

**2017 ELECTRICAL****Hybrid/EV System Heating and Cooling - CT6****SPECIFICATIONS****TEMPERATURE VERSUS RESISTANCE****B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1\***

| Temperature Degrees C (Degrees F) | Resistance k ohm (typical) |
|-----------------------------------|----------------------------|
| -40Â°C (-40Â°F)                   | 75.5                       |
| -20Â°C (-4Â°F)                    | 21.6                       |
| 0Â°C (32Â°F)                      | 7.2                        |
| 20Â°C (68Â°F)                     | 2.7                        |
| 40Â°C (104Â°F)                    | 1.2                        |
| 60Â°C (140Â°F)                    | 0.550                      |
| 80Â°C (176Â°F)                    | 0.280                      |
| 100Â°C (212Â°F)                   | 0.155                      |
| 140Â°C (284Â°F)                   | 0.054                      |
| *Part # 55562530                  |                            |

**B32 Hybrid/EV Battery Temperature Sensor\***

| Temperature Degrees C (Degrees F) | Resistance k ohm (typical) |
|-----------------------------------|----------------------------|
| -40Â°C (-40Â°F)                   | 202                        |
| -20Â°C (-4Â°F)                    | 71.2                       |
| 0Â°C (32Â°F)                      | 27.8                       |
| 20Â°C (68Â°F)                     | 12.1                       |
| 40Â°C (104Â°F)                    | 5.8                        |
| 60Â°C (140Â°F)                    | 3                          |
| 80Â°C (176Â°F)                    | 1.7                        |
| 90Â°C (194Â°F)                    | 1.2                        |
| *Part # 23348948                  |                            |

**B202 Hybrid/EV Electronics Coolant Temperature Sensor\***

| Temperature Degrees C (Degrees F) | Resistance k ohm (typical) |
|-----------------------------------|----------------------------|
| -40Â°C (-40Â°F)                   | 45                         |
| -20Â°C (-4Â°F)                    | 15                         |
| 0Â°C (32Â°F)                      | 5.8                        |
| 20Â°C (68Â°F)                     | 2.5                        |
| 40Â°C (104Â°F)                    | 1.2                        |
| 60Â°C (140Â°F)                    | 0.595                      |
| 80Â°C (176Â°F)                    | 0.323                      |
| 100Â°C (212Â°F)                   | 0.187                      |
| 150Â°C (302Â°F)                   | 0.057                      |
| *Part # 12641072                  |                            |

**FASTENER SPECIFICATIONS****Reusable Threaded Fastener Tightening Specifications****NOTE:**

*All fasteners listed in this table can be reused after removal.*

| <b>NOTE:</b>                                                           |                         |
|------------------------------------------------------------------------|-------------------------|
| <b>Application</b>                                                     | <b>Specification</b>    |
|                                                                        | <b>Metric (English)</b> |
| <i>All fasteners listed in this table can be reused after removal.</i> |                         |
| <b>Application</b>                                                     | <b>Specification</b>    |
|                                                                        | <b>Metric (English)</b> |
| Drive Motor Battery Coolant/Air Separator Bolt                         | 9 N.m (80 lb in)        |
| Drive Motor Battery Coolant Cooler Bracket Nut                         | 22 N.m (16 lb ft)       |
| Drive Motor Battery Coolant Cooler Nut                                 | 9 N.m (80 lb in)        |
| Drive Motor Battery Coolant Pump Bolt                                  | 9 N.m (80 lb in)        |
| Drive Motor Generator Control Module Coolant Pump Hose Bolt            | 9 N.m (80 lb in)        |
| Drive Motor Generator Control Module Radiator Inlet Hose Bolt          | 9 N.m (80 lb in)        |
| Drive Motor Generator Control Module Radiator Outlet Hose Bolt         | 9 N.m (80 lb in)        |
| Generator Control Module Coolant/Air Separator Bolt                    | 9 N.m (80 lb in)        |
| Generator Control Module Coolant Pump Bracket Bolt                     | 9 N.m (80 lb in)        |
| Generator Control Module Coolant Pump Bracket Nut                      | 9 N.m (80 lb in)        |
| Generator Control Module Coolant Radiator Bracket Nut                  | 9 N.m (80 lb in)        |
| Water Inlet Nut                                                        | 9 N.m (80 lb in)        |

## APPROXIMATE FLUID CAPACITIES

| <b>Application</b>                | <b>Specification</b> |                   |
|-----------------------------------|----------------------|-------------------|
|                                   | <b>Metric</b>        | <b>US English</b> |
| Cooling Systems                   |                      |                   |
| High Voltage Battery Pack Cooling | 3.05 L               | 3.2 qt            |
| Power Electronics Cooling         | 4.0 L                | 4.2 qt            |

## ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

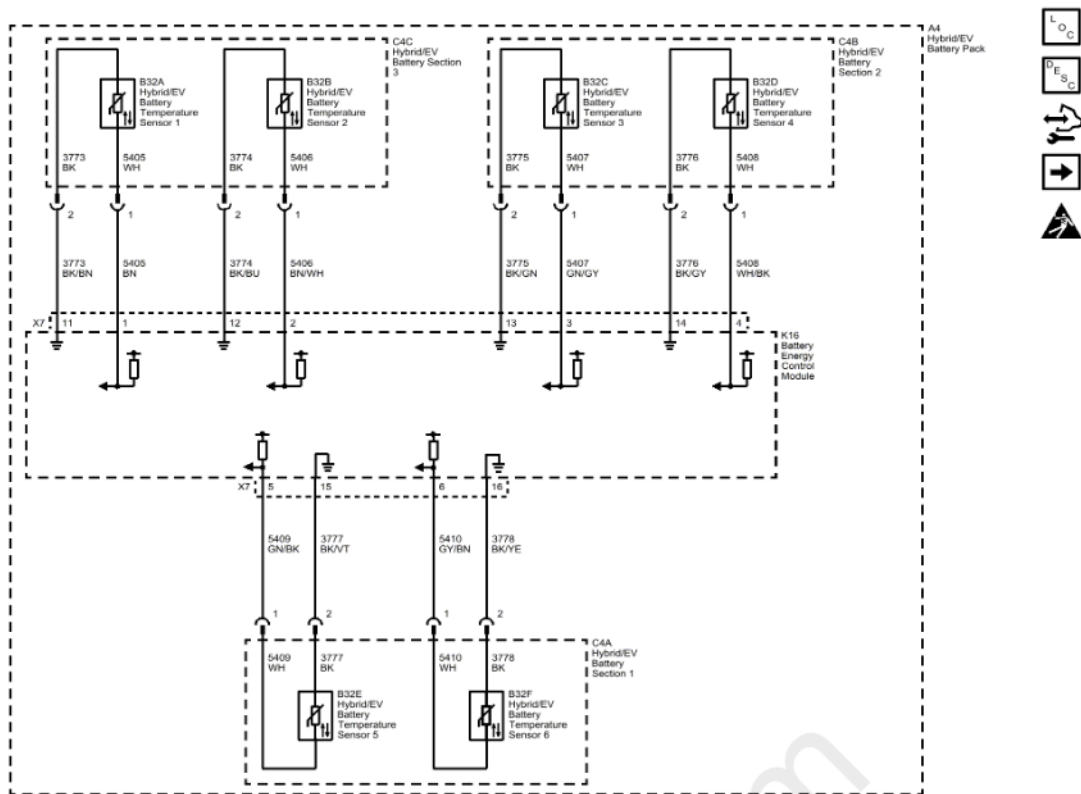
| <b>Application</b>                             | <b>Type of Material</b> | <b>GM Part Number</b> |               |
|------------------------------------------------|-------------------------|-----------------------|---------------|
|                                                |                         | <b>United States</b>  | <b>Canada</b> |
| DEX-COOLÂ® (Premix 50/50 with Deionized Water) | Coolant                 | 12378390              | 10953456      |

## SCHEMATIC WIRING DIAGRAMS

### HYBRID/EV COOLING WIRING SCHEMATICS

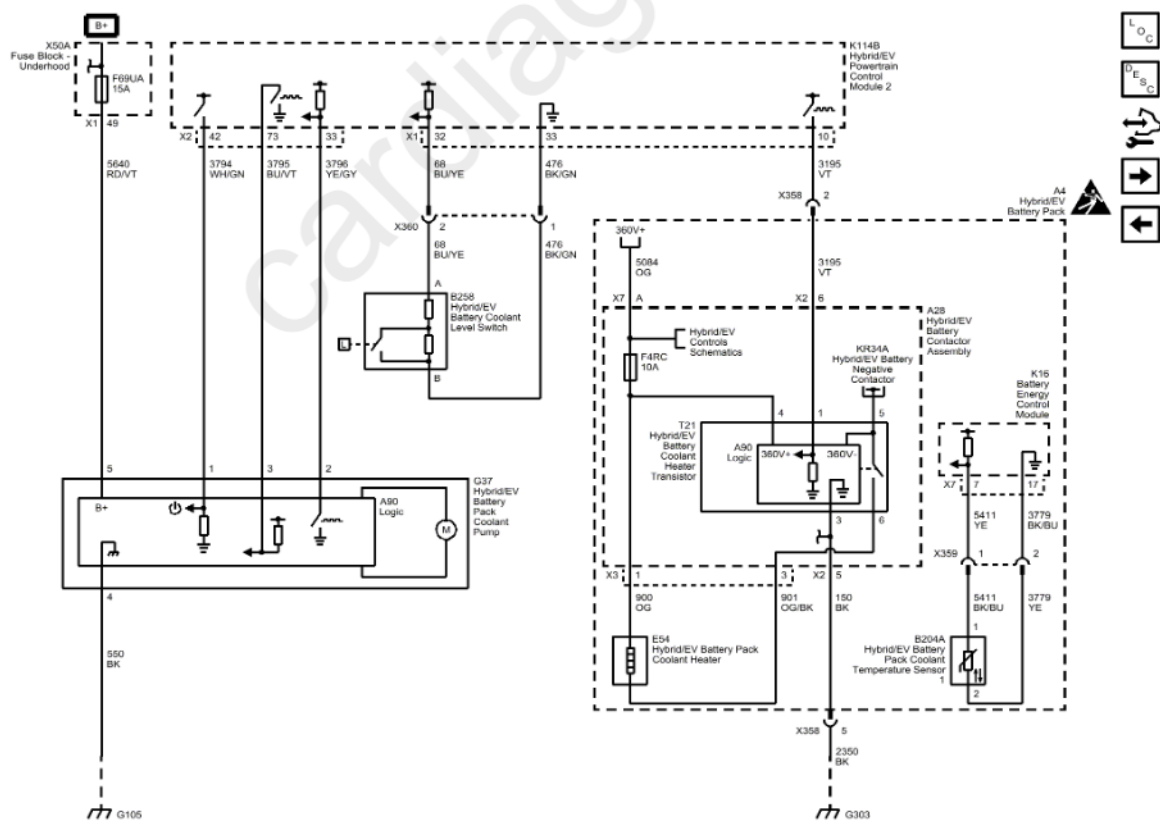
Hybrid/EV Battery Modules - Temperature Sensors 1 through 6





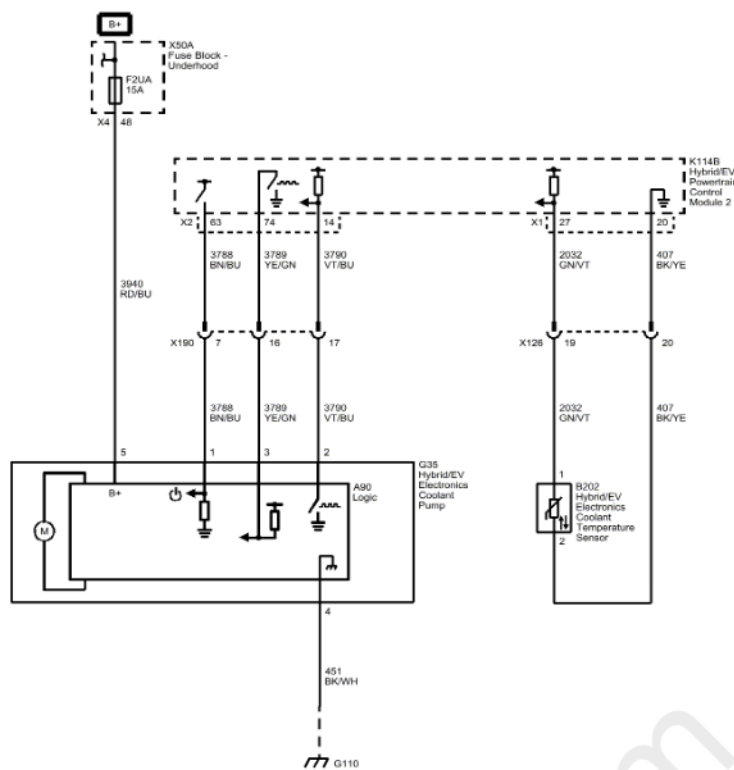
**Fig. 1: Hybrid/EV Battery Modules - Temperature Sensors 1 through 6**  
Courtesy of GENERAL MOTORS COMPANY

### Hybrid/EV Battery Pack Cooling



**Fig. 2: Hybrid/EV Battery Pack Cooling**  
Courtesy of GENERAL MOTORS COMPANY

### Hybrid/EV Electronics Cooling



**Fig. 3: Hybrid/EV Electronics Cooling**

Courtesy of GENERAL MOTORS COMPANY

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DTC P0480: COOLING FAN RELAY 1 CONTROL CIRCUIT

#### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

#### DTC Descriptors

#### DTC P0480

Cooling Fan Relay 1 Control Circuit

#### Circuit/System Description

The radiator cooling fan is controlled with a pulse width modulated (PWM) signal on the cooling fan relay control circuit from the hybrid/EV powertrain control module 2. Although the hybrid/EV powertrain control module 2 is directly connected to the cooling fan, the ECM is considered the master controller. The ECM sends a fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan signal hardwire circuit. The hybrid/EV powertrain control module 2 operates in a pass-through mode for any ECM-derived fan request. The higher the duty cycle the higher the cooling fan speed.

When the ECM is awake and there are no faults, the hybrid/EV powertrain control module 2 sends its cooling fan requests to the ECM via serial data. The ECM uses this request and other vehicle inputs to decide if and what speed the cooling fan should operate. The ECM sends a processed cooling fan signal command back to the hybrid/EV powertrain control module 2 via a PWM signal. The hybrid/EV powertrain control module 2 sends the fan relay control PWM signal to the cooling fan to operate and at what speed.

If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fan to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will directly control the cooling fan. If active cooling is needed, the ECM wakes up to operate the air conditioning control module and then the ECM is the master controller for the fan.

### **Conditions for Running the DTC**

The 12 V battery voltage is greater than or equal to 10.2 V.

### **Conditions for Setting the DTC**

The hybrid/EV powertrain control module 2 has detected an open, short to ground or short to voltage fault on the fan relay control circuit.

### **Action Taken When the DTC Sets**

DTC P0480 is a type B DTC.

### **Conditions for Clearing the DTC**

DTC P0480 is a type B DTC.

### **Reference Information**

Schematic Reference

### **Engine Heating/Cooling Schematics**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

### **Circuit/System Verification**

1. Vehicle in Service Mode.
2. Verify that the cooling fan is operating at a high speed when commanding the Cooling Fan Motor Command to 90% with a scan tool.
  - **If not operating at a high speed**  
Refer to Circuit/System Testing.
  - **If operating as commanded**
3. Verify that the cooling fan is operating at a low speed when commanding the Cooling Fan Motor Command to 20% with a scan tool.

- **If not operating at a low speed**

Refer to Circuit/System Testing.

- **If operating as commanded**

4. All OK.

### Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G10 Cooling Fan Motor.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 2 and ground.

- **If 10  $\Omega$  or greater**

Repair the open/high resistance in the circuit.

- **If less than 10  $\Omega$**

3. Connect a test lamp between the B+ circuit terminal 1 and ground.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the G10 Cooling Fan Motor and the fuse.

- **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.
6. Verify the test lamp changes between dim (20%) and bright (90%) when commanding the Cooling Fan Motor Command ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp changes illumination between bright (90%) and dim (20%)**

7. Replace the G10 cooling fan motor.

### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- [Engine Coolant Fan Shroud Replacement \(LGW LGX LTG\)](#) for G10 cooling fan motor replacement
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

## **DTC P0A7E: HYBRID/EV BATTERY PACK HIGH TEMPERATURE**

### **Diagnostic Instructions**

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

### **DTC Descriptors**

#### **DTC P0A7E**

Hybrid/EV Battery Pack High Temperature

### **Circuit/System Description**

The hybrid/EV battery pack has 6 hybrid/EV battery module temperature sensors. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to determine the hybrid/EV battery module temperature to control the energy storage cooling system operation.

The energy storage system cooling system uses a 12 V hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the electric A/C compressor motor control module assembly to cool down the high voltage hybrid/EV battery.

### **Conditions for Running the DTC**

- The hybrid/EV powertrain control module 2 and hybrid/EV battery energy control module are awake and communicating.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36 or U179C.

### **Conditions for Setting the DTC**

The maximum sensed temperature in the hybrid/EV battery is greater than 54°C (129.2°F).

### **Action Taken When the DTC Sets**

- DTC P0A7E is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

### **Conditions for Clearing the DTC**

DTC P0A7E is a type A DTC.

### **Reference Information**

Schematic Reference

### **Hybrid/EV Cooling Schematics**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**



## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

### **Circuit/System Verification**

1. Vehicle in Service Mode.
2. Verify that DTC P0480, P0534, P0C47, P148A-P148C, P1EC6, P1E8C or P1E8D is not set.
  - **If any DTC is set**  
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
  - **If none of the DTCs are set**
3. Test for proper coolant level and operation of the hybrid/EV battery coolant system, refrigerant system and coolant fan system. Refer to **High Voltage Battery Diagnostic**.

## **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5 OR P0C34-P0C36: HYBRID/EV BATTERY TEMPERATURE SENSOR**

### **Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

### **DTC Descriptors**

#### **DTC P0A9C**

Hybrid/EV Battery Temperature Sensor 1 Performance

#### **DTC P0A9D**

Hybrid/EV Battery Temperature Sensor 1 Circuit Low Voltage

#### **DTC P0A9E**

Hybrid/EV Battery Temperature Sensor 1 Circuit High Voltage

#### **DTC P0AC6**

Hybrid/EV Battery Temperature Sensor 2 Performance

#### **DTC P0AC7**

Hybrid/EV Battery Temperature Sensor 2 Circuit Low Voltage

#### **DTC P0AC8**

Hybrid/EV Battery Temperature Sensor 2 Circuit High Voltage

#### **DTC P0ACB**

Hybrid/EV Battery Temperature Sensor 3 Performance

#### **DTC P0ACC**

Hybrid/EV Battery Temperature Sensor 3 Circuit Low Voltage

#### **DTC P0ACD**



#### **DTC P0AE9**

Hybrid/EV Battery Temperature Sensor 4 Performance

#### **DTC P0AEA**

Hybrid/EV Battery Temperature Sensor 4 Circuit Low Voltage

#### **DTC P0AEB**

Hybrid/EV Battery Temperature Sensor 4 Circuit High Voltage

#### **DTC P0BC3**

Hybrid/EV Battery Temperature Sensor 5 Performance

#### **DTC P0BC4**

Hybrid/EV Battery Temperature Sensor 5 Circuit Low Voltage

#### **DTC P0BC5**

Hybrid/EV Battery Temperature Sensor 5 Circuit High Voltage

#### **DTC P0C34**

Hybrid/EV Battery Temperature Sensor 6 Performance

#### **DTC P0C35**

Hybrid/EV Battery Temperature Sensor 6 Circuit Low Voltage

#### **DTC P0C36**

Hybrid/EV Battery Temperature Sensor 6 Circuit High Voltage

#### **Circuit/System Description**

The hybrid/EV battery temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery cell groups. The hybrid/EV battery interface control module supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery temperature sensor resistance changes with battery temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to control the battery cooling system operation.

#### **Conditions for Running the DTC**

**P0A9D, P0A9E, P0AC7, P0AC8, P0ACC, P0ACD, P0AEA, P0AEB, P0BC4, P0BC5, P0C35, P0C36 and P0C7E**

- The 12 V battery voltage is greater than 9 V.
- Hybrid/EV powertrain control module 2 and hybrid/EV battery energy control module are awake and communicating
- None of the following DTCs are set: P1E93, P1E99, P1E9F, P1EA5, P1E8E, P1E94, P1E9A or P1EA0

**P0A9C, P0AC6, P0ACB, P0AE9, P0BC3 and P0C34**

None of the following DTCs are set: P0A9D, P0A9E, P0A9F, P0AC7, P0AC8, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC4, P0BC5, P0C35, P0C36, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1,

P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, U2401, U2603, U2604, U2605, U2606.

### Conditions for Setting the DTC

#### **P0A9C, P0AC6, P0ACB, P0AE9, P0BC3 and P0C34**

The difference between a hybrid/EV battery temperature sensor and the average of all the other hybrid/EV battery temperature sensors is greater than 20Â°C (36Â°F).

#### **P0A9D, P0AC7, P0ACC, P0AEA, P0BC4 and P0C35**

The hybrid/EV battery temperature sensor is greater than 87.5Â°C (189.5Â°F).

#### **P0A9E, P0AC8, P0ACD, P0AEB, P0BC5 and P0C36**

The hybrid/EV battery temperature sensor is less than -40Â°C (-40Â°F).

### Action Taken When the DTC Sets

- DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35 and P0C36 are type B DTCs.
- If all sensors fail, the vehicle will operate in a reduced power mode with the engine running.

### Conditions for Clearing the DTC

DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35 and P0C36 are type B DTCs.

### Diagnostic Aids

Low or no coolant or refrigerant in the system may set a DTC P0A9D, P0AC7, P0ACC, P0AEA, P0BC4 or P0C35.

### Reference Information

Schematic Reference

- [Hybrid/EV Cooling Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

[Control Module References](#) for scan tool information

## EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

### Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0C47, P1E8C or P1EC6 is not set.

- If any DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- If none of the DTCs are set

3. Observe the scan tool Hybrid Battery 1-6 temperature parameters. The sensor readings should be between -39 and +87.5°C (-38.2 and +189.5°F) with less than a 20°C (36°F) difference between any of the temperature sensor readings. Refer to [Temperature Versus Resistance](#)

- If not within the specified range

Refer to Circuit/System Testing.

- If within the specified range

4. All OK.

### Circuit/System Testing

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Replace the High Voltage Battery assembly.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

### [High Voltage Battery Replacement and Shipping Preparation](#)

## DTC P0C43-P0C46: HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

### DTC Descriptors

## **DTC P0C43**

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Performance

## **DTC P0C44**

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Low Voltage

## **DTC P0C45**

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit High Voltage

## **DTC P0C46**

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Erratic

### **Circuit/System Description**

The hybrid/EV battery pack coolant temperature sensor is located in the coolant inlet of the hybrid/EV battery. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery coolant. The hybrid/EV battery pack coolant temperature sensor resistance changes with battery coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The battery energy control module uses the hybrid/EV battery temperature sensor to determine the hybrid/EV battery pack temperature to control the battery cooling and heating operations.

### **Conditions for Running the DTC**

#### **P0C43**

- Vehicle ON after all high voltage contactor relays had been Open for 4 hours.
- The 12 V battery voltage is greater than 10.2 V.
- None of the following DTCs are set: P0C44, P0C45, P0C46, P0C47, P0A9C, P0A9D, P0A9E, P1E8C, P1E8D, P19FD, P19FE, P19FF or U0111.

#### **P0C44**

- The 12 V battery voltage is greater than 9 V.
- Battery energy control module is awake and communicating.

#### **P0C45**

- The 12 V battery voltage is greater than 9 V.
- Battery energy control module is awake and communicating.

#### **P0C46**

- The 12 V battery voltage is greater than 10.2 V.
- Battery energy control module is awake and communicating.
- None of the following DTCs are set: DTC P0C44, P0C45 or U185A.

### **Conditions for Setting the DTC**

#### **P0C43**

The hybrid/EV battery pack coolant temperature sensor reading is not within 30Â°C (54Â°F) of the outside air temperature AND is not within 32Â°C (58Â°F) of the Average Hybrid Battery Pack Temperature.

#### **P0C44**

The hybrid/EV battery pack coolant temperature sensor 1 is greater than 87.9Â°C (190Â°F).

## **P0C45**

The hybrid/EV battery pack coolant temperature sensor 1 is less than  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ).

## **P0C46**

The hybrid/EV battery pack coolant temperature sensor is intermittent or has changed by  $64^{\circ}\text{C}$  ( $115^{\circ}\text{F}$ ) or greater within 4 seconds.

### **Action Taken When the DTC Sets**

- DTC P0C43-P0C46 are type B DTCs.
- The active heating mode is disabled.
- The hybrid/EV battery pack coolant pump is commanded to a fixed speed.

### **Conditions for Clearing the DTC**

DTC P0C43-P0C46 are type B DTCs.

### **Diagnostic Aids**

- Low or no coolant or refrigerant in the system may set a DTC P0C43.
- DTC P0C43-P0C46 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below  $-25^{\circ}\text{C}$  ( $-13^{\circ}\text{F}$ ).

### **Reference Information**

Schematic Reference

- [Hybrid/EV Cooling Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

**EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

### **Circuit/System Verification**



1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 parameter is between -40 and +87.9°C (-40 and +190°F).
  - **If not within the specified range**  
  
Refer to Circuit/System Testing.
  - **If within the specified range**
3. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor and Outside Air Temperature Sensor parameters are within 30°C (54°F) of each other after the vehicle has been OFF and not charging for 4 hours or greater.
  - **If not within the specified range**  
  
Refer to Circuit/System Testing.
  - **If within the specified range**
4. All OK.

### Circuit/System Testing

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Replace the High Voltage Battery assembly.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

### [High Voltage Battery Replacement and Shipping Preparation](#)

## DTC P0C47, P1E8C OR P1E8D: HYBRID/EV BATTERY PACK COOLANT PUMP

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

## DTC Descriptors

### DTC P0C47

Hybrid/EV Battery Pack Coolant Pump Control Circuit

### DTC P1E8C

Hybrid/EV Battery Pack Coolant Pump Enable Circuit Low Voltage

### DTC P1E8D

Hybrid/EV Battery Pack Coolant Pump Enable Circuit High Voltage

## Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

## Conditions for Running the DTC

### P0C47

The 12 V battery voltage is greater than or equal to 10.2 V.

### P1E8C

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.

### P1E8D

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled.

## Conditions for Setting the DTC

### P0C47

The hybrid/EV powertrain control module 2 detects the Coolant Pump Control circuit is open, shorted to voltage or shorted to ground.

### P1E8C

The hybrid/EV powertrain control module 2 detects the Coolant Pump Enable circuit is shorted to ground.

### P1E8D

The hybrid/EV powertrain control module 2 detects the Coolant Pump Enable circuit is open or shorted to voltage.

### Action Taken When the DTC Sets

- DTCs P0C47, P1E8C and P1E8D are type B DTCs.
- Hybrid/EV battery pack active heating and active cooling are disabled.

### Conditions for Clearing the DTC

DTCs P0C47, P1E8C and P1E8D are type B DTCs.

### Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to  $-37^{\circ}\text{C}$  ( $-34^{\circ}\text{F}$ ).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### Coolant Pump Feedback Parameter

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication                                     |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 0%                                                                            | Pump has lost power/ground, feedback circuit open or Vehicle is On* |
| 10%                                                                           | Pump Under Voltage detected*                                        |
| 20%                                                                           | Pump Under/Over Current detected*                                   |
| 30%                                                                           | Blocked or Dry pump detected*                                       |
| 45-55%                                                                        | Normal operation, actual pump speed provided by circuit frequency   |
| 80%                                                                           | Pump Over Voltage detected*                                         |
| 90%                                                                           | Pump Over Temperature detected*                                     |
| 100%                                                                          | Feedback circuit shorted to ground*                                 |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                                                     |

### Reference Information

Schematic Reference

### Hybrid/EV Cooling Schematics

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

### Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

## Control Module References for scan tool information

### Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B or U2602 is not set.

- **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.

- Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
- Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
- Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**

4. All OK.

### Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.

- **If 5  $\Omega$  or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5  $\Omega$**

3. Vehicle On.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$  and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20-90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the pump enable circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2  $\Omega$  in the pump enable circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (90%)**

10. Remove the test lamp.

11. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.

13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the feedback circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Test for less than 2  $\Omega$  in the feedback circuit end to end.



- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

## Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P0CE9, P1F44 OR P1F45: HYBRID/EV ELECTRONICS COOLANT PUMP

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0CE9

Hybrid/EV Electronics Coolant Pump Control Circuit

#### DTC P1F44

Hybrid/EV Electronics Coolant Pump Enable Circuit Low Voltage

#### DTC P1F45

Hybrid/EV Electronics Coolant Pump Enable Circuit High Voltage

### Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger and the 14 V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

### Conditions for Running the DTC

#### P0CE9

The 12 V battery voltage is greater than 10.2 V.

#### P1F44

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV electronics coolant pump is enabled.

## P1F45

- The 12 V battery voltage is greater than 10.2 V.
- The Hybrid/EV electronics coolant pump is disabled.

### Conditions for Setting the DTC

## P0CE9

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Control circuit is open, shorted to voltage or shorted to ground.

## P1F44

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Enable circuit is shorted to ground.

## P1F45

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Enable circuit is open or shorted to voltage.

### Action Taken When the DTC Sets

DTCs P0CE9, P1F44 and P1F45 are a Type B DTCs.

### Conditions for Clearing the DTC

DTCs P0CE9, P1F44 and P1F45 are a Type B DTCs.

### Diagnostic Aids

- DTC P1F44 and P1F45 may cause DTC P0CE9 to set.
- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to  $-37^{\circ}\text{C}$  ( $-34^{\circ}\text{F}$ ).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### Coolant Pump Feedback Parameter

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication                                     |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 0%                                                                            | Pump has lost power/ground, feedback circuit open or Vehicle is On* |
| 10%                                                                           | Pump Under Voltage detected*                                        |
| 20%                                                                           | Pump Under/Over Current detected*                                   |
| 30%                                                                           | Blocked or Dry pump detected*                                       |
| 45-55%                                                                        | Normal operation, actual pump speed provided by circuit frequency   |
| 80%                                                                           | Pump Over Voltage detected*                                         |
| 90%                                                                           | Pump Over Temperature detected*                                     |
| 100%                                                                          | Feedback circuit shorted to ground*                                 |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                                                     |

### Reference Information

Schematic Reference

### Hybrid/EV Cooling Schematics

Connector End View Reference

Description and Operation

**Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

**Circuit/System Verification**

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P0C47 or P1EC6 is not set.
  - **If any of the DTCs are set**  
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
  - **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.
  - Hybrid/EV Electronics Coolant Pump Command to be 10% or greater
  - Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%
  - Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
  - **The scan tool parameters listed are not within the specified ranges**  
Refer to Circuit/System Testing.
  - **The scan tool parameters listed are within the specified range**
4. All OK.

**Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.
  - **If 5  $\Omega$  or greater**  
Repair the open/high resistance on the ground circuit.
  - **If less than 5  $\Omega$**
3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
  - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If  $2\ \Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than  $2\ \Omega$  and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
- **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
  6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
    - **If the test lamp is ON**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
      2. Test for less than 1 V between the pump enable circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is OFF**
  7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV electronics coolant pump ON (20-90%) with a scan tool if necessary.
    - **If the test lamp is OFF**
  8. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    1. Test for infinite resistance between the pump enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    2. Test for less than  $2\ \Omega$  in the pump enable circuit end to end.
      - If  $2\ \Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than  $2\ \Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is ON**
  9. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
  10. Verify the test lamp changes illumination between bright (20%) and dim (90%) when commanding the hybrid/EV electronics coolant pump ON between 20% and 90% with a scan tool.
    - **If the test lamp is always dim or does not illuminate**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Test for less than  $2\ \Omega$  in the control circuit end to end.
        - If  $2\ \Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than  $2\ \Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is always bright**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **The test lamp changes illumination between bright (20%) and dim (90%)**
  11. Remove the test lamp.
  12. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.
    - **If greater than 0%**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for infinite resistance between the feedback circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If 0%**
13. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
  14. Verify the scan tool, Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.
    - **If 90% or less**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for less than 1 V between the feedback circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Test for less than 2  $\Omega$  in the feedback circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
  15. Replace the G35 Hybrid/EV Electronics Coolant Pump.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Generator Control Module Coolant Pump Replacement](#) for Hybrid/EV electronics coolant pump replacement
- [Control Module References](#) for G35 hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P0CEF-P0CF2: HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR

### Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

### DTC Descriptor

#### DTC P0CEF

Hybrid/EV Electronics Coolant Temperature Sensor Performance

#### DTC P0CF0

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Low Voltage

#### DTC P0CF1

Hybrid/EV Electronics Coolant Temperature Sensor Circuit High Voltage

#### DTC P0CF2

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Erratic

### Circuit/System Description

The hybrid/EV electronics coolant temperature sensor is located in the electronics coolant radiator assembly. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV electronics coolant. The hybrid/EV electronics coolant temperature sensor resistance changes with



coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The hybrid/EV powertrain control module 2 uses the hybrid/EV electronics coolant temperature sensor to determine the hybrid/EV electronics temperature to control the hybrid/EV electronics cooling operation.

### Conditions for Running the DTC

#### P0CEF

- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle ON for less than 20 seconds.
- Propulsion system inactive time is greater than 1 hour.
- Hybrid/EV electronics coolant pump off soak time is greater than 1 hour.
- Air Conditioning compressor off soak time is greater than 2 hours.
- On Board Charger module off soak time is greater than 1 hour.
- None of the following DTCs are set; P0071-P0074, P0532, P0533, P0606, P0711-P0713, P0CF0, P0CF1, P0CF2, P0CE9, P1F44 or P1F45.

#### P0CF0, P0CF1 and P0CF2

- Vehicle ON.
- The 12 V battery voltage is greater than or equal to 10.2 V.

### Conditions for Setting the DTC

#### P0CEF

- The hybrid/EV electronics coolant temperature does not fall within  $20^{\circ}\text{C}$  ( $36^{\circ}\text{F}$ ) of the outside air temperature.

AND

- The hybrid/EV electronics coolant temperature does not fall within  $32^{\circ}\text{C}$  ( $57.6^{\circ}\text{F}$ ) of the transmission fluid temperature.

AND

- The hybrid/EV electronics coolant temperature does not fall within  $28^{\circ}\text{C}$  ( $50^{\circ}\text{F}$ ) of the air conditioning high side pressure, converted to temperature.

#### P0CF0

The hybrid/EV electronics coolant temperature is greater than  $100^{\circ}\text{C}$  ( $212^{\circ}\text{F}$ ) indicating a circuit voltage less than 0.20 V.

#### P0CF1

The hybrid/EV electronics coolant temperature is less than  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) indicating a circuit voltage greater than 4.90 V.

#### P0CF2

- The hybrid/EV electronics coolant temperature is intermittent or has changed greater than  $90^{\circ}\text{C}$  ( $162^{\circ}\text{F}$ ).
- Condition exists for 4 seconds or more.

### Actions Taken When the DTC Sets

- P0CEF-P0CF2 are type B DTCs.
- The Hybrid/EV Electronics Coolant Pump is commanded to a fixed speed.
- The radiator cooling fan is commanded to a fixed speed.

## **Conditions for Clearing the DTC**

P0CEF-P0CF2 are type B DTCs.

## **Reference Information**

Schematic Reference

## **Hybrid/EV Cooling Schematics**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

## **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

## **Control Module References** for scan tool information

## **Circuit/System Verification**

1. Vehicle in Service Mode, verify that DTC P0CE9 is not set.
  - **If the DTC is set**  
Refer to **DTC P0CE9, P1F44 or P1F45**
  - **If the DTC is not set**
2. Verify the Hybrid Electronics Coolant Temperature is between -39 and +99Â°C (-38.2 and +210Â°F) with a scan tool.
  - **If not within the specified range**  
Refer to Circuit/System Testing.
  - **If within the specified range**
3. All OK.

## **Circuit/System Testing**

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
2. Test for less than 10  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 10  $\Omega$  or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.

- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
  - **If less than 10  $\Omega$**
3. Vehicle in Service Mode.
  4. Verify the scan tool Hybrid Electronics Coolant Temperature is less than  $-35^{\circ}\text{C}$  ( $-38.2^{\circ}\text{F}$ ).
    - **If  $-35^{\circ}\text{C}$  ( $-38.2^{\circ}\text{F}$ ) or greater**
      1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for infinite resistance between the signal circuit and the circuits listed below:
        - Low reference circuit
        - Chassis ground
        - If less than infinite resistance, repair the appropriate short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than  $-35^{\circ}\text{C}$  ( $-38.2^{\circ}\text{F}$ )**
  5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
  6. Verify the scan tool Hybrid Electronics Coolant Temperature is greater than  $99^{\circ}\text{C}$  ( $210^{\circ}\text{F}$ ).
    - **If less than  $99^{\circ}\text{C}$  ( $210^{\circ}\text{F}$ )**
      1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle ON.
      2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Vehicle OFF, test for less than 2  $\Omega$  in the signal circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If  $99^{\circ}\text{C}$  ( $210^{\circ}\text{F}$ ) or greater**
  7. Replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.

### Component Testing

1. Vehicle OFF, disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
2. Test for 2-2.5 k $\Omega$  at approximately  $21.11^{\circ}\text{C}$  ( $70^{\circ}\text{F}$ ) between the signal terminal and the low reference terminal. Refer to [Temperature Versus Resistance](#) for Hybrid/EV Electronics Coolant Temperature Sensor.
  - **If not within the specified range**  
 Replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
  - **If within the specified range**
3. All OK.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Temperature Sensor Replacement - Radiator Side](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P19FA-P19FC: HYBRID/EV ELECTRONICS COOLANT PUMP FEEDBACK CIRCUIT

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

## DTC Descriptors

### DTC P19FA

Hybrid/EV Electronics Coolant Pump Feedback Circuit High Frequency

### DTC P19FB

Hybrid/EV Electronics Coolant Pump Feedback Circuit Low Frequency

### DTC P19FC

Hybrid/EV Electronics Coolant Pump Feedback Circuit Performance

## Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger and the 14 V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

## Conditions for Running the DTC

### P19FA and P19FB

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11-90%.
- All above conditions met for at least 3 seconds.

### P19FC

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled for at least 10 seconds.
- DTC P19FC has not already failed when coolant pump was enabled.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11-90%.
- Hybrid/EV electronics coolant temperature sensor is greater than -30Â°C (-22Â°F).
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0CE9, P0CEF, P0CF0, P0CF1, P0CF2, P1F44 or P1F45.

## Conditions for Setting the DTC

### P19FA



The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

### **P19FB**

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

### **P19FC**

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 250 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11-90% PWM.

### **Action Taken When the DTC Sets**

DTCs P19FA, P19FB and P19FC are type B DTCs.

### **Conditions for Clearing the DTC**

DTCs P19FA, P19FB and P19FC are type B DTCs.

### **Diagnostic Aids**

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### **Coolant Pump Feedback Parameter**

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication                                     |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 0%                                                                            | Pump has lost power/ground, feedback circuit open or Vehicle is On* |
| 10%                                                                           | Pump Under Voltage detected*                                        |
| 20%                                                                           | Pump Under/Over Current detected*                                   |
| 30%                                                                           | Blocked or Dry pump detected*                                       |
| 45-55%                                                                        | Normal operation, actual pump speed provided by circuit frequency   |
| 80%                                                                           | Pump Over Voltage detected*                                         |
| 90%                                                                           | Pump Over Temperature detected*                                     |
| 100%                                                                          | Feedback circuit shorted to ground*                                 |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                                                     |

### **Reference Information**

Schematic Reference

### **Hybrid/EV Cooling Schematics**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation



### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

### DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

### Scan Tool Reference

### [Control Module References](#) for scan tool information

### Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46 or P0C47 is not set.
  - **If any DTC is set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
  - **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.
  - Hybrid/EV Electronics Coolant Pump Command to be 10% or greater.
  - Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%.
  - Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
  - **The scan tool parameters listed are not within the specified ranges**  
Refer to Circuit/System Testing.
  - **The scan tool parameters listed are within the specified ranges**
4. All OK.

### Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.
  - **If 5  $\Omega$  or greater**  
Repair the open/high resistance on the ground circuit.
  - **If less than 5  $\Omega$**
3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
  - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$  and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
  - **If less than B+**

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Electronics Coolant Pump ON (20-90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the pump enable circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Electronics Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (90%)**

10. Remove the test lamp.

11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the feedback circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.

13. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the feedback circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Replace the G35 Hybrid/EV Electronics Coolant Pump.

### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Control Module Coolant Pump Replacement** for G35 Hybrid/EV electronics coolant pump replacement.
- **Control Module References** for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P19FD-P19FF: HYBRID/EV BATTERY PACK COOLANT PUMP FEEDBACK CIRCUIT

### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

### DTC Descriptors

#### DTC P19FD

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit High Frequency

#### DTC P19FE

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Low Frequency

#### DTC P19FF

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Performance

### Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the

pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

### Conditions for Running the DTC

#### P19FD and P19FE

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11-90%.
- All above conditions met for at least 3 seconds.

#### P19FF

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled for at least 10 seconds.
- DTC P19FF has not already failed when coolant pump was enabled.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11-90%.
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0C43, P0C44, P0C45, P0C47, P1E8C, P1E8D, P19FD or P19FE.

### Conditions for Setting the DTC

#### P19FD

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

#### P19FE

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

#### P19FF

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 250 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11-90% PWM.

### Action Taken When the DTC Sets

- DTCs P19FD, P19FE and P19FF are type B DTCs.
- Hybrid/EV battery pack active heating and active cooling are disabled.

### Conditions for Clearing the DTC

DTCs P19FD, P19FE and P19FF are type B DTCs.

## Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to  $-37^{\circ}\text{C}$  ( $-34^{\circ}\text{F}$ ).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### Coolant Pump Feedback Parameter

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication                                                  |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 0%                                                                            | Pump has lost power/ground, feedback circuit open or Vehicle is in Service Mode* |
| 10%                                                                           | Pump Under Voltage detected*                                                     |
| 20%                                                                           | Pump Under/Over Current detected*                                                |
| 30%                                                                           | Blocked or Dry pump detected*                                                    |
| 45-55%                                                                        | Normal operation, actual pump speed provided by circuit frequency                |
| 80%                                                                           | Pump Over Voltage detected*                                                      |
| 90%                                                                           | Pump Over Temperature detected*                                                  |
| 100%                                                                          | Feedback circuit shorted to ground*                                              |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                                                                  |

## Reference Information

Schematic Reference

### Hybrid/EV Cooling Schematics

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

### Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information.

## Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B or U2602 is not set.
  - If any DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .



- **If none of the DTCs are set**

3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.

- Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
- Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
- Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**

4. All OK.

### Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.

2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.

- **If 5  $\Omega$  or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5  $\Omega$**

3. Vehicle in Service Mode.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$  and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle ON. Verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20-90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the pump enable circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (90%)**

10. Remove the test lamp.

11. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.

13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the feedback circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

## Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#) for G37 hybrid/EV battery pack coolant pump replacement.
- [Control Module References](#) for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P148A-P148C: COOLING FAN SIGNAL CIRCUIT

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

### DTC Descriptors

#### DTC P148A

Cooling Fan Signal Circuit Performance

#### DTC P148B

Cooling Fan Signal Circuit Low Voltage

#### DTC P148C

Cooling Fan Signal Circuit High Voltage

### Diagnostic Fault Information

| Circuit                                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Cooling Fan Speed Signal Circuit          | P148B, P1486    | P148A, P1485         | P148C, P1487     | -                  |
| Fans operate at 90% with all malfunctions |                 |                      |                  |                    |

### Circuit/System Description

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. When propulsion is active, the engine control module (ECM) processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The ECM decides if and at what speed the cooling fans should operate. The ECM sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans without ECM intervention.

The ECM communicates the fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan speed signal circuit/hardwire circuit and also sends a redundant serial data signal. Since the hardwire circuit is an output from the ECM but an input to the hybrid/EV powertrain control module 2, each module has unique DTCs to monitor the same circuit.

### Conditions for Running the DTC

#### P148A

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is active for more than 43 seconds.
- The cooling fan speed request has not changed by greater than 5% for at least 43 seconds.
- None of the following DTCs are set: P148B, P148C or U0293.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fans are enabled for more than 43 seconds.

- The cooling fan speed request has not changed by greater than 5% for at least 43 seconds.
- None of the following DTCs are set: P148B, P148C or U0293.

### **P148B**

The 12 V battery voltage is greater than or equal to 10.2 V.

### **P148C**

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is active for more than 43 seconds.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fans are enabled for more than 43 seconds.

### **Conditions for Setting the DTC**

### **P148A**

The PWM cooling fan signal circuit duty cycle request from engine control module (Hardwire) is not within 30% of the redundant engine cooling fan speed sent to the hybrid/EV powertrain control module 2 via serial data.

### **P148B**

The hybrid/EV powertrain control module 2 has detected a duty cycle of less than 3% from the engine control module.

### **P148C**

The hybrid/EV powertrain control module 2 has detected a duty cycle of greater than 97% from the engine control module.

### **Action Taken When the DTC Sets**

DTCs P148A, P148B and P148C are type B DTCs.

### **Conditions for Clearing the DTC**

DTCs P148A, P148B and P148C are type B DTCs.

### **Reference Information**

Schematic Reference

### **Engine Heating/Cooling Schematics**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**



- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### [Circuit/System Verification](#)

1. Vehicle ON.
2. Verify DTC P1485, P1486, P1487, P148A, P148B or P148C is not set.
  - **If the DTC is set**  
Refer to Circuit/System Testing.
  - **If the DTC is not set**
3. All OK.

### [Circuit/System Testing](#)

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
2. Test for 3-4 V between the cooling fan circuit terminal 9 and ground.

**NOTE:** The cooling fan circuit is pulled up to a voltage within the ECM. 3-4 V measured on this circuit with the hybrid/EV powertrain control module 2 disconnected is normal.

- **If less than 3 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the cooling fan circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
  - **If 4 V or greater**
    1. Vehicle OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the cooling fan circuit and ground.
      - If greater than 1 V, repair the short to voltage on the circuit.
      - If 1 V or less, replace the K20 Engine Control Module.
  - **If 3-4 V**
3. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
  4. Reconnect the K114B Hybrid/EV Powertrain Control Module 2 connector X2.
  5. Vehicle in Service Mode. Test for greater than 10 V between the signal circuit and ground.
    - **If 10 V or less**  
Replace the Hybrid/EV Powertrain Control Module 2.
    - **If greater than 10 V**
  6. Replace the K20 Engine Control Module.



## Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

**Control Module References** for K20 engine control module or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

## DTC P1EC6: HYBRID/EV BATTERY PACK HEATER PERFORMANCE

### Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

### DTC Descriptor

#### DTC P1EC6

Hybrid/EV Battery Pack Heater Performance

### Circuit/System Description

The hybrid/EV battery pack coolant heater is mounted to the coolant inlet on the inside of the hybrid/EV battery pack assembly. The hybrid/EV battery pack coolant heater uses the hybrid/EV battery high voltage as its power source. The hybrid/EV battery pack heater high voltage is controlled by a solid state relay/transistor. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage solid state relay/transistor. The hybrid/EV battery pack coolant heater high voltage circuit is fuse protected.

When the Conditions for Running the DTC are met, the hybrid/EV battery pack coolant heater is commanded ON. The hybrid/EV powertrain control module 2 then monitors for a temperature change at the hybrid/EV battery pack coolant temperature sensor 1 to determine if the hybrid/EV battery pack coolant heater is functioning properly.

### Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV battery pack coolant temperature sensor is less than 20°C (68°F).
- Runs once per drive cycle, either in propulsion system active or in Charge Mode.
- Hybrid/EV battery pack voltage is greater than 211 V.
- None of the following DTCs are set; P0C43, P0C44, P0C45, P0C47, P19FD, P19FE, P19FF, P1EC3, P1E8C, P1E8D, P1FFB, P1FFC, P1FFD or P1FFE.

### Conditions for Setting the DTC

- The hybrid/EV powertrain control module 2 commands the hybrid/EV battery pack coolant pump to 7% and the battery heater to 100% for 4 seconds, then varies battery heater output in relation to battery voltage for a maximum of 3 minutes.
- The hybrid/EV powertrain control module 2 did not see the battery pack coolant temperature rise more than 3°C (5.4°F) within 60 seconds of commanding the battery heater OFF.

### Action Taken When the DTC Sets

- DTC P1EC6 is a type B DTC.
- Hybrid/EV battery pack active heating is disabled.

### Conditions for Clearing the DTC

DTC P1EC6 is a type B DTC.

### Diagnostic Aids

P1EC6 will prevent battery heating and the vehicle will be unable to start in cold weather if battery temperature drops below  $-25^{\circ}\text{C}$  ( $-13^{\circ}\text{F}$ ).

## Reference Information

Schematic Reference

## Hybrid/EV Cooling Schematics

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

## Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

**EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

## Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE1, P0AE3, P0D0A, P0D09, P1EBD, P1EC0 or P1EC3 is not set.

- **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Vehicle OFF. Remove the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Set the vehicle Charge Mode to IMMEDIATE. Connect the charge cord set. With the vehicle in Charge Mode, Vehicle in Service Mode.

**NOTE:** Other DTCs will set.

4. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor parameter increases  $3^{\circ}\text{C}$  ( $5.4^{\circ}\text{F}$ ) within 120 s when command the hybrid/EV battery pack coolant heater ON with a scan tool.

- **If the Hybrid/EV Battery Pack Coolant Temperature Sensor did not increase  $3^{\circ}\text{C}$  ( $5.4^{\circ}\text{F}$ ) within 120s**

Refer to Circuit/System Testing.

- If the Hybrid/EV Battery Pack Coolant Temperature Sensor did increase 3A°C (5.4Å°F) within 120s

5. All OK.

### Circuit/System Testing

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Replace the high voltage battery assembly.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

### [High Voltage Battery Replacement and Shipping Preparation](#)

#### **DTC P1FFB-P1FFE: HYBRID/EV BATTERY PACK COOLANT LEVEL**

#### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

#### DTC Descriptors

##### **DTC P1FFB**

Hybrid/EV Battery Pack Coolant Level Sensor Circuit

##### **DTC P1FFC**

Hybrid/EV Battery Pack Coolant Level Sensor Circuit Low Voltage

##### **DTC P1FFD**

**DTC P1FFE**

Hybrid/EV Battery Pack Coolant Level Low

**Circuit/System Description**

The hybrid/EV battery pack coolant system has a level sensor. The hybrid/EV battery pack coolant level sensor is attached to the coolant surge tank. The level sensor is a 2 state bi-metallic reed switch which changes state when the switch reed is exposed to magnetism. The level of the hybrid/EV battery pack coolant in the surge tank causes a magnet-equipped float to move towards and away from the sensor as coolant level decreases or increases. The hybrid/EV powertrain control module 2 supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery pack coolant level sensor resistance decreases when the battery coolant level in the surge tank gets low. The hybrid/EV powertrain control module 2 uses the hybrid/EV battery pack coolant level sensor to determine if the hybrid/EV battery pack coolant system is low on coolant.

**Conditions for Running the DTC****P1FFB, P1FFC and P1FFD**

The 12 V battery voltage is greater than 10.2 V.

**P1FFE**

- The vehicle speed is zero for more than 30 seconds.
- The battery pack temperature is between -7Â°C (19.4Â°F) and 120Â°C (248Â°F).
- None of the following DTCs are set: P0ABC, P0ABB, P0ABD, P0721, P077B, P215C, P2610, U0100, U0101, U0111 or U185A.
- Once set, the DTC will not run again until a scan tool clear code command is sent.

**Conditions for Setting the DTC****P1FFB**

The hybrid/EV battery pack coolant level sensor voltage is between 2.8 V - 3.1 V

**P1FFC**

The hybrid/EV battery pack coolant level sensor voltage is below 1.37 V

**P1FFD**

The hybrid/EV battery pack coolant level sensor voltage is above 4.0 V

**P1FFE**

The hybrid/EV battery pack coolant level sensor voltage is between 1.38-2.84 V for more than 2 consecutive key cycles

**Action Taken When the DTC Sets**

- DTC P1FFB, P1FFC, P1FFD and P1FFE are type A DTCs.
- The driver information center (DIC) displays the SERVICE HIGH VOLTAGE CHARGING SYSTEM message.
- Hybrid/EV battery pack charging is disabled.
- Hybrid/EV battery pack active heating and active cooling are disabled.
- DTC P1FFF is set.

**Conditions for Clearing the DTC**

- DTC P1FFB, P1FFC and P1FFD are type A DTCs.



- DTC P1FFE is a type A DTC but will only clear with a scan tool clear code command.

### **Diagnostic Aids**

- Parking the vehicle on a steep incline may set DTC P1FFE.
- DTC P1FFE will not clear or go to history with ignition cycles once DTC is set. DTC P1FFE will only clear with a scan tool clear code command.

### **Reference Information**

Schematic Reference

### **Hybrid/EV Cooling Schematics**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

### **Control Module References** for scan tool information

### **Circuit/System Verification**

1. Verify that the vehicle hybrid/EV battery cooling system is full.
  - **If the hybrid/EV battery cooling system is low**  
Refer to **High Voltage Battery Cooling System Loss of Coolant**
  - **If the hybrid/EV battery cooling system is full**
2. Refer to Circuit/System Testing.

### **Circuit/System Testing**

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B258 Hybrid/EV Battery Coolant Level Sensor.
2. Test for less than 10  $\Omega$  between the low reference circuit terminal B and ground.
  - **If 10  $\Omega$  or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
  - **If less than 10  $\Omega$**
3. Vehicle in Service Mode.



4. Test for 4.8-5.2 V between the 5 V signal circuit terminal A and ground.

- **If 4.8 V or less**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 5.2 V or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If within the specified range**

5. Vehicle OFF, remove the B258 Hybrid/EV Battery Coolant Level Sensor from the coolant surge tank.

6. Test for 24-25.4k $\Omega$  between the signal terminal A and the low reference terminal B.

**NOTE:** The coolant sensor must be removed from the coolant surge tank to ensure the coolant float magnet does not close the internal reed switch.

- **If not within the specified range**

Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

- **If within the specified range**

7. Using a magnet, place the magnet off center of the B258 Hybrid/EV Battery Coolant Level Sensor, opposite of the terminals on the epoxy side to close the internal reed switch.

**NOTE:** Moving the magnet slightly along the bottom of the sensor will assist closing the internal switch.

8. Test for 7.1-7.54k $\Omega$  between the signal terminal A and the low reference terminal B.

- **If not within the specified range**

Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

- **If within the specified range**

9. Replace the coolant surge tank.

## Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Level Sensor Replacement \(LTG with HP9\)](#) for B258 Hybrid/EV coolant level sensor replacement.
- [Drive Motor Battery Coolant/Air Separator Replacement](#) for coolant surge tank replacement.
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

**DTC P1FFF: SYSTEM ISOLATION/COOLANT LEVEL SENSOR FAULT - HYBRID/EV BATTERY CHARGING SYSTEM DISABLED**

## **Diagnostic Instructions**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

## **DTC Descriptor**

### **DTC P1FFF**

System Isolation/Coolant Level Sensor Fault - Hybrid/EV Battery Charging System Disabled

## **Circuit/System Description**

This diagnostic is an indicator that hybrid/EV battery pack charging is disabled because the hybrid/EV powertrain control module 2 detected one of the following conditions:

- A loss of isolation between the hybrid/EV battery pack high voltage circuits and vehicle chassis
- A low coolant condition of the hybrid/EV battery pack coolant system
- A fault in the hybrid/EV battery pack coolant level sensor/circuit

## **Conditions for Running the DTC**

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- Once set, the DTC will not run again until a scan tool clear code command is sent.

## **Conditions for Setting the DTC**

**NOTE:** DTC P1FFF will never set alone.

When DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD or P1FFE is set, DTC P1FFF will also be set.

## **Action Taken When the DTC Sets**

- DTC P1FFF is a type A DTC.
- The driver information center (DIC) displays the SERVICE HIGH VOLTAGE CHARGING SYSTEM message.
- Hybrid/EV battery pack charging is disabled.

## **Conditions for Clearing the DTC**

DTC P1FFF is a type A DTC but will only clear with a scan tool clear code command.

## **Diagnostic Aids**

- DTC P1FFF will not clear or go to history with ignition cycles once DTC is set.
- DTC P1FFF will only clear with a scan tool clear code command.

## **Reference Information**

Schematic Reference

### **Hybrid/EV Cooling Schematics**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX**

Description and Operation

### **Drive Motor Battery System Description**

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### [Circuit/System Verification](#)

1. Verify that DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD or P1FFE are not set.
  - If DTC P0AA6 or P1AE6 is set  
Refer to [DTC P0AA6 or P1AE6](#) .
  - If DTC P1FFB, P1FFC, P1FFD or P1FFE is set  
Refer to [DTC P1FFB-P1FFE](#).
  - If none of the DTCs are set
2. Clear Codes. Verify DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD or P1FFE does not set.

**NOTE:** In order to clear P1FFF, the K114B Hybrid/EV Powertrain Control Module 2 may have to be programmed even if the module contains the current calibration level.

- If any DTC is set  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - If none of the DTCs are set
3. All OK.

## HIGH VOLTAGE BATTERY DIAGNOSTIC

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Yes                 | No                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------|
| 1    | Were you sent here from Symptoms or another diagnostic table?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Go to <b>Step 2</b> | Go to <b><u>Diagnostic System Check - Vehicle</u></b> |
| 2    | <p>1. Disable the high voltage system.<br/>Refer to <b><u>High Voltage Disabling</u></b></p> <p><b>WARNING:</b><br/>Refer to <b><u>Moving Parts and Hot Surfaces Warning</u></b> .</p> <p><b>WARNING:</b><br/>Wear safety glasses in order to avoid eye damage.</p> <p>Check the drive motor battery coolant/air separator coolant level. Add coolant to the drive motor battery coolant/air separator as needed. Refer to <b><u>High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</u></b> and/or <b><u>High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</u></b></p> <p>2. Using Global Diagnosis System 2, turn on the drive motor battery coolant pump.</p> <p>3. Quickly remove and install the drive motor battery radiator outlet hose from the high voltage battery. Refer to <b><u>Drive Motor Battery Radiator Outlet Hose Replacement</u></b></p> <p>Is there coolant flowing out of the high voltage battery?</p> | Go to <b>Step 3</b> | Go to <b>Step 13</b>                                  |
| 3    | <p>Quickly remove and install the drive motor battery radiator outlet hose from the drive motor battery coolant pump. Refer to <b><u>Drive Motor Battery Radiator Outlet Hose Replacement</u></b></p> <p>Is there coolant flowing out of the drive motor battery radiator outlet hose?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Go to <b>Step 4</b> | Go to <b>Step 08</b>                                  |
| 4    | <p>Quickly remove and install the drive motor battery coolant cooler outlet hose from the drive motor battery coolant pump. Refer to <b><u>Drive Motor Battery Coolant Cooler Outlet Hose Replacement</u></b></p> <p>Is there coolant flowing out of the drive motor battery coolant pump?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Go to <b>Step 5</b> | Go to <b>Step 9</b>                                   |



| Step | Action                                                                                                                                                                                                                                                                                                | Yes                  | No                   |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| 5    | Quickly remove and install the drive motor battery coolant cooler outlet hose from the drive motor battery coolant cooler. Refer to <a href="#">Drive Motor Battery Coolant Cooler Outlet Hose Replacement</a><br>Is there coolant flowing out of the drive motor battery coolant cooler outlet hose? | Go to <b>Step 6</b>  | Go to <b>Step 10</b> |
| 6    | Quickly remove and install the drive motor battery radiator inlet hose from the drive motor battery coolant cooler. Refer to <a href="#">Drive Motor Battery Radiator Inlet Hose Replacement</a><br>Is there coolant flowing out of the drive motor battery coolant cooler?                           | Go to <b>Step 7</b>  | Go to <b>Step 11</b> |
| 7    | Quickly remove and install the drive motor battery radiator inlet hose from the high voltage battery. Refer to <a href="#">Drive Motor Battery Radiator Inlet Hose Replacement</a><br>Is there coolant flowing out of the drive motor battery radiator inlet hose?                                    | Go to <b>Step 8</b>  | Go to <b>Step 12</b> |
| 8    | Replace the drive motor battery radiator outlet hose. Refer to <a href="#">Drive Motor Battery Radiator Outlet Hose Replacement</a><br>Is the repair complete?                                                                                                                                        | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |
| 9    | Replace the drive motor battery coolant pump. Refer to <a href="#">Drive Motor Battery Coolant Pump Replacement</a><br>Is the repair complete?                                                                                                                                                        | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |
| 10   | Replace the drive motor battery coolant cooler outlet hose. Refer to <a href="#">Drive Motor Battery Coolant Cooler Outlet Hose Replacement</a><br>Is the repair complete?                                                                                                                            | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |
| 11   | Replace the drive motor battery coolant cooler. Refer to <a href="#">Drive Motor Battery Coolant Cooler Replacement</a><br>Is the repair complete?                                                                                                                                                    | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |
| 12   | Replace the drive motor battery radiator inlet hose. Refer to <a href="#">Drive Motor Battery Radiator Inlet Hose Replacement</a><br>Is the repair complete?                                                                                                                                          | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |
| 13   | Replace the high voltage battery <a href="#">High Voltage Battery Replacement and Shipping Preparation</a><br>Is the repair complete?                                                                                                                                                                 | Go to <b>Step 14</b> | Go to <b>Step 1</b>  |



| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Yes       | No                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|
| 14   | <ol style="list-style-type: none"> <li>1. Add coolant to the drive motor battery coolant/air separator as needed. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a>.</li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a>.</li> <li>3. Operate the system in order to verify the repair.</li> </ol> <p>Did you find and correct the condition?</p> | System OK | Go to <b>Step 1</b> |

## POWER ELECTRONICS AND AUXILIARY RADIATOR COOLING SYSTEM DIAGNOSTIC

### **WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

| Step | Action                                                        | Yes                 | No                                                      |
|------|---------------------------------------------------------------|---------------------|---------------------------------------------------------|
| 1    | Were you sent here from Symptoms or another diagnostic table? | Go to <b>Step 2</b> | Go to <a href="#">Diagnostic System Check - Vehicle</a> |
|      |                                                               |                     |                                                         |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Yes                 | No                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|
| 2    | <p>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></p> <p>Add coolant to the generator control module coolant/air separator if needed. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></p> <p><b>WARNING:</b><br/>Refer to <a href="#">Moving Parts and Hot Surfaces Warning</a> .</p> <p><b>WARNING:</b><br/><b>Wear safety glasses in order to avoid eye damage.</b></p> <p>2. Using Global Diagnosis System 2, turn on the generator control module coolant pump.</p> <p>3. Quickly remove and install the drive motor generator control module coolant pump hose from the generator control module coolant pump. Reffer to <a href="#">Drive Motor Generator Control Module Coolant Pump Hose Replacement</a></p> <p>Is there coolant flowing out of the drive motor generator control module coolant pump hose?</p> | Go to <b>Step 3</b> | Go to <b>Step 21</b> |
| 3    | <p>Quickly remove and install the drive motor generator control module radiator inlet hose from the generator control module coolant pump. Refer to <a href="#">Drive Motor Generator Control Module Radiator Inlet Hose Replacement</a></p> <p>Is there coolant flowing out of the generator control module coolant pump?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 4</b> | Go to <b>Step 22</b> |
| 4    | <p>Quickly remove and install the drive motor generator control module radiator inlet hose from the auxiliary radiator. Refer to <a href="#">Drive Motor Generator Control Module Radiator Inlet Hose Replacement</a></p> <p>Is there coolant flowing out of the drive motor generator control module radiator inlet hose?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Go to <b>Step 5</b> | Go to <b>Step 23</b> |
| 5    | <p>Quickly remove and install the drive motor generator control module radiator outlet hose from the auxiliary radiator. Refer to <a href="#">Drive Motor Generator Control Module Radiator Outlet Hose Replacement</a></p> <p>Is there coolant flowing out of the auxiliary radiator?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Go to <b>Step 6</b> | Go to <b>Step 24</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                | Yes                  | No                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| 6    | Quickly remove and install the drive motor generator control module radiator outlet hose from the accessory dc power control module. Refer to <b><u>Drive Motor Generator Control Module Radiator Outlet Hose Replacement</u></b><br>Is there coolant flowing out of the drive motor generator control module radiator outlet hose?                                                                                                   | Go to <b>Step 7</b>  | Go to <b>Step 25</b> |
| 7    | Quickly remove and install the generator control module coolant radiator hose from accessory dc power control module. Refer to <b><u>Generator Control Module Coolant Radiator Hose Replacement</u></b><br>Is there coolant flowing out of the accessory dc power control module?                                                                                                                                                     | Go to <b>Step 8</b>  | Go to <b>Step 26</b> |
| 8    | Quickly remove and install the generator control module coolant radiator hose from the heater inlet pipe connector. Refer to <b><u>Generator Control Module Coolant Radiator Hose Replacement</u></b><br>Is there coolant flowing out of the generator control module coolant radiator hose?                                                                                                                                          | Go to <b>Step 9</b>  | Go to <b>Step 27</b> |
| 9    | Quickly remove and install the drive motor power inverter module cooling outlet hose from the heater inlet pipe connector. Refer to <b><u>Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</u></b><br>Is there coolant flowing out of the heater inlet pipe connector?                                                                                                                                               | Go to <b>Step 10</b> | Go to <b>Step 28</b> |
| 10   | Quickly remove and install the drive motor power inverter module cooling outlet hose from the auxiliary air conditioning evaporator intermediate tube. Refer to <b><u>Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</u></b><br>Is there coolant flowing out of the drive motor power inverter module cooling outlet hose?                                                                                         | Go to <b>Step 11</b> | Go to <b>Step 29</b> |
| 11   | Quickly remove and install the generator control module coolant outlet hose (Outlet) from the auxiliary air conditioning evaporator intermediate tube. Refer to <b><u>Generator Control Module Coolant Outlet Hose Replacement (Inlet)</u></b> and/or <b><u>Generator Control Module Coolant Outlet Hose Replacement (Outlet)</u></b><br>Is there coolant flowing out of the auxiliary air conditioning evaporator intermediate tube? | Go to <b>Step 12</b> | Go to <b>Step 30</b> |
| 12   | Quickly remove and install the generator control module coolant outlet hose (Outlet) from the drive motor battery charger. Refer to <b><u>Generator Control Module Coolant Outlet Hose Replacement (Inlet)</u></b> and/or <b><u>Generator Control Module Coolant Outlet Hose Replacement (Outlet)</u></b><br>Is there coolant flowing out of the generator control module coolant outlet hose (Outlet)?                               | Go to <b>Step 13</b> | Go to <b>Step 31</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes                  | No                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| 13   | <p>Quickly remove and install the generator control module coolant outlet hose (Inlet) from the drive motor battery charger. Refer to <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Inlet)</a> and/or <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Outlet)</a>.</p> <p>Is there coolant flowing out of the drive motor battery charger?</p>                                                                                                                                                                                                                       | Go to <b>Step 14</b> | Go to <b>Step 32</b> |
| 14   | <p>Quickly remove and install the generator control module coolant outlet hose (Inlet) from the auxiliary air conditioning evaporator intermediate tube. Refer to <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Inlet)</a> and/or <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Outlet)</a>.</p> <p>Is there coolant flowing out of the generator control module coolant outlet hose (Inlet)?</p>                                                                                                                                                                  | Go to <b>Step 15</b> | Go to <b>Step 33</b> |
| 15   | <p>Quickly remove and install the drive motor power inverter module cooling inlet hose from the heater inlet pipe connector. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Drive Motor Power Inverter Module to Heater Inlet Pipe Connector)</a> and/or <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Heater Inlet Pipe Connector Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector)</a>.</p> <p>Is there coolant flowing out of the heater inlet pipe connector?</p>                                | Go to <b>Step 16</b> | Go to <b>Step 28</b> |
| 16   | <p>Quickly remove and install the drive motor power inverter module cooling inlet hose from the drive motor power inverter module. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Drive Motor Power Inverter Module to Heater Inlet Pipe Connector)</a> and/or <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Heater Inlet Pipe Connector Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector)</a>.</p> <p>Is there coolant flowing out of the drive motor power inverter module cooling inlet hose?</p> | Go to <b>Step 17</b> | Go to <b>Step 34</b> |
| 17   | <p>Quickly remove and install the drive motor power inverter module cooling outlet hose from the drive motor power inverter module. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</a>.</p> <p>Is there coolant flowing out of the drive motor power inverter module?</p>                                                                                                                                                                                                                                                                                                  | Go to <b>Step 18</b> | Go to <b>Step 35</b> |



| Step | Action                                                                                                                                                                                                                                                                                                            | Yes           | No            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|
| 18   | Quickly remove and install the drive motor power inverter module cooling outlet hose from the heater inlet pipe connector. Refer to <b><u>Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</u></b><br>Is there coolant flowing out of the drive motor power inverter module cooling outlet hose? | Go to Step 19 | Go to Step 36 |
| 19   | Quickly remove and install the generator control module coolant tank hose from the heater inlet pipe connector. Refer to <b><u>Generator Control Module Coolant Tank Hose Replacement</u></b><br>Is there coolant flowing out of the heater inlet pipe connector?                                                 | Go to Step 20 | Go to Step 30 |
| 20   | Quickly remove and install the generator control module coolant tank hose from the generator control module coolant/air separator. Refer to <b><u>Generator Control Module Coolant Tank Hose Replacement</u></b><br>Is there coolant flowing out of the generator control module coolant tank hose?               | Go to Step 38 | Go to Step 37 |
| 21   | Replace the drive motor generator control module coolant pump hose. Refer to <b><u>Drive Motor Generator Control Module Coolant Pump Hose Replacement</u></b><br>Is the repair complete?                                                                                                                          | Go to Step 38 | Go to Step 1  |
| 22   | Replace the generator control module coolant pump. Refer to <b><u>Generator Control Module Coolant Pump Replacement</u></b><br>Is the repair complete?                                                                                                                                                            | Go to Step 38 | Go to Step 1  |
| 23   | Replace the drive motor generator control module radiator inlet hose. Refer to <b><u>Drive Motor Generator Control Module Radiator Inlet Hose Replacement</u></b><br>Is the repair complete?                                                                                                                      | Go to Step 38 | Go to Step 1  |
| 24   | Replace the auxiliary radiator. Refer to <b><u>Auxiliary Radiator Replacement</u></b><br>Is the repair complete?                                                                                                                                                                                                  | Go to Step 38 | Go to Step 1  |
| 25   | Replace the drive motor generator control module radiator outlet hose. Refer to <b><u>Drive Motor Generator Control Module Radiator Outlet Hose Replacement</u></b><br>Is the repair complete?                                                                                                                    | Go to Step 38 | Go to Step 1  |
| 26   | Replace the accessory dc power control module. Refer to <b><u>Accessory DC Power Control Module Replacement</u></b><br>Is the repair complete?                                                                                                                                                                    | Go to Step 38 | Go to Step 1  |
| 27   | Replace the generator control module coolant radiator hose. Refer to <b><u>Generator Control Module Coolant Radiator Hose Replacement</u></b><br>Is the repair complete?                                                                                                                                          | Go to Step 38 | Go to Step 1  |
| 28   | Replace the heater inlet pipe connector. Refer to <b><u>Heater Inlet Pipe Connector Replacement (LTG with HP9)</u></b><br>Is the repair complete?                                                                                                                                                                 | Go to Step 38 | Go to Step 1  |



| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Yes           | No           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|
| 29   | Replace the drive motor power inverter module cooling outlet hose. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                      | Go to Step 38 | Go to Step 1 |
| 30   | Replace the auxiliary air conditioning evaporator intermediate tube. Refer to <a href="#">Auxiliary Air Conditioning Evaporator Intermediate Tube Replacement</a> and/or <a href="#">Auxiliary Air Conditioning Evaporator Intermediate Tube Replacement (With HP9)</a><br>Is the repair complete?                                                                                                                                                                                            | Go to Step 38 | Go to Step 1 |
| 31   | Replace the generator control module coolant outlet hose (Outlet). Refer to <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Outlet)</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                      | Go to Step 38 | Go to Step 1 |
| 32   | Replace the drive motor battery charger. Refer to <a href="#">Drive Motor Battery Charger Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                                                                          | Go to Step 38 | Go to Step 1 |
| 33   | Replace the generator control module coolant outlet hose (Inlet). Refer to <a href="#">Generator Control Module Coolant Outlet Hose Replacement (Inlet)</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                        | Go to Step 38 | Go to Step 1 |
| 34   | Replace the drive motor power inverter module cooling inlet hose. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Drive Motor Power Inverter Module to Heater Inlet Pipe Connector)</a> and/or <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Heater Inlet Pipe Connector)</a> and/or <a href="#">Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector</a><br>Is the repair complete? | Go to Step 38 | Go to Step 1 |
| 35   | Replace the drive motor power inverter module. Refer to <a href="#">Drive Motor Power Inverter Module Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                                                              | Go to Step 38 | Go to Step 1 |
| 36   | Replace the drive motor power inverter module cooling outlet hose. Refer to <a href="#">Drive Motor Power Inverter Module Cooling Outlet Hose Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                      | Go to Step 38 | Go to Step 1 |
| 37   | Replace the generator control module coolant tank hose. Refer to <a href="#">Generator Control Module Coolant Tank Hose Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                                                                                                            | Go to Step 38 | Go to Step 1 |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                | Yes       | No                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|
| 38   | <ol style="list-style-type: none"> <li>1. Add coolant to the generator control module coolant/air separator as needed. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Operate the system in order to verify the repair.</li> </ol> | System OK | Go to <b>Step 1</b> |
|      | Did you find and correct the condition?                                                                                                                                                                                                                                                                                                                                               |           |                     |

## HYBRID/EV BATTERY PACK COOLANT PUMP MALFUNCTION

### Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

### Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

### Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Å°C (-34Å°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### Coolant Pump Feedback Parameter

| Displayed PWM Value | Pump Self-Diagnostic Indication                                     |
|---------------------|---------------------------------------------------------------------|
| 0%                  | Pump has lost power/ground, feedback circuit open or Vehicle is On* |
| 10%                 | Pump Under Voltage detected*                                        |
| 20%                 | Pump Under/Over Current detected*                                   |
| 30%                 | Blocked or Dry pump detected*                                       |
| 45-55%              | Normal operation, actual pump speed provided by circuit frequency   |
| 80%                 | Pump Over Voltage detected*                                         |

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication     |
|-------------------------------------------------------------------------------|-------------------------------------|
| 90%                                                                           | Pump Over Temperature detected*     |
| 100%                                                                          | Feedback circuit shorted to ground* |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                     |

## Reference Information

Schematic Reference

## Hybrid/EV Cooling Schematics

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

## Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

## Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C47, P1E8C, P1E8D, P19FD, P19FE or P19FF is not set.
  - **If any DTC is set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.
  - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
  - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
  - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
  - **The scan tool parameters listed are not within the specified ranges**  
Refer to Circuit/System Testing.
  - **The scan tool parameters listed are within the specified ranges**
4. All OK.

## Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.
  - **If 5  $\Omega$  or greater**  
Repair the open/high resistance on the ground circuit.
  - **If less than 5  $\Omega$**

3. Vehicle On.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$  and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Battery Pack Coolant Pump ON (20-90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the pump enable circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.



- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
  - **The test lamp changes illumination between bright (20%) and dim (90%)**
10. Remove the test lamp.
  11. Verify the scan tool Hybrid/EV Battery Pack Coolant Pump Feedback parameter is 0%.
    - **If greater than 0%**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 0%**
  12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
  13. Verify the scan tool Hybrid/EV Battery Pack Coolant Pump Feedback parameter is greater than 90%.
    - **If 90% or less**
      1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for less than 1 V between the feedback circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Test for less than 2  $\Omega$  in the control circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
  14. Connect the G37 Hybrid/EV Battery Pack Coolant Pump.
  15. Vehicle On.
  16. Place your hand on the coolant pump and verify that pump operation is felt when commanding the Hybrid/EV Battery Pack Coolant Pump ON to 90% with a scan tool.
    - **If pump operation cannot be felt at 90%**  
Replace the G37 Hybrid/EV Battery Pack Coolant Pump.
    - **If pump operation is felt at 90%**
  17. All OK. Refer to [High Voltage Battery Diagnostic](#) to verify for proper flow of the coolant pump and system.

## Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

## HYBRID/EV ELECTRONICS COOLANT PUMP MALFUNCTION

### Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

### Circuit/System Description



The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger and the 14V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

### Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Å°C (-34Å°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

### Coolant Pump Feedback Parameter

| Displayed PWM Value                                                           | Pump Self-Diagnostic Indication                                     |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 0%                                                                            | Pump has lost power/ground, feedback circuit open or Vehicle is On* |
| 10%                                                                           | Pump Under Voltage detected*                                        |
| 20%                                                                           | Pump Under/Over Current detected*                                   |
| 30%                                                                           | Blocked or Dry pump detected*                                       |
| 45-55%                                                                        | Normal operation, actual pump speed provided by circuit frequency   |
| 80%                                                                           | Pump Over Voltage detected*                                         |
| 90%                                                                           | Pump Over Temperature detected*                                     |
| 100%                                                                          | Feedback circuit shorted to ground*                                 |
| *Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM. |                                                                     |

### Reference Information

Schematic Reference

### Hybrid/EV Cooling Schematics

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

### Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

## Control Module References for scan tool information

### Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0CE9, P1F44, P1F45, P19FA, P19FB or P19FC is not set.
  - **If any of the DTCs are set**  
  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
    - **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.
  - Hybrid/EV Electronics Coolant Pump Command to be 10% or greater.
  - Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%.
  - Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
  - **The scan tool parameters listed are not within the specified ranges**  
  
Refer to Circuit/System Testing.
  - **The scan tool parameters listed are within the specified ranges**
4. All OK.

### Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 4 and ground.
  - **If 5  $\Omega$  or greater**  
  
Repair the open/high resistance on the ground circuit.
  - **If less than 5  $\Omega$**
3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
  - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$  and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
  - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
  - **If the test lamp is ON**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the pump enable circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.
  - **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Electronics Coolant Pump ON (20-90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the pump enable circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2  $\Omega$  in the pump enable circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Electronics Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (90%)**

10. Remove the test lamp.
11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the feedback circuit terminal and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V

3. Test for less than 2  $\Omega$  in the feedback circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Connect the G35 Hybrid/EV Electronics Coolant Pump.

15. Vehicle On.

16. Place your hand on the coolant pump and verify that pump operation is felt when commanding the Hybrid/EV Electronics Coolant Pump ON to 90% with a scan tool.

- **If pump operation cannot be felt at 90%**

Replace the G35 Hybrid/EV Electronics Coolant Pump.

- **If pump operation is felt at 90%**

17. All OK. Refer to **Power Electronics and Auxiliary Radiator Cooling System Diagnostic** to verify for proper flow of the coolant pump and system.

### Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Control Module Coolant Pump Replacement** for Hybrid/EV electronics coolant pump replacement.
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

### HIGH VOLTAGE BATTERY COOLING SYSTEM LOSS OF COOLANT

| Step | Action | Yes | No |
|------|--------|-----|----|
|      |        |     |    |

| Step                                                                                                                                                                                                                              | Action | Yes | No |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|----|
| DEFINITION: Perform this procedure in conjunction with a high-voltage battery overheating condition, low coolant in the high-voltage battery surge tank or when instructed to by DTC P1FFE, P1AE6 or P0AA6 diagnostic procedures. |        |     |    |

**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

|   |                                                                                                                                                                                                                                                                                                                                                                               |                          |                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------|
| 1 | Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a><br>Access drive motor battery coolant/air separator. Refer to <a href="#">High Voltage Battery Coolant Level Inspection</a>                                                                                                                                                                  | Go to <b>Step 2</b>      | -                   |
| 2 | Visually inspect the coolant level in the drive motor battery coolant/air separator.<br>Is the coolant level at the fill line?                                                                                                                                                                                                                                                | Go to <b>Step 3</b>      | Go to <b>Step 4</b> |
| 3 | Are any of the following DTCs present? <ul style="list-style-type: none"> <li>• P0AA6 (Hybrid/EV Battery Voltage System Isolation Lost)</li> <li>• P1AE6 (Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit)</li> <li>• P1FFE (Hybrid/EV Battery Pack Coolant Level Low)</li> <li>• P0A7E (Hybrid/EV Battery Pack High Temperature)</li> </ul> | Perform DTC Diagnostics. | Go to <b>Step 4</b> |



| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Yes                                                                                                                                                                                     | No                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 4    | <p>Inspect the high voltage battery for internal coolant leakage. Remove the drain plug from the high voltage battery pack. Insert rolled paper towel and swab in and around drain hole. Refer to <b>High Voltage System Inspection</b></p> <p>Did coolant flow from drain hole or does the paper towel show evidence of coolant residue?</p>                                                                                                                                       | <p>Allow Fluid to Drain Completely.<br/>Then Go to <b>Step 5</b></p>                                                                                                                    | Go to <b>Step 6</b> |
| 5    | <p>Call the GM Technical Assistance Center (TAC) for further instructions regarding coolant leakage at the drain hole.</p> <p><b>DO NOT ATTEMPT TO REPAIR VEHICLE WITHOUT CALLING TAC.</b></p> <p>Was TAC called?</p>                                                                                                                                                                                                                                                               | Go to <b>Step 6</b>                                                                                                                                                                     | Go to <b>Step 5</b> |
| 6    | <p>Pressure test the high voltage battery cooling system <b>High Voltage Battery Cooling System Leak Testing</b> and the high voltage battery cooling system pressure cap <b>High Voltage Battery Cooling System Pressure Cap Testing</b></p> <p>Does the system hold pressure for at least five minutes?</p>                                                                                                                                                                       | Go to <b>Step 8</b>                                                                                                                                                                     | Go to <b>Step 7</b> |
| 7    | <p><b>NOTE:</b></p> <p><b>When raising vehicle on hoist, vehicle must be level.</b></p> <p>Visually inspect the following components-Also inspect their hoses, clamps and hose connections for coolant leaks:</p> <ul style="list-style-type: none"> <li>• Drive motor battery coolant/air separator</li> <li>• Drive motor battery coolant pump</li> <li>• Drive motor battery coolant cooler</li> <li>• High voltage battery assembly</li> </ul> <p>Was a coolant leak found?</p> | <p>Replace component(s), hose(s) or clamp(s) that is/are leaking. Refer to appropriate procedure(s). Validate repair with additional pressure test.</p> <p>Then Go to <b>Step 8</b></p> | Go to <b>Step 8</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes                 | No                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|
| 8    | <p>Special Tools:</p> <ul style="list-style-type: none"> <li>• <b>J-26568</b> Coolant and Battery Fluid Tester</li> <li>• <b>J-46143-2</b> Cooling System Adapter</li> <li>• <b>GE-47716</b> Vac N Fill Coolant Refill Tool</li> </ul> <p>Fill and adjust high-voltage battery cooling system level at the drive motor battery coolant/air separator. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a>. Was the high-voltage battery cooling system level filled and adjusted at the drive motor battery coolant/air separator?</p> | Go to <b>Step 9</b> | Go to <b>Step 8</b> |
| 9    | <p>Verify the following before returning vehicle to customer:</p> <ul style="list-style-type: none"> <li>• Coolant level is at the fill line of the drive motor battery coolant/air separator.</li> <li>• DTC P1FFE (Hybrid/EV Battery Pack Coolant Level Low) is cleared from ECU.</li> </ul> <p>Did you find and correct the condition? Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></p>                                                                                                                                                                                                                                                                    | System OK           | Go to <b>Step 1</b> |

## POWER ELECTRONICS AND AUXILIARY RADIATOR COOLING SYSTEM LOSS OF COOLANT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Yes                  | No                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------|
| 1    | Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a><br>Inspect the coolant level.<br>Is the coolant at the proper level?                                                                                                                                                                                                                                                                                                                             | Go to <b>Step 13</b> | Go to <b>Step 2</b> |
| 2    | Fill the cooling system to the proper level.<br>Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a><br>Is the action complete?                                                                                                                                                                                                                                                                                                             | Go to <b>Step 3</b>  | -                   |
| 3    | Overheating can cause a loss of coolant.<br>Is the power electronics and auxiliary radiator system overheating?                                                                                                                                                                                                                                                                                                                                                                   | Go to <b>Step 11</b> | Go to <b>Step 4</b> |
| 4    | Visually inspect the hoses, pipes and hose clamps.<br>Are any of the hoses, clamps or pipes leaking?                                                                                                                                                                                                                                                                                                                                                                              | Go to <b>Step 12</b> | Go to <b>Step 5</b> |
| 5    | Visually inspect the following components: <ul style="list-style-type: none"> <li>• Accessory DC power control module</li> <li>• Coolant pressure cap</li> <li>• Coolant pumps</li> <li>• Coolant surge tank</li> <li>• Coolant Valves</li> <li>• Drive motor power inverter module</li> <li>• Drive motor battery charger</li> <li>• Generator control module coolant/air separator</li> <li>• Radiators</li> <li>• Sensors</li> </ul> Are any of the listed components leaking? | Go to <b>Step 12</b> | Go to <b>Step 6</b> |
| 6    | 1. Pressure test the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Cooling System Leak Testing</a><br>2. With the power electronics and auxiliary radiator cooling system pressurized, visually inspect the components listed in step 5.<br>Are any leaks present?                                                                                                                                       | Go to <b>Step 12</b> | Go to <b>Step 7</b> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                  | No                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| 7    | Pressure test the power electronics and auxiliary radiator cooling system pressure cap. Refer to <a href="#">Power Electronics and Auxiliary Radiator Cooling System Pressure Cap Testing</a><br>Does the power electronics and auxiliary radiator cooling system pressure cap hold pressure?                                                                                                                    | Go to <b>Step 9</b>  | Go to <b>Step 8</b>  |
| 8    | Replace the power electronics and auxiliary radiator cooling system pressure cap.<br>Is the repair complete?                                                                                                                                                                                                                                                                                                     | Go to <b>Step 13</b> | -                    |
| 9    | 1. Pressure test the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Cooling System Leak Testing</a><br>2. With the power electronics and auxiliary radiator cooling system pressurized, remove the engine cooling system radiator surge tank cap.<br><br>Does the power electronics and auxiliary radiator cooling system hold pressure? | -                    | Go to <b>Step 10</b> |
| 10   | Replace the generator control module coolant/air separator. Refer to <a href="#">Generator Control Module Coolant/Air Separator Replacement</a><br>Is the repair complete?                                                                                                                                                                                                                                       | Go to <b>Step 13</b> | -                    |
| 11   | Repair the hybrid cooling system overheating condition. Refer to <a href="#">Power Electronics and Auxiliary Radiator Cooling System Diagnostic</a><br>Is the repair complete?                                                                                                                                                                                                                                   | Go to <b>Step 13</b> | -                    |
| 12   | Repair or replace the leaking component.<br>Is the repair complete?                                                                                                                                                                                                                                                                                                                                              | Go to <b>Step 13</b> | -                    |
| 13   | Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a><br>Operate the system in order to verify the repair.<br><br><b>NOTE:</b><br><b>Do not use stop leak or any other chemicals. Only use premix Dexcool® (50/50 mixture of Dexcool and deionized water).</b><br><br>Did you find and correct the condition?                                                                           | System OK            | Go to <b>Step 2</b>  |

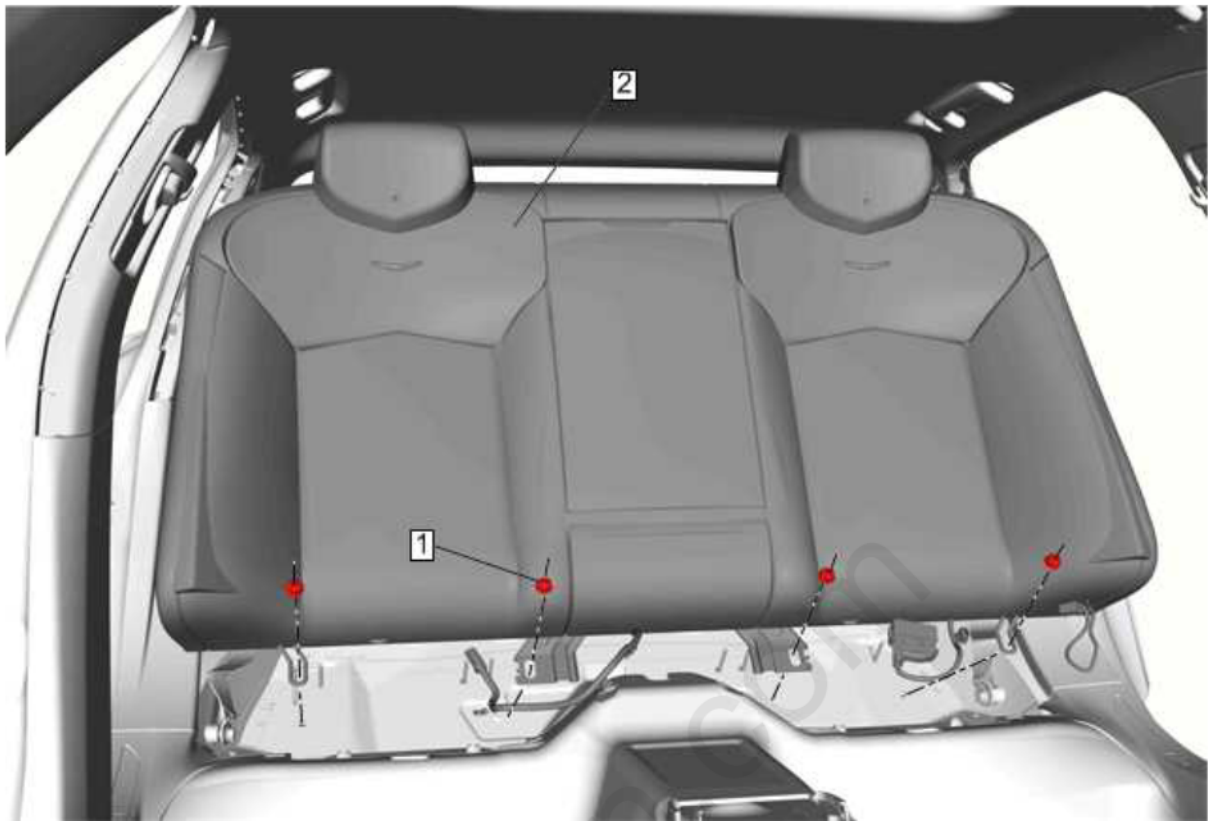
## HIGH VOLTAGE BATTERY COOLING SYSTEM PRESSURE CAP TESTING

### Special Tools

- EN-24460-A Cooling System Pressure Tester
- J-46143-1 Radiator Cap / Surge Tank Test Adapter

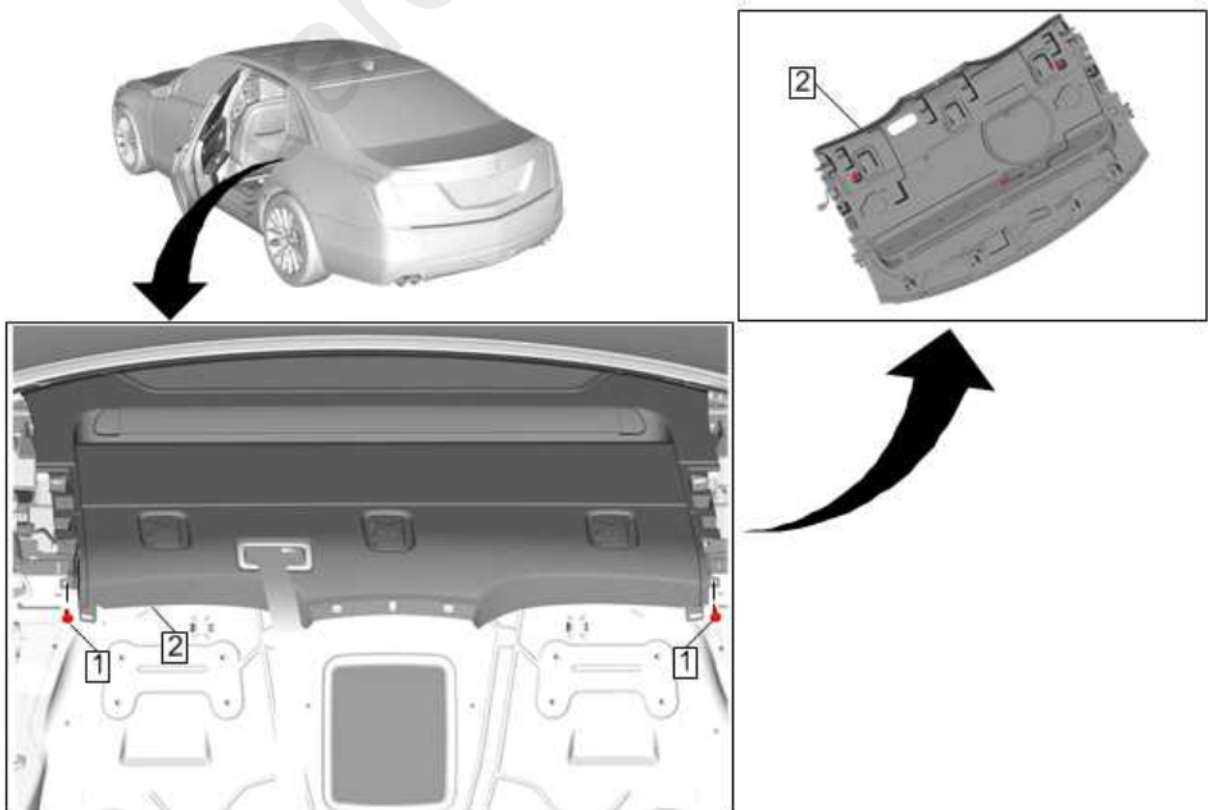
### Pressure Cap Testing

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Seat Back Cushion (2) » Remove - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 4: Rear Seat Back Cushion (Base)**  
Courtesy of GENERAL MOTORS COMPANY

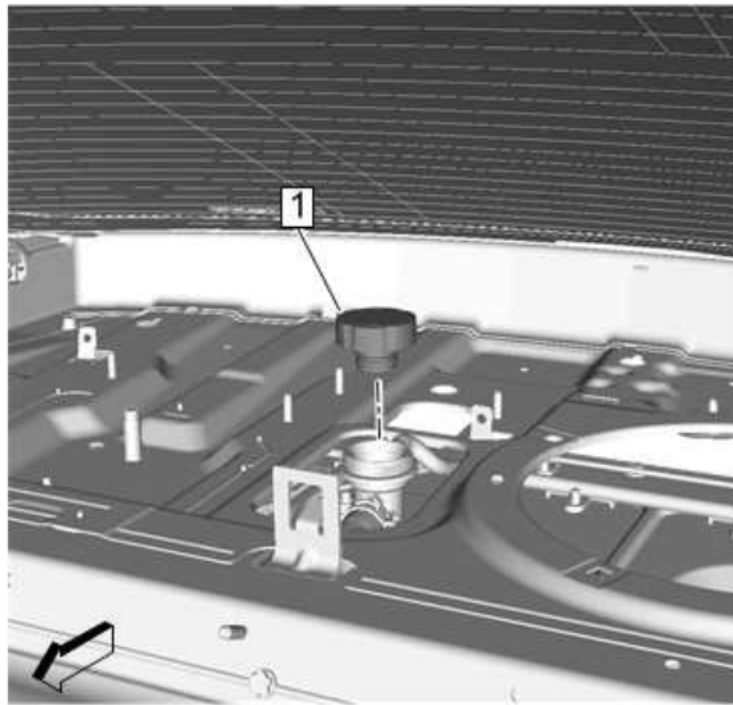
3. Rear Window Panel Trim (2) » Remove - [Rear Window Panel Trim Replacement](#)



**Fig. 5: Rear Window Panel Trim**  
Courtesy of GENERAL MOTORS COMPANY



4. Remove the pressure cap (1) from water inlet.

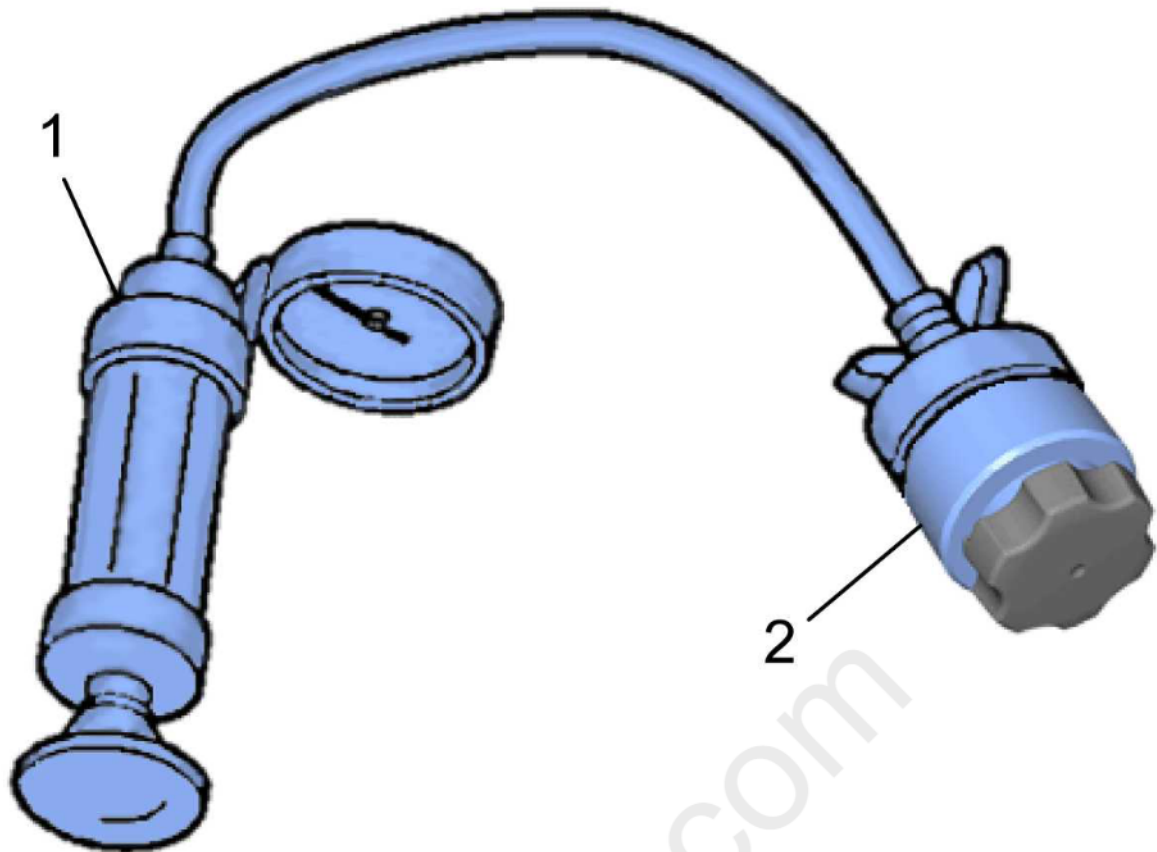


**Fig. 6: Pressure Cap**

Courtesy of GENERAL MOTORS COMPANY

**WARNING:** 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.

5. Wash the pressure cap sealing surface with water.
6. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **J-46143-1** Radiator Cap / Surge Tank Test Adapter (2) in order to test the pressure cap.



**Fig. 7: Cooling System Pressure Tester and Radiator Cap/Surge Tank Test Adapter**  
Courtesy of GENERAL MOTORS COMPANY

7. Test the pressure cap for the following conditions:

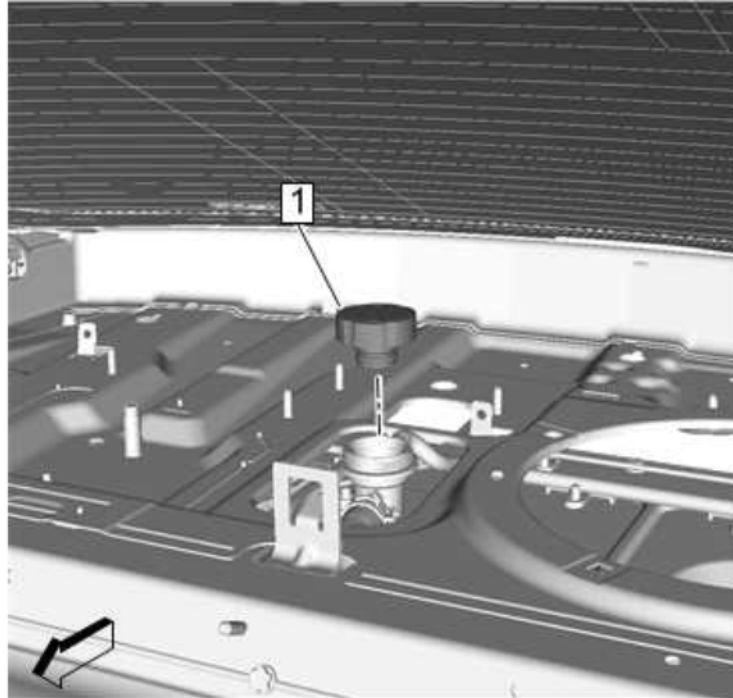
- Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
- Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

8. 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.

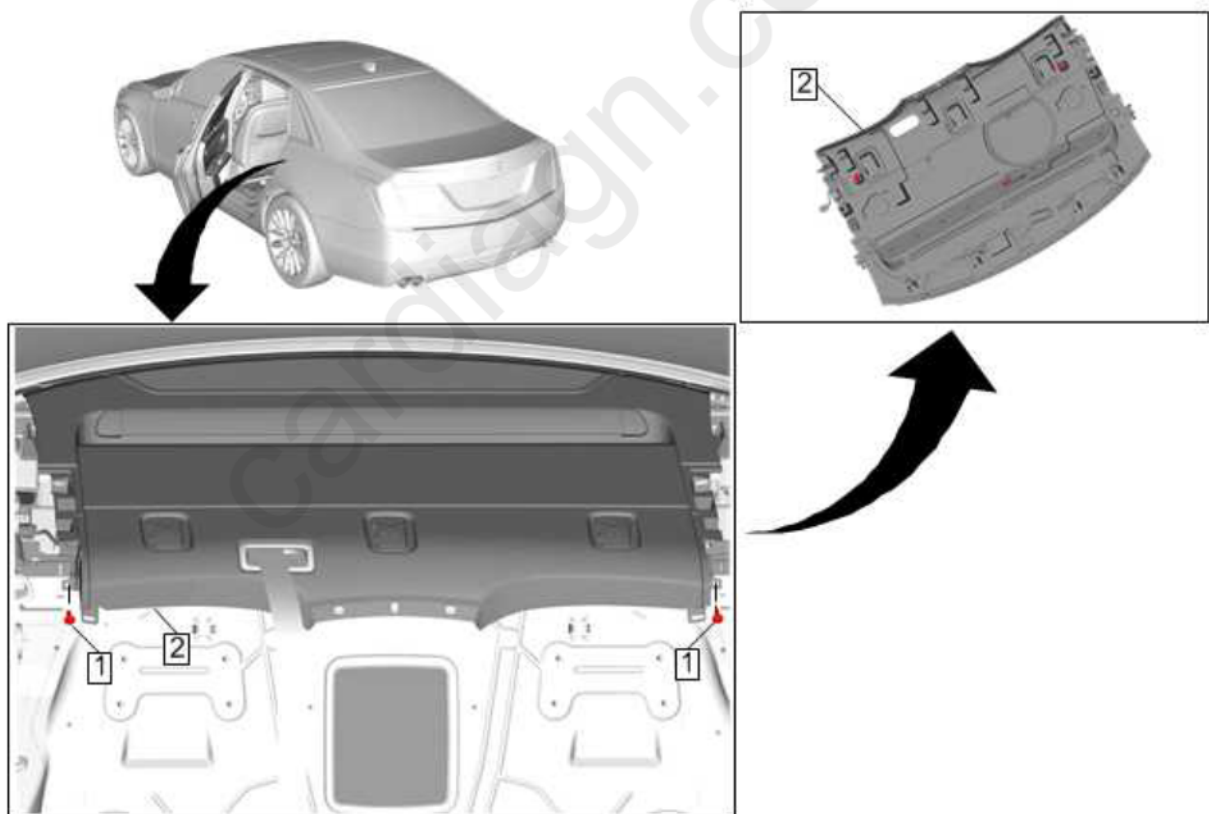
9. Install cap (1) to the water inlet.



