

2006 Hummer H3

2006 ENGINE Engine Electrical - H3

2006 ENGINE**Engine Electrical - H3****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS****Fastener Tightening Specifications**

Application	Specification	
	Metric	English
Air Conditioning Compressor Bolt	50 N.m	37 lb ft
Battery Cable to Battery Nut	9 N.m	80 lb in
Battery Retainer Nut	15 N.m	11 lb ft
Generator Mounting Bolt	50 N.m	37 lb ft
Generator Output BAT Terminal Nut	20 N.m	15 lb ft
Generator Positive Cable to Underhood Fuse Block Nut	9 N.m	80 lb in
Negative Battery Cable to Battery Tray Bolt	9 N.m	80 lb in
Negative Battery Cable to Engine Block Bolt	35 N.m	26 lb ft
Positive Battery Cable to Starter Terminal Nut	9 N.m	80 lb in
Positive Battery Cable to Underhood Fuse Block Nut	9 N.m	80 lb in
Starter Motor Bolt/Nut	50 N.m	37 lb ft
Starter Solenoid S Terminal Nut	3.5 N.m	31 lb in

BATTERY USAGE**Battery Usage**

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

GENERATOR USAGE**Generator Usage**

Generator Model	Valeo

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Rated Output	100 A
Load Test Output	70 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

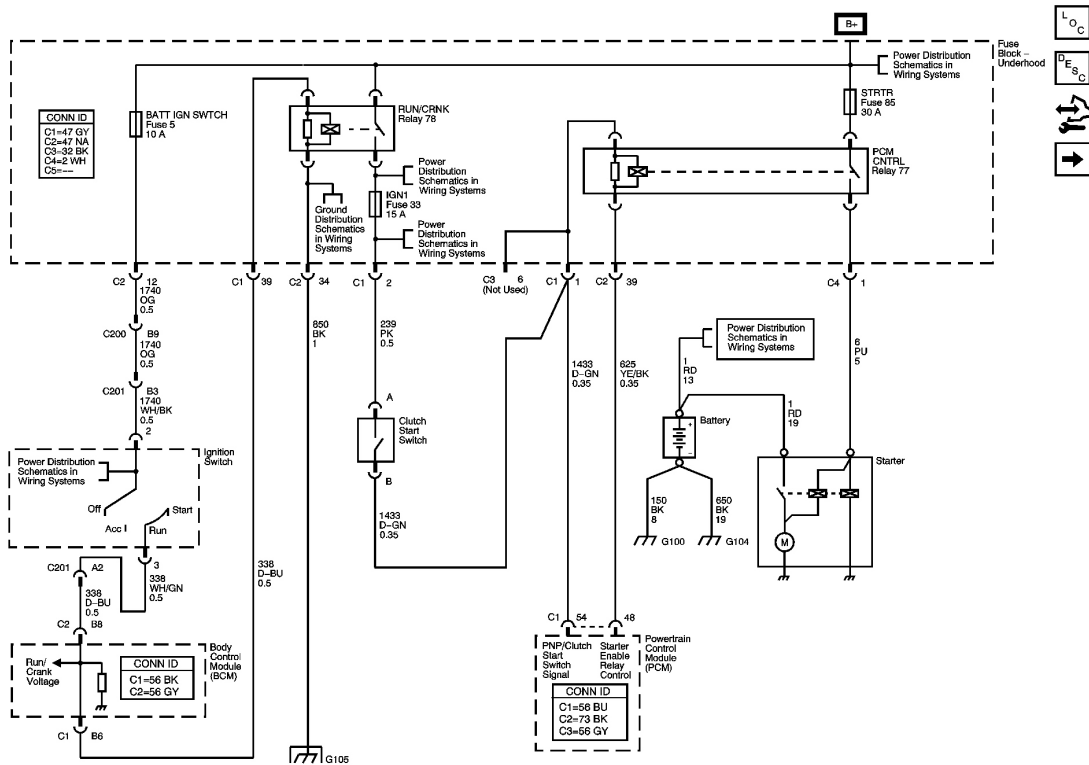


Fig. 1: Starting System - MA5
 Courtesy of GENERAL MOTORS CORP.

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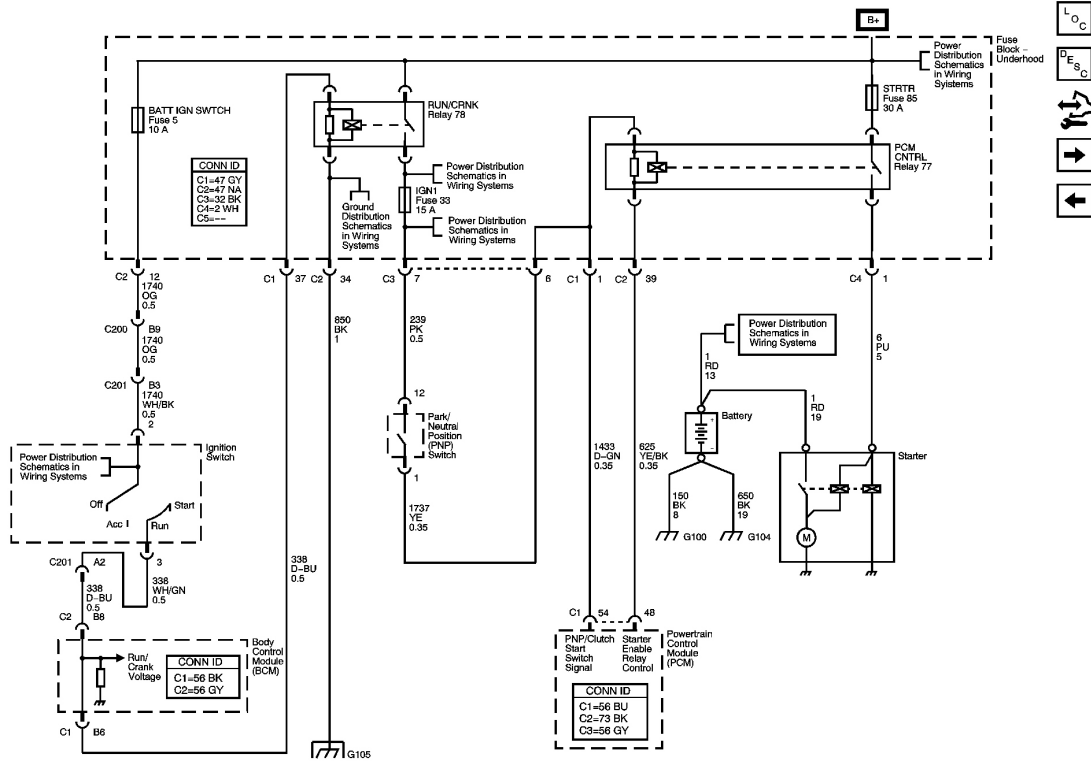


Fig. 2: Starting System - M30
Courtesy of GENERAL MOTORS CORP.

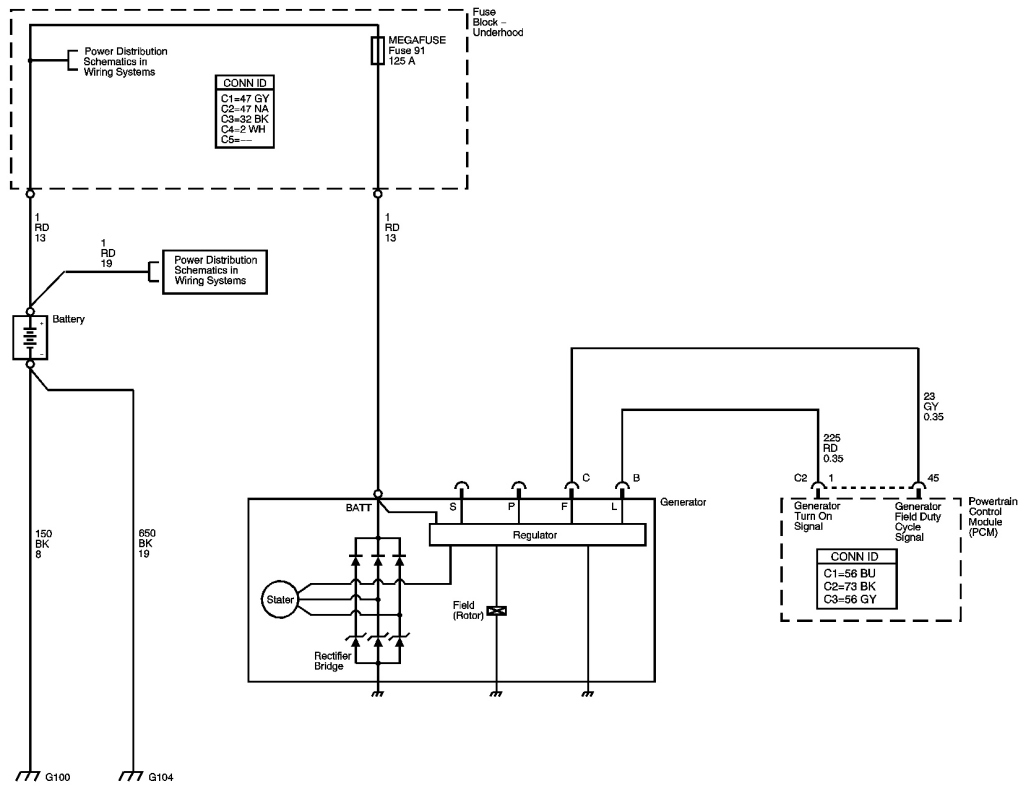


Fig. 3: Charging System
 Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE ELECTRICAL COMPONENT VIEWS

