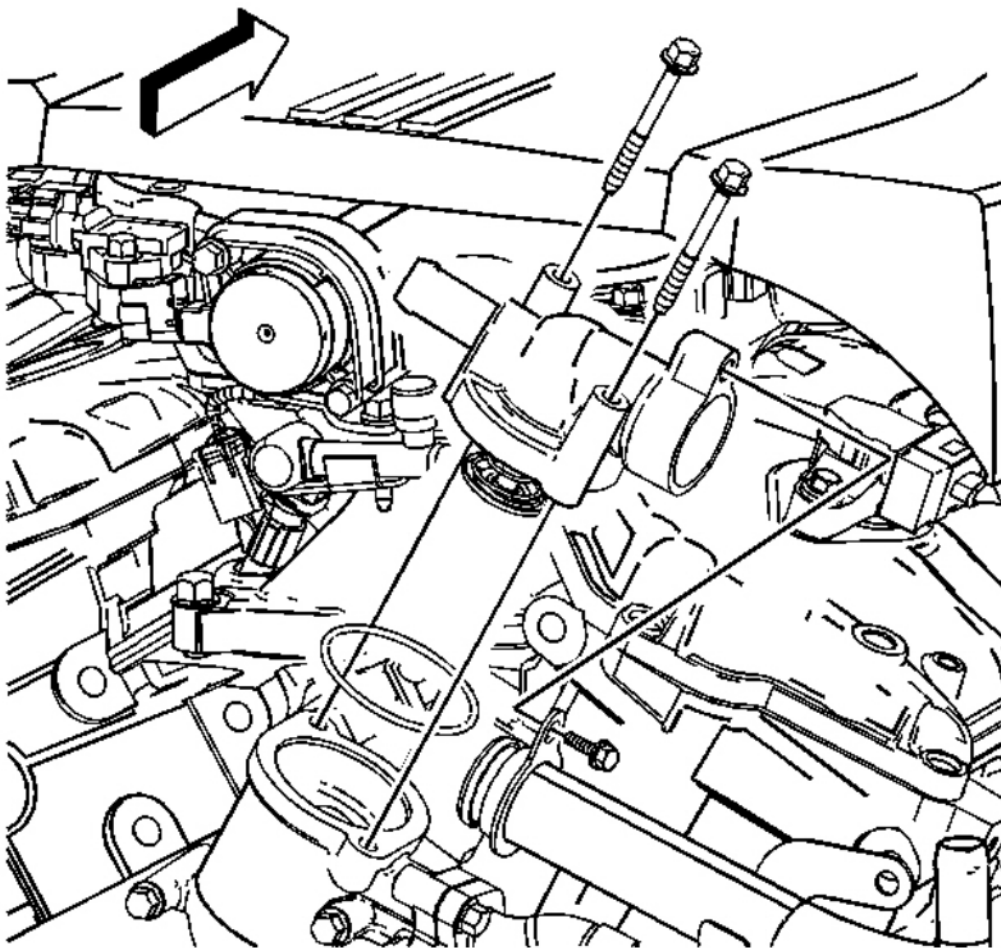


Fig. 96: View Of Thermostat
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

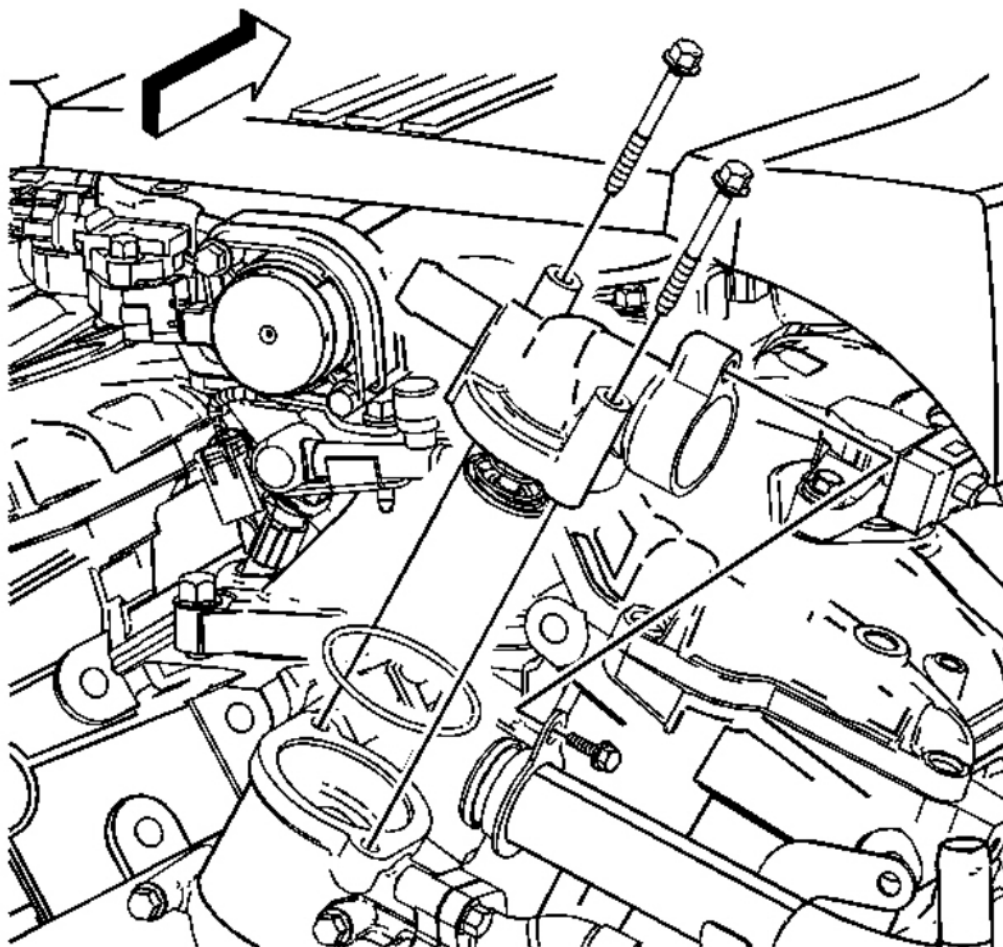


Fig. 97: View Of Thermostat

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).

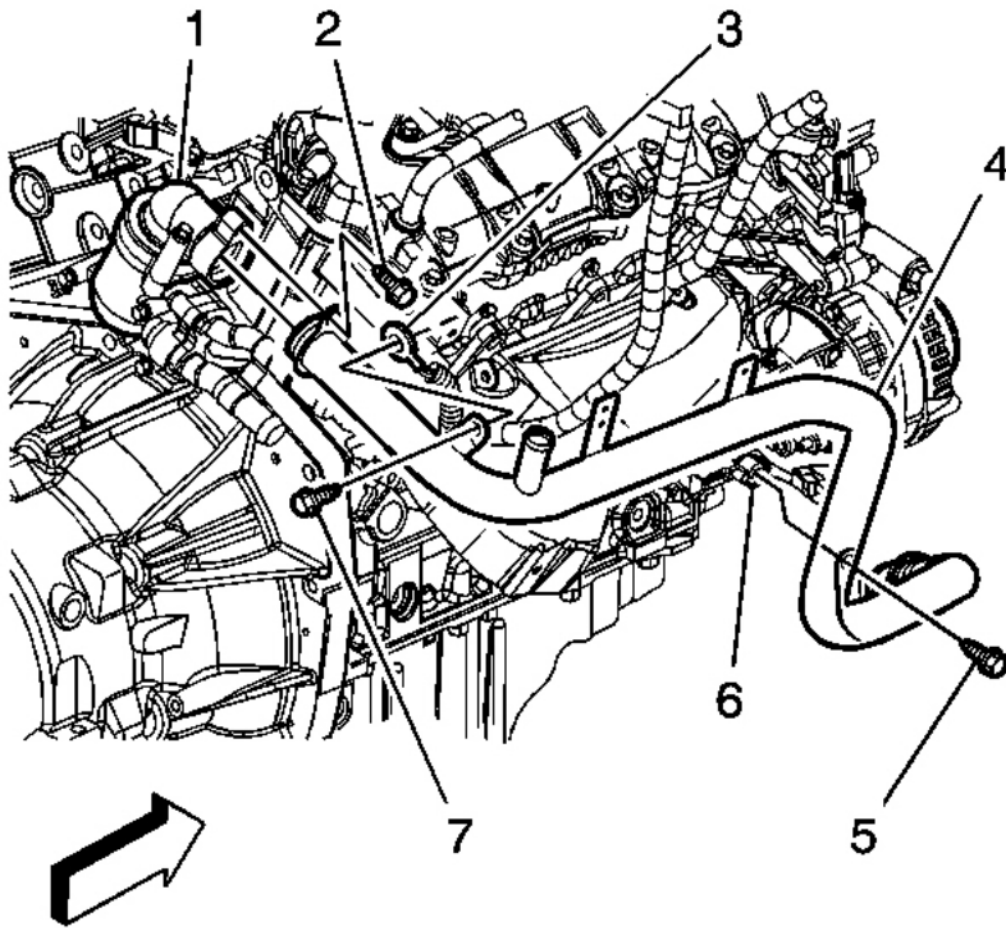


Fig. 98: View Of Coolant Inlet Pipe

Courtesy of GENERAL MOTORS CORP.

3. Install the coolant pipe (4), NEW seal, and fasteners (2 and 7). Refer to **Coolant Pipe Replacement - Inlet (LP1, 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 - 2.8L (LP1), or **Intake Manifold Replacement - Lower** in Engine Mechanical - 3.6L (LY7).
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

WATER OUTLET HOUSING REPLACEMENT (LP1, LY7)**Removal Procedure**

1. Partially drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Remove the radiator hose from the water outlet. Refer to **Radiator Hose Replacement - Inlet (LP1, LY7)** or **Radiator Hose Replacement - Inlet (LS6)**.
3. Remove the surge tank inlet hose from the water outlet housing.

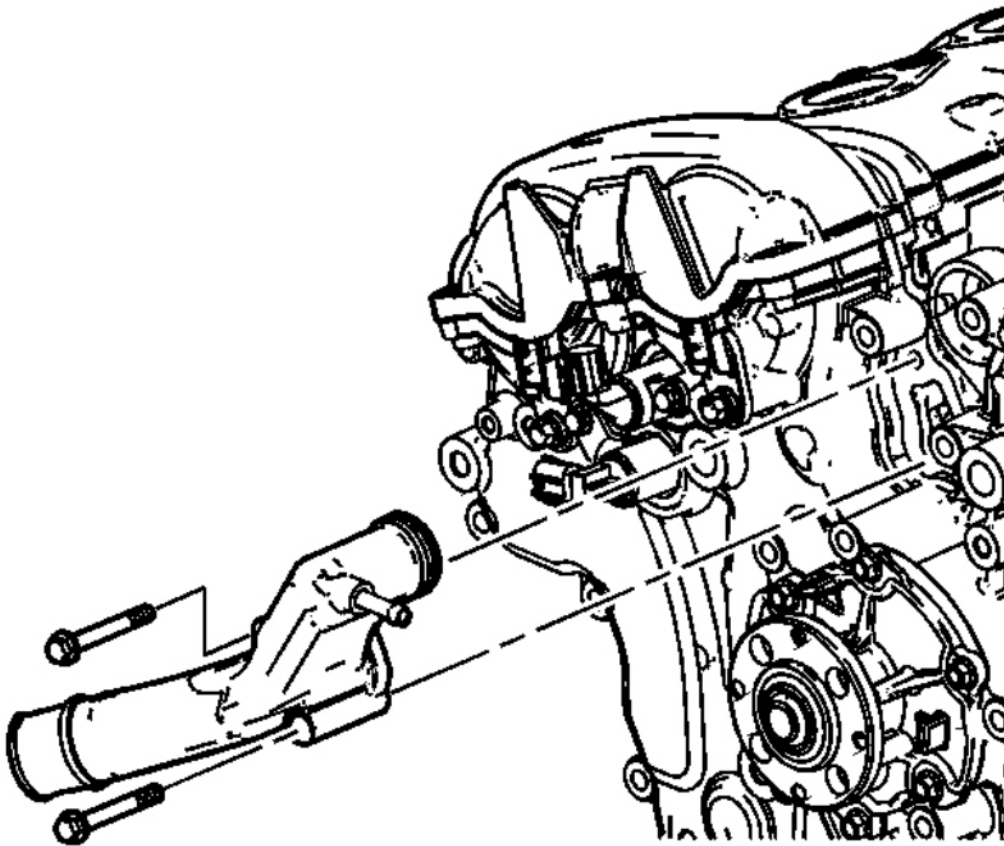


Fig. 99: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

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

6. Remove and discard the water outlet seals.
7. Clean the water outlet housing sealing surfaces.

Installation Procedure

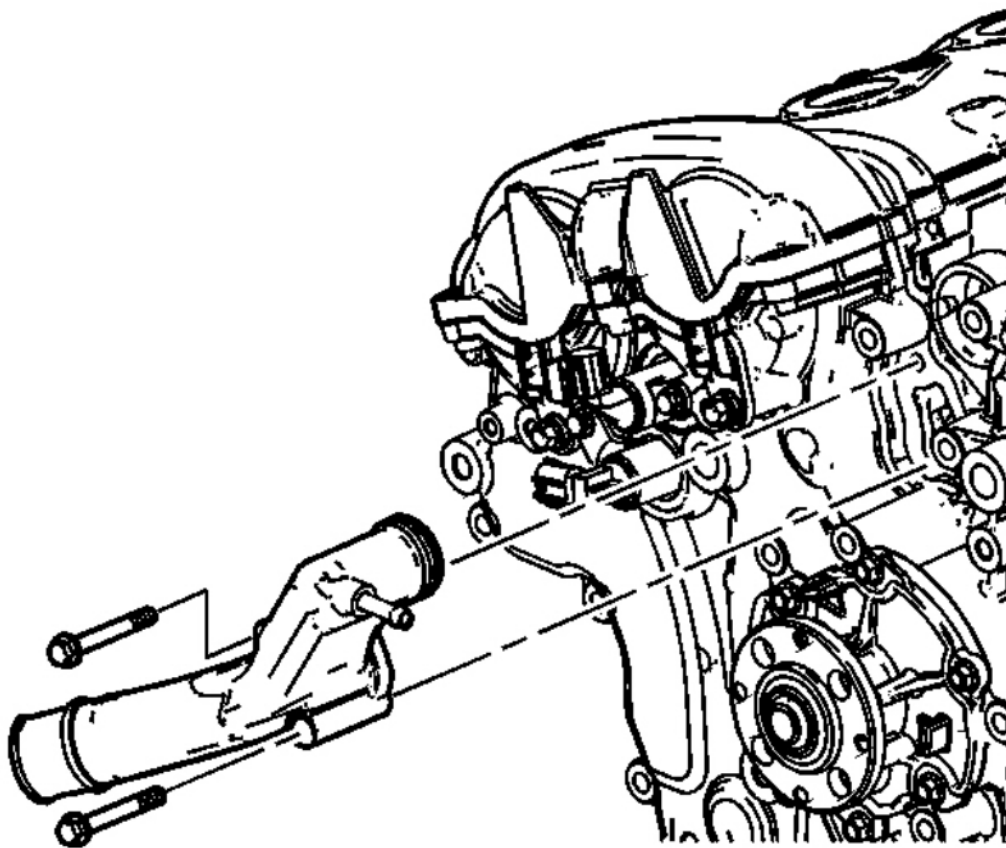


Fig. 100: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

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 surge tank inlet hose to the water outlet housing.
5. Install the radiator hose to the water outlet. Refer to **Radiator Hose Replacement - Inlet (LP1, LY7)** or **Radiator Hose Replacement - Inlet (LS6)**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

COOLANT PIPE REPLACEMENT - INLET (LP1, LY7)

Removal Procedure

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

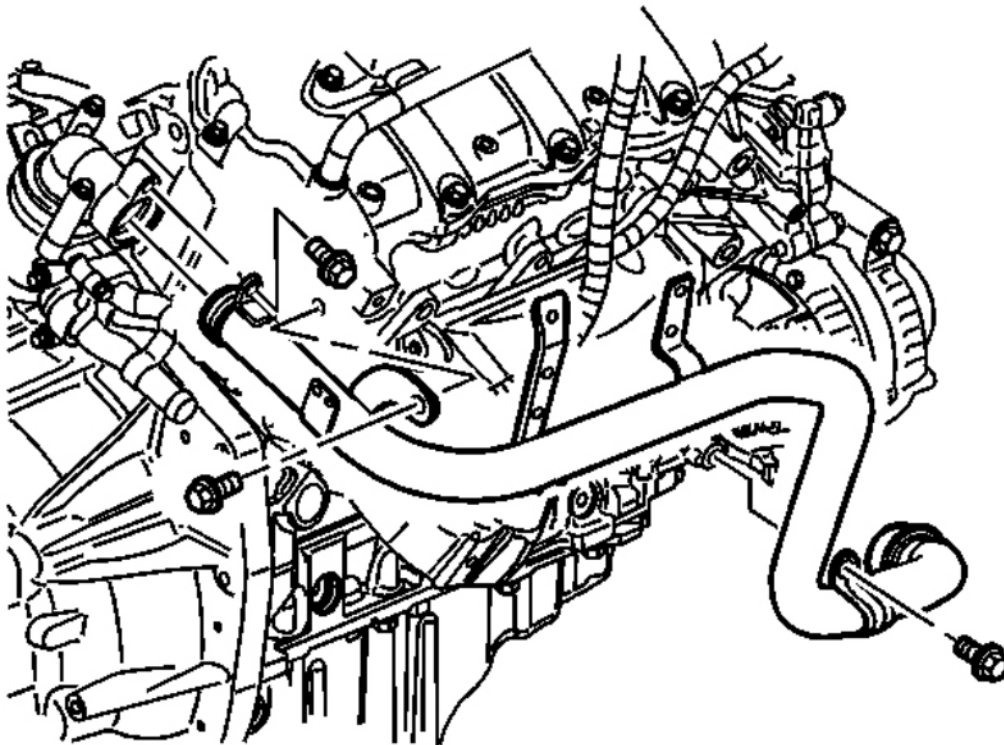


Fig. 101: View Of Radiator Outlet Pipe & Bolt
Courtesy of GENERAL MOTORS CORP.