**Fig. 8: Pressure Cap**

Courtesy of GENERAL MOTORS COMPANY

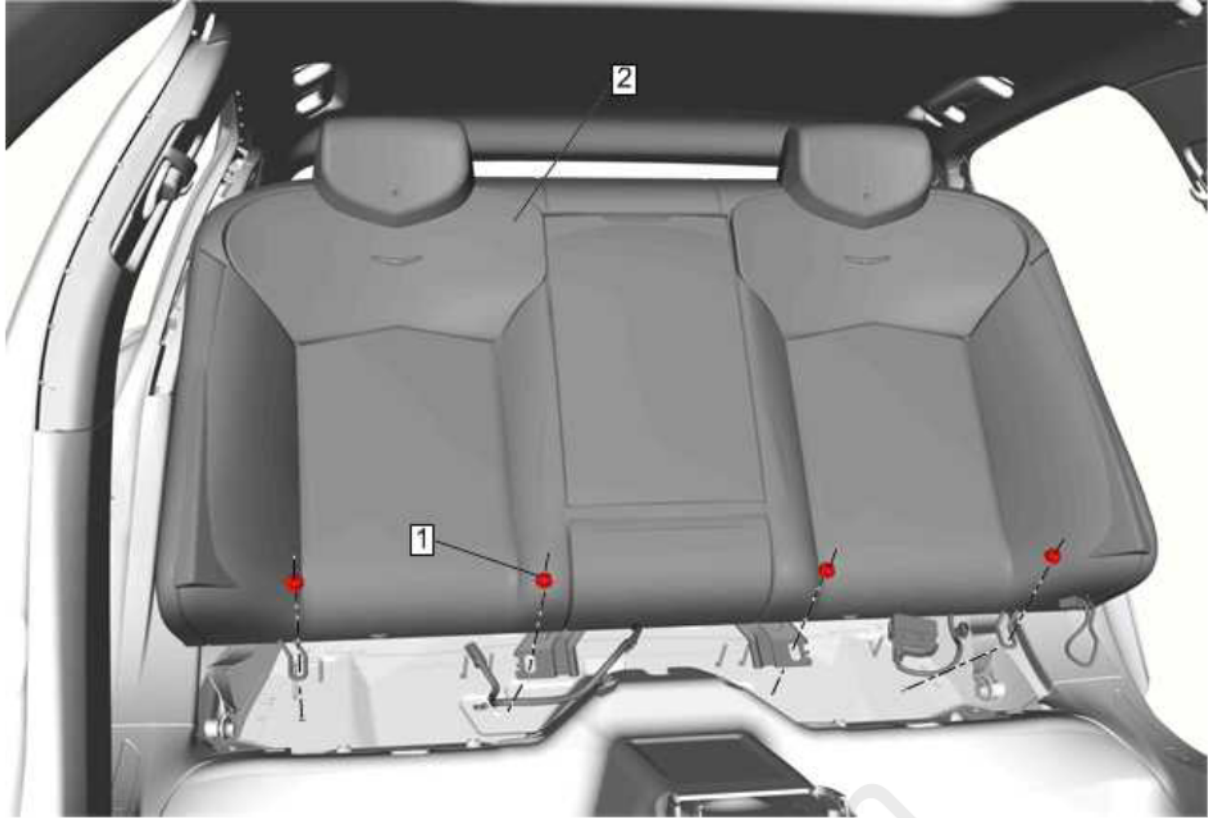
10. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)



**Fig. 9: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

11. Rear Seat Back Cushion (2)» Install - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 10: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

12. Enable the high voltage system. Refer to [High Voltage Enabling](#)

## **POWER ELECTRONICS AND AUXILIARY RADIATOR COOLING SYSTEM PRESSURE CAP TESTING**

### **Special Tools**

- EN-24460-A Cooling System Pressure Tester
- J-46143-1 Radiator Cap / Surge Tank Test Adapter

Equivalent regional tools: [Special Tools](#)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

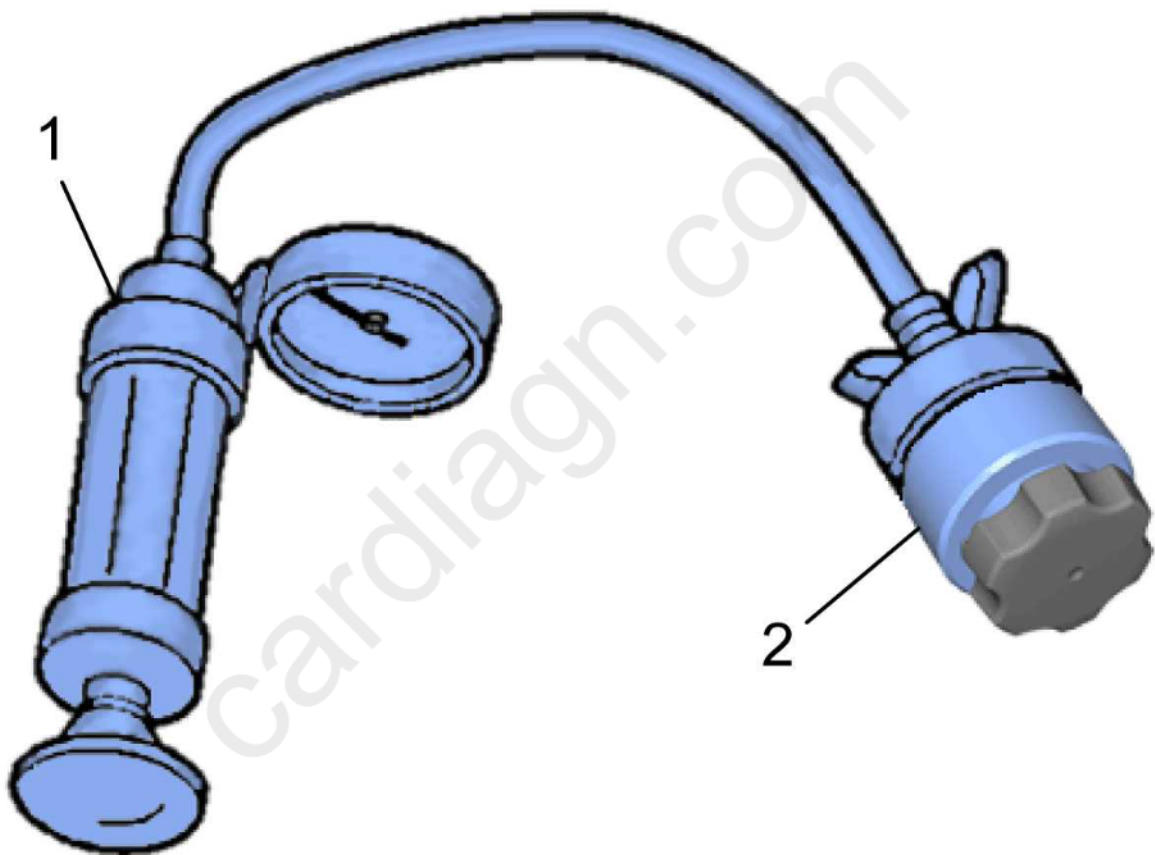
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

### Pressure Cap Testing

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove the pressure cap.

**WARNING:** 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.

3. Wash the pressure cap sealing surface with water.
4. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **J-46143-1** Radiator Cap / Surge Tank Test Adapter (2) in order to test the pressure cap.



**Fig. 11: Cooling System Pressure Tester and Radiator Cap/Surge Tank Test Adapter**  
Courtesy of GENERAL MOTORS COMPANY

5. Test the pressure cap for the following conditions:
  - Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
  - Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

6. 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.
- Install the pressure cap.
- Enable the high voltage system. Refer to [High Voltage Enabling](#)

## HIGH VOLTAGE BATTERY LEAK TESTING

### Special Tools

- EN-24460-A Cooling System Pressure Tester
- GE-46143-2 Cooling System Adapter
- GE-47716 Vac N Fill Coolant Refill Tool
- GE-47716-20 Cooling System Fill Adapter
- GE-50385 Battery Pack Coolant Passage Test Adapter
- GE-50389 Coolant Pressure Test Quick Connect

Equivalent regional tools: [Special Tools](#)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

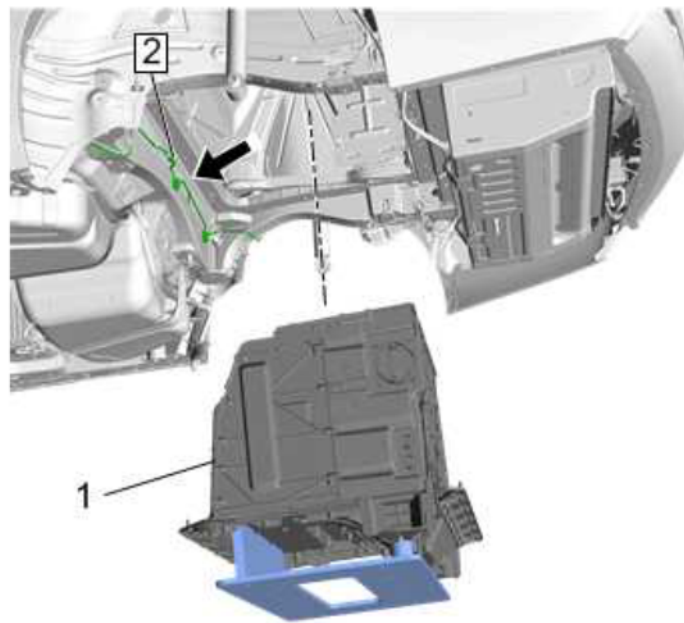
Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. High Voltage Battery (1)A» Remove - [High Voltage Battery Replacement and Shipping Preparation](#)

**WARNING:** 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 anti-freeze, such as alcohol, is not recommended for use at any time. Flammable anti-freeze could cause a serious fire.

**WARNING:** 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.

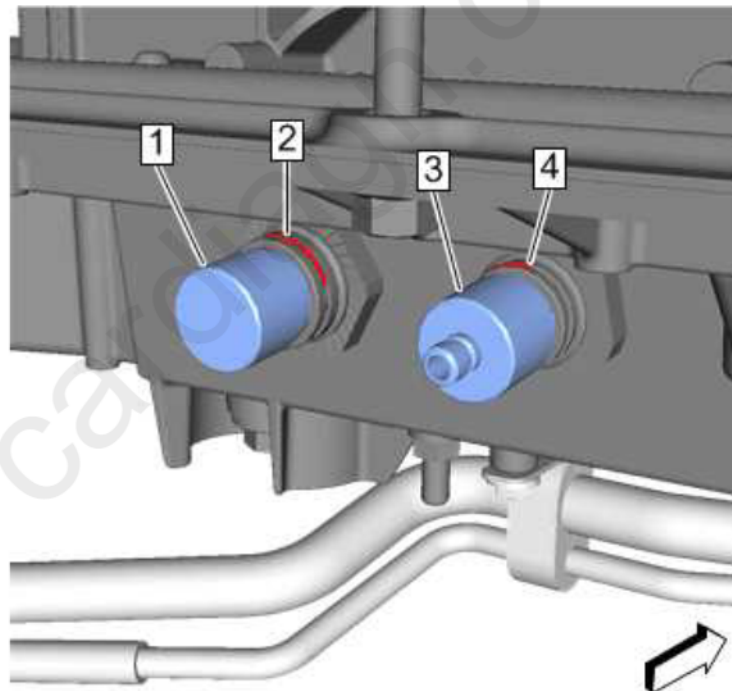
**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .



**Fig. 12: High Voltage Battery**

Courtesy of GENERAL MOTORS COMPANY

3. Install **GE-50385-2** Battery Pack Coolant Passage Test Adapter (1) to the battery inlet port.



**Fig. 13: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**

Courtesy of GENERAL MOTORS COMPANY

4. Engage the inlet port retaining clip (2).
5. Install **GE-47716-20** Cooling System Fill Adapter (3) to the battery outlet port.
6. Engage the outlet port retaining clip (4).
7. Install **GE-50389** Coolant Pressure Test Quick Connect to **GE-47716-20** Cooling System Fill Adapter.
8. Install **GE-47716-8** Vac N Fill Cap to **GE-50389** Coolant Pressure Test Quick Connect.
9. Install the Cooling System Pressure Test Cap Adapter to **GE-47716-8** Vac N Fill Cap
10. Install **EN-24460-A** Cooling System Pressure Tester to the Cooling System Adapter.

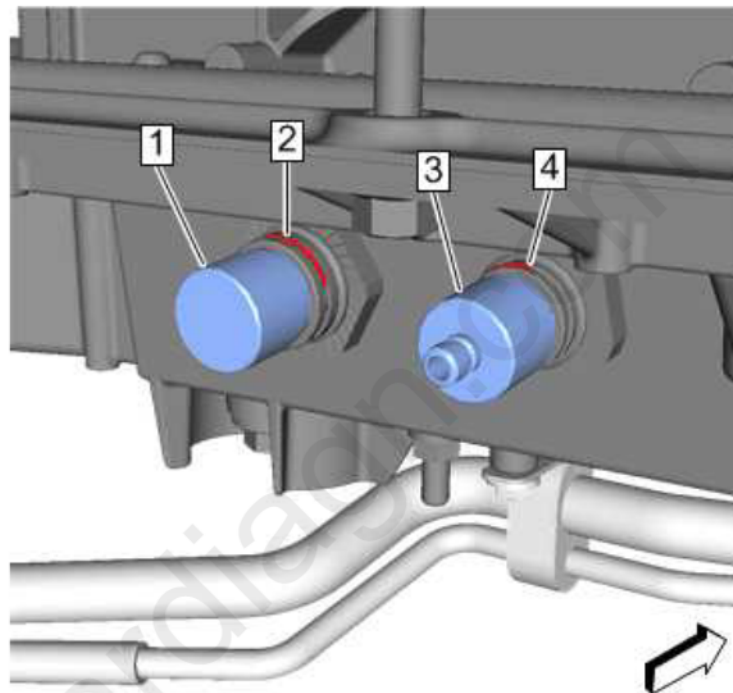
11. Ensure RESS Bottle Pressure Cap is tight.
12. Apply pressure to the battery pack coolant passages.

**NOTE:** Do not exceed the pressure cap rating.

13. The cooling passages should hold the rated pressure for at least 2 minutes.

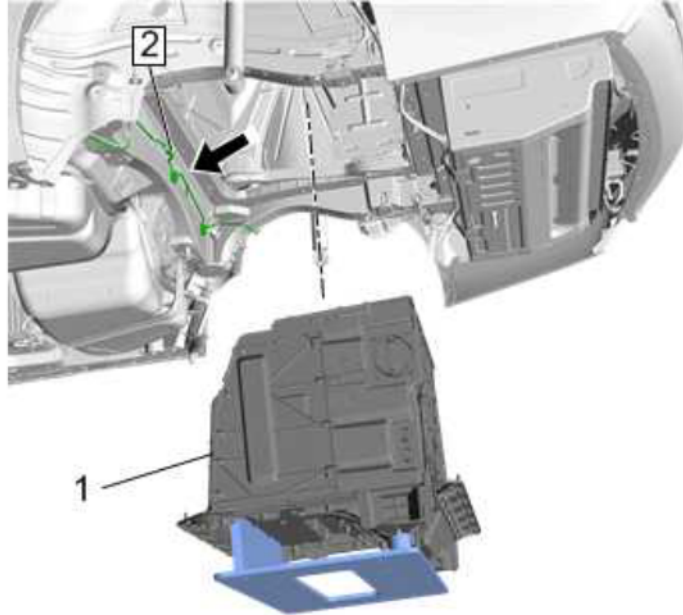
Observe the gauge for any pressure loss.

14. Repair any leaks as required.
15. Remove **EN-24460-A** Cooling System Pressure Tester from the Cooling System Adapter.
16. Remove the Cooling System Pressure Test Cap Adapter from **GE-47716-8** Vac N Fill Cap
17. Remove **GE-47716-8** Vac N Fill Cap from **GE-50389** Coolant Pressure Test Quick Connect.
18. Remove **GE-50389** Coolant Pressure Test Quick Connect from **GE-47716-20** Cooling System Fill Adapter.
19. Disengage the outlet port retaining clip (4).



**Fig. 14: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

20. Remove **GE-47716-20** Cooling System Fill Adapter (3) from the battery outlet port.
21. Disengage the inlet port retaining clip (2).
22. Remove **GE-50385-2** Battery Pack Coolant Passage Test Adapter (1) from the battery inlet port.
23. High Voltage Battery (1)» Install - **High Voltage Battery Replacement and Shipping Preparation**



**Fig. 15: High Voltage Battery**

Courtesy of GENERAL MOTORS COMPANY

24. Enable the high voltage system. Refer to [High Voltage Enabling](#)

## **HIGH VOLTAGE BATTERY COOLING SYSTEM LEAK TESTING**

### **Special Tools**

- EN-24460-A Cooling System Pressure Tester
- GE-46143-2 Cooling System Adapter

Equivalent regional tools: [Special Tools](#).

### **WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)



**WARNING:**

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 anti-freeze, such as alcohol, is not recommended for use at any time. Flammable anti-freeze could cause a serious fire.

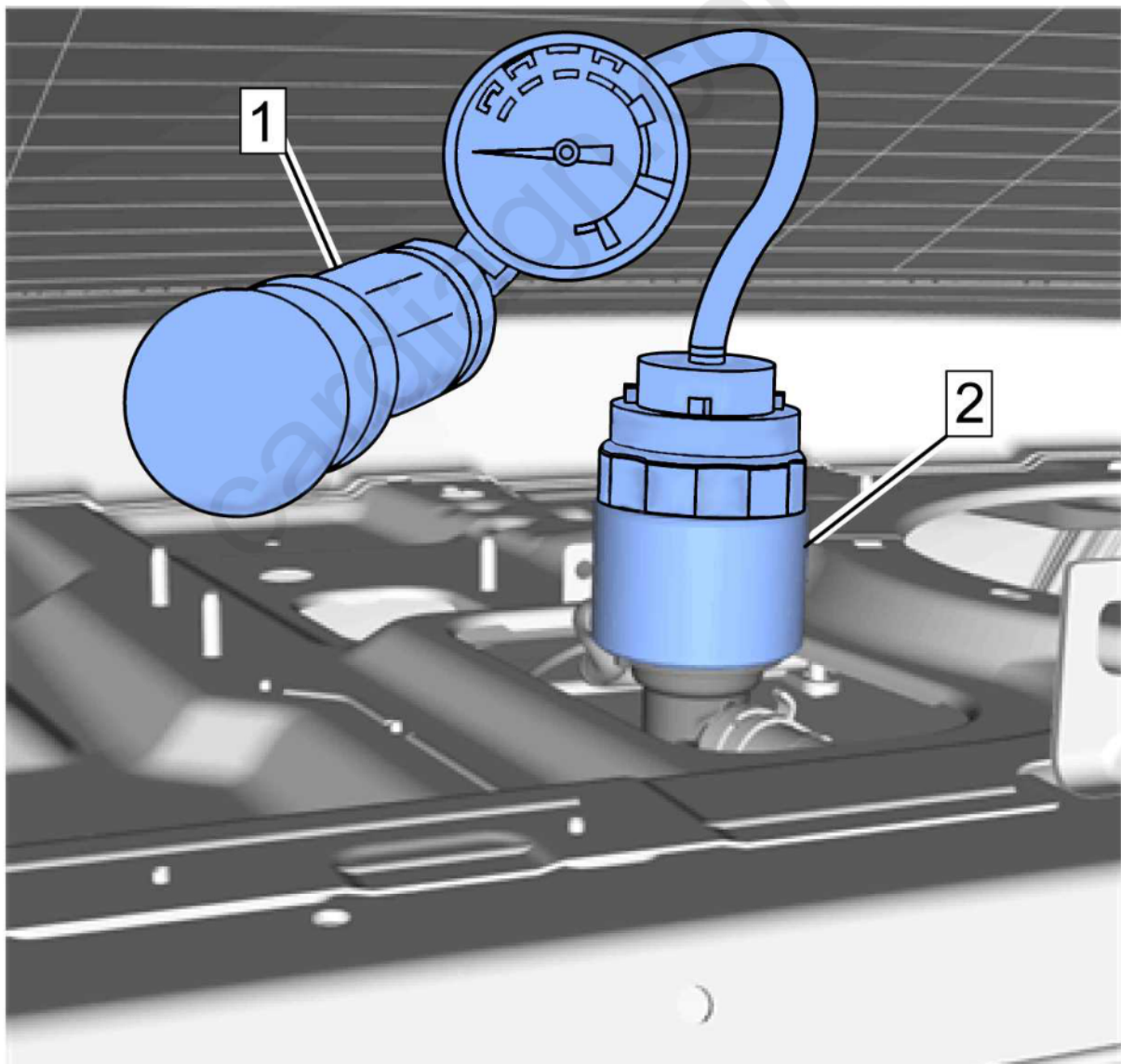
**WARNING:**

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.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

2. Remove the high voltage battery cooling system pressure cap. Refer to [High Voltage Battery Coolant Level Inspection](#)
3. Test the operation of the high voltage battery cooling system pressure cap. Refer to [High Voltage Battery Cooling System Pressure Cap Testing](#)
4. Install absorbent rags under the water inlet to absorb any coolant loss.
5. Clean the high voltage battery cooling system pressure cap mating surface.
6. Install **J-46143-2** Cooling System Adapter (2) to the water inlet.



**Fig. 16: Cooling System Adapter And Cooling System Pressure Tester**  
Courtesy of GENERAL MOTORS COMPANY

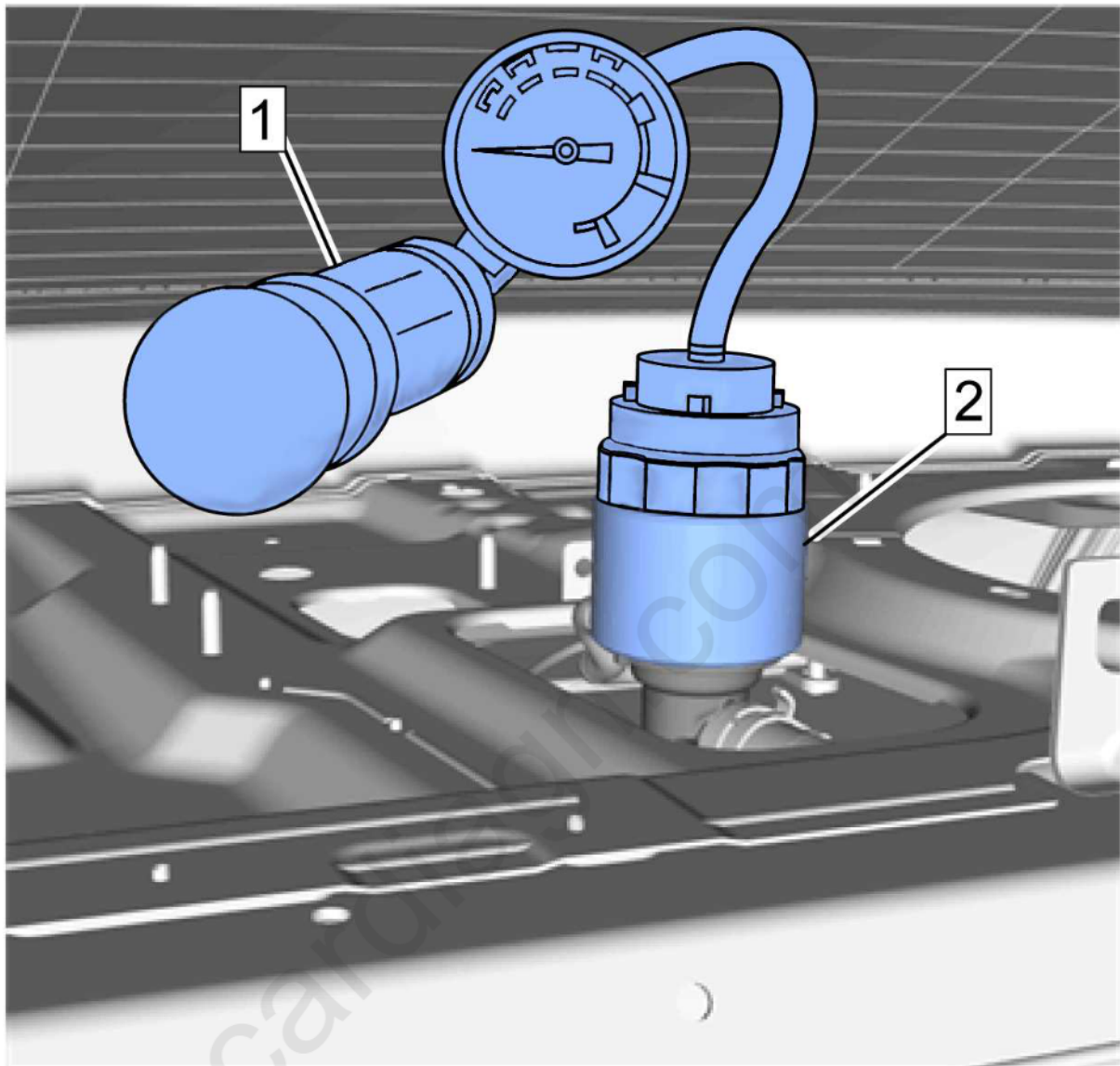
7. Install **EN-24460-A** Cooling System Pressure Tester (1) to Cooling System Adapter.



8. Apply pressure to the high voltage battery cooling system. Do not exceed the pressure cap rating.
9. Repair any leaks as required.

**NOTE:** Do not use stop leak or any other chemicals. Only use premix Dexcool® (50/50 mixture of Dexcool and deionized water).

10. Remove EN-24460-A Cooling System Pressure Tester (1) to Cooling System Adapter.



**Fig. 17: Cooling System Adapter And Cooling System Pressure Tester**  
Courtesy of GENERAL MOTORS COMPANY

11. Remove J-46143-2 Cooling System Adapter (2) to the water inlet.
12. Remove the absorbent rags from under the water inlet.
13. Fill system to correct level as needed. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#).
14. Install the high voltage battery cooling system pressure cap. Refer to [High Voltage Battery Coolant Level Inspection](#).
15. Enable the high voltage system. Refer to [High Voltage Enabling](#).

## **POWER ELECTRONICS AND AUXILIARY RADIATOR COOLING SYSTEM LEAK TESTING**

### **Special Tools**

- EN-24460-A Cooling System Pressure Tester
- GE-46143-2 Radiator Cap and Surge Tank Test Adapter

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

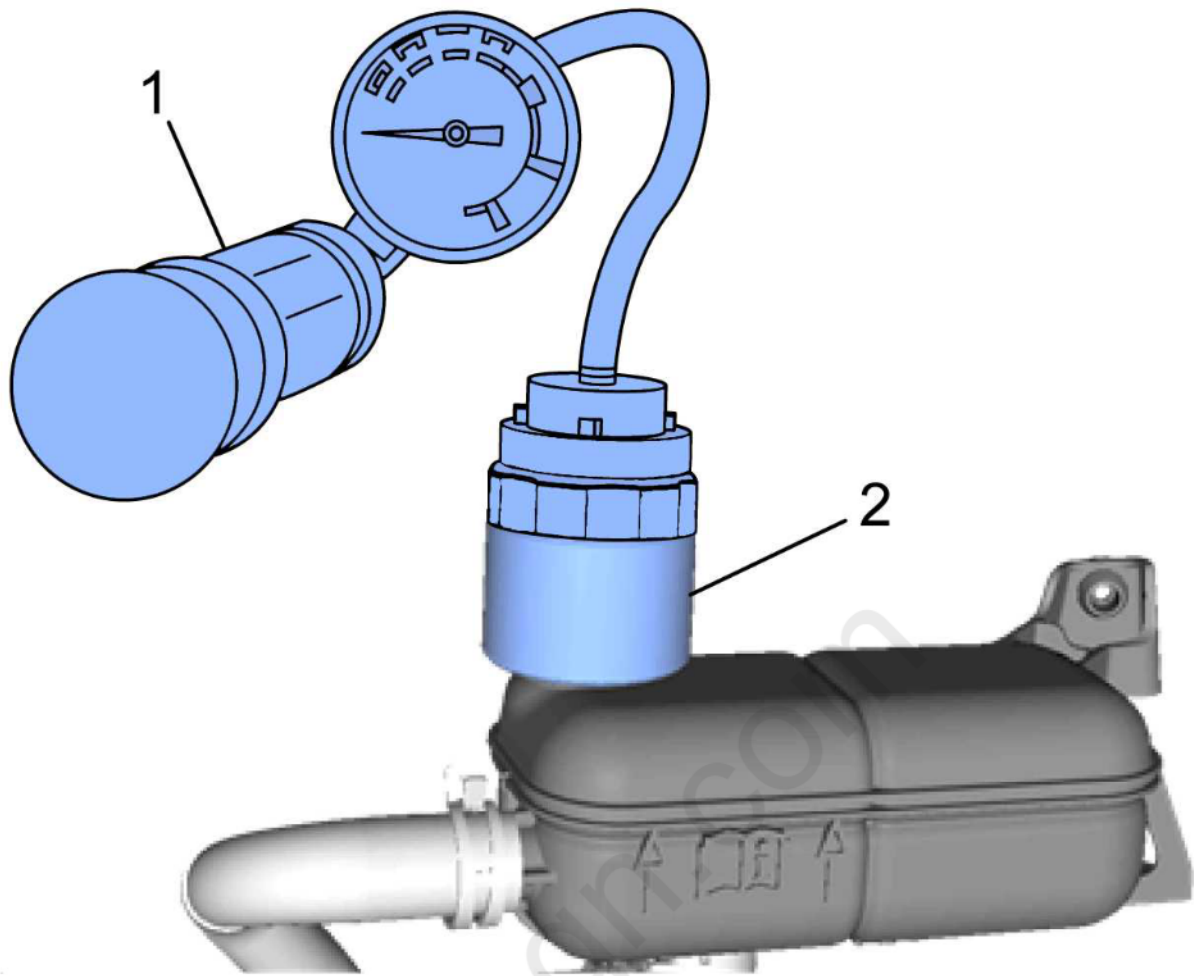
**WARNING:** Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine,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

**WARNING:** 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.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

2. Remove the power electronics and auxiliary radiator pressure cap.
3. Test the operation of the power electronics and the auxiliary radiator pressure cap. Refer to [Power Electronics and Auxiliary Radiator Cooling System Pressure Cap Testing](#).
4. Wash the power electronics and the auxiliary radiator pressure cap mating surface with water.
5. Use the **EN-24460-A** Cooling System Pressure Tester (1) with the **GE-46143-2** Radiator Cap and Surge Tank Test Adapter (2) in order to apply pressure to the power electronics and auxiliary radiator cooling system.

Do not exceed the power electronics and the auxiliary radiator pressure cap rating.



**Fig. 18: Cooling System Pressure Tester and Radiator Cap and Surge Tank Test Adapter**  
Courtesy of GENERAL MOTORS COMPANY

6. The power electronics and auxiliary the radiator cooling system should hold the rated pressure for at least 2 minutes.

Observe the gauge for any pressure loss.

7. Repair any leaks as required.

**NOTE:** Do not use stop leak or any other chemicals. Only use premix Dexcool<sup>®</sup> (50/50 mixture of Dexcool and deionized water).

8. Enable the high voltage system. Refer to [High Voltage Enabling](#)

## REPAIR INSTRUCTIONS

### HIGH VOLTAGE BATTERY COOLANT LEVEL INSPECTION

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must

be followed.

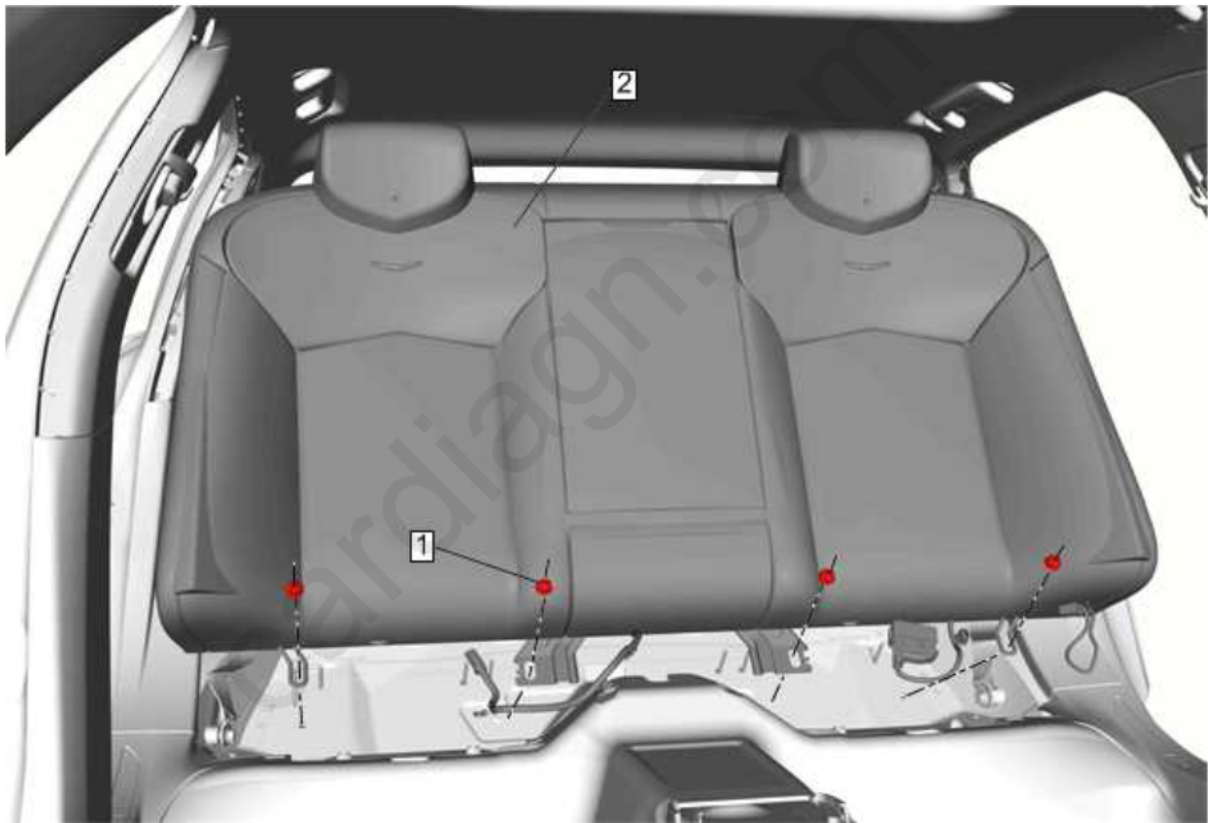
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Seat Back Cushion (2)» Remove - [Rear Seat Back Cushion Removal and Installation](#)

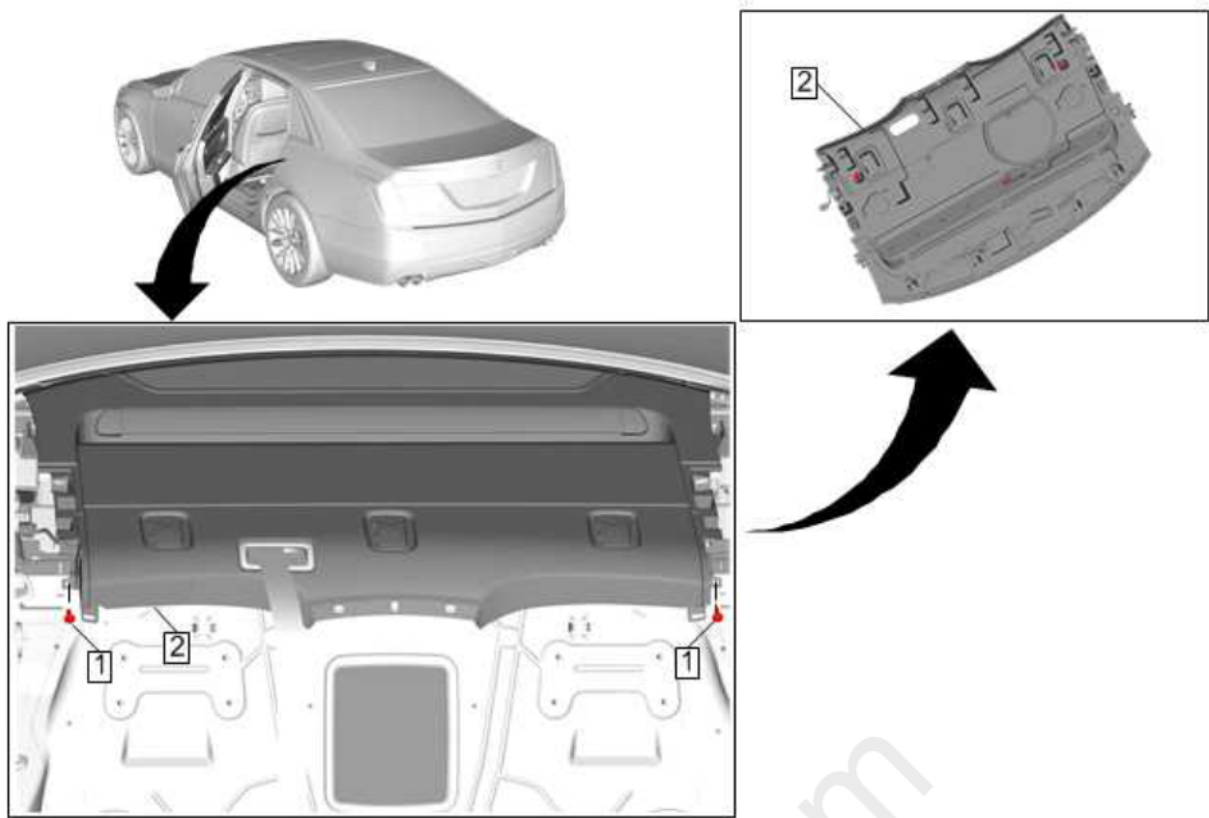


**Fig. 19: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

3. Rear Window Panel Trim (2)» Remove - [Rear Window Panel Trim Replacement](#)

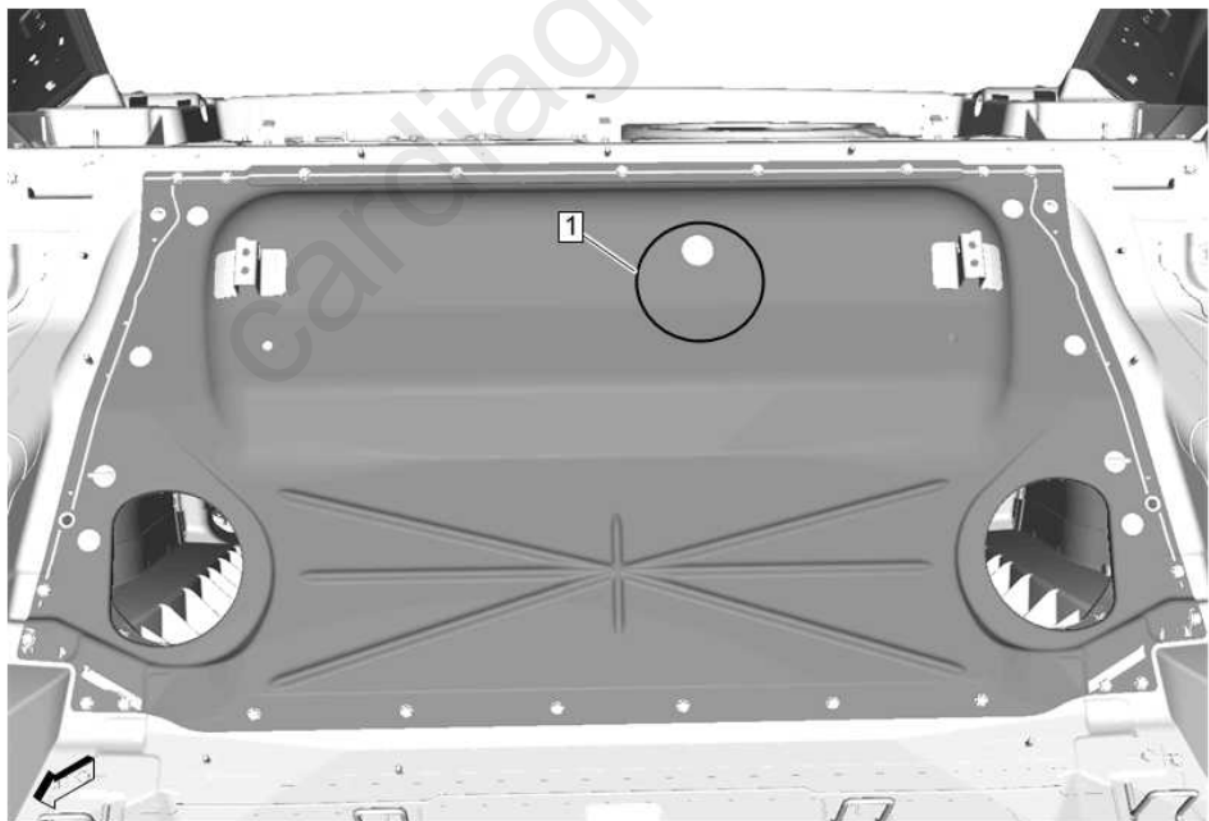




**Fig. 20: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

4. If this is the first time this procedure has been performed on this vehicle, you will need to cut-out the circle portion scribed in the rear seat back body panel (1).



**Fig. 21: Rear Seat Back Body Panel**

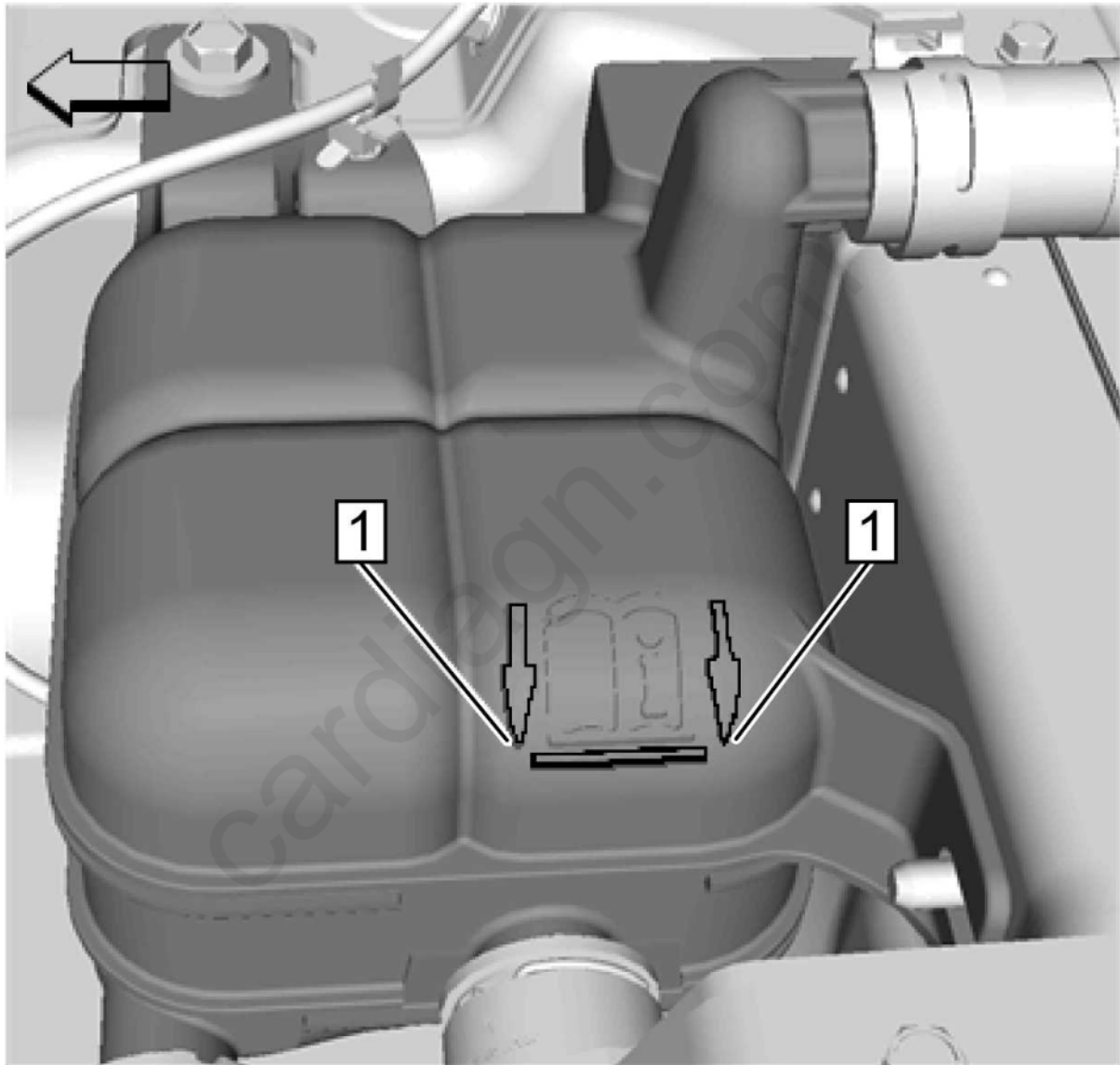
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** When cutting the service opening in the rear panel use only an air nibbler. Using a different tool can cause damage to underlying components requiring unnecessary replacement of those parts.

5. Remove all metal shavings from the rear of the vehicle created from cutting the circle portion of the rear seat back body panel.
6. Using an inspection mirror through the cut-out in the rear seat back body panel, verify the coolant level of the drive motor battery coolant/air separator using the arrows (1) found on the driver's side of the drive motor battery coolant/air separator.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

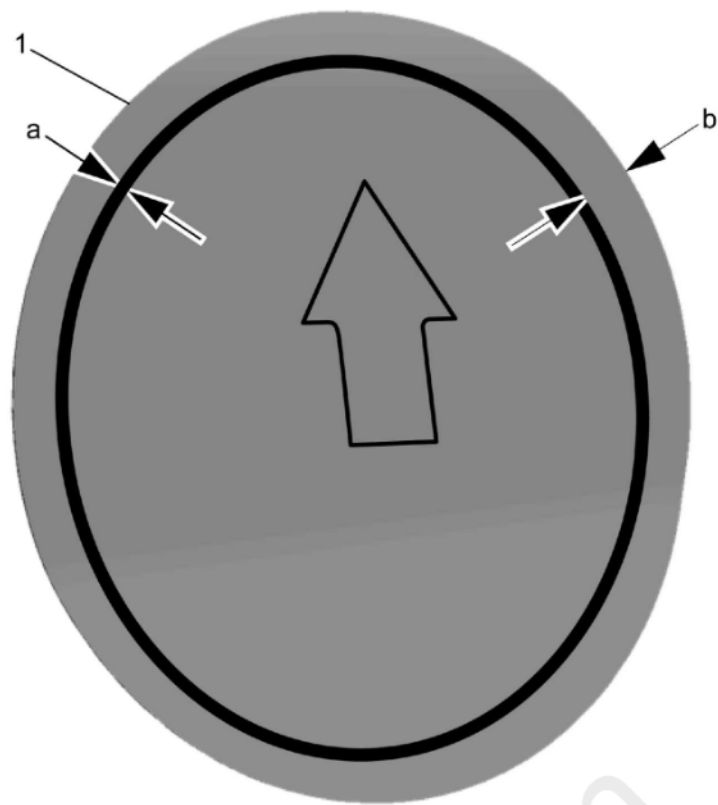
**CAUTION:** Do NOT manually add coolant to the High Voltage Battery Cooling System. Only use the GE-47716 Vac N Fill Coolant Refill Tool to fill the cooling system. Failure to use the proper tool could allow spilled coolant into the High Voltage Battery, resulting in damage to the Battery and will lead to loss of vehicle propulsion.



**Fig. 22: Coolant Level Of Drive Motor Battery Coolant/Air Separator**  
Courtesy of GENERAL MOTORS COMPANY

#### **Installation Procedure**

1. Apply a continuous bead 1.6 mm (0.1 in) (A) of a urethane adhesive which meets GM Specification GM 3651G 9 mm (0.4 in) (B) from the outer edge of the rear seat back body panel patch (1).

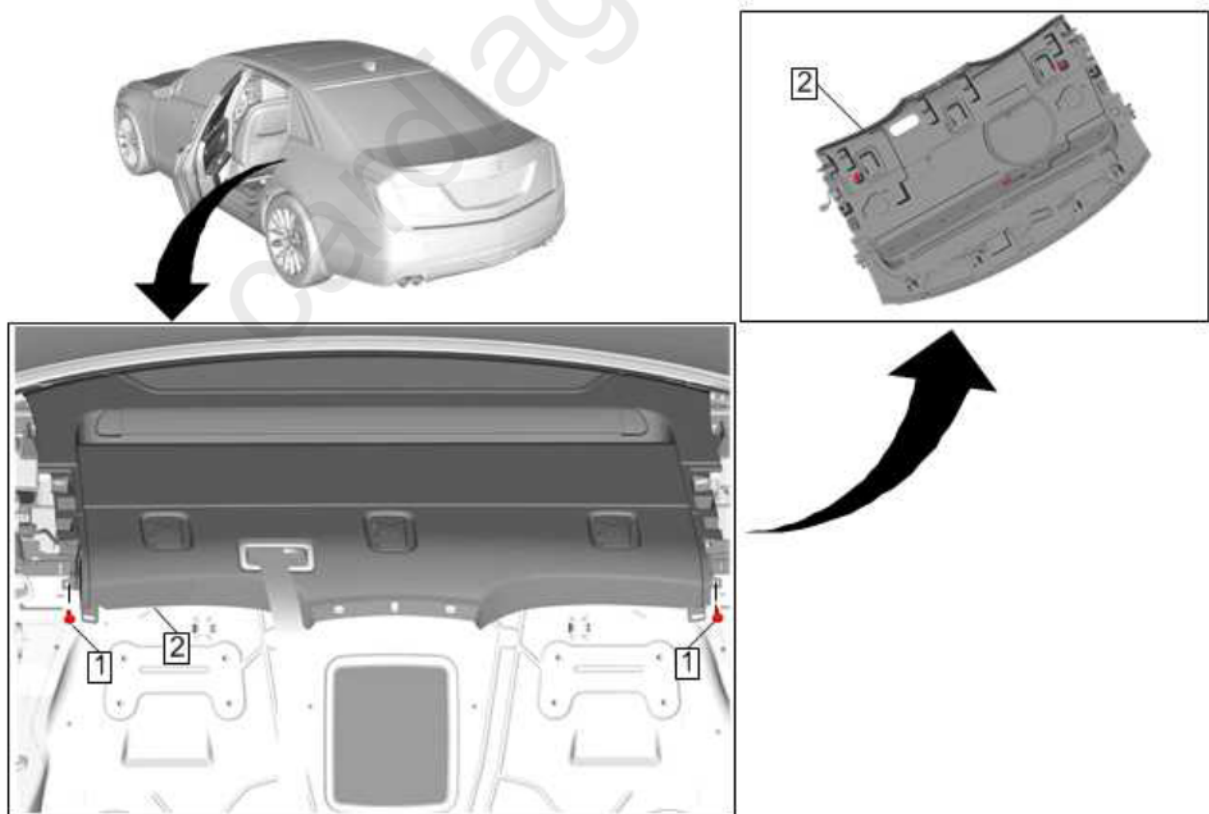


**Fig. 23: Applying Urethane Adhesive**

Courtesy of GENERAL MOTORS COMPANY

See GM Electronics Parts Catalog for Rear Seat Back Body Panel Patch Part Number.

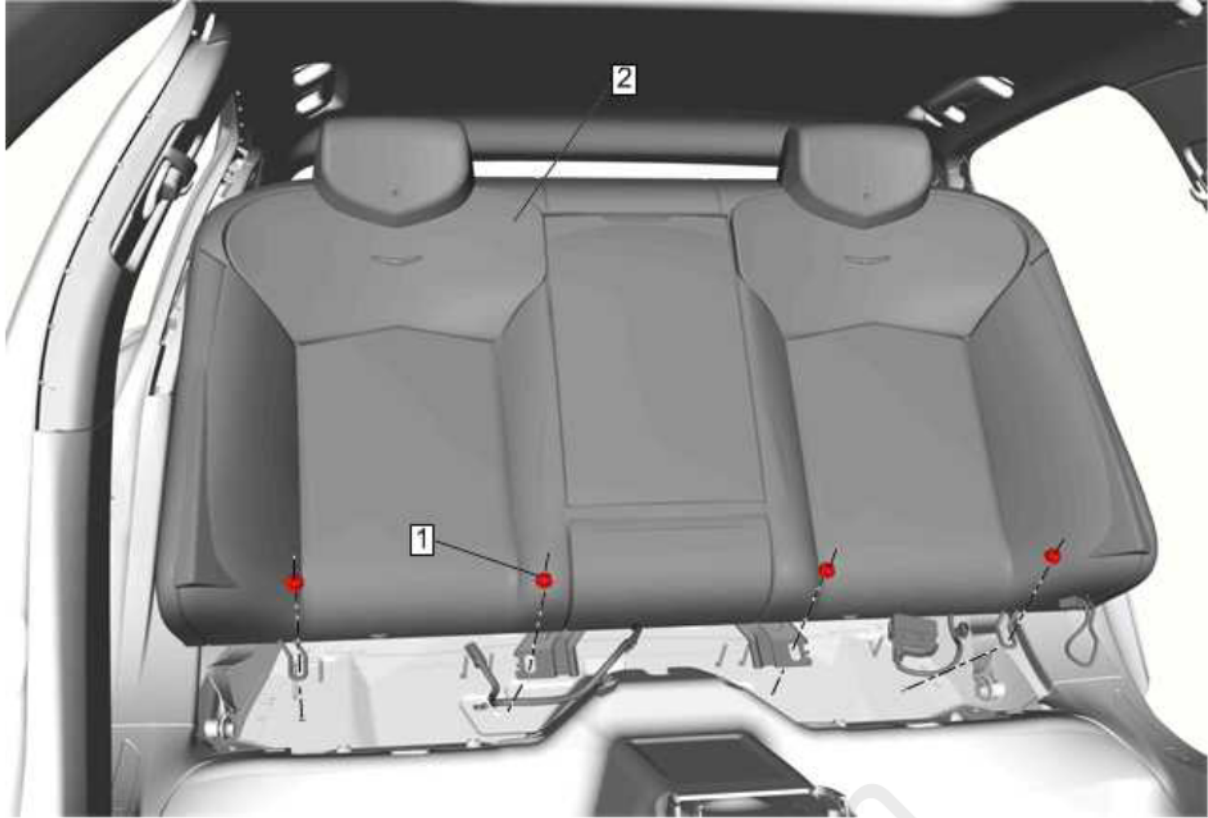
2. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)



**Fig. 24: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

3. Rear Seat Back Cushion (2)» Install - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 25: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

4. Enable the high voltage system. Refer to [High Voltage Enabling](#)

### **HIGH VOLTAGE BATTERY DRAIN AND FILLING (WITHOUT HEATER VENT HOSE QUICK CONNECT)**

#### **Special Tools**

- J-26568 Coolant and Battery Fluid Tester
- J-46143-2 Cooling System Adapter
- GE-47716 Vac N Fill Coolant Refill Tool
- GE-47716-20 Cooling System Fill Adapter
- GE-50385 Battery Pack Coolant Passage Test Adapter

Equivalent regional tools: [Special Tools](#)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.



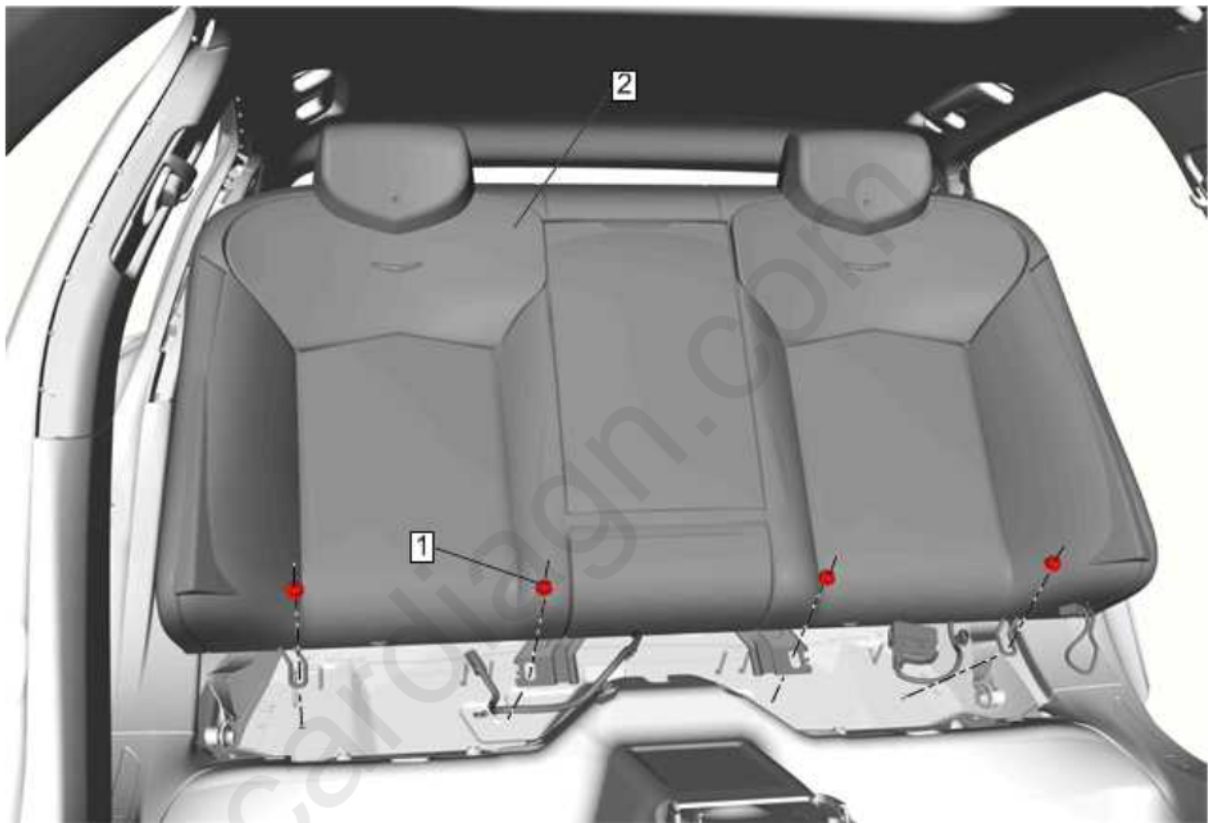
- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

### Draining Procedure

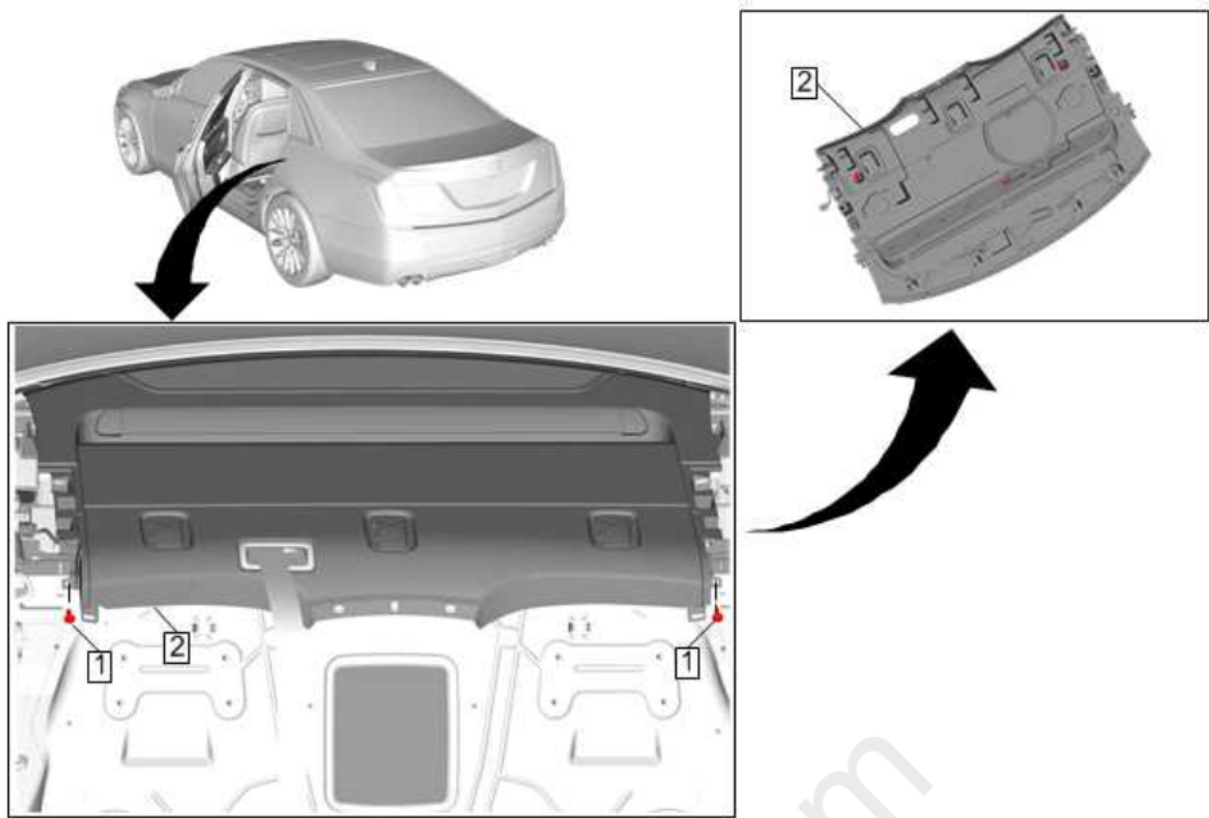
**WARNING:** To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Seat Back Cushion (2)» Remove - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 26: Rear Seat Back Cushion (Base)**  
Courtesy of GENERAL MOTORS COMPANY

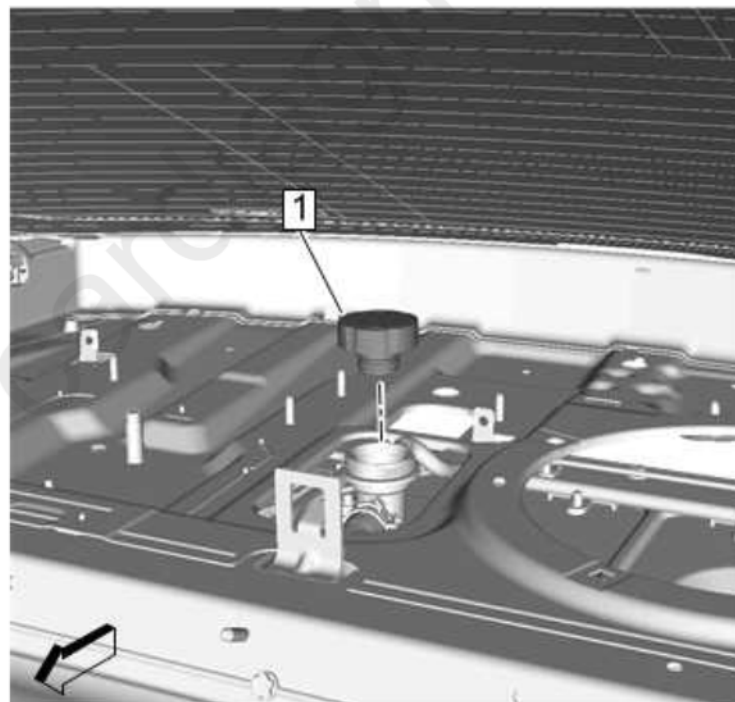
3. Rear Window Panel Trim (2)» Remove - [Rear Window Panel Trim Replacement](#)



**Fig. 27: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

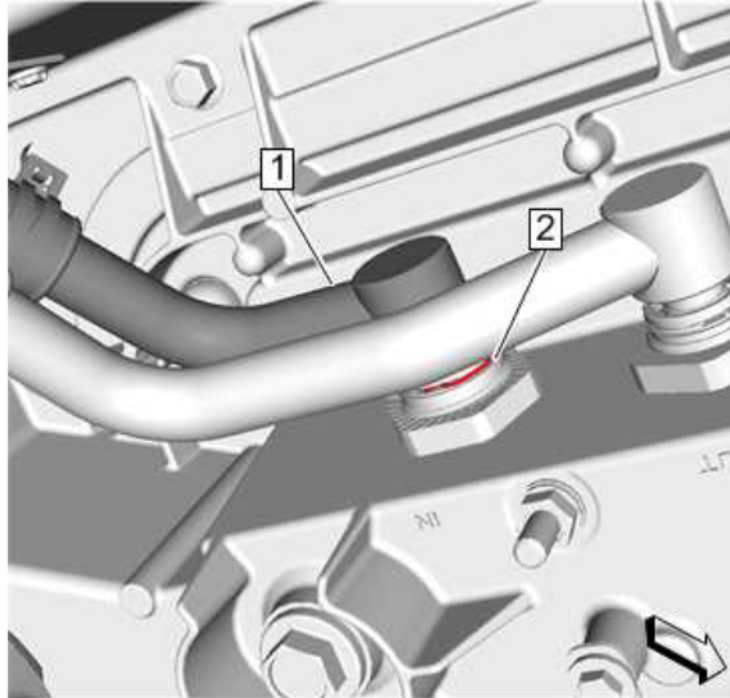
4. Remove the cap (1) from water inlet.



**Fig. 28: Pressure Cap**

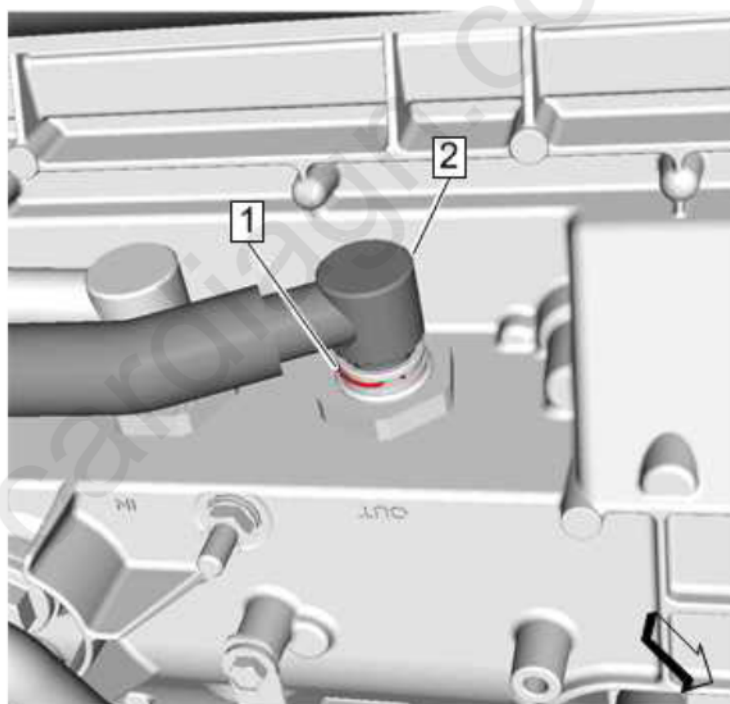
Courtesy of GENERAL MOTORS COMPANY

5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Place a drain pan under the vehicle.
7. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage BatteryÂ» Remove - [Drive Motor Battery Radiator Inlet Hose Replacement](#)



**Fig. 29: Drive Motor Battery Radiator Inlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery» Remove - **Drive Motor Battery Radiator Outlet Hose Replacement**



**Fig. 30: Drive Motor Battery Radiator Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

9. Allow the coolant to drain from both the high voltage battery and its hoses.  
10. Lower the vehicle.

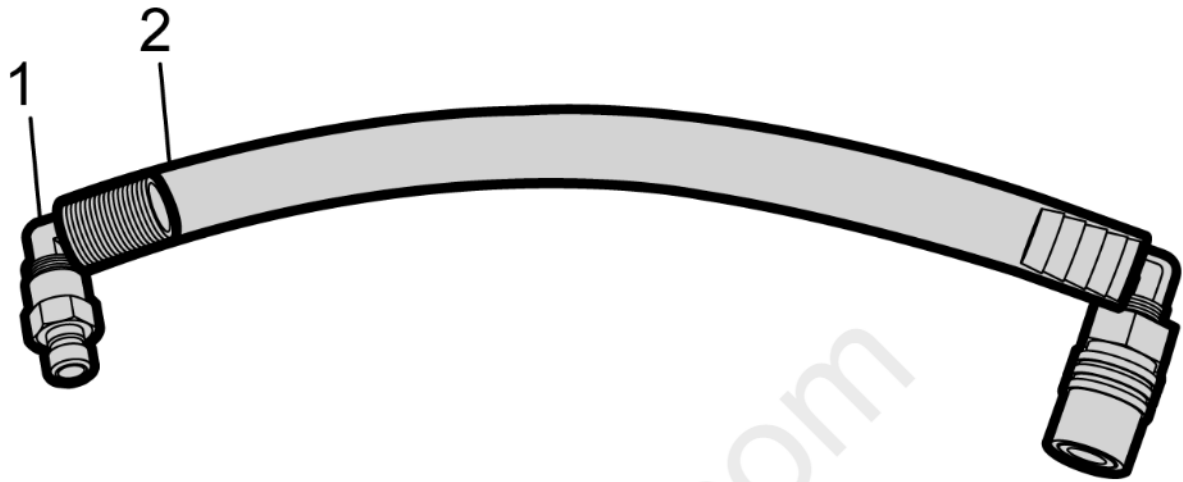
#### **Purging and Removal of Coolant From Battery**

**NOTE:** Prior to performing high-voltage battery internal service, it is necessary to purge any residual coolant inside the battery that is left over from the cooling system draining procedure. Similarly, coolant must be removed from the battery prior to return shipping. This procedure must also be used when purging complete system of contaminated coolant.

**NOTE:** This procedure can be performed in vehicle or with battery removed from

vehicle.

1. Take the short hose with dual 90° fittings from the Vac N Fill and remove the 90° fitting (1) from the Vac and Fill short hose (2).

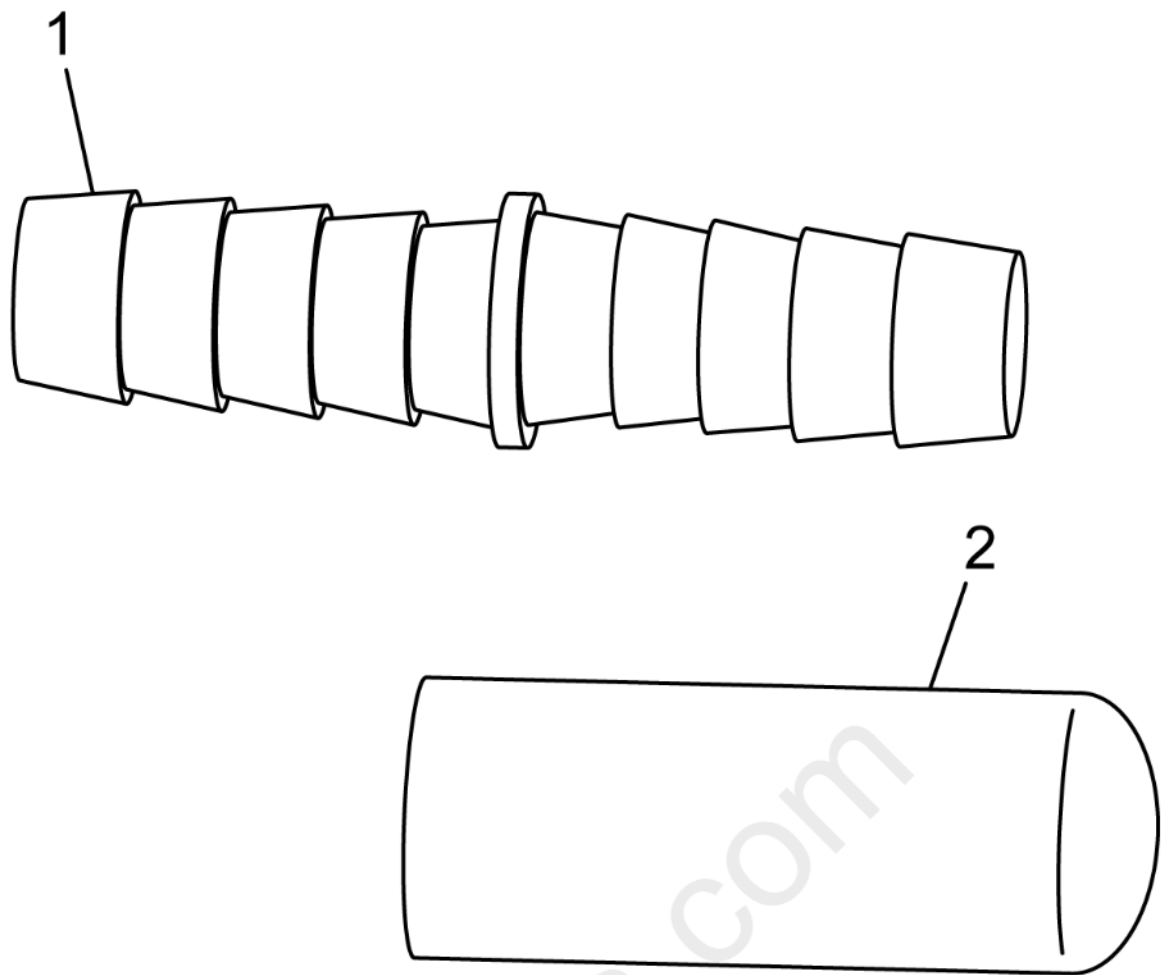


**Fig. 31: Vac and Fill Short Hose With Fitting**

Courtesy of GENERAL MOTORS COMPANY

2. Install a rubber cap (2) to a 10 mm (.375 in) x 10 mm (.375 in) barbed fitting with a flange (1).

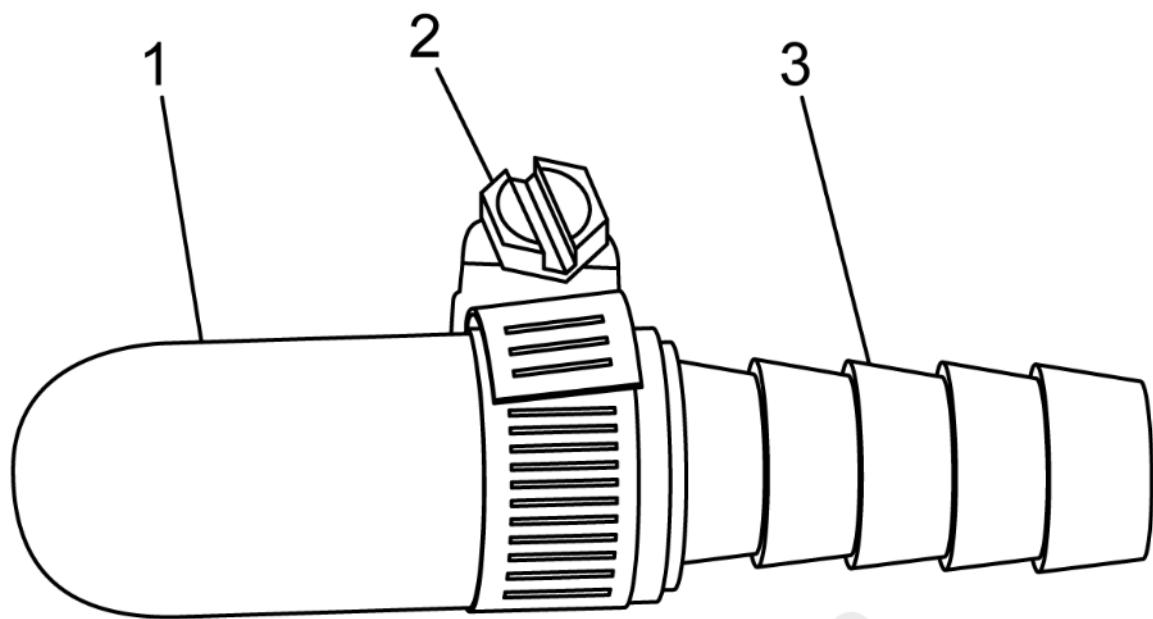




**Fig. 32: Rubber Cap**

**Courtesy of GENERAL MOTORS COMPANY**

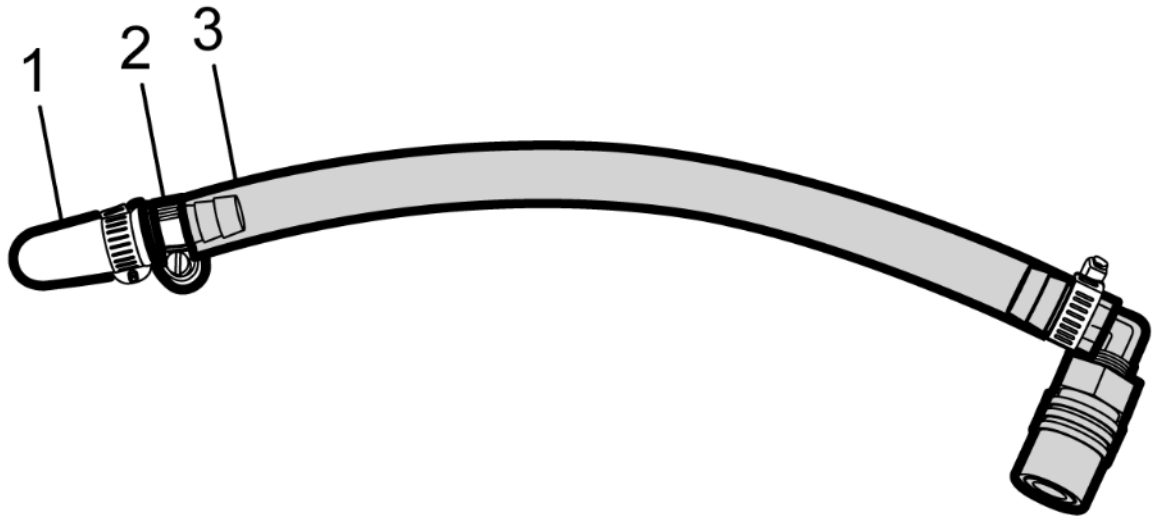
3. Install a hose clamp (2) to the rubber cap (1) on the 10 mm (.375 in) x 10 mm (.375 in) Barbed fitting (3) and tighten the hose clamp.



**Fig. 33: Hose Clamp and Rubber Cap**

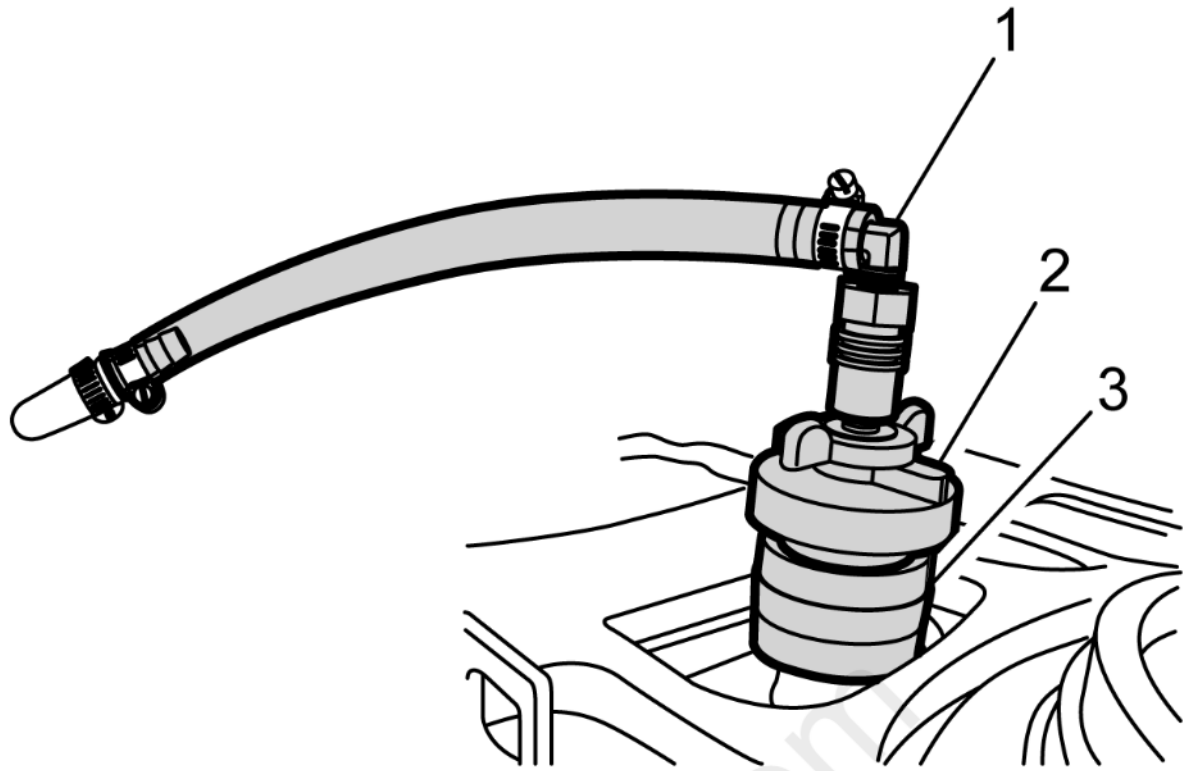
**Courtesy of GENERAL MOTORS COMPANY**

4. Install the 10 mm (.375 in) x 10 mm (.375 in) barbed and rubber cap assembly (1) to the short hose (3).



**Fig. 34: Rubber Cap Assembly And Short Hose**  
Courtesy of GENERAL MOTORS COMPANY

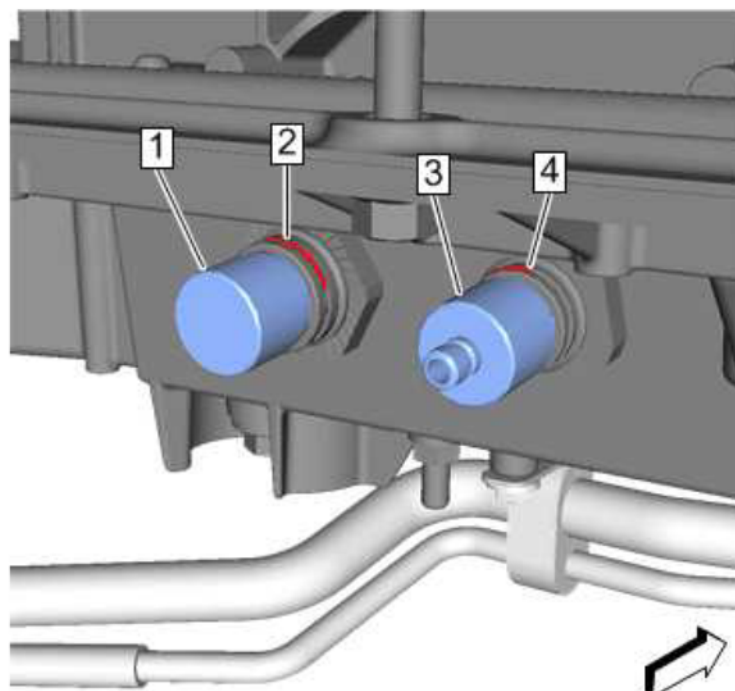
5. Install a hose clamp (2) to the short hose assembly (3) and tighten.
6. Install **J-46143-2** Cooling System Adapter (3) the to the water inlet.



**Fig. 35: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

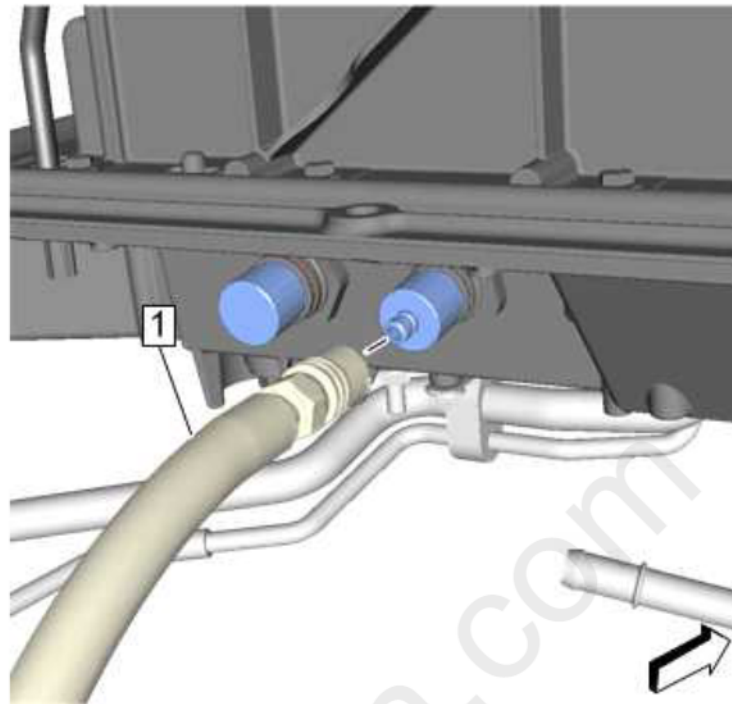
7. Install the Vac N Fill cap (2) to **J-46143-2** Cooling System Adapter.
8. Install the quick connect fitting on the short hose assembly (1) to the Vac N Fill cap.
9. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
10. Install **GE-50385** Battery Pack Coolant Passage Test Adapter (1) to the battery inlet port.





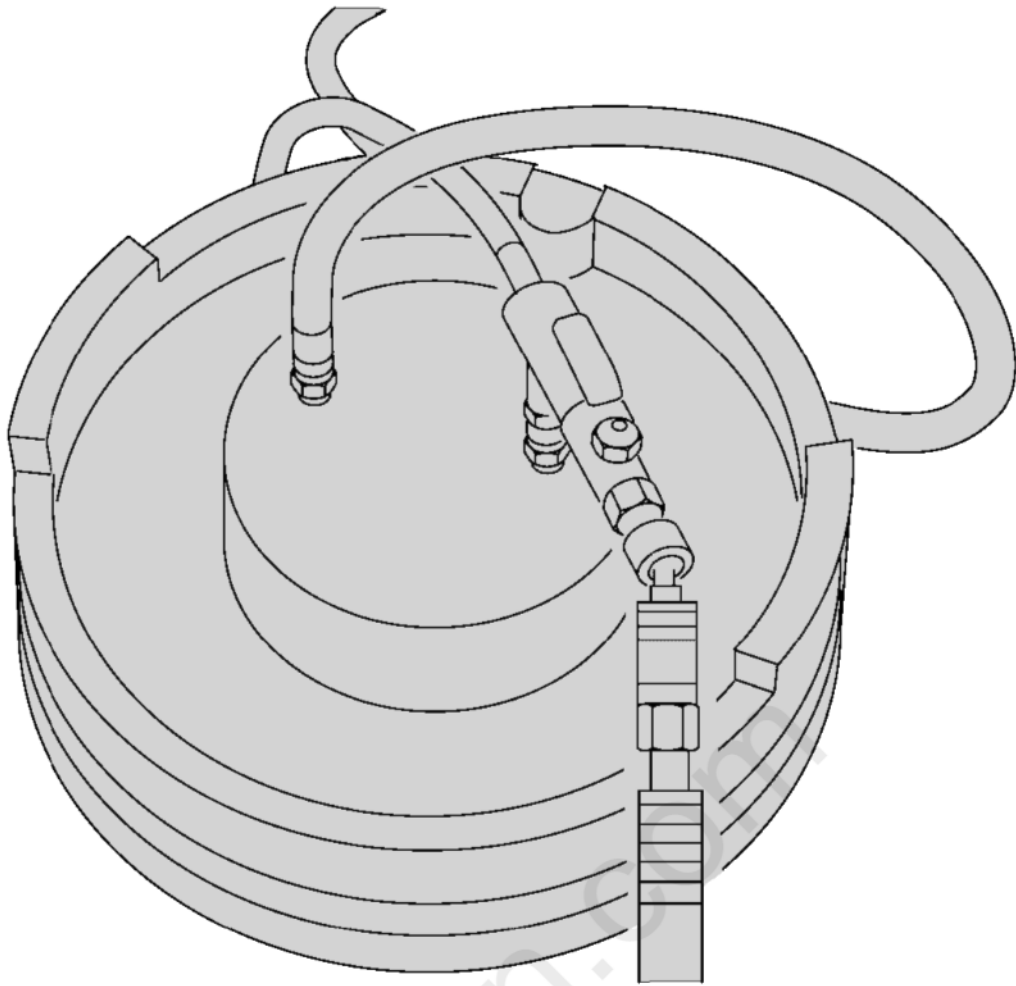
**Fig. 36: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

11. Engage the inlet port retaining clip (2).
12. Install **GE-47716-20** Cooling System Fill Adapter (3) to the battery outlet port.
13. Engage the outlet port retaining clip (4).
14. Connect the Vac N Fill Hose to **GE-47716-20** Cooling System Fill Adapter.



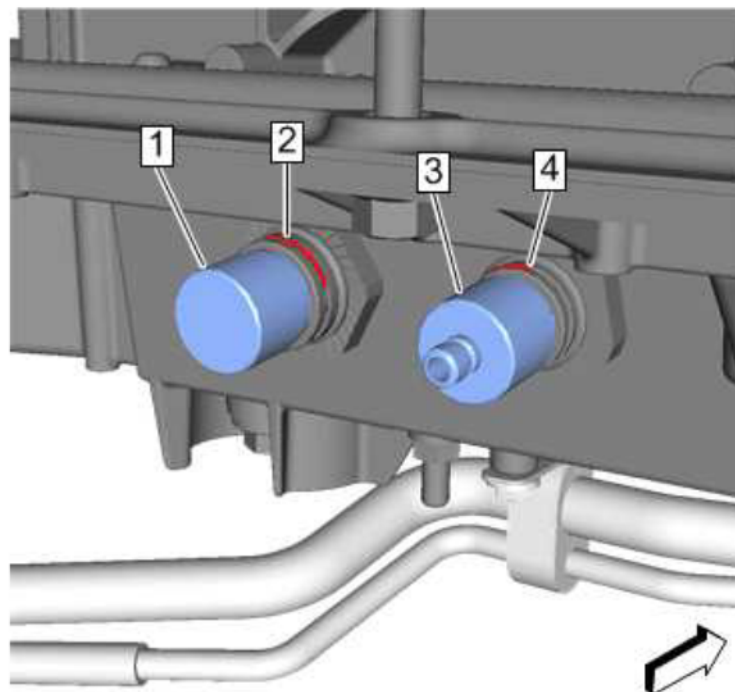
**Fig. 37: Cooling System Fill Adapter**  
Courtesy of GENERAL MOTORS COMPANY

15. Connect the other end of the Vac N Fill Hose to the Vac N Fill vacuum tank.



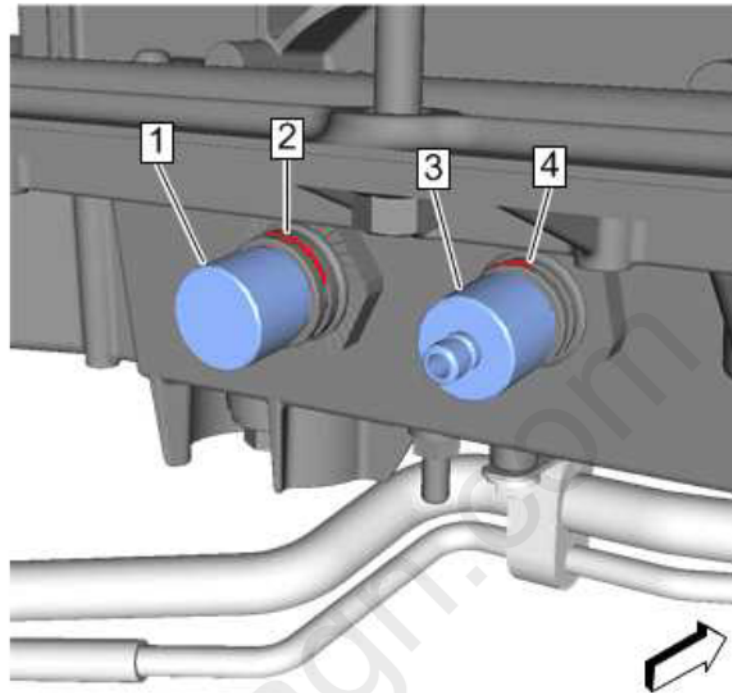
**Fig. 38: Connect Other End Of Vacuum Hose to Vac N Fill Vacuum Tank**  
**Courtesy of GENERAL MOTORS COMPANY**

16. Install the venturi assembly to the vacuum tank with the valve closed.
17. Attach a regulated shop air supply hose to the venturi assembly.
18. Open the valve on the venturi assembly to apply vacuum to the high voltage battery internal loop.
19. Build vacuum for at least one minute.
20. Disengage the inlet port retaining clip (2).



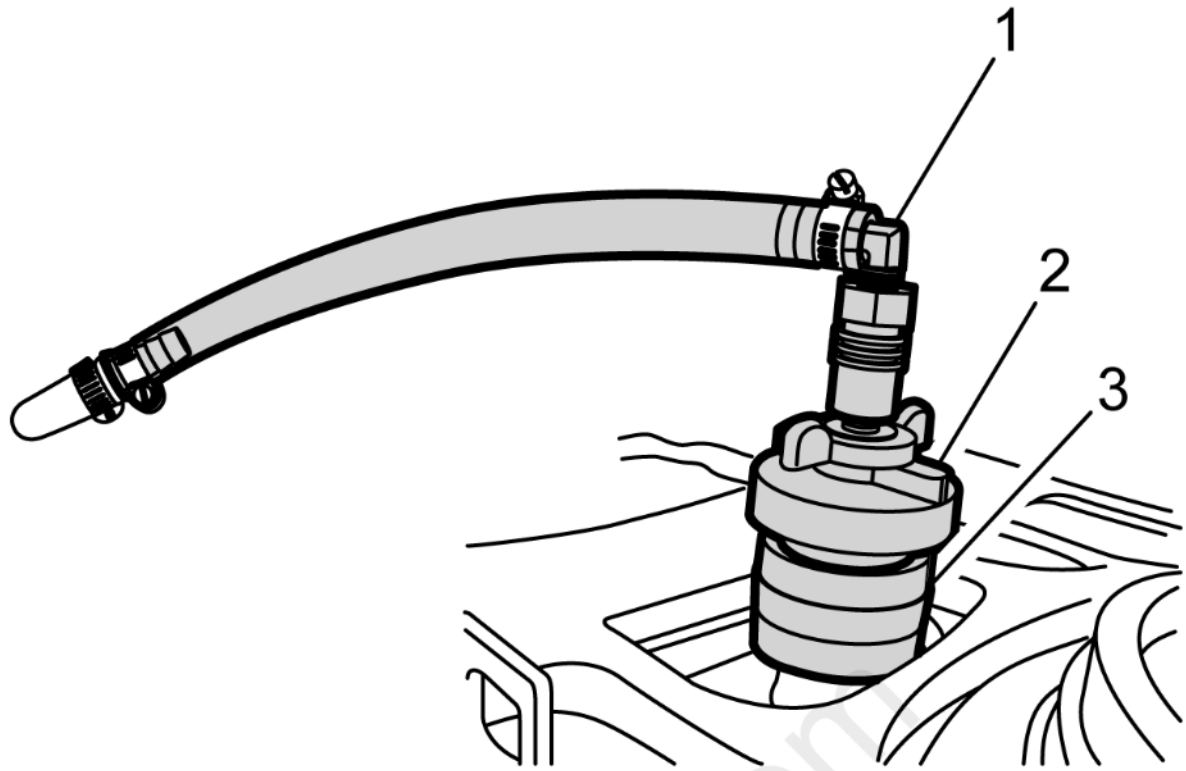
**Fig. 39: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
**Courtesy of GENERAL MOTORS COMPANY**

21. Temporarily remove **GE-50385** Battery Pack Coolant Passage Test Adapter (1) from the battery inlet port to break vacuum and purge the battery of coolant.
22. Install **GE-50385** Battery Pack Coolant Passage Test Adapter.
23. Engage the inlet port retaining clip (2).
24. Build vacuum again.
25. Repeat steps 10-13 several times until no more coolant can be extracted.
26. Disengage the outlet port retaining clip (4).



**Fig. 40: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
**Courtesy of GENERAL MOTORS COMPANY**

27. Remove **GE-47716-20** Cooling System Fill Adapter (3) from the battery outlet port.
28. Disengage the inlet port retaining clip (2).
29. Remove **GE-50385** Battery Pack Coolant Passage Test Adapter (1) from the battery inlet port.
30. Lower the vehicle.
31. Remove the quick connect fitting on the short hose assembly (1) from the Vac N Fill cap.



**Fig. 41: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

32. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

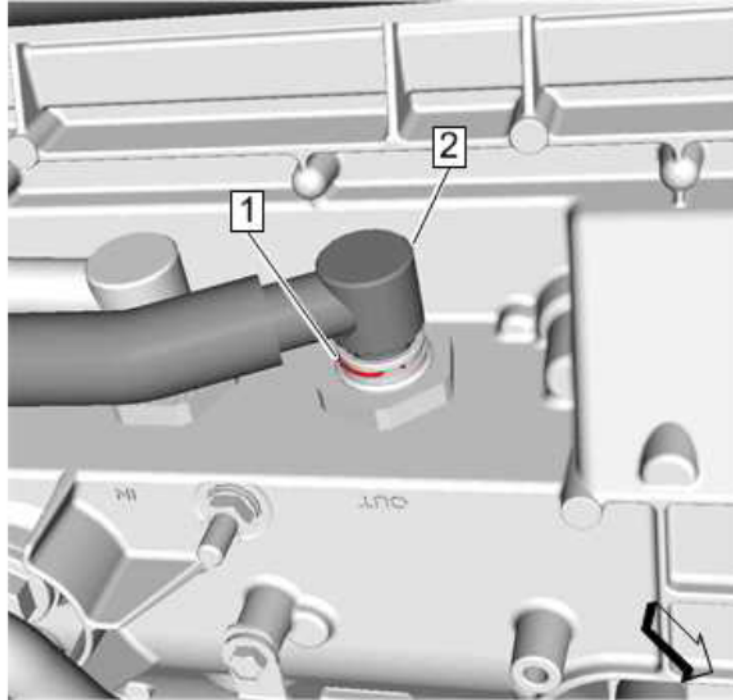
#### **Vac-N-Fill Procedure**

1. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery » Install - [Drive Motor Battery Radiator Outlet Hose Replacement](#)

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

**CAUTION:** Do NOT manually add coolant to the High Voltage Battery Cooling System. Only use the GE-47716 Vac N Fill Coolant Refill Tool to fill the cooling system. Failure to use the proper tool could allow spilled coolant into the High Voltage Battery, resulting in damage to the Battery and will lead to loss of vehicle propulsion.

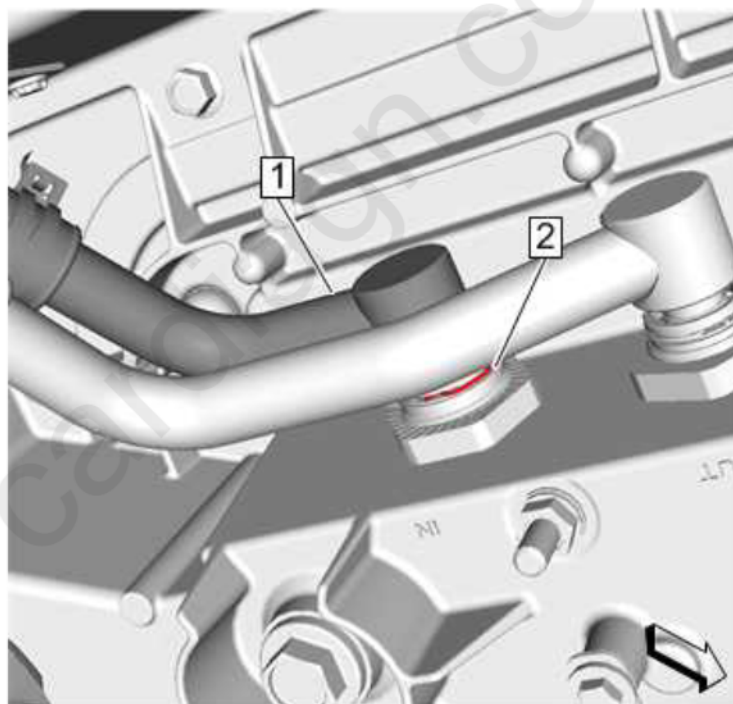
**NOTE:** To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.



**Fig. 42: Drive Motor Battery Radiator Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage Battery » Install - **Drive Motor Battery Radiator Inlet Hose Replacement**

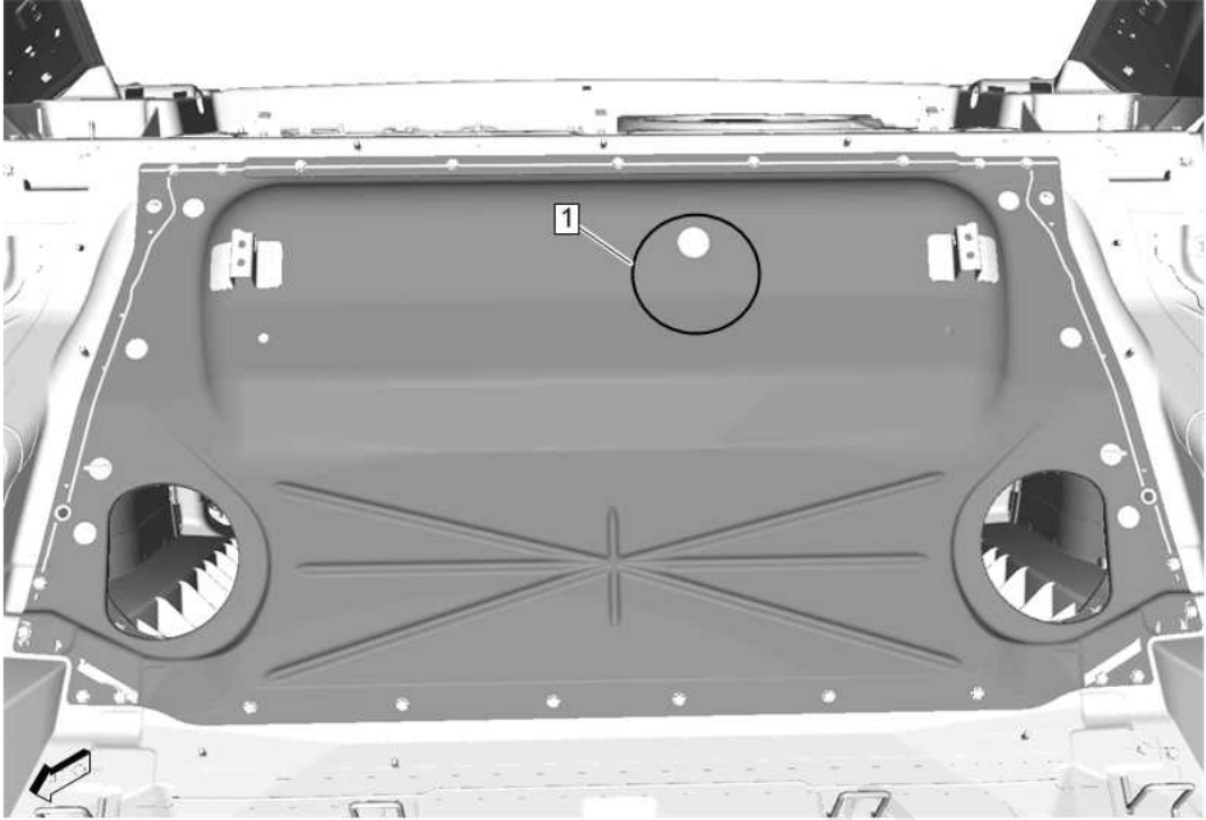


**Fig. 43: Drive Motor Battery Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

3. Remove the drain pan.
4. Lower the vehicle.
5. If this is the first time this procedure has been performed on this vehicle, you will need to cut-out the circle portion scribed in the rear seat back body panel (1).



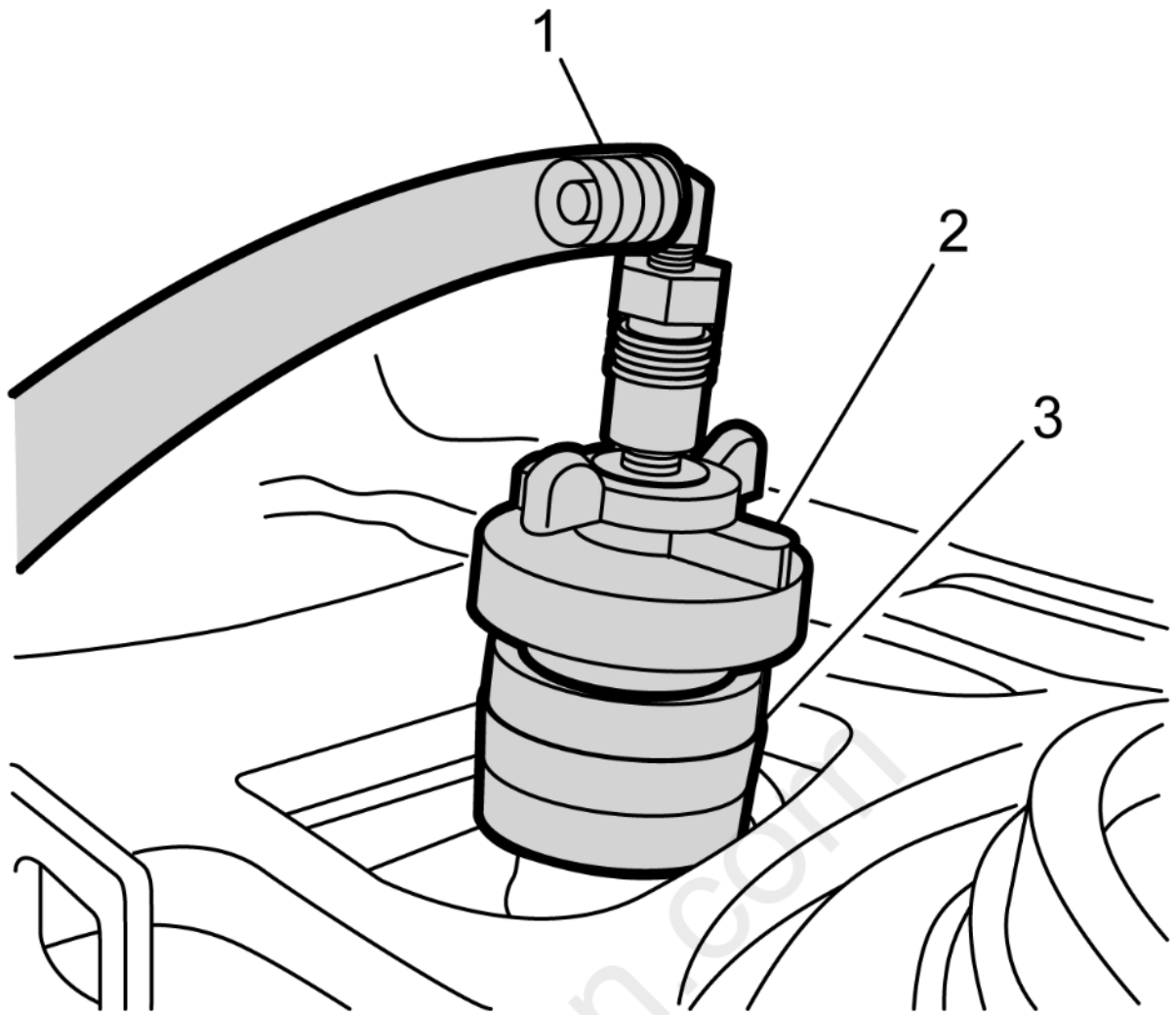


**Fig. 44: Rear Seat Back Body Panel**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** When cutting the service opening in the rear panel use only an air nibbler. Using a different tool can cause damage to underlying components requiring unnecessary replacement of those parts.