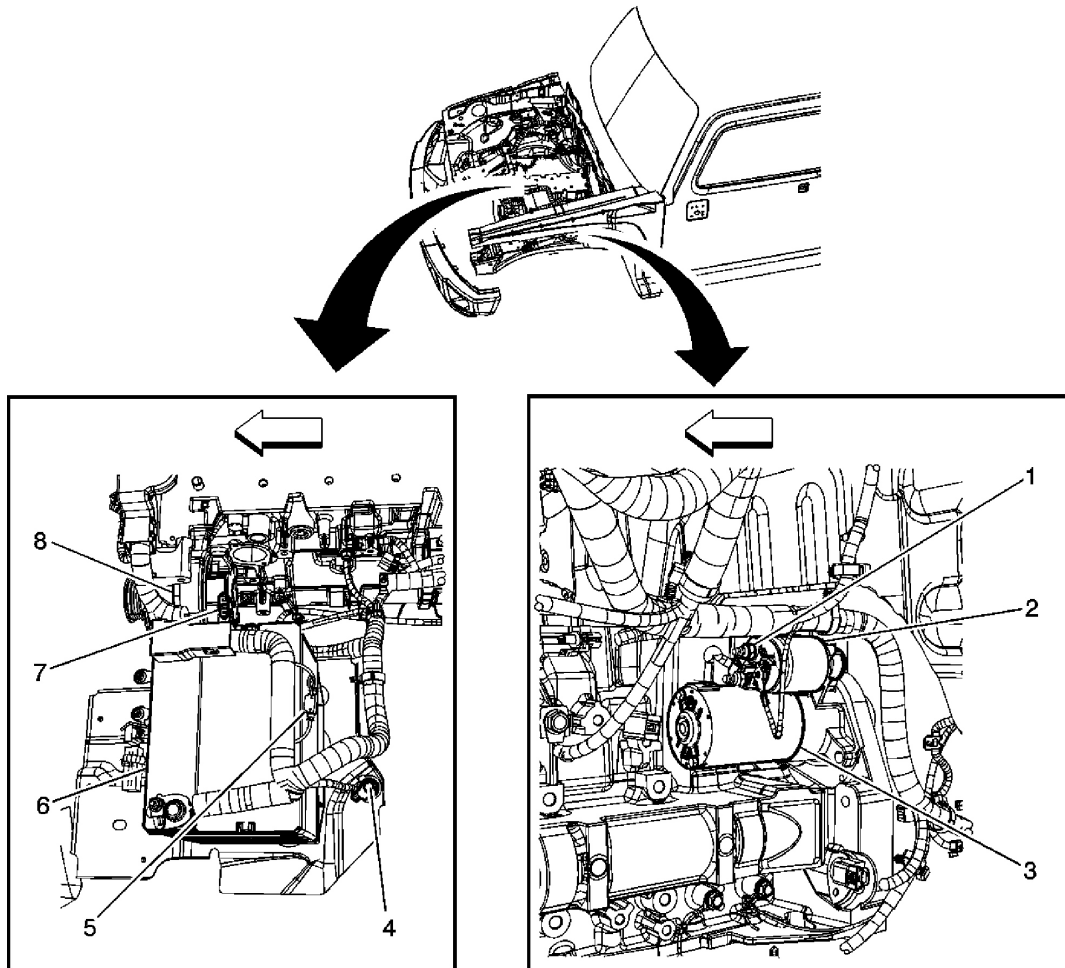


Fig. 4: Engine Electrical Components 1 of 2
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Battery Positive Voltage
2	Starter Solenoid
3	Starter Crank Voltage
4	Starter Motor
5	G100
6	Battery
7	Generator Connector
8	Generator

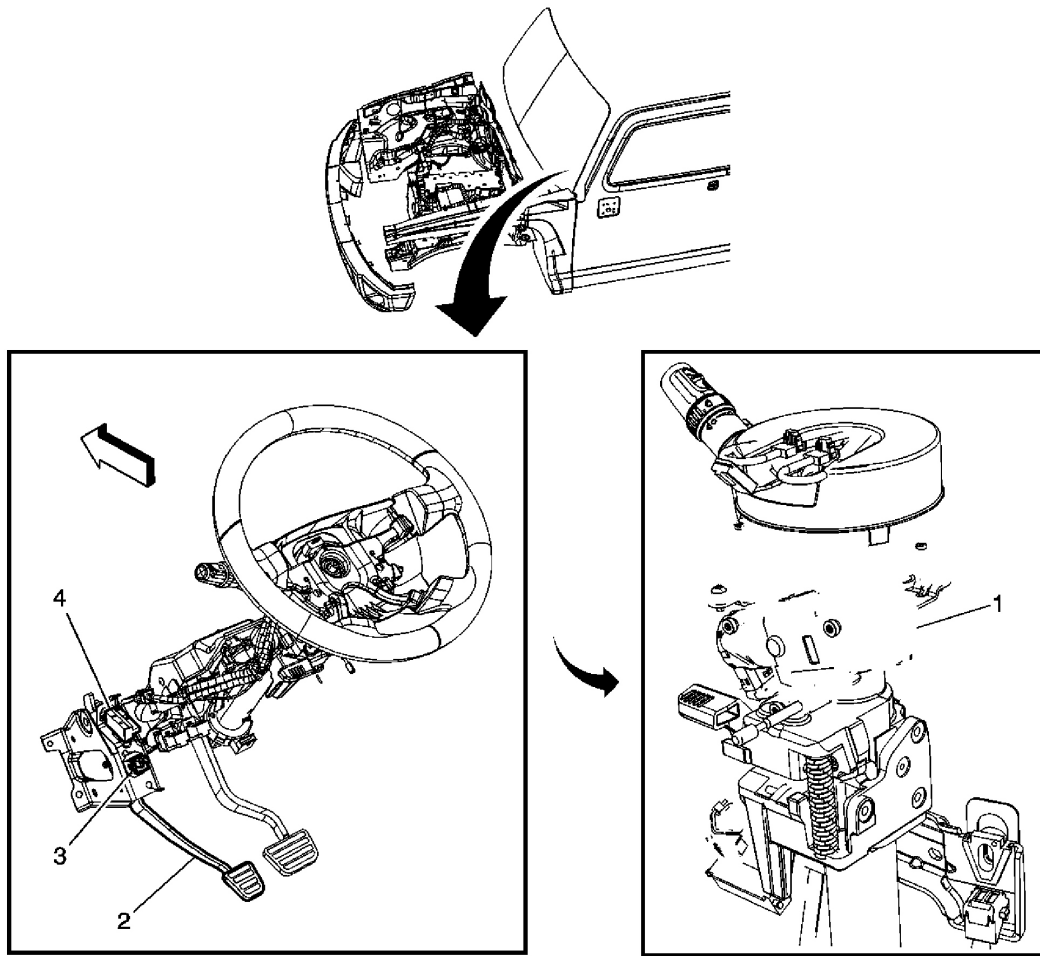


Fig. 5: Engine Electrical Components 2 of 2
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Ignition Switch
2	Clutch Pedal (MA5)
3	Clutch Release Switch (MA5)
4	Clutch Start Switch (MA5)

ENGINE ELECTRICAL CONNECTOR END VIEWS

Clutch Start Switch

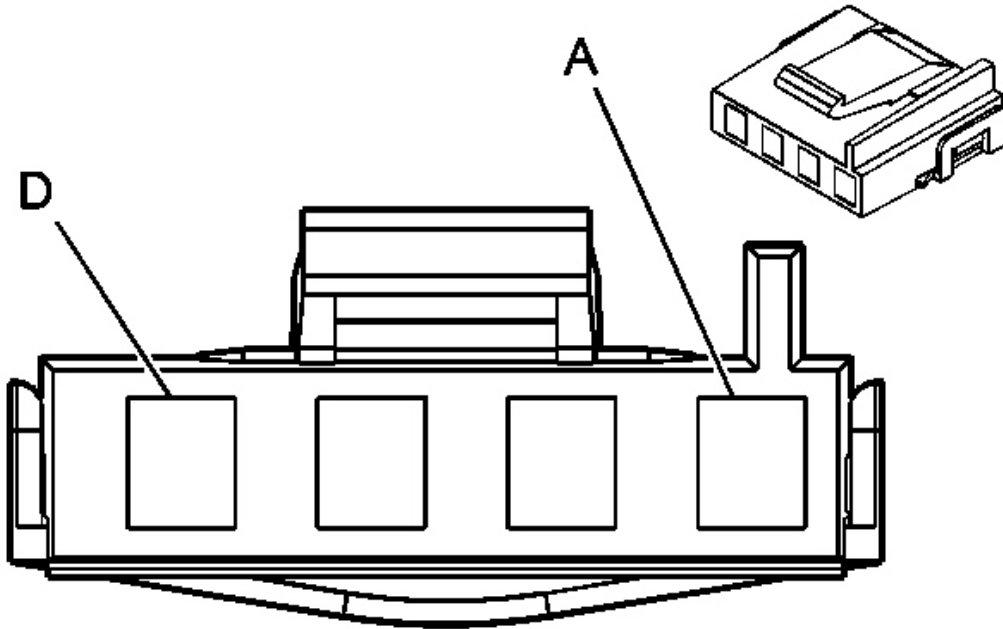


Fig. 6: Clutch Start Switch Connector End Views
 Courtesy of GENERAL MOTORS CORP.

