

2004 ENGINE

Engine Cooling - Aztek & Rendezvous

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Condenser Mounting Bolts (All)	6 N.m	53 lb in
A/C Condenser Tube Clip Bolt (All)	2.5 N.m	22 lb in
Coolant Heater Bolt (LA1)	2 N.m	18 lb in
Coolant Inlet Pipe Lower (Bell Hosing) Bolt (LY7)	50 N.m	37 lb ft
Coolant Inlet Pipe Upper Bolt (LY7)	23 N.m	17 lb ft
Cooling Fan Motor Screws (All)	6 N.m	53 lb in
Cooling Fan Nut (All)	6 N.m	53 lb in
Cooling Fan Shroud Bolts (All)	6 N.m	53 lb in
Discharge Hose to Condenser Nut (All)	16 N.m	12 lb ft
Evaporator Inlet Tube to Condenser Bolt (All)	16 N.m	12 lb ft
Radiator Bracket Bolt (All)	24 N.m	18 lb ft
Radiator Inlet Hose Support Bolt (LY7)	50 N.m	37 lb ft
Radiator Upper Mount Bolt (All)	10 N.m	89 lb in
Thermostat Bolts (LY7)	10 N.m	89 lb in
Thermostat Bypass Pipe Bolt (LA1)	11 N.m	98 lb in
Thermostat Bypass Pipe Nut (LA1)	25 N.m	18 lb ft
Thermostat Housing Bolts (LA1)	25 N.m	18 lb ft
Water Outlet Housing Bolt (LY7)	10 N.m	89 lb in
Water Pump Bolt (All)	10 N.m	89 lb in
Water Pump Pulley Bolt (LA1)	25 N.m	18 lb ft
Water Pump Pulley Bolt (LY7)	12 N.m	106 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

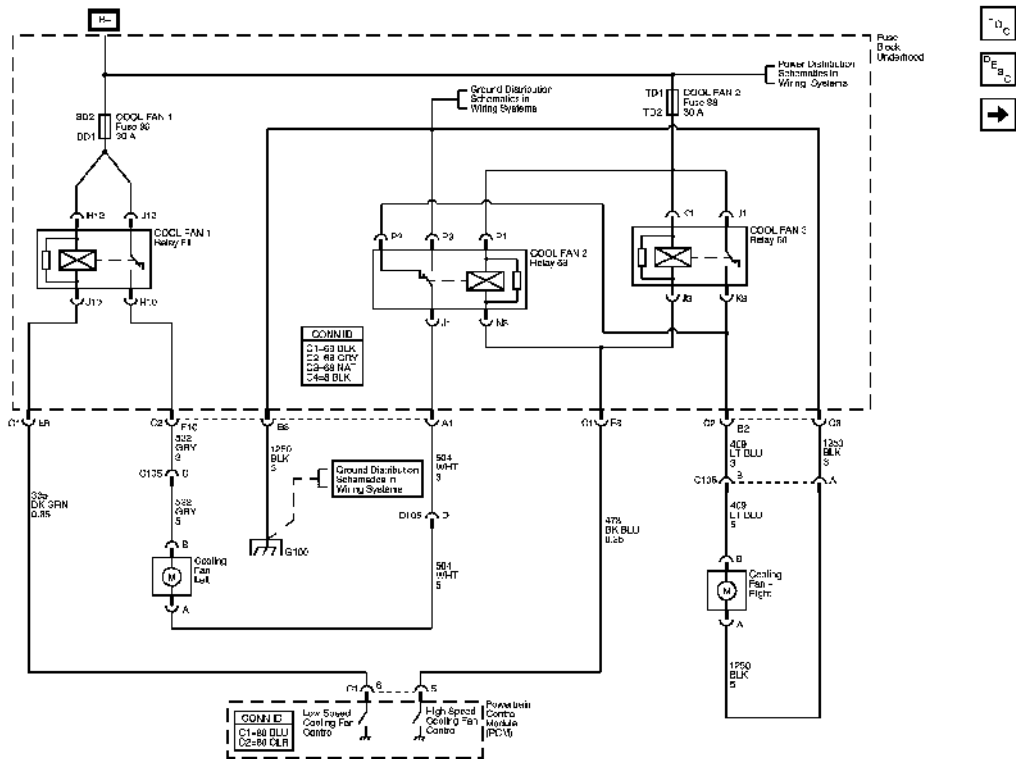


Fig. 1: Cooling Fans Schematics
 Courtesy of GENERAL MOTORS CORP.

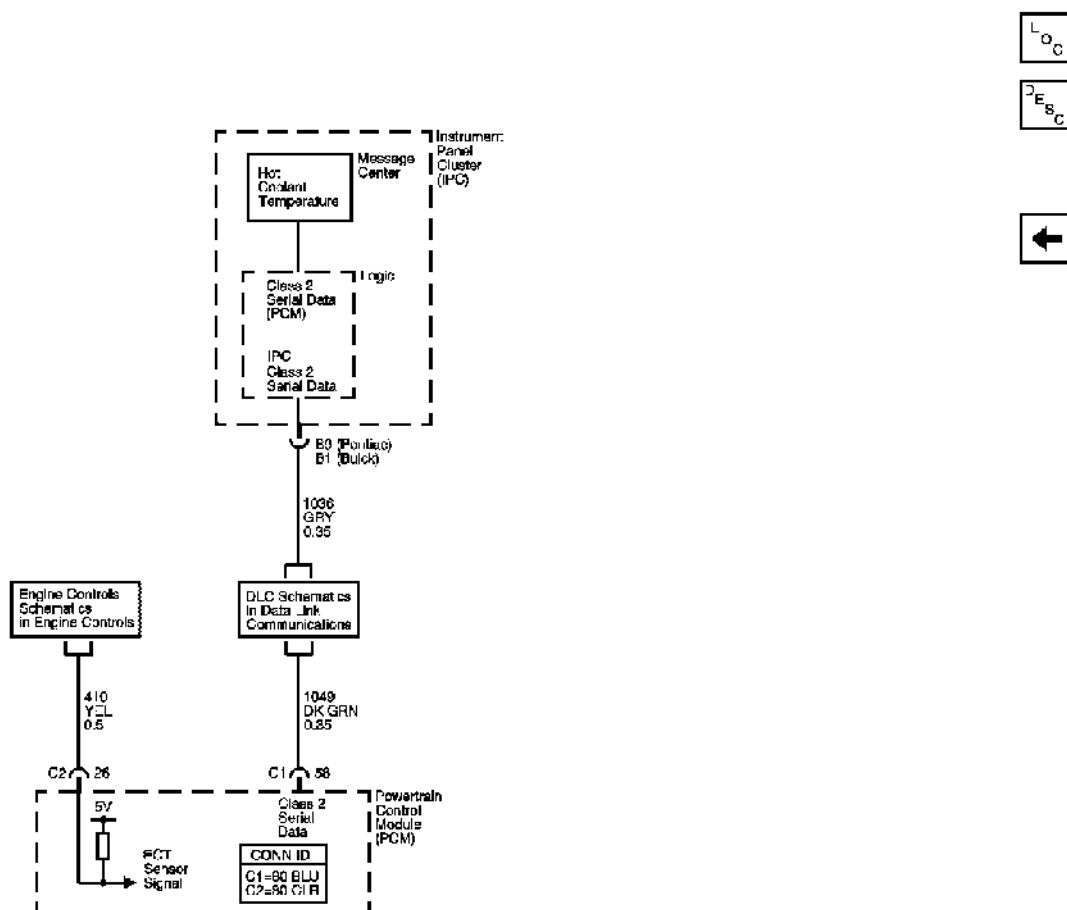


Fig. 2: Indicators, Sensors Schematics
 Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

COOLING SYSTEM COMPONENT VIEWS

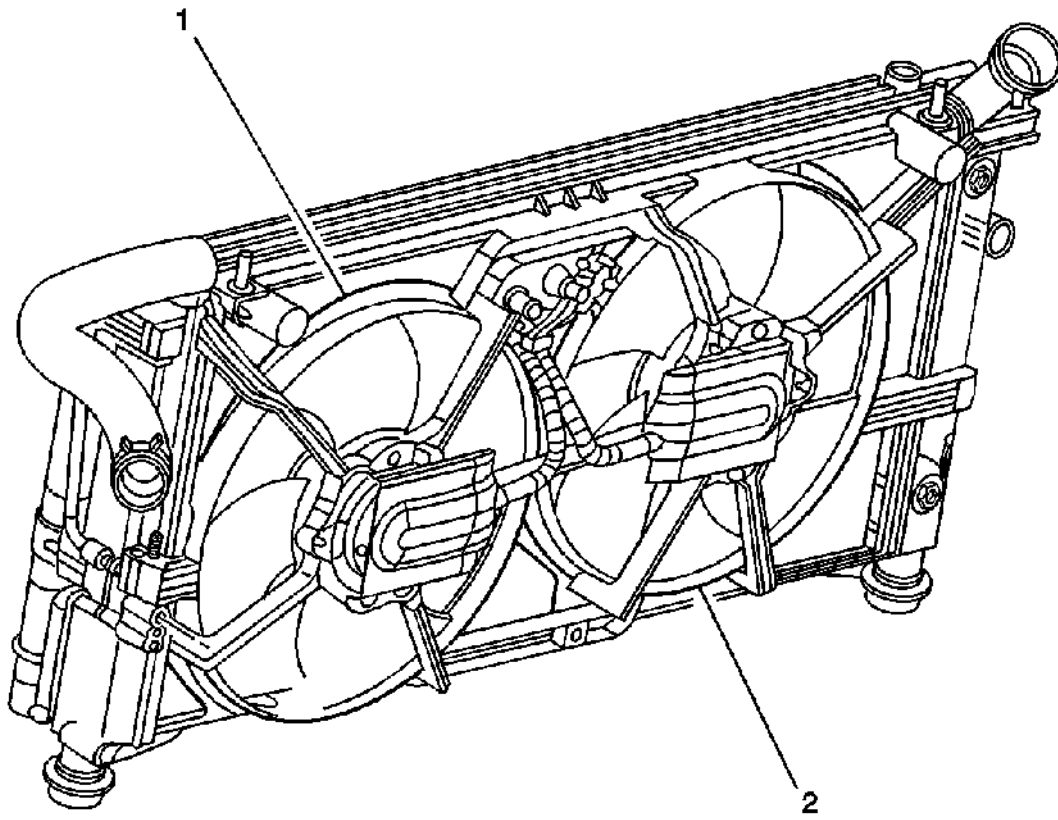


Fig. 3: Cooling System Component View
Courtesy of GENERAL MOTORS CORP.

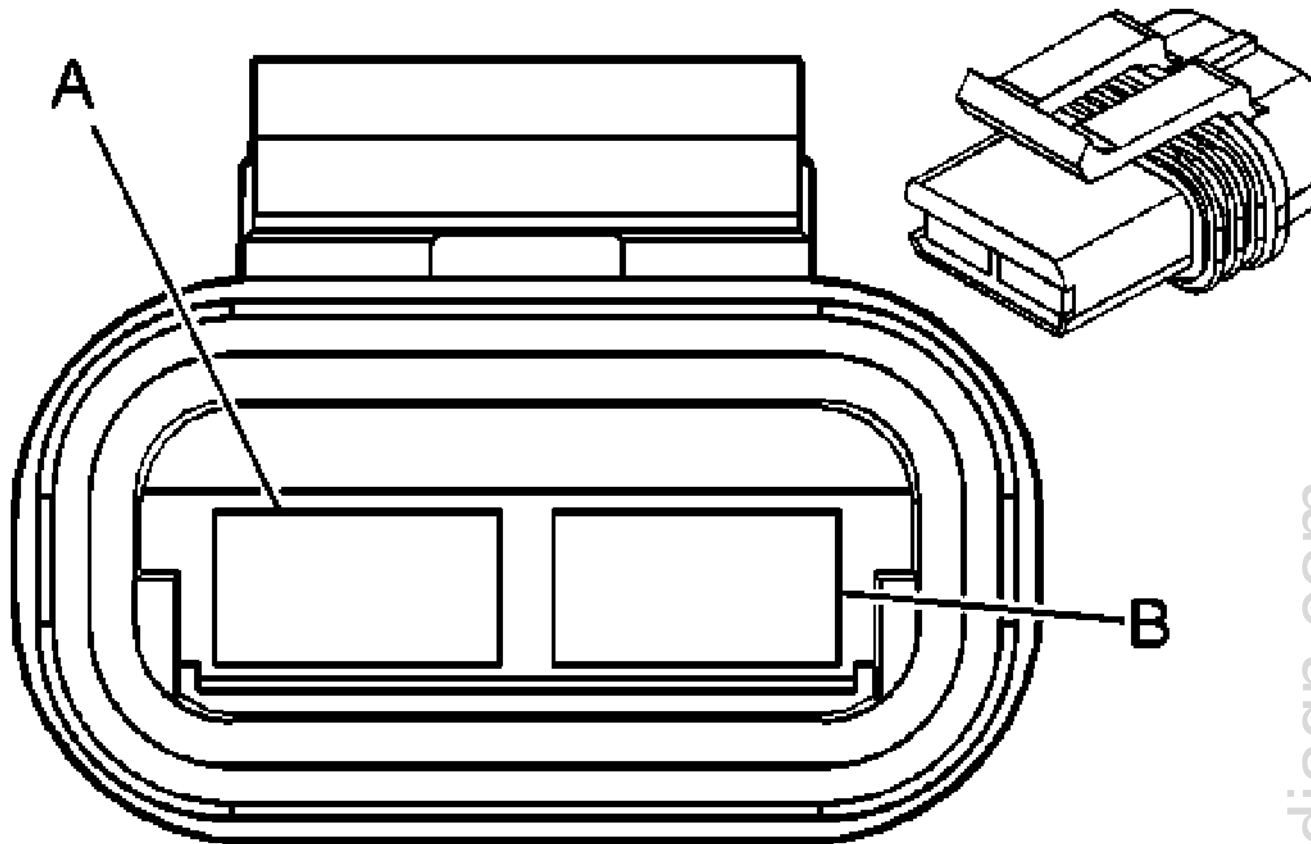
Callouts For Fig. 3

Callout	Component Name
1	Cooling Fan-Left
2	Cooling Fan-Right

COOLING SYSTEM CONNECTOR END VIEWS

Cooling Fan Connector End View - Left

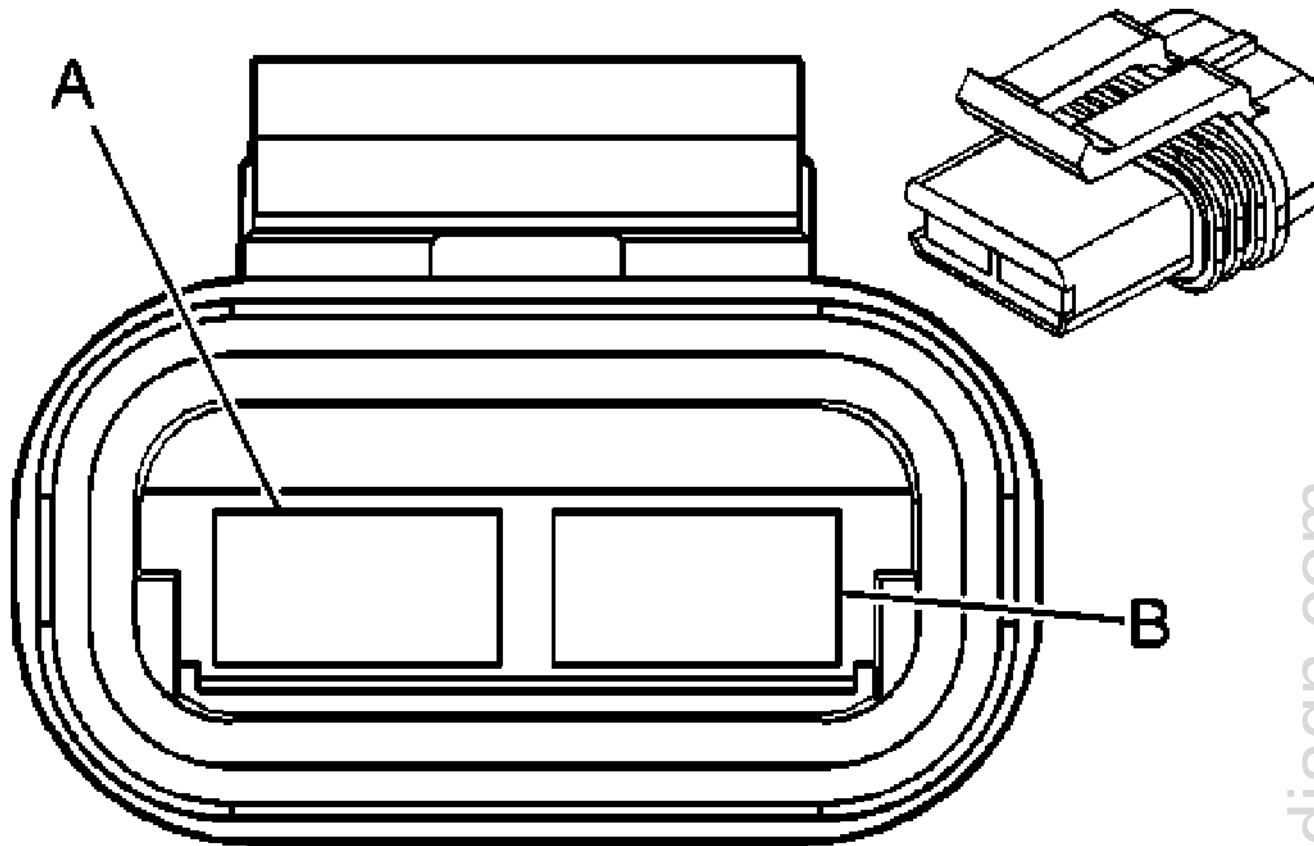




Connector Part Information		• 12033769 • 2-Way F Metri-Pack 630 Series Sealed P2S	
Pin	Wire Color	Circuit No.	Function
A	WH	504	Cooling Fan Motor Ground (LA1)
	RD	504	Cooling Fan Motor Ground (LY7)
B	GY	532	Cooling Fan Motor Supply Voltage
	BK	532	Cooling Fan Motor Supply Voltage

Cooling Fan Connector End View - Right





Connector Part Information		• 12033769 • 2-Way F Metri-Pack 630 Series Sealed P2S	
Pin	Wire Color	Circuit No.	Function
A	BK	1250	Ground (LA1)
	RD	1250	Ground (LY7)
B	L- BU	409	Cooling Fan Motor Supply Voltage
	BK	409	Cooling Fan Motor Supply Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE COOLING

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

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

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

DIAGNOSTIC SYSTEM CHECK - ENGINE COOLING

Test Description

The number(s) below refer to the step number(s) 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 Powertrain Control Modules have set DTC's which may affect Engine Cooling operation are present.

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

Diagnostic System Check - Engine Cooling

Step	Action	Yes	No
1	Install a scan tool. Does the scan tool power up?	Go to Step 2	Go to <u>Scan Tool Does Not Power Up</u> in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the following control modules: • Instrument Cluster • Powertrain Control Module		Go to <u>Scan Tool Does Not Communicate with Class 2 Device</u> in Data Link Communications
3	Does the scan tool communicate with the control modules? Select the powertrain control module display DTCs function on the scan tool. Does the scan tool display any DTCs?	Go to Step 3 Go to Step 4	Go to <u>Symptoms - Engine Cooling</u>

	Does the scan tool display the Engine Oil Off light with a "U"?	Go to Scan Tool Does Not Step 3	Go to Scan Tool Do
3	Select the powertrain control module display DTCs function on the scan tool. Does the scan tool display any DTCs?	Communicate with Class 2 Device in Step 4	Go to Symptom - Engine Diagnostic
		Link Communications	Trouble Code (DTC) List

SCAN TOOL OUTPUT CONTROLS

Powertrain Control Module (PCM) 3.4 Liter LA1 Scan Tool Output Control

Scan Tool Output Control	Additional Menu Selection(s)	Description
Fans Low Speed	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the powertrain control module (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.

Engine Control Module (ECM) 3.6L LY7 Scan Tool Output Control

Scan Tool Output Control	Additional Menu Selection(s)	Description
Fan Relay 1	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the electronic control module (ECM) and activate or deactivate the cooling fan 1 relay, manually turning the low speed fans On and Off.
Fan Relays 2 and 3	Fan Relays	The scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the ECM to activate or deactivate the cooling fan 2 and 3 relays, manually turning the medium speed fans On.

Fan Relays 1, 2, and 3	Fan Relays	This scan tool displays a Commanded State of None, Off or On. This allows you to communicate with the ECM with the ECM to deactivate the cooling fan. To deactivate the cooling fan fully turning the relay medium speed fans Off and the high speed fans On.
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SCAN TOOL DATA LIST

Powertrain Control Module Scan Tool Data List (PCM) 3.4 Liter LA1

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories Off			
ECT Sensor	Engine Data 1 and Engine Data 2	Degrees	Varies
FC Relay 1 Command	Engine Data 2	OK/Fault/Invalid State	OK
FC Relay 2 and 3 Command	Engine Data 2	OK/Fault/Invalid State	OK

Engine Control Module Scan Tool Data List (ECM) 3.6L LY7

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories Off			
ECT Sensor	Engine Data 1, Engine Data 2 and Cooling/HVAC Data	Degrees	Varies
FC Relay 1 Command	Cooling/HVAC Data	OK/Fault/Invalid State	OK
FC Relay 2 and 3 Command	Cooling/HVAC Data	OK/Fault/Invalid State	OK

SCAN TOOL DATA DEFINITIONS

ECT

The scan tool displays -40 to +151°C (-40 to +304°F). The Engine Coolant Temperature (ECT) sensor is mounted in the coolant stream. The PCM/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 PCM/ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal decreases and the PCM/ECM interprets the lower voltage as a warm engine.

FC Relay 1 Command

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

FC Relay 2 and 3 Command

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

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module(s)
P0125	<u>DTC P0125</u>	PCM/ECM
P0128	<u>DTC P0128</u>	PCM/ECM
P0480	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P0481	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P0691	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P0692	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P0693	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P0694	<u>DTC P0480, P0481, P0691, P0692, P0693, or P0694</u>	PCM/ECM
P1258	<u>DTC P1258</u>	PCM/ECM

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

Circuit Description

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

Battery positive voltage is supplied to the cooling fan 2 relay and the cooling fan 3 or S/P relay from the COOL FAN #2 fuse. The PCM/ECM controls the relays by grounding the high speed cooling fan relay control circuit.

When the PCM/ECM is commanding a relay on, the voltage potential of the control circuit should be low, near 0 volts. When the PCM/ECM is commanding the control circuit to a relay, the voltage potential of the circuit should be high, near battery voltage. If the fault detection circuit senses a voltage other than what is expected, the DTC will set.

The PCM/ECM will monitor the control circuit for the following:

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

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

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0480 Cooling Fan 1 Relay Control Circuit
- DTC P0481 Cooling Fan 2 and 3 or S/P Relay Control Circuit
- DTC P0691 Cooling Fan 1 relay Control Circuit Low Voltage
- DTC P0692 Cooling Fan 1 Relay Control Circuit High Voltage
- DTC P0693 Cooling Fan 2 and 3 or S/P Relay Control Circuit Low Voltage
- DTC P0694 Cooling Fan 2 and 3 or S/P Relay Control Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.

- System voltage is between 9-18 volts.
- The relay control circuit is transitioned from OFF to ON or ON to OFF.

Conditions for Setting the DTC

- The PCM/ECM detects an open, a short to ground or a short to voltage on the cooling fan relay control circuit.
- The above conditions are present for at least 30 seconds.

Action Taken When the DTC Sets

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

Diagnostic Aids

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

Test Description

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

2: Listen for an audible click when the cooling fan 1 relay operates. Command both the ON and OFF states. Repeat the commands as necessary.

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

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

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

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Step	Action	Yes	No
Schematic Reference: <u>Engine Cooling Schematics</u>			
Connector End View Reference: <u>Cooling System Connector End Views</u>			
1	Did you perform the Diagnostic System Check - Engine Cooling ?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Low Speed ON and OFF. Does the cooling fan 1 relay turn ON and OFF with each command?	Go to Step 3	Go to Step 4
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans High Speed ON and OFF. Do the cooling fan 2 and the cooling fan 3 or S/P 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 cooling fan 1 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the cooling fan 1 relay with a test lamp that is connected to a good ground. 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 cooling fan 1 relay and the battery positive voltage circuit of the cooling fan 1 relay. 2. With a scan tool, command the Fans Low		

	Install Speed ON and OFF.	Go to	Go to Step 6
	1. Turn OFF the ignition. Does the test lamp turn ON and OFF with each command? 2. Disconnect the cooling fan 1 relay.	Go to Step 12	Go to Step 9
4	3. Turn ON the ignition, with the engine OFF. 2. Disconnect the cooling fan 3 or S/P relay. 4. Probe the battery positive voltage circuit of the cooling fan 1 relay with a test lamp that is connected to a good ground. 3. Turn ON the ignition, with the engine OFF.		
6	Does the test lamp illuminate? 4. Probe the battery positive voltage circuit of the cooling fan 3 or S/P relay with a test lamp that is connected to a good ground.	Go to Step 5	Go to Step 1
	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 cooling fan 3 or S/P relay and the battery positive voltage circuit of the cooling fan 3 or S/P 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 cooling fan 2 relay. 3. Turn ON the ignition with the engine OFF. 4. Connect a test lamp between the control circuit of the cooling fan 2 relay and the battery positive voltage circuit of the cooling fan 2 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? Test the control circuit of the appropriate	Go to Step 11	Go to Step 10

10	relay for a short to voltage or an open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. 2. Disconnect the cooling fan 2 relay. 3. Turn ON the ignition with the engine OFF. Did you find and correct the condition?	Go to Step 21	Go to Step 15
11	4. Connect a test lamp between the control circuit of the cooling fan 2 relay and the battery positive voltage circuit of the cooling fan 2 relay. 5. With the scan tool, command the Fans High Speed ON and OFF.	Go to Step 21	Go to Step 15
12	Inspect for poor connections at the cooling fan 1 relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. 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? Did you find and correct the condition?	Go to Step 21	Go to Step 17
	Inspect for poor connections at the cooling fan 2 relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems.	Go to Step 21	Go to Step 18
13	Inspect for poor connections at the cooling fan 3 or S/P relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	Go to Step 19
14	Inspect for poor connections at the harness connector of the powertrain control module (PCM)/engine control module (ECM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	Go to Step 20
15	Repair the battery positive voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 21	-
16	Replace the cooling fan 1 relay. Did you complete the replacement?	Go to Step 21	-
17	Replace the cooling fan 2 relay. Did you complete the replacement?	Go to Step 21	-
18	Replace the cooling fan 3 or S/P relay. Did you complete the replacement?	Go to Step 21	-
19			

	IMPORTANT Poor connections at the cooling fan 3	Go to Step 21	Go to Step 1
25	Perform the programming procedure for the PCM/ECM. Replace the powertrain control module (PCM)/engine control module (ECM). Refer to <u>Testing for Intermittent Conditions and Control Module (PCM) Replacement in Engine Controls - 3.4L or Engine Control Module (ECM) Replacement in Engine Controls - 3.6L</u> . Did you find and correct the condition? Refer to <u>Wiring Repairs</u> in Wiring Systems.	Go to Step 21	Go to Step 2
16	Repair the battery positive voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 21	-
	Use the scan tool to clear the DTCs. Did you complete the repair?	Go to Step 21	-
17	Replace the cooling fan 1 relay. Did you complete the replacement?	Go to Step 21	-
21	Replace the cooling fan 2 relay. Did you complete the replacement?	Go to Step 21	-
18	Replace the cooling fan 3 or S/P relay. Did you complete the replacement?	Go to Step 21	-
19	Replace the cooling fan 3 or S/P relay. Does the DTC reset?	Go to Step 2	System OK

DTC P1258

Circuit Description

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

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

- The PCM/ECM will illuminate the malfunction indicator Lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The PCM/ECM will signal the IPC to turn ON the Service Engine Soon indicator.
- The PCM/ECM will alternately disable 2 groups of four cylinders by turning OFF the

fuel injectors.

- The PCM/ECM will store conditions which were present when the DTC set as Freeze Frame and File Records data.
- A history DTC is stored.

Conditions for Clearing the MIL/DTC

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

DTC P1258

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

SYMPTOMS - ENGINE COOLING

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

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

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

ENGINE COOLANT TEMPERATURE INDICATOR ALWAYS ON

Engine Coolant Temperature Indicator Always On

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Cooling ?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Cooling</u>
2	Start the engine. Does the Engine Coolant Temperature indicator illuminate?	Go to Step 3	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems
3	With the scan tool, observe the engine coolant temperature parameter in the powertrain control module (PCM) or engine control module (ECM) data list. Does the scan tool indicate that the coolant temperature is within the temperature range shown on the temperature gage?	Go to <u>Engine Overheating</u>	Go to Step 4
4	Replace the instrument panel cluster (IPC). Refer to <u>Instrument Panel Cluster (IPC) Replacement</u> in Instrument Panel, Gages, and Console.		-
	Did you complete the repair?	Go to Step 5	
5	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

COOLING FAN ALWAYS ON

Cooling Fan Always On

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

	Turn ON the ignition with the engine OFF.	Go to Step 18	Go to Testing for Intermittent Conditions and Poor Connections in Wiring System
2 11	Are one or both cooling fans ON? Repair the short to voltage in the right cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 18	Go to Step 18
3	Are both cooling fans running continuously? Inspect for poor connections at the cool fan?	Go to Step 4	Go to Step 6
4 12	Are both fans running continuously? Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition? Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs.	Go to Step 5	Go to Step 7
5 13	Is the right cooling fan running continuously? Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 18	Go to Step 15
6 14	Is the left cooling fan running continuously? Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 18	Go to Step 14
7 15	Inspect the cool fan connections at the A/C refrigerant pressure sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Repairs. Did you find and correct the condition?	Go to Step 12	Go to Step 9
8 16	Replace the cool fan 2 relay. Did you complete the replacement?	Go to Step 13	Go to Step 11
9 17	Replace the short to voltage in the left cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 18	Go to Step 17
10 18	Replace the A/C refrigerant pressure sensor. Refer to Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement . Did you complete the replacement? Operate the system in order to verify the repair. Did you correct the condition?	Go to Step 18	Go to Step 18
		System OK	Go to Step 2

COOLING FAN INOPERATIVE

Cooling Fan Inoperative

Step	Action	Yes	No
Schematic Reference : Engine Cooling Schematics			
Connector End View Reference: Cooling System Connector End Views			

Step **DEFINITION:** One or both cooling fan motors are inoperative **Yes** either high, low, or both speeds. **Action:**

1	Did you perform the Diagnostic System Check - Engine Cooling?	Go to Step 2	Go to Diagnostic System Check - Engine Cooling
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, command the Fans Low Speed ON and OFF. Do the low speed engine cooling fans turn ON and OFF with each command? IMPORTANT: A 3 second delay occurs before the powertrain control module (PCM)/engine control module (ECM) changes the cooling fan speed.	Go to Step 3	Go to Step 4
3	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? 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.	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 11
4	1. Disconnect the cooling fan 1 relay. 2. Connect the first 20-A fused jumper between the battery positive voltage circuit of the cooling fan 1 relay and the cooling fan motor supply voltage circuit of the cooling fan 1 relay. Do both cooling fans operate in low speed?	Go to Step 13	Go to Step 5
5	1. Disconnect the cooling fan s/p relay. 2. Connect the second 20-A fused jumper between the left cooling fan motor low reference circuit of the cooling fan 2 relay and the right cooling fan motor		

	Install a voltage circuit of the cooling fan 2 relay. Turn ON the ignition, with the engine OFF. With both cooling fans operating, do the fans speed?	Go to Step 13	Go to Step 4
6 3	IMPORTANT: The second 20-A fused jumper has a second delay occurs before the powertrain control module (PCM)/engine control module (ECM) changes the cooling fan speed. Does the right cooling fan operate in high 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? 1. Install the cooling fan 2 relay.	Go to Testing for Intermittent Conditions and Poor Connections in Step 9 in Wiring Systems	Go to Step 7 Go to Step 11
7 4	2. 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. 3. Reconnect the second 20-Amp fused jumper wire from the cooling fan motor supply voltage circuit of the 1. right cooling fan electrical connector to the cooling fan motor ground circuit 2. Connect the first 20-A fused jumper of the right cooling fan electrical between the battery positive voltage connector circuit of the cooling fan 1 relay and the cooling fan motor supply voltage circuit of the cooling fan 1 relay. Does the left cooling fan operate in high speed? Reconnect the second 20-Amp fused jumper wire from the cooling fan motor supply Does the left cooling fan operate in high speed?	Go to Step 16 Go to Step 13	Go to Step 8 Go to Step 5
8	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 cooling fan 2 relay. 2. Disconnect the left cooling fan electrical connector. 3. Reconnect the second 20-Amp fused jumper wire from cooling fan motor supply voltage circuit of the left cooling fan electrical connector to the cooling fan low reference circuit of the left cooling fan electrical connector.		

	Reconnect the second 20-A fused jumper wire from the 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 17	Go to Step 10
	Reconnect the second 20-Amp fused jumper wire from the 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 9	Go to Step 7
10	1. Disconnect the cooling fan 2 relay. 2. Disconnect the right cooling fan electrical connector. Does the right cooling fan operate in high speed?	Go to Step 18	Go to Step 22
11	1. 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 left cooling fan low reference circuit of the cooling fan 2 relay. 2. Disconnect the cooling fan 2 relay. Does the left cooling fan operate in high speed?	Go to Step 12	Go to Step 15
12	1. Reconnect the cooling fan 2 relay. 2. Connect a fused jumper between the left cooling fan low reference circuit of the cooling fan 2 relay and the ground circuit of the cooling fan 2 relay. 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 14	Go to Step 19
	Does the left cooling fan operate in high speed? Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 20	Go to Step 2
13	Intermittent Conditions and Poor Connections and Connector Repairs 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 cooling fan 2 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 24
15	Inspect for poor connections at the cooling fan 3 or S/P relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 28	Go to Step 25
16	Inspect for poor connections at the harness connector of the right cooling fan. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.		

	Repairs in Wiring Systems Does the right cooling fan operate in high speed? Inspect for poor connections at the harness connector of the left cooling fan. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 18	Go to Step 21
11	Did you find and correct the condition? Inspect for poor connections at the harness connector of the left cooling fan. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 28	Go to Step 26
17	1. Disconnect the cooling fan 2 relay. 2. Connect a 20-A fused jumper between the left cooling fan low reference circuit of the cooling fan 2 relay and the ground circuit of the cooling fan 2 relay. Repair the left cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems.		
12	Did you find and correct the condition? Repair the left cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems.	Go to Step 28	Go to Step 27
18	Does the left cooling fan operate properly in high speed?	Go to Step 14	- Go to Step 19
19	Did you complete the repair? Inspect for poor connections at the cooling fan 1 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 28	-
19	Did you complete the repair? Repair the left cooling fan motor ground circuit. Refer to Wiring Repairs in Wiring Systems.	Go to Step 28	-
20	Did you find and correct the condition? Inspect for poor connections at the cooling fan 2 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 28	-
14	Did you complete the repair? Repair the right cooling fan motor supply voltage circuit. Refer to Wiring Repairs in Wiring Systems.	Go to Step 28	-
21	Did you find and correct the condition? Inspect for poor connections at the cooling fan 3 or S/P relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 28	-
23	Did you find and correct the condition? Inspect for poor connections at the cooling fan 3 or S/P relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 28	-
23	Did you complete the repair? Replace the cooling fan 1 relay.	Go to Step 28	Go to Step 24
24	Did you complete the replacement? Replace the cooling fan 2 relay.	Go to Step 28	-
25	Did you complete the replacement? Replace the cooling fan 3 or S/P relay.	Go to Step 28	-
26	Did you complete the replacement? Replace the right cooling fan. Refer to Cooling Fan Motor Replacement - Electric .	Go to Step 28	-
27	Did you complete the replacement? Replace the left cooling fan. Refer to Cooling Fan Motor Replacement - Electric .	Go to Step 28	-

	Inspect and complete the replacement harness	Go to Step 28	
28	Open the system left cooling fan. Refer to repair cooling fan. Refer to Testing for	Go to Step 28	Go to Step 2
	Repair the left cooling fan motor supply	System OK	Go to Step 3

ENGINE OVERHEATING

Engine Overheating

Step	Action	Yes	No
DEFINITION: Either of the following conditions indicate a probable engine overheat condition.			
	- The engine temperature gauge is in the red (overheat) zone and/or the engine temperature indicator is ON. - Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the ground while the engine is running.		
1	- Inspect and fill the cooling system as necessary. Refer to Draining and Filling Cooling System. - Inspect the cooling system for leaks as necessary. - Repair the cooling system leaks as necessary.		
	Has the inspection/repair been performed?	Go to Step 2	-
2	- Start the engine and allow the engine to run at approximately 1200 RPM. - Use the Scan Tool in order to verify the overheat condition.		Go to Engine Coolant Temperature Gauge Inaccurate or Inoperative in Instrument Panel, Gauges and Console
	Does the Scan Tool verify the engine overheat condition?	Go to Step 3	
3	- Verify that the cooling fans are operating properly. - Repair the cooling fan system as necessary.		
	Does the engine still overheat? Perform the following inspections:	Go to Step 4	System OK

Step	Action	Yes	No
DEFINITION	- Inspect the radiator and the A/C condenser cooling fins for debris or any other obstruction. - Inspect the drive belt system and the drive belt tensioner for proper operation in order to ensure that the coolant pump is rotating properly. - Hot engine coolant overflows from the coolant recovery reservoir and/or radiator cap onto the ground while the engine is running. - Inspect for a loose, damaged, and/or missing and fallen cooling fan system as Radiator Air Baffle and Drainage and Belling Cooling System.		
4	- Inspect the cooling system for leaks systematically. - Repair the system as necessary.		
1	Has the inspection/repair been performed?	Go to Step 2	System OK
2	CAUTION: Start the engine and allow the engine to run at approximately 1200 RPM. As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the pressure cap while the engine is hot and pressure is high will cause the solution to boil instantaneously - possibly with explosive force - spewing the solution over the engine, fenders and the person removing the cap. Verify that the cooling fans are operating properly.		Go to Engine Coolant Temperature Gage Inaccurate or Inoperative Instrument Panel Gauges and Console
5	Use the Scan Tool in order to verify the solution in the radiator without causing the solution to boil. Does the Scan Tool verify the engine overheat condition?	Go to Step 3	
3	- Repair the cooling fan system as necessary. - Inspect the thermostat for proper operation. Refer to Thermostat Diagnosis. Is the thermostat operating properly?	Go to Step 7	Go to Step 6
	Does the engine still overheat?	Go to Step 4	System OK
6	Thermostat Replacement (LA1) or Thermostat Replacement (LY7). Does the engine still overheat? IMPORTANT: Excessive coolant freeze point protection MAY cause the coolant to boil at low temperatures. Inspect for the proper coolant concentration (mixture). Correct the	Go to Step 7	System OK

7	coolant concentration as necessary. Perform the following inspections: 2. ~~Respect the radiator and the A/C~~ 3. ~~ser cooling fins for debris or any other~~ - Start the engine and inspect for a steady • ~~and is not any other of his trouble~~ ing in the drive belt system and the drive belt tensioner for proper operation in Is there a steady and constant flow of air bubbles in the engine coolant? • coolant pump is rotating properly.	Go to Step 8	Go to Step 9
4	The probable cause of the engine overheat is combustion chamber gases leaking into the cooling system. This condition is usually caused by the following: <u>Radiator Air Baffle Assemblies and</u> • <u>affle Assemblies and Deflectors.</u> • A faulty cylinder head gasket • A faulty cooling system hose. • A faulty engine block		
8	Repair the systems as necessary. Repair the systems as necessary.	Go to Step 5	System OK
5	CAUTION: Verify this condition by using spark plug electrodes or the porcelain surrounding the spark plug electrodes that exhibit signs of the boiling temperature of the solution in the radiator. Without causing the solution to boil. Removal of the pressure cap while the engine is hot and pressure is high will cause the solution to boil instantaneously - possibly with explosive force spewing the solution over the engine, fenders and the person removing the cap. The engine overheat may be caused by a cooling system blockage. Flush the cooling system. Refer to <u>Flushing</u>.	Go to Step 1	System OK
9	Inspect the thermostat for proper operation. Refer to <u>Thermostat Diagnosis</u>. Is the thermostat operating properly? IMPORTANT: It is VERY unlikely that the water pump is the	Go to Step 10 Go to Step 7	System OK Go to Step 6
6	Replace the thermostat. Refer to <u>Thermostat Replacement (LA1)</u> or <u>Thermostat Replacement (LY7)</u>.		
10	Does NONE of the cooling system passages are restricted, replace the coolant pump. Refer to <u>Water Pump Replacement (LA1)</u> or <u>Water Pump Replacement (LY7)</u>. Does the engine still overheat?	Go to Step 7	System OK
		Go to Step 1	System OK

LOSS OF COOLANT

Loss of Coolant

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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 <u>Diagnostic System Check - Engine Cooling</u> . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to <u>Draining and Filling Cooling System</u> . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 26
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 27	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 29	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe.		
	Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 28	Go to Step 10
	With the engine idling, inspect the coolant		

Step	recovery system. Action	Yes	No
DEFINITION	Does the coolant recovery system discharge either internally or externally.		
1	coolant while the engine is idling? Were you sent here from Symptoms or another diagnostic table? Visually inspect the hoses, pipes and hose clamps at the following locations:	Go to Step 15	Go to Step 11 Go to Symptom - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Engine Cooling . Is the action complete?	Go to Step 3	-
11 3	Inspect the coolant level. Is the radiator at the proper level?	Go to Step 6	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Draining and Filling Cooling System . Are any of the hoses, clamps or pipes leaking? Is the action complete?	Go to Step 20	Go to Step 12
5	Visually inspect the following components: If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 20
6	Engine overheating can cause a loss of coolant. Is the engine overheating? Cylinder head gaskets	Go to Step 27	Go to Step 7
12 7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking? Engine block Intake manifold	Go to Step 29	Go to Step 8
8	1. Radiator Idle the engine at normal operating temperature. 2. Thermostat housing Water pump Inspect for heavy white smoke coming out of the exhaust pipe. Are any of the listed components leaking? Is a heavy white smoke present from the exhaust pipe? Pressure test the cooling system. Refer to Cooling System Leak Testing .	Go to Step 20 Go to Step 9	Go to Step 13 Go to Step 10
13	With the cooling system pressurized, condensation in the exhaust system can cause a distinctive burning coolant odor in the exhaust. Visually inspect the components listed in the previous steps.		
14	Are any leaks present? Pressure test the coolant pressure cap. Refer to Pressure Cap Testing . Does the coolant pressure cap hold pressure?	Go to Step 20 Go to Step 16	Go to Step 14 Go to Step 21
15	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing .		

9	Does the white smoke have a burning coolant type odor? Inspect for the following conditions: Does the white smoke have a burning coolant type odor? Does the white smoke have a burning coolant smell inside of the vehicle.	Go to Step 30	Go to Step 21
10	With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant on the vehicle floor covering near the HVAC module assembly.	Go to Step 28	Go to Step 16
17	Visually inspect the hoses, pipes and hose clamps at the following locations: Is coolant present? Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to Step 22	Go to Step 17
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 18	Go to Step 19
19	Visually inspect the following components: Inspect the automatic transmission oil fluid level indicator. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 20	Go to Step 12
20	Repair or replace the leaking component. Refer to the appropriate repair.	Go to Step 23	Go to Step 31
21	Is the repair complete?	Go to Step 31	-
22	Replace the heater core. Refer to Heater Core Replacement (LA1) or Heater Core Replacement (LY7) in Heating, Ventilation and Air Conditioning.	Go to Step 31	-
23	Are any of the listed components leaking?	Go to Step 20	Go to Step 13
13	Is the repair complete?	Go to Step 31	-
23	1. Pressure test the cooling system. Refer to Cooling System Leak Testing . 2. Remove the transmission oil cooler lines from the radiator. 3. With the cooling system pressurized, pressure test the cooling system. Refer to Cooling System Leak Testing . 4. Visually inspect the components listed in the previous steps. 5. Inspect the transmission oil cooler for coolant.		

	Are any leaks present?	Go to Step 24 Go to Step 20	Go to Step 25 Go to Step 14
14	1. Replace the radiator. Refer to Radiator Replacement (LA1) or Radiator Pressure Cap Testing (LY7) . Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 21
24 15	2. Service the automatic transmission. Refer to Engine Coolant/Water in Pressure Cap Testing Transmission in Automatic . Does the coolant pressure cap hold pressure?	Go to Step 30	Go to Step 21
25 16 26	Inspect for the following conditions: Is the repair complete? • A coolant smell inside of the vehicle. Install the cooler lines to the radiator. • Coolant in the HVAC module assembly Is the action complete? drain tube. Repair the engine no crank condition. Refer to Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical - 3.4L. Is the repair complete? Is coolant present?	Go to Step 31 Go to Step 31 Go to Step 31 Go to Step 22	- - Go to Step 17
27 17	Repair the engine overheating condition. Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is the repair complete? Is there a milky substance under the oil fill cap? Repair the engine internal coolant leak. Refer to the following procedure:	Go to Step 31 Go to Step 18	- Go to Step 19
18 28	Inspect the engine oil fluid level indicator for a gray/white milky substance. • Coolant in Combustion Chamber in Engine Mechanical - 3.4L Is there a milky substance on the engine oil fluid level indicator?	Go to Step 28	Go to Step 19
19	• Coolant in Engine Oil in Engine Mechanical - 3.4L 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 31 Go to Step 23	Go to Step 31
29	Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed in Engine Mechanical - 3.4L. Is the repair complete?	Go to Step 31 Go to Step 31	-
21	Replace the coolant pressure cap. Repair the combustion pressure in the cooling system problem. Refer to Cylinder Leakage Test in Engine Mechanical - 3.4L. Is the repair complete?	Go to Step 31	-
30	Replace the heater core. Refer to Heater Core Replacement (LA1) or Heater Core . Is the repair complete?	Go to Step 31	-
31	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS

Tools Required

J 24731 Tempil Stick. See **Special Tools and Equipment**.

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

Thermostat Test Procedure Using Tempil Sticks

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 thermostat housing.

1. Use a tempil stick in order to find the opening and the closing temperatures of the coolant thermostat.
 - J 24731-188 tempil stick melts at 87°C (188°F). The thermostat should begin to open.
 - J 24731-206 tempil stick melts at 97°C (206°F). The thermostat should be fully open.
2. Replace the coolant thermostat if it does not operate properly between this temperature range.

COOLANT HEATER INOPERATIVE

Coolant Heater Inoperative

Step	Action	Yes	No
1	Did you perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Engine Cooling</u>
2	Test the engine coolant heater power supply cord for an open or short to ground. Refer to <u>Circuit Testing</u> in Wiring Systems. Did you find a condition?		Go to Step 4
3	Replace the engine coolant heater power supply cord. Refer to <u>Coolant Heater Cord Replacement (LA1)</u> or <u>Coolant Heater Cord Replacement (LY7)</u> . Did you complete the repair?	Go to Step 6	-
	Inspect for poor connections at the harness connector of the engine coolant heater. Refer to <u>Testing for Intermittent Conditions</u>		

Step	Action and Connector	Yes	No
4	Repairs in Wiring Systems Did you find and correct the condition? Replace the engine coolant heater. Refer to Coolant Heater Replacement (LA1) or Coolant Heater Replacement (LY7) .	Go to Step 6	Go to Symptom Go to Step 5
5	Did you complete the repair? Operate the system in order to verify the repair.	Go to Step 6	-
6	Did you correct the condition?	System OK	Go to Step 2

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

Step	Action	Yes	No
1	1. Ensure that the cooling system is full. 2. Allow the engine/radiator cap to cool. 3. Start the engine. 4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s) Is either engine cooling fan on?		
2	1. Diagnose and repair the cooling fan system. 2. Verify the customer complaint.	Go to Step 2	Go to Step 3
3	Does the engine still fail to reach normal operating temperature? Install the Scan Tool to the DLC. Compare the Scan Tool coolant temperature reading to the I/P cluster coolant temperature. Is the I/P cluster coolant temperature close to the Scan Tool coolant temperature?	Go to Step 3	System OK
		Go to Step 5	Go to Step 4
4	1. Diagnose and repair the coolant temperature gage system. Refer to Engine Coolant Temperature Gage Inaccurate or Inoperative in Instrument Panel Gauges and Console. 2. Verify the customer complaint.		

Step	Does the engine still fail to reach normal operating temperature?	Yes	No
1	1. Ensure that the cooling system is full. CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. 2. Allow the engine/radiator cap to cool. 3. Start the engine and let it run for 5 minutes. 4. Turn the air conditioning system off. 5. Inspect both the Removal of the pressure cap while the engine is hot and pressure is high will cause the solution to boil instantaneously - possibly with explosive force - spewing the solution over the engine, radiator and the person removing the cap.	Go to Step 5	System OK
5	Is either engine cooling fan on?	Go to Step 2	Go to Step 3
6	Inspect the thermostat for proper operation. Refer to Thermostat Diagnosis. Is the thermostat operating properly? 1. Replace the thermostat. Refer to Thermostat Replacement (LA1) or Thermostat Replacement (LY7). 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to Step 1	Go to Step 6
		Go to Step 1	System OK

PRESSURE CAP TESTING

Tools Required

J 24460-01 Cooling System Pressure Tester. See **Special Tools and Equipment**.

Test Procedure

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

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

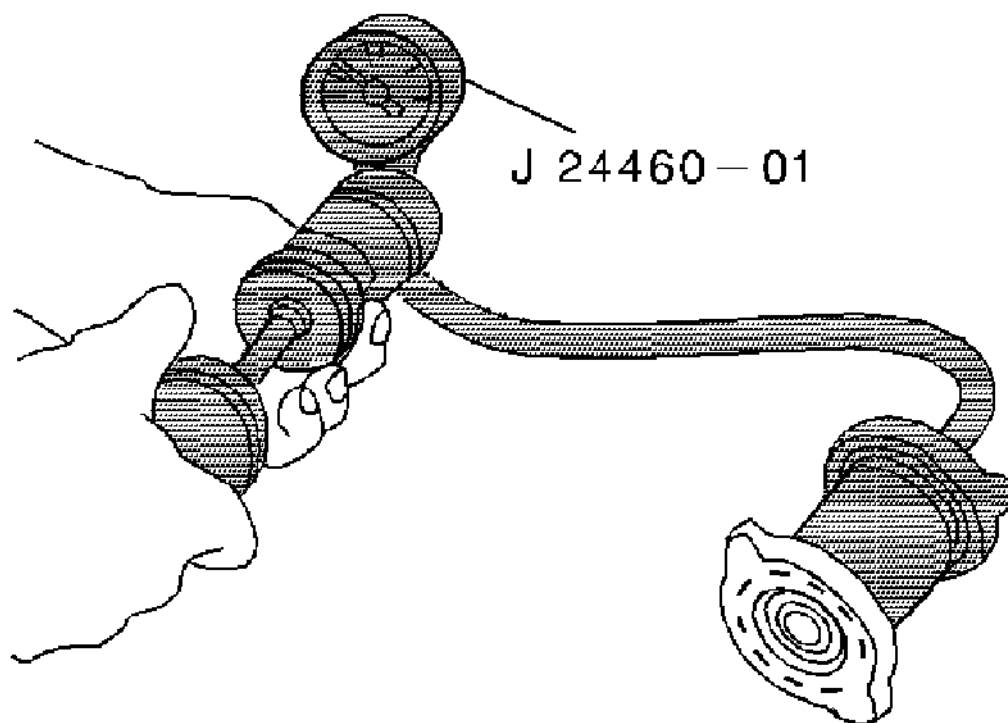


Fig. 4: Identifying J 24460-01
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 24460-01** in order to test the pressure cap. See **Special Tools and Equipment**.
4. Test the pressure cap for the following conditions:
 - Pressure release when the **J 24460-01** exceeds the pressure rating of the pressure cap. See **Special Tools and Equipment**.
 - Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

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

COOLING SYSTEM LEAK TESTING

Tools Required

Test Procedure

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.