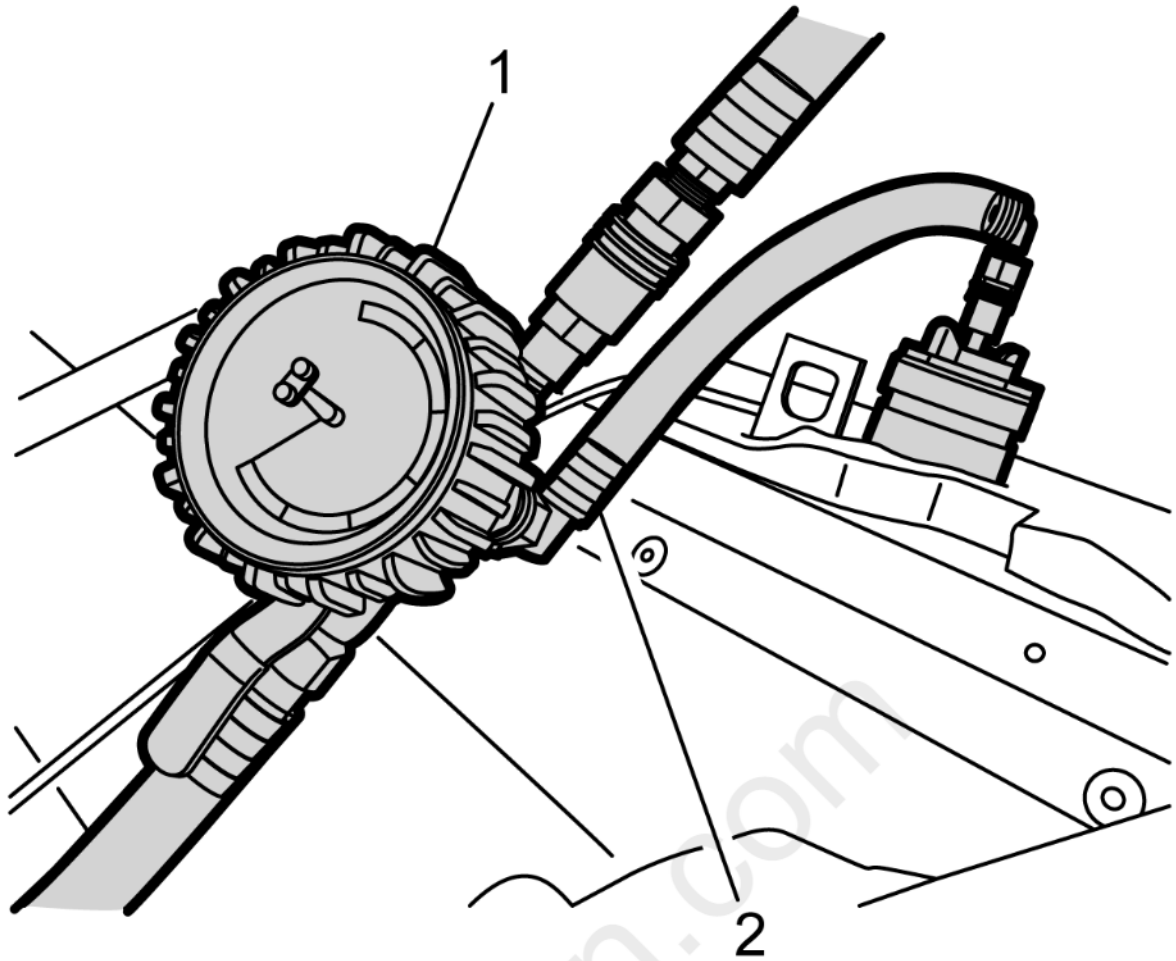
6. Using an air nibbler, cut-out the circle portion (1) scribed into the rear seat back body panel.
7. Remove all metal shavings from the rear of the vehicle created from cutting the circle portion of the rear seat back body panel.
8. Install **J-46143-2** Cooling System Adapter (3) to the water inlet.



**Fig. 45: Cooling System Adapter**

**Courtesy of GENERAL MOTORS COMPANY**

9. Install Vac-N-Fill Cap (2) to **J-46143-2** Cooling System Adapter.
10. Install the 90° adapter fitting and hose (1) to Vac-N-Fill Cap (2).
11. Attach the vacuum gauge assembly (1) to the 90° Hose (2).



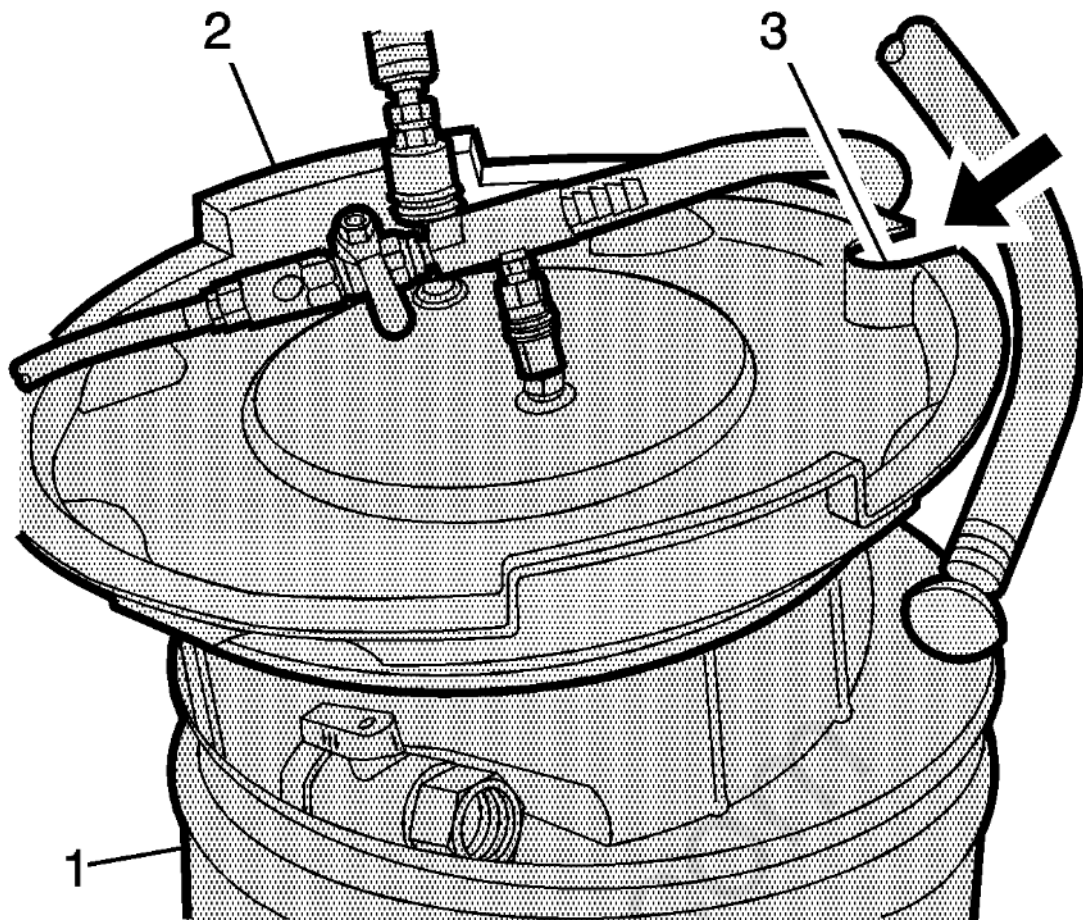
**Fig. 46: Vacuum Gauge Assembly.**

**Courtesy of GENERAL MOTORS COMPANY**

12. Attach the fill hose to the barb fitting on the vacuum gauge assembly (1).

Ensure that the valve is closed.

13. Pour the coolant mixture into the graduated reservoir (1).



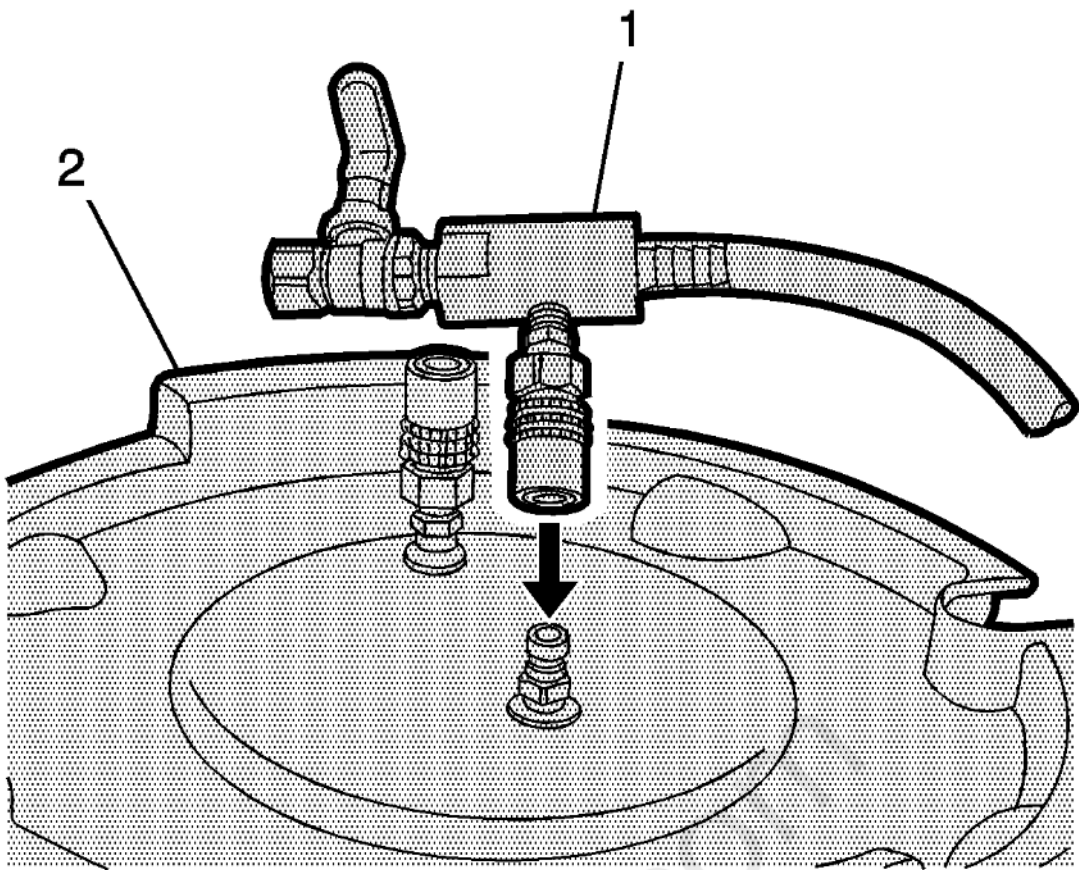
**Fig. 47: Graduated Reservoir, Vacuum Tank & Cut-Out Area**  
Courtesy of GENERAL MOTORS COMPANY

14. Place the fill hose in the graduated reservoir (1).
15. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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

16. Attach the venturi assembly (1) to the vacuum tank (2).



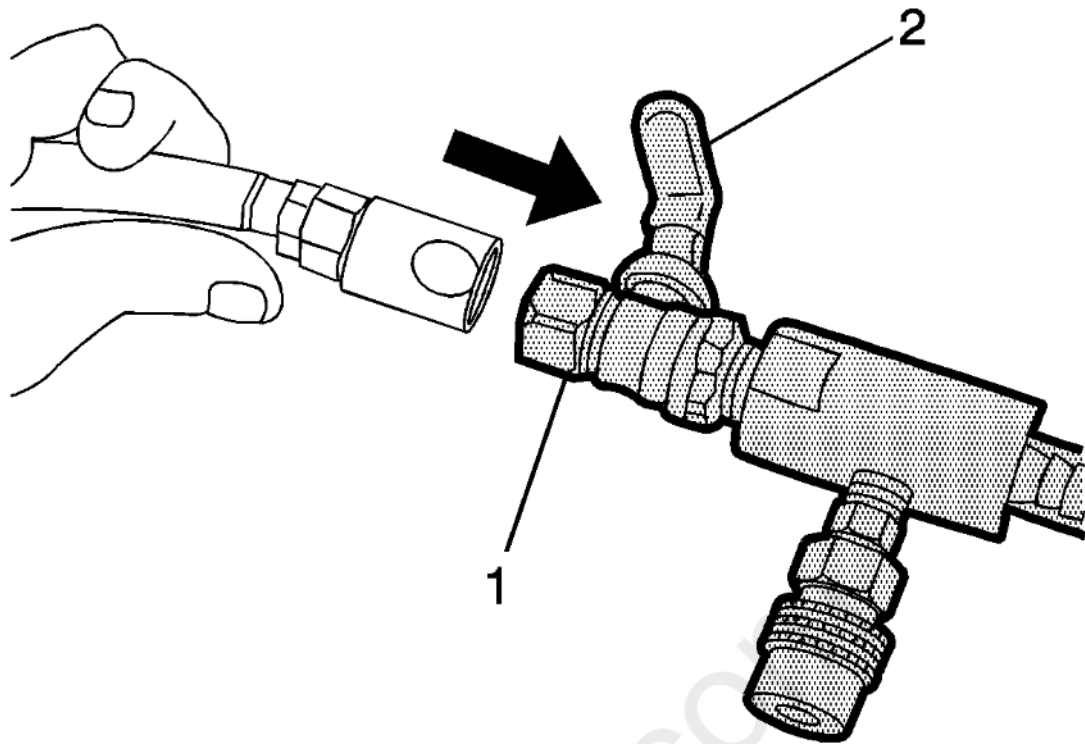


**Fig. 48: Vacuum Tank & Venturi Assembly**

**Courtesy of GENERAL MOTORS COMPANY**

17. Attach a shop air hose to the venturi assembly (1).

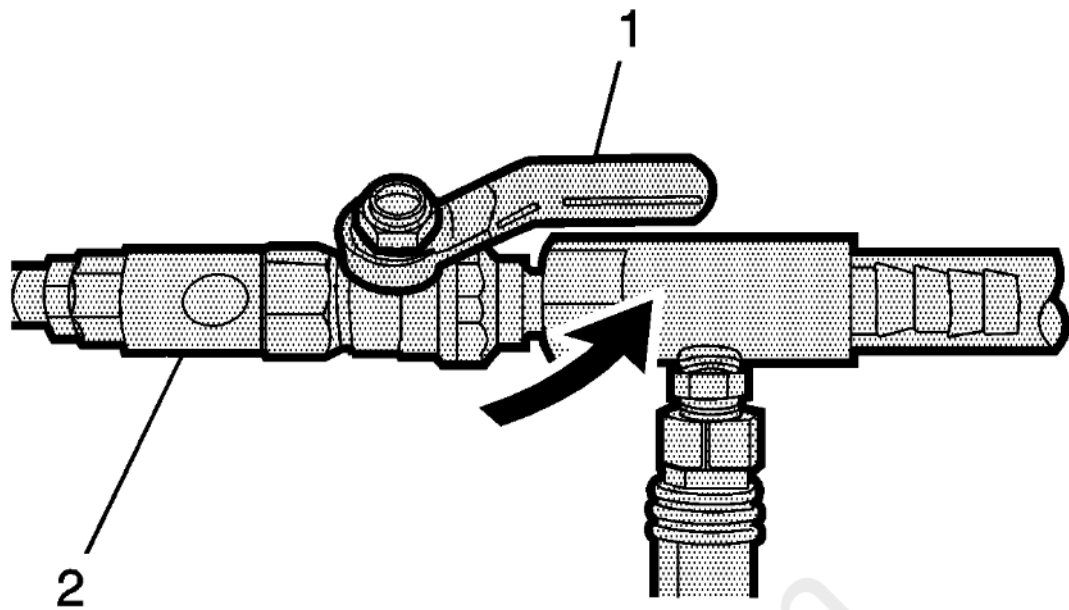




**Fig. 49: Venturi Assembly & Valve**  
**Courtesy of GENERAL MOTORS COMPANY**

Ensure the valve (2) on the venturi assembly is closed.

18. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.
19. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

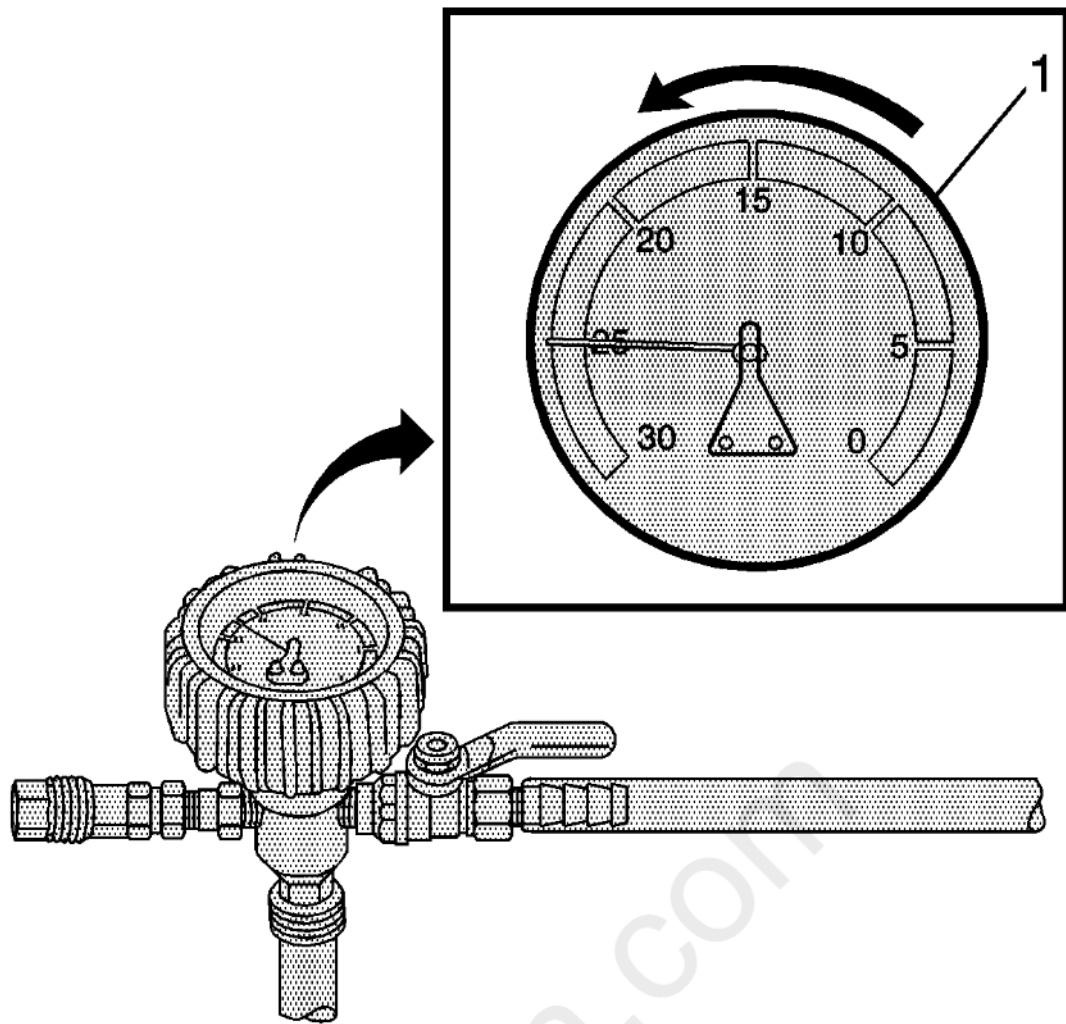


**Fig. 50: Valve & Venturi Assembly**

**Courtesy of GENERAL MOTORS COMPANY**

20. Continue to draw vacuum until the needle stops rising (1). This should be 610-660 mm Hg (24-26 in Hg).

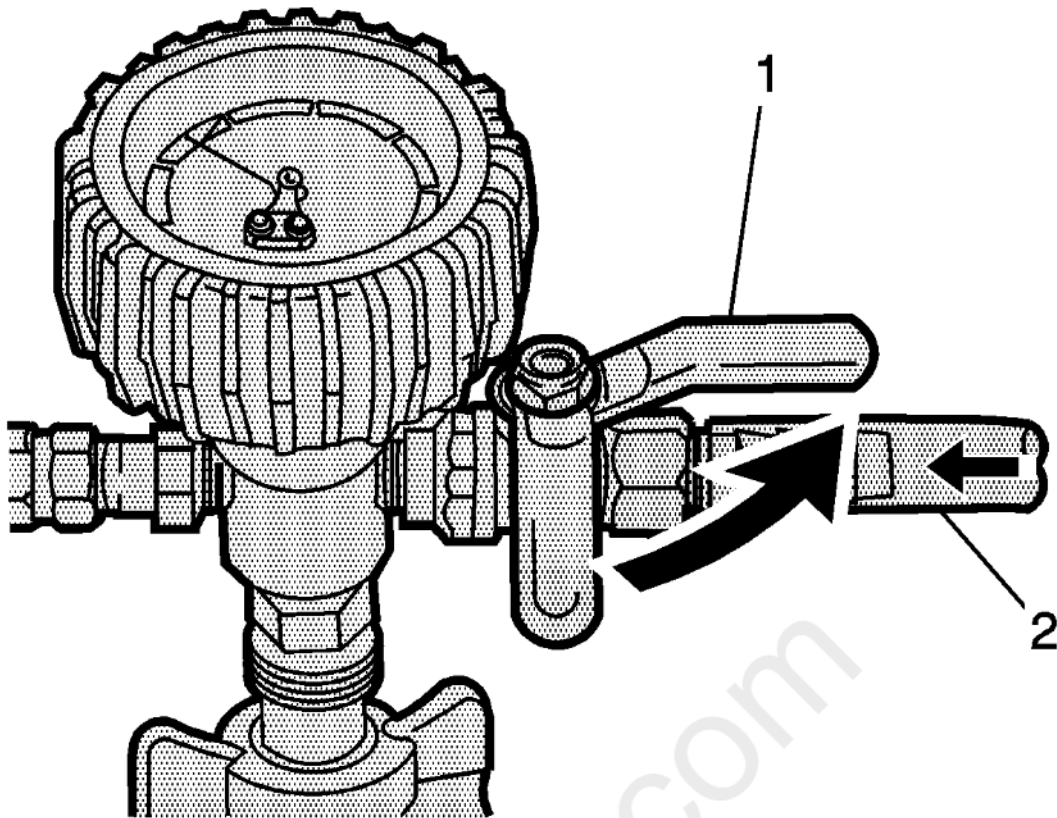
Cooling hoses may start to collapse. This is normal due to vacuum draw.



**Fig. 51: Vacuum Gauge Needle**

Courtesy of GENERAL MOTORS COMPANY

21. To aid in the fill process, position the graduated reservoir above the coolant fill port.
22. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.

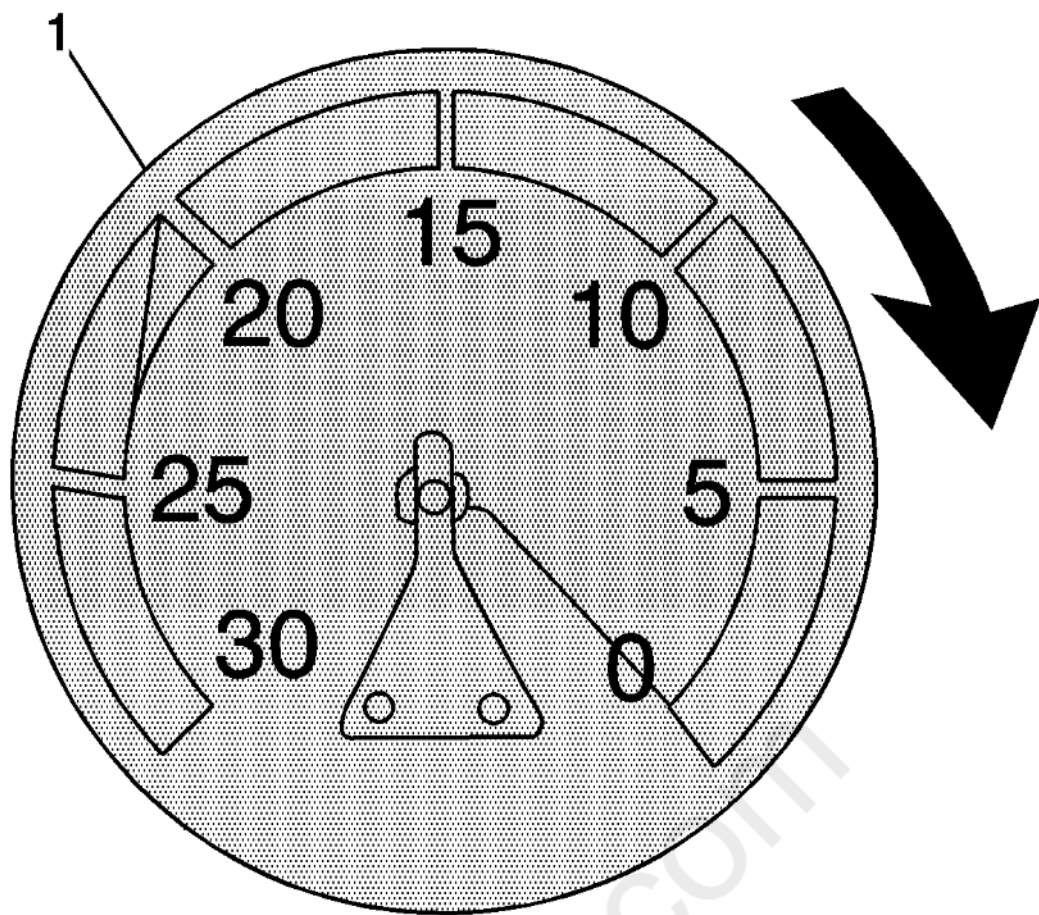


**Fig. 52: Vacuum Gauge Assembly & Needle**  
Courtesy of GENERAL MOTORS COMPANY

23. Close the valve on the venturi assembly.
24. 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 **High Voltage Battery Cooling System Loss of Coolant**.

25. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
26. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly.

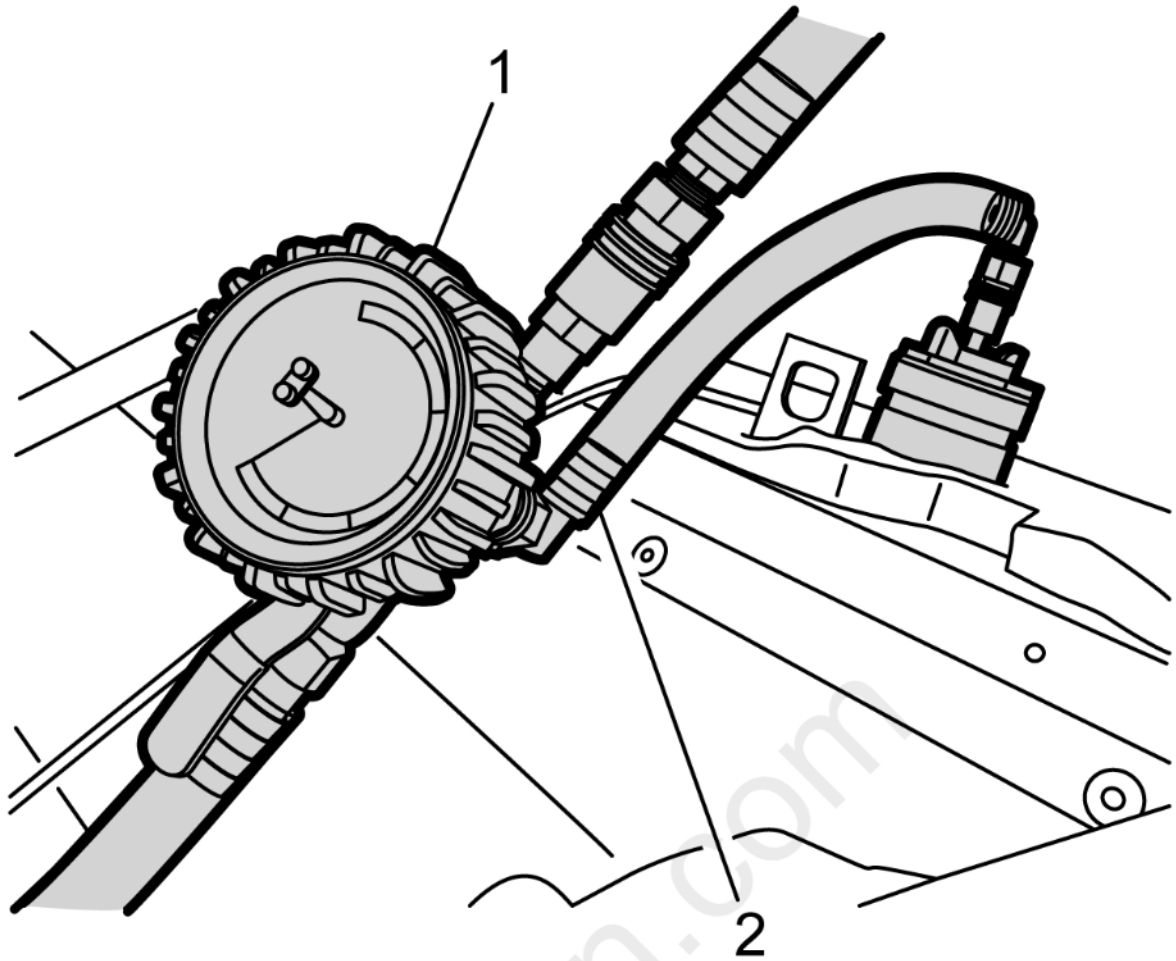


**Fig. 53: Vacuum Gauge**

Courtesy of GENERAL MOTORS COMPANY

27. Detach the vacuum gauge assembly (1) from the 90° Hose (2).

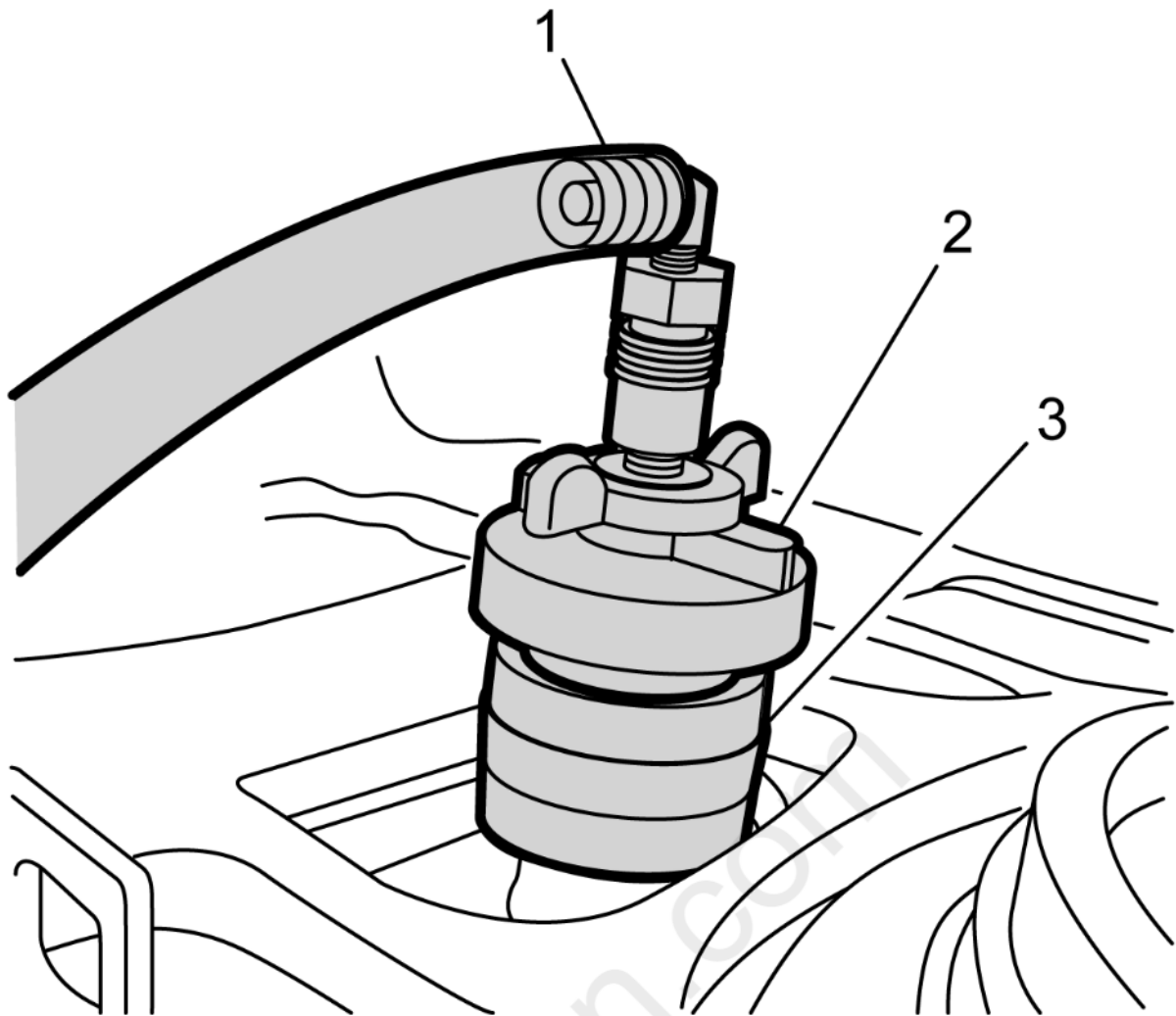




**Fig. 54: Vacuum Gauge Assembly.**

**Courtesy of GENERAL MOTORS COMPANY**

28. Remove the 90° adapter fitting and hose (1) at Vac-N-Fill Cap (2).

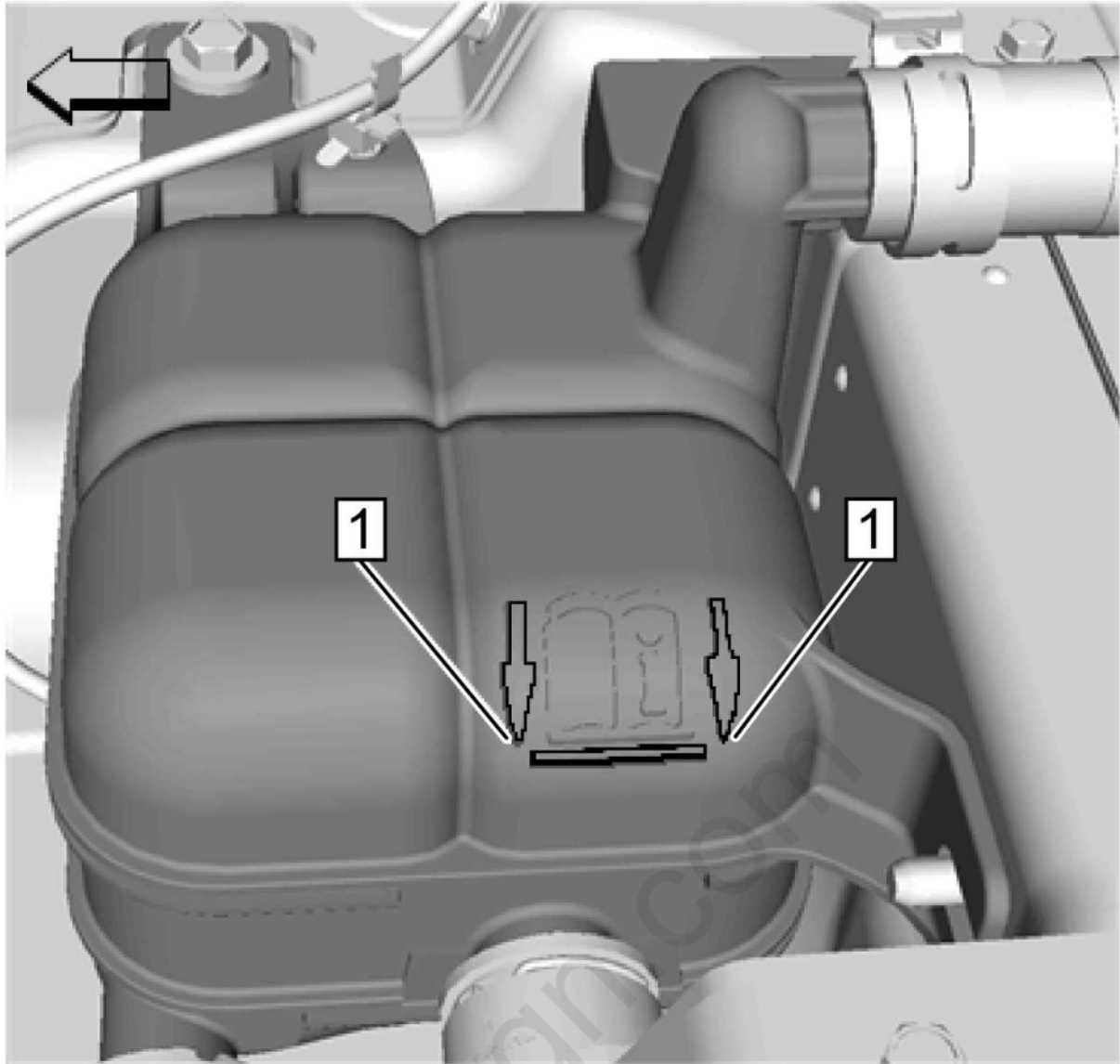


**Fig. 55: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

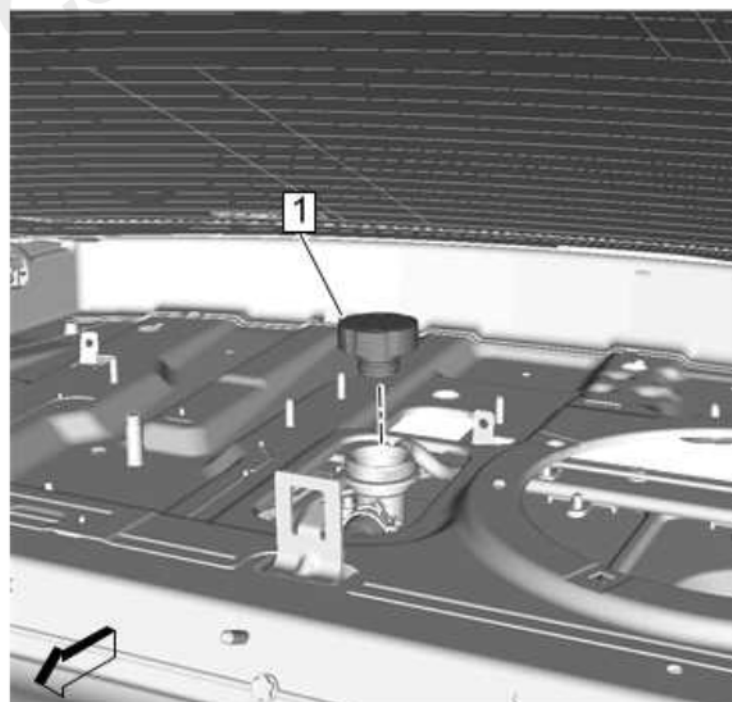
29. Remove Vac-N-Fill Cap (2) from **J-46143-2** Cooling System Adapter.
30. Remove **J-46143-2** Cooling System Adapter (3) from the water inlet.
31. Inspect the concentration of the coolant mixture using the **J-26568** Coolant and Battery Fluid Tester.
32. Using an inspection mirror through the cut-out in the rear seat back body panel, verify coolant level of the drive motor battery coolant/air separator using the arrows (1) found on the driver's side of the drive motor battery coolant/air separator.

**CAUTION:** Do NOT manually add coolant to the High Voltage Battery Cooling System. Only use the GE-47716 Vac N Fill Coolant Refill Tool to fill the cooling system. Failure to use the proper tool could allow spilled coolant into the High Voltage Battery, resulting in damage to the Battery and will lead to loss of vehicle propulsion.



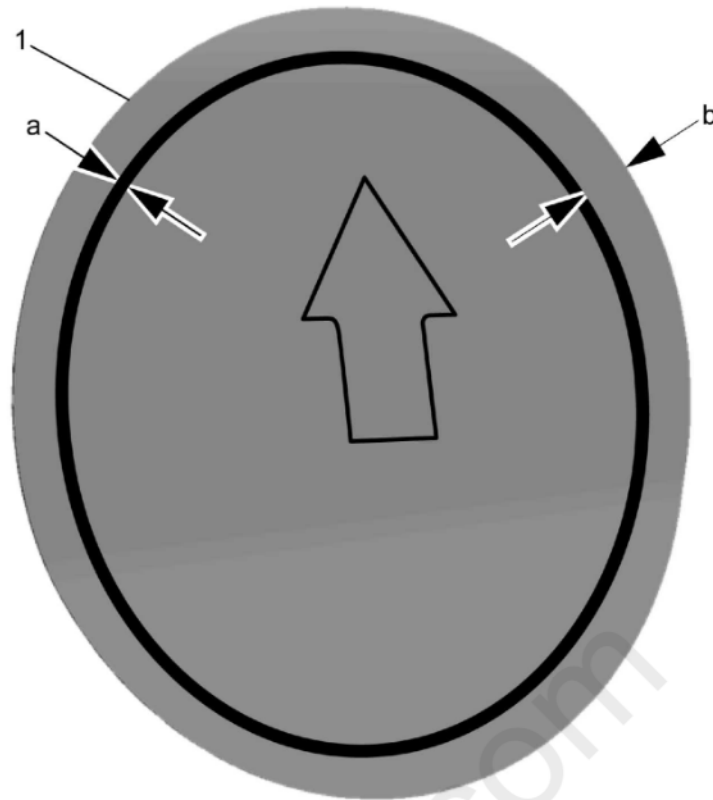
**Fig. 56: Verifying Coolant Level Of Drive Motor Battery Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

33. If coolant level is low or if air appears to be in the system, steps 12-32 of the Vac-N-Fill procedure will need to be repeated.
34. Install cap (1) to the water inlet.



**Fig. 57: Pressure Cap**  
 Courtesy of GENERAL MOTORS COMPANY

35. Apply a continuous bead 1.6 mm (0.1 in) (A) of a urethane adhesive which meets GM Specification GM 3651G 9 mm (0.4 in) (B) from the outer edge of the rear seat back body panel patch (1).

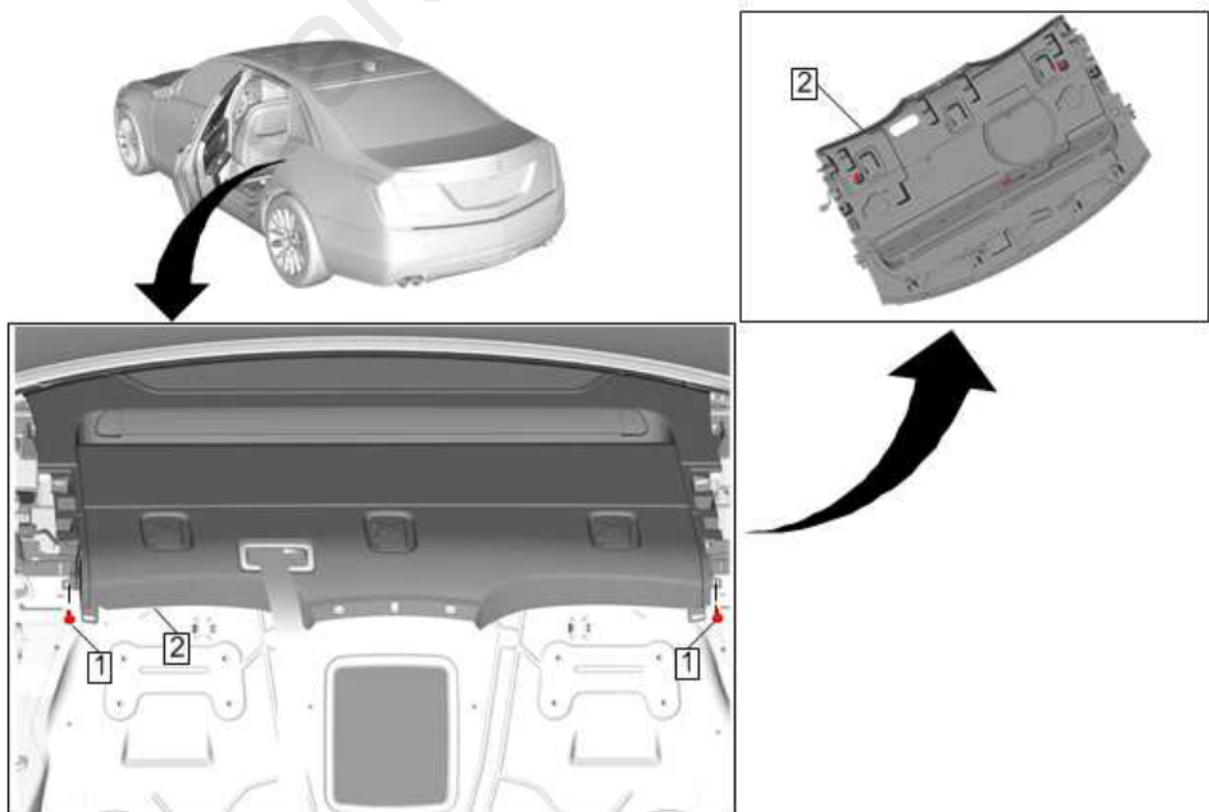


**Fig. 58: Applying Urethane Adhesive**

Courtesy of GENERAL MOTORS COMPANY

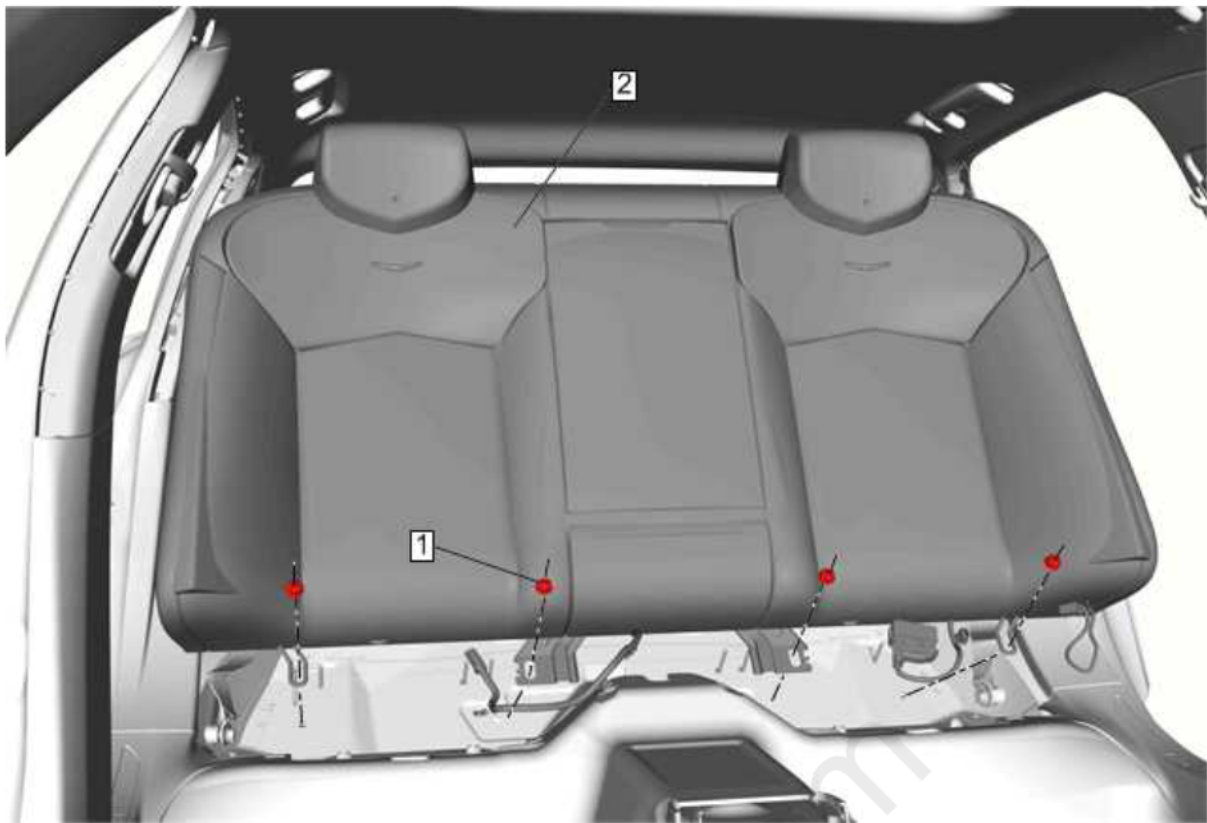
See GM Electronics Parts Catalog for Rear Seat Back Body Panel Patch Part Number.

36. Install the rear seat back body panel patch to the rear seat back body panel.
37. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)



**Fig. 59: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY



**Fig. 60: Rear Seat Back Cushion (Base)**  
Courtesy of GENERAL MOTORS COMPANY

39. Enable the high voltage system. Refer to [High Voltage Enabling](#)

### **HIGH VOLTAGE BATTERY DRAIN AND FILLING (WITH HEATER VENT HOSE QUICK CONNECT)**

#### **Special Tools**

- J-26568 Coolant and Battery Fluid Tester
- J-46143-2 Cooling System Adapter
- GE-47716 Vac N Fill Coolant Refill Tool
- GE-47716-20 Cooling System Fill Adapter
- GE-50385 Battery Pack Coolant Passage Test Adapter

Equivalent regional tools: [Special Tools](#)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.



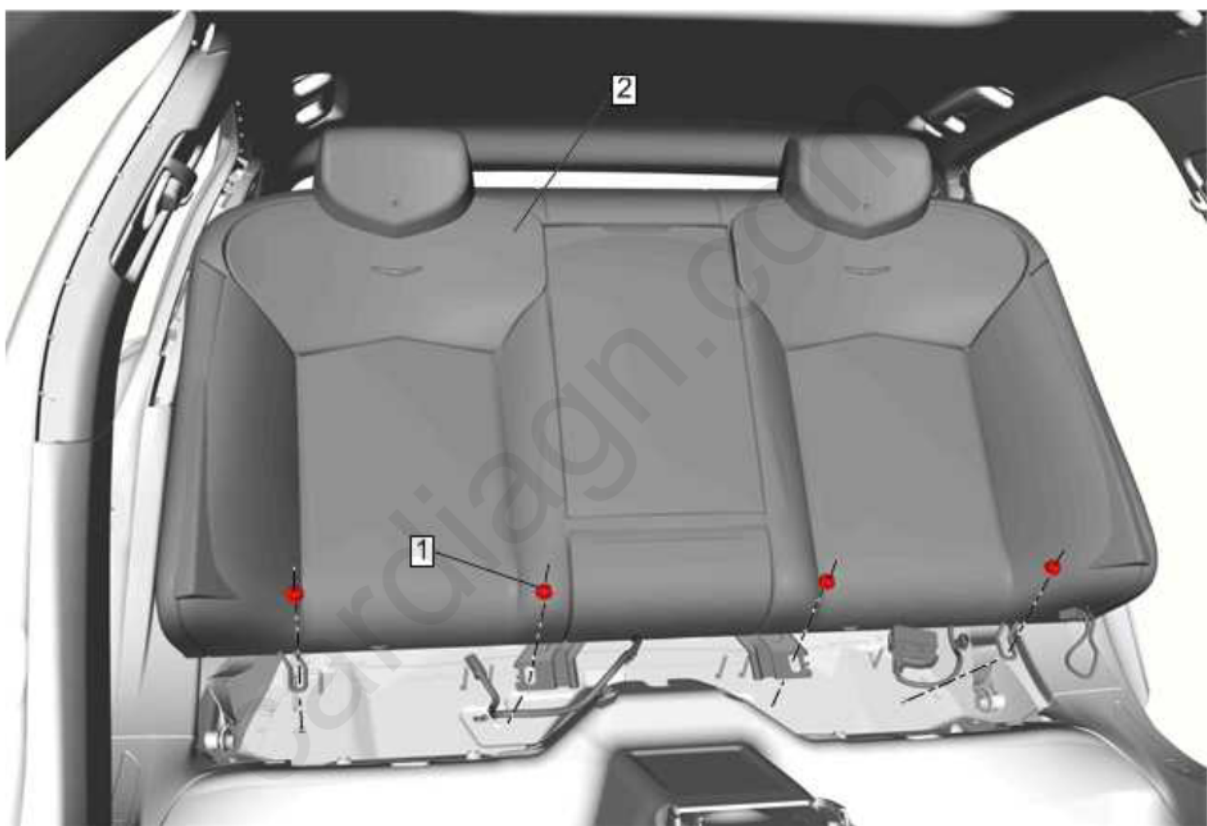
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

### Draining Procedure

**WARNING:** 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.

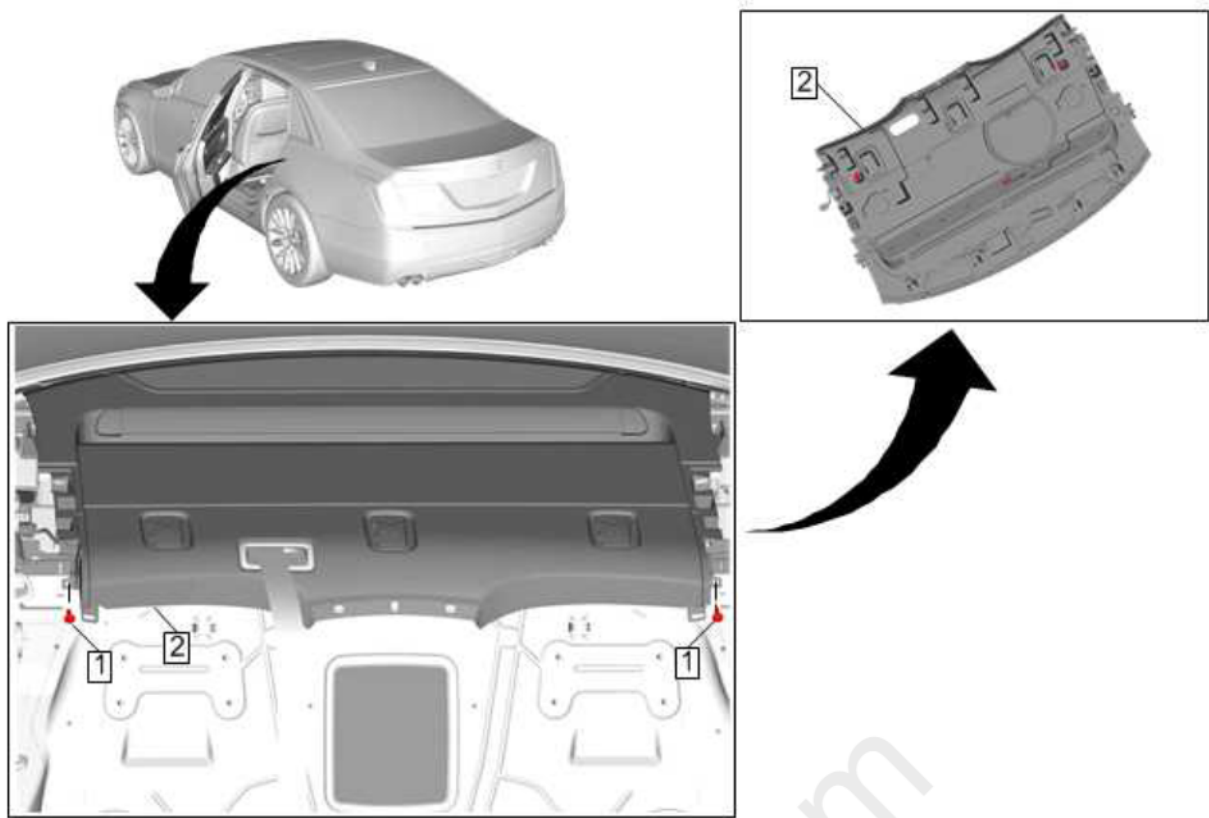
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Seat Back Cushion (2)» Remove - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 61: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

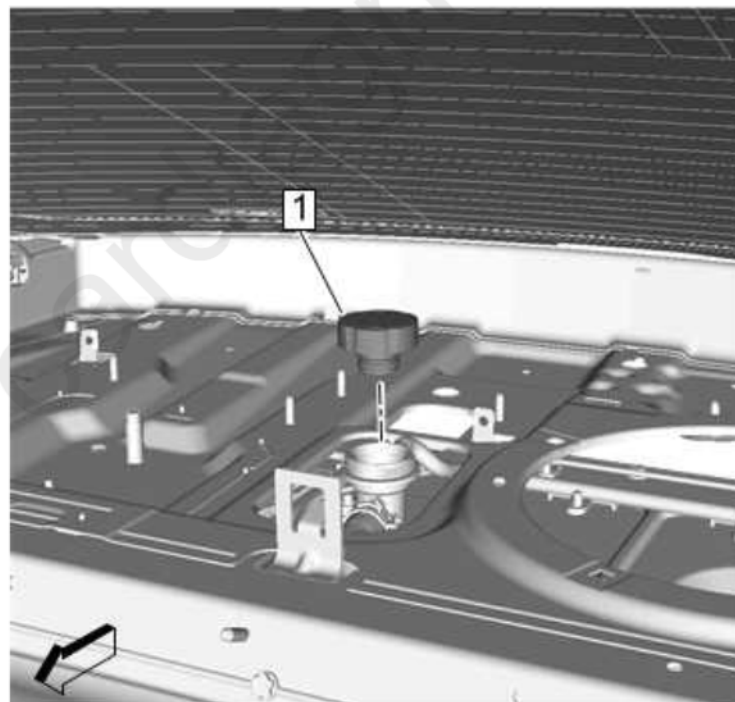
3. Rear Window Panel Trim (2)» Remove - [Rear Window Panel Trim Replacement](#)



**Fig. 62: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

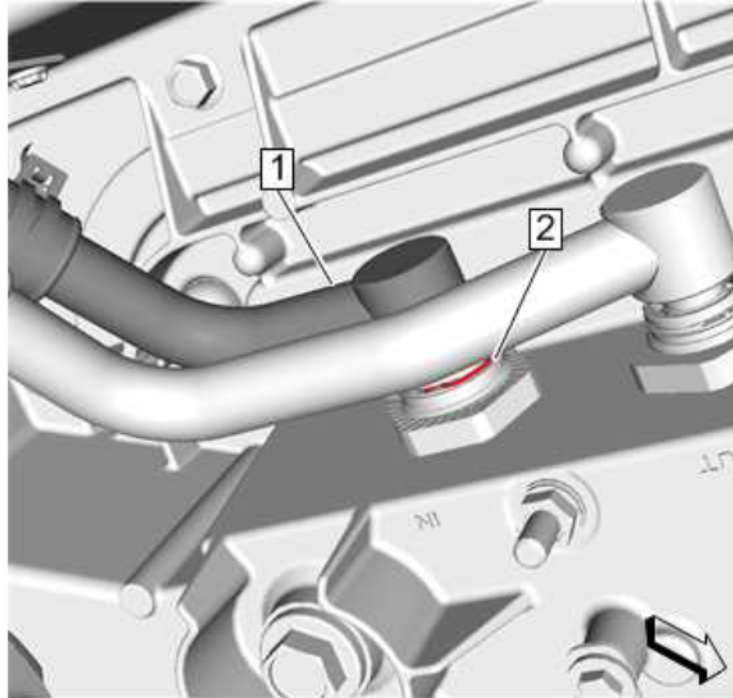
4. Remove the cap (1) from water inlet.



**Fig. 63: Pressure Cap**

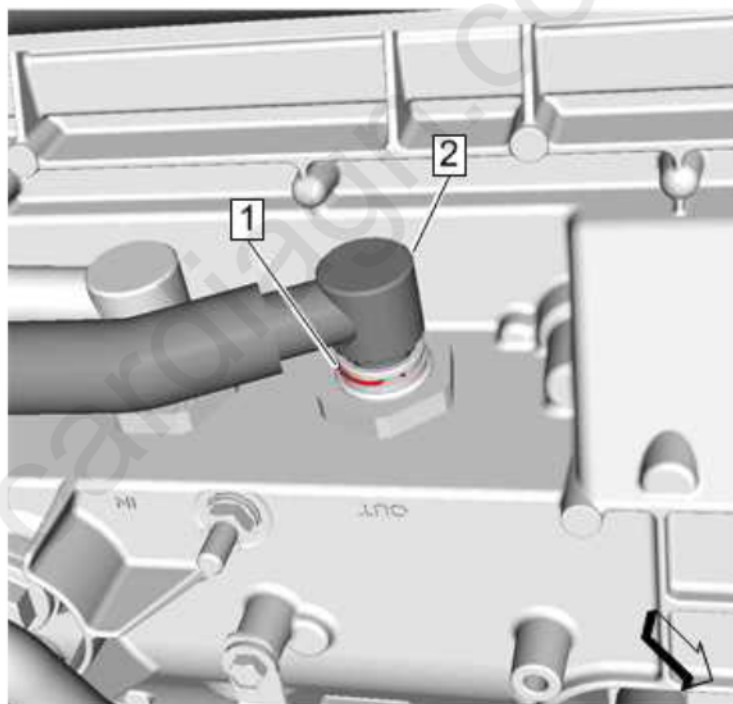
Courtesy of GENERAL MOTORS COMPANY

5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Place a drain pan under the vehicle.
7. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage BatteryÂ» Remove - [Drive Motor Battery Radiator Inlet Hose Replacement](#)



**Fig. 64: Drive Motor Battery Radiator Inlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery» Remove - **Drive Motor Battery Radiator Outlet Hose Replacement**



**Fig. 65: Drive Motor Battery Radiator Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

9. Allow the coolant to drain from both the high voltage battery and its hoses.  
10. Lower the vehicle.

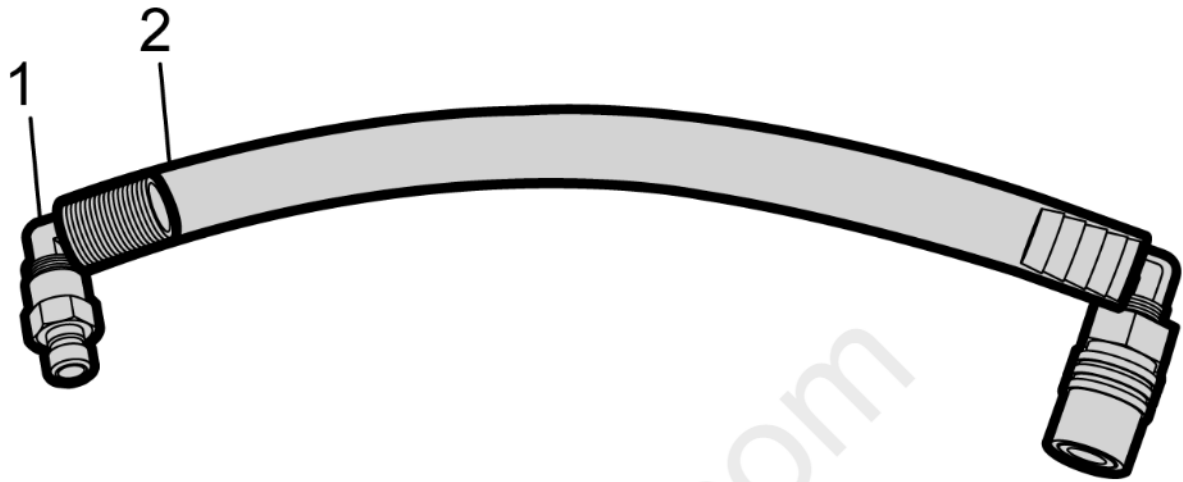
#### **Purging and Removal of Coolant From Battery**

**NOTE:** Prior to performing high-voltage battery internal service, it is necessary to purge any residual coolant inside the battery that is left over from the cooling system draining procedure. Similarly, coolant must be removed from the battery prior to return shipping. This procedure must also be used when purging complete system of contaminated coolant.

**NOTE:** This procedure can be performed in vehicle or with battery removed from

vehicle.

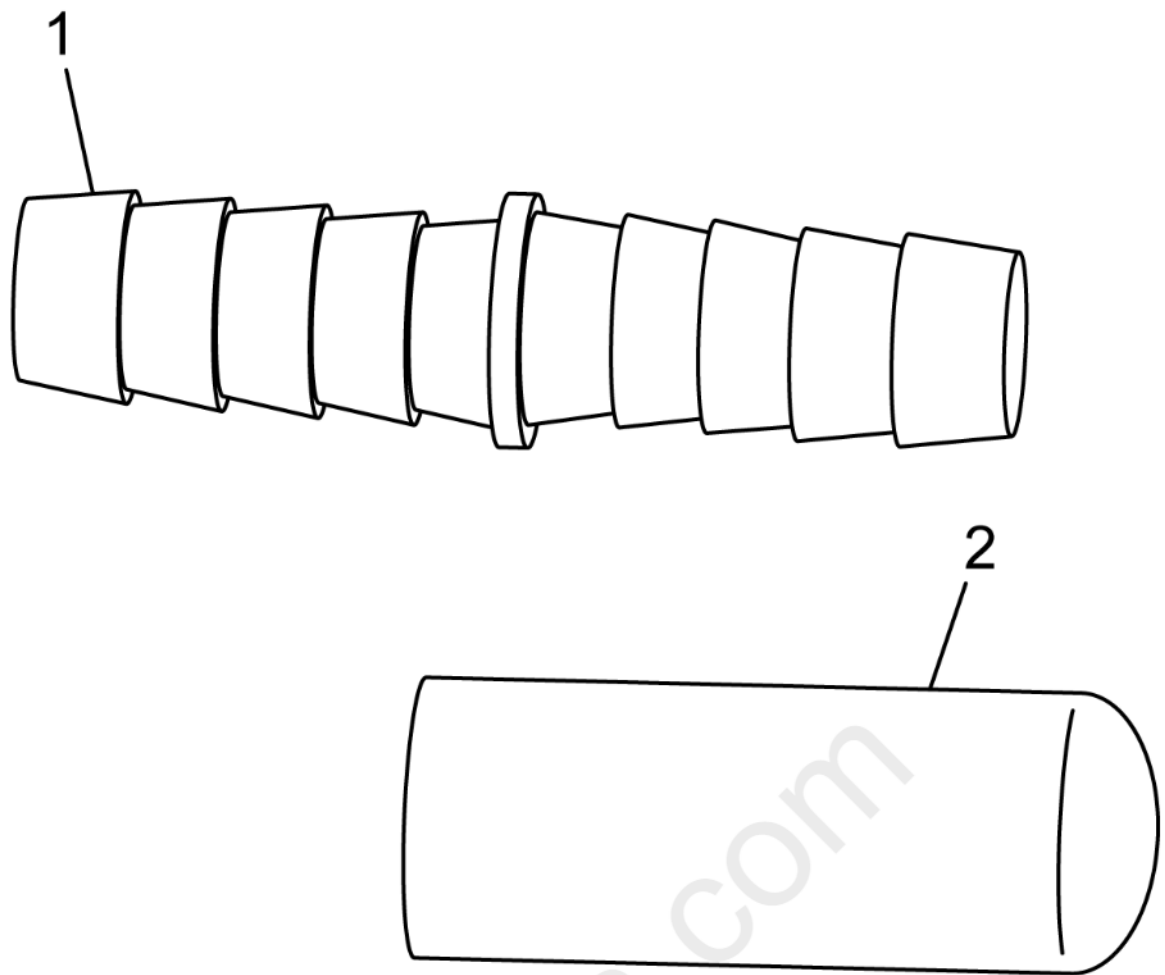
1. Take the short hose with dual 90° fittings from the Vac N Fill and remove the 90° fitting (1) from the Vac and Fill short hose (2).



**Fig. 66: Vac and Fill Short Hose With Fitting**

Courtesy of GENERAL MOTORS COMPANY

2. Install a rubber cap (2) to a 10 mm (.375 in) x 10 mm (.375 in) barbed fitting with a flange (1).

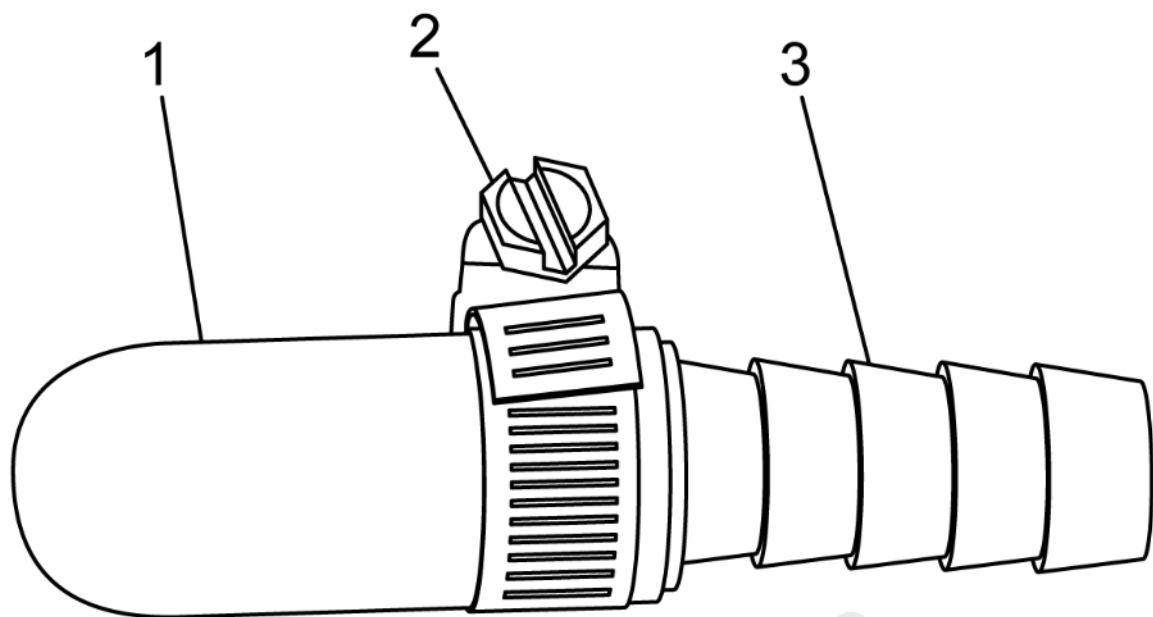


**Fig. 67: Rubber Cap**

**Courtesy of GENERAL MOTORS COMPANY**

3. Install a hose clamp (2) to the rubber cap (1) on the 10 mm (.375 in) x 10 mm (.375 in) Barbed fitting (3) and tighten the hose clamp.

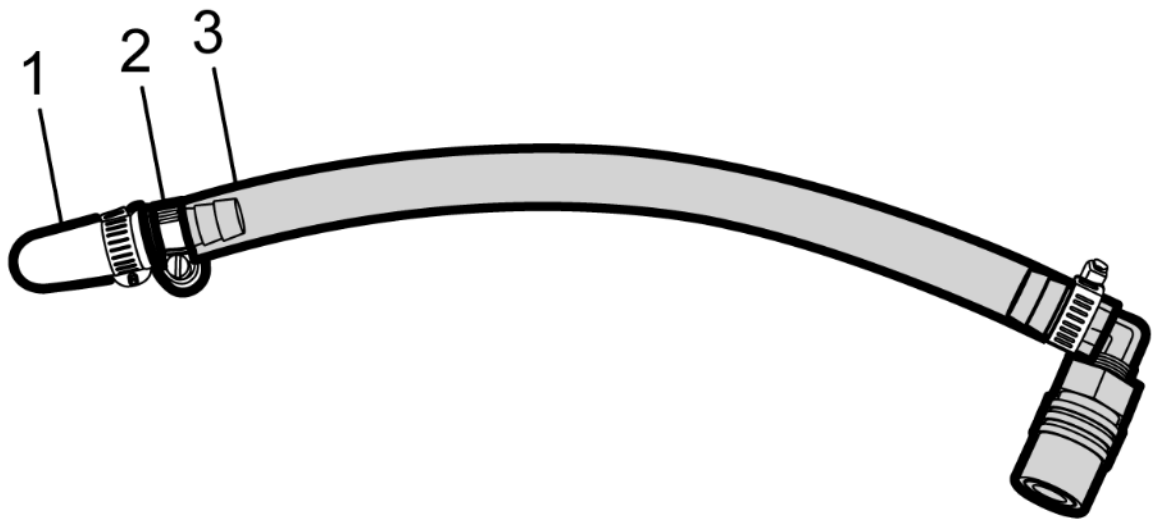




**Fig. 68: Hose Clamp and Rubber Cap**

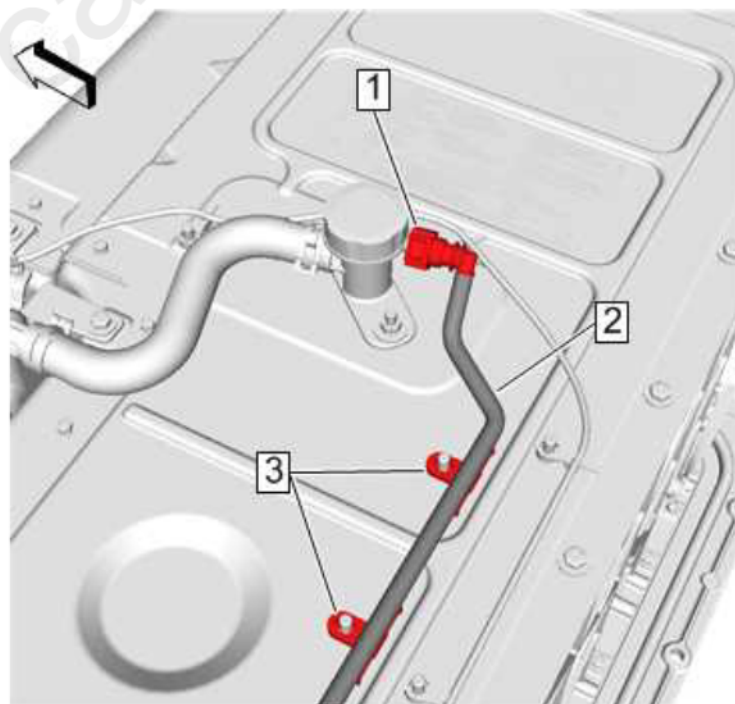
**Courtesy of GENERAL MOTORS COMPANY**

4. Install the 10 mm (.375 in) x 10 mm (.375 in) barbed and rubber cap assembly (1) to the short hose (3).



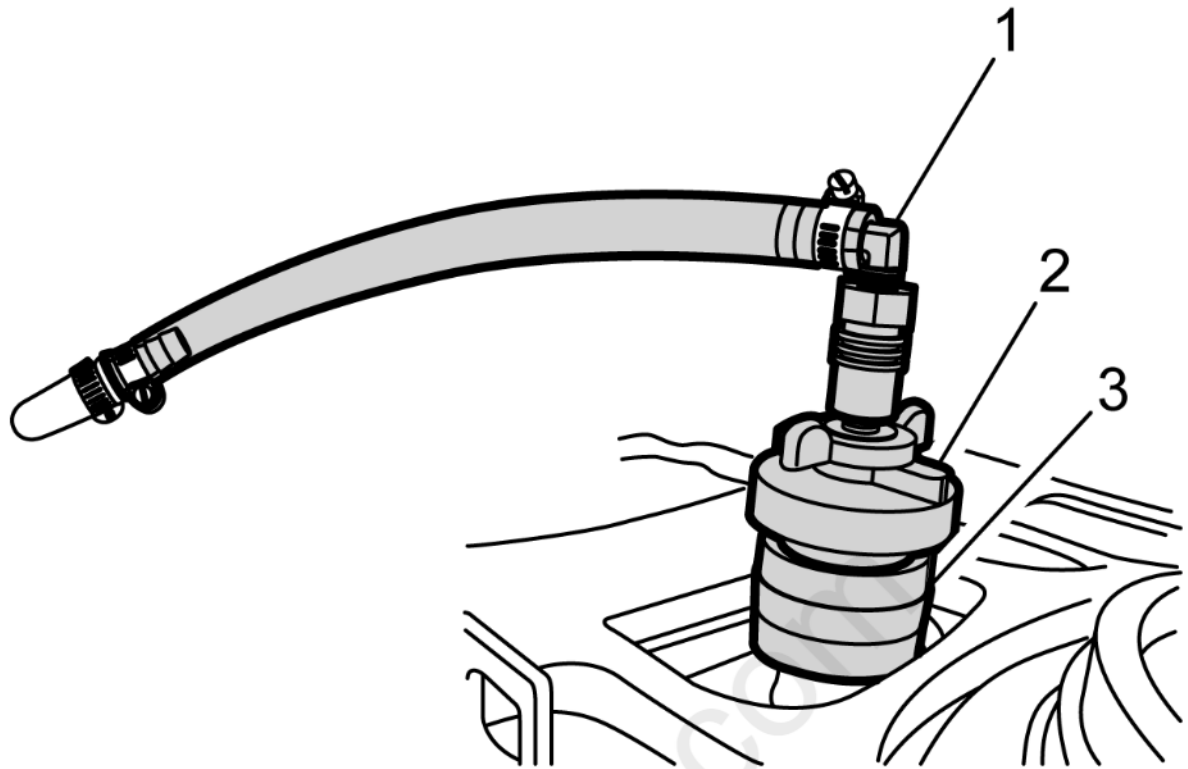
**Fig. 69: Rubber Cap Assembly And Short Hose**  
 Courtesy of GENERAL MOTORS COMPANY

5. Install a hose clamp (2) to the short hose assembly (3) and tighten.
6. Quick Connect Fitting (1) @ Water Inlet» Disengage



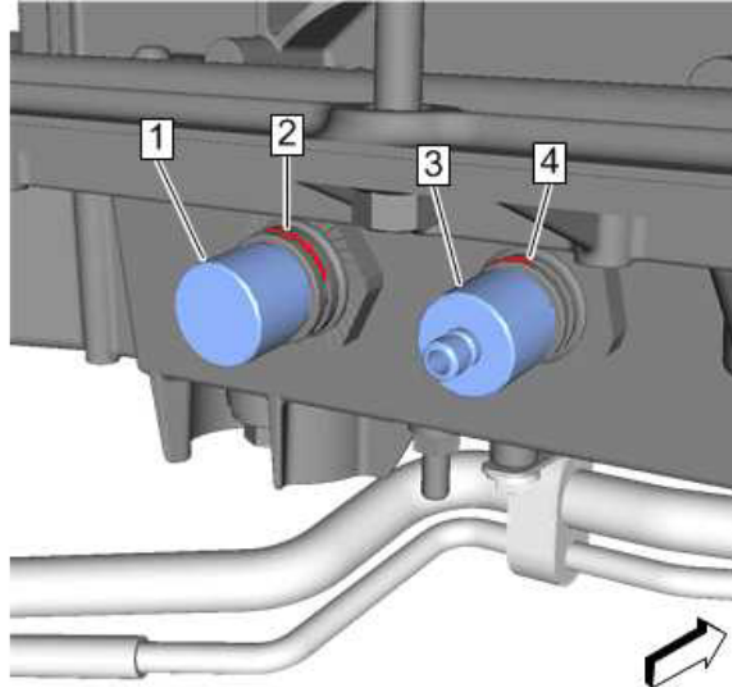
**Fig. 70: Quick Connect Fitting**  
 Courtesy of GENERAL MOTORS COMPANY

7. Heater Vent Hose (2) @ Water InletA» Remove
8. Install **J-46143-2** Cooling System Adapter (3) the to the water inlet.



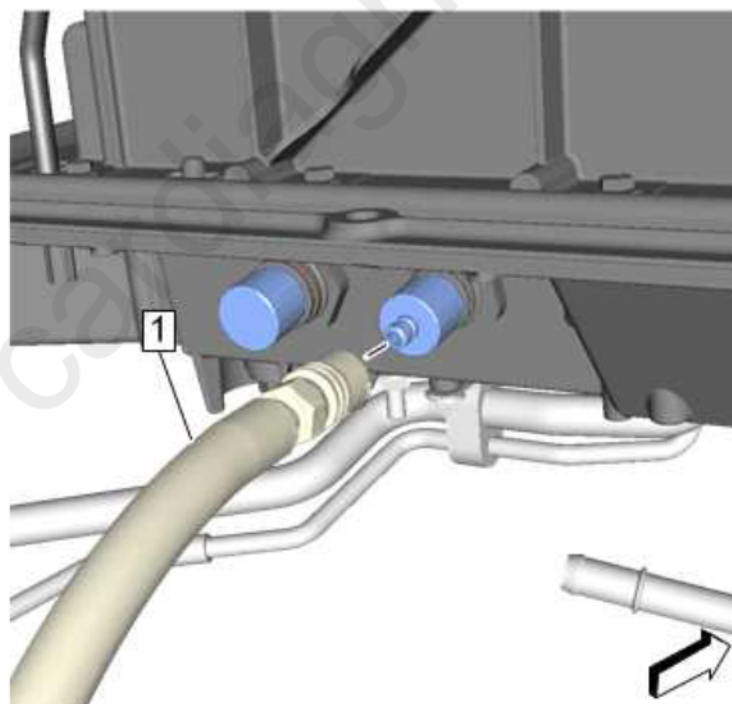
**Fig. 71: Cooling System Adapter**  
**Courtesy of GENERAL MOTORS COMPANY**

9. Install the Vac N Fill cap (2) to **J-46143-2** Cooling System Adapter.
10. Install the quick connect fitting on the short hose assembly (1) to the Vac N Fill cap.
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
12. Install **GE-50385** Battery Pack Coolant Passage Test Adapter (1) to the battery inlet port.



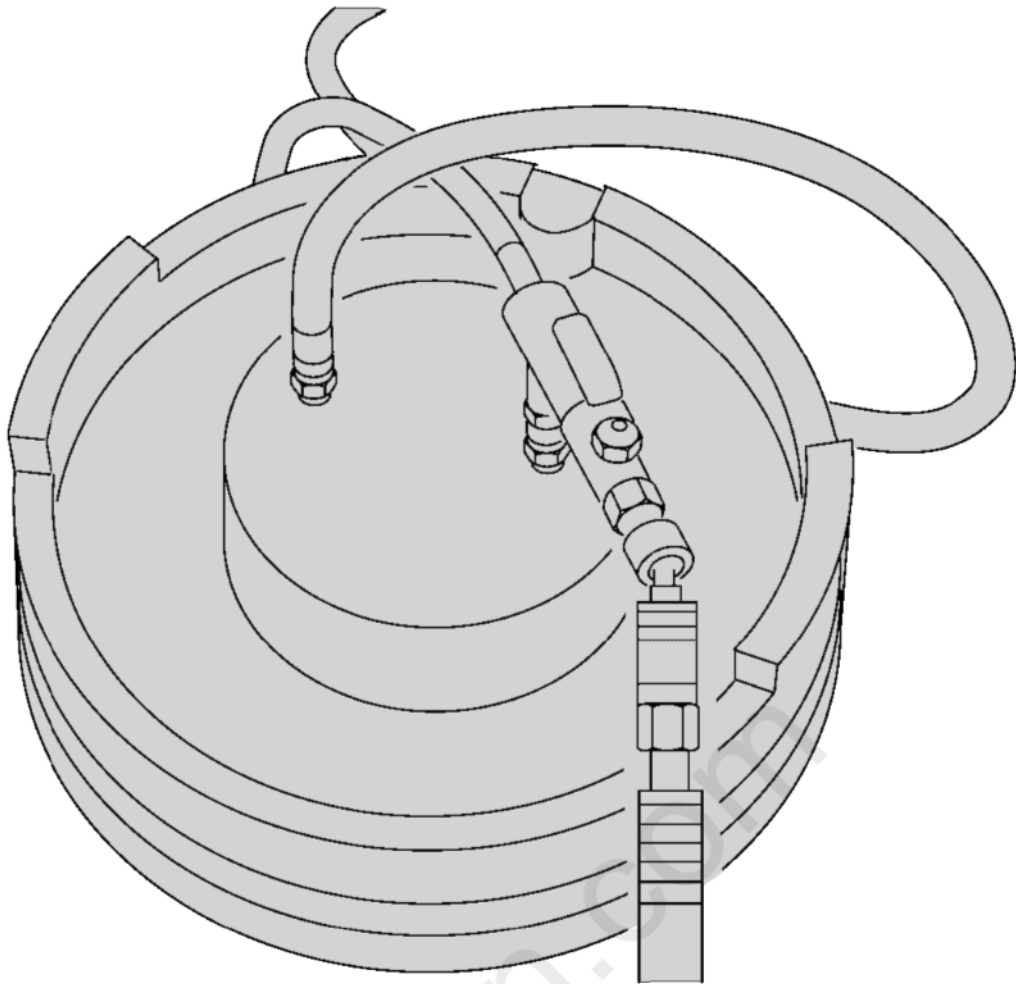
**Fig. 72: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
 Courtesy of GENERAL MOTORS COMPANY

13. Engage the inlet port retaining clip (2).
14. Install **GE-47716-20** Cooling System Fill Adapter (3) to the battery outlet port.
15. Engage the outlet port retaining clip (4).
16. Connect the Vac N Fill Hose to **GE-47716-20** Cooling System Fill Adapter.



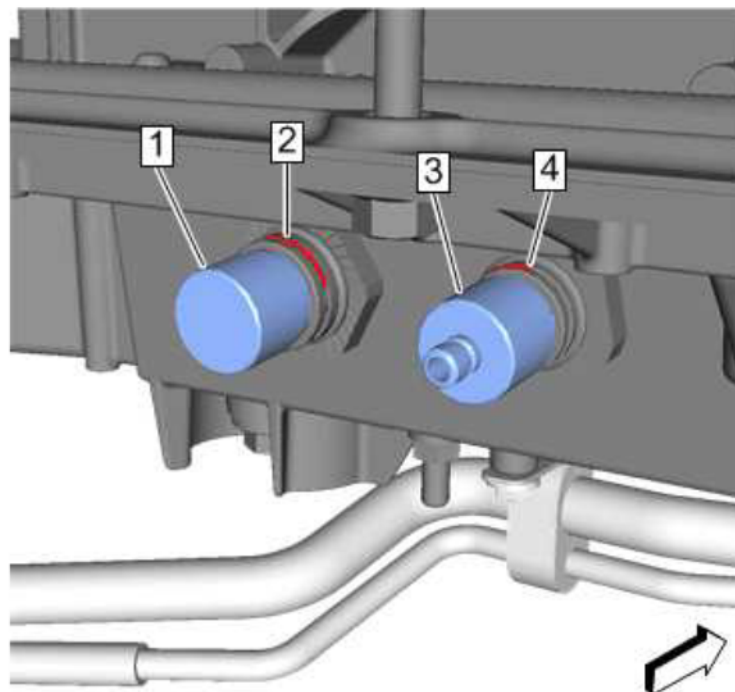
**Fig. 73: Cooling System Fill Adapter**  
 Courtesy of GENERAL MOTORS COMPANY

17. Connect the other end of the Vac N Fill Hose to the Vac N Fill vacuum tank.



**Fig. 74: Connect Other End Of Vacuum Hose to Vac N Fill Vacuum Tank**  
**Courtesy of GENERAL MOTORS COMPANY**

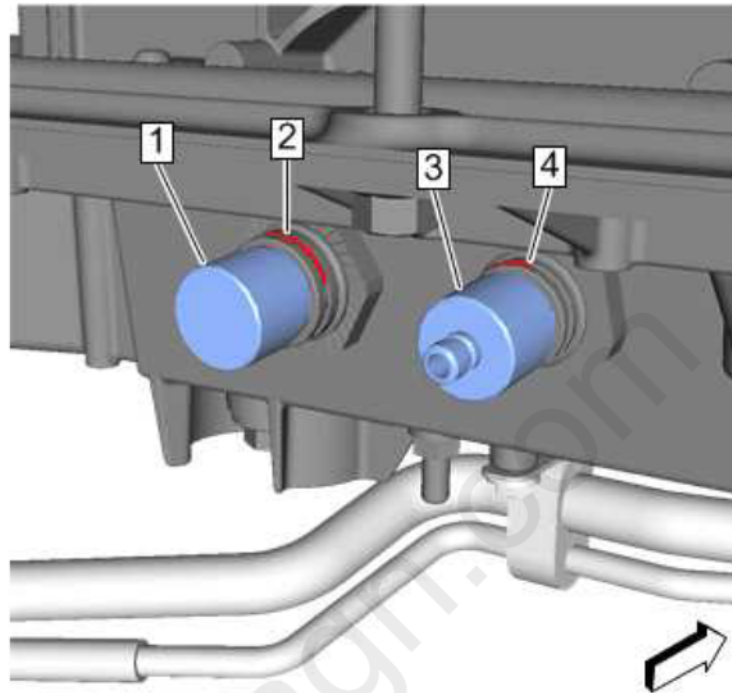
18. Install the venturi assembly to the vacuum tank with the valve closed.
19. Attach a regulated shop air supply hose to the venturi assembly.
20. Open the valve on the venturi assembly to apply vacuum to the high voltage battery internal loop.
21. Build vacuum for at least one minute.
22. Disengage the inlet port retaining clip (2).





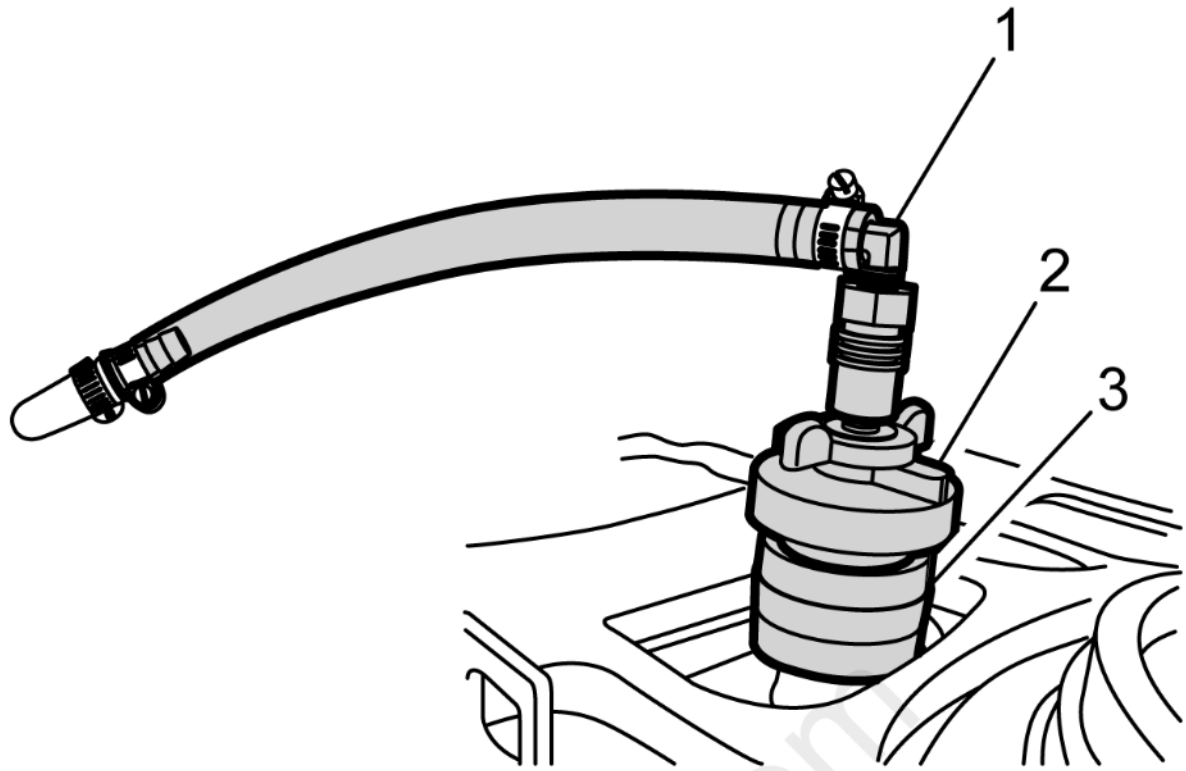
**Fig. 75: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

23. Temporarily remove **GE-50385** Battery Pack Coolant Passage Test Adapter (1) from the battery inlet port to break vacuum and purge the battery of coolant.
24. Install **GE-50385** Battery Pack Coolant Passage Test Adapter.
25. Engage the inlet port retaining clip (2).
26. Build vacuum again.
27. Repeat steps 10-13 several times until no more coolant can be extracted.
28. Disengage the outlet port retaining clip (4).



**Fig. 76: Battery Pack Coolant Passage Test Adapter, Inlet Port Retaining Clip, Cooling System Fill Adapter And Outlet Port Retaining Clip**  
Courtesy of GENERAL MOTORS COMPANY

29. Remove **GE-47716-20** Cooling System Fill Adapter (3) from the battery outlet port.
30. Disengage the inlet port retaining clip (2).
31. Remove **GE-50385** Battery Pack Coolant Passage Test Adapter (1) from the battery inlet port.
32. Lower the vehicle.
33. Remove the quick connect fitting on the short hose assembly (1) from the Vac N Fill cap.



**Fig. 77: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

34. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

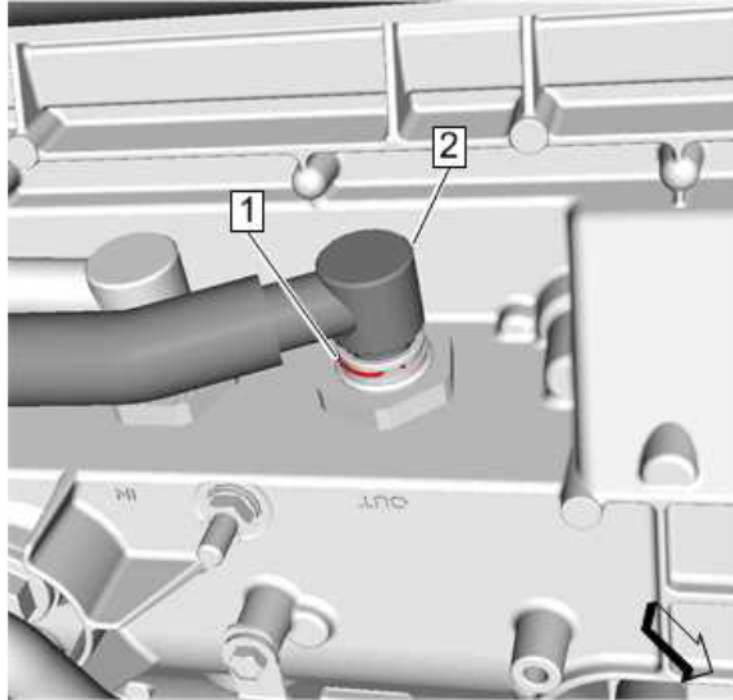
#### **Vac-N-Fill Procedure**

1. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery » Install - [Drive Motor Battery Radiator Outlet Hose Replacement](#)

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

**CAUTION:** Do NOT manually add coolant to the High Voltage Battery Cooling System. Only use the GE-47716 Vac N Fill Coolant Refill Tool to fill the cooling system. Failure to use the proper tool could allow spilled coolant into the High Voltage Battery, resulting in damage to the Battery and will lead to loss of vehicle propulsion.

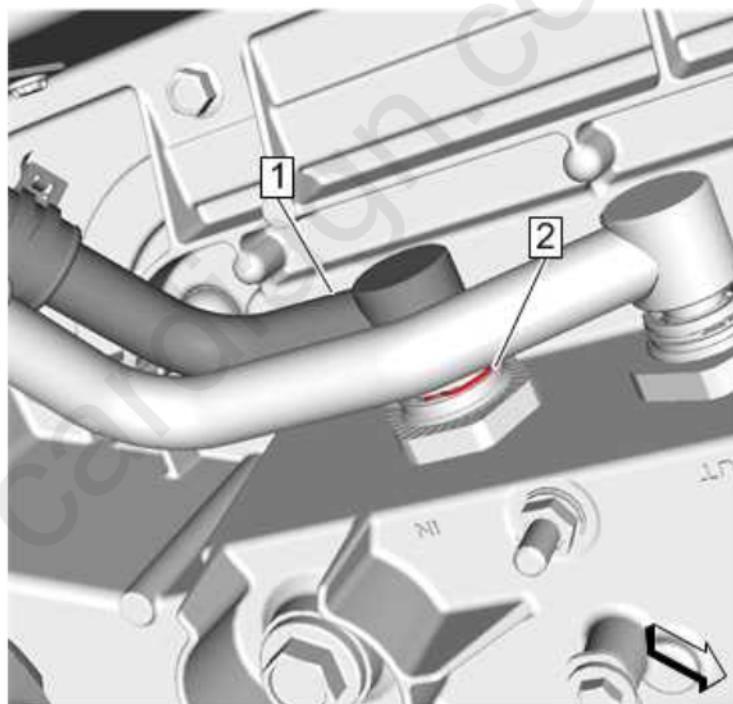
**NOTE:** To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.



**Fig. 78: Drive Motor Battery Radiator Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

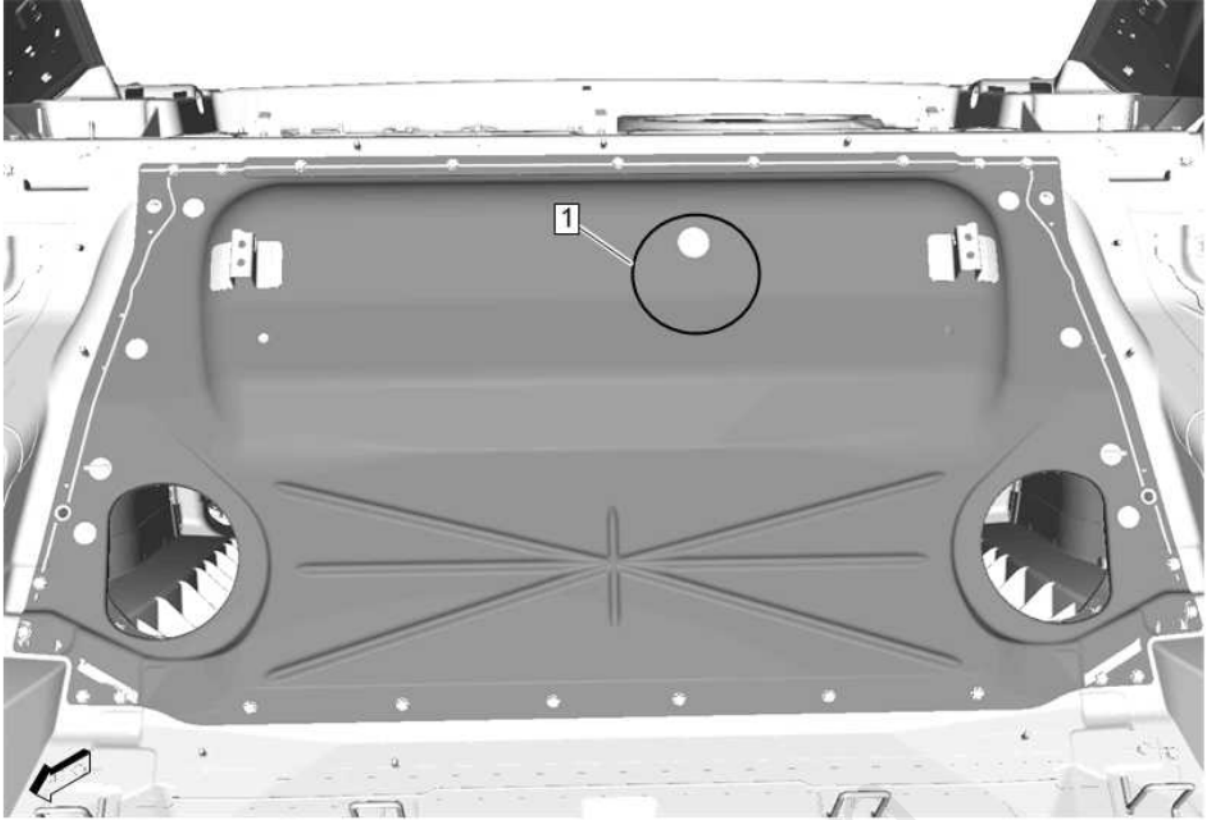
2. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage Battery » Install - **Drive Motor Battery Radiator Inlet Hose Replacement**



**Fig. 79: Drive Motor Battery Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

3. Remove the drain pan.
4. Lower the vehicle.
5. If this is the first time this procedure has been performed on this vehicle, you will need to cut-out the circle portion scribed in the rear seat back body panel (1).

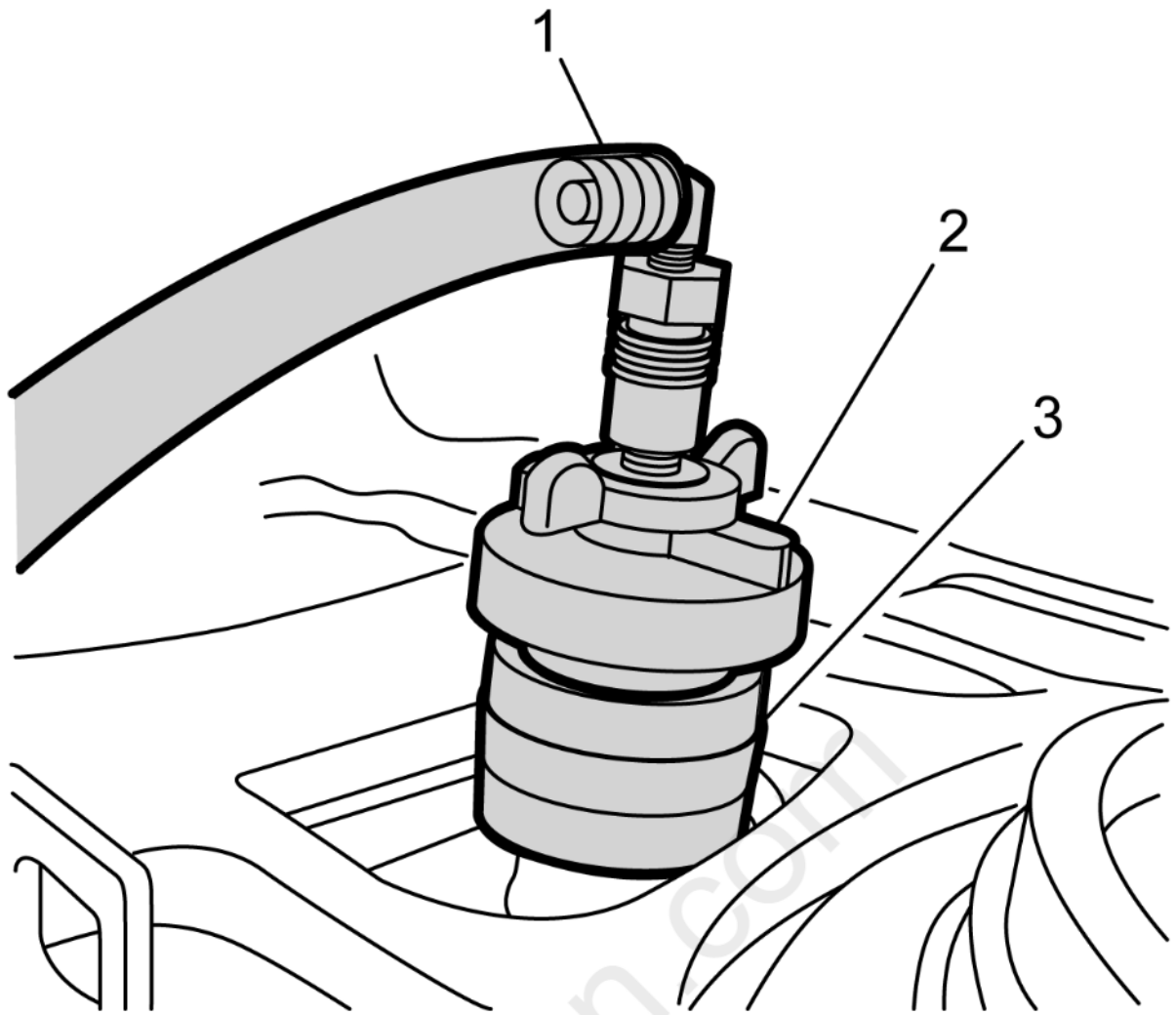


**Fig. 80: Rear Seat Back Body Panel**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** When cutting the service opening in the rear panel use only an air nibbler. Using a different tool can cause damage to underlying components requiring unnecessary replacement of those parts.

6. Using an air nibbler, cut-out the circle portion (1) scribed into the rear seat back body panel.
7. Remove all metal shavings from the rear of the vehicle created from cutting the circle portion of the rear seat back body panel.
8. Install **J-46143-2** Cooling System Adapter (3) to the water inlet.

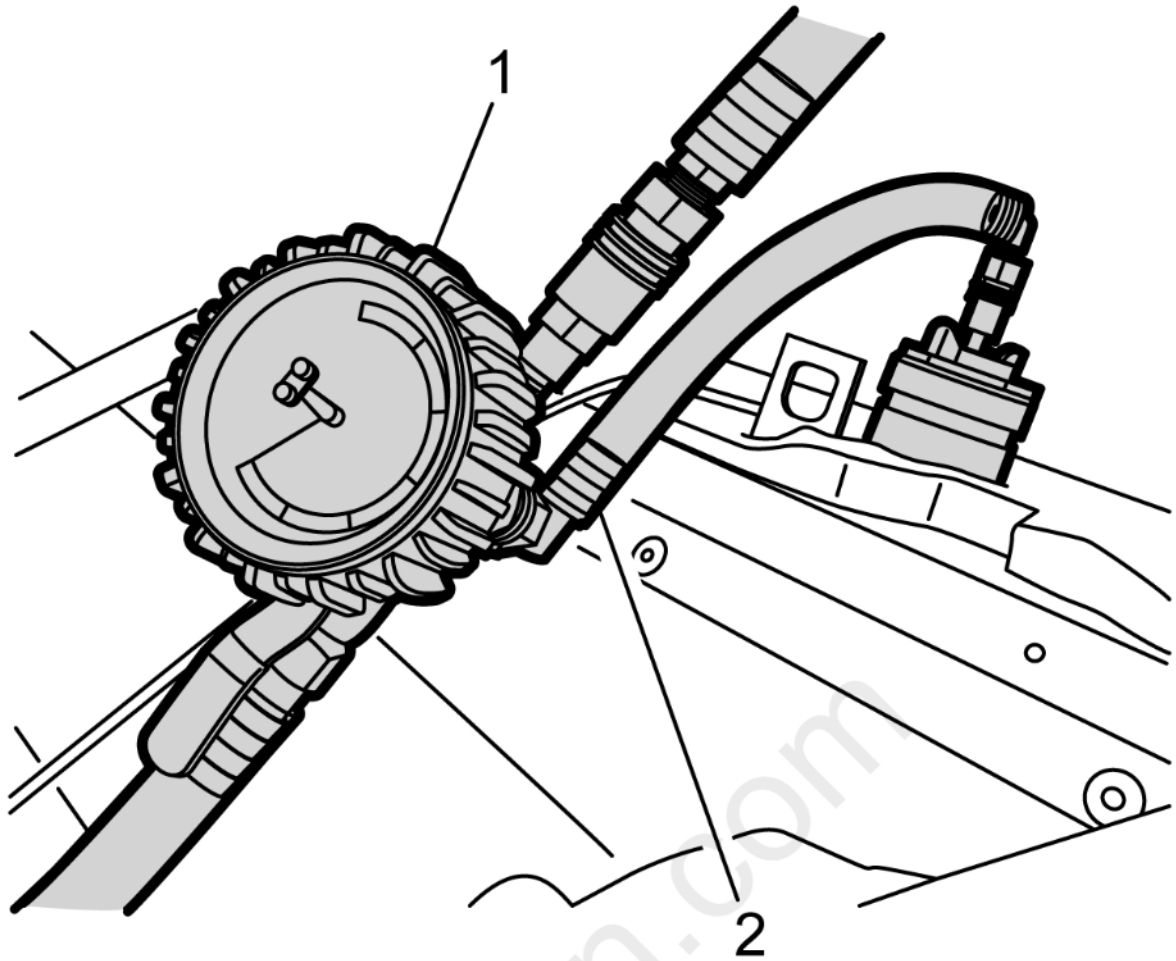


**Fig. 81: Cooling System Adapter**

**Courtesy of GENERAL MOTORS COMPANY**

9. Install Vac-N-Fill Cap (2) to **J-46143-2** Cooling System Adapter.
10. Install the 90° adapter fitting and hose (1) to Vac-N-Fill Cap (2).
11. Attach the vacuum gauge assembly (1) to the 90° Hose (2).





