

2006 ENGINE

Engine Cooling - XLR

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

| Application | Specification | |
|--|---------------|-----------|
| | Metric | English |
| Auxiliary Transmission Oil Cooler Brace bolts | 22 N.m | 16 lb ft |
| Auxiliary Transmission Oil Cooler Bracket Nuts | 8 N.m | 6 lb ft |
| Charge Air Coolant Cap Bolts | 10 N.m | 89 lb in |
| Coolant Heater Cord Clip Bolt | 32 N.m | 24 lb ft |
| Drain Cock | 2 N.m | 18 lb in |
| Engine Cooling Fan Module Screw | 6 N.m | 53 lb in |
| Fan Shroud to Radiator Bolts | 5 N.m | 44 lb in |
| Generator Cooling Hose Assembly to Generator Bolt | 27 N.m | 20 lb ft |
| Generator Cooling Inlet Hose Fitting | 25 N.m | 18 lb ft |
| Radiator Air Baffle Screws | 2.5 N.m | 22 lb in |
| Radiator Front Air Deflector Bolts | 2.5 N.m | 22 lb in |
| Radiator Front Air Deflector Upper Mounting Screws | 2.5 N.m | 22 lb in |
| Radiator Support Bolts | 9 N.m | 80 lb in |
| Surge Tank Nuts | 8 N.m | 71 lb in |
| Thermostat Housing Bolt (LC3) | 10 N.m | 89 lb in |
| Thermostat Housing Bolt (LH2) | 10 N.m | 89 lb in |
| Water Outlet Housing Bolts (LC3, LH2) | 25 N.m | 18 lb ft |
| Water Pump Bolts (LC3) | 10 N.m | 89 lb in |
| Water Pump Bolts (LH2) | 30 N.m | 22 lb ft |
| Water Pump Pulley Bolts (LC3) | 12 N.m | 106 lb in |
| Water Pump Pulley Bolts (LH2) | 10 N.m | 89 lb in |

SCHEMATIC AND ROUTING DIAGRAMS

ENGINE COOLING SCHEMATICS

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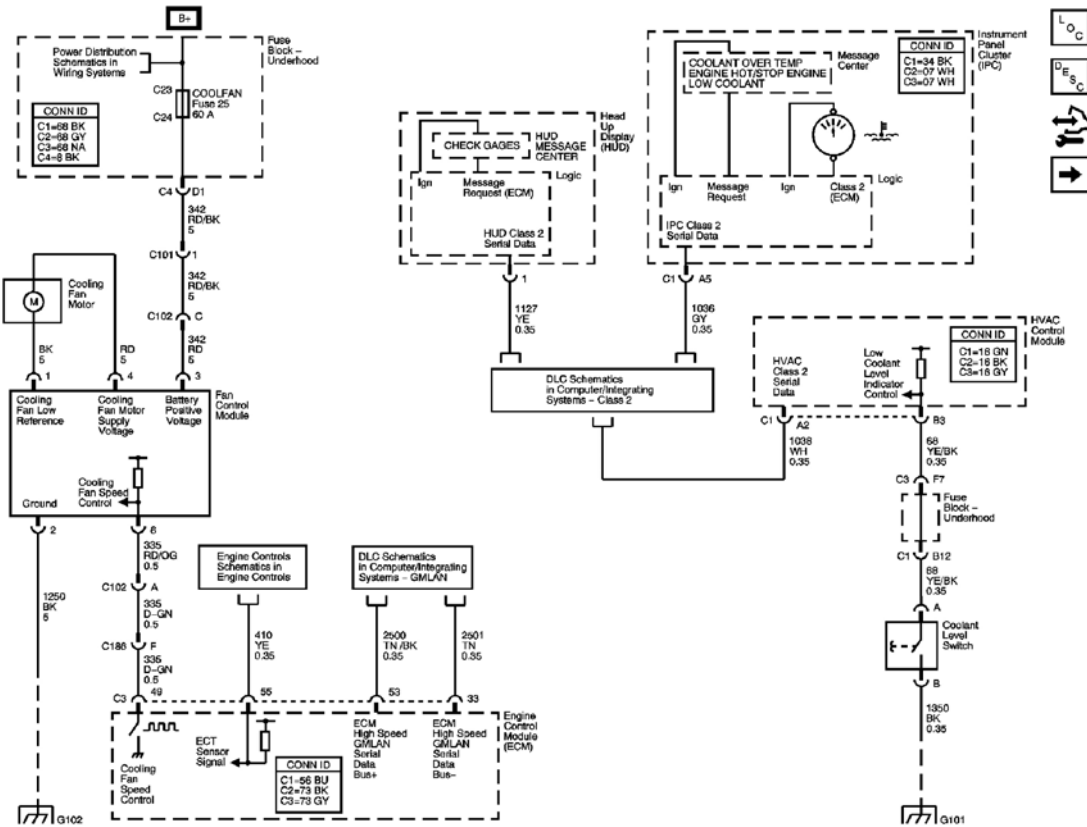


Fig. 1: Engine Cooling Schematic - LC3
Courtesy of GENERAL MOTORS CORP.

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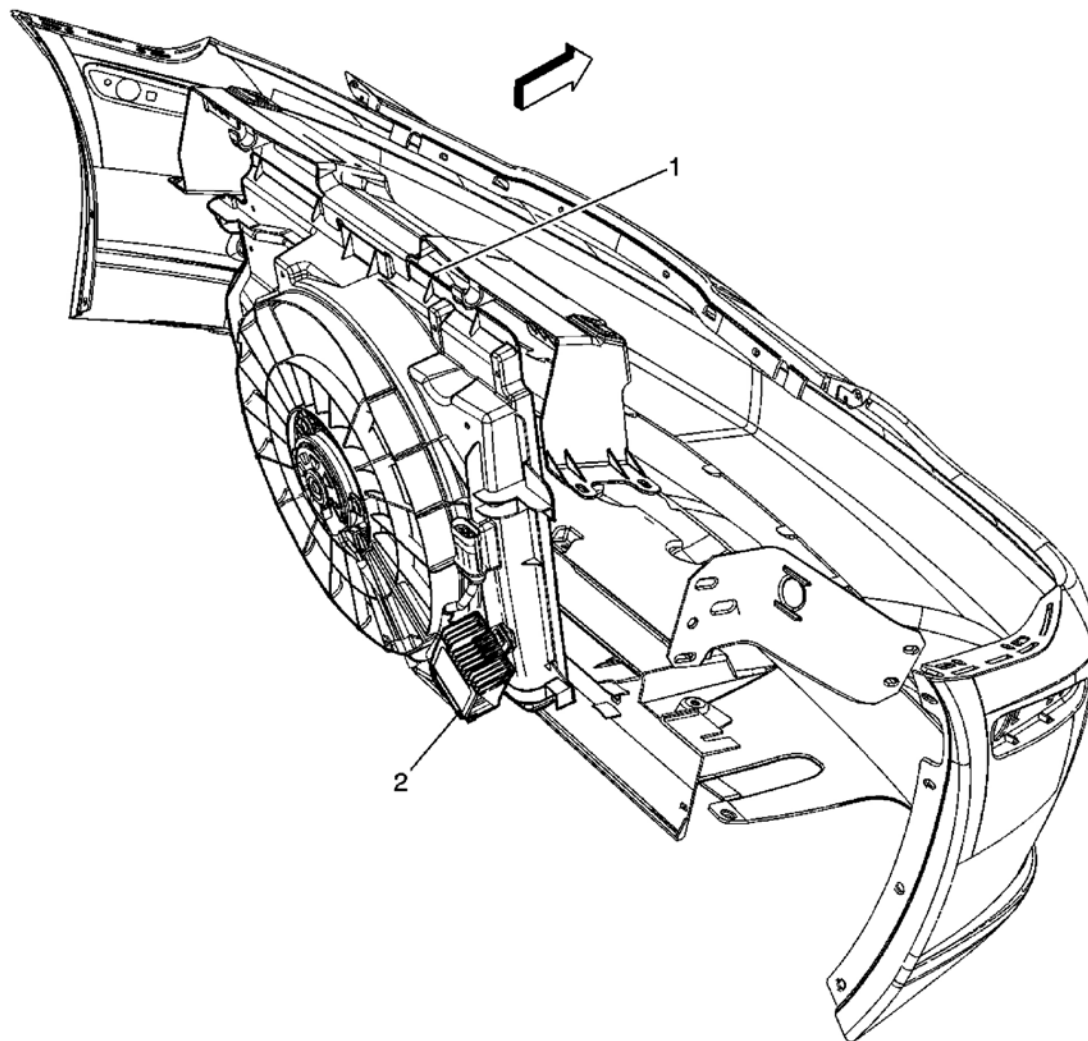


Fig. 3: Front Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

| Callout | Component Name |
|---------|--------------------|
| 1 | Cooling Fan Motor |
| 2 | Fan Control Module |

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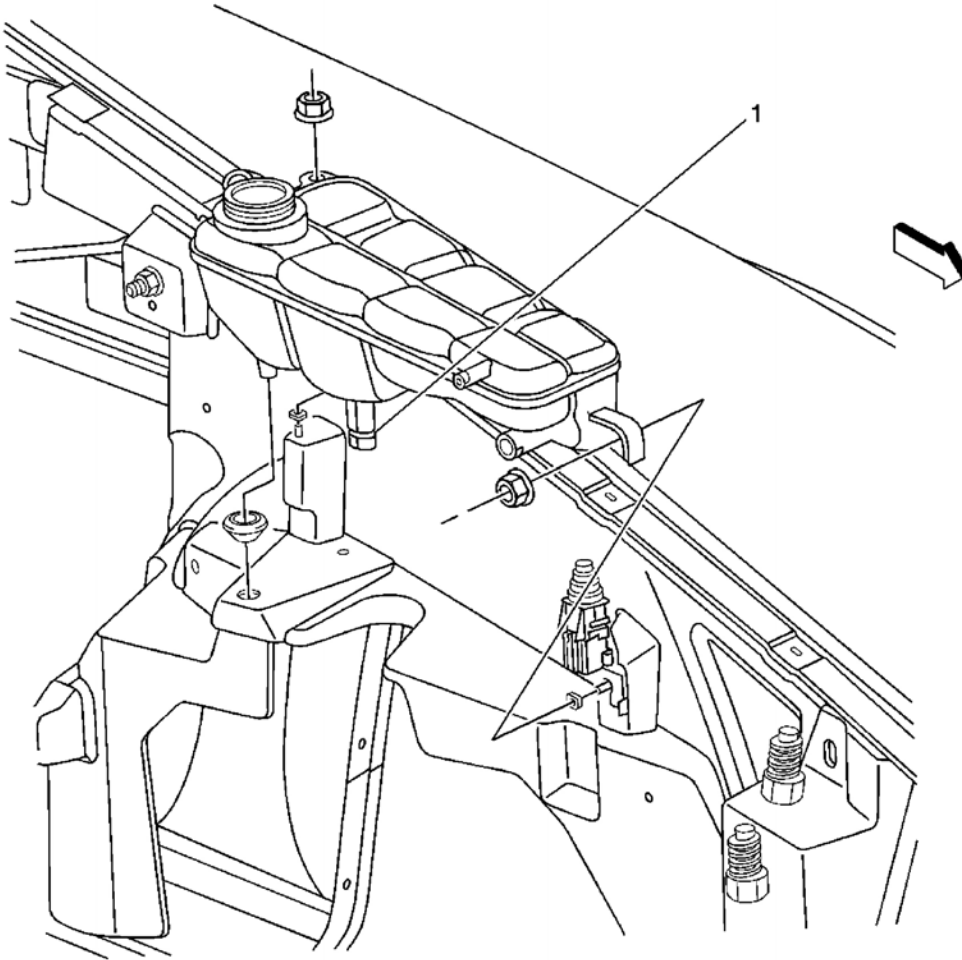


Fig. 4: Coolant Level Switch - Left Side of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

| Callout | Component Name |
|---------|----------------------|
| 1 | Coolant Level Switch |

COOLING SYSTEM CONNECTOR END VIEWS

Coolant Level Switch

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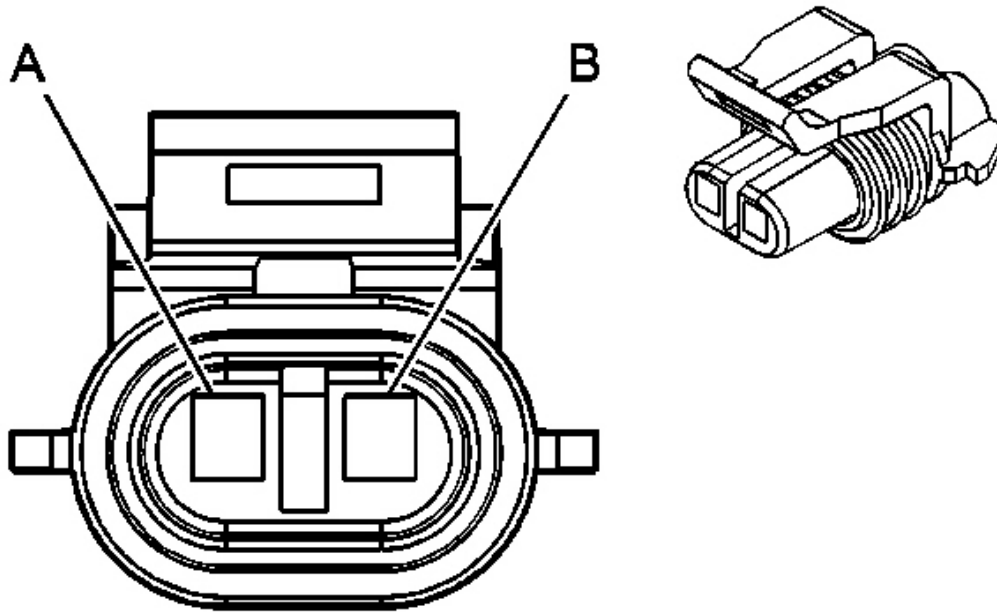


Fig. 5: Coolant Level Switch Connector View
Courtesy of GENERAL MOTORS CORP.

Cooling System Connector End Views

Connector Part Information

- OEM: 12052641
- Service: 12102747
- Description: 2-Way F Metri-Pack 150 Series (BK)

Terminal Part Information

- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Coolant Level Switch

| Pin | Wire Color | Circuit No. | Function |
|-----|------------|-------------|-------------------------------------|
| A | YE/BK | 68 | Low Coolant Level Indicator Control |
| B | BK | 1350 | Ground |

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Cooling Fan Module

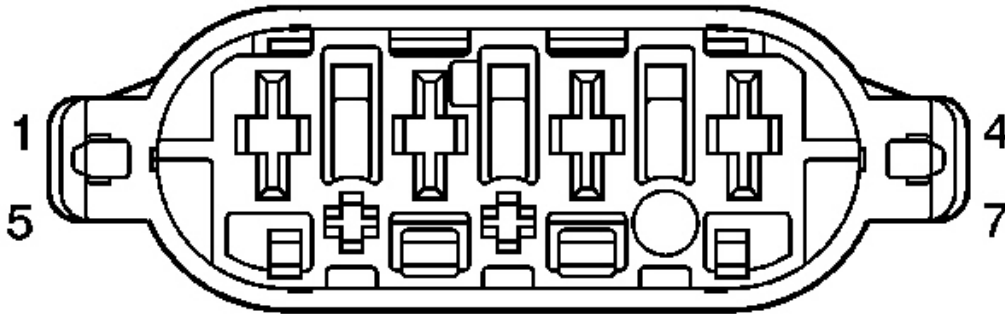


Fig. 6: Cooling Fan Module Connector View
Courtesy of GENERAL MOTORS CORP.

Cooling System Connector End Views

Connector Part Information

- OEM: 9440194
- Service: See Catalog
- Description: 7-Way F (BK)

Terminal Part Information

- Pins: 1, 2, 3, 4, 6
- Terminal/Tray: See Terminal Repair Kit
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Cooling Fan Module

| Pin | Wire Color | Circuit No. | Function |
|-----|------------|-------------|----------------------------------|
| 1 | BK | - | Cooling Fan Low Reference |
| 2 | BK | 1250 | Ground |
| 3 | RD | 342 | Battery Positive Voltage |
| 4 | RD | - | Cooling Fan Motor Supply Voltage |
| 5 | - | - | Not Used |
| 6 | RD/OG | 335 | Cooling Fan Speed Control |
| 7 | - | - | Not Used |

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DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

| DTC | Description |
|------------------|---|
| DTC P1258 | Engine Coolant Overtemperature - Protection Mode Active |
| DTC P1482 | ** DESCRIPTION NOT COLLECTED ** |

DIAGNOSTIC STARTING POINT - ENGINE COOLING

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

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

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

SCAN TOOL OUTPUT CONTROLS

ECM - 4.6 Liter LH2

| Scan Tool Output Control | Additional Menu Selection(s) | Description |
|--------------------------|------------------------------|---|
| Commanded Fan | Fan Control | The scan tool displays the Commanded fan state in 10% increments. This allows you to communicate with the ECM and activate or deactivate the cooling fan speeds manually. |

SCAN TOOL DATA LIST

Engine Control Module (ECM) 4.6 Liter LN2

| Scan Tool Parameter | Data List | Units Displayed | Typical Data Value |
|---------------------------|-----------------------------|--|--------------------|
| Key ON, Engine OFF | | | |
| ECT Sensor | Engine Data, Engine Cooling | Degrees Celsius (°C)/Degrees Fahrenheit (°F) | Varies |
| Cooling Fan Speed Command | Engine Data, Engine Cooling | % | % |

SCAN TOOL DATA DEFINITIONS

Coolant Temperature

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The scan tool displays -40 to +151°C (-40 to +304°F). This data is the coolant temperature the Instrument Cluster is attempting to display on the coolant temperature gage.

ECT

The scan tool displays -40 to +151°C (-40 to +304°F). The engine coolant temperature (ECT) sensor is mounted in the coolant stream. The powertrain control module (PCM) applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold, internal resistance high, the PCM 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 interprets the lower voltage as a warm engine.

Cooling Fan Speed Command

The scan tool displays %. This parameter indicates the commanded state of the cooling fan.

Coolant Level Input

The scan tool displays OK or Low. If the ground circuit opens, the scan too will display Low.

DTC P1258

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1258 Engine Coolant Overtemperature - Protection Mode Active

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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- The ECM will illuminate the malfunction indicator lamp (MIL) during the first trip in which the diagnostic test has been run and failed.
- The ECM will signal the instrument panel cluster (IPC) to turn ON the Service Engine Soon indicator.
- The ECM will alternately disable 2 groups of 4 cylinders by turning OFF the fuel injectors.
- The ECM will store conditions which were present when the DTC set in Freeze Frame Data.
- Ninety percent fan power is commanded.

Conditions for Clearing the MIL/DTC

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

DTC P1258

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

DTC P1482

DTC Descriptor

DTC P1482

Cooling Fan Speed Output Circuit

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

The engine cooling fan is a variable speed fan. The engine control module (ECM) controls the fan speed by sending a pulse width modulated signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the engine cooling fan motor in relation to the pulse width modulated signal. The cooling fan speed is effected by many different conditions and can be adjusted from 10% to 90% duty cycle (PWM), 90% is considered high speed fan. When multiple cooling fan speed requests are received the ECM uses the highest cooling fan speed of all the requests. During normal operation the control circuit voltage will be low and near battery voltage when OFF.

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Conditions for Running the DTC

- The ignition voltage is between 10 and 18 volts.
- The engine speed is more than 400 RPM.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) ON the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM will store conditions which were present when the DTC set as Freeze Frame and Failure Records data.

Conditions for Clearing the DTC

- The ECM will turn OFF the MIL during the third consecutive ignition cycle that the diagnostic runs and passes.
- The History DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

- Cooling fan duty cycle starts when engine coolant temperature reaches approximately 95°C (204°F) and reaches high speed at temperatures above 113°C (235°F).
- Cooling fan duty cycle starts when A/C pressure reaches approximately 1100 kPa (160 psi) and reaches high speed at A/C pressures above 2480 kPa (360 psi)
- At engine oil temperatures above approximately 150°C (302°F) the cooling fan duty cycle will be commanded to high speed.
- At transmission oil temperatures above approximately 132°C (270°F) the cooling fan duty cycle will be commanded to high speed.
- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 113°C (235°F) or the A/C pressure is greater than 1720 kPa (249 psi) the cooling fan duty cycle is set to 50%, low speed. If the coolant temperature drops below 110°C (230°F) and the A/C pressure drops below 1660 kPa (241 psi) the fan will shut OFF. The fans will automatically shut OFF after 2 min. regardless of coolant temperature.

Reference Information

Schematic Reference

Engine Cooling Schematics

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Connector End View Reference

Cooling System Connector End Views

Description and Operation

Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Circuit/System Verification

Ignition ON, command the cooling fan ON and OFF with a scan tool. Observe that the cooling fan turns ON and OFF with each command.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Fan control module.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the ground circuit and ground.
 - If greater than 1.0 ohm, test the ground circuit for an open/high resistance.
3. Ignition ON, test for B+ between the battery positive voltage circuit and ground.
 - If less than B+, test the battery positive voltage circuit for a short to ground or an open/high resistance. If the COOLFAN fuse is open, test battery positive voltage circuit for a short to ground.
4. With a DMM, test for B+ between the B+ circuit terminal 3 and the control circuit terminal 6.
 - If less than B+, test the control circuit for and open/high resistance. If the circuit tests normal replace the ECM.
5. Test for 1.5-.5 ohms of resistance between the low reference terminal 1 and supply voltage terminal 4.
 - If not within specified value, test and replace the cooling fan.
6. If all circuits test normal, test and replace the cooling fan control module.

Component Testing

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Install a 60A fused Jumper wire between the cooling fan supply voltage terminal 4 and B+. Momentarily install a jumper wire between the cooling fan low reference terminal 1 and ground. The cooling fan should turn ON.

- If the function does not perform as specified, replace the cooling fan.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Cooling Fan and Shroud Replacement (w/PWM)** or **Cooling Fan and Shroud Replacement (w/o PWM)**
- **Control Module References** for ECM replacement, setup, and programming.

SYMPTOMS - ENGINE COOLING

IMPORTANT: The following steps must be completed before using the symptom tables.

Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:

1. There are no DTCs set.
2. The control modules can communicate via the serial data link.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect cooling system operation. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

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

Symptom List

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

- **Low Engine Coolant Indicator Always On**
- **Cooling Fan Always On**
- **Cooling Fan Inoperative**
- **Coolant Heater Inoperative**
- **Loss of Coolant (LH2)** or **Loss of Coolant (LC3)**

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- **Thermostat Diagnosis**
- **Engine Fails To Reach Normal Operating Temperature**

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

| Step | Action | Yes | No |
|--|--|----------------------|--|
| Schematic Reference: <u>Engine Cooling Schematics</u> | | | |
| 1 | Did you perform the Diagnostic System Check - Vehicle? | Go to Step 2 | Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information |
| 2 | 1. Verify the coolant level is at the proper level in the surge tank. 2. Turn ON the ignition with the engine OFF. Is the low coolant message displayed on the IPC? | Go to Step 3 | Go to <u>Testing for Electrical Intermittents</u> in Wiring Systems |
| 3 | 1. Turn OFF the ignition. 2. Disconnect the coolant level switch. 3. Inspect the ground circuit for an open or high resistance at the coolant level switch connector. Did you find and correct the condition? | Go to Step 10 | Go to Step 4 |
| 4 | 1. Turn ON the ignition with the engine OFF. 2. Inspect the control circuit at the coolant level switch connector for a 5-volt signal. Is 5 volts present on the control circuit? | Go to Step 6 | Go to Step 5 |
| 5 | Inspect the control circuit of the low coolant switch for and open or short to voltage. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition? | Go to Step 10 | Go to Step 8 |
| 6 | Inspect for poor connections at the coolant level switch. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition? | Go to Step 10 | Go to Step 7 |
| 7 | Replace the coolant level switch. Refer to <u>Radiator Surge Tank Replacement</u> . Did you complete the replacement? | Go to Step 10 | - |
| 8 | Inspect for poor connections at the HVAC control module. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition? | Go to Step 10 | Go to Step 9 |

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| | | | |
|----|---|----------------------|---------------------|
| 9 | Replace the HVAC control module. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement? | Go to Step 10 | - |
| 10 | Operate the system in order to verify the repair. Did you correct the condition? | System OK | Go to Step 3 |

COOLING FAN ALWAYS ON

Diagnostic Aids

Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. The cooling fan control module is sensitive to heat. If the module is covered with thick mud or dirt it may cause the cooling fan module to overheat and command the fan on at undesired times.

Test Description

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

3: This step checks for ground on the cooling fan control circuit.

Cooling Fan Always On

| Step | Action | Values | Yes | No |
|--|---|--------|---------------------|--|
| Schematic Reference: <u>Engine Cooling Schematics</u> Connector End View Reference: <u>Cooling System Connector End Views</u> DEFINITION: Engine cooling fan operates all the time when the vehicle is started or not started. | | | | |
| 1 | Did you perform the Diagnostic System Check - Vehicle? | - | Go to Step 2 | Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information |
| 2 | IMPORTANT: The vehicle must be allowed to cool down. The HVAC control system must be in the OFF position and the coolant temperature must stay below 91° (195°F) for this diagnostic. 1. Start the vehicle. 2. Turn OFF the HVAC system. Is the cooling fan ON? | - | Go to Step 3 | Go to Diagnostic Aids |
| | 1. Turn OFF the ignition. 2. Disconnect the fan control module connector. | | | |

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| | | | | |
|---|---|---|---------------------|---------------------|
| 3 | 3. Probe the cooling fan speed control circuit of the fan control module with a test lamp that is connected to voltage. Does the test lamp illuminate? | - | Go to Step 7 | Go to Step 4 |
| 4 | Inspect the battery positive voltage circuit of the cooling fan motor for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you find and correct the condition? | - | Go to Step 9 | Go to Step 5 |
| 5 | Inspect for poor connections at the fan control module. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. Did you find and correct the condition? | - | Go to Step 9 | Go to Step 6 |
| 6 | Replace the fan control module. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement? | - | Go to Step 9 | - |
| 7 | Inspect for poor connections at the engine control module (ECM). Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. Did you find and correct the condition? | - | Go to Step 9 | Go to Step 8 |
| 8 | Replace the ECM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement? | - | Go to Step 9 | - |
| 9 | Operate the system in order to verify the repair. Did you correct the condition? | - | System OK | Go to Step 2 |

COOLING FAN INOPERATIVE**Diagnostic Fault Information**

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

The engine cooling fan is a variable speed fan. The ECM controls the fan speed by sending a pulse width modulated signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the engine cooling fan motor in relation to the pulse width modulated signal. The cooling fan speed is effected by many different conditions and can be adjusted from 10% to 90% duty cycle (PWM), 90% is considered high speed fan. When multiple cooling fan speed requests are received the ECM uses the highest cooling fan speed of all the requests. During normal operation the control circuit voltage will be low and near battery voltage when OFF.

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Diagnostic Aids

1. Cooling fan duty cycle starts when engine coolant temperature reaches approximately 95°C (204°F) and reaches high speed at temperatures above 113°C (235°F).
2. Cooling fan duty cycle starts when A/C pressure reaches approximately 1100 kPa (160 Psi) and reaches high speed at A/C pressures above 2480 kPa (360 psi)
3. At engine oil temperatures above approximately 150°C (302°F) the cooling fan duty cycle will be commanded to high speed.
4. At transmission oil temperatures above approximately 132°C (270°F) the cooling fan duty cycle will be commanded to high speed.
5. After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 113°C (235°F) or the A/C pressure is greater than 1720 kPa (249 psi) the cooling fan duty cycle is set to 50%, low speed. If the coolant temperature drops below 110°C (230°F) and the A/C pressure drops below 1660 kPa (241 psi) the fan will shut OFF. The fans will automatically shut OFF after 2 min. regardless of coolant temperature.

Reference Information

Schematic Reference

Engine Cooling Schematics

Connector End View Reference

Cooling System Connector End Views

Description and Operation

Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**
- **Scan Tool Output Controls**

Circuit/System Verification

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Ignition ON, command the cooling fan ON and OFF with a scan tool. Observe that the cooling fan turns ON and OFF with each command.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Fan control module.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the ground circuit and ground.
 - If greater than 1.0 ohm, test the ground circuit for an open/high resistance.
3. Ignition ON, test for B+ between the battery positive voltage circuit and ground.
 - If less than B+, test the battery positive voltage circuit for a short to ground or an open/high resistance. If the COOLFAN fuse is open, test battery positive voltage circuit for a short to ground.
4. With a DMM, test for B+ between the B+ circuit terminal 3 and the control circuit terminal 6.
 - If less than B+, test the control circuit for an open/high resistance. If the circuit tests normal replace the ECM.
5. Test for 1.5-.5 ohms of resistance between the low reference terminal 1 and supply voltage terminal 4.
 - If not within specified value, test and replace the cooling fan.
6. If all circuits test normal, test and replace the cooling fan control module.

Component Testing

Install a 60A fused Jumper wire between the cooling fan supply voltage terminal 4 and B+. Momentarily install a jumper wire between the cooling fan low reference terminal 1 and ground. The cooling fan should turn ON.

- If the function does not perform as specified, replace the cooling fan.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Cooling Fan and Shroud Replacement (w/PWM)** or **Cooling Fan and Shroud Replacement (w/o PWM)**
- **Control Module References** for ECM replacement, setup, and programming.

ENGINE OVERHEATING

Engine Overheating

| Step | Action | Yes | No |
|------|--|---------------------|---------------------|
| 1 | Inspect for a missing or damaged radiator, upper or lower baffle, and/or radiator air deflector. Is the baffle and/or deflector missing or damaged? | Go to Step 8 | Go to Step 2 |
| 2 | Inspect for a loss of coolant. Is there a loss of coolant? | Go to Step 3 | Go to Step 4 |
| 3 | Fill the system to the specified level. Refer to <u>Loss of Coolant (LH2)</u> or <u>Loss of Coolant (LC3)</u> . | | |

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| | | | |
|----|--|----------------------|----------------------|
| | Does the engine overheat? | Go to Step 4 | System OK |
| 4 | Inspect for low coolant protection. Is the coolant to the correct concentration? | Go to Step 5 | Go to Step 8 |
| 5 | Inspect for a loss of cooling system pressure. Is there a loss of system pressure? | Go to Step 8 | Go to Step 6 |
| 6 | Inspect for a faulty engine coolant temperature (ECT) sensor. Refer to DTC P0117 , DTC P0118 , or DTC P0125 in Engine Controls - 4.6L (LH2). Is the sensor operating properly? | Go to Step 7 | Go to Step 8 |
| 7 | Inspect for a cracked coolant surge tank or a leaking hose. Is the coolant surge tank cracked or is the hose leaking? | Go to Step 8 | Go to Step 3 |
| 8 | Repair or install new parts as necessary, then retest. Does the engine overheat? | Go to Step 9 | System OK |
| 9 | Inspect for incorrect drive belt tension. Is the belt tension correct? | Go to Step 10 | Go to Step 8 |
| 10 | 1. Remove the water pump. Refer to Water Pump Replacement (LH2) or Water Pump Replacement (LC3) . 2. Inspect for a damaged water pump driveshaft. Is the water pump driveshaft damaged or is the seal leaking? | Go to Step 8 | Go to Step 11 |
| 11 | Inspect for obstructed radiator air flow or bent radiator fins. Is the radiator air flow obstructed? | Go to Step 8 | Go to Step 12 |
| 12 | Inspect for blocked cooling system passages. Are the cooling system passages blocked? | Go to Step 8 | Go to Step 13 |
| 13 | Inspect for inoperative cooling fans. Refer to Cooling Fan Inoperative . Are the cooling fans and the motors operating correctly? | Go to Step 14 | Go to Step 8 |
| 14 | Inspect the thermostat. Refer to Thermostat Diagnosis . Is the thermostat stuck in the closed position? | Go to Step 15 | Go to Step 16 |
| 15 | Replace the thermostat. Refer to Engine Coolant Thermostat Replacement (LH2) or Engine Coolant Thermostat Replacement (LC3) . Does the engine overheat? | Go to Step 16 | System OK |
| 16 | Inspect the radiator cooling capacity. Is the proper sized radiator being used on the vehicle? | Go to Step 3 | Go to Step 17 |
| 17 | Consult the current parts catalog and replace the radiator. Refer to Radiator Replacement . Is the repair complete? | System OK | - |

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LOSS OF COOLANT (LH2)

Loss of Coolant (LH2)

| Step | Action | Yes | No |
|---|---|----------------------|--|
| DEFINITION: The cooling system is losing coolant either internally or externally. | | | |
| 1 | Were you sent here from Symptoms or another diagnostic table? | Go to Step 2 | Go to Symptoms - Engine Cooling |
| 2 | Repair any present DTCs. Refer to Diagnostic Starting Point - Engine Cooling . Is the action complete? | Go to Step 3 | - |
| 3 | Inspect the coolant level at the surge tank. Is the coolant at the proper level? | Go to Step 5 | Go to Step 4 |
| 4 | Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716) . Is the action complete? | Go to Step 5 | - |
| 5 | If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate? | Go to Step 6 | Go to Step 22 |
| 6 | Engine overheating can cause a loss of coolant. Is the engine overheating? | Go to Step 23 | Go to Step 7 |
| 7 | Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking? | Go to Step 25 | Go to Step 8 |
| 8 | Visually inspect the hoses, pipes and hose clamps at the following locations: <ul style="list-style-type: none"> • Surge Tank • Throttle Body • Water Pump • Heater Core • Radiator Are any of the hoses, clamps or pipes leaking? | Go to Step 18 | Go to Step 9 |
| 9 | Visually inspect the following components: <ul style="list-style-type: none"> • Block heater • Coolant Pressure Cap • Core Plugs • Cylinder Head Gaskets • Cylinder Heads • Engine Block | | |

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| | | | |
|----|---|----------------------|----------------------|
| | <ul style="list-style-type: none"> • Radiator • Thermostat housing • Water pump | | |
| | Are any of the listed components leaking? | Go to Step 18 | Go to Step 10 |
| 10 | <ol style="list-style-type: none"> 1. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing (Powertrain)</u> or <u>Cooling System Leak Testing (Charge Air Cooling)</u>. 2. With the cooling system pressurized, visually inspect the components listed in steps 8 and 9. | | |
| | Are any leaks present? | Go to Step 18 | Go to Step 11 |
| 11 | Pressure test the coolant pressure cap. Refer to <u>Pressure Cap Testing</u> . | | |
| | Does the coolant pressure cap hold pressure? | Go to Step 12 | Go to Step 19 |
| 12 | <ol style="list-style-type: none"> 1. Apply the parking brake. 2. Ensure the vehicle is in PARK. 3. Start and idle the engine until it reaches normal operating temperature. 4. Inspect for heavy white smoke coming out of the exhaust pipe. | | |
| | Is a heavy white smoke present from the exhaust pipe? | Go to Step 13 | Go to Step 14 |
| 13 | Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor? | Go to Step 24 | Go to Step 14 |
| 14 | With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling? | Go to Step 26 | Go to Step 15 |
| 15 | Inspect for the following conditions: <ul style="list-style-type: none"> • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. | | |
| | Is coolant present? | Go to Step 20 | Go to Step 16 |

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|----|---|----------------------|----------------------|
| 16 | Inspect the engine oil for a gray/white milky substance. Is there a milky substance in the engine oil ? | Go to Step 24 | Go to Step 17 |
| 17 | Inspect the transmission oil fluid for a gray/white milky substance. Does the transmission fluid contain a gray/white milky substance? | Go to Step 21 | Go to Step 27 |
| 18 | Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete? | Go to Step 27 | - |
| 19 | Replace the coolant pressure cap. Is the repair complete? | Go to Step 27 | - |
| 20 | Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete? | Go to Step 27 | - |
| 21 | 1. Replace the radiator. Refer to <u>Radiator Replacement</u> . 2. Service the transmission. Refer to <u>Engine Coolant/Water in Transmission</u> . Is the repair complete? | Go to Step 27 | - |
| 22 | Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> . Is the repair complete? | Go to Step 27 | - |
| 23 | Repair the engine overheating condition. Refer to <u>Engine Overheating</u> . Is the repair complete? | Go to Step 27 | - |
| 24 | Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> or <u>Coolant in Engine Oil</u> . Is the repair complete? | Go to Step 27 | - |
| 25 | Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> . Is the repair complete? | Go to Step 27 | - |
| 26 | Repair the combustion pressure in the cooling system problem. Refer to <u>Cylinder Leakage Test</u> . Is the repair complete? | Go to Step 27 | - |
| 27 | Operate the system in order to verify the repair. Did you find and correct the condition? | System OK | Go to Step 2 |

LOSS OF COOLANT (LC3)

Loss of Coolant (LC3)

| Step | Action | Yes | No |
|---|--------|-----|----|
| DEFINITION: The cooling system is losing coolant either internally or externally. | | | |
| | | | |

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|----|--|----------------------|--|
| 1 | Were you sent here from Symptoms or another diagnostic table? | Go to Step 2 | Go to Symptoms - Engine Cooling |
| 2 | Repair any present DTCs. Refer to Diagnostic Starting Point - Engine Cooling . Is the action complete? | Go to Step 3 | - |
| 3 | Inspect the coolant level at the surge tank. Is the coolant at the proper level? | Go to Step 4 | Go to Step 5 |
| 4 | Inspect the charge air cooling system coolant level. Is the coolant at the proper level? | Go to Step 7 | Go to Step 6 |
| 5 | Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716) . Is the action complete? | Go to Step 4 | - |
| 6 | Fill the charge air cooling system to the proper level. Refer to Charge Air Cooling System Draining and Filling (Static Fill) or Charge Air Cooling System Draining and Filling (GE 47716) . Is the action complete? | Go to Step 7 | - |
| 7 | 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 8 | Go to Step 27 |
| 8 | Engine overheating can cause a loss of coolant. Is the engine overheating? | Go to Step 28 | Go to Step 9 |
| 9 | Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking? | Go to Step 30 | Go to Step 10 |
| 10 | Visually inspect the hoses, pipes and hose clamps at the following locations: <ul style="list-style-type: none"> • Radiator - Charge Air Cooler • Pump - Charge Air Cooler • Charge Air Cooler Are any of the hoses, clamps or pipes leaking? | Go to Step 23 | Go to Step 11 |
| 11 | Visually inspect the following components: <ul style="list-style-type: none"> • Radiator - Charge Air Cooler • Pump - Charge Air Cooler • Charge Air Cooler • Charge Air Coolant Cap Are any of the listed components leaking? | Go to Step 23 | Go to Step 12 |

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|----|---|----------------------|----------------------|
| 12 | <ol style="list-style-type: none">1. Pressure test the charge air cooling system. Refer to <u>Cooling System Leak Testing (Powertrain)</u> or <u>Cooling System Leak Testing (Charge Air Cooling)</u>.2. With the cooling system pressurized, visually inspect the components listed in steps 10 and 11. <p>Are any leaks present?</p> | Go to Step 23 | Go to Step 13 |
| 13 | <p>Visually inspect the hoses, pipes and hose clamps at the following locations:</p> <ul style="list-style-type: none">• Surge Tank• Throttle Body• Water Pump• Generator• Heater Core• Radiator <p>Are any of the hoses, clamps or pipes leaking?</p> | Go to Step 23 | Go to Step 14 |
| 14 | <p>Visually inspect the following components:</p> <ul style="list-style-type: none">• Block heater• Coolant Pressure Cap• Core Plugs• Cylinder Head Gaskets• Cylinder Heads• Engine Block• Radiator• Thermostat housing• Water pump <p>Are any of the listed components leaking?</p> | Go to Step 23 | Go to Step 15 |
| 15 | <ol style="list-style-type: none">1. Pressure test the cooling system. Refer to <u>Cooling System Leak Testing (Powertrain)</u> or <u>Cooling System Leak Testing (Charge Air Cooling)</u>.2. With the cooling system pressurized, visually inspect the components listed in steps 13 and 14. <p>Are any leaks present?</p> | Go to Step 23 | Go to Step 16 |

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|----|--|----------------------|----------------------|
| 16 | Pressure test the coolant pressure cap. Refer to <u>Pressure Cap Testing</u> . Does the coolant pressure cap hold pressure? | Go to Step 17 | Go to Step 24 |
| 17 | <ol style="list-style-type: none"> 1. Apply the parking brake. 2. Ensure the vehicle is in PARK. 3. Start and idle the engine until it reaches normal operating temperature. 4. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe? | Go to Step 18 | Go to Step 19 |
| 18 | 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 29 | Go to Step 19 |
| 19 | With the engine idling, inspect the surge tank. Does the surge tank discharge coolant while the engine is idling? | Go to Step 31 | Go to Step 20 |
| 20 | Inspect for the following conditions: <ul style="list-style-type: none"> • A coolant smell inside of the vehicle. • Coolant in the HVAC module drain tube. • Coolant on the vehicle floor covering near the HVAC module. Is coolant present? | Go to Step 25 | Go to Step 21 |
| 21 | Inspect the engine oil for a gray/white milky substance. Is there a milky substance in the engine oil ? | Go to Step 29 | Go to Step 22 |
| 22 | Inspect the transmission oil fluid for a gray/white milky substance. Does the transmission fluid contain a gray/white milky substance? | Go to Step 26 | Go to Step 32 |
| 23 | Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete? | Go to Step 32 | - |
| 24 | Replace the coolant pressure cap. Is the repair complete? | Go to Step 32 | - |
| 25 | Replace the heater core. Refer to <u>Heater Core Replacement</u> . Is the repair complete? | Go to Step 32 | - |
| | | | |

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| | | | |
|----|---|----------------------|---------------------|
| 26 | <ol style="list-style-type: none">1. Replace the radiator. Refer to <u>Radiator Replacement</u>.2. Service the transmission. Refer to <u>Engine Coolant/Water in Transmission</u> . <p>Is the repair complete?</p> | Go to Step 32 | - |
| 27 | <p>Repair the engine no crank condition. Refer to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> .</p> <p>Is the repair complete?</p> | Go to Step 32 | - |
| 28 | <p>Repair the engine overheating condition. Refer to <u>Engine Overheating</u>.</p> <p>Is the repair complete?</p> | Go to Step 32 | - |
| 29 | <p>Repair the engine internal coolant leak. Refer to <u>Coolant in Combustion Chamber</u> or <u>Coolant in Engine Oil</u> .</p> <p>Is the repair complete?</p> | Go to Step 32 | - |
| 30 | <p>Repair the engine knock. Refer to <u>Lower Engine Noise, Regardless of Engine Speed</u> .</p> <p>Is the repair complete?</p> | Go to Step 32 | - |
| 31 | <p>Repair the combustion pressure in the cooling system problem. Refer to <u>Cylinder Leakage Test</u> .</p> <p>Is the repair complete?</p> | Go to Step 32 | - |
| 32 | <p>Operate the system in order to verify the repair.</p> <p>Did you find and correct the condition?</p> | System OK | Go to Step 2 |

THERMOSTAT DIAGNOSIS

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

Tools Required

J 24731 Tempilstick. See **Special Tools**.

Thermostat Test Procedure Using Tempilsticks

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

Thermostat Test Procedure Using Glycol

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

In order to inspect if the thermostat valve is opening properly, perform the following test:

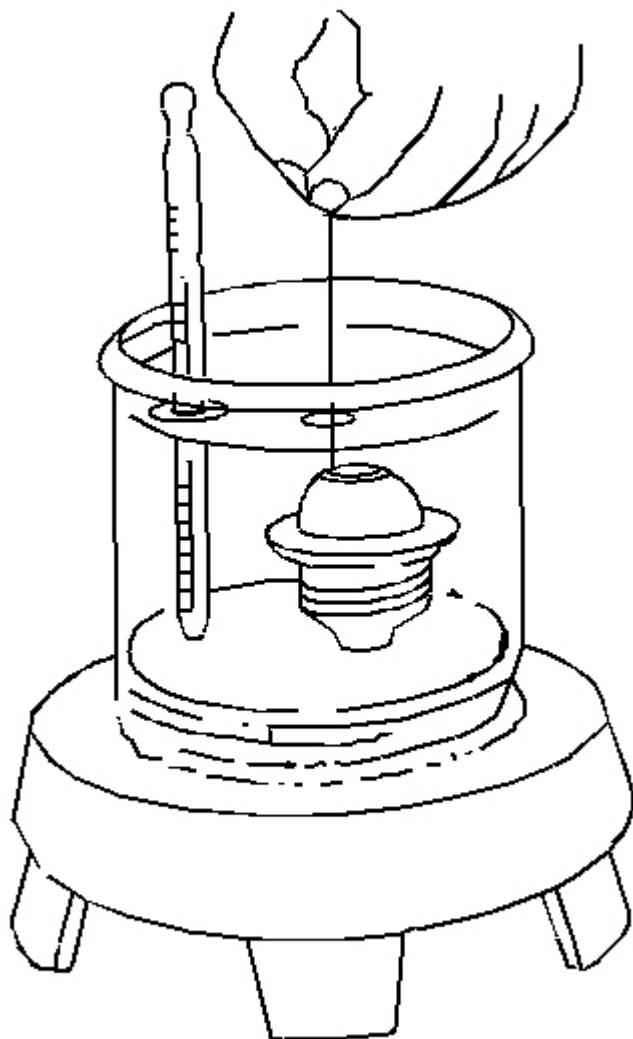


Fig. 7: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS CORP.

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

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temperature indicated on the thermostat valve.

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

In order to inspect if the thermostat valve is closing properly, perform the following test:

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

COOLANT HEATER INOPERATIVE

Coolant Heater Inoperative

| Step | Action | Yes | No |
|--|---|---------------------|---|
| Connector End View Reference: <u>Cooling System Connector End Views</u> | | | |
| 1 | Did you perform the Diagnostic System Check - Vehicle? | Go to Step 2 | Go to Diagnostic System Check - Vehicle in Vehicle DTC Information |
| 2 | Test the engine coolant heater power supply cord for an open or short to ground. Refer to Circuit Testing in Wiring Systems. Did you find a condition? | Go to Step 3 | Go to Step 4 |
| 3 | Replace the engine coolant heater power supply cord. Refer to Coolant Heater Cord Replacement . Did you complete the repair? | Go to Step 6 | - |
| 4 | Inspect for poor connections at the harness connector of the engine coolant heater. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition? | Go to Step 6 | Go to Step 5 |
| 5 | Replace the engine coolant heater. Refer to Engine Coolant Heater Replacement - Left Side . Did you complete the repair? | Go to Step 6 | - |
| 6 | Operate the system in order to verify the repair. Did you correct the condition? | System OK | Go to Step 2 |

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Engine Fails To Reach Normal Operating Temperature

| Step | Action | Yes | No |
|------|--|---------------------|---------------------|
| 1 | Check the level of the coolant in the coolant surge tank. Is the coolant in the surge tank at the proper level? | Go to Step 3 | Go to Step 2 |
| | Add engine coolant as necessary. Refer to Cooling System Draining and Filling (Static Fill) or Cooling | | |

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| | | | |
|---|--|---------------------|---------------------|
| 2 | System Draining and Filling (GE 47716). Does the engine still fail to reach normal operating temperature? | Go to Step 3 | System OK |
| 3 | Check if the thermostat is stuck open. Is the thermostat stuck in the open position? | Go to Step 5 | Go to Step 4 |
| 4 | Check to see if the correct type of thermostat was installed. Was the incorrect thermostat installed? | Go to Step 5 | System OK |
| 5 | Replace the thermostat. Refer to Engine Coolant Thermostat Replacement (LH2) or Engine Coolant Thermostat Replacement (LC3) . Does the engine still fail to reach normal operating temperature? | - | System OK |

PRESSURE CAP TESTING

Tools required

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

Pressure Cap Testing

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

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

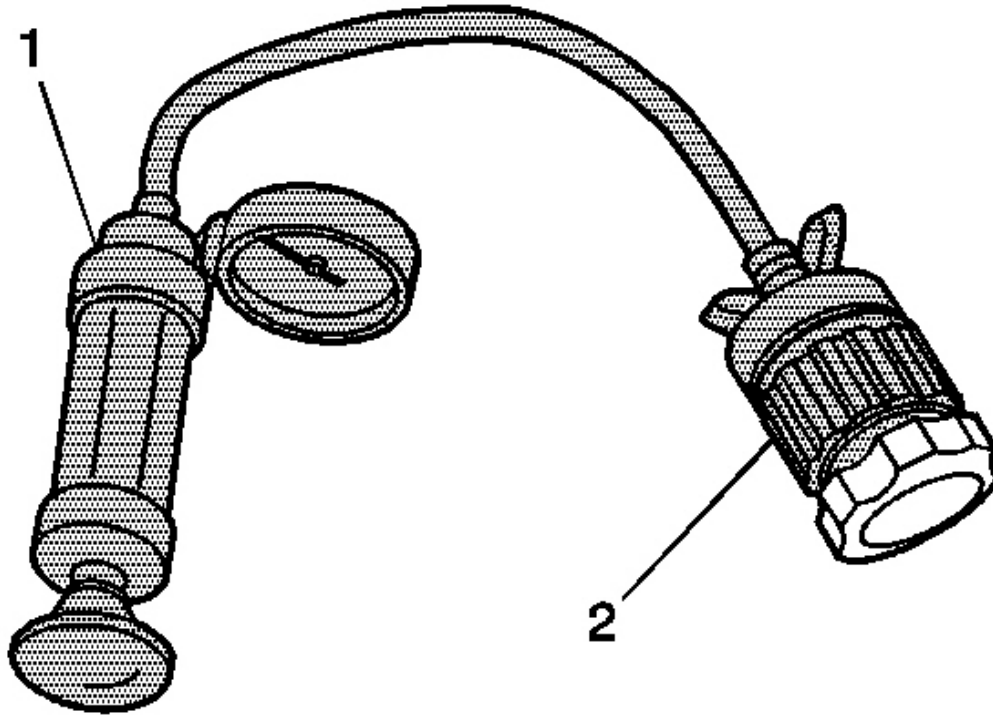


Fig. 8: Pressure Testing Radiator Cap
Courtesy of GENERAL MOTORS CORP.

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

Note the rate of pressure loss.

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

COOLING SYSTEM LEAK TESTING (POWERTRAIN)

Tools Required

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

Cooling System Leak Testing

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

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

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to Pressure Cap Testing.
3. Wash the pressure cap mating surface with water.

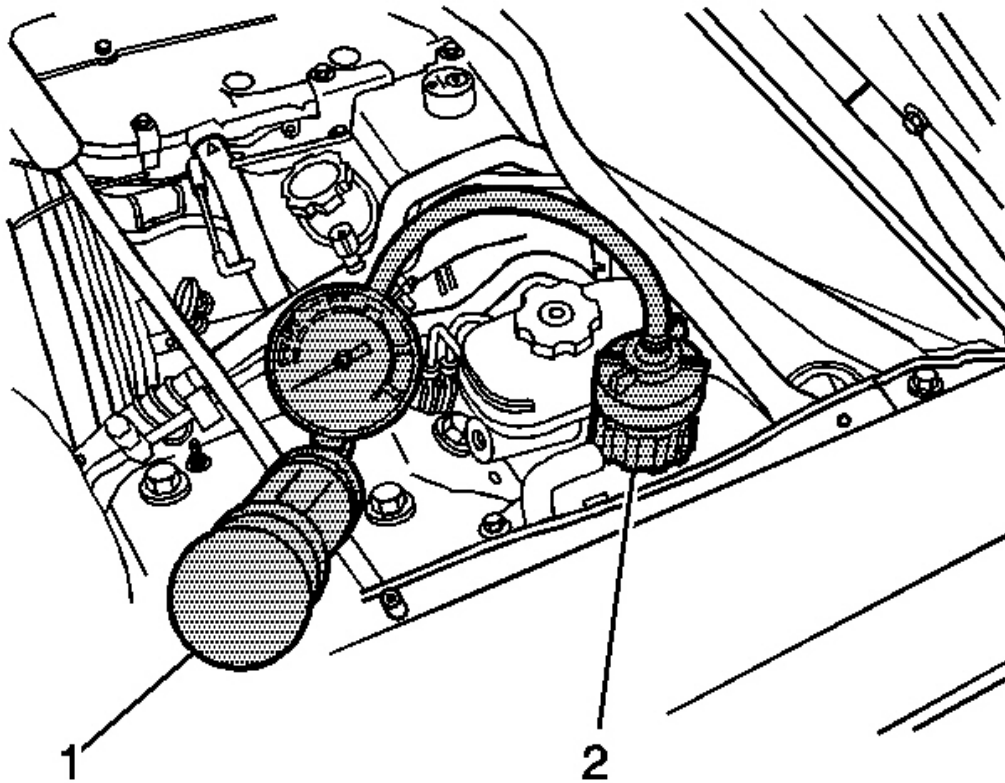


Fig. 9: Applying Pressure To Cooling System
Courtesy of GENERAL MOTORS CORP.

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

Do not exceed the pressure cap rating.

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

Observe the gage for any pressure loss.

6. Repair any leaks as required.

COOLING SYSTEM LEAK TESTING (CHARGE AIR COOLING)

Tools Required

- **J 24460-01** Cooling System Pressure Tester. See Special Tools.
- **GE-47844** Charge Air Cooling System Pressure Test Adapter

CAUTION: To avoid being burned, do not remove the charge air coolant cap while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

IMPORTANT: Ensure the intercooler system is cool and that the pump is not ON.

1. Remove the manifold sight shield. Refer to Intake Manifold Sight Shield Replacement for the 4.4L engine.

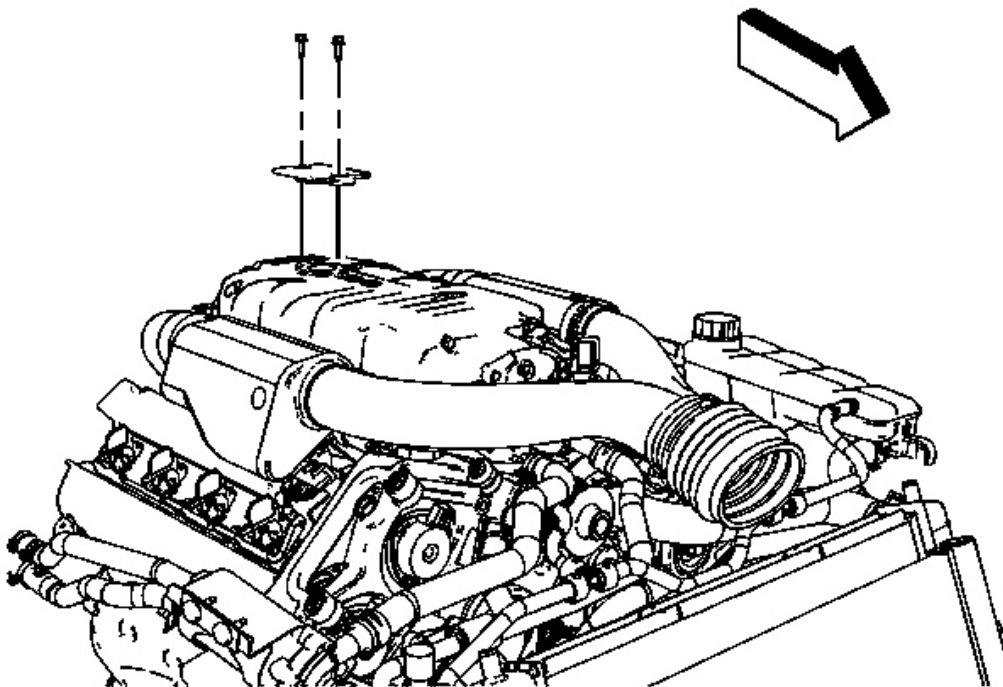


Fig. 10: Charge Air Coolant Cap
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: It is normal to have a very small pocket of air at the top of the system below the fill cap on a properly filled charge air cooling system.

2. Remove the charge air coolant cap.

NOTE: Refer to Fastener Notice .

3. Install the **GE-47844** onto the charge air cooler cap port.

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

4. Use the **J 24460-01** with **GE-47844** in order to apply pressure to the cooling system. Do not exceed 34 kPa (5 psi).
5. The cooling system should hold 34 kPa (5 psi) at least 2 minutes. Observe the gage for any pressure loss.
6. Repair any leaks as required.
7. Remove the **GE-47844** from the charge air cooler cap port.

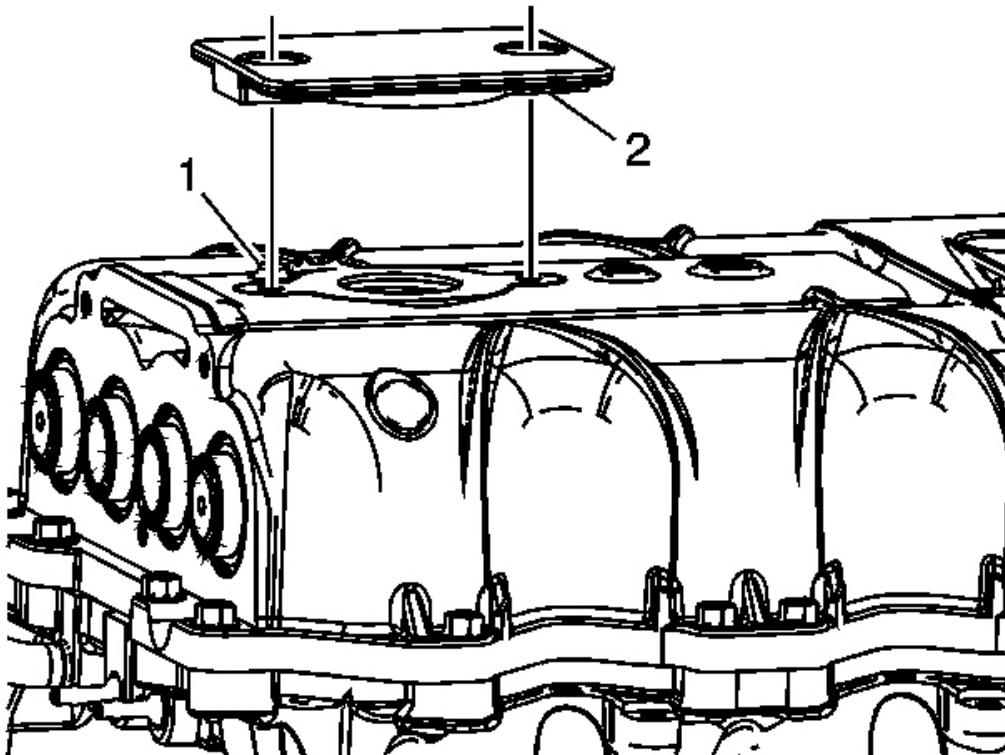


Fig. 11: Charge Air Cooler Cooling Fill Cap
Courtesy of GENERAL MOTORS CORP.

8. Install the charge air cooler cooling fill cap.
9. Ensure the charge air cooler cooling fill cap is installed in the proper orientation:
 - The alignment boss (1) is at the rear of the charge air cooler manifold.
 - The alignment boss (2) is at the front of the charge air cooler cooling filling cap.

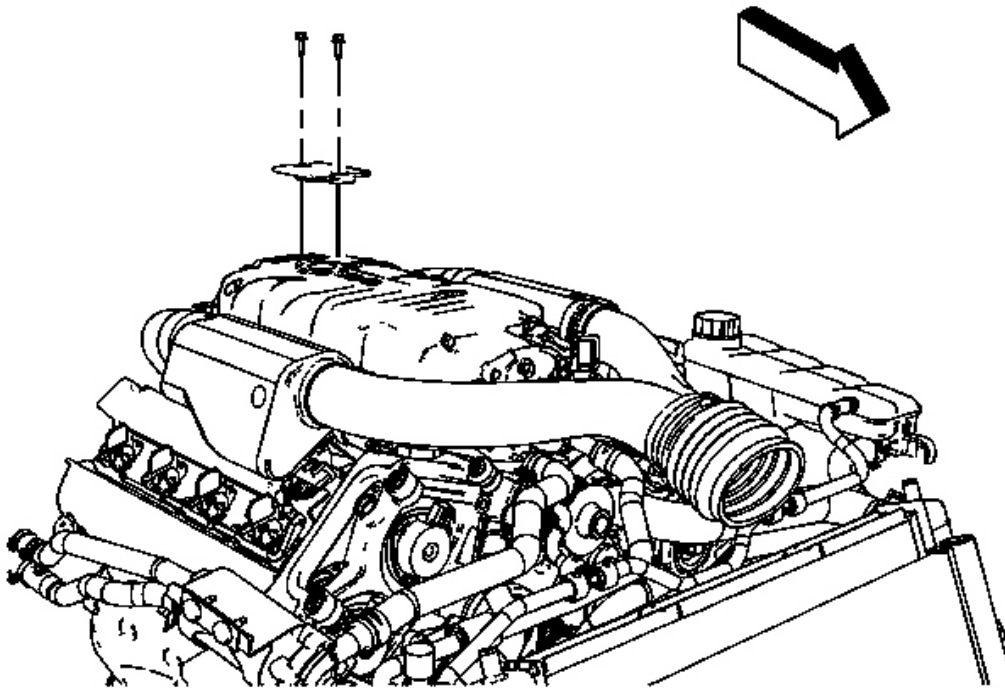


Fig. 12: Charge Air Coolant Cap Bolts
Courtesy of GENERAL MOTORS CORP.

10. Install the charge air coolant cap bolts.

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

11. Install the manifold sight shield. Refer to **Intake Manifold Sight Shield Replacement** for the 4.4L engine.

REPAIR INSTRUCTIONS

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Tools Required

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

Draining Procedure

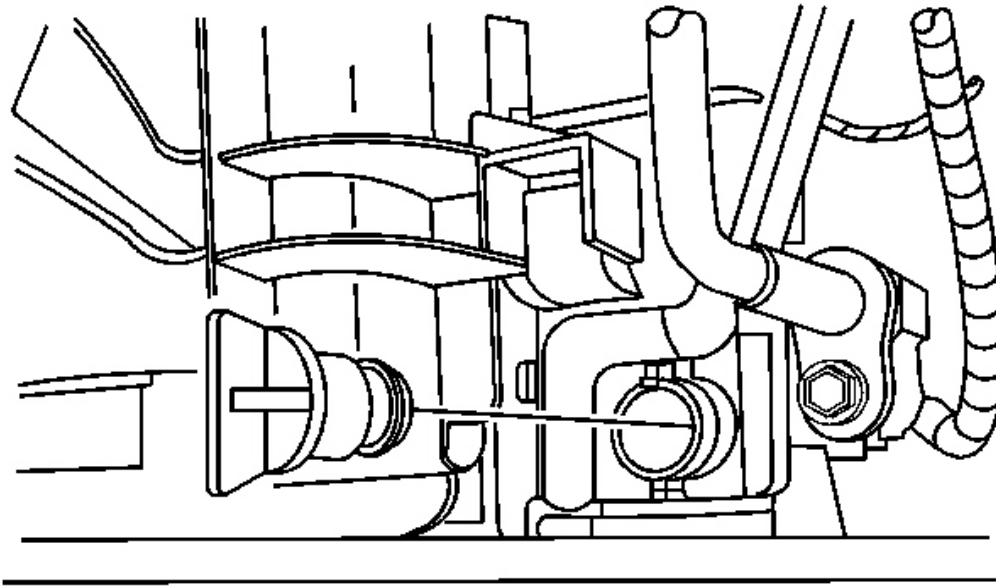


Fig. 13: Identifying Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

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 coolant pressure cap.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
3. Place a drain pan under the drain cock.
4. Remove the radiator drain cock.
5. Drain the cooling system.
6. Lower the vehicle.
7. Inspect the coolant.

8. 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 (Powertrain)Flushing (Charge Air Cooling)** .

Filling Procedure

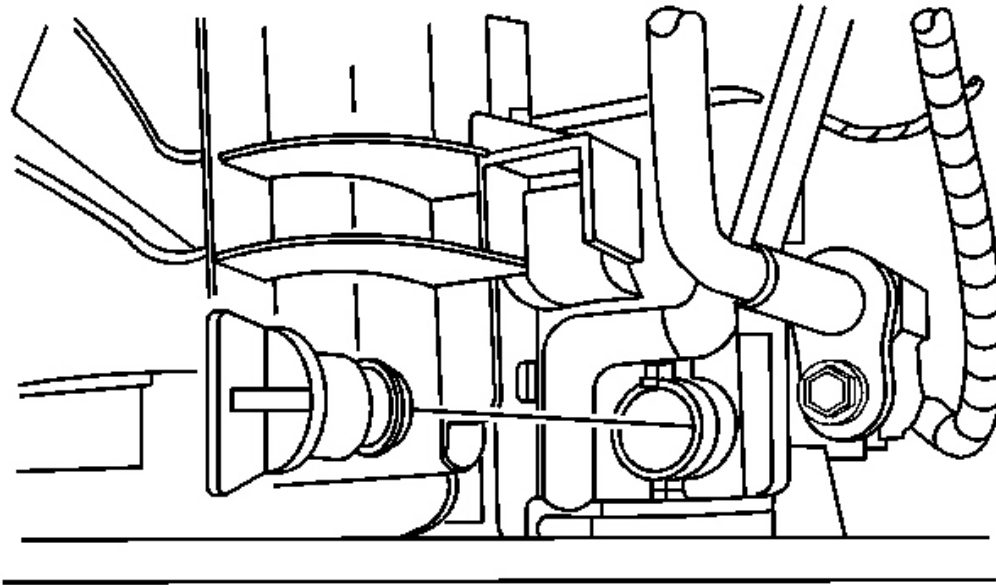


Fig. 14: Identifying Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

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

1. Raise and support the vehicle.

IMPORTANT: Inspect the drain cock O-ring for signs of cracks or damage. Replace, if necessary.

2. Lubricate the drain cock O-ring with clean coolant prior to installation.

NOTE: Refer to **Fastener Notice** .

3. Install the radiator drain cock.

Tighten: Tighten the radiator drain cock to 2 N.m (18 lb in).

4. Lower the vehicle.

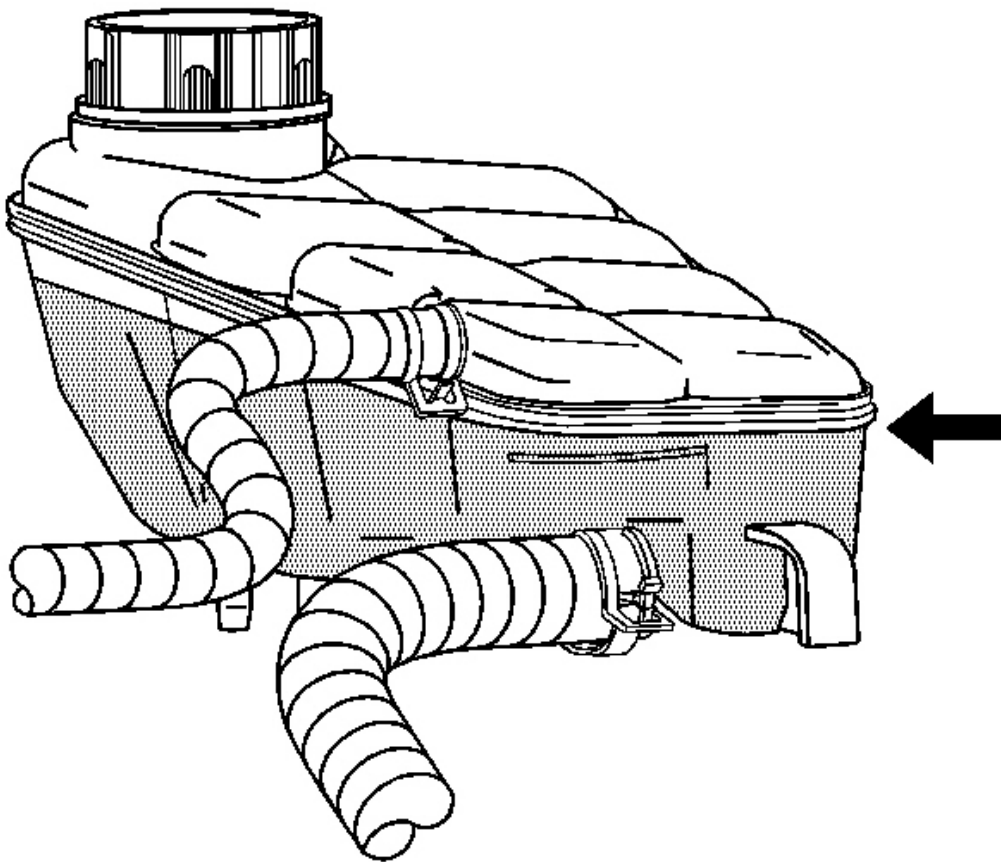


Fig. 15: Monitoring Surge Tank Coolant Level
Courtesy of GENERAL MOTORS CORP.

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

5. Slowly fill the surge tank with a 50/50 coolant mixture until the coolant level reaches the base of the surge tank fill neck. Refer to **Approximate Fluid Capacities** .

IMPORTANT: Monitor the surge tank coolant level closely. The surge tank coolant level

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will begin to decrease once the engine is started.

6. Start the engine and allow to the engine to idle.

Allow the engine to idle for approximately 4 minutes.

7. Slowly fill the coolant mixture until the level stabilizes at the base of the surge tank fill neck.
8. Run the engine between 2,000-2,500 RPM for approximately 2 minutes.
9. Allow engine to idle and add approximately 1 liter (1.1 quarts) of coolant to the surge tank.
10. Install the coolant pressure cap.
11. Turn the engine OFF.
12. Allow the engine to cool.
13. Top off the coolant as necessary.
14. Inspect the concentration of the engine coolant. Using the **J 26568** . See **Special Tools**.
15. Rinse away any excess coolant from the engine and the engine compartment.
16. Inspect the cooling system for leaks.

COOLING SYSTEM DRAINING AND FILLING (GE 47716)

Tools Required

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

Draining Procedure

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

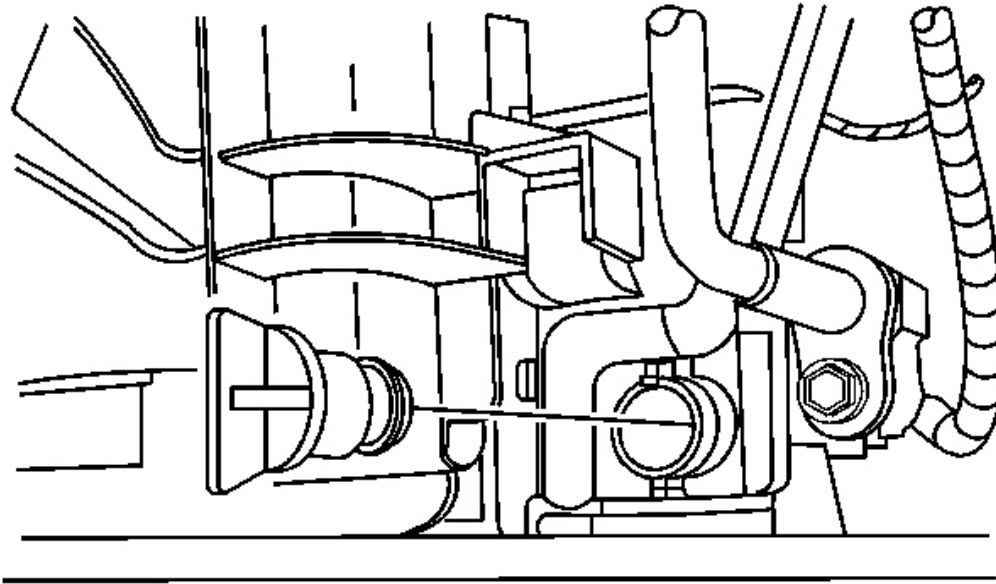


Fig. 16: Identifying Radiator Drain Cock
Courtesy of GENERAL MOTORS CORP.

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 coolant pressure cap.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Place a drain pan under the drain cock.
4. Remove the radiator drain cock.
5. Drain the cooling system.
6. Lower the vehicle.
7. Inspect the coolant.
8. 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 (Powertrain)** or **Flushing (Charge Air Cooling)**.

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

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

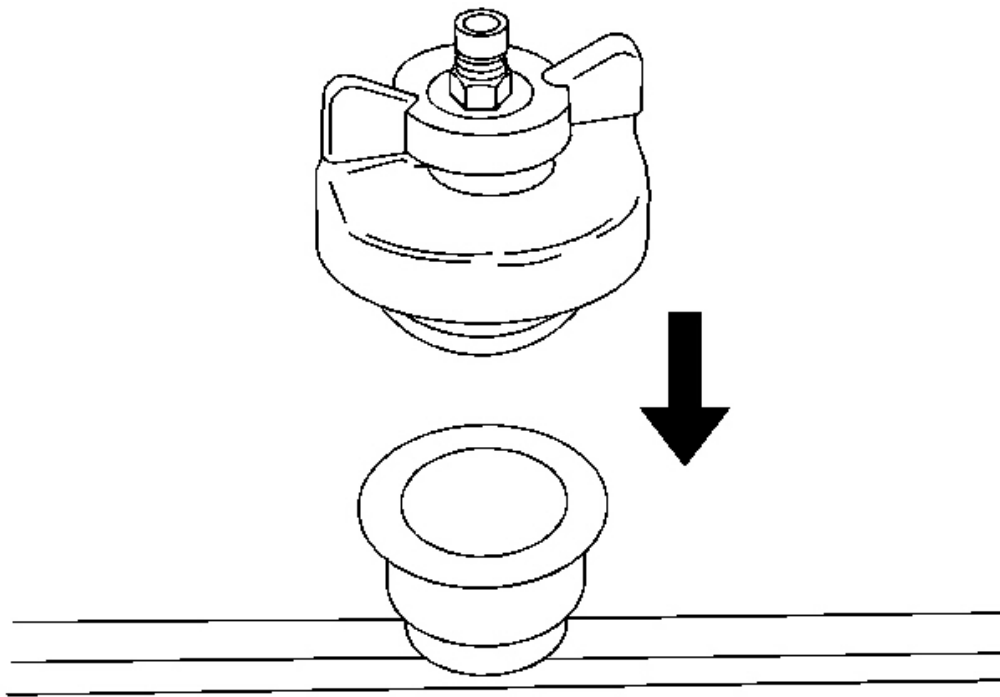


Fig. 17: Vac N Fill Cap
Courtesy of GENERAL MOTORS CORP.

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

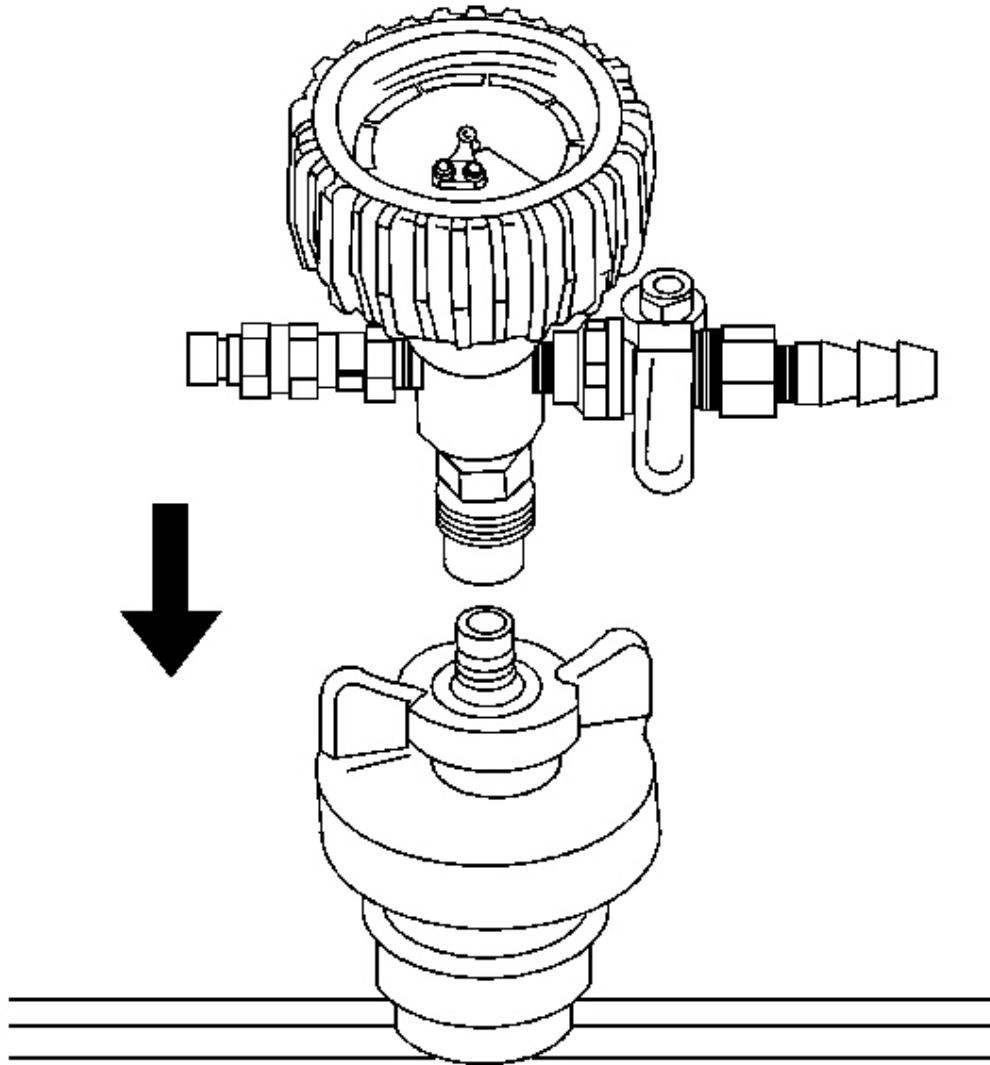


Fig. 18: Attaching The Vacuum Gage Assembly To The Vac N Fill Cap
Courtesy of GENERAL MOTORS CORP.

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

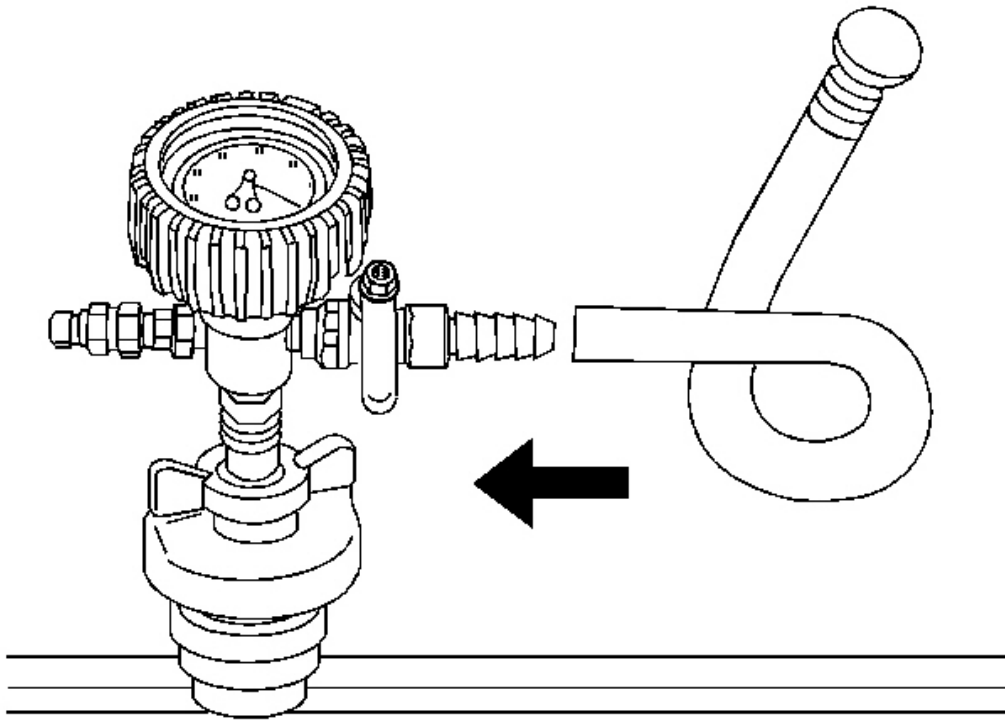


Fig. 19: Fill Hose

Courtesy of GENERAL MOTORS CORP.

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

Ensure that the valve is closed.

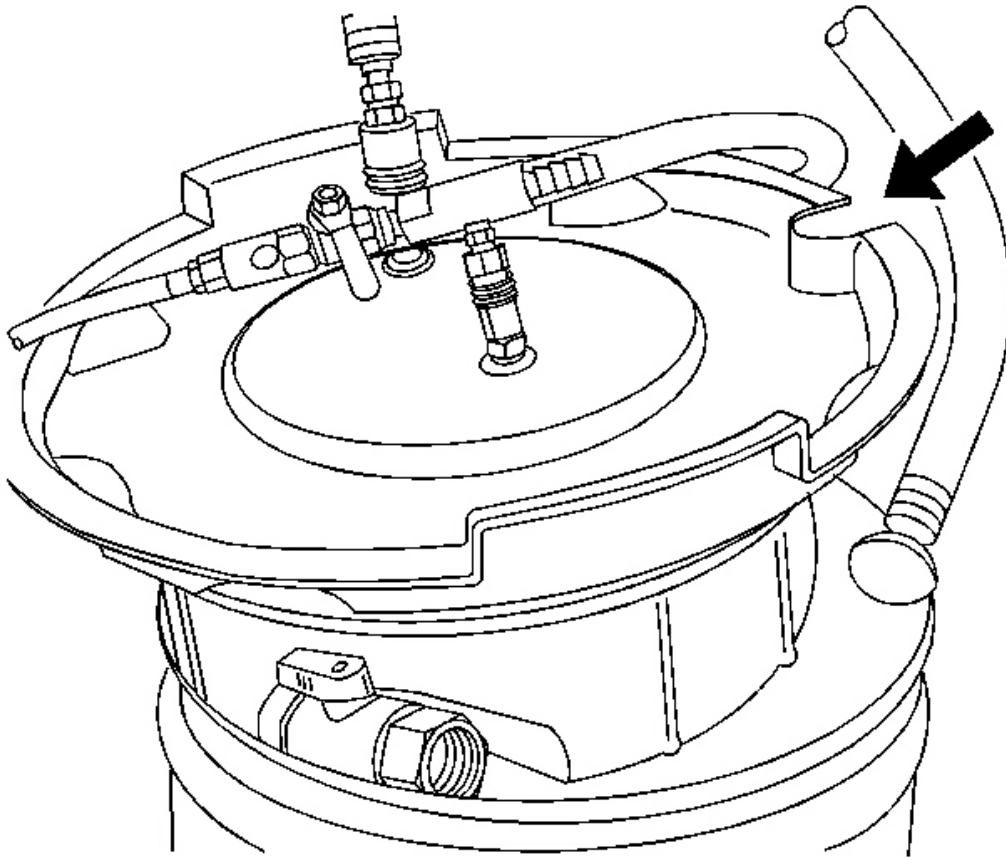


Fig. 20: Graduated Reservoir
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

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

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

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

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

vacuum tank.

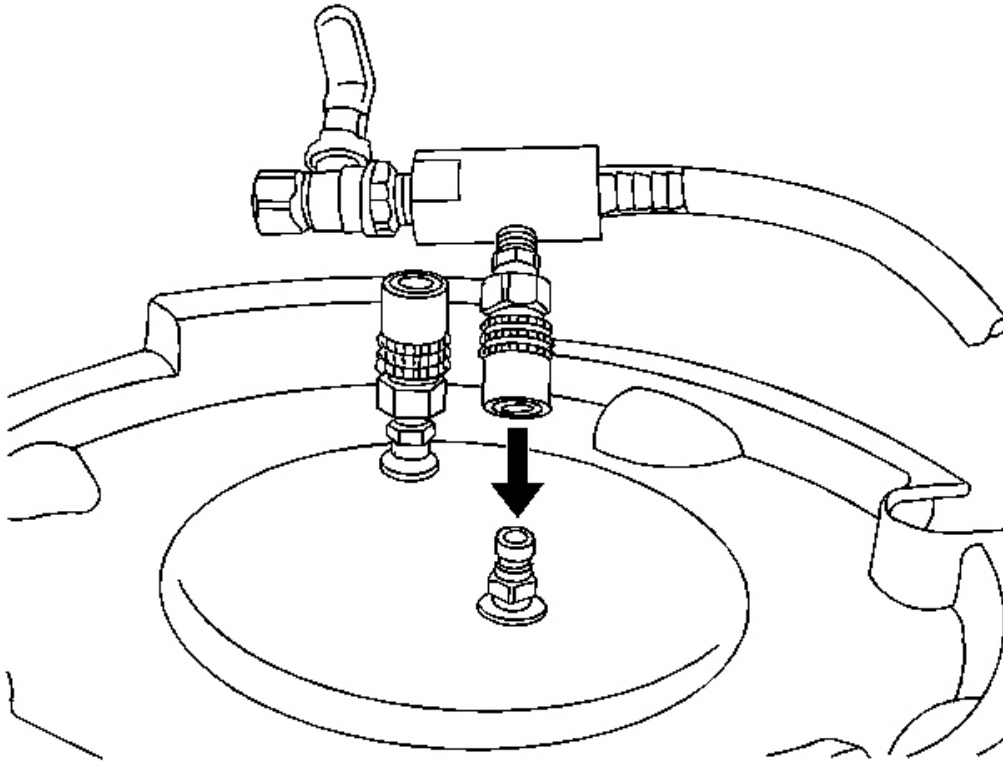


Fig. 21: Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

8. Attach the venturi assembly to the vacuum tank.

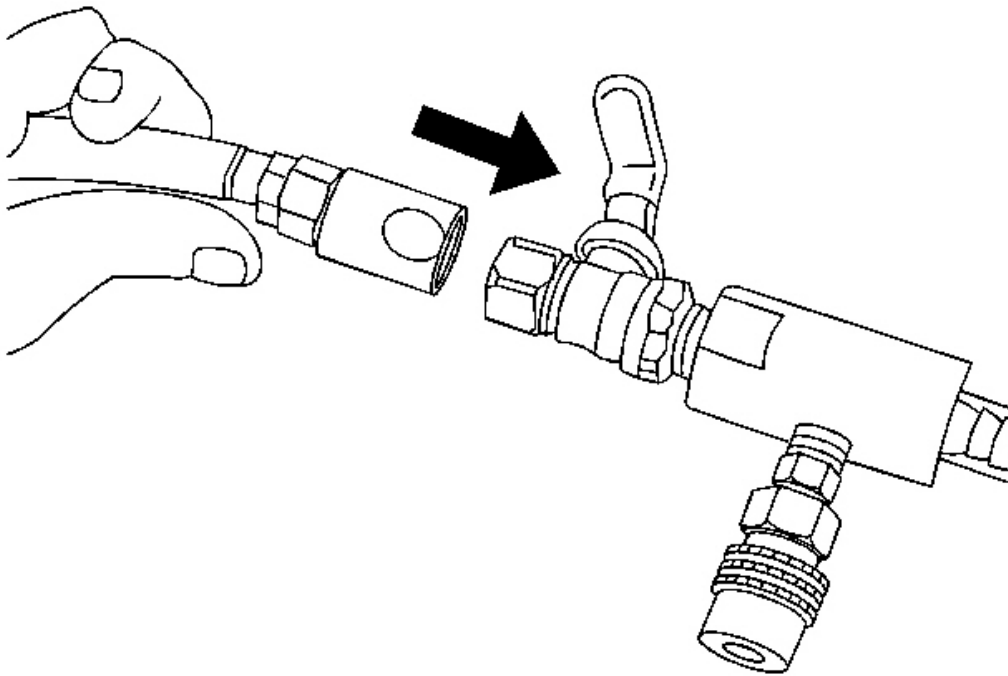


Fig. 22: Shop Air Hose
Courtesy of GENERAL MOTORS CORP.