Clutch Start Switch Connector Parts Information

Connector Part Information

- OEM: 12033706
- Service: 15306359
- Description: 4-Way F Metri-Pack 280 (BU)

Terminal Part Information

- Pins:
- Terminal: 12034046/2
- Core/Insulation Crimp:
- Release Tool/Test Probe: 12094430/J-35616-4A (PU)

Clutch Start Switch Connector Terminal Identification

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Pin	Wire Color	Circuit No.	Function
A	PK	239	Run/Crank Ignition 1 Voltage
B	D-GN	1433	Clutch Start Switch Signal
C-D	-	-	Not Used

Generator

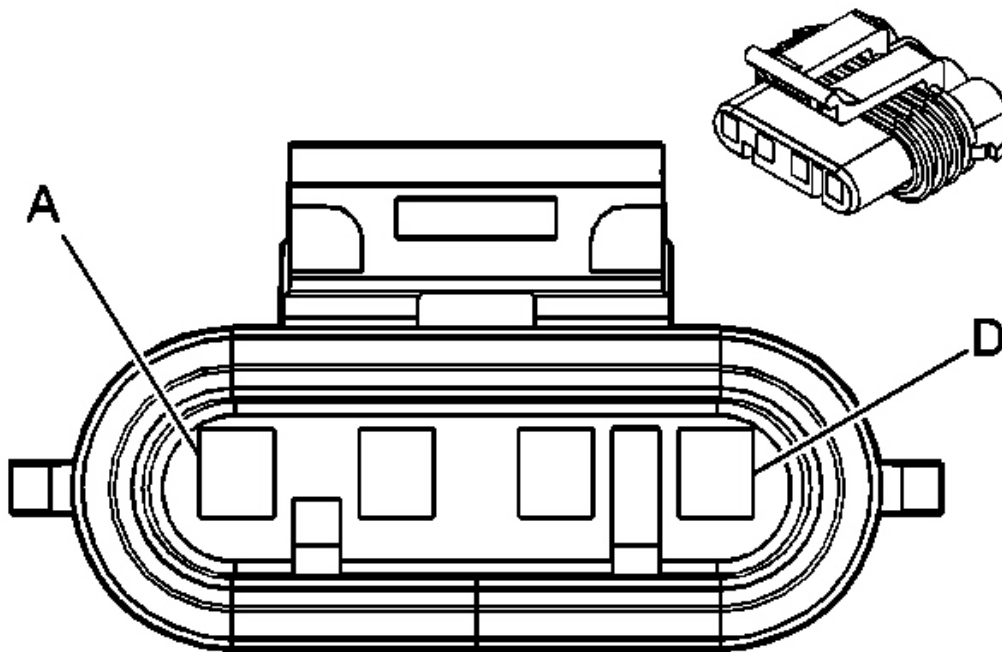


Fig. 7: Generator Connector End Views
Courtesy of GENERAL MOTORS CORP.

Generator Connector Parts Information

Connector Part Information

- OEM: 12186568
- Service: See Catalog
- Description: 4-Way F Metri-Pack 150 Sealed (BK)

Terminal Part Information

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- Pins:
- Terminal:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Generator Connector Terminal Identification

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

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-Terimal 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:

- 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

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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
Ignition ON/Engine OFF			
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

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

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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 is more than 20 seconds and above 1,200 RPM.
- Vehicle speed is 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.
- 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	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>				
Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
	Did you perform the Diagnostic System Check - Vehicle?			Go to Diagnostic

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1		-	Go to Step 2	<u>System Check - Vehicle in Vehicle DTC Information</u>
2	<p>With the scan tool monitor the ignition 1 signal voltage in the powertrain control module (PCM) data list.</p> <p>Does the scan tool display ignition 1 voltage greater than the specified value?</p>	11 V	Go to Step 4	Go to Step 3
3	<p>Test the ignition feed circuit to the PCM for high resistance or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 7	Go to Step 5
4	<ol style="list-style-type: none"> 1. Inspect for poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. 2. If you find a poor connection, repair the condition as necessary. Refer to Wiring Repairs in Wiring Systems. <p>Did you find and correct the condition?</p>	-	Go to Step 7	Go to Step 6
5	<p>Repair the ignition feed circuit to the PCM for an open or a short to ground. Refer to Wiring Repairs in Wiring Systems.</p> <p>Is the action complete?</p>	-	Go to Step 7	-
6	<p>Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Did you complete the replacement?</p>	-	Go to Step 7	-
7	<ol style="list-style-type: none"> 1. Select the DTC option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the Conditions for Running the DTC as 	-		

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specified in the supporting text, if applicable.

Does the DTC reset?

Go to **Step 2** 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.
- The engine is running above 1,200 RPM.
- Vehicle speed is 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

- 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.

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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	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u> Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-		Go to <u>Diagnostic System Check - Vehicle</u> 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 Step 4 Go to Step 3
3	Replace the generator. Refer to <u>Generator Replacement</u> . Is the action complete?	-	Go to Step 5	-
4	Replace the powertrain control module (PCM). Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 5	-
	1. Select the DTC option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the			

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5	Conditions for Running the DTC as specified in the supporting text, if applicable.	-		
	Does the DTC reset?		Go to Step 2	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

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.

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Action Taken When the DTC Sets

- The PCM will record the operating conditions presents 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
Schematic Reference: <u>Starting and Charging Schematics</u> Connector End View Reference: <u>Engine Electrical Connector End Views</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, monitor the DTC information for DTC P0621 in Engine Controls. Does the scan tool indicate that DTC P0621 has passed?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Test the generator turn on signal circuit for a short or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Connector Repairs in Wiring		

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	Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
6	<ol style="list-style-type: none"> 1. Review and record the scan tool Fail Records data. 2. Clear any DTCs. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for this DTC. Does the scan tool indicate that this DTC failed this ignition?	Go to Step 2	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 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 percent and 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:

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DTC P0622 Generator F-Terimal 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 then 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

- 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	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u> Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
	Did you perform the Diagnostic System Check - Vehicle?			Go to <u>Diagnostic System</u>

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1		-	Go to Step 2	Check - Vehicle in Vehicle DTC Information
2	<p>1. Install a scan tool.</p> <p>2. Start the engine.</p> <p>3. With a scan tool, observe the GEN - F Terminal parameter in the powertrain control module (PCM) data list.</p> <p>Does the scan tool indicate that the GEN - F Terminal parameter is within the specified range?</p>	5-95%	Go to Step 3	Go to Step 4
3	<p>With the scan tool command the generator OFF.</p> <p>Does the GEN - F Terminal equal the specified value?</p>	0%	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 4
4	<p>1. Turn OFF the ignition.</p> <p>2. Disconnect the generator connector.</p> <p>3. Connect test lamp to battery positive voltage.</p> <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 Charging System Test	Go to Step 5
	Test the generator field duty cycle signal			

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5	circuit for a short or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the harness connector of the PCM. Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 7
7	Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 8	-
8	<ol style="list-style-type: none"> 1. Review and record the scan tool Fail Records data. 2. Clear any DTCs. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for this DTC. Does the scan tool indicate that this DTC failed this ignition?	-	Go to Step 2	System OK

SYMPTOMS - ENGINE ELECTRICAL

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

- Perform **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 modules 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.
 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.

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- 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
CAUTION: Refer to Battery Disconnect Caution 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 Step 2	Go to Step 19
2	Compare the Cold Cranking Amperage (CCA) and Reserve Capacity (RC) of the battery to the original battery or Original Equipment (OE) specification. Refer to Battery Usage . Does the battery meet or exceed the specifications?	-	Go to Step 3	Go to Step 19
3	Does the hydrometer display a yellow dot?	-	Go to Step 4	Go to Step 5
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 Step 19	Go to Step 5
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 Step 6	Go to Step 7

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6	<p>Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt.</p> <p>Is the torque above the specified value?</p>	10 N.m (88 lb in)	Go to Step 8	Go to Step 7
7	<p>Disconnect the negative battery cable.</p> <p>Is the cable disconnected?</p>	-	Go to Step 9	-
8	<p>1. Disconnect the negative battery cable.</p> <p>2. Inspect for the following conditions and repair as needed:</p> <ul style="list-style-type: none"> • The cable bolt is too long or deformed at the end. • There is foreign material present inside the nut in the battery terminal. • Damage to the battery terminal face or cable connector ring. <p>Is the repair complete?</p>	-	Go to Step 9	-
9	<p>Rotate the positive battery cable connector clockwise with light finger pressure.</p> <p>Does the positive connector rotate?</p>	-	Go to Step 10	Go to Step 11
10	<p>Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt.</p> <p>Is the torque above the specified value?</p>	10 N.m (88 lb in)	Go to Step 12	Go to Step 11
11	<p>Disconnect the positive battery cable.</p> <p>Is the cable disconnected?</p>	-	Go to Step 13	-
12	<p>1. Disconnect the positive battery cable.</p> <p>2. Inspect for the following conditions and repair as needed:</p> <ul style="list-style-type: none"> • The cable bolt is too long or deformed at the end. • There is foreign material present inside the nut in the battery terminal. • Damage to the battery terminal face or cable connector ring. 	-		

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	Is the repair complete?		Go to Step 13	-
13	<ol style="list-style-type: none"> Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed. <p>Are the metal connecting parts clean and in good condition?</p>	-	Go to Step 14	-
14	<ol style="list-style-type: none"> Connect the positive battery cable to the battery positive terminal. Tighten the cable bolt to the specified value. <p>Is the cable bolt properly tightened?</p>	15 N.m (11 lb ft)	Go to Step 15	-
15	<ol style="list-style-type: none"> Connect the negative battery cable to the battery negative terminal. Tighten the cable bolt to the specified value. <p>Is the cable bolt properly tightened?</p>	15 N.m (11 lb ft)	Go to Step 16	-
16	<p>IMPORTANT: Ensure that all of the electrical loads are turned OFF.</p> <ol style="list-style-type: none"> Install the J 42000 Battery Tester. See Special Tools. Follow the directions supplied with the tester. Follow any direction displayed on the 	-		

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	tester.		Go to Step 17	Go to Step 18
	Did the tester pass the battery?			
17	<ol style="list-style-type: none"> 1. Press the CODE button on the J 42000 . See Special Tools. 2. For warranty purposes, write the displayed code on the repair order. 	-		
	Did you complete this action?		Battery OK	-
18	<ol style="list-style-type: none"> 1. Press the CODE button on the J 42000 . See Special Tools. 2. For warranty purposes, write the displayed code on the repair order. 3. Replace the battery. Refer to Battery Replacement. 	-		
	Did you complete the replacement?		Battery OK	-
19	Replace the battery. Refer to Battery Replacement .	-		
	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.