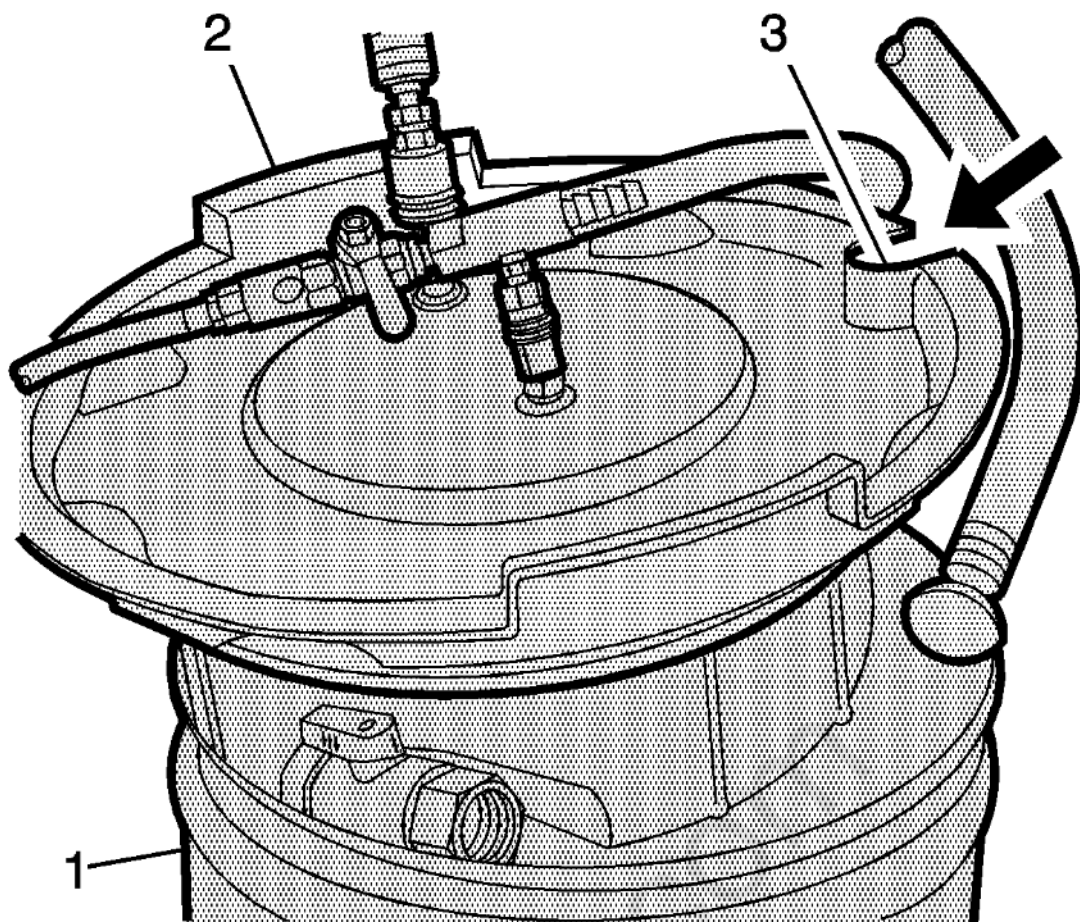
**Fig. 82: Vacuum Gauge Assembly.**

**Courtesy of GENERAL MOTORS COMPANY**

12. Attach the fill hose to the barb fitting on the vacuum gauge assembly (1).

Ensure that the valve is closed.

13. Pour the coolant mixture into the graduated reservoir (1).

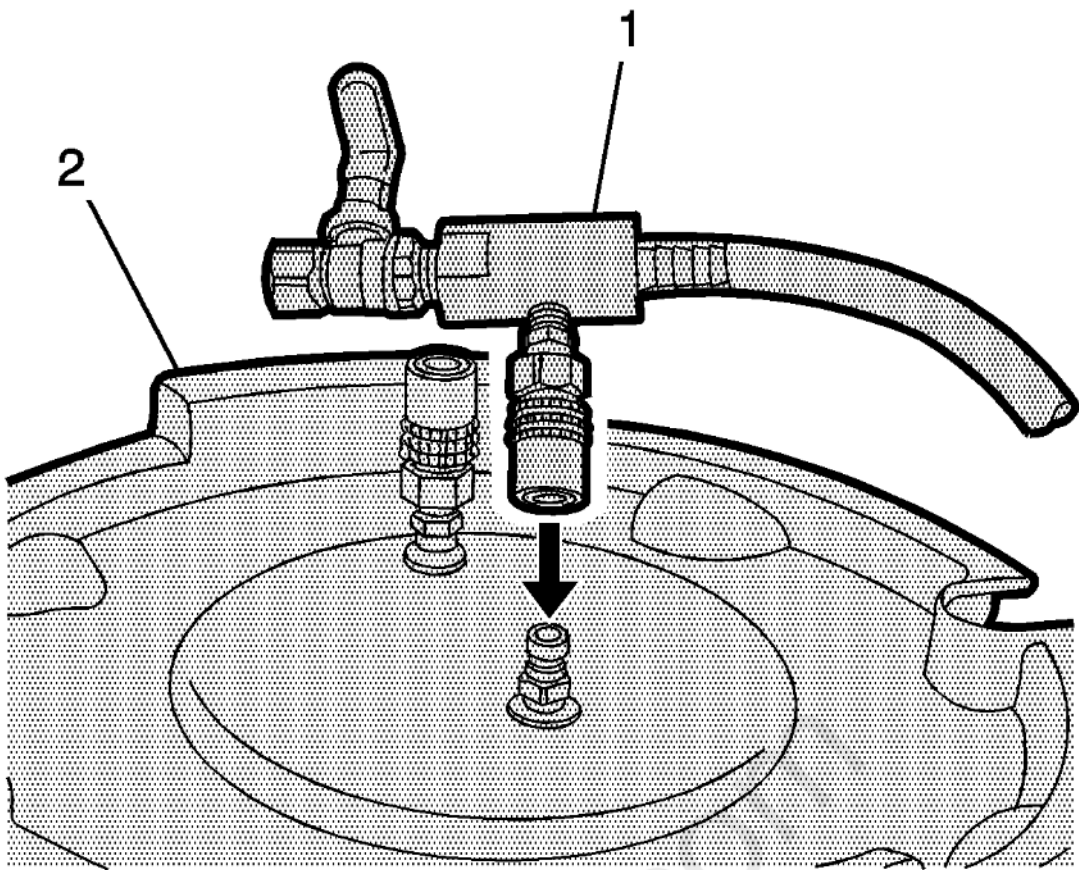


**Fig. 83: Graduated Reservoir, Vacuum Tank & Cut-Out Area**  
Courtesy of GENERAL MOTORS COMPANY

14. Place the fill hose in the graduated reservoir (1).
15. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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

16. Attach the venturi assembly (1) to the vacuum tank (2).

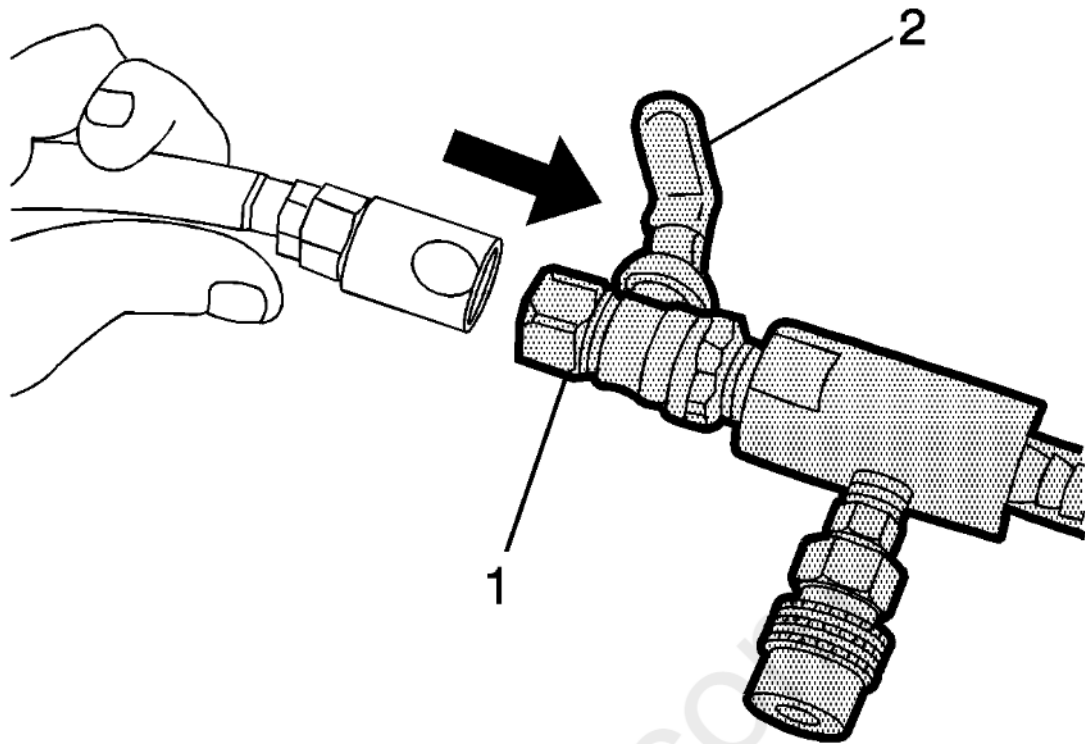


**Fig. 84: Vacuum Tank & Venturi Assembly**

Courtesy of GENERAL MOTORS COMPANY

17. Attach a shop air hose to the venturi assembly (1).

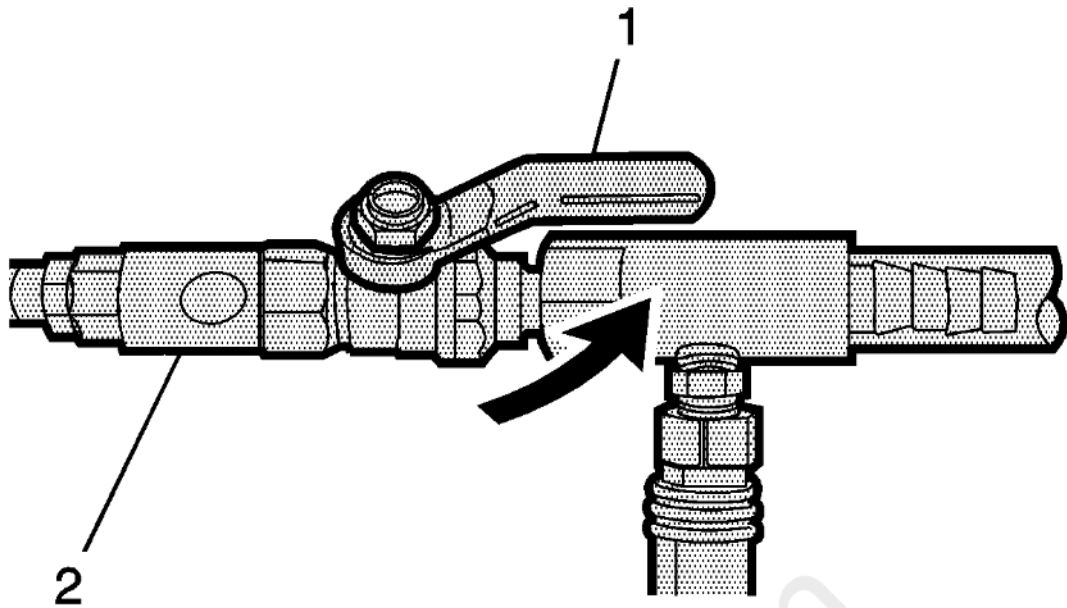
Ensure the valve (2) on the venturi assembly is closed.



**Fig. 85: Venturi Assembly & Valve**

**Courtesy of GENERAL MOTORS COMPANY**

18. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.
19. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.



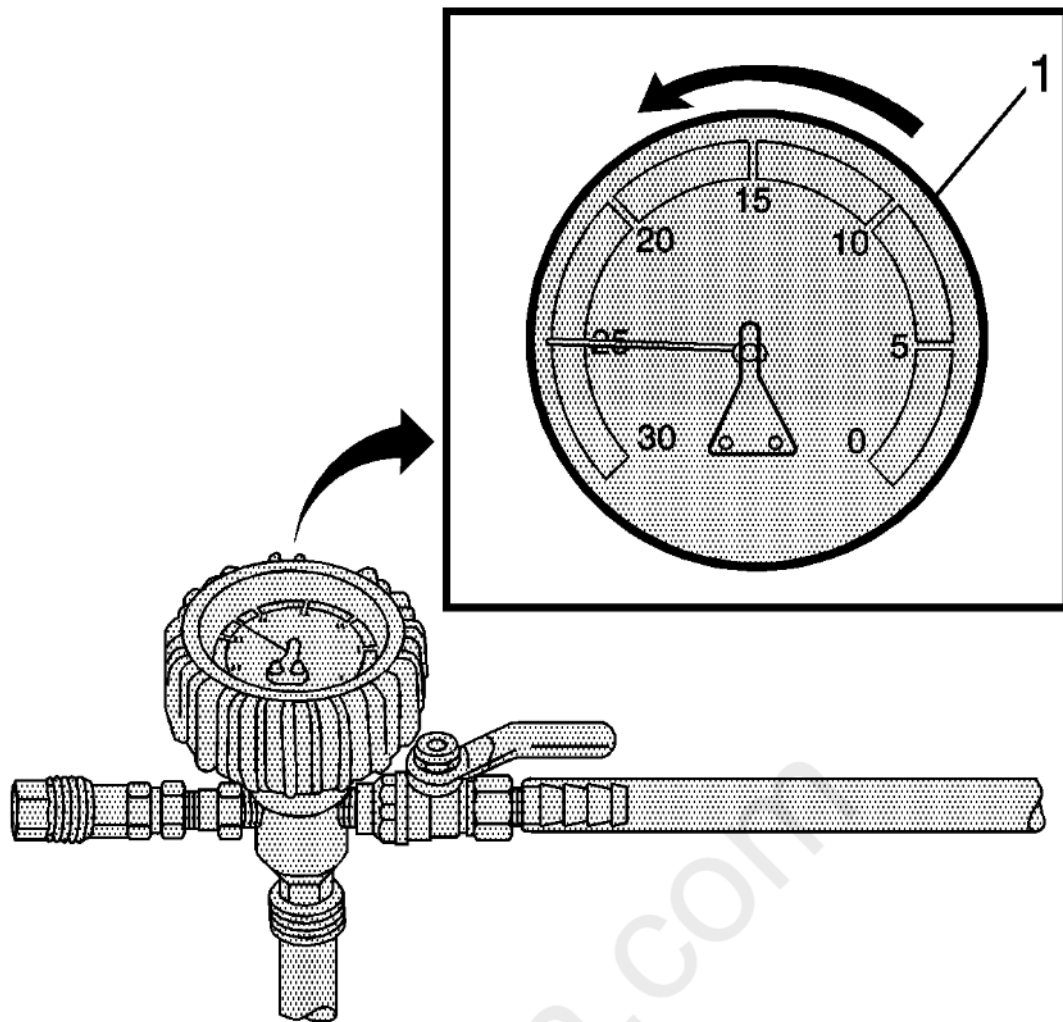
**Fig. 86: Valve & Venturi Assembly**

**Courtesy of GENERAL MOTORS COMPANY**

20. Continue to draw vacuum until the needle stops rising (1). This should be 610-660 mm Hg (24-26 in Hg).

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

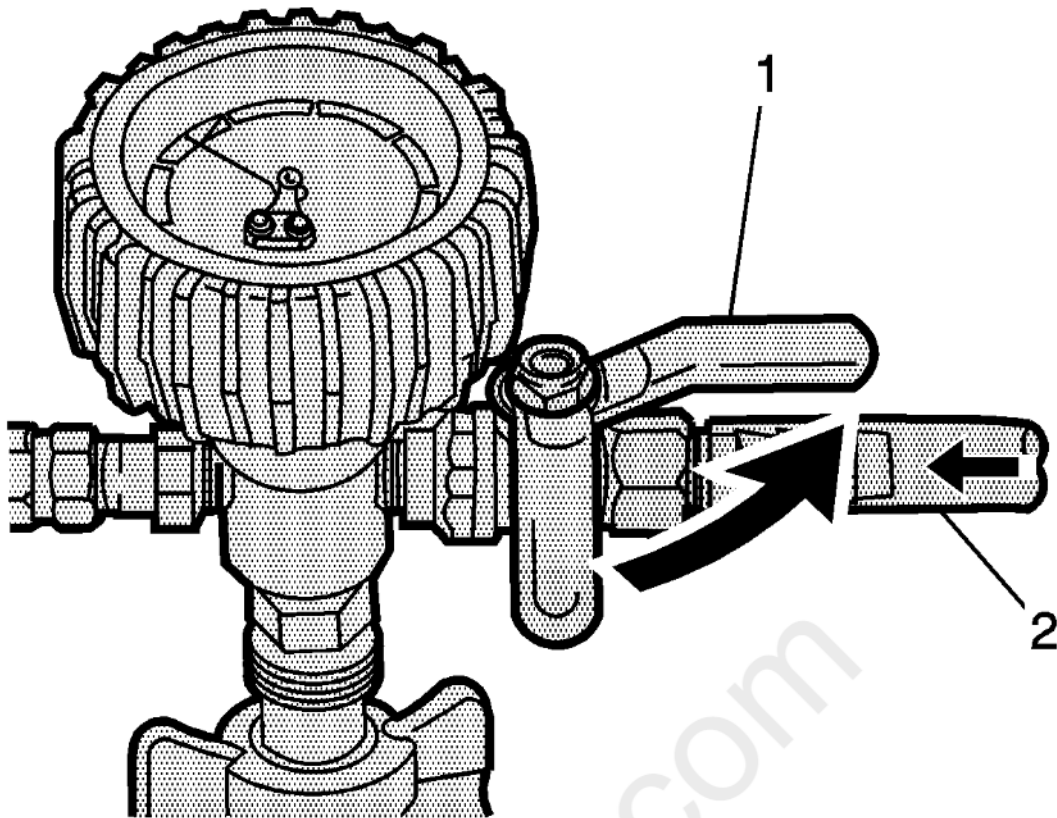




**Fig. 87: Vacuum Gauge Needle**

Courtesy of GENERAL MOTORS COMPANY

21. To aid in the fill process, position the graduated reservoir above the coolant fill port.
22. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.

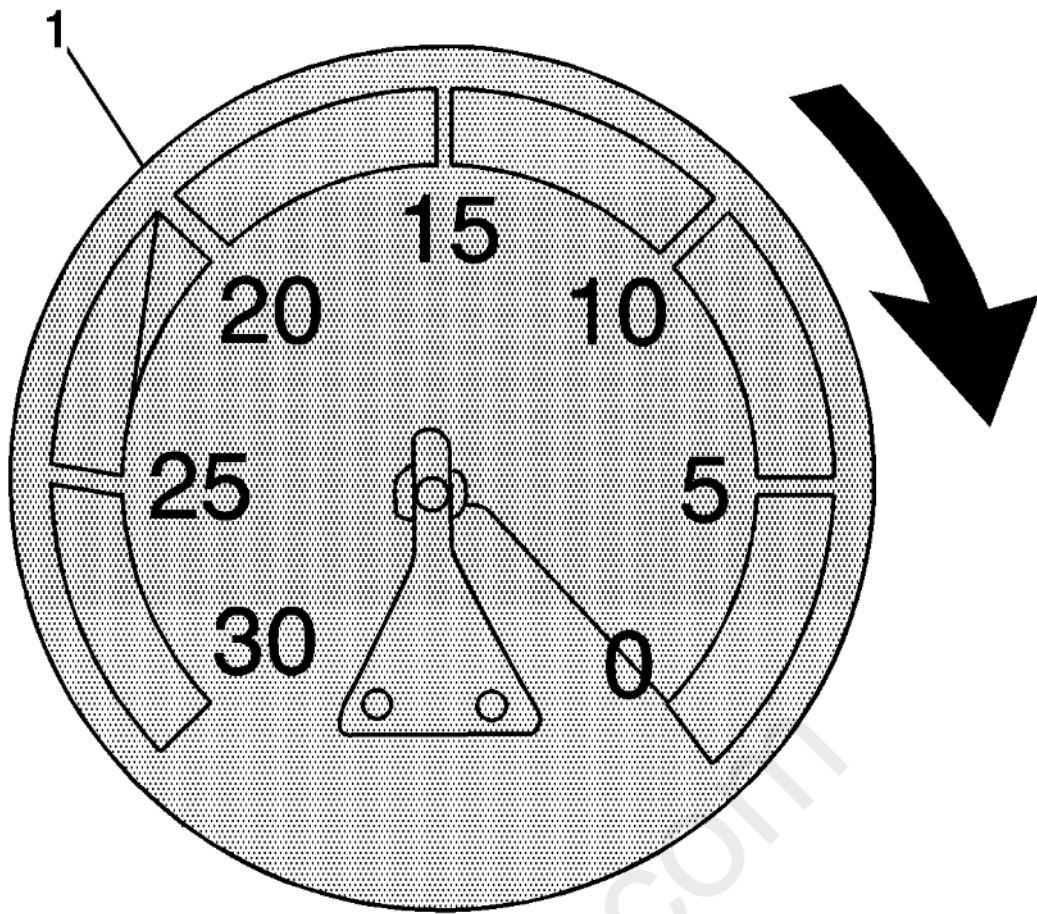


**Fig. 88: Vacuum Gauge Assembly & Needle**  
Courtesy of GENERAL MOTORS COMPANY

23. Close the valve on the venturi assembly.
24. 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 **High Voltage Battery Cooling System Loss of Coolant**.

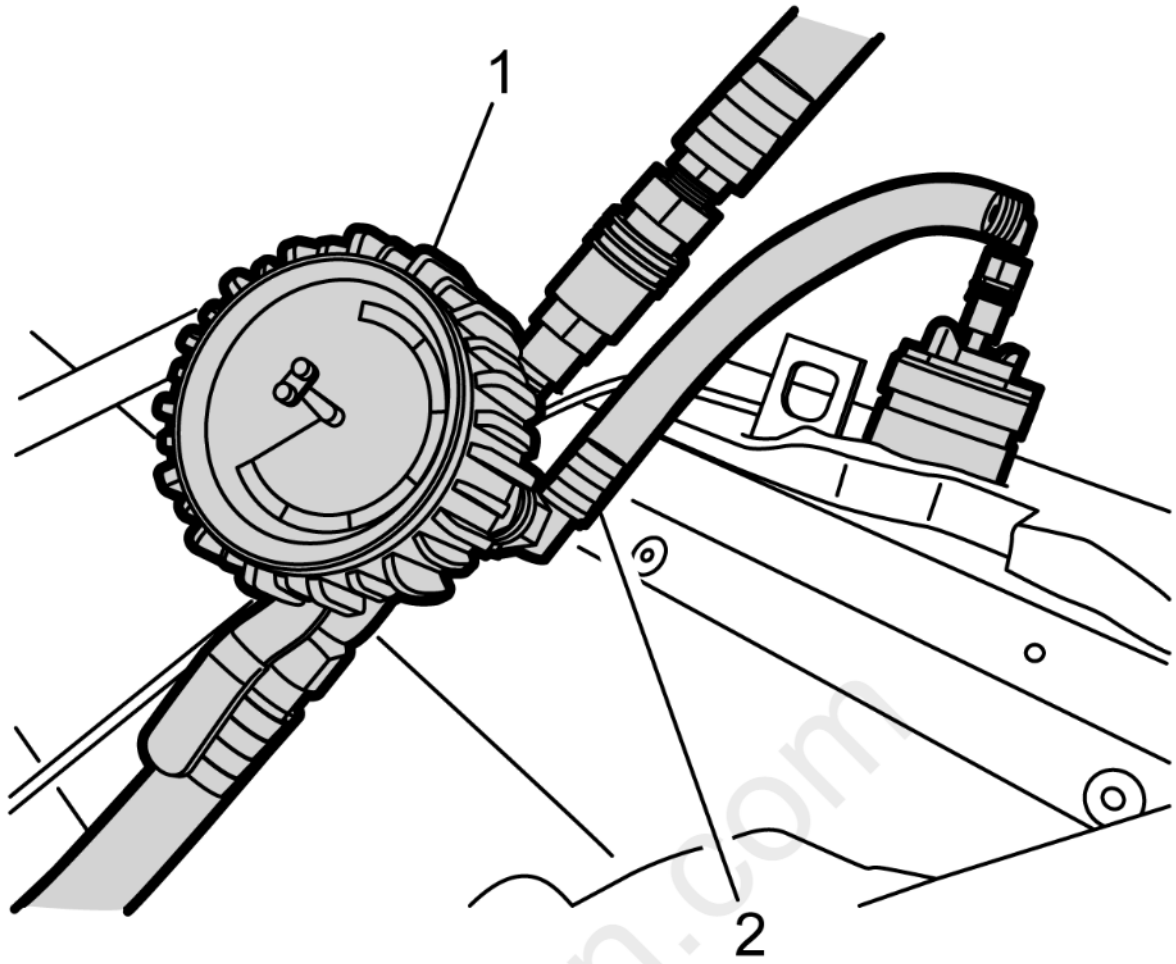
25. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
26. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly.



**Fig. 89: Vacuum Gauge**

**Courtesy of GENERAL MOTORS COMPANY**

27. Detach the vacuum gauge assembly (1) from the 90° Hose (2).

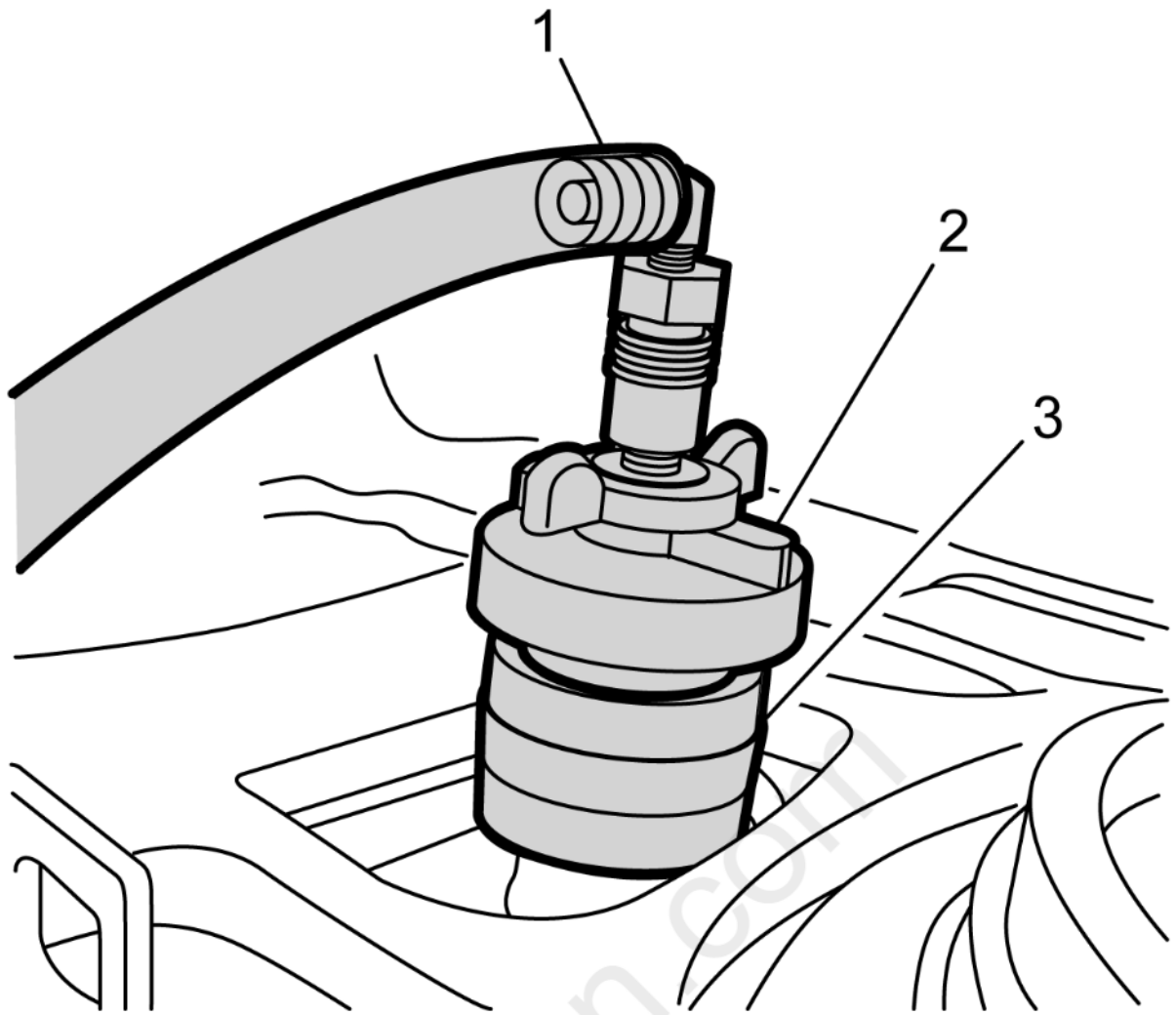


**Fig. 90: Vacuum Gauge Assembly.**

**Courtesy of GENERAL MOTORS COMPANY**

28. Remove the 90° adapter fitting and hose (1) at Vac-N-Fill Cap (2).

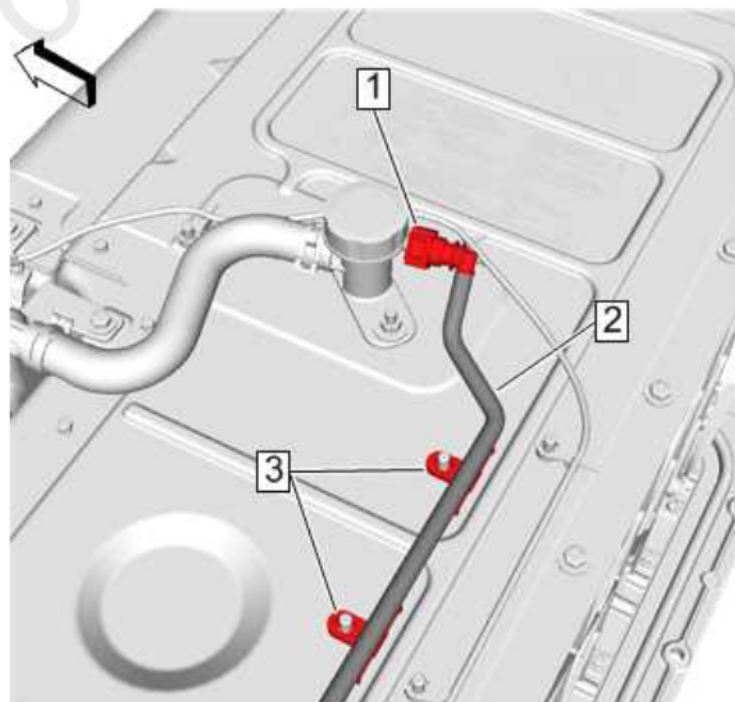




**Fig. 91: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

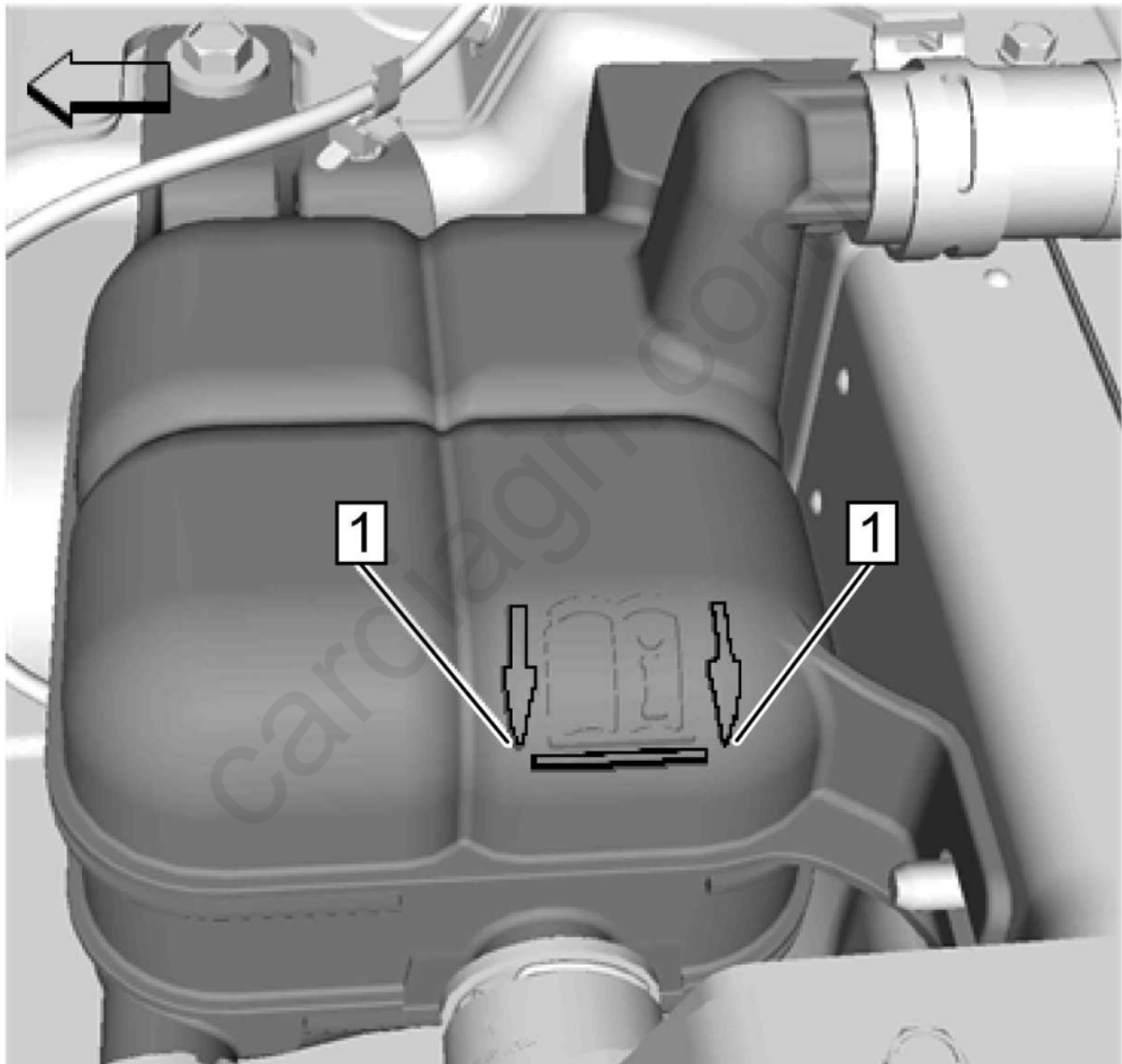
29. Remove Vac-N-Fill Cap (2) from **J-46143-2** Cooling System Adapter.
30. Remove **J-46143-2** Cooling System Adapter (3) from the water inlet.
31. Heater Vent Hose (2) @ Water Inlet» Install





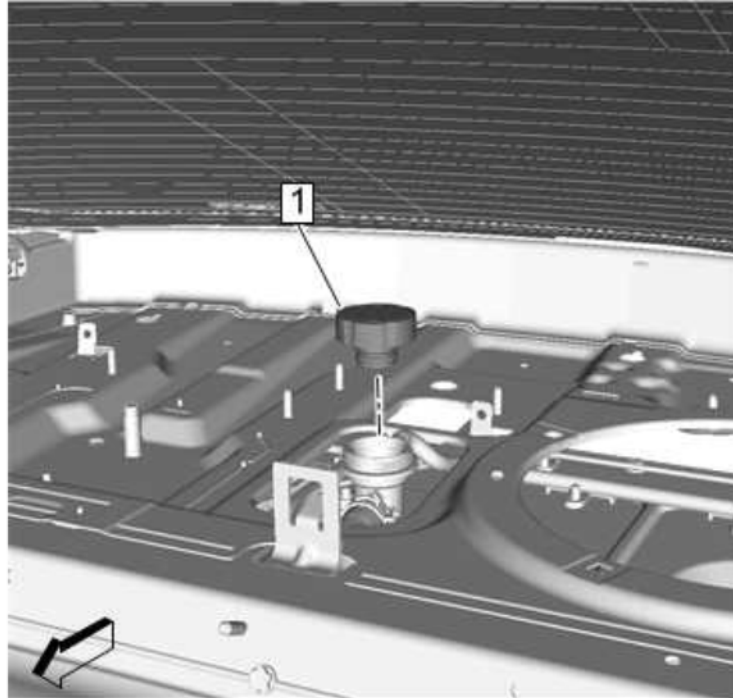
32. Quick Connect Fitting (1) @ Water Inlet» Engage
33. Inspect the concentration of the coolant mixture using the **J-26568** Coolant and Battery Fluid Tester.
34. Using an inspection mirror through the cut-out in the rear seat back body panel, verify coolant level of the drive motor battery coolant/air separator using the arrows (1) found on the driver's side of the drive motor battery coolant/air separator.

**CAUTION:** Do NOT manually add coolant to the High Voltage Battery Cooling System. Only use the GE-47716 Vac N Fill Coolant Refill Tool to fill the cooling system. Failure to use the proper tool could allow spilled coolant into the High Voltage Battery, resulting in damage to the Battery and will lead to loss of vehicle propulsion.



**Fig. 93: Verifying Coolant Level Of Drive Motor Battery Coolant/Air Separator**

35. If coolant level is low or if air appears to be in the system, steps 12-34 of the Vac-N-Fill procedure will need to be repeated.
36. Install cap (1) to the water inlet.

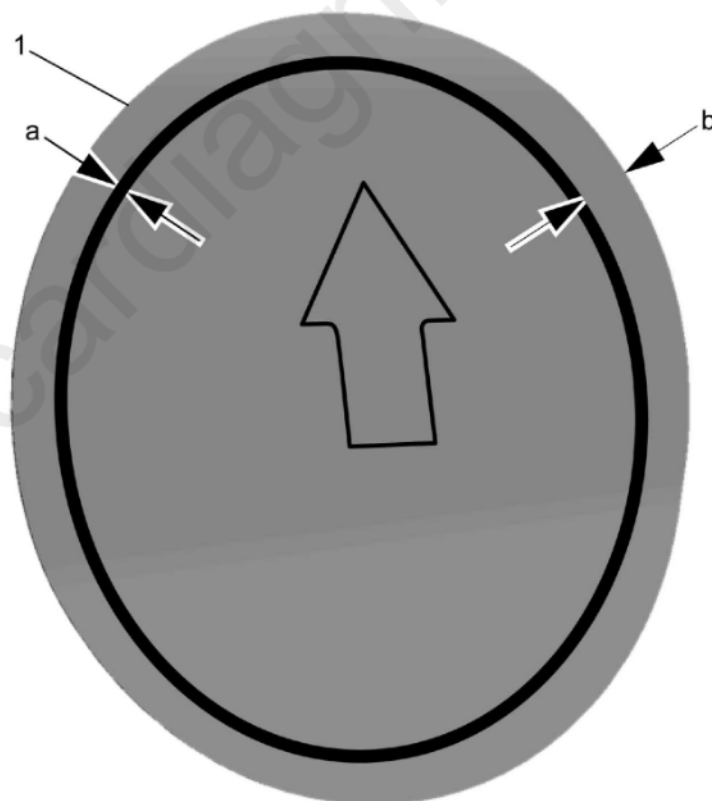


**Fig. 94: Pressure Cap**

Courtesy of GENERAL MOTORS COMPANY

37. Apply a continuous bead 1.6 mm (0.1 in) (A) of a urethane adhesive which meets GM Specification GM 3651G 9 mm (0.4 in) (B) from the outer edge of the rear seat back body panel patch (1).

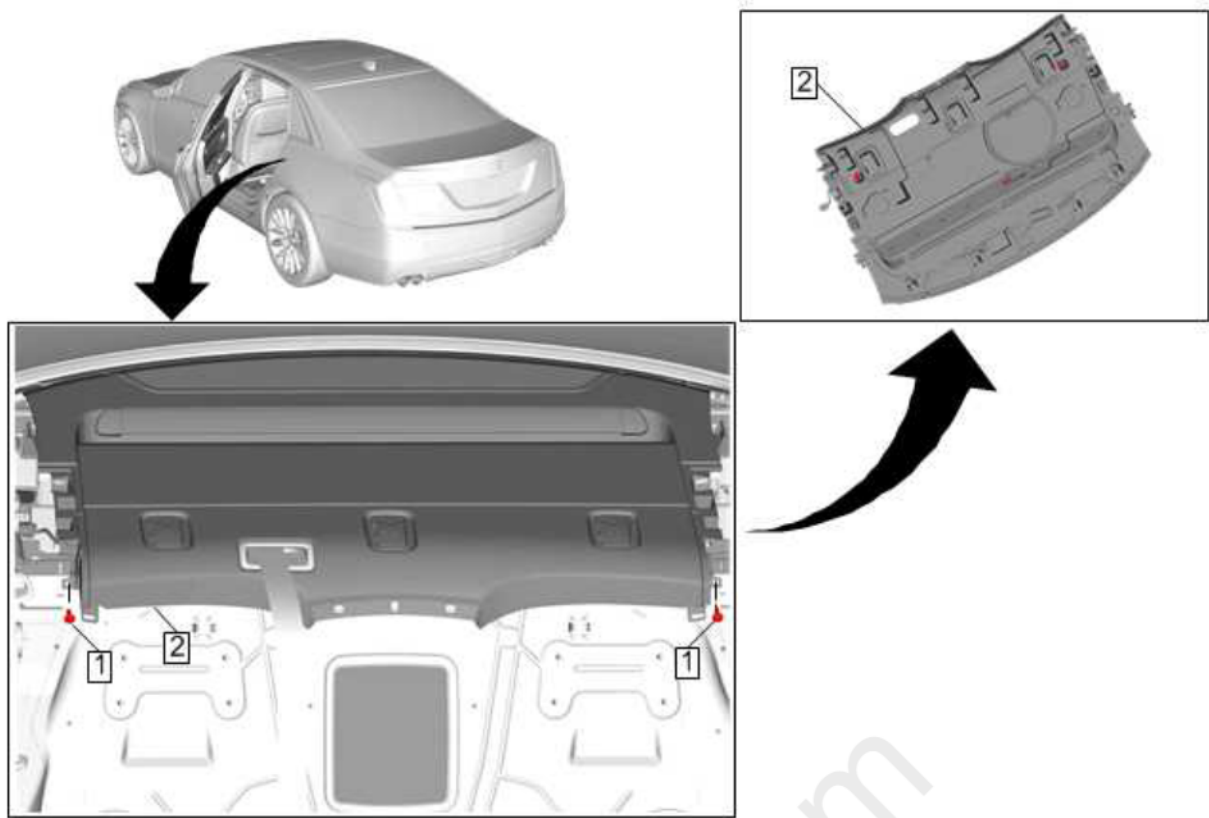
See GM Electronics Parts Catalog for Rear Seat Back Body Panel Patch Part Number.



**Fig. 95: Applying Urethane Adhesive**

Courtesy of GENERAL MOTORS COMPANY

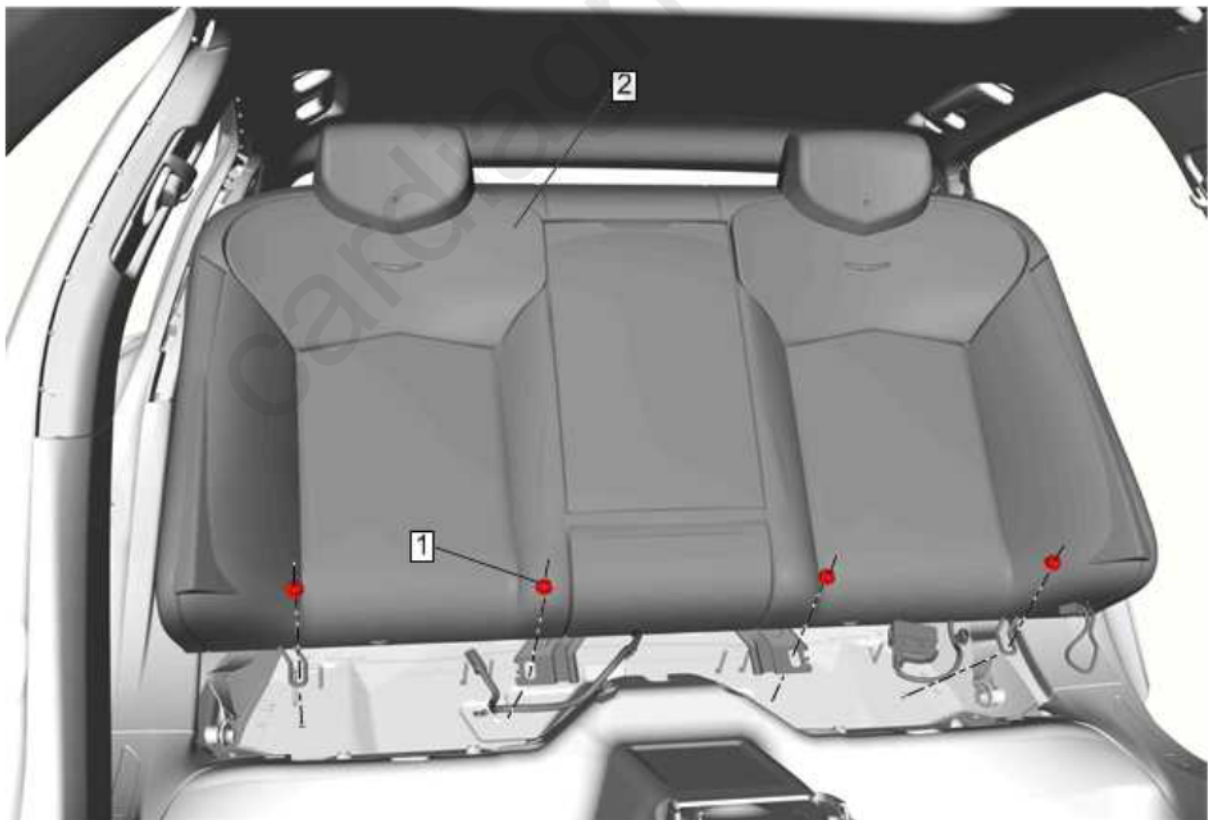
38. Install the rear seat back body panel patch to the rear seat back body panel.
39. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)



**Fig. 96: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

40. Rear Seat Back Cushion (2)» Install - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 97: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

41. Enable the high voltage system. Refer to [High Voltage Enabling](#)

**POWER ELECTRONICS AND AUXILIARY RADIATOR DRAIN AND FILL (LTG HP9)**

**Special Tools**

- J-46143-2 Cooling System Adapter
- GE-47716 Vac-N-Fill Coolant Refill Tool

Equivalent regional tools: [Special Tools](#)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

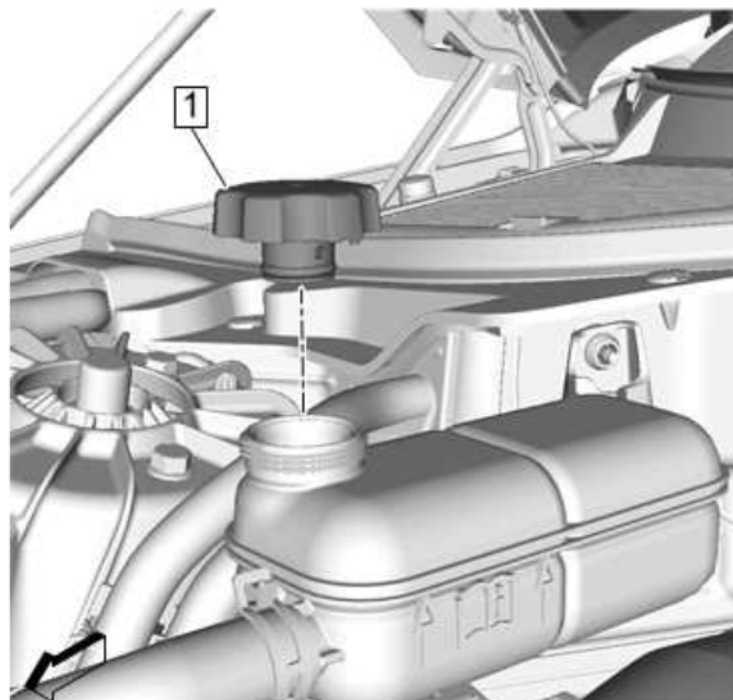
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**WARNING:** 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.

### Draining Procedure

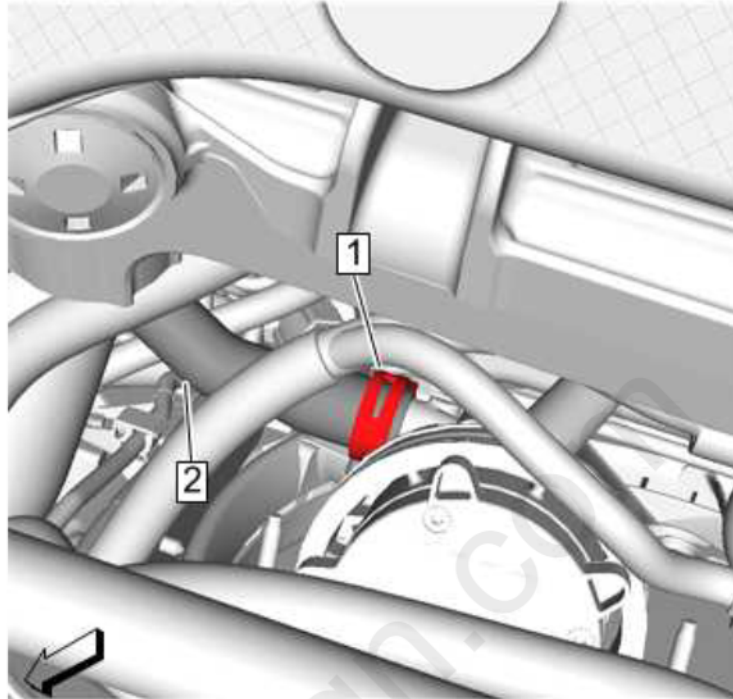
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove the cap (1) from the generator control module coolant/air separator.





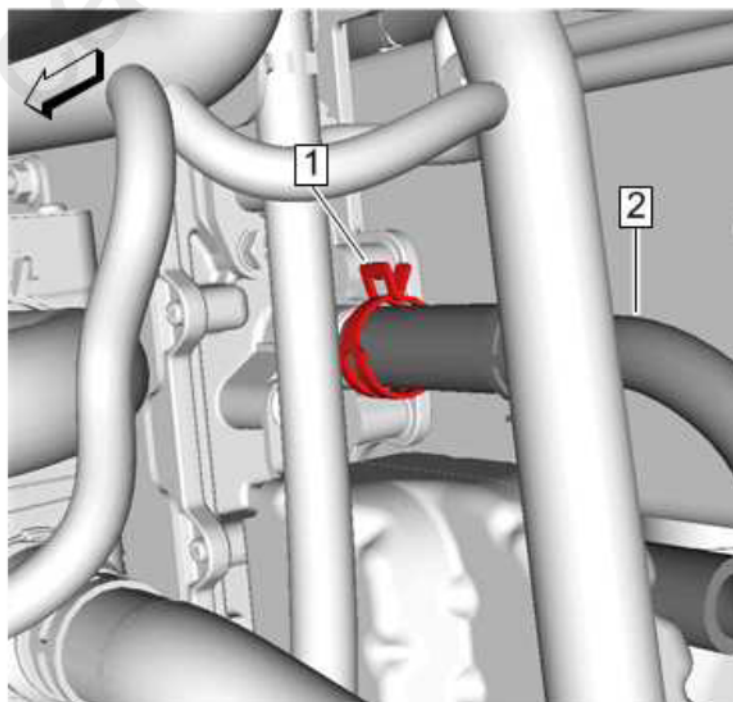
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
4. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Remove - **Drive Motor Generator Control Module Radiator Inlet Hose Replacement**

**NOTE:** Allow the coolant to fully drain from each hose location into a clean container.



**Fig. 99: Drive Motor Generator Control Module Radiator Inlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

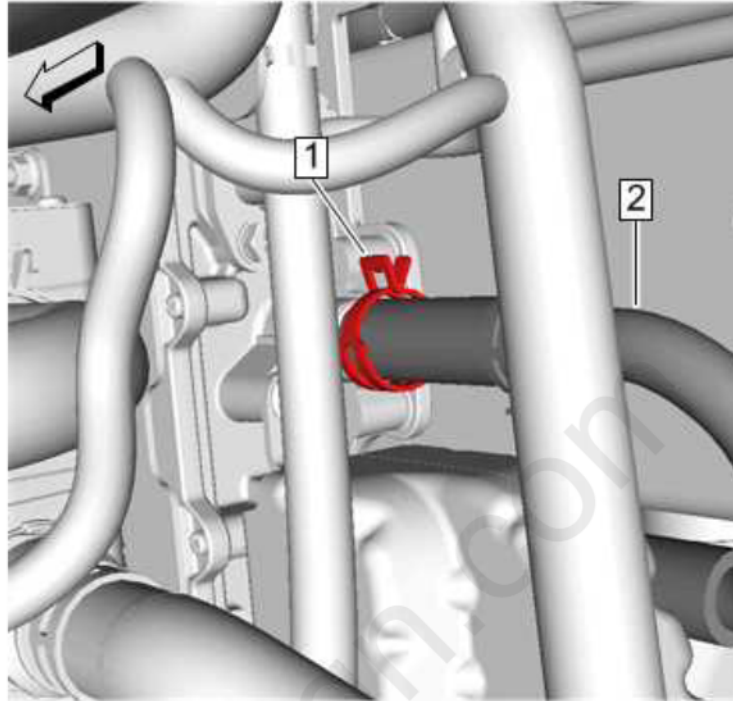
5. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Accessory DC Power Control Module» Remove - **Drive Motor Generator Control Module Radiator Outlet Hose Replacement**



**Fig. 100: Drive Motor Generator Control Module Radiator Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

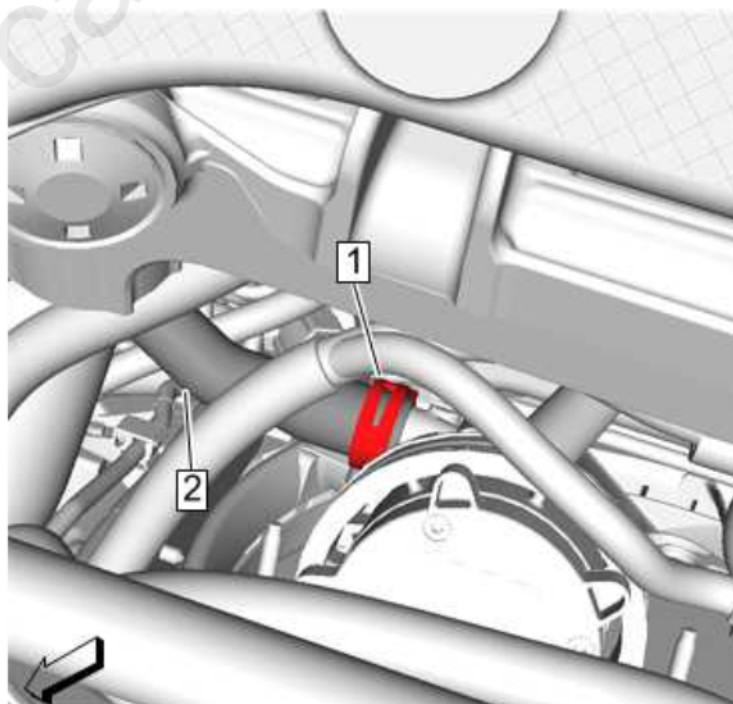


6. Remove both generator control module coolant outlet hoses from the drive motor battery charger. Refer to [Generator Control Module Coolant Outlet Hose Replacement \(Inlet\)](#) and/or [Generator Control Module Coolant Outlet Hose Replacement \(Outlet\)](#)
7. Measure and record the amount of coolant drained.
8. Install both generator control module coolant outlet hoses to the drive motor battery charger. Refer to [Generator Control Module Coolant Outlet Hose Replacement \(Inlet\)](#) and/or [Generator Control Module Coolant Outlet Hose Replacement \(Outlet\)](#)
9. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Accessory DC Power Control Module» Install - [Drive Motor Generator Control Module Radiator Outlet Hose Replacement](#)



**Fig. 101: Drive Motor Generator Control Module Radiator Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

10. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Install - [Drive Motor Generator Control Module Radiator Inlet Hose Replacement](#)

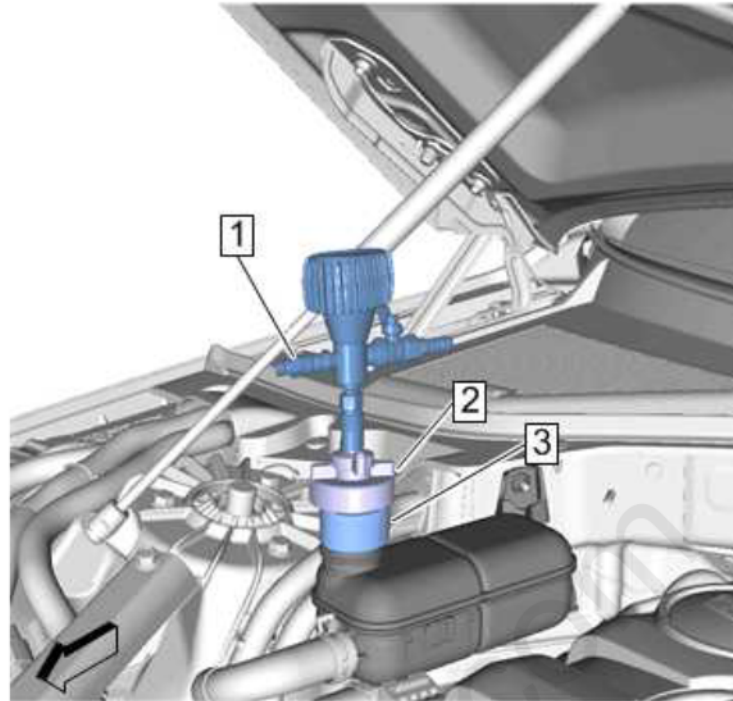


**Fig. 102: Drive Motor Generator Control Module Radiator Inlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

11. Clean off any coolant residue from underneath vehicle
12. Lower the vehicle.

### Vac-N-Fill Procedure

1. Install **GE-46143-2** Cooling System Adapter (3) to Generator Control Module Coolant/Air Separator.



**Fig. 103: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

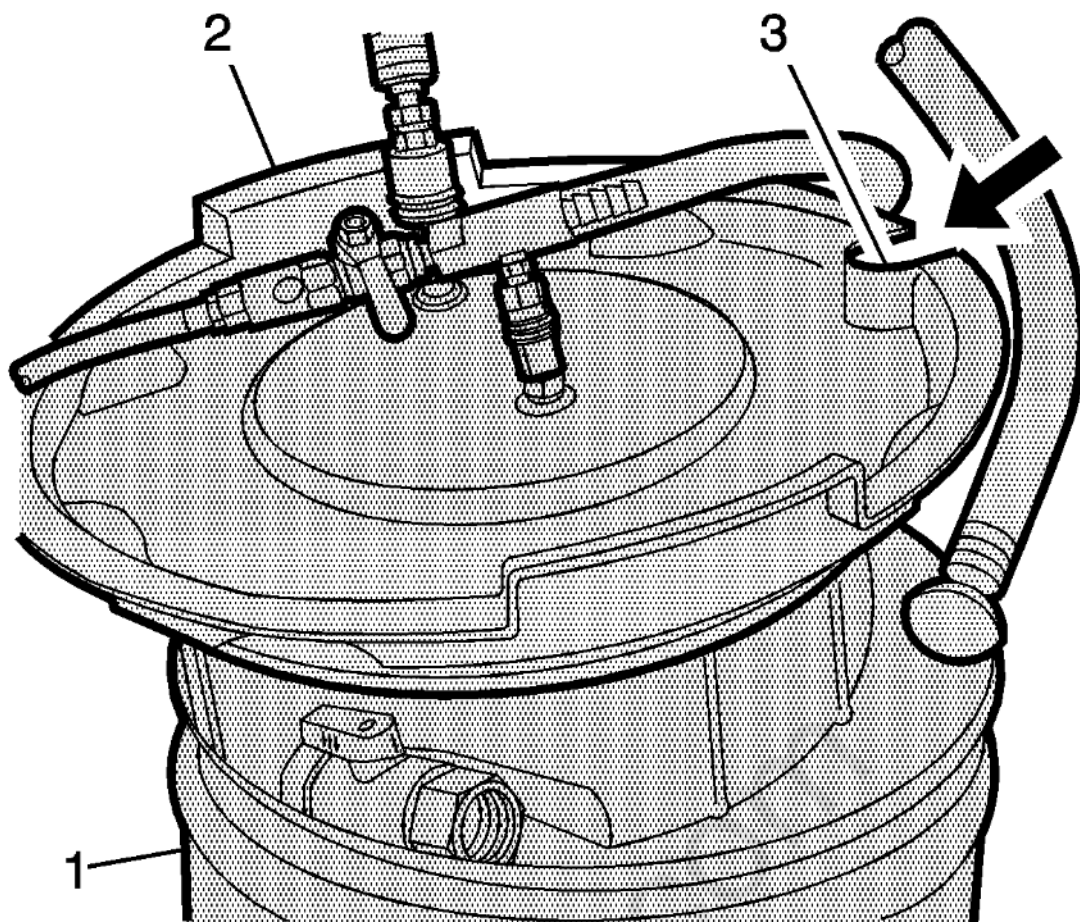
**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

**NOTE:** It is critical that the system must be completely free of air to prevent pump noise and loss of system performance.

2. Install the Vac N Fill cap (2) to **GE-46143-2** Cooling System Adapter (3)
3. Attach the Vac-N-Fill gage assembly (1) to Vac N Fill cap (2).
4. Attach the fill hose to the barb fitting on the vacuum gauge assembly.

Ensure that the valve is closed.

5. Pour the coolant mixture into the graduated reservoir (1).



**Fig. 104: Graduated Reservoir, Vacuum Tank & Cut-Out Area**

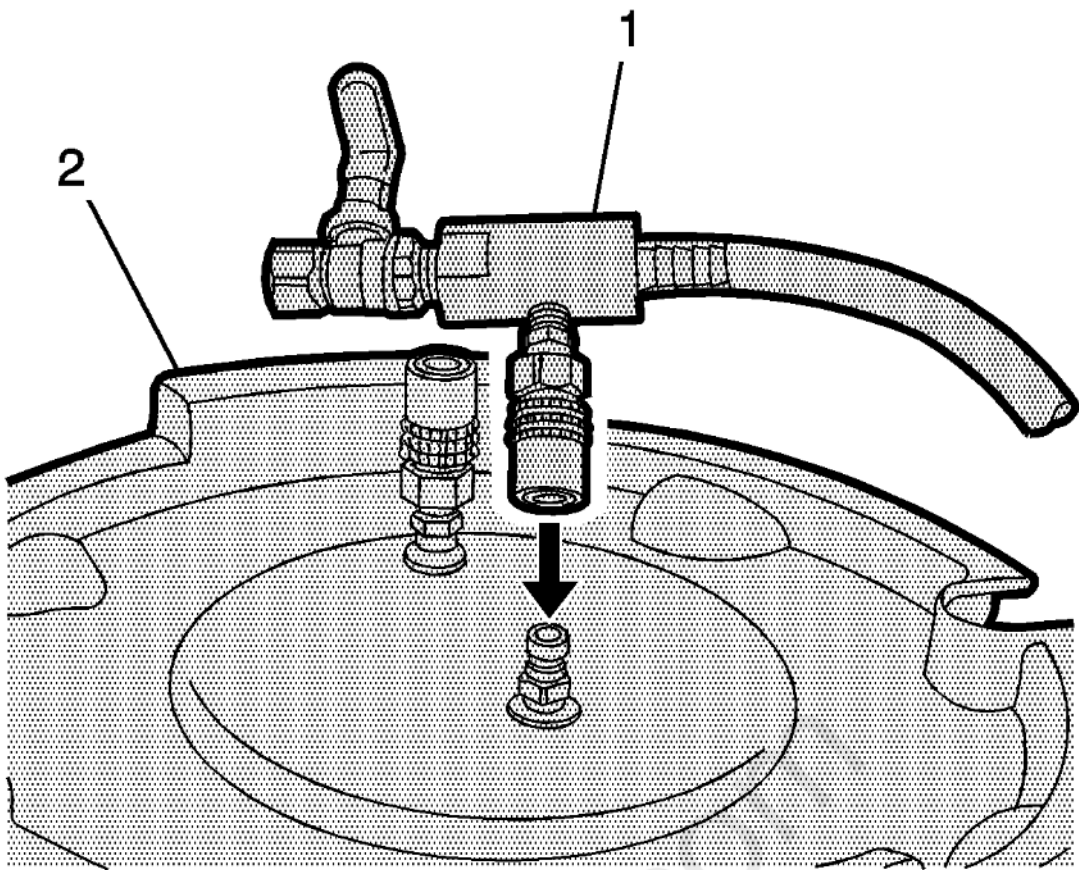
Courtesy of GENERAL MOTORS COMPANY

6. Place the fill hose in the graduated reservoir (1).
7. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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

8. Attach the venturi assembly (1) to the vacuum tank (2).

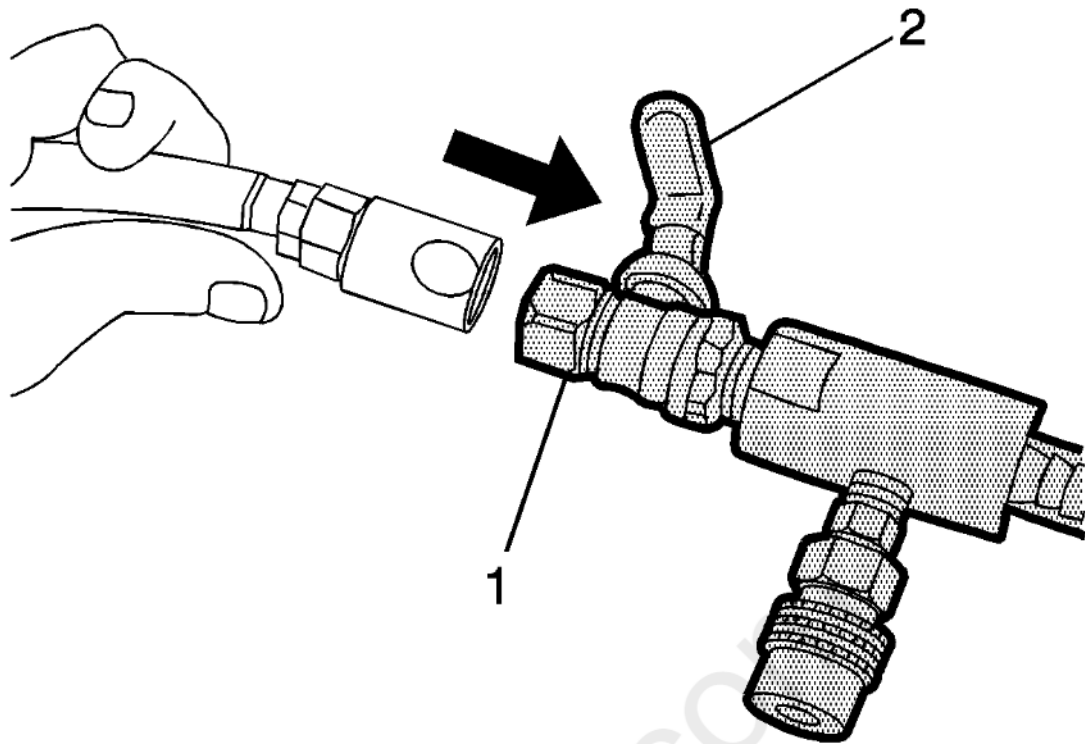




**Fig. 105: Vacuum Tank & Venturi Assembly**

**Courtesy of GENERAL MOTORS COMPANY**

9. Attach a shop air hose to the venturi assembly (1).

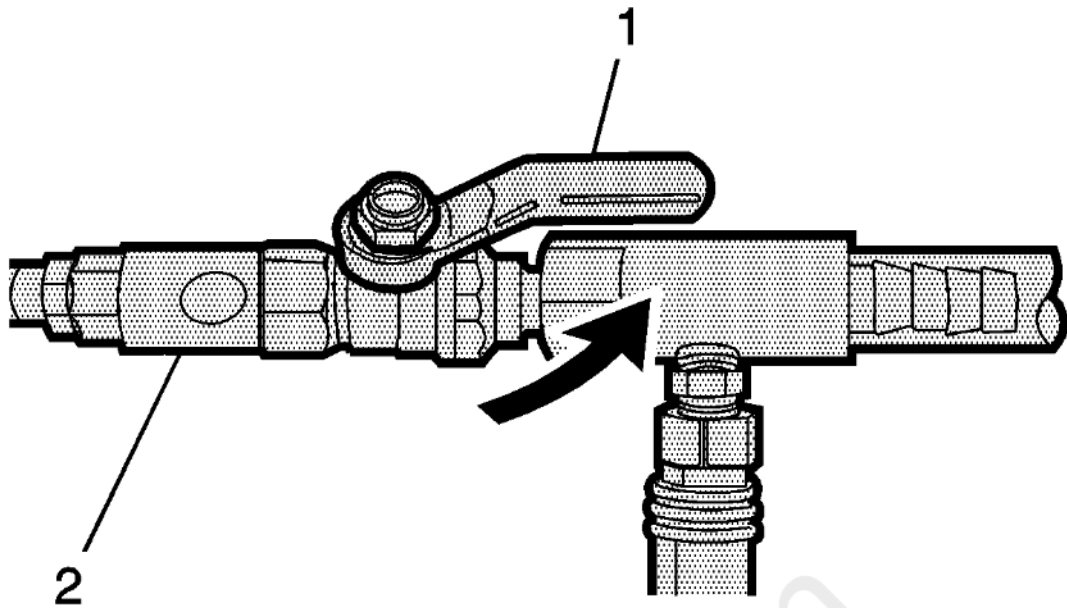


**Fig. 106: Venturi Assembly & Valve**  
**Courtesy of GENERAL MOTORS COMPANY**

Ensure the valve (2) on the venturi assembly is closed.

10. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.
11. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

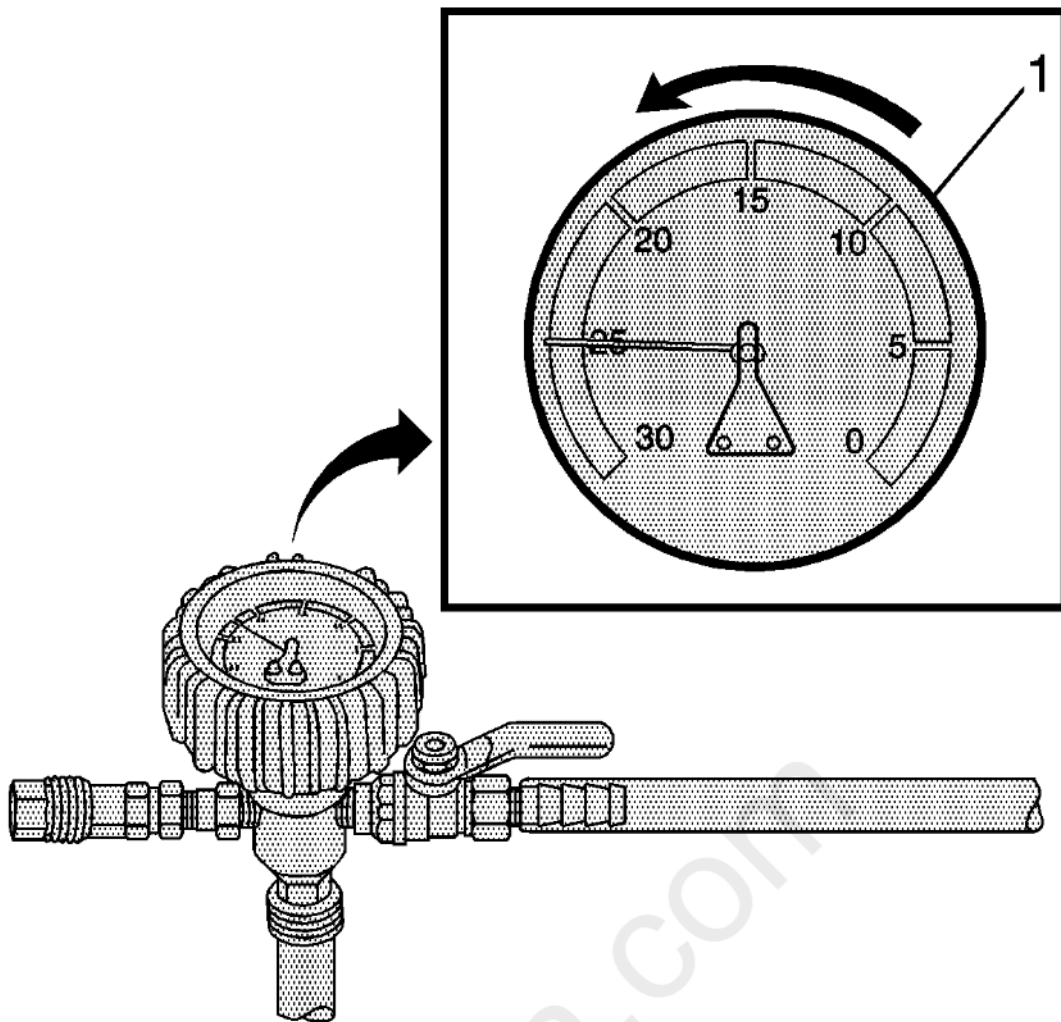




**Fig. 107: Valve & Venturi Assembly**

**Courtesy of GENERAL MOTORS COMPANY**

12. Continue to draw vacuum until the needle stops rising (1). This should be 610-660 mm Hg (24-26 in Hg).

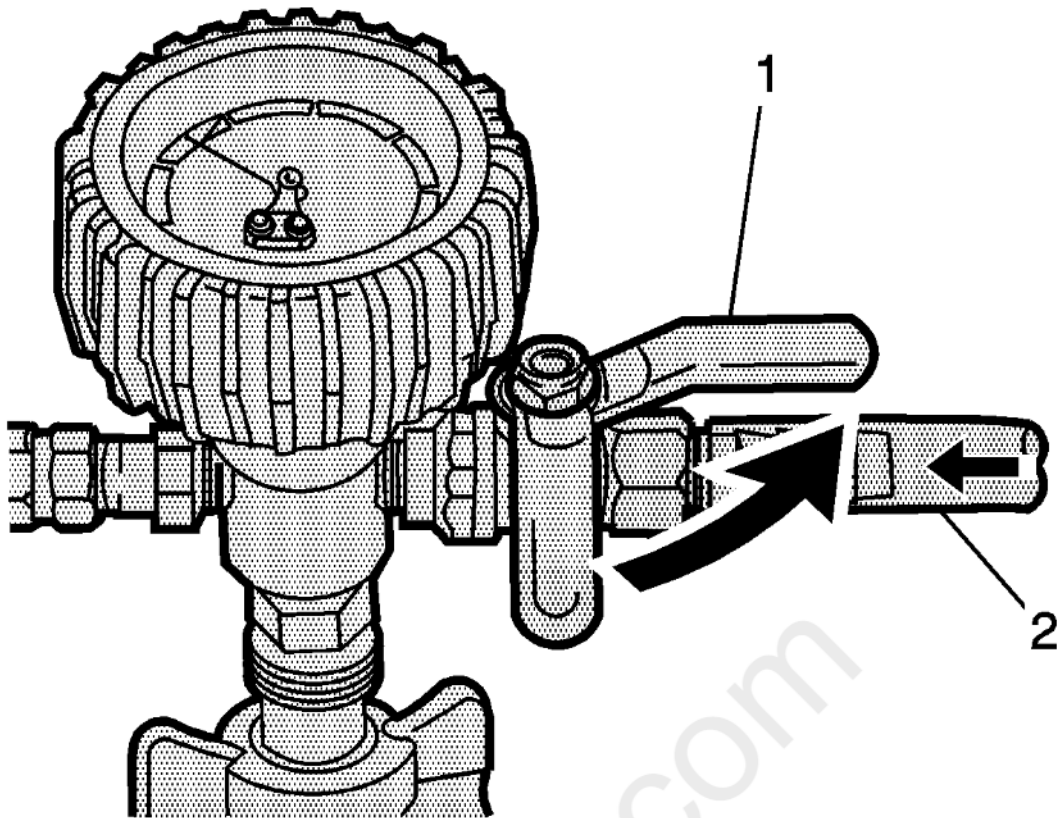


**Fig. 108: Vacuum Gauge Needle**

Courtesy of GENERAL MOTORS COMPANY

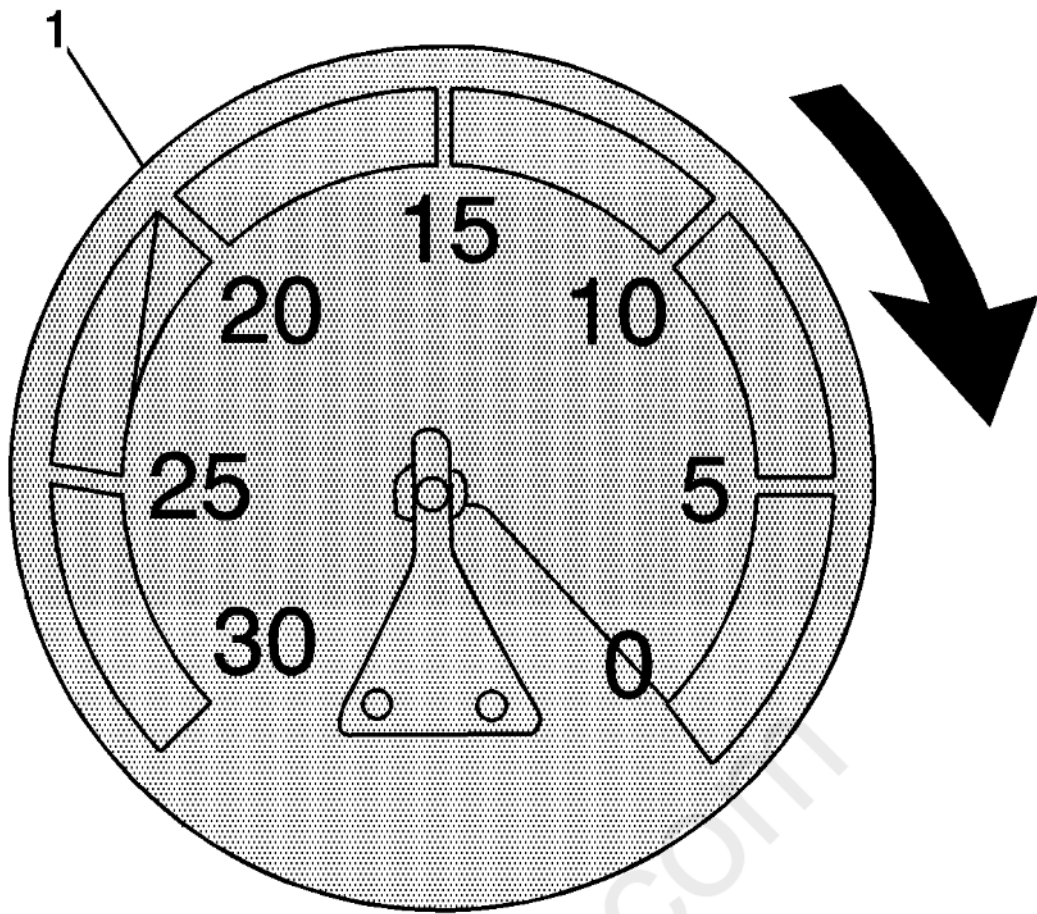
Cooling hoses may start to collapse. This is normal due to vacuum draw.

13. To aid in the fill process, position the graduated reservoir above the coolant fill port.
14. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.



**Fig. 109: Vacuum Gauge Assembly & Needle**  
Courtesy of GENERAL MOTORS COMPANY

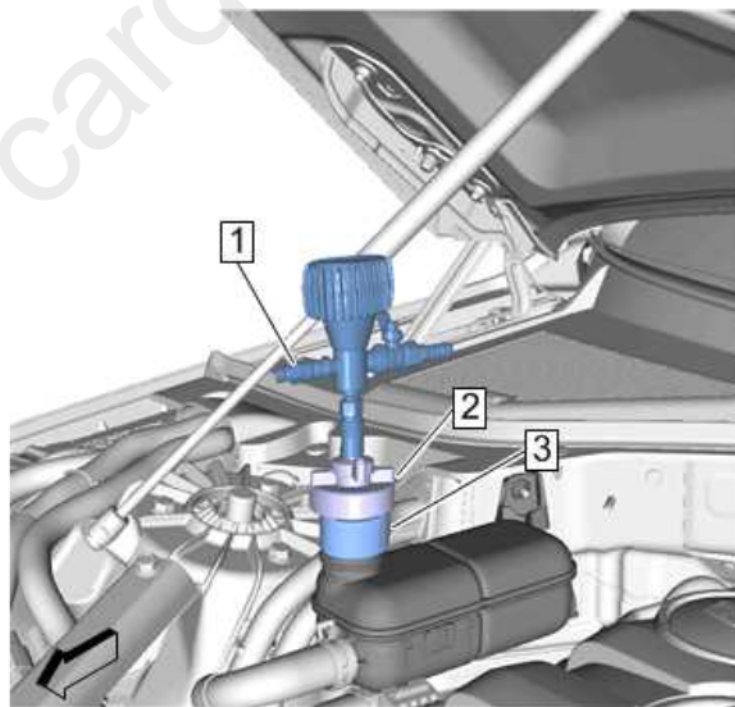
15. Close the valve on the venturi assembly.
16. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.  
  
If vacuum loss is observed, refer to **Power Electronics and Auxiliary Radiator Cooling System Loss of Coolant**.
17. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
18. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly.



**Fig. 110: Vacuum Gauge**

Courtesy of GENERAL MOTORS COMPANY

19. Detach the Vac-N-Fill gauge assembly (1) from Vac N Fill cap (2).



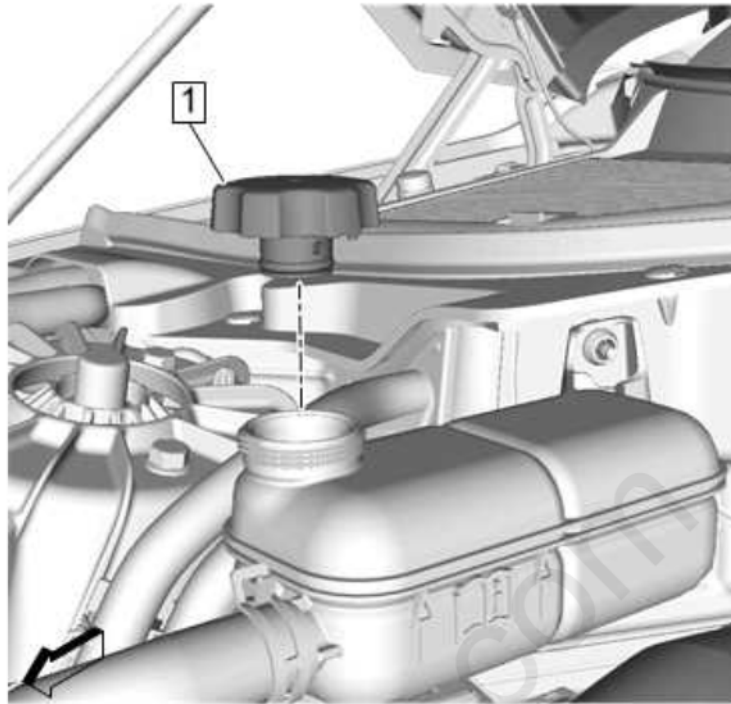
**Fig. 111: Cooling System Adapter**

Courtesy of GENERAL MOTORS COMPANY

20. Remove the Vac N Fill cap (2) from **GE-46143-2** Cooling System Adapter (3)
21. Remove **GE-46143-2** Cooling System Adapter (3) from Generator Control Module Coolant/Air Separator.



22. Enable the high voltage system. Refer to [High Voltage Enabling](#)
23. Start vehicle. Allow Gas Engine to run for at least 1 minute. Inspect Generator Control Module Coolant/Air Separator Coolant Level. Add coolant to Generator Control Module Coolant/Air Separator if needed. If any noise is heard coming from the coolant pump, steps 12-19 of the Vac-N-Fill procedure will need to be repeated.
24. Inspect the cooling system for leaks.
25. Install the cap (1) to the generator control module coolant/air separator.



**Fig. 112: Generator Control Module Coolant/Air Separator Cap**  
Courtesy of GENERAL MOTORS COMPANY

26. Rinse away any excess coolant from the engine and the engine compartment.

### **DRIVE MOTOR BATTERY COOLANT LEVEL SENSOR REPLACEMENT (LTG WITH HP9)**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

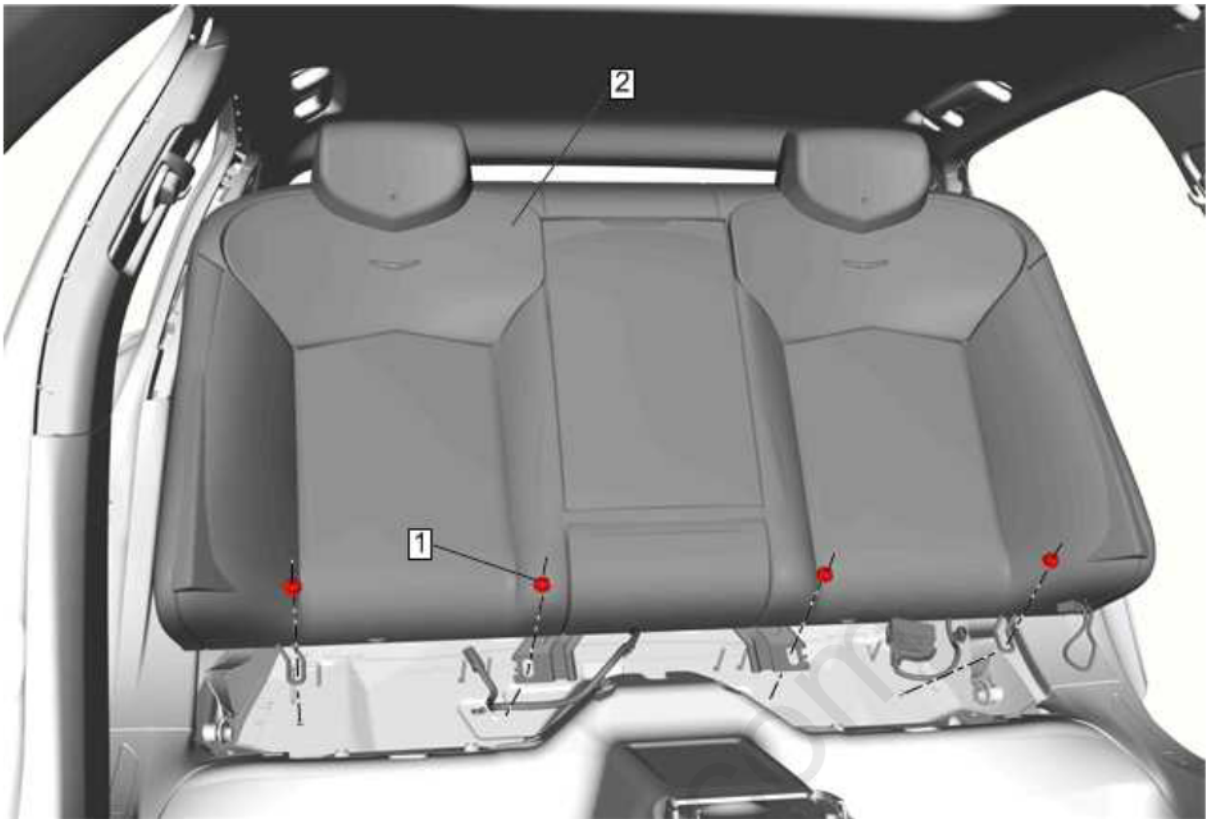
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.



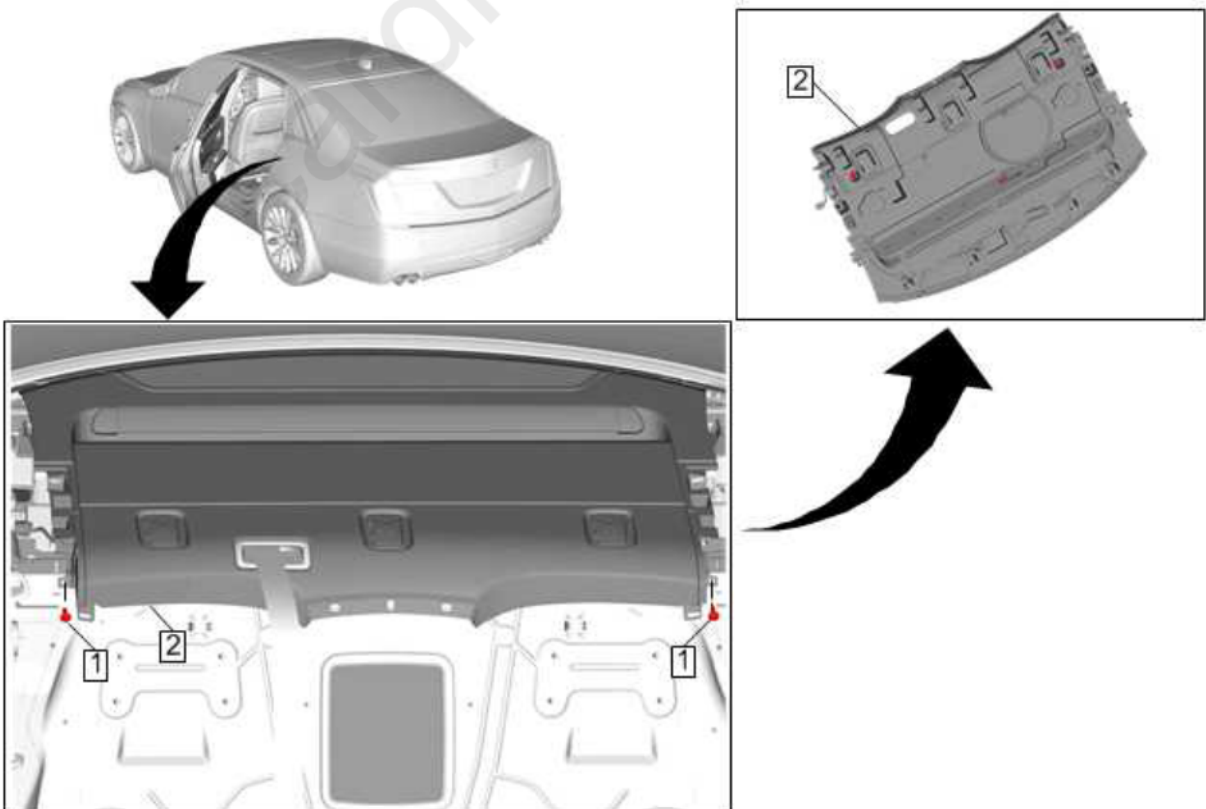
## Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Seat Back Cushion (2)» Remove - [Rear Seat Back Cushion Removal and Installation](#)



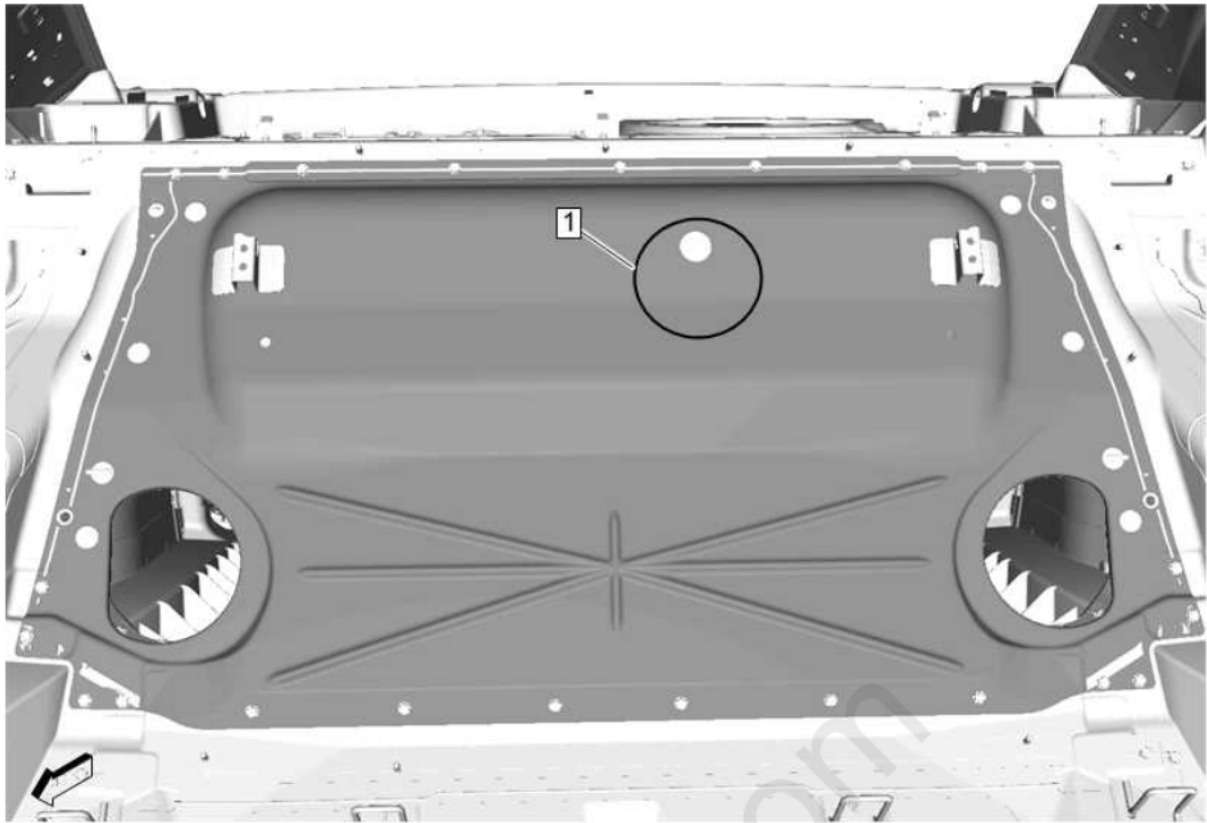
**Fig. 113: Rear Seat Back Cushion (Base)**  
Courtesy of GENERAL MOTORS COMPANY

3. Rear Window Panel Trim (2)» Remove - [Rear Window Panel Trim Replacement](#)



**Fig. 114: Rear Window Panel Trim**  
Courtesy of GENERAL MOTORS COMPANY

4. If this is the first time this procedure has been performed on this vehicle, you will need to cut-out the circle portion scribed in the rear seat back body panel (1).

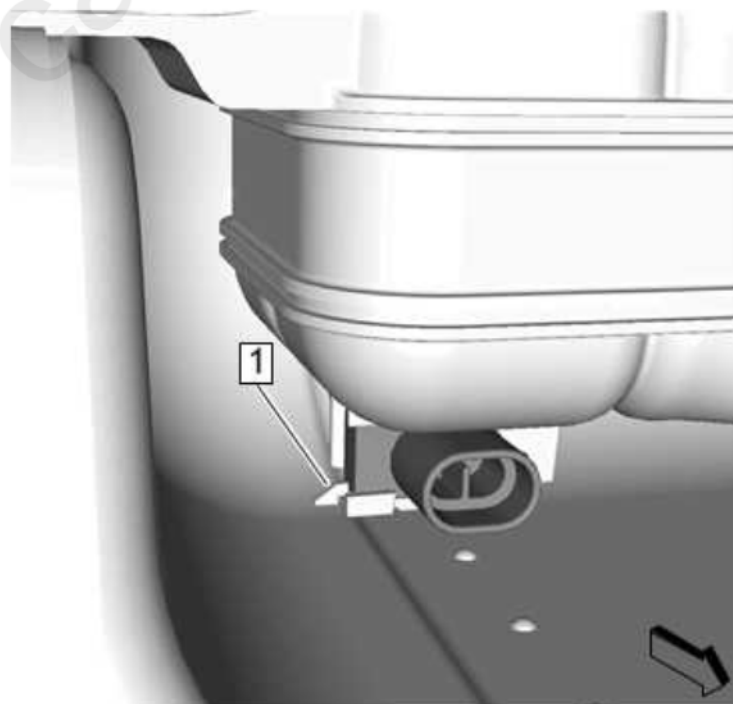


**Fig. 115: Rear Seat Back Body Panel**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** When cutting the service opening in the rear panel use only an air nibbler. Using a different tool can cause damage to underlying components requiring unnecessary replacement of those parts.

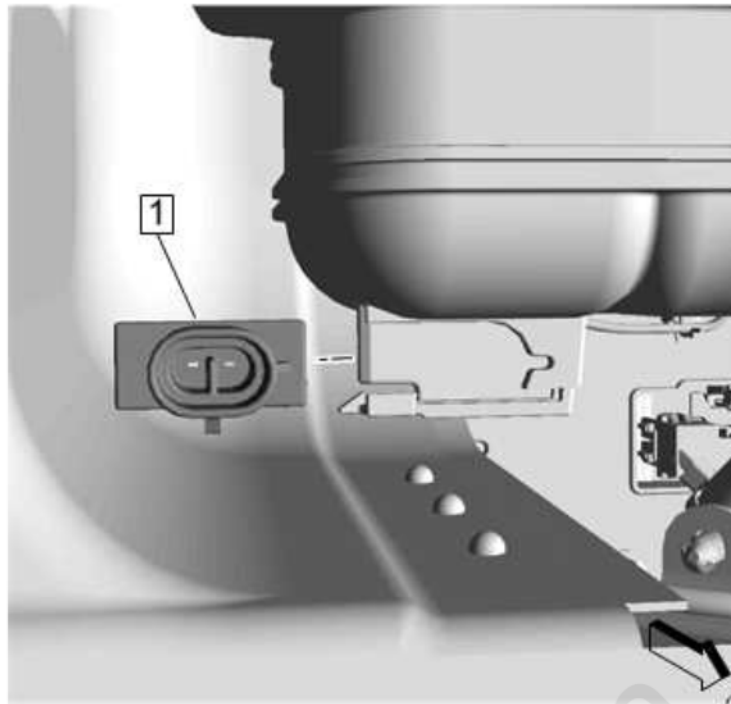
5. Remove all metal shavings from the rear of the vehicle created from cutting the circle portion of the rear seat back body panel.
6. Electrical Connector @ Drive Motor Battery Coolant Level Sensor» Remove
7. Retaining Tab (1)» Disengage



**Fig. 116: Retaining Tab**

Courtesy of GENERAL MOTORS COMPANY

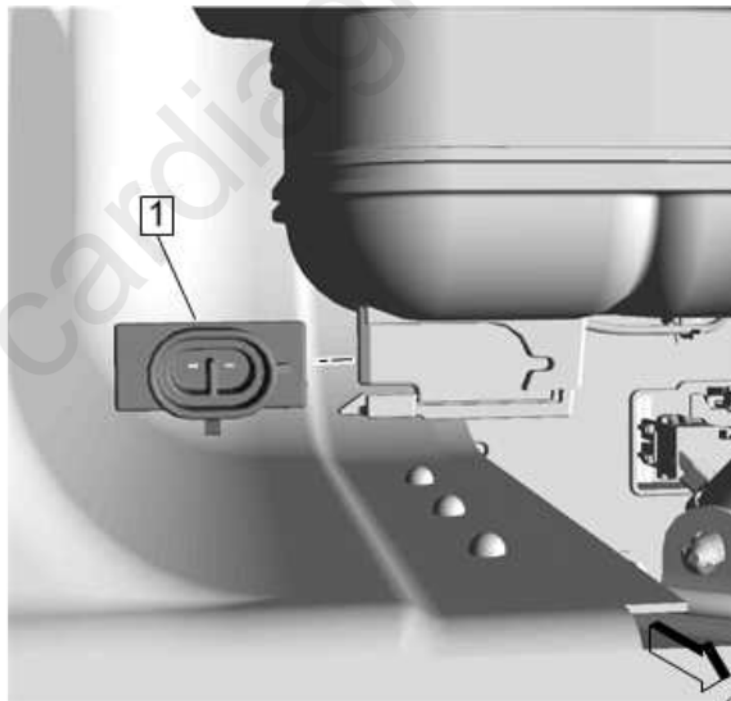
8. Drive Motor Battery Coolant Level Sensor (1) @ Drive Motor Battery Coolant/Air Separator»  
Remove



**Fig. 117: Drive Motor Battery Coolant Level Sensor**  
Courtesy of GENERAL MOTORS COMPANY

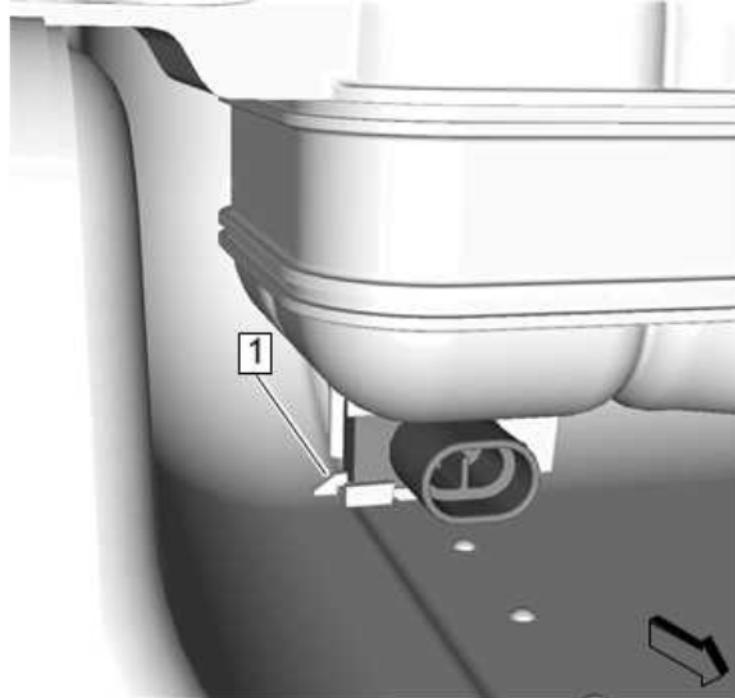
#### Installation Procedure

1. Drive Motor Battery Coolant Level Sensor (1) @ Drive Motor Battery Coolant/Air Separator»  
Install



**Fig. 118: Drive Motor Battery Coolant Level Sensor**  
Courtesy of GENERAL MOTORS COMPANY

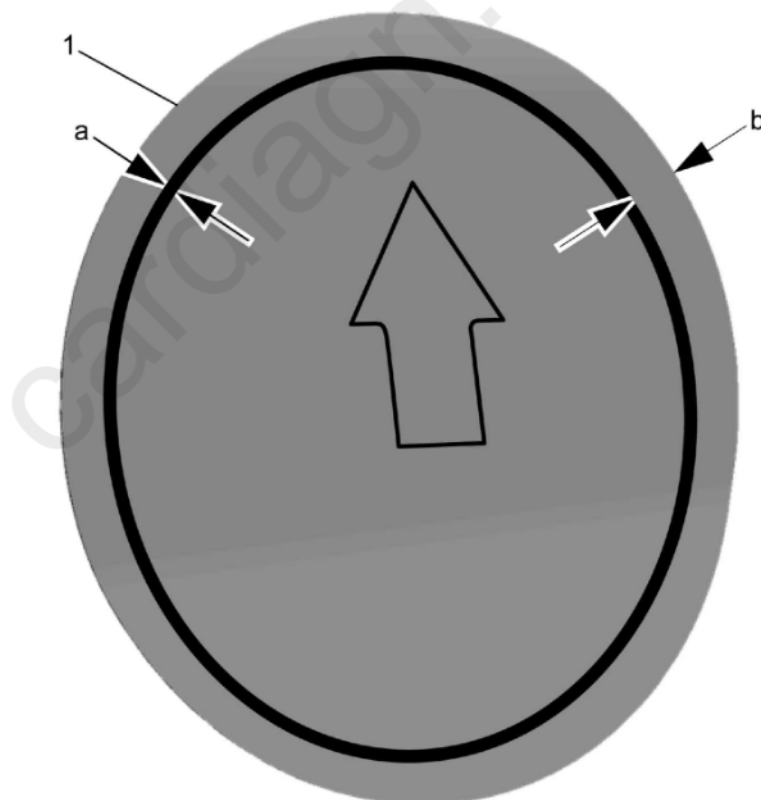
2. Retaining Tab (1)» Engage



**Fig. 119: Retaining Tab**

Courtesy of GENERAL MOTORS COMPANY

3. Electrical Connector @ Drive Motor Battery Coolant Level Sensor» Install
4. Apply a continuous bead 1.6 mm (0.1 in) (A) of a urethane adhesive which meets GM Specification GM 3651G 9 mm (0.4 in) (B) from the outer edge of the rear seat back body panel patch (1).