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 (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
5. Disconnect the radiator outlet hose from the coolant pipe. Refer to **Radiator Hose Replacement - Outlet (LP1, LY7)** or **Radiator Hose Replacement - Outlet (LS6)**.
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

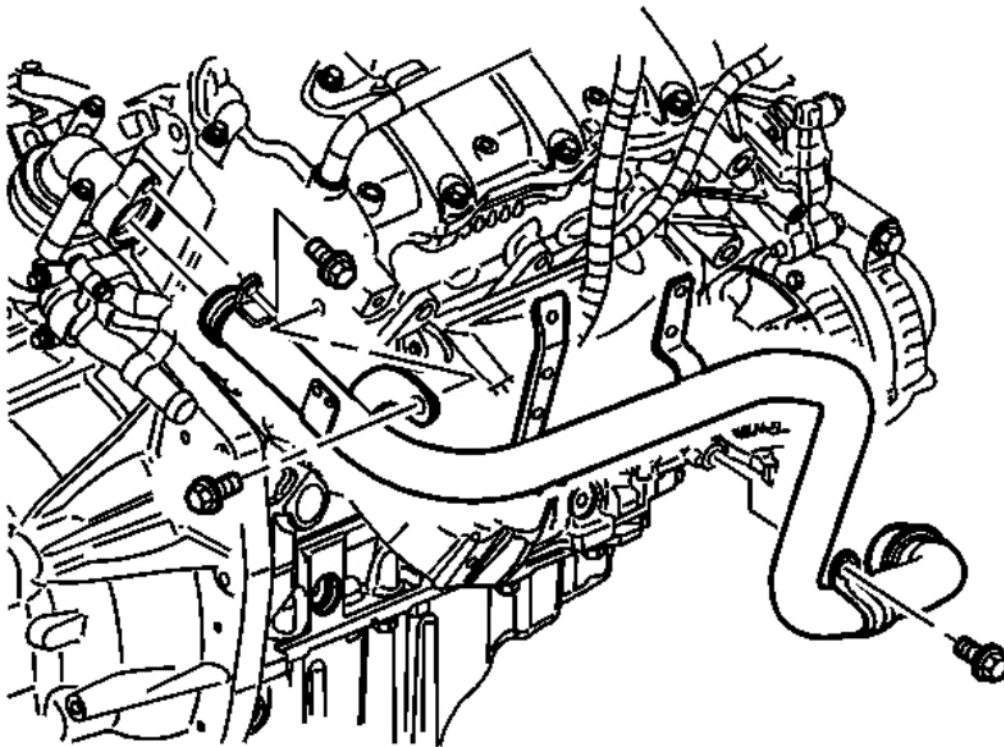


Fig. 102: View Of Radiator Outlet Pipe & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant pipe.

2. Loose 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 10 N.m (89 lb in).

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 10 N.m (89 lb in).

7. Connect the radiator outlet hose to the coolant pipe. Refer to Radiator Hose Replacement - Outlet (LP1, LY7) or Radiator Hose Replacement - Outlet (LS6).
8. Install the wiring harnesses to the coolant inlet pipe.
9. Fill the cooling system. Refer to Draining and Filling Cooling System (LP1, LY7 Static Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).

COOLANT PIPE REPLACEMENT - OUTLET (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See Special Tools.

Removal Procedure

1. Drain the cooling system. Refer to Draining and Filling Cooling System (LP1, LY7 Static Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).

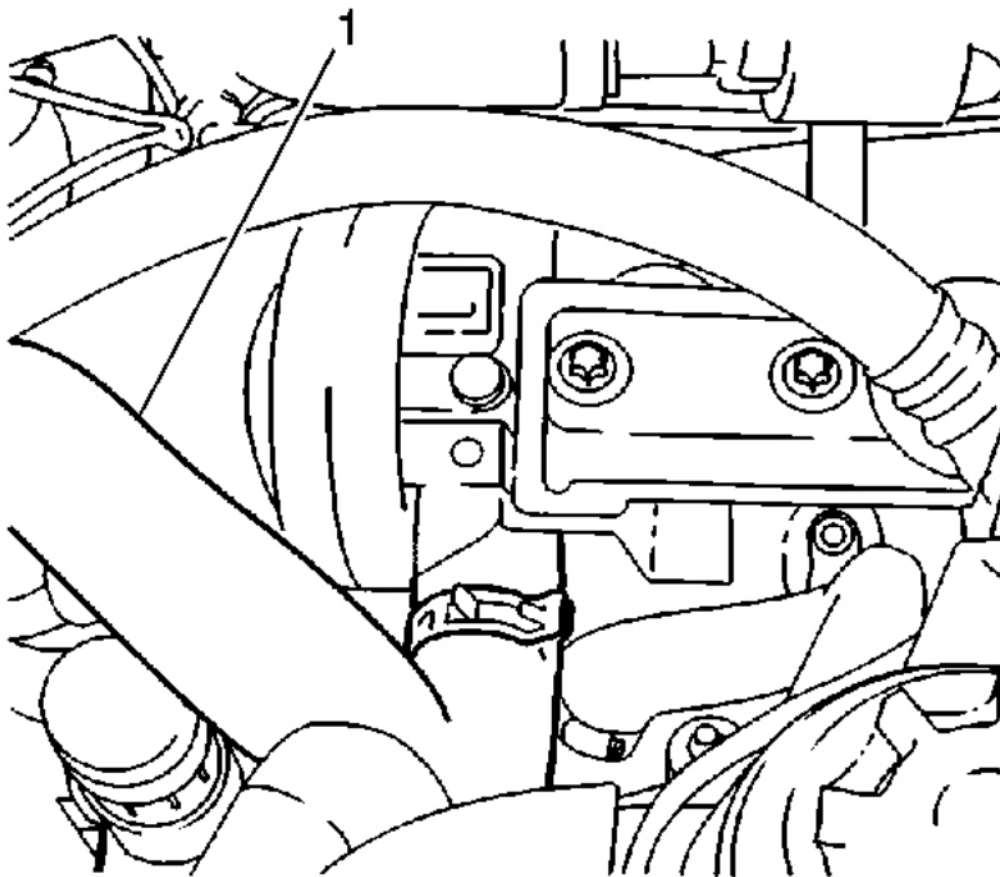


Fig. 103: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Position the **J 38185** to the clamp in order to remove the radiator inlet hose (1) from the coolant outlet pipe. See **Special Tools**.

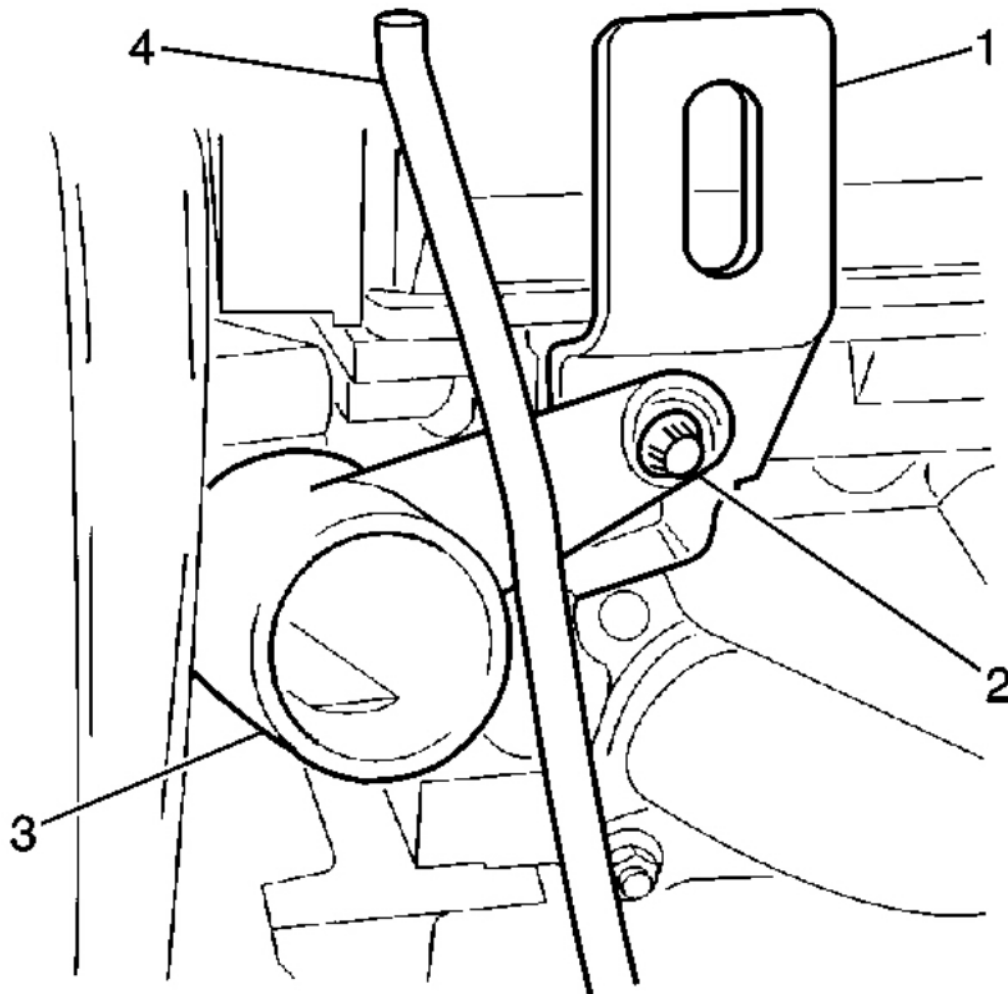


Fig. 104: Identifying Bolt Securing Oil Level Indicator Tube, Coolant Outlet Pipe & Engine Front Lift Bracket To Cylinder Head

Courtesy of GENERAL MOTORS CORP.

3. Remove the bolt (2) securing the following to the cylinder head:
 - The oil level indicator tube (4)
 - The coolant outlet pipe (3)
 - The engine front lift bracket (1)
4. Remove the coolant outlet pipe (3) from the thermostat housing.



Fig. 105: Removing & Installing O-Ring Seals From Pipe
Courtesy of GENERAL MOTORS CORP.

5. Remove the O-ring seals from the coolant outlet pipe.

Discard the O-rings.

Installation Procedure

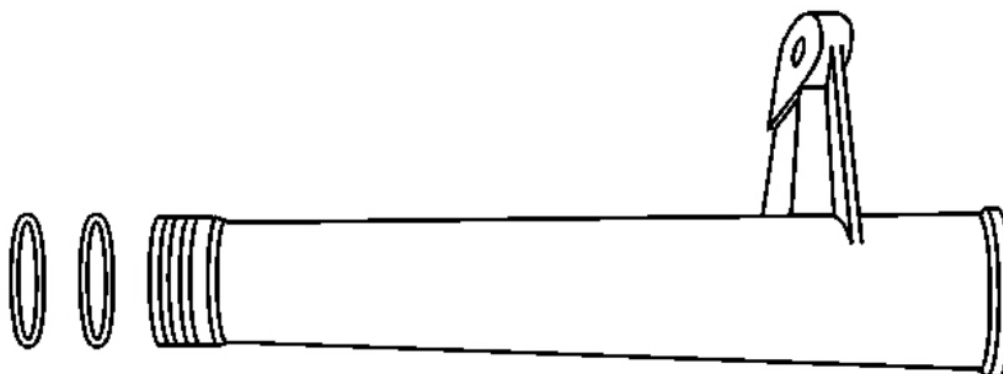


Fig. 106: Removing & Installing O-Ring Seals From Pipe
Courtesy of GENERAL MOTORS CORP.

1. Lubricate 2 new O-ring seals with coolant.

IMPORTANT: Ensure the O-rings are not twisted.

2. Install the new O-ring seals around the coolant outlet pipe grooves.

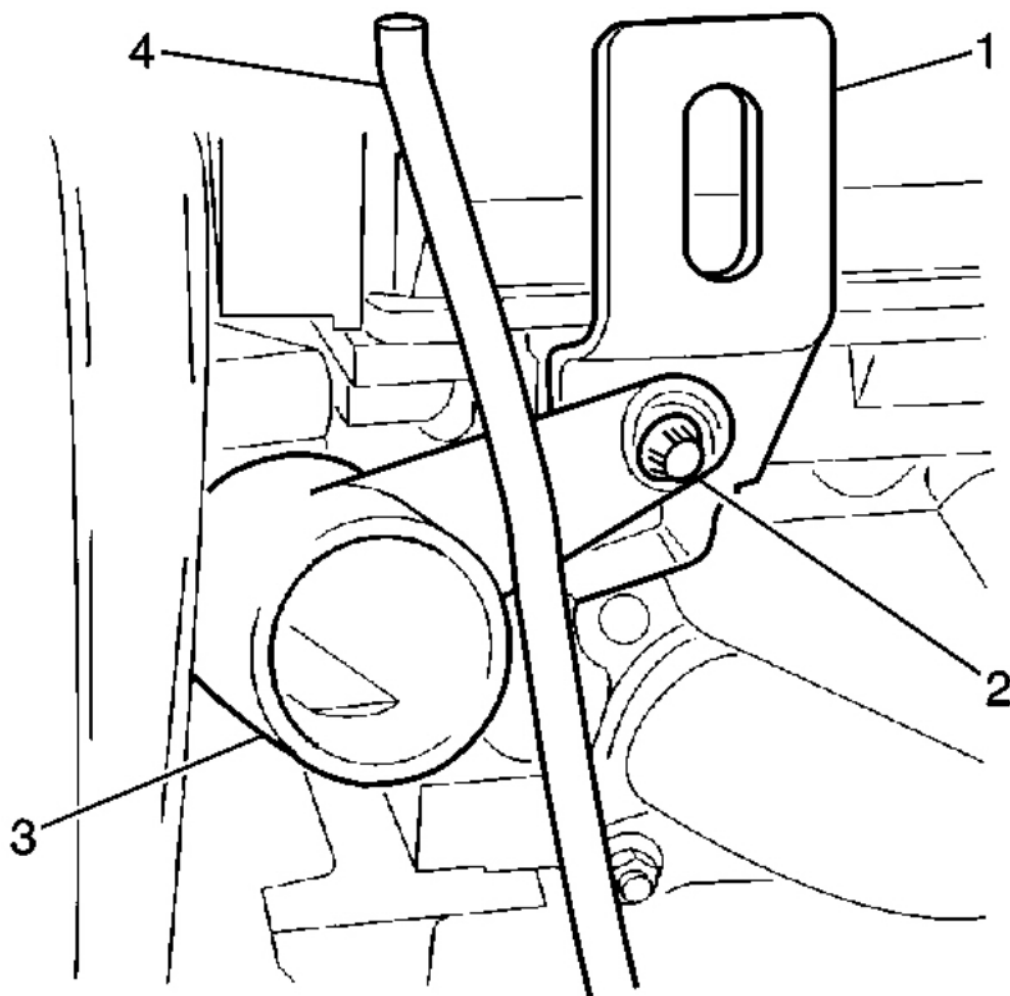


Fig. 107: Identifying Bolt Securing Oil Level Indicator Tube, Coolant Outlet Pipe & Engine Front Lift Bracket To Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Insert the coolant outlet pipe (3) into the thermostat housing.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the bolt (2) securing the following to the cylinder head:

- The oil level indicator tube (4)
- The coolant outlet pipe (3)
- The engine front lift bracket (1)

Tighten: Tighten the oil level indicator tube bolt to 20 N.m (15 lb ft).

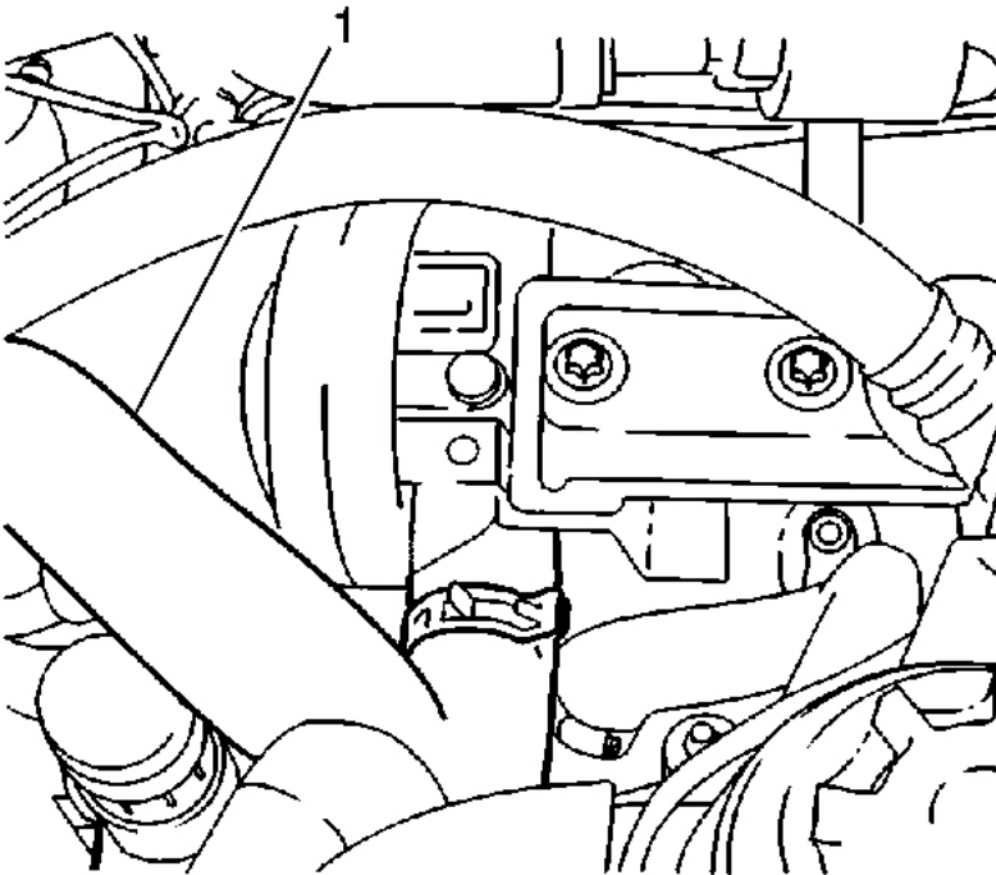


Fig. 108: View Of Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Position the **J 38185** to the clamp in order to connect the radiator inlet hose (1) to the coolant outlet pipe. See Special Tools.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

6. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

WATER PUMP REPLACEMENT (LP1, LY7)

Tools Required

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Remove the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump** in Engine Mechanical - 2.8L (LP1), or **Drive Belt Replacement - Generator and Water Pump** in Engine Mechanical - 3.6L (LY7).

