SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

B32 Hybrid/EV Battery Temperature Sensor

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	205
-20Â°C (-4Â°F)	70
0Â°C (32Â°F)	27.6
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)	1.3

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 # 25186240	

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

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

Application	Specification Metric (English)
Battery Cooling Air Inlet Duct Mounting Nut	9 N.m (80 lb in)
Drive Motor Generator Battery Cooling Blower Fastener	1.2 N.m (11 lb in)
Generator Control Module Coolant Pump Bracket Bolt	6.5 N.m (58 lb in)

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

Application	Specification
	Metric (English)
Hybrid Powertrain Control Module 2 Mounting Nut	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV COOLING WIRING SCHEMATICS

Starter/Generator

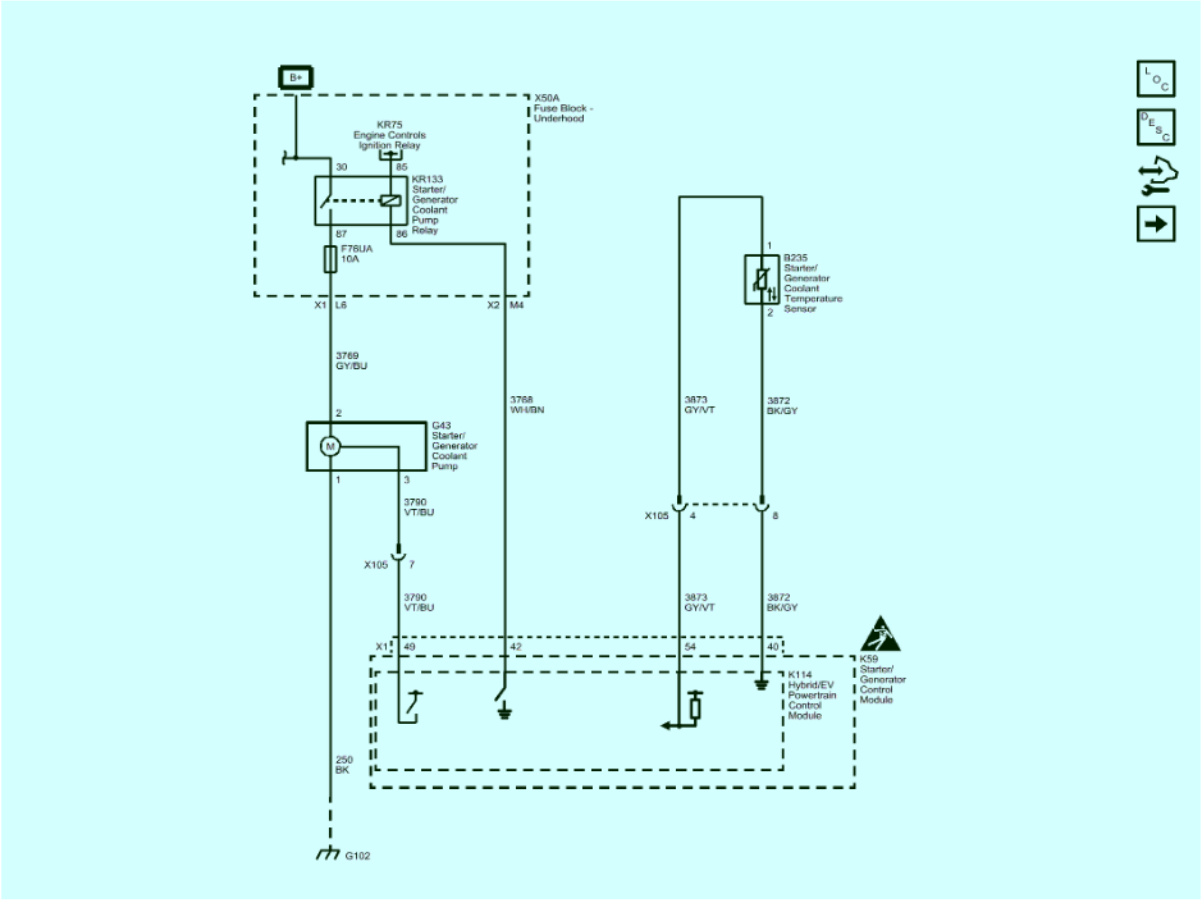


Fig. 1: Starter/Generator
Courtesy of GENERAL MOTORS COMPANY

Battery Pack

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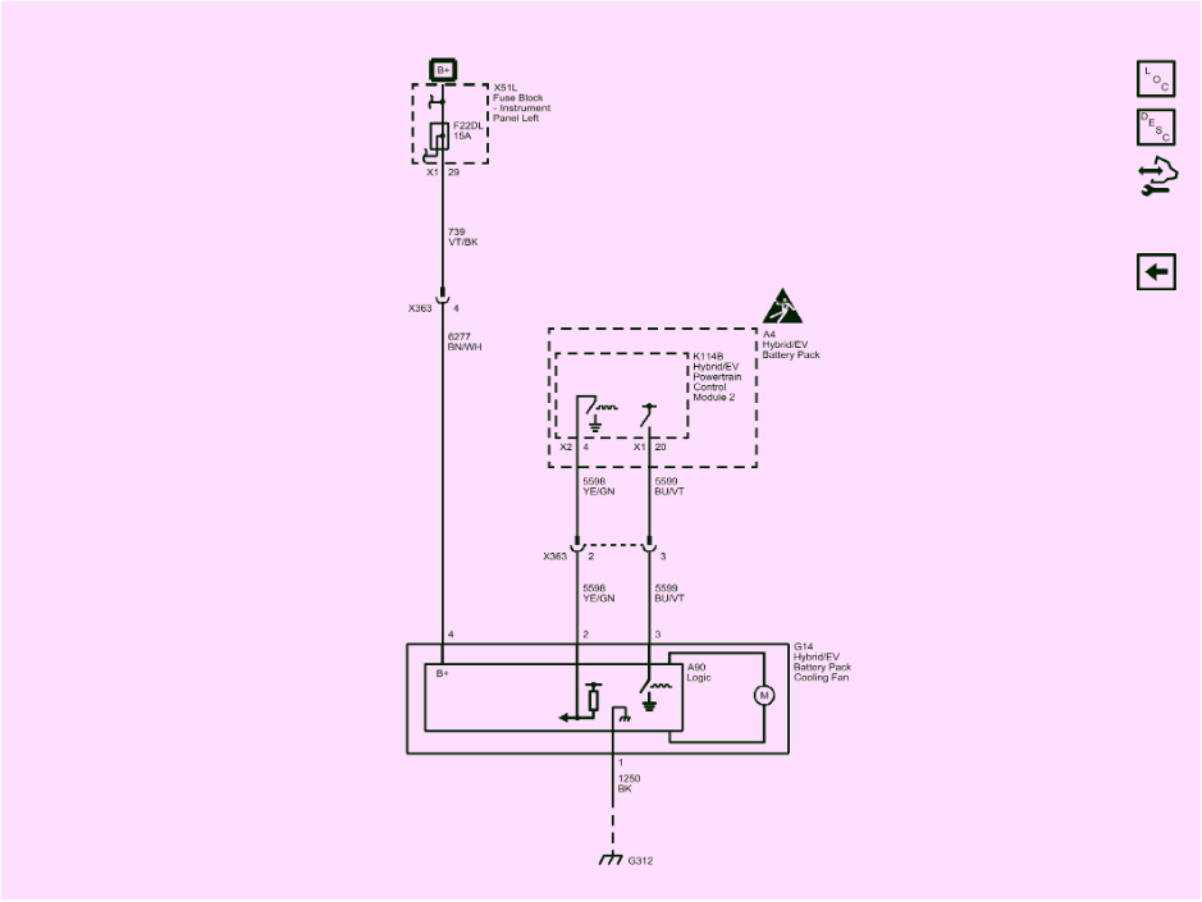


Fig. 2: Battery Pack
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0A7E: HYBRID/EV BATTERY PACK

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 P0A7E

Hybrid/EV Battery Pack High Temperature

Circuit/System Description

Four temperature sensors are used to monitor the battery temperature. The non-serviceable battery temperature sensors are located within the battery sections. Two temperature sensors are located in each battery section. The temperature sensor is a variable resistor that measures the temperature of the battery cell group. The hybrid/EV battery interface control module supplies 5V to the signal circuit and a ground for the low reference circuit. The battery temperature sensor resistance changes with battery temperature. As the temperature decreases, the

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sensor resistance increases. As the temperature increases, the sensor resistance decreases.

Each hybrid/EV battery interface control module communicates the temperature sensor values to the hybrid/EV powertrain control module 2 via serial data.

The hybrid/EV battery pack is air cooled. The high voltage battery cooling fan draws air through the battery pack via cooling duct openings at the sides of the battery.

Conditions for Running the DTC

None of the following DTCs are set: P0A9D, P0A9E, P0AC7, P0AC8, P0ACD, P0ACC, P0AEA, P0AEB, P1E8E, P1E94, U179C..

Conditions for Setting the DTC

The battery temperature as measured by the temperature sensors is greater than 72Â°C (162Â°F) for at least 8 out of 10 seconds.

Actions Taken When the DTC Sets

DTC P0A7E is a Type B DTC.

Conditions for Clearing the DTC

DTC P0A7E is a Type B DTC.

Diagnostic Aids

Proper hybrid/EV battery pack cooling requires unrestricted airflow through both the inlet and exhaust openings and/or ducts. Verify the vehicle operator had not blocked any of these vents on a vehicle with an intermittent condition.

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

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Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

Equivalent regional tools:, Refer to:**Special Tools** .

Circuit/System Verification

NOTE: **You should be able to hear the fan operate and feel airflow in and out of the high voltage battery assembly.**

1. Verify the G14 Hybrid/EV Battery Pack Cooling Fan speed increases and decreases when commanding the Hybrid/EV Powertrain Control Module 2 Hybrid/EV Battery Pack Cooling Fan with a scan tool.
   - **If the fan speed does not increase and decrease as commanded**

     Refer to:**DTC P0A81-P0A85 or P0BC8-P0BCA**.

   - **If the fan speed operates as commanded**
2. Visually inspect the inlet and outlet of the Hybrid/EV Battery Pack assembly.
3. Verify the inlet and outlet are free of any debris or obstructions that will limit airflow.
   - **If any debris or obstructions are found**

     Remove the obstruction to allow proper airflow and allow the Hybrid/EV Battery Pack to cool before retesting.

   - **If no debris or obstructions are found**
4. Verify the Hybrid/EV Battery Pack Cooling Fan blade is properly secured and not damaged in a manner that will limit airflow through the battery assembly.
   - **If the fan is damaged**

     Repair or replace as necessary and allow the Hybrid/EV Battery Pack to cool before retesting.

   - **If the fan is undamaged**
5. Ignition On .
6. Operate the vehicle under the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.
7. Verify the DTC does not set.
   - **If the DTC sets**

     Replace the Hybrid/EV Battery Pack.

   - **If the DTC does not set**
8. All OK.

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Repair Instructions

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

High Voltage Battery Replacement and Shipping Preparation (with Center Console) **High Voltage Battery Replacement and Shipping Preparation (with Front Center Seat)** for Hybrid/EV Battery Pack Replacement

DTC P0A81-P0A85 OR P0BC8-P0BCA: HYBRID/EV BATTERY PACK COOLING FAN

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 P0A81

Hybrid/EV Battery Pack Cooling Fan Control Circuit

DTC P0A84

Hybrid/EV Battery Pack Cooling Fan Control Circuit Low Voltage

DTC P0A85

Hybrid/EV Battery Pack Cooling Fan Control Circuit High Voltage

DTC P0BC8

Hybrid/EV Battery Pack Cooling Fan Performance

DTC P0BC9

Hybrid/EV Battery Pack Cooling Fan Feedback Circuit Low Frequency

DTC P0BCA

Hybrid/EV Battery Pack Cooling Fan Feedback Circuit High Frequency

Circuit/System Description

The hybrid/EV battery pack cooling fan draws air through the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the battery pack cooling fan.

The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the battery pack cooling fan speed. The higher the duty cycle the higher the fan speed. The hybrid/EV battery pack cooling fan utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain

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control module 2. During normal operation, the feedback circuit provides fan speed information to the hybrid/EV powertrain control module 2. If the battery pack cooling fan determines there is an internal fault it provides this information on the same feedback circuit instead of fan speed information.

The hybrid/EV battery cooling fan has a fused 12 V power circuit and a ground circuit.

Conditions for Running the DTC

P0A81, P0A84

- Ignition is RUN or CRANK
- 12 V battery voltage is greater than 9.1 V
- DTC P2534 or P2535 not set
- The hybrid/EV battery pack cooling fan PWM is commanded between 0-10%

P0A85

- Ignition is RUN or CRANK
- 12 V battery voltage is greater than 9.1 V
- DTC P2534 or P2535 not set
- The hybrid/EV battery pack cooling fan PWM is commanded between 11-100%

P0BC8

- Ignition is RUN or CRANK
- The hybrid/EV battery pack cooling fan is enabled
- 12 V battery voltage is greater than 9.1 V
- The hybrid/EV battery pack cooling fan is commanded between 11-90%
- The hybrid/EV battery pack cooling fan ON time is greater than 20 s
- DTC P0A81, P0A84, P0A85, P0A9C-P0A9E, P0BC9, P0BCA, P0D64, P0D65, P0D66, P2534, or P2535 is not set

OR

- Ignition is RUN or CRANK
- The hybrid/EV battery pack cooling fan is NOT enabled
- 12 V battery voltage is greater than 9.1 V
- The hybrid/EV battery pack cooling fan OFF time is greater than 20 s
- DTC P2534 or P2535 is not set

P0BC9, P0BCA

- Ignition is RUN or CRANK
- The hybrid/EV battery pack cooling fan is enabled
- 12 V battery voltage is greater than 9.1 V
- The hybrid/EV battery pack cooling fan is commanded between 11-90%
- The hybrid/EV battery pack cooling fan ON time is greater than 20 s

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- DTC P2534 or P2535 is not set

Conditions for Setting the DTC

DTC P0A81

An open is detected on the hybrid/EV battery pack cooling fan speed control circuit for at least 5 seconds continuously

DTC P0A84

A short to ground is detected on the hybrid/EV battery pack cooling fan speed control circuit for at least 5 seconds continuously

DTC P0A85

A short to voltage is detected on the hybrid/EV battery pack cooling fan speed control circuit for at least 5 seconds continuously

DTC P0A81

Fan Enabled State: There is an excessive difference between the commanded hybrid/EV battery pack cooling fan speed and the hybrid/EV battery pack cooling fan speed feedback signal

Fan NOT Enabled State: hybrid/EV battery pack cooling fan feedback is greater than 250 RPM

DTC P0BC9

The hybrid/EV battery pack cooling fan speed feedback signal is less than 5 Hz for at least 5 seconds continuously

DTC P0BCA

The hybrid/EV battery pack cooling fan speed feedback signal is greater than 90 Hz for at least 5 seconds continuously

Actions Taken When the DTC Sets

DTCs P0A81, P0A84, P0A85, P0BC8, P0BC9, and P0BCA are Type B DTCs

Conditions for Clearing the DTC

DTCs P0A81, P0A84, P0A85, P0BC8, P0BC9, and P0BCA are Type B DTCs

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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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

Special Tools

EL-48900 HEV Safety Kit

Equivalent regional tools:, Refer to:**Special Tools**

Circuit/System Verification

1. Verify the actual G14 Hybrid/EV Battery Pack Cooling Fan speed increases and decreases when commanding the Hybrid/EV Battery Pack Cooling Fan with a scan tool.
   - **If the fan speed does not increase and decrease as commanded**

     Refer to Circuit/System Testing.

   - **If the fan speed increases and decreases as commanded**
2. 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**

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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. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the G14 Hybrid/EV Battery Pack Cooling Fan. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 ohms or greater**
   1. Ignition Off .
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 ohms**
3. Ignition On .
4. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition Off
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, 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. Ignition 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 G14 Hybrid/EV Battery Pack Cooling Fan.
   - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 and ground.
6. Verify the test lamp turns ON when commanding the Hybrid/EV Battery Pack Cooling Fan with a scan tool and OFF when releasing the control.
   - **If the test lamp is always Off**
   1. Ignition OFF, disconnect the X1 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
   3. Test for less than 2 Ω in the control circuit end to end.

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

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

1. Ignition 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 and ground.
    - If 1 V or greater, test the control circuit for a short to voltage.
    - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp turns On and Off**

7. Test for 12 V between the feedback signal circuit terminal 3 and ground.

- **If less than 10 V**

1. Ignition 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 Ω in the signal circuit end to end.
    - If 2 ohms or greater, repair the open/high resistance in the circuit
    - If less than 2 ohms, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 10 V or greater**

8. Connect a 3 A fused jumper wire to the signal circuit terminal 3.
9. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Battery Pack Cooling Fan Speed parameter is greater than 0 RPM while rapidly tapping the jumper wire to ground.

- **If 0 RPM**

1. Ignition OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, test the signal circuit for a short to voltage.
    - If less than 1 V - Replace the component:K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 0 RPM**

10. Connect a test lamp between the control circuit terminal 2 and B+.
11. Verify the test lamp becomes progressively dimmer as the fan speed is increased and progressively brighter as the fan speed is decreased when commanding the Hybrid/EV Battery Pack Cooling Fan with a scan tool.

- **If the test lamp does not illuminate**

1. Ignition 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 and ground.
    - If 1 V or greater, test the control circuit for a short to voltage.
    - If less than 1 V
3. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit

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- If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates, but does not change in brightness**

1. Ignition OFF, disconnect the X1 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 brightness changes as commanded**

12. Test or replace the component:G14 Hybrid/EV Battery Pack Cooling Fan.

Repair Instructions

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

- **Battery Cooling Air Inlet Duct Replacement (L8B)** for G14 Hybrid/EV Battery Pack Cooling Fan replacement.
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P0A9C-P0A9F, P0AC6-P0AC9, P0ACB-P0ACE, OR P0AE9-P0AEC: HYBRID/EV BATTERY 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 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 P0A9F

Hybrid/EV Battery Temperature Sensor 1 Circuit Erratic

DTC P0AC6

Hybrid/EV Battery Temperature Sensor 2 Performance

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DTC P0AC7

Hybrid/EV Battery Temperature Sensor 2 Circuit Low Voltage

DTC P0AC8

Hybrid/EV Battery Temperature Sensor 2 Circuit High Voltage

DTC P0AC9

Hybrid/EV Battery Temperature Sensor 2 Circuit Erratic

DTC P0ACB

Hybrid/EV Battery Temperature Sensor 3 Performance

DTC P0ACC

Hybrid/EV Battery Temperature Sensor 3 Circuit Low Voltage

DTCP0ACD

Hybrid/EV Battery Temperature Sensor 3 Circuit High Voltage

DTC P0ACE

Hybrid/EV Battery Temperature Sensor 3 Circuit Erratic

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 P0AEC

Hybrid/EV Battery Temperature Sensor 4 Circuit Erratic

Circuit/System Description

Four temperature sensors are used to monitor the battery temperature. The non-serviceable battery temperature sensors are located within the battery sections. Two temperature sensors are located in each battery section.

The temperature sensor is a variable resistor that measures the temperature of the battery cell group. The hybrid/EV interface control module supplies 5 V to the signal circuit and a ground for the low reference circuit. The battery temperature sensor resistance changes with battery temperature. As the temperature decreases, the sensor resistance increases. As the temperature increases, the sensor resistance decreases.

Each hybrid/EV battery interface control module communicates the temperature sensor values to the hybrid/EV

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powertrain control module 2 via serial data.

Conditions for Running the DTC

P0A9C, P0AC6, P0ACB, P0AE9

- Battery energy control module is awake and communicating.
- None of the following DTCs are set: P0A9D, P0A9E, P0A9F, P0AC7, P0AC8, P0AC9, P0ACC, P0ACD, P0ACE, P0AEA, P0AEB, P0AEC, P0BC4, P0BC5, or P0C35.

P0A9D, P0A9E, P0A9F, P0AC7, P0AC8, P0AC9, P0ACC, P0ACD, P0ACE, P0AEA, P0AEB, P0AEC

- The 12 V battery voltage is greater than 9.1 V.
- Battery energy control module is awake and communicating.
- DTC U179C is not set.

Conditions for Setting the DTC

DTC P0A9C, P0AC6, P0ACB, P0AE9

The difference between a single battery temperature sensor and an average of the other battery temperature sensors is greater than 25Â°C (45Â°F).

DTC P0A9D, P0AC7, P0ACC, P0AEA

The hybrid battery temperature sensor is greater than 160Â°C (320Â°F).

DTC P0A9E, P0AC8, P0ACD, P0AEB

The hybrid battery temperature sensor is less than -69Â°C (-92Â°F)

DTC P0A9F, P0AC9, P0ACE, P0AEC

The hybrid battery temperature sensor is intermittent or has changed by 10Â°C (18Â°F) or greater for 4 out of 5 seconds.

Actions Taken When the DTC Sets

DTCs P0A9C, P0A9D, P0A9E, P0A9F, P0AC6, P0AC7, P0AC8, P0AC9, P0ACB, P0ACC, P0ACD, P0ACE, P0AE9, P0AEA, P0AEB, and P0AEC are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0A9C, P0A9D, P0A9E, P0A9F, P0AC6, P0AC7, P0AC8, P0AC9, P0ACB, P0ACC, P0ACD, P0ACE, P0AE9, P0AEA, P0AEB, and P0AEC are Type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

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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

Special Tools

- **EL-48751** High Voltage Battery Pin Out Box
- **EL-48571-45** Battery Pinout Box Adapter
- **EL-48900** HEV Safety Kit

Equivalent regional tools:Refer to:**Special Tools** .

Circuit/System Verification

1. Ignition On .
2. Verify the scan tool Battery Energy Control Module Battery Temperature parameters are all be between -69Â° and 160Â°C (-92 and 320Â°F).
   - **If not between the specified range**

     Refer to Circuit/System Testing.

   - **If between the specified range**
3. Verify that no single Battery Energy Control Module Battery Temperature parameter is greater than 25Â°C (45Â°F) different than the average of the remaining temperature sensors.
   - **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

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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. Ignition OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling** .
2. Disconnect the X3 harness connector at the hybrid/EV battery interface control module for the appropriate C4 Hybrid/EV Battery Section.
3. Connect the **EL-48751** High Voltage Battery Pinout Box with the **EL-48571-45** Battery Pinout Box Adapter to the appropriate battery section.
4. Insert the DMM probes into the **EL-48571** test cavities.
5. Test for 8-13k Ω at 19-24Â°C (66.2-75.2Â°F) by cycling the **EL-48571** switches to the correct position for the appropriate temperature sensor. Refer to the **EL-48571 High Voltage Battery Pin Out Box Reference** .
   - **If not between 8-13k Ω**

     Replace the Battery Section.

   - **If between 8-13k Ω**
6. Replace the hybrid/EV battery interface control module.

Repair Instructions

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

- **Cell Battery Module Replacement (Cell Battery 1)** **Cell Battery Module Replacement (Cell Battery 2)**
- **Control Module References** for hybrid/EV battery interface control module replacement, programming,

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and setup.

DTC P0CED, P1F44, OR P1F45: HYBRID/EV ELECTRONICS COOLANT PUMP

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 P0CED

Hybrid/EV Electronics Coolant Pump Enable 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 is a single speed ON/OFF pump that circulates coolant through the auxiliary coolant radiator, starter/generator control module, and the starter/generator to control the temperature of these components.

The Enable and Feedback circuits allow the drive motor control module to control and monitor the hybrid/EV electronics coolant pump.

The Enable circuit controls the starter/generator coolant pump relay by applying ground to the relay coil control circuit. With the coil grounded, the relay switch is closed and voltage is sent to the coolant pump, which begins circulating coolant.

The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the drive motor control module. During normal operation, the feedback circuit provides pump speed information to the control module. 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.

The starter/generator control module contains the hybrid/EV powertrain control module 1, drive motor control module, and the 14 V power module.

The hybrid/EV powertrain control module 1 will determine when a fault condition is present. Diagnostics and system status are communicated from the drive motor control module to the hybrid/EV powertrain control module 1 through internal serial data. The hybrid/EV powertrain control module 1 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P0CED, P1F44

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- The 12 V battery voltage is greater than 10 V.
- The hybrid/EV electronics coolant pump is enabled.
- DTC P2534 is not set.
- For after-run operation, DTCs P0685-P0690 not set.

P1F45

- The 12 V battery voltage is greater than 10 V.
- The Hybrid/EV electronics coolant pump is disabled.
- DTC P2534 is not set.

Conditions for Setting the DTC

P0CED

The Hybrid/EV Powertrain Control Module 1 detects the Coolant Pump Enable circuit is open for 4 out of 5 seconds.

P1F44

The Hybrid/EV Powertrain Control Module 1 detects the Coolant Pump Enable circuit is shorted to ground for 4 out of 5 seconds.

P1F45

The Hybrid/EV Powertrain Control Module 1 detects the Coolant Pump Enable circuit is shorted to voltage for 4 out of 5 seconds.

Actions Taken When the DTC Sets

DTCs P0CED, P1F44, and P1F45 are a Type B DTCs.

Conditions for Clearing the DTC

DTCs P0CED, P1F44, and P1F45 are a Type B DTCs.

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Schematic Reference

Hybrid/EV Cooling Schematics

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- **Circuit Testing**

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- **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

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC 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 that DTC P0CED, P1F44, or P1F45 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**
4. All OK.

