

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
A/C Condenser Mounting Bolt	6.5 N-m	58 lb in
A/C Line Clip to Fan Shroud Screw	4.5 N-m	40 lb in
Afterboil Coolant Pump Bolt	10 N-m	89 lb in
Auxiliary Cooling Fan Mounting Bolt	6.5 N-m	58 lb in
Coolant Bypass Inlet Hose/Pipe Bolt	9 N-m	80 lb in
Coolant Bypass Valve Bolt	6.5 N-m	58 lb in
Coolant Heater	60 N-m	44 lb ft
Coolant Heater Ground Lead Bolt	9 N-m	80 lb in
Coolant Inlet Pipe Bolt	20 N-m	15 lb ft
Coolant Inlet Pipe Support Bolt	20 N-m	15 lb ft
Electric Cooling Fan Blade Retaining Nut	7 N-m	62 lb in
Electric Cooling Fan Motor Mounting Screw	5 N-m	44 lb in
Electric Cooling Fan to Plenum Mounting Bolt	6.5 N-m	58 lb in
Electric Cooling Fan to Radiator Mounting Bolt	6.5 N-m	58 lb in
Engine Coolant Temperature (ECT) Sensor	18 N-m	13 lb ft
Engine Rear Lift Bracket Bolt	20 N-m	15 lb ft
Manual Shift Shaft Nut	9 N-m	80 lb in
Oil Level Indicator Tube Bolt	20 N-m	15 lb ft
Radiator Support Bracket Bolt	9 N-m	80 lb in
Remote Power Steering Fluid Reservoir to Cylinder Head Mounting Bolt	25 N-m	18 lb ft
Remote Power Steering Fluid Reservoir to Intake Plenum Mounting Bolt	9 N-m	80 lb in
Surge Tank Fastener	9 N-m	80 lb in
Surge Tank Outlet Pipe to Engine Rear Lift Bracket Bolt	9 N-m	80 lb in
Surge Tank Outlet Pipe to Vent Housing Bolt	9 N-m	80 lb in
Thermostat Housing Bolt	20 N-m	15 lb ft
Throttle Body Heater Inlet Hose/Pipe Bolt	9 N-m	80 lb in
Throttle Body Inlet Heater Hose Fitting	20 N-m	15 lb ft
Water Crossover Fitting	20 N-m	15 lb ft
Water Crossover Pipe Plug	5 N-m	44 lb in
Water Pump Bolt	25 N-m	18 lb ft
Water Pump Pulley Bolt	8 N-m	71 lb in

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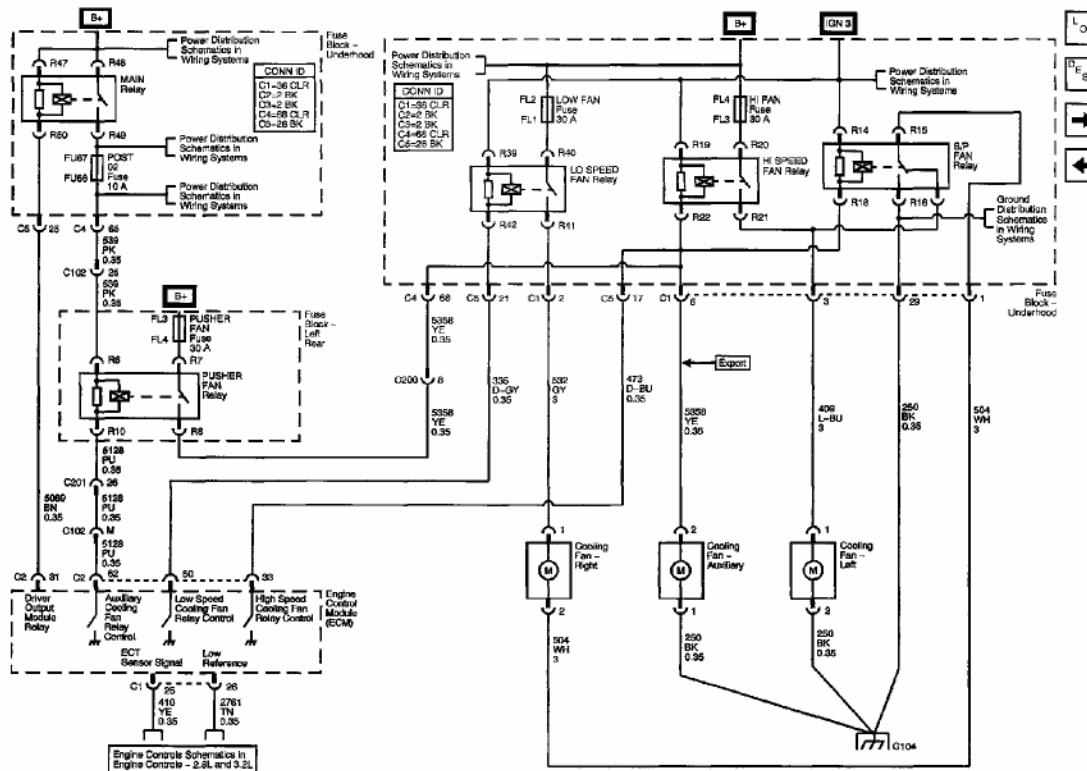
Fig. 1: Fastener Tightening Specifications
Courtesy of GENERAL MOTORS CORP.

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

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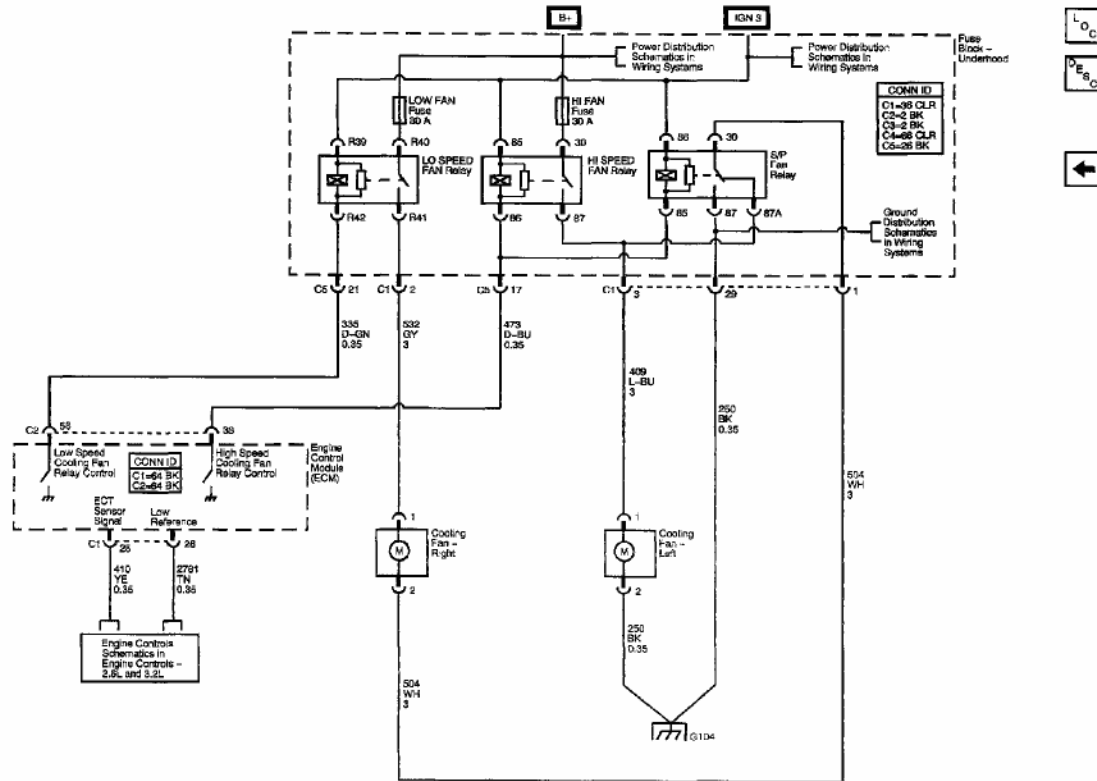


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Fig. 3: Engine Cooling Schematics (Cooling Fans (Export))
Courtesy of GENERAL MOTORS CORP.

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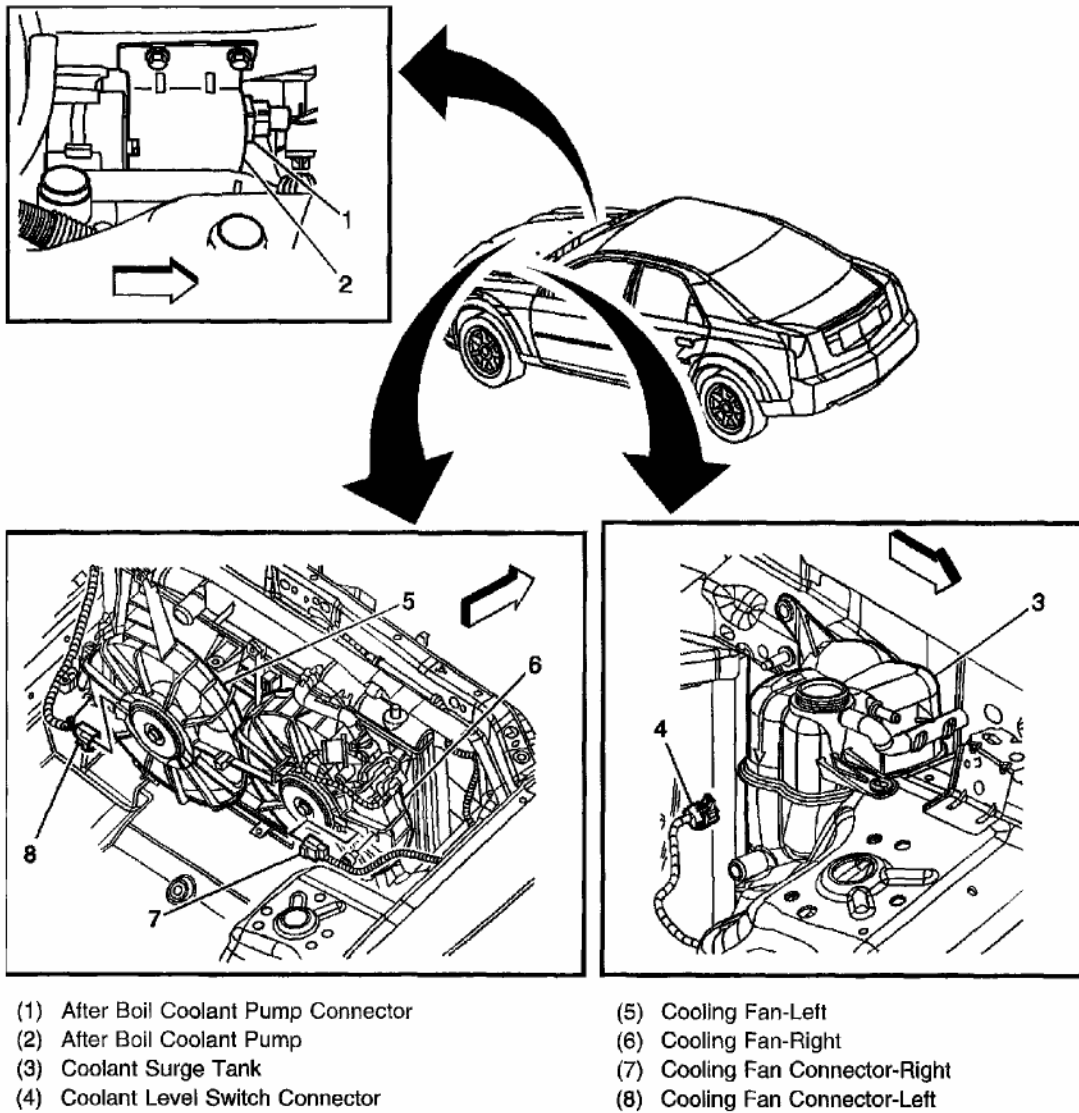
Fig. 4: Engine Cooling Schematics (Cooling Fans (Domestic))
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

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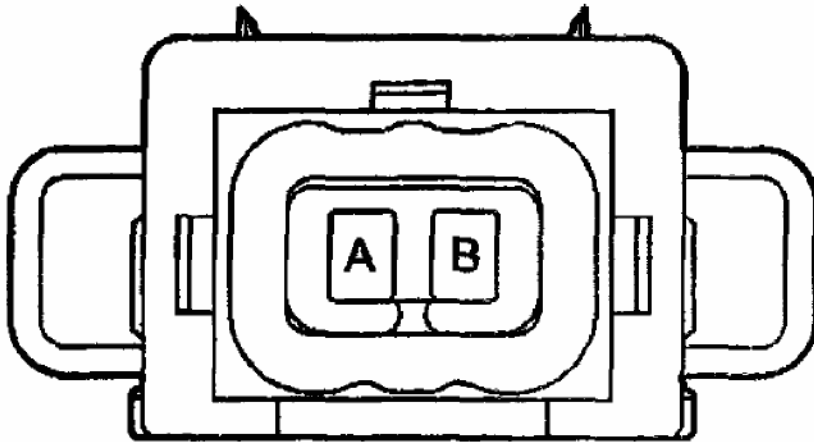
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Fig. 5: Identifying Engine Cooling Sub-Systems
Courtesy of GENERAL MOTORS CORP.

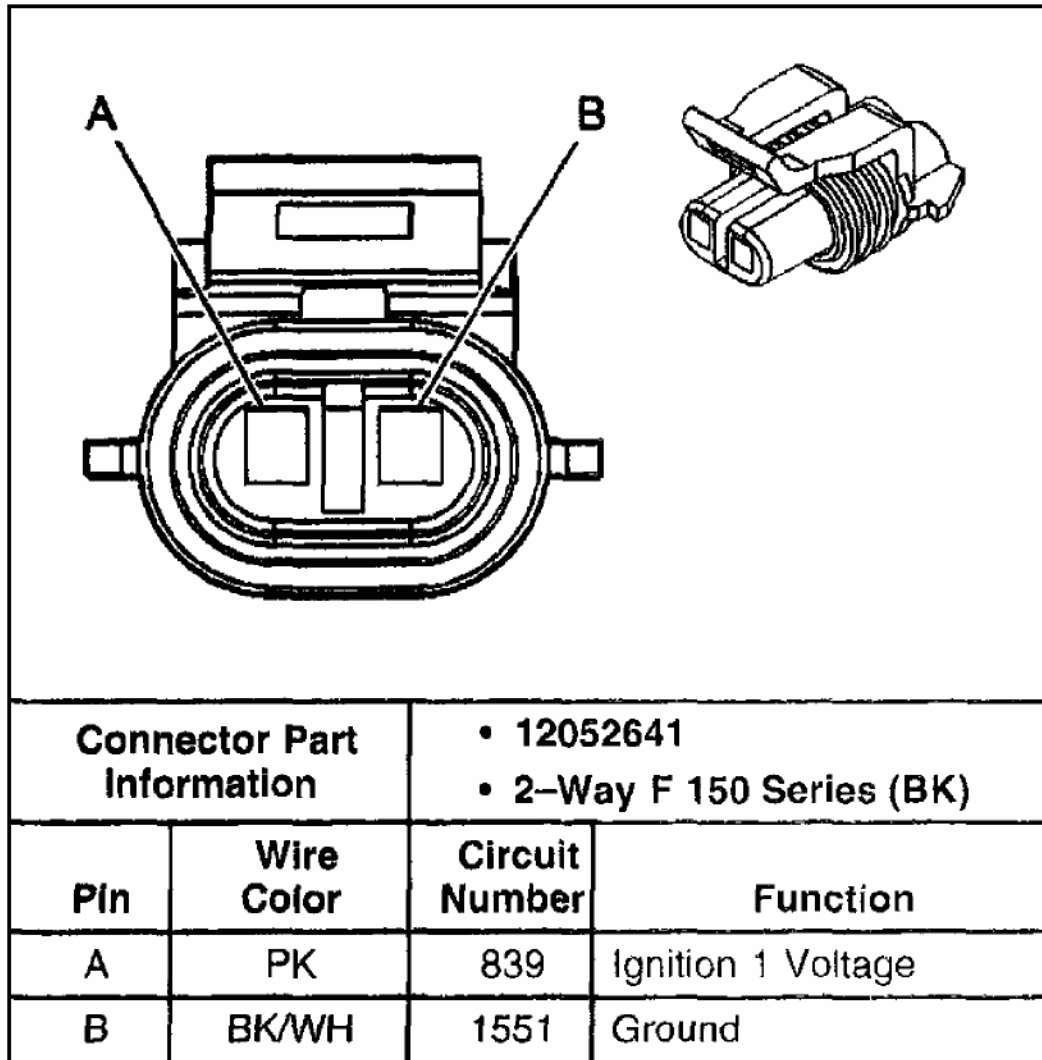
COOLING SYSTEMS



Connector Part Information		• 12084126 • 2-Way F 280 Series (BK)	
Pin	Wire Color	Circuit Number	Function
A	BK/WH	1551	Ground
B	PK	5126	After Boil Coolant Pump Relay Control

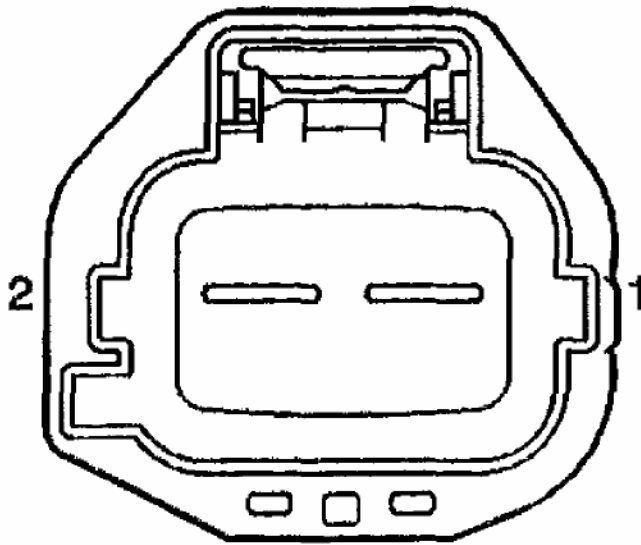
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Fig. 6: After Boil Coolant Pump Connector End View
Courtesy of GENERAL MOTORS CORP.



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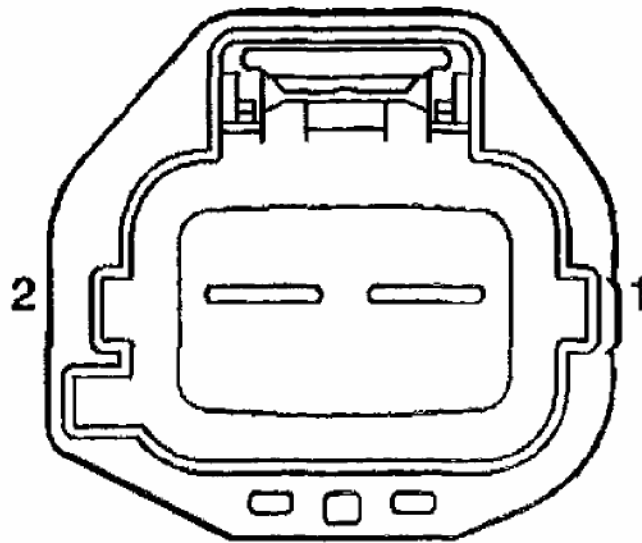
Fig. 7: Coolant By-Pass Solenoid Connector End View
Courtesy of GENERAL MOTORS CORP.



Connector Part Information		• 7283-5596-10 • 2-Way F 6.3 Series (D-GY)	
Pin	Wire Color	Circuit Number	Function
1	GY	532	Engine Cooling Fan Supply Voltage
2	WH	504	Cooling Fan Low Reference

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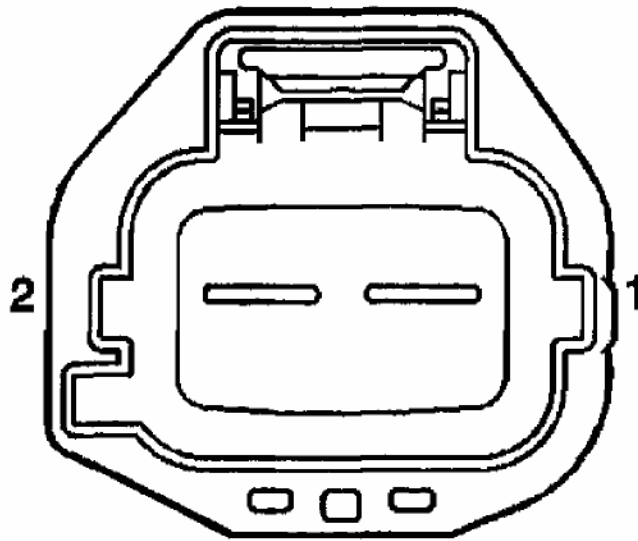
Fig. 8: Cooling Fan - Right Connector End View
Courtesy of GENERAL MOTORS CORP.



Connector Part Information		• 7283-5596-10 • 2-Way F 6.3 Series (D-GY)	
Pin	Wire Color	Circuit Number	Function
1	L-BU	409	Cooling Fan Motor Supply Voltage
2	BK	250	Ground

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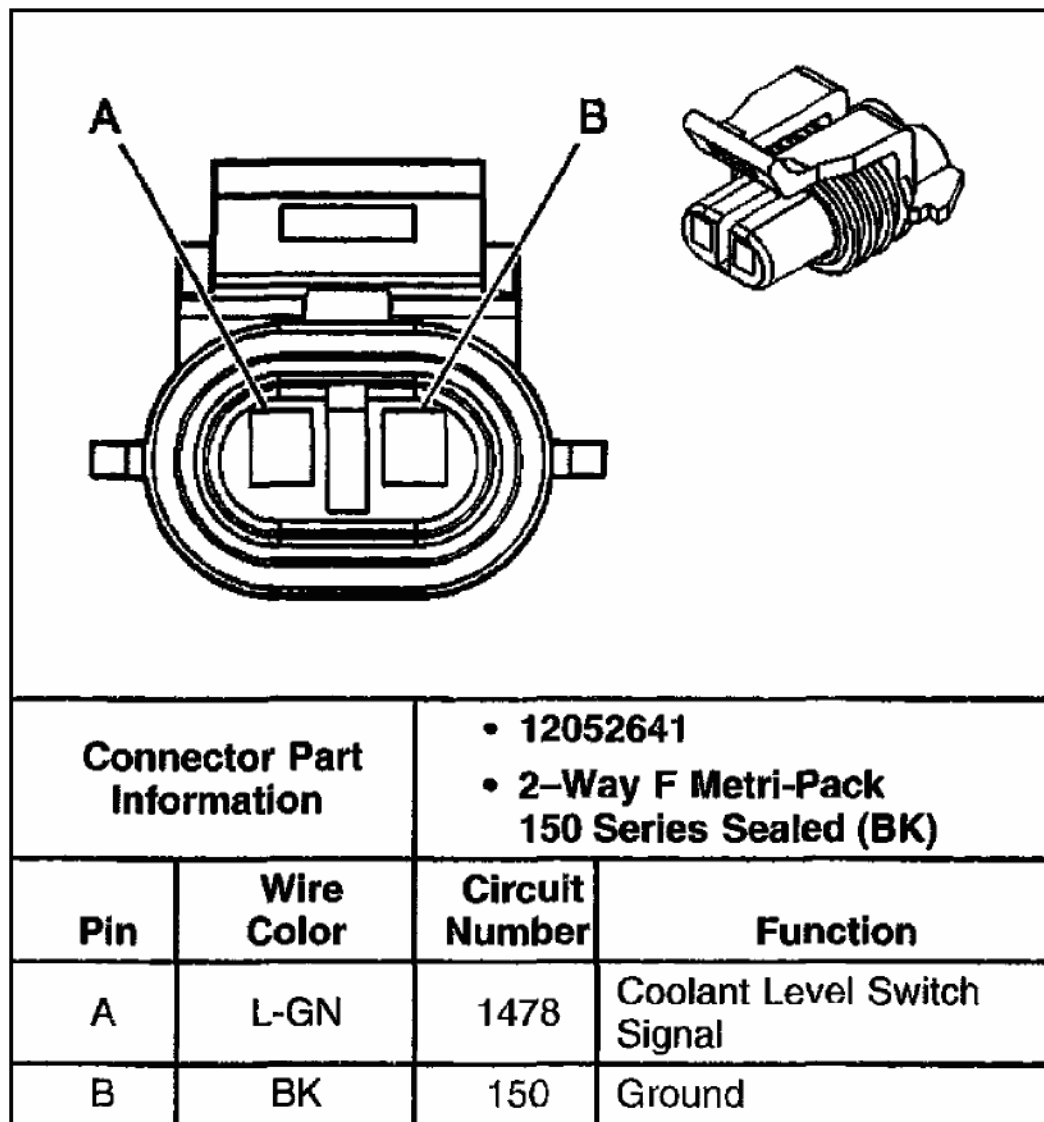
Fig. 9: Cooling Fan - Left Connector End View
Courtesy of GENERAL MOTORS CORP.



Connector Part Information		• 7282-5596-10 • 2-Way F 6.3 Series (D-GY)	
Pin	Wire Color	Circuit Number	Function
1	BK	250	Ground
2	YE	5358	Auxiliary Cooling Fan Motor Supply Voltage

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Fig. 10: Cooling Fan - Auxiliary Connector End View
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Fig. 11: Coolant Level Switch Connector End View
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE COOLING

Begin the system diagnosis with the **DIAGNOSTIC SYSTEM CHECK - ENGINE COOLING**. The Diagnostic System Check will provide the following information:

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- The identification of the control module(s) which command the system
- The ability of the control module(s) to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

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

DIAGNOSTIC SYSTEM CHECK - ENGINE COOLING

Test Description

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

2. Lack of communication may be due to a partial malfunction of the class 2 serial data circuit or due to a total malfunction of the class 2 serial data circuit. The specified procedure will determine the particular condition.
3. Determine if the Instrument Cluster or Engine Control Modules have set DTCs which may affect Engine Cooling operation are present.
4. The presence of DTCs which begin with "U" indicate some other module is not communicating. The specified procedure will compile all the available information before tests are performed.

Step	Action	Yes	No
1	Install a scan tool. Does the scan tool power up?	Go to Step 2	Go to Scan Tool Does Not Power Up in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the following control modules: • Instrument Cluster • Engine Control Module Does the scan tool communicate with the control modules?	Go to Step 3	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications
3	Select the engine control module display DTCs function on the scan tool. Does the scan tool display any DTCs?	Go to Step 4	Go to Symptoms - Engine Cooling
4	Does the scan tool display any DTCs which begin with a "U"?	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications	Go to Diagnostic Trouble Code (DTC) List

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Fig. 12: Diagnostic System Check - Engine Cooling
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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.
Fans Low Speed	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.
Fans High Speed	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the PCM to activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On. After a 3 second delay the PCM will activate the cooling fan 2 relay and the cooling fan 3 relay. This turns the high speed fans On and Off.

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Fig. 13: Engine Control Module (ECM) Scan Tool Output Controls
Courtesy of GENERAL MOTORS CORP.

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.

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Fig. 14: HVAC Control Module Scan Tool Output Controls
Courtesy of GENERAL MOTORS CORP.

SCAN TOOL DATA LIST

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition On, Engine Off			
Cooling Fan After Run	Engine Data 2, Engine Data 3	Not Requested/Requested	Not Requested
ECT	Engine Data 1, Engine Data 2, Engine Data 3, EVAP Data, Fuel Trim Data, HVAC System Data	°C/°F	varies
Engine Coolant Fan	Engine Data 2, Engine Data 3	OFF/Level 1/Level 2/Level 3	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

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Fig. 15: Scan Tool Data List Table

Courtesy of GENERAL MOTORS CORP.

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 low coolant level indicator should be illuminated.

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.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

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DTC	Diagnostic Procedure	Module(s)
P0480	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM
P0481	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM
P0691	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM
P0692	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM
P0693	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM
P0694	DTC P0480, P0481, P0691, P0692, P0693, or P0694	ECM

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Fig. 16: Diagnostic Trouble Code (DTC) List Table
Courtesy of GENERAL MOTORS CORP.

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.

Conditions for Running the DTC

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

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Conditions for Setting the DTC

- P0481 - The ECM detects an open circuit on the high speed cooling fan relay control circuit.
- P0693 - The ECM detects a short to ground on the high speed cooling fan relay control circuit.
- P0694 - The ECM detects a short to voltage on the high speed cooling fan relay control circuit.
- P0480 - The ECM detects an open on the low speed cooling fan relay control circuit.
- P0691 - The ECM detects a short to ground on the low speed cooling fan relay control circuit.
- P0692 - The ECM detects a short to voltage on the low speed cooling fan relay control circuit.
- The above condition is present for one second.

Action Taken When the DTC Sets

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

Conditions for Clearing the MIL/DTC

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

Diagnostic Aids

- If the condition is not present, refer to **TESTING FOR INTERMITTENT 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.

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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.

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Step	Action	Yes	No
Schematic Reference: <i>Engine Cooling Schematics</i>			
Connector End View Reference: <i>Cooling System Connector End Views</i>			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to <i>Diagnostic System Check - Engine Cooling</i>
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 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 <i>Testing for Intermittent and Poor Connections and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	Go to Step 15

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Fig. 17: DTC P0480, P0481, P0691, P0692 P0693, or P0694 (Steps 1-10)
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Step	Action	Yes	No
11	Test the control circuit of the appropriate relay for a short to ground. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Wiring Repairs</i> 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 <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> 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 <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> 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 <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> 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 ECM. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	Go to Step 20
16	Repair the ignition 3 voltage circuit for an open or high resistance. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 21	—
17	Replace the low speed fan relay. Did you complete the repair?	Go to Step 21	—
18	Replace the S/P fan relay. Did you complete the repair?	Go to Step 21	—
19	Replace the high speed fan relay. Did you complete the repair?	Go to Step 21	—
20	Important: Perform the programming procedure for the ECM. Replace the ECM. Refer to <i>Engine Control Module</i> in Removal & Installation. 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

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Fig. 18: DTC P0480, P0481, P0691, P0692 P0693, or P0694 (Steps 11-21)
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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 AND POOR CONNECTIONS** in Wiring Systems.

Symptom List

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

- **LOW ENGINE COOLANT INDICATOR ALWAYS ON**
- **COOLING FAN INOPERATIVE**
- **COOLING FAN INOPERATIVE - AUXILIARY**
- **COOLING FAN ALWAYS ON**
- **COOLING FAN ALWAYS ON - AUXILIARY**
- **ENGINE OVERHEATING**
- **LOSS OF COOLANT (M 82)** or **LOSS OF COOLANT (M 35)**
- **THERMOSTAT DIAGNOSIS**
- **ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE**
- **PRESSURE CAP TESTING**
- **COOLING SYSTEM LEAK TESTING**

LOW ENGINE COOLANT INDICATOR ALWAYS ON

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Step	Action	Yes	No
Schematic Reference: <i>Body Control System Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: The low coolant indicator is always on when the key is in the ON position.			
1	Did you perform the Instrument Cluster Diagnostic System Check?	Go to Step 2	Go to <i>Diagnostic System Check - Instrument Cluster</i>
2	1. Turn the ignition ON, with the engine OFF. 2. With a scan tool command the instrument cluster display(s) ON and OFF. Does the low coolant indicator lamp turn ON and OFF with each command?	Go to Step 3	Go to Step 7
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 indicator turn off?	Go to Step 8	Go to Step 4
4	Connect a 3 amp fused jumper wire from the coolant level switch signal circuit at the coolant level switch harness connector to a good ground. Does the low coolant level indicator turn off?	Go to Step 6	Go to Step 5
5	Test the signal circuit of the coolant level switch for an open. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 9
6	Repair the open or high resistance in the coolant level switch ground circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 13	—
7	Inspect for poor connections at the harness connector of the instrument panel cluster (IPC). Refer to <i>Testing for Intermittent and Poor Connections and Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 10

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Fig. 19: Low Engine Coolant Indicator Always On (Steps 1-7)
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Step	Action	Yes	No
8	Inspect for poor connections at the harness connector of the coolant level switch. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 11
9	Inspect for poor connections at the harness connector of the HVAC control module. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 13	Go to Step 12
10	Replace the instrument cluster (IPC). Refer to <i>Instrument Panel Cluster (IPC) Replacement</i> in Instrument Panel, Gages and Console. Did you complete the repair?	Go to Step 13	—
11	Replace the coolant level switch. Refer to <i>Surge Tank Replacement (RHD)</i> or <i>Surge Tank Replacement (LHD M 82)</i> or <i>Surge Tank Replacement (LHD M 35)</i> . Did you complete the replacement?	Go to Step 13	—
12	Replace the HVAC control module. Refer to <i>HVAC Control Module Replacement</i> in HVAC Systems - Automatic. Did you complete the repair?	Go to Step 13	—
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

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Fig. 20: Low Engine Coolant Indicator Always On (Steps 8-13)
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COOLING FAN ALWAYS ON

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Step	Action	Yes	No
Schematic Reference <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: One or both engine cooling fan motors run continuously in high or low speed.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go To Diagnostic System Check - Engine Cooling
2	Turn ON the ignition, with the engine OFF. Are one or both cooling fans ON?	Go to Step 3	Go to Testing for Intermittent and Poor Connections in Wiring Systems
3	Are both cooling fans running continuously?	Go to Step 5	Go to Step 4
4	Remove the s/p fan relay. Did the right cooling fan turn OFF?	Go to Step 6	Go to Step 7
5	Repair the short to voltage in the left cooling fan motor supply voltage circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 8	—
6	Repair the short to voltage in the left cooling fan low reference circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 8	—
7	Repair the short to voltage in the right cooling fan motor supply voltage circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 8	—
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

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Fig. 21: Cooling Fan Always On
 Courtesy of GENERAL MOTORS CORP.

COOLING FAN INOPERATIVE

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
Schematic Reference <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: One or both cooling fan motors are inoperative in either high, low, or both speeds.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans 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 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 and Poor Connections in Wiring Systems	Go to Step 11
4	Important: Do NOT remove the 20-A fused jumper wire connected during this step. Use a second 20-A fused jumper wire while performing the following steps. 1. Disconnect the low speed fan relay. 2. Connect the first 20-A fused jumper between the battery positive voltage circuit of the low speed fan relay 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 13	Go to Step 5
5	1. Disconnect the s/p fan relay. 2. Connect the second 20-A fused jumper between the left cooling fan motor low reference circuit of the s/p fan relay and the right cooling fan motor supply voltage circuit of the s/p fan relay. Do both cooling fans operate in low speed?	Go to Step 14	Go to Step 6
6	Reconnect the second 20-A fused jumper between the battery positive voltage circuit of the s/p fan relay and the cooling fan motor supply voltage circuit of the s/p fan relay. Does the right cooling fan operate in high speed?	Go to Step 9	Go to Step 7
7	1. Install the s/p fan relay. 2. Disconnect the right cooling fan electrical connector. 3. Reconnect the second 20-Amp fused jumper wire from the cooling fan motor supply voltage circuit of the right cooling fan electrical connector to the cooling fan motor ground circuit of the right cooling fan electrical connector. Does the left cooling fan operate in high speed?	Go to Step 16	Go to Step 8
8	Reconnect the second 20-Amp fused jumper wire from the cooling fan motor supply voltage circuit of the right cooling fan electrical connector to a good ground. Does the left cooling fan operate in high speed?	Go to Step 20	Go to Step 21
9	1. Install the s/p fan relay. 2. Disconnect the left cooling fan electrical connector. 3. Reconnect the second 20-Amp fused jumper wire from cooling fan motor supply voltage circuit of the left cooling fan electrical connector to the cooling fan low reference circuit of the left cooling fan electrical connector. Does the right cooling fan operate in high speed?	Go to Step 17	Go to Step 10

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Fig. 22: Cooling Fan Inoperative (Steps 1-9)
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
10	Reconnect the second 20-Amp fused jumper wire from battery positive voltage to the left cooling fan low reference circuit of the left cooling fan electrical connector. Does the right cooling fan operate in high speed?	Go to Step 18	Go to Step 22
11	Does the right cooling fan operate in high speed?	Go to Step 12	Go to Step 15
12	1. Disconnect the s/p fan relay. 2. Connect a 20-A fused jumper between the left cooling fan low reference circuit of the s/p fan relay and the ground circuit of the s/p fan relay. Does the left cooling fan operate properly in high speed?	Go to Step 14	Go to Step 19
13	Inspect for poor connections at the low speed fan relay. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 23
14	Inspect for poor connections at the s/p fan relay. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 24
15	Inspect for poor connections at the high speed fan relay. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 25
16	Inspect for poor connections at the harness connector of the right cooling fan. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 26
17	Inspect for poor connections at the harness connector of the left cooling fan. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 27
18	Repair the left cooling fan motor supply voltage circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 28	—
19	Repair the left cooling fan motor ground circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 28	—
20	Repair the right cooling fan motor ground circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 28	—
21	Repair the right cooling fan motor supply voltage circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 28	—
22	Repair the left cooling fan low reference circuit. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 28	—
23	Replace the low speed fan relay. Did you complete the replacement?	Go to Step 28	—
24	Replace the s/p fan relay. Did you complete the replacement?	Go to Step 28	—
25	Replace the high speed fan relay. Did you complete the replacement?	Go to Step 28	—

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Fig. 23: Cooling Fan Inoperative (Steps 10-25)
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
26	Replace the right cooling fan. Refer to <i>Cooling Fan Motor Replacement - Electric</i> . Did you complete the replacement?	Go to Step 28	—
27	Replace the left cooling fan. Refer to <i>Cooling Fan Motor Replacement - Electric</i> . Did you complete the replacement?	Go to Step 28	—
28	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

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Fig. 24: Cooling Fan Inoperative (Steps 26-28)
Courtesy of GENERAL MOTORS CORP.

COOLING FAN ALWAYS ON - AUXILIARY

Step	Action	Yes	No
Schematic Reference: <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: The auxiliary cooling fan is always ON.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	Is the auxiliary cooling fan always ON?	Go to Step 3	Go to Testing for Intermittent and Poor Connections in Wiring Systems
3	Disconnect the auxiliary cooling fan relay. 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 <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 10	—
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 7	Go to Step 6
6	Inspect for poor connections at the auxiliary cooling fan relay. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> Wiring Systems. Did you find and correct the condition?	Go to Step 10	Go to Step 8
7	Inspect for poor connections at the harness connector of the Engine Control Module (ECM). Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 10	Go to Step 9
8	Replace the auxiliary cooling fan relay. Did you complete the replacement?	Go to Step 10	—
9	Important: Perform the programming procedure for the ECM. Replace the ECM. Refer to <i>Engine Control Module</i> in Removal & Installation. Did you complete the repair?	Go to Step 10	—
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

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2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Fig. 25: Cooling Fan Always On - Auxiliary
Courtesy of GENERAL MOTORS CORP.

COOLING FAN INOPERATIVE - AUXILIARY

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
Schematic Reference: <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: The auxiliary cooling fan is inoperative.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the auxiliary cooling fan ON and OFF. Does the auxiliary cooling fan turn ON and OFF with each command?	Go to Testing for Intermittent and Poor Connections in Wiring Systems	Go to Step 3
3	1. Disconnect the auxiliary fan relay. 2. 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 4	Go to Step 6
4	Probe the battery positive voltage circuit of the auxiliary 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 7
5	Connect a 20-A fused jumper between the battery positive voltage circuit of the auxiliary fan relay and the auxiliary cooling fan motor supply voltage circuit of the auxiliary fan relay. Does the auxiliary cooling fan operate?	Go to Step 12	Go to Step 8
6	Test the control circuit of the auxiliary fan relay for an open or high resistance. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 11
7	Test the battery positive voltage circuit of the auxiliary fan relay for a short to ground or an open. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 10
8	Test the auxiliary cooling fan motor supply voltage circuit of the auxiliary cooling fan for an open or high resistance. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 9
9	Test the auxiliary cooling fan motor ground circuit for an open or high resistance. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 13
10	Repair the auxiliary cooling fan motor supply voltage circuit for a short to ground. Refer to <i>Wiring Repairs</i> in Wiring Systems. Did you complete the repair?	Go to Step 17	—
11	Inspect for poor connections Engine Control module (ECM). Refer to <i>Testing for Intermittent and Poor Connections and Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 14
12	Inspect for poor connections at the auxiliary fan relay. Refer to <i>Circuit Testing on page</i> and <i>Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 15
13	Inspect for poor connections at the harness connector of the auxiliary cooling fan. Refer to <i>Circuit Testing and Connector Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to Step 17	Go to Step 16

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Fig. 26: Cooling Fan Inoperative - Auxiliary (Steps 1-13)
 Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
14	Important: Perform the programming procedure for the ECM. Replace the ECM. Refer to <i>Engine Control Module</i> in Removal & Installation. Did you complete the repair?	Go to <i>Step 17</i>	—
15	Replace the auxiliary fan relay. Did you complete the replacement?	Go to <i>Step 17</i>	—
16	Replace the auxiliary cooling fan. Refer to <i>Cooling Fan and Motor Replacement - Auxiliary</i> . Did you complete the replacement?	Go to <i>Step 17</i>	—
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <i>Step 2</i>

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Fig. 27: Cooling Fan Inoperative - Auxiliary (Steps 14-17)
Courtesy of GENERAL MOTORS CORP.

AFTER BOIL COOLANT PUMP INOPERATIVE

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
Schematic Reference: <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: The afterboil coolant pump does not operate under certain conditions.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to <i>Step 2</i>	Go to <i>Diagnostic System Check - Engine Cooling</i>
2	1. Start the engine. 2. Turn ON the HVAC blower. 3. Set temperature to 90°F. Does the afterboil coolant pump operate?	Go to <i>Testing for Intermittent and Poor Connections in Wiring Systems</i>	Go to <i>Step 3</i>
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Water Pump Control ON in climate control panel (CCP) special functions, miscellaneous test. Does the afterboil coolant pump operate?	Go to <i>Step 11</i>	Go to <i>Step 4</i>
4	1. Disconnect the afterboil relay. 2. Connect a test lamp between the control circuit of the afterboil relay and the coil supply voltage circuit of the afterboil relay. 3. With a scan tool command the Water Pump Control ON and OFF. Does the test lamp illuminate?	Go to <i>Step 5</i>	Go to <i>Step 6</i>
5	Connect a 5 amp fused jumper wire between the battery positive voltage circuit of the afterboil relay and the afterboil coolant pump supply voltage circuit of the afterboil relay. Does the afterboil coolant pump operate?	Go to <i>Step 13</i>	Go to <i>Step 9</i>
6	Test the control circuit of the afterboil relay for an open. Refer to <i>Circuit Testing and Wiring Repairs in Wiring Systems</i> . Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 7</i>
7	Test the battery positive voltage circuit of the afterboil relay for an open or a short to ground. Refer to <i>Circuit Testing and Wiring Repairs in Wiring Systems</i> . Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 8</i>
8	Test the voltage supply circuit of the afterboil coolant pump for a short to ground. Refer to <i>Circuit Testing and Wiring Repairs in Wiring Systems</i> . Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 11</i>

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Fig. 28: After Boil Coolant Pump Inoperative (Steps 1-8)
 Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
9	Test the voltage supply circuit of the afterboil coolant pump for an open. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 10</i>
10	Test the ground circuit of the afterboil coolant pump for an open. Refer to <i>Circuit Testing and Wiring Repairs</i> in Wiring Systems. Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 12</i>
11	Replace the HVAC Control Module. Refer to <i>HVAC Control Module Replacement</i> in HVAC Systems - Automatic. Did you complete the replacement?	Go to <i>Step 14</i>	—
12	Replace the afterboil coolant pump. Refer to <i>Afterboil Coolant Pump Replacement</i> . Did you complete the replacement?	Go to <i>Step 14</i>	—
13	Replace the afterboil relay. Did you complete the replacement?	Go to <i>Step 14</i>	—
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <i>Step 3</i>

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Fig. 29: After Boil Coolant Pump Inoperative (Steps 9-14)

Courtesy of GENERAL MOTORS CORP.

COOLANT BYPASS VALVE INOPERATIVE

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
Schematic Reference: <i>Engine Cooling Schematics</i> Connector End View Reference: <i>Cooling System Connector End Views</i> DEFINITION: The coolant by-pass valve does not move from the radiator flow position to the engine block flow position when the engine is started.			
1	Did you perform the Engine Cooling Diagnostic System Check?	Go to Step 2	Go to <i>Diagnostic System Check - Engine Cooling</i>
2	Start the engine while observing the coolant by-pass valve. Does the coolant by-pass valve move from the radiator flow position to the engine block flow position when the engine is started?	Go to <i>Testing for Intermittent and Poor Connections in Wiring Systems</i>	Go to Step 3
3	With the engine still running, disconnect the vacuum hose from the coolant by-pass valve. Is there vacuum present at the hose?	Go to Step 12	Go to Step 4
4	Inspect the vacuum line from the by-pass solenoid to the by-pass valve for a restriction or damage. Did you find and correct the condition?	Go to Step 14	Go to Step 5
5	With the engine still running, disconnect the vacuum hose on the engine side of the coolant by-pass solenoid. Is there vacuum present at the hose?	Go to Step 6	Go to Step 8
6	1. Turn the ignition OFF. 2. Disconnect the harness connector from the coolant by-pass solenoid. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the coolant by-pass solenoid harness connector with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to Step 7	Go to Step 9
7	Connect a test lamp between the ignition 1 voltage circuit and the ground circuit of the coolant by-pass solenoid harness connector. Does the test lamp illuminate?	Go to Step 11	Go to Step 10

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Fig. 30: Coolant Bypass Valve Inoperative (Steps 1-7)
 Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
8	Repair the damaged or blocked vacuum line that is causing a low vacuum condition between the coolant by-pass solenoid and the engine. Did you complete the repair?	Go to <i>Step 14</i>	—
9	Repair the open, short to ground, or high resistance in the ignition 1 voltage circuit of the coolant by-pass solenoid. Did you complete the repair?	Go to <i>Step 14</i>	—
10	Repair the open or high resistance in the ground circuit of the coolant by-pass solenoid. Did you complete the repair?	Go to <i>Step 14</i>	—
11	Inspect for poor connections at the harness connector of the coolant by-pass solenoid. Refer to <i>Testing for Intermittent and Poor Connections</i> and <i>Connector Repairs</i> in <i>Wiring Systems</i> . Did you find and correct the condition?	Go to <i>Step 14</i>	Go to <i>Step 13</i>
12	Replace the coolant by-pass valve. Refer to <i>Coolant Bypass Valve Replacement</i> . Did you complete the repair?	Go to <i>Step 14</i>	—
13	Replace the coolant by-pass solenoid. Refer to <i>Coolant Bypass Solenoid Replacement</i> . Did you complete the repair?	Go to <i>Step 14</i>	—
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <i>Step 2</i>

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Fig. 31: Coolant Bypass Valve Inoperative (Steps 8-14)
Courtesy of GENERAL MOTORS CORP.

ENGINE OVERHEATING

Diagnostic Aids

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

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

For electrical inspection of the cooling fans and the after boil heater pump, refer to **TESTING FOR INTERMITTENT AND POOR CONNECTIONS** in *Wiring Systems*.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Value(s)	Yes	No
DEFINITION: Engine temperature lamp comes ON and stays ON, or the temperature gage shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.				
1	Did you perform the engine cooling diagnostic system check?	—	Go to <i>Step 2</i>	Go to <i>Diagnostic System Check - Engine Cooling</i>
2	Inspect the surge tank for low coolant. Is there a loss of coolant?	—	Go to <i>Loss of Coolant (M 82)</i> or <i>Loss of Coolant (M 35)</i>	Go to <i>Step 3</i>
3	Important: Do not allow the engine temperature to exceed the specified value. Start the engine and allow to reach normal operating temperature. Does the engine begin to exceed the specified value?	107°C (225°F)	Go to <i>Step 4</i>	Go to Diagnostic Aids

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Fig. 32: Engine Overheating (Steps 1-3)
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Value(s)	Yes	No
4	Inspect for loose, damaged, and/or missing of the following: • The A/C condenser seals • The front air deflector • The side seals Repair the system as necessary. Does the engine still overheat?	---	Go to Step 5	Go to Step 18
5	Using the <i>J 23688</i> Coolant and Battery Fluid Tester, test for insufficient coolant concentration. Is the coolant protection greater than the specified value?	-37°C (-34°F)	Go to Step 6	Go to Step 7
6	Correct the coolant concentration as necessary. Does the engine still overheat?	---	Go to Step 7	Go to Step 18
7	Inspect for obstructed radiator air flow or bent radiator fins. Is the radiator air flow obstructed?	---	Go to Step 8	Go to Step 9
8	Clean the radiator. Refer to <i>Radiator Cleaning</i> . Does the engine still overheat?	---	Go to Step 9	Go to Step 18
9	Inspect the drive belt tensioner. Refer to <i>Drive Belt Tensioner Diagnosis</i> in Engine Mechanical-2.6L and 3.2L. Is the drive belt tensioner working properly and is the tension correct?	---	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner. Refer to <i>Drive Belt Tensioner Replacement</i> in Engine Mechanical-2.6L and 3.2L. Does the engine still overheat?	---	Go to Step 11	Go to Step 18
11	Inspect the thermostat for proper operation. Refer to <i>Thermostat Diagnosis</i> . Does the thermostat operate properly?	---	Go to Step 13	Go to Step 12
12	Replace the thermostat. Refer to <i>Thermostat Replacement</i> . Does the engine still overheat?	---	Go to Step 13	Go to Step 18
13	Inspect for a inoperative after boil coolant pump. Refer to <i>After Boil Coolant Pump Inoperative</i> . Does the engine still overheat?	---	Go to Step 14	Go to Step 18
14	Inspect for an inoperative cooling fan. Refer to <i>Cooling Fan Inoperative</i> or <i>Cooling Fan Inoperative Auxiliary</i> . Does the engine still overheat?	---	Go to Step 15	Go to Step 18
15	Inspect for blocked cooling system passages. Are the cooling system passages blocked?	---	Go to Step 16	Go to Step 17
16	Replace the radiator. Refer to <i>Radiator Replacement</i> . Does the engine still overheat?	---	Go to Step 17	Go to Step 18
17	Replace the engine water pump. Refer to <i>Water Pump Replacement</i> . Did you complete the repair?	---	Go to Step 18	---
18	Operate the system in order to verify the repair. Did you correct the condition?	---	System OK	Go to Step 2

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Fig. 33: Engine Overheating (Steps 4-18)
Courtesy of GENERAL MOTORS CORP.

LOSS OF COOLANT (M 82)

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

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 <i>Diagnostic System Check - Engine Cooling</i> . Is the action complete?	Go to Step 3	—
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to <i>Draining and Filling Cooling System</i> . Is the action complete?	Go to Step 5	—
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 26
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 27	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 29	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 28	Go to Step 10
10	With the engine idling, inspect the coolant recovery system. Does the surge tank discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • Coolant bypass • Coolant crossover • Surge tank • Heater core • Heater bypass valve • Radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 20	Go to Step 12
12	Visually inspect the following components: • Coolant pressure cap • Core plugs • Cylinder head gaskets • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 20	Go to Step 13

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Fig. 34: Loss of Coolant M 82 (Steps 1-12)
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Step	Action	Yes	No
13	1. Pressure test the cooling system. Refer to <i>Cooling System Leak Testing</i> . 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 20	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to <i>Pressure Cap Testing</i> . Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 21
15	Pressure test the coolant pressure cap. Refer to <i>Pressure Cap Testing</i> . Does the coolant pressure cap hold pressure?	Go to Step 30	Go to Step 21
16	Inspect for the following conditions: • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. Is coolant present?	Go to Step 22	Go to Step 17
17	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance on under the oil fill cap?	Go to Step 18	Go to Step 19
18	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to Step 28	Go to Step 19
19	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 23	Go to Step 31
20	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 31	—
21	Replace the coolant pressure cap. Is the repair complete?	Go to Step 31	—
22	Replace the heater core. Refer to <i>Heater Core Replacement</i> in Heating, Ventilation and Air Conditioning. Is the repair complete?	Go to Step 31	—
23	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to <i>Cooling System Leak Testing</i> . 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to Step 24	Go to Step 25
24	1. Replace the radiator. Refer to <i>Radiator Replacement</i> . 2. Service the automatic transmission. Refer to <i>Engine Coolant in Transmission</i> in Automatic Transmissions — 5L40-E. Is the repair complete?	Go to Step 31	—
25	Install the cooler lines to the radiator. Is the action complete?	Go to Step 31	—
26	Repair the engine no crank condition. Refer to <i>Engine Will Not Crank - Crankshaft Will Not Rotate</i> in Engine Mechanical-2.6L and 3.2L. Is the repair complete?	Go to Step 31	—
27	Repair the engine overheating condition. Refer to <i>Engine Overheating</i> . Is the repair complete?	Go to Step 31	—

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Fig. 35: Loss of Coolant M 82 (Steps 13-27)
Courtesy of GENERAL MOTORS CORP.

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Step	Action	Yes	No
28	Repair the engine internal coolant leak. Refer to <i>Coolant in Combustion Chamber or coolant in Engine Oil</i> in Engine Mechanical-2.6L and 3.2L. Is the repair complete?	Go to Step 31	—
29	Repair the engine knock. Refer to <i>Lower Engine Noise, Regardless of Engine Speed</i> in Engine Mechanical-2.6L and 3.2L. Is the repair complete?	Go to Step 31	—
30	Repair the combustion pressure in the cooling system problem. Refer to <i>Cylinder Leakage Test</i> in Engine Mechanical-2.6L and 3.2L. Is the repair complete?	Go to Step 31	—
31	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

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Fig. 36: Loss of Coolant M 82 (Steps 28-31)
Courtesy of GENERAL MOTORS CORP.

LOSS OF COOLANT (M 35)

Step	Action	Yes	No
1	Were you sent here from symptoms?	Go to Step 2	Go to Symptoms - Engine Cooling in Engine Cooling
2	Repair any present DTCs. Refer to <i>Diagnostic System Check - Engine Cooling</i> . Is the action complete?	Go to Step 3	—
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to <i>Draining and Filling Cooling System</i> . 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	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 24	Go to Step 10
10	With the engine idling, inspect the surge tank. Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11

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Fig. 37: Loss of Coolant M 35 (Steps 1-10)
Courtesy of GENERAL MOTORS CORP.

Step	Action	Yes	No
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • Coolant bypass • Coolant reservoir • Heater core • Coolant bypass valve • Radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 19	Go to Step 12
12	Visually inspect the following components: • Coolant pressure cap • Core plugs • Cylinder head gaskets • Engine block • Hot water shut off valve • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 19	Go to Step 13
13	1. Pressure test the cooling system. Refer to <i>Cooling System Leak Testing</i> . 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 19	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to <i>Pressure Cap Testing</i> . Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 20
15	Pressure test the coolant pressure cap. Refer to <i>Pressure Cap Testing</i> . Does the coolant pressure cap hold pressure?	Go to Step 26	Go to Step 20
16	Inspect for the following conditions: • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. Is coolant present?	Go to Step 21	Go to Step 17
17	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance on under the oil fill cap?	Go to Step 18	Go to Step 19
18	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to Step 24	Go to Step 19
19	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 27	—
20	Replace the coolant pressure cap. Is the repair complete?	Go to Step 27	—
21	Replace the heater core. Refer to <i>Heater Core Replacement</i> in Heating, Ventilation and Air Conditioning. Is the repair complete?	Go to Step 27	—
22	Repair the engine no crank condition. Refer to <i>Engine Will Not Crank - Crankshaft Will Not Rotate</i> in Engine Mechanical-2.6L and 3.2L. Is the repair complete?	Go to Step 27	—

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Fig. 38: Loss of Coolant M 35 (Steps 11-22)
Courtesy of GENERAL MOTORS CORP.

Step	Action	Yes	No
23	Repair the engine overheating condition. Refer to <i>Engine Overheating</i> . Is the repair complete?	Go to <i>Step 27</i>	—
24	Repair the engine internal coolant leak. Refer to <i>Coolant in Combustion Chamber</i> or <i>Coolant in Engine Oil</i> page 6-30 in <i>Engine Mechanical-2.6L and 3.2L</i> . Is the repair complete?	Go to <i>Step 27</i>	—
25	Repair the engine knock. Refer to <i>Lower Engine Noise, Regardless of Engine Speed</i> in <i>Engine Mechanical-2.6L and 3.2L</i> . Is the repair complete?	Go to <i>Step 27</i>	—
26	Repair the combustion pressure in the cooling system problem. Refer to <i>Cylinder Leakage Test</i> in <i>Engine Mechanical</i> . Is the repair complete?	Go to <i>Step 27</i>	—
27	Operate the system in order to verify the repair. Does the system operate correctly?	System OK	Go to <i>Step 2</i>

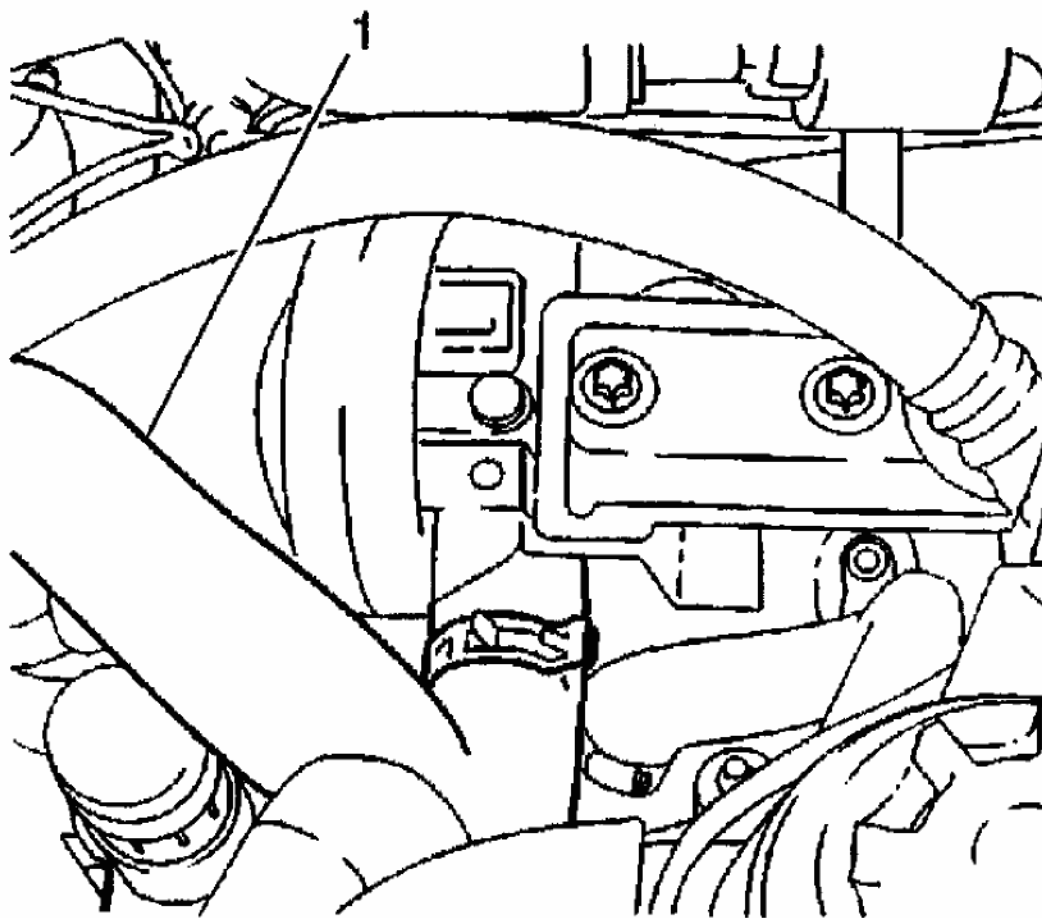
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Fig. 39: Loss of Coolant M 35 (Steps 23-27)
Courtesy of GENERAL MOTORS CORP.

THERMOSTAT DIAGNOSIS

Use one of the following procedures in testing for a malfunctioning thermostat:

Thermostat Test Procedure Using Tempilsticks



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Fig. 40: Testing Thermostat Using Tempilsticks
Courtesy of GENERAL MOTORS CORP.

The coolant thermostat can be tested using a temperature (tempil) stick. The temperature stick is a pencil like device. It has a wax material containing certain chemicals which melt at a given temperature. Temperature sticks can be used to determine a thermostat's operating range, by rubbing 87°C (188°F) and 97°C (206°F) sticks on the outlet coolant pipe, located between the thermostat housing and the inlet radiator hose (1).

Tools Required

- *J 24731* 188 Tempilstick
- *J 24731* 206 Tempilstick

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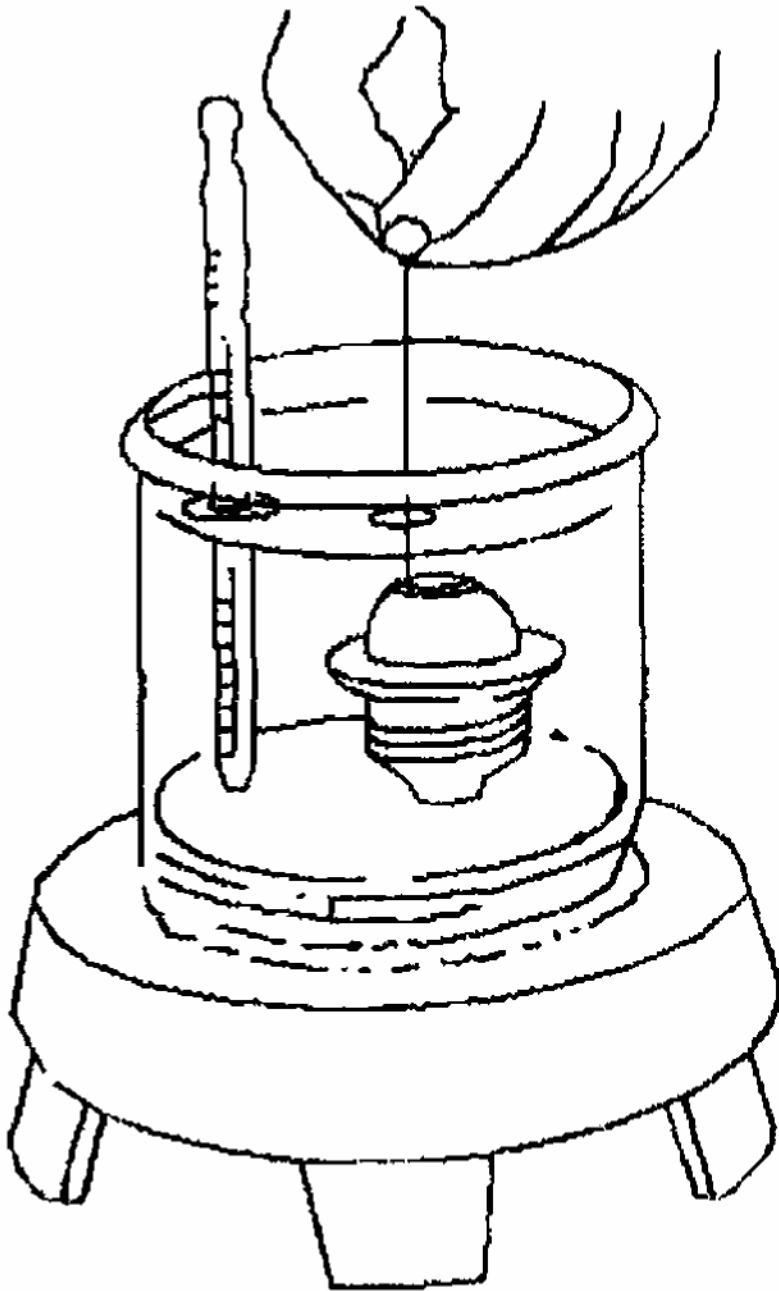
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1. Use a tempilstick in order to find the opening and the closing temperatures of the coolant thermostat.
 - J 24731-188 tempilstick melts at 87°C (188°F). The thermostat should begin to open at 90°C (194°F).
 - J 24731-206 tempilstick melts at 97°C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

Glycol Thermostat Testing Procedure

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

In order to Inspect if the thermostat valve is opening properly, do the following test:



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Fig. 41: Testing Glycol Thermostat
Courtesy of GENERAL MOTORS CORP.

1. Completely submerge the thermostat in a glycol solution. The solution should be 11°C (22°

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F) above the temperature indicated on the thermostat valve.

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

In order to Inspect if the thermostat valve is closing properly, do the following test:

1. Completely submerge the thermostat in a glycol solution. The solution should be 6°C (10°F) below the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should close completely.

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 <i>Circuit Testing</i> 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 <i>Coolant Heater Cord Replacement (K05)</i> or <i>Coolant Heater Cord Replacement (KA3)</i> . 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 <i>Testing for Intermittent and Poor Connections and Connector Repairs</i> 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 <i>Coolant Heater Replacement (K05)</i> or <i>Coolant Heater Replacement (KA3)</i> . 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

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Fig. 42: Coolant Heater Inoperative
Courtesy of GENERAL MOTORS CORP.

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Diagnostic Aids

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

- The coolant bypass valve

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- The thermostat

For electrical inspection of the coolant bypass solenoid, refer to **TESTING FOR INTERMITTENT AND POOR CONNECTIONS** in Wiring Systems.

Step	Action	Yes	No
DEFINITION: Normal coolant temperature readings will be expected to vary from 92°C (198°F) and 107°C (225°F).			
1	Did you perform the engine cooling diagnostic system check?	Go to Step 2	Go to <i>Diagnostic System Check - Engine Cooling</i>
2	Verify that the engine fails to reach normal operating temperature. Is the engine failing to reach normal operating temperature?	Go to Step 3	Go to Diagnostic Aids
3	Inspect the surge tank for low coolant. Is there a loss of coolant?	Go to <i>Loss of Coolant (M 82)</i> or <i>Loss of Coolant (M35)</i>	Go to Step 4
4	Inspect for an inoperative coolant bypass valve. Refer to <i>Coolant Bypass Valve Inoperative</i> . Does the engine still fail to reach normal operating temperature?	Go to Step 5	Go to Step 7
5	Inspect the thermostat for proper operation. Refer to <i>Thermostat Diagnosis</i> . Does the thermostat operate properly?	Go to Step 7	Go to Step 6
6	Replace the thermostat. Refer to <i>Thermostat Replacement</i> . Did you complete the repair?	Go to Step 7	—
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

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Fig. 43: Engine Fails To Reach Normal Operating Temperature
Courtesy of GENERAL MOTORS CORP.

PRESSURE CAP TESTING

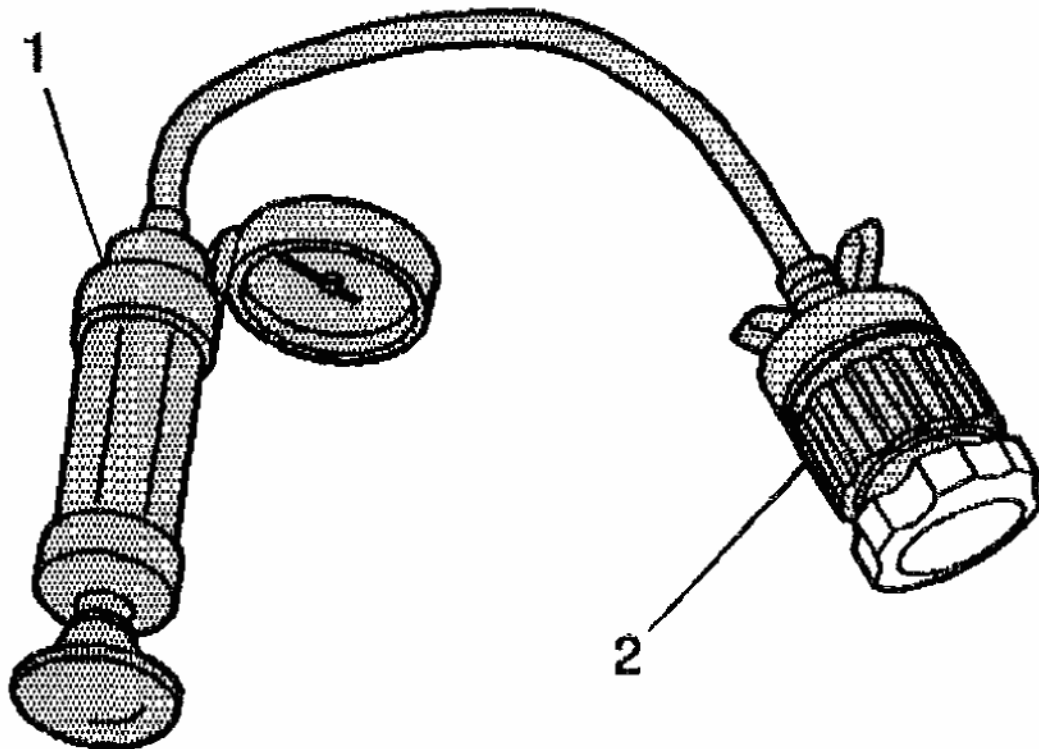
Tools Required

- J 24460-01 Cooling System Pressure Tester
- J 42401 Radiator Cap / Surge Tank Test Adapter

Pressure Cap Testing

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

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



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Fig. 44: Identifying J 24460-01 & J 42401
Courtesy of GENERAL MOTORS CORP.

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

Note the rate of pressure loss.

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

- The pressure cap does not hold the rated pressure.

Cooling System Leak Testing

Tools Required

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

COOLING SYSTEM LEAK TESTING

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

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

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **PRESSURE CAP TESTING** .
3. Wash the pressure cap mating surface with water.

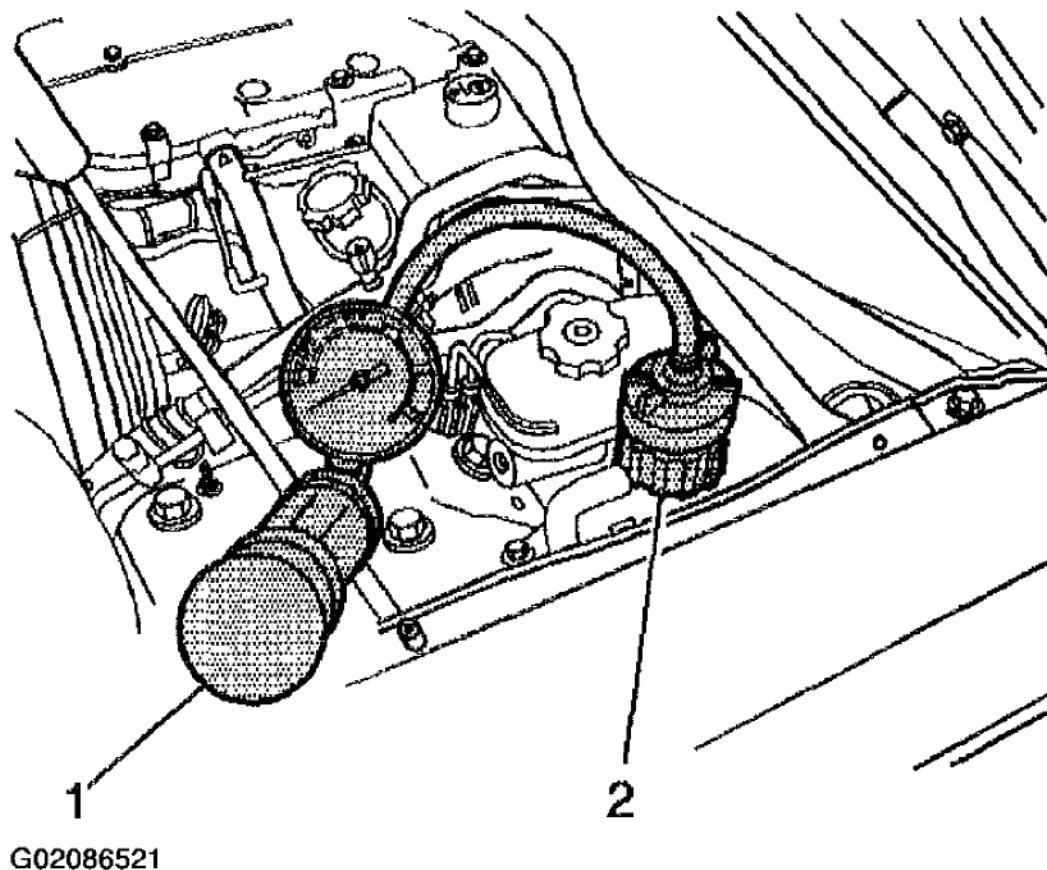


Fig. 45: Testing Operation Of Pressure Cap
Courtesy of GENERAL MOTORS CORP.

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

Tools Required

J 38185 Hose Clamp Pliers

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.

NOTE: If the procedure below is not followed a low or high coolant level condition and/or vehicle damage could 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 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.
7. Slowly remove the lower radiator hose and drain the coolant into the drain pan.
8. Inspect the engine coolant for the following:
 - Discolored appearance - follow the flush procedure. Refer to FLUSHING .
 - Normal in appearance - follow the filling procedure.
 - If a complete block drain is required, remove the block drain located on the LH side of the block. Fill the system using the Special Coolant Fill Procedure.