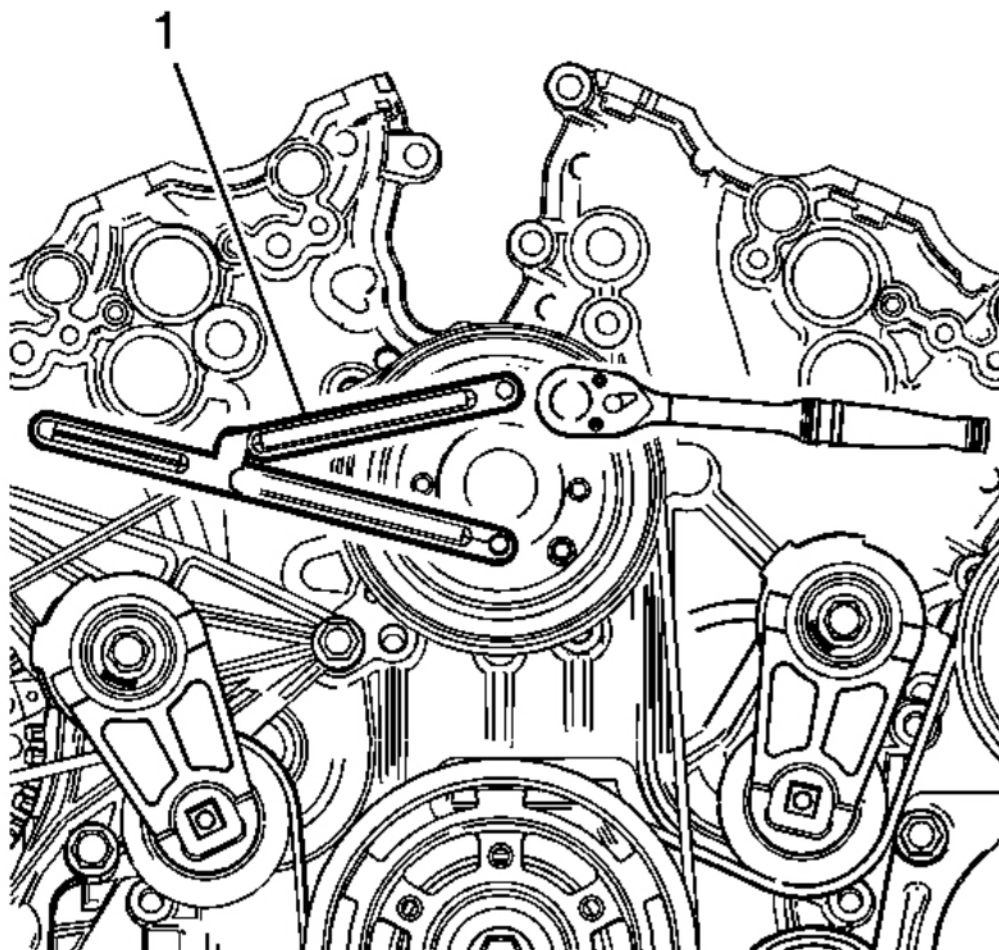


Fig. 109: Securing Water Pump Pulley With EN 46104
Courtesy of GENERAL MOTORS CORP.

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

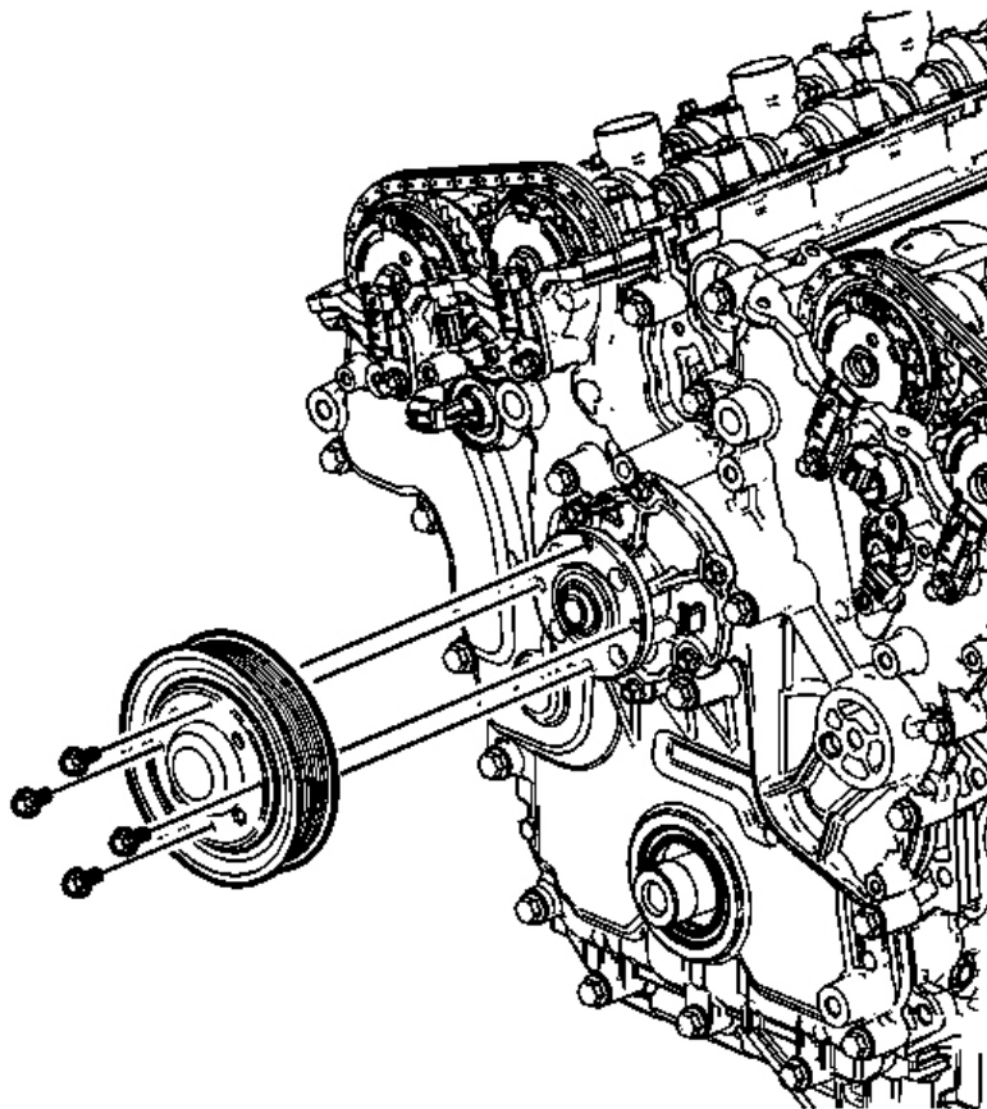


Fig. 110: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

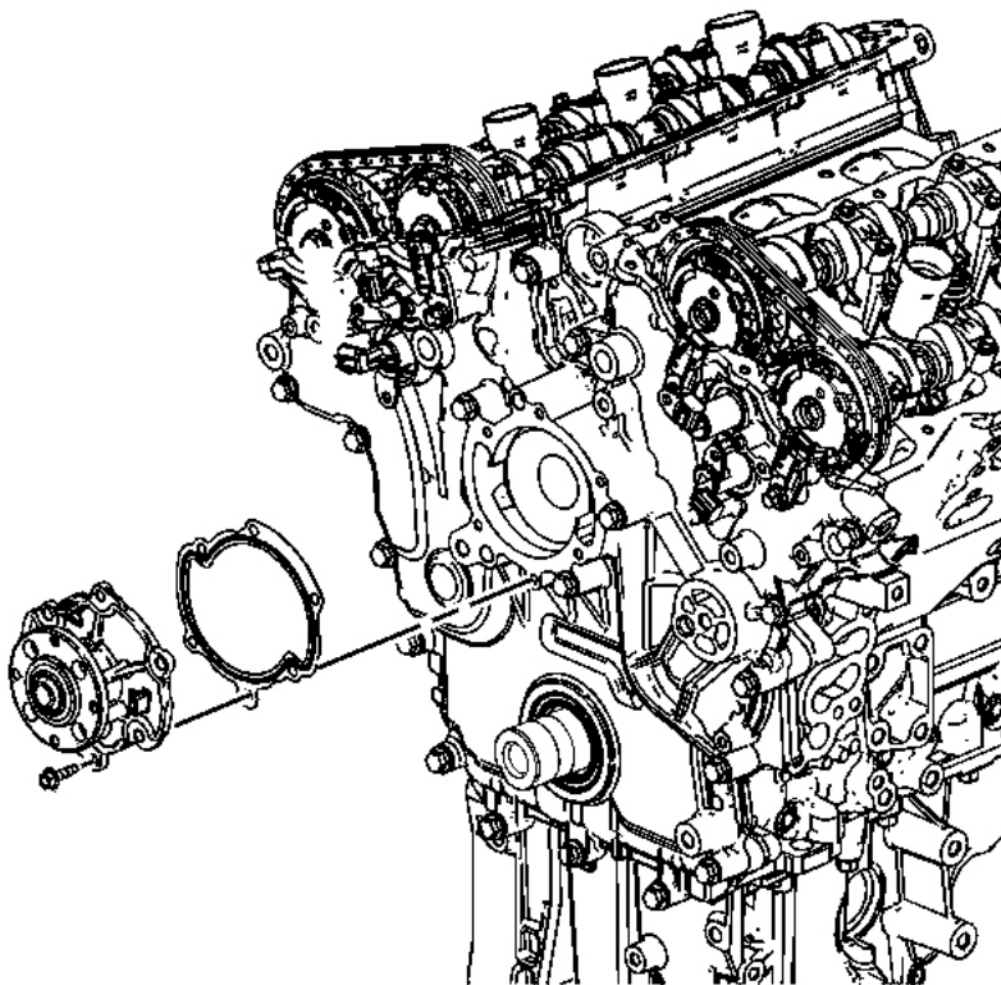


Fig. 111: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

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.

Installation Procedure

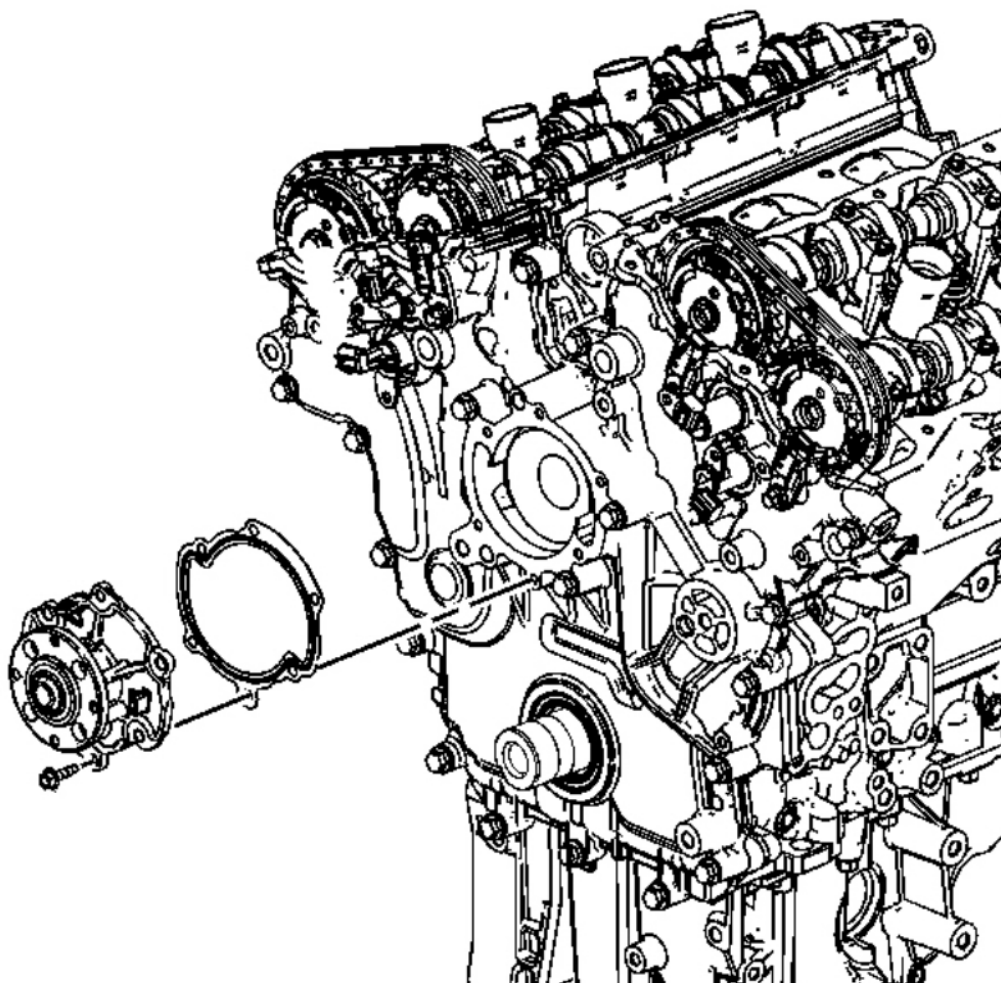


Fig. 112: View Of Water Pump

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).

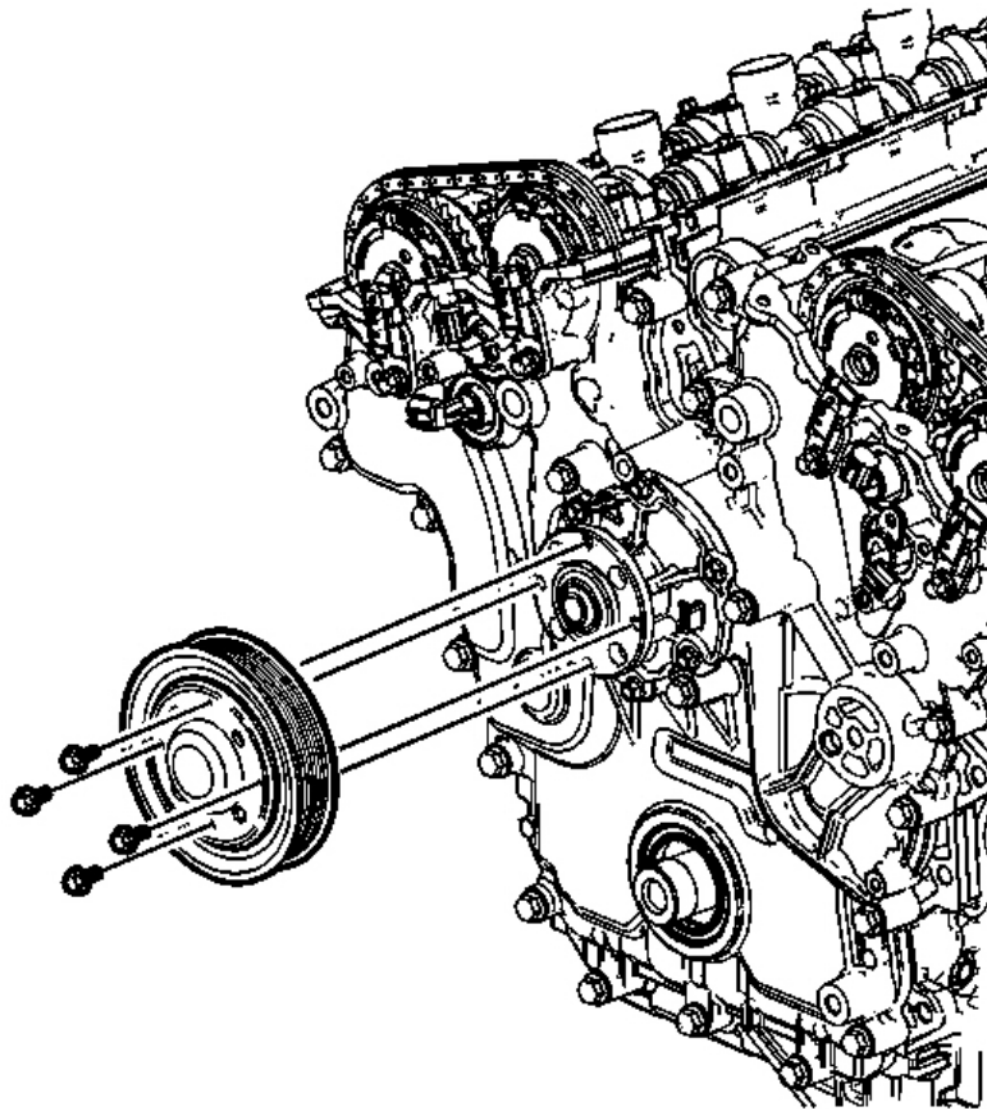


Fig. 113: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

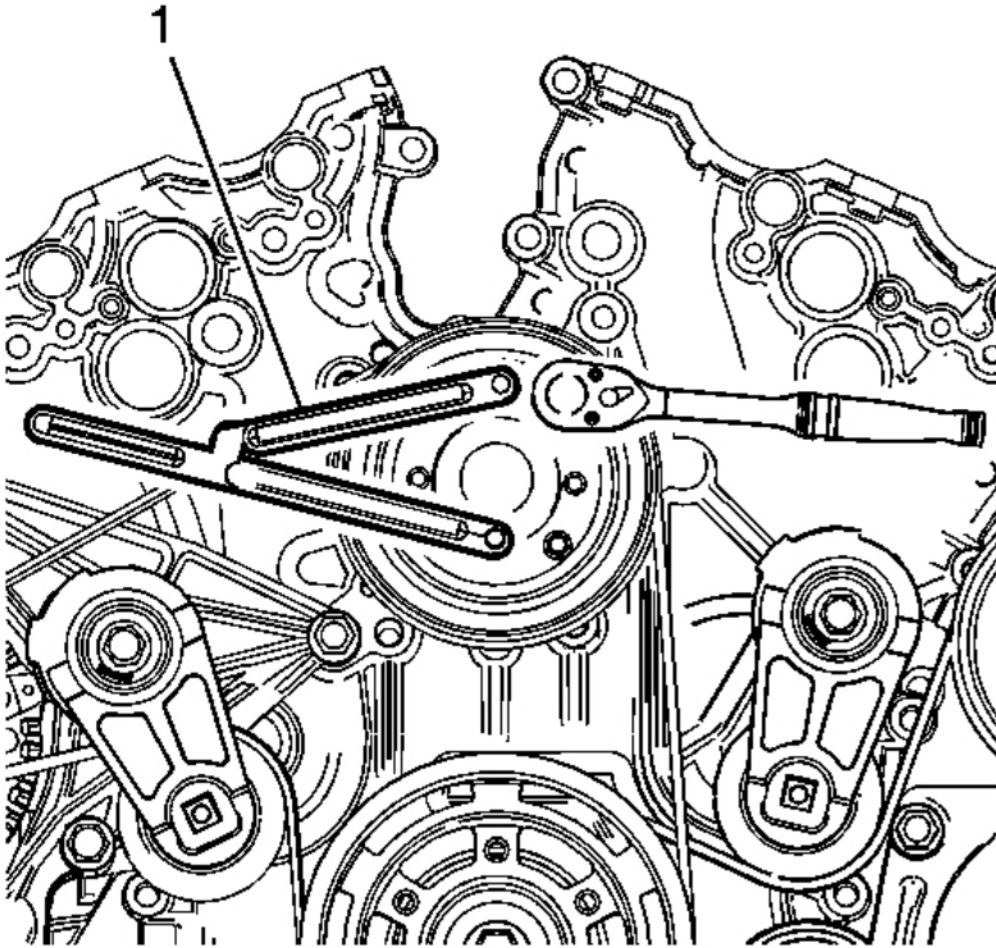


Fig. 114: Securing Water Pump Pulley With EN 46104
 Courtesy of GENERAL MOTORS CORP.