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

Ensure the valve on the venturi assembly is closed.

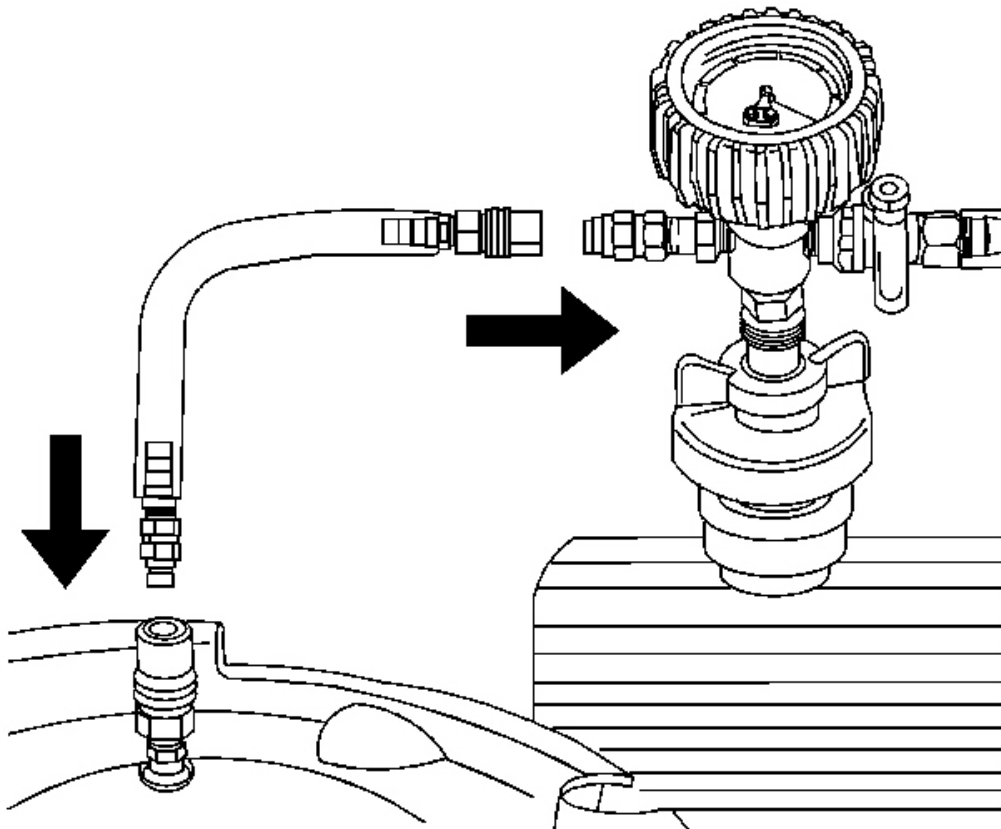


Fig. 23: Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

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

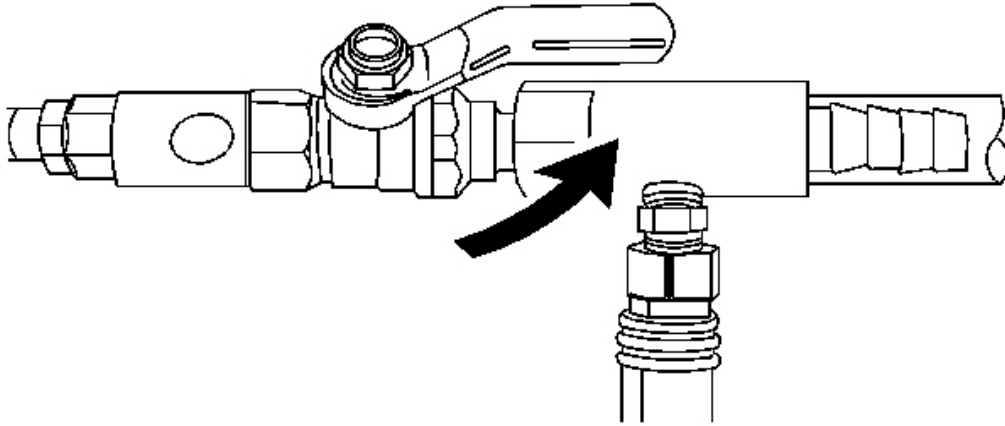


Fig. 24: Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

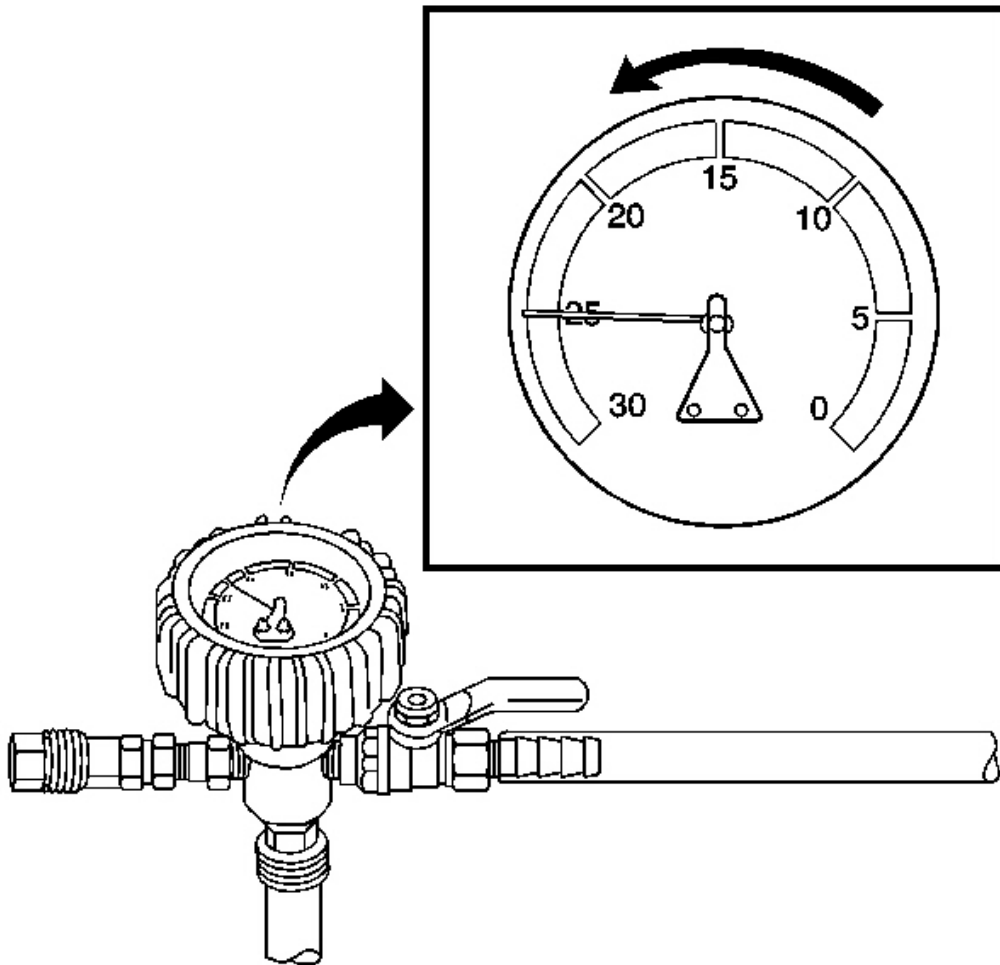


Fig. 25: Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

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

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

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

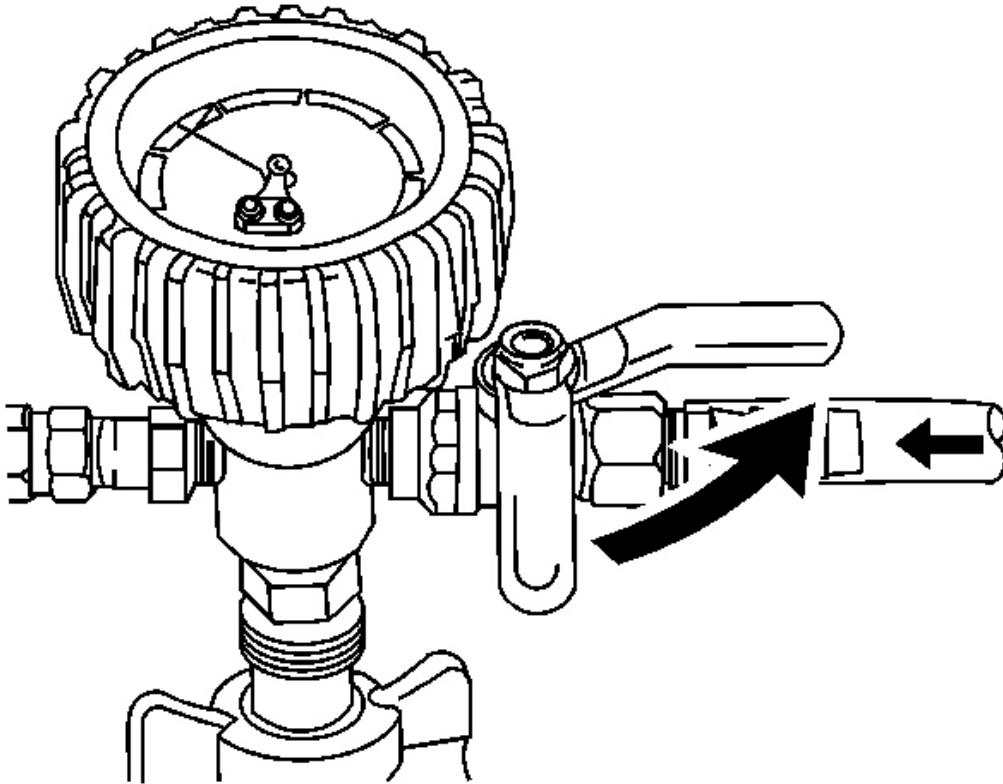


Fig. 26: Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

If vacuum loss is observed, refer to **Loss of Coolant (LH2)** or **Loss of Coolant (LC3)**.

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

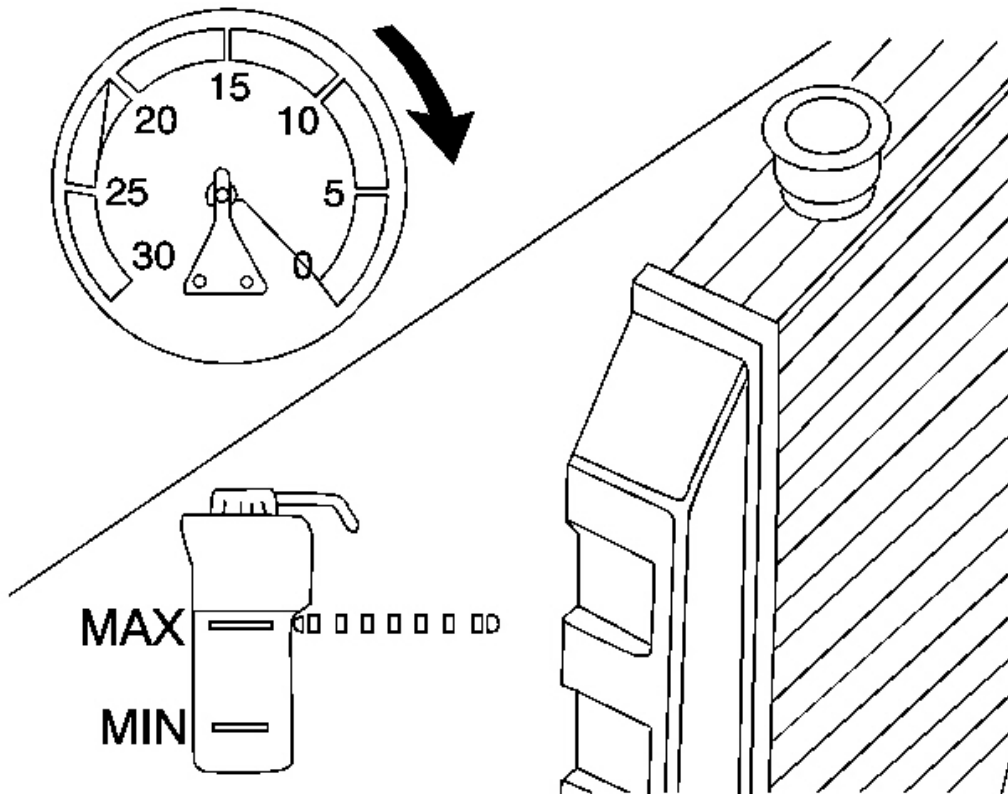


Fig. 27: Vacuum Gage Reading
Courtesy of GENERAL MOTORS CORP.

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

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

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

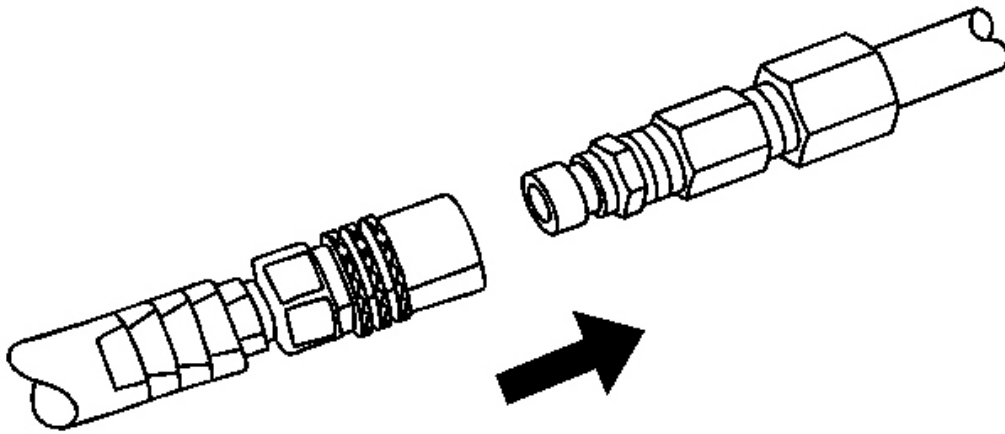


Fig. 28: Extraction Hose

Courtesy of GENERAL MOTORS CORP.

24. Attach the extraction hose to the vacuum hose.

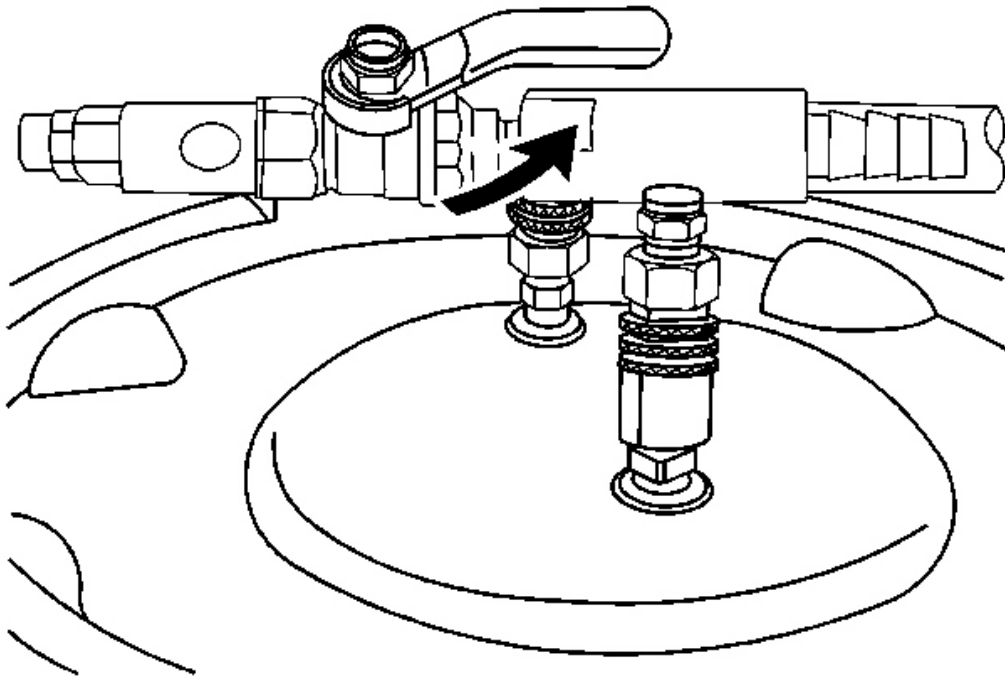


Fig. 29: Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

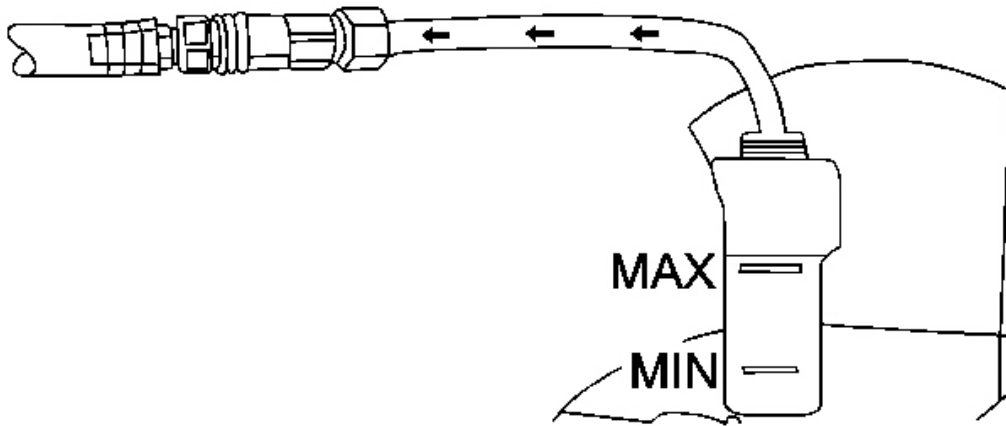


Fig. 30: Extraction Hose
Courtesy of GENERAL MOTORS CORP.

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

CHARGE AIR COOLING SYSTEM COOLANT LEVEL INSPECTION

IMPORTANT: Make sure the intercooler system is cool and that the pump is not in the ON position.

1. Remove the manifold sight shield. Refer to **Intake Manifold Sight Shield Replacement** .

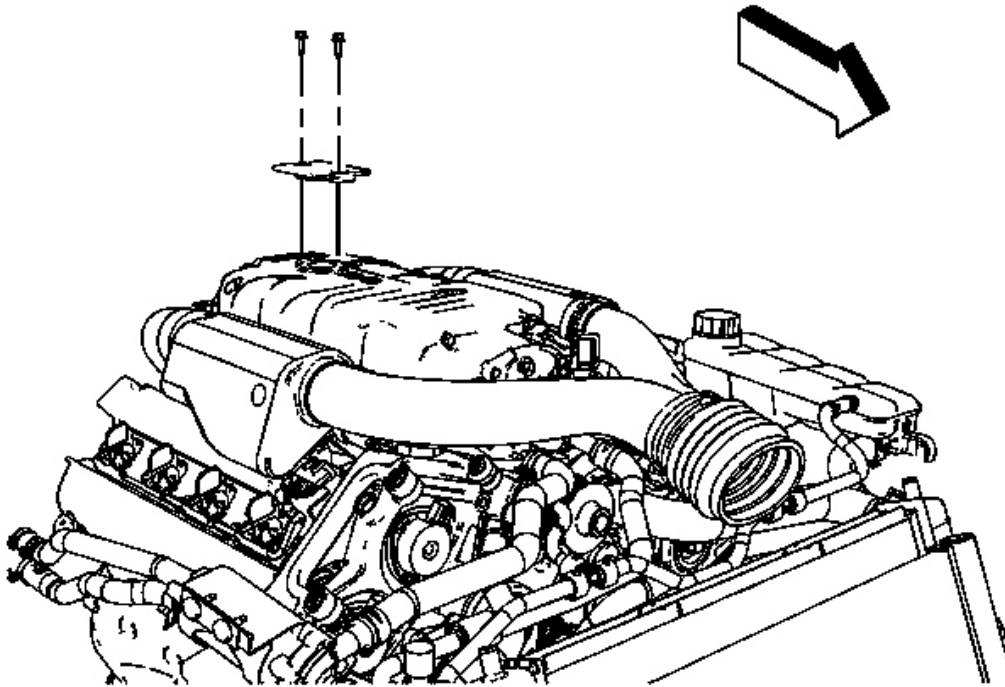


Fig. 31: Charge Air Coolant Cap
Courtesy of GENERAL MOTORS CORP.

2. Remove the charge air coolant cap.

IMPORTANT: It is normal to have a very small pocket of air at the top of the system below the fill cap on a properly filled charge air cooling system.

3. Verify that coolant is visible near to top of the opening.

IMPORTANT: Use a 50/50 mixture of DEX-COOL® antifreeze and clean drinkable water. Pour the coolant in very small amounts to avoid coolant spillage from the charge air coolant cap port or from funnel.

4. Using a small funnel, slowly fill the charge air cooling system through the charge air coolant cap port with a 50/50 coolant mixture until the level is slightly below the charge air coolant cap port. Refer to **Approximate Fluid Capacities** .

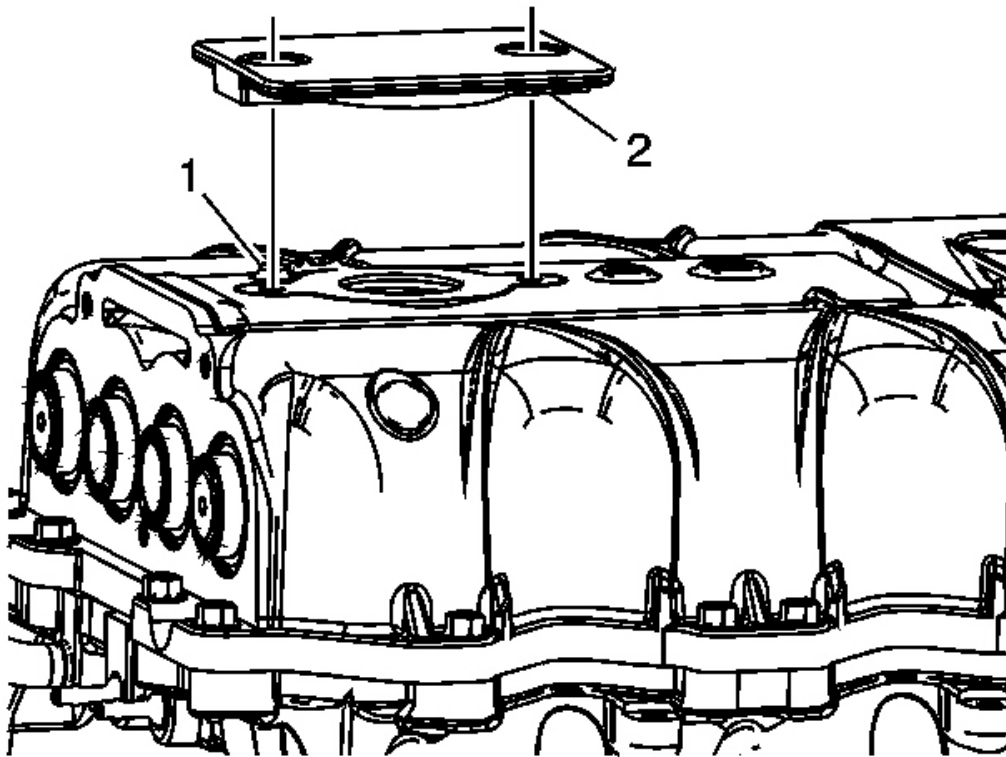


Fig. 32: Charge Air Cooler Cooling Fill Cap
Courtesy of GENERAL MOTORS CORP.

5. Ensure the charge air cooler cooling fill cap is installed in the proper orientation.
 - The alignment boss (1) is at the rear of the charge air cooler manifold.
 - The alignment boss (1) is at the front of the charge air cooler cooling filling cap.

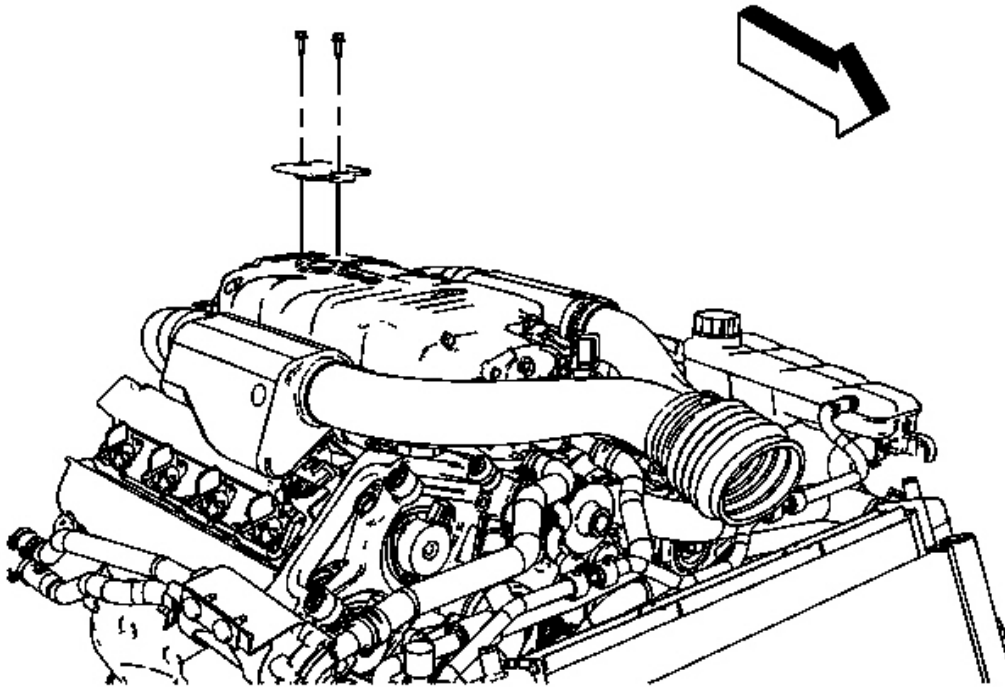


Fig. 33: Charge Air Coolant Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

6. Install the charge air coolant cap bolts.

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

7. Install the manifold sight shield. Refer to Intake Manifold Sight Shield Replacement .

CHARGE AIR COOLING SYSTEM DRAINING AND FILLING (STATIC FILL)

Draining Procedure

Tools Required

- **J 26568** Coolant and Battery Tester. See Special Tools.
- **J 38185** Hose Clamp Pliers

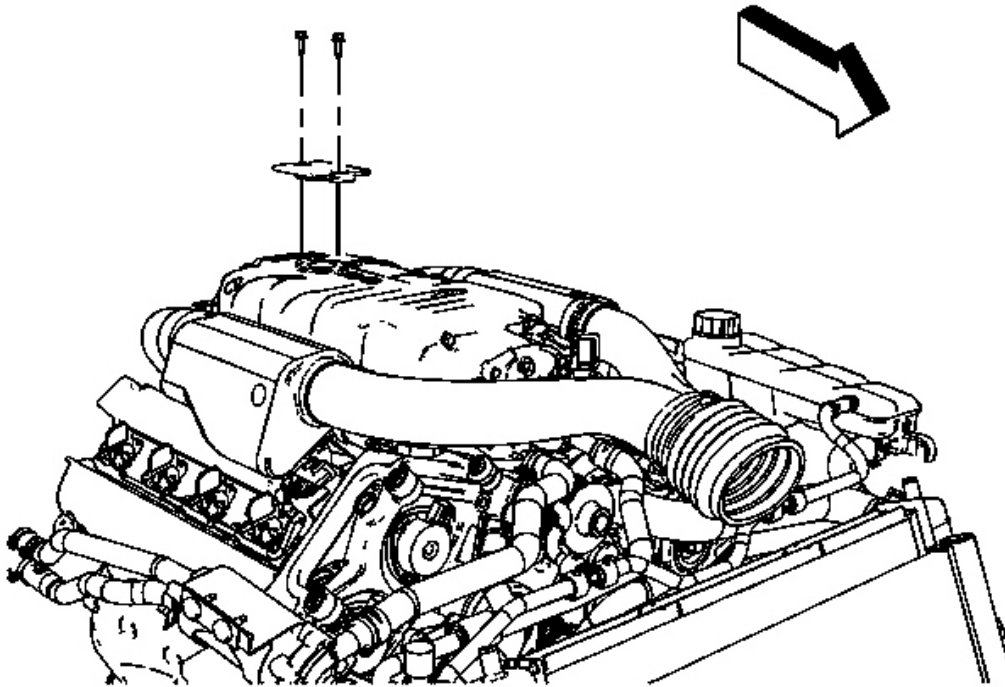


Fig. 34: Charge Air Coolant Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: To avoid being burned, do not remove the charge air coolant cap while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

IMPORTANT: Make sure the intercooler system is cool and that the pump is not in the ON position.

1. Remove the manifold sight shield. Refer to **Intake Manifold Sight Shield Replacement** .
2. Remove the charge air coolant cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Place a drain pan under the charge air cooler radiator.

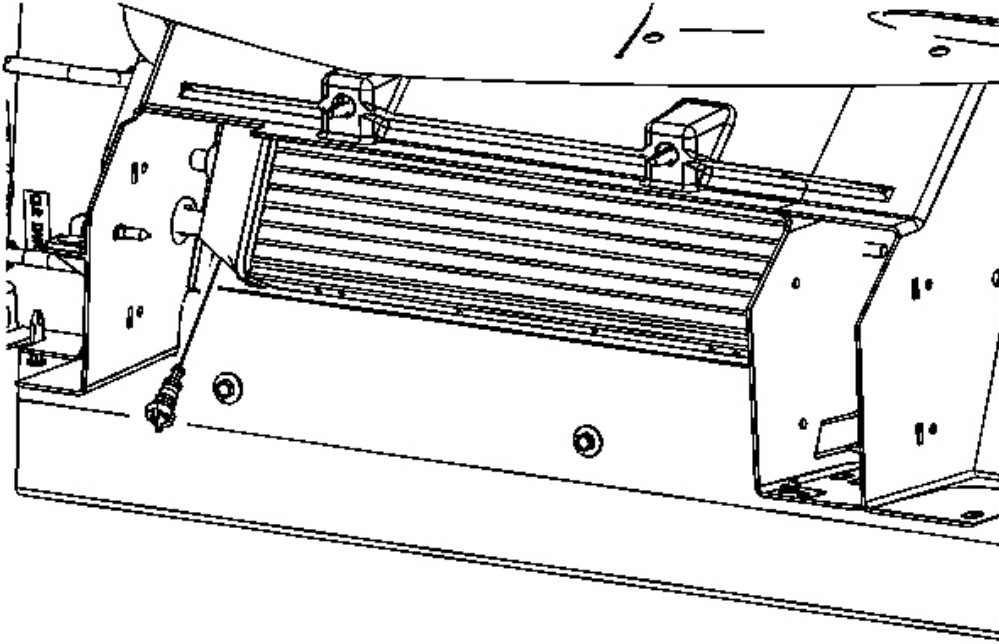


Fig. 35: Drain Plug From Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS CORP.

5. Remove the drain plug from the charge air cooler radiator.
6. Drain the charge air cooling system.
7. Inspect the coolant.
8. 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 (Powertrain)Flushing (Charge Air Cooling)** .
9. Install the drain plug to the charge air cooler radiator.
10. Remove the drain pan from under the charge air coolant radiator.
11. Lower the vehicle.

Filling Procedure

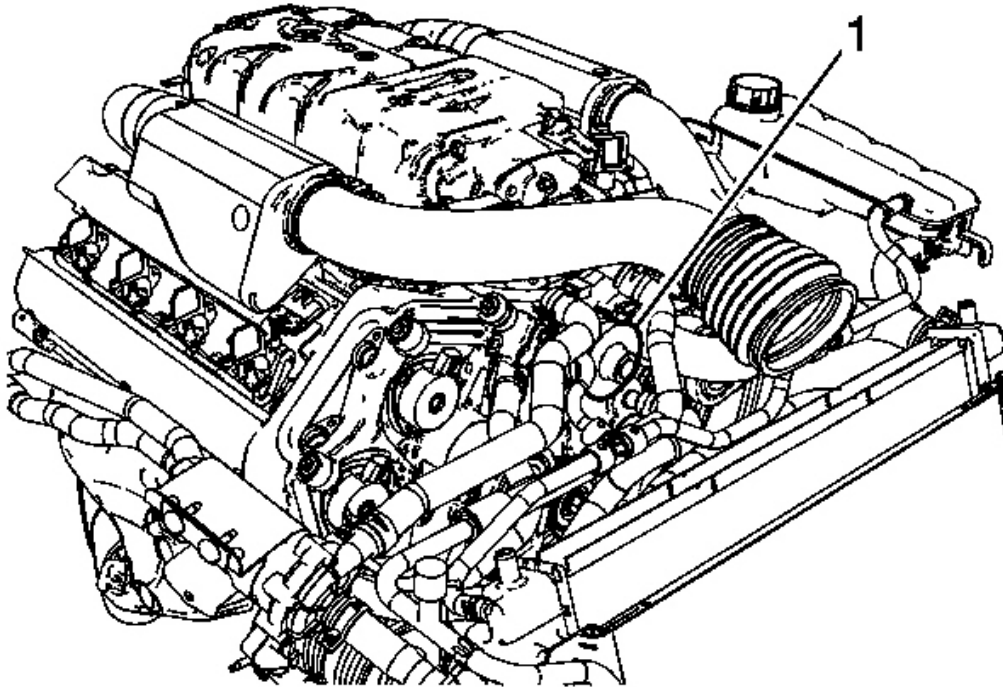


Fig. 36: Charge Air Cooler Manifold Lines
Courtesy of GENERAL MOTORS CORP.

NOTE: The procedure below must be followed. Improper coolant level could result in poor system performance.

IMPORTANT: The charge air cooling system is filled through the fitting in the charge air coolant pump outlet hose.
Be sure the coolant does not make contact with the drive belt or any other surfaces. Coolant contact will cause belt noise and require belt replacement.

1. Place a moderate amount of absorbent material below the charge air cooler manifold lines (1) to ensure that coolant does not contact the belts or other components.

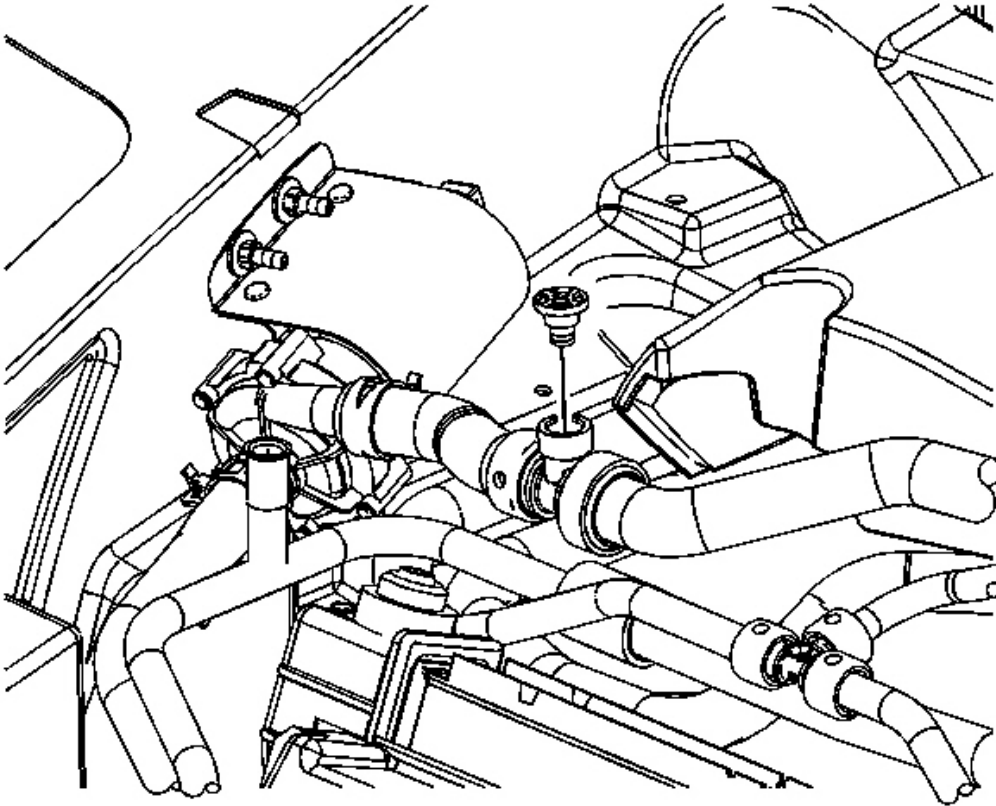


Fig. 37: Charge Air Cooler Pump Outlet Hose Cap
Courtesy of GENERAL MOTORS CORP.

2. Remove the cap on the charge air cooler pump outlet hose.

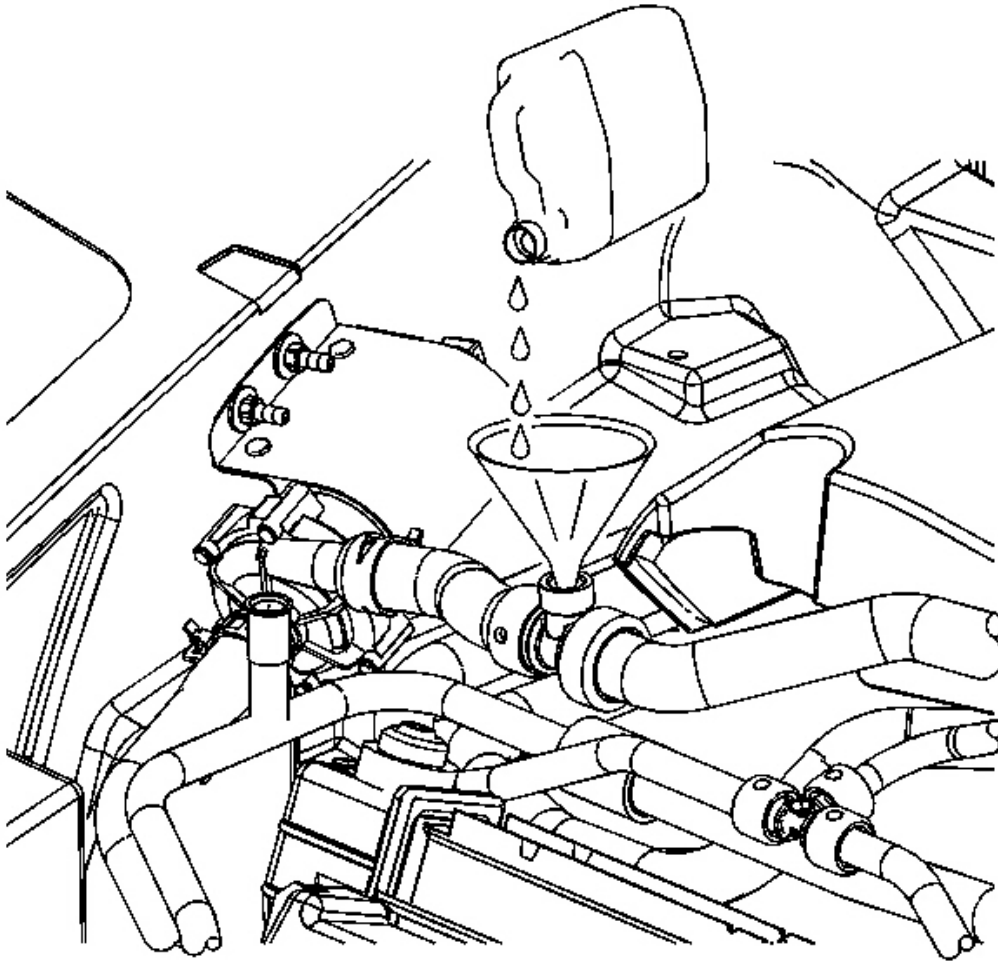


Fig. 38: Filling Charge Air Cooling System
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Use a 50/50 mixture of DEX-COOL® antifreeze and clean drinkable water. Pour coolant in very small amounts to avoid coolant spillage from the charge air coolant cap port or from the funnel.

3. Using a small funnel, slowly fill the charge air cooling system through the charge air coolant cap port with a 50/50 coolant mixture until the level is slightly below the charge air coolant cap port. Refer to Approximate Fluid Capacities .

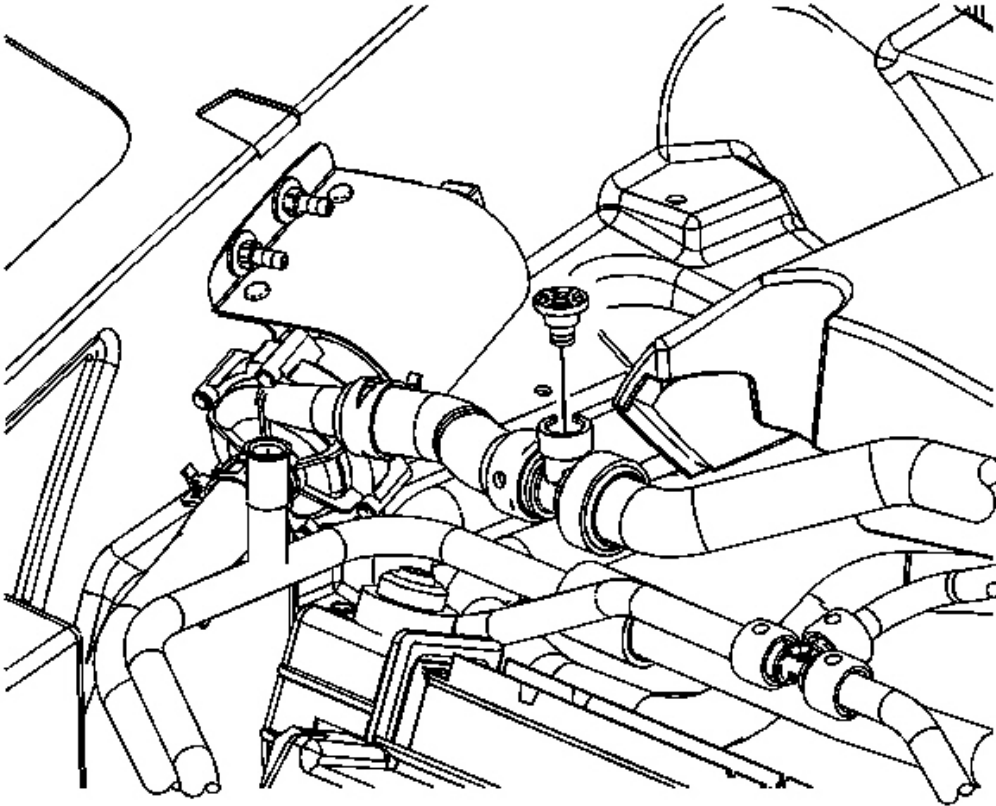


Fig. 39: Charge Air Cooler Pump Outlet Hose Cap
Courtesy of GENERAL MOTORS CORP.

4. Install the cap on the charge air cooler pump outlet hose.

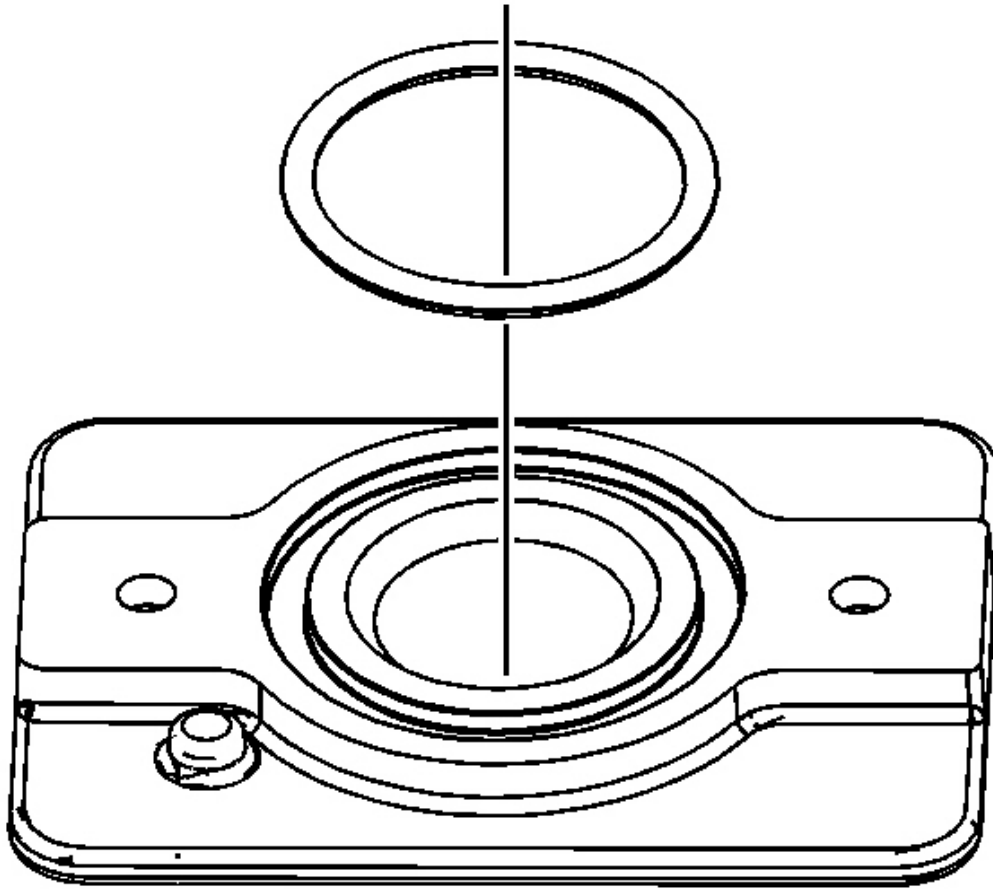


Fig. 40: Charge Air Cooler Cooling Fill Cap O-Ring
Courtesy of GENERAL MOTORS CORP.

5. Install a new charge air cooler cooling fill cap O-ring.

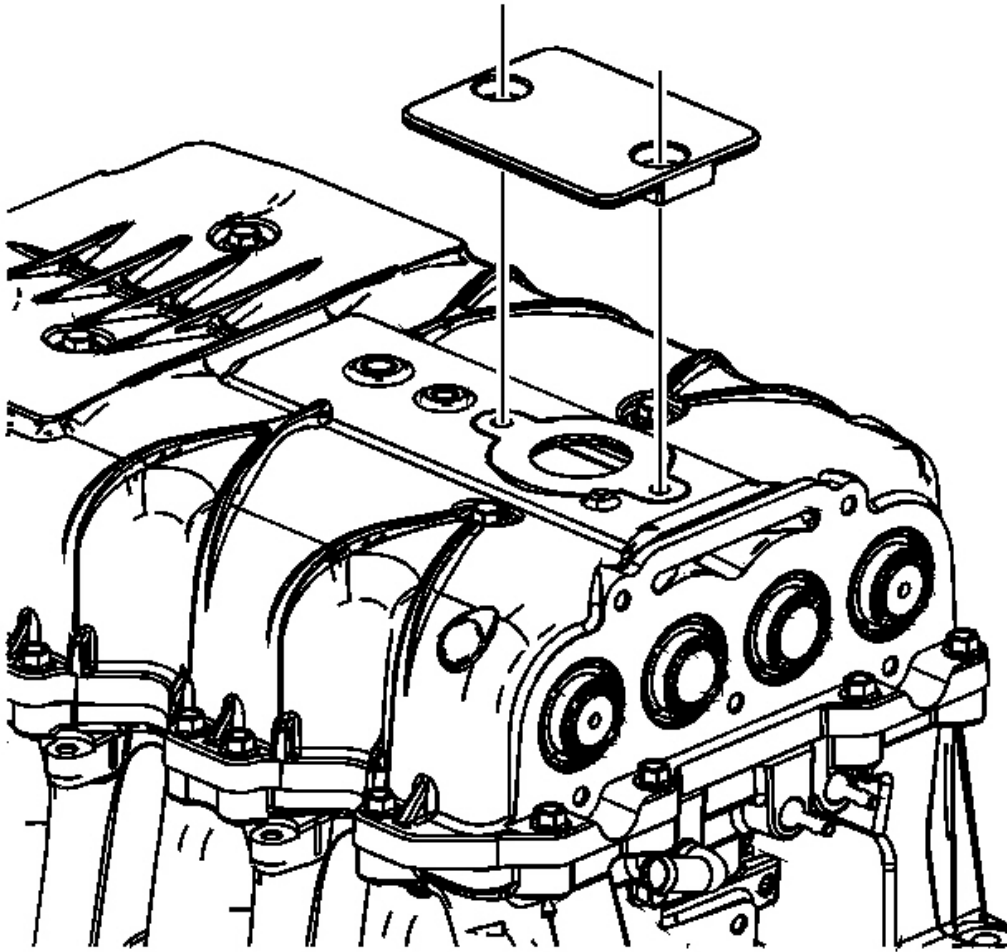


Fig. 41: Charge Air Cooler Cooling Fill Cap
Courtesy of GENERAL MOTORS CORP.

6. Install a new charge air cooler cooling fill cap.

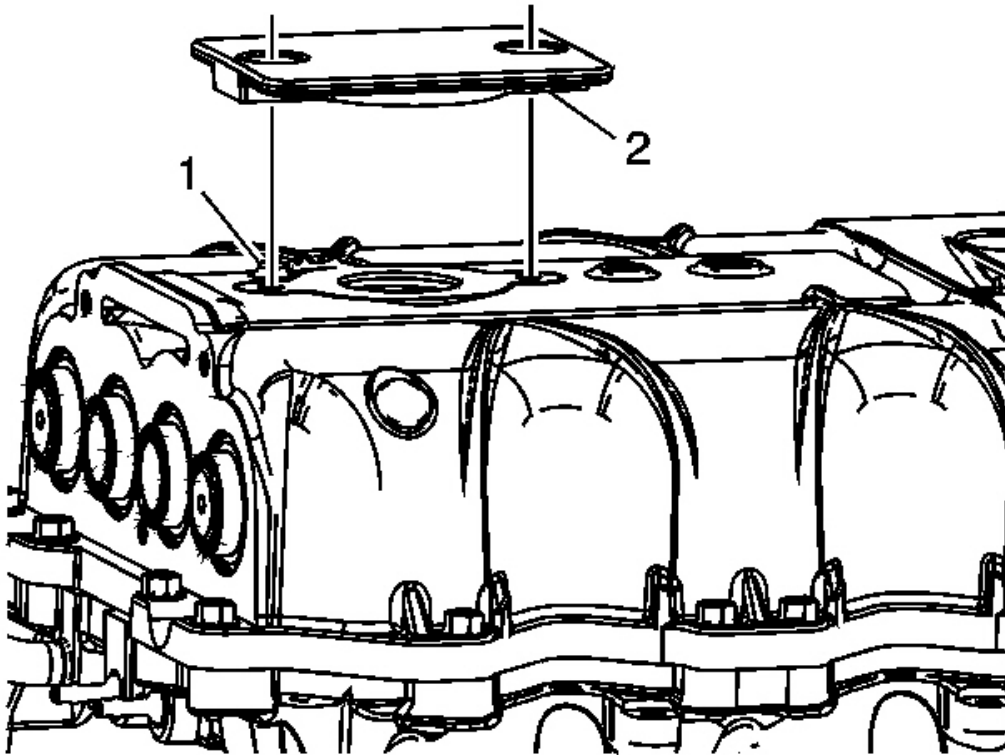


Fig. 42: Charge Air Cooler Cooling Fill Cap
Courtesy of GENERAL MOTORS CORP.

7. Ensure the charge air cooler cooling fill cap is installed in the proper orientation:
 - The alignment boss (1) is at the rear of the charge air cooler manifold.
 - The alignment boss (2) is at the front of the charge air cooler cooling filling cap.

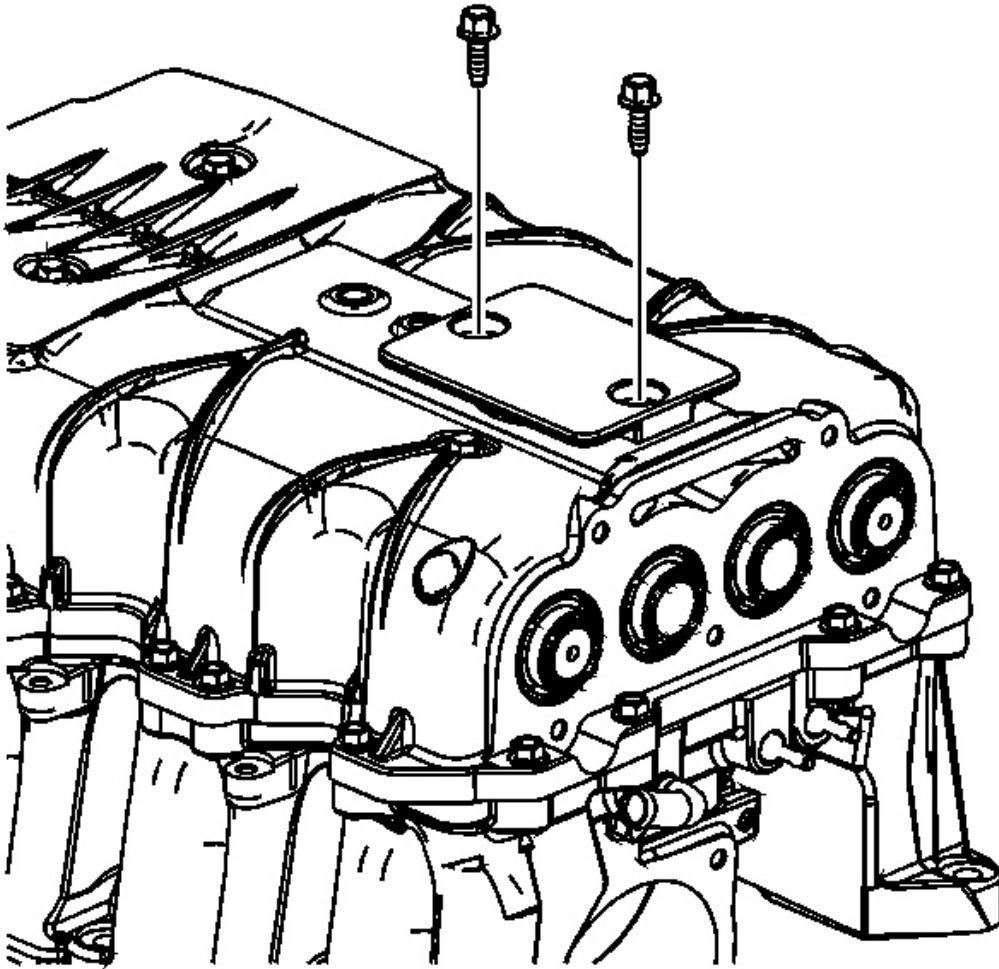


Fig. 43: Charge Air Cooler Cooling Fill Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Fastener Notice .

8. Install the charge air coolant cap bolts.

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

IMPORTANT: Do not cycle the charge air cooling system without the charge air cooling cap in place or coolant loss will occur.

9. Cycle the charge air cooling system ON by using the Tech 2 or by starting the engine for approximately 2 minutes.
10. Cycle the charge air cooling system OFF.
11. Remove the charge air coolant cap bolts.
12. Remove the charge air coolant cap.

IMPORTANT: It is normal to have a very small pocket of air at the top of the system below the fill cap on a properly filled charge air cooling system.

13. Ensure that coolant is almost level with the coolant cap fill port (1). Top off with a 50/50 coolant mixture through the charge air coolant cap port if necessary.

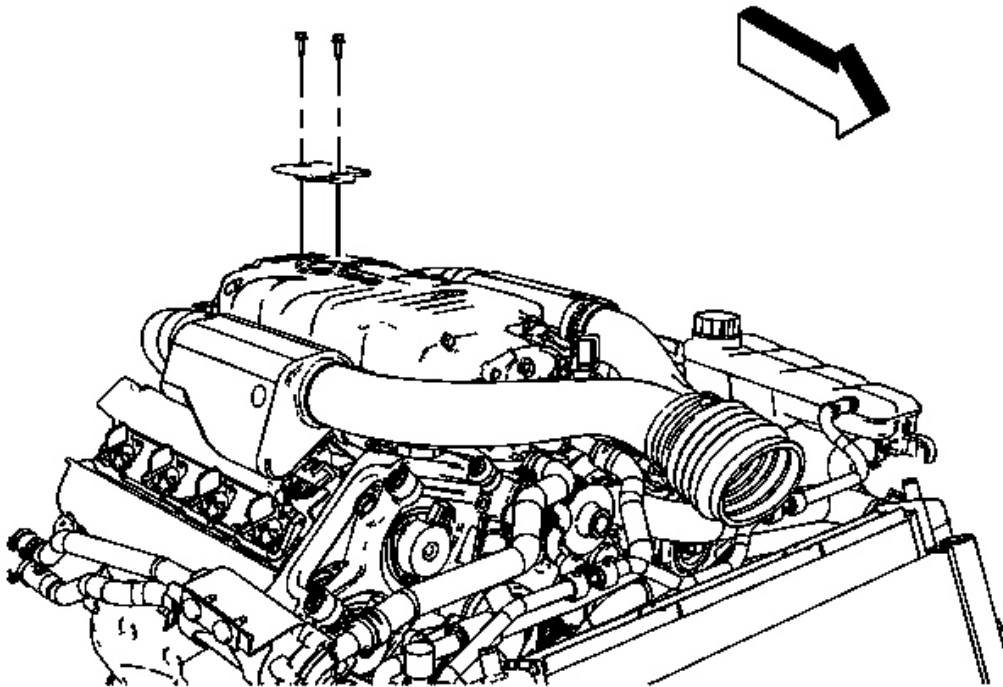


Fig. 44: Charge Air Coolant Cap
Courtesy of GENERAL MOTORS CORP.

14. Install the charge air coolant cap.
15. Install the charge air coolant cap bolts.

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

16. Repeat steps 10-16 two more times to ensure the system is properly purged of air.
17. Inspect the concentration of the engine coolant, using the **J 26568** . See **Special Tools**.
18. Inspect the charge air cooling system for leaks.
19. Install the manifold sight shield. Refer to **Intake Manifold Sight Shield Replacement** .

CHARGE AIR COOLING SYSTEM DRAINING AND FILLING (GE 47716)

Draining Procedure

Tools Required

- **J 26568** Coolant and Battery Tester. See **Special Tools**.
- **GE-47844** Charge Air Cooling System Pressure Test Adapter
- **GE-47716** Vac N Fill Coolant Refill Tool. See **Special Tools**.

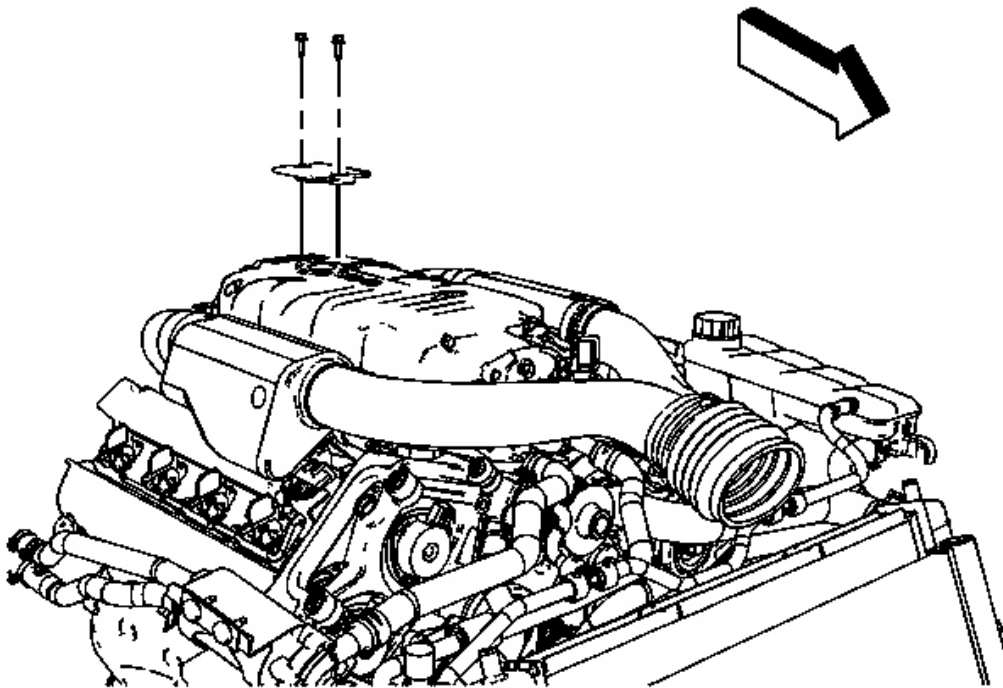


Fig. 45: Charge Air Coolant Cap
Courtesy of GENERAL MOTORS CORP.

CAUTION: To avoid being burned, do not remove the charge air coolant cap

while the system is hot. The cooling system will release scalding fluid and steam under pressure if charge air coolant cap is removed while the system is still hot.

IMPORTANT: Make sure the intercooler system is cool and that the pump is not in the ON position.

1. Remove the manifold sight shield. Refer to Intake Manifold Sight Shield Replacement .
2. Remove the charge air coolant cap.
3. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
4. Place a drain pan under the charge air cooler radiator.

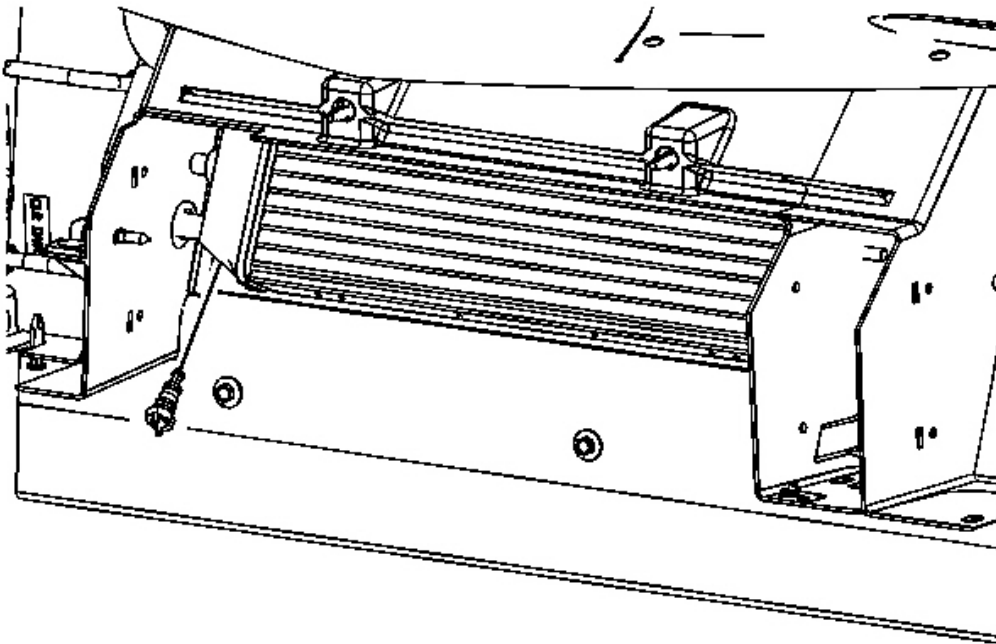


Fig. 46: Charge Air Cooler Radiator Drain Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the drain plug from the charge air cooler radiator.
6. Drain the charge air cooling system.
7. Inspect the coolant.
8. Follow the appropriate procedure based on the condition of the coolant:

2006 Cadillac XLR

2006 ENGINE Engine Cooling - XLR

- Normal in appearance-Follow the filling procedure.
 - Discolored-Follow the flush procedure. Refer to **Flushing (Powertrain)Flushing (Charge Air Cooling)** .
9. Install the drain plug to the charge air cooler radiator.
 10. Remove the drain pan from under the charge air coolant radiator.
 11. Lower the vehicle.

GE 47716 Procedure

IMPORTANT: To prevent boiling of the coolant/water mixture in the vehicles cooling system, do NOT apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

1. Install the **GE-47844** onto the charge air cooler cap port.

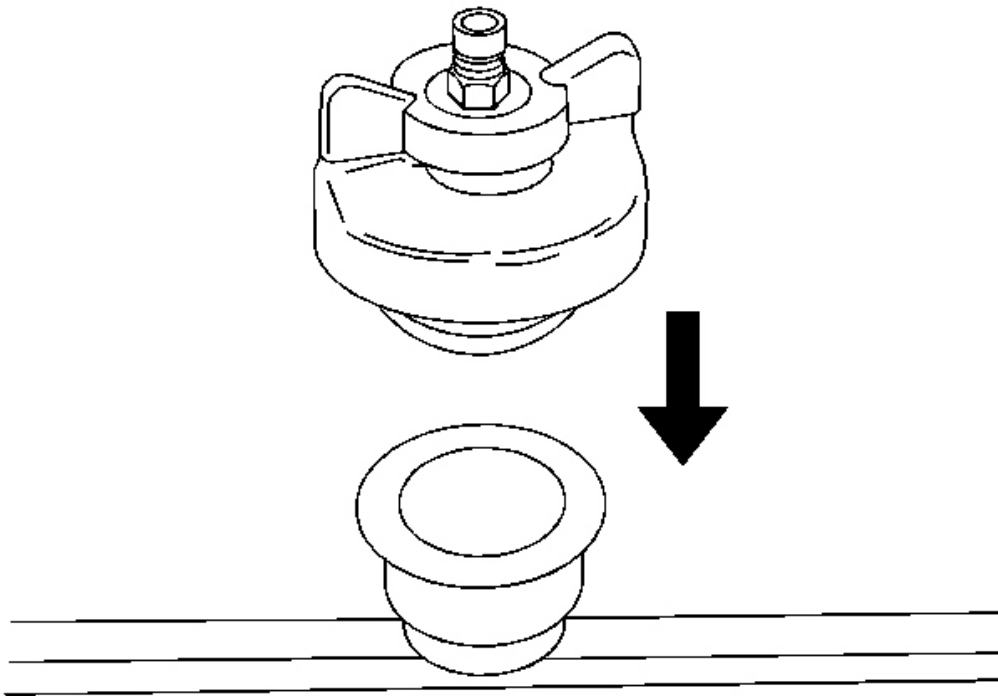


Fig. 47: Vac N Fill Cap
Courtesy of GENERAL MOTORS CORP.

2. Attach the Vac-N-Fill cap to the **GE-47844** .

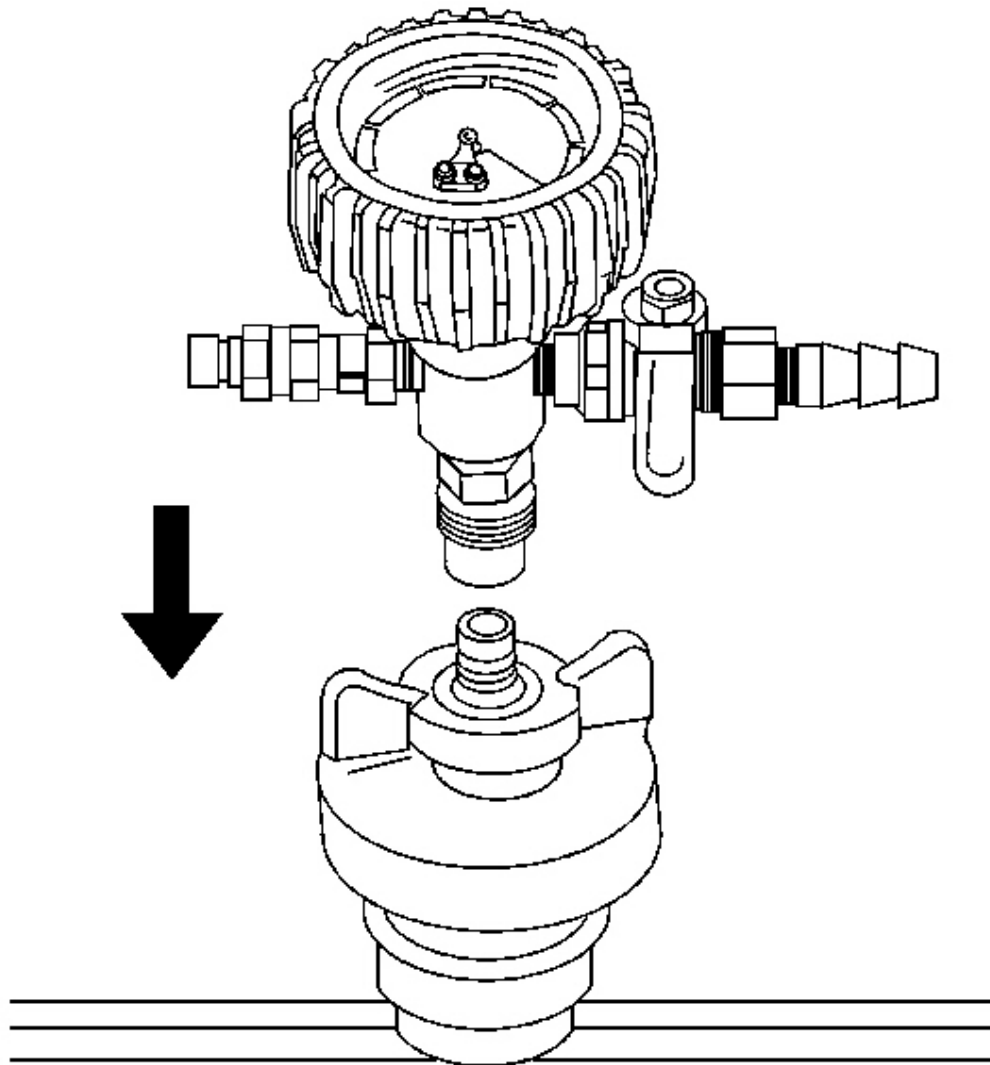


Fig. 48: Attaching The Vacuum Gage Assembly To The Vac N Fill Cap
Courtesy of GENERAL MOTORS CORP.

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

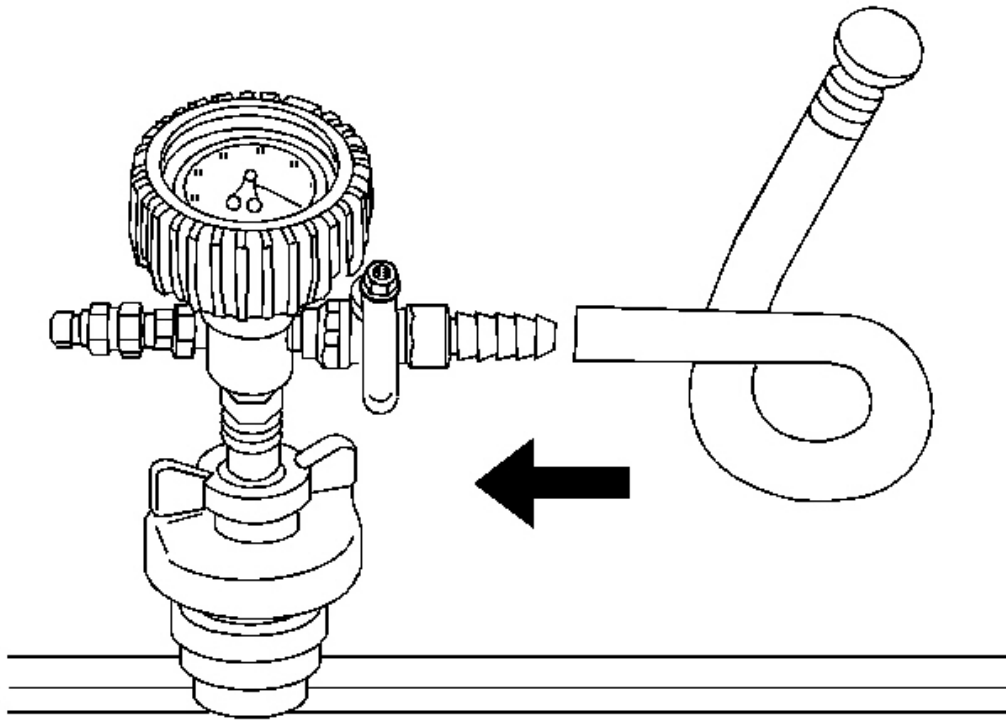


Fig. 49: Fill Hose

Courtesy of GENERAL MOTORS CORP.

4. Attach the fill hose to the barb fitting on the vacuum gage assembly. Ensure the valve is closed.

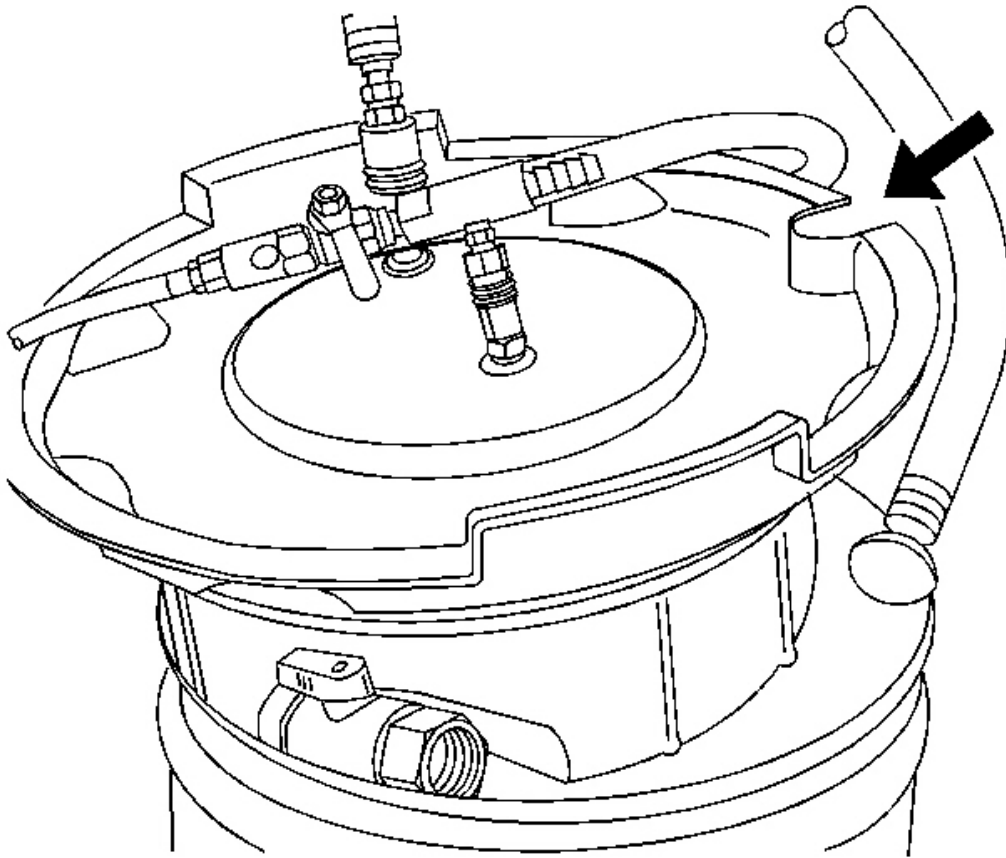


Fig. 50: Graduated Reservoir
Courtesy of GENERAL MOTORS CORP.

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

5. Pour the coolant mixture into the graduated reservoir.

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

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

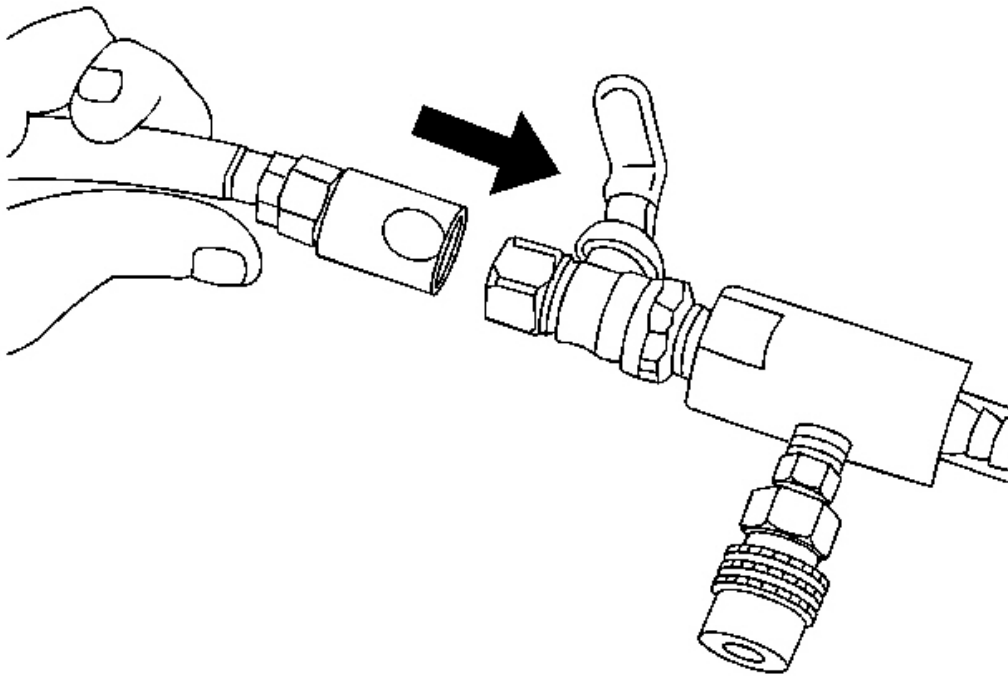


Fig. 51: Shop Air Hose

Courtesy of GENERAL MOTORS CORP.

7. Attach a shop air hose to the venturi assembly. Ensure the valve on the venturi assembly is closed.

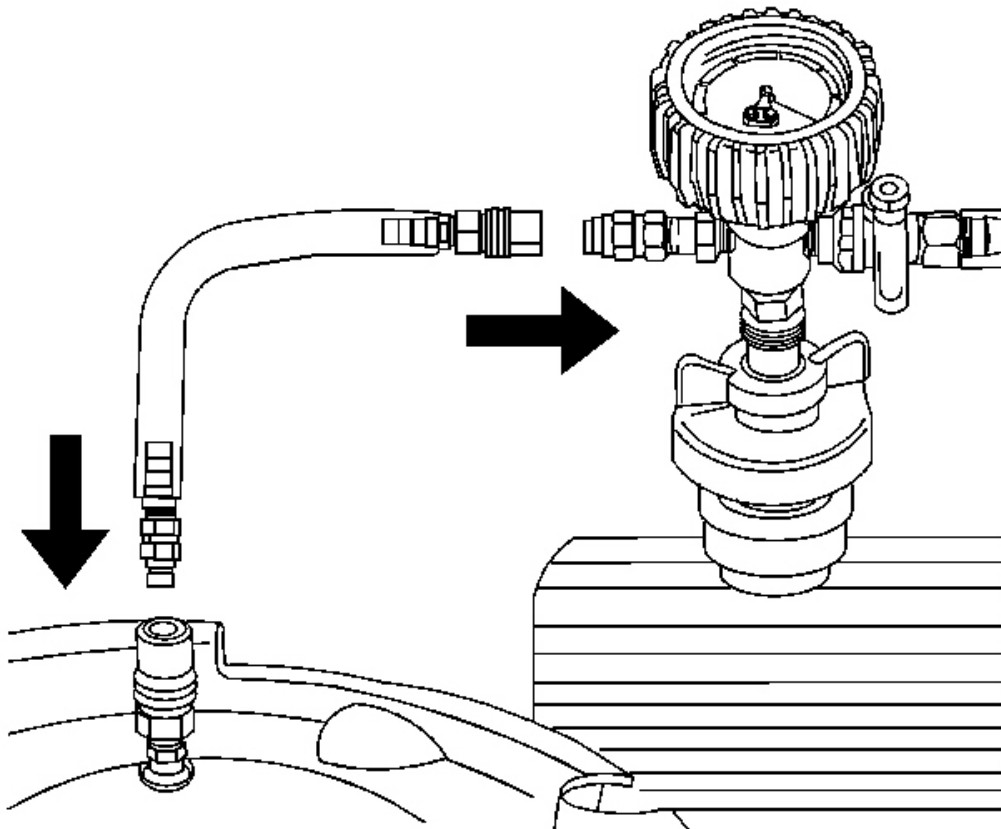


Fig. 52: Vacuum Hose

Courtesy of GENERAL MOTORS CORP.

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

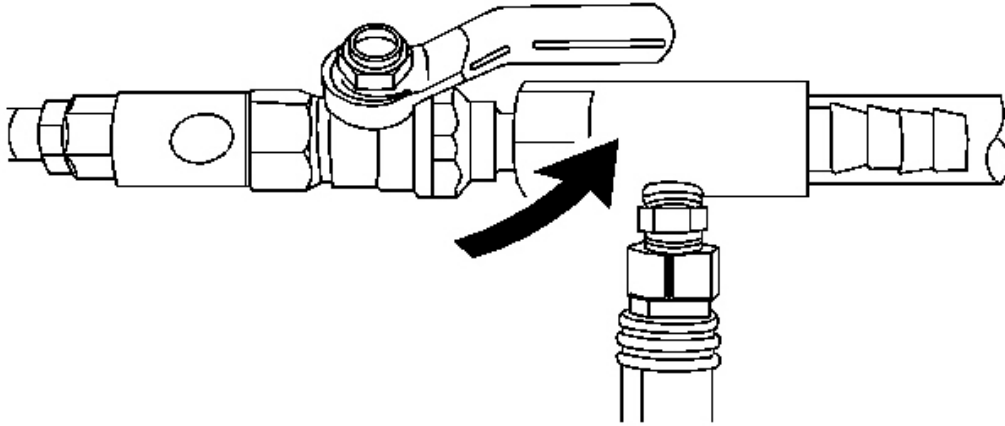


Fig. 53: Valve On Venturi Assembly
Courtesy of GENERAL MOTORS CORP.

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

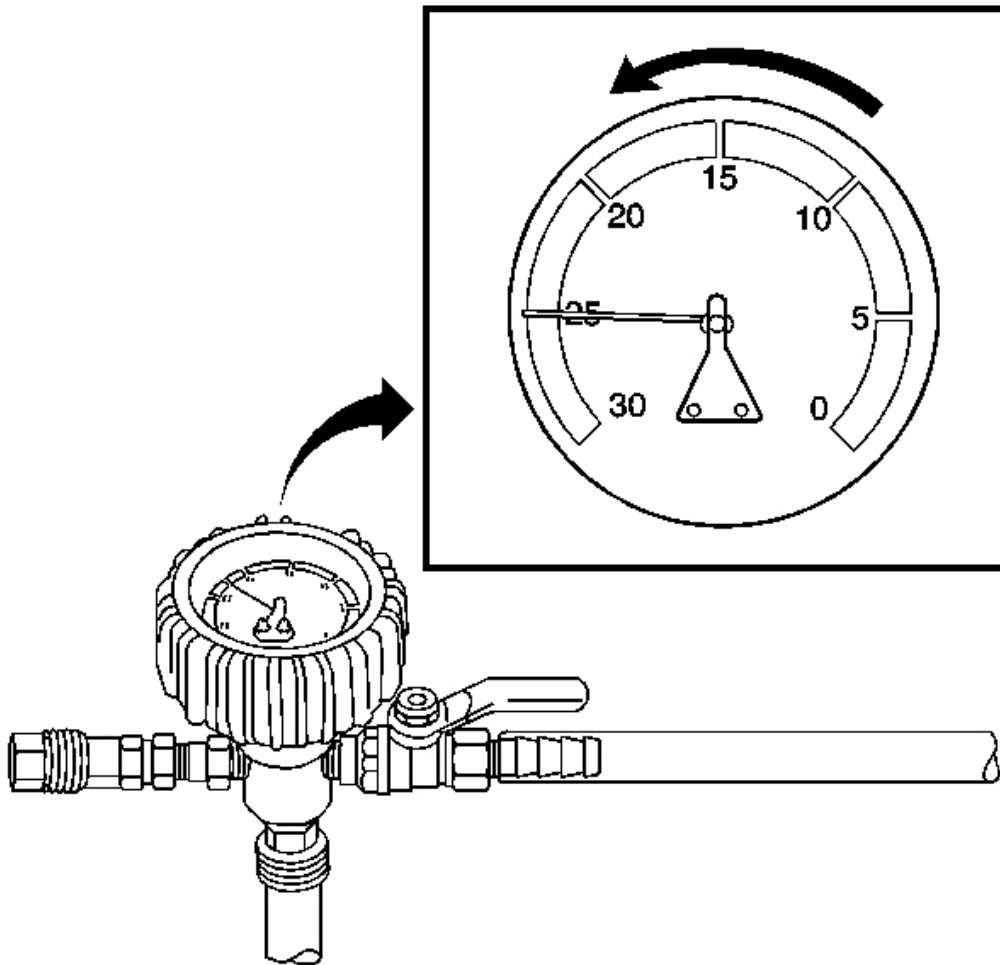


Fig. 54: Vacuum Gauge
Courtesy of GENERAL MOTORS CORP.

10. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm (24-26 in Hg). Cooling hoses may start to collapse. This is normal due to vacuum draw.
11. To aid in the filling process, position the graduated reservoir above the fill neck.