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
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 10A 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 digital multimeter to the 10A scale.
13. Connect the digital multimeter 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 digital multimeter.
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 digital multimeter 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 digital multimeter, 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°C (-65°F). However, a battery with a low state of charge may freeze at temperatures as high as -7°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°C (-25°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.

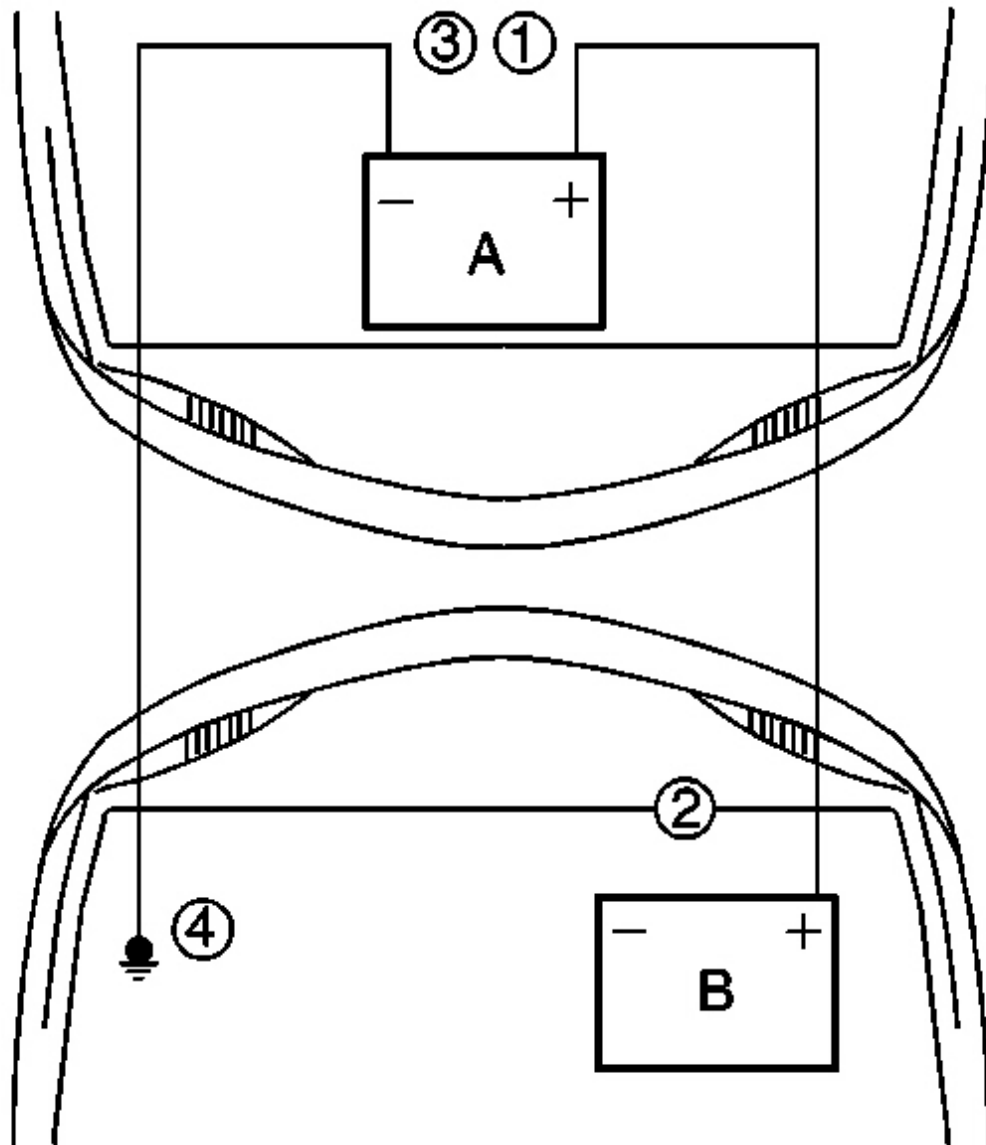


Fig. 8: Identifying Proper Jumper Cable Connection
Courtesy of GENERAL MOTORS CORP.

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

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

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	Did you perform the Battery Inspection Test?		Go to Step 3	Go to Battery Inspection/Test (Non-HP2)
3	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Start the engine. 3. With a scan tool, command the GEN-L Terminal OFF and ON. 4. Observe the Ignition 1 Signal parameter. <p>Does the voltage change with each command?</p>	-		
4	<ol style="list-style-type: none"> 1. Turn ON the following accessories: <ul style="list-style-type: none"> • Headlights-High beams • A/C on Max • Blower fan-ON high • Heated seats, if equipped 2. With a scan tool, observe the Ignition 1 Signal parameter in the engine data list. 3. Increase engine speed to 2,500 RPM. <p>Is the voltage within the specified value?</p>	12-15.5 V		
	<ol style="list-style-type: none"> 1. Turn OFF all accessories. 2. Turn OFF the ignition. <p>CAUTION: 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"> 3. Connect a carbon pile tester to the vehicle. 			

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5	<p>IMPORTANT: When measuring generator output current, be sure the inductive probe encircles the generator output wire.</p> <ol style="list-style-type: none"> 4. Connect an inductive ammeter probe to the output circuit of the generator. 5. Start the engine. 6. With a scan tool, command the GEN-L Terminal ON. 7. Increase engine speed to 2,500 RPM. 8. Adjust the carbon pile as necessary in order to obtain the maximum current output. <p>Is the generator output greater than or equal to the load test value as specified in Generator Usage ?</p>	-	System OK	Go to Step 7
6	<p>Is the voltage measured greater than 15.5 volts?</p>	-	Go to Step 12	Go to Step 7
7	<ol style="list-style-type: none"> 1. Leave the vehicle accessories ON or maintain load test value. 2. Maintain engine speed at 2,500 RPM. 3. Measure the voltage between the generator output terminal and the generator metal housing. <p>Is the voltage measured equal to the specified value?</p>	B+	Go to Step 14	Go to Step 9
	<ol style="list-style-type: none"> 1. Turn ON the ignition, with the engine OFF. 2. Disconnect the generator harness connector. 3. Measure the voltage between the 			

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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>	<p>Go to Step 14</p>	<p>Go to Step 11</p>
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 Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Is the voltage measured less than the specified value?</p>	<p>0.5 V</p>	<p>Go to Step 10</p>	<p>Go to Step 15</p>
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 Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Is the voltage measured less than the specified value?</p>	<p>0.5 V</p>	<p>Go to Step 14</p>	<p>Go to Step 16</p>
11	<p>Test the generator turn on signal circuit for a short or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	<p>-</p>	<p>Go to Step 19</p>	<p>Go to Step 13</p>
	<p>Test the generator battery voltage sense</p>			

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

CHARGE INDICATOR ALWAYS ON

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Charge Indicator Always On

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the Charge indicator on the instrument panel cluster (IPC). Does the charge indicator illuminate?	Go to Step 3	Go to <u>Symptoms - Engine Electrical</u>
3	1. Turn OFF the ignition. 2. Disconnect the generator connector. 3. Turn ON the ignition, with the engine OFF. Does the charge indicator illuminate?	Go to Step 4	Go to <u>Charging System Test</u>
4	Test the charge indicator control circuit for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Replace the powertrain control module (PCM). Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?		Go to <u>Diagnostic System Check - Vehicle</u> in

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

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 Charging System Test . Is the generator operating properly?	Go to Step 2	Go to Step 11
2	<ol style="list-style-type: none"> 1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the 4-way connector from the generator. 4. Start the engine. 		