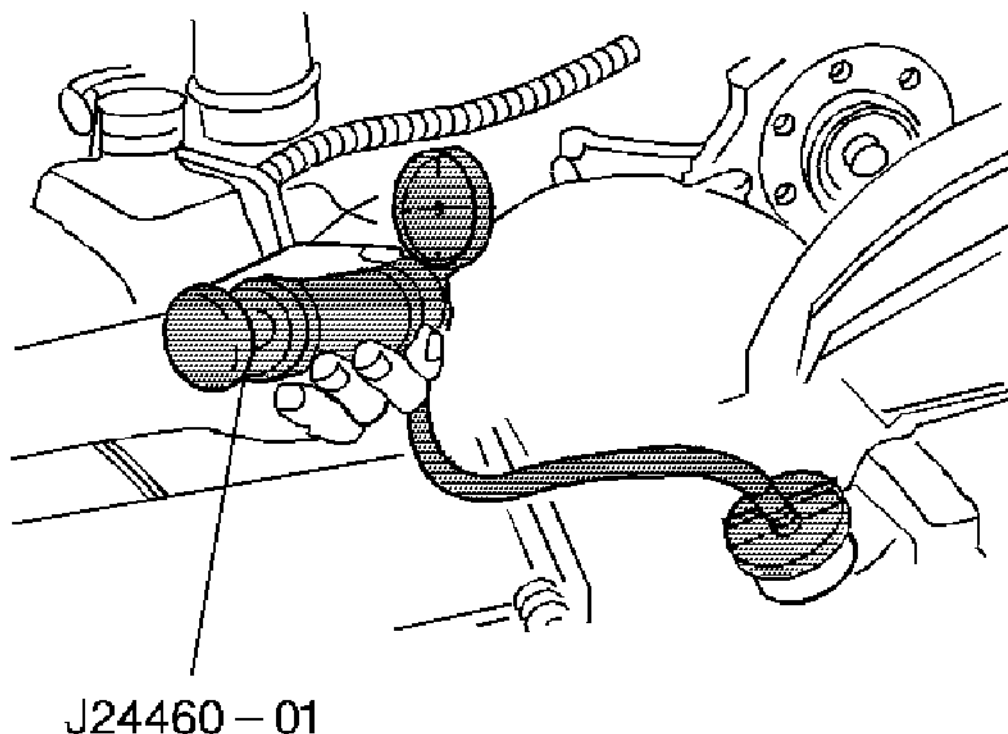


Fig. 5: Pressure Testing Cooling System Using J 24460-01
Courtesy of GENERAL MOTORS CORP.

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

Do not exceed the pressure cap rating.

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

Observe the gage for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

DRAINING AND FILLING COOLING SYSTEM

Tools Required

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

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

IMPORTANT: Draining the cooling system with the pressure cap installed will siphon the coolant from the overflow tank.

1. Remove the coolant pressure cap.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle in General Information.
3. Place a drain pan under the drain cock.
4. Open the radiator drain cock.
5. Drain the cooling system.
6. If a complete engine block drain is required LA1 engine, remove the engine block drain plugs.
7. If a complete engine block drain is required LY7 engine, remove the starter motor. Refer to Starter Motor Replacement (LA1) or Starter Motor Replacement (LY7) in Engine Electrical.
8. If a complete engine block drain is required LY7 engine, remove the engine block drain plugs.
9. Inspect the coolant.
10. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance - follow the filling procedure.
 - Discolored - follow the flush procedure. Refer to: Flushing.

Filling Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Close the radiator drain cock.
2. If the engine block drain plugs were removed from the LA1 or LY7 engine, perform the following:
 - Apply pipe sealer to the drain plugs.
 - Install the drain plugs.

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

3. If the engine block was drained L Y7 engine, install the starter motor. Refer to **Starter Motor Replacement (LA1)** or **Starter Motor Replacement (LY7)** in Engine Electrical.
4. Lower the vehicle.
5. Open the cooling system bleeder screws.

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

6. Slowly fill the cooling system with a 50/50 coolant mixture. Refer to **Capacities - Approximate Fluid**.
7. Close the cooling system bleeder screws.
8. Install the coolant pressure cap.
9. Start the engine.
10. Run the engine at 2000 - 2500 RPM until the engine reaches normal operating temperature.
11. Allow the engine to idle for 3 minutes.
12. Shut the engine off.
13. Allow the engine to cool.
14. Top off the coolant as necessary.
15. Inspect the concentration of the engine coolant. Using the **J 26568**. See **Special Tools and Equipment**.
16. Rinse away any excess coolant from the engine and the engine compartment.

FLUSHING

Flushing Procedure

IMPORTANT: Do not use a chemical flush.

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

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

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

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement**.
3. Clean and flush the coolant recovery reservoir with clean, drinkable water.
4. Install the coolant recovery reservoir. Refer to **Coolant Recovery Reservoir Replacement**.
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to **Draining and Filling Cooling System**.
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. 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.

COOLANT RECOVERY RESERVOIR REPLACEMENT

Tools Required

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

Removal Procedure

1. Reposition the reservoir hose clamp at the radiator overflow fitting using the **J 38185** .
See **Special Tools and Equipment**.
2. Remove the reservoir hose at the radiator overflow fitting.

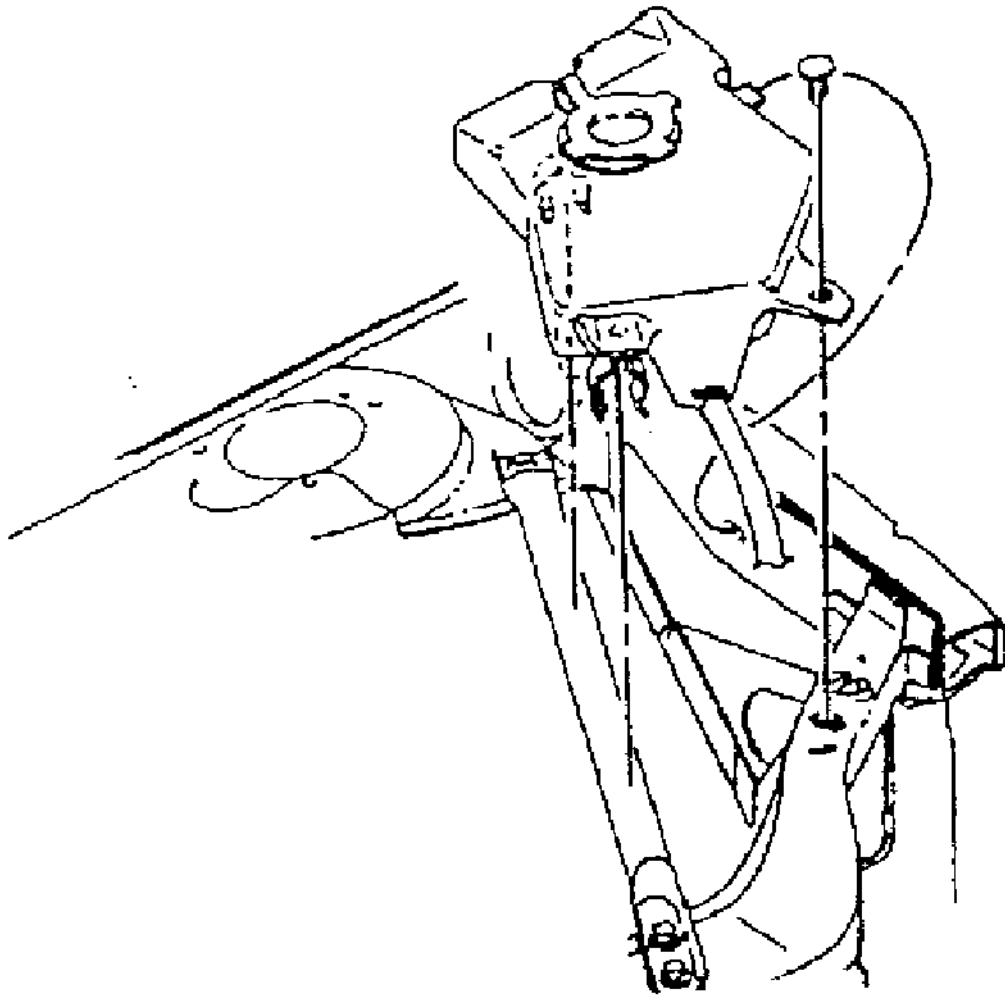


Fig. 6: View Of Coolant Reservoir
Courtesy of GENERAL MOTORS CORP.

3. Remove the reservoir mounting clip.
4. Remove the coolant reservoir.

Installation Procedure

1. Install the coolant reservoir.

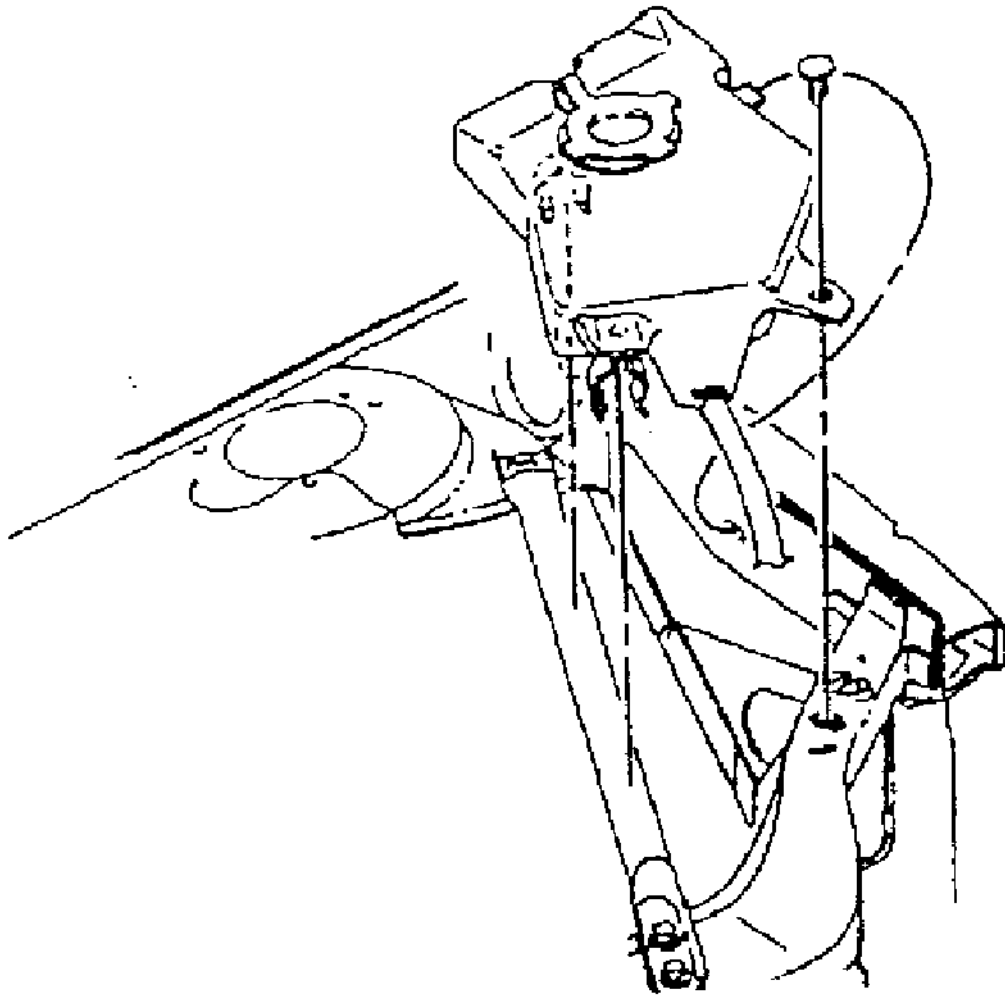


Fig. 7: View Of Coolant Reservoir
Courtesy of GENERAL MOTORS CORP.

2. Install the reservoir mounting clip.
3. Connect the reservoir hose to the radiator overflow fitting.
4. Reposition the reservoir hose clamp to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
5. Fill the coolant reservoir. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - INLET (LA1)

Tools Required

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

Removal Procedure

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

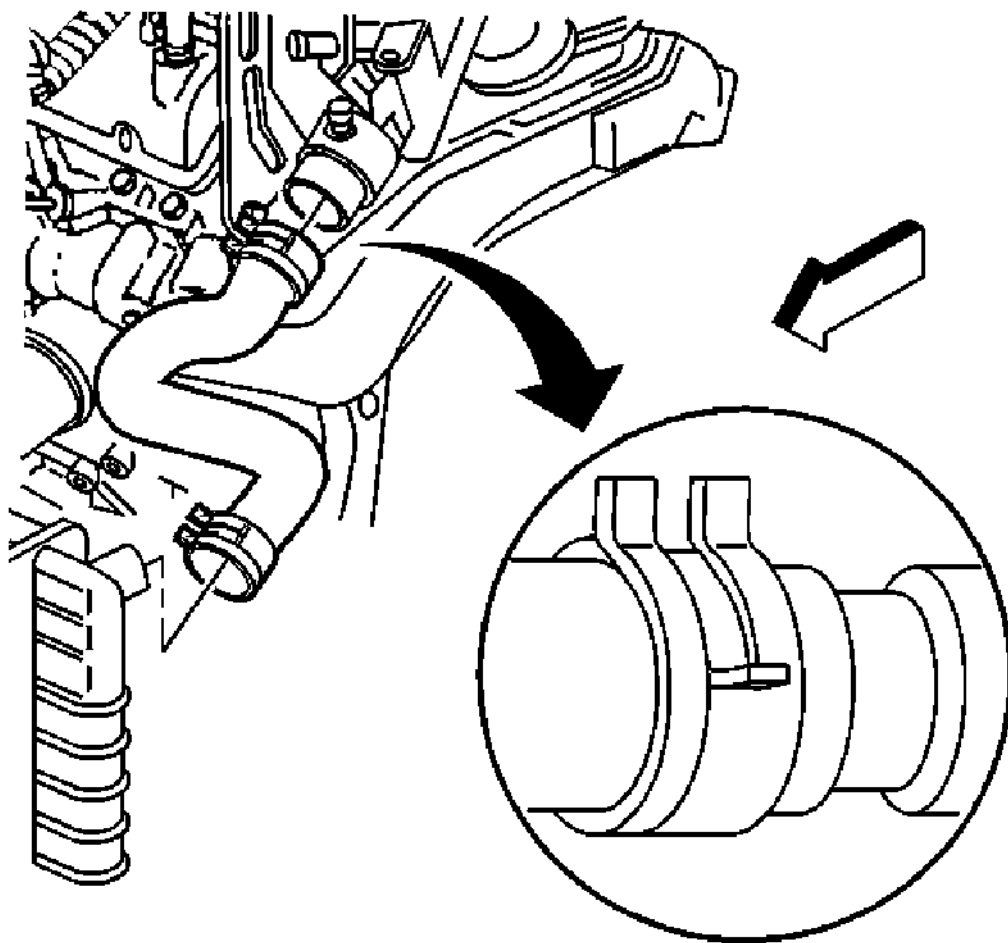


Fig. 8: Identifying Radiator Hose Clamp
Courtesy of GENERAL MOTORS CORP.

2. Reposition the hose clamp at the radiator using the **J 38185** . See **Special Tools and Equipment**.
3. Disconnect the radiator inlet hose from the radiator.
4. Reposition the hose clamp at the thermostat housing using the **J 38185** . See **Special Tools and Equipment**.
5. Disconnect the radiator inlet hose from the thermostat housing.

6. Remove the radiator inlet hose.

Installation Procedure

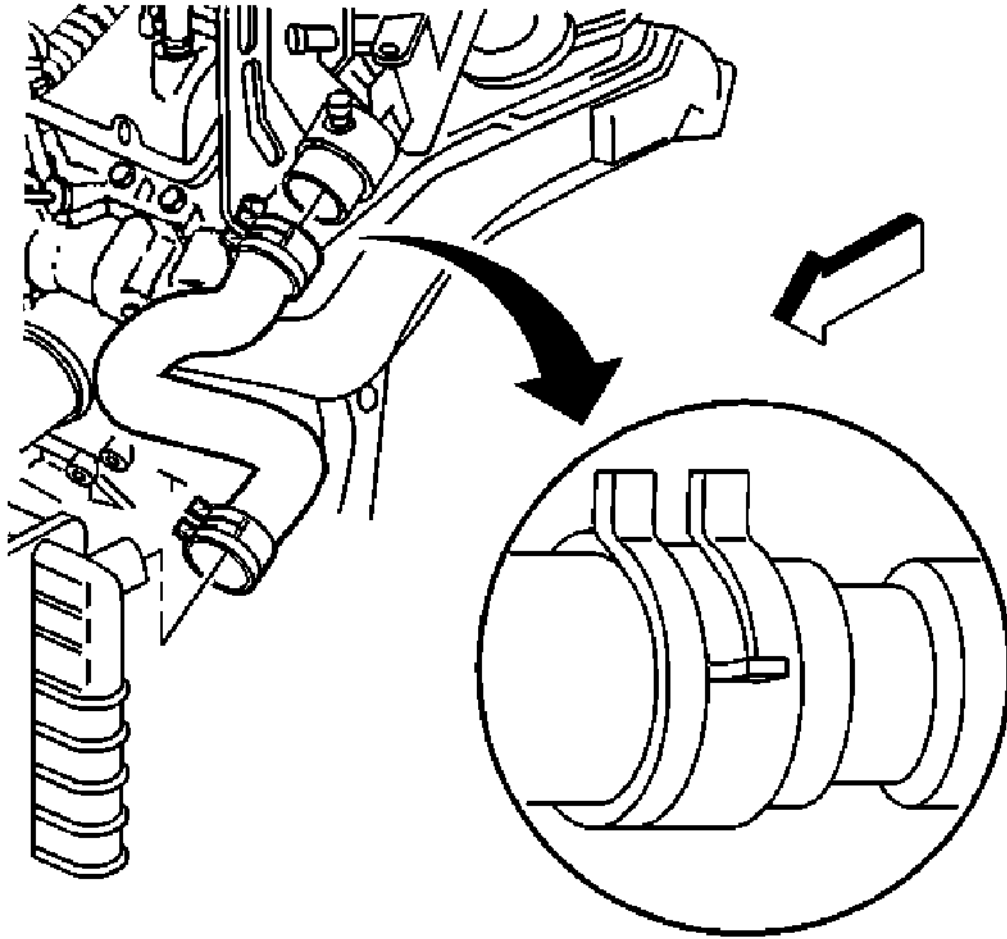


Fig. 9: Identifying Radiator Hose Clamp
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator inlet hose.
2. Connect the radiator inlet hose to the radiator.
3. Reposition the hose clamp at the radiator to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
4. Connect the radiator inlet hose to the thermostat housing.
5. Reposition the hose clamp at the thermostat housing to secure the hose using the **J 38185** . See **Special Tools and Equipment**.

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

RADIATOR HOSE REPLACEMENT - INLET (LY7)

Tools Required

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

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Use **J 38185** to reposition the hose clamp at the radiator. See **Special Tools and Equipment**.

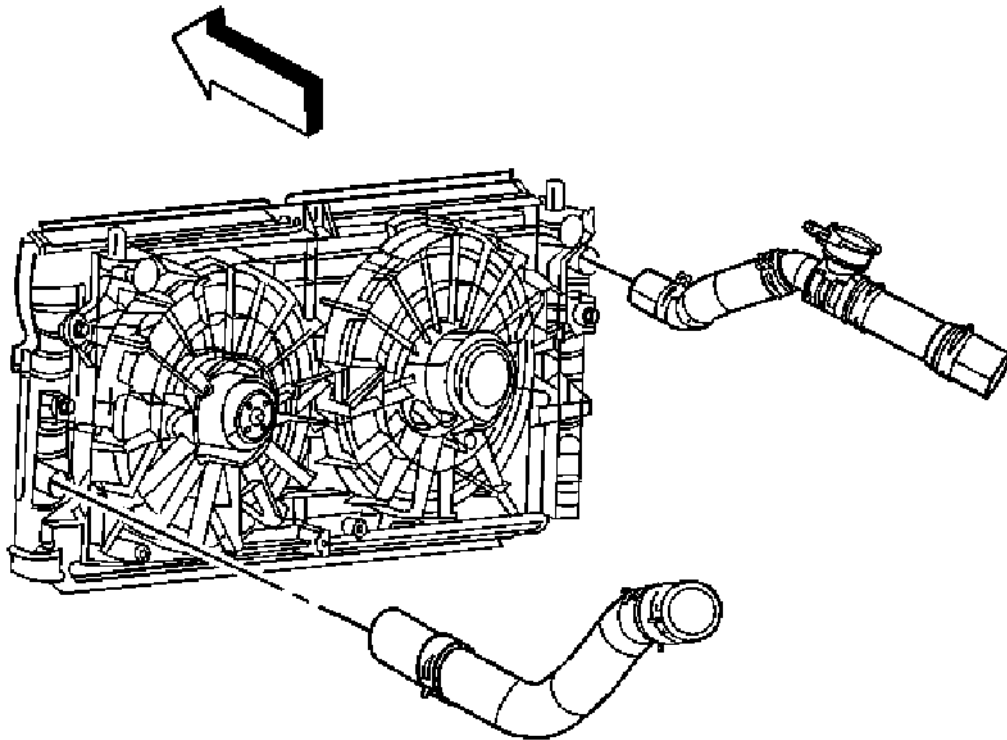


Fig. 10: Locating Radiator Inlet/Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the radiator inlet hose from the radiator.
4. Use **J 38185** to reposition the hose clamp at the engine. See **Special Tools and Equipment**.

5. Disconnect the radiator inlet hose from the engine.
6. Remove the radiator inlet hose.

Installation Procedure

1. Install the radiator inlet hose.

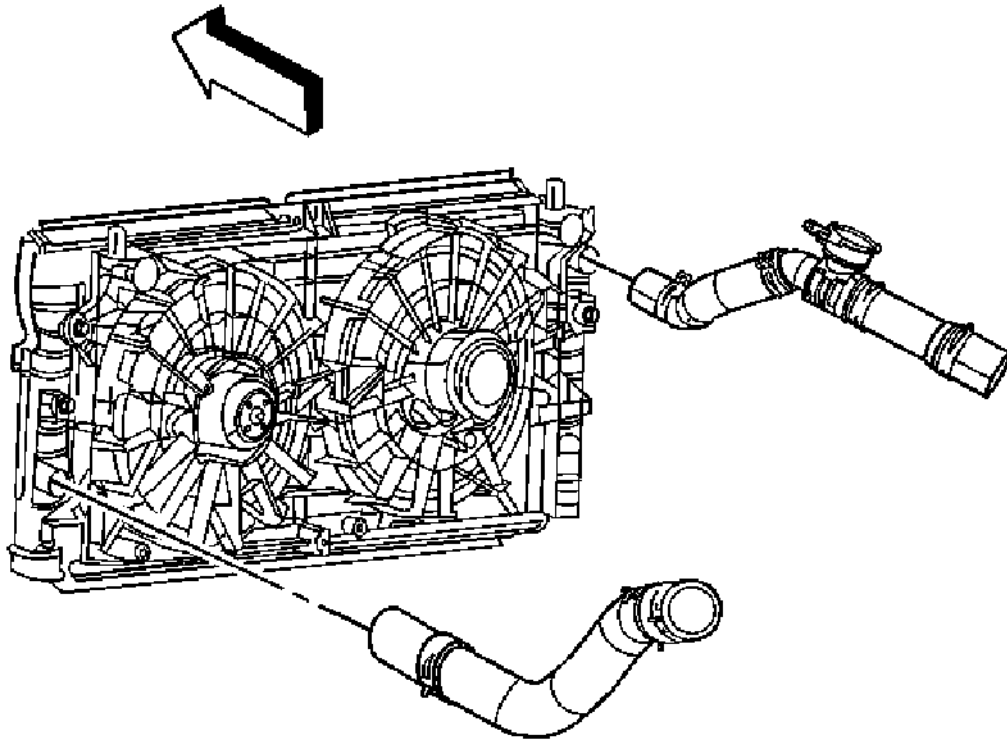


Fig. 11: Locating Radiator Inlet/Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the radiator inlet hose to the radiator.
3. Using **J 38185** , reposition the hose clamp at the radiator to secure the hose. See **Special Tools and Equipment**.
4. Connect the radiator inlet hose to the engine.
5. Using **J 38185** , reposition the hose clamp at the engine to secure the hose. See **Special Tools and Equipment**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

Tools Required

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

Removal Procedure

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

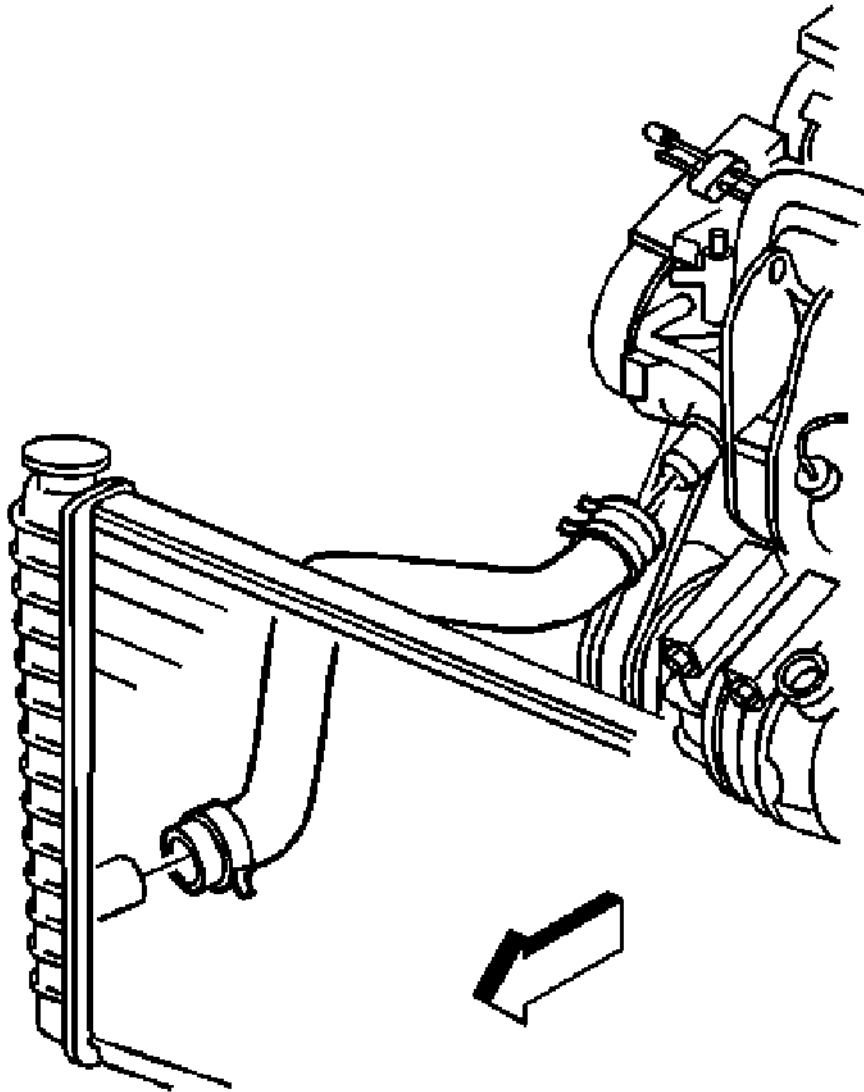


Fig. 12: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Reposition the hose clamp at the water pump housing using the **J 38185** . See **Special Tools and Equipment**.
3. Disconnect the radiator outlet hose from the water pump housing.
4. Reposition the hose clamp at the radiator using the **J 38185** . See **Special Tools and Equipment**.
5. Disconnect the radiator outlet hose from the radiator.
6. Remove the radiator outlet hose.

Installation Procedure

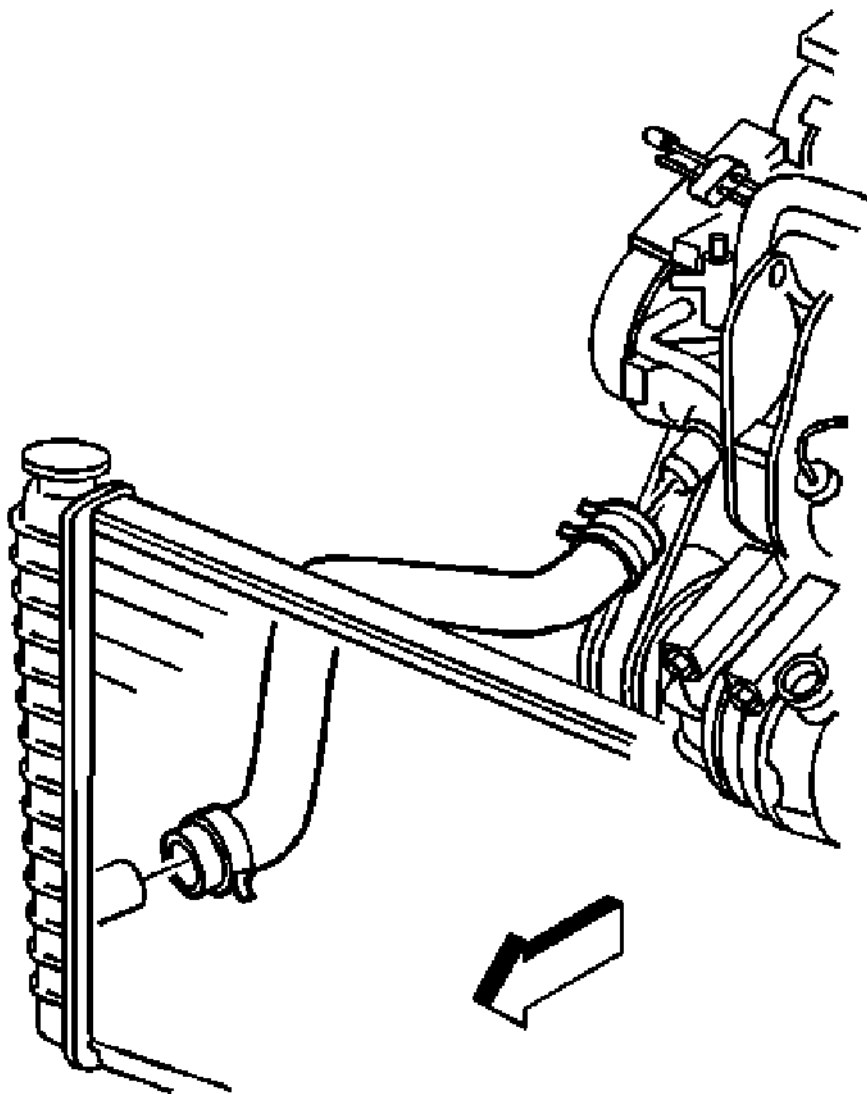


Fig. 13: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator outlet hose.
2. Connect the radiator outlet hose to the radiator.
3. Reposition the hose clamp at the radiator to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
4. Connect the radiator outlet hose to the water pump housing.
5. Reposition the hose clamp at the water pump housing to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

RADIATOR HOSE REPLACEMENT - OUTLET (LY7)

Tools Required

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

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Use **J 38185** to reposition the hose clamp at the engine. See **Special Tools and Equipment**.

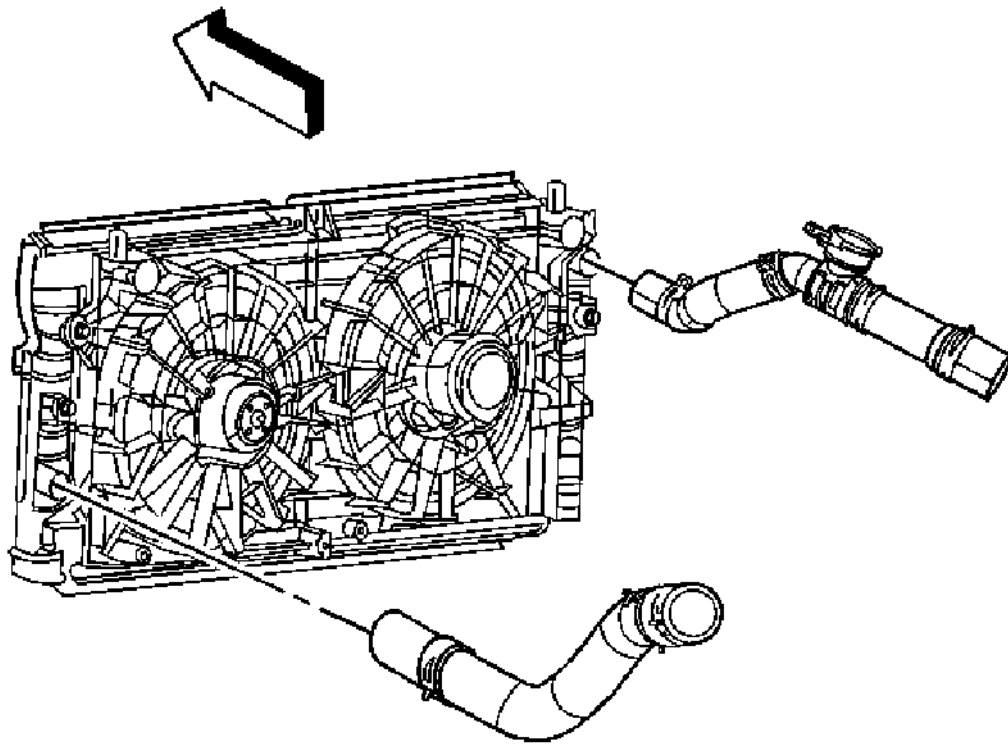


Fig. 14: Locating Radiator Inlet/Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the radiator outlet hose from the engine.
4. Use **J 38185** to reposition the hose clamp at the radiator. See **Special Tools and Equipment**.
5. Disconnect the radiator outlet hose from the radiator.
6. Remove the radiator outlet hose.

Installation Procedure

1. Install the radiator outlet hose.

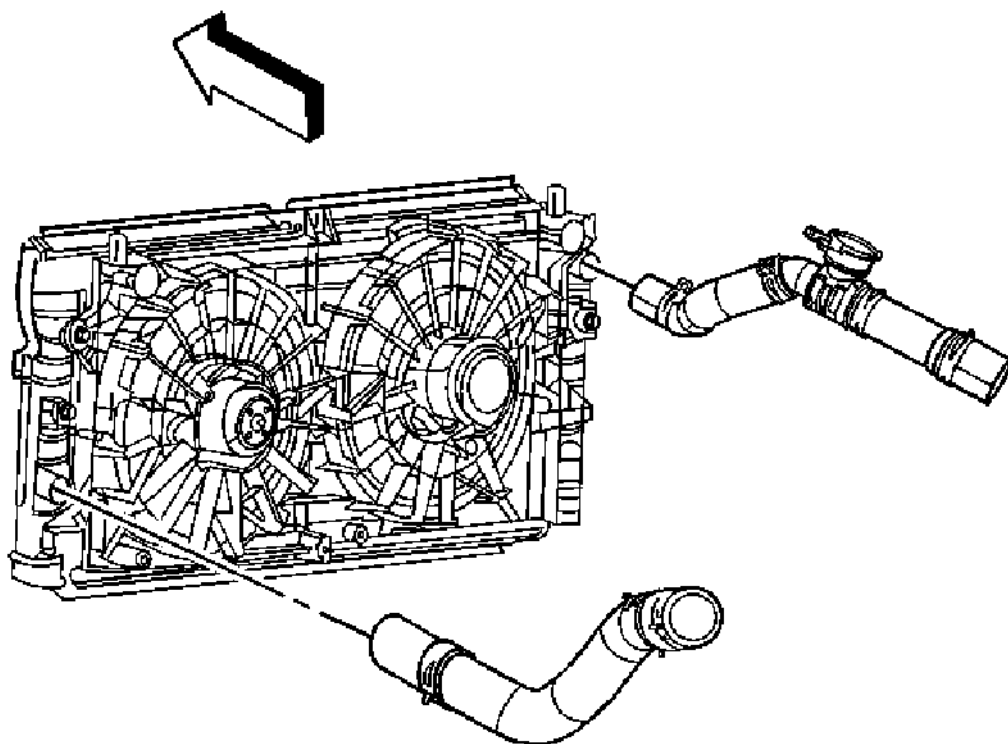


Fig. 15: Locating Radiator Inlet/Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the radiator outlet hose to the radiator.
3. Using **J 38185** , reposition the hose clamp at the radiator to secure the hose. See **Special Tools and Equipment**.
4. Connect the radiator outlet hose to the engine.
5. Using **J 38185** , reposition the hose clamp at the engine to secure the hose. See **Special Tools and Equipment**.
6. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

THROTTLE BODY HEATER HOSE REPLACEMENT - INLET

Tools Required

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

Removal Procedure

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

Engine Controls - 3.4L.

2. Remove the throttle cable bracket in order to gain access to the throttle body heater hose clamp.
3. Drain the coolant until the coolant level is below the throttle body heater hoses. Refer to **Draining and Filling Cooling System**.
4. Use the **J 38185** in order to remove the hose clamp. See **Special Tools and Equipment**.

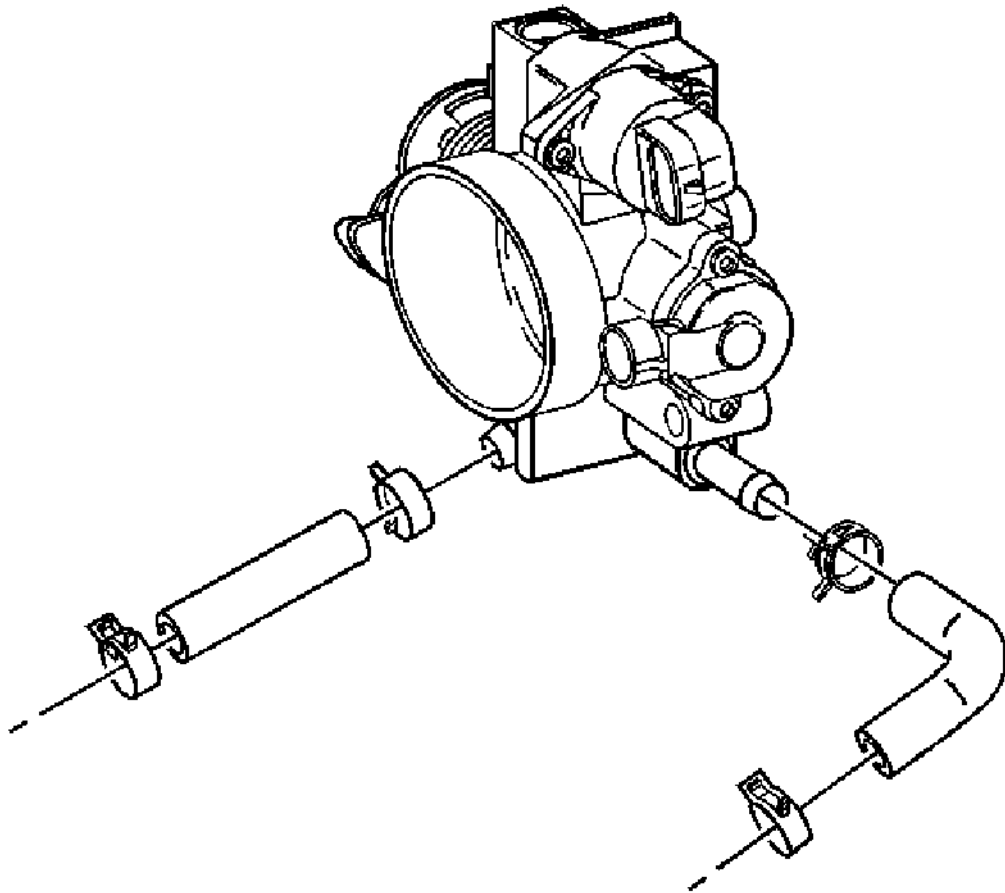


Fig. 16: View Of Throttle Body Heater Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Remove the throttle body heater inlet hose.

Installation Procedure

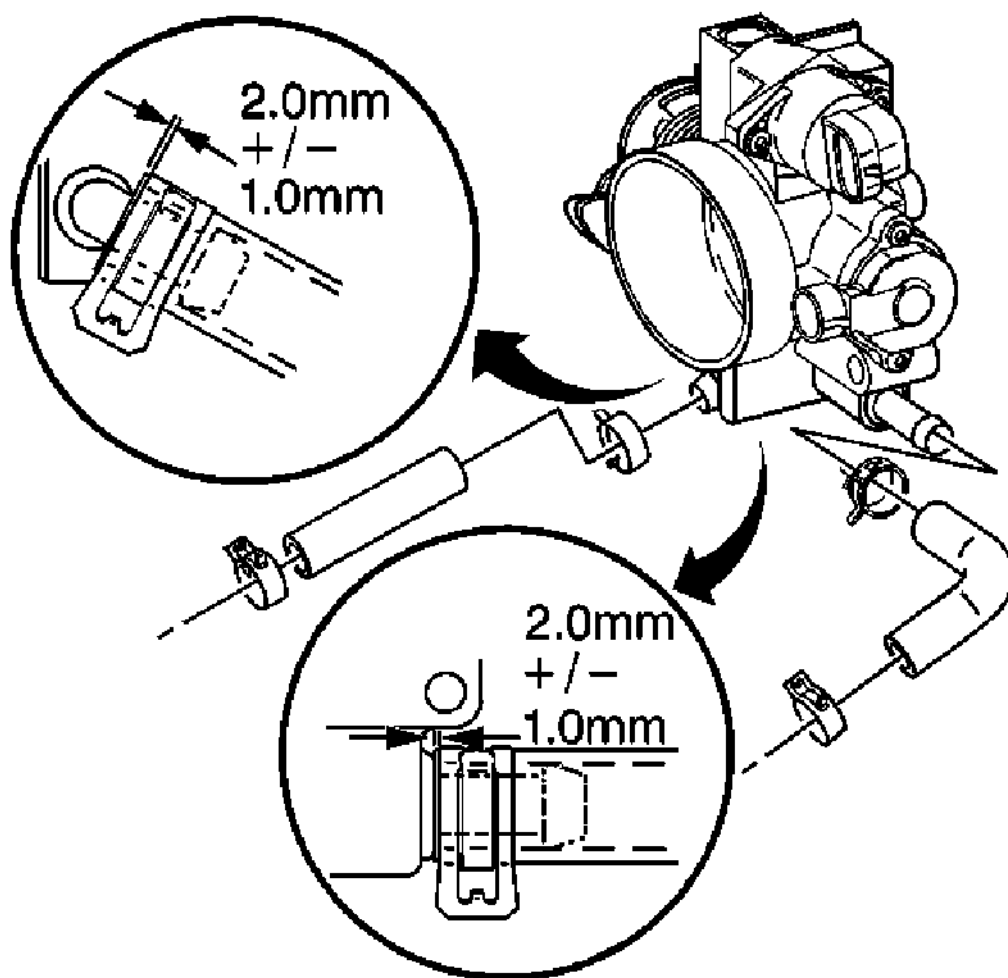


Fig. 17: Checking Throttle Body Heater Inlet Hose Clearances
Courtesy of GENERAL MOTORS CORP.

1. Install the throttle body heater inlet hose.
2. Use the **J 38185** in order to install the hose clamps. See **Special Tools and Equipment**.
3. Install the throttle cable bracket.
4. Fill the cooling system. Refer to **Draining and Filling Cooling System**.
5. Install the air cleaner duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.4L.

THROTTLE BODY HEATER HOSE REPLACEMENT - OUTLET

Tools Required

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

Removal Procedure

1. Remove the air cleaner duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.4L.
2. Drain the coolant until the coolant level is below the throttle body heater hoses. Refer to **Draining and Filling Cooling System**.
3. Use the **J 38185** in order to remove the hose clamp. See **Special Tools and Equipment**.

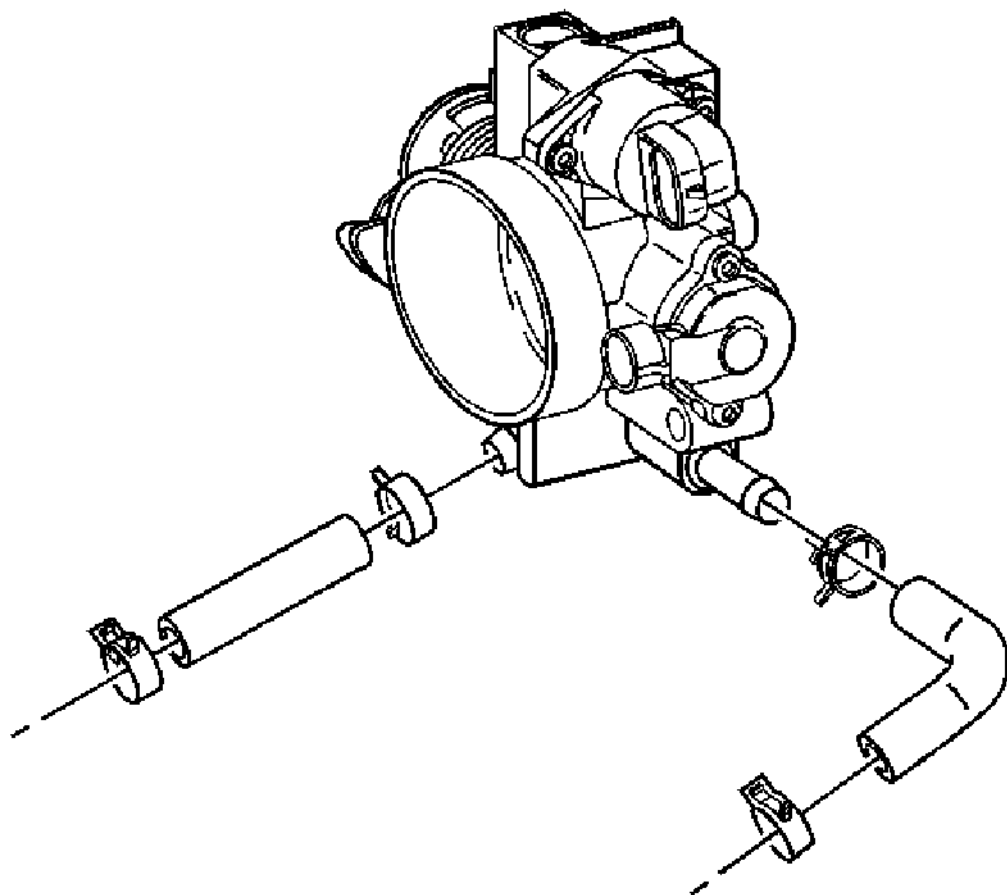


Fig. 18: View Of Throttle Body Heater Inlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Remove the throttle body heater outlet hose.

Installation Procedure

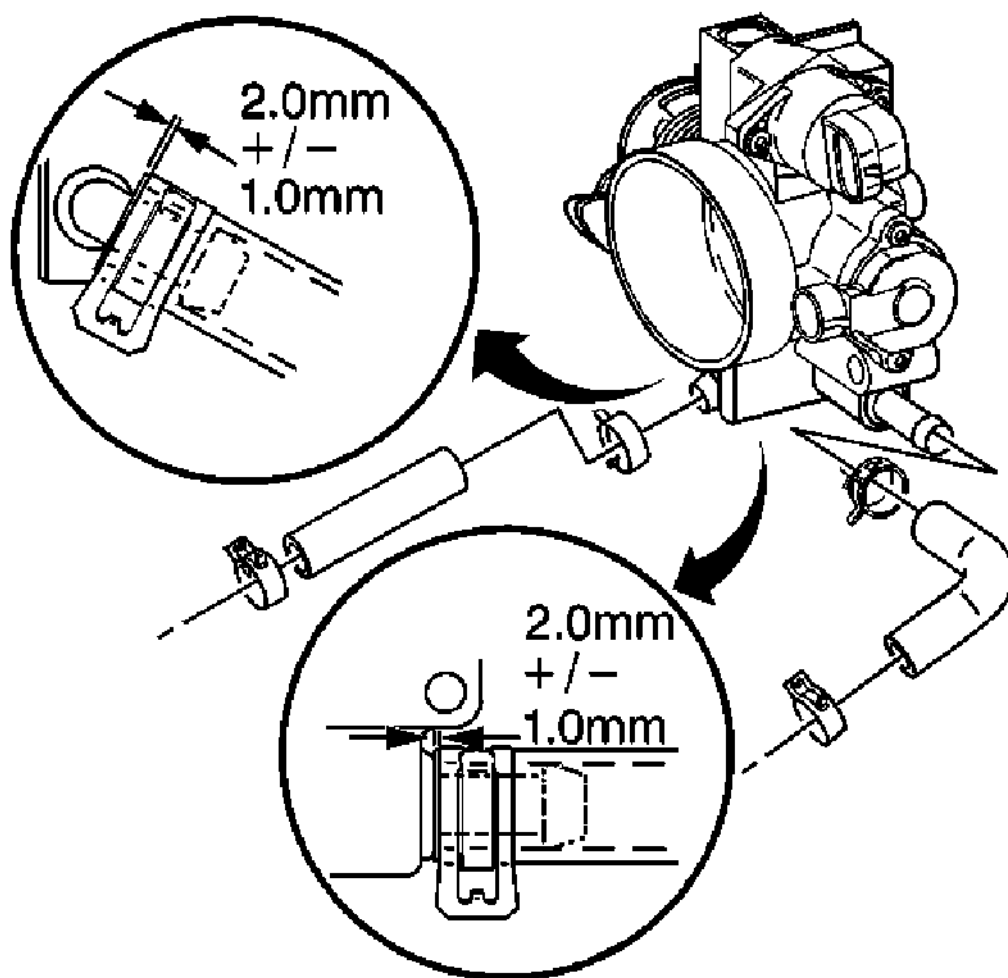


Fig. 19: Checking Throttle Body Heater Inlet Hose Clearances
Courtesy of GENERAL MOTORS CORP.

1. Install the throttle body heater outlet hose.
2. Use the **J 38185** in order to install the hose clamps. See **Special Tools and Equipment**.
3. Fill the cooling system. Refer to **Draining and Filling Cooling System**.
4. Install the air cleaner duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.4L.

FAN REPLACEMENT

Removal Procedure

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and

Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and Notices.

IMPORTANT: If abnormal noise or vibration is felt from the engine compartment, inspect and clean any foreign material from the cooling fan blades.

1. Turn the ignition off.
2. Remove the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

IMPORTANT: Turn the cooling fan nut clockwise to loosen.