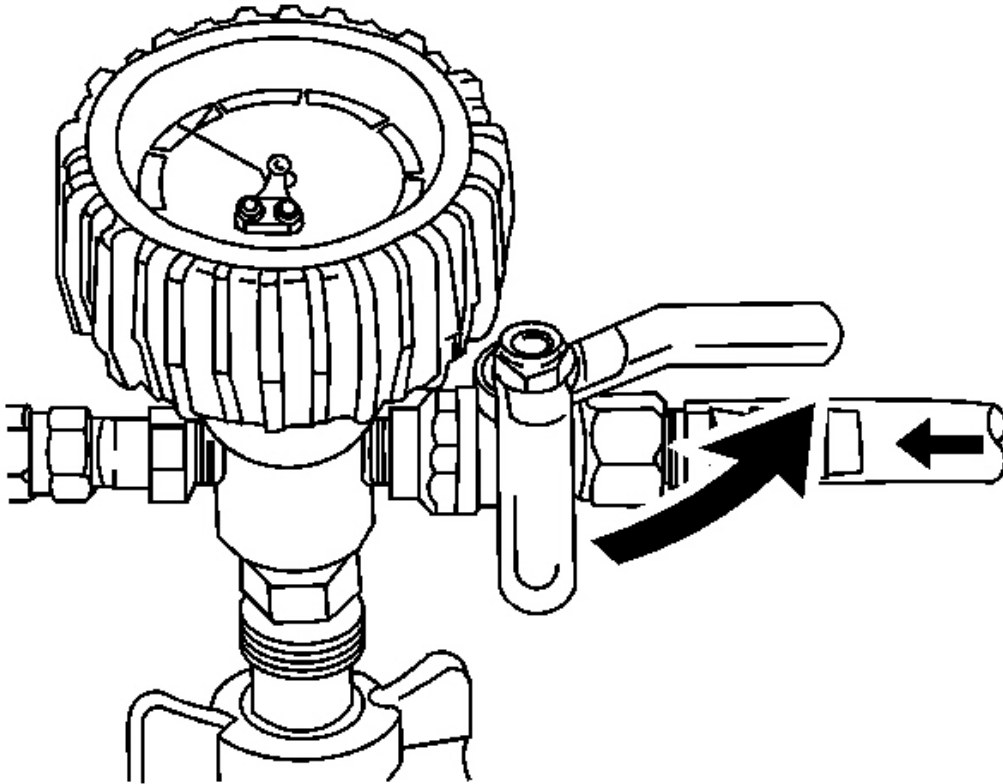


Fig. 55: Valve On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS CORP.

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

If vacuum loss is observed, refer to **Loss of Coolant (LH2)** or **Loss of Coolant (LC3)**.

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

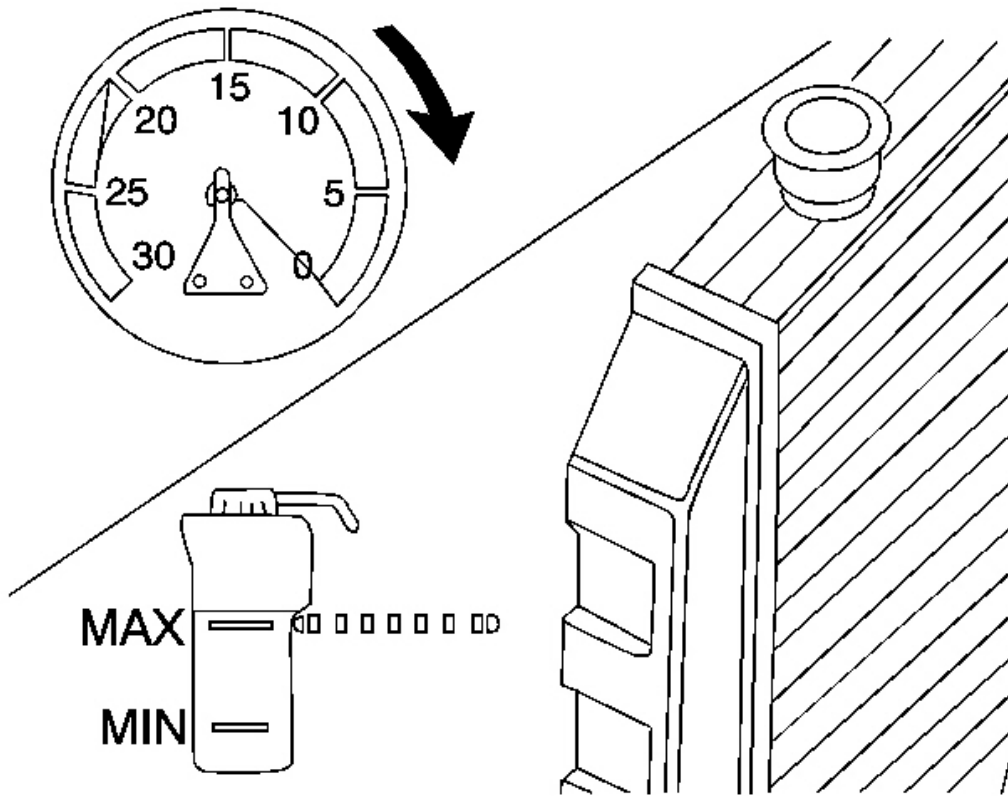


Fig. 56: Vacuum Gage Reading
Courtesy of GENERAL MOTORS CORP.

16. Once the vacuum reaches zero, close the valve on the vacuum gage assembly and repeat steps 10 and 16.
17. Detach the Vac-N-Fill cap from the **GE-47844**.
18. Remove the **GE-47844** from the fill neck.
19. Add coolant to the system as necessary.
20. Inspect the concentration of the coolant mixture using **J 26568**. See **Special Tools**.
21. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

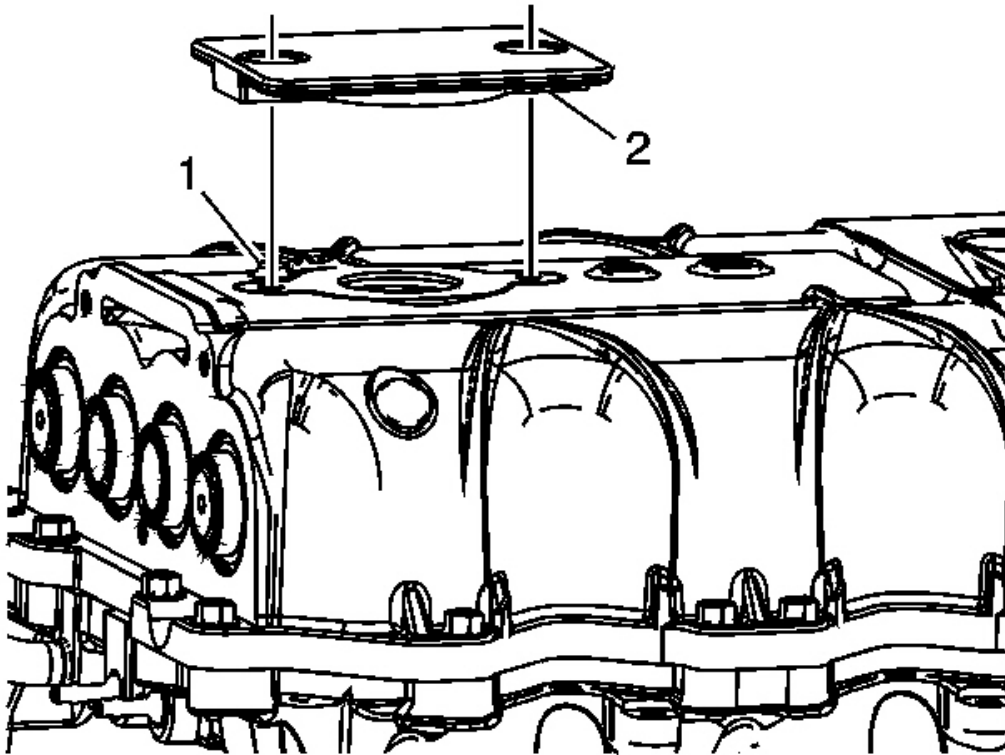


Fig. 57: Charge Air Cooler Cooling Fill Cap
Courtesy of GENERAL MOTORS CORP.

22. Install the charge air cooler cap.
23. Ensure the charge air cooler cooling fill cap is installed in the proper orientation:
 - The alignment boss (1) is at the rear of the charge air cooler manifold.
 - The alignment boss (2) is at the front of the charge air cooler cooling filling cap.

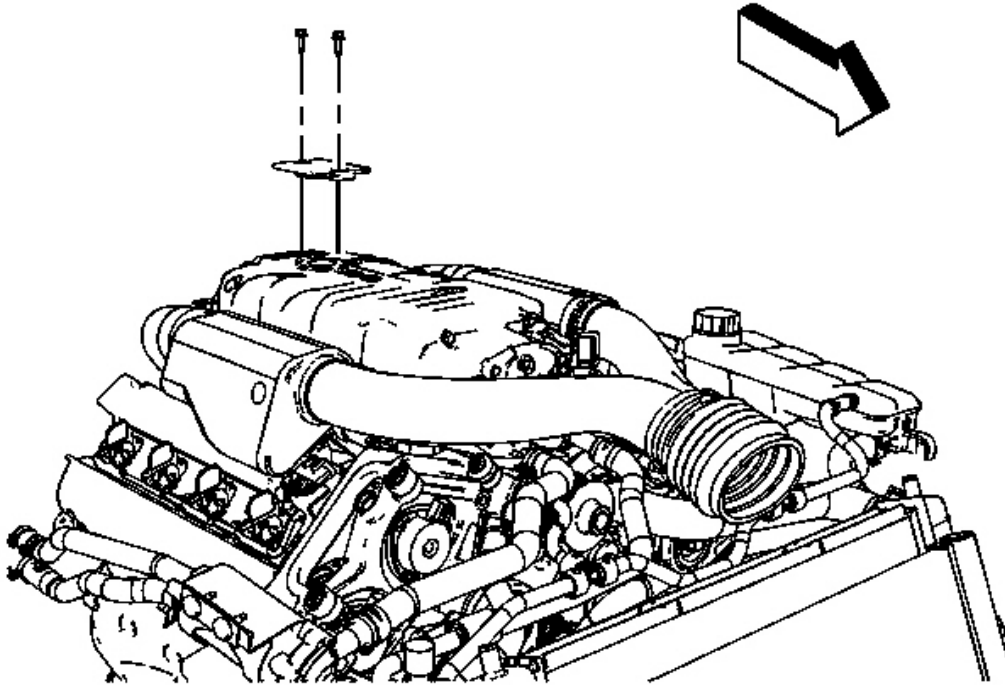


Fig. 58: Charge Air Coolant Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

24. Install the charge air coolant cap bolts.

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

25. Inspect the charge air cooling system for leaks.
26. Install the manifold sight shield. Refer to Intake Manifold Sight Shield Replacement .

FLUSHING (POWERTRAIN)

Flushing

IMPORTANT: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer

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

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

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the surge tank. Refer to **Radiator Surge Tank Replacement**.
3. Clean and flush the surge tank with clean, drinkable water.
4. Install the surge tank. Refer to **Radiator Surge Tank Replacement**.
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

FLUSHING (CHARGE AIR COOLING)

Flushing

IMPORTANT: Do not use a chemical flush.

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

Various methods and equipment can be used to flush the charge air cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction.

When the charge air cooling system becomes contaminated, the system should be flushed thoroughly to remove the contaminants before any components are damaged.

1. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Follow the FILL procedure using only clean, drinkable water. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

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3. Cycle the charge air coolant pump ON with the TECH 2 for approximately 5 minutes.
4. Cycle the charge air coolant pump OFF.
5. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.
6. Repeat the procedure if necessary, until the fluid is nearly colorless.
7. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

RADIATOR CLEANING (POWERTRAIN)

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.

RADIATOR CLEANING (CHARGE AIR COOLING)

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 charge air coolant 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 charge air coolant radiator.
- Clean the charge air coolant radiator cooling fins.

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- Straighten any damaged cooling fins.

RADIATOR SURGE TANK REPLACEMENT

Removal Procedure

Tools Required

J 38185 Hose Clamp Pliers

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. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).

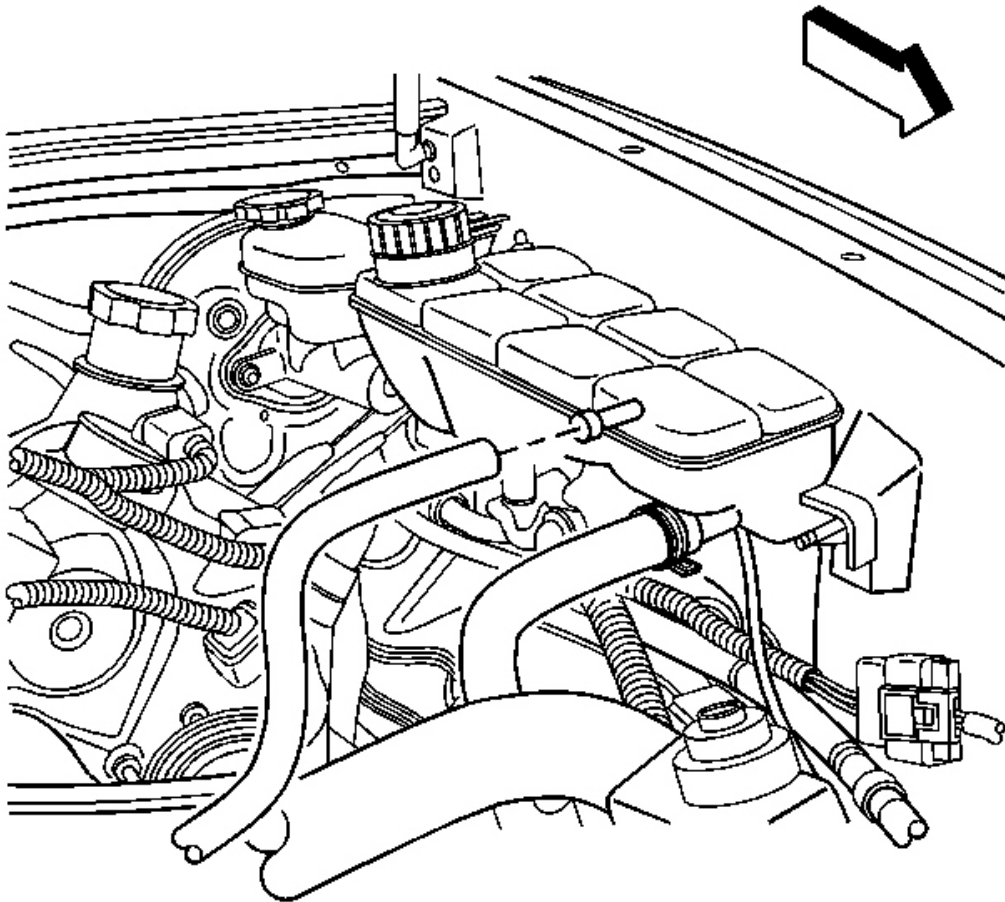


Fig. 59: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Disengage tension on the surge tank inlet hose clamp.
3. Disconnect the surge tank inlet hose from the surge tank.

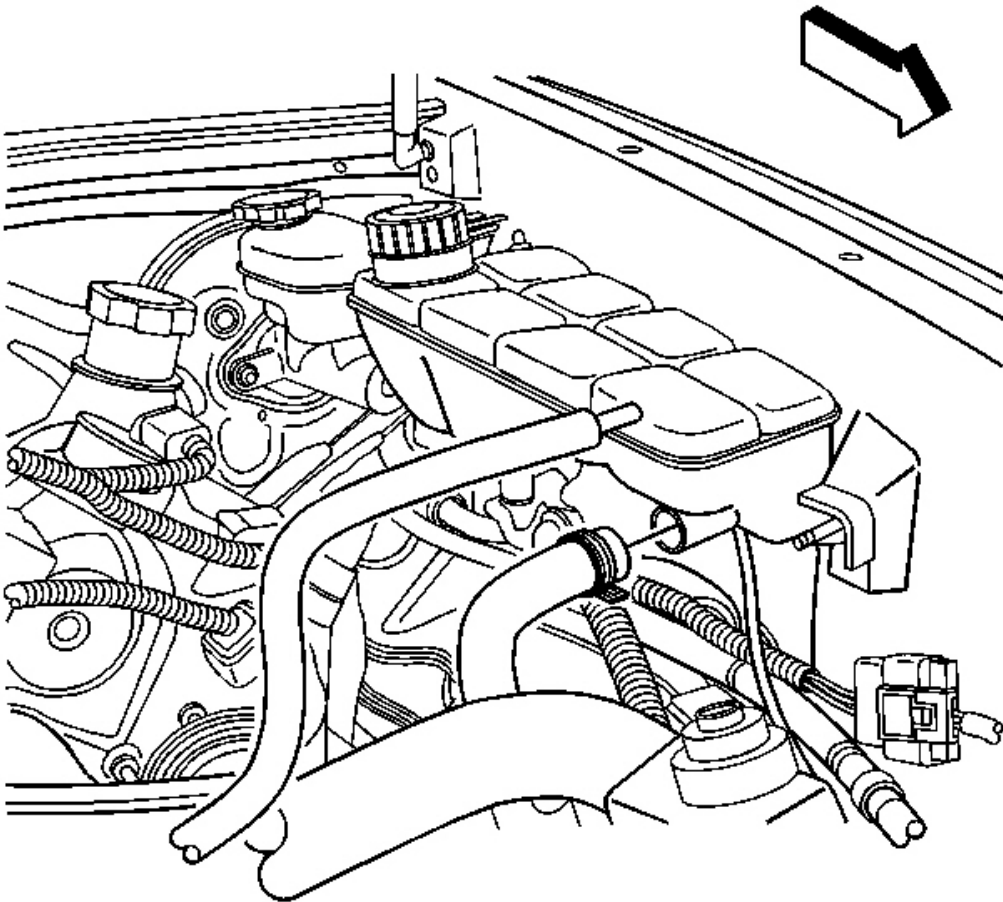


Fig. 60: Disconnecting/Connecting Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Disengage tension on the surge tank outlet hose clamp using the **J 38185** .
5. Disconnect the surge tank outlet hose from the surge tank.
6. Remove the protective cap on the surge tank upper stud.
7. Remove the surge tank upper nut.

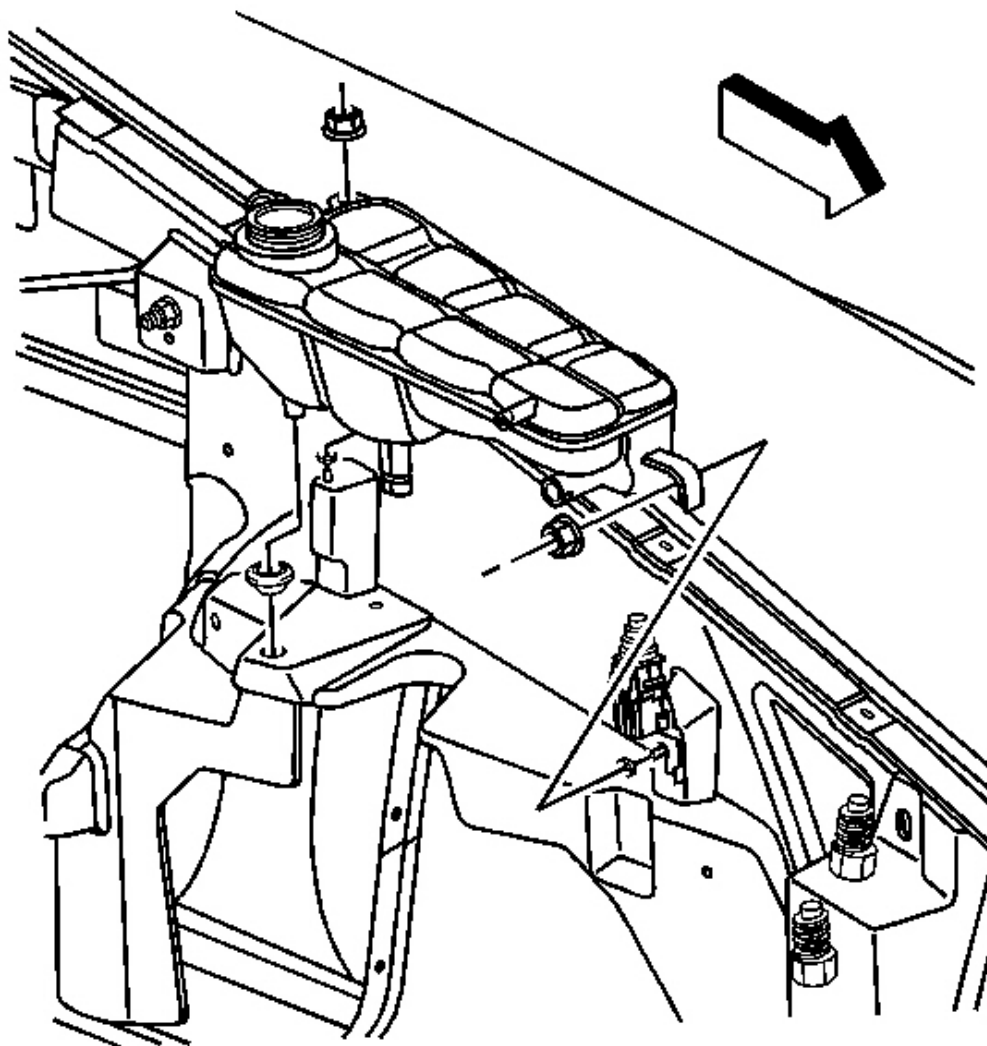


Fig. 61: View of Surge Tank
Courtesy of GENERAL MOTORS CORP.

8. Loosen the surge tank side nut.
9. Disconnect the coolant level sensor electrical connector.
10. Remove the surge tank.

Installation Procedure

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

1. Install the surge tank.

NOTE: Refer to Fastener Notice .

2. Install the upper surge tank nut.

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

3. Install the protective cap on the surge tank upper stud.

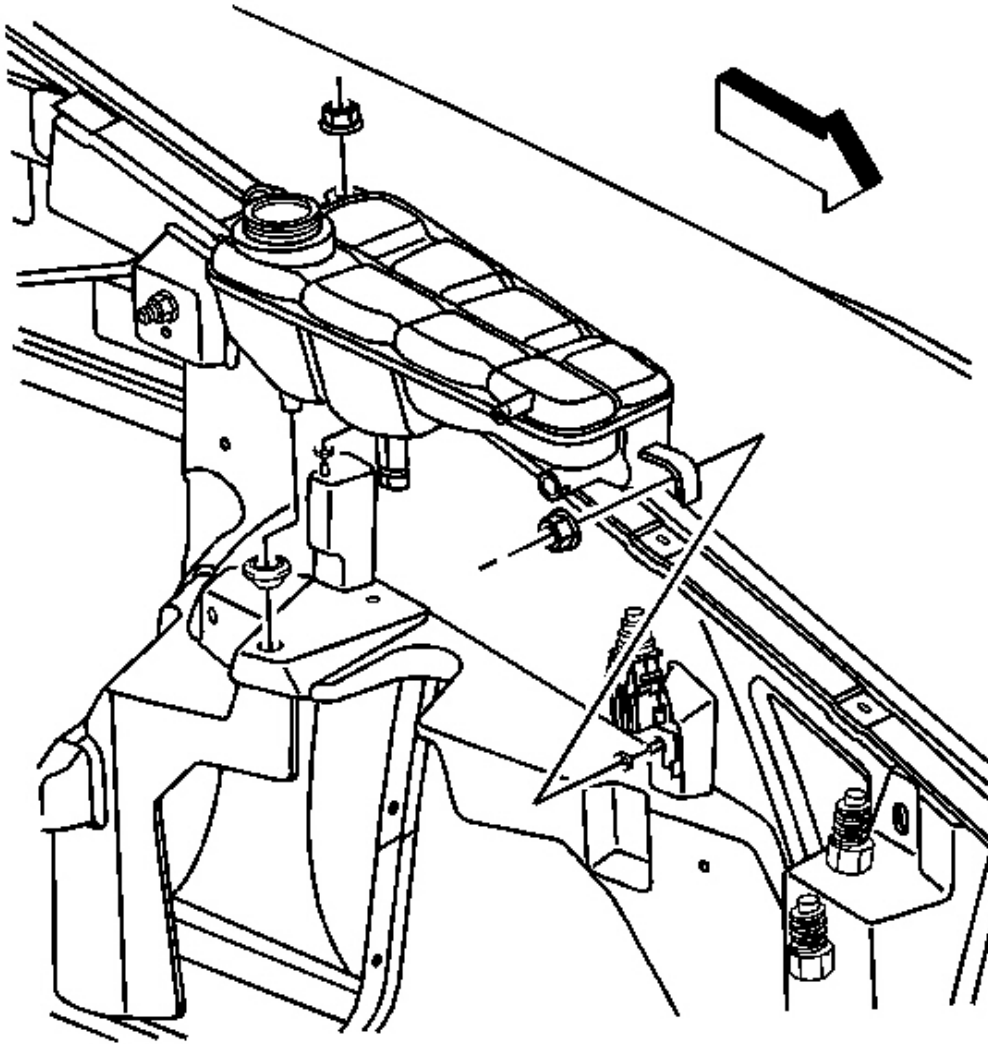


Fig. 62: View of Surge Tank
Courtesy of GENERAL MOTORS CORP.

4. Connect the coolant level sensor electrical connector.

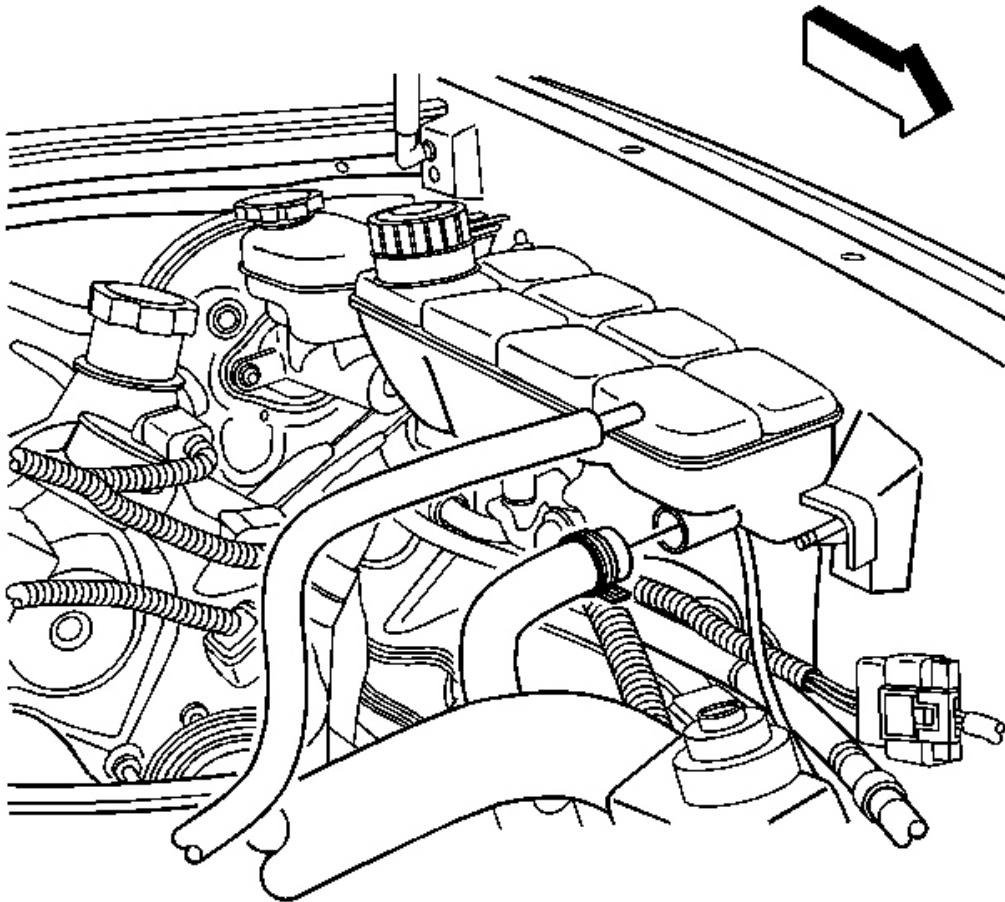


Fig. 63: Disconnecting/Connecting Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the surge tank outlet hose to the surge tank.
6. Engage tension on the surge tank outlet hose clamp.

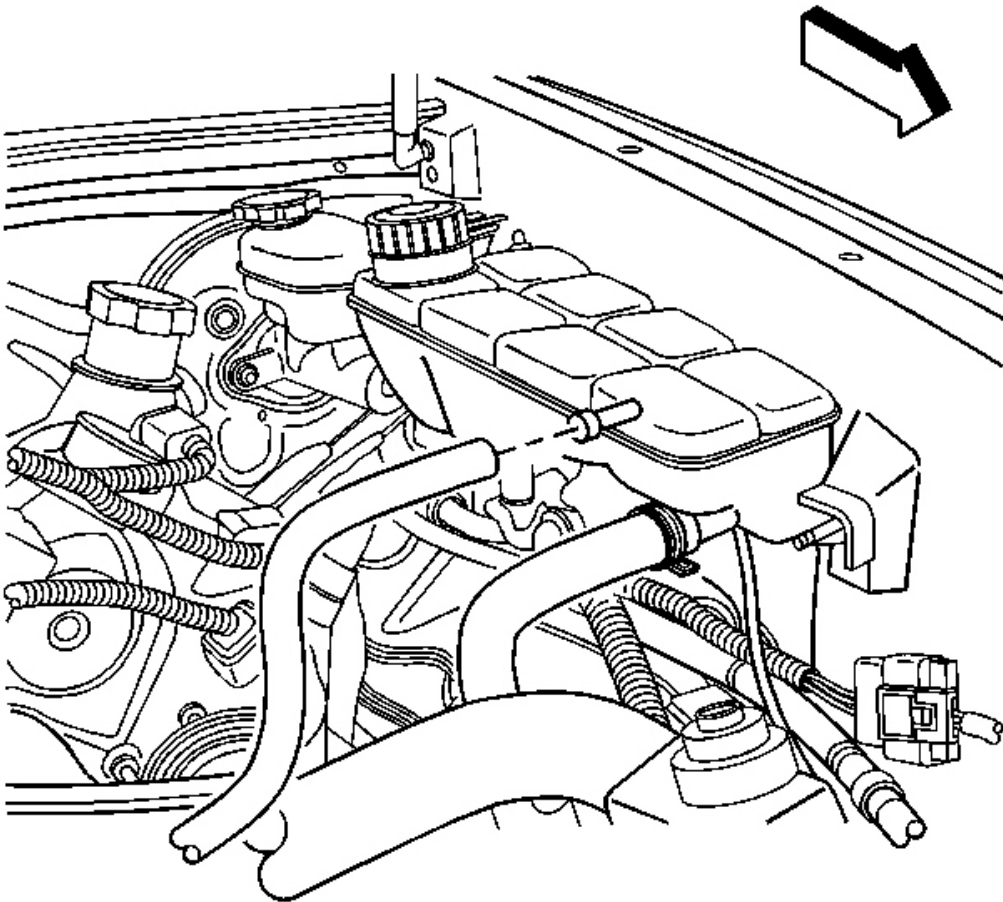


Fig. 64: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Connect the surge tank inlet hose to the surge tank.
8. Engage tension on the surge tank inlet hose clamp.
9. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).

RADIATOR SURGE TANK INLET HOSE/PIPE REPLACEMENT

Removal Procedure

Tools Required

J 38185 Hose Clamp Pliers

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).
2. Remove the radiator support. Refer to Radiator Support Replacement.

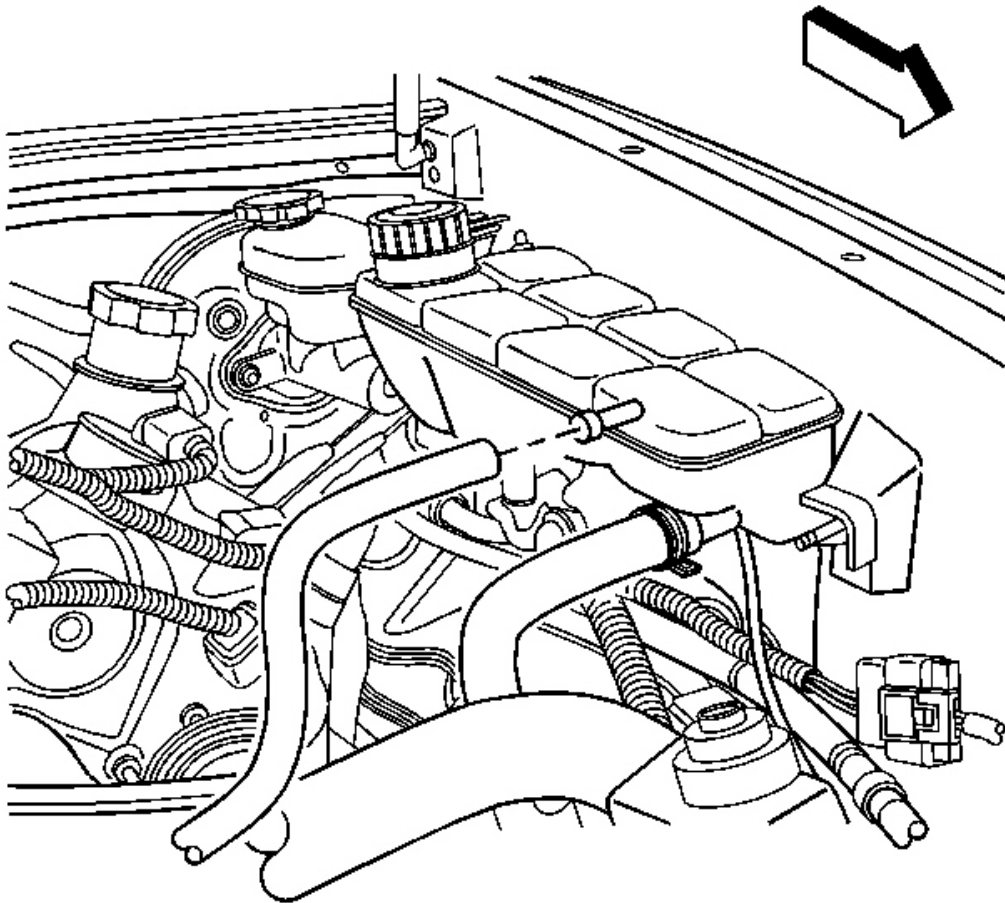


Fig. 65: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Disengage tension and reposition the surge tank inlet hose clamp at the surge tank using the **J 38185**.
4. Disconnect the surge tank inlet hose from the surge tank.

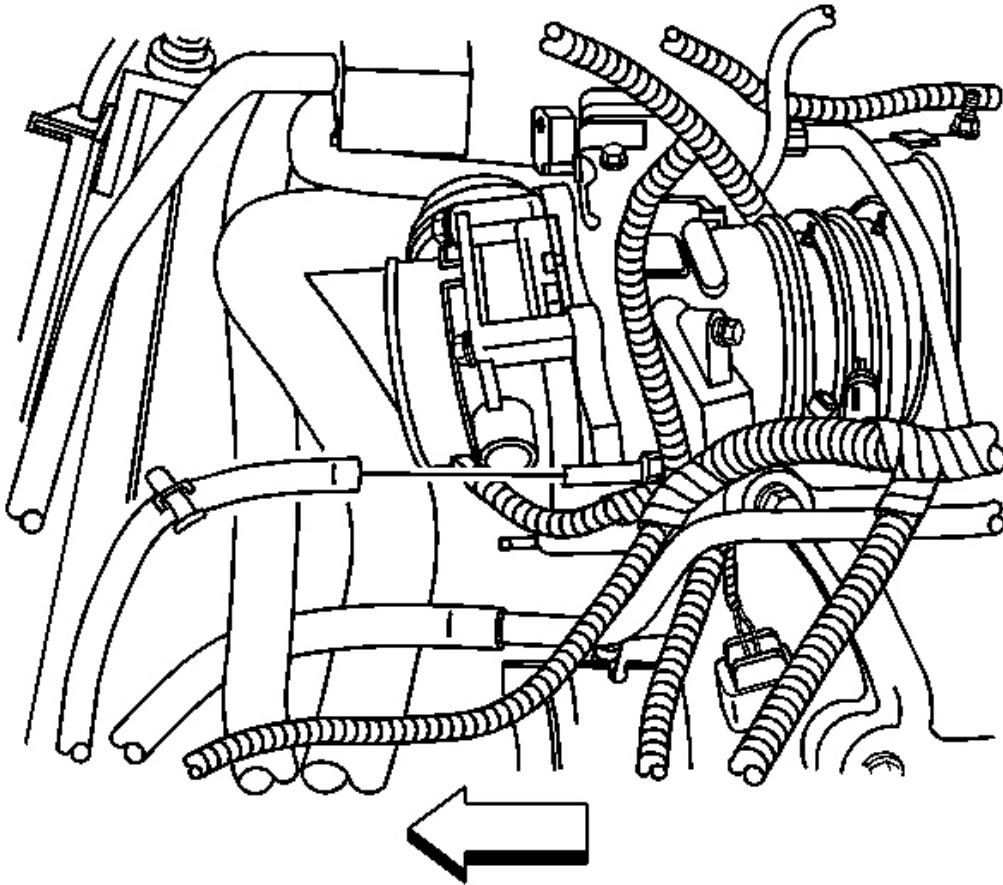


Fig. 66: Repositioning Surge Tank Inlet Hose Clamp At Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

5. Disengage tension and reposition the surge tank inlet hose clamp at the throttle body assembly using the **J 38185**.
6. Disconnect the surge tank inlet hose from the throttle body assembly.

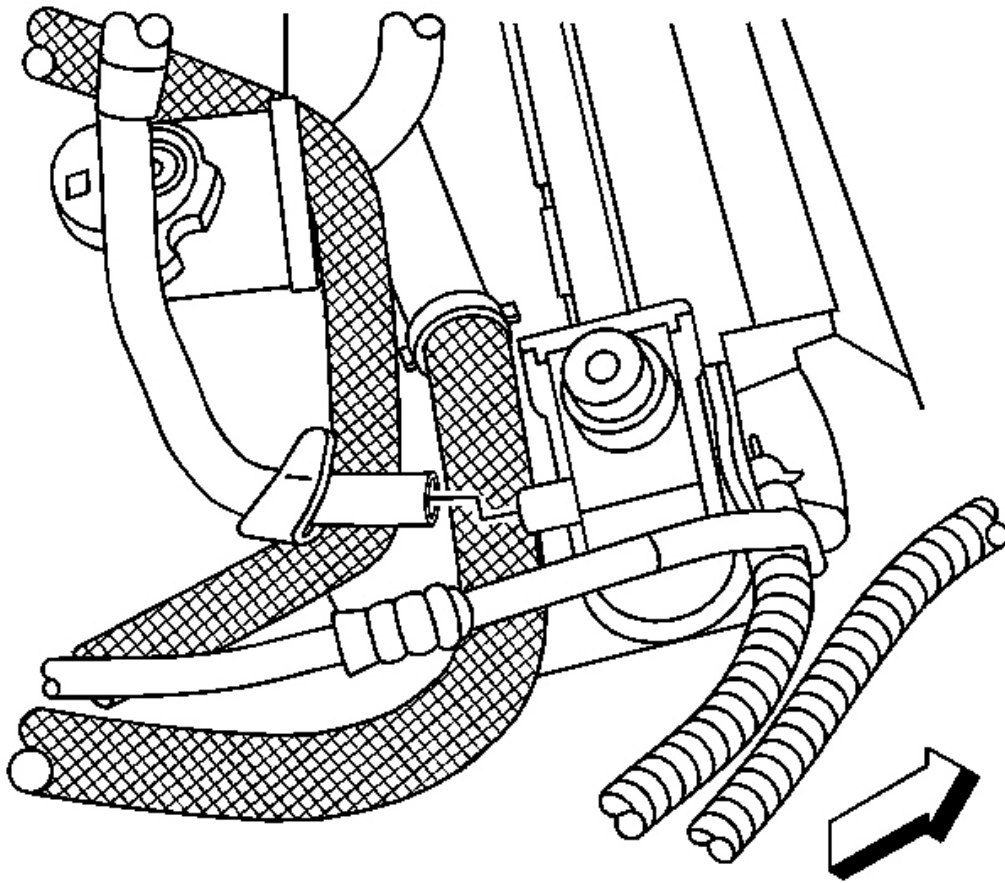


Fig. 67: Repositioning Surge Tank Inlet Hose Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

7. Disengage tension and reposition the surge tank inlet hose clamp at the radiator using the **J 38185** .
8. Disconnect the surge tank inlet hose from the radiator.

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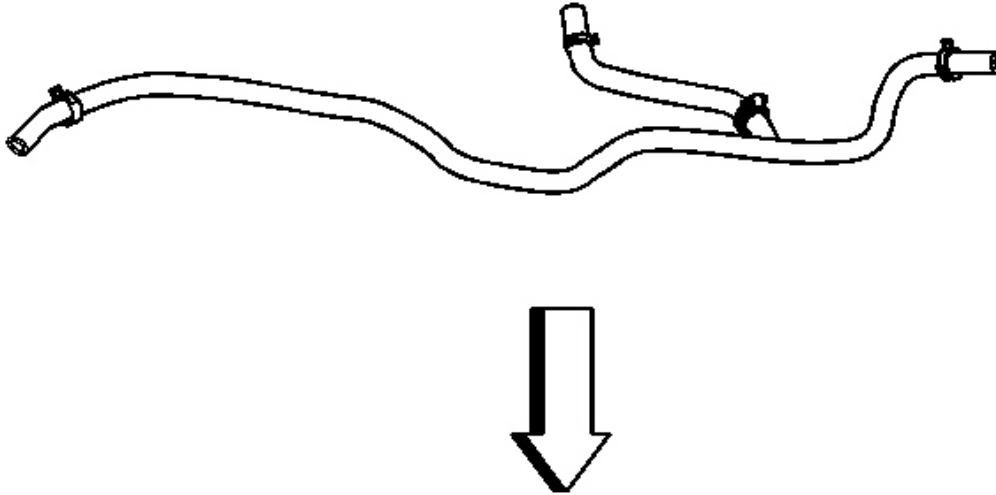


Fig. 68: Removing/Installing Surge Tank Inlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

9. Remove the surge tank inlet hose assembly from the vehicle.

Installation Procedure

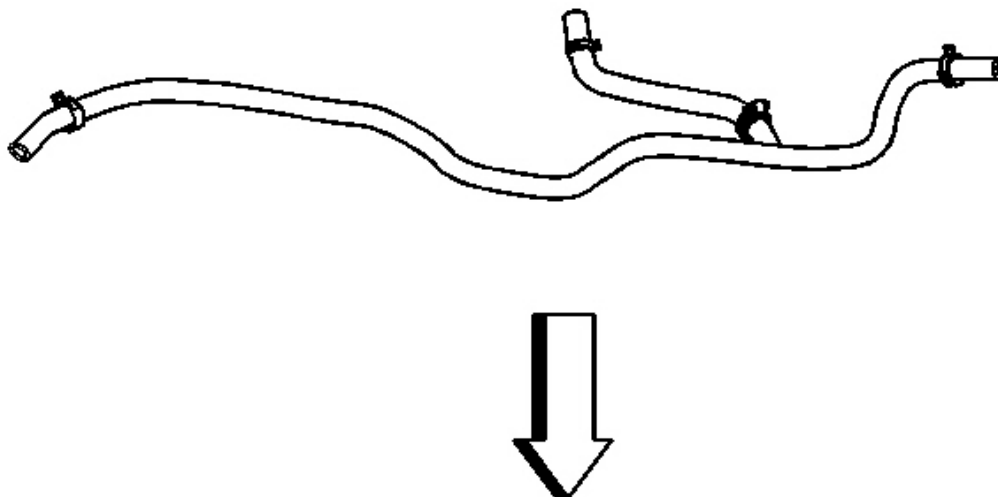


Fig. 69: Removing/Installing Surge Tank Inlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

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

1. Install the surge tank inlet hose assembly to the vehicle.
2. Connect the surge tank inlet hose to the radiator.

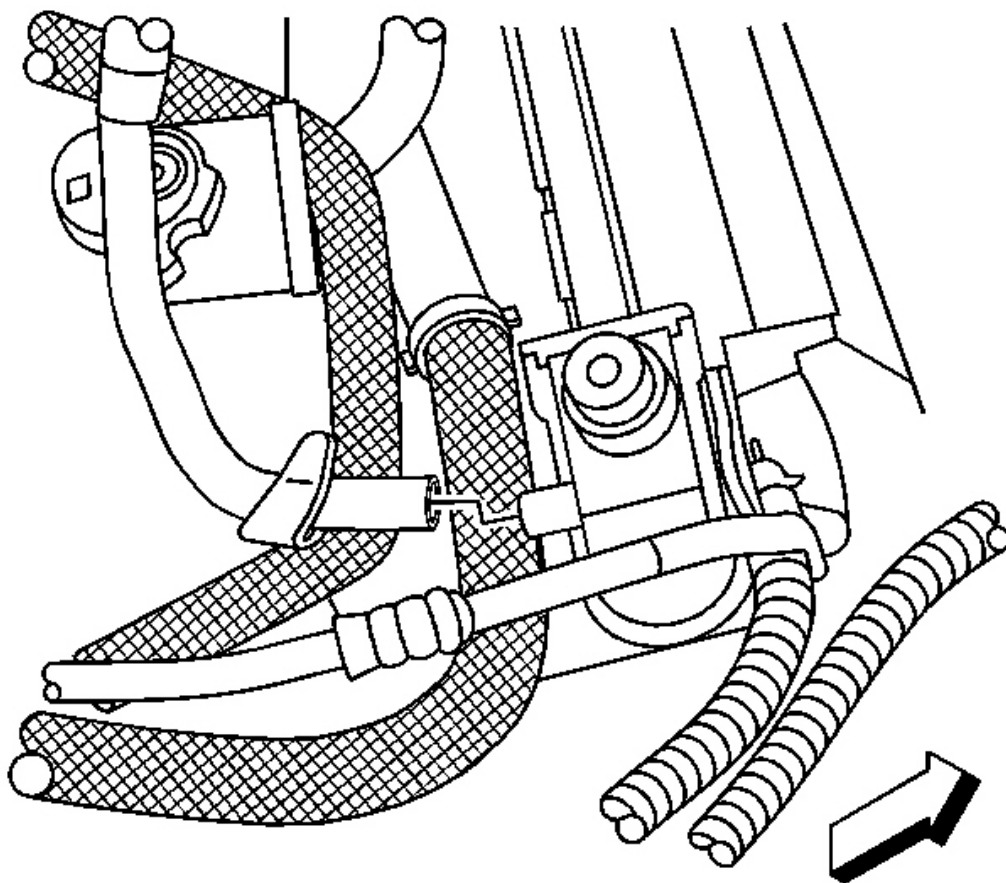


Fig. 70: Repositioning Surge Tank Inlet Hose Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

3. Disengage tension and reposition the surge tank inlet hose clamp at the radiator using the **J 38185**.
4. Connect the surge tank inlet hose to the throttle body assembly.

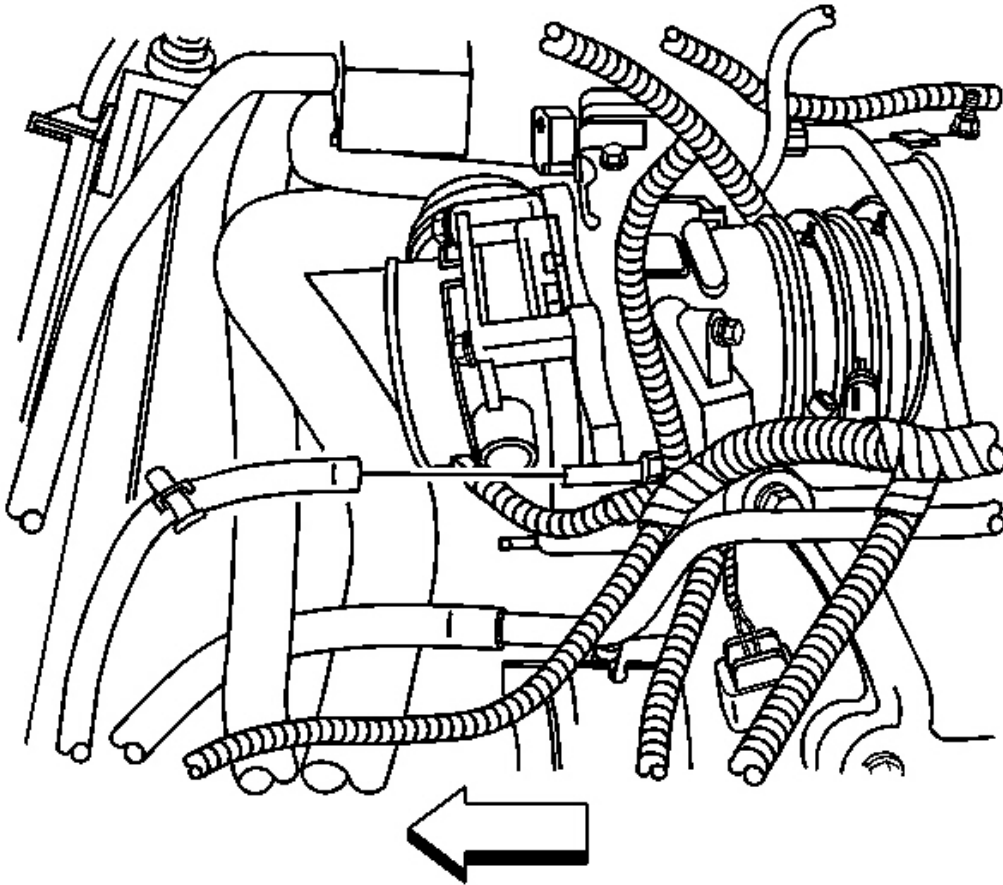


Fig. 71: Repositioning Surge Tank Inlet Hose Clamp At Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

5. Disengage tension and reposition the surge tank inlet hose clamp at the throttle body assembly using the **J 38185**.
6. Connect the surge tank inlet hose to the surge tank.

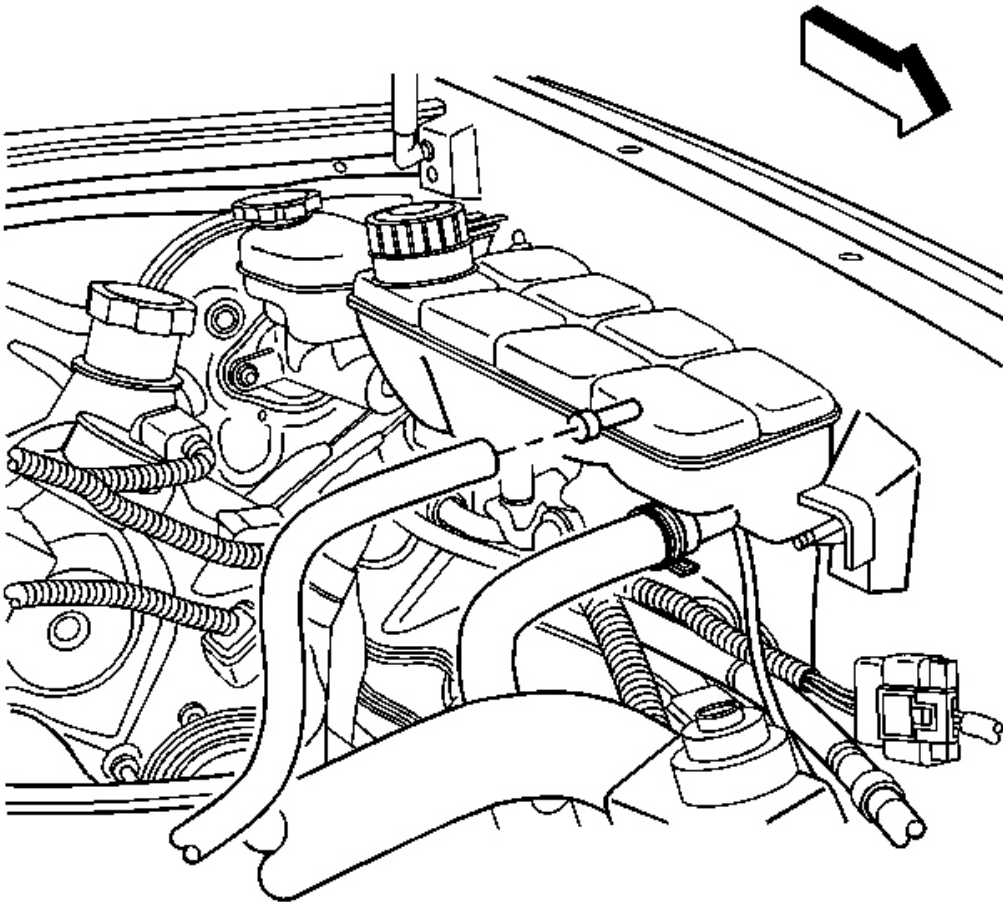


Fig. 72: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Disengage tension and reposition the surge tank inlet hose clamp at the surge tank using the **J 38185** .
8. Install the radiator support. Refer to **Radiator Support Replacement**.
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

RADIATOR SURGE TANK OUTLET HOSE/PIPE REPLACEMENT

Removal Procedure

Tools Required

J 38185 Hose Clamp Pliers

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).
2. Remove the radiator support. Refer to Radiator Support Replacement.

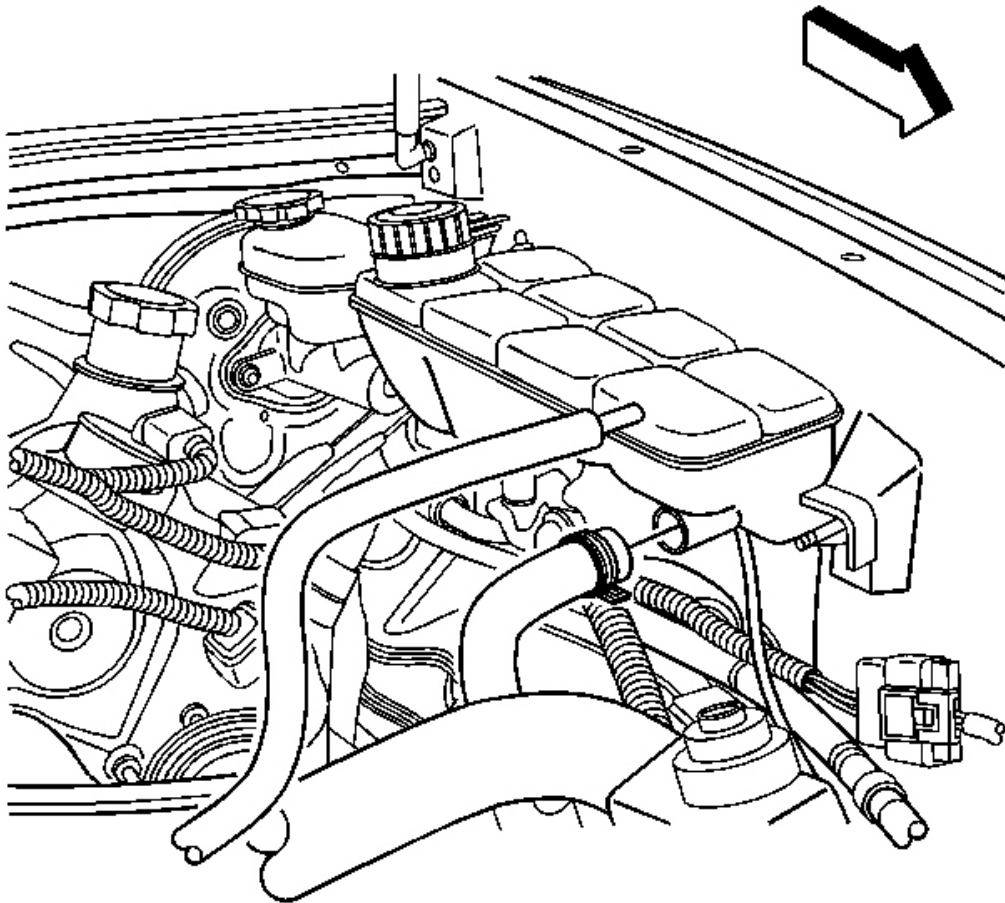


Fig. 73: Disconnecting/Connecting Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Disengage tension on the surge tank outlet hose clamp at the surge tank using the **J 38185** .
4. Disconnect the surge tank outlet hose from the surge tank.

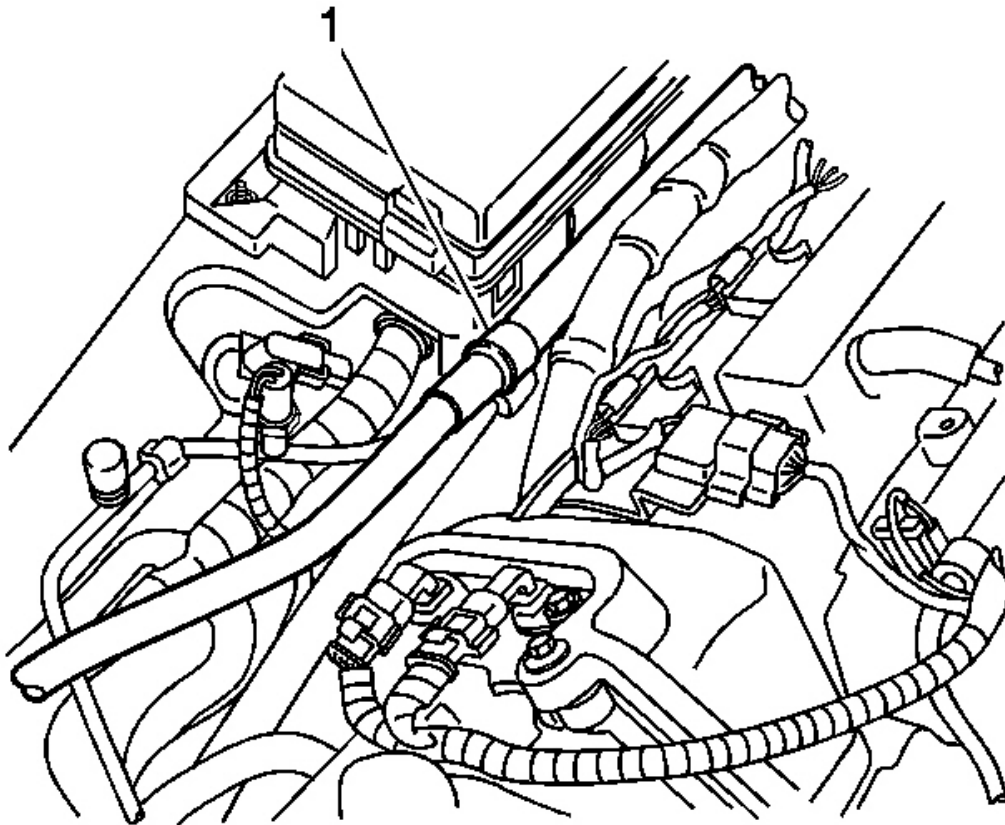


Fig. 74: View Of Underhood Junction Box Retainer Clip
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the surge tank outlet hose assembly from the support tabs on the cooling fan shroud.
6. Disconnect the surge tank outlet hose from the underhood junction box retainer clip (1).
7. Disengage tension on the surge tank outlet hose clamp at the heater pipe assembly.

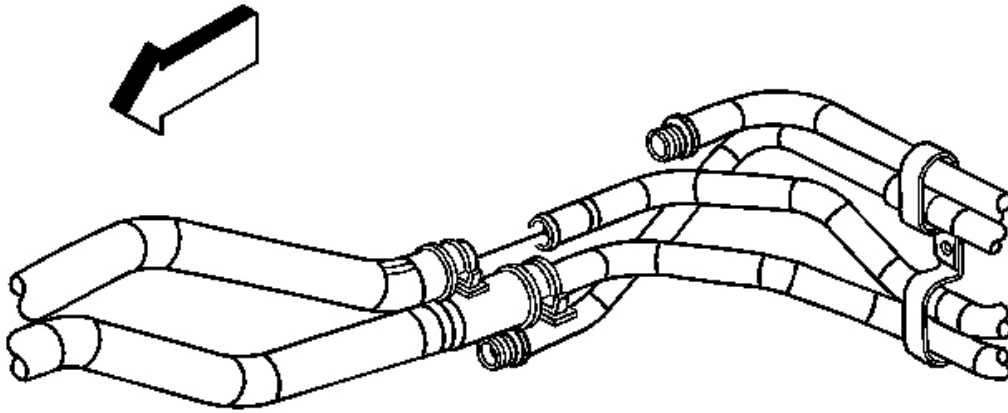


Fig. 75: Disconnecting/Connecting Surge Tank Outlet Hose From Heater Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the surge tank outlet hose from the heater pipe assembly.
9. Disengage tension on the radiator inlet hose clamp at the radiator using **J 38185** .
10. Disconnect the radiator inlet hose from the radiator.
11. Disengage tension on the radiator inlet hose clamp at the engine using **J 38185** .

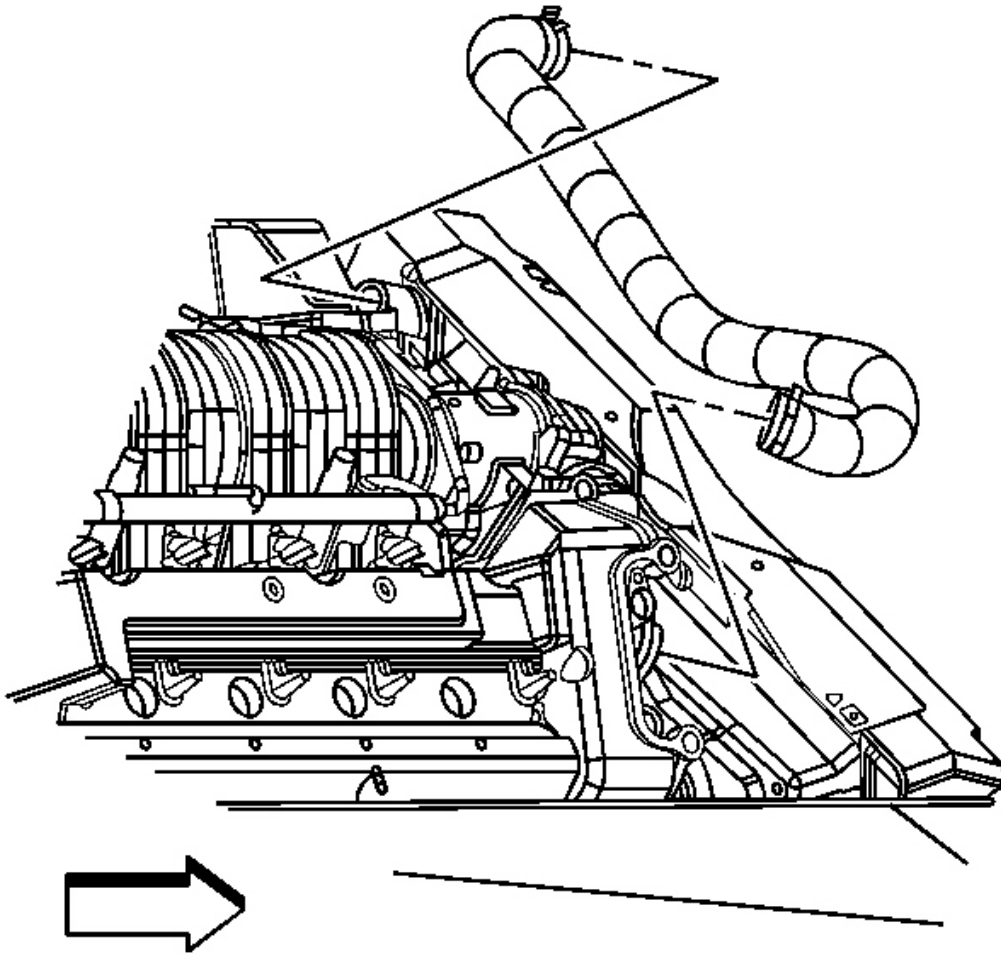


Fig. 76: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the radiator inlet hose from the engine.
13. Remove the radiator inlet hose.

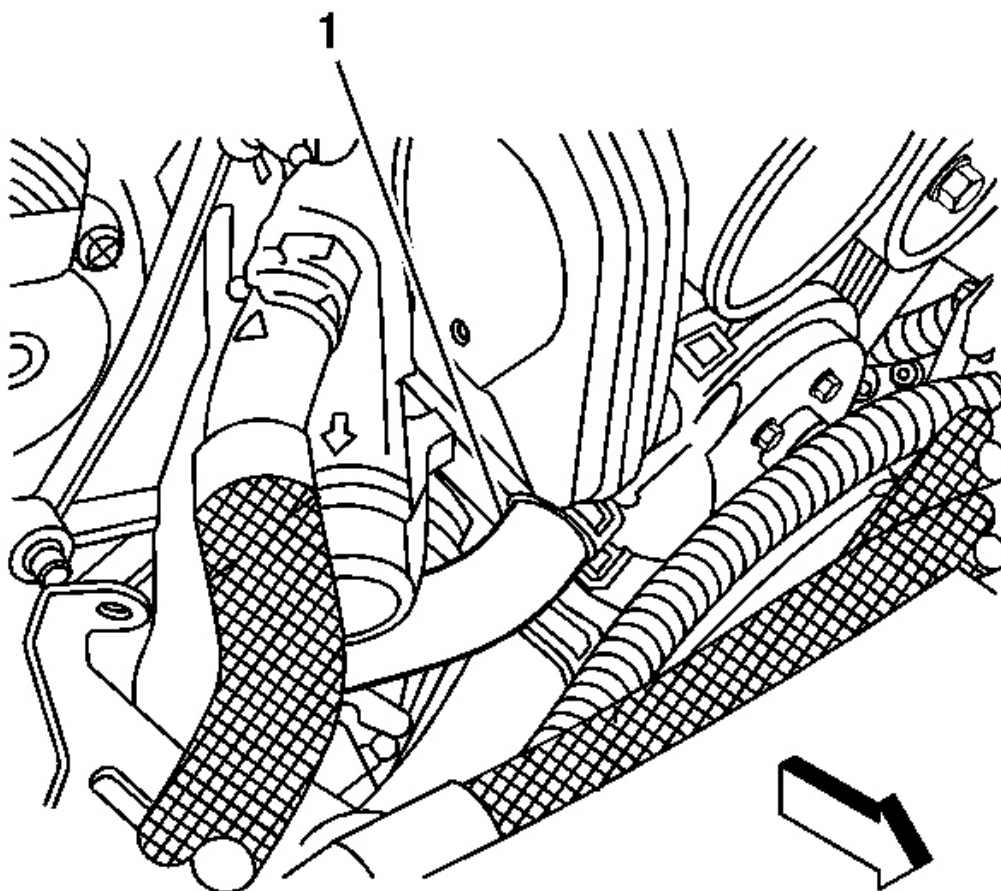


Fig. 77: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

14. Disengage tension on the surge tank outlet hose clamp at the thermostat housing (1).
15. Disconnect the surge tank outlet hose from the thermostat housing.

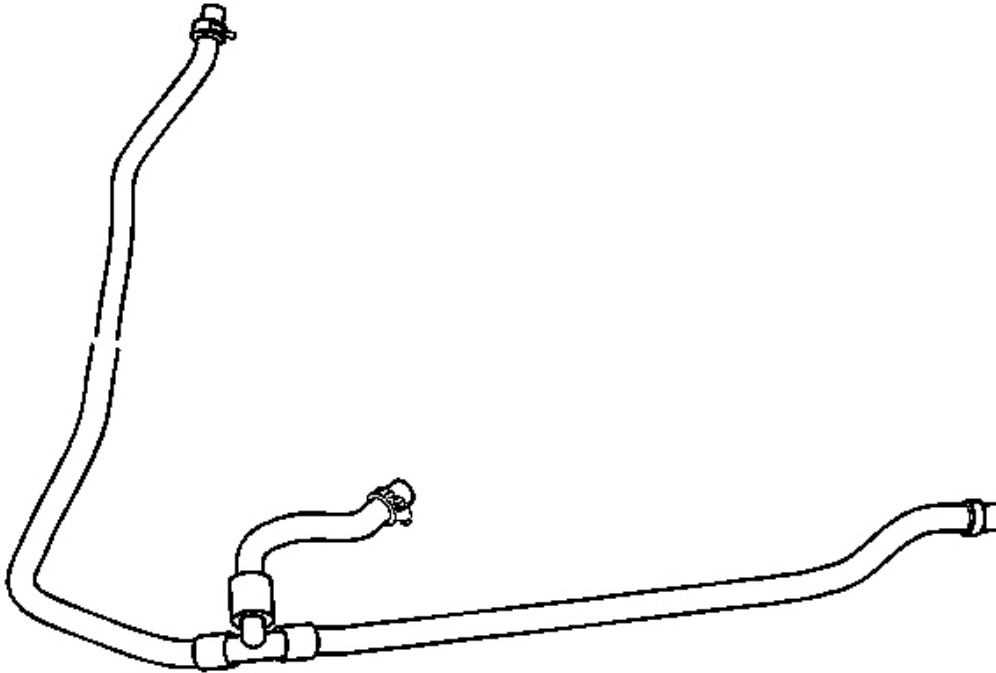


Fig. 78: Removing/Installing Surge Tank Outlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

16. Remove the surge tank outlet hose assembly from the vehicle.

Installation Procedure

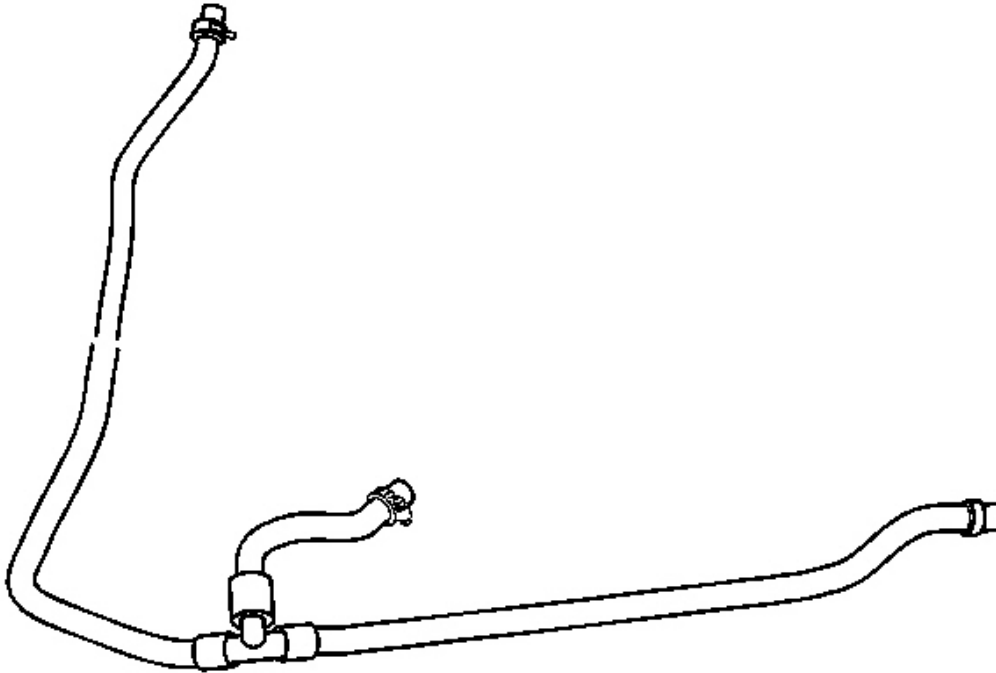


Fig. 79: Removing/Installing Surge Tank Outlet Hose Assembly
Courtesy of GENERAL MOTORS CORP.

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

1. Install the surge tank outlet hose assembly to the vehicle.

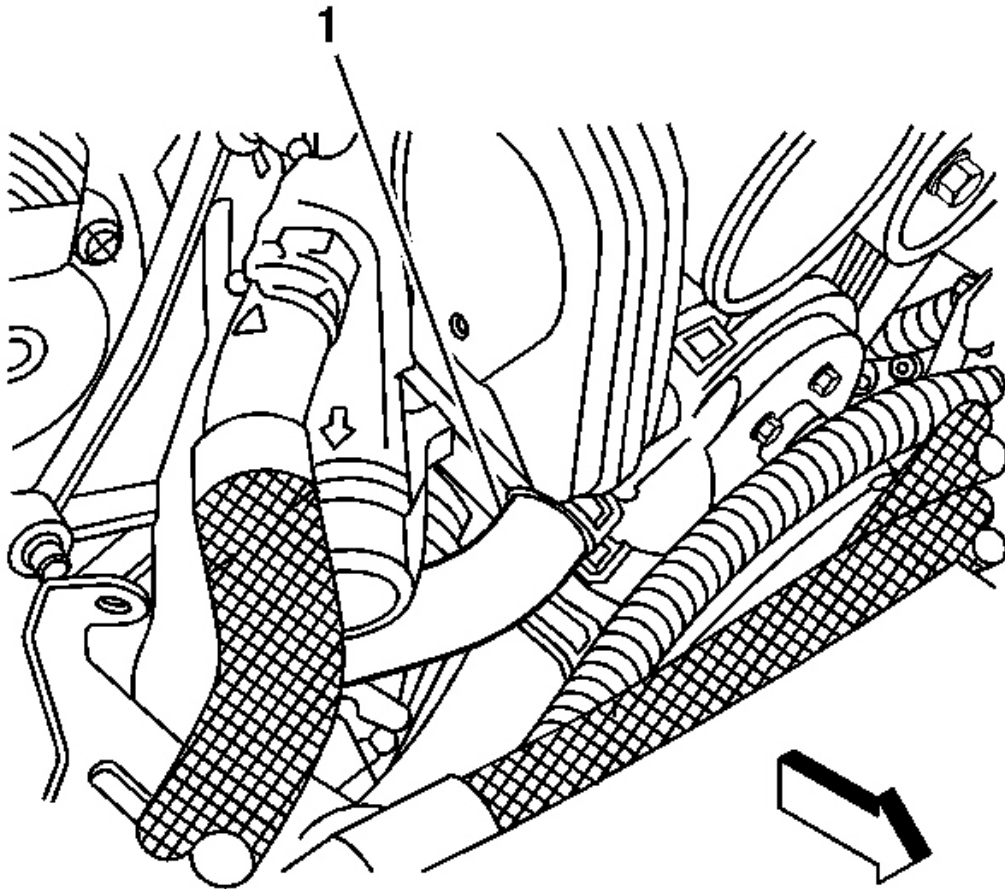


Fig. 80: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

2. Connect the surge tank outlet hose to the thermostat housing (1).
3. Engage tension on the surge tank outlet hose clamp at the thermostat housing.
4. Install the radiator inlet hose.

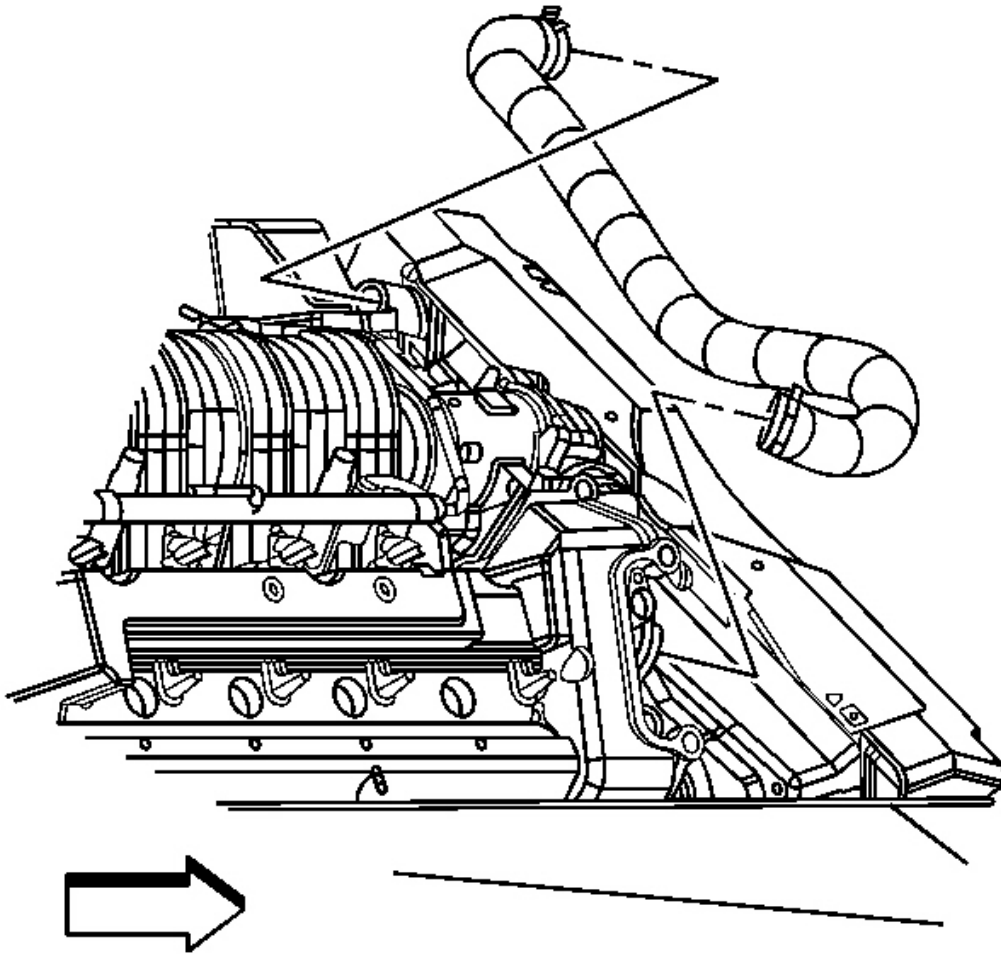


Fig. 81: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the radiator inlet hose to the engine.
6. Engage tension on the radiator inlet hose clamp at the engine using **J 38185** .
7. Connect the radiator inlet hose to the radiator.
8. Engage tension on the radiator inlet hose clamp at the radiator using **J 38185** .

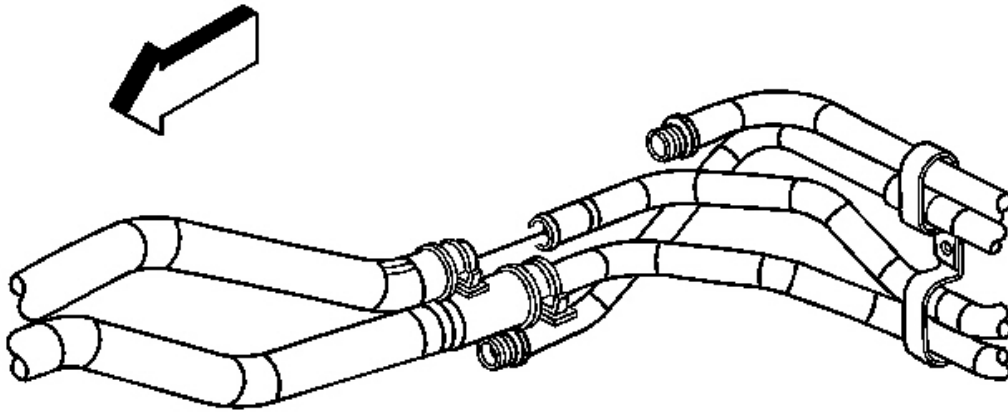


Fig. 82: Disconnecting/Connecting Surge Tank Outlet Hose From Heater Pipe Assembly
Courtesy of GENERAL MOTORS CORP.

9. Connect the surge tank outlet hose to the heater pipe assembly.
10. Engage tension on the surge tank outlet hose clamp at the heater pipe assembly.

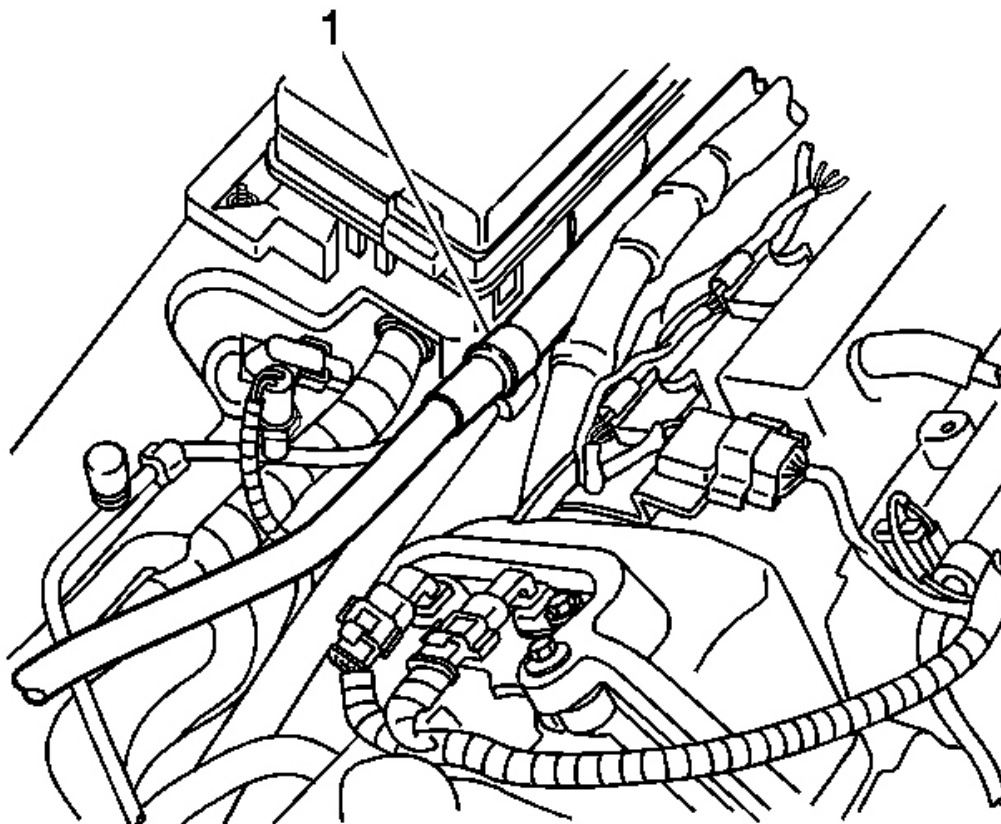


Fig. 83: View Of Underhood Junction Box Retainer Clip
Courtesy of GENERAL MOTORS CORP.

11. Connect the surge tank outlet hose to the underhood junction box retainer clip (1).
12. Connect the surge tank outlet hose assembly to the support tabs on the cooling fan shroud.

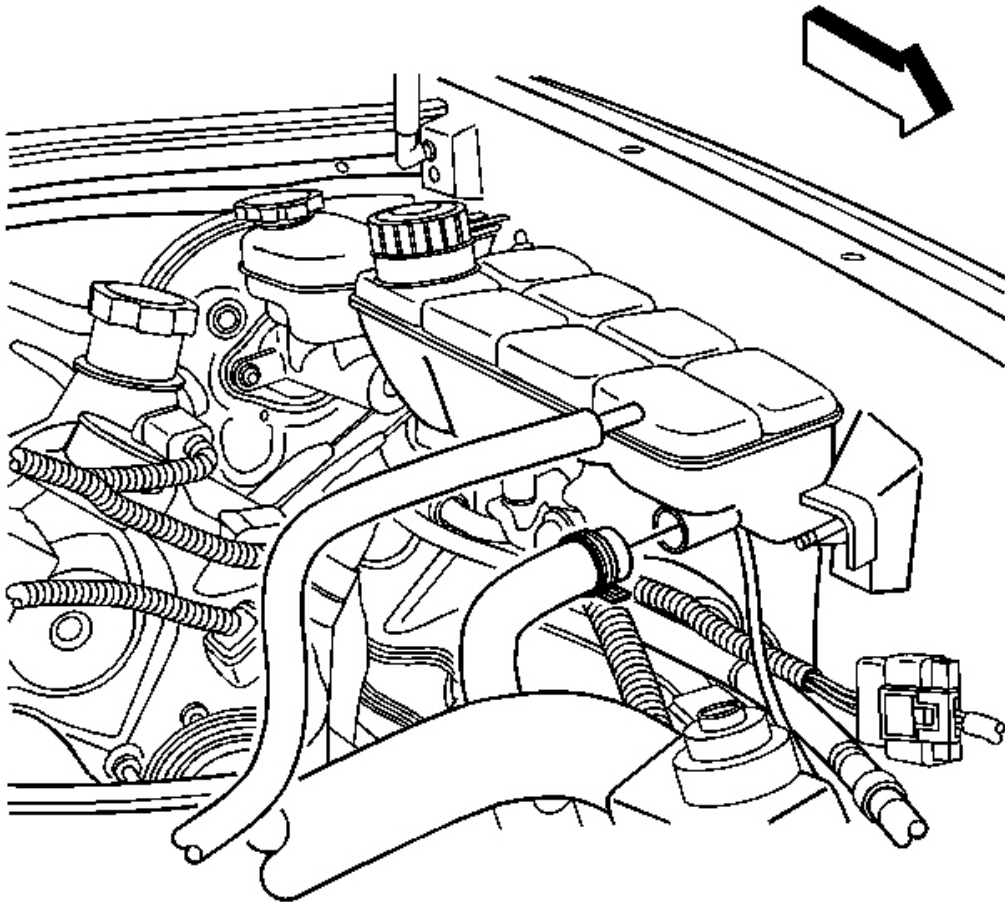


Fig. 84: Disconnecting/Connecting Surge Tank Outlet Hose
Courtesy of GENERAL MOTORS CORP.

13. Connect the surge tank outlet hose to the surge tank.
14. Engage tension on the surge tank outlet hose clamp at the surge tank using the **J 38185**.
15. Install the radiator support. Refer to **Radiator Support Replacement**.
16. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

RADIATOR INLET HOSE REPLACEMENT

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
3. Disengage tension on the radiator inlet hose clamp at the radiator using **J 38185**.
4. Disconnect the radiator inlet hose from the radiator.
5. Disengage tension on the radiator inlet hose clamp at the engine using **J 38185**.