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 and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump** in Engine Mechanical - 2.8L (LP1), or **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 (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE**

47716).

RADIATOR REPLACEMENT (LP1, LY7)

Tools Required

- **J 38185** Hose Clamp Pliers. See **Special Tools**.
- **J 44827** Transmission Cooler Quick Disconnect. See **Special Tools**.

Removal Procedure

1. Drain the coolant. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.
2. Remove the radiator support brackets. Refer to **Radiator Support Bracket Replacement (LP1, LY7)** or **Radiator Support Bracket Replacement (LS6)**.
3. Remove the cooling fans. Refer to **Cooling Fan Replacement - Electric (LP1, LY7)**.

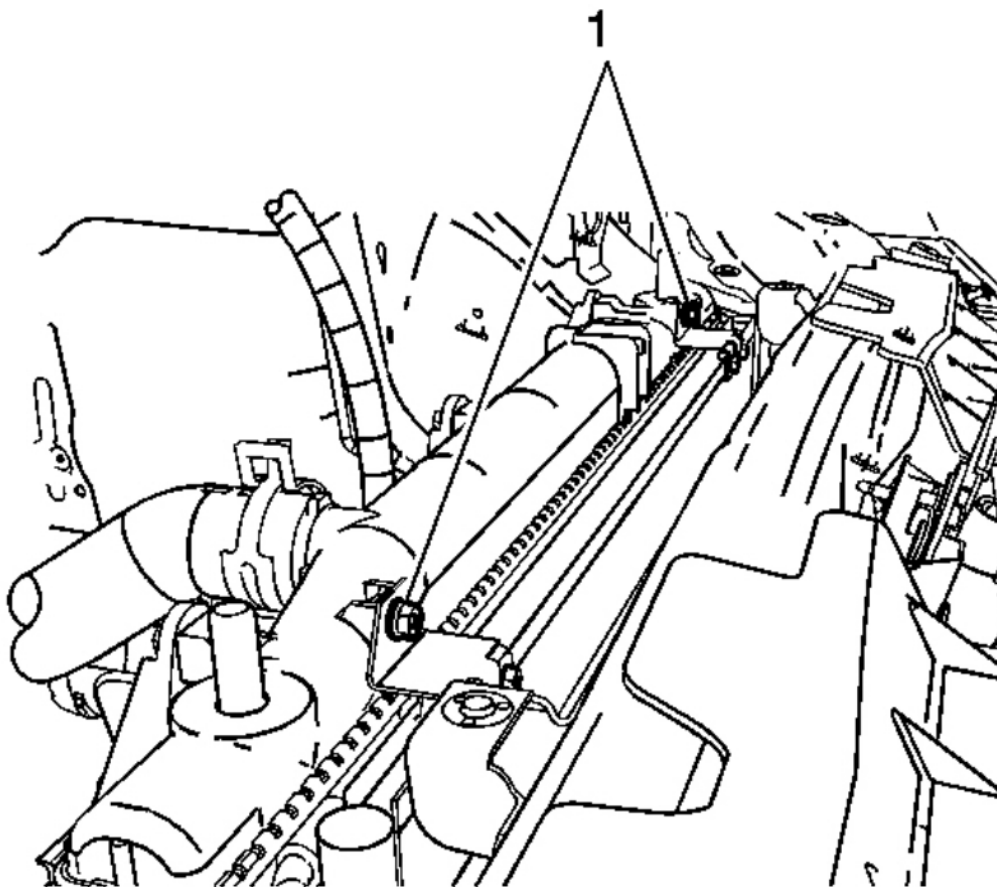


Fig. 115: View Of Condenser Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the 2 upper condenser mounting bolts (1).
5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

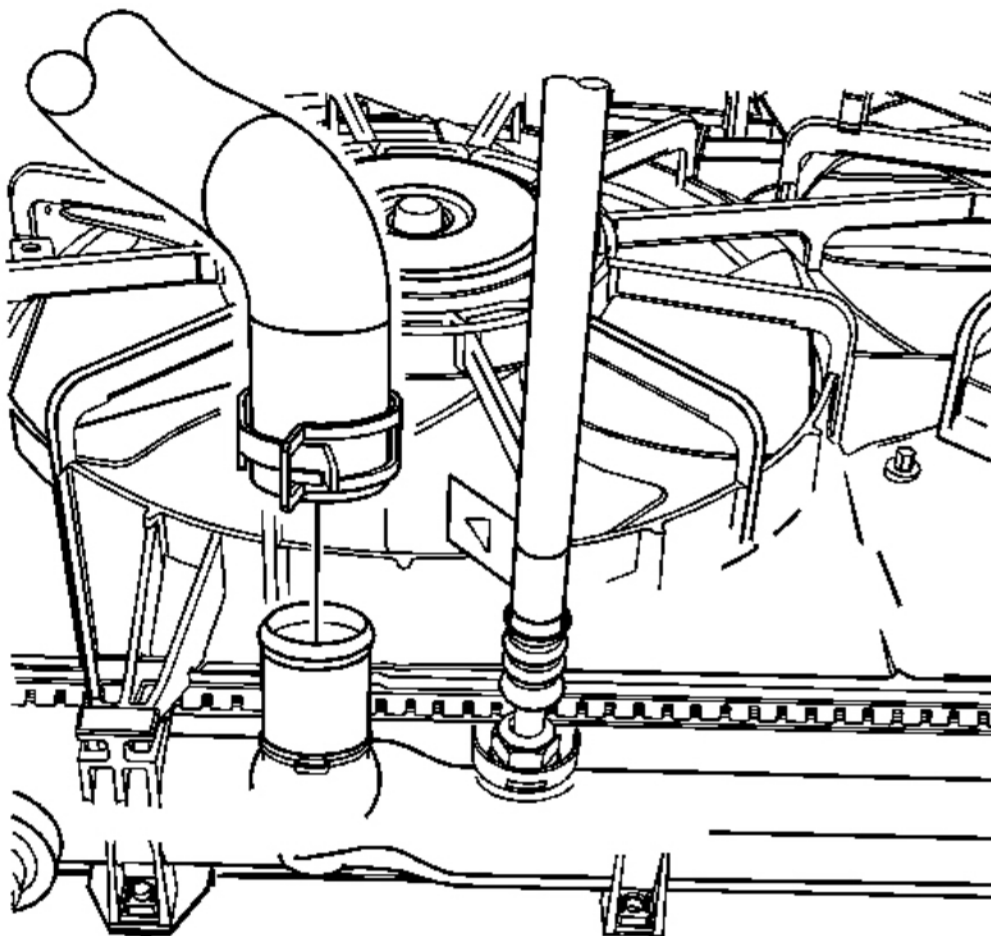


Fig. 116: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

6. Using **J 38185** disconnect the lower radiator hose from the radiator. See **Special Tools**.

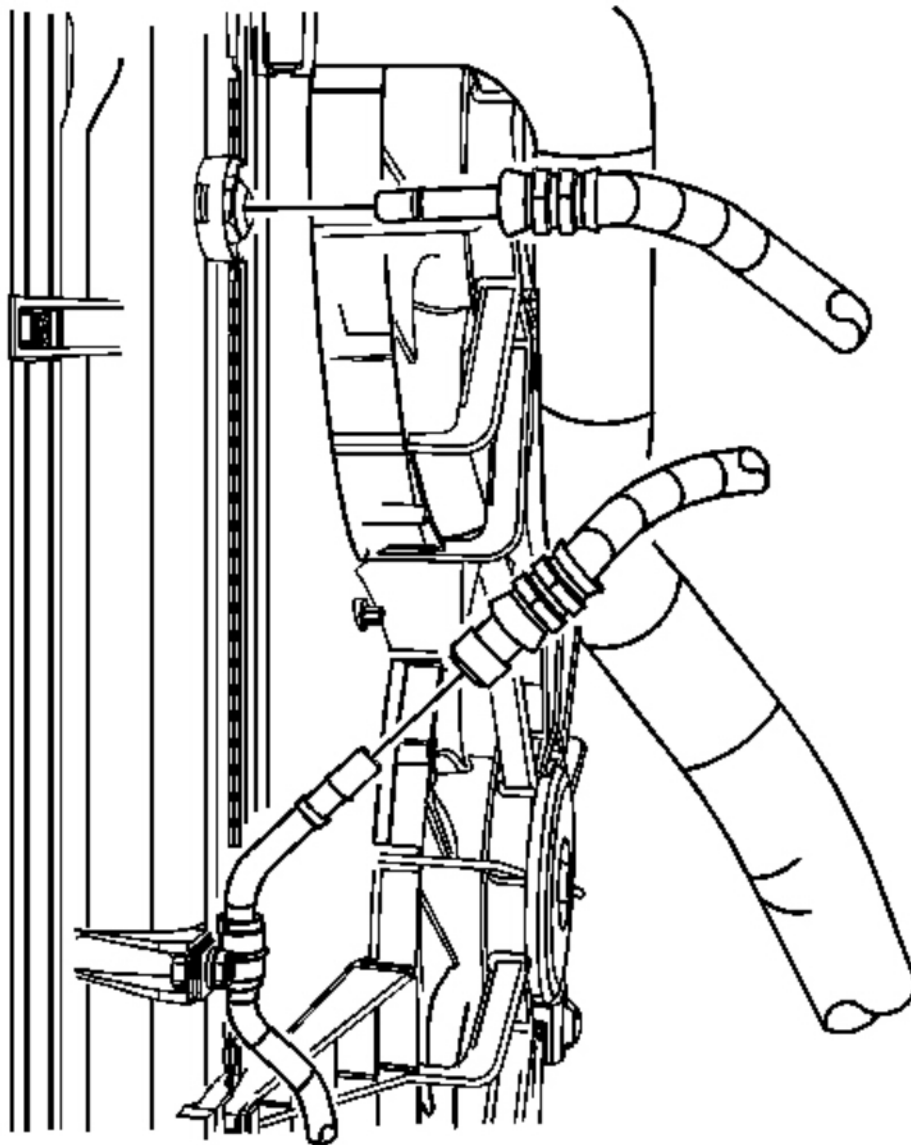


Fig. 117: Identifying Transmission Oil Cooler System Quick Connect Fittings
Courtesy of GENERAL MOTORS CORP.

7. Remove the front air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.

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.

8. Using **J 44827** disconnect the lower transaxle oil cooler line from the radiator. See **Special Tools**.

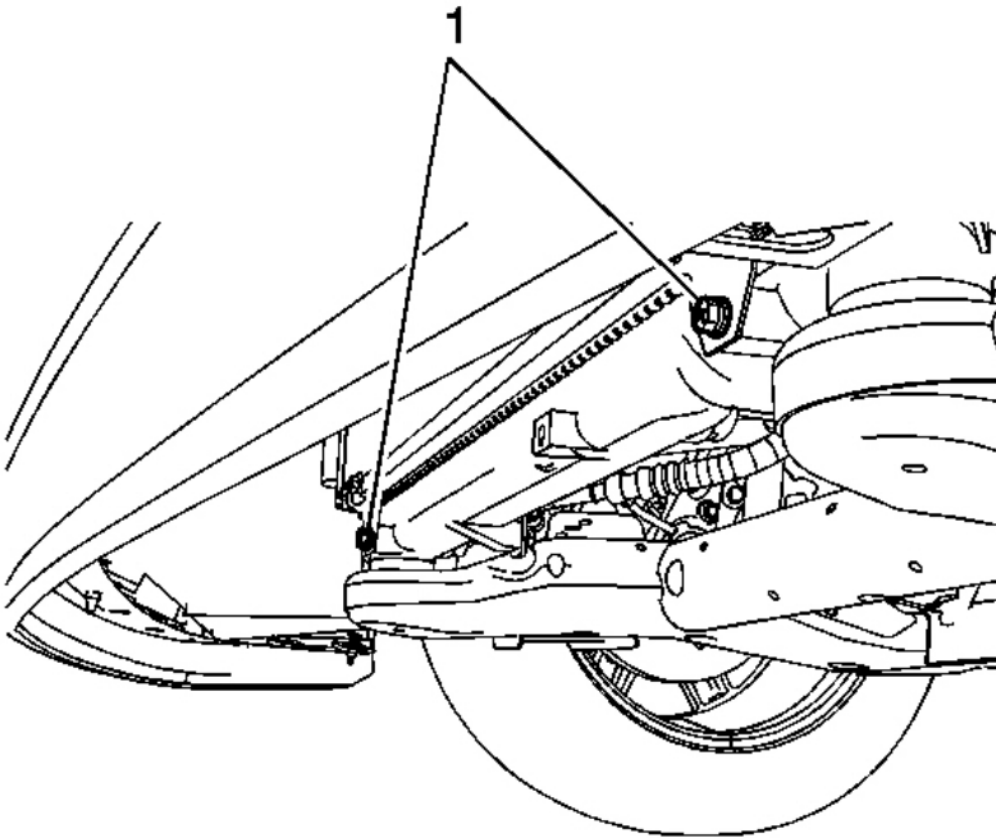


Fig. 118: Locating Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the lower condenser mounting bolts (1).
10. Remove the push pins from the radiator side seal.
11. Separate the side seals from the radiator.
12. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

13. Remove the radiator.

Installation Procedure

1. Install the radiator into the insulator in the frame.

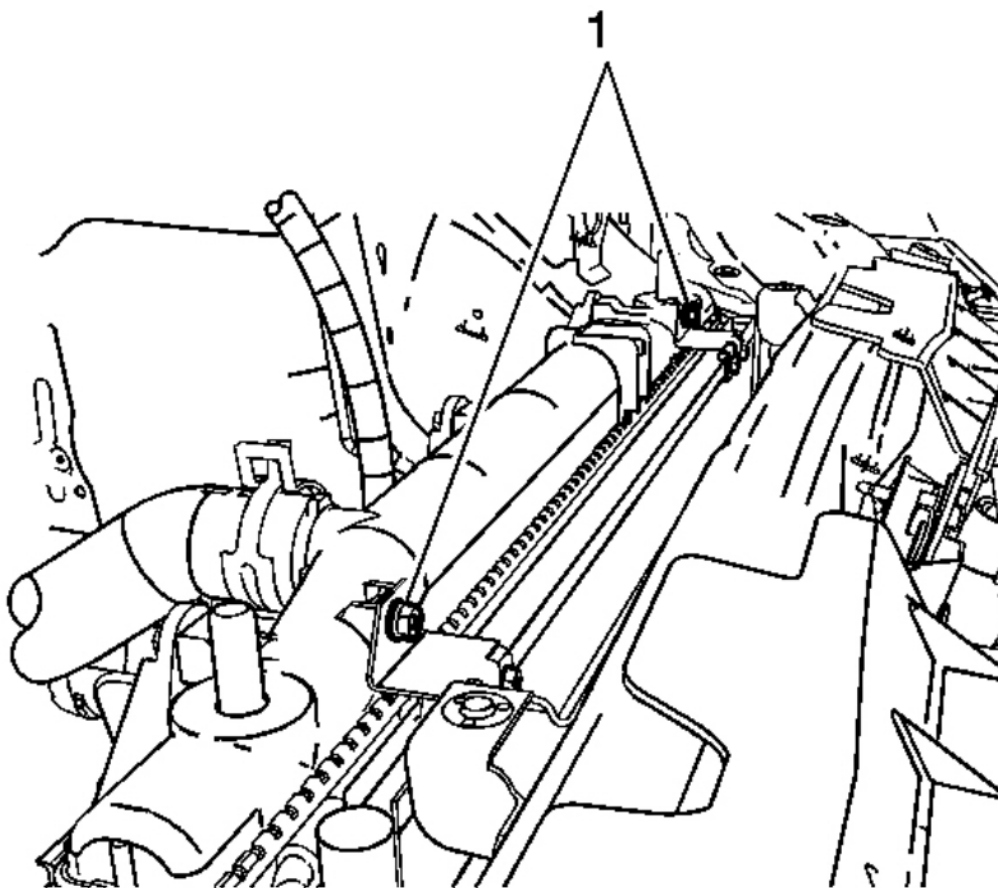


Fig. 119: View Of Condenser Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the upper condenser mounting bolts (1).