3. Remove the cooling fan nut.

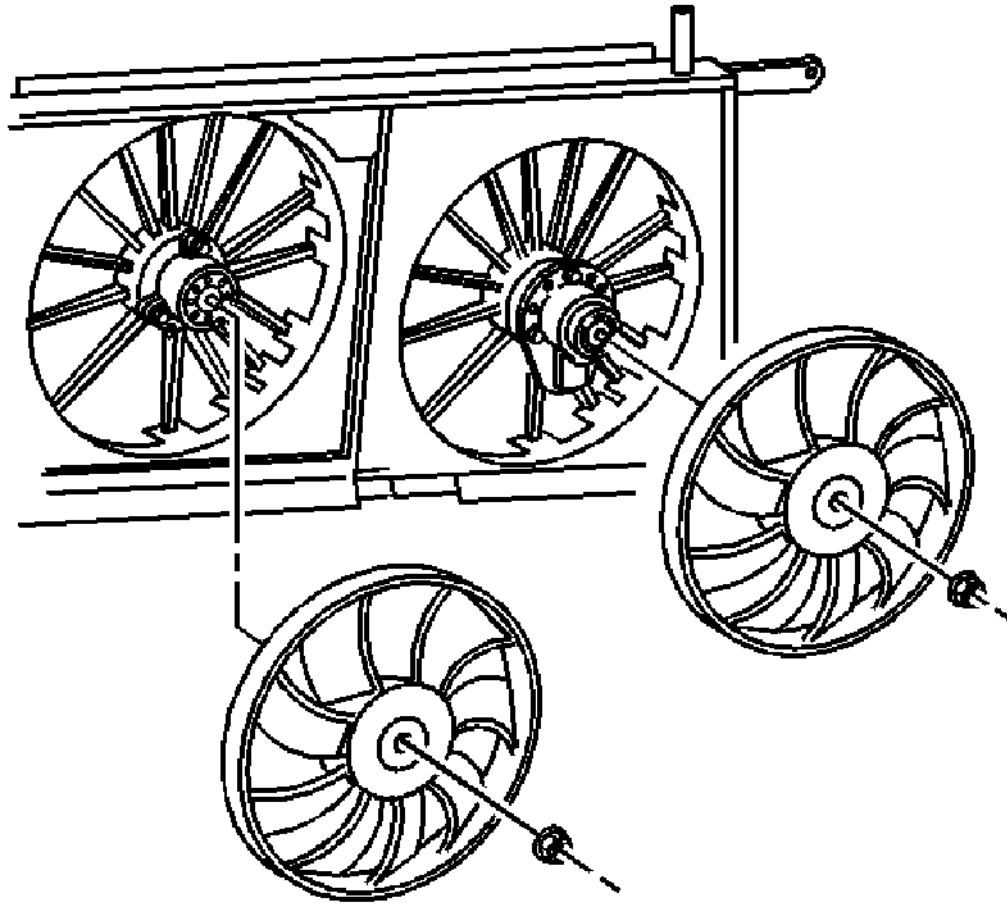


Fig. 20: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

4. Remove the cooling fan.

Installation Procedure

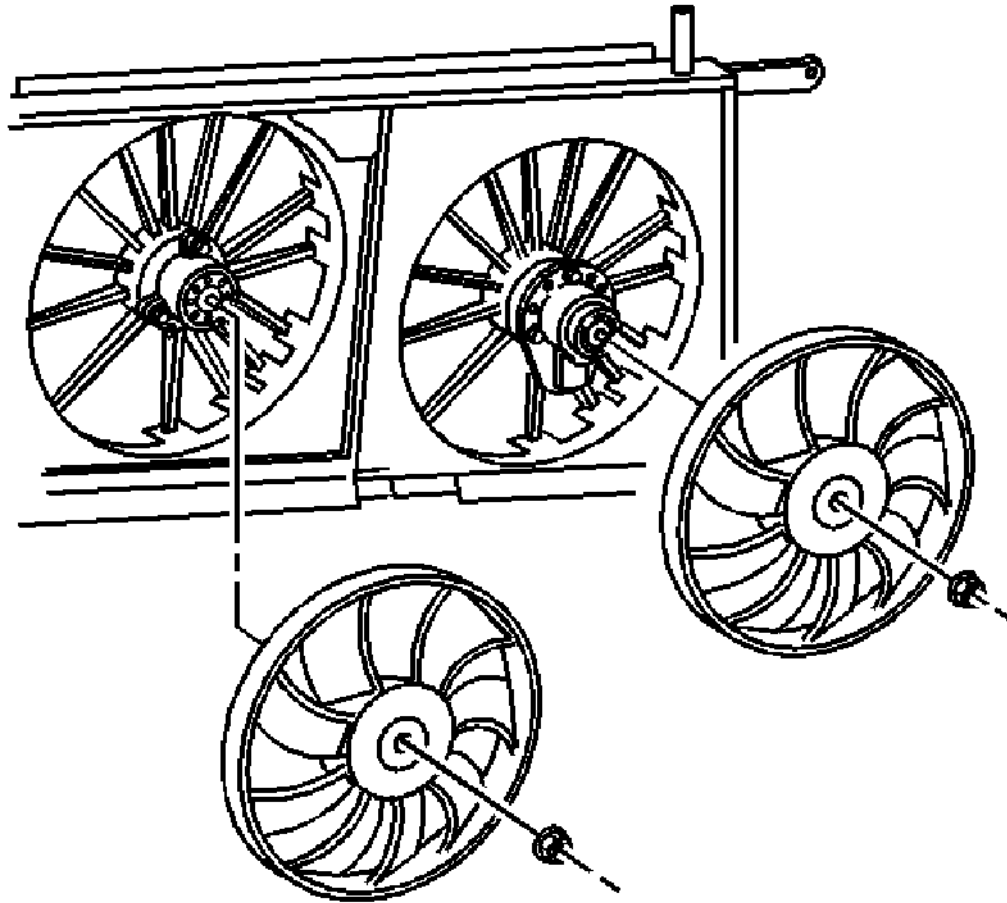


Fig. 21: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Turn the cooling fan nut counterclockwise to tighten.

2. Install the cooling fan nut.

Tighten: Tighten the nut to 6 N.m (53 lb in).

3. Install the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

COOLING FAN REPLACEMENT - ELECTRIC (LA1)

Tools Required

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

Removal Procedure

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and Notices.

1. Remove the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.4L.

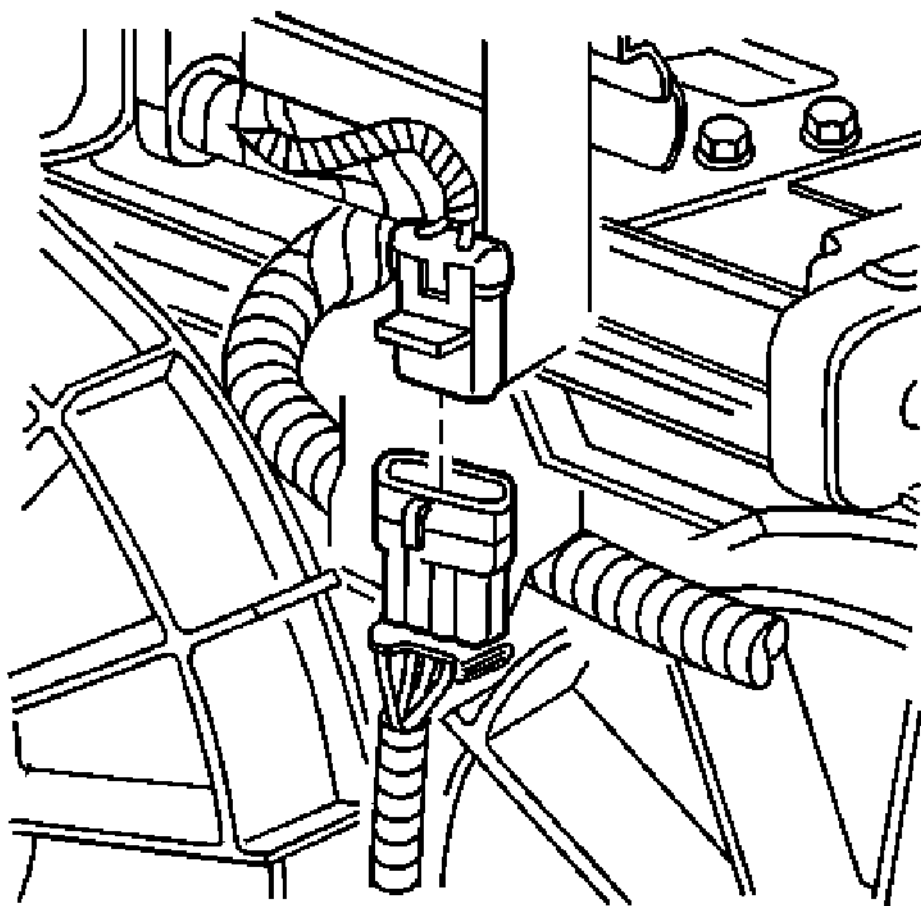


Fig. 22: Locating Cooling Fan Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Remove the cooling fan harness electrical connector.
3. Remove right side diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal - Right** in Body Front End.

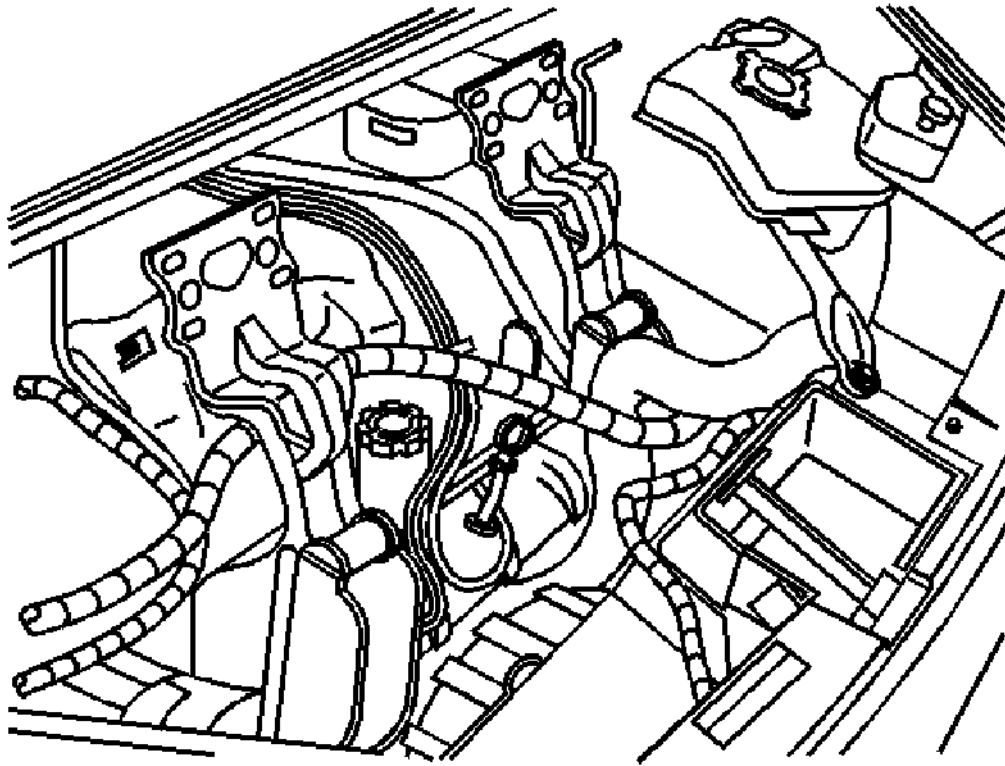


Fig. 23: Identifying Engine Mount Strut Bracket Brace Bolts
Courtesy of GENERAL MOTORS CORP.

4. Loosen the engine mount strut nuts.
5. Remove the engine mount strut bracket brace bolts from the upper radiator support and rotate the struts and brackets rearward.
6. Remove upper radiator hose. Refer to **Radiator Hose Replacement - Inlet (LA1)** or **Radiator Hose Replacement - Inlet (LY7)**

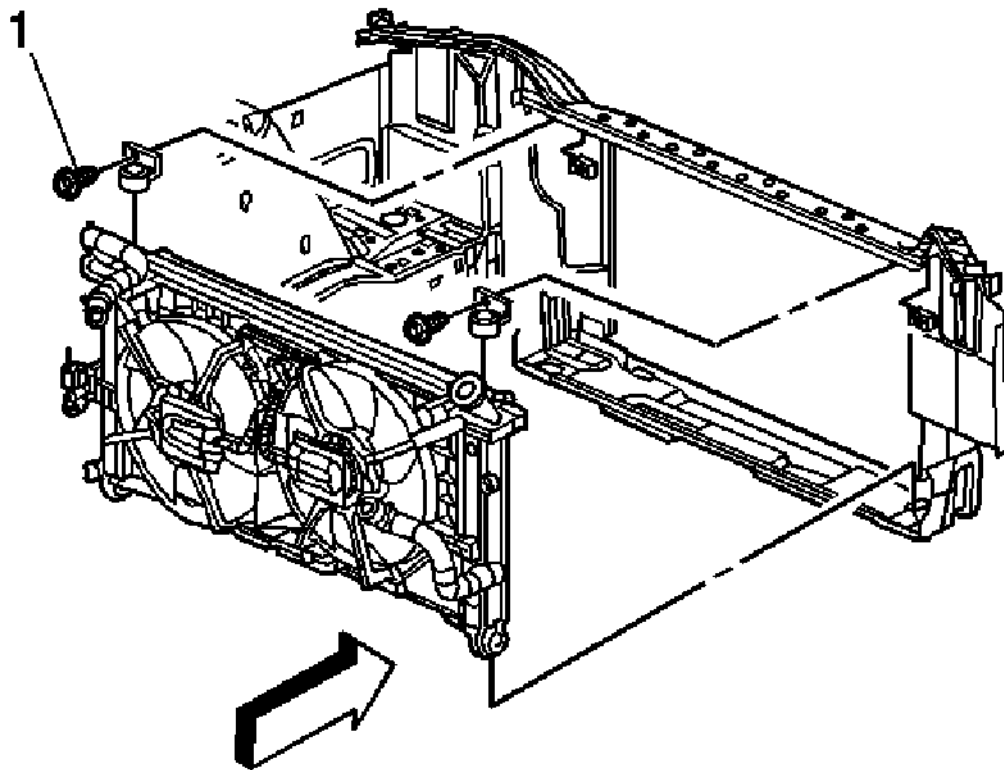


Fig. 24: View Of Radiator Upper Mount Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the radiator upper mount bolts (1).
8. Remove the radiator upper mounts.
9. Remove the cooling fan shroud bolts.
10. Reposition the coolant overflow hose clamp at the radiator using the **J 38185** . See **Special Tools and Equipment**.
11. Disconnect and reposition the coolant overflow hose.
12. Disconnect the upper TOC line from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.
13. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
14. Disconnect the TOC lines from the fan module retainer clip.
15. Lower the vehicle.

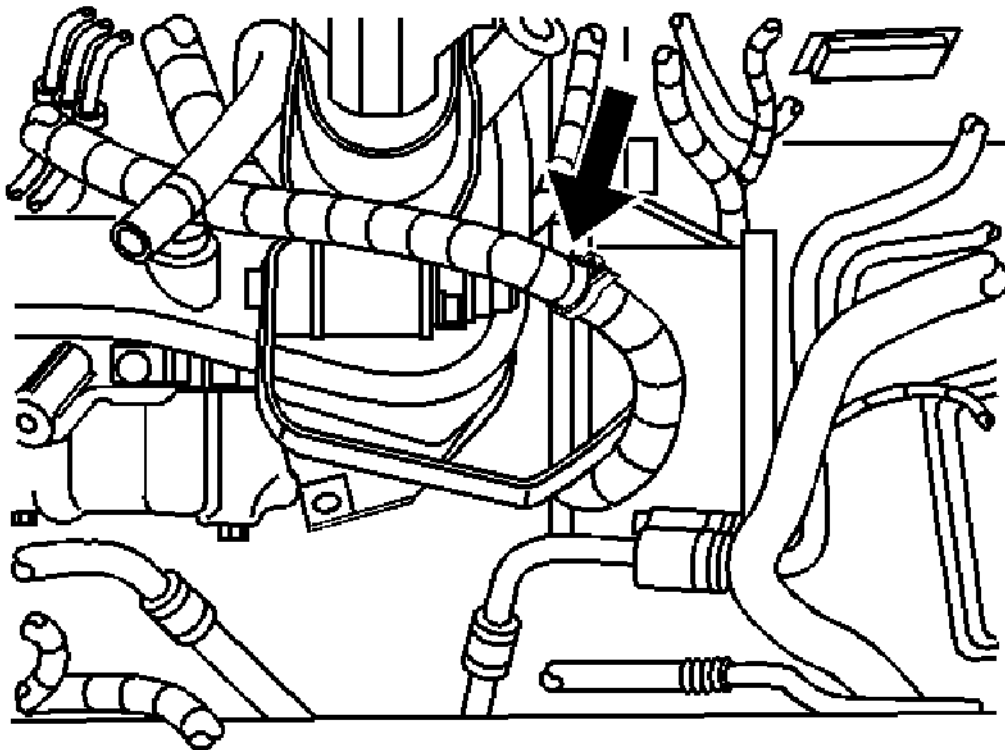


Fig. 25: Locating Engine Wiring Harness Retainers At The Engine Harness Bracket

Courtesy of GENERAL MOTORS CORP.

16. Disconnect the engine wiring harness retainers at the engine harness bracket.
17. Reposition the engine wiring harness.
18. Remove the cooling fans with the cooling fan shroud.

Installation Procedure

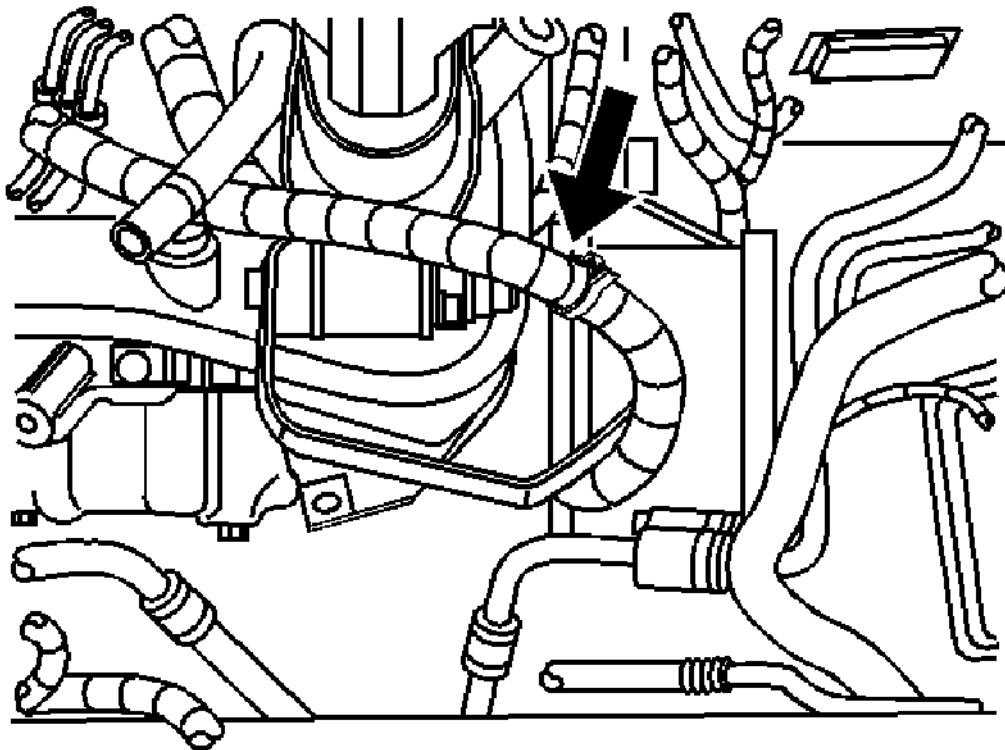


Fig. 26: Locating Engine Wiring Harness Retainers At The Engine Harness Bracket

Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fans with the cooling fan shroud.
2. Reposition the engine wiring harness.
3. Connect the engine wiring harness retainers at the engine harness bracket.
4. Raise the vehicle.
5. Connect the TOC lines to the fan module retainer clip.
6. Lower the vehicle.
7. Connect the upper TOC line to the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.

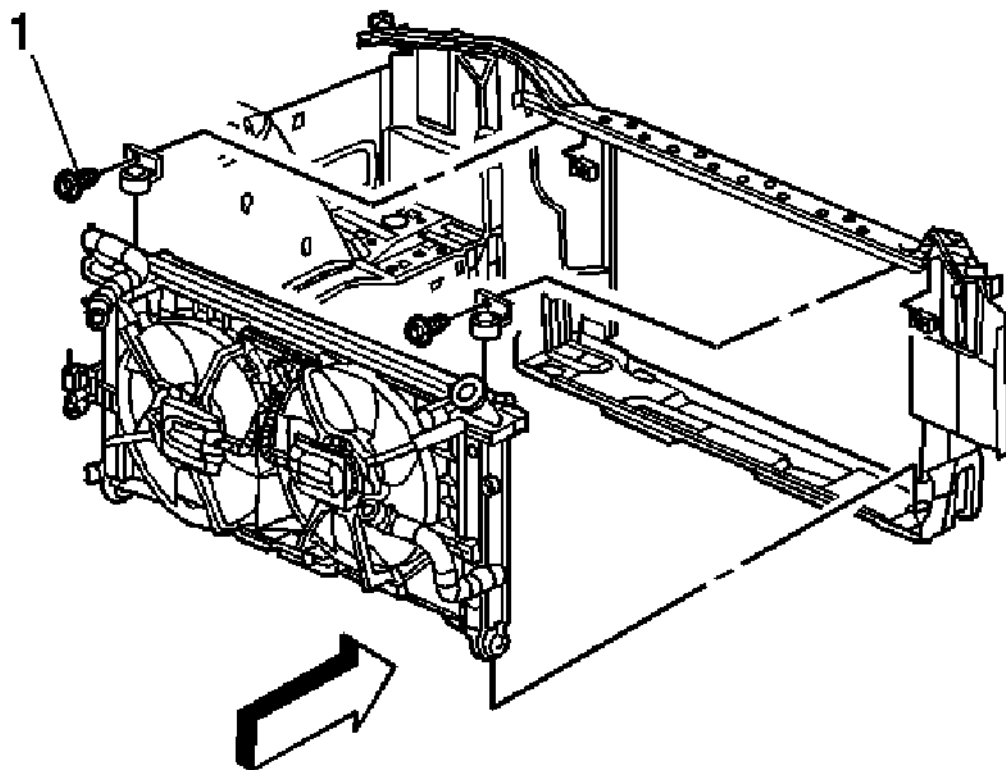


Fig. 27: View Of Radiator Upper Mount Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the cooling fan shroud bolts.

Tighten: Tighten the bolts to 6 N.m (53 lb in).

9. Install the radiator upper mounts.
10. Install the radiator upper mount bolts (1).

Tighten: Tighten the bolts to 10 N.m (88 lb in).

11. Install the coolant overflow hose to the radiator.
12. Reposition the hose clamp to secure the coolant overflow hose using the **J 38185** . See **Special Tools and Equipment**.
13. Install the upper radiator hose. Refer to **Radiator Hose Replacement - Inlet (LA1)** or

Radiator Hose Replacement - Inlet (LY7).

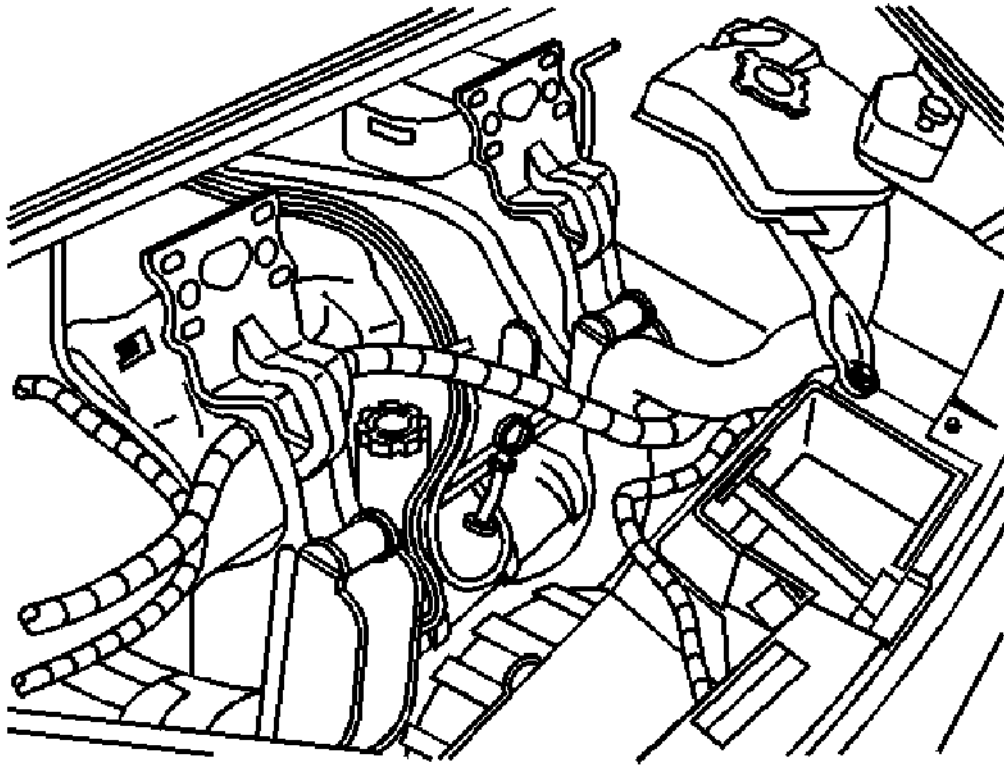


Fig. 28: Identifying Engine Mount Strut Bracket Brace Bolts
Courtesy of GENERAL MOTORS CORP.

14. Position the engine mount struts brackets flush with the upper radiator support.
15. Install the engine mount strut bracket brace bolts to the upper radiator support.

Tighten: Tighten bolts to 28 N.m (21 lb ft).

16. Tighten the engine mount strut nuts.

Tighten: Tighten the nuts to 48 N.m (35 lb ft).

17. Install right side diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal - Right** in Body Front End.

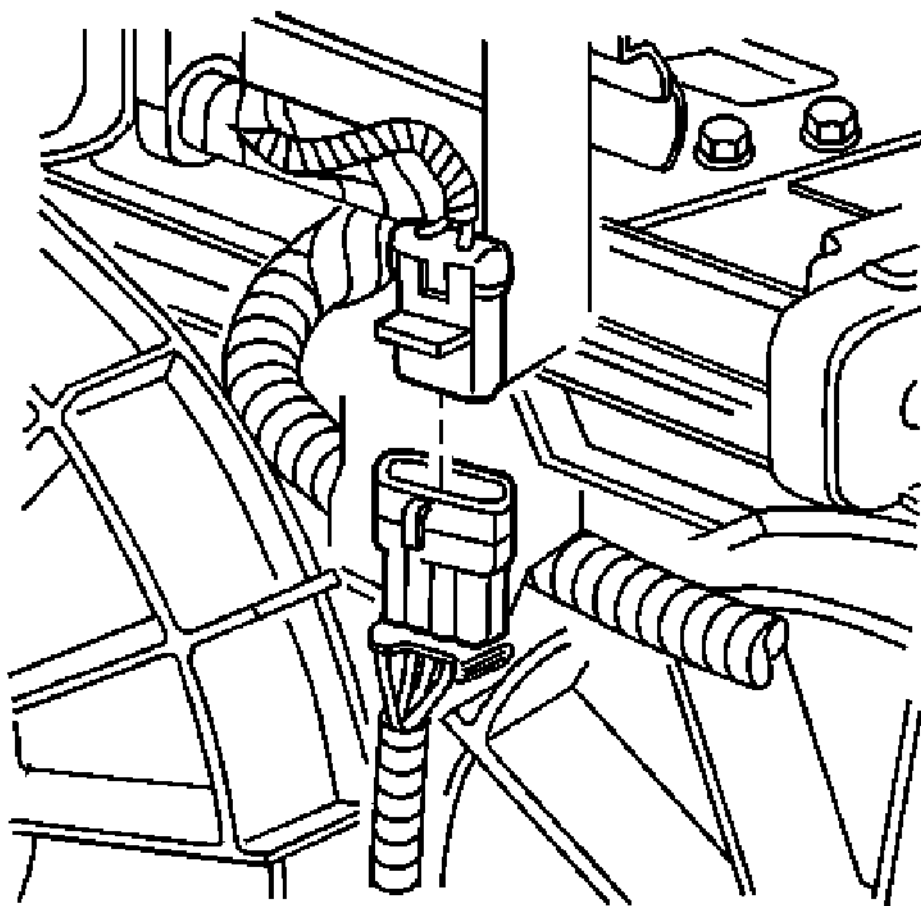


Fig. 29: Locating Cooling Fan Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

18. Install the cooling fan harness electrical connector.
19. Install the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.4L.

COOLING FAN REPLACEMENT - ELECTRIC (LY7)

Tools Required

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

Removal Procedure

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and Notices.

1. Remove the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.6L.

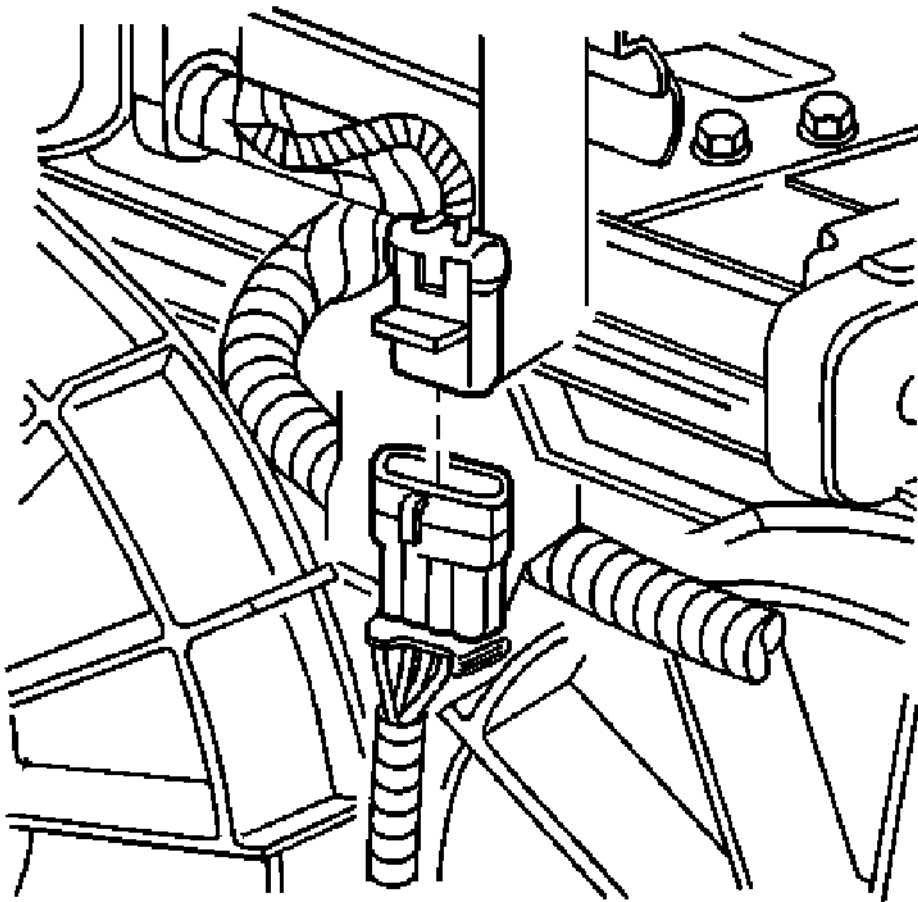


Fig. 30: Locating Cooling Fan Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector from the cooling fan harness.
3. Remove right side diagonal brace. Refer to **Brace Replacement - Front Fender Upper**

Diagonal - Right in Body Front End.

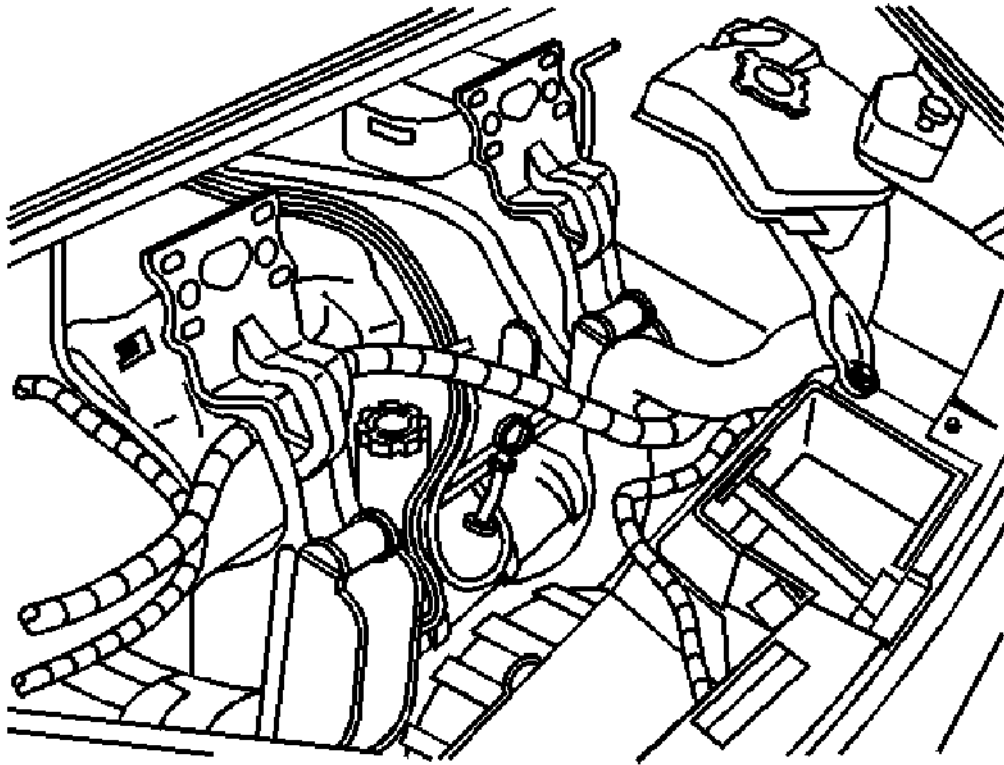


Fig. 31: Identifying Engine Mount Strut Bracket Brace Bolts
Courtesy of GENERAL MOTORS CORP.

4. Loosen the engine mount strut nuts. Do NOT remove the nuts.
5. Remove the bracket brace bolts for the engine mount strut from the upper radiator support. Rotate the struts and brackets rearward.
6. Remove upper radiator hose. Refer to **Radiator Hose Replacement - Inlet (LA1)** or **Radiator Hose Replacement - Inlet (LY7)**.

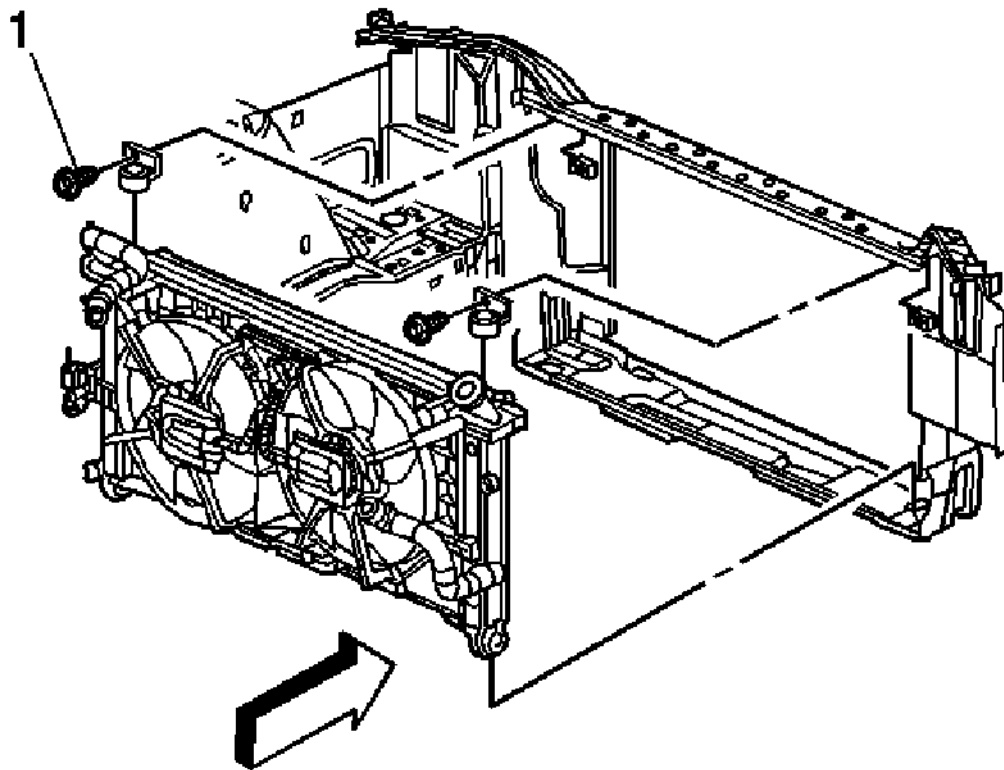


Fig. 32: View Of Radiator Upper Mount Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the radiator upper mount bolts (1).
8. Remove the radiator upper mounts.
9. Remove the cooling fan shroud bolts.
10. Use **J 38185** to reposition the coolant overflow hose clamp at the radiator. See **Special Tools and Equipment**.
11. Disconnect and reposition the coolant overflow hose.
12. Disconnect the upper transmission oil cooler (TOC) line from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.
13. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
14. Disconnect the TOC lines from the fan module retainer clip.
15. Lower the vehicle.

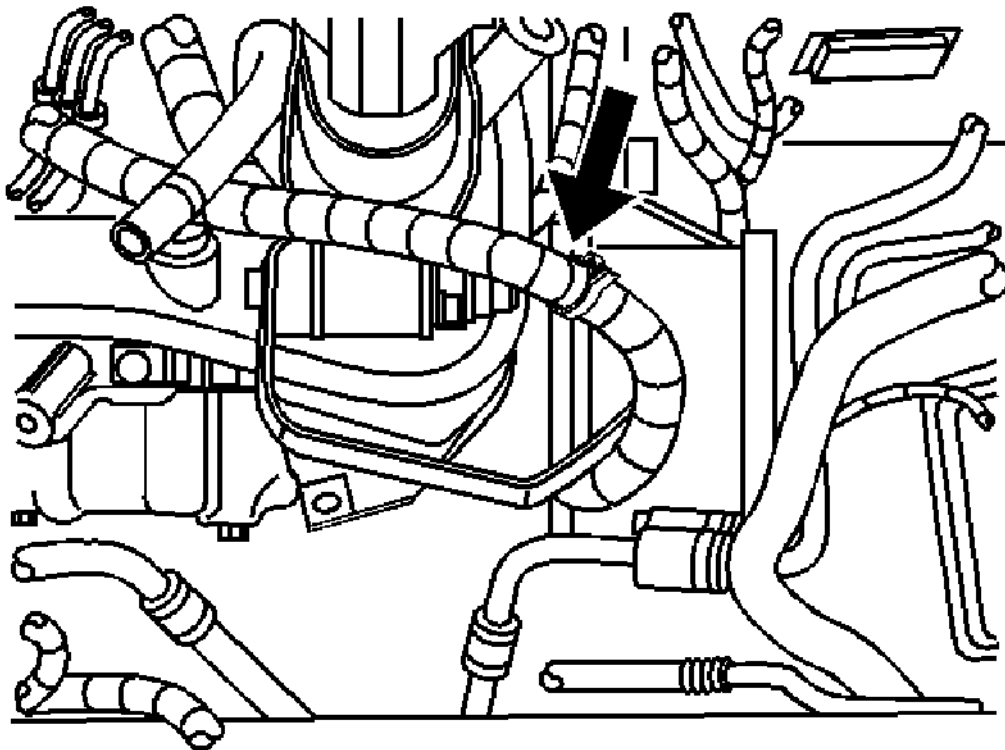


Fig. 33: Locating Engine Wiring Harness Retainers At The Engine Harness Bracket

Courtesy of GENERAL MOTORS CORP.

16. Disconnect the engine wiring harness retainers at the engine harness bracket.
17. Reposition the engine wiring harness.
18. Remove the cooling fans with the cooling fan shroud.

Installation Procedure

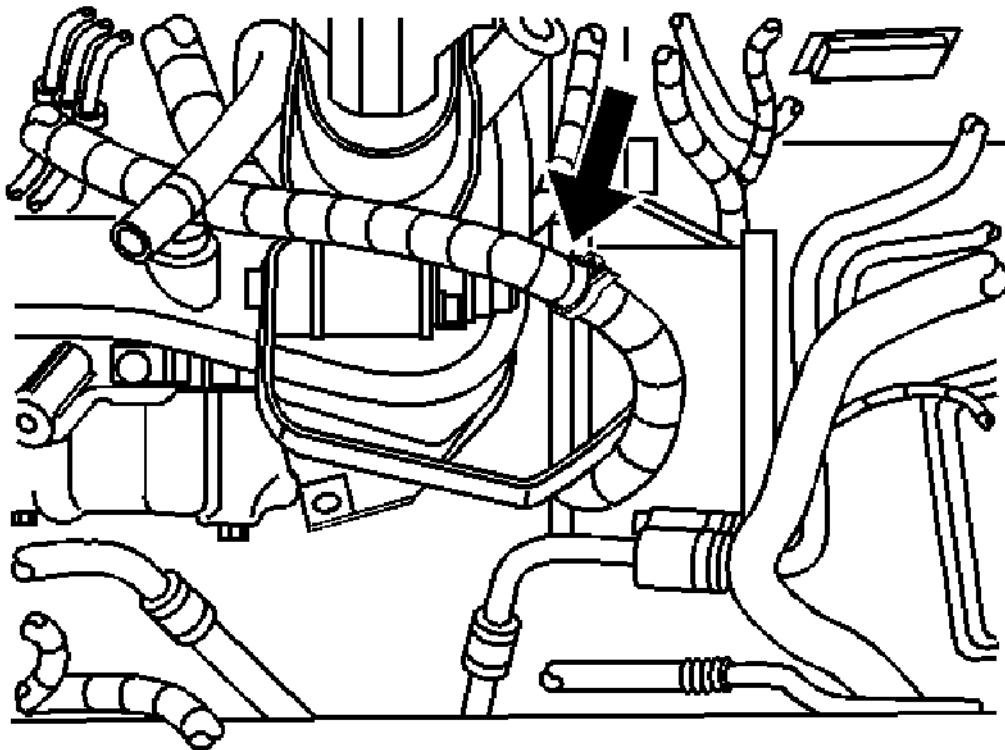


Fig. 34: Locating Engine Wiring Harness Retainers At The Engine Harness Bracket

Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fans with the cooling fan shroud.
2. Reposition the engine wiring harness.
3. Connect the engine wiring harness retainers at the engine harness bracket.
4. Raise the vehicle.
5. Connect the TOC lines to the fan module retainer clip.
6. Lower the vehicle.
7. Connect the upper TOC line to the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.

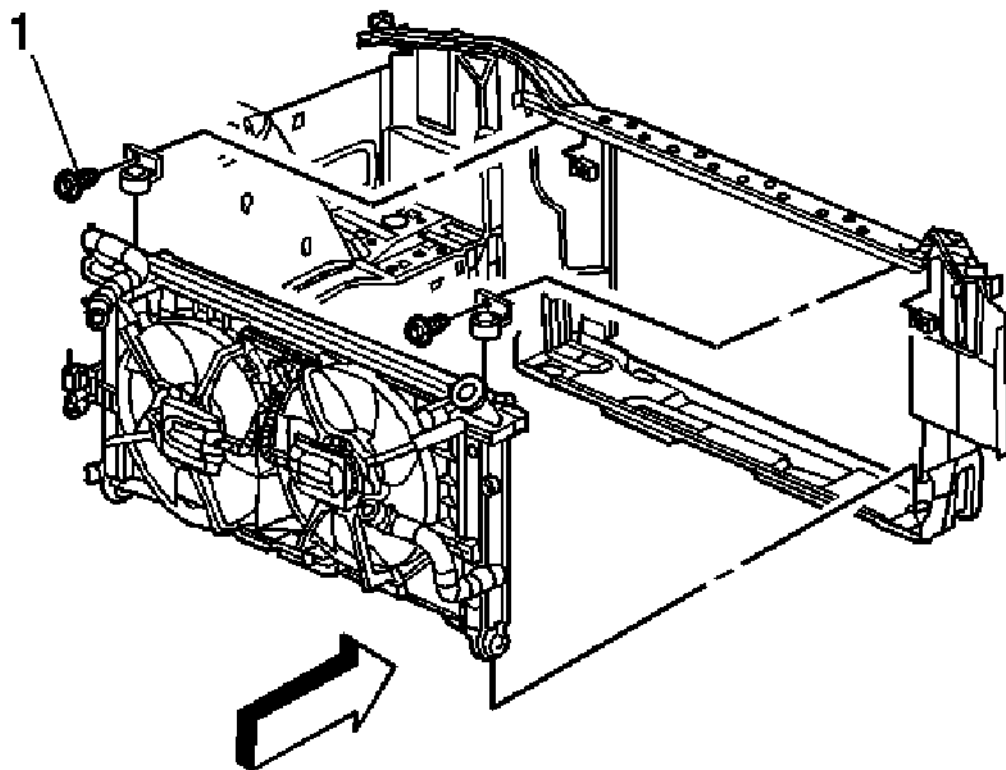


Fig. 35: View Of Radiator Upper Mount Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the cooling fan shroud bolts.

Tighten: Tighten the bolts to 6 N.m (53 lb in).

9. Install the radiator upper mounts.
10. Install the radiator upper mount bolts (1).

Tighten: Tighten the bolts to 10 N.m (88 lb in).

11. Install the coolant overflow hose to the radiator.
12. Using **J 38185** , reposition the hose clamp to secure the coolant overflow hose. See Special Tools and Equipment.
13. Install the upper radiator hose. Refer to Radiator Hose Replacement - Inlet (LA1) or

Radiator Hose Replacement - Inlet (LY7).

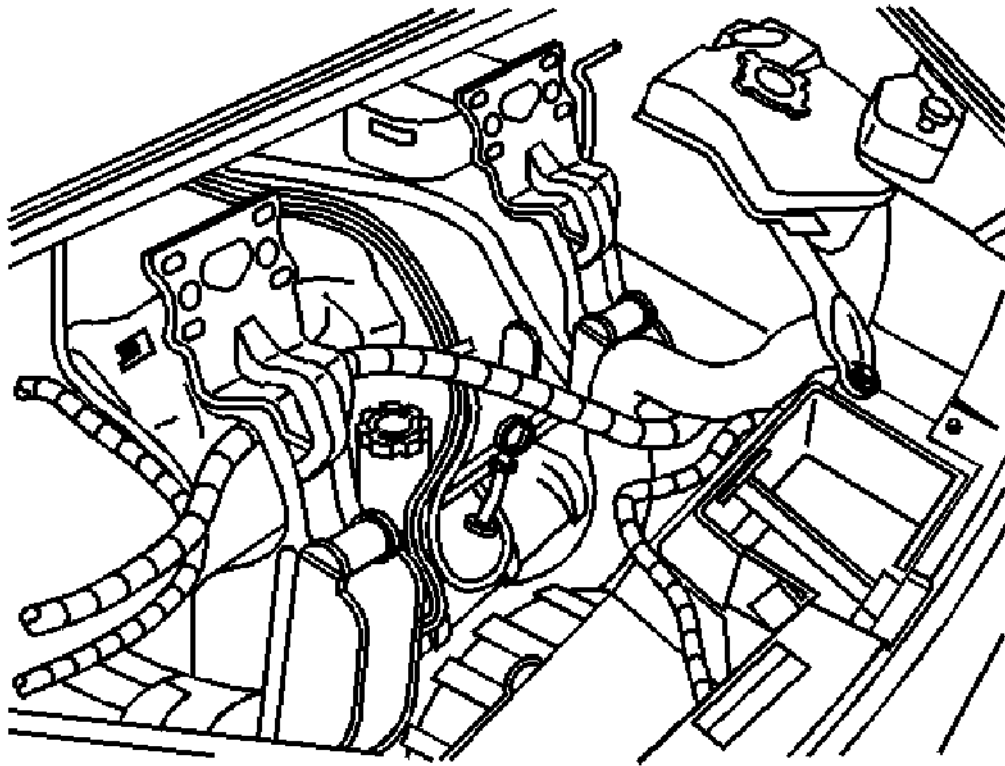


Fig. 36: Identifying Engine Mount Strut Bracket Brace Bolts
Courtesy of GENERAL MOTORS CORP.

14. Position the engine mount struts brackets flush with the upper radiator support.
15. Install the brace bolts to secure the engine mount strut bracket with the upper radiator support.

Tighten: Tighten bolts to 28 N.m (21 lb ft).

16. Install the engine mount strut nuts.

Tighten: Tighten the nuts to 48 N.m (35 lb ft).

17. Install right side diagonal brace. Refer to **Brace Replacement - Front Fender Upper Diagonal - Right** in Body Front End.

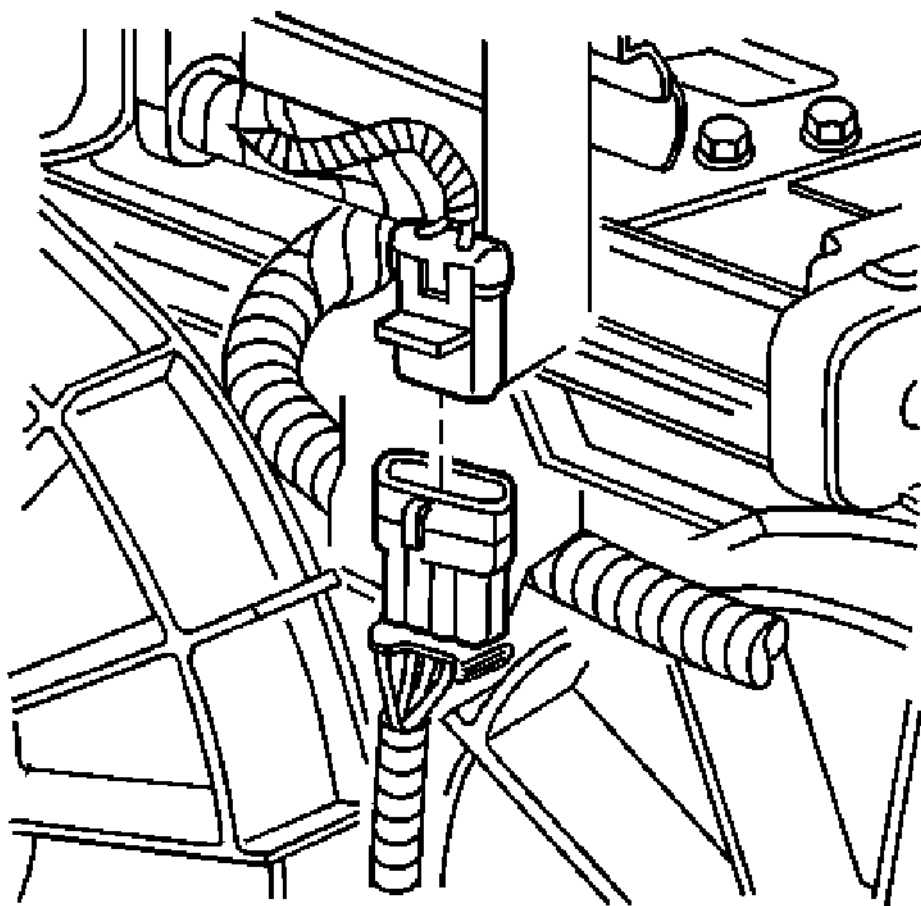


Fig. 37: Locating Cooling Fan Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

18. Connect the cooling fan harness electrical connector.
19. Install the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.6L.

