

## 2006 Buick Rainier

2006 ENGINE Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

### 2006 ENGINE

Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning Line Bracket Bolt (4.2L)	10 N.m	89 lb in
Battery Cable Channel Bolt (5.3L)	12 N.m	106 lb in
Battery Hold Down Retainer Nut	15 N.m	11 lb ft
Battery Negative Cable	15 N.m	11 lb ft
Battery Positive Cable	15 N.m	11 lb ft
Battery Positive Cable Lead to Starter Nut	9 N.m	80 lb in
Battery Tray Bolt	20 N.m	15 lb ft
Battery Tray Brace Bolt	10 N.m	89 lb in
Engine Harness to Engine Block Bolt (4.2L)	50 N.m	37 lb ft
Engine Harness to Shock Tower Bolt (4.2L)	10 N.m	89 lb in
Engine Harness to Wheelhouse Panel Bolt (4.2L)	10 N.m	89 lb in
Engine Lift Hook Bolt (4.2L)	50 N.m	37 lb ft
Generator Bolt	50 N.m	37 lb ft
Generator Bracket Bolt (5.3L)	50 N.m	37 lb ft
Generator Cable Nut	9 N.m	80 lb in
Ground Cable to Shock Tower Bolt (5.3L)	10 N.m	89 lb in
Ground Terminal to Engine Block Bolt (5.3L)	50 N.m	37 lb ft
Ground Terminal to Front Fender Bolt (5.3L)	10 N.m	89 lb in
Positive Terminal to Underhood Junction Block Bolt	10 N.m	89 lb in
Starter Bolt	50 N.m	37 lb ft
Starter Solenoid Nut	3.4 N.m	30 lb in
Transmission Cover Bolt (5.3L)	9 N.m	80 lb in

### BATTERY USAGE

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## Battery Usage

Base	
Cold Cranking Amperage (CCA)	690 A
Reserve Capacity Rating	90 Minutes
Replacement Battery Number	78-6YR

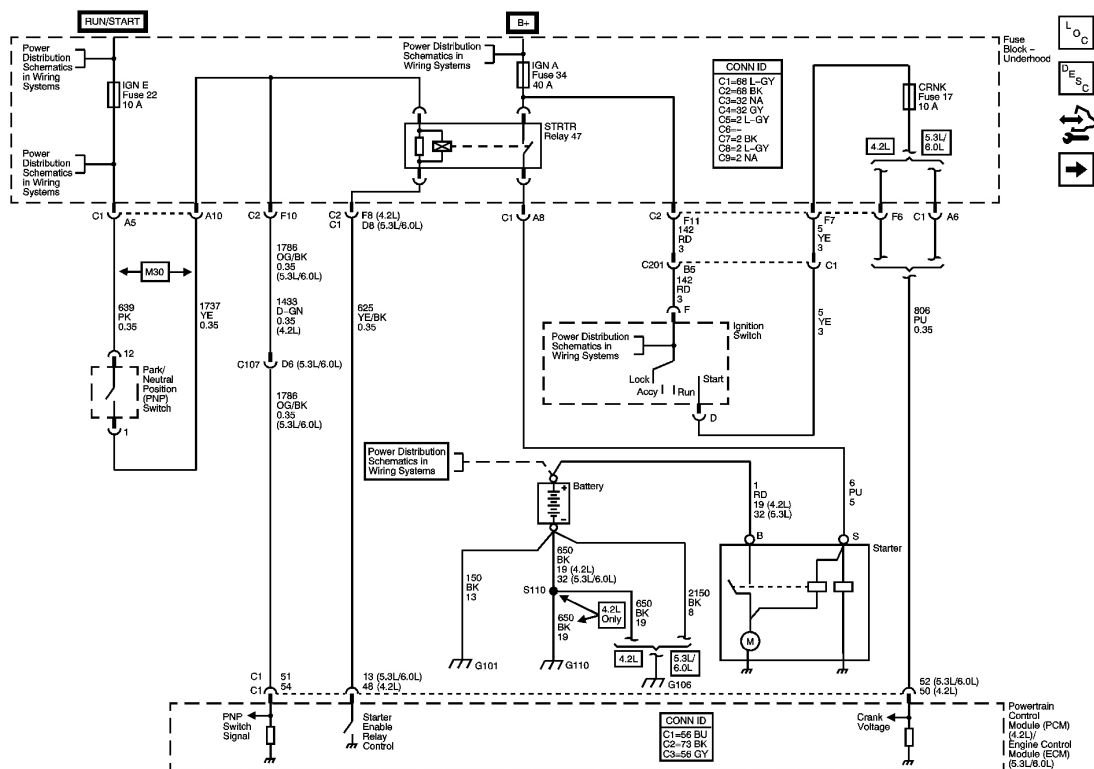
## GENERATOR USAGE

## Generator Usage

<b>Generator Model</b>	<b>AD-244</b>
Rated Output	150 A
Load Test Output	105 A

## SCHEMATIC AND ROUTING DIAGRAMS

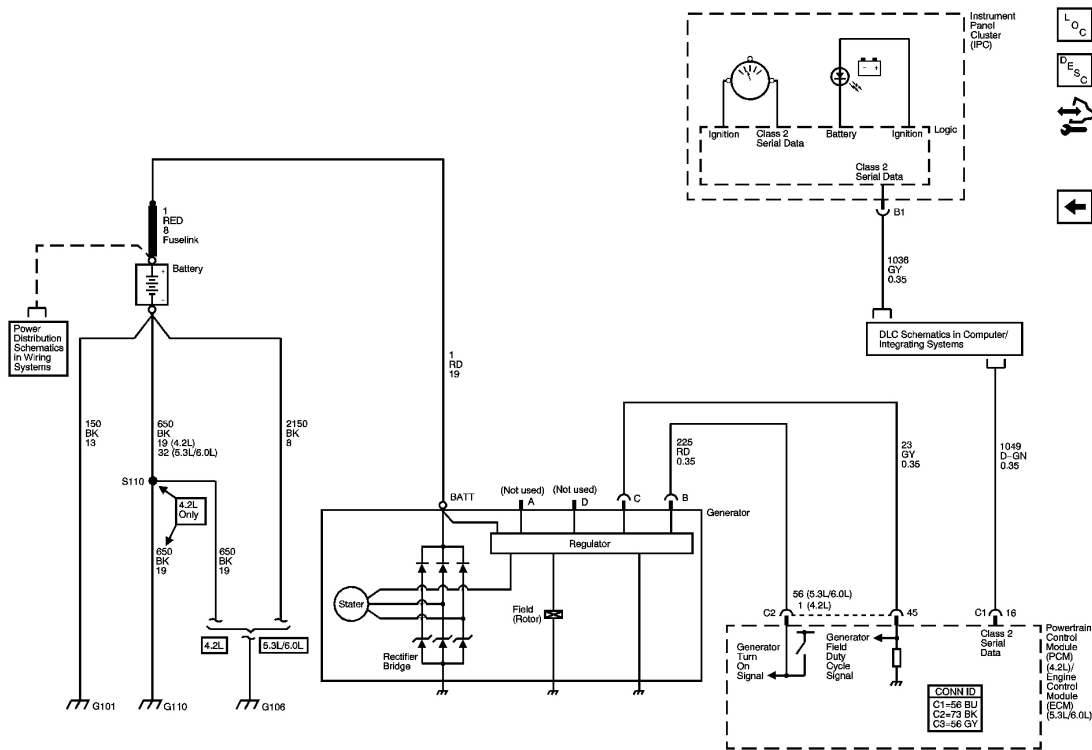
## STARTING AND CHARGING SCHEMATICS



**Fig. 1: Starting System**  
**Courtesy of GENERAL MOTORS CORP.**

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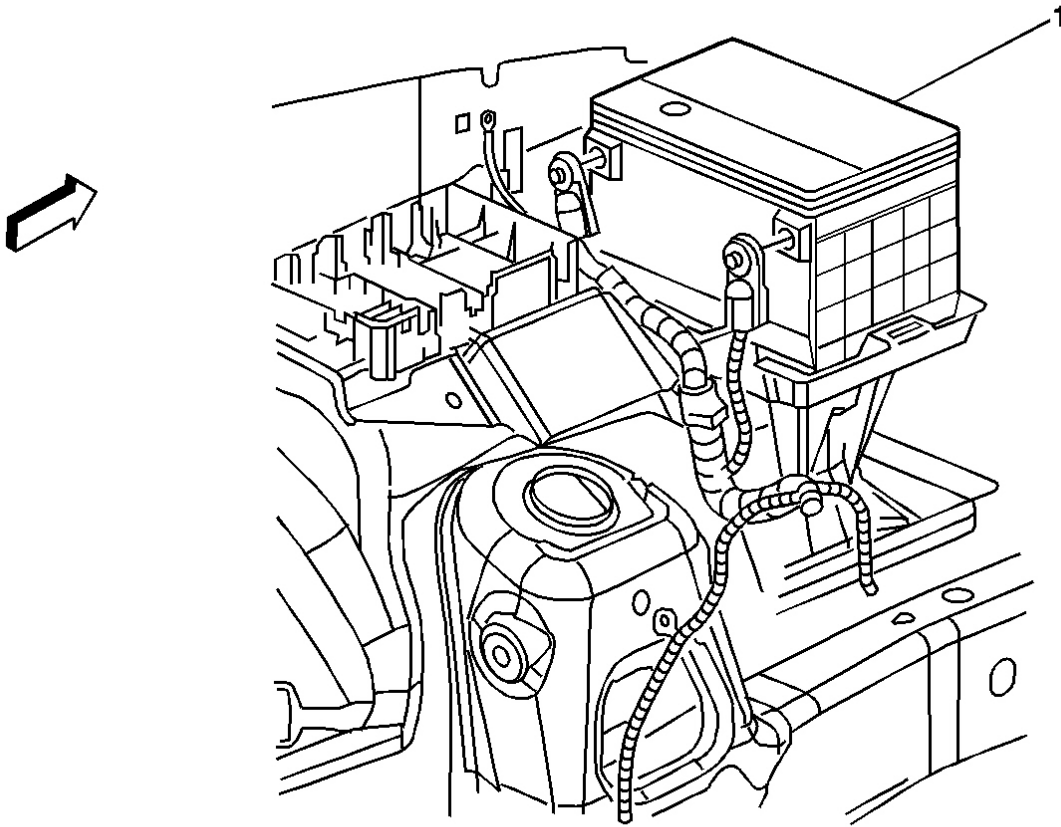
**Fig. 2: Charging System**  
Courtesy of GENERAL MOTORS CORP.

## COMPONENT LOCATOR

## ENGINE ELECTRICAL COMPONENT VIEWS

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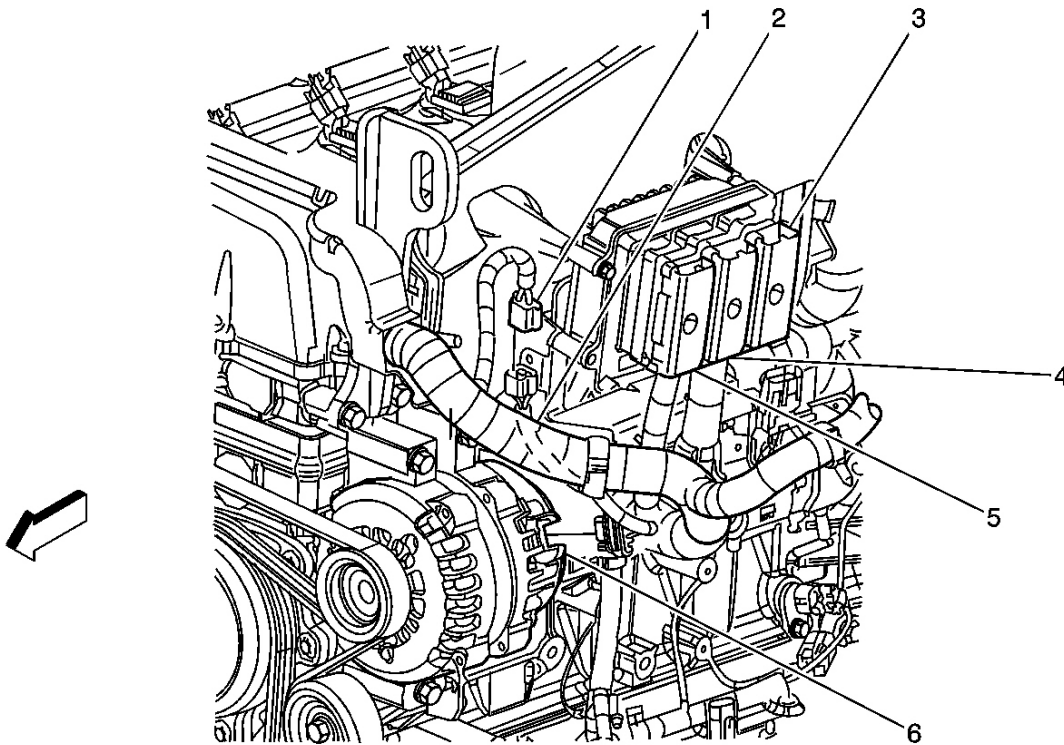
**Fig. 3: View Of Battery - Left Front**  
**Courtesy of GENERAL MOTORS CORP.**

### Callouts For Fig. 3

Callout	Component Name
1	Battery

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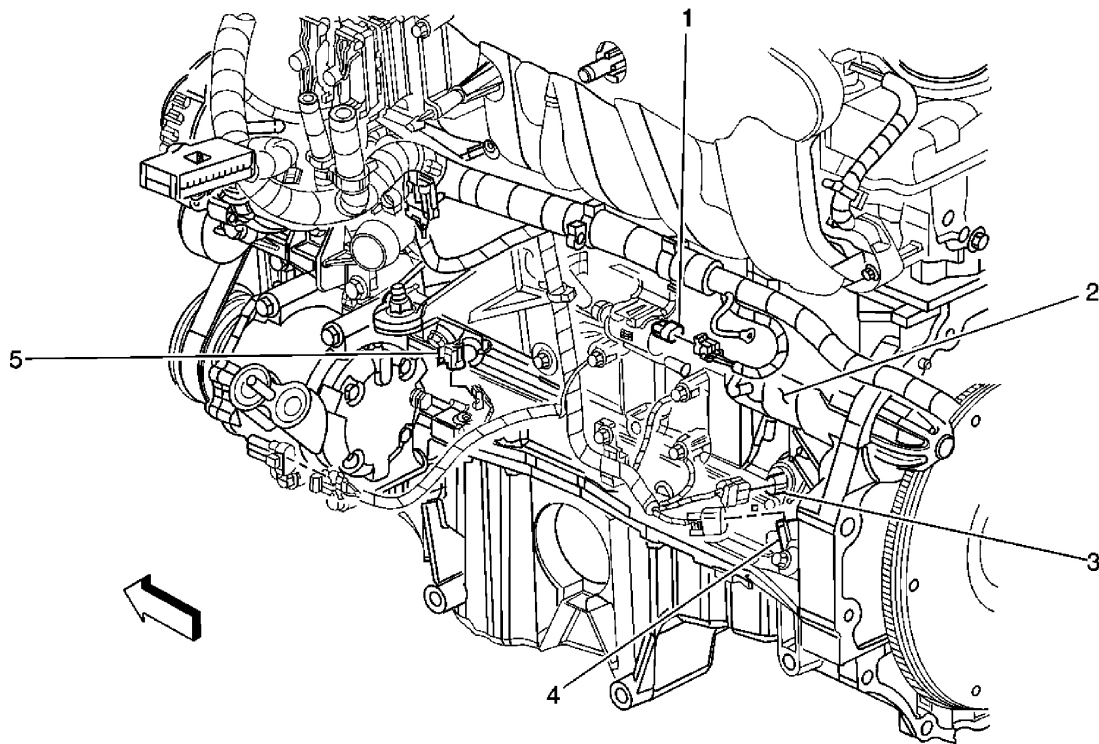
**Fig. 4: View Of Upper Left Side of the Engine - Front**  
Courtesy of GENERAL MOTORS CORP.

### Callouts For Fig. 4

Callout	Component Name
1	Engine Coolant Temperature (ECT) Sensor
2	Engine Harness
3	Powertrain Control Module (PCM) C1
4	Powertrain Control Module (PCM) C2
5	Powertrain Control Module (PCM) C3
6	Generator

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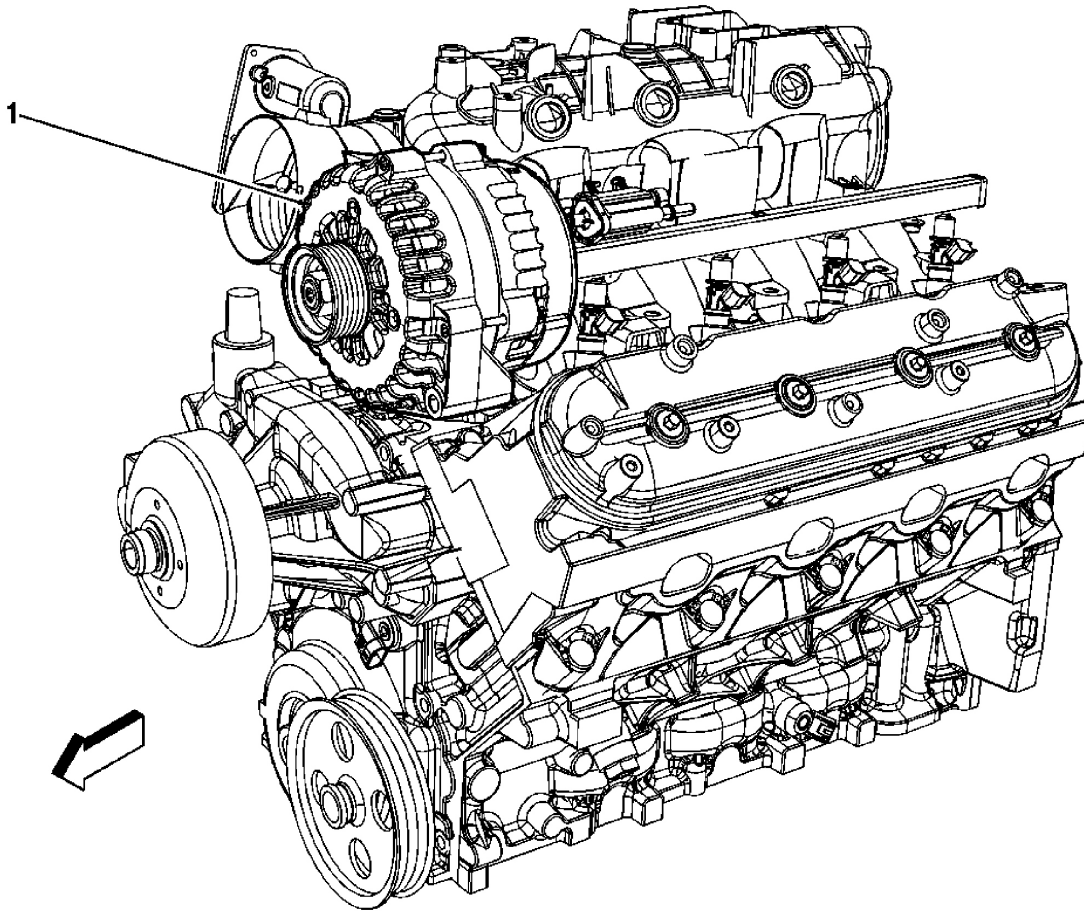
**Fig. 5: View Of Lower Left Side of the Engine**  
**Courtesy of GENERAL MOTORS CORP.**

### Callouts For Fig. 5

Callout	Component Name
1	Evaporative Emission (EVAP) Canister Purge Solenoid
2	Starter
3	Crankshaft Position (CKP) Sensor
4	Knock Sensor (KS) 2, Rear
5	Knock Sensor (KS) 1, Front

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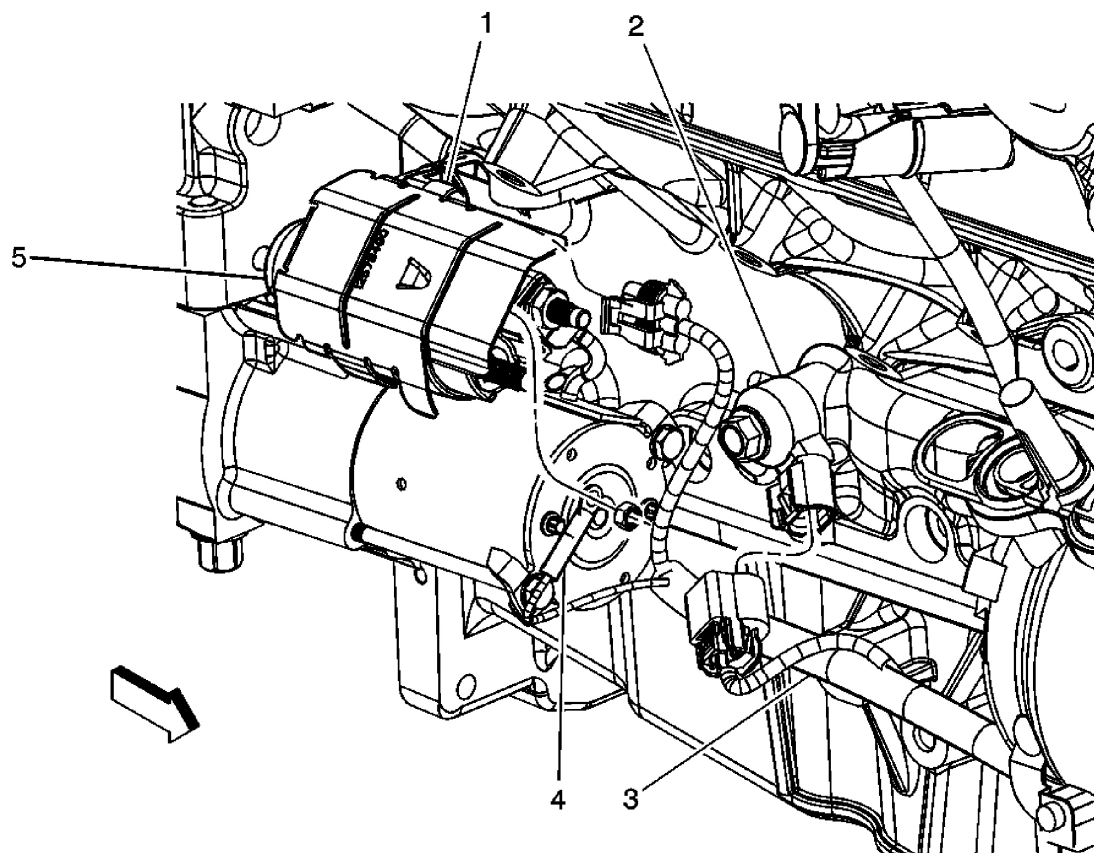
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**Fig. 6: Left Front of Engine (5.3L)**  
**Courtesy of GENERAL MOTORS CORP.**

### **Callouts For Fig. 6**

<b>Callout</b>	<b>Component Name</b>
1	Generator



**Fig. 7: View Of Lower Right Side of the Engine - Rear**  
**Courtesy of GENERAL MOTORS CORP.**

**Callouts For Fig. 7**

Callout	Component Name
1	Crankshaft Position (CKP) Sensor
2	Knock Sensor (KS) 2 - Right
3	Engine Harness
4	Starter
5	Engine

**ENGINE ELECTRICAL CONNECTOR END VIEWS**

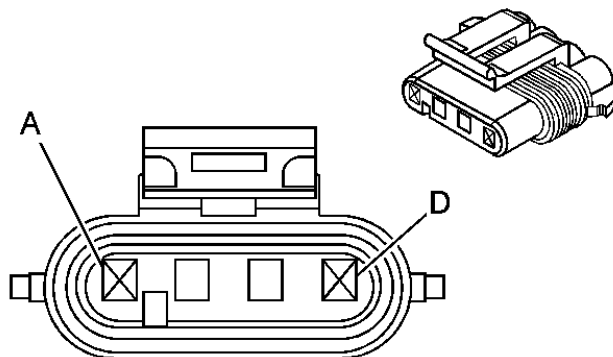
**Generator**





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### Connector Part Information

- 15355066
- 4-Way F Metri-Pack 150 Series Sealed (TN)

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	RD	225	Generator Turn On Signal
C	GY	23	Generator Field Duty Cycle Signal
D	-	-	Not Used

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC CODE INDEX

### DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC P0562</u>	System Voltage Low
<u>DTC P0563</u>	System Voltage High
<u>DTC P0621</u>	Generator L-Terminal Circuit
<u>DTC P0622</u>	Generator F-Terminal Circuit
<u>DTC P1633</u>	Ignition 0 Switch Circuit
<u>DTC P1634</u>	Ignition 1 Switch Circuit
<u>DTC P1637</u>	Generator L-Terminal Circuit

### DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

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- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored DTCs and their status.

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

### SCAN TOOL OUTPUT CONTROLS

#### Powertrain Control Module

Scan Tool Output Control	Additional Menu Selection(s)	Description
GEN L Terminal	-	The PCM commands the generator Off when you select Off. The Generator will stop generating an output voltage.

### SCAN TOOL DATA LIST

#### Powertrain Control Module (PCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
<b>Ignition ON/Engine OFF</b>			
Generator L Terminal Signal	Engine 2	OK/No Output	OK
Generator F Terminal Signal	Engine 2	%	10 - 90%
Ignition 1 Signal	Engine 1,2,3	volts	9.6 - 14.4v

### SCAN TOOL DATA DEFINITIONS

#### Generator L Terminal Signal

The scan tool displays OK/No Output. The scan tool displays OK until malfunction is detected on the generator L terminal circuit, then it reads No Output.

#### Generator F Terminal Signal

The scan tool displays 0-100 percent. The scan tool displays 0-5 percent until the engine is running, then the percentage value varies depending on electrical loads.

#### Ignition 1 Signal

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The scan tool displays system voltage received by the module.

### DTC P0562

#### Circuit Description

The powertrain control module (PCM) monitors the system voltage to make sure that the voltage stays within the proper range. If the PCM detects an excessively low system voltage, DTC P0562 will set.

When the charging system detects a fault, the instrument panel cluster (IPC) displays a message or the charge indicator will light.

#### DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0562 System Voltage Low

#### Conditions for Running the DTC

- Engine run time more than 20 seconds and above 1,200 RPM.
- Vehicle speed above 8 km/h (5 mph).

#### Conditions for Setting the DTC

The PCM detects an improper voltage below 11 volts for 5 seconds.

#### Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The PCM will store conditions which were present when the DTC set as Failure Records data only.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The IPC displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

#### Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.

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- A history DTC will clear after 40 malfunction-free ignition cycles.
- The PCM receives the clear code command from the scan tool.

### DTC P0562

Step	Action	Value(s)	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b>				
<b>Connector End View Reference: <u>Engine Electrical Connector End Views</u></b>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	With the scan tool monitor the Ignition 1 signal voltage in the powertrain control module (PCM) data list. Does the scan tool display Ignition 1 voltage greater than the specified value?	11 V	Go to <b>Step 4</b>	Go to <b>Step 3</b>
3	Test the ignition feed circuit to the PCM for high resistance or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 7</b>	Go to <b>Step 5</b>
4	1. Inspect for poor connections at the PCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems. 2. If you find a poor connection, repair the condition as necessary. Refer to <b><u>Wiring Repairs</u></b> in Wiring Systems.  Did you find and correct the condition?	-	Go to <b>Step 7</b>	Go to <b>Step 6</b>
5	Repair the ignition feed circuit to the PCM for an open or a short to ground. Refer to <b><u>Wiring Repairs</u></b> in Wiring Systems. Is the action complete?	-	Go to <b>Step 7</b>	-
	Replace the PCM. Refer to <b><u>Control</u></b>			

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6	<b>Module References</b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to <b>Step 7</b>	-
7	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool.  2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text, if applicable.  Does the DTC reset?	-	Go to <b>Step 2</b>	System OK

### DTC P0563

#### Circuit Description

The powertrain control module (PCM) continuously monitors that the system voltage stays within the proper range. If the PCM detects an excessively high system voltage, DTC P0563 will set. A high voltage condition may cause a stalling condition or other driveability concerns.

#### DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0563 System Voltage High

#### Conditions for Running the DTC

- The engine run time is more than 20 seconds.
- Engine running above 1,200 RPM.
- Vehicle speed above 8 km/h (5 mph).

#### Conditions for Setting the DTC

- The PCM senses the system voltage is above 19 volts.
- All of the conditions are present for 5 seconds.

#### Action Taken When the DTC Sets

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- The PCM stores DTC P0563 in the PCM memory when the diagnostic runs and fails.
- The PCM will record the operating conditions at the time the diagnostic fails. The PCM stores this information in Failure Records.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The instrument panel cluster (IPC) displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

### Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.
- The PCM receives the clear code command from the scan tool.

### DTC P0563

Step	Action	Value(s)	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b>				
<b>Connector End View Reference: <u>Engine Electrical Connector End Views</u></b>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	1. Turn OFF all the accessories. 2. Measure the battery voltage at the battery using the DMM. 3. Operate the engine speed above 2,000 RPM.  Is the battery voltage less than the specified value?	19 V	Go to <b>Step 4</b>	Go to <b>Step 3</b>
3	Replace the generator. Refer to <b><u>Generator Replacement (4.2L Engine)</u></b> or <b><u>Generator Replacement (5.3L and 6.0L</u></b>	-		

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	<b>Engines).</b> Is the action complete?		Go to <b>Step 5</b>	-
4	Replace the powertrain control module (PCM). Refer to <b>Control Module References</b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to <b>Step 5</b>	-
5	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text, if applicable.  Does the DTC reset?	-	Go to <b>Step 2</b>	System OK

### DTC P0621

#### Circuit Description

The powertrain control module (PCM) uses the generator turn on signal circuit to control the load of the generator on the engine. A high side driver in the PCM applies a voltage to the voltage regulator. This signals the voltage regulator to turn the field circuit ON and OFF. When the PCM turns ON the high side driver, the voltage regulator turns ON the field circuit. When the PCM turns OFF the high side driver, the voltage regulator turns OFF the field circuit.

The PCM monitors the state of the generator turn on signal circuit. The PCM should detect a low generator turn on signal circuit voltage when the key is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the PCM should detect a high generator turn on signal circuit. The PCM performs key ON and RUN tests to determine the status of the generator turn on signal circuit. During the key ON test, if the PCM detects a high generator turn on signal circuit voltage, DTC P0621 will set. DTC P0621 will also set, if during the RUN test, the PCM detects a low generator turn on signal circuit. When the DTC sets, the PCM will send a class 2 serial data message to the instrument panel cluster (IPC) to illuminate the charge indicator.

#### DTC Descriptor

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This diagnostic procedure supports the following DTC:

### DTC P0621 Generator L-Terminal Circuit

#### Conditions for Running the DTC

- The ignition is ON.
- The engine speed is more than 1,000 RPM.

#### Conditions for Setting the DTC

- The PCM detects the GEN L-Terminal active with the ignition ON.
- The PCM detects the GEN L-Terminal inactive with the engine operating.
- The above conditions are present for 6 seconds.

#### Action Taken When the DTC Sets

- The PCM will record the operating conditions present when the DTC set as Failure Records data only.
- The IPC displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

#### Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.
- The PCM receives the clear code command from the scan tool.

### DTC P0621

Step	Action	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b> <b>Connector End View Reference: <u>Engine Electrical Connector End Views</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
	1. Install a scan tool. 2. Start the engine.		



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2	<p>3. With a scant tool, monitor the DTC information for DTC P0621 in Engine Controls.</p> <p>Does the scan tool indicate that DTC P0621 has passed?</p>	<p>Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems</p>	Go to <b>Step 3</b>
3	<p>Test the generator turn on signal circuit for a short or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	<p>Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	<p>Replace the PCM. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Did you complete the replacement?</p>	Go to <b>Step 6</b>	-
6	<ol style="list-style-type: none"> <li>1. Review and record the scan tool Fail Records data.</li> <li>2. Clear any DTCs.</li> <li>3. Operate the vehicle within the Fail Records conditions, as noted.</li> <li>4. Using a scan tool, monitor the Specific DTC info for this DTC.</li> </ol> <p>Does the scan tool indicate that this DTC failed this ignition?</p>	Go to <b>Step 2</b>	System OK

### DTC P0622

#### Circuit Description

The powertrain control module (PCM) uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to the high side of the field winding in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field winding ON and OFF. The PCM uses the PWM signal input to determine the generator load on the engine. This allows the PCM to adjust the idle

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speed to compensate for high electrical loads.

The PCM monitors the state of the generator field duty cycle signal circuit. When the key is in the RUN position, and the engine is OFF, the PCM should detect a duty cycle near 0 percent. However, when the engine is running, the duty cycle should be between 5-100 percent. The PCM monitors the PWM signal using a key ON test and a RUN test. During the tests, if the PCM detects an out of range PWM signal, DTC P0622 will set. When the DTC sets, the PCM will send a class 2 serial data message to the instrument panel cluster (IPC) to illuminate the charge indicator.

### DTC Descriptor

This diagnostic procedure supports the following DTC:

### DTC P0622 Generator F-Terminal Circuit

#### Conditions for Running the DTC

#### Key ON Test

- No generator, crankshaft position (CKP) sensors, or camshaft position (CMP) sensor DTCs are set.
- The key is in the RUN position.
- The engine is not running.

#### Run Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The engine is less than 3,000 RPM.

#### Conditions for Setting the DTC

- During the ignition ON test, the PCM detects a PWM signal is out of range.
- During the RUN test, the PCM detects a PWM signal less than 5 percent for more than 6 seconds.

#### Action Taken When the DTC Sets

- The PCM will store the conditions present when the DTC set as Fail Records data only.
- The malfunction indicator lamp (MIL) will not illuminate.

#### Conditions for Clearing the DTC

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- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.
- The PCM receives the clear code command from the scan tool.

### DTC P0622

Step	Action	Value(s)	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b> <b>Connector End View Reference: <u>Engine Electrical Connector End Views</u></b>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the GEN - F Terminal parameter in the powertrain control module (PCM) data list.  Does the scan tool indicate that the GEN - F Terminal parameter is within the specified range?	5-95%	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	With the scan tool command the generator OFF. Does the GEN - F Terminal equal the specified value?	0%	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 4</b>
	1. Turn OFF the ignition. 2. Disconnect the generator connector. 3. Connect test lamp to battery positive voltage.			

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4	<p>4. Turn ON the ignition, with the engine OFF.</p> <p>5. Probe the F-Terminal in the generator connector.</p> <p>6. Observe the GEN - F Terminal Signal parameter in the PCM data list.</p> <p>Is the GEN - F Terminal Signal parameter near the specified value?</p>	100%	Go to <b><u>Charging System Test</u></b>	Go to <b>Step 5</b>
5	<p>Test the generator field duty cycle signal circuit for a short or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	<p>Inspect for poor connections at the harness connector of the PCM. Refer to <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	<p>Replace the PCM. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Did you complete the repair?</p>	-	Go to <b>Step 8</b>	-
8	<p>1. Review and record the scan tool Fail Records data.</p> <p>2. Clear any DTCs.</p> <p>3. Operate the vehicle within the Fail Records conditions as noted.</p> <p>4. Using a scan tool, monitor the Specific DTC info for this DTC.</p> <p>Does the scan tool indicate that this DTC failed this ignition?</p>	-	Go to <b>Step 2</b>	System OK

**DTC P1633**

**Circuit Description**

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The powertrain control module (PCM) receives the following ignition inputs from the ignition switch:

- The ignition 0 signal
- The ignition 1 signal
- The crank signal

The PCM uses a class 2 Ignition mode message and the voltage input from 2 separate systems to test the ignition 0 circuit. If the PCM detects an improper ignition 0 signal, DTC P1633 will set.

### DTC Descriptor

This diagnostic procedure supports the following DTC:

### DTC P1633 Ignition 0 Switch Circuit

#### Conditions for Running the DTC

There is no class 2 serial data circuit condition.

#### Conditions for Setting the DTC

The ignition 1 signal is present, but the ignition 0 signal is not.

#### Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

#### Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

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Step	Action	Yes	No
<b>Schematic Reference: <u>Engine Controls Schematics</u></b> <b>Connector End View Reference: <u>Powertrain Control Module (PCM) Connector End Views</u> or <u>Engine Controls Connector End Views</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	Does the engine run with the ignition OFF?	Go to <b>Step 6</b>	Go to <b>Step 3</b>
3	Are DTCs P0740, P0753, P0785, or P1860 also set?	Go to <b><u>Diagnostic Trouble Code (DTC) List - Vehicle</u></b> in Vehicle DTC Information	Go to <b>Step 4</b>
4	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Connect a test lamp between the ignition 0 voltage circuit and a good ground. 4. Turn ON the ignition, with the engine OFF.  Does the test lamp illuminate?	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	Test the ignition 0 voltage circuit for an open between the splice and the PCM. Refer to <b><u>Testing for Continuity</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 9</b>	-
6	1. Disconnect the PCM. 2. Test both ignition 1 voltage circuits for a short to voltage. Refer to <b><u>Testing for a Short to Voltage</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems.  Did you find and correct the condition?	Go to <b>Step 9</b>	-

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7	Test for an intermittent and for poor connection at the PCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 9</b>	Go to <b>Step 8</b>
8	Replace the PCM. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to <b>Step 9</b>	-
9	<ol style="list-style-type: none"><li>1. Clear the DTCs with a scan tool.</li><li>2. Turn OFF the ignition for 30 seconds.</li><li>3. Start the engine.</li><li>4. 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.</li></ol> Did the DTC fail this ignition?	Go to <b>Step 2</b>	Go to <b>Step 10</b>
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to <b><u>Diagnostic Trouble Code (DTC) List - Vehicle</u></b> in Vehicle DTC Information	System OK

**DTC P1634****Circuit Description**

The powertrain control module (PCM) receives the following ignition inputs from the ignition switch:

- The ignition 0 signal
- The ignition 1 signal
- The crank signal

The PCM uses a class 2 Ignition mode message and the voltage input from 2 separate systems to test the ignition 1 circuit. If the PCM detects an improper ignition 1 signal, DTC P1634 will set.

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### DTC Descriptor

This diagnostic procedure supports the following DTC:

### DTC P1634 Ignition 1 Switch Circuit

#### Conditions for Running the DTC

There is no class 2 serial data circuit condition.

#### Conditions for Setting the DTC

The ignition 1 signal is present, but the ignition 0 signal is not.

#### Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

#### Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

### DTC P1634

Step	Action	Yes	No
<b>Schematic Reference: <u>Engine Controls Schematics</u></b> <b>Connector End View Reference: <u>Powertrain Control Module (PCM) Connector End Views</u> or <u>Engine Controls Connector End Views</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information



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2	Does the engine run with the ignition OFF?	Go to <b>Step 6</b>	Go to <b>Step 3</b>
3	Are DTCs P0740, P0753, P0785, or P1860 also set?	Go to <b><u>Diagnostic Trouble Code (DTC) List - Vehicle</u></b> in Vehicle DTC Information	Go to <b>Step 4</b>
4	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the powertrain control module (PCM).</li> <li>3. Connect a test lamp between the ignition 1 voltage circuit and a good ground.</li> <li>4. Turn ON the ignition, with the engine OFF.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	<p>Test the ignition 1 voltage circuit for an open between the splice and the PCM. Refer to <b><u>Testing for Continuity</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 9</b>	-
6	<ol style="list-style-type: none"> <li>1. Disconnect the PCM.</li> <li>2. Test both ignition 1 voltage circuits for a short to voltage. Refer to <b><u>Testing for a Short to Voltage</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems.</li> </ol> <p>Did you find and correct the condition?</p>	Go to <b>Step 9</b>	-
7	<p>Test for an intermittent and for poor connection at the PCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Circuit Testing</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 9</b>	Go to <b>Step 8</b>
8	<p>Replace the PCM. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Did you complete the replacement?</p>	Go to <b>Step 9</b>	-

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9	<ol style="list-style-type: none"><li>1. Clear the DTCs with a scan tool.</li><li>2. Turn OFF the ignition for 30 seconds.</li><li>3. Start the engine.</li><li>4. 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.</li></ol>		
	Did the DTC fail this ignition?	Go to <b>Step 2</b>	Go to <b>Step 10</b>
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to <b><u>Diagnostic Trouble Code (DTC) List - Vehicle</u></b> in Vehicle DTC Information	System OK

### DTC P1637

#### Circuit Description

The powertrain control module (PCM) uses the generator turn ON signal circuit to control the generator. A high side driver within the PCM allows the PCM to turn the generator ON and OFF. When generator operation is desired, the PCM sends a 10-volt signal to the voltage regulator via the generator turn ON signal circuit. This causes the voltage regulator to begin controlling the generator field circuit. Once the generator is enabled by the PCM, the voltage regulator controls generator output independently of the PCM. Under certain operating conditions, the PCM can turn OFF the generator by turning OFF the 10-volt signal on the generator turn ON signal circuit. The PCM has fault detection circuitry which monitors the state of the generator turn ON signal circuit. If the fault detection circuit senses a voltage other than what is expected, this DTC will set. The voltage regulator also contains fault detection circuitry. If the regulator detects a problem, the regulator will ground the generator turn on signal circuit, pulling the voltage low. This also causes the PCM to set the DTC.

#### DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1637 Generator L-Terminal Circuit

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### Conditions for Running the DTC

- The ignition is ON.
- System voltage is between 9-18 volts.

### Conditions for Setting the DTC

- An improper voltage level has been detected on the generator L-terminal circuit.
- The above conditions are present for at least 30 seconds.

### Action Taken When the DTC Sets

The PCM stores conditions which were present when the DTC set as Failure Records only. This information will not be stored as Freeze Frame Records.

### Conditions for Clearing the MIL/DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives a clear code command from the scan tool.

## DTC P1637

Step	Action	Value	Yes	No
<b>Schematic Reference: Starting and Charging Schematics</b>				
<b>Connector End View Reference: Engine Electrical Connector End Views</b>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, monitor the DTC information for DTC P1637 in Engine Controls.  Does the scan tool indicate that DTC P1637 has passed?	-	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 3</b>

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3	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the generator harness connector.</li> <li>3. Start the engine.</li> <li>4. Measure the voltage between the generator turn on signal circuit and ground.</li> </ol> <p>Does the voltage measure near the specified value?</p>	10 V		Go to <b>Step 5</b>	Go to <b>Step 4</b>
4	<p>Test the generator turn on signal circuit for a short or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-		Go to <b>Step 8</b>	Go to <b>Step 6</b>
5	<p>Inspect for poor connections at the harness connector of the generator. Refer to <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-		Go to <b>Step 8</b>	Go to <b><u>Charging System Test</u></b>
6	<p>Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-		Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	<p>Replace the PCM/engine control module (ECM). Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Is action complete?</p>	-		Go to <b>Step 8</b>	-
8	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text.</li> </ol>	-			

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Does the DTC reset?

Go to **Step 2** | System OK

### SYMPTOMS - ENGINE ELECTRICAL

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

- Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information, before using the Symptom Tables in order to verify that all of the following are true:
  1. There are no DTCs set.
  2. The control module(s) can communicate via the serial data link.
- Review the system operation in order to familiarize yourself with the system functions. Refer to one of the following system operations:
  - **Battery Description and Operation**
  - **Starting System Description and Operation**
  - **Charging System Description and Operation**

#### Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Starting and Charging Systems. Refer to **Checking Aftermarket Accessories** in Wiring Systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

#### Intermittent

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

#### Symptom List

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

- **Battery Inspection/Test (Non-HP2)**
- **Charging System Test**
- **Charge Indicator Always On**
- **Charge Indicator Inoperative**

- **Generator Noise Diagnosis**
- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**
- **Engine Cranks Slowly**

## BATTERY INSPECTION/TEST (NON-HP2)

### Diagnostic Aids

**CAUTION:** Refer to **Battery Disconnect Caution** in Cautions and Notices.

- IMPORTANT:**
- The battery test using the J 42000 Battery Tester requires correct connections to the battery terminals. See **Special Tools**. A failure to obtain the correct connections during the test may result in a failed test on a good battery.
  - Use the Out of Vehicle test for each battery when testing a vehicle with dual batteries.

Follow these instructions in order to avoid an incorrect diagnosis because of connections:

- If testing the vehicle with the battery cables still connected, wiggle the **J 42000** clips on the terminal bolt. See **Special Tools**. This may cut through any coating or through any oxidation that may be present on the bolt.

Even new bolts contain a protective coating that may insulate or cause a resistance in the test circuit.

- If correct connections to the battery terminal bolts in the vehicle are in doubt, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
  3. Install the test adapters on the terminals.
  4. Follow the instructions for testing a removed battery.
- If the tester displays a REPLACE BATTERY or BAD CELL-REPLACE result for a battery tested in the vehicle with the battery cables connected, perform the following steps:
  1. Disconnect the negative battery cable.

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2. Disconnect the positive battery cable.
3. Install the tester adapters.

**IMPORTANT:** Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the second, or Out of Vehicle test.

4. Follow the instructions for testing a removed battery.
5. Replace the battery only if the second test shows a REPLACE BATTERY or BAD CELL-REPLACE result.

Use the test code from the second test for any warranty purposes.

- Use the correct terminal adapters.

Do not use any common bolts or a combination of bolts, of nuts, and of washers as adapters when testing the battery.

Use the test adapters that are provided with the **J 42000** or GM P/N 12303040 terminal adapters. See **Special Tools**. If the adapters that are provided with the **J 42000** require replacement, use GM P/N 12303040. See **Special Tools**. Any other adapter may not contact the correct areas of the battery terminal, causing a resistance that may result in an invalid battery test result.

### Battery Inspection/Test (Non-HP2)

Step	Action	Value(s)	Yes	No
<b>CAUTION:</b> Refer to <b>Battery Disconnect Caution</b> in Cautions and Notices.				
1	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to <b>Step 2</b>	Go to <b>Step 19</b>
	Compare the Cold Cranking Amperage (CCA) and Reserve Capacity (RC) of the battery to the original battery or Original			

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2	Equipment (OE) specification. Refer to <b>Battery Usage</b> . Does the battery meet or exceed the specifications?	-	Go to <b>Step 3</b>	Go to <b>Step 19</b>
3	Does the hydrometer display a yellow dot?	-	Go to <b>Step 4</b>	Go to <b>Step 5</b>
4	Tap the hydrometer lightly on top with the handle of a small screwdriver in order to dislodge any air bubbles inside the battery. Does the hydrometer still display a yellow dot?	-	Go to <b>Step 19</b>	Go to <b>Step 5</b>
5	1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector clockwise with light finger pressure.  Does the negative connector rotate?	-	Go to <b>Step 6</b>	Go to <b>Step 7</b>
6	Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	Disconnect the negative battery cable. Is the cable disconnected?	-	Go to <b>Step 9</b>	-
8	1. Disconnect the negative battery cable. 2. Inspect for the following conditions and repair as needed: <ul style="list-style-type: none"> <li>• The cable bolt is too long or deformed at the end.</li> <li>• There is foreign material present inside the nut in the battery terminal.</li> <li>• Damage to the battery terminal face or cable connector ring.</li> </ul> Is the repair complete?	-	Go to <b>Step 9</b>	-
9	Rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to <b>Step 10</b>	Go to <b>Step 11</b>



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10	Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to <b>Step 12</b>	Go to <b>Step 11</b>
11	Disconnect the positive battery cable. Is the cable disconnected?	-	Go to <b>Step 13</b>	-
12	<ol style="list-style-type: none"> <li>1. Disconnect the positive battery cable.</li> <li>2. Inspect for the following conditions and repair as needed: <ul style="list-style-type: none"> <li>• The cable bolt is too long or deformed at the end.</li> <li>• There is foreign material present inside the nut in the battery terminal.</li> <li>• Damage to the battery terminal face or cable connector ring.</li> </ul> </li> </ol> Is the repair complete?	-	Go to <b>Step 13</b>	-
13	<ol style="list-style-type: none"> <li>1. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors.</li> <li>2. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed.</li> <li>3. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed.</li> </ol> Are the metal connecting parts clean and in good condition?	-	Go to <b>Step 14</b>	-
14	<ol style="list-style-type: none"> <li>1. Connect the positive battery cable to the battery positive terminal.</li> <li>2. Tighten the cable bolt to the specified value.</li> </ol>	15 N.m (11 lb ft)	Go to <b>Step</b>	

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	Is the cable bolt properly tightened?		<b>15</b>	-
15	<ol style="list-style-type: none"> <li>1. Connect the negative battery cable to the battery negative terminal.</li> <li>2. Tighten the cable bolt to the specified value.</li> </ol>	15 N.m (11 lb ft)	Go to <b>Step 16</b>	-
	Is the cable bolt properly tightened?		<b>16</b>	-
16	<p><b>IMPORTANT:</b> Ensure that all of the electrical loads are turned OFF.</p> <ol style="list-style-type: none"> <li>1. Install the <b>J 42000</b> Battery Tester. See <b>Special Tools</b>.</li> <li>2. Follow the directions supplied with the tester.</li> <li>3. Follow any direction displayed on the tester.</li> </ol>	-	Go to <b>Step 17</b>	Go to <b>Step 18</b>
	Did the tester pass the battery?		<b>17</b>	<b>18</b>
17	<ol style="list-style-type: none"> <li>1. Press the CODE button on the <b>J 42000</b> . See <b>Special Tools</b>.</li> <li>2. For warranty purposes, write the displayed code on the repair order.</li> </ol>	-		
	Did you complete this action?		Battery OK	-
18	<ol style="list-style-type: none"> <li>1. Press the CODE button on the <b>J 42000</b> . See <b>Special Tools</b>.</li> <li>2. For warranty purposes, write the displayed code on the repair order.</li> <li>3. Replace the battery. Refer to <b>Battery Replacement</b>.</li> </ol>	-		
	Did you complete the replacement?		Battery OK	-
19	Replace the battery. Refer to <b>Battery Replacement</b> .	-		
	Did you complete the replacement?		Battery OK	-

## BATTERY CHARGING

### Tools Required

**J 42000** Battery Tester. See Special Tools.

- For best results, use an automatic taper-rate battery charger with a voltage capability of 16 volts.
- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the **J 42000** before charging. See Special Tools.

### Battery State of Charge

**IMPORTANT:** Using voltage to determine the batteries state of charge (SOC) is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery SOC will only be an estimate.

The maintenance-free batteries SOC is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the batteries SOC:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
  - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
  - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

**IMPORTANT:** The table is accurate to 10 percent only after the battery has been at rest for 12 hours.

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4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the SOC according to the estimated battery temperature:

### Battery Charging

Battery Voltage	% Charge at 0°C (32°F)	% Charge at 25°C (75°F)
12.75 V	100%	100%
12.7 V	100%	90%
12.6 V	90%	75%
12.45 V	75%	65%
12.2 V	65%	45%
12.0 V	40%	20%

Use the SOC information as follows:

- A battery with a SOC that is below 65 percent must always be recharged before returning it to service or continuing storage.
- A battery with a SOC that is 65 percent or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90 percent, before returning it to service or continuing storage.

### Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity-The higher the charger amperage, the less time it will take to charge the battery.
- The SOC of the battery-A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 volts, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery-The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

**Charging Procedure**

**NOTE:** Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the PCM or other electronic components.

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

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

**Tighten:** Tighten the battery side terminal adapters to 15 N.m (11 lb ft).

Use the following procedure to charge the battery:

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.
3. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

**NOTE:** Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

4. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
5. Turn ON the charger and set to the highest setting for normal charging.
6. Inspect the battery every half hour after starting the battery charger.
  - Charge the battery until the taper-rate charger indicates that the battery is fully charged.
  - Estimate the battery temperature by feeling the side of the battery. If it feels hot to the touch or its temperature is over 45°C (125°F), discontinue charging and allow the battery to cool before resuming charging.
7. After charging, test the battery. Refer to Battery Inspection/Test (Non-HP2).

**BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST****Tools Required**

**J 38758** Parasitic Draw Test Switch. See **Special Tools**.

**Diagnostic Aids**

- Be sure to rule out any possible obvious influences, such as customer error or aftermarket equipment.
- Customer driving habits, such as regular short trips-This does not allow enough time to properly charge the battery. Refer to **Battery Description and Operation**.
- Verify that the battery and charging system are in proper working order. Refer to **Battery Charging** and **Charging System Test**.
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar®, and regulated voltage control (RVC), if equipped, are designed to wake-up, perform a task, and go back asleep at regular intervals. Refer to **Body Control System Description and Operation** in Computer/Integrating Systems for the system or modules description and operation.
- Remote keyless entry (RKE) will wake up due to an outside input. Refer to **Keyless Entry System Description and Operation** in Keyless Entry.

**IMPORTANT:** The battery specification listed below is a generic specification. Refer to **Battery Usage** when testing the battery.

- The battery run down time will vary depending on cold cranking amperage (CCA) and reserve capacity (RC). If the CCA and RC are higher, then the battery run down time would be longer. If the CCA and RC are lower, then the battery run down time would be shorter. The graph below indicates roughly how many days a 690 CCA battery with at 110 min. RC (60.5 AH) starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery rating and temperature will affect the results.

**Battery Electrical Drain/Parasitic Load Test**

Current Drain	Days
25 mA	30.5

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50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

**CAUTION:** Refer to Battery Disconnect Caution in Cautions and Notices.

**NOTE:** Do not turn the parasitic draw test switch to the OFF position with the engine running. Damage will occur to the vehicle's electrical system.

**NOTE:** The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.

**IMPORTANT:** The switch knob (1) on the J 38758 is marked ON and OFF. See Special Tools. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Disconnect the battery negative cable from the battery negative terminal.
2. Install the male end of the **J 38758** to the battery ground terminal. See Special Tools.
3. Turn the **J 38758** knob to the OFF position. See Special Tools.
4. Install the battery negative cable to the female end of the **J 38758** . See Special Tools.
5. Connect a 10-amp fused jumper wire to the test switch tool terminals.
6. Turn the **J 38758** knob to the ON position. See Special Tools.
7. Road test the vehicle and activate ALL of the accessories, including the radio and air conditioning. This may take up to 30 minutes.
8. Park the vehicle. Turn the ignition switch to the OFF position and remove the ignition

switch key.

9. Turn the **J 38758** knob to the OFF position. See **Special Tools**. The current now flows through the jumper wire.
10. Wait 1 minute. If the fuse blows, install an inductive ammeter and go to step 20.
11. Remove the fused jumper wire.
12. Set a DMM to the 10A scale.
13. Connect the DMM to the test switch tool terminals.
14. Turn the **J 38758** knob to the OFF position. See **Special Tools**. The current flows now through the DMM.
15. Wait 1 minute. Check and record the current reading.
  1. When there is a current reading on 2A or less, turn the **J 38758** knob to the ON position. See **Special Tools**. The electrical current will now pass through the switch.
  2. Then switch the DMM down to the 2A scale for a more accurate reading when the **J 38758** knob is turned OFF. See **Special Tools**.
16. Turn the **J 38758** knob to the OFF position. See **Special Tools**. Wait 15 minutes for most vehicles.
17. Check and record the current reading.
18. Note the battery reserve capacity, amp hour rating. Refer to **Battery Usage**.
  1. Divide the reserve capacity by 4, amp hour rating by 2.4.
  2. Compare this to the multimeter milliamperere reading taken in the previous step. The parasitic current drain should not exceed this number. Example: If a battery has a reserve capacity of 100 minutes, (60 A/H) the current drain should not exceed 25 mA.
19. If excessive current drain is not found at this time and there are no other apparent causes, complete the following:
20. Using the MIN/MAX function of the DMM, monitor the parasitic drain overnight or during the day. This will determine if something has been activated during that time frame.

**NOTE:**      **The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.**

**IMPORTANT:** **Removing fuses, relays, and connectors to determine the failure area may wake up modules. You must wait for these modules to go to sleep or use the sleep function on the scan**



**tool.**

21. When the vehicle has an unacceptable amount of parasitic current drain, remove each fuse one at a time until the current drain falls to an acceptable level. This will indicate which circuit is causing the drain. Refer to **Power Distribution Schematics** in Wiring Systems to diagnose exactly which part of the suspect circuit is causing the parasitic drain. In some cases a non-fused circuit or component, such as a relay, is the cause of excessive parasitic current drain.
22. Repeat the parasitic current drain test procedure after any repair has been completed to make sure that the parasitic current drain is at an acceptable level.
23. When the cause of the excessive current drain has been located and repaired, remove the **J 38758** . See **Special Tools**.
24. Connect the battery negative cable to the battery negative terminal.

**BATTERY COMMON CAUSES OF FAILURE**

A battery is not designed to last forever. With proper care, however, the battery will provide years of good service. If the battery tests good but still fails to perform well, the following are some of the more common causes:

- A vehicle accessory was left on overnight.
- The driving speeds have been slow with frequent stops with many electrical accessories in use, particularly air conditioning, headlights, wipers, heated rear window, cellular telephone, etc.
- The electrical load has exceeded the generator output, particularly with the addition of aftermarket equipment.
- Existing conditions in the charging system, including the following possibilities:
  - A slipping belt
  - A bad generator
- The battery has not been properly maintained, including a loose battery hold down or missing battery insulator if used.
- There are mechanical conditions in the electrical system, such as a short or a pinched wire, attributing to power failure. Refer to **General Electrical Diagnosis Procedures** in Wiring Systems.

**Electrolyte Freezing**

The freezing point of electrolyte depends on its specific gravity. A fully charged battery will not

freeze until the ambient temperature gets below  $-54^{\circ}\text{C}$  ( $-65^{\circ}\text{F}$ ). However, a battery with a low state of charge may freeze at temperatures as high as  $-7^{\circ}\text{C}$  ( $+20^{\circ}\text{F}$ ). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged. As long as the green eye is visible in the hydrometer, the freezing point of the battery will be somewhere below  $-32^{\circ}\text{C}$  ( $-25^{\circ}\text{F}$ ).

#### **Battery Protection During Vehicle Storage**

Certain devices on the vehicle maintain a small continuous current drain on the battery. A battery that is not used for an extended period of time will discharge. Eventually permanent damage will result. Discharged batteries will also freeze in cold weather. Refer to **Battery Inspection/Test (Non-HP2)**.

In order to maintain a battery state of charge while storing the vehicle for more than 30 days:

**IMPORTANT: If a green dot is not visible in the hydrometer, charge the battery. Refer to Battery Charging.**

1. Ensure that the green dot is visible in the built-in hydrometer.

**CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.**

2. Disconnect the battery ground to protect the battery from discharge by parasitic current drains.

When the battery cannot be disconnected:

1. Maintain a high state of charge.
2. Establish a regular schedule for recharging the battery every 20-45 days.

A battery that has remained in a discharged state for a long period of time is difficult to recharge or may be permanently damaged.

#### **JUMP STARTING IN CASE OF EMERGENCY (NON HP2)**

**CAUTION: Batteries produce explosive gases. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe**

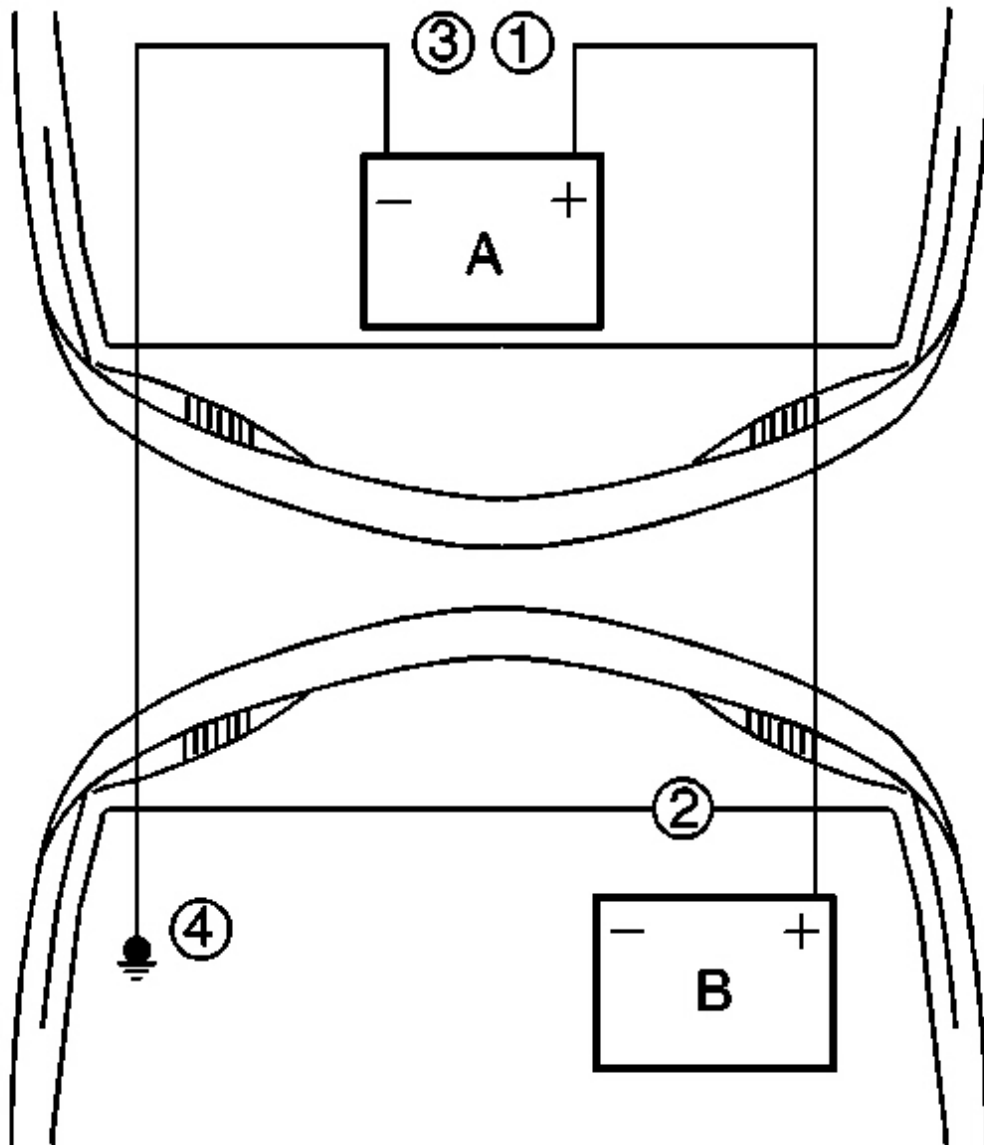
**the following guidelines:**

- **Always shield your eyes.**
- **Avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow battery acid to contact the eyes or the skin.**
  - **Flush any contacted areas with water immediately and thoroughly.**
  - **Get medical help.**

**NOTE:**      **This vehicle has a 12 volt, negative ground electrical system. Make sure the vehicle or equipment being used to jump start the engine is also 12 volt, negative ground. Use of any other type of system will damage the vehicle's electrical components.**

This vehicle has a 12-volt positive, negative ground electrical system. Do not try to jump start a vehicle, if you are unsure of the other vehicle's positive voltage or ground position. The booster battery and the discharged battery should be treated carefully when using jumper cables.

1. Position the vehicle with the booster battery so that the jumper cables will comfortably reach the battery of the other vehicle.
  - Do not let the 2 vehicles touch.
  - Make sure that the jumper cables do not have loose clamps or missing insulation.
2. Perform the following steps on both vehicles:
  1. Place the automatic transmission in PARK.
  2. Block the wheels.
  3. Set the parking brake.
  4. Turn off all electrical loads that are not needed. Leave the hazard flashers ON.
  5. Turn OFF the ignition switch.



**Fig. 8: Identifying Proper Jumper Cable Connection**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Some vehicles have a battery remote positive stud. ALWAYS use the battery remote positive stud in order to give or to receive a jump start. Consult the vehicle's owner's manual

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**for proper connections.**

3. Attach the end of one jumper cable to the positive terminal of the discharged battery.
4. Attach the other end of the first cable to the positive terminal of the booster battery.
5. Attach one end of the remaining jumper cable to the negative terminal of the booster battery.

**NOTE:** Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

6. Make the final connection of the negative jumper cable to the block or suitable bracket connected directly to the block, away from the battery.
7. Start the engine of the vehicle that is providing the jump start and turn off all electrical accessories. Raise the engine RPM to approximately 1,500 RPM.
8. Crank the engine of the vehicle with the weak battery.

If the engine does not crank or cranks too slowly, perform the following steps:

1. Turn the ignition OFF.
2. Allow the booster vehicle engine to run at approximately 1,500 RPM for 5 minutes.
3. Attempt to start the engine of the vehicle with the discharged battery.
9. Reverse the steps exactly when removing the jumper cables. The negative battery cable must first be disconnected from the engine that was jump started.

### CHARGING SYSTEM TEST

#### Charging System Test

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	<b>IMPORTANT:</b> The battery must be above a 70 percent state of charge.	-		

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	Did you perform the Battery Inspection Test?		Go to <b>Step 3</b>	Go to <b>Battery Inspection/Test (Non-HP2)</b>
3	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Start the engine.</li> <li>3. With a scan tool, command the GEN-L Terminal OFF and ON.</li> <li>4. Observe the Ignition 1 Signal parameter.</li> </ol> <p>Does the voltage change with each command?</p>	-	Go to <b>Step 4</b>	Go to <b>Step 8</b>
4	<ol style="list-style-type: none"> <li>1. Turn ON the following accessories: <ul style="list-style-type: none"> <li>• Headlights-high beams</li> <li>• A/C on Max</li> <li>• Blower fan-ON high</li> <li>• Heated seats, if equipped</li> </ul> </li> <li>2. With a scan tool, observe the ignition 1 signal parameter in the engine data list.</li> <li>3. Increase engine speed to 2,500 RPM.</li> </ol> <p>Is the voltage within the specified value?</p>	12-15.5 V	Go to <b>Step 5</b>	Go to <b>Step 6</b>
	<ol style="list-style-type: none"> <li>1. Turn OFF all accessories.</li> <li>2. Turn OFF the ignition.</li> </ol> <p><b>CAUTION:</b> Make sure that the load is completely turned off before connecting or disconnecting a carbon pile load tester to the battery. Otherwise, sparking could ignite battery gasses which are extremely flammable and may explode violently.</p> <ol style="list-style-type: none"> <li>3. Connect a carbon pile tester to the vehicle.</li> </ol>			

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5	<p><b>IMPORTANT:</b> When measuring generator output current, be sure the inductive probe encircles the generator output wire.</p> <ol style="list-style-type: none"> <li>Connect an inductive ammeter probe to the output circuit of the generator.</li> <li>Start the engine.</li> <li>With a scan tool, command the GEN-L Terminal ON.</li> <li>Increase engine speed to 2,500 RPM.</li> <li>Adjust the carbon pile, as necessary, in order to obtain the maximum current output.</li> </ol> <p>Is the generator output greater than or equal to the load test value as specified in <b>Generator Usage</b> ?</p>	-	System OK	Go to <b>Step 7</b>
6	Is the voltage measured greater than 15.5 volts?	-	Go to <b>Step 12</b>	Go to <b>Step 7</b>
7	<ol style="list-style-type: none"> <li>Leave the vehicle accessories ON or maintain load test value.</li> <li>Maintain engine speed at 2,500 RPM.</li> <li>Measure the voltage between the generator output terminal and the generator metal housing.</li> </ol> <p>Is the voltage measured equal to the specified value?</p>	B+	Go to <b>Step 14</b>	Go to <b>Step 9</b>
	<ol style="list-style-type: none"> <li>Turn ON the ignition, with the engine OFF.</li> <li>Disconnect the generator harness connector.</li> <li>Measure the voltage between the</li> </ol>			

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8	<p>generator turn ON signal circuit and ground.</p> <p>4. With a scan tool, command the GEN-L Terminal ON and OFF.</p> <p>Does the voltage measure greater than the first value ON and near the second value OFF?</p>	<p>4.7 V 0 V</p>	Go to <b>Step 14</b>	Go to <b>Step 11</b>
9	<p>1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the battery negative terminal to the metal housing of the generator. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Is the voltage measured less than the specified value?</p>	0.5 V	Go to <b>Step 10</b>	Go to <b>Step 15</b>
10	<p>1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the output terminal of the generator to the positive terminal on the battery. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Is the voltage measured less than the specified value?</p>	0.5 V	Go to <b>Step 14</b>	Go to <b>Step 16</b>
11	<p>Test the generator turn on signal circuit for a short or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 19</b>	Go to <b>Step 13</b>
12	<p>Test the generator battery voltage sense circuit, if equipped, for an open or high resistance. Refer to <b><u>Circuit Testing</u></b> and</p>	-		



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	<b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?		Go to <b>Step 19</b>	Go to <b>Step 14</b>
13	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 19</b>	Go to <b>Step 17</b>
14	Inspect for poor connections at the generator. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 19</b>	Go to <b>Step 18</b>
15	Repair the high resistance or open in the ground circuit of the generator. Refer to <b>Wiring Repairs</b> in Wiring Systems. Did you complete the repair?	-	Go to <b>Step 19</b>	-
16	Repair the high resistance or open in the generator output circuit. Refer to <b>Wiring Repairs</b> in Wiring Systems. Did you complete the repair?	-	Go to <b>Step 19</b>	-
17	Replace the PCM. Refer to <b>Control Module References</b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to <b>Step 19</b>	-
18	Replace the generator. Refer to <b>Generator Replacement (4.2L Engine)</b> or <b>Generator Replacement (5.3L and 6.0L Engines)</b> . Did you complete the replacement?	-	Go to <b>Step 19</b>	-
19	Operate the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to <b>Step 2</b>

**CHARGE INDICATOR ALWAYS ON**

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### Charge Indicator Always On

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	Start the engine. Does the battery charge indicator remain illuminated after the 5-second bulb check?	-	Go to <b>Step 3</b>	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems
3	1. Install a scan tool. 2. With a scan tool, observe the Battery Voltage parameter in the instrument panel cluster (IPC) data list.  Does the voltage measure within the normal operating range?	10-15 V	Go to <b>Step 4</b>	Go to <b><u>Charging System Test</u></b>
4	Replace the IPC. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to <b>Step 5</b>	-
5	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to <b>Step 2</b>

### CHARGE INDICATOR INOPERATIVE

#### Charge Indicator Inoperative

Step	Action	Yes	No
	Did you perform the Diagnostic System Check -		Go to

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1	Vehicle?	Go to <b>Step 2</b>	<b><u>Diagnostic System Check - Vehicle in Vehicle DTC Information</u></b>
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the charge indicator on the instrument panel cluster (IPC).  Is the charge indicator illuminated?	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 3</b>
3	Replace the IPC. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to <b>Step 4</b>	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

## GENERATOR NOISE DIAGNOSIS

### Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise (magnetic whine) usually varies with the electrical load placed on the generator and is a normal operating characteristic of all generators. When diagnosing a noisy generator, it is important to remember that loose or misaligned components around the generator may transmit the noise into the passenger compartment and that replacing the generator may not solve the problem.

### Generator Noise Diagnosis

Step	Action	Yes	No
1	Test the generator for proper operation using the Generator Tester. Refer to <b><u>Charging System Test</u></b> . Is the generator operating properly?	Go to <b>Step 2</b>	Go to <b>Step 11</b>
	1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the 4-way connector from the		

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2	<p>generator.</p> <ol style="list-style-type: none"> <li>Start the engine.</li> <li>Listen for the noise.</li> </ol> <p>Has the noise stopped?</p>	Go to <b>Step 11</b>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>Turn OFF the engine.</li> <li>Remove the drive belt. Refer to <b><u>Drive Belt Replacement</u></b> for the 4.2L engine, <b><u>Drive Belt Replacement - Air Conditioning</u></b> for the 5.3L engine, or <b><u>Drive Belt Replacement - Air Conditioning</u></b> for the 6.0L engine.</li> <li>Spin the generator pulley by hand.</li> </ol> <p>Does the generator shaft spin smoothly and without any roughness or grinding noise?</p>	Go to <b>Step 4</b>	Go to <b>Step 11</b>
4	<p>Inspect the generator for a loose pulley and/or pulley nut.</p> <p>Is the generator pulley or pulley nut loose?</p>	Go to <b>Step 11</b>	Go to <b>Step 5</b>
5	<ol style="list-style-type: none"> <li>Loosen all of the generator mounting bolts.</li> <li>Tighten the generator mounting bolts to specifications and in the proper sequence (if necessary). Refer to <b><u>Generator Replacement (4.2L Engine)</u></b> or <b><u>Generator Replacement (5.3L and 6.0L Engines)</u></b>.</li> <li>Install the drive belt. Refer to <b><u>Drive Belt Replacement</u></b> for the 4.2L engine.</li> <li>Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 6</b>
6	<p>Inspect the generator for the following conditions:</p> <ul style="list-style-type: none"> <li>Strained or stretched electrical connections.</li> <li>Hoses or other vehicle equipment resting on the generator (which may cause the noise to be transmitted into the passenger compartment)</li> </ul>		

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	Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?	Go to <b>Step 7</b>	Go to <b>Step 8</b>
7	<ol style="list-style-type: none"> <li>1. Reroute the electrical connections to relieve the tension.</li> <li>2. Reroute the hoses, etc. away from the generator.</li> <li>3. Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 8</b>
8	<p>Inspect the drive belt for proper tension. Refer to <b><u>Drive Belt Tensioner Diagnosis</u></b> for the 5.3L engine or <b><u>Drive Belt Tensioner Diagnosis</u></b> for the 6.0L engine.</p> <p>Is the drive belt loose?</p>	Go to <b>Step 9</b>	Go to <b>Step 10</b>
9	<ol style="list-style-type: none"> <li>1. Replace the drive belt tensioner. Refer to <b><u>Drive Belt Tensioner Replacement</u></b> for the 4.2L engine, <b><u>Drive Belt Tensioner Replacement - Air Conditioning</u></b> for the 5.3L engine or <b><u>Drive Belt Tensioner Replacement - Air Conditioning</u></b> for the 6.0L engine.</li> <li>2. Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 11</b>
10	<p>Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?</p>	System OK	Go to <b>Step 11</b>
11	<p><b>IMPORTANT:</b></p> <p>If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.</p> <p>Replace the generator. Refer to <b><u>Generator Replacement (4.2L Engine)</u></b> or <b><u>Generator Replacement (5.3L and 6.0L Engines)</u></b>. Has the</p>		

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	noise decreased or stopped?	Go to <b>Step 12</b>	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

### STARTER SOLENOID DOES NOT CLICK

#### Starter Solenoid Does Not Click

Step	Action	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	Turn the ignition switch to the START position. Does the engine crank?	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 3</b>
3	Is the security indicator flashing?	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information	Go to <b>Step 4</b>
4	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Crank parameter in the powertrain control module (PCM) data list. 4. Turn the ignition switch to the START position.  Does the scan tool display Yes?	Go to <b>Step 5</b>	Go to <b>Step 13</b>
	1. Turn ON the ignition, with the engine OFF.		

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5	<ol style="list-style-type: none"> <li>2. With a scan tool, observe the Starter Relay Command parameter in the PCM data list.</li> <li>3. Turn the ignition switch to the START position.</li> </ol> <p>Does the scan tool display Yes?</p>	Go to <b>Step 7</b>	Go to <b>Step 6</b>
6	<ol style="list-style-type: none"> <li>1. Turn ON the ignition, with the engine OFF.</li> <li>2. Verify that the transmission is in Park or Neutral.</li> <li>3. With a scan tool, observe the Current Gear parameter in the PCM data list.</li> </ol> <p>Does the scan tool display Park or Neutral?</p>	Go to <b>Step 7</b>	Go to <b><u>Range Selector Displays Incorrect Range (4.2L) or Range Selector Displays Incorrect Range (5.3L and 6.0L)</u></b> in Automatic Transaxle - 4L60-E
7	<p>Turn the ignition switch to the START position.</p> <p>Do you hear the STARTER relay click?</p>	Go to <b>Step 10</b>	Go to <b>Step 8</b>
8	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the STARTER relay.</li> <li>3. Turn ON the ignition, with the engine OFF.</li> <li>4. Connect a test lamp between the battery positive voltage circuit of the STARTER relay coil and a good ground.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 9</b>	Go to <b>Step 21</b>
9	<ol style="list-style-type: none"> <li>1. Connect a test lamp between the battery positive voltage circuit of the STARTER relay coil and the control circuit of the STARTER relay.</li> <li>2. Turn the ignition to the START position.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 17</b>	Go to <b>Step 15</b>

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10	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the STARTER relay.</li> <li>3. Connect a test lamp between the battery positive voltage circuit of the STARTER relay switch and a good ground.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 11</b>	Go to <b>Step 22</b>
11	<p>Connect a 30-amp fused jumper between the battery positive voltage circuit of the STARTER relay switch and the starter solenoid crank voltage circuit.</p> <p>Does the engine crank?</p>	Go to <b>Step 17</b>	Go to <b>Step 12</b>
12	Does the fuse in the jumper open?	Go to <b>Step 23</b>	Go to <b>Step 14</b>
13	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the PCM harness connector.</li> <li>3. Connect a test lamp between the crank voltage circuit of the PCM and a good ground.</li> <li>4. Turn the ignition to the START position.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 20</b>	Go to <b>Step 16</b>
14	<p>Test the starter solenoid crank voltage circuit for a high resistance or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 18</b>
15	<p>Test the control circuit of the STARTER relay for an open or short to battery voltage. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 20</b>
16	<p>Test the crank voltage circuit of the PCM for a high resistance or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 19</b>
	Inspect for poor connections at the STARTER		



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17	<p>relay. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 24</b>
18	<p>Inspect for poor connections at the starter solenoid. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 25</b>
19	<p>Inspect for poor connections at the ignition switch. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 26</b>
20	<p>Inspect for poor connections at the harness connector of the PCM. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 28</b>	Go to <b>Step 27</b>
21	<p>Repair an open or high resistance in the battery positive voltage circuit of the STARTER relay coil. Refer to <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to <b>Step 28</b>	-
22	<p>Repair the open or high resistance in the battery positive voltage circuit of the STARTER relay switch. Refer to <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to <b>Step 28</b>	-
23	<p>Repair the short to ground in the starter solenoid crank voltage circuit. Refer to <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to <b>Step 28</b>	-
24	<p>Replace the STARTER relay. Refer to <b><u>Relay Replacement (Within an Electrical Center)</u></b> or <b><u>Relay Replacement (Attached to Wire Harness)</u></b> in Wiring Systems.</p>		-

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	Did you complete the replacement?	Go to <b>Step 28</b>	
25	Replace the starter motor. Refer to <b><u>Starter Motor Replacement (4.2L Engine)</u></b> or <b><u>Starter Motor Replacement (5.3L and 6.0L Engines)</u></b> . Did you complete the replacement?	Go to <b>Step 28</b>	-
26	Replace the ignition switch. Refer to <b><u>Ignition Switch Replacement</u></b> in Steering Wheel and Column. Did you complete the replacement?	Go to <b>Step 28</b>	-
27	Replace the PCM. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to <b>Step 28</b>	-
28	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

### STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

#### Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
<b>Schematic Reference: <u>Starting and Charging Schematics</u></b>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to <b>Step 3</b>	Go to <b><u>Starter Solenoid Does Not Click</u></b>
3	Inspect the engine and belt drive system for mechanical binding (seized engine, seized generator). Does the engine move freely?	Go to <b>Step 4</b>	Go to <b><u>Engine Will Not Crank - Crankshaft Will Not Rotate</u></b>
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.		

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	Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 5</b>
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Inspect for poor connections at the starter. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	Replace the starter. Refer to <b><u>Starter Motor Replacement (4.2L Engine)</u></b> or <b><u>Starter Motor Replacement (5.3L and 6.0L Engines)</u></b> . Did you complete the replacement?	Go to <b>Step 8</b>	-
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to <b>Step 2</b>

### ENGINE CRANKS SLOWLY

Perform the following checks:

- Battery - Battery Inspection/Test. Refer to **Battery Inspection/Test (Non-HP2)** in this section.
- Wiring - Inspect the wiring for damage. Inspect all connections to the starter motor, solenoid, battery, and all ground connections. Refer to **Circuit Testing** , **Wiring Repairs** , **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.
- Engine - Make sure the engine is not seized.

If the battery, the wiring and the engine are functioning properly and the engine continues to crank slowly, replace the starter motor. Refer to **Starter Motor Replacement (4.2L Engine)** or **Starter Motor Replacement (5.3L and 6.0L Engines)** in this section.

### STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

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Inspect the flywheel ring gear for damage or unusual wear.

### Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	Start the engine. Does the starter operate normally?	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 3</b>
3	Start the engine while listening to the starter motor turn. Is there a loud whoop, it may sound like a siren if the engine is revved while the starter is engaged after the engine starts, but while the starter is still held in the engaged position?	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	Do you hear a rumble, a growl, or, in some cases, a knock as the starter is coasting down to a stop after starting the engine?	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	This is often diagnosed as a starter drive gear hang-in or a weak solenoid. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to <b>Step 6</b>	Go to <b>Step 7</b>
6	Inspect the flywheel ring gear for the following conditions: <ul style="list-style-type: none"><li>• Chipped gear teeth</li><li>• Missing gear teeth</li><li>• Milled teeth</li></ul> Is the flywheel bent, or does it have damaged teeth?	Go to <b>Step 8</b>	Go to <b>Step 9</b>

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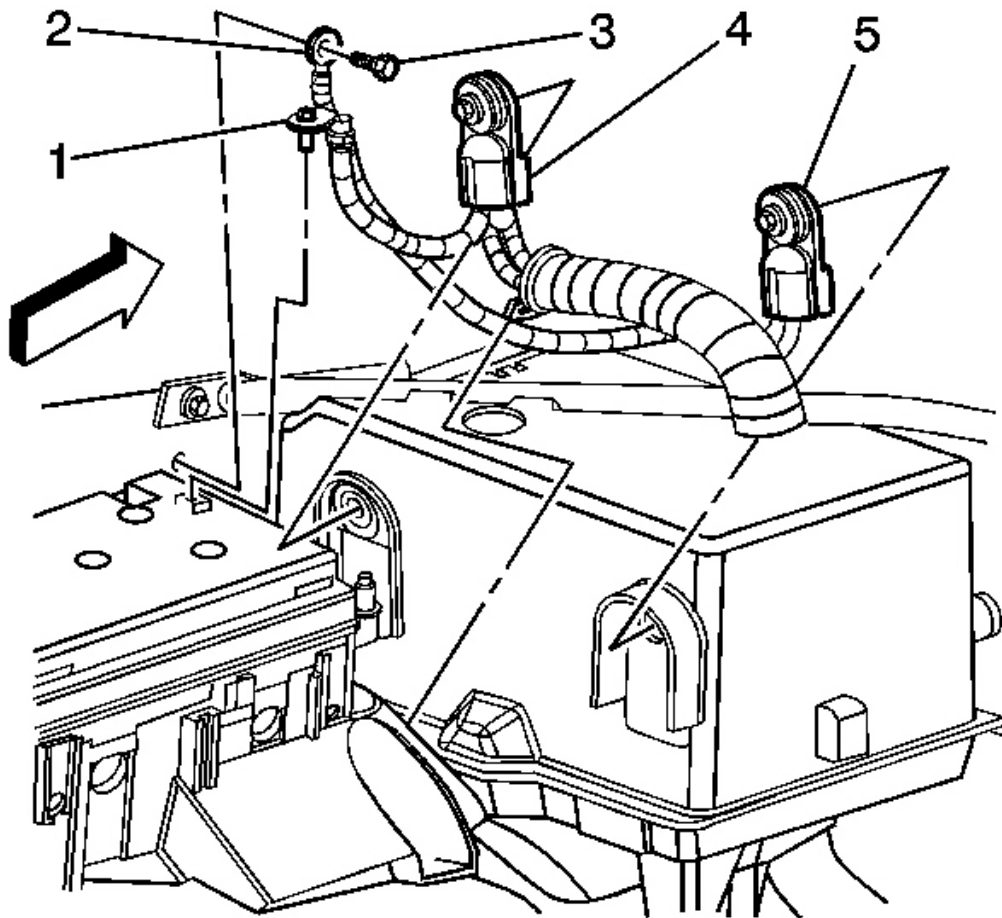
7	<ol style="list-style-type: none"><li>1. Remove the starter motor. Refer to <b><u>Starter Motor Replacement (4.2L Engine)</u></b> or <b><u>Starter Motor Replacement (5.3L and 6.0L Engines)</u></b>.</li><li>2. Inspect the starter motor bushings and clutch gear.</li></ol> <p>Does the clutch gear have chipped or milled teeth or worn bushings?</p>	Go to <b>Step 9</b>	Go to <b>Step 8</b>
8	<p>Replace the flywheel. Refer to <b><u>Engine Flywheel Replacement</u></b> in Engine Mechanical - 4.2L.</p> <p>Did you complete the replacement?</p>	Go to <b>Step 10</b>	-
9	<p>Replace the starter motor. Refer to <b><u>Starter Motor Replacement (4.2L Engine)</u></b> or <b><u>Starter Motor Replacement (5.3L and 6.0L Engines)</u></b>.</p> <p>Did you complete the replacement?</p>	Go to <b>Step 10</b>	-
10	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to <b>Step 3</b>

## REPAIR INSTRUCTIONS

### BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE

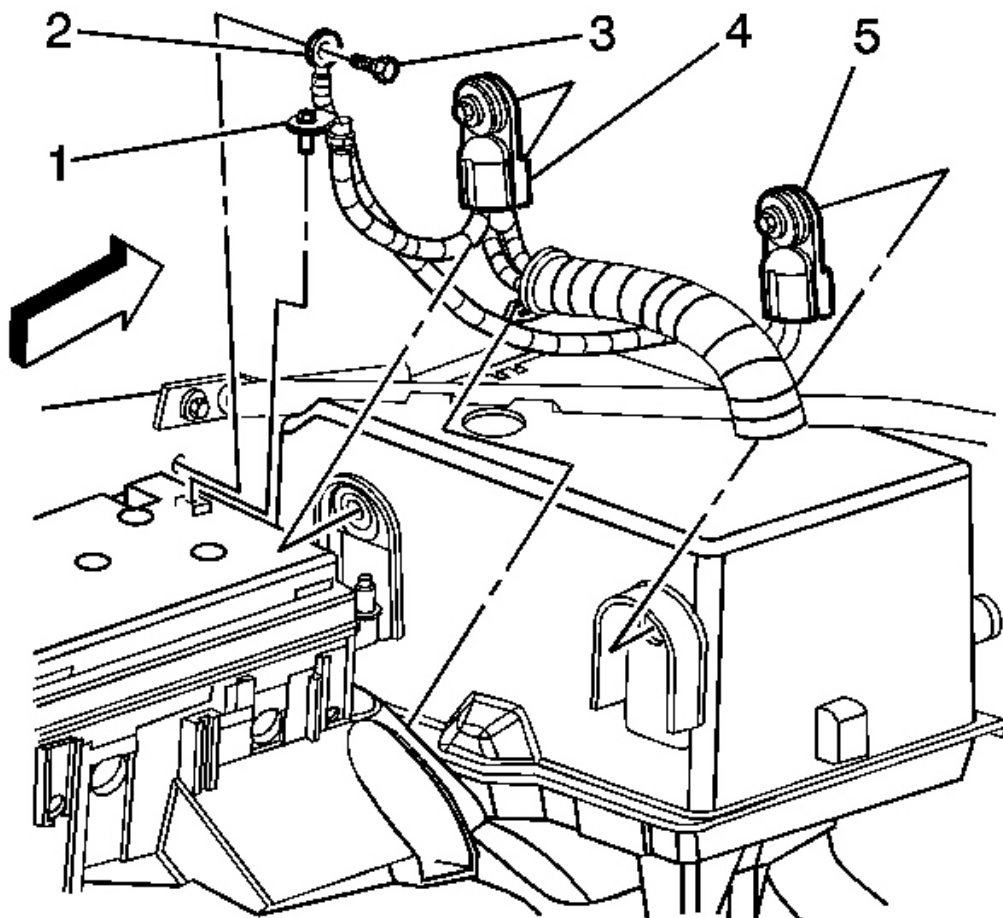
#### Disconnecting Procedure

**CAUTION:** Refer to Battery Disconnect Caution in Cautions and Notices.



**Fig. 9: Identifying Battery Cable Components**  
**Courtesy of GENERAL MOTORS CORP.**

1. Record all preset and theft codes from the radio.
2. Turn the ignition switch to the LOCK position.
3. Verify that all the electrical components are off such as interior lights, all doors are closed, the underhood lamp, etc.
4. Loosen the negative battery cable bolt.
5. Remove the negative battery cable (5) from the battery.
6. Position the negative battery cable away from any body ground.



**Fig. 10: Identifying Battery Cable Components**

**Courtesy of GENERAL MOTORS CORP.**

1. Verify that all electrical components are off such as interior lights, all doors are closed, the underhood lamp, etc.
2. Clean any corrosion from the negative battery cable using a wire brush.
3. Position the negative battery cable (5) to the battery.

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

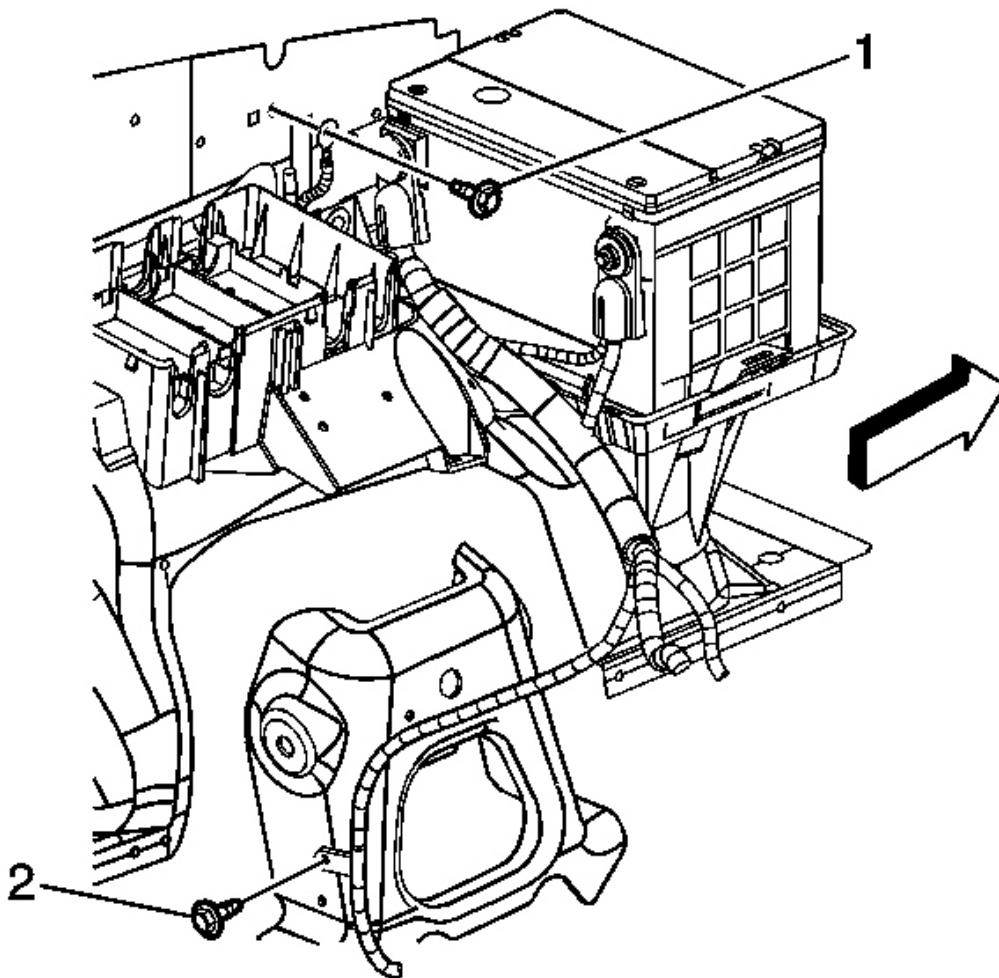
4. Tighten negative battery cable bolt.

**Tighten:** Tighten the bolt to 15 N.m (11 lb ft).

## BATTERY NEGATIVE CABLE REPLACEMENT (4.2L ENGINE)

### Removal Procedure

1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnect/Connect Procedure.



**Fig. 11: View Of Front Wheelhouse Panel Bolt & Shock Tower Bolt**  
Courtesy of GENERAL MOTORS CORP.



## 2006 Buick Rainier

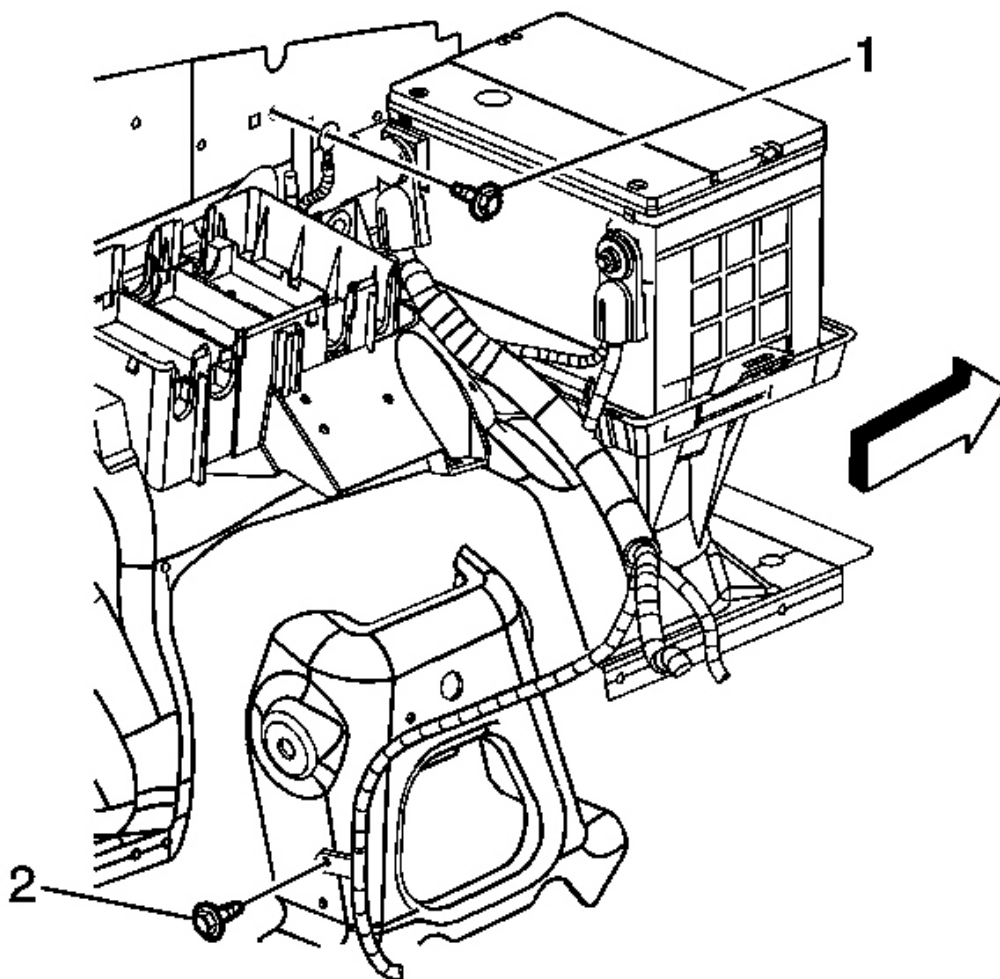
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2. Remove the bolt that secures the harness to the front wheelhouse panel (1).
3. Remove the bolt that secures the harness to the shock tower (2).
4. Remove the harness from the engine harness bracket.
5. Remove the bolt that secures the harness to the engine block.

### Installation Procedure

- IMPORTANT:**
- The negative battery cable must not be connected to the battery prior to the installation of the engine harness ground terminal to the engine block.
  - The negative battery cable must not be connected to the battery prior to the installation of the instrument panel harness and the engine harness to the powertrain control module.

1. Clip the harness to the engine harness bracket.



**Fig. 12: View Of Front Wheelhouse Panel Bolt & Shock Tower Bolt**  
Courtesy of GENERAL MOTORS CORP.

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

2. Install the bolt that secures the harness to the shock tower (2).

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

3. Install the bolt that secures the harness to the engine block.

**Tighten:** Tighten the bolt to 50 N.m (37 lb ft).

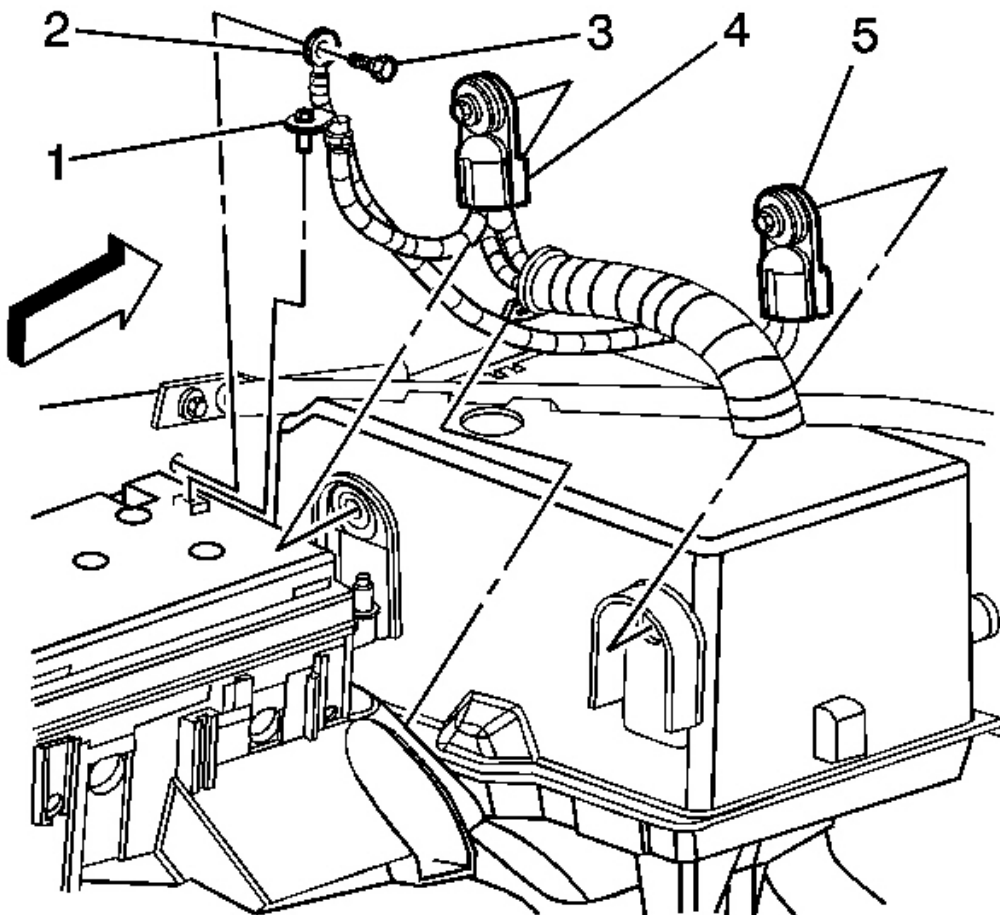
4. Install the bolt that secures the harness to the wheelhouse panel (1).

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

5. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

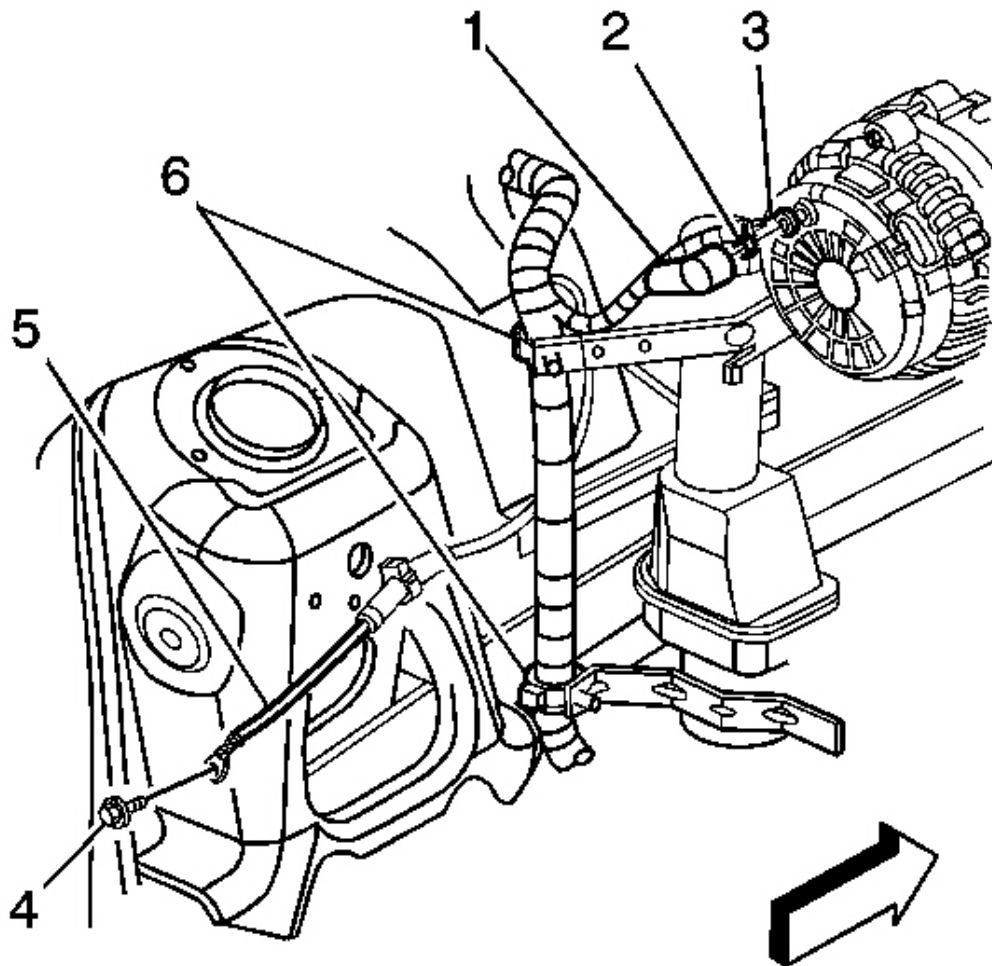
### BATTERY NEGATIVE CABLE REPLACEMENT (5.3L AND 6.0L ENGINES)

#### Removal Procedure



**Fig. 13: Identifying Battery Cable Components**  
Courtesy of GENERAL MOTORS CORP.

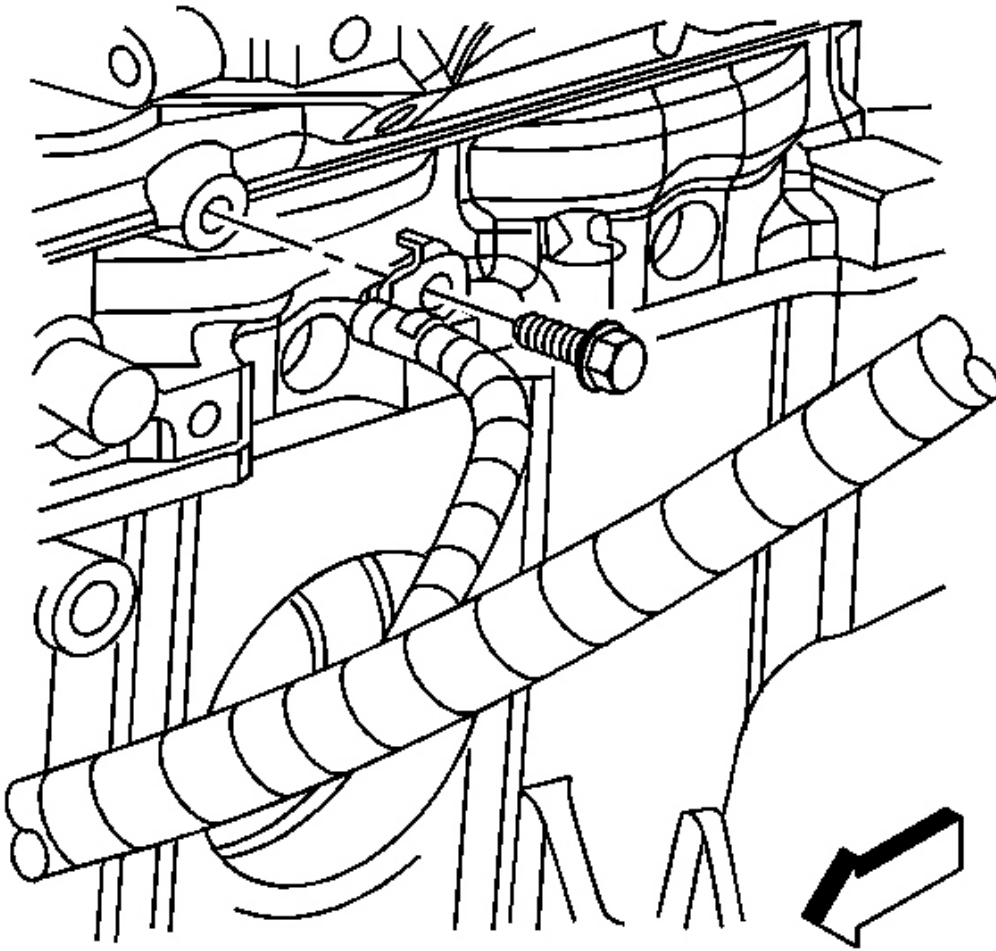
1. Disconnect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Remove the ground terminal bolt (3) that secures the harness to the front fender.



**Fig. 14: View Of Generator Cable Boot, Head, Nut & Bolt**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the ground cable bolt (4) that secures the harness to the shock tower.

4. Remove the ground cable clip from the shock tower.



**Fig. 15: View Of Ground Terminal Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

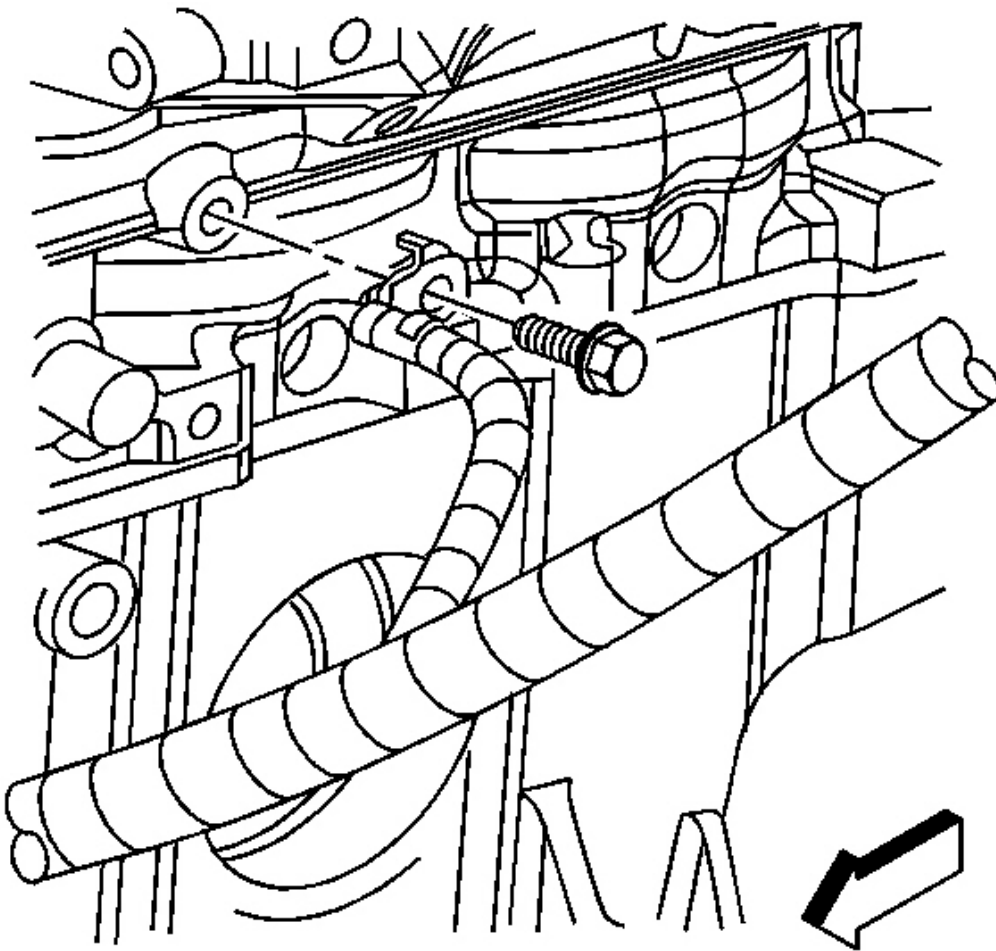
5. Remove the ground terminal bolt from the engine block.
6. Remove the cable from the engine harness conduit.

#### Installation Procedure

**IMPORTANT:**     • The negative battery cable must not be connected to the

**battery prior to the installation of the engine harness ground terminal to the engine block.**

- **The negative battery cable must not be connected to the battery prior to the installation of the instrument panel harness and the engine harness to the powertrain control module.**

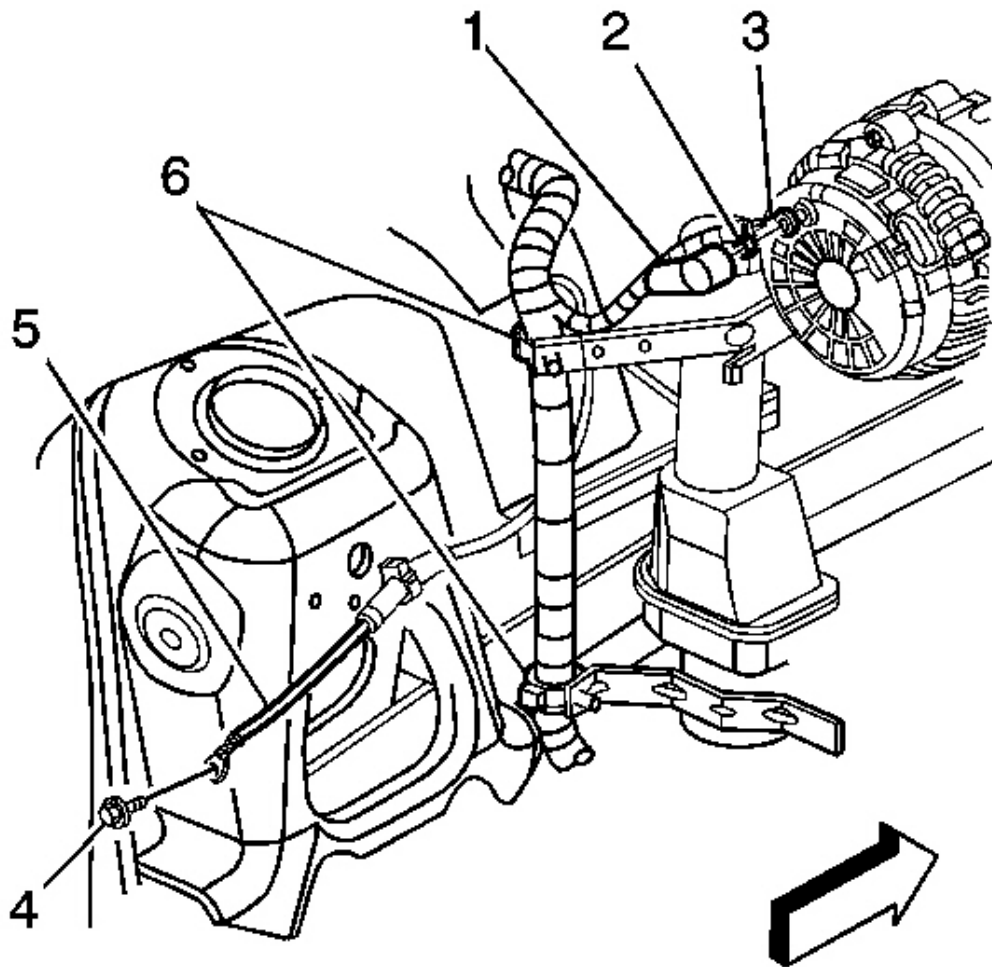


**Fig. 16: View Of Ground Terminal Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

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

1. Install the cable to the engine harness conduit.
2. Install the ground terminal bolt to the engine block.

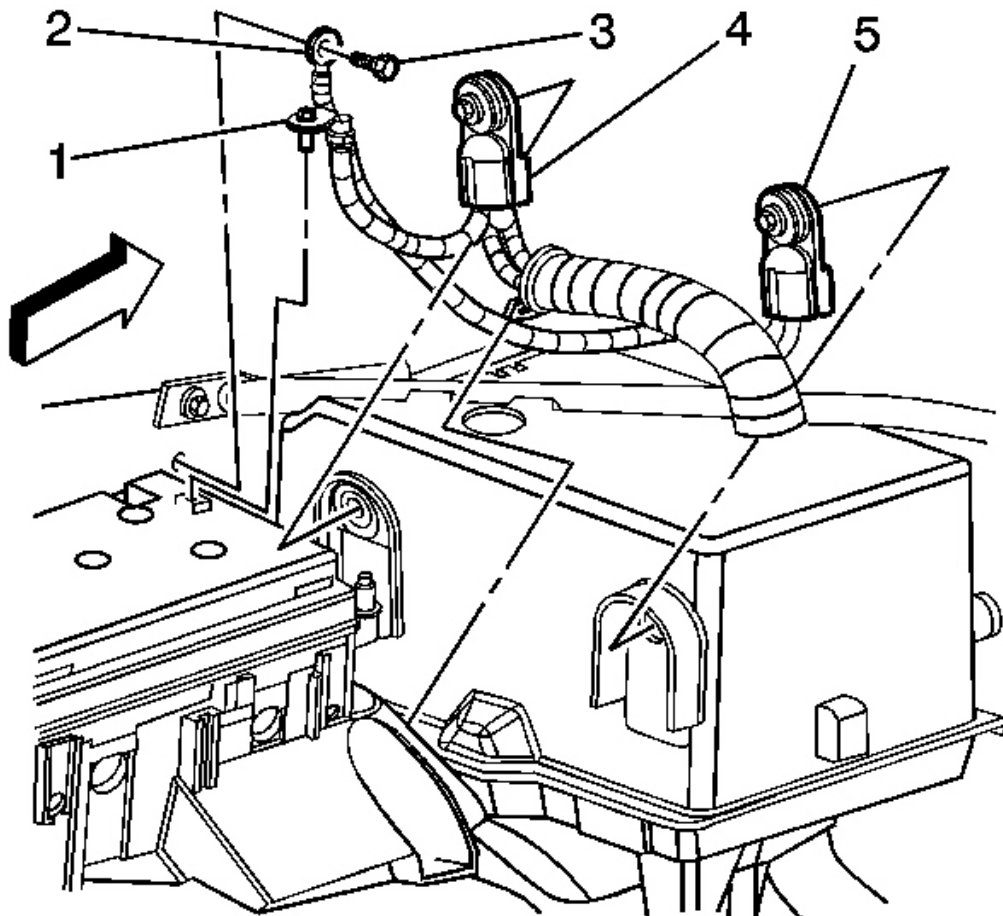
**Tighten:** Tighten the bolt to 50 N.m (37 lb ft).



**Fig. 17: View Of Generator Cable Boot, Head, Nut & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install the ground cable clip to the shock tower.
4. Install the ground cable bolt (4) that secures the harness to the shock tower.

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



**Fig. 18: Identifying Battery Cable Components**  
**Courtesy of GENERAL MOTORS CORP.**

5. Install the ground terminal bolt (3) that secures the harness to the front fender.

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

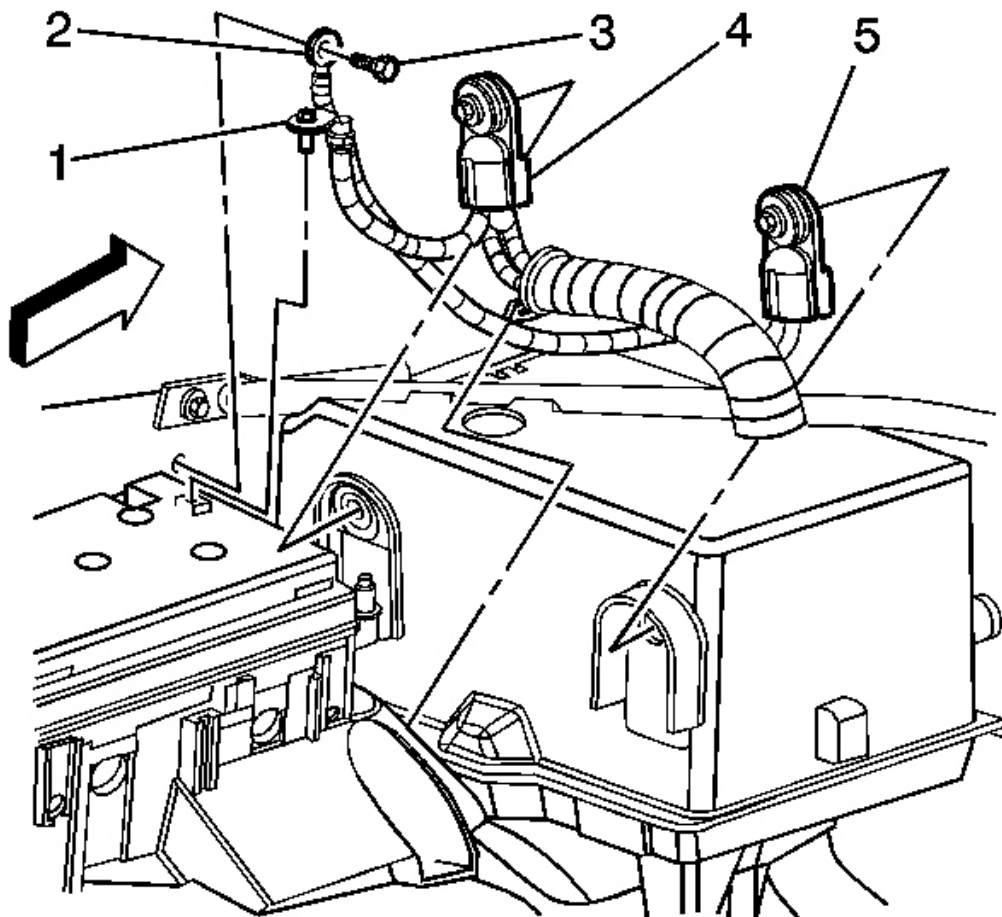


6. Connect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

#### BATTERY POSITIVE CABLE REPLACEMENT (4.2L ENGINE)

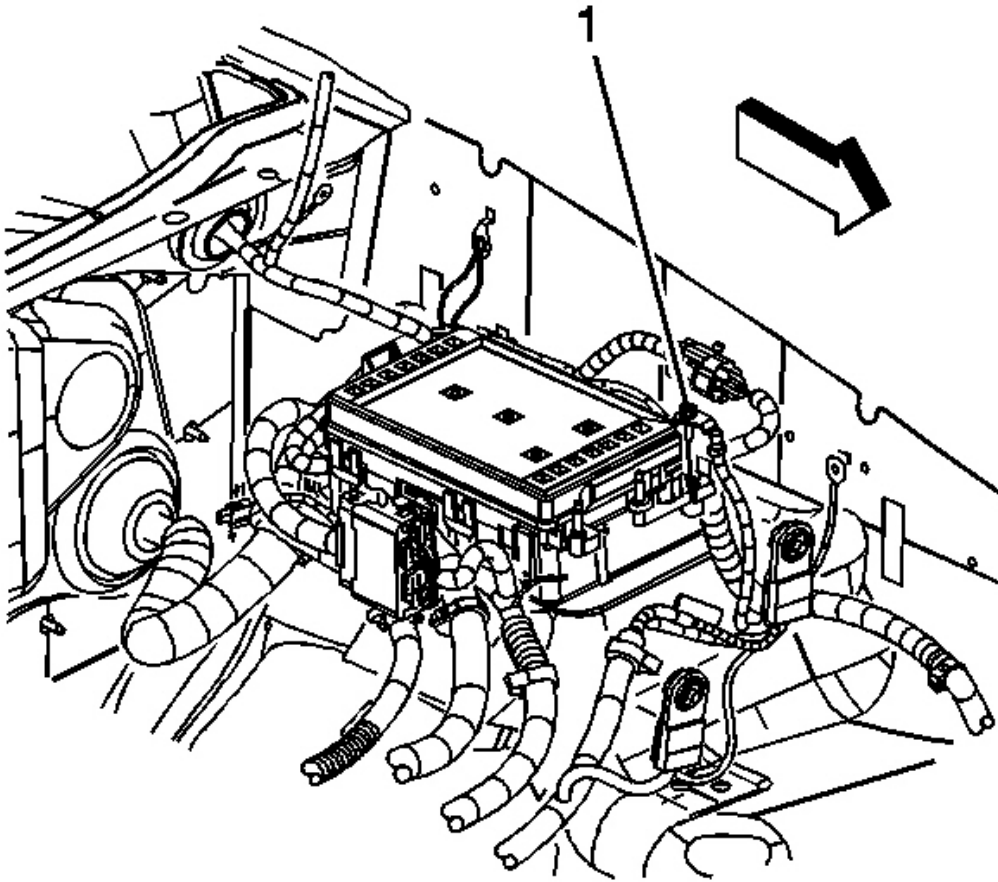
##### Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.