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

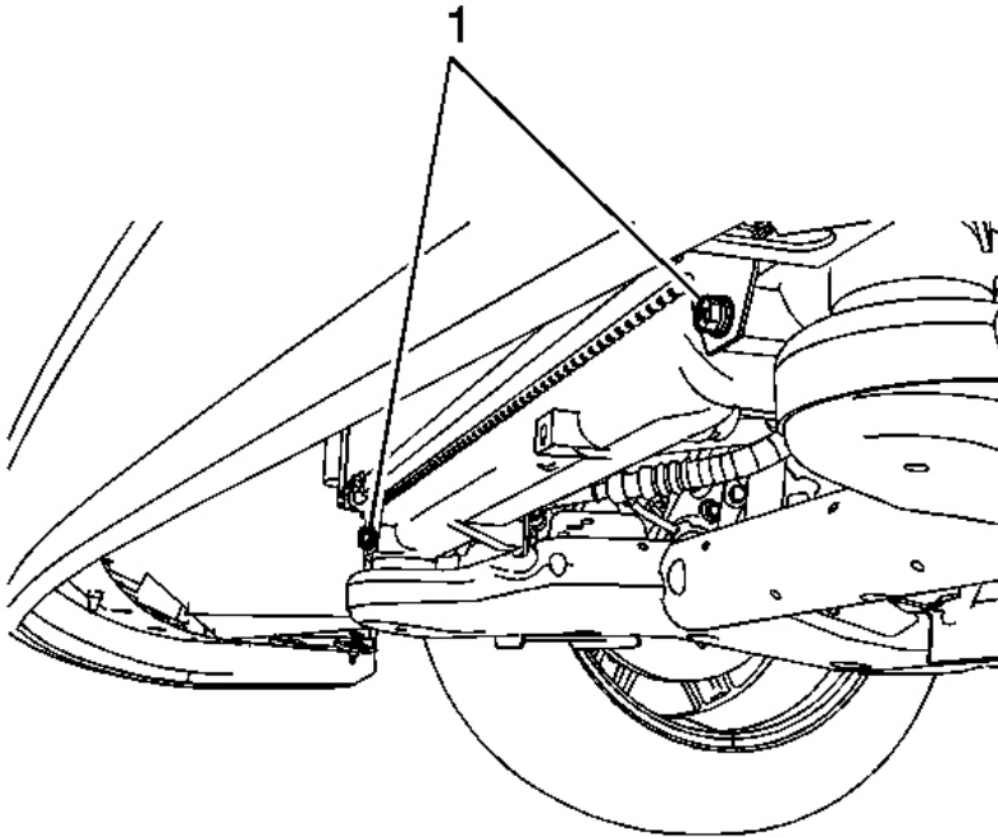


Fig. 120: Locating Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Install the lower condenser mounting bolts (1).

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

5. Push the lower transaxle oil cooler lines into the radiator until you hear the lines engage.
6. Gently tug out on the oil cooler lines to verify that the lines are engaged into position.

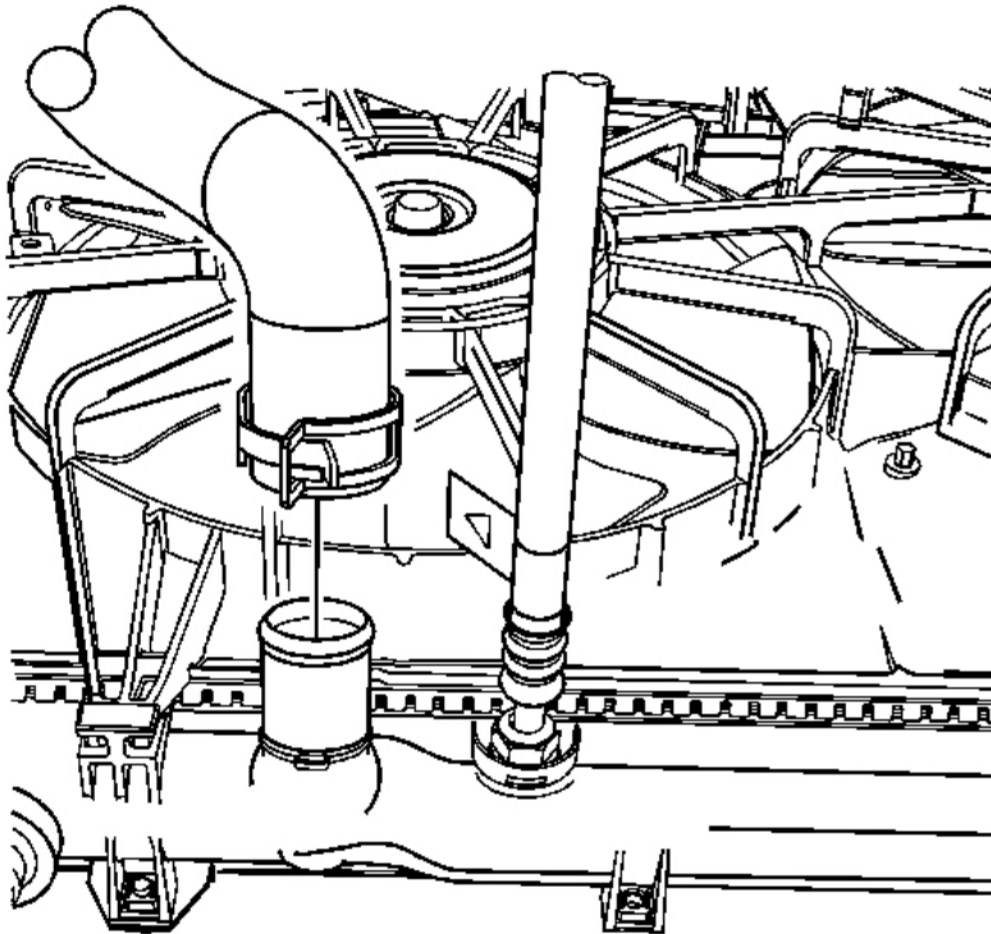


Fig. 121: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

7. Connect the lower radiator hose to the radiator.
8. Using **J 38185** slide the clamp into the original position on the hose. See **Special Tools**.
9. Install the side seal pushpin into the radiator.
10. Ensure that all seals are in place around the radiator.
11. Lower the vehicle.
12. Install the cooling fans. Refer to **Cooling Fan Replacement - Electric (LP1, LY7)**.
13. Install the radiator supports. Refer to **Radiator Support Bracket Replacement (LP1, LY7)** or **Radiator Support Bracket Replacement (LS6)**.
14. Fill the cooling system with coolant. Refer to **Draining and Filling Cooling System (LP1, LY7 Static**

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).

RADIATOR REPLACEMENT (LS6)

Tools Required

J 38185 Hose Clamp Pliers. See Special Tools.

Removal Procedure

1. Drain the coolant. Refer to Draining and Filling Cooling System (LP1, LY7 Static Fill) or Draining and Filling Cooling System (LS2 Static Fill) or Draining and Filling Cooling System (GE 47716).
2. Remove the radiator support brackets. Refer to Radiator Support Bracket Replacement (LP1, LY7) or Radiator Support Bracket Replacement (LS6).
3. Remove the cooling fans. Refer to Cooling Fan Replacement - Electric (LP1, LY7).

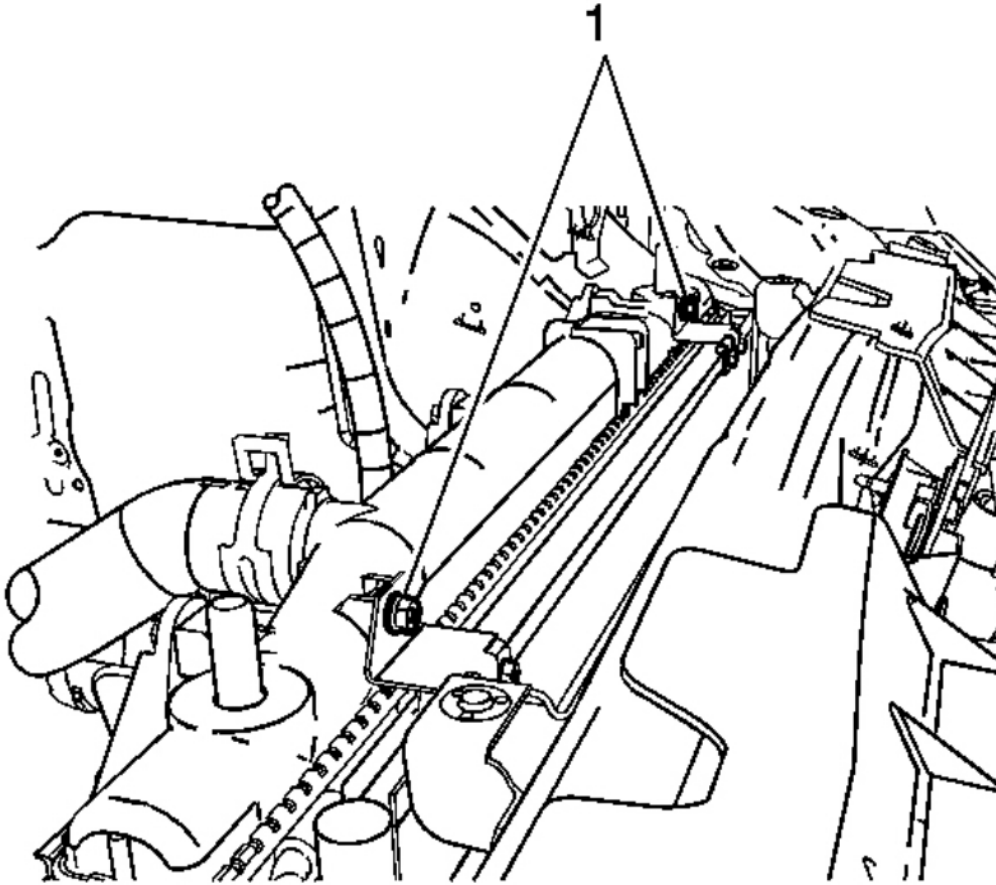


Fig. 122: View Of Condenser Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the 2 upper condenser mounting bolts (1).
5. Using the **J 38185** disconnect the upper radiator hose clamp. See **Special Tools**.
6. Remove the upper radiator hose from the radiator.
7. Using the **J 38185** disconnect the surge tank inlet hose clamp. See **Special Tools**.
8. Remove the surge tank hose from the radiator.

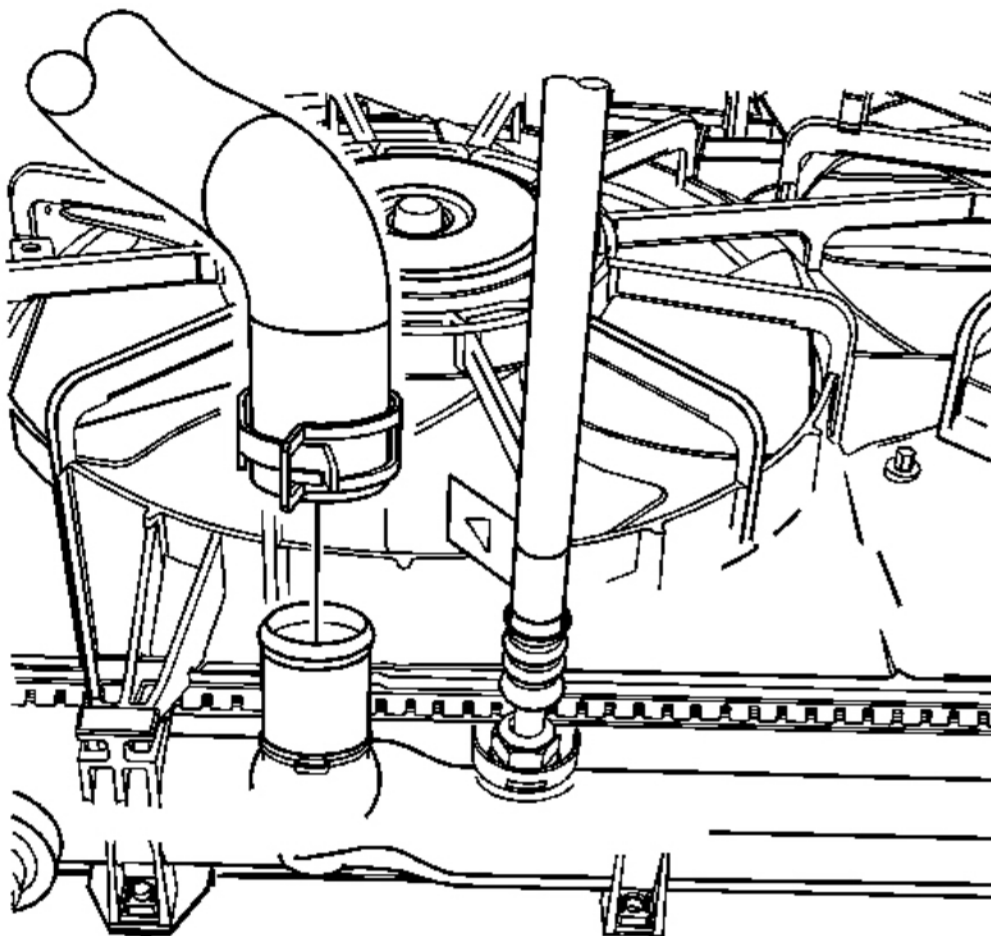


Fig. 123: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

9. Using **J 38185** disconnect the lower radiator hose from the radiator. See **Special Tools**.

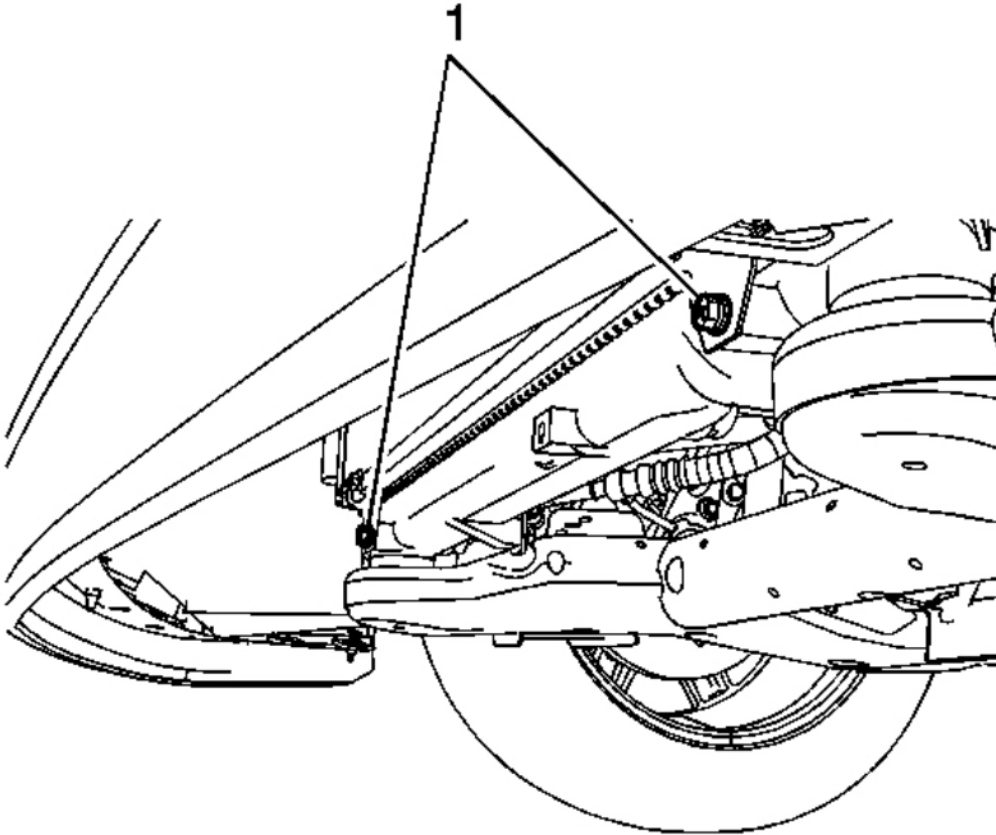


Fig. 124: Locating Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower condenser mounting bolts (1).
11. Remove the push pins from the radiator side seal.
12. Separate the side seals from the radiator.
13. Lower the vehicle.
14. Remove the radiator.

Installation Procedure

1. Install the radiator into the insulator in the frame.

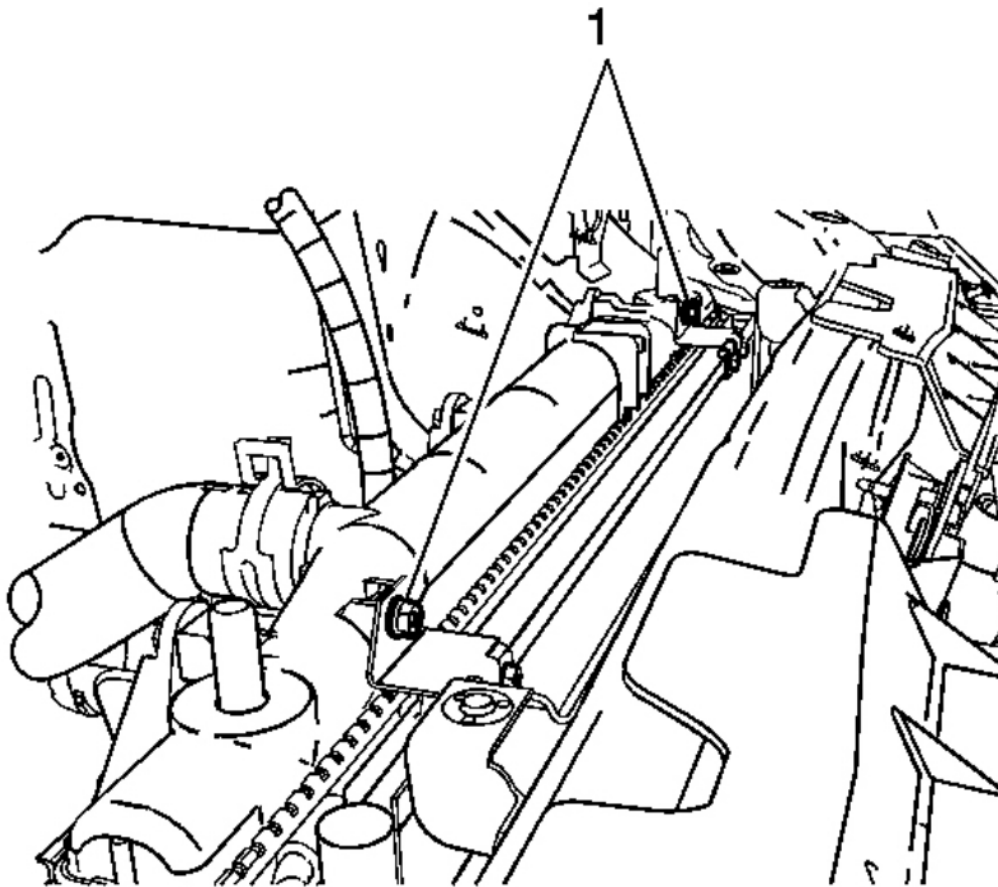


Fig. 125: View Of Condenser Upper Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the upper condenser mounting bolts (1).