Tools Required

- *J 26568* Coolant and Battery Fluid Tester
- *J 38185* Hose Clamp Plier

Fill Procedure

Important: Due to the system configuration, standard filling procedure may not ensure a complete system fill. The standard coolant fill procedure applies to conditions where coolant was drained only through the radiator hose. The special coolant fill procedure must be used if any of the following events have occurred.

- Engine block drain removed or replaced.
- Water pump seal is broken or pump was replaced.
- Thermostat removal.
- Auxiliary coolant pump removal.
- Complete engine removed or replace.

Standard Coolant Filling Procedure

1. Install the lower radiator hose.
2. Using the *J 38185* slide the clamp into the original position.
3. Lower the vehicle.
4. Slowly add a mixture of 50/50 DEX-COOL antifreeze and deionized water to the cooling system through the top of the surge tank opening.
5. Fill the cooling system until the coolant reaches the FULL COLD mark on the surge tank.
6. Install surge tank cap.
7. Start the engine.
8. Run the engine at 2,000-2,500 RPM until engine reaches normal operating temperature.
9. Allow the engine to idle for 3 minutes.
10. Shut the engine OFF.
11. Allow the engine to cool.
12. Top off the coolant as necessary.
13. Inspect the cooling system for leaks.
14. Rinse away any excess coolant from the engine and the engine compartment.
15. Inspect the concentration of the engine coolant using *J 26568*.
16. Install the air deflector. Refer to AIR DEFLECTOR REPLACEMENT - FRONT in Body Front End.

Special Coolant Fill Procedure

1. Install the lower radiator hose.

2. Using the **J 38185** slide the clamp into the original position.
3. Lower the vehicle.
4. Using the **J 38185** remove the upper radiator hose from the radiator connection.
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.
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 the *J 38185* slide the radiator hose clamp into the original position.
9. Fill the surge tank to the FULL COLD.
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 it 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 there is no flow through surge tank repeat steps 1-9.
17. Install the air deflector. Refer to AIR DEFLECTOR REPLACEMENT - FRONT in Body Front End.
18. Allow engine to cool.
19. Remove the surge tank cap and fill to the FULL COLD.

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, until the fluid is nearly colorless. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
7. Fill the coolant reservoir to the FULL HOT mark.
8. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

RADIATOR CLEANING

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

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

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

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

SURGE TANK REPLACEMENT (RHD)

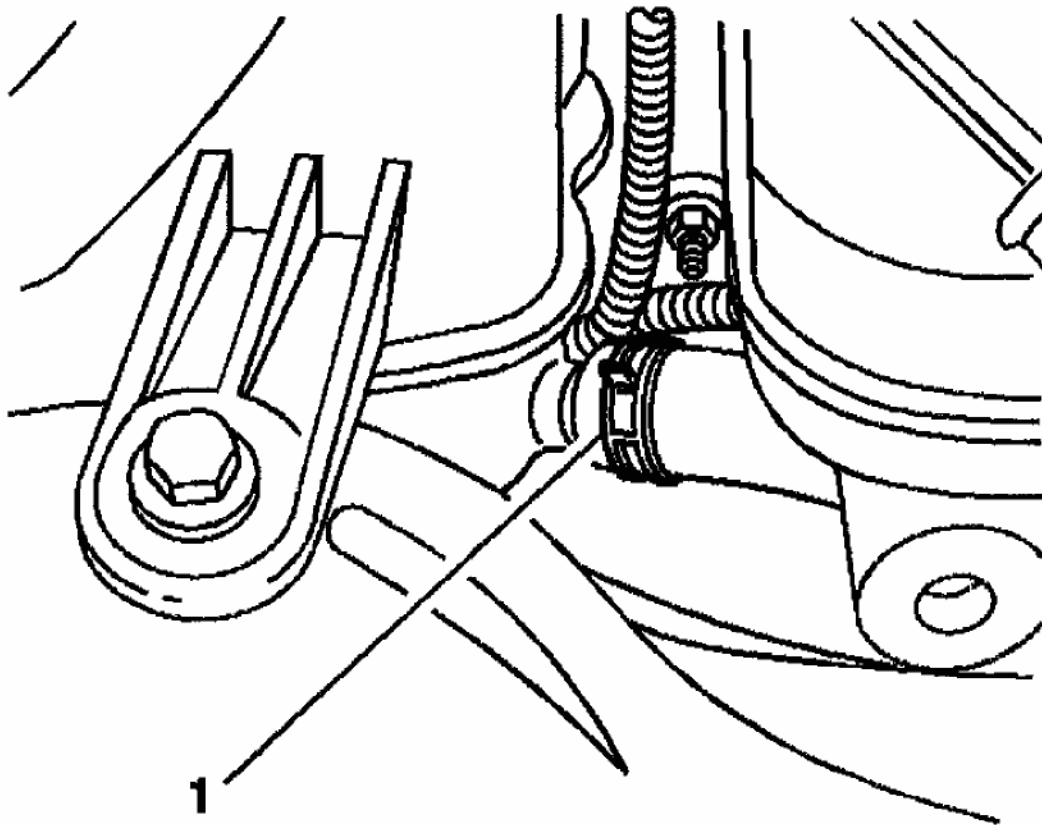
Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Using the **J 38185**, loosen and slide the clamp (1).
3. Disconnect the surge tank outlet hose.
4. Without disconnecting brake lines separate the master cylinder from the brake booster.

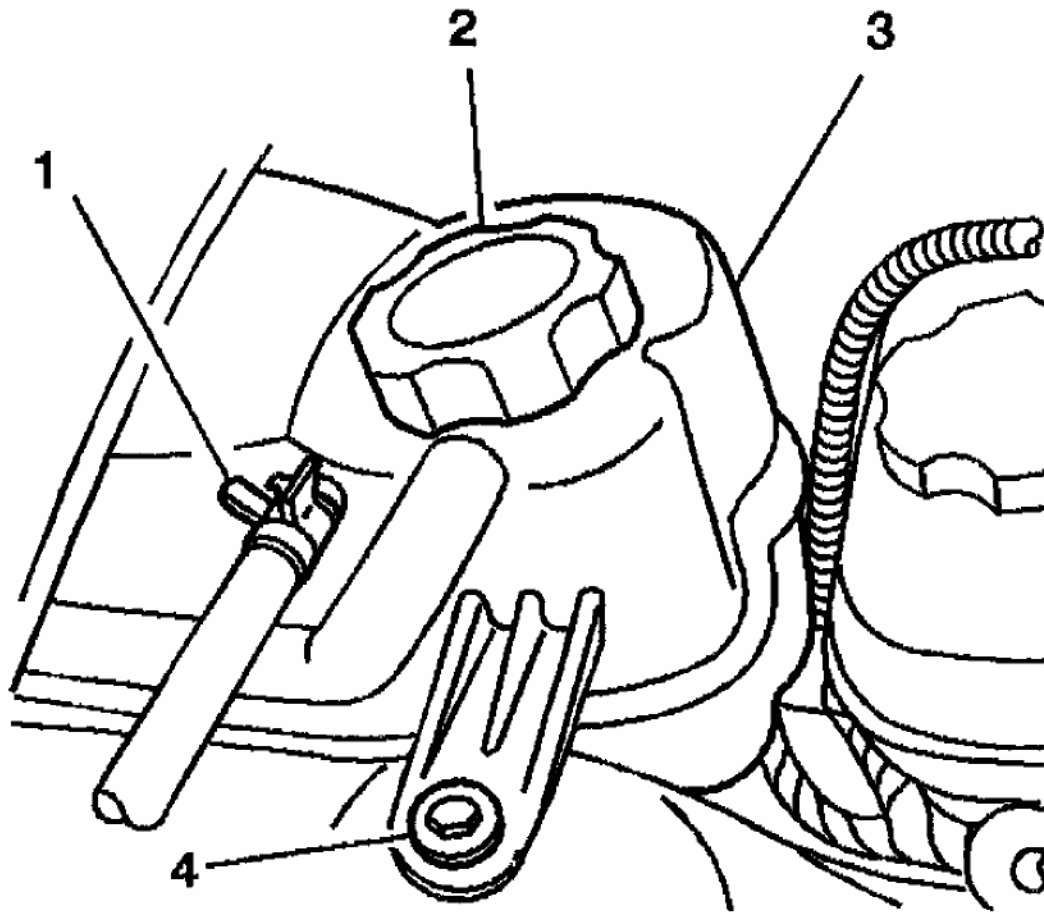
Refer to MASTER CYLINDER in Disc.



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Fig. 46: Identifying Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

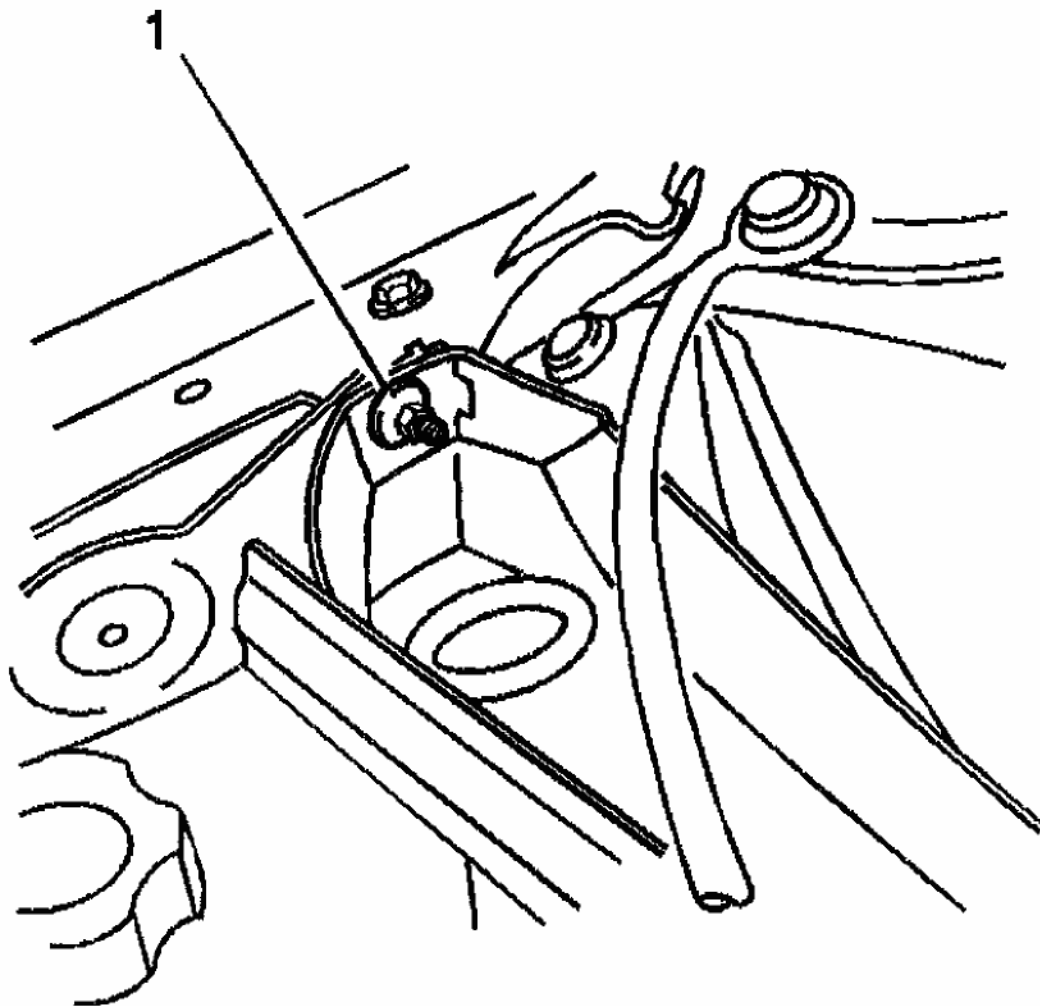
5. Disconnect the surge tank inlet hose (1).
6. Remove the surge tank bolt (4).



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Fig. 47: Disconnecting Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Remove the surge tank nut (1).



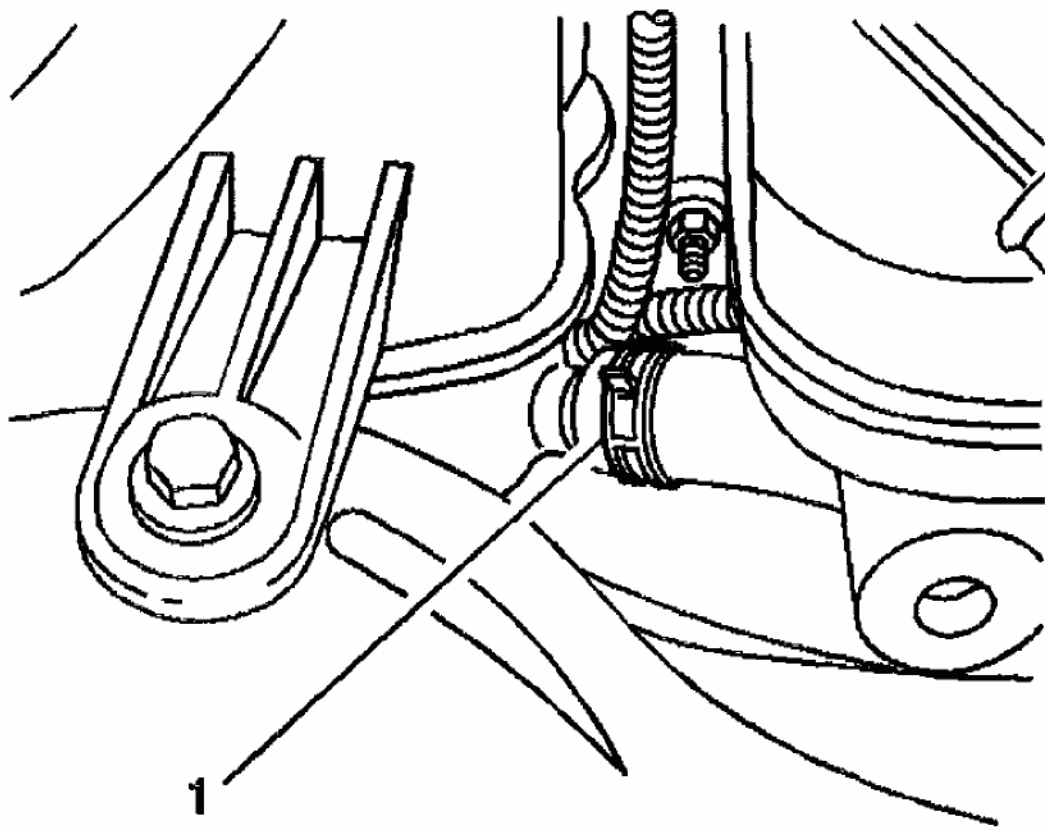
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Fig. 48: Locating Surge Tank Nut
Courtesy of GENERAL MOTORS CORP.

8. Remove the lower surge tank bolt.
9. Lift the air inlet grille panel partially out of the way to remove the surge tank.
10. Disconnect the low coolant sensor electrical connector.
11. 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 grill screen.
4. Reposition the air inlet grille.
5. Connect the surge tank outlet hose.
6. Using the **J 38185** position the surge tank outlet hose clamp (1).



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Fig. 49: Identifying Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

7. Install the surge tank nut (1).

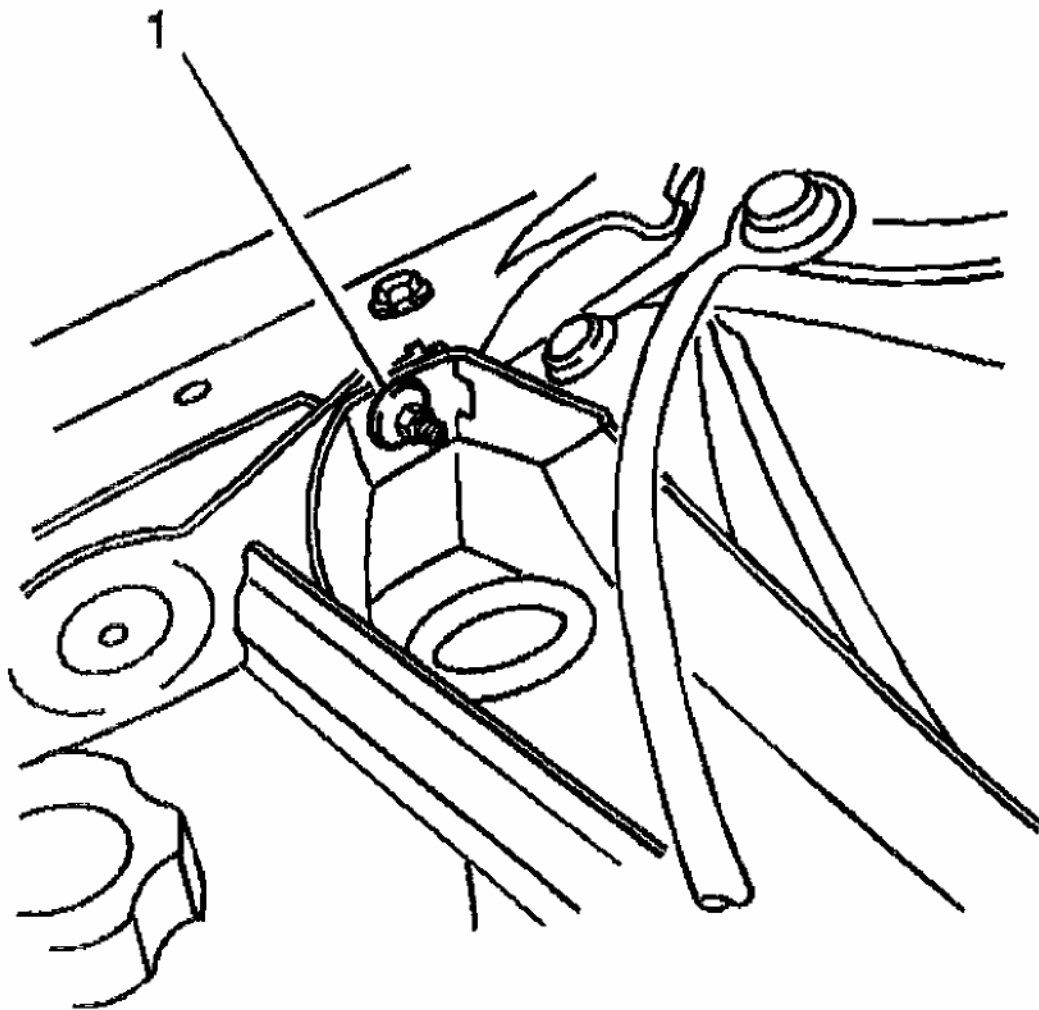
Tighten

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

8. Install the lower surge tank bolt.

Tighten

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

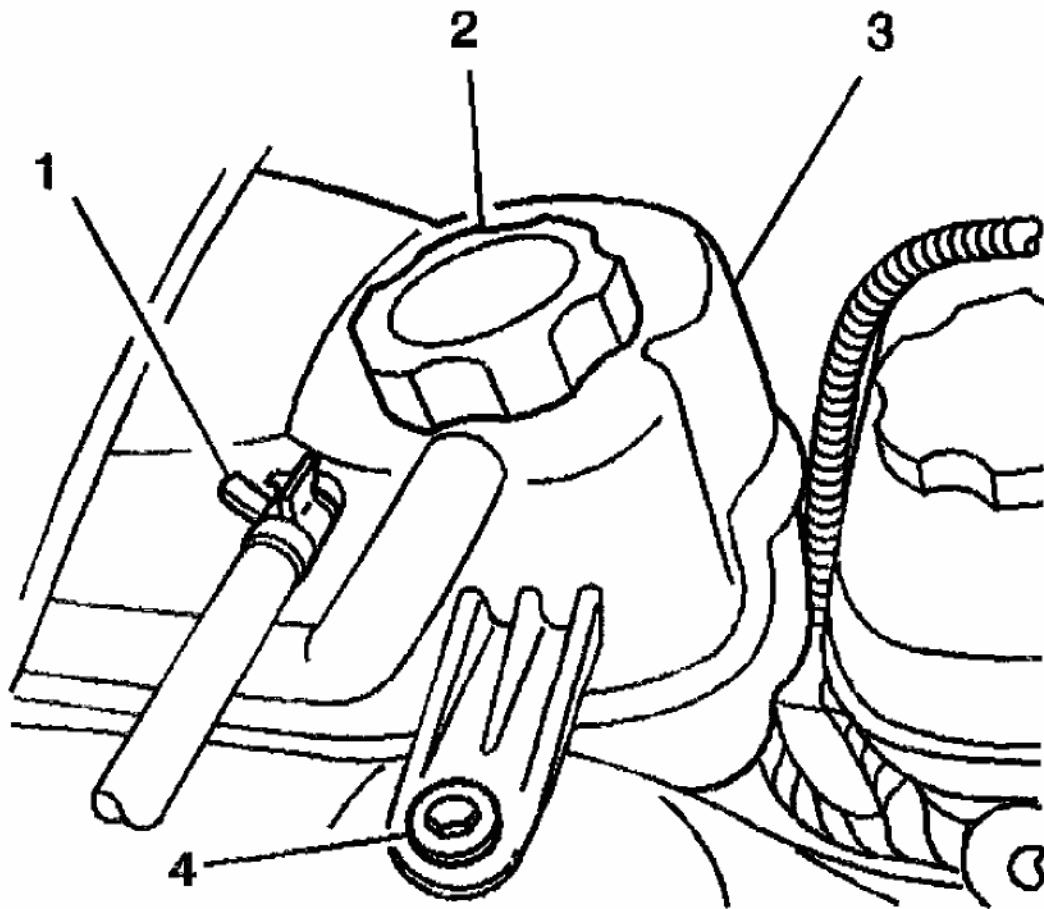


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Fig. 50: Locating Surge Tank Nut

Courtesy of GENERAL MOTORS CORP.

9. Connect the surge tank inlet hose (1).



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Fig. 51: Connecting Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

10. Install the surge tank bolt (4).

Tighten

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

11. Connect the master cylinder to the vacuum booster. Refer to **MASTER CYLINDER** in

Disc.

12. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

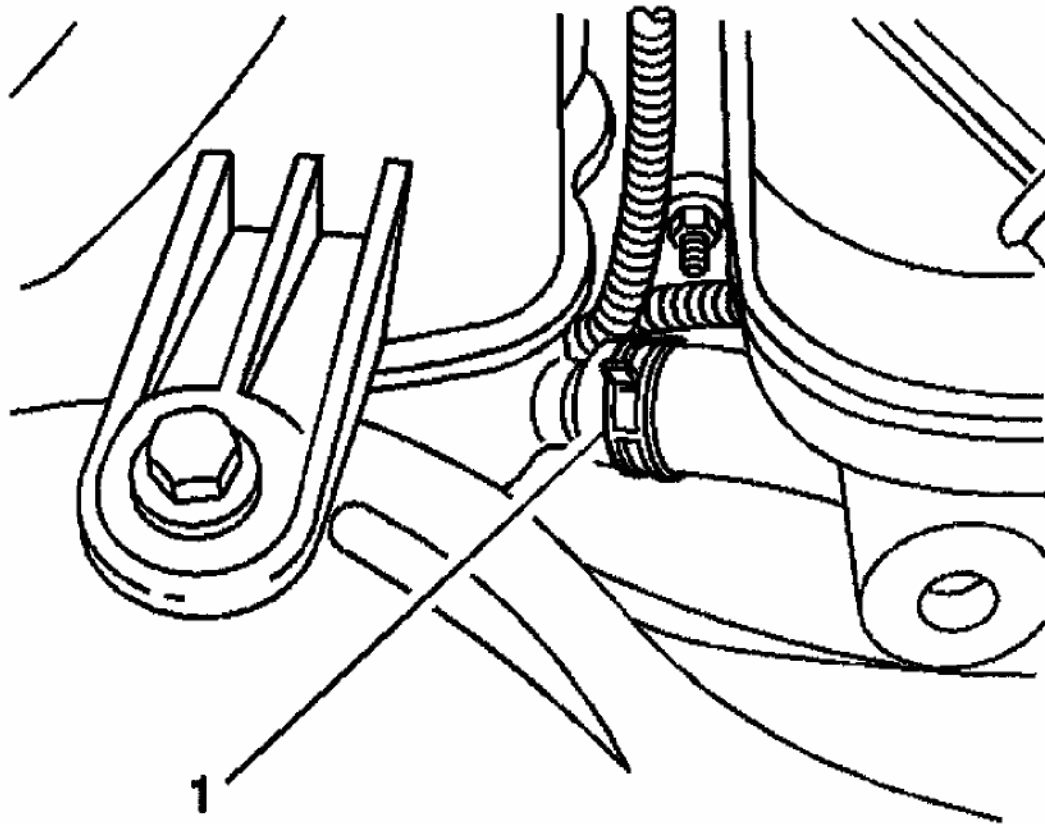
SURGE TANK REPLACEMENT (LHD M 82)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

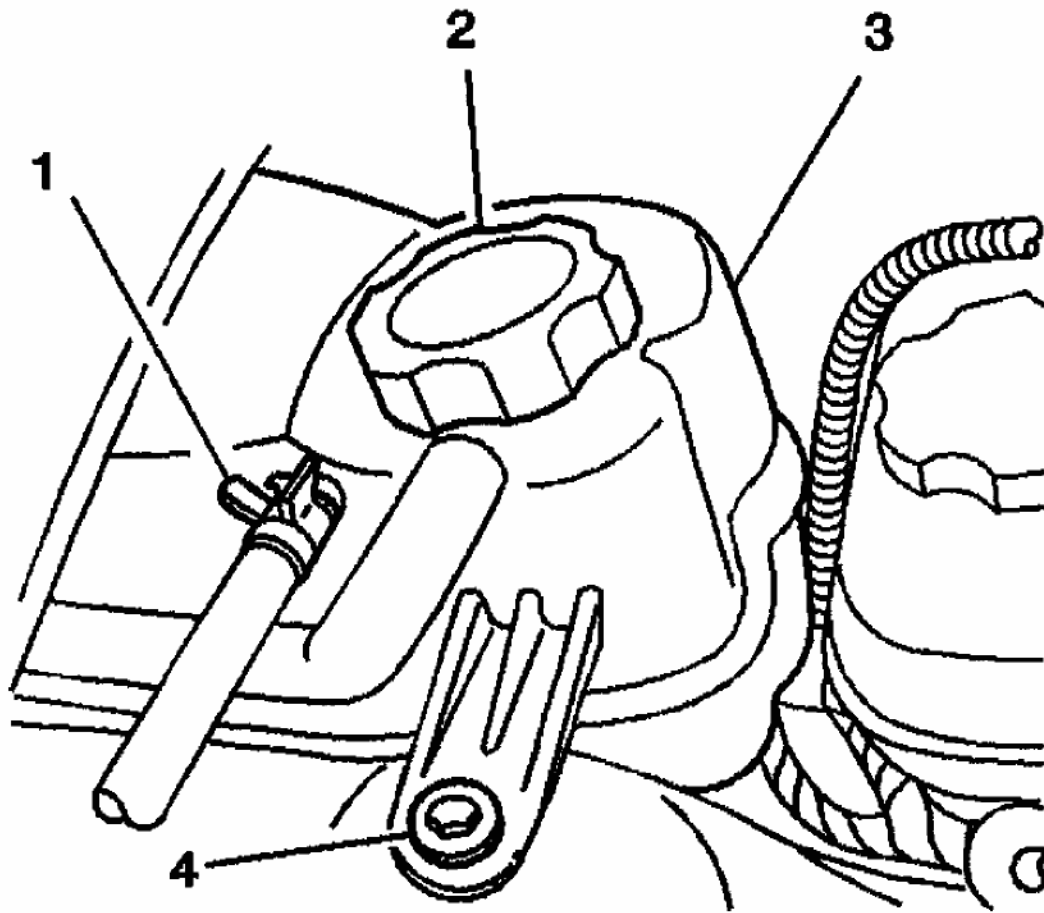
1. Drain the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Using the **J 38185** , loosen and slide the clamp (1).
3. Disconnect the surge tank outlet hose (1).
4. Without disconnecting brake lines separate the master cylinder from the brake booster. Refer to **MASTER CYLINDER** in Disc.



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Fig. 52: Identifying Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

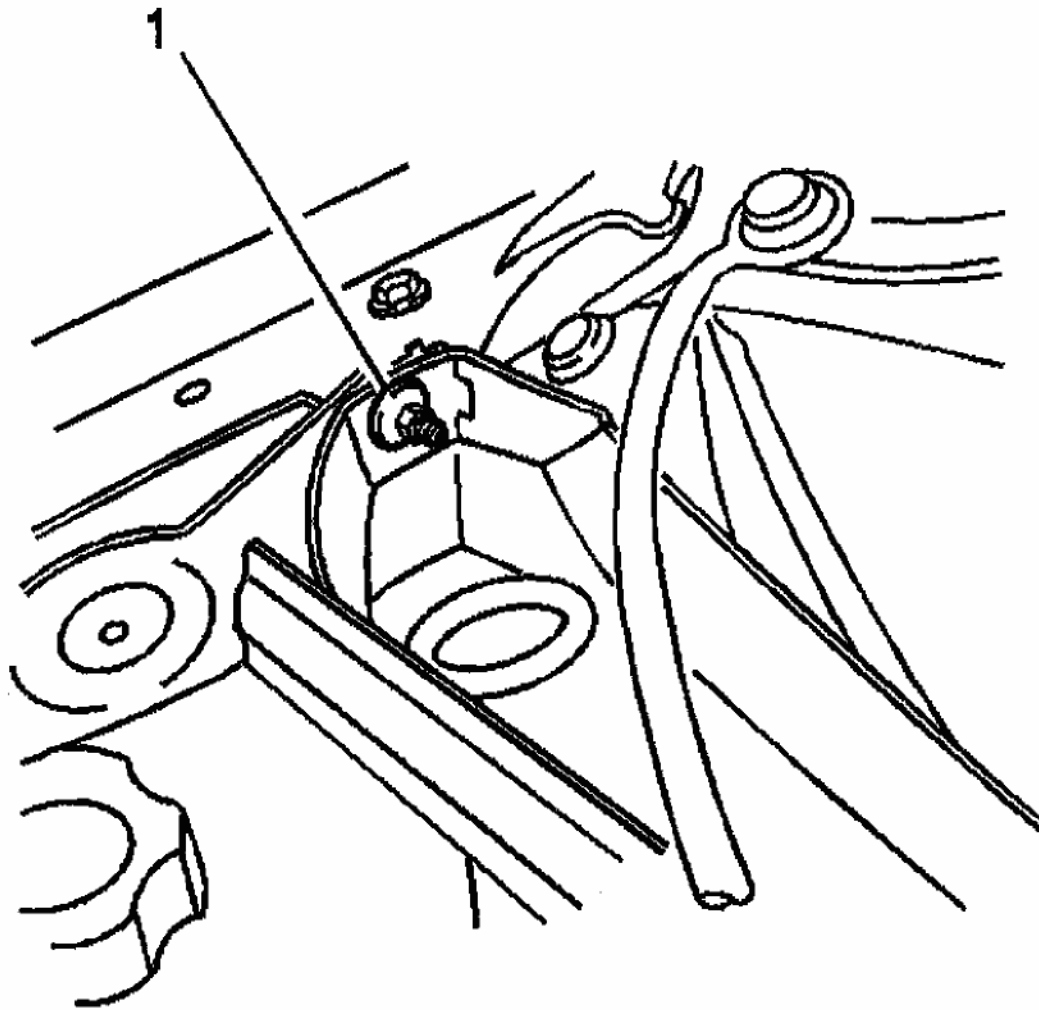
5. Disconnect the surge tank inlet hose (1).
6. Remove the surge tank bolt (4).



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Fig. 53: Disconnecting Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Remove the surge tank nut (1).



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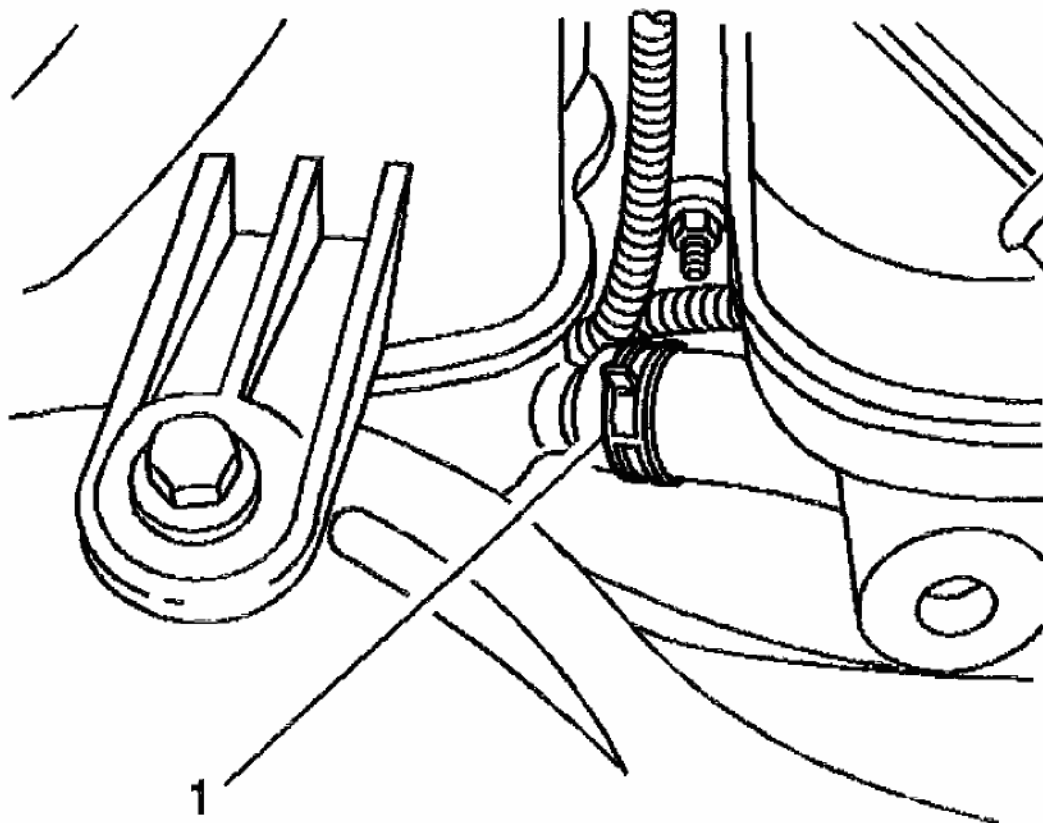
Fig. 54: Removing Surge Tank Nut
Courtesy of GENERAL MOTORS CORP.

8. Lift the air inlet grille panel partially out of the way to remove the surge tank.
9. Disconnect the low coolant sensor electrical connector.
10. 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.
5. Connect the surge tank outlet hose (1).



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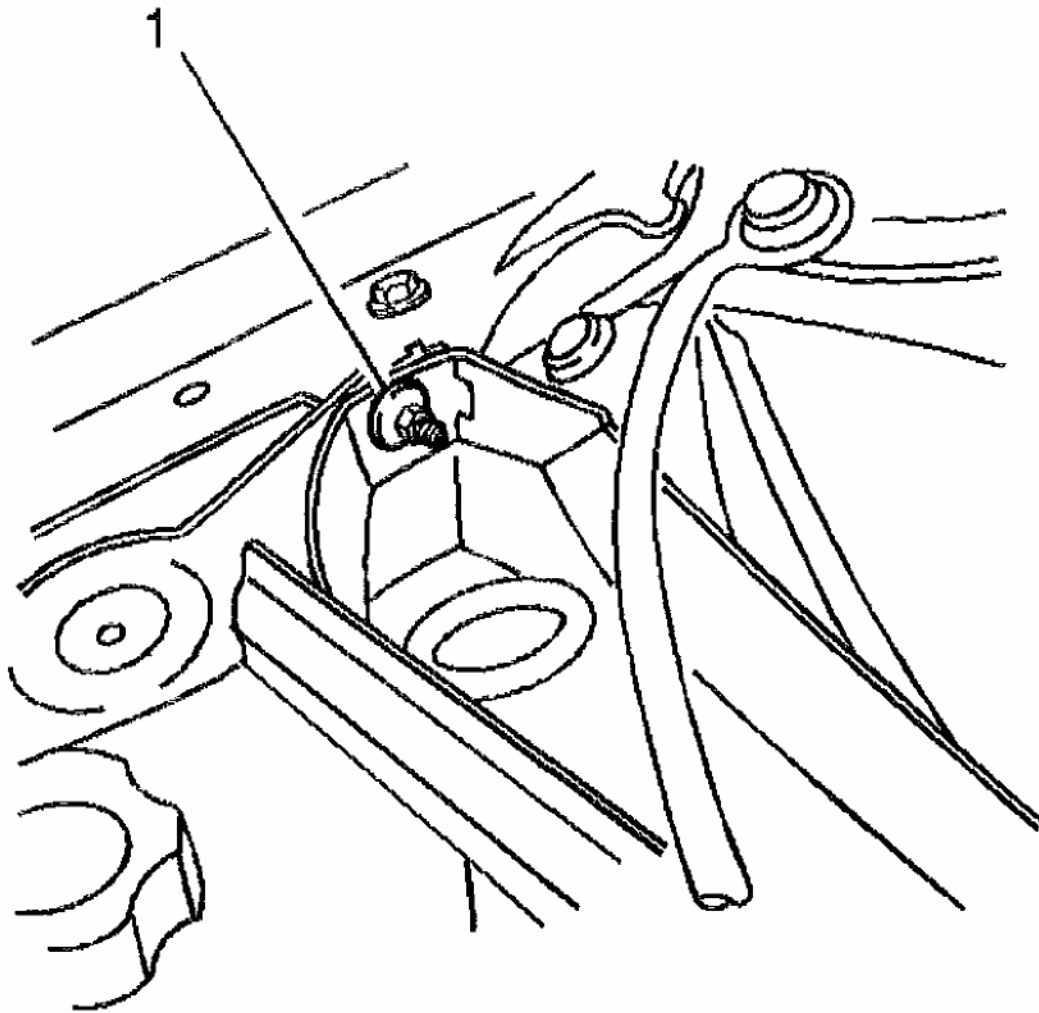
Fig. 55: Identifying Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

6. Install the surge tank nut (1).

Tighten

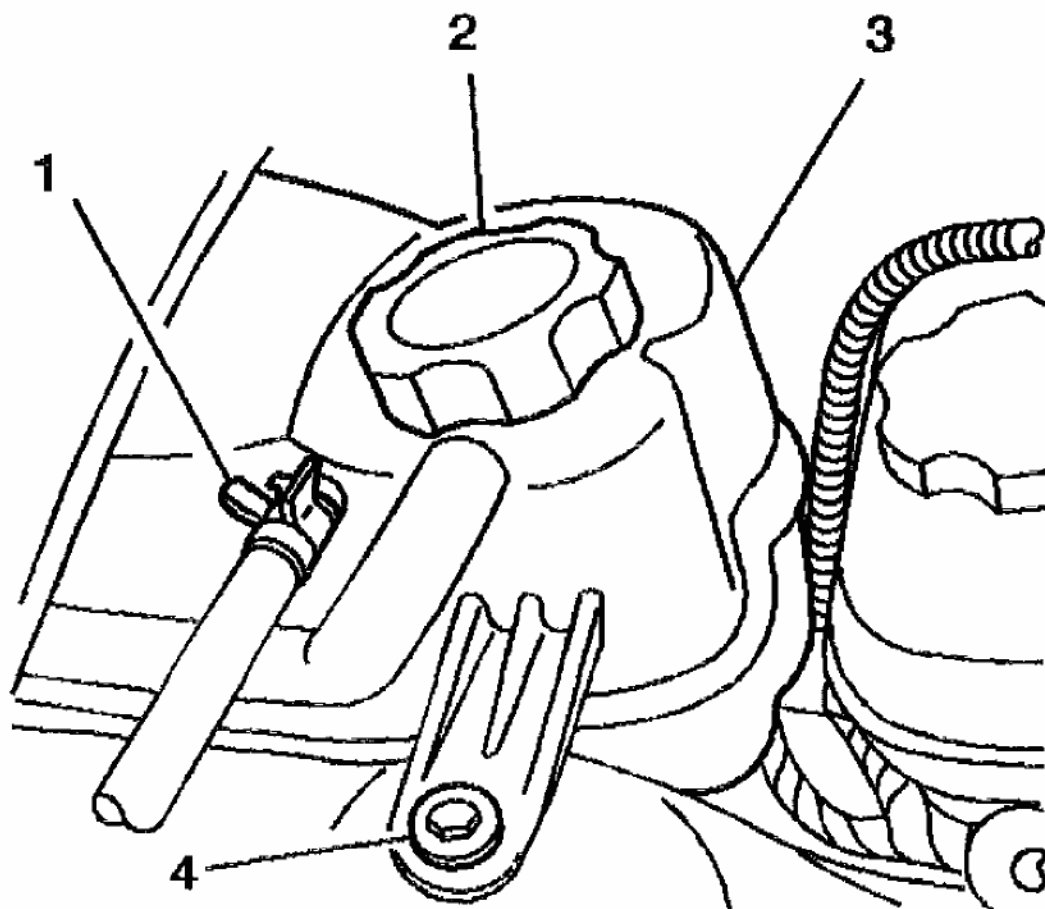
Tighten the nut to 9 N.m (80 lb in).



G02086532

Fig. 56: Installing Surge Tank Nut
Courtesy of GENERAL MOTORS CORP.

7. Connect the surge tank inlet hose (1).



G02086533

Fig. 57: Connecting Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

8. Install the surge tank bolt (4).

Tighten

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

9. Connect the master cylinder to the vacuum booster. Refer to **MASTER CYLINDER** in Disc.
10. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

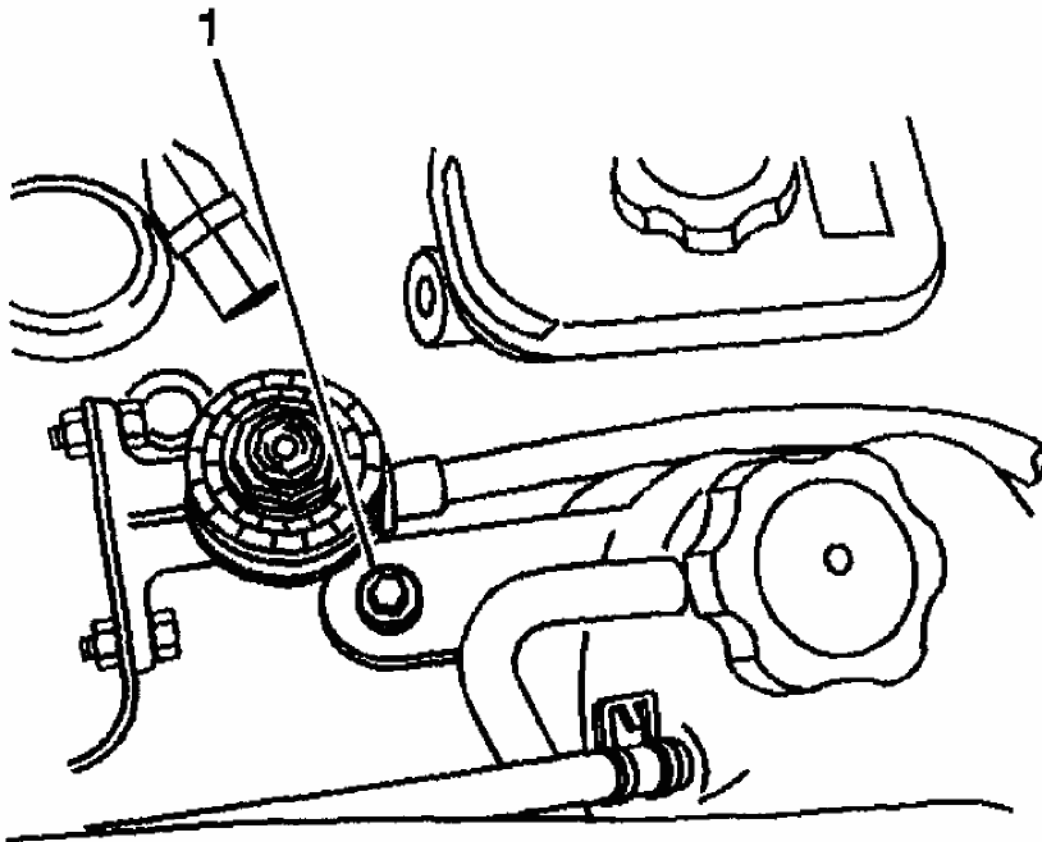
SURGE TANK REPLACEMENT (LHD M 35)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Remove the upper surge tank bolt (1).

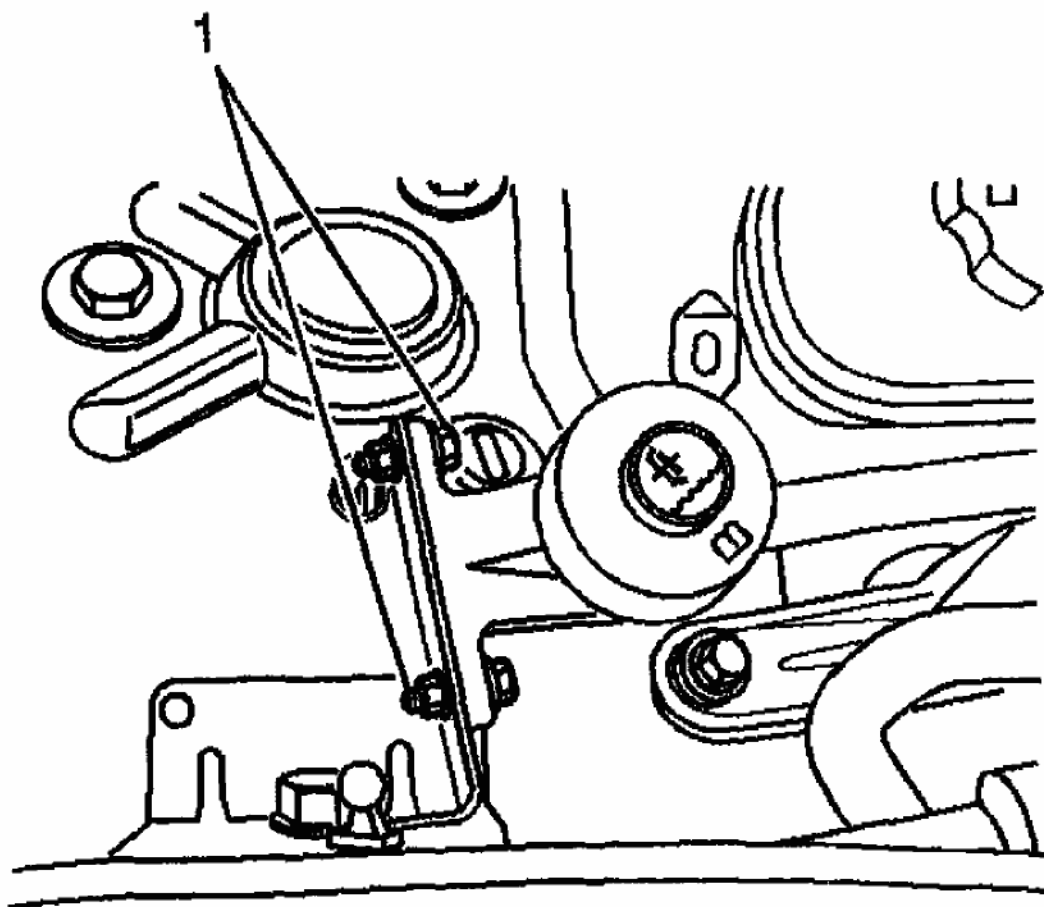


G02086534

Fig. 58: Locating Upper Surge Tank Bolt
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the surge tank inlet hose.

4. Remove the clutch master cylinder reservoir bolts (1).



G02086535

Fig. 59: Removing Clutch Master Cylinder Reservoir Bolts
Courtesy of GENERAL MOTORS CORP.

5. Position the clutch master cylinder reservoir out of the way.
6. Without disconnecting brake lines separate the master cylinder from the brake booster. Refer to **MASTER CYLINDER** in Disc.
7. Using the **J 38185** , loosen and slide the clamp on the surge tank outlet hose.
8. Disconnect the surge tank outlet hose.
9. Remove the lower surge tank bolt.
10. Remove the surge tank bolt at the air inlet grille.

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

Installation Procedure

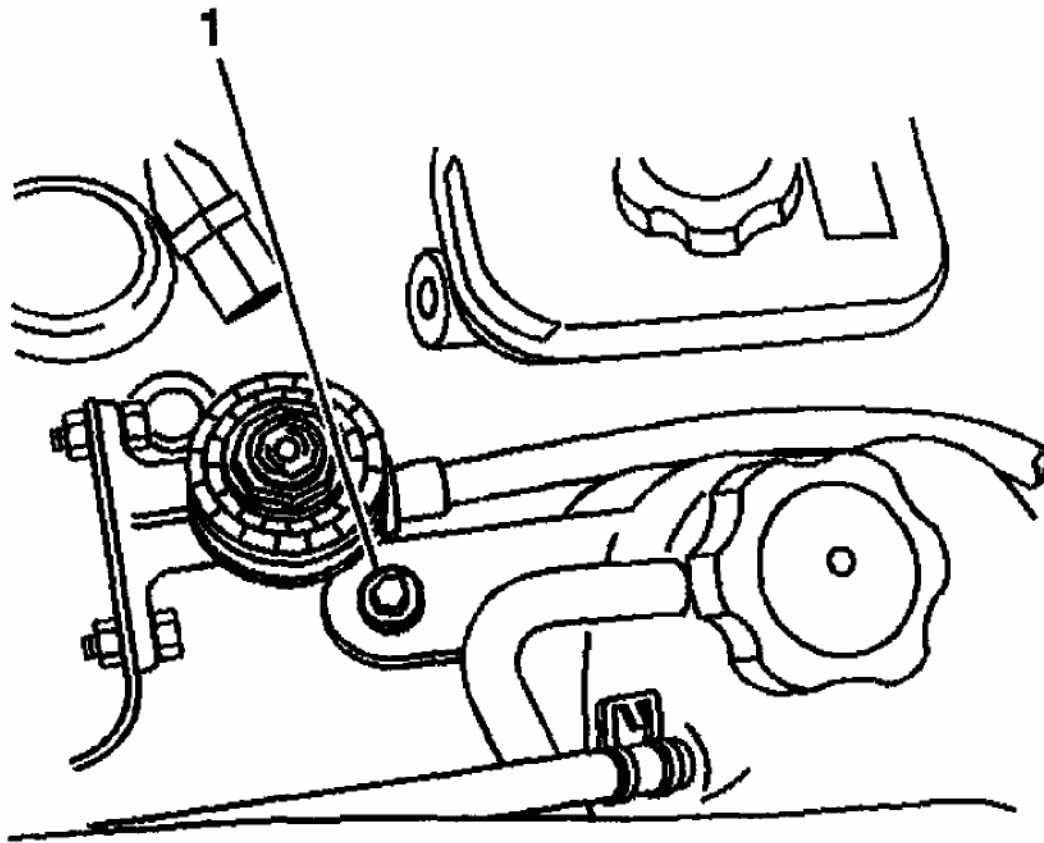
1. Connect the low coolant sensor electrical connector.
2. Install the surge tank.
3. Position the surge tank tab behind the air inlet grille screen.
4. Reposition the air inlet grille.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

5. Install the surge tank nut.

Tighten

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



G02086536

Fig. 60: Installing Surge Tank Nut
Courtesy of GENERAL MOTORS CORP.

6. Connect the surge tank outlet hose.
7. Using the **J 38185** reposition the surge tank outlet hose clamp into the original position.
8. Connect the surge tank inlet hose.
9. Install the lower surge tank bolt.

Tighten

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

10. Install the surge tank bolt (1).

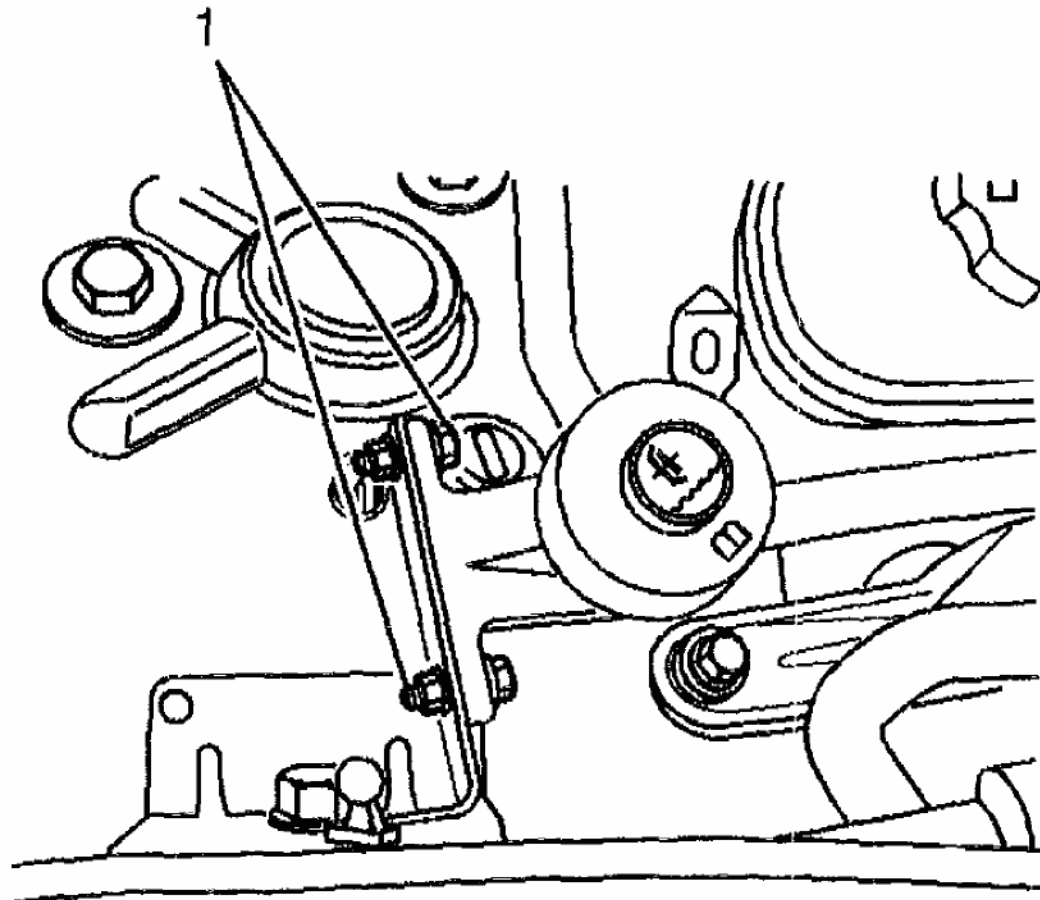
Tighten

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

11. Reposition the clutch master cylinder reservoir.
12. Install the clutch master cylinder reservoir bolts (1).

Tighten

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



G02086537

Fig. 61: Installing Clutch Master Cylinder Reservoir Bolts
Courtesy of GENERAL MOTORS CORP.

13. Connect the master cylinder to the vacuum booster. Refer to **MASTER CYLINDER** in

Disc.

14. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

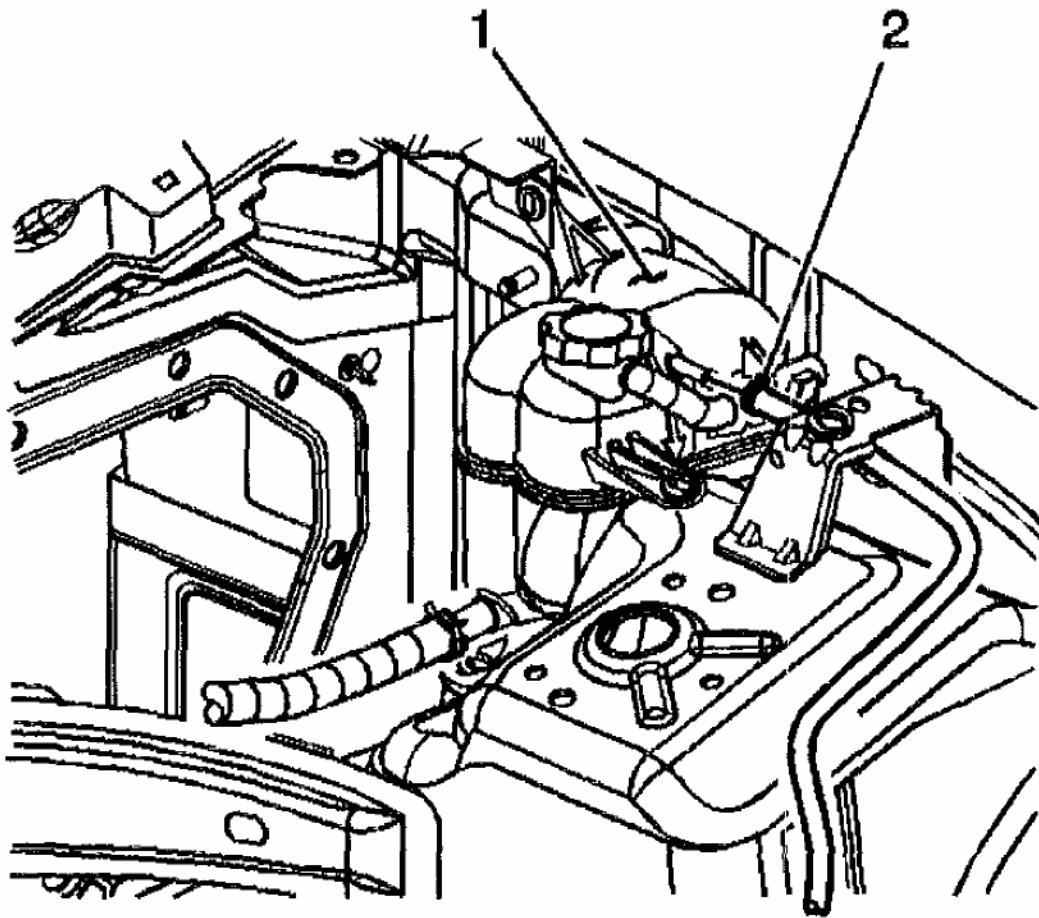
SURGE TANK HOSE/PIPE REPLACEMENT - INLET (LHD)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

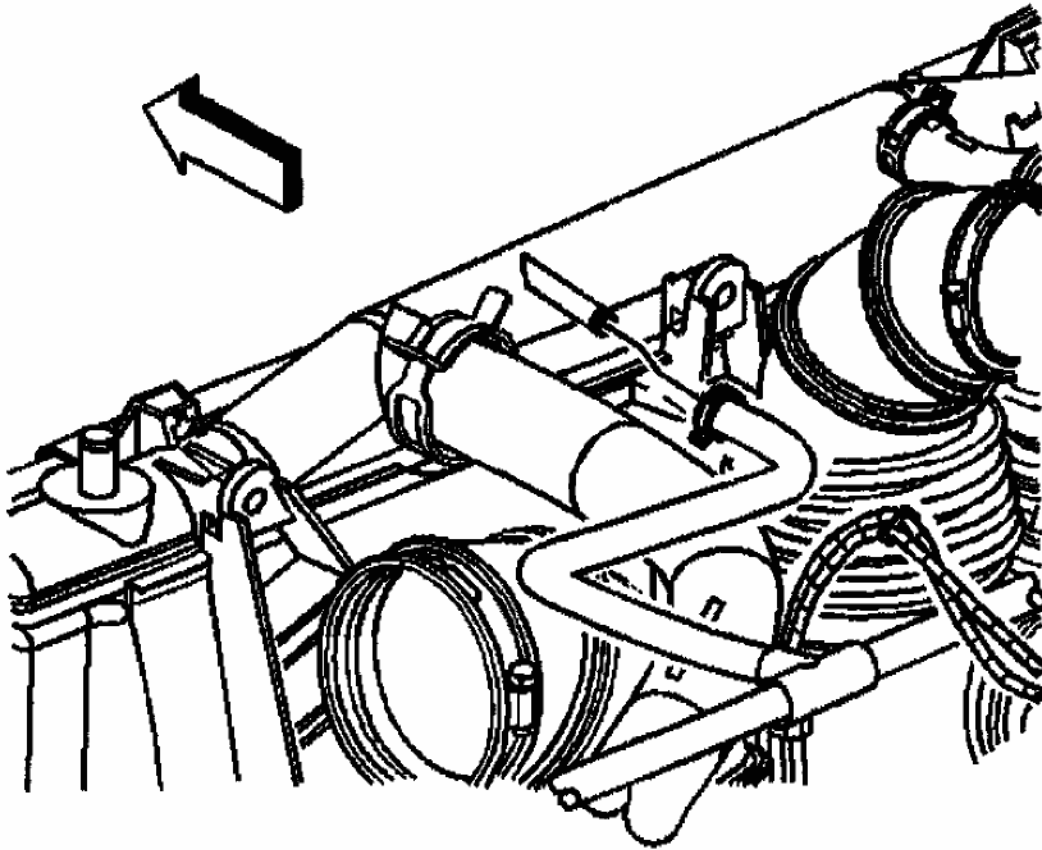
1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Position the **J 38185** to the clamp in order to remove the surge tank inlet hose (2) from the surge tank (1).



G02086538

Fig. 62: Removing Surge Tank Inlet Hose From Surge Tank
Courtesy of GENERAL MOTORS CORP.

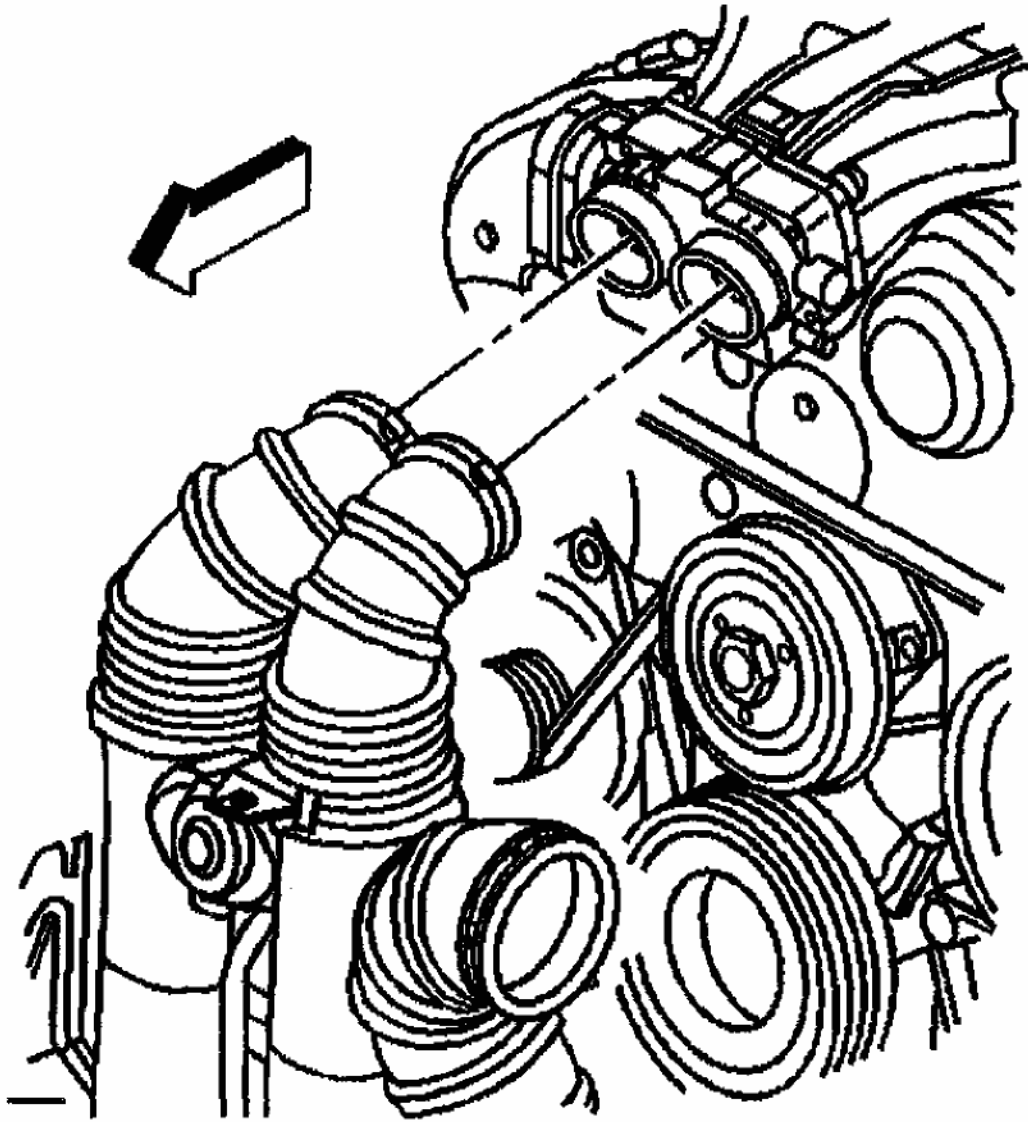
3. Position the **J 38185** to the clamp in order to remove the surge tank inlet hose from the radiator.



G02086539

Fig. 63: Removing Surge Tank Inlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

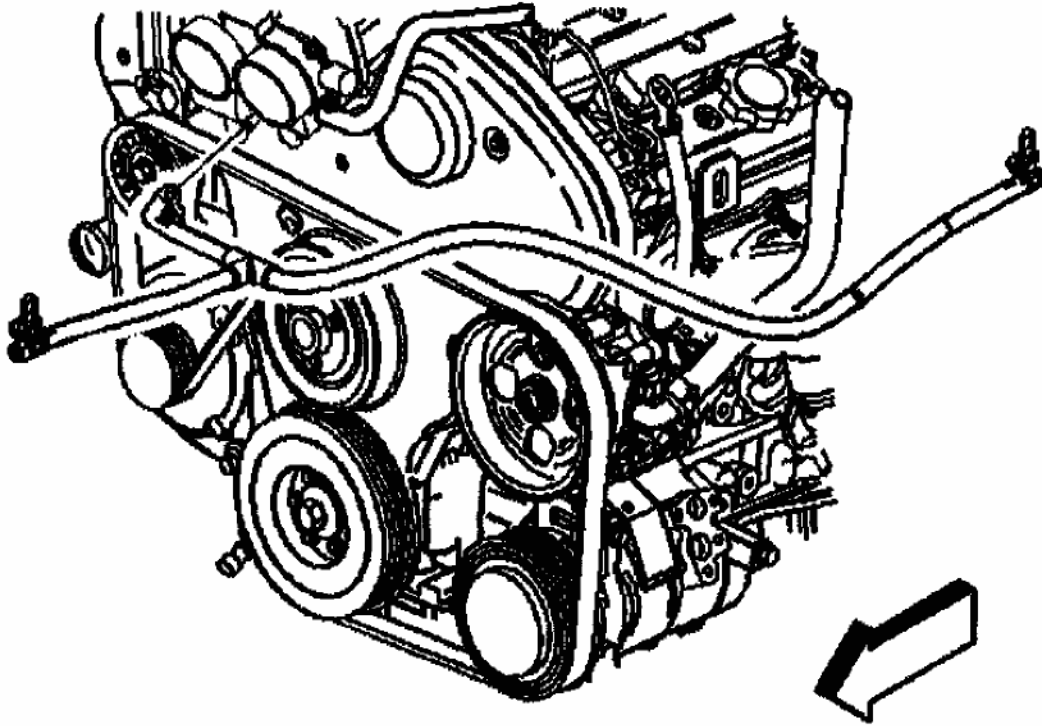
4. Disconnect the air intake duct hoses from the throttle body assembly.



G02086540

Fig. 64: Disconnecting Air Intake Duct Hoses From Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

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

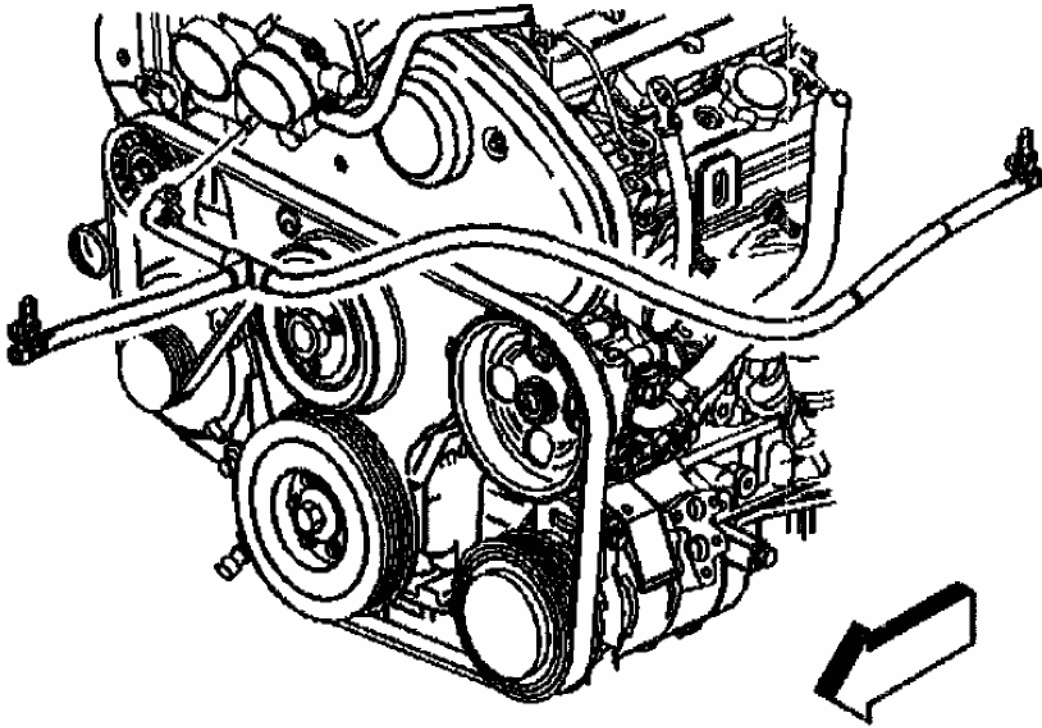


G02086541

Fig. 65: Removing Surge Tank Inlet Hose From Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

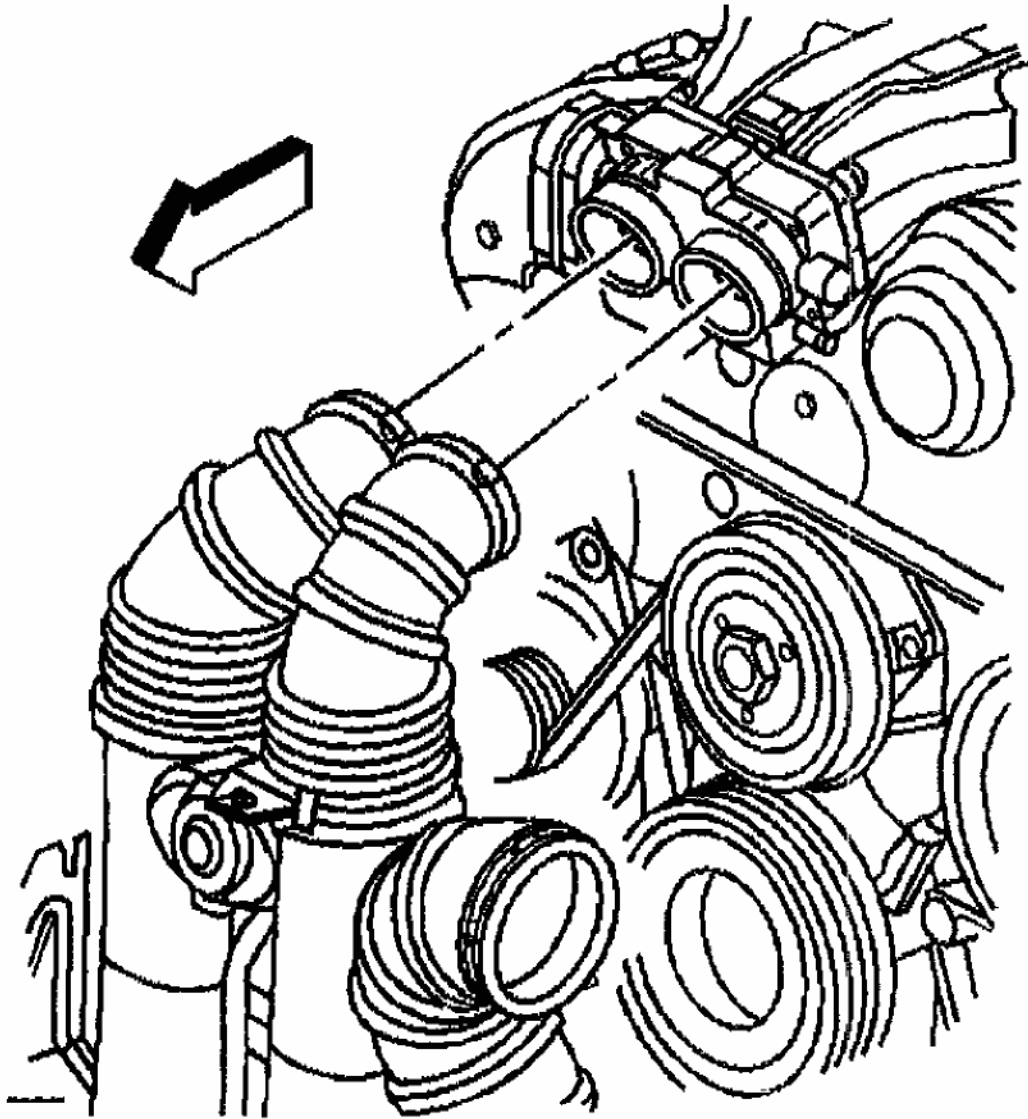
1. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose to the throttle body assembly.