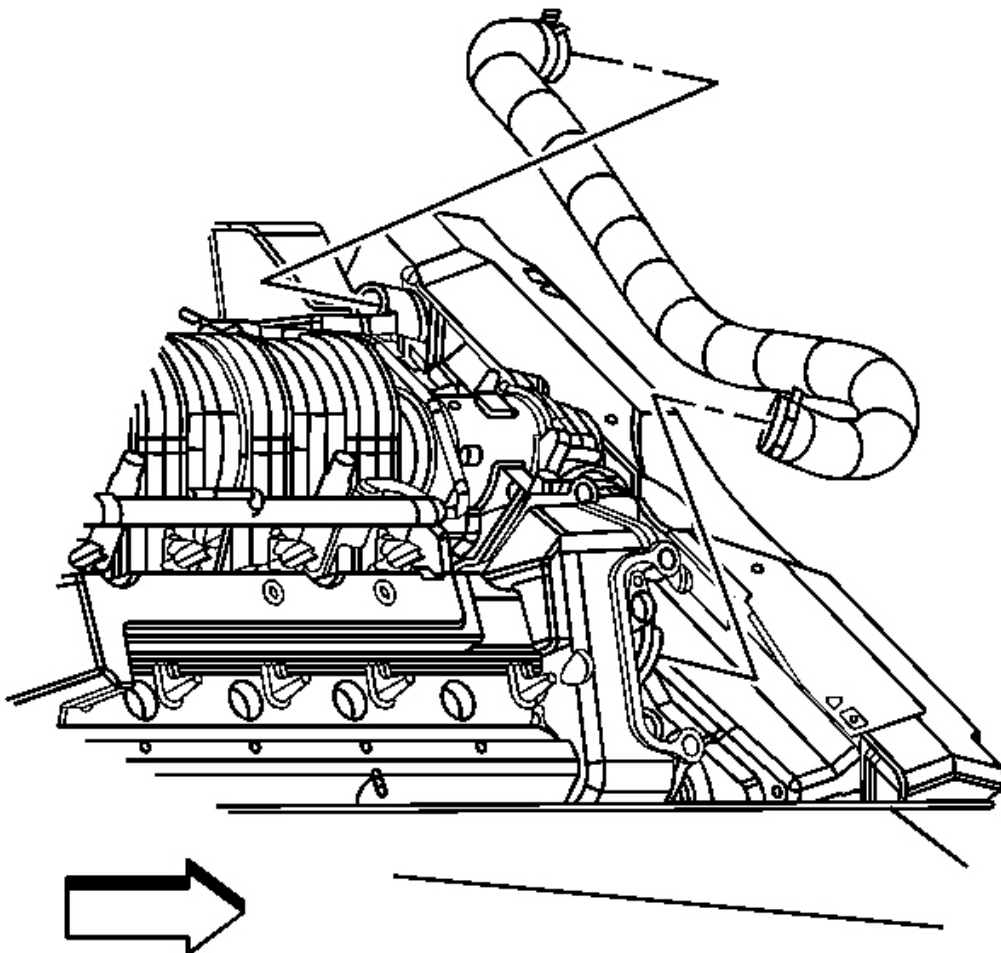


Fig. 85: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

NOTE: Make sure the reference marks on the hoses and the radiator are lined up. A twist on the hose would place strain on the radiator fitting which could cause the fitting to crack or break.

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

1. Install the radiator inlet hose.

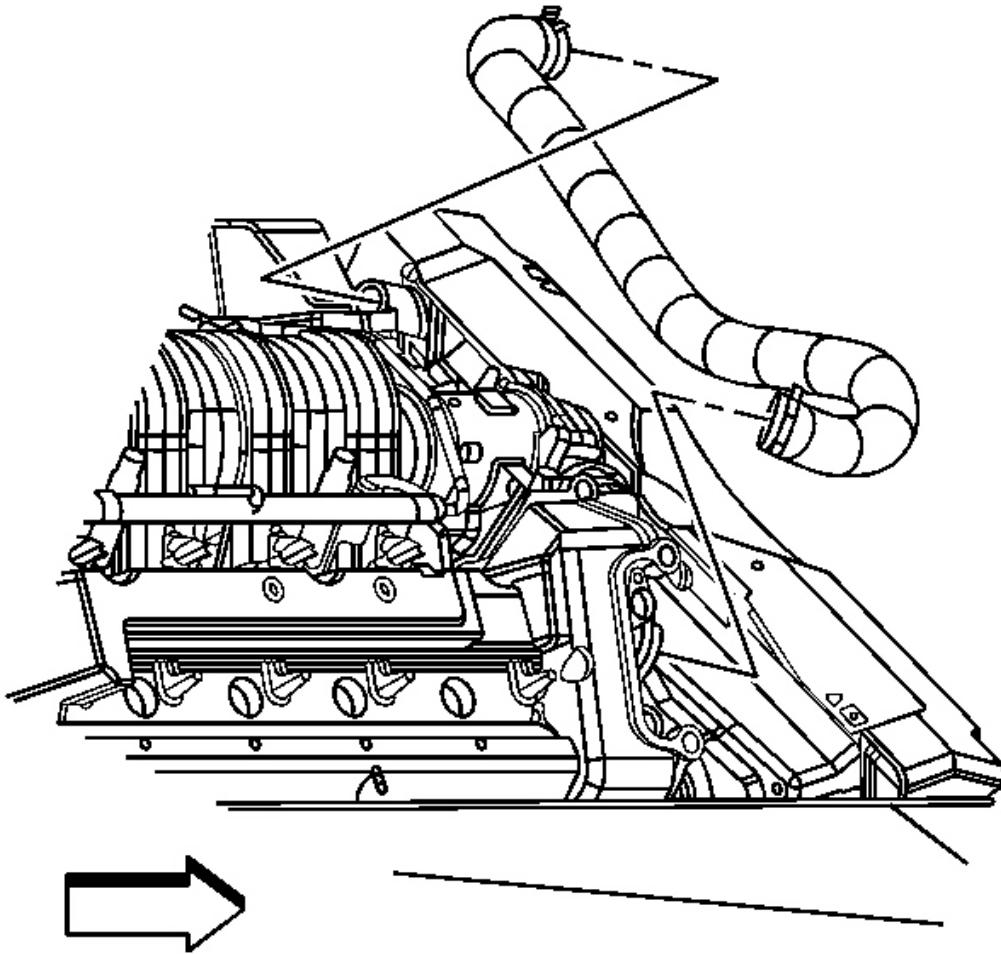


Fig. 86: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the radiator inlet hose to the engine.
3. Engage tension on the radiator inlet hose clamp at the engine using **J 38185**.
4. Connect the radiator inlet hose to the radiator.
5. Engage tension on the radiator inlet hose clamp at the radiator using **J 38185**.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

RADIATOR OUTLET HOSE REPLACEMENT

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Removal Procedure

Tools Required

J 38185 Hose Clamp Pliers

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).
2. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
3. Disengage tension on the radiator inlet hose clamp at the radiator using **J 38185**.
4. Disconnect the radiator inlet hose from the radiator.
5. Disengage tension on the radiator inlet hose clamp at the engine using **J 38185**.

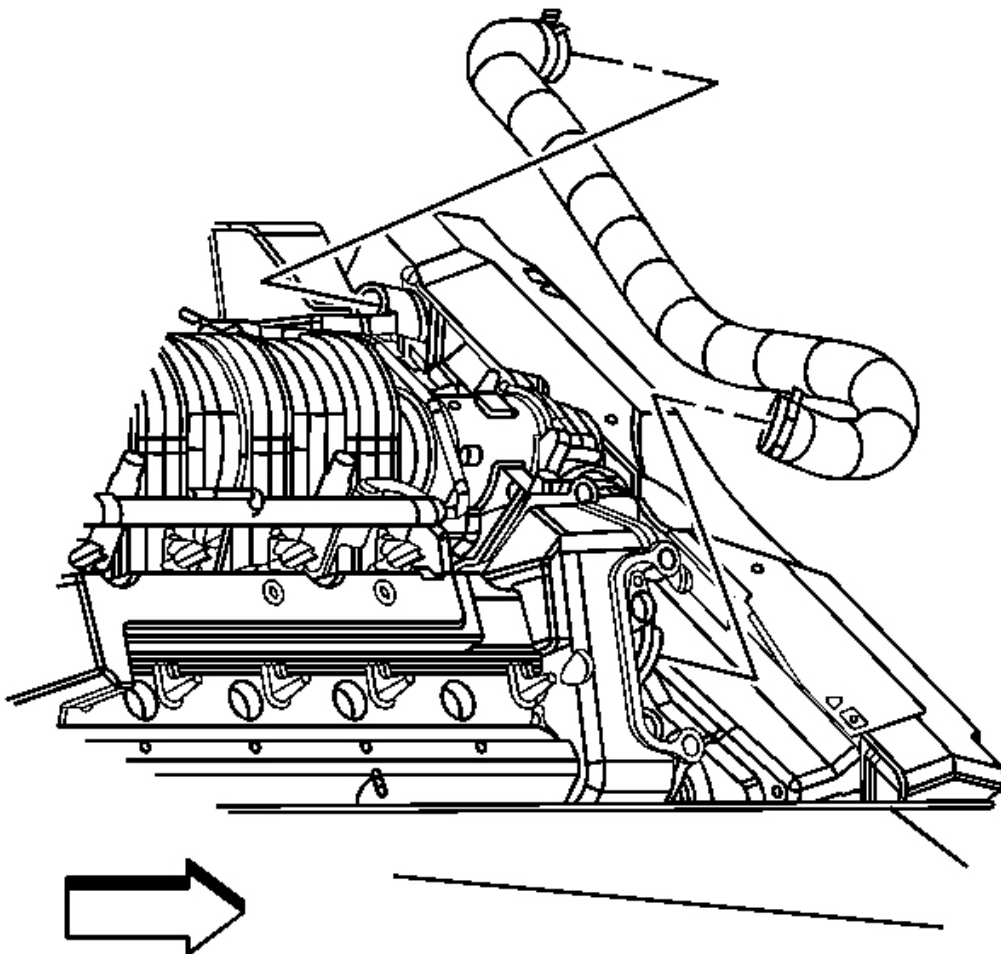


Fig. 87: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the radiator inlet hose from the engine.
7. Remove the radiator inlet hose.
8. Remove the remote power steering reservoir. Refer to **Remote Power Steering Fluid Reservoir Replacement**.
9. Disengage tension on the radiator outlet hose clamp at the water pump using the **J 38185**.

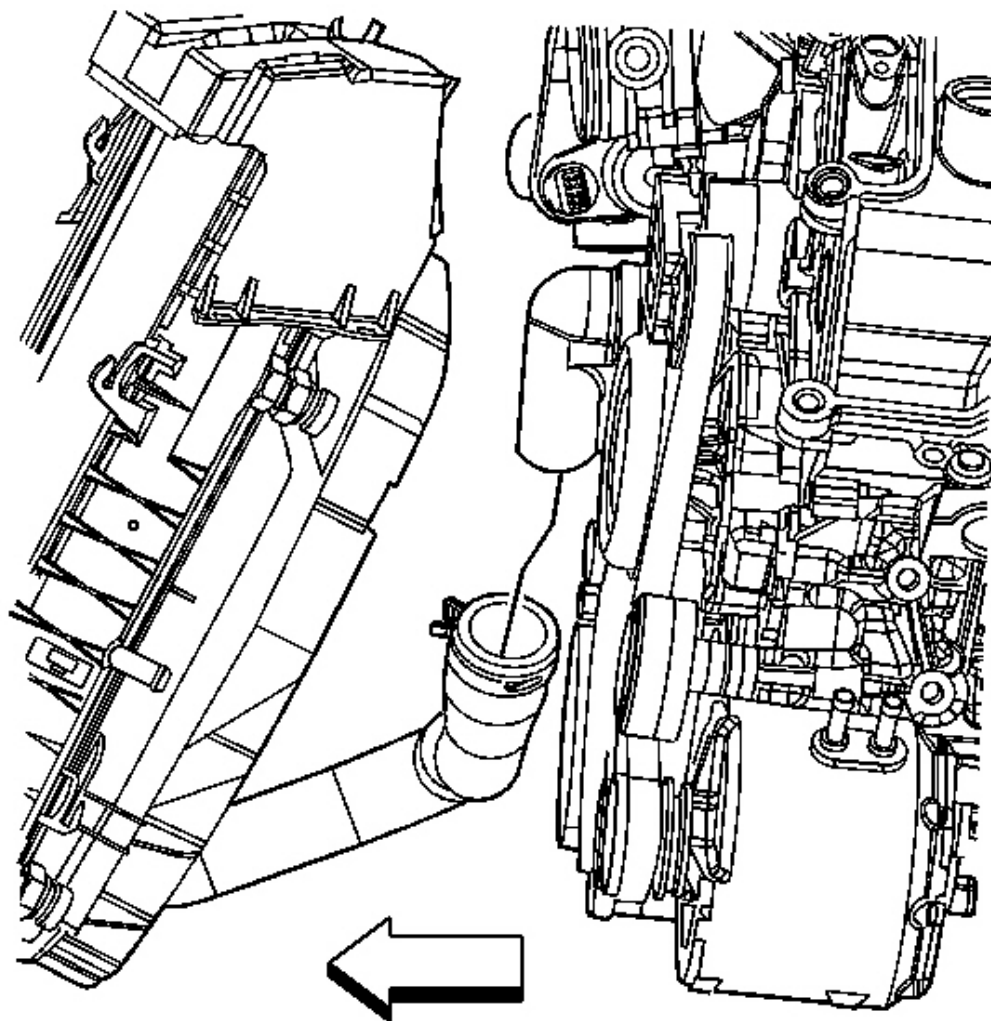


Fig. 88: Disconnecting/Connecting Radiator Outlet Hose To Water Pump

Courtesy of GENERAL MOTORS CORP.

10. Disconnect the radiator outlet hose from the water pump.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

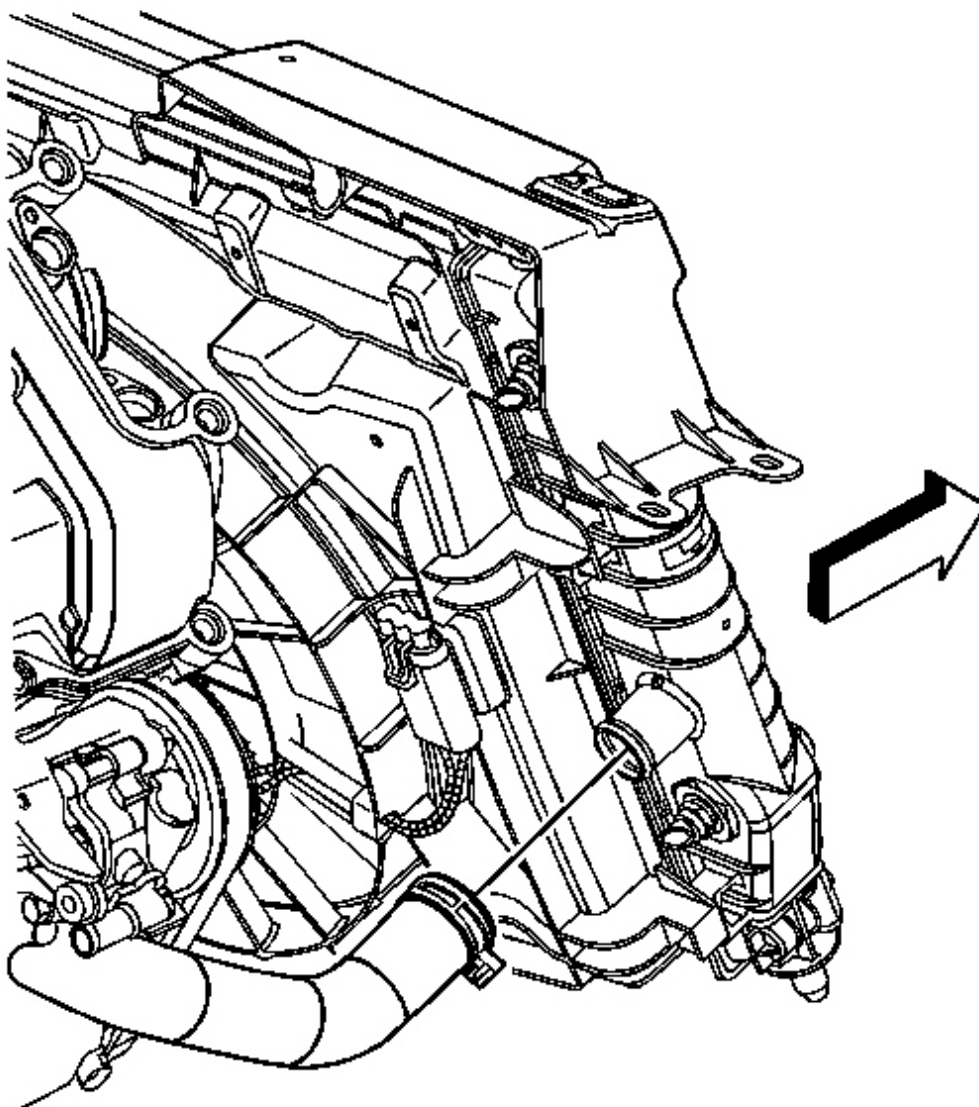


Fig. 89: Disconnecting/Connecting Radiator Outlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

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12. Disengage tension on the radiator outlet hose clamp at the radiator using **J 38185** .
13. Disconnect the radiator outlet hose from the radiator.
14. Remove the radiator outlet hose.

Installation Procedure

NOTE: **Make sure the reference marks on the hoses and the radiator are lined up. A twist on the hose would place strain on the radiator fitting which could cause the fitting to crack or break.**

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

1. Install the radiator outlet hose.

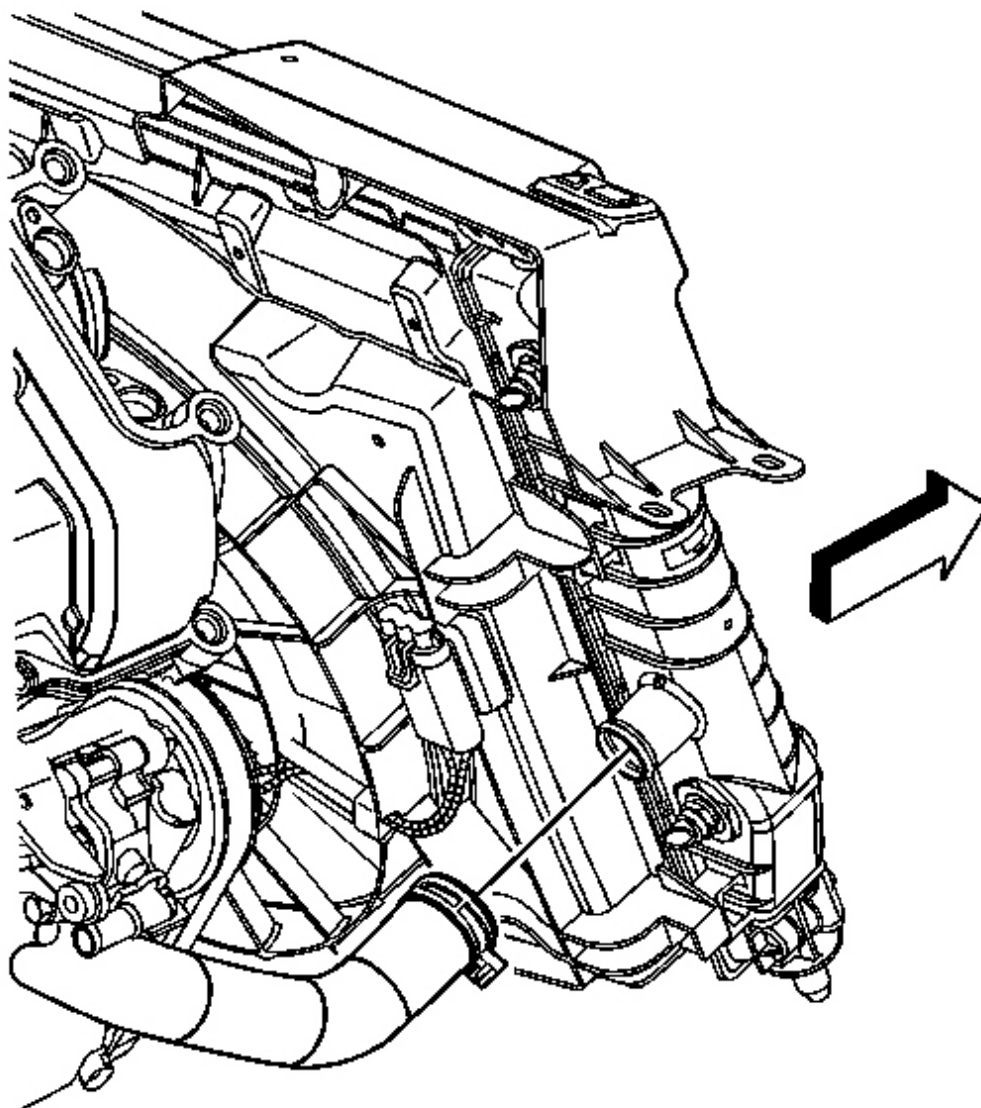


Fig. 90: Disconnecting/Connecting Radiator Outlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

2. Connect the radiator outlet hose to the radiator.
3. Engage tension on the radiator outlet hose clamp at the radiator.
4. Lower the vehicle.

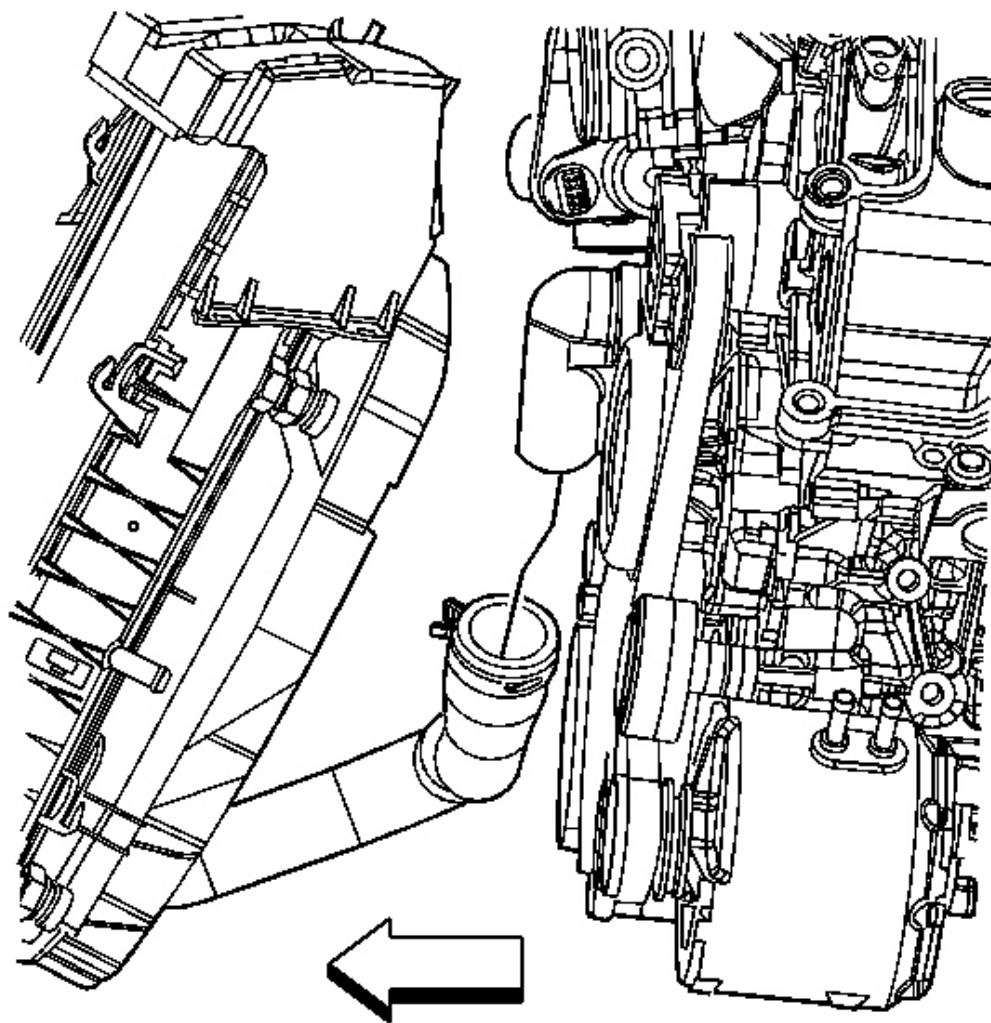


Fig. 91: Disconnecting/Connecting Radiator Outlet Hose To Water Pump
Courtesy of GENERAL MOTORS CORP.

5. Connect the radiator outlet hose to the water pump.
6. Engage tension on the radiator outlet hose clamp at the water pump.
7. Install the remote power steering reservoir. Refer to **Remote Power Steering Fluid Reservoir Replacement**.
8. Install the radiator inlet hose.

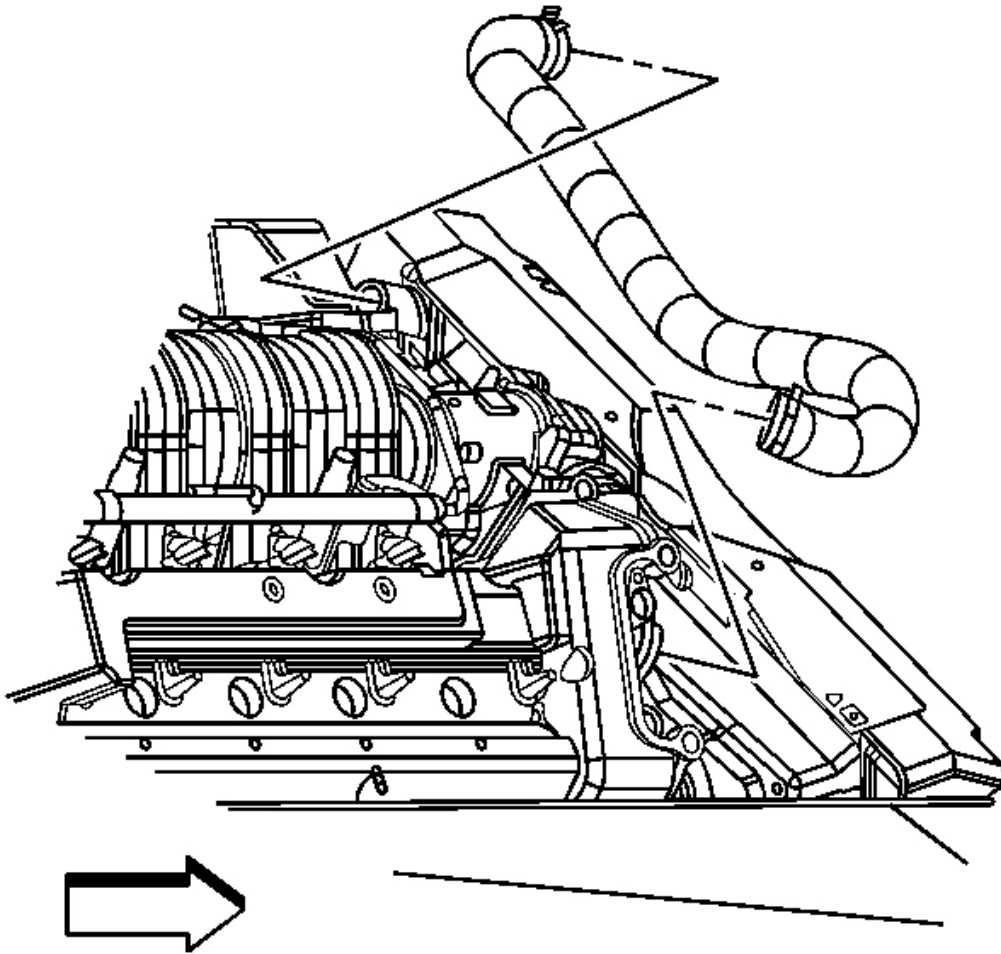


Fig. 92: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Connect the radiator inlet hose to the engine.
10. Engage tension on the radiator inlet hose clamp at the engine using **J 38185**.
11. Connect the radiator inlet hose to the radiator.
12. Engage tension on the radiator inlet hose clamp at the radiator using **J 38185**.
13. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
14. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER INLET HOSE REPLACEMENT

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Tools Required

GE-47622 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

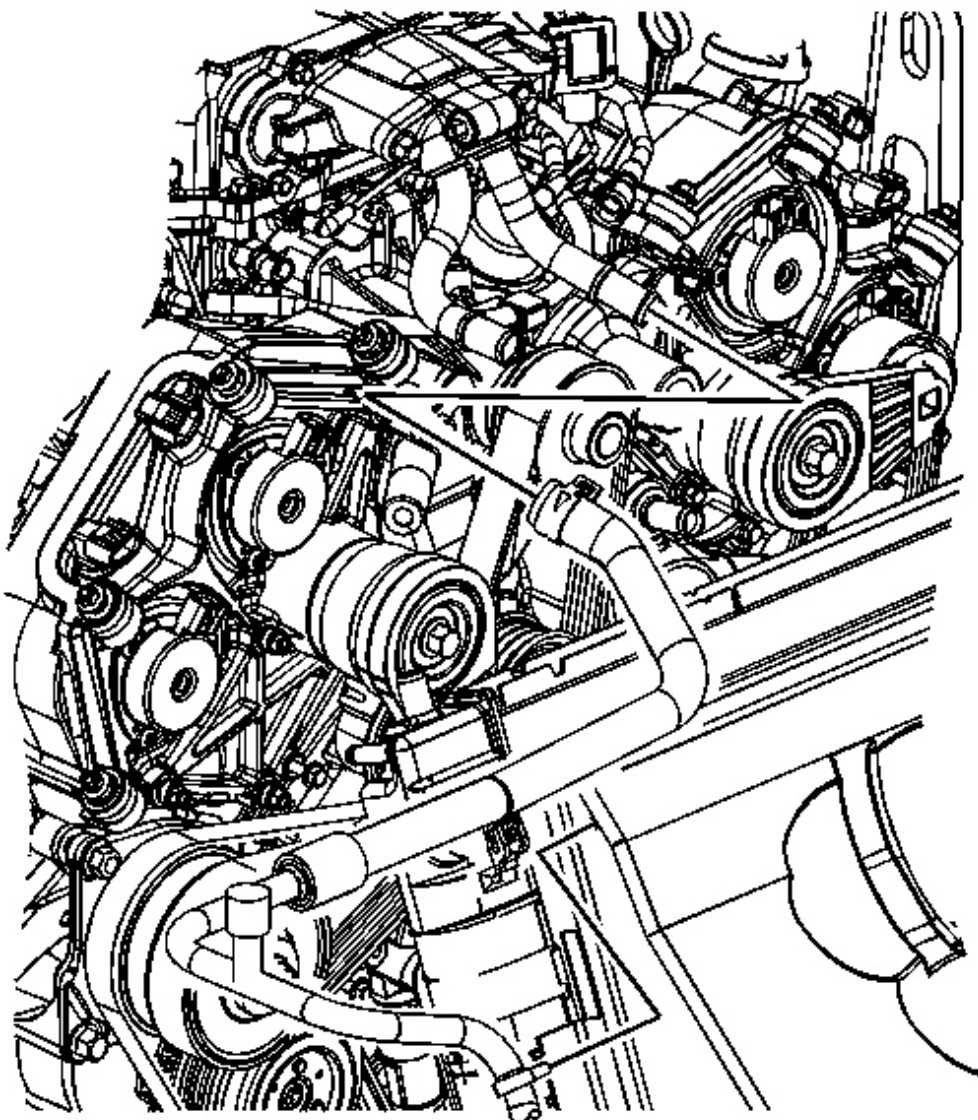


Fig. 93: Charge Air Cooler Coolant Inlet Hose From Charge Air Cooler
Courtesy of GENERAL MOTORS CORP.

2. Using the **GE-47622** , reposition the charge air cooler coolant inlet hose from the charge air cooler. See **Special Tools**.
3. Remove the charge air cooler coolant inlet hose from the charge air cooler.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

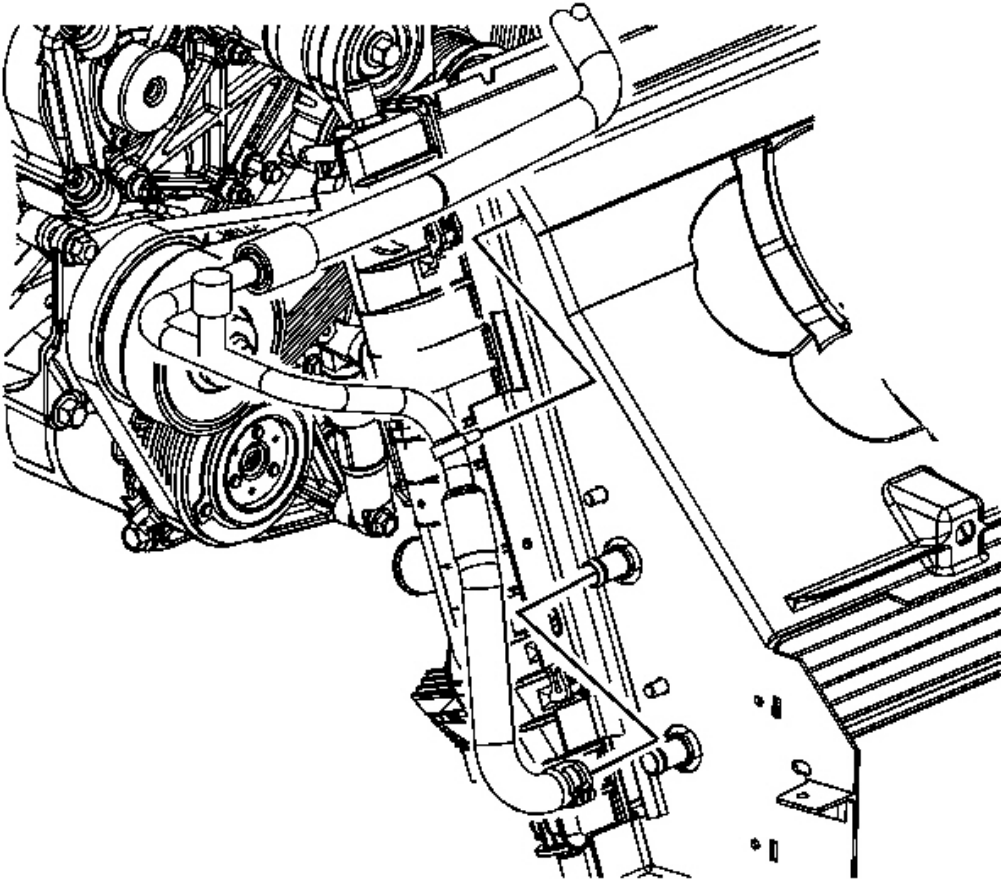


Fig. 94: Charge Air Cooler Coolant Inlet Hose From Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS CORP.

5. Using the **GE-47622** , reposition the charge air cooler coolant inlet hose from the charge air cooler radiator. See **Special Tools**.

IMPORTANT: Note the routing of the charge air cooler coolant inlet hose to ensure proper installation.

6. Remove the charge air cooler coolant inlet hose from the charge air cooler radiator.
7. Gently pull on the charge air cooler coolant inlet hose to release the charge air cooler inlet hose retainer from the fan shroud.
8. Remove the charge air cooler coolant inlet hose from the vehicle.

1. Install the charge air cooler coolant inlet hose to the vehicle.

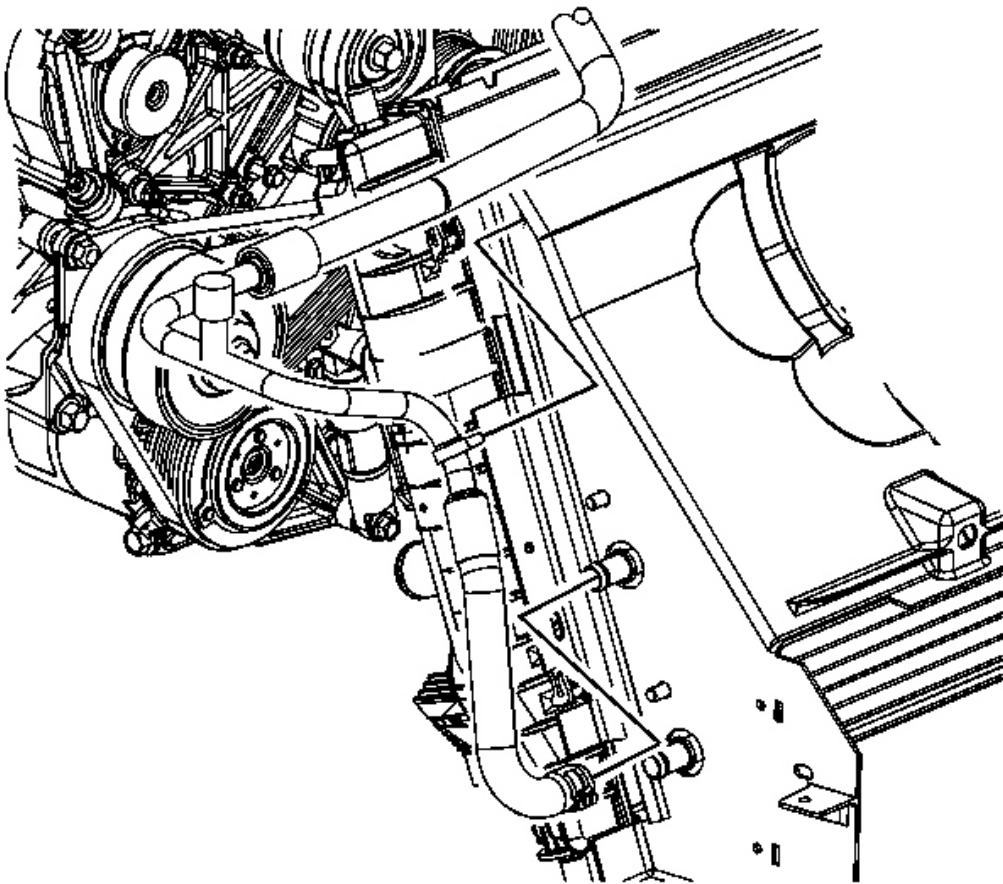


Fig. 95: Charge Air Cooler Coolant Inlet Hose From Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS CORP.

2. Install the charge air cooler coolant inlet hose to the charge air cooler radiator.
3. Using the **GE-47622** , reposition the charge air cooler coolant inlet hose clamp at the charge air cooler radiator. See **Special Tools**.
4. Gently push the charge air cooler coolant inlet hose retainer into the hole in the fan shroud.
5. Lower the vehicle.

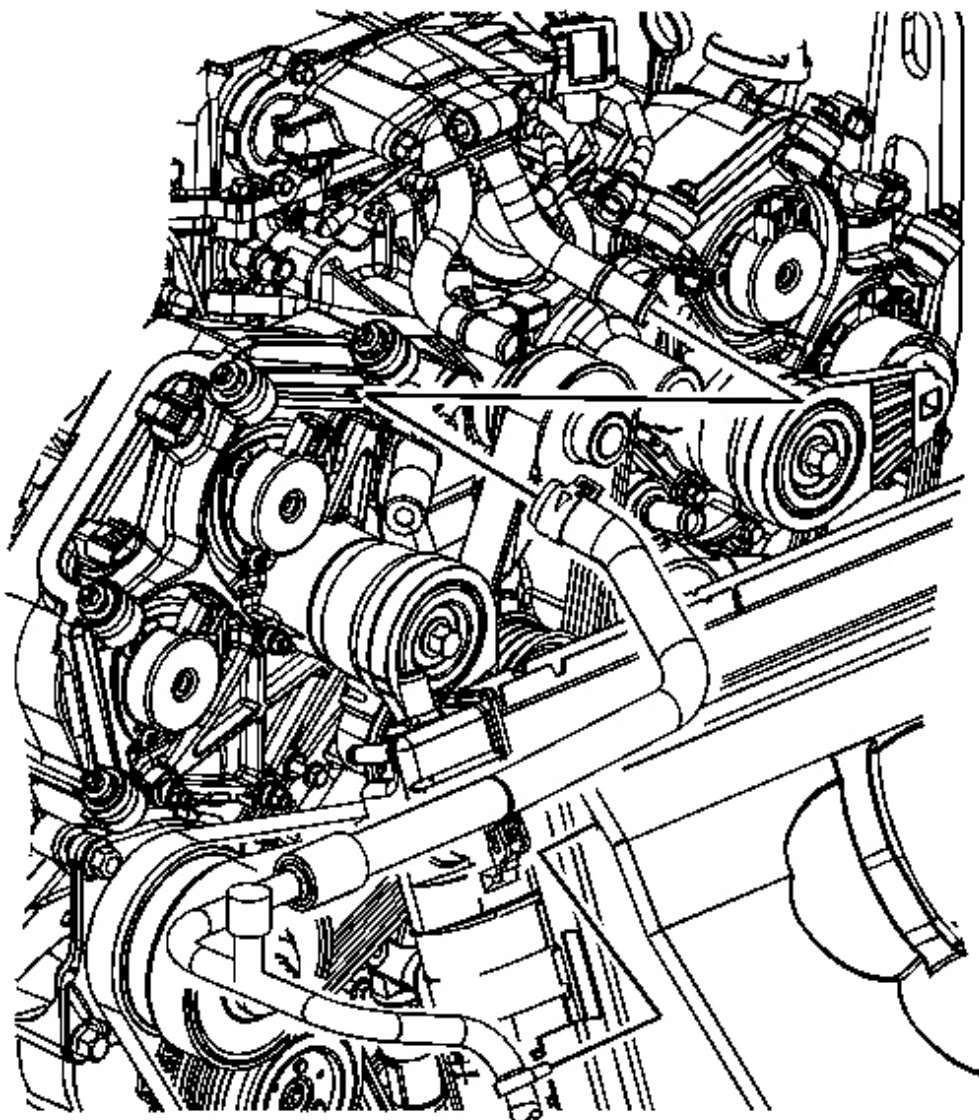


Fig. 96: Charge Air Cooler Coolant Inlet Hose From Charge Air Cooler
Courtesy of GENERAL MOTORS CORP.

6. Install the charge air cooler coolant outlet hose to the charge air cooler.
7. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose at the charge air cooler. See **Special Tools**.
8. Fill the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling**

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

CHARGE AIR COOLER OUTLET HOSE REPLACEMENT

Tools Required

GE-47622 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill) or Charge Air Cooling System Draining and Filling (GE 47716)**.

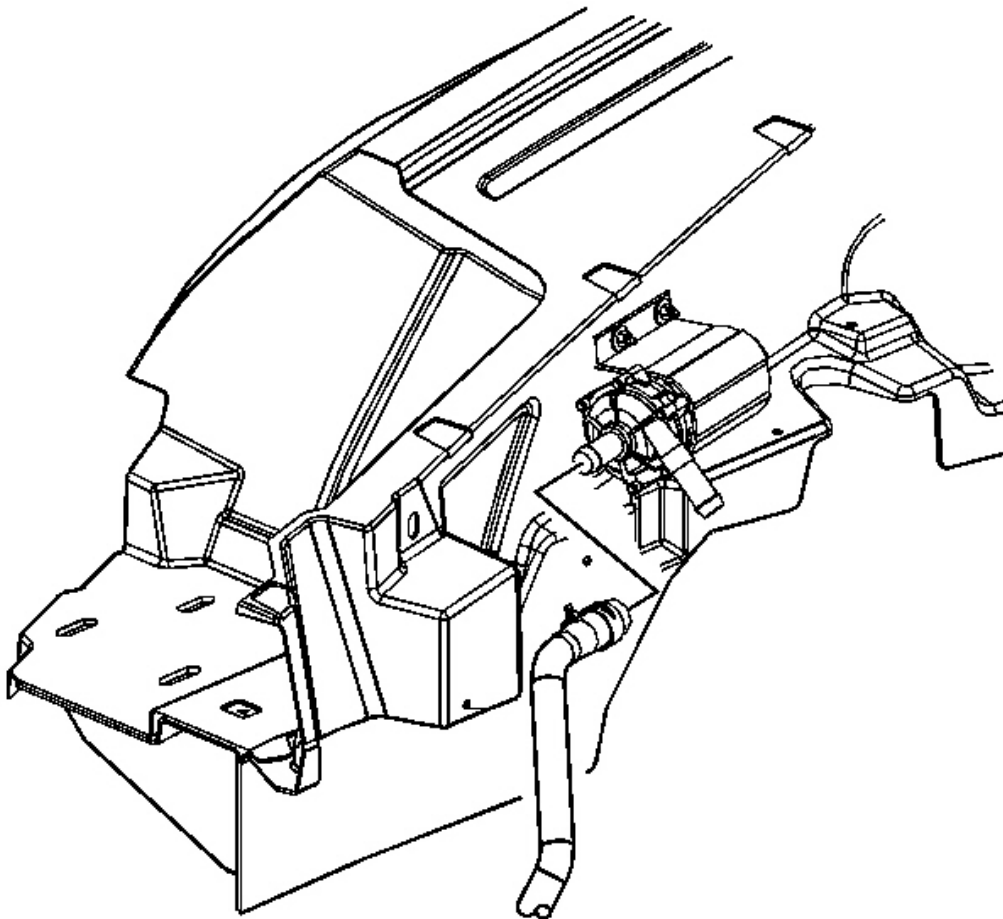


Fig. 97: Charge Air Coolant Pump

Courtesy of GENERAL MOTORS CORP.

2. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose from the charge air coolant pump. See **Special Tools**.
3. Remove the charge air cooler coolant outlet hose from the charge air coolant pump.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

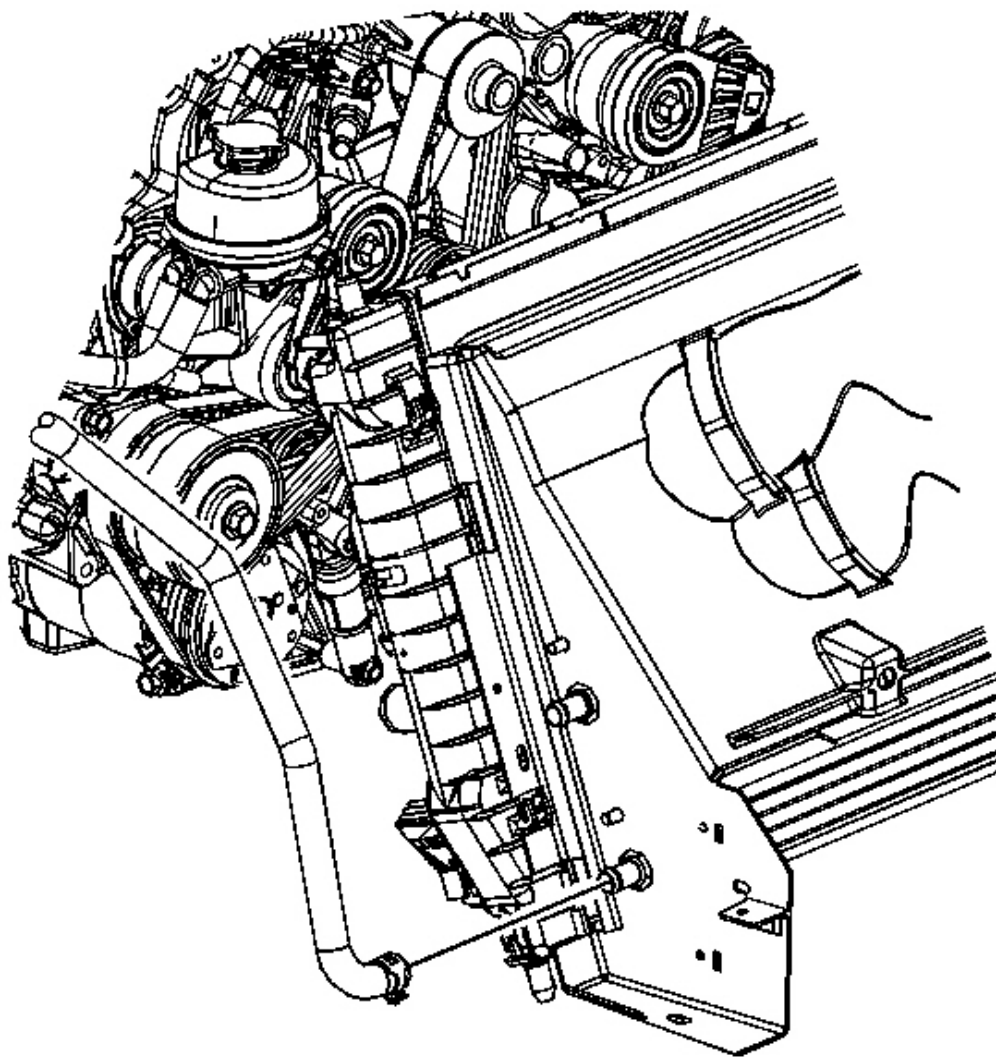


Fig. 98: Charge Air Cooler Coolant Outlet Hose
Courtesy of GENERAL MOTORS CORP.

| |
|----------------------------------|
| 2006 Cadillac XLR |
| 2006 ENGINE Engine Cooling - XLR |

5. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose from the charge air cooler radiator. See **Special Tools**.

IMPORTANT: Note the routing of the charge air cooler coolant outlet hose to ensure proper installation.

6. Remove the charge air cooler coolant outlet hose from the charge air cooler radiator.
7. Remove the charge air cooler coolant outlet hose from the vehicle.

Installation Procedure

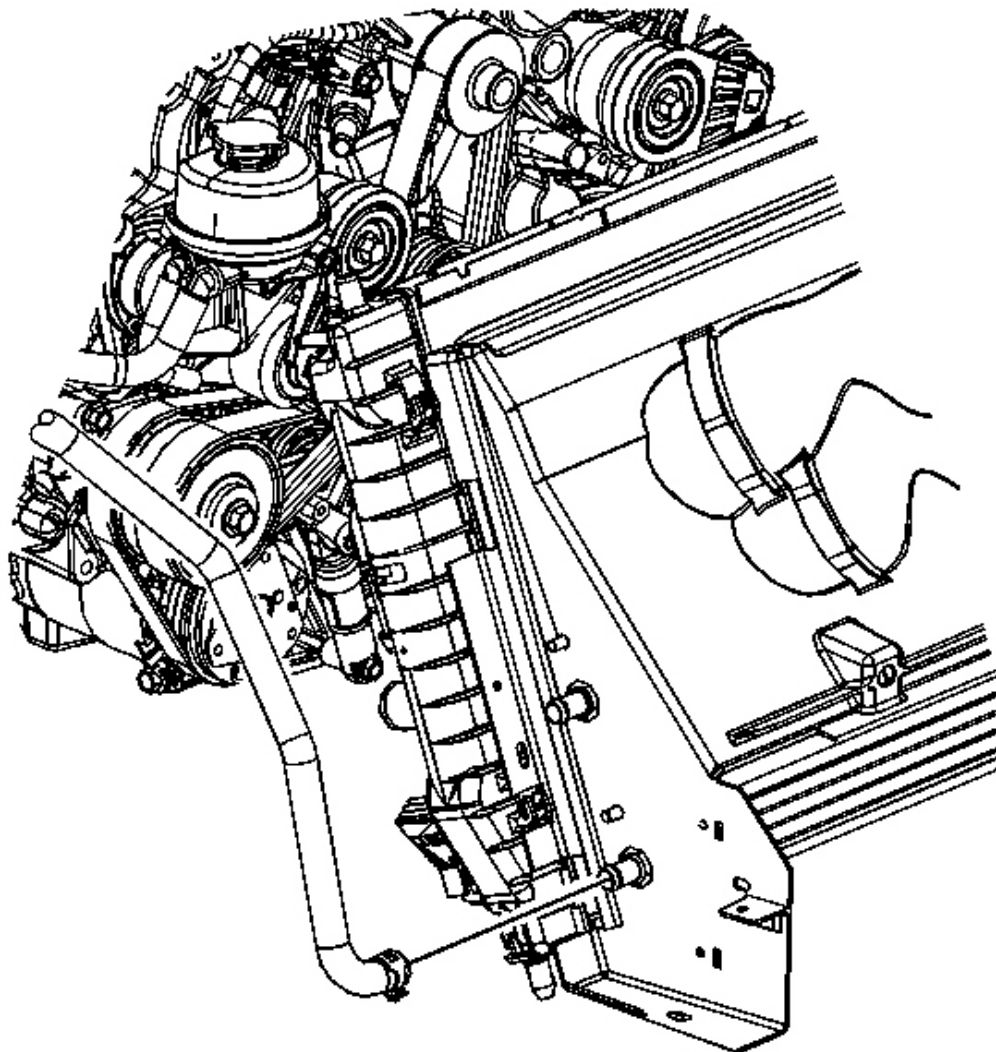


Fig. 99: Charge Air Cooler Coolant Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the charge air cooler coolant outlet hose to the vehicle.
2. Install the charge air cooler coolant outlet hose to the charge air cooler radiator.
3. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose clamp at the charge air cooler radiator. See **Special Tools**.
4. Lower the vehicle.

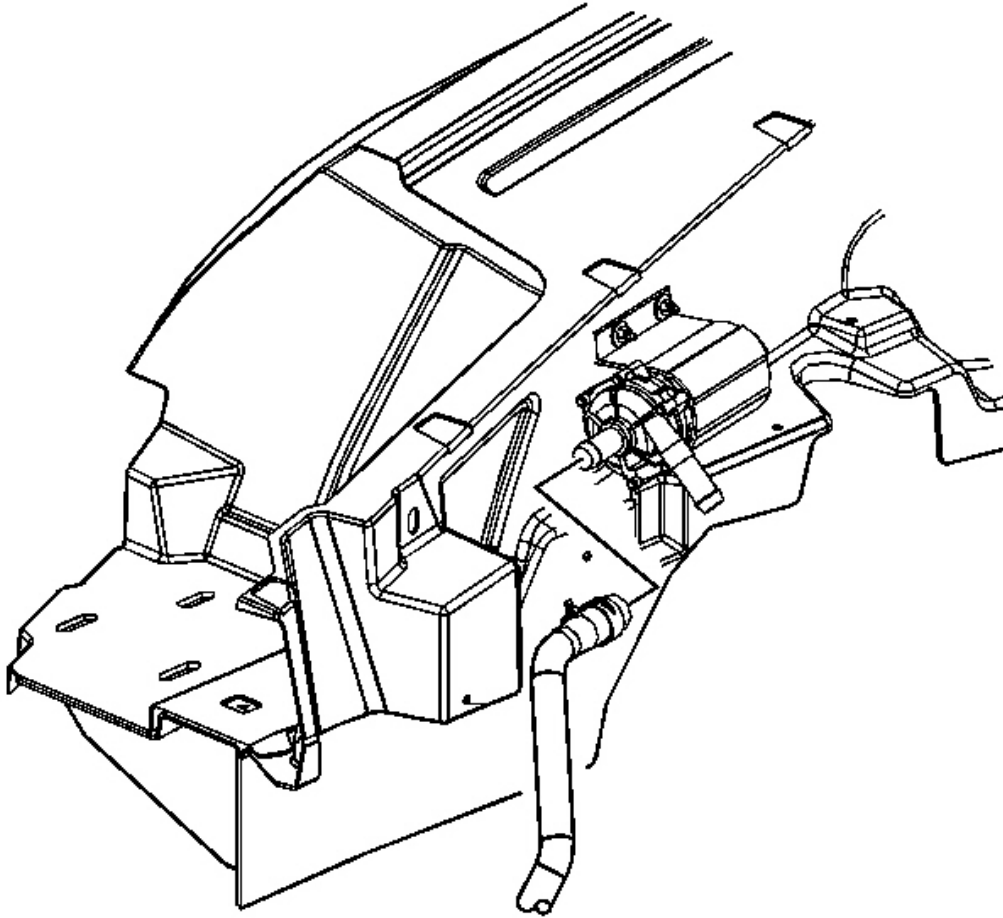


Fig. 100: Charge Air Coolant Pump
Courtesy of GENERAL MOTORS CORP.

5. Install the charge air cooler coolant outlet hose to the charge air coolant pump.
6. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose at the charge air coolant pump. See **Special Tools**.
7. Fill the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

GENERATOR COOLING INLET HOSE FITTING REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling**

System Draining and Filling (GE 47716).

2. Remove the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .

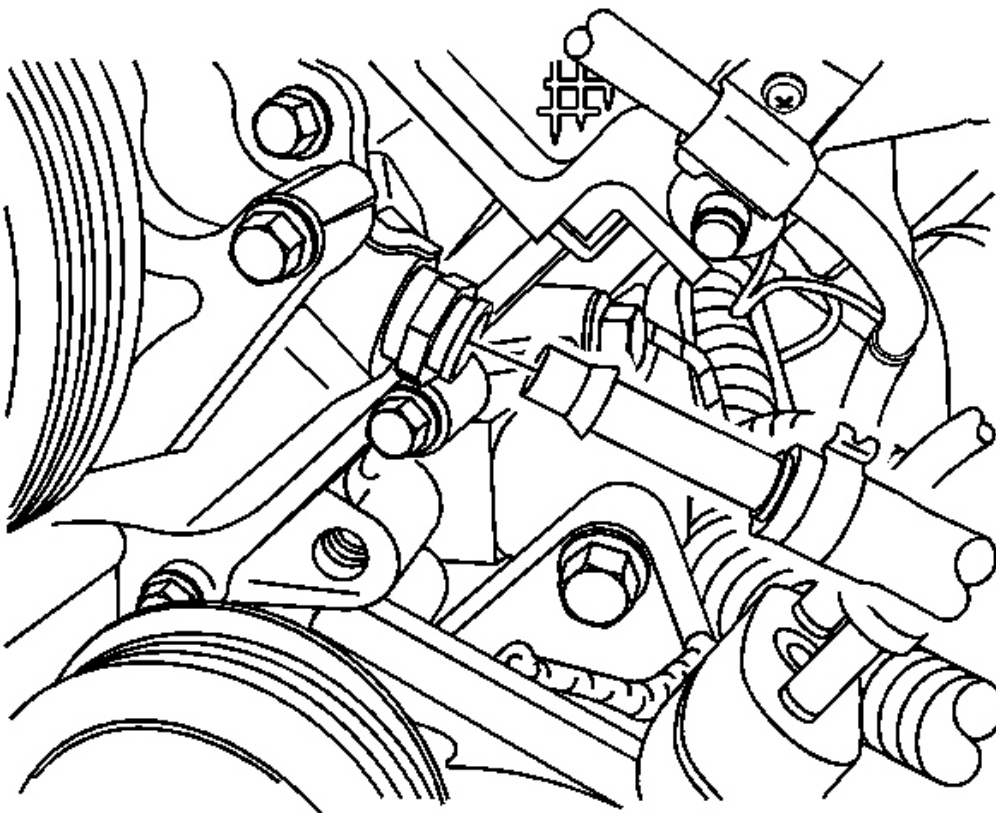


Fig. 101: Disconnecting/Connecting Generator Cooling Hose To Water Pump
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the generator cooling hose from the water pump. Refer to **Generator Cooling Pipe/Hose Quick Connect Fitting.**

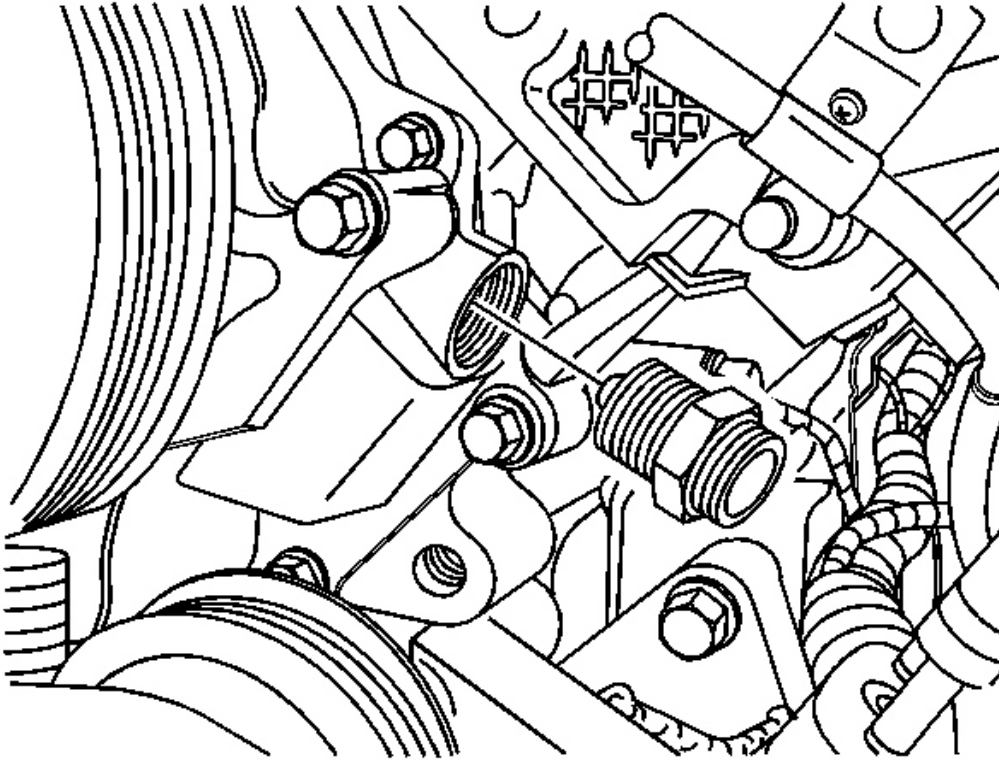


Fig. 102: Removing/Installing Generator Cooling Inlet Hose Fitting
Courtesy of GENERAL MOTORS CORP.

4. Remove the generator cooling inlet hose fitting from the vehicle.
5. Remove and discard the seal washer.

Installation Procedure

IMPORTANT: Flat washer type seals do not require lubrication.

1. Inspect the new seal washer for any signs of cracks, cuts, or damage.

Do not use a damaged seal washer.

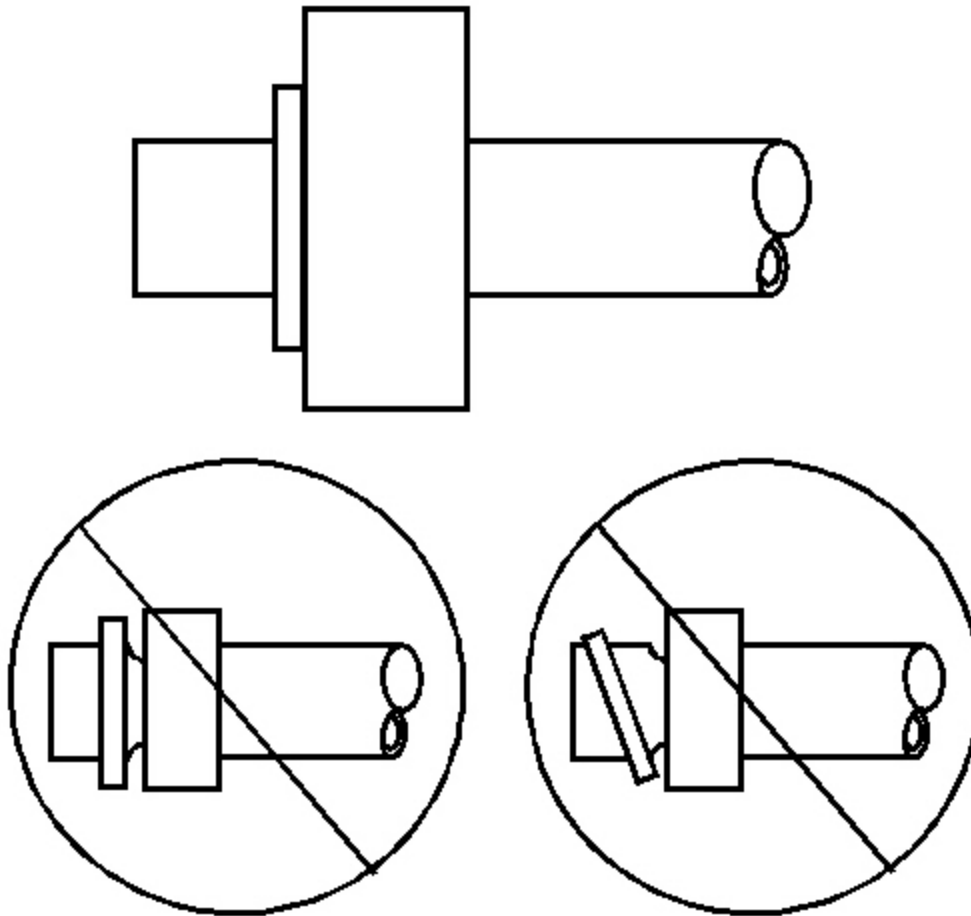


Fig. 103: Identifying Good And Bad Sealing Washer Positions
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The seal washer must completely bottom against the surface of the fitting.

2. Using a lint-free clean, dry cloth, clean the sealing surfaces at the water pump and generator cooling inlet hose fitting.

Carefully install the new seal washer onto the generator cooling inlet hose fitting.

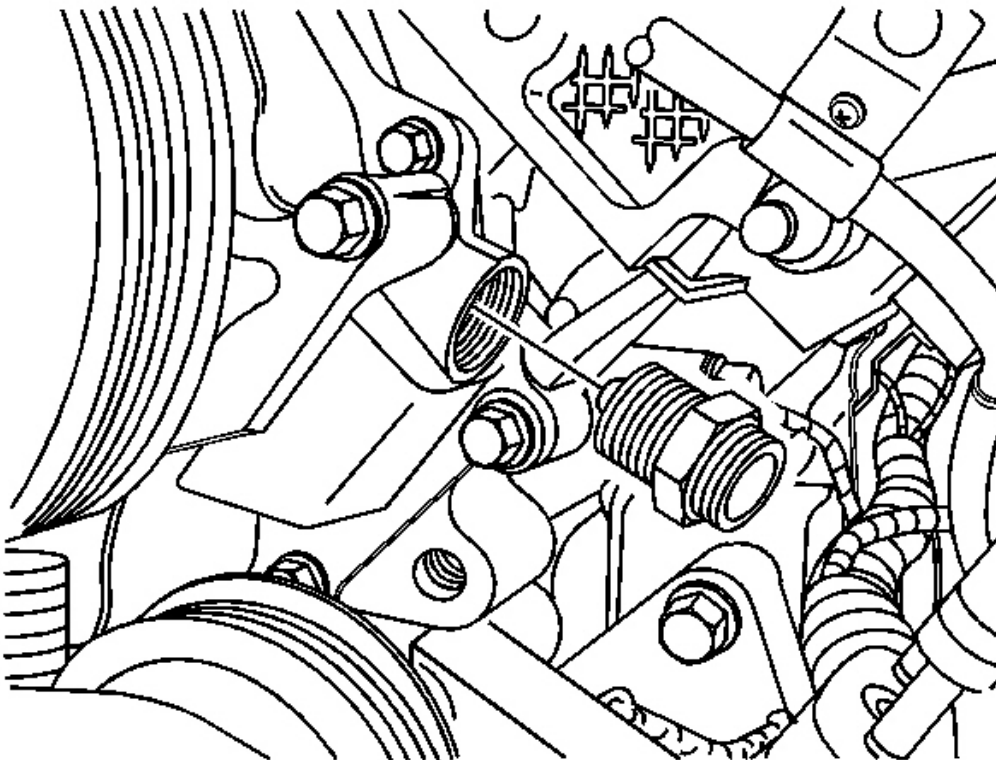


Fig. 104: Removing/Installing Generator Cooling Inlet Hose Fitting
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

3. Install the generator cooling inlet hose fitting to the vehicle.

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

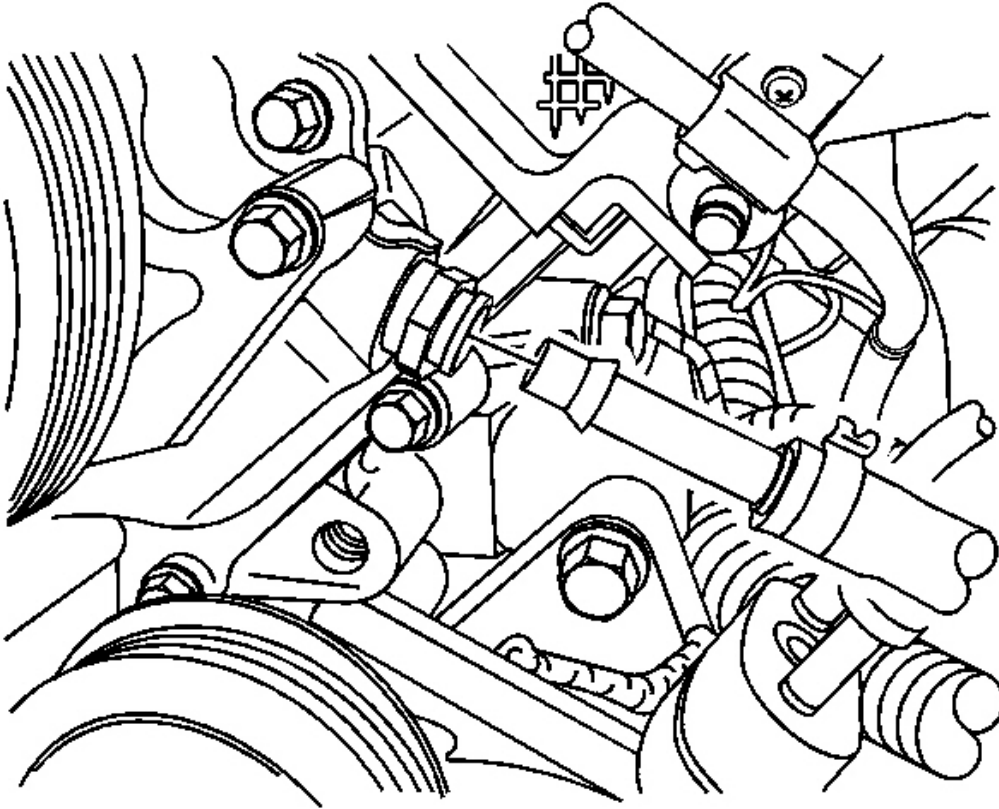


Fig. 105: Disconnecting/Connecting Generator Cooling Hose To Water Pump
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator cooling hose to the water pump. Refer to **Generator Cooling Pipe/Hose Quick Connect Fitting**.
5. Install the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .
6. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

GENERATOR COOLING HOSE ASSEMBLY REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

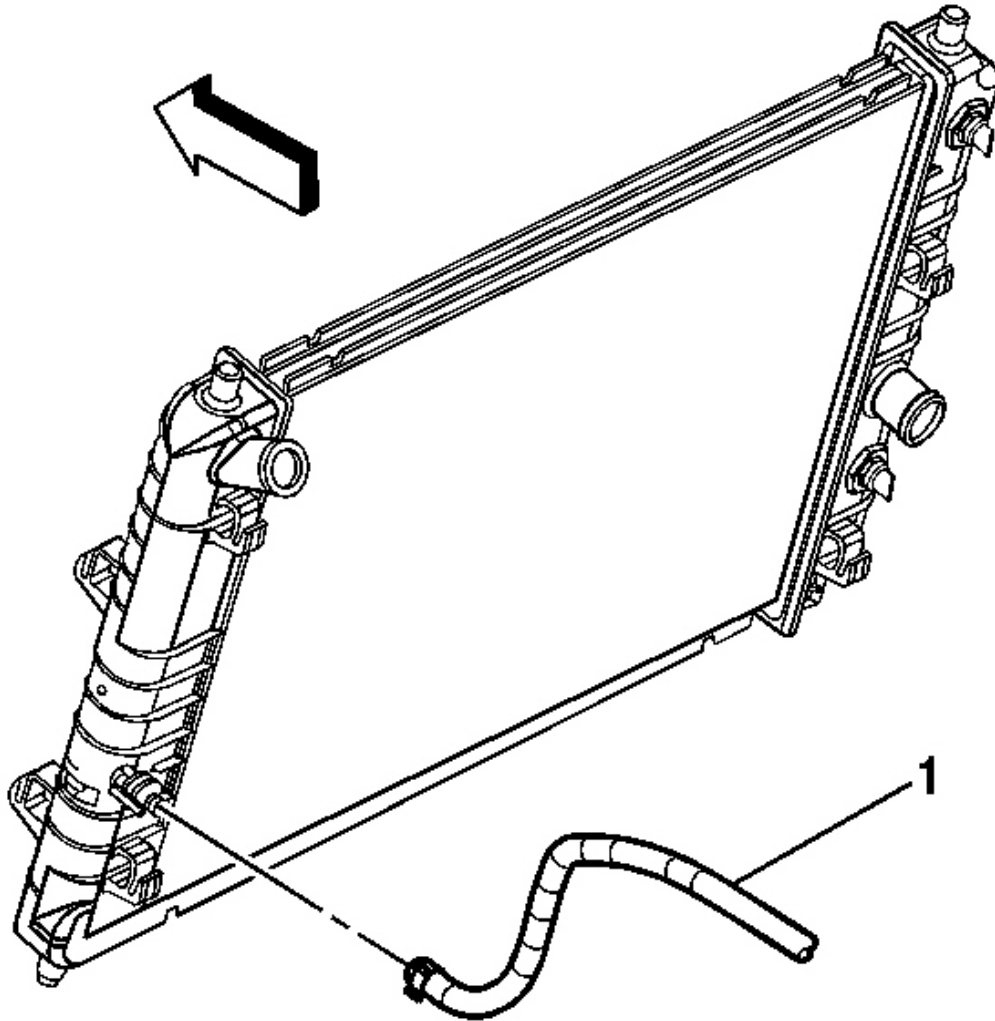


Fig. 106: Disconnecting/Connecting Generator Cooling Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

3. Disengage the generator cooling hose clamp at the radiator.
4. Disconnect the generator cooling hose (1) from the radiator.
5. Lower the vehicle.
6. Remove the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .

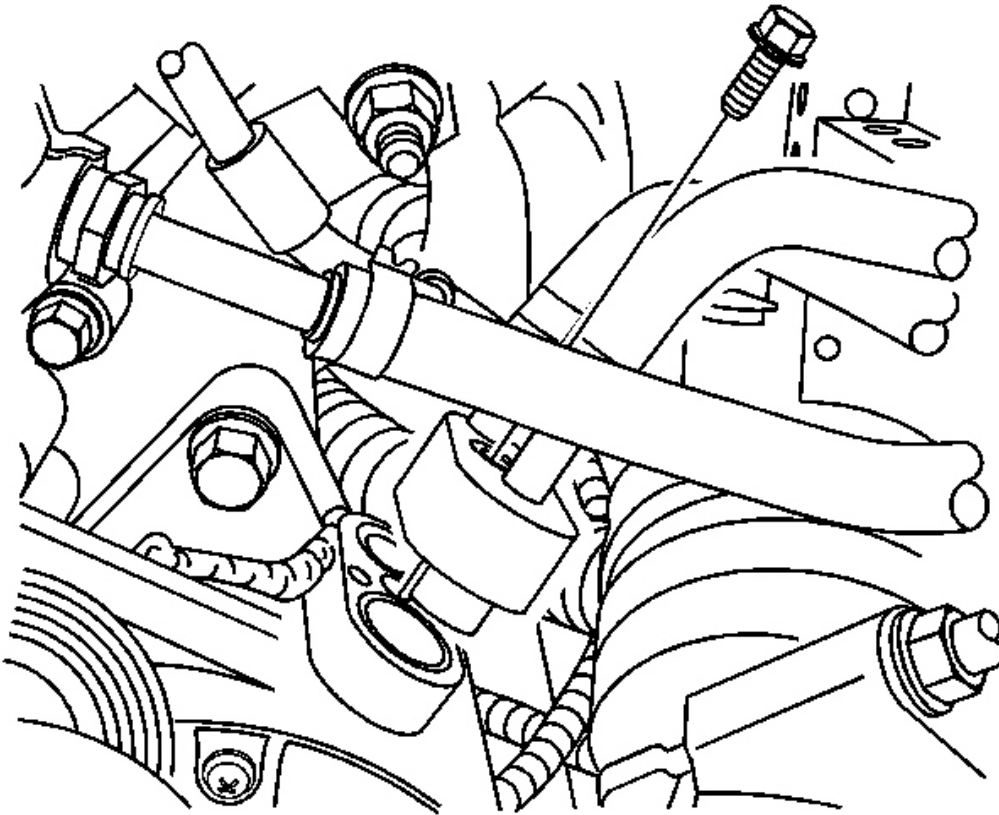


Fig. 107: Removing/Installing Generator Cooling Hose Assembly To Generator Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the generator cooling hose assembly to generator bolt.
8. Disconnect the generator cooling hose assembly from the generator.

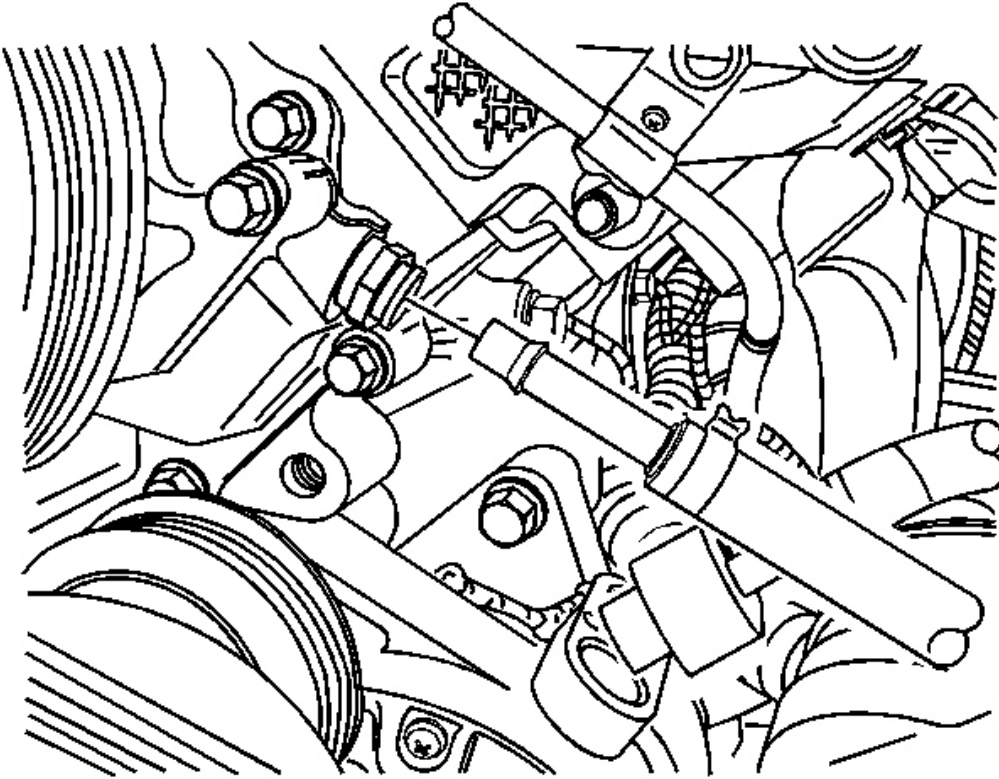


Fig. 108: Removing/Installing Generator Cooling Hose Assembly
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the generator cooling hose from the water pump. Refer to **Generator Cooling Pipe/Hose Quick Connect Fitting**.
10. Remove the generator cooling hose assembly from the vehicle.
11. Remove and discard the seal washers.

Installation Procedure

IMPORTANT: Flat washer type seals do not require lubrication.

1. Inspect the new seal washer for any signs of cracks, cuts, or damage.

Do not use a damaged seal washer.

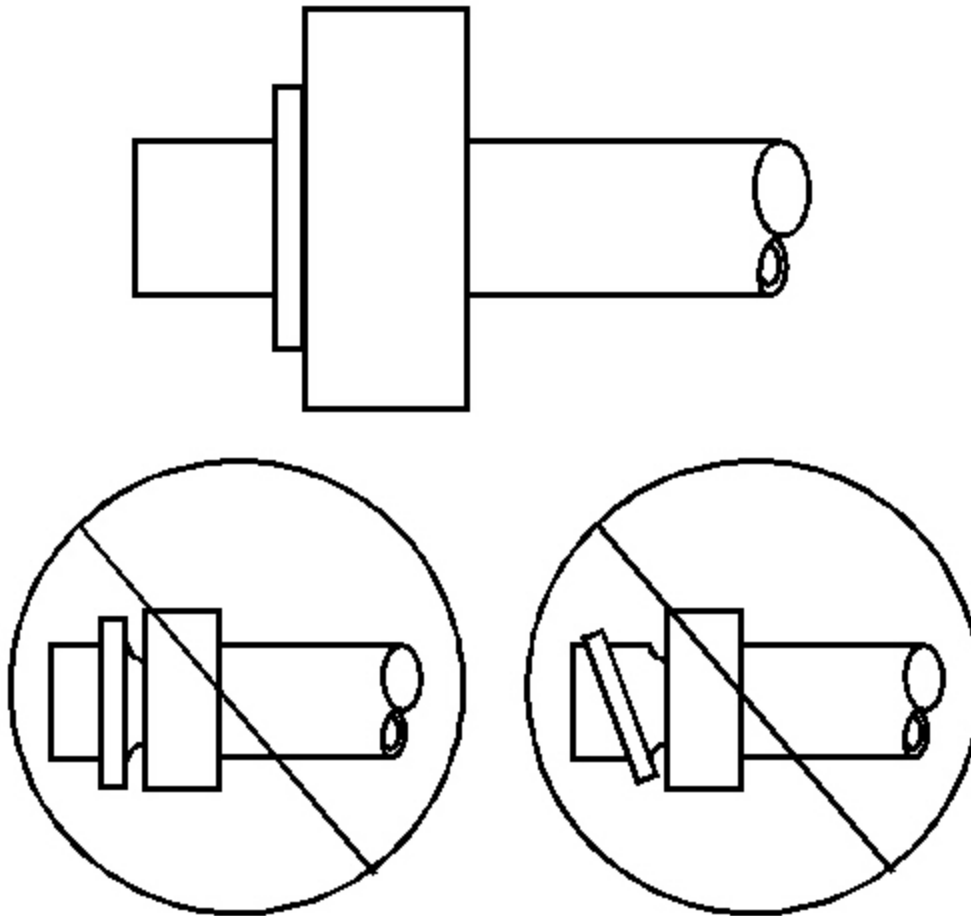


Fig. 109: Identifying Good And Bad Sealing Washer Positions
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The seal washer must completely bottom against the surface of the fitting.

2. Using a lint-free clean, dry cloth, clean the sealing surfaces at the generator and generator cooling hose assembly.

Carefully install the new seal washers onto the generator cooling hose assembly.

3. Install the generator cooling hose assembly to the vehicle.

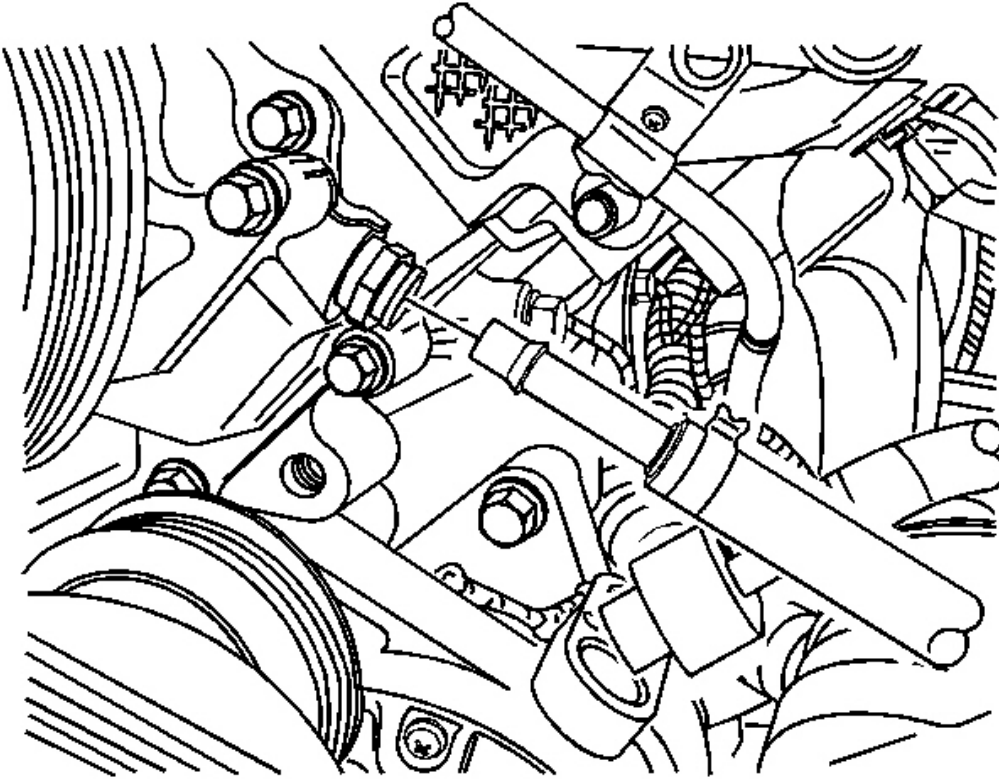


Fig. 110: Removing/Installing Generator Cooling Hose Assembly
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator cooling hose to the water pump. Refer to **Generator Cooling Pipe/Hose Quick Connect Fitting**.
5. Connect the generator cooling hose assembly to the generator.

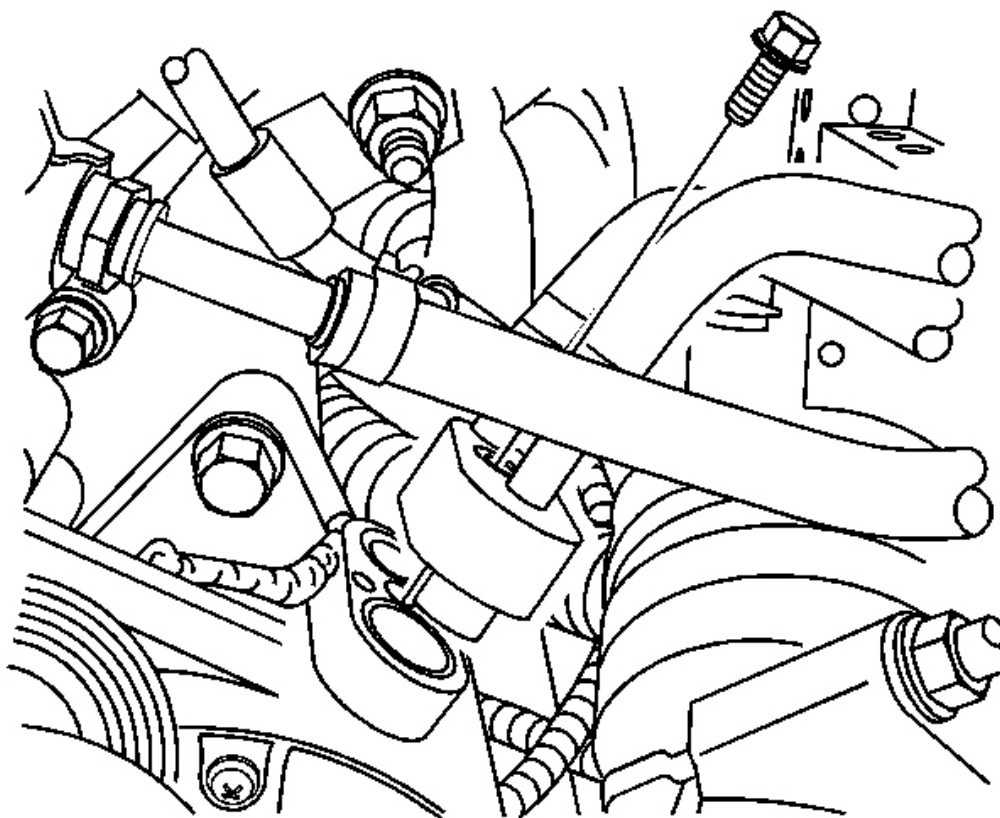


Fig. 111: Removing/Installing Generator Cooling Hose Assembly To Generator Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **Fastener Notice** .