Circuit/System Testing

1. Ignition Off - Remove the Starter/Generator Coolant Pump Relay from the X50A Fuse Block - Underhood.
2. Ignition On - Verify a test lamp illuminates between the B+ circuit terminal 85 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**

     Replace the component: X50A Fuse Block - Underhood

   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition Off - Test for infinite resistance between the test points: B+ circuit terminal 85 & Ground
      - If less than infinite resistance

        Replace the component: X50A Fuse Block - Underhood

      - If infinite resistance
   2. Test for less than 2 Ω in the B+ circuit between the relay terminal 85 and the fuse.
      - If 2 ohms or greater

        Replace the component: X50A Fuse Block - Underhood

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- If less than 2 ohms

  Replace the component: Starter/Generator Coolant Pump Relay

- **If the test lamp illuminates**

3. Connect a test lamp between the test points: enable circuit terminal 86 & B+ circuit terminal 85
4. Ignition Off - Verify the test lamp is OFF.
   - **If the test lamp is ON**
   1. Ignition Off - Disconnect the X1 harness connector at the K59 Starter/Generator Control Module
   2. Remove - Test Lamp
   3. Test for infinite resistance between the test points: pump enable circuit terminal 86 & Ground.
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component:K59 Starter/Generator Control Module
   - **If the test lamp is OFF**
5. Ignition On - Command the Drive Motor Coolant Pump Relay ON with a scan tool. Verify the test lamp illuminates.
   - **If the test lamp is OFF**
   1. Ignition Off - Disconnect the X1 harness connector at the K59 Starter/Generator Control Module
   2. Test for less than 2 Ω in the pump enable circuit end to end.
      - If 2 ohms or greater - Repair the open/high resistance in the circuit.
      - If less than 2 ohms - Replace the component:K59 Starter/Generator Control Module
   - **If the test lamp is ON**
6. Replace the component: Starter/Generator Coolant Pump Relay.

Repair Instructions

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

Control Module References for K59 Starter/Generator Control Module 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

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DTC P0CF1

Hybrid/EV Electronics Coolant Temperature Sensor Circuit High Voltage

DTC P0CF2

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0CF0	P0CF1	P0CF1	P0CEF, P0CF2
Low Reference	-	P0CF1	-	P0CEF, P0CF2

Circuit/System Description

The hybrid electronics coolant temperature sensor is a variable resistor that measures the temperature of the starter/generator coolant. The Starter/Generator Control Module supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid electronics coolant temperature sensor resistance changes with starter/generator coolant temperature. As the temperature decreases, the sensor resistance increases. As the temperature increases, the sensor resistance decreases. The Hybrid/EV Powertrain Control Module 1 monitors the hybrid electronics coolant temperature sensor to determine the temperature of the starter/generator coolant. As the coolant temperature changes, the control module will turn the coolant pump ON or OFF to accommodate the cooling requirements.

The starter/generator control module contains the hybrid/EV powertrain control module 1, drive motor control module and the 14 V power module.

Conditions for Running the DTC

P0CEF

- The 12 V battery voltage is greater than 10 V.
- Ignition is RUN for less than 20 seconds.
- Engine off time is greater than six hours.
- None of the following DTCs are set: P0071, P0072, P0073, P0074, P0711, P0712, P0713, P0CF0, P0CF1, or P0CF2.

P0CF0, P0CF1, P0CF2

- The 12 V battery voltage is greater than 10 V.
- Ignition is RUN.

Conditions for Setting the DTC

DTC P0CEF

The hybrid electronics coolant temperature sensor is more than 15Â°C (27Â°F) different than the outside temperature.

AND

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The hybrid electronics coolant temperature sensor is more than 35Â°C (63Â°F) different than the transmission fluid temperature.

DTC P0CF0

The hybrid electronics coolant temperature sensor resistance is less than 38 Ω for 4 out of 5 seconds.

DTC P0CF1

The hybrid electronics coolant temperature sensor resistance is greater than 250k Ω for 4 out of 5 seconds.

DTC P0CF2

The hybrid electronics coolant temperature sensor is intermittent or has changed greater than 95Â°C (171Â°F) for 5 out of 7 seconds.

Actions Taken When the DTC Sets

DTC P0CEF-P0CF2 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0CEF-P0CF2 are Type B DTCs.

Reference Information

Schematic Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

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1. Verify the scan tool Drive Motor Coolant Temperature sensor parameter is warmer than -39Â°C (-38Â°F) and colder than 150Â°C (302Â°F) and changes with engine run time.
    - **If colder than -39Â°C (-38Â°F) or warmer than 150Â°C (302Â°F) and does not change**

      Refer to Circuit/System Testing.

    - **If warmer than -40Â°C (-40Â°F) and colder than 150Â°C (302Â°F) and changes**
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
    - **If the DTC sets**

      Refer to Circuit/System Testing.

    - **If the DTC does not set**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Hybrid Electronics Coolant Temperature Sensor.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
    - **If 5 ohms or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K59 Starter/Generator Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K59 Starter/Generator Control Module.
    - **If less than 5 ohms**
3. Ignition On
4. Verify the scan tool Drive Motor Coolant Temperature sensor parameter is colder than -39Â°C (-38Â°F).
    - **If warmer than -39Â°C (-38Â°F)**
    1. Ignition OFF, disconnect the X1 harness connector at the K59 Starter/Generator Control Module.
    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, replace the K59 Starter/Generator Control Module.
    - **If colder than -39Â°C (-38Â°F)**

    CAUTION: If the fuse in the jumper wire opens, the signal circuit may have a short to a voltage or a short to ground and the sensor might be damaged.

5. Install a 1 A fused jumper wire between the signal circuit terminal and ground.
6. Verify the scan tool Drive Motor Coolant Temperature sensor parameter is warmer than 149Â°C (300Â°F).
    - **If 149Â°C (300Â°F) or colder**
    1. Ignition OFF, remove the jumper wire, disconnect the X1 harness connector at the K59 Starter/Generator Control Module.

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2. Ignition ON, test for less than 1 V between the signal circuit terminal and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
3. Ignition Off .
4. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω replace the K59 Starter Generator Control Module.

- **If warmer than 149Â°C (300Â°F)**

7. Replace the Hybrid Electronics Coolant Temperature Sensor.

Repair Instructions

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

Control Module References for K59 Starter/Generator Control Module replacement, programming, and setup

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

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 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 is a single speed ON/OFF pump that circulates coolant through the auxiliary coolant radiator, starter/generator control module, and the starter/generator to control the temperature of these components.

The Enable and Feedback circuits allow the drive motor control module to control and monitor the hybrid/EV electronics coolant pump.

The Enable circuit controls the starter/generator coolant pump relay by applying ground to the relay coil control circuit. With the coil grounded, the relay switch is closed and voltage is sent to the coolant pump, which begins circulating coolant.

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The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the drive motor control module. During normal operation, the feedback circuit provides pump speed information to the control module . 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.

The starter/generator control module contains the hybrid/EV powertrain control module 1, drive motor control module and the 14 V power module.

The hybrid/EV powertrain control module 1 will determine when a fault condition is present. Diagnostics and system status are communicated from the drive motor control module to the hybrid/EV powertrain control module 1 through internal serial data. The hybrid/EV powertrain control module 1 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P19FA, P19FB

- The 12 V battery voltage is greater than 10 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 10-90%.
- All above conditions met for at least 5 seconds.
- DTC P2534 is not set.

P19FC

- The 12 V battery voltage is greater than or equal to 10 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 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 10-90%.
- Hybrid/EV electronics coolant temperature sensor is greater than -20Â°C (-4Â°F).
- All above conditions met for at least 9 seconds.
- None of the following DTCs are set: P0CE9, P1F44, P1F45, or P2534.

Conditions for Setting the DTC

P19FA

The hybrid/EV powertrain control module 1 detects the Coolant Pump Feedback circuit frequency is greater than 355 Hz.

P19FB

The hybrid/EV powertrain control module 1 detects the Coolant Pump Feedback circuit frequency is less than 20 Hz.

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P19FC

The hybrid/EV powertrain control module 1 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 225 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 1 detects the Coolant Pump Feedback circuit indicated pump speed is more than 1870 RPM different than the expected pump speed when the pump is enabled.

Actions 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** fluid tester or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F) .
- The Drive Motor Coolant Pump Feedback Duty Cycle 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:

Drive Motor Coolant Pump Feedback Duty Cycle 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

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Special Tools

J-26568 Coolant and Battery Fluid Tester

Equivalent regional tools:Refer to:**Special Tools**.

Circuit/System Verification

1. Ignition On .
2. Verify that DTC P0CED, P1F44, or P1F45 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 1 parameters listed below when commanding the Drive Motor Coolant Pump Relay ON with a scan tool.
   - Drive Motor Coolant Pump Feedback Duty Cycle to be 50% +/-5%.
   - Drive Motor Coolant Pump Speed Feedback is greater than 500 RPM.
   - **If the scan tool parameters listed are not within the specified ranges**

     Refer to Circuit/System Testing.

   - **If the scan tool parameters listed are within the specified ranges**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the G43 Starter/Generator Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
   - **If 5 ohms or greater**

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Repair the open/high resistance on the ground circuit.

- **If less than 5 ohms**

3. Connect a test lamp between the B+ circuit terminal 2 and the ground circuit terminal 1.
4. Ignition ON. Command the Drive Motor Coolant Pump Relay ON and OFF with a scan tool. Verify the test lamp illuminates as commanded.
    - **If the test lamp is always Off**
    1. Ignition OFF, test for infinite resistance between the B+ circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit and replace the fuse if blown.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms and the fuse is blown, replace the G43 Starter/Generator Coolant Pump.
        - If less than 2 ohms and the fuse is good, replace the Starter/Generator Coolant Pump Relay.
    - **If the test lamp is always On**

      Replace the Starter/Generator Coolant Pump Relay.

    - **If the test lamp turns On and Off**
5. Remove the test lamp.
6. Verify the scan tool Drive Motor Coolant Pump Feedback Duty Cycle parameter is 0%.
    - **If greater than 0%**
    1. Ignition OFF, disconnect the X1 harness connector at the K59 Starter/Generator Control Module.
    2. Test for infinite resistance between the feedback circuit terminal 3 and ground.
        - If less than infinite resistance - Repair the short to ground on the circuit:
        - If infinite resistance, replace the K59 Starter/Generator Control Module.
    - **If 0%**
7. Install a 3 A fused jumper wire between the feedback circuit terminal 3 and the ground circuit terminal 1.
8. Verify the scan tool Drive Motor Coolant Pump Feedback Duty Cycle parameter is greater than 90%.
    - **If 90% or less**
    1. Ignition OFF, disconnect the X1 harness connector at the K59 Starter/Generator Control Module.
    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 Ω in the feedback circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the K59 Starter/Generator Control Module.
    - **If greater than 90%**
9. Replace the G43 Starter/Generator Coolant Pump.

Repair Instructions

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

- **Generator Coolant Pump Replacement (L8B)** for G43 Starter/Generator Coolant Pump replacement.
- **Control Module References** for K59 Starter/Generator Control Module replacement, programming and setup.

REPAIR INSTRUCTIONS

RADIATOR REPLACEMENT (LOW TEMPERATURE RADIATOR L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill LC8 L96)** **Cooling System Draining and Filling (Vac N Fill LC8 L96)** **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)** **Cooling System Draining and Filling (Static Fill LV3)** **Cooling System Draining and Filling (Vac N Fill LV3)** **Cooling System Draining and Filling (Vac N Fill L8B)** **Cooling System Draining and Filling (GE 47716 L5P)** **Cooling System Draining and Filling (Static L5P)**

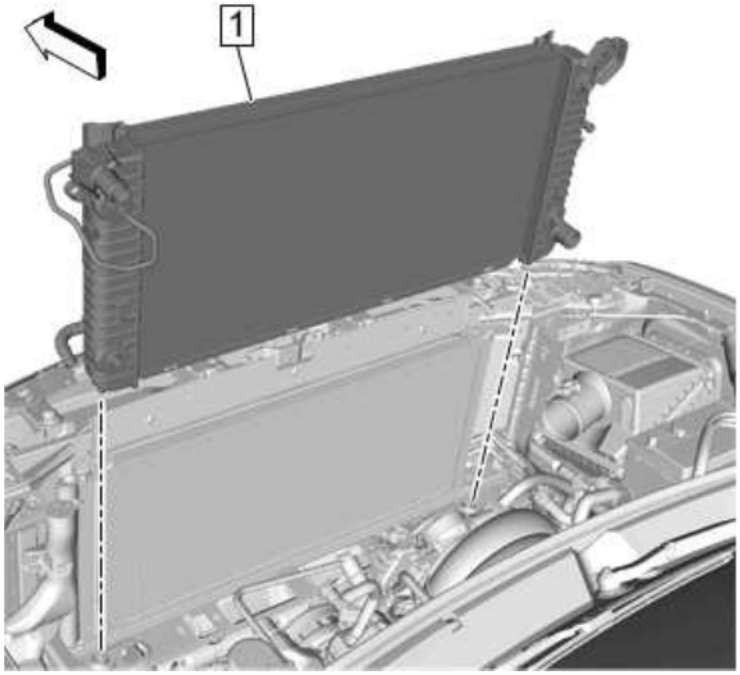


Fig. 3: Radiator
Courtesy of GENERAL MOTORS COMPANY

2. Carefully lift the radiator and low temperature radiator (1) out of the vehicle as an assembly. **Radiator Replacement (LV3)** **Radiator Replacement (L83, L86)** **Radiator Replacement (LC8, L96)** **Radiator Replacement (L8B)** **Radiator Replacement (L5P)**

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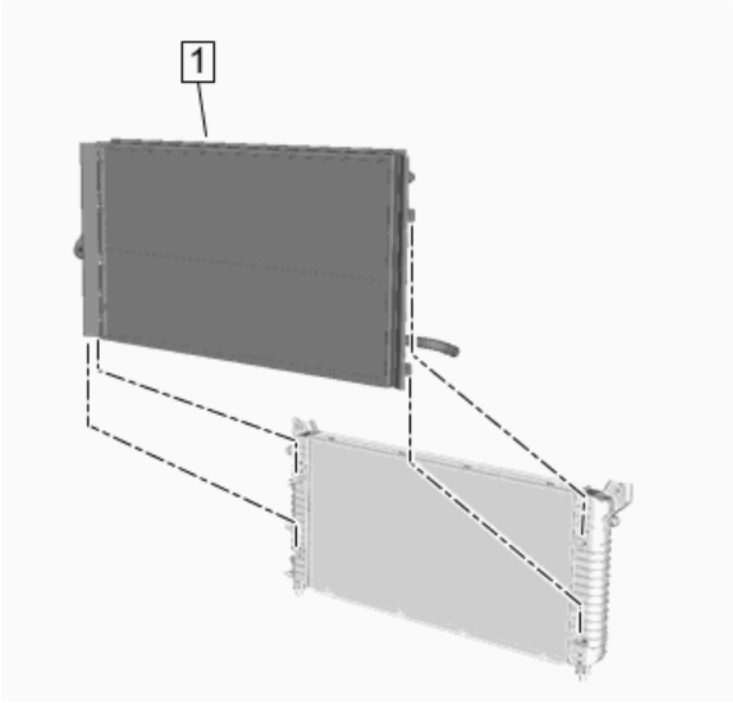


Fig. 4: Low Temperature Radiator
Courtesy of GENERAL MOTORS COMPANY

3. Remove the low temperature radiator (1) from the radiator.
4. If replacing the low temperature radiator transfer the components as necessary.

Installation Procedure

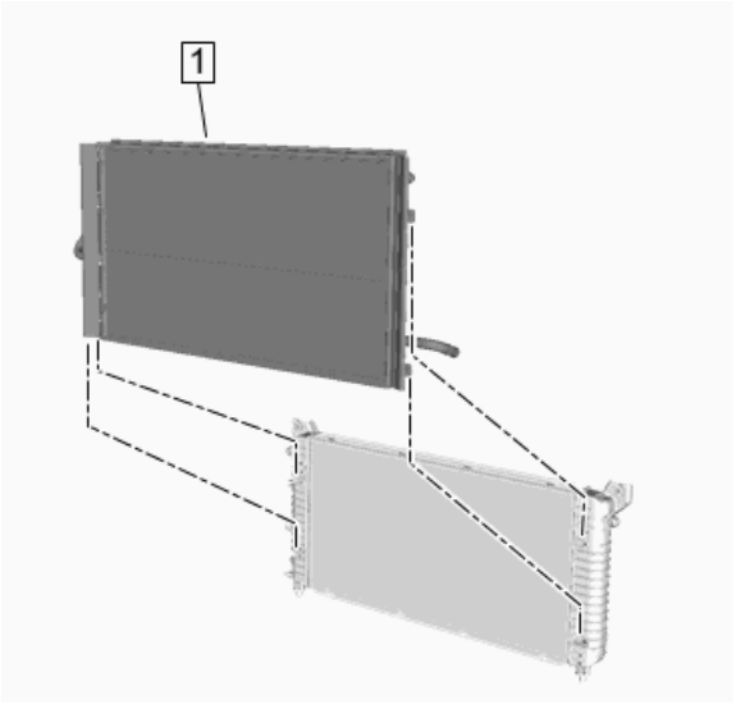


Fig. 5: Low Temperature Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Install the low temperature radiator (1) to the radiator.

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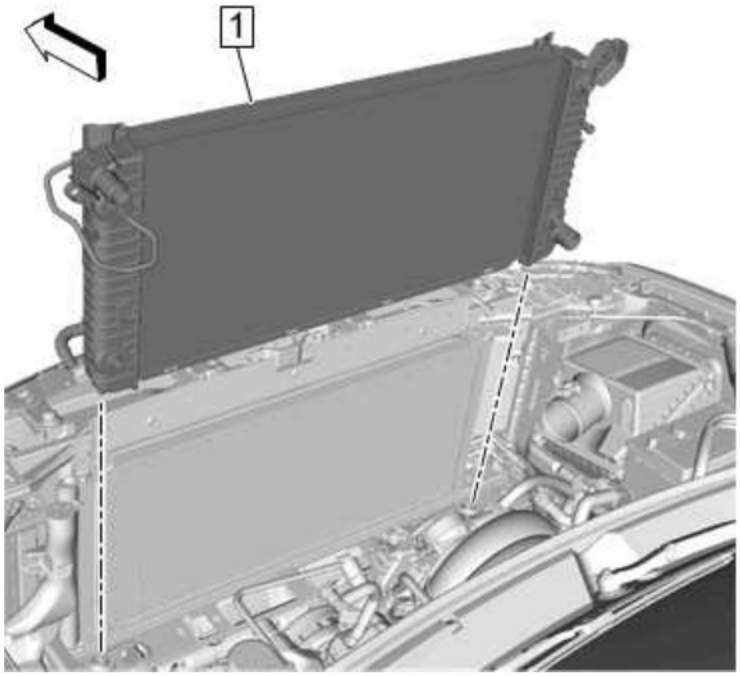


Fig. 6: Radiator
Courtesy of GENERAL MOTORS COMPANY

2. Install the radiator and low temperature radiator (1) as an assembly to the vehicle. **Radiator Replacement (LV3)** **Radiator Replacement (L83, L86)** **Radiator Replacement (LC8, L96)** **Radiator Replacement (L8B)** **Radiator Replacement (L5P)**
3. Fill the cooling system. **Cooling System Draining and Filling (Static Fill LC8 L96)** **Cooling System Draining and Filling (Vac N Fill LC8 L96)** **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)** **Cooling System Draining and Filling (Static Fill LV3)** **Cooling System Draining and Filling (Vac N Fill LV3)** **Cooling System Draining and Filling (Vac N Fill L8B)** **Cooling System Draining and Filling (GE 47716 L5P)** **Cooling System Draining and Filling (Static L5P)**
4. Start the engine and check for coolant leaks.

GENERATOR CONTROL MODULE COOLANT TANK HOSE REPLACEMENT (BOTTOM L8B)

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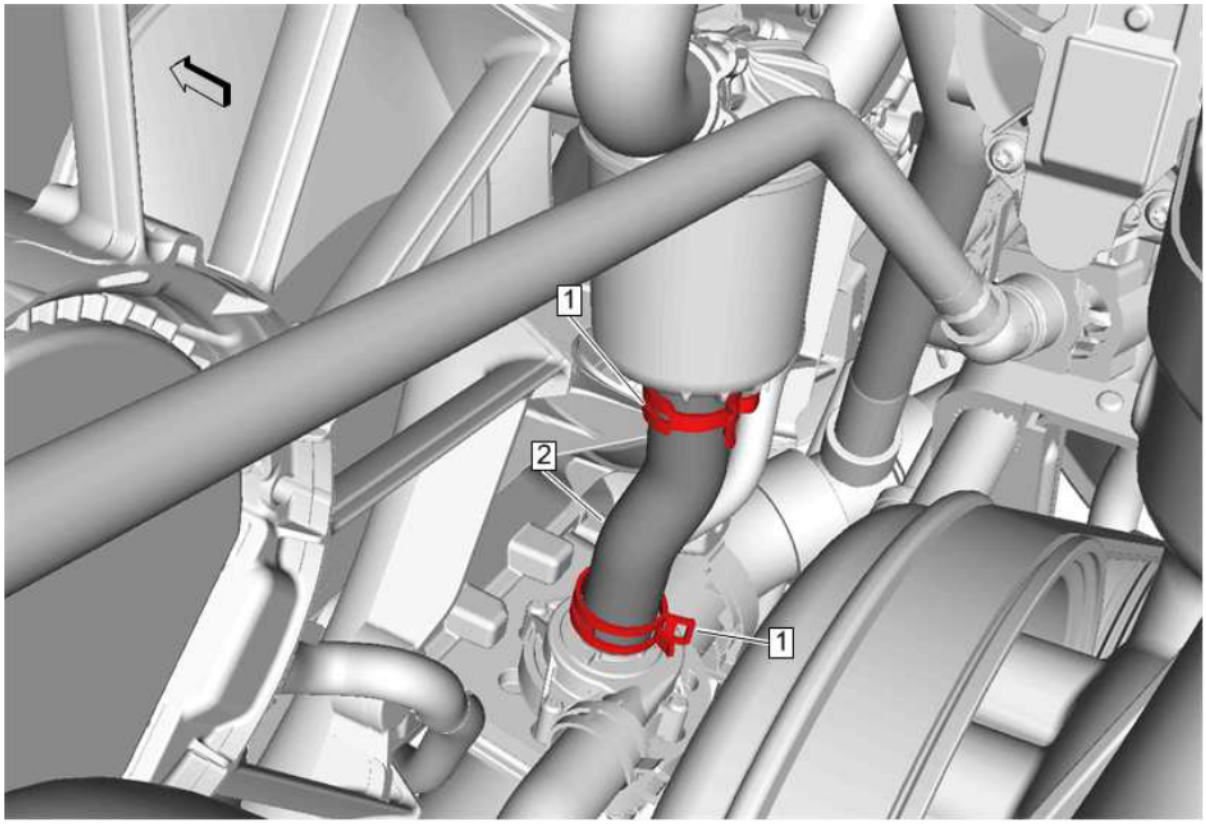


Fig. 7: Generator Control Module Coolant Tank Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)** 2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**	
1	Generator Control Module Coolant Tank Hose Clamp **Procedure** **Hose Clamp Replacement Guidelines - Spring Type**
2	Generator Control Module Coolant Tank Hose **Procedure** 1. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Vac N Fill L8B)** 2. Start the engine and check for coolant leaks.