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

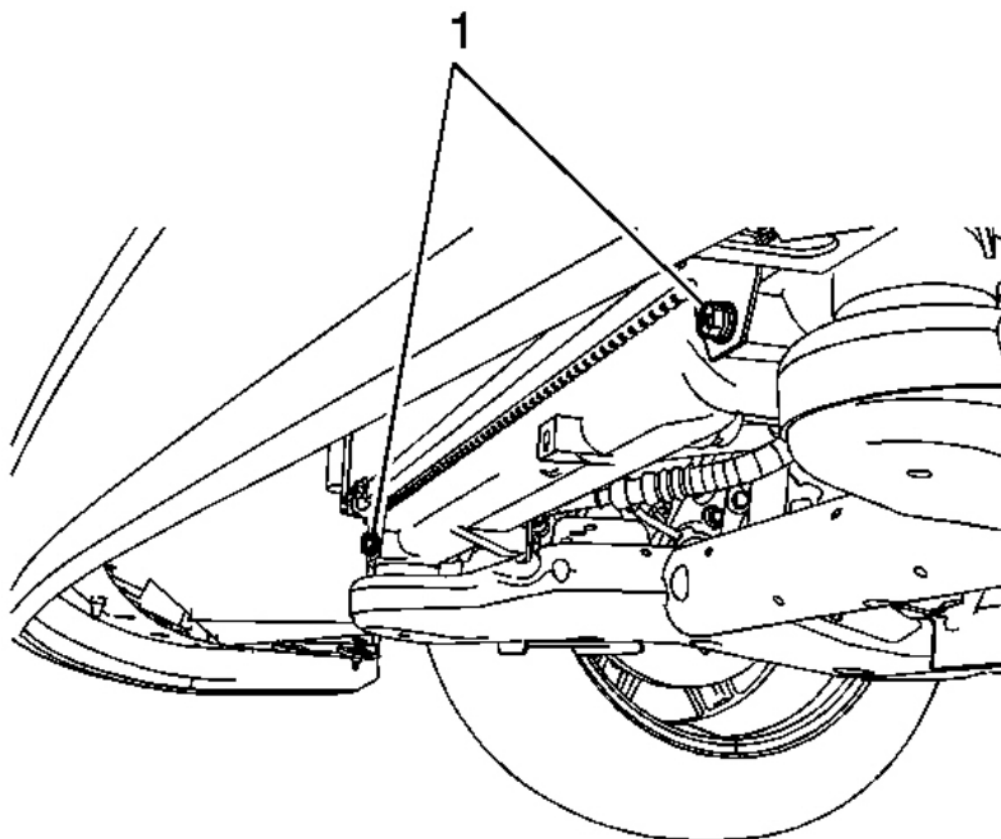


Fig. 126: Locating Condenser Lower Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Raise the vehicle.
4. Install the lower condenser mounting bolts (1).

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

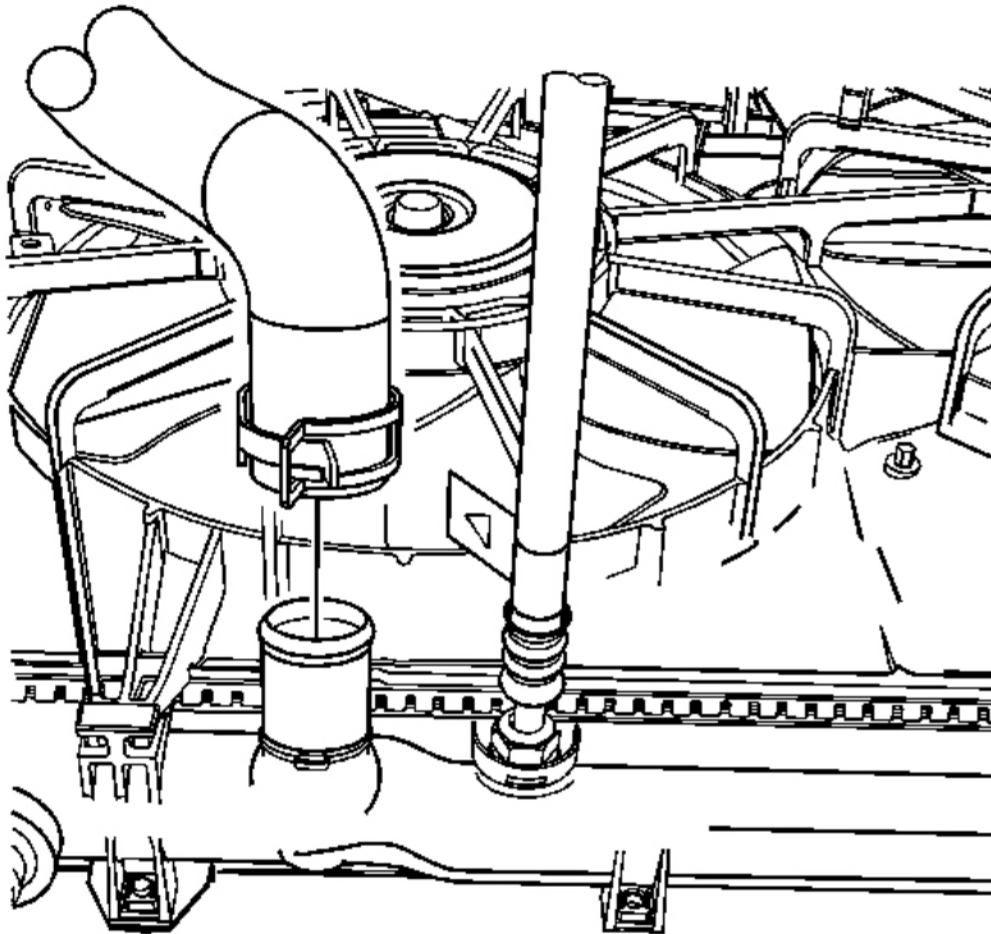


Fig. 127: View Of Lower Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

5. Connect the lower radiator hose to the radiator.
6. Using **J 38185** slide the clamp into the original position on the hose. See **Special Tools**.
7. Install the side seal pushpin into the radiator.
8. Ensure that all seals are in place around the radiator.
9. Lower the vehicle.
10. Install the upper radiator hose to the radiator.
11. Using the **J 38185** reposition the upper radiator hose clamp. See **Special Tools**.
12. Install the surge tank hose to the radiator.

13. Using the **J 38185** reposition the surge tank inlet hose clamp. See **Special Tools**.
14. Install the cooling fans. Refer to **Cooling Fan Replacement - Electric (LP1, LY7)**.
15. Install the radiator supports. Refer to **Radiator Support Bracket Replacement (LP1, LY7)** or **Radiator Support Bracket Replacement (LS6)**.
16. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)**.

RADIATOR SUPPORT BRACKET REPLACEMENT (LP1, LY7)

Tools Required

J 38185 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

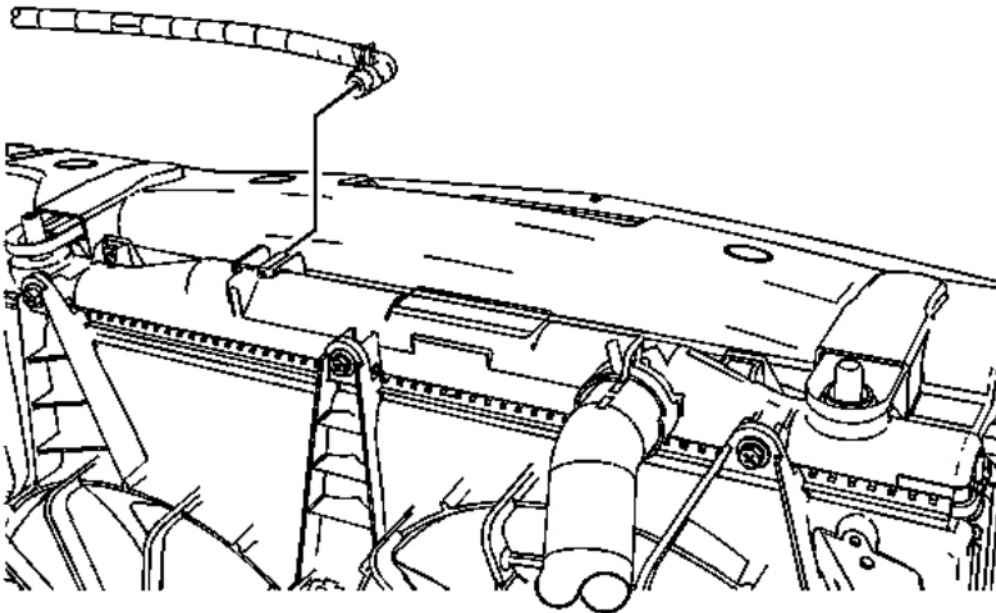


Fig. 128: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

1. Using a **J 38185** , slide the hose clamp away from the base of the surge tank inlet hose. See **Special Tools**.
2. Remove the surge tank inlet hose from the radiator assembly.

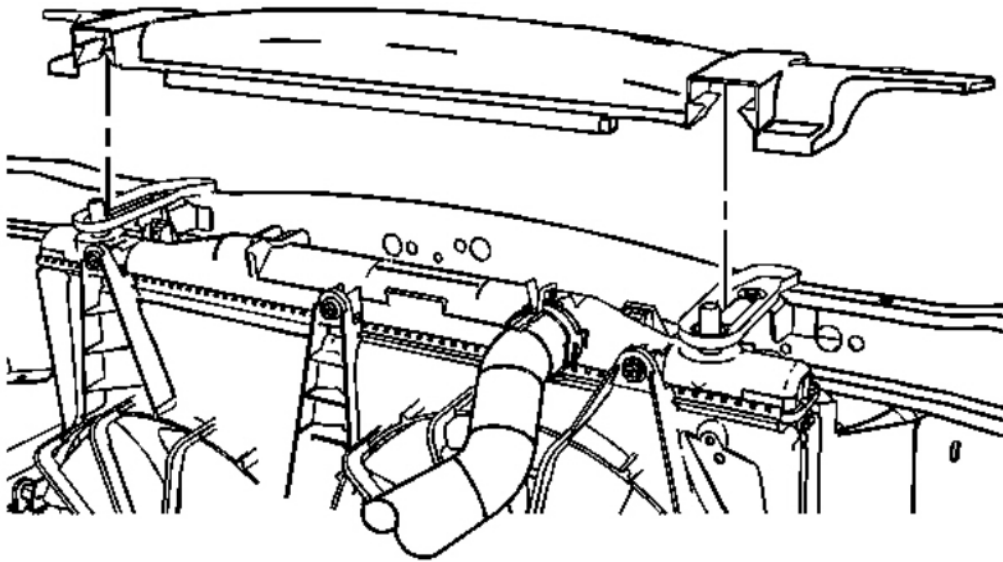


Fig. 129: View Of Condenser Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the condenser seal.

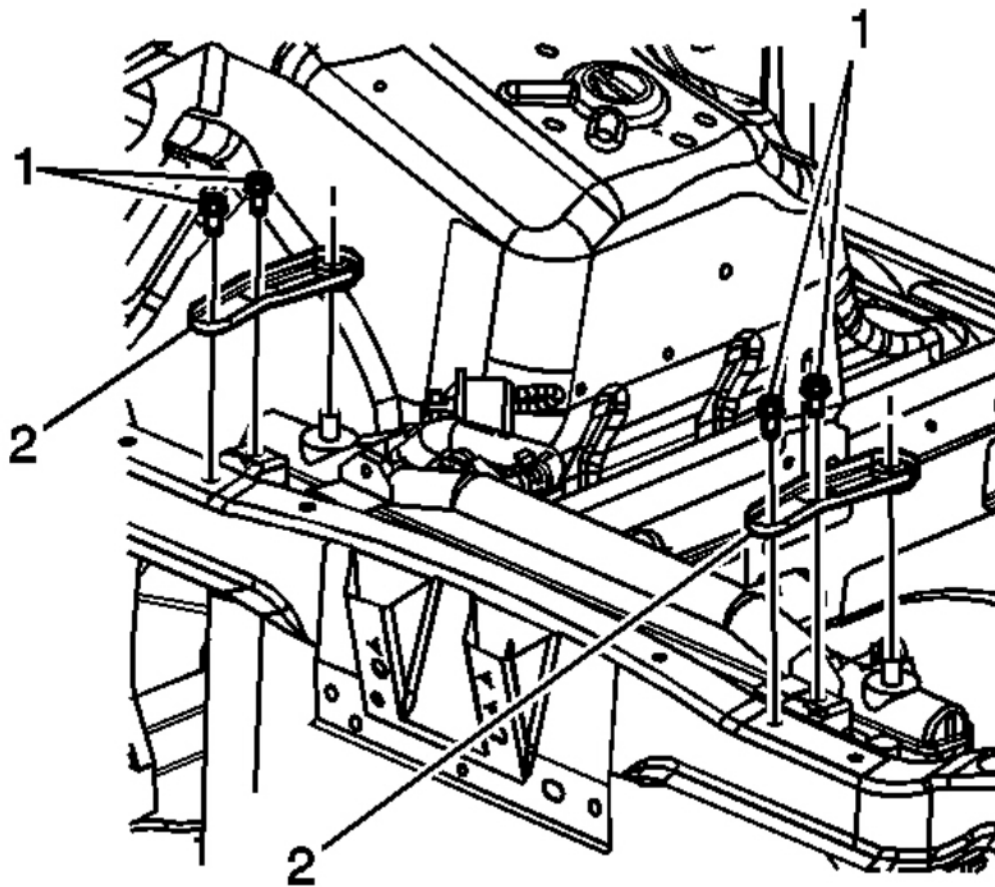


Fig. 130: Locating Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the radiator support bolts (1).
5. Remove the radiator support brackets (2).

Installation Procedure

1. Install the radiator support brackets (2).

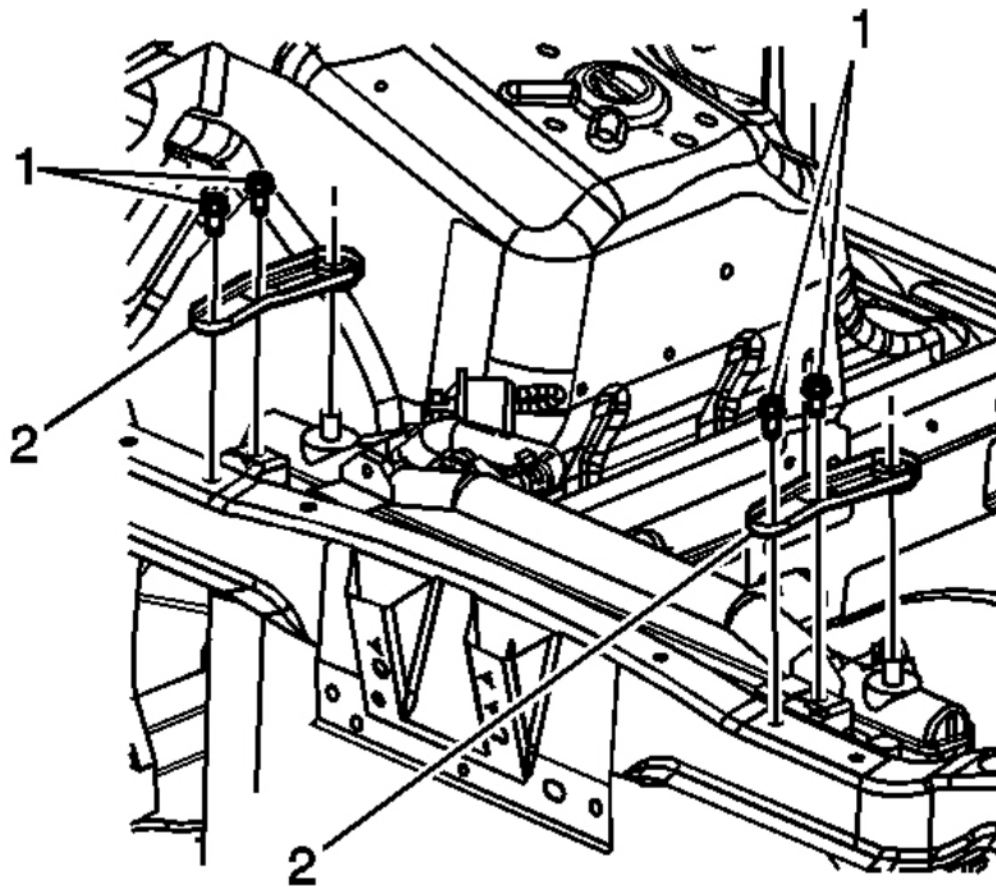


Fig. 131: Locating Radiator Support Bolts

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the radiator support bolts (1).