6. Install the generator cooling hose assembly to generator bolt.

Tighten: Tighten the bolt to 27 N.m (20 lb ft).

7. Install the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .
8. Raise and support the vehicle.

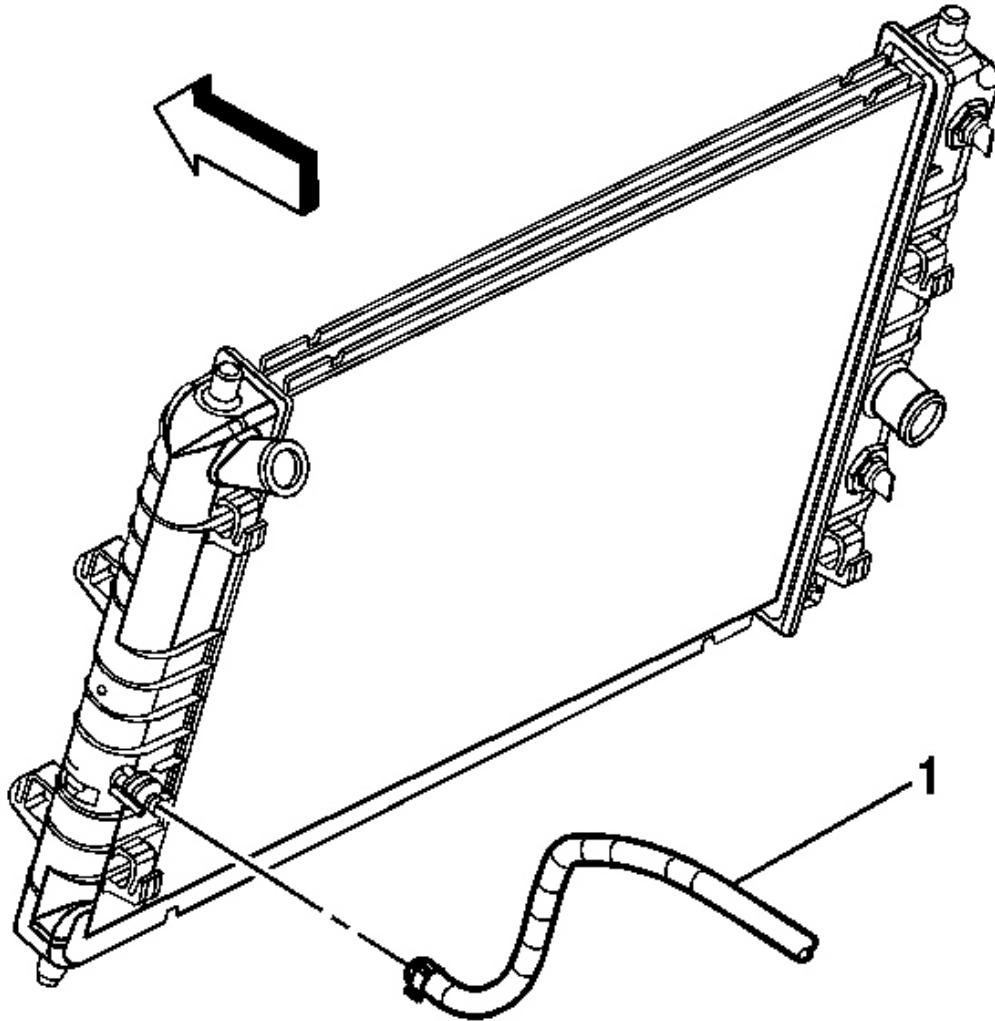


Fig. 112: Disconnecting/Connecting Generator Cooling Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

9. Connect the generator cooling hose (1) to the radiator.
10. Engage the generator cooling hose clamp at the radiator.
11. Lower the vehicle.
12. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

Tools Required

J 41623-B Cooler Quick Connect Tool. See **Special Tools**.

Removal Procedure

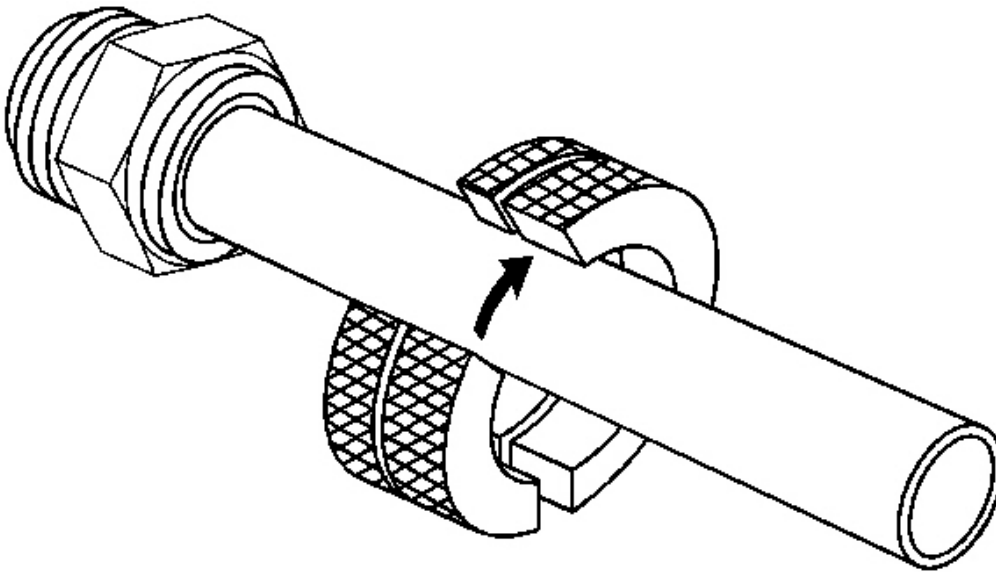


Fig. 113: Installing J 41623-B Onto Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

1. Install the **J 41623-B** onto the generator cooling inlet pipe. See **Special Tools**.

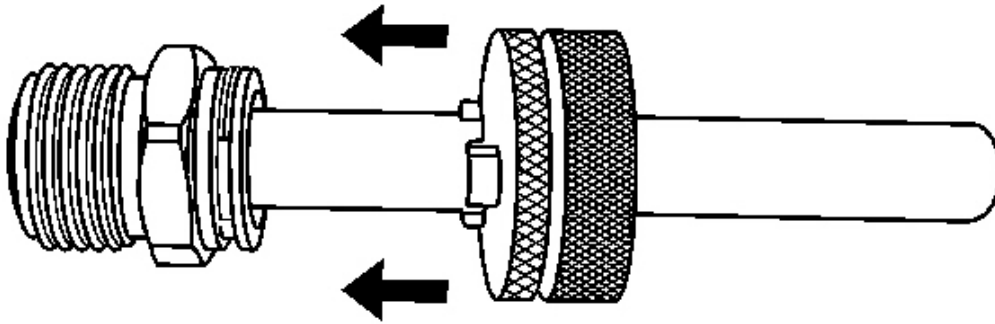


Fig. 114: Sliding J 41623-B Toward Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

2. Slide the **J 41623-B** toward the generator cooling inlet pipe fitting. See **Special Tools**.

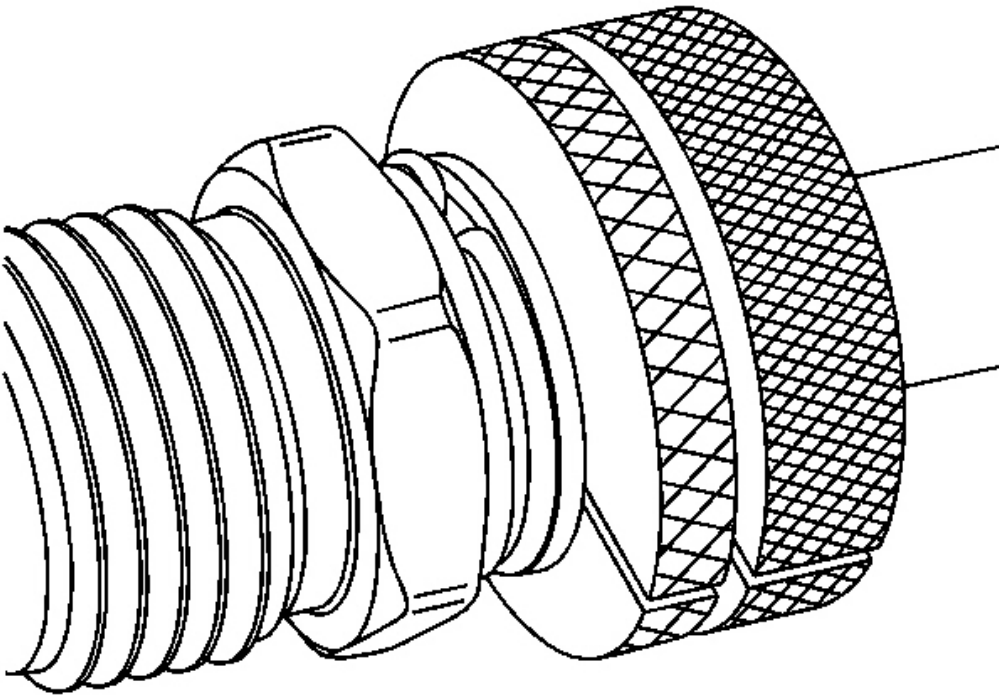


Fig. 115: Rotating J 41623-B On Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the J 41623-B to engage the generator cooling inlet pipe fitting's retainer slots. See Special Tools.
The J 41623-B should be nearly flush with the fitting. See Special Tools.

3. Connect the **J 41623-B** onto the generator cooling inlet pipe fitting. See Special Tools.

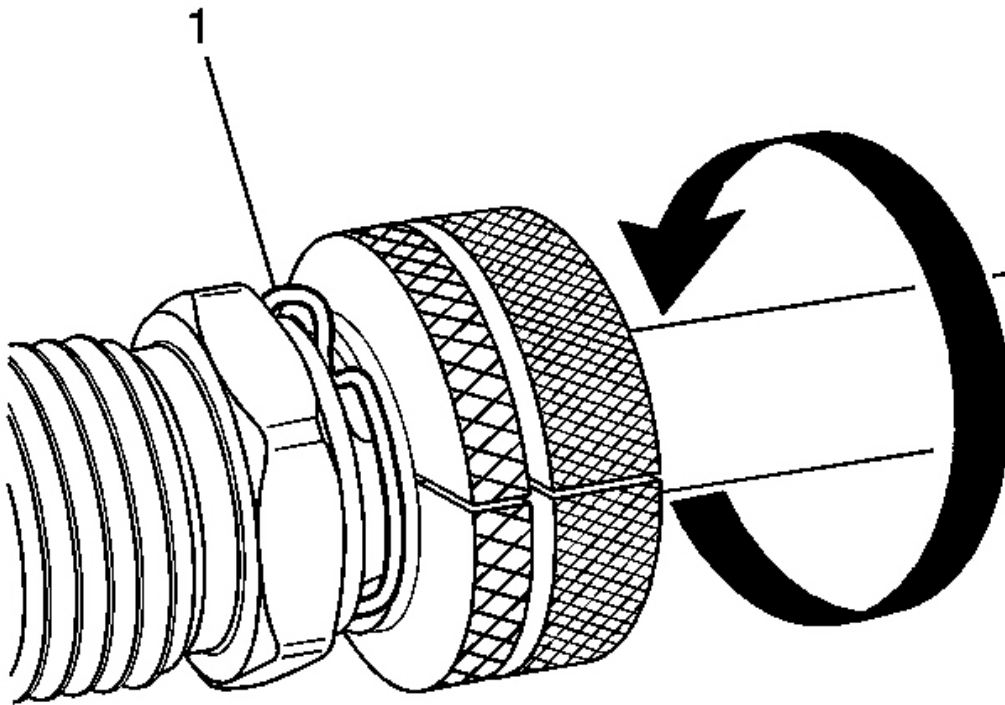


Fig. 116: Rotating J 41623-B Until Retainer Clip Rises Above Fitting Retainer Seat
Courtesy of GENERAL MOTORS CORP.

4. Rotate the **J 41623-B** until the retainer clip (1) rises above the fitting retainer seat. See **Special Tools**.

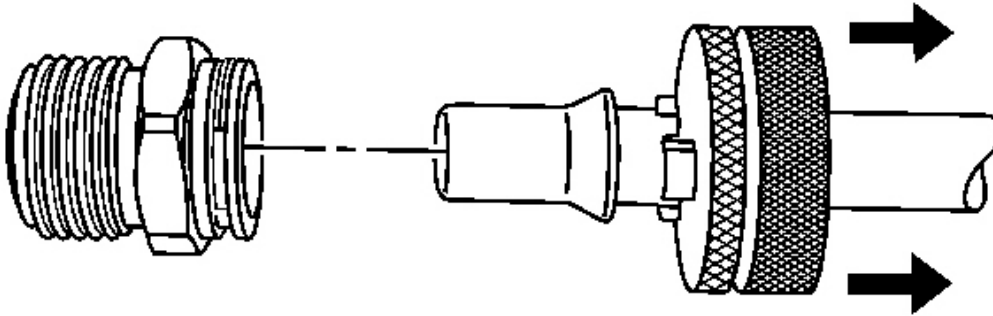


Fig. 117: Removing J 41623-B From Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

5. Pull back on the generator cooling inlet pipe to disengage the pipe from the generator cooling inlet pipe fitting.
6. Remove the **J 41623-B** from the generator cooling inlet pipe. See **Special Tools**.

Installation Procedure

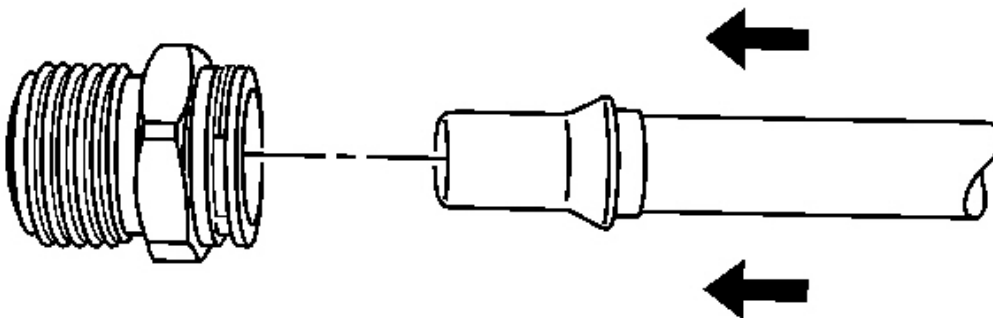


Fig. 118: Installing Generator Cooling Inlet Pipe Into Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the generator cooling inlet pipe fitting and retaining clip for signs of wear or damage. Replace the components if necessary.

1. Install the generator cooling inlet pipe into the generator cooling inlet pipe fitting.

A distinct snap should be heard or felt when assembling the generator cooling inlet pipe to the fitting.

2. To ensure the cooler line is properly installed, give the cooler pipe a gentle pull.

ENGINE OIL COOLER CONNECTOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the left lower front bumper close out panel. Refer to **Front Bumper Fascia Lower Close Out Panel Replacement** .

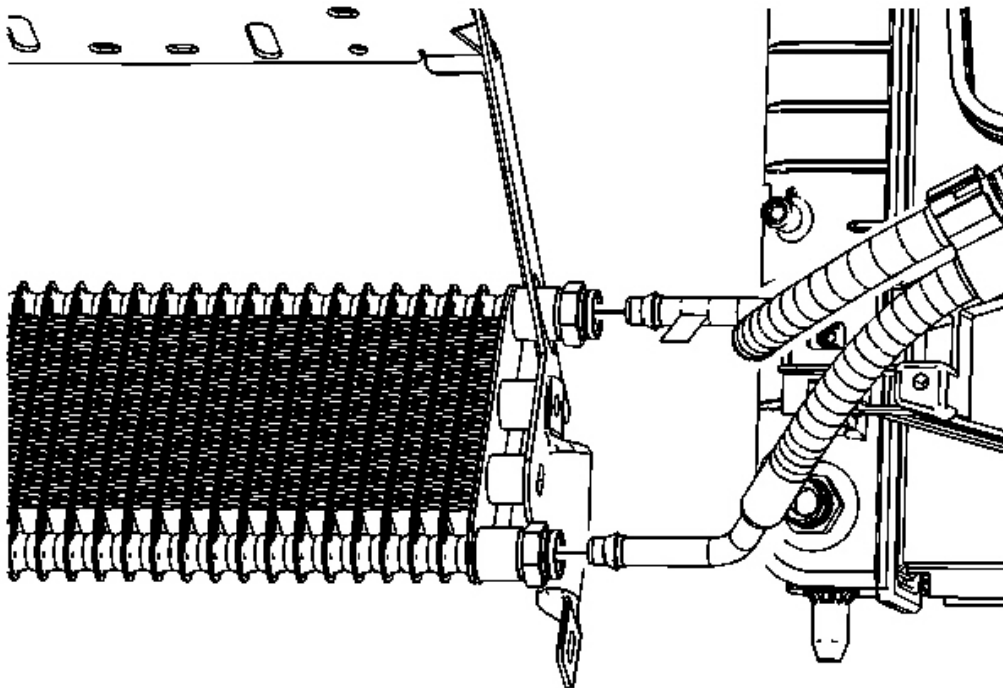


Fig. 119: Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

3. Install oil drain pan under the vehicle.
4. Remove the engine oil cooler hose/pipe from the external oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.

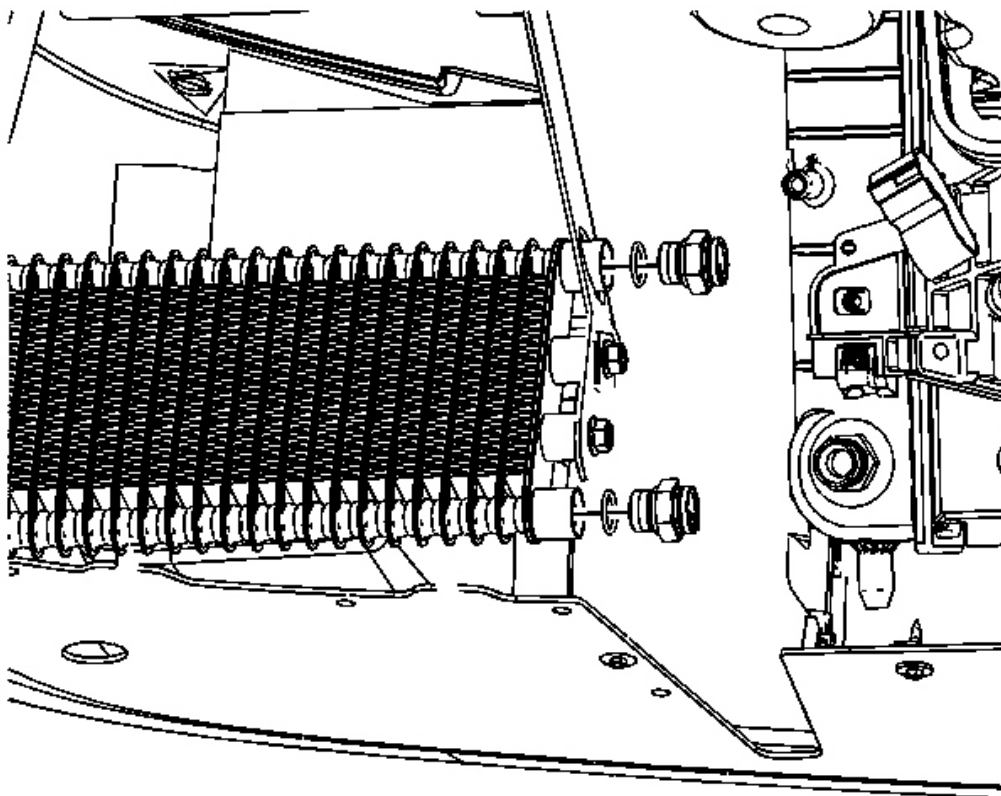


Fig. 120: External Engine Oil Cooler Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

5. Remove the external engine oil cooler quick connect fitting.
6. Remove and discard all engine oil cooler hose/pipe seals.

Installation Procedure

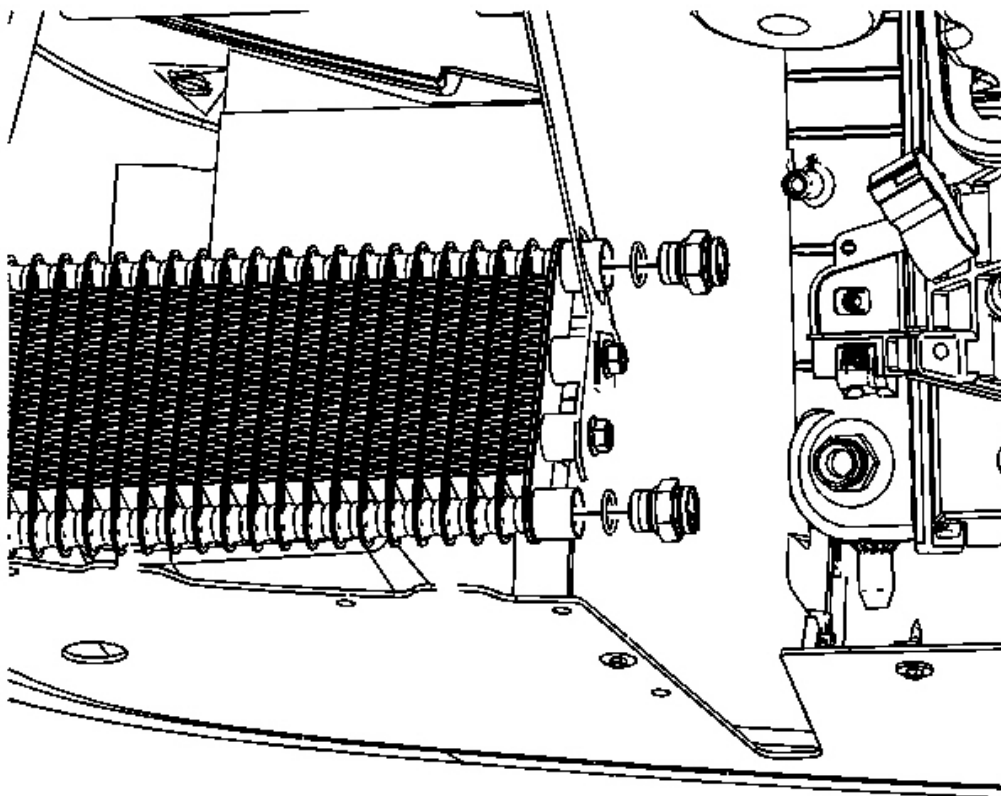


Fig. 121: External Engine Oil Cooler Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

1. Install new engine oil cooler hose/pipe seals.

NOTE: Refer to Fastener Notice .

2. Install the external engine oil cooler quick connect fitting.

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

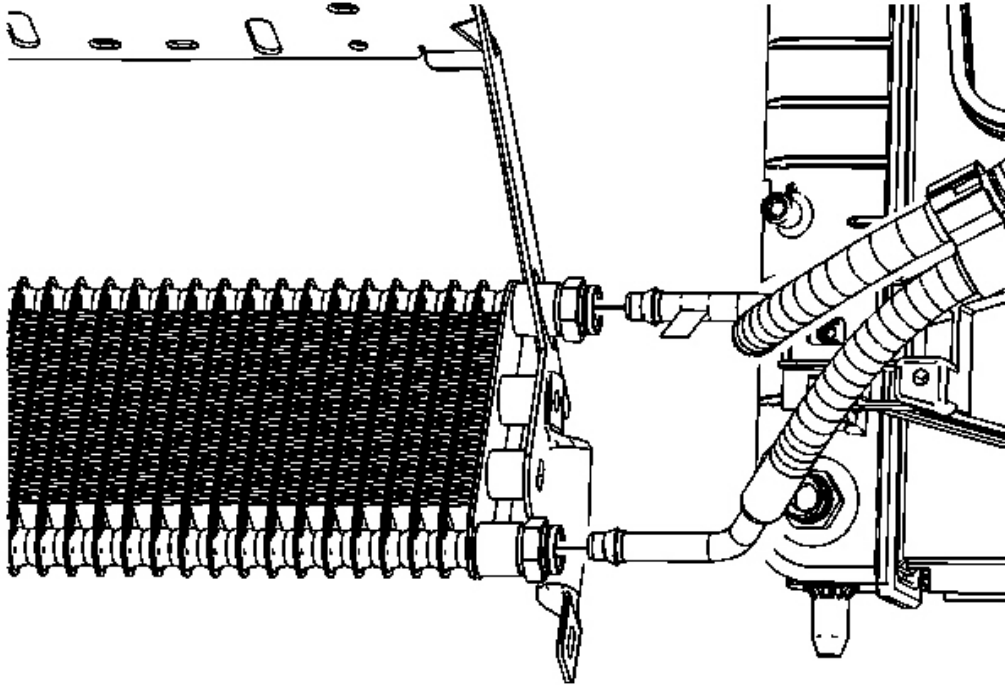


Fig. 122: Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The quick connect fitting must be pushed on and then pulled back to verify proper connector engagement.

3. Install the engine oil cooler hose/pipes to the external oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
4. Remove the oil drain pan from under the vehicle.
5. Install the left lower front bumper close out panel. Refer to **Front Bumper Fascia Lower Close Out Panel Replacement** .
6. Refill the engine with oil and check for leaks.

ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING

Tools Required

DT-47731 Transmission Cooler Quick Disconnect

Removal Procedure

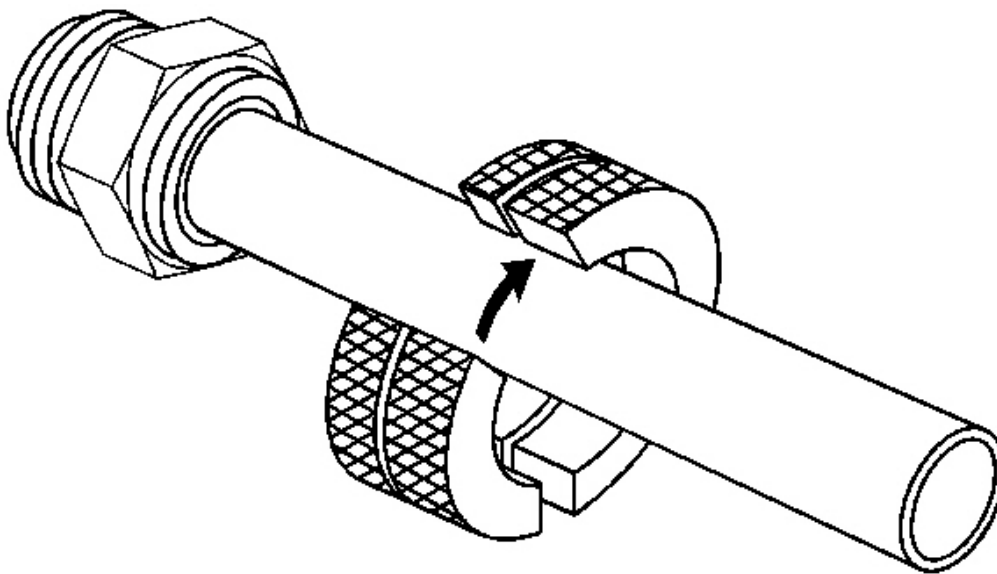


Fig. 123: Installing J 41623-B Onto Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

1. Install the **DT-47731** onto the engine oil cooler (EOC) pipe.

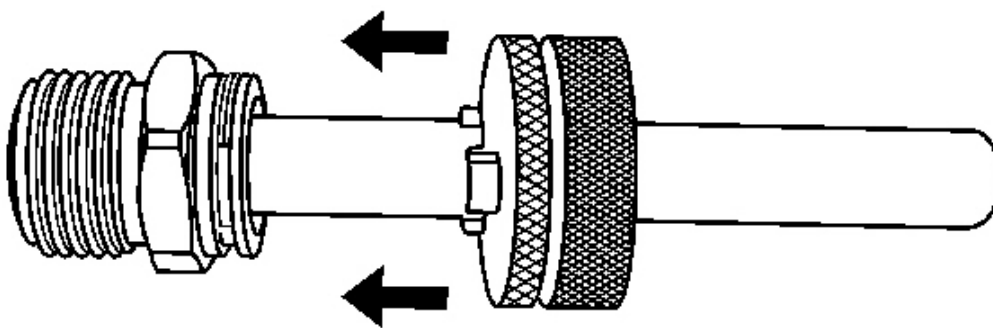


Fig. 124: Sliding J 41623-B Toward Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

2. Slide the **DT-47731** toward the EOC pipe fitting.

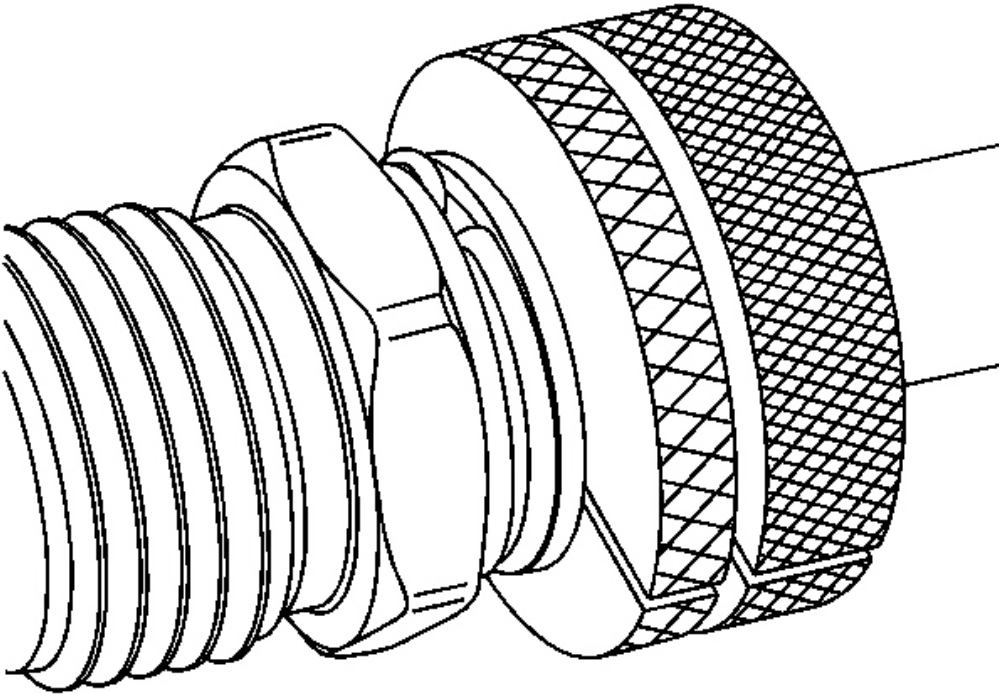


Fig. 125: Rotating J 41623-B On Coolant Pipe
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the DT-47731 to engage the EOC pipe fitting's retainer slots.
The DT-47731 should be nearly flush with the fitting.

3. Connect the **DT-47731** onto the EOC pipe fitting.

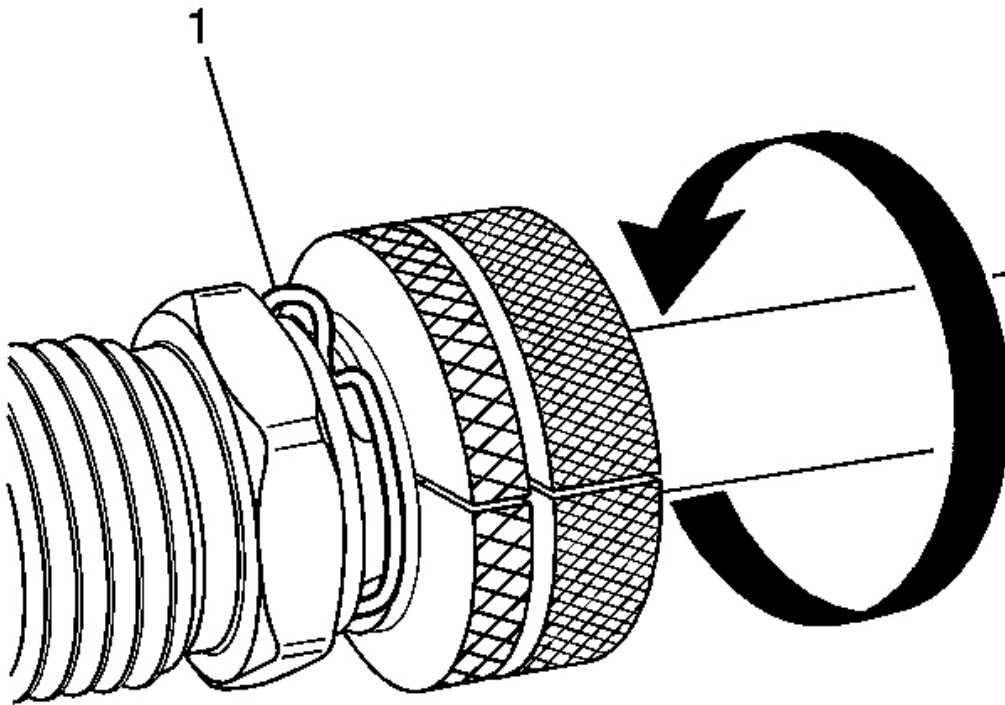


Fig. 126: Rotating J 41623-B Until Retainer Clip Rises Above Fitting Retainer Seat
Courtesy of GENERAL MOTORS CORP.

4. Rotate the **DT-47731** until the retainer clip (1) rises above the fitting retainer seat.

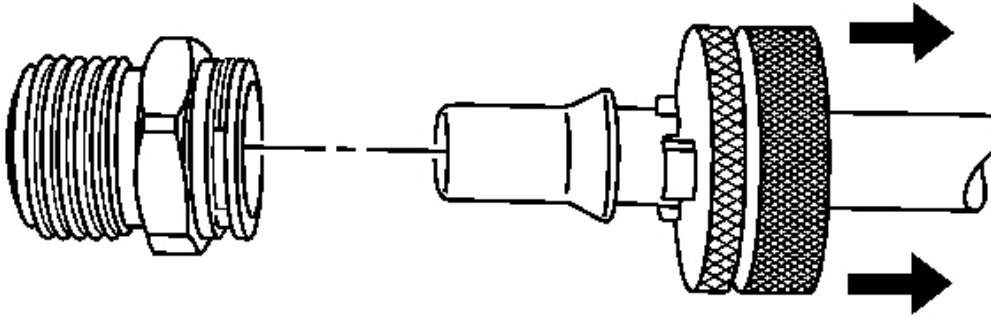


Fig. 127: Removing J 41623-B From Generator Cooling Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

5. Pull back on the EOC pipe to disengage the pipe from the EOC pipe fitting.
6. Remove the **DT-47731** from the EOC pipe.

Installation Procedure

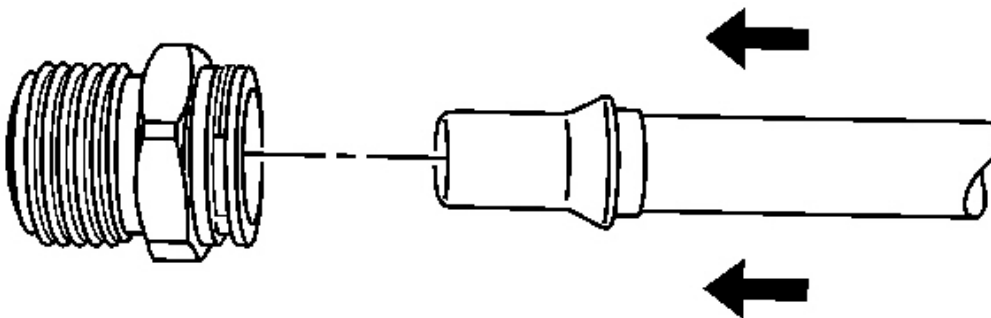


Fig. 128: Installing Generator Cooling Inlet Pipe Into Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect the EOC pipe fitting and retaining clip for signs of wear or damage. Replace the components if necessary.

1. Install the EOC pipe into the EOC pipe fitting.

A distinct snap should be heard or felt when assembling the EOC pipe to the fitting.

2. To ensure the cooler line is properly installed, give the cooler pipe a gentle pull.

ENGINE OIL COOLER HOSE/PIPE REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the left lower front bumper close out panel. Refer to **Front Bumper Fascia Lower Close Out Panel Replacement** .

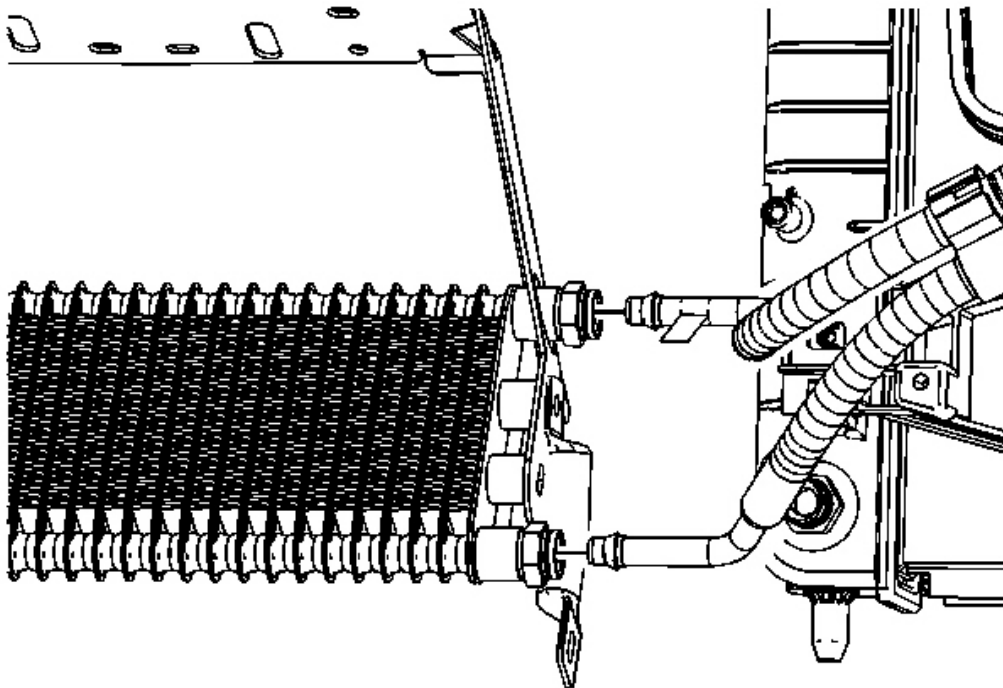


Fig. 129: External Oil Cooler
Courtesy of GENERAL MOTORS CORP.

3. Install oil drain pan under the vehicle.
4. Remove the engine oil cooler hose/pipe from the external oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.

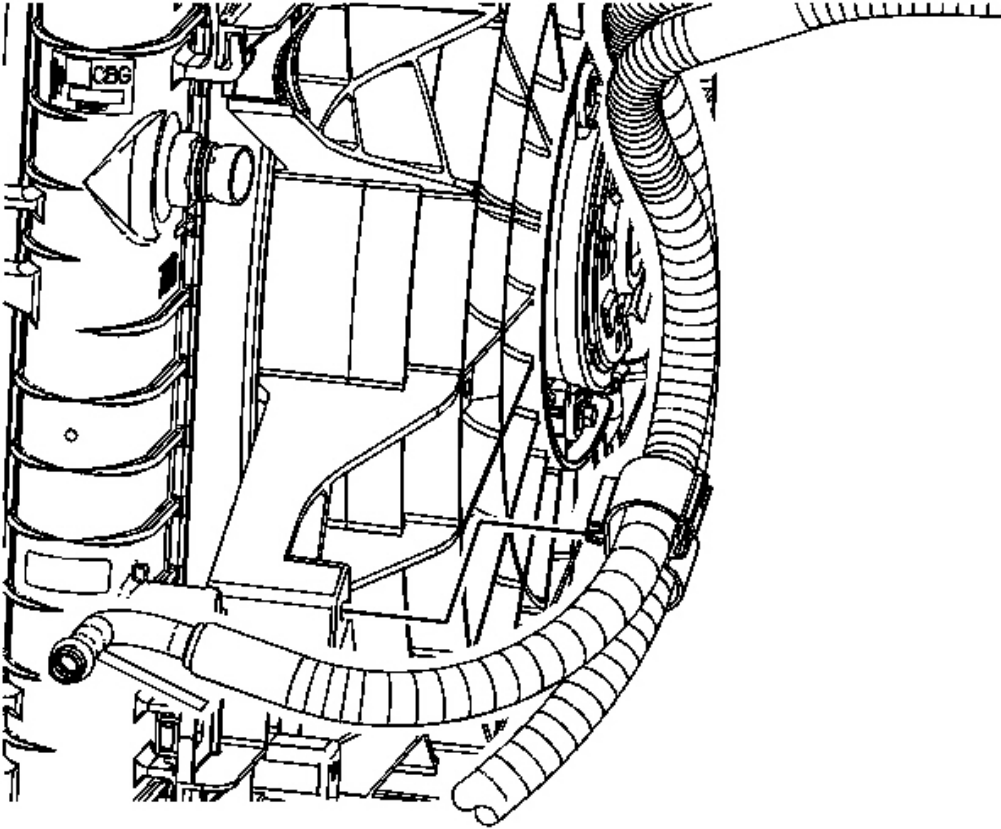


Fig. 130: Engine Oil Cooler Hose/Pipe Clip From Fan Shroud
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine oil cooler hose/pipe clip from the fan shroud.

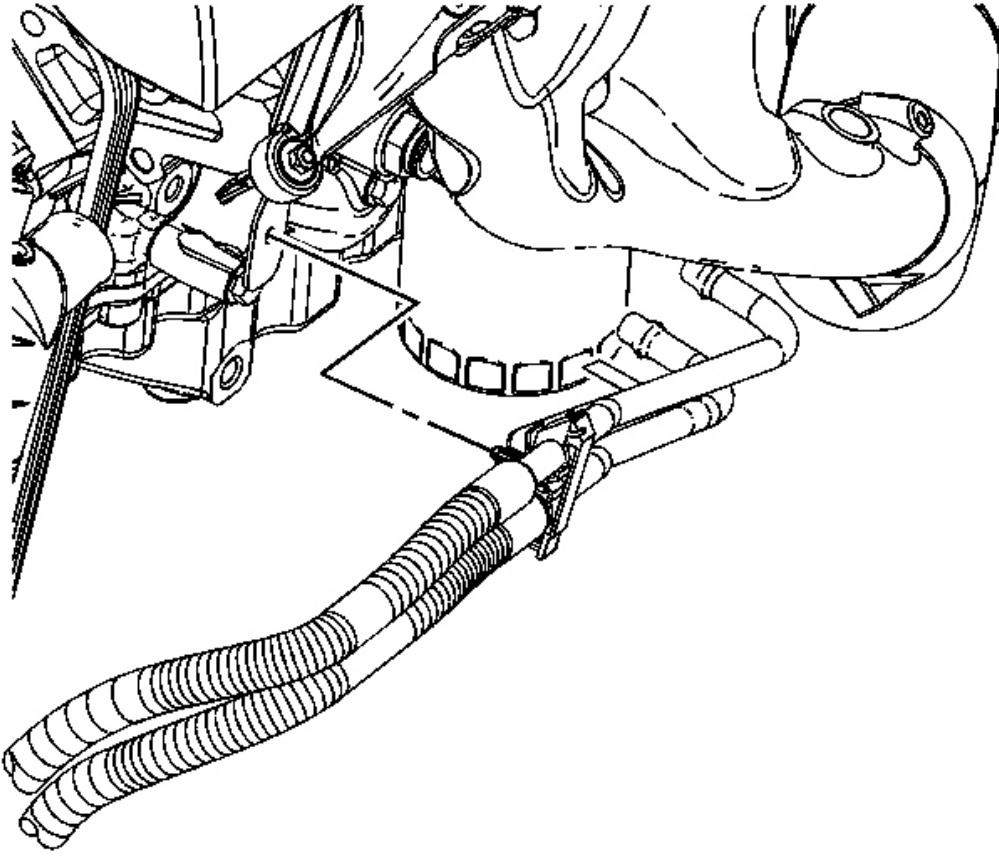


Fig. 131: Engine Oil Cooler Hose/Pipe Clip
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the engine oil cooler hose/pipe clip from the engine.

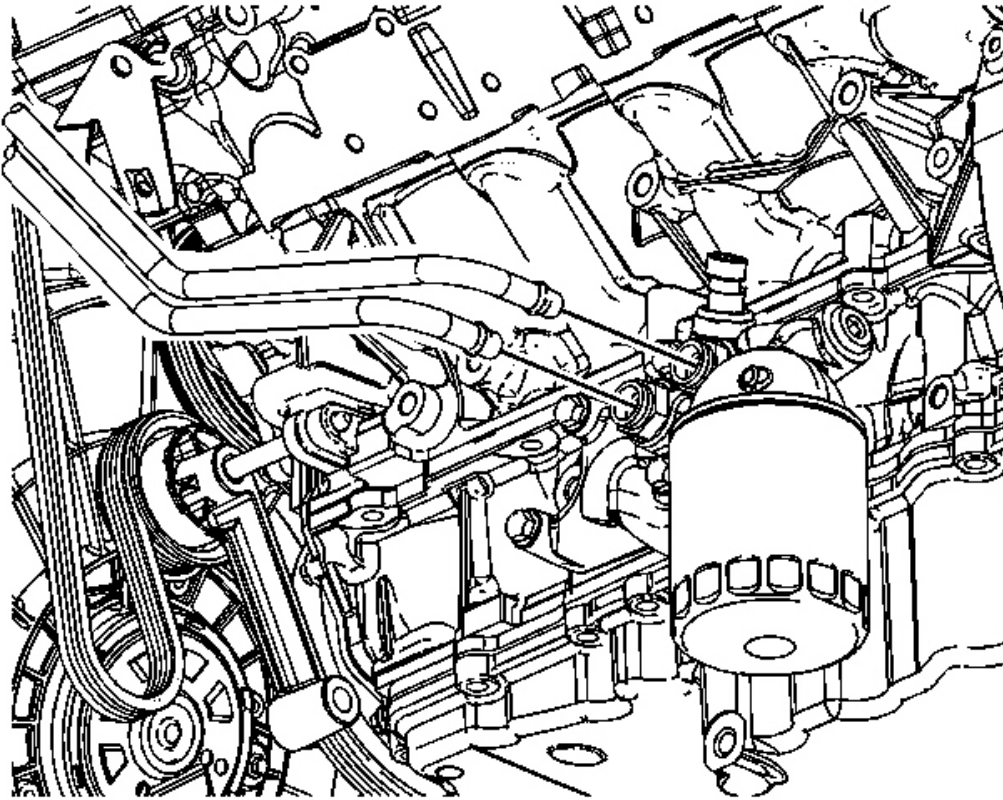


Fig. 132: External Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

7. Remove the external engine oil cooler hose/pipe from the engine. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
8. Remove the external engine oil cooler hose/pipe from the vehicle.
9. Remove and discard all engine oil cooler hose/pipe seals.

Installation Procedure

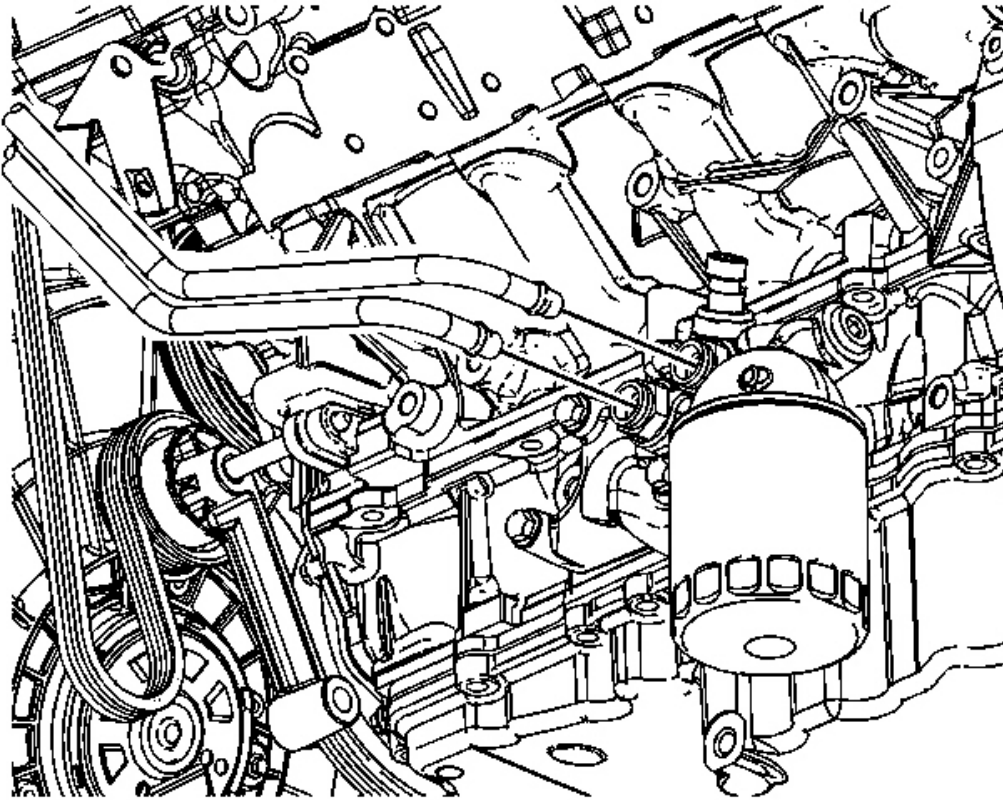


Fig. 133: External Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

1. Install new engine oil cooler hose/pipe seals.
2. Install the external engine oil cooler hose/pipe to the vehicle.

IMPORTANT: The quick connect fitting must be pushed on and then pulled back to verify proper connector engagement.

3. Install the external engine oil cooler hose/pipe to the engine. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.

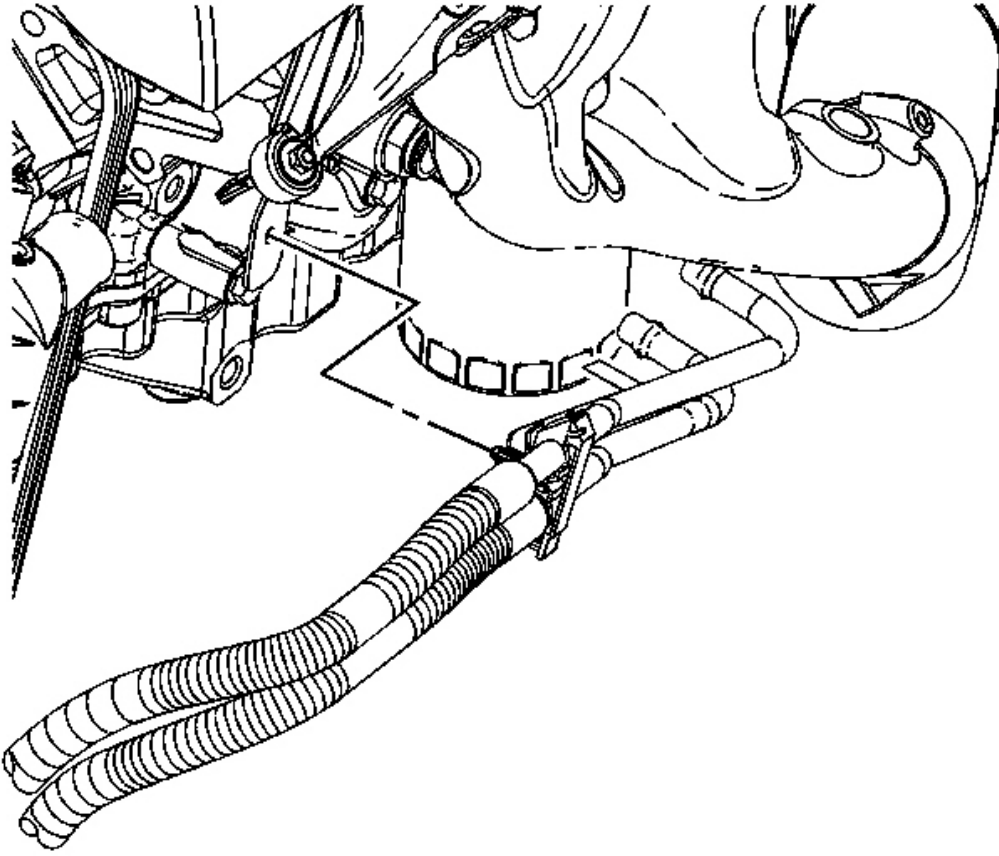


Fig. 134: Engine Oil Cooler Hose/Pipe Clip
Courtesy of GENERAL MOTORS CORP.

4. Connect the engine oil cooler hose/pipe clip to the engine.

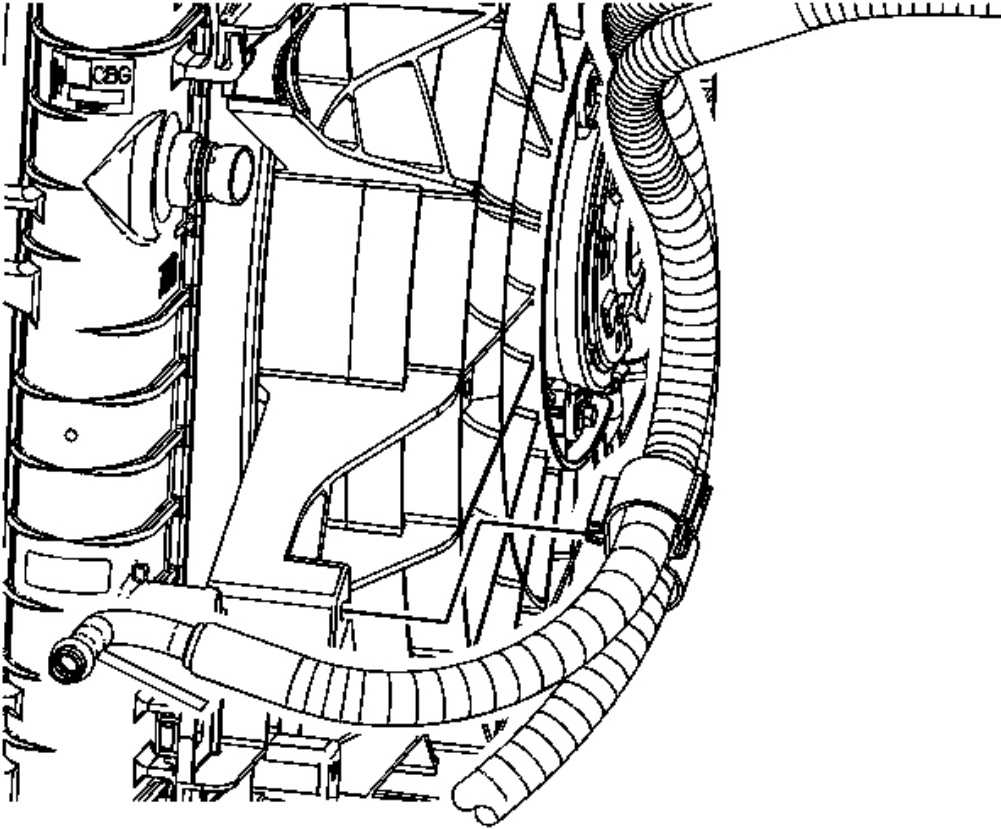


Fig. 135: Engine Oil Cooler Hose/Pipe Clip From Fan Shroud
Courtesy of GENERAL MOTORS CORP.

5. Connect the engine oil cooler hose/pipe clip to the fan shroud.

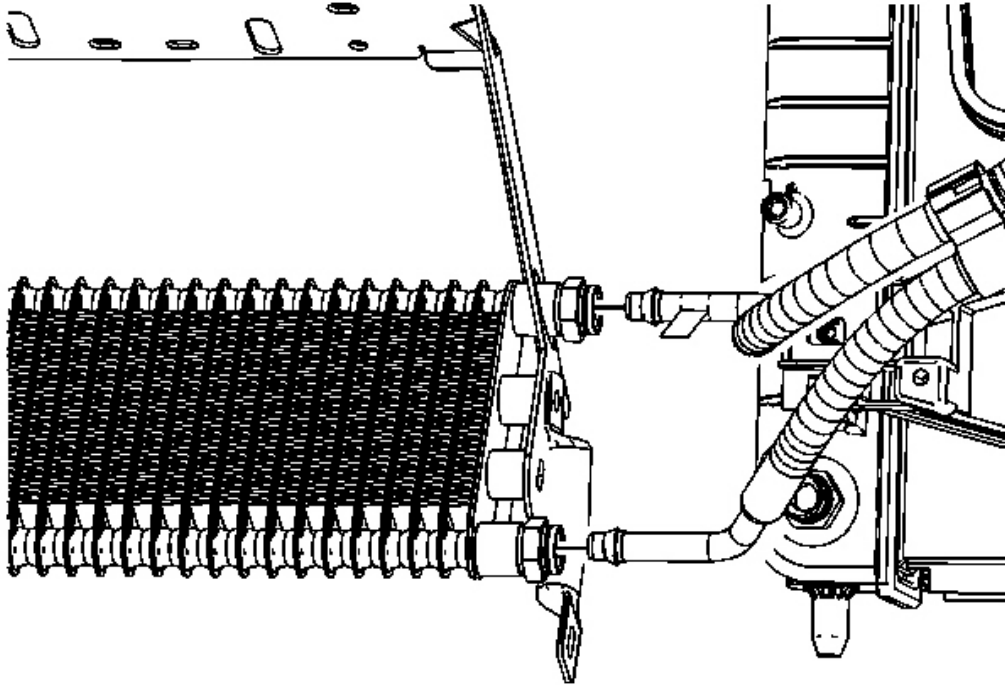


Fig. 136: External Oil Cooler
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The quick connect fitting must be pushed on and then pulled back to verify proper connector engagement.

6. Install the engine oil cooler hose/pipes to the external oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting**.
7. Remove the oil drain pan from under the vehicle.
8. Install the left lower front bumper close out panel. Refer to **Front Bumper Fascia Lower Close Out Panel Replacement** .
9. Refill the engine with oil and check for leaks.

AUXILIARY ENGINE OIL COOLER REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the left lower front bumper close out panel. Refer to **Front Bumper Fascia Lower Close Out**

Panel Replacement .

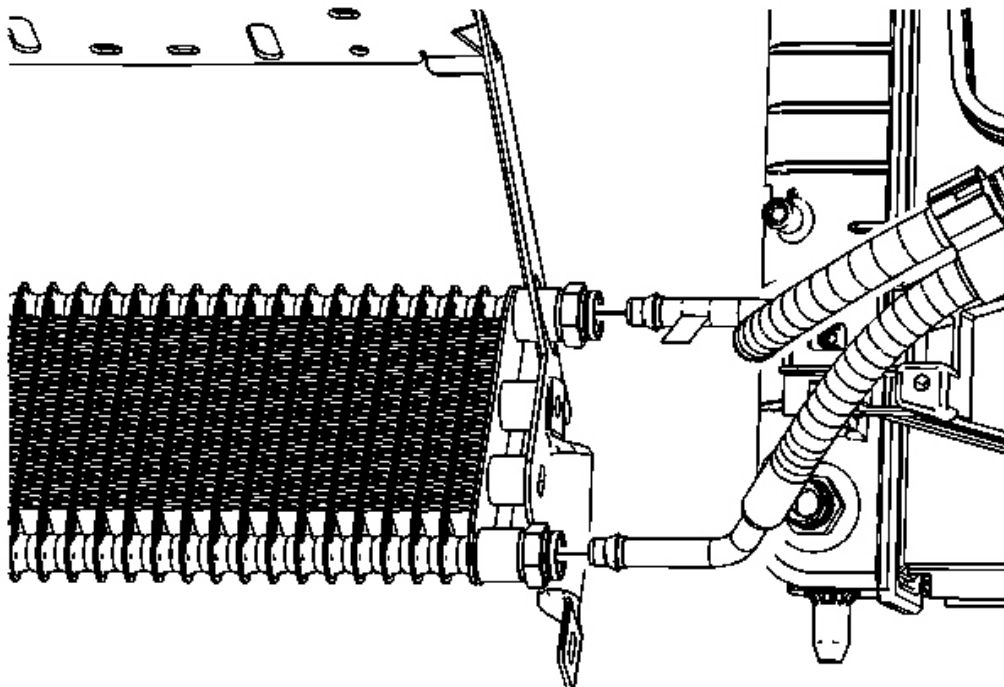


Fig. 137: External Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

3. Install oil drain pan under the vehicle.
4. Remove the engine oil cooler hose/pipe from the external oil cooler. Refer to **Engine Oil Cooler Pipe/Hose Quick Connect Fitting.**

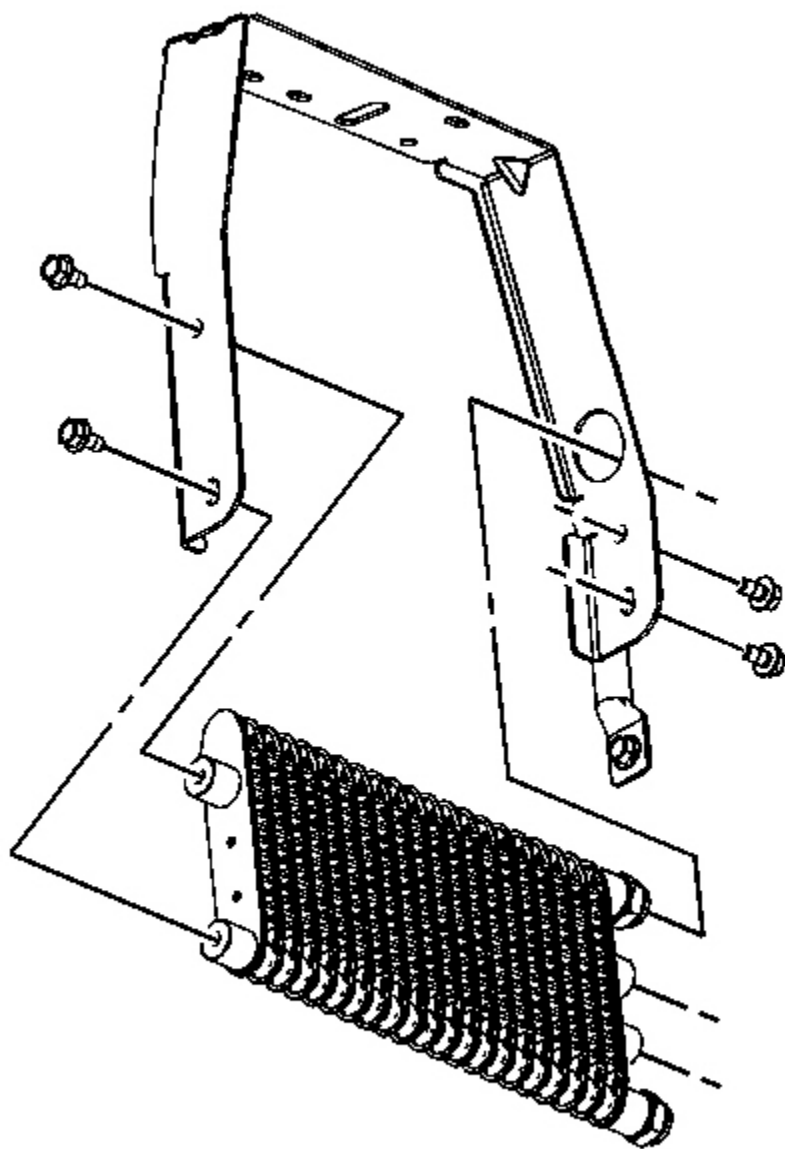


Fig. 138: External Engine Oil Cooler Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the external engine oil cooler retaining bolts.
6. Remove the external engine oil cooler.
7. Remove and discard all engine oil cooler hose/pipe seals.

Installation Procedure

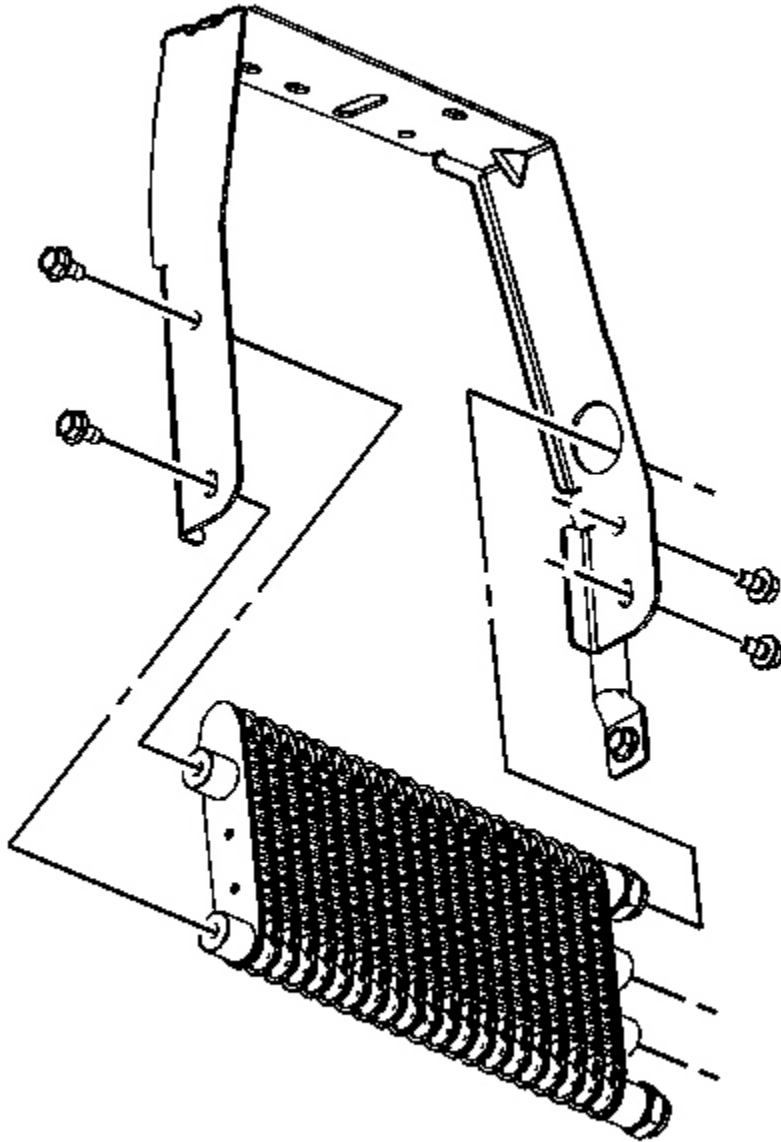


Fig. 139: External Engine Oil Cooler Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install new engine oil cooler hose/pipe seals.
2. Install the external engine oil cooler.

NOTE: Refer to Fastener Notice .

3. Install the external engine oil cooler retaining bolts.

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

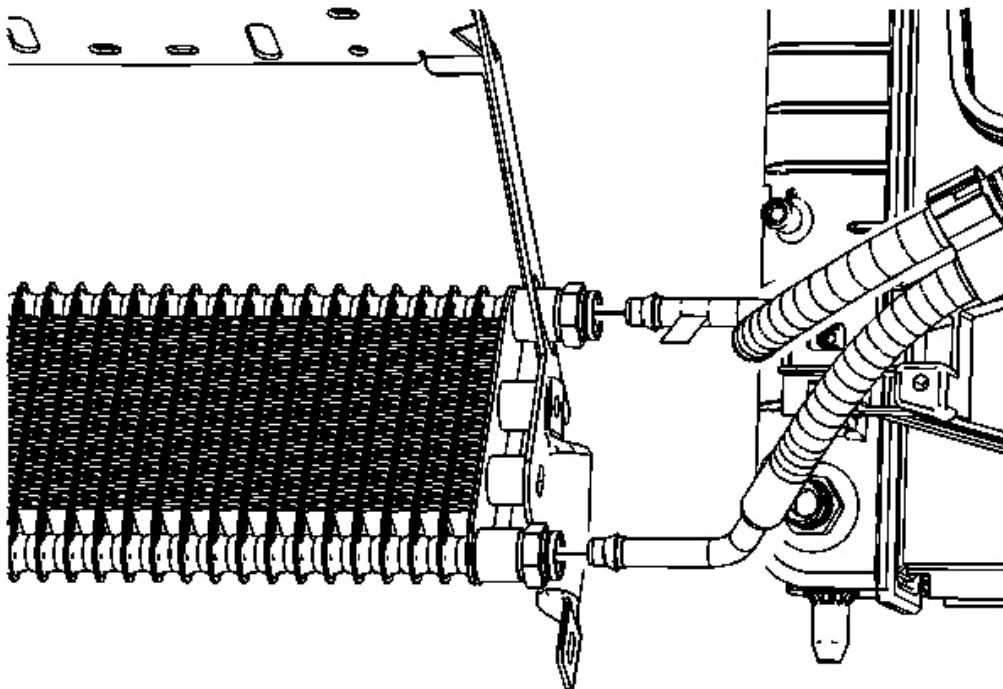


Fig. 140: External Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The quick connect fitting must be pushed on and then pulled back to verify proper connector engagement.

4. Install the engine oil cooler hose/pipes to the external oil cooler. Refer to Engine Oil Cooler Pipe/Hose Quick Connect Fitting.
5. Remove the oil drain pan from under the vehicle.
6. Install the left lower front bumper close out panel. Refer to Front Bumper Fascia Lower Close Out Panel Replacement .
7. Refill the engine with oil and check for leaks.

| |
|----------------------------------|
| 2006 Cadillac XLR |
| 2006 ENGINE Engine Cooling - XLR |

COOLING FAN AND SHROUD REPLACEMENT (W/PWM)

Removal Procedure

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

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

CAUTION: Before servicing any electrical component, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Remove the radiator support. Refer to **Radiator Support Replacement**.
2. Disconnect the engine wiring harness from the cooling fan shroud.
3. Disconnect the surge tank outlet hose from the retaining clips on the cooling fan shroud.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** in Front Suspension.

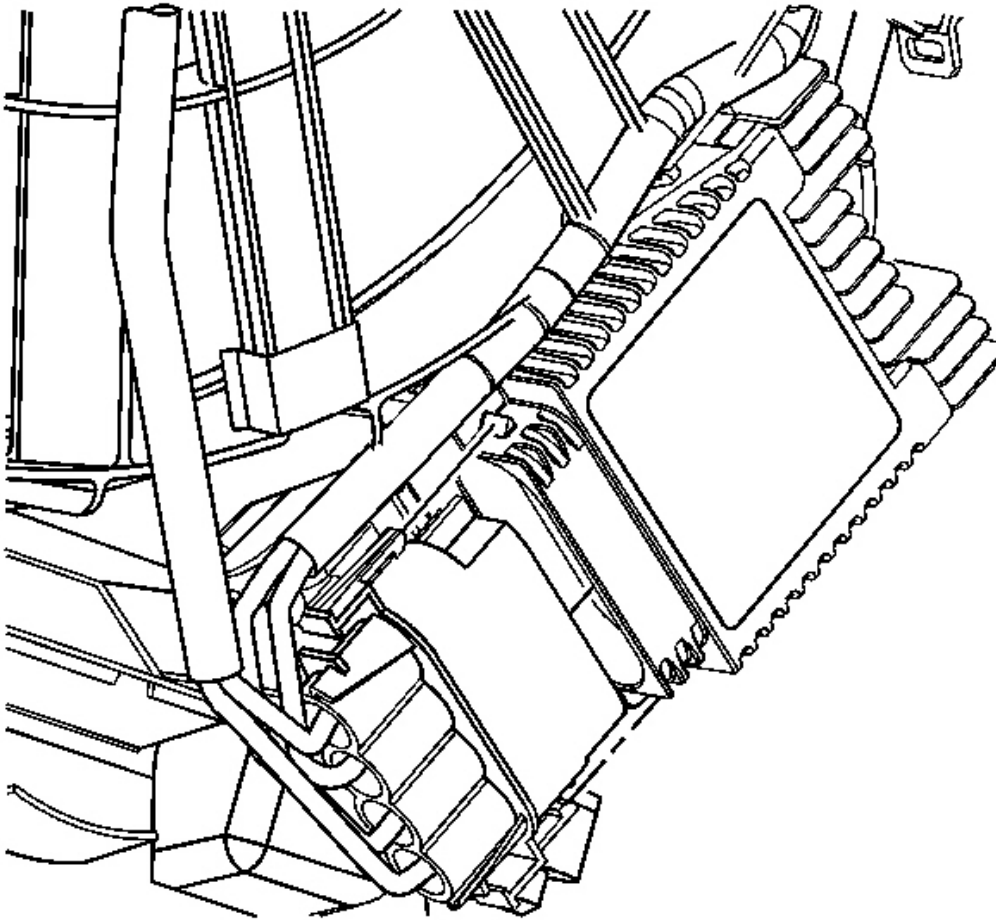


Fig. 141: View Of Cooling Fan Control Module Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the cooling fan electrical connector.
7. Disconnect the lower transmission oil cooler line from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-E.

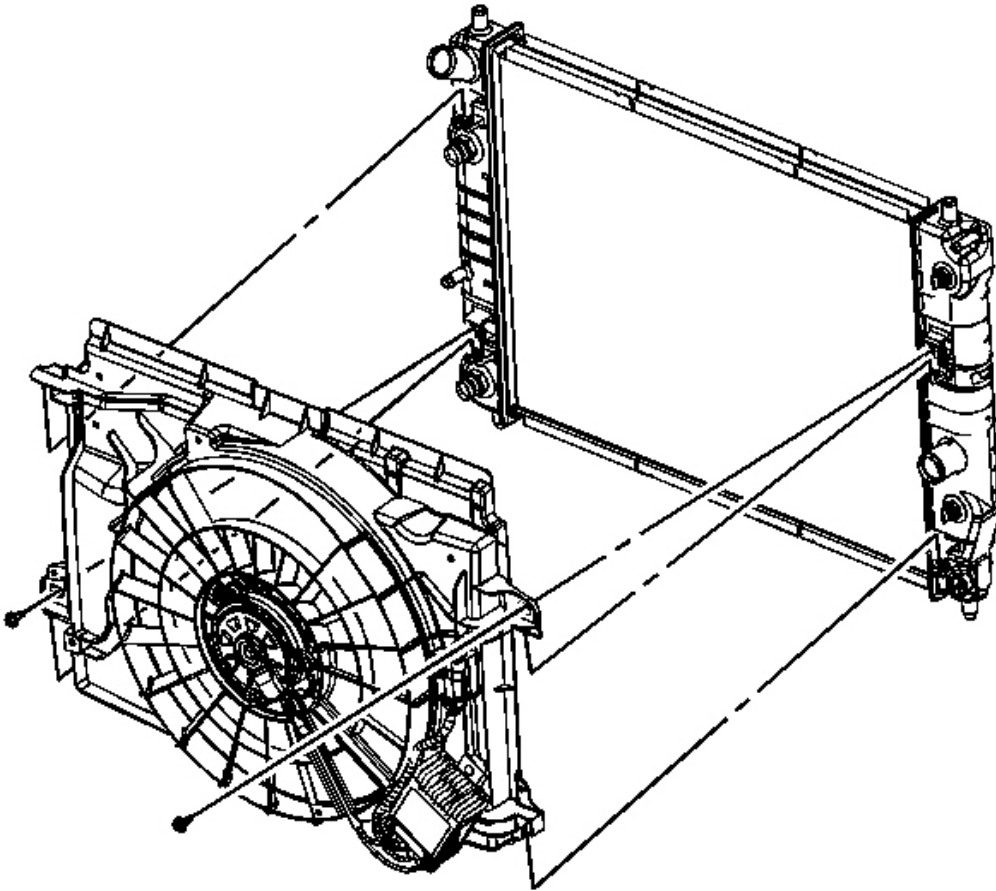


Fig. 142: Fan Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the cooling fan shroud retaining bolts.
9. Remove the cooling fan and shroud.

Installation Procedure

IMPORTANT: Ensure the cooling fan and shroud is properly seated on the radiator

1. Install the cooling fan and shroud.

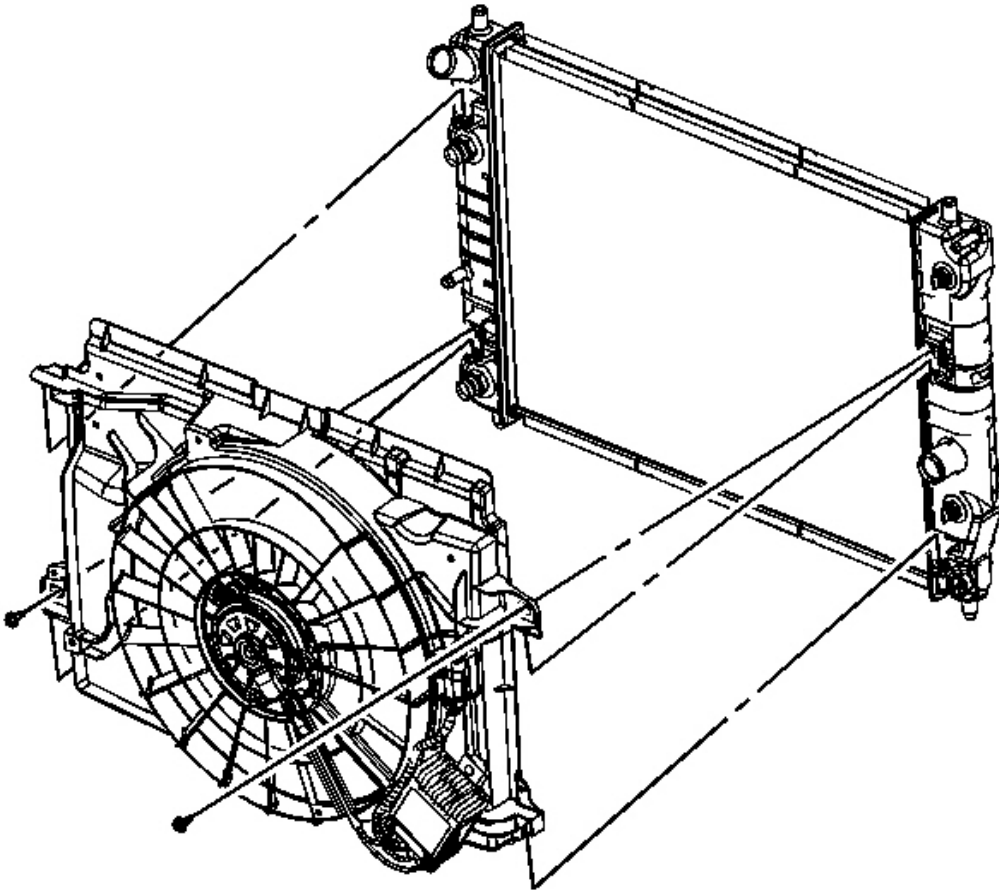


Fig. 143: Fan Assembly

Courtesy of GENERAL MOTORS CORP.

2. Install the cooling fan shroud retaining bolts.

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

3. Install the lower transmission oil cooler line. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50- E.

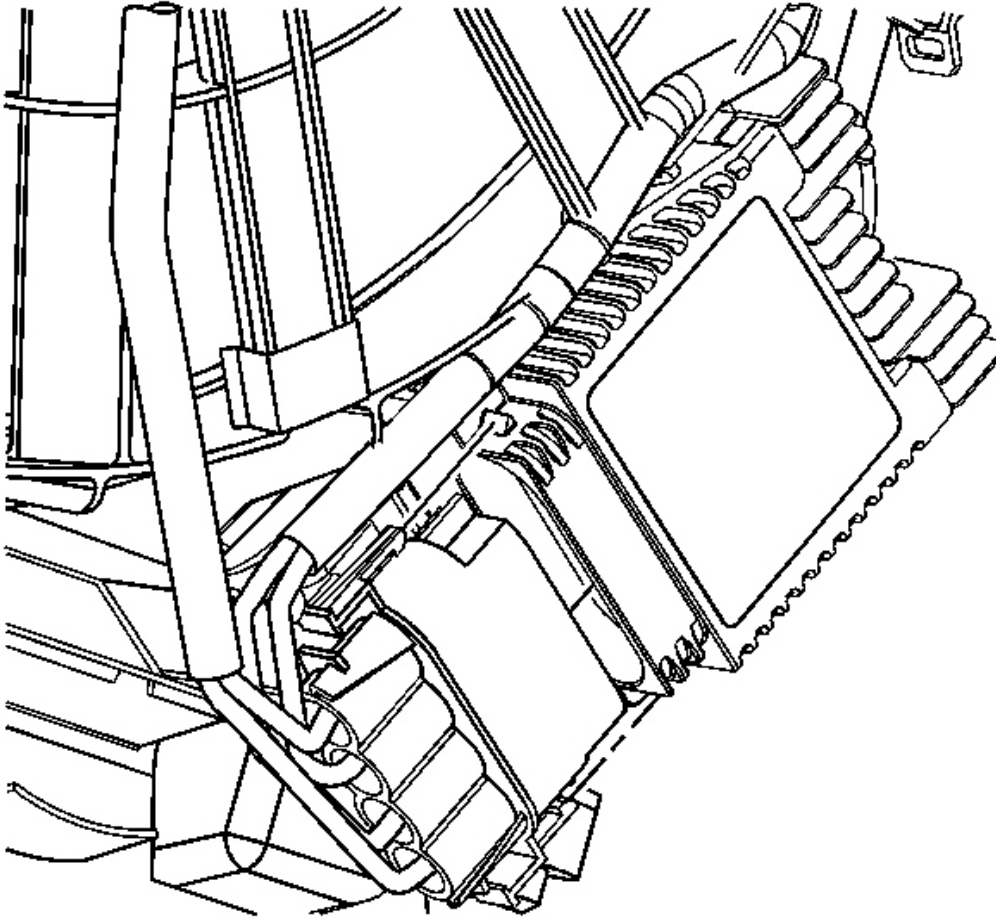


Fig. 144: View Of Cooling Fan Control Module Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the cooling fan electrical connector.
5. Install the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** in Front Suspension.
6. Lower the vehicle.
7. Connect the surge tank outlet hose to the retaining clips on the cooling fan shroud.
8. Connect the engine wiring harness to the cooling fan shroud.
9. Install the radiator support. Refer to **Radiator Support Replacement**.

COOLING FAN AND SHROUD REPLACEMENT (W/O PWM)

Removal Procedure

2006 Cadillac XLR

2006 ENGINE Engine Cooling - XLR

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

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

CAUTION: Before servicing any electrical component, the ignition and start switch must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Remove the radiator support. Refer to **Radiator Support Replacement**.
2. Disconnect the engine wiring harness from the cooling fan shroud.
3. Disconnect the surge tank outlet hose from the retaining clips on the cooling fan shroud.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** in Front Suspension.

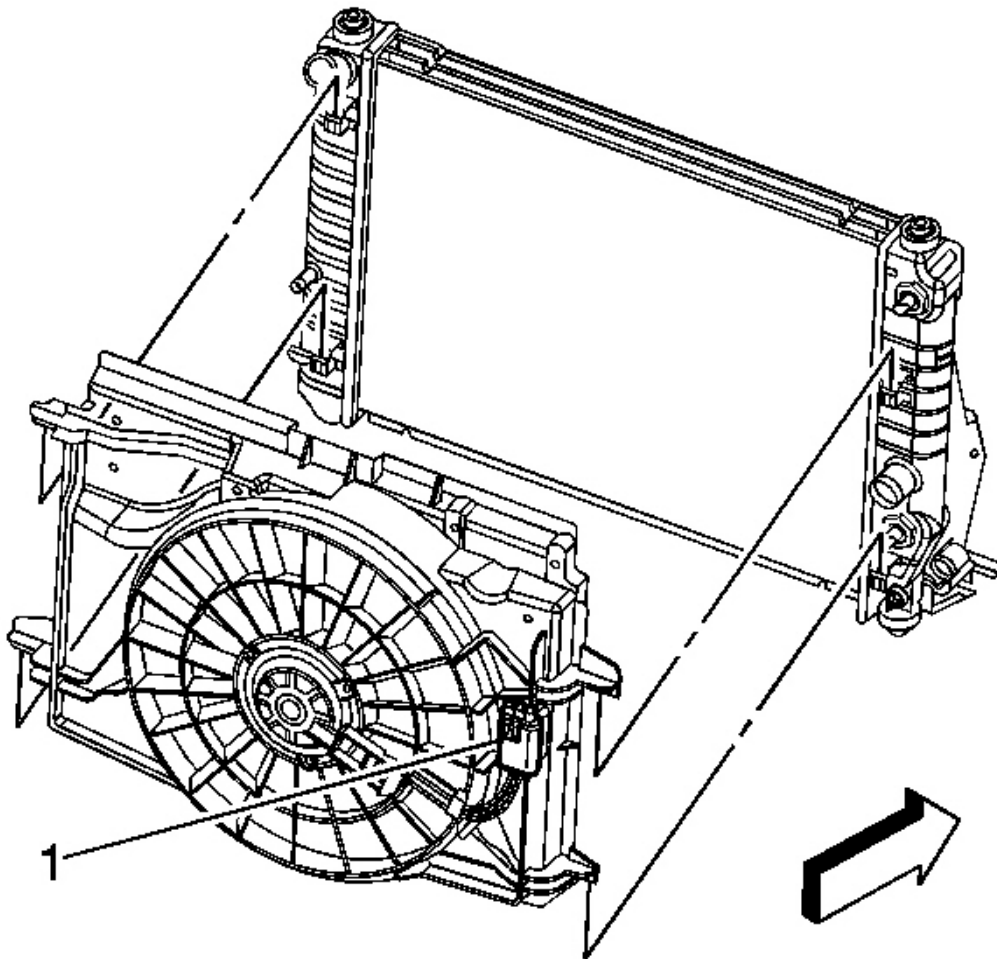


Fig. 145: Disconnecting/Connecting Cooling Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the cooling fan electrical connector (1).
7. Disconnect the lower transmission oil cooler line from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-E.