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	<p>5. Listen for the noise.</p> <p>Has the noise stopped?</p>	Go to Step 11	Go to Step 3
3	<p>1. Turn OFF the engine.</p> <p>2. Remove the drive belt. Refer to <u>Drive Belt Replacement (Without A/C)</u> or <u>Drive Belt Replacement (With A/C)</u> for the 3.5L engine.</p> <p>3. Spin the generator pulley by hand.</p> <p>Does the generator shaft spin smoothly and without any roughness or grinding noise?</p>	Go to Step 4	Go to Step 11
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 Step 11	Go to Step 5
5	<p>1. Loosen all of the generator mounting bolts.</p> <p>2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to <u>Generator Replacement</u>.</p> <p>3. Install the drive belt. Refer to <u>Drive Belt Replacement (Without A/C)</u> or <u>Drive Belt Replacement (With A/C)</u> for the 3.5L engine.</p> <p>4. Start the engine.</p> <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 6
6	<p>Inspect the generator for the following conditions:</p> <ul style="list-style-type: none"> • Strained or stretched electrical connections • Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment 		

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	Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?	Go to Step 7	Go to Step 8
7	<ol style="list-style-type: none"> Reroute the electrical connections to relieve the tension. Reroute the hoses, etc. away from the generator. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 8
8	<p>Inspect the drive belt for proper tension. Refer to <u>Drive Belt Tensioner Diagnosis</u> for the 3.5L engine.</p> <p>Is the drive belt loose?</p>	Go to Step 9	Go to Step 10
9	<ol style="list-style-type: none"> Replace the drive belt tensioner. Refer to <u>Drive Belt Tensioner Replacement</u> for the 3.5L engine. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 11
10	<p>Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?</p>	System OK	Go to Step 11
11	<p>IMPORTANT: 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 <u>Generator Replacement</u>. Has the noise decreased or stopped?</p>	Go to Step 12	-
12	<p>Operate the system in order to verify the repair. Did you correct the condition?</p>	System OK	Go to Step 2

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

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Step	Action	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Turn the ignition switch to the START position. Does the engine crank?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Is the security indicator flashing?	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information	Go to Step 4
4	<ol style="list-style-type: none"> 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 Step 5	Go to Step 13
5	<ol style="list-style-type: none"> 1. Turn ON the ignition, with the engine OFF. 2. With a scan tool, observe the Starter Relay Command parameter in the PCM data list. 3. Turn the ignition switch to the START position. Does the scan tool display Yes?	Go to Step 6	Go to Step 13

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6	<ol style="list-style-type: none"> 1. Turn ON the ignition, with the engine OFF. 2. Verify that the transmission is in Park or Neutral. 3. With a scan tool, observe the Current Gear parameter in the PCM data list. <p>Does the scan tool display Park or Neutral?</p>	Go to Step 7	<p align="center">Go to <u>Range Selector Displays Incorrect Range</u> in Automatic Transaxle - 4L60-E</p>
7	<p>Turn the ignition switch to the START position. Do you hear the STARTER relay click?</p>	Go to Step 10	Go to Step 8
8	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the STARTER relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the battery positive voltage circuit of the STARTER relay coil and a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 9	Go to Step 21
9	<ol style="list-style-type: none"> 1. Connect a test lamp between the battery positive voltage circuit of the STARTER relay coil and the control circuit of the STARTER relay. 2. Turn the ignition to the START position. <p>Does the test lamp illuminate?</p>	Go to Step 17	Go to Step 15
10	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the STARTER relay. 3. Connect a test lamp between the battery positive voltage circuit of the STARTER relay switch and a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 11	Go to Step 22
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>		

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	Does the engine crank?	Go to Step 17	Go to Step 12
12	Does the fuse in the jumper open?	Go to Step 23	Go to Step 14
13	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the PCM harness connector. 3. Connect a test lamp between the crank voltage circuit of the PCM and a good ground. 4. Turn the ignition to the START position. 		
	Does the test lamp illuminate?	Go to Step 20	Go to Step 16
14	<p>Test the starter solenoid crank voltage circuit for a high resistance or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 28	Go to Step 18
15	<p>Test the control circuit of the STARTER relay for an open or short to battery voltage. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 28	Go to Step 20
16	<p>Test the crank voltage circuit of the PCM for a high resistance or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 28	Go to Step 19
17	<p>Inspect for poor connections at the STARTER relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 28	Go to Step 24
18	<p>Inspect for poor connections at the starter solenoid. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 28	Go to Step 25
	Inspect for poor connections at the ignition switch. Refer to <u>Testing for Intermittent</u>		

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

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	for replacement, setup, and programming. Did you complete the replacement?	Go to Step 28	-
28	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to Step 3	Go to <u>Starter Solenoid Does Not Click</u>
3	Inspect the engine and belt drive system for mechanical binding, e.g. seized engine, seized generator. Does the engine move freely?	Go to Step 4	Go to <u>Engine Will Not Crank - Crankshaft Will Not Rotate</u> for the 3.5L engine
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 8	Go to Step 5
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the starter. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the starter. Refer to <u>Starter Motor Replacement</u> .		

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	Did you complete the replacement?	Go to Step 8	-
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to Step 2

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** in this section.

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

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 Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Start the engine. Does the starter operate normally?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>	Go to Step 3
3	Start the engine while listening to the starter motor turn. Is there a loud "whoop", it may sound like a		

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	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 Step 6	Go to Step 4
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 Step 7	Go to Step 5
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 Step 6	Go to Step 7
6	Inspect the flywheel ring gear for the following: <ul style="list-style-type: none"> • Chipped gear teeth • Missing gear teeth • Milled teeth Is the flywheel bent, or does it have damaged teeth?	Go to Step 8	Go to Step 9
7	1. Remove the starter motor. Refer to <u>Starter Motor Replacement</u> . 2. Inspect the starter motor bushings and clutch gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to Step 9	Go to Step 8
8	Replace the flywheel. Refer to <u>Engine Flywheel Replacement (w/Automatic Transmission)</u> or <u>Engine Flywheel Replacement (w/Manual Transmission)</u> for the 3.5L engine. Did you complete the replacement?	Go to Step 10	-
9	Replace the starter motor. Refer to <u>Starter Motor Replacement</u> . Did you complete the replacement?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE

Disconnecting Procedure

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.

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

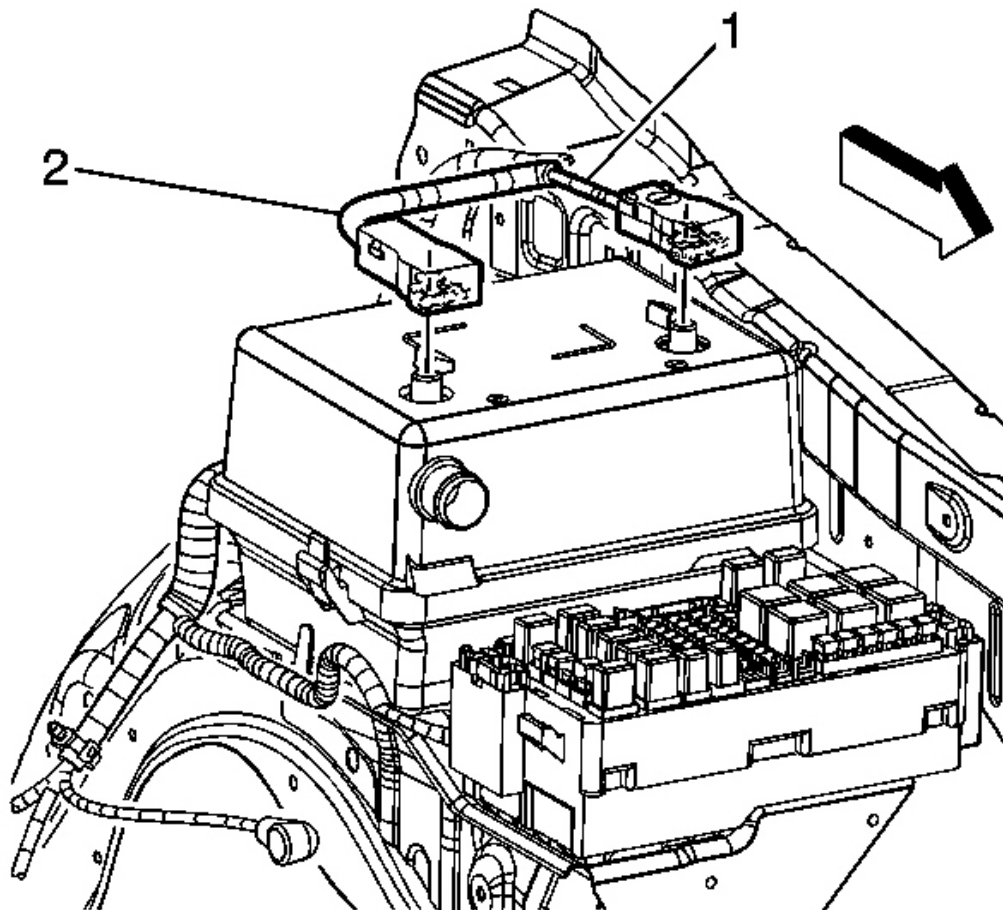


Fig. 9: Battery Cables

Courtesy of GENERAL MOTORS CORP.

1. Record all preset and theft codes from the radio.
2. Turn off all lamps and accessories.
3. Turn the ignition switch to the LOCK position.
4. Open the negative battery cable cover.
5. Loosen the negative battery cable nut.
6. Remove the negative battery cable (1) from the battery.