GENERATOR CONTROL MODULE COOLANT TANK HOSE REPLACEMENT (LOW TEMP RADIATOR TO GENERATOR CONTROL MODULE L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**

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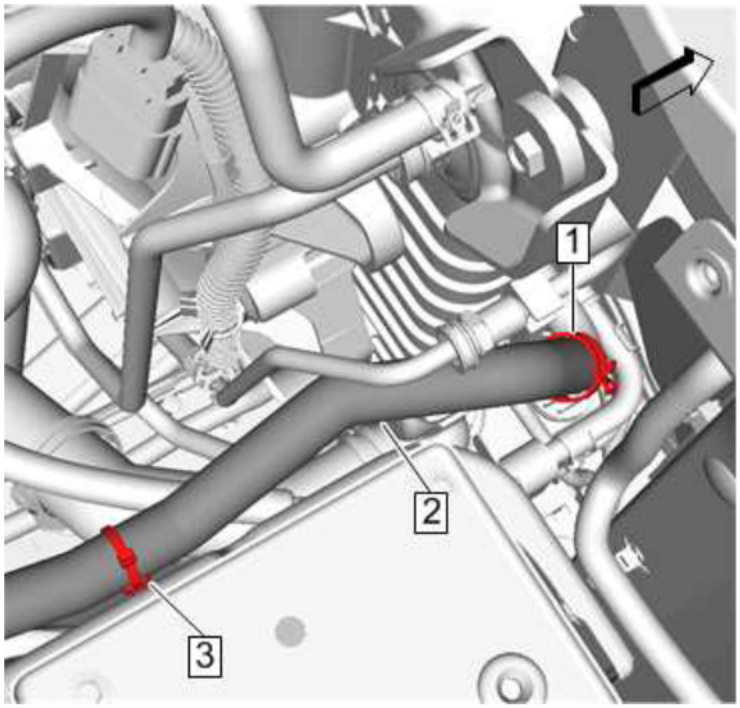


Fig. 8: Generator Control Module Coolant Tank Hose
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Tank Hose Clamp 1 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Generator Control Module Coolant Tank Hose 2 @Radiator - Remove
5. Generator Control Module Coolant Pipe Clip 3 - Remove

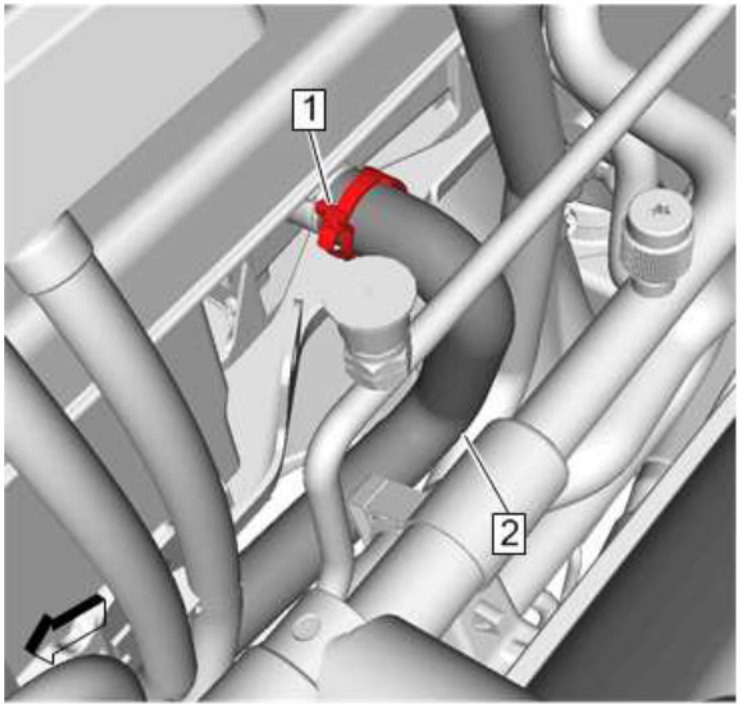


Fig. 9: Generator Control Module Coolant Tank Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Tank Hose Clamp 1 - Disengage - **Hose Clamp Replacement**

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Guidelines - Spring Type

7. Generator Control Module Coolant Tank Hose 2 @Generator Control Module - Remove
8. Generator Control Module Coolant Tank Hose 2 - Remove

Installation Procedure

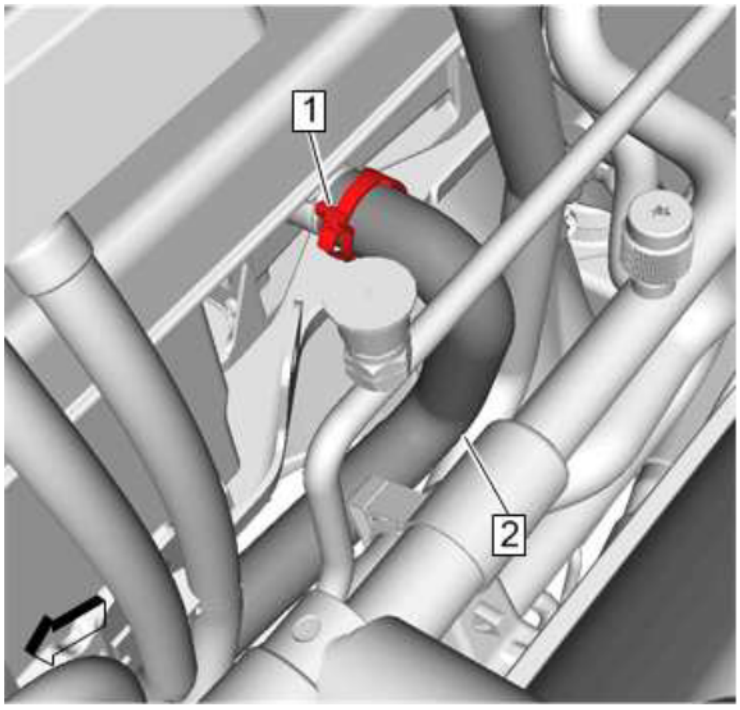


Fig. 10: Generator Control Module Coolant Tank Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Generator Control Module Coolant Tank Hose 2 @Generator Control Module - Install
2. Generator Control Module Coolant Tank Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**

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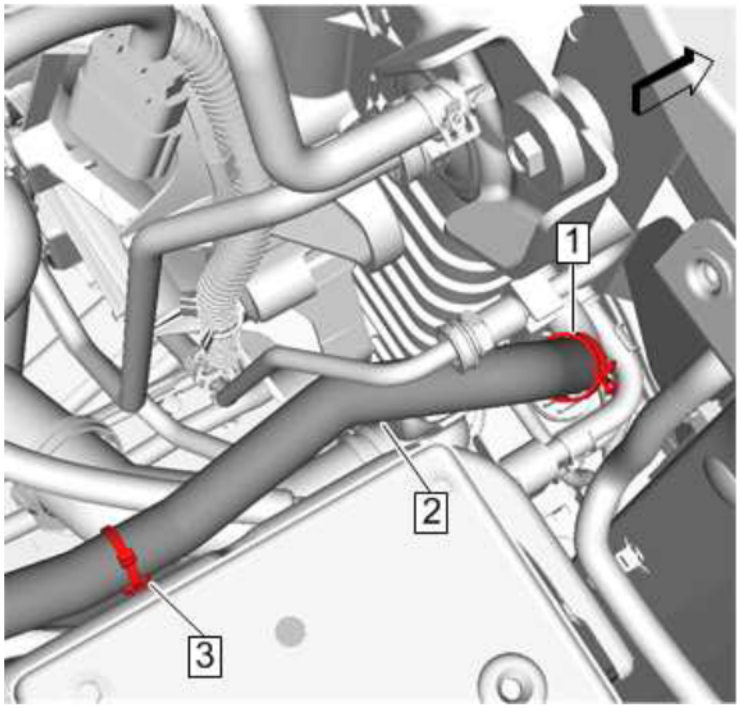


Fig. 11: Generator Control Module Coolant Tank Hose
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Tank Hose 2 @Radiator - Install
4. Generator Control Module Coolant Tank Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Generator Control Module Coolant Pipe Clip 3 - Install
6. Air Cleaner Outlet Duct - Install - **Air Cleaner Outlet Duct Replacement**
7. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
8. Start the engine and check for coolant leaks.

GENERATOR CONTROL MODULE COOLANT PUMP HOSE REPLACEMENT (LEFT SIDE L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**

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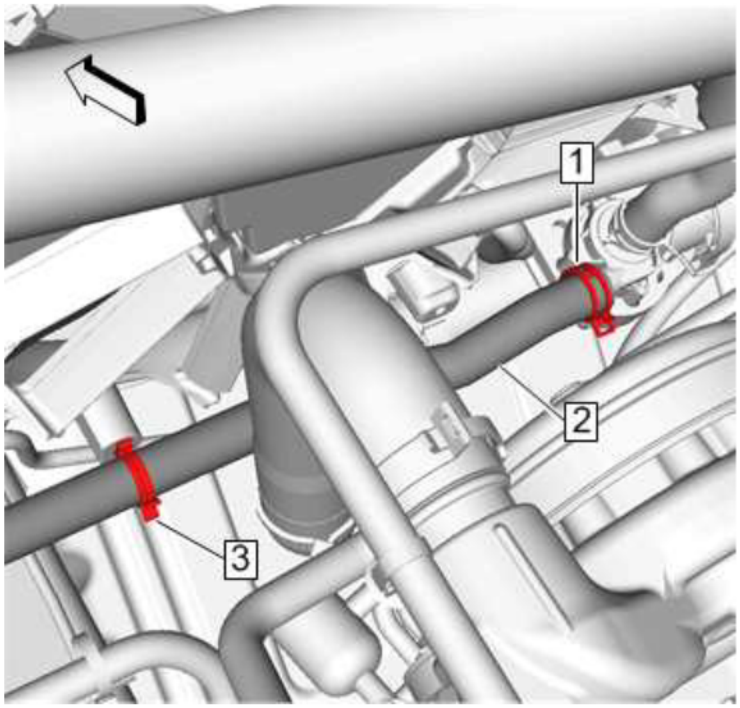


Fig. 12: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Pump Hose Clamp 1 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Generator Control Module Coolant Pump Hose 2 @Generator Coolant Pump - Remove
5. Generator Control Module Coolant Pump Hose 2 @Hose Clip 3 - Remove

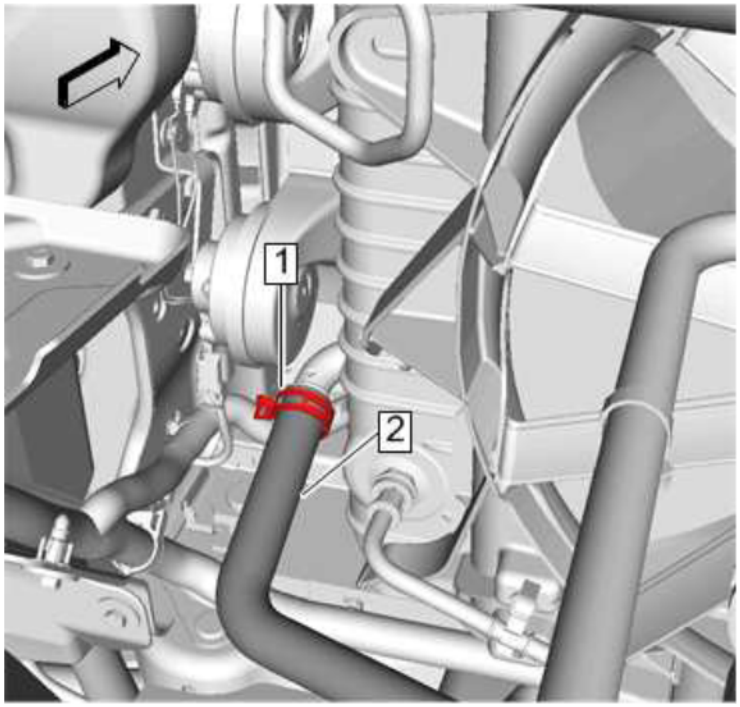


Fig. 13: Generator Control Module Coolant Pump Hose
Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Pump Hose Clamp 1 - Disengage - **Hose Clamp Replacement**

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Guidelines - Spring Type

7. Generator Control Module Coolant Pump Hose 2 @Radiator - Remove
8. Generator Control Module Coolant Pump Hose 2 - Remove

Installation Procedure

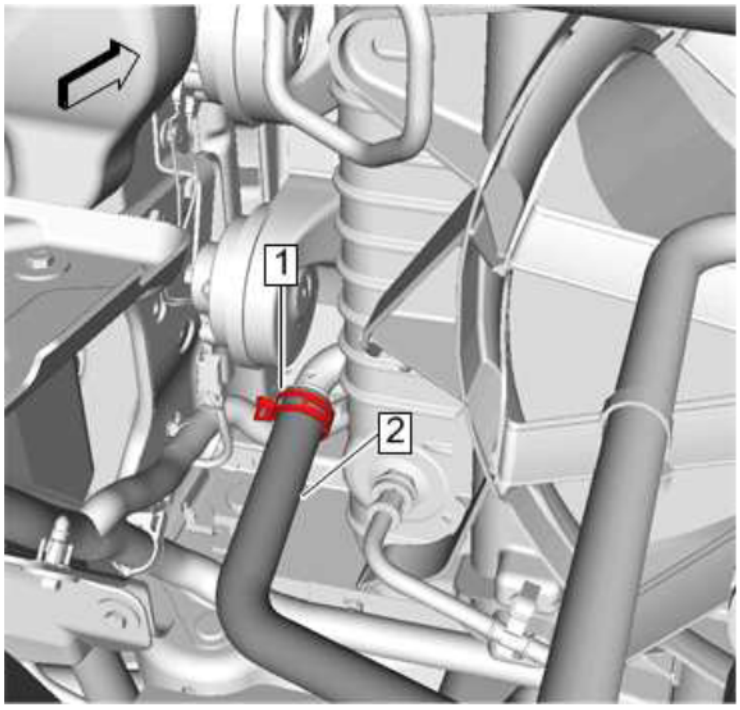


Fig. 14: Generator Control Module Coolant Pump Hose
Courtesy of GENERAL MOTORS COMPANY

1. Generator Control Module Coolant Pump Hose 2 @Radiator - Install
2. Generator Control Module Coolant Pump Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**

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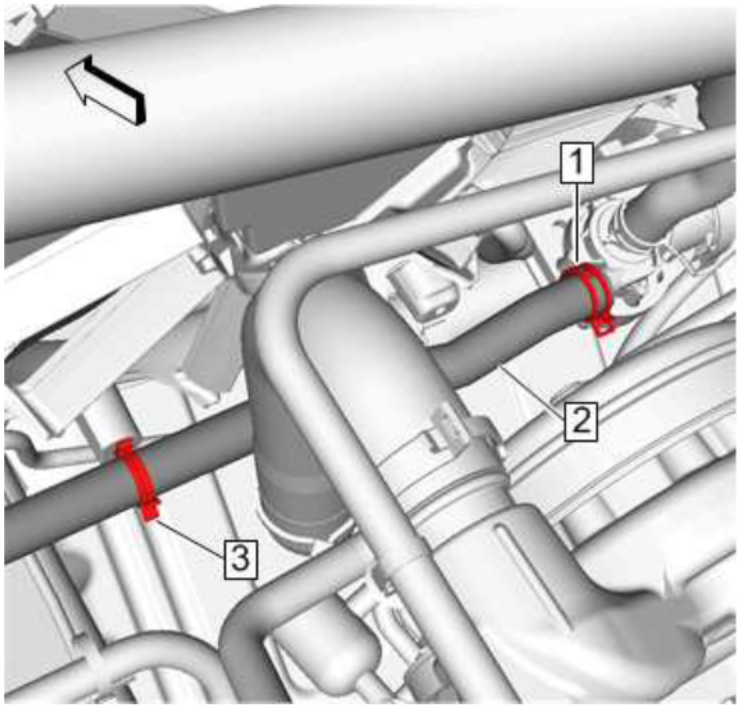


Fig. 15: Engine Coolant Fan Shroud
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Pump Hose 2 @Hose Clip 3 - Install
4. Generator Control Module Coolant Pump Hose 2 @Generator Coolant Pump - Install
5. Generator Control Module Coolant Pump Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**
6. Air Cleaner Outlet Duct - Install - **Air Cleaner Outlet Duct Replacement**
7. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
8. Start the engine and check for coolant leaks.

GENERATOR CONTROL MODULE COOLANT OUTLET HOSE REPLACEMENT (STARTER GENERATOR TO GENERATOR CONTROL MODULE L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**
3. Reposition the wiring harness.

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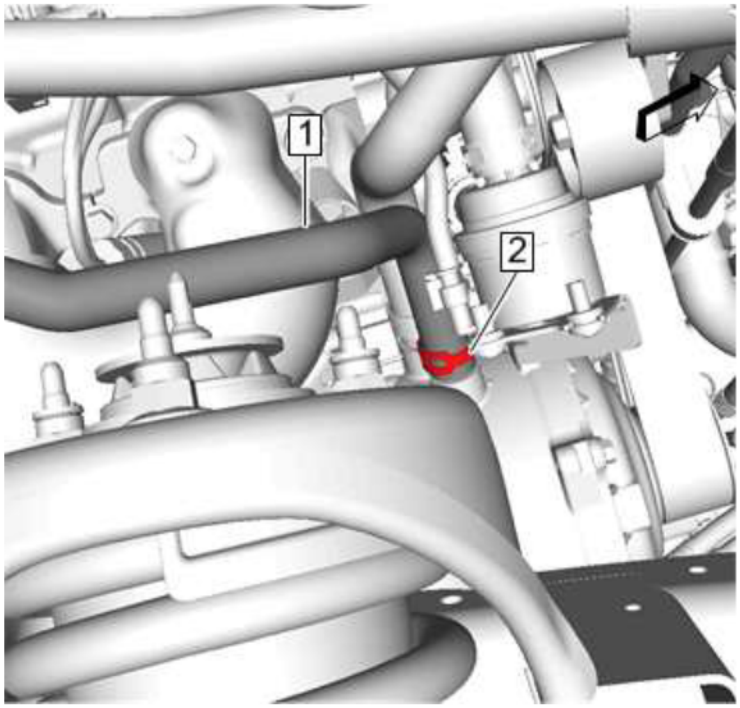


Fig. 16: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Generator Control Module Coolant Outlet Hose Clamp 2 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Generator Control Module Coolant Outlet Hose 1 @Starter Generator - Remove
6. Lower the vehicle. **Lifting and Jacking the Vehicle**

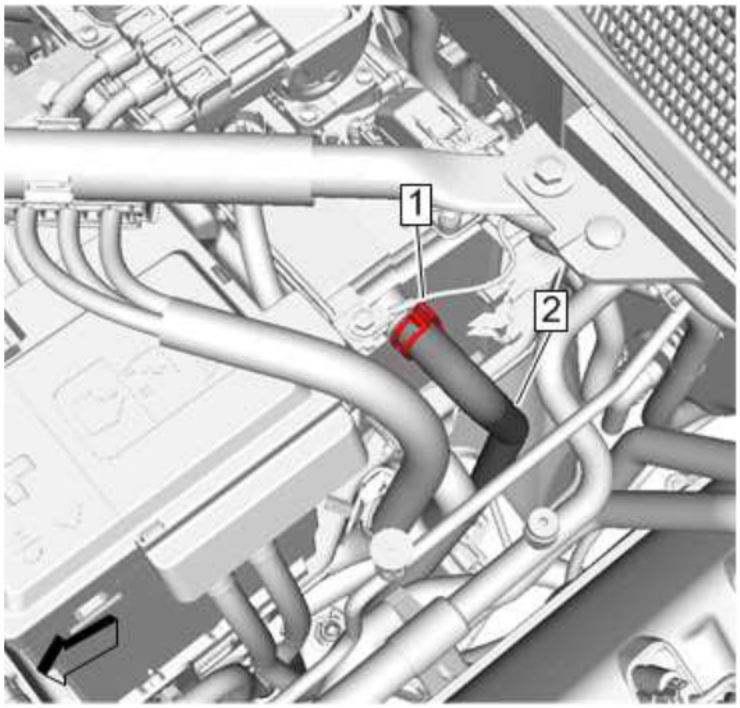


Fig. 17: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Generator Control Module Coolant Outlet Hose Clamp 1 - Disengage - **Hose Clamp Replacement**

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Guidelines - Spring Type

8. Generator Control Module Coolant Outlet Hose 2 @Generator Control Module - Remove
9. Generator Control Module Coolant Outlet Hose 2 - Remove

Installation Procedure

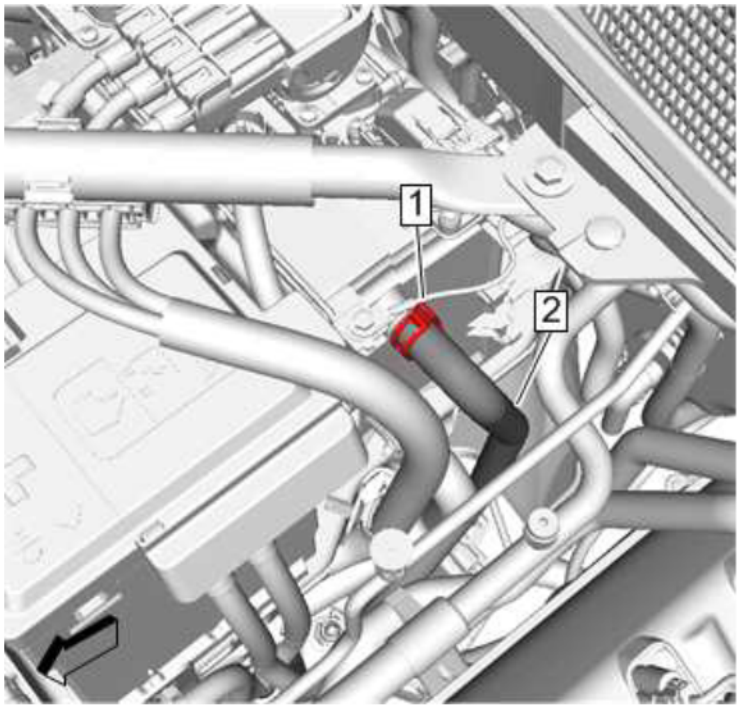


Fig. 18: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Generator Control Module Coolant Outlet Hose 2 @Generator Control Module - Install
2. Generator Control Module Coolant Outlet Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle**

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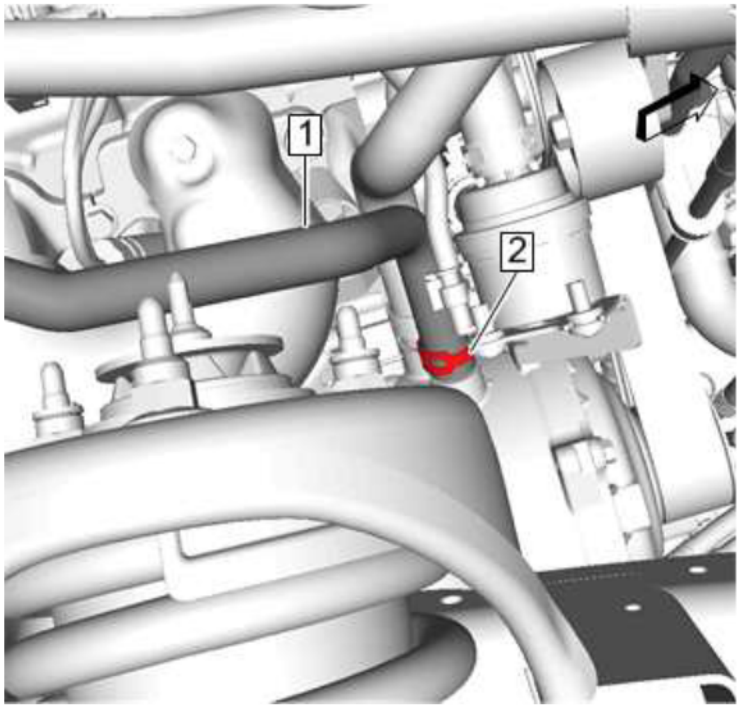


Fig. 19: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Generator Control Module Coolant Outlet Hose 1 @Starter Generator - Install
5. Generator Control Module Coolant Outlet Hose Clamp 2 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**
6. Reposition the wiring harness.
7. Air Cleaner Outlet Duct - Install - **Air Cleaner Outlet Duct Replacement**
8. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
9. Start the engine and check for coolant leaks.

GENERATOR CONTROL MODULE COOLANT OUTLET HOSE REPLACEMENT (STARTER GENERATOR TO DRIVE MOTOR BATTERY SURGE TANK INLET HOSE L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**

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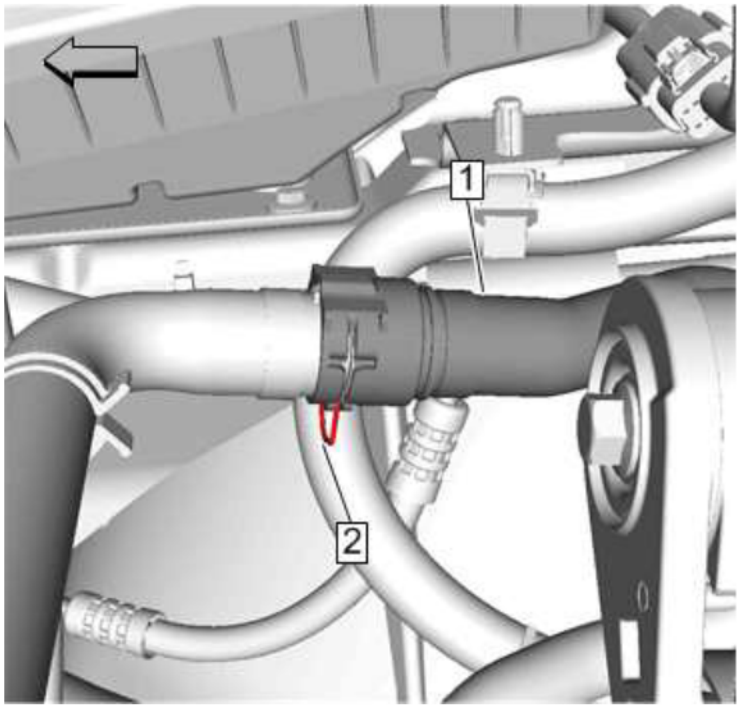


Fig. 20: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Outlet Hose Retainer 2 - Disengage
4. Generator Control Module Coolant Outlet Hose 1 @Drive Motor Battery Surge Tank Inlet Hose - Remove

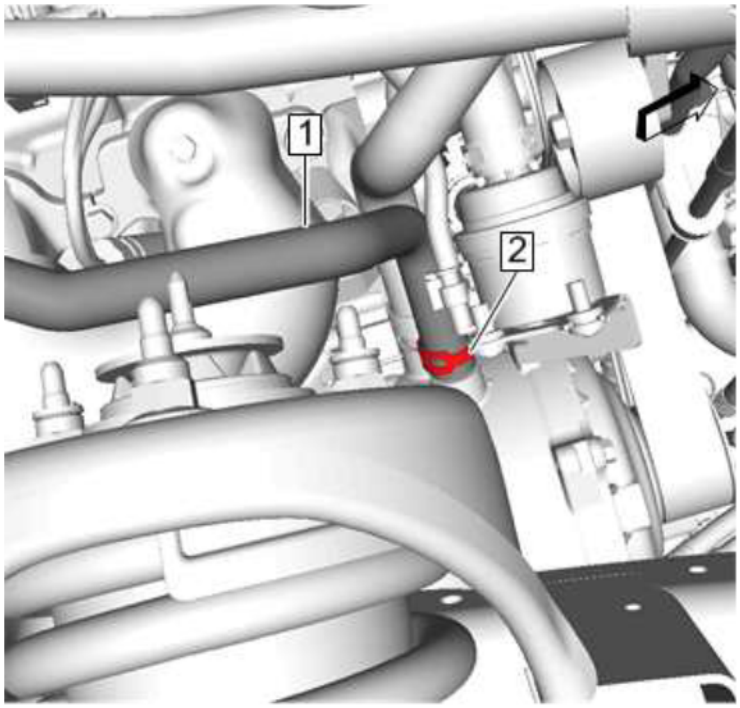


Fig. 21: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Outlet Hose 1 @Starter Generator - Remove - **Generator Control Module Coolant Outlet Hose Replacement (Starter Generator to Generator Control Module**

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L8B)Generator Control Module Coolant Outlet Hose Replacement (Starter Generator to Drive Motor Battery Surge Tank Inlet Hose L8B)