G02086542

Fig. 66: Connecting Surge Tank Inlet Hose To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

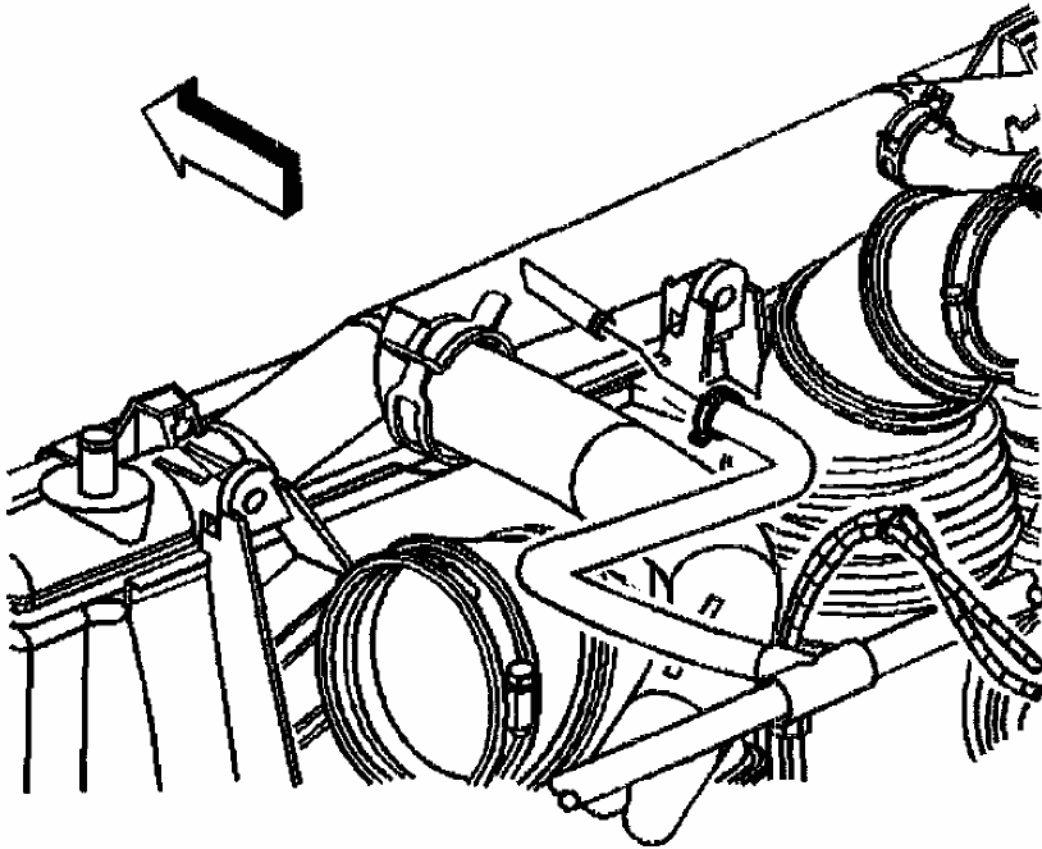
2. Connect the air intake duct hoses to the throttle body assembly.



G02086543

Fig. 67: Connecting Air Intake Duct Hoses To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

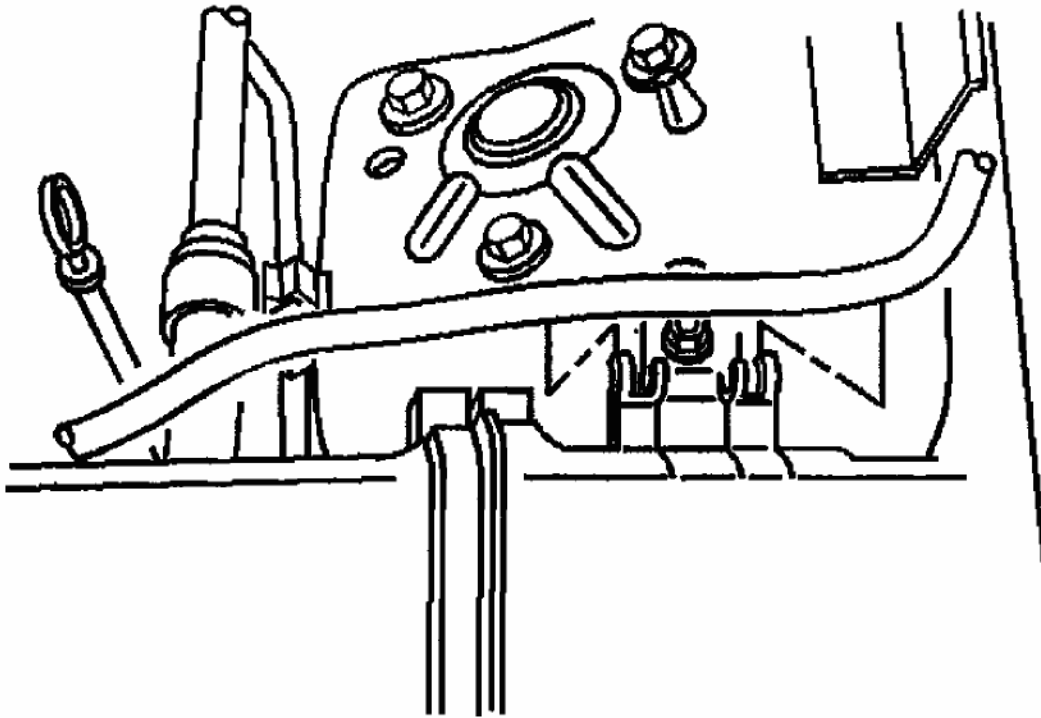
3. Position the **J 38185** to the clamp in order to connect the surge tank inlet hose to the radiator.



G02086544

Fig. 68: Connecting Surge Tank Inlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

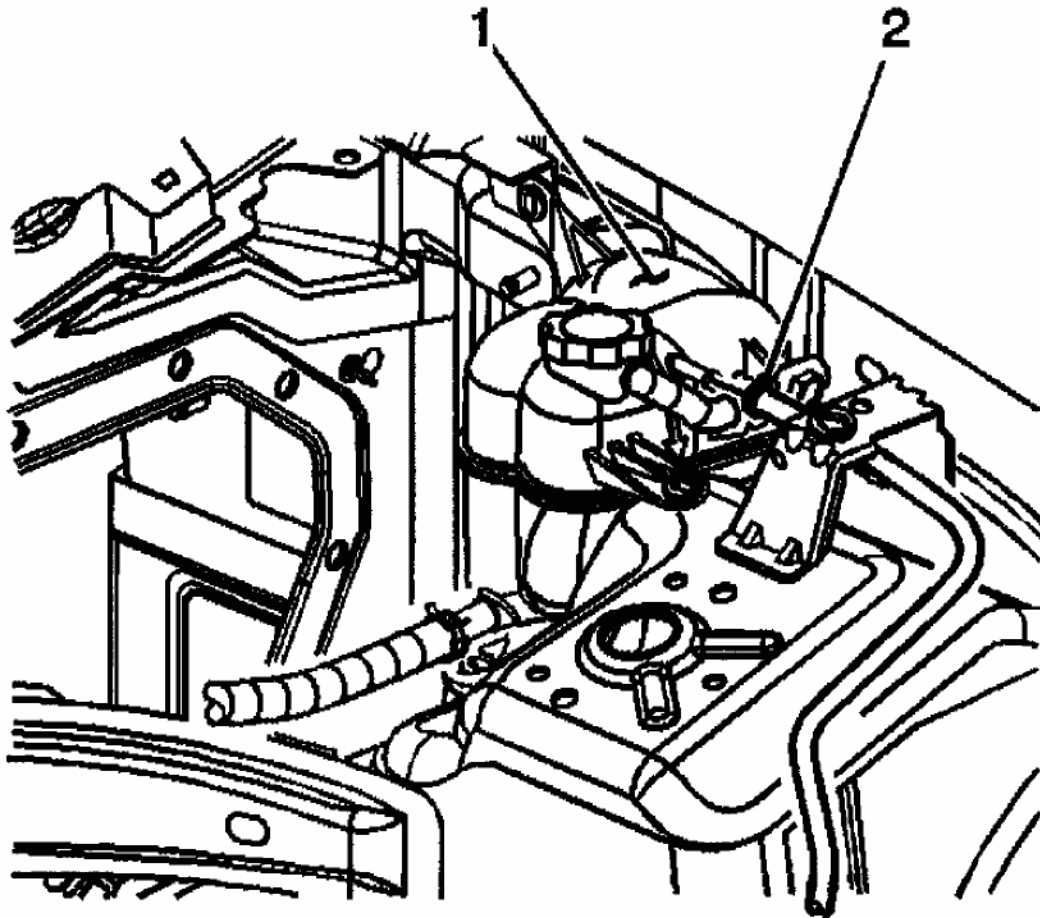
4. Position the surge tank inlet hose to the retaining feature of the air cleaner assembly.



G02086545

Fig. 69: Positioning Surge Tank Inlet Hose To Retainer
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).



G02086546

Fig. 70: Connecting Surge Tank Inlet Hose To Surge Tank
Courtesy of GENERAL MOTORS CORP.

7. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

SURGE TANK HOSE/PIPE REPLACEMENT - INLET (RHD)

Tools Required

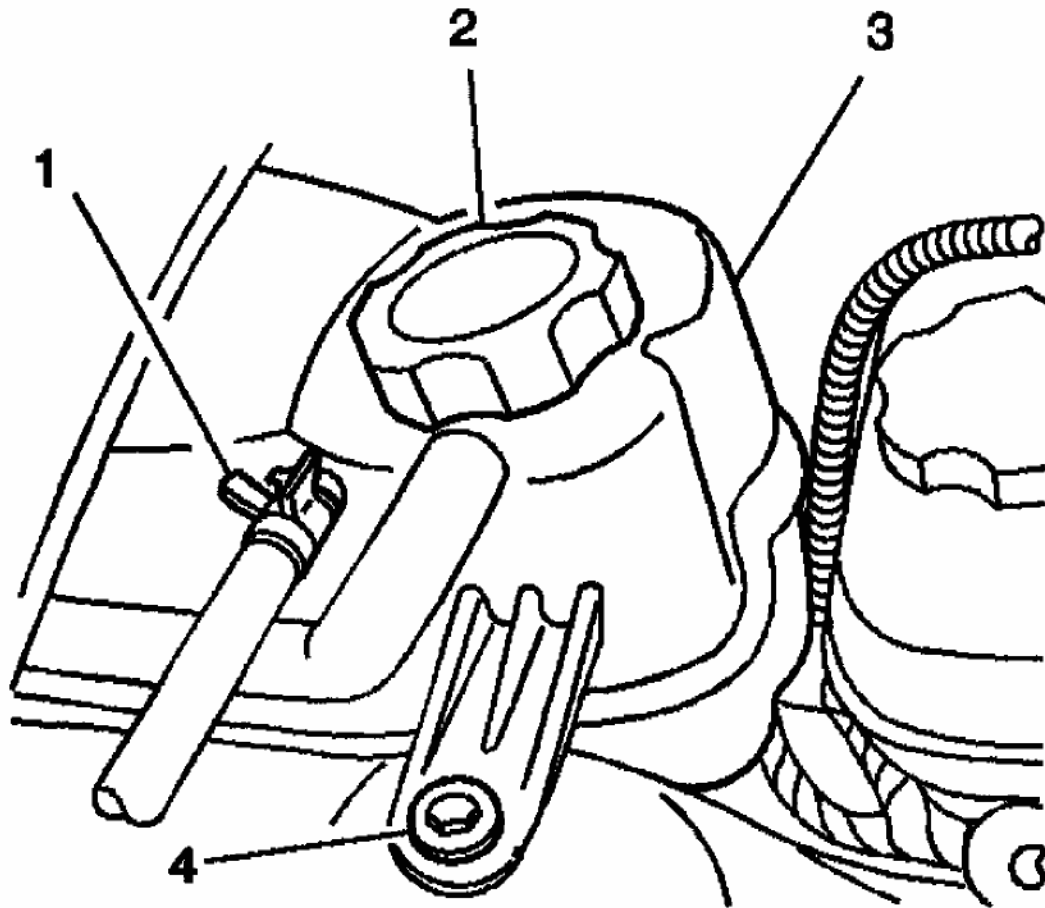
J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING**

SYSTEM .

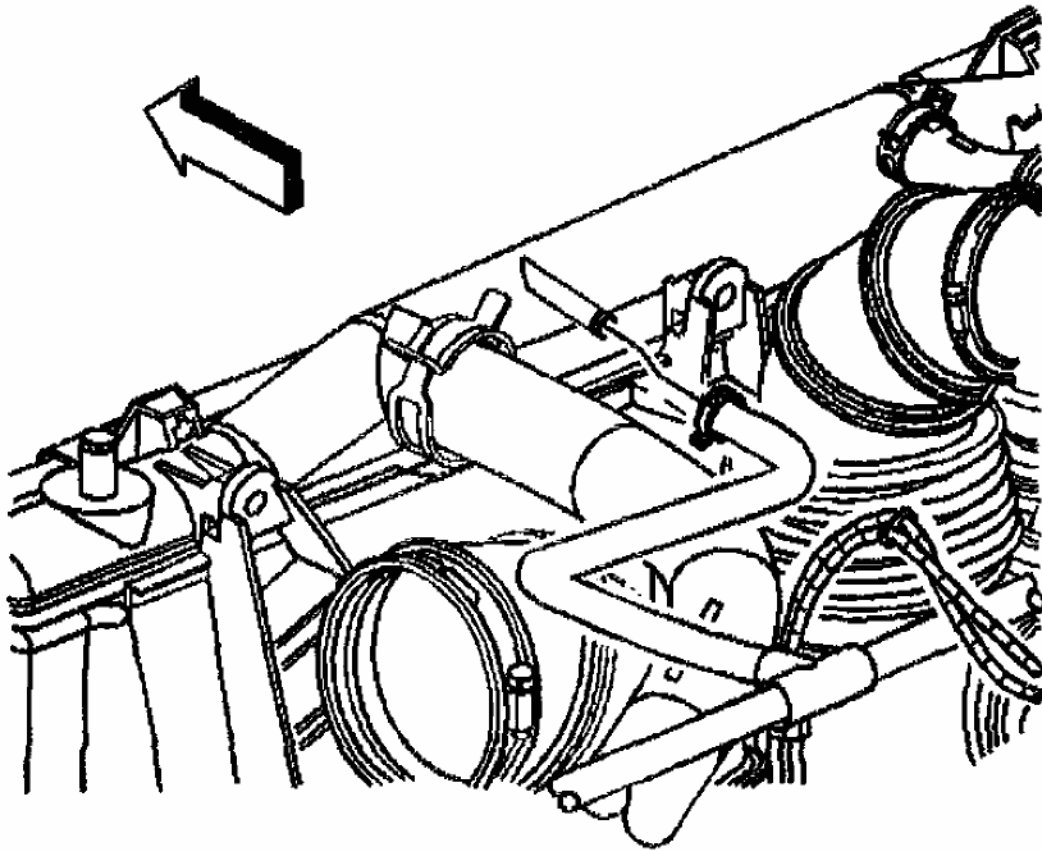
2. Position the *J 38185* to the clamp in order to remove the surge tank inlet hose (1) from the surge tank (3).



G02086547

Fig. 71: Removing Surge Tank Inlet Hose From Surge Tank
Courtesy of GENERAL MOTORS CORP.

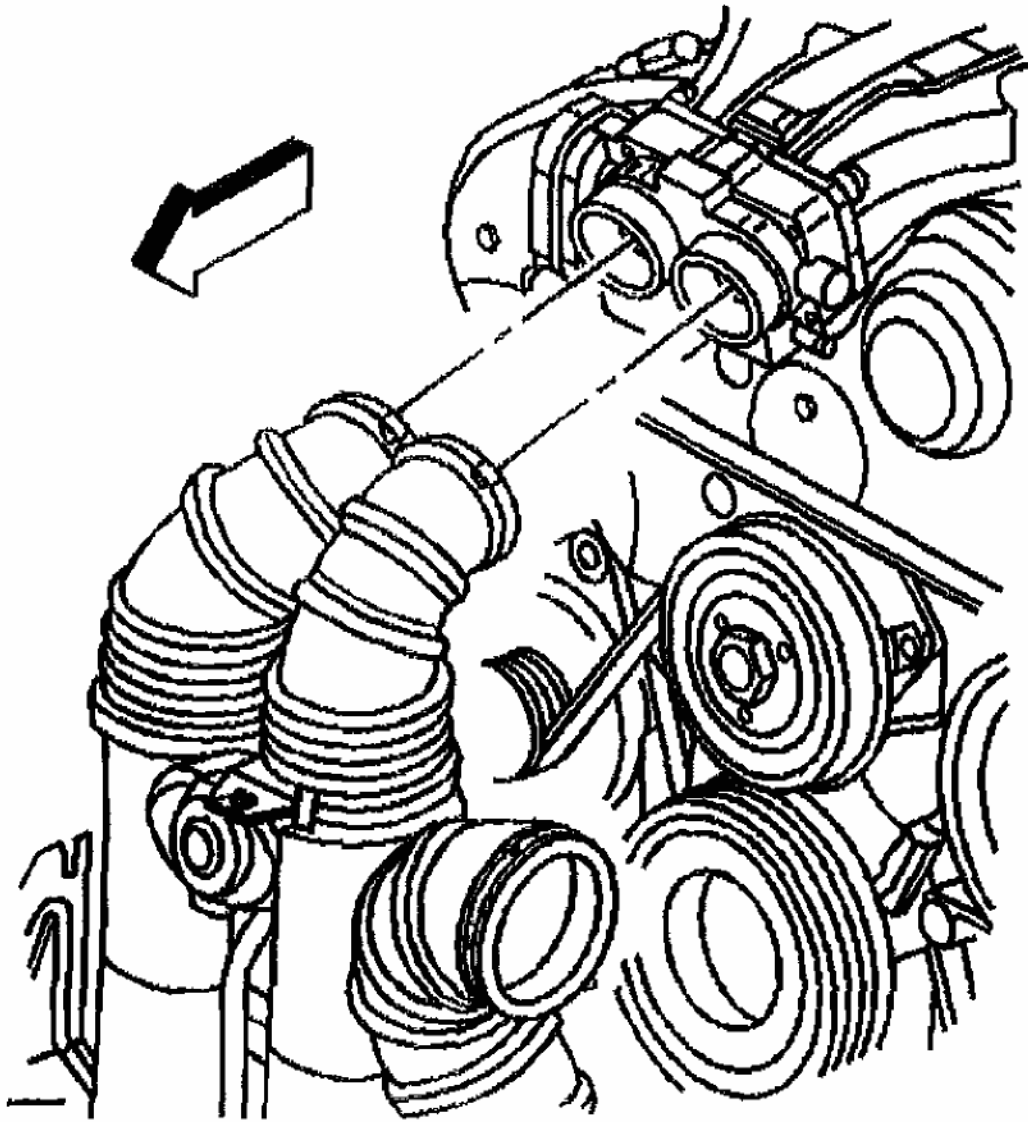
3. Position the *J 38185* to the clamp in order to remove the surge tank inlet hose from the radiator.



G02086548

Fig. 72: Removing Surge Tank Inlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

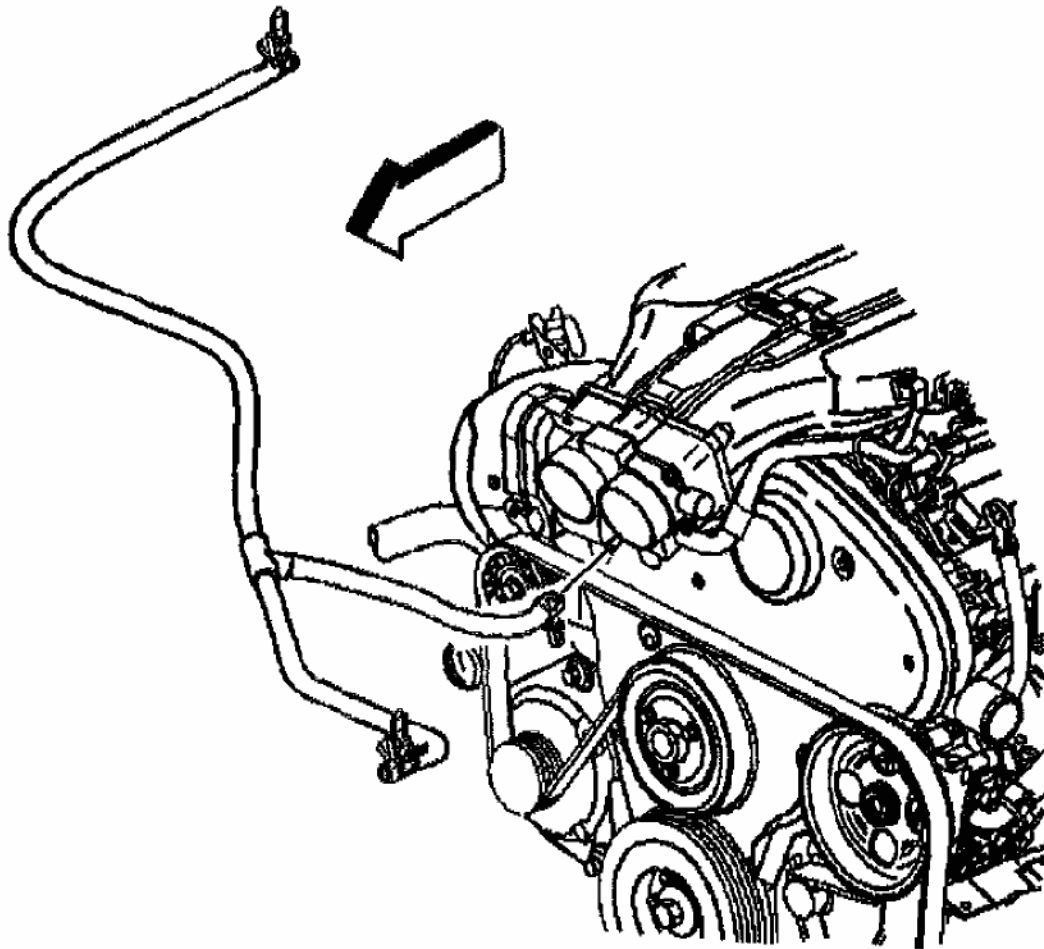
4. Disconnect the air intake duct hoses from the throttle body assembly.



G02086549

Fig. 73: Disconnecting Air Intake Duct Hoses From Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

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

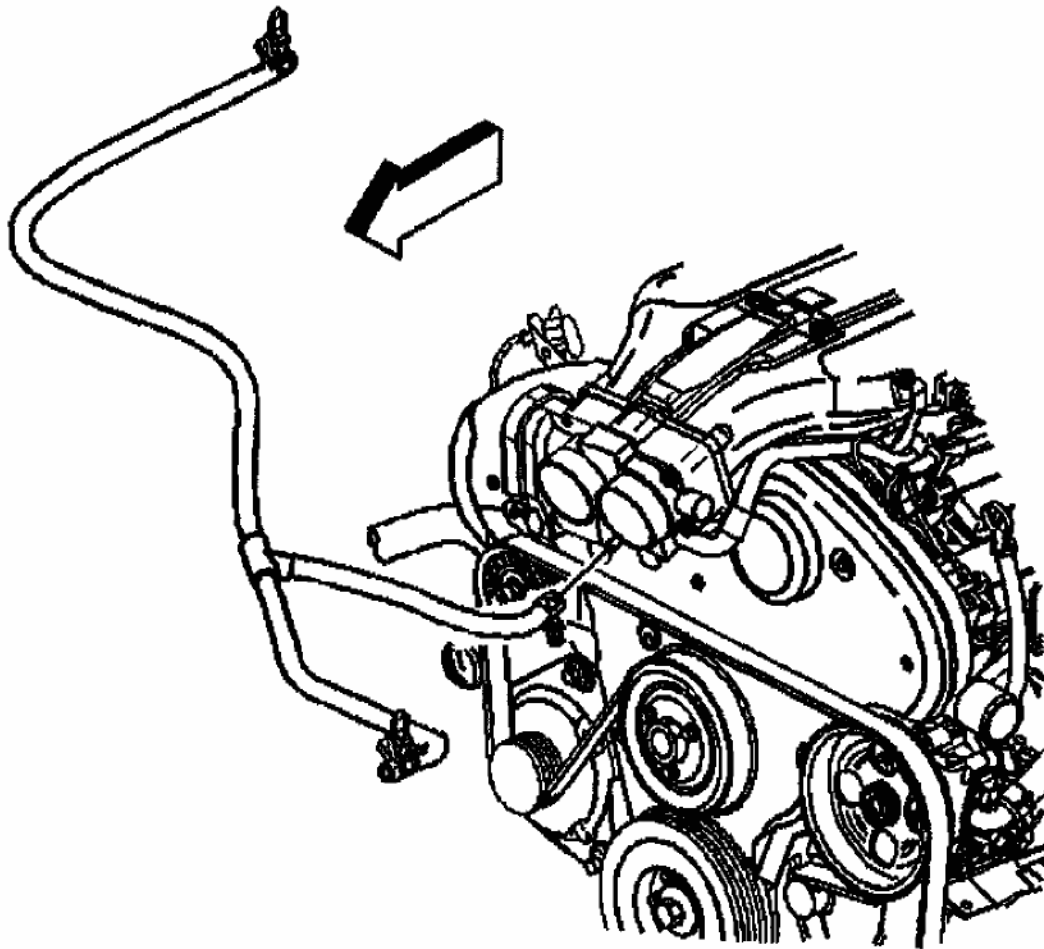


G02086550

Fig. 74: Removing Surge Tank Inlet Hose From Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

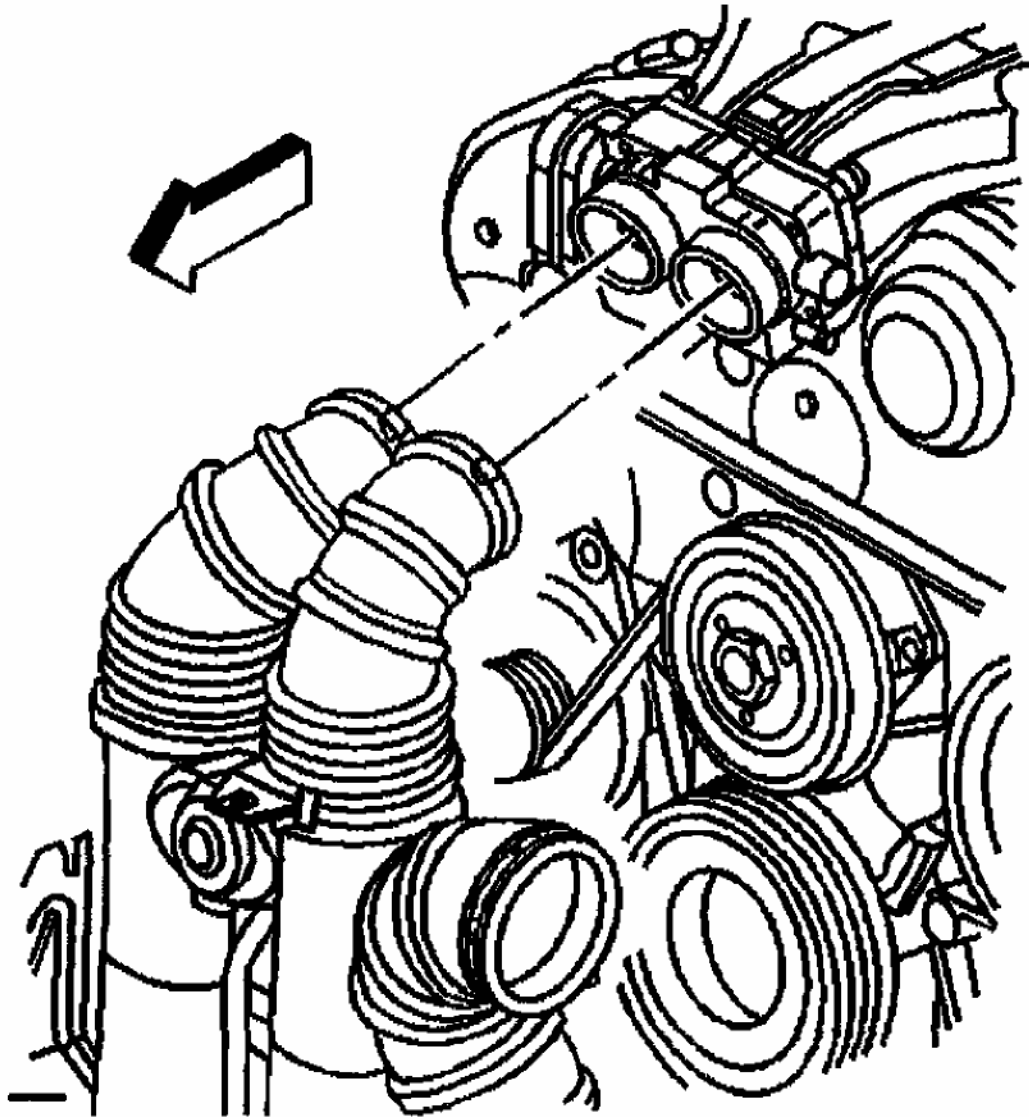
1. Position the *J 38185* to the clamp in order to connect the surge tank inlet hose to the throttle body assembly.



G02086551

Fig. 75: Connecting Surge Tank Inlet Hose To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

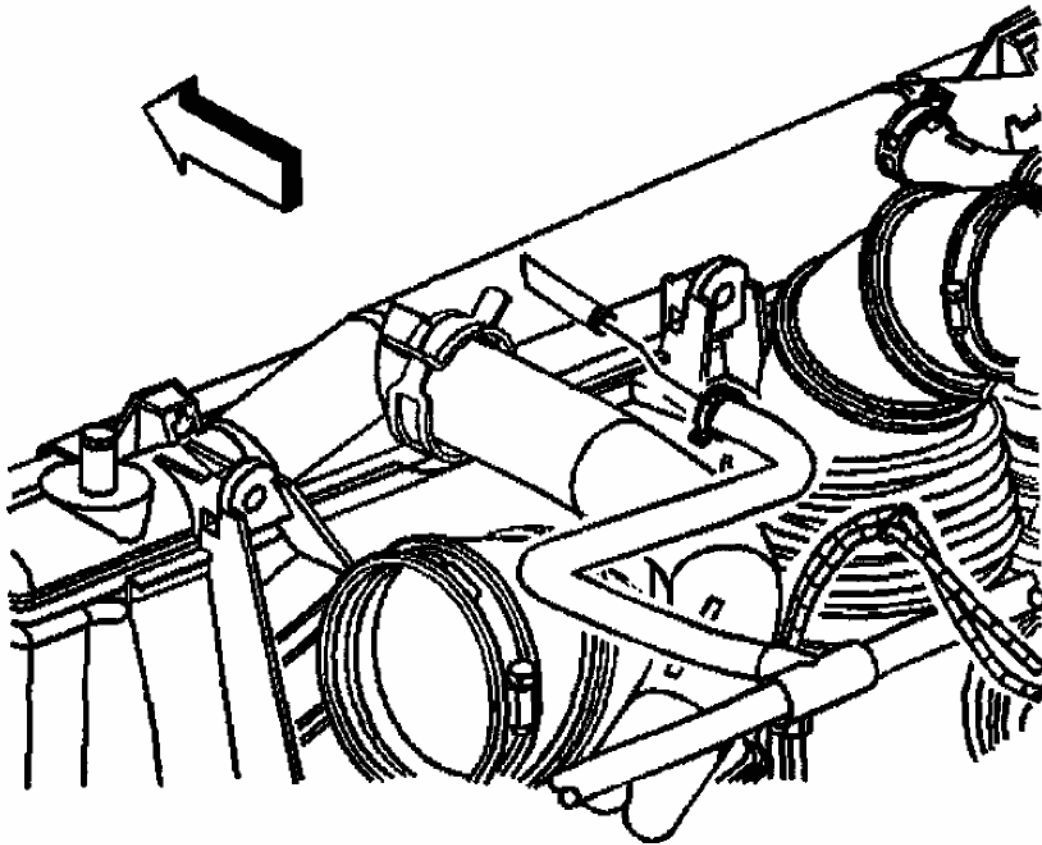
2. Connect the air intake duct hoses to the throttle body assembly.



G02086552

Fig. 76: Connecting Air Intake Duct Hoses To Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

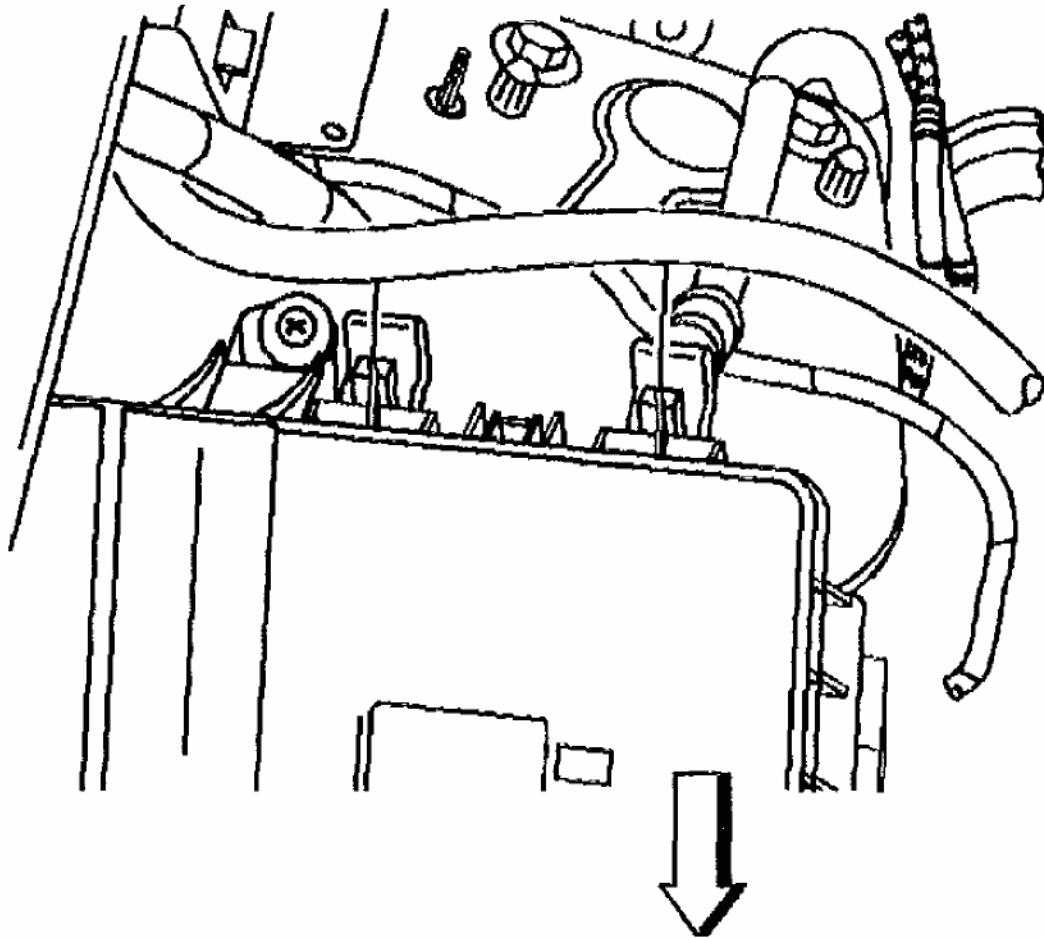
3. Position the *J 38185* to the clamp in order to connect the surge tank inlet hose to the radiator.



G02086553

Fig. 77: Connecting Surge Tank Inlet Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

4. Position the surge tank inlet hose to the retaining feature of the underhood fuse block cover.

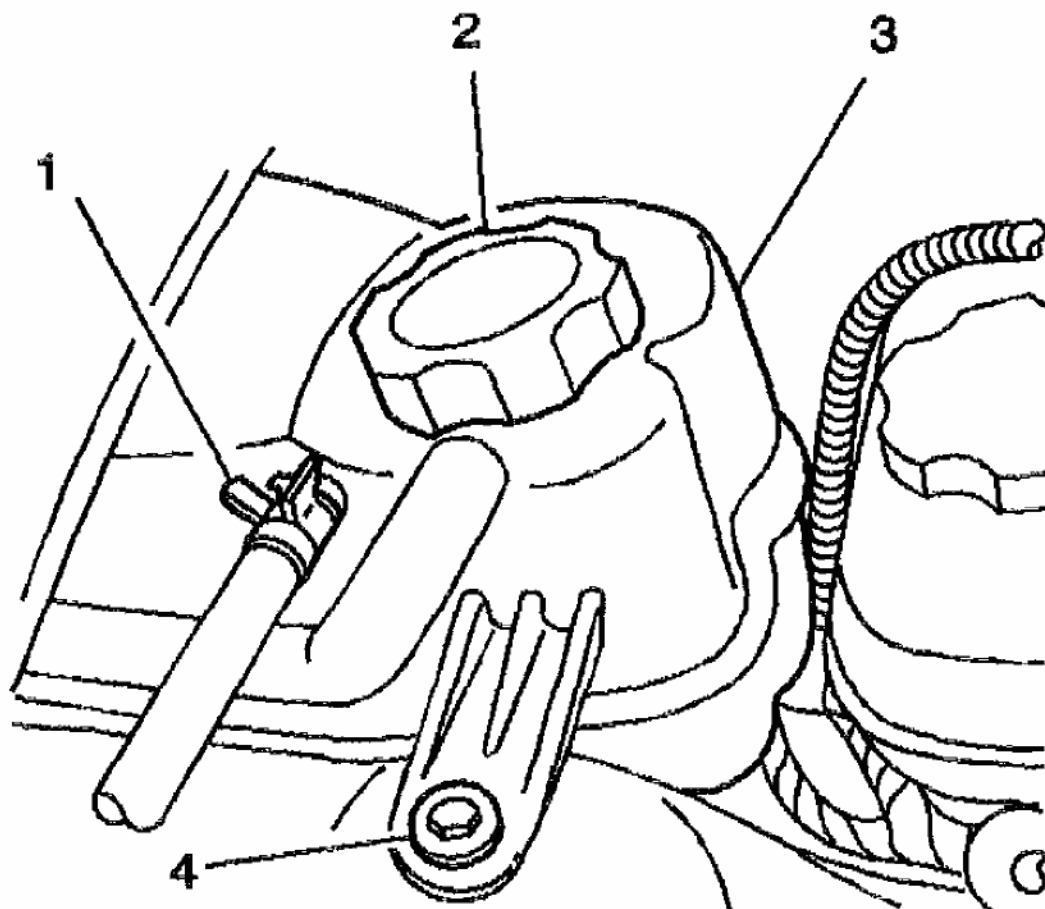


G02086554

Fig. 78: Positioning Surge Tank Inlet Hose To Underhood Fuse Block Cover Retainer

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 (1) to the surge tank (3).



G02086555

Fig. 79: Connecting Surge Tank Inlet Hose To Surge Tank
Courtesy of GENERAL MOTORS CORP.

7. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LHD)

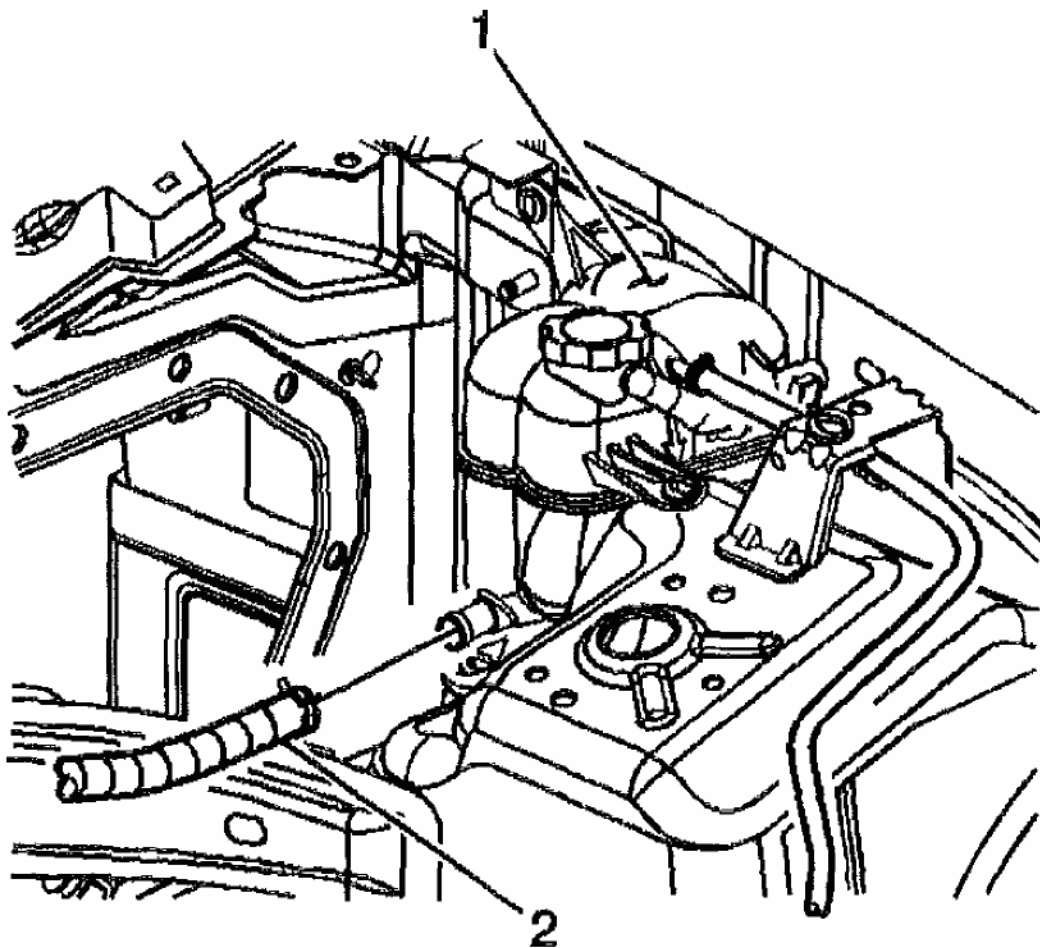
Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

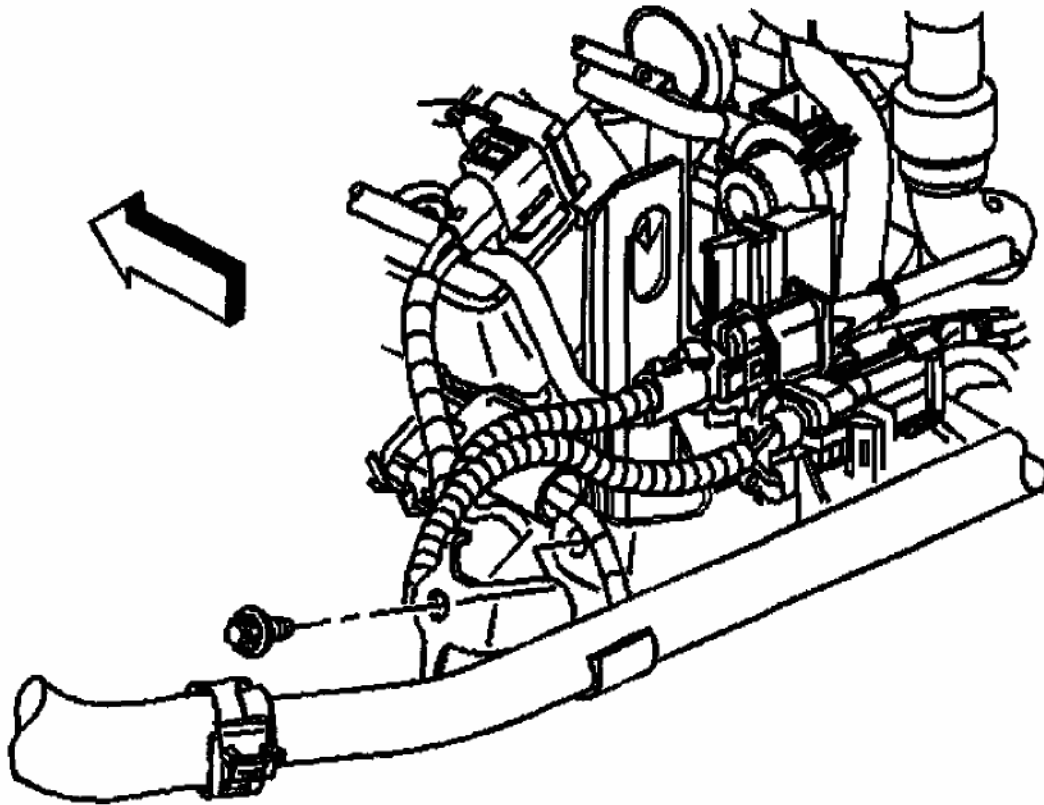
2. Position the *J 38185* to the clamp in order to remove the surge tank outlet hose (2) from the surge tank (1).



G02086556

Fig. 80: Removing Surge Tank Outlet Hose From Surge Tank
Courtesy of GENERAL MOTORS CORP.

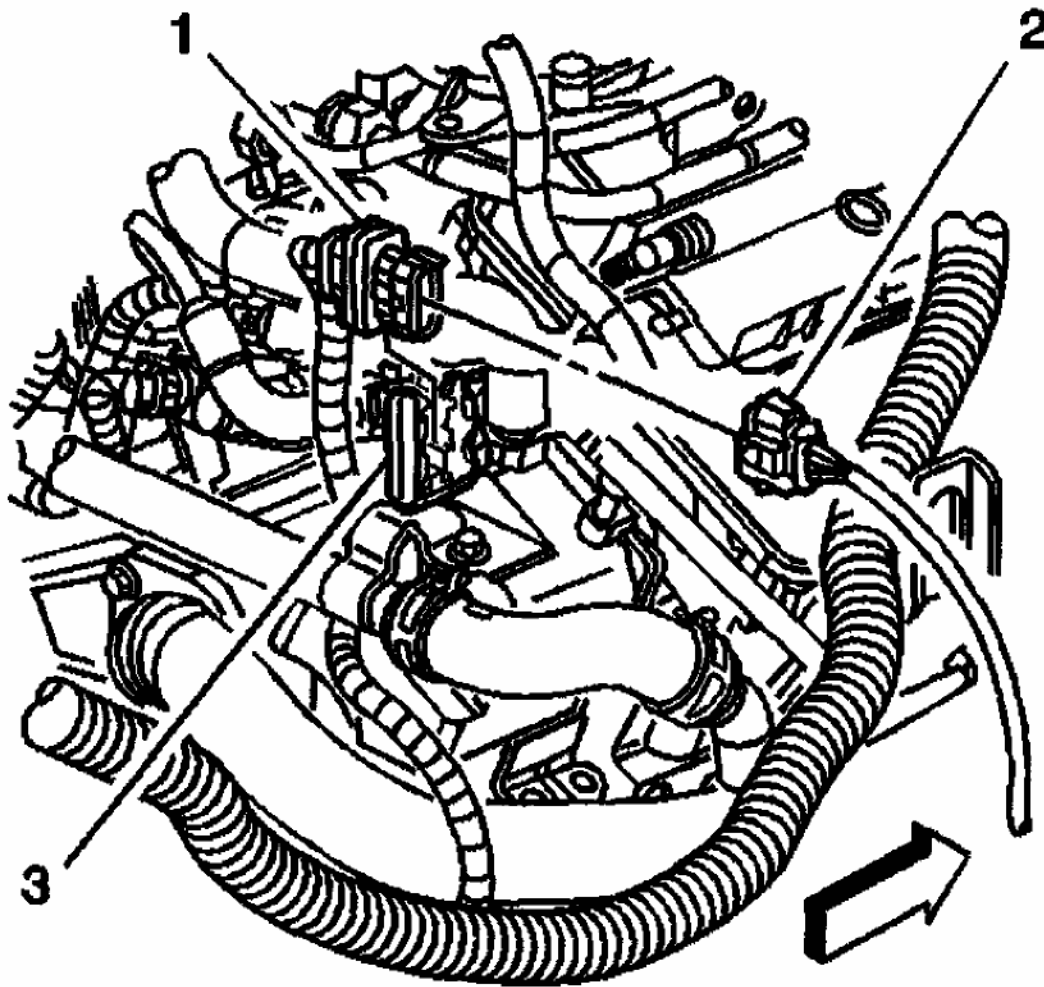
3. Remove the wiper motor module. Refer to WIPER MOTOR MODULE REPLACEMENT (LHD) or WIPER MOTOR MODULE REPLACEMENT (RHD) in Wipers/Washer Systems.
4. Remove the bolt securing the surge tank outlet pipe to the engine rear lift bracket.



G02086557

Fig. 81: Removing Surge Tank Outlet Pipe Mounting Bolt
Courtesy of GENERAL MOTORS CORP.

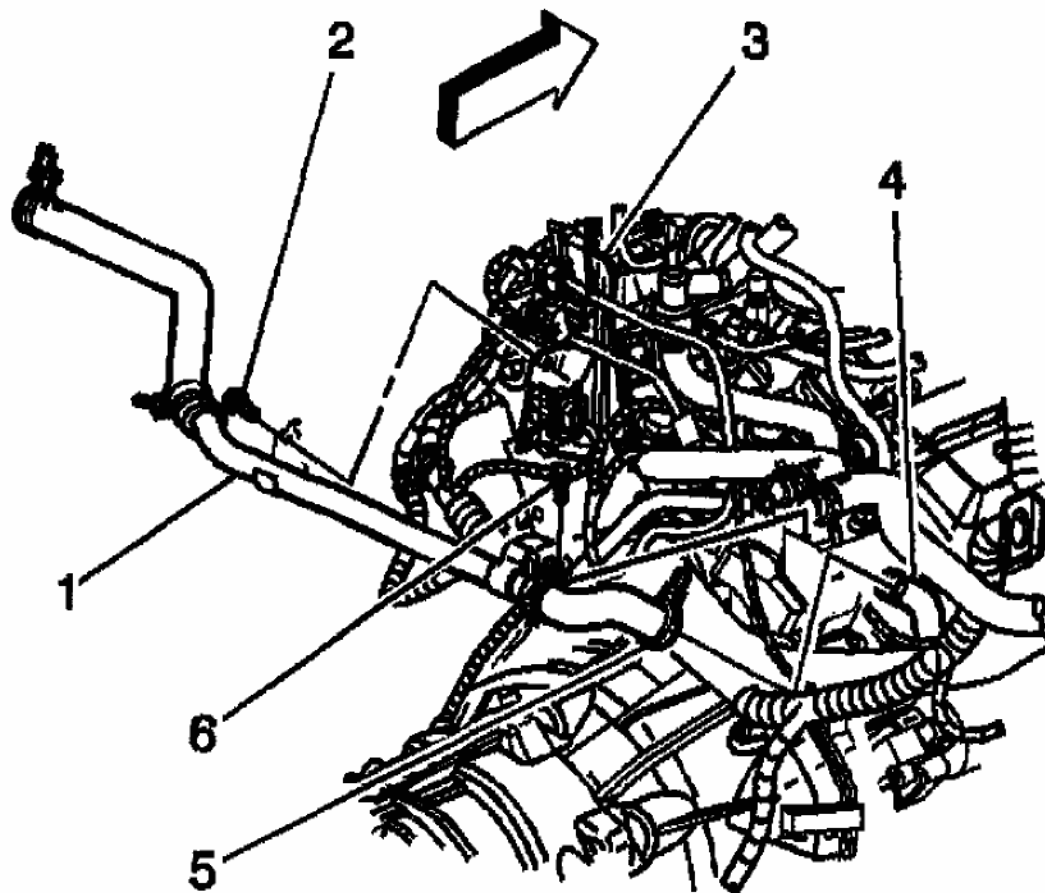
5. Disconnect the heated oxygen sensor connector (1) from the bracket (3).



G02086558

Fig. 82: Disconnecting Heated Oxygen Sensor Connector
Courtesy of GENERAL MOTORS CORP.

6. Remove the bolt (6) securing the surge tank outlet pipe (1) to the vent housing.
7. Position the *J 38185* to the clamp (5) in order to remove the surge tank outlet hose from the coolant inlet pipe (4).



G02086559

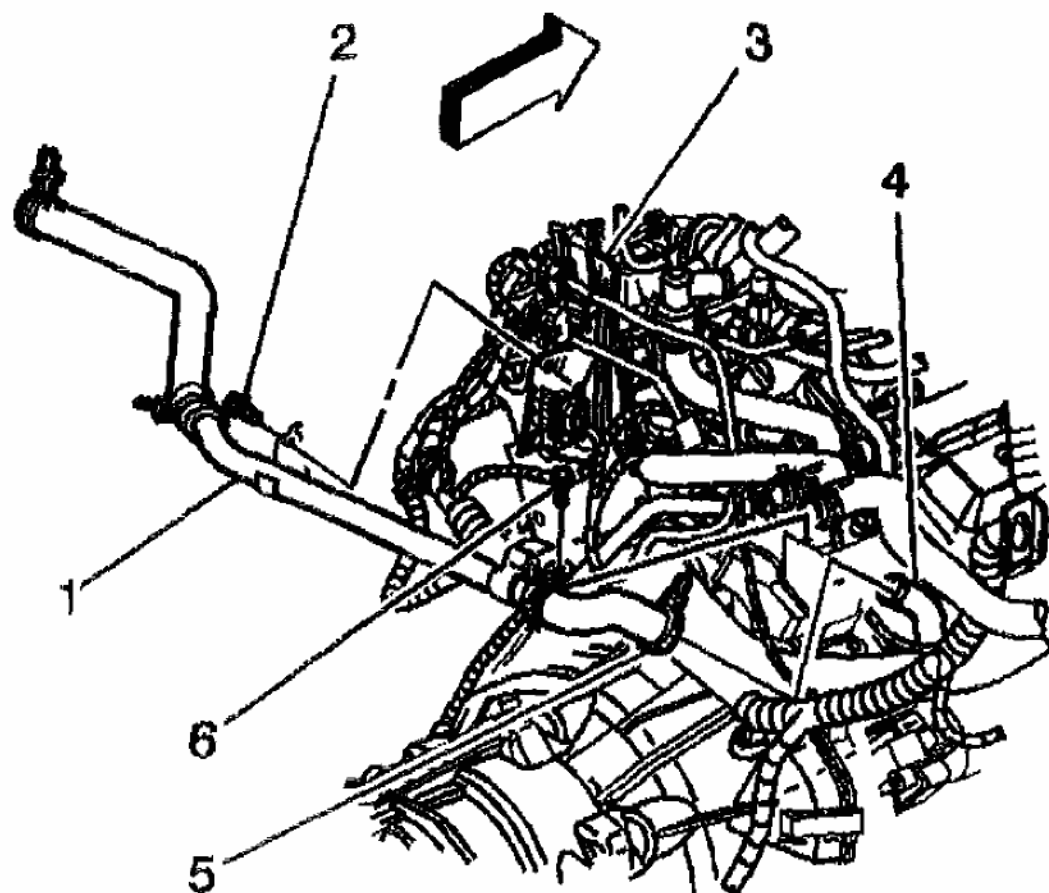
Fig. 83: Removing Surge Tank Outlet Hose From Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

8. Remove the surge tank outlet hose/pipe (1) from the engine.

Installation Procedure

1. Position the surge tank outlet hose/pipe (1) to the engine.
2. Position the *J 38185* to the clamp (5) in order to connect the surge tank outlet hose to the coolant inlet pipe (4).

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.



G02086560

Fig. 84: Connecting Surge Tank Outlet Hose To Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

3. Install the bolt (2) securing the surge tank outlet pipe (1) to the engine rear lift bracket.

Tighten

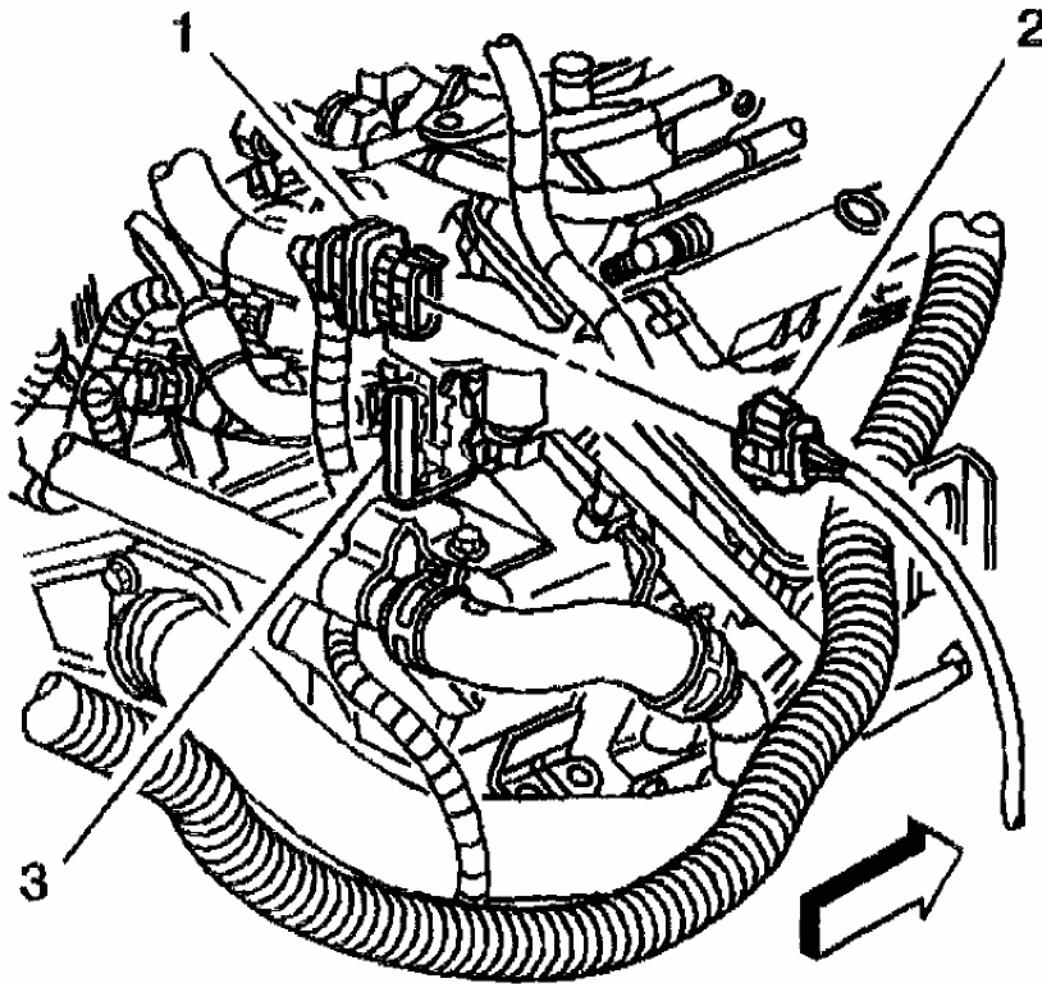
Tighten the surge tank outlet pipe to engine rear lift bracket bolt to 9 N.m (80 lb in).

4. Install the bolt (6) securing the surge tank outlet pipe (1) to the vent housing.

Tighten

Tighten the surge tank outlet pipe to vent housing bolt to 9 N.m (80 lb in).

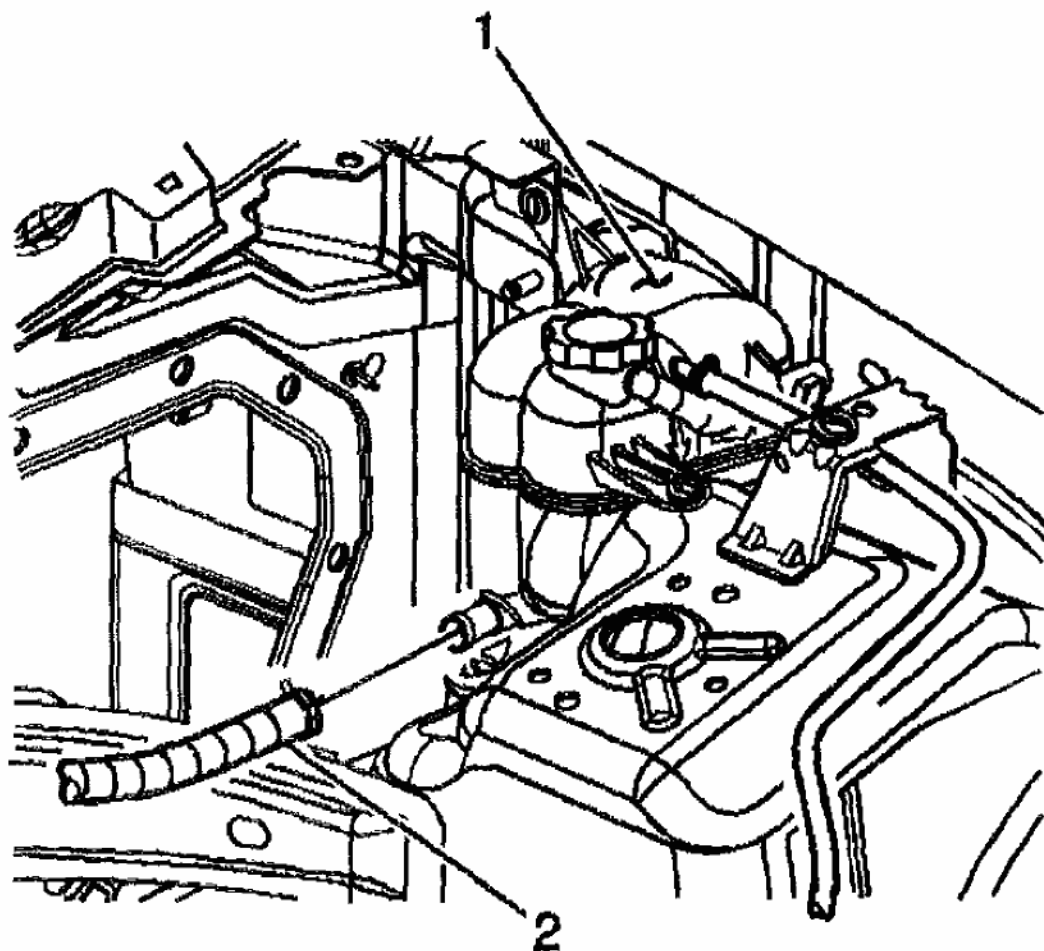
5. Connect the heated oxygen sensor connector (1) to the bracket (3).



G02086561

Fig. 85: Connecting Heated Oxygen Sensor Connector
Courtesy of GENERAL MOTORS CORP.

6. Position the *J 38185* to the clamp in order to connect the surge tank outlet hose (2) to the surge tank (1).



G02086562

Fig. 86: Connecting Surge Tank Outlet Hose To Surge Tank
Courtesy of GENERAL MOTORS CORP.

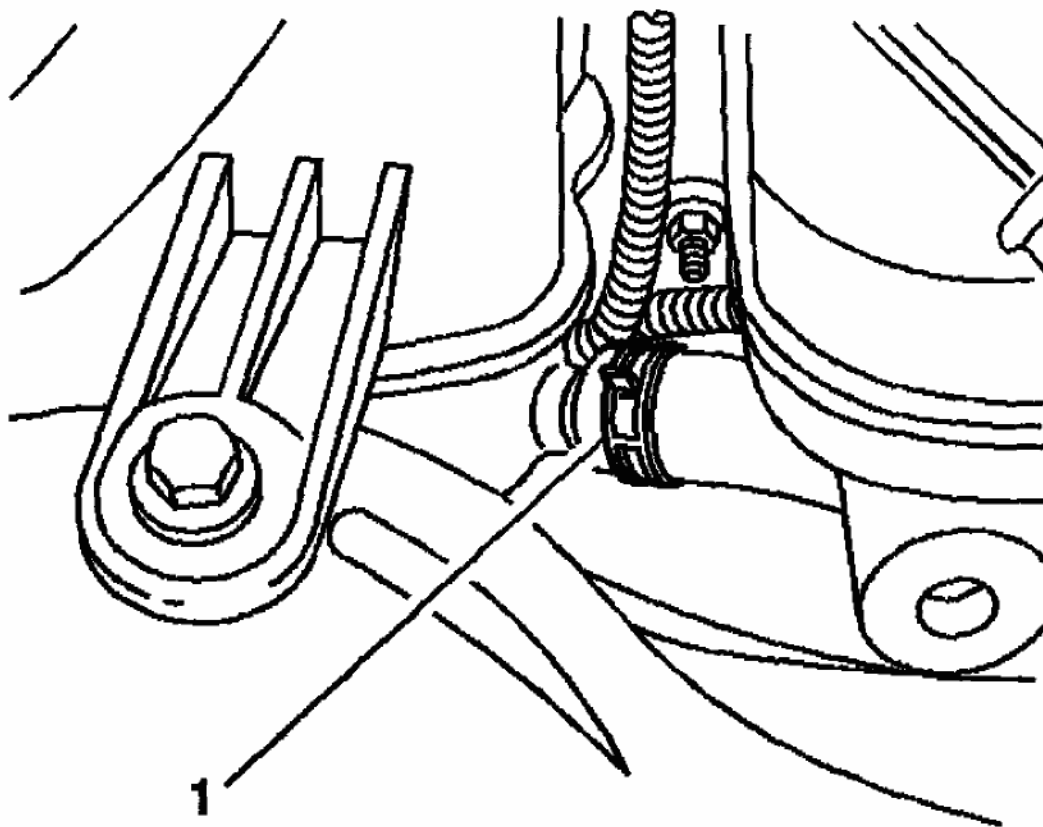
7. Install the wiper motor module. Refer to WIPER MOTOR MODULE REPLACEMENT (LHD) or WIPER MOTOR MODULE REPLACEMENT (RHD) in Wipers/Washer Systems.
8. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (RHD)

Tools Required

J 38185 Hose Clamp Pliers**Removal Procedure**

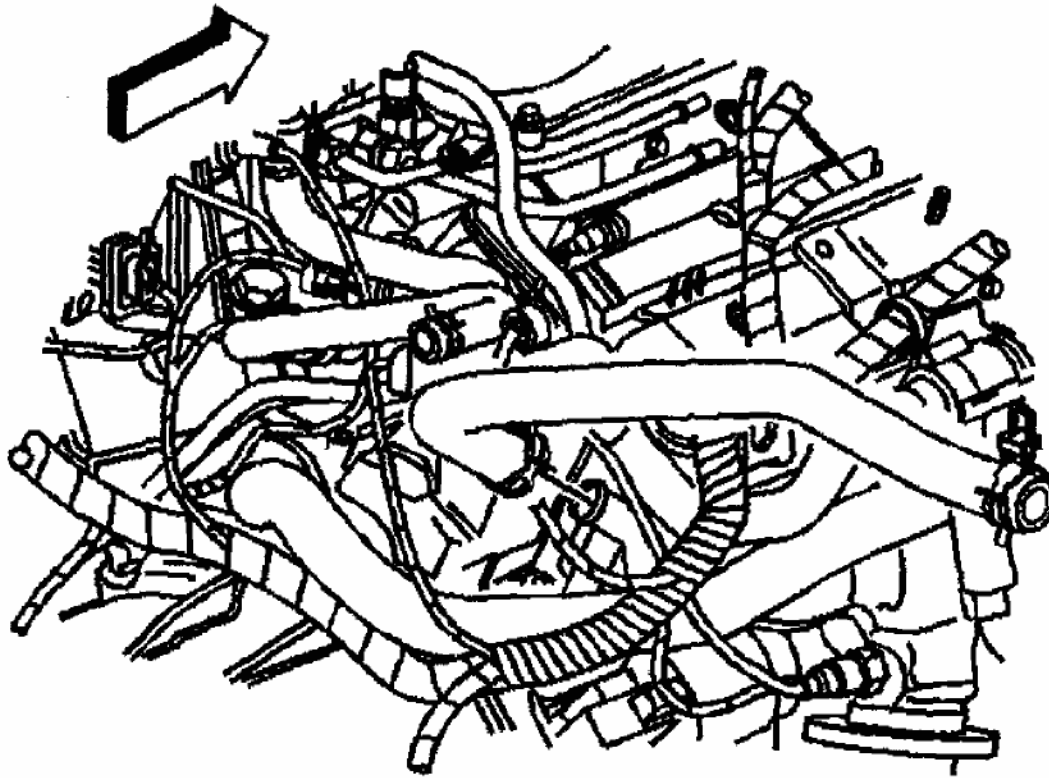
1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Position the *J 38185* to the clamp (1) in order to remove the surge tank outlet hose from the surge tank.



G02086563

Fig. 87: Identifying Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

3. Position the *J 38185* to the clamp in order to remove the surge tank outlet hose from the coolant inlet pipe.
4. Remove the surge tank outlet hose from vehicle.

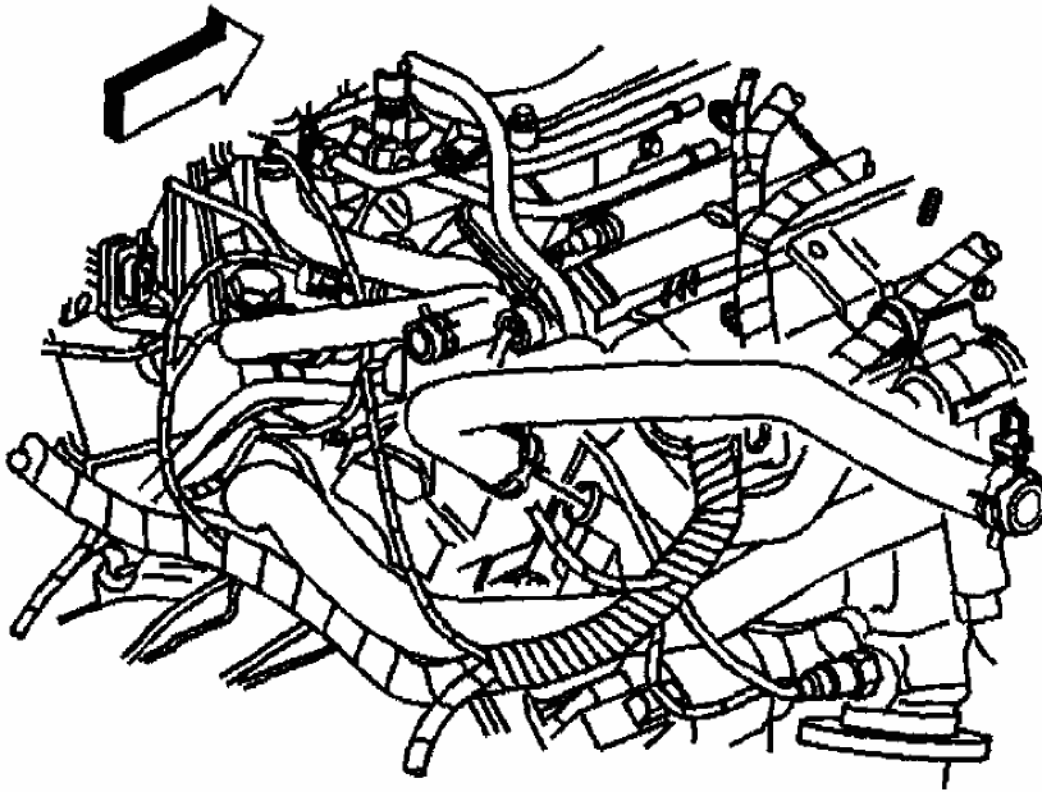


G02086564

Fig. 88: Removing Surge Tank Outlet Hose From Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

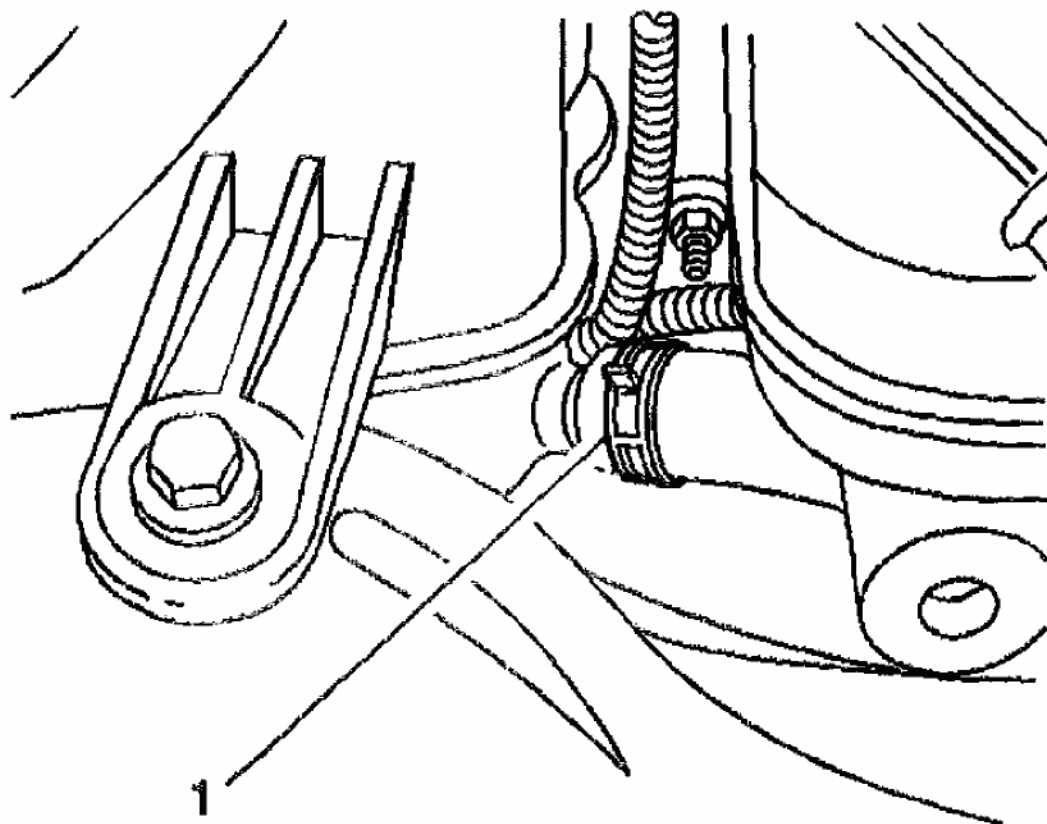
1. Position the **J 38185** to the clamp in order to connect the surge tank outlet hose to the coolant inlet pipe.