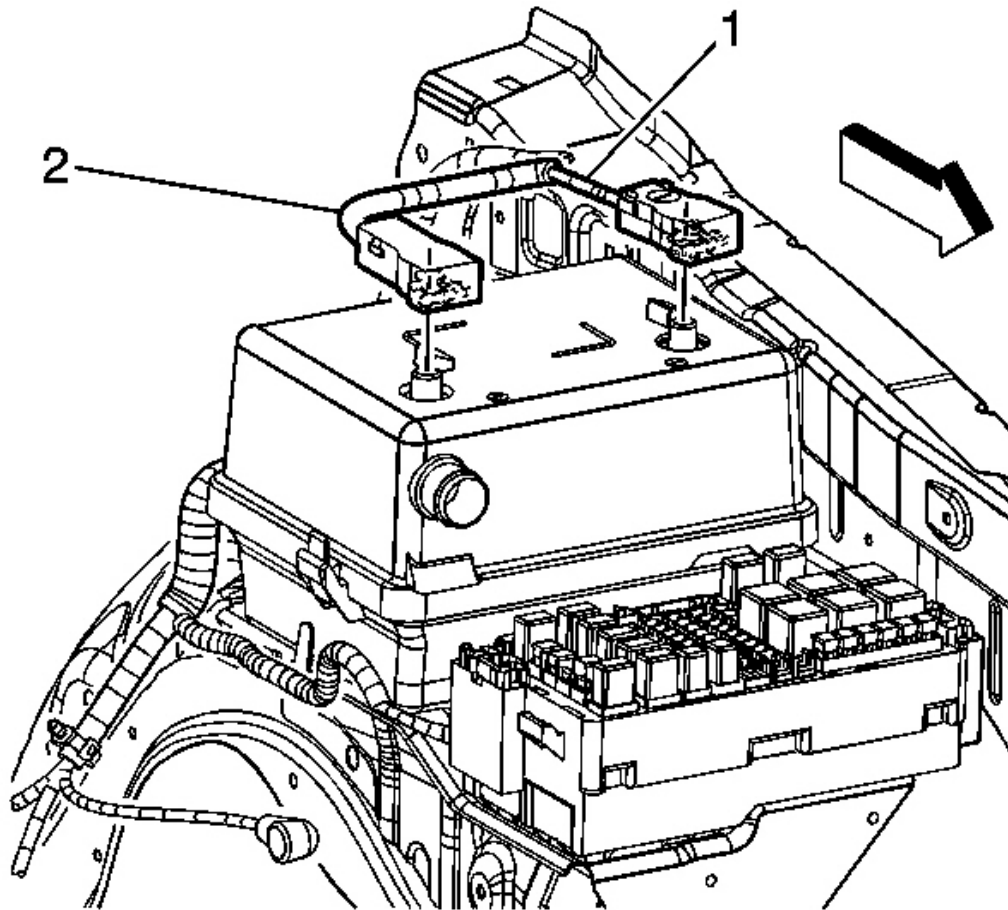


Fig. 10: Battery Cables

Courtesy of GENERAL MOTORS CORP.

1. Clean any existing corrosion from the battery terminal and battery cable (1) using a wire brush.
2. Install the negative battery cable (1) to the battery.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Tighten the negative battery cable nut.

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

4. Close the negative battery cable cover.
5. Reset all preset and theft codes previously recorded to the radio.

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT

- IMPORTANT:**
- Always use replacement cables that are of the same type, diameter and length of the cables that are being replaced.
 - Always route the replacement cable the same way as the original cable.

Removal Procedure

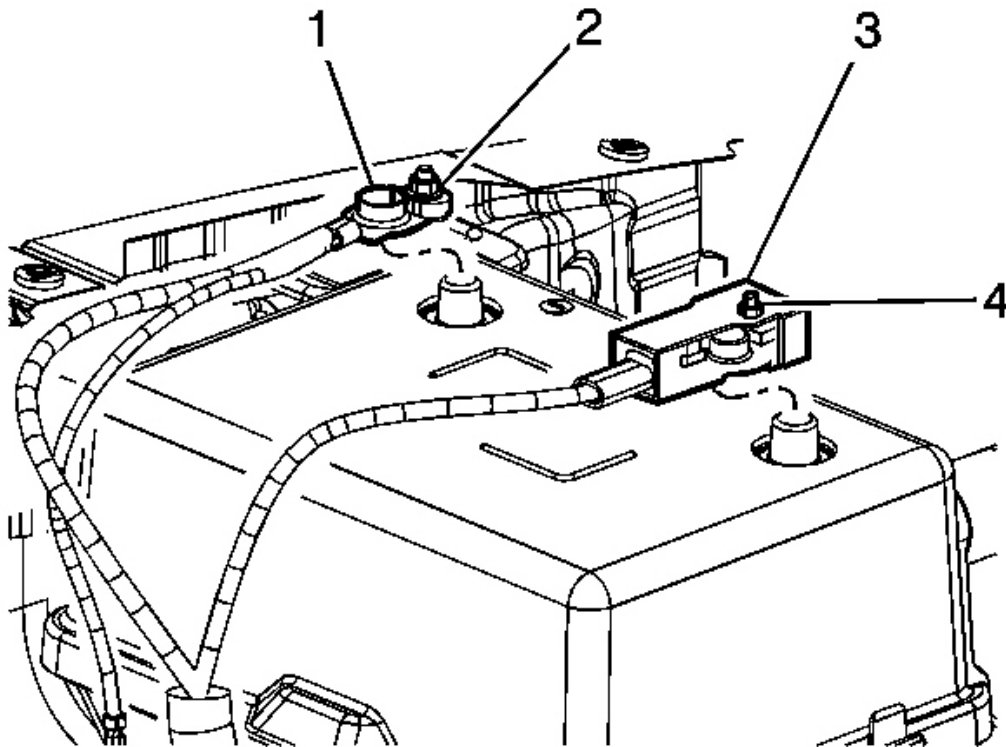


Fig. 11: View Of Battery Cables
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Open the protective cover to access the positive battery cable terminal.
3. Loosen the positive battery cable nut (3).
4. Remove the positive battery cable (4) from the battery.
5. Remove the bolt (1) securing the negative battery cable ground (2) to the battery tray.

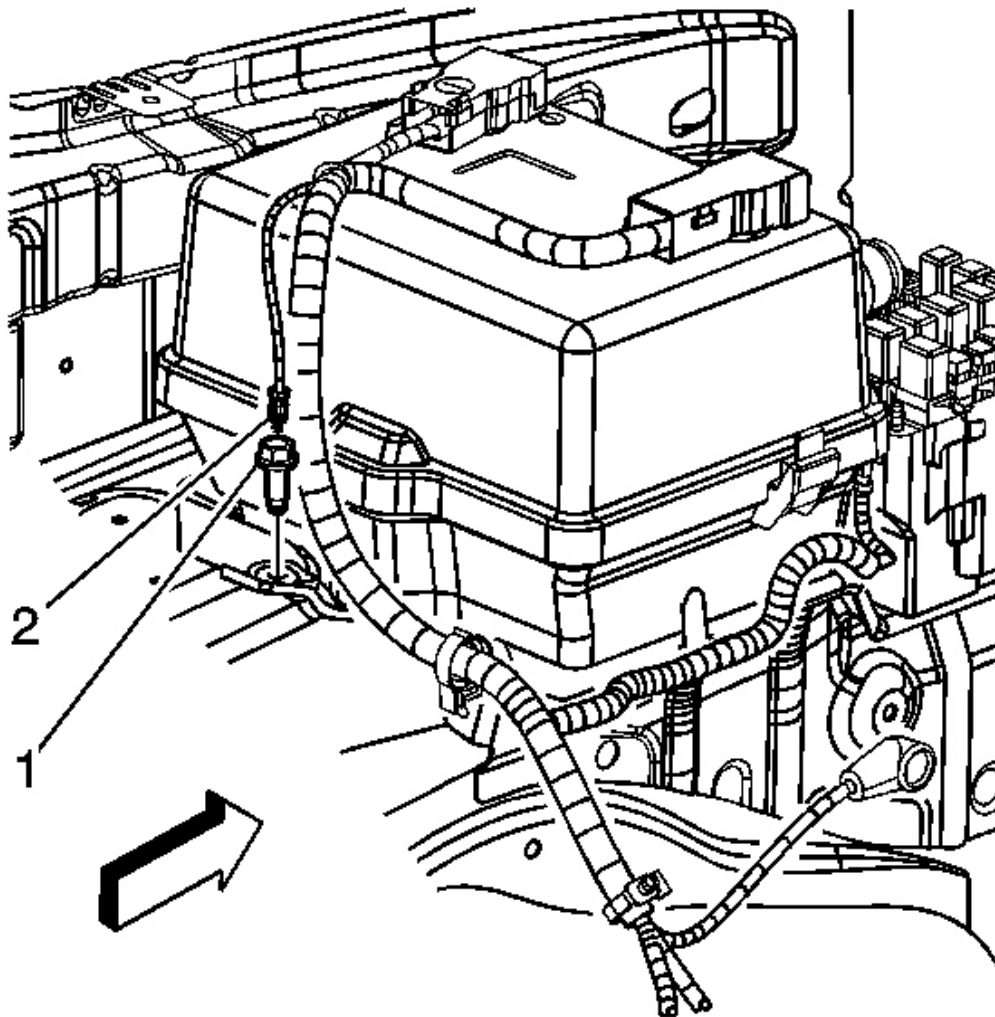


Fig. 12: Bolt Securing Negative Battery Cable Ground To Battery Tray
Courtesy of GENERAL MOTORS CORP.

6. Press the locking tabs inward in order to remove the underhood fuse block cover from the underhood fuse block.
7. Remove the nuts (1) securing the battery cables to the underhood fuse block.