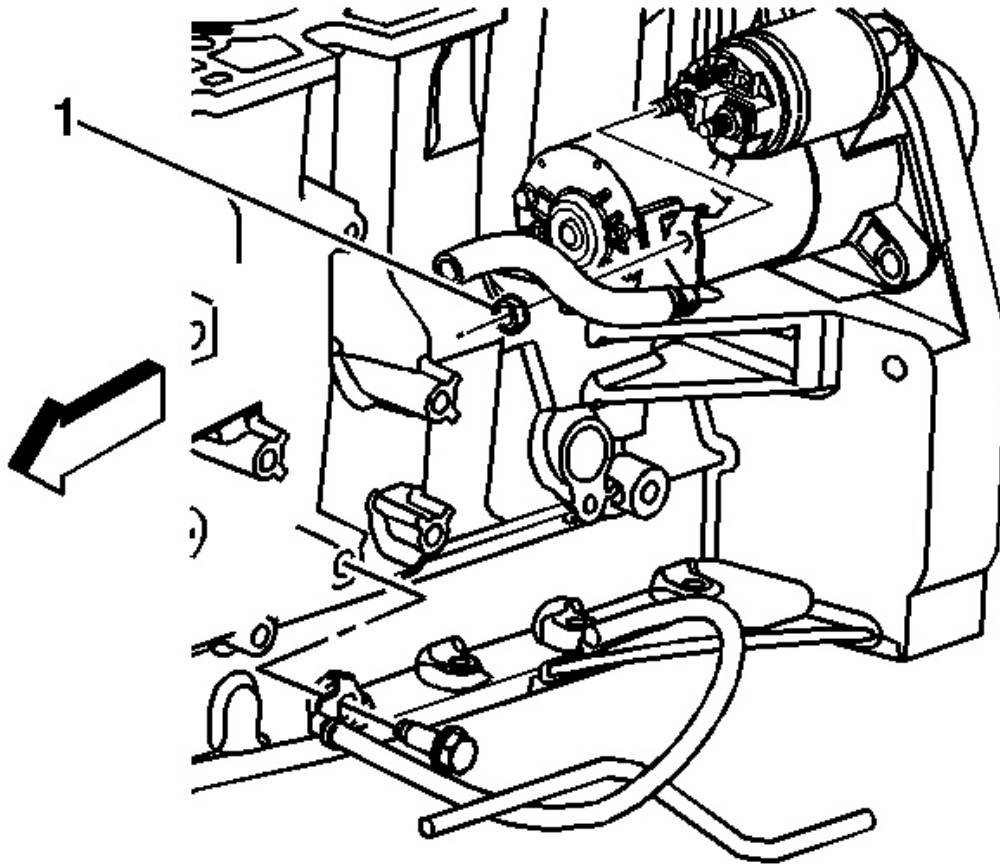
**Fig. 19: Identifying Battery Cable Components**  
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the battery positive cable (4) from the battery.



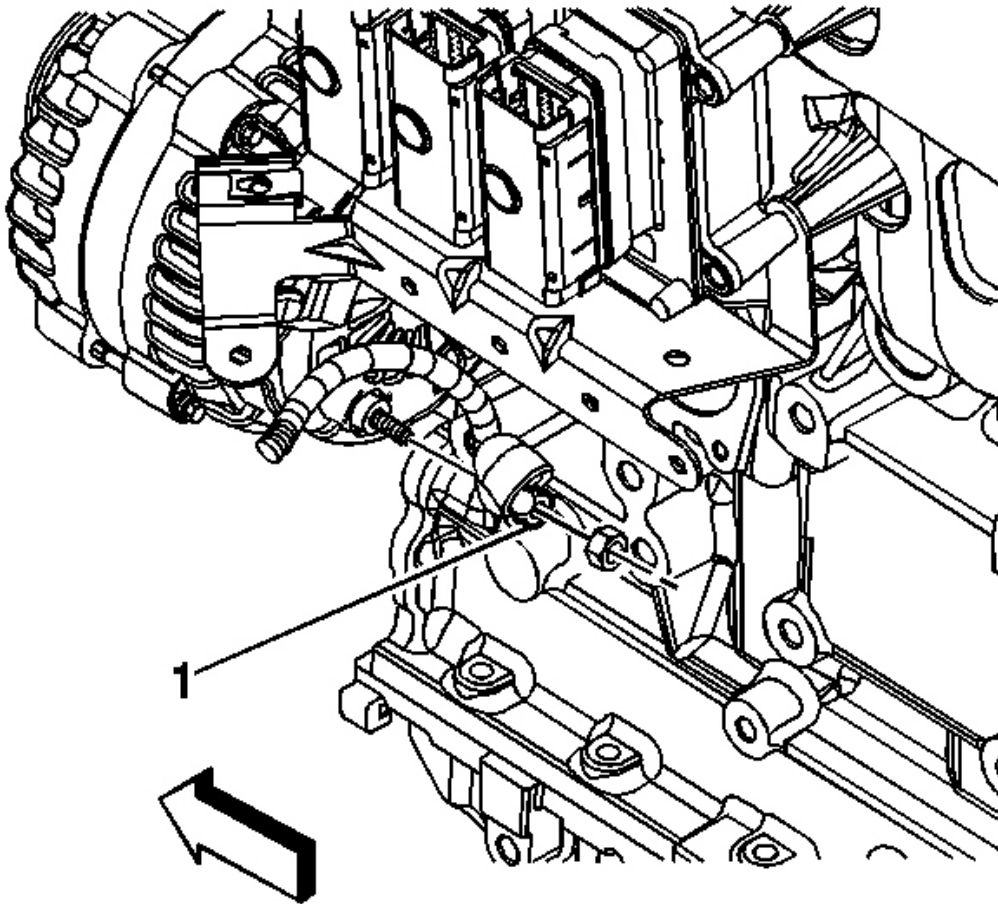
**Fig. 20: View Of Positive Cable Lead At Junction Block**  
**Courtesy of GENERAL MOTORS CORP.**

3. Disconnect the positive cable lead from the junction block (1).
4. Disconnect the battery cable conduit from the conduit retaining clip.
5. Remove the battery positive cable from the conduit.
6. Remove the battery positive cable harness from the fir-tree retainer on the powertrain control module (PCM) bracket.



**Fig. 21: View Of Starter & Related Components**  
**Courtesy of GENERAL MOTORS CORP.**

7. Disconnect the positive cable lead from the starter (1).

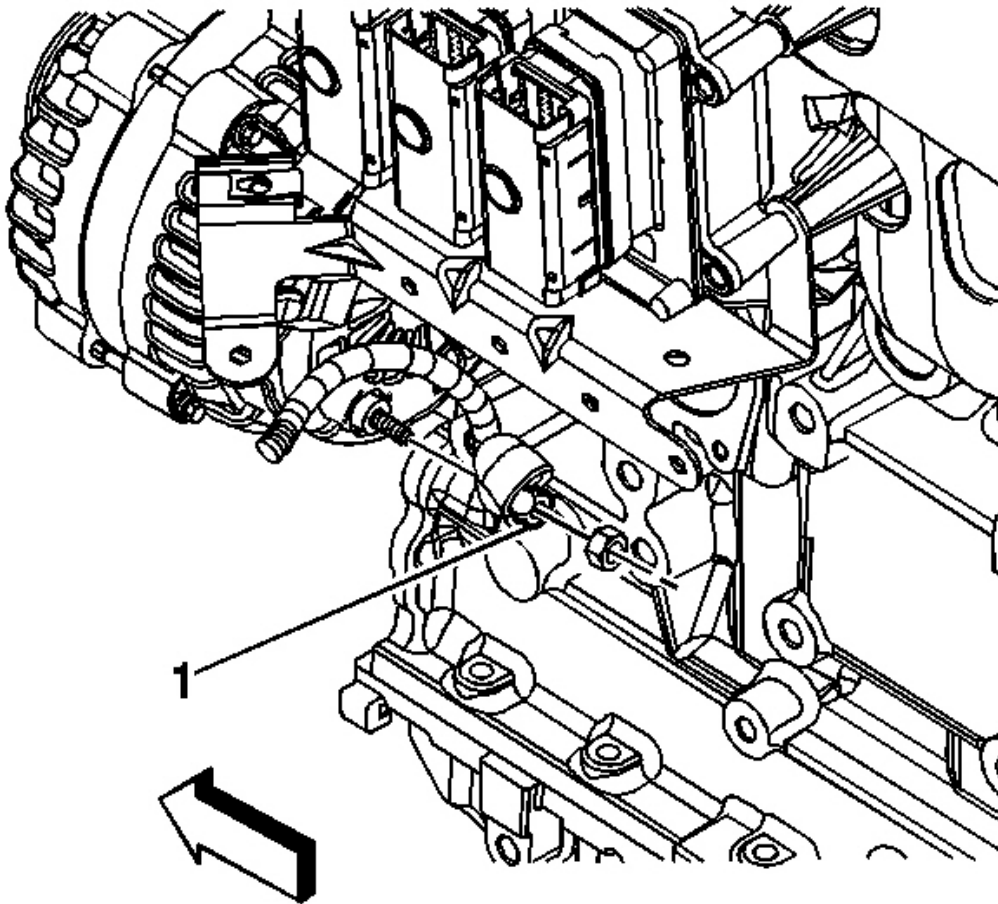


**Fig. 22: Rear Of Generator (Alternator) View**  
**Courtesy of GENERAL MOTORS CORP.**

8. Disconnect the positive cable lead from the generator (1).
9. Remove the battery positive cable from the vehicle.

**Installation Procedure**

1. Position the battery positive cable in the engine compartment.

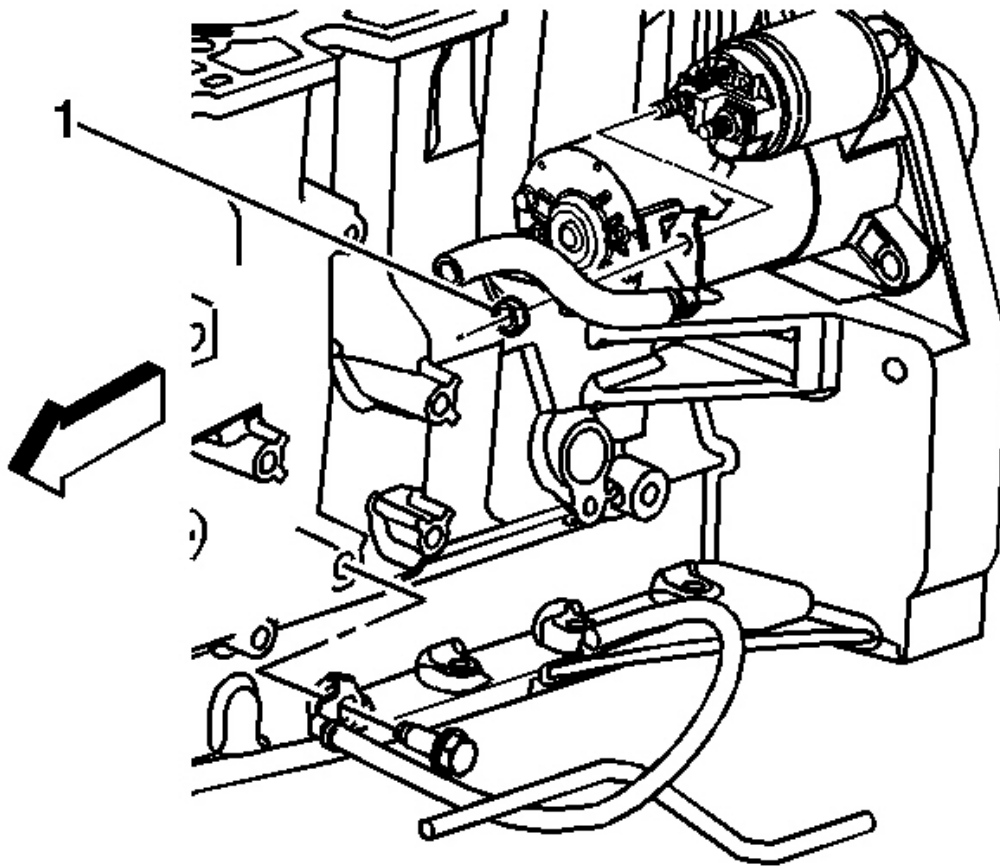


**Fig. 23: Rear Of Generator (Alternator) View**  
Courtesy of GENERAL MOTORS CORP.

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

2. Install the battery positive cable to the generator and secure with the nut (1).

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

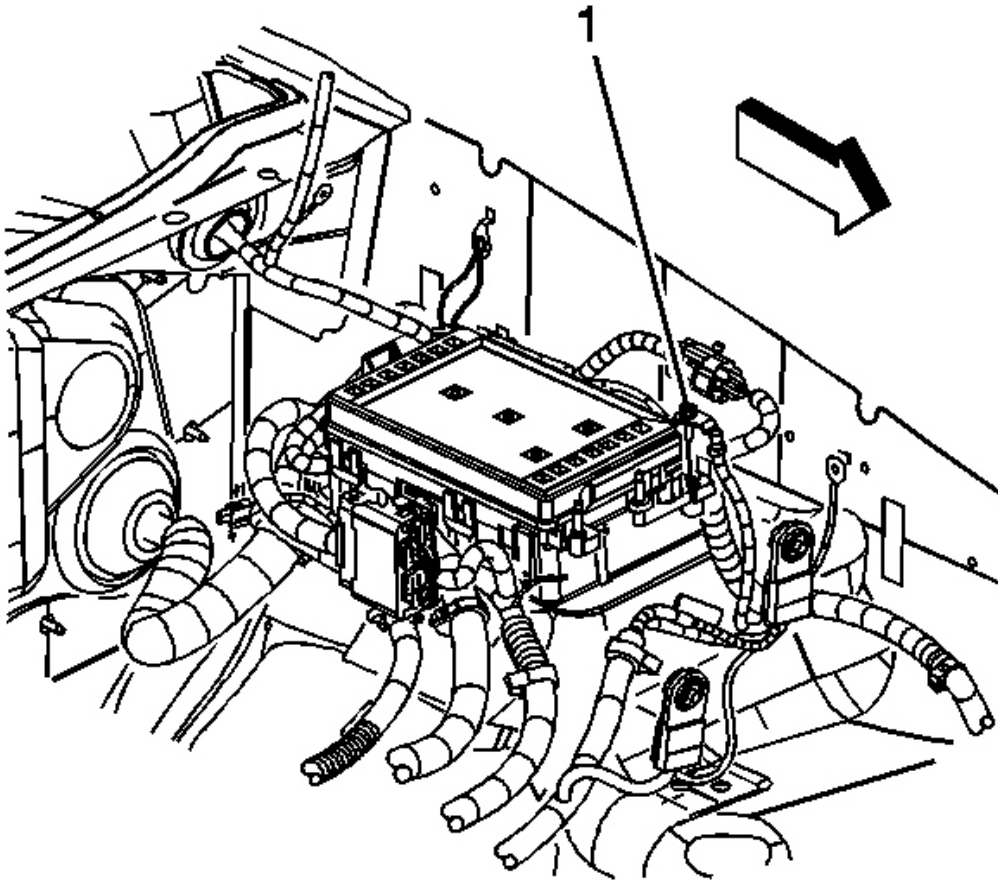


**Fig. 24: View Of Starter & Related Components**  
**Courtesy of GENERAL MOTORS CORP.**

3. Connect the positive cable to the starter and secure the positive cable with the nut (1).

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

4. Install the battery positive cable harness to the fir-tree retainer on the PCM bracket.
5. Install the battery positive cable into the conduit.
6. Connect the battery cable conduit to the conduit retaining clip.

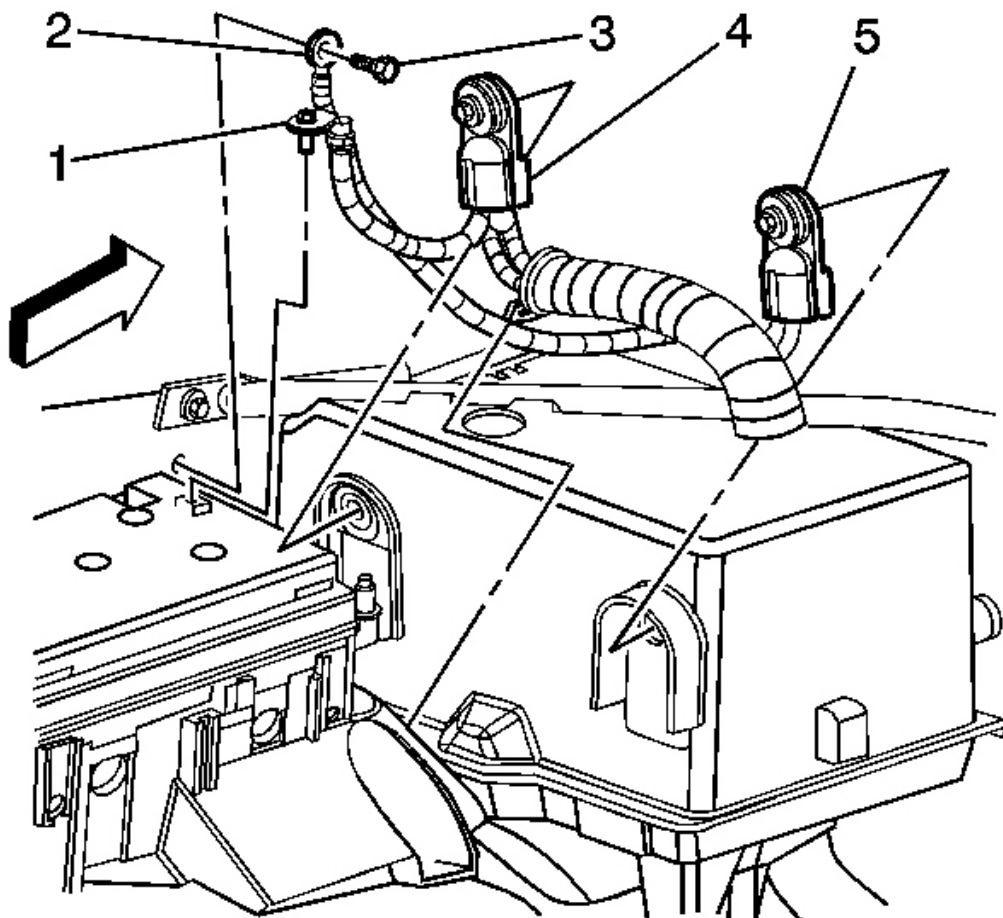


**Fig. 25: View Of Positive Cable Lead At Junction Block**  
**Courtesy of GENERAL MOTORS CORP.**

7. Connect the positive cable to the junction block and secure the positive cable with the bolt (1).

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





**Fig. 26: Identifying Battery Cable Components**  
Courtesy of GENERAL MOTORS CORP.

8. Connect the battery positive cable (4) to the positive battery post.

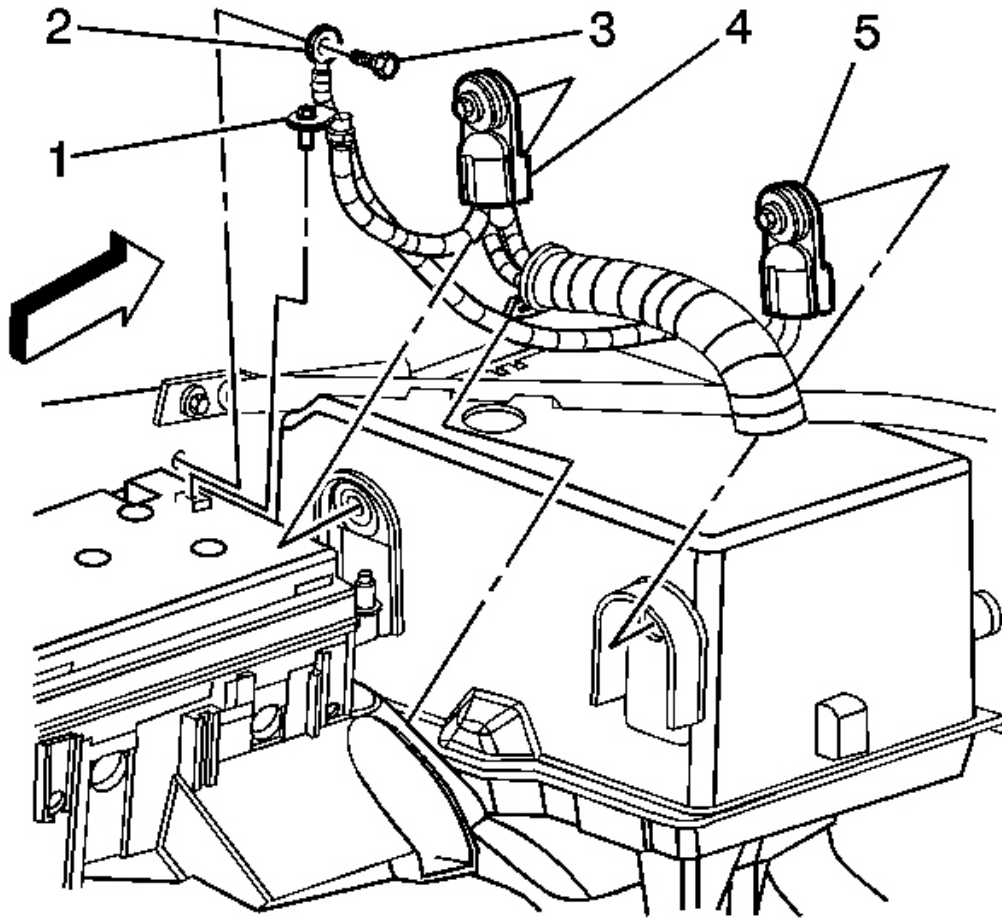
**Tighten:** Tighten the battery positive bolt to 15 N.m (11 lb ft).

9. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

#### **BATTERY POSITIVE CABLE REPLACEMENT (5.3L AND 6.0L ENGINES)**

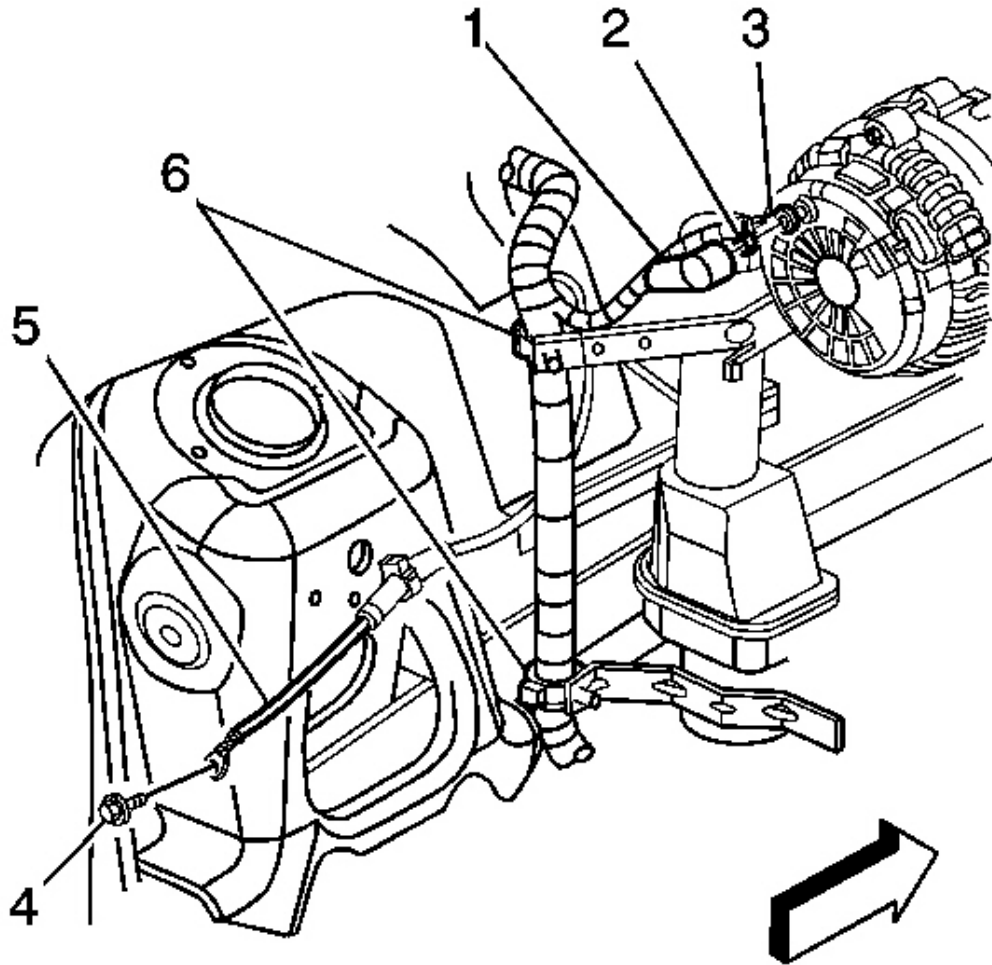
##### **Removal Procedure**





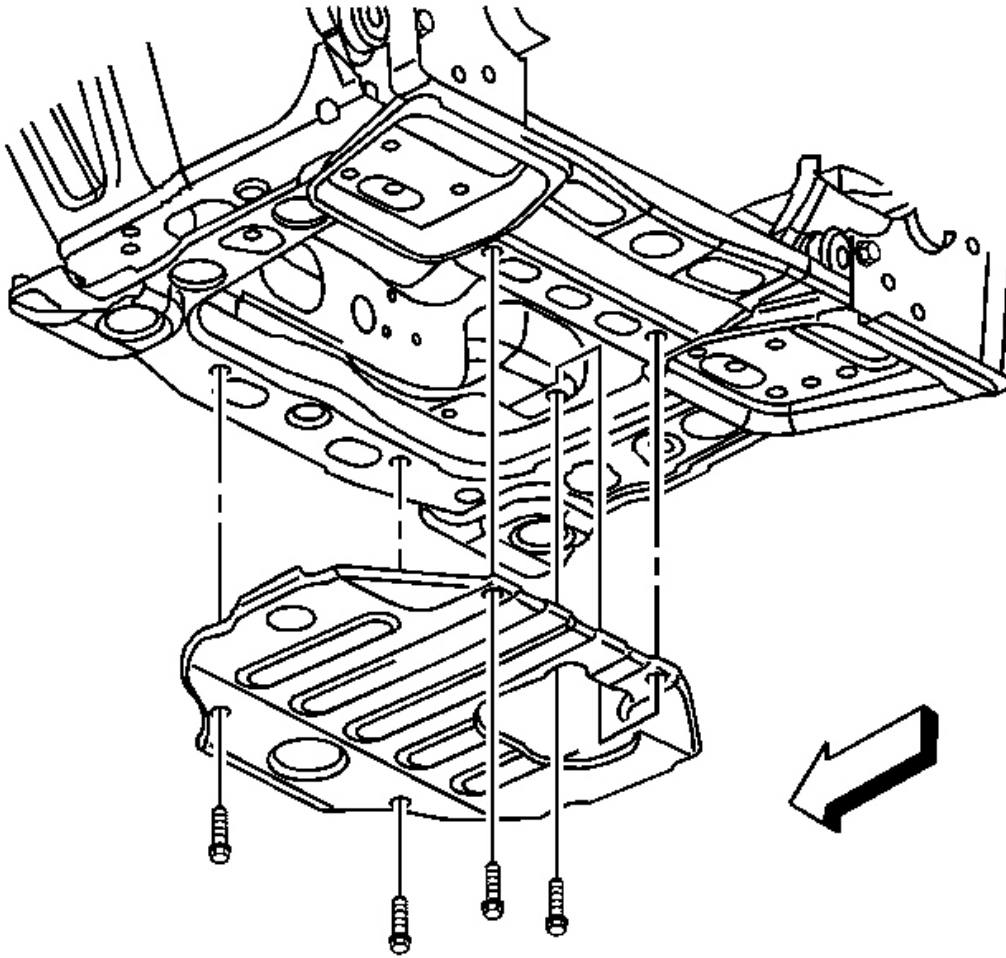
**Fig. 27: Identifying Battery Cable Components**  
**Courtesy of GENERAL MOTORS CORP.**

1. Disconnect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Disconnect the positive battery cable (4).
3. Loosen the positive terminal bolt (1) that secures the harness to the junction block.



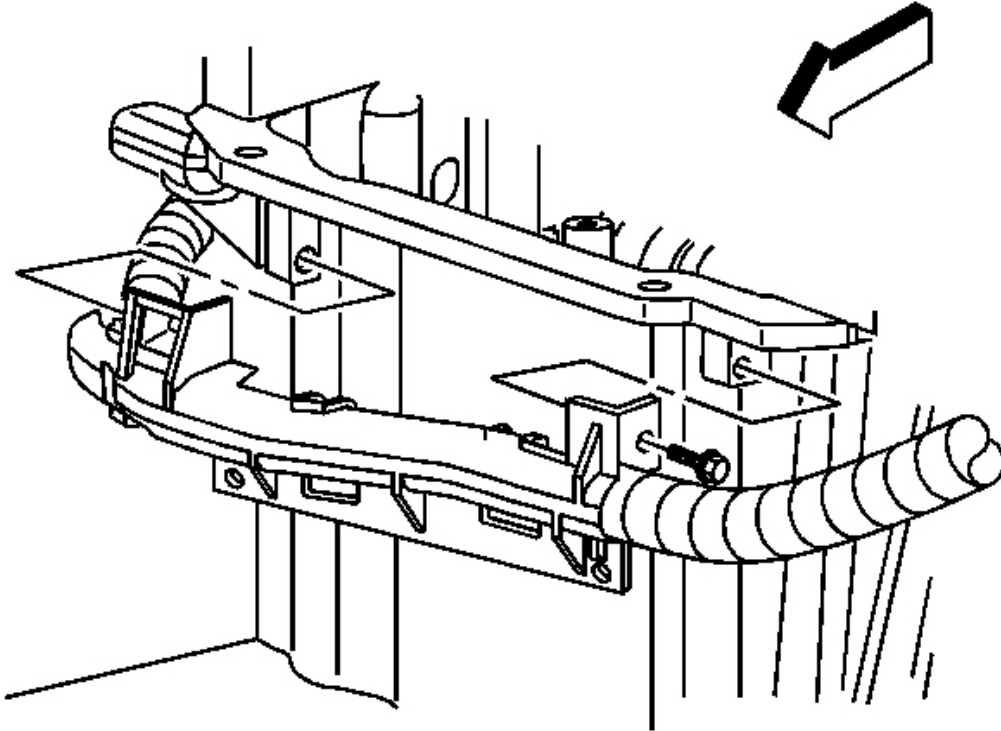
**Fig. 28: View Of Generator Cable Boot, Head, Nut & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

4. Reposition the generator cable boot (1).
5. Remove the generator cable nut (2).
6. Remove the generator cable lead (3).
7. Open the clips on the retaining brackets.



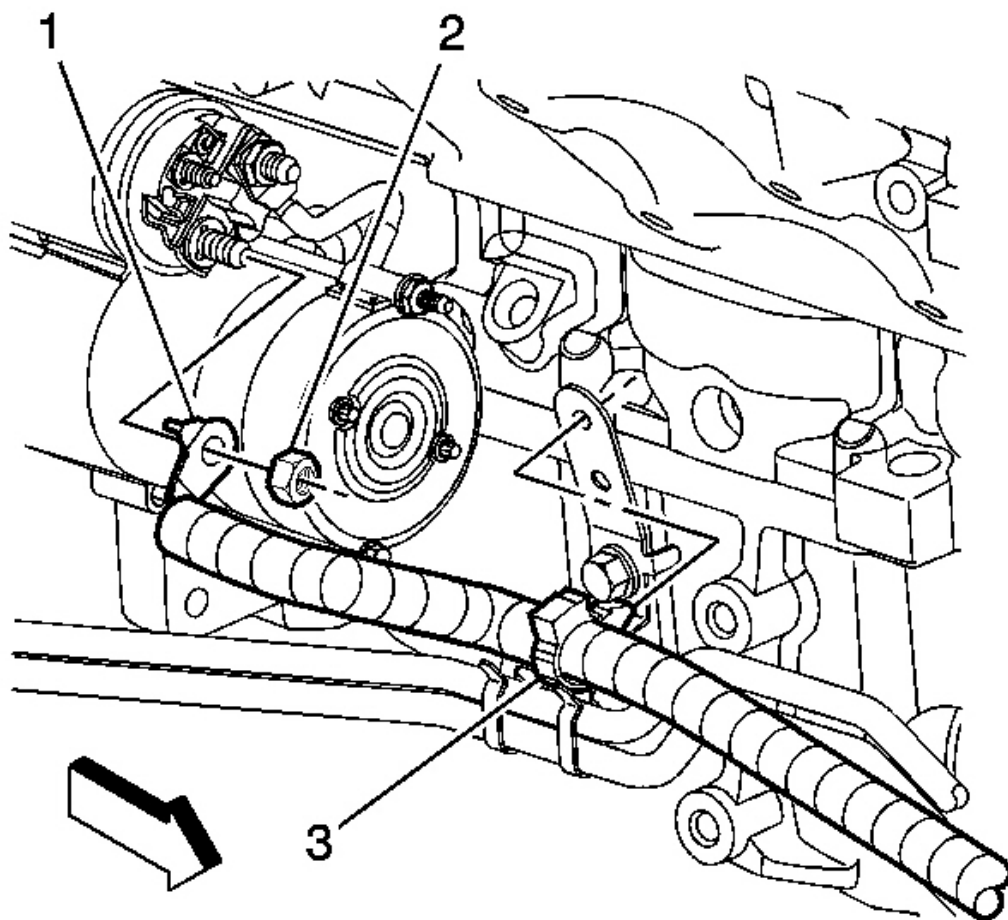
**Fig. 29: Engine Protection Shield Removed**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** .



**Fig. 30: View Of Battery Cable Channel & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

9. Remove the battery cable channel bolt.
10. Remove the battery cable channel.
11. Remove the battery cable from the channel.

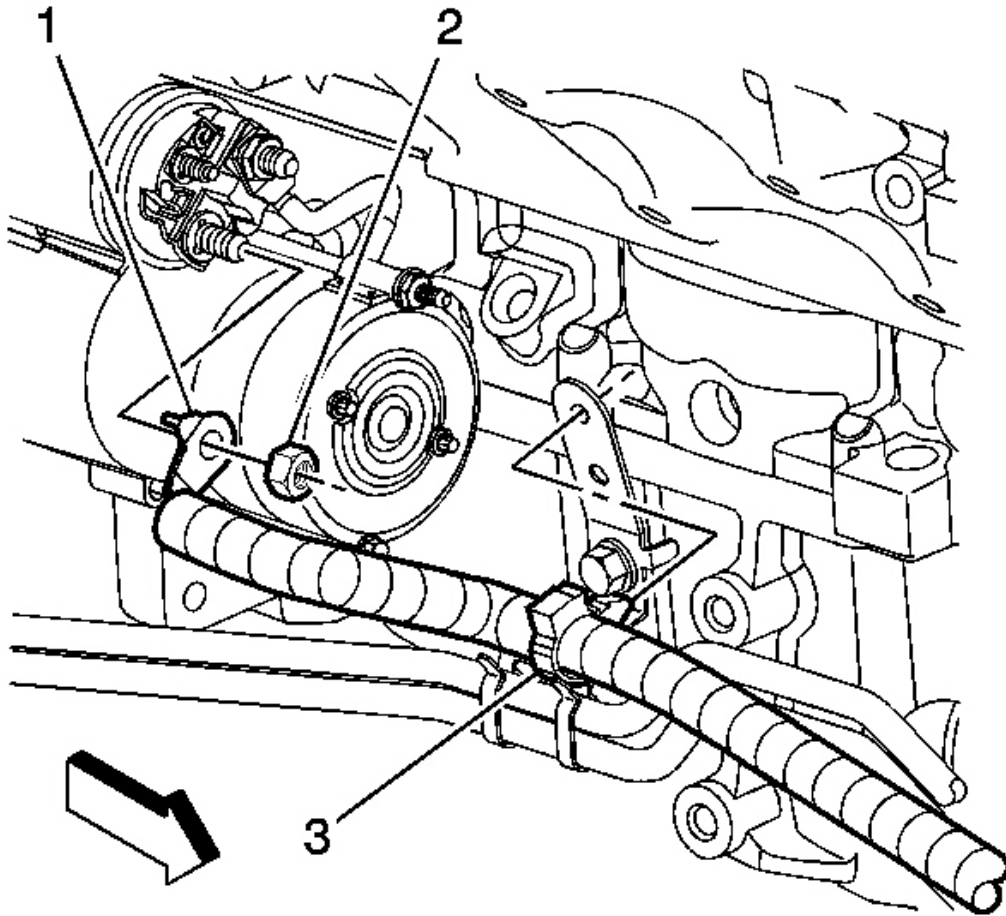


**Fig. 31: View Of Positive Cable Lead, Nut & Cable Clip**  
**Courtesy of GENERAL MOTORS CORP.**

12. Remove the positive cable lead nut (2) from the starter.
13. Remove the positive cable lead (1).
14. Remove the cable clip (3) from the bracket.
15. Remove the battery cable from the conduit.