G02086565

Fig. 89: Connecting Surge Tank Outlet Hose To Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

2. Position the *J 38185* to the clamp (1) in order to connect the surge tank outlet hose to the surge tank.



G02086566

Fig. 90: Identifying Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

3. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

RADIATOR HOSE REPLACEMENT - INLET

Tools Required

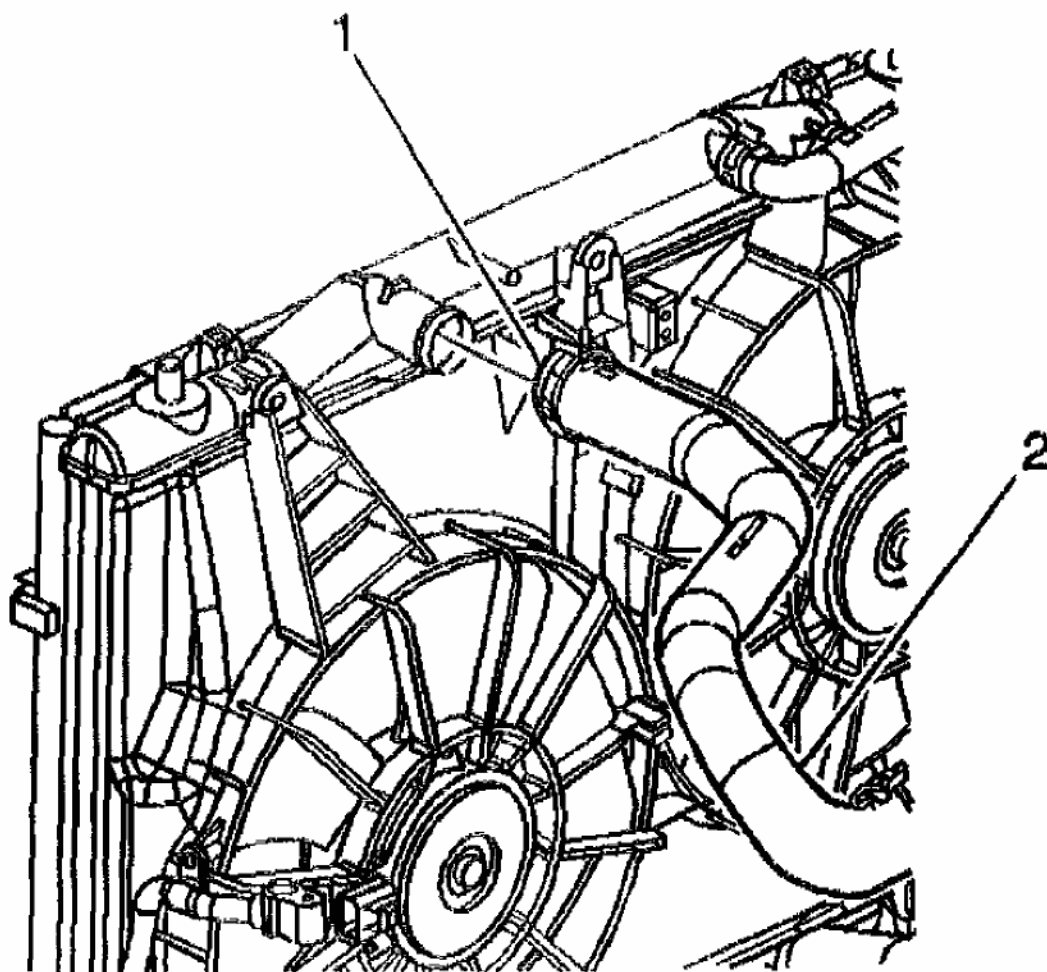
J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Position the *J 38185* to the clamp in order to remove the inlet radiator hose (1) from the

radiator.

3. Position the *J 38185* to the clamp in order to remove the inlet radiator hose (2) from the engine.
4. Remove the inlet radiator hose.



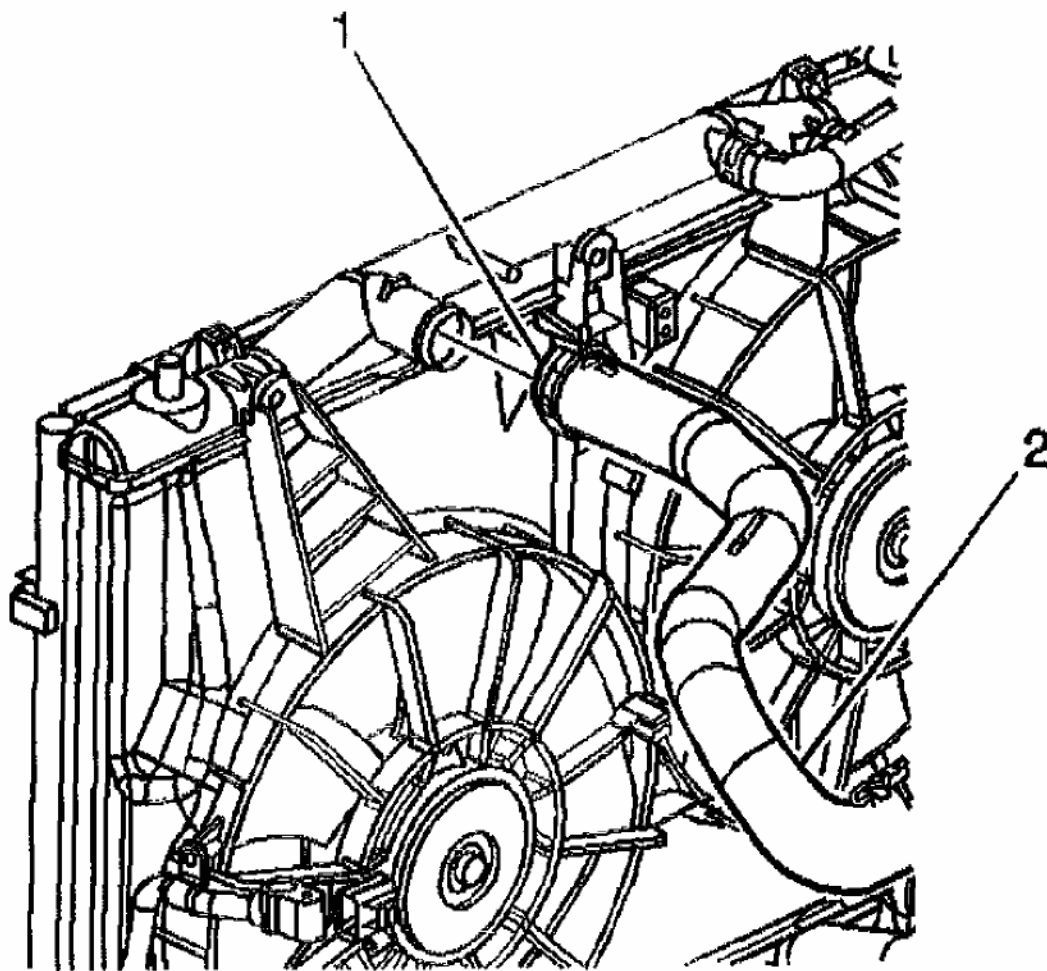
G02086567

Fig. 91: Removing Inlet Radiator Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the inlet radiator hose into the vehicle with the mark in the top position.

2. Position the *J 38185* to the clamp in order to connect the inlet radiator hose (2) to the engine.
3. Position the *J 37097-A* to the clamp in order to connect the inlet radiator hose (1) to the radiator.
4. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.



G02086568

Fig. 92: Connecting Inlet Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

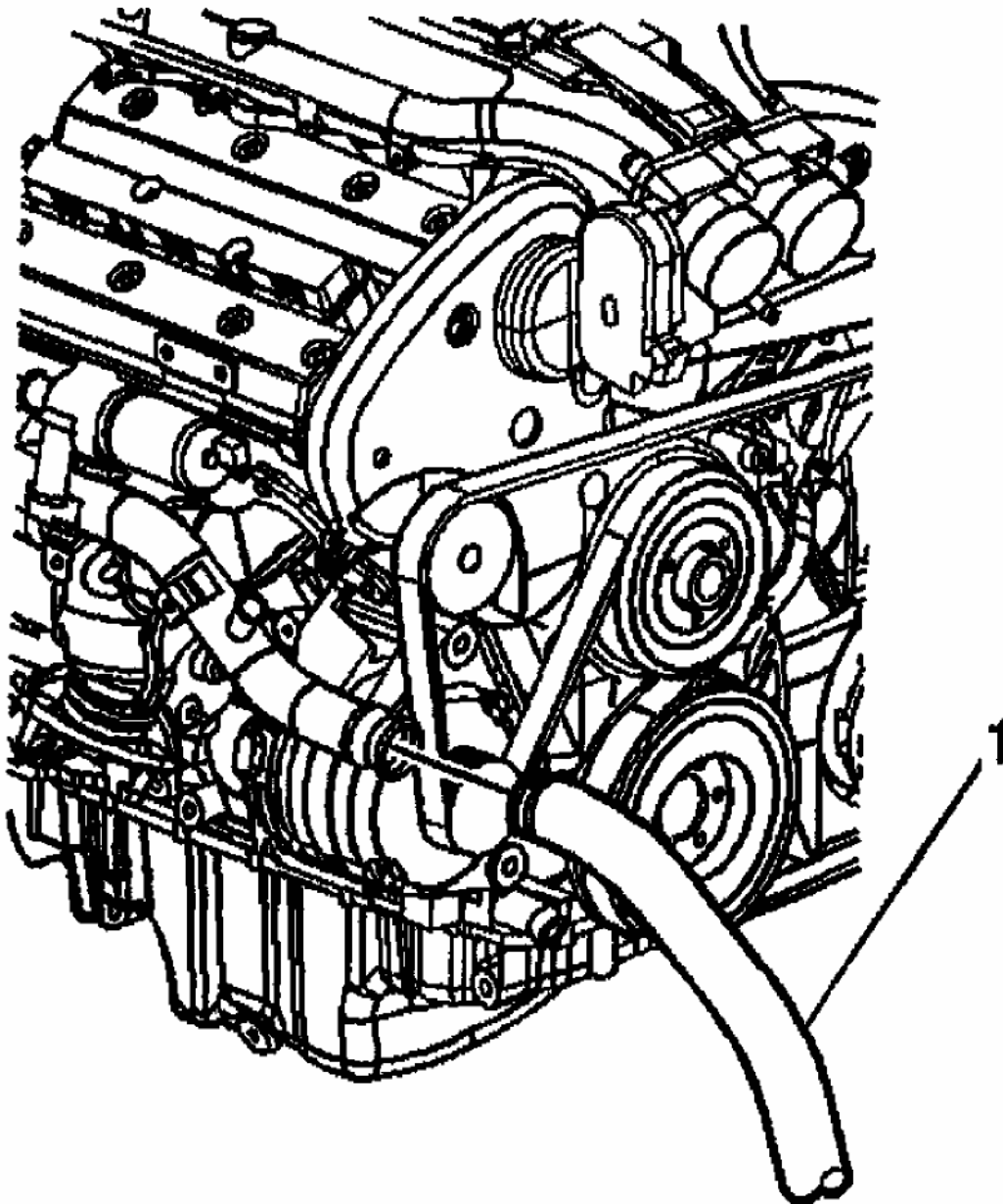
2003 ENGINE Engine Cooling - CTS

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Position the *J 38185* to the clamp in order to remove the outlet radiator hose (1) from the cooling pipe.



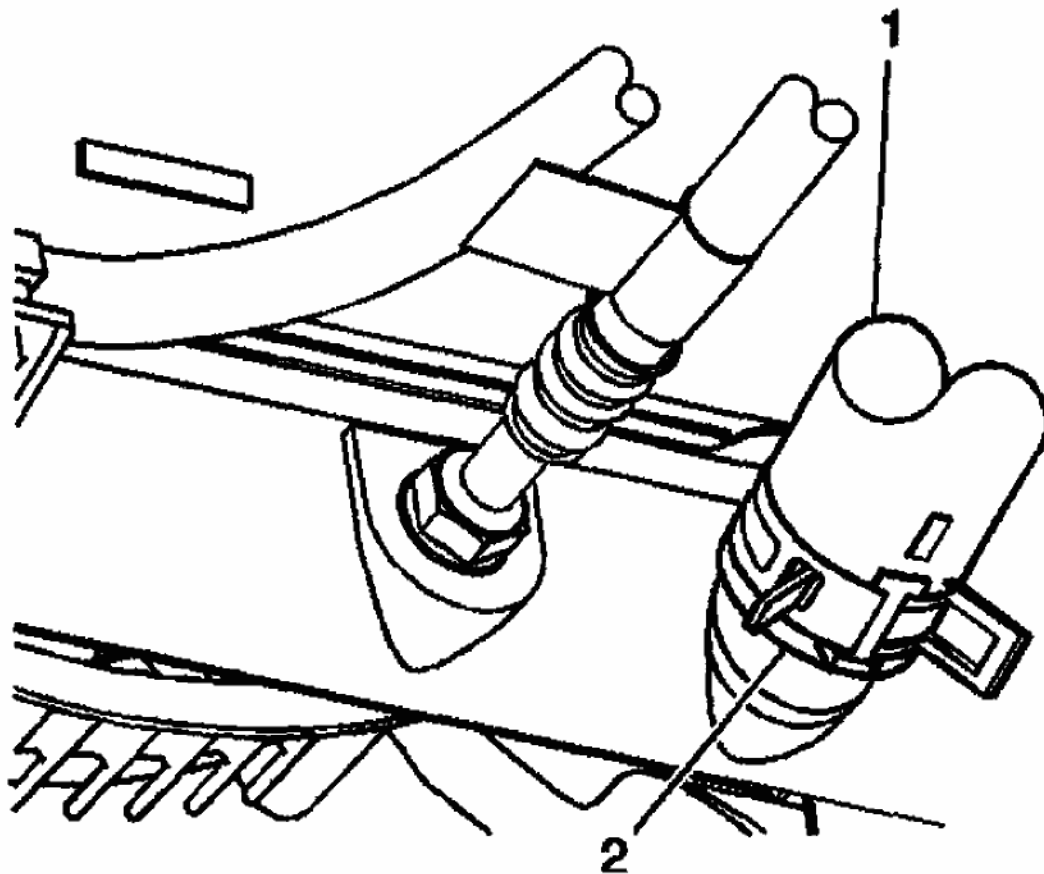
G02086569

Fig. 93: Removing Outlet Radiator Hose From Cooling Pipe
Courtesy of GENERAL MOTORS CORP.

3. Raise the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** in General

Information.

4. Position the *J 37097-A* to the clamp (2) in order to remove the outlet radiator hose (1) from the radiator.



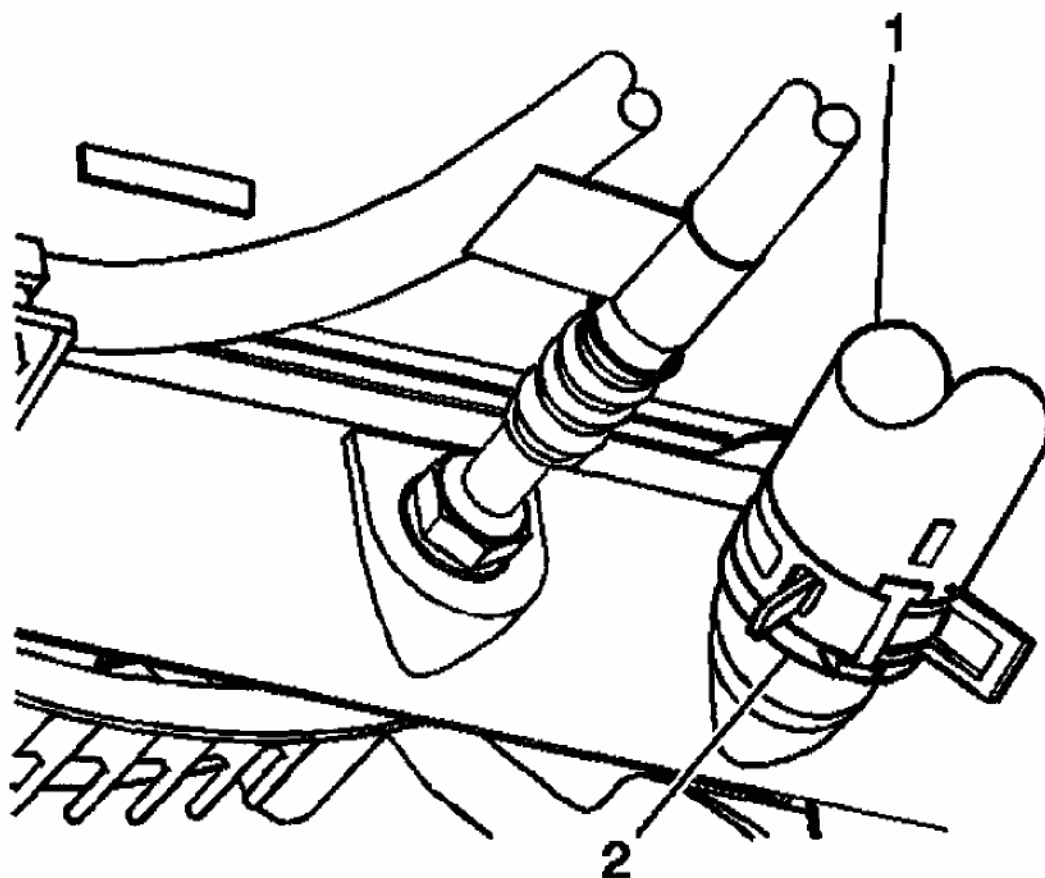
G02086570

Fig. 94: Removing Outlet Radiator Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

5. Remove the outlet radiator hose from the vehicle.

Installation Procedure

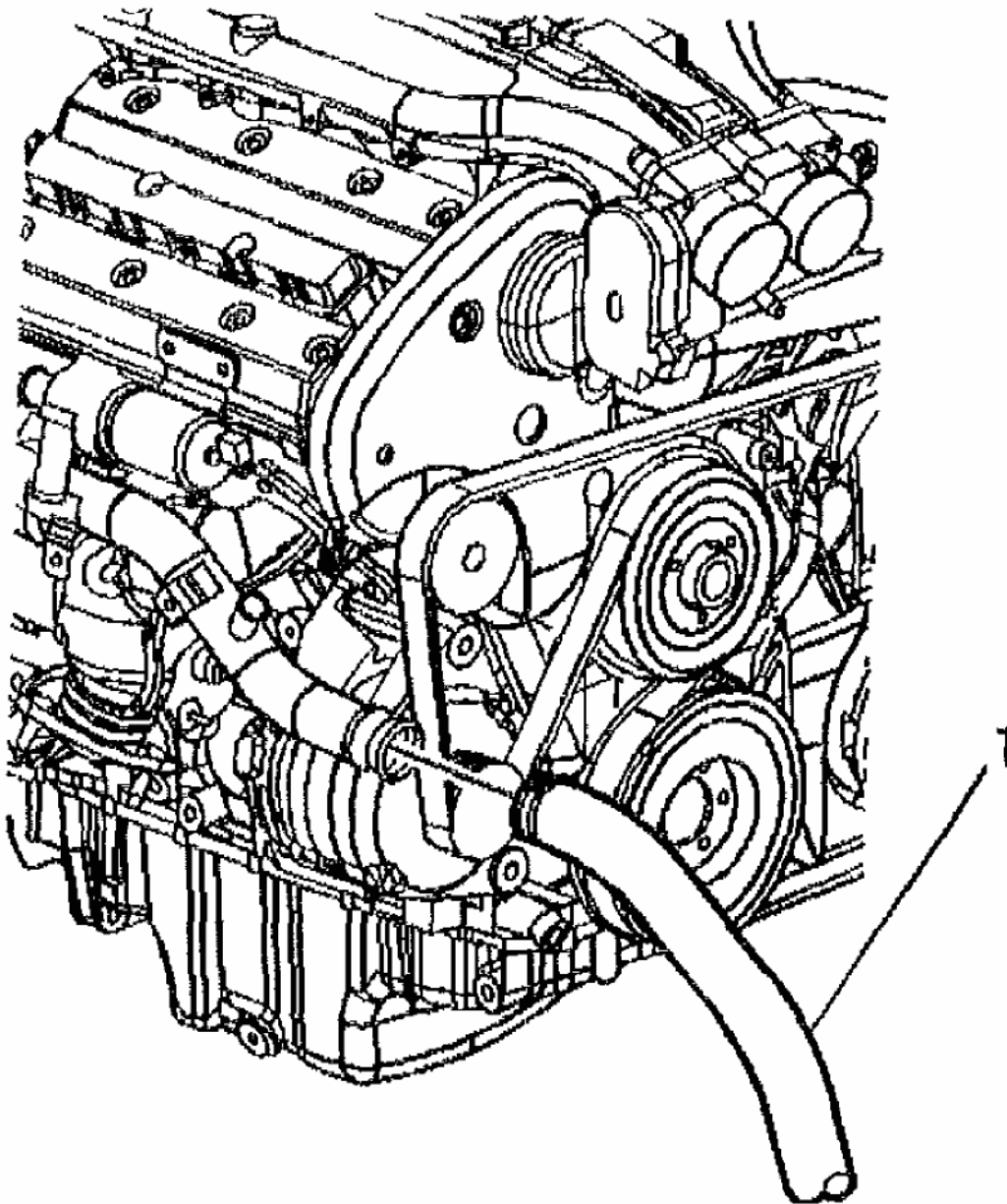
1. Position the radiator hose into the vehicle.
2. Position the *J 38185* to the clamp (2) in order to connect the outlet radiator hose (1) to the radiator.



G02086571

Fig. 95: Connecting Outlet Radiator Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

3. Install the air deflector. Refer to AIR DEFLECTOR REPLACEMENT - FRONT in Body Front End.
4. Position the *J 38185* to the clamp in order to connect the outlet radiator hose (1) to the cooling pipe.



G02086572

Fig. 96: Connecting Outlet Radiator Hose To Cooling Pipe
Courtesy of GENERAL MOTORS CORP.

5. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

THROTTLE BODY HEATER HOSE/PIPE REPLACEMENT - INLET

Removal Procedure

1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Disconnect the following from the remote power steering fluid reservoir (1):
 - The brake booster hose
 - The wiring harness (2)

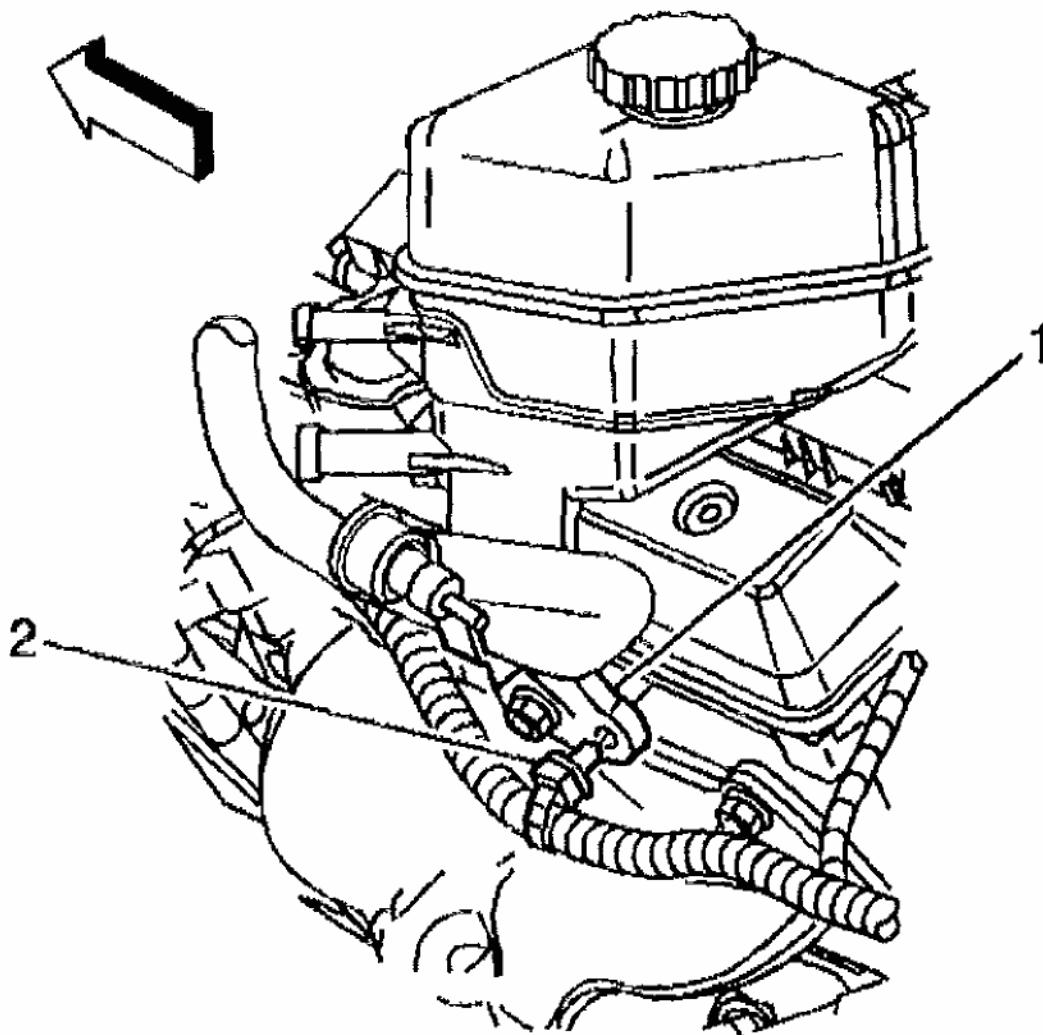
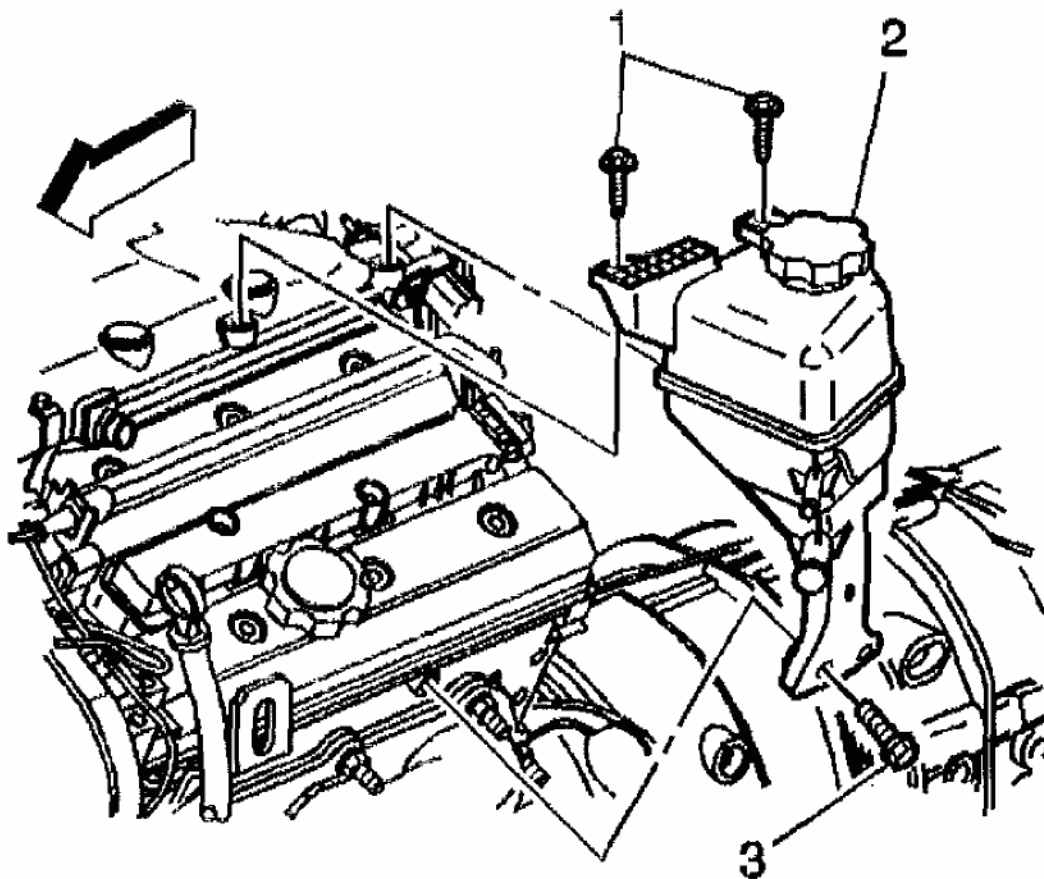


Fig. 97: Disconnecting Brake Booster Hose & Wiring Harness From Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Remove the remote power steering fluid reservoir mounting bolts (1, 3) ONLY, and position aside.
4. Remove the wiper motor module in order to gain access to the rear of the throttle body heater inlet hose. Refer to WIPER MOTOR MODULE REPLACEMENT (LHD) or WIPER MOTOR MODULE REPLACEMENT (RHD) in Wipers/Washer Systems.

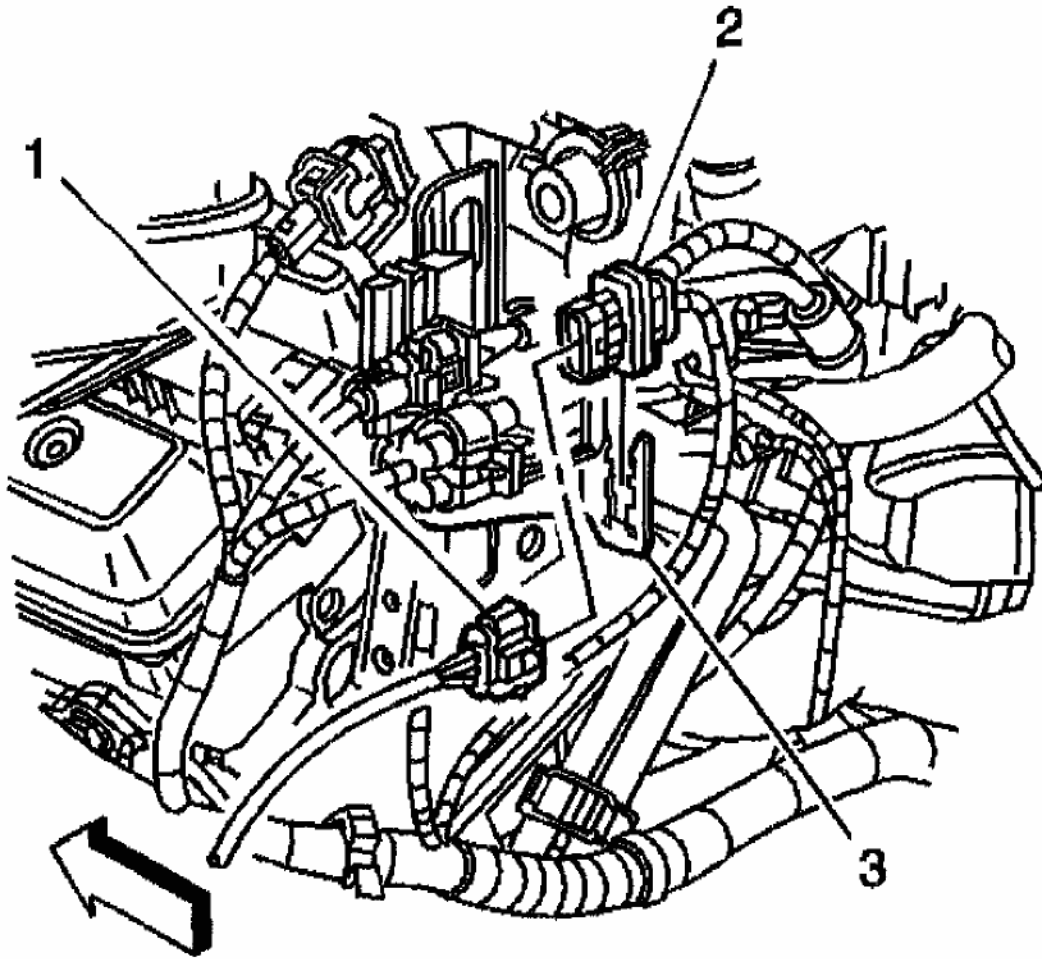


G02086574

Fig. 98: Removing Remote Power Steering Fluid Reservoir Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the heated oxygen sensor connector (2) from the rear of the throttle body heater inlet hose/pipe (3).

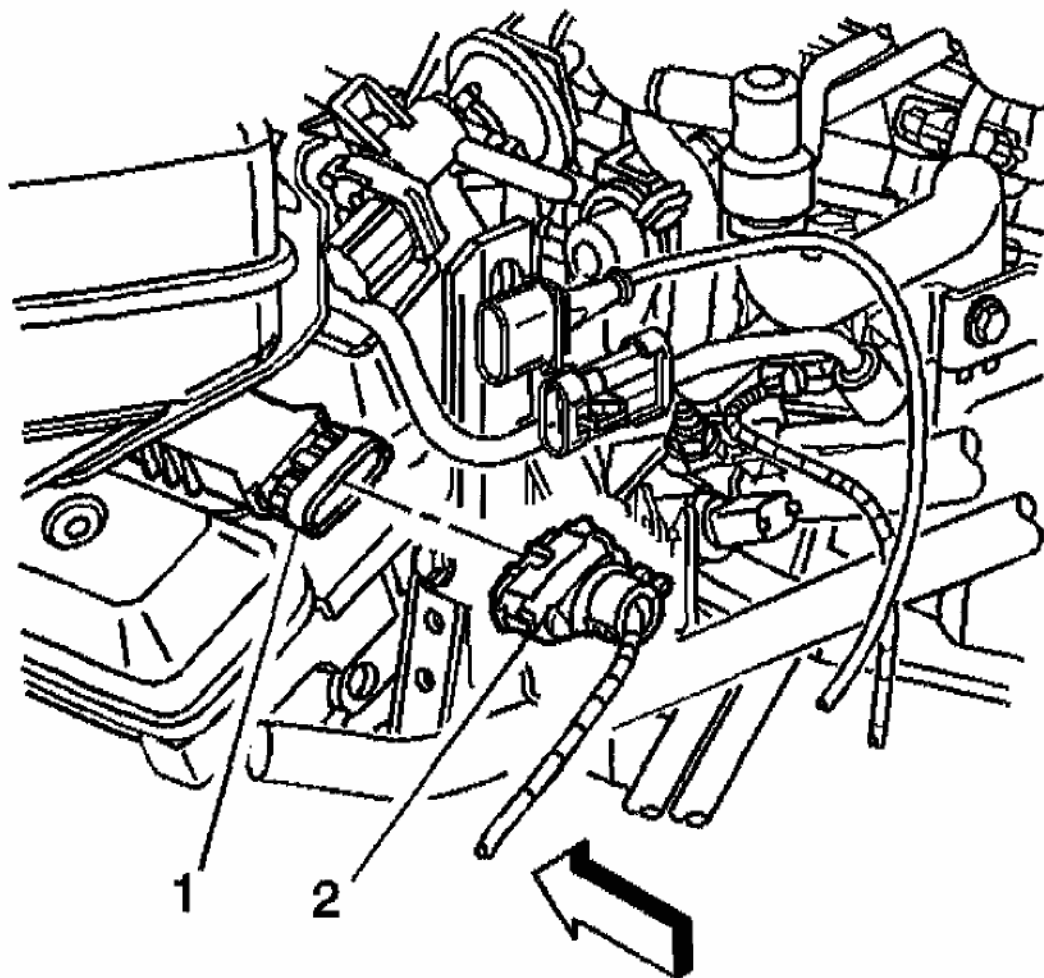
6. Disconnect the throttle body heater inlet hose from the water crossover, using 90° needlenose pliers.



G02086575

Fig. 99: Disconnecting Heated Oxygen Sensor Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the electrical connector (2) from the coil pack (1).



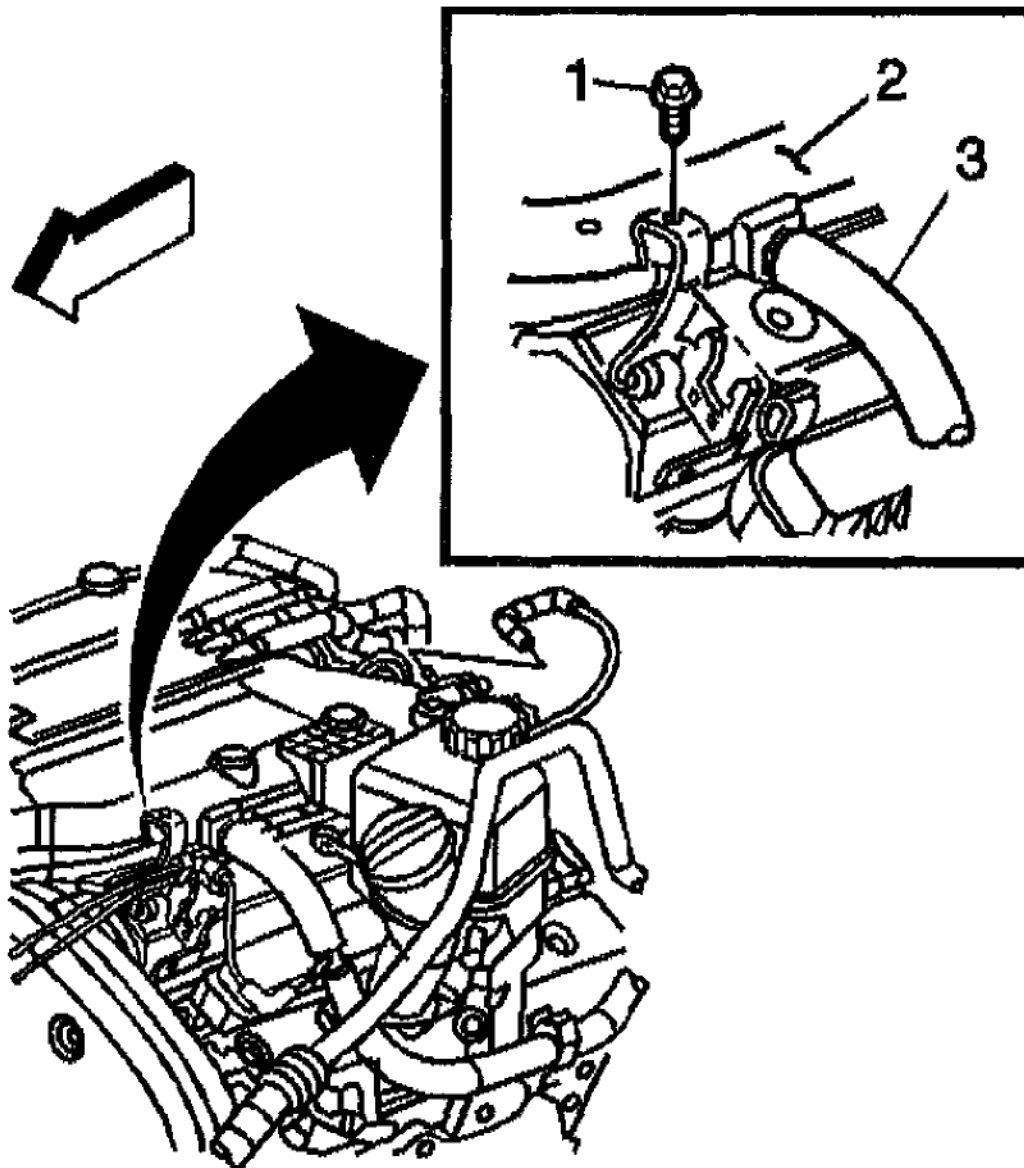
G02086576

Fig. 100: Disconnecting Electrical Connector From Coil Pack
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the following from the front of the throttle body heater inlet hose/pipe:
 - The camshaft position (CMP) sensor connector
 - The left knock sensor connector
 - The vacuum pipe retainer
9. Disconnect the vacuum brake booster hose (3) from the vacuum source.
10. Remove the bolts securing the throttle body heater inlet hose/pipe to the following:
 - The intake plenum (2)

- The engine rear lift bracket

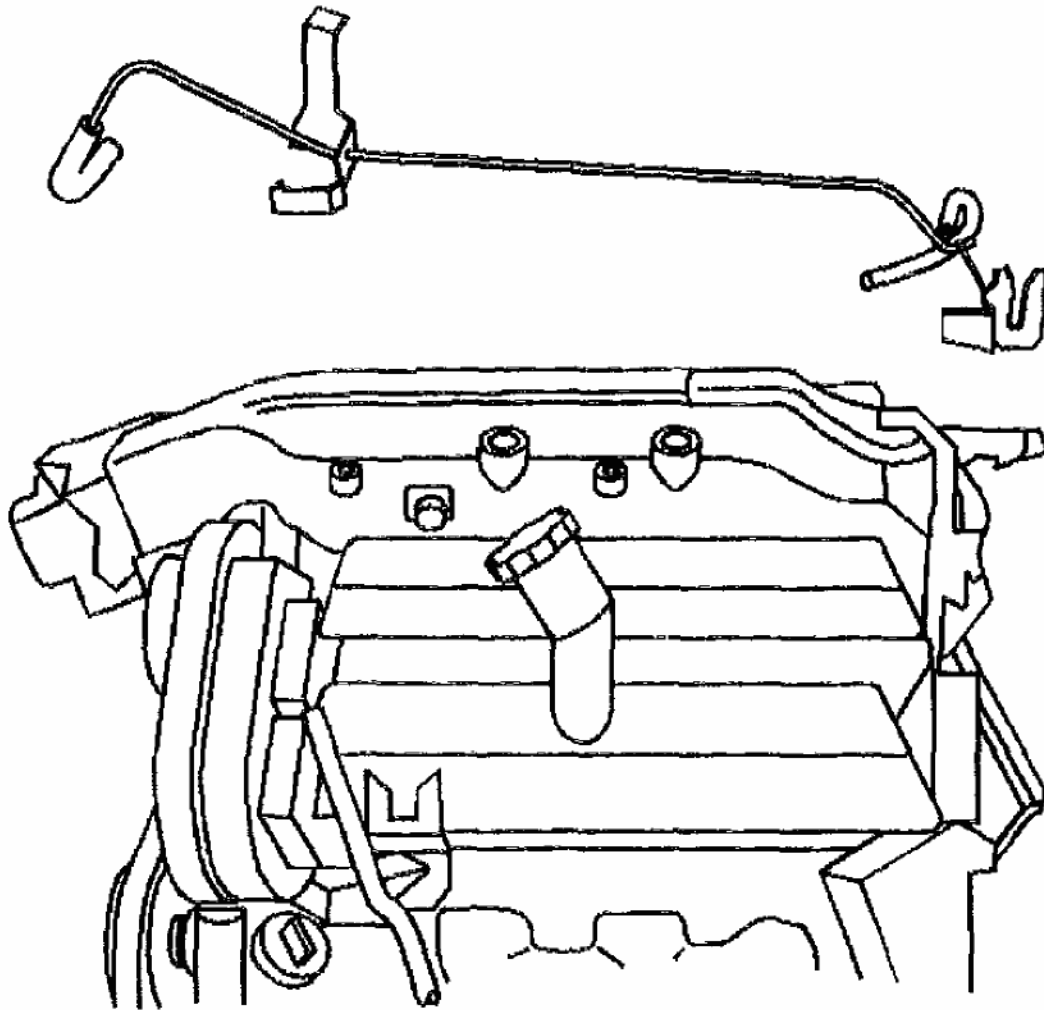
11. Disconnect the throttle body heater inlet hose from the throttle body.



G02086577

Fig. 101: Disconnecting Vacuum Brake Booster Hose From Vacuum Source
Courtesy of GENERAL MOTORS CORP.

12. Remove the throttle body heater inlet hose/pipe from the engine.

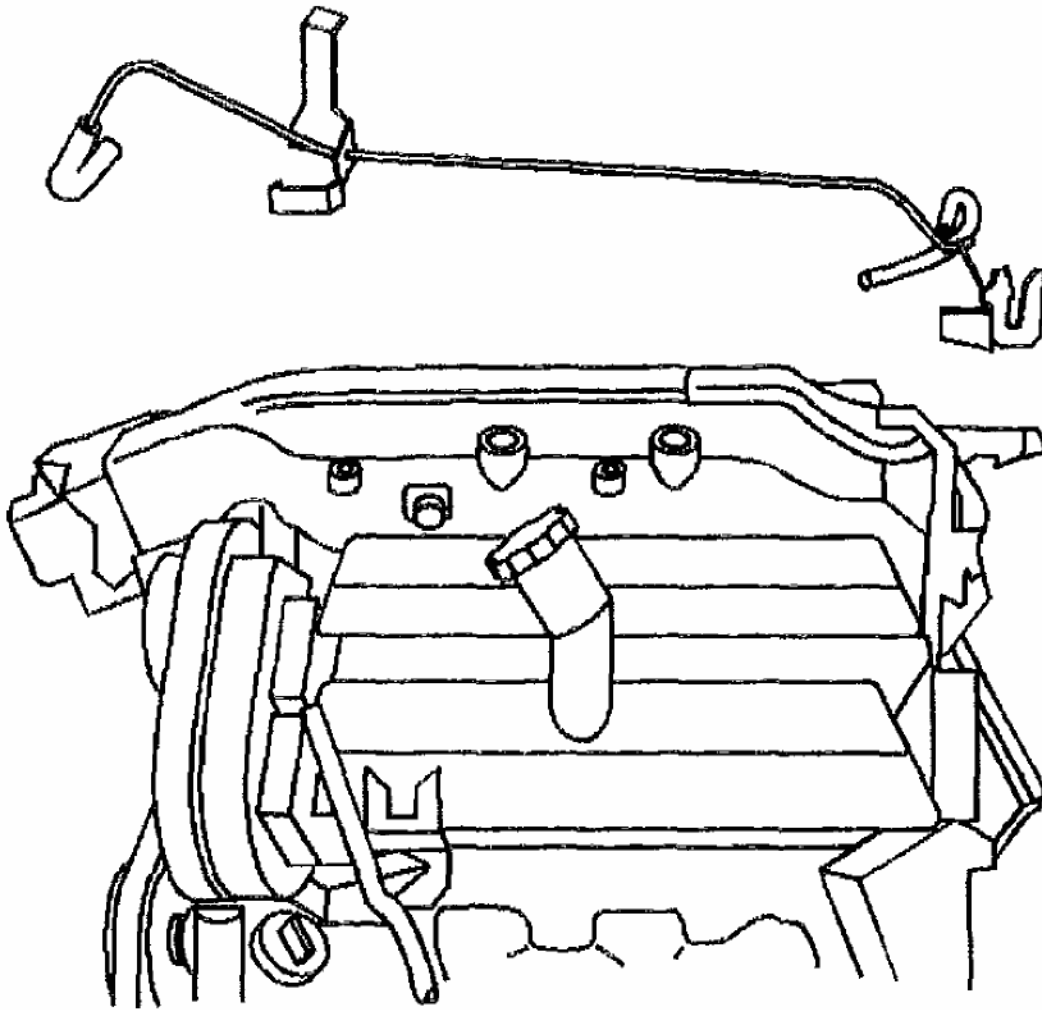


G02086578

Fig. 102: Removing Throttle Body Heater Inlet Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Position the throttle body heater inlet hose/pipe to the engine.
2. Connect the throttle body heater inlet hose to the throttle body.



G02086579

Fig. 103: Connecting Throttle Body Heater Inlet Hose To Throttle Body
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

3. Install the bolts securing the throttle body heater inlet hose/pipe to the following:
 - The intake plenum (2)
 - The engine rear lift bracket

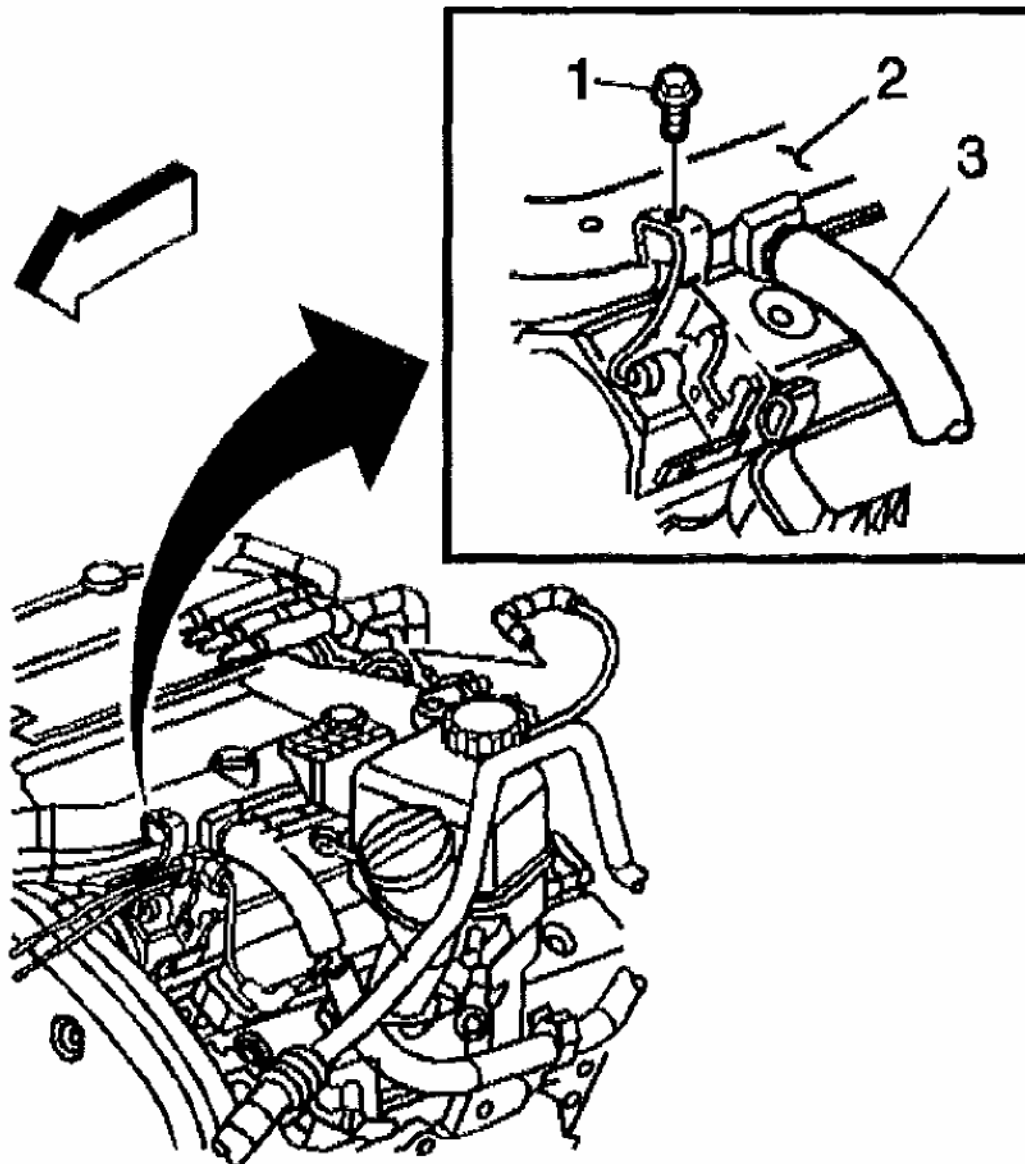
Tighten

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Tighten the throttle body heater inlet hose/pipe bolts to 9 N.m (80 lb in).

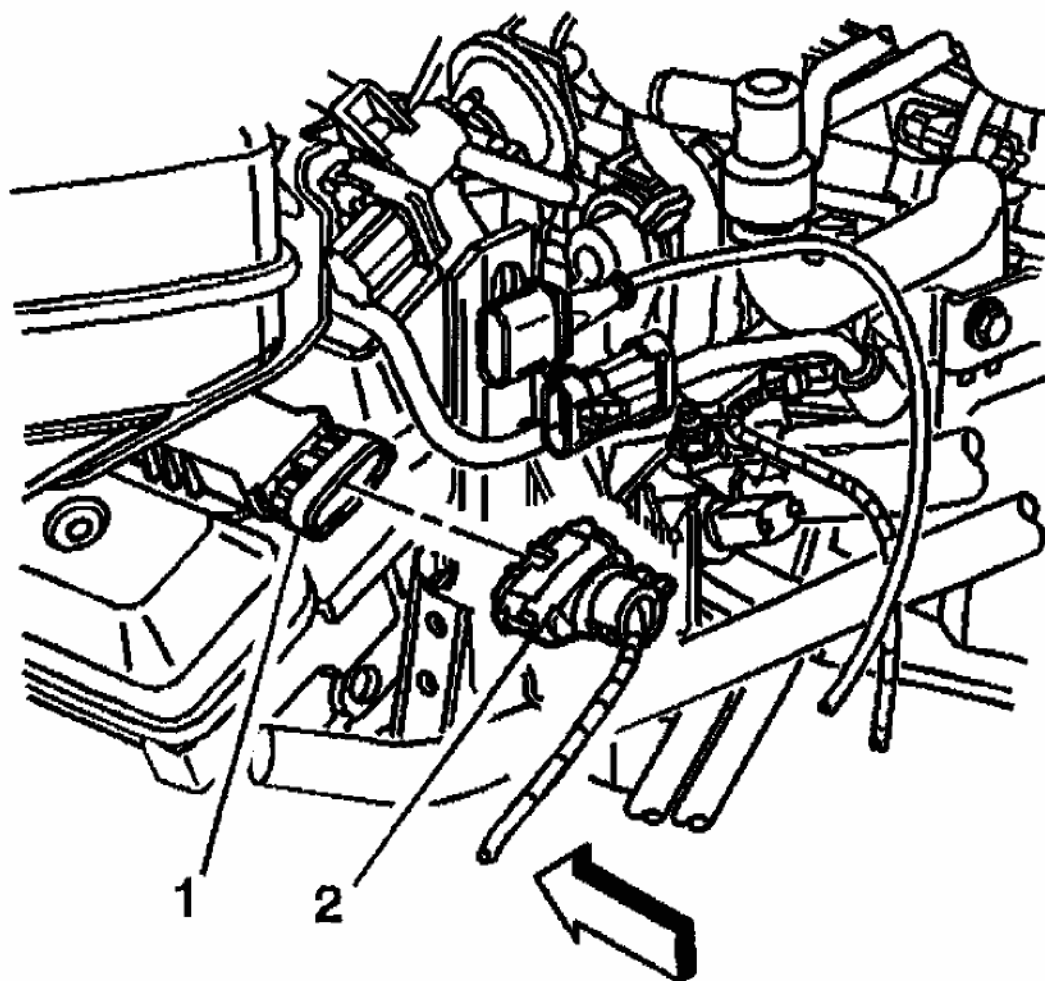
4. Connect the vacuum brake booster hose (3) to the vacuum source.
5. Connect the following to the front of the throttle body heater inlet hose/pipe:
 - The CMP sensor connector
 - The left knock sensor connector
 - The vacuum pipe retainer



G02086580

Fig. 104: Connecting Vacuum Brake Booster Hose To Vacuum Source
Courtesy of GENERAL MOTORS CORP.

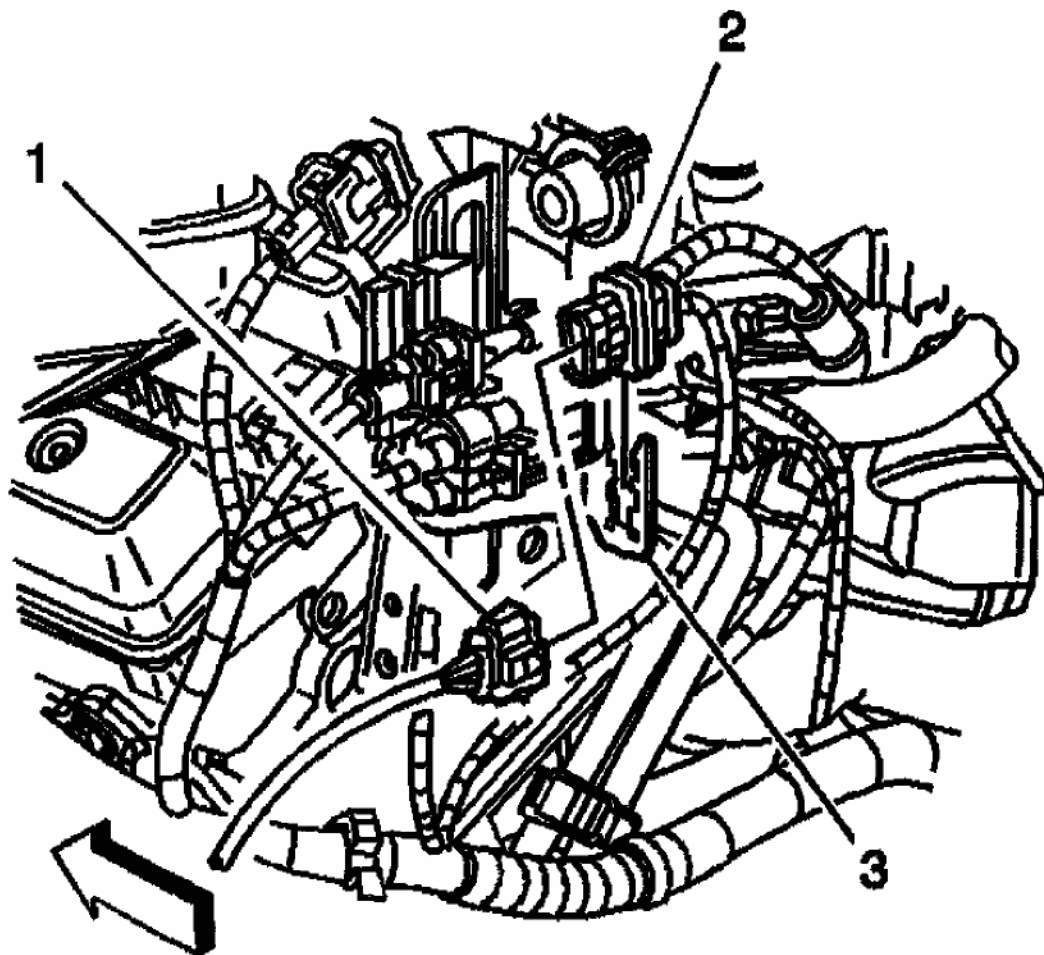
6. Connect the electrical connector (2) to the coil pack (1).



G02086581

Fig. 105: Connecting Electrical Connector To Coil Pack
Courtesy of GENERAL MOTORS CORP.

7. Connect the throttle body heater inlet hose to the water crossover, using 90° needlenose pliers.
8. Connect the heated oxygen sensor connector (2) to the rear of the throttle body heater inlet hose/pipe (3).



G02086582

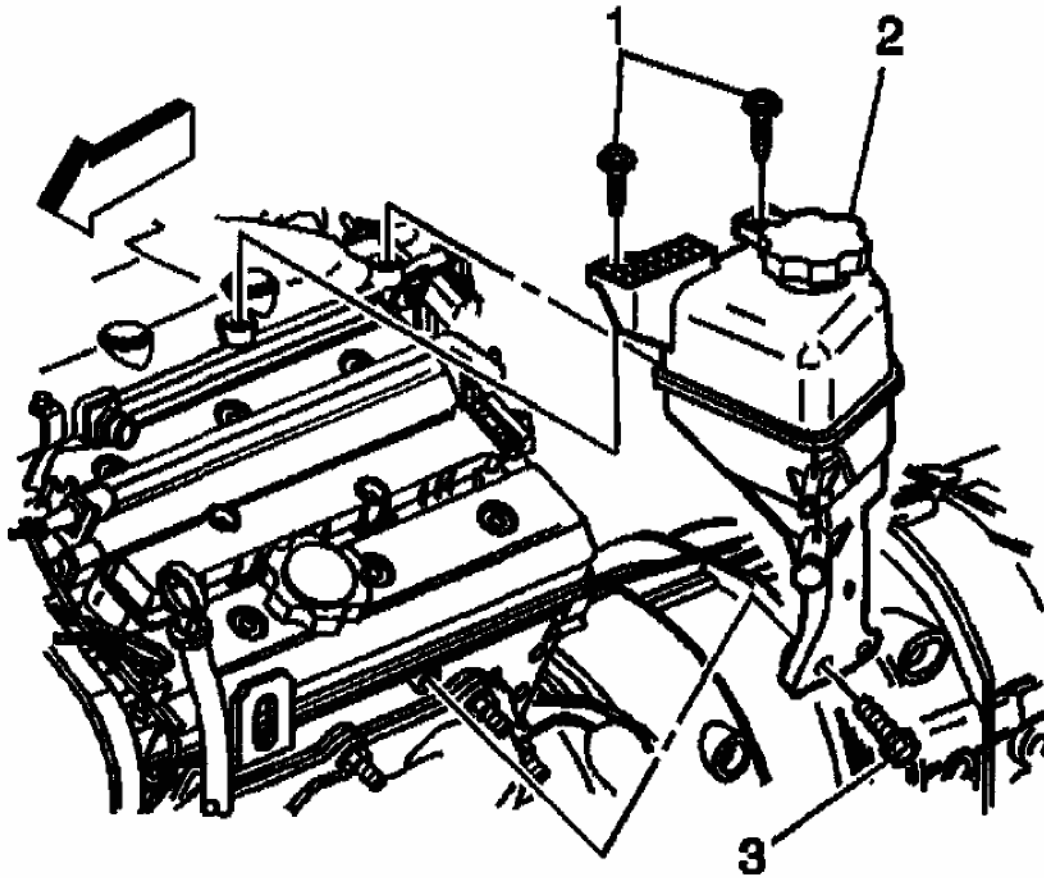
Fig. 106: Connecting Heated Oxygen Sensor Connector
Courtesy of GENERAL MOTORS CORP.

9. Install the wiper motor module. Refer to WIPER MOTOR MODULE REPLACEMENT (LHD) or WIPER MOTOR MODULE REPLACEMENT (RHD) in Wipers/Washer Systems.
10. Install the remote power steering fluid reservoir mounting bolts (1, 3).

Tighten

- Tighten the remote power steering fluid reservoir to intake plenum mounting bolts to 9 N.m (80 lb in).

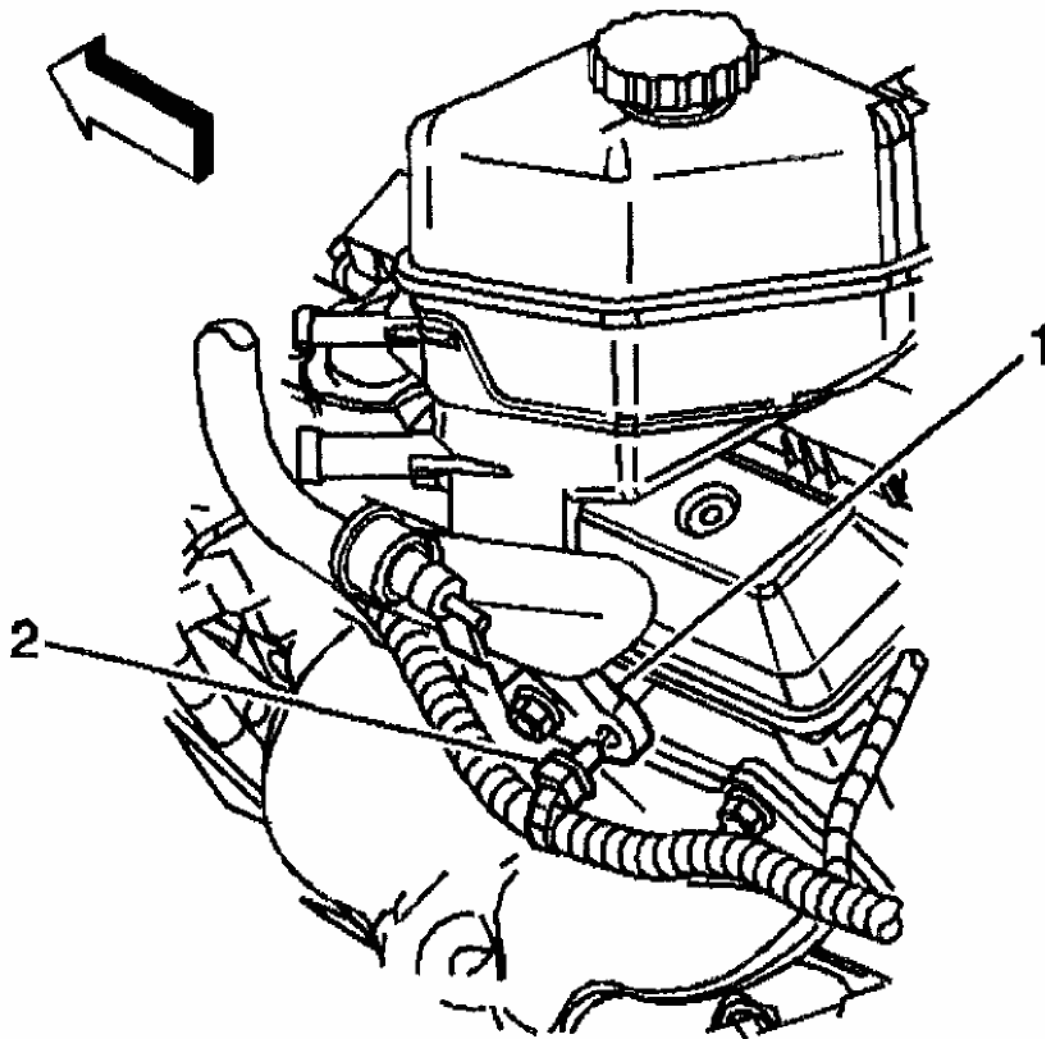
- Tighten the remote power steering fluid reservoir to cylinder head mounting bolt to 25 N.m (18 lb ft).



G02086583

Fig. 107: Installing Remote Power Steering Fluid Reservoir Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

11. Connect the following to the remote power steering fluid reservoir (1):
 - The brake booster hose
 - The wiring harness (2)



G02086584

Fig. 108: Connecting Brake Booster Hose & Wiring Harness To Reservoir
Courtesy of GENERAL MOTORS CORP.

12. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

COOLING FAN REPLACEMENT - ELECTRIC

Tools Required

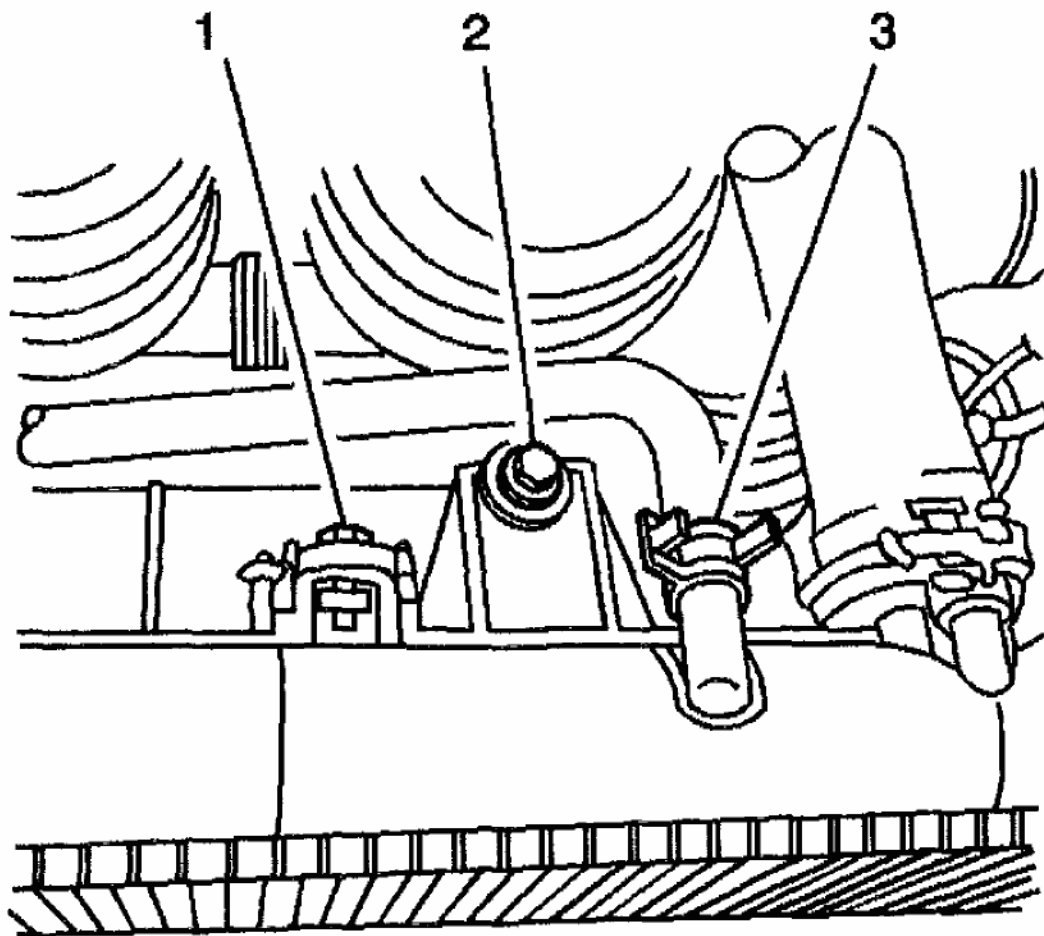
J 38185 Hose Clamp Pliers

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.

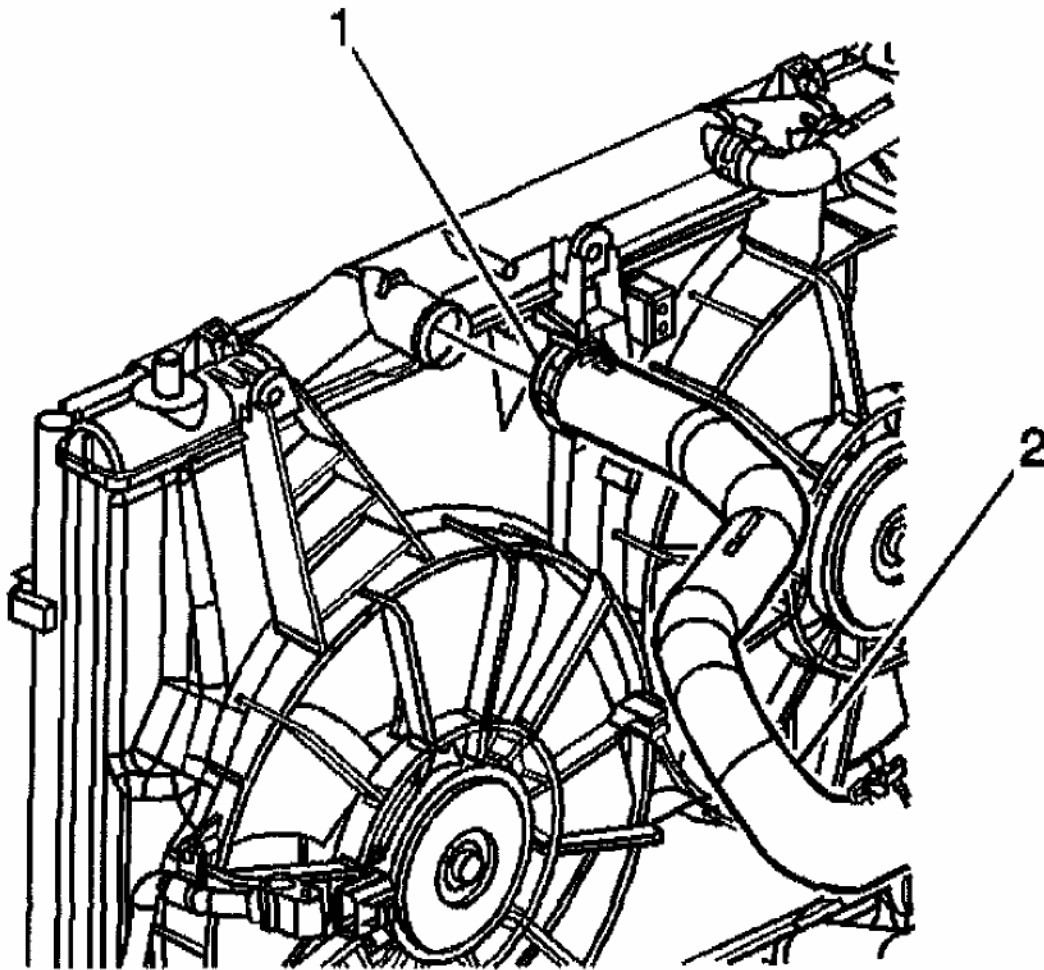
1. Disconnect the battery negative cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Battery.
2. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
3. Disconnect the surge tank hose (3).
4. Remove the fan shroud to radiator bolt (1).
5. Remove the fan shroud to air plenum bolt (2).
6. Remove remaining fan shroud to radiator bolts.