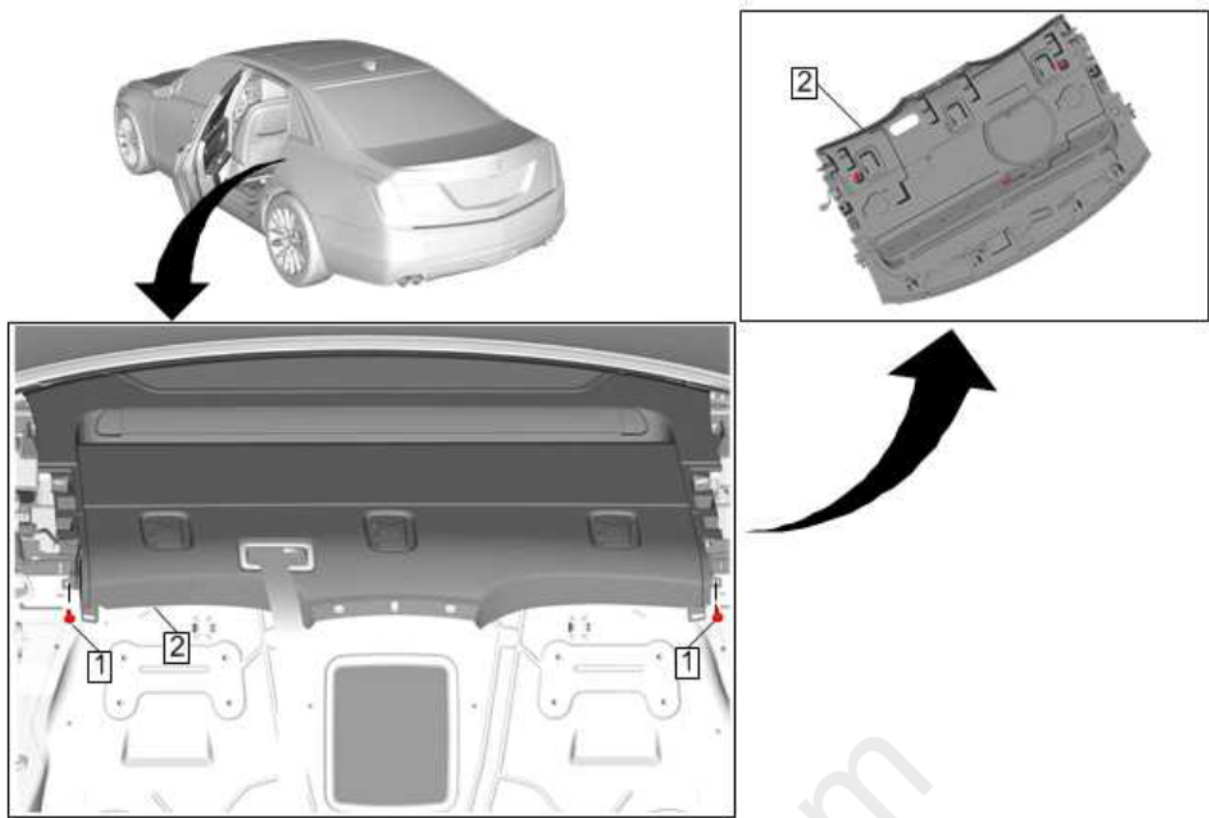


**Fig. 120: Applying Urethane Adhesive**

Courtesy of GENERAL MOTORS COMPANY

See GM Electronics Parts Catalog for Rear Seat Back Body Panel Patch Part Number.

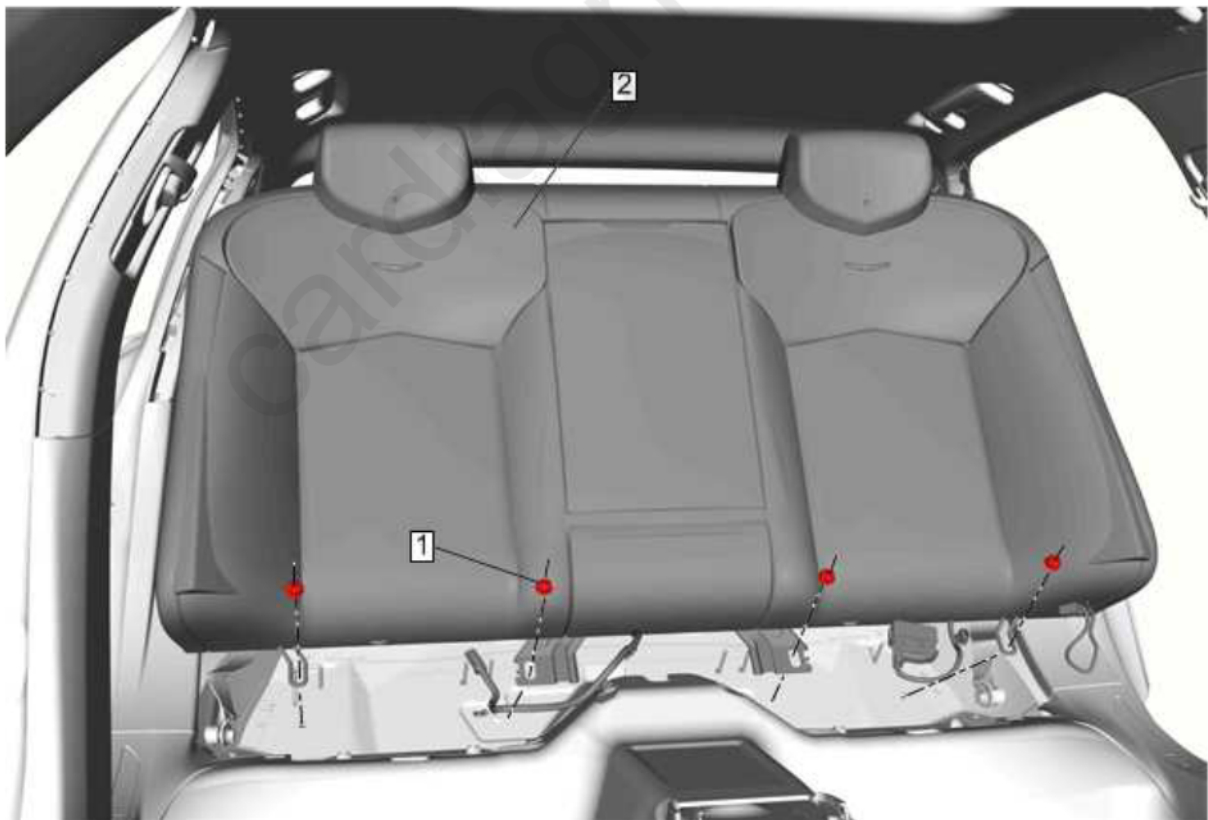
5. Enable the high voltage system. Refer to [High Voltage Enabling](#)
6. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)



**Fig. 121: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

7. Rear Seat Back Cushion (2)» Install - [Rear Seat Back Cushion Removal and Installation](#)



**Fig. 122: Rear Seat Back Cushion (Base)**

Courtesy of GENERAL MOTORS COMPANY

## AUXILIARY RADIATOR REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.



The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

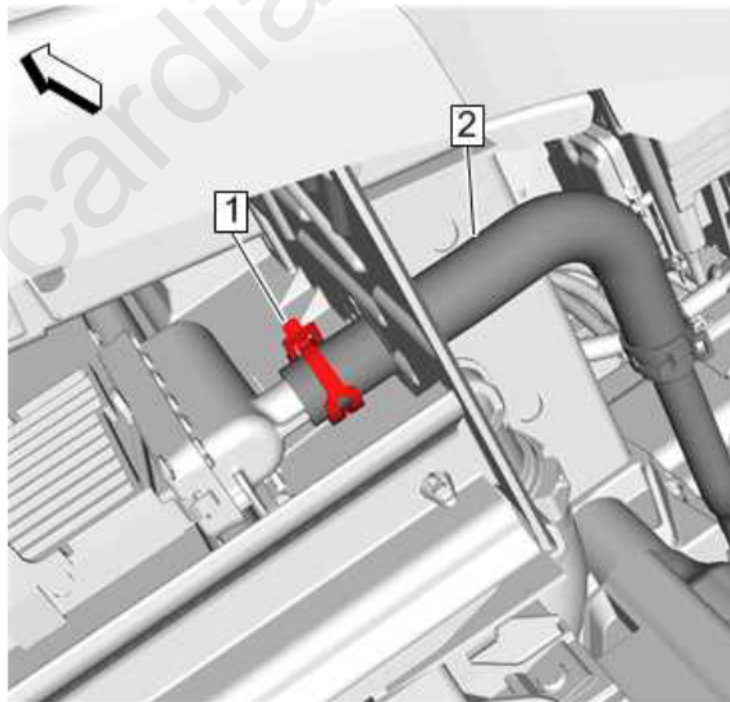
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

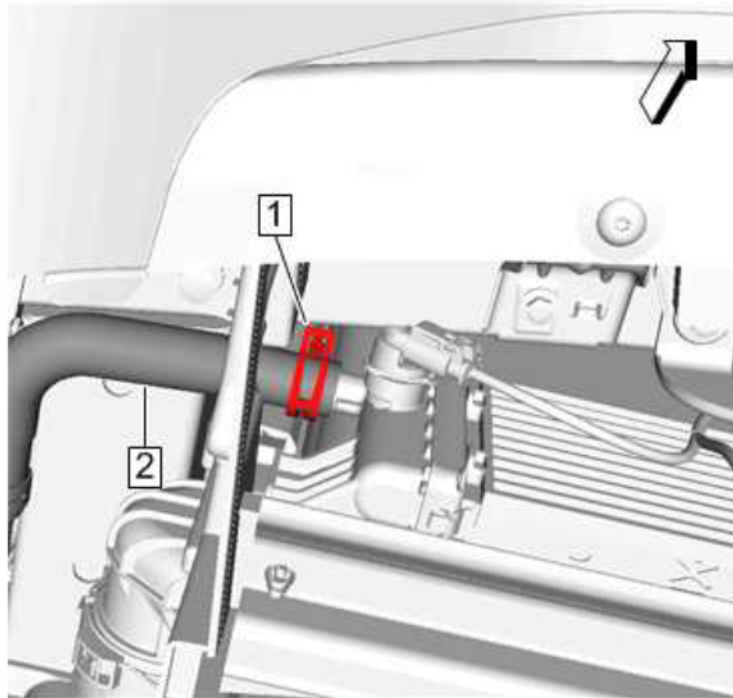
#### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Auxiliary Radiator» Remove - [Drive Motor Generator Control Module Radiator Inlet Hose Replacement](#)



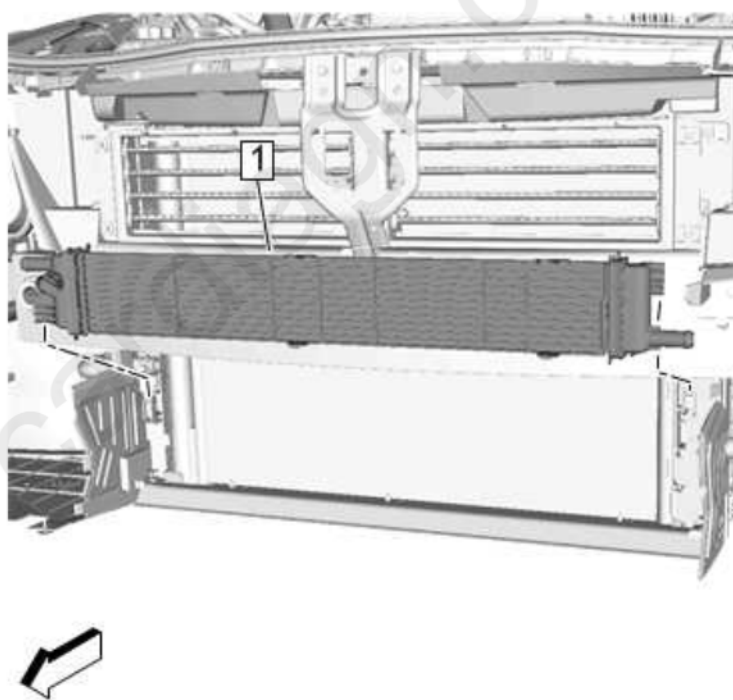
**Fig. 123: Drive Motor Generator Control Module Radiator Inlet Hose Clamp**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Auxiliary Radiator» Remove - [Drive Motor Generator Control Module Radiator Outlet Hose Replacement](#)



**Fig. 124: Drive Motor Generator Control Module Radiator Outlet Hose Clamp**  
**Courtesy of GENERAL MOTORS COMPANY**

5. Engine Coolant Temperature Sensor Electrical Connector» Disconnect
6. Air Conditioning Condenser Bracket Retainer @ Auxiliary Radiator» Disengage
7. Auxiliary Radiator (1) @ Air Conditioning Condenser Bracket» Remove

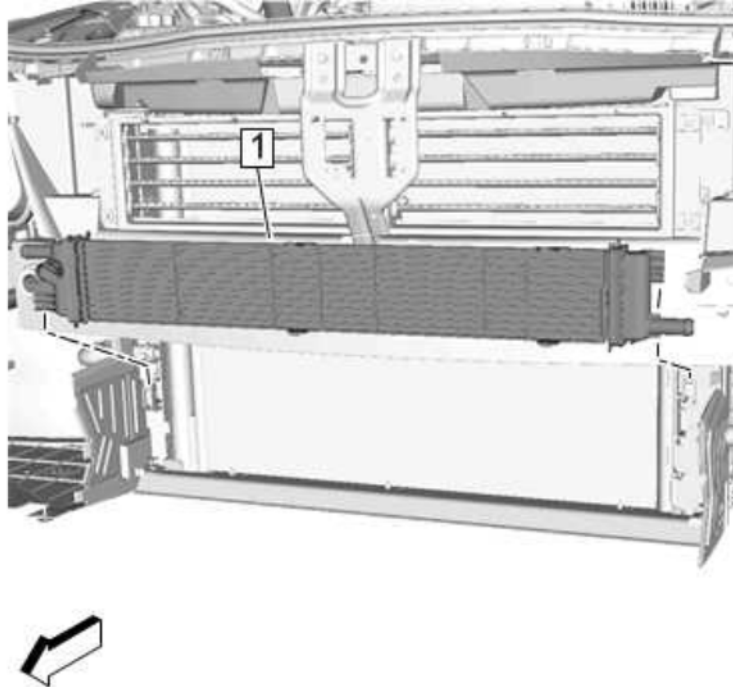


**Fig. 125: Auxiliary Radiator**  
**Courtesy of GENERAL MOTORS COMPANY**

8. Transfer components as necessary.

### **Installation Procedure**

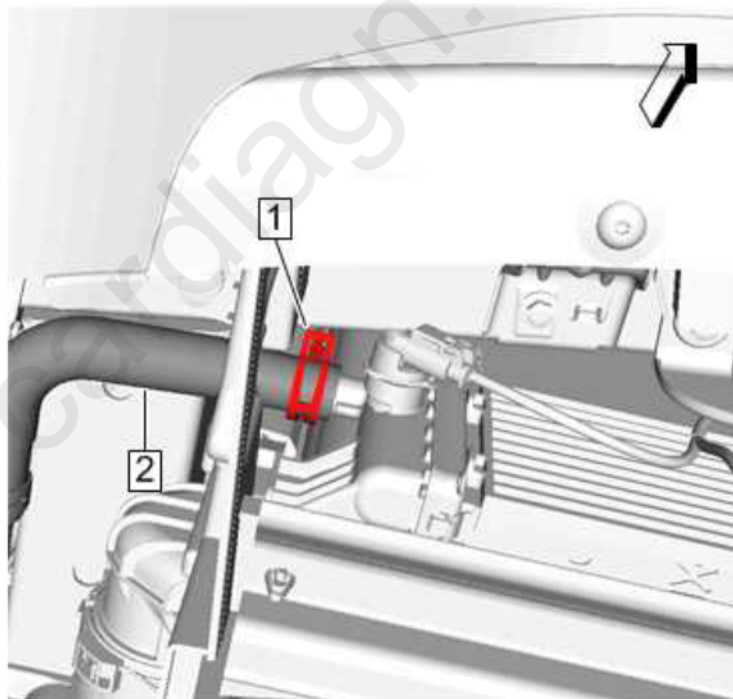
1. Auxiliary Radiator (1) @ Air Conditioning Condenser Bracket» Install



**Fig. 126: Auxiliary Radiator**

Courtesy of GENERAL MOTORS COMPANY

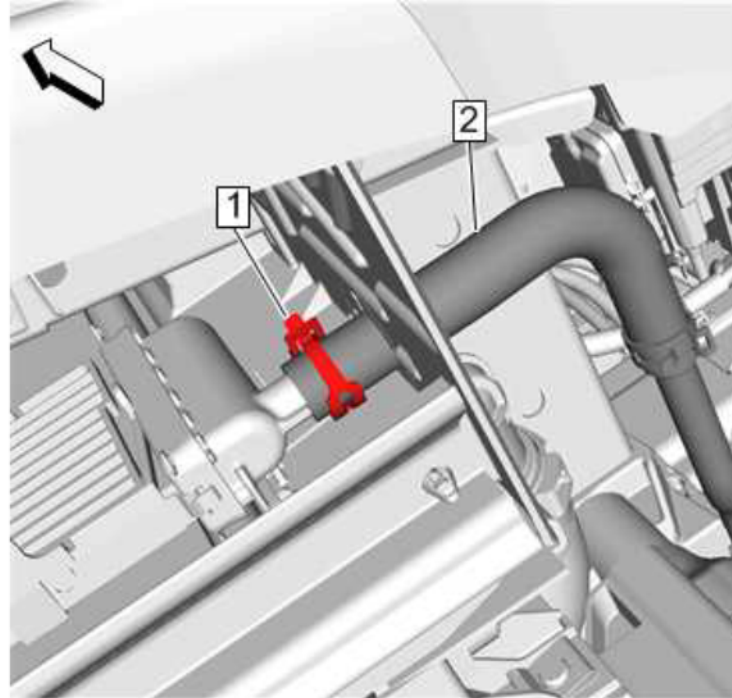
2. Air Conditioning Condenser Bracket Retainer @ Auxiliary Radiator» Engage
3. Engine Coolant Temperature Sensor Electrical Connector» Connect
4. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Auxiliary Radiator» Install  
- **Drive Motor Generator Control Module Radiator Outlet Hose Replacement**



**Fig. 127: Drive Motor Generator Control Module Radiator Outlet Hose Clamp**

Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Auxiliary Radiator» Install -  
**Drive Motor Generator Control Module Radiator Inlet Hose Replacement**



**Fig. 128: Drive Motor Generator Control Module Radiator Inlet Hose Clamp**  
Courtesy of GENERAL MOTORS COMPANY

6. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)
8. Start the engine and check for coolant leaks.

## **GENERATOR CONTROL MODULE COOLANT TANK HOSE REPLACEMENT**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

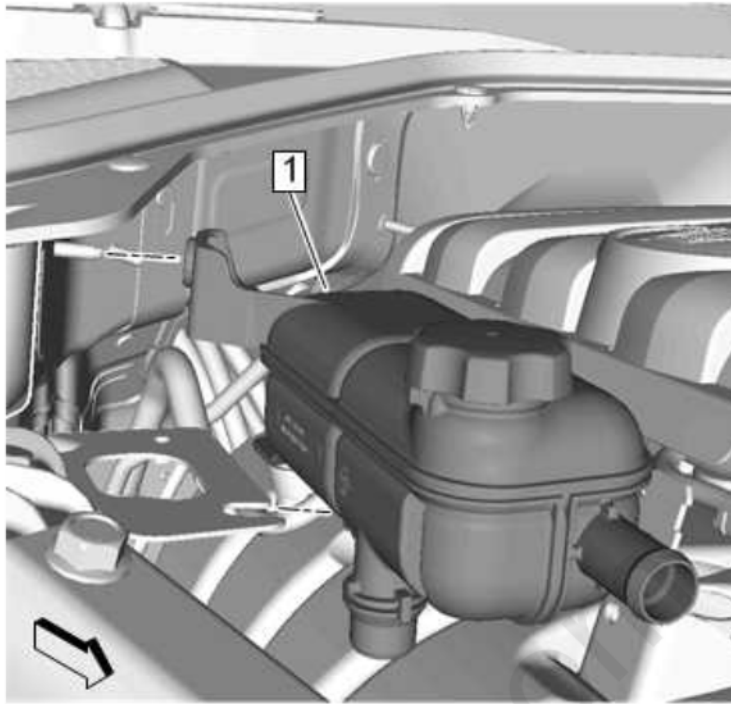
Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

## **Removal Procedure**

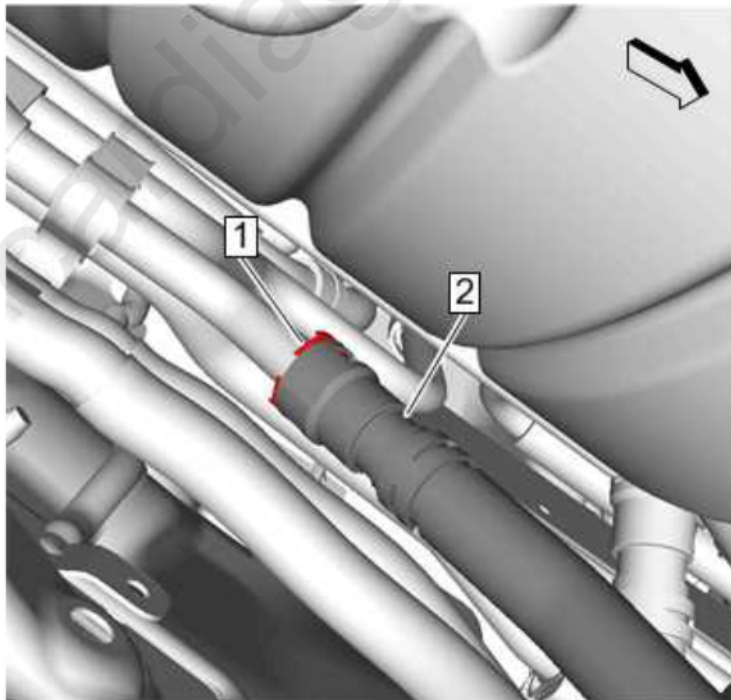


1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Generator Control Module Coolant/Air Separator (1)» Remove - [Generator Control Module Coolant/Air Separator Replacement](#)



**Fig. 129: Generator Control Module Coolant/Air Separator**  
Courtesy of GENERAL MOTORS COMPANY

4. Generator Control Module Coolant Tank Hose Retainer (1) @ Generator Control Module Coolant Tank Hose (2)» Disengage



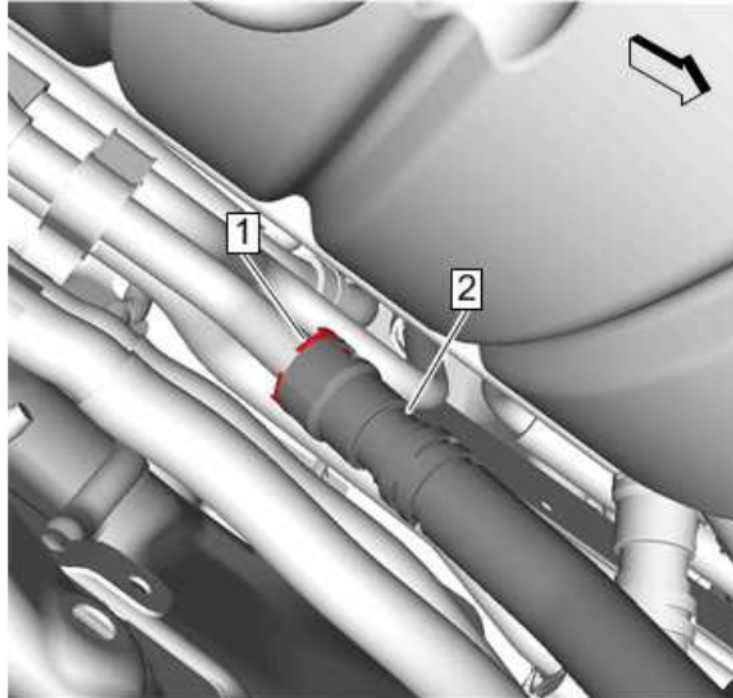
**Fig. 130: Generator Control Module Coolant Tank Hose**  
Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Tank Hose (2) @ Heater Inlet Pipe Connector» Remove
6. Generator Control Module Coolant Tank Hose (2)» Remove

### **Installation Procedure**

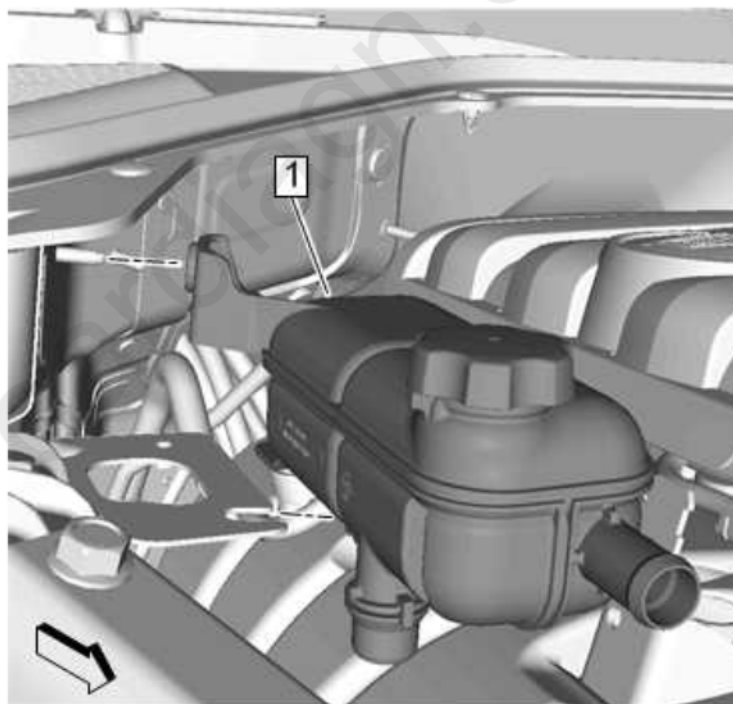
1. Generator Control Module Coolant Tank Hose (2) @ Heater Inlet Pipe Connector» Install





**Fig. 131: Generator Control Module Coolant Tank Hose**  
 Courtesy of GENERAL MOTORS COMPANY

2. Generator Control Module Coolant Tank Hose Retainer (1) @ Generator Control Module Coolant Tank Hose (2) » Engage
3. Generator Control Module Coolant/Air Separator (1) » Install - [Generator Control Module Coolant/Air Separator Replacement](#)



**Fig. 132: Generator Control Module Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

4. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
5. Enable the high voltage system. Refer to [High Voltage Enabling](#)
6. Start the engine and check for coolant leaks.

## **ENGINE COOLANT AIR BLEED HOSE REPLACEMENT**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

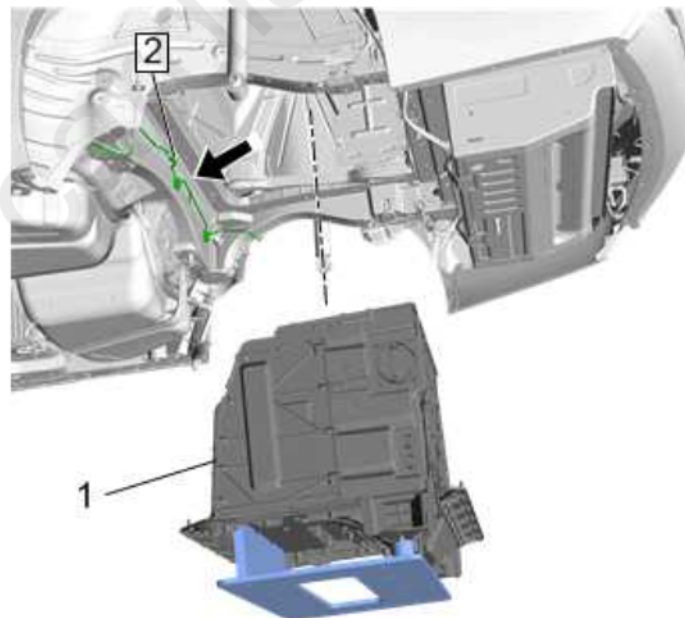
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

#### Removal Procedure

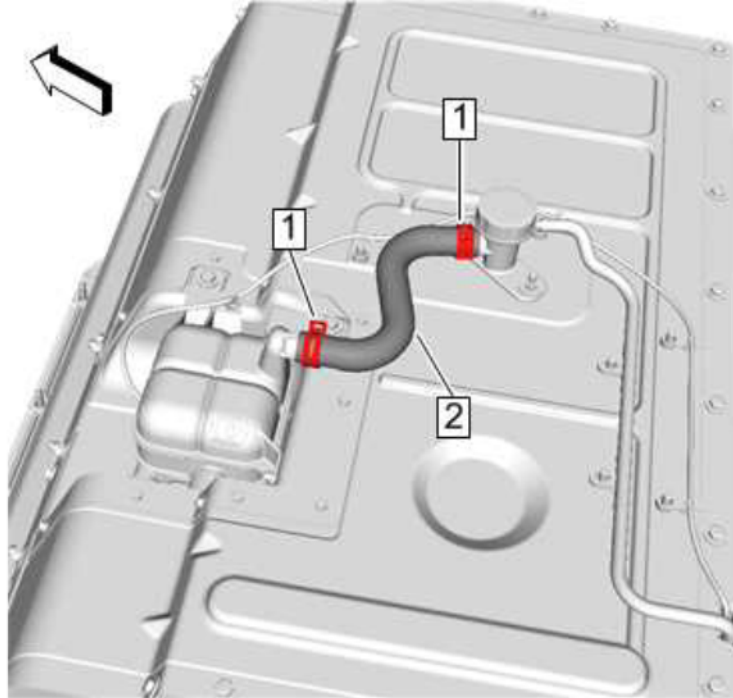
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. High Voltage Battery (1)» Remove - [High Voltage Battery Replacement and Shipping Preparation](#)



**Fig. 133: High Voltage Battery**

Courtesy of GENERAL MOTORS COMPANY

4. Engine Coolant Air Bleed Hose Clamp (1)» Disengage [2x] [Hose Clamp Replacement Guidelines - Spring Type](#)

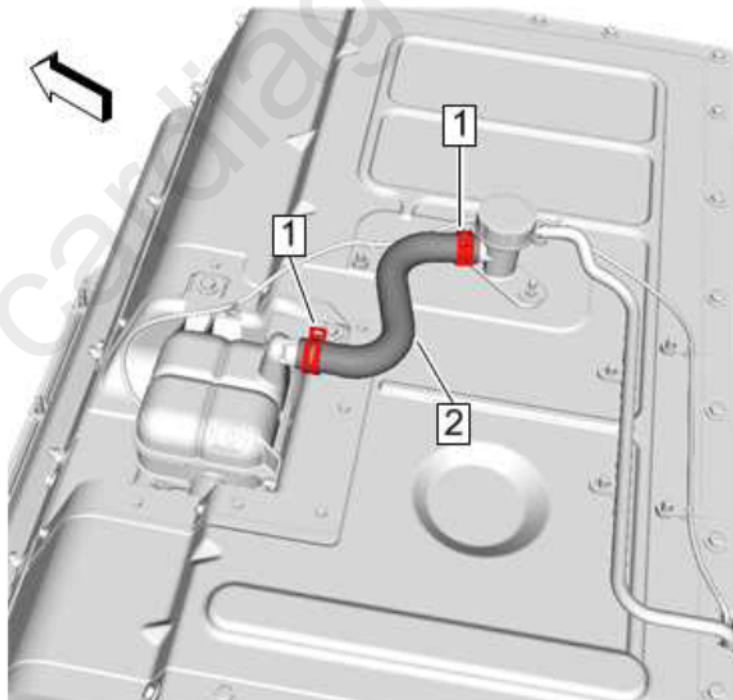


**Fig. 134: Engine Coolant Air Bleed Hose And Clamps**  
**Courtesy of GENERAL MOTORS COMPANY**

5. Engine Coolant Air Bleed Hose (2) @ Water Inlet» Remove
6. Engine Coolant Air Bleed Hose (2) @ Drive Motor Battery Coolant/Air Separator» Remove
7. Engine Coolant Air Bleed Hose (2)» Remove

#### **Installation Procedure**

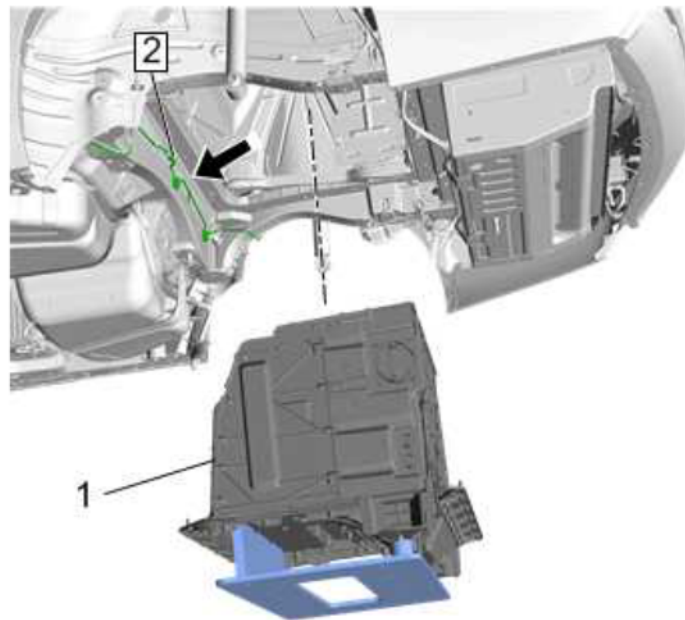
1. Engine Coolant Air Bleed Hose (2) @ Drive Motor Battery Coolant/Air Separator» Install



**Fig. 135: Engine Coolant Air Bleed Hose And Clamps**  
**Courtesy of GENERAL MOTORS COMPANY**

2. Engine Coolant Air Bleed Hose (2) @ Water Inlet» Install
3. Engine Coolant Air Bleed Hose Clamp (1)» Engage [2x] - **Hose Clamp Replacement Guidelines - Spring Type**
4. Prior to installing the high voltage battery perform the off vehicle high voltage battery leak test. Refer to **High Voltage Battery Leak Testing**

5. High Voltage Battery (1)A» Install - [High Voltage Battery Replacement and Shipping Preparation](#)



**Fig. 136: High Voltage Battery**

Courtesy of GENERAL MOTORS COMPANY

6. Fill the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)
8. Start the engine and check for coolant leaks.

## WATER INLET REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

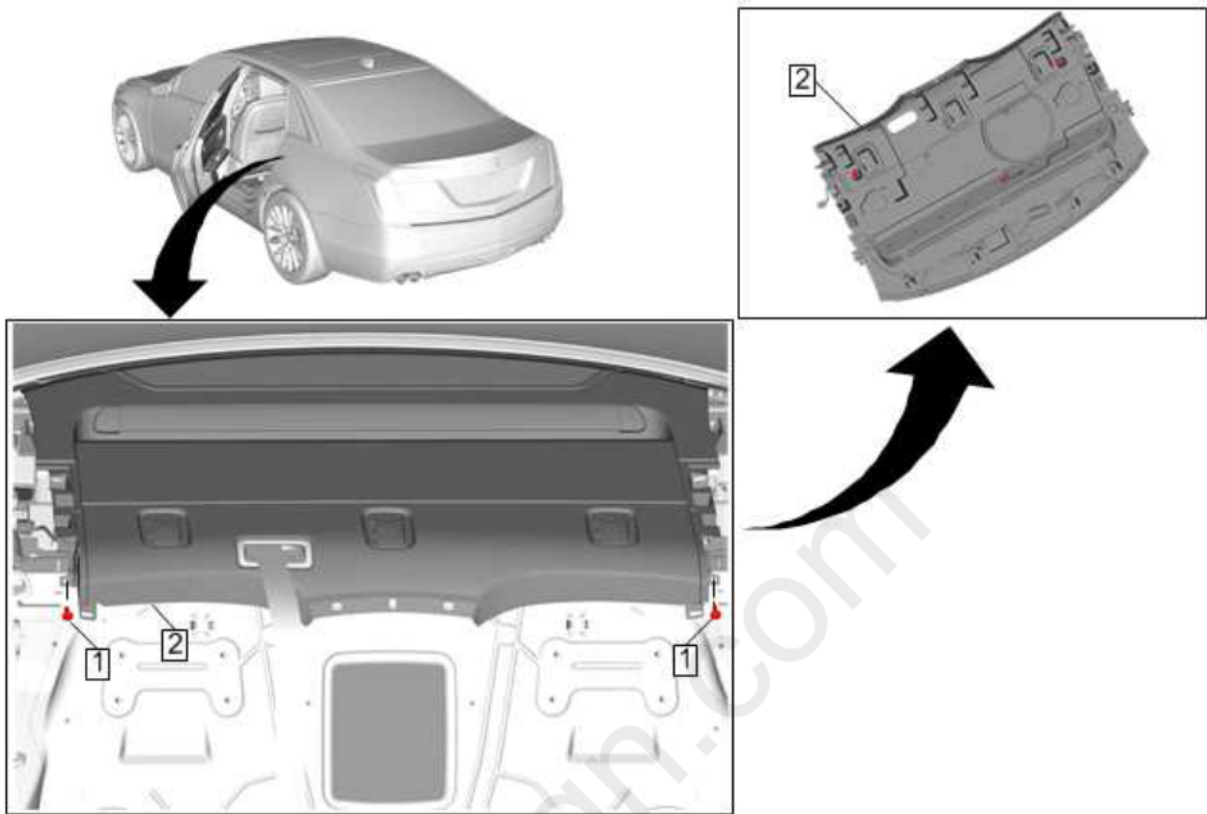
Failure to follow the procedures may result in serious injury or death.



**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

### Removal Procedure

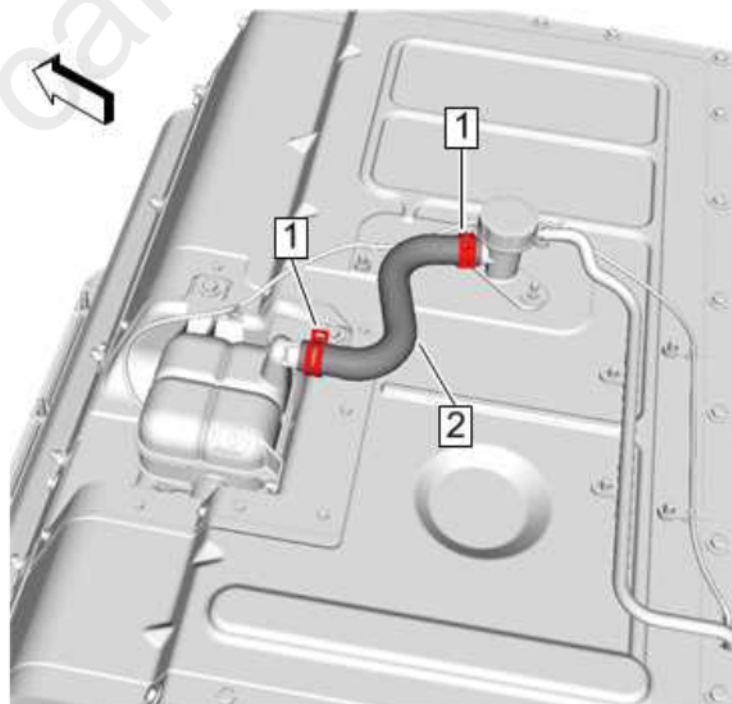
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Window Panel Trim (2) » Remove - [Rear Window Panel Trim Replacement](#)



**Fig. 137: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

3. Engine Coolant Air Bleed Hose (2) @ Water Inlet » Remove - [Engine Coolant Air Bleed Hose Replacement](#)

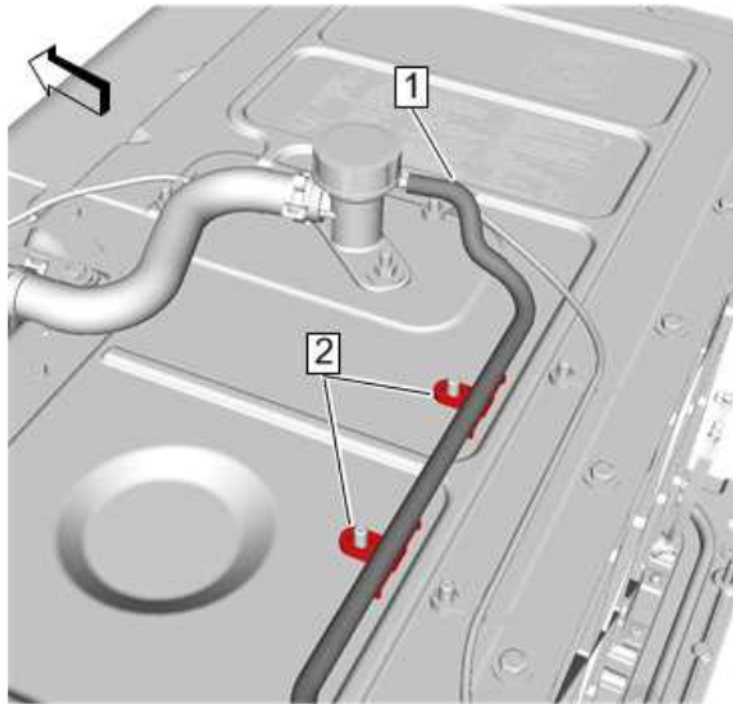


**Fig. 138: Engine Coolant Air Bleed Hose And Clamps**

Courtesy of GENERAL MOTORS COMPANY

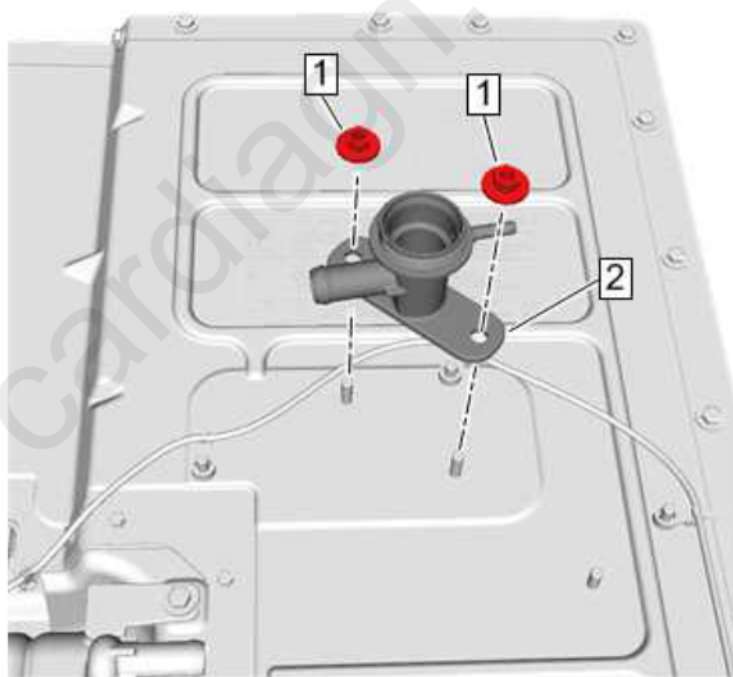


4. Heater Vent Hose (1) @ Water Inlet» Remove - **Heater Vent Hose Replacement (Without Quick Connect)****Heater Vent Hose Replacement (With Quick Connect)**



**Fig. 139: Heater Vent Hose And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

5. Water Inlet Nut (1) @ Water Inlet» Remove [2x]

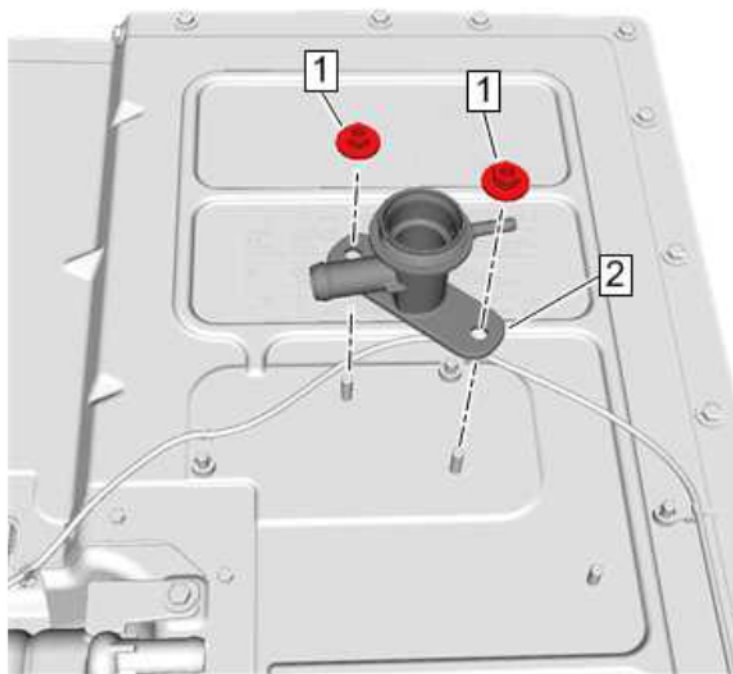


**Fig. 140: Water Inlet Nuts**  
Courtesy of GENERAL MOTORS COMPANY

6. Water Inlet (2) @ High Voltage Battery Cover» Remove  
7. Water Inlet (2)» Remove

#### **Installation Procedure**

1. Water Inlet (2) @ High Voltage Battery Cover» Install



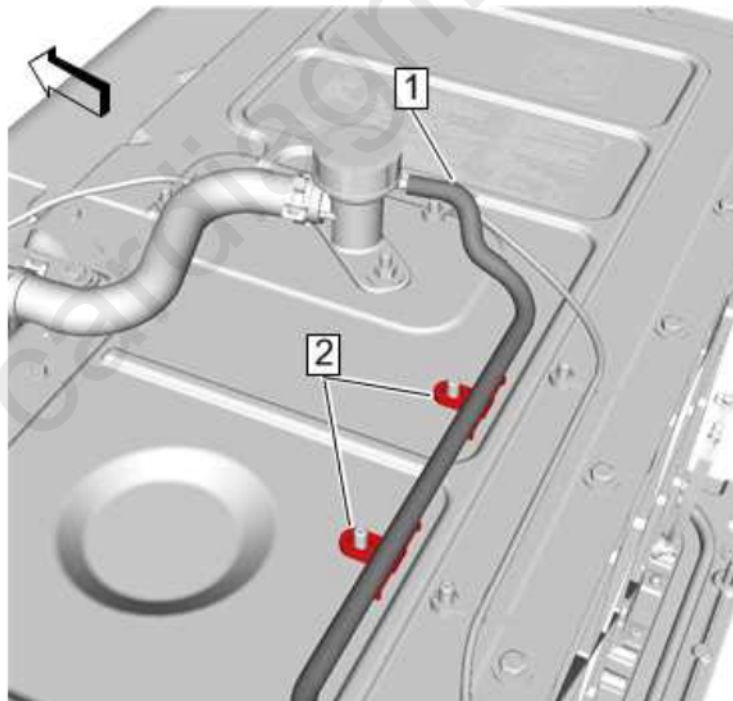
**Fig. 141: Water Inlet Nuts**

Courtesy of GENERAL MOTORS COMPANY

2. Water Inlet Nut (1) @ Water Inlet» Install and tighten [2x] 9 N.m (80 lb in)

**CAUTION:** Refer to [Fastener Caution](#) .

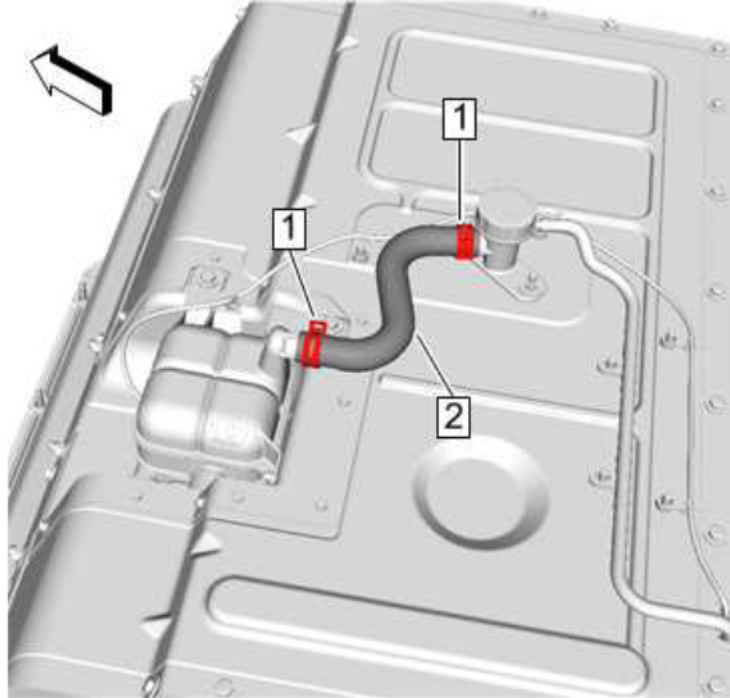
3. Heater Vent Hose (1) @ Water Inlet» Install



**Fig. 142: Heater Vent Hose And Retainers**

Courtesy of GENERAL MOTORS COMPANY

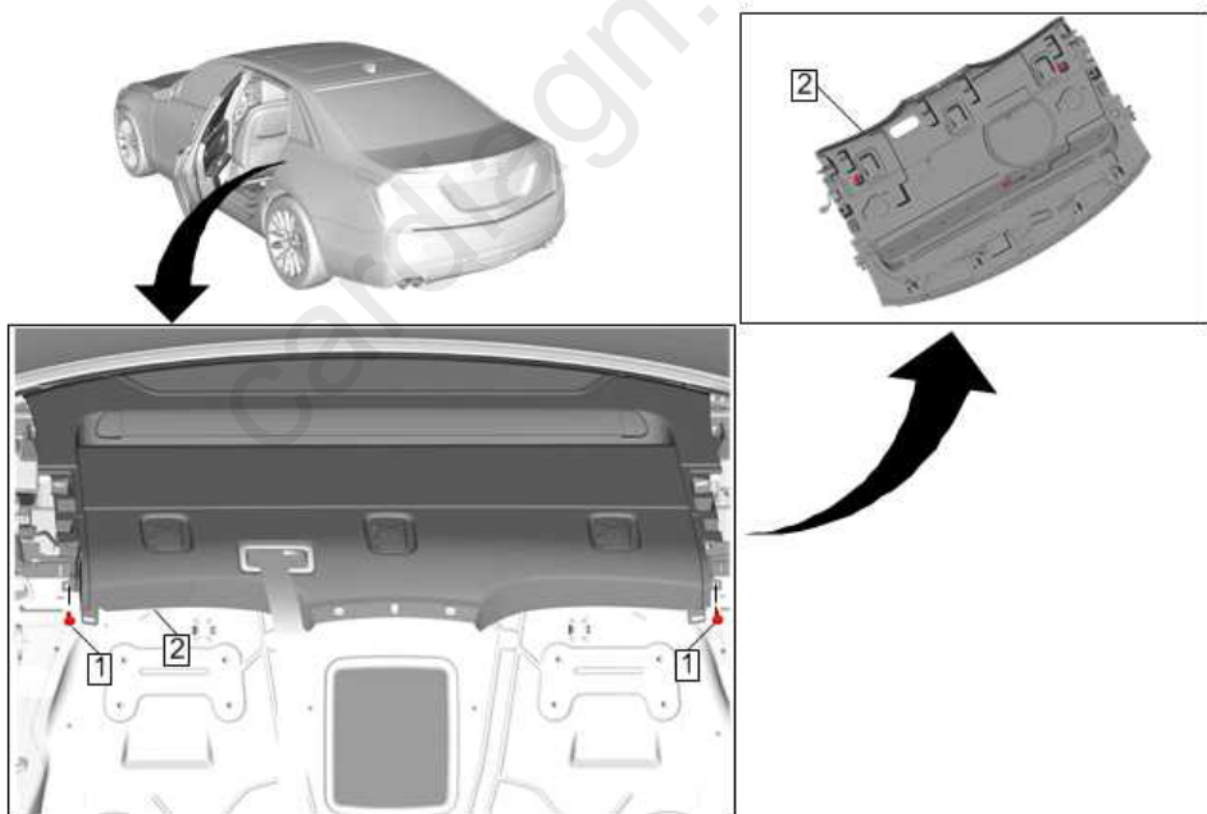
4. Engine Coolant Air Bleed Hose (2) @ Water Inlet» Install - [Engine Coolant Air Bleed Hose Replacement](#)



**Fig. 143: Engine Coolant Air Bleed Hose And Clamps**

Courtesy of GENERAL MOTORS COMPANY

5. Inspect the high voltage battery coolant level. Refer to [High Voltage Battery Coolant Level Inspection](#)
6. Rear Window Panel Trim (2)» Install - [Rear Window Panel Trim Replacement](#)

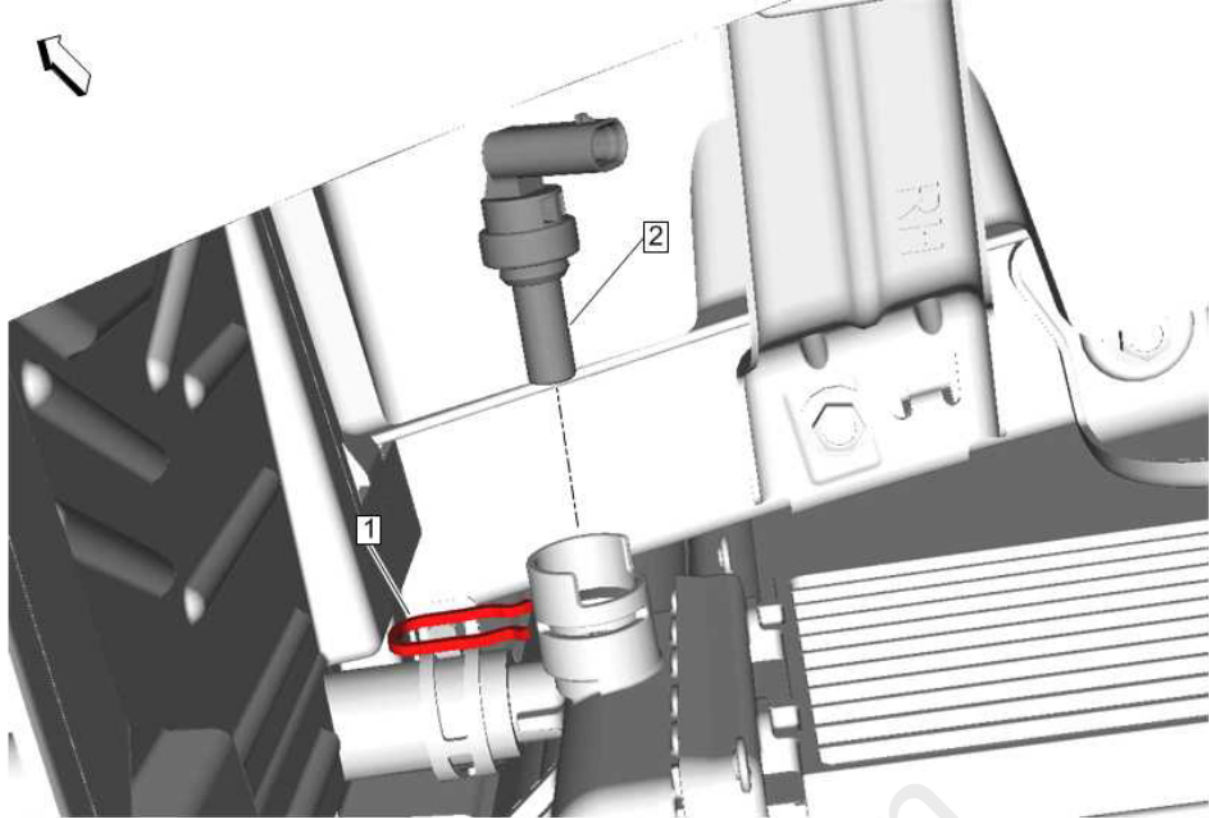


**Fig. 144: Rear Window Panel Trim**

Courtesy of GENERAL MOTORS COMPANY

7. Enable the high voltage system. Refer to [High Voltage Enabling](#)
8. Start the engine and check for coolant leaks.

## **ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - RADIATOR SIDE**



**Fig. 145: Engine Coolant Temperature Sensor - Radiator Side**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>3. <a href="#">Front Bumper Fascia Lower Stiffener Replacement</a></li> <li>4. Disconnect the electrical connector.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Engine Coolant Temperature Sensor Retainer                                                                                                                                                                                                                                                                                                                                                                                              |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>Engine Coolant Temperature Sensor</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

## DRIVE MOTOR GENERATOR CONTROL MODULE COOLANT PUMP HOSE REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.



- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

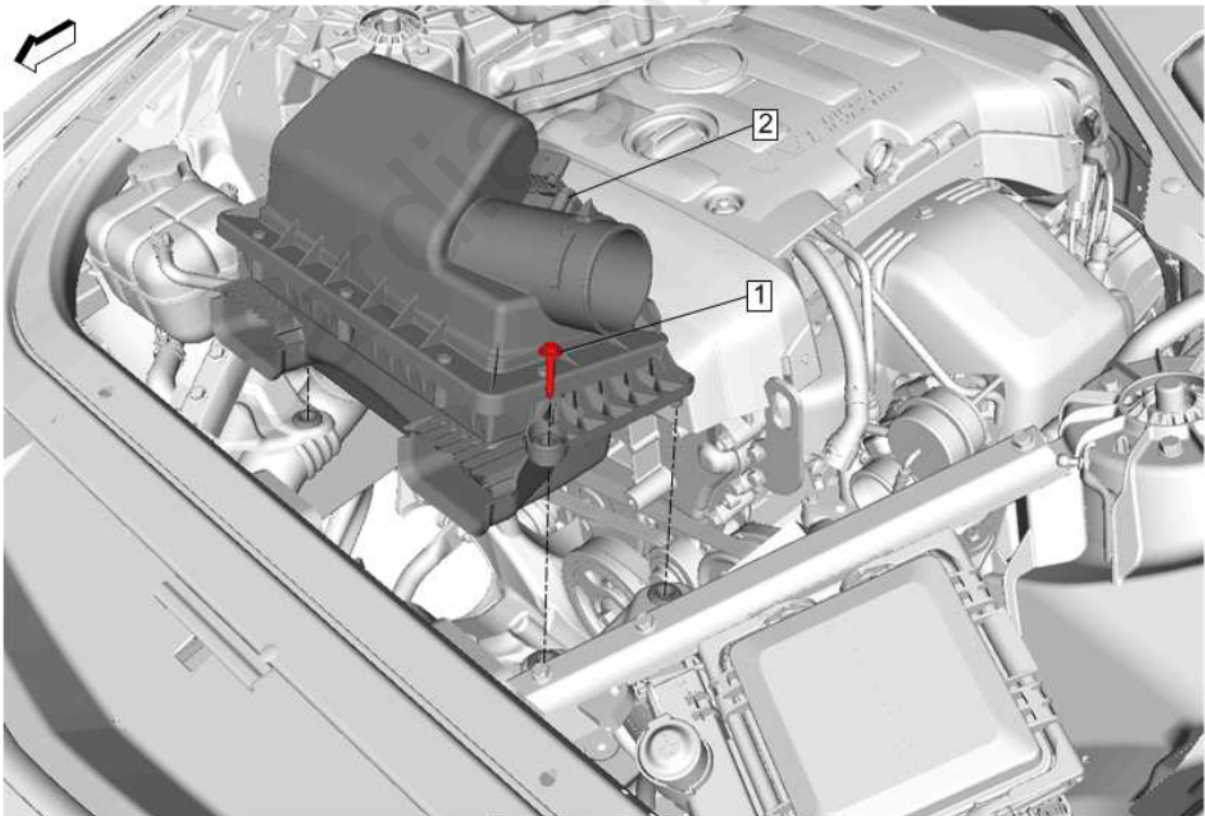
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

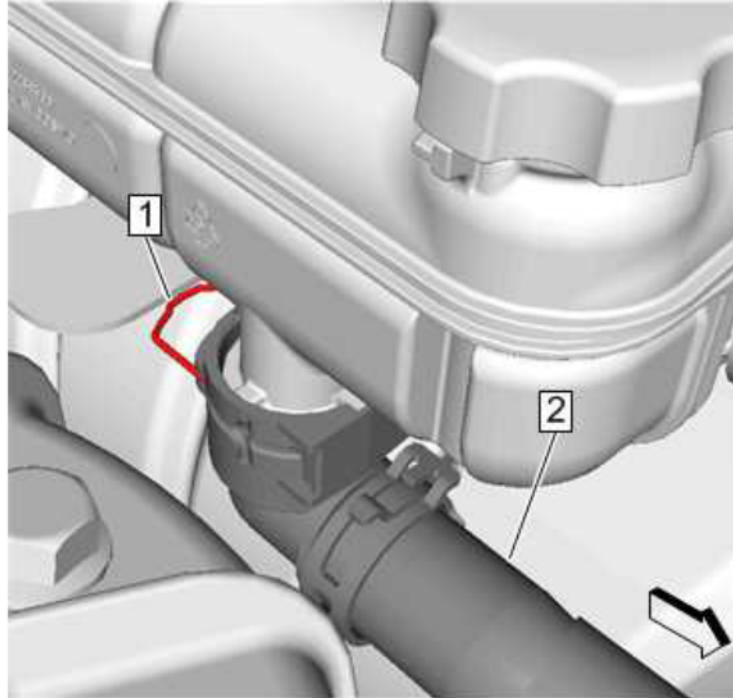
#### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Air Cleaner Assembly (2)» Remove - [Air Cleaner Assembly Replacement](#)



**Fig. 146: Air Cleaner Assembly**  
Courtesy of GENERAL MOTORS COMPANY

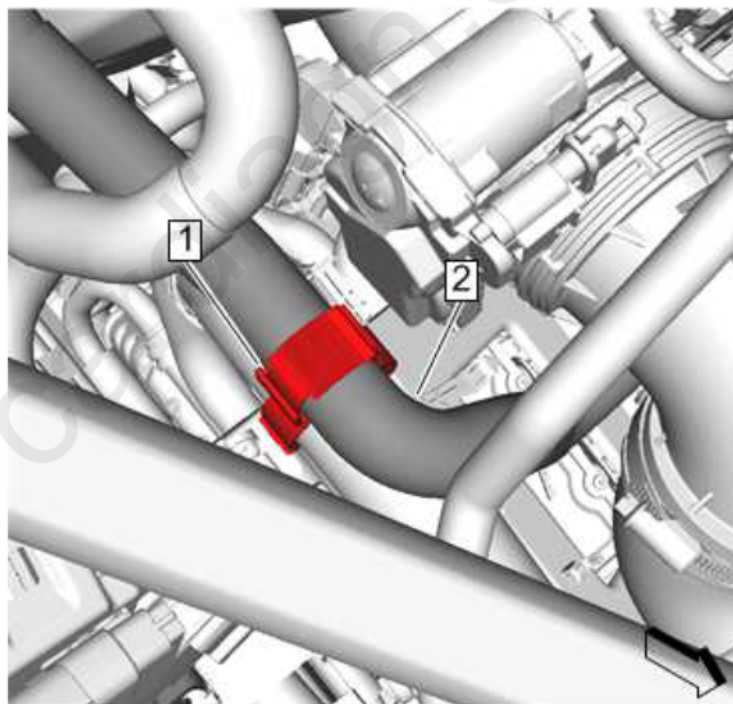
4. Retainer (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Disengage



**Fig. 147: Retainer**

Courtesy of GENERAL MOTORS COMPANY

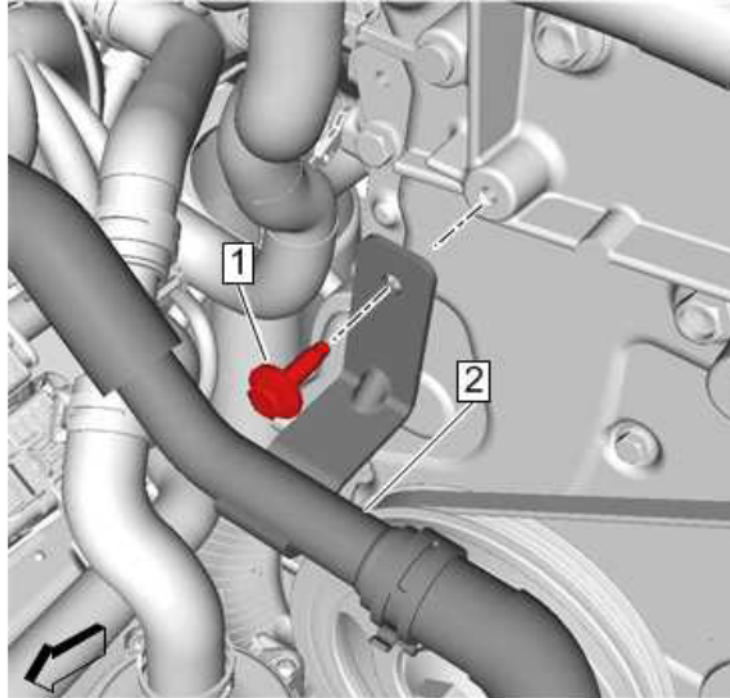
5. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant/Air Separator» Remove
6. Radiator Inlet Hose Clip (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Remove



**Fig. 148: Radiator Inlet Hose Clip**

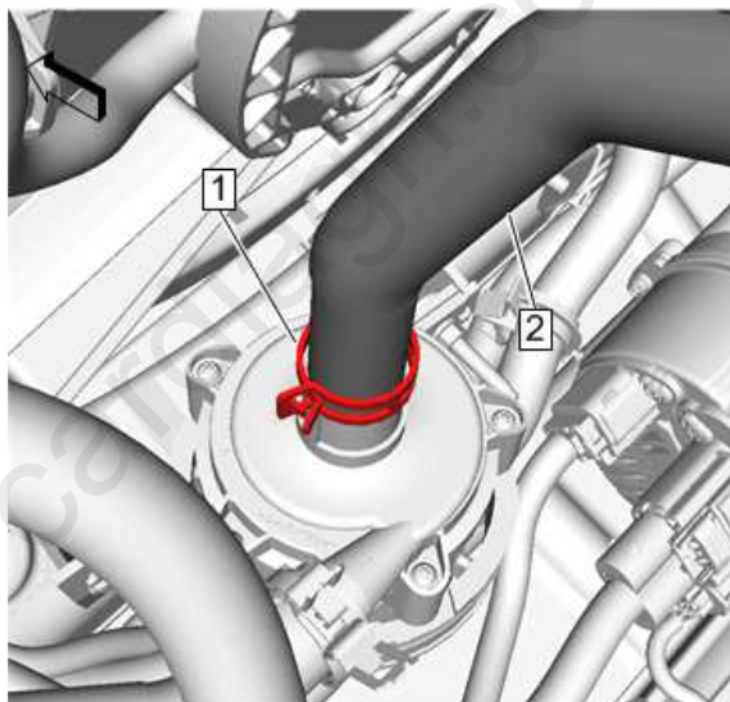
Courtesy of GENERAL MOTORS COMPANY

7. Drive Motor Generator Control Module Coolant Pump Hose Bolt (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Remove



**Fig. 149: Drive Motor Generator Control Module Coolant Pump Hose**  
 Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Generator Control Module Coolant Pump Hose Clamp (1)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**



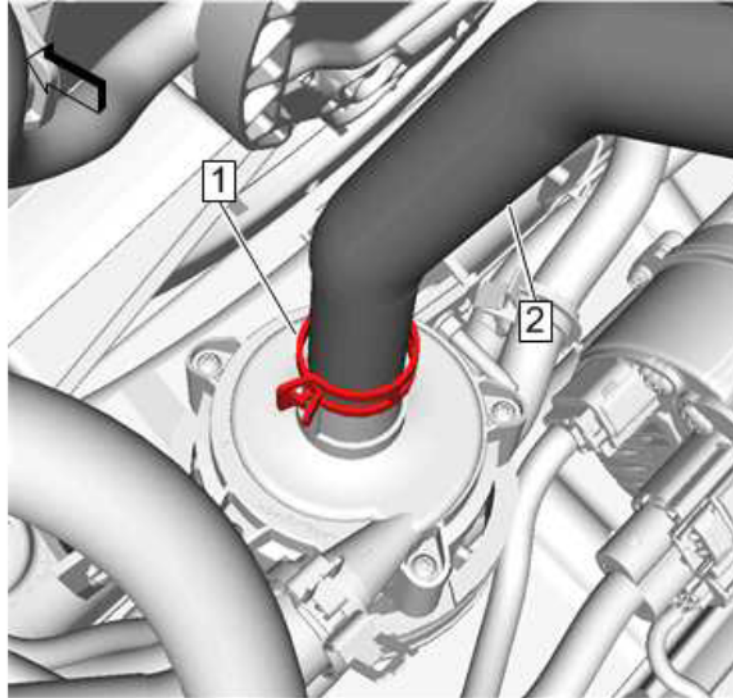
**Fig. 150: Drive Motor Generator Control Module Coolant Pump Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

9. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant Pump» Remove
10. Drive Motor Generator Control Module Coolant Pump Hose (2)» Remove

#### **Installation Procedure**

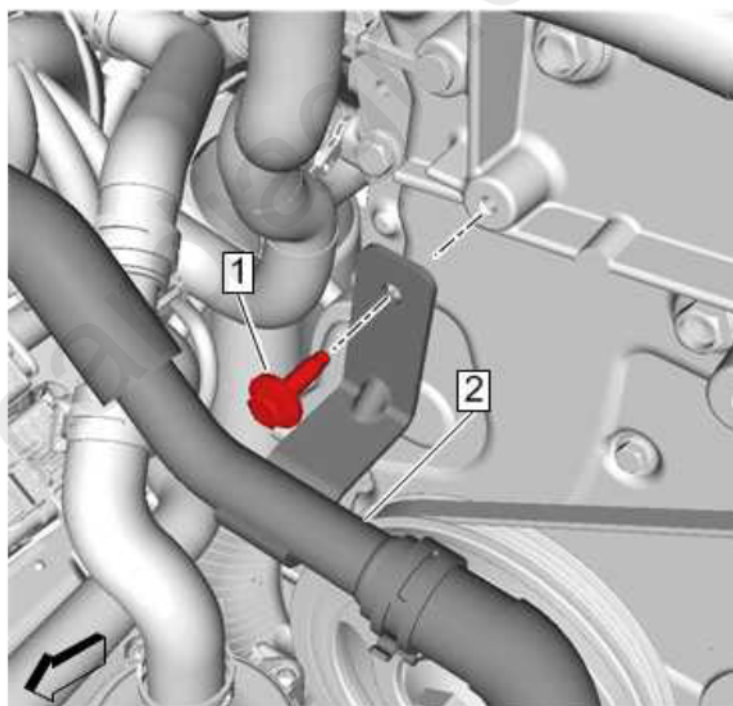
1. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant Pump» Install





**Fig. 151: Drive Motor Generator Control Module Coolant Pump Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Generator Control Module Coolant Pump Hose Clamp (1) » Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Drive Motor Generator Control Module Coolant Pump Hose Bolt (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2) » Install and tighten

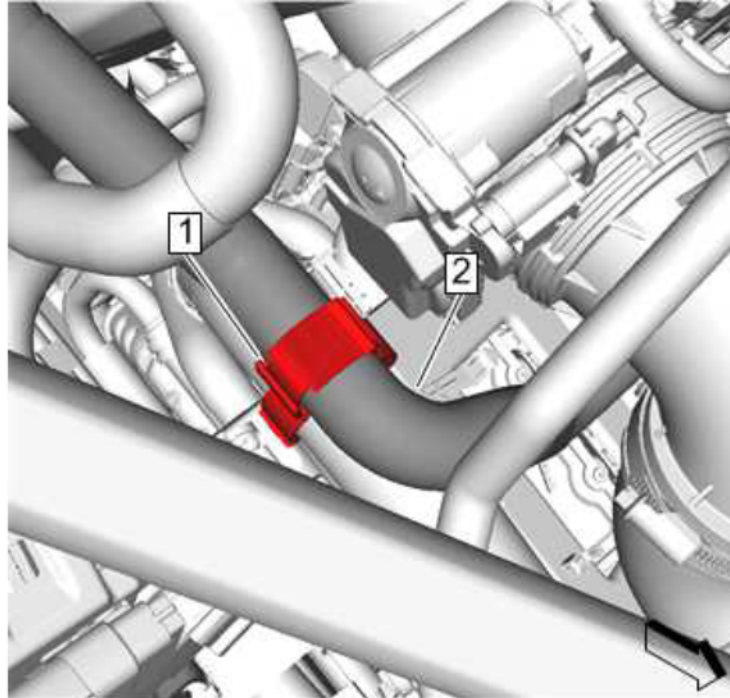


**Fig. 152: Drive Motor Generator Control Module Coolant Pump Hose**  
 Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to **Fastener Caution** .

9 N.m (80 lb in)

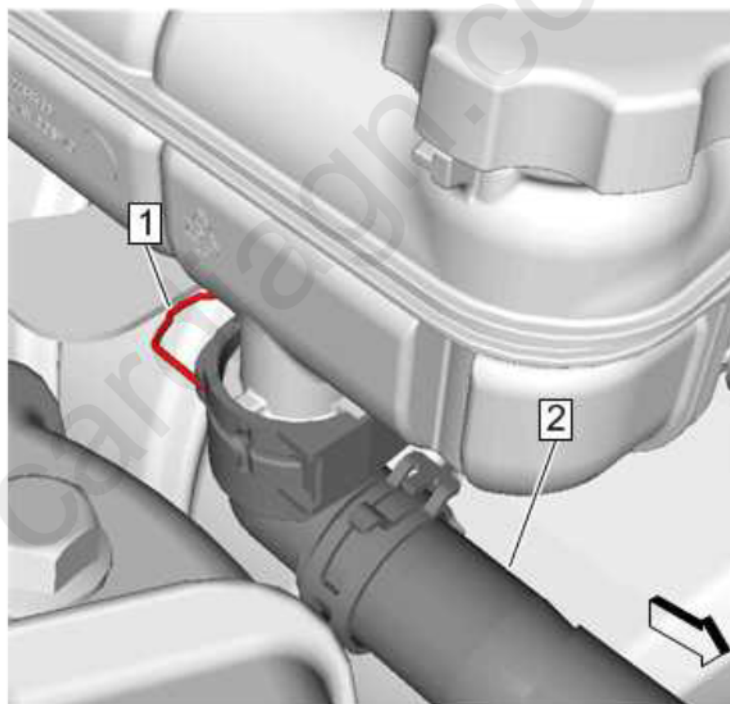
4. Radiator Inlet Hose Clip (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2) » Install



**Fig. 153: Radiator Inlet Hose Clip**

Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Generator Control Module Coolant Pump Hose @ Generator Control Module Coolant/Air Separator» Install

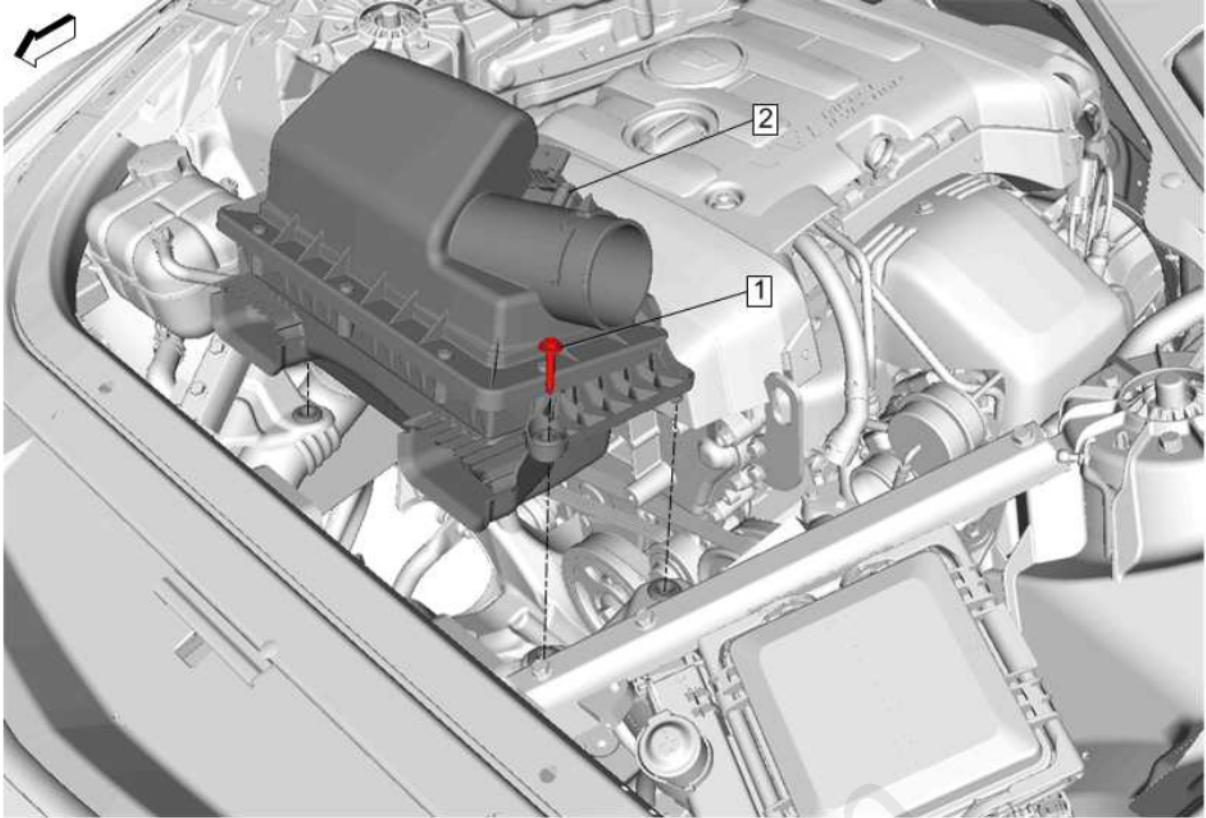


**Fig. 154: Retainer**

Courtesy of GENERAL MOTORS COMPANY

6. Retainer (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Engage
7. Air Cleaner Assembly (2)» Install - [Air Cleaner Assembly Replacement](#)



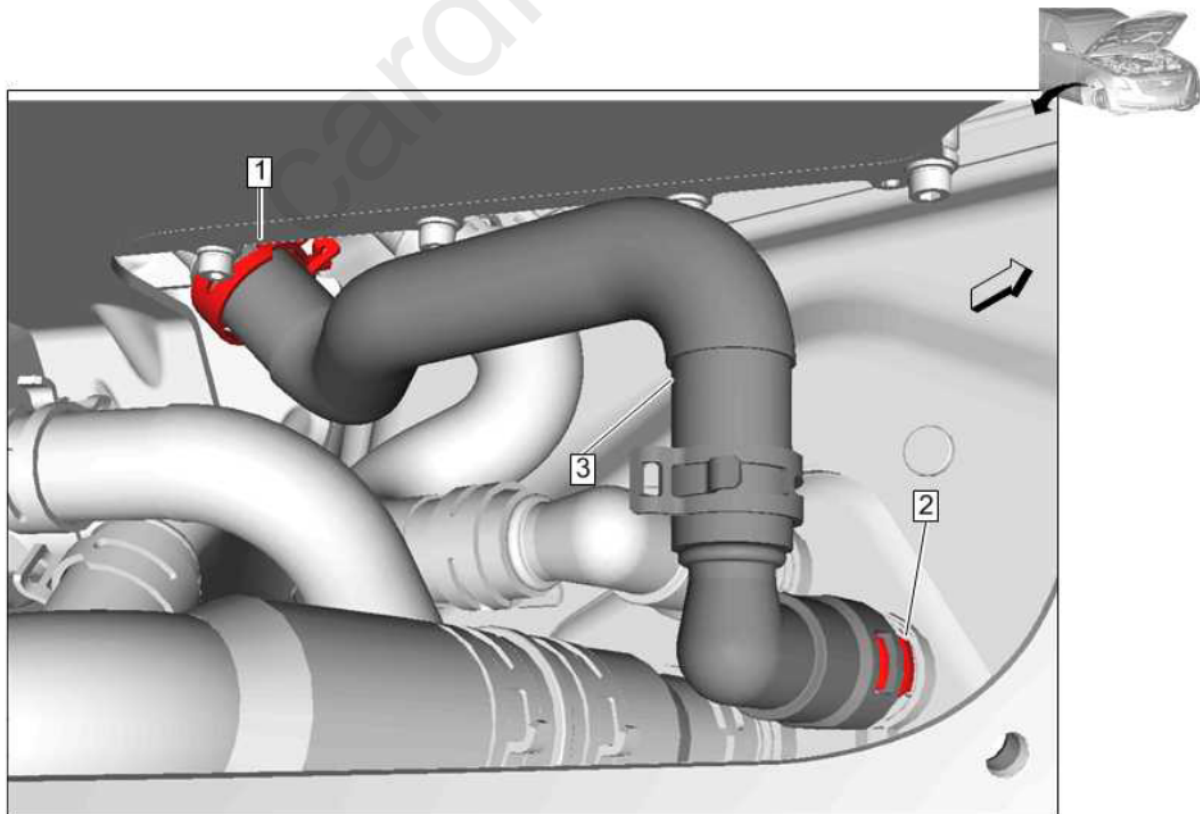


**Fig. 155: Air Cleaner Assembly**

Courtesy of GENERAL MOTORS COMPANY

8. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
9. Enable the high voltage system. Refer to [High Voltage Enabling](#)
10. Start the engine and check for coolant leaks.

### **DRIVE MOTOR GENERATOR CONTROL MODULE COOLING OUTLET HOSE REPLACEMENT**



**Fig. 156: Drive Motor Generator Control Module Cooling Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>3. <a href="#">Front Wheelhouse Front Panel Replacement (HP9)</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Drive Motor Generator Control Module Cooling Outlet Hose Clamp<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                               |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Drive Motor Generator Control Module Cooling Outlet Hose Retainer<br><b>Procedure</b><br>Squeeze the plastic quick connect fitting release tabs.                                                                                                                                                                                                                                                                                                    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Drive Motor Generator Control Module Cooling Outlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

## DRIVE MOTOR GENERATOR CONTROL MODULE RADIATOR INLET HOSE REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

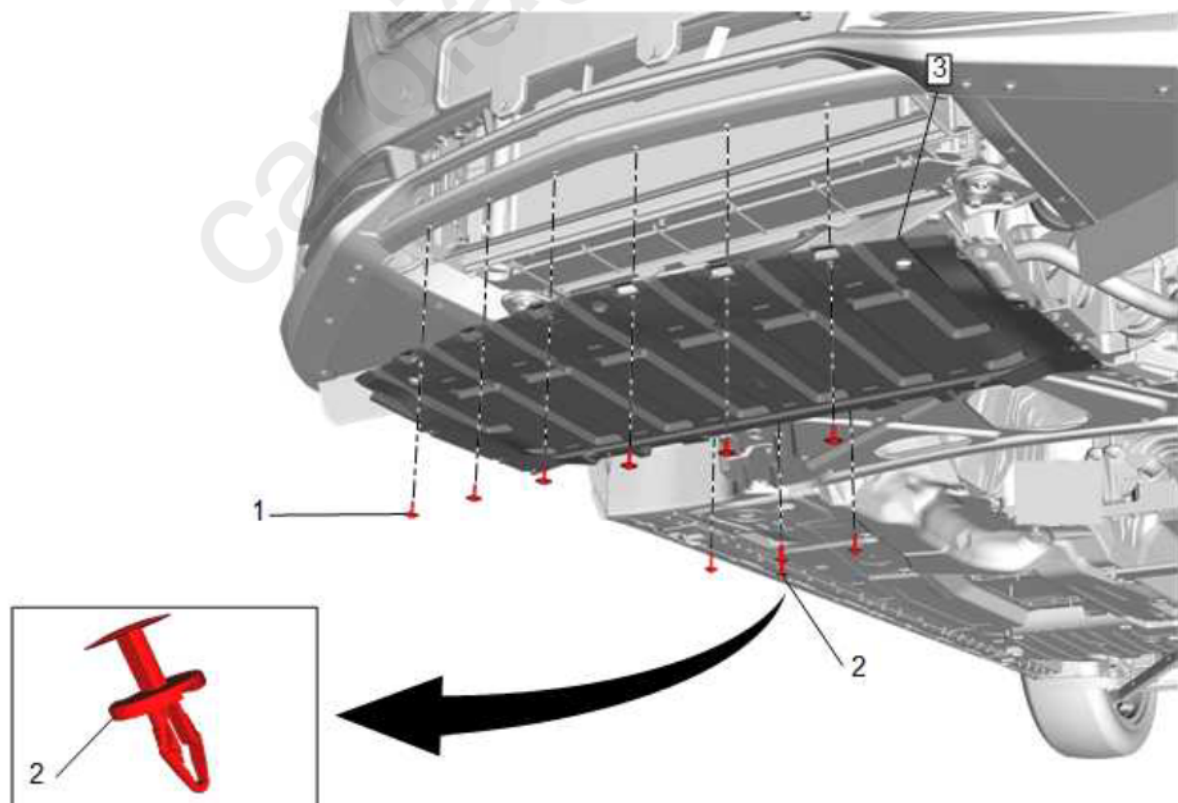
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

#### Removal Procedure

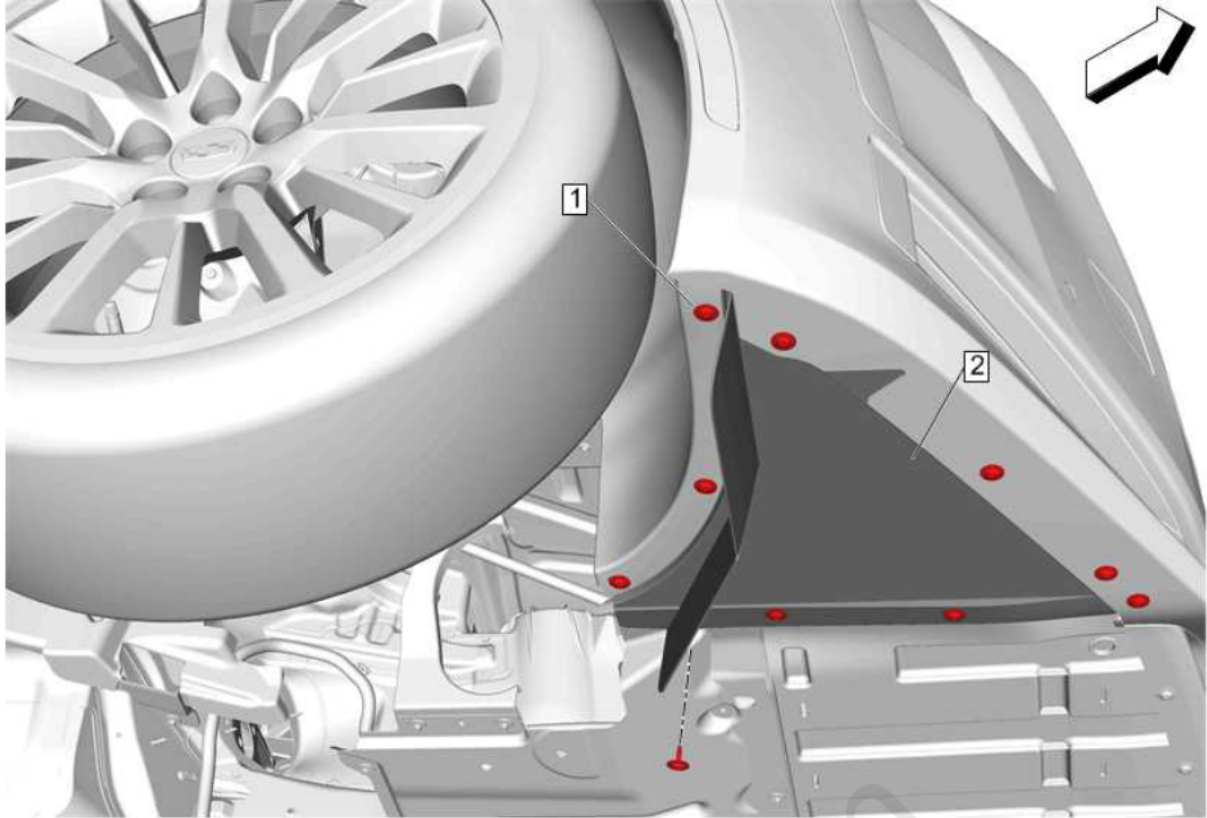
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Front Bumper Fascia Lower Stiffener (3)» Remove - [Front Bumper Fascia Lower Stiffener Replacement](#)



**Fig. 157: Front Bumper Fascia Lower Stiffener**  
Courtesy of GENERAL MOTORS COMPANY

4. Front Tire Front Air Deflector - Left Side (2)» Remove - [Front Tire Front Air Deflector Replacement](#)

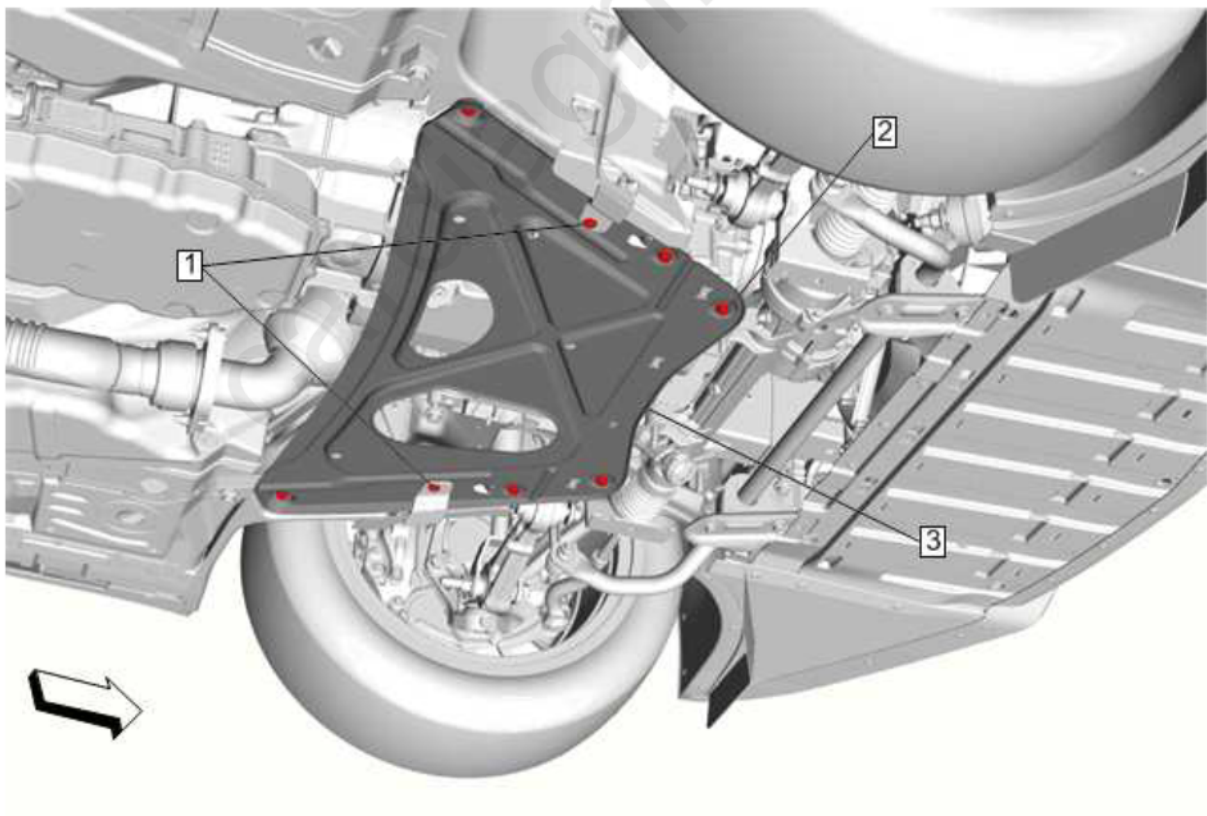




**Fig. 158: Front Tire Front Air Deflector**

Courtesy of GENERAL MOTORS COMPANY

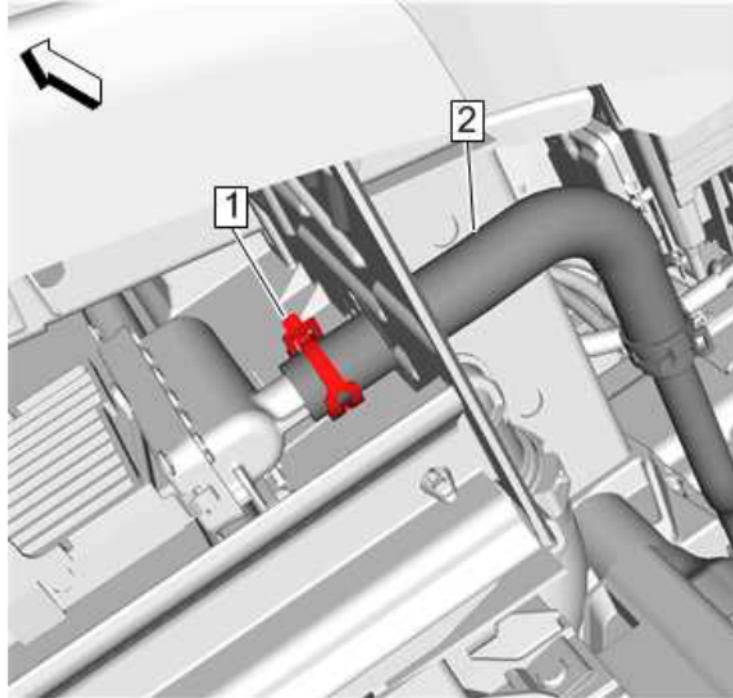
5. Drivetrain and Front Suspension Cradle Plate (3)» Remove - [Drivetrain and Front Suspension Cradle Plate Replacement](#)



**Fig. 159: Drivetrain and Front Suspension Cradle Plate**

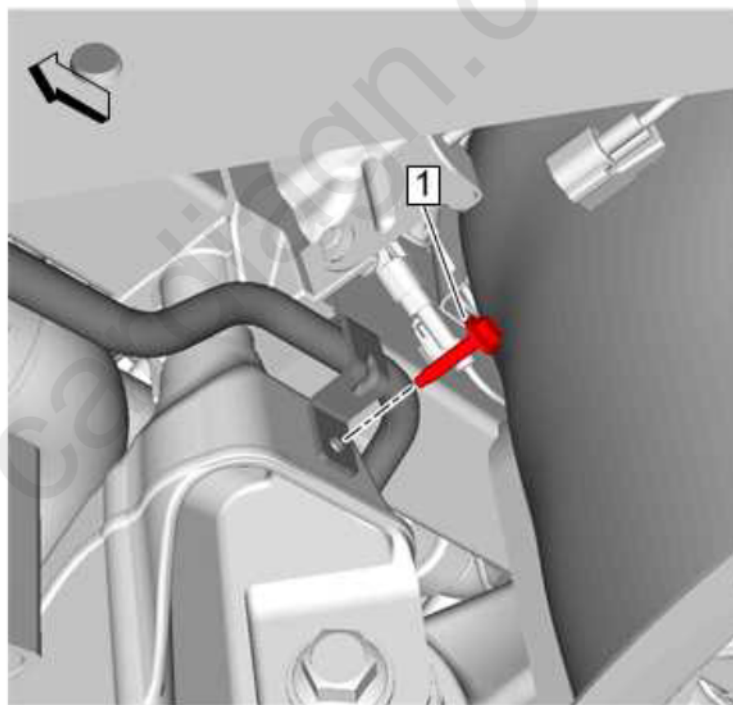
Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Generator Control Module Radiator Inlet Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



**Fig. 160: Drive Motor Generator Control Module Radiator Inlet Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

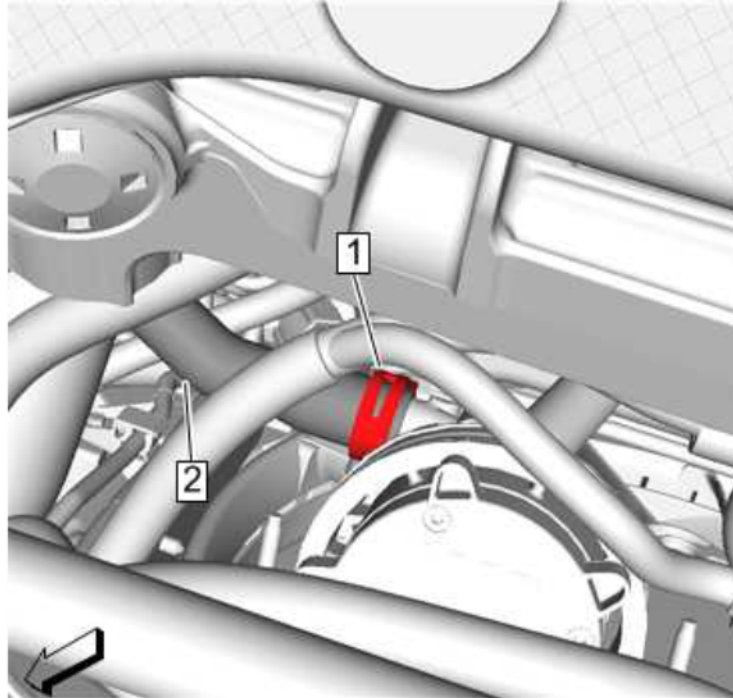
7. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Auxiliary Radiator» Remove
8. Drive Motor Generator Control Module Radiator Inlet Hose Bolt (1) @ Drivetrain and Front Suspension Cradle» Remove



**Fig. 161: Drive Motor Generator Control Module Radiator Inlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

9. Drive Motor Generator Control Module Radiator Inlet Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



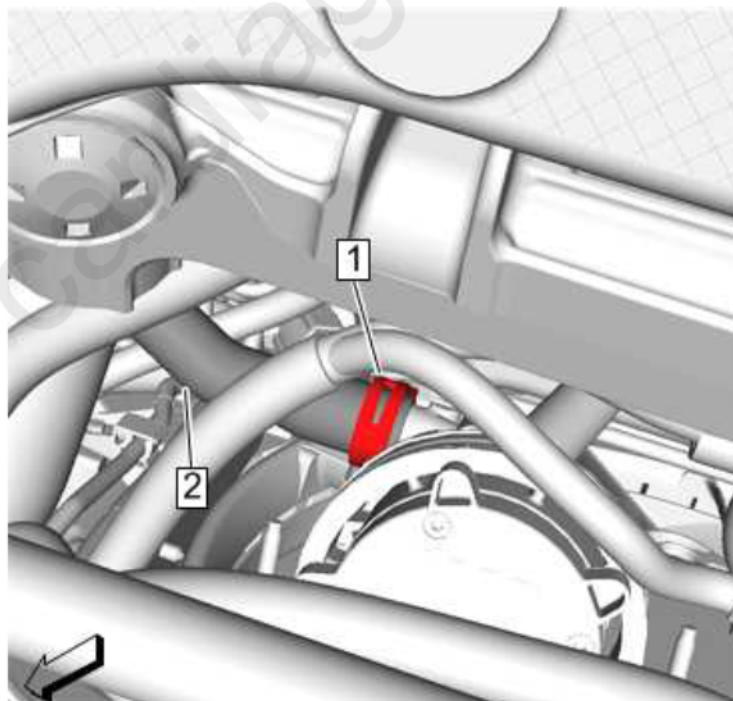


**Fig. 162: Drive Motor Generator Control Module Radiator Inlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

10. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Remove
11. Drive Motor Generator Control Module Radiator Inlet Hose (2)» Remove

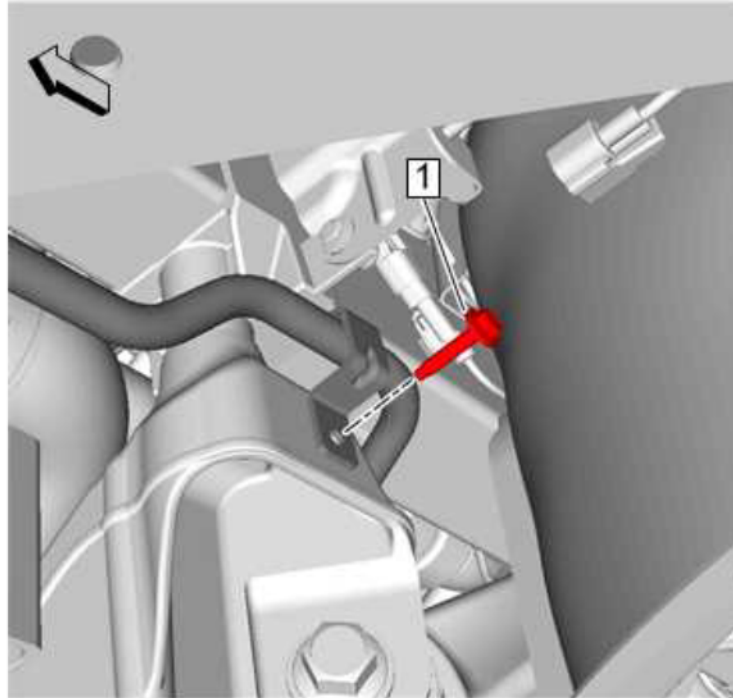
#### **Installation Procedure**

1. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Install



**Fig. 163: Drive Motor Generator Control Module Radiator Inlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

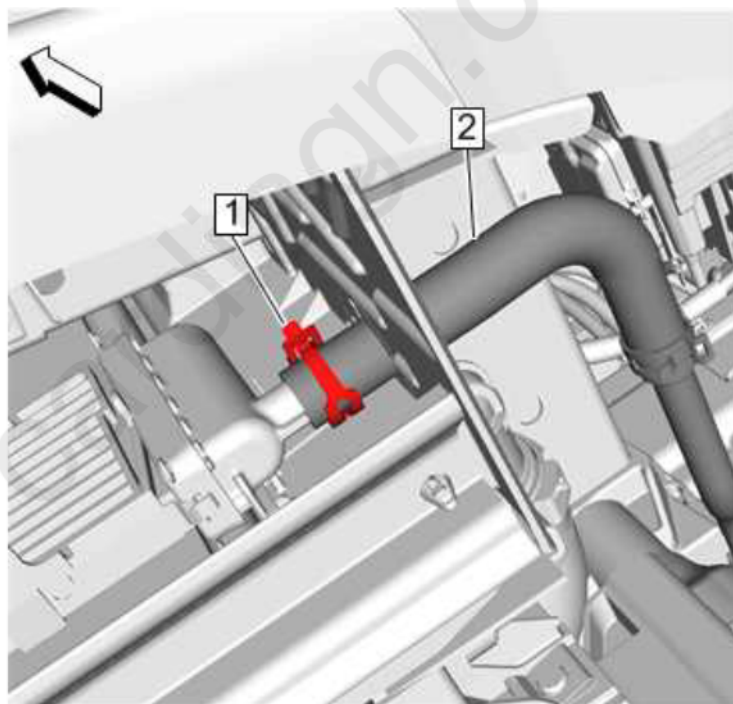
2. Drive Motor Generator Control Module Radiator Inlet Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Drive Motor Generator Control Module Radiator Inlet Hose Bolt (1) @ Drivetrain and Front Suspension Cradle» Install and tighten 9 N.m (80 lb in)



**Fig. 164: Drive Motor Generator Control Module Radiator Inlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

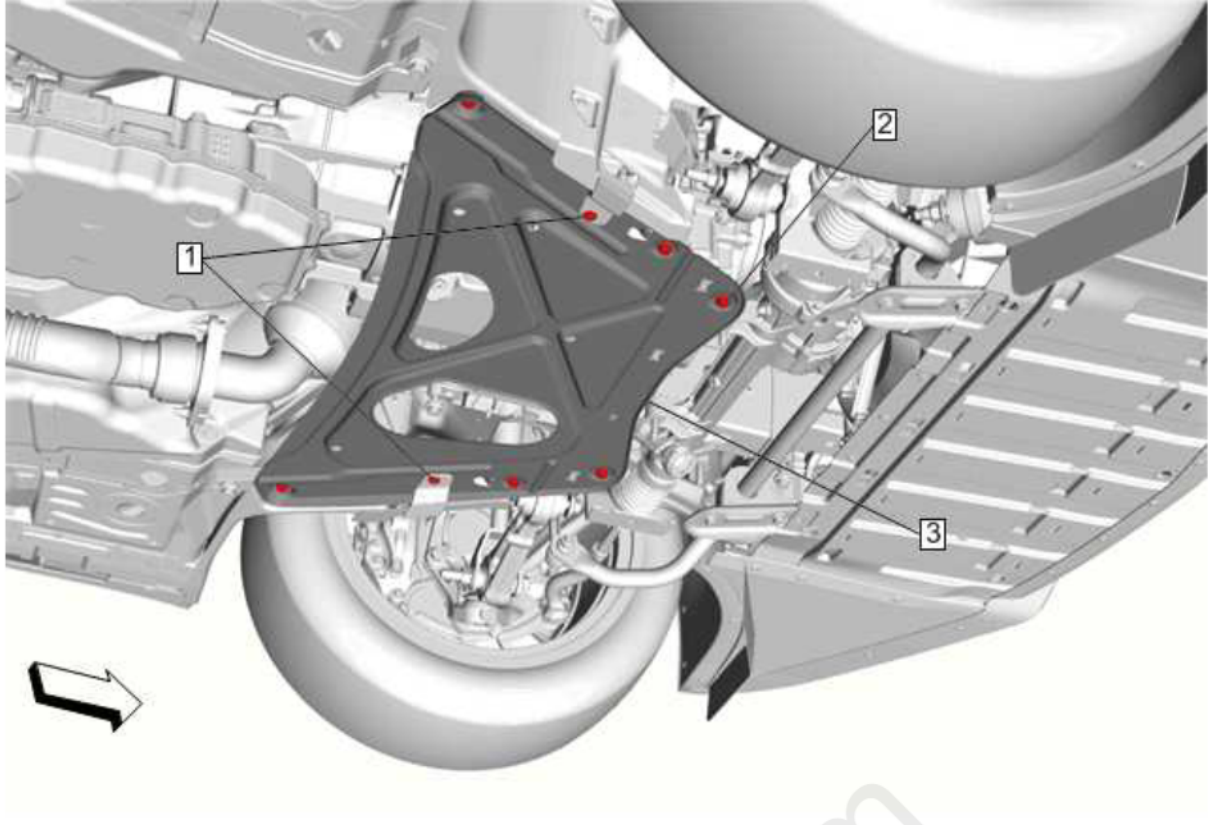
**CAUTION:** Refer to [Fastener Caution](#) .

4. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Auxiliary Radiator» Install



**Fig. 165: Drive Motor Generator Control Module Radiator Inlet Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

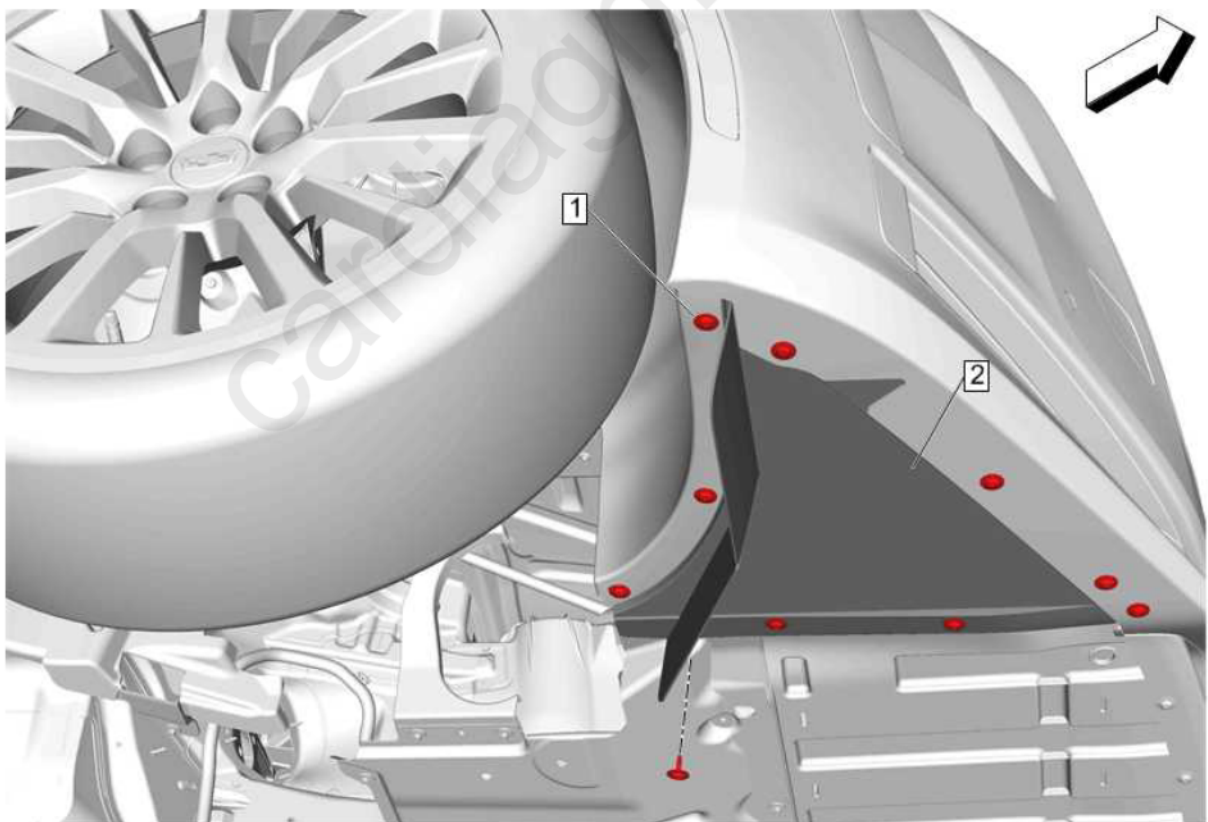
5. Drive Motor Generator Control Module Radiator Inlet Hose Clamp (1)» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Drivetrain and Front Suspension Cradle Plate (3)» Install - [Drivetrain and Front Suspension Cradle Plate Replacement](#)



**Fig. 166: Drivetrain and Front Suspension Cradle Plate**

Courtesy of GENERAL MOTORS COMPANY

7. Front Tire Front Air Deflector - Left Side (2) » Install - **Front Tire Front Air Deflector Replacement**

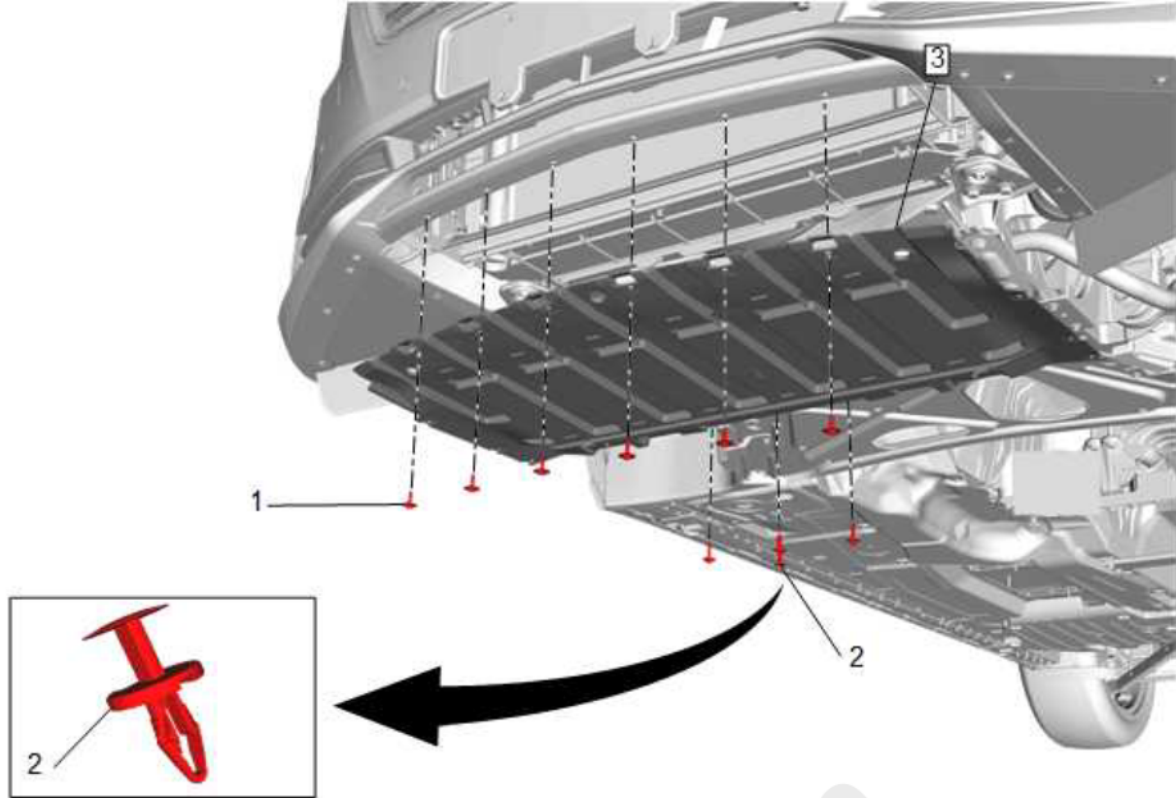


**Fig. 167: Front Tire Front Air Deflector**

Courtesy of GENERAL MOTORS COMPANY

8. Front Bumper Fascia Lower Stiffener (3) » Install - **Front Bumper Fascia Lower Stiffener Replacement**





**Fig. 168: Front Bumper Fascia Lower Stiffener**  
Courtesy of GENERAL MOTORS COMPANY

9. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
10. Enable the high voltage system. Refer to [High Voltage Enabling](#)
11. Start the engine and check for coolant leaks.

## **DRIVE MOTOR GENERATOR CONTROL MODULE RADIATOR OUTLET HOSE REPLACEMENT**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

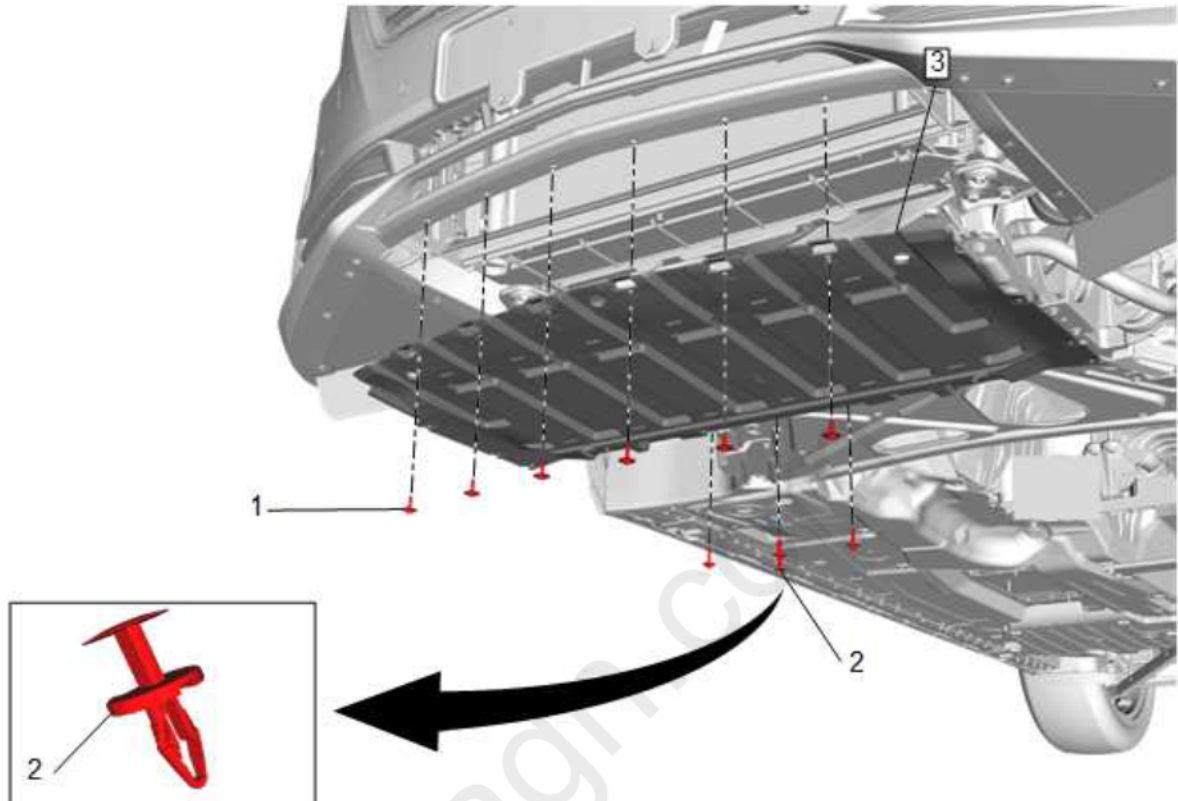
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

#### Removal Procedure

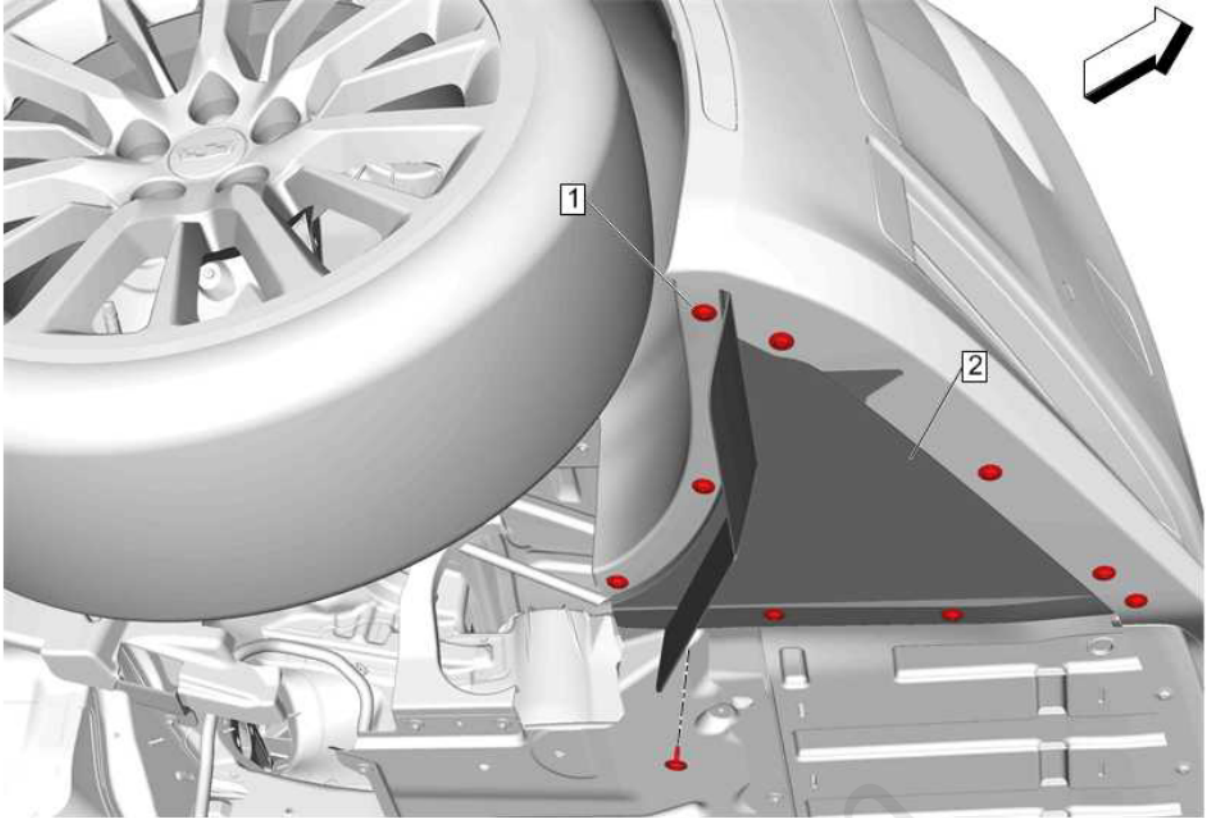
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Front Bumper Fascia Lower Stiffener (3)» Remove - [Front Bumper Fascia Lower Stiffener Replacement](#)



**[Fig. 169: Front Bumper Fascia Lower Stiffener](#)**  
Courtesy of GENERAL MOTORS COMPANY

4. Front Tire Front Air Deflector - Right Side (2)» Remove - [Front Tire Front Air Deflector Replacement](#)

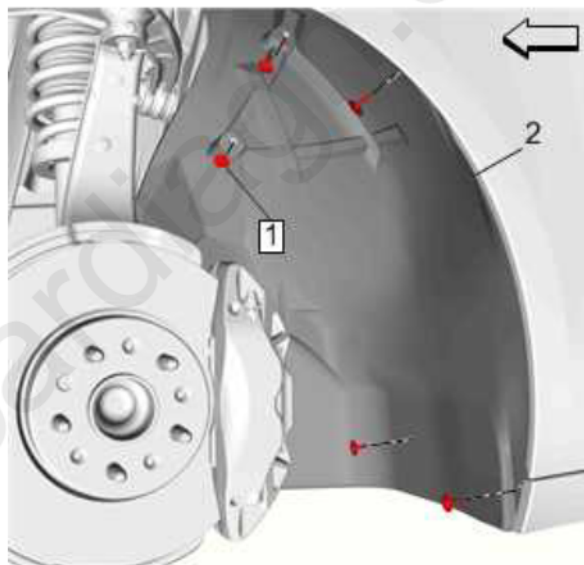




**Fig. 170: Front Tire Front Air Deflector**

Courtesy of GENERAL MOTORS COMPANY

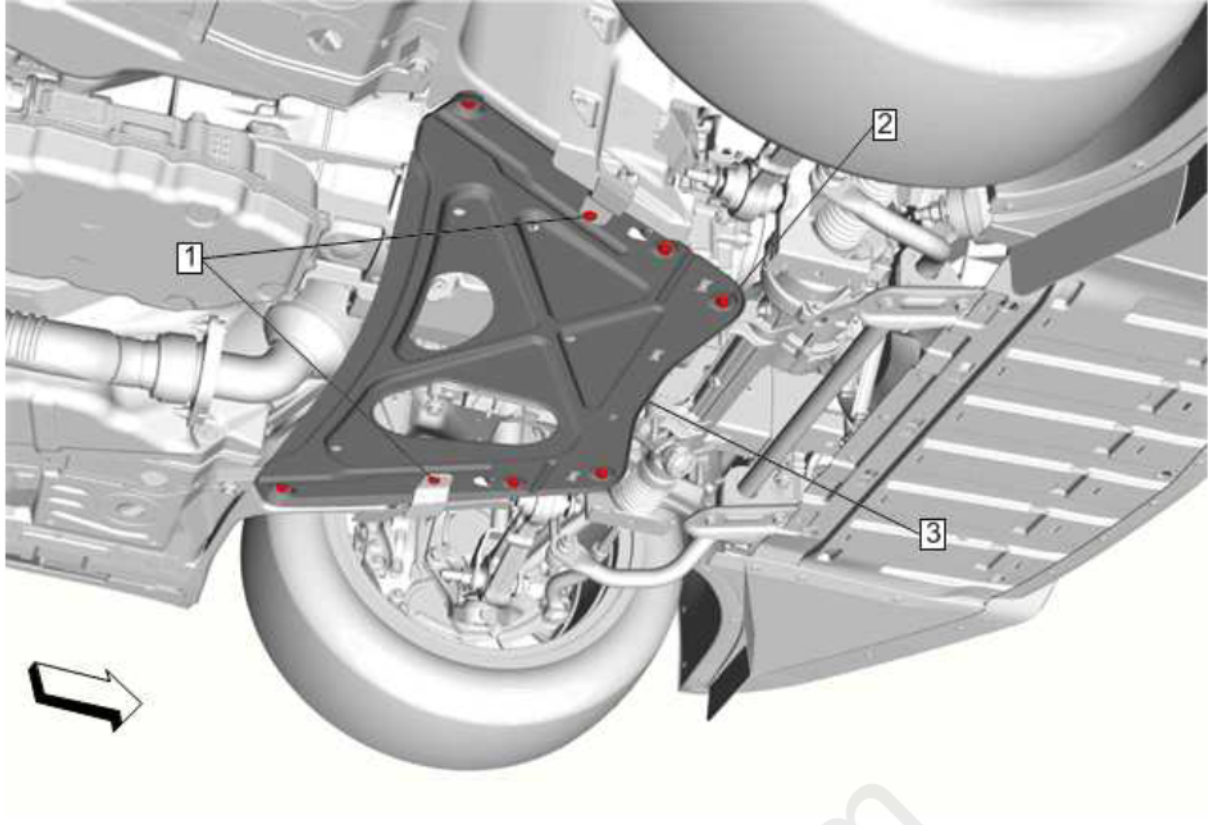
5. Front Wheelhouse Liner - Right Side (2) » Remove - [Front Wheelhouse Liner Replacement](#)



**Fig. 171: Front Wheelhouse Liner**

Courtesy of GENERAL MOTORS COMPANY

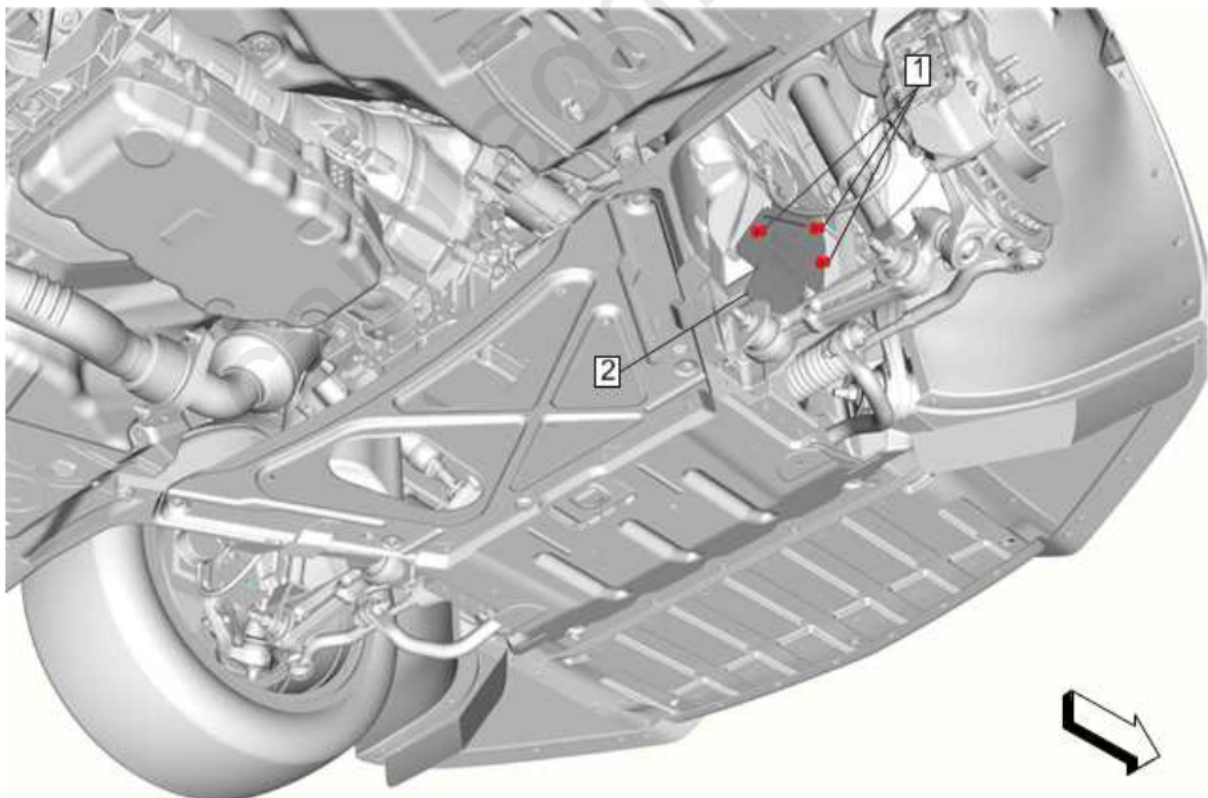
6. Drivetrain and Front Suspension Cradle Plate (3) » Remove - [Drivetrain and Front Suspension Cradle Plate Replacement](#)



**Fig. 172: Drivetrain and Front Suspension Cradle Plate**

Courtesy of GENERAL MOTORS COMPANY

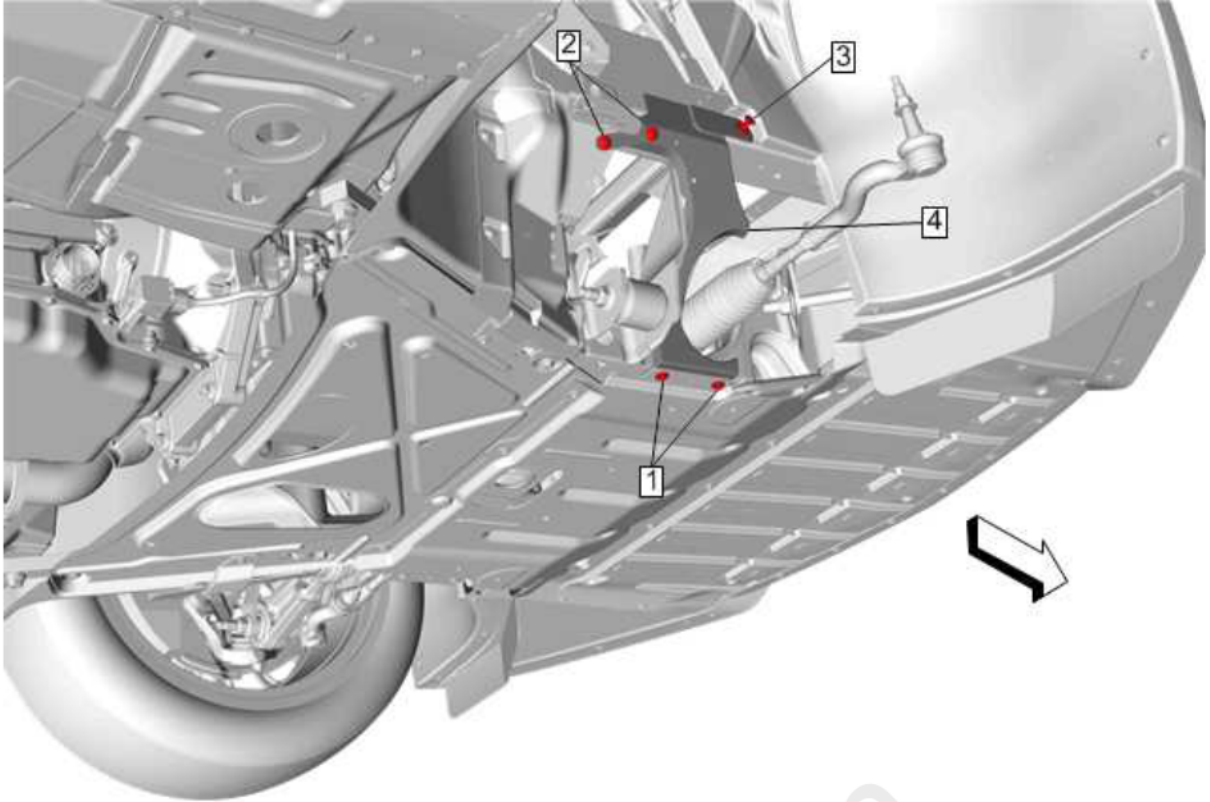
7. Engine Lower Front Splash Shield (2)» Remove - **Engine Lower Front Splash Shield Replacement (LTG)**



**Fig. 173: Engine Lower Front Splash Shield (LTG)**

Courtesy of GENERAL MOTORS COMPANY

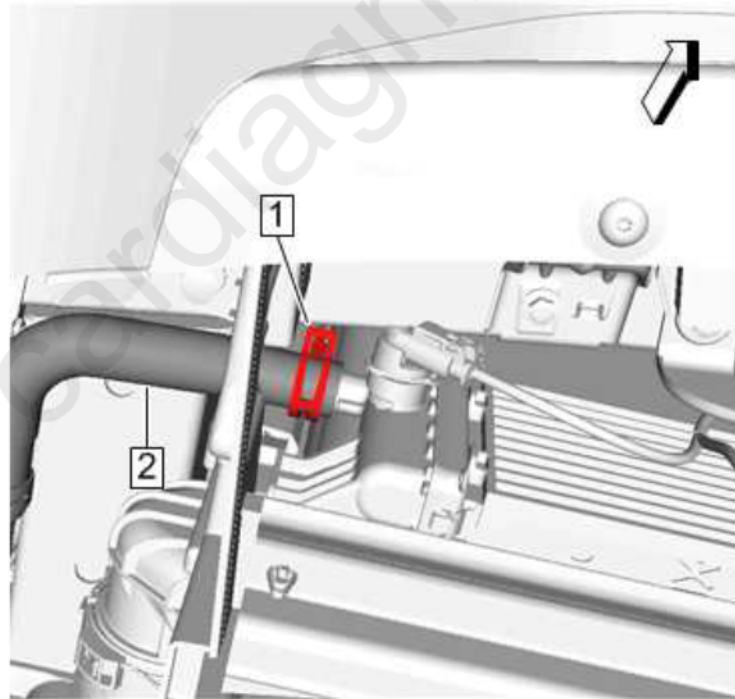
8. Engine Front Splash Shield - Right Side - Front (4)» Remove - **Engine Front Splash Shield Replacement - Right Side (Front)**



**Fig. 174: Engine Front Splash Shield - Right Side (Front)**

Courtesy of GENERAL MOTORS COMPANY

9. Drive Motor Generator Control Module Radiator Outlet Hose Clamp (1) » Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

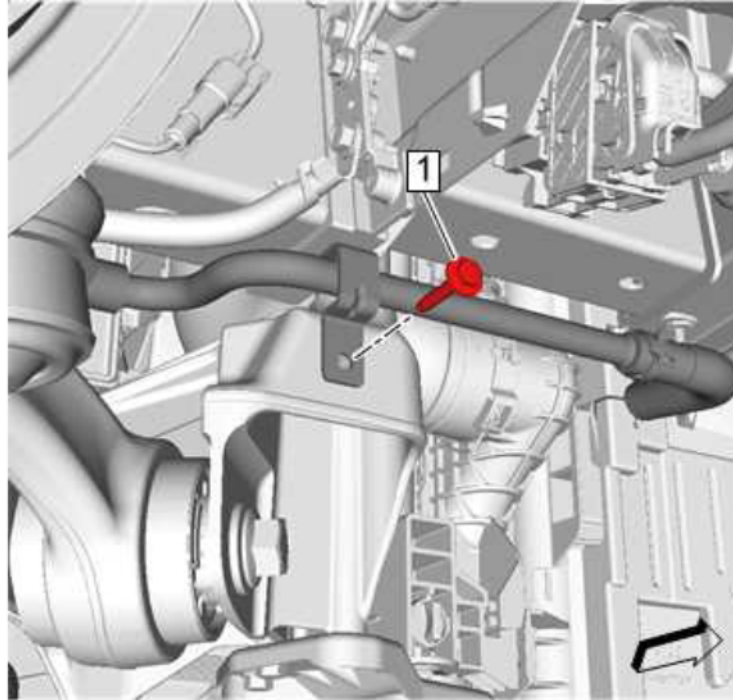


**Fig. 175: Drive Motor Generator Control Module Radiator Outlet Hose Clamp**

Courtesy of GENERAL MOTORS COMPANY

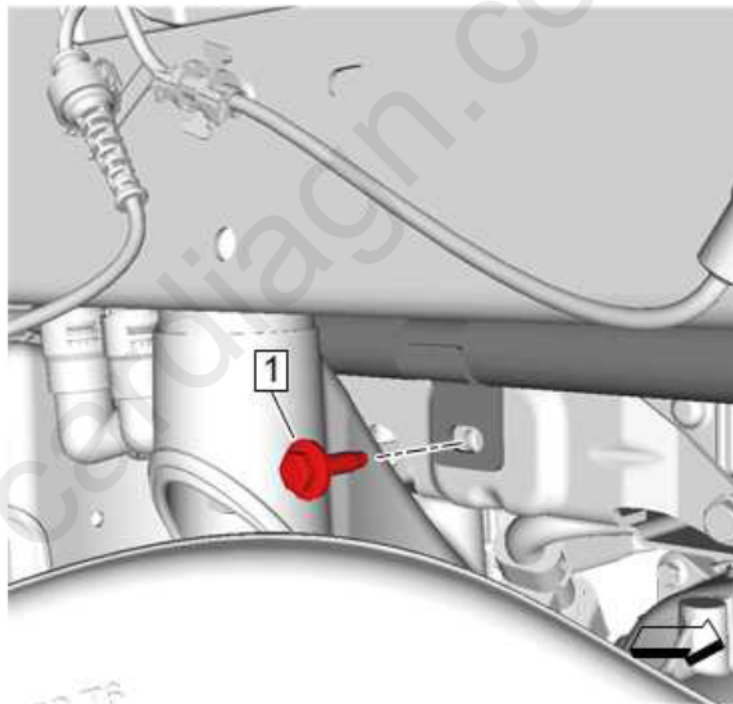
10. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Auxiliary Radiator » Remove
11. Drive Motor Generator Control Module Radiator Outlet Hose Bolt (1) @ Drivetrain and Front Suspension Cradle » Remove





**Fig. 176: Drive Motor Generator Control Module Radiator Outlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

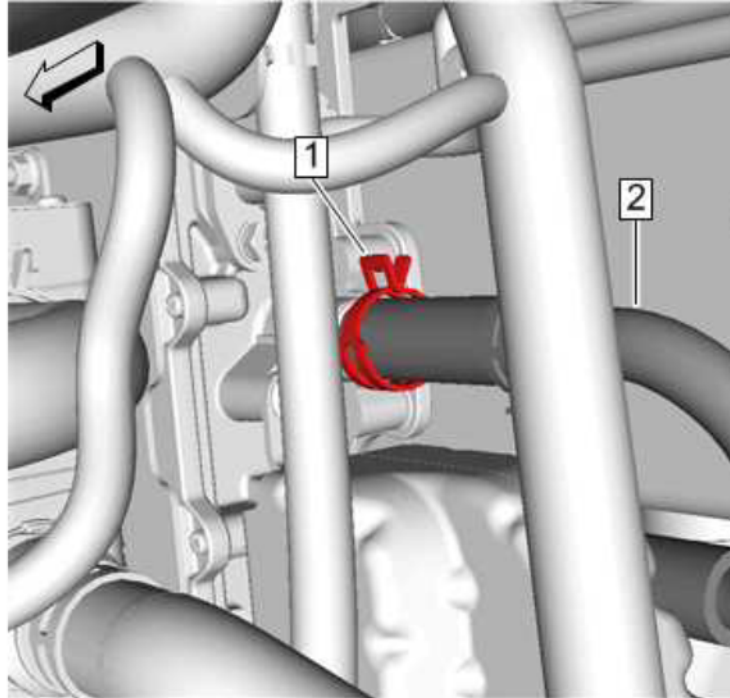
12. Drive Motor Generator Control Module Radiator Outlet Hose Bolt (1) @ Accessory DC Power Control Module» Remove



**Fig. 177: Drive Motor Generator Control Module Radiator Outlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

13. Drive Motor Generator Control Module Radiator Outlet Hose Clamp (1)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**



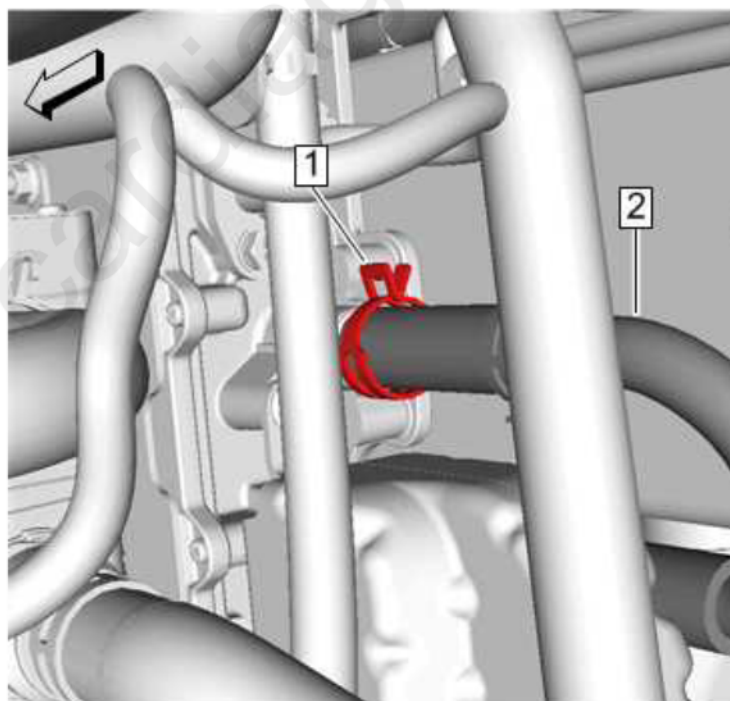


**Fig. 178: Drive Motor Generator Control Module Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS COMPANY**

14. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Accessory DC Power Control Module» Remove
15. Drive Motor Generator Control Module Radiator Outlet Hose (2)» Remove

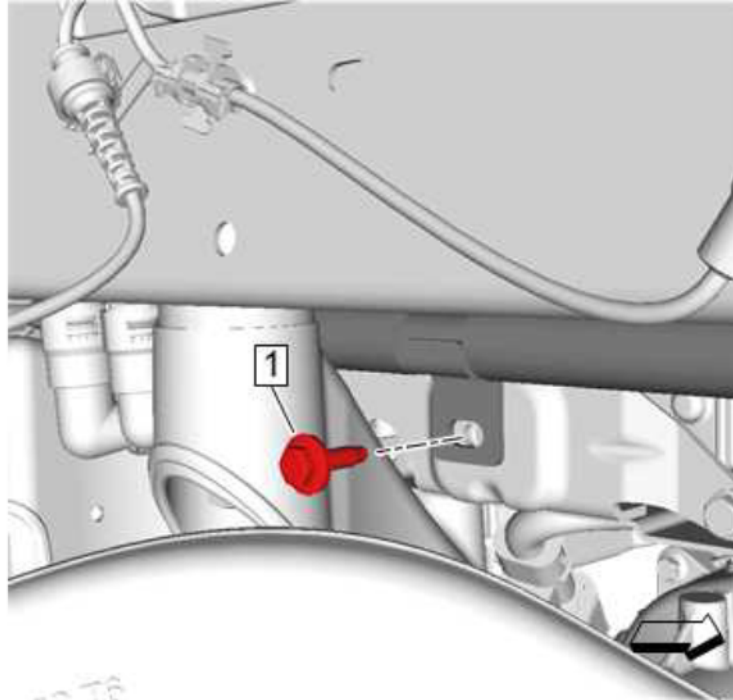
#### **Installation Procedure**

1. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Accessory DC Power Control Module» Install



**Fig. 179: Drive Motor Generator Control Module Radiator Outlet Hose**  
**Courtesy of GENERAL MOTORS COMPANY**

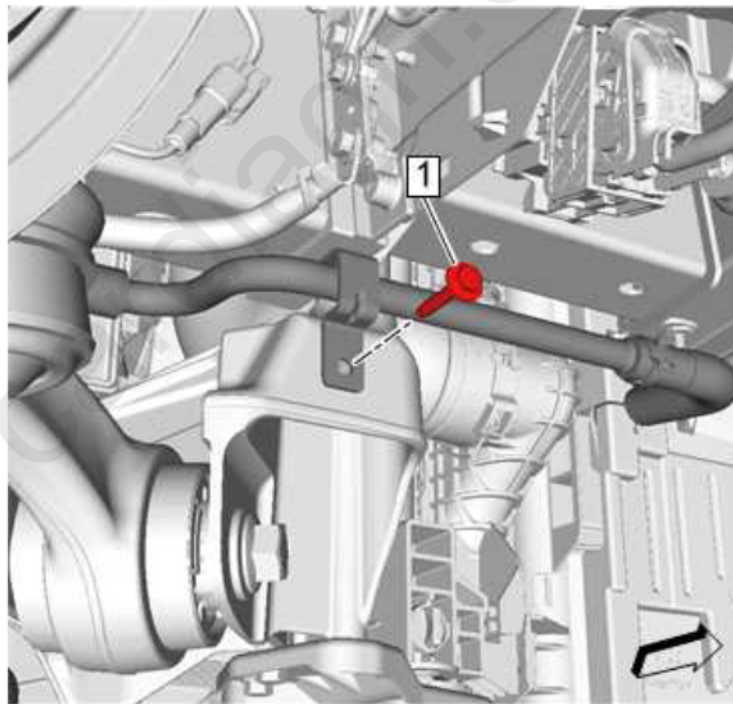
2. Drive Motor Generator Control Module Radiator Outlet Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Drive Motor Generator Control Module Radiator Outlet Hose Bolt (1) @ Accessory DC Power Control Module» Install and tighten 9 N.m (80 lb in)



**Fig. 180: Drive Motor Generator Control Module Radiator Outlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

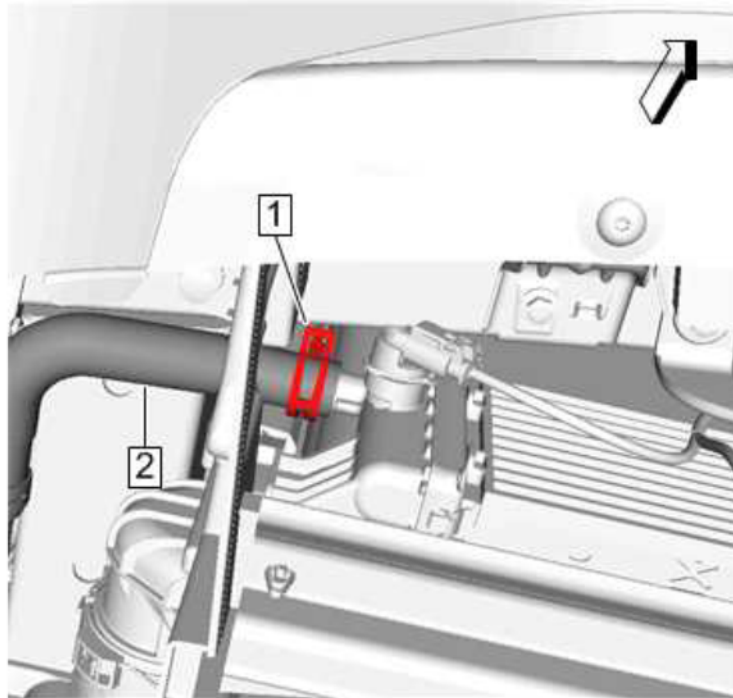
**CAUTION:** Refer to **Fastener Caution** .

4. Drive Motor Generator Control Module Radiator Outlet Hose Bolt (1) @ Drivetrain and Front Suspension Cradle» Install and tighten 9 N.m (80 lb in)



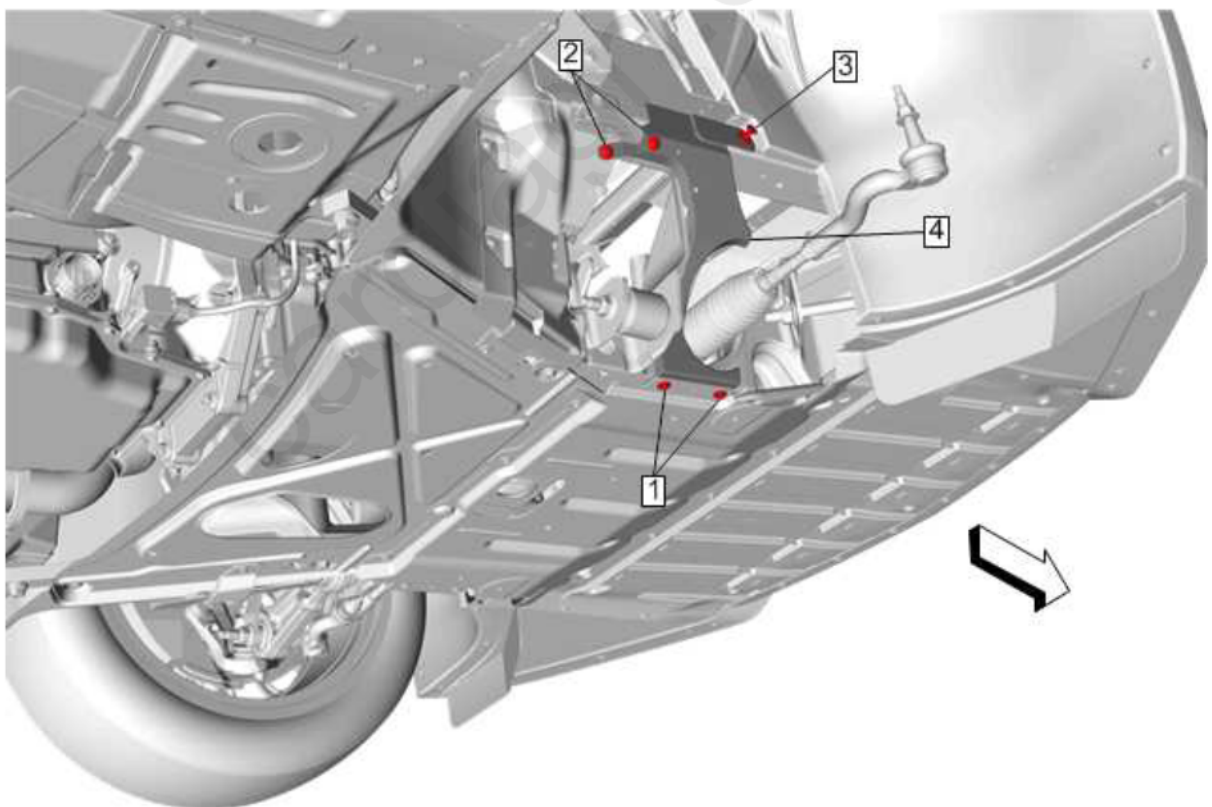
**Fig. 181: Drive Motor Generator Control Module Radiator Outlet Hose Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Generator Control Module Radiator Outlet Hose (2) @ Auxiliary Radiator» Install



**Fig. 182: Drive Motor Generator Control Module Radiator Outlet Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

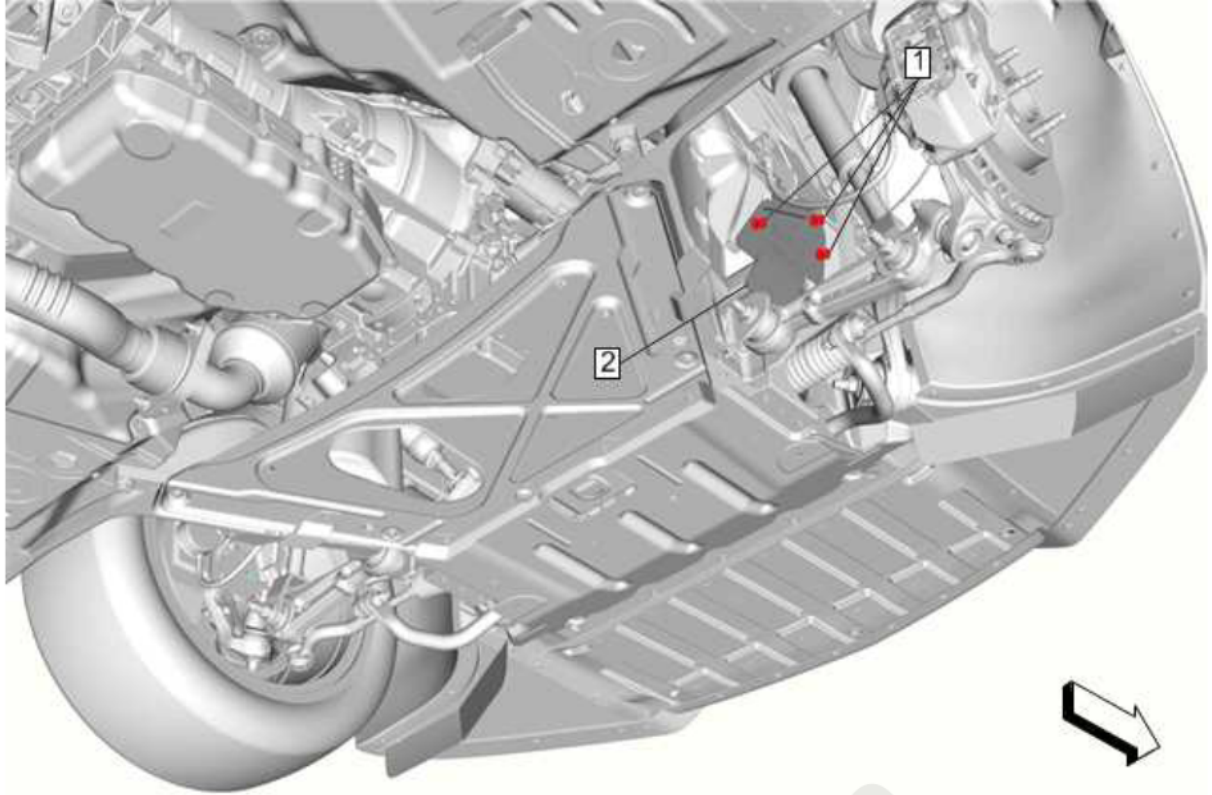
6. Drive Motor Generator Control Module Radiator Outlet Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. Engine Front Splash Shield - Right Side - Front (4)» Install - **Engine Front Splash Shield Replacement - Right Side (Front)**



**Fig. 183: Engine Front Splash Shield - Right Side (Front)**  
 Courtesy of GENERAL MOTORS COMPANY

8. Engine Lower Front Splash Shield (2)» Install - **Engine Lower Front Splash Shield Replacement (LTG)**

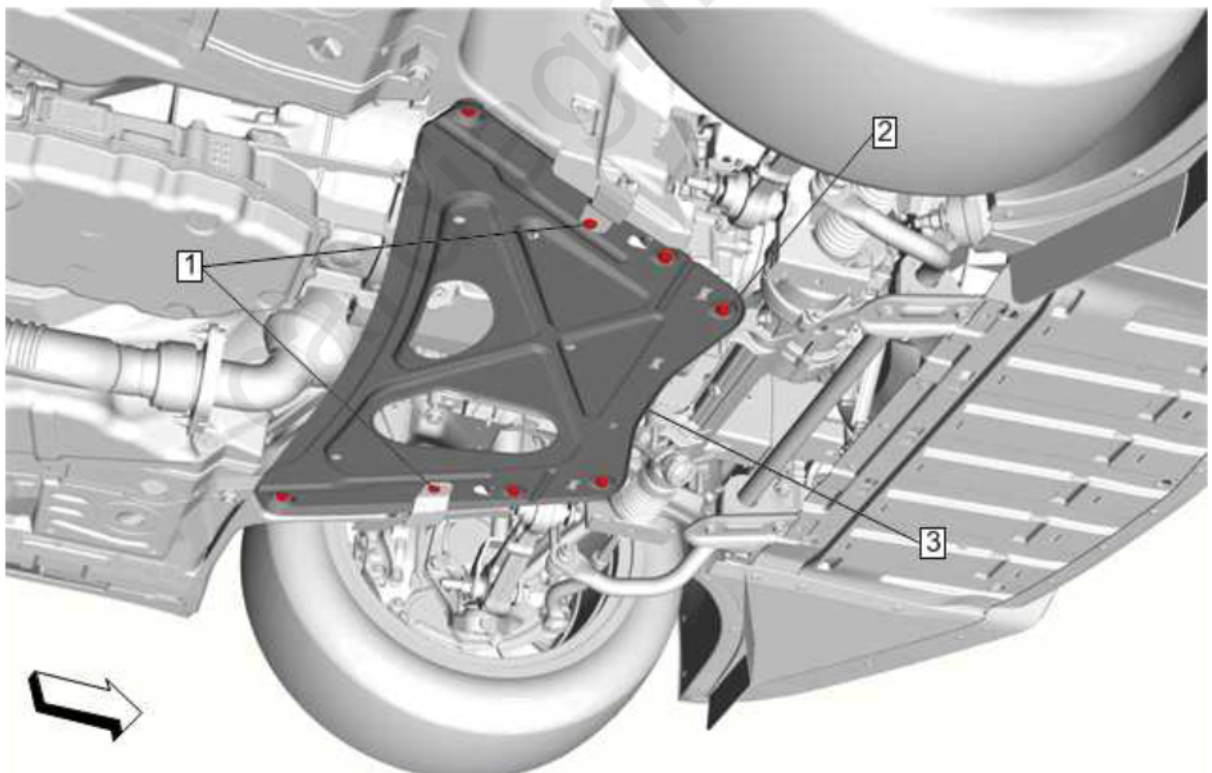




**Fig. 184: Engine Lower Front Splash Shield (LTG)**

Courtesy of GENERAL MOTORS COMPANY

9. Drivetrain and Front Suspension Cradle Plate (3)» Install - **Drivetrain and Front Suspension Cradle Plate Replacement**

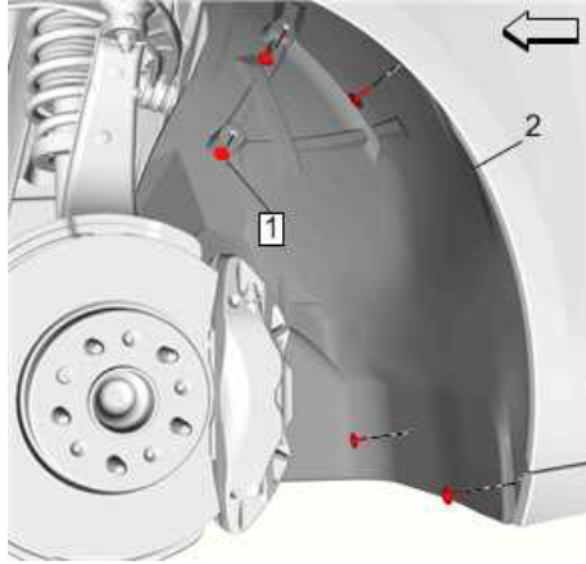


**Fig. 185: Drivetrain and Front Suspension Cradle Plate**

Courtesy of GENERAL MOTORS COMPANY

10. Front Wheelhouse Liner - Right Side (2)» Install - **Front Wheelhouse Liner Replacement**

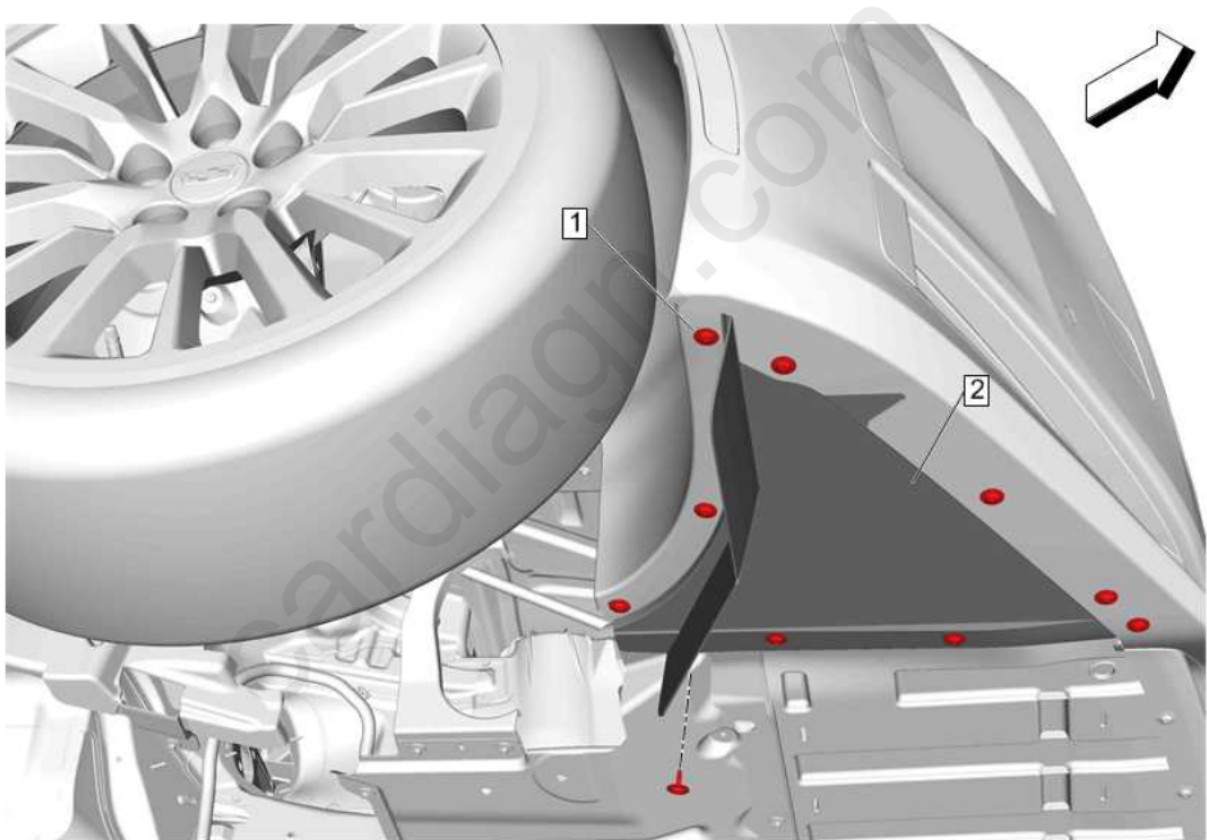




**Fig. 186: Front Wheelhouse Liner**

Courtesy of GENERAL MOTORS COMPANY

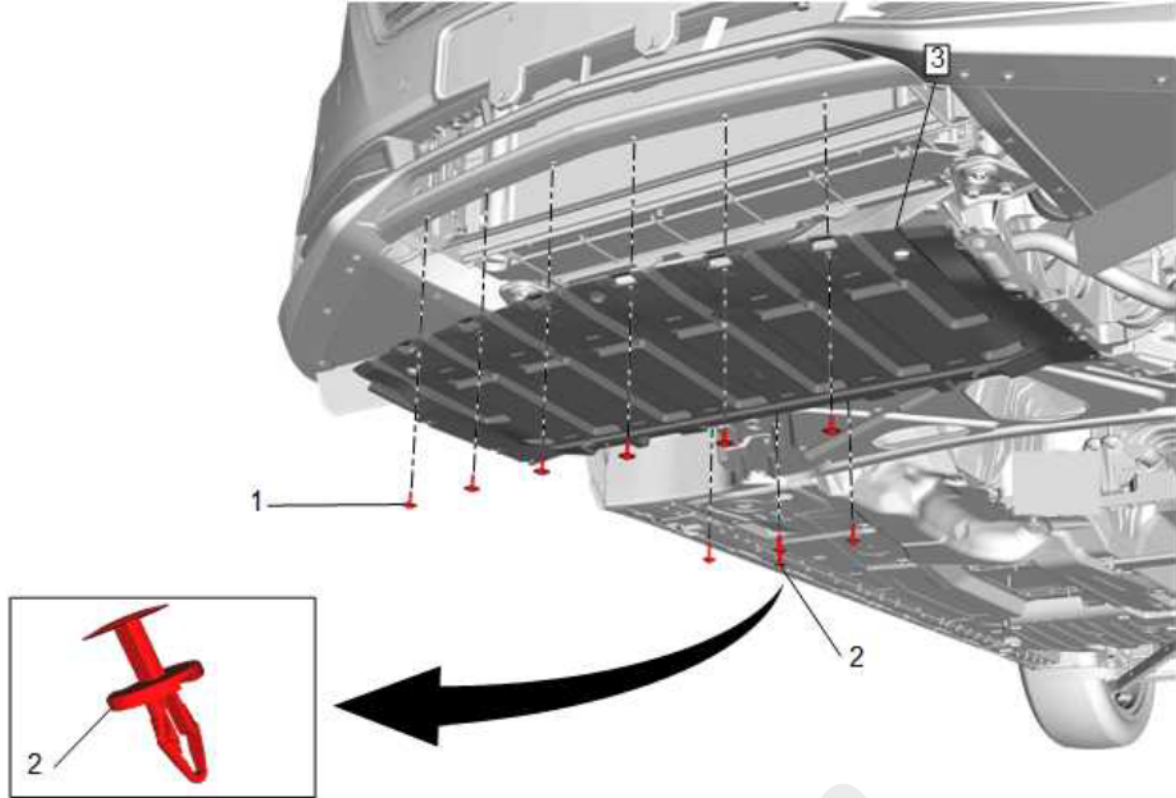
11. Front Tire Front Air Deflector - Right Side (2)» Install - **Front Tire Front Air Deflector Replacement**



**Fig. 187: Front Tire Front Air Deflector**

Courtesy of GENERAL MOTORS COMPANY

12. Front Bumper Fascia Lower Stiffener (3)» Install - **Front Bumper Fascia Lower Stiffener Replacement**



**Fig. 188: Front Bumper Fascia Lower Stiffener**  
Courtesy of GENERAL MOTORS COMPANY

13. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
14. Enable the high voltage system. Refer to [High Voltage Enabling](#)
15. Start the engine and check for coolant leaks.

## GENERATOR CONTROL MODULE COOLANT RADIATOR HOSE REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

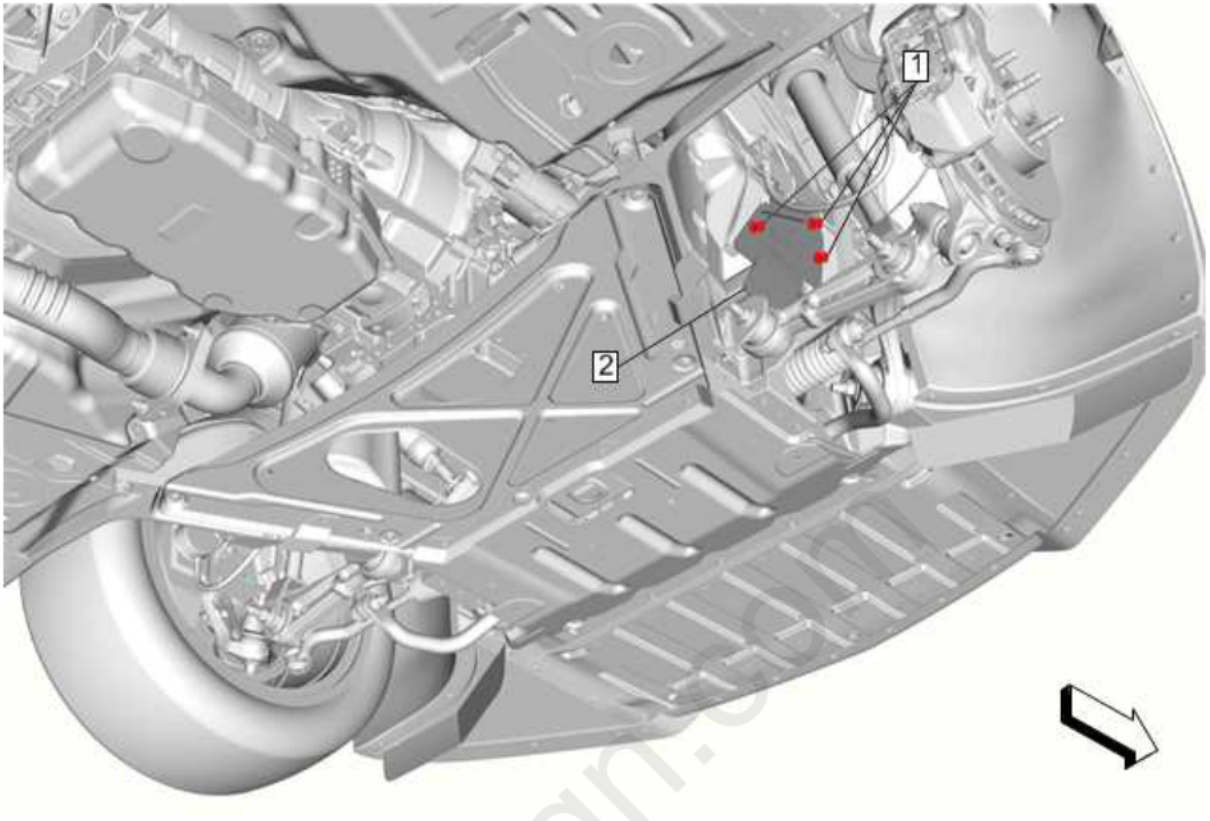
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

## Removal Procedure

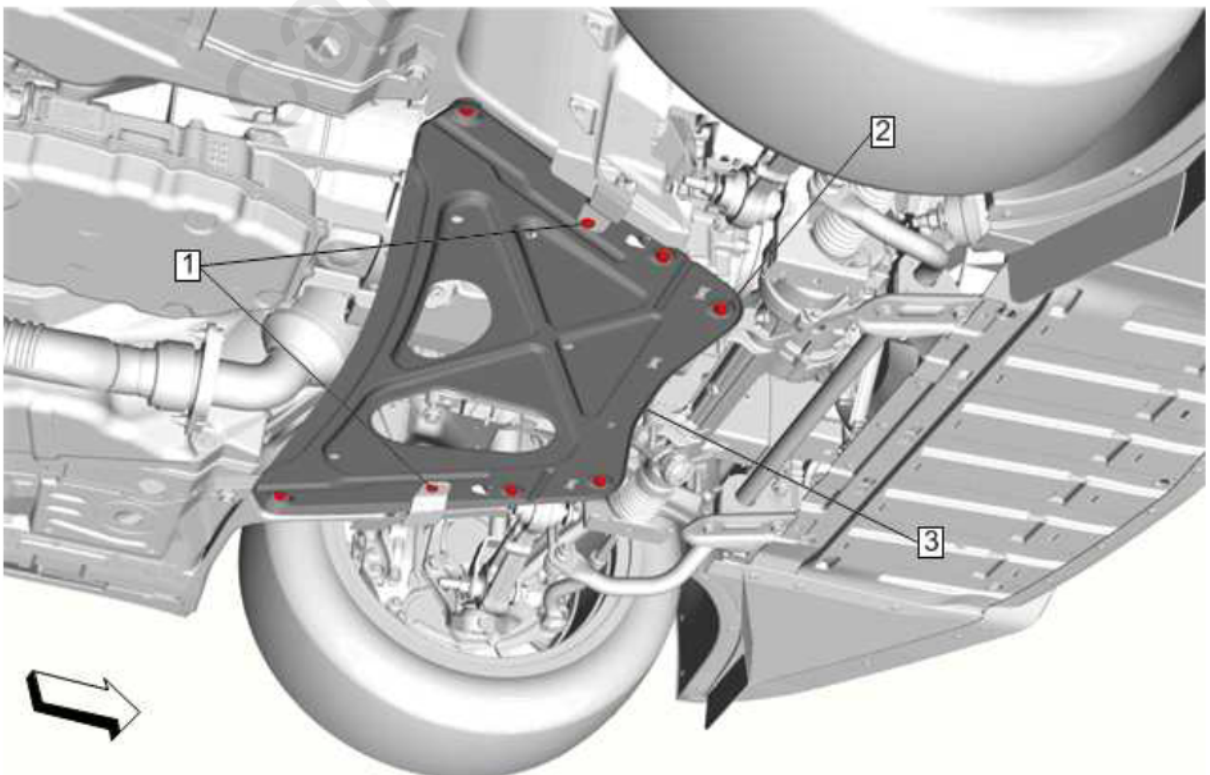
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Engine Lower Front Splash Shield (2)» Remove - [Engine Lower Front Splash Shield Replacement \(LTG\)](#)



**Fig. 189: Engine Lower Front Splash Shield (LTG)**

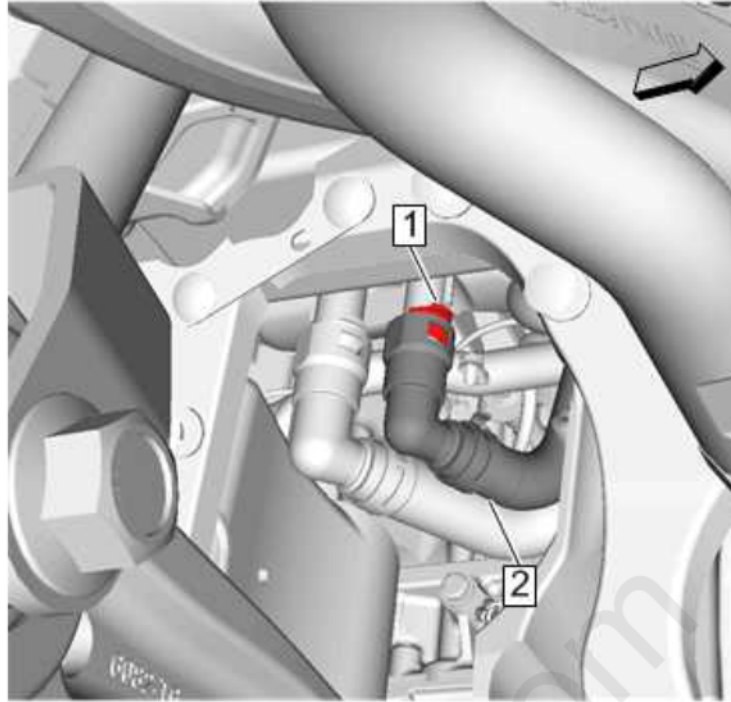
Courtesy of GENERAL MOTORS COMPANY

4. Drivetrain and Front Suspension Cradle Plate (3)» Remove - [Drivetrain and Front Suspension Cradle Plate Replacement](#)



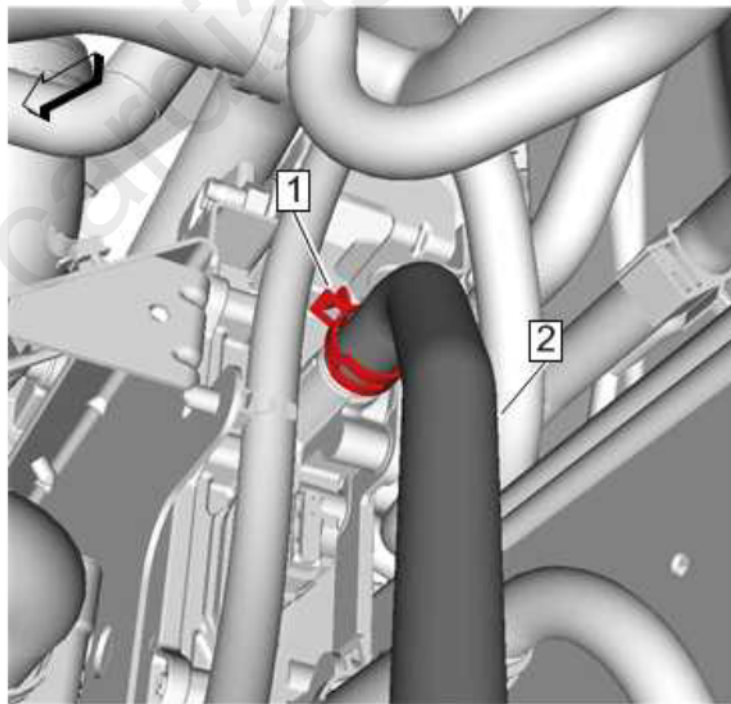


5. Generator Control Module Coolant Radiator Hose Retainer (1) @ Generator Control Module Coolant Radiator Hose» Disengage



**Fig. 191: Generator Control Module Coolant Radiator Hose**  
Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Radiator Hose (2) @ Heater Inlet Pipe Connector» Remove  
7. Generator Control Module Coolant Radiator Hose Clamp (1) @ Generator Control Module Coolant Radiator Hose» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

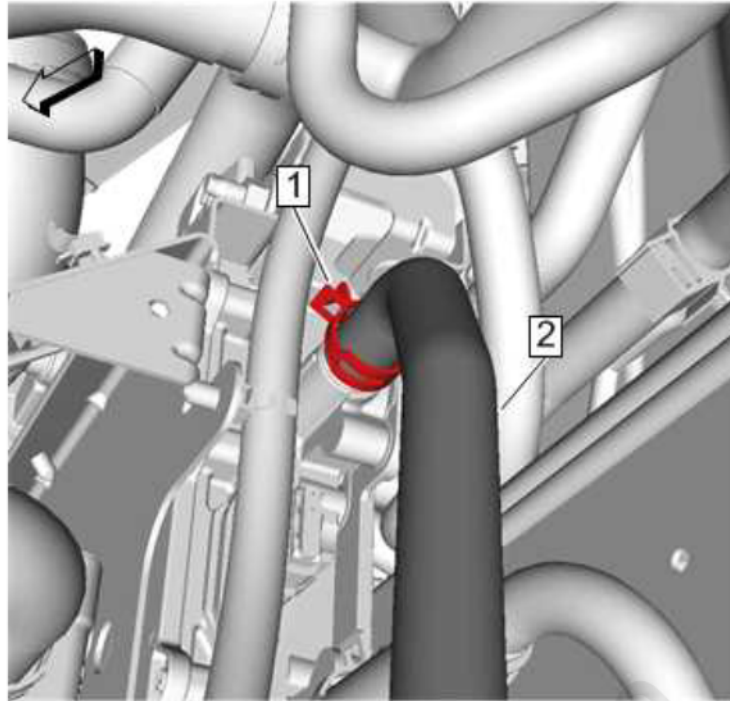


**Fig. 192: Generator Control Module Coolant Radiator Hose Clamp**  
Courtesy of GENERAL MOTORS COMPANY

8. Generator Control Module Coolant Radiator Hose (2) @ Accessory DC Power Control Module» Remove  
9. Generator Control Module Coolant Radiator Hose (2)» Remove

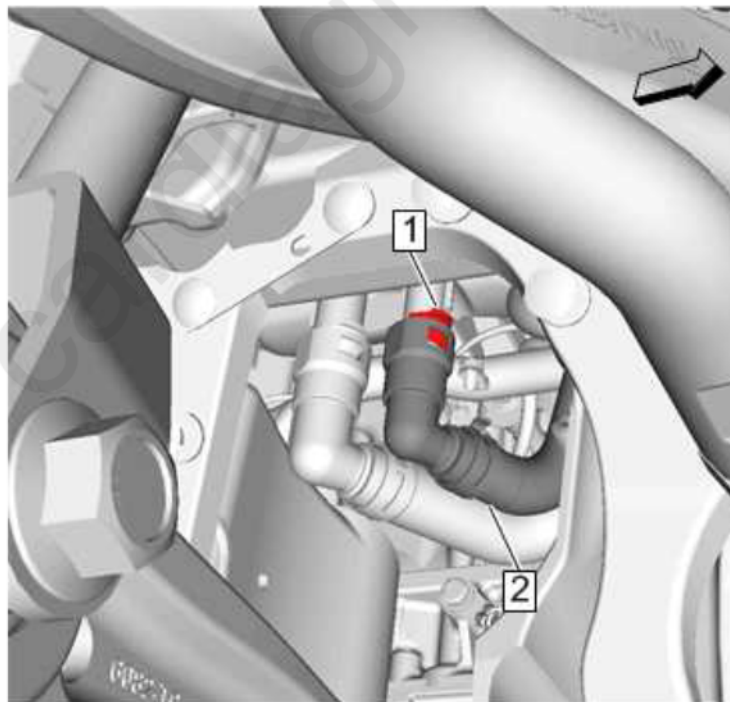


1. Generator Control Module Coolant Radiator Hose (2) @ Accessory DC Power Control Module» Install



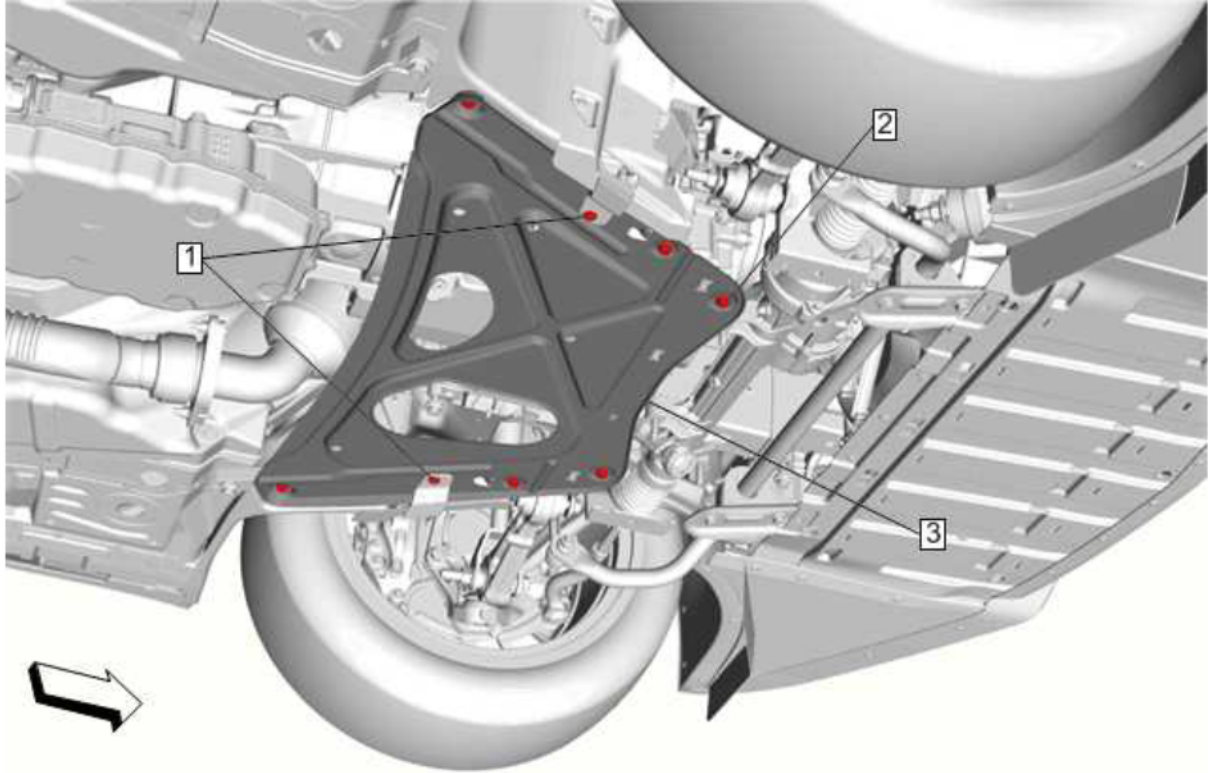
**Fig. 193: Generator Control Module Coolant Radiator Hose**  
Courtesy of GENERAL MOTORS COMPANY

2. Generator Control Module Coolant Radiator Hose Clamp (1) @ Generator Control Module Coolant Radiator Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Generator Control Module Coolant Radiator Hose (2) @ Heater Inlet Pipe Connector» Install



**Fig. 194: Generator Control Module Coolant Radiator Hose**  
Courtesy of GENERAL MOTORS COMPANY

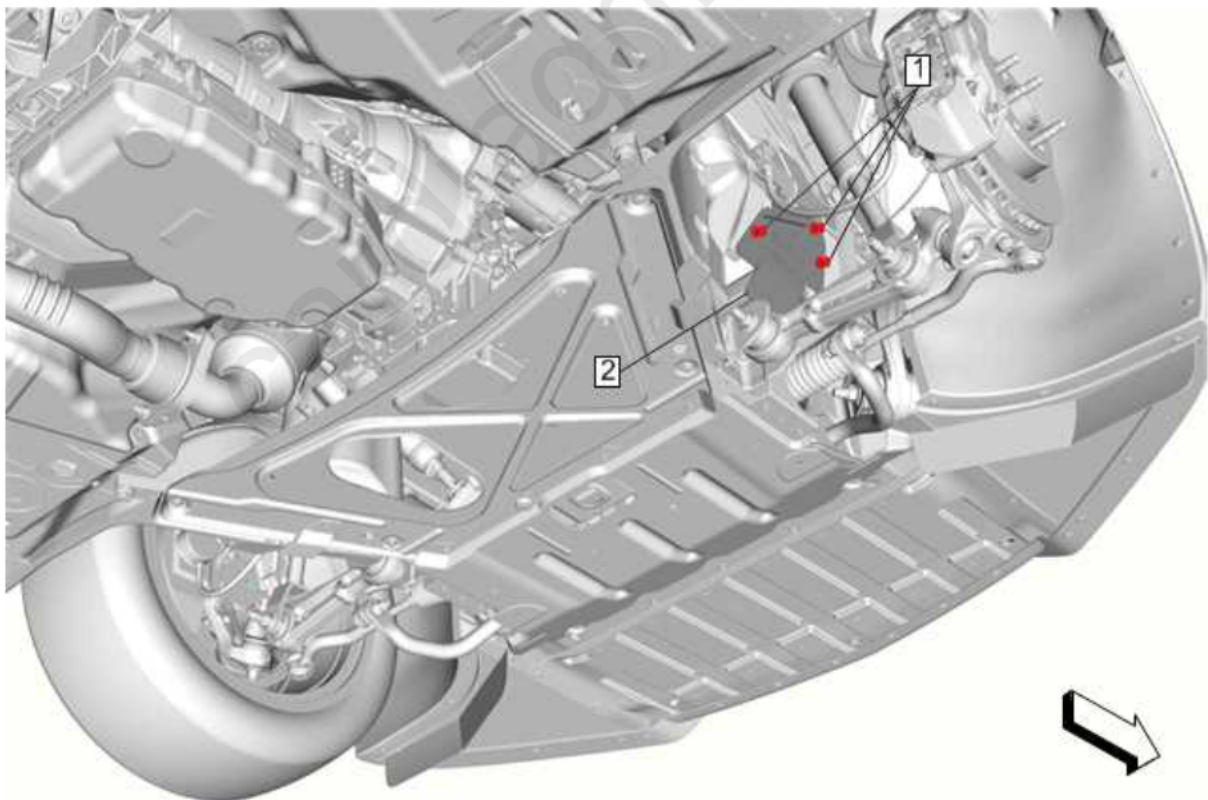
4. Generator Control Module Coolant Radiator Hose Retainer (1) @ Generator Control Module Coolant Radiator Hose» Engage
5. Drivetrain and Front Suspension Cradle Plate (3)» Install - **Drivetrain and Front Suspension Cradle Plate Replacement**



**Fig. 195: Drivetrain and Front Suspension Cradle Plate**

Courtesy of GENERAL MOTORS COMPANY

6. Engine Lower Front Splash Shield (2)» Install - **Engine Lower Front Splash Shield Replacement (LTG)**

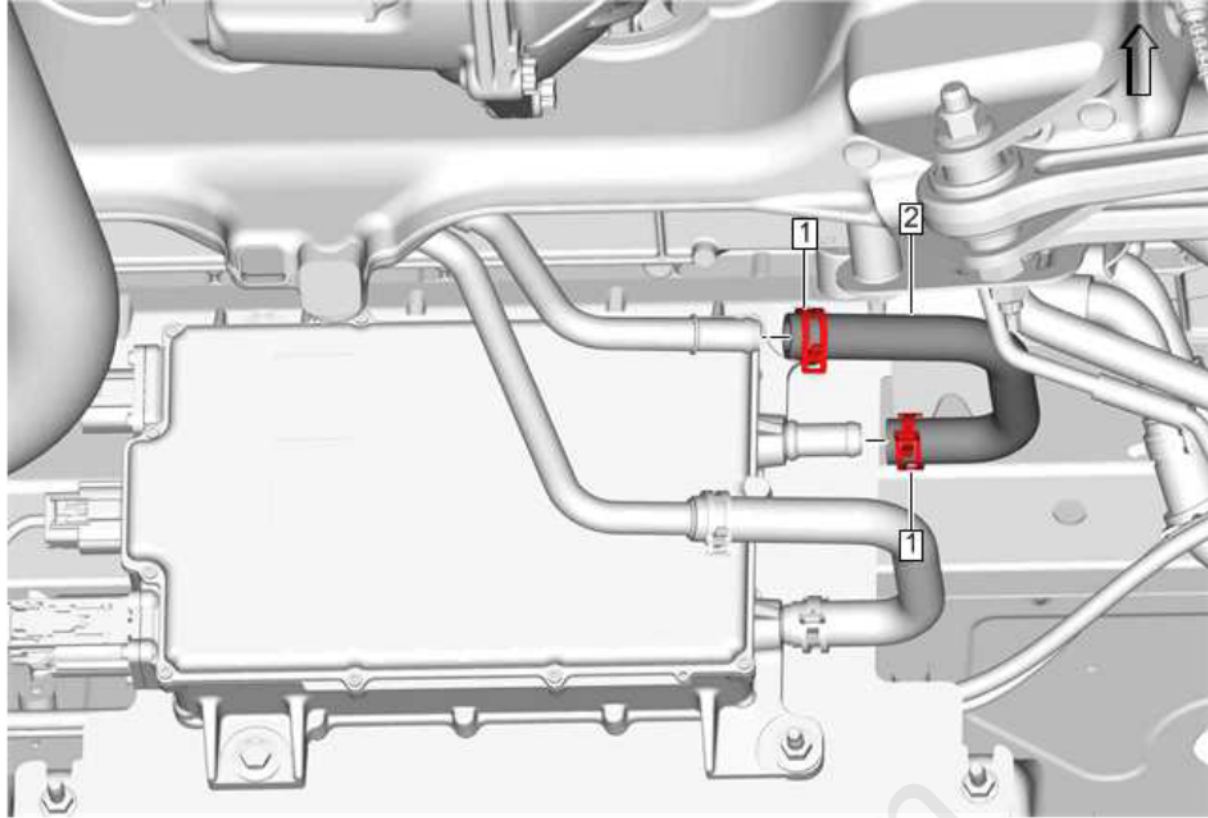


**Fig. 196: Engine Lower Front Splash Shield (LTG)**

Courtesy of GENERAL MOTORS COMPANY

7. Fill the power electronics and auxiliary radiator cooling system. Refer to **Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)**
8. Enable the high voltage system. Refer to **High Voltage Enabling**
9. Start the engine and check for coolant leaks.

**GENERATOR CONTROL MODULE COOLANT OUTLET HOSE REPLACEMENT (INLET)**



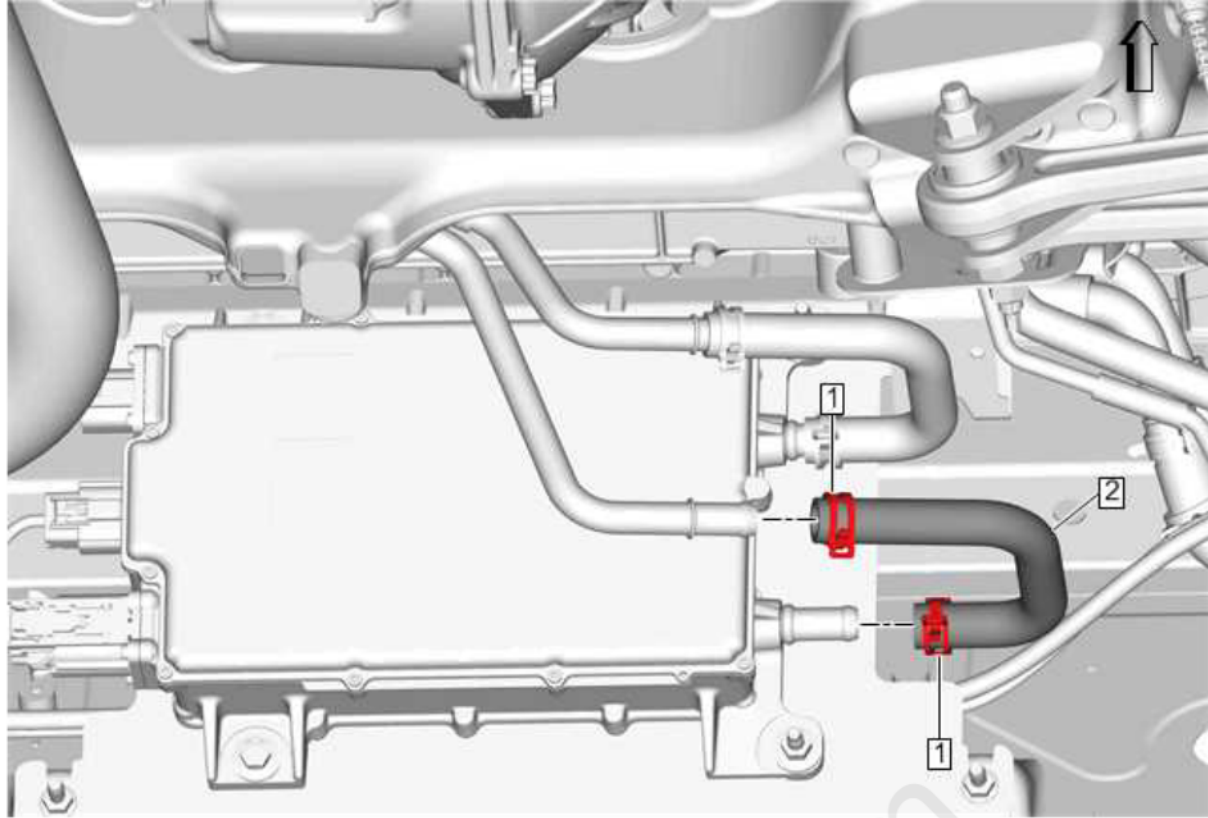
**Fig. 197: Generator Control Module Coolant Inlet Hose -- Inlet**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Generator Control Module Coolant Outlet Hose Clamp [2x]<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                          |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Generator Control Module Coolant Outlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

## GENERATOR CONTROL MODULE COOLANT OUTLET HOSE REPLACEMENT (OUTLET)





**Fig. 198: Generator Control Module Coolant Outlet Hose -- Outlet**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Generator Control Module Coolant Outlet Hose Clamp [2x]<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                          |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Generator Control Module Coolant Outlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

## GENERATOR CONTROL MODULE COOLANT PUMP REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

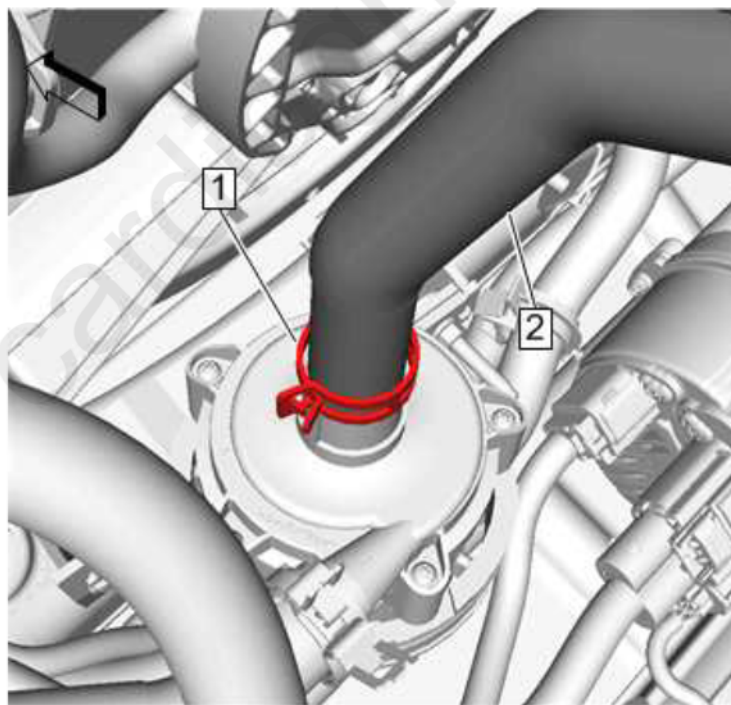
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

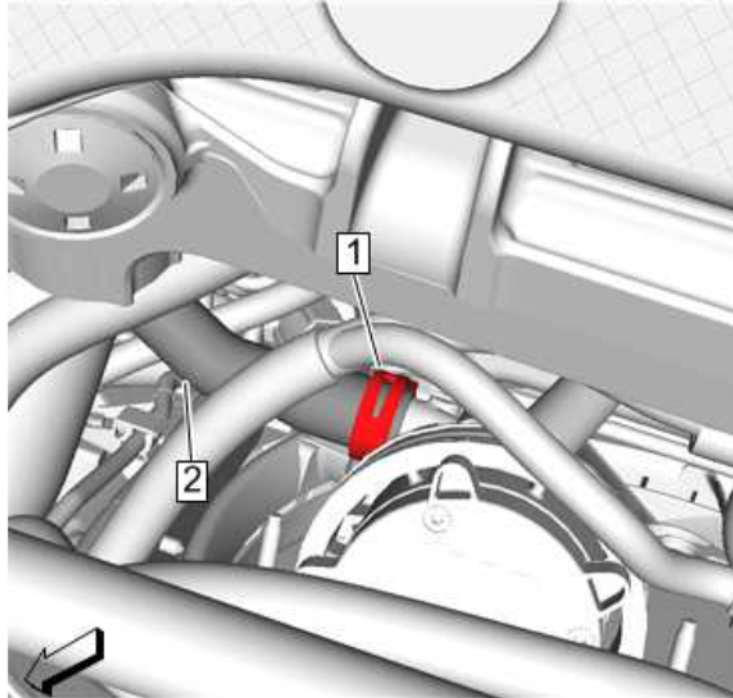
#### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant Pump» Remove - [Drive Motor Generator Control Module Coolant Pump Hose Replacement](#)



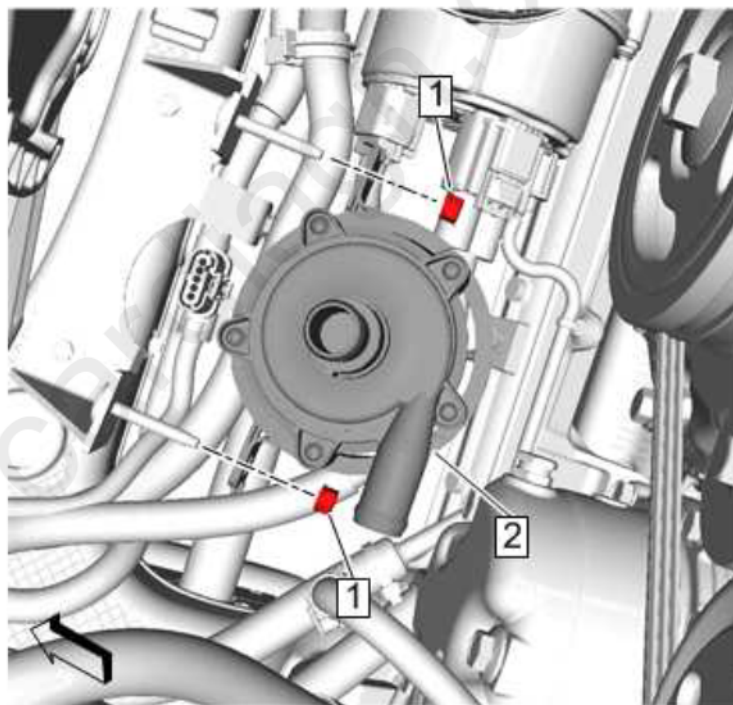
**Fig. 199: Drive Motor Generator Control Module Coolant Pump Hose Clamp**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Remove - [Drive Motor Generator Control Module Radiator Inlet Hose Replacement](#)



**Fig. 200: Drive Motor Generator Control Module Radiator Inlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

5. Electrical Connector @ Generator Control Module Coolant Pump» Disconnect
6. Generator Control Module Coolant Pump Bracket Nut (1) @ Generator Control Module Coolant Pump Bracket» Remove [2x]



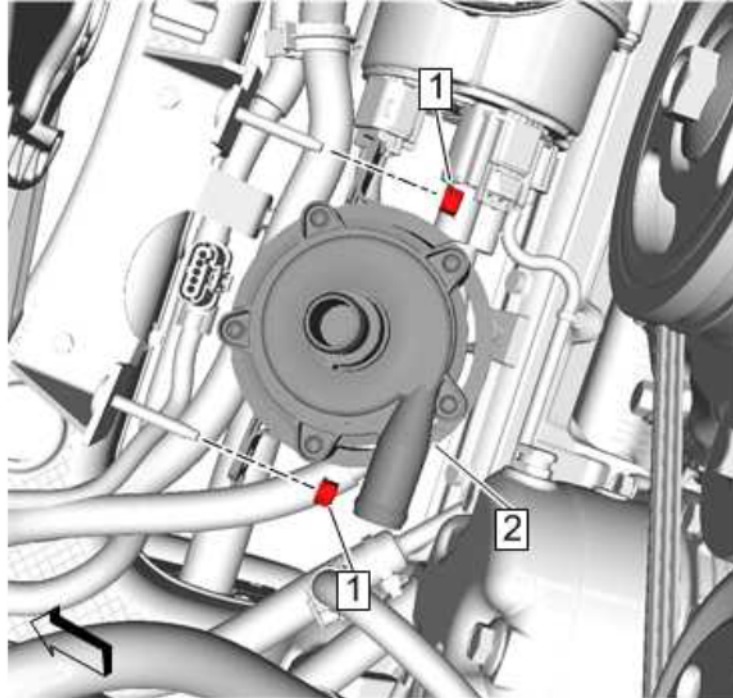
**Fig. 201: Generator Control Module Coolant Pump Bracket Nut**  
 Courtesy of GENERAL MOTORS COMPANY

7. Generator Control Module Coolant Pump (2) @ Generator Control Module Coolant Pump Bracket» Remove
8. Generator Control Module Coolant Pump (2)» Remove

### **Installation Procedure**

1. Generator Control Module Coolant Pump (2) @ Generator Control Module Coolant Pump Bracket» Install



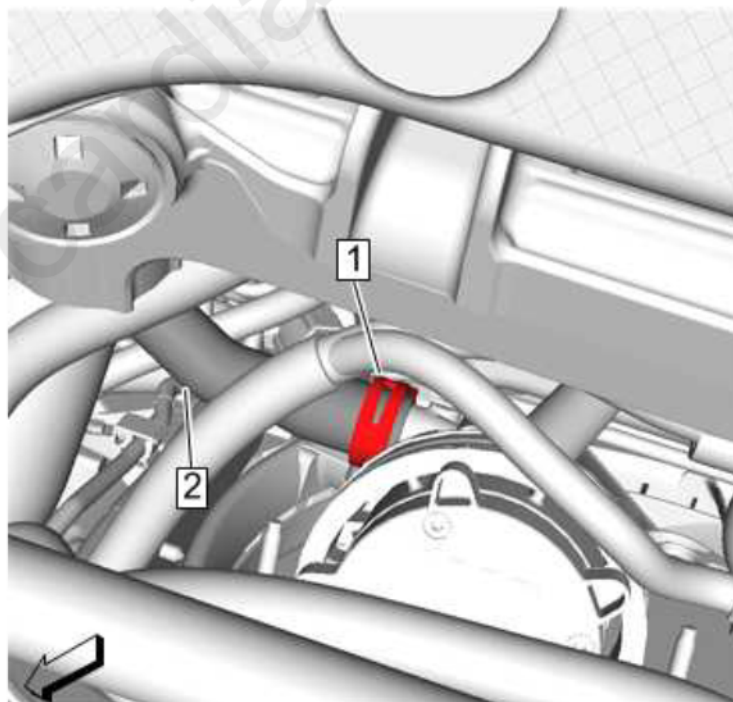


**Fig. 202: Generator Control Module Coolant Pump Bracket Nut**  
 Courtesy of GENERAL MOTORS COMPANY

2. Generator Control Module Coolant Pump Bracket Nut (1) @ Generator Control Module Coolant Pump Bracket» Install and tighten [2x] 9 N.m (80 lb in)

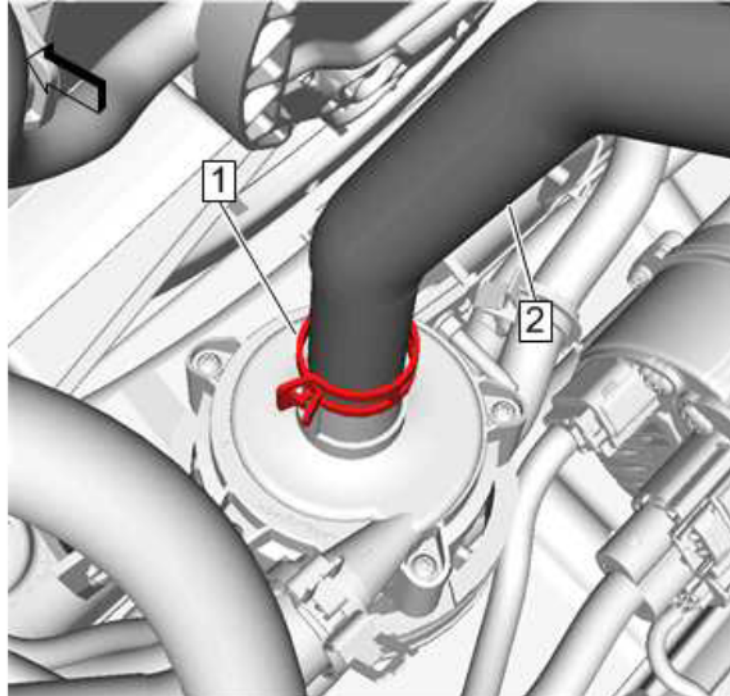
**CAUTION:** Refer to **Fastener Caution** .

3. Electrical Connector @ Generator Control Module Coolant Pump» Connect
4. Drive Motor Generator Control Module Radiator Inlet Hose (2) @ Generator Control Module Coolant Pump» Install - **Drive Motor Generator Control Module Radiator Inlet Hose Replacement**



**Fig. 203: Drive Motor Generator Control Module Radiator Inlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

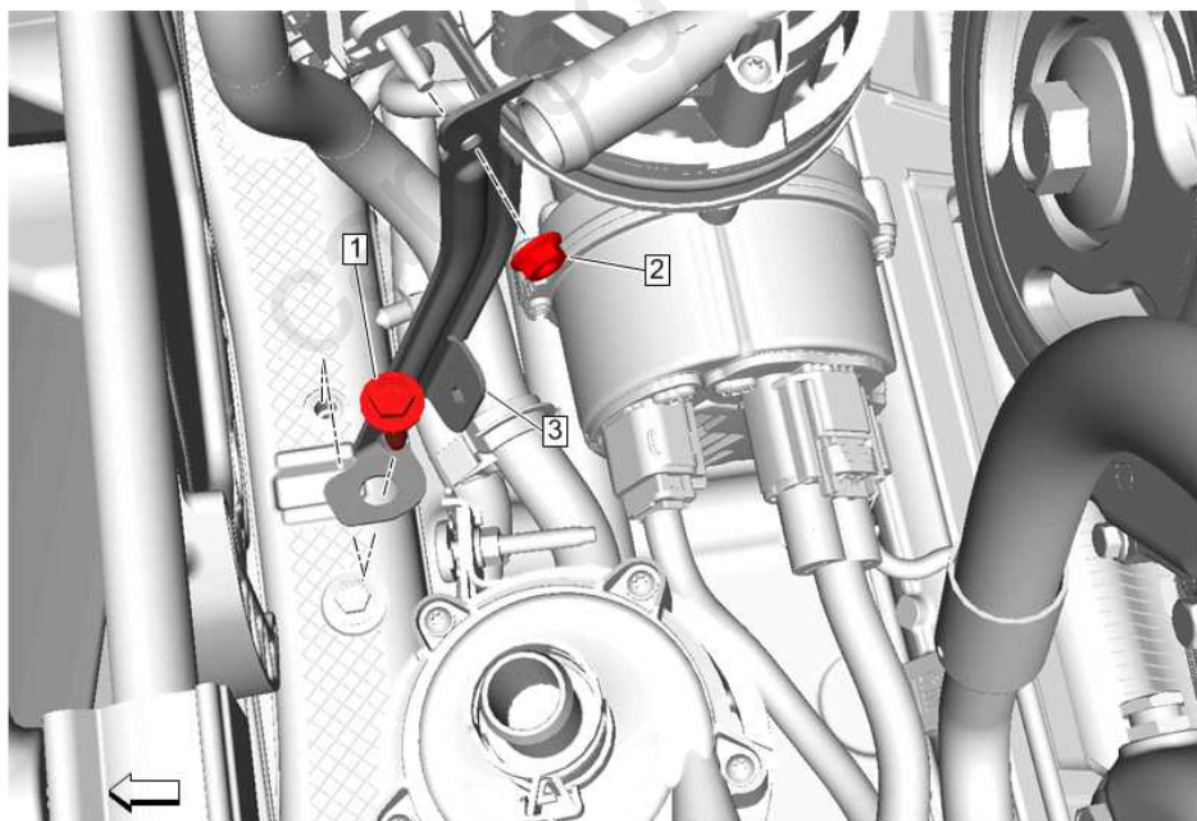
5. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant Pump» Install - **Drive Motor Generator Control Module Coolant Pump Hose Replacement**



**Fig. 204: Drive Motor Generator Control Module Coolant Pump Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

6. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)
8. Start the engine and check for coolant leaks.