**Installation Procedure**

1. Install the battery cable to the conduit.



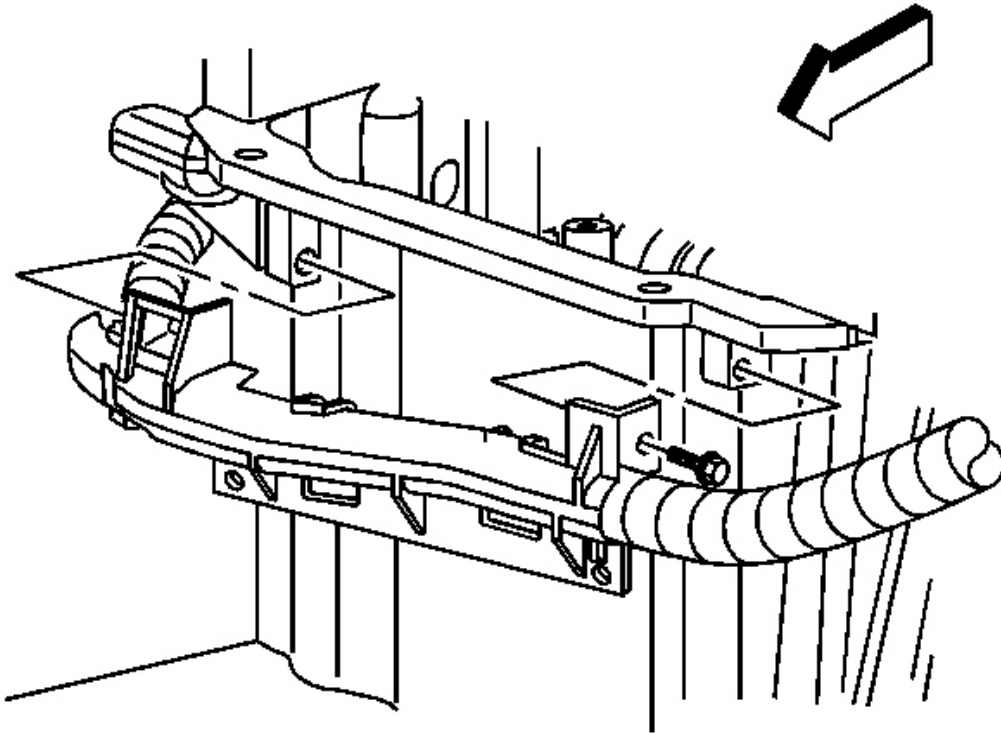
**Fig. 32: View Of Positive Cable Lead, Nut & Cable Clip**  
**Courtesy of GENERAL MOTORS CORP.**

2. Install the cable clip (3) to the bracket.
3. Install the positive cable lead (1).

**NOTE:** Refer to Fastener Notice .

4. Install the positive cable lead nut (2) to the starter.

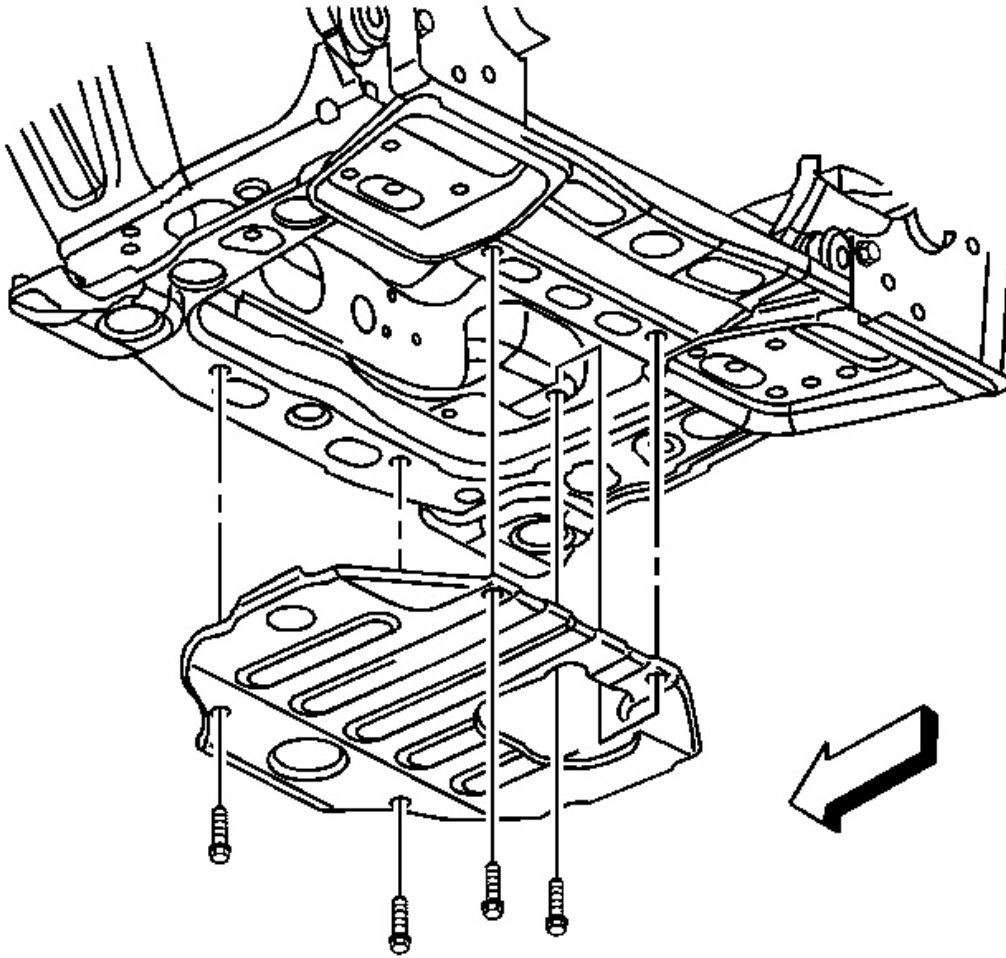
**Tighten:** Tighten the nut to 9 N.m (80 lb in).



**Fig. 33: View Of Battery Cable Channel & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

5. Install the battery cable to the channel.
6. Install the battery cable channel.
7. Install the battery cable channel bolt.

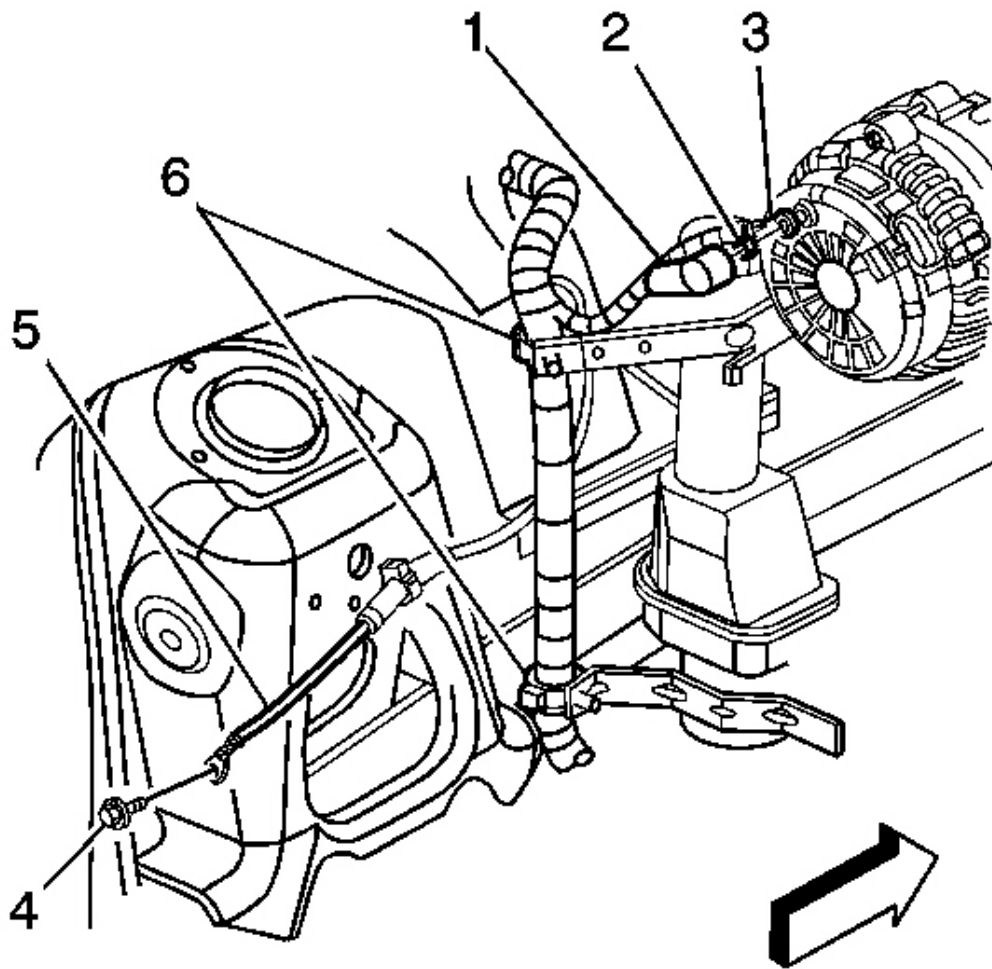
**Tighten:** Tighten the battery cable channel bolt to 12 N.m (106 lb in).



**Fig. 34: Engine Protection Shield Removed**  
Courtesy of GENERAL MOTORS CORP.

8. Install the engine protection shield. Refer to **Engine Protection Shield Replacement** .



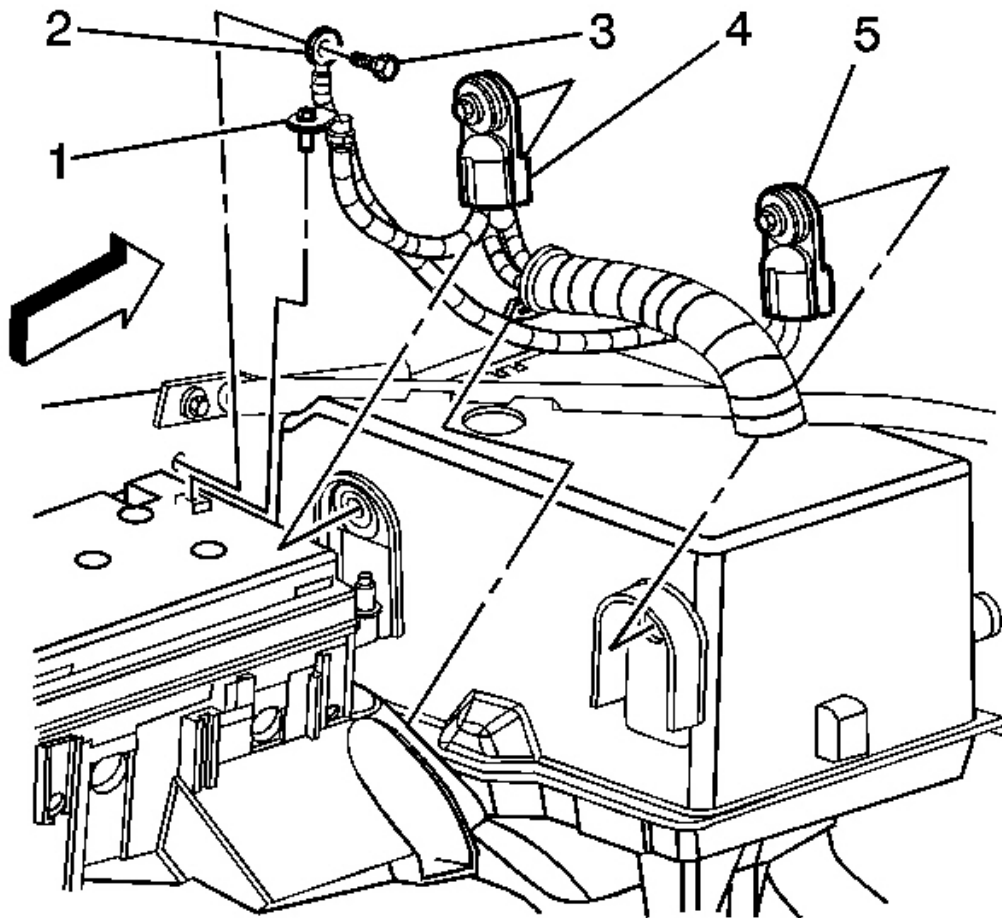


**Fig. 35: View Of Generator Cable Boot, Head, Nut & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

9. Install the generator cable lead (3).
10. Install the generator cable nut (2).

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

11. Position the generator cable boot (1).
12. Close the clips on the retaining brackets.



**Fig. 36: Identifying Battery Cable Components**  
**Courtesy of GENERAL MOTORS CORP.**

13. Tighten the positive terminal bolt (1) that secures the harness to the junction block.

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

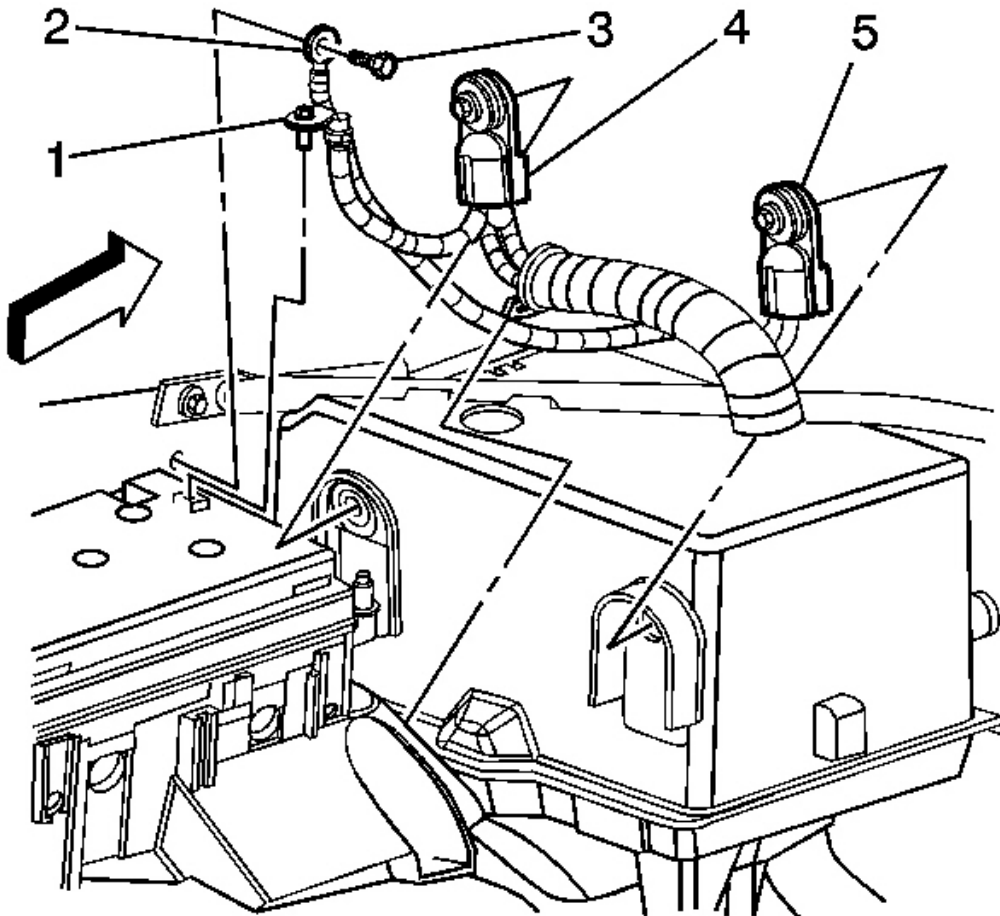
14. Connect the positive battery cable (4).

**Tighten:** Tighten the positive cable to 15 N.m (11 lb ft).

15. Connect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

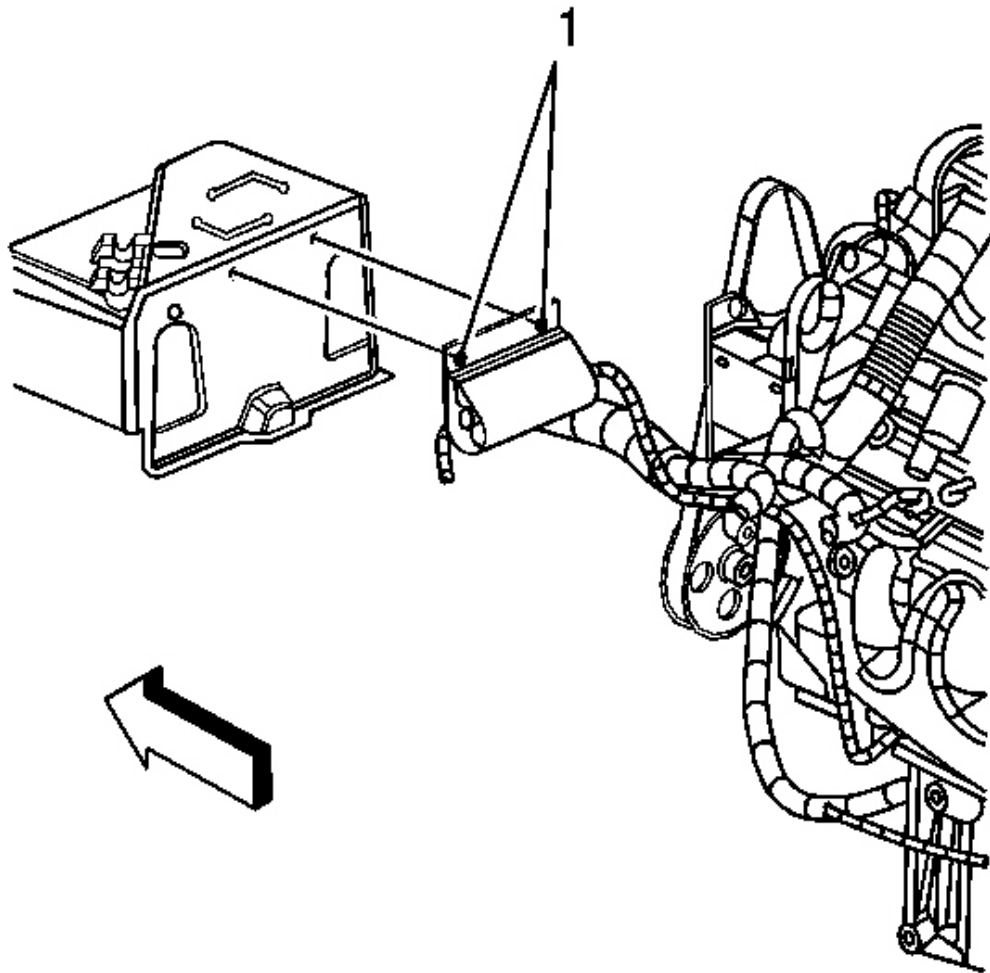
## BATTERY REPLACEMENT

### Removal Procedure



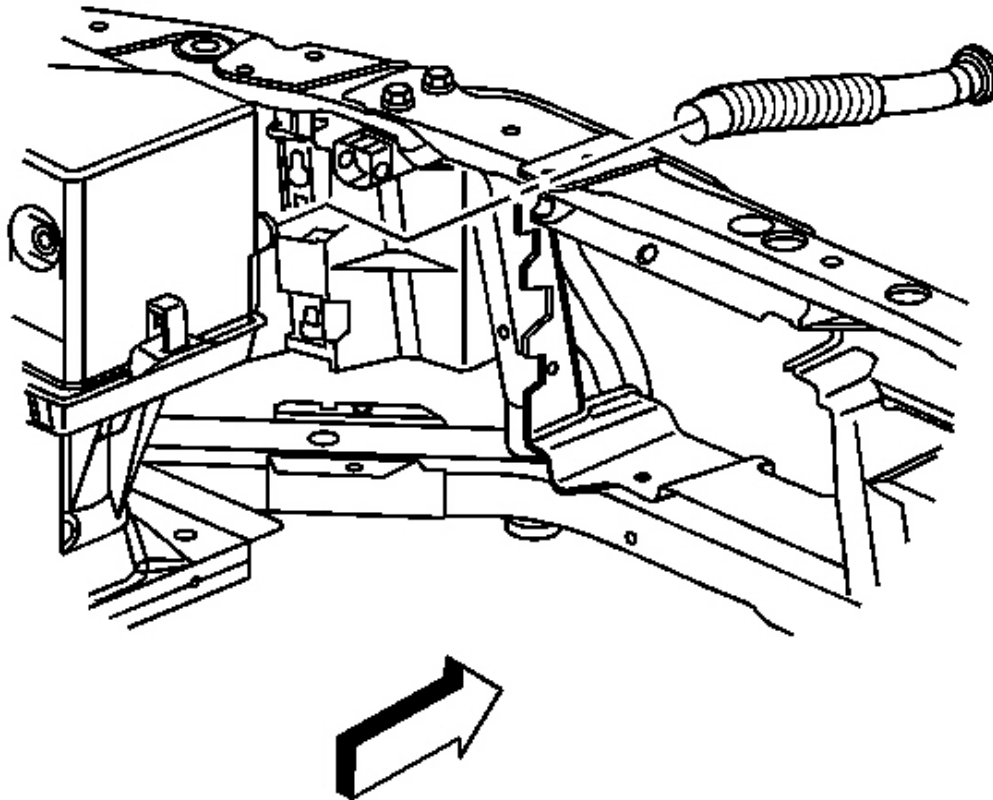
**Fig. 37: Identifying Battery Cable Components**  
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Loosen the positive battery cable bolt.
3. Remove the positive battery cable (4) from the battery.



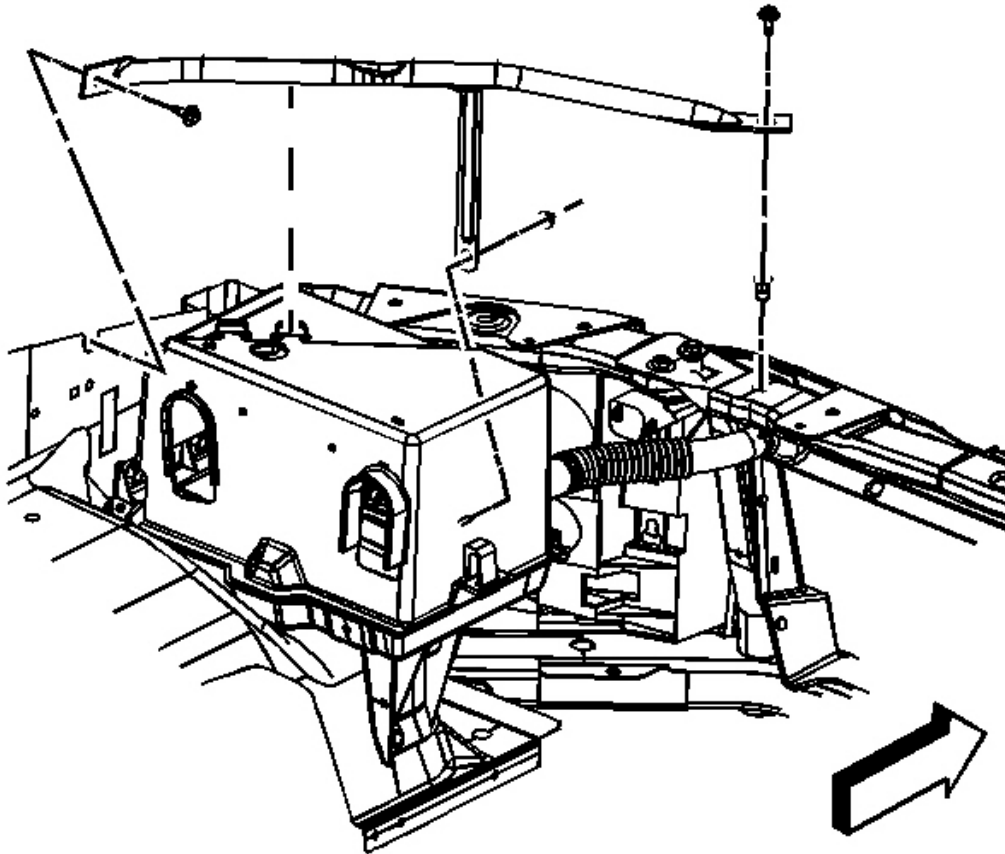
**Fig. 38: View Of Coolant Heater Cord Retainers**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the coolant heater cord retainers (1) from the battery cover, if equipped.



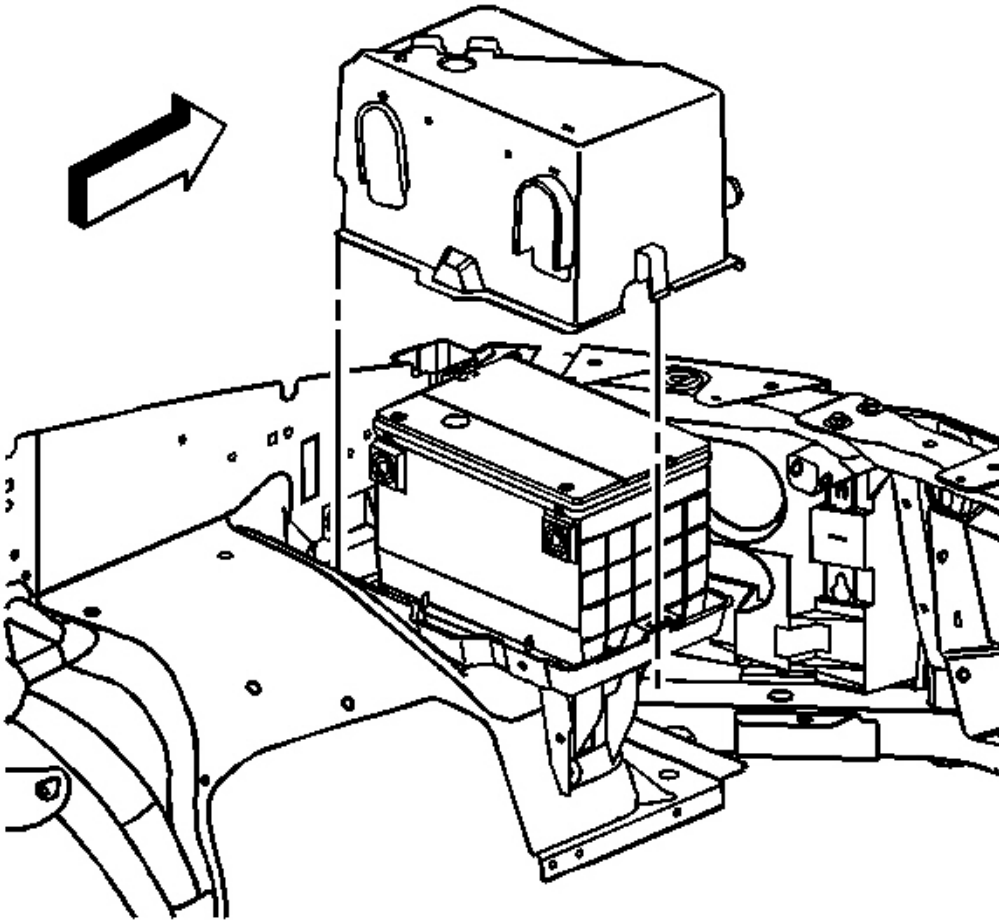
**Fig. 39: View Of Battery Air Duct**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the battery air duct from the battery cover.



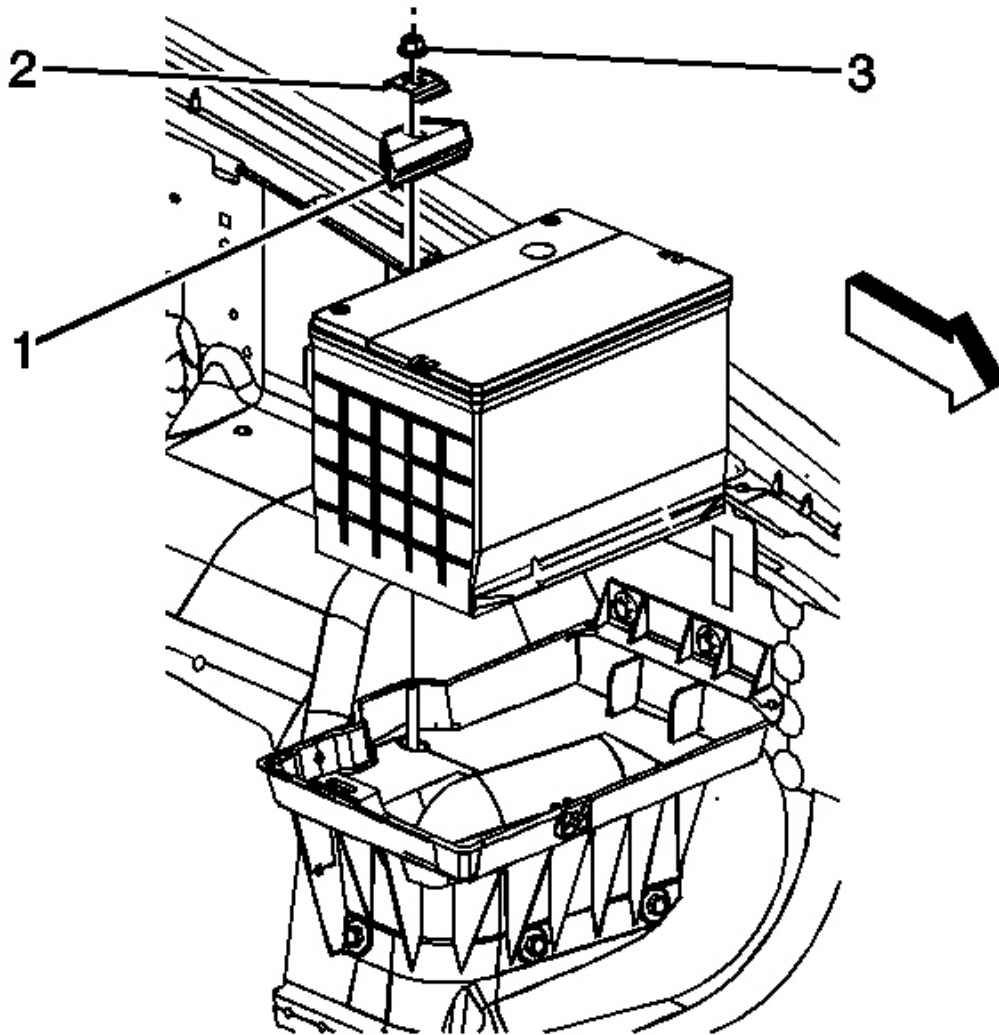
**Fig. 40: Radiator Support Diagonal Brace**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the battery tray brace bolts/nut.



**Fig. 41: View Of Battery Cover**  
**Courtesy of GENERAL MOTORS CORP.**

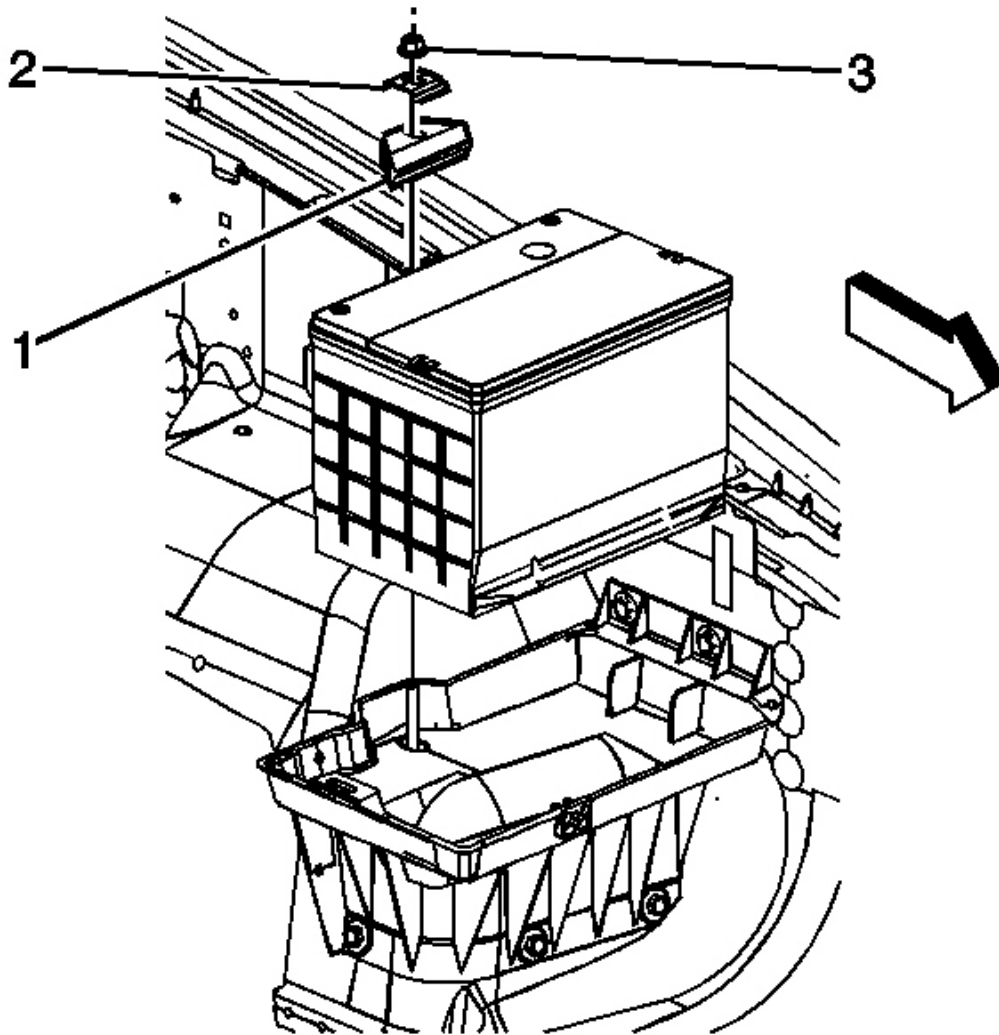
7. Remove the battery cover.



**Fig. 42: View Of Battery Hold Down Nut, Washer & Retainer**  
**Courtesy of GENERAL MOTORS CORP.**

8. Remove the battery hold down nut (3), retainer (1), and washer.
9. Remove the battery.



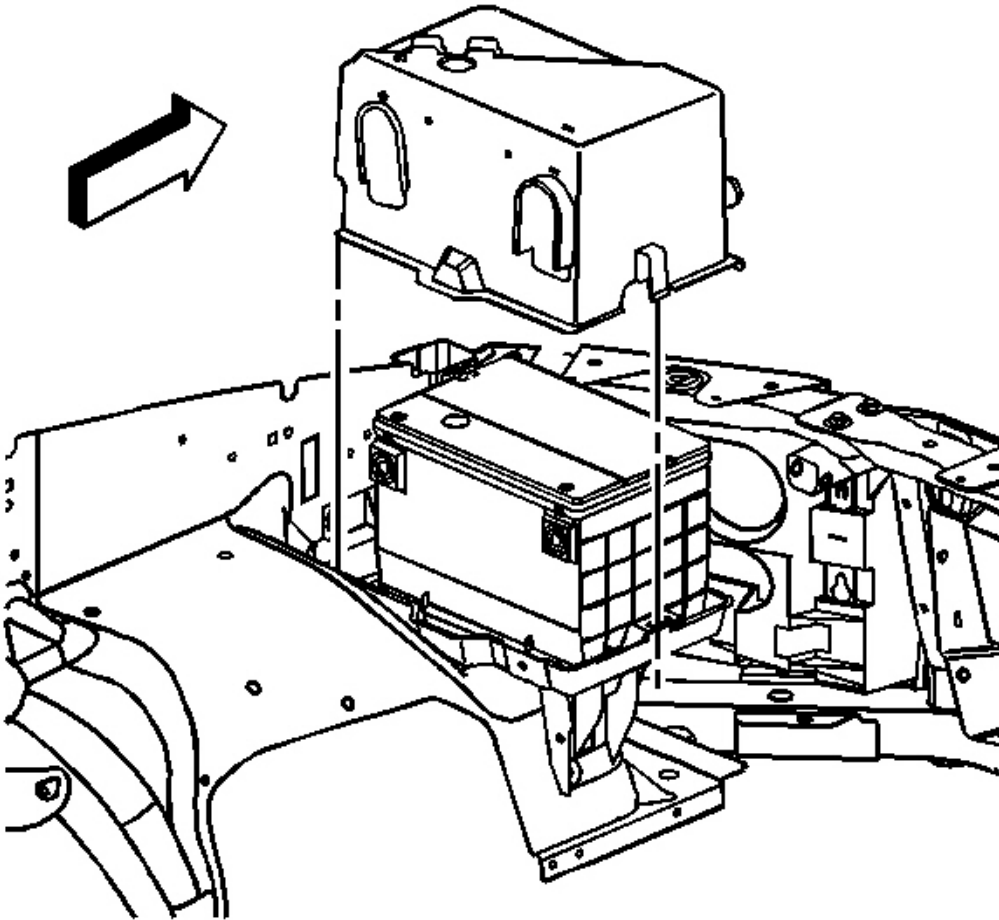


**Fig. 43: View Of Battery Hold Down Nut, Washer & Retainer**  
Courtesy of GENERAL MOTORS CORP.

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

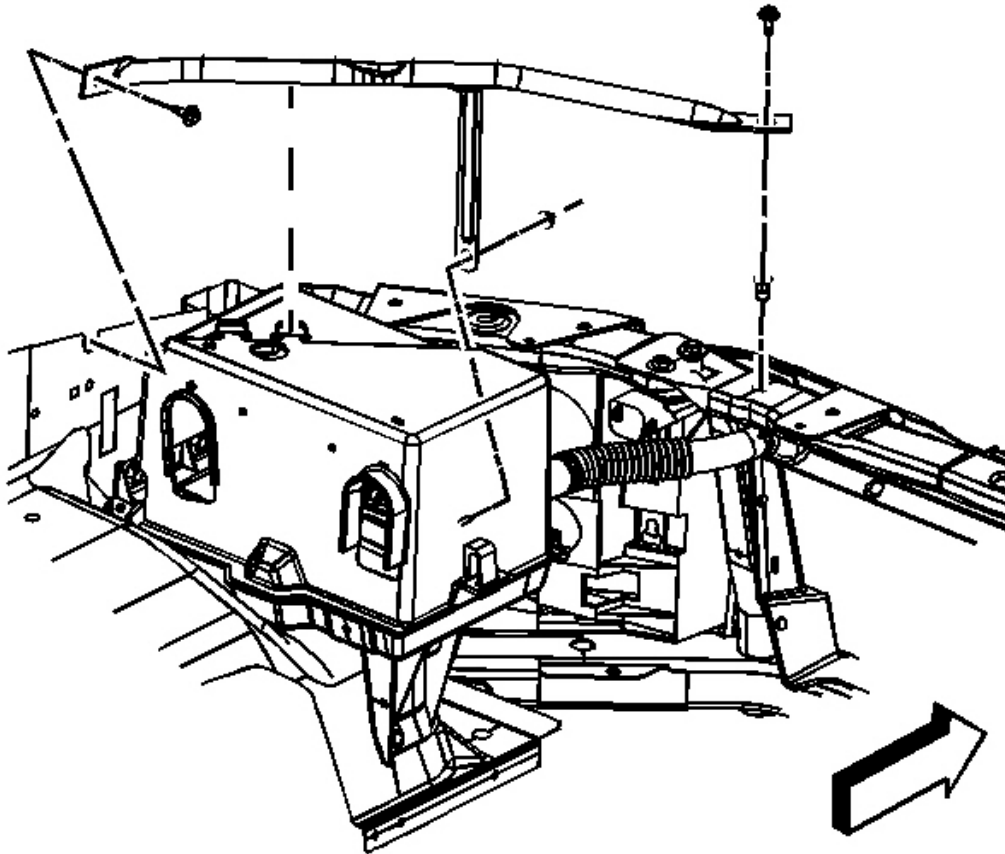
1. Install the battery.
2. Install the battery hold down retainer (1), nut (3), and washer.

**Tighten:** Tighten the nut to 15 N.m (11 lb ft).



**Fig. 44: View Of Battery Cover**  
**Courtesy of GENERAL MOTORS CORP.**

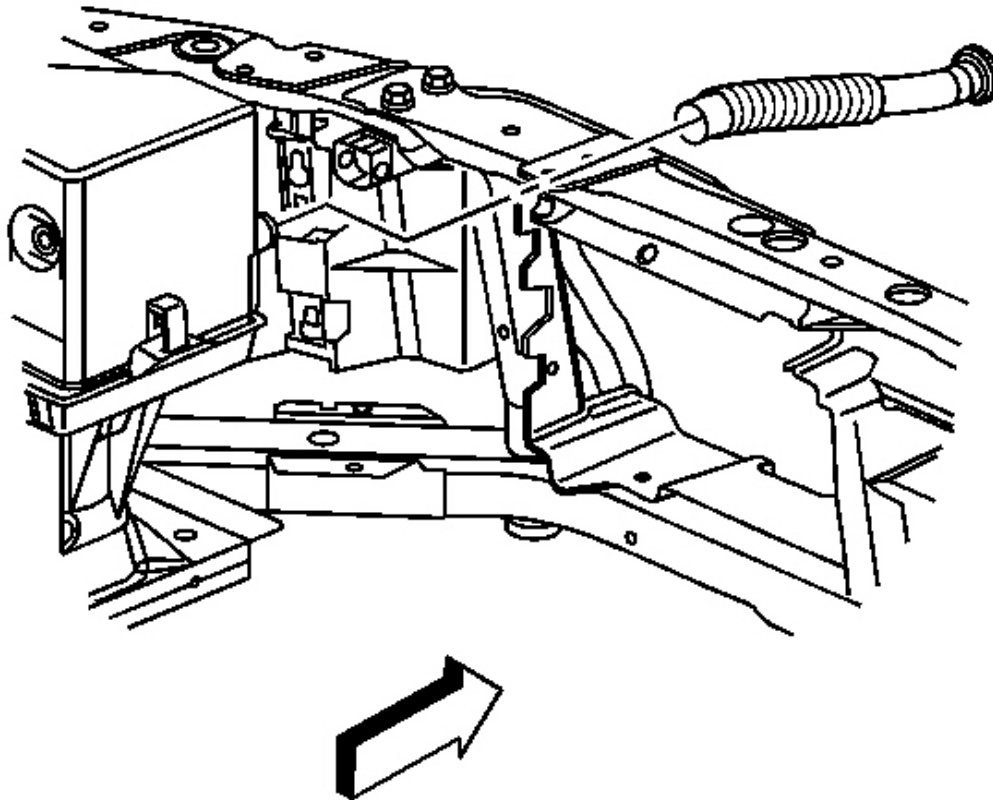
3. Install the battery cover.