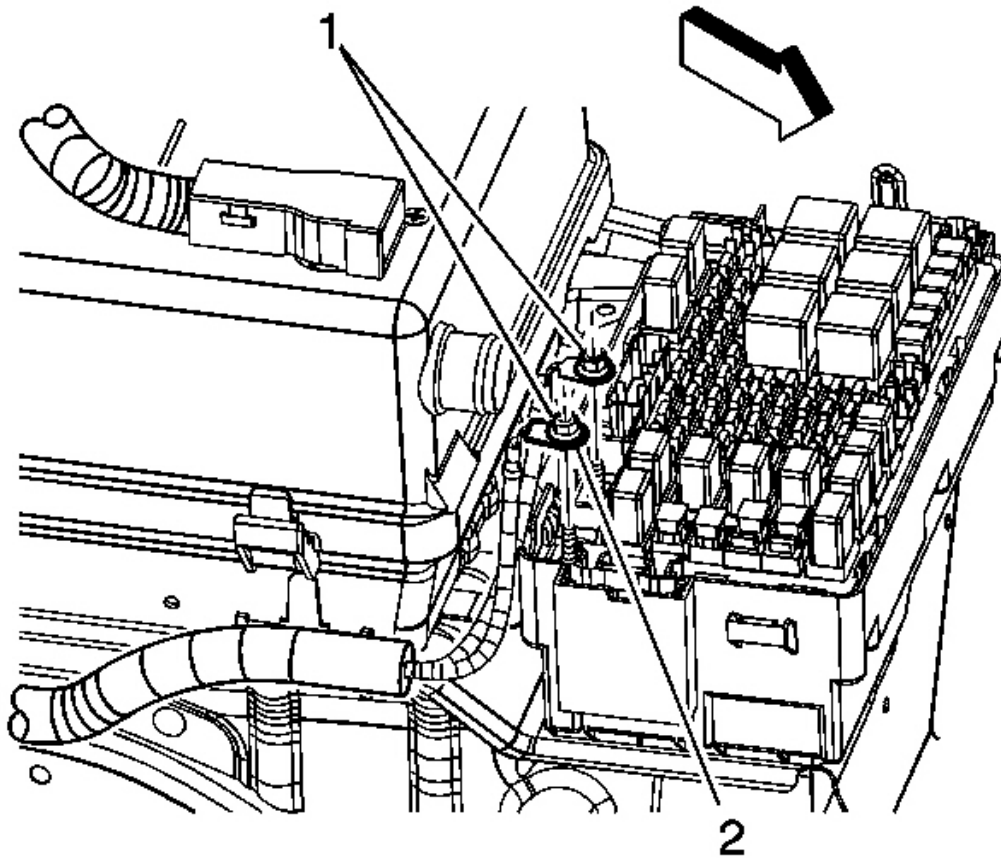


Fig. 13: Nuts Securing The Battery Cables To Underhood Fuse Block
Courtesy of GENERAL MOTORS CORP.

8. Remove the battery cable harness clips (1, 2) from the battery tray.

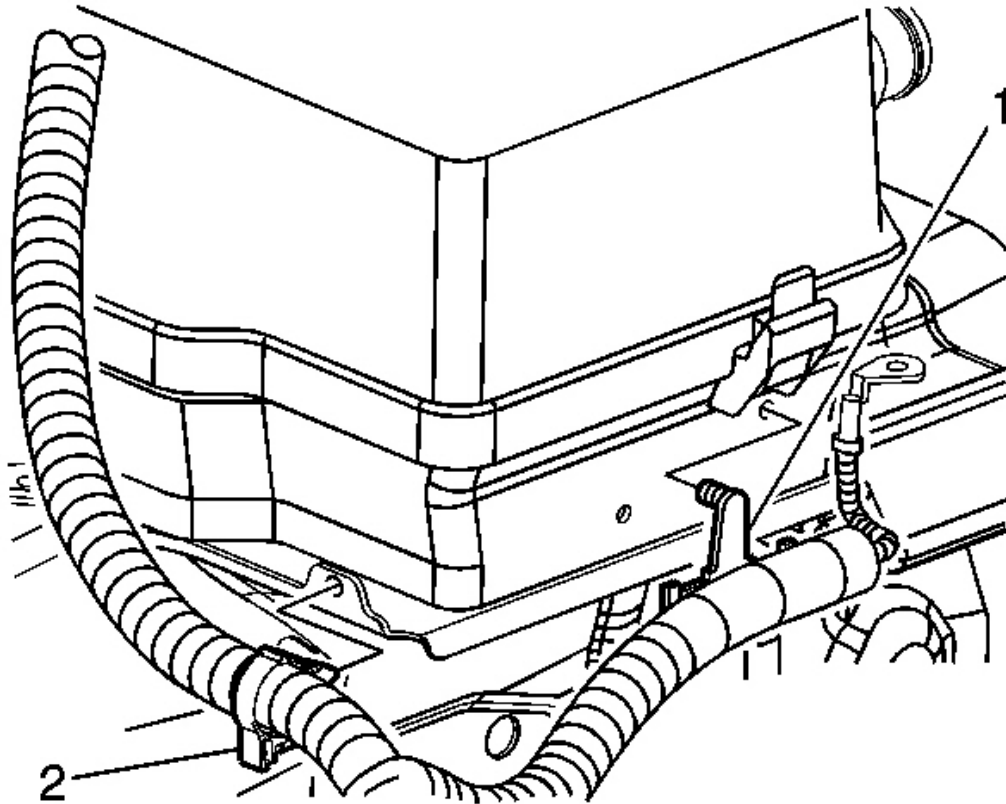


Fig. 14: Harness Clips
Courtesy of GENERAL MOTORS CORP.

9. Remove the left wheelhouse liner. Refer to Wheelhouse Panel Replacement .

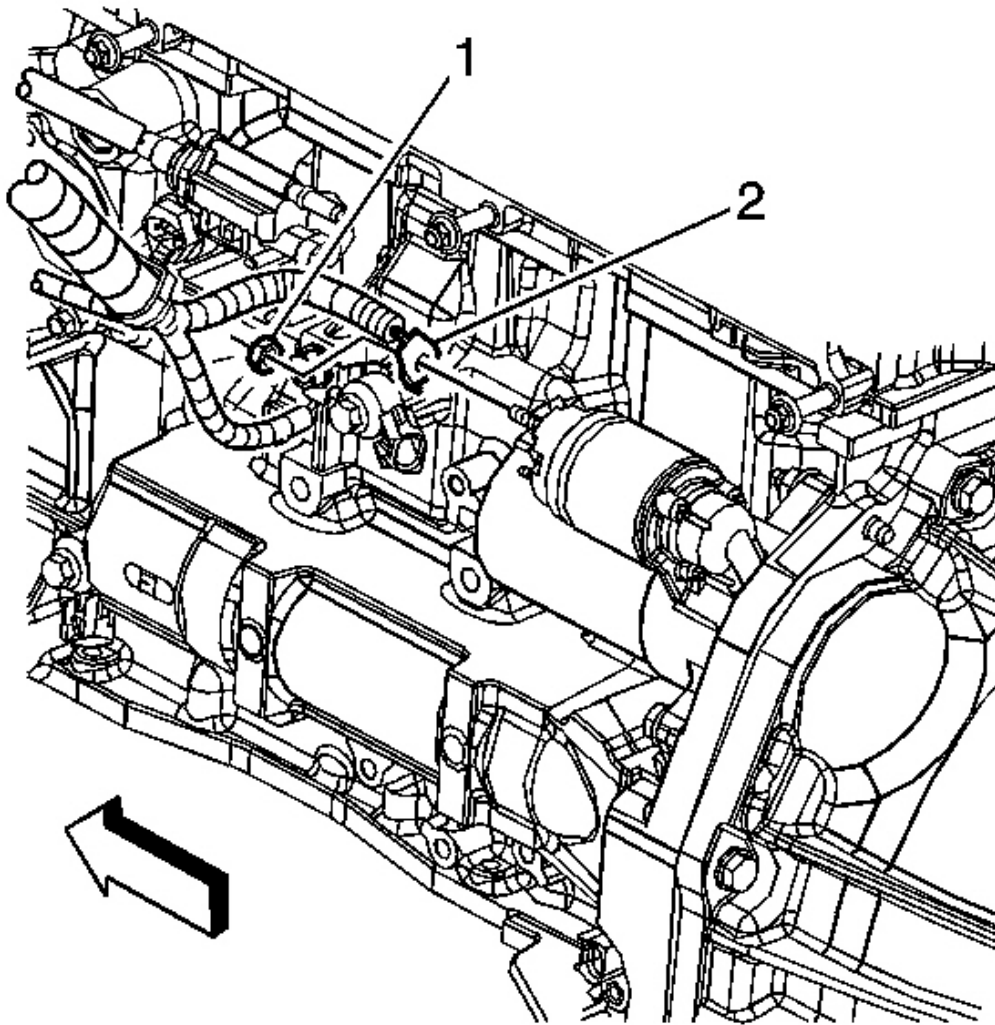


Fig. 15: Starter Wiring (1 of 2)
Courtesy of GENERAL MOTORS CORP.