IMPORTANT: Lift up on the cooling fan and shroud to disengage the retaining tabs from the radiator

8. Remove the cooling fan and shroud.

Installation Procedure

IMPORTANT: Ensure the cooling fan and shroud is properly seated on the radiator

1. Install the cooling fan and shroud.
2. Install the lower transmission oil cooler line. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50- E.

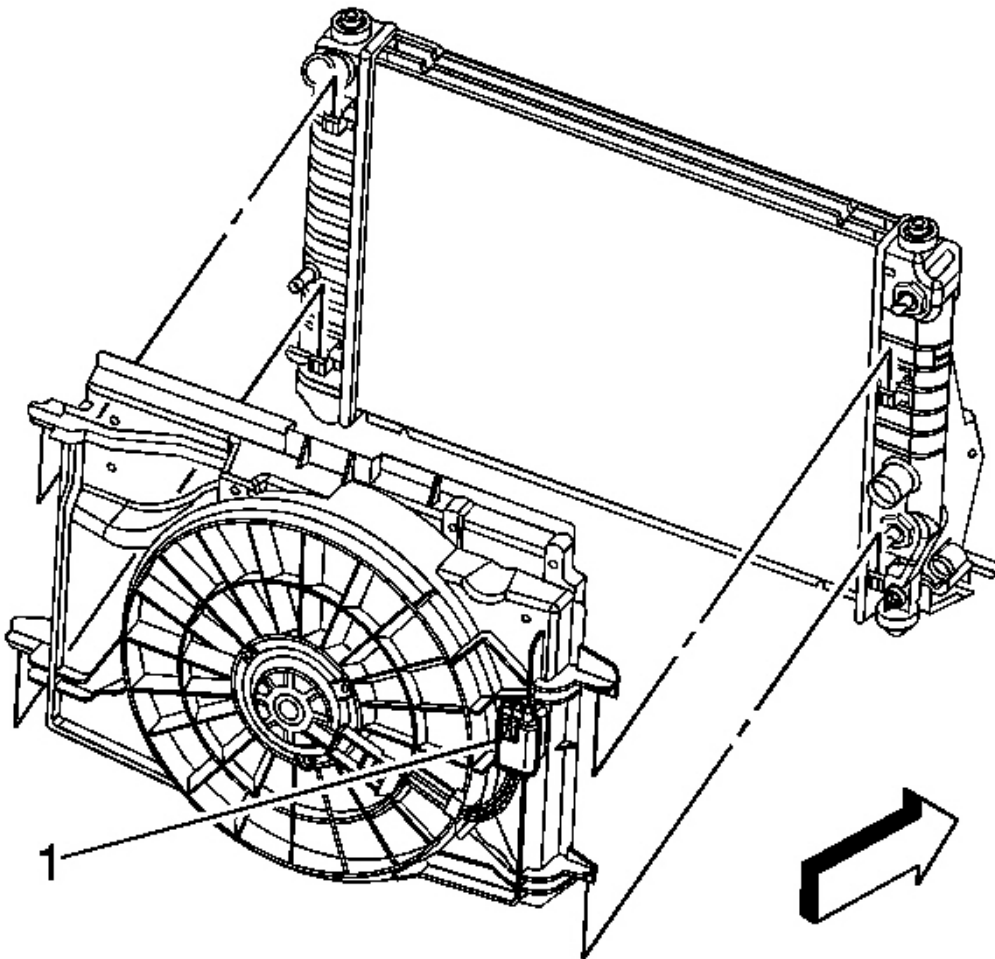


Fig. 146: Disconnecting/Connecting Cooling Fan Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the cooling fan electrical connector (1).

4. Install the stabilizer shaft. Refer to **Stabilizer Shaft Replacement** in Front Suspension.
5. Lower the vehicle.
6. Connect the surge tank outlet hose to the retaining clips on the cooling fan shroud.
7. Connect the engine wiring harness to the cooling fan shroud.
8. Install the radiator support. Refer to **Radiator Support Replacement**.

COOLING FAN CONTROL MODULE REPLACEMENT

Removal Procedure

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

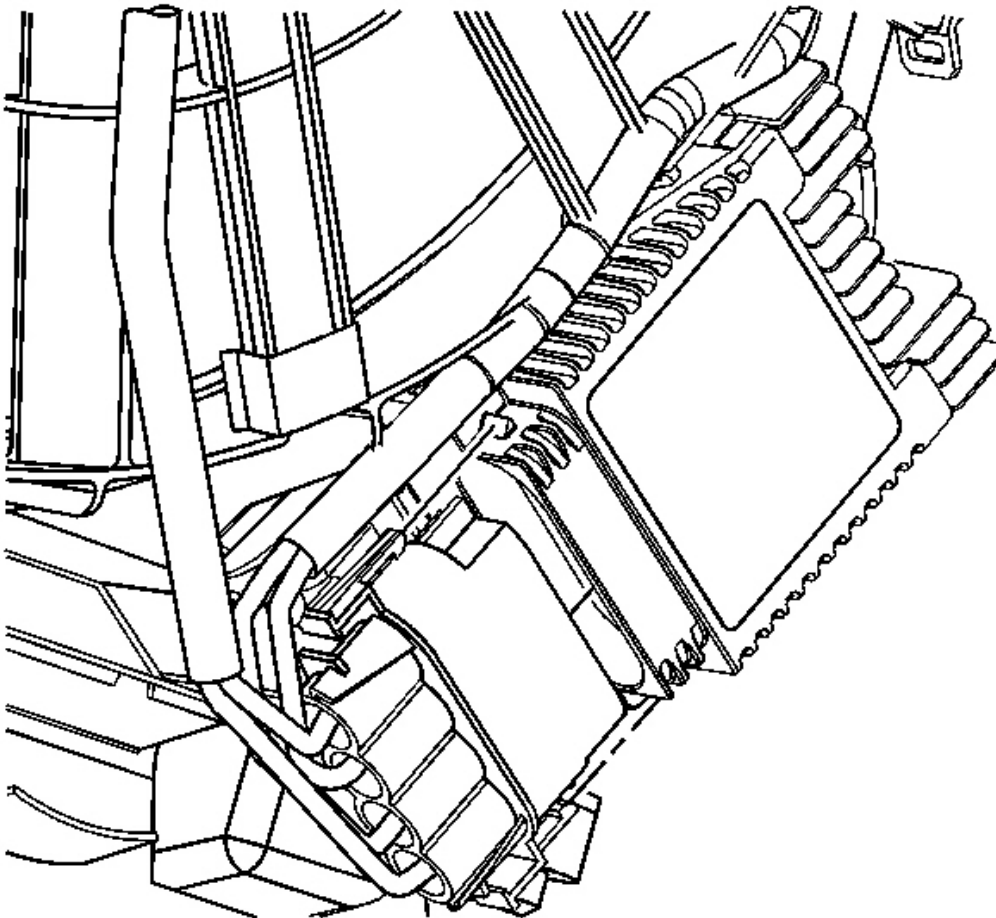


Fig. 147: View Of Cooling Fan Control Module Electrical Connector

Courtesy of GENERAL MOTORS CORP.

2. Disconnect the cooling fan control module electrical connector.

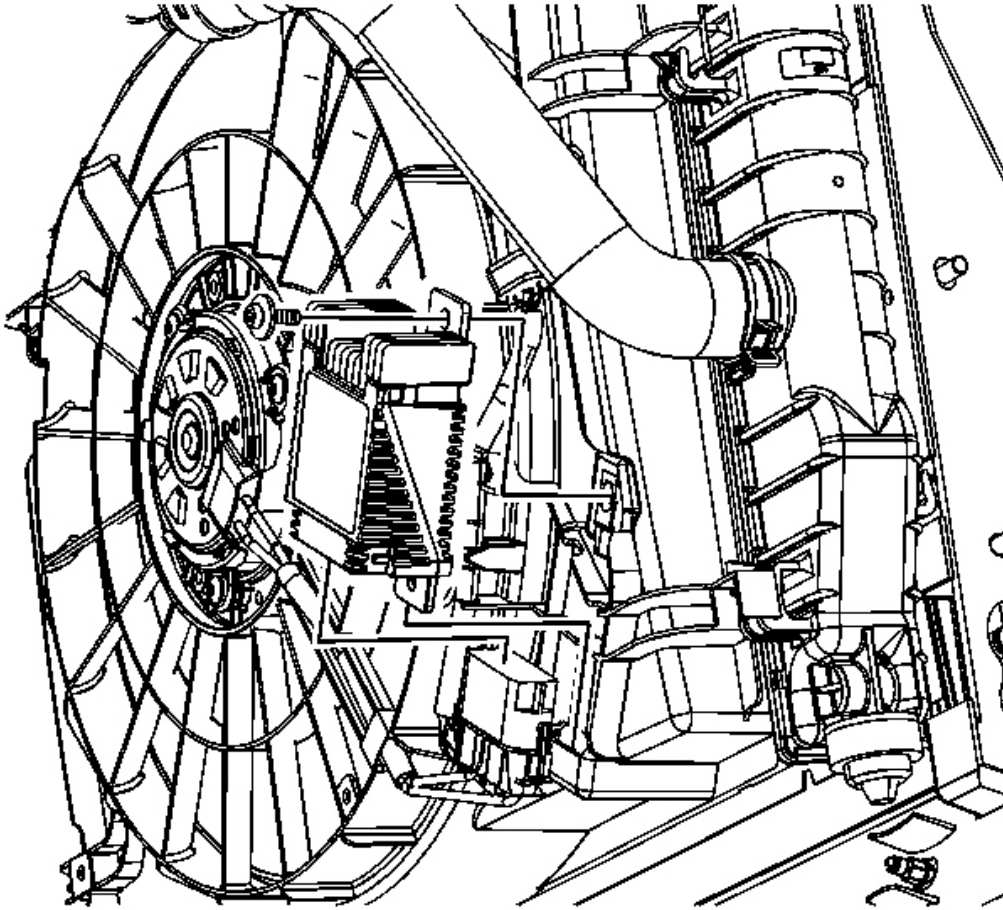


Fig. 148: View Of Cooling Fan Control Module
Courtesy of GENERAL MOTORS CORP.

3. Remove the cooling fan control module retaining bolt.
4. Remove the cooling fan control module from the vehicle.

Installation Procedure

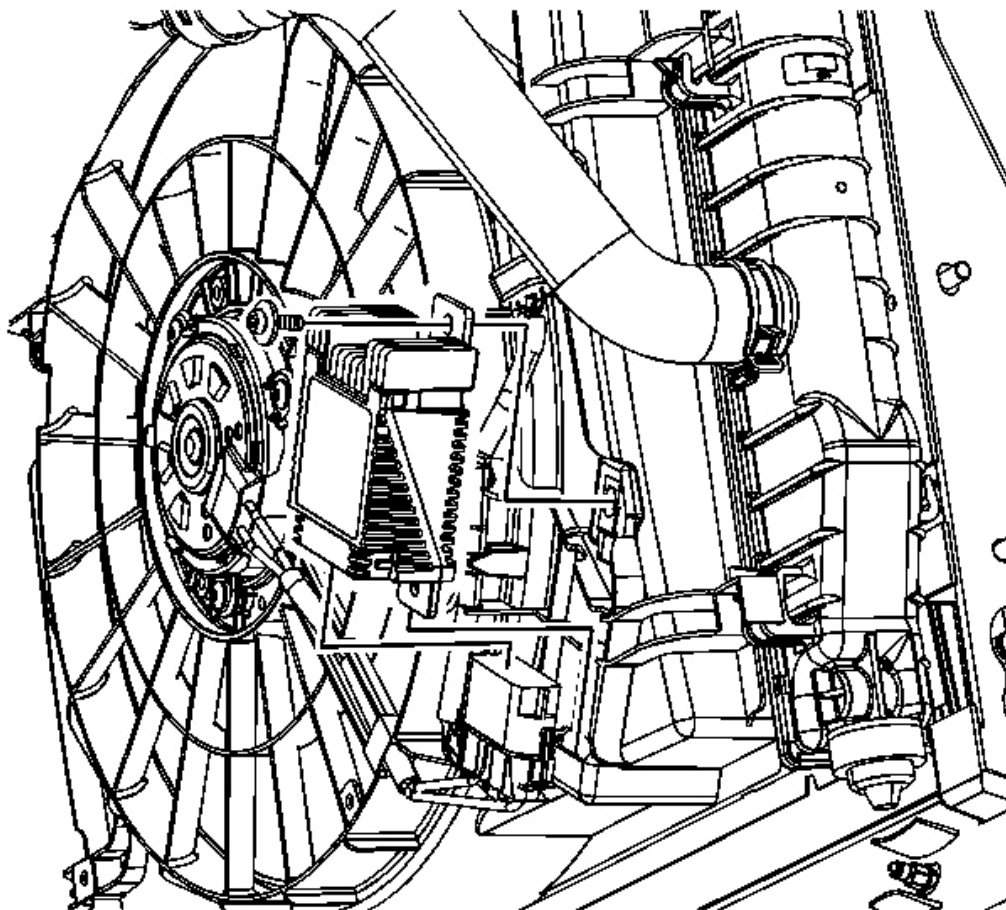


Fig. 149: View Of Cooling Fan Control Module
Courtesy of GENERAL MOTORS CORP.

1. Install the cooling fan control module to the vehicle.

NOTE: Refer to Fastener Notice .

2. Install the cooling fan control module retaining bolt.

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

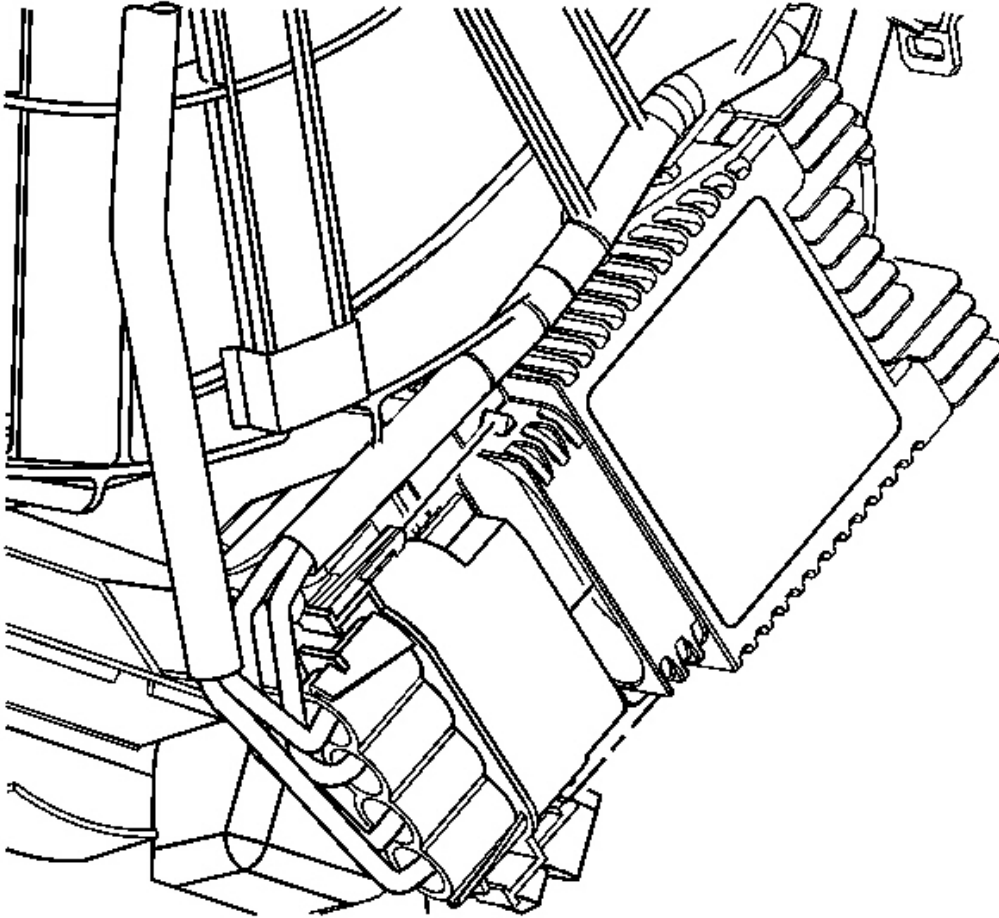


Fig. 150: View Of Cooling Fan Control Module Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the cooling fan control module electrical connector.
4. Lower the vehicle.
5. Refer to **Control Module References** for programming and setup information.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LH2)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air outlet duct in order to gain access to the thermostat housing. Refer to **Air Cleaner Inlet Duct Replacement**.

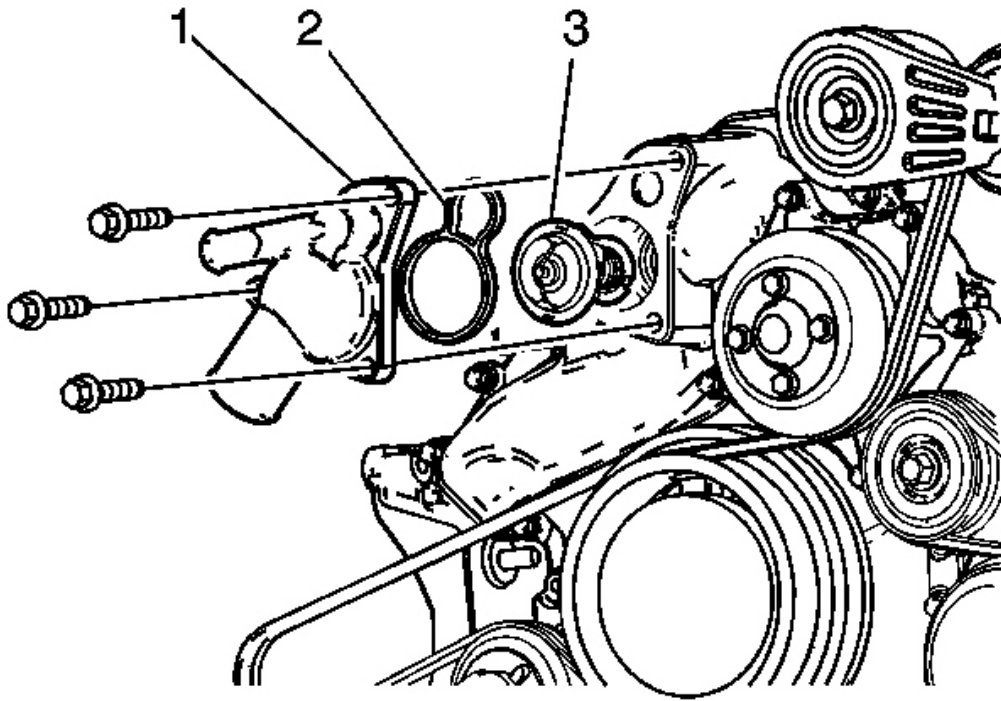


Fig. 151: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the heater hose from the thermostat housing using a **J 38185**.
4. Remove the coolant radiator hose from the thermostat housing. Refer to **Coolant Bypass Hose Replacement (LH2)** or **Coolant Bypass Hose Replacement (LC3)**.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing (1) with thermostat from the engine front cover.
7. Remove the thermostat (3) and seal ring (2) and discard the seal ring.

Installation Procedure

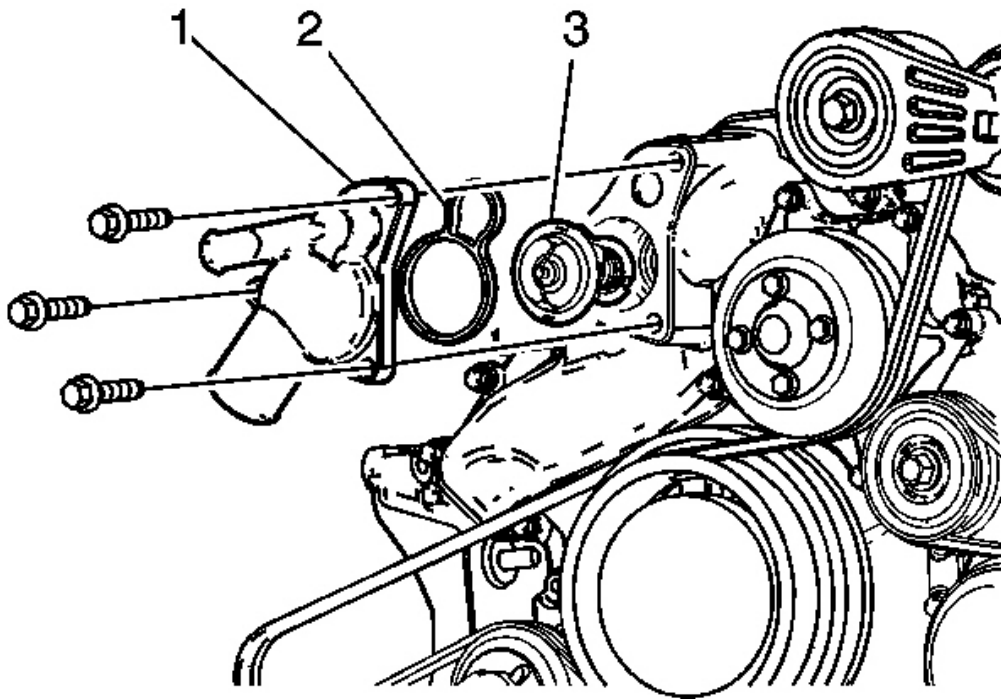


Fig. 152: View Of Exploded View Of Thermostat Assembly
 Courtesy of GENERAL MOTORS CORP.

1. Install a new seal ring (2) on the thermostat (3).
2. Install the thermostat and new seal ring into the thermostat housing (1).
3. Install the thermostat housing (1) with the thermostat (3) assembly to the engine front cover.

NOTE: Refer to Fastener Notice .

4. Install the thermostat housing bolts.

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

5. Position the radiator hose over to the thermostat housing and reposition the clamp using the **J 38185** .
6. Install the heater hose to the thermostat housing using **J 38185** .
7. Install the air outlet duct. Refer to Air Cleaner Inlet Duct Replacement .
8. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).

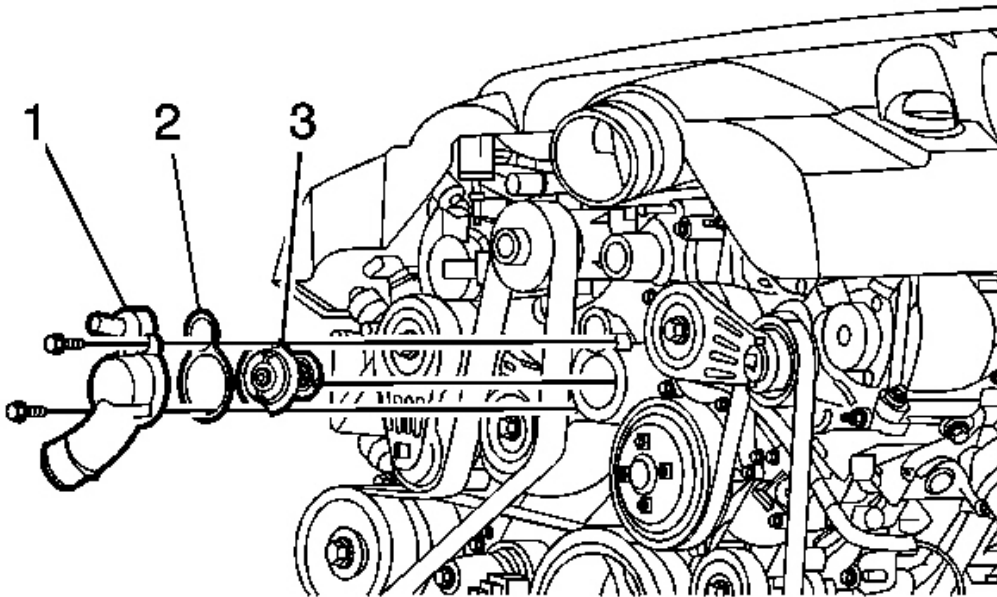
ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LC3)**Removal Procedure**

Fig. 153: Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
3. Remove the radiator hose from the thermostat housing. Refer to **Radiator Outlet Hose Replacement**.
4. Remove the heater hose from the thermostat housing.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing (1) with thermostat (3), from the water housing.
7. Remove and discard the seal ring (2).
8. Remove the thermostat from the thermostat housing.

Installation Procedure

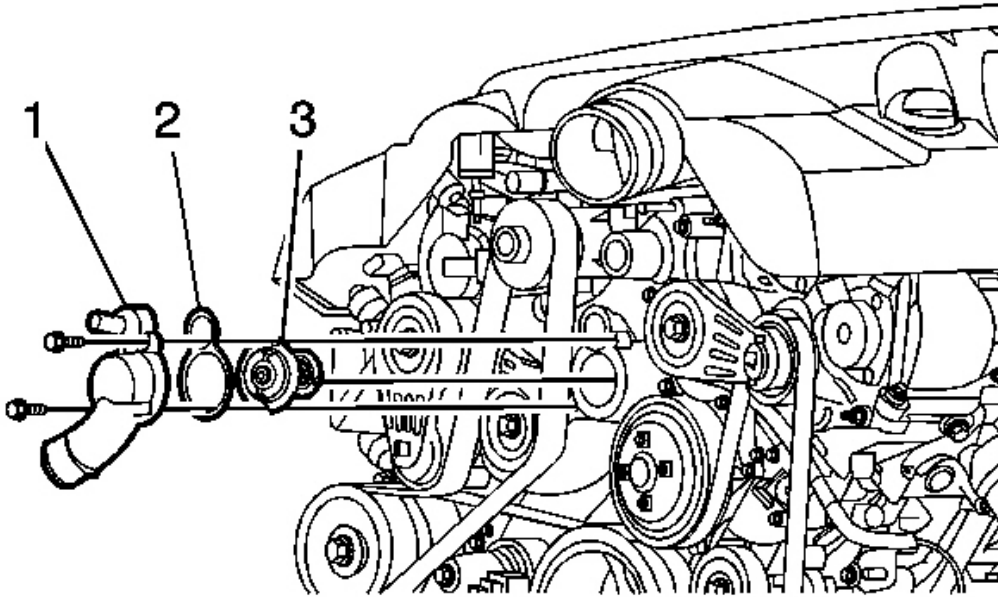


Fig. 154: Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to **Fastener Notice** .

5. Install the thermostat housing bolts.

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

6. Install the heater hose to the thermostat housing.
7. Install the radiator hose to the thermostat housing. Refer to **Radiator Outlet Hose Replacement**.
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air outlet duct in order to gain access to the thermostat housing. Refer to **Air Cleaner Inlet Duct Replacement**.

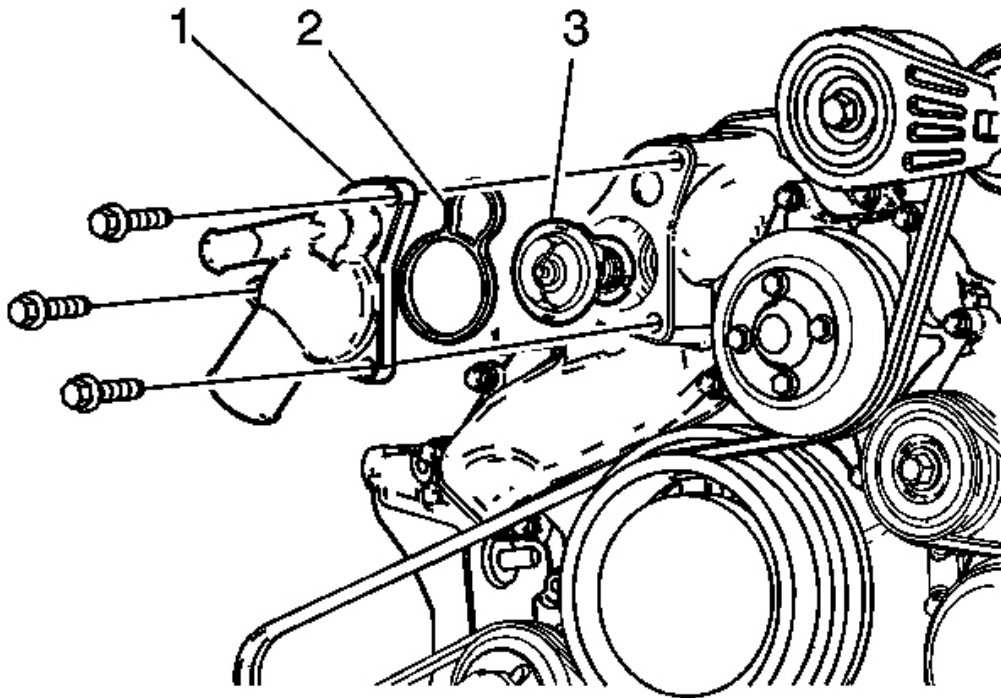


Fig. 155: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the heater hose from the thermostat housing using a **J 38185**.
4. Remove the coolant radiator hose from the thermostat housing. Refer to **Coolant Bypass Hose Replacement (LH2)** or **Coolant Bypass Hose Replacement (LC3)**.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing with thermostat from the engine front cover.

7. Remove the thermostat and seal ring and discard the seal ring.

Installation Procedure

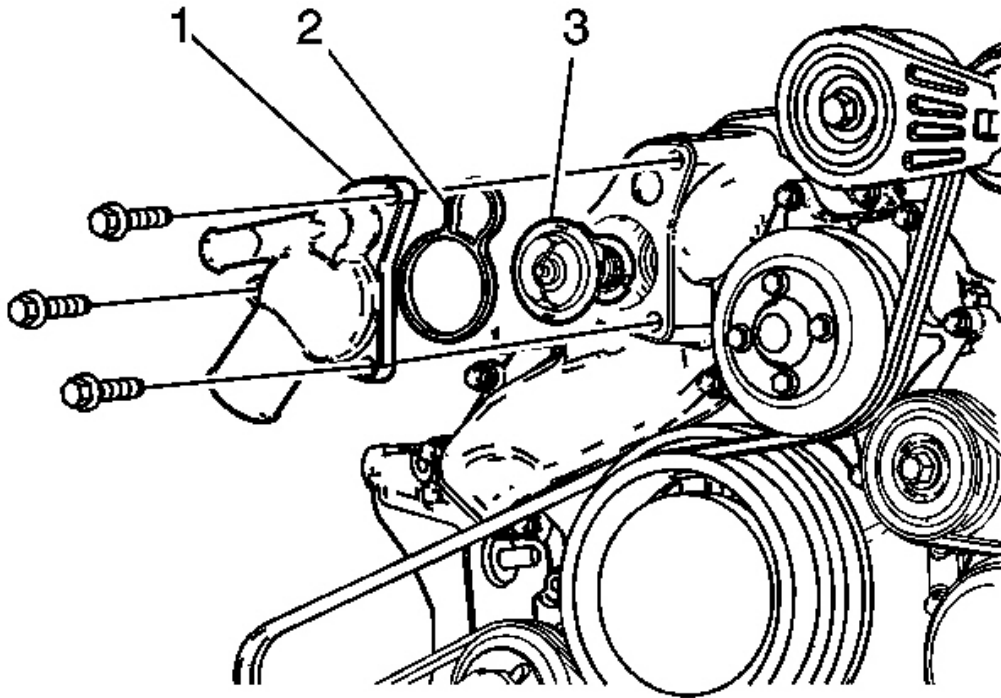


Fig. 156: View Of Exploded View Of Thermostat Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install a new seal ring on the thermostat.
2. Install the thermostat and new seal ring into the thermostat housing.
3. Install the thermostat housing with the thermostat assembly to the engine front cover.

NOTE: Refer to Fastener Notice .

4. Install the thermostat housing bolts.

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

5. Position the radiator hose over to the thermostat housing and reposition the clamp using the **J 38185** .
6. Install the heater hose to the thermostat housing using **J 38185** .

7. Install the air outlet duct. Refer to **Air Cleaner Inlet Duct Replacement** .
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

ENGINE COOLANT THERMOSTAT REPLACEMENT (LC3)

Removal Procedure

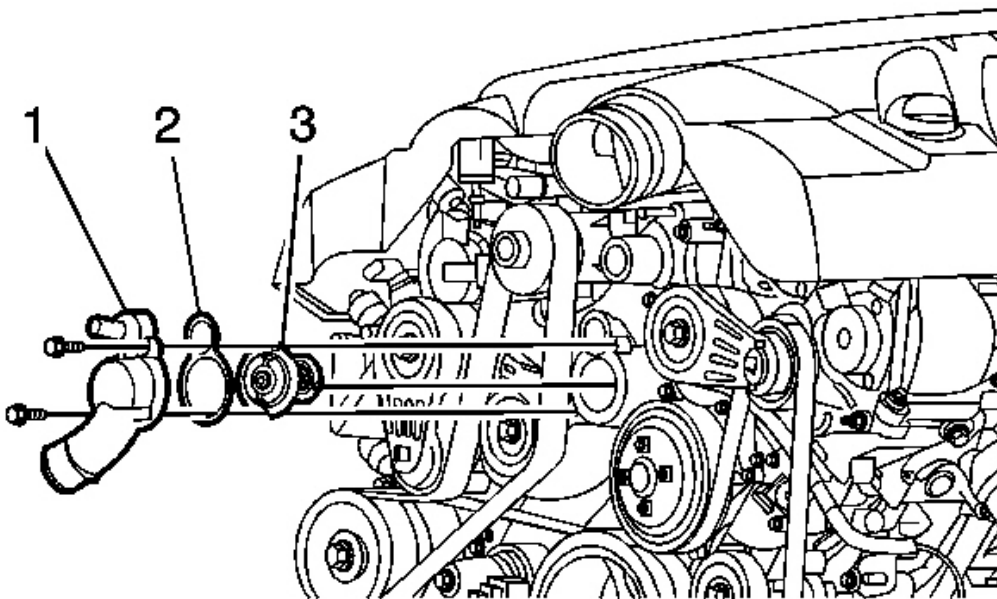


Fig. 157: Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
3. Remove the radiator hose from the thermostat housing. Refer to **Radiator Outlet Hose Replacement**.
4. Remove the heater hose from the thermostat housing.
5. Remove the thermostat housing bolts.
6. Remove the thermostat housing (1) with thermostat (3), from the water housing.
7. Remove and discard the seal ring (2).
8. Remove the thermostat from the thermostat housing.

Installation Procedure

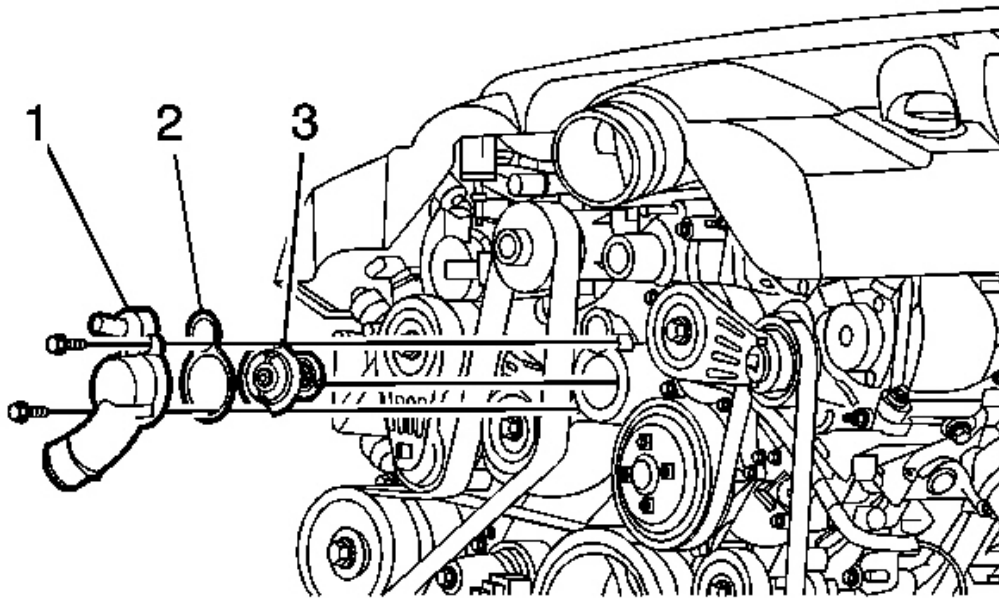


Fig. 158: Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

5. Install the thermostat housing bolts.

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

6. Install the heater hose to the thermostat housing.
7. Install the radiator hose to the thermostat housing. Refer to Radiator Outlet Hose Replacement.
8. Install the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .
9. Fill the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).

WATER OUTLET HOUSING REPLACEMENT (LH2)

Tools Required

J 38185 Hose Clamp Pliers

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).
2. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
3. Remove the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement.

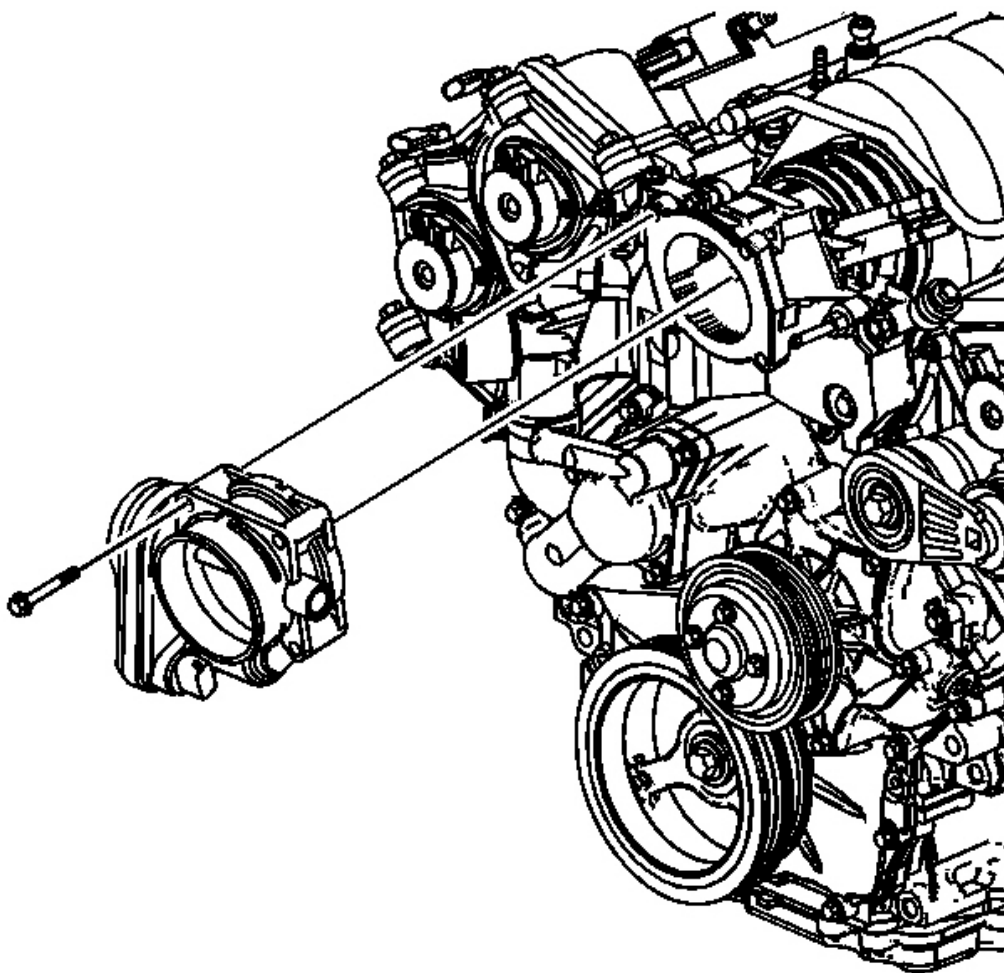


Fig. 159: View Of Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the throttle body from the water outlet housing. Refer to **Throttle Body Assembly Replacement** .
5. Remove the manifold absolute pressure (MAP) sensor. Refer to **Manifold Absolute Pressure Sensor Replacement** .
6. Remove the purge solenoid. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .
7. Position the **J 38185** to the hose clamps to remove the following hoses from the water outlet housing:
 - The surge tank outlet hose
 - The radiator hose
 - The heater hose
 - The bypass hose

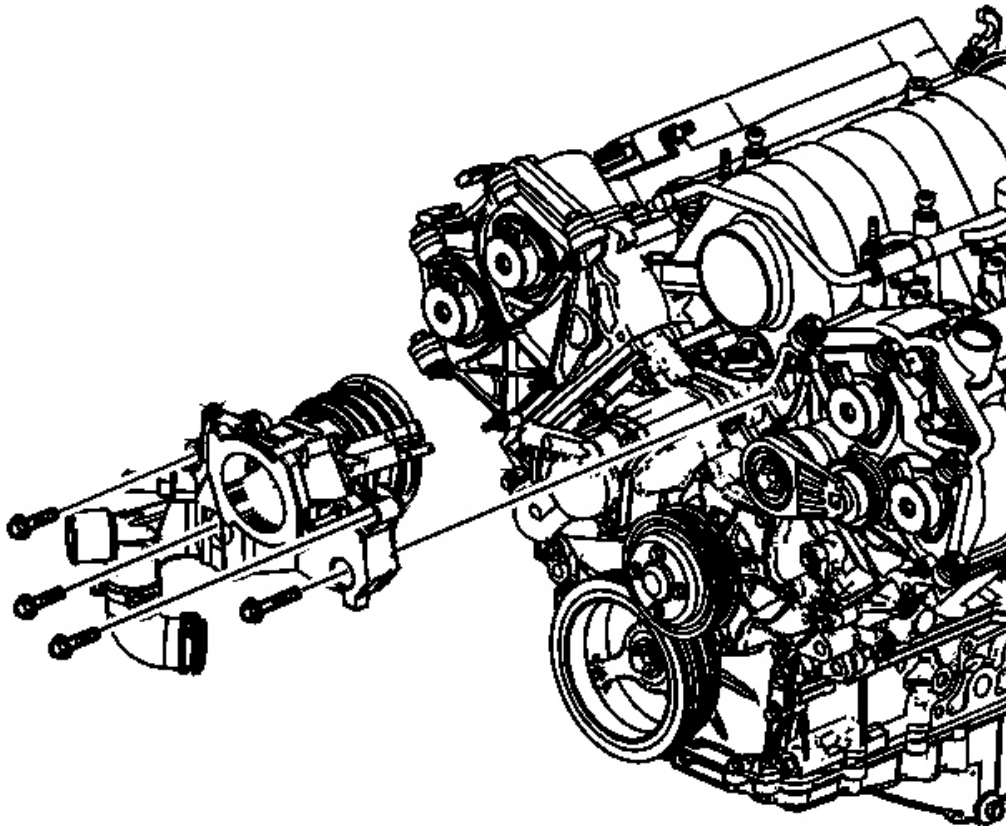


Fig. 160: View Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

8. Remove the bolts securing the water outlet housing to the cylinder heads. Discard the gasket.
9. Clean and inspect. Refer to **Water Outlet Housing Cleaning and Inspection** .
10. Remove the following components from the water outlet housing:
 - The water crossover pipe plug
 - The throttle body inlet heater hose fitting

Installation Procedure

1. Install a new water outlet housing gasket.
2. Place the water outlet housing in position and hand start the bolts to hold the housing in place.

NOTE: Refer to **Fastener Notice** .

3. Tighten the water outlet housing bolts.

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

4. Connect the following hoses to the water outlet housing:
 - The bypass hose
 - The heater hose
 - The radiator hose
 - The surge tank inlet hose
5. Position the **J 38185** to the hose clamps to secure the hoses to the water outlet housing.
6. Install the purge solenoid. Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement** .

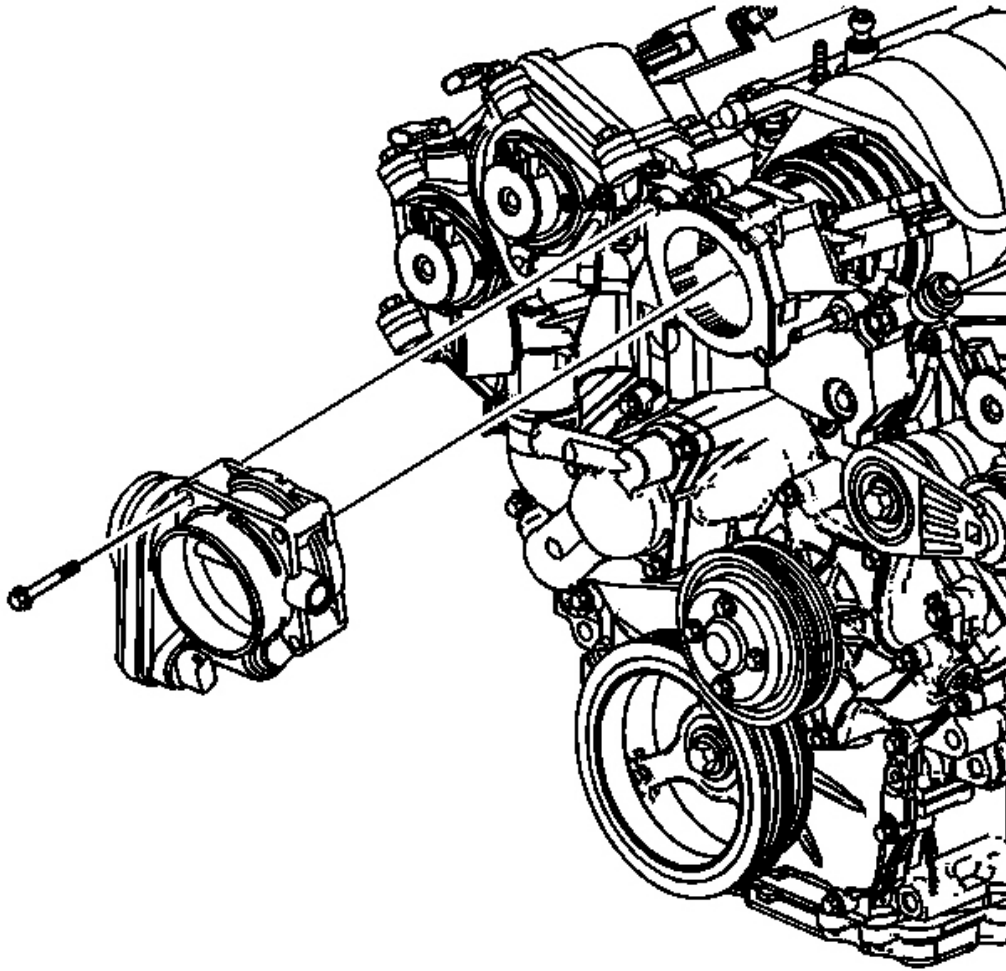


Fig. 161: View Of Throttle Body Assembly
Courtesy of GENERAL MOTORS CORP.

7. Install the MAP sensor. Refer to **Manifold Absolute Pressure Sensor Replacement** .
8. Install the throttle body to the water outlet housing. Refer to **Throttle Body Assembly Replacement** .
9. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement** .
10. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
11. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

WATER OUTLET HOUSING REPLACEMENT (LC3)

Removal Procedure

1. Drain the engine cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Drain the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

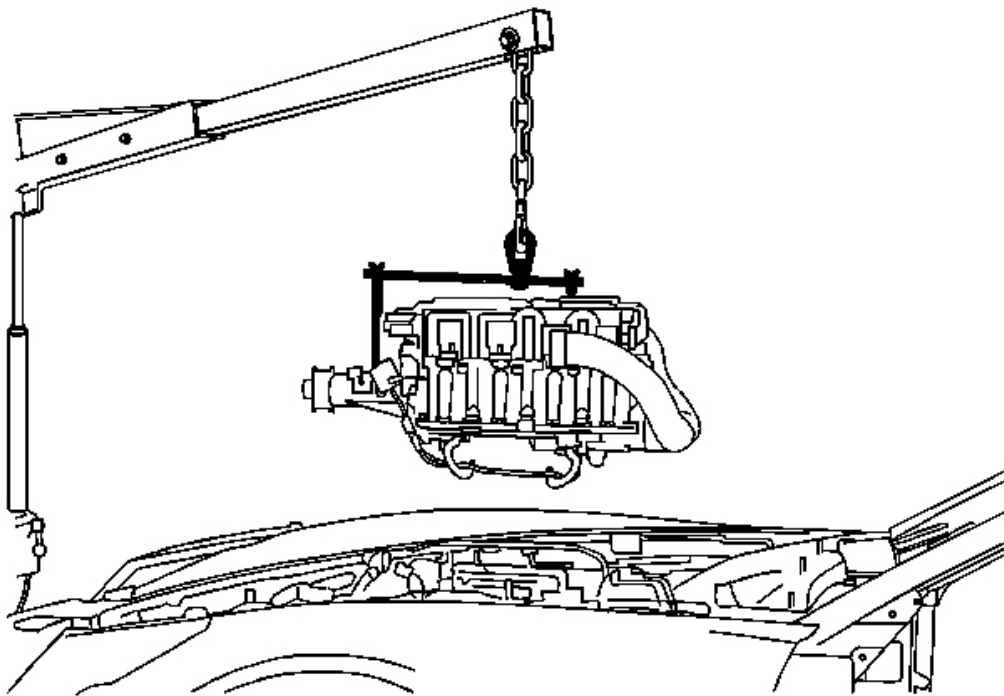


Fig. 162: Supercharger Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the supercharger assembly. Refer to **Supercharger Replacement**.
4. Remove the supercharger belt tensioner. Refer to **Drive Belt Tensioner Replacement - Supercharger**.
5. Remove the supercharger idler pulley. Refer to **Supercharger Belt Idler Pulley Replacement**.
6. Remove the two coolant hoses from the water outlet housing. Refer to **Radiator Surge Tank Inlet Hose/Pipe Replacement**.
7. Remove the radiator hose from the water outlet housing. Refer to **Radiator Inlet Hose Replacement**.

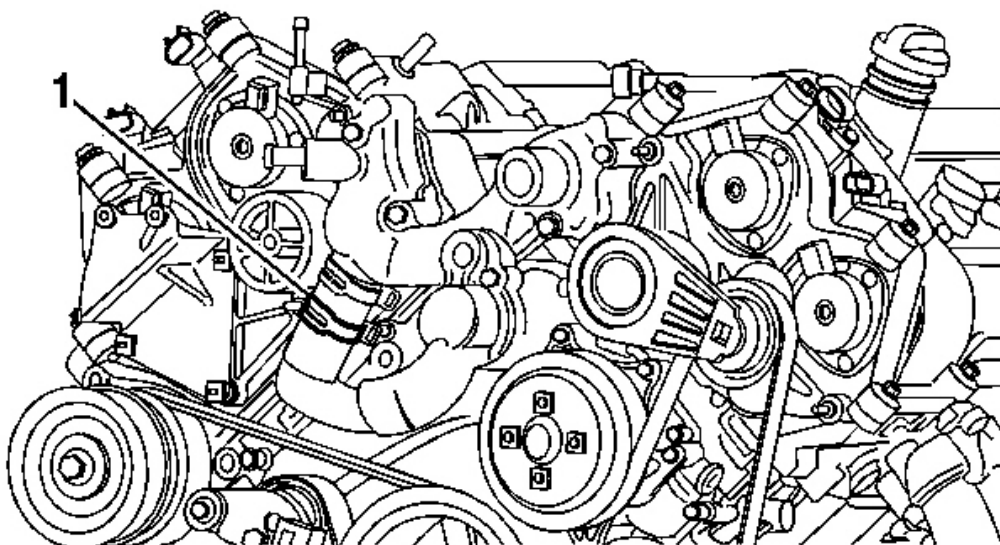


Fig. 163: Bypass Hose

Courtesy of GENERAL MOTORS CORP.

8. Reposition the lower clamp on the bypass hose (1) as shown.

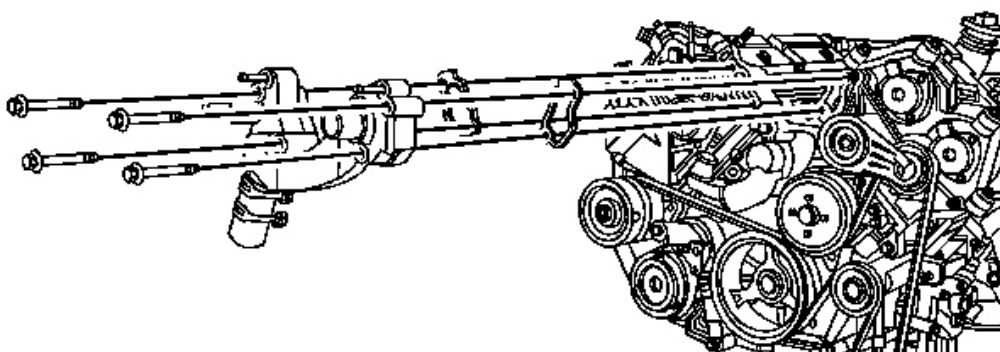


Fig. 164: Water Outlet Housing

Courtesy of GENERAL MOTORS CORP.

9. Remove the bolts securing the water outlet housing to the cylinder heads.
10. Remove the water outlet housing along with the bypass hose from the engine.
11. Discard the water outlet housing gaskets.
12. Disassemble the water outlet housing if necessary. Refer to **Water Outlet Housing Disassemble**
13. Clean and inspect the water outlet housing. Refer to **Water Outlet Housing Cleaning and Inspection** .

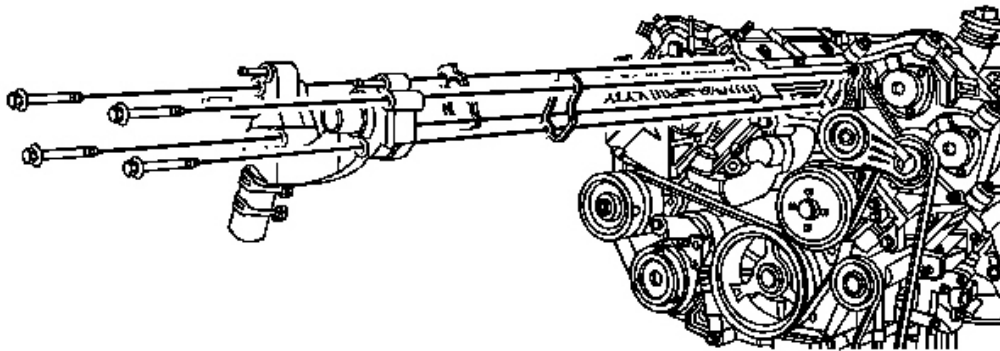
Installation Procedure

Fig. 165: Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **Fastener Notice** .

1. Assemble the water outlet housing if necessary. Refer to **Water Outlet Housing Assemble** .
2. Install NEW water outlet housing gaskets.
3. Install the water outlet housing with bypass hose to the vehicle.
4. Install the water outlet housing bolts.

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

5. Install the bypass hose clamp in the proper position.
6. Install the radiator hose to the water outlet housing. Refer to **Radiator Inlet Hose Replacement**.
7. Install the two coolant hoses to the water outlet housing. Refer to **Radiator Surge Tank Inlet Hose/Pipe Replacement**.

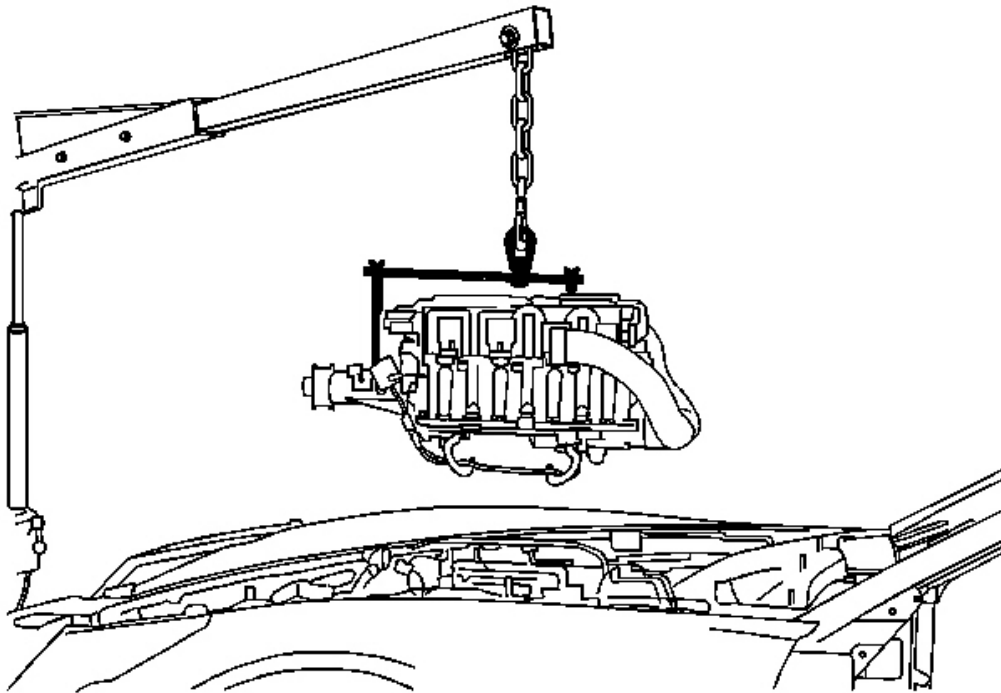


Fig. 166: Supercharger Assembly
Courtesy of GENERAL MOTORS CORP.

8. Install the supercharger idler pulley. Refer to **Supercharger Belt Idler Pulley Replacement** .
9. Install the supercharger belt tensioner. Refer to **Drive Belt Tensioner Replacement - Supercharger** .
10. Install the supercharger assembly. Refer to **Supercharger Replacement** .
11. Fill the charge air cooling system with coolant. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.
12. Fill the engine cooling system with coolant. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
13. Check the engine cooling system for leaks.
14. Check the charge air cooling system for leaks.

COOLANT BYPASS HOSE REPLACEMENT (LH2)

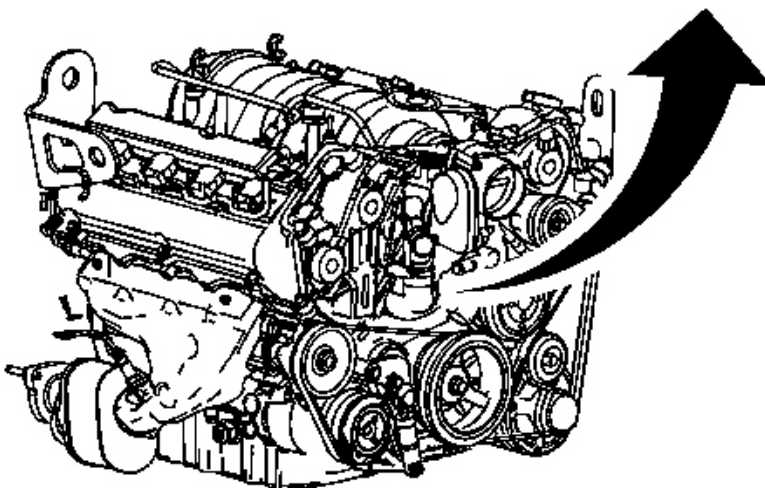
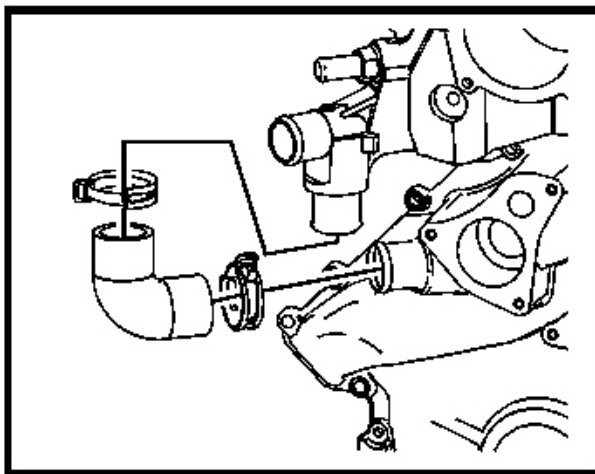
Removal Procedure

Tools Required

J 38185 Hose Clamp Pliers

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. Drain the cooling system. Refer to Cooling System Draining and Filling (Static Fill) or Cooling System Draining and Filling (GE 47716).
2. Remove the surge tank outlet hose assembly. Refer to Radiator Surge Tank Outlet Hose/Pipe Replacement.



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Fig. 167: View Of Upper & Lower Coolant Bypass Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

3. Disengage tension on the upper coolant bypass hose clamp using the **J 38185** .
4. Disengage tension on the lower coolant bypass hose clamp using the **J 38185** .
5. Remove the coolant bypass hose from the vehicle.

Installation Procedure

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

1. Install the coolant bypass hose to the vehicle.

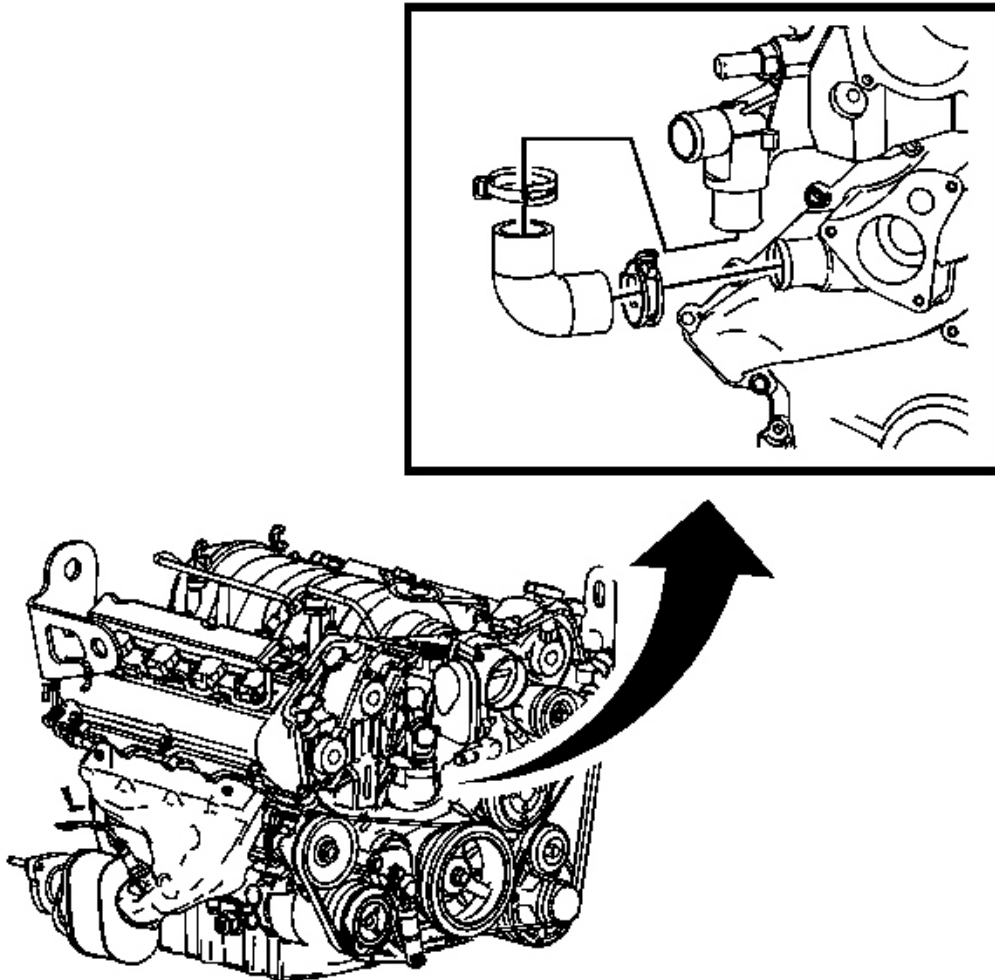


Fig. 168: View Of Upper & Lower Coolant Bypass Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

2. Position and engage tension on the lower coolant bypass hose clamp using the **J 38185** .
3. Position and engage tension on the upper coolant bypass hose clamp using the **J 38185** .
4. Install the surge tank outlet hose assembly. Refer to **Radiator Surge Tank Outlet Hose/Pipe Replacement**.
5. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

Removal Procedure

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

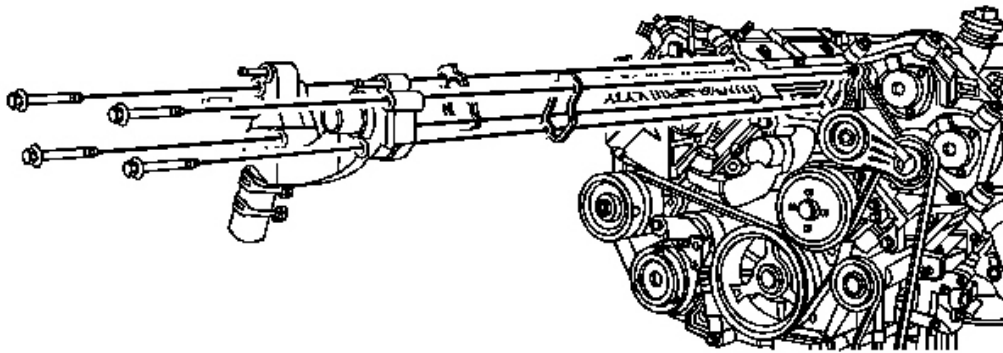


Fig. 169: Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

2. Remove the water outlet housing. Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LC3)**.

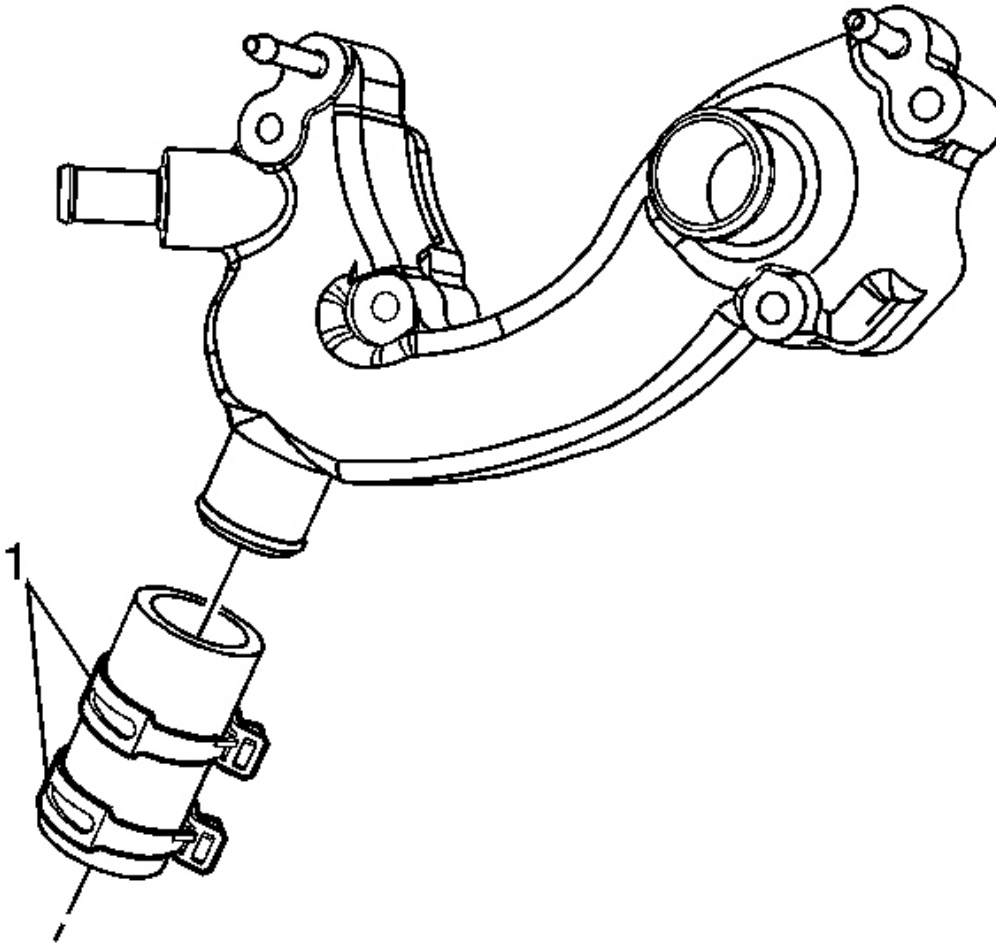


Fig. 170: Bypass Hose
Courtesy of GENERAL MOTORS CORP.

3. Compress the clamps (1) as shown, and remove the bypass hose from the water outlet housing.

Installation Procedure

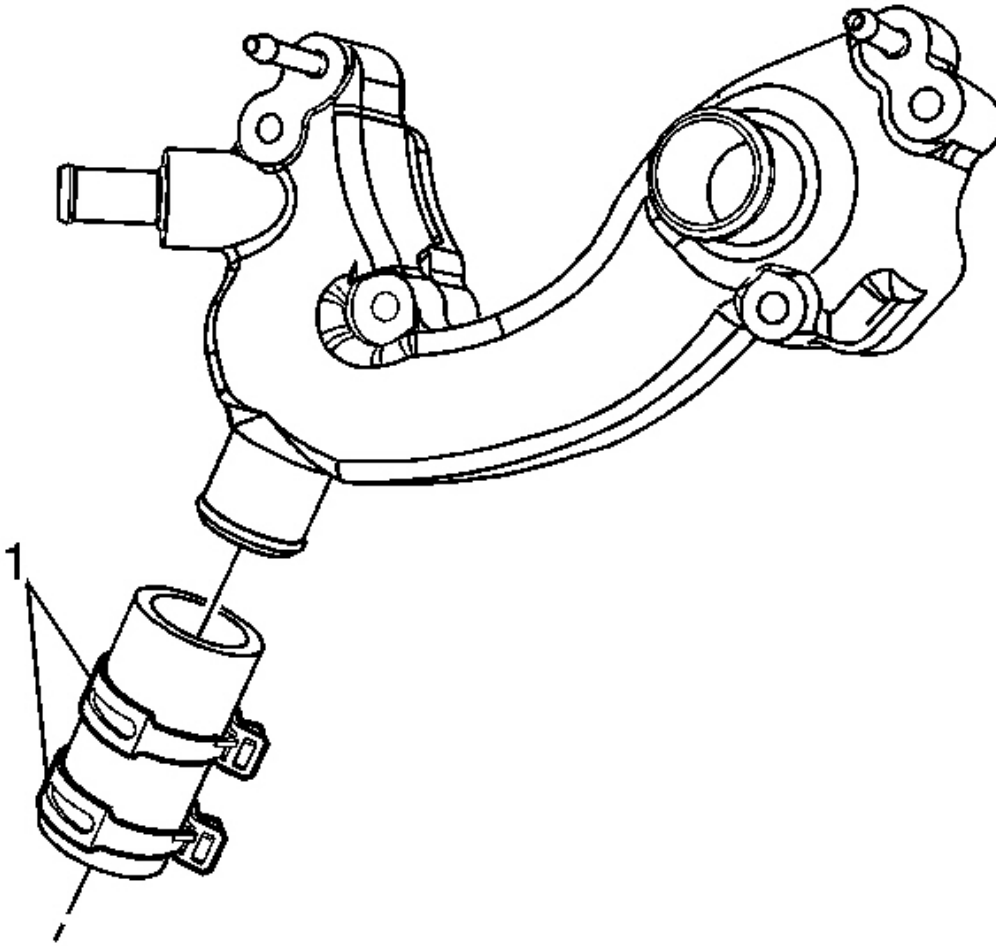


Fig. 171: Bypass Hose

Courtesy of GENERAL MOTORS CORP.

1. Install the bypass hose and clamps (1) to the water outlet housing.

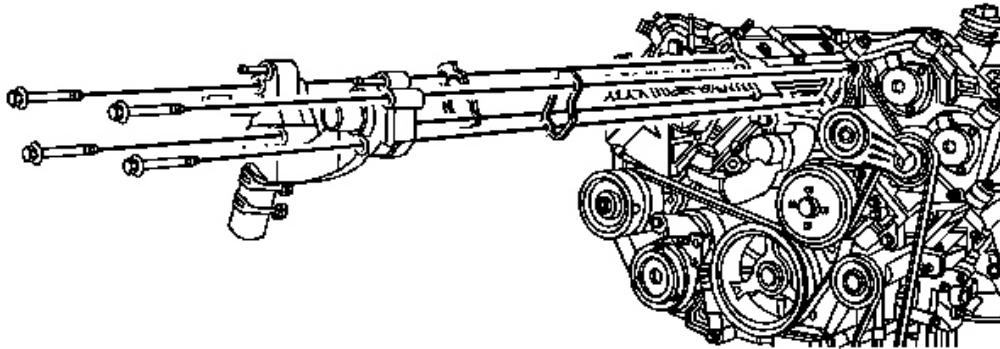


Fig. 172: Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

2. Install the water outlet housing. Refer to **Water Outlet Housing Replacement (LH2)** or **Water Outlet Housing Replacement (LC3)**.
3. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
4. Check the cooling system for leaks.

WATER PUMP REPLACEMENT (LH2)

Removal Procedure

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
2. Remove the drive belt. Refer to **Drive Belt Replacement** .
3. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .
4. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
5. Remove the water pump bolts.

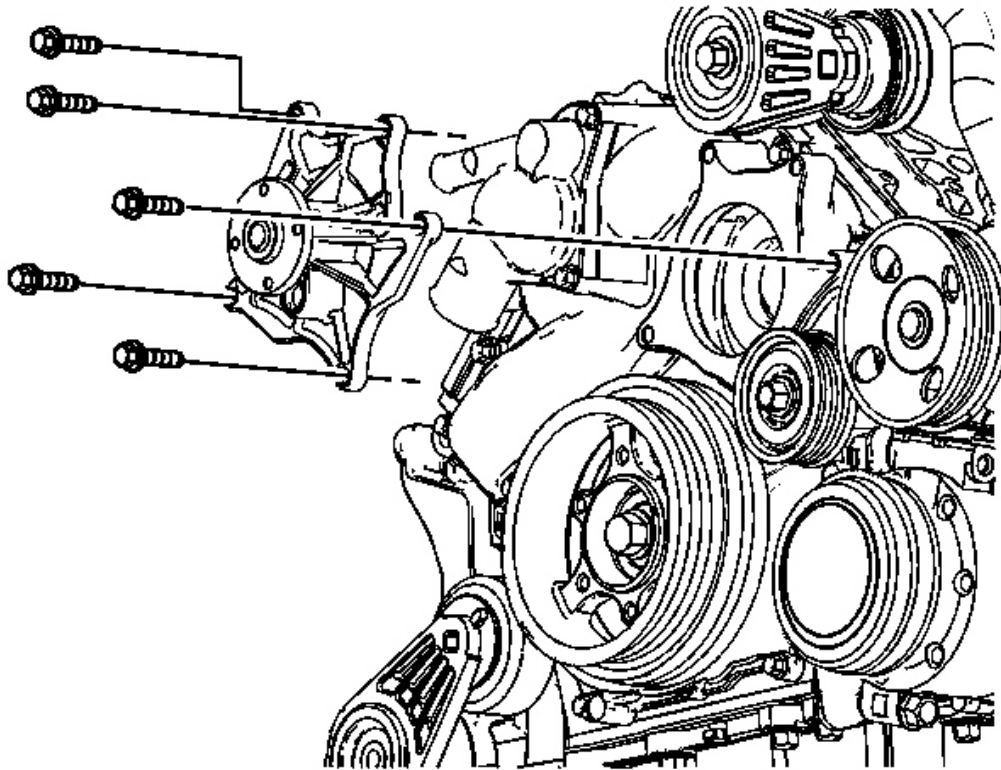


Fig. 173: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

6. Remove the water pump pulley from the water pump.
7. Remove the water pump from the engine front cover.
8. Remove the water pump gasket and discard.
9. Clean and inspect the water pump. Refer to **Water Pump Cleaning and Inspection** .

Installation Procedure

1. Install the water pump pulley to the water pump.

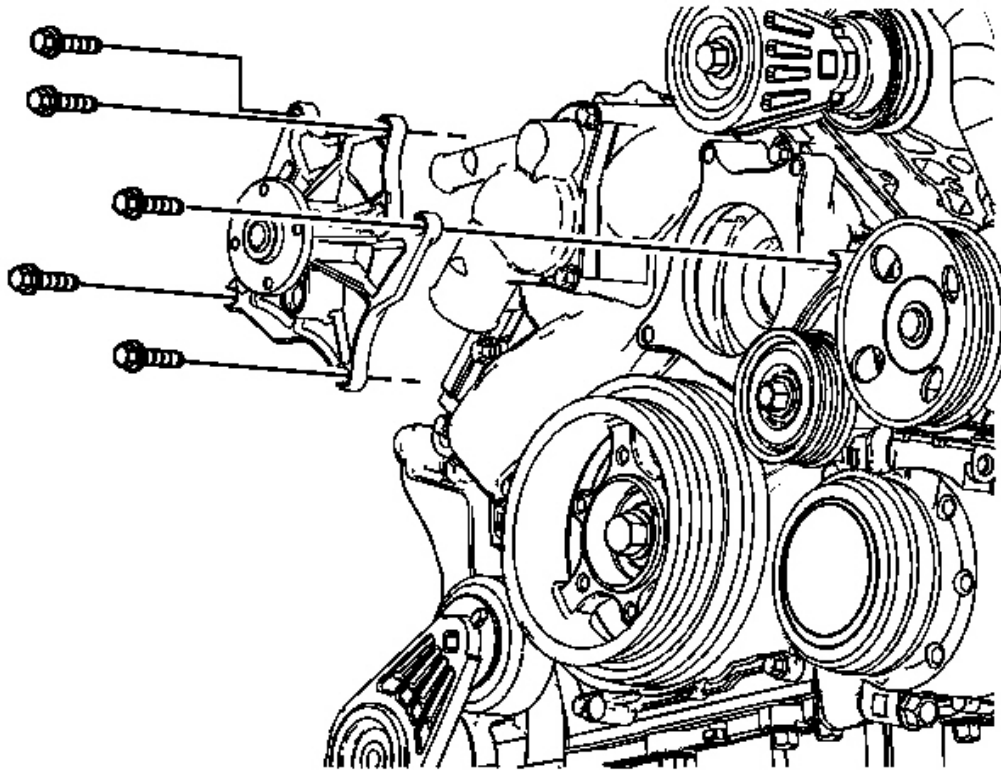


Fig. 174: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

2. Install the water pump and gaskets to the engine front cover.

NOTE: Refer to Fastener Notice .

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

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

4. Install the water pump bolts.

Tighten:

1. Tighten the water pump bolts a first pass to 15 N.m (11 lb ft).
2. Tighten the water pump bolts a final pass to 30 N.m (22 lb ft).

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5. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .
6. Install the drive belt. Refer to **Drive Belt Replacement** .
7. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .

WATER PUMP REPLACEMENT (LC3)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
3. Remove the water pump drive belt. Refer to **Water Pump and Generator Belt Replacement** .
4. Remove the water pump and generator drive belt tensioner. Refer to **Water Pump and Generator Drive Belt Tensioner Replacement** .

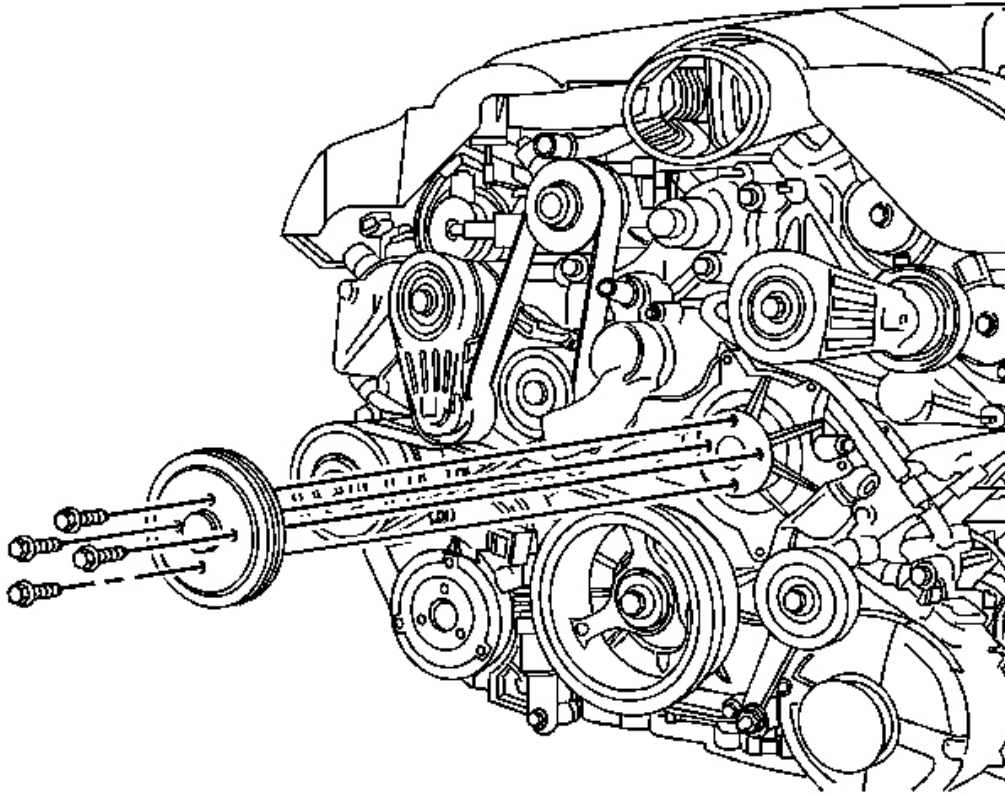


Fig. 175: Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

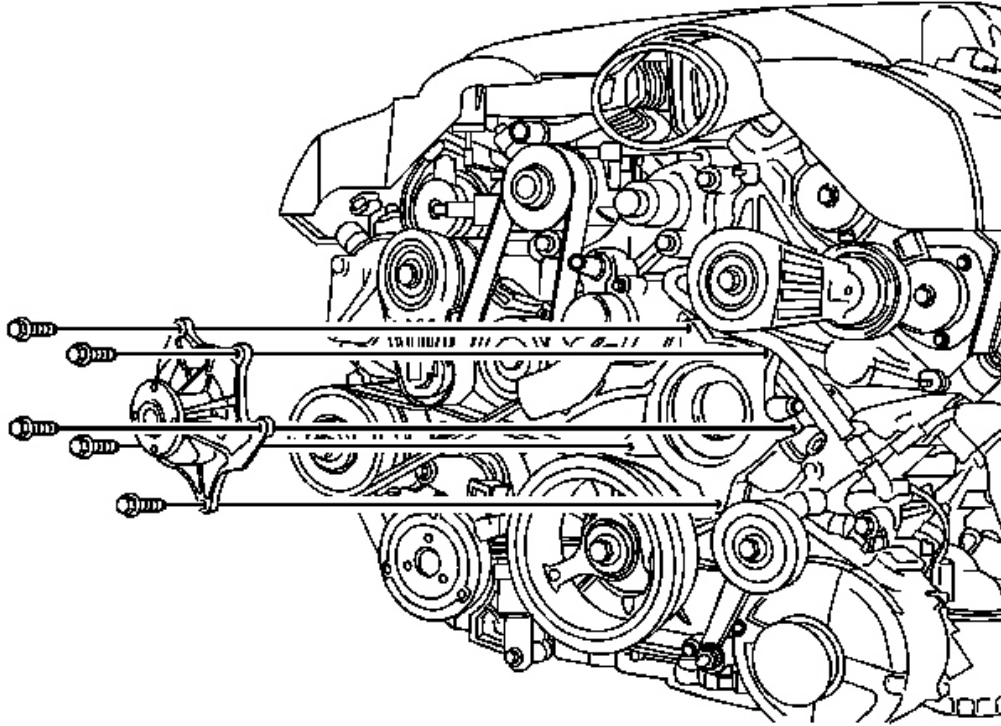


Fig. 176: Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the water pump bolts.

IMPORTANT: Use a drain pan to collect escaping coolant.

8. Remove the water pump and seal.

Do not reuse the seal.

9. Clean the water pump mating surfaces.
10. Clean and inspect the water pump. Refer to Water Pump Cleaning and Inspection .