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

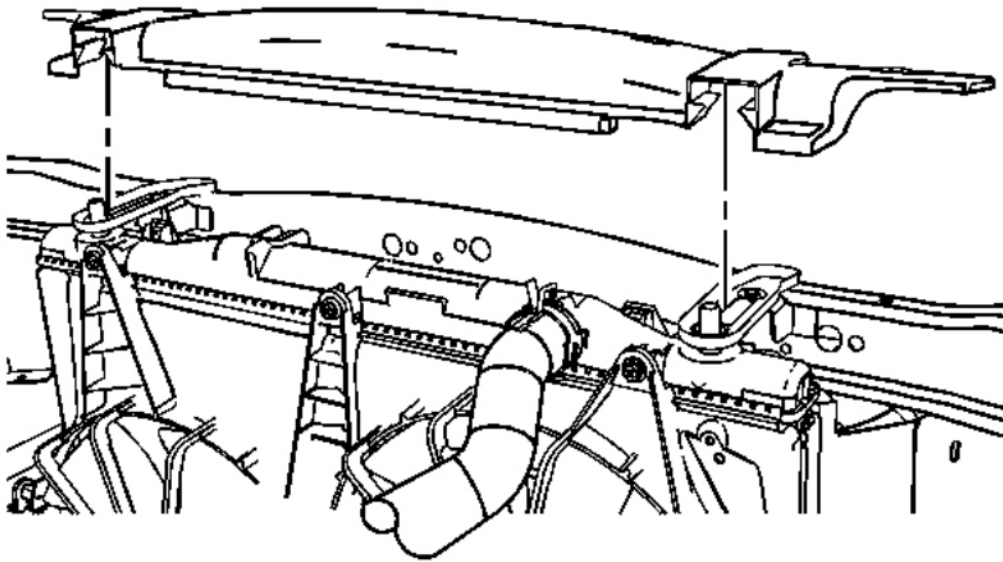


Fig. 132: View Of Condenser Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the condenser seal.

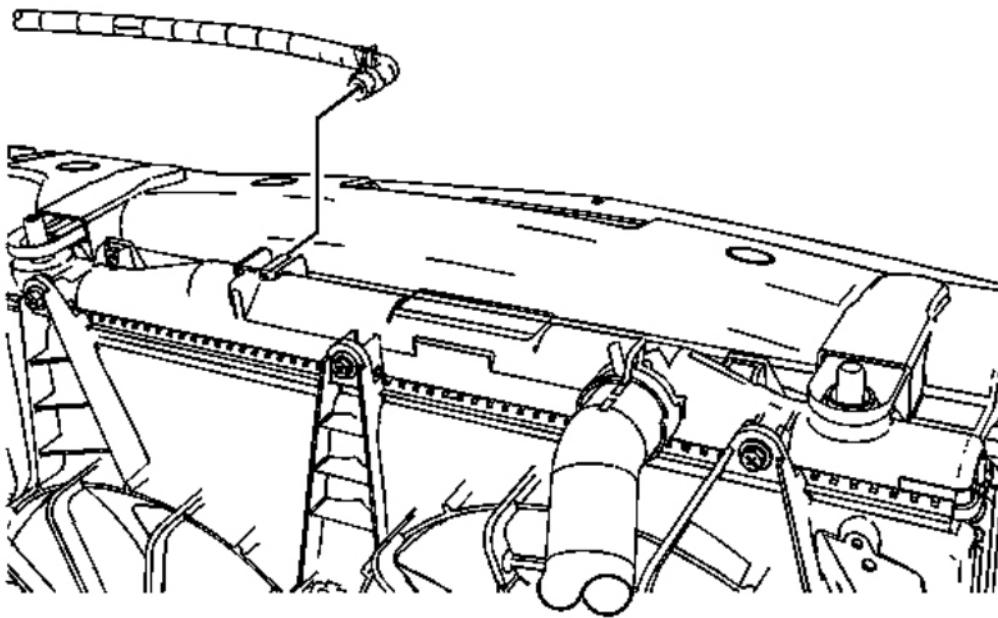


Fig. 133: View Of Surge Tank Inlet Hose - LY7
Courtesy of GENERAL MOTORS CORP.

4. Install the surge tank inlet hose to the radiator assembly.
5. Using a **J 38185** , slide the hose clamp into the original position on the hose. See **Special Tools**.

RADIATOR SUPPORT BRACKET REPLACEMENT (LS6)

Removal Procedure

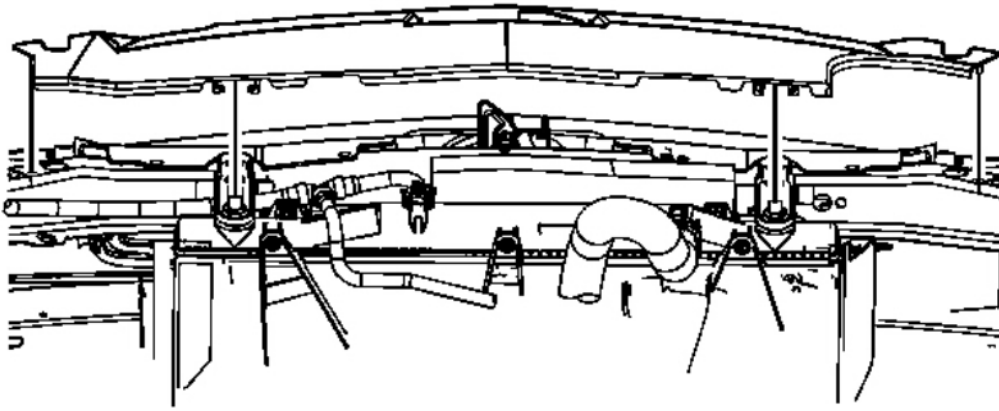


Fig. 134: View Of Condenser Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the condenser seal.

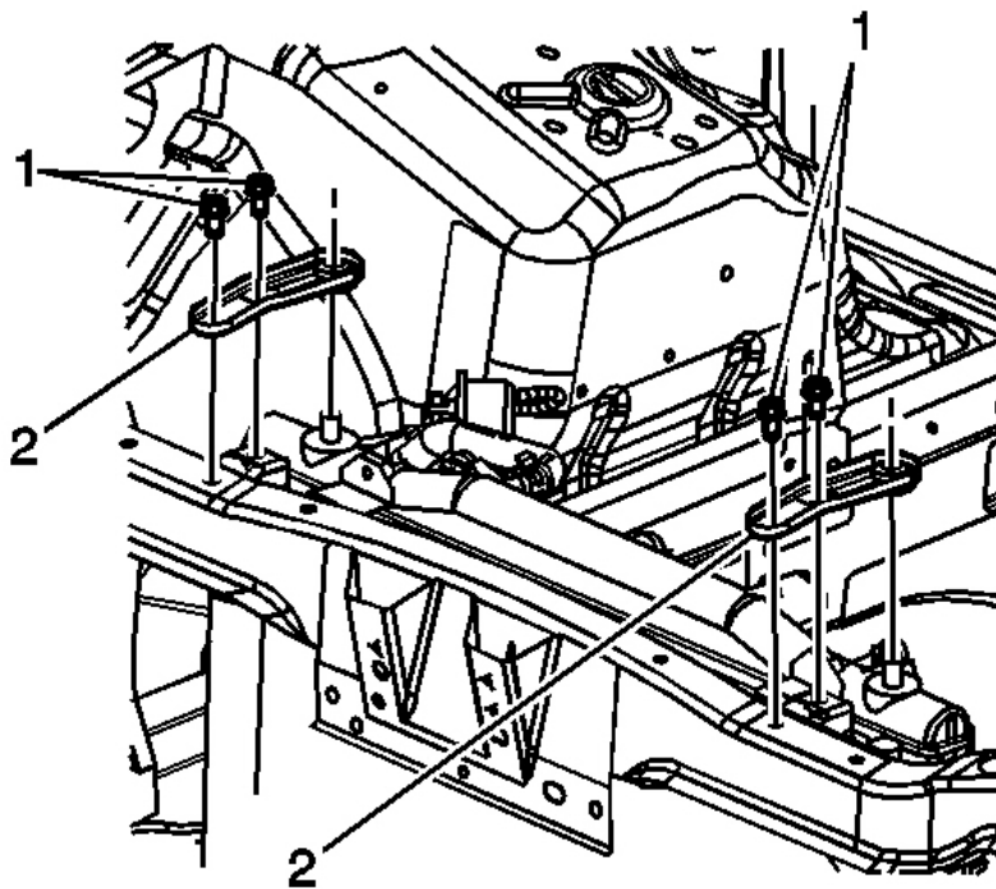


Fig. 135: Locating Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

2. Remove the radiator support bolts (1).
3. Remove the radiator support brackets (2).

Installation Procedure

1. Install the radiator support brackets (2).

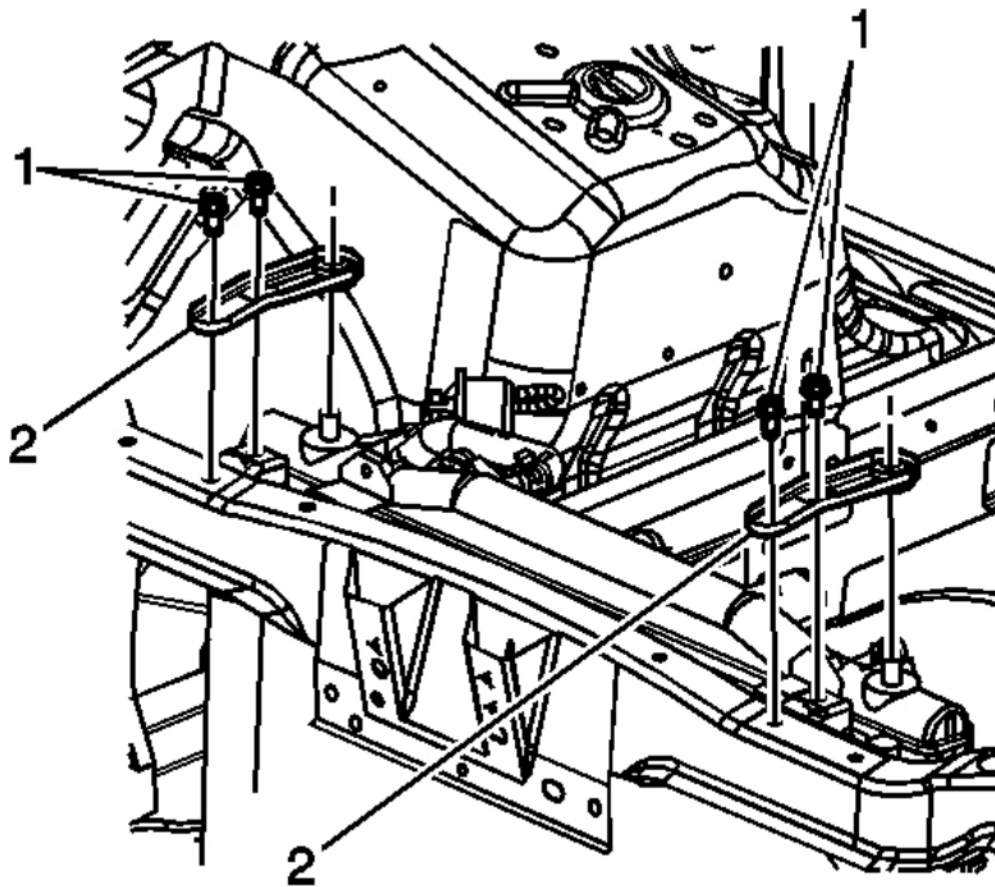


Fig. 136: Locating Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the radiator support bolts (1).

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

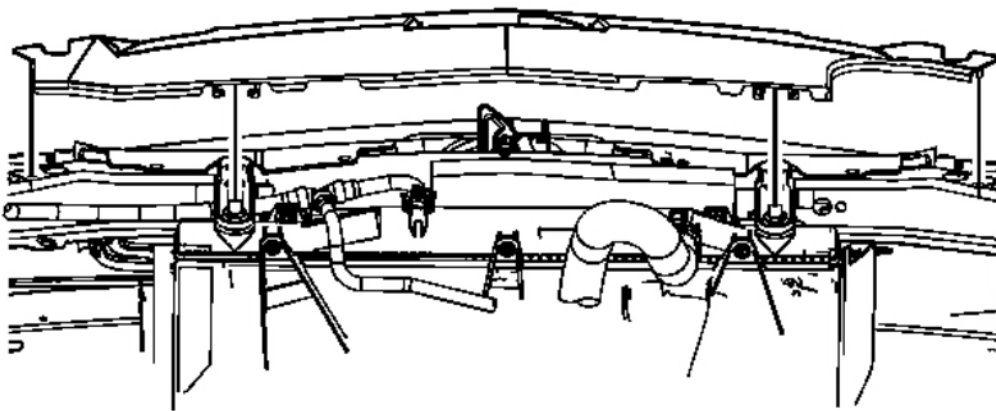


Fig. 137: View Of Condenser Seal
Courtesy of GENERAL MOTORS CORP.

3. Install the condenser seal.

COOLANT HEATER REPLACEMENT (LP1, LY7)

Removal Procedure

1. Turn the ignition OFF.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
3. Disconnect the coolant heater cord from the coolant heater.

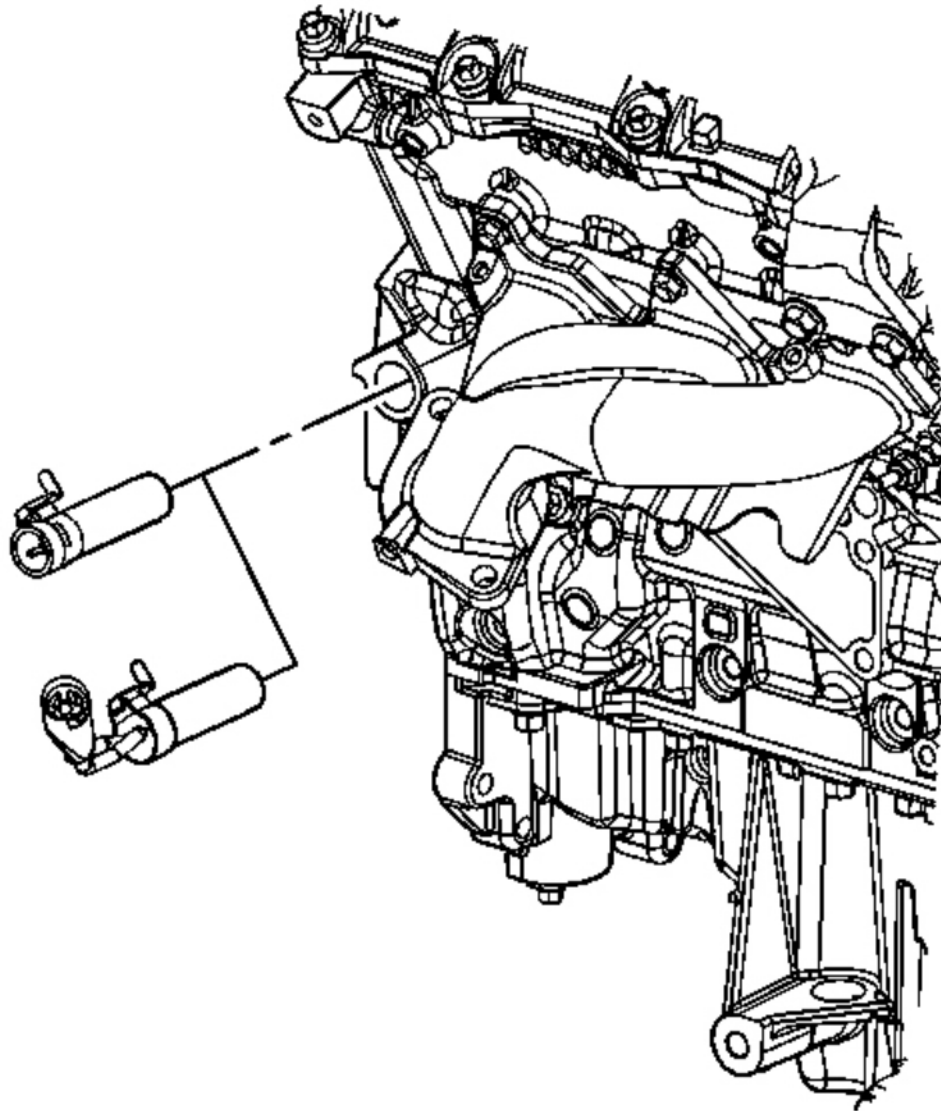


Fig. 138: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater.

Installation Procedure

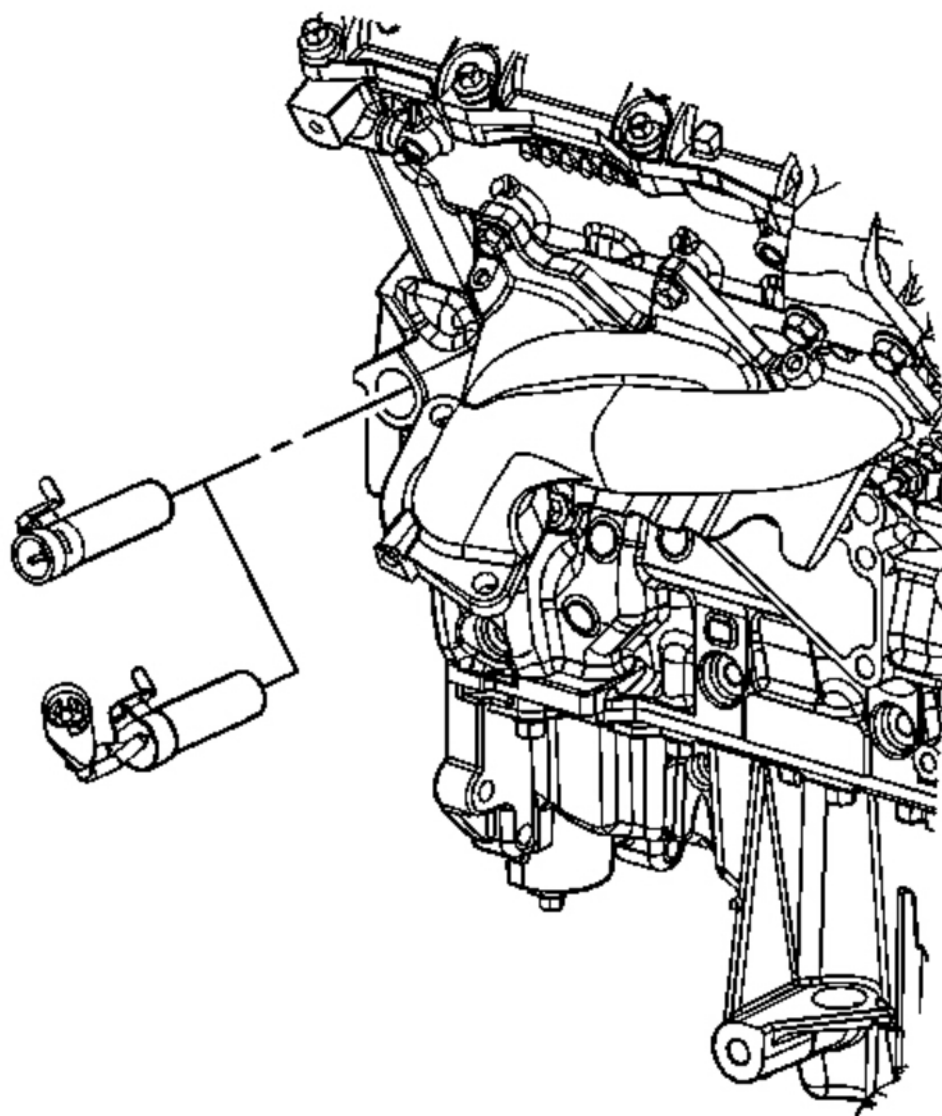


Fig. 139: View Of Coolant Heater - LY7, KO5
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater.
2. Connect the coolant heater cord to the coolant heater.
3. Lower the vehicle.