G02086585

Fig. 109: Removing Fan Shroud Bolts & Disconnecting Surge Tank Hose
Courtesy of GENERAL MOTORS CORP.

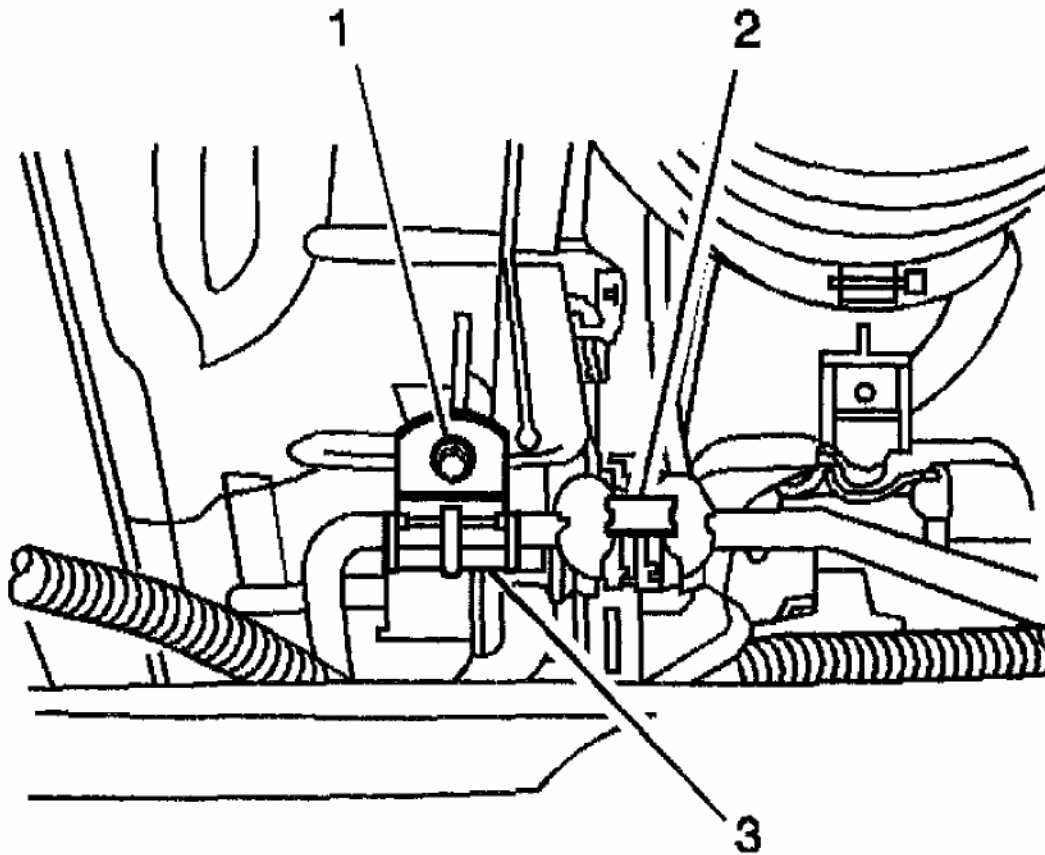
7. Using the *J 38185* disconnect the upper radiator hose at the radiator (1).
8. Remove the coolant bypass valve bolt.
9. Reposition the coolant bypass valve.
10. Release the coolant bypass solenoid from the fan shroud.
11. Remove the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY** in Removal & Installation.



G02086586

Fig. 110: Disconnecting Upper Radiator Hose At Radiator
Courtesy of GENERAL MOTORS CORP.

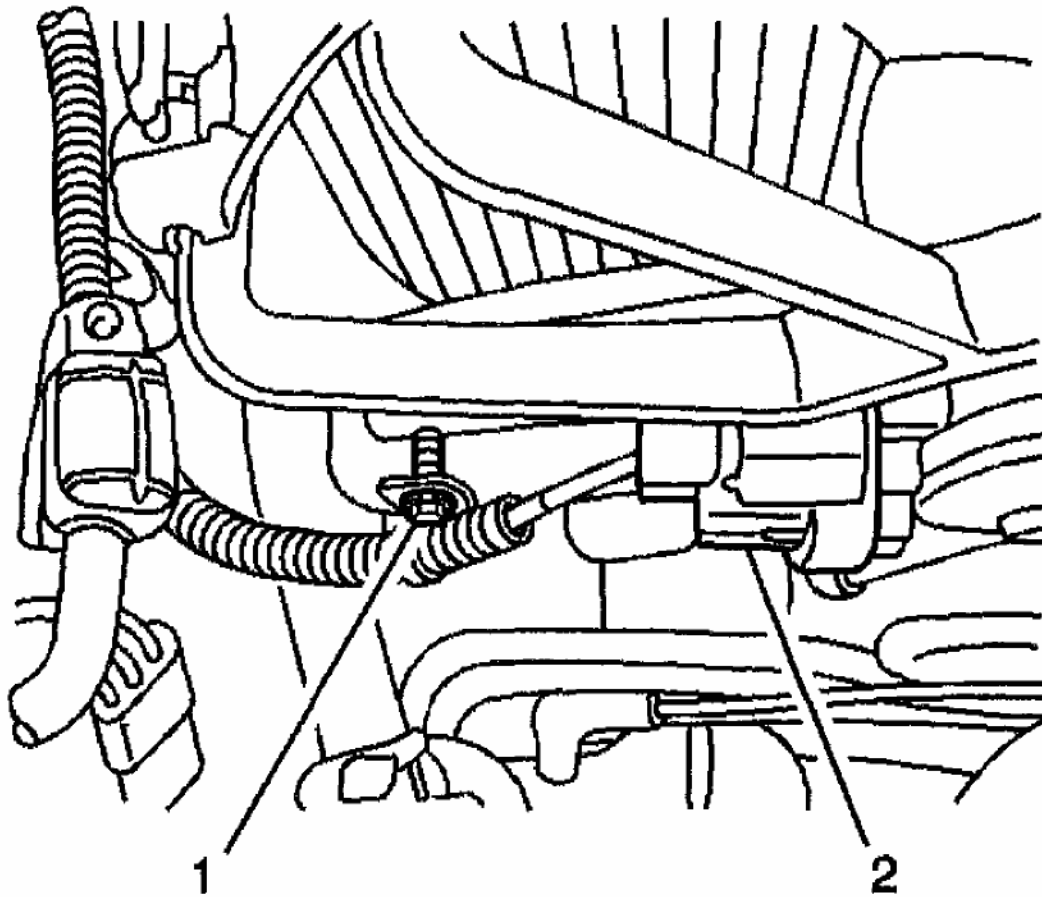
12. Remove the screw (1).
13. Rotate the A/C line retaining clip (3).



G02086587

Fig. 111: Aligning A/C Line Retaining Clip
Courtesy of GENERAL MOTORS CORP.

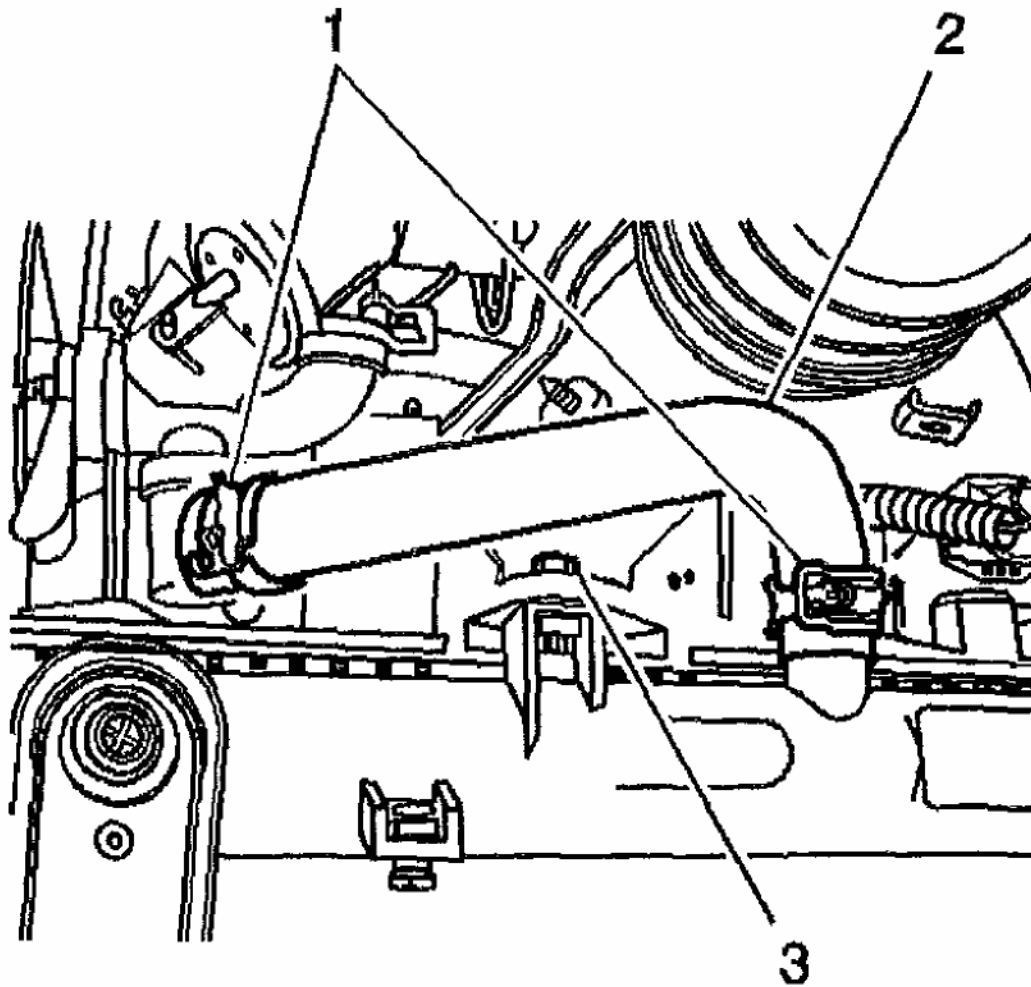
14. Remove the electric fan harness clip (1).



G02086588

Fig. 112: Removing Electric Fan Harness Clip
Courtesy of GENERAL MOTORS CORP.

15. Disconnect the fan motor electrical connectors (2).
16. Separate the wiring harness from the fan shroud.
17. Using the *J 38185* remove the coolant bypass hose (2) from the radiator.



G02086589

Fig. 113: Removing Coolant Bypass Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

18. Remove the right fan shroud bolt (3).
19. Remove the left fan shroud bolt.

Important: Care should be taken when removing the electric cooling fan assembly from the vehicle, to protect the radiator core.

20. Pull upward on the fan assembly removing it from the vehicle.

Installation Procedure

Important: Care should be taken when installing 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.
3. Install the upper fan shroud to radiator mounting bolts.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

Tighten

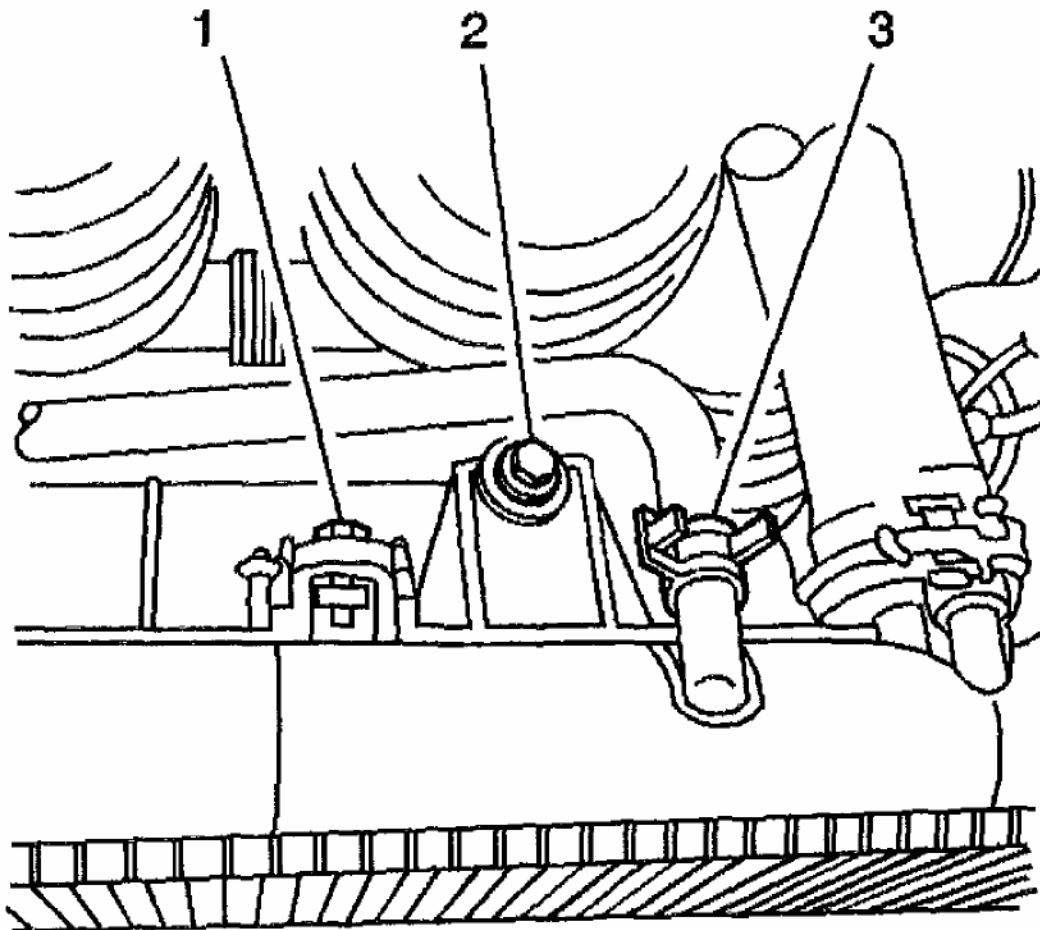
Tighten the bolt to 6.5 N.m (58 lb in).

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

Tighten

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

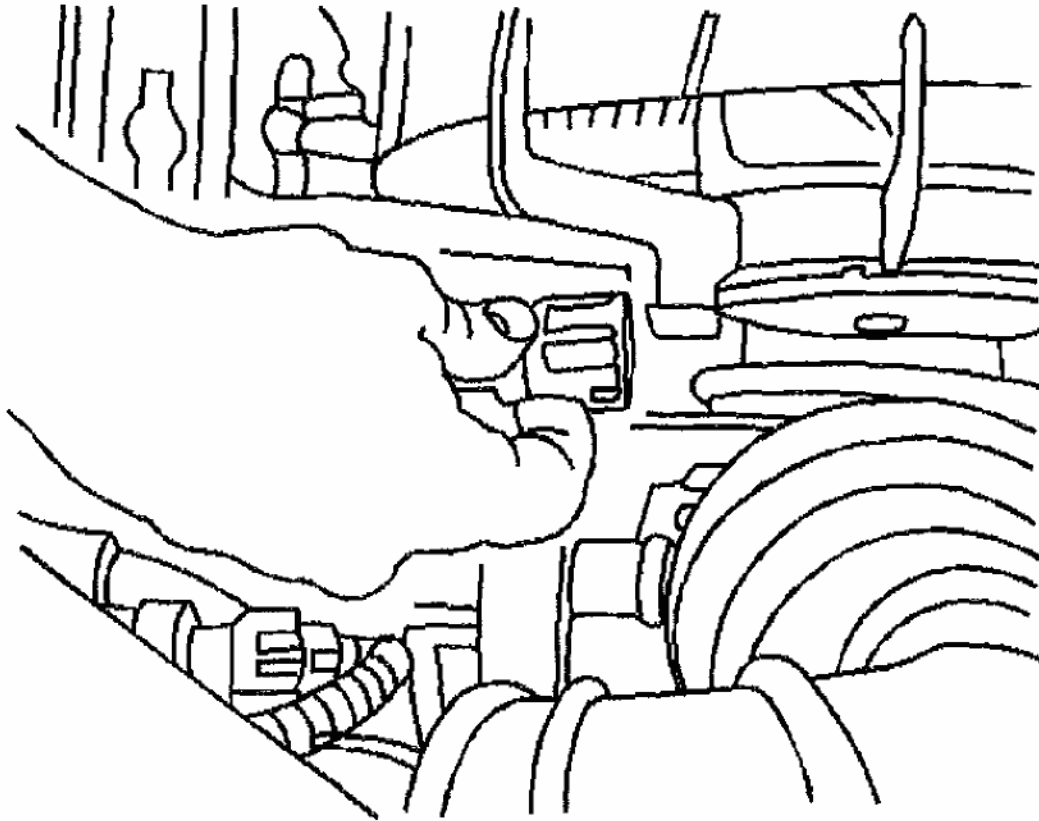
5. Connect the surge tank hose to radiator (3).



G02086590

Fig. 114: Connecting Surge Tank Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

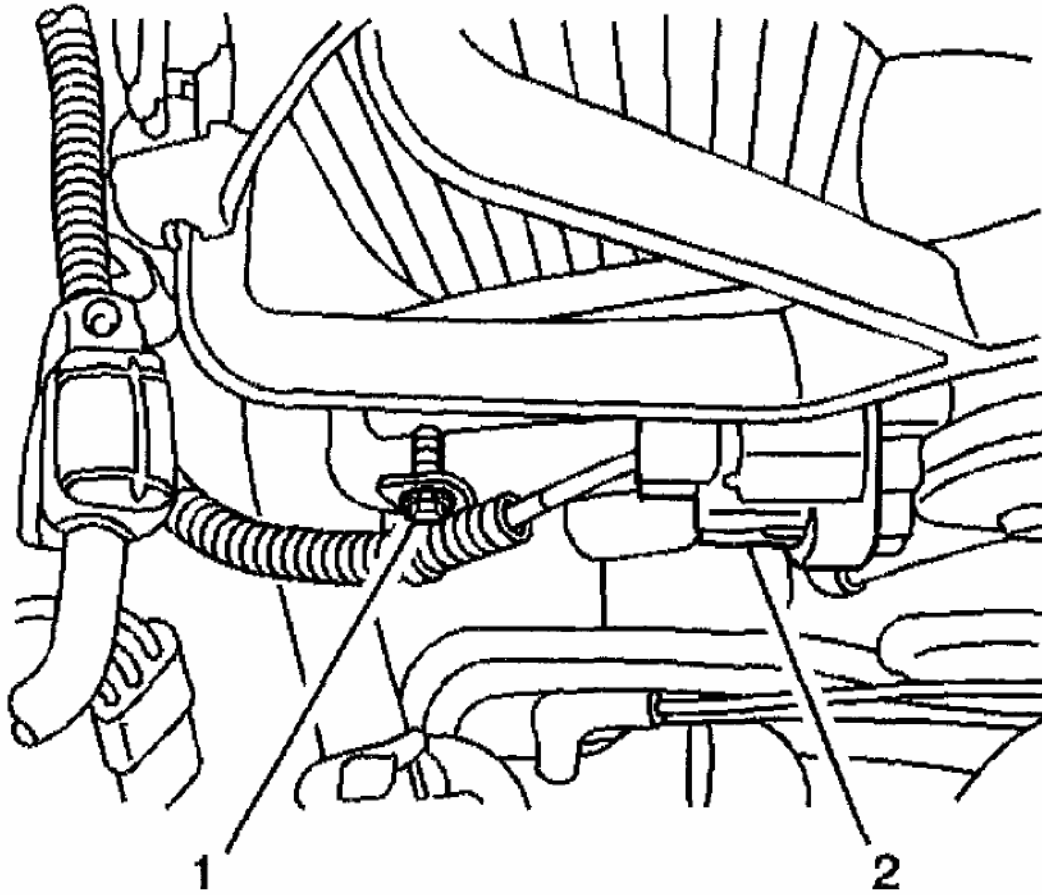
6. Connect the wiring harness electrical connectors to the cooling fan motors.



G02086591

Fig. 115: Connecting Wiring Harness Electrical Connectors To Cooling Fan Motors
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.



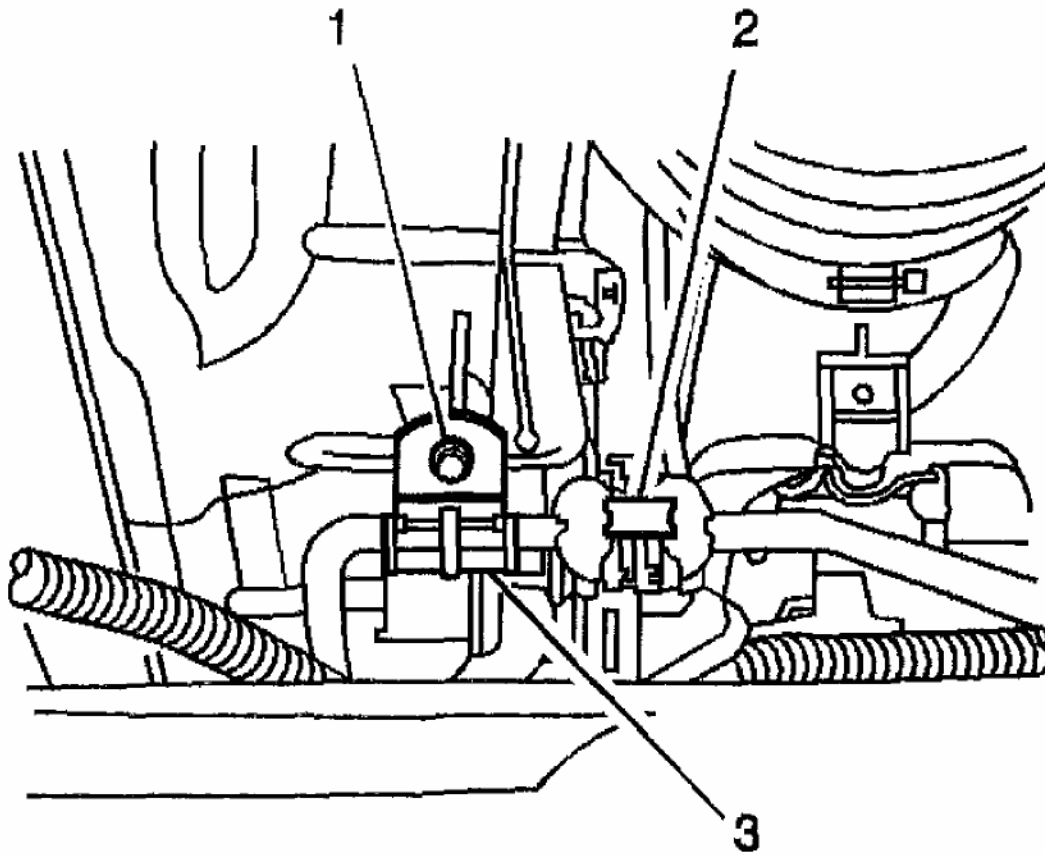
G02086592

Fig. 116: Connecting Fan Electrical Harness Retainers
Courtesy of GENERAL MOTORS CORP.

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

Tighten

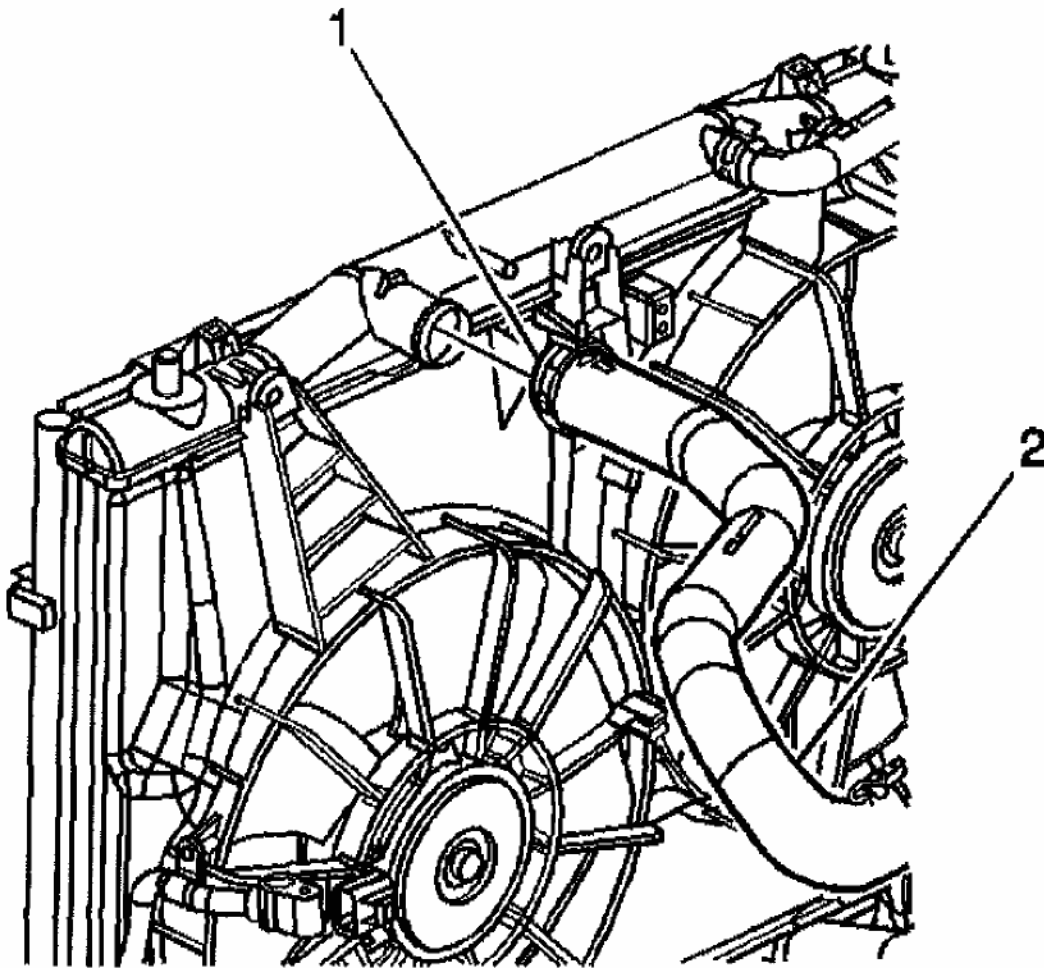
Tighten the screw to 1 N.m (9 lb in).



G02086593

Fig. 117: Installing A/C Line Retaining Clip Screw To Fan Shroud
Courtesy of GENERAL MOTORS CORP.

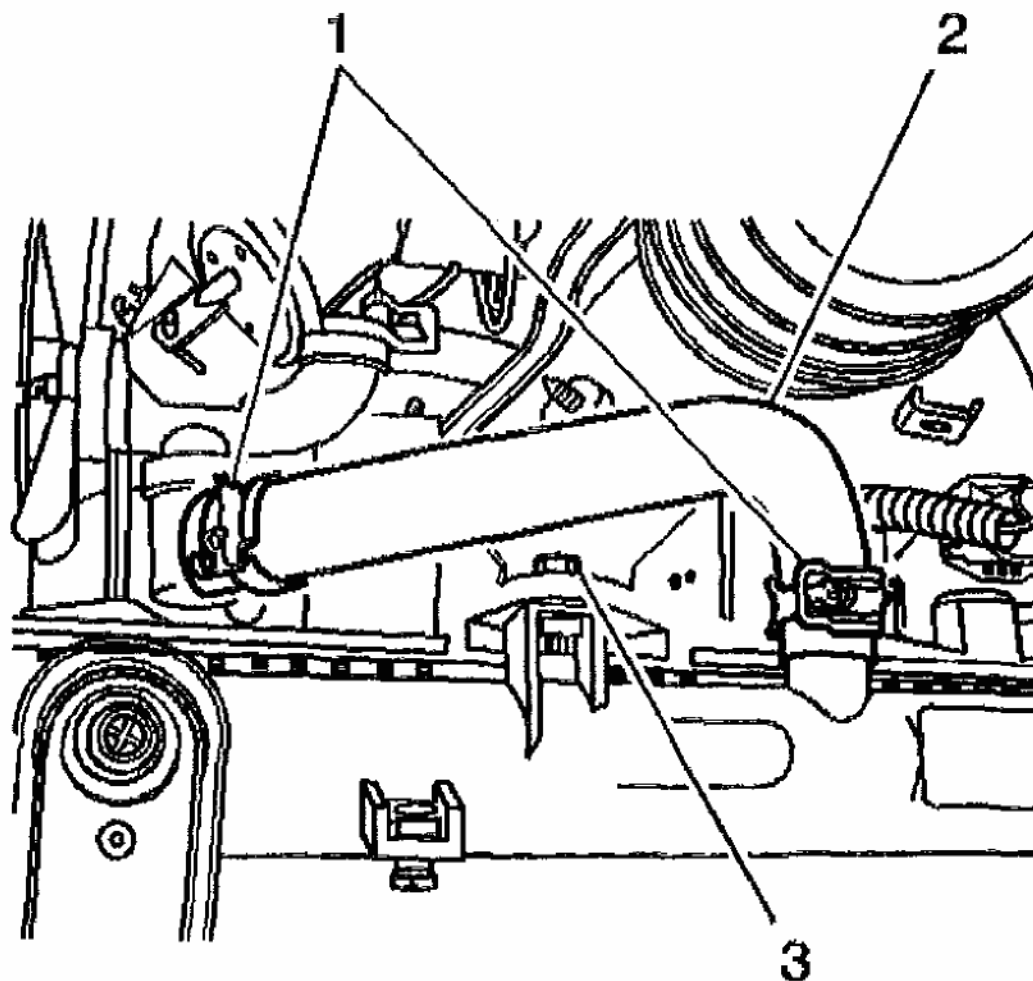
10. Position the radiator hose with the mark facing up.
11. Position the *J 38185* to the clamp (1) and position the clamp on the radiator hose.



G02086594

Fig. 118: Aligning Coolant Bypass Hose Clamp To Radiator
Courtesy of GENERAL MOTORS CORP.

12. Using the *J 38185* install the coolant bypass hose (2) at the radiator.



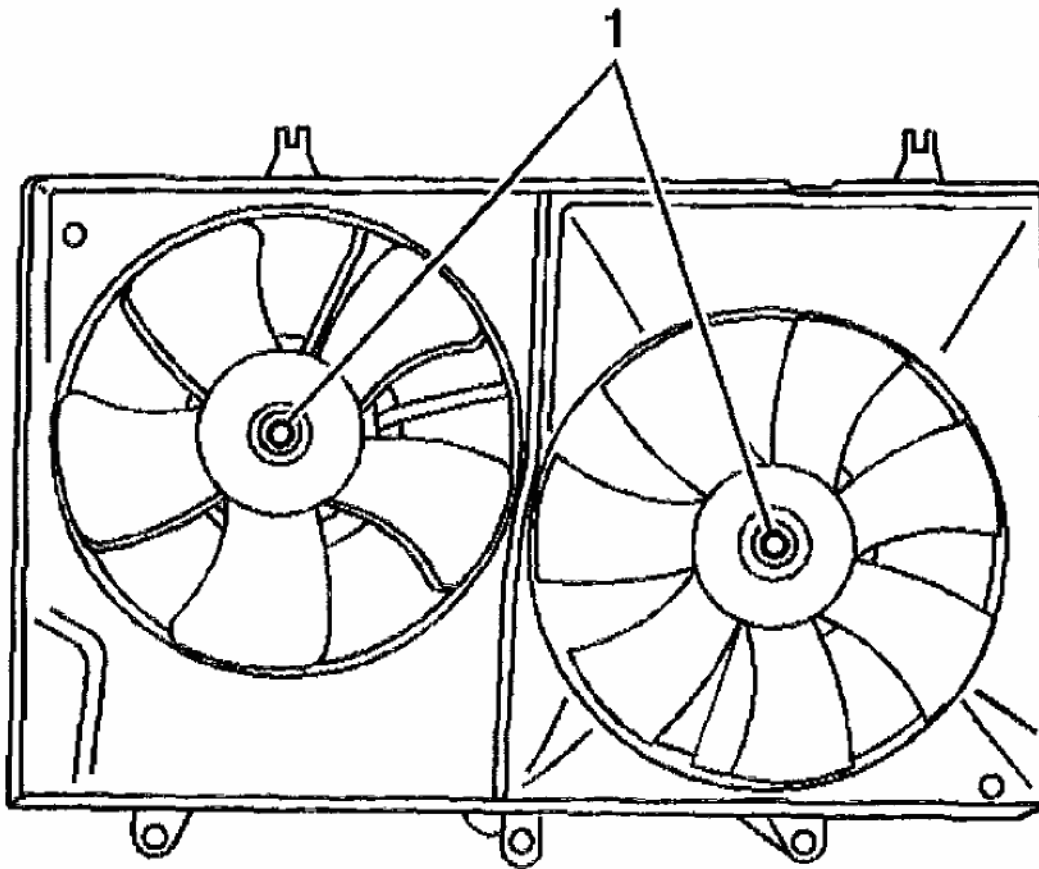
G02086595

Fig. 119: Installing Coolant Bypass Hose At Radiator
Courtesy of GENERAL MOTORS CORP.

13. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
14. Install the air cleaner assembly. Refer to **AIR CLEANER ASSEMBLY** in Removal & Installation.
15. Connect the battery negative cable. Refer to **BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE** in Battery.

Removal Procedure

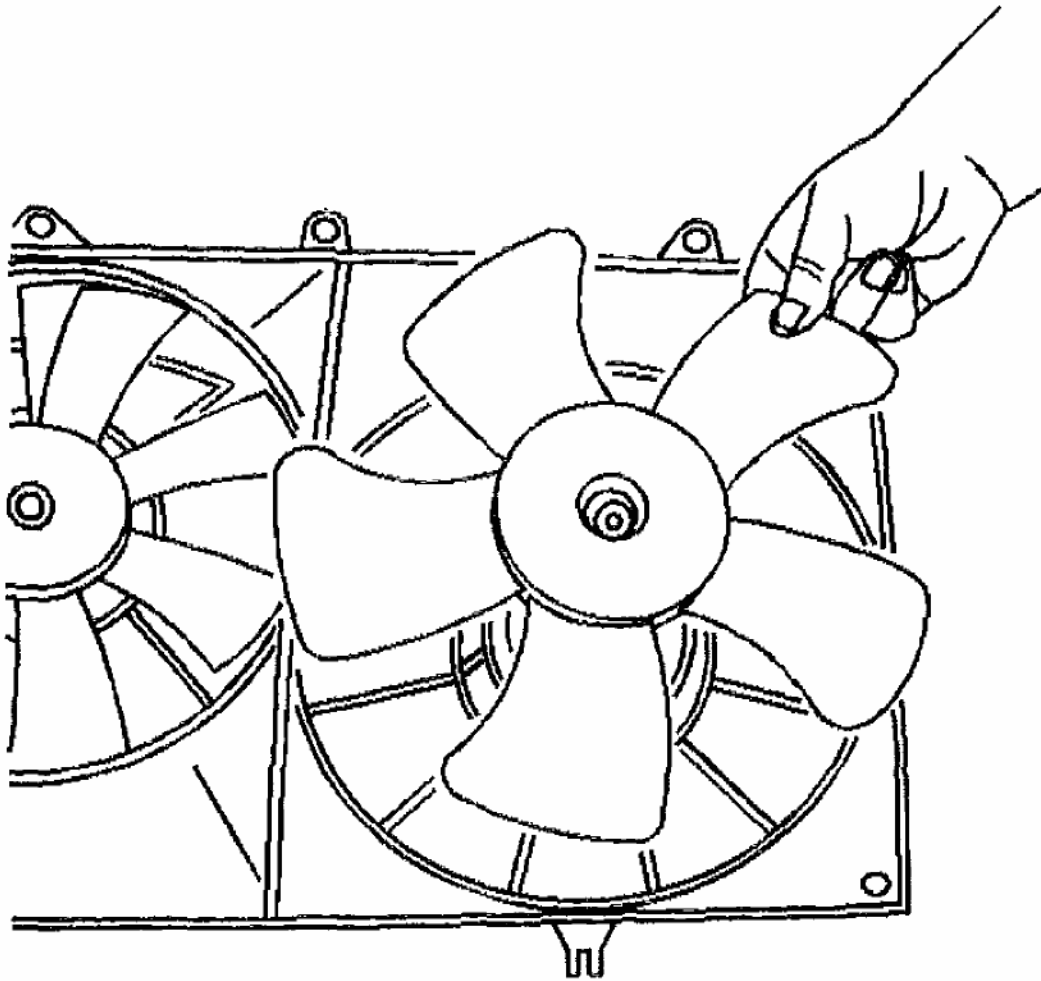
1. Remove the cooling fan assembly. Refer to **COOLING FAN REPLACEMENT - ELECTRIC**.
2. Remove the fan blade retaining nut (1) from the motor.



G02086596

Fig. 120: Locating Fan Blade Retaining Nut
Courtesy of GENERAL MOTORS CORP.

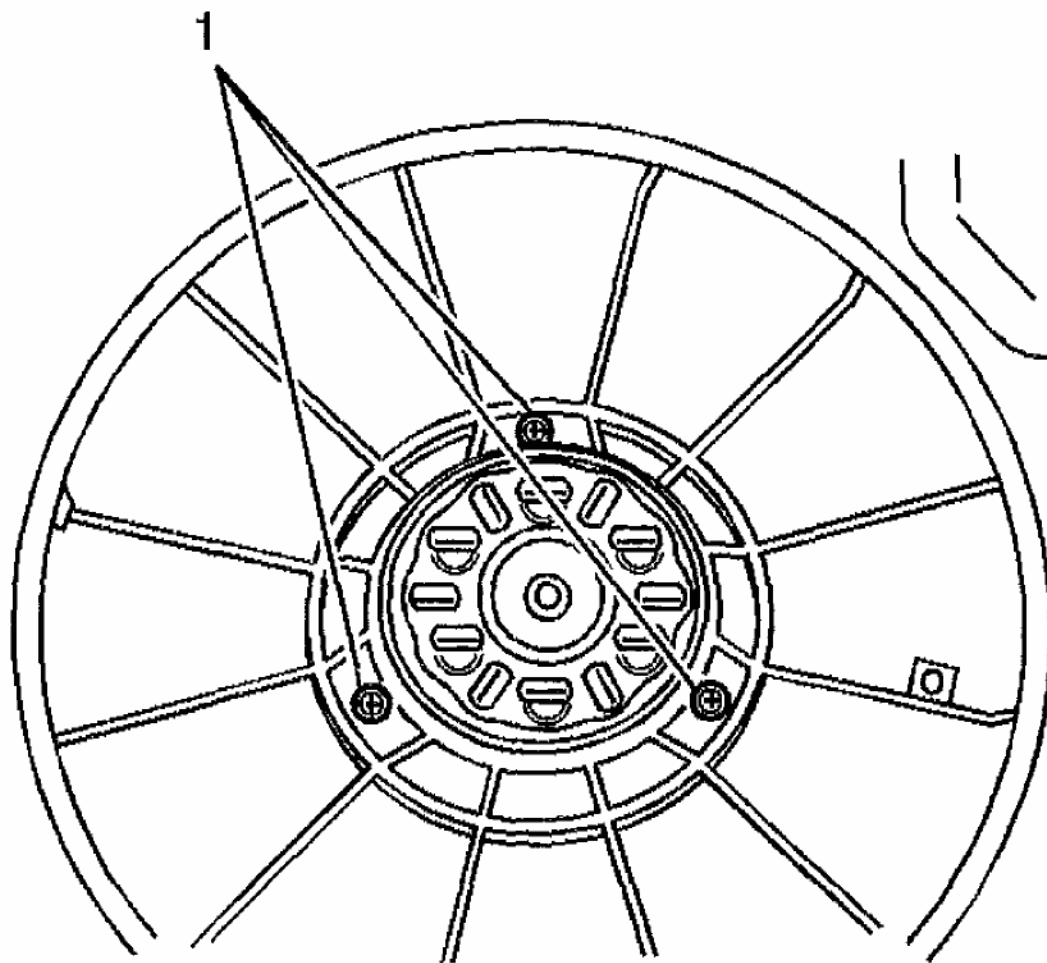
3. Remove the fan blade from the motor shaft.



G02086597

Fig. 121: Removing Fan Blade From Motor Shaft
Courtesy of GENERAL MOTORS CORP.

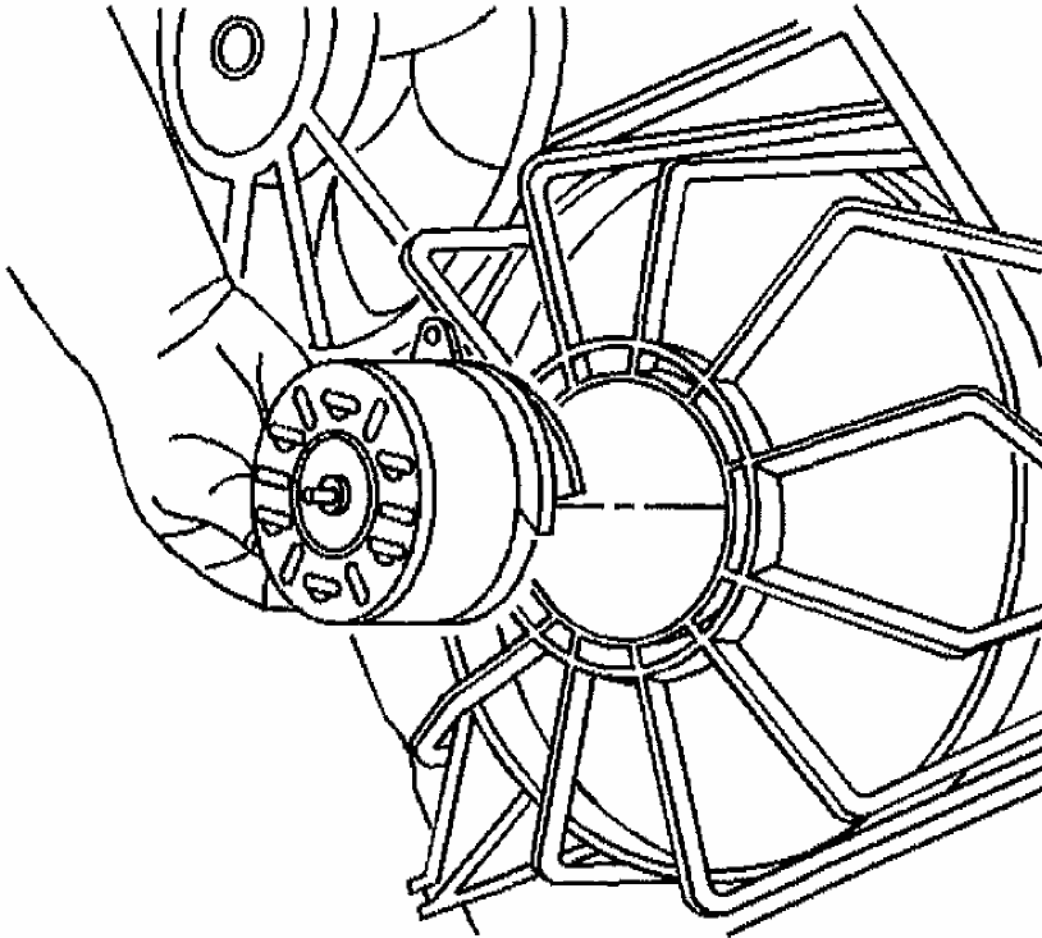
4. Remove the motor retaining screws (1).



G02086598

Fig. 122: Identifying Motor Retaining Screws
Courtesy of GENERAL MOTORS CORP.

5. Remove the motor from the shroud.

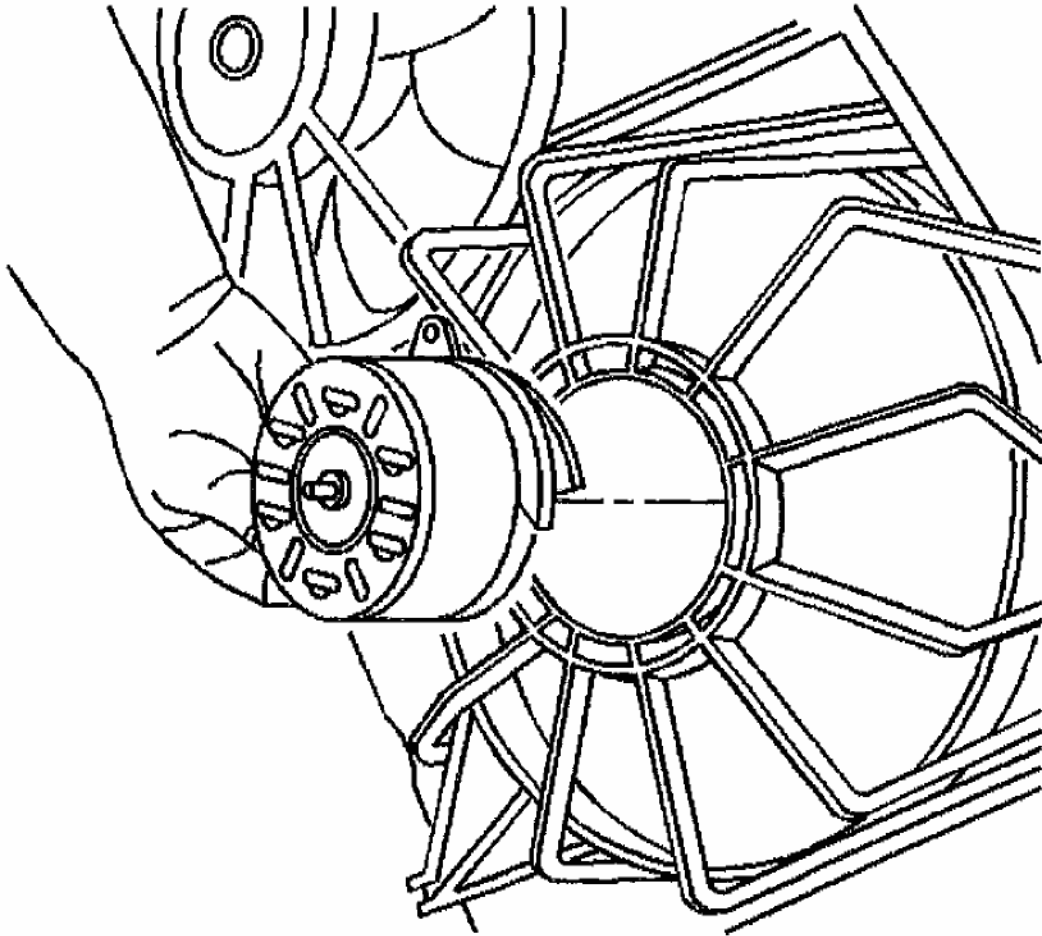


G02086599

Fig. 123: Removing Motor From Shroud
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the motor to the shroud.



G02086600

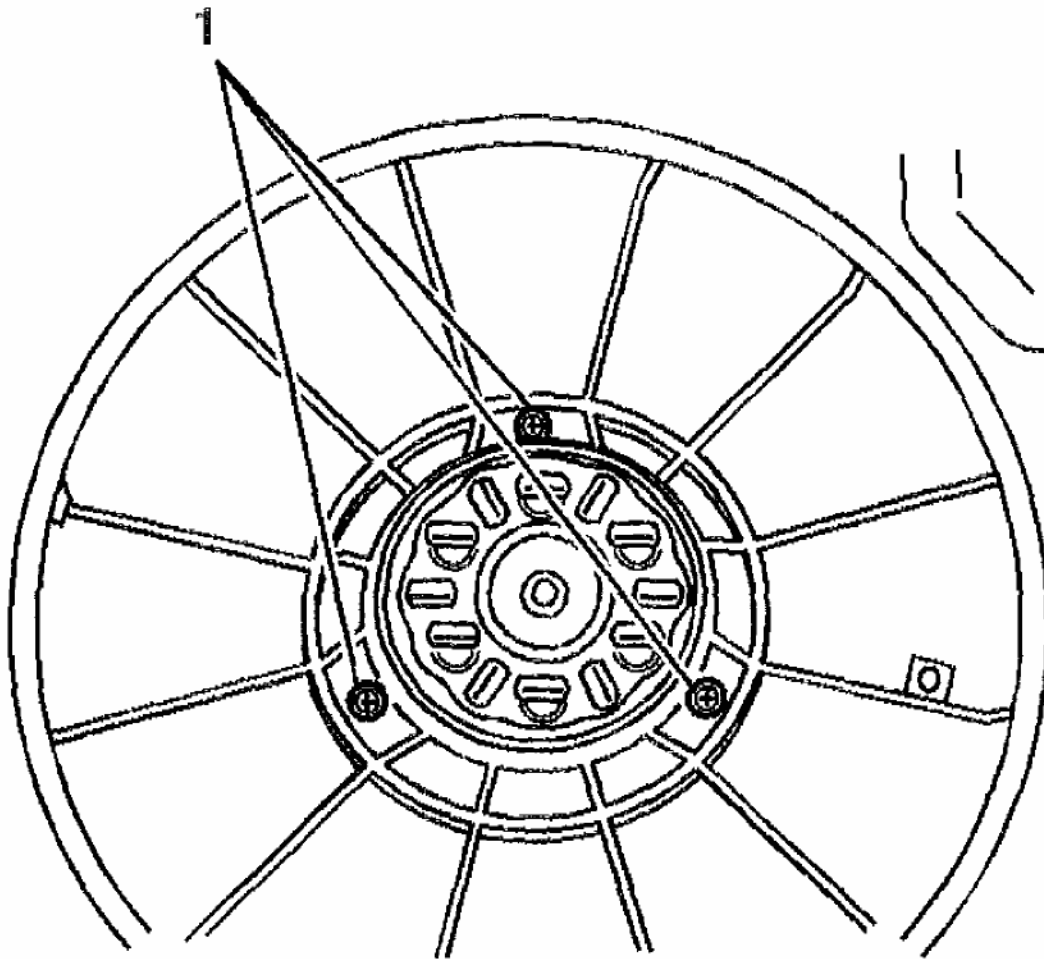
Fig. 124: Installing Motor To Shroud
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

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

Tighten

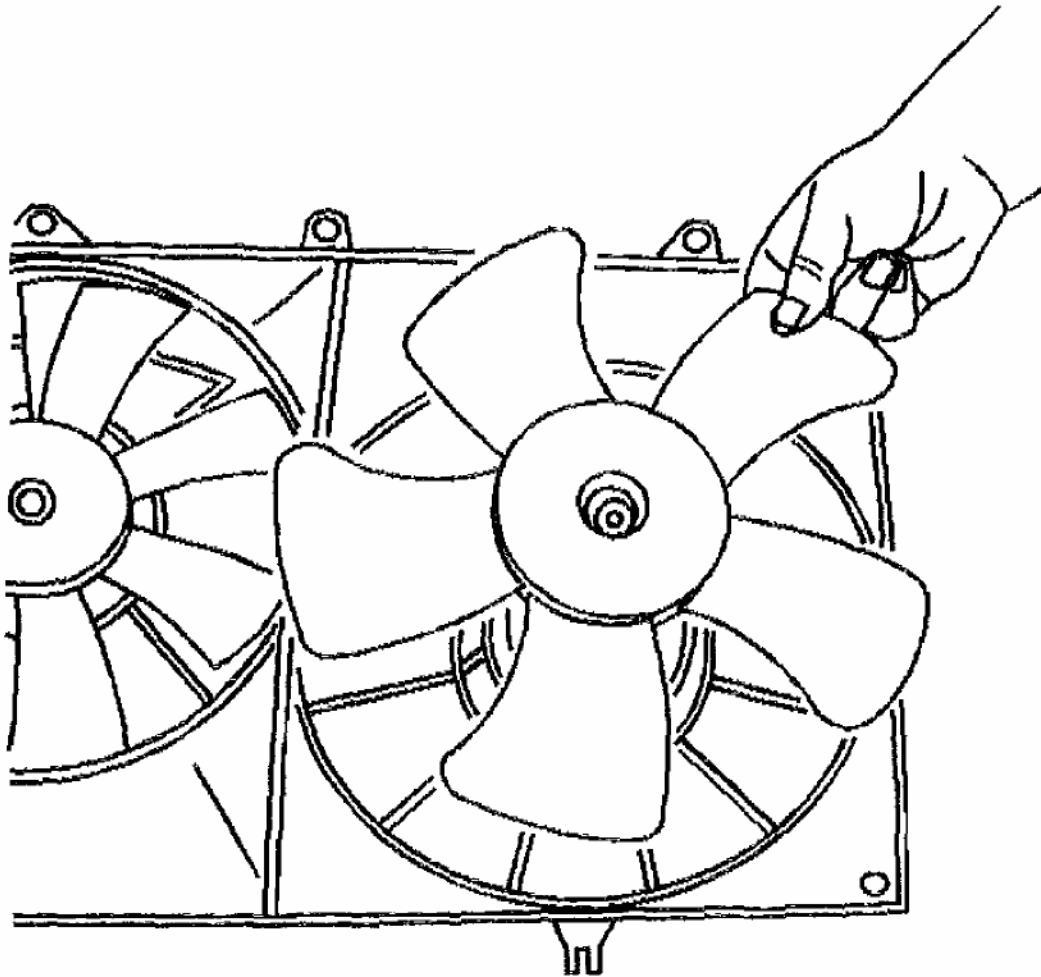
Tighten the screws to 5 N.m (44 lb in).



G02086601

Fig. 125: Identifying Motor Retaining Screws
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.



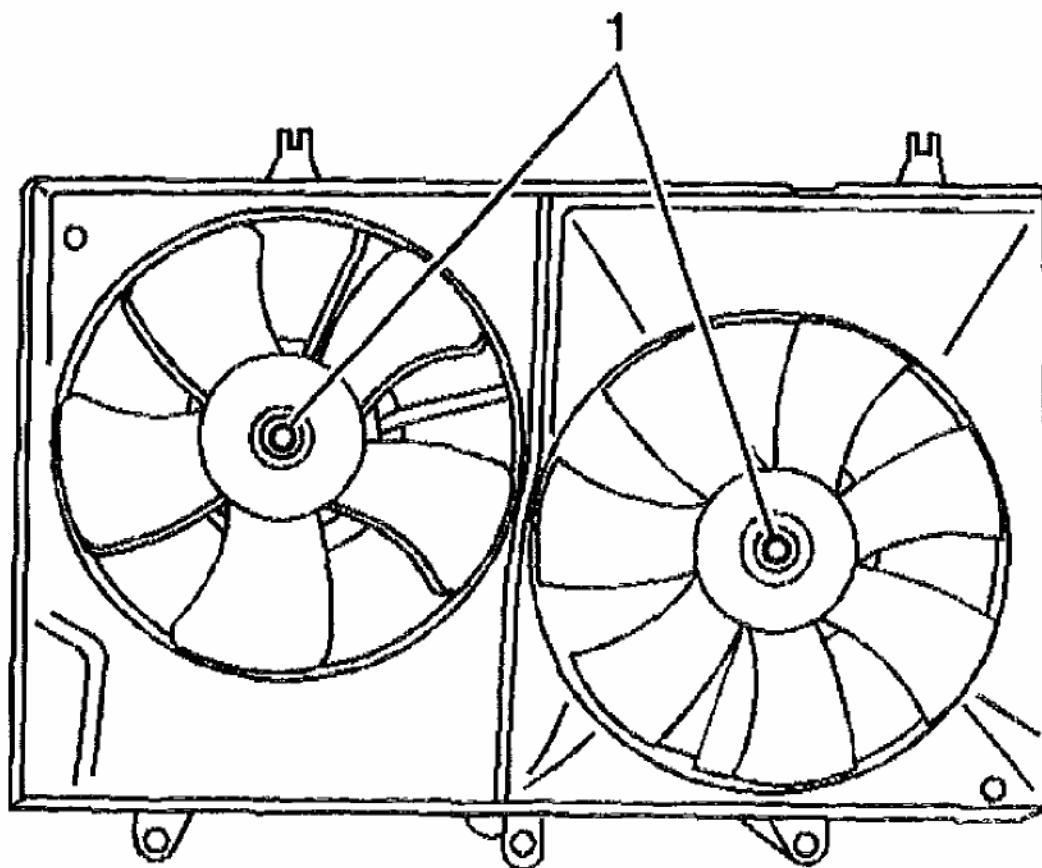
G02086602

Fig. 126: Installing Fan Blade To Motor Shaft
Courtesy of GENERAL MOTORS CORP.

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

Tighten

Tighten the electric cooling fan blade retaining nut to 7 N.m (62 lb in).



G02086603

Fig. 127: Locating Fan Blade Retaining Nut
Courtesy of GENERAL MOTORS CORP.

6. Install the cooling fan assembly. Refer to **COOLING FAN REPLACEMENT - ELECTRIC** .

COOLING FAN AND MOTOR REPLACEMENT - AUXILIARY

Tools Required

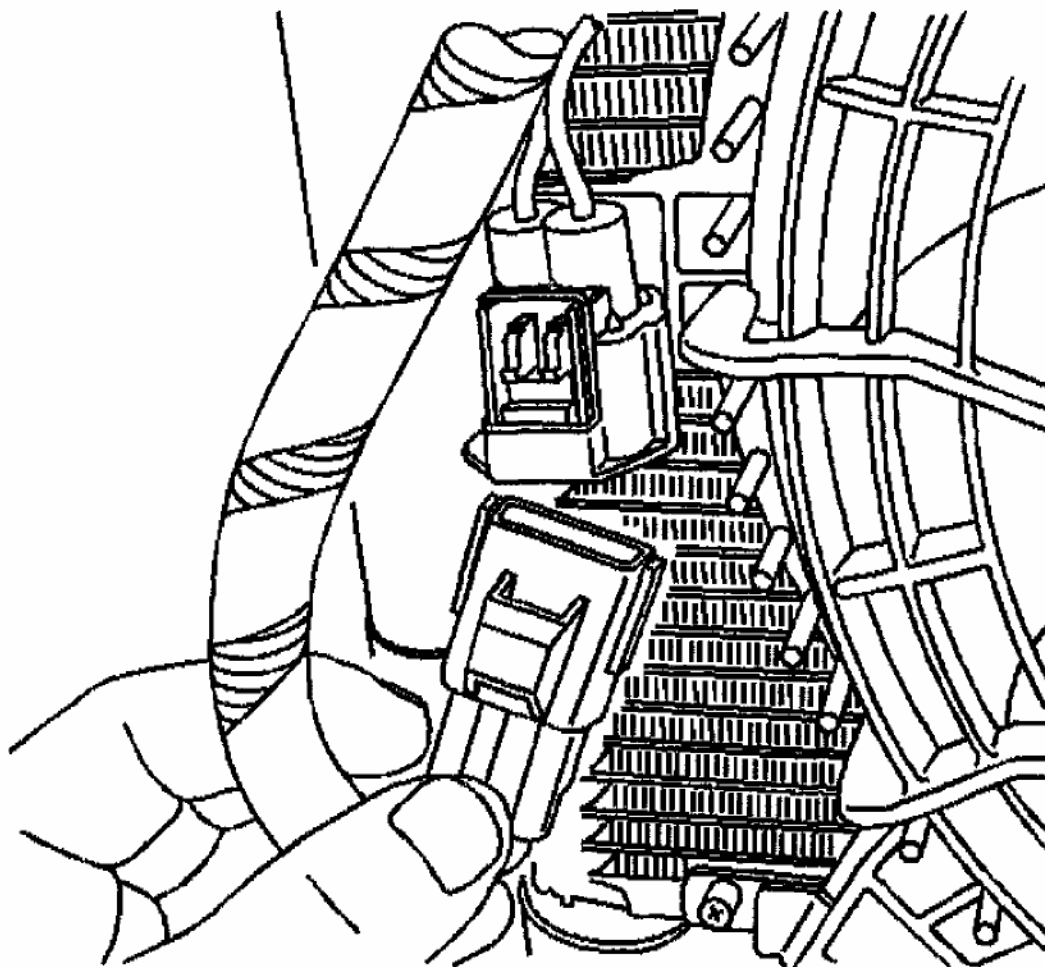
J 44827 Transmission Cooler Quick Disconnect

Removal Procedure

1. Remove the air deflector. Refer to **AIR DEFLECTOR REPLACEMENT - FRONT** in

Body Front End.

2. Disconnect the auxiliary cooling fan electrical connector.



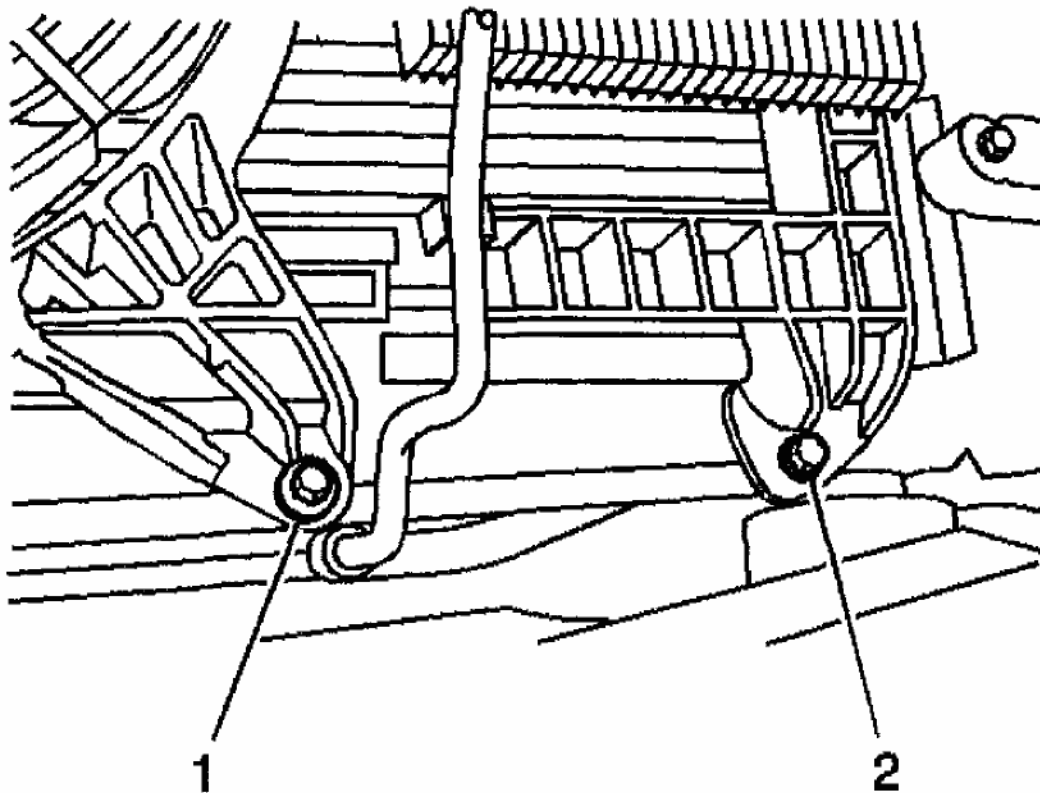
G02086604

Fig. 128: Disconnecting Auxiliary Cooling Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: The transmission oil cooler lines use a quick connect fitting at the radiator. The quick connect fitting must be removed using a special tool. Removing the transmission oil cooler lines without the tool will result in damage to the radiator and the transmission oil cooler, and may damage the transmission due

to mixing of the transmission oil and coolant.

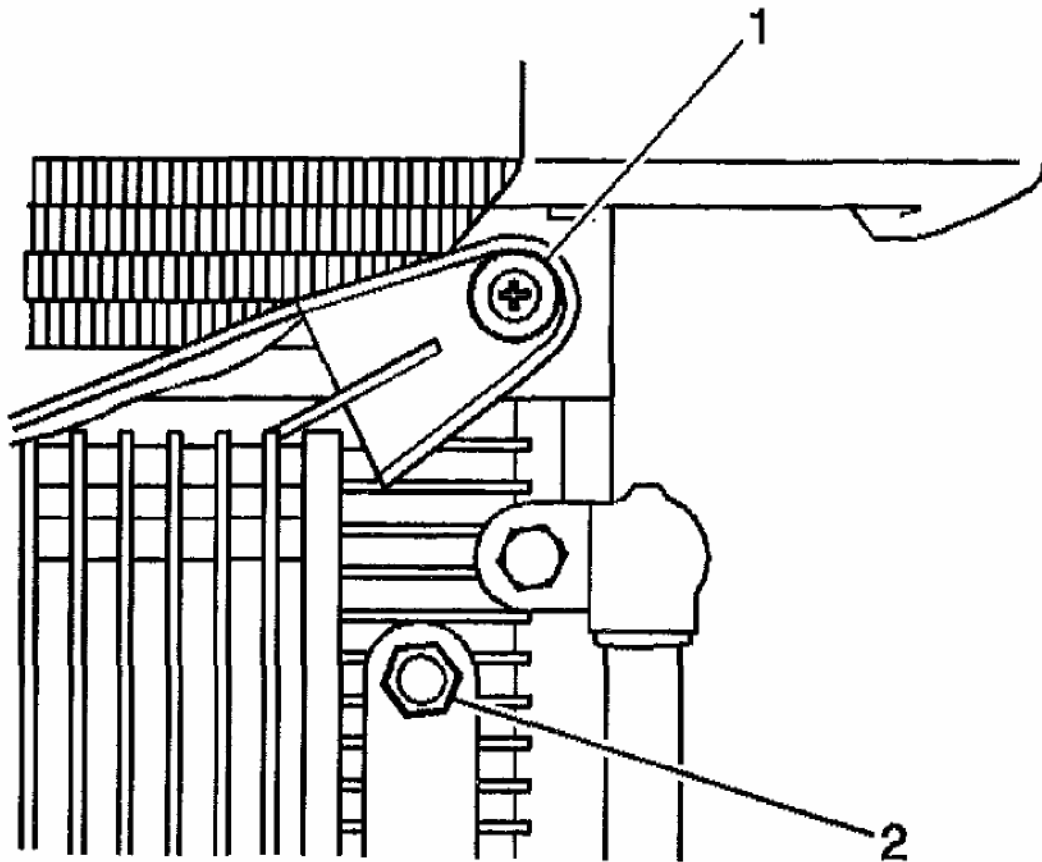
3. Using the *J 44827* disconnect the auxiliary transmission cooler lines from the auxiliary cooler.
4. Position the auxiliary cooler lines out of the way.
5. Remove the auxiliary cooling fan assembly bolts (1, 2).
6. Remove the lower left auxiliary cooling fan bolt.



G02086605

Fig. 129: Removing Auxiliary Cooling Fan Assembly 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 car.



G02086606

Fig. 130: Removing Auxiliary Cooling Fan Assembly Bolt
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

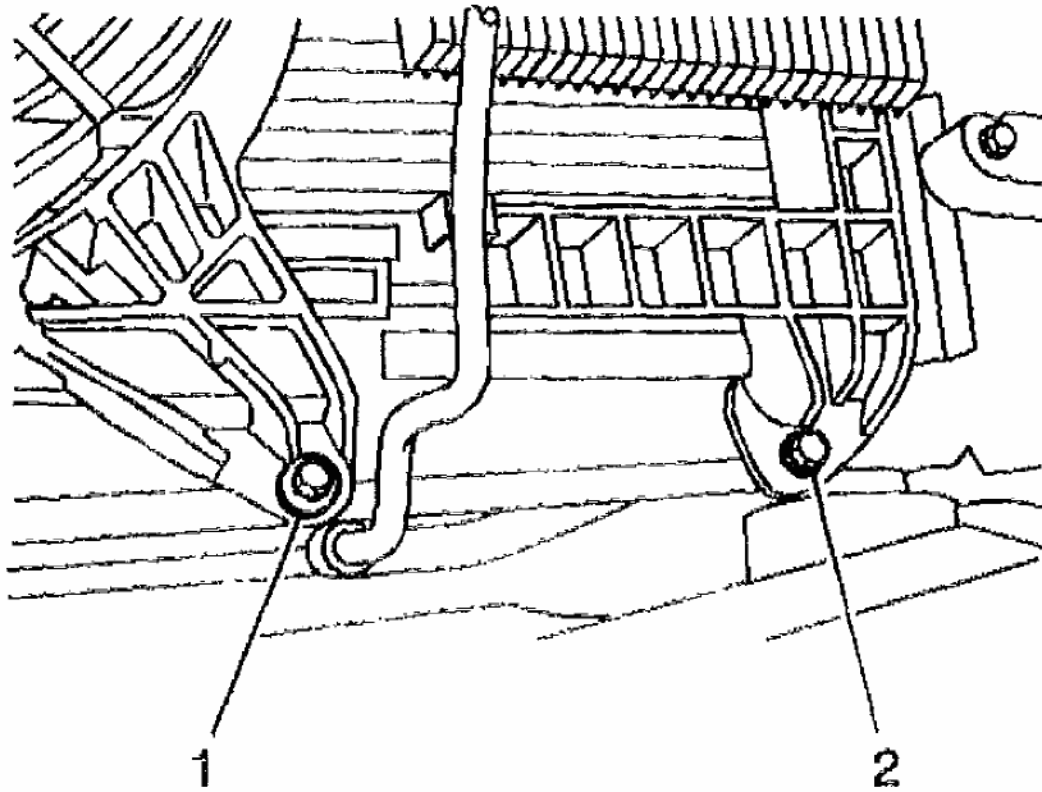
1. Position the auxiliary fan assembly into the vehicle.

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).



G02086607

Fig. 131: Installing Auxiliary Cooling Fan Lower 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).

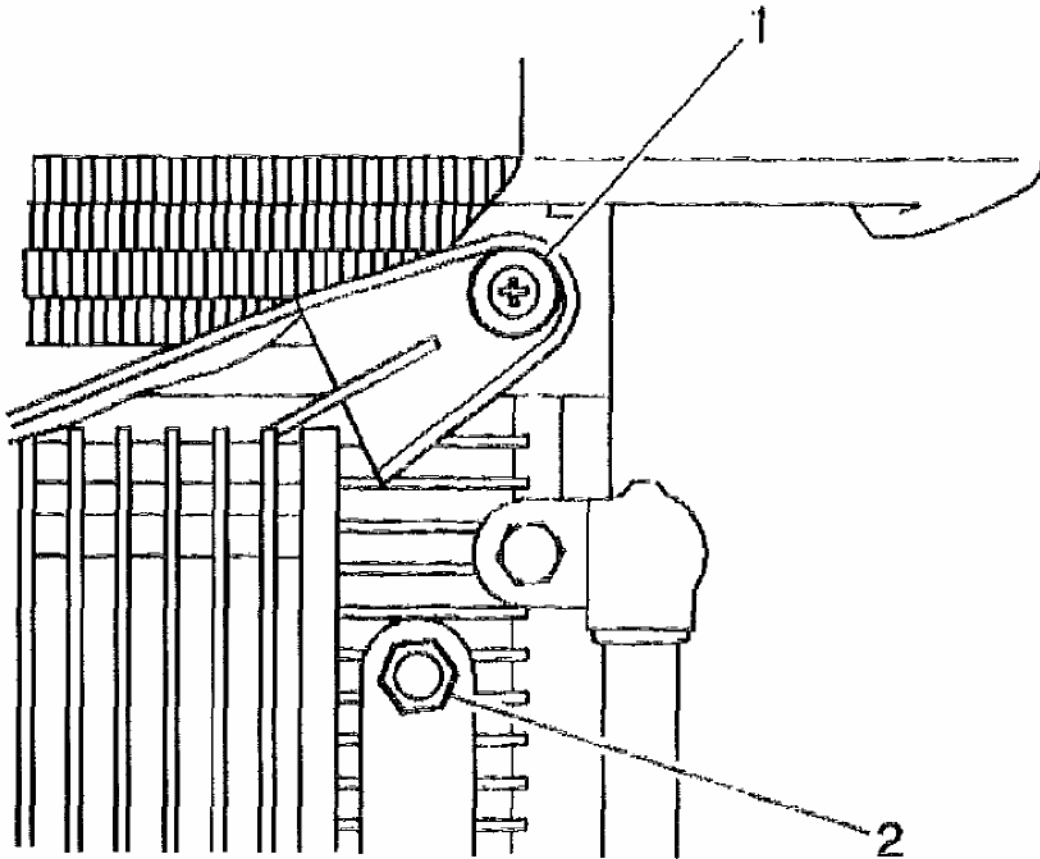
4. Install the remaining auxiliary cooling fan bolts.

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.