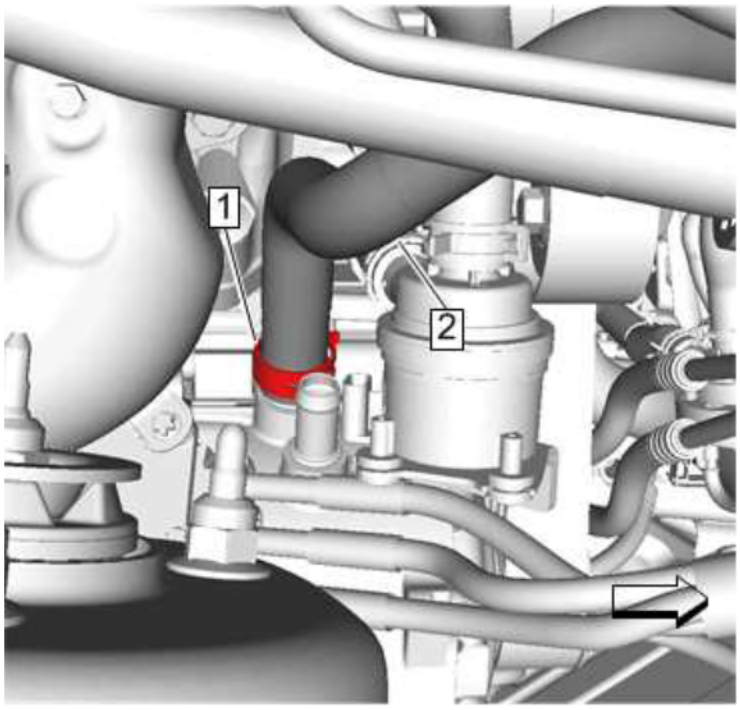
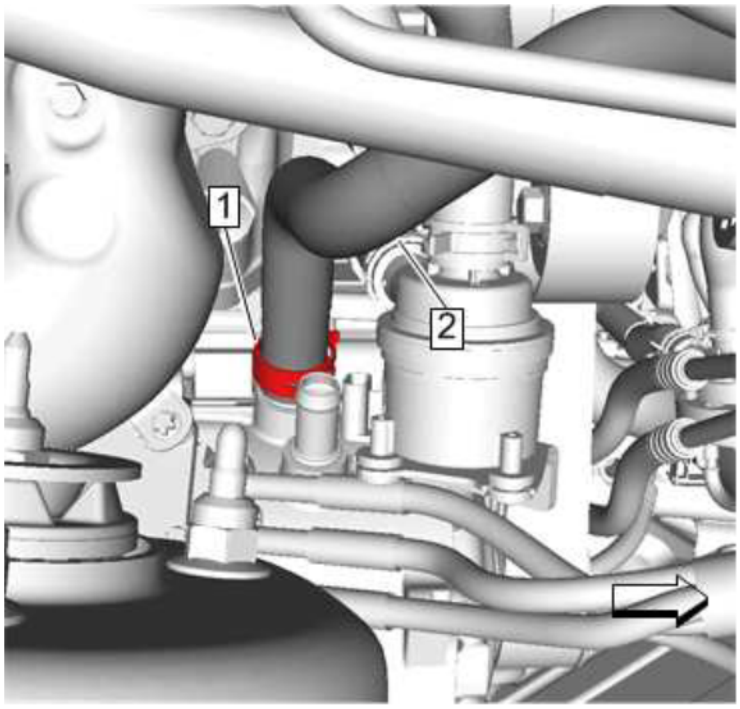


Fig. 22: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Generator Control Module Coolant Outlet Hose Clamp 1 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
7. Generator Control Module Coolant Outlet Hose 2 @Starter Generator - Remove
8. Generator Control Module Coolant Outlet Hose 2 - Remove

Installation Procedure



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Fig. 23: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Generator Control Module Coolant Outlet Hose 2 @Starter Generator - Install
2. Generator Control Module Coolant Outlet Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**

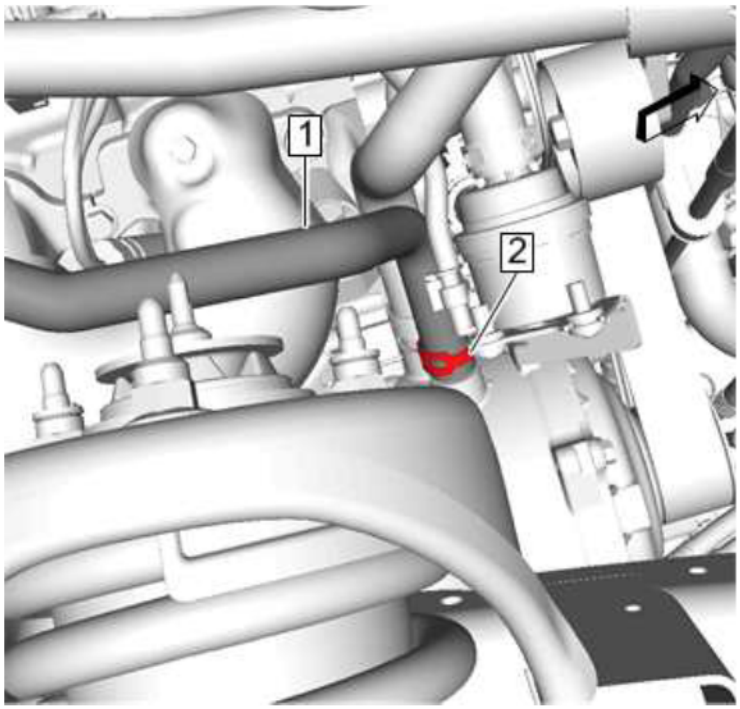


Fig. 24: Generator Control Module Coolant Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Generator Control Module Coolant Outlet Hose 1 @Starter Generator - Install - **Generator Control Module Coolant Outlet Hose Replacement (Starter Generator to Generator Control Module L8B)Generator Control Module Coolant Outlet Hose Replacement (Starter Generator to Drive Motor Battery Surge Tank Inlet Hose L8B)**

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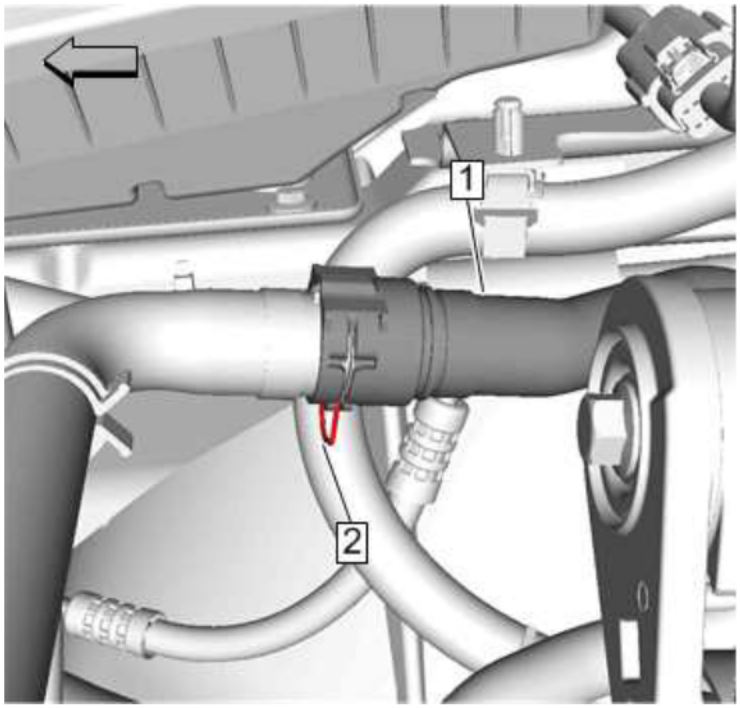


Fig. 25: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Generator Control Module Coolant Outlet Hose 1 @Drive Motor Battery Surge Tank Inlet Hose - Install
5. Generator Control Module Coolant Outlet Hose Retainer 2, 1 - Engage
6. Air Cleaner Outlet Duct - Install - **Air Cleaner Outlet Duct Replacement**
7. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
8. Start the engine and check for coolant leaks.

GENERATOR COOLANT PUMP REPLACEMENT (L8B)

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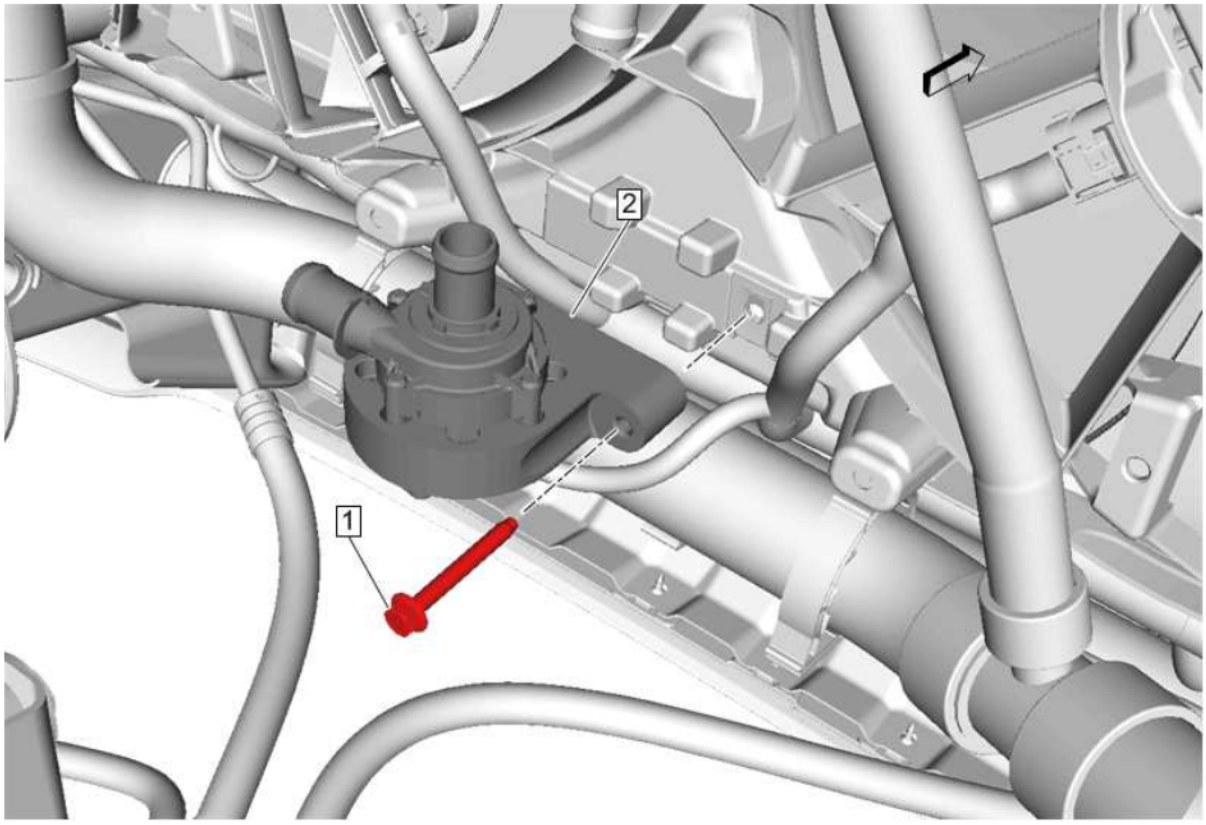


Fig. 26: Generator Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)** 2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement** 3. Generator Control Module Coolant Pump Hose@Generator Coolant Pump - Remove - **Generator Control Module Coolant Pump Hose Replacement (Left Side L8B)** 4. Generator Control Module Coolant Tank Hose@Generator Coolant Pump - Remove - **Generator Control Module Coolant Tank Hose Replacement (Bottom L8B)Generator Control Module Coolant Tank Hose Replacement (Low Temp Radiator to Generator Control Module L8B)**	
1	Generator Control Module Coolant Pump Bracket Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 6.5 N.m (58 lb in)
2	Generator Coolant Pump **Procedure**

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Callout	Component Name
	1. Disconnect the electrical connector. 2. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Vac N Fill L8B)** 3. Start the engine and check for coolant leaks.

DRIVE MOTOR GENERATOR BATTERY COOLING BLOWER REPLACEMENT (L8B)

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

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

- **Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.**

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

Removal Procedure

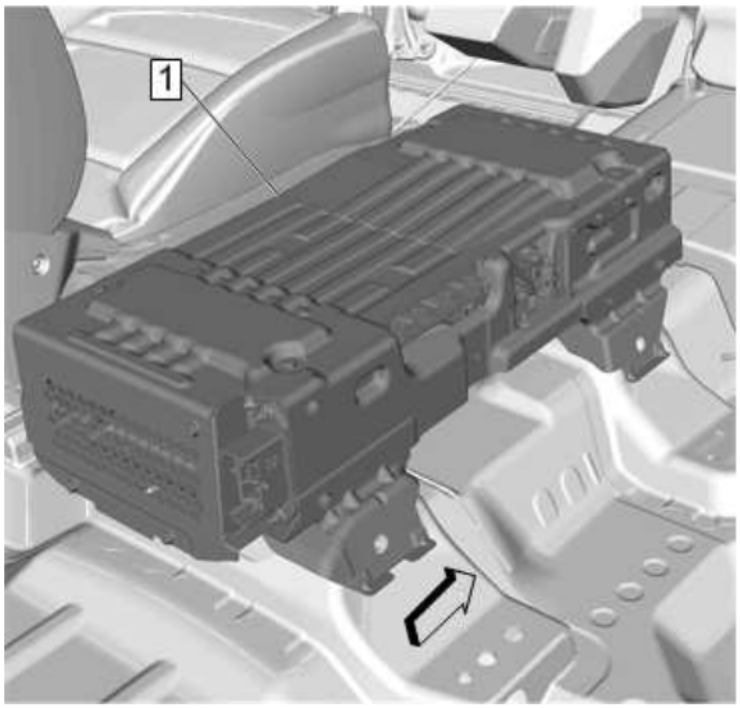


Fig. 27: High Voltage Battery
Courtesy of GENERAL MOTORS COMPANY

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1. High Voltage Battery 1 - Remove - **High Voltage Battery Replacement and Shipping Preparation (with Center Console)** **High Voltage Battery Replacement and Shipping Preparation (with Front Center Seat)**

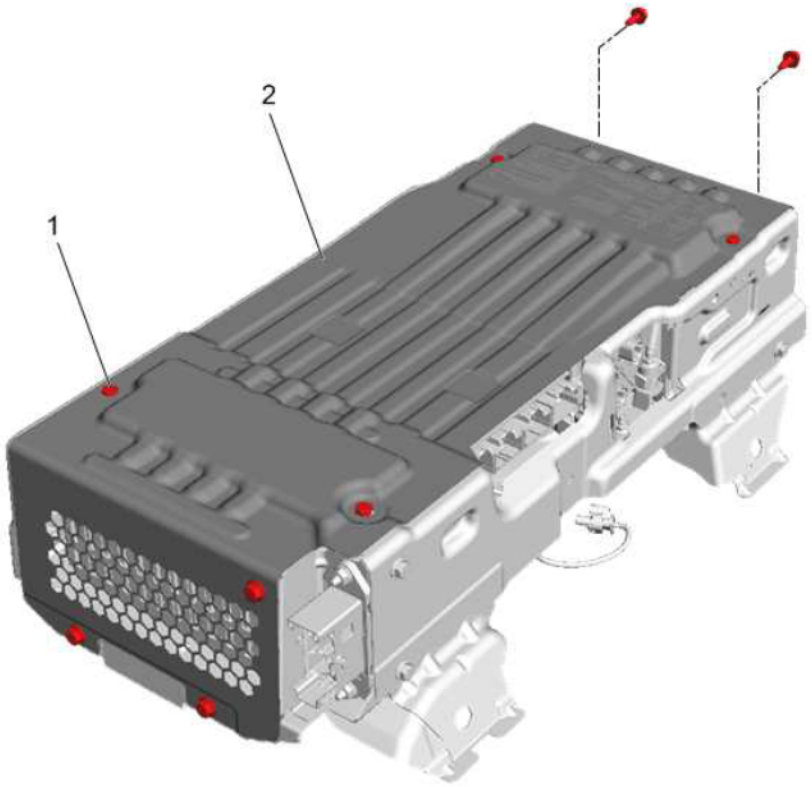
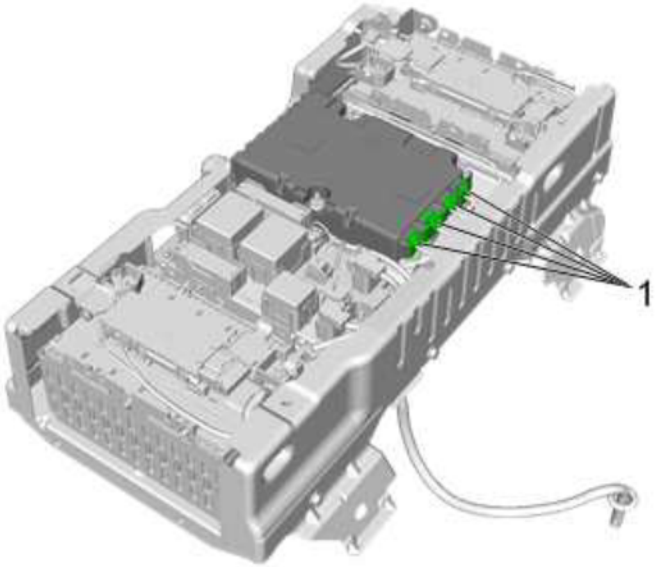


Fig. 28: High Voltage Battery Top Cover
Courtesy of GENERAL MOTORS COMPANY

2. High Voltage Battery Top Cover 2 - Remove - **High Voltage Battery Cover Replacement (Battery Positive and Negative Cable)** **High Voltage Battery Cover Replacement**



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Fig. 29: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Electrical Connector 1 - Disconnect

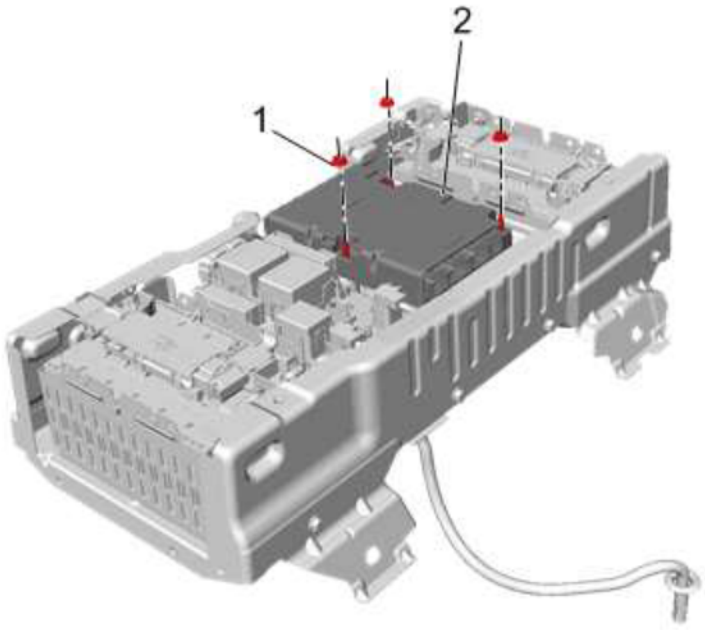


Fig. 30: Hybrid Powertrain Control Module 2
Courtesy of GENERAL MOTORS COMPANY

4. Hybrid Powertrain Control Module 2 Mounting Nut 1 - Remove
5. Hybrid Powertrain Control Module 2 (2) - Remove

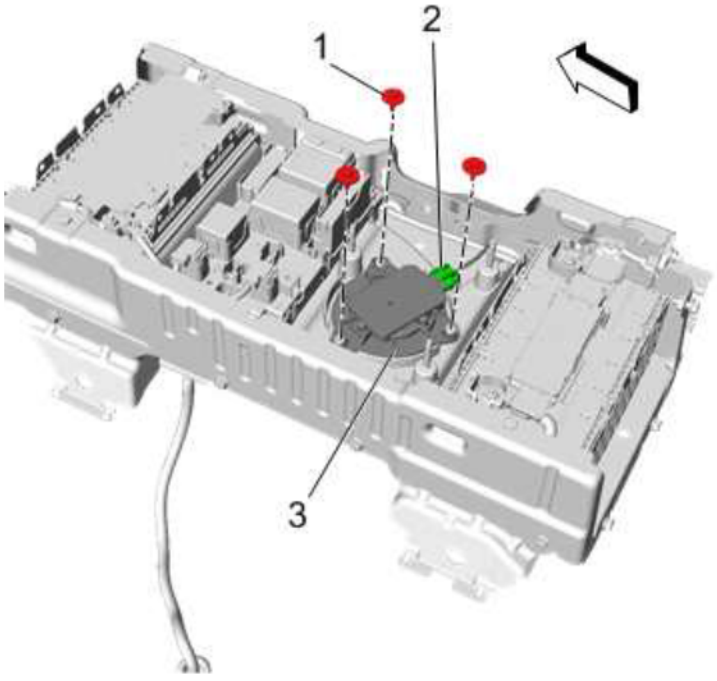


Fig. 31: Drive Motor Generator Battery Cooling Blowe

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Courtesy of GENERAL MOTORS COMPANY

6. Electrical Connector 2 - Disconnect
7. Drive Motor Generator Battery Cooling Blower Fastener 1 - Remove
8. Drive Motor Generator Battery Cooling Blower 3 - Remove

Installation Procedure

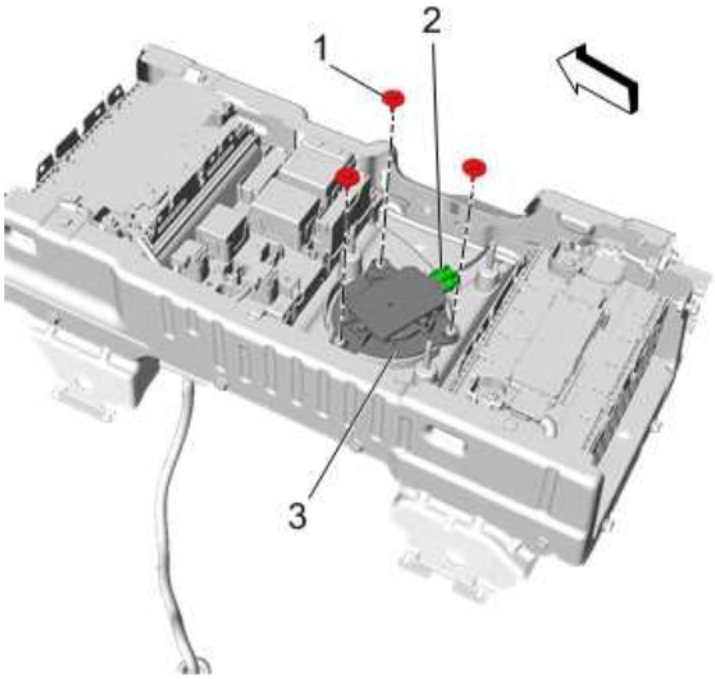


Fig. 32: Drive Motor Generator Battery Cooling Blowe
Courtesy of GENERAL MOTORS COMPANY

1. Electrical Connector 2 - Connect
2. Drive Motor Generator Battery Cooling Blower 3 - Install

CAUTION: Refer to Fastener Caution

3. Drive Motor Generator Battery Cooling Blower Fastener 1 - Install and tighten 1.2 N.m (11 lb in)

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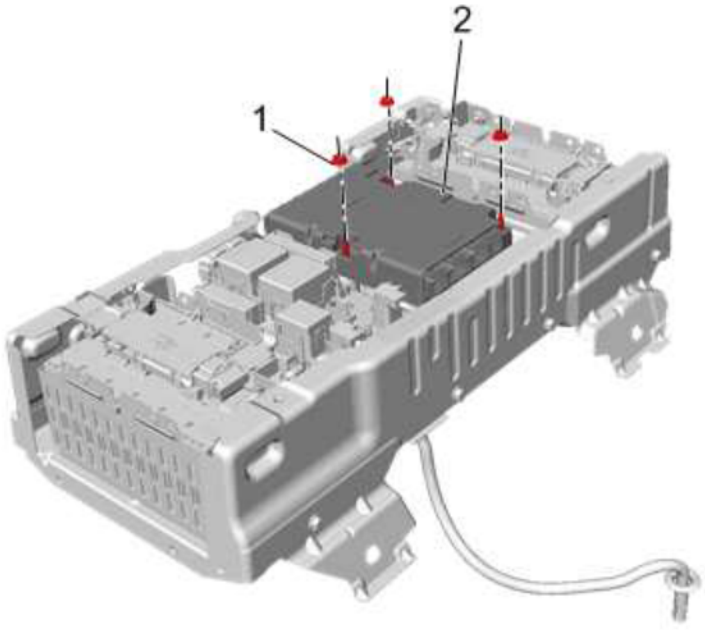


Fig. 33: Hybrid Powertrain Control Module 2
Courtesy of GENERAL MOTORS COMPANY

4. Hybrid Powertrain Control Module 2 (2)- Install
5. Hybrid Powertrain Control Module 2 Mounting Nut 1 - Install and tighten 9 N.m (80 lb in)

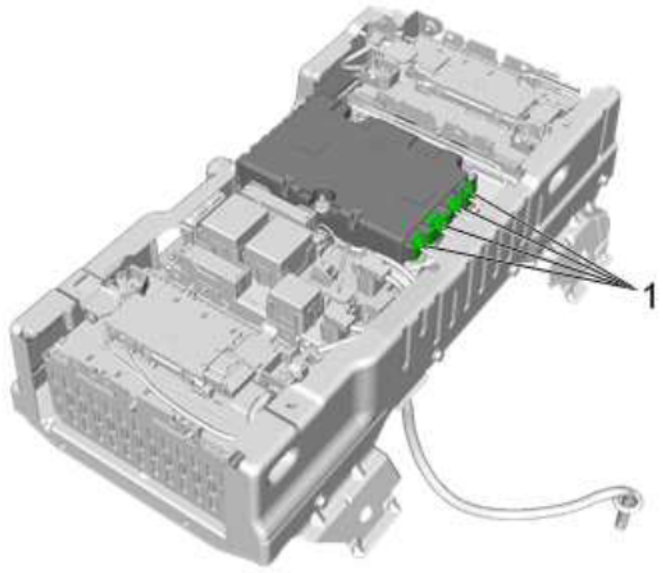


Fig. 34: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Electrical Connector 1 - Connect