Installation Procedure

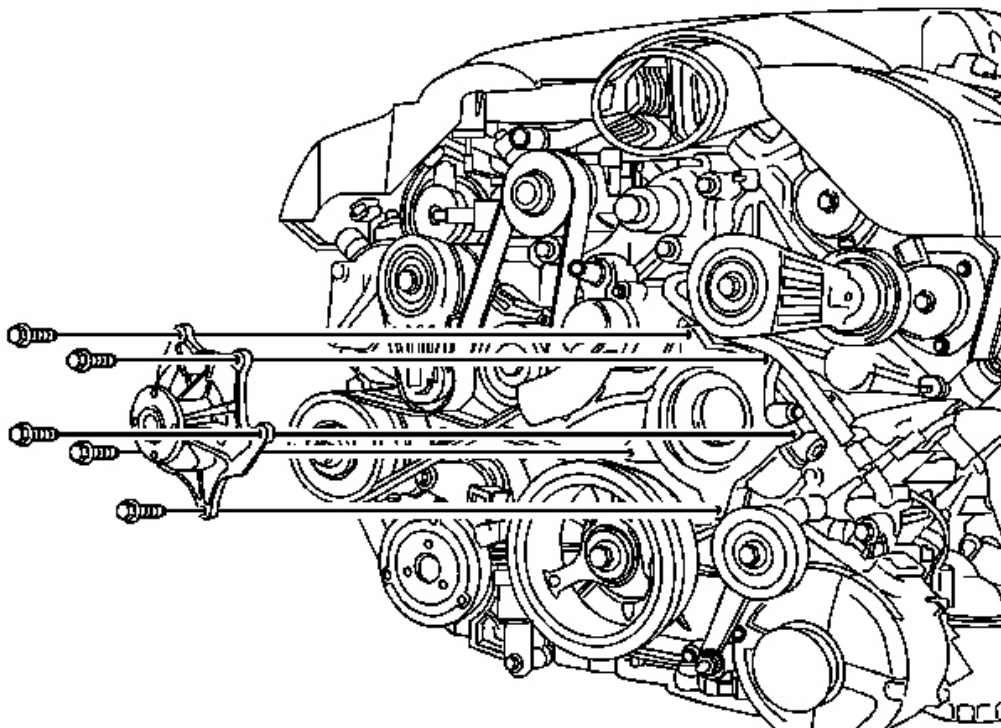


Fig. 177: Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

2. Install the water pump bolts.

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

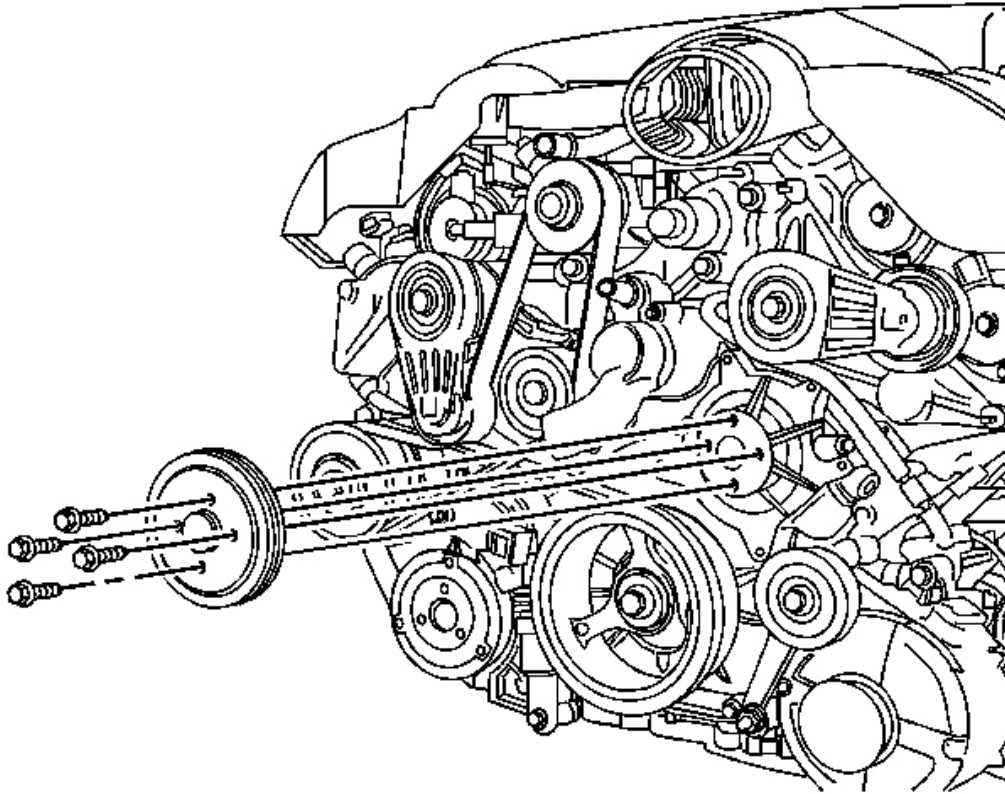


Fig. 178: Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

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

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

5. Install the water pump and generator drive belt tensioner. Refer to **Water Pump and Generator Drive Belt Tensioner Replacement** .
6. Install the water pump drive belt. Refer to **Water Pump and Generator Belt Replacement** .
7. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.

Tools Required

GE-47622 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

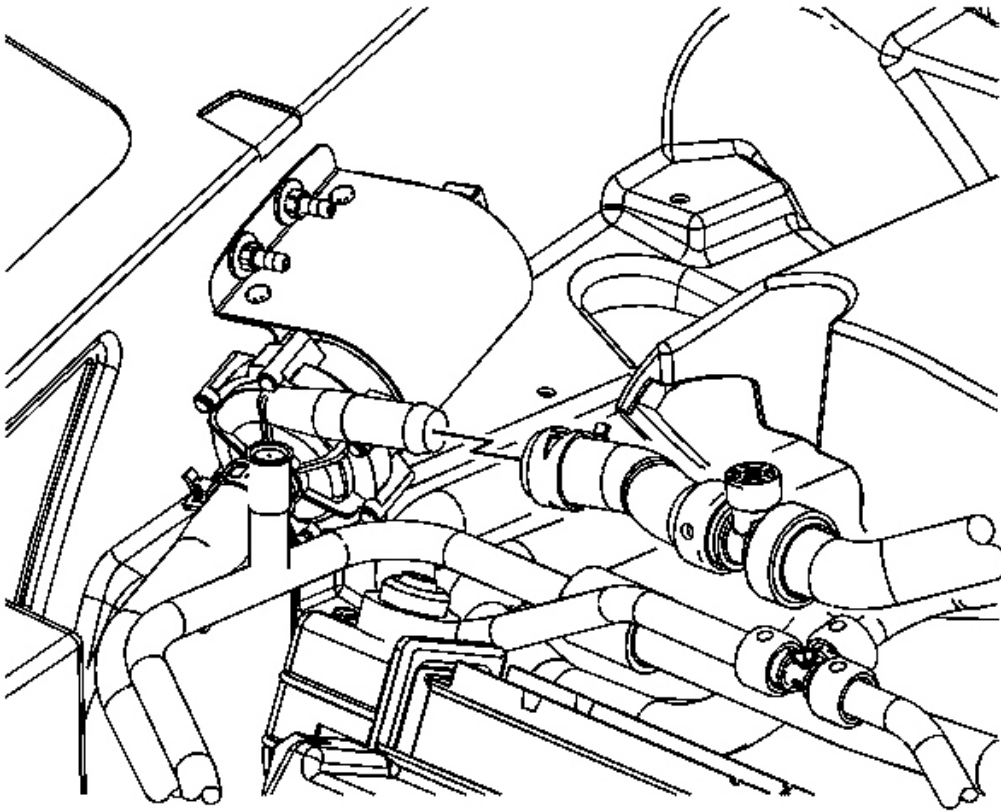


Fig. 179: Charge Air Cooler Coolant Pump Outlet Hose
Courtesy of GENERAL MOTORS CORP.

2. Using the **GE-47622** , reposition the charge air cooler coolant pump outlet hose from the charge air coolant pump. See **Special Tools**.
3. Remove the charge air cooler coolant pump outlet hose from the charge air coolant pump.

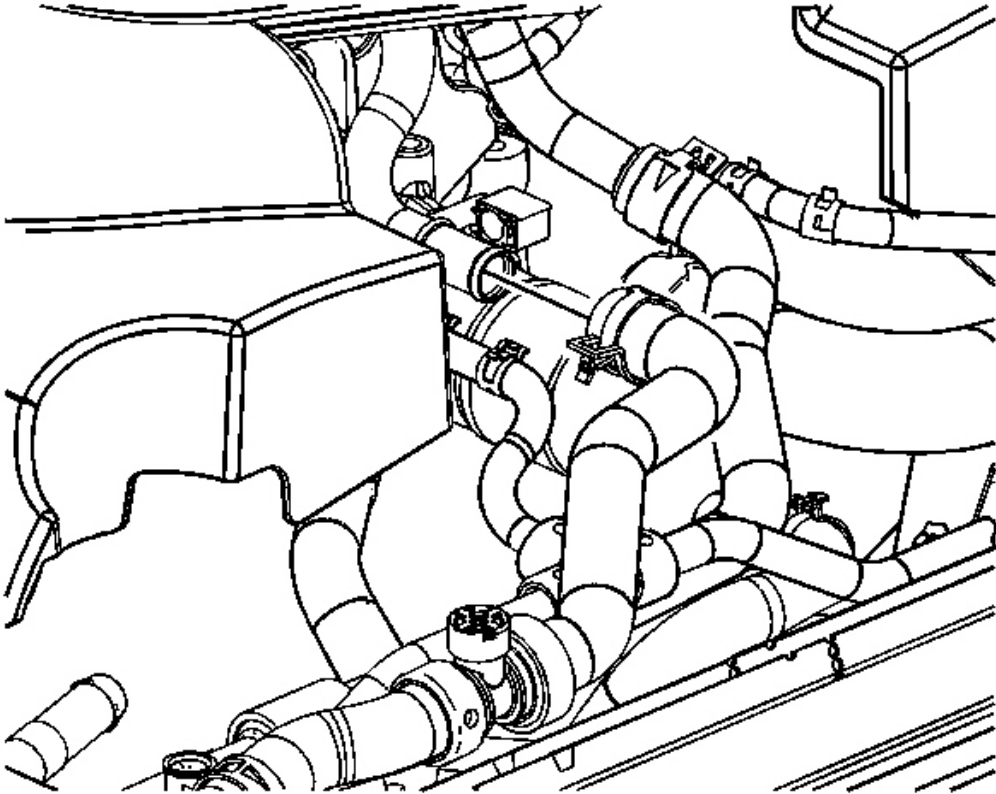


Fig. 180: Charge Air Cooler Coolant Pump Hose
Courtesy of GENERAL MOTORS CORP.

4. Using the **GE-47622** , reposition the charge air cooler coolant pump outlet hose from the charge air cooler. See **Special Tools**.

IMPORTANT: Note the routing of the charge air cooler coolant pump outlet hose to ensure proper installation.

5. Remove the charge air cooler coolant pump outlet hose from the charge air cooler.
6. Remove the charge air cooler coolant pump outlet hose from the vehicle.

Installation Procedure

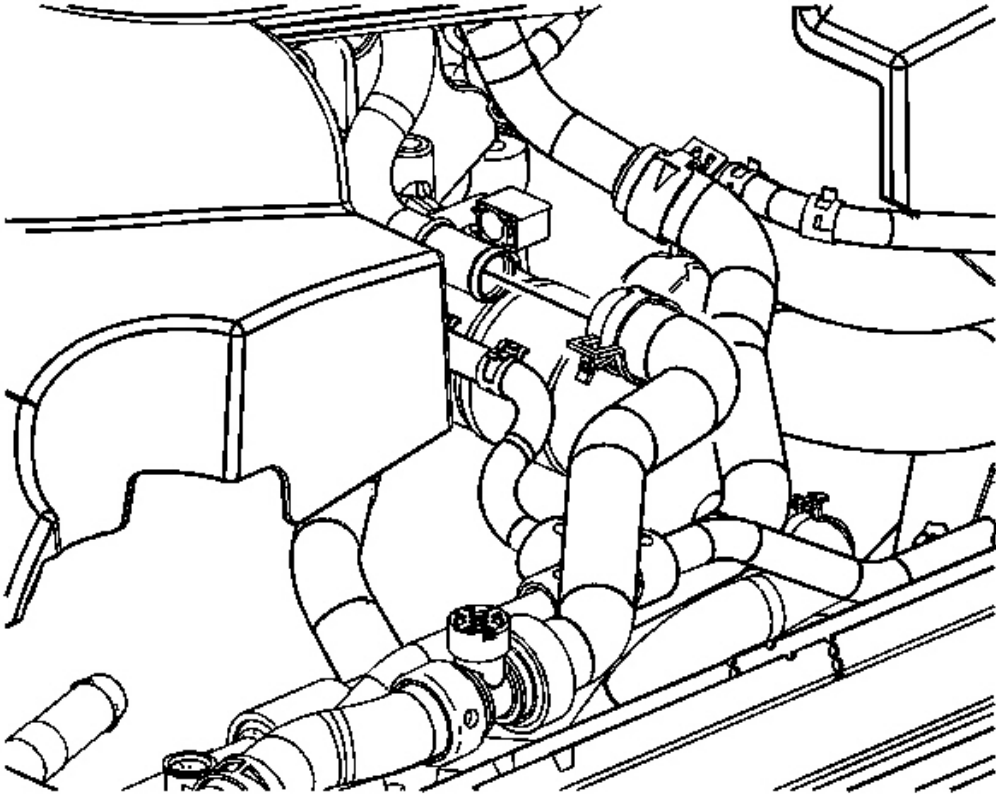


Fig. 181: Charge Air Cooler Coolant Pump Hose
Courtesy of GENERAL MOTORS CORP.

1. Install the charge air cooler coolant pump outlet hose to the vehicle.
2. Install the charge air cooler coolant pump outlet hose to the charge air cooler.
3. Using the **GE-47622** , reposition the charge air cooler coolant pump outlet hose clamp at the charge air cooler. See **Special Tools**.

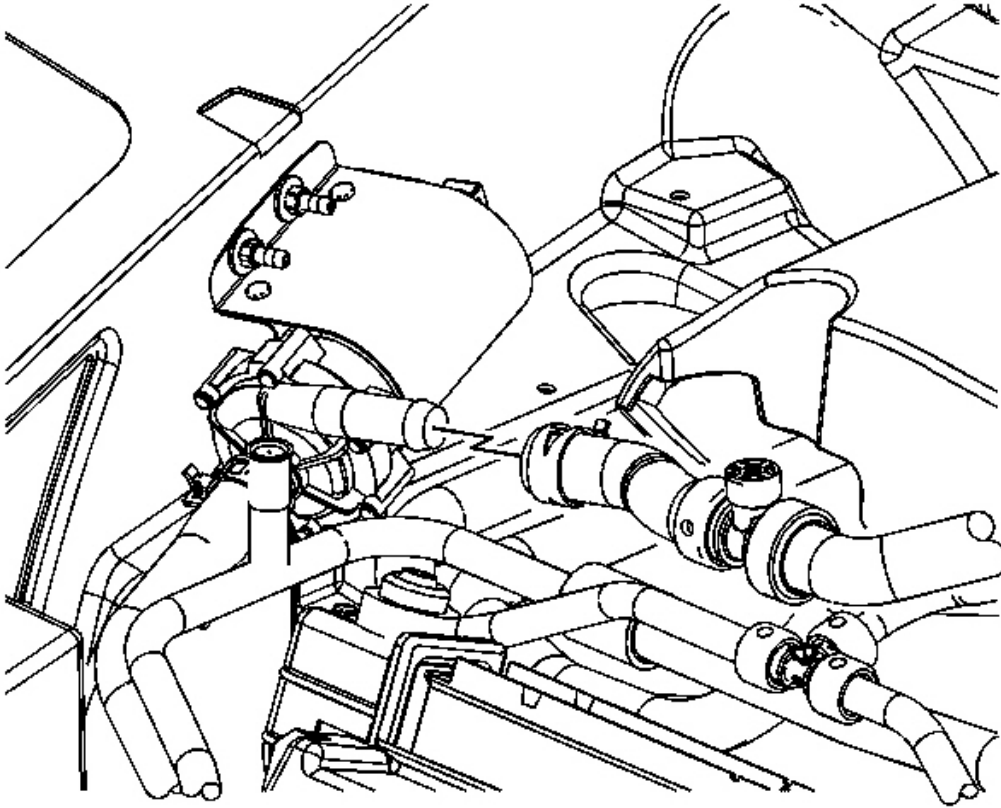


Fig. 182: Charge Air Cooler Coolant Pump Outlet Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the charge air cooler coolant pump outlet hose to the charge air coolant pump.
5. Using the **GE-47622** , reposition the charge air cooler coolant pump outlet hose at the charge air coolant pump. See **Special Tools**.
6. Fill the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

CHARGE AIR COOLER COOLANT PUMP REPLACEMENT

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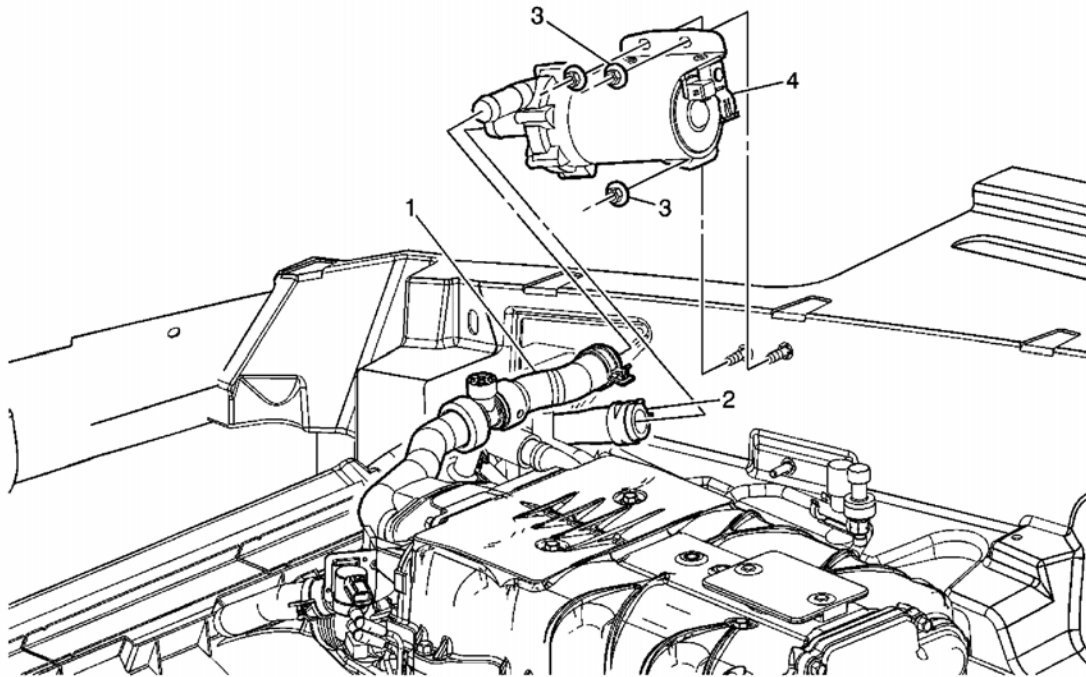


Fig. 183: Charge Air Cooler Coolant Pump
Courtesy of GENERAL MOTORS CORP.

Charge Air Cooler Coolant Pump Replacement

| Callout | Component Name |
|--|--|
| NOTE: Refer to <u>Fastener Notice</u> . | |
| Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> . | |
| Preliminary Procedure | |
| <ol style="list-style-type: none">1. Disconnect the charge air cooler coolant pump electrical connector.2. Drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (Static Fill) or Charge Air Cooling System Draining and Filling (GE 47716). | |
| 1 | Charge Air Cooler Coolant Hose Assembly, (Pump to Cooler) <ol style="list-style-type: none">1. Using J 38185 position the air cooler coolant hose to pump hose clamp.2. Remove the air charge coolant hose from the charge air cooler coolant pump. |
| 2 | Charge Air Cooler Coolant Hose Assembly, (Pump to Radiator) <ol style="list-style-type: none">1. Using J 38185 position the air cooler coolant hose to pump hose clamp.2. Remove the air charge coolant hose from the charge air cooler coolant pump. |
| | Charge Air Cooler Coolant Pump Assembly Nut (Qty: 3) |

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| 3 | Tighten: 8 N.m (71 lb in) |
| 4 | Charge Air Cooler Coolant Pump Assembly |

RADIATOR REPLACEMENT

Tools Required

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

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 **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
3. Remove the condenser. Refer to **Condenser Replacement** in Heating, Ventilation and Air Conditioning.
4. Disengage tension on the radiator inlet hose clamp at the radiator using**J 38185** .
5. Disconnect the radiator inlet hose from the radiator.
6. Disengage tension on the radiator inlet hose clamp at the engine using**J 38185** .

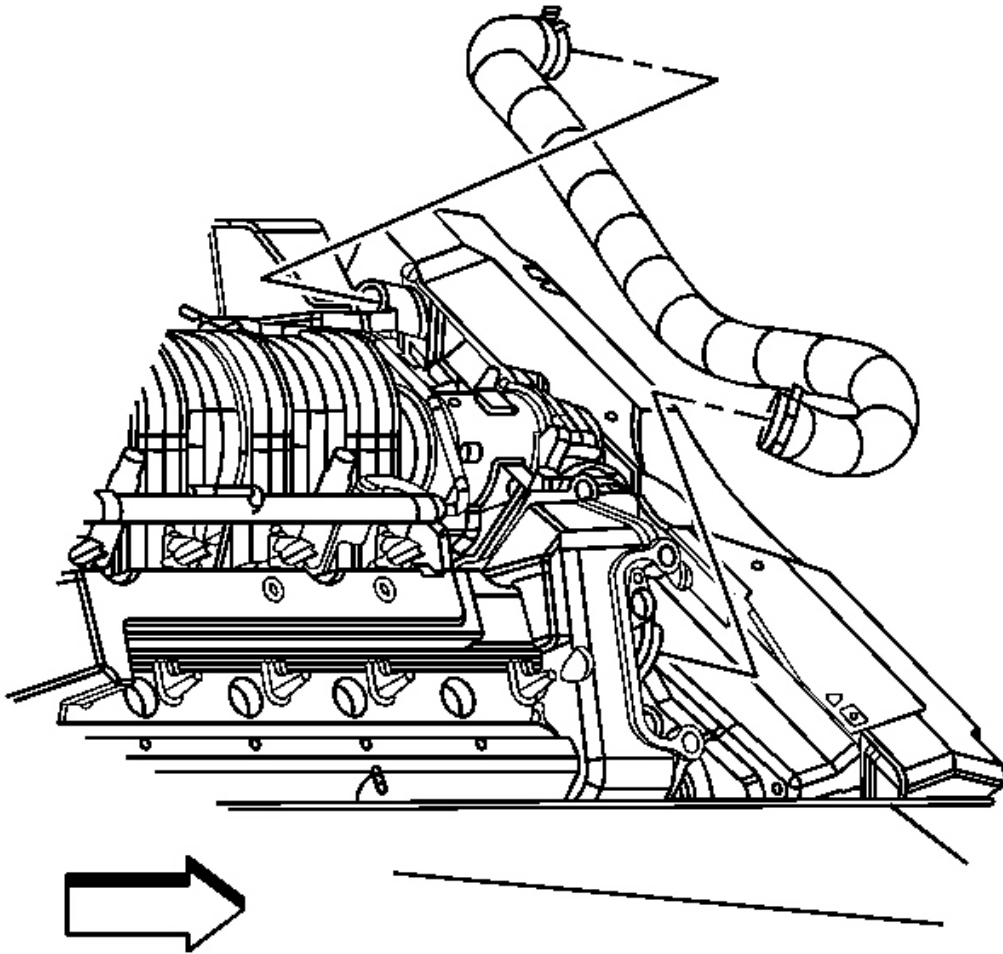


Fig. 184: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the radiator inlet hose from the engine.
8. Remove the radiator inlet hose.

IMPORTANT: Lift up on the cooling fan and shroud assembly to disengage the tabs from the radiator slots.

9. Disconnect the cooling fan and shroud assembly from the radiator.

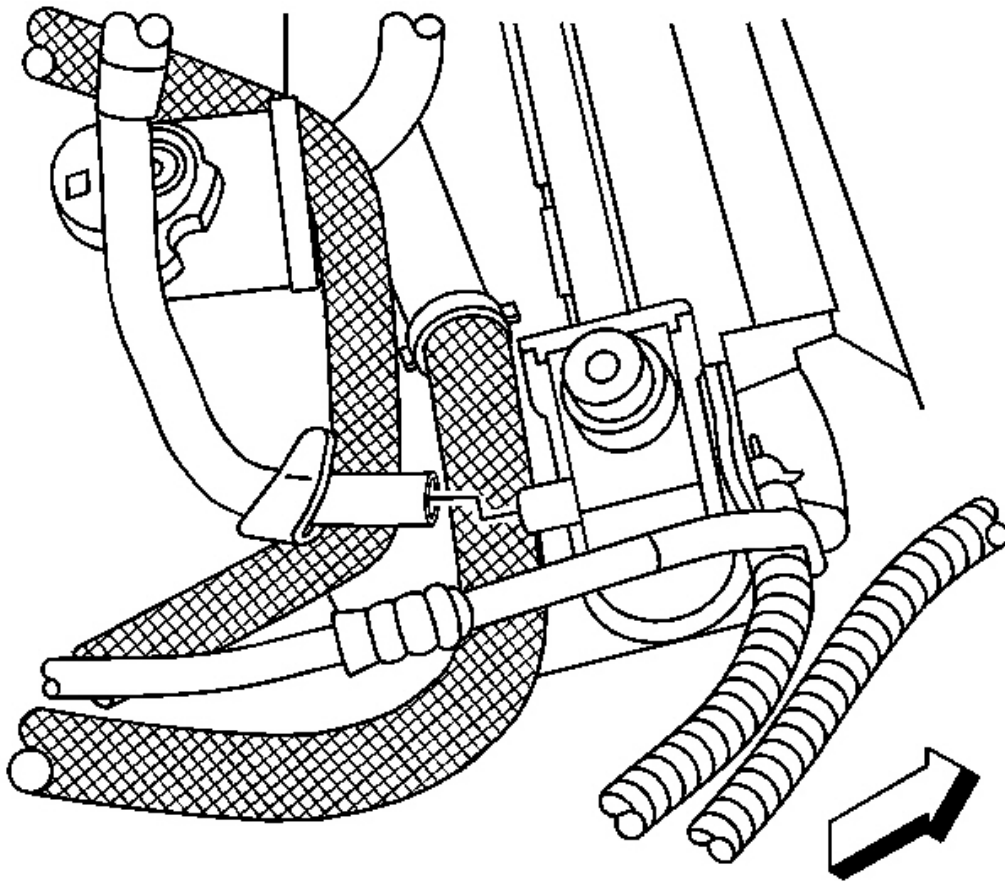


Fig. 185: Repositioning Surge Tank Inlet Hose Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

10. Disengage tension and reposition the surge tank inlet hose clamp at the radiator using **J 38185** .
11. Disconnect the surge tank inlet hose from the radiator.
12. Disconnect the upper transmission oil cooler line from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-E.
13. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

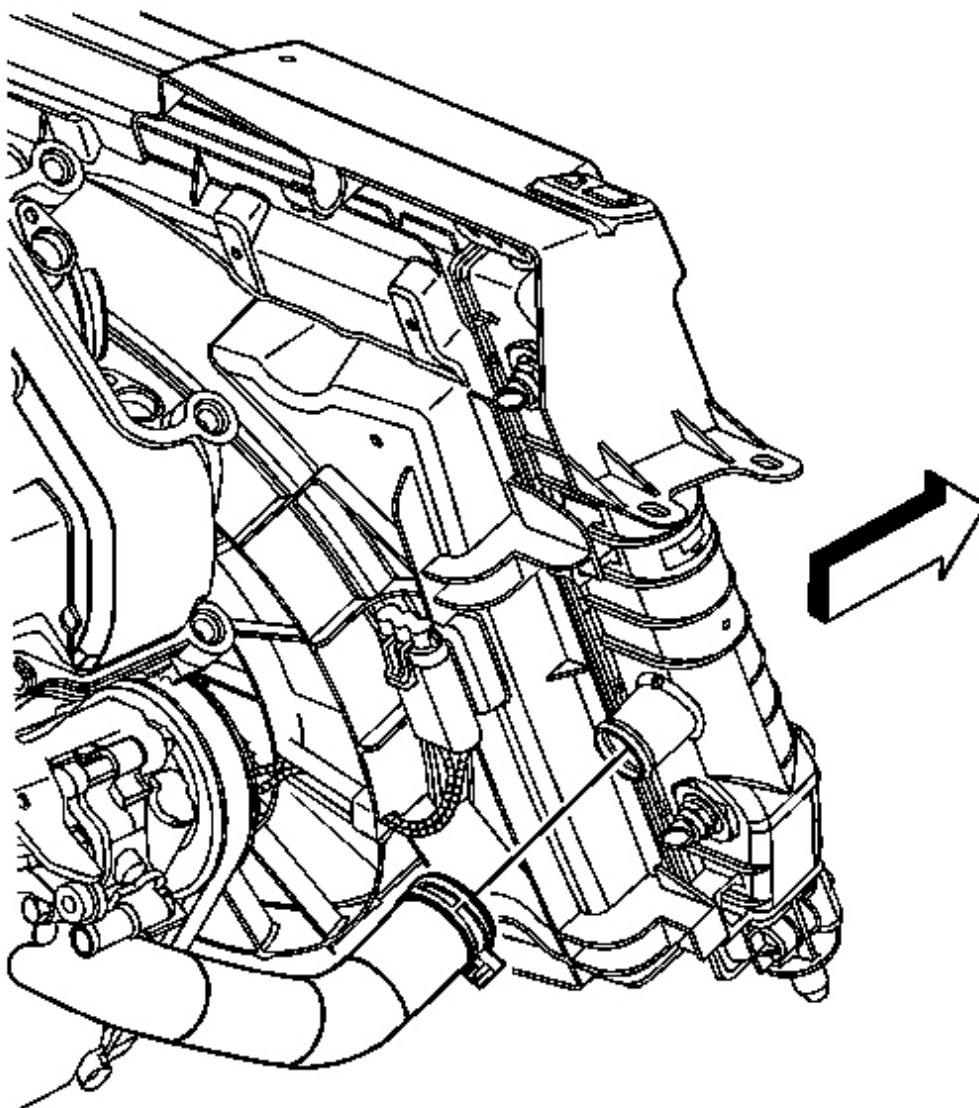


Fig. 186: Disconnecting/Connecting Radiator Outlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

14. Disengage tension on the radiator outlet hose clamp at the radiator using the **J 38185** .
15. Disconnect the radiator outlet hose from the radiator.
16. Disconnect the lower transmission oil cooler line from the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-

E.

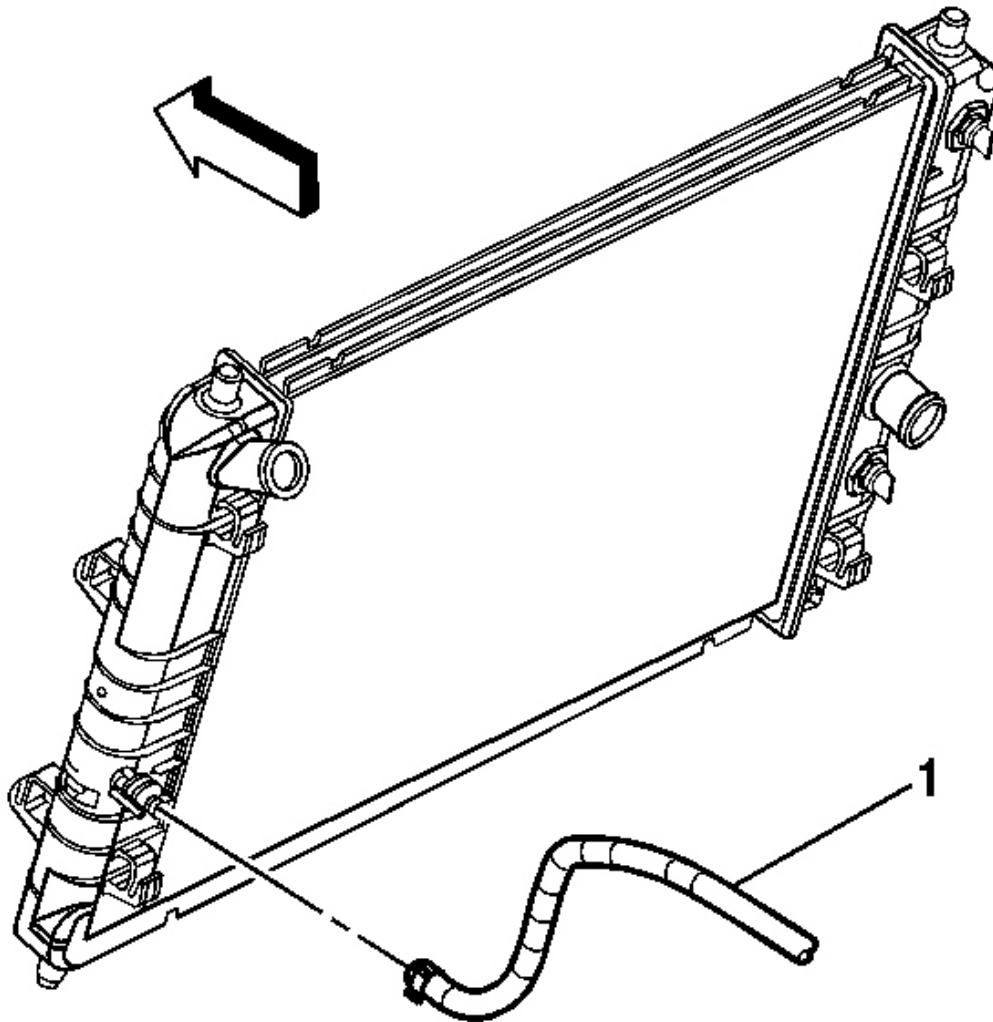


Fig. 187: Disconnecting/Connecting Generator Cooling Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

17. Disengage the generator cooling hose clamp at the radiator.
18. Disconnect the generator cooling hose (1) from the radiator.
19. Lower the vehicle.
20. Remove the radiator from the vehicle.

Installation Procedure

1. Install the radiator to the vehicle.
2. Raise the vehicle.
3. Connect the generator cooling hose (1) to the radiator.

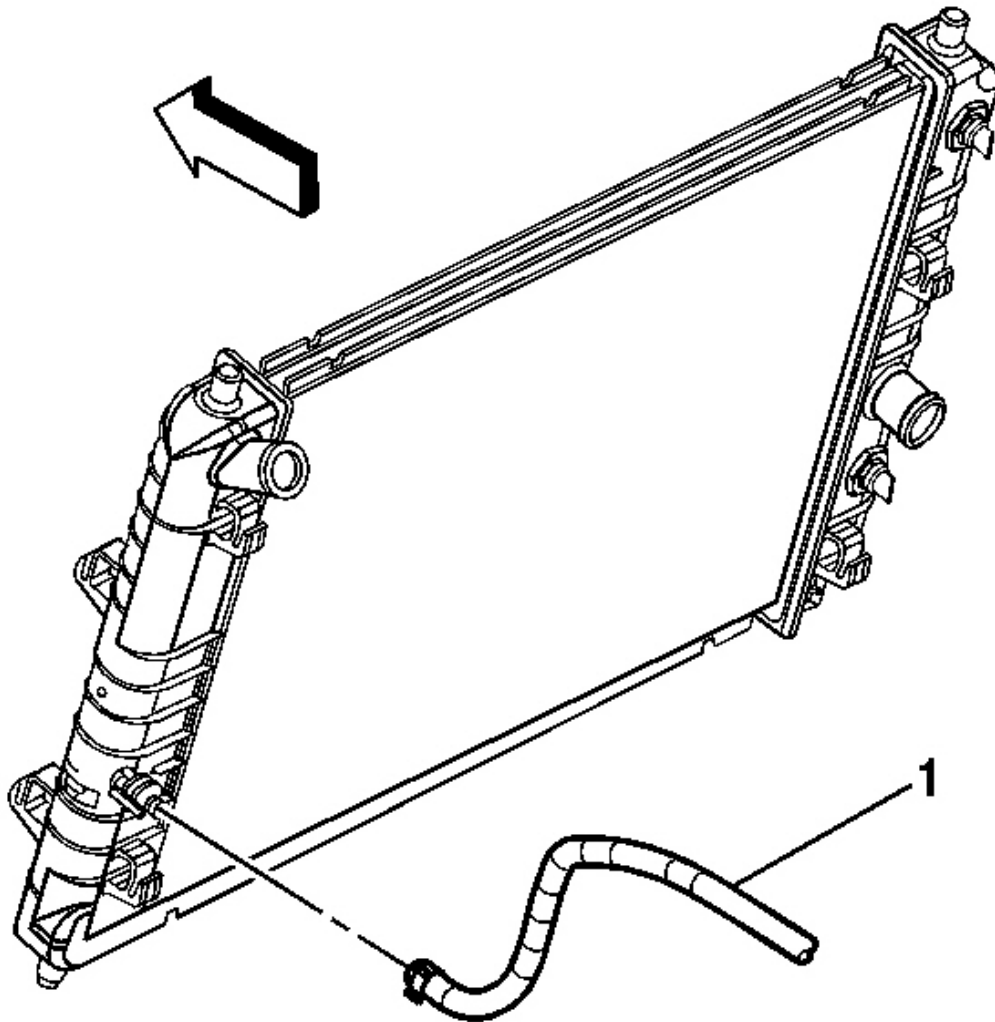


Fig. 188: Disconnecting/Connecting Generator Cooling Hose To Radiator
Courtesy of GENERAL MOTORS CORP.

4. Engage the generator cooling hose clamp at the radiator.

5. Connect the lower transmission oil cooler line to the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-E.
6. Connect the radiator outlet hose to the radiator.

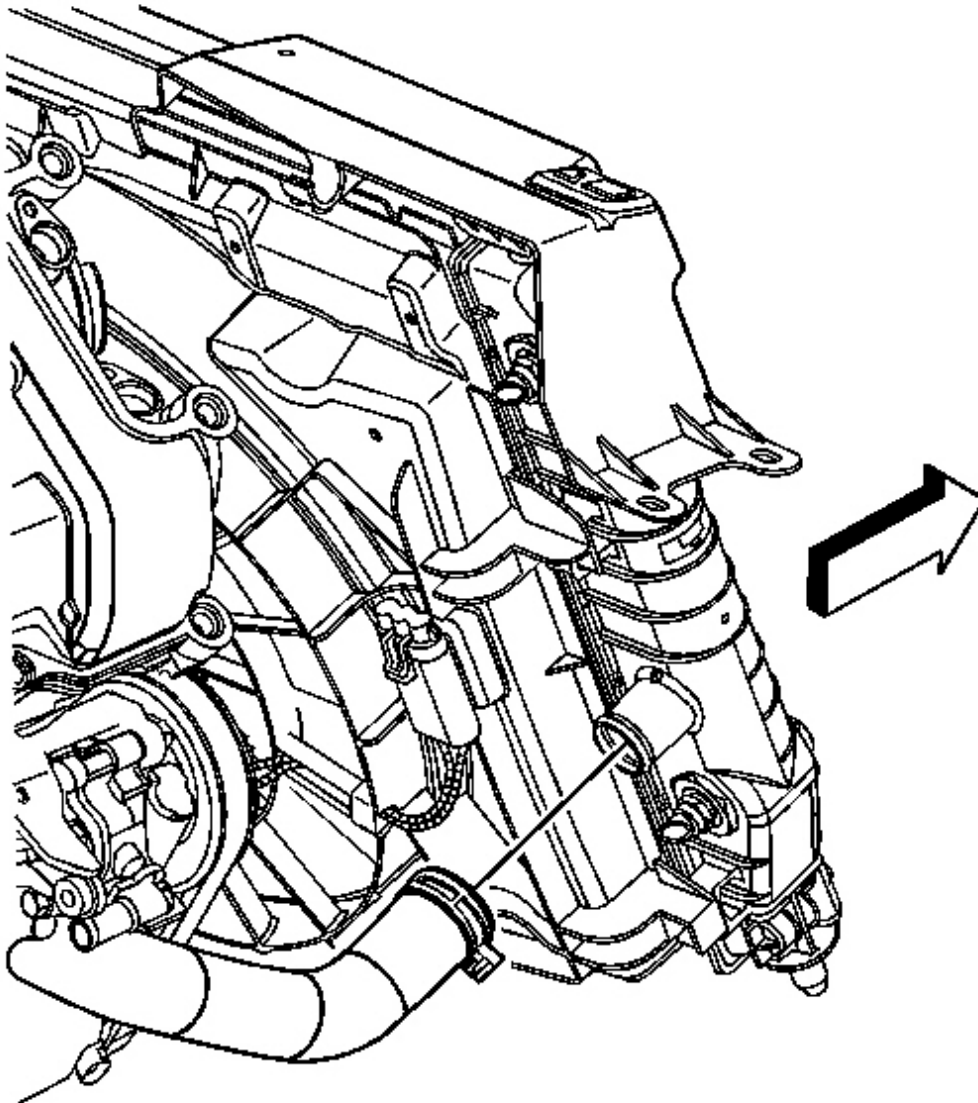


Fig. 189: Disconnecting/Connecting Radiator Outlet Hose From Radiator
Courtesy of GENERAL MOTORS CORP.

7. Engage tension on the radiator outlet hose clamp at the radiator.
8. Lower the vehicle.
9. Connect the upper transmission oil cooler line to the radiator. Refer to **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection** in Automatic Transmission - 5L50-E.
10. Connect the surge tank inlet hose to the radiator.

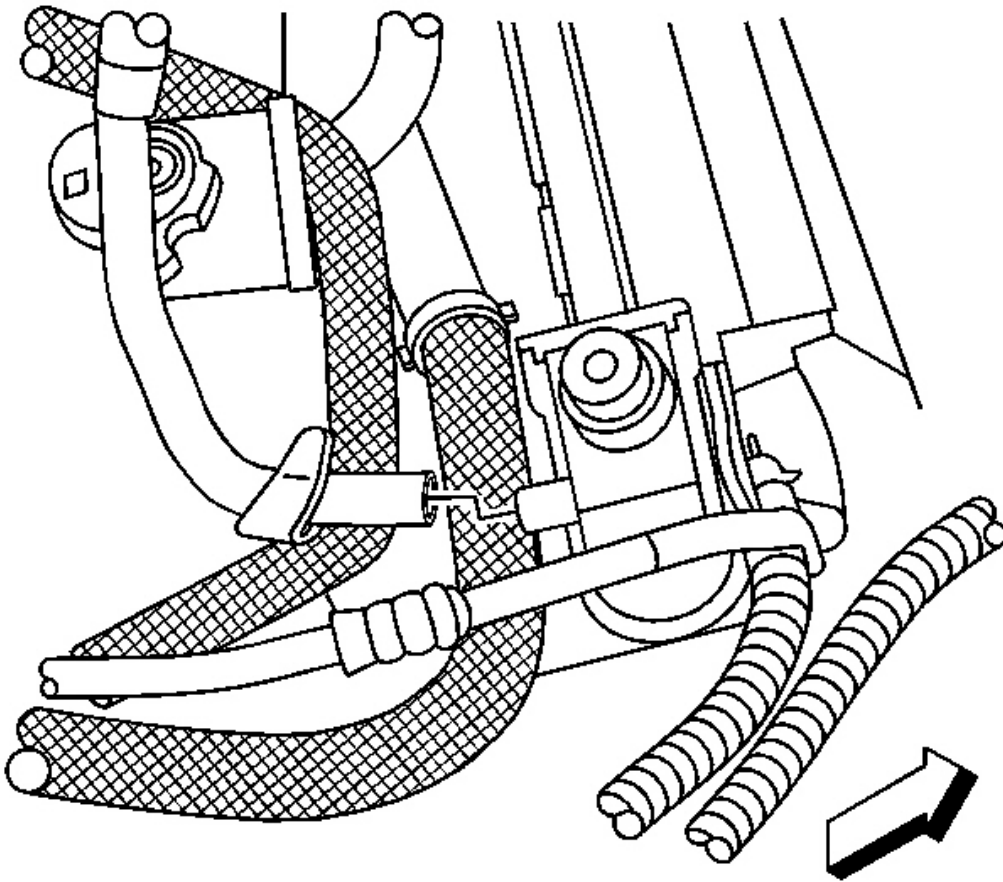


Fig. 190: Repositioning Surge Tank Inlet Hose Clamp At Radiator
Courtesy of GENERAL MOTORS CORP.

11. Engage tension on the surge tank inlet hose clamp at the radiator.

IMPORTANT: Lift up on the cooling fan and shroud assembly and engage the tabs to the radiator slots.

12. Connect the cooling fan and shroud assembly to the radiator.
13. Install the radiator inlet hose.

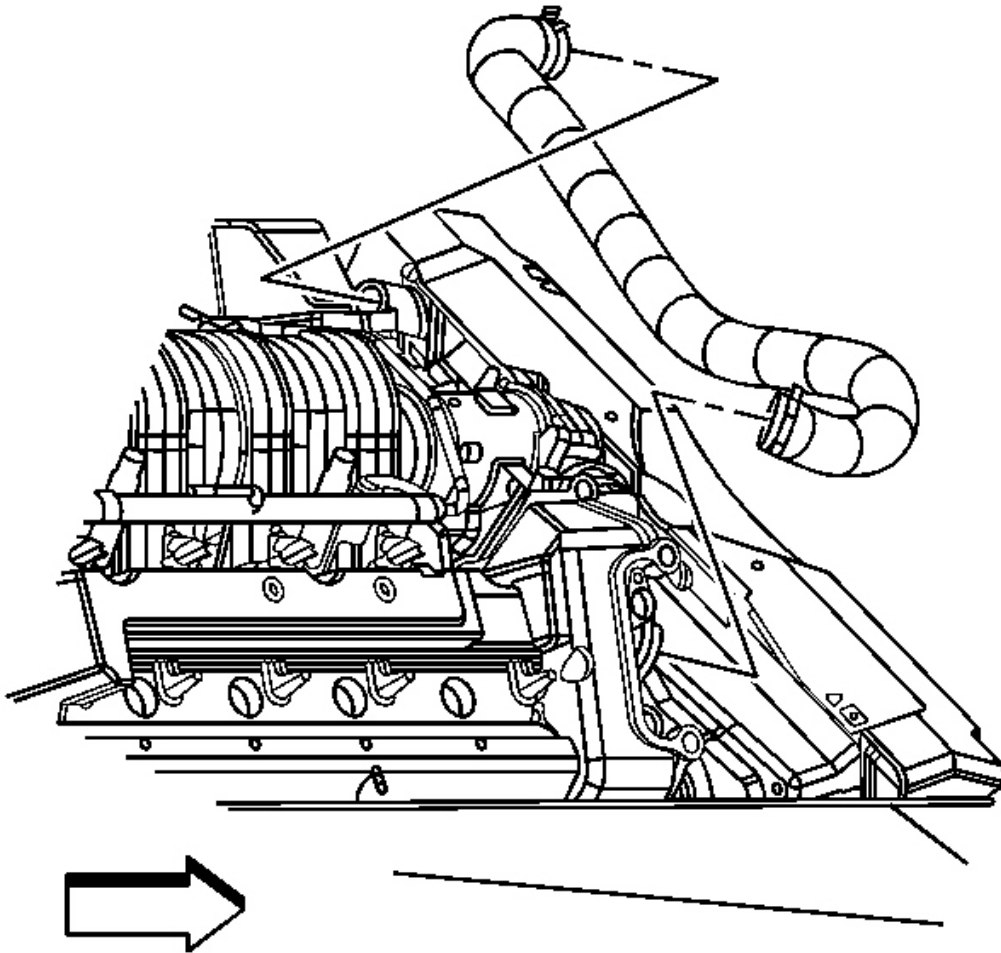


Fig. 191: Removing/Installing Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

14. Connect the radiator inlet hose to the engine.
15. Engage tension on the radiator inlet hose clamp at the engine using **J 38185**.
16. Connect the radiator inlet hose to the radiator.
17. Engage tension on the radiator inlet hose clamp at the radiator using **J 38185**.
18. Install the condenser. Refer to **Condenser Replacement** in Heating, Ventilation and Air Conditioning.

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19. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill)** or **Cooling System Draining and Filling (GE 47716)**.
20. Evacuate and recharge the A/C system. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
21. Leak test the fittings of the component using **J 39400-A** . See **Special Tools**.
22. Inspect the transmission fluid level. Refer to **Transmission Fluid Check** in Automatic Transmission - 5L50-E.

CHARGE AIR COOLER RADIATOR REPLACEMENT

Tools Required

GE-47622 Hose Clamp Pliers. See **Special Tools**.

Removal Procedure

1. Drain the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

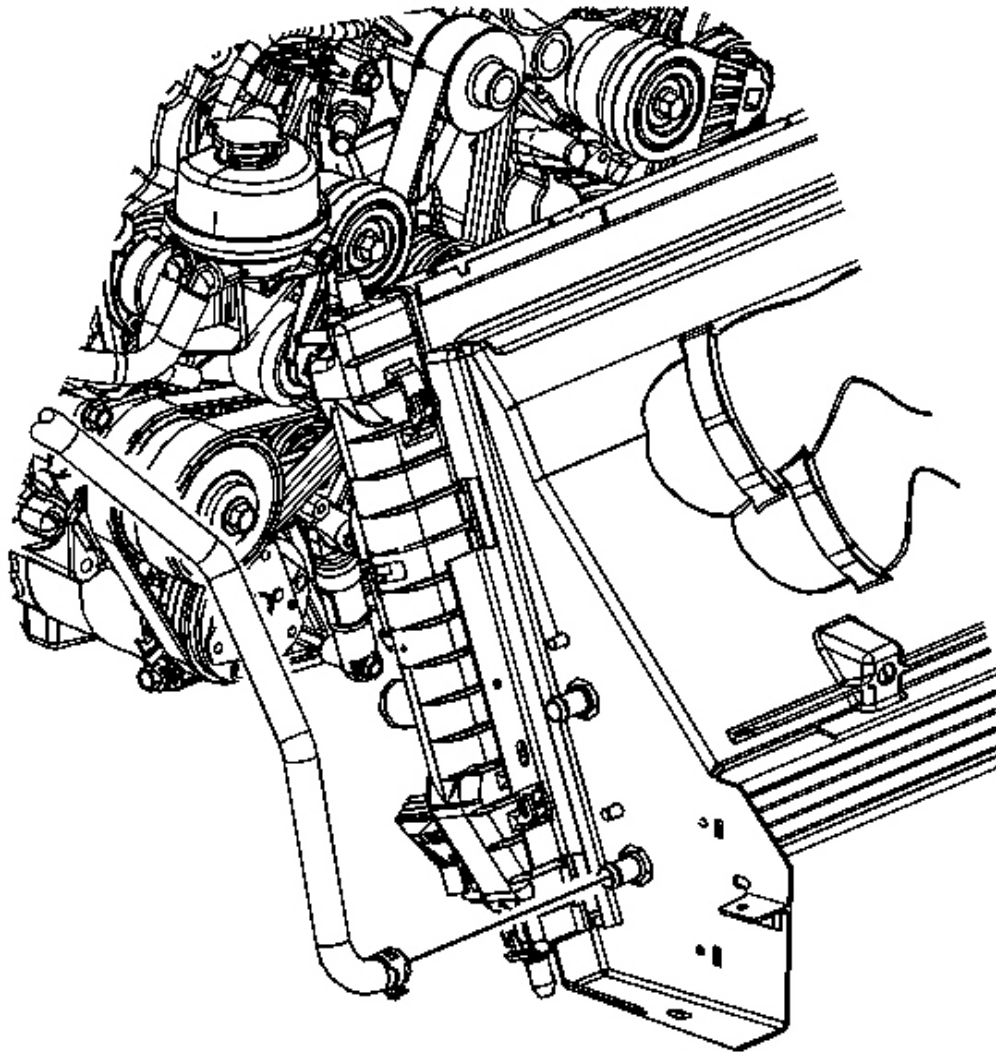


Fig. 192: Charge Air Cooler Coolant Outlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose from the charge air cooler radiator. See **Special Tools**.
4. Remove the charge air cooler coolant outlet hose from the charge air cooler radiator.

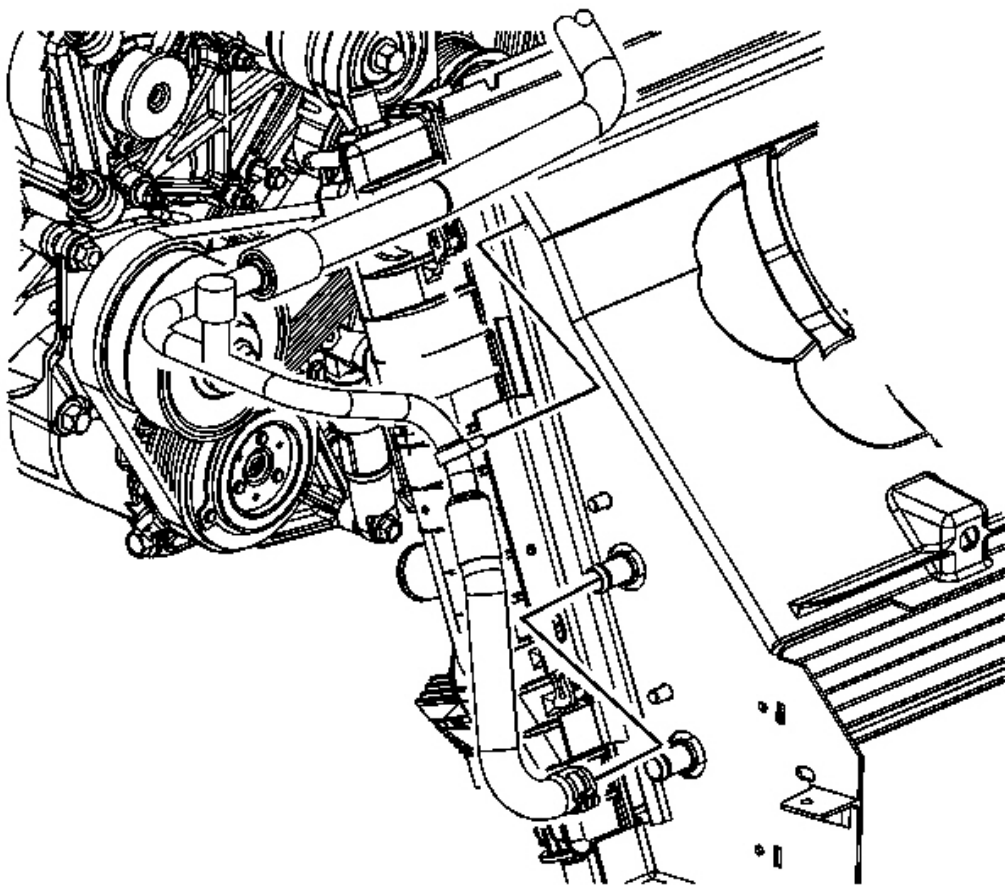


Fig. 193: Charge Air Cooler Coolant Inlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Using the **GE-47622** , reposition the charge air cooler coolant inlet hose from the charge air cooler radiator. See **Special Tools**.
6. Remove the charge air cooler coolant inlet hose from the charge air cooler radiator.

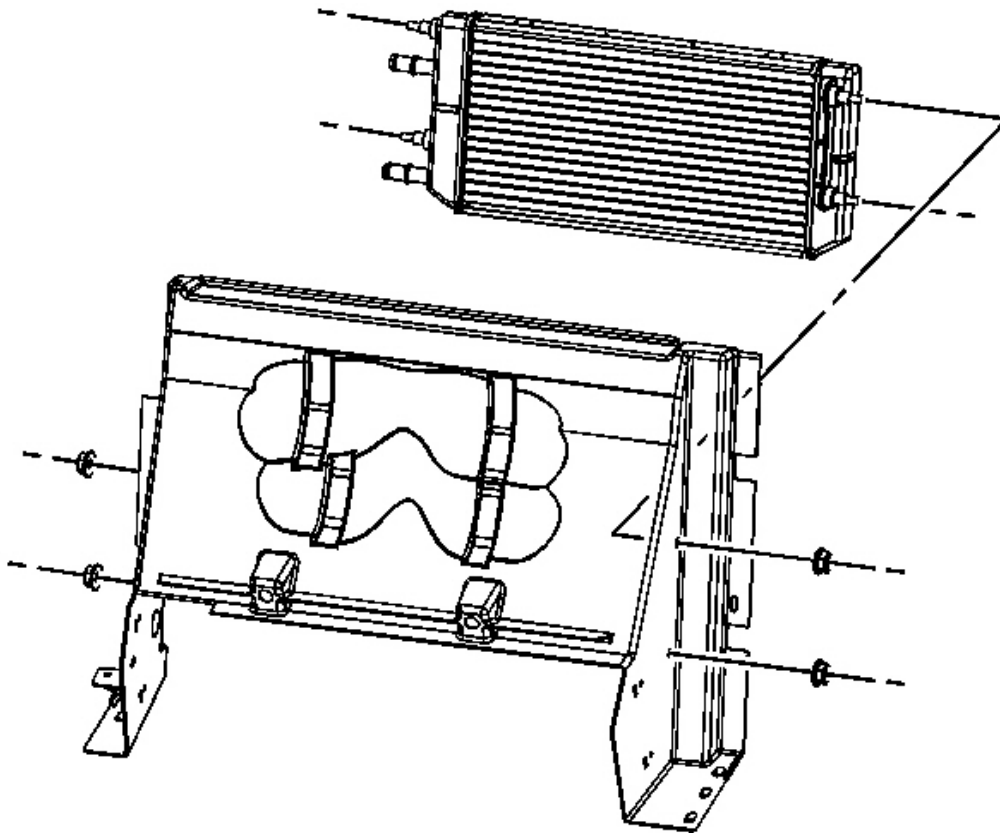


Fig. 194: Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS CORP.

7. Remove the charge air cooler radiator retaining nuts.
8. Remove the charge air cooler radiator from the vehicle.

Installation Procedure

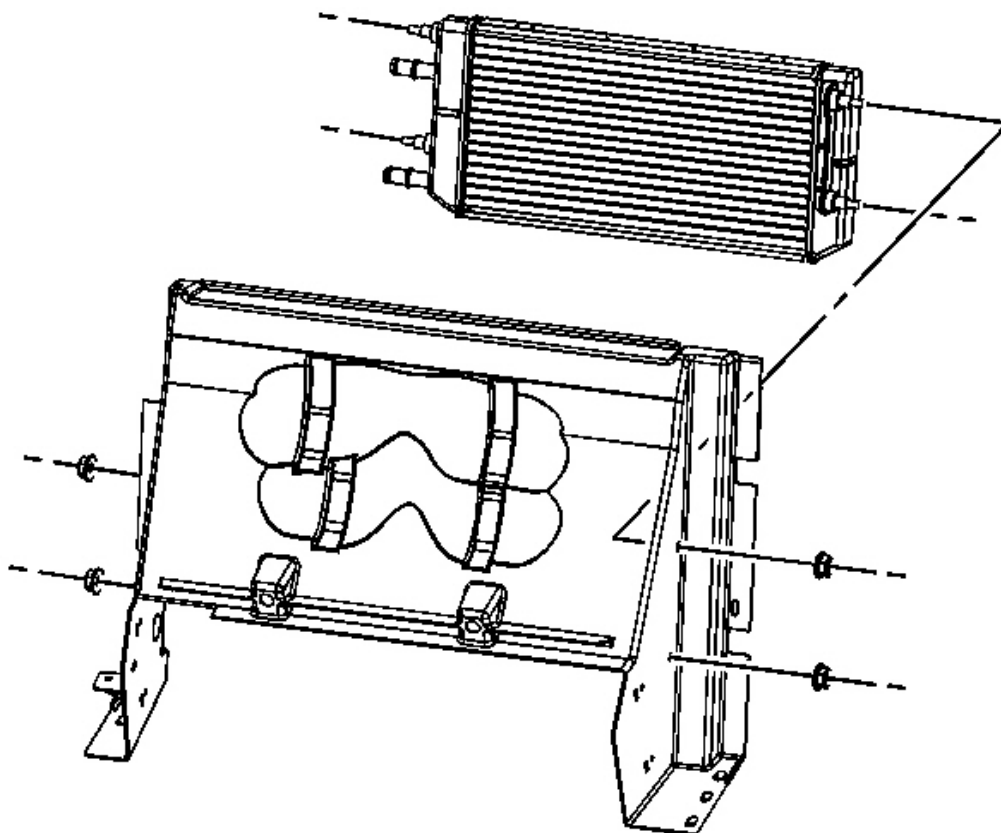


Fig. 195: Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS CORP.

1. Install the charge air cooler radiator to the vehicle.

NOTE: Refer to Fastener Notice .

2. Install the charge air cooler radiator retaining nuts.

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

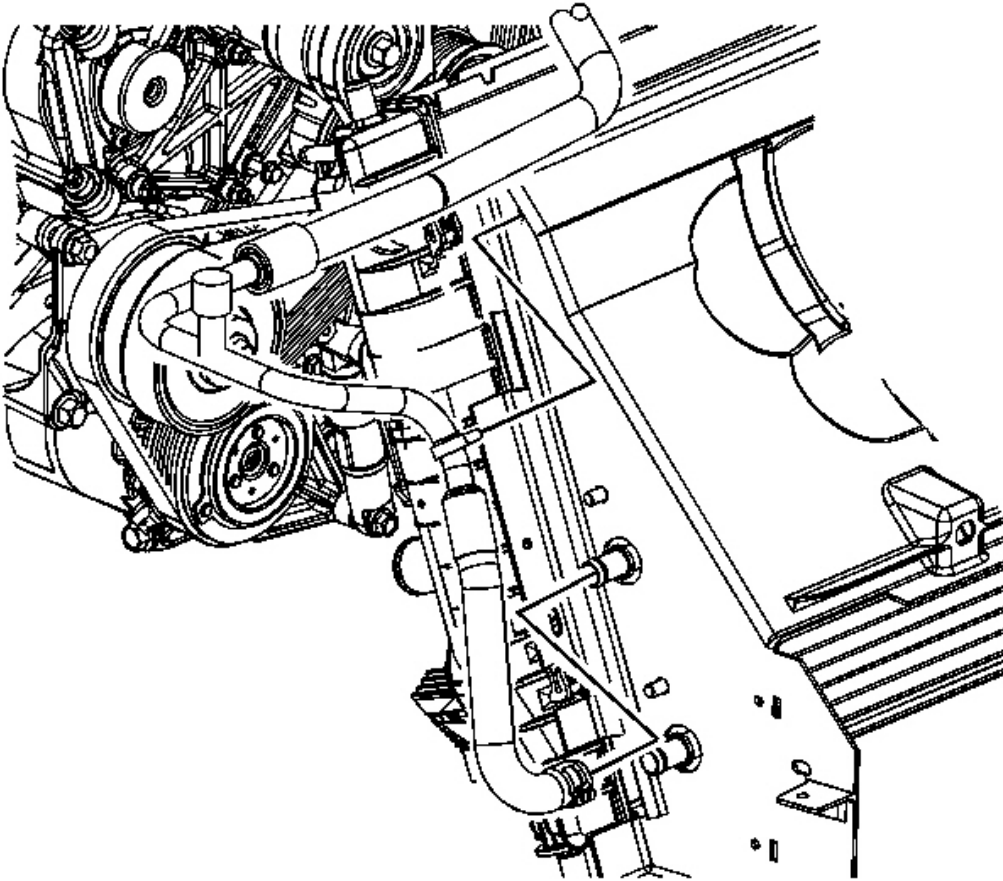


Fig. 196: Charge Air Cooler Coolant Inlet Hose
Courtesy of GENERAL MOTORS CORP.

3. Install the charge air cooler coolant inlet hose to the charge air cooler radiator.
4. Using the **GE-47622** , reposition the charge air cooler coolant inlet hose clamp at the charge air cooler radiator. See **Special Tools**.

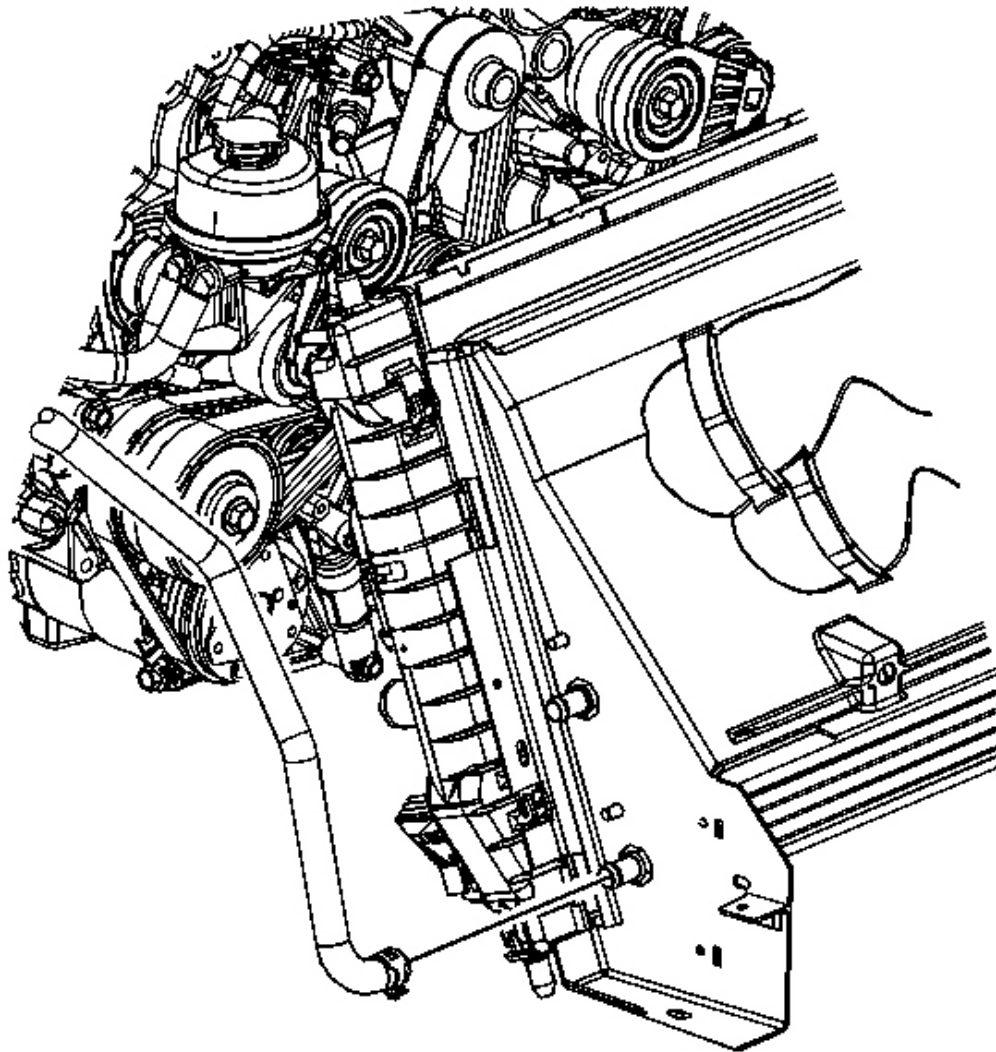


Fig. 197: Charge Air Cooler Coolant Outlet Hose
Courtesy of GENERAL MOTORS CORP.

5. Install the charge air cooler coolant outlet hose to the charge air coolant radiator.
6. Using the **GE-47622** , reposition the charge air cooler coolant outlet hose at the charge air coolant radiator. See **Special Tools**.
7. Lower the vehicle.
8. Fill the charge air cooler cooling system. Refer to **Charge Air Cooling System Draining and Filling (Static Fill)** or **Charge Air Cooling System Draining and Filling (GE 47716)**.

RADIATOR SUPPORT REPLACEMENT

Removal Procedure

1. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .

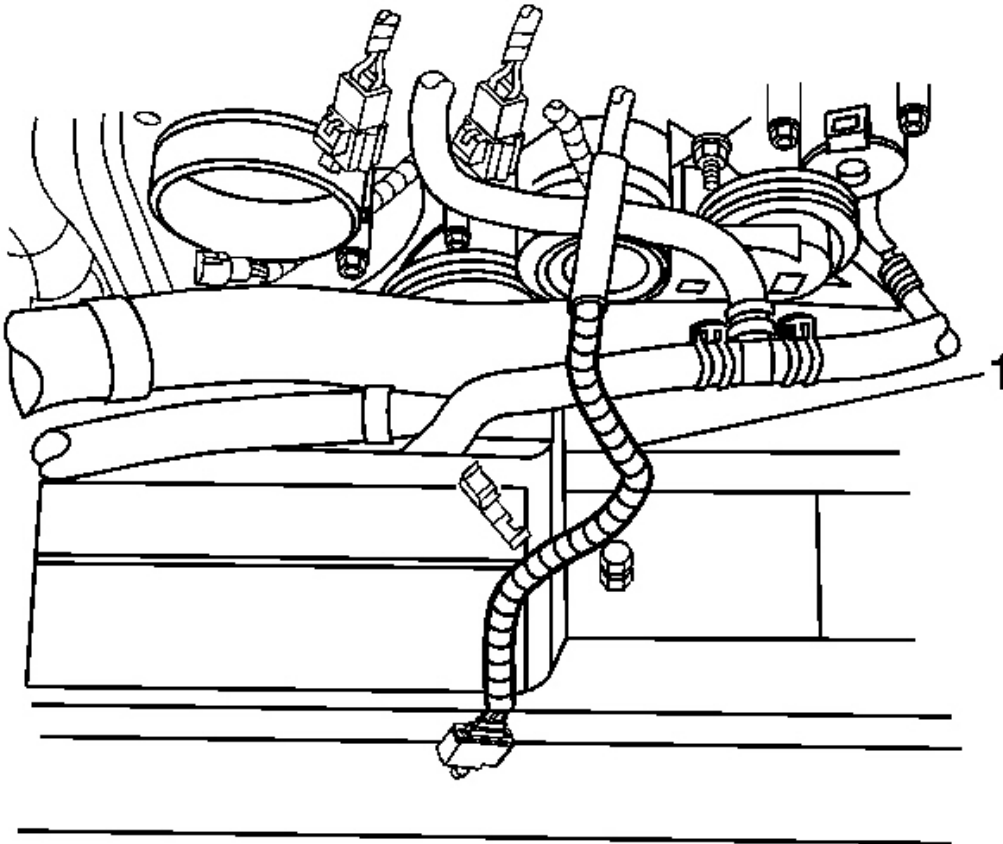


Fig. 198: Identifying Mass Air Flow Sensor Wire
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the MAF sensor wire (1) from the radiator support retainer clip.
3. Disconnect the surge tank inlet hose assembly from the radiator support tabs.

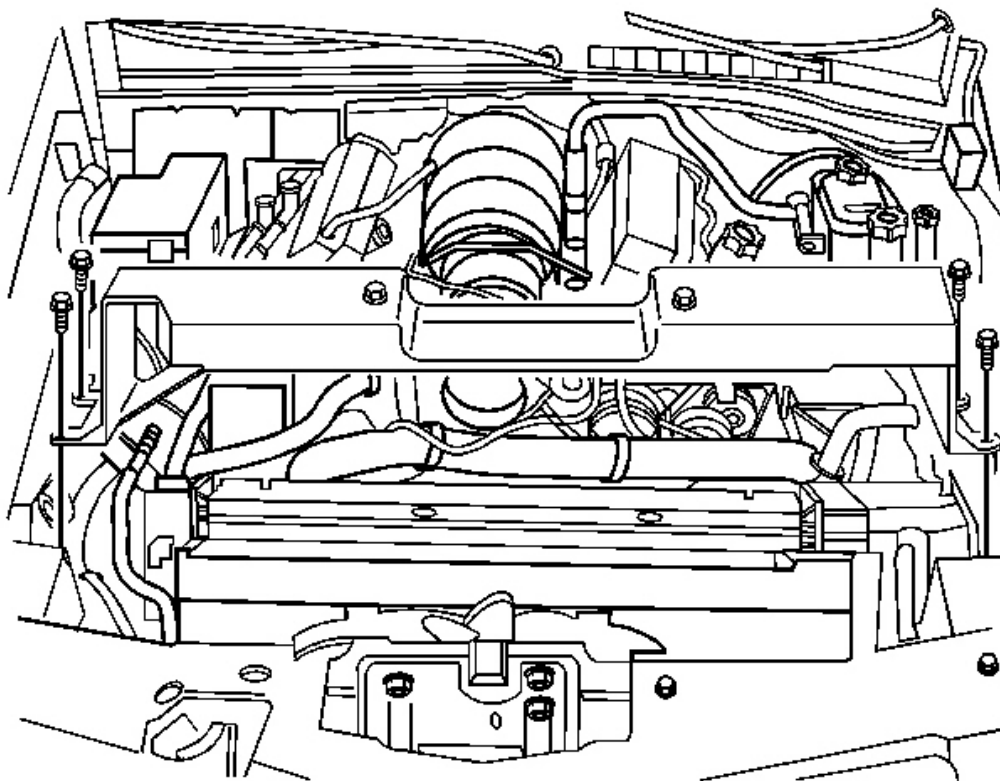


Fig. 199: Identifying Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the radiator support bolts.

IMPORTANT: Note the position of the radiator support in relationship to the fan shroud. This must be reassembled correctly in order to retain the fan shroud.

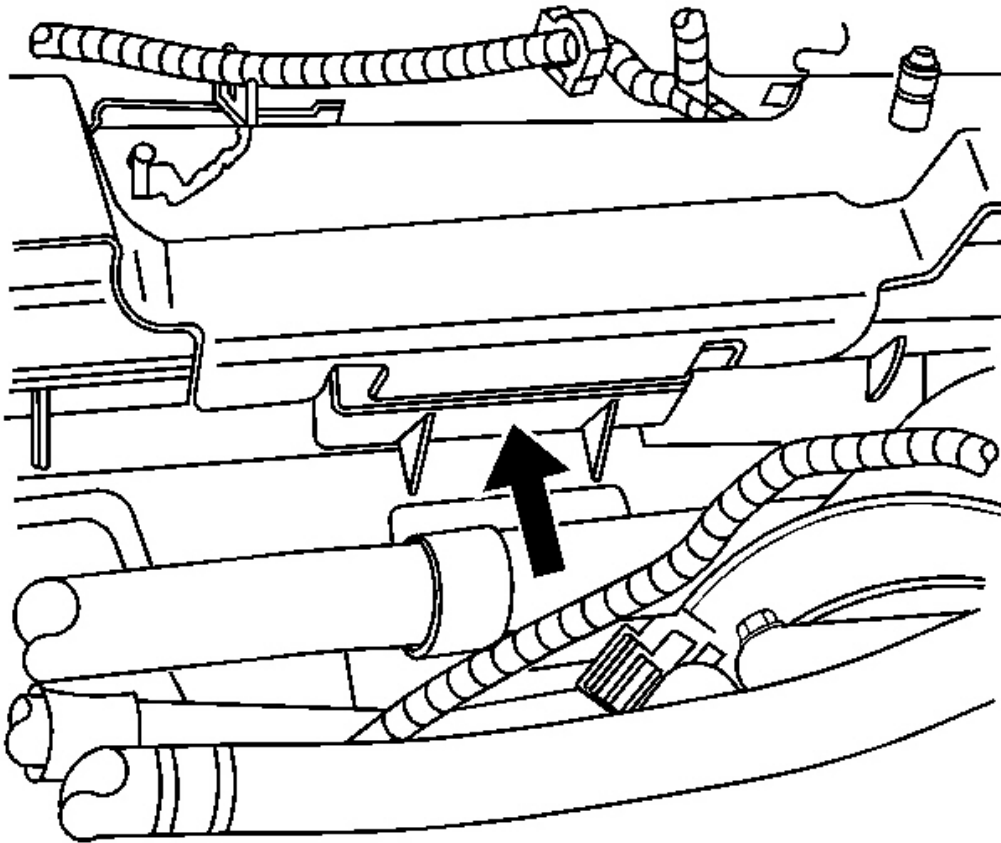


Fig. 200: Identifying Radiator Support
Courtesy of GENERAL MOTORS CORP.

5. Remove the radiator support.

Installation Procedure

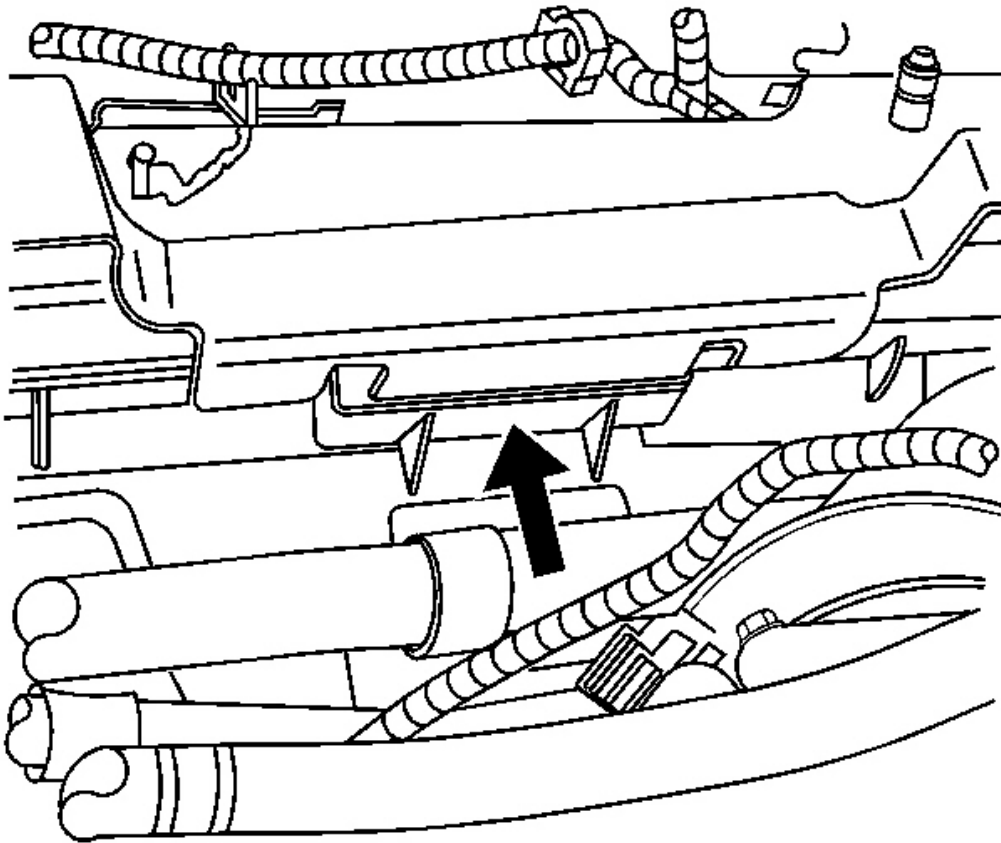


Fig. 201: Identifying Radiator Support
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Position the radiator support in the correct relationship to the fan shroud.

1. Install the radiator support.

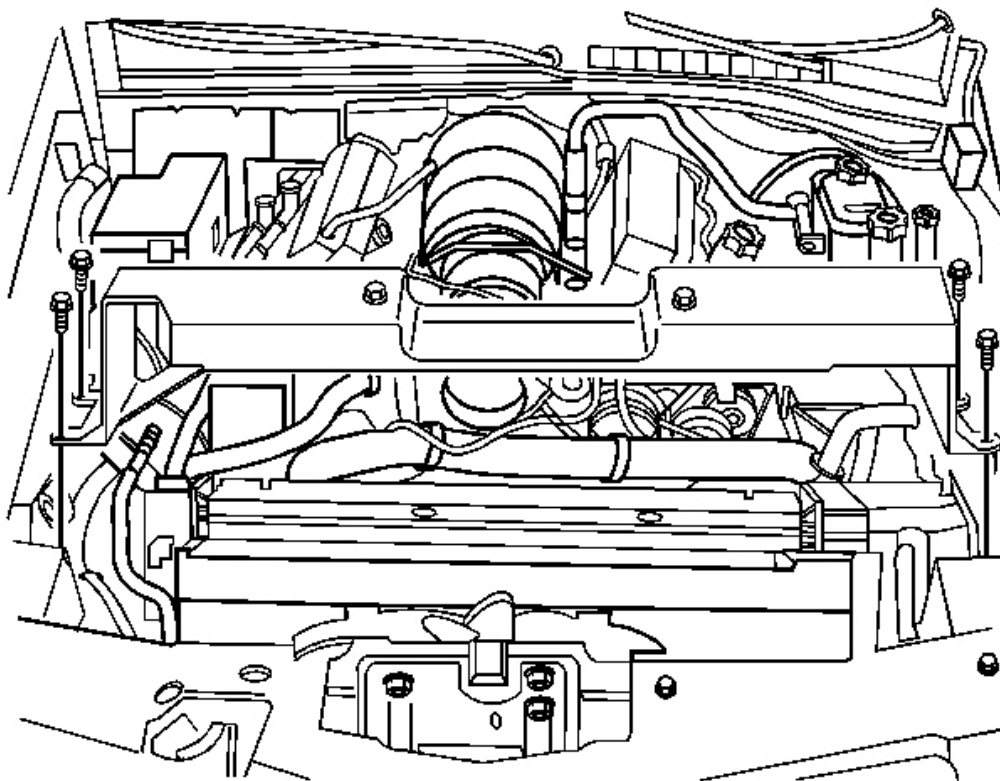


Fig. 202: Identifying Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2. Install the radiator support bolts.

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

3. Connect the surge tank inlet hose assembly to the radiator support tabs.

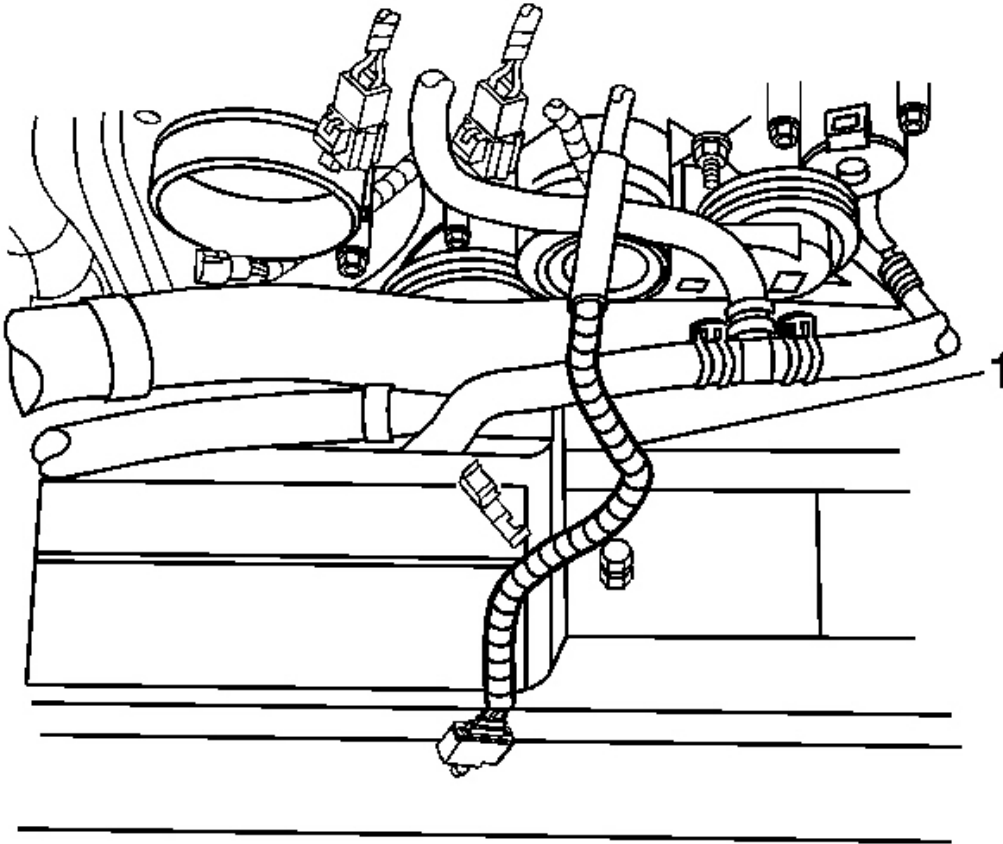


Fig. 203: Identifying Mass Air Flow Sensor Wire
Courtesy of GENERAL MOTORS CORP.

4. Connect the MAF sensor wire (1) to the radiator support retainer clip.
5. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .

RADIATOR AIR BAFFLE ASSEMBLIES AND DEFLECTORS (RADIATOR AIR BAFFLE)

Removal Procedure

1. Remove the cruise control bracket. Refer to [Distance Sensing Cruise Control Bracket Replacement](#) .
2. Remove the ambient air temperature sensor. Refer to [Ambient Air Temperature Sensor Replacement](#) .
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

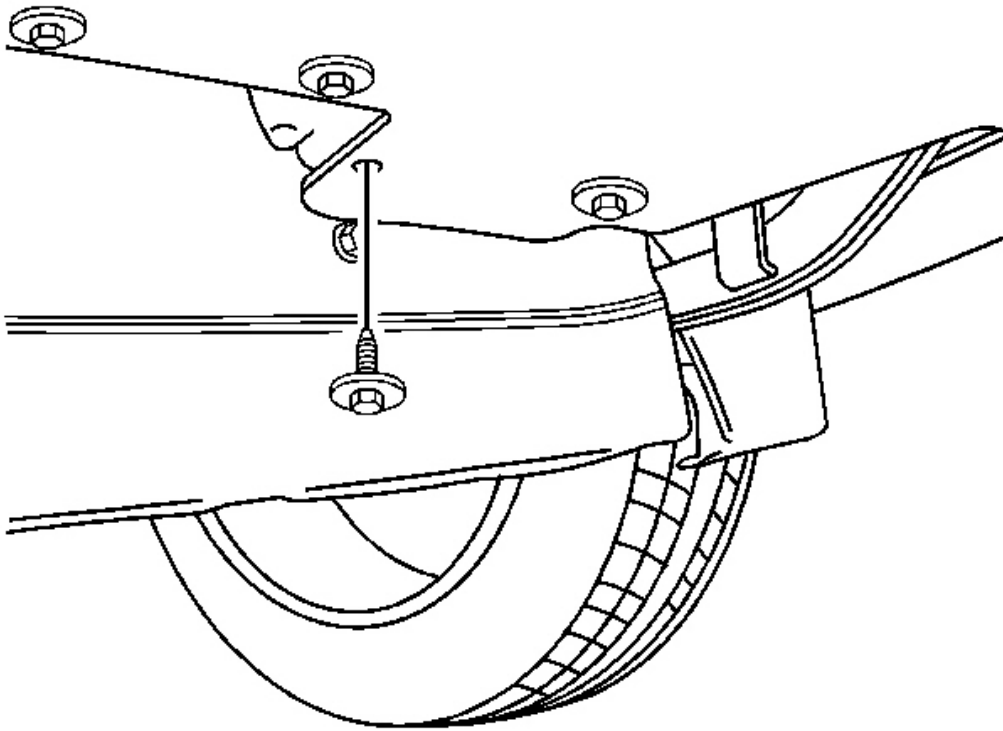


Fig. 204: Removing/Installing LH Radiator Air Baffle Lower Screws
Courtesy of GENERAL MOTORS CORP.