COOLANT HEATER CORD REPLACEMENT (LP1, LY7)**Removal Procedure**

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

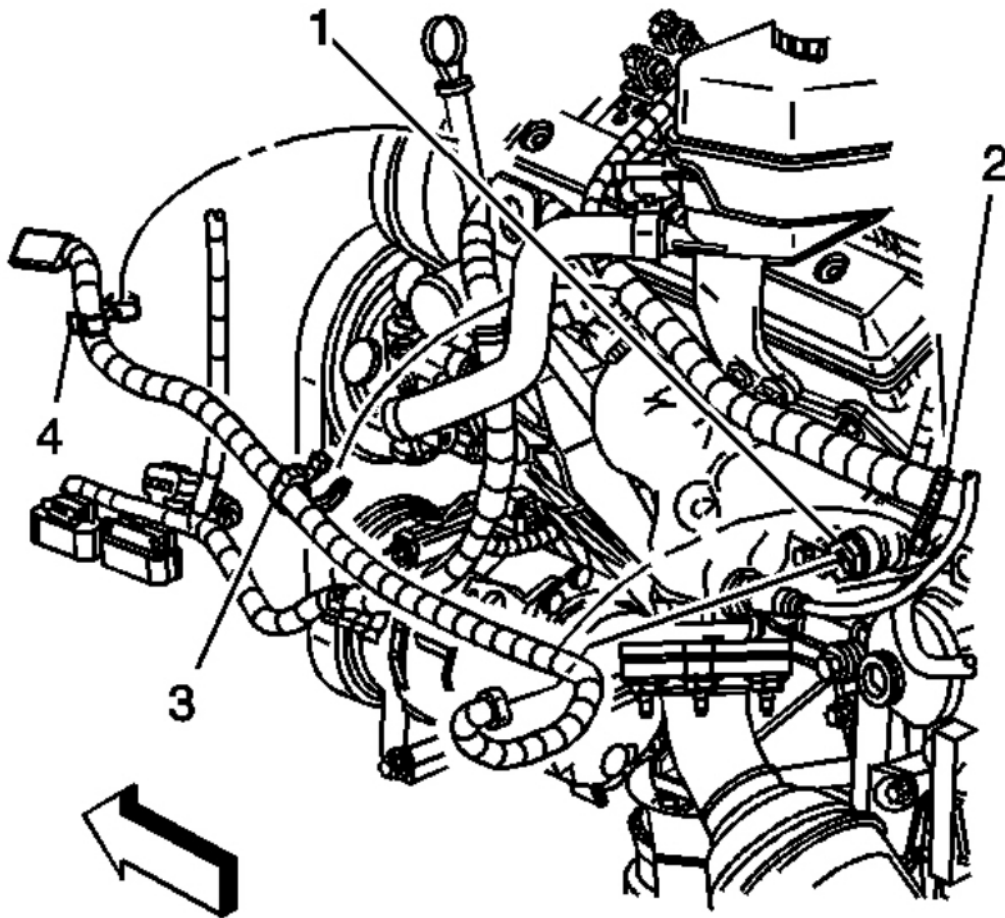


Fig. 140: View Of Coolant Heater Cord - LY7 (KO5)

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

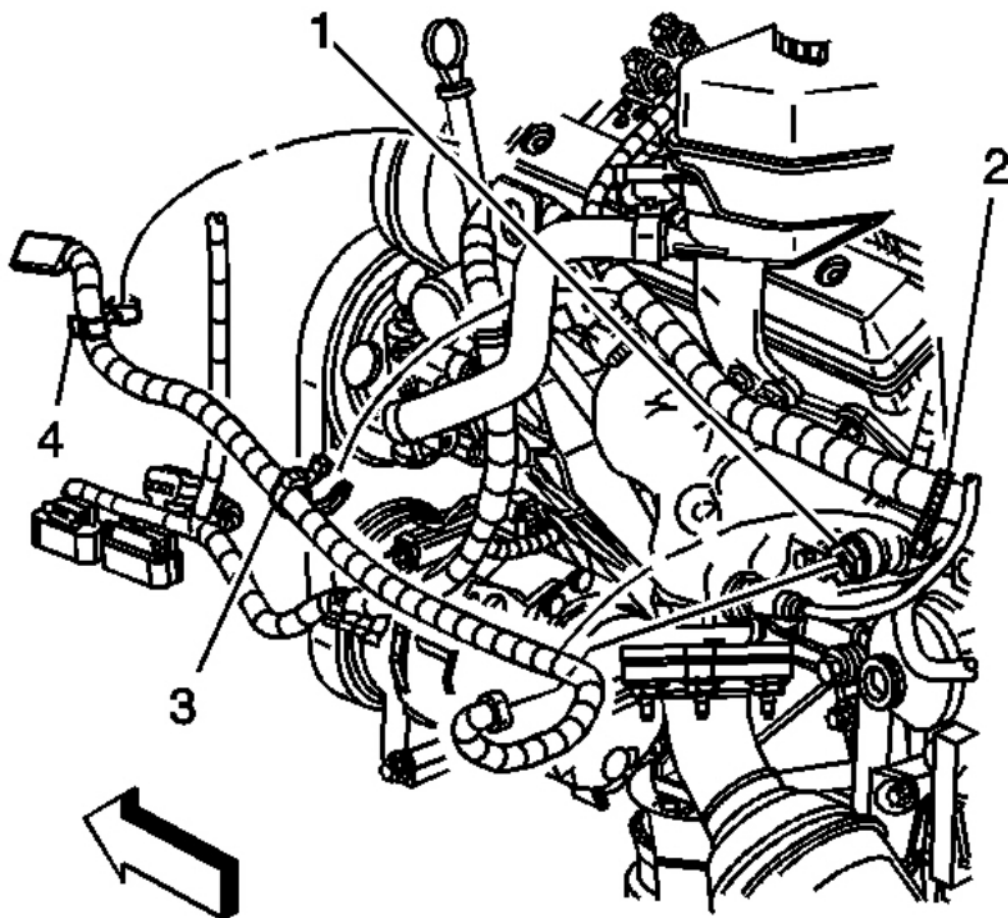


Fig. 141: View Of Coolant Heater Cord - LY7 (KO5)

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 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 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 min. regardless of coolant temperature.

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

- Engine coolant temperature exceeds approximately 104.25°C (220°F).
- A/C refrigerant pressure exceeds approximately 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 3 electrical cooling fans and 4 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 auxiliary cooling fan relay is located in the left rear fuse block and receives ignition 1 voltage from the underhood fuse block. The auxiliary cooling fan receives battery positive voltage from the left rear fuse block through the auxiliary cooling fan motor supply voltage circuit via the underhood fuse block.

During auxiliary cooling fan operation, the ECM supplies the ground path for the auxiliary cooling fan relay through the auxiliary cooling fan relay control circuit. This energizes the auxiliary cooling fan relay coil, closes the relay contacts, and supplies battery positive voltage from the 30 amp maxi-fuse through the auxiliary cooling fan motor supply voltage circuit. The ground path is provided at G104.

The ECM commands the low speed 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 4 min. regardless of coolant temperature.

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

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

- Engine coolant temperature exceeds approximately 104.25°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.

The ECM commands the auxiliary cooling fan ON when the engine coolant temperature exceeds approximately 108°C (226°F).

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 (1) enters the heater core (2) 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. If the coolant temperature is below 95°C (203°F), the afterboil coolant pump (3) may be turned on to increase the flow through the heater core. This pump is located down stream of the heater core in the heater outlet hose. Coolant will flow through this pump even if the pump is not required and is turned off. Coolant then flows from the after/boil coolant pump to the by-pass valve (4) that directs coolant to the engine block if the engine is running to improve heater performance or to the radiator (5) if the engine is off and over temperature to prevent overheating. Engine vacuum from the by-pass solenoid controls the coolant bypass valve positions. When the engine is running, vacuum is supplied to the valve directing coolant to the engine block. When the engine is off, no vacuum is supplied to the valve directing the coolant to the radiator. If the coolant bypass valve does not open to the engine block flow position when the engine is started, the vehicle may not reach operating temperature and heater performance may be affected.

Heater Coolant Flow Circuit

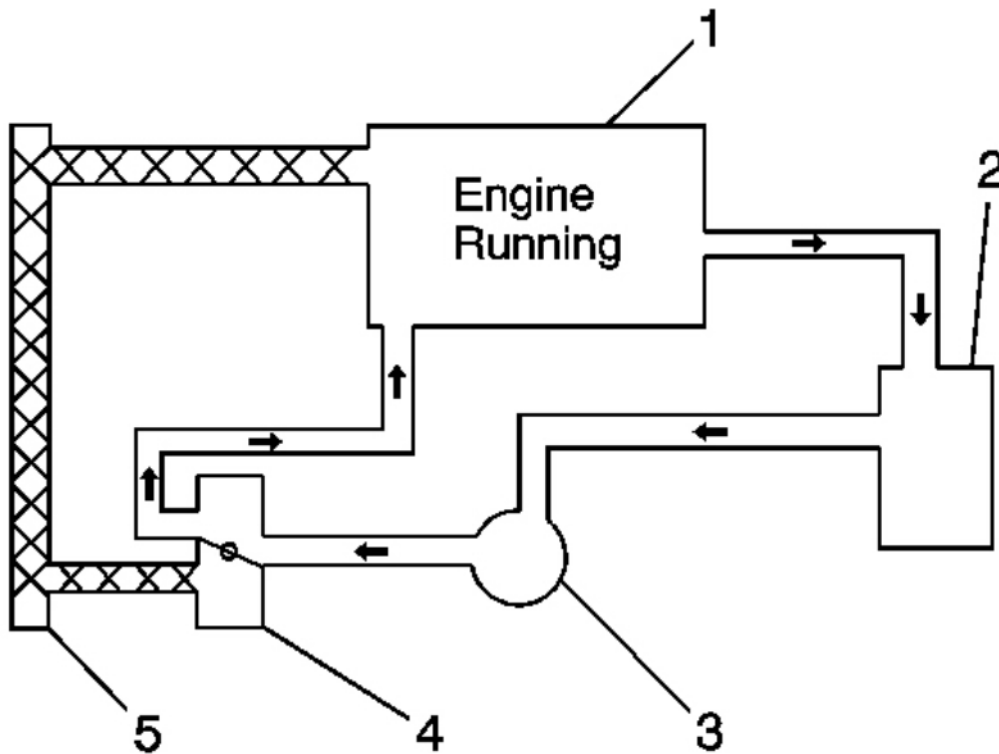


Fig. 142: Heater Coolant Flow Circuit
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 142

Callout	Component Name
1	Engine Block
2	Heater Core
3	After-Boil Coolant Pump
4	Coolant By-Pass Valve
5	Radiator

The HVAC control module will command the afterboil/heater coolant pump on for improved performance under the following conditions:

- The engine is running

- The engine coolant temperature is below 95°C (203°F)
- The engine speed is below 4000 RPM
- The blower motor is ON
- Selected air temperature requires heat

Afterboil Coolant Flow Circuit

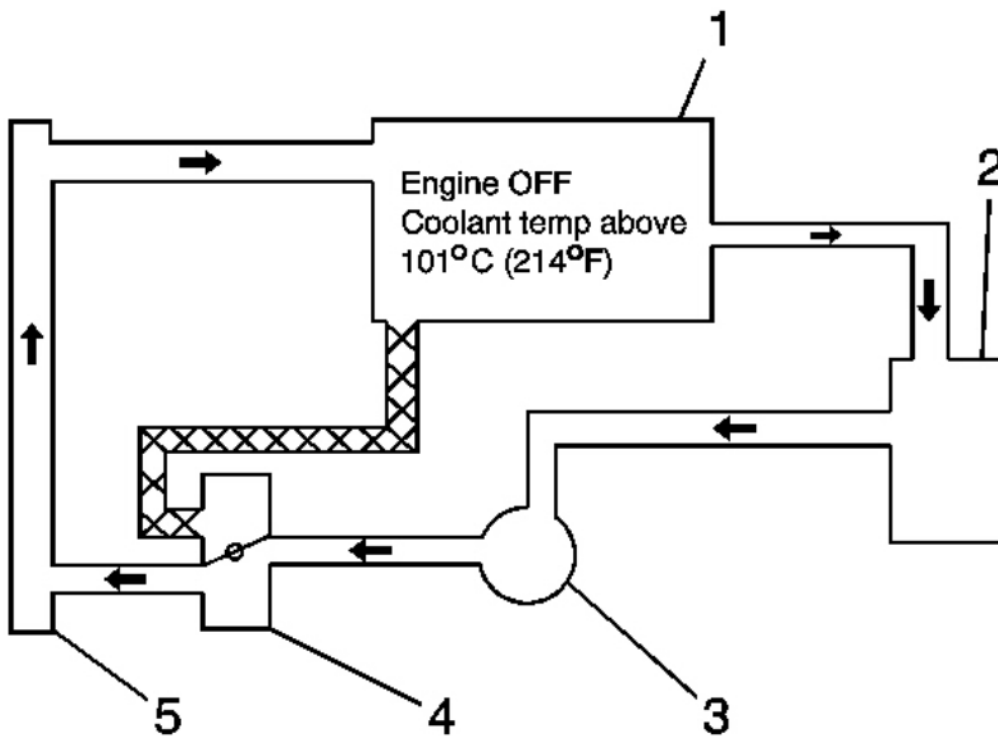


Fig. 143: Afterboil Heater Coolant Flow Circuit
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 143

Callout	Component Name
1	Engine Block
2	Heater Core
3	After-Boil Coolant Pump
4	Coolant By-Pass Valve
5	Radiator

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

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

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

The above coolant flow circuits are designed to show the coolant flow related to the coolant by-pass 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, will be displayed if coolant temperature is above 117°C (243°F). For imports 115°C (239°F).

Engine coolant hot - idle engine, will be displayed if coolant temperature is above 118°C (245°F).

Engine overheated - stop engine, will be displayed if coolant temperature is above 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, it will send a class 2 message to the radio requesting display of the low coolant level message. There is approximately a 10 second delay 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.

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.

2006 Cadillac CTS

2006 ENGINE Engine Cooling - CTS

There are two 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.

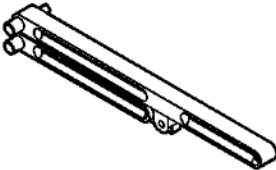
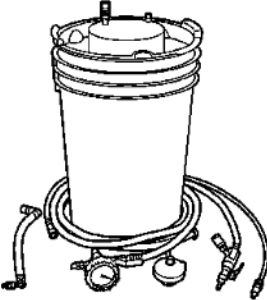
Power Steering Oil Cooler

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

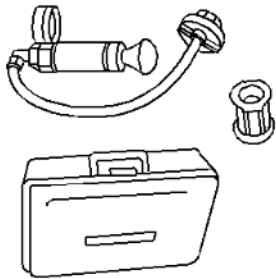
SPECIAL TOOLS

Special Tools

Illustration	Tool Number / Description
	EN 46104 Water Pump Pulley Holding Tool
	GE 47716 Vac N Fill Coolant Refill Tool

2006 Cadillac CTS

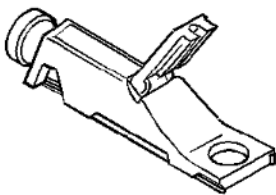
2006 ENGINE Engine Cooling - CTS



J 24460-01
Cooling System Pressure Tester



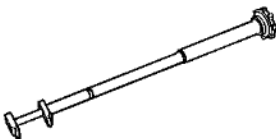
J 24731
Tempil Stick



J 26568
Coolant and Battery Fluid Tester



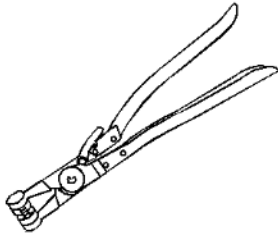
J 28410
Gasket Remover (Aluminum Components)



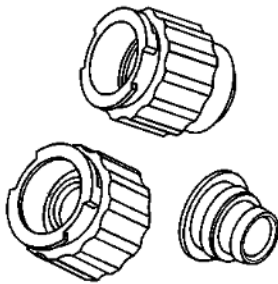
J 37097-A
Heater Hose Clamp Tool

2006 Cadillac CTS

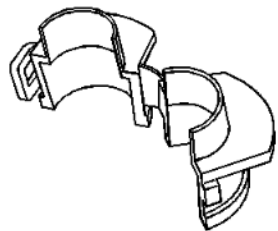
2006 ENGINE Engine Cooling - CTS



J 38185
Hose Clamp Pliers



J 42401
Radiator Cap and Surge tank Tester Adapter



J 44827
Transmission Cooler Quick Disconnect