### **GENERATOR CONTROL MODULE COOLANT PUMP BRACKET REPLACEMENT (AT HEATER COOLANT PUMP)**



**Fig. 205: Generator Control Module Coolant Pump Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout                                          | Component Name |
|--------------------------------------------------|----------------|
| Preliminary Procedure                            |                |
| <a href="#">Air Cleaner Assembly Replacement</a> |                |

| Callout | Component Name                                                                                                                                                          |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Generator Control Module Coolant Pump Bracket Bolt<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>9 N.m (80 lb in)      |
| 2       | Generator Control Module Coolant Pump Bracket Nut<br><b>Tighten</b><br>9 N.m (80 lb in)                                                                                 |
| 3       | Generator Control Module Coolant Pump Bracket<br><b>Preliminary Procedure</b><br>Engine Wiring Harness Retainer @ Generator Control Module Coolant Pump Bracket» Remove |

## GENERATOR CONTROL MODULE COOLANT PUMP BRACKET REPLACEMENT (AT GENERATOR CONTROL MODULE COOLANT PUMP)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

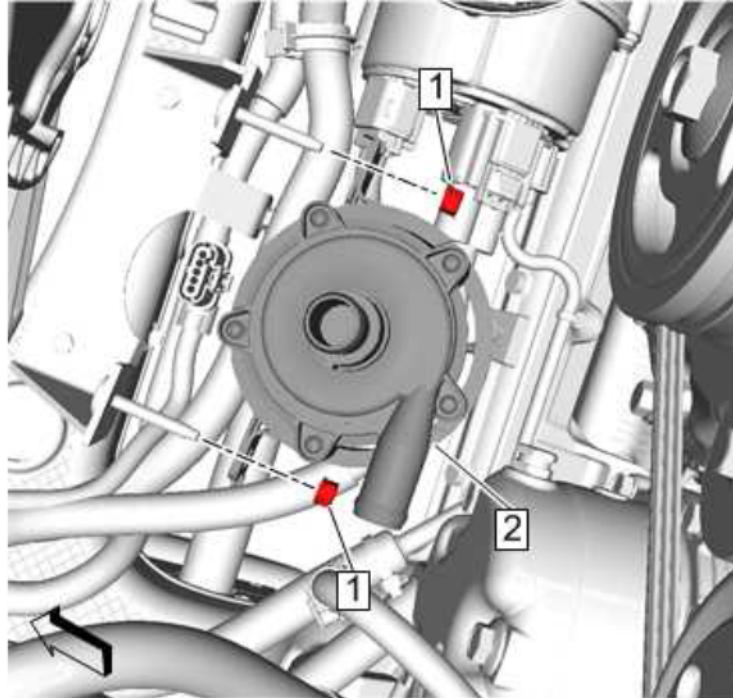
Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

### Removal Procedure

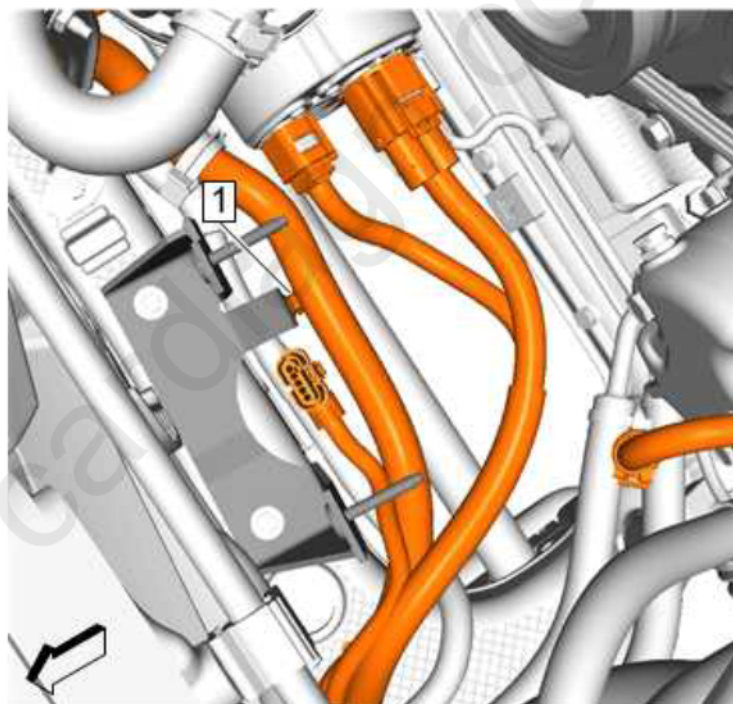
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Generator Control Module Coolant Pump (2) @ Generator Control Module Coolant Pump Bracket» Remove - [Generator Control Module Coolant Pump Replacement](#)





**Fig. 206: Generator Control Module Coolant Pump Bracket Nut**  
 Courtesy of GENERAL MOTORS COMPANY

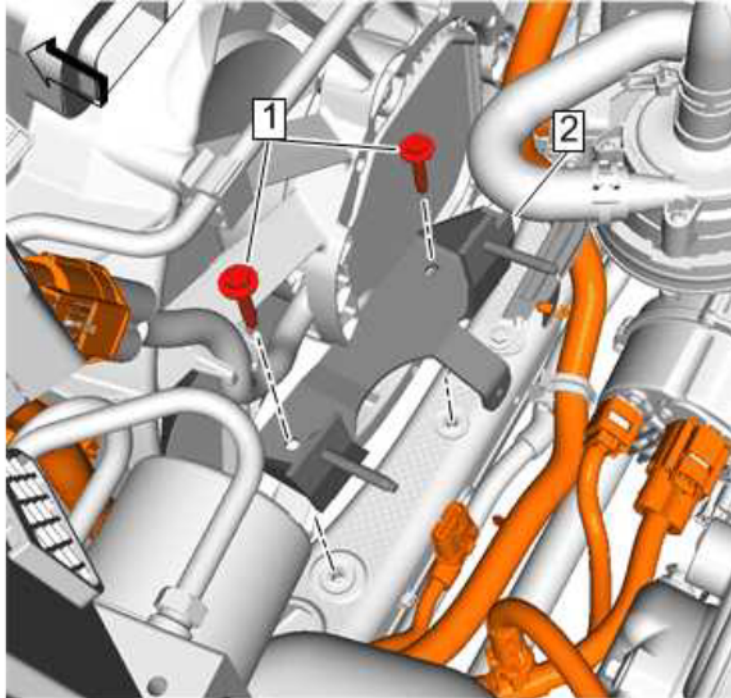
4. Engine Wiring Harness Retainer (1) @ Generator Control Module Coolant Pump Bracket» Remove



**Fig. 207: Engine Wiring Harness Retainer**  
 Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Pump Bracket Bolt (1) @ Generator Control Module Coolant Pump Bracket» Remove [2x]



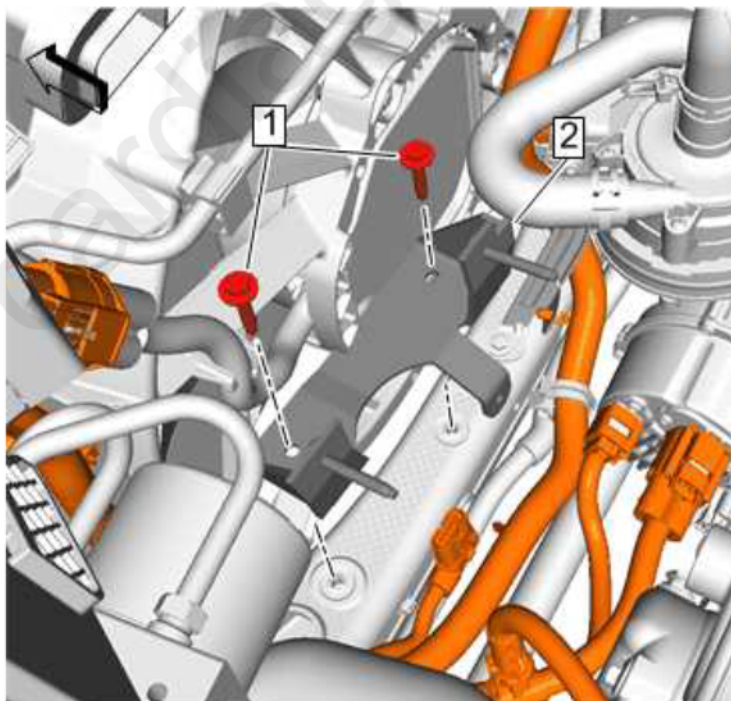


**Fig. 208: Generator Control Module Coolant Pump Bracket Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Pump Bracket (2) @ Drivetrain and Front Suspension Cradle» Remove
7. Generator Control Module Coolant Pump Bracket (2)» Remove

#### Installation Procedure

1. Generator Control Module Coolant Pump Bracket (2) @ Drivetrain and Front Suspension Cradle» Install

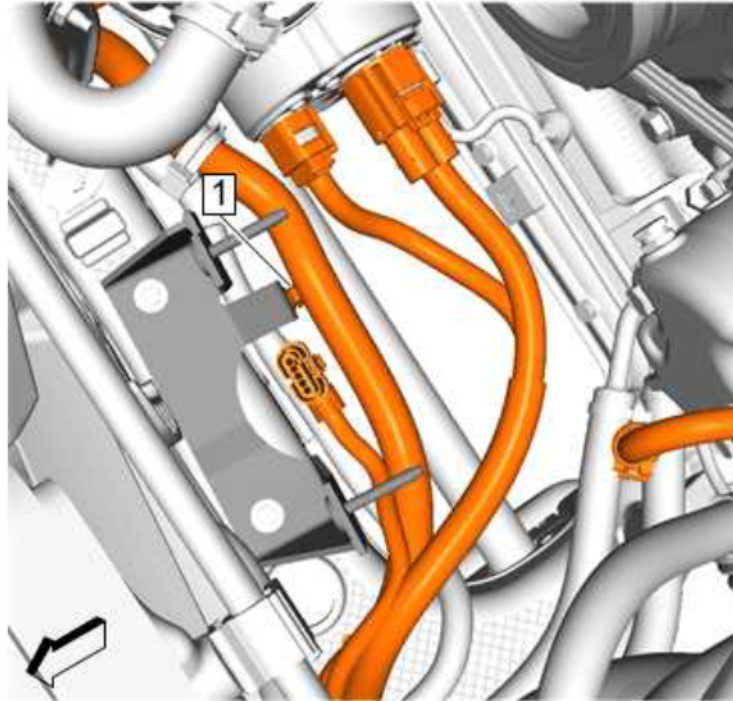


**Fig. 209: Generator Control Module Coolant Pump Bracket Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

2. Generator Control Module Coolant Pump Bracket Bolt (1) @ Generator Control Module Coolant Pump Bracket» Install and tighten [2x] 9 N.m (80 lb in)

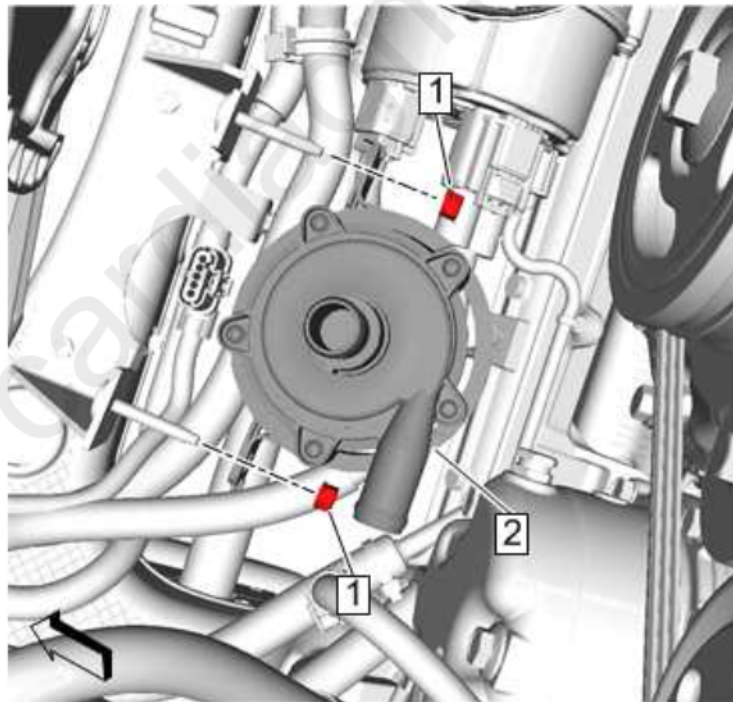
**CAUTION:** Refer to **Fastener Caution** .

3. Engine Wiring Harness Retainer (1) @ Generator Control Module Coolant Pump BracketA» Install



**Fig. 210: Engine Wiring Harness Retainer**  
Courtesy of GENERAL MOTORS COMPANY

4. Generator Control Module Coolant Pump (2) @ Generator Control Module Coolant Pump BracketA» Install - **Generator Control Module Coolant Pump Replacement**



**Fig. 211: Generator Control Module Coolant Pump Bracket Nut**  
Courtesy of GENERAL MOTORS COMPANY

5. Enable the high voltage system. Refer to **High Voltage Enabling**
6. Fill the power electronics and auxiliary radiator cooling system. Refer to **Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)**
7. Start the engine and check for coolant leaks.

## **GENERATOR CONTROL MODULE COOLANT RADIATOR BRACKET REPLACEMENT**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection

Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

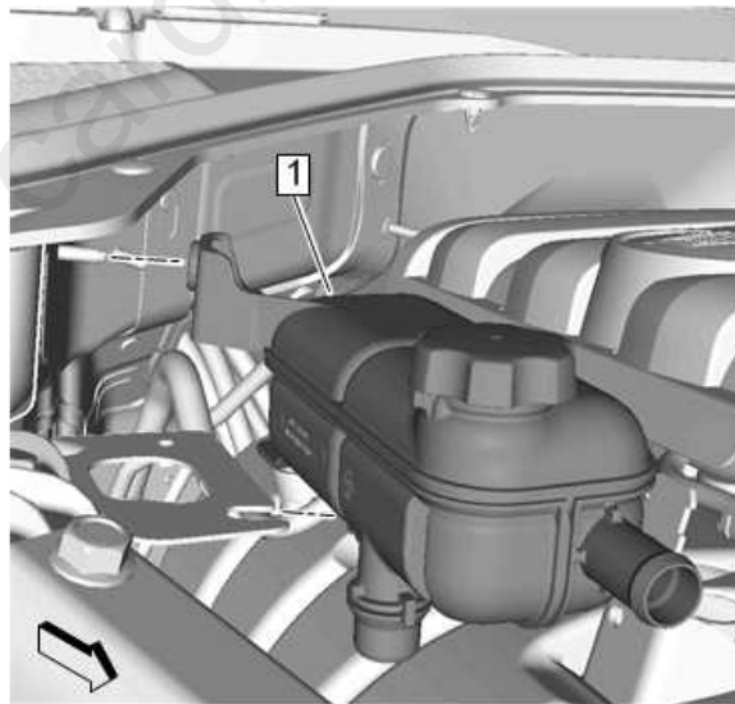
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

#### Removal Procedure

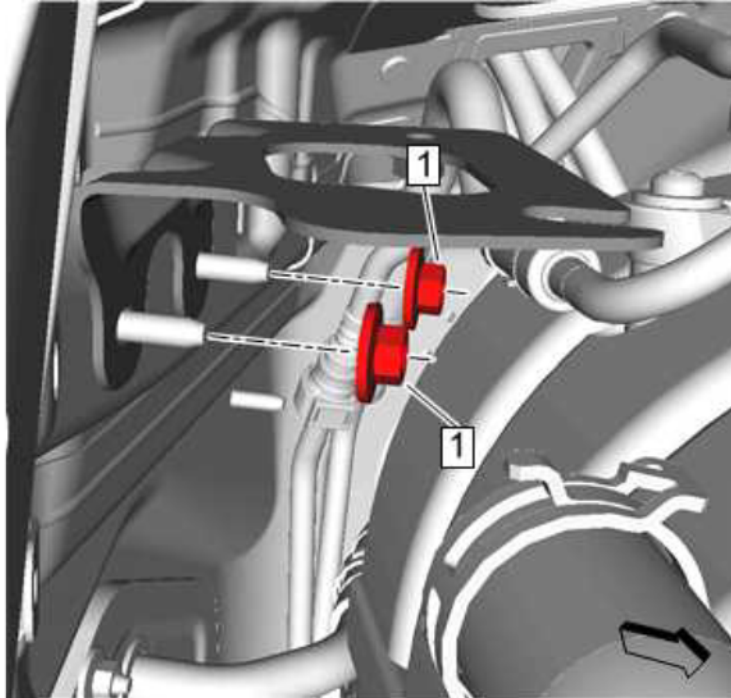
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Generator Control Module Coolant/Air Separator (1) » Remove - [Generator Control Module Coolant/Air Separator Replacement](#)



**Fig. 212: Generator Control Module Coolant/Air Separator**  
Courtesy of GENERAL MOTORS COMPANY

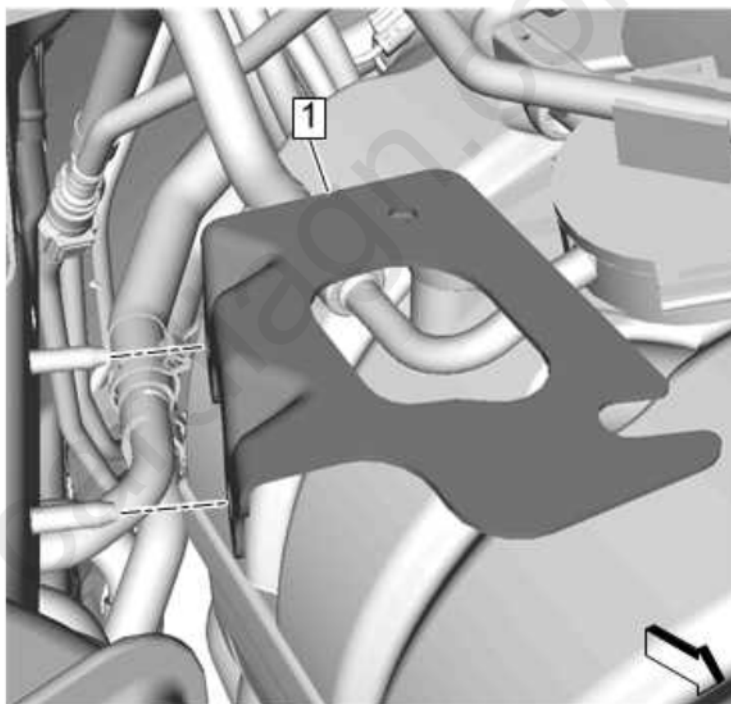
4. Generator Control Module Coolant Radiator Bracket Nut (1) @ Generator Control Module Coolant Radiator Bracket » Remove [2x]





**Fig. 213: Generator Control Module Coolant Radiator Bracket Nut**  
 Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Radiator Bracket (1)» Remove

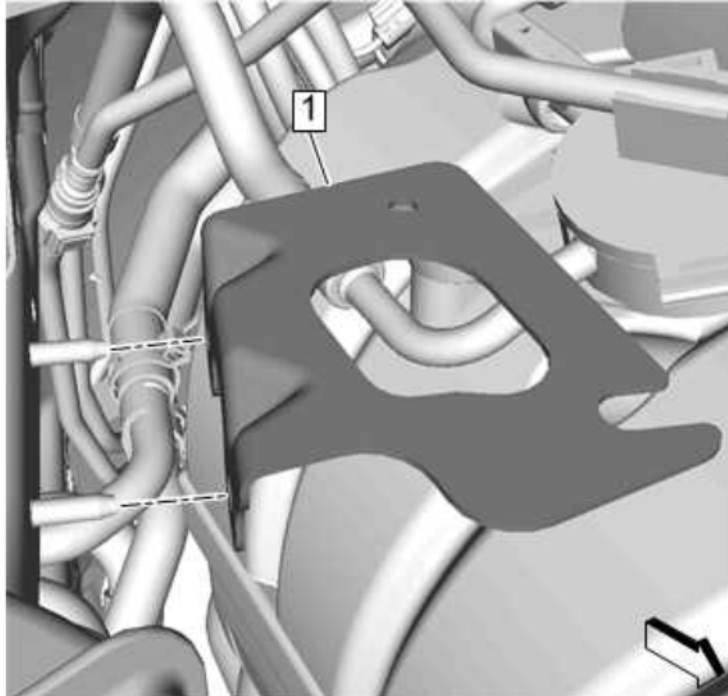


**Fig. 214: Generator Control Module Coolant Radiator Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

#### **Installation Procedure**

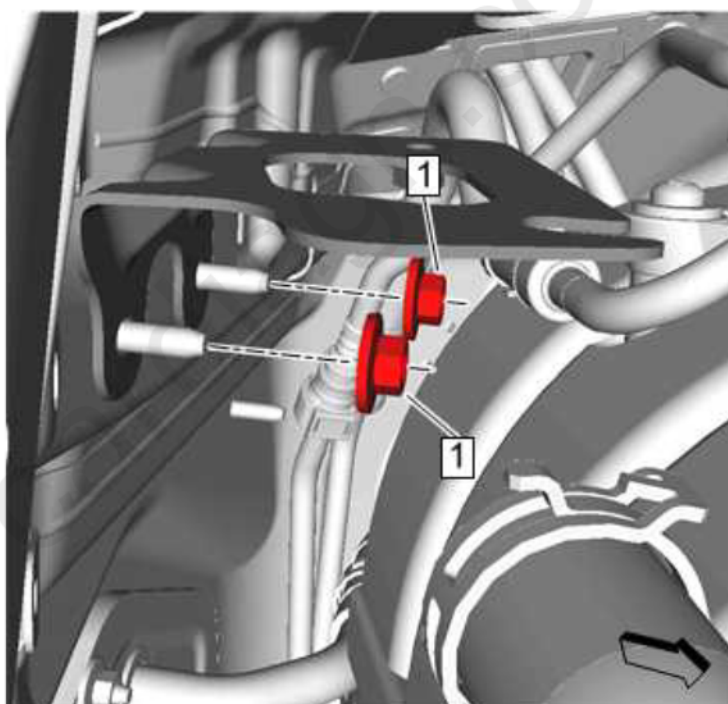
1. Generator Control Module Coolant Radiator Bracket (1)» Install





**Fig. 215: Generator Control Module Coolant Radiator Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

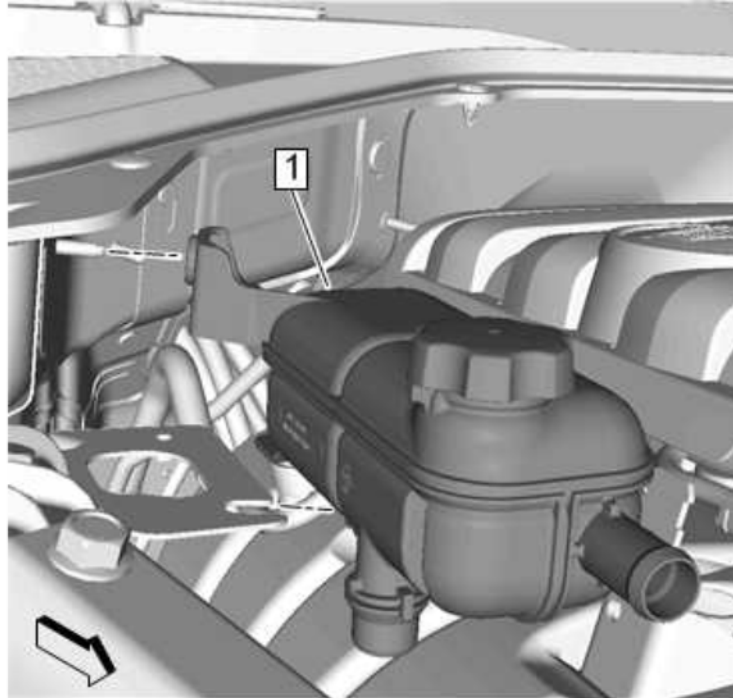
2. Generator Control Module Coolant Radiator Bracket Nut (1) @ Generator Control Module Coolant Radiator Bracket» Install and tighten [2x] 9 N.m (80 lb in)



**Fig. 216: Generator Control Module Coolant Radiator Bracket Nut**  
 Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to [Fastener Caution](#) .

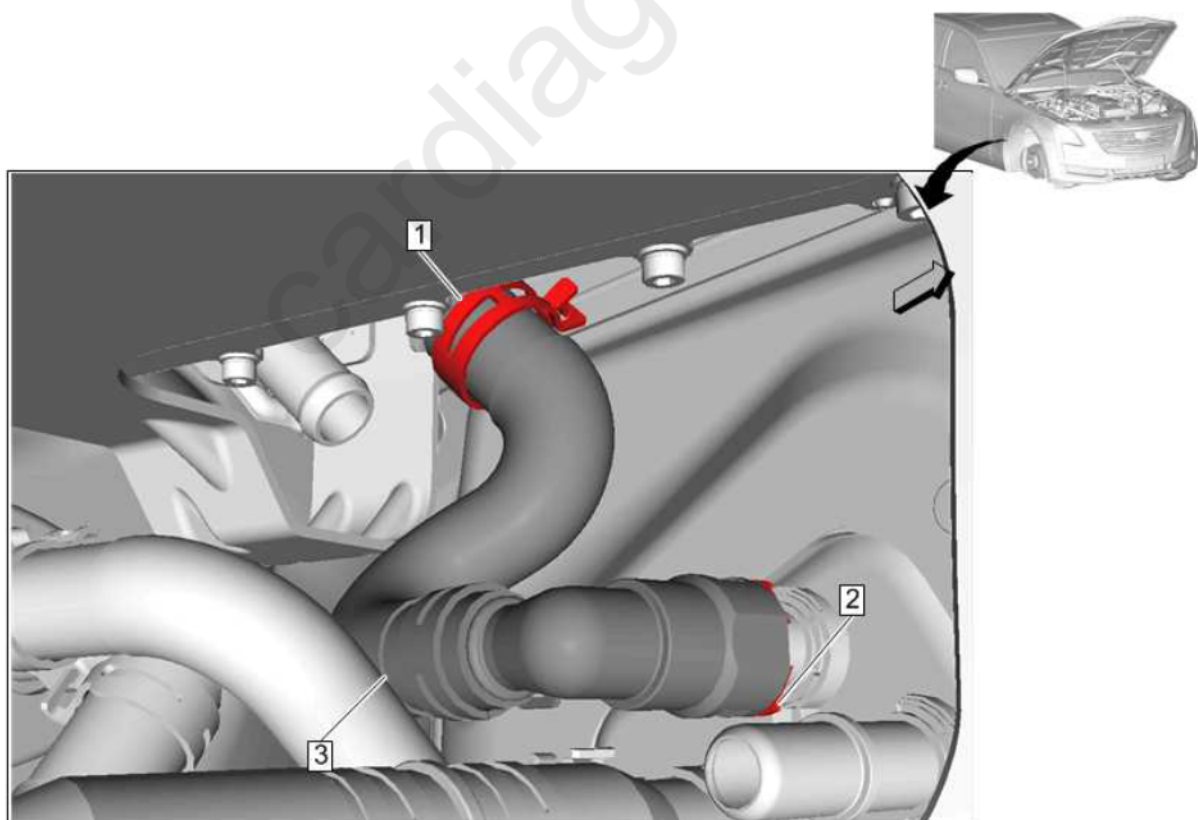
3. Generator Control Module Coolant/Air Separator (1)» Install - [Generator Control Module Coolant/Air Separator Replacement](#)



**Fig. 217: Generator Control Module Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

4. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
5. Enable the high voltage system. Refer to [High Voltage Enabling](#)
6. Start the engine and check for coolant leaks.

**DRIVE MOTOR POWER INVERTER MODULE COOLING INLET HOSE REPLACEMENT  
 (DRIVE MOTOR POWER INVERTER MODULE TO HEATER INLET PIPE CONNECTOR)**

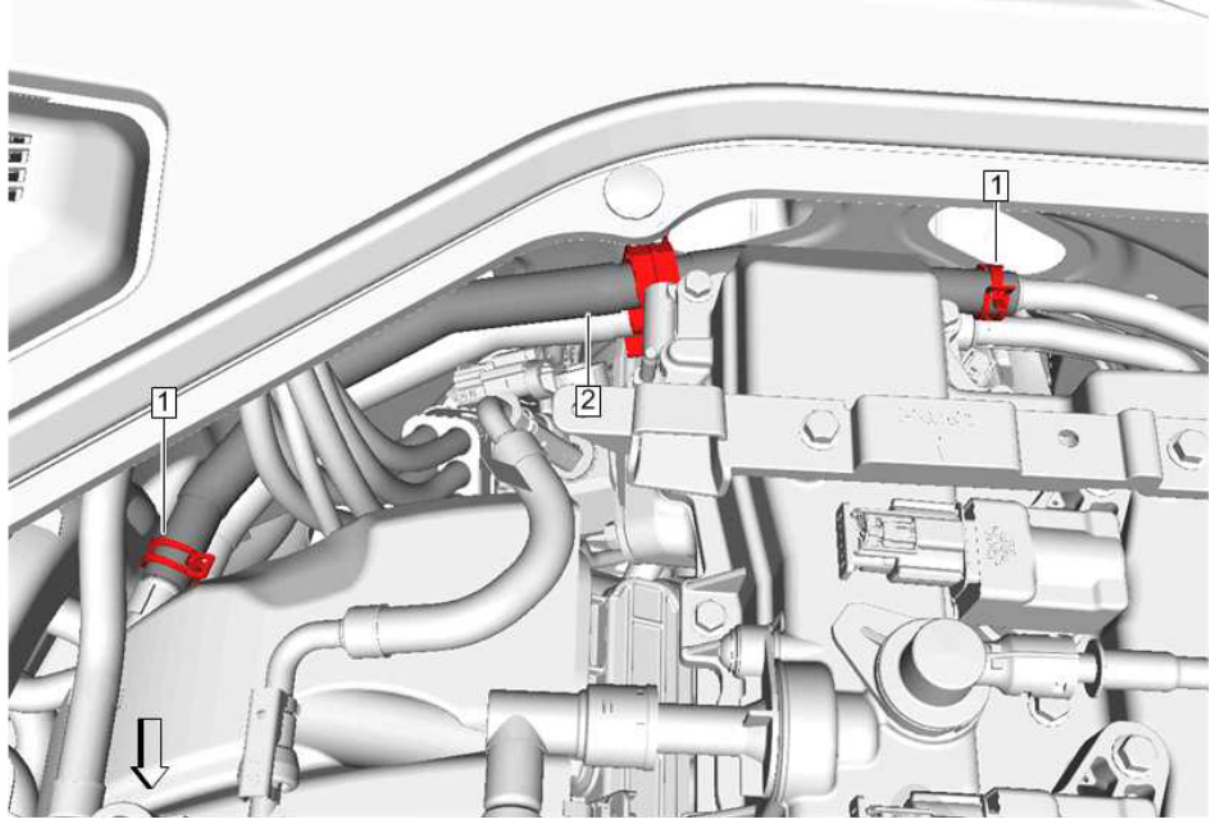


**Fig. 218: Drive Motor Power Inverter Module Cooling Inlet Hose (Drive Motor Power Inverter Module to Heater Inlet Pipe Connector)**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>3. <a href="#">Drive Motor Generator Control Module Cooling Outlet Hose Replacement</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Drive Motor Power Inverter Module Cooling Inlet Hose Clamp<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                               |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Drive Motor Power Inverter Module Cooling Inlet Hose Retainer<br><b>Procedure</b><br>Squeeze the plastic quick connect fitting release tabs.                                                                                                                                                                                                                                                                                                    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Drive Motor Power Inverter Module Cooling Inlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

**DRIVE MOTOR POWER INVERTER MODULE COOLING INLET HOSE REPLACEMENT (HEATER INLET PIPE CONNECTOR AUXILIARY AIR CONDITIONING EVAPORATOR INTERMEDIATE TUBE TO HEATER INLET PIPE CONNECTOR)**



**Fig. 219: Drive Motor Power Inverter Module Cooling Inlet Hose (Heater Inlet Pipe Connector Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector)**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |



**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

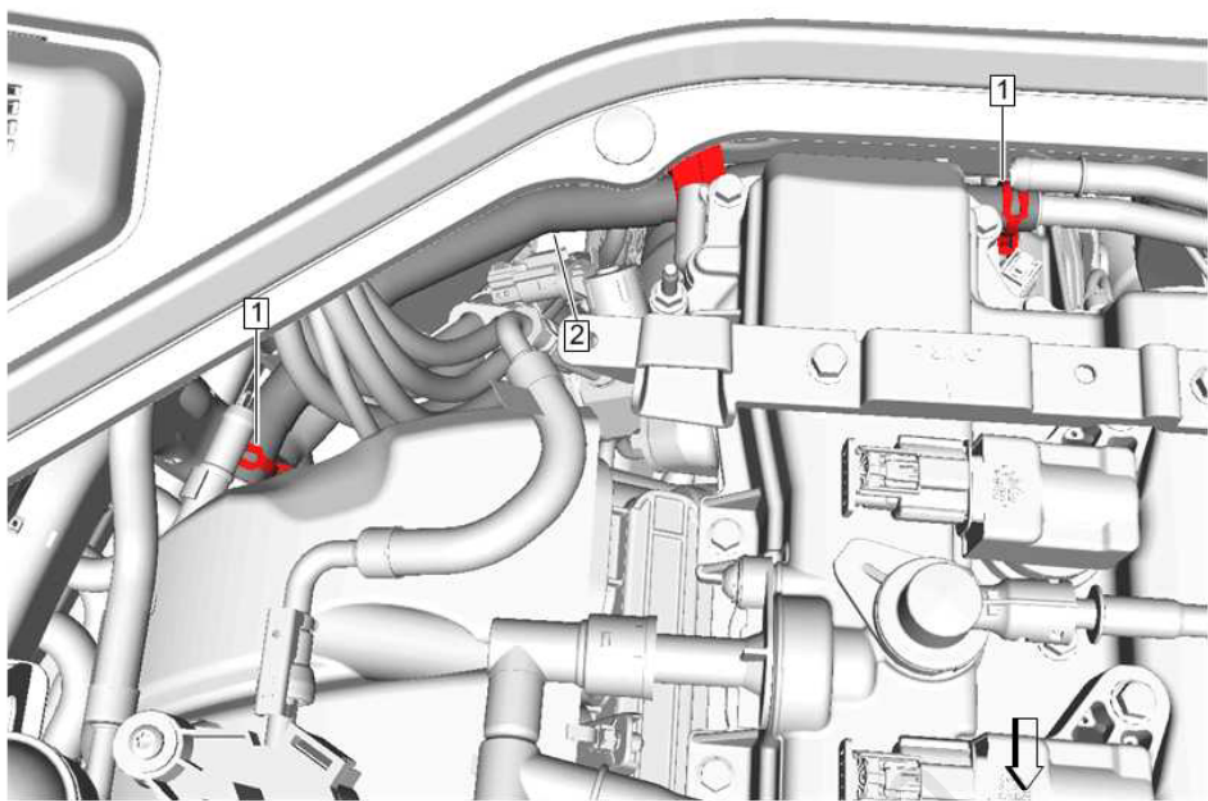
**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

**Preliminary Procedures**

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. [Intake Manifold Cover Replacement](#)

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Drive Motor Power Inverter Module Cooling Inlet Hose Clamp [2x]<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 2 | Drive Motor Power Inverter Module Cooling Inlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Drive Motor Power Inverter Module Cooling Inlet Hose @ Generator Control Module Coolant Pipe Clip » Remove - <a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Drive Motor Power Inverter Module to Heater Inlet Pipe Connector)</a><a href="#">Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (Heater Inlet Pipe Connector Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector)</a></li> <li>2. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>3. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>4. Inspect for coolant leaks.</li> </ol> |



**Fig. 220: Drive Motor Power Inverter Module Cooling Outlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

**Preliminary Procedures**

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. [Intake Manifold Cover Replacement](#)
4. [Drive Motor Power Inverter Module Cooling Inlet Hose Replacement \(Drive Motor Power Inverter Module to Heater Inlet Pipe Connector\)](#)[Drive Motor Power Inverter Module Cooling Inlet Hose Replacement \(Heater Inlet Pipe Connector Auxiliary Air Conditioning Evaporator Intermediate Tube to Heater Inlet Pipe Connector\)](#)

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Drive Motor Power Inverter Module Cooling Outlet Hose Clamp [2x]<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                                                                                                                              |
| 2 | Drive Motor Power Inverter Module Cooling Outlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Drive Motor Power Inverter Module Cooling Outlet Hose @ Generator Control Module Coolant Pipe Clip» Remove</li> <li>2. Fill the power electronics and auxiliary radiator cooling system. Refer to <a href="#">Power Electronics and Auxiliary Radiator Drain and Fill (LTG HP9)</a></li> <li>3. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>4. Inspect for coolant leaks.</li> </ol> |



**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

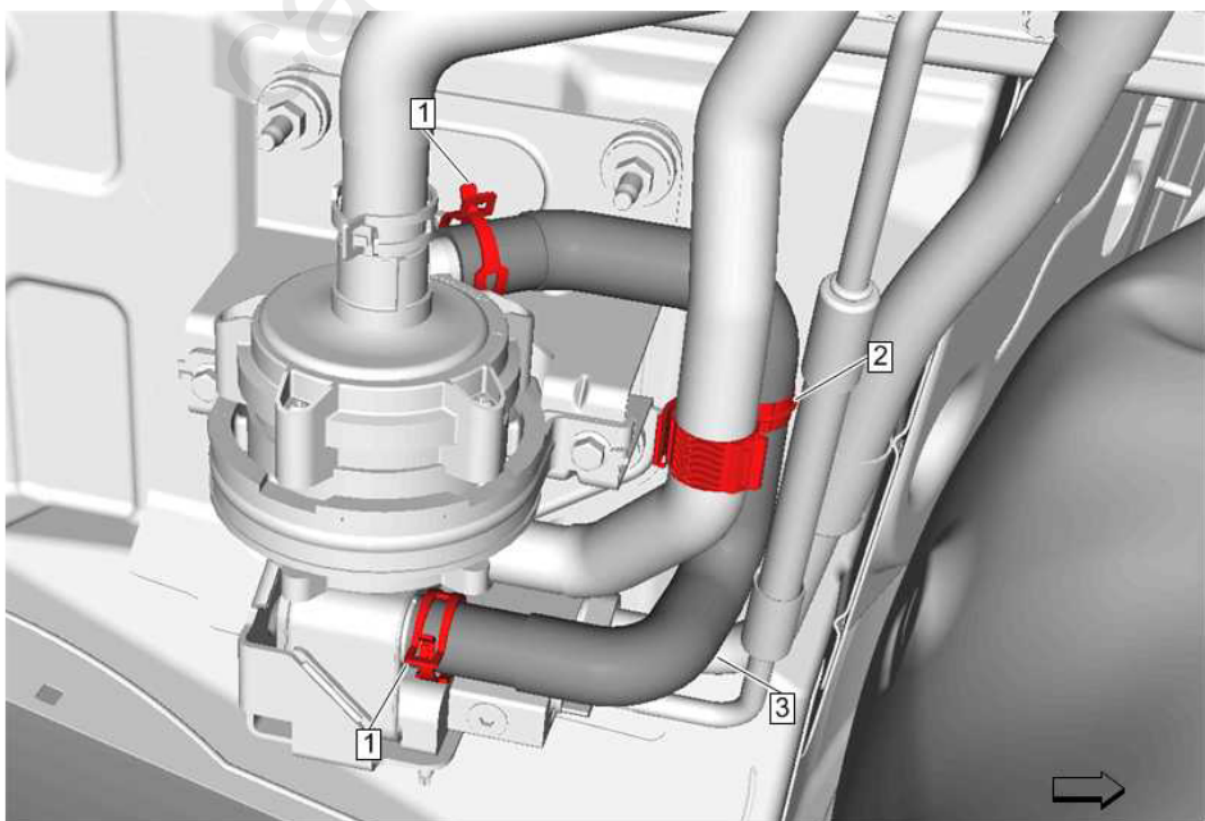
Failure to follow the procedures may result in serious injury or death.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

**Removal Procedure**

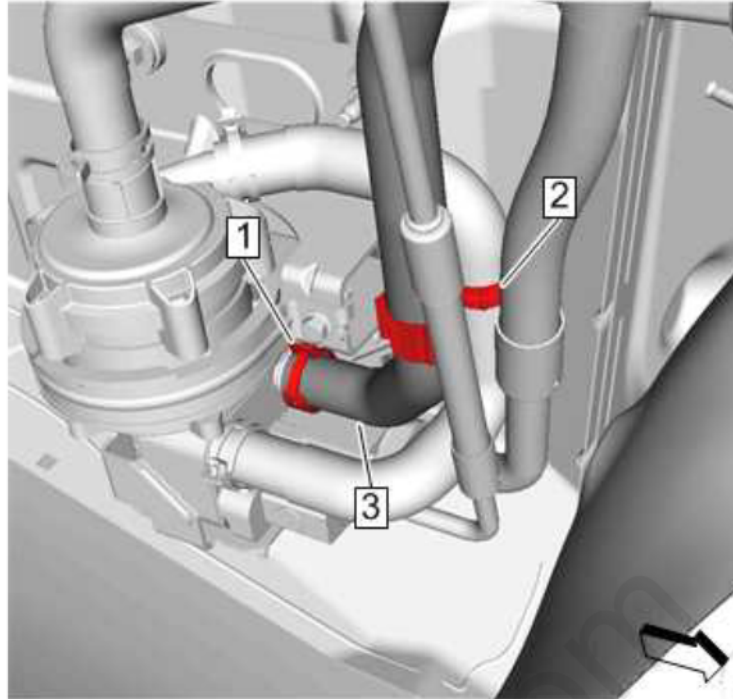
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. Drive Motor Battery Coolant Cooler Outlet Hose (3) @ Drive Motor Battery Coolant Cooler» Remove - [Drive Motor Battery Coolant Cooler Outlet Hose Replacement](#)





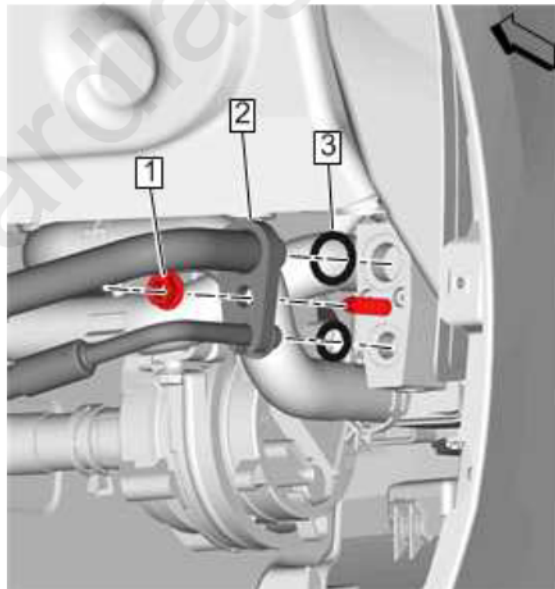
**Fig. 221: Drive Motor Battery Coolant Cooler Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Radiator Inlet Hose (3) @ Drive Motor Battery Coolant Cooler» Remove - **Drive Motor Battery Radiator Inlet Hose Replacement**



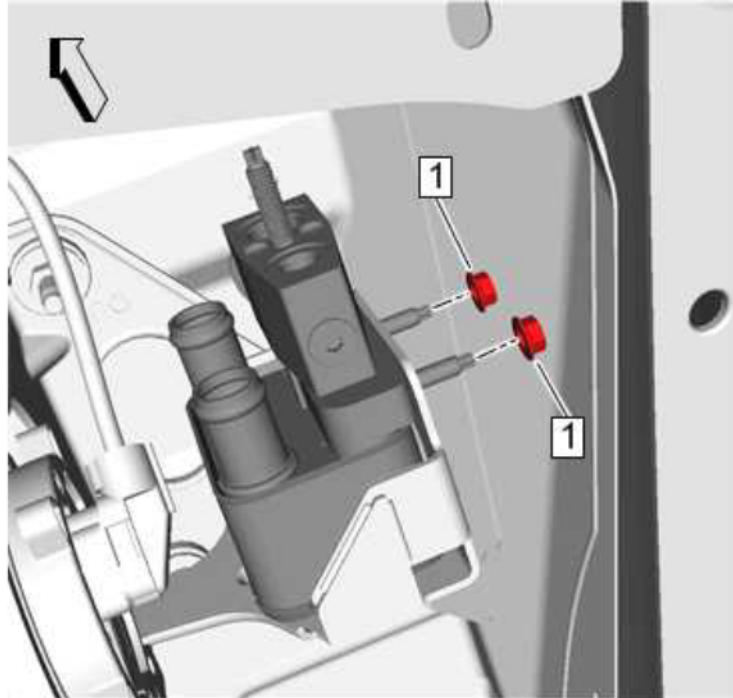
**Fig. 222: Drive Motor Battery Radiator Inlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

5. Auxiliary Air Conditioning Evaporator Intermediate Tube (2) @ Air Conditioning Evaporator Thermal Expansion Valve» Remove - **Auxiliary Air Conditioning Evaporator Intermediate Tube Replacement (With HP9)**



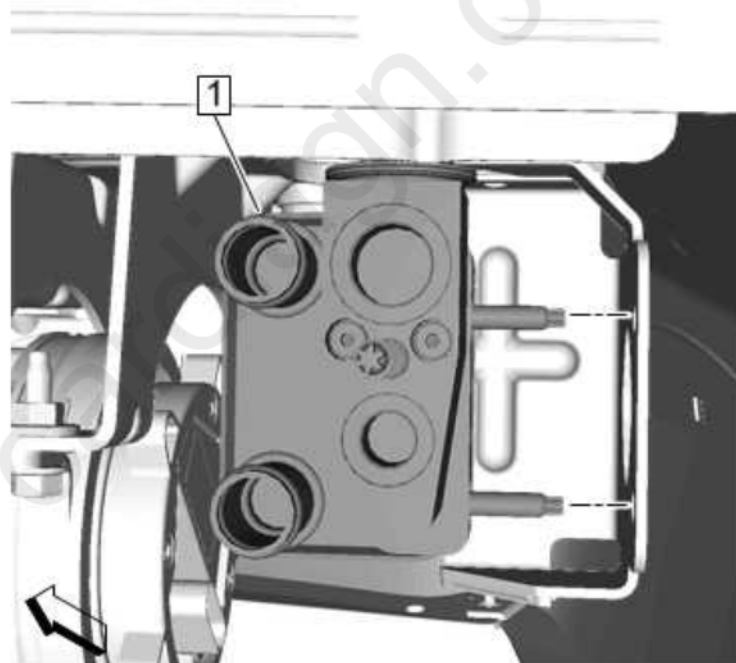
**Fig. 223: Sealing Washers**  
Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Battery Coolant Cooler Nut (1) @ Drive Motor Battery Coolant Cooler» Remove [2x]



**Fig. 224: Drive Motor Battery Coolant Cooler Nut**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Drive Motor Battery Coolant Cooler (1) @ Drive Motor Battery Coolant Cooler Bracket» Remove

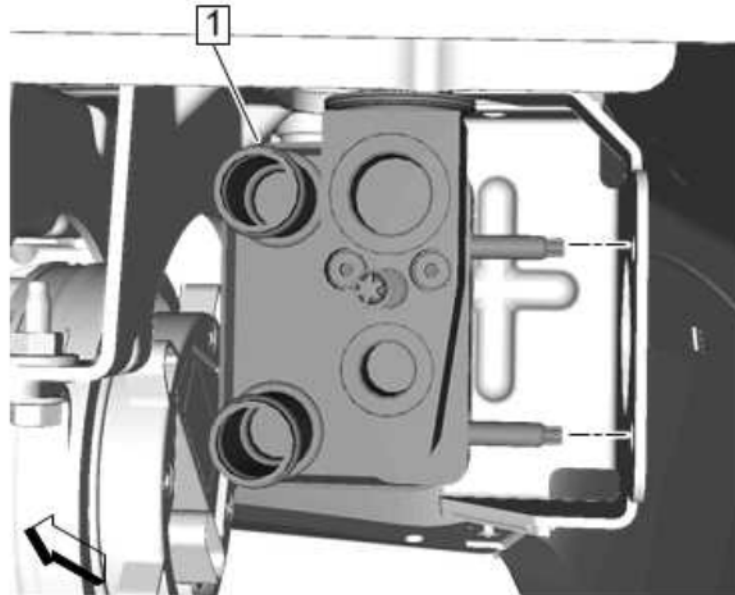


**Fig. 225: Drive Motor Battery Coolant Cooler**  
**Courtesy of GENERAL MOTORS COMPANY**

8. Drive Motor Battery Coolant Cooler (1)» Remove

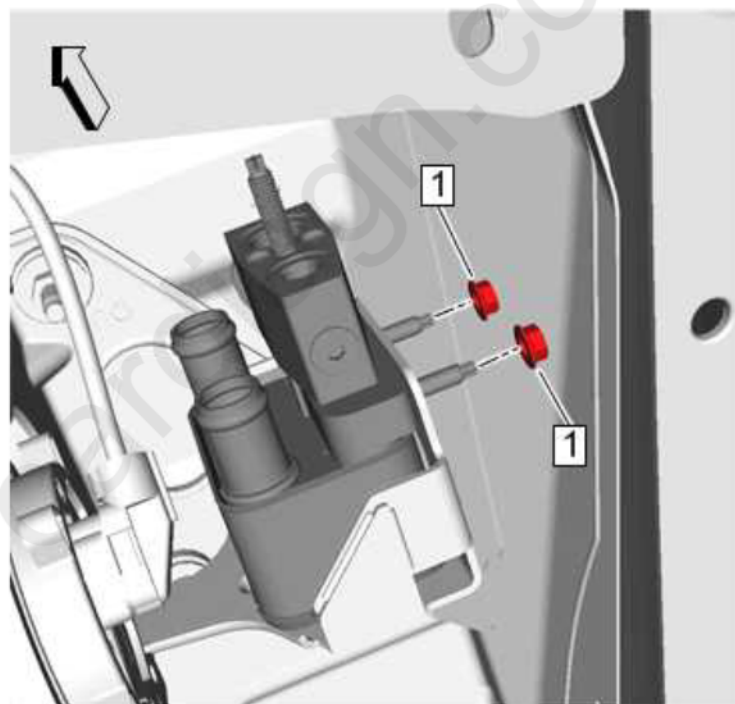
### **Installation Procedure**

1. Drive Motor Battery Coolant Cooler (1) @ Drive Motor Battery Coolant Cooler Bracket» Install



**Fig. 226: Drive Motor Battery Coolant Cooler**  
 Courtesy of GENERAL MOTORS COMPANY

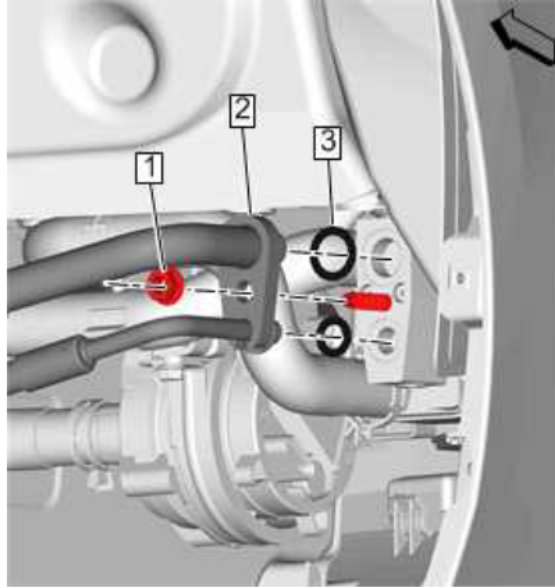
2. Drive Motor Battery Coolant Cooler Nut (1) @ Drive Motor Battery Coolant Cooler» Install and tighten [2x] 9 N.m (80 lb in)



**Fig. 227: Drive Motor Battery Coolant Cooler Nut**  
 Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to [Fastener Caution](#) .

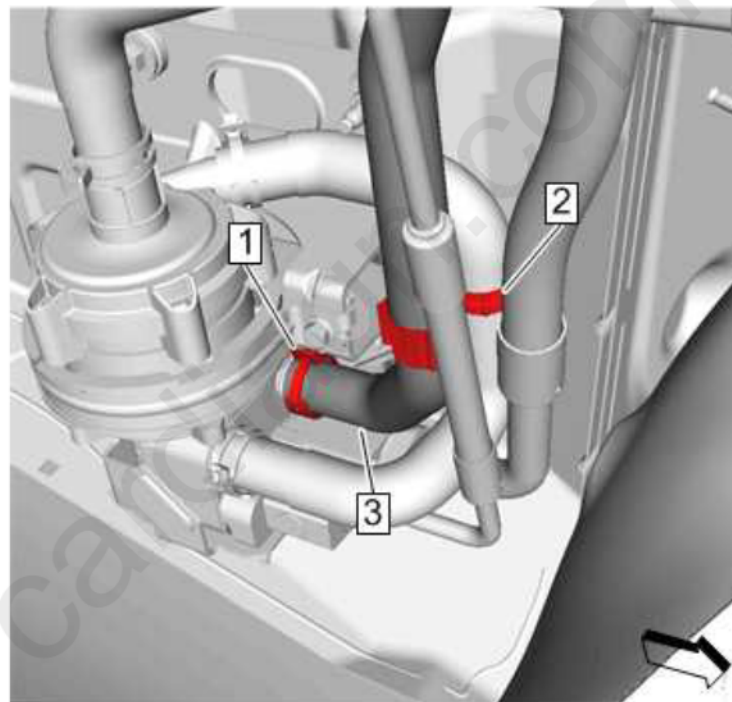
3. Auxiliary Air Conditioning Evaporator Intermediate Tube (2) @ Air Conditioning Evaporator Thermal Expansion Valve» Install - [Auxiliary Air Conditioning Evaporator Intermediate Tube Replacement \(With HP9\)](#)



**Fig. 228: Sealing Washers**

Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Radiator Inlet Hose (3) @ Drive Motor Battery Coolant Cooler» Install - **Drive Motor Battery Radiator Inlet Hose Replacement**

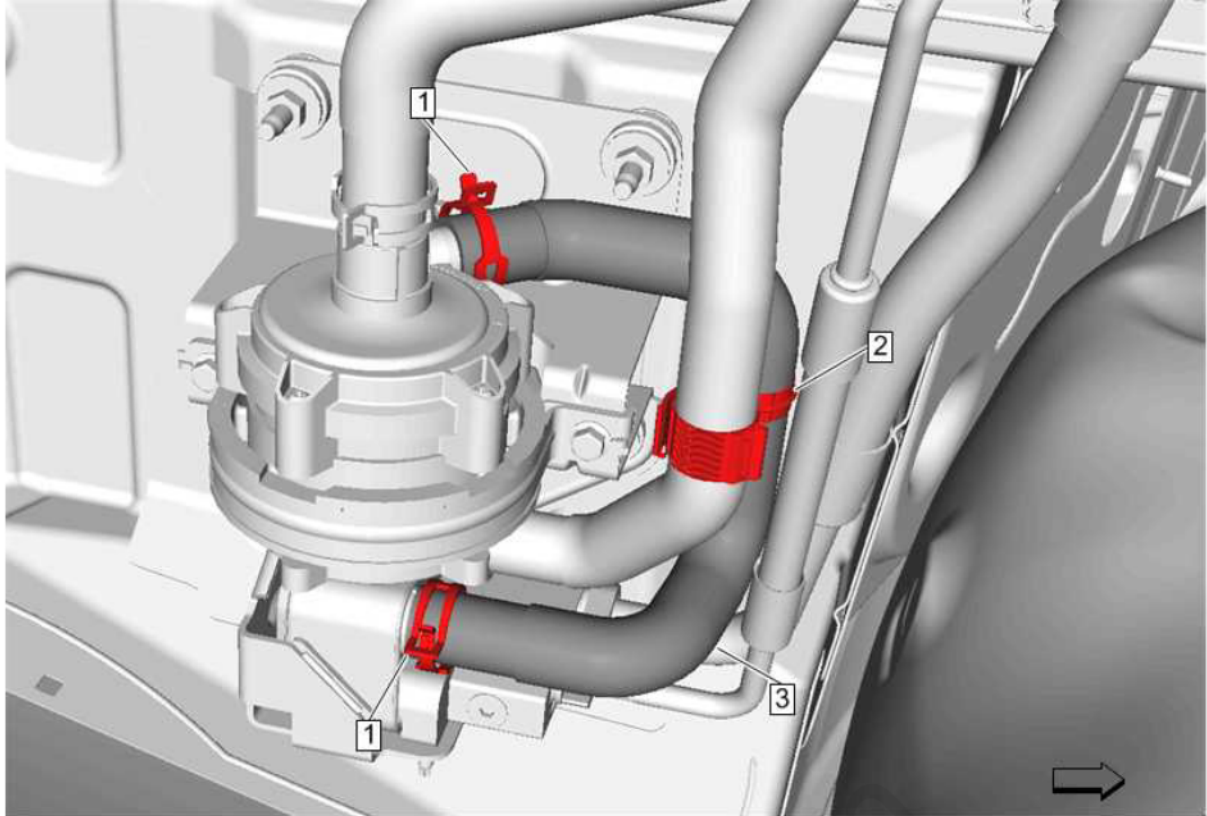


**Fig. 229: Drive Motor Battery Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Battery Coolant Cooler Outlet Hose (3) @ Drive Motor Battery Coolant Cooler» Install - **Drive Motor Battery Coolant Cooler Outlet Hose Replacement**





**Fig. 230: Drive Motor Battery Coolant Cooler Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

6. Fill the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)
8. Start the engine and check for coolant leaks.

### DRIVE MOTOR BATTERY COOLANT COOLER BRACKET REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

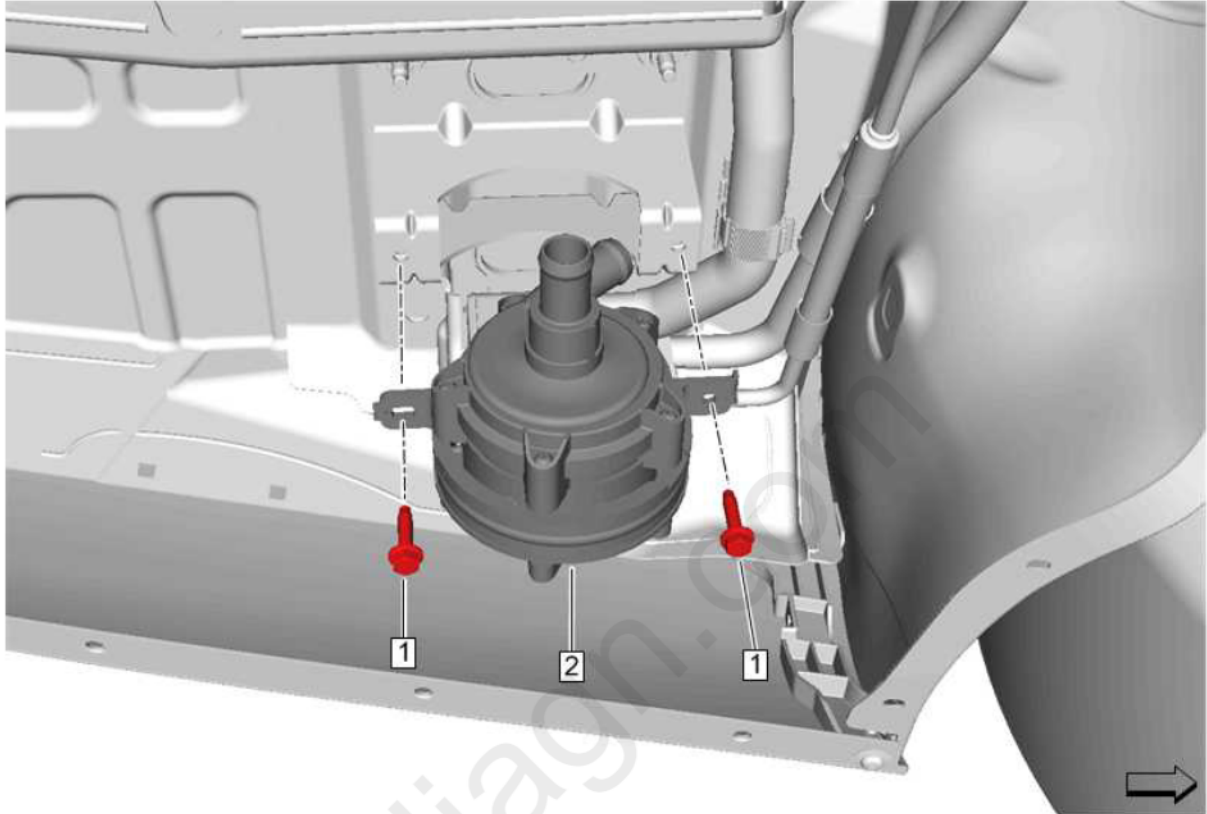
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

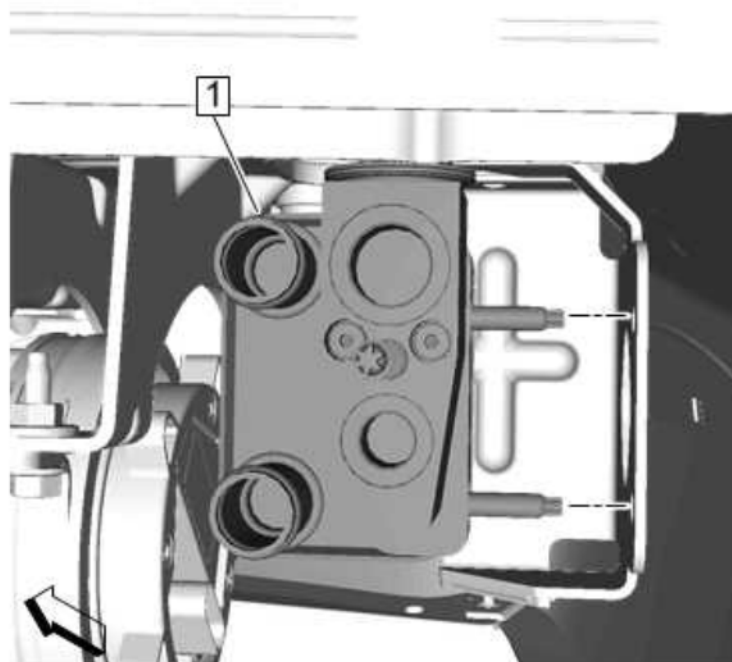
### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. Drive Motor Battery Coolant Pump (2) » Remove - [Drive Motor Battery Coolant Pump Replacement](#)



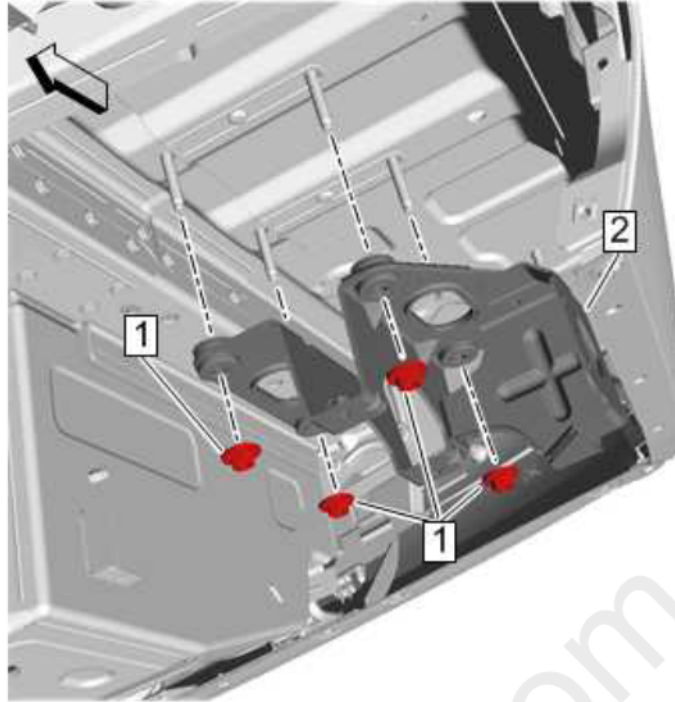
**Fig. 231: Drive Motor Battery Coolant Pump**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Coolant Cooler (1) » Remove - [Drive Motor Battery Coolant Cooler Replacement](#)



**Fig. 232: Drive Motor Battery Coolant Cooler**  
Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Battery Coolant Cooler Bracket Nut (1) @ Drive Motor Battery Coolant Cooler Bracket» Remove [4x]

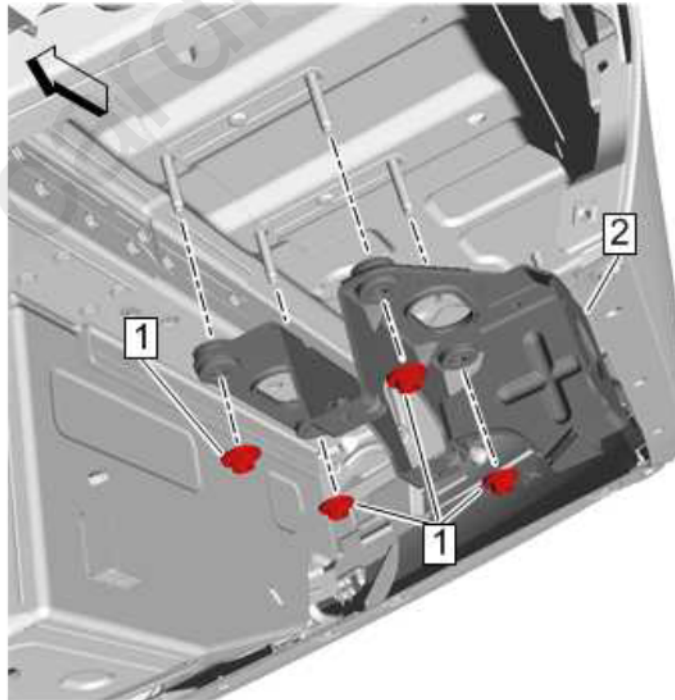


**Fig. 233: Drive Motor Battery Coolant Cooler Bracket Nuts**  
Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Battery Coolant Cooler Bracket (2)» Remove

#### Installation Procedure

1. Drive Motor Battery Coolant Cooler Bracket (2)» Install

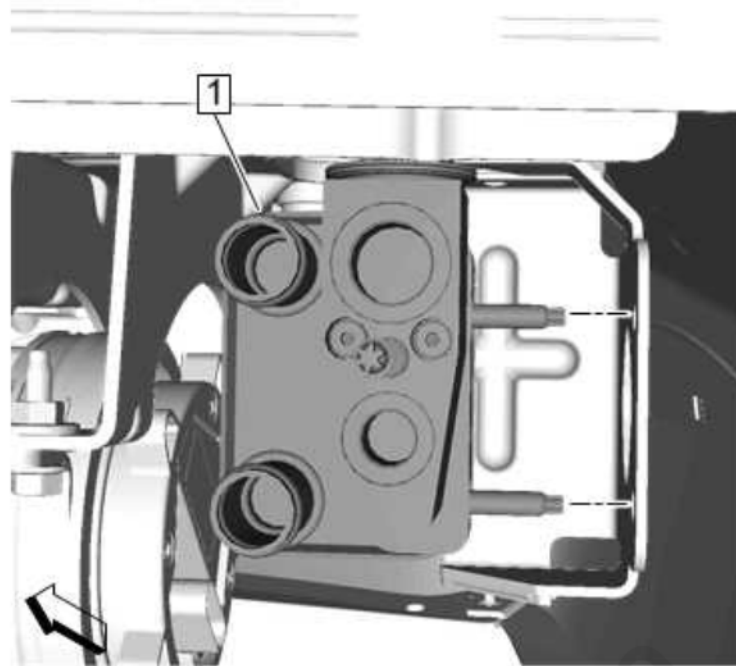


**Fig. 234: Drive Motor Battery Coolant Cooler Bracket Nuts**  
Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Battery Coolant Cooler Bracket Nut (1)» Install and tighten [4x] 22 N.m (16 lb ft)

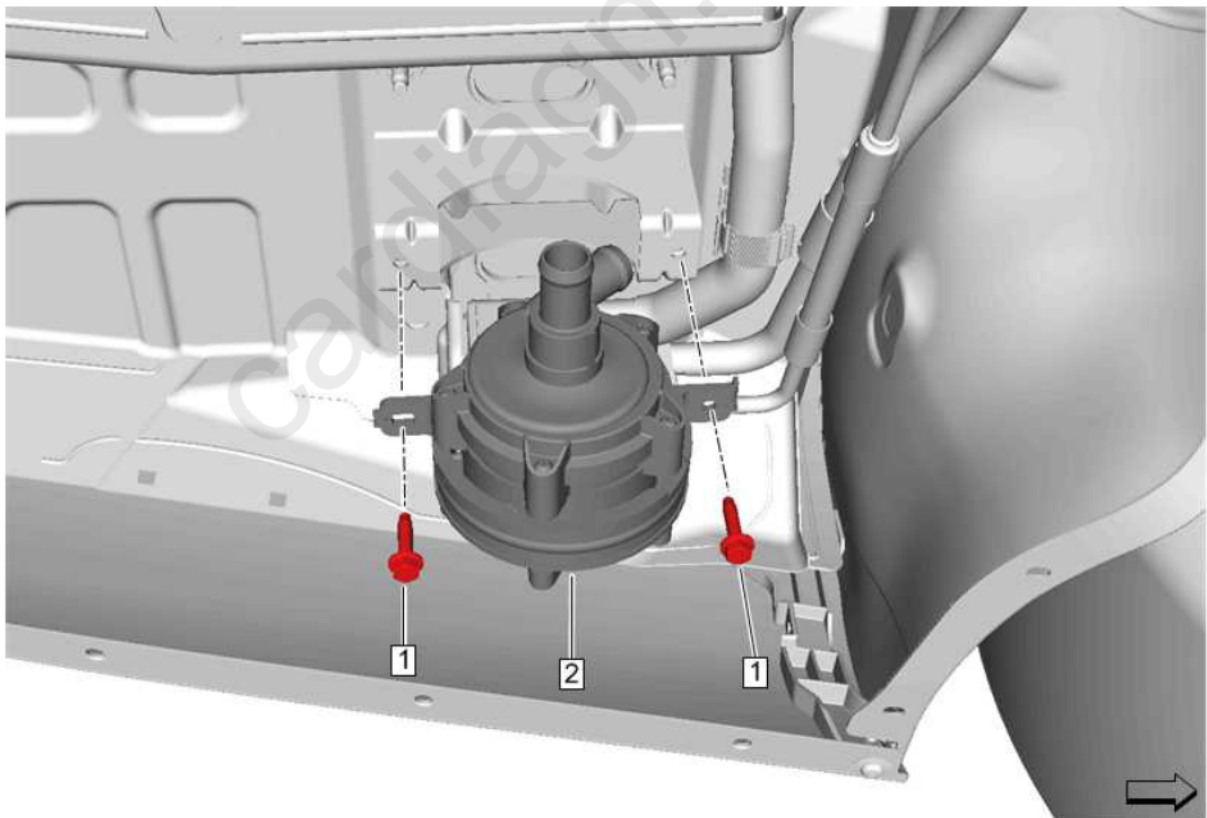
**CAUTION:** Refer to **Fastener Caution** .

3. Drive Motor Battery Coolant Cooler (1)» Install - [Drive Motor Battery Coolant Cooler Replacement](#)



**Fig. 235: Drive Motor Battery Coolant Cooler**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Coolant Pump (2)» Install - [Drive Motor Battery Coolant Pump Replacement](#)

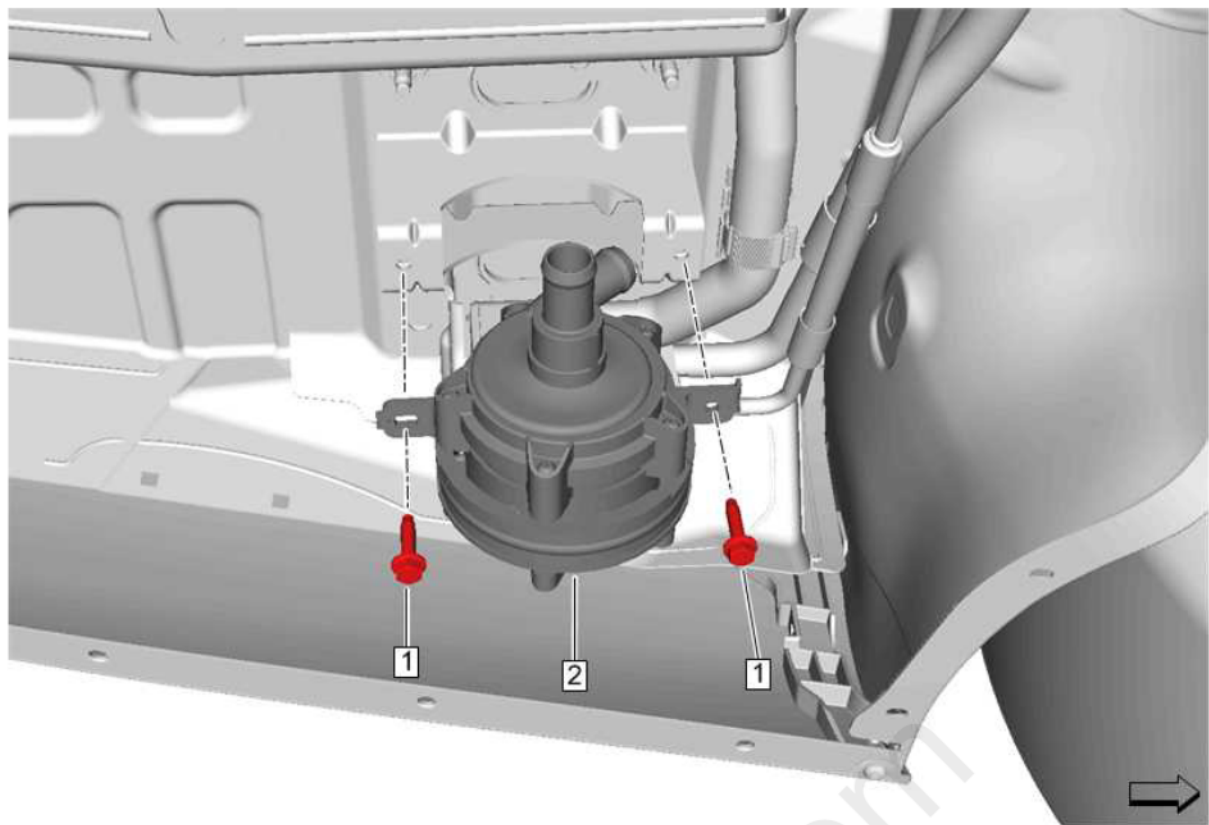


**Fig. 236: Drive Motor Battery Coolant Pump**  
Courtesy of GENERAL MOTORS COMPANY

5. Fill the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
6. Enable the high voltage system. Refer to [High Voltage Enabling](#)
7. Start the engine and check for coolant leaks.



## DRIVE MOTOR BATTERY COOLANT PUMP REPLACEMENT



**Fig. 237: Drive Motor Battery Coolant Pump**  
Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Component Name                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>WARNING:</b></p> <p>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>Preliminary Procedures</p> <ol style="list-style-type: none"> <li>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></li> <li>2. Drain the high voltage battery cooling system. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a></li> <li>3. Drive Motor Battery Coolant Cooler Outlet Hose @ Drive Motor Battery Coolant Pump» Remove - <a href="#">Drive Motor Battery Coolant Cooler Outlet Hose Replacement</a></li> <li>4. Drive Motor Battery Radiator Outlet Hose @ Drive Motor Battery Coolant Pump» Remove - <a href="#">Drive Motor Battery Radiator Outlet Hose Replacement</a></li> </ol> |                                                                                                                                                                        |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>Drive Motor Battery Coolant Pump Bolt [2x]</p> <p><b>CAUTION:</b></p> <p>Refer to <a href="#">Fastener Caution</a> .</p> <p><b>Tighten</b><br/>9 N.m (80 lb in)</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                        |

| Callout | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2       | Drive Motor Battery Coolant Pump<br><br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Disconnect the electrical connector.</li> <li>2. Fill the high voltage battery cooling system. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a></li> <li>3. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>4. Start the engine and check for coolant leaks.</li> </ol> |

## DRIVE MOTOR BATTERY COOLANT/AIR SEPARATOR REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

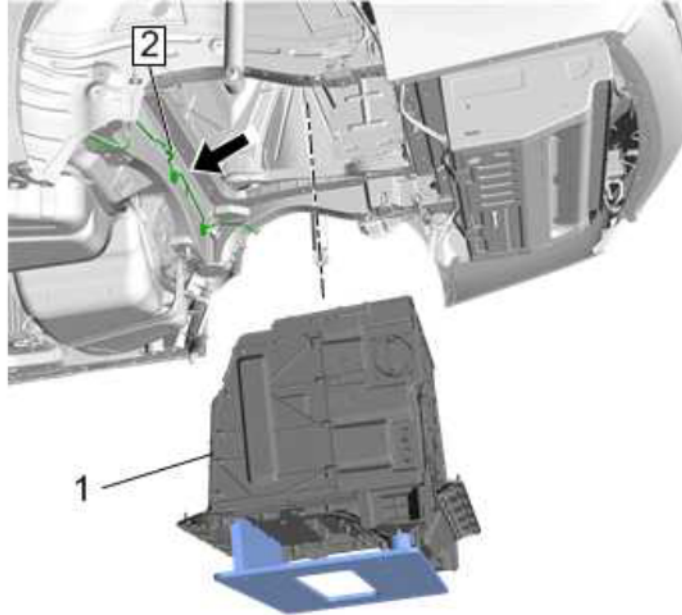
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

### Removal Procedure

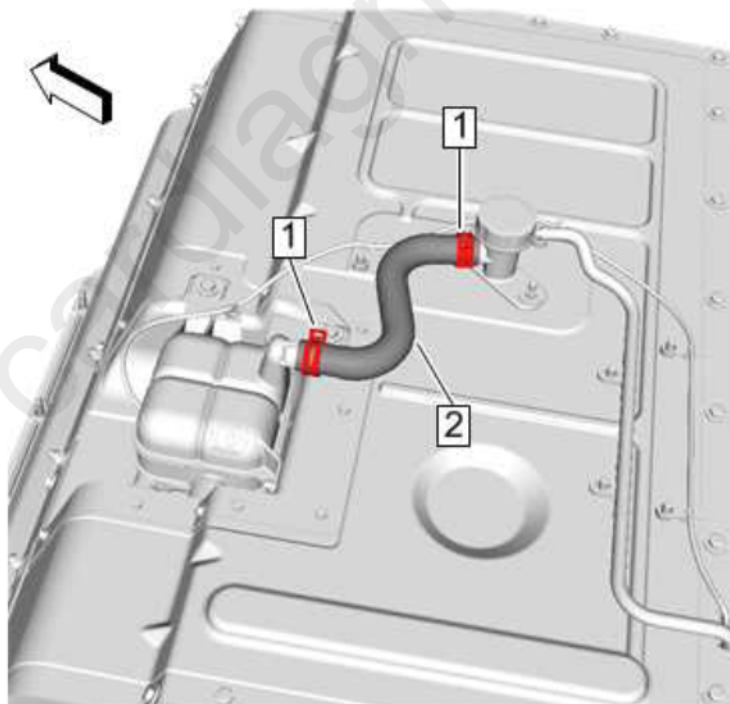
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. High Voltage Battery (1)» Remove - [High Voltage Battery Replacement and Shipping Preparation](#)



**Fig. 238: High Voltage Battery**

Courtesy of GENERAL MOTORS COMPANY

4. Electrical Connector @ Drive Motor Battery Coolant/Air Separator» Remove
5. Install absorbent rags under the drive motor battery coolant/air separator to absorb any coolant loss.
6. Engine Coolant Air Bleed Hose (2) @ Drive Motor Battery Coolant/Air Separator» Remove - **Engine Coolant Air Bleed Hose Replacement**

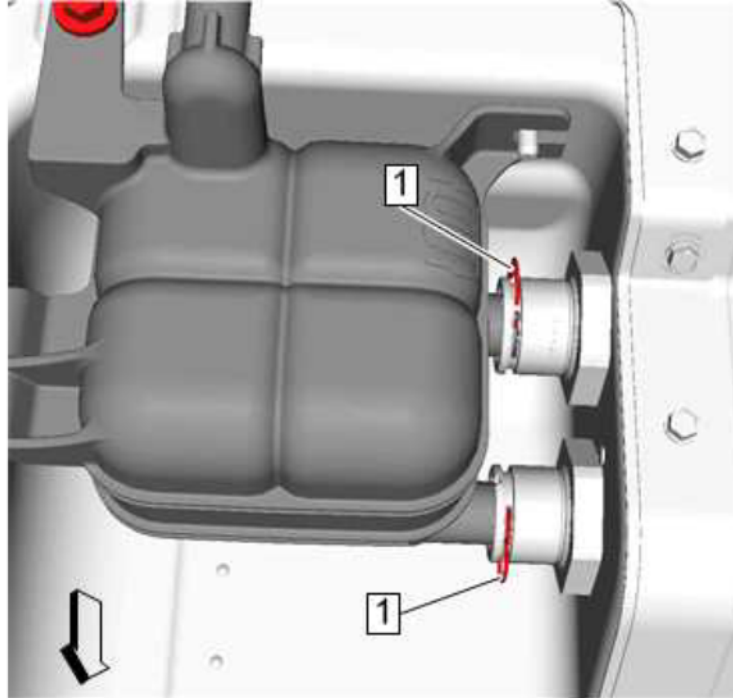


**Fig. 239: Engine Coolant Air Bleed Hose And Clamps**

Courtesy of GENERAL MOTORS COMPANY

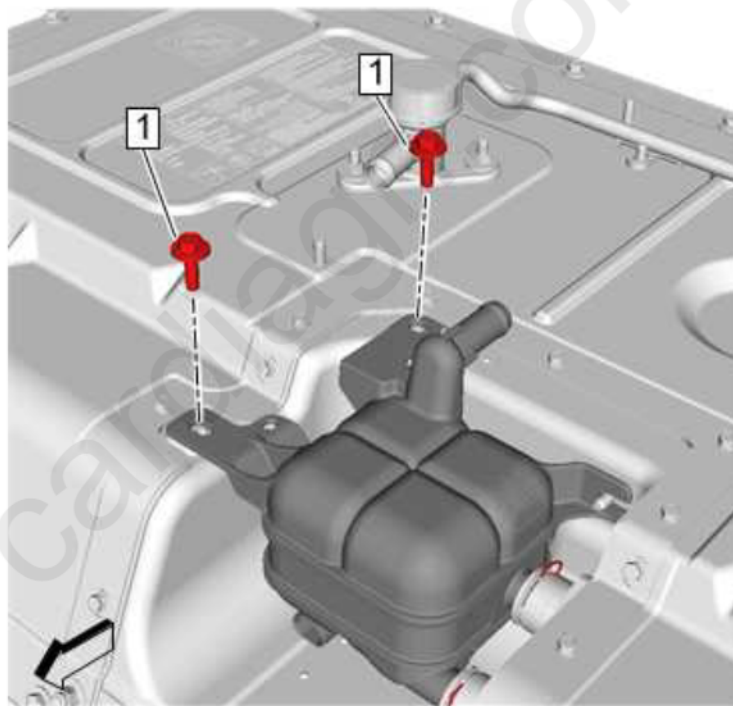
7. High Voltage Battery Cooling Manifold Outlet Hose Retainer Clip (1) @ Drive Motor Battery Coolant/Air Separator» Disengage [2x]





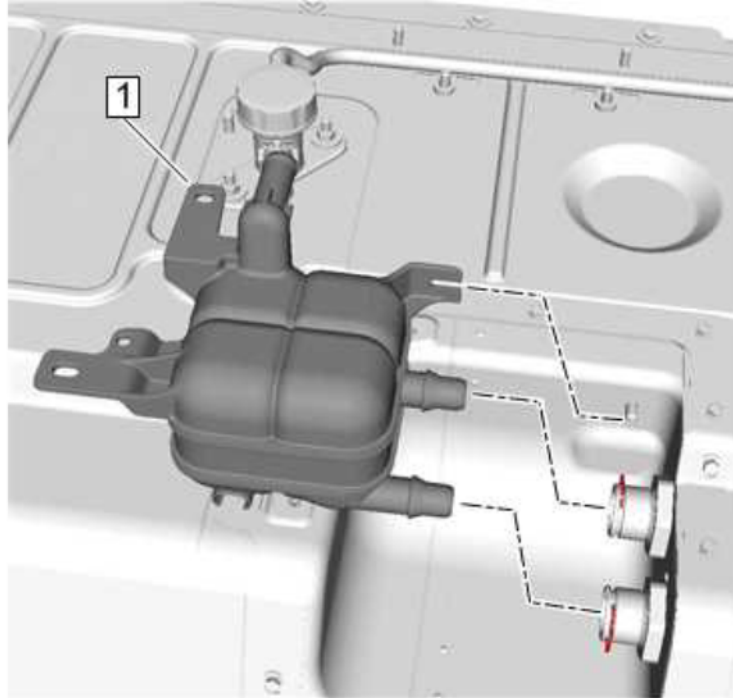
**Fig. 240: High Voltage Battery Cooling Manifold Outlet Hose Retainer Clip**  
 Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Coolant/Air Separator Bolt (1)» Remove [2x]



**Fig. 241: Drive Motor Battery Coolant/Air Separator Bolt**  
 Courtesy of GENERAL MOTORS COMPANY

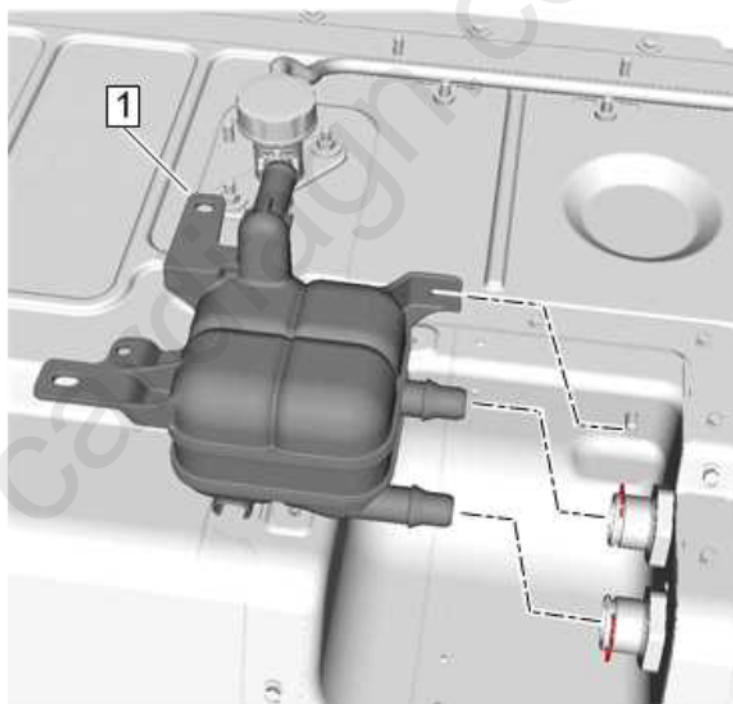
9. Drive Motor Battery Coolant/Air Separator (1)» Remove



**Fig. 242: Drive Motor Battery Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

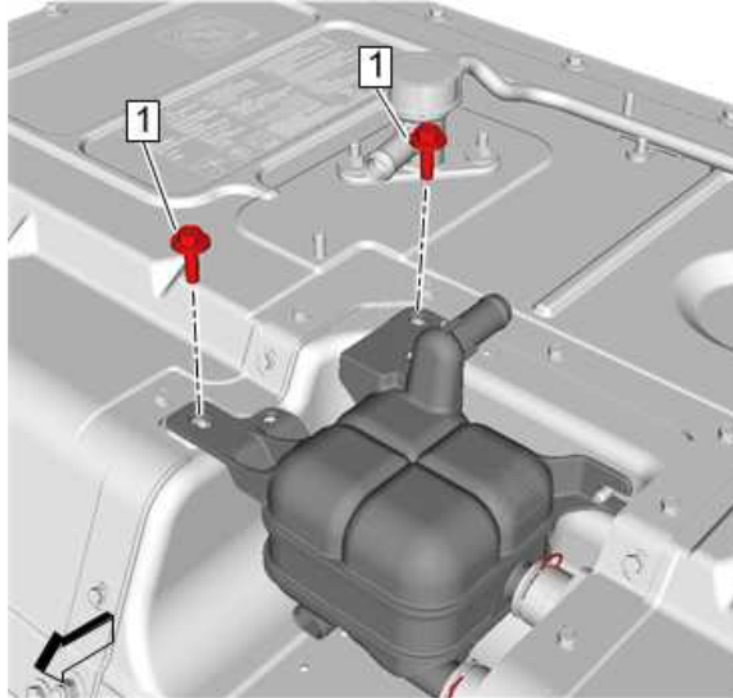
#### Installation Procedure

1. Drive Motor Battery Coolant/Air Separator (1)» Install



**Fig. 243: Drive Motor Battery Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

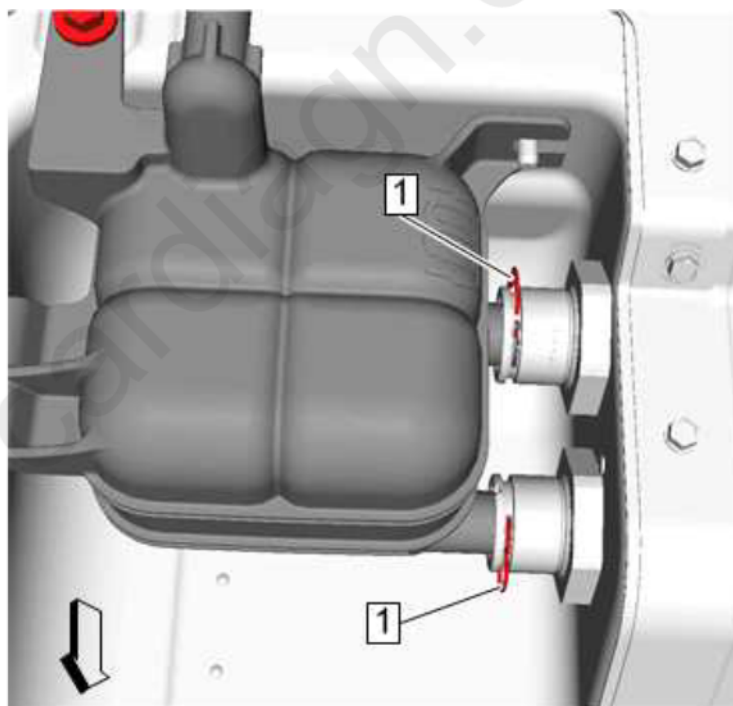
2. Drive Motor Battery Coolant/Air Separator Bolt (1)» Install and tighten [2x] 9 N.m (80 lb in)



**Fig. 244: Drive Motor Battery Coolant/Air Separator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

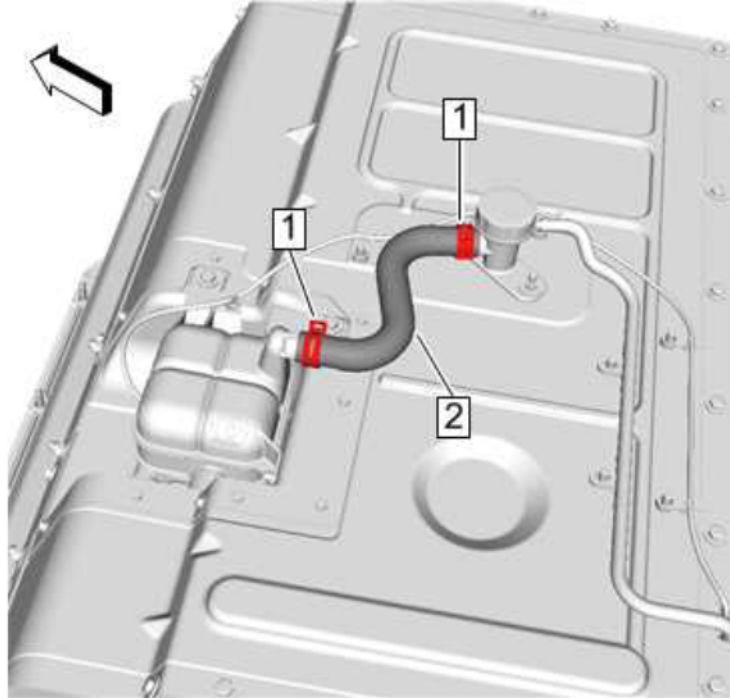
**CAUTION:** Refer to **Fastener Caution** .

3. High Voltage Battery Cooling Manifold Outlet Hose Retainer Clip (1) @ Drive Motor Battery Coolant/Air Separator» Engage [2x]



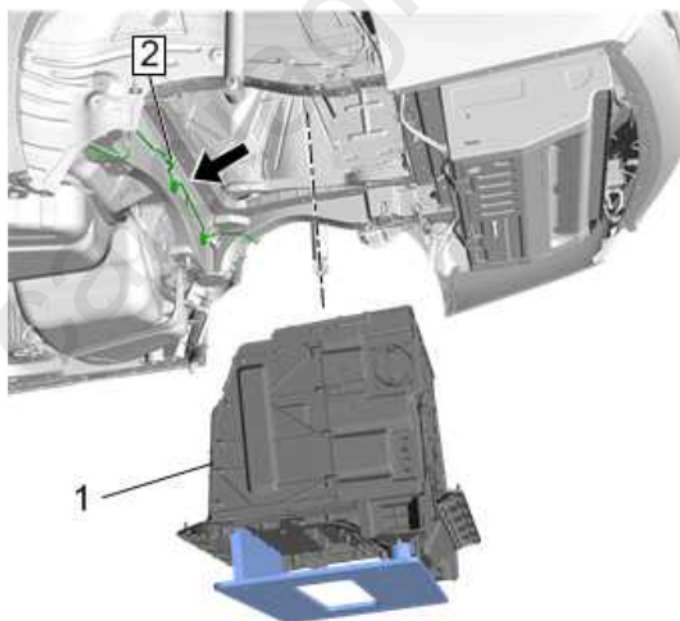
**Fig. 245: High Voltage Battery Cooling Manifold Outlet Hose Retainer Clip**  
Courtesy of GENERAL MOTORS COMPANY

4. Engine Coolant Air Bleed Hose (2) @ Drive Motor Battery Coolant/Air Separator» Install - **Engine Coolant Air Bleed Hose Replacement**



**Fig. 246: Engine Coolant Air Bleed Hose And Clamps**  
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the absorbent rags.
6. Electrical Connector @ Drive Motor Battery Coolant/Air Separator» Install
7. Prior to installing the high voltage battery perform the off vehicle high voltage battery leak test. Refer to [High Voltage Battery Leak Testing](#)
8. High Voltage Battery (1)» Install - [High Voltage Battery Replacement and Shipping Preparation](#)



**Fig. 247: High Voltage Battery**  
 Courtesy of GENERAL MOTORS COMPANY

9. Enable the high voltage system. Refer to [High Voltage Enabling](#)
10. Fill the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
11. Start the engine and check for coolant leaks.



**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

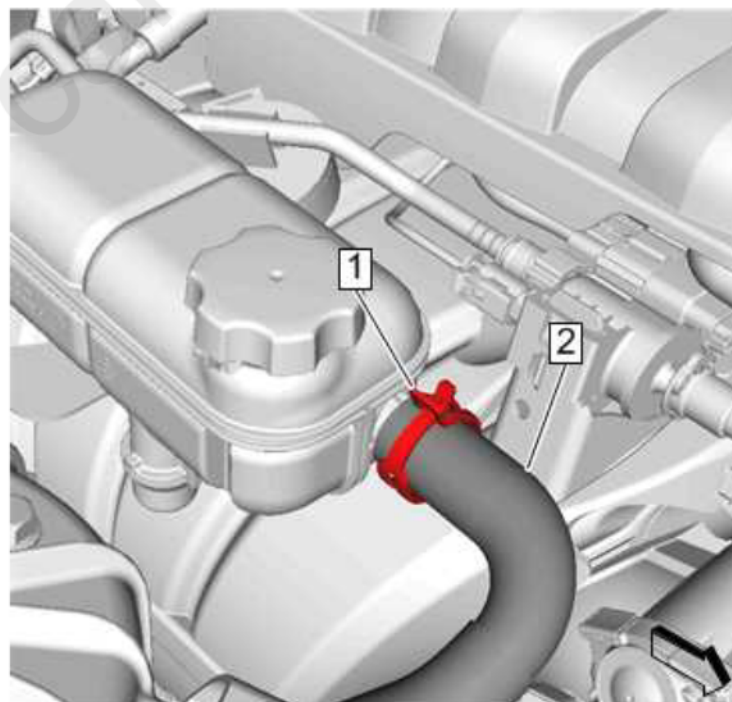
Failure to follow the procedures may result in serious injury or death.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#) .

**Removal Procedure**

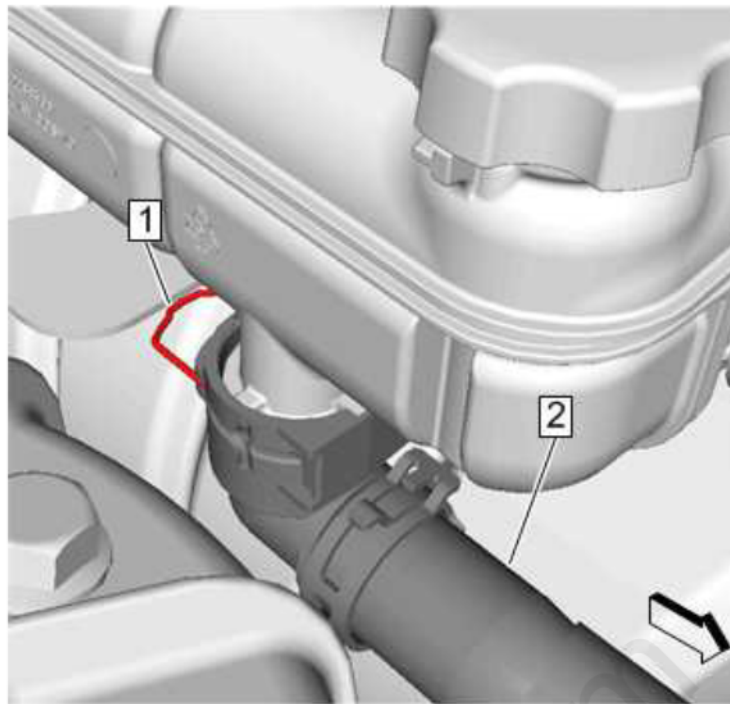
1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
3. Generator Control Module Coolant Tank Hose Clamp (1) Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)



**Fig. 248: Generator Control Module Coolant Tank Hose Clamp**

Courtesy of GENERAL MOTORS COMPANY

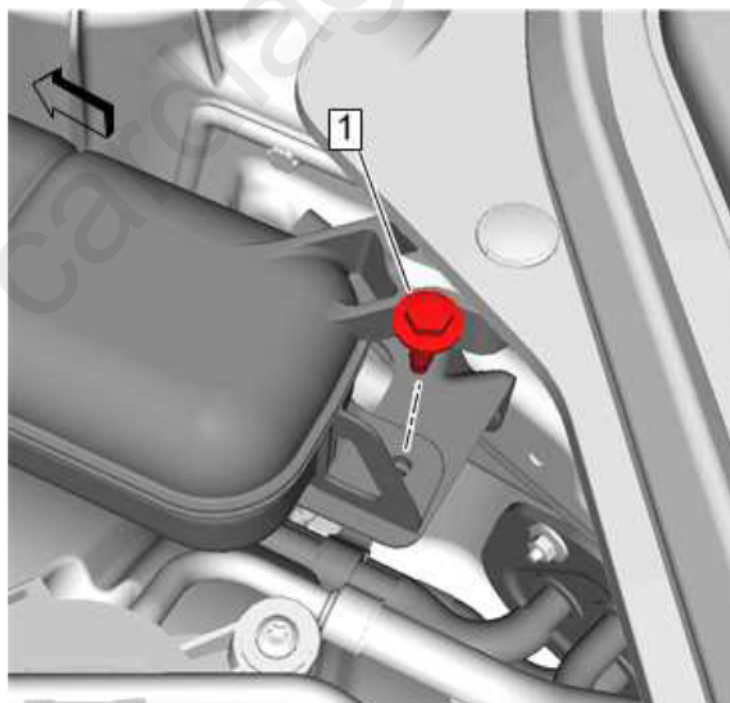
4. Generator Control Module Coolant Tank Hose (2) @ Generator Control Module Coolant/Air Separator» Remove
5. Retainer (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Disengage



**Fig. 249: Retainer**

Courtesy of GENERAL MOTORS COMPANY

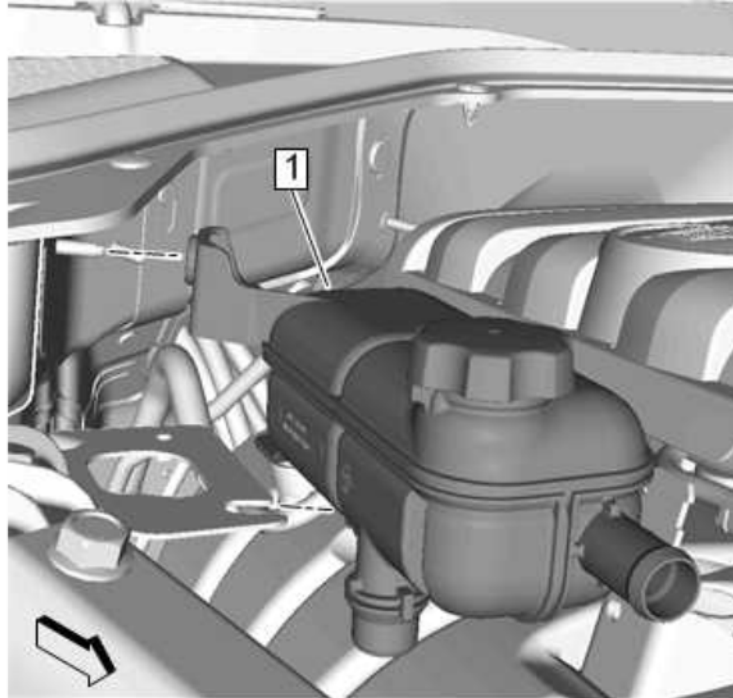
6. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant/Air Separator» Remove
7. Generator Control Module Coolant/Air Separator Bolt (1) @ Generator Control Module Coolant/Air Separator» Remove



**Fig. 250: Generator Control Module Coolant/Air Separator Bolt**

Courtesy of GENERAL MOTORS COMPANY

8. Generator Control Module Coolant/Air Separator (1) @ Generator Control Module Coolant Radiator Bracket» Remove

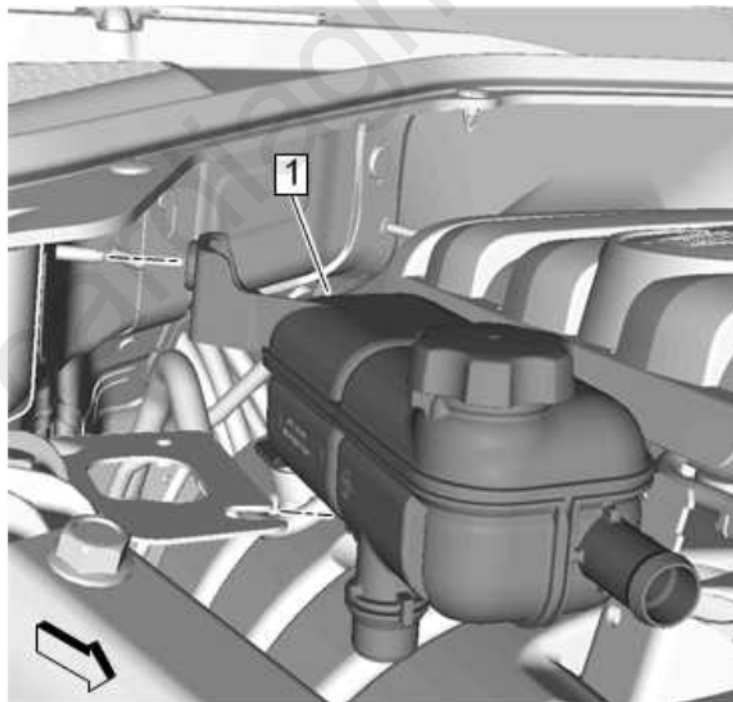


**Fig. 251: Generator Control Module Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

9. Generator Control Module Coolant/Air Separator (1) » Remove

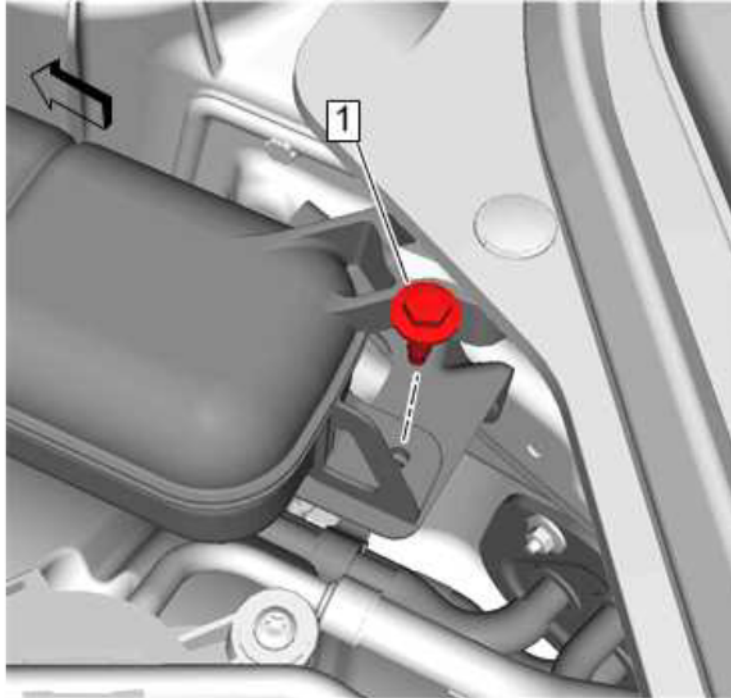
#### Installation Procedure

1. Generator Control Module Coolant/Air Separator (1) @ Generator Control Module Coolant Radiator Bracket » Install



**Fig. 252: Generator Control Module Coolant/Air Separator**  
 Courtesy of GENERAL MOTORS COMPANY

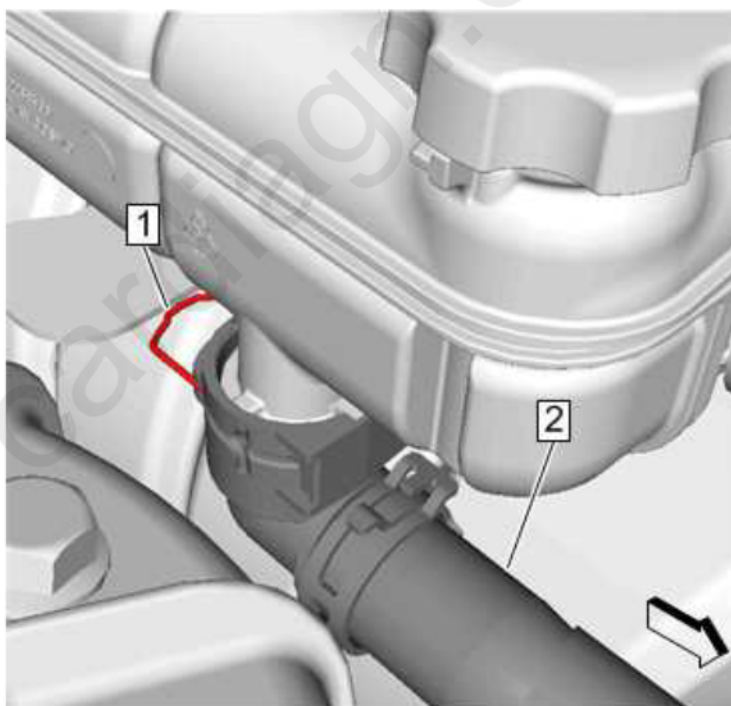
2. Generator Control Module Coolant/Air Separator Bolt (1) @ Generator Control Module Coolant/Air Separator » Install and tighten 9 N.m (80 lb in)



**Fig. 253: Generator Control Module Coolant/Air Separator Bolt**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to **Fastener Caution** .

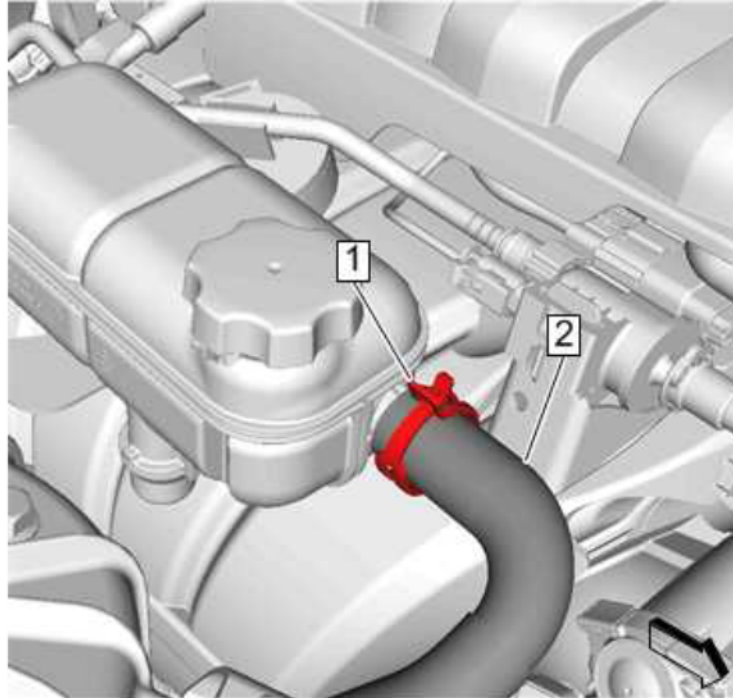
3. Drive Motor Generator Control Module Coolant Pump Hose (2) @ Generator Control Module Coolant/Air Separator» Install



**Fig. 254: Retainer**  
Courtesy of GENERAL MOTORS COMPANY

4. Retainer (1) @ Drive Motor Generator Control Module Coolant Pump Hose (2)» Engage
5. Generator Control Module Coolant Tank Hose (2) @ Generator Control Module Coolant/Air Separator» Install

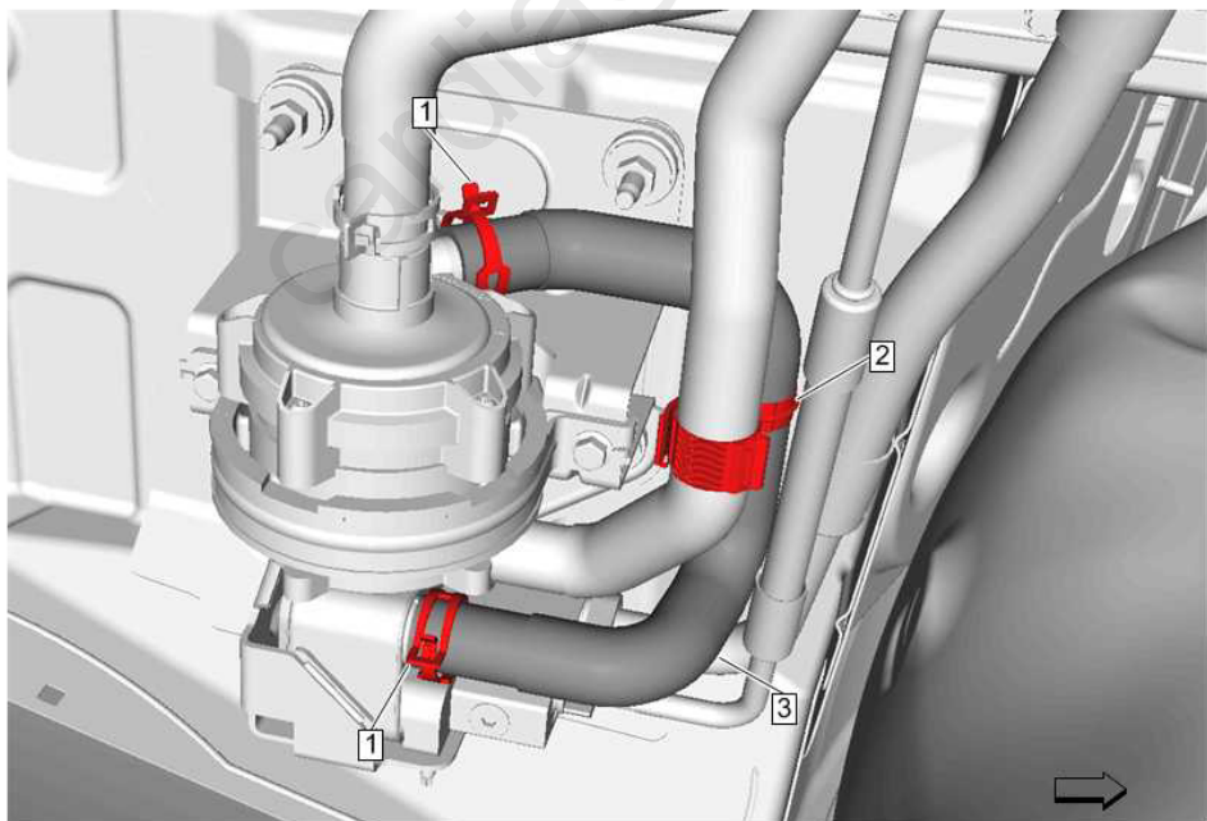




**Fig. 255: Generator Control Module Coolant Tank Hose Clamp**  
 Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Tank Hose Clamp (1) Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Fill the power electronics and auxiliary radiator cooling system. Refer to [Power Electronics and Auxiliary Radiator Drain and Fill \(LTG HP9\)](#)
8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Start the engine and check for coolant leaks.