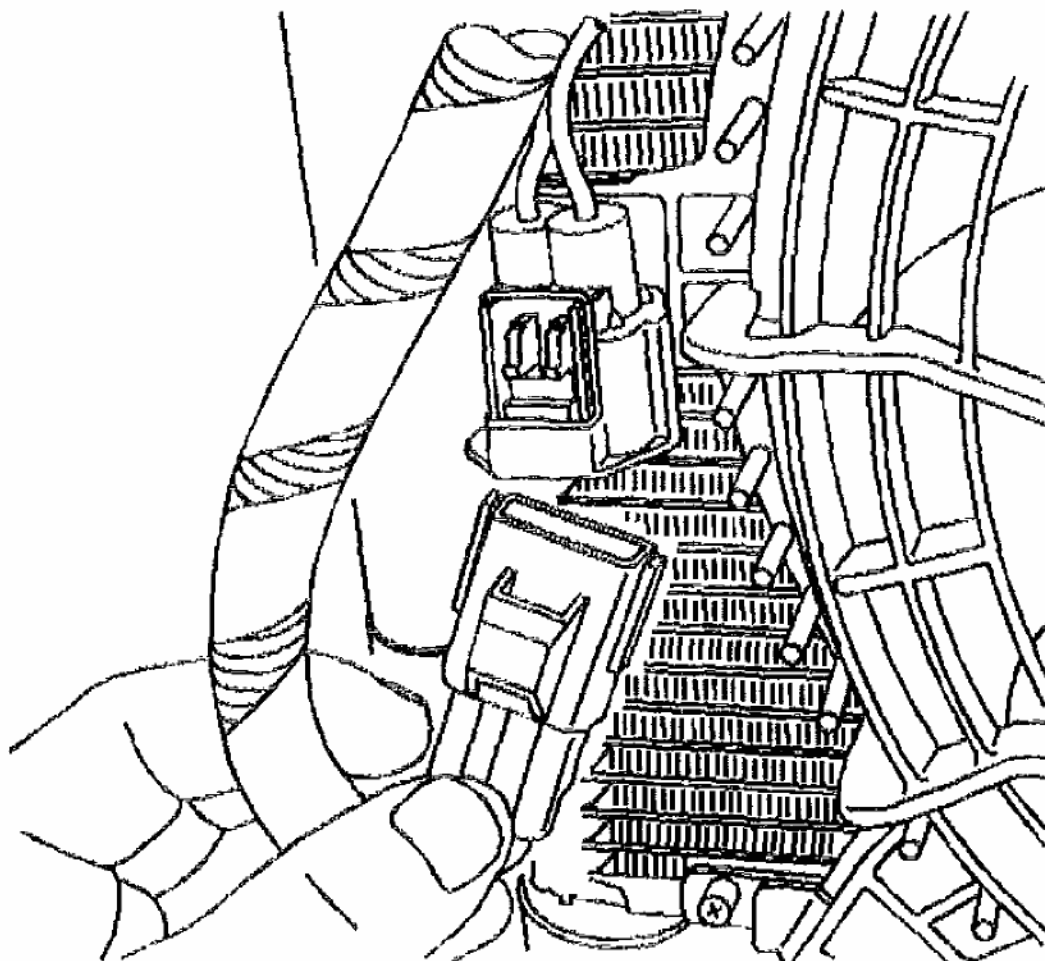
6. Gently tug out on the transmission oil cooler line to verify that the line is engaged into position.



G02086608

Fig. 132: Installing Fan Assembly Bolt
Courtesy of GENERAL MOTORS CORP.

7. Connect the auxiliary fan electrical connector.



G02086609

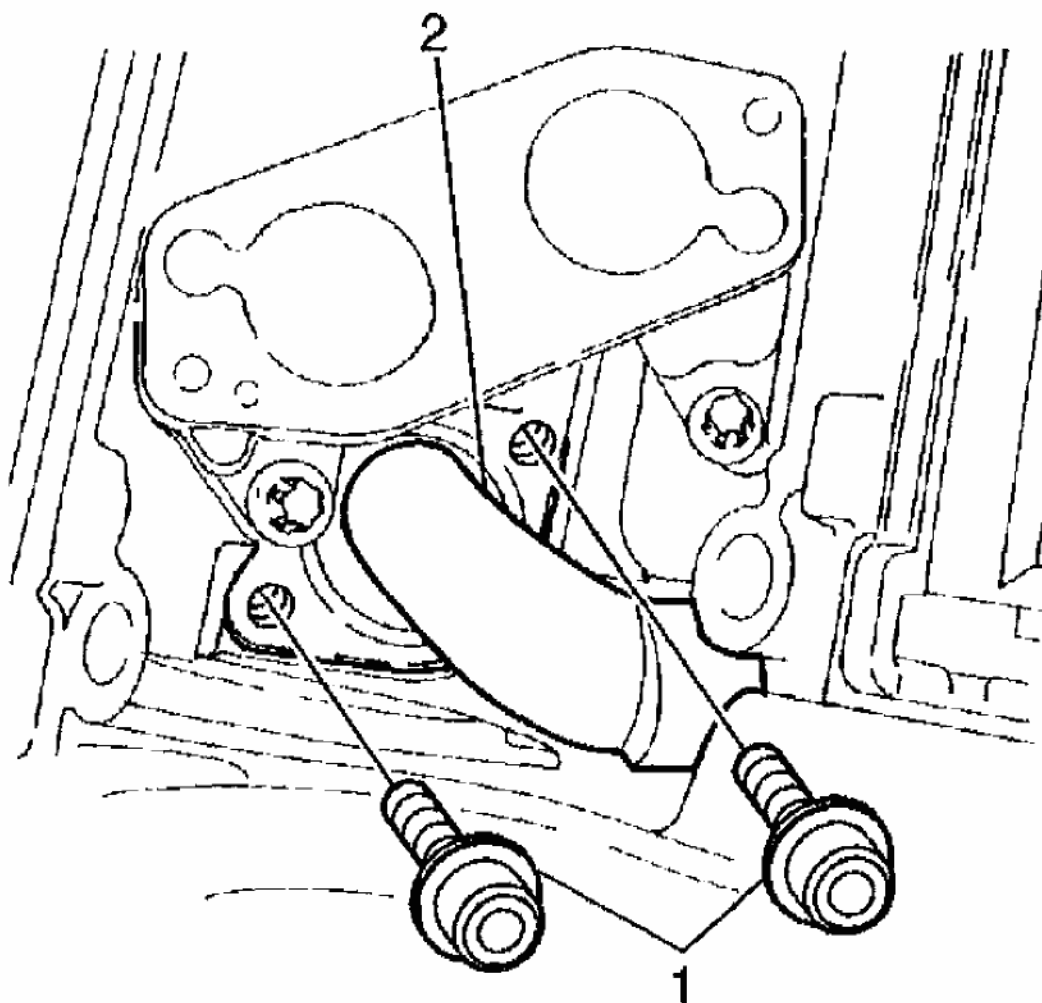
Fig. 133: Connecting Auxiliary Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Install the air deflector. Refer to **AIR DEFLECTOR REPLACEMENT - FRONT** in Body Front End.
9. Inspect the transmission fluid level. Refer to **FLUID CONDITION & LEVEL CHECK** in Servicing - A/T.

THERMOSTAT HOUSING REPLACEMENT

Removal Procedure

1. Remove the coolant outlet pipe. Refer to **COOLANT PIPE REPLACEMENT - OUTLET**.
2. Remove the intake manifold. Refer to INTAKE MANIFOLD REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
3. Remove the thermostat housing bolts (1).
4. Remove the thermostat housing (2) with thermostat, from the engine.



G02086610

Fig. 134: Removing Thermostat Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove and discard the seal ring.
6. Remove the thermostat from the thermostat housing. Refer to **THERMOSTAT REPLACEMENT** .

Installation Procedure

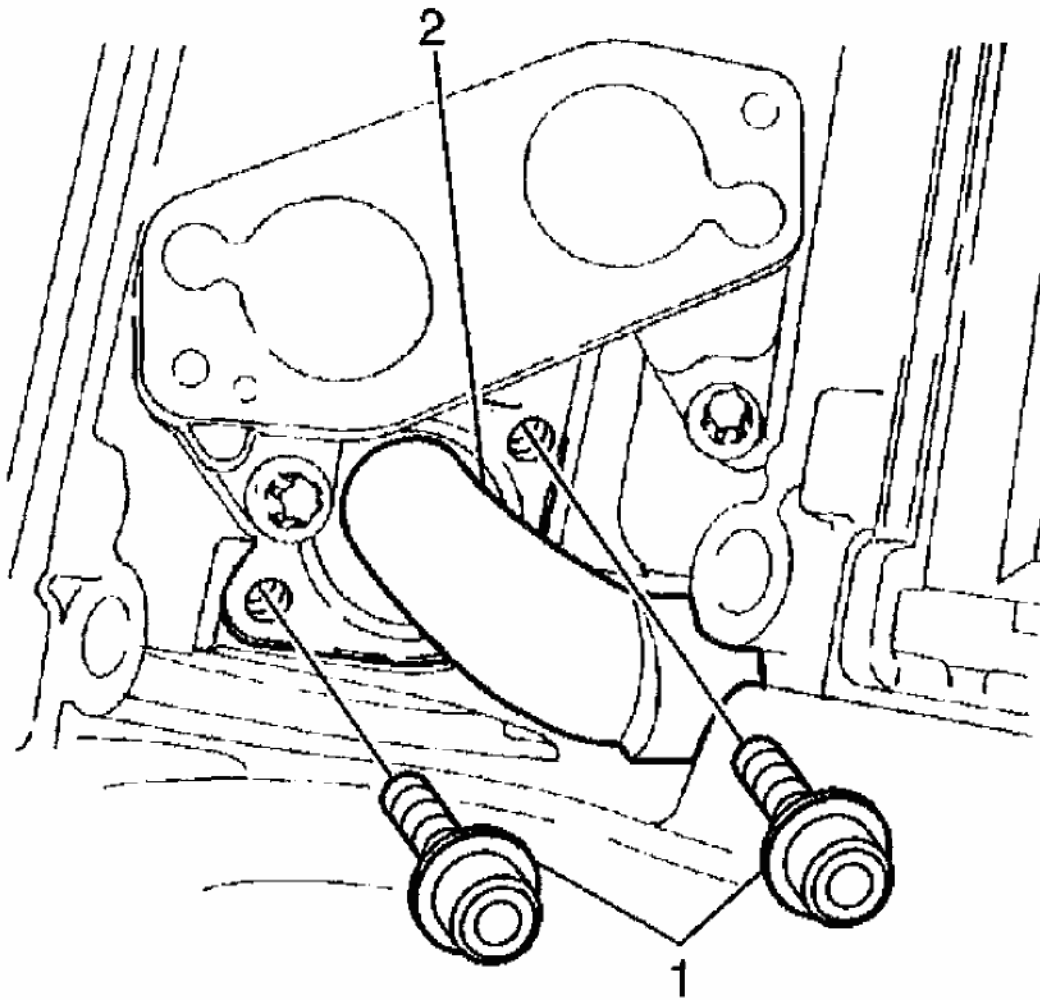
1. Install the thermostat into the thermostat housing. Refer to **THERMOSTAT REPLACEMENT** .
2. Install a new seal ring.
3. Position the thermostat housing (2) with thermostat, to the engine.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

4. Install the thermostat housing bolts (1).

Tighten

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



G02086611

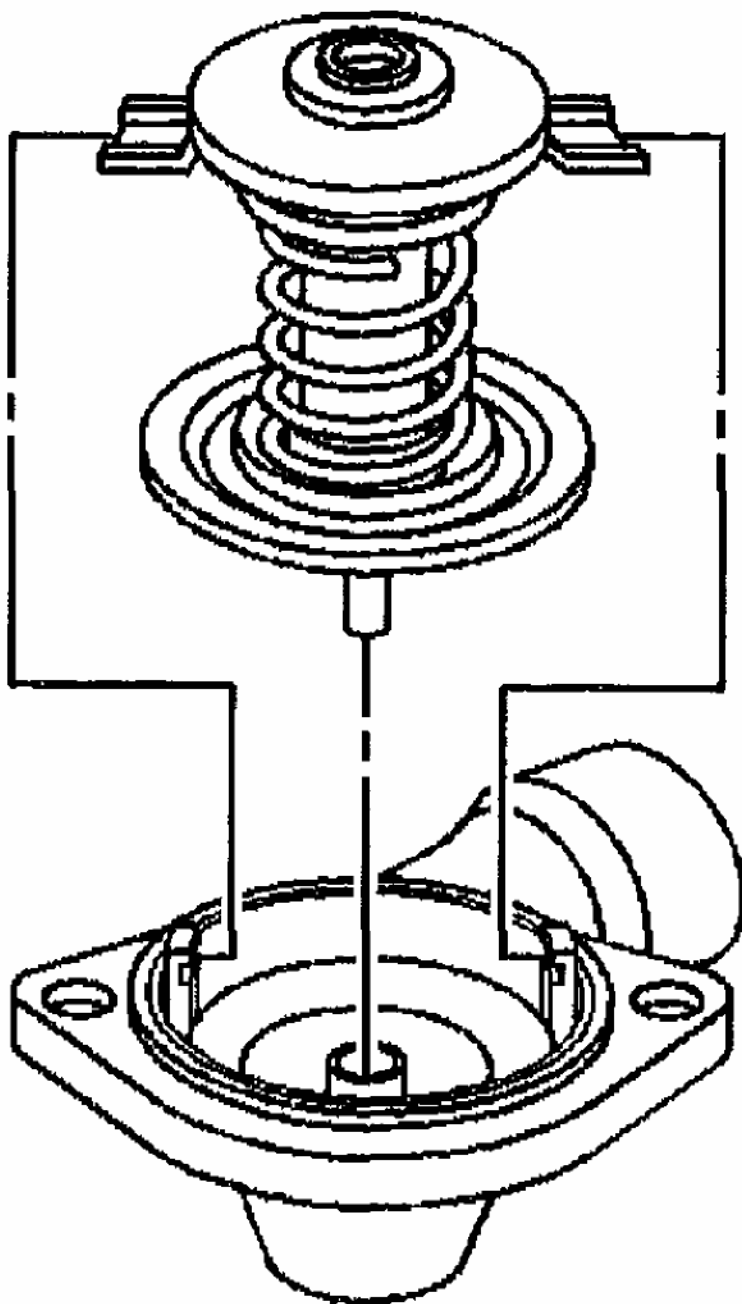
Fig. 135: Installing Thermostat Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the intake manifold. Refer to INTAKE MANIFOLD REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
6. Install the coolant outlet pipe. Refer to COOLANT PIPE REPLACEMENT - OUTLET.

THERMOSTAT REPLACEMENT

Removal Procedure

1. Remove the thermostat housing. Refer to **THERMOSTAT HOUSING REPLACEMENT** .
2. Complete the following in order to remove the thermostat from the thermostat housing:
 - 2.1. Depress the ears on both sides of the thermostat.
 - 2.2. Rotate the thermostat until it clears the retaining feature of the housing.
 - 2.3. Release the pressure from the thermostat.
 - 2.4. Pull the thermostat from the thermostat housing.



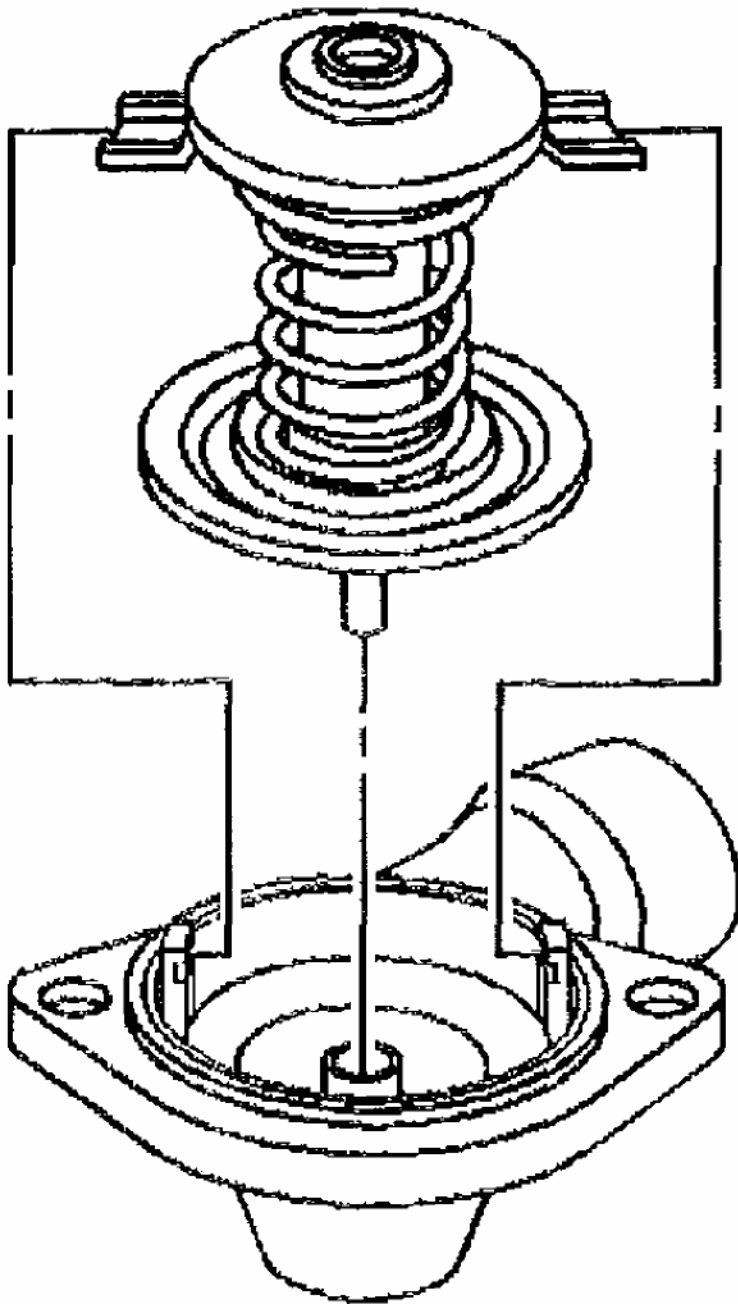
G02086612

Fig. 136: Removing Thermostat
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

1. Complete the following in order to Install the thermostat into the thermostat housing:
 - 1.1. Align the thermostat pin to the thermostat housing orifice.
 - 1.2. Depress the ears on both sides of the thermostat.
 - 1.3. Rotate the thermostat until it aligns with the retaining feature of the housing.
 - 1.4. Release the pressure from the thermostat.



G02086613

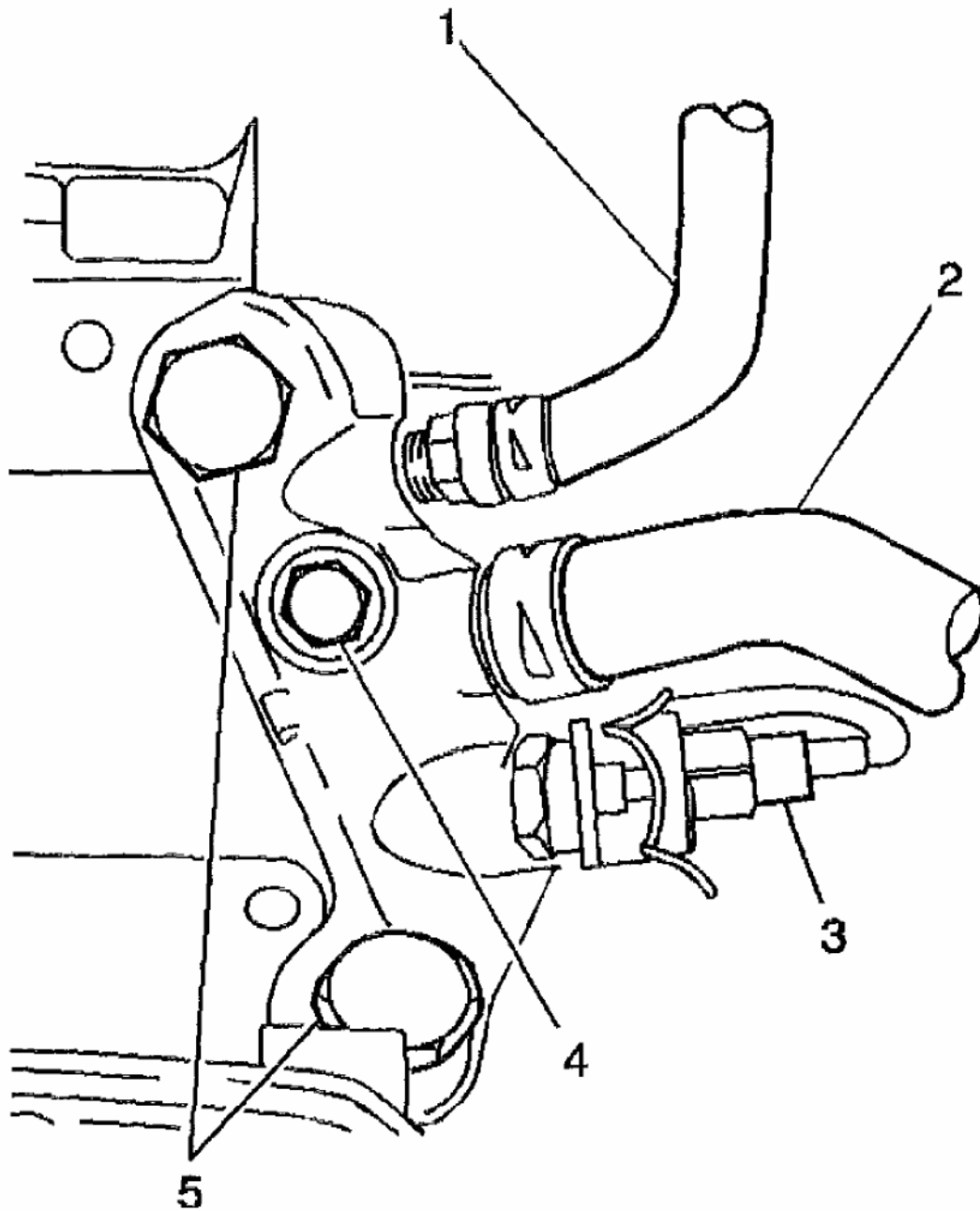
Fig. 137: Installing Thermostat
Courtesy of GENERAL MOTORS CORP.

2. Install the thermostat housing. Refer to **THERMOSTAT HOUSING REPLACEMENT**.

WATER CROSSOVER REPLACEMENT

Removal Procedure

1. Partially drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Remove the intake manifold. Refer to INTAKE MANIFOLD REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
3. Disconnect the electrical connector (3) from the engine coolant temperature (ECT) sensor.

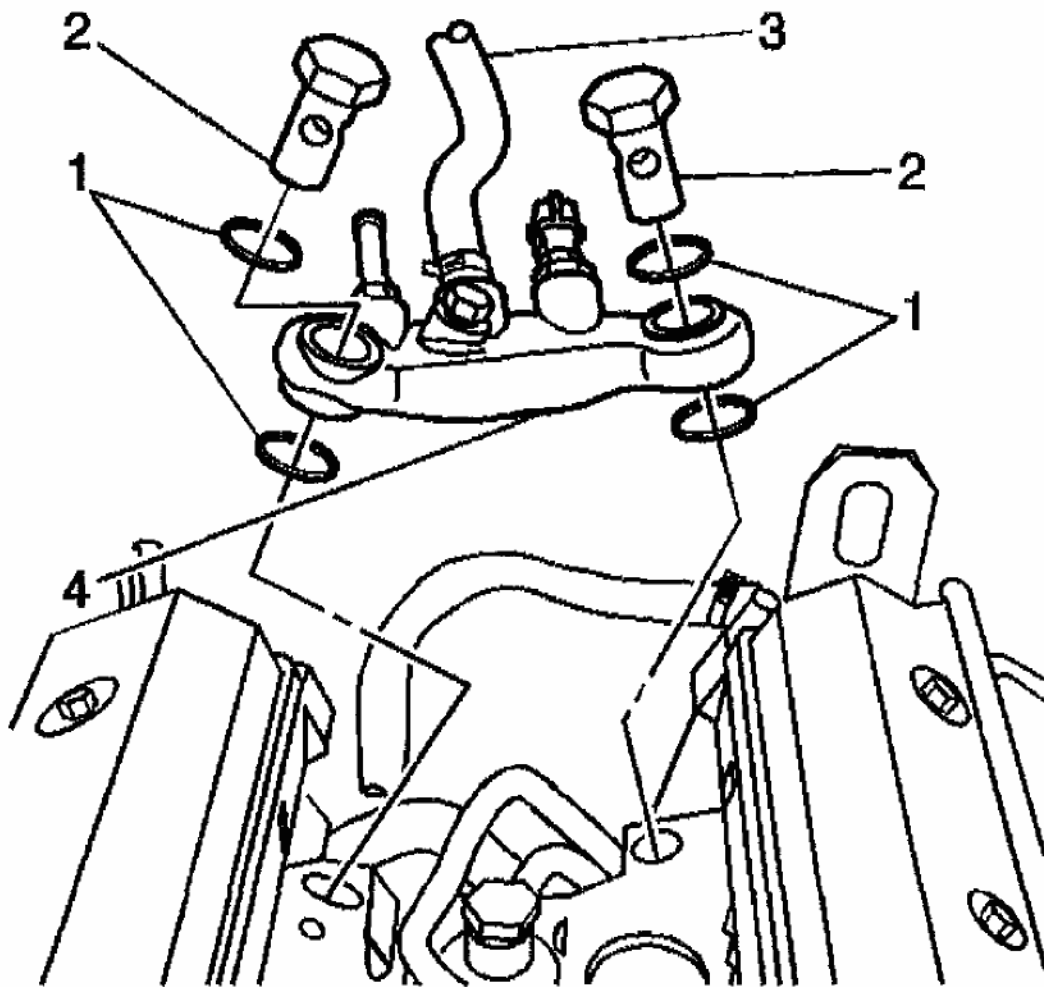


G02086614

Fig. 138: Disconnecting Engine Coolant Temperature (ECT) Sensor Electrical Connector

Courtesy of GENERAL MOTORS CORP.

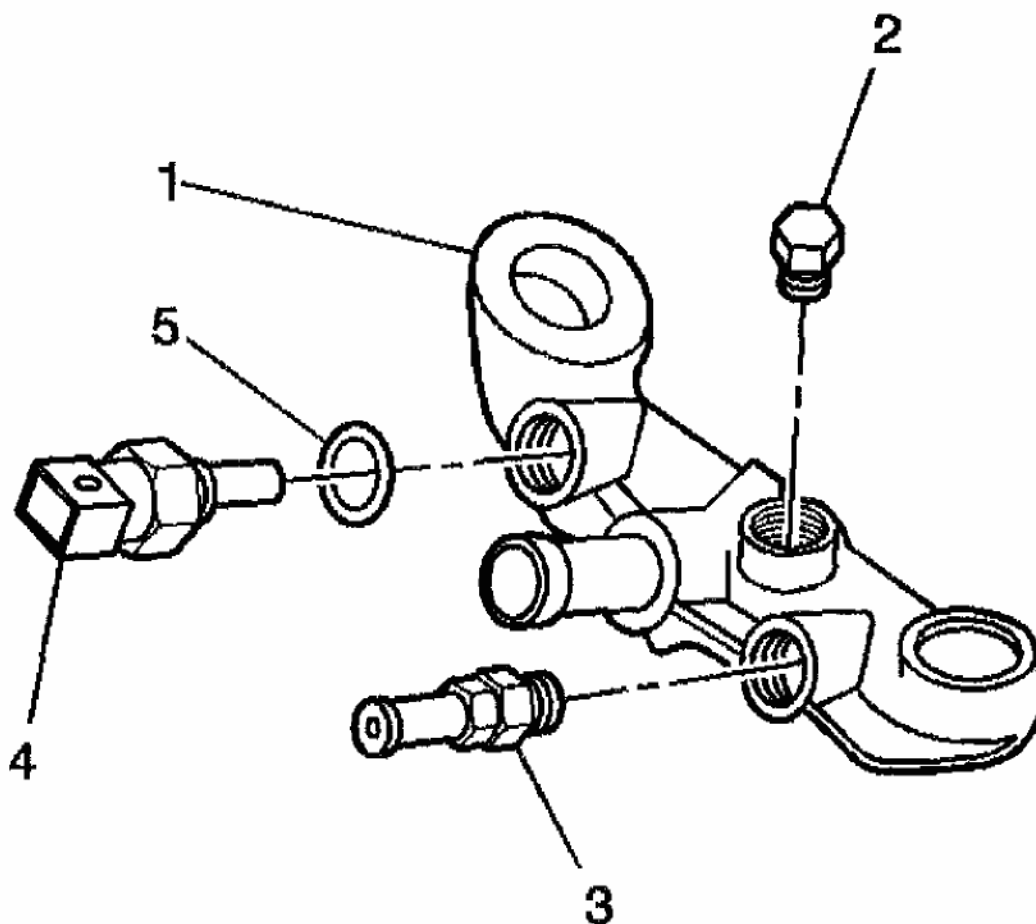
4. Disconnect the throttle body heater hose (1) from the fitting.
5. Remove the following from the cylinder heads with the heater hose (3) still attached:
 - The water crossover fittings (2)
 - The upper and lower seals (1)
 - The water crossover (4)
6. Disconnect the heater hose (3) from the water crossover (4) if replacement is necessary.



G02086615

Fig. 139: Removing Water Crossover
Courtesy of GENERAL MOTORS CORP.

7. Remove the following components from the water crossover (1) if replacement is necessary:
- The water crossover pipe plug (2)
 - The ECT sensor (4) and gasket (5)
 - The throttle body inlet heater hose fitting (3)



G02086616

Fig. 140: Removing ECT Sensor, Gasket & Throttle Body Inlet Heater Hose Fitting

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

NOTE: Refer to COMPONENT FASTENER TIGHTENING NOTICE in Cautions

and Notices.

1. Install the following components to the water crossover (1) if previously removed:

- The ECT sensor (4) and gasket (5)

Tighten

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

- The throttle body inlet heater hose fitting (3)

Tighten

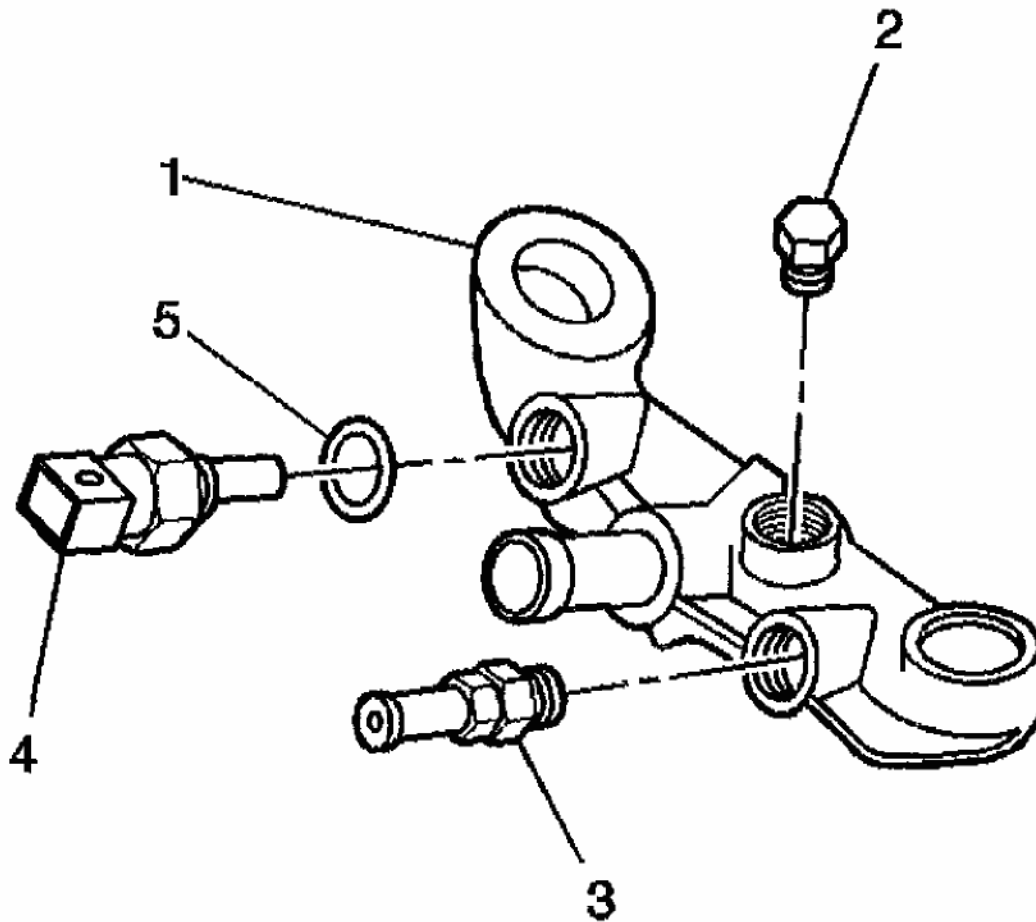
Tighten the throttle body inlet heater hose fitting to 20 N.m (15 lb ft).

- The water crossover pipe plug (2)

Tighten

Tighten the water crossover pipe plug to 5 N.m (44 lb in).

- The heater hose



G02086617

Fig. 141: Installing ECT Sensor, Gasket & Throttle Body Inlet Heater Hose Fitting

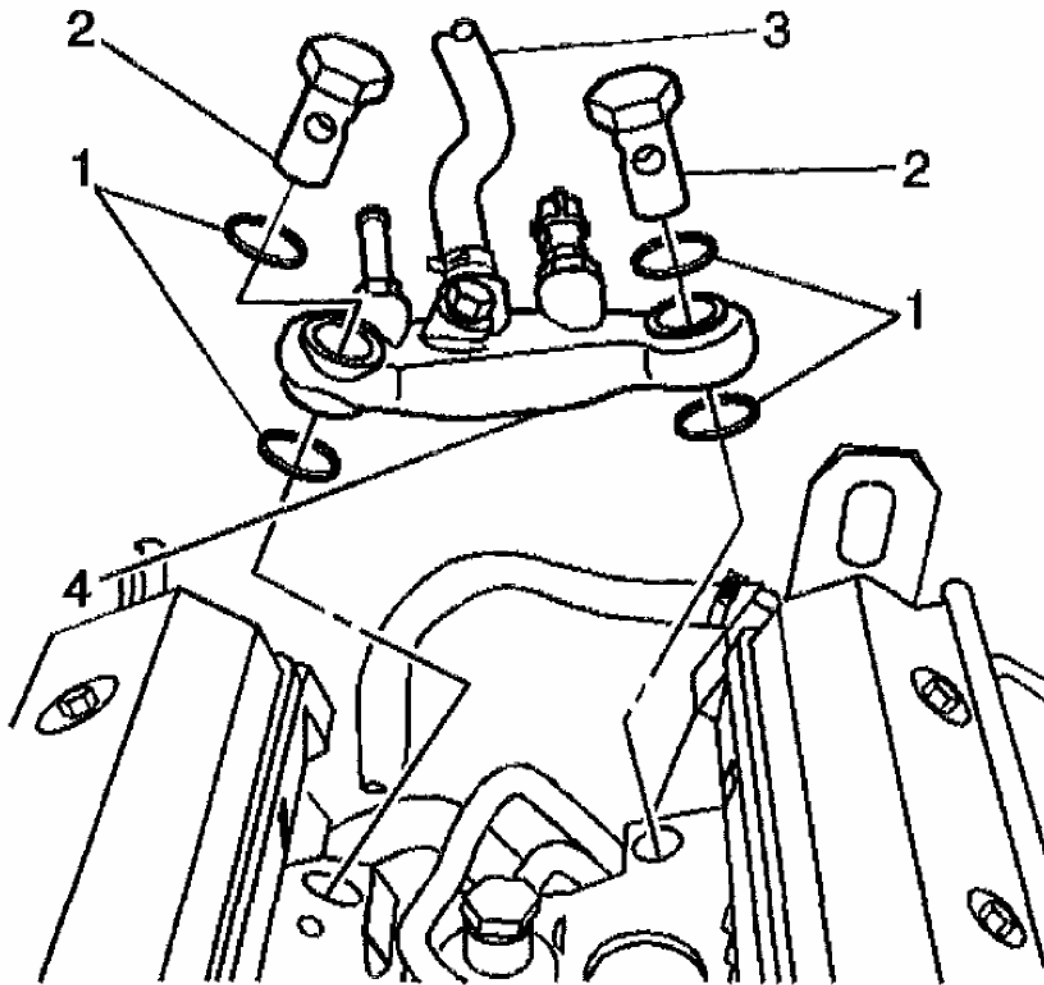
Courtesy of GENERAL MOTORS CORP.

2. Install the following to the cylinder heads:

- The upper and lower seals (1)
- The water crossover (4)
- The water crossover fittings (2)

Tighten

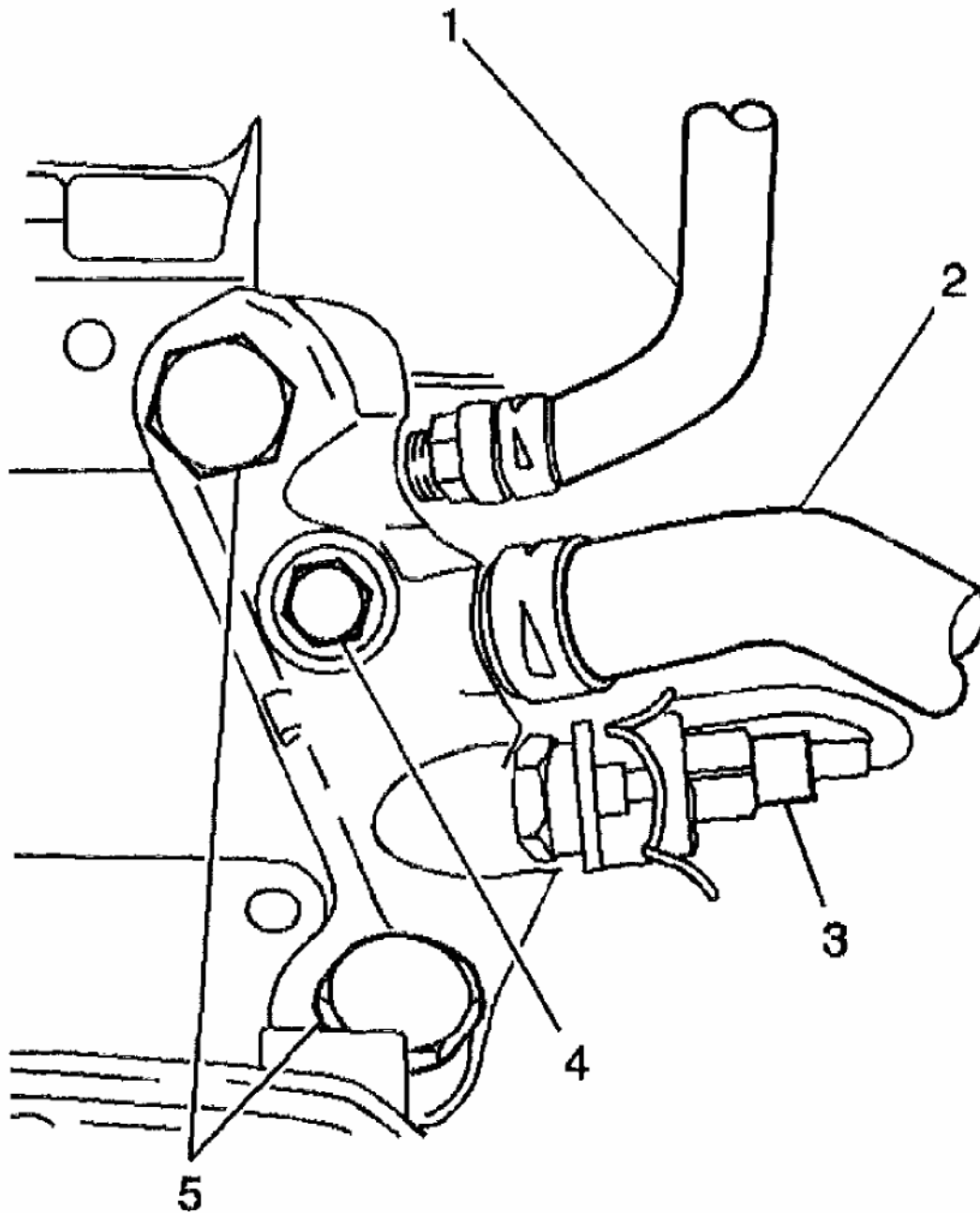
Tighten the water crossover fittings to 20 N.m (15 lb ft).



G02086618

Fig. 142: Installing Water Crossover
Courtesy of GENERAL MOTORS CORP.

3. Connect the electrical connector (3) to the ECT sensor.



G02086619

Fig. 143: Connecting Engine Coolant Temperature (ECT) Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

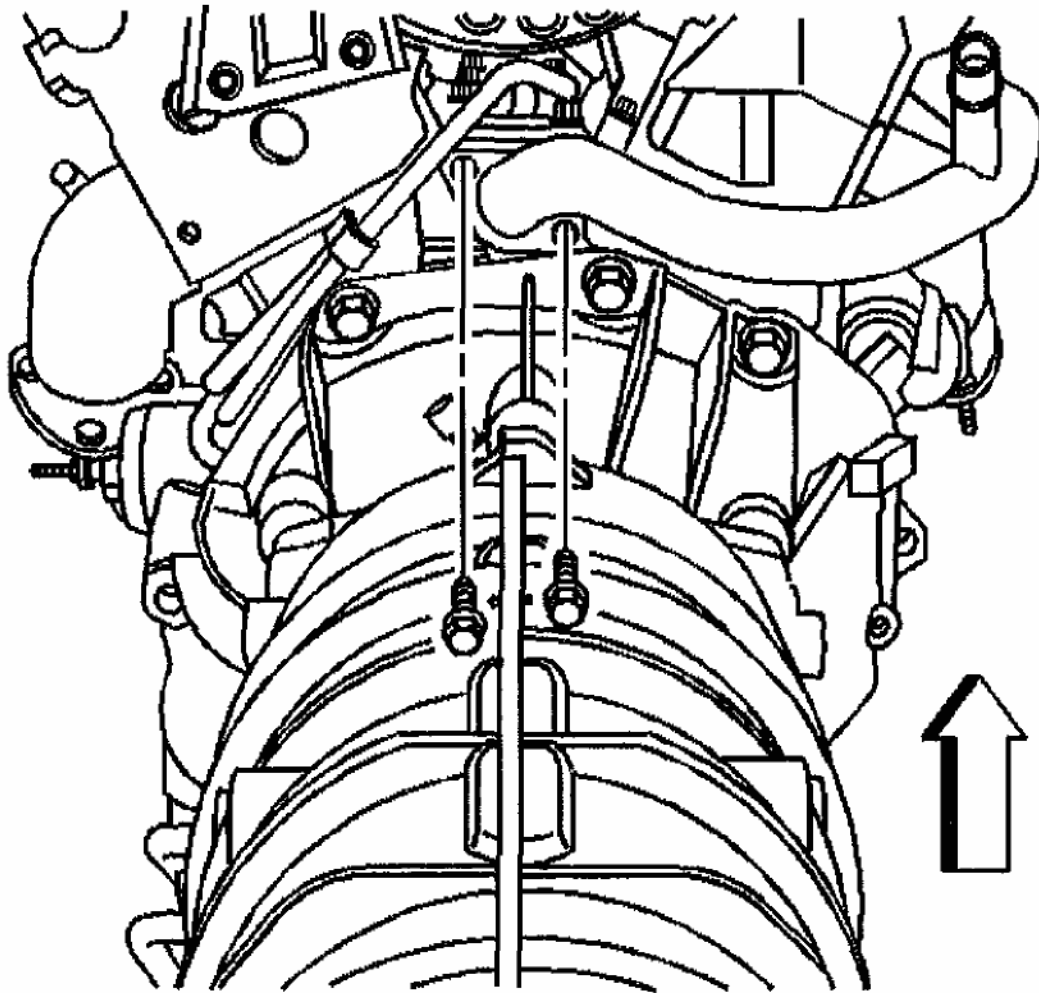
4. Connect the throttle body heater hose (1) to the fitting.
5. Install the intake manifold. Refer to INTAKE MANIFOLD REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
6. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

COOLANT PIPE REPLACEMENT - INLET**Tools Required**

J 38185 Hose Clamp Pliers

Removal Procedure

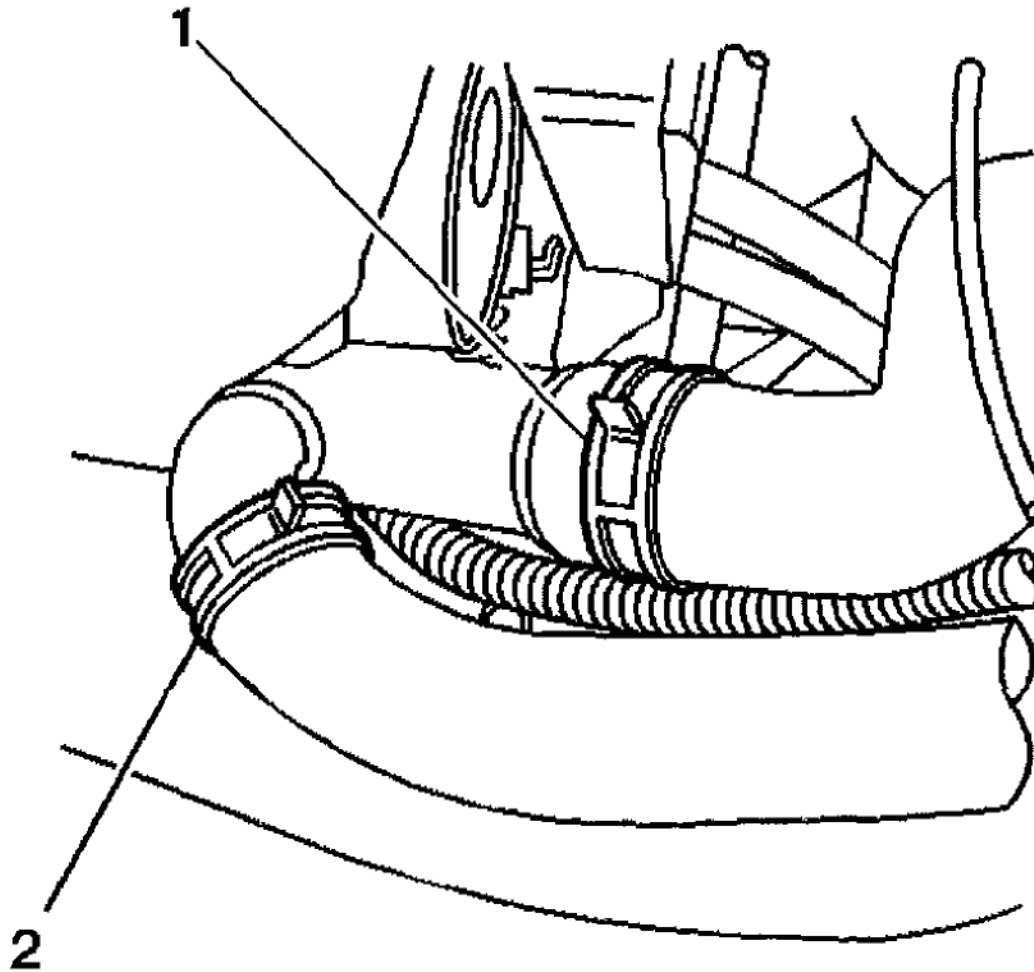
1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Remove the surge tank outlet hose/pipe. Refer to **SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LHD)** or **SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (RHD)** .
3. Remove the crankcase vent housing. Refer to CRANKCASE VENT HOUSING REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
4. Remove the water crossover. Refer to **WATER CROSSOVER REPLACEMENT** .
5. Remove the 2 bolts securing the coolant inlet pipe to the engine block.



G02086620

Fig. 144: Removing Coolant Pipe Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

6. Position the *J 38185* to the clamps in order to remove the following from the coolant inlet pipe:
 - The radiator outlet hose (1)
 - The coolant bypass outlet hose (2)

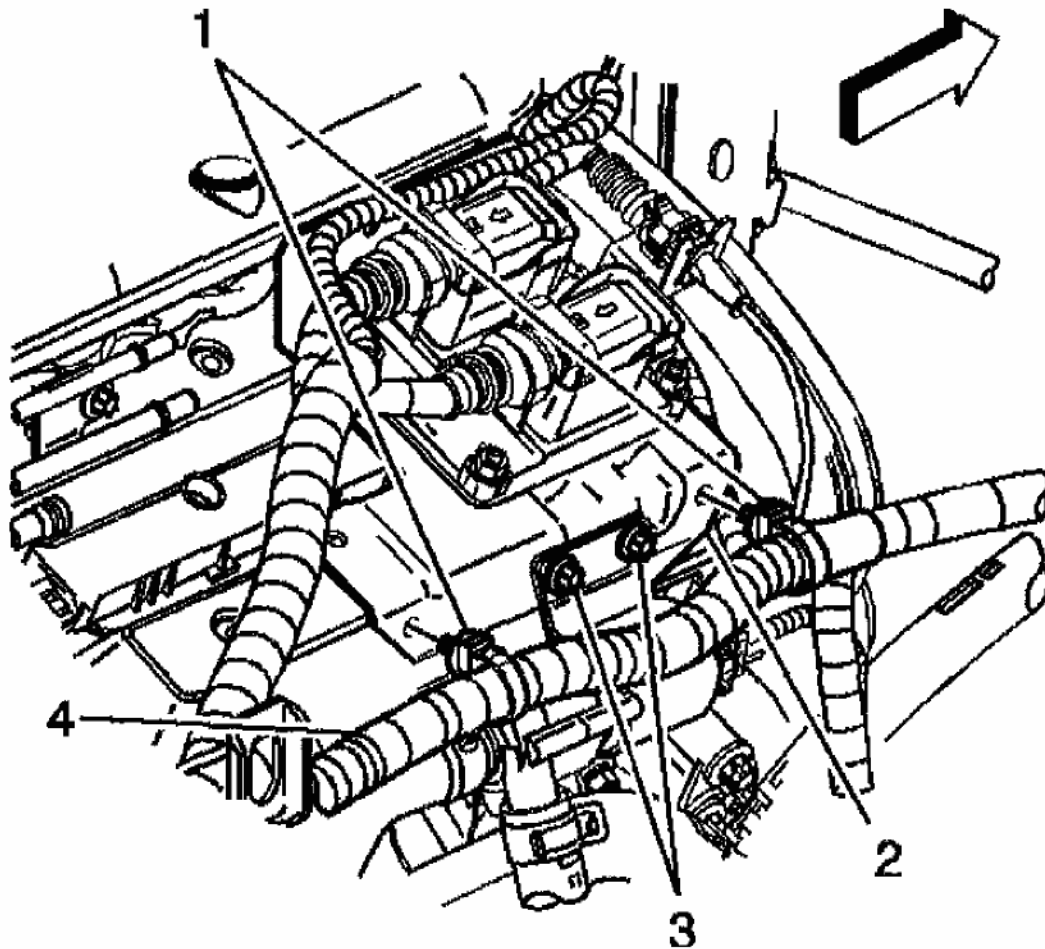


G02086621

Fig. 145: Identifying Radiator Outlet Hose & Coolant Bypass Outlet Hose Clamps

Courtesy of GENERAL MOTORS CORP.

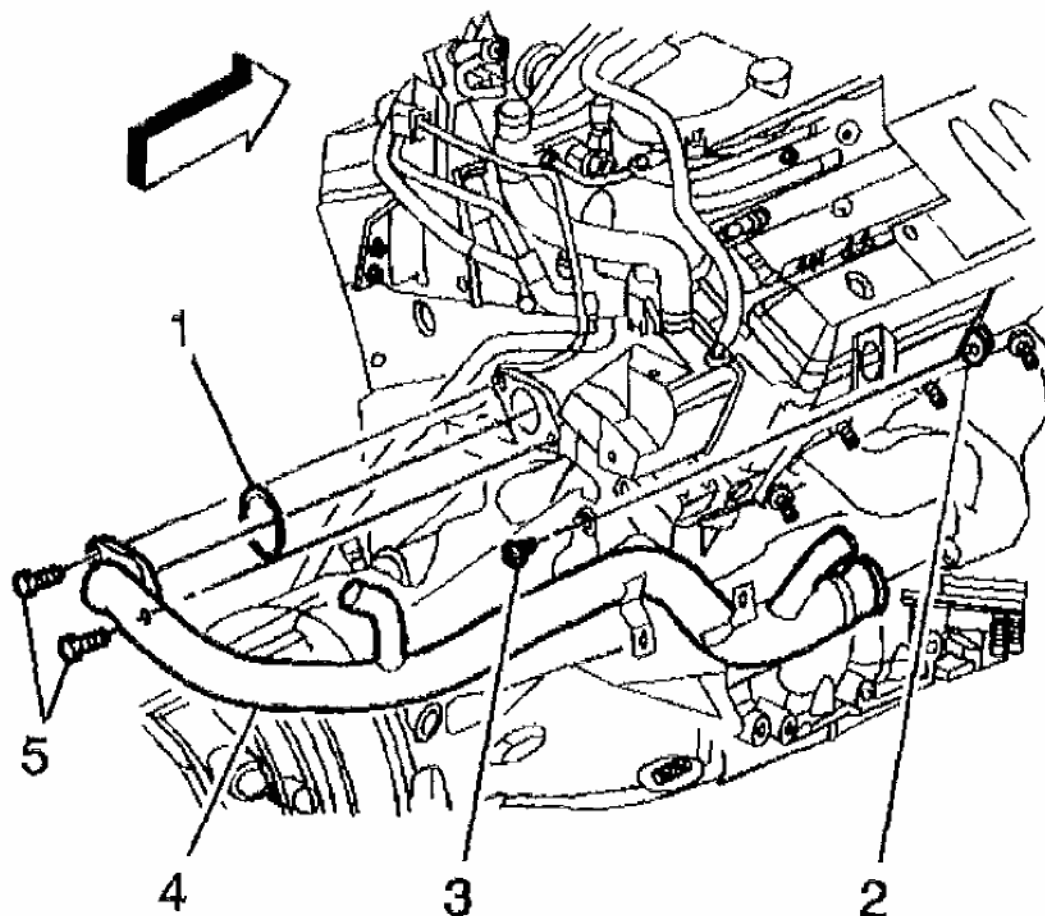
7. Disconnect the 2 cable harness clips (1) securing the engine wiring harness (4) to the engine control module (ECM) bracket (2) and position aside.



G02086622

Fig. 146: Disconnecting Cable Harness Clips To Engine Wiring Harness
Courtesy of GENERAL MOTORS CORP.

8. Remove the afterboil coolant pump. Refer to **AFTERBOIL COOLANT PUMP REPLACEMENT**.
9. Remove the 2 bolts securing the coolant bypass inlet hose/pipe to the coolant inlet pipe.
10. Remove the bolt securing the engine rear lift bracket to the cylinder head.
11. Remove the engine rear lift bracket from the cylinder head.
12. Remove the bolt (3) securing the coolant inlet pipe (4) to the ECM bracket (2).
13. Lift the coolant inlet pipe (4) upward from the engine.
14. Remove the coolant inlet pipe seal (1).



G02086623

Fig. 147: Removing Coolant Inlet Pipe, Seal & Bolts
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Insert the coolant inlet pipe seal (1) into the coolant inlet pipe seal groove.
2. Position the coolant inlet pipe (4) to the rear of the engine block.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

3. Install the 2 bolts (5) securing the coolant inlet pipe (4) to the engine block.

Tighten

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Tighten the coolant inlet pipe bolts to 20 N.m (15 lb ft).

4. Position the engine rear lift bracket to the cylinder head.
5. Install the bolt securing the engine rear lift bracket to the cylinder head.

Tighten

Tighten the engine rear lift bracket bolt to 20 N.m (15 lb ft).

6. Install the bolt (3) securing the coolant inlet pipe (4) to the ECM bracket (2).

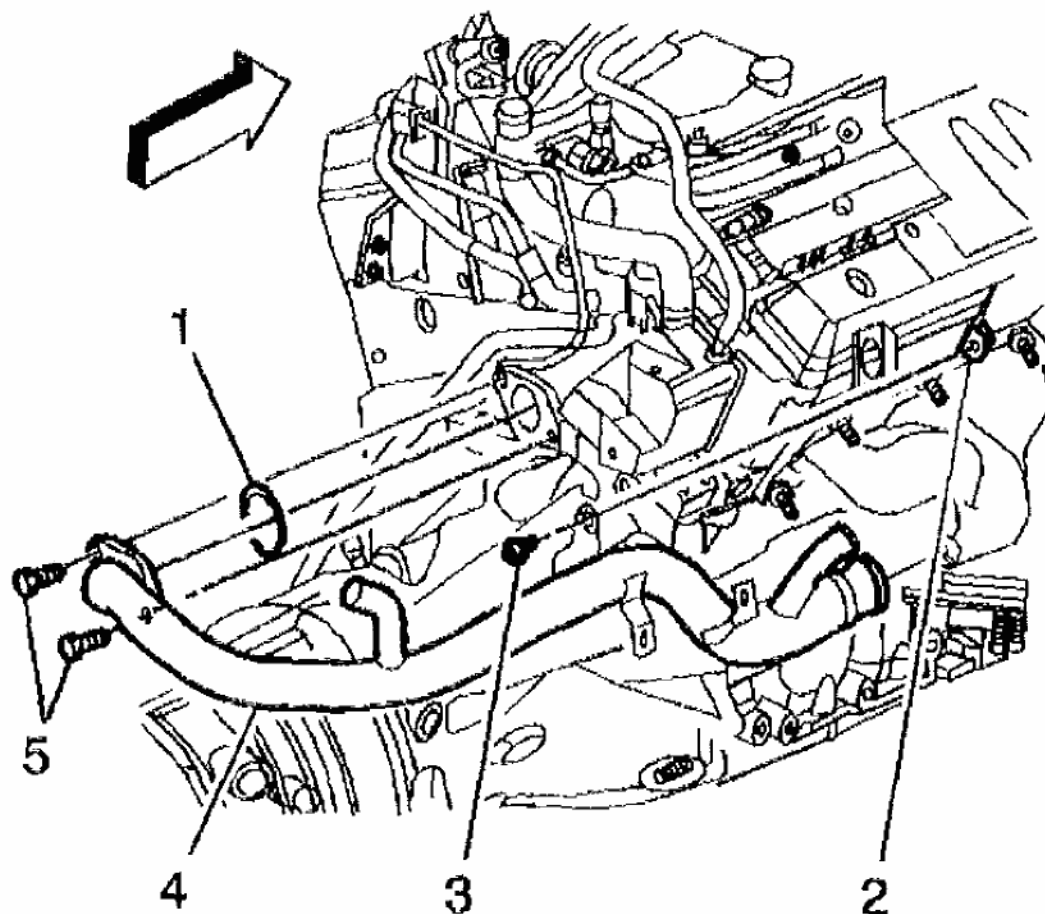
Tighten

Tighten the coolant inlet pipe support bolt to 20 N.m (15 lb ft).

7. Install the 2 bolts securing the coolant bypass inlet hose/pipe to the coolant inlet pipe.

Tighten

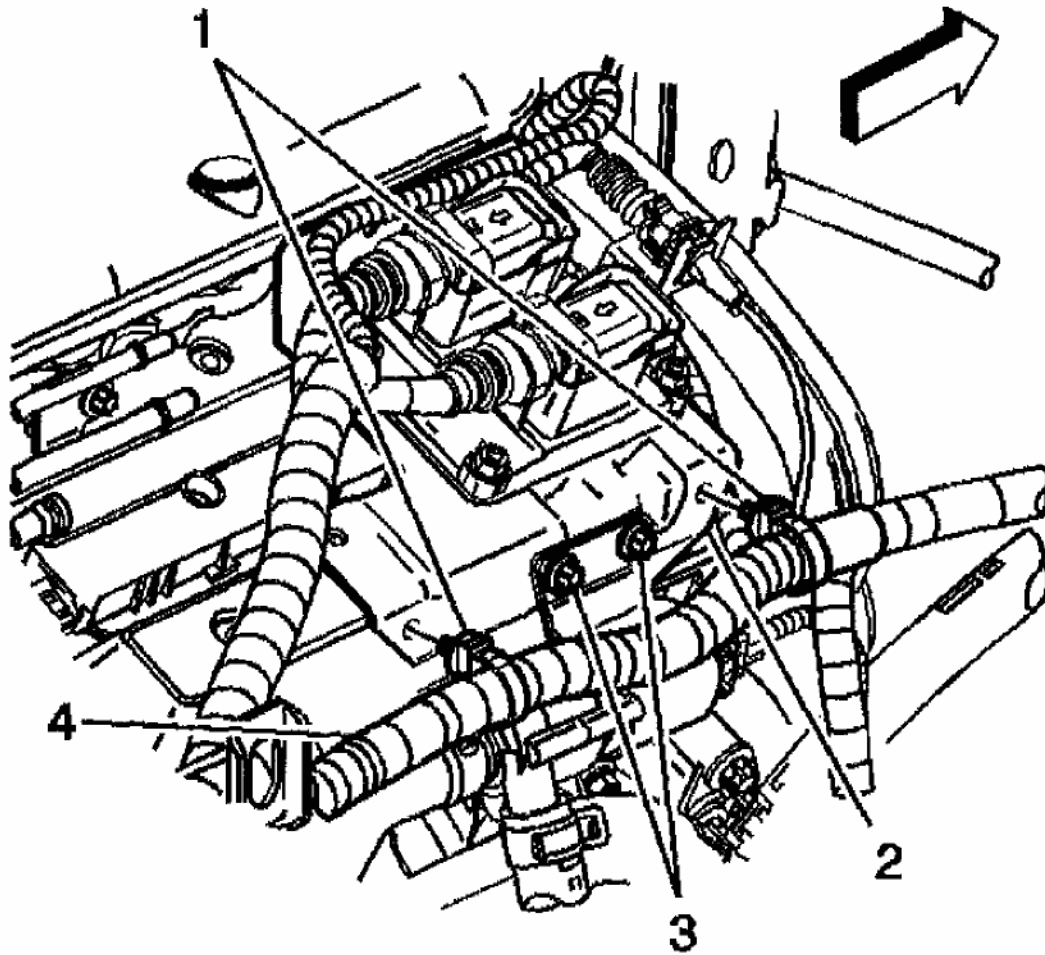
Tighten the coolant bypass inlet hose/pipe bolt to 9 N.m (80 lb in).



G02086624

Fig. 148: Installing Coolant Inlet Pipe, Seal & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the afterboil coolant pump. Refer to **AFTERBOIL COOLANT PUMP REPLACEMENT**.
9. Connect the 2 cable harness clips (1) securing the engine wiring harness (4) to the ECM bracket (2).



G02086625

Fig. 149: Connecting Cable Harness Clips To Engine Wiring Harness
Courtesy of GENERAL MOTORS CORP.

10. Position the *J 38185* to the clamps in order to connect the following to the coolant inlet pipe:
 - The radiator outlet hose (1)
 - The coolant bypass outlet hose (2)

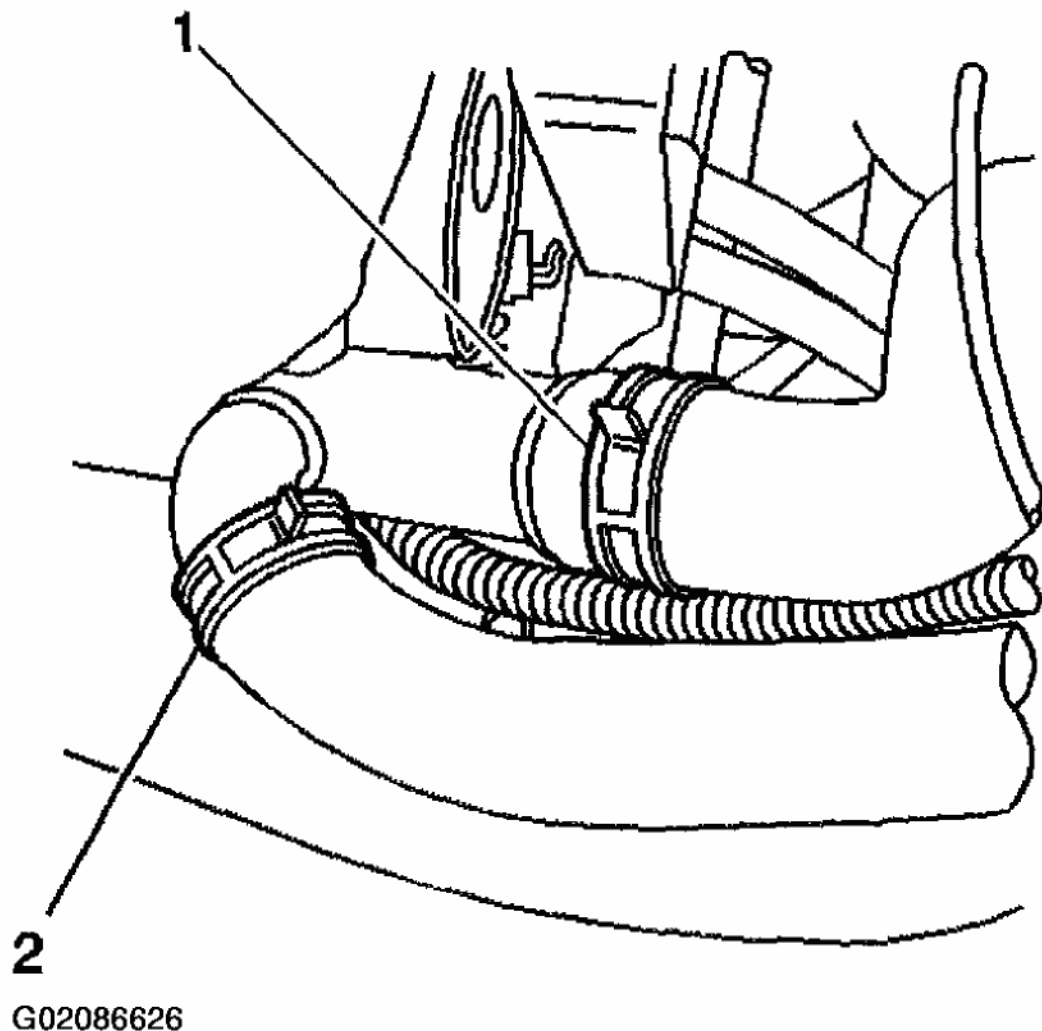


Fig. 150: Identifying Radiator Outlet Hose & Coolant Bypass Outlet Hose Clamps
Courtesy of GENERAL MOTORS CORP.

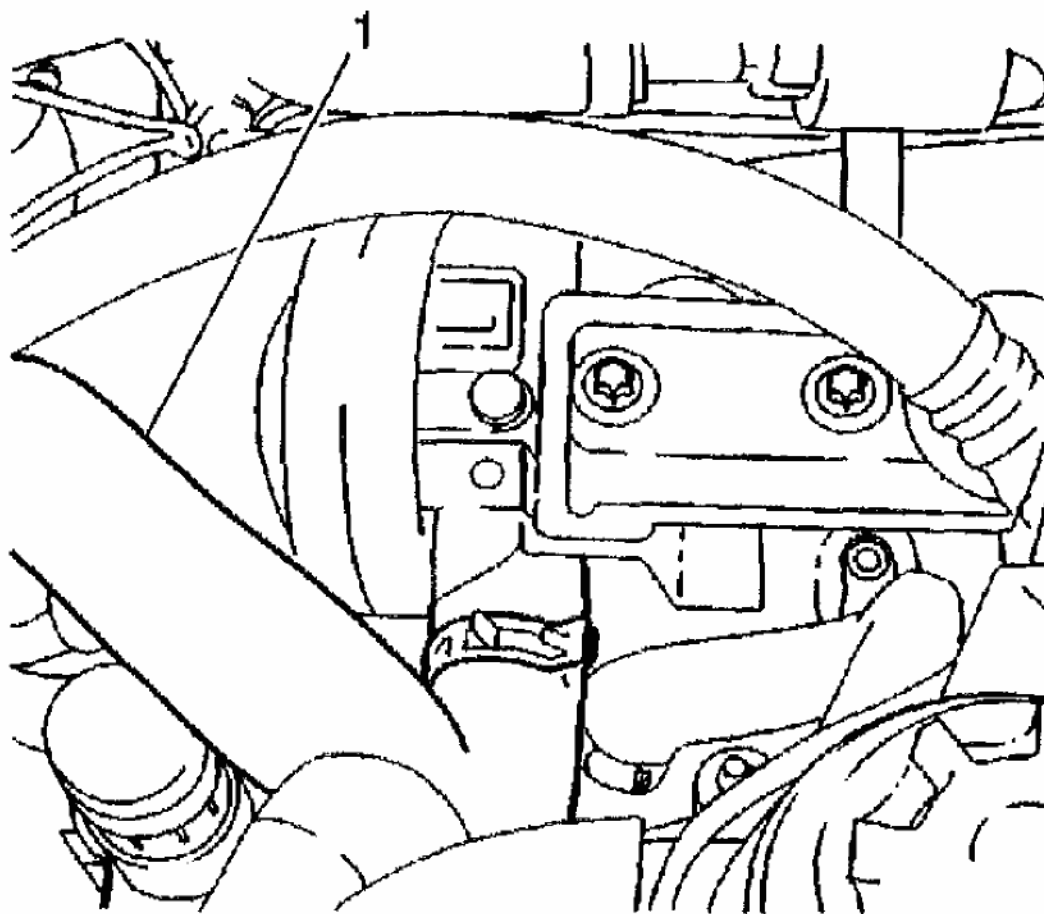
11. Install the water crossover. Refer to **WATER CROSSOVER REPLACEMENT** .
12. Install the crankcase vent housing. Refer to CRANKCASE VENT HOUSING REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
13. Install the surge tank outlet hose/pipe. Refer to **SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (LHD)** or **SURGE TANK HOSE/PIPE REPLACEMENT - OUTLET (RHD)** .
14. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

COOLANT PIPE REPLACEMENT - OUTLET**Tools Required**

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Position the *J 38185* to the clamp in order to remove the radiator inlet hose (1) from the coolant outlet pipe.

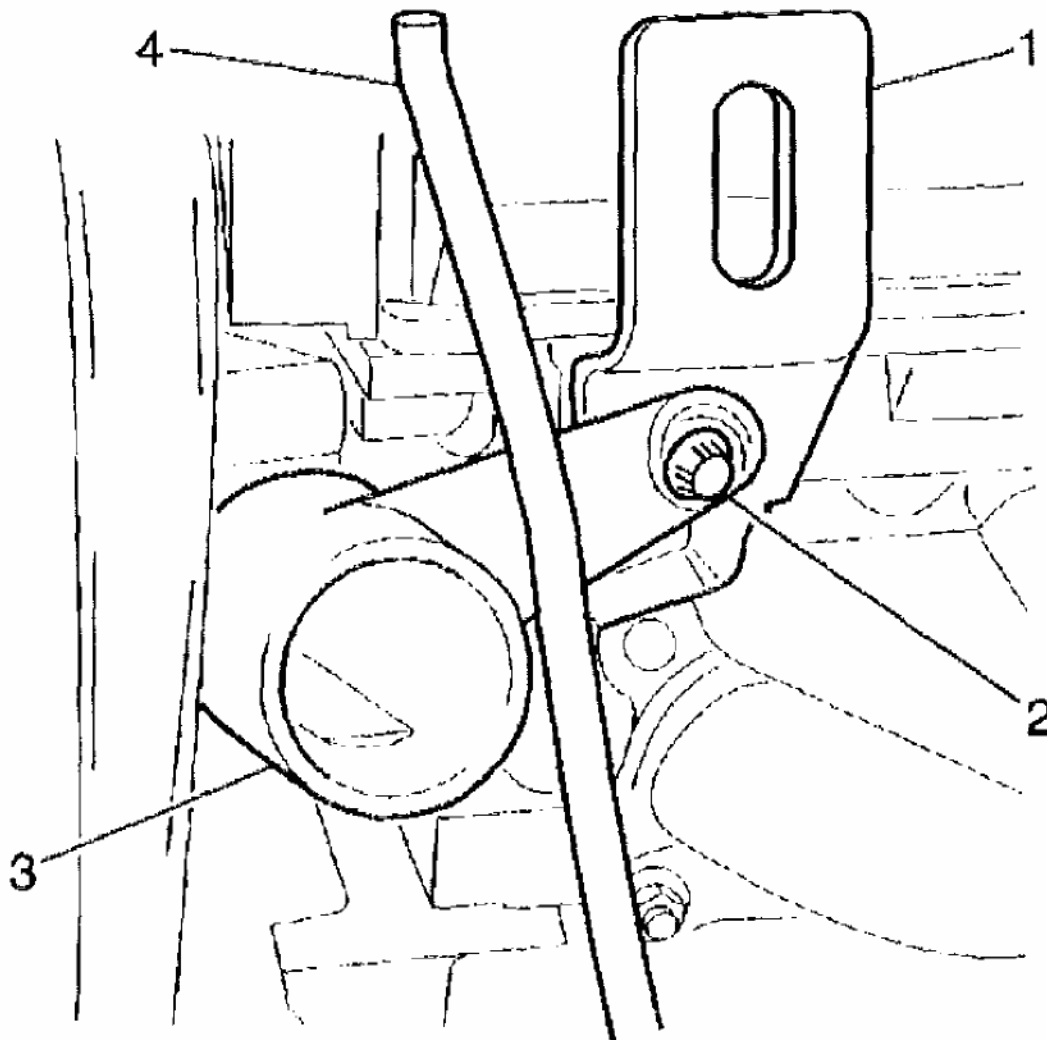


G02086627

Fig. 151: View Of Radiator Inlet Hose From Coolant Outlet Pipe

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.