COOLING FAN MOTOR REPLACEMENT - ELECTRIC

Removal Procedure

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and

Notices.

IMPORTANT: If abnormal noise or vibration is felt from the engine compartment, inspect and clean any foreign material from the cooling fan blades.

1. Turn the ignition off.
2. Remove the cooling fan and shroud assembly. Refer to Cooling Fan Replacement - Electric (LA1) or Cooling Fan Replacement - Electric (LY7).

IMPORTANT: Turn the cooling fan nut clockwise to loosen.

3. Remove the cooling fan nut.

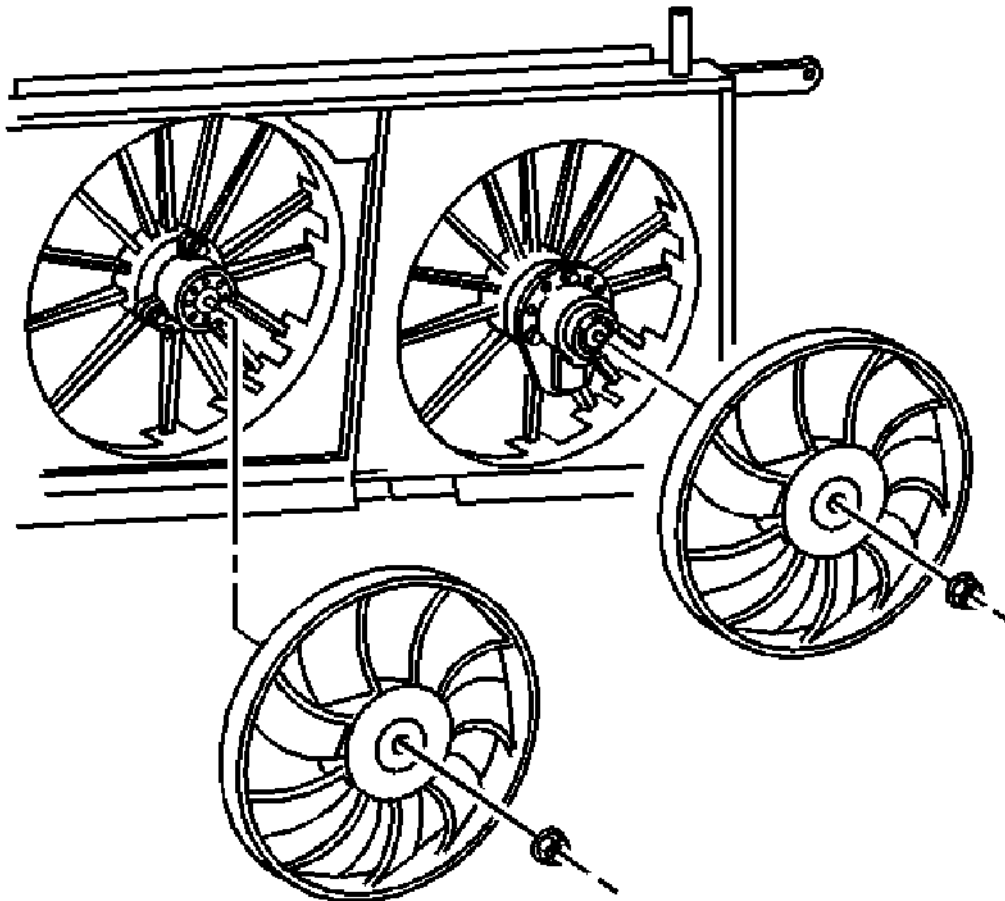


Fig. 38: Identifying Cooling Fans

Courtesy of GENERAL MOTORS CORP.

4. Remove the cooling fan from the shroud.
5. Disconnect the electrical connector from the cooling fan motor.

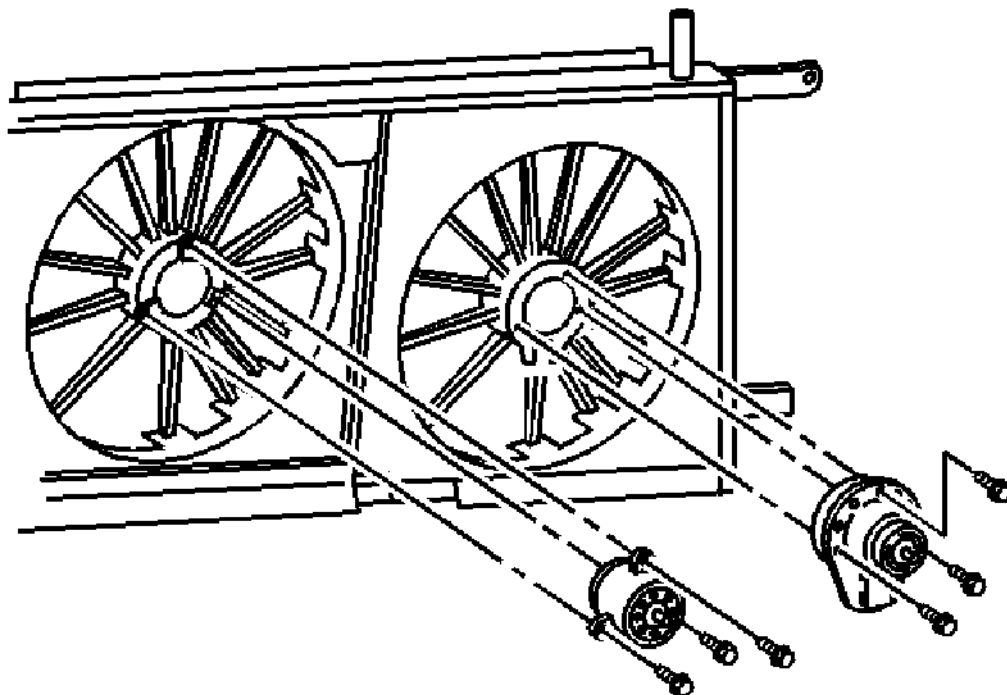


Fig. 39: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

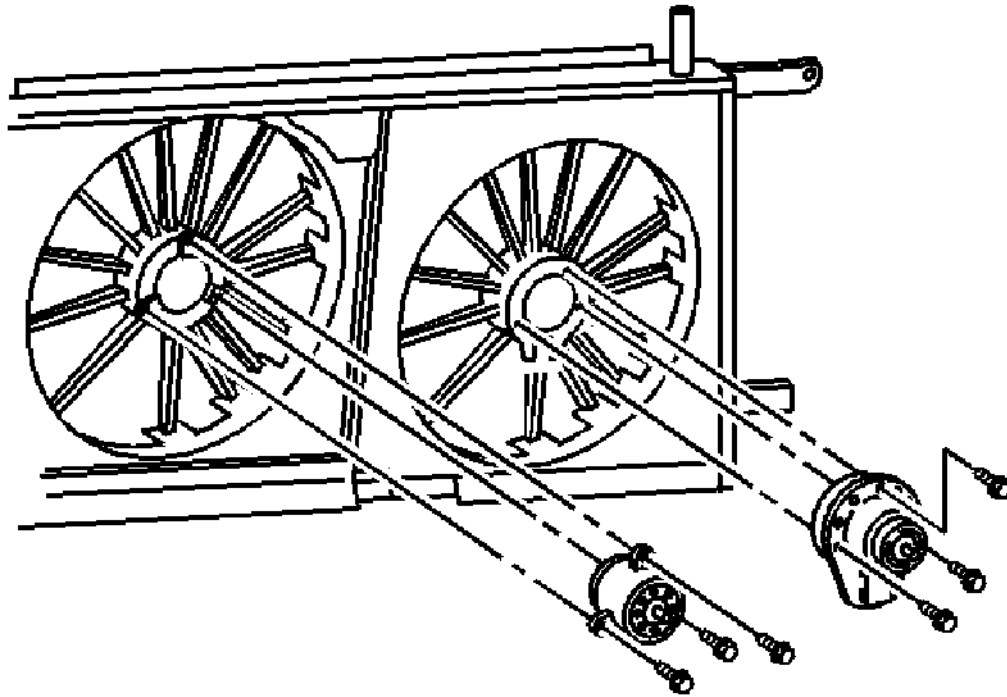


Fig. 40: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan motor.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the screws to the cooling fan motor.

Tighten: Tighten the screws to 6 N.m (53 lb in).

3. Connect the electrical connector to the cooling fan motor.

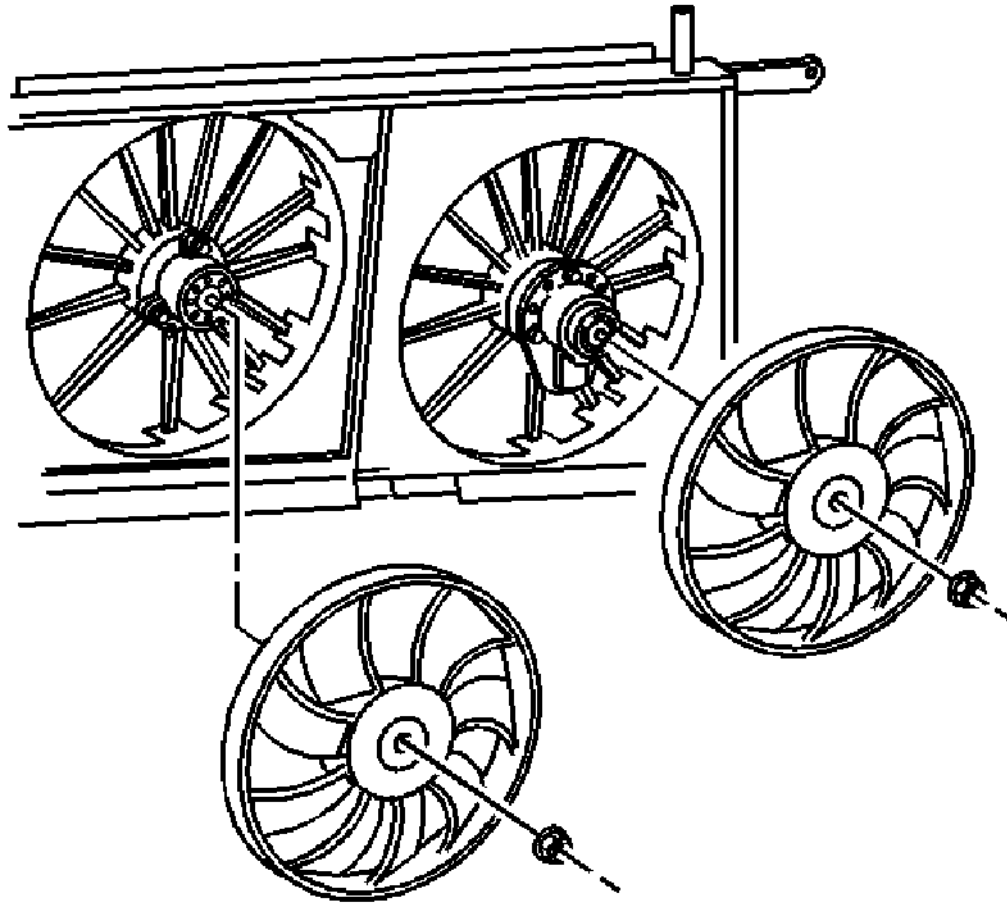


Fig. 41: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

4. Install the cooling fan to the shroud.

IMPORTANT: Turn the cooling fan nut counterclockwise to tighten.

5. Install the cooling fan nut.

Tighten: Tighten the nut to 6 N.m (53 lb in).

6. Install the cooling fan and shroud assembly. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

Tools Required

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

Removal Procedure

1. Remove the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.4L.
2. Drain the coolant until the coolant level is below the thermostat. Refer to **Draining and Filling Cooling System**.
3. Remove the crossover exhaust pipe. Refer to **Exhaust Crossover Pipe Replacement (LA1)** or **Exhaust Crossover Pipe Replacement (LY7)** in Engine Exhaust.
4. Remove the radiator hose from the thermostat housing.

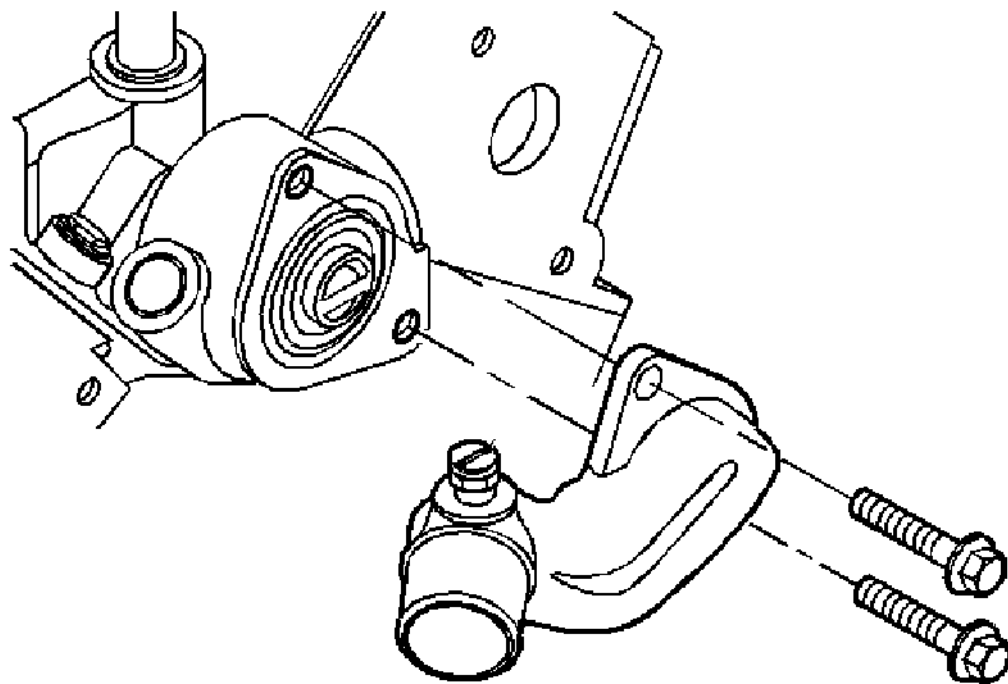


Fig. 42: Water Outlet Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the thermostat housing bolts and clean any sealer from the bolt threads.
6. Remove the thermostat housing and gasket.

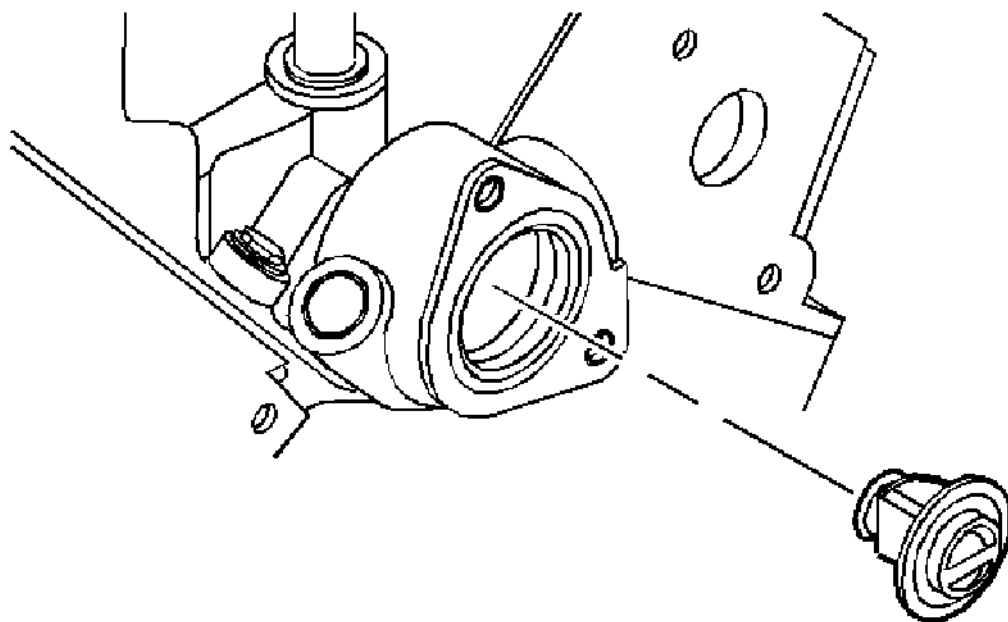


Fig. 43: View Of Thermostat (3.4L)
Courtesy of GENERAL MOTORS CORP.

7. Remove the thermostat.
8. Clean the mating surfaces.

Installation Procedure

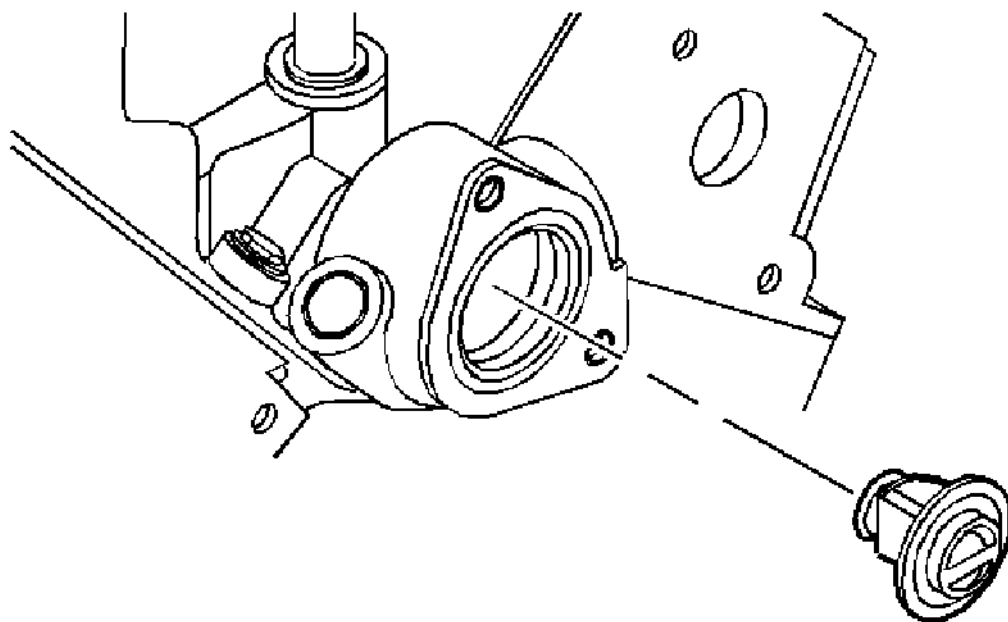


Fig. 44: View Of Thermostat (3.4L)
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat.

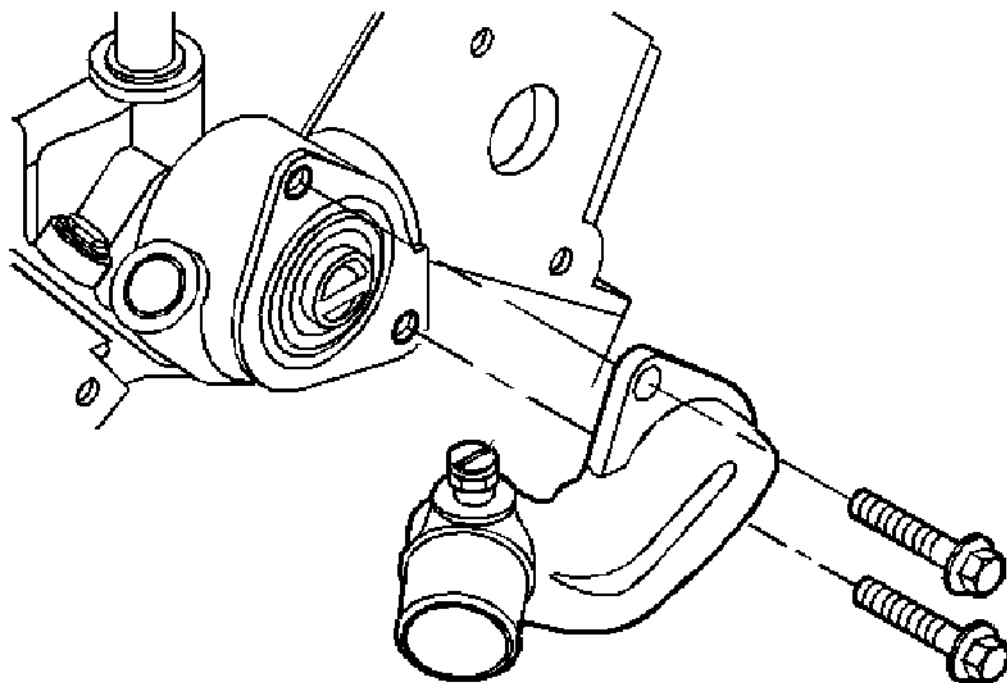


Fig. 45: Water Outlet Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the thermostat housing and gasket.

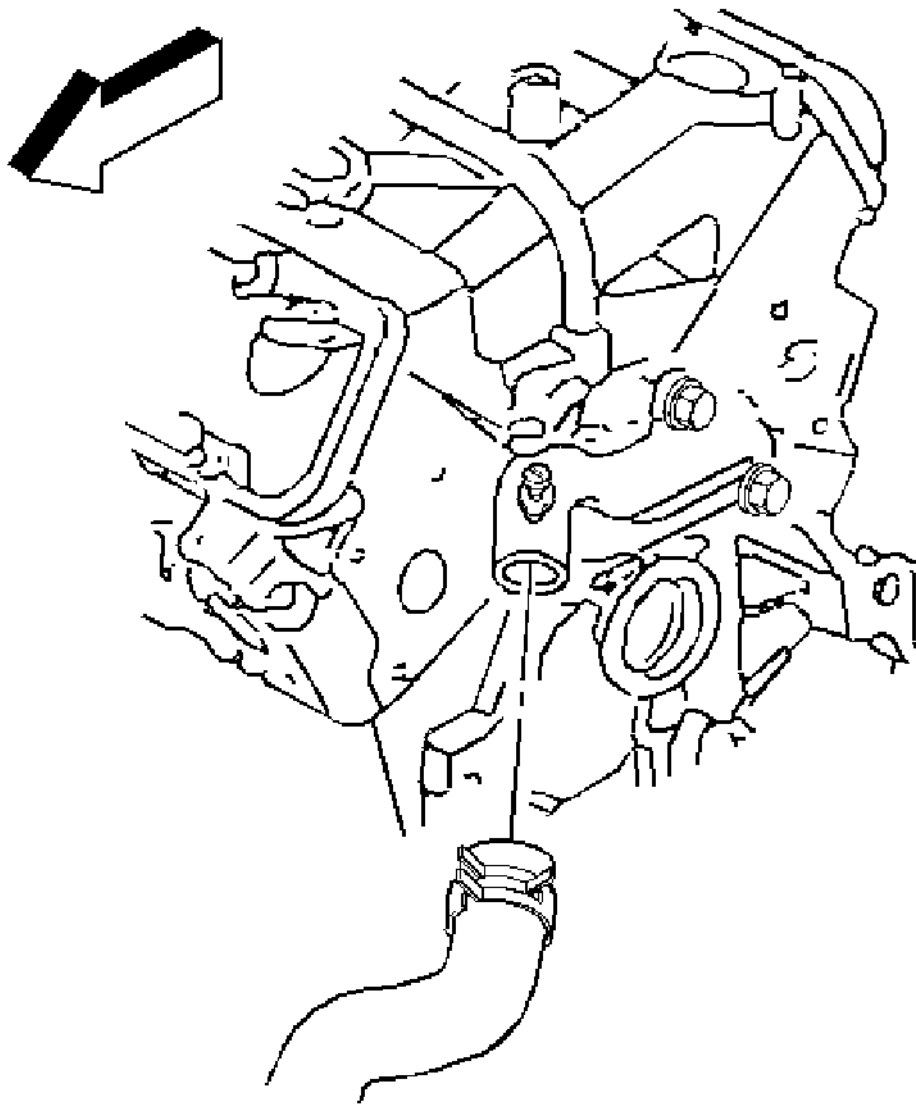


Fig. 46: Identifying Radiator Inlet Hose & Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the thermostat housing bolts.

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

4. Install the radiator hose to the thermostat housing.

5. Install the crossover exhaust pipe. Refer to **Exhaust Crossover Pipe Replacement (LA1)** or **Exhaust Crossover Pipe Replacement (LY7)** in Engine Exhaust.
6. Install the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.4L.
7. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

THERMOSTAT REPLACEMENT (LY7)

Removal Procedure

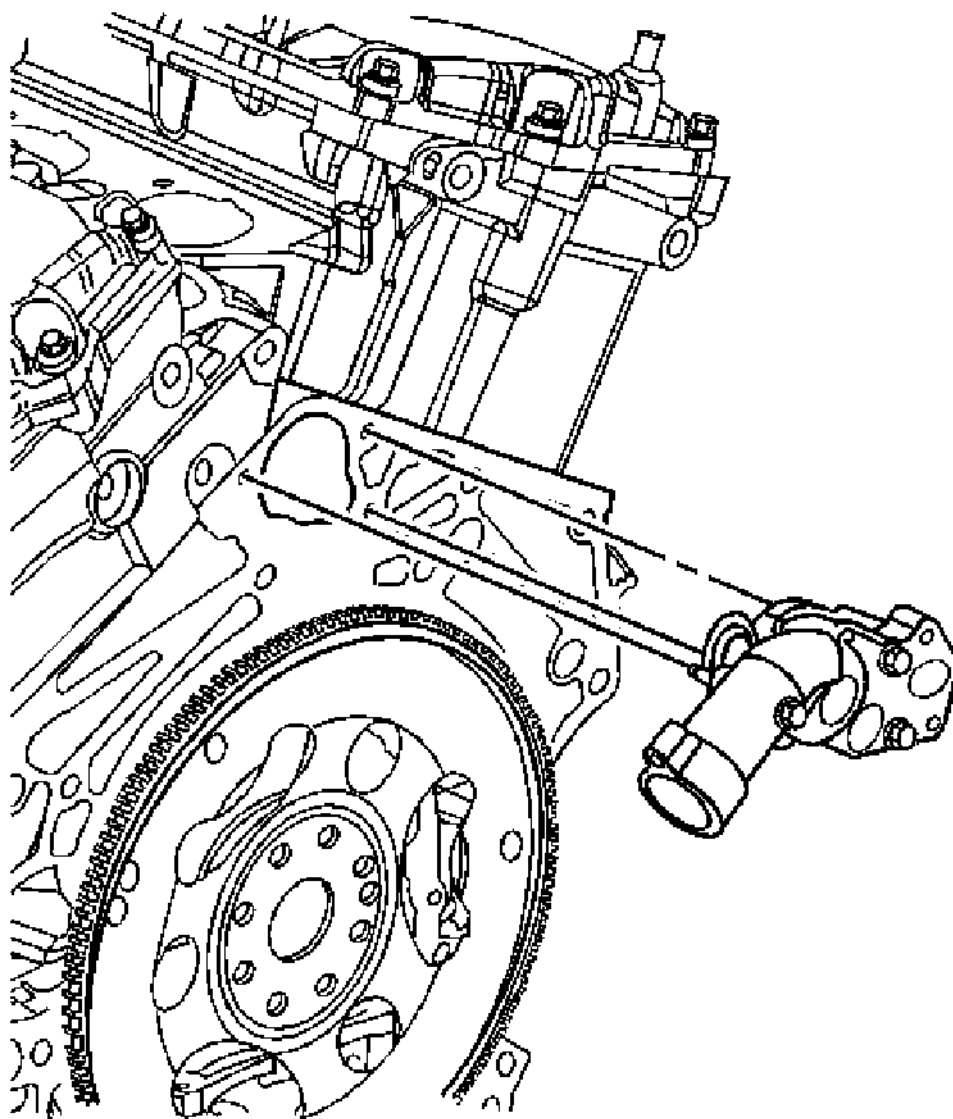


Fig. 47: View Of Thermostat (LY7)

Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** in Engine Controls-3.6L (LY7).
2. Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement** .
3. Remove the heater pipes. Refer to **Heater Pipes Replacement (LY7)** in Heating, Ventilation and Air Conditioning.

IMPORTANT: Use a universal or swivel socket with a long extension in order to remove the bolts.

4. Remove the coolant inlet pipe. Refer to **Coolant Pipe Replacement - Inlet.**

IMPORTANT: Use a universal or swivel socket with a long extension in order to remove the bolts.

5. Remove the thermostat bolts and the thermostat.
6. Clean the thermostat and heater pipe sealing surfaces.

Installation Procedure

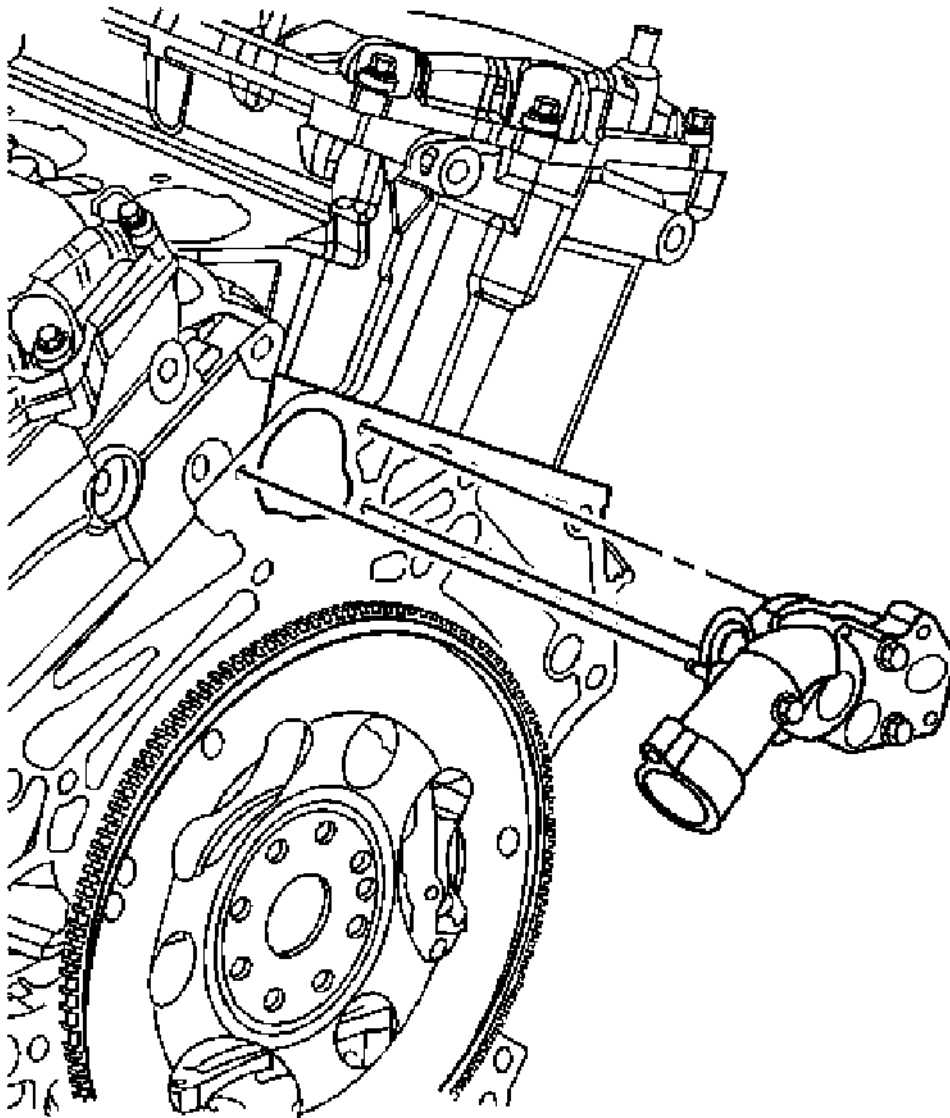


Fig. 48: View Of Thermostat (LY7)
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW thermostat gasket.
2. Install the thermostat and gasket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the thermostat bolts.

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

4. Install the coolant inlet pipe. Refer to **Coolant Pipe Replacement - Inlet**.
5. Install the heater pipes. Refer to **Heater Pipes Replacement (LY7)** in Heating, Ventilation and Air Conditioning.
6. Install the throttle body assembly. Refer to **Throttle Body Assembly Replacement**.
7. Install the air cleaner. Refer to **Air Cleaner Assembly Replacement** in Engine Controls-3.6L (LY7).
8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER OUTLET HOUSING REPLACEMENT (LA1)

Tools Required

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

Removal Procedure

1. Remove the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls-3.4L.
2. Drain the coolant until the coolant level is below the thermostat. Refer to **Draining and Filling Cooling System**.
3. Remove the crossover exhaust pipe. Refer to **Exhaust Crossover Pipe Replacement (LA1)** or **Exhaust Crossover Pipe Replacement (LY7)** in Engine Exhaust.
4. Remove the radiator hose from the thermostat housing.

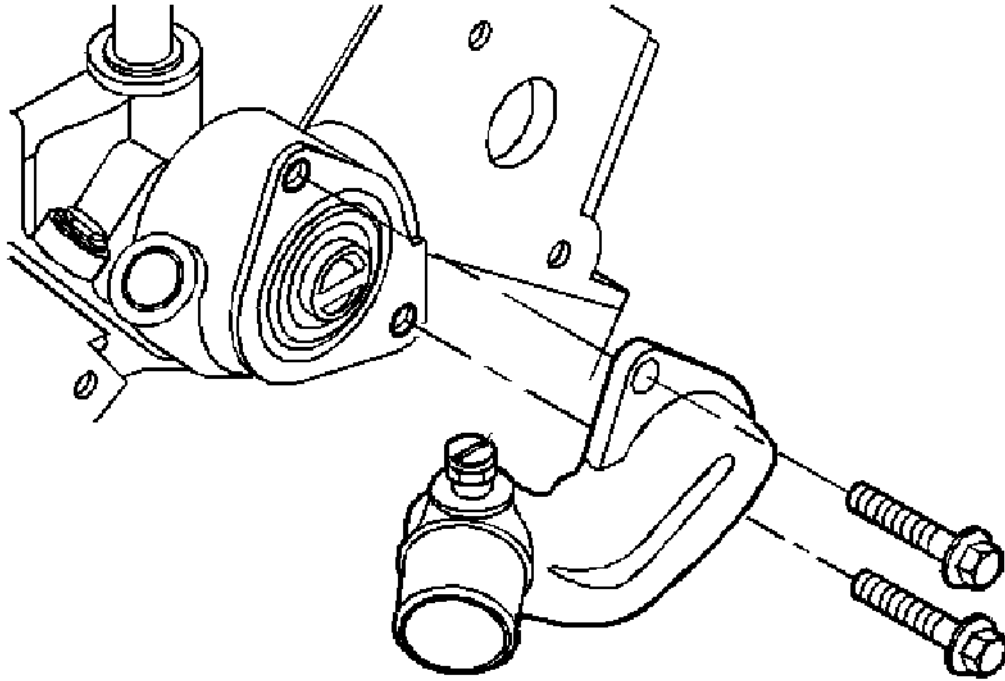


Fig. 49: Water Outlet Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the thermostat housing bolts and clean any sealer from the bolt threads.
6. Remove the thermostat housing and gasket.

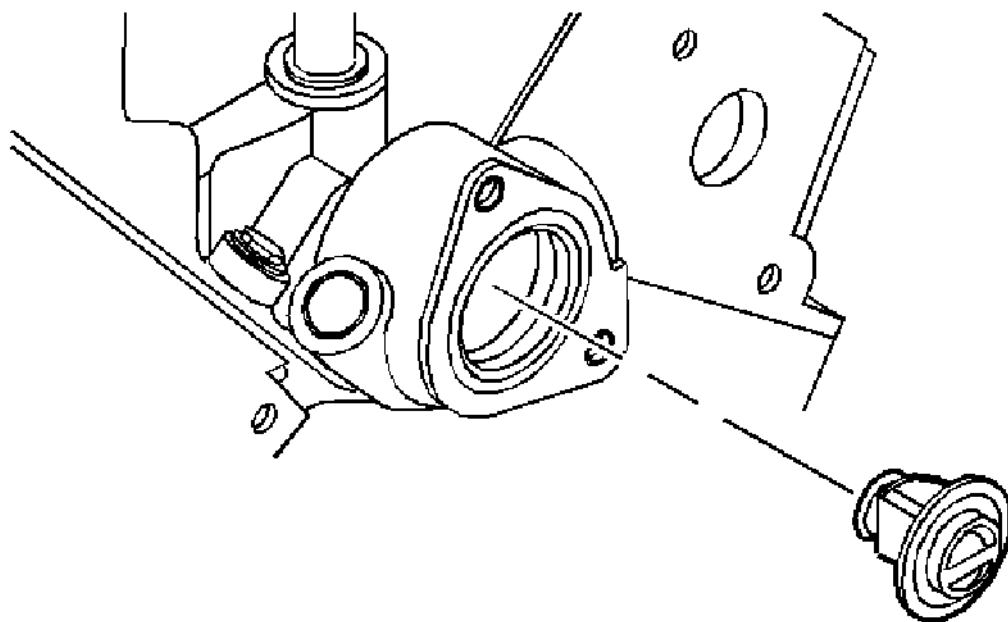


Fig. 50: View Of Thermostat (3.4L)
Courtesy of GENERAL MOTORS CORP.

7. Remove the thermostat.
8. Clean the mating surfaces.

Installation Procedure

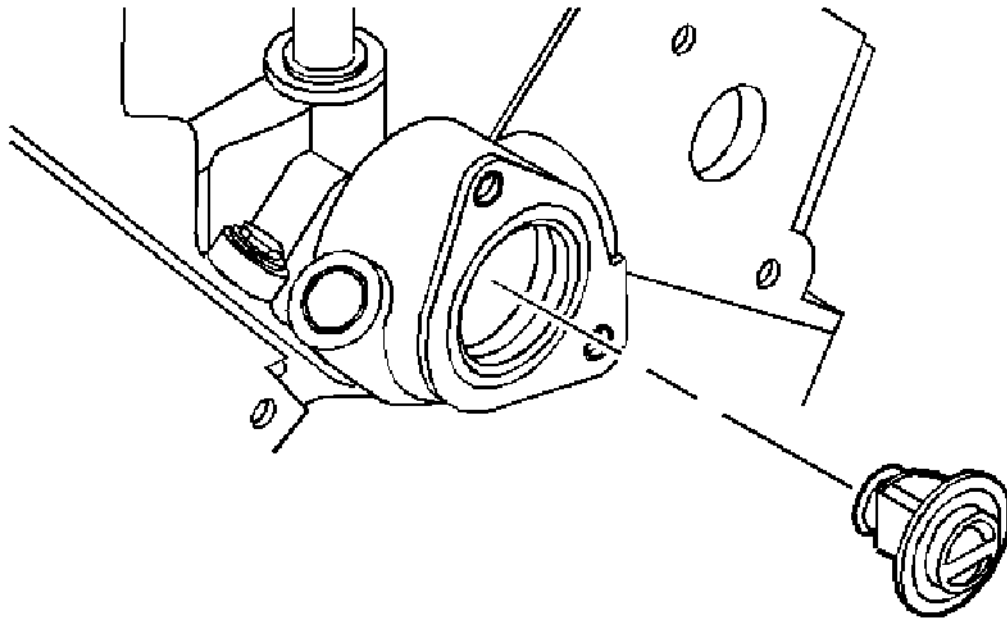


Fig. 51: View Of Thermostat (3.4L)
Courtesy of GENERAL MOTORS CORP.

1. Install the thermostat.

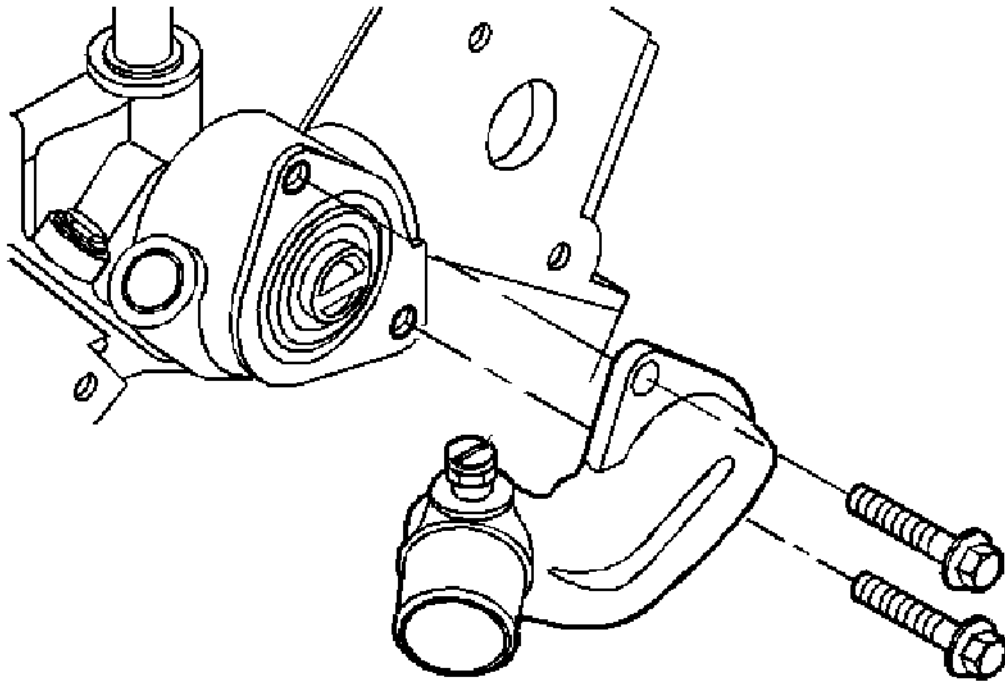


Fig. 52: Water Outlet Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the thermostat housing and gasket.
3. Install RTV sealer (GMP/N 1052366 or the equivalent) to the thermostat housing bolt threads.

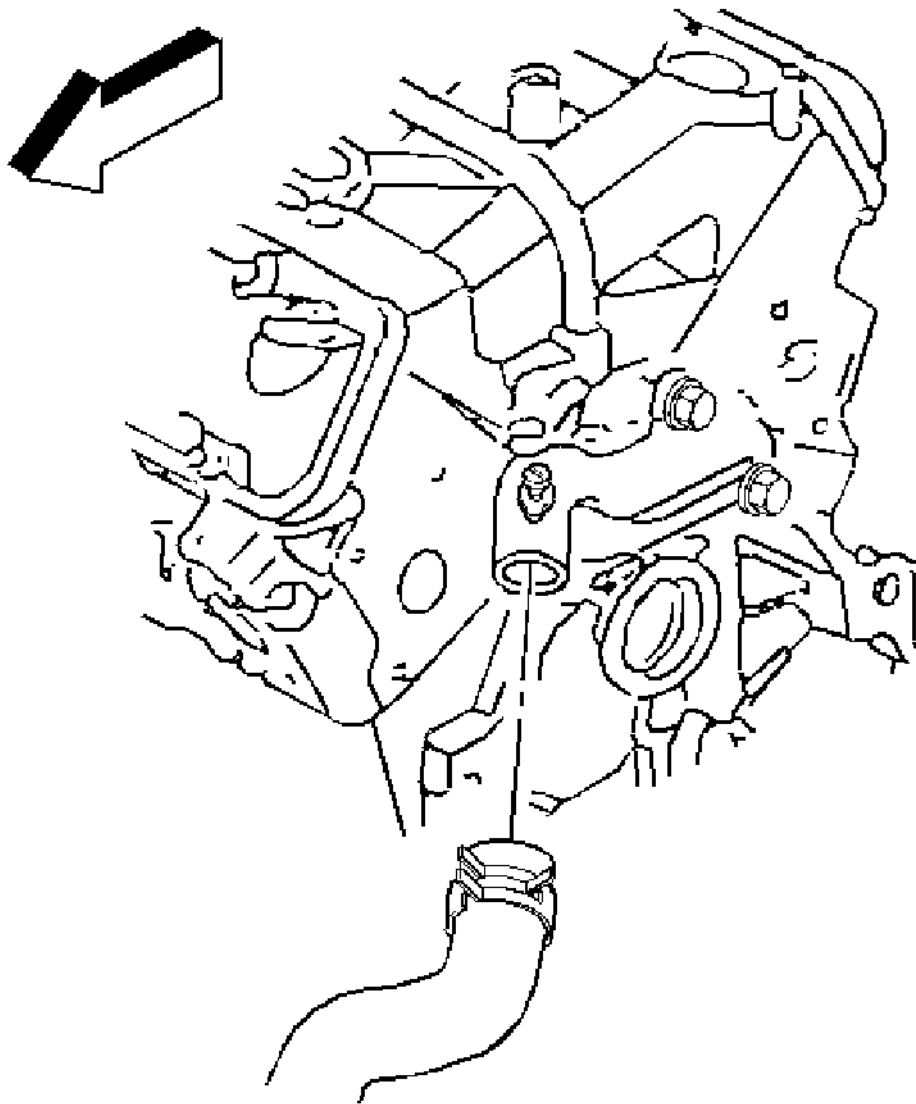


Fig. 53: Identifying Radiator Inlet Hose & Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the thermostat housing bolts.

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

5. Install the radiator hose to the thermostat housing.

6. Install the crossover exhaust pipe. Refer to **Exhaust Crossover Pipe Replacement (LA1)** or **Exhaust Crossover Pipe Replacement (LY7)** in Engine Exhaust.
7. Install the air cleaner and duct assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls-3.4L.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER OUTLET HOUSING REPLACEMENT (LY7)

Removal Procedure

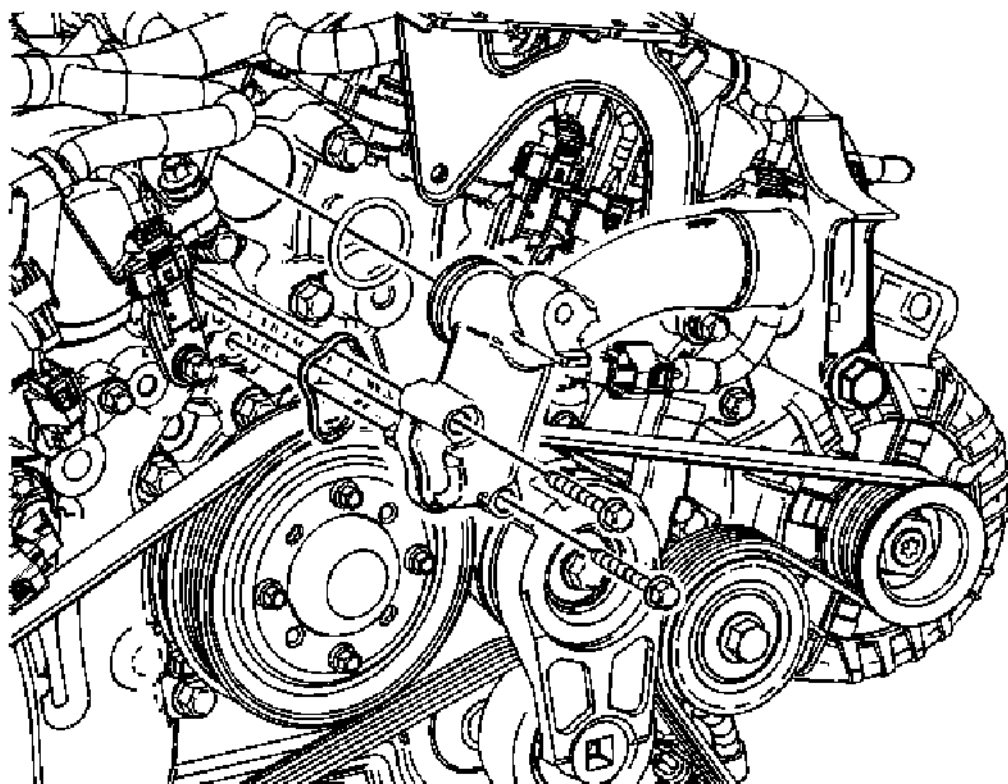


Fig. 54: Identifying Water Outlet Bolts And The Water Outlet
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant until the coolant level is below the water outlet. Refer to **Draining and Filling Cooling System**.
2. Remove the upper radiator hose from the water outlet. Refer to **Radiator Hose Replacement - Inlet (LA1)** or **Radiator Hose Replacement - Inlet (LY7)**.

IMPORTANT: Do not disconnect the power steering hoses or drain the power steering fluid.

3. Remove and reposition the power steering pressure hose and the power steering reservoir from the water outlet. Refer to **Remote Power Steering Fluid Reservoir Replacement (LY7)** in Power Steering System.
4. Remove the water outlet bolts and the water outlet.
5. Remove and discard the water outlet seals.
6. Clean the water outlet sealing surfaces.

Installation Procedure

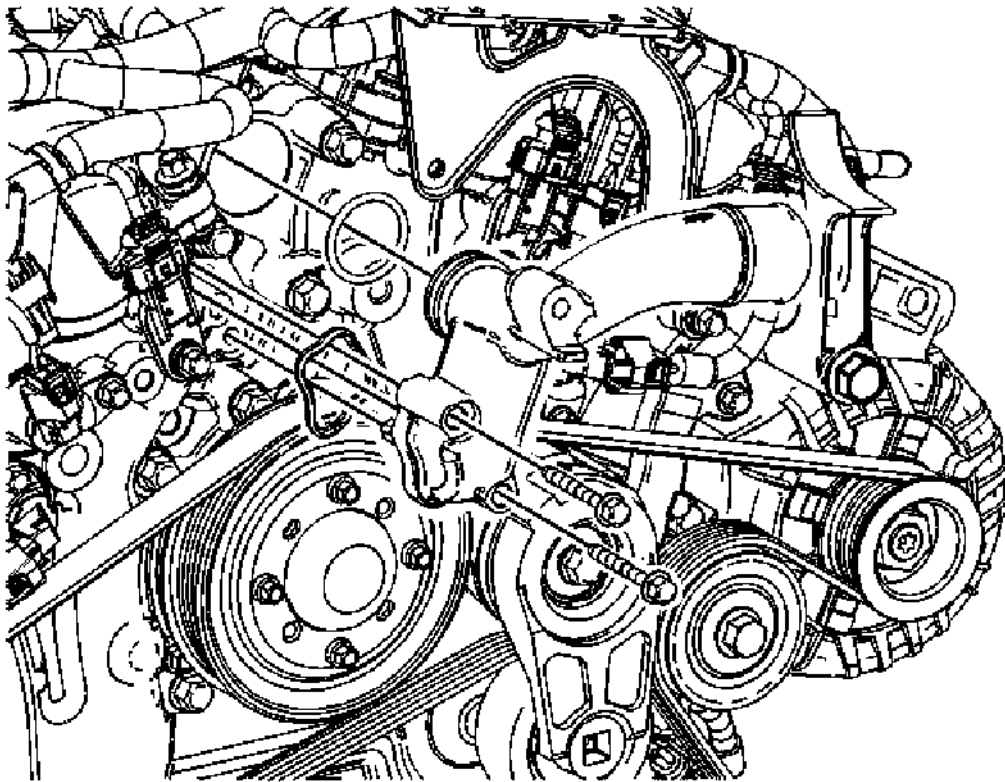


Fig. 55: Identifying Water Outlet Bolts And The Water Outlet
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW water outlet seals.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the water outlet and the water outlet bolts.