## DRIVE MOTOR BATTERY COOLANT COOLER OUTLET HOSE REPLACEMENT



**Fig. 256: Drive Motor Battery Coolant Cooler Outlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <p>1. Disable the high voltage system. Refer to <a href="#">High Voltage Disabling</a></p> <p><b>WARNING:</b><br/>Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.</p> <p>The High Voltage Disabling procedure includes the following steps:</p> <ul style="list-style-type: none"> <li>• Identify how to disable high voltage.</li> <li>• Identify how to test for the presence of high voltage.</li> <li>• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.</li> </ul> <p>Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:</p> <ul style="list-style-type: none"> <li>• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.</li> <li>• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. <ul style="list-style-type: none"> <li>• Visually and functionally inspect the gloves before use.</li> <li>• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.</li> </ul> </li> </ul> <p>Failure to follow the procedures may result in serious injury or death.</p> <p><b>CAUTION:</b><br/>Refer to <a href="#">Hybrid Cooling System Caution</a> .</p> <p>2. Drain the high voltage battery cooling system. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a></p> <p>3. Underbody Rear Air Outer Deflector - Left Side» Remove - <a href="#">Underbody Rear Air Outer Deflector Replacement (with HP9)</a></p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Drive Motor Battery Coolant Cooler Outlet Hose Clamp [2x]<br><b>Procedure</b><br><a href="#">Hose Clamp Replacement Guidelines - Spring Type</a>                                                                                                                                                                                                                                                                                                                                                                                        |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Drive Motor Battery Radiator Inlet Hose Retainer Clip                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Drive Motor Battery Coolant Cooler Outlet Hose<br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Fill the high voltage battery cooling system. Refer to <a href="#">High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)</a> and/or <a href="#">High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)</a></li> <li>2. Enable the high voltage system. Refer to <a href="#">High Voltage Enabling</a></li> <li>3. Start the engine and check for coolant leaks.</li> </ol> |

## DRIVE MOTOR BATTERY RADIATOR INLET HOSE REPLACEMENT

**WARNING:**

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

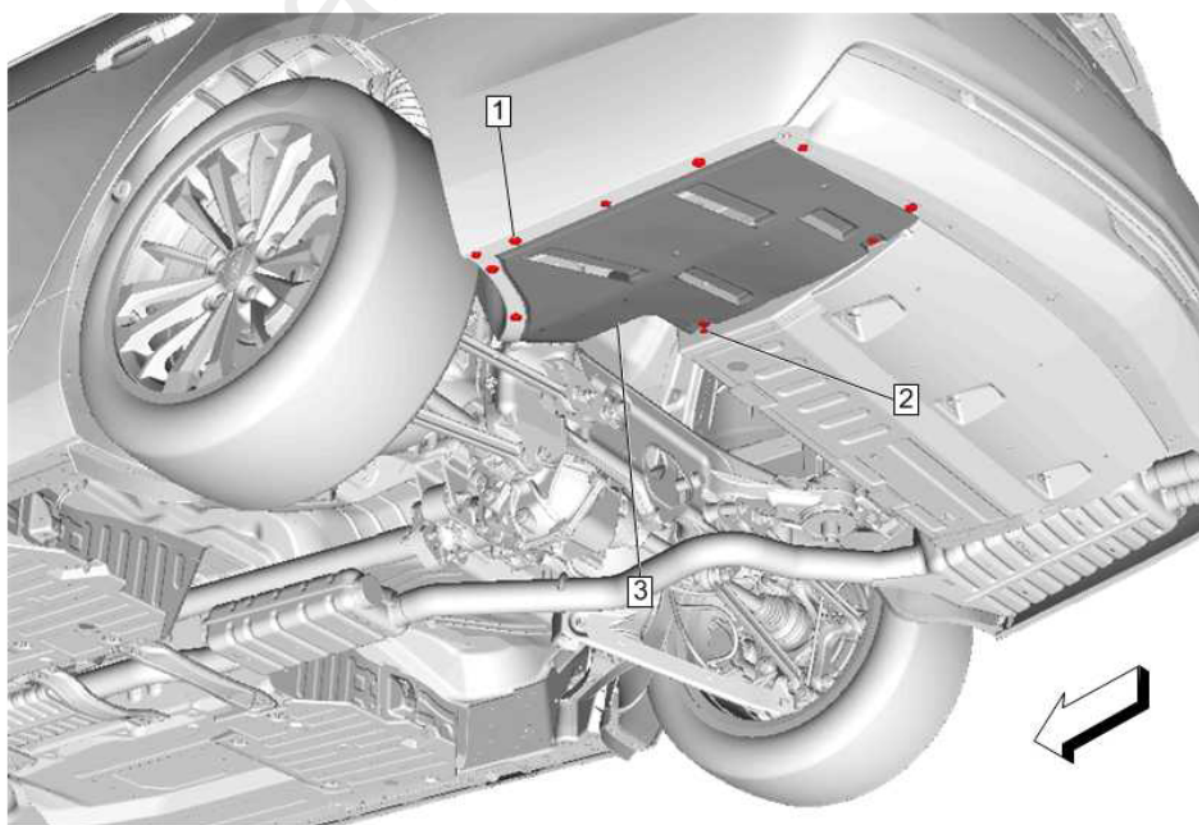
Failure to follow the procedures may result in serious injury or death.

**CAUTION:**

Refer to [Hybrid Cooling System Caution](#).

**Removal Procedure**

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. Underbody Rear Air Outer Deflector - Left Side» Remove - [Underbody Rear Air Outer Deflector Replacement \(with HP9\)](#)





4. Drive Motor Battery Convenience Charger Bracket (2)» Remove - **Drive Motor Battery Convenience Charger Bracket Replacement**

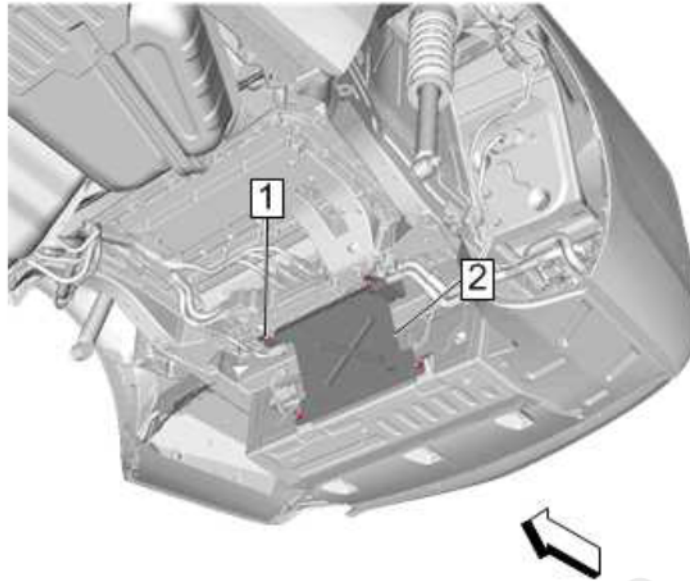


Fig. 258: Drive Motor Battery Convenience Charger Bracket  
Courtesy of GENERAL MOTORS COMPANY

5. Drive Motor Battery Radiator Inlet Hose Retainer Clip (2)» Disengage

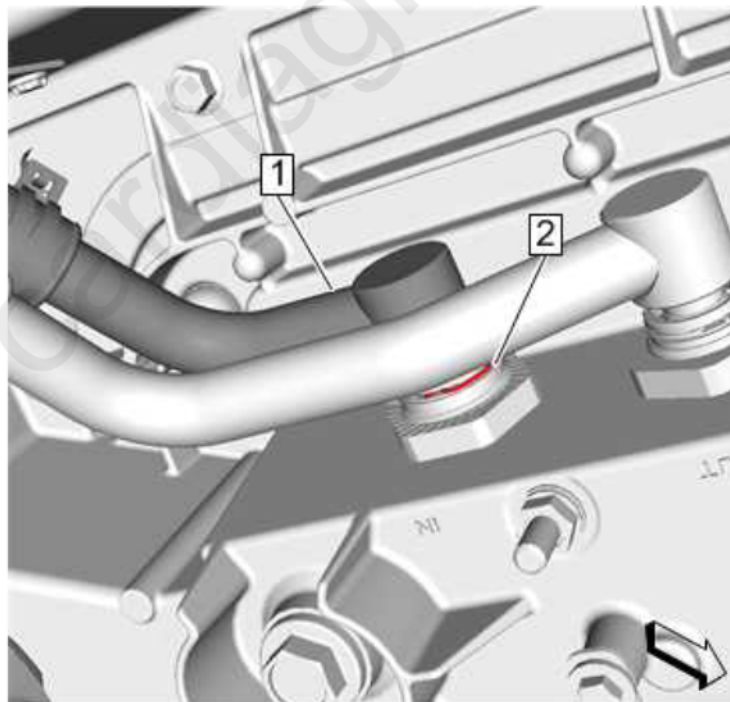
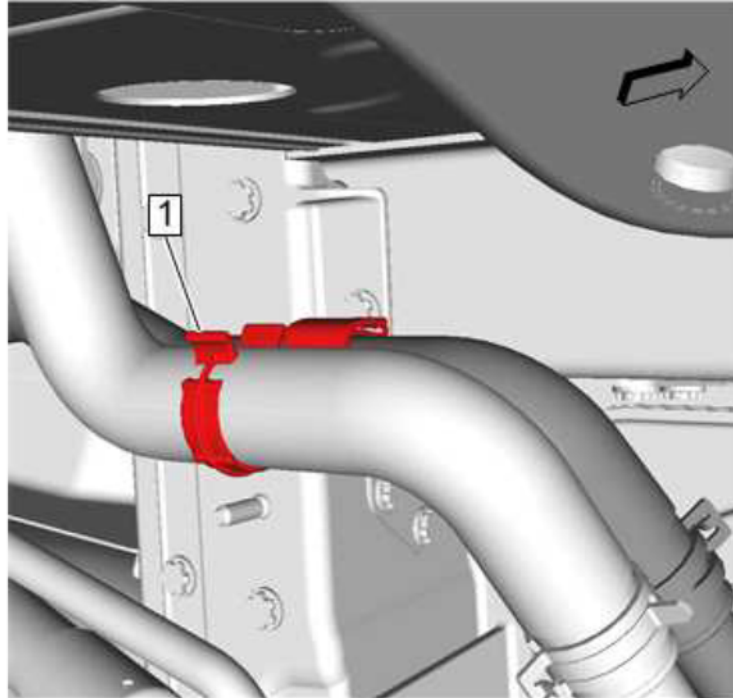


Fig. 259: Drive Motor Battery Radiator Inlet Hose  
Courtesy of GENERAL MOTORS COMPANY

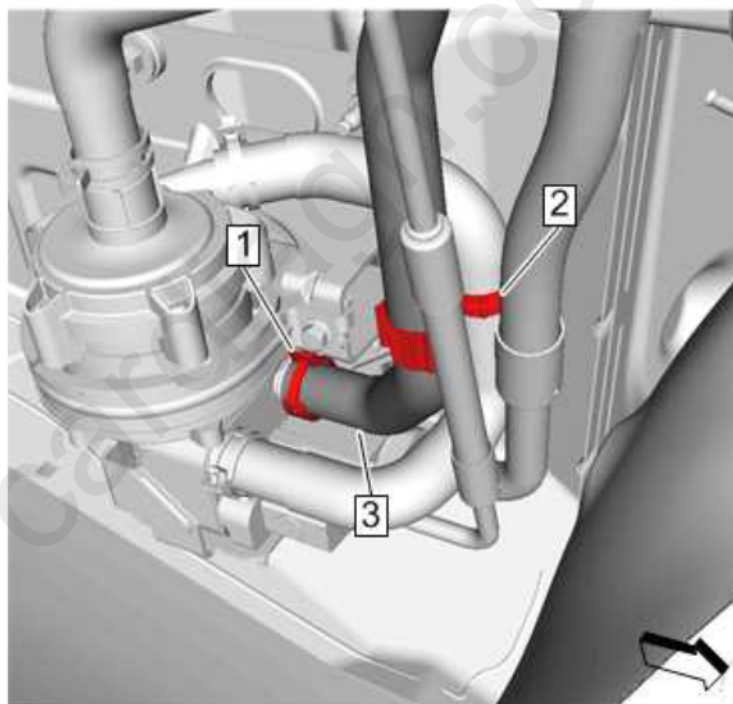
6. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage Battery» Remove  
7. Drive Motor Battery Radiator Inlet Hose Retainer Clip (1) @ Drive Motor Battery Coolant Cooler Outlet Hose» Remove





**Fig. 260: Drive Motor Battery Radiator Inlet Hose Retainer Clip**  
 Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Radiator Outlet Hose Clamp (1)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

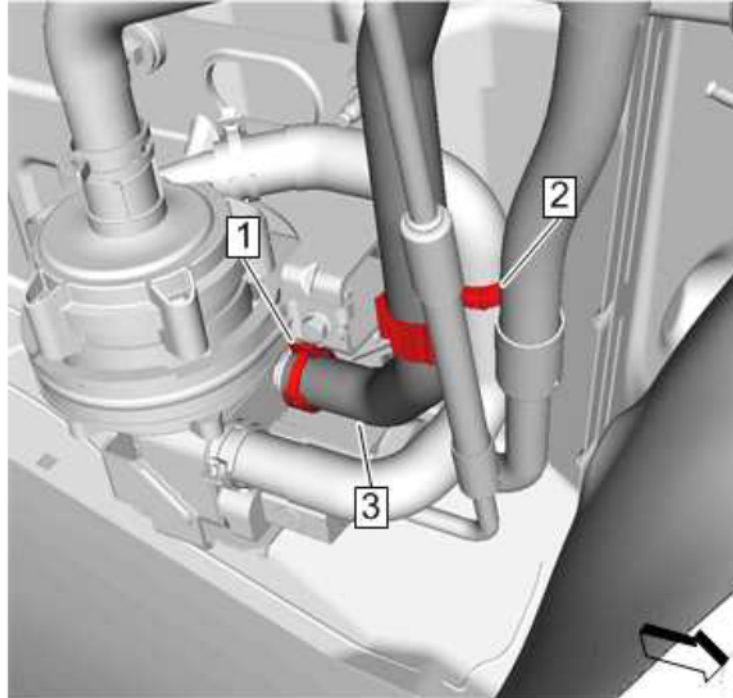


**Fig. 261: Drive Motor Battery Radiator Inlet Hose**  
 Courtesy of GENERAL MOTORS COMPANY

9. Drive Motor Battery Radiator Inlet Hose Retainer Clip (3) @ Drive Motor Battery Coolant Cooler Outlet Hose» Remove
10. Drive Motor Battery Radiator Inlet Hose (3) @ Drive Motor Battery Coolant Cooler» Remove
11. Drive Motor Battery Radiator Inlet Hose» Remove

#### **Installation Procedure**

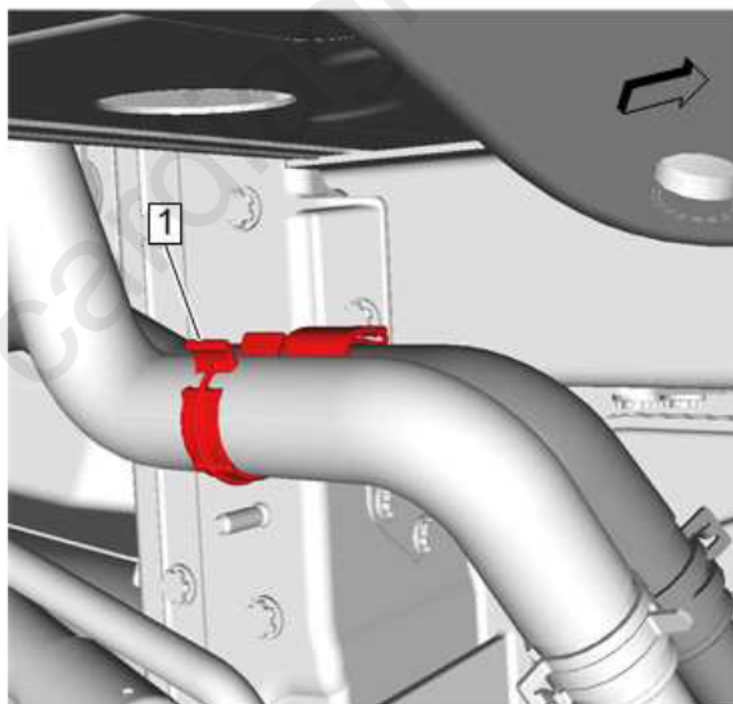
1. Drive Motor Battery Radiator Inlet Hose (3) @ Drive Motor Battery Coolant Cooler» Install



**Fig. 262: Drive Motor Battery Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

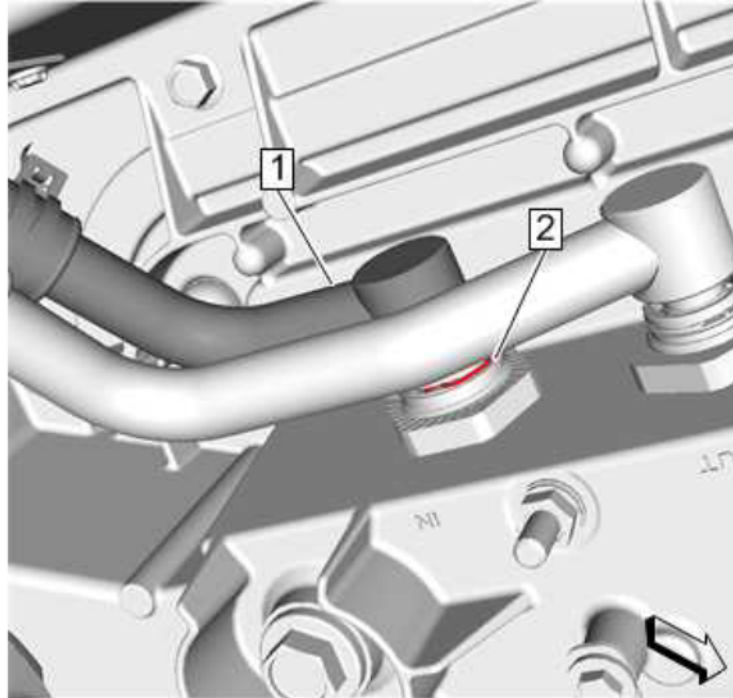
2. Drive Motor Battery Radiator Outlet Hose Clamp (1) » Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Drive Motor Battery Radiator Inlet Hose Retainer Clip (2) @ Drive Motor Battery Coolant Cooler Outlet Hose » Install
4. Drive Motor Battery Radiator Inlet Hose Retainer Clip (1) @ Drive Motor Battery Coolant Cooler Outlet Hose » Install



**Fig. 263: Drive Motor Battery Radiator Inlet Hose Retainer Clip**

Courtesy of GENERAL MOTORS COMPANY

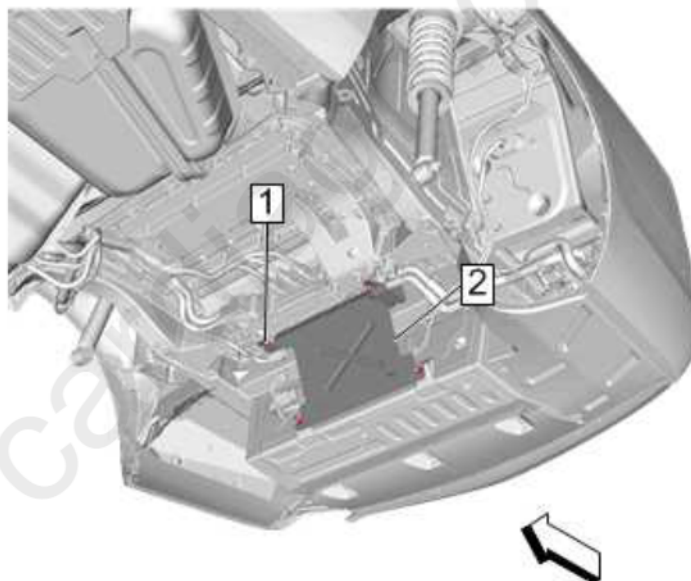
5. Drive Motor Battery Radiator Inlet Hose (1) @ High Voltage Battery » Install



**Fig. 264: Drive Motor Battery Radiator Inlet Hose**

Courtesy of GENERAL MOTORS COMPANY

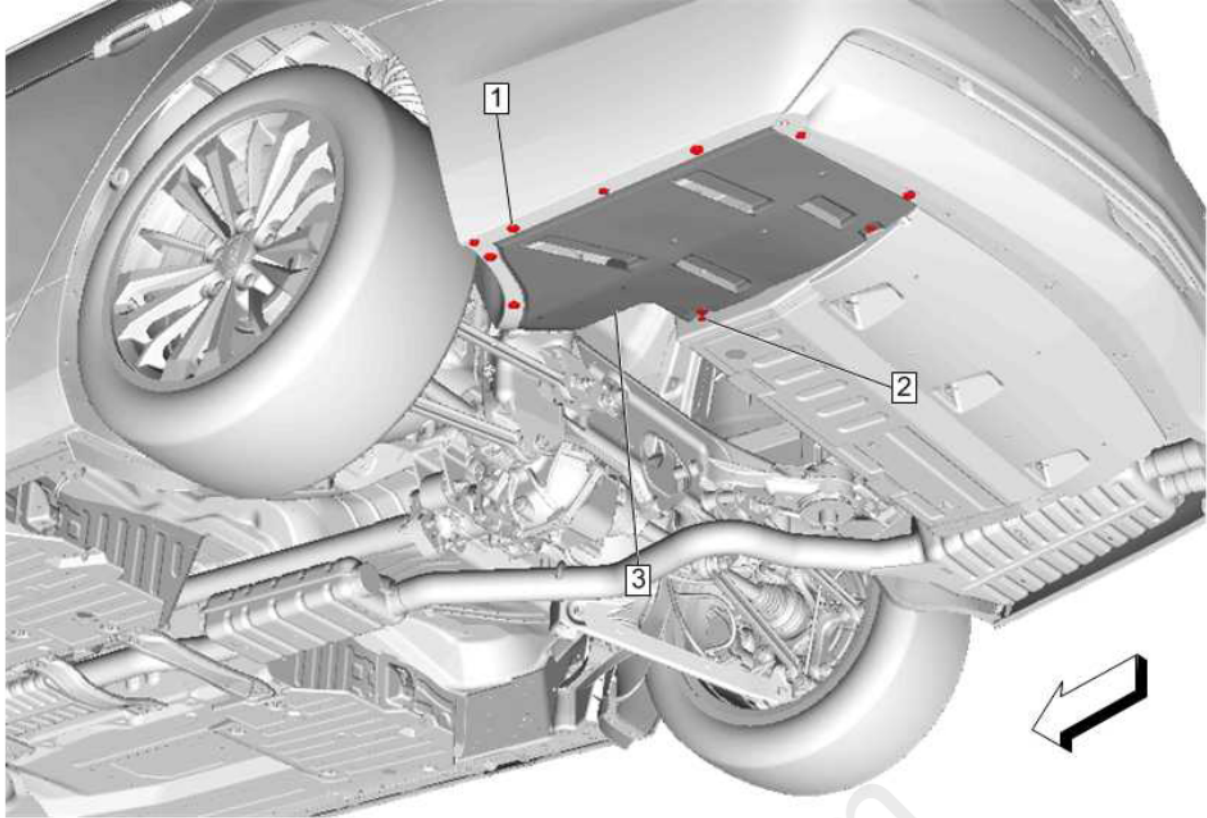
6. Drive Motor Battery Radiator Inlet Hose Retainer Clip (2)» Engage
7. Drive Motor Battery Convenience Charger Bracket (2)» Install - **Drive Motor Battery Convenience Charger Bracket Replacement**



**Fig. 265: Drive Motor Battery Convenience Charger Bracket**

Courtesy of GENERAL MOTORS COMPANY

8. Underbody Rear Air Outer Deflector - Left Side (3)» Install - **Underbody Rear Air Outer Deflector Replacement (with HP9)**



**Fig. 266: Underbody Rear Air Outer Deflector (with HP9)**

Courtesy of GENERAL MOTORS COMPANY

9. Fill the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
10. Enable the high voltage system. Refer to [High Voltage Enabling](#)
11. Start the engine and check for coolant leaks.

## DRIVE MOTOR BATTERY RADIATOR OUTLET HOSE REPLACEMENT

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

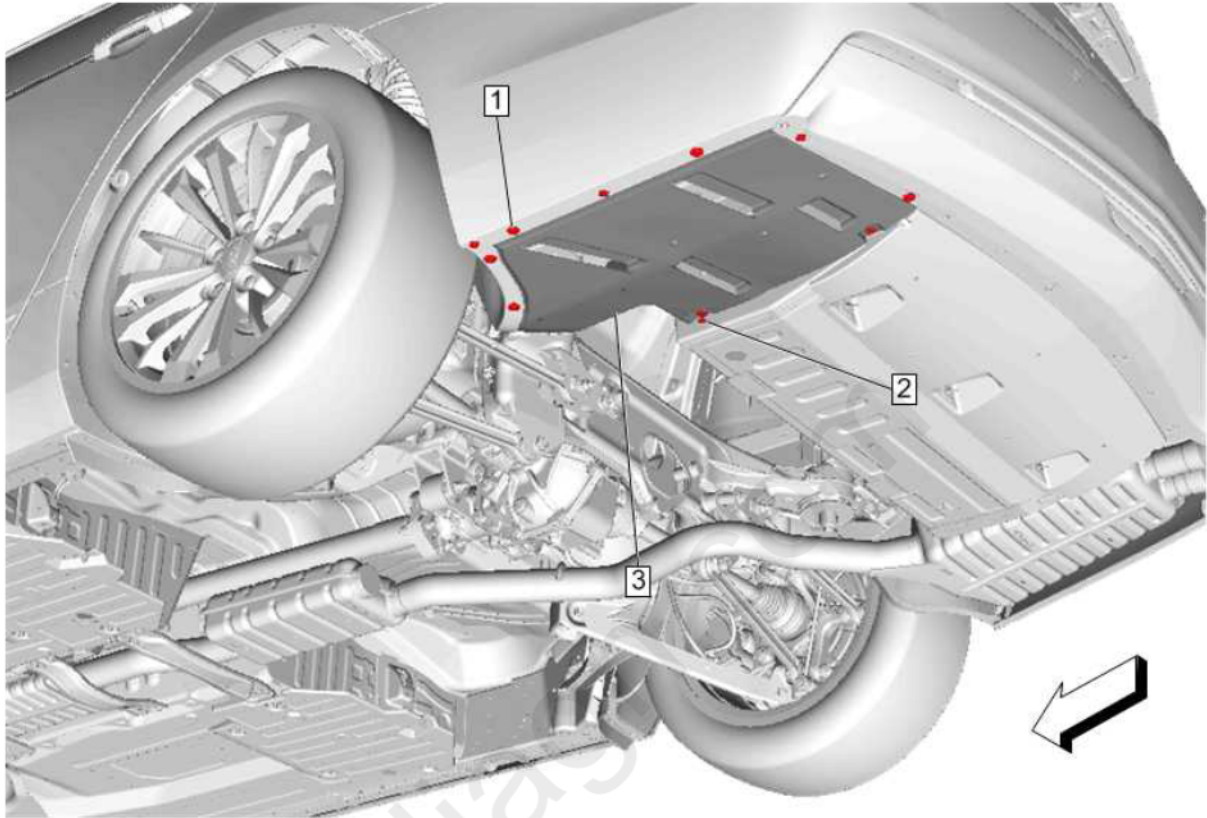
Failure to follow the procedures may result in serious injury or death.



**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

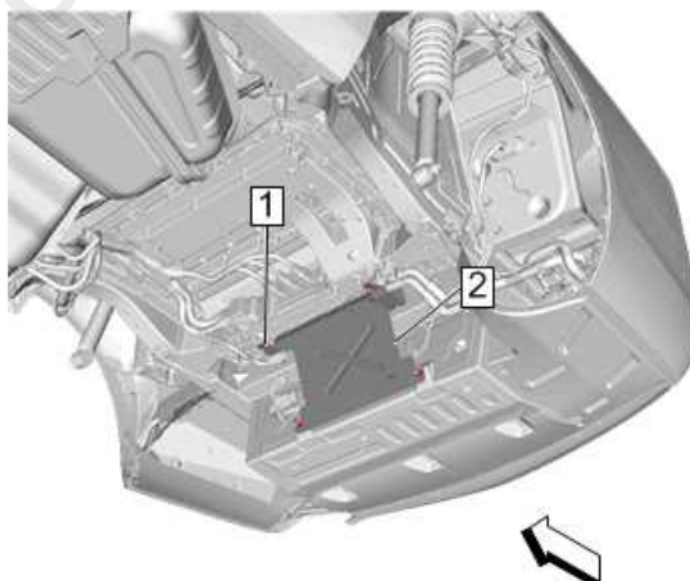
## Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the high voltage battery cooling system. Refer to [High Voltage Battery Drain and Filling \(Without Heater Vent Hose Quick Connect\)](#) and/or [High Voltage Battery Drain and Filling \(With Heater Vent Hose Quick Connect\)](#)
3. Underbody Rear Air Outer Deflector - Left Side (3) » Remove - [Underbody Rear Air Outer Deflector Replacement \(with HP9\)](#)

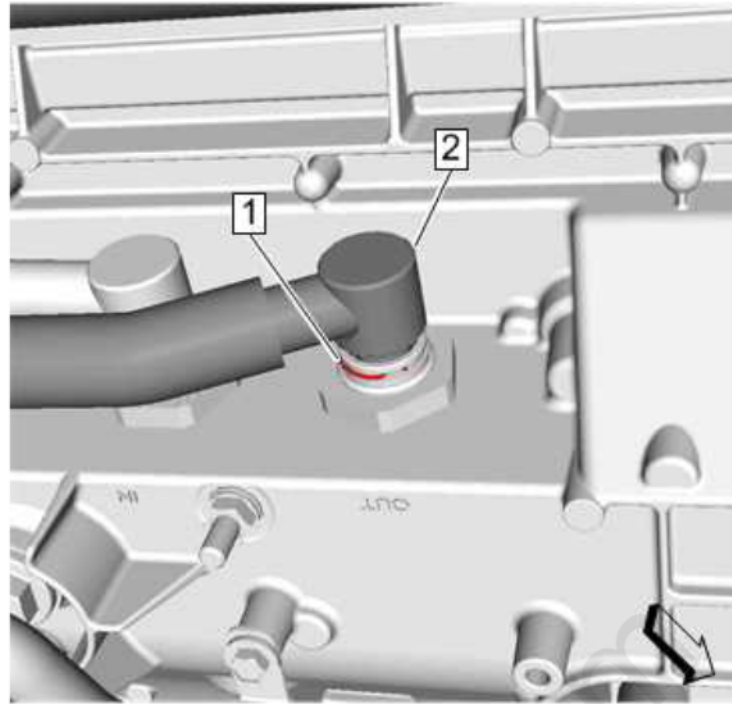


**Fig. 267: Underbody Rear Air Outer Deflector (with HP9)**  
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Convenience Charger Bracket (2) » Remove - [Drive Motor Battery Convenience Charger Bracket Replacement](#)

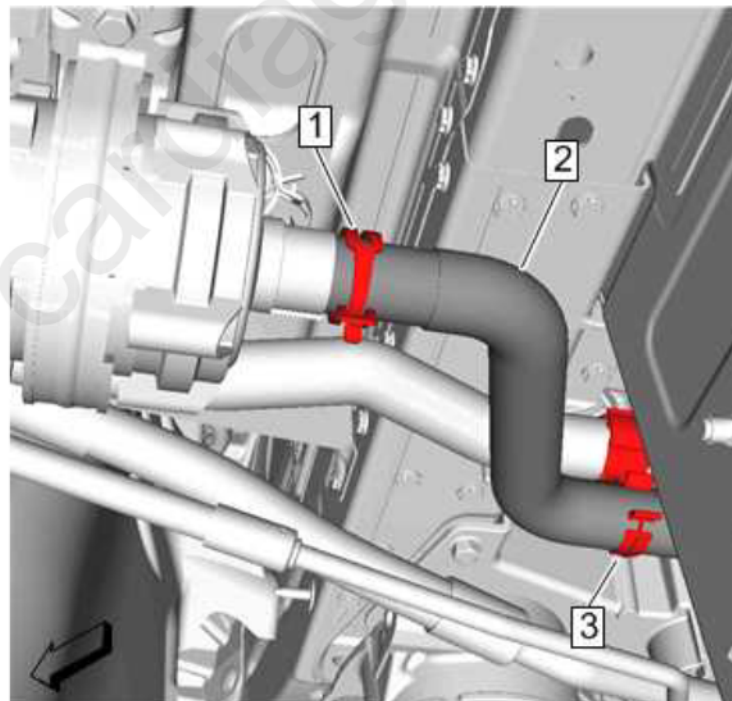


5. Drive Motor Battery Radiator Outlet Hose Retainer Clip (1)» Disengage



**Fig. 269: Drive Motor Battery Radiator Outlet Hose**  
Courtesy of GENERAL MOTORS COMPANY

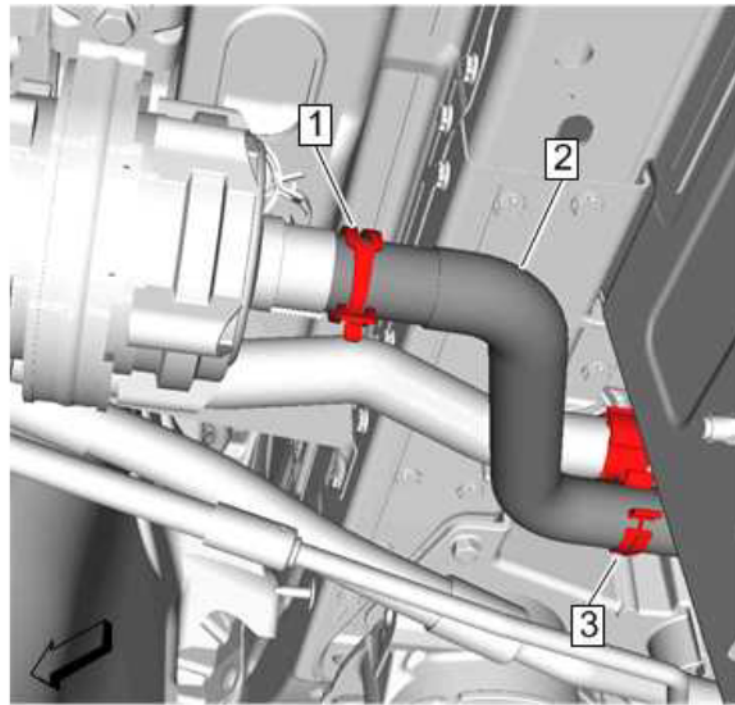
6. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery» Remove
7. Drive Motor Battery Radiator Outlet Hose Clamp (1)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**



**Fig. 270: Drive Motor Battery Radiator Outlet Hose Clamp**  
Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Radiator Outlet Hose (2) @ Drive Motor Battery Coolant Pump» Remove
9. Drive Motor Battery Radiator Inlet Hose Retainer Clip (3) @ Drive Motor Battery Radiator Outlet Hose» Remove
10. Drive Motor Battery Radiator Outlet Hose (2)» Remove

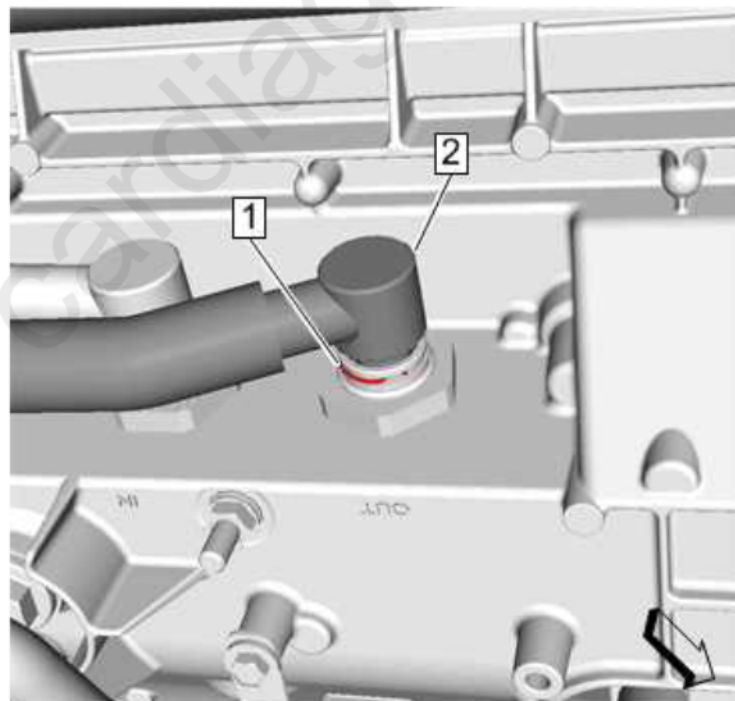
1. Drive Motor Battery Radiator Outlet Hose (2) @ Drive Motor Battery Coolant PumpA» Install



**Fig. 271: Drive Motor Battery Radiator Outlet Hose Clamp**

Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Battery Radiator Outlet Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Drive Motor Battery Radiator Inlet Hose Retainer Clip (3) @ Drive Motor Battery Radiator Outlet Hose» Install
4. Drive Motor Battery Radiator Outlet Hose (2) @ High Voltage Battery» Install

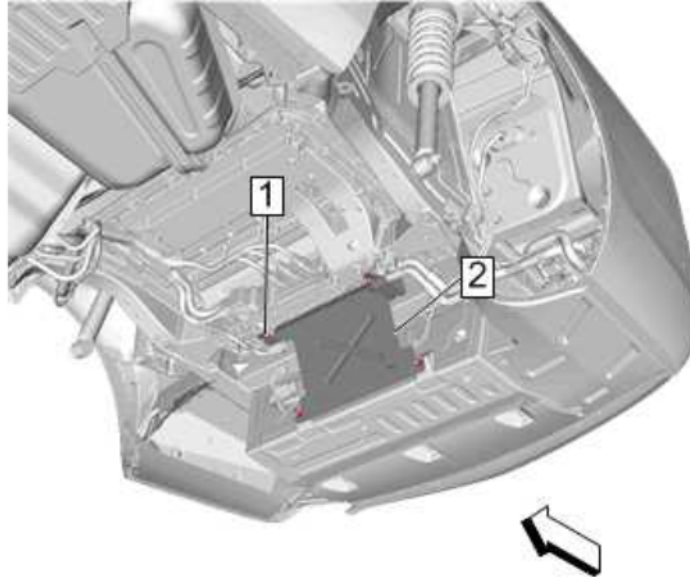


**Fig. 272: Drive Motor Battery Radiator Outlet Hose**

Courtesy of GENERAL MOTORS COMPANY

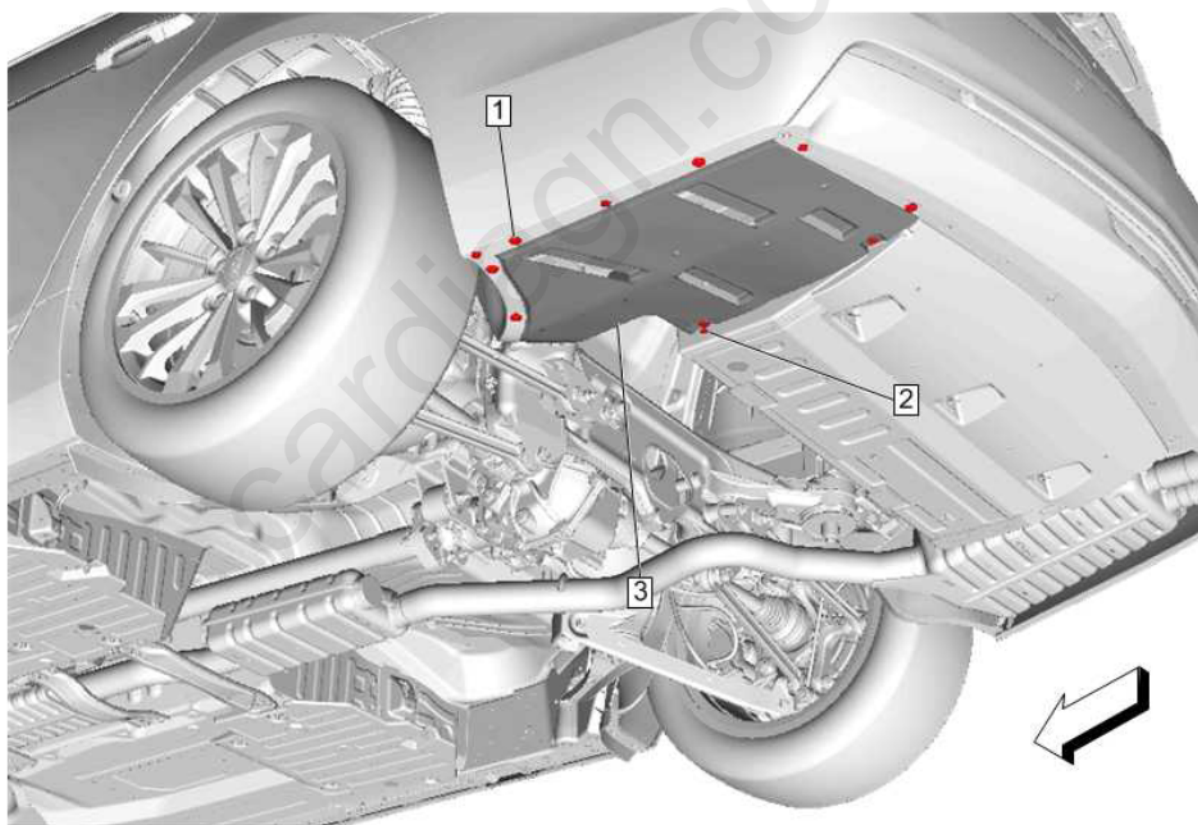
5. Drive Motor Battery Radiator Outlet Hose Retainer Clip (1)» Engage
6. Drive Motor Battery Convenience Charger Bracket (2)» Install - **Drive Motor Battery Convenience Charger Bracket Replacement**





**Fig. 273: Drive Motor Battery Convenience Charger Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

7. Underbody Rear Air Outer Deflector - Left Side (3)» Install - **Underbody Rear Air Outer Deflector Replacement (with HP9)**



**Fig. 274: Underbody Rear Air Outer Deflector (with HP9)**  
 Courtesy of GENERAL MOTORS COMPANY

8. Fill the high voltage battery cooling system. Refer to **High Voltage Battery Drain and Filling (Without Heater Vent Hose Quick Connect)** and/or **High Voltage Battery Drain and Filling (With Heater Vent Hose Quick Connect)**
9. Enable the high voltage system. Refer to **High Voltage Enabling**
10. Start the engine and check for coolant leaks.

### **HEATER VENT HOSE REPLACEMENT (WITHOUT QUICK CONNECT)**

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing



any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

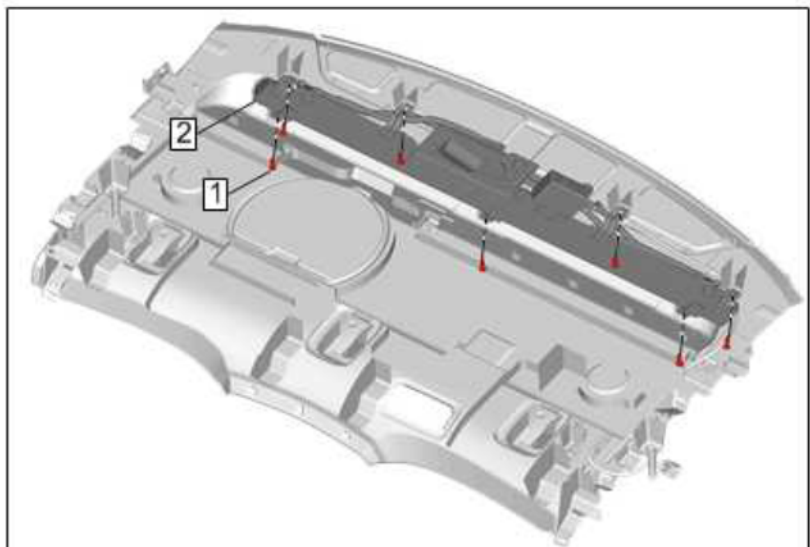
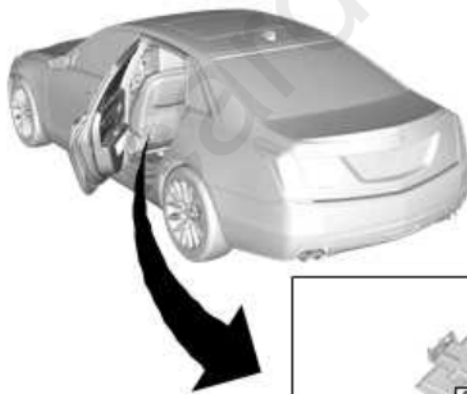
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#).

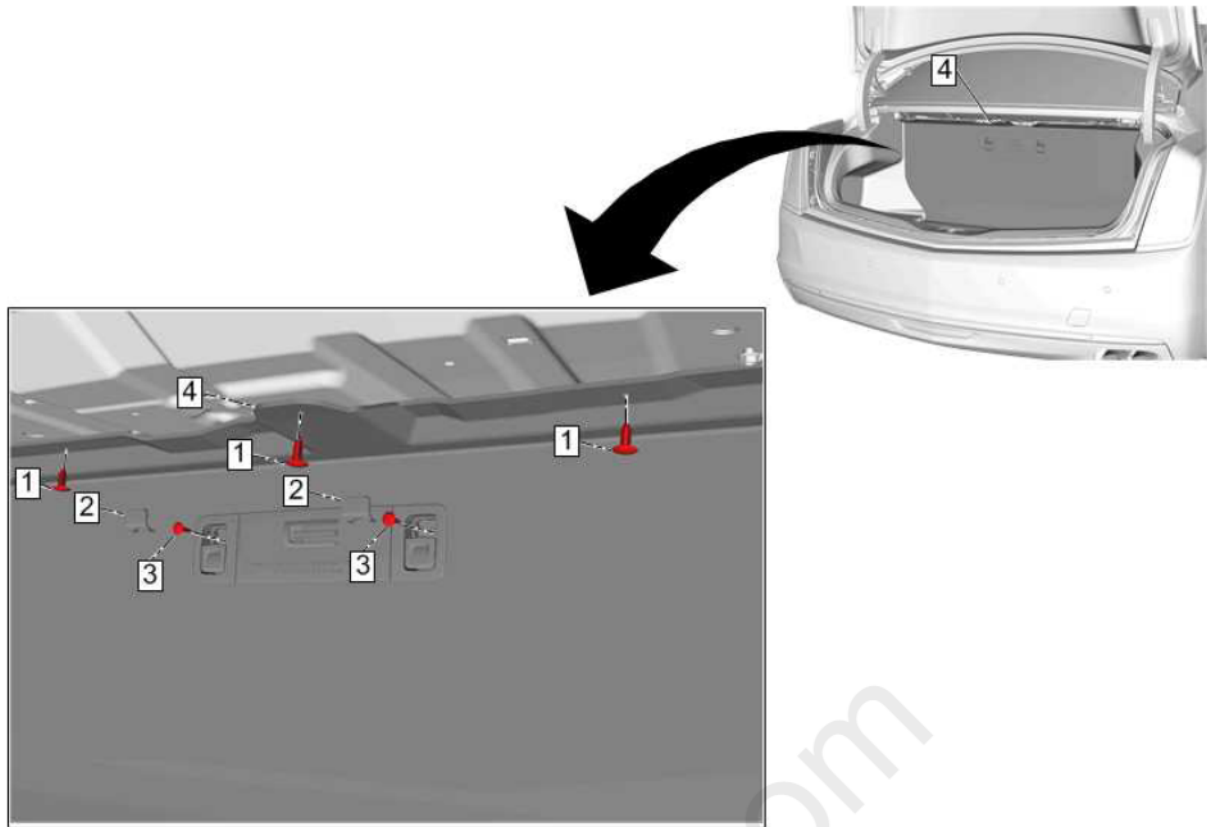
#### Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Window Inside Sunshade (2)» Remove - [Rear Window Inside Sunshade Replacement](#)



**Fig. 275: Rear Window Inside Sunshade**  
Courtesy of GENERAL MOTORS COMPANY

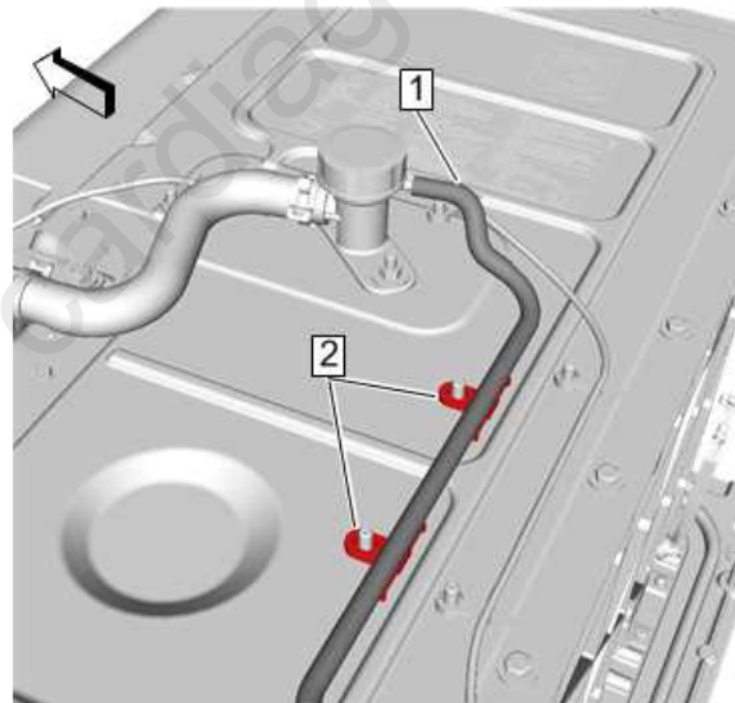
3. Drive Motor Battery Cover (4)» Remove - [Drive Motor Battery Cover Replacement \(With HP9\)](#)



**Fig. 276: Drive Motor Battery Cover (With HP9)**

Courtesy of GENERAL MOTORS COMPANY

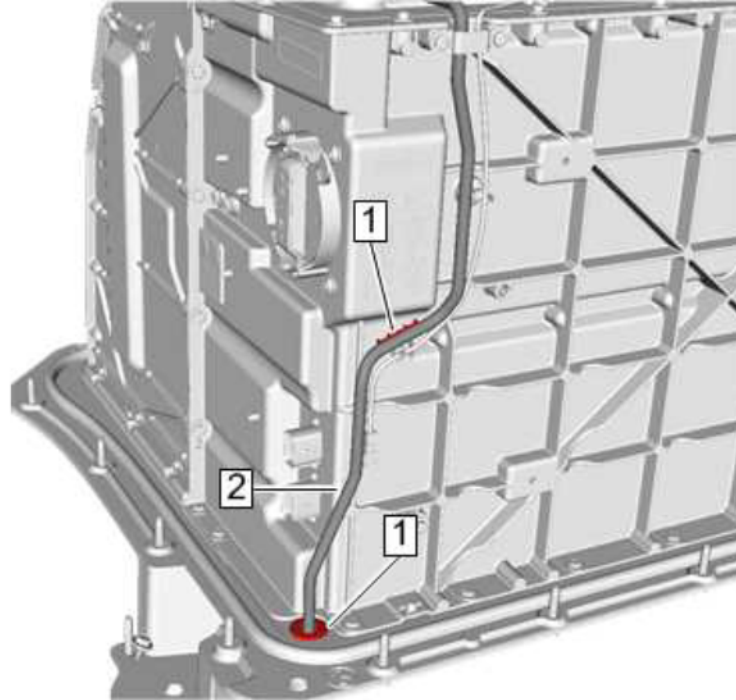
4. Heater Vent Hose (1) @ Water Inlet» Remove



**Fig. 277: Heater Vent Hose And Retainers**

Courtesy of GENERAL MOTORS COMPANY

5. Heater Vent Hose Retainer (2) @ High Voltage Battery Cover» Remove [2x]  
6. Heater Vent Hose Retainer (1) @ High Voltage Battery Cover» Remove [2x]

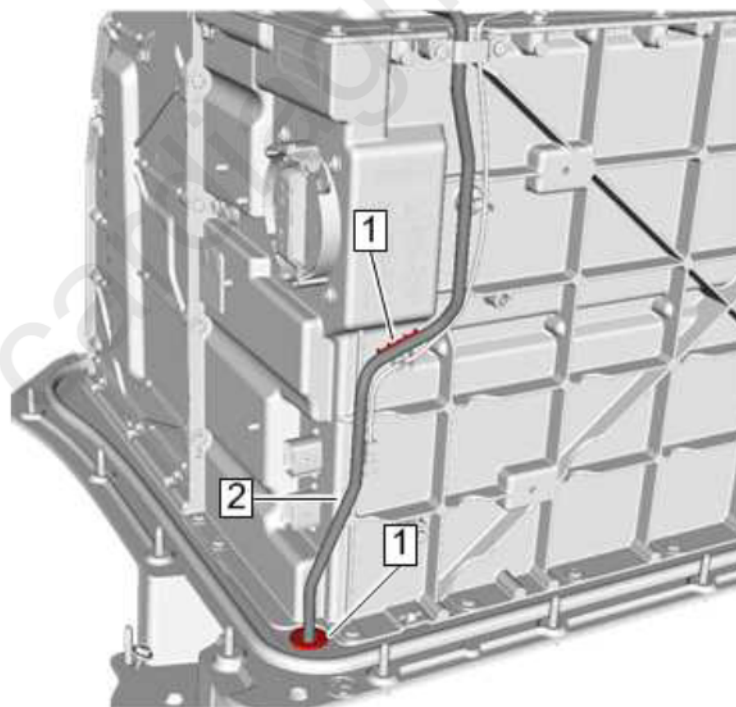


**Fig. 278: Heater Vent Hose And Retainers**  
**Courtesy of GENERAL MOTORS COMPANY**

7. Heater Vent Hose (2) @ High Voltage Battery Cover» Remove
8. Heater Vent Hose (2)» Remove

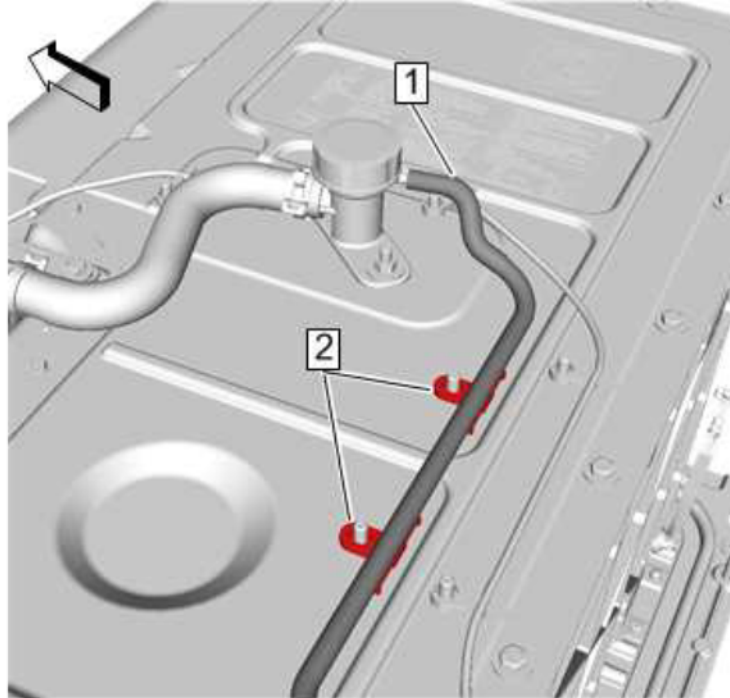
#### **Installation Procedure**

1. Heater Vent Hose (2) @ High Voltage Battery Cover» Install



**Fig. 279: Heater Vent Hose And Retainers**  
**Courtesy of GENERAL MOTORS COMPANY**

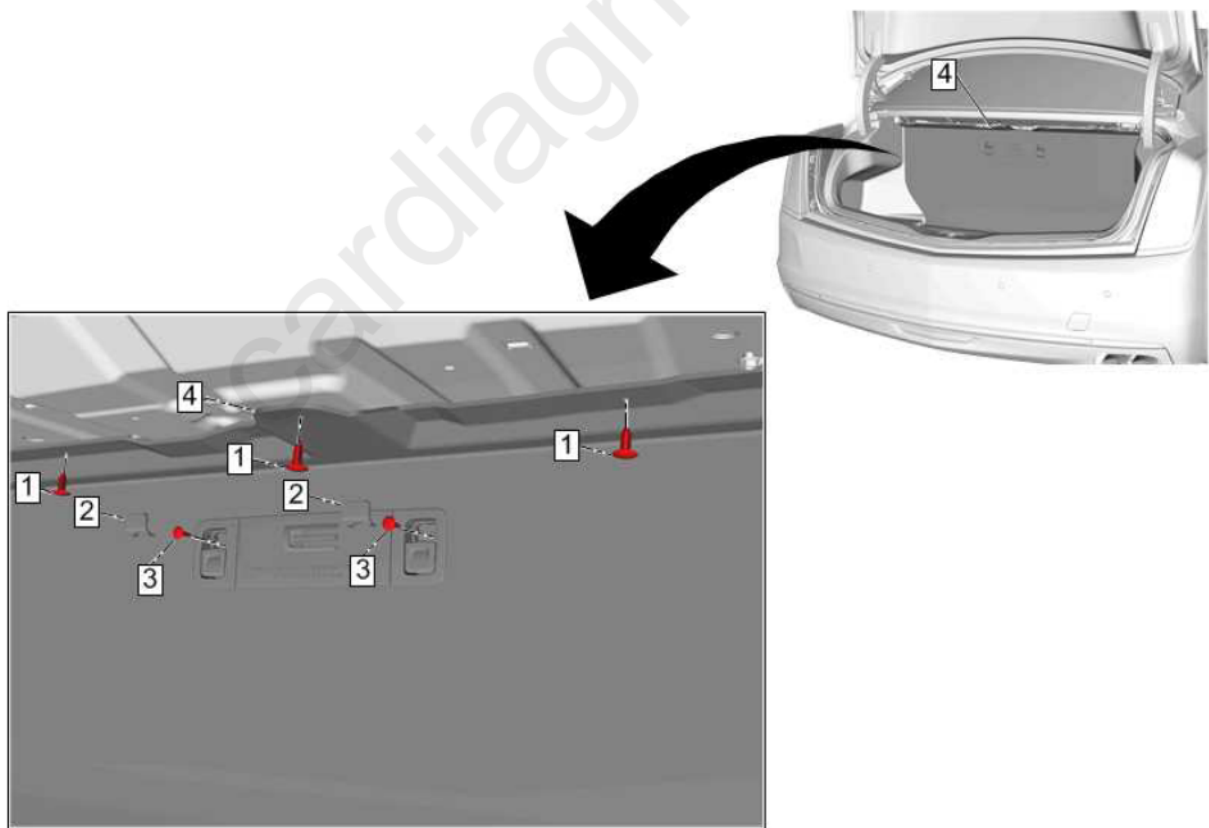
2. Heater Vent Hose Retainer (1) @ High Voltage Battery Cover» Install [2x]
3. Heater Vent Hose Retainer (2) @ High Voltage Battery Cover» Install [2x]



**Fig. 280: Heater Vent Hose And Retainers**

Courtesy of GENERAL MOTORS COMPANY

4. Heater Vent Hose (1) @ Water Inlet» Install
5. Inspect the high voltage battery coolant level. Refer to [High Voltage Battery Coolant Level Inspection](#)
6. Drive Motor Battery Cover (4)» Remove - [Drive Motor Battery Cover Replacement \(With HP9\)](#)

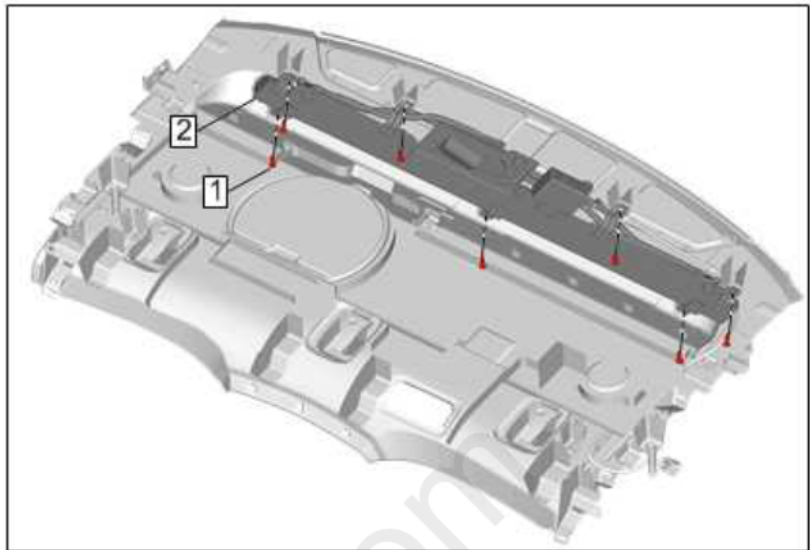
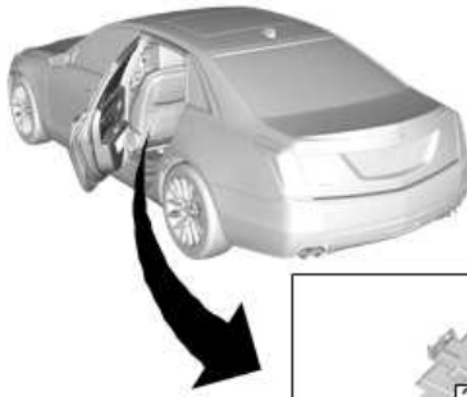


**Fig. 281: Drive Motor Battery Cover (With HP9)**

Courtesy of GENERAL MOTORS COMPANY

7. Rear Window Inside Sunshade (2)» Install - [Rear Window Inside Sunshade Replacement](#)





**Fig. 282: Rear Window Inside Sunshade**  
Courtesy of GENERAL MOTORS COMPANY

8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Start the engine and check for coolant leaks.

### HEATER VENT HOSE REPLACEMENT (WITH QUICK CONNECT)

**WARNING:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

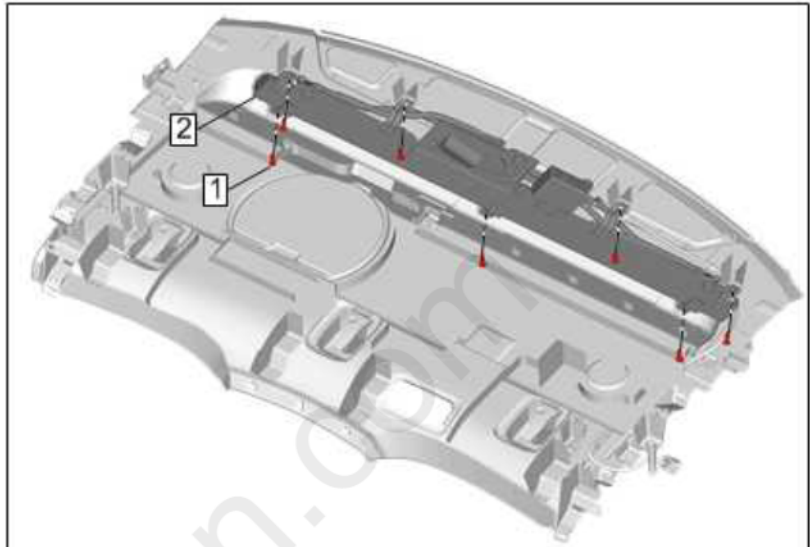
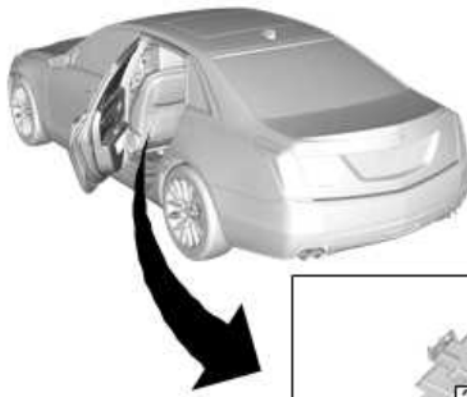
- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

**CAUTION:** Refer to [Hybrid Cooling System Caution](#) .

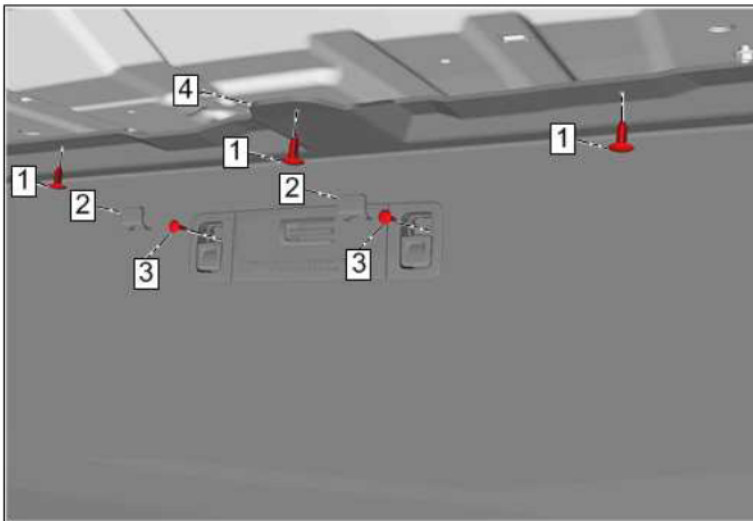
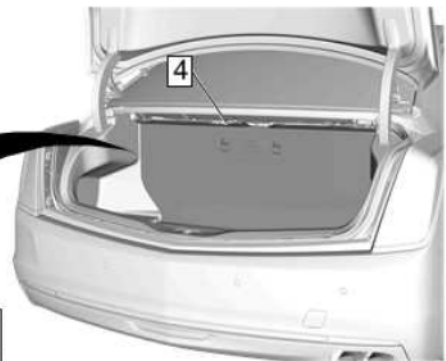
## Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Rear Window Inside Sunshade (2)» Remove - [Rear Window Inside Sunshade Replacement](#)



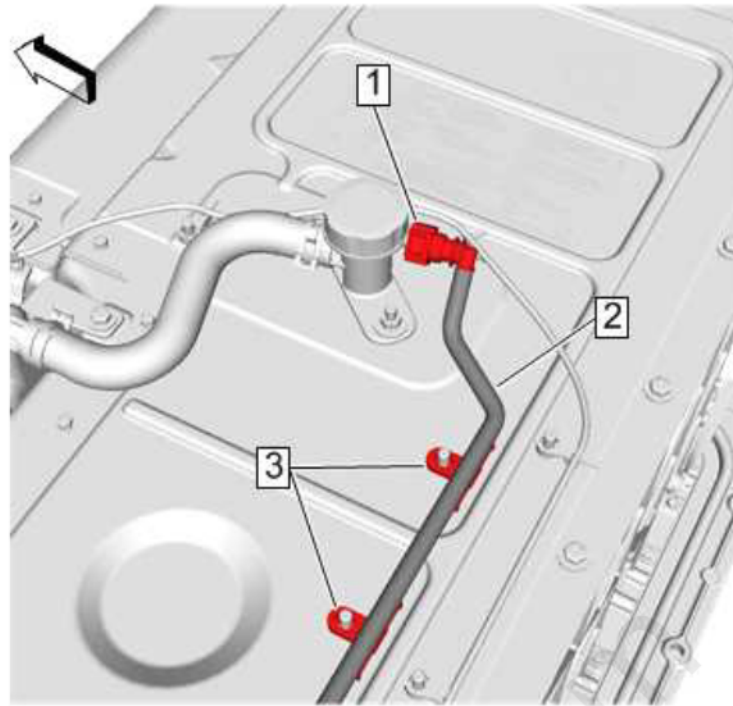
**Fig. 283: Rear Window Inside Sunshade**  
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Cover (4)» Remove - [Drive Motor Battery Cover Replacement \(With HP9\)](#)



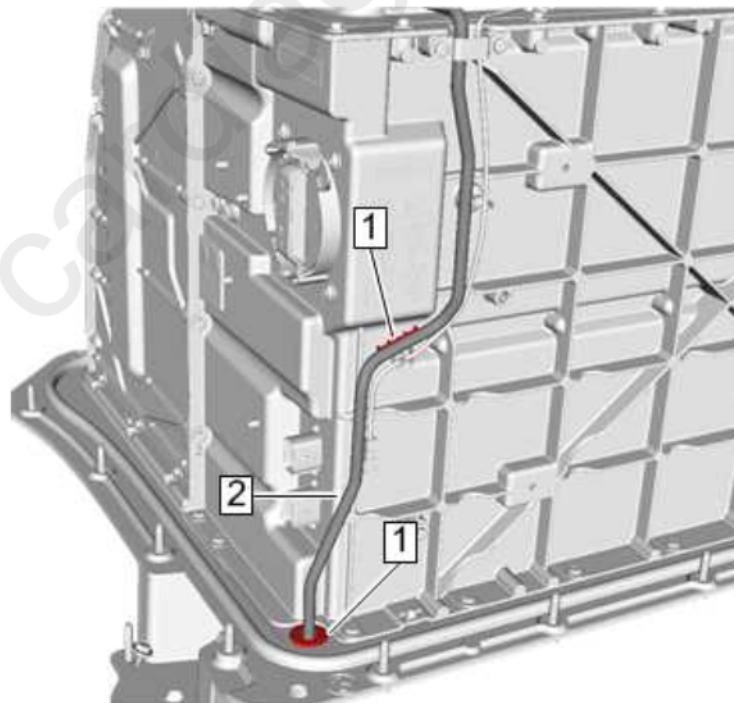
**Fig. 284: Drive Motor Battery Cover (With HP9)**  
Courtesy of GENERAL MOTORS COMPANY

4. Quick Connect Fitting (1) @ Water Inlet» Disengage



**Fig. 285: Quick Connect Fitting**  
Courtesy of GENERAL MOTORS COMPANY

- 5. Heater Vent Hose (2) @ Water Inlet» Remove
- 6. Heater Vent Hose Retainer (3) @ High Voltage Battery Cover» Remove [2x]
- 7. Heater Vent Hose Retainer (1) @ High Voltage Battery Cover» Remove [2x]

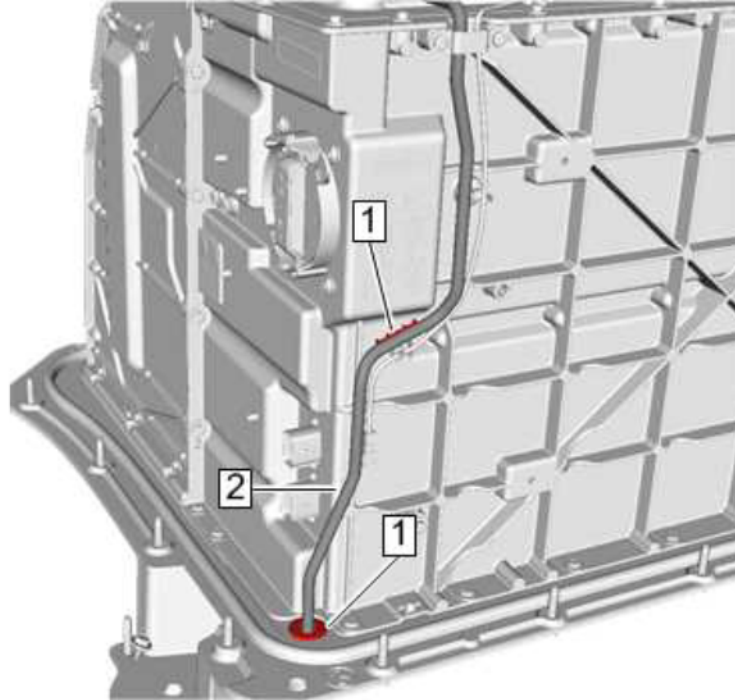


**Fig. 286: Heater Vent Hose And Retainers**  
Courtesy of GENERAL MOTORS COMPANY

- 8. Heater Vent Hose (2) @ High Voltage Battery Cover» Remove
- 9. Heater Vent Hose (2)» Remove

#### **Installation Procedure**

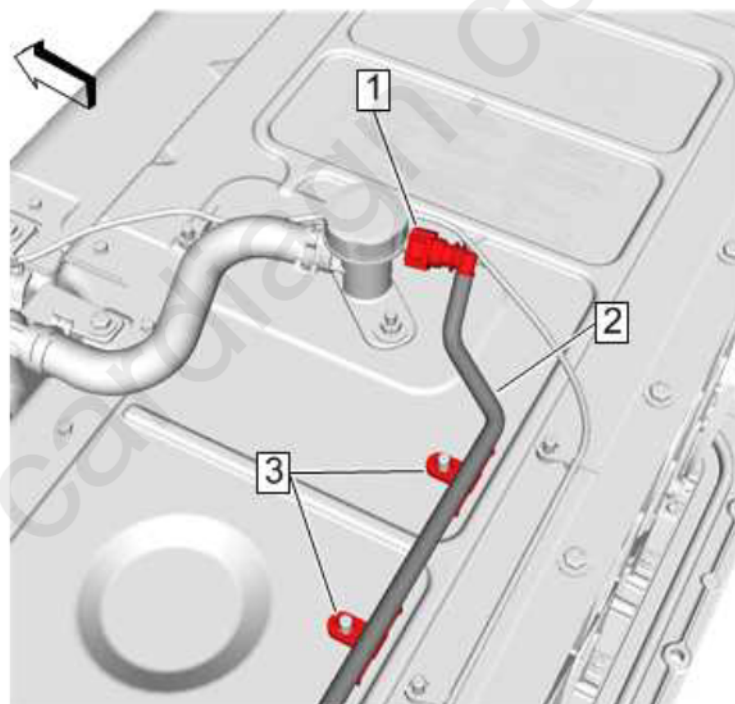
- 1. Heater Vent Hose (2) @ High Voltage Battery Cover» Install



**Fig. 287: Heater Vent Hose And Retainers**

Courtesy of GENERAL MOTORS COMPANY

2. Heater Vent Hose Retainer (1) @ High Voltage Battery Cover» Install [2x]
3. Heater Vent Hose (1) @ Water Inlet» Install

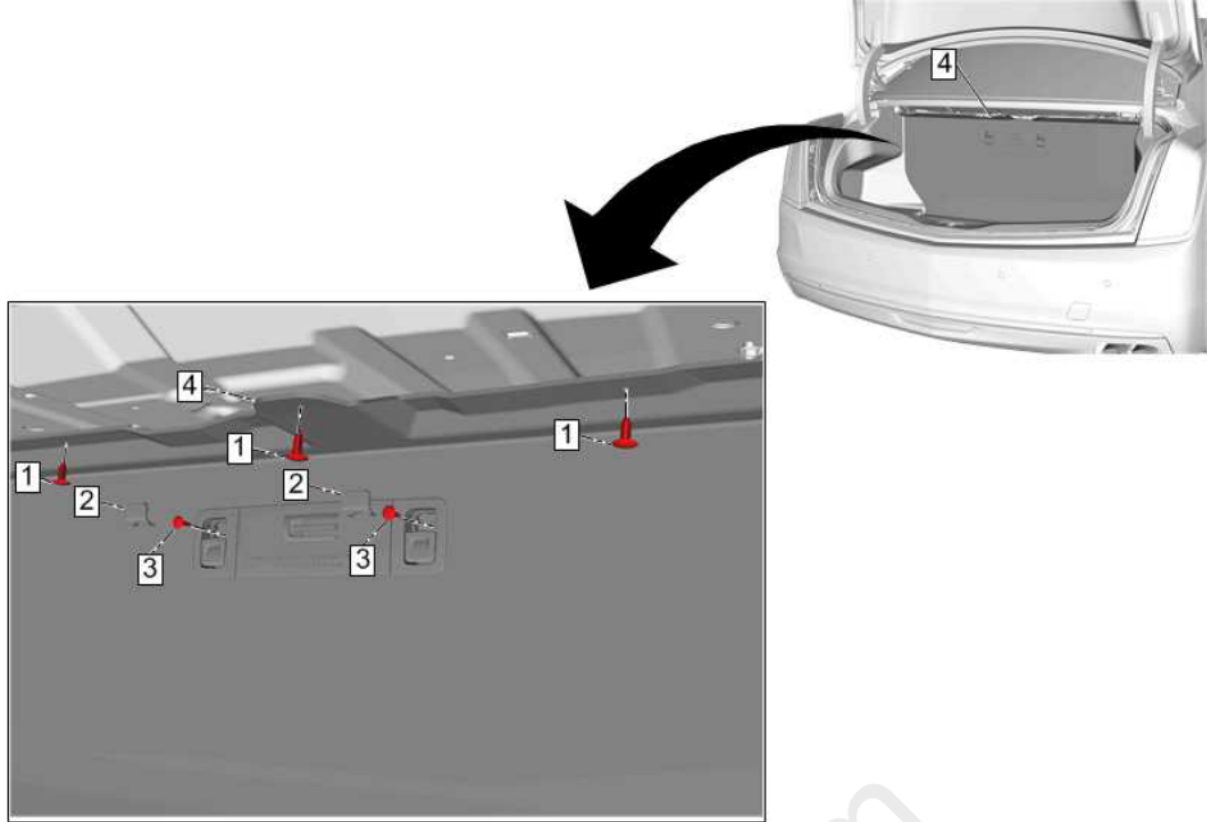


**Fig. 288: Quick Connect Fitting**

Courtesy of GENERAL MOTORS COMPANY

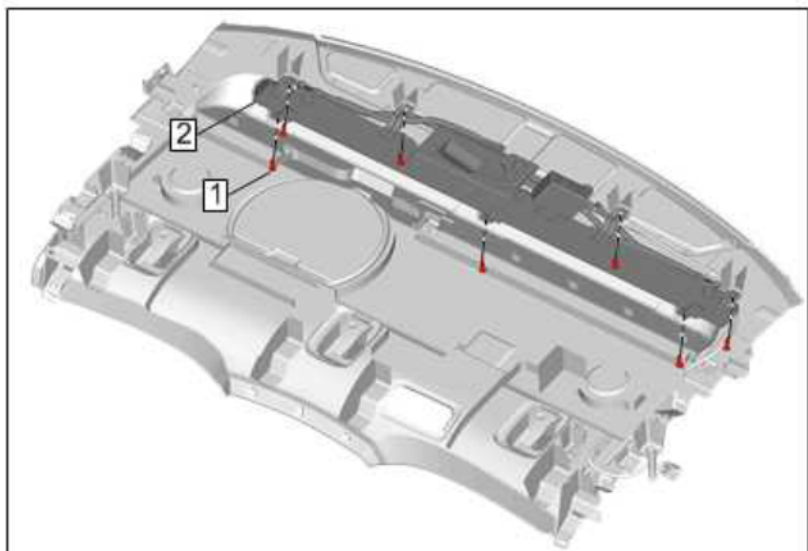
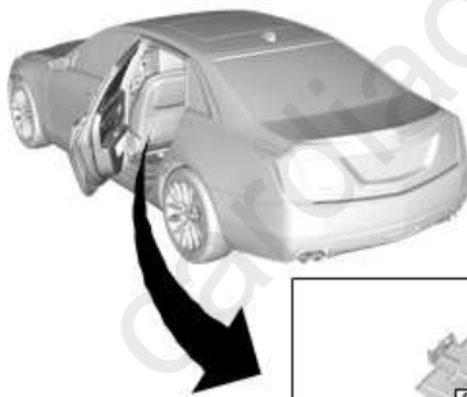
4. Quick Connect Fitting (1) @ Water Inlet» Engage
5. Heater Vent Hose Retainer (3) @ High Voltage Battery Cover» Install [2x]
6. Inspect the high voltage battery coolant level. Refer to [High Voltage Battery Coolant Level Inspection](#)
7. Drive Motor Battery Cover (4)» Remove - [Drive Motor Battery Cover Replacement \(With HP9\)](#)





**Fig. 289: Drive Motor Battery Cover (With HP9)**  
 Courtesy of GENERAL MOTORS COMPANY

8. Rear Window Inside Sunshade (2)» Install - **Rear Window Inside Sunshade Replacement**



**Fig. 290: Rear Window Inside Sunshade**  
 Courtesy of GENERAL MOTORS COMPANY

9. Enable the high voltage system. Refer to **High Voltage Enabling**
10. Start the engine and check for coolant leaks.

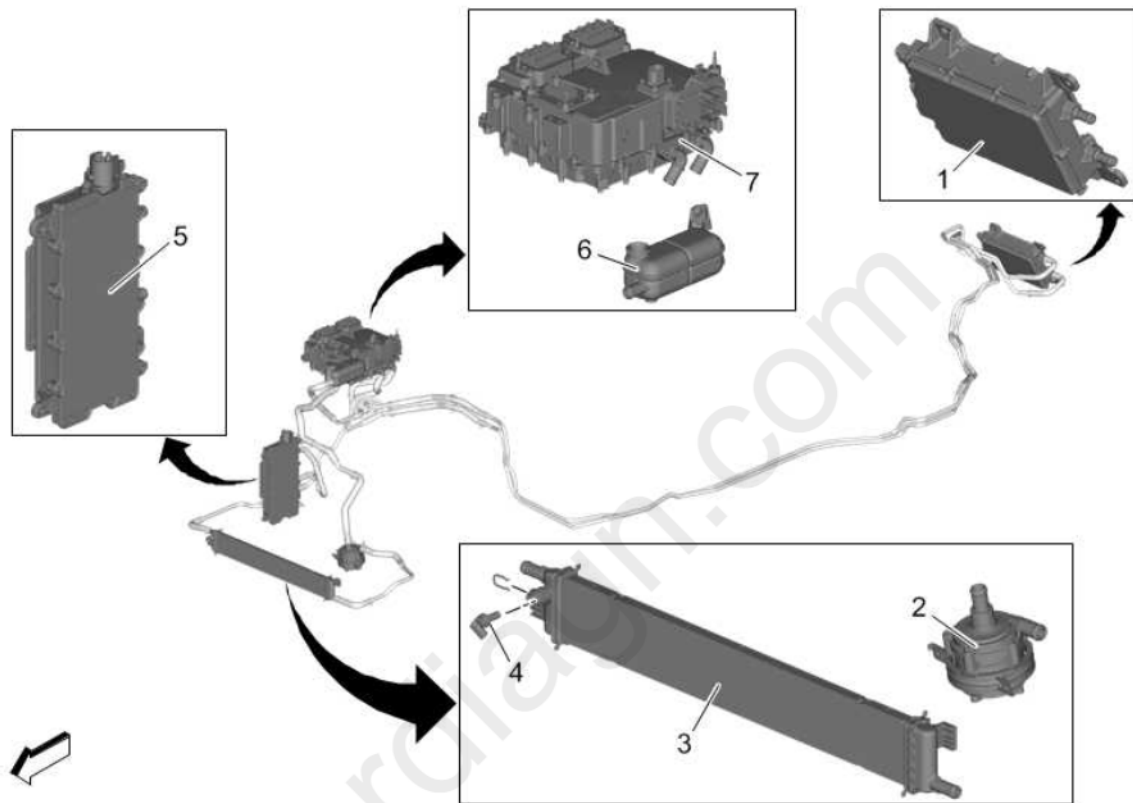
## **DESCRIPTION AND OPERATION**

## HYBRID/EV COOLING SYSTEM DESCRIPTION AND OPERATION

This vehicle is equipped with three fully independent cooling systems.

1. The hybrid/EV electronics cooling system is dedicated to cooling the power electronics components.
2. The hybrid/EV battery pack cooling system is dedicated to cooling and heating the high voltage hybrid/EV battery pack.
3. The engine cooling system is dedicated to:
  - cooling the engine
  - providing heat to the passenger compartment

### Hybrid/EV Electronics Cooling System Description and Operation



**Fig. 291: Hybrid/EV Electronics Cooling System**  
Courtesy of GENERAL MOTORS COMPANY

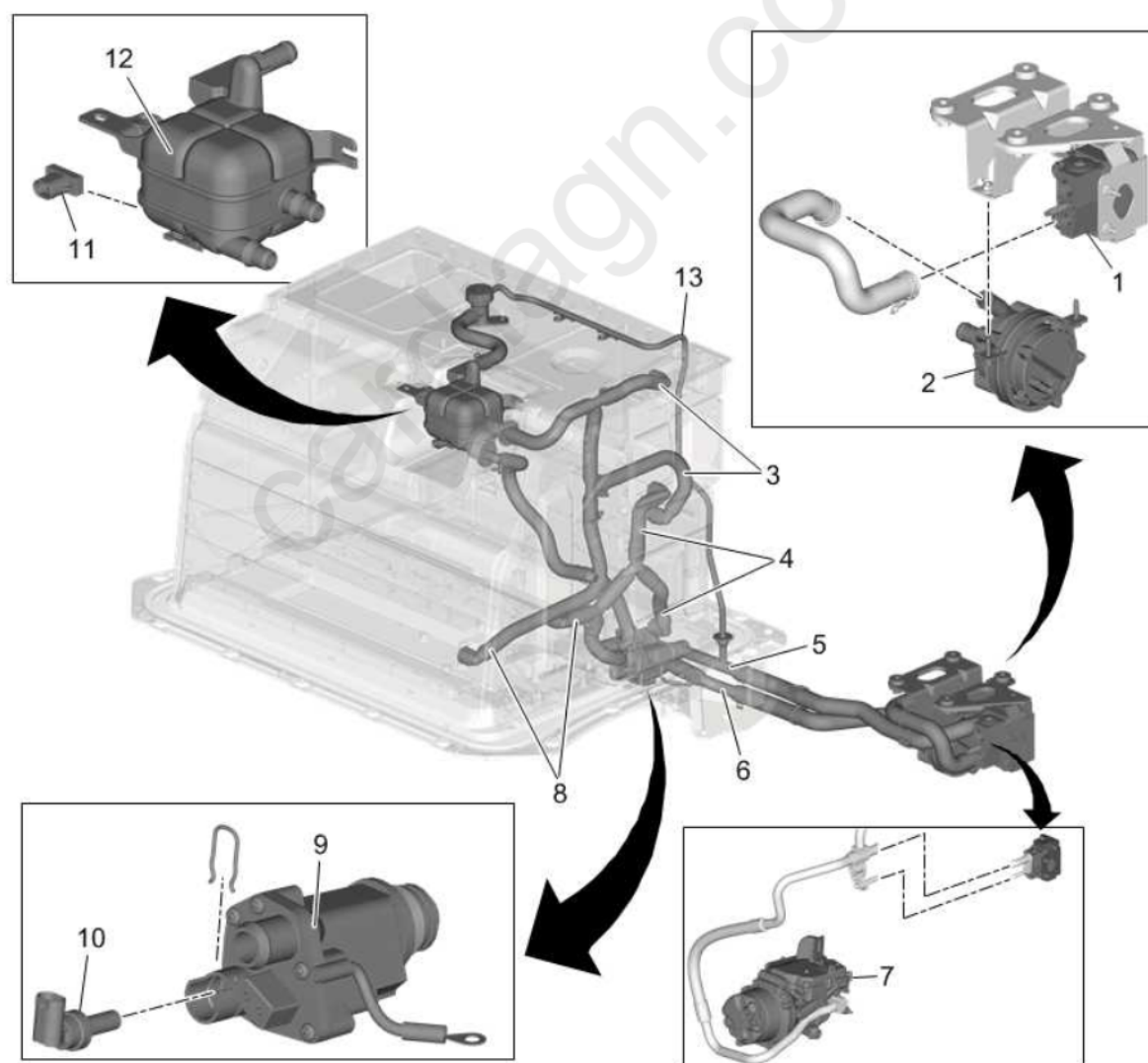
| Callout | Schematic Reference or Generic Name                   | Scan Tool Reference                       | Service Part Name                              |
|---------|-------------------------------------------------------|-------------------------------------------|------------------------------------------------|
| 1       | T18 Battery Charger                                   | Battery Charger                           | Drive Motor Battery Charger                    |
| 2       | G35 Hybrid/EV Electronics Coolant Pump                | Hybrid/EV Electronics Coolant Pump        | Generator Control Module Coolant Pump          |
| 3       | Cooler                                                | N/A                                       | Auxiliary Radiator                             |
| 4       | B202 Hybrid/EV Electronics Coolant Temperature Sensor | Hybrid/EV Electronics Coolant Temperature | Engine Coolant Temperature Sensor              |
| 5       | K1 14V Power Module                                   | 14V Power Module                          | Accessory DC Power Control Module              |
| 6       | Coolant Reservoir                                     | N/A                                       | Generator Control Module Coolant/Air Separator |

| Callout | Schematic Reference or Generic Name | Scan Tool Reference                                                                                                                                            | Service Part Name                 |
|---------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| 7       | T6 Power Inverter Module            | <ul style="list-style-type: none"> <li>Hybrid Powertrain Control Module</li> <li>Drive Motor Control Module 1</li> <li>Drive Motor Control Module 2</li> </ul> | Drive Motor Power Inverter Module |

The primary purpose of the hybrid/EV electronics cooling loop is to cool the T6 power inverter module, T18 battery charger and the K1 14V power module. The hybrid/EV electronics cooling system uses the auxiliary radiator, engine control module inputs, radiator fan(s) and 12 V G35 hybrid/EV electronics coolant pump to circulate coolant through the system. The K114B hybrid/EV powertrain control module 2 activates the coolant pump and monitors the B202 hybrid/EV electronics coolant temperature sensor in the auxiliary radiator. The coolant pump will activate when the vehicle is on and during charging.

The hybrid/EV electronics cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the hybrid/EV electronics coolant system.

### Hybrid/EV Battery Pack Cooling System Description and Operation



**Fig. 292: Hybrid/EV Battery Pack Cooling System**

Courtesy of GENERAL MOTORS COMPANY

| Callout | Schematic Reference or Generic Name | Scan Tool Reference | Service Part Name |
|---------|-------------------------------------|---------------------|-------------------|
|         |                                     |                     |                   |

| Callout | Schematic Reference or Generic Name                       | Scan Tool Reference                                 | Service Part Name                                           |
|---------|-----------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------|
| 1       | Refrigerant/Coolant Heat Exchanger or Chiller             | N/A                                                 | Drive Motor Battery Coolant Cooler                          |
| 2       | G37 Hybrid/EV Battery Pack Coolant Pump                   | Hybrid/EV Battery Pack Coolant Pump                 | Drive Motor Battery Coolant Pump                            |
| 3       | Hybrid/EV Battery Section 2 Coolant Inlet and Outlet      | N/A                                                 | N/A                                                         |
| 4       | Hybrid/EV Battery Section 3 Coolant Inlet and Outlet      | N/A                                                 | N/A                                                         |
| 5       | Hybrid/EV Battery Pack Coolant Inlet                      | N/A                                                 | N/A                                                         |
| 6       | Hybrid/EV Battery Pack Coolant Outlet                     | N/A                                                 | N/A                                                         |
| 7       | G1 A/C Compressor                                         | Electric A/C Compressor Control Module              | Air Conditioning and Drive Motor Battery Cooling Compressor |
| 8       | Hybrid/EV Battery Section 1 Coolant Inlet and Outlet      | N/A                                                 | N/A                                                         |
| 9       | E54 Hybrid/EV Battery Pack Coolant Heater                 | Hybrid/EV Battery Pack Heater                       | High Voltage Battery Heater                                 |
| 10      | B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1 | Hybrid/EV Battery Pack Coolant Temperature Sensor 1 | N/A                                                         |
| 11      | B258 Hybrid/EV Battery Coolant Level Switch               | Hybrid/EV Battery Pack Coolant Level Switch         | Drive Motor Battery Coolant Level Sensor                    |
| 12      | Coolant Reservoir                                         | N/A                                                 | Drive Motor Battery Coolant/Air Separator                   |
| 13      | Coolant Overflow Drain Hose                               | N/A                                                 | Heater Vent Hose                                            |

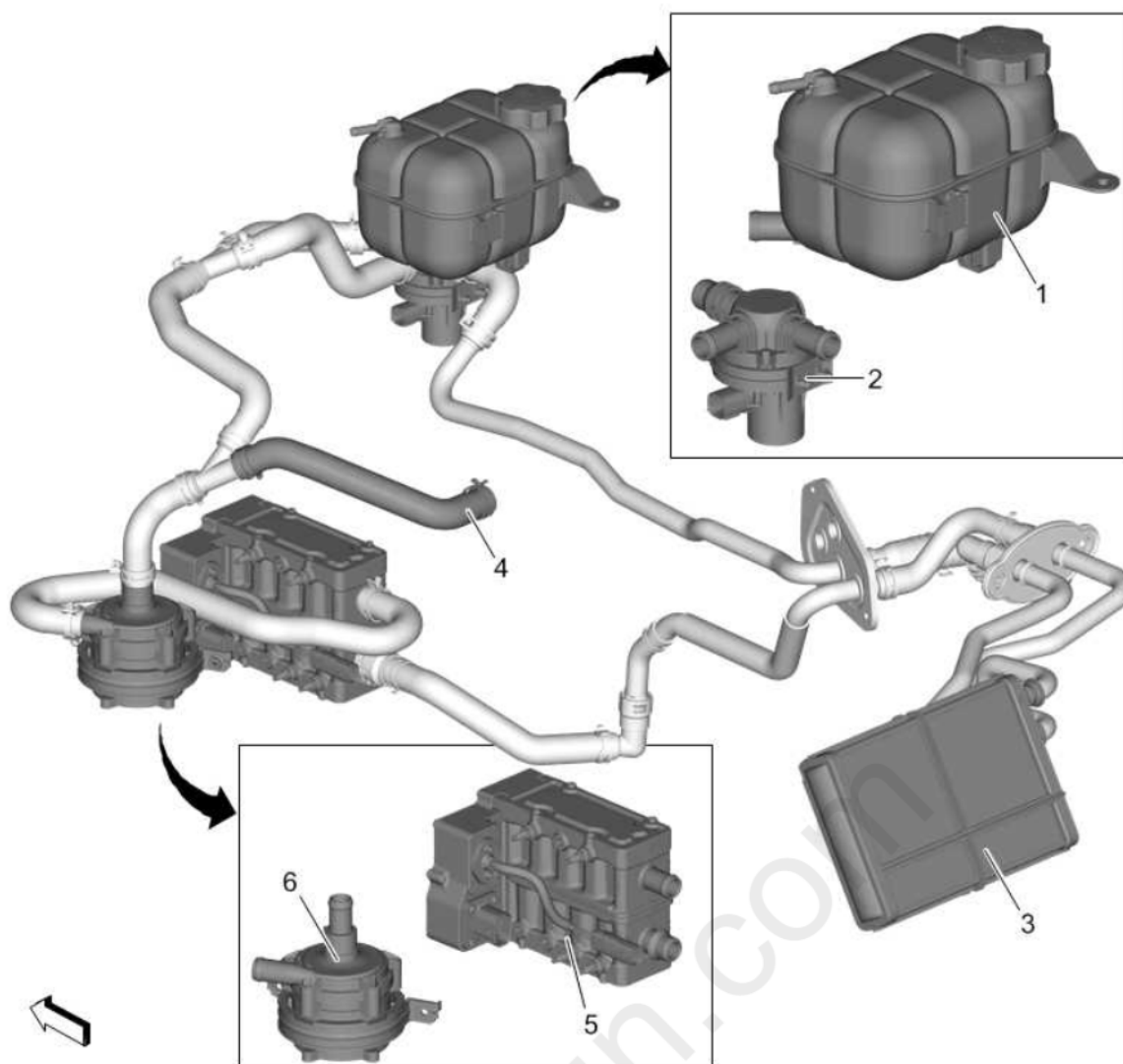
The energy storage system cooling system uses the 12 V G37 hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the high voltage G1 A/C compressor to cool down the A4 hybrid/EV battery pack. There is also a high voltage E54 hybrid/EV battery pack coolant heater inside the hybrid/EV battery to heat the coolant entering the hybrid/EV battery when needed. The K114B hybrid/EV powertrain control module 2 monitors the B204A hybrid/EV battery pack coolant temperature sensor 1, hybrid/EV battery cell temperature sensors, refrigerant temperature, refrigerant pressure and the B258 Hybrid/EV Battery Coolant Level Switch. The K114B hybrid/EV powertrain control module 2 determines how much hybrid/EV battery cooling or heating is required and turns on the G37 hybrid/EV battery pack coolant pump. Depending on what is required, it will operate the radiator fan(s) and request the A/C Compressor Module to turn on the high voltage A/C compressor or turn on the high voltage E54 hybrid/EV battery pack coolant heater. The hybrid/EV battery pack cooling system could be activated when the vehicle is operating, during charging or when the vehicle is OFF and maintaining the hybrid/EV battery pack temperature. Refer to [Automatic HVAC Description and Operation](#).

The B258 hybrid/EV battery pack coolant level switch is attached to the coolant reservoir. The level sensor is a 2 state magnet/reed switch which changes state when the level in the reservoir gets low. The K114B hybrid/EV powertrain control module 2 uses the B258 hybrid/EV battery pack coolant level switch to determine if disabling the hybrid/EV battery pack charging operation is necessary due to a loss of coolant.

The hybrid/EV battery pack cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the battery coolant system.

### Passenger Compartment Heater System Description and Operation





**Fig. 293: Passenger Compartment Heater System**  
Courtesy of GENERAL MOTORS COMPANY

| Callout | Schematic Reference or Generic Name                    | Scan Tool Reference                                         | Service Part Name                |
|---------|--------------------------------------------------------|-------------------------------------------------------------|----------------------------------|
| 1       | Engine Coolant Surge Tank                              | N/A                                                         | Radiator Surge Tank              |
| 2       | Q66 Passenger Compartment Heater Coolant Control Valve | Passenger Compartment Heater Coolant Control Solenoid Valve | Heater Water Bypass Valve        |
| 3       | Heater Core                                            | N/A                                                         | Heater Core                      |
| 4       | Engine Coolant System Connection                       | N/A                                                         | Heater Water Auxiliary Pump Hose |
| 5       | K10 Coolant Heater Control Module                      | Electric Passenger Compartment Heater                       | Heater Coolant Heater            |
| 6       | G36 Auxiliary Heater Coolant Pump                      | Auxiliary Coolant Pump                                      | Heater Coolant Pump              |

The passenger compartment heater system uses the engine radiator, the 12 V G36 auxiliary heater coolant pump, Q66 passenger compartment heater coolant control valve, high voltage K10 coolant heater control module and a heater core to provide warm cabin air.

The Q66 passenger compartment heater coolant control valve has two positions. When commanded in bypass mode, as when the engine is OFF, the Q66 passenger compartment heater coolant control valve separates the engine and the high voltage coolant heater coolant loops to prevent heat generated by the high voltage K10 coolant heater control module from dissipating into the engine coolant loop. After the engine starts up and has attained sufficient warmth, the Q66 passenger compartment heater coolant control valve is commanded to normal mode and the two coolant loops are linked. Linking allows excess engine heat to assist the high voltage K10 coolant heater control module in heating the passenger compartment. The Q66 passenger compartment heater control valve contains an internal position sensor

that the K114B hybrid powertrain control module 2 monitors. When the engine coolant temperature heats up, a valve position learn procedure takes place.

The K33 HVAC control module turns on the G36 auxiliary heater coolant pump and monitors the temperature sensors in the passenger compartment and coolant loop to determine if high voltage K10 coolant heater control module operation is needed. Passenger compartment heat is provided by air flowing through the heater core. When operating the vehicle in cold temperatures, the engine may run for short periods to assist in maximizing heat efficiency to the passenger compartment depending on the outside temperature and the amount of passenger compartment heat requested by the vehicle operator.

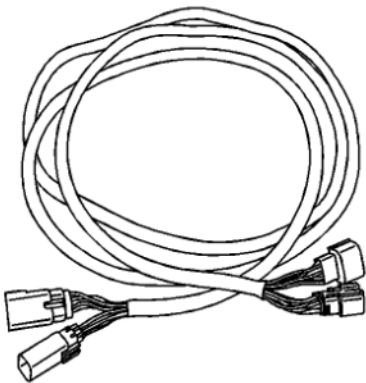
The K114B hybrid/EV powertrain control module 2 will command the Q66 passenger compartment heater coolant control valve into bypass mode when the module goes to sleep, at controller wake-up and during other times except:

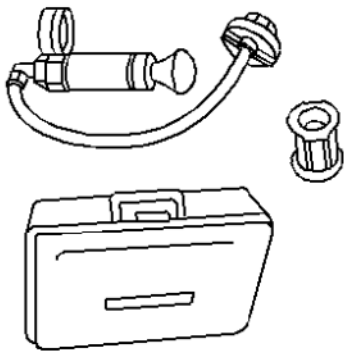
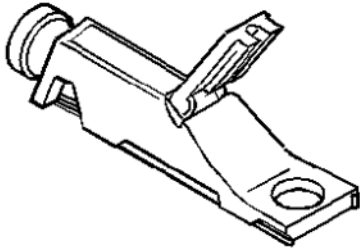
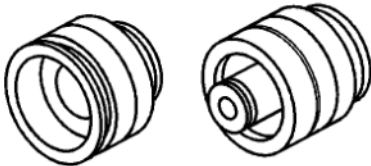
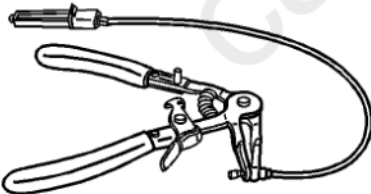
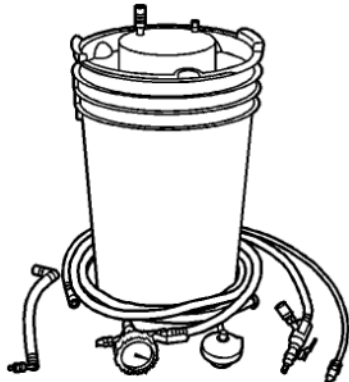
- During learn, after extended loss of 12 V power to the control module
- When the scan tool is sending a command.
- If the valve is stuck in an intermediate position, between two end positions, due to failure or debris.

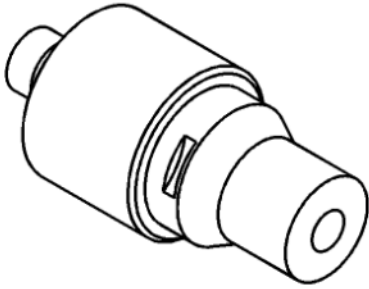
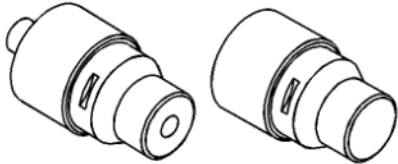
The engine/passenger compartment heater cooling system circulates a 50/50 mixture of DEX-COOLÂ® and clean, drinkable water.

## SPECIAL TOOLS AND EQUIPMENT

### SPECIAL TOOLS

| Illustration                                                                        | Tool Number/ Description                 |
|-------------------------------------------------------------------------------------|------------------------------------------|
|   | BO 38185<br>J 38185<br>Hose Clamp Pliers |
|  | EL 48900-A<br>HEV Safety Kit             |
|  | EL 50211<br>Low Voltage Harness          |

| Illustration                                                                        | Tool Number/ Description                                            |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|
|     | <p>EN 24460-A<br/>J 24460-01<br/>Cooling System Pressure Tester</p> |
|    | <p>GE 26568<br/>J 26568<br/>Coolant and Battery Fluid Tester</p>    |
|  | <p>GE 46143<br/>J 46143<br/>Cooling System Adapter</p>              |
|  | <p>GE 47622<br/>Hose Clamp Pliers</p>                               |
|  | <p>GE 47716<br/>Vac N Fill Coolant Refill Tool</p>                  |

| Illustration                                                                       | Tool Number/ Description                                      |
|------------------------------------------------------------------------------------|---------------------------------------------------------------|
|    | <p>GE 47716-20<br/>Cooling System Fill Adapter</p>            |
|   | <p>GE 50385<br/>Battery Pack Coolant Passage Test Adapter</p> |
|  | <p>GE 50389<br/>Coolant Pressure Test Quick Connector</p>     |