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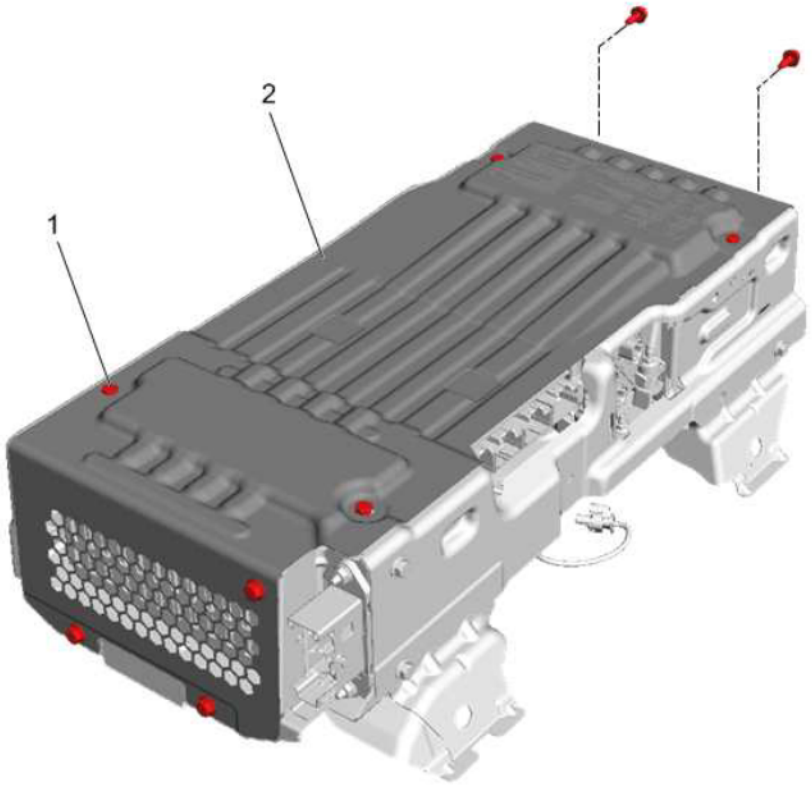


Fig. 35: High Voltage Battery Top Cover
Courtesy of GENERAL MOTORS COMPANY

7. High Voltage Battery Top Cover 2 - Install - **High Voltage Battery Cover Replacement (Battery Positive and Negative Cable)** **High Voltage Battery Cover Replacement**

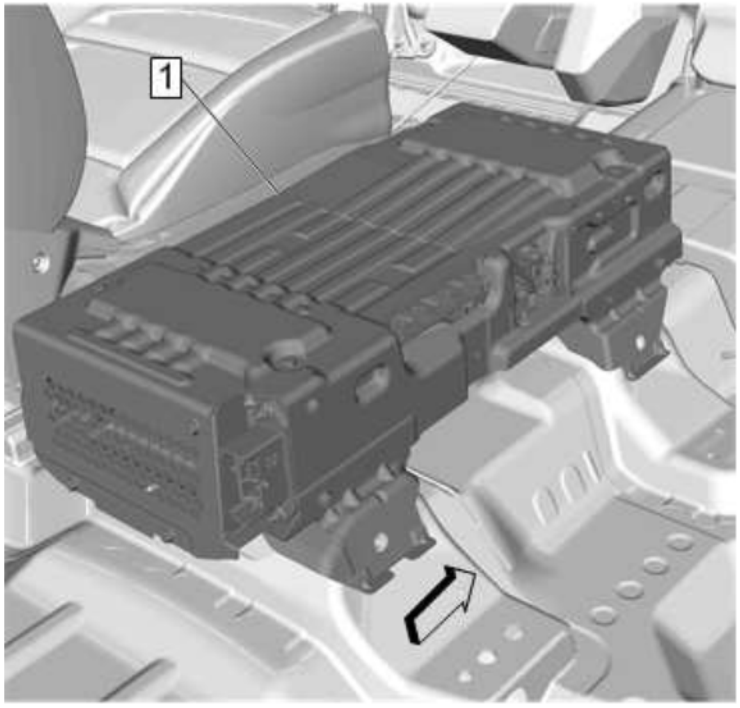


Fig. 36: High Voltage Battery
Courtesy of GENERAL MOTORS COMPANY

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8. High Voltage Battery 1 - Install - **High Voltage Battery Replacement and Shipping Preparation (with Center Console)** **High Voltage Battery Replacement and Shipping Preparation (with Front Center Seat)**
9. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY SURGE TANK INLET HOSE REPLACEMENT (L8B)

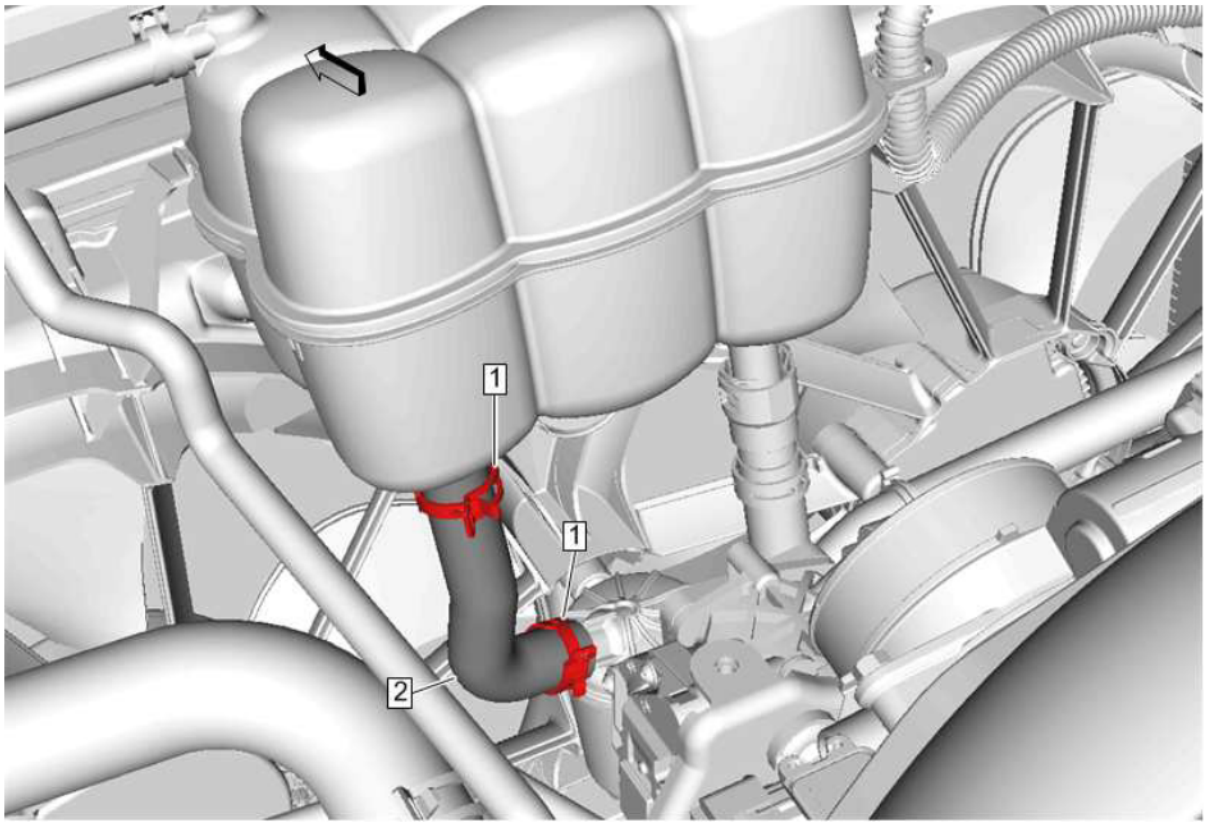


Fig. 37: Generator Control Module Coolant Pump Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)** 2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**	
1	Drive Motor Battery Surge Tank Inlet Hose Clamp **Procedure** **Hose Clamp Replacement Guidelines - Spring Type**
2	Drive Motor Battery Surge Tank Inlet Hose **Procedure** 1. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Vac N Fill L8B)** 2. Start the engine and check for coolant leaks.

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DRIVE MOTOR BATTERY COOLANT/AIR SEPARATOR REPLACEMENT (L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
2. Air Cleaner Outlet Duct - Remove - **Air Cleaner Outlet Duct Replacement**

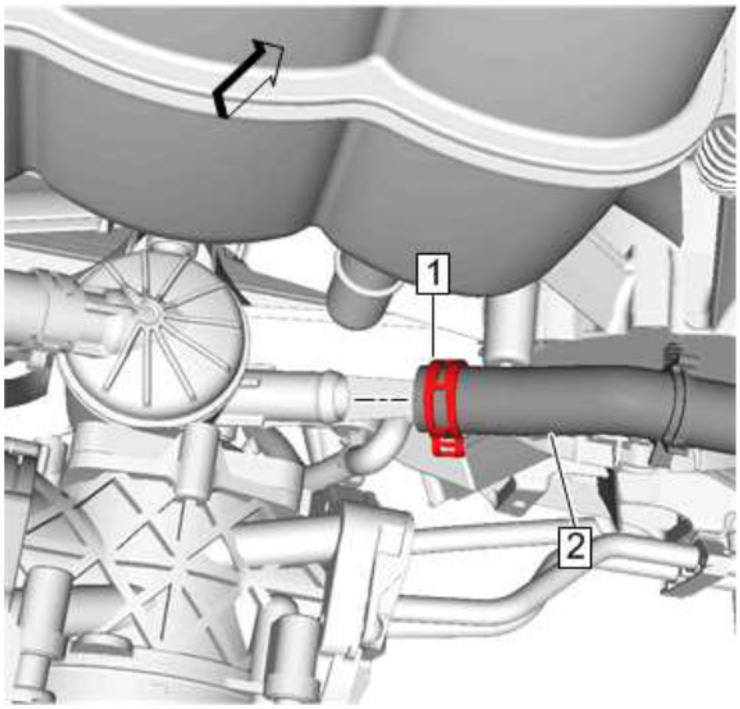


Fig. 38: Drive Motor Battery Coolant Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air SeparatorRemove - **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (L8B)**

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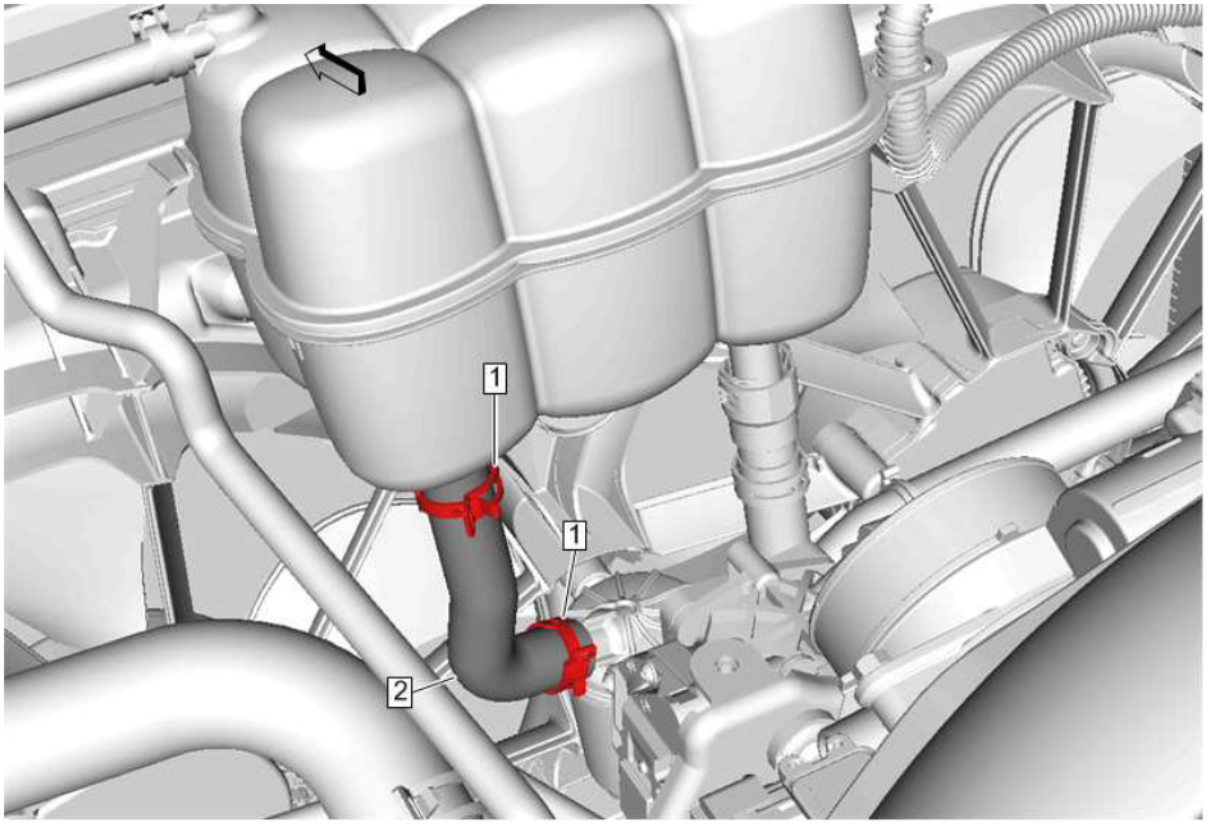
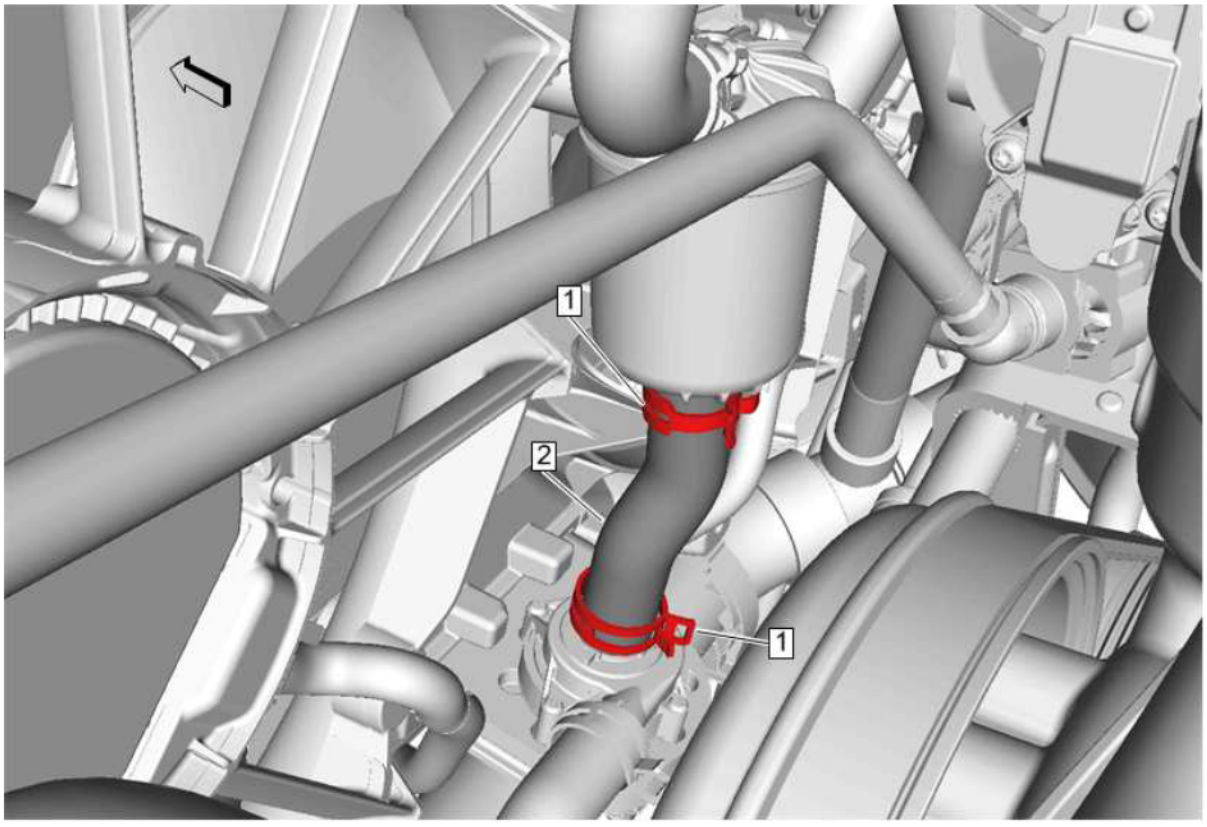


Fig. 39: Generator Control Module Coolant Pump Hose
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Surge Tank Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Remove - **Drive Motor Battery Surge Tank Inlet Hose Replacement (L8B)**



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Fig. 40: Generator Control Module Coolant Tank Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Tank Hose Clamp 1 @Drive Motor Battery Coolant/Air Separator - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

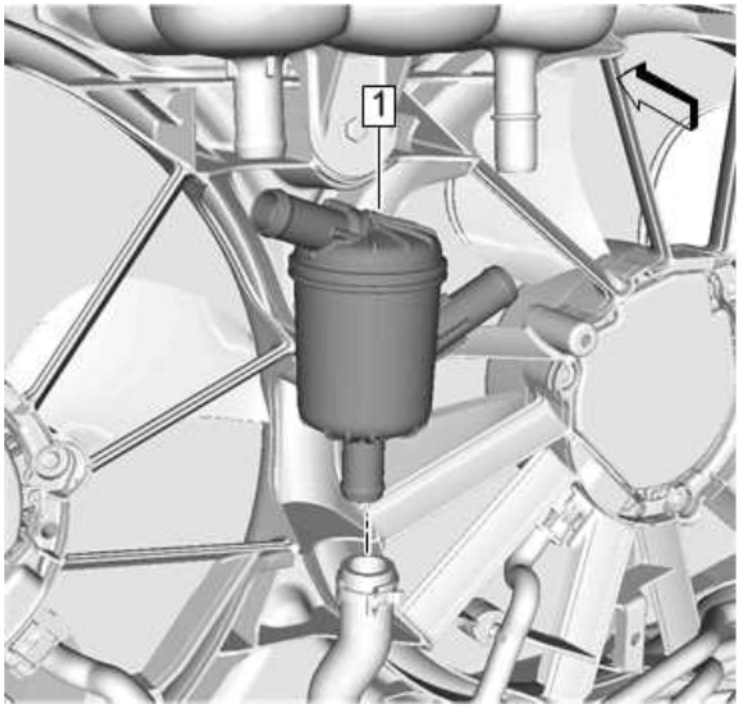


Fig. 41: Drive Motor Battery Coolant/Air Separator
Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Battery Coolant/Air Separator 1 @Generator Control Module Coolant Tank Hose - Remove
7. Drive Motor Battery Coolant/Air Separator 1 - Remove

Installation Procedure

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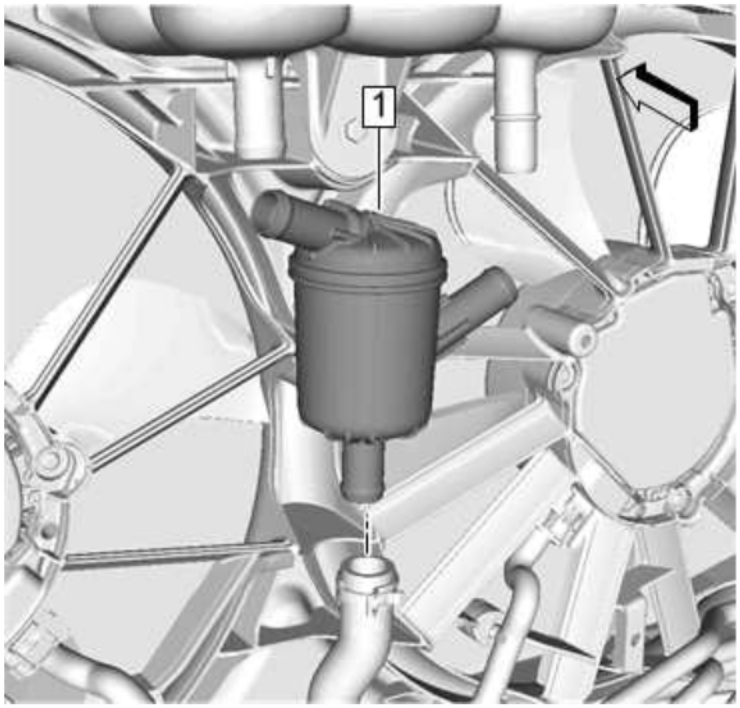


Fig. 42: Drive Motor Battery Coolant/Air Separator
Courtesy of GENERAL MOTORS COMPANY

1. Drive Motor Battery Coolant/Air Separator 1 @Generator Control Module Coolant Tank Hose - Install

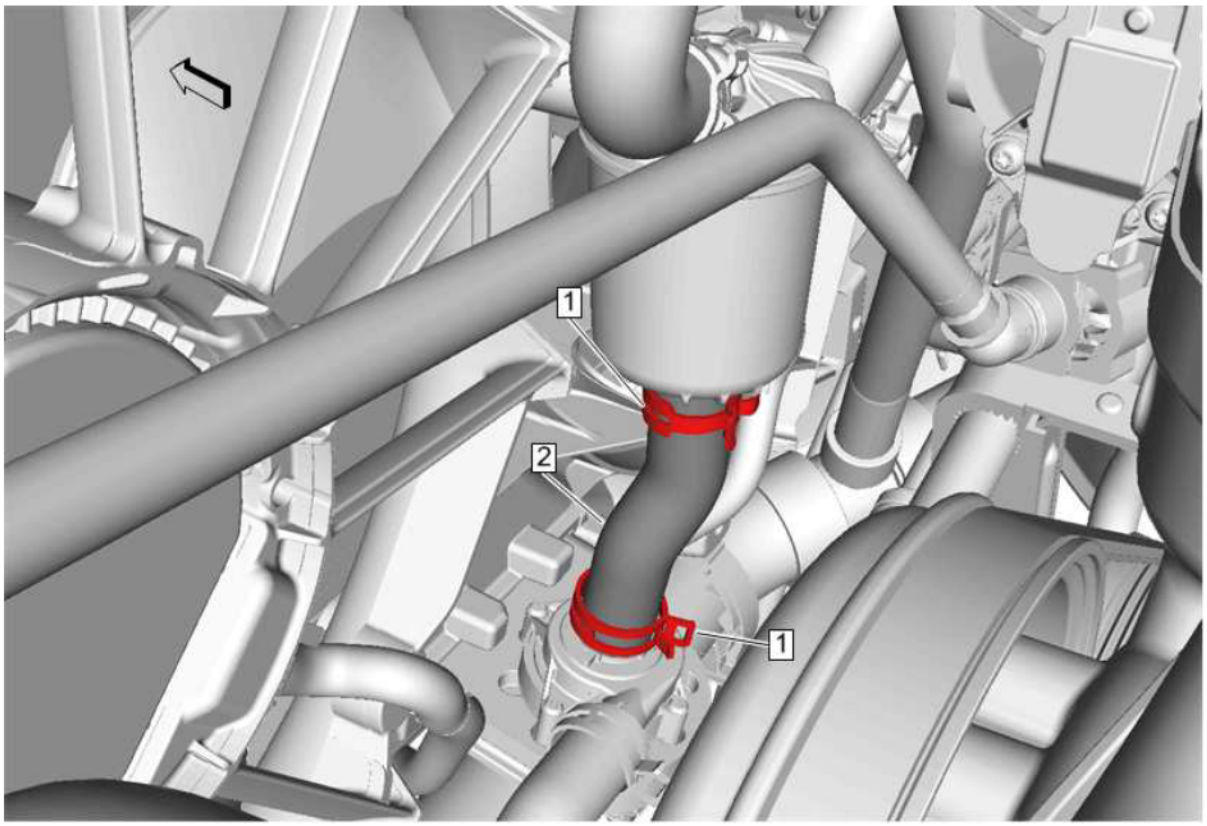


Fig. 43: Generator Control Module Coolant Tank Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Generator Control Module Coolant Tank Hose Clamp 2 @Drive Motor Battery Coolant/Air Separator -

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Engage - **Hose Clamp Replacement Guidelines - Spring Type**