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

3. Install the power steering reservoir and the power steering pressure hose bracket to the water outlet. Refer to **Remote Power Steering Fluid Reservoir Replacement (LY7)** in Power Steering System.
4. Install the upper radiator hose to the water outlet. Refer to **Radiator Hose Replacement - Inlet (LA1)** or **Radiator Hose Replacement - Inlet (LY7)**.
5. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

COOLANT PIPE REPLACEMENT - INLET

Removal Procedure

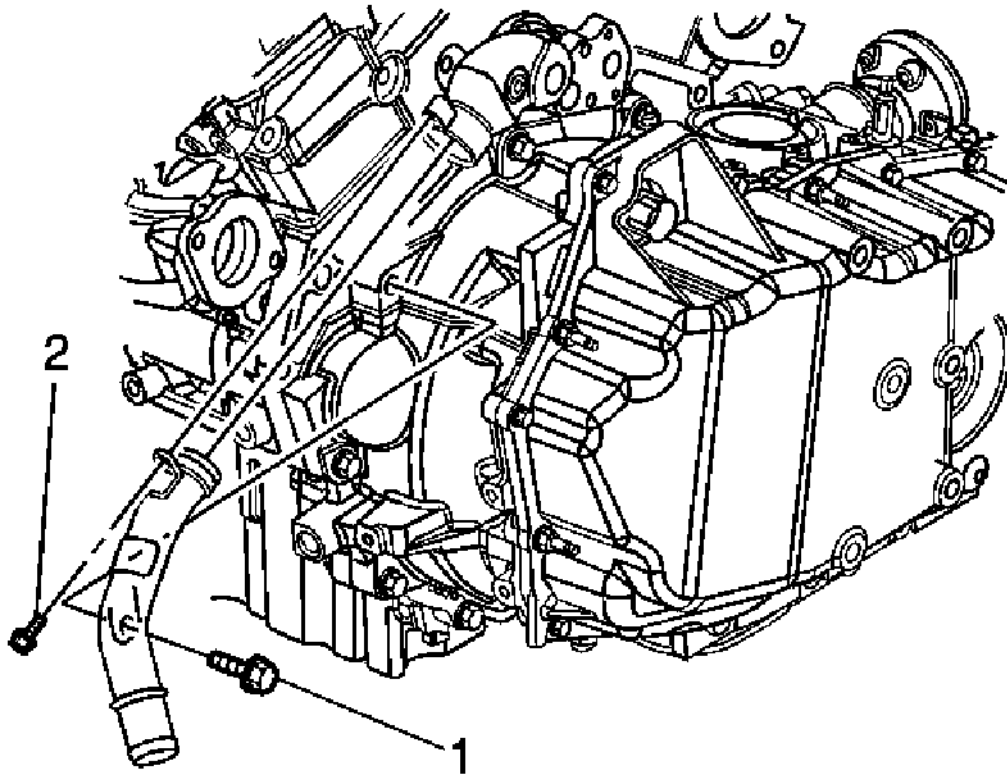


Fig. 56: View Of Water Coolant Inlet Pipe Bolts & Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

1. Drain the coolant until the coolant level is below the lower radiator hose. Refer to

Draining and Filling Cooling System.

2. Remove the lower radiator hose from the coolant inlet pipe. Refer to **Radiator Hose Replacement - Outlet (LA1)** or **Radiator Hose Replacement - Outlet (LY7)**.
3. Remove the water coolant inlet pipe bolts and the coolant inlet pipe.
4. Remove and discard the coolant inlet pipe seal.

Installation Procedure

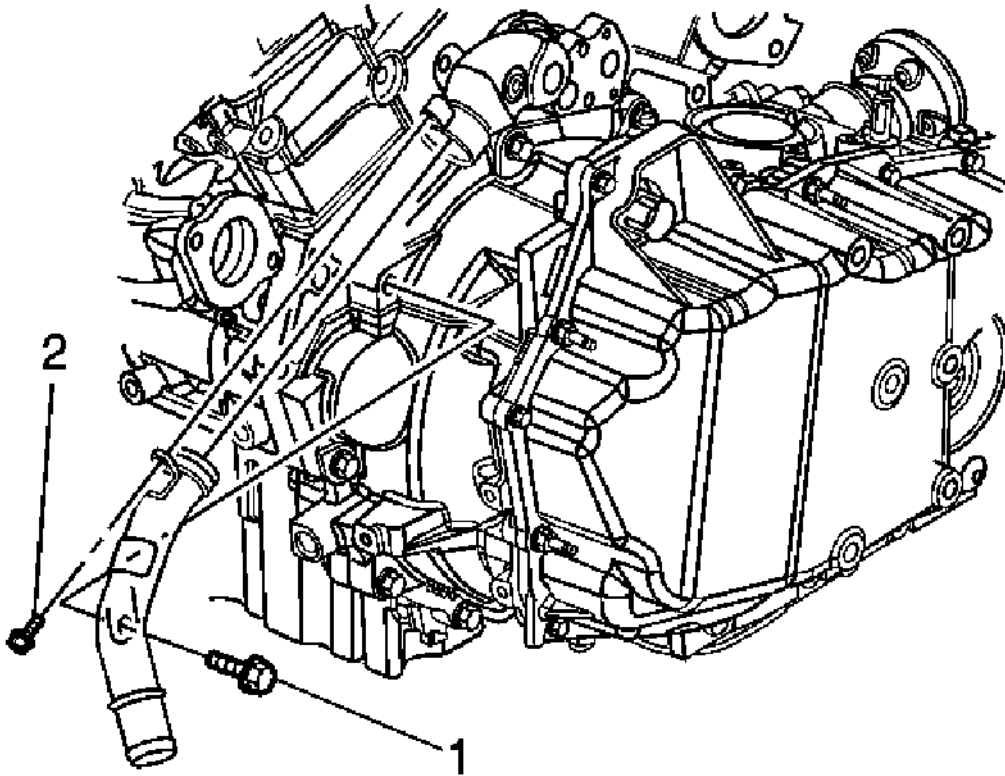


Fig. 57: View Of Water Coolant Inlet Pipe Bolts & Coolant Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW coolant inlet pipe seal.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the coolant inlet pipe bolts.

Tighten

- Tighten the water outlet upper bolt (2) to 23 N.m (17 lb ft).
 - Tighten the water outlet lower bolt (1) to 50 N.m (37 lb ft).
3. Install the lower radiator hose to the coolant inlet pipe. Refer to **Radiator Hose Replacement - Inlet (LA1)** or **Radiator Hose Replacement - Inlet (LY7)**.
 4. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

THERMOSTAT BYPASS PIPES REPLACEMENT

Tools Required

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

Removal Procedure

1. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
2. Remove the spark plug wire harness from the thermostat bypass pipe.
3. Remove the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.4L.
4. Remove the upper radiator hose from the thermostat housing.
5. Disconnect the left engine mount strut from the engine.
6. Remove the heater hose from the bypass pipe.

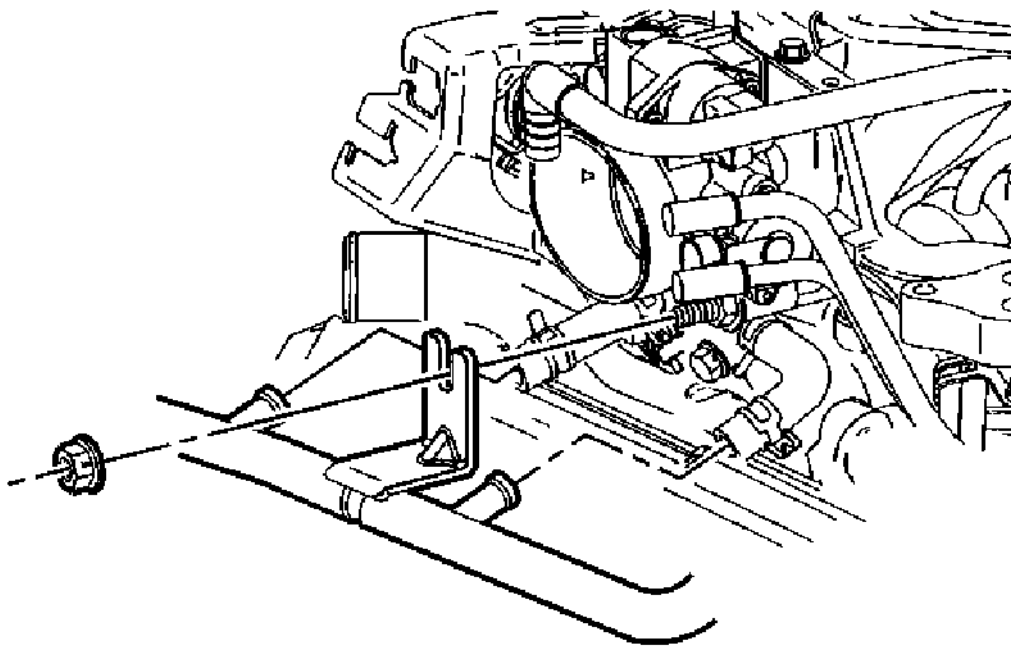


Fig. 58: Locating Heater Pipe Nut
Courtesy of GENERAL MOTORS CORP.

7. Remove the thermostat bypass pipe to throttle body nut.

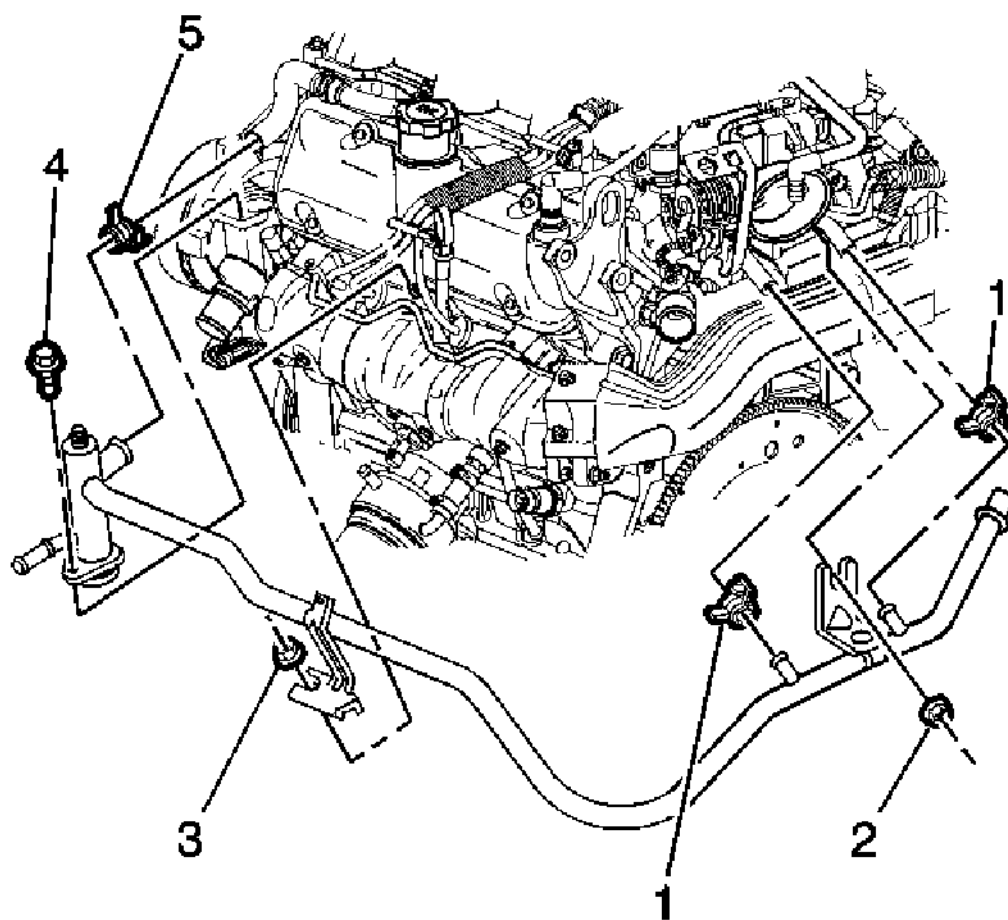


Fig. 59: Identifying Thermostat Bypass Pipes
Courtesy of GENERAL MOTORS CORP.

8. Use the **J 38185** in order to remove the thermostat bypass pipe hose clamps (1,5). See **Special Tools and Equipment**.
9. Remove the thermostat bypass pipe to cylinder head nut (3).
10. Remove the thermostat bypass pipe bolt (4).

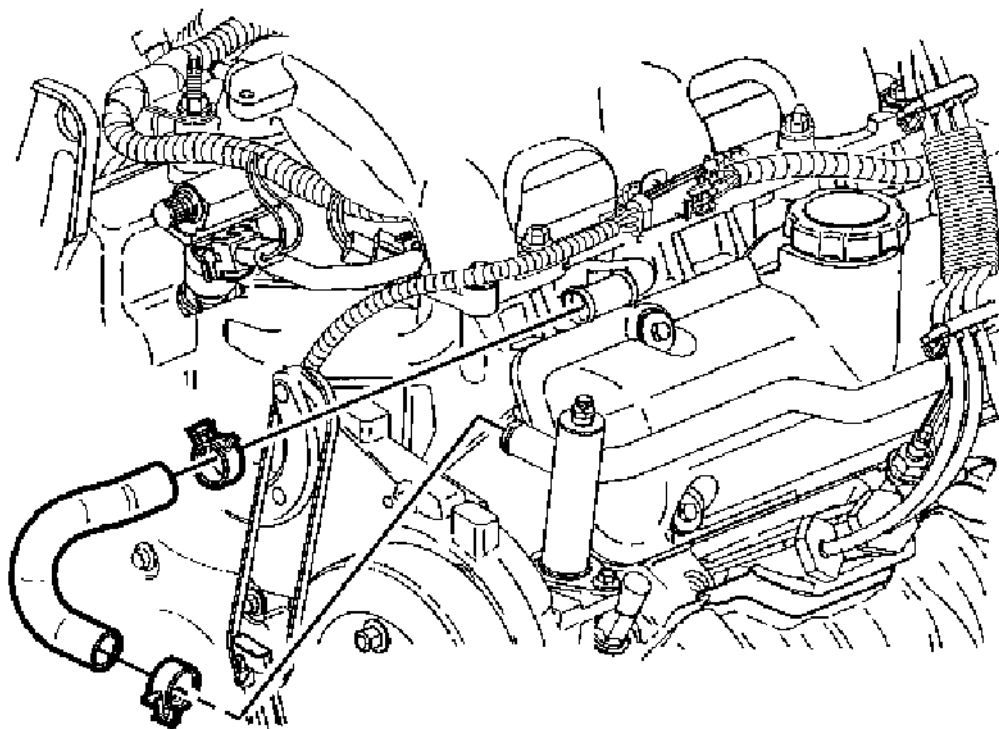


Fig. 60: Removing/Installing Thermostat Bypass Pipe Hose
Courtesy of GENERAL MOTORS CORP.

11. Remove the thermostat bypass pipe hose.
12. Remove the thermostat bypass pipe.

Installation Procedure

1. Apply engine coolant to the bypass pipe seal in order to ease installation.
2. Install the thermostat bypass pipe.

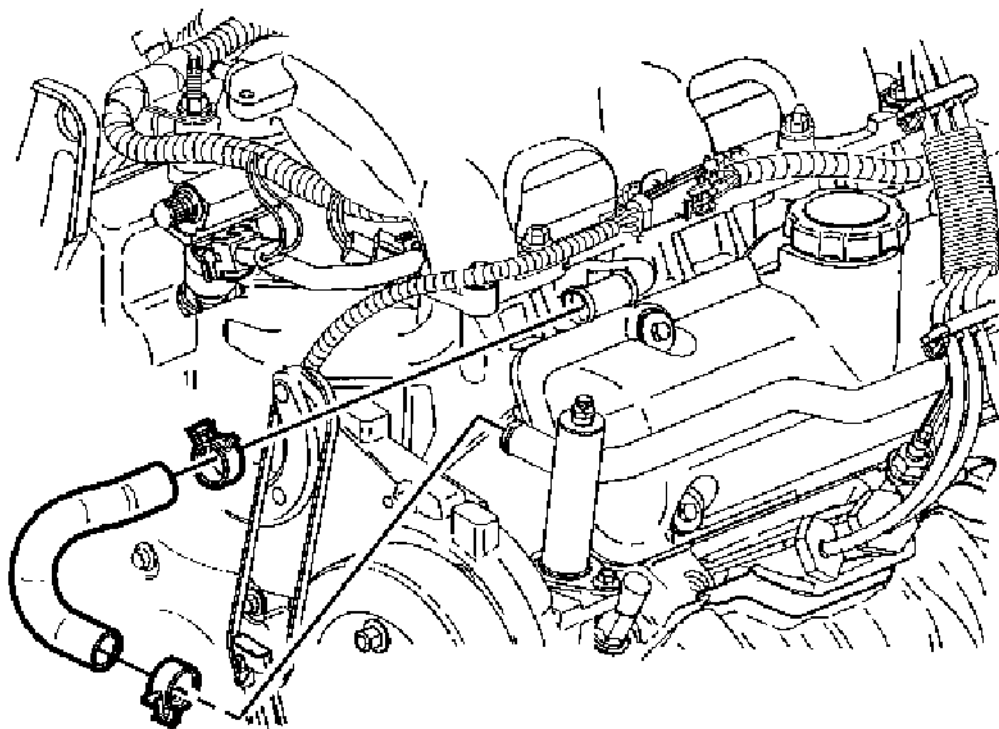


Fig. 61: Removing/Installing Thermostat Bypass Pipe Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the thermostat bypass pipe hose.

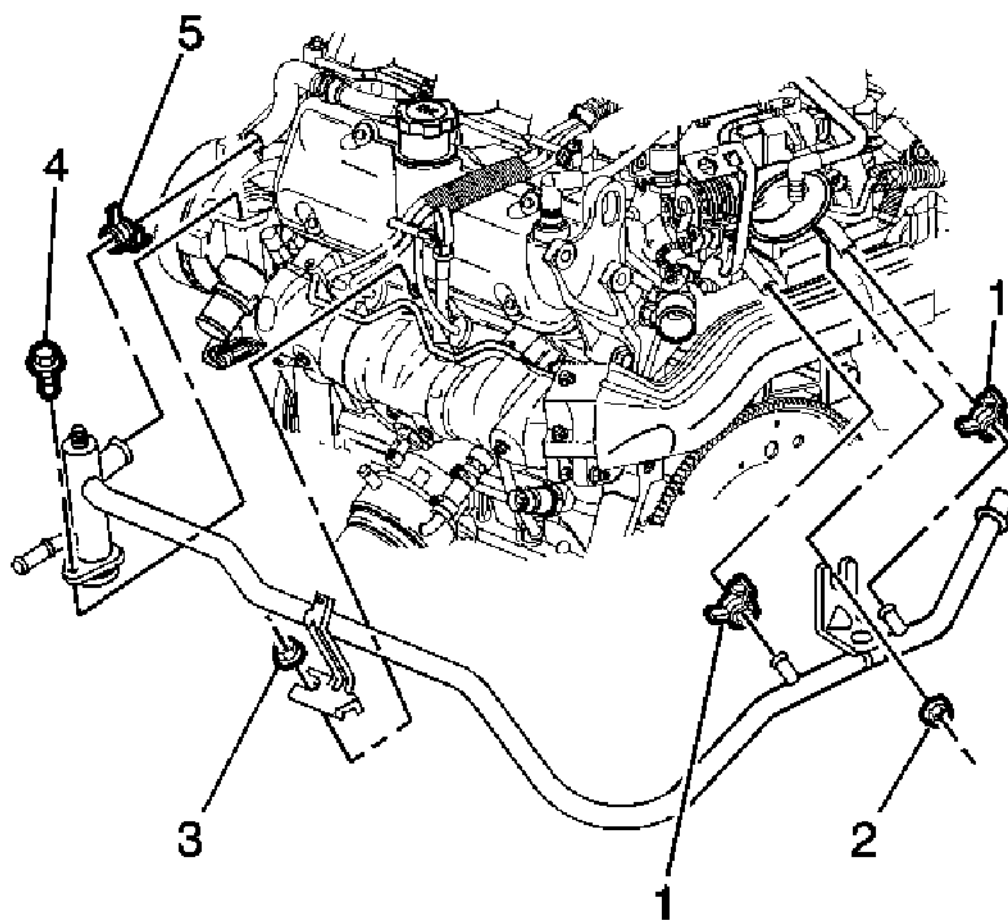


Fig. 62: Identifying Thermostat Bypass Pipes
Courtesy of GENERAL MOTORS CORP.

4. Install the thermostat bypass pipe hose clamp (5).

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the thermostat bypass pipe bolt (4).

Tighten: Tighten the thermostat bypass pipe bolt to 11 N.m (98 lb in).

6. Install the thermostat bypass pipe to cylinder head nut (3).

Tighten: Tighten the thermostat bypass pipe nut to 25 N.m (18 lb ft).

7. Install the thermostat bypass pipe to throttle body hose clamps (1).

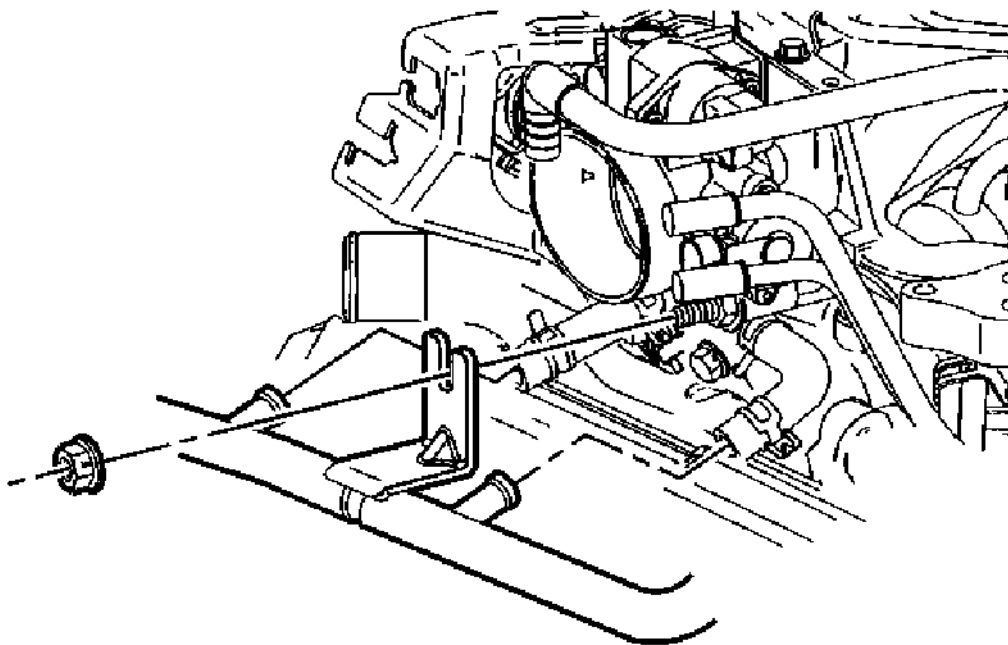


Fig. 63: Locating Heater Pipe Nut
Courtesy of GENERAL MOTORS CORP.

8. Install the thermostat bypass pipe to throttle body nut.

Tighten: Tighten the thermostat bypass pipe nut to 25 N.m (18 lb ft).

9. Install the heater hose to the bypass pipe.
10. Install the left engine mount strut to the engine.
11. Install the upper radiator hose to the engine.
12. Install the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 3.4L.
13. Install the spark plug wire harness to the thermostat bypass pipe.
14. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER PUMP REPLACEMENT (LA1)

Removal Procedure

1. Drain the cooling system until the coolant is below the level of the water pump. Refer to **Draining and Filling Cooling System**.

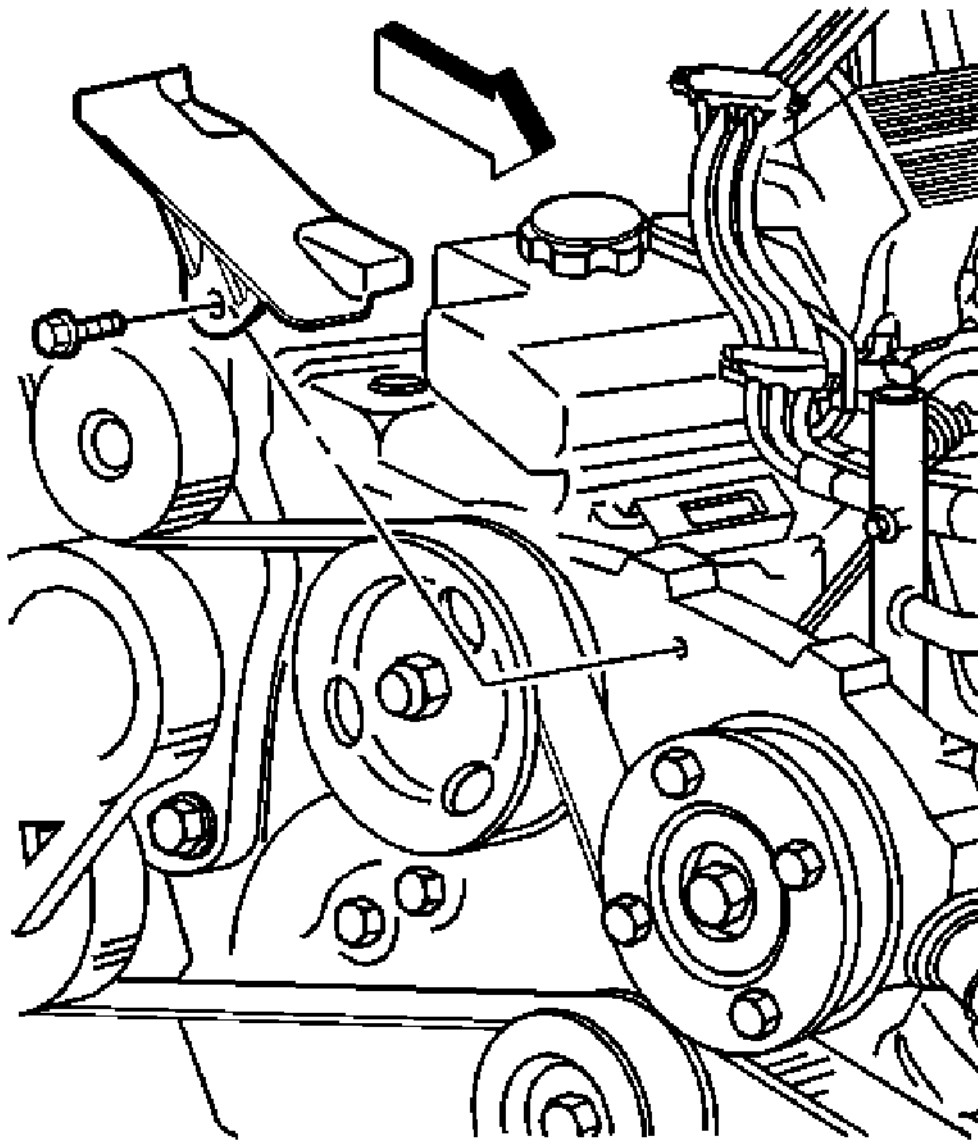


Fig. 64: Locating Drive Belt Guard
Courtesy of GENERAL MOTORS CORP.

2. Remove the drive belt guard.
3. Loosen the water pump pulley bolts.
4. Remove the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 3.4L.

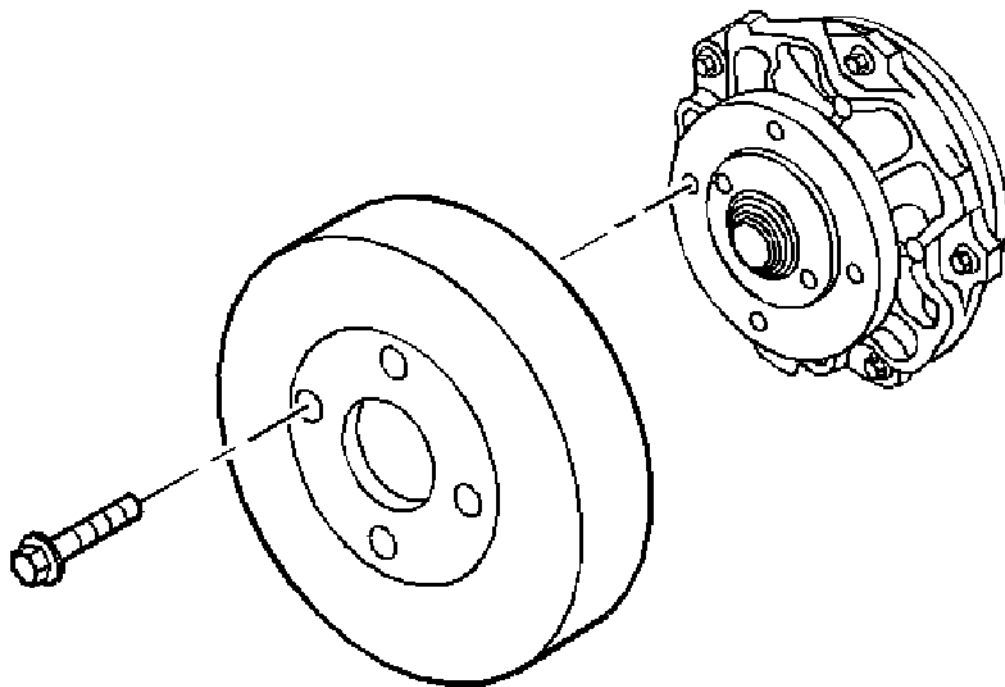


Fig. 65: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

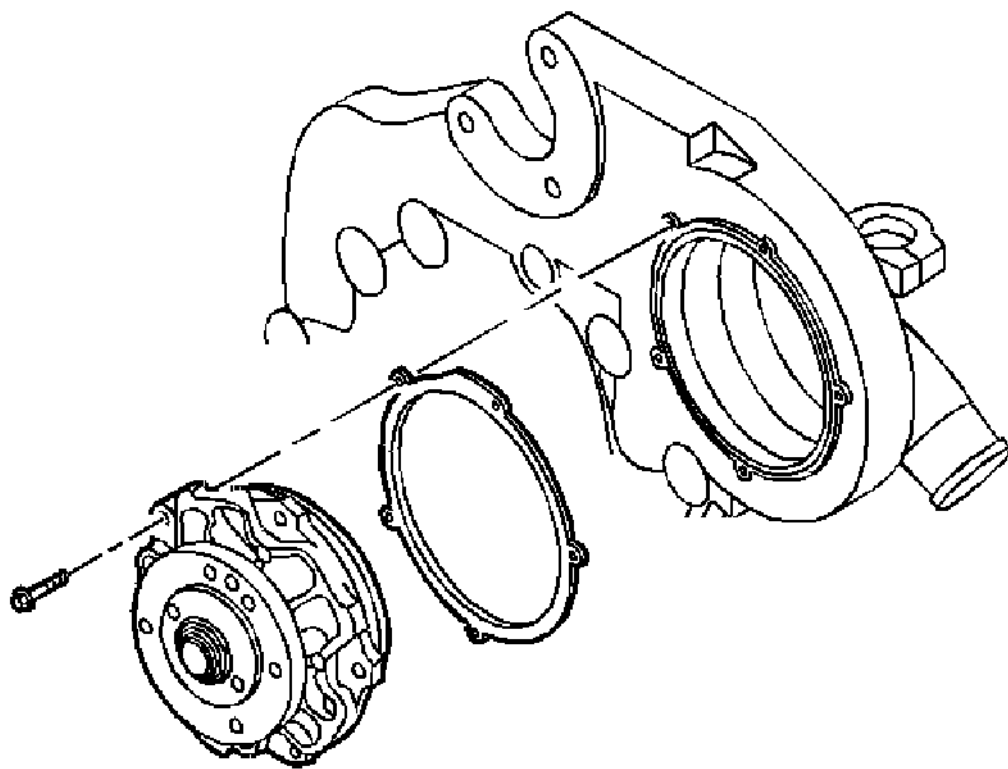


Fig. 66: Identifying Water Pump & Gasket
Courtesy of GENERAL MOTORS CORP.

7. Remove the water pump bolts.
8. Remove the water pump.
9. Remove the water pump gasket.
10. Clean the water pump mating surfaces.

Installation Procedure

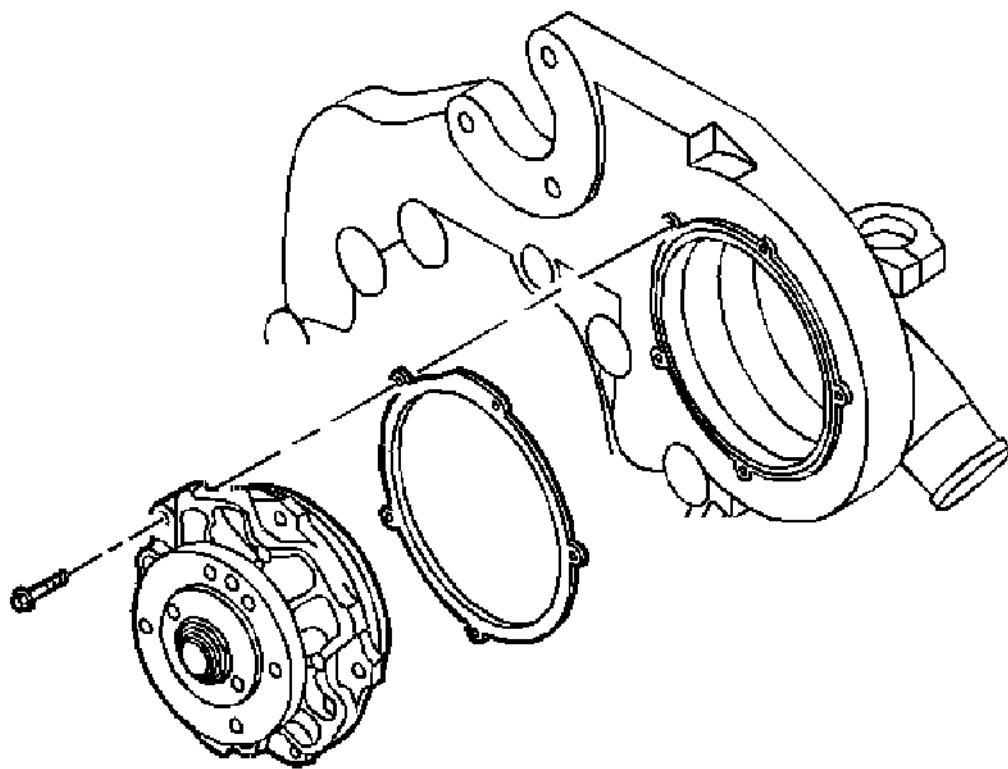


Fig. 67: Identifying Water Pump & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the water pump gasket.
2. Install the water pump.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the water pump bolts.

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

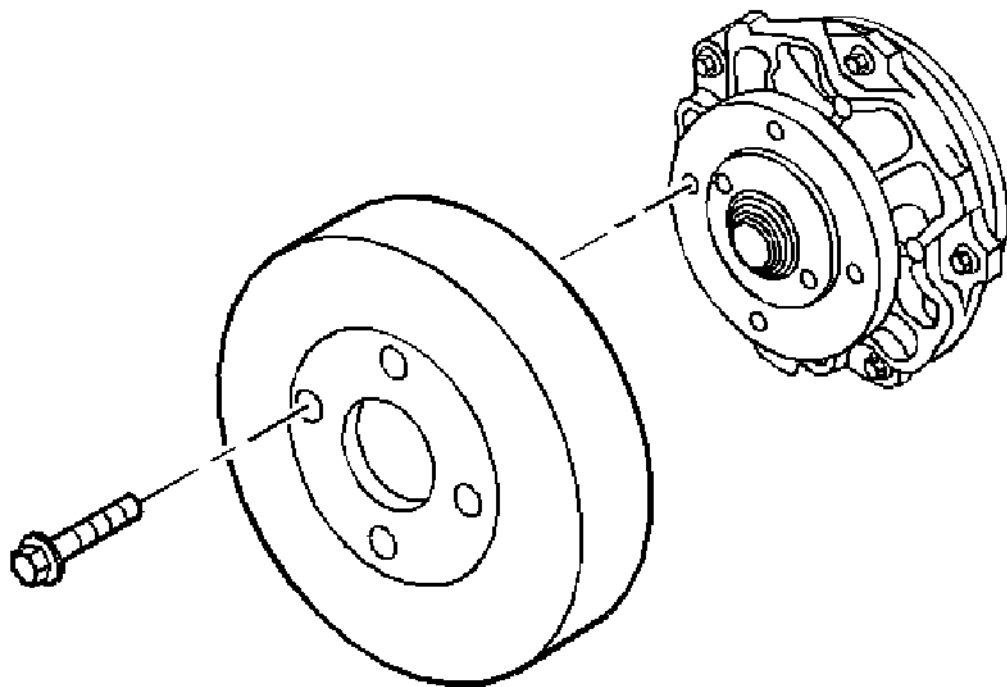


Fig. 68: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley.
5. Install the water pump pulley bolts.
6. Install the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 3.4L.

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

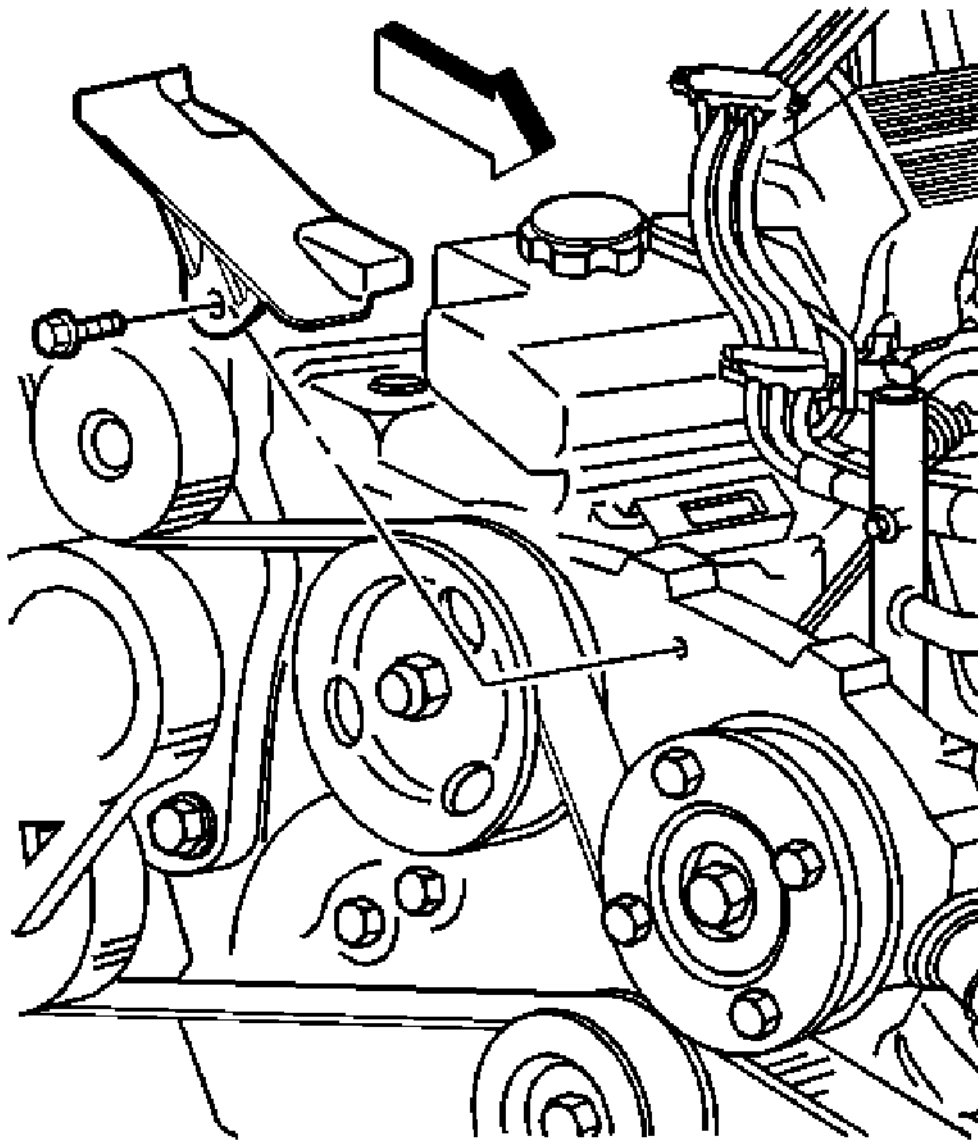


Fig. 69: Locating Drive Belt Guard
Courtesy of GENERAL MOTORS CORP.

7. Install the drive belt guard.
8. Fill the cooling system. Refer to **Draining and Filling Cooling System**.

WATER PUMP REPLACEMENT (LY7)

Tools Required

EN 46104 Water Pump Pulley Holding Tool

Removal Procedure

1. Drain the cooling system until the coolant is below the water pump. Refer to **Draining and Filling Cooling System**.
2. Remove the accessory drive belt from the water pump. Refer to **Drive Belt Replacement** in Engine Mechanical - 3.6L (LY7).

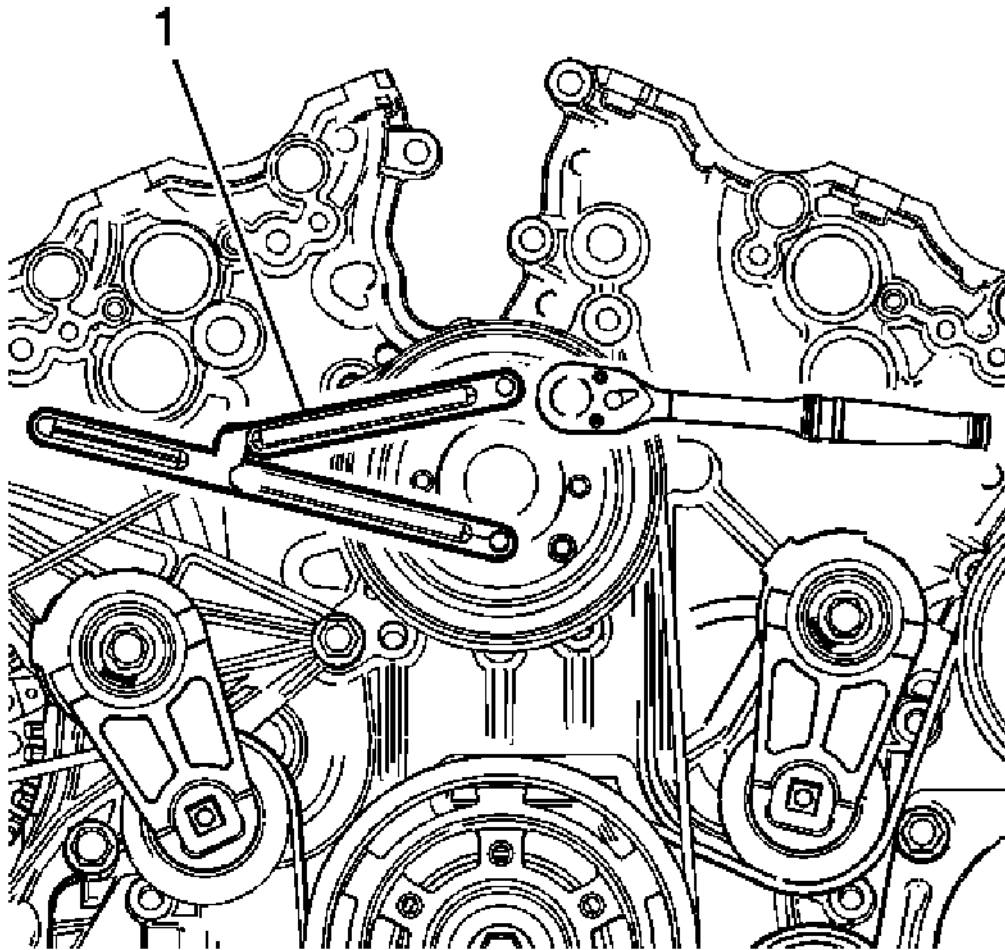


Fig. 70: Securing Water Pump Pulley With EN 46104
Courtesy of GENERAL MOTORS CORP.

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

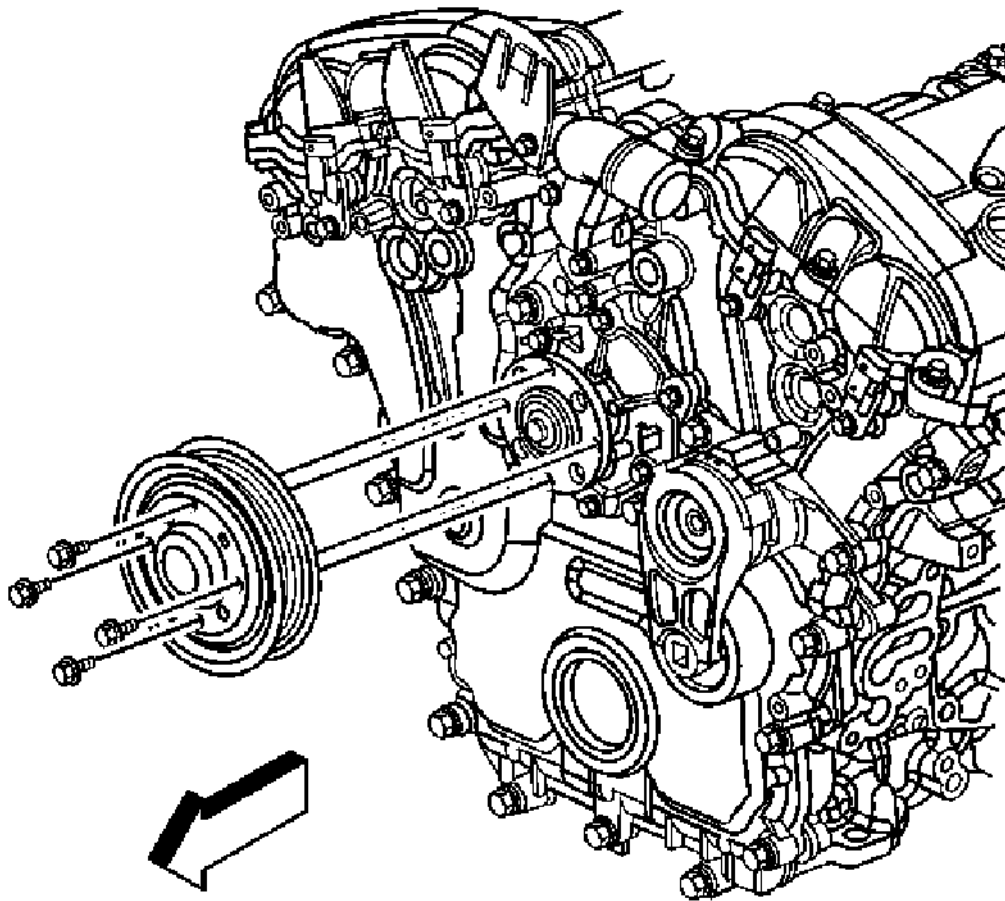


Fig. 71: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

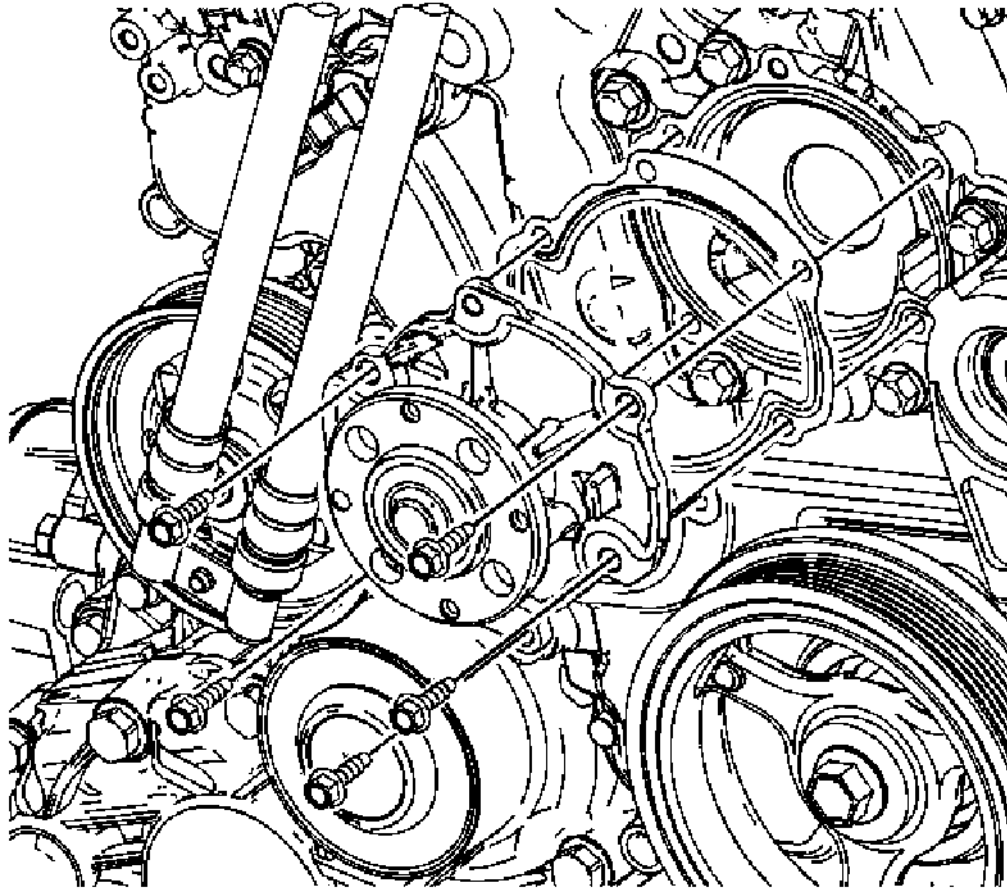


Fig. 72: Identifying Water Pump Components
Courtesy of GENERAL MOTORS CORP.

5. Remove the water pump bolts.
6. Remove the water pump.
7. Remove and discard the water pump gasket.
8. Clean the water pump sealing surfaces.

Installation Procedure

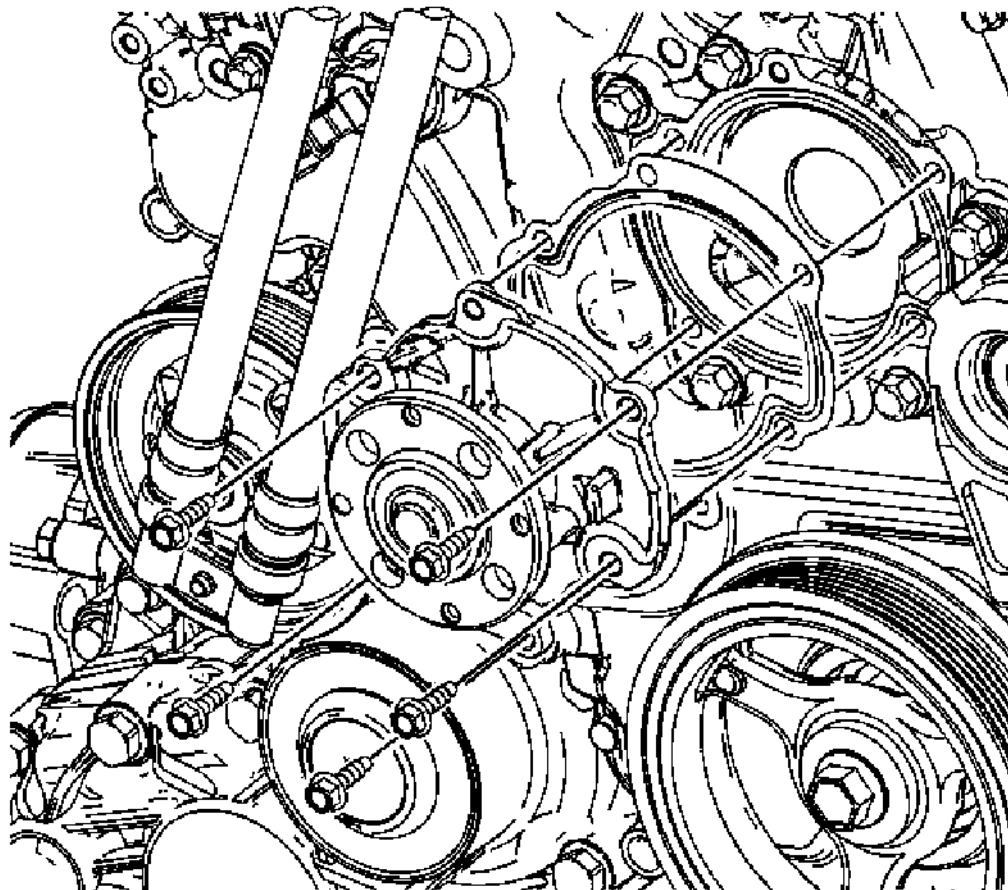


Fig. 73: Identifying Water Pump Components
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW water pump gasket.
2. Install the water pump.