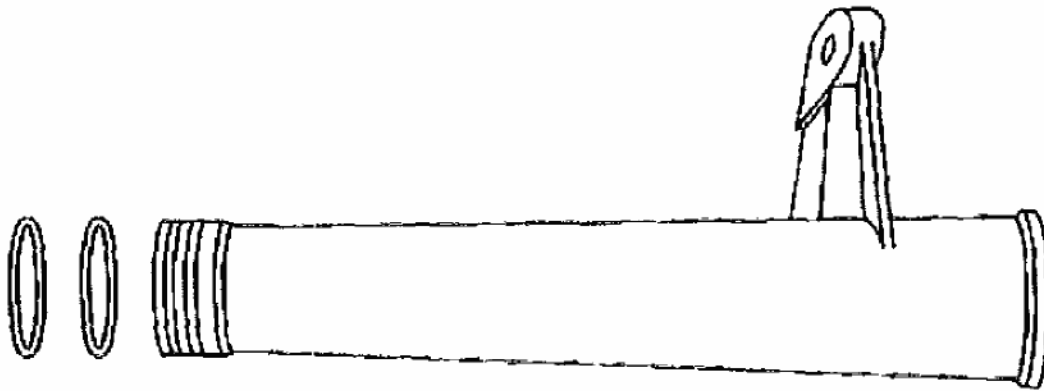
G02086628

Fig. 152: View Of Coolant Outlet Pipe

Courtesy of GENERAL MOTORS CORP.

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

Discard the O-rings.



G02086629

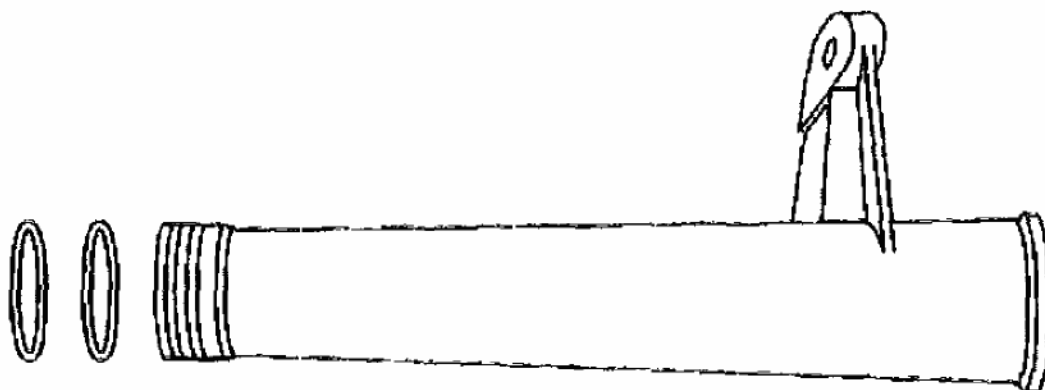
Fig. 153: Removing Coolant Outlet Pipe O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

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.



G02086630

Fig. 154: Installing Coolant Outlet Pipe O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

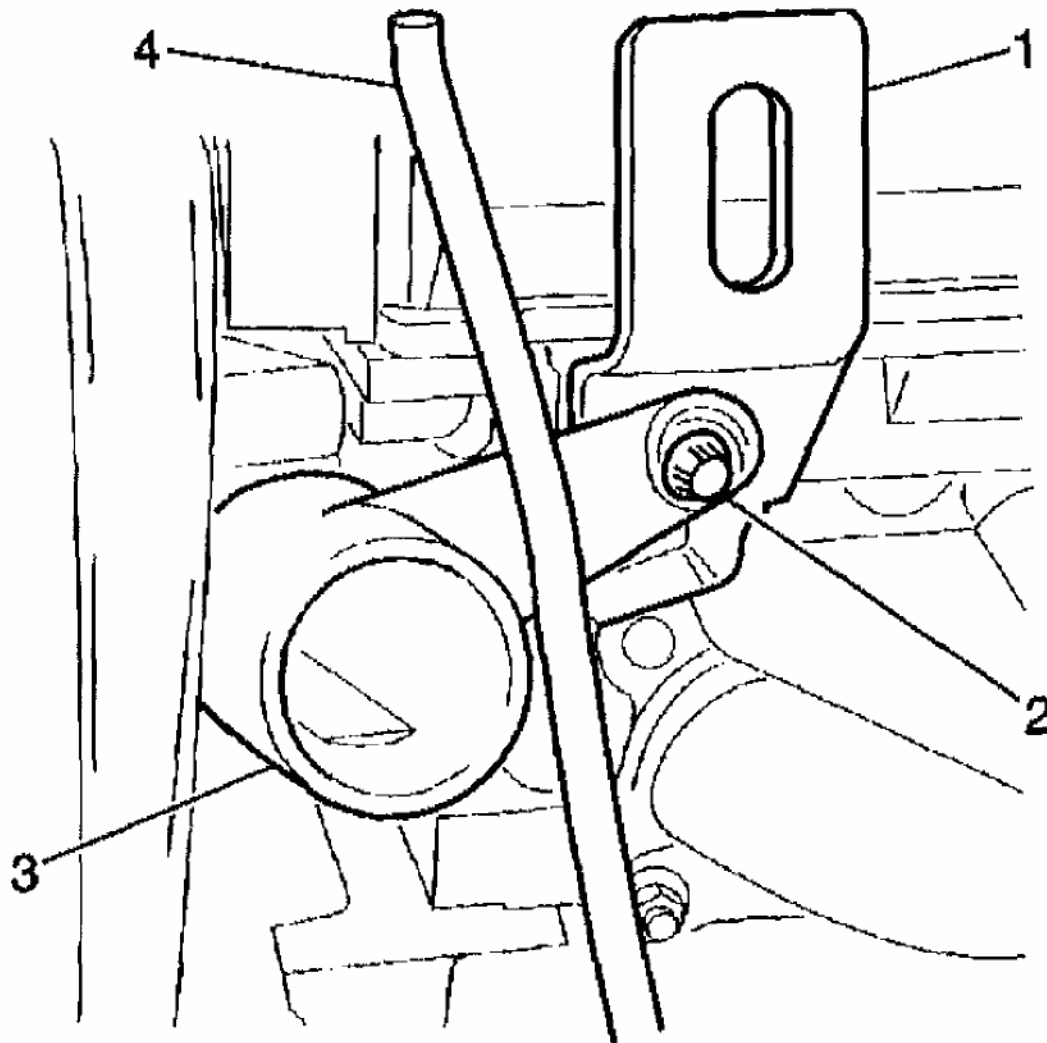
3. Insert the coolant outlet pipe (3) into the thermostat housing.

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

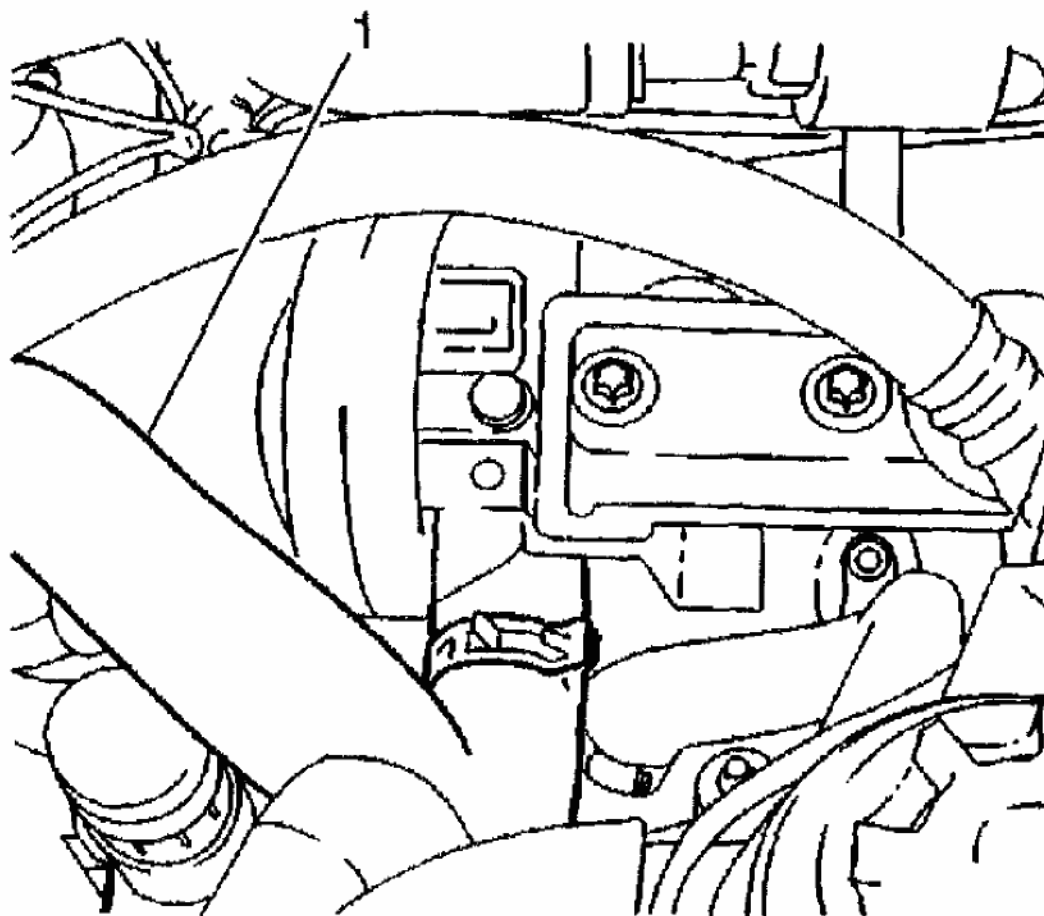
Tighten the oil level indicator tube bolt to 20 N.m (15 lb ft).



G02086631

Fig. 155: View Of Coolant Outlet Pipe
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.



G02086632

Fig. 156: View Of Radiator Inlet Hose To Coolant Outlet Pipe
Courtesy of GENERAL MOTORS CORP.

6. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

COOLANT BYPASS HOSE REPLACEMENT

Tools Required

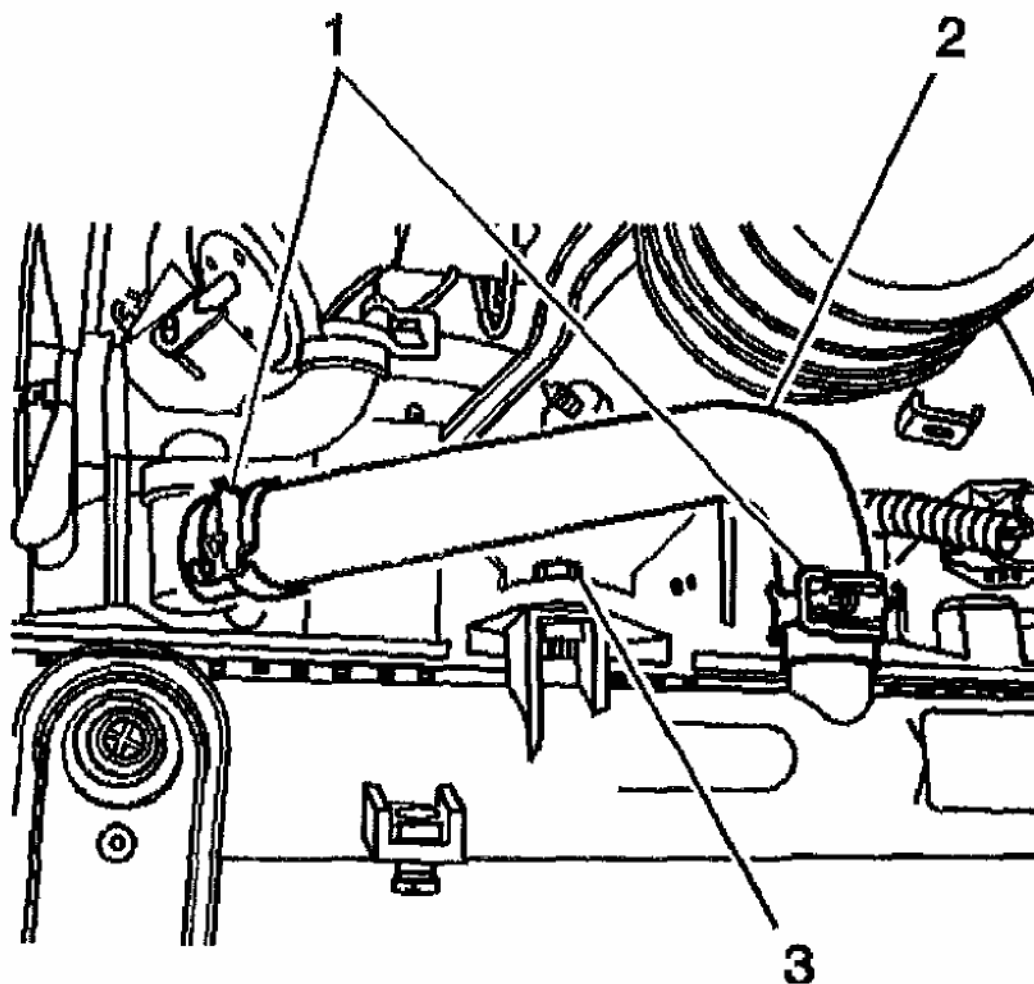
J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain and recover the coolant. Refer to **DRAINING AND FILLING COOLING**

SYSTEM .

2. Using *J 38185* slide the hose clamps (1) back on the bypass hose (2).
3. Remove the bypass hose.



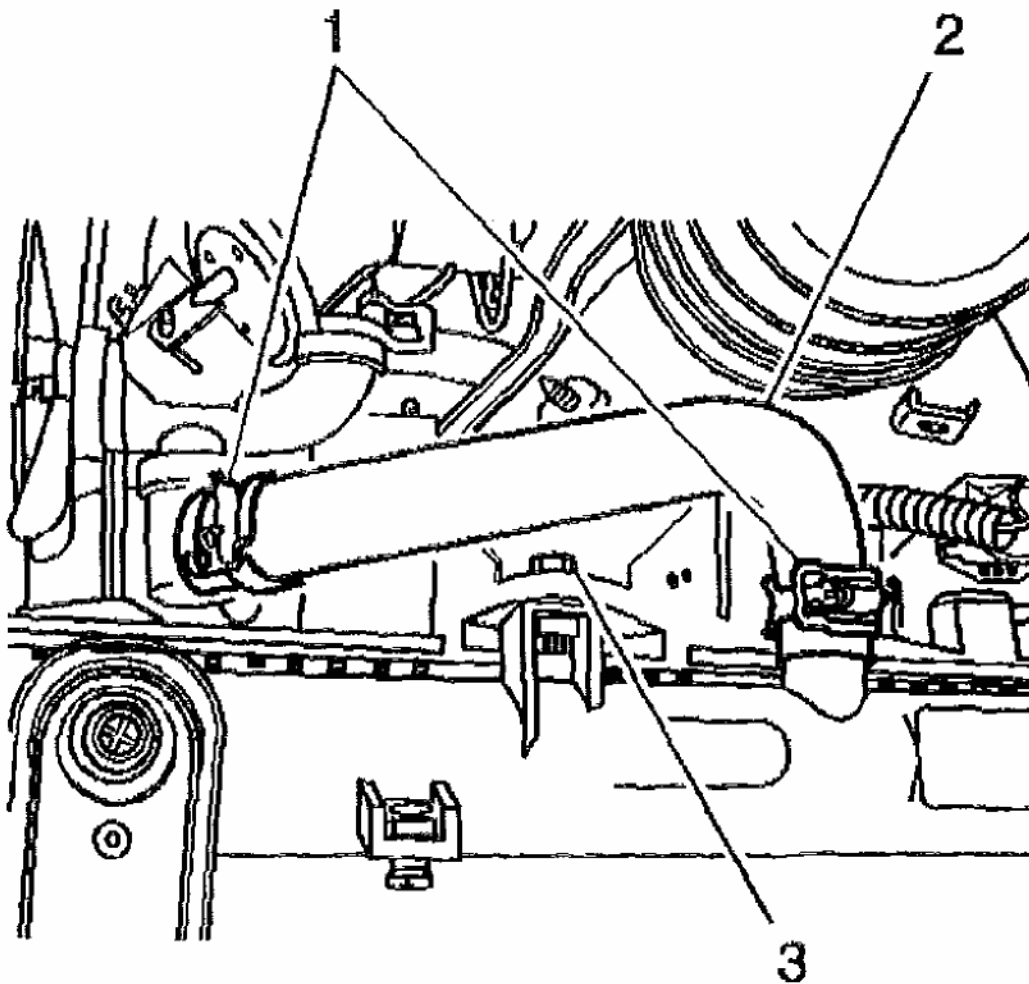
G02086633

Fig. 157: Identifying Bypass Hose Clamps
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the bypass hose.
2. Using *J 38185* install the hose clamps (1) into the original position on the bypass hose (2).

3. Fill the vehicle with coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.



G02086634

Fig. 158: Identifying Bypass Hose Clamps
Courtesy of GENERAL MOTORS CORP.

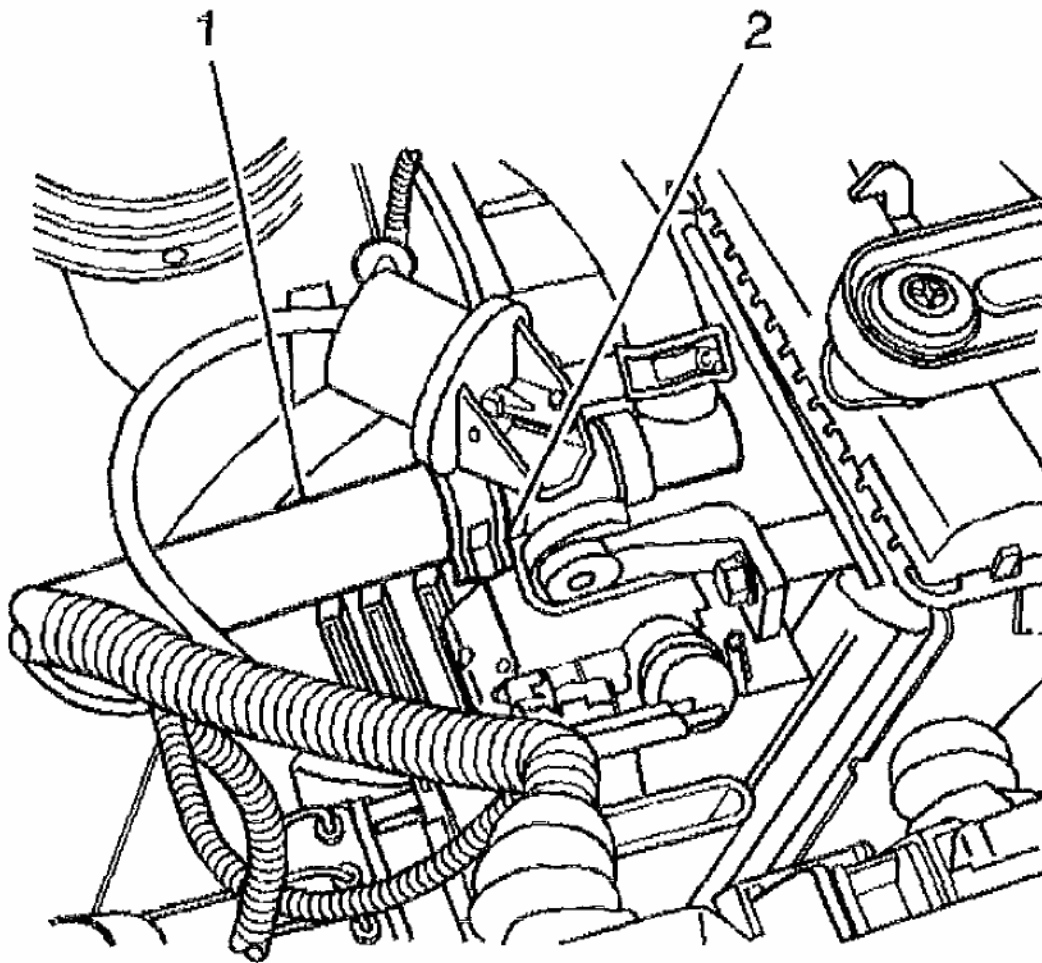
COOLANT BYPASS VALVE REPLACEMENT

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Partially drain the engine coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Using the *J 38185* slide the hose clamp (2) back on the coolant bypass inlet hose.

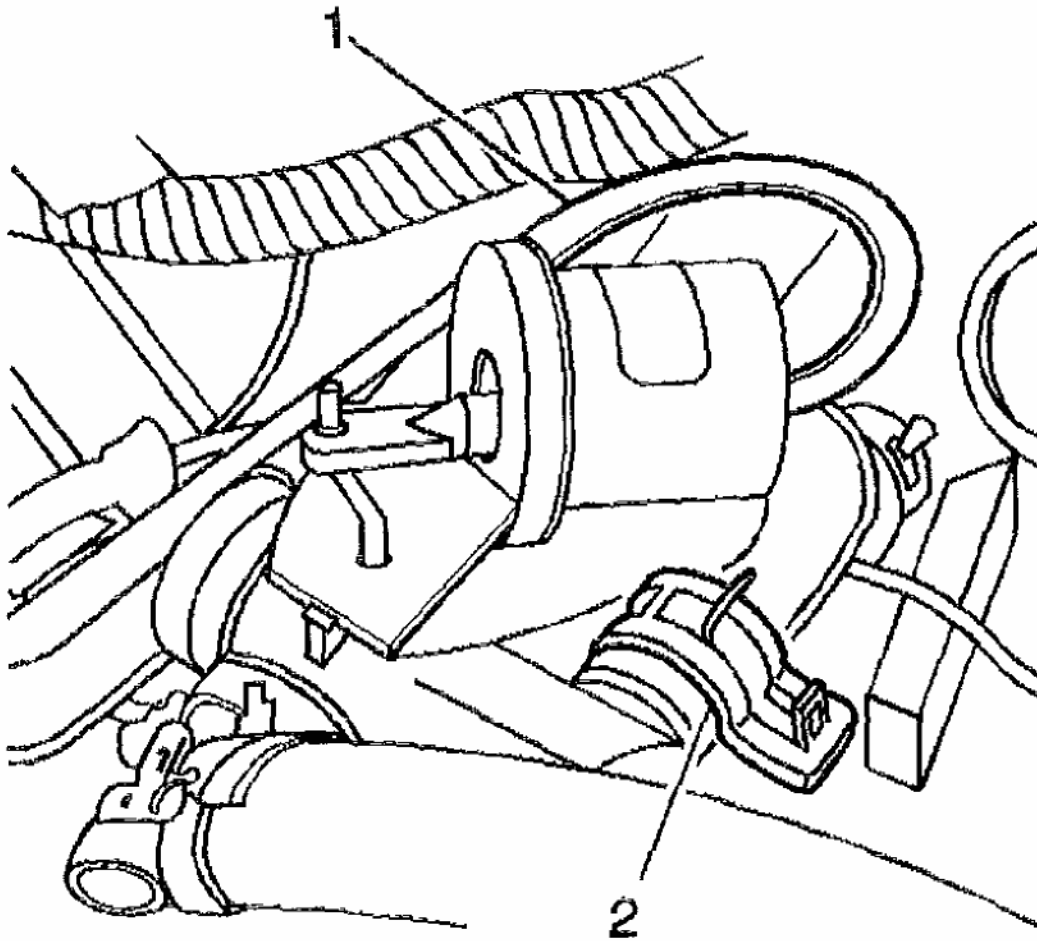


G02086635

Fig. 159: View Of Coolant Bypass Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant bypass inlet hose (1).
4. Using the *J 38185* slide the hose clamp back on the coolant bypass outlet hose.
5. Using the *J 38185* slide the hose clamp (2) back on the coolant bypass outlet hose.

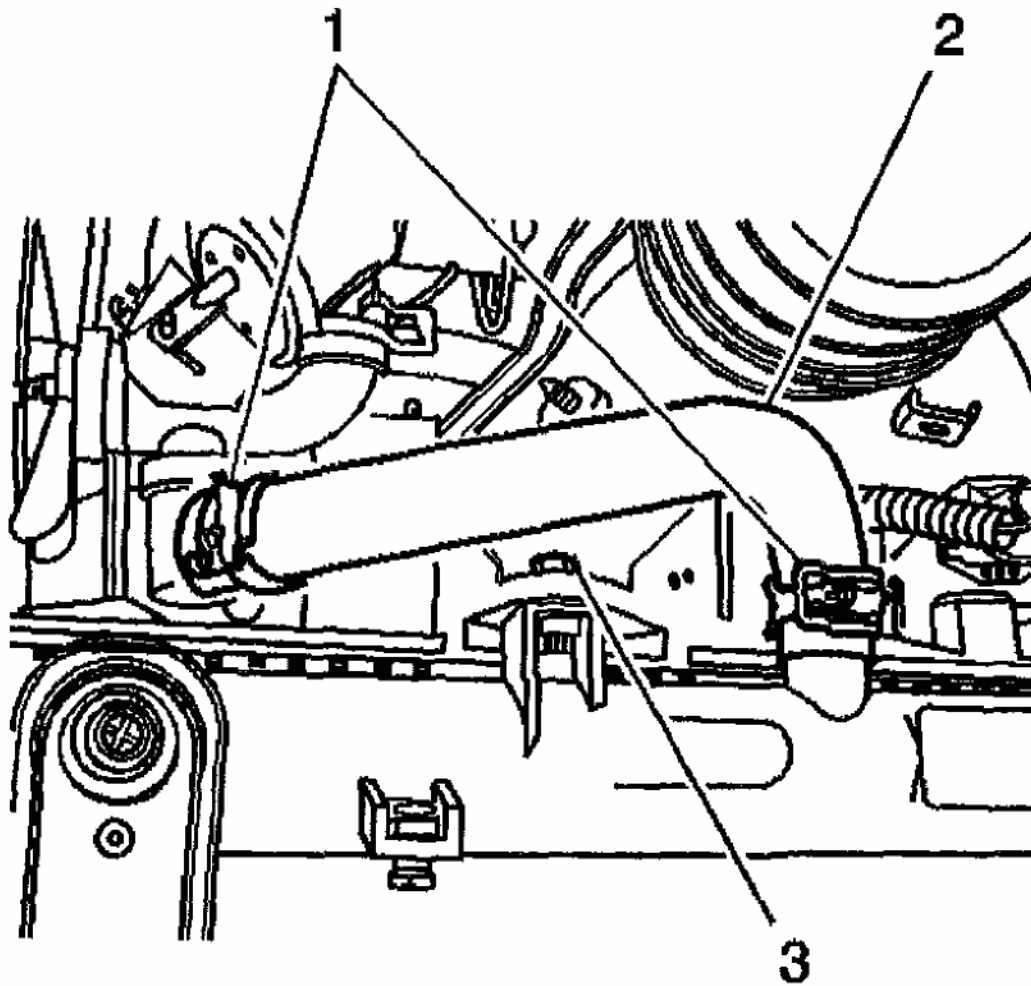
6. Disconnect the coolant bypass outlet hose.
7. Disconnect the vacuum hose (1).



G02086636

Fig. 160: Identifying Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

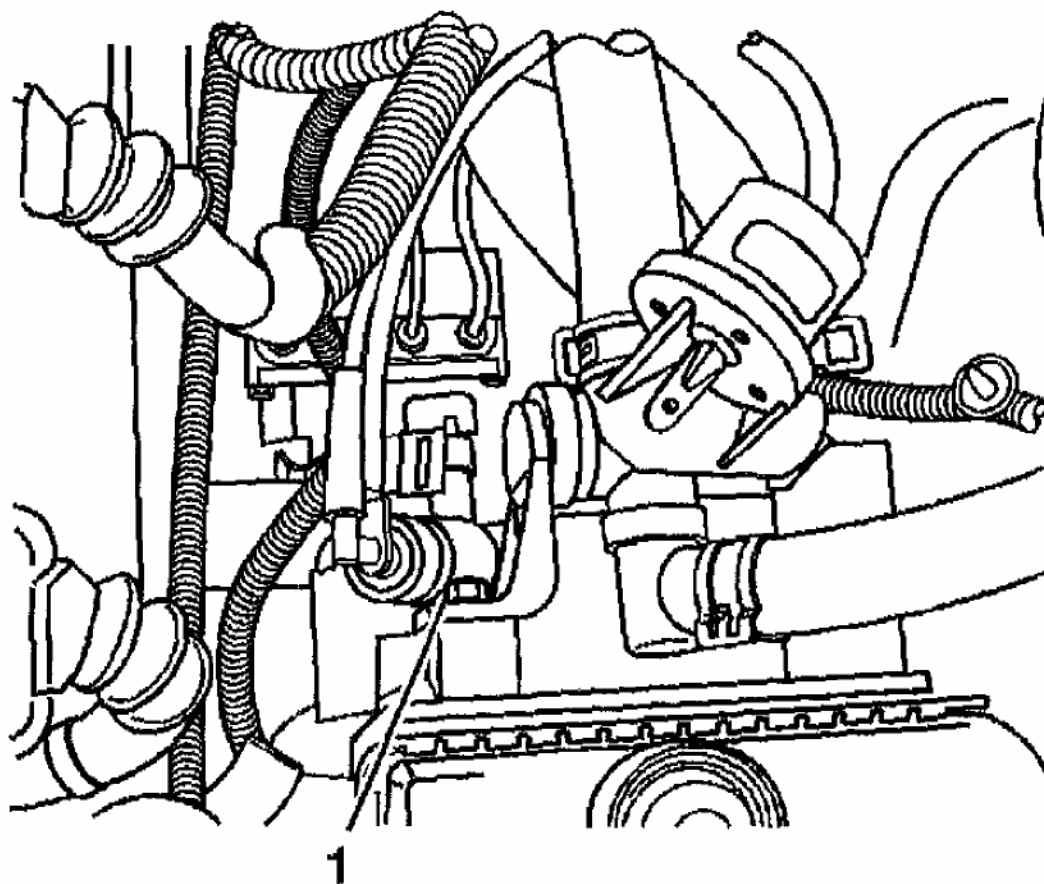
8. Using the *J 38/85* slide the hose clamp (1) back on the coolant bypass hose.
9. Disconnect the coolant bypass hose.



G02086637

Fig. 161: Locating Coolant Bypass Hose Clamp
Courtesy of GENERAL MOTORS CORP.

10. Remove the bolt (1) that retains the valve to the coolant bypass valve assembly.
11. Remove the coolant bypass valve.



G02086638

Fig. 162: Removing Coolant Bypass Valve Assembly & Bolt
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

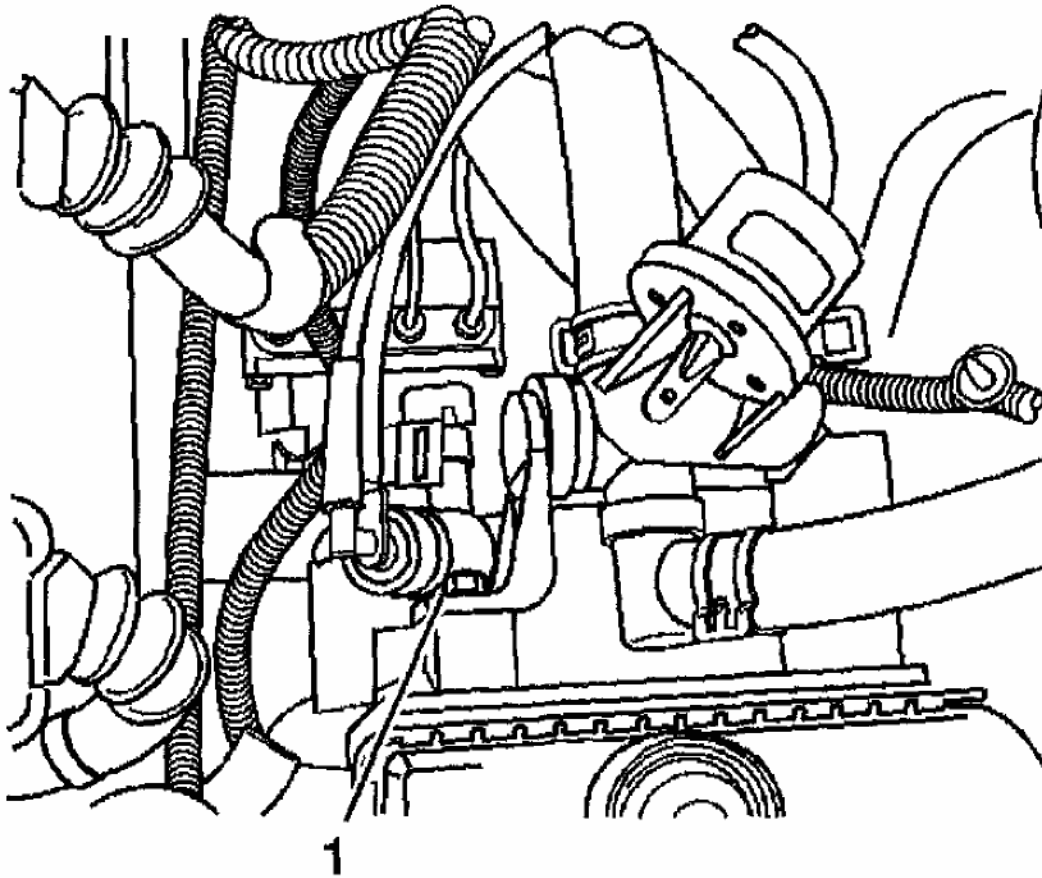
1. Install the heater hoses to the coolant bypass valve.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

2. Install the coolant bypass valve bolt (1).

Tighten

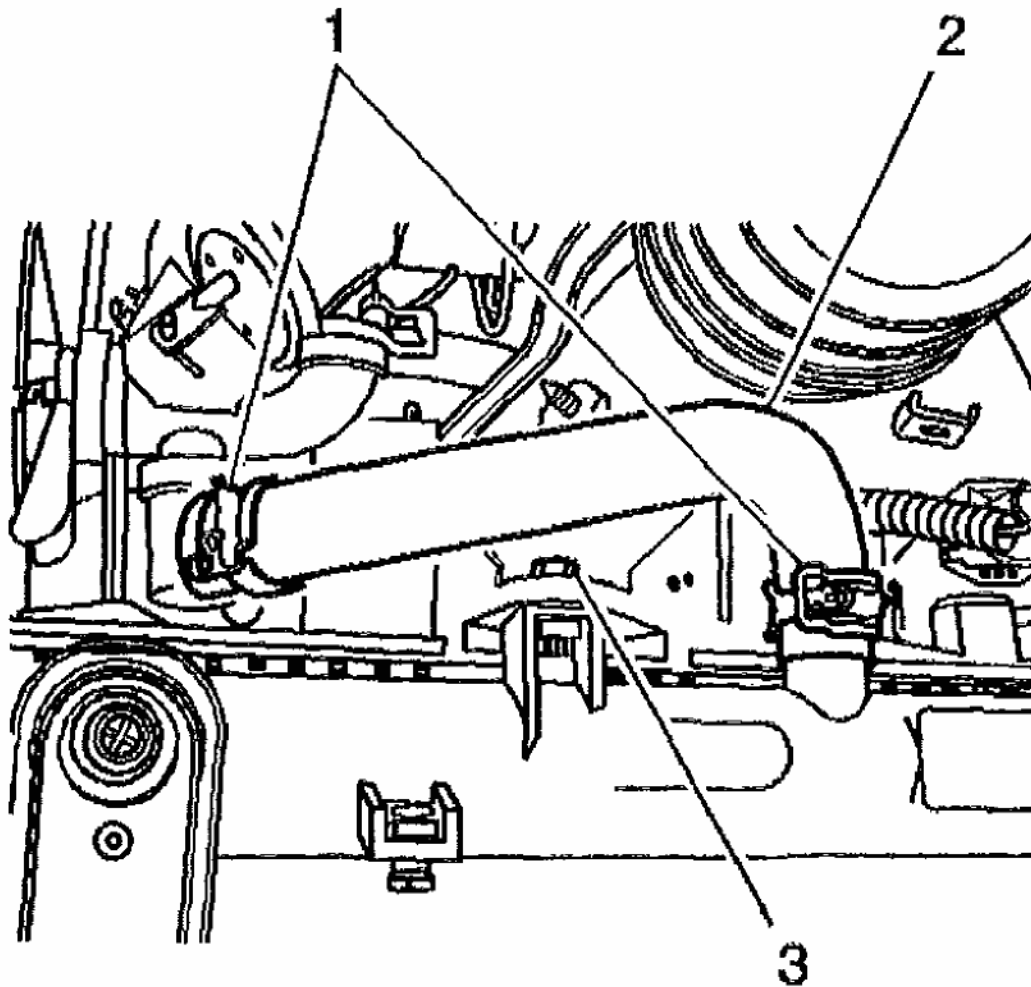
Tighten the bolt to 6.5 N.m (58 lb in).



G02086639

Fig. 163: Installing Coolant Bypass Valve Assembly & Bolt
Courtesy of GENERAL MOTORS CORP.

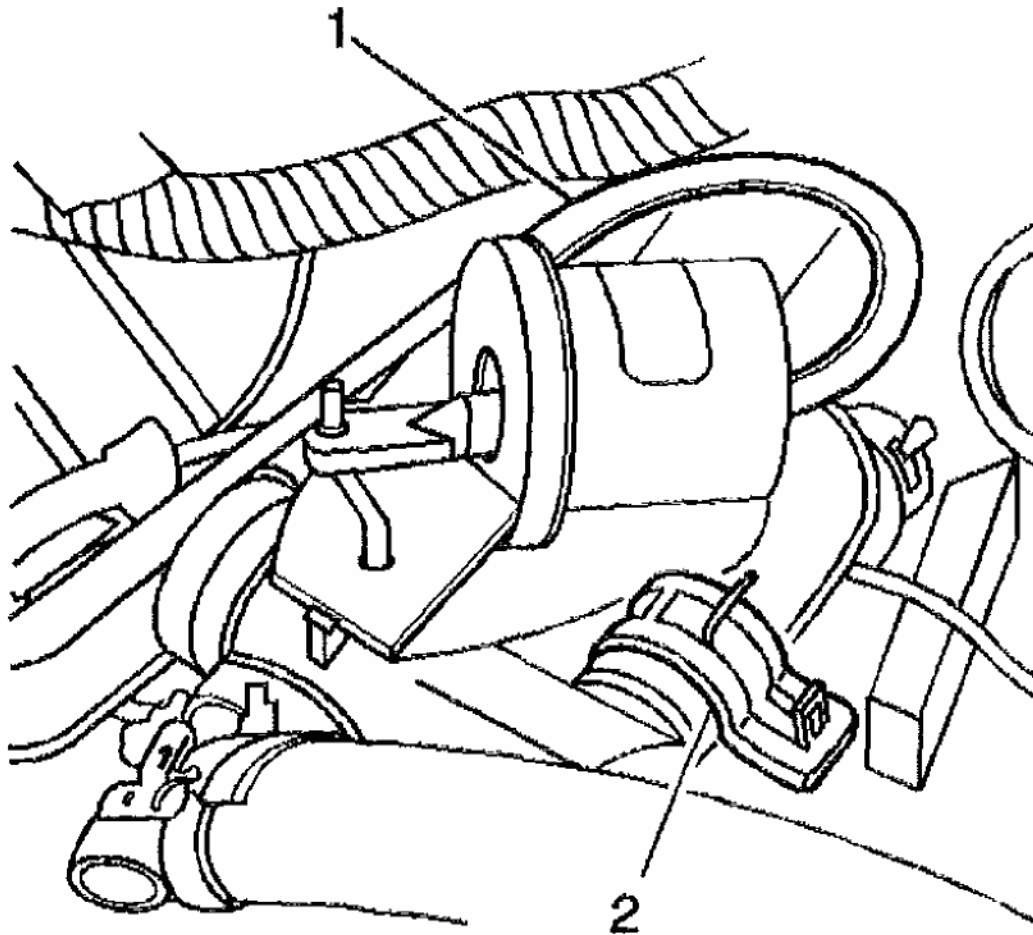
3. Position the coolant bypass hose (2) into the original position.
4. Using the *J 38185* slide the hose clamp (1) back into the original position.



G02086640

Fig. 164: Locating Coolant Bypass Hose Clamp
Courtesy of GENERAL MOTORS CORP.

5. Install the outlet bypass hose to the coolant bypass valve.
6. Use the *J 38185* to slide the hose clamp (2) into there original position.
7. Connect the vacuum hose (1).



G02086641

Fig. 165: Identifying Vacuum Hose
 Courtesy of GENERAL MOTORS CORP.

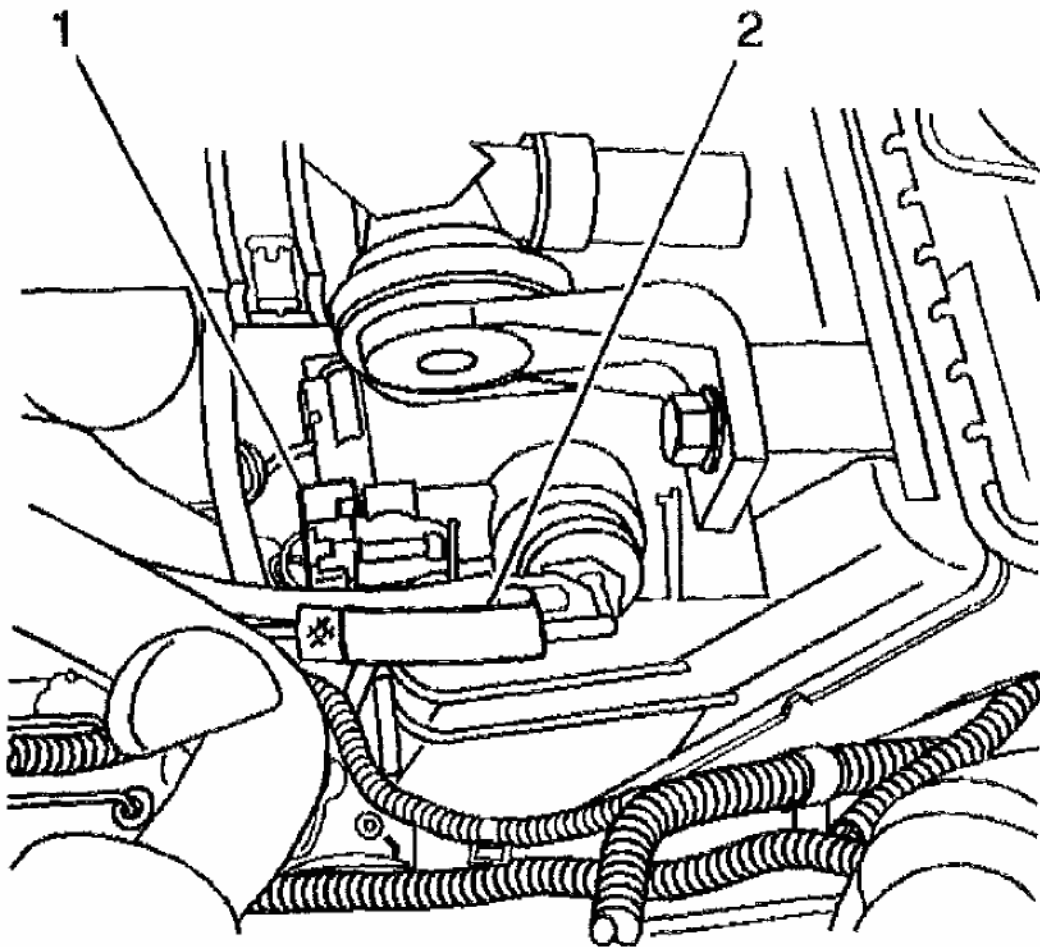
8. Install the bypass inlet hose (1) to the coolant bypass valve.
9. Use the *J 38185* to slide the hose clamp (2) into their original position.
10. Refill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

COOLANT BYPASS SOLENOID REPLACEMENT

Removal Procedure

1. Disconnect the coolant bypass solenoid electrical connector (1).

2. Disconnect the vacuum hoses (2) from the coolant bypass solenoid.
3. Release the tab and remove the coolant bypass solenoid.

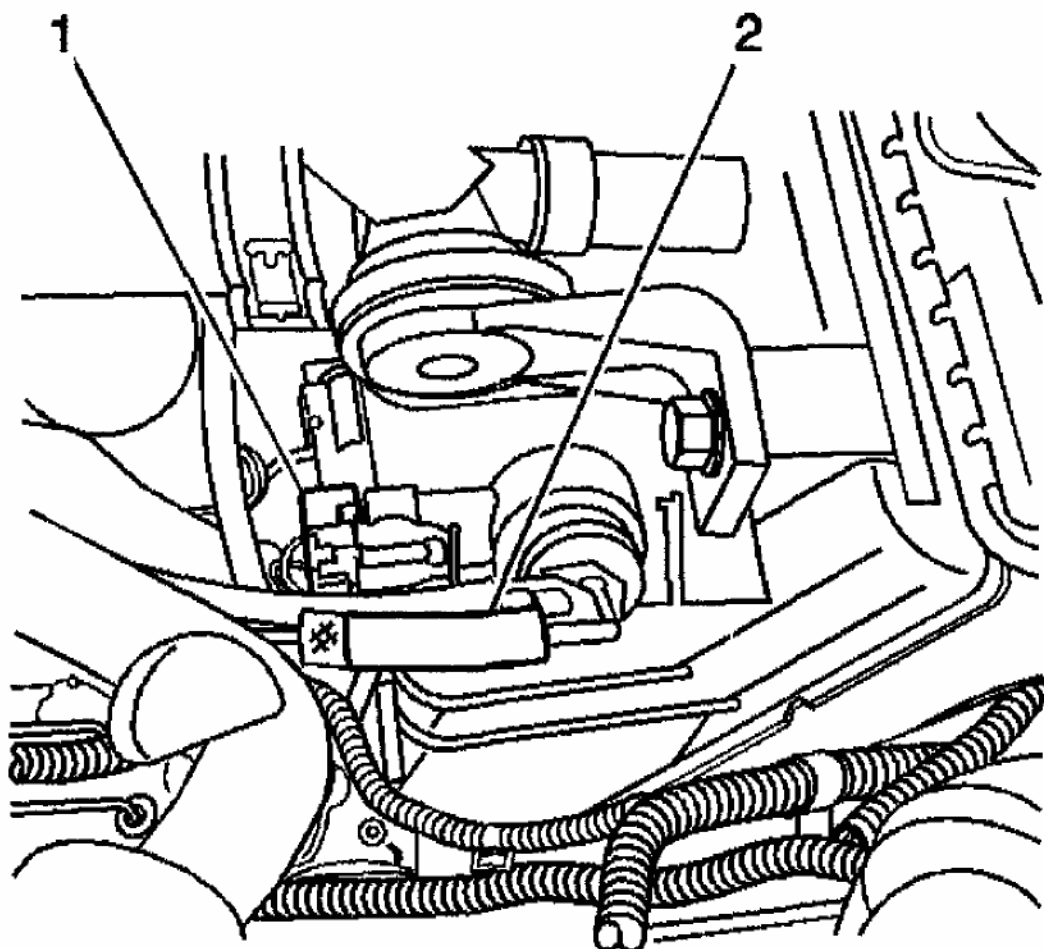


G02086642

Fig. 166: Disconnecting Coolant Bypass Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the coolant bypass solenoid into slot and engage.
2. Connect the vacuum hose (2) to the valve coolant bypass solenoid.
3. Connect the electrical connector (1) to the coolant bypass solenoid.



G02086643

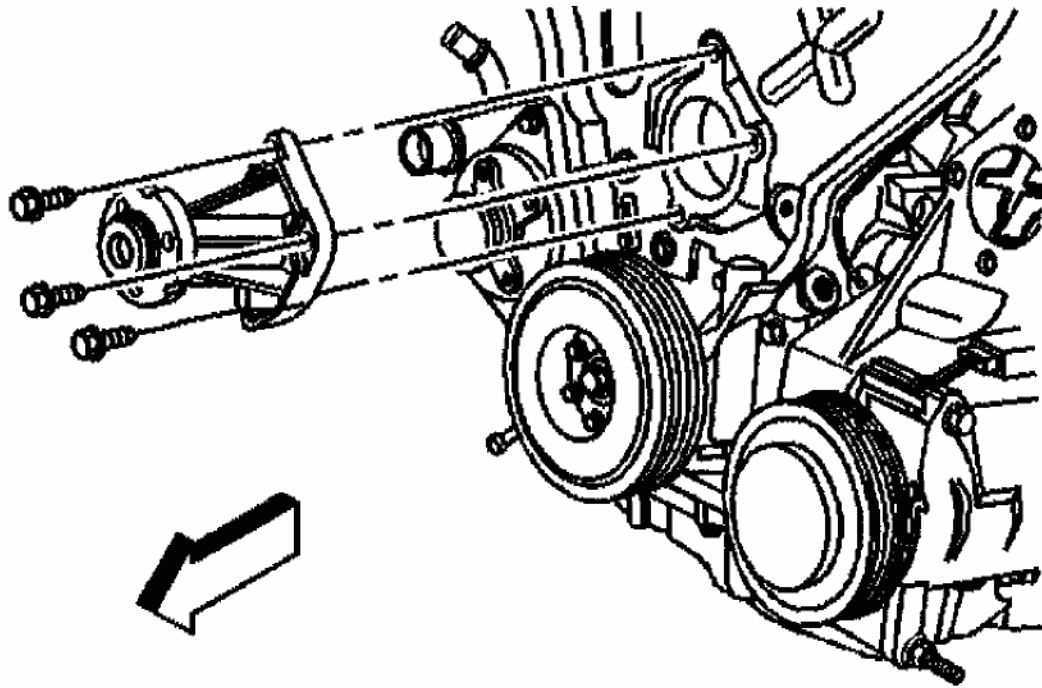
Fig. 167: Connecting Coolant Bypass Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

WATER PUMP REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Remove the timing belt cover. Refer to TIMING BELT COVER REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
3. Remove the water pump bolts.

Important: Use a catch basin to collect escaping coolant.



G02086644

Fig. 168: Removing Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the water pump and seal.

Do not reuse the seal.

5. Clean the water pump mating surfaces.
6. Clean and inspect the water pump. Refer to WATER PUMP CLEANING AND INSPECTION in Engine Mechanical-2.6L and 3.2L.

Installation Procedure

1. Coat the seal ring of the water pump with silicone grease, GM P/N 12345579 (Canadian P/N 1974984) or equivalent.

Important: Ensure the O-ring seal is properly positioned to the water pump.

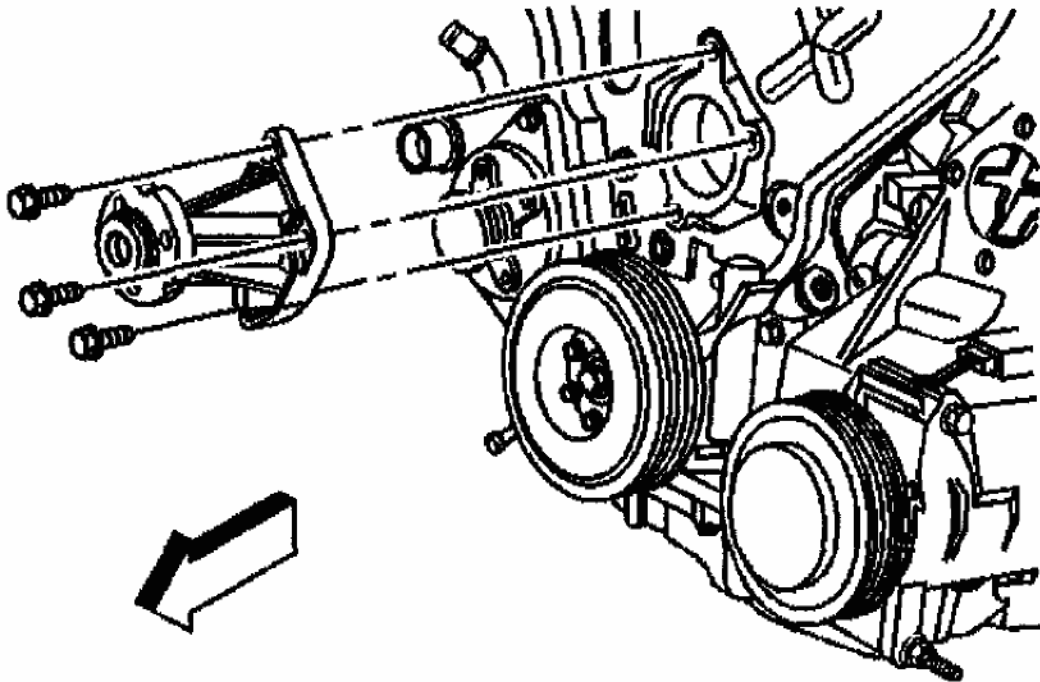
2. Install the O-ring seal to the water pump.
3. Install the water pump into the engine block.

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

4. Install the water pump bolts.

Tighten

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



G02086645

Fig. 169: Installing Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

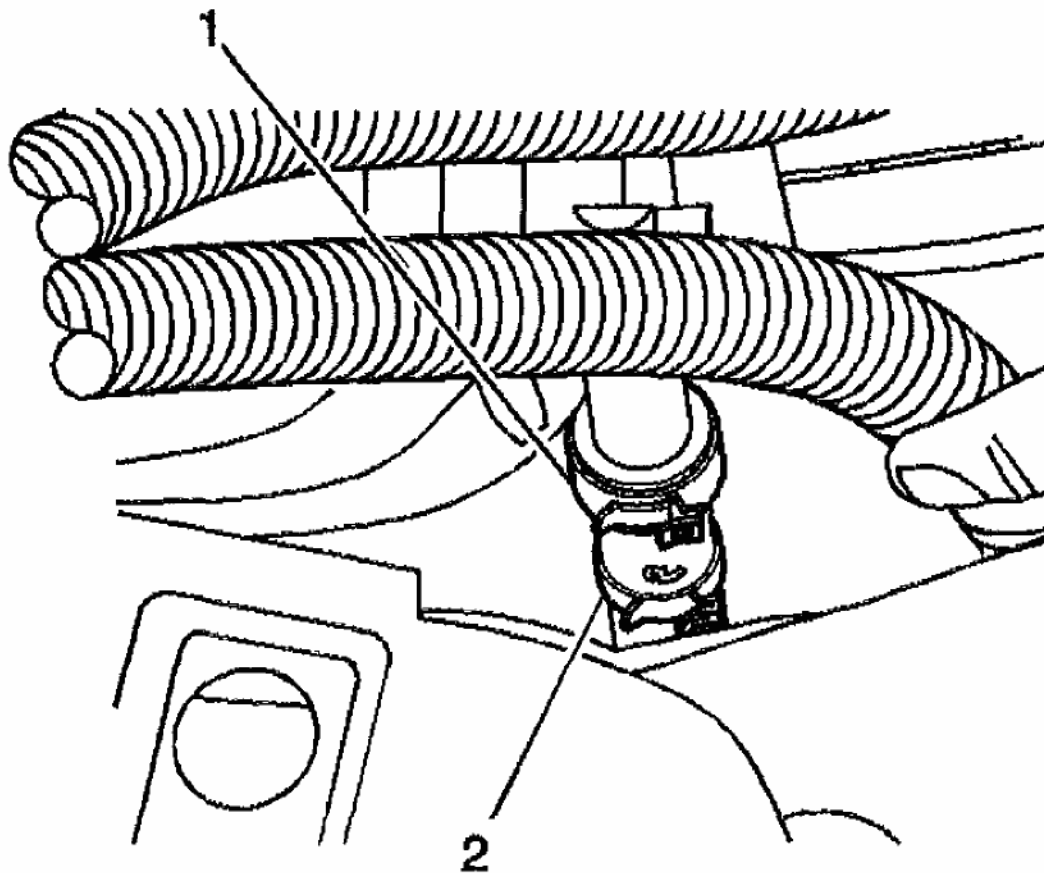
5. Install the timing belt cover. Refer to TIMING BELT COVER REPLACEMENT in Engine Mechanical-2.6L and 3.2L.
6. Fill the cooling system. Refer to DRAINING AND FILLING COOLING SYSTEM.

AFTERBOIL COOLANT PUMP REPLACEMENT**Tools Required**

J 38185 Hose Clamp Pliers

Removal Procedure

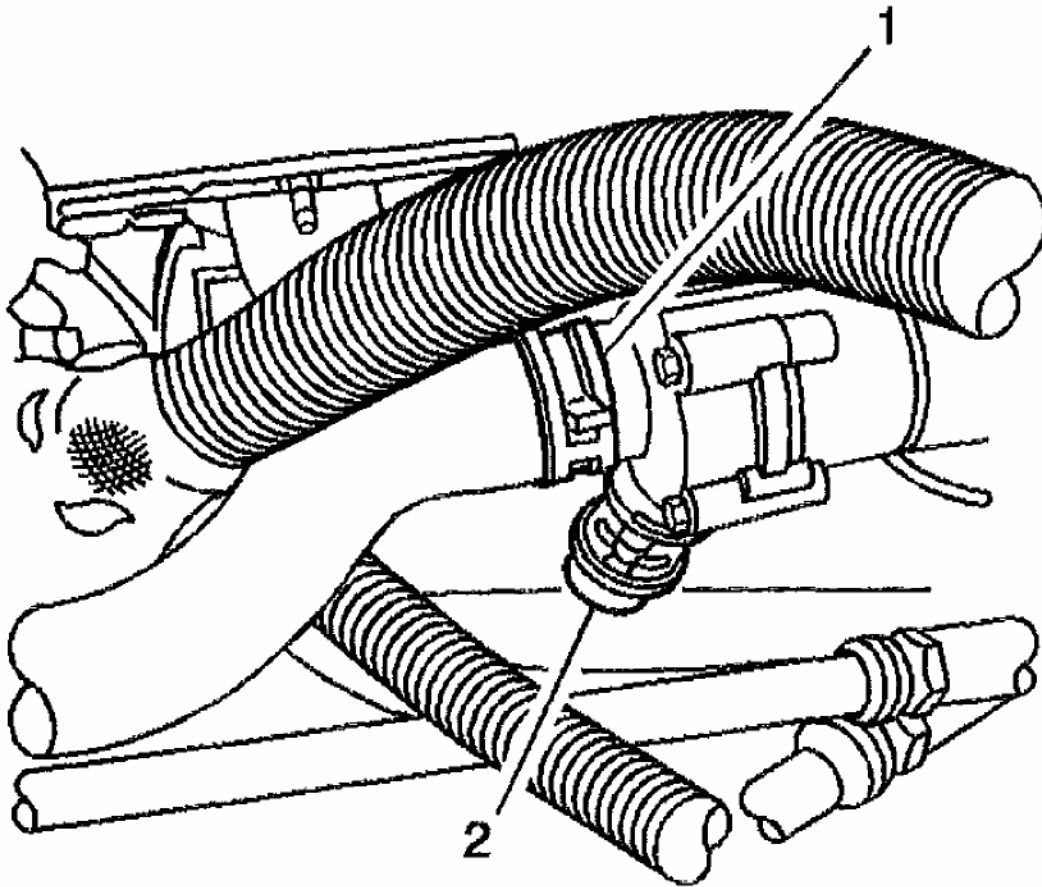
1. Drain the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Using the *J 38185* slide the hose clamp (1) down on the hose.
3. Disconnect the hose from the afterboil coolant pump.



G02086646

Fig. 170: Locating Afterboil Coolant Pump Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

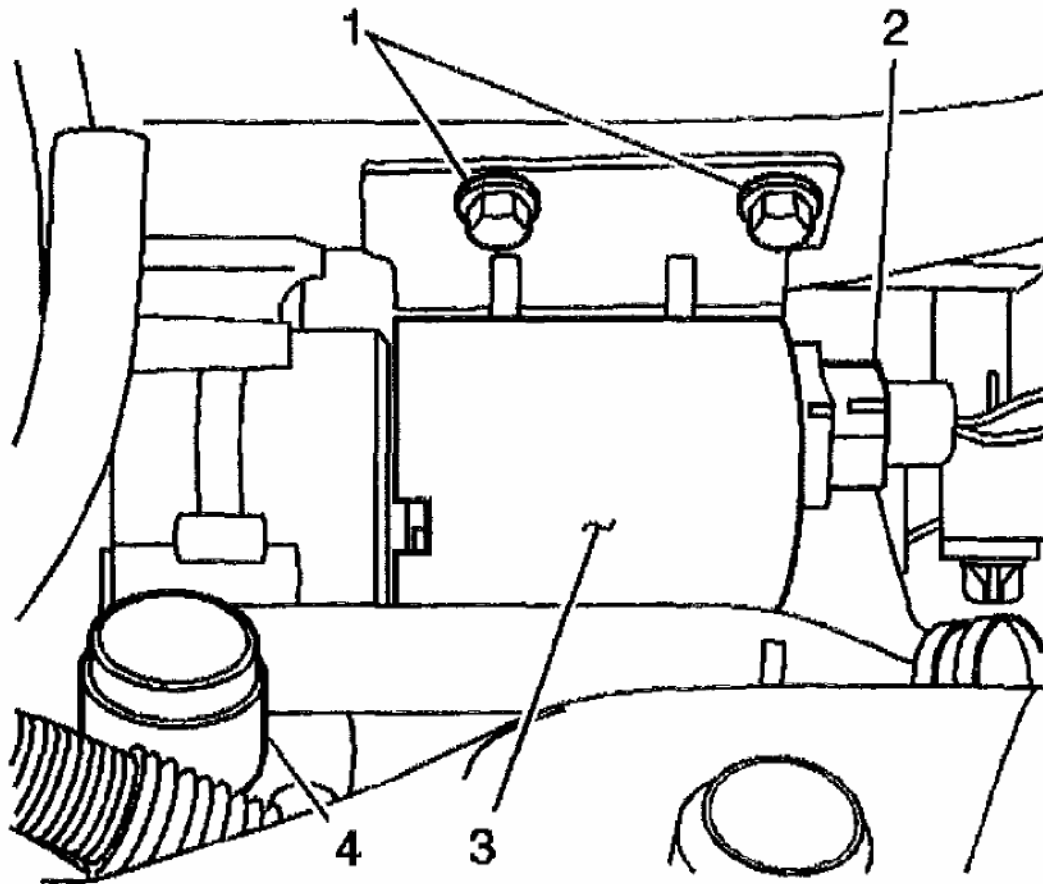
4. Using the *J 38185* slide the hose clamp (1) back on the hose.
5. Disconnect the hose from the afterboil coolant pump.



G02086647

Fig. 171: View Of Afterboil Coolant Pump Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the afterboil coolant pump electrical connector (2) from the afterboil coolant pump (3).



G02086648

Fig. 172: Disconnecting Afterboil Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Remove the afterboil coolant pump bolts (1).
8. Remove the afterboil coolant pump.

Installation Procedure

1. Install the afterboil coolant pump.

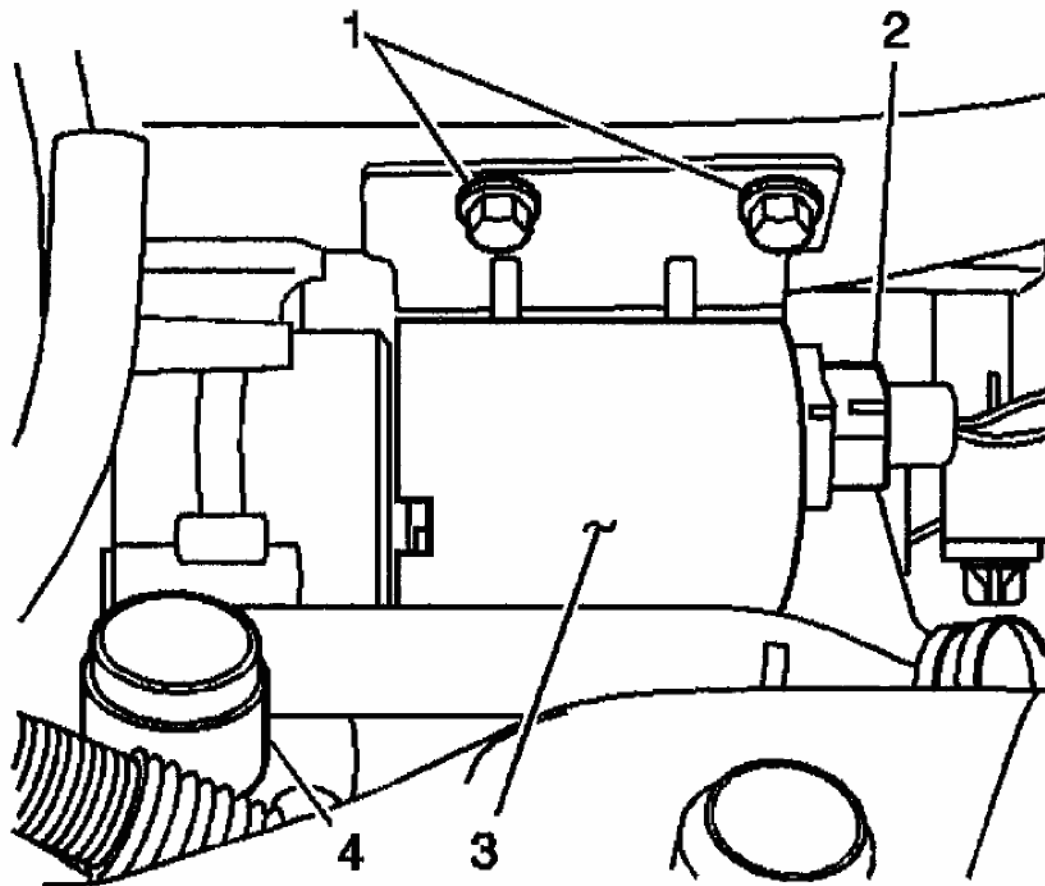
NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the afterboil coolant pump bolts (1).

Tighten

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

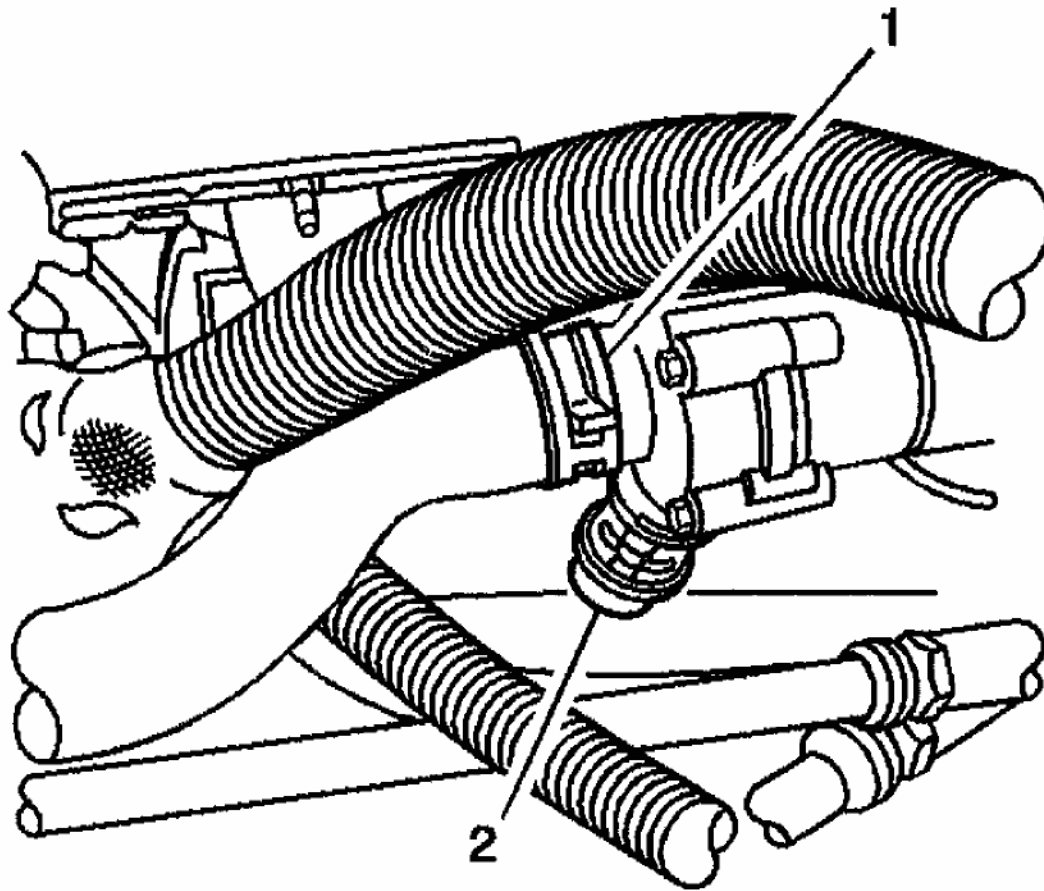
3. Connect the afterboil coolant pump electrical connector (2) to the afterboil coolant pump (3).



G02086649

Fig. 173: Connecting Afterboil Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS CORP.

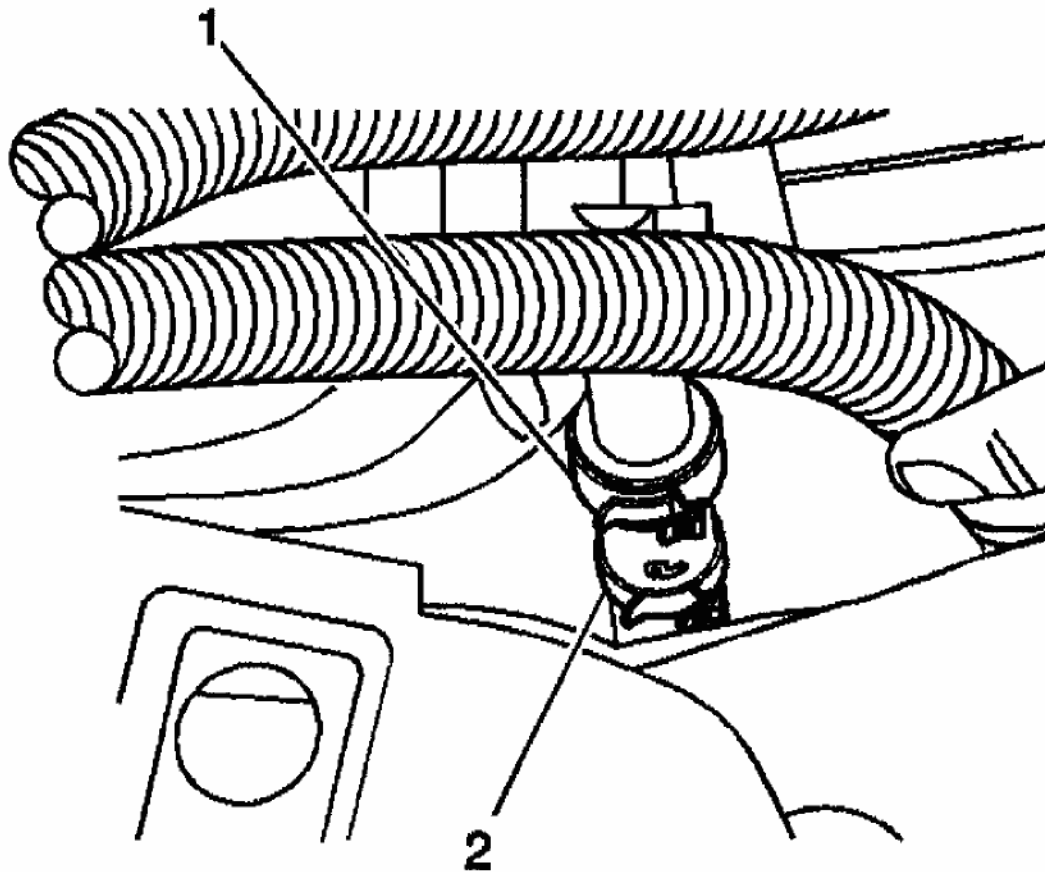
4. Connect the hose to the afterboil coolant pump.
5. Using the *J 38185* slide the hose clamp (1) back into the original position on the hose.



G02086650

Fig. 174: View Of Afterboil Coolant Pump Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

6. Connect the hose to the afterboil coolant pump.
7. Using the *J 38185* slide the hose clamp (1) back to the original position on the hose.