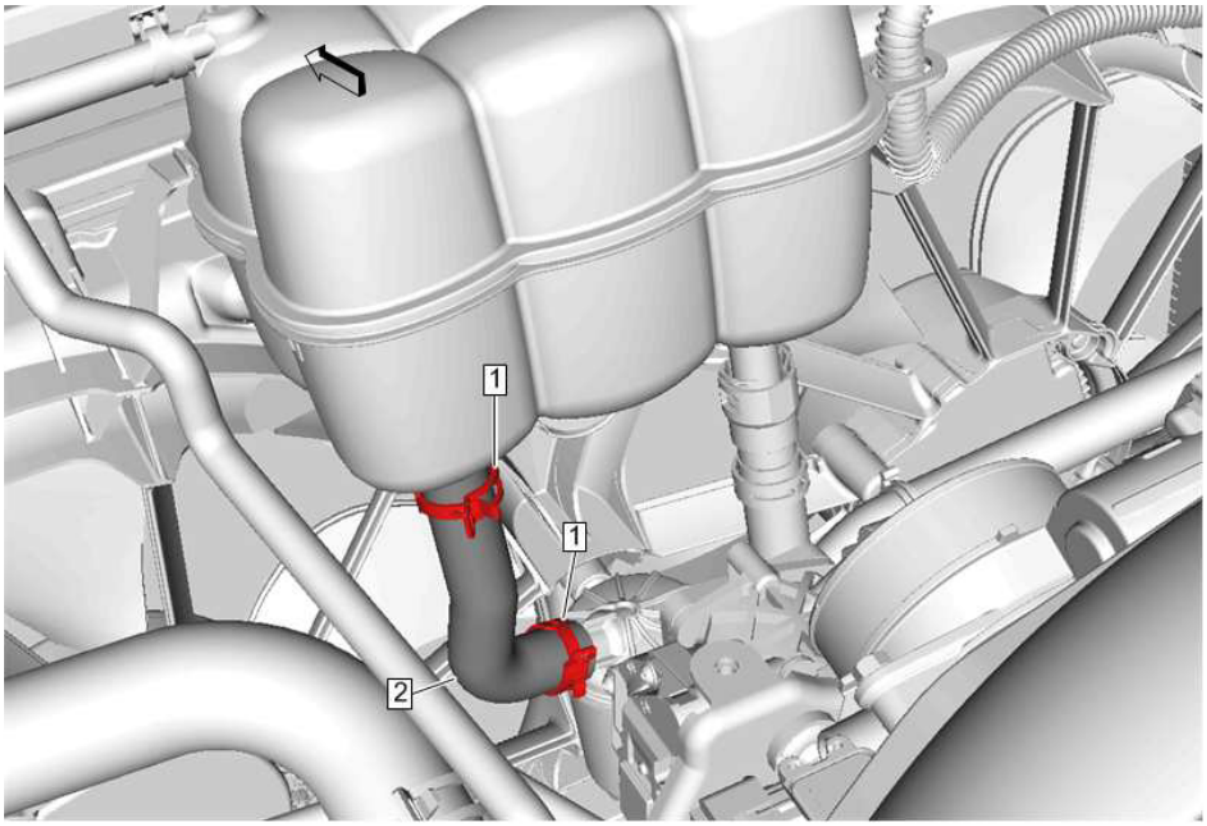


Fig. 44: Generator Control Module Coolant Pump Hose
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Surge Tank Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Install - **Drive Motor Battery Surge Tank Inlet Hose Replacement (L8B)**

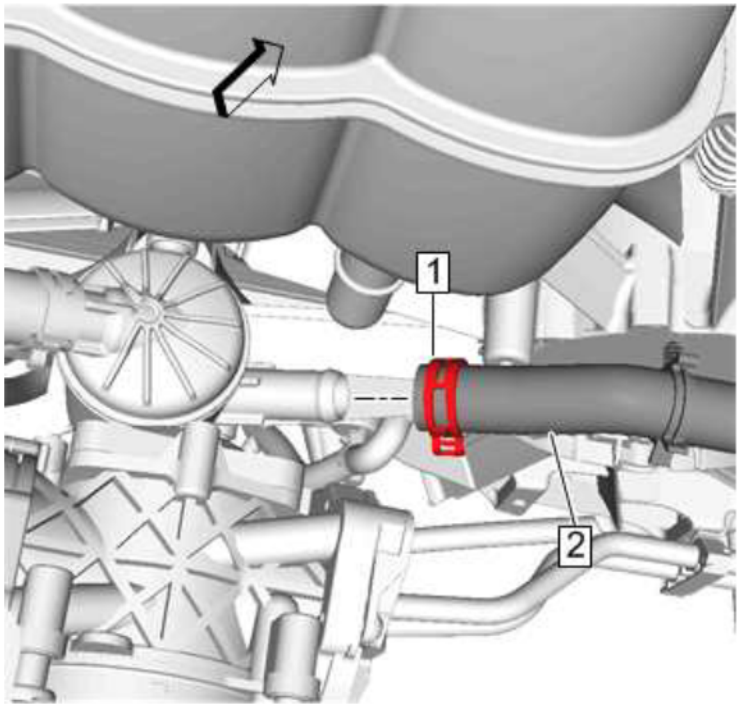


Fig. 45: Drive Motor Battery Coolant Cooler Inlet Hose Clamp

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Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air SeparatorInstall - **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (L8B)**
5. Air Cleaner Outlet Duct - Install - **Air Cleaner Outlet Duct Replacement**
6. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
7. Start the engine and check for coolant leaks.

DRIVE MOTOR BATTERY COOLANT INLET HOSE REPLACEMENT (L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**

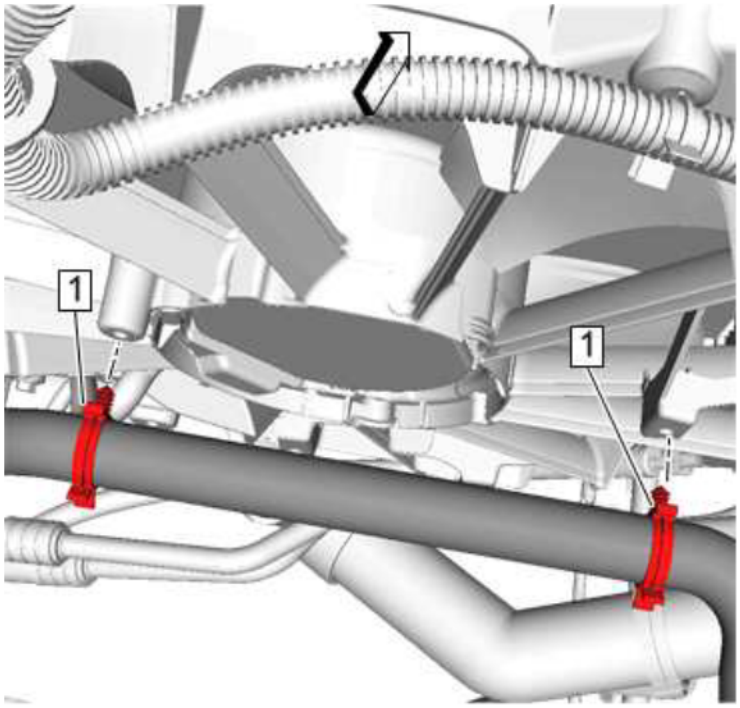


Fig. 46: Engine Coolant Fan Shroud Clip
Courtesy of GENERAL MOTORS COMPANY

2. Hose Clip 1 @Engine Coolant Fan Shroud - Remove

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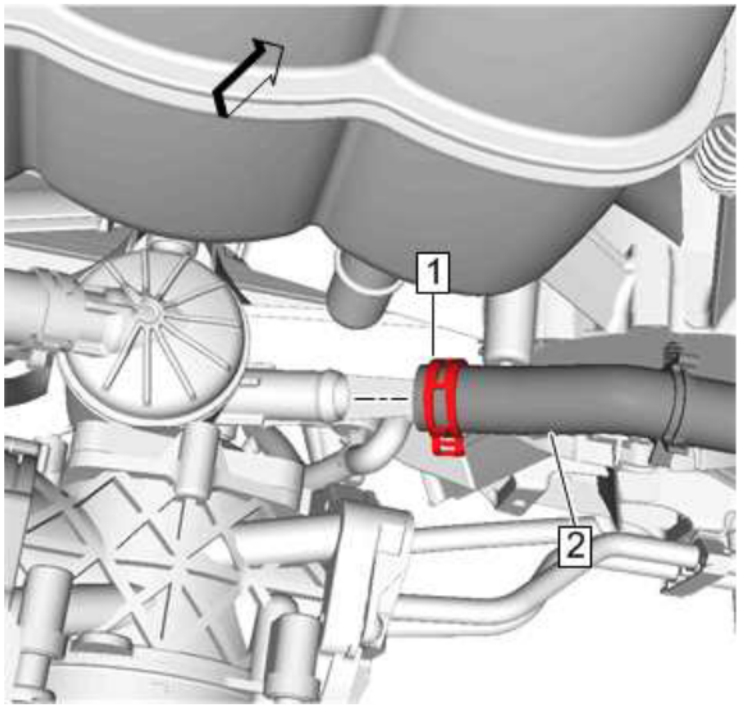


Fig. 47: Drive Motor Battery Coolant Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Coolant Cooler Inlet Hose Clamp 1 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Remove

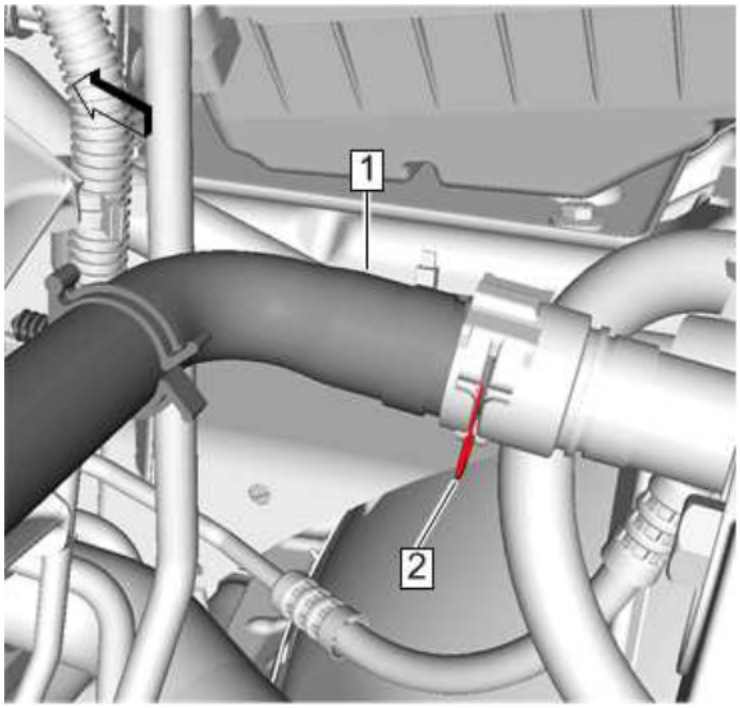


Fig. 48: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Outlet Hose Retainer 2 - Disengage
6. Drive Motor Battery Coolant Cooler Inlet Hose 1 @Generator Control Module Coolant Outlet Hose -

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Remove

7. Drive Motor Battery Coolant Cooler Inlet Hose 2 - Remove

Installation Procedure

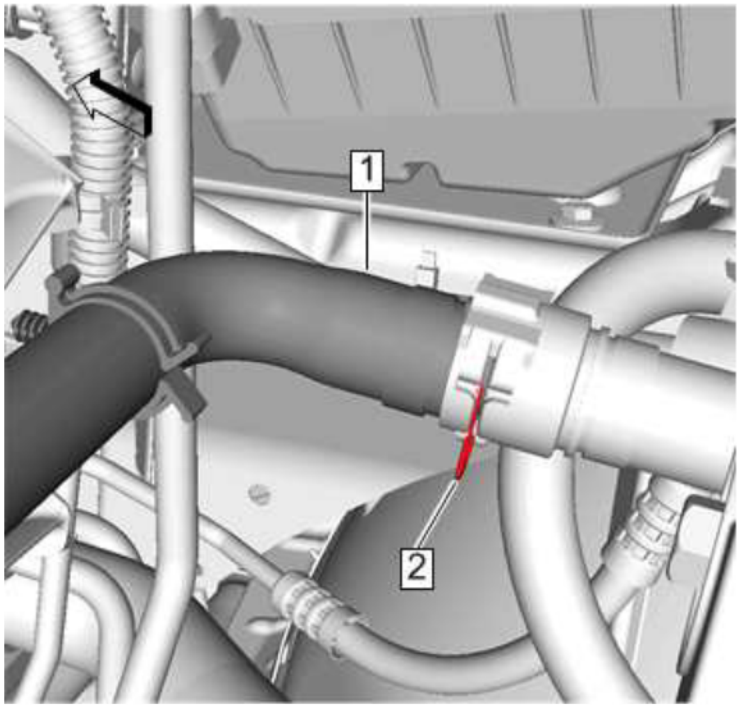
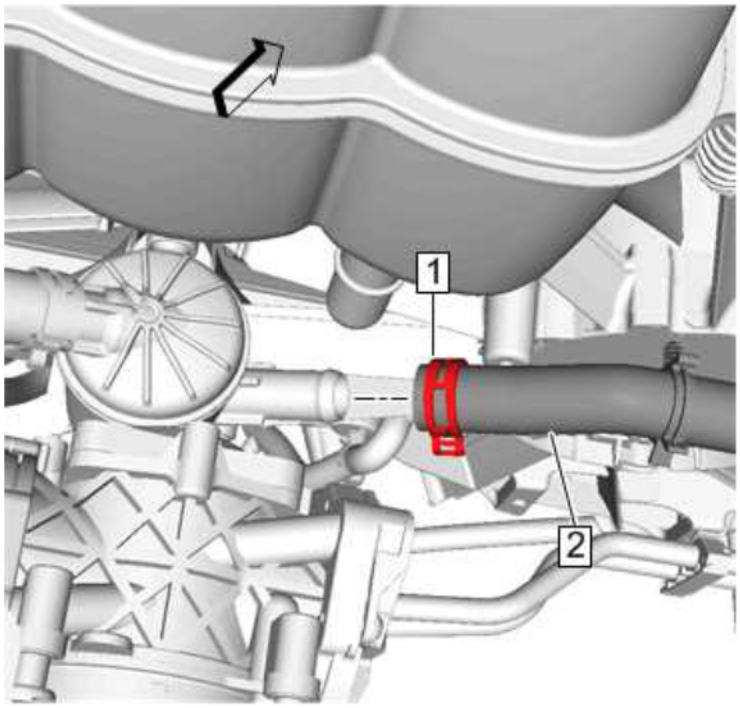


Fig. 49: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Drive Motor Battery Coolant Cooler Inlet Hose 1 @Generator Control Module Coolant Outlet Hose - Install
2. Generator Control Module Coolant Outlet Hose Retainer 2- Engage



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Fig. 50: Drive Motor Battery Coolant Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Install
4. Drive Motor Battery Coolant Cooler Inlet Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**

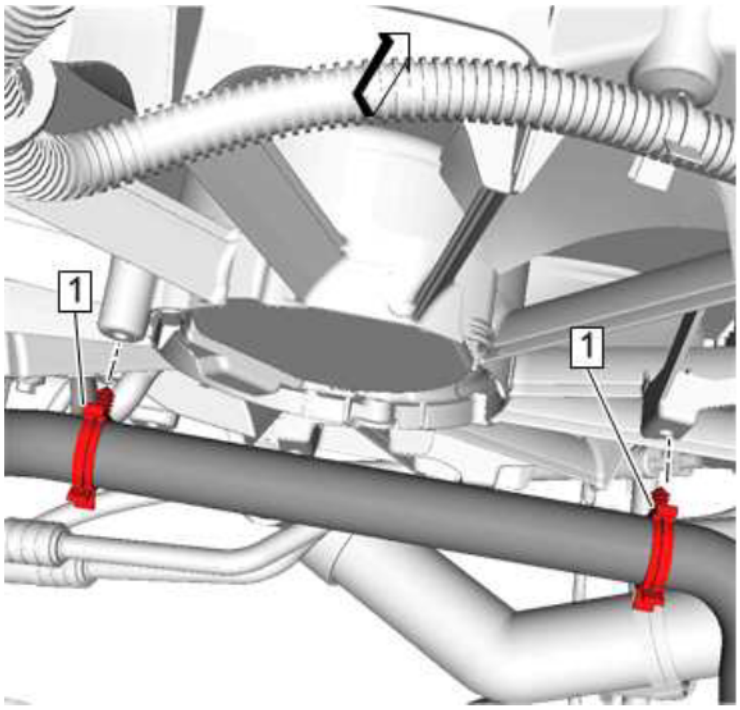


Fig. 51: Engine Coolant Fan Shroud Clip
Courtesy of GENERAL MOTORS COMPANY

5. Hose Clip 1 @Engine Coolant Fan Shroud - Install
6. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
7. Start the engine and check for coolant leaks.

DRIVE MOTOR BATTERY COOLANT COOLER INLET HOSE REPLACEMENT (L8B)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**

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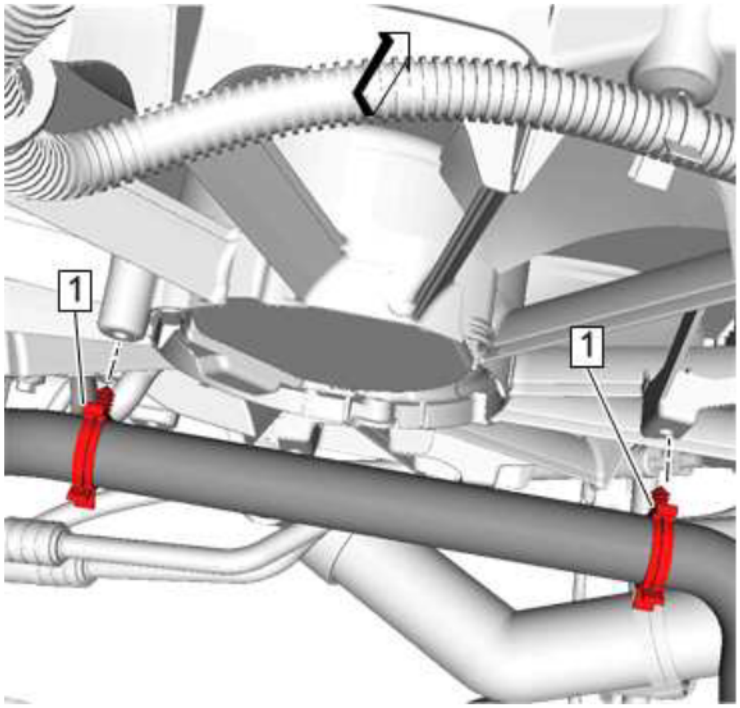


Fig. 52: Engine Coolant Fan Shroud Clip
Courtesy of GENERAL MOTORS COMPANY

2. Hose Clip 1 @Engine Coolant Fan Shroud - Remove

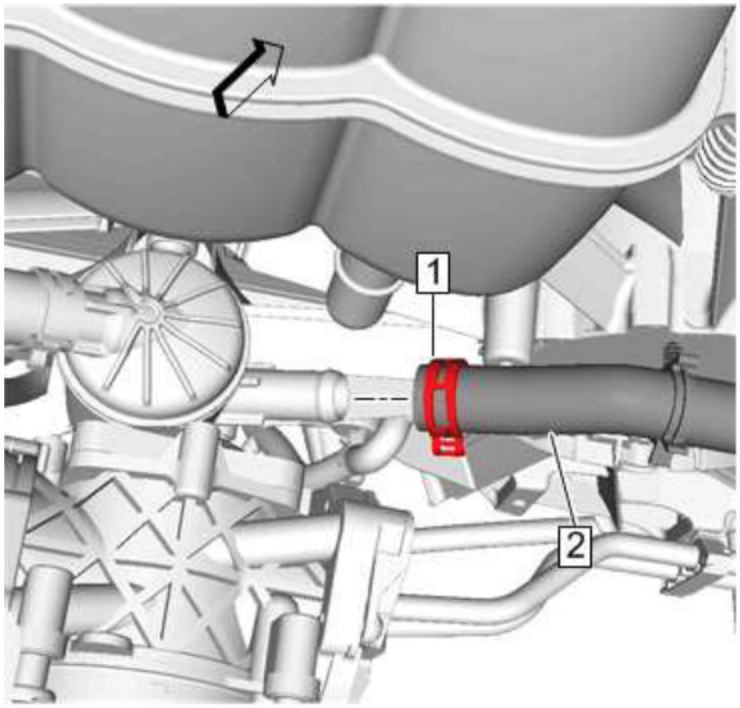


Fig. 53: Drive Motor Battery Coolant Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Coolant Cooler Inlet Hose Clamp 1 - Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Remove

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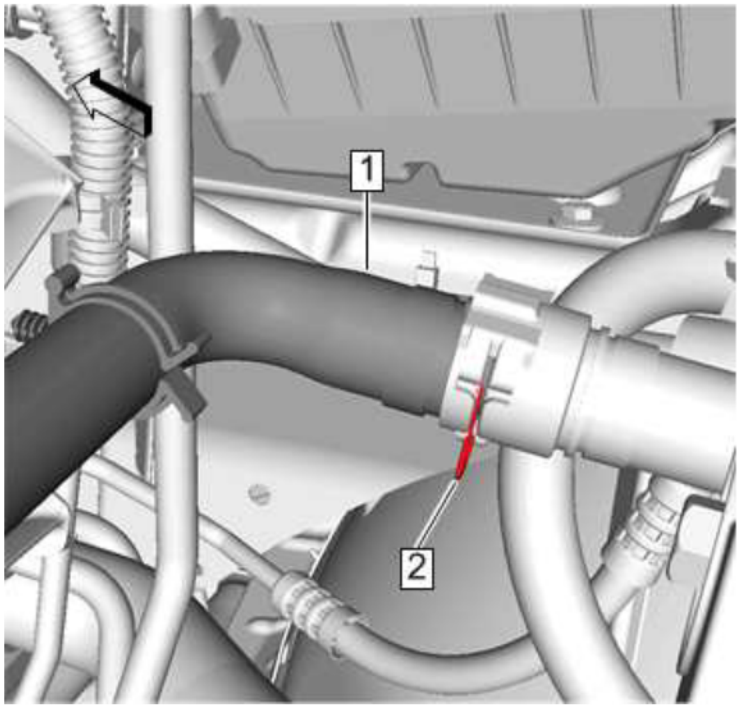


Fig. 54: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Generator Control Module Coolant Outlet Hose Retainer 2 - Disengage
6. Drive Motor Battery Coolant Cooler Inlet Hose 1 @Generator Control Module Coolant Outlet Hose - Remove
7. Drive Motor Battery Coolant Cooler Inlet Hose 2 - Remove

Installation Procedure

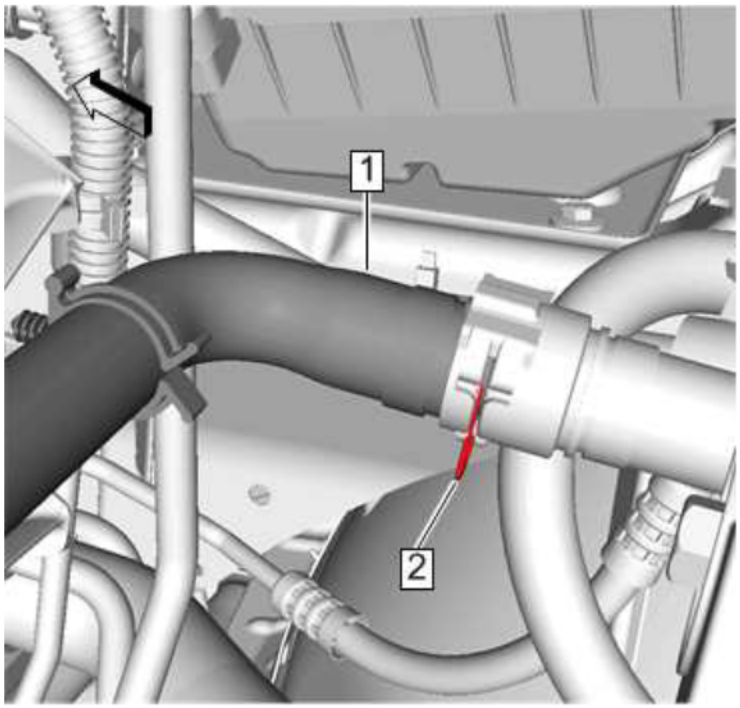


Fig. 55: Generator Control Module Coolant Outlet Hose Retainer
Courtesy of GENERAL MOTORS COMPANY

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1. Drive Motor Battery Coolant Cooler Inlet Hose 1 @Generator Control Module Coolant Outlet Hose - Install
2. Generator Control Module Coolant Outlet Hose Retainer 2 - Engage

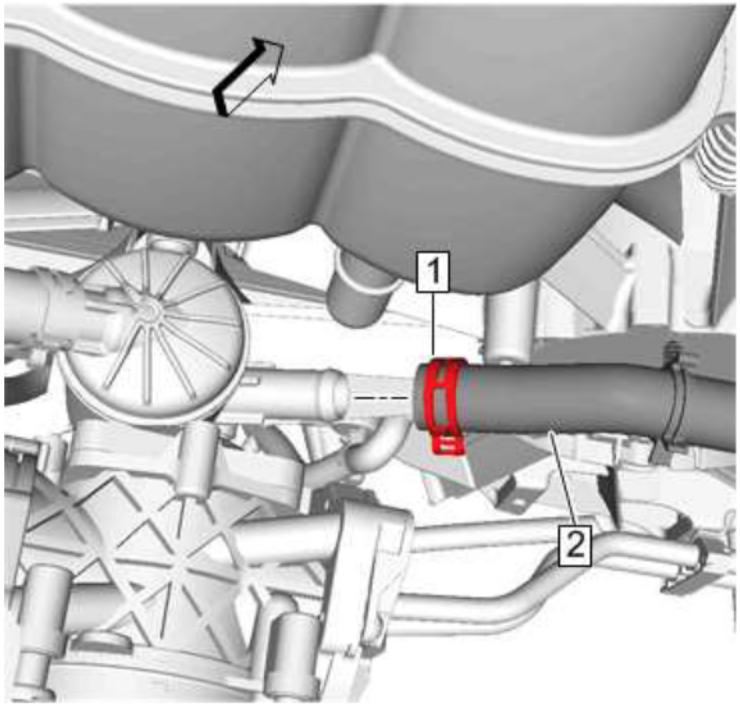


Fig. 56: Drive Motor Battery Coolant Cooler Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Drive Motor Battery Coolant Cooler Inlet Hose 2 @Drive Motor Battery Coolant/Air Separator - Install
4. Drive Motor Battery Coolant Cooler Inlet Hose Clamp 1 - Engage - **Hose Clamp Replacement Guidelines - Spring Type**

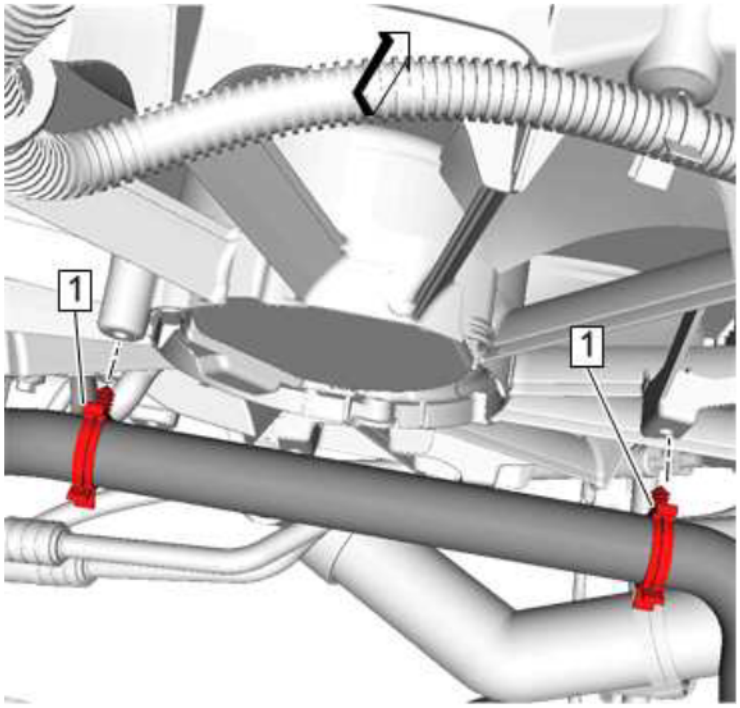


Fig. 57: Engine Coolant Fan Shroud Clip

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Courtesy of GENERAL MOTORS COMPANY

5. Hose Clip 1 @Engine Coolant Fan Shroud - Install
6. Fill the cooling system. **Cooling System Draining and Filling (Vac N Fill L8B)**
7. Start the engine and check for coolant leaks.