**Fig. 45: Radiator Support Diagonal Brace**  
**Courtesy of GENERAL MOTORS CORP.**

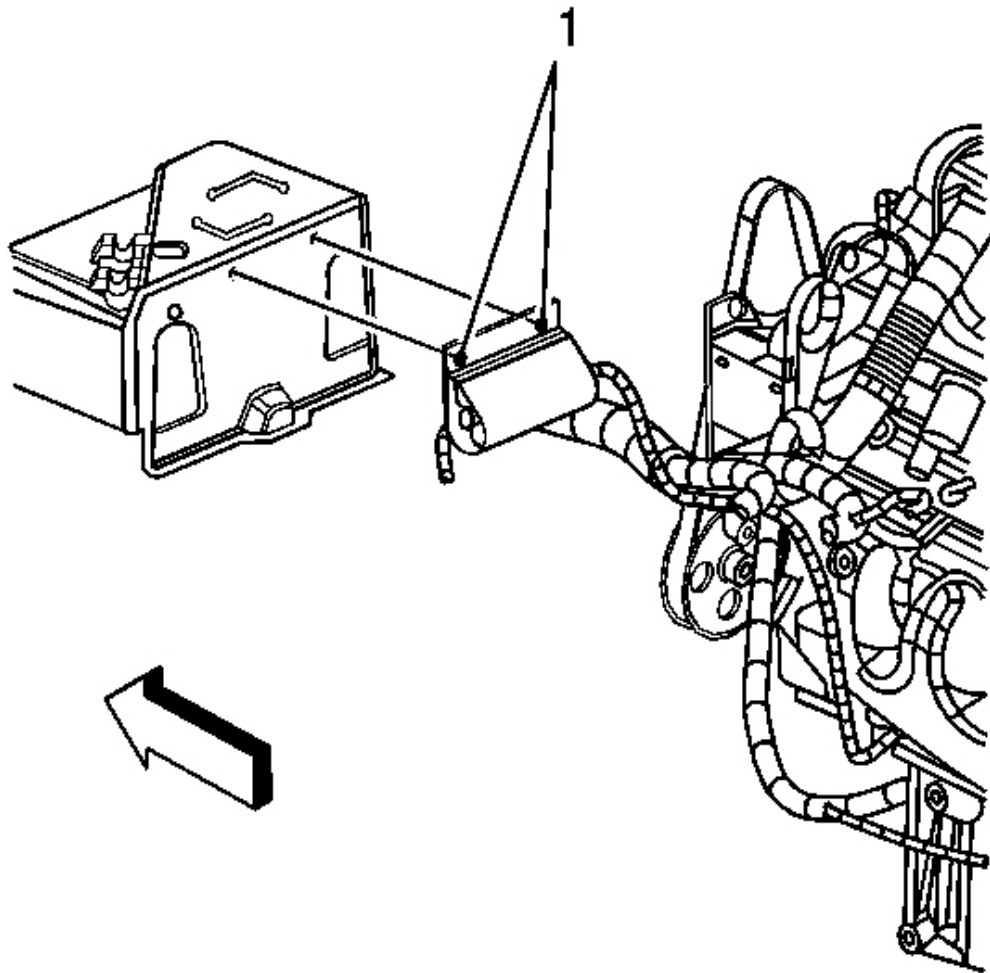
4. Install the battery tray brace bolts/nut.

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



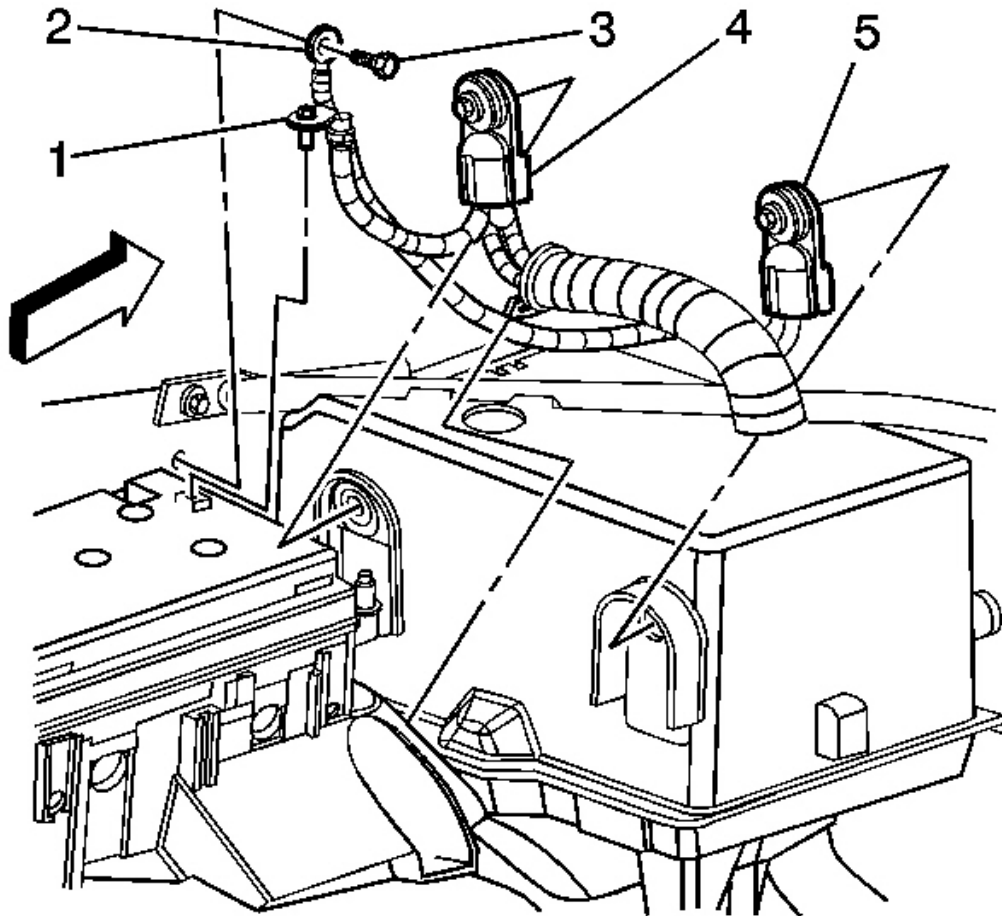
**Fig. 46: View Of Battery Air Duct**  
**Courtesy of GENERAL MOTORS CORP.**

5. Install the battery air duct to the battery cover.



**Fig. 47: View Of Coolant Heater Cord Retainers**  
**Courtesy of GENERAL MOTORS CORP.**

6. Install the coolant heater cord retainers (1) to the battery cover, if equipped.



**Fig. 48: Identifying Battery Cable Components**  
Courtesy of GENERAL MOTORS CORP.

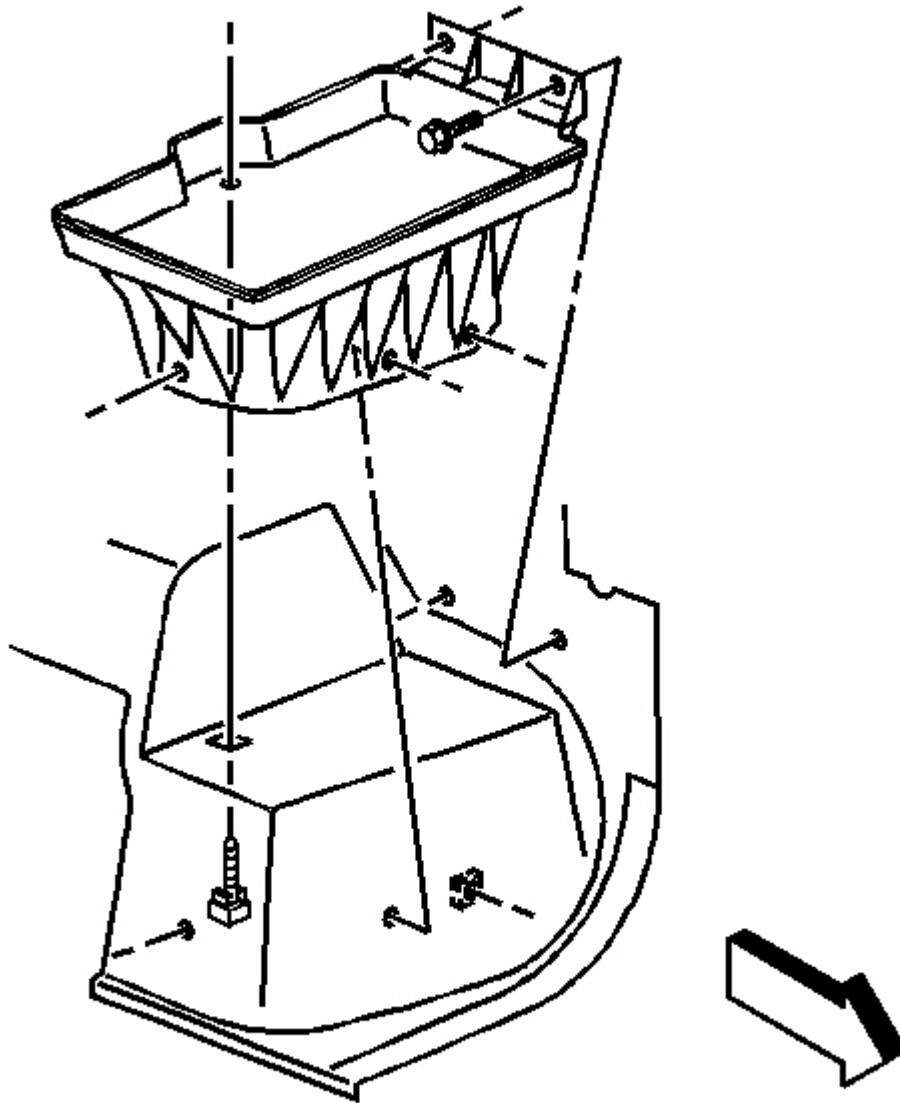
7. Position the positive battery cable (4) to the battery.
8. Tighten the positive battery cable bolt.

**Tighten:** Tighten the bolt to 15 N.m (11 lb ft).

9. Connect the negative battery cable (5). Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

### Removal Procedure

1. Remove the battery. Refer to **Battery Replacement**.



**Fig. 49: View Of Battery Tray Bolts**  
Courtesy of GENERAL MOTORS CORP.

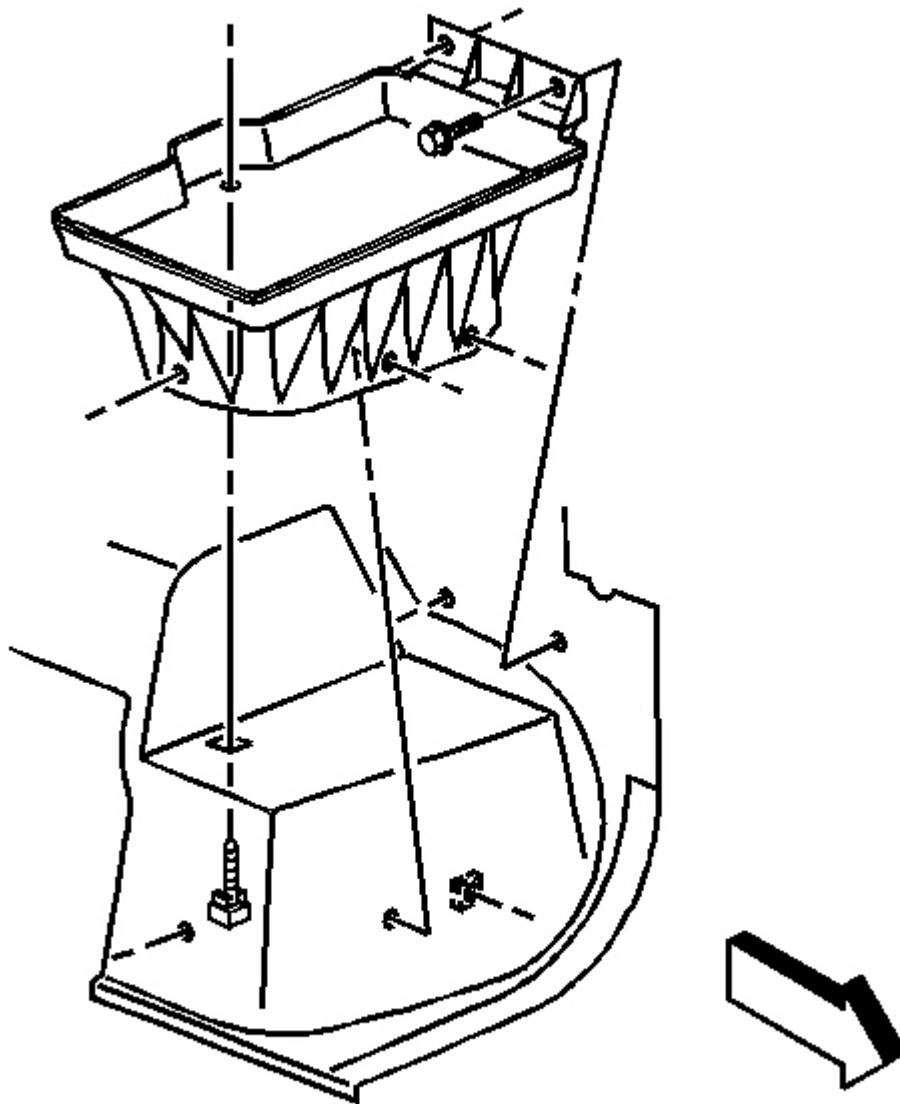
## 2006 Buick Rainier

2006 ENGINE Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

2. Loosen and remove the 5 bolts that secure the battery tray to the wheelhouse.
3. Remove the battery tray.

### Installation Procedure

1. Install the battery tray.





**Fig. 50: View Of Battery Tray Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

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

2. Install the 5 bolts to the battery tray.

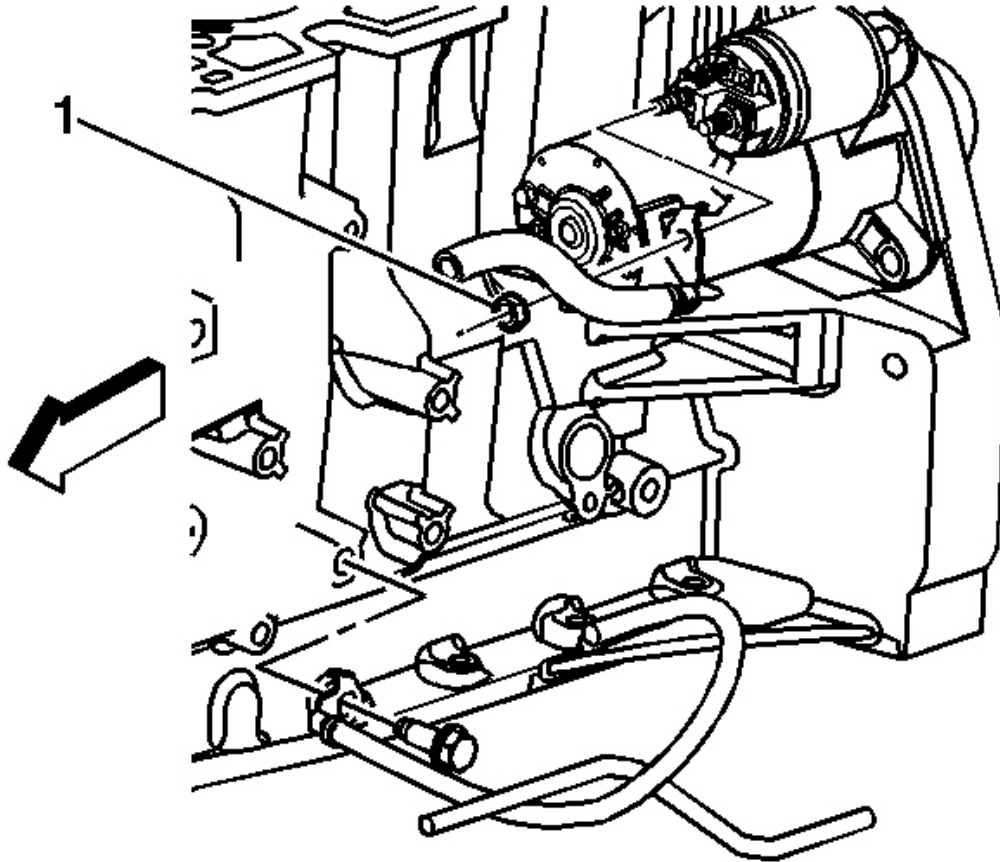
**Tighten:** Tighten the bolts to 20 N.m (15 lb ft).

3. Install the battery.

**STARTER MOTOR REPLACEMENT (4.2L ENGINE)**

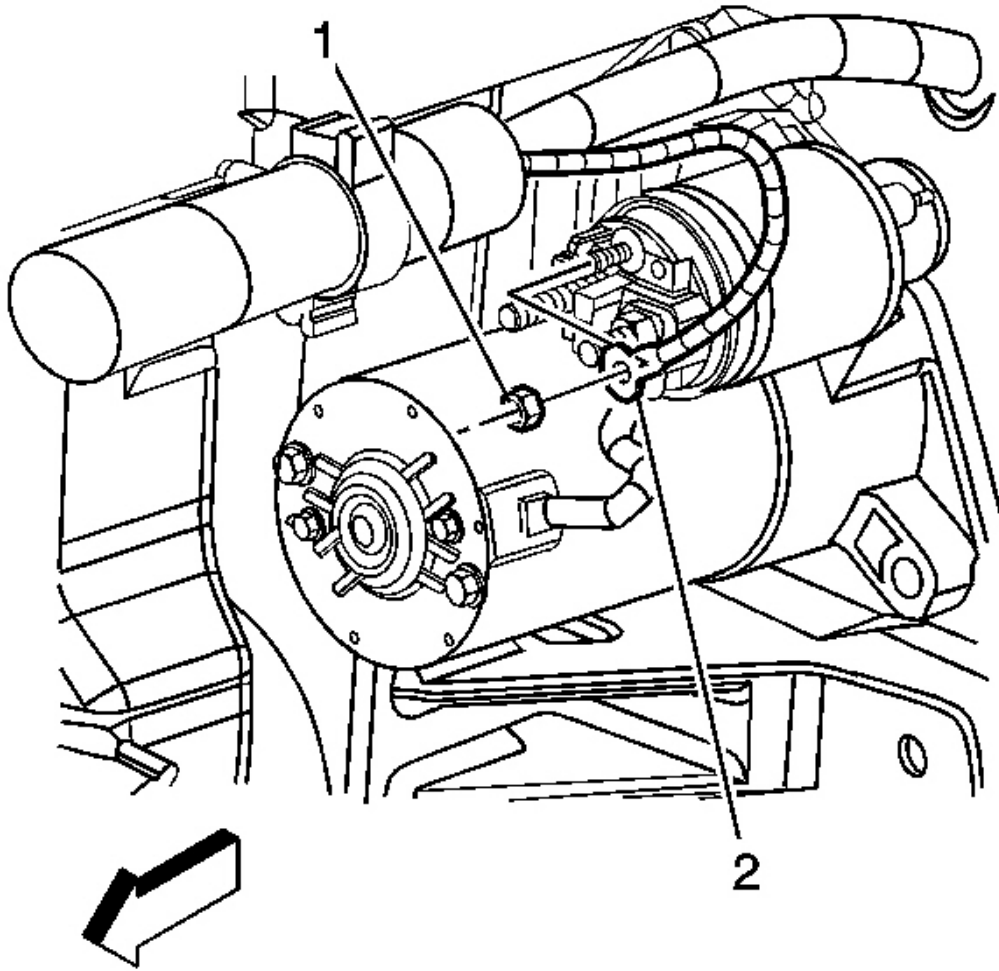
**Removal Procedure**

1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnect/Connect Procedure.
2. Remove the vacuum brake booster hose. Refer to Vacuum Brake Booster Check Valve and/or Hose Replacement in Hydraulic Brakes.



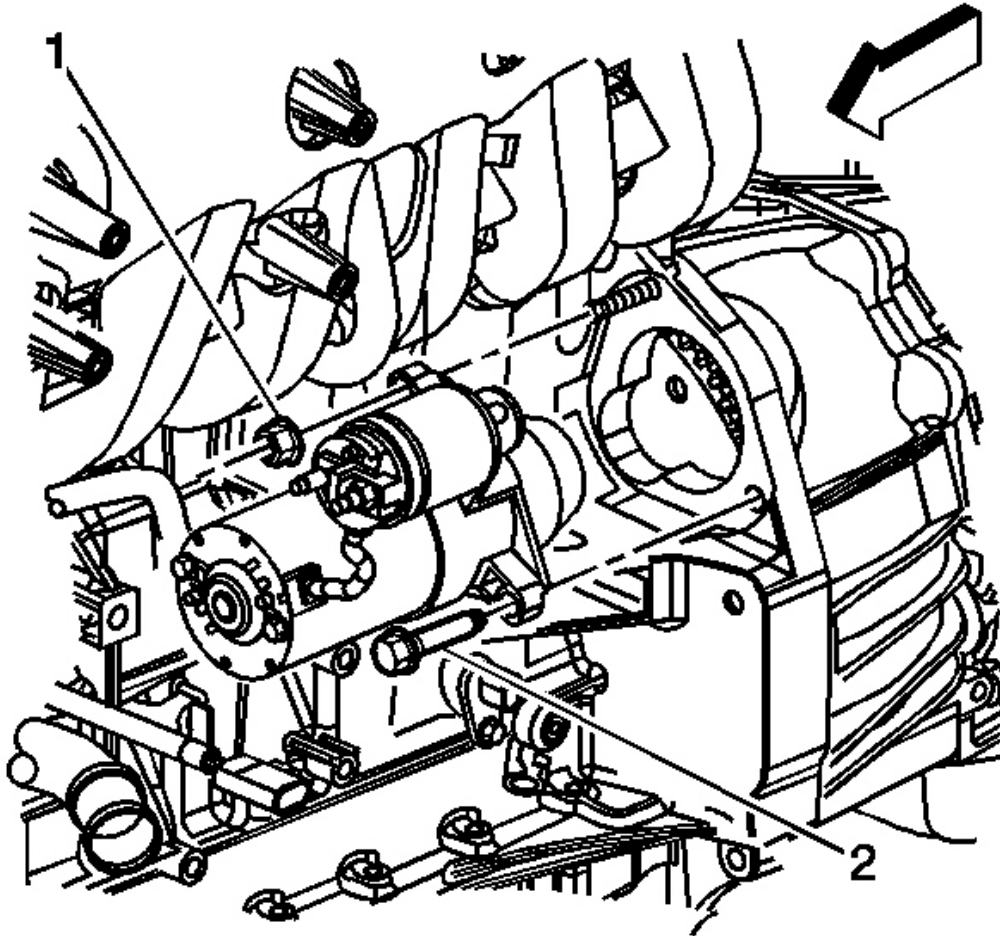
**Fig. 51: View Of Starter & Related Components**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the battery positive lead from the solenoid (1).



**Fig. 52: View Of Starter Solenoid S-Terminal Lead & Nut**  
**Courtesy of GENERAL MOTORS CORP.**

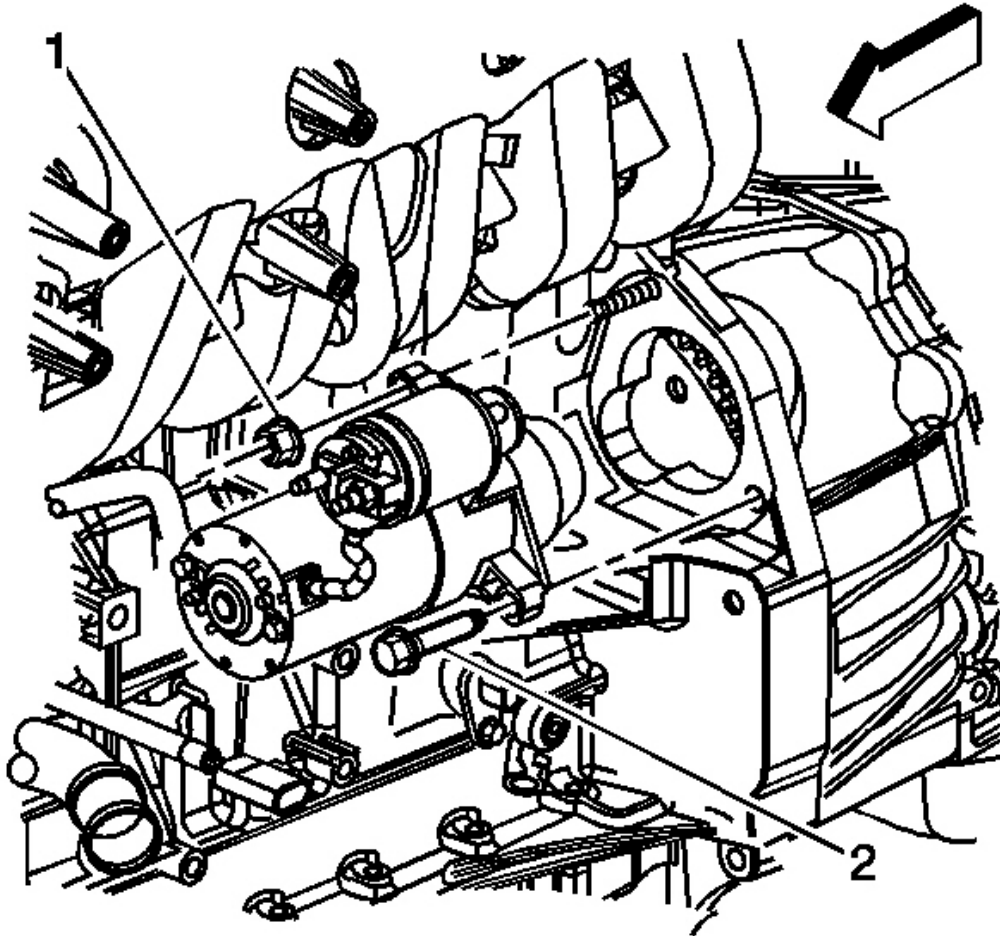
4. Remove the starter solenoid S-terminal lead nut (1) from the solenoid.
5. Remove the starter solenoid S-terminal lead (2) from the solenoid.



**Fig. 53: View Of Starter Mount Bolt & Nut**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the starter mount bolt and nut (1, 2).
7. Remove the starter motor.

**Installation Procedure**



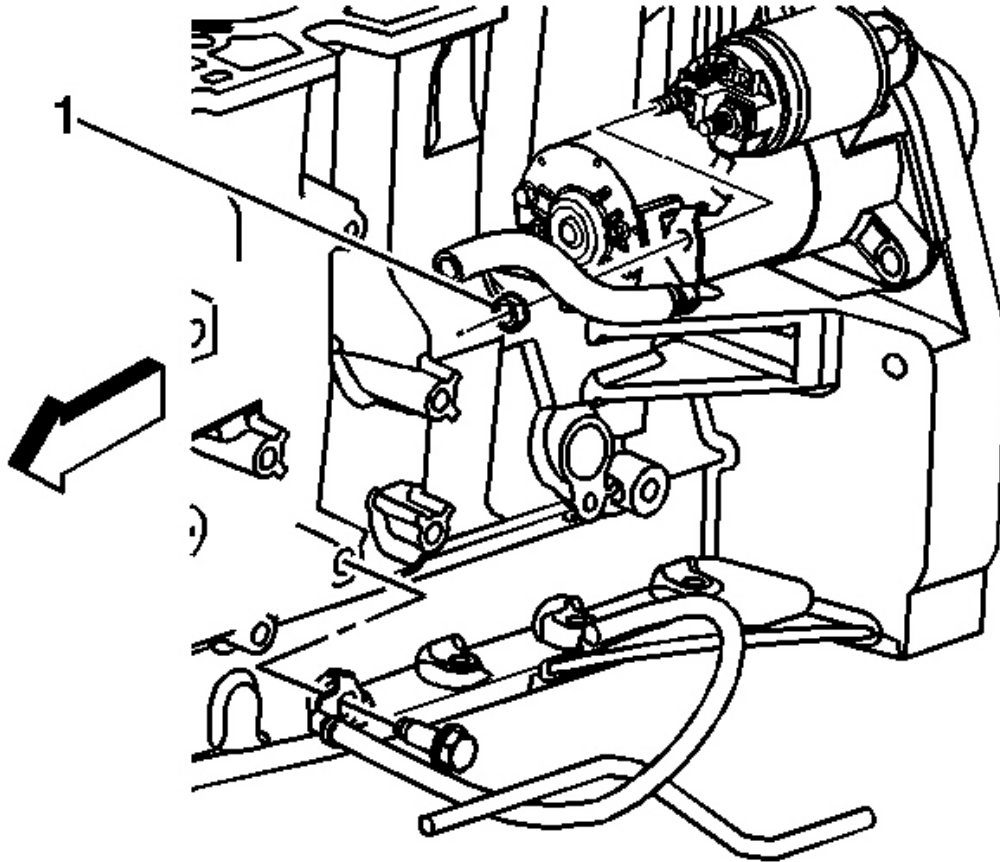
**Fig. 54: View Of Starter Mount Bolt & Nut**  
Courtesy of GENERAL MOTORS CORP.

1. Install the starter motor.

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

2. Install the starter motor mount bolt (2) and nut (1).

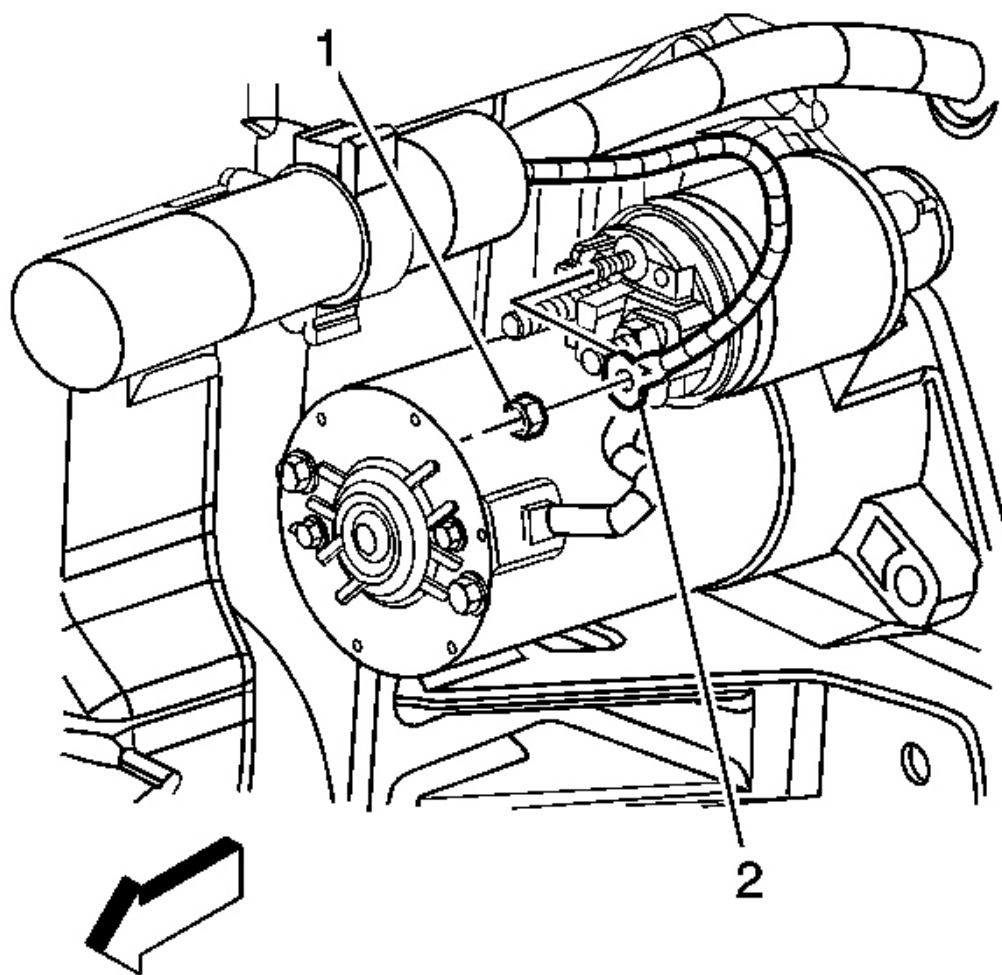
**Tighten:** Tighten the starter mount bolt and nut to 50 N.m (37 lb ft).



**Fig. 55: View Of Starter & Related Components**  
**Courtesy of GENERAL MOTORS CORP.**

3. Connect the positive battery cable to the starter solenoid and secure the cable with a nut (1).

**Tighten:** Tighten the positive cable nut to 9 N.m (80 lb in).



**Fig. 56: View Of Starter Solenoid S-Terminal Lead & Nut**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the starter solenoid S-terminal lead (2) to the solenoid and secure the lead with a nut (1).

**Tighten:** Tighten the S-terminal nut to 2.3 N.m (20 lb in).

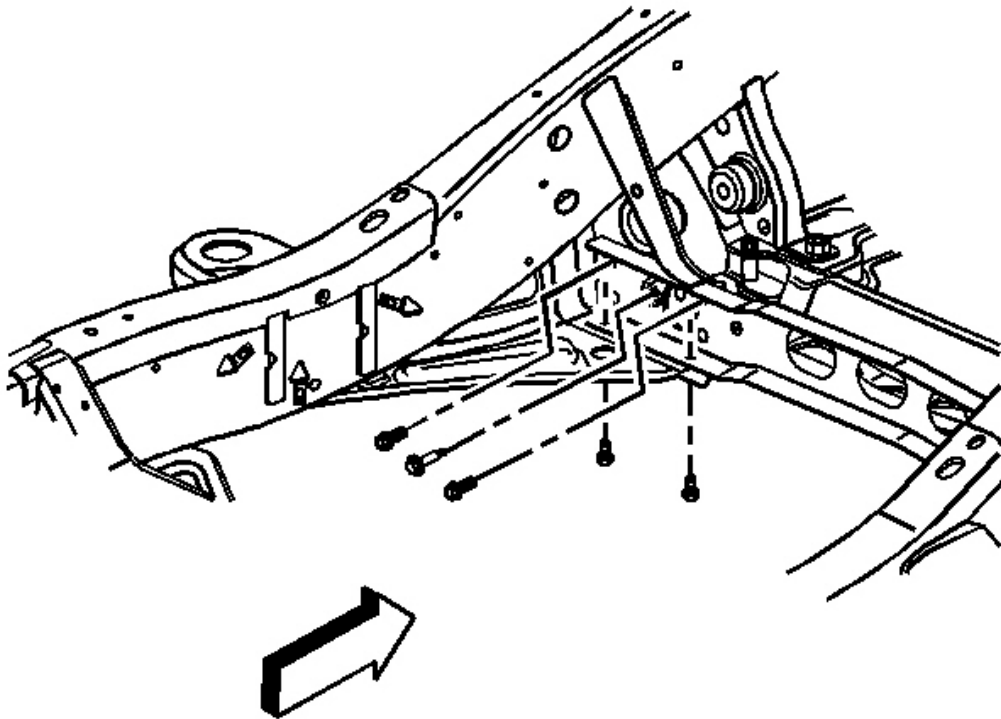
5. Install the vacuum brake booster hose. Refer to **Vacuum Brake Booster Check Valve and/or Hose Replacement** in Hydraulic Brakes.
6. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect**

## **Procedure.**

### **STARTER MOTOR REPLACEMENT (5.3L AND 6.0L ENGINES)**

#### **Removal Procedure**

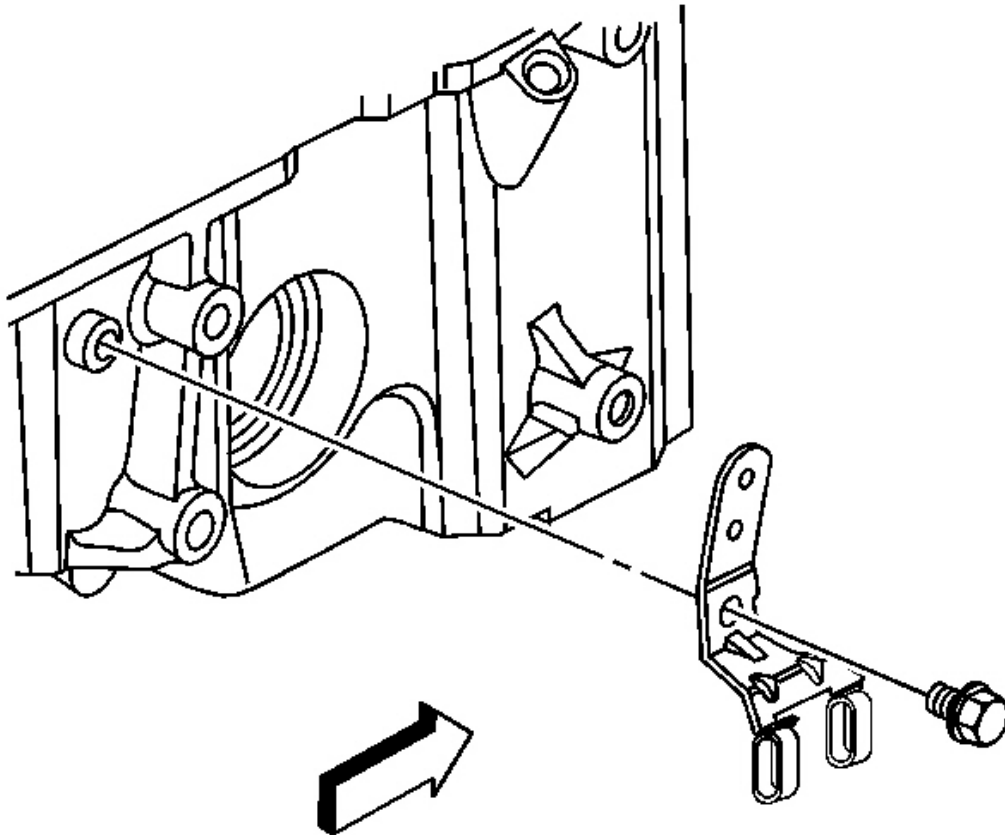
1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure.**
2. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle .**



**Fig. 57: Removing Rear Steering Gear Crossmember**  
**Courtesy of GENERAL MOTORS CORP.**

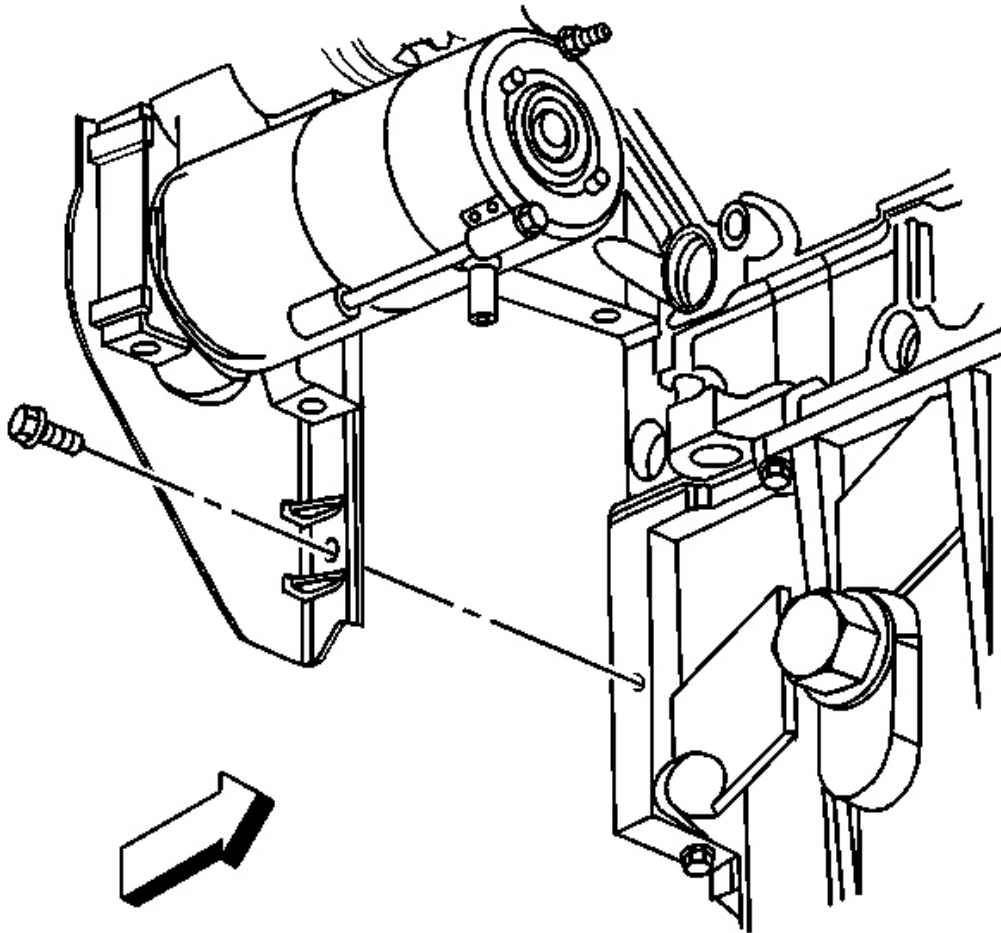
3. Remove the rear steering gear crossmember. Refer to **Crossmember Replacement - Rear Steering Gear .**
4. Remove the wire harness from the wire harness retaining clips on the transmission oil cooler line bracket.