G02086651

Fig. 175: Locating Afterboil Coolant Pump Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

8. Fill the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

RADIATOR REPLACEMENT

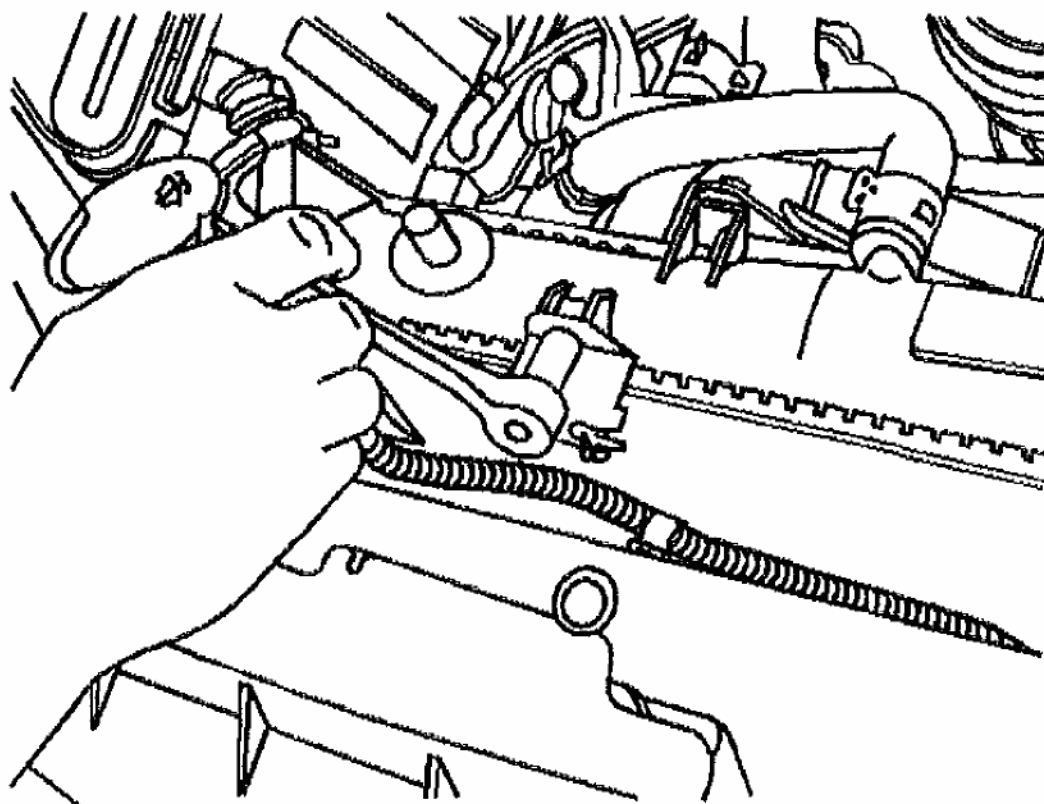
Tools Required

- *J 38185* Hose Clamp Pliers
- *J 44827* Transmission Cooler Quick Disconnect

Removal Procedure

1. Drain the coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

2. Remove the radiator support brackets. Refer to **RADIATOR SUPPORT BRACKET REPLACEMENT**.
3. Remove the cooling fans. Refer to **COOLING FAN REPLACEMENT - ELECTRIC**.
4. Remove the 2 upper condenser mounting bolts.



G02086652

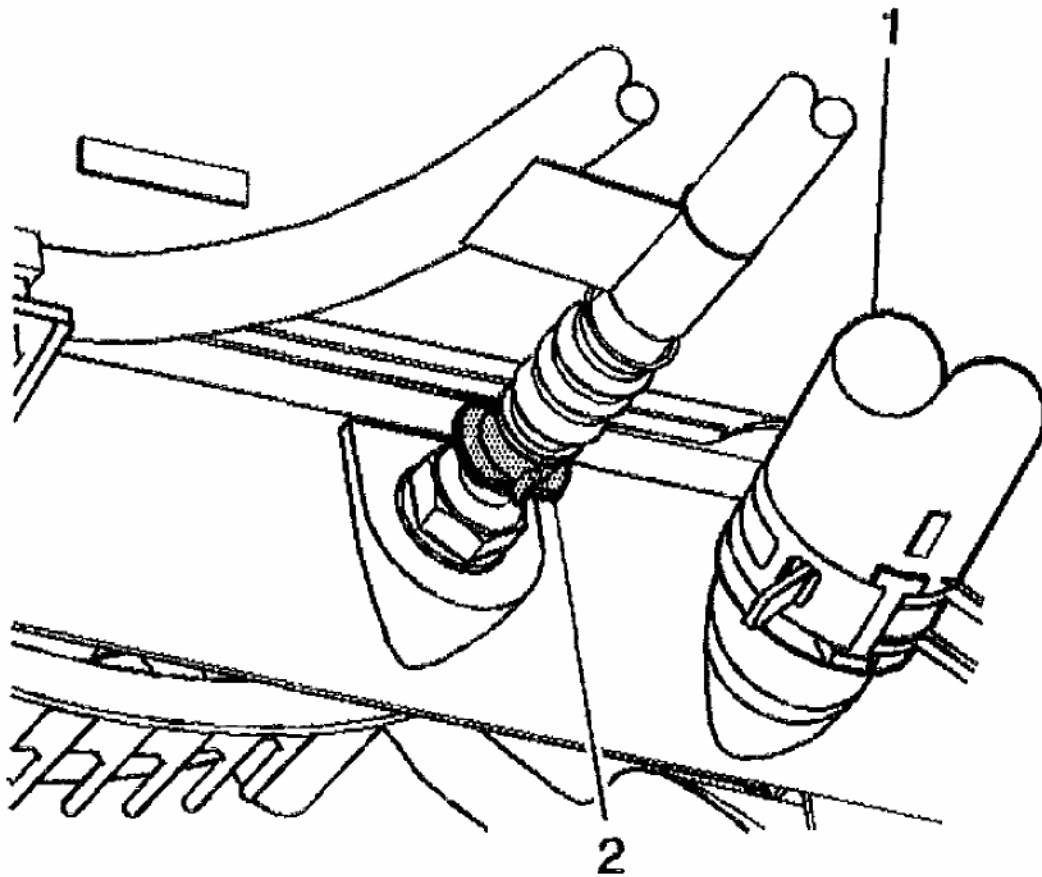
Fig. 176: Removing Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Raise the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** in General Information.

NOTE: The transmission oil cooler lines use a quick connect fitting at the radiator. The quick connect fitting must be removed using a special tool. Removing the transmission oil cooler lines without the tool will result in damage to the radiator and the

transmission oil cooler, and may damage the transmission due to mixing of the transmission oil and coolant.

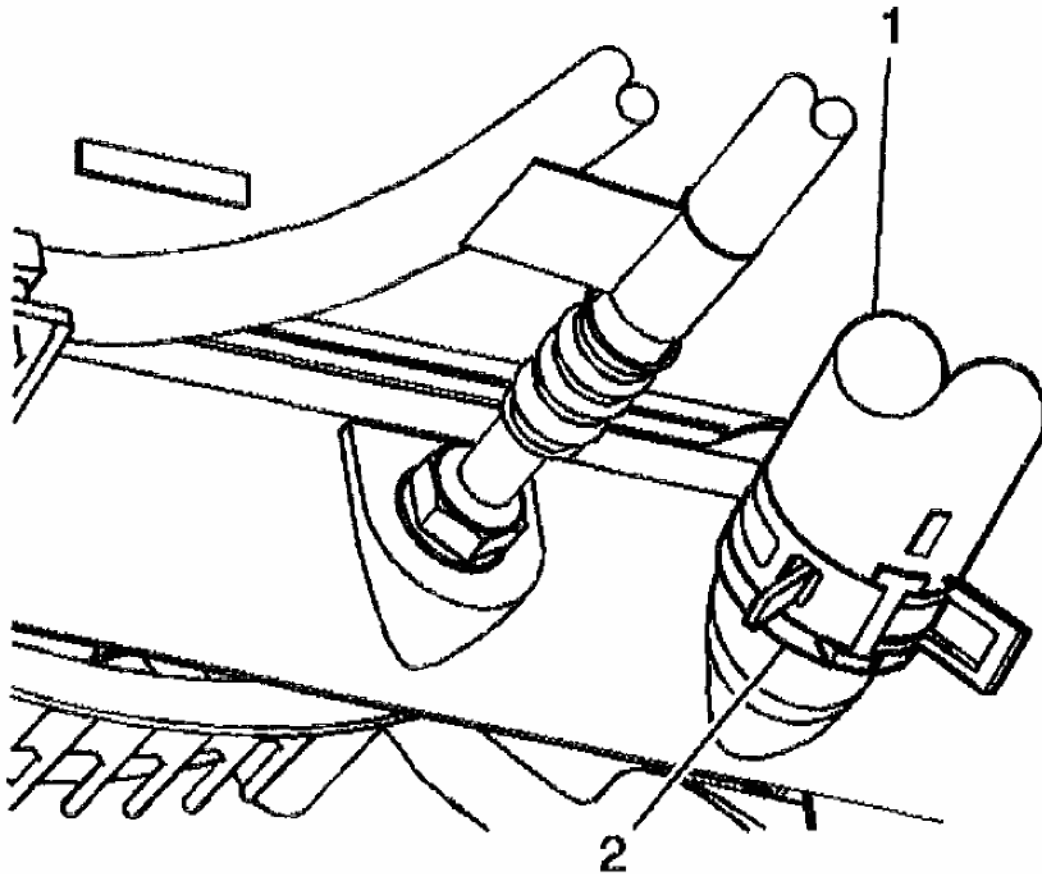
6. Using the *J 44827* (2) disconnect the lower transaxle oil cooler line from the radiator.



G02086653

Fig. 177: Identifying Lower Transaxle Oil Cooler Line From Radiator
Courtesy of GENERAL MOTORS CORP.

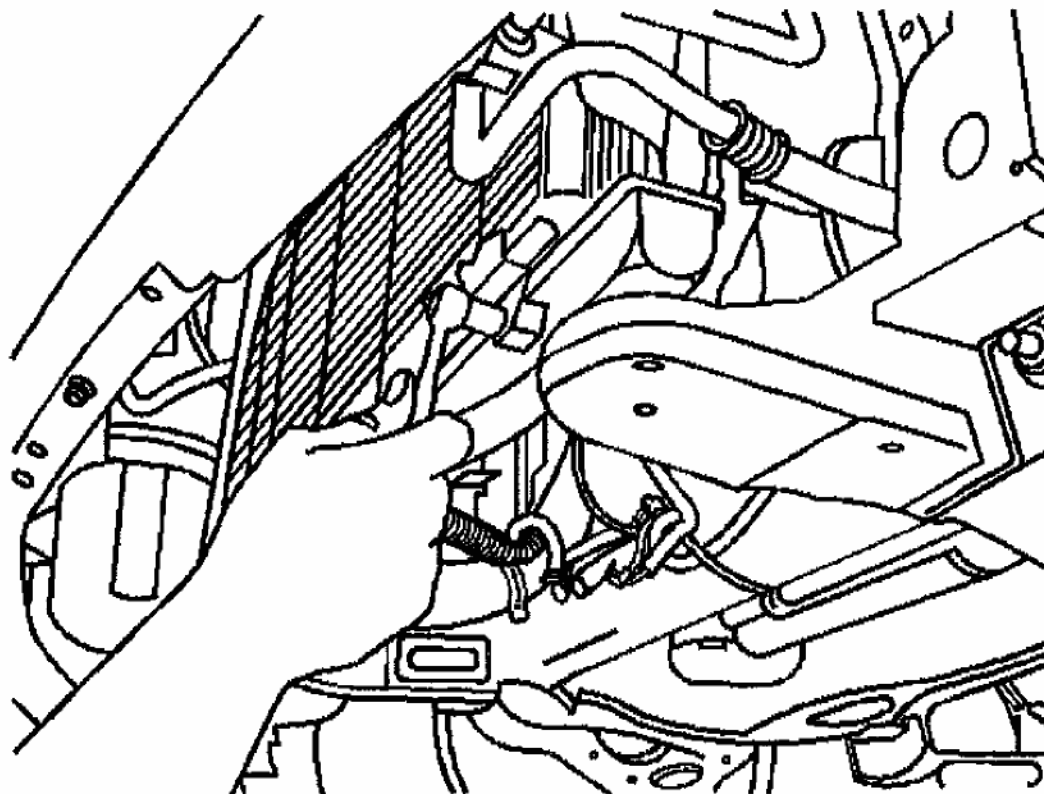
7. Using the *J 38185* disconnect the lower radiator hose (1) from the radiator.



G02086654

Fig. 178: View Of Lower Radiator Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

8. Remove the lower condenser mounting bolts.



G02086655

Fig. 179: Removing Lower Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the radiator side seal push pins.
10. Separate the side seals from the radiator.
11. Lower the vehicle.
12. Remove the radiator.

Installation Procedure

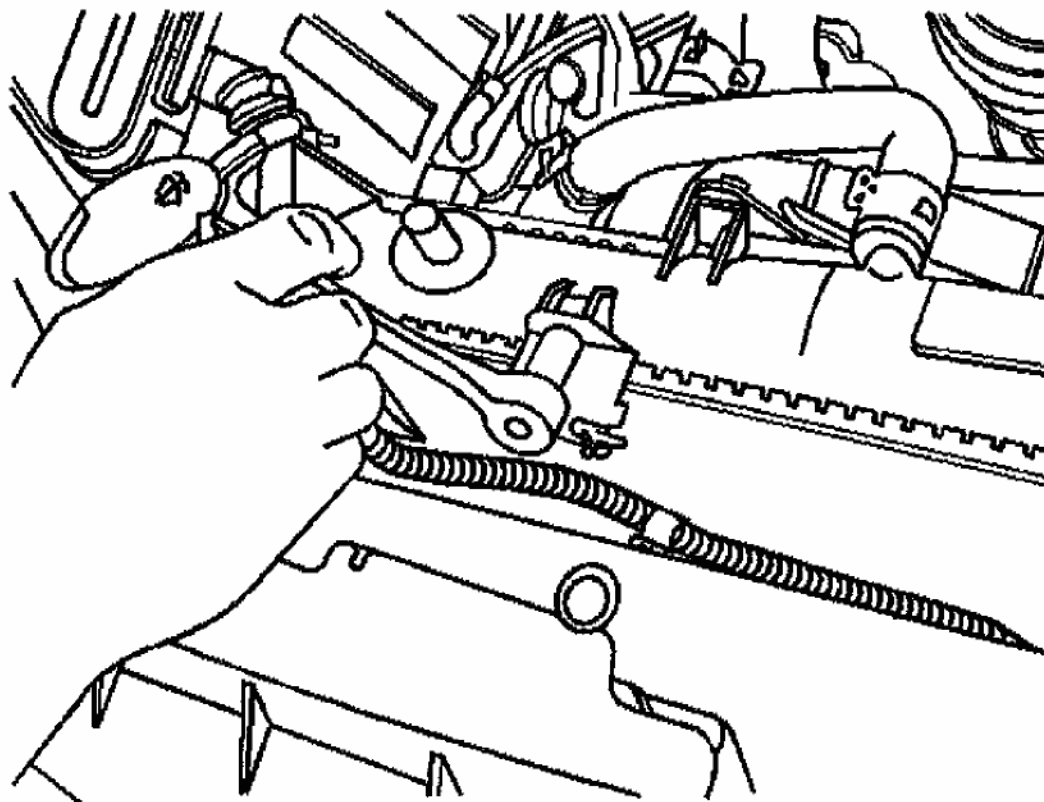
1. Install the radiator into the insulator in the frame.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

2. Install the upper condenser mounting bolts.

Tighten

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



G02086656

Fig. 180: Installing Upper Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Raise the vehicle.
4. Install the lower condenser mounting bolts.

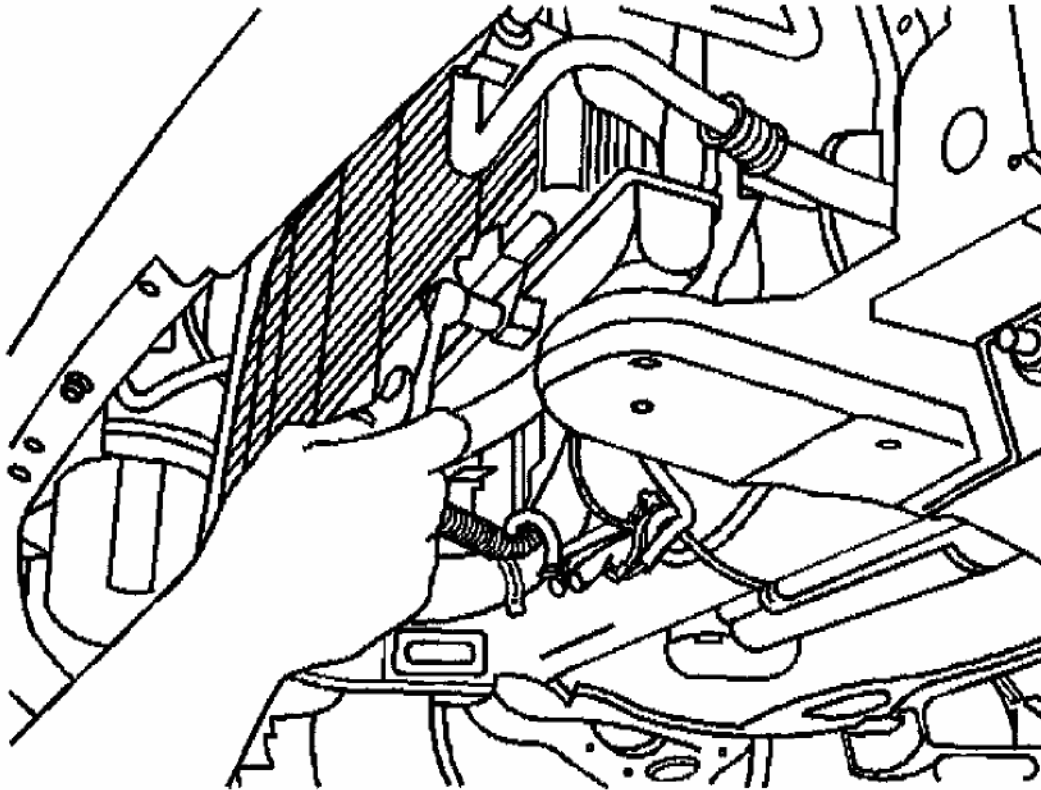
Tighten

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 it engage.
6. Gently tug out on the transmission oil cooler lines to verify that the lines are engaged into

position.

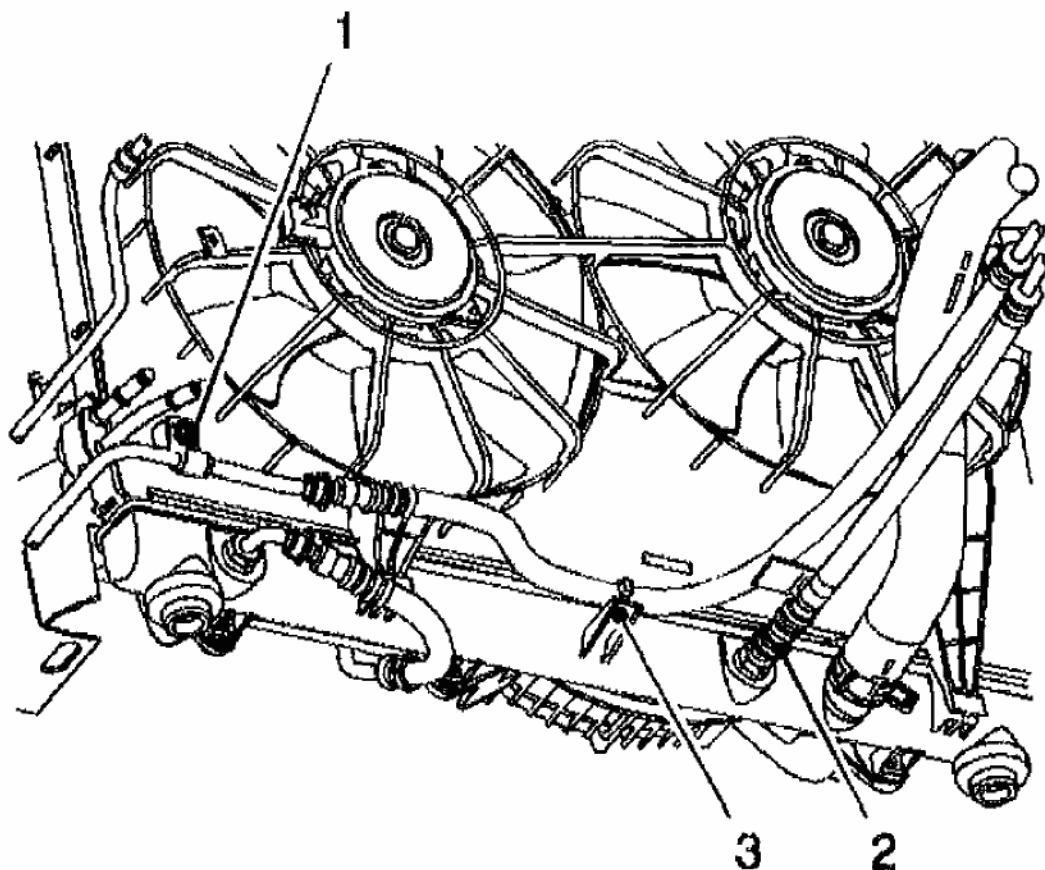
7. Connect the lower radar hose to the radiator.
8. Using the *J 38185* slide the clamp into the original position on the hose.



G02086657

Fig. 181: Installing Lower Condenser Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

9. Connect the auxiliary transmission oil cooler line to the radiator (3).



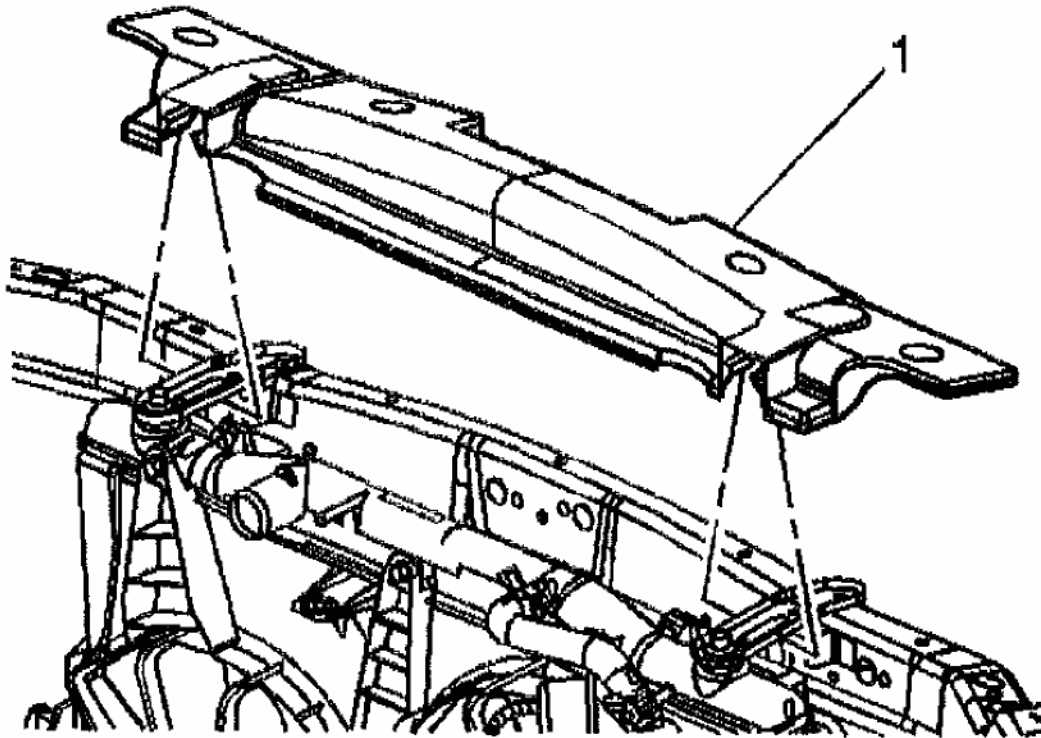
G02086658

Fig. 182: Installing Auxiliary Transmission Oil Cooler Line
Courtesy of GENERAL MOTORS CORP.

10. Install the side seal pushpin into the radiator.
11. Ensure that all seal are in place around the radiator.
12. Lower the vehicle.
13. Install the cooling fans. Refer to **COOLING FAN REPLACEMENT - ELECTRIC**.
14. Install the radiator supports. Refer to **RADIATOR SUPPORT BRACKET REPLACEMENT**.
15. Fill the system with coolant. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

Removal Procedure

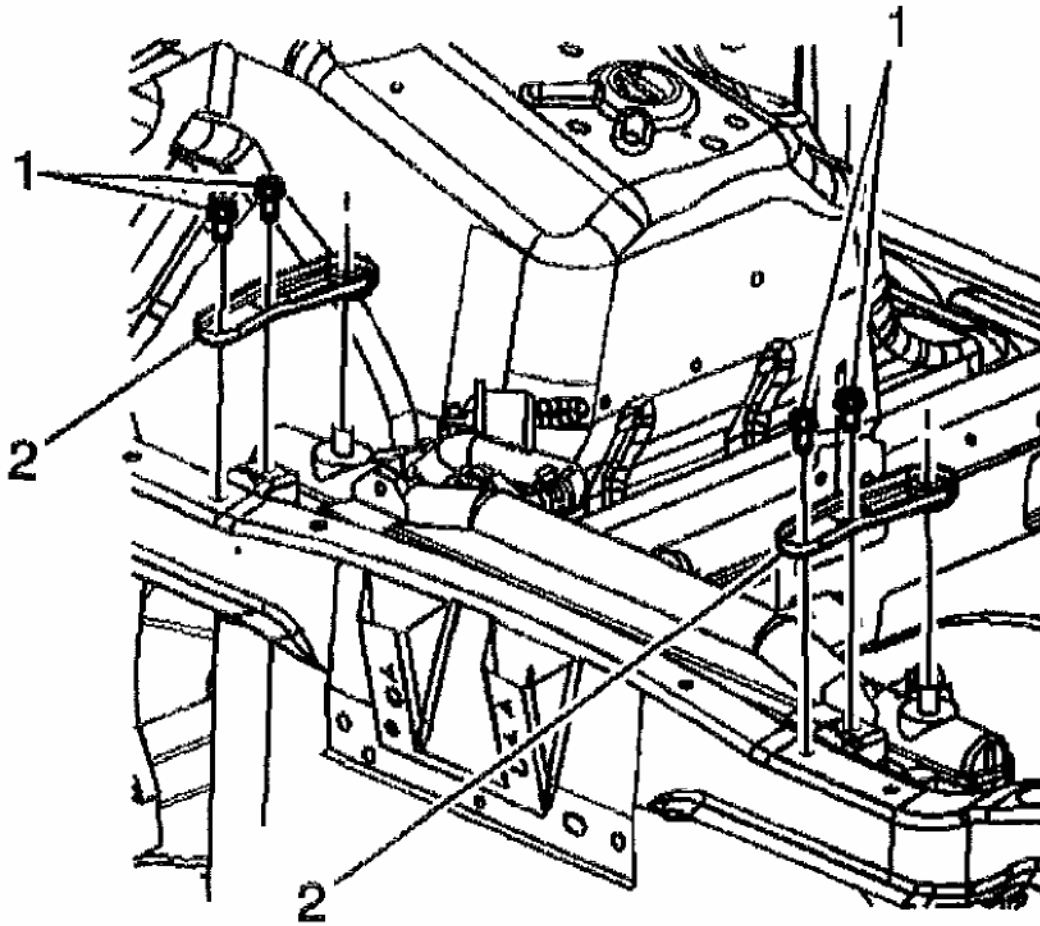
1. Remove the condenser seal (1).



G02086659

Fig. 183: Removing Condenser Seal
Courtesy of GENERAL MOTORS CORP.

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



G02086660

Fig. 184: Removing Radiator Support Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

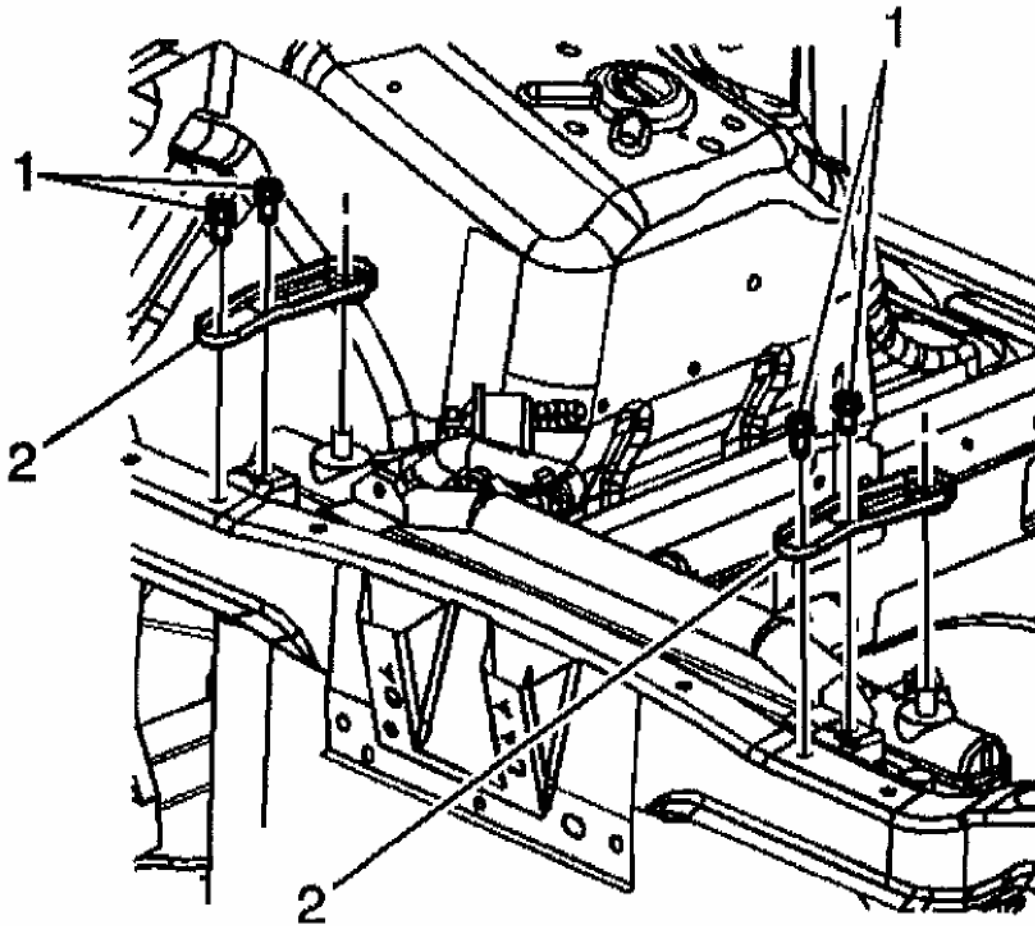
1. Install the radiator support brackets (2).

NOTE: Refer to FASTENER NOTICE in Cautions and Notices.

2. Install the radiator support bolts (1).

Tighten

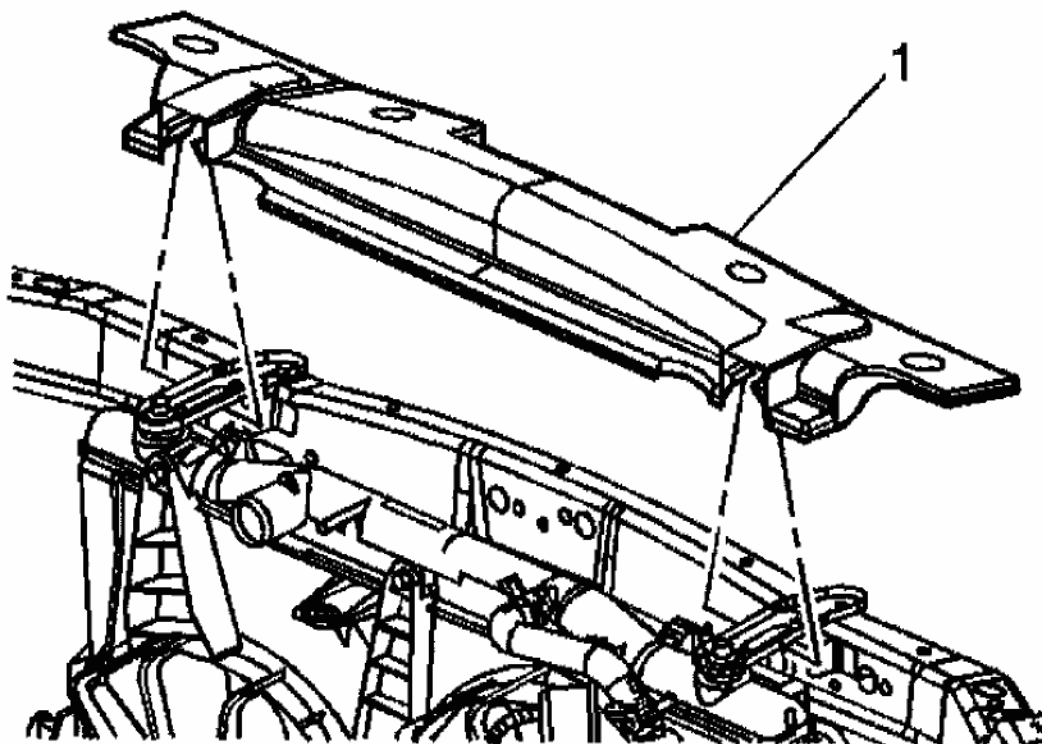
Tighten the bolts to 9 N.m (80 lb in).



G02086661

Fig. 185: Installing Radiator Support Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the condenser seal (1).



G02086662

Fig. 186: Installing Condenser Seal
Courtesy of GENERAL MOTORS CORP.

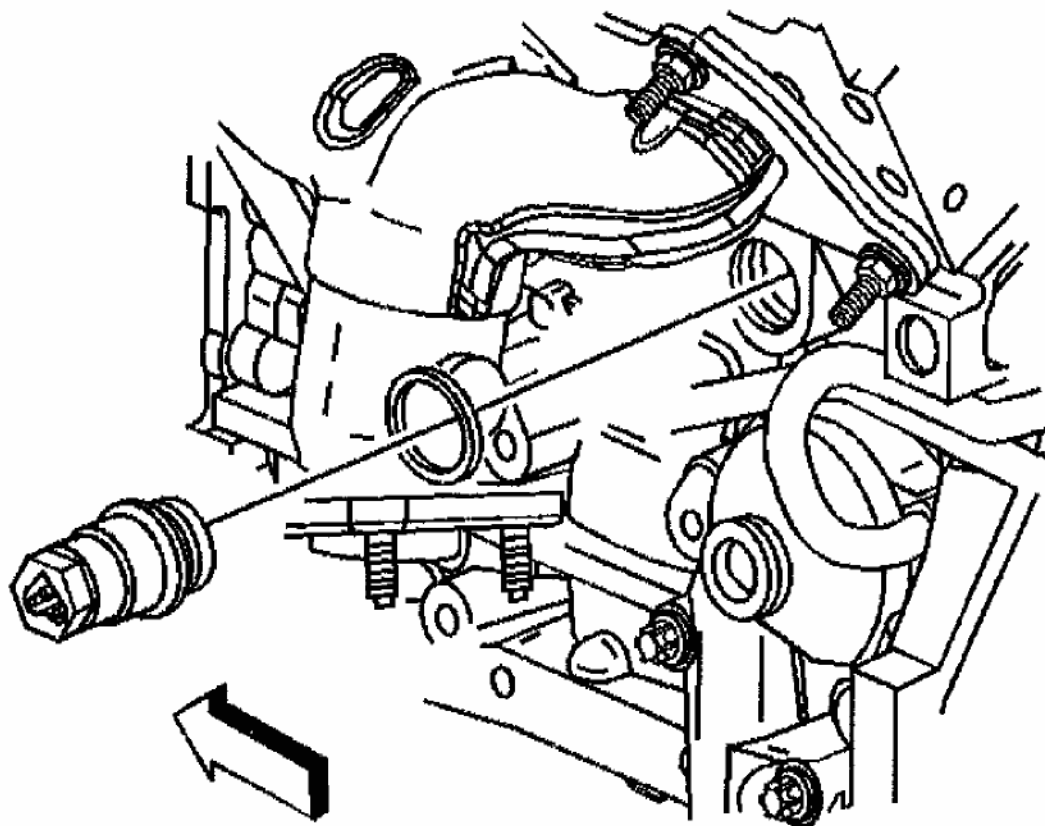
COOLANT HEATER REPLACEMENT (K05)

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.
2. Remove the heated oxygen sensor. Refer to **HEATED OXYGEN SENSOR** in Removal & Installation.
3. Disconnect the coolant heater power supply cord from the coolant heater.

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

4. Remove the coolant heater and seal from the engine block.



G02086663

Fig. 187: Removing Coolant Heater & Seal
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

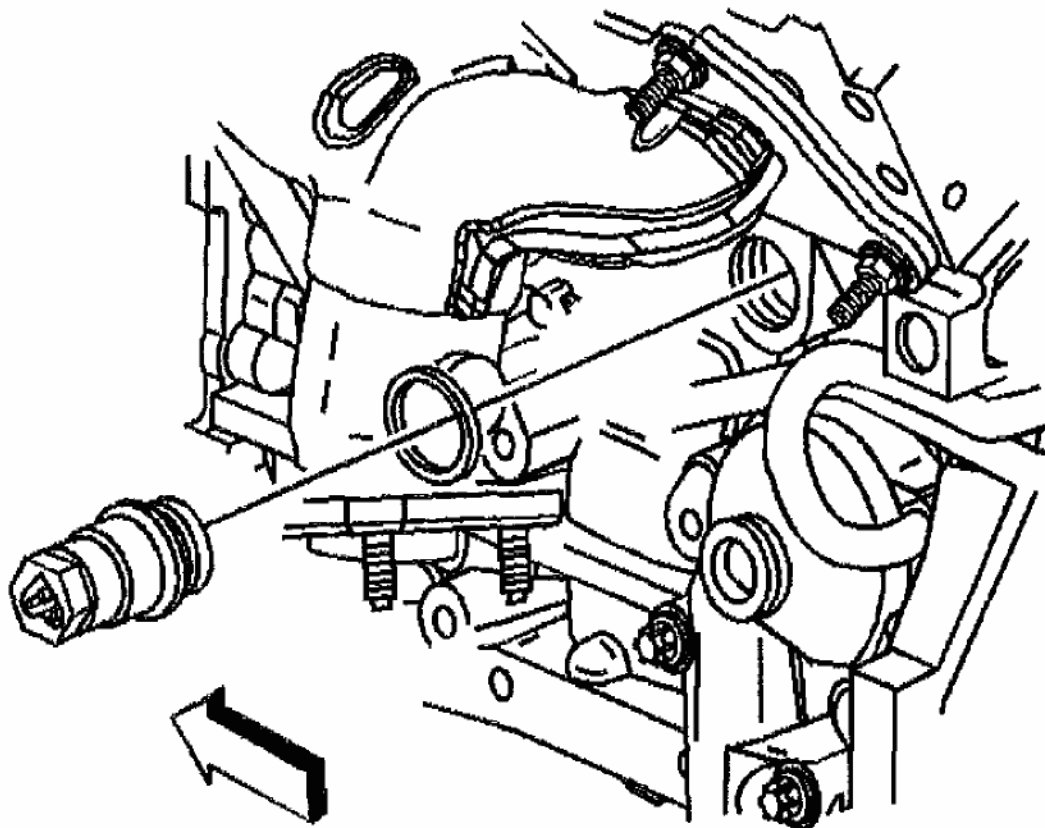
1. Install the seal to the coolant heater.

NOTE: Refer to COMPONENT FASTENER TIGHTENING NOTICE in Cautions and Notices.

2. Install the coolant heater into the engine block.

Tighten

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



G02086664

Fig. 188: Installing Coolant Heater & Seal
Courtesy of GENERAL MOTORS CORP.

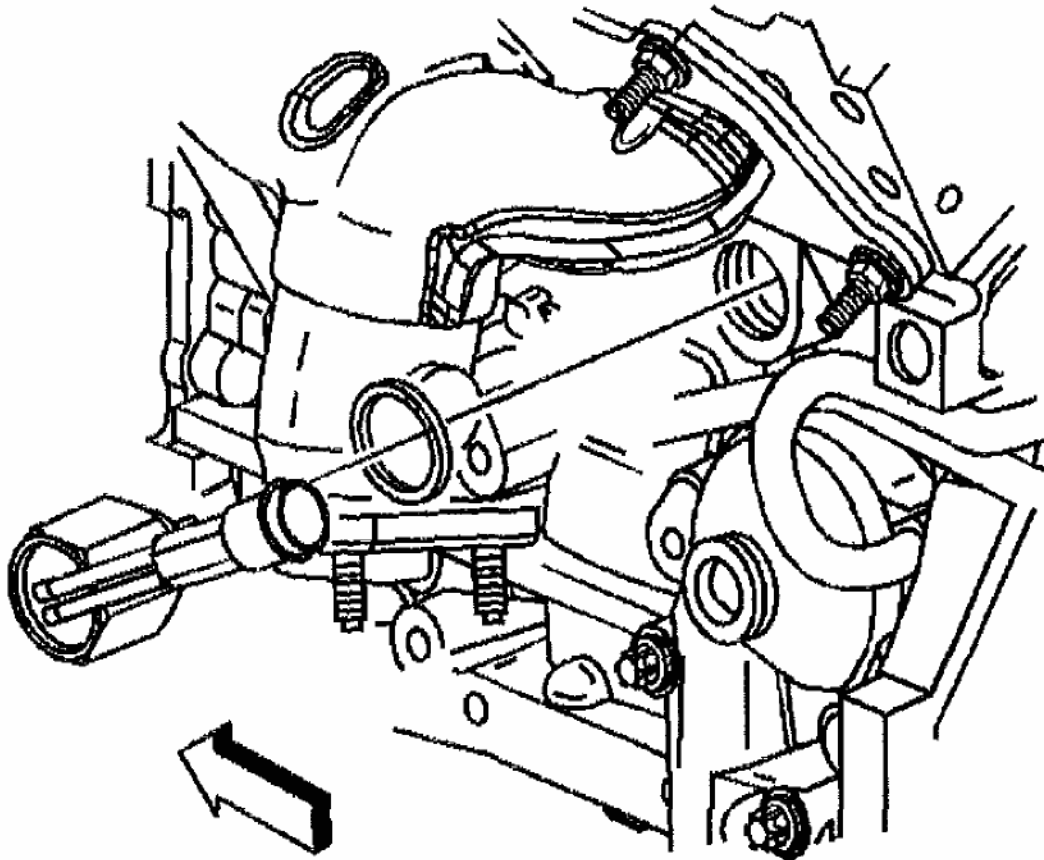
3. Connect the coolant heater power supply cord to the coolant heater.
4. Install the heated oxygen sensor. Refer to **HEATED OXYGEN SENSOR** in Removal & Installation.
5. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .

COOLANT HEATER REPLACEMENT (KA3)

Removal Procedure

1. Drain the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM** .
2. Remove the heated oxygen sensor. Refer to **HEATED OXYGEN SENSOR** in Removal & Installation.

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



G02086665

Fig. 189: Removing Coolant Heater KA3
Courtesy of GENERAL MOTORS CORP.

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

4. Remove the coolant heater and seal from the engine block.

Installation Procedure

1. Install the seal to the coolant heater.

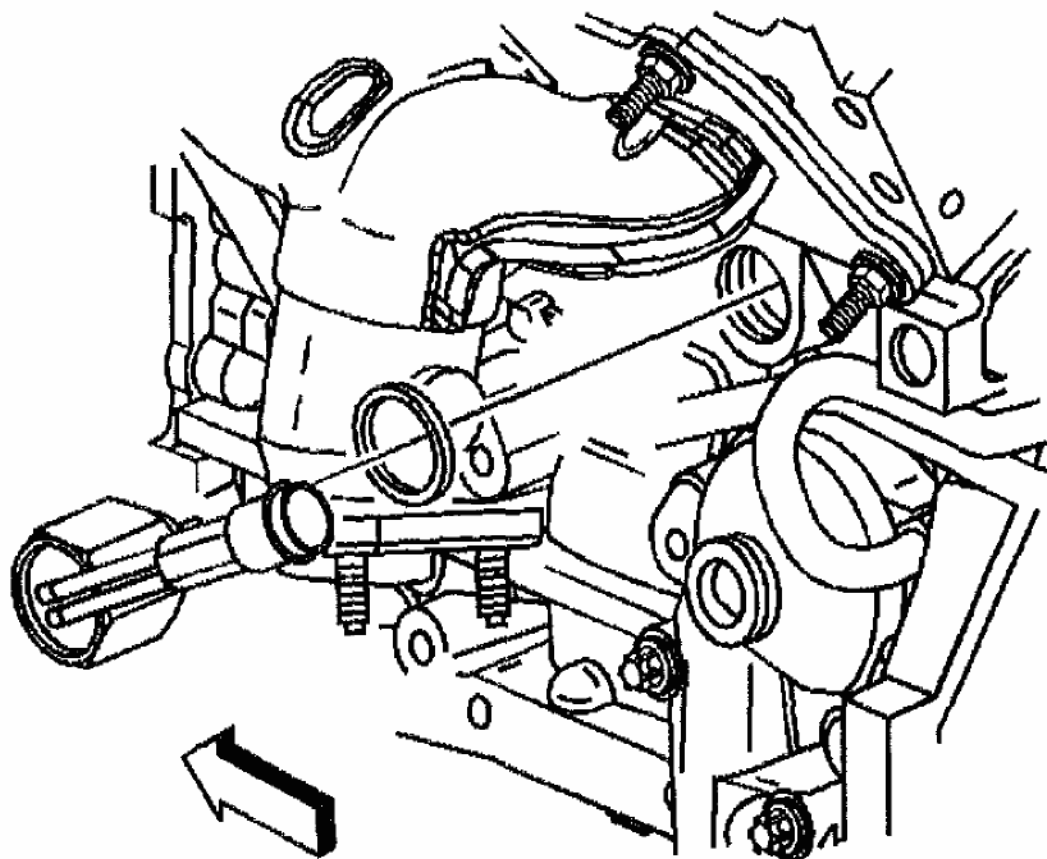
NOTE: Refer to COMPONENT FASTENER TIGHTENING NOTICE in Cautions and Notices.

2. Install the coolant heater into the engine block.

Tighten

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

3. Connect the coolant heater power supply cord to the coolant heater.
4. Install the heated oxygen sensor. Refer to **HEATED OXYGEN SENSOR** in Removal & Installation.



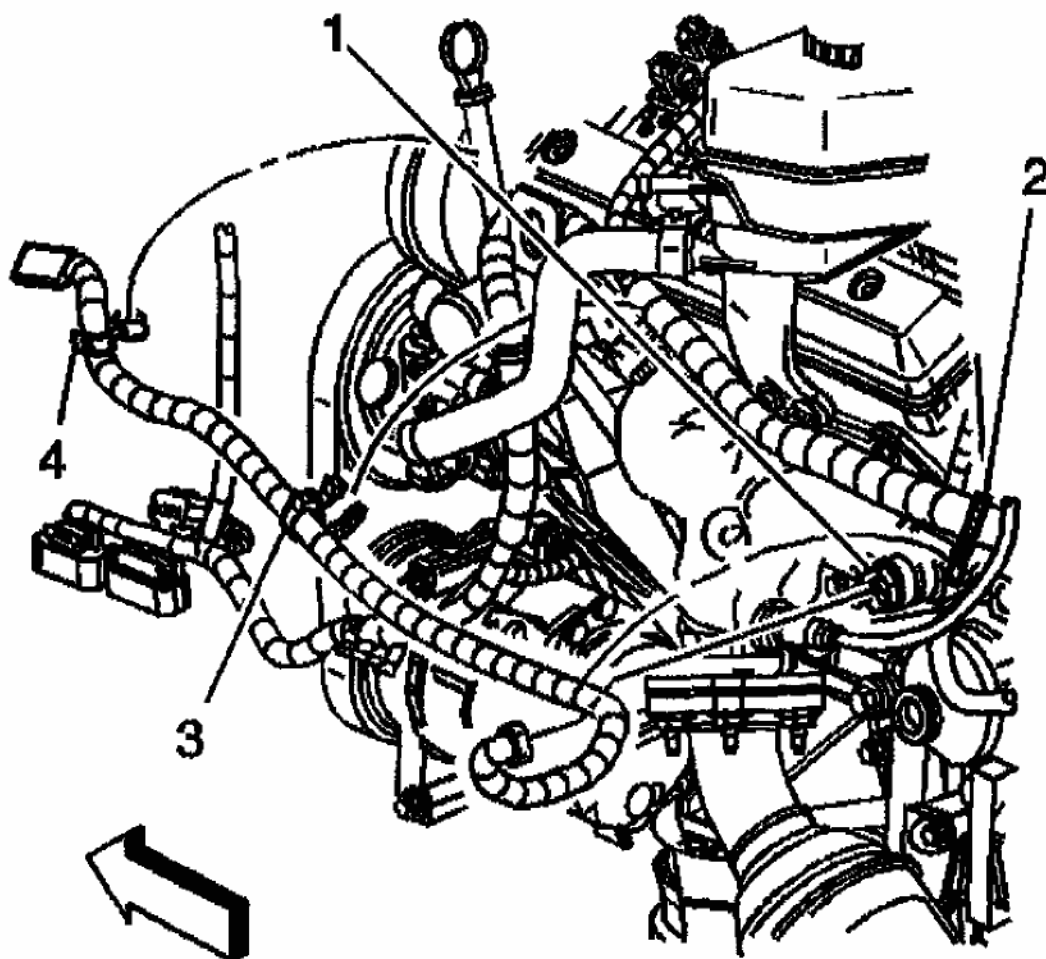
G02086666

Fig. 190: Installing Coolant Heater & Seal
Courtesy of GENERAL MOTORS CORP.

5. Fill the cooling system. Refer to **DRAINING AND FILLING COOLING SYSTEM**.

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

1. Raise and support the vehicle. Refer to LIFTING AND JACKING THE VEHICLE in General Information.
2. Disconnect the coolant heater power supply cord from the coolant heater (1).



G02086667

Fig. 191: Removing Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the coolant heater cord clip (2) from the coolant heater cord.

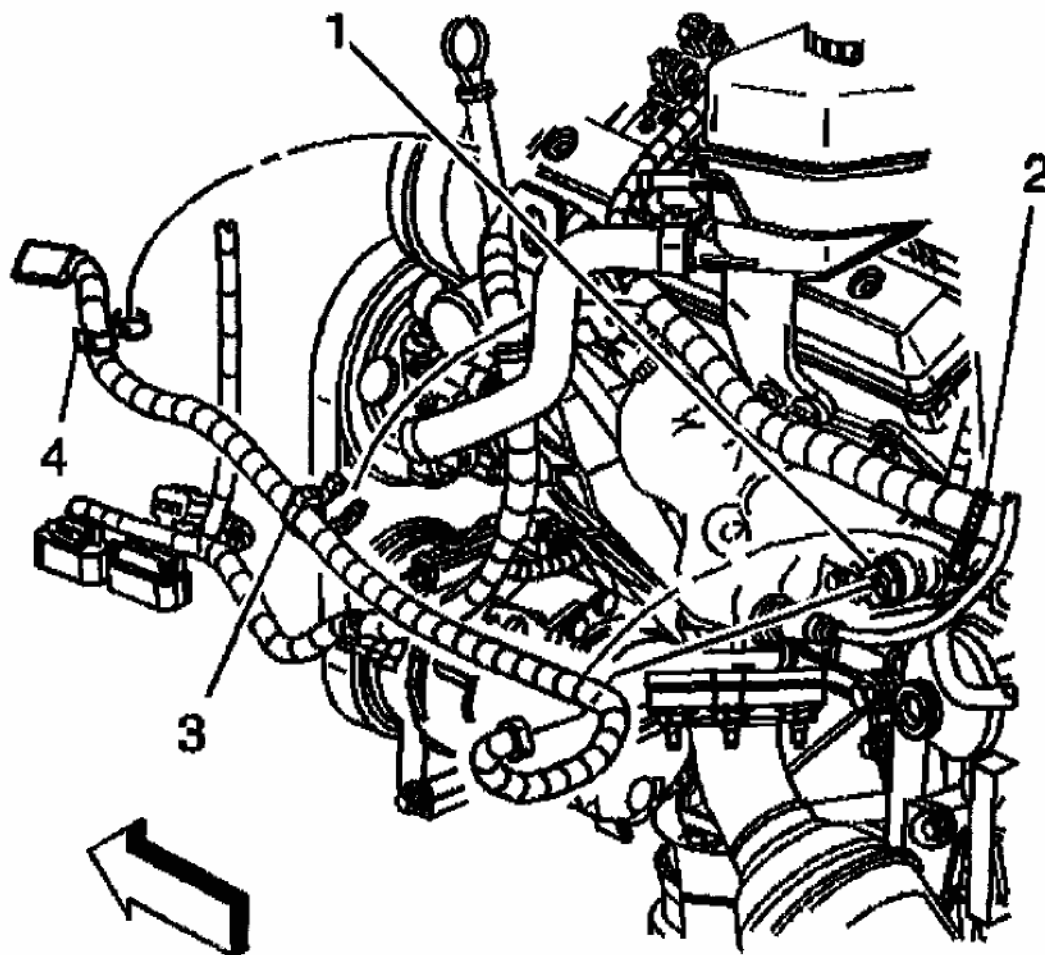
2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

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

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).



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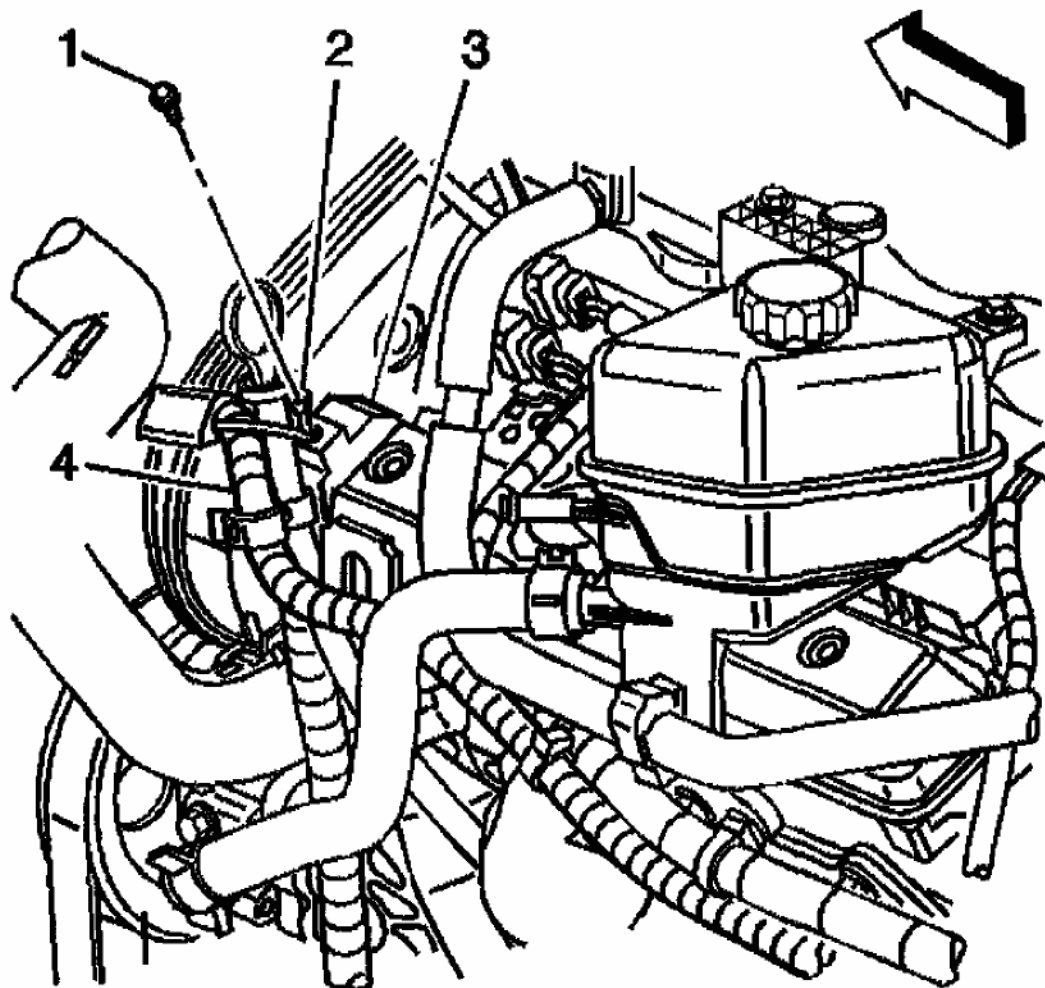
Fig. 192: Installing Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

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

COOLANT HEATER CORD REPLACEMENT (KA3)

Removal Procedure

1. Remove the bolt (1) securing the coolant heater ground lead (2) to the camshaft bearing cap (3).
2. Raise and support the vehicle. Refer to **LIFTING AND JACKING THE VEHICLE** in General Information.
3. Disconnect the coolant heater power supply cord from the coolant heater (1).

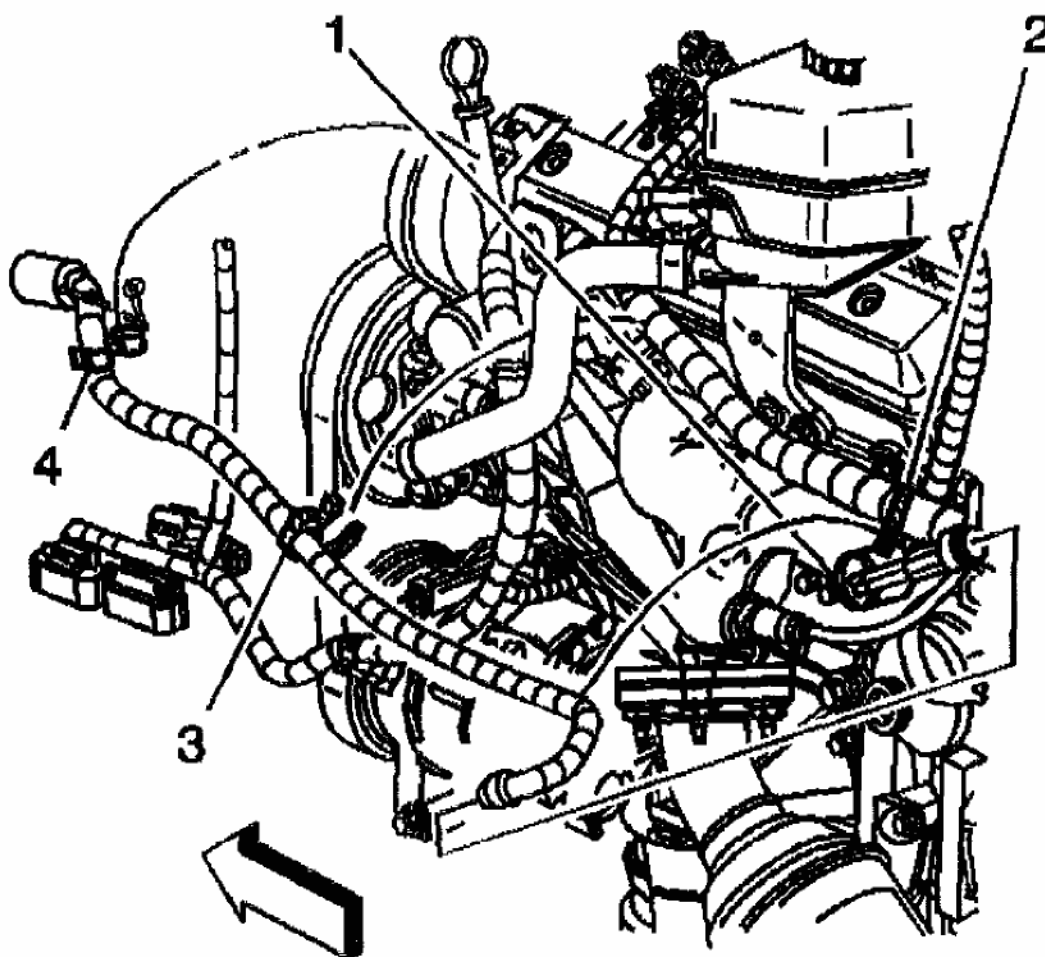


G02086669

Fig. 193: Removing Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the coolant heater cord clip (2) from the coolant heater cord.

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

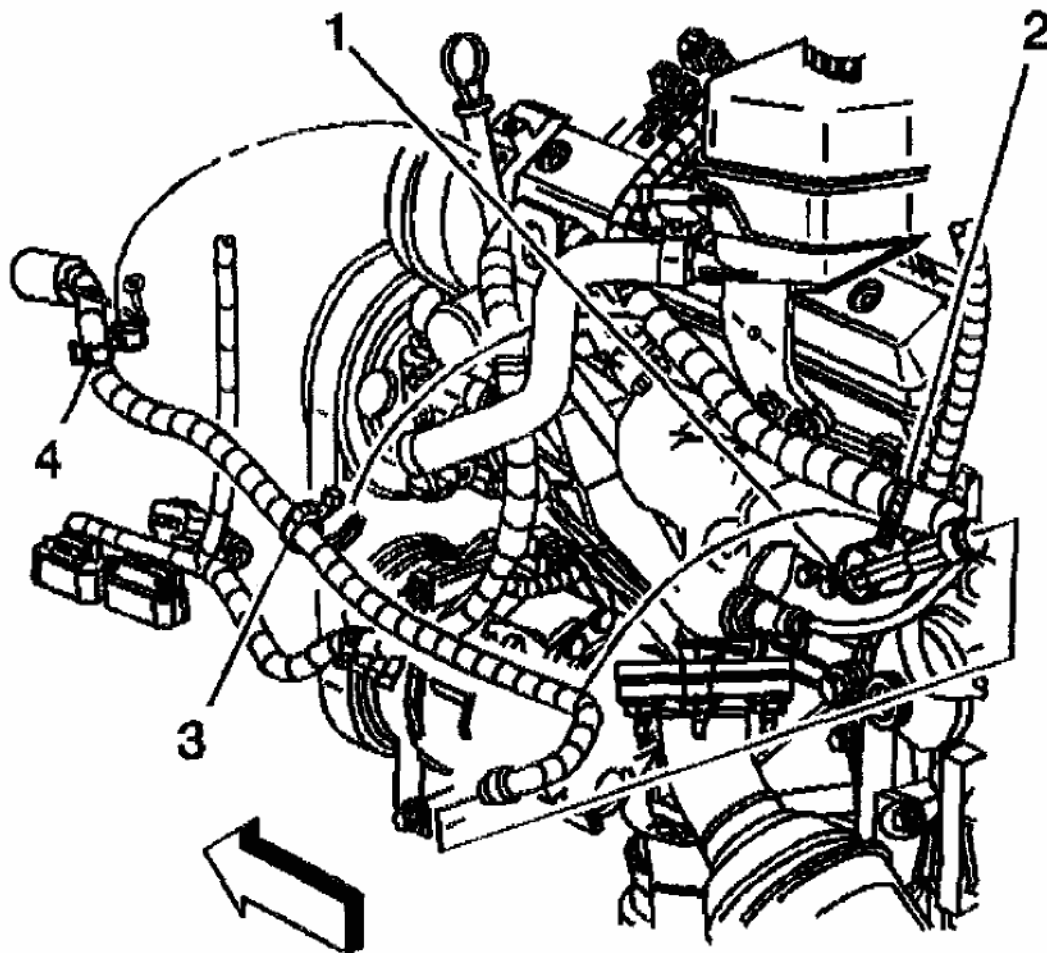


G02086670

Fig. 194: Removing Coolant Heater Cord Clips
Courtesy of GENERAL MOTORS CORP.

7. Remove the coolant heater cord from the vehicle.

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).

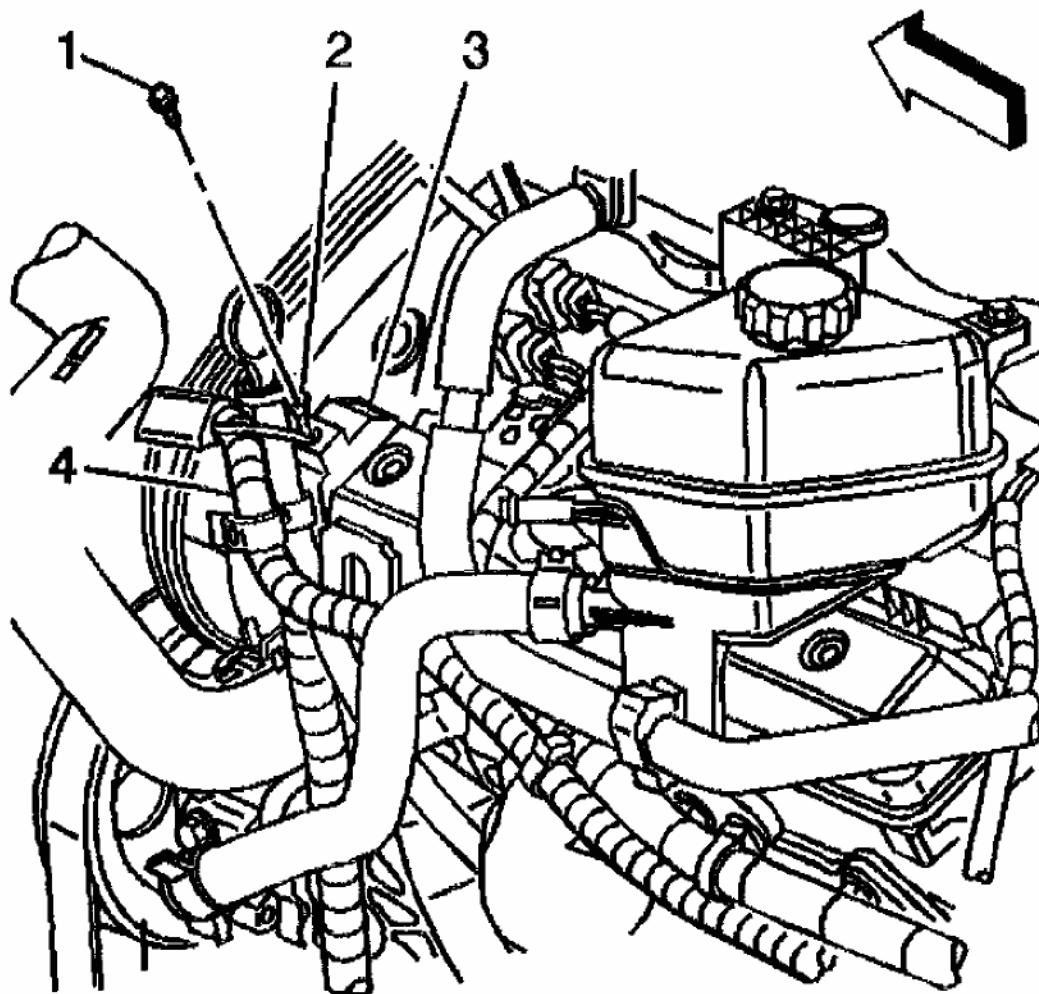


G02086671

Fig. 195: Installing Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

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



G02086672

Fig. 196: Installing Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **FASTENER NOTICE** in Cautions and Notices.

8. Install the bolt (1) securing the coolant heater ground lead (2) to the camshaft bearing cap

(3).

Tighten

Tighten the coolant heater ground lead bolt to 9 N.m (80 lb in).

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:

- 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.

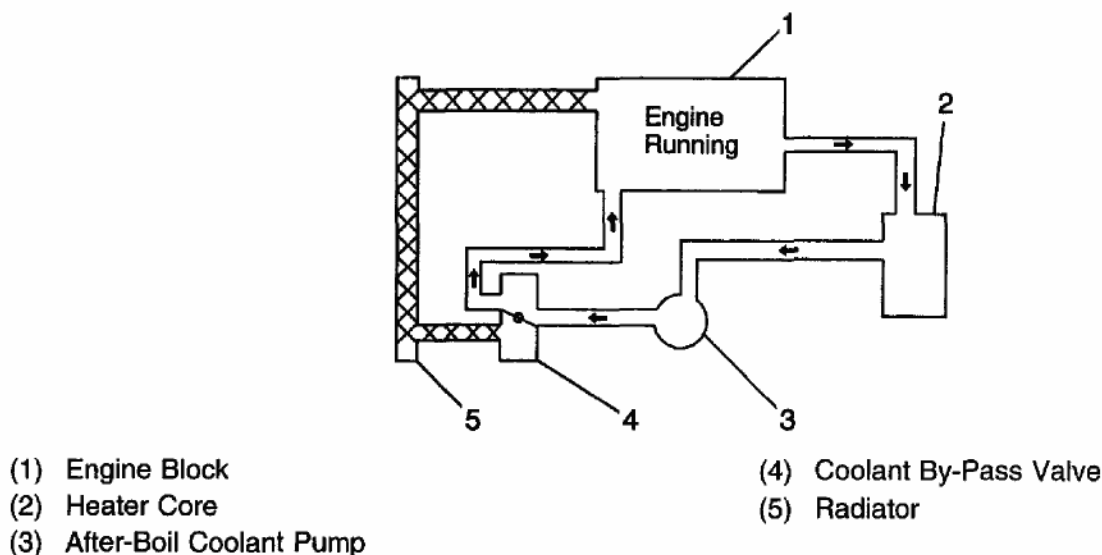
The ECM commands the auxiliary cooling fan ON when the engine coolant temperature exceeds approximately 108°C (226°F).

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

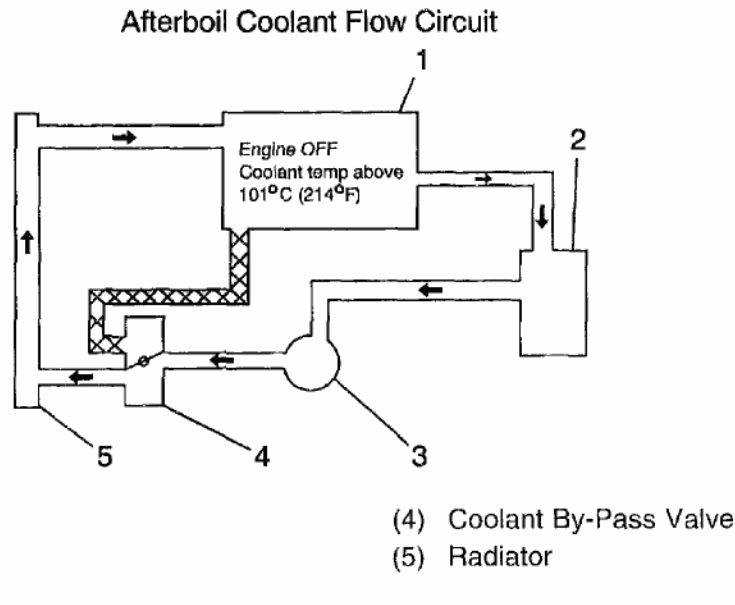


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Fig. 197: Heater Coolant Flow Circuit Diagram
Courtesy of GENERAL MOTORS CORP.

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



G02086674

Fig. 198: Afterboil Coolant Flow Circuit
Courtesy of GENERAL MOTORS CORP.

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 lines use a quick connect fitting at the radiator. The quick connect fitting must be removed using a special tool. Removing the transmission oil cooler lines without the tool will result in damage to the radiator and the transmission oil cooler, and may damage the transmission due to mixing of the transmission oil and coolant.

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 lines use a quick connect fitting at the radiator. The quick connect fitting must be removed using a special tool. Removing the transmission oil cooler lines without the tool

will result in damage to the radiator and the transmission oil cooler, and may damage the transmission due to mixing of the transmission oil and coolant.

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.

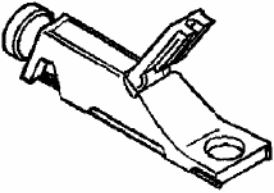
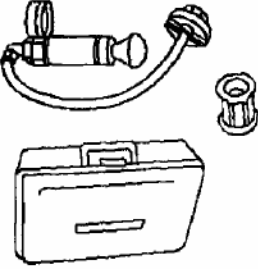
Power Steering Oil Cooler

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

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

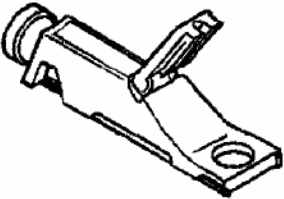
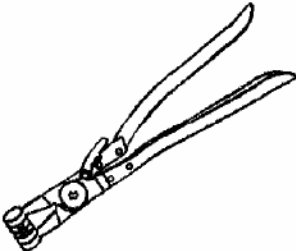
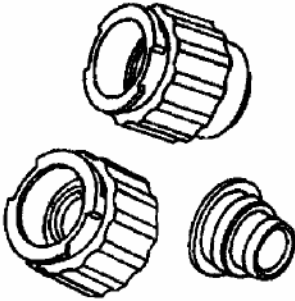
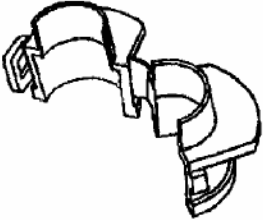
Illustration	Tool Number / Description
	J 23688 Coolant and Battery Fluid Tester
	J 24460-01 Cooling System Pressure Tester
	J 24731 Tempilstick 188
	J 24731 Tempilstick 206

G02086675

Fig. 199: Special Tools & Equipment (1 Of 2)
Courtesy of GENERAL MOTORS CORP.

2003 Cadillac CTS

2003 ENGINE Engine Cooling - CTS

Illustration	Tool Number / Description
	J 26568 Coolant and Battery Fluid Tester
	J 38185 Hose Clamp Pliers
	J 42401 Radiator Cap / Surge tank Tester
	J 44827 Transmission Cooler Quick Disconnect

G02086676

Fig. 200: Special Tools & Equipment (2 Of 2)
Courtesy of GENERAL MOTORS CORP.