10. Remove the starter terminal nut (1) and remove the positive battery cable terminal (2) from the starter.

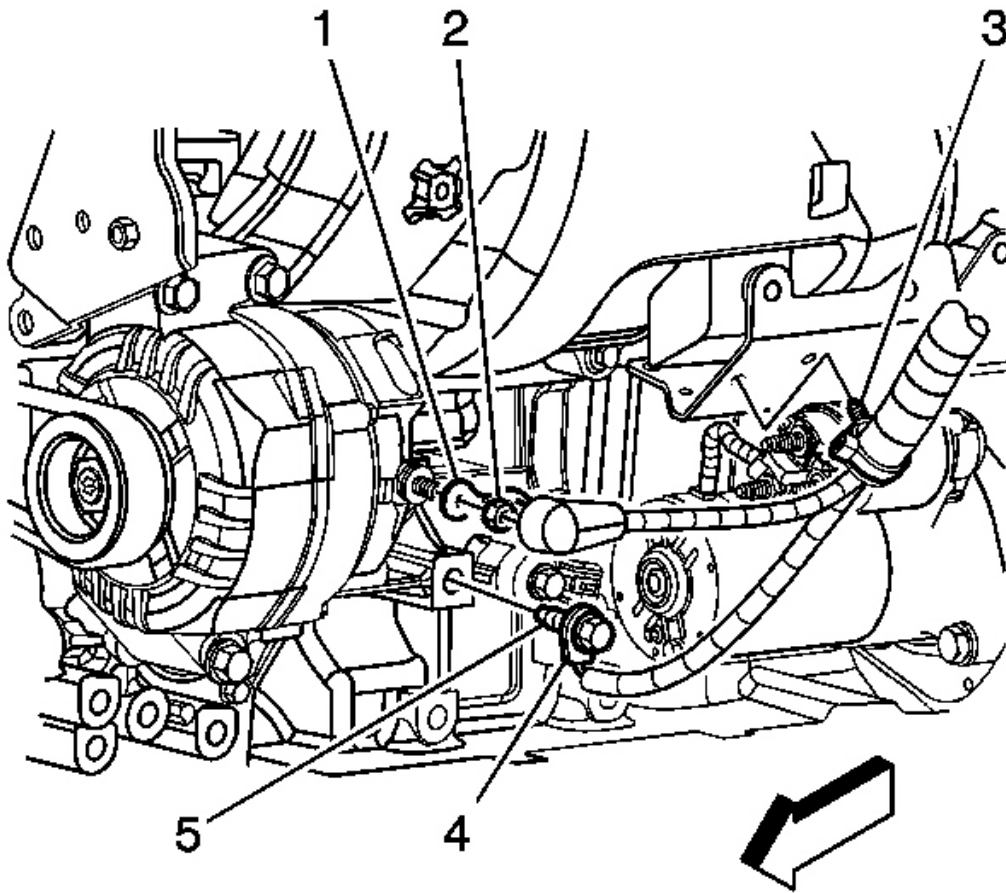


Fig. 16: Starter Wiring (2 of 2)
Courtesy of GENERAL MOTORS CORP.

11. Remove the bolt (5) securing the negative battery cable ground terminal (4) to the engine block.
12. Remove the battery cable clip (3) from the engine wiring harness bracket.
13. Remove the battery cables from the vehicle.

Installation Procedure

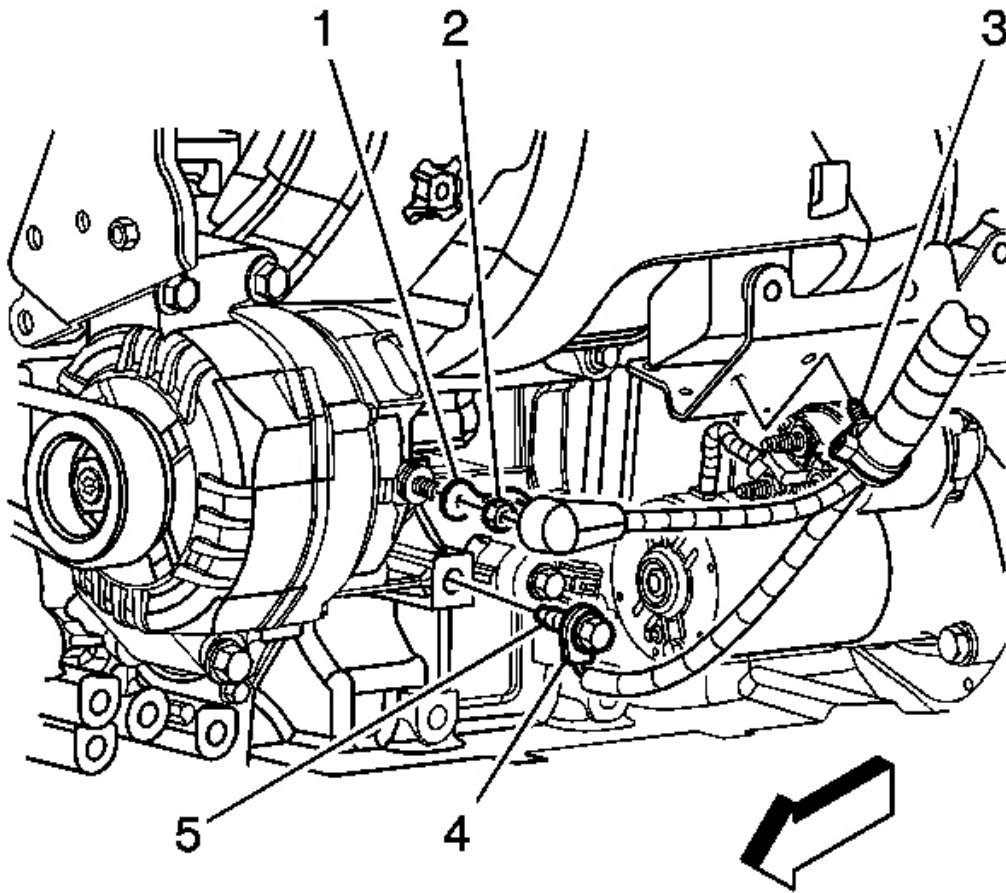


Fig. 17: Starter Wiring (2 of 2)
Courtesy of GENERAL MOTORS CORP.

1. Insert the battery cables to the vehicle.
2. Install the battery cable clip (3) to the engine wiring harness bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the bolt (5) securing the negative battery cable ground terminal (4) to the engine block.

Tighten: Tighten the bolt to 35 N.m (26 lb ft).

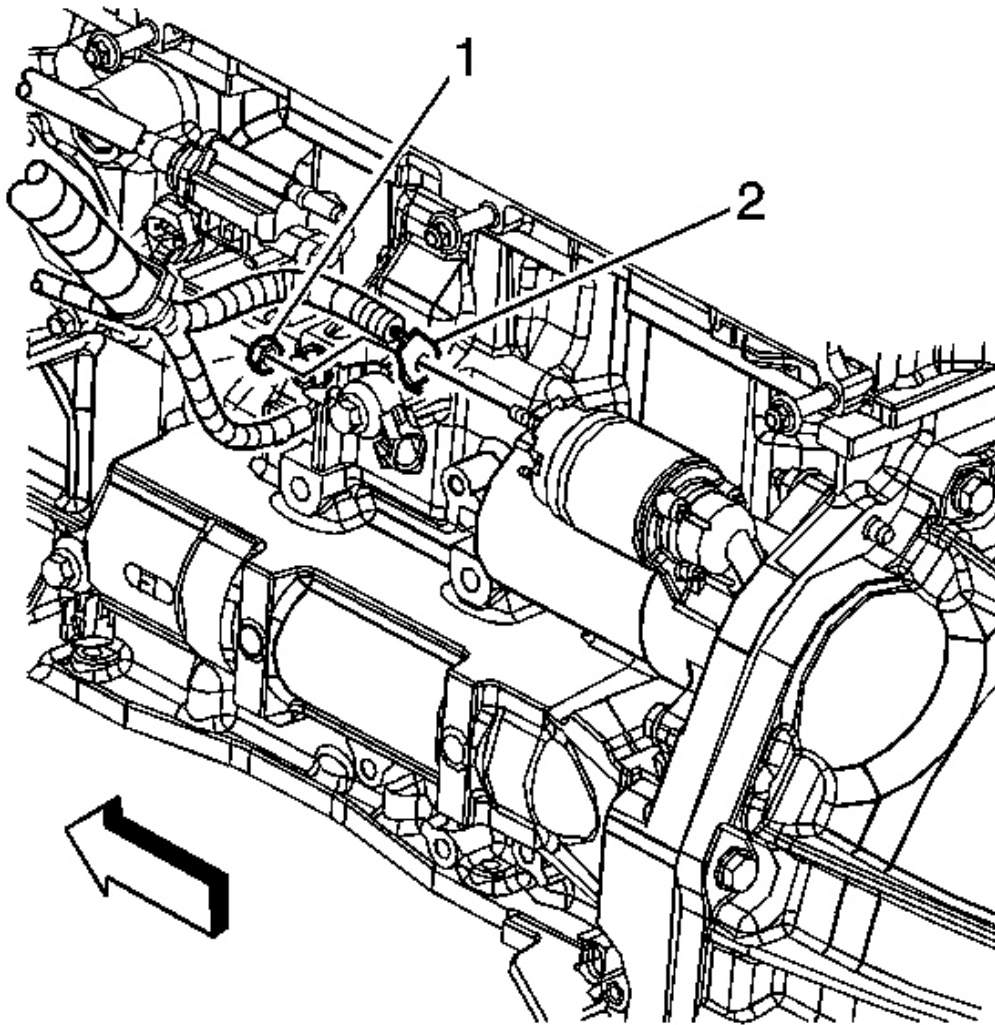


Fig. 18: Starter Wiring (1 of 2)
Courtesy of GENERAL MOTORS CORP.

4. Install the positive battery cable terminal (2) to the starter and the starter terminal nut (1).
5. Install the left wheelhouse liner. Refer to **Wheelhouse Panel Replacement** .