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

3. Install the water pump bolts.

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

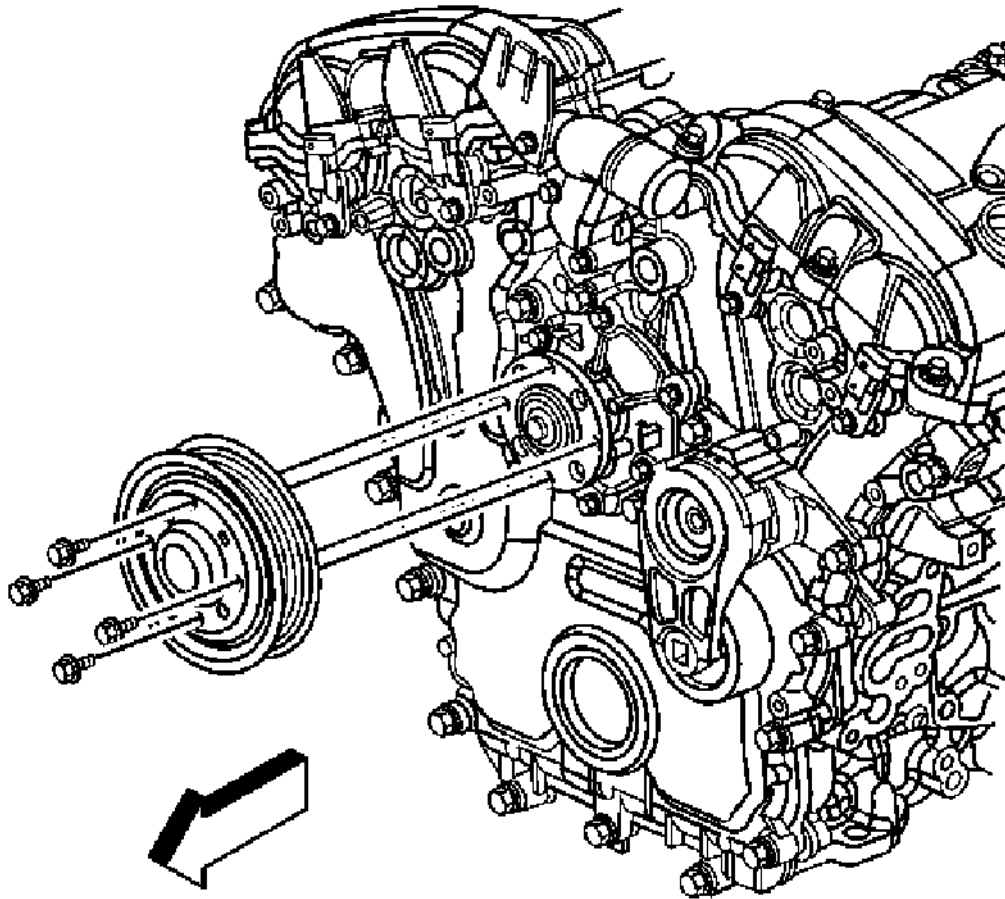


Fig. 74: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

4. Install the water pump pulley.

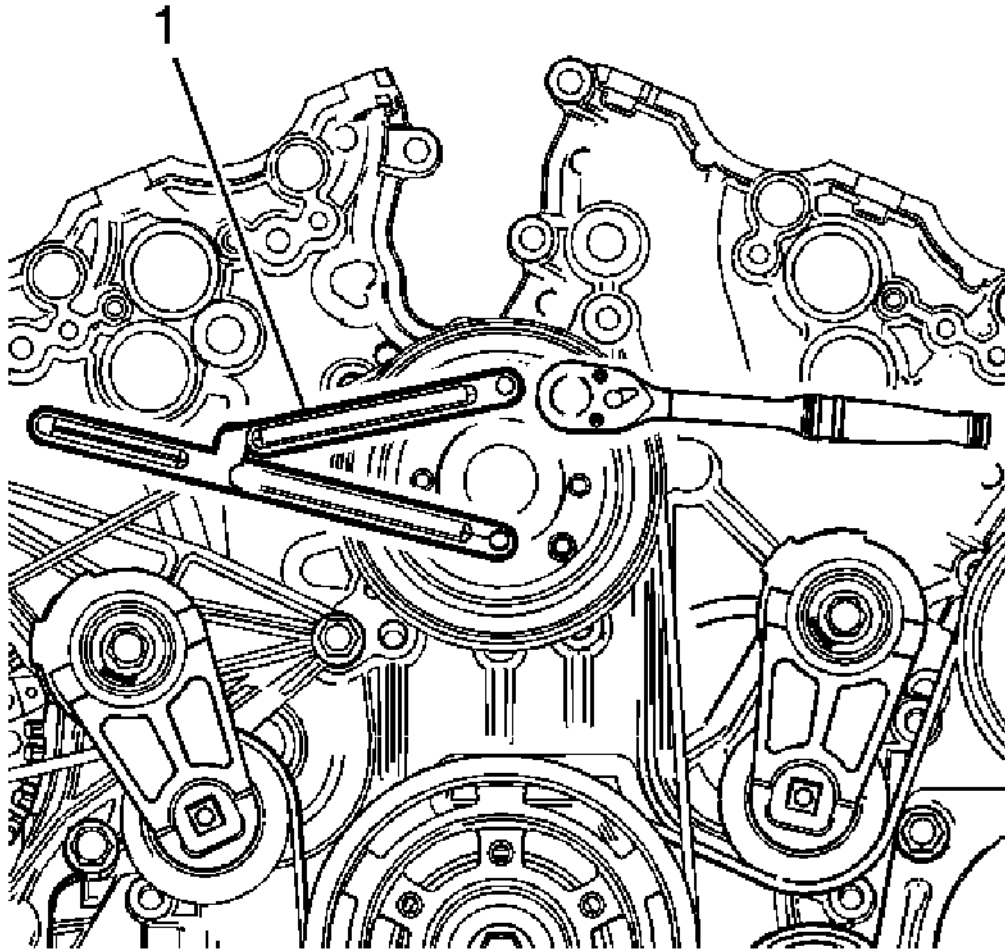


Fig. 75: Securing Water Pump Pulley With EN 46104
Courtesy of GENERAL MOTORS CORP.

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

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

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

FAN SHROUD REPLACEMENT (LA1)

Removal Procedure

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and Notices.

IMPORTANT: If abnormal noise or vibration is felt from the engine compartment, inspect and clean any foreign material from the cooling fan blades.

1. Remove the cooling fan assembly including the shroud. Refer to Cooling Fan Replacement - Electric (LA1) or Cooling Fan Replacement - Electric (LY7).

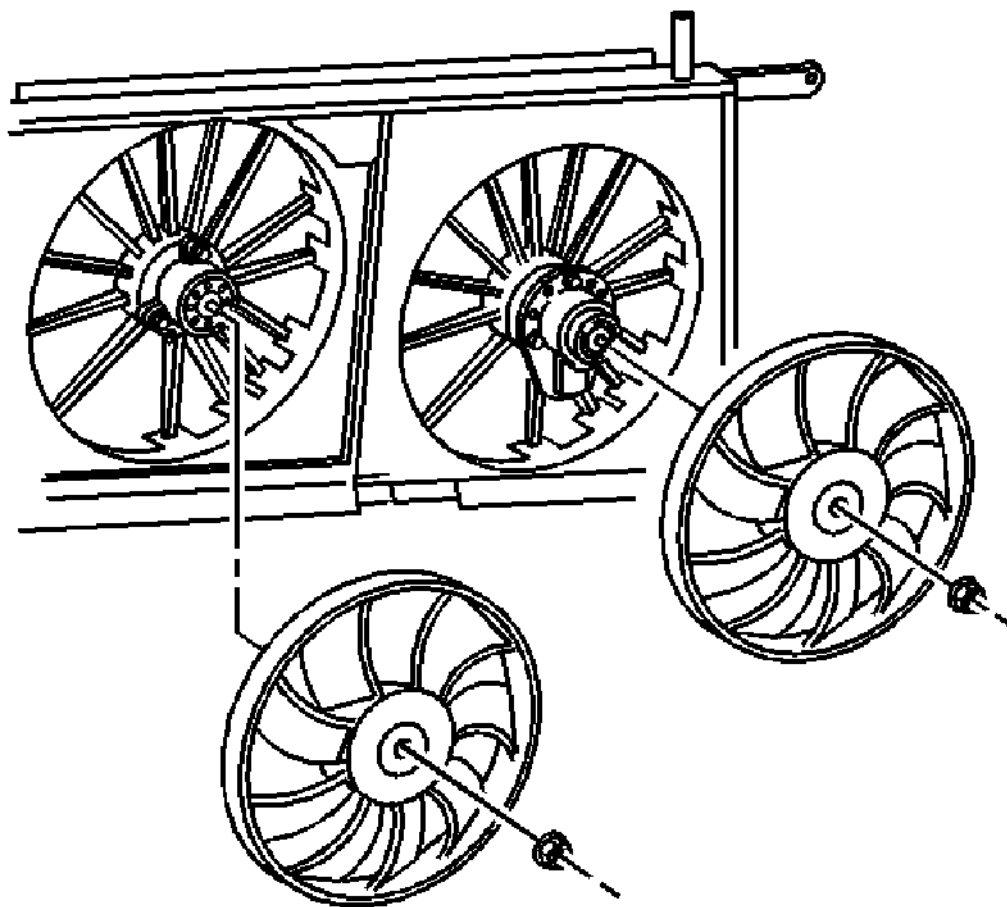


Fig. 76: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Turn the cooling fan nuts clockwise to loosen.

2. Remove the cooling fan nuts.
3. Remove the cooling fans from the shroud.

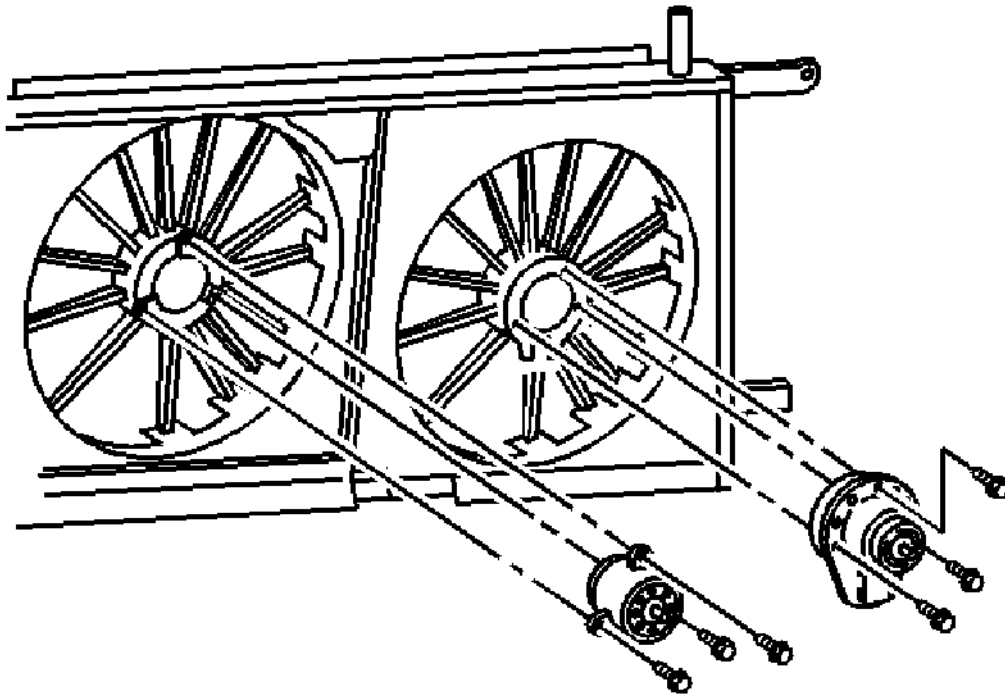


Fig. 77: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the fan motor electrical connectors.
5. Remove the fan motor screws.
6. Remove the fan motors from the cooling fan shroud.

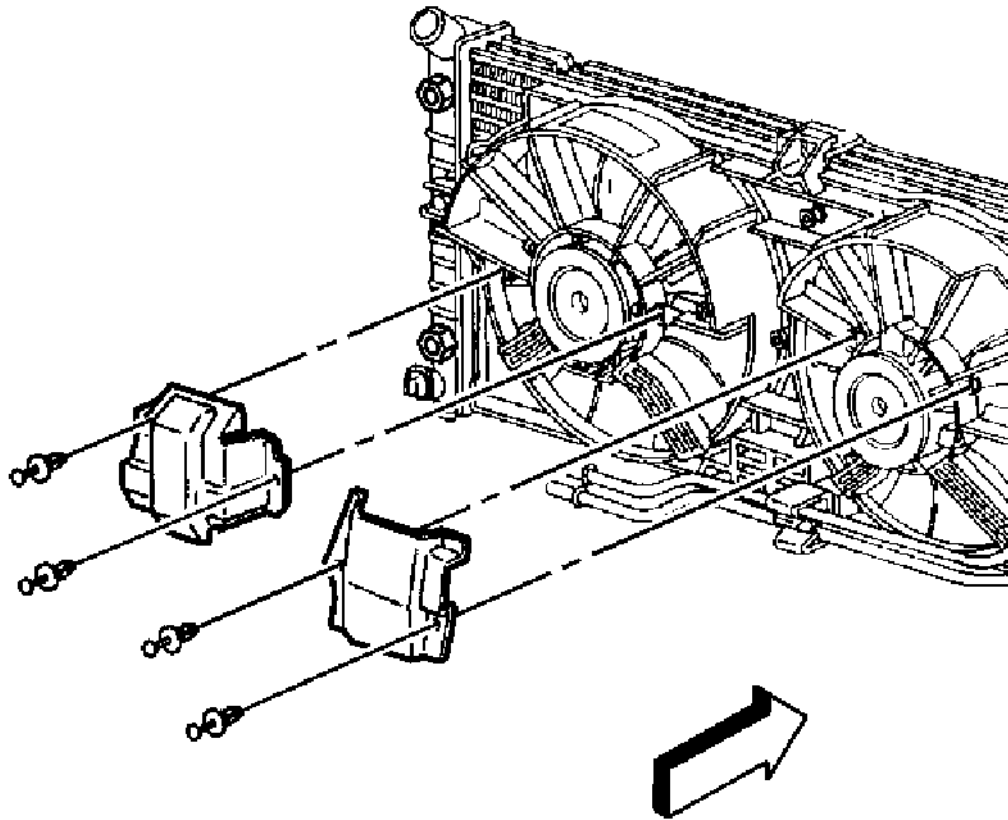


Fig. 78: Locating Heat Shield On Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

7. Remove the heat shields from the cooling fan shroud.

Installation Procedure

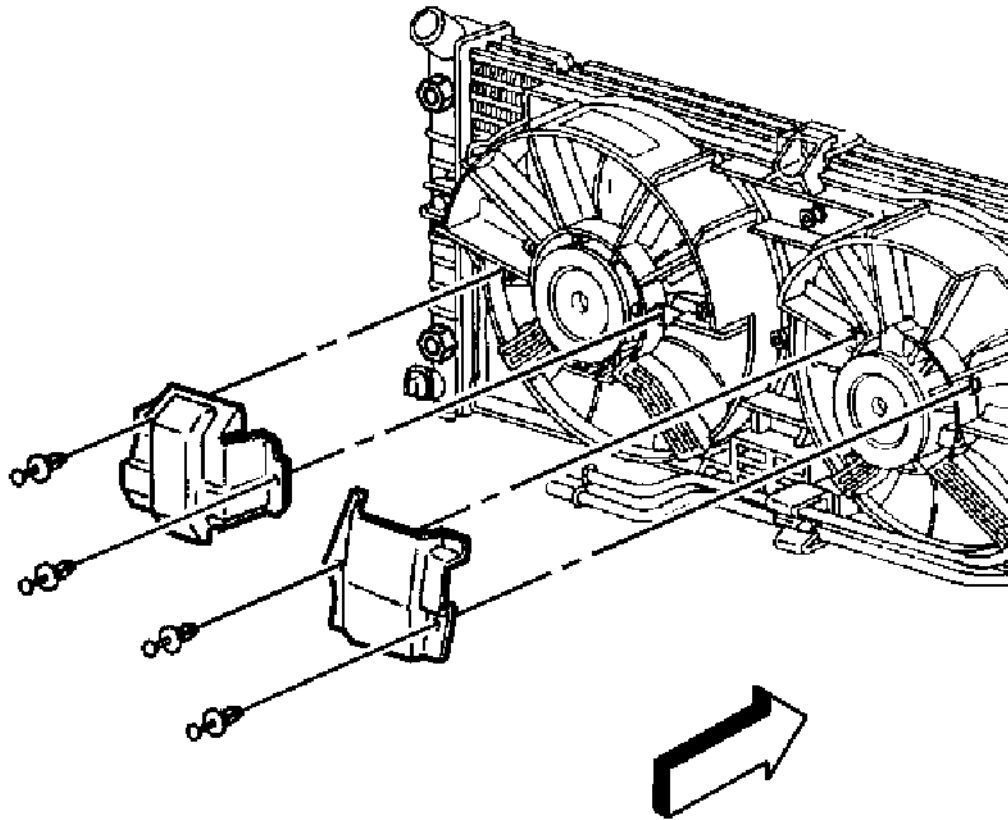


Fig. 79: Locating Heat Shield On Cooling Fan Shroud
Courtesy of GENERAL MOTORS CORP.

1. Install the heat shields to the cooling fan shroud.

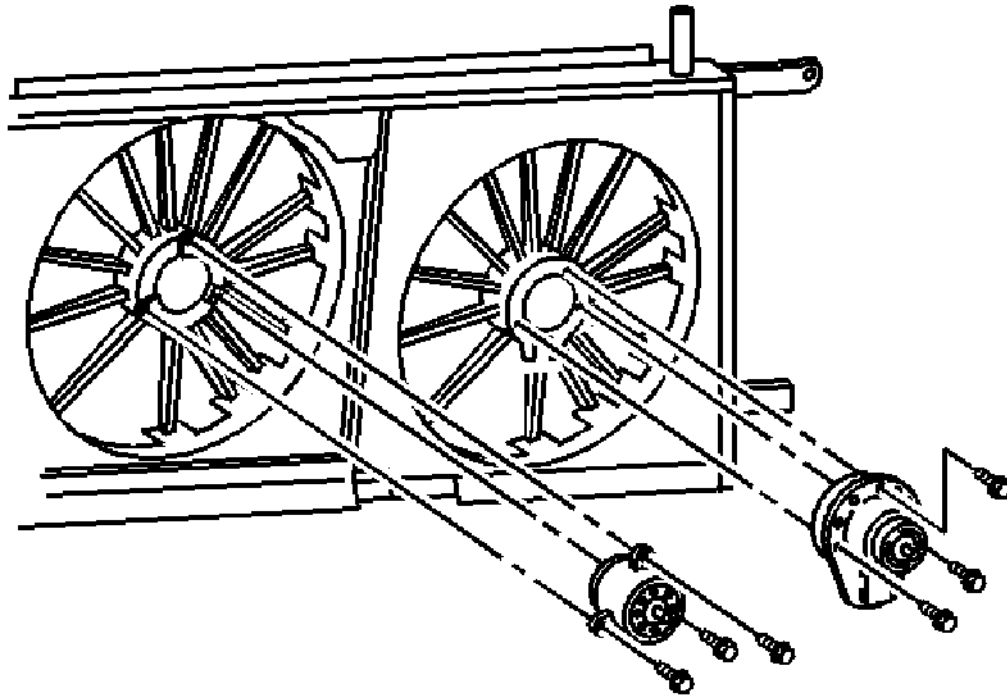


Fig. 80: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

2. Install the fan motors to the cooling fan shroud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the screws to the cooling fan motor.

Tighten: Tighten the screws to 6 N.m (53 lb in).

4. Connect the cooling fan motor electrical connectors.

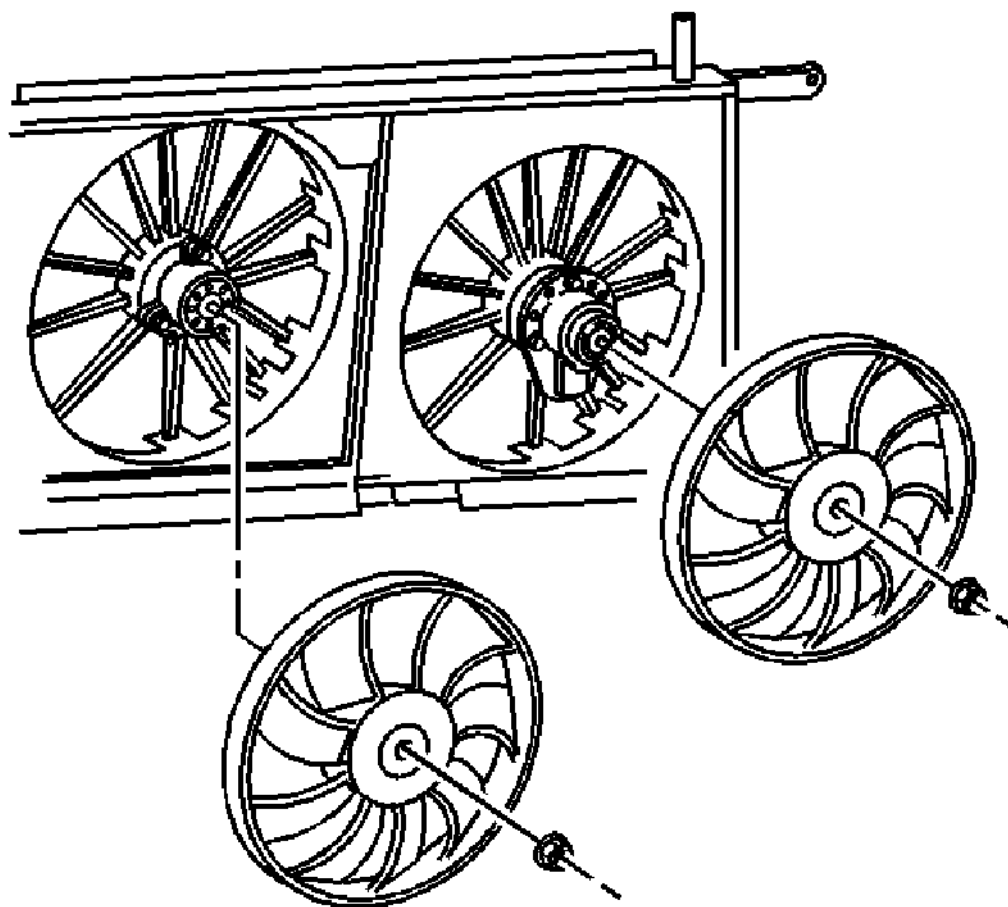


Fig. 81: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

5. Install the cooling fans to the shroud.

IMPORTANT: Turn the cooling fan nuts counterclockwise to tighten.

6. Install the cooling fan nuts.

Tighten: Tighten the nuts to 6 N.m (53 lb in).

7. Install the cooling fan assembly including the shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

CAUTION: Refer to Electric Coolant Fan Caution in Cautions and Notices.

CAUTION: Refer to Damaged Fan Blade Caution in Cautions and Notices.

IMPORTANT: If abnormal noise or vibration is felt from the engine compartment, inspect and clean any foreign material from the cooling fan blades.

1. Remove the cooling fan assembly including the shroud. Refer to Cooling Fan Replacement - Electric (LA1) or Cooling Fan Replacement - Electric (LY7).

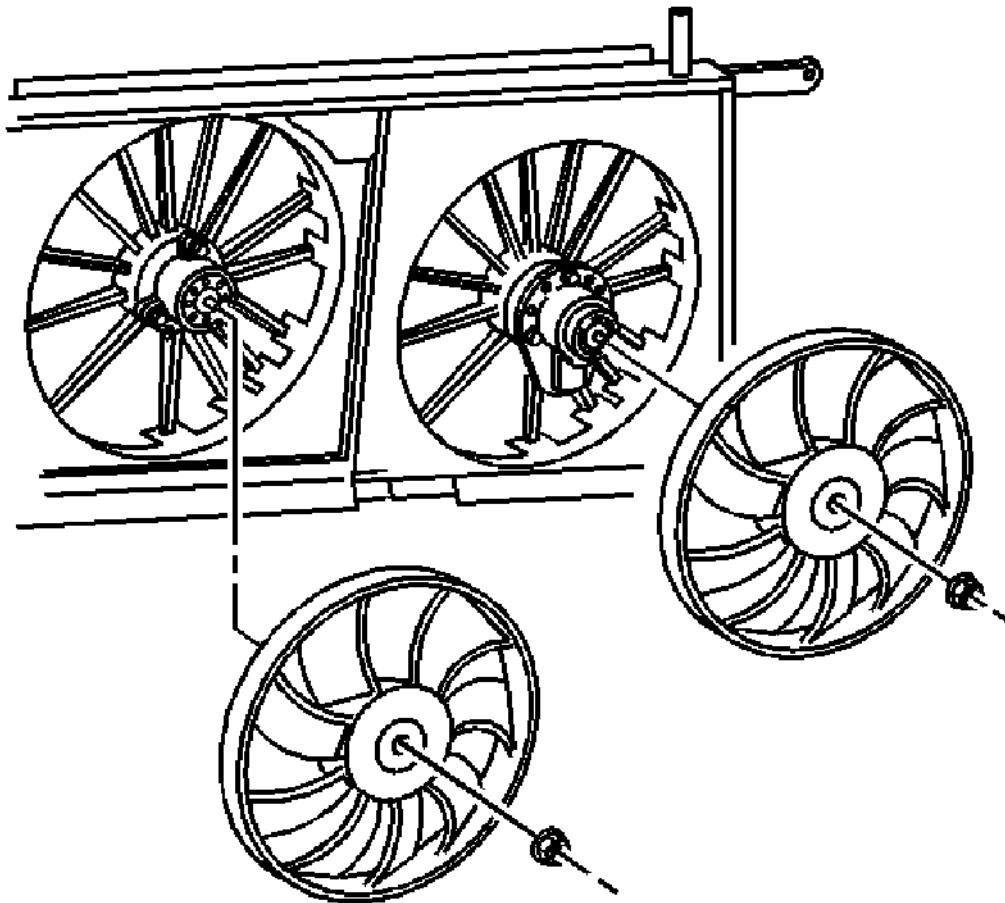


Fig. 82: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Turn the cooling fan nuts clockwise to loosen.

2. Remove the cooling fan nuts.
3. Remove the cooling fans from the shroud.

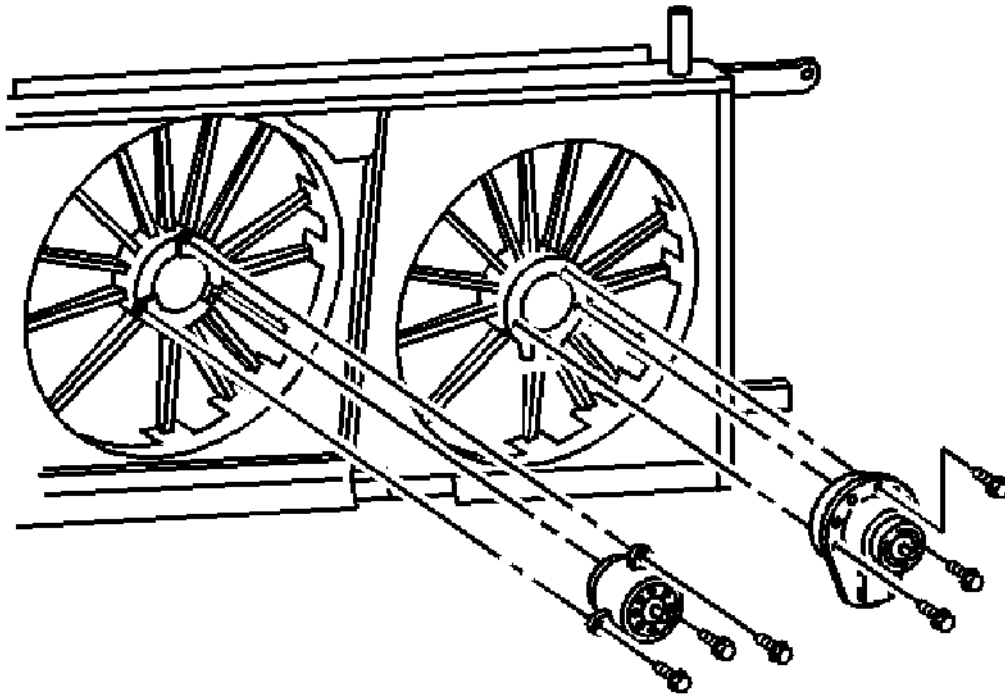


Fig. 83: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the fan motor electrical connectors.
5. Remove the fan motor screws.
6. Remove the fan motors and the heat shields from the cooling fan shroud.

Installation Procedure

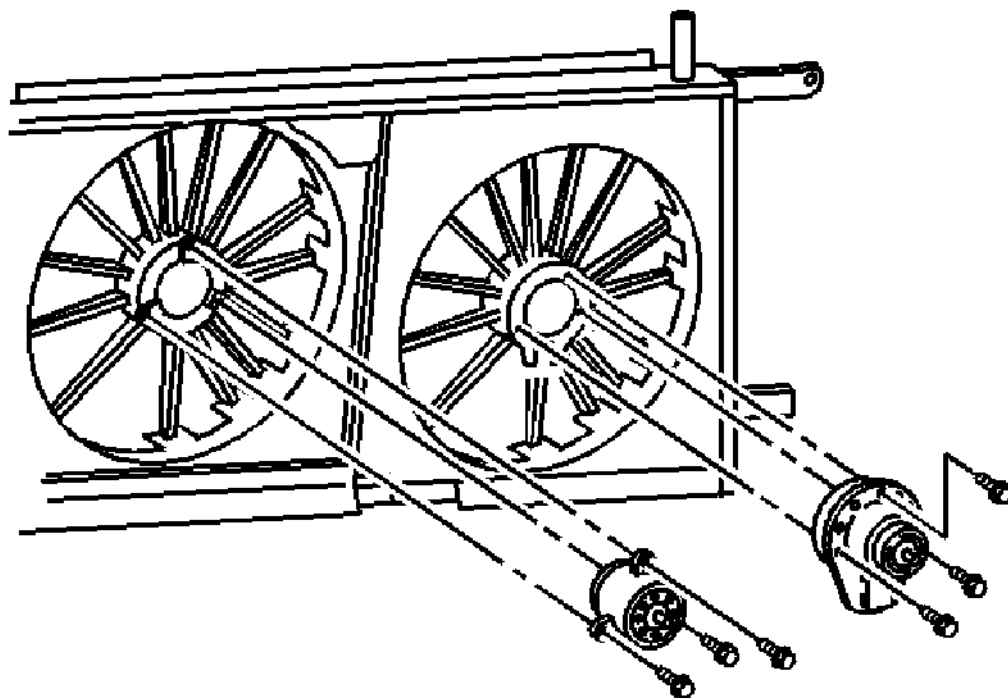


Fig. 84: Locating Cooling Fan Motor Screws
Courtesy of GENERAL MOTORS CORP.

1. Install the fan motors and the heat shields to the cooling fan shroud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the screws to the cooling fan motor.

Tighten: Tighten the screws to 6 N.m (53 lb in).

3. Connect the cooling fan motor electrical connectors.

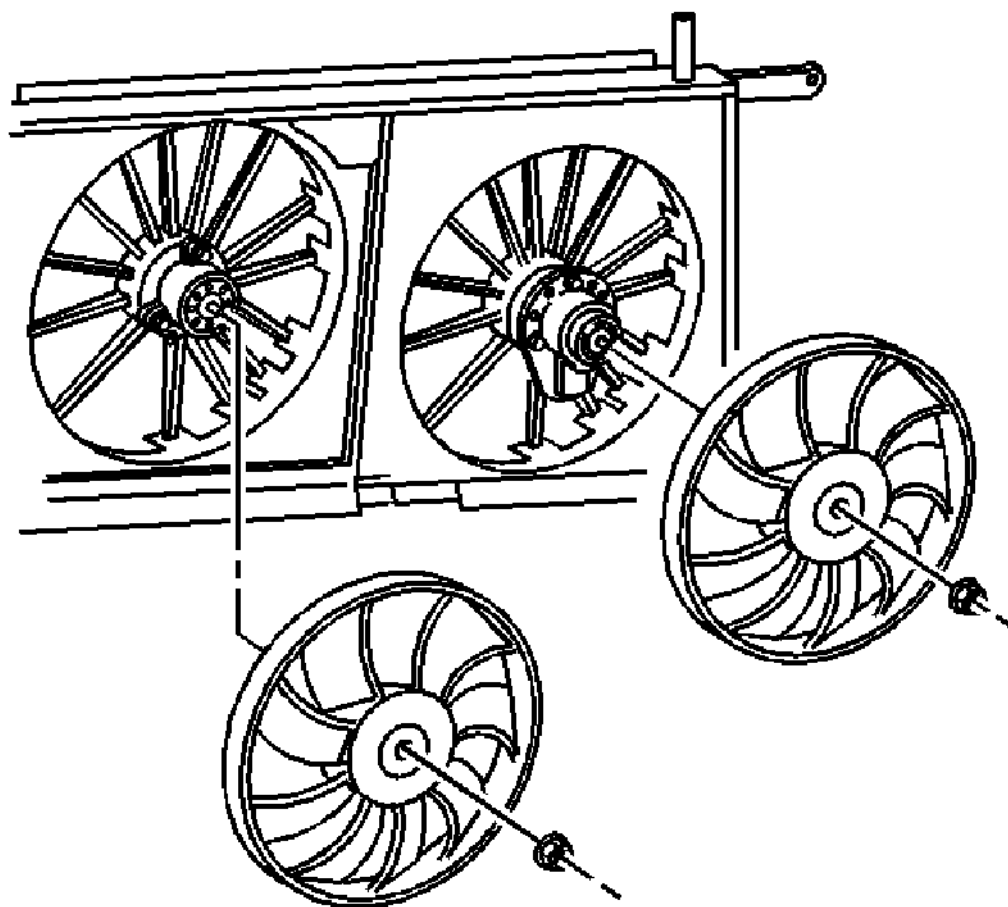


Fig. 85: Identifying Cooling Fans
Courtesy of GENERAL MOTORS CORP.

4. Install the cooling fans to the shroud.

IMPORTANT: Turn the cooling fan nuts counterclockwise to tighten.

5. Install the cooling fan nuts.

Tighten: Tighten the nuts to 6 N.m (53 lb in).

6. Install the cooling fan assembly including the shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

Tools Required

- **J 38185** Hose Clamp Pliers. See **Special Tools and Equipment**.
- **J 39400-A** Halogen Leak Detector. See **Special Tools and Equipment**.

Removal Procedure

1. Recover the refrigerant from the A/C system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
2. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
3. Remove the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

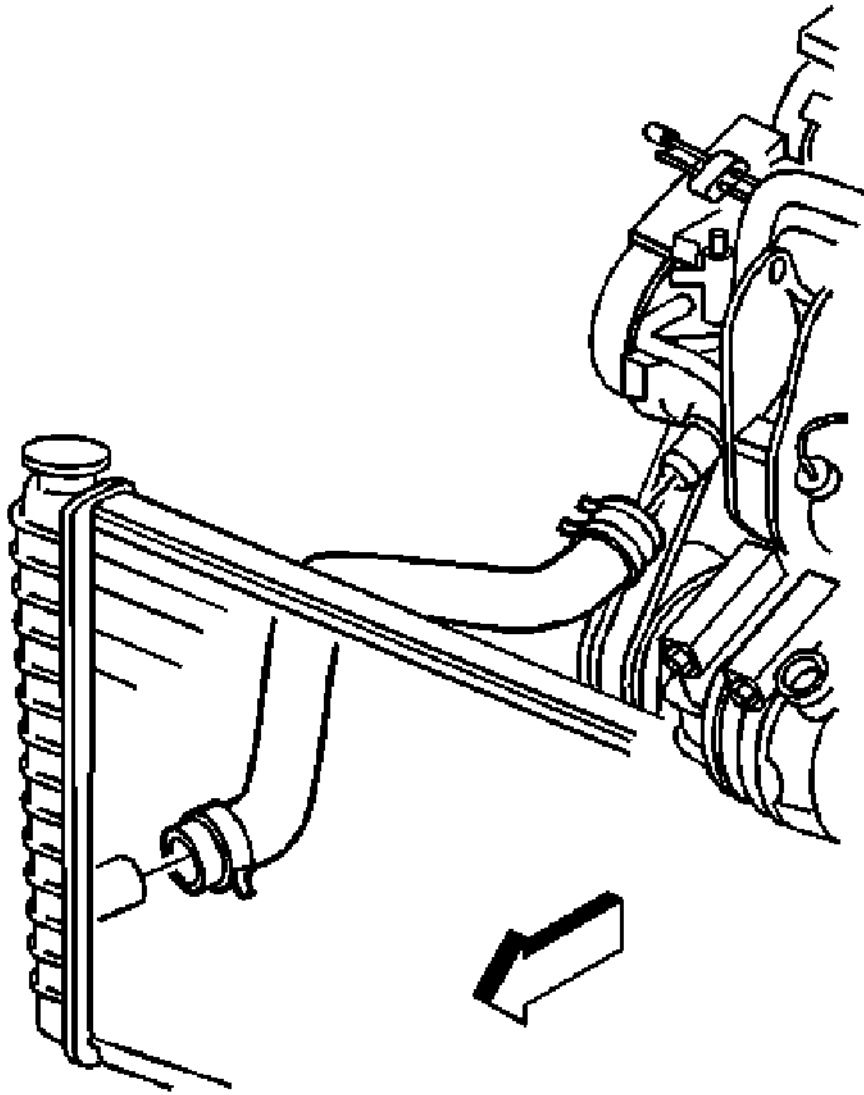


Fig. 86: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Reposition the hose clamp at the water pump housing using the **J 38185** . See **Special Tools and Equipment**.
5. Disconnect the radiator outlet hose from the water pump housing.
6. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
7. Reposition the hose clamp at the radiator using the **J 38185** . See **Special Tools and Equipment**.

8. Disconnect the radiator outlet hose from the radiator.
9. Remove the radiator outlet hose.
10. Disconnect the lower TOC line from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.
11. Lower the vehicle.

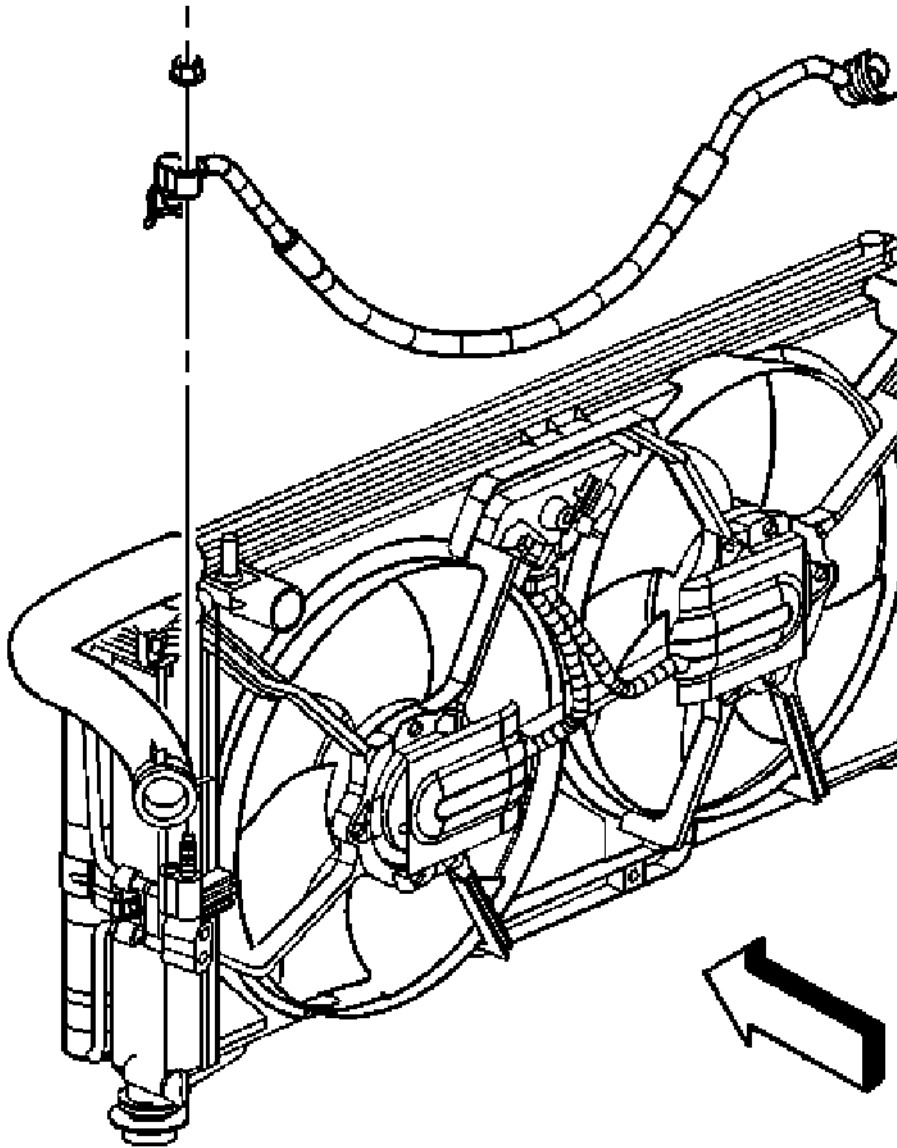


Fig. 87: Locating A/C Discharge Hose From Condenser Block
Courtesy of GENERAL MOTORS CORP.

12. Remove the nut which secures the A/C discharge hose to the condenser block.
13. Disconnect the A/C discharge hose from the condenser block.
14. Remove and discard the sealing washer.

IMPORTANT: Cap or tape off the open A/C hose immediately to prevent system contamination.

15. Cap or tape off the A/C discharge hose.

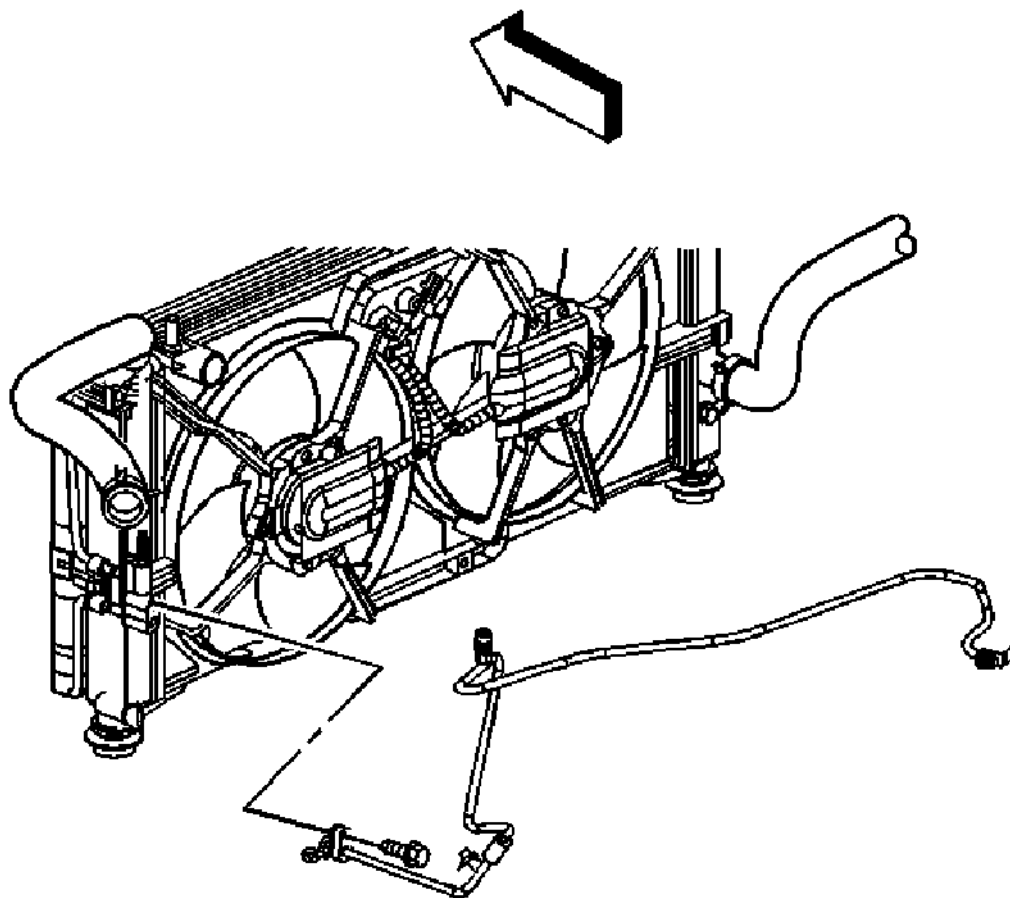


Fig. 88: Identifying Evaporator Inlet Tube To Condenser Block
Courtesy of GENERAL MOTORS CORP.

16. Remove the bolt which secures the evaporator inlet tube to the condenser block.
17. Disconnect the evaporator inlet tube from the condenser block.
18. Cap or tape off the evaporator inlet tube.

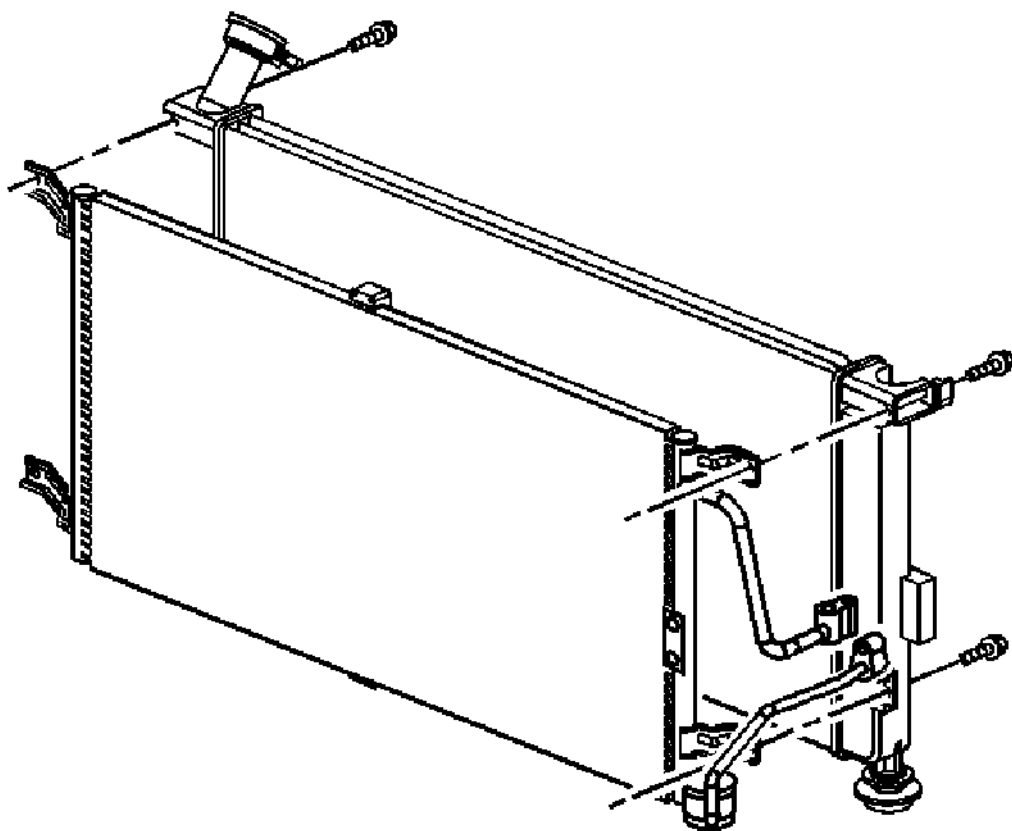


Fig. 89: View Of Radiator And Condenser Assembly
Courtesy of GENERAL MOTORS CORP.

19. Remove the radiator and condenser assembly.
20. Remove the condenser tube clip bolt.
21. Remove the condenser mounting bolts.
22. Remove the condenser from the radiator.

Installation Procedure

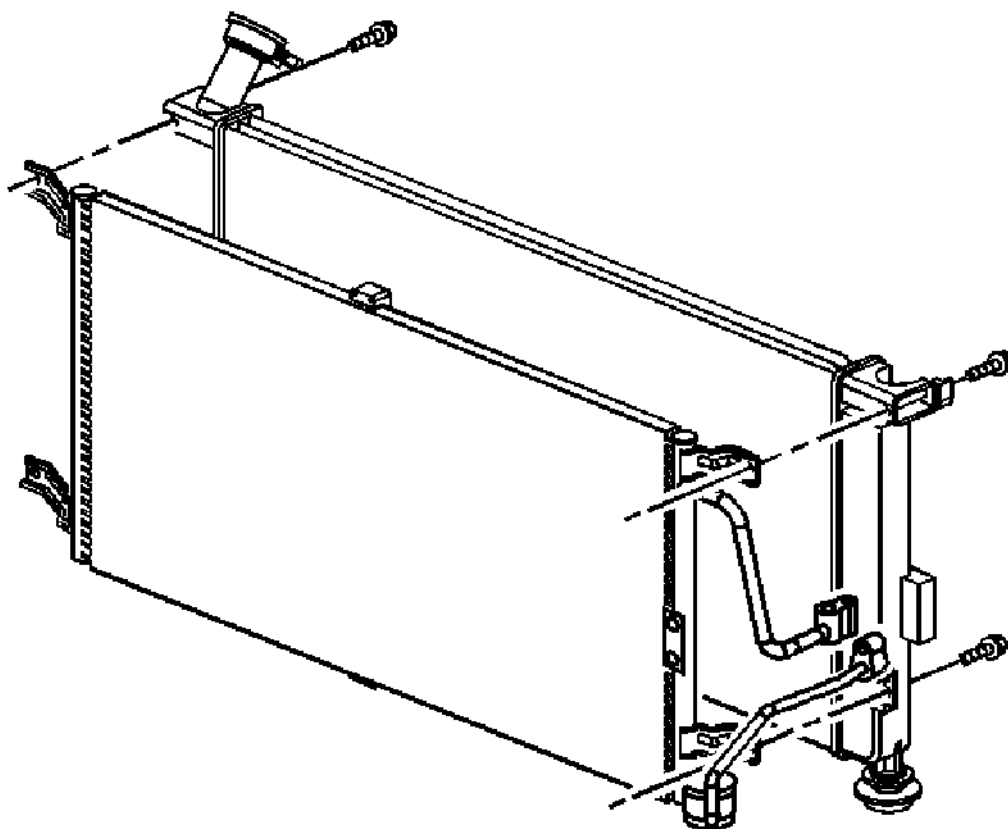


Fig. 90: View Of Radiator And Condenser Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the condenser to the radiator.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the mounting bolts that secure the condenser to the radiator.