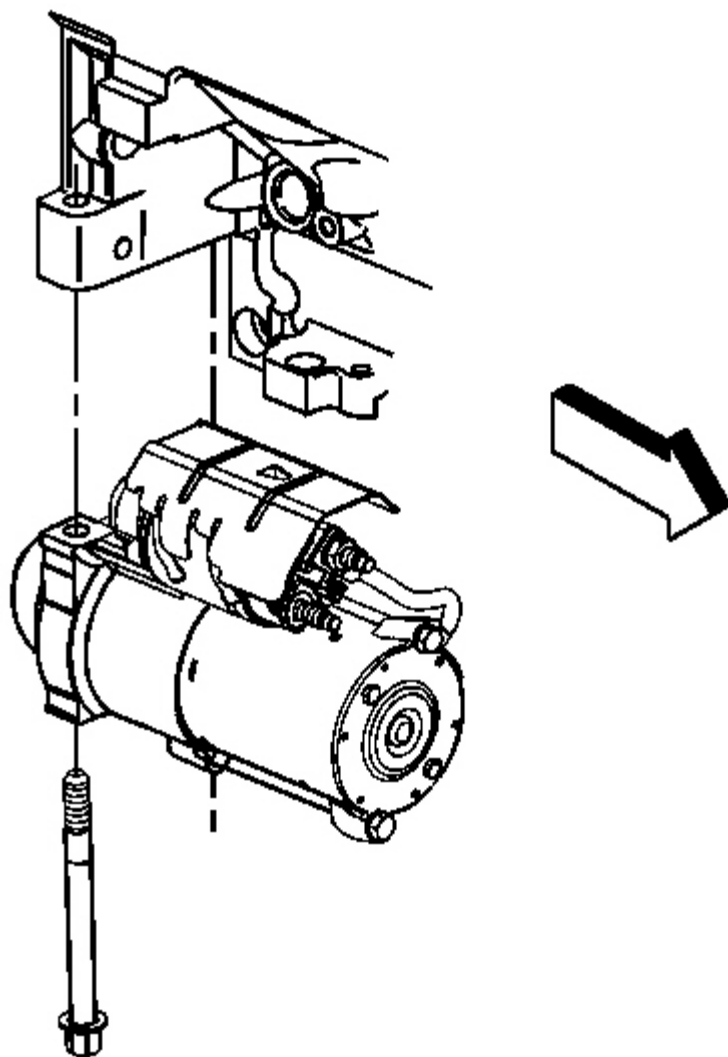
**Fig. 58: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt**  
Courtesy of GENERAL MOTORS CORP.

5. Remove the transmission oil cooler line bracket bolt.



**Fig. 59: View Of Transmission Cover Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

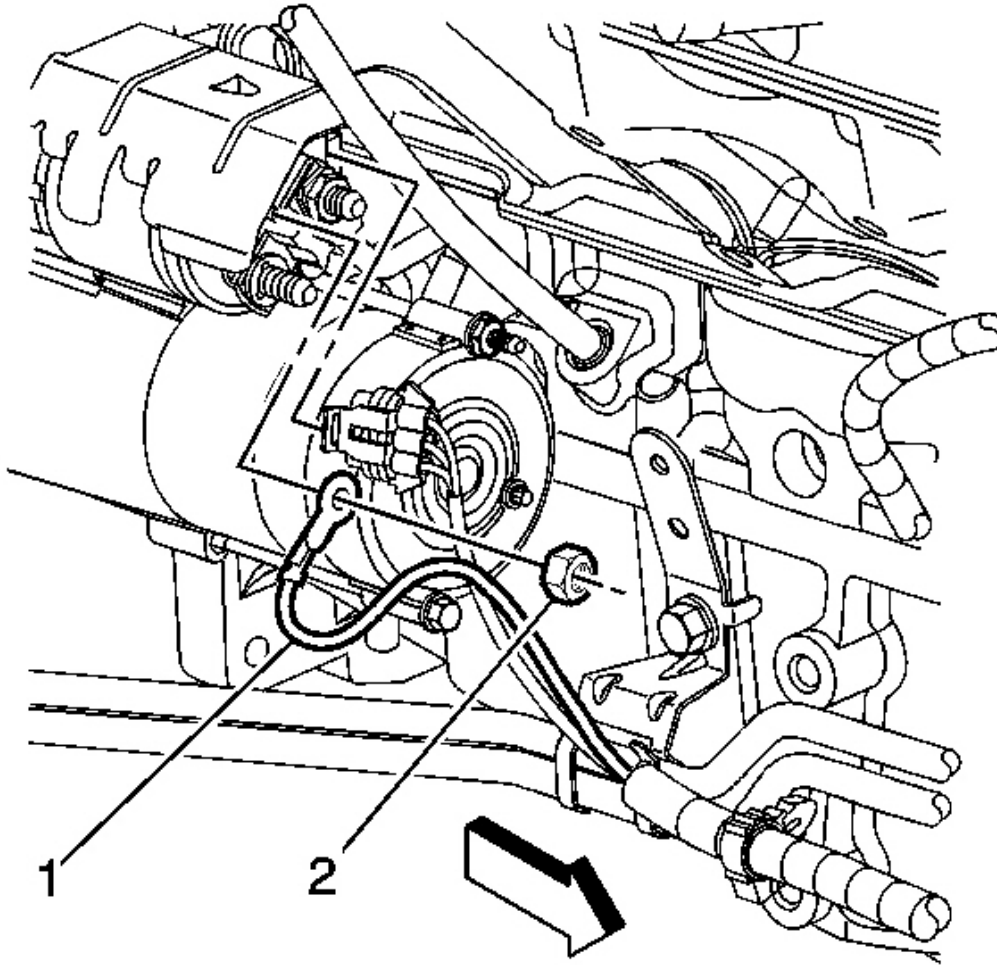
6. Remove the right transmission cover bolt.



**Fig. 60: View Of Starter & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

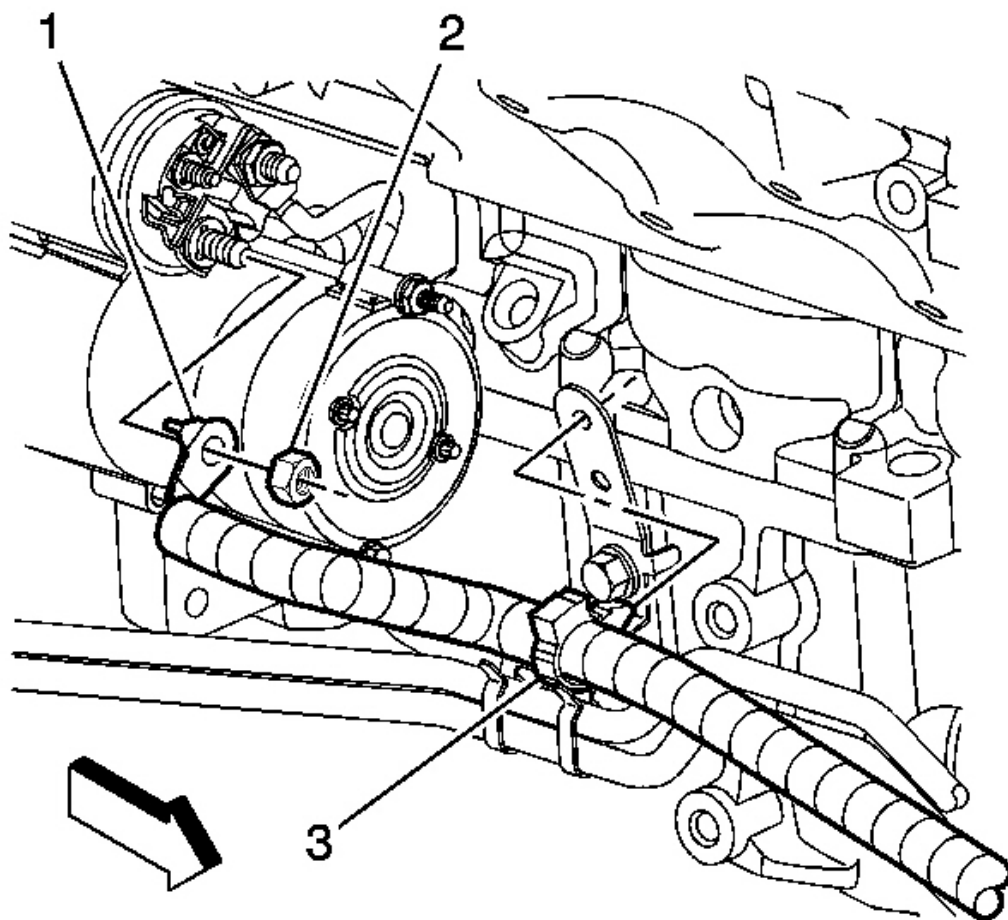
7. Remove the starter bolts.
8. Move the starter toward the front of the vehicle, and remove the transmission cover.
9. Remove the starter solenoid heat shield.
10. Tilt and rotate the starter in order to pass the starter between the transmission oil cooler

lines and the engine oil pan.



**Fig. 61: View Of Starter Solenoid Lead & Nut**  
**Courtesy of GENERAL MOTORS CORP.**

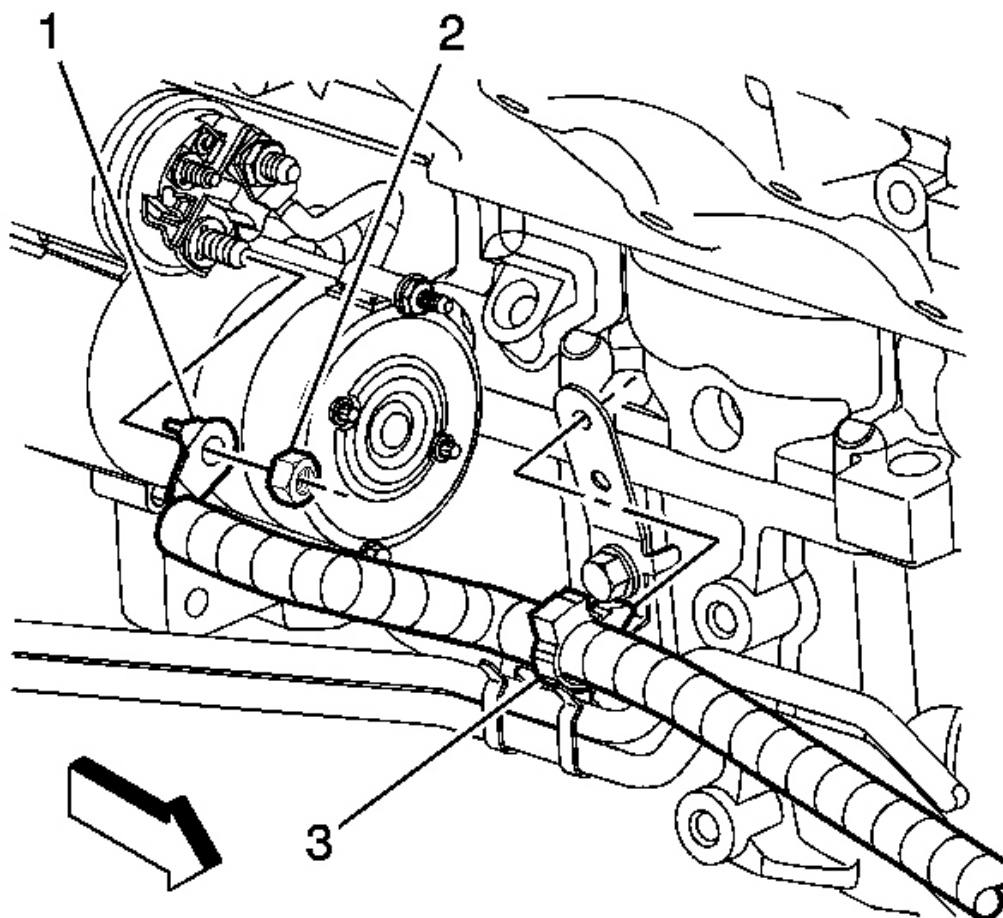
11. Remove the starter solenoid nut (2).
12. Remove the starter lead (1) from the solenoid stud.



**Fig. 62: View Of Positive Cable Lead, Nut & Cable Clip**  
**Courtesy of GENERAL MOTORS CORP.**

13. Remove the battery positive cable nut (2).
14. Remove the battery positive cable (1) from the starter solenoid.
15. Finish removing the starter from the vehicle.

**Installation Procedure**



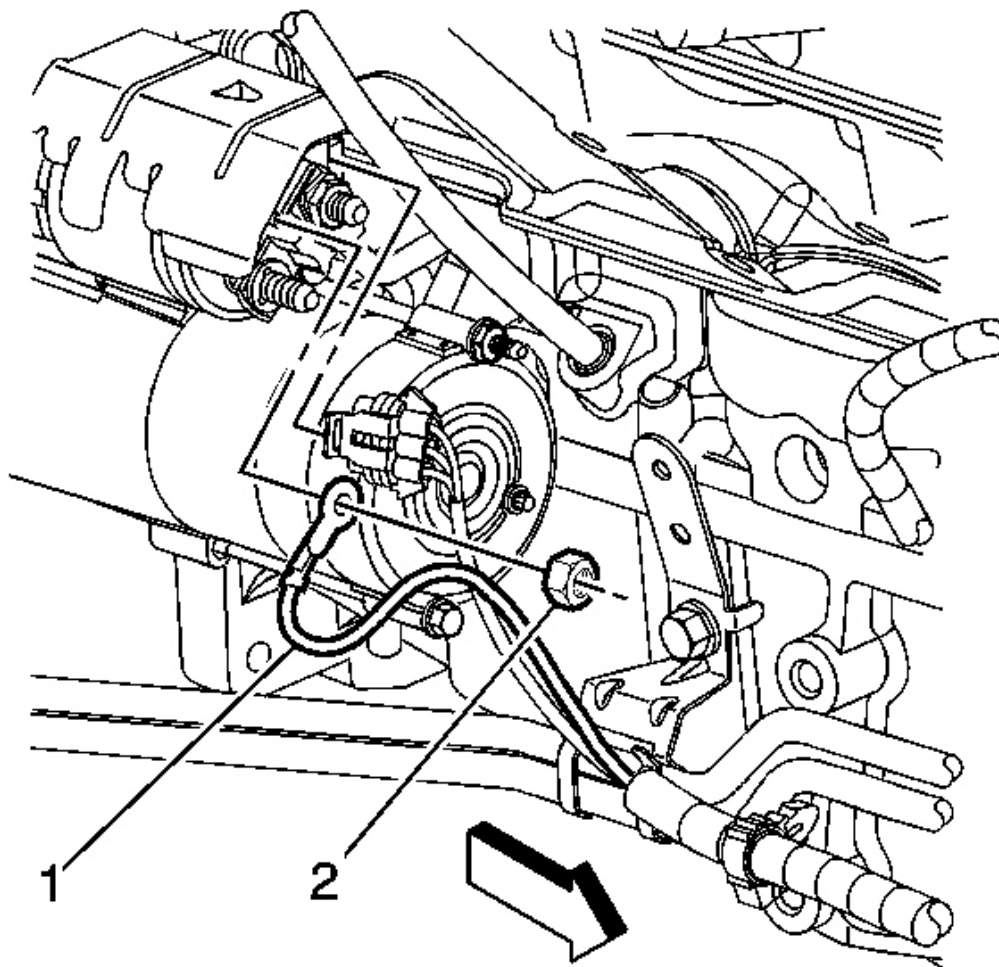
**Fig. 63: View Of Positive Cable Lead, Nut & Cable Clip**  
**Courtesy of GENERAL MOTORS CORP.**

1. Begin installing the starter between the transmission oil cooler lines and the engine oil pan.
2. Install the battery positive cable (1) to the starter stud.

**NOTE:** Refer to **Fastener Notice** .

3. Install the battery positive cable nut (2).

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

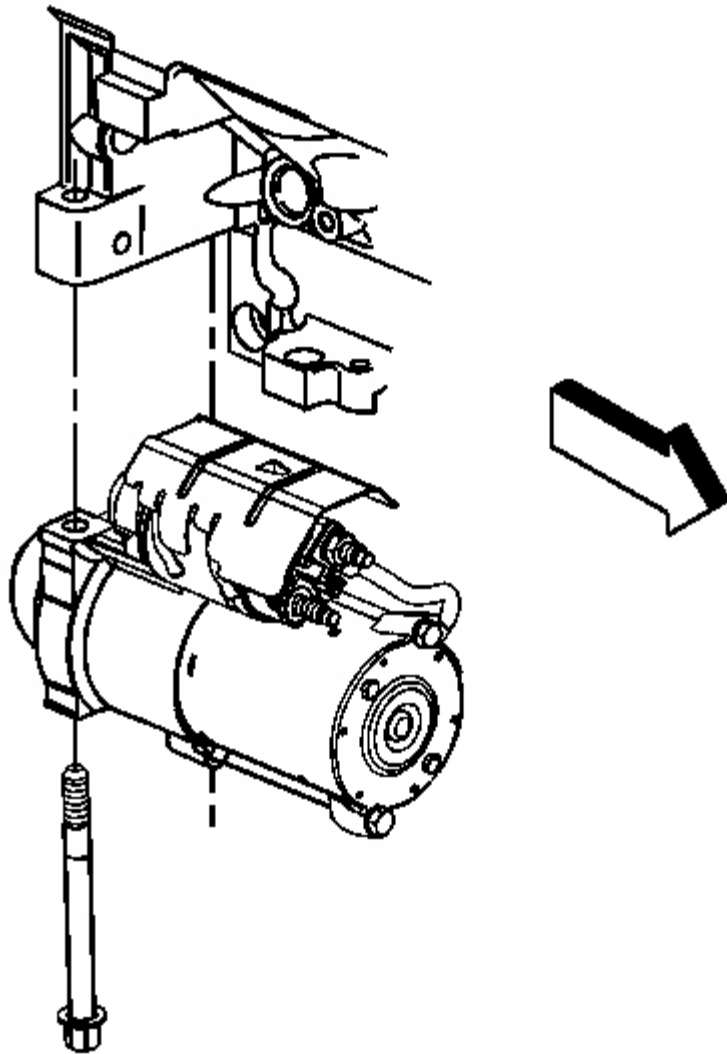


**Fig. 64: View Of Starter Solenoid Lead & Nut**  
**Courtesy of GENERAL MOTORS CORP.**

4. Install the starter solenoid lead (1) to the solenoid stud.
5. Install the starter solenoid nut (2).

**Tighten:** Tighten the nut to 3.4 N.m (30 lb in).

6. Install the starter solenoid heat shield.



**Fig. 65: View Of Starter & Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

7. Slide the starter toward the front of the vehicle.

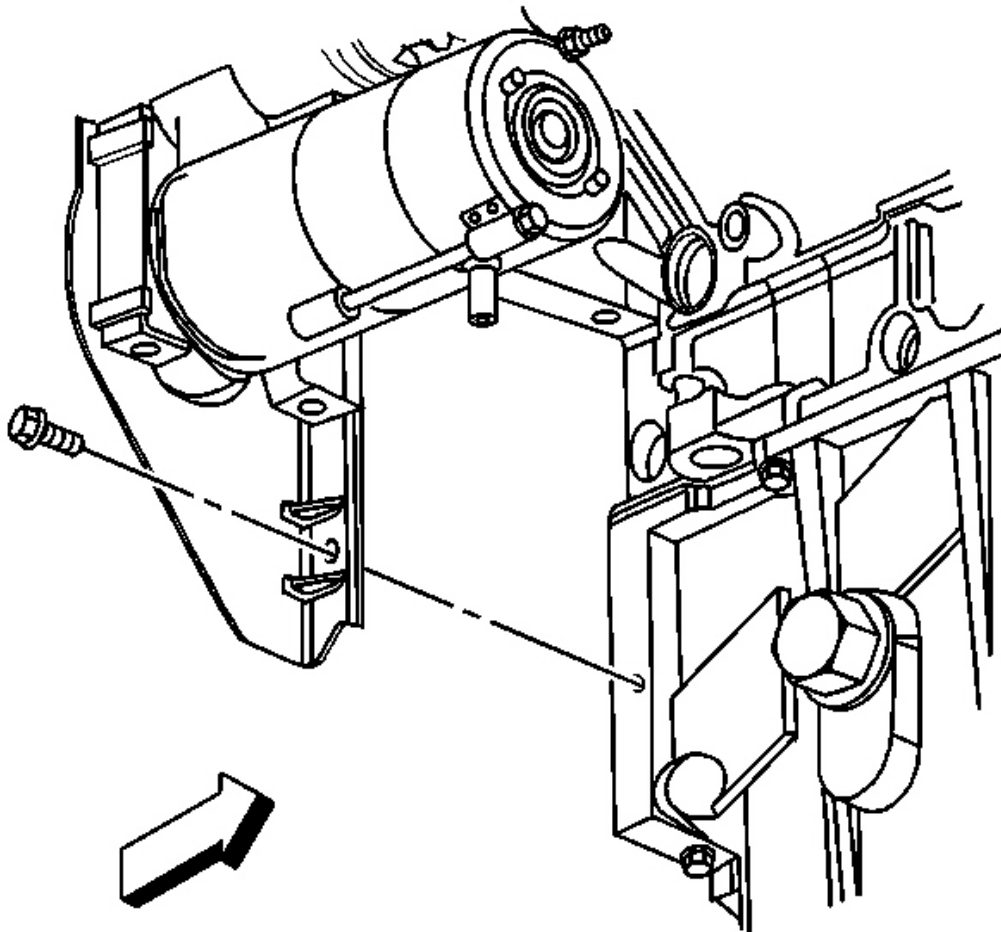
Position the transmission cover to the transmission.

8. Position the starter to the engine



9. Install the starter bolts.

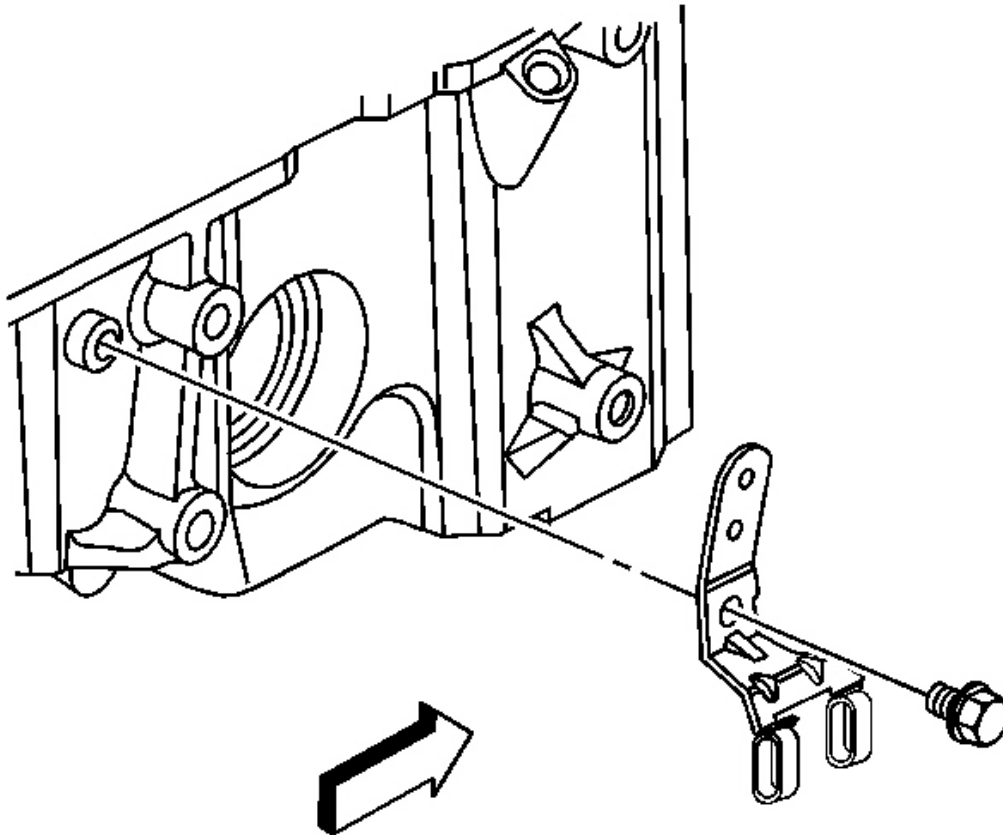
**Tighten:** Tighten the bolts to 50 N.m (37 lb ft).



**Fig. 66: View Of Transmission Cover Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

10. Install the right transmission cover bolt.

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

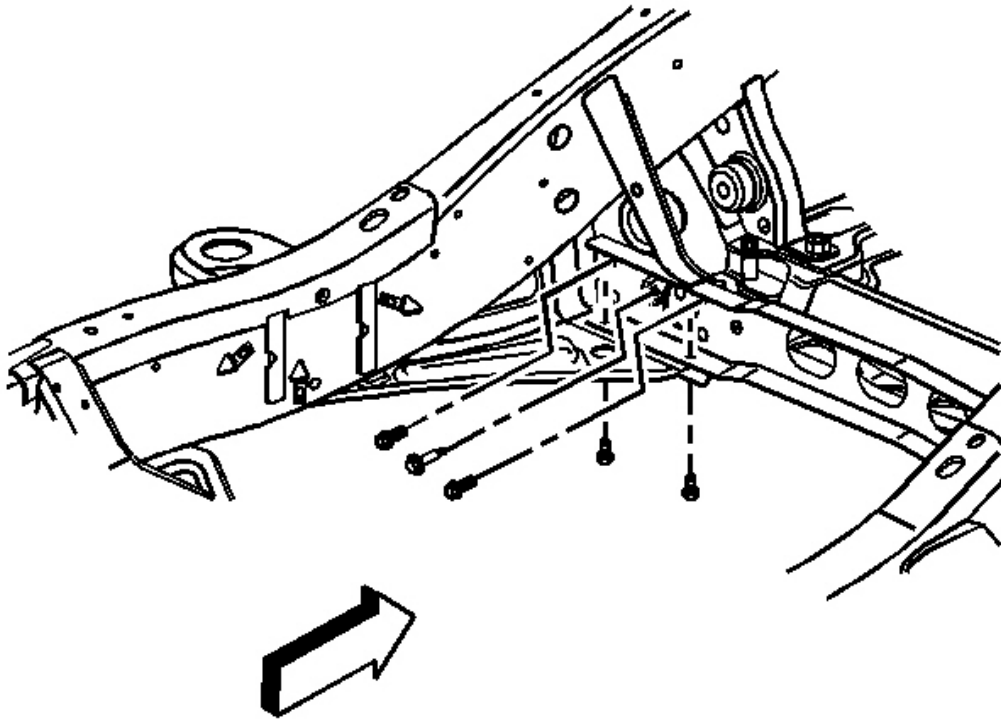


**Fig. 67: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt**  
Courtesy of GENERAL MOTORS CORP.

11. Install the transmission oil cooler line bracket bolt.

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

12. Attach the wire harness to the wire harness retaining clips on the transmission oil cooler line bracket.

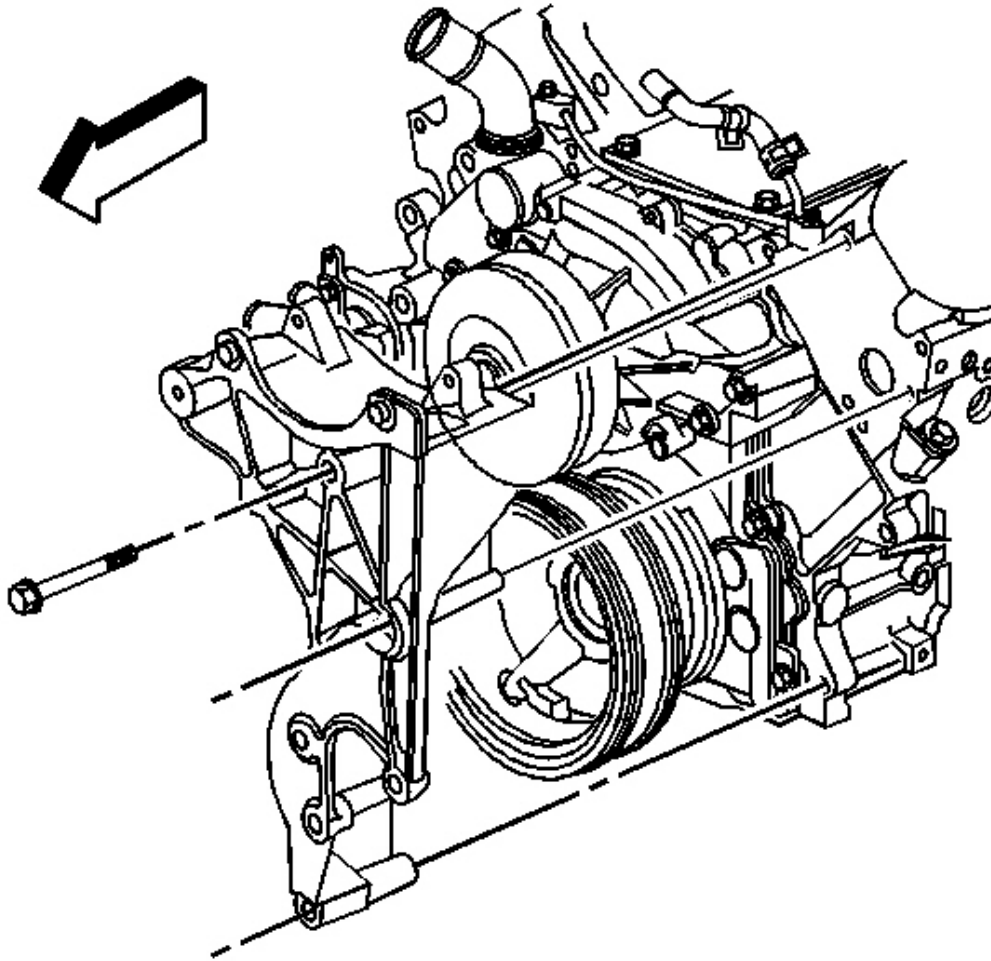


**Fig. 68: Removing Rear Steering Gear Crossmember**  
Courtesy of GENERAL MOTORS CORP.

13. Install the rear steering gear crossmember. Refer to **Crossmember Replacement - Rear Steering Gear** .
14. Lower the vehicle.
15. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

#### GENERATOR BRACKET REPLACEMENT (5.3L AND 6.0L ENGINES)

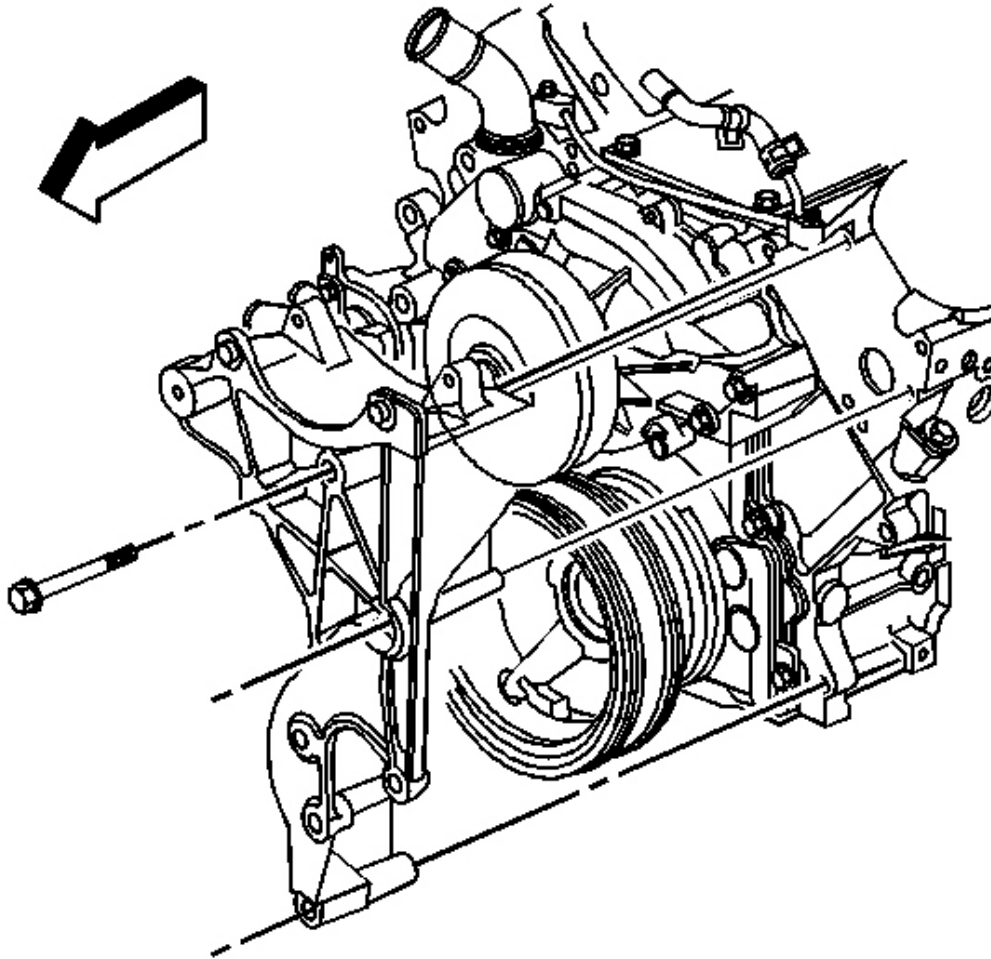
##### Removal Procedure



**Fig. 69: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the generator. Refer to **Generator Replacement (4.2L Engine)** or **Generator Replacement (5.3L and 6.0L Engines)**.
2. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)** .
3. Remove the generator bracket bolts.
4. Remove the generator bracket.

## Installation Procedure



**Fig. 70: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)**  
Courtesy of GENERAL MOTORS CORP.

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

1. Install the generator bracket.
2. Install the generator bracket bolts.

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

## 2006 Buick Rainier

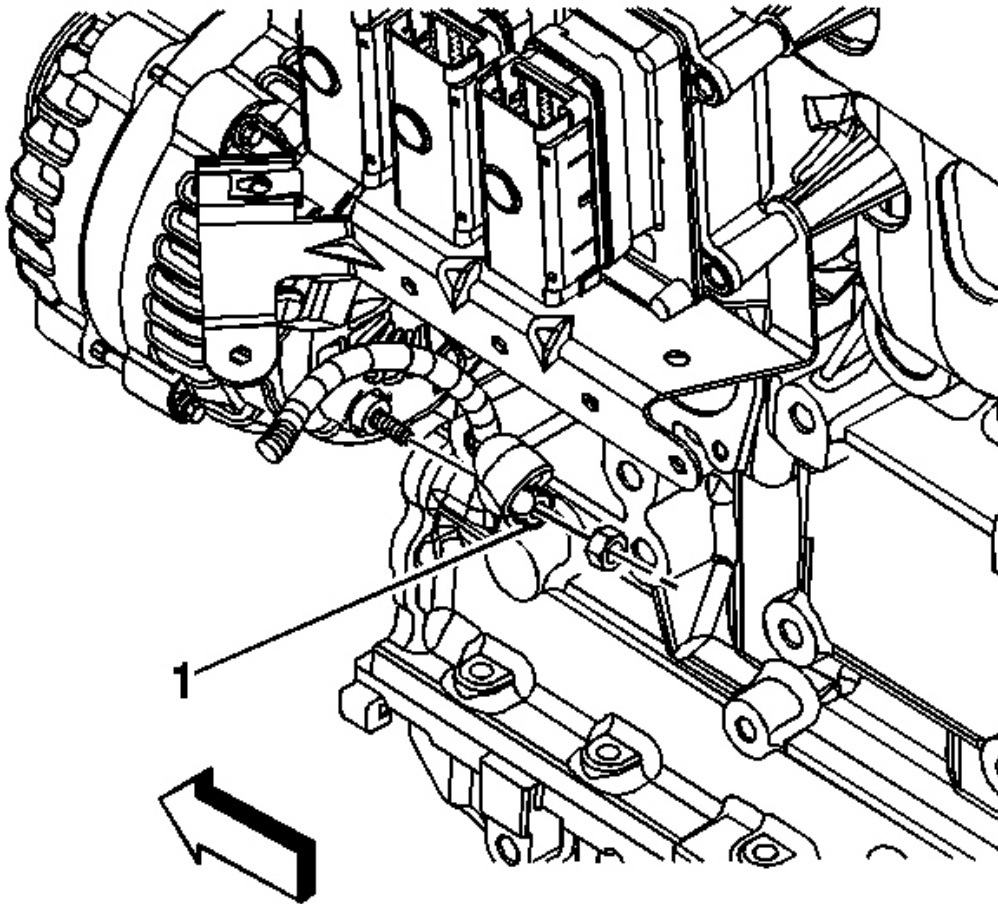
2006 ENGINE Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

3. Install the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (5.3L)** .
4. Install the generator. Refer to **Generator Replacement (4.2L Engine)** or **Generator Replacement (5.3L and 6.0L Engines)**.

### GENERATOR REPLACEMENT (4.2L ENGINE)

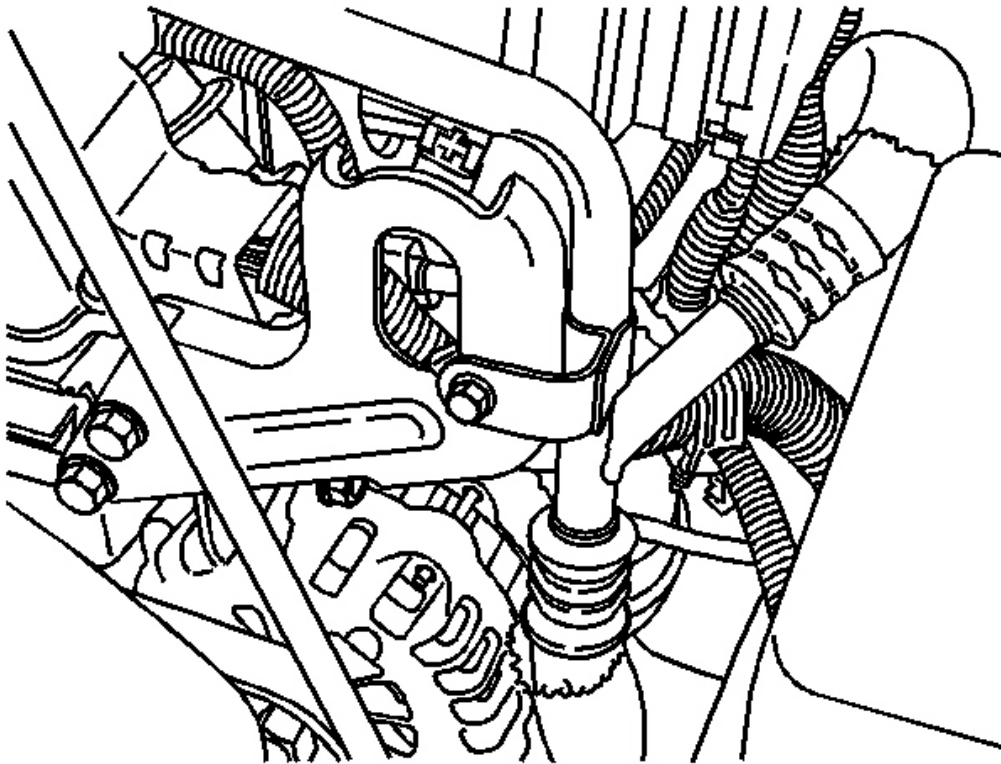
#### Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Remove the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.