BATTERY COOLING AIR INLET DUCT REPLACEMENT (L8B)

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

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

- **Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.**

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

Removal Procedure

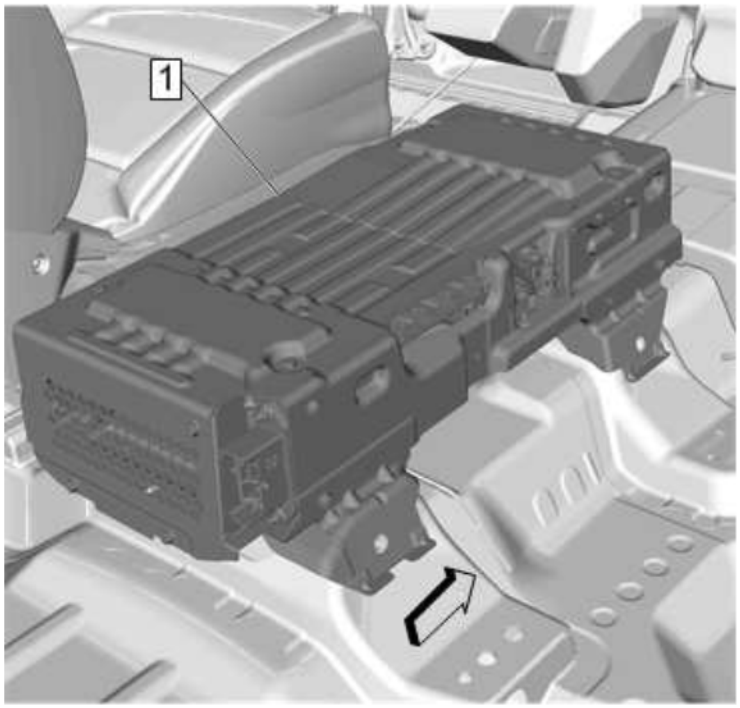


Fig. 58: High Voltage Battery
Courtesy of GENERAL MOTORS COMPANY

1. High Voltage Battery 1 - Remove - **High Voltage Battery Replacement and Shipping Preparation**

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(with Center Console) High Voltage Battery Replacement and Shipping Preparation (with Front Center Seat)

2. Remove the high voltage battery top and side covers, refer to High Voltage Battery Cover Replacement (Battery Positive and Negative Cable) High Voltage Battery Cover Replacement

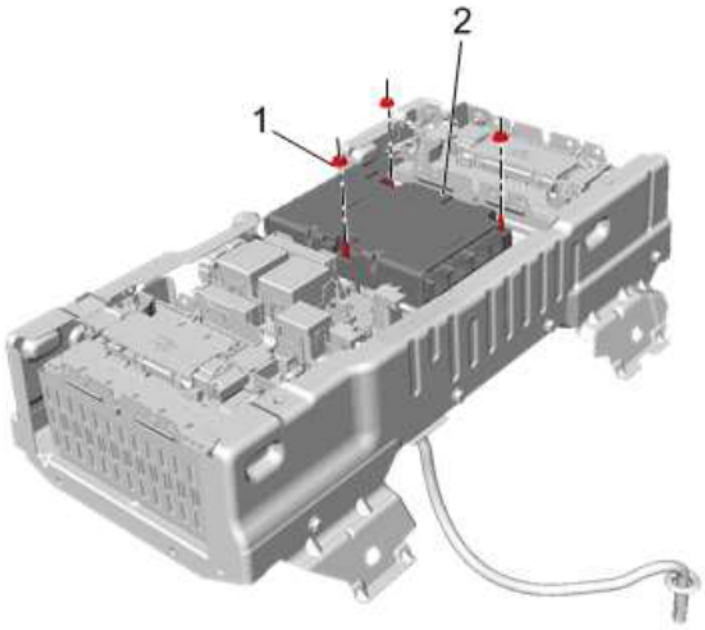


Fig. 59: Hybrid Powertrain Control Module 2
Courtesy of GENERAL MOTORS COMPANY

3. Hybrid Powertrain Control Module 2 (2) - Remove - Hybrid Powertrain Control Module 2 Replacement

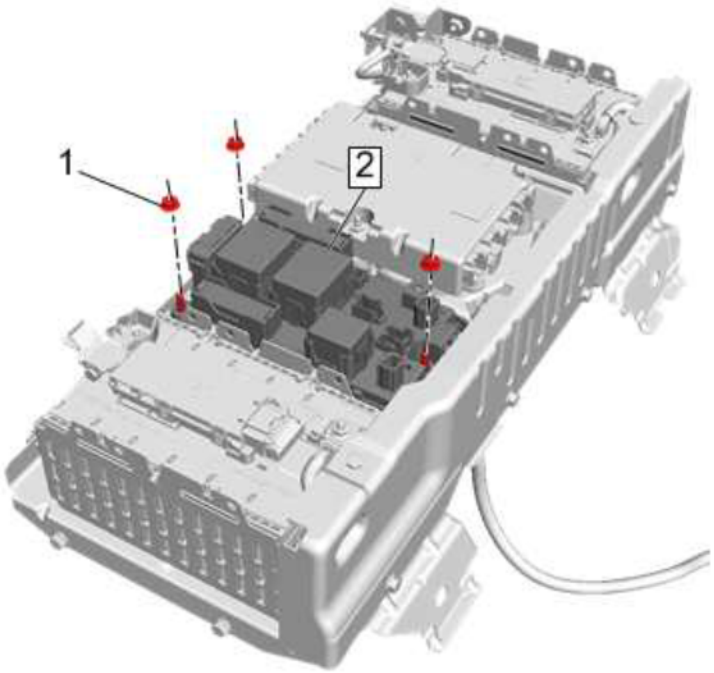


Fig. 60: Generator Battery Disconnect Relay

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Courtesy of GENERAL MOTORS COMPANY

4. Generator Battery Disconnect Relay 2 - Remove - **Generator Battery Disconnector Relay Replacement**

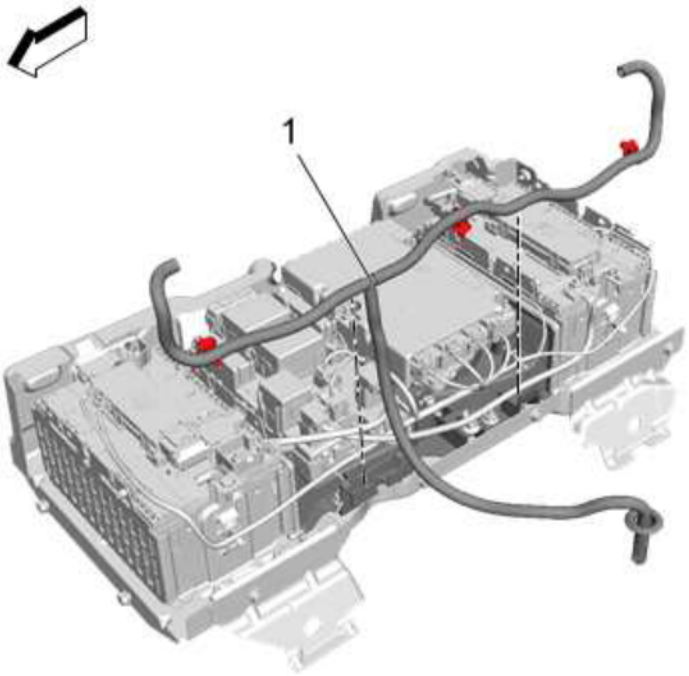


Fig. 61: Cell Battery Vent Tube
Courtesy of GENERAL MOTORS COMPANY

5. Cell Battery Vent Tube 1 - Remove - **Cell Battery Vent Tube Replacement**

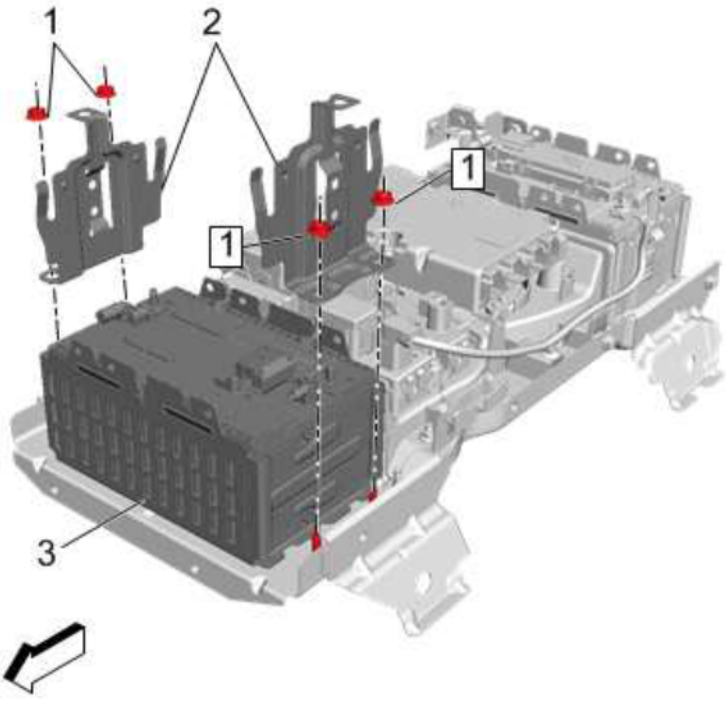


Fig. 62: Retainer Nuts
Courtesy of GENERAL MOTORS COMPANY

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NOTE: **Not necessary to remove the high voltage interface control module on top of cell battery.**

6. Cell Battery Module 1 (3) - Remove - **Cell Battery Module Replacement (Cell Battery 1)** **Cell Battery Module Replacement (Cell Battery 2)**

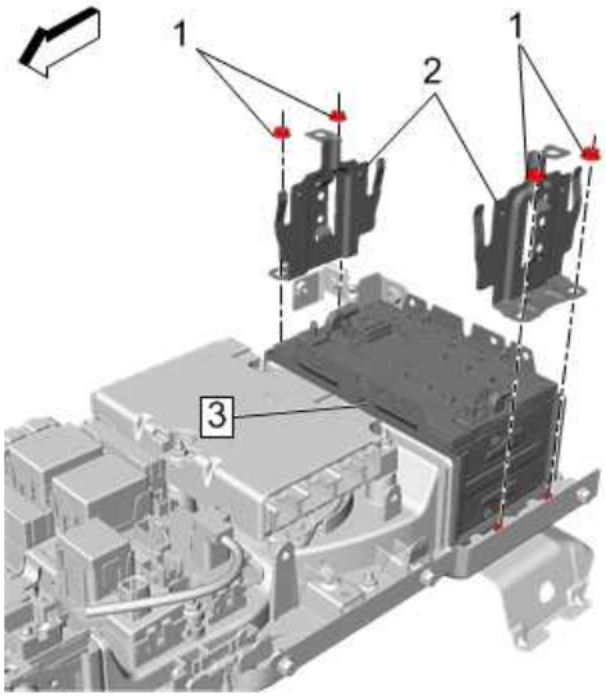


Fig. 63: Cell Battery Module 2
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Not necessary to remove the high voltage interface control module on top of cell battery.**

7. Cell Battery Module 2 (3) - Remove - **Cell Battery Module Replacement (Cell Battery 1)** **Cell Battery Module Replacement (Cell Battery 2)**

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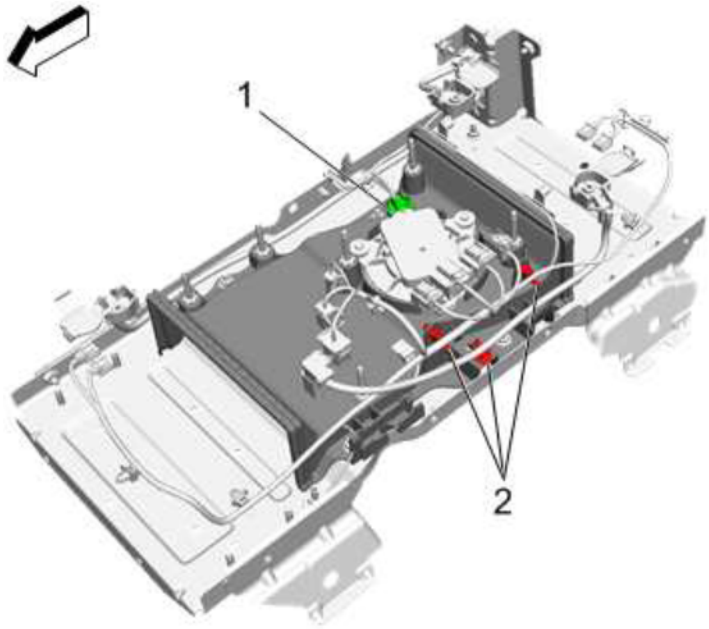


Fig. 64: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Electrical Connector 1 - Disconnect
9. Retainer 2 - Disengage

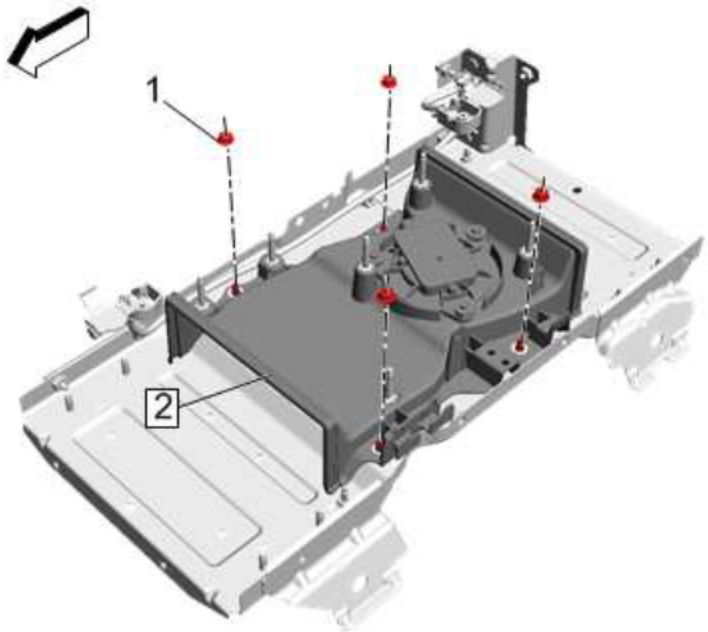


Fig. 65: Battery Cooling Air Inlet Duct
Courtesy of GENERAL MOTORS COMPANY

10. Battery Cooling Air Inlet Duct Mounting Nut 1 - Remove
11. Battery Cooling Air Inlet Duct (2) - Remove

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12. If replacing the battery cooling air inlet duct, transfer the drive motor generator battery cooling blower, refer to **Drive Motor Generator Battery Cooling Blower Replacement (L8B)**

Installation Procedure

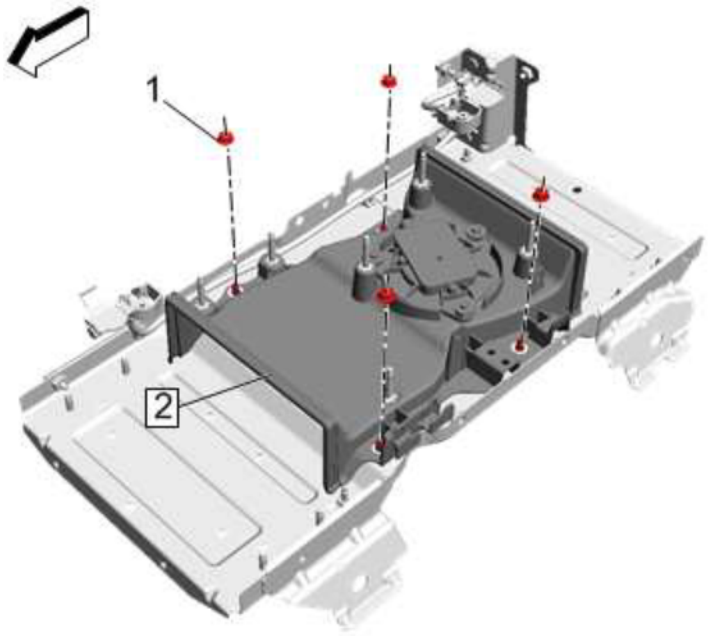


Fig. 66: Battery Cooling Air Inlet Duct
Courtesy of GENERAL MOTORS COMPANY

1. Battery Cooling Air Inlet Duct 2 - Install

CAUTION: Refer to Fastener Caution

2. Battery Cooling Air Inlet Duct Mounting Nut 1 - Install and tighten 9 N.m (80 lb in)

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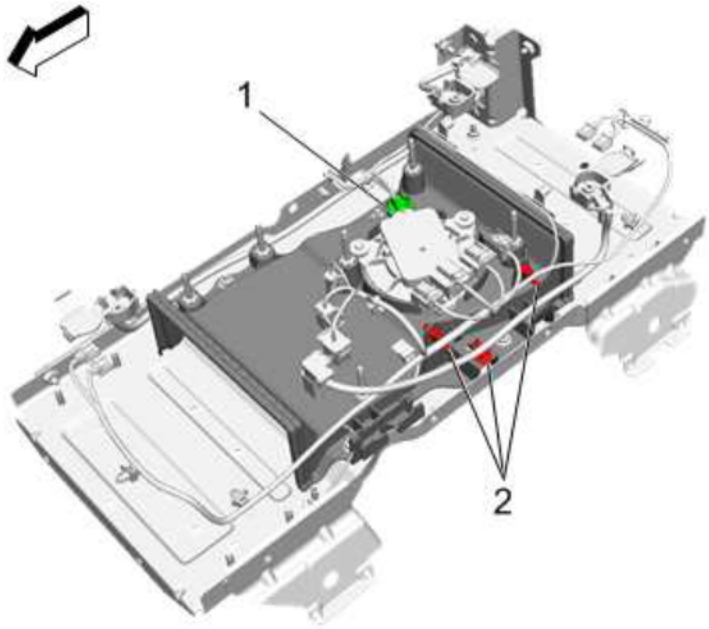


Fig. 67: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Electrical Connector 1 - Connect
4. Retainer 2 - Engage

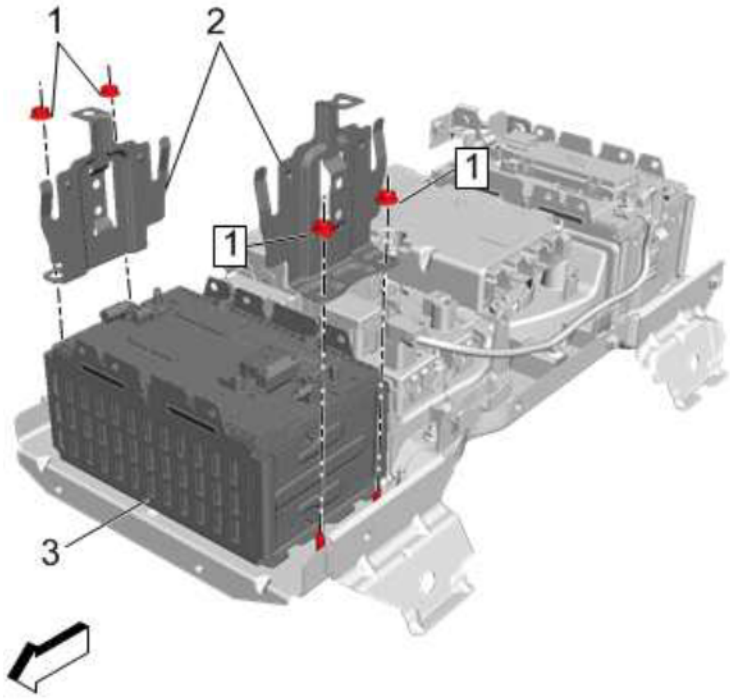


Fig. 68: Retainer Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Cell Battery Module 1 (3) - Install - **Cell Battery Module Replacement (Cell Battery 1)** **Cell Battery Module Replacement (Cell Battery 2)**

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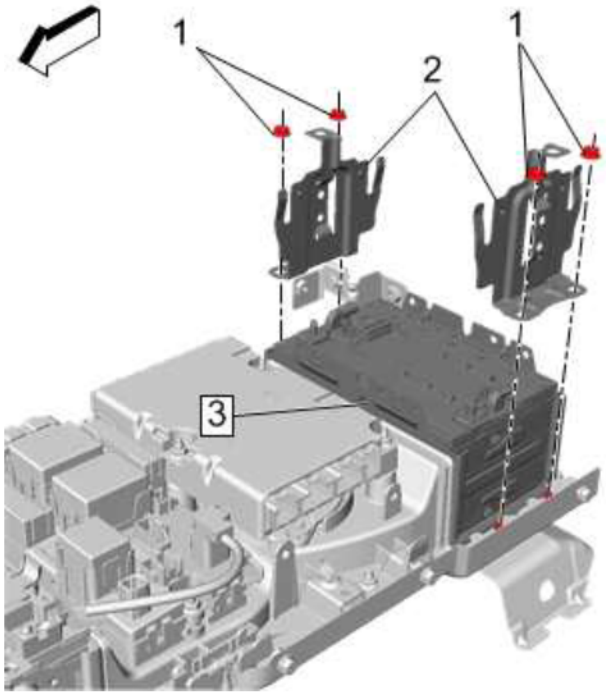


Fig. 69: Cell Battery Module 2
Courtesy of GENERAL MOTORS COMPANY

6. Cell Battery Module 2 (3) - Install - **Cell Battery Module Replacement (Cell Battery 1)** **Cell Battery Module Replacement (Cell Battery 2)**

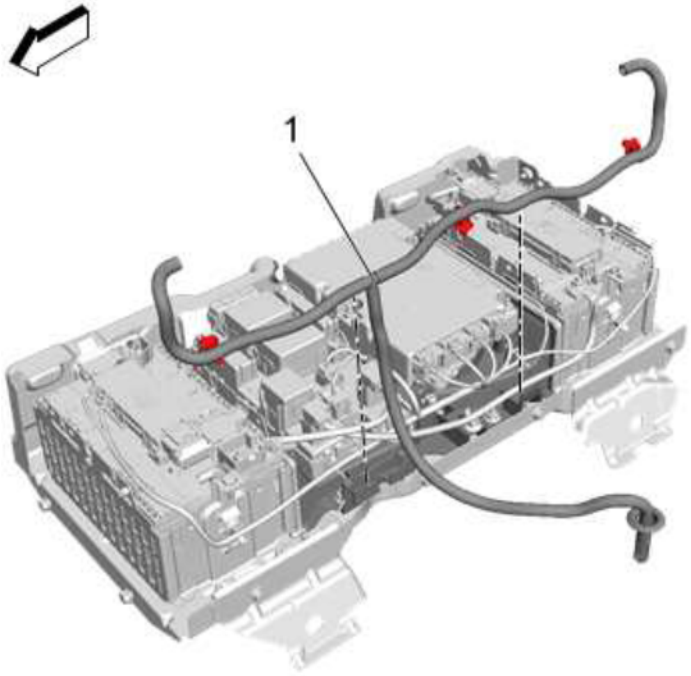


Fig. 70: Cell Battery Vent Tube
Courtesy of GENERAL MOTORS COMPANY

7. Cell Battery Vent Tube 1 Install **Cell Battery Vent Tube Replacement**

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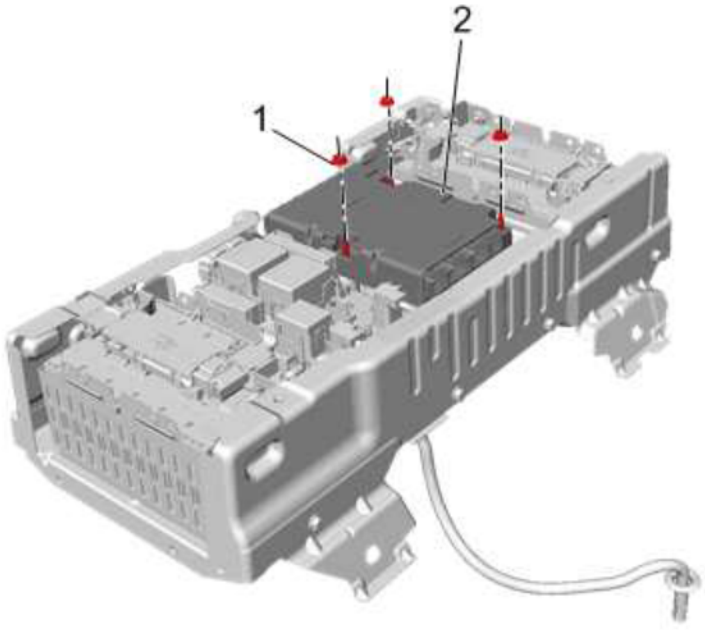