Tighten: Tighten the bolts to 6 N.m (53 lb in).

3. Install the condenser tube clip bolt.

Tighten: Tighten the bolt to 2.5 N.m (22 lb in).

4. Install the radiator and condenser assembly.
5. Remove the cap or the tape from the evaporator inlet tube.
6. Install a new seal washer to the evaporator inlet tube. Refer to **Sealing Washer**

Replacement

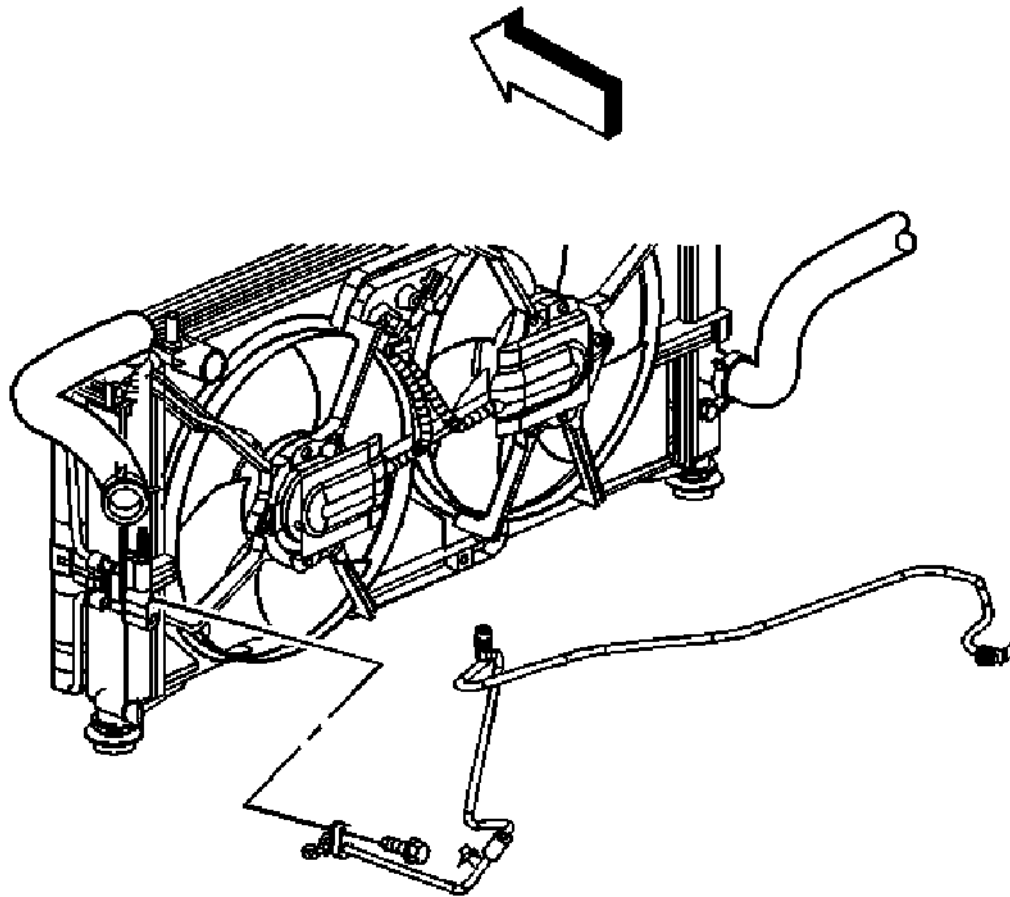


Fig. 91: Identifying Evaporator Inlet Tube To Condenser Block
Courtesy of GENERAL MOTORS CORP.

7. Install the evaporator inlet tube and the bolt to the condenser block.

Tighten: Tighten bolt to 16 N.m (12 lb ft).

8. Remove the cap or the tape from the A/C discharge hose.
9. Install a new sealing washer to the A/C discharge hose. Refer to **Sealing Washer Replacement**.

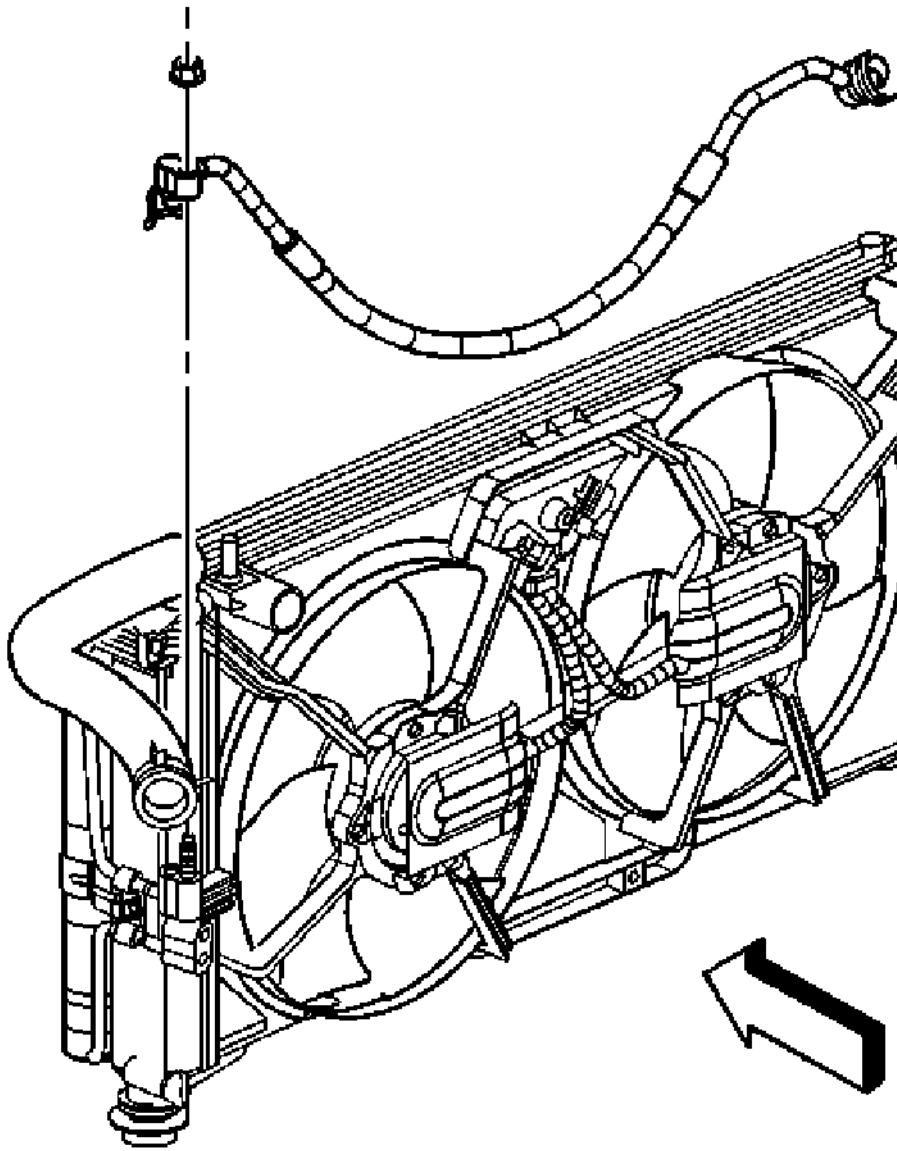


Fig. 92: Locating A/C Discharge Hose From Condenser Block
Courtesy of GENERAL MOTORS CORP.

10. Install the A/C discharge hose and the nut to the condenser block.

Tighten: Tighten the nut to 16 N.m (12 lb ft).

11. Raise the vehicle.
12. Connect the lower TOC line to the radiator. Refer to **Transmission Fluid Cooler Line**

Quick Connect Fitting in Automatic Transaxle - 4T65-E.

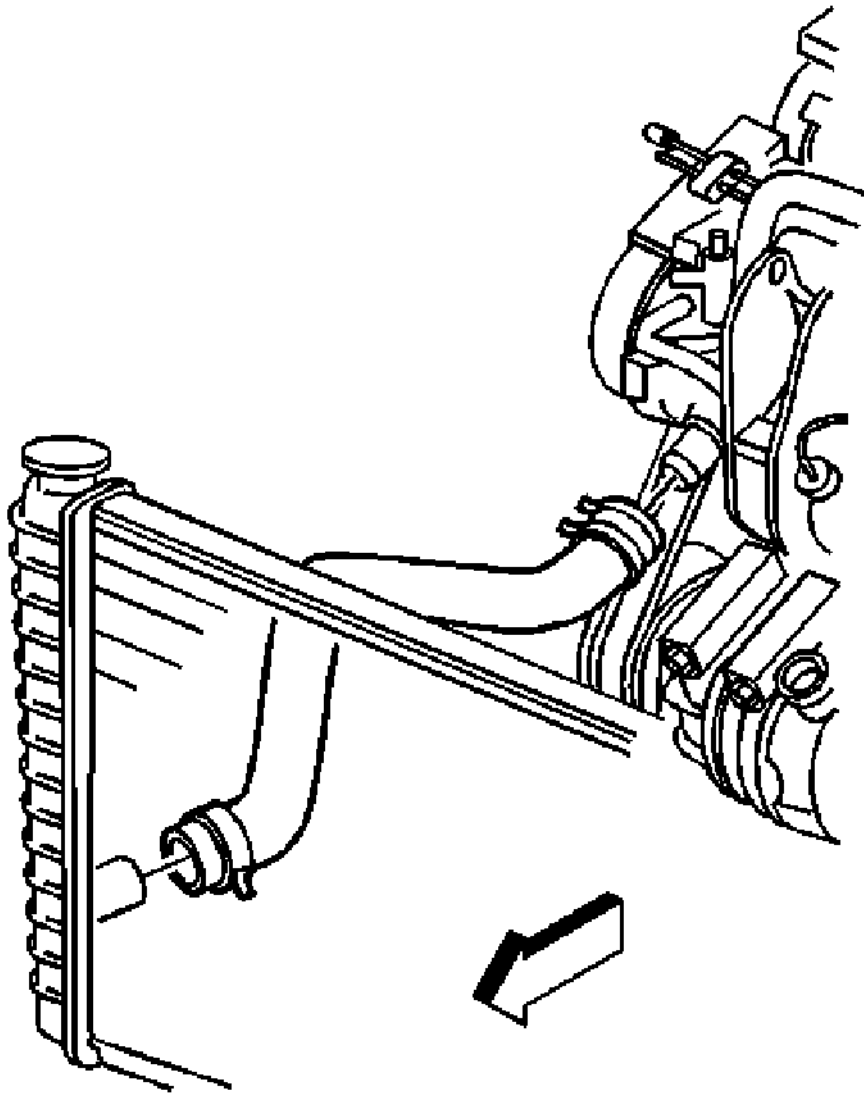


Fig. 93: View Of Radiator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

13. Install the radiator outlet hose.
14. Connect the radiator outlet hose to the radiator.
15. Reposition the hose clamp at the radiator to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
16. Lower the vehicle.

17. Connect the radiator outlet hose to the water pump housing.
18. Reposition the hose clamp at the water pump housing to secure the hose using the **J 38185** . See **Special Tools and Equipment**.
19. Install the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.
20. Fill the cooling system. Refer to **Draining and Filling Cooling System**.
21. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
22. Leak test the fittings of the component using the **J 39400-A** . See **Special Tools and Equipment**.
23. Inspect the transmission fluid level. Refer to **Transmission Fluid Checking Procedure** in Automatic Transaxle - 4T65-E.

RADIATOR REPLACEMENT (LY7)

Tools Required

- **J 38185** Hose Clamp Pliers. See **Special Tools and Equipment**.
- **J 39400-A** Halogen Leak Detector. See **Special Tools and Equipment**.

Removal Procedure

1. Recover the refrigerant from the A/C system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
2. Drain the cooling system. Refer to **Draining and Filling Cooling System**.
3. Remove the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.

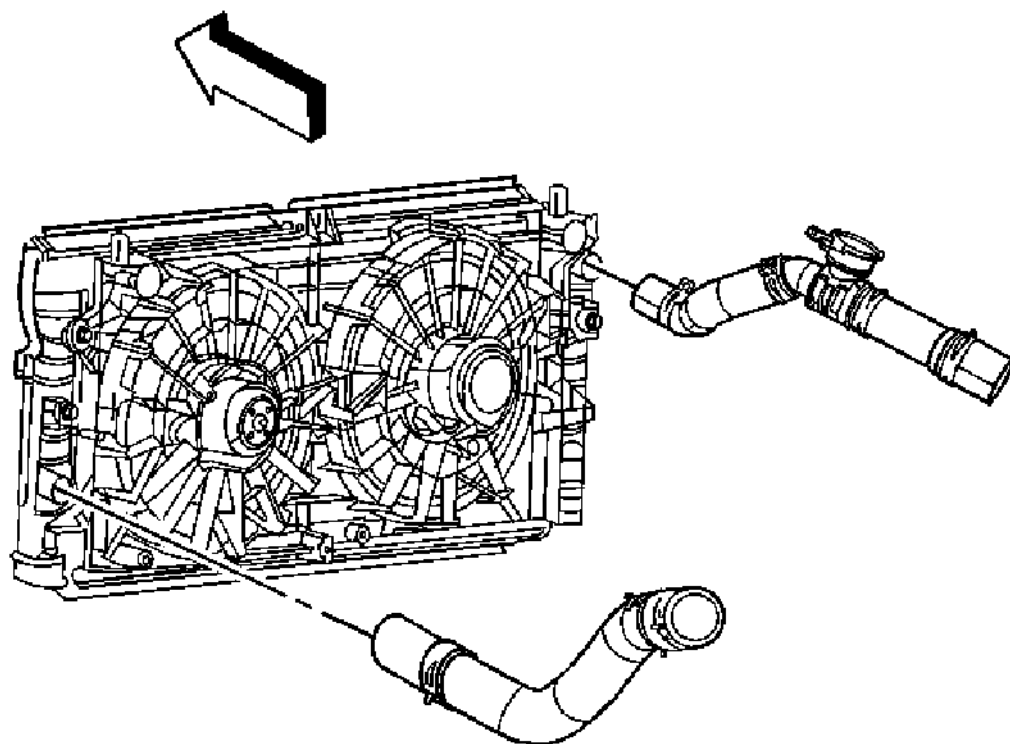


Fig. 94: Locating Radiator Inlet/Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Use **J 38185** to reposition the hose clamp at the engine. See **Special Tools and Equipment**.
5. Disconnect the radiator outlet hose from the engine.
6. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
7. Use **J 38185** to reposition the hose clamp at the radiator. See **Special Tools and Equipment**.
8. Disconnect the radiator outlet hose from the radiator.
9. Remove the radiator outlet hose.
10. Disconnect the lower TOC line from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** in Automatic Transaxle - 4T65-E.
11. Lower the vehicle.

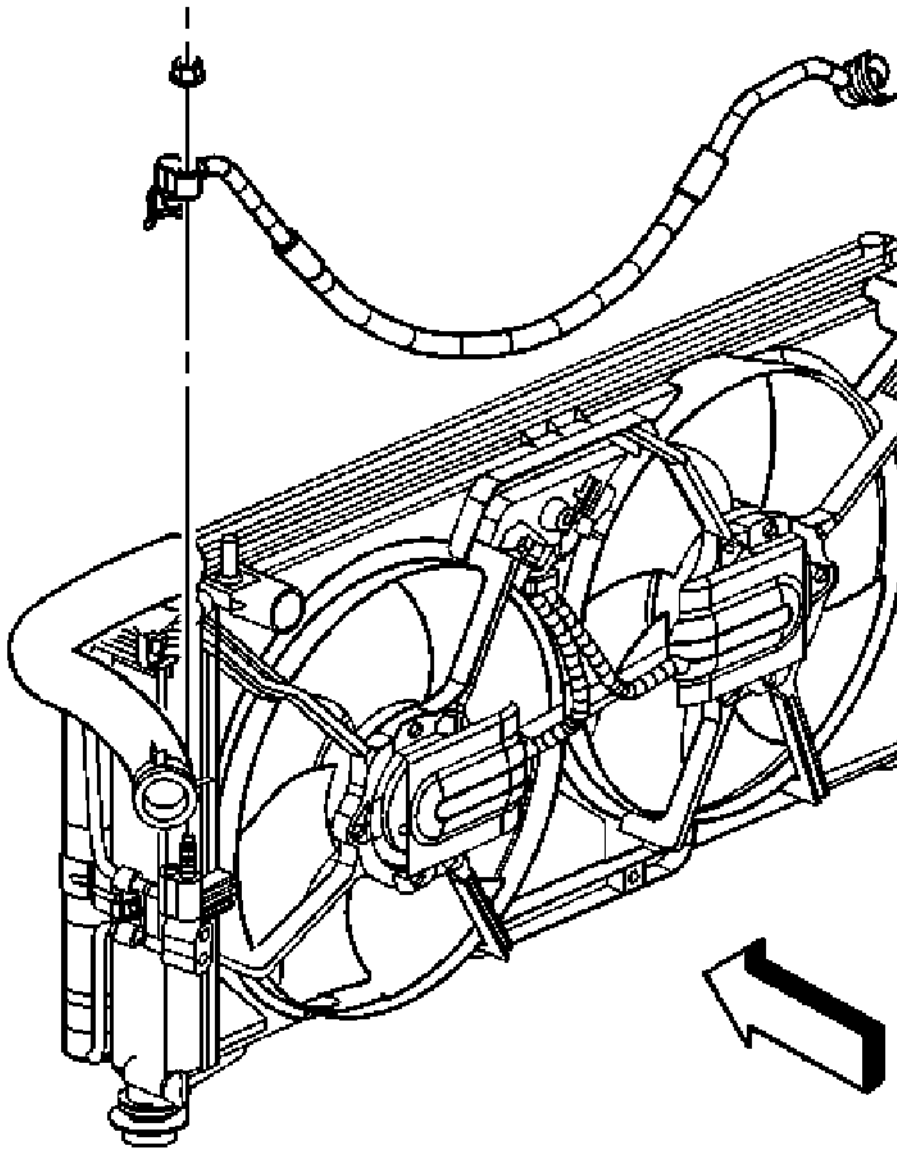


Fig. 95: Locating A/C Discharge Hose From Condenser Block
Courtesy of GENERAL MOTORS CORP.

12. Remove the nut which secures the A/C discharge hose to the condenser block.
13. Disconnect the A/C discharge hose from the condenser block.
14. Remove and discard the sealing washer.

IMPORTANT: Cap or tape off the open A/C hose immediately to prevent

system contamination.

15. Cap or tape off the A/C discharge hose.

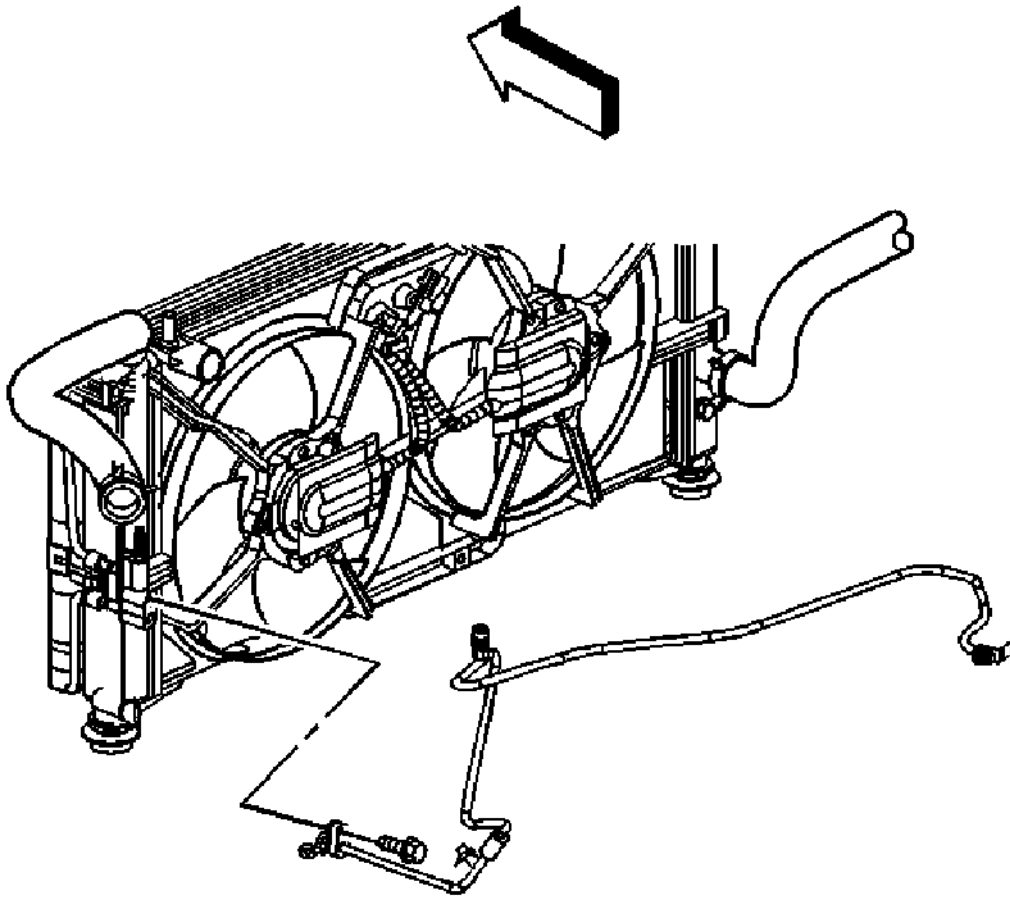


Fig. 96: Identifying Evaporator Inlet Tube To Condenser Block
Courtesy of GENERAL MOTORS CORP.

16. Remove the bolt which secures the evaporator inlet tube to the condenser block.
17. Disconnect the evaporator inlet tube from the condenser block.
18. Cap or tape off the evaporator inlet tube.

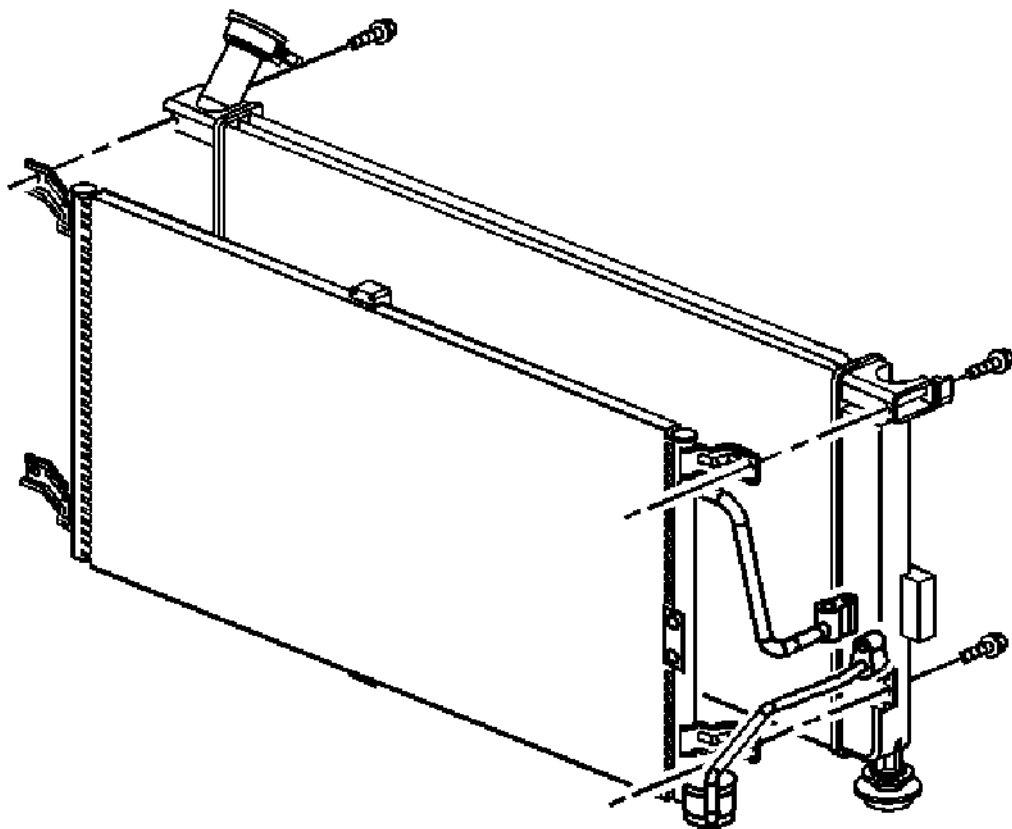


Fig. 97: View Of Radiator And Condenser Assembly
Courtesy of GENERAL MOTORS CORP.

19. Remove the radiator and condenser assembly.
20. Remove the condenser tube clip bolt.
21. Remove the condenser mounting bolts.
22. Remove the condenser from the radiator.

Installation Procedure

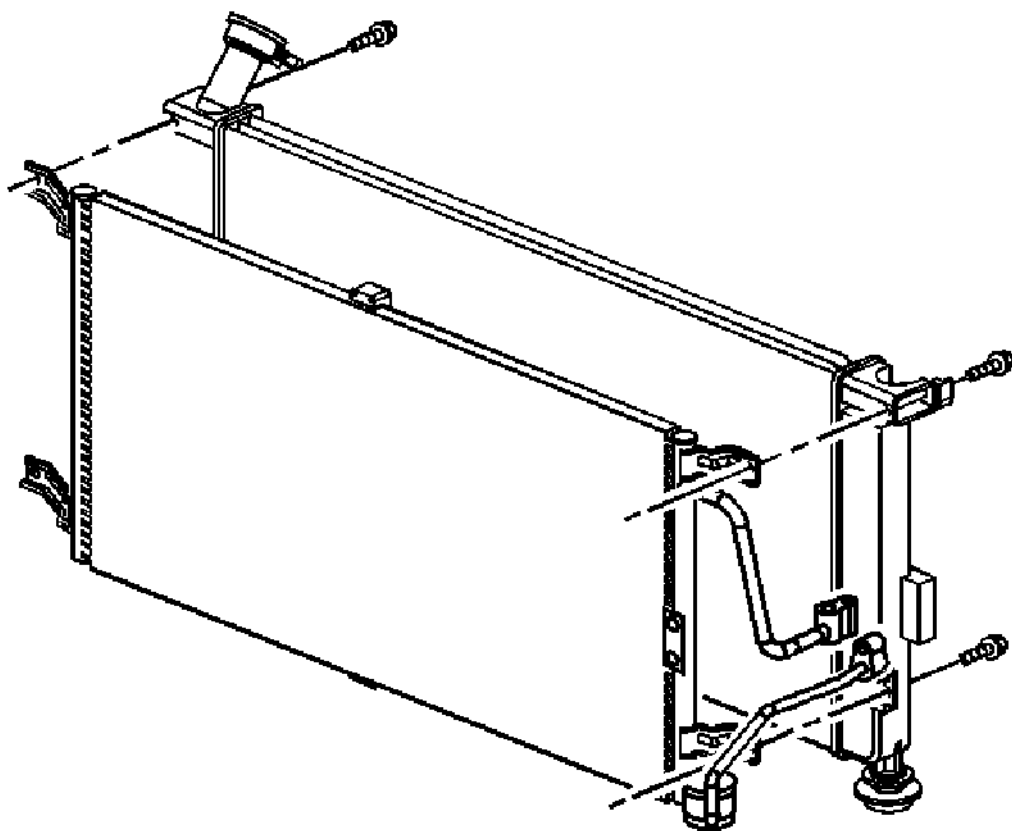


Fig. 98: View Of Radiator And Condenser Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the condenser to the radiator.

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

2. Install the mounting bolts that secure the condenser to the radiator.

Tighten: Tighten the bolts to 6 N.m (53 lb in).

3. Install the condenser tube clip bolt.

Tighten: Tighten the bolt to 2.5 N.m (22 lb in).

4. Install the radiator and condenser assembly.
5. Remove the cap or the tape from the evaporator inlet tube.
6. Install a new seal washer to the evaporator inlet tube. Refer to **Sealing Washer**

Replacement

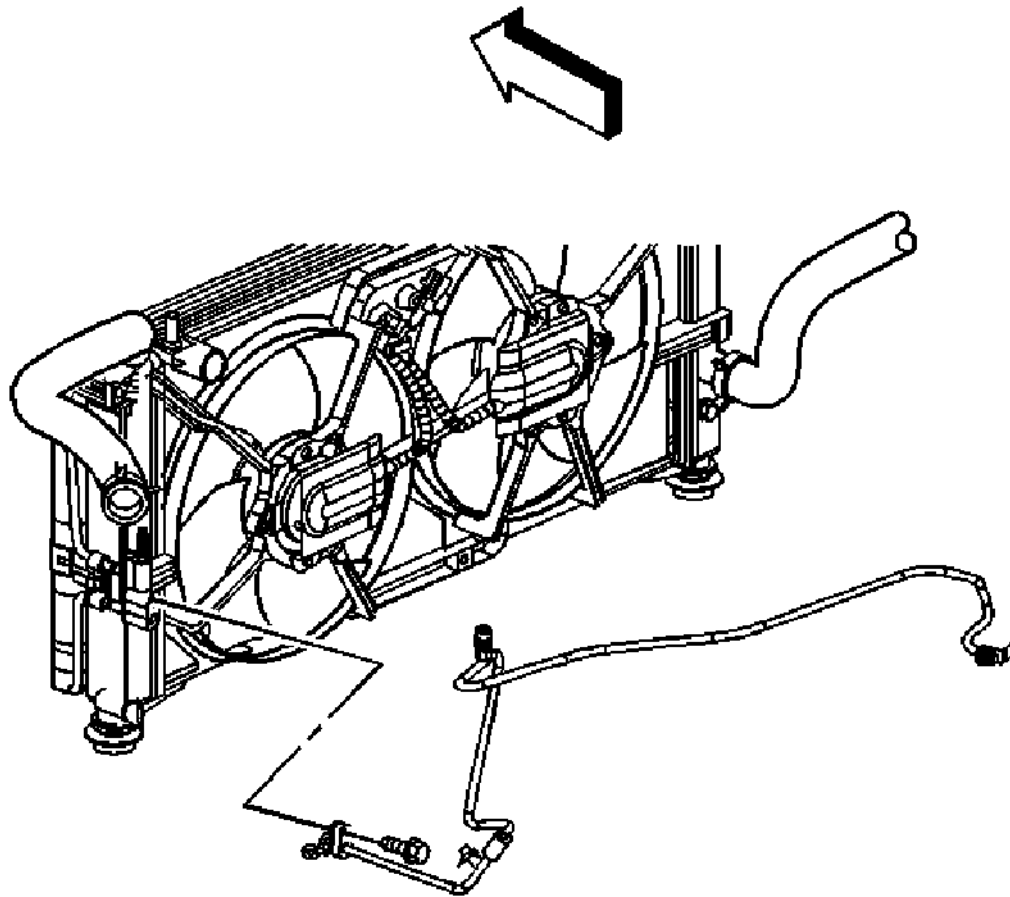


Fig. 99: Identifying Evaporator Inlet Tube To Condenser Block
Courtesy of GENERAL MOTORS CORP.

7. Install the evaporator inlet tube and the bolt to the condenser block.

Tighten: Tighten bolt to 16 N.m (12 lb ft).

8. Remove the cap or the tape from the A/C discharge hose.
9. Install a new sealing washer to the A/C discharge hose. Refer to **Sealing Washer Replacement**.

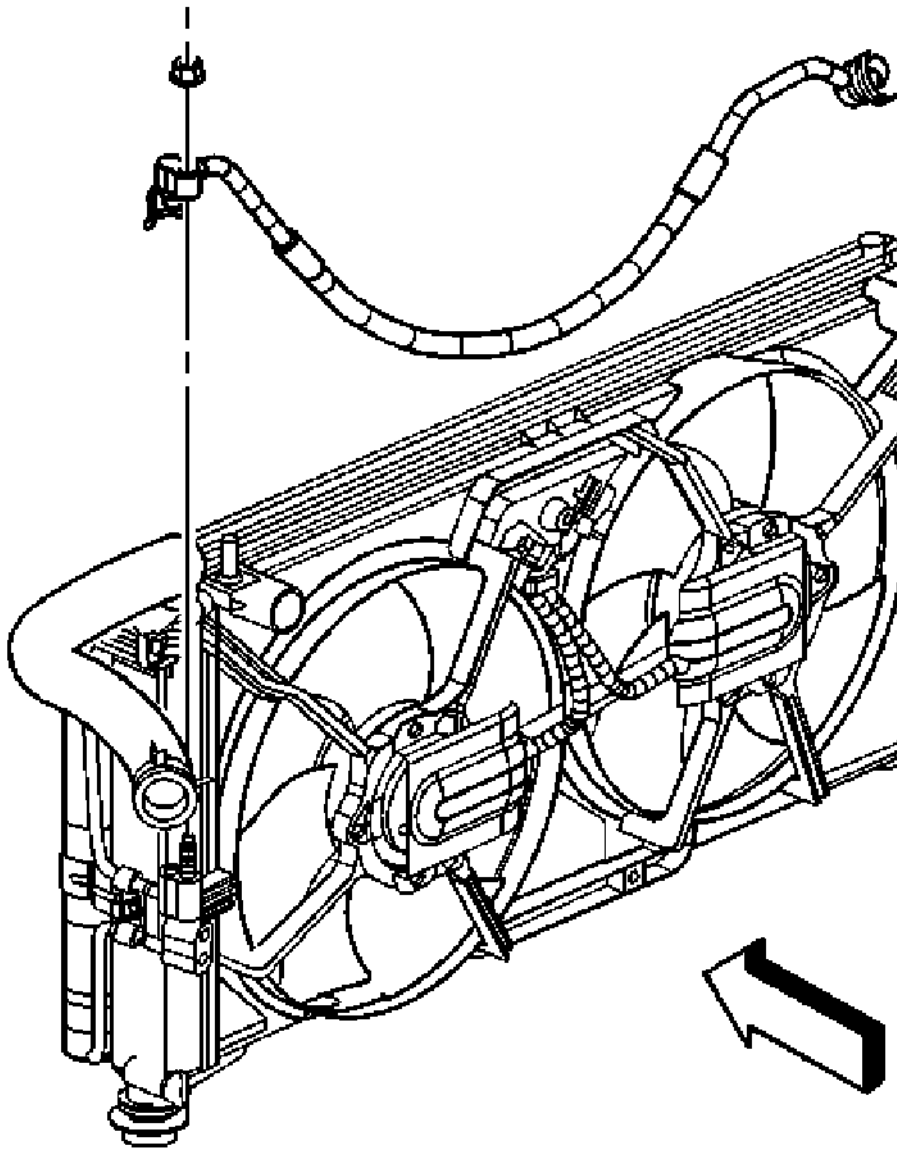


Fig. 100: Locating A/C Discharge Hose From Condenser Block
Courtesy of GENERAL MOTORS CORP.

10. Install the A/C discharge hose and the nut to the condenser block.

Tighten: Tighten the nut to 16 N.m (12 lb ft).

11. Raise the vehicle.
12. Connect the lower TOC line to the radiator. Refer to **Transmission Fluid Cooler Line**

Quick Connect Fitting in Automatic Transaxle - 4T65-E.

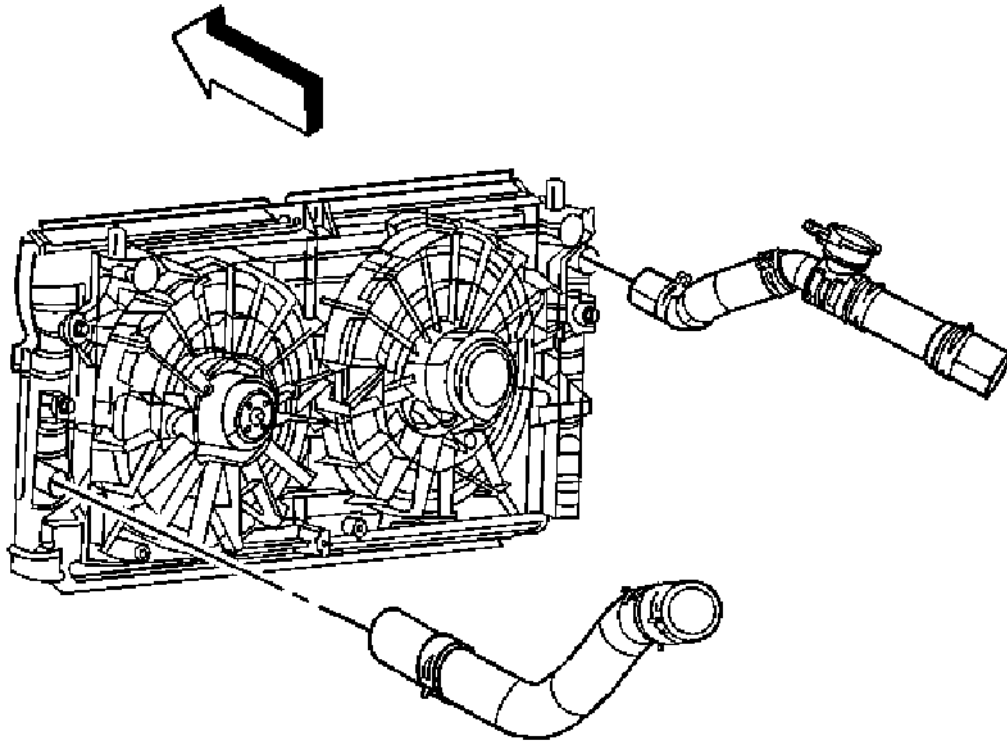


Fig. 101: Locating Radiator Inlet/Outlet Hoses
Courtesy of GENERAL MOTORS CORP.

13. Install the radiator outlet hose.
14. Connect the radiator outlet hose to the radiator.
15. Using **J 38185** , reposition the hose clamp at the radiator to secure the hose. See **Special Tools and Equipment**.
16. Lower the vehicle.
17. Connect the radiator outlet hose to the engine
18. Using **J 38185** , reposition the hose clamp at the engine to secure the hose. See **Special Tools and Equipment**.
19. Install the cooling fans with the cooling fan shroud. Refer to **Cooling Fan Replacement - Electric (LA1)** or **Cooling Fan Replacement - Electric (LY7)**.
20. Fill the cooling system. Refer to **Draining and Filling Cooling System**.
21. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.

22. Using **J 39400-A** , leak test the fittings of the component. See **Special Tools and Equipment**.
23. Inspect the transmission fluid level. Refer to **Transmission Fluid Checking Procedure** in Automatic Transaxle - 4T65-E.

RADIATOR AIR BAFFLE ASSEMBLIES AND DEFLECTORS

Removal Procedure

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

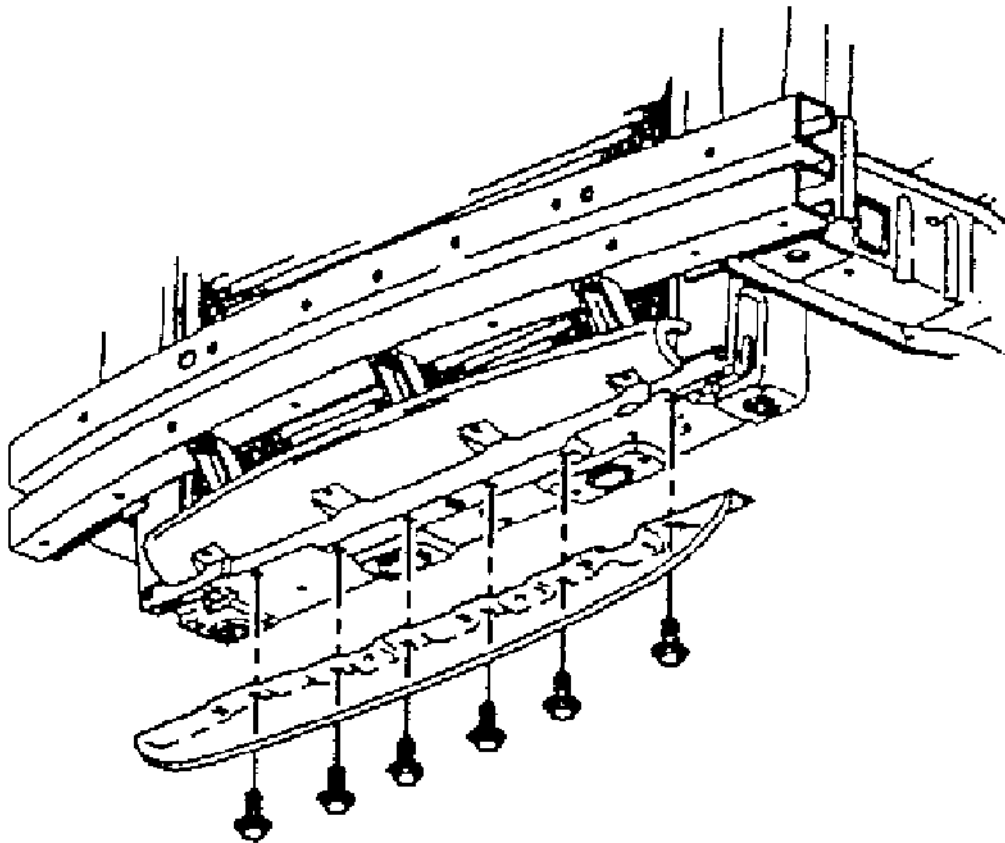


Fig. 102: View Of Lower Air Deflector/Baffle
Courtesy of GENERAL MOTORS CORP.

2. Remove the air baffle bolts.
3. Remove the air baffle.

Installation Procedure

1. Install the air baffle.

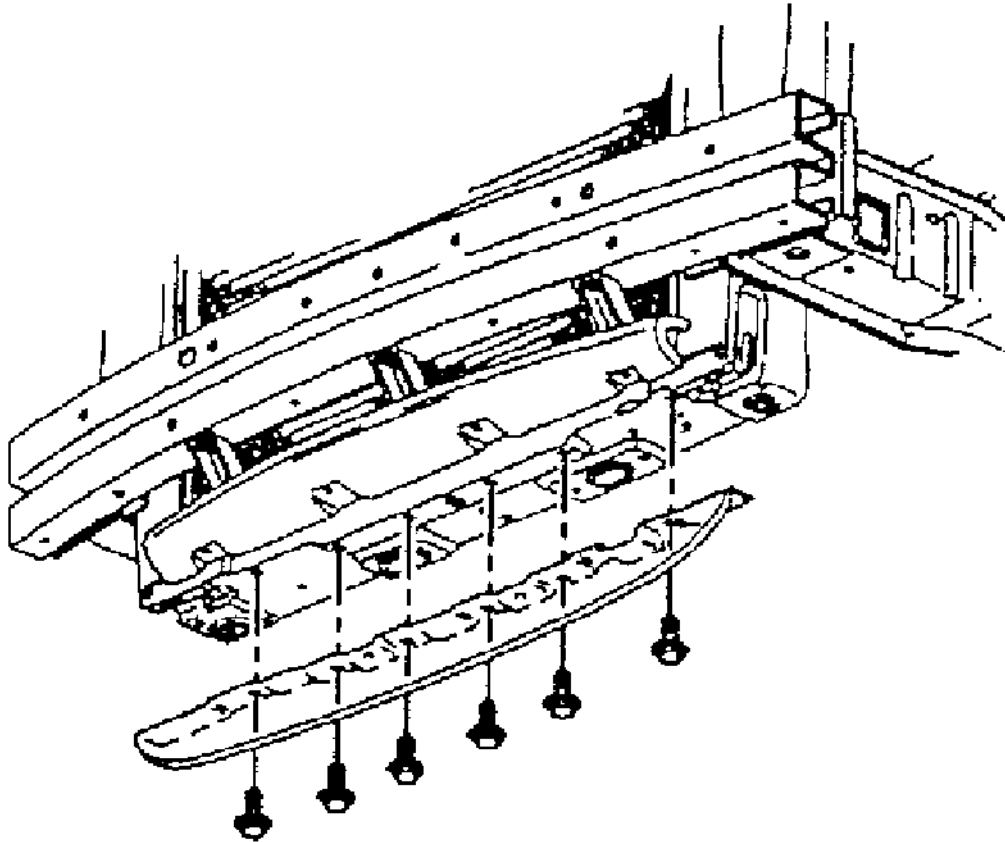


Fig. 103: View Of Lower Air Deflector/Baffle
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the air baffle bolts.

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

3. Lower the vehicle.

COOLANT HEATER REPLACEMENT (LA1)

Removal Procedure

1. Drain the engine cooling system. Refer to **Draining and Filling Cooling System**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine** in Body Front End.

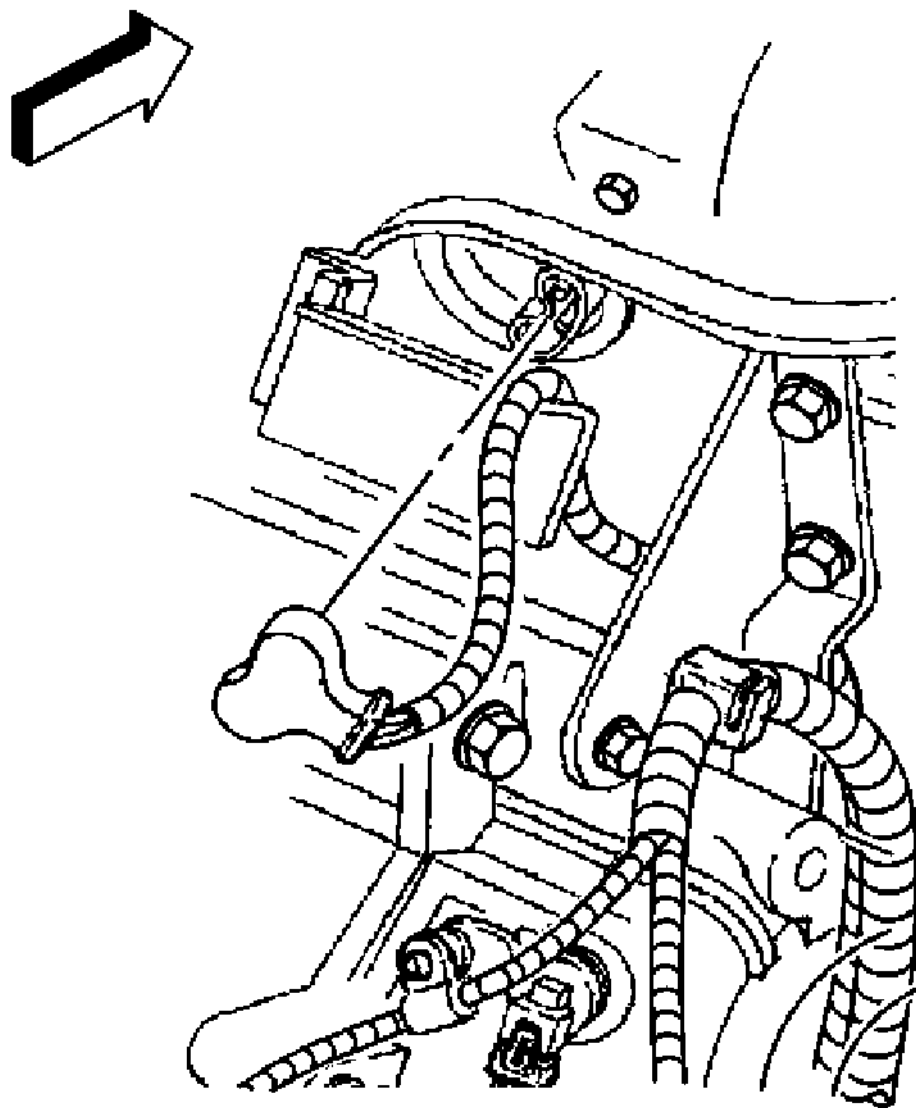


Fig. 104: View Of Engine Coolant Heater Cord

Courtesy of GENERAL MOTORS CORP.

5. Remove the engine coolant heater cord from the engine coolant heater.
6. Loosen the coolant heater bolt.

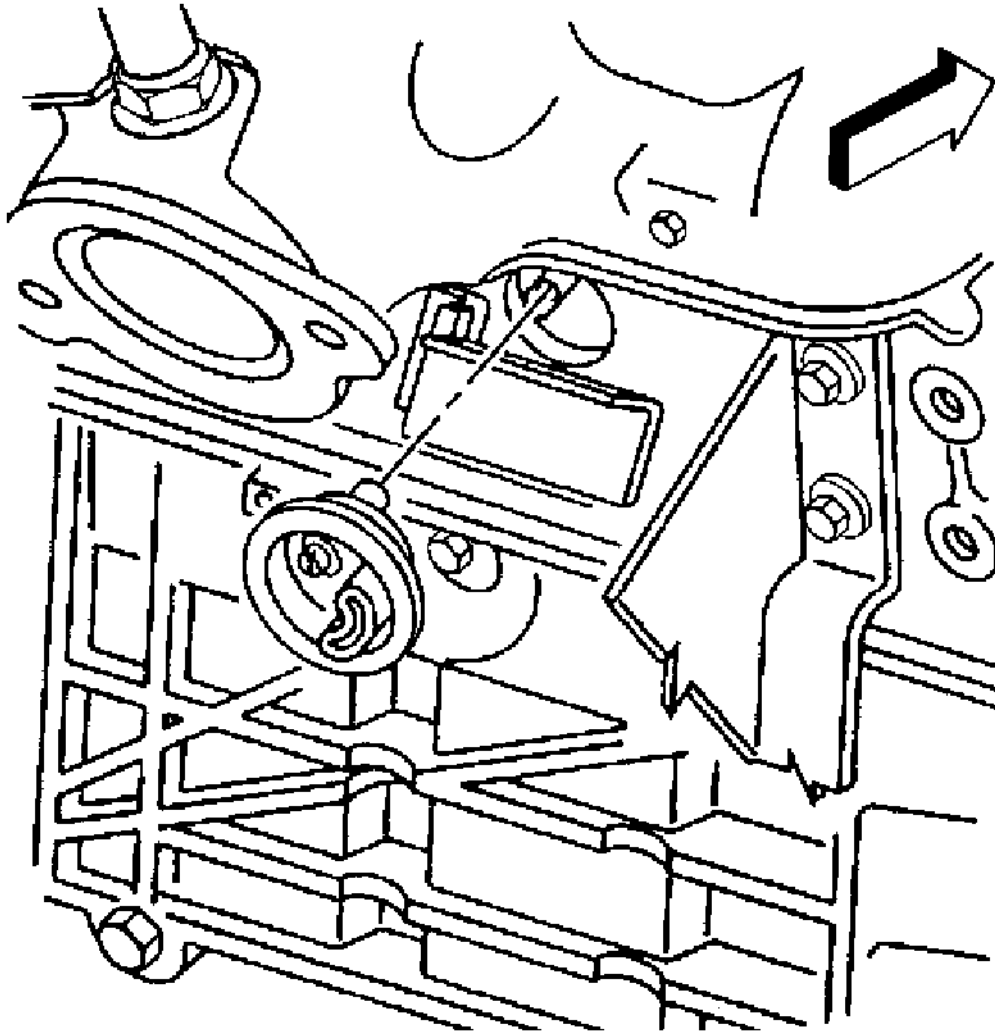


Fig. 105: Identifying Coolant Heater (LA1)
Courtesy of GENERAL MOTORS CORP.

7. Remove the coolant heater.

Installation Procedure

1. Apply GM P/N United States 12346004, GM P/N Canada 10953480 or equivalent to

the coolant heater seal and the coolant heater hole.

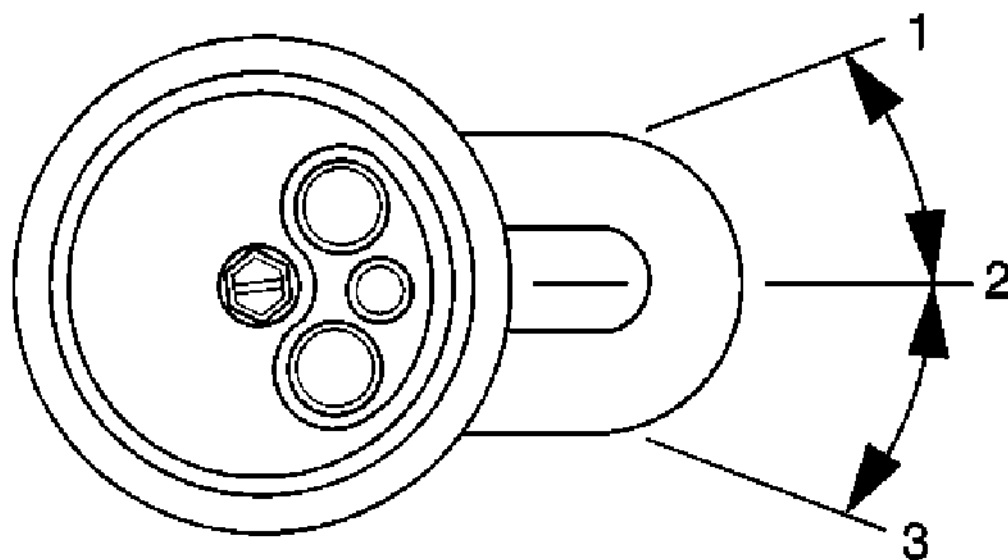


Fig. 106: Aligning Coolant Heater Element (LA1)
Courtesy of GENERAL MOTORS CORP.

2. Ensure that the coolant heater element is horizontal and pointed toward the front of the engine.

The 3 o'clock position (2) is DESIRED.

The 2 o'clock position (1) and the 4 o'clock position (3) are acceptable.

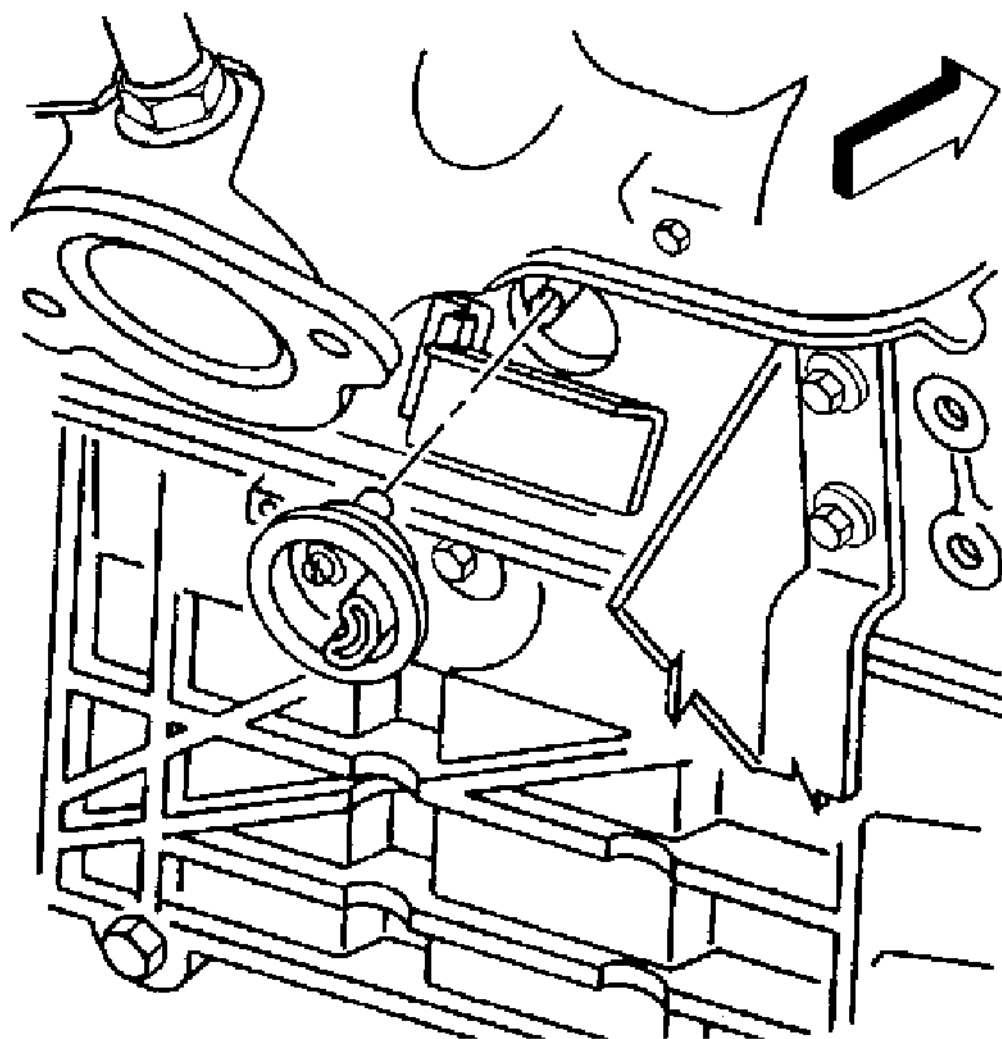


Fig. 107: Identifying Coolant Heater (LA1)
Courtesy of GENERAL MOTORS CORP.

3. Install the coolant heater.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the coolant heater bolt.

Tighten: Tighten the bolt to 2 N.m (18 lb in).

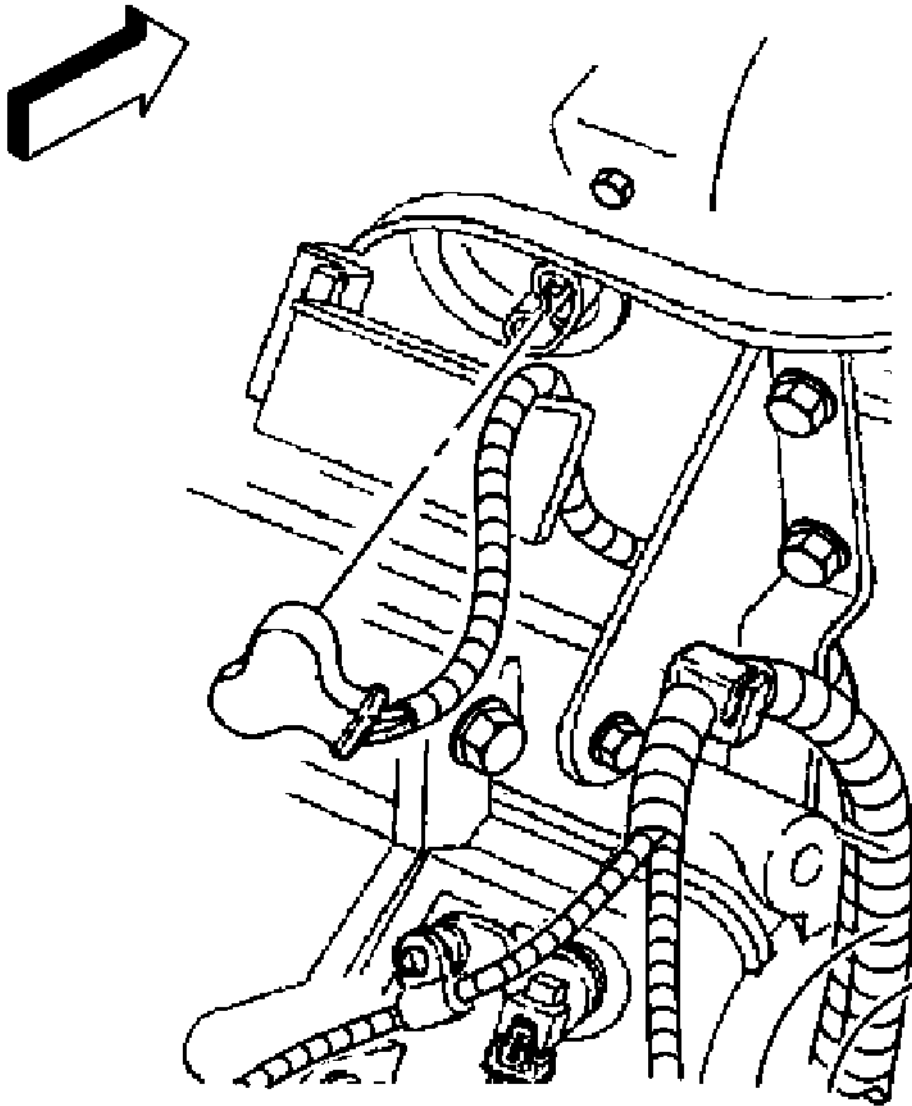


Fig. 108: View Of Engine Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

NOTE: The heater cord must not touch the engine, hot pipes, manifold, or any moving parts. Route the cord to the left front of the engine compartment securing with tie straps as necessary to prevent damage.

5. Install the engine coolant heater cord to the engine coolant heater.

6. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine** in Body Front End.
7. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Lower the vehicle.
9. Fill the engine cooling system. Refer to **Draining and Filling Cooling System**.

COOLANT HEATER REPLACEMENT (LY7)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the catalytic converter. Refer to **Catalytic Converter Replacement** in Engine Exhaust.
3. Remove the engine coolant heater cord from the engine coolant heater.

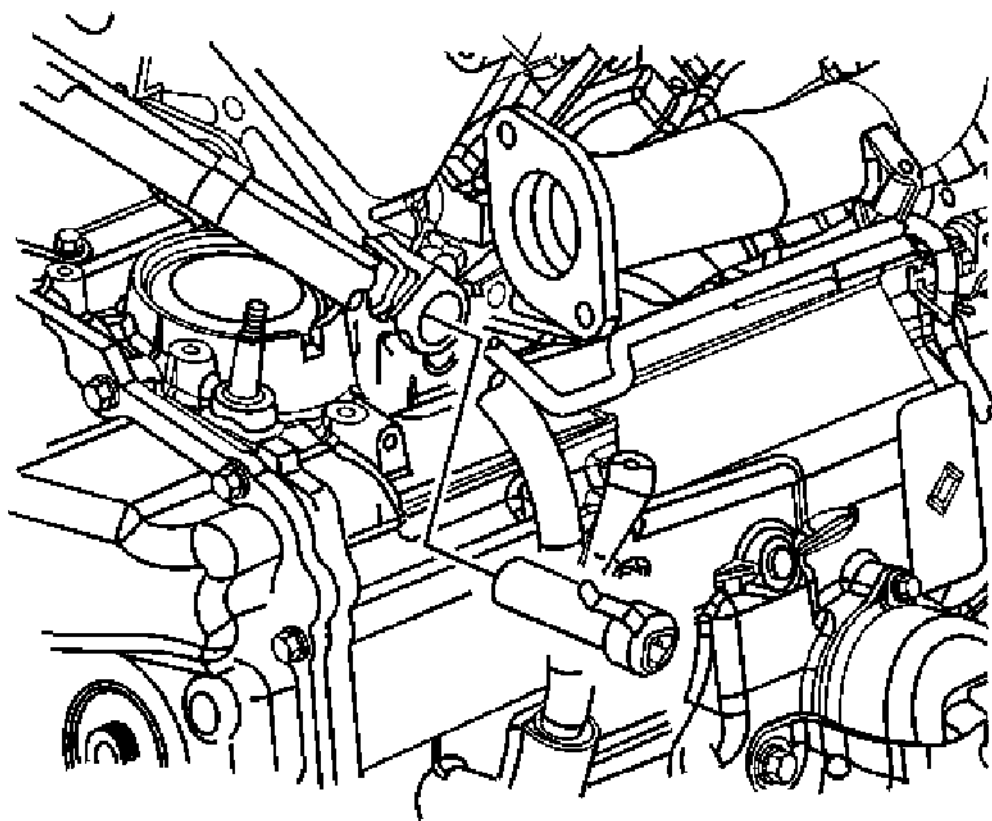


Fig. 109: View Of Coolant Heater (LY7)
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant heater.

Installation Procedure

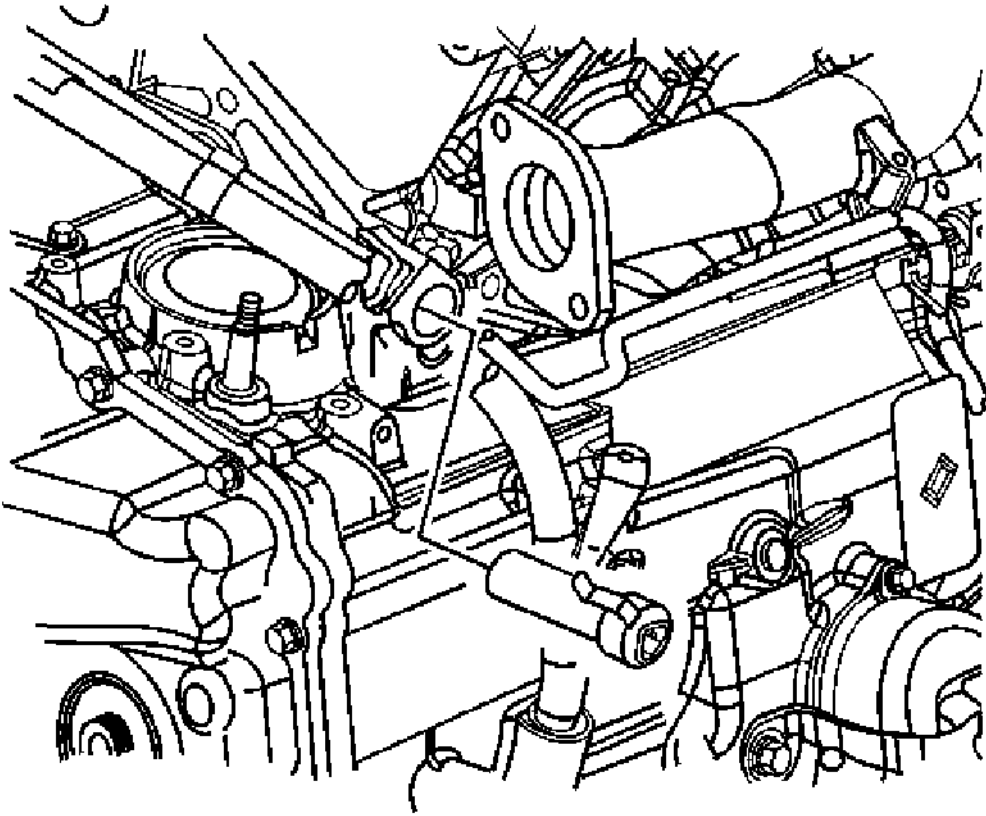


Fig. 110: View Of Coolant Heater (LY7)
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater.
2. Install the engine coolant heater cord to the engine coolant heater.
3. Install the catalytic converter. Refer to **Catalytic Converter Replacement** in Engine Exhaust.
4. Lower the vehicle.

COOLANT HEATER CORD REPLACEMENT (LA1)

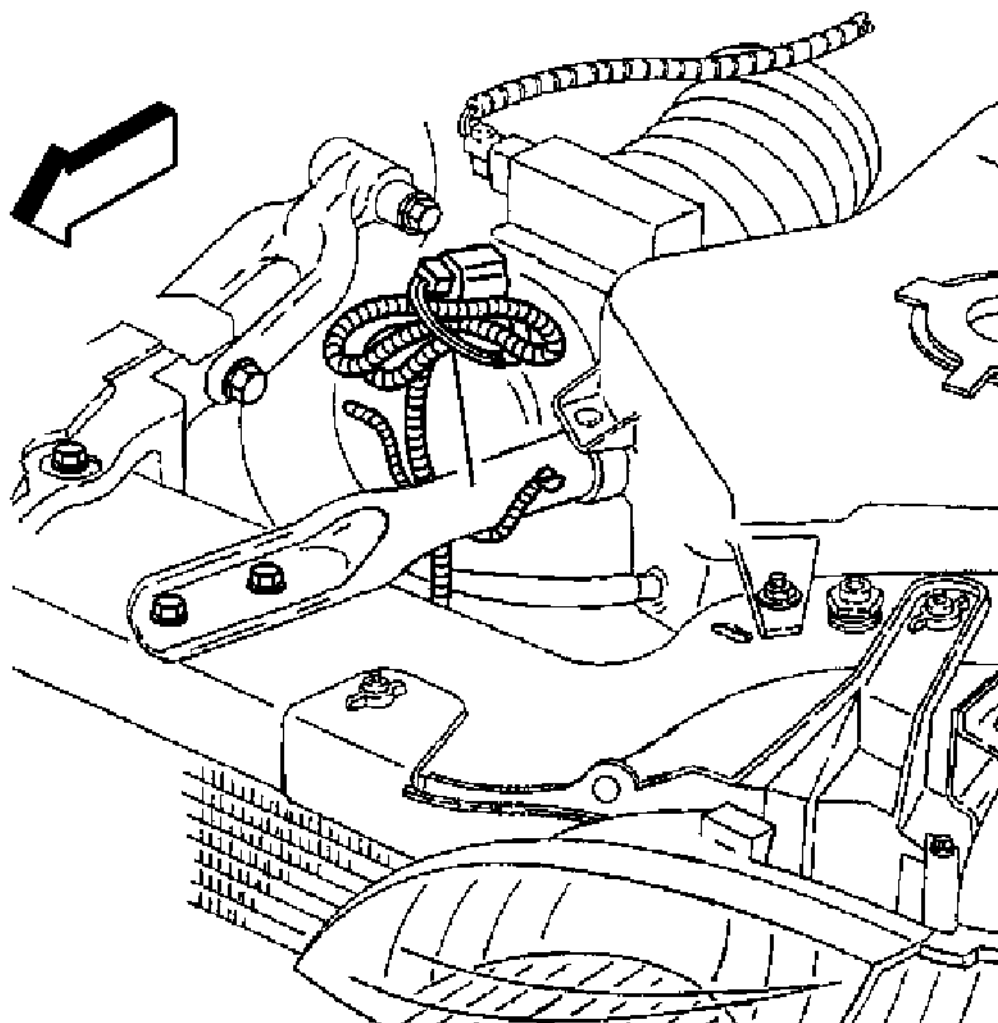


Fig. 111: Identifying Coolant Heater Cord (LA1)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The strap that secures the coolant heater cord to the diagonal brace is reusable. Do NOT cut this strap in order to remove it.

1. Press the coolant heater strap retainer tab in order to remove coolant heater cord strap.
2. Use wire cutters in order to remove the remaining coolant heater cord straps from the engine wiring harness.

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

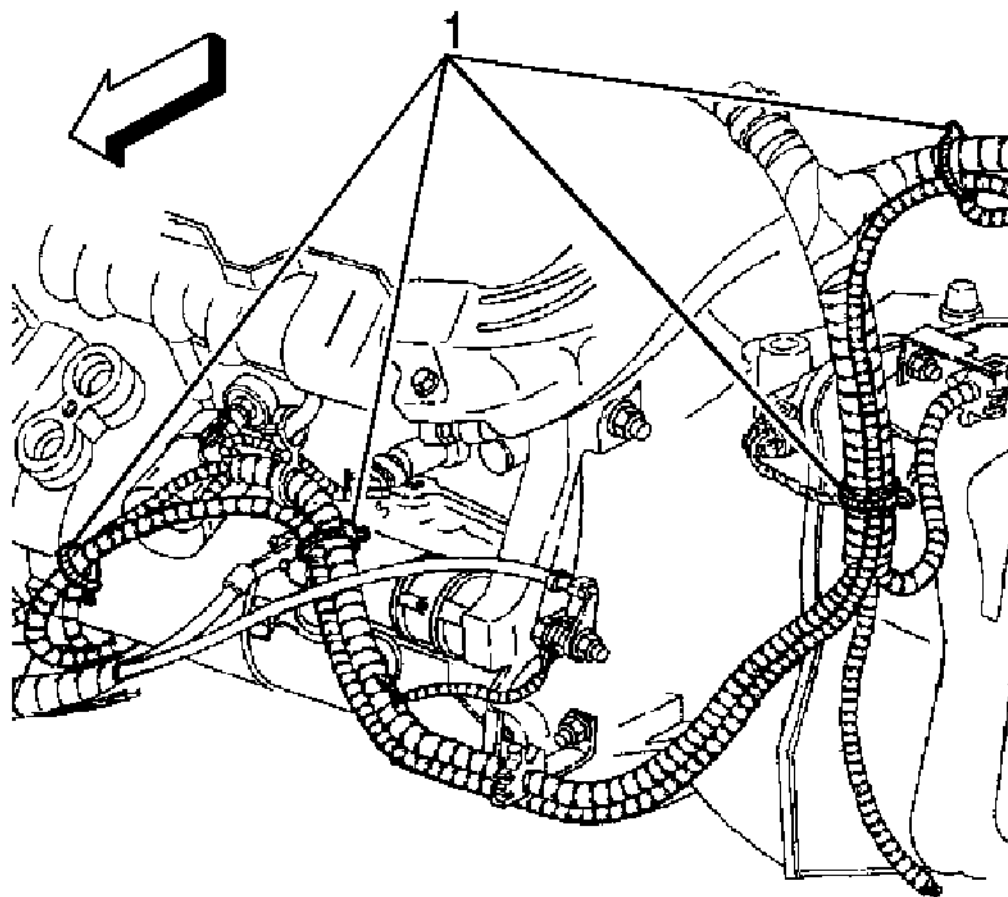


Fig. 112: Locating 3 Coolant Heater Cord Lower Straps
Courtesy of GENERAL MOTORS CORP.

4. Use wire cutters in order to remove the 3 coolant heater cord lower straps (1) from the engine wiring harness.
5. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Remove the right engine splash shield. Refer to **Splash Shield Replacement - Engine** in Body Front End.

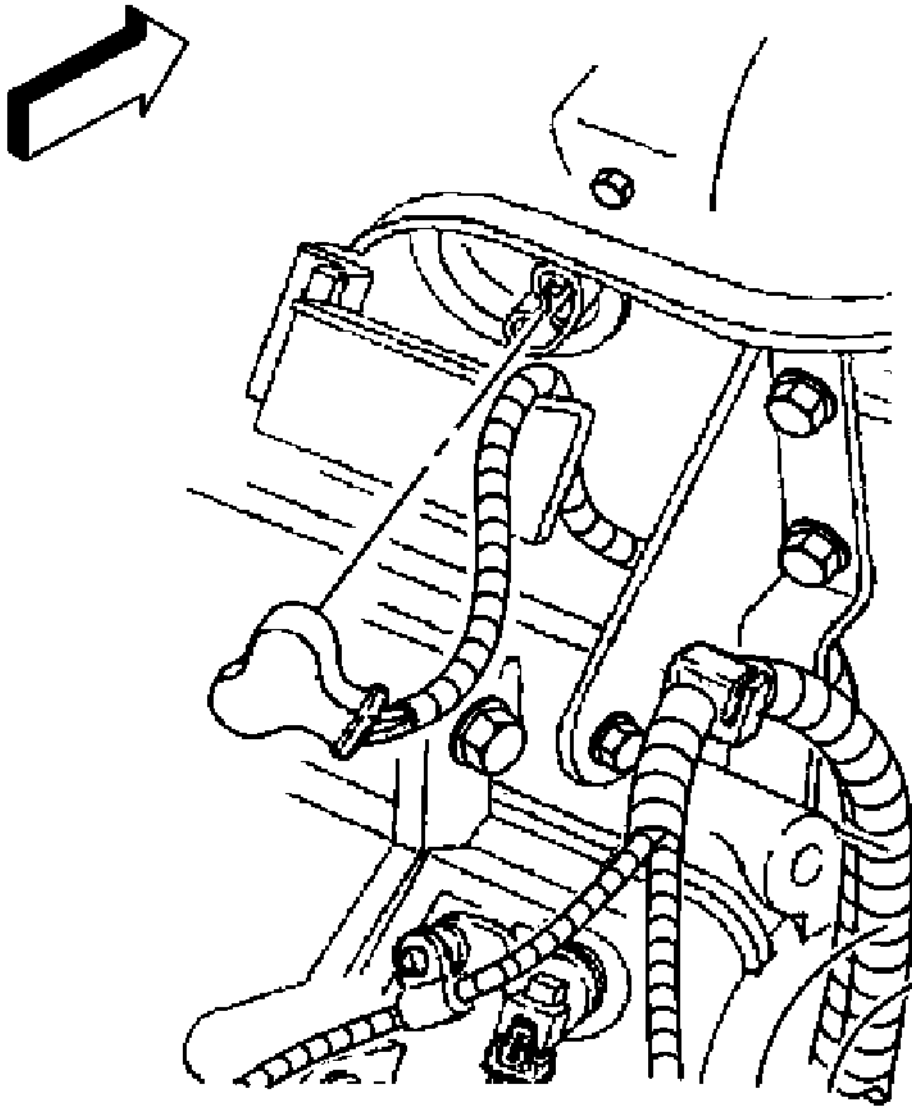


Fig. 113: View Of Engine Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine coolant heater cord from the engine coolant heater.
8. Remove the engine coolant heater cord.

Installation Procedure

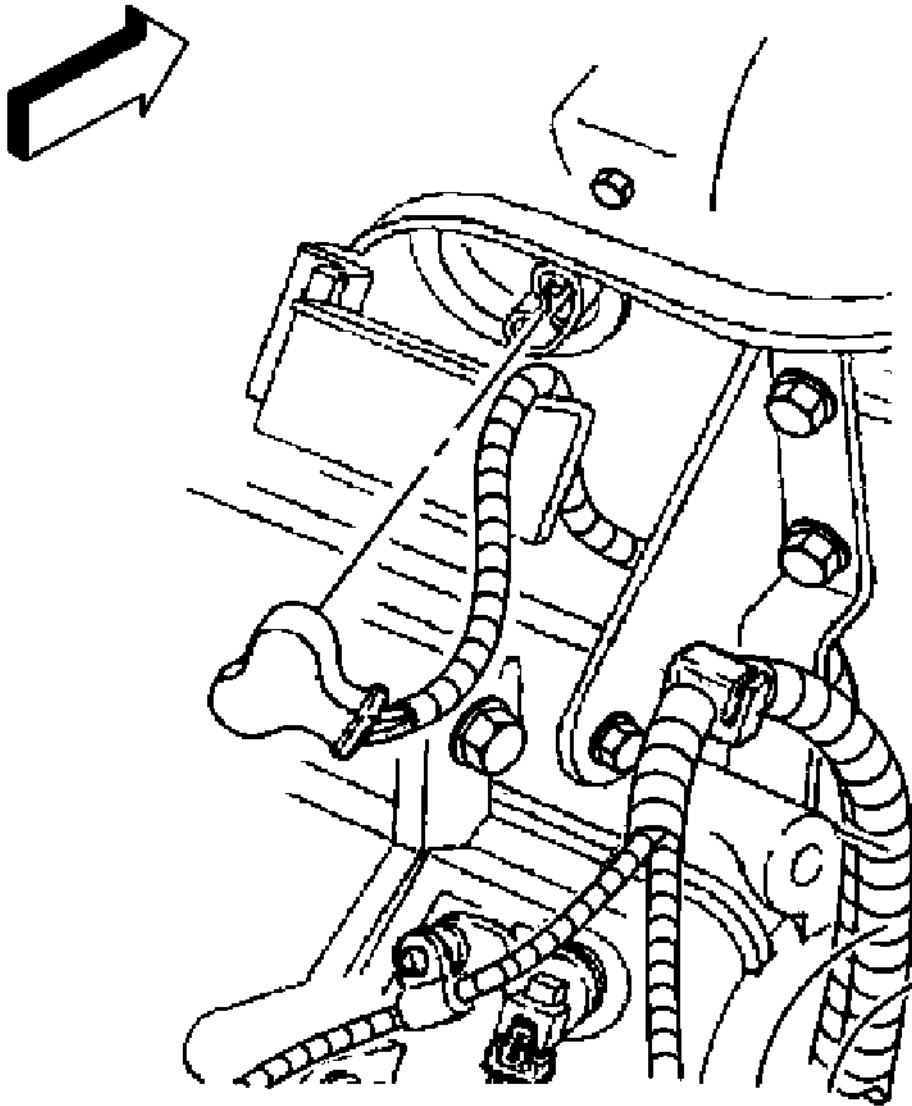


Fig. 114: View Of Engine Coolant Heater Cord
Courtesy of GENERAL MOTORS CORP.

1. Install the engine coolant heater cord to the engine coolant heater.

NOTE: The heater cord must not touch the engine, hot pipes, manifold, or any moving parts. Route the cord to the left front of the engine compartment securing with tie straps as necessary to prevent damage.

2. Properly route the coolant heater cord.

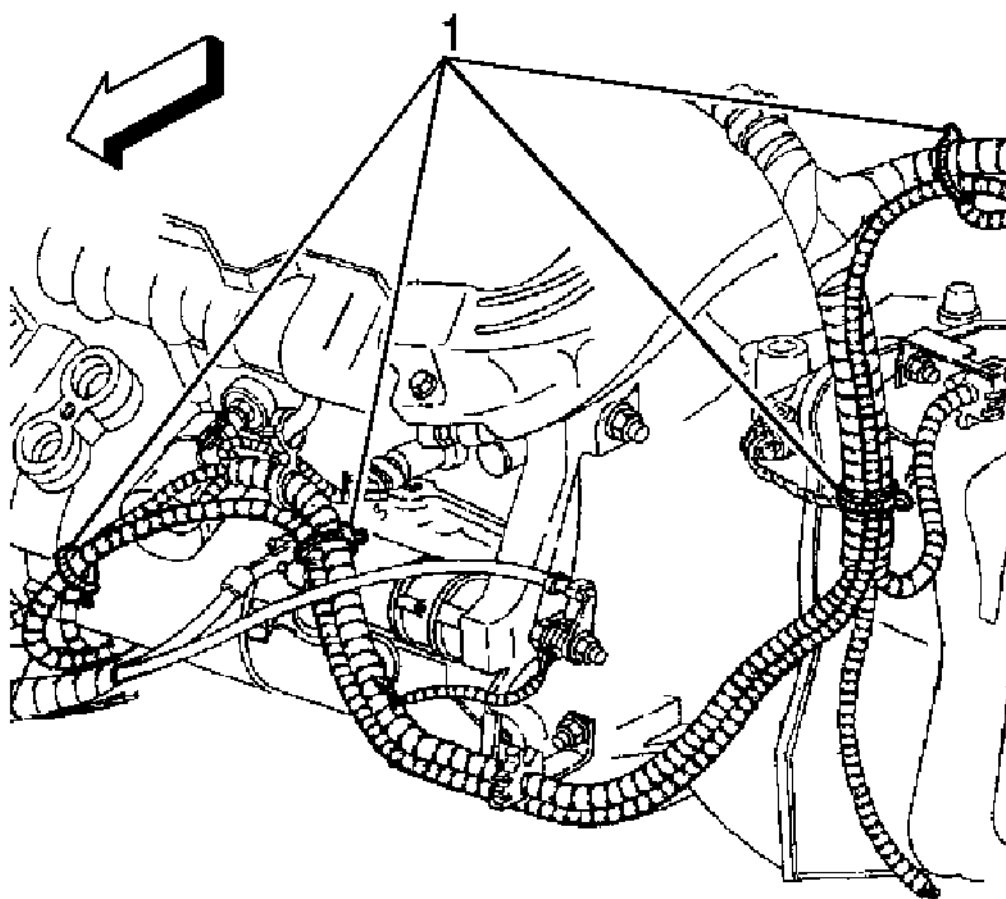


Fig. 115: Locating 3 Coolant Heater Cord Lower Straps
Courtesy of GENERAL MOTORS CORP.

3. Install new tie straps (1) in order to secure the coolant heater cord to the engine wiring harness.
4. Install the right engine splash shield. Refer to **Splash Shield Replacement - Engine** in Body Front End.
5. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Lower the vehicle.

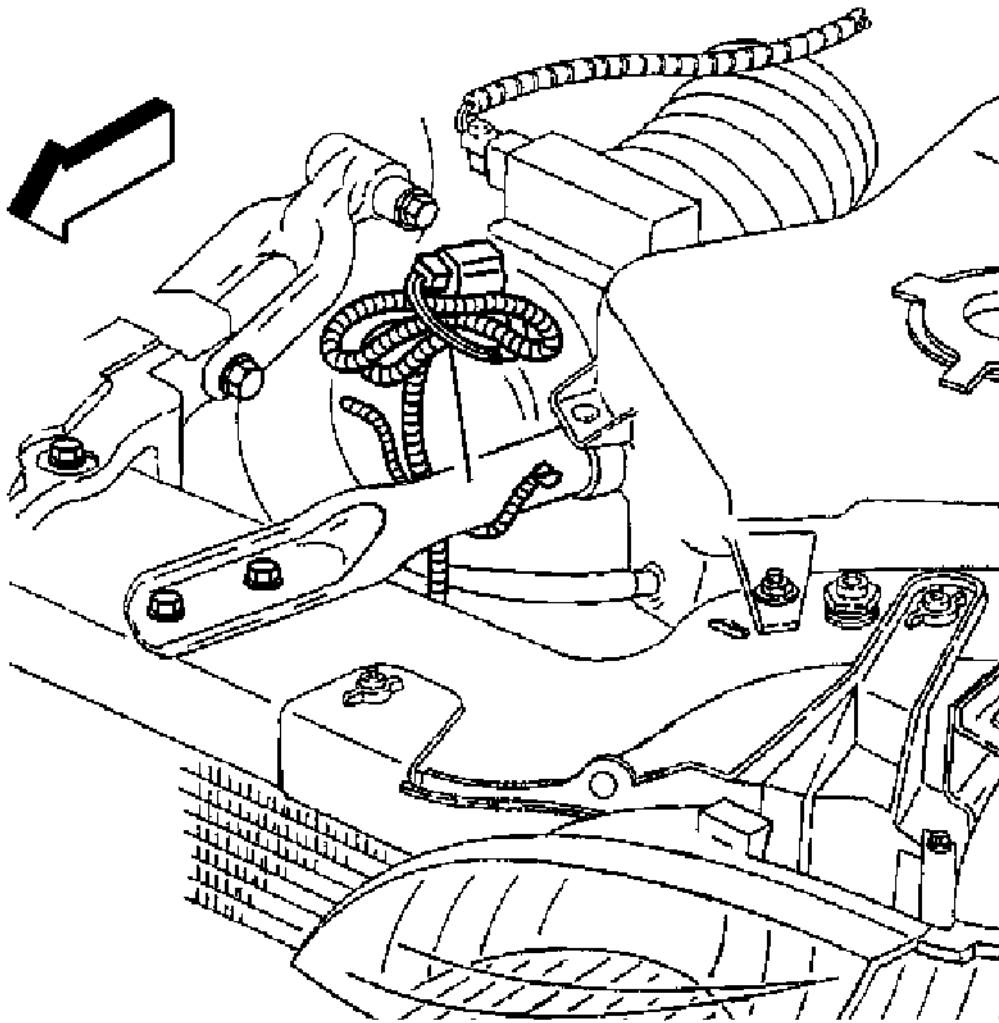


Fig. 116: Identifying Coolant Heater Cord (LA1)
Courtesy of GENERAL MOTORS CORP.

7. Install the reusable strap in order to secure the coolant heater cord to the diagonal brace.

COOLANT HEATER CORD REPLACEMENT (LY7)

Removal Procedure

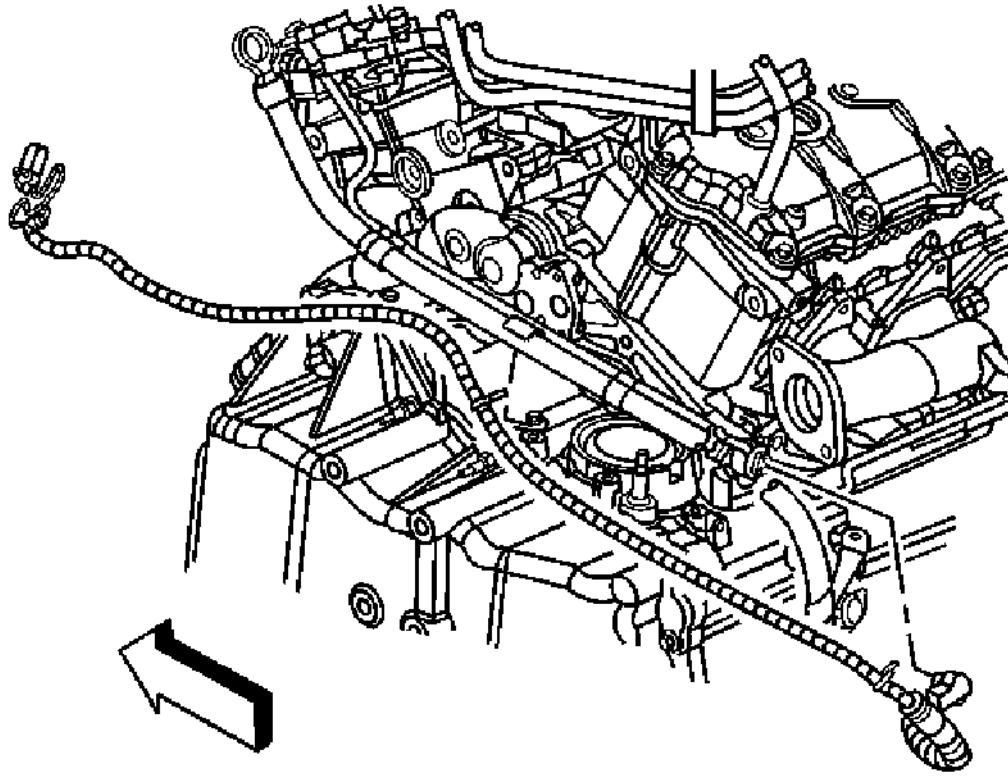


Fig. 117: View Of Coolant Heater Cord (LY7)
Courtesy of GENERAL MOTORS CORP.

1. Remove the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** Engine Controls - 3.6L (LY7).
2. Remove the coolant (block) heater cord from the transmission fill tube.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the catalytic converter. Refer to **Catalytic Converter Replacement** in Engine Exhaust.
5. Remove the engine coolant (block) heater cord from the engine coolant heater.
6. Remove the engine coolant (block) heater cord.

Installation Procedure

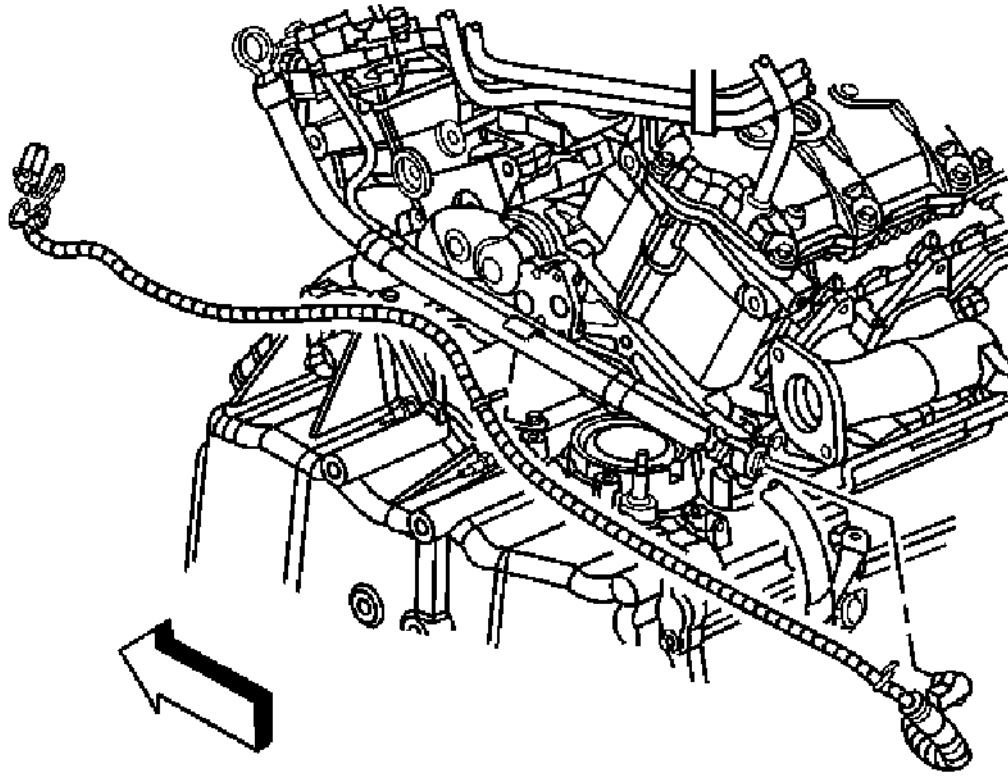


Fig. 118: View Of Coolant Heater Cord (LY7)
Courtesy of GENERAL MOTORS CORP.

1. Install the engine coolant (block) heater cord above the transmission.
2. Install the engine coolant (block) heater cord to the engine coolant heater.
3. Install the catalytic converter. Refer to **Catalytic Converter Replacement** in Engine Exhaust.
4. Lower the vehicle.
5. Install the coolant (block) heater cord to the transmission fill tube.
6. Install the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** Engine Controls - 3.6L (LY7).

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system is controlled by the body control module (BCM) and the powertrain control module (PCM) or engine control module (ECM). The BCM performs the calculations as to how long, when and what speed the cooling fans should turn on. The BCM then sends a class 2 message to the PCM/ECM to engage the cooling fan relays. If there is a malfunction with the BCM, the PCM/ECM will control the engine cooling fans independently. The engine cooling system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the PCM/ECM to operate both fans together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood accessory wiring junction block. The ground path is provided at G100.

During low speed operation, the PCM/ECM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the cooling fan 1 relay coil, closes the relay contacts, and supplies battery positive voltage from the cool fan 1 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 2 relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the PCM/ECM supplies the ground path for the cooling fan 1 relay through the low speed cooling fan relay control circuit. After a 3-second delay, the PCM/ECM supplies a ground path for the cooling fan 3 or S/P relay and the cooling fan 2 relay through the high speed cooling fan relay control circuit. This energizes the cooling fan 2 relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the cooling fan 2 relay coil is energized closing the relay contacts and provides battery positive voltage from the cool fan 2 fuse on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have their own ground path. The result is a parallel circuit with both fans running at high speed.

The BCM and PCM/ECM command Low Speed Fans on under the following conditions:

- Engine coolant temperature exceeds approximately 106°C (223°F).
- A/C refrigerant pressure exceeds 1 310 kPa (190 psi).
- After the vehicle is shut off if the engine coolant temperature at key-off is greater than 140°C (284°F) and system voltage is more than 12 volts. The fans will stay on for approximately 3 minutes.

The BCM and PCM/ECM command High Speed Fans on under the following conditions:

- Engine coolant temperature reaches 110°C (230°F).
- A/C refrigerant pressure exceeds 1 655 kPa (240 psi).
- When certain DTCs set.

Engine Coolant Indicator(s)

Hot Coolant Temp

The instrument panel cluster (IPC) illuminates the hot coolant temp indicator in the message center when the PCM determines that the coolant temperature is greater than 128°C (262°F). The IPC receives a class 2 message from the PCM requesting illumination.

The IPC sends a class 2 message to the radio in order to activate an audible warning.

Reduced Engine Power

The IPC displays REDUCED ENGINE POWER message when the IPC detects a reduced engine power condition from the PCM. The IPC receives a class 2 message from the PCM requesting illumination when the engine temperature reaches 110°C (230°F).

Coolant Heater

The optional engine coolant heater (RPO K05) is rated at 400 watts and supplies 1365 btu/hr. The engine coolant heater 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 is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the system cools slowly or not at all. This allows the engine to warm quickly.

Cooling Cycle

Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. Coolant will then be pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders, where the radiator absorbs heat.

Some coolant is also pumped from the water pump to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost.

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

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

From the cylinder heads, the coolant is then forced to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine is warmed, or the coolant will flow through the thermostat and into the radiator where the radiator is cooled and the coolant cycle is completed.

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

Coolant

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

When the coolant temperature is below 91°C (195°F), 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 91°C (195°F), 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.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a crossflow tube and fin design. This is a series of tubes that extend side to side from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, nylon reinforced plastic. A high temperature rubber gasket seals the tank flange edge. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock which is located in the bottom of the left hand tank. The drain cock includes the drain cock and drain cock seal.

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

During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into the surge tank. As the coolant circulates, air is allowed to exit. This is an advantage to the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Pressure Cap

The pressure cap is a cap that seals and pressurizes the cooling system. It contains a blow off

or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against the seat by a spring of predetermined strength, which protects the radiator by relieving pressure if it exceeds 15 psi. The vacuum valve is held against the seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as the radiator cools off. The vacuum, if not relieved, might cause the radiator to collapse.

The pressure cap allows pressure in the cooling system to build up. As the pressure builds, the boiling point of the coolant goes up as well. Therefore, the coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat moves from the radiator to the cooler, passing air. The pressure in the cooling system can get too high, however. When the pressure exceeds the strength of the spring, the pressure valve rises so that the excess pressure can escape. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the cooling system. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator from collapsing.

Coolant Recovery System

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

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure in the cooling system gets too high, the pressure valve opens in the pressure cap. This allows the coolant, which has expanded due to being heated, is allowed to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, coolant is not lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is that most of the air bubbles are eliminated from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

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

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is 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. These sealed bearings never need to be lubricated. With a sealed bearing, grease cannot leak out, and dirt and water cannot get in.

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.

Engine Oil Cooler

The engine oil cooler is a heat exchanger. It is located inside the left side end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds the oil cooler in the radiator.

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

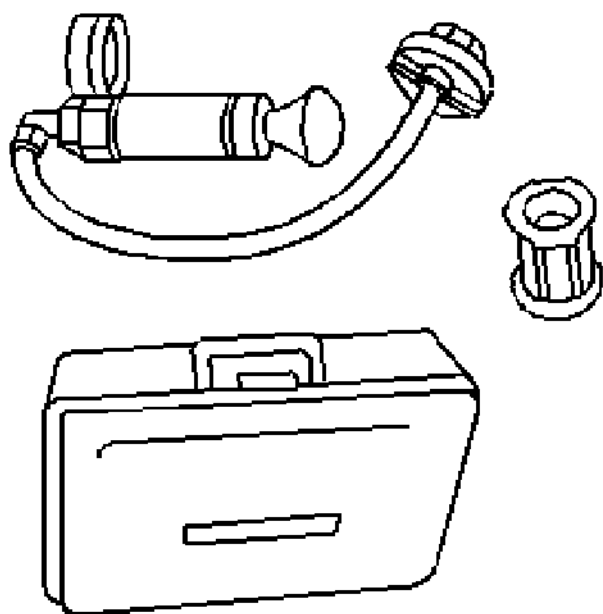
Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the right side end tank of the radiator. The transmission fluid temperature is regulated by the temperature of the engine coolant that surrounds the oil cooler as the transmission fluid passes down through the cooler.

SPECIAL TOOLS AND EQUIPMENT

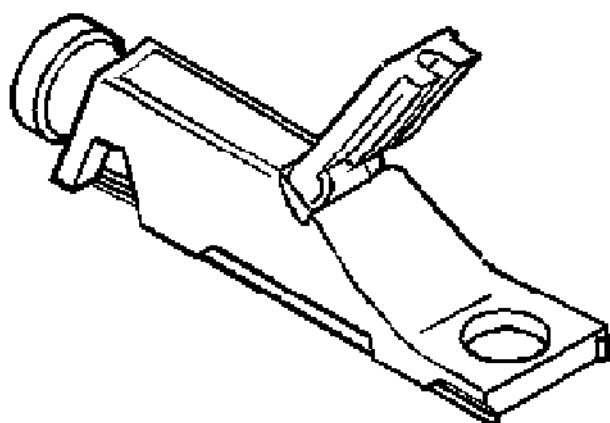
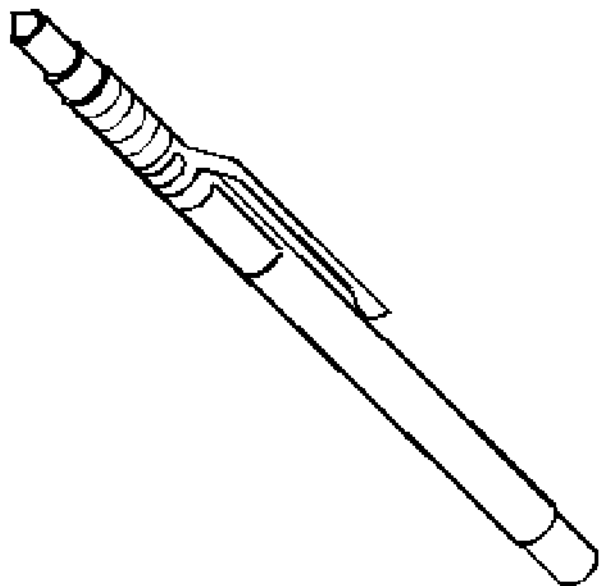
SPECIAL TOOLS

Special Tools

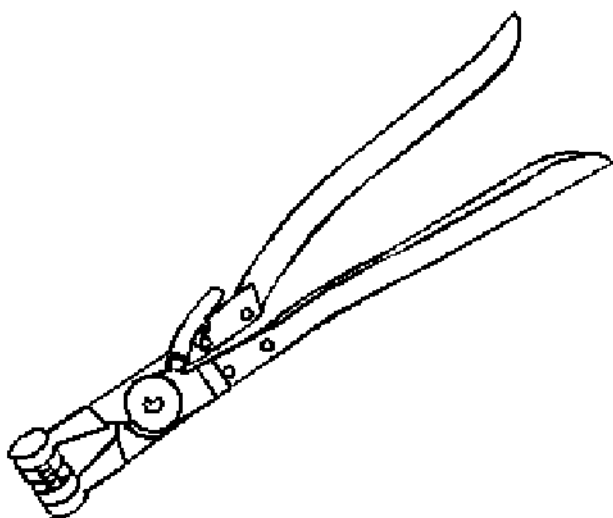
Illustration**Tool Number/Description**

J 24460-O1
Cooling System Pressure Tester

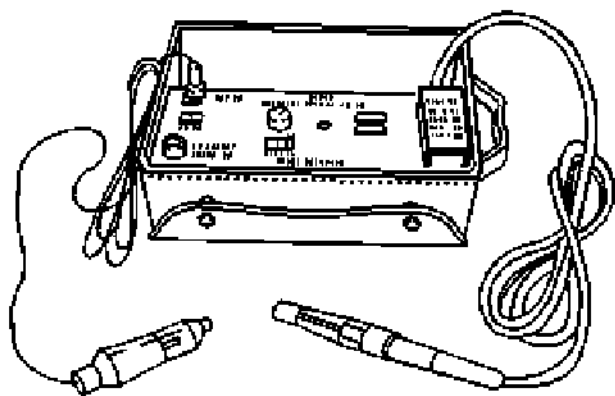
J 24731
Tempilstick



J 26568
Coolant and Battery Fluid
Tester



J 38185
Hose Clamp Pliers



J 39400-A
Halogen Leak Detector