**Fig. 71: Rear Of Generator (Alternator) View**  
**Courtesy of GENERAL MOTORS CORP.**

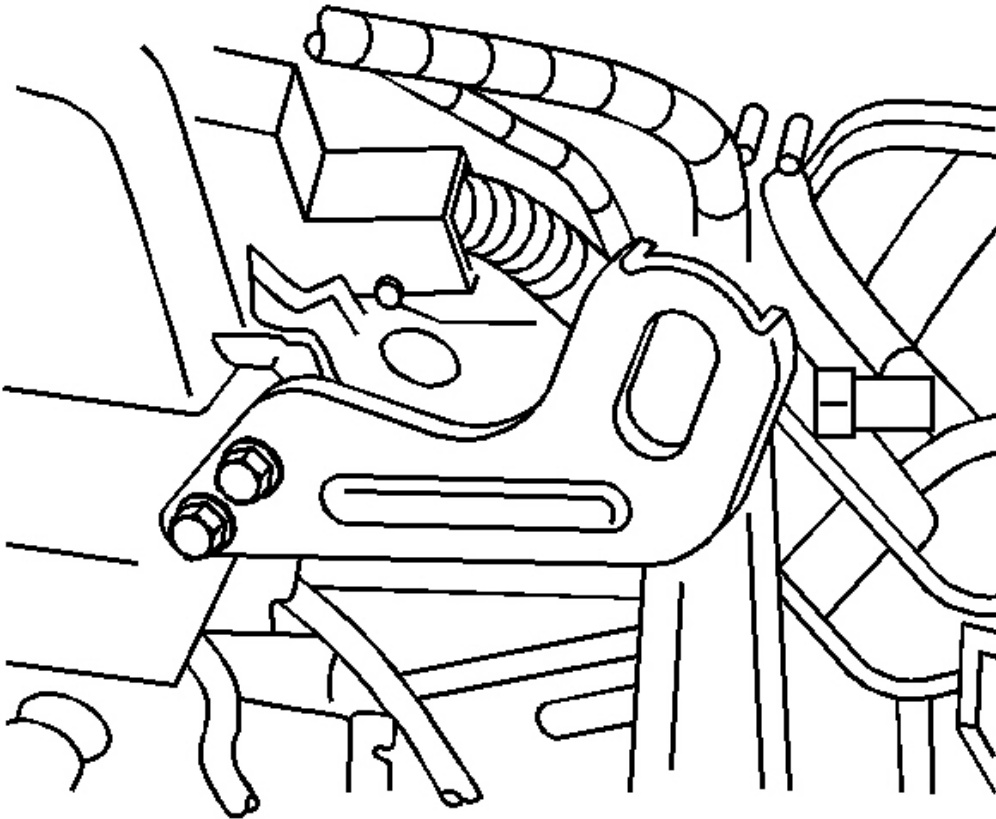
3. Disconnect the battery positive cable nut (1) on the generator.



**Fig. 72: View Of Engine Lift Hook & A/C Bracket Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

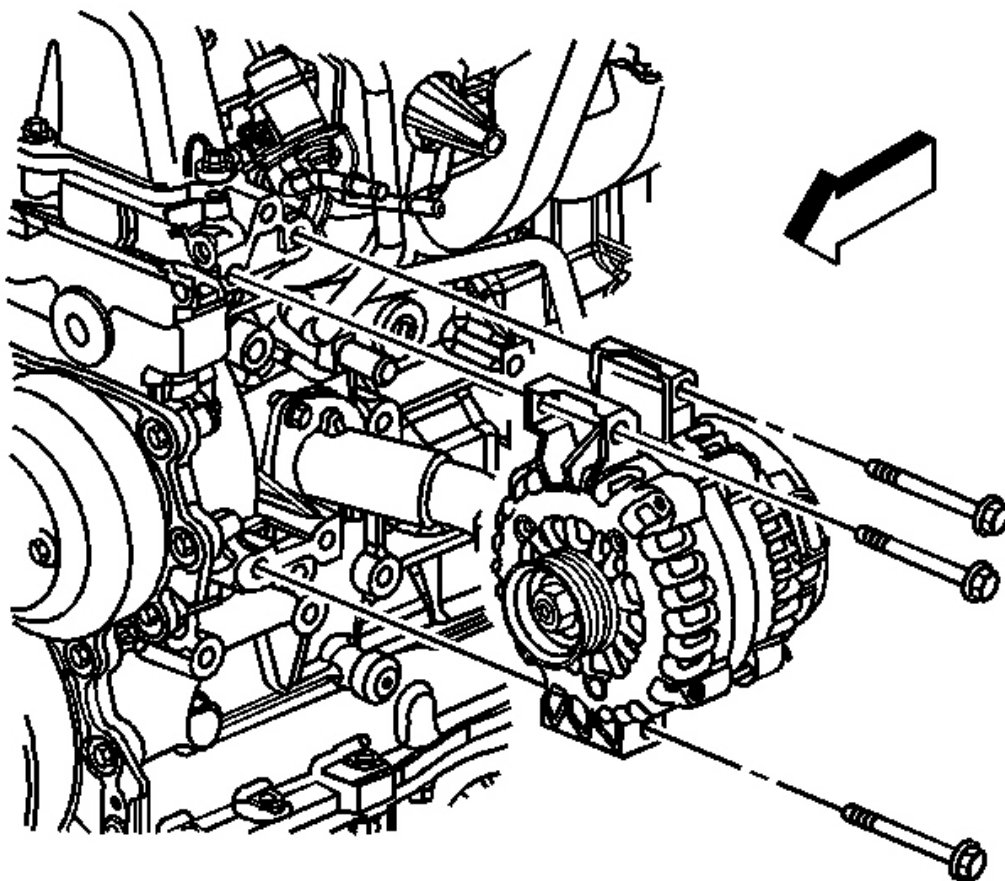
4. Remove the A/C line mounting bracket bolt at the engine life hook.





**Fig. 73: View Of Engine Lift Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the right engine lift hook bolts and remove the lift hook.



**Fig. 74: View Of Generator & Mounting Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

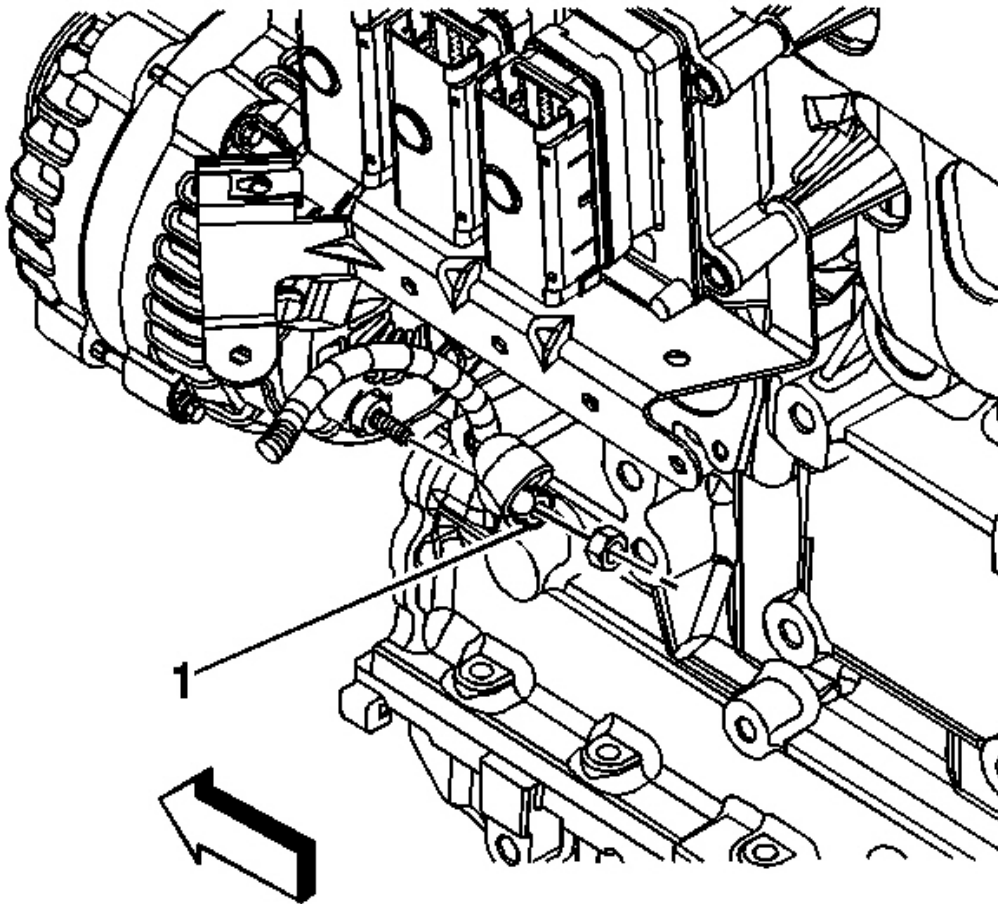
6. Remove the 3 generator mounting bolts and remove the generator.

**Installation Procedure**

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

1. Install the generator and secure the generator with 3 bolts.

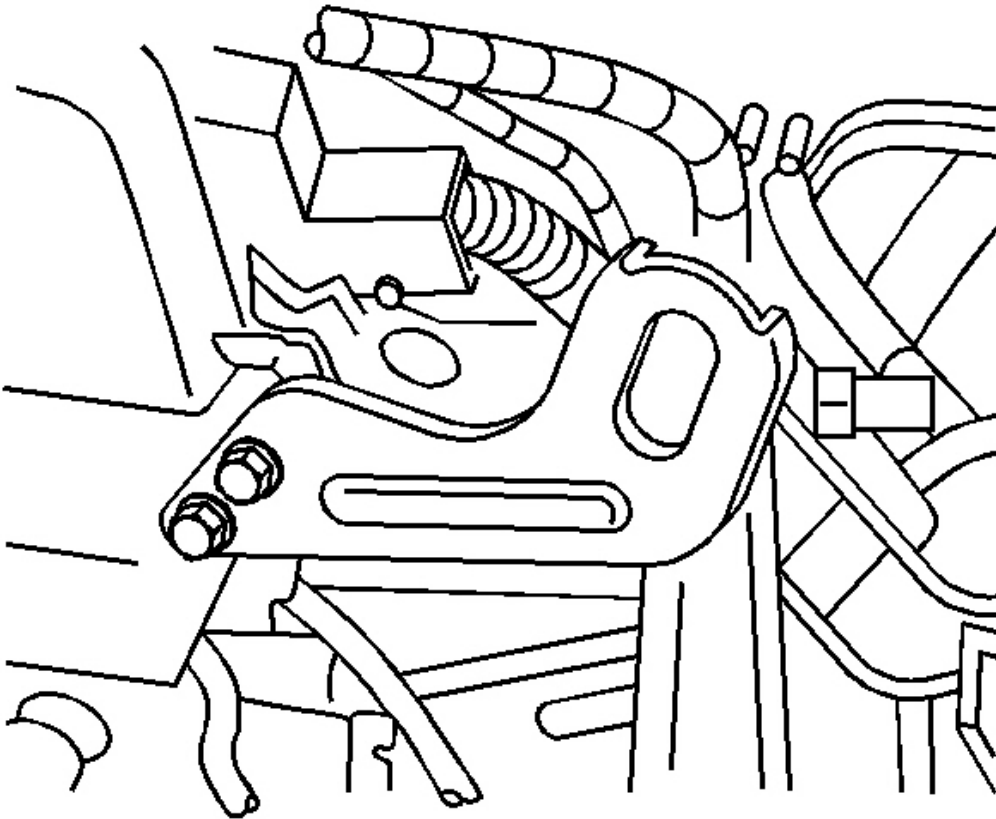
**Tighten:** Tighten the generator bolts to 50 N.m (37 lb ft).



**Fig. 75: Rear Of Generator (Alternator) View**  
**Courtesy of GENERAL MOTORS CORP.**

2. Connect the battery positive cable to the generator and secure the positive cable with the nut (1).

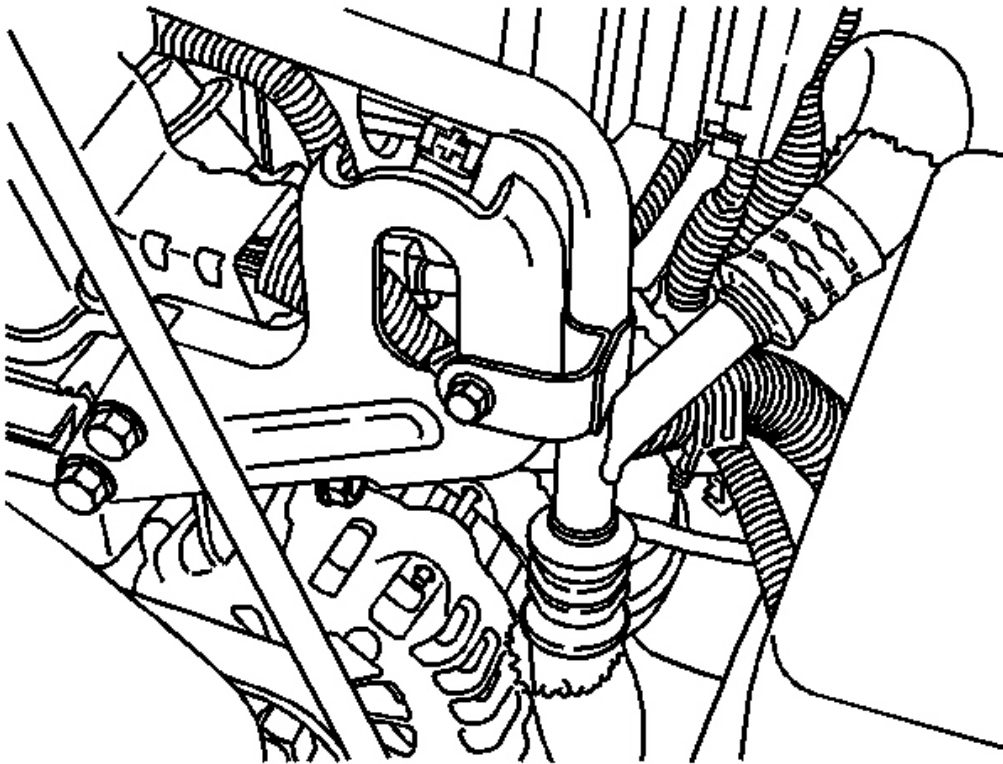
**Tighten:** Tighten the generator positive cable nut to 9 N.m (80 lb in).



**Fig. 76: View Of Engine Lift Bracket**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install the engine lift hook and secure the lift hook with 2 bolts.

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



**Fig. 77: View Of Engine Lift Hook & A/C Bracket Bolt**  
Courtesy of GENERAL MOTORS CORP.

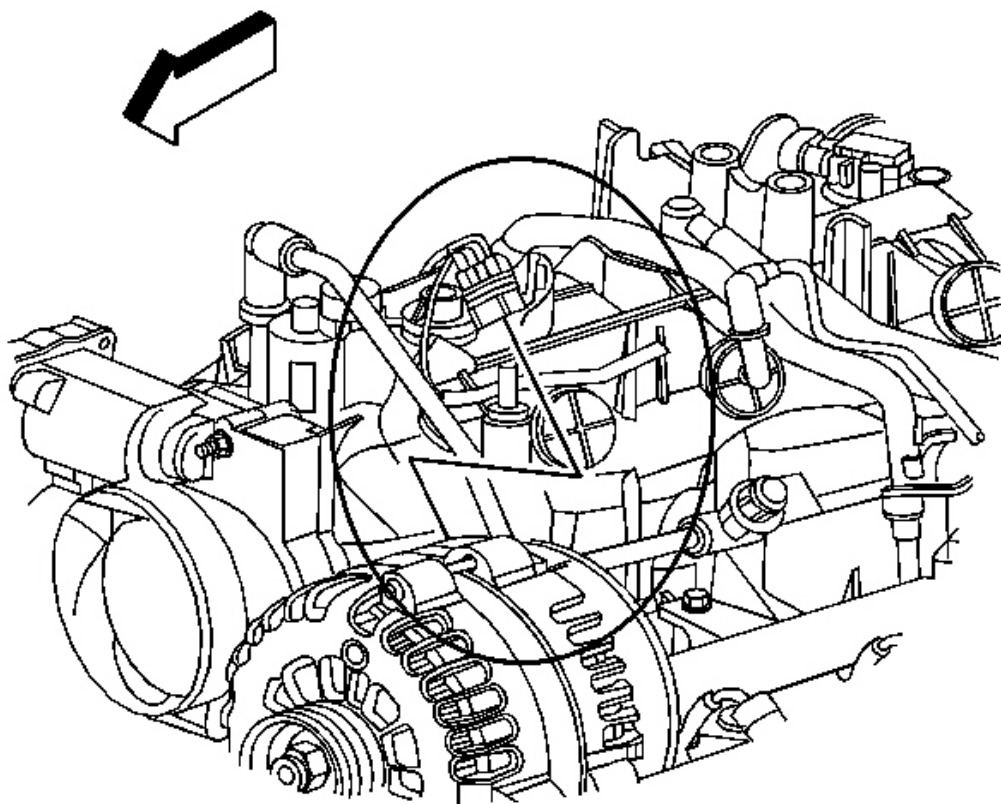
4. Install the A/C line bracket to the lift hook and secure the bracket with the bolt.

**Tighten:** Tighten the A/C line bracket bolt to 10 N.m (89 lb in).

5. Install the drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 4.2L.
6. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

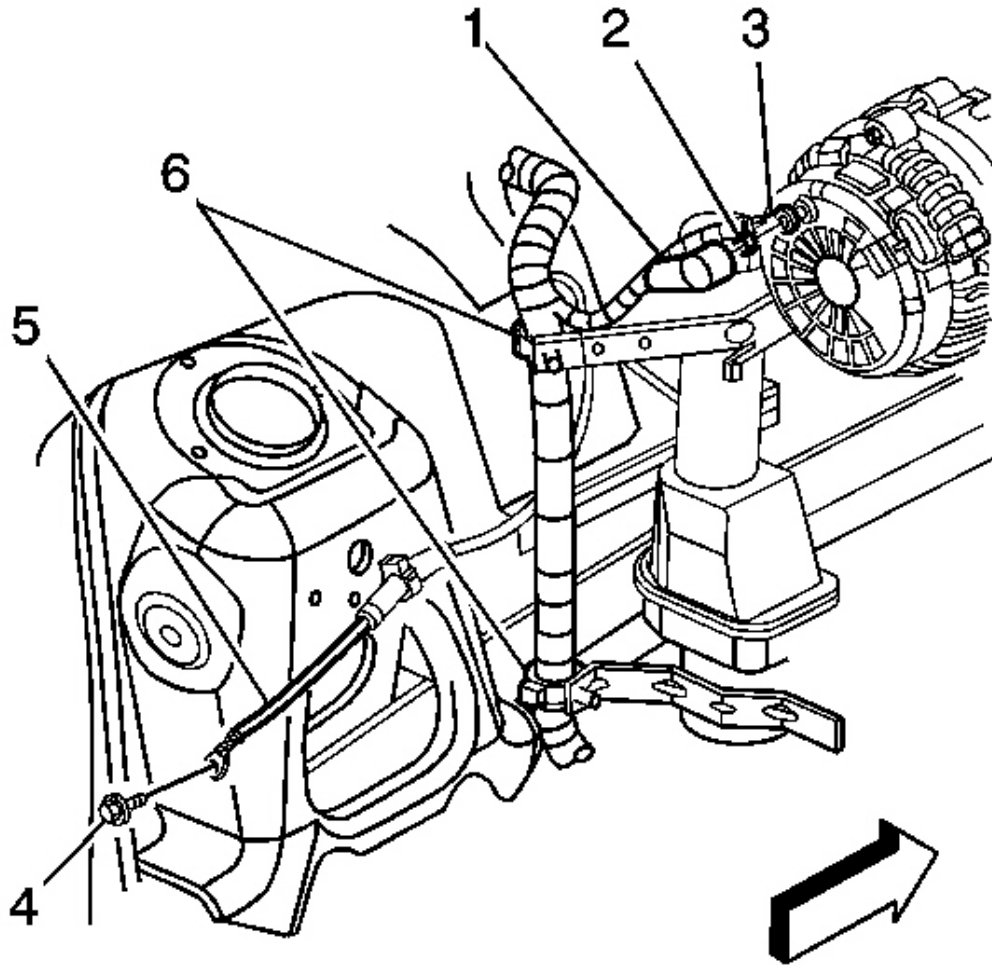
## GENERATOR REPLACEMENT (5.3L AND 6.0L ENGINES)

### Removal Procedure



**Fig. 78: View Of Generator Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

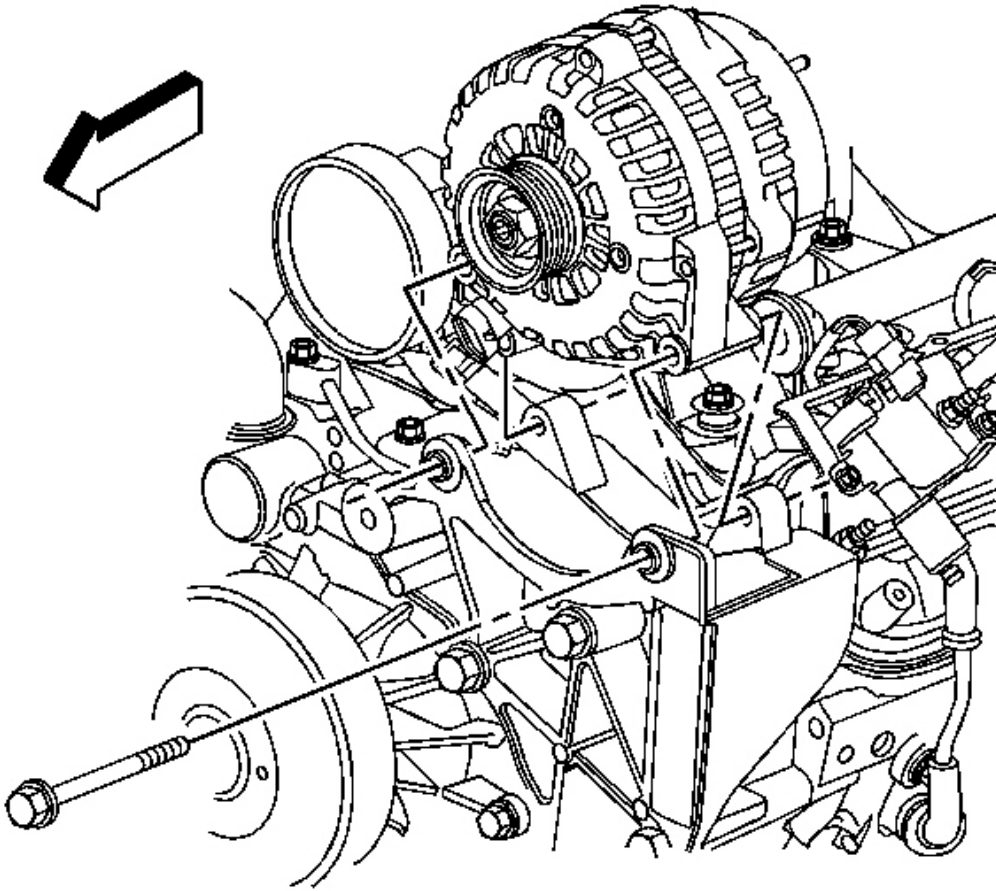
1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L engine or **Drive Belt Replacement - Accessory** for the 6.0L engine.
3. Disconnect the generator electrical connector.



**Fig. 79: View Of Generator Cable Boot, Head, Nut & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the generator cable (3) from the generator, perform the following:
  1. Slide the boot (1) down revealing the terminal stud.
  2. Remove the generator cable nut (2) from the terminal stud.
  3. Remove the generator cable (3).



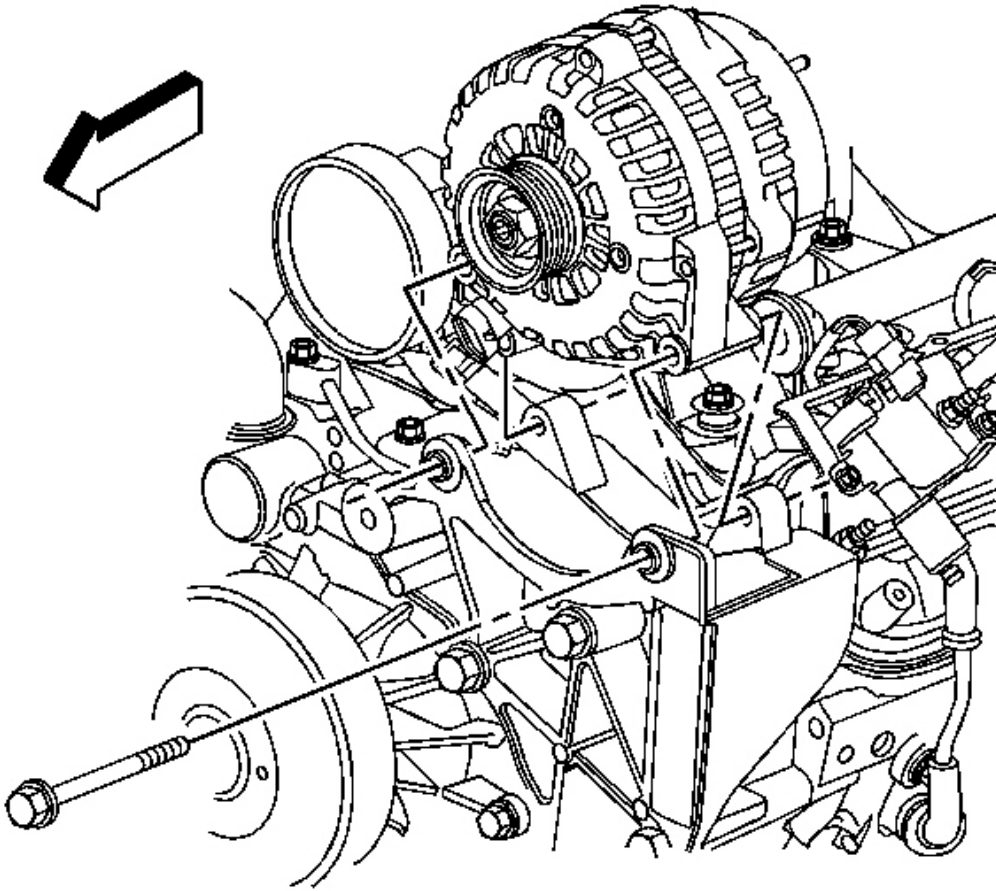


**Fig. 80: View Of Generator & Bolts (5.3L)**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove the generator bolts.
6. Remove the generator.

**Installation Procedure**



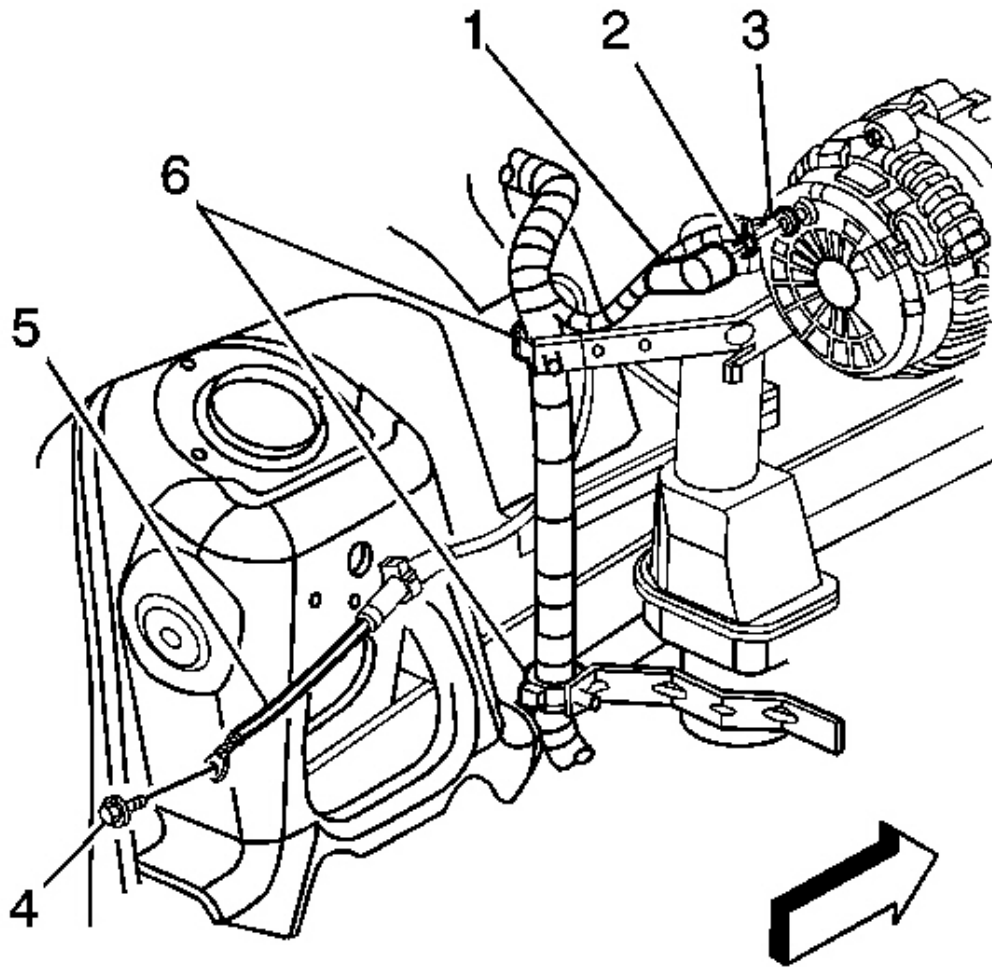


**Fig. 81: View Of Generator & Bolts (5.3L)**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

1. Install the generator.
2. Install the generator bolts.

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

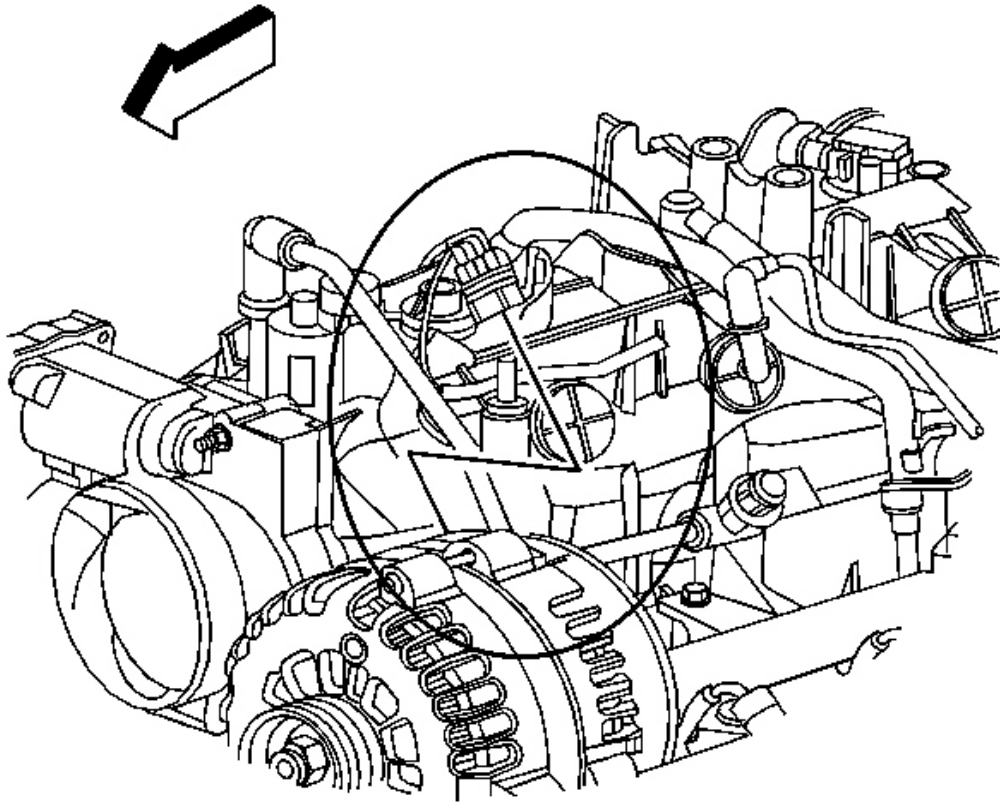


**Fig. 82: View Of Generator Cable Boot, Head, Nut & Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install the generator cable (3) to the generator, perform the following:
  1. Install the generator cable (3).
  2. Install the generator cable nut (2) to the terminal stud.

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

3. Slide the boot (1) over the terminal stud.

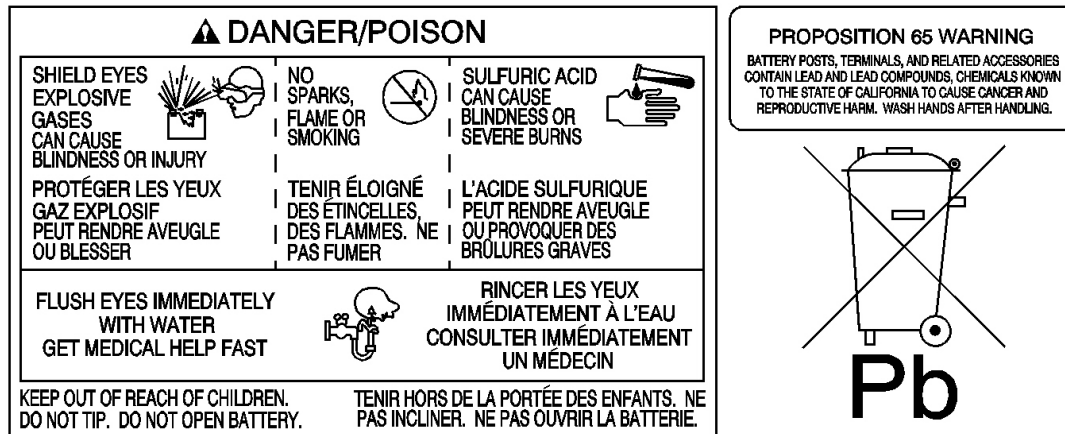


**Fig. 83: View Of Generator Electrical Connector**  
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator electrical connector.
5. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** for the 5.3L engine or **Drive Belt Replacement - Accessory** for the 6.0L engine.
6. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

## DESCRIPTION AND OPERATION

### BATTERY DESCRIPTION AND OPERATION



**Fig. 84: View Of Battery Danger Label**  
 Courtesy of GENERAL MOTORS CORP.

**CAUTION:** Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.
- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

The battery has 3 functions as a major source of energy:

- Engine cranking

- Voltage stabilizer
- Alternate source of energy with generator overload

The battery specification label, example below, contains information about the following:

- The test ratings
- The original equipment catalog number
- The recommended replacement model number

CATALOG NO.

**1819**

<b>CCA</b> <b>770</b>	<b>LOAD TEST</b> <b>380</b>
<b>REPLACEMENT MODEL</b> <b>100 – 6YR</b>	

**Fig. 85: View Of Battery Specification Label**  
**Courtesy of GENERAL MOTORS CORP.**

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A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

When a battery is replaced use a battery with similar ratings. Refer to the battery specification label on the original battery or refer to **Battery Usage**.

### Reserve Capacity

Reserve capacity is the amount of time in minutes it takes a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F) to reach a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the reserve capacity rating of the original equipment battery.

### Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 volts. Refer to **Battery Usage** for the cold cranking amperage rating for this vehicle.

### Auxiliary Battery

Auxiliary batteries are an available option on vehicles where many accessories can be utilized such as TVs, radios, lights, computers, etc. The charging of these batteries is explained in charging system description and operation. Also, the auxiliary battery is only for accessory use and not part of the starting system.

## CHARGING SYSTEM DESCRIPTION AND OPERATION

### Generator

The AD-244 generator is non-repairable. They are electrically similar to earlier models. The generator(s) feature the following major components:

- The delta stator
- The rectifier bridge
- The rotor with slip rings and brushes
- A conventional pulley
- Dual internal fans

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- A voltage regulator

The pulley and the fan cool the slip ring and the frame.

The AD stands for Air-cooled Dual internal fan; the 2 is an electrical design designator; the 44 denotes the outside diameter of the stator laminations in millimeters, over 100 millimeters. The generator is rated at 150 amperes.

The generator features permanently lubricated bearings. Service should only include the tightening of mounting components. Otherwise, the generator is replaced as a complete unit.

### Regulator

The voltage regulator controls the field current of the rotor in order to limit system voltage. The regulator switches the current on and off at a rate of 400 cycles per second in order to perform the following functions:

- Radio noise control
- Obtain the correct average current needed for proper system voltage control

At high speeds, the on-time may be 10 percent with the off-time at 90 percent. At low speeds, the on-time may be 90 percent and the off-time 10 percent.

### Charging System Indicators

#### BATTERY

The IPC illuminates the battery indicator when the following occurs:

- The PCM detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the PCM requesting illumination.
- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the body control module (BCM) indicating the system voltage.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.
- The ignition is on, with the engine off.

#### BATTERY NOT CHARGING

The IPC illuminates the battery not charging indicator in the driver information center when the

following occurs:

- The PCM detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the PCM requesting illumination.
- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the body control module (BCM) indicating the system voltage.

**STARTING SYSTEM DESCRIPTION AND OPERATION**

The PG-260L is a non-repairable starter motor. It has pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. At the same time, the plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

As soon as the solenoid switch contacts close, current stops flowing thorough the pull-in winding as battery voltage is now applied to both ends of the windings. The hold-in winding remains energized; its magnetic field is strong enough to hold the plunger, shift lever, starter drive assembly, and solenoid switch contacts in place to continue cranking the engine. When the engine starts, the pinion gear overrun sprag protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the CRANK position, voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now in the opposite direction of the current flow when the winding was first energized.

The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, cause the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter motor is turned off.

**LOAD SHED SYSTEM DESCRIPTION AND OPERATION**

**Load Shed System Description and Operation**

Load Shed		
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Level	Affected Systems	Action Taken
Load-Shed Level 0	No systems affected	Normal operation
Load-Shed Level 1	Heated Outside Rear View Mirrors, Heated Rear Window / Rear Window Defrost, Heated Seats	Cycled at 80% duty cycle, OFF for 4 of every 20 second cycle. Indicator and timer not affected.
	Front Automatic HVAC	Reduce blower speed to 80% of current setting if the HVAC is not in the Defrost mode. The HVAC controller uses a ramping program to make the change invisible to the operator. No action is taken if the HVAC system is in Defrost.
	Rear Automatic HVAC	Turn OFF blower. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited.
	Message Center, Instrument Cluster	No messages or indicators are displayed. Data (DPID) indicating that the Load-Shed 1 was entered is stored and may be accessed with a scan tool. DPID will reset after 50 ignition switch cycles with no repeated load-shed 1 action or with a battery disconnection.
	Heated Outside Rear View Mirrors, Heated Rear Window / Rear Window Defrost, Heated Seats	Turned OFF. Indicator and timer also turned OFF. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited. This system will respond to only one Load-Shed Level 2 command per ignition switch cycle.
	Front Automatic HVAC	Blower turned OFF if the HVAC system is not in the Defrost mode. No action is taken if the HVAC system is in the Defrost mode. Operator may over-ride by manually turning the blower ON. This system will respond to only one Load-Shed 2 command per ignition switch cycle.

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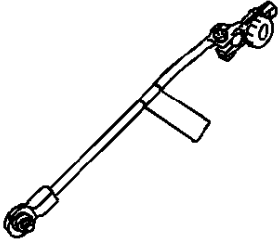
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Load-Shed Level 2	Rear Automatic HVAC	Rear HVAC blower remains OFF. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited. This system will respond to only one Load-Shed Level 2 command per ignition switch cycle.
	Message Center, Instrument Cluster	"Battery Saver Action" message is displayed. Battery / Charging System Failure icon is illuminated. Chime may be activated constantly until the load-shed level is exited. Data (DPID) indicating that the Load-Shed Level 2 was entered is stored and may be accessed with a scan tool. DPID will reset after 50 ignition switch cycles with no repeated Load-Shed 2 actions or with a battery disconnection.

## SPECIAL TOOLS AND EQUIPMENT

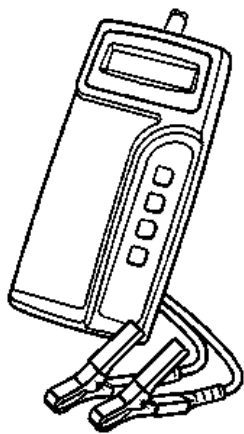
### SPECIAL TOOLS

#### Special Tools

Illustration	Tool Number/Description
	J 38758 Parasitic Draw Test Switch

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J 42000  
Battery Tester