Fig. 71: Hybrid Powertrain Control Module 2
Courtesy of GENERAL MOTORS COMPANY

8. Hybrid Powertrain Control Module 2 (2) - Install - **Hybrid Powertrain Control Module 2 Replacement**

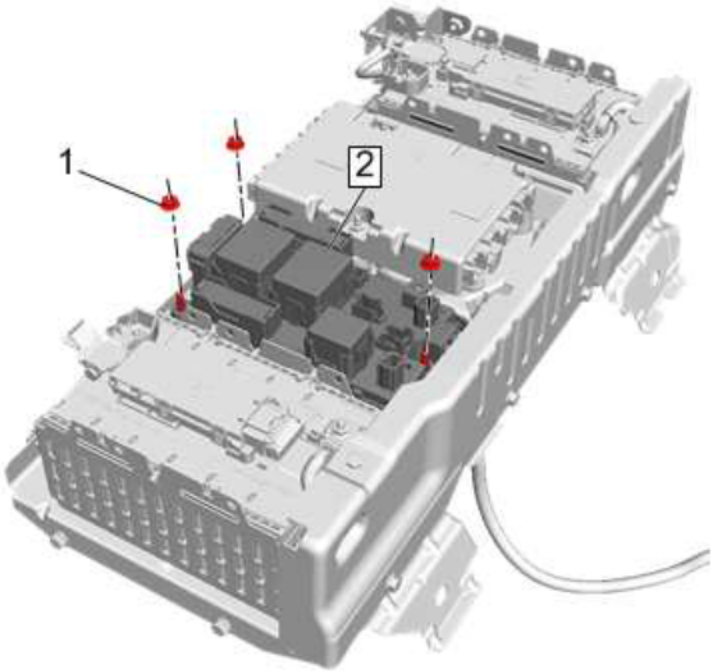


Fig. 72: Generator Battery Disconnect Relay
Courtesy of GENERAL MOTORS COMPANY

9. Generator Battery Disconnect Relay 2 - Install - **Generator Battery Disconnector Relay Replacement**
10. Install the high voltage battery top and side covers, refer to **High Voltage Battery Cover Replacement (Battery Positive and Negative Cable)** **High Voltage Battery Cover Replacement**

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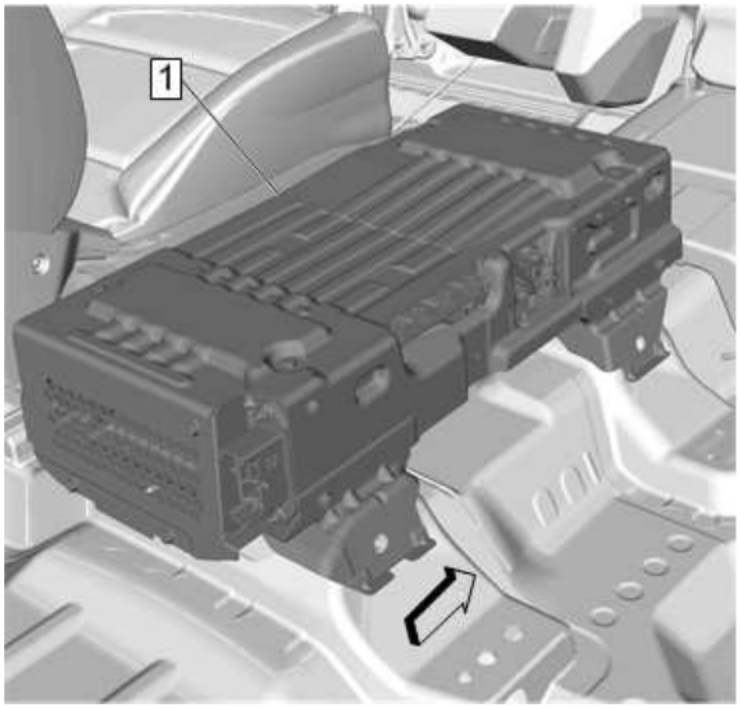


Fig. 73: High Voltage Battery
Courtesy of GENERAL MOTORS COMPANY

11. High Voltage Battery 1 - Install - **High Voltage Battery Replacement and Shipping Preparation (with Center Console)** **High Voltage Battery Replacement and Shipping Preparation (with Front Center Seat)**

DESCRIPTION AND OPERATION

HYBRID/EV COOLING SYSTEM DESCRIPTION AND OPERATION

This vehicle is equipped with three independent cooling systems.

1. The starter/generator cooling system is dedicated to cooling the starter/generator and the starter/generator control module.
2. The high voltage battery assembly cooling system is dedicated to cooling the high voltage battery assembly.
3. The engine cooling system is dedicated to:
   - cooling the engine
   - providing heat to the passenger compartment

Starter/Generator Cooling System Description and Operation

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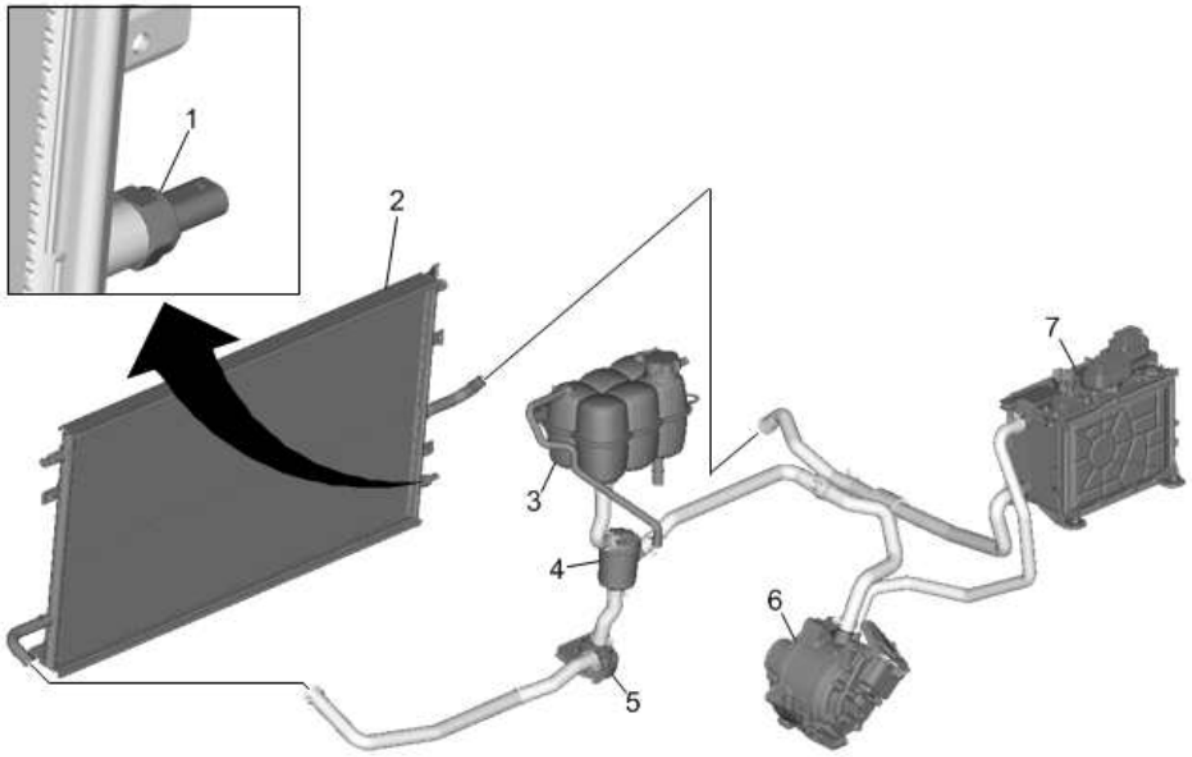


Fig. 74: Starter/Generator Cooling System
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hybrid/EV Electronics Coolant Temperature Sensor
2	Hybrid/EV Electronics Coolant Fan Module Radiator
3	Radiator Surge Tank
4	Hybrid/EV Electronics Coolant/Air Separator
5	Hybrid/EV Electronics Coolant Pump
6	Starter/Generator
7	Starter/Generator Control Module

The starter/generator cooling system uses the engine coolant fan module radiator, hybrid/EV powertrain control module coolant sensor input, two 12 V pulse width modulated (PWM) radiator fans and a hybrid/EV electronics coolant pump to circulate coolant through the system. The hybrid/EV powertrain control module activates the hybrid/EV electronics coolant pump and monitors the hybrid/EV electronics coolant temperature sensor in the engine coolant fan module radiator. The hybrid/EV electronics coolant pump will be enabled whenever the vehicle is on.

The starter/generator cooling system circulates a 50/50 mixture of DEX-COOLÂ® and clean, drinkable water. The starter/generator cooling system and the engine cooling system share the radiator surge tank but are otherwise independently functioning systems.

High Voltage Battery Assembly Cooling System Description and Operation

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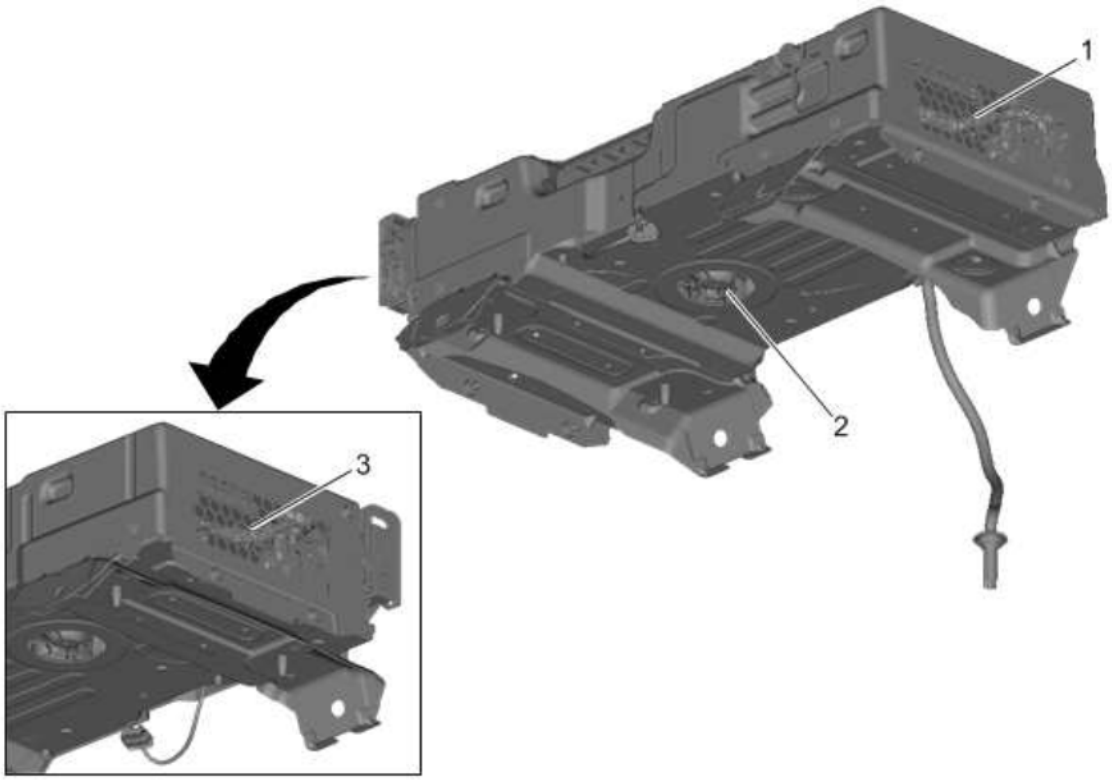


Fig. 75: High Voltage Battery Assembly Cooling System
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Assembly Front Airflow Outlet
2	High Voltage Battery Assembly Internal Cooling Fan Inlet
3	High Voltage Battery Assembly Rear Airflow Outlet

The high voltage battery assembly cooling system uses an internal 12V cooling fan to cool down the high voltage battery assembly. The hybrid/EV powertrain control module 2 monitors the hybrid/EV battery inlet air temperature and the hybrid/EV battery cell temperature. The control module determines how much hybrid/EV battery cooling is required and turns on the high voltage battery assembly cooling fan.

Passenger Compartment Heater System Description and Operation

The passenger compartment heater system uses the engine radiator and a 12 V auxiliary heater coolant pump.

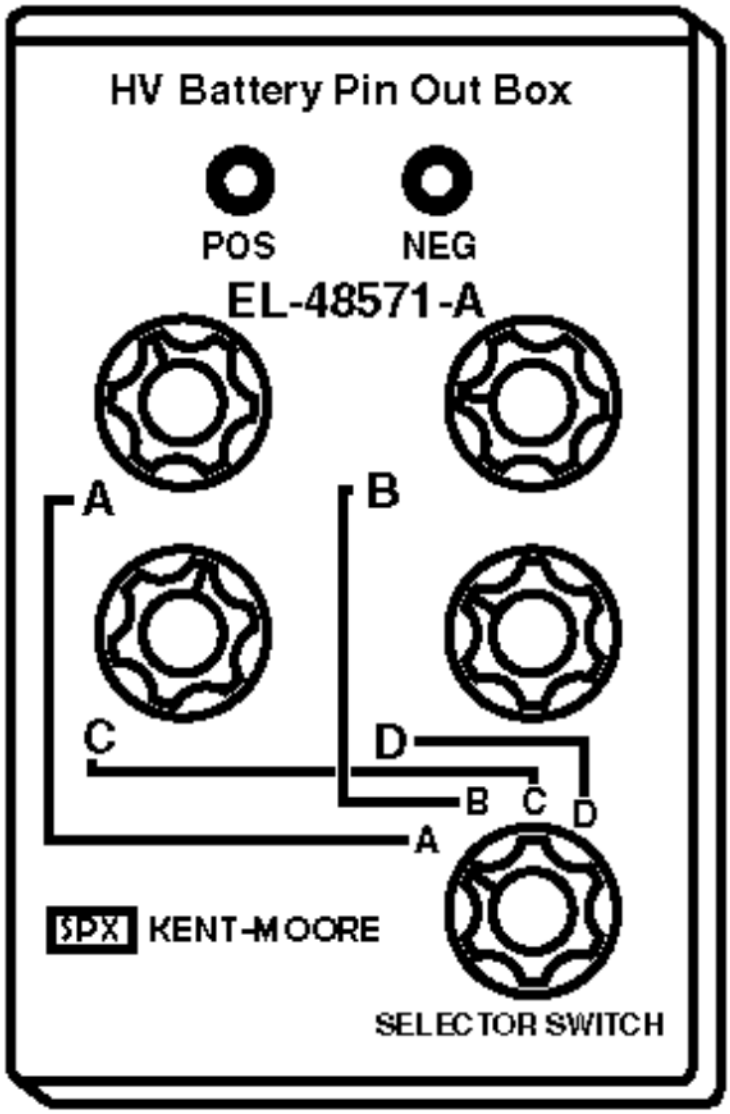
The HVAC control module turns on the auxiliary heater coolant pump when the engine is in Autostop mode. Passenger compartment heat is provided by air flowing through the heater core.

The engine/passenger compartment heater cooling system circulates a 50/50 mixture of DEX-COOLÂ® and clean, drinkable water. The starter/generator cooling system and the engine cooling system share the radiator surge tank but are otherwise independently functioning systems.

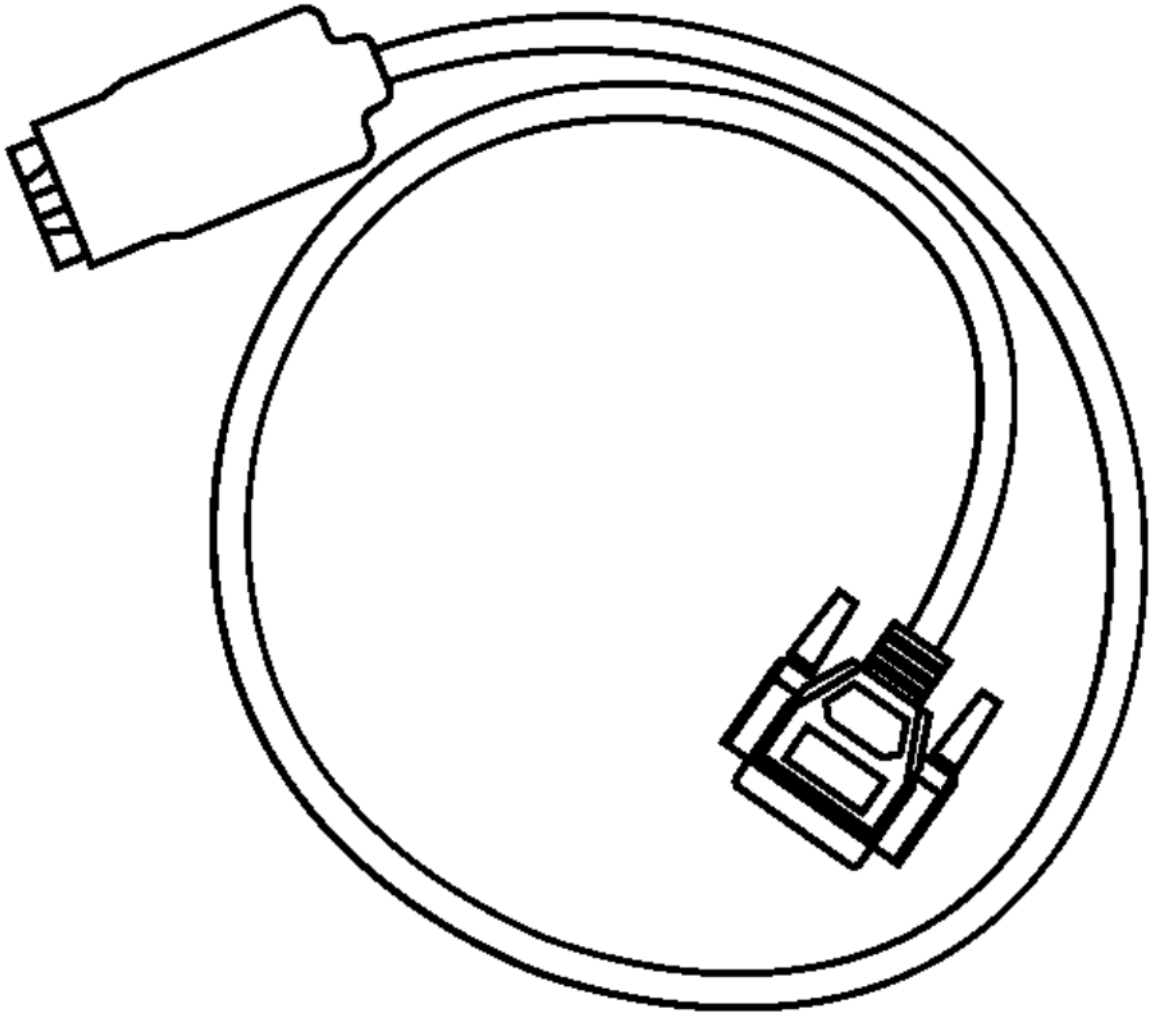
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

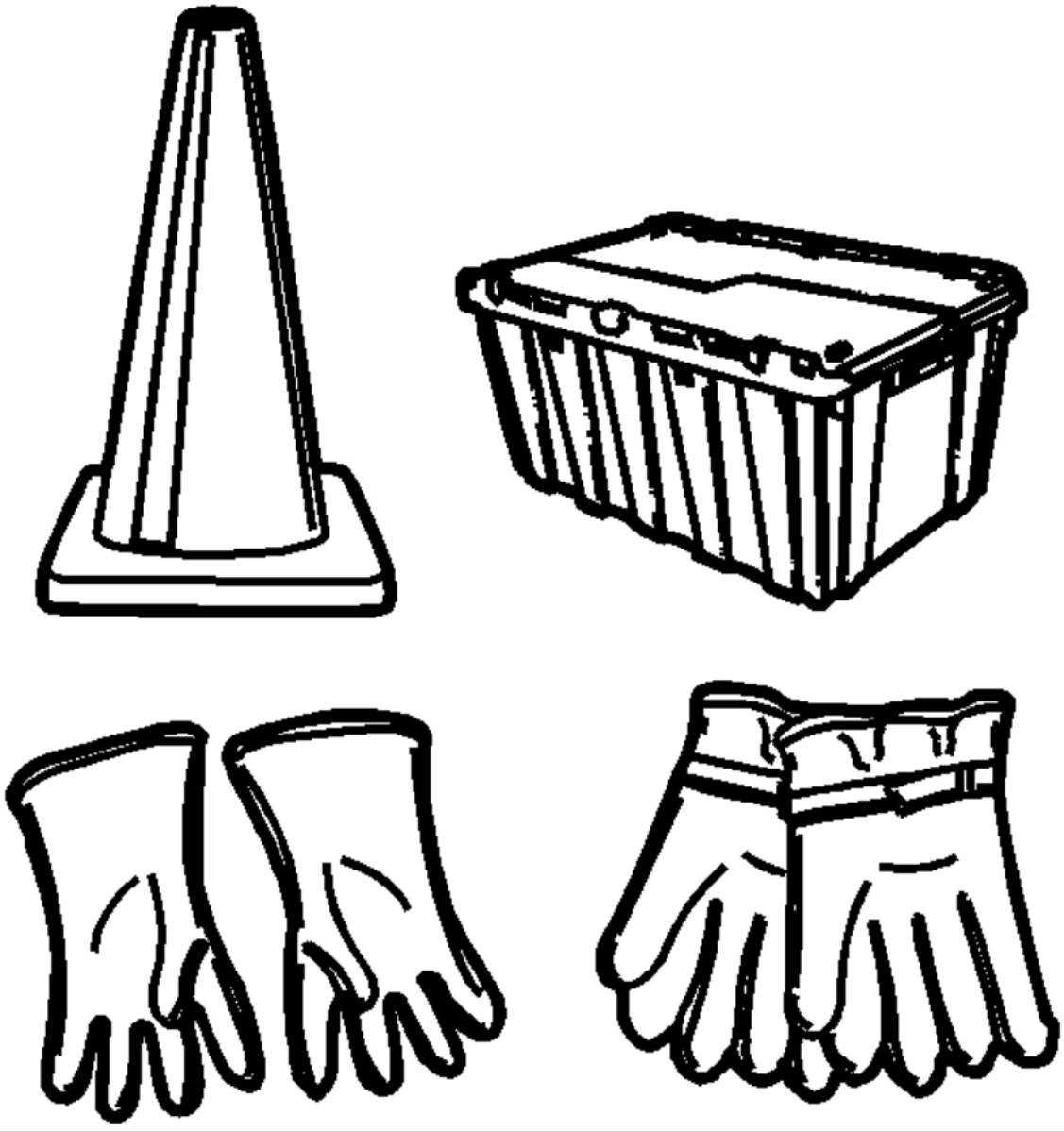
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Illustration	Tool Number/ Description
	EL-48571 High Voltage Battery Pin Out Box

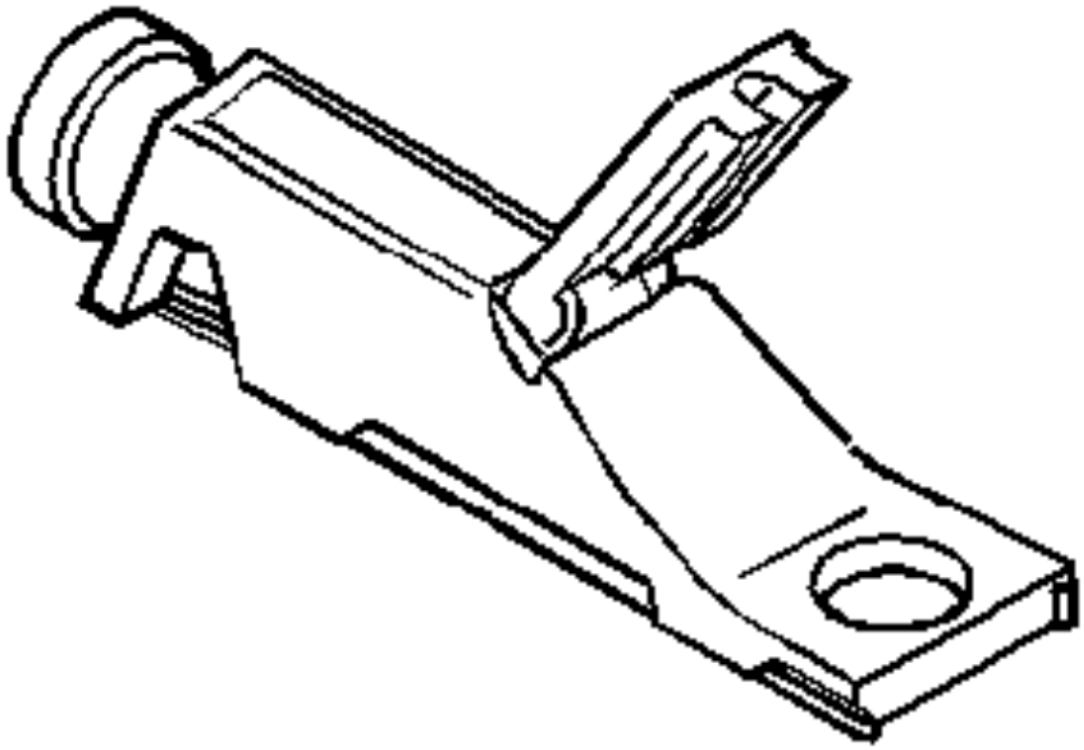
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Illustration	Tool Number/ Description
	EL-48571-45 Battery Pin Out Box Adapter

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Illustration	Tool Number/ Description
	EL-48900 HEV Safety Kit

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Illustration	Tool Number/ Description
	J-26568 Coolant and Battery Fluid Tester

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