4. Remove the LH radiator air baffle lower screws.

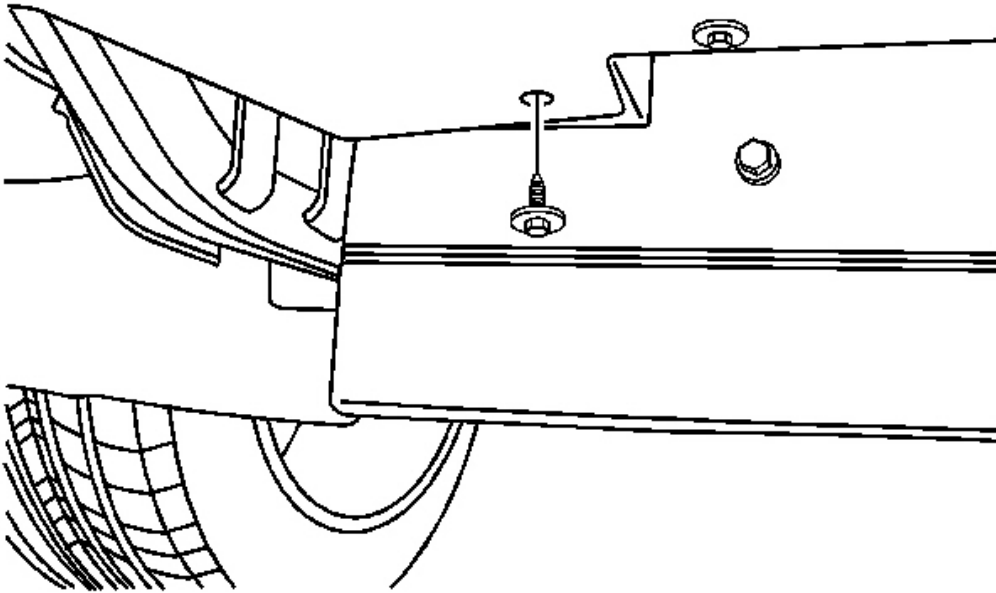


Fig. 205: Removing/Installing RH Radiator Air Baffle Lower Screw
Courtesy of GENERAL MOTORS CORP.

5. Remove the RH radiator air baffle lower screw.

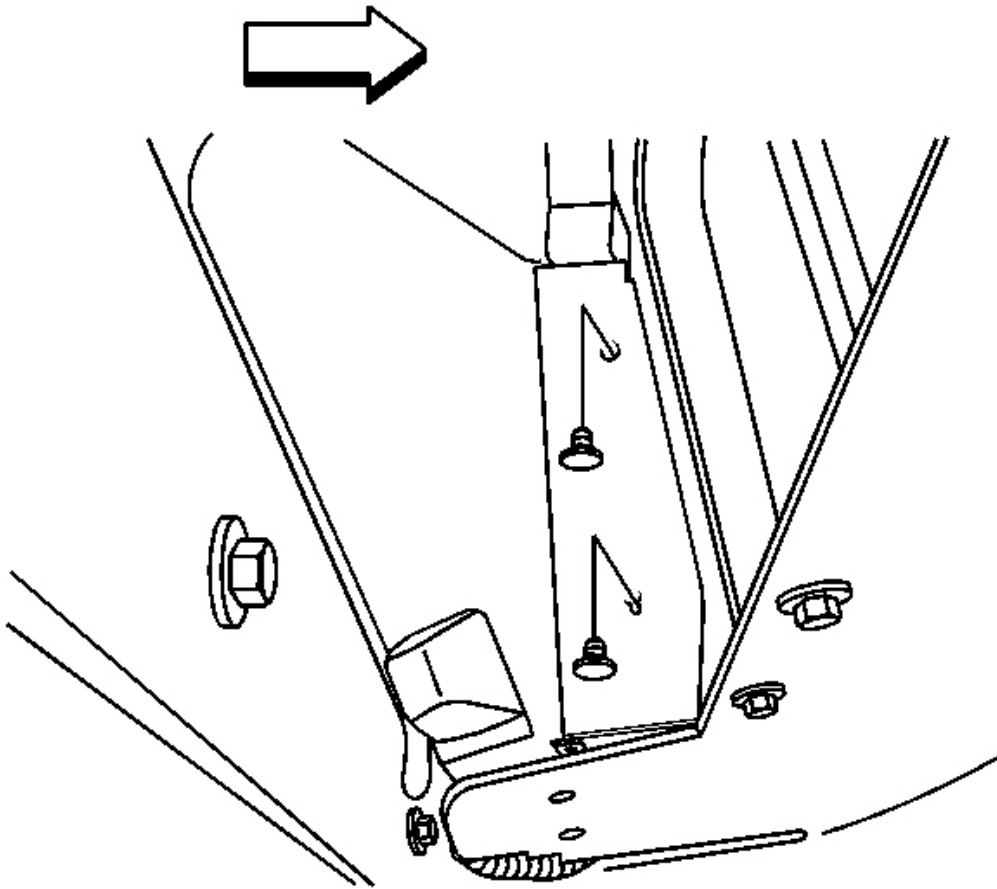


Fig. 206: Removing/Installing LH Side Air Deflector Retainer Pins
Courtesy of GENERAL MOTORS CORP.

6. Remove the LH side air deflector retainer pins.

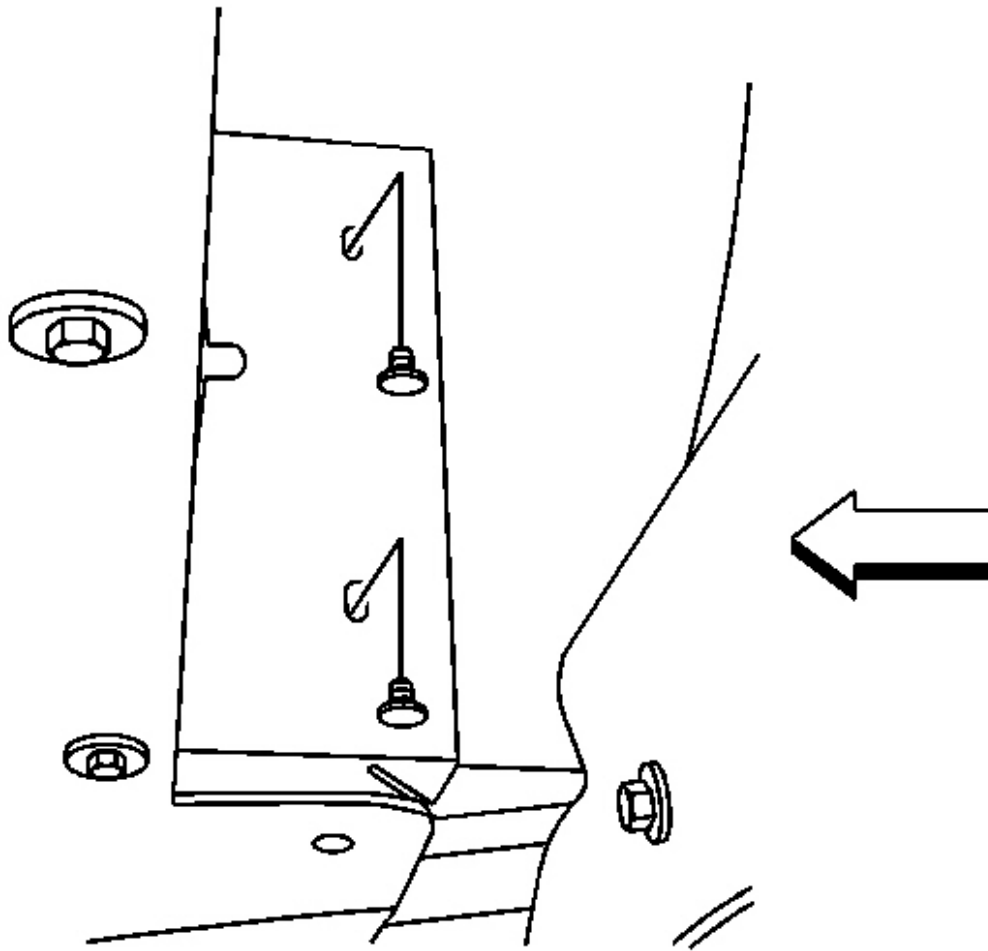


Fig. 207: Removing/Installing RH Side Air Deflector Retainer Pins
Courtesy of GENERAL MOTORS CORP.

7. Remove the RH side air deflector retainer pins.
8. Lower the vehicle.

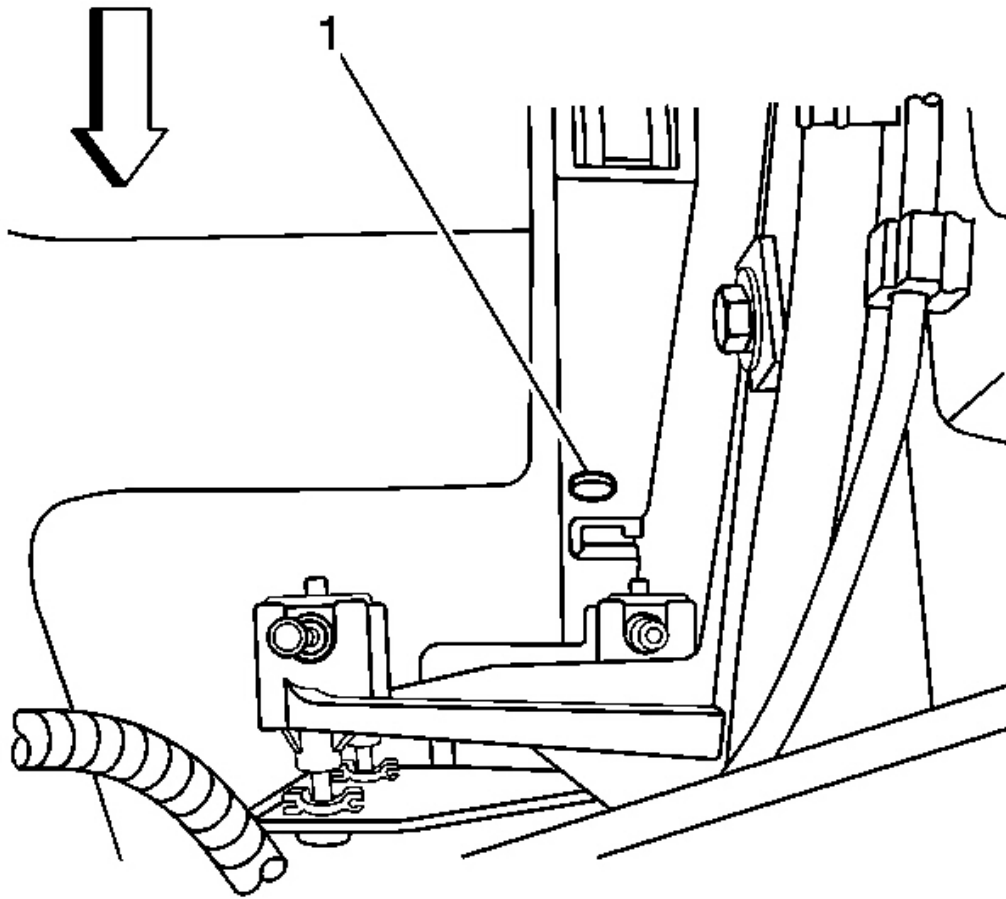


Fig. 208: Removing/Installing LH Radiator Air Baffle Upper Retainer Pin
Courtesy of GENERAL MOTORS CORP.

9. Remove the LH radiator air baffle upper retainer pin (1).

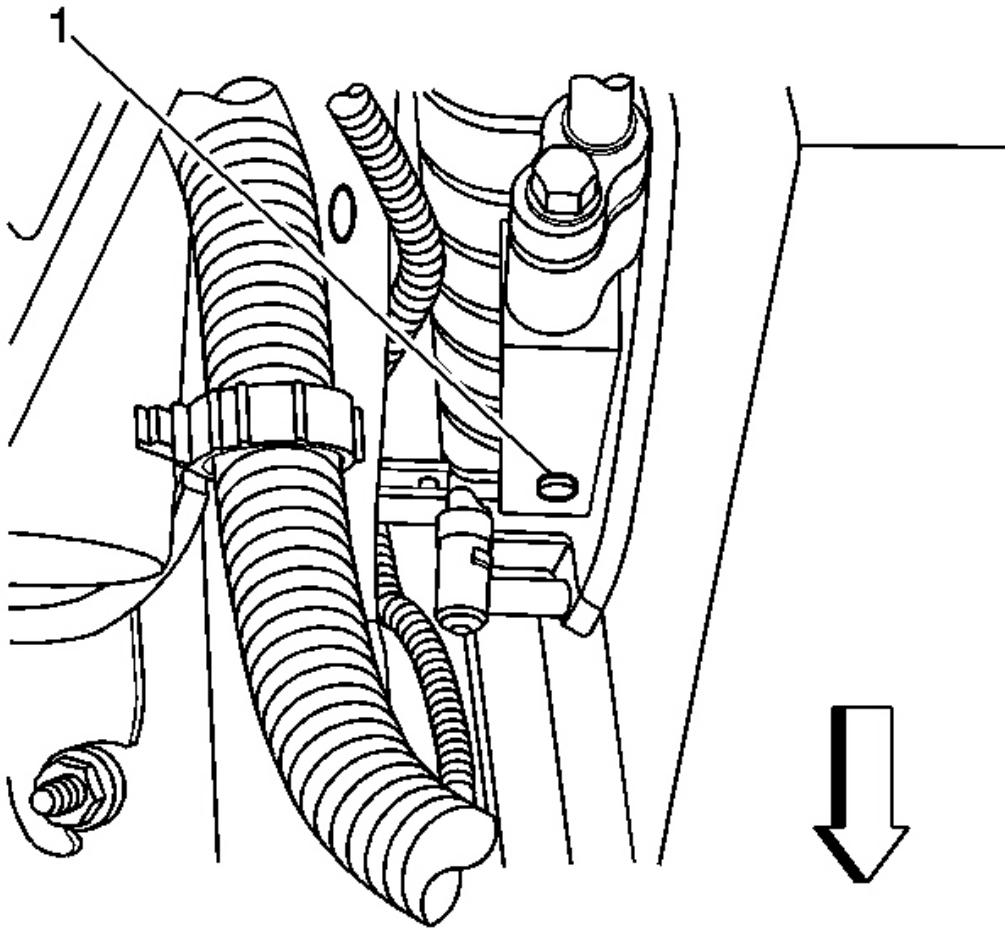


Fig. 209: Removing/Installing RH Radiator Air Baffle Upper Retainer Pin
Courtesy of GENERAL MOTORS CORP.

10. Remove the RH radiator air baffle upper retainer pin (1).

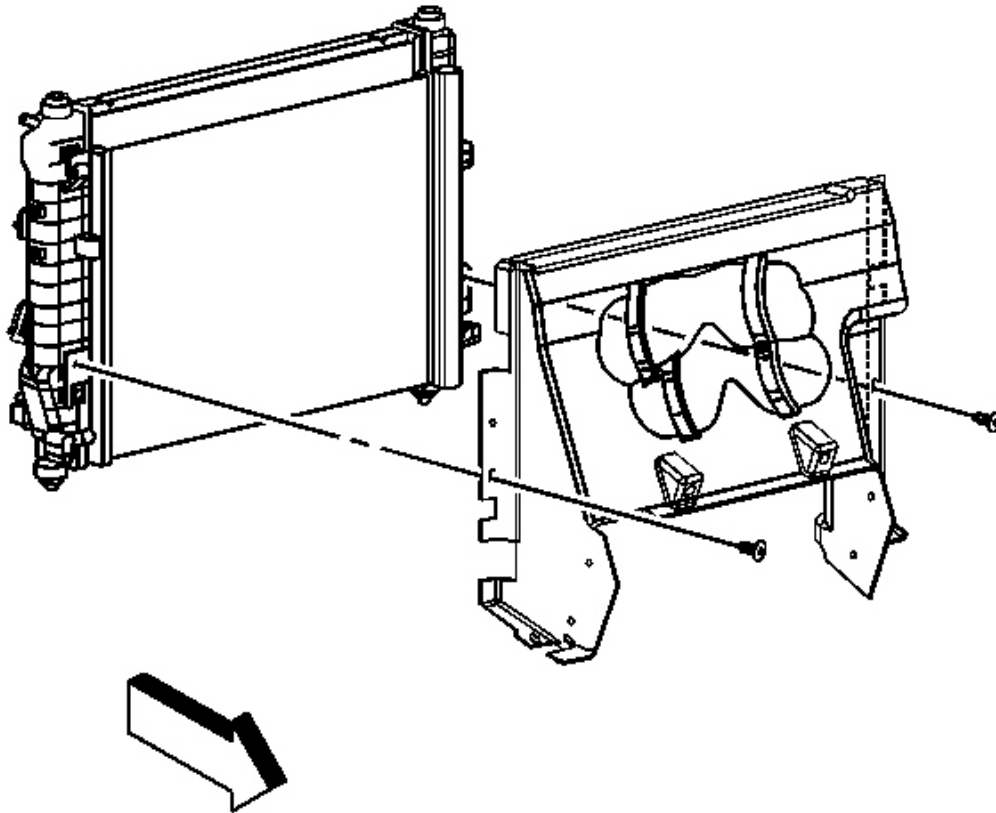


Fig. 210: Removing/Installing Radiator Air Baffle
Courtesy of GENERAL MOTORS CORP.

11. Remove the radiator air baffle.

Installation Procedure

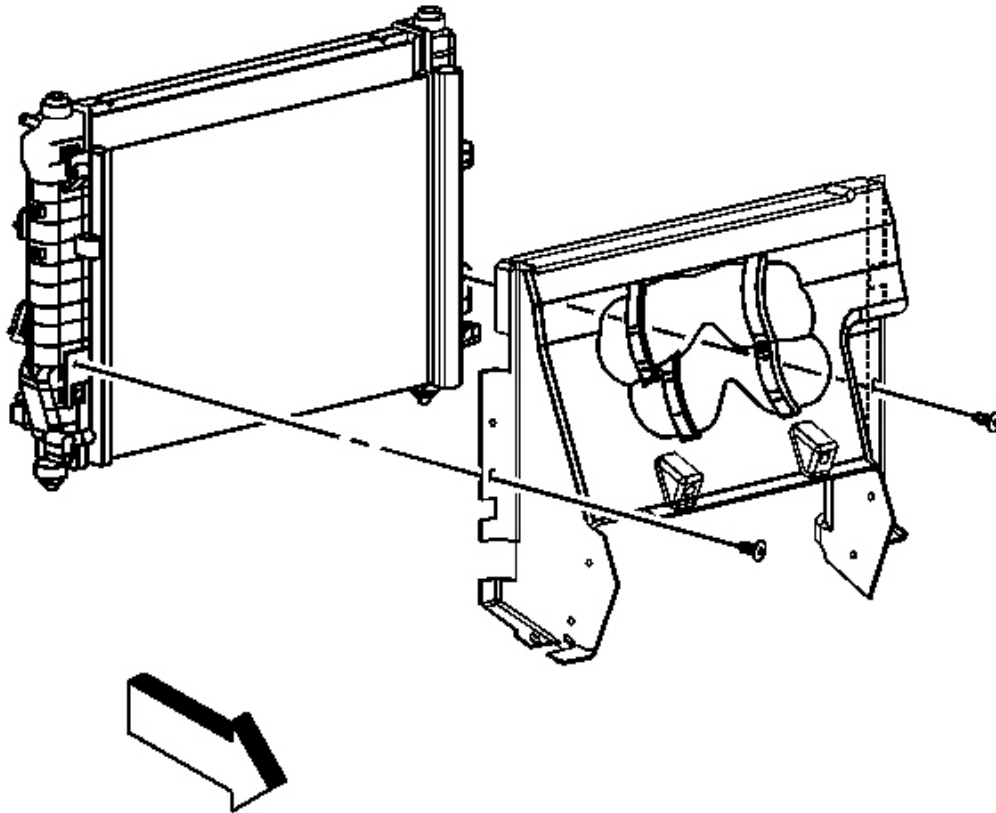


Fig. 211: Removing/Installing Radiator Air Baffle
Courtesy of GENERAL MOTORS CORP.

1. Install the radiator air baffle.

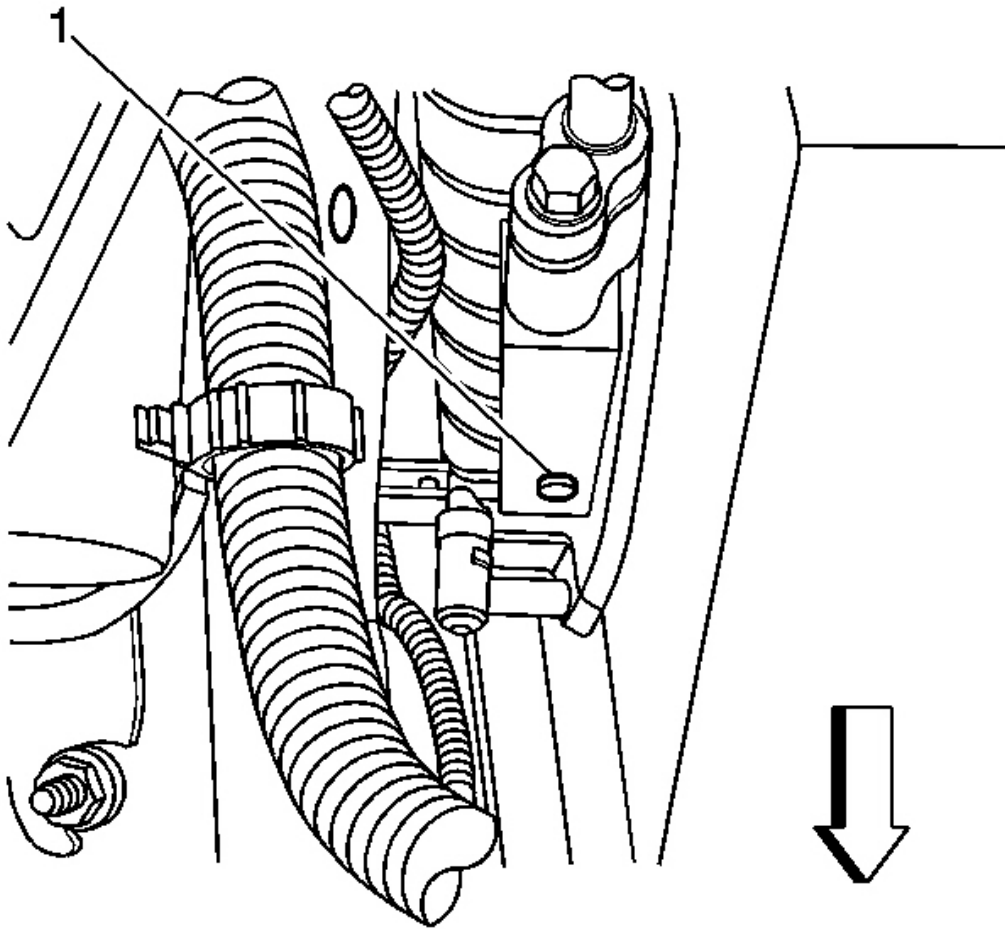


Fig. 212: Removing/Installing RH Radiator Air Baffle Upper Retainer Pin
Courtesy of GENERAL MOTORS CORP.

2. Install the RH radiator air baffle upper retainer pin (1).

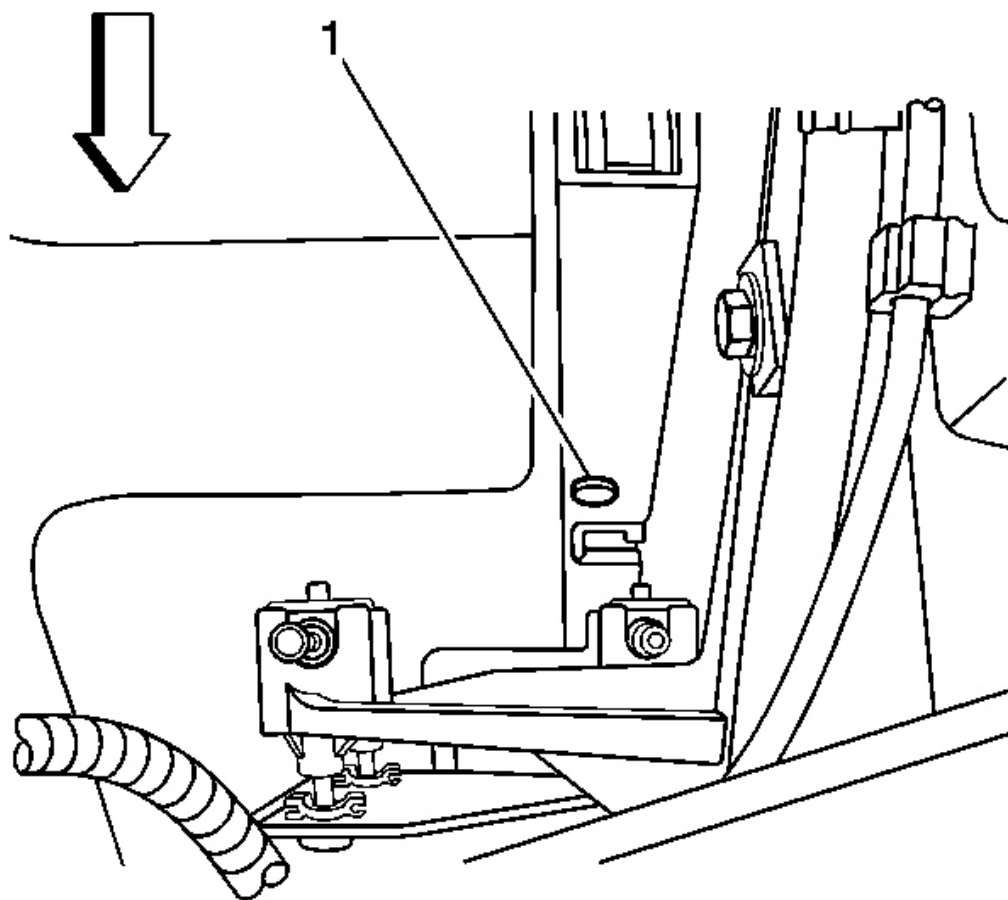


Fig. 213: Removing/Installing LH Radiator Air Baffle Upper Retainer Pin
Courtesy of GENERAL MOTORS CORP.

3. Install the LH radiator air baffle upper retainer pin (1).
4. Raise and support the vehicle.

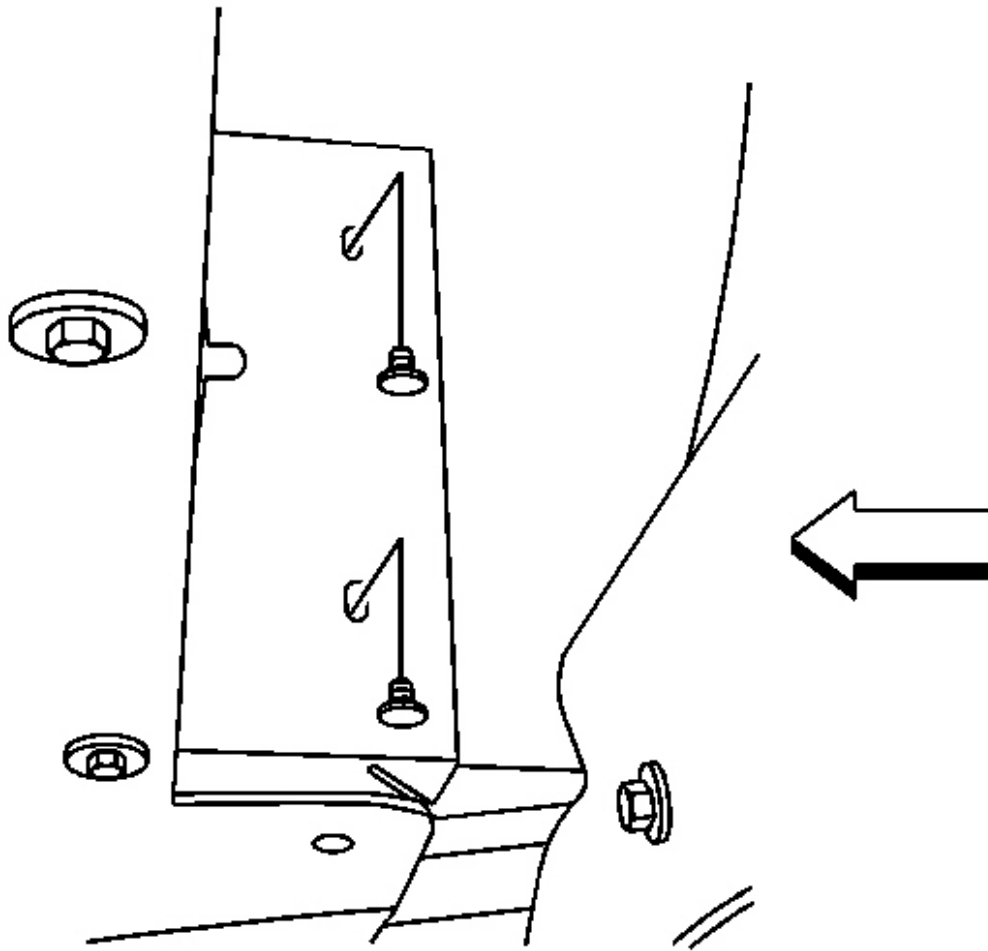


Fig. 214: Removing/Installing RH Side Air Deflector Retainer Pins
Courtesy of GENERAL MOTORS CORP.

5. Install the RH side air deflector retainer pins.

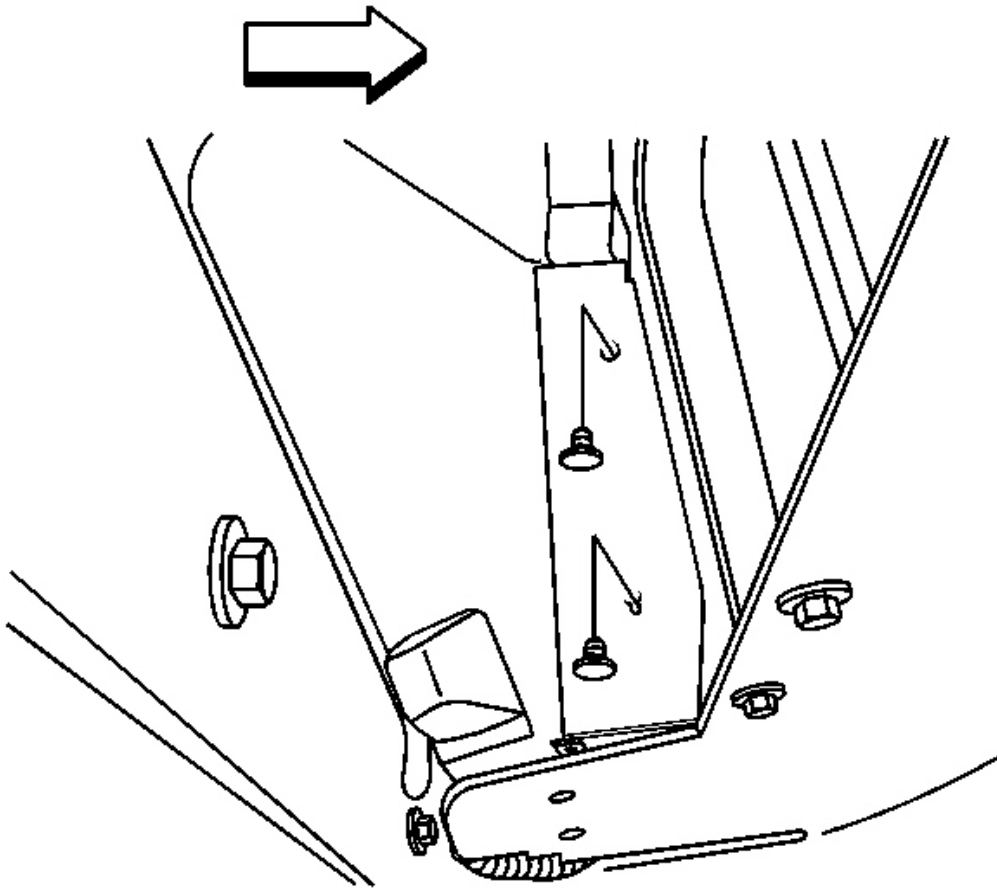


Fig. 215: Removing/Installing LH Side Air Deflector Retainer Pins
Courtesy of GENERAL MOTORS CORP.

6. Install the LH side air deflector retainer pins.

NOTE: Refer to Fastener Notice .

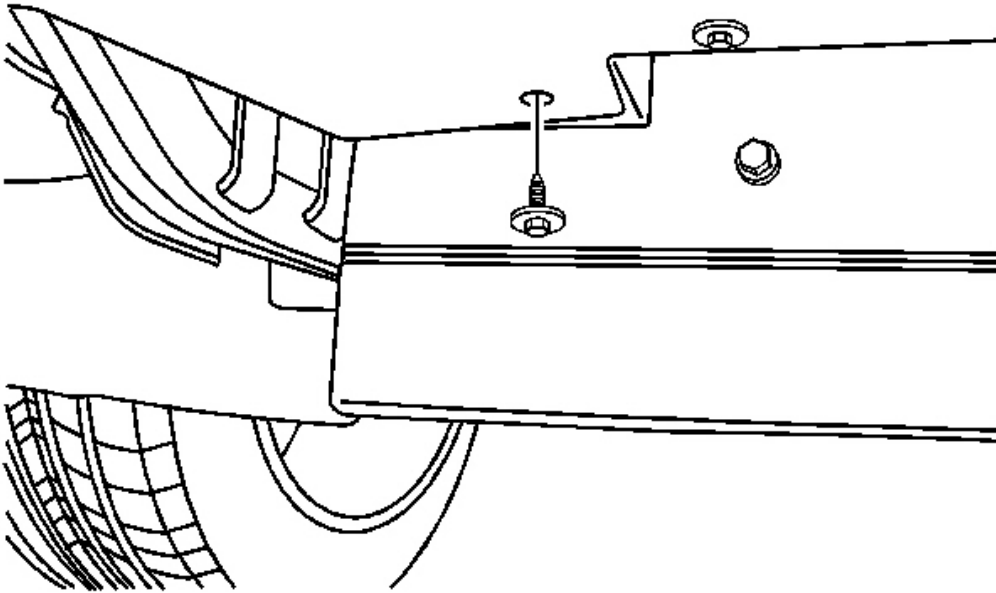


Fig. 216: Removing/Installing RH Radiator Air Baffle Lower Screw
Courtesy of GENERAL MOTORS CORP.

7. Install the RH radiator air baffle lower screw.

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

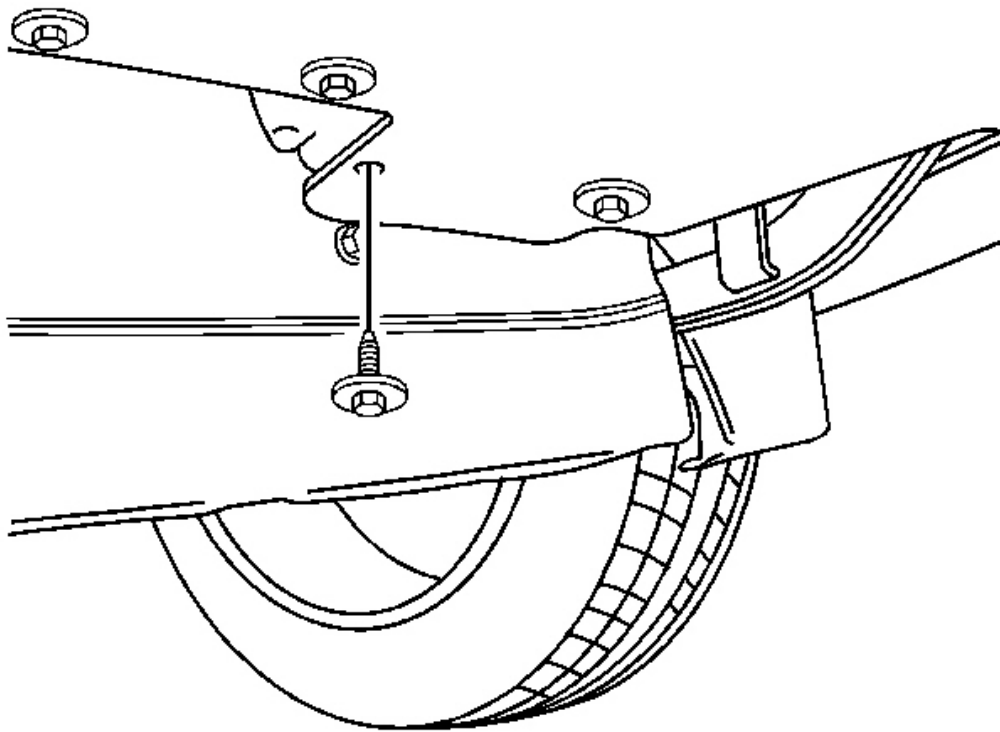


Fig. 217: Removing/Installing LH Radiator Air Baffle Lower Screws
Courtesy of GENERAL MOTORS CORP.

8. Install the LH radiator air baffle lower screws.

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

9. Lower the vehicle.
10. Install the ambient air temperature sensor. Refer to **Ambient Air Temperature Sensor Replacement** .
11. Install the cruise control bracket. Refer to **Distance Sensing Cruise Control Bracket Replacement** .

RADIATOR AIR BAFFLE ASSEMBLIES AND DEFLECTORS (FRONT AIR DEFLECTOR)

Removal Procedure

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

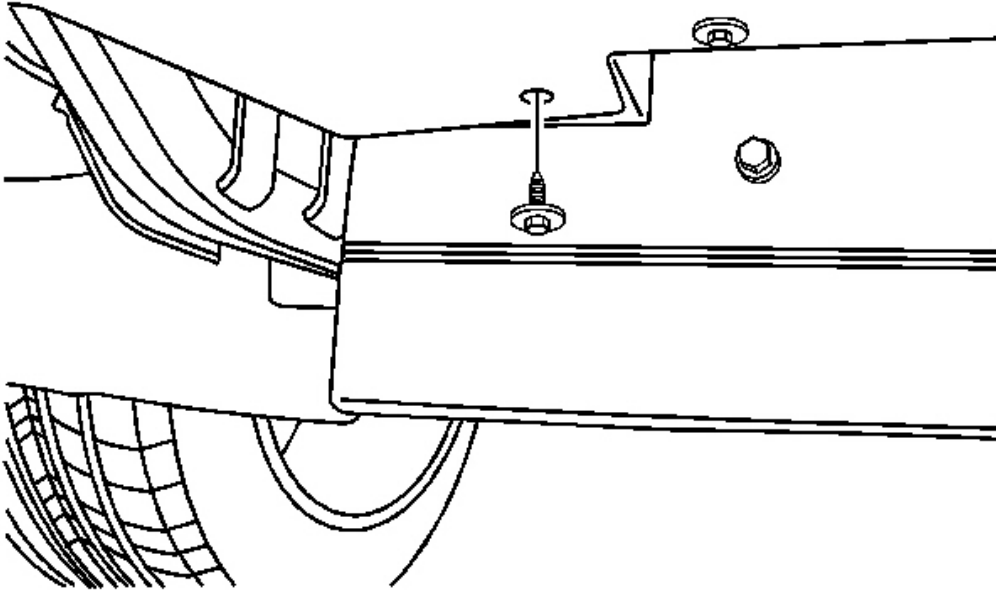


Fig. 218: Removing/Installing RH Radiator Air Baffle Lower Screw
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove the outer most front fascia screws to add additional clearance when removing the front air deflector.

2. Remove the RH radiator air baffle lower screw.

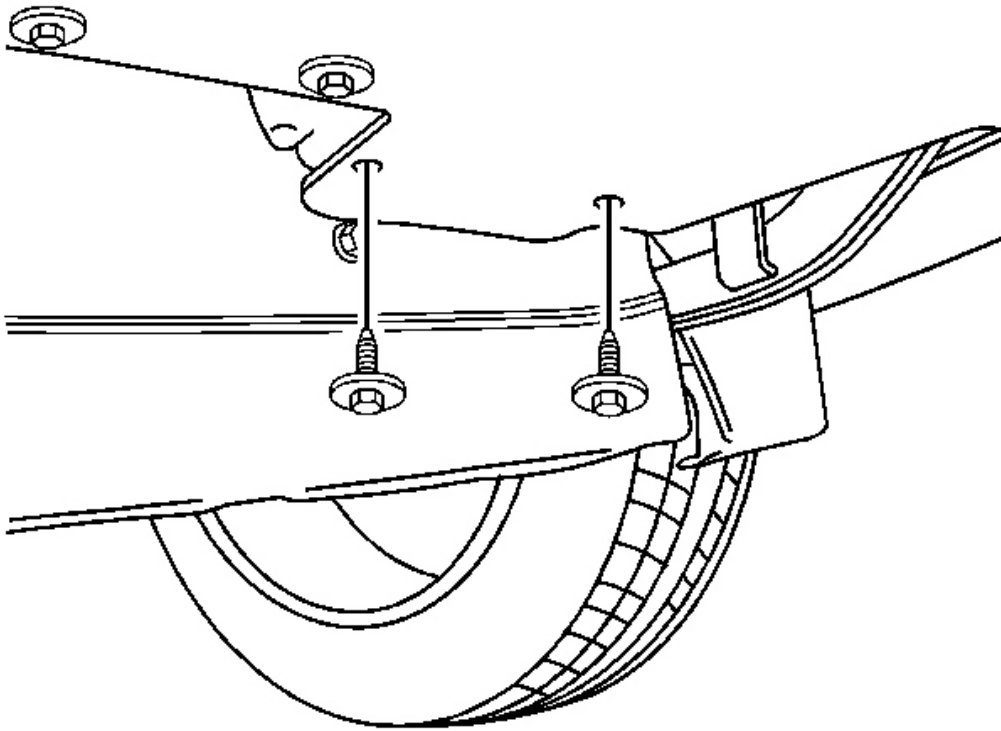


Fig. 219: Removing/Installing LH Radiator Air Baffle Lower Screws
Courtesy of GENERAL MOTORS CORP.

3. Remove the LH radiator air baffle lower screws.
4. Remove the front air deflector upper mounting screws.

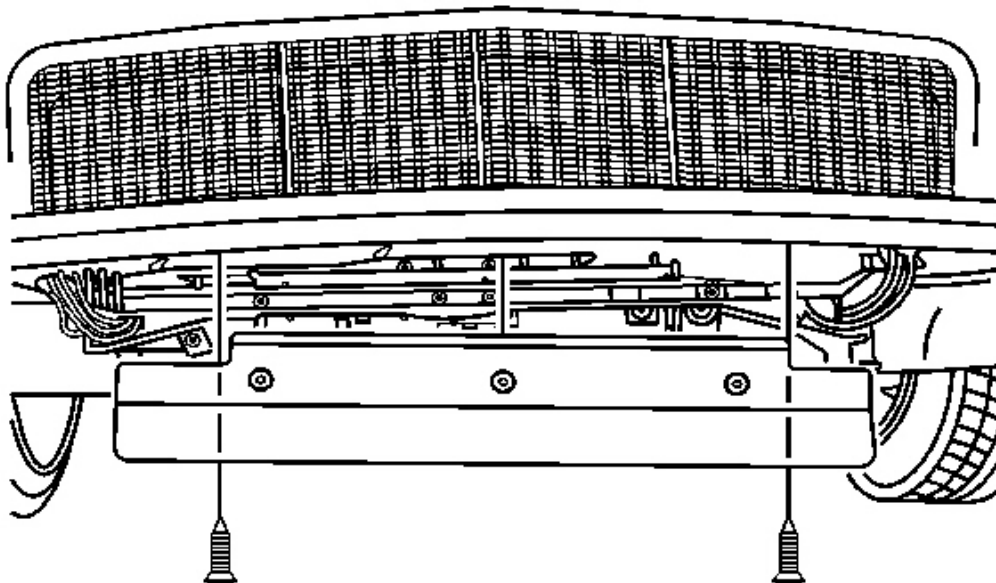


Fig. 220: Removing/Installing Front Air Deflector Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the front air deflector bolts from the frame support.
6. Remove the front air deflector.

Installation Procedure

1. Install the front air deflector.

NOTE: Refer to Fastener Notice .

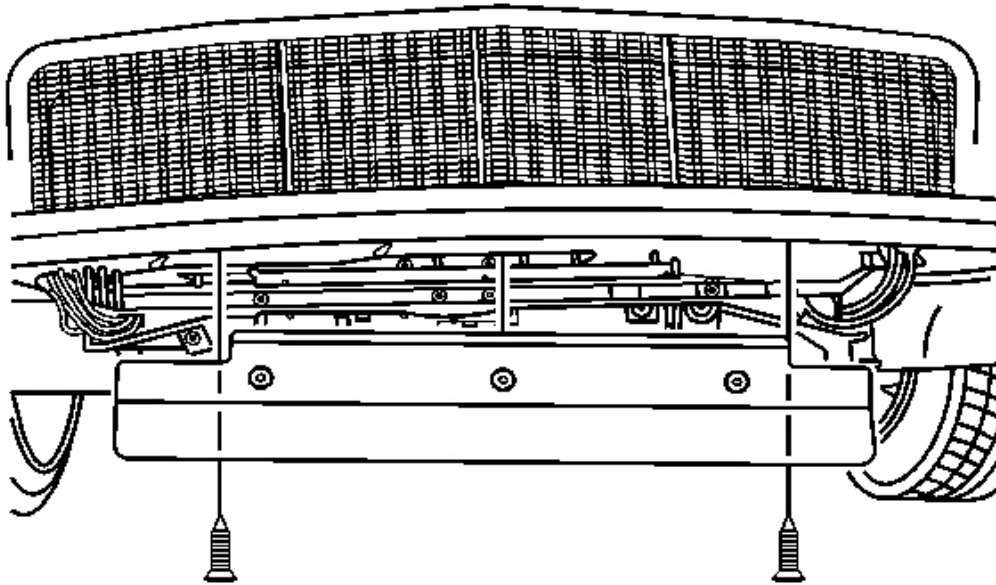


Fig. 221: Removing/Installing Front Air Deflector Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the front air deflector bolts to the frame support.

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

3. Install the front air deflector upper mounting screws.

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

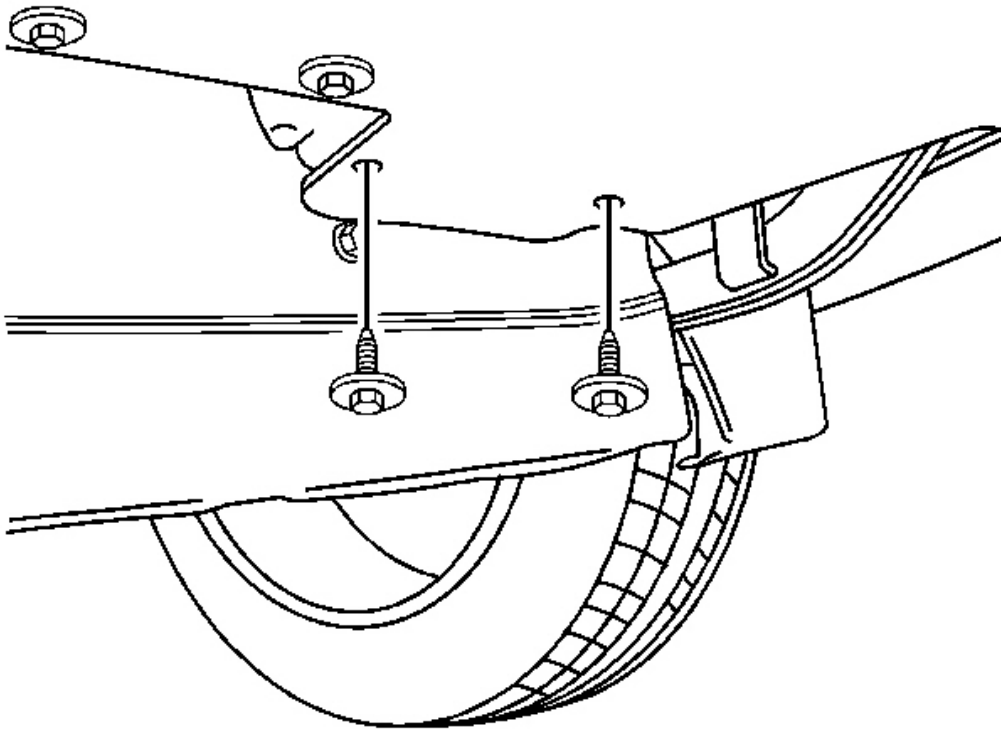


Fig. 222: Removing/Installing LH Radiator Air Baffle Lower Screws
Courtesy of GENERAL MOTORS CORP.

4. Install the LH radiator air baffle lower screws.

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

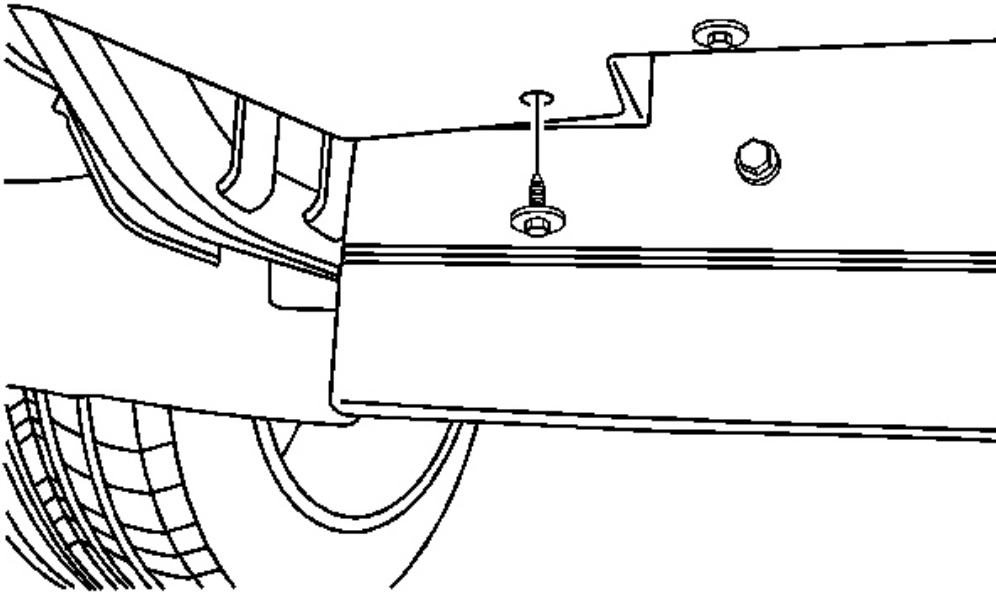


Fig. 223: Removing/Installing RH Radiator Air Baffle Lower Screw
Courtesy of GENERAL MOTORS CORP.

5. Install the RH radiator air baffle lower screw.

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

6. Lower the vehicle.

ENGINE COOLANT HEATER REPLACEMENT - LEFT SIDE

Removal Procedure

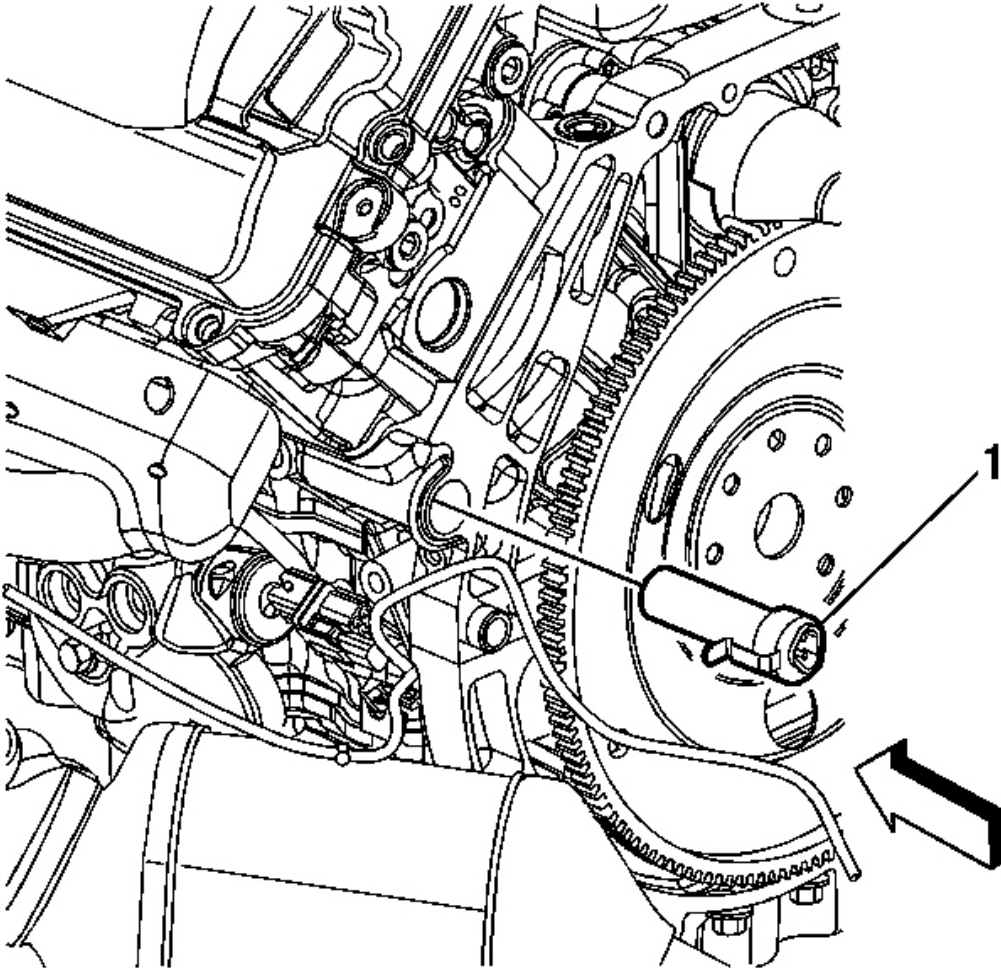


Fig. 224: View Of Coolant Heater From Engine Block
Courtesy of GENERAL MOTORS CORP.

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

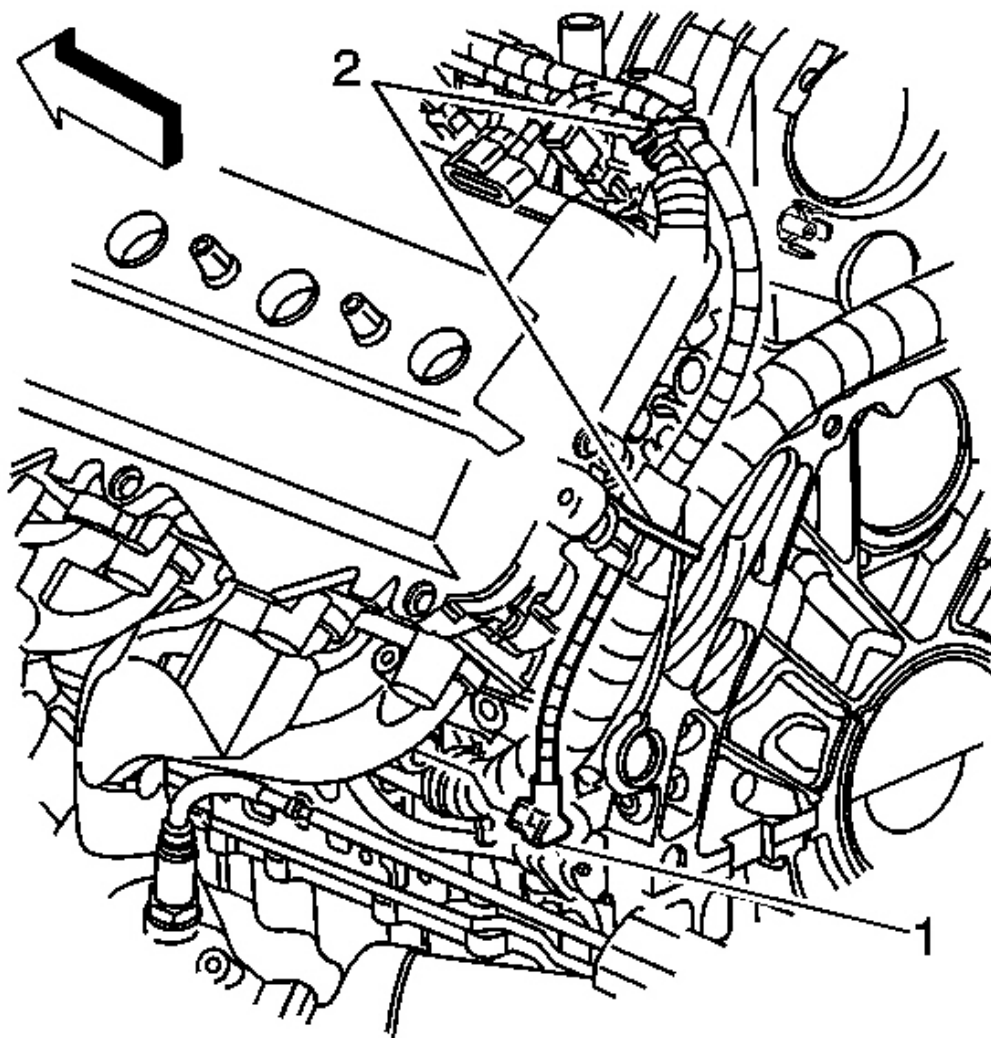


Fig. 225: Disconnecting/Connecting Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

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

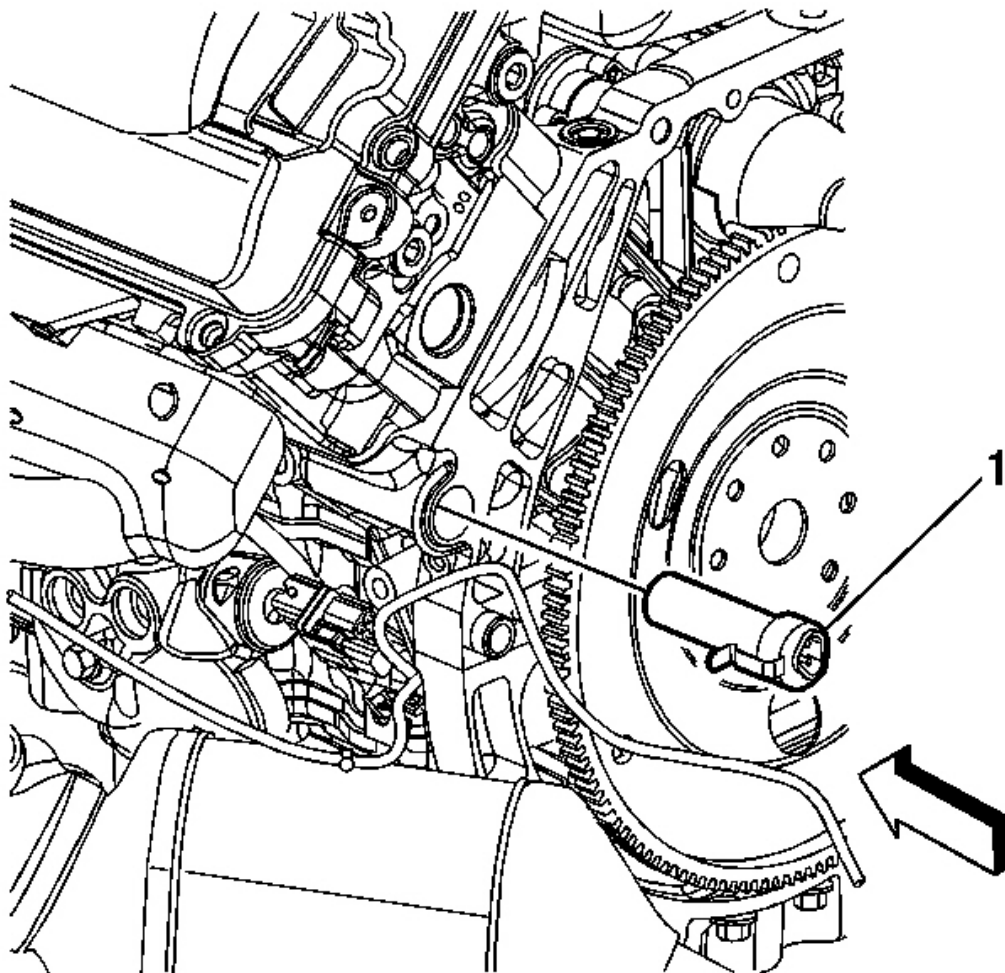


Fig. 226: View Of Coolant Heater From Engine Block
Courtesy of GENERAL MOTORS CORP.

3. Pry outward on the heater retaining clip.
4. Pull the heater (1) from the engine block.

Installation Procedure

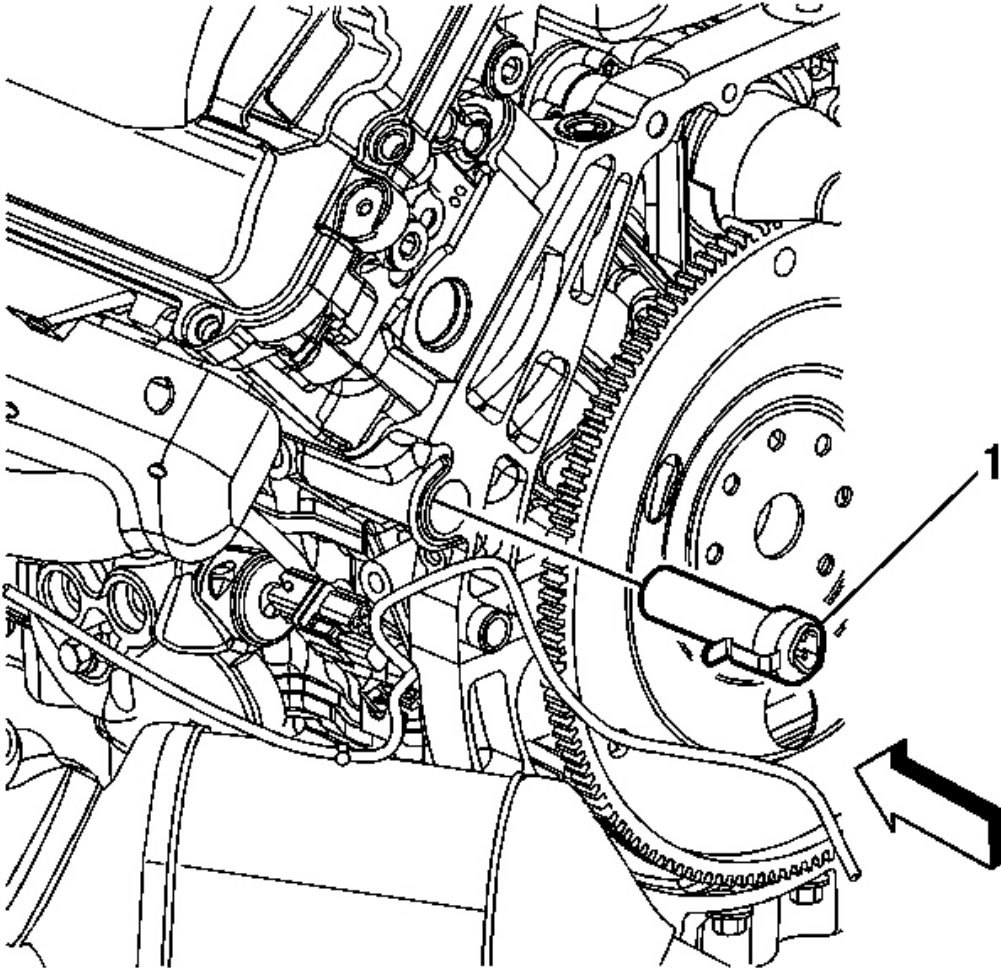


Fig. 227: View Of Coolant Heater From Engine Block
Courtesy of GENERAL MOTORS CORP.

1. Install the coolant heater (1) into the engine block. The retaining clip should snap into place.

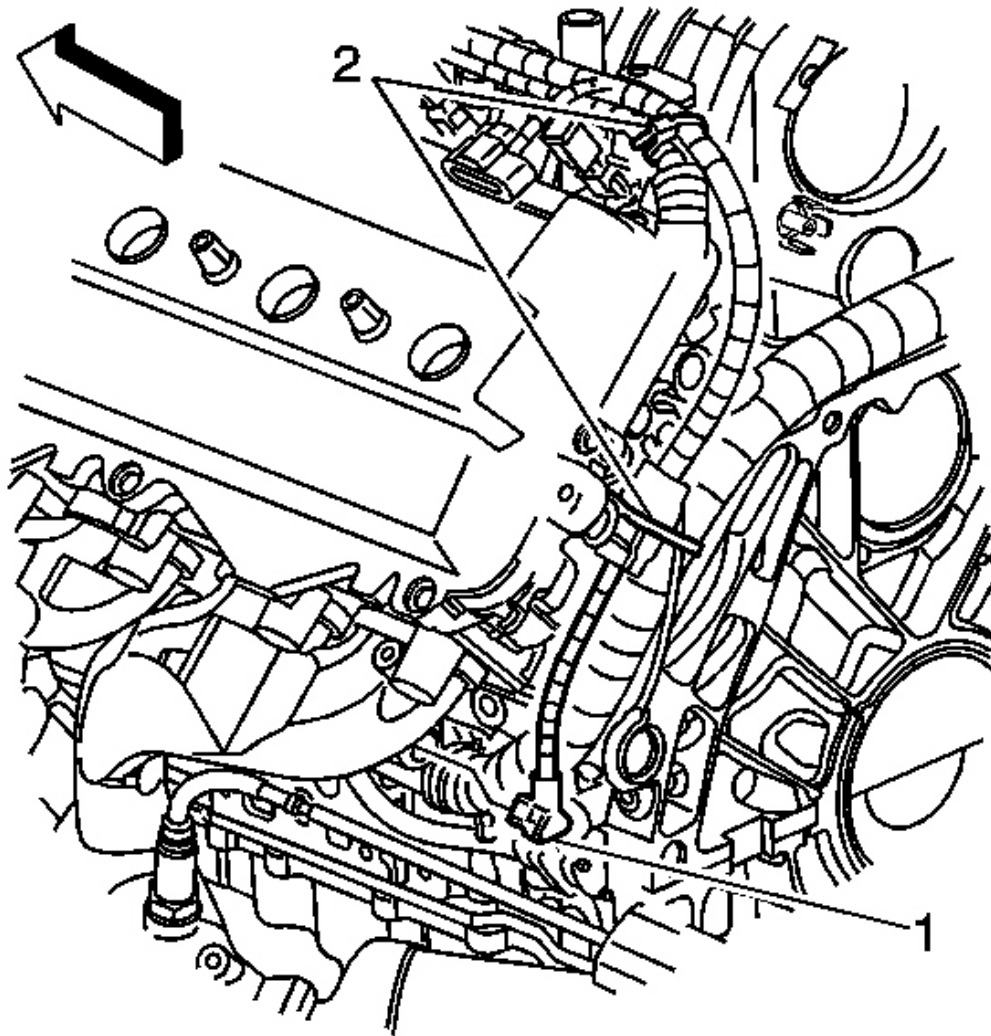


Fig. 228: Disconnecting/Connecting Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

2. Connect the electrical connector to the coolant heater.
3. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** .

COOLANT HEATER CORD REPLACEMENT

Removal Procedure

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

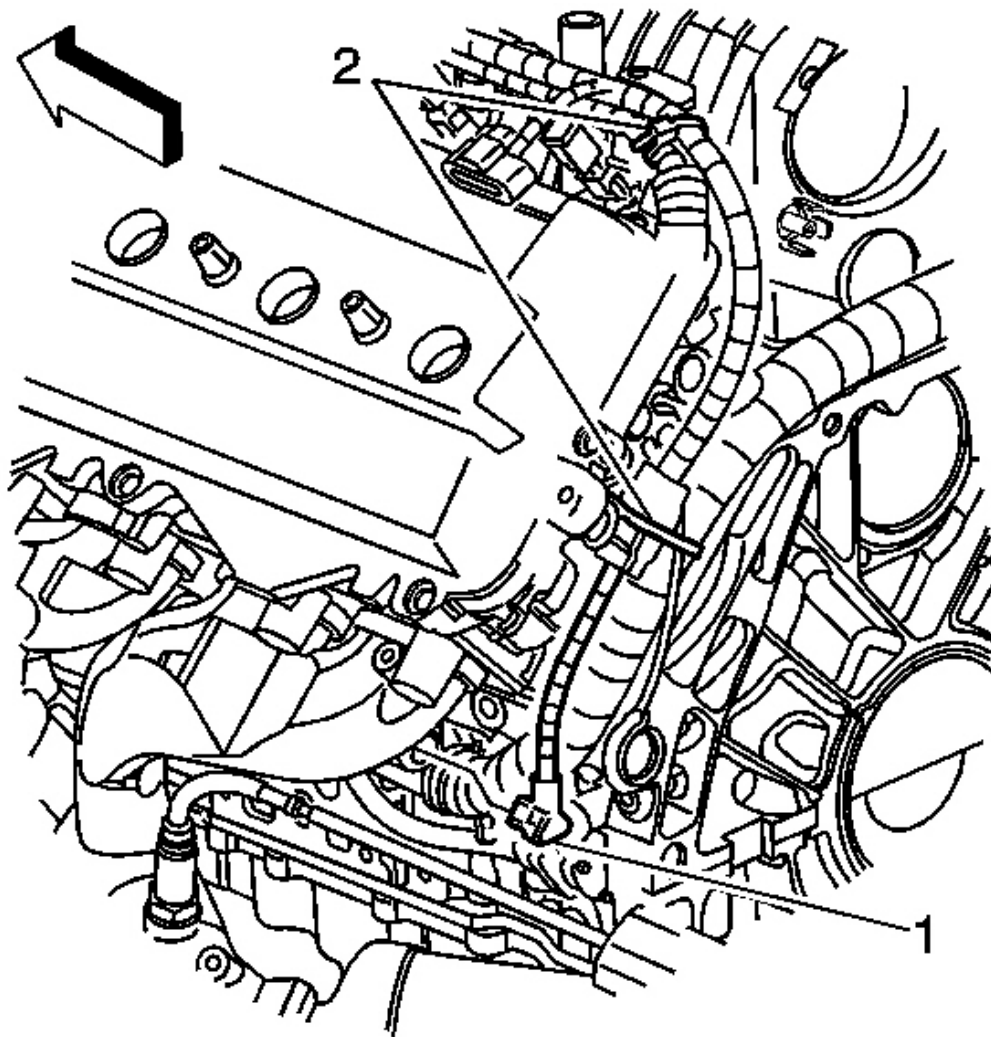


Fig. 229: Disconnecting/Connecting Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the engine coolant heater cord from the engine coolant heater (1).
3. Lower the vehicle.
4. Disconnect the coolant heater cord clips (2) from the wiring harness conduit.
5. Remove the engine coolant heater cord.

Installation Procedure

1. Position the coolant heater power supply cord to the engine.
2. Route the coolant heater cord along the engine wiring harness conduit.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

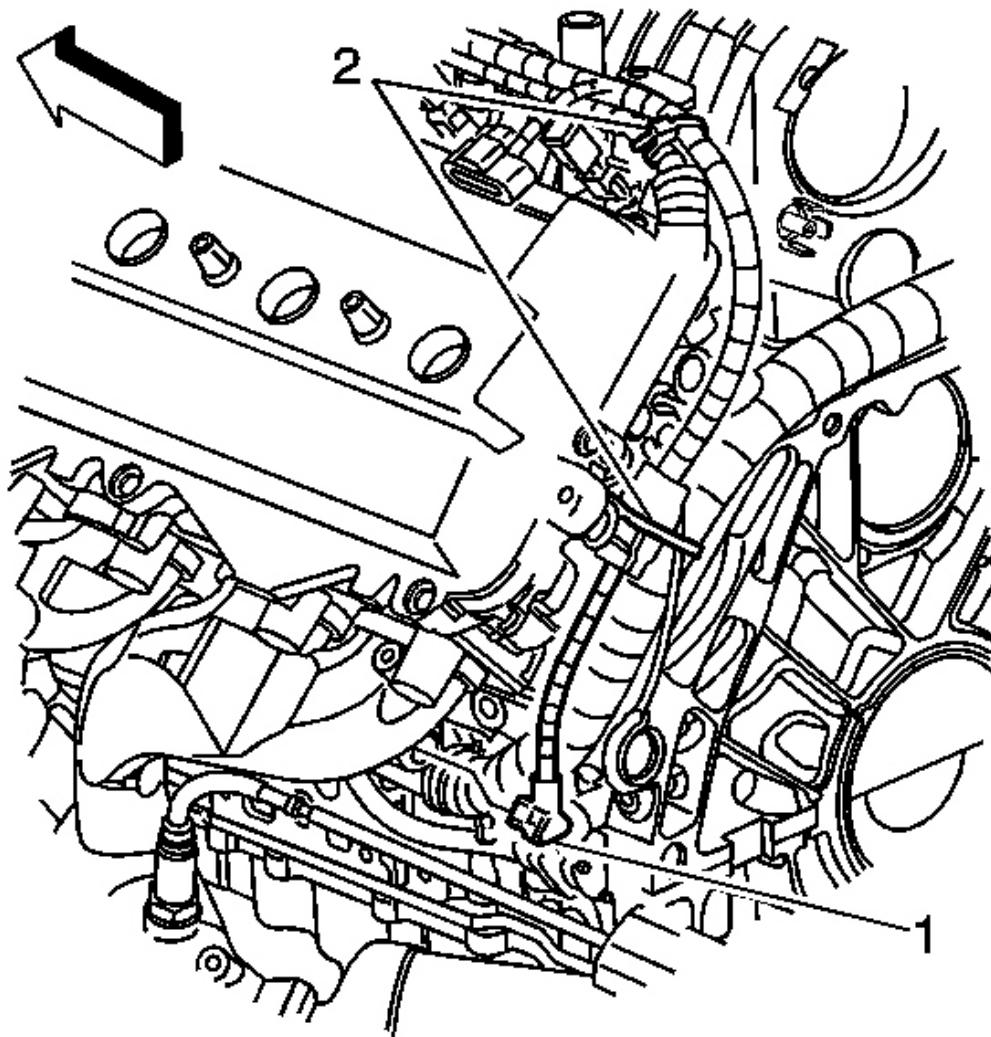


Fig. 230: Disconnecting/Connecting Coolant Heater Power Supply Cord
Courtesy of GENERAL MOTORS CORP.

4. Connect the coolant heater power cord to the heater.

5. Secure the coolant heater cord clip to the coolant cord.
6. Lower the vehicle.
7. Secure the coolant heater cord clips (2) to the engine wiring harness conduit.

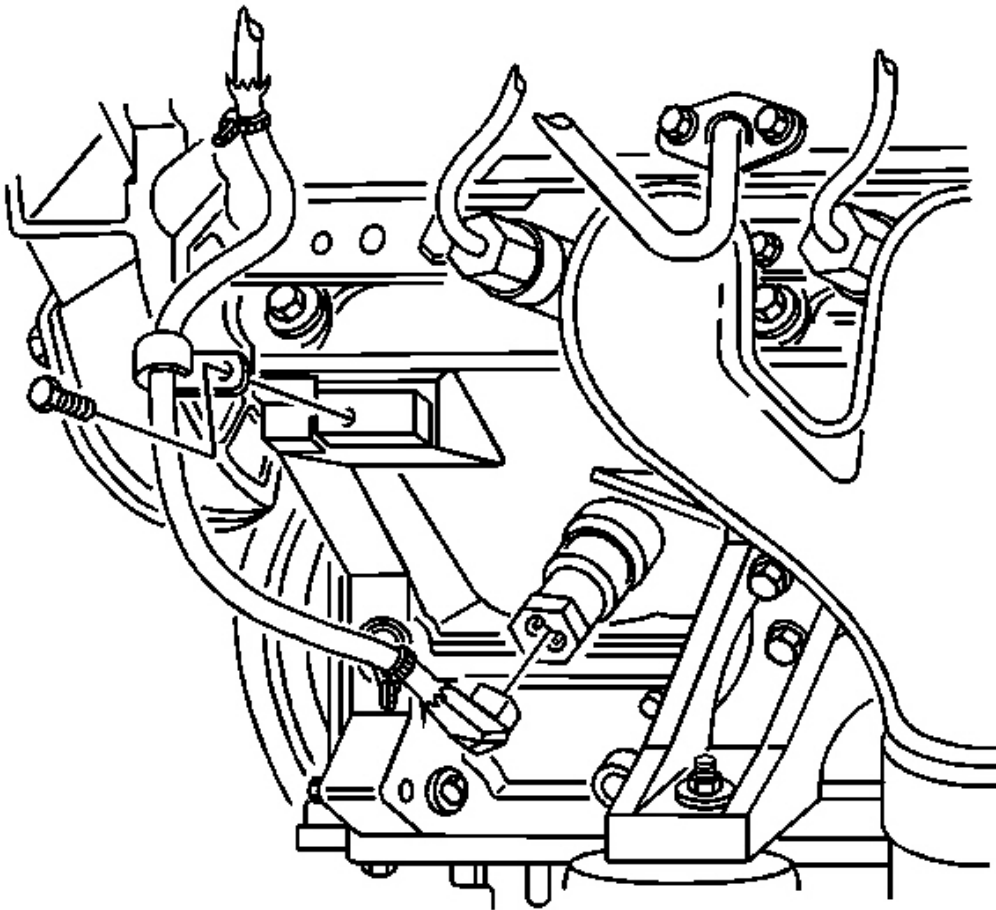


Fig. 231: Identifying Engine Coolant Heater Cord Clip Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

8. Install the engine coolant heater cord to the engine coolant heater (1).
9. Position the engine coolant heater cord clip and install the bolt.

Tighten: Tighten the engine coolant heater cord clip bolt to 32 N.m (24 lb ft).

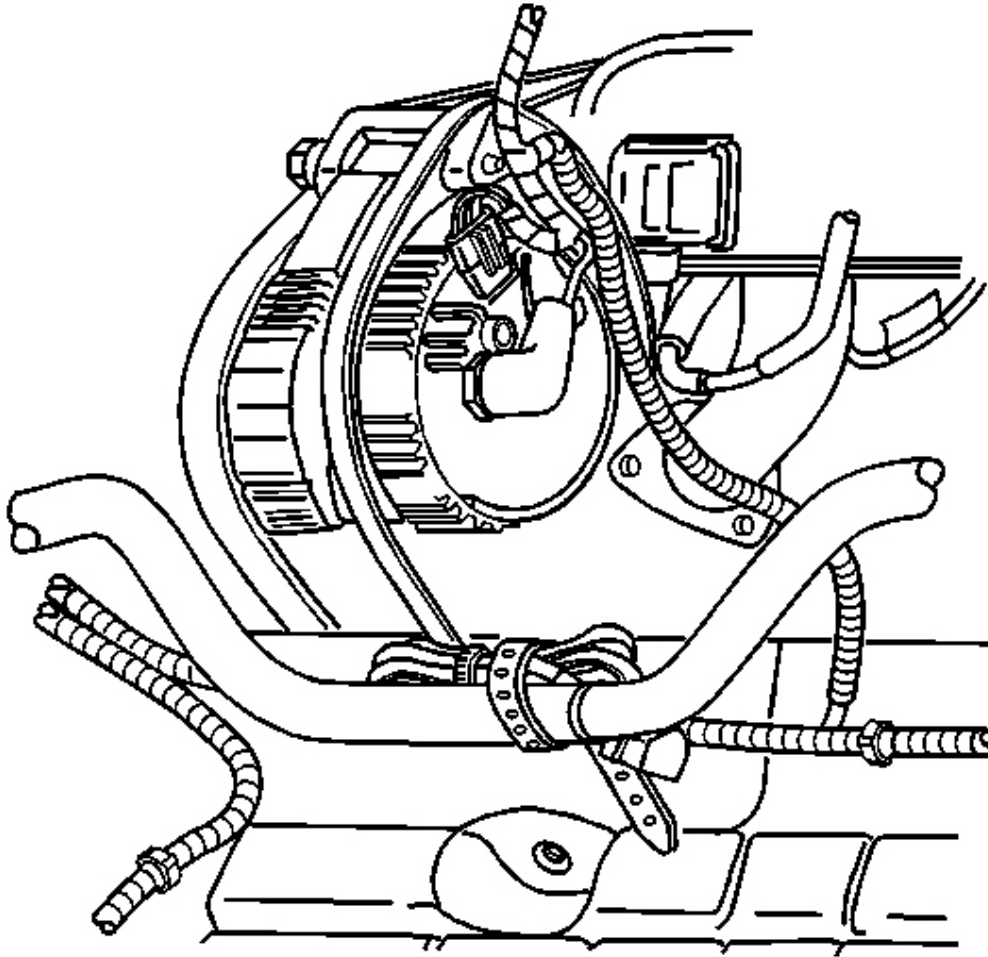


Fig. 232: Proper Routing Of Engine Coolant Heater Cord Over Generator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The engine coolant heater cord must not contact the engine, pipes, manifold or any moving parts. Always keep the electrical cord neatly rolled up with the plug end of the cord tucked into the center of the coil and secured in place with the supplied tie straps.

10. Route the engine coolant heater cord over the generator.
11. Coil the engine coolant heater cord into a bundle and secure the bundle to the secondary air injection hose pump with the strap.

DESCRIPTION AND OPERATION

COOLING SYSTEM DESCRIPTION AND OPERATION

Cooling Fan Control - Variable Speed Single Fan System

The engine cooling fan is a variable speed fan. The ECM controls the fan speed by sending a pulse width modulated signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal.

Cooling fan speed is effected by many different conditions and can be adjusted from 10% to 90% duty cycle (PWM), 90% is considered high speed fan. When multiple cooling fan speed requests are received the ECM uses the highest cooling fan speed of all the requests. The ECM commands the cooling fan ON under the following conditions:

- Cooling fan duty cycle starts when engine coolant temperature reaches approximately 95°C (204°F) and reaches high speed at temperatures above 113°C (235°F).
- Cooling fan duty cycle starts when A/C pressure reaches approximately 1100 kPa (160 psi) and reaches high speed at A/C pressures above 2480 kPa (360 psi).
- At engine oil temperatures above approximately 150°C (302°F) the cooling fan duty cycle will be commanded to high speed.
- At transmission oil temperatures above approximately 132°C (270°F) the cooling fan duty cycle will be commanded to high speed.
- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 113°C (235°F) or the A/C pressure is greater than 1720 kPa (249 psi) the cooling fan duty cycle is set to 50%, low speed. If the coolant temperature drops below 110°C (230°F) and the A/C pressure drops below 1660 kPa (241 psi) the fan will shut OFF. The fans will automatically shut OFF after 2 min. regardless of coolant temperature.

Low Coolant Message

The engine cooling system contains an engine coolant level switch to alert the driver in the event of a low coolant level. When the engine coolant level in the surge tank falls below a certain level, the coolant level switch opens. When the HVAC control module detects an open level on the coolant level indicator control circuit for at least 10 seconds, it will send a message to the IPC requesting display of the LOW COOLANT message. There is approximately a 10 second delay before the HVAC control module sends a class 2 message, to prevent the message from being displayed due to coolant sloshing in the surge tank. After the LOW COOLANT message has been triggered the message will be displayed for that entire ignition cycle.

Engine Coolant Indicator(s)

COOLANT OVER TEMP

The IPC illuminates the COOLANT OVER TEMP indicator in the message center when the following occurs:

- The PCM detects that the engine coolant temperature exceeds 124°C (256°F). The IPC receives a class 2

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message from the PCM indicating the high coolant temperature.

- The IPC will also illuminate the CHECK GAGES indicator and a chime sounds when this condition exists.

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

Coolant is also pumped through the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

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

Coolant is also directed to the throttle body. There it circulates through passages in the casting. During initial 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 it will flow through the thermostat and into the radiator where it 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.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a crossflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire assembly is then brazed forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks

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are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock which is located in the bottom of the passenger side tank. The drain cock includes the drain cock and drain cock seal.

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

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

Pressure Cap

The pressure cap is a cap that seals and pressurizes the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring and protects the radiator by relieving pressure if it exceeds 18 psi. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, could cause the radiator hoses to collapse.

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

Surge Tank

The surge tank is a plastic tank with a pressure cap mounted to it. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system. The air space allows the coolant to expand and contract. The surge tank also provides a coolant fill point and a central air bleed location.

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

Air Baffles and Seals

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing 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. It's purpose is to regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a piston. When the element is heated, it expands and exerts pressure against a rubber diaphragm. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below 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.

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.

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.

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 on the cord is provided to protect the plug when not in use.

SPECIAL TOOLS AND EQUIPMENT

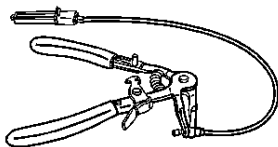
SPECIAL TOOLS

Special Tools

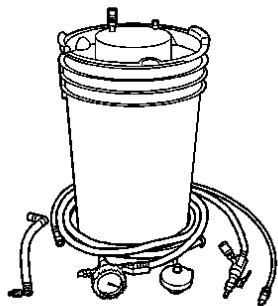
| Illustration | Tool Number/Description |
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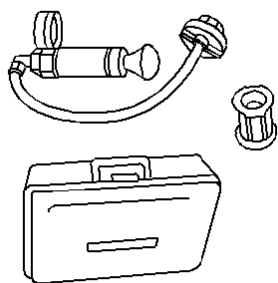
2006 ENGINE Engine Cooling - XLR



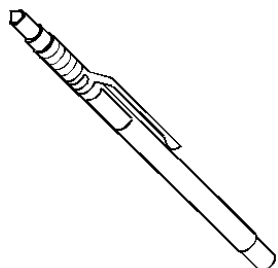
GE 47622
Hose Clamp Pliers



GE 47716
Vac N Fill Coolant Refill Tool



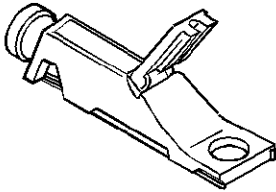
J 24460-01
Cooling System Pressure Tester



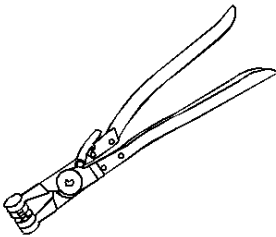
J 24731
Tempilstick

2006 Cadillac XLR

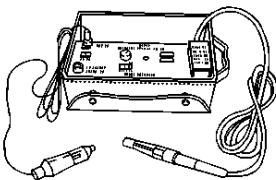
2006 ENGINE Engine Cooling - XLR



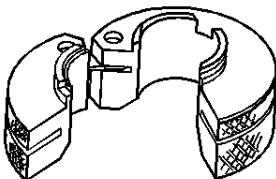
J 26568
Coolant and Battery Fluid Tester



J 38185
Hose Clamp Pliers



J 39400-A
Halogen Leak Detector



J 41623-B
Cooler Quick Connect Tool

J 42401
Radiator Cap and Surge Tank Test Adapter

2006 Cadillac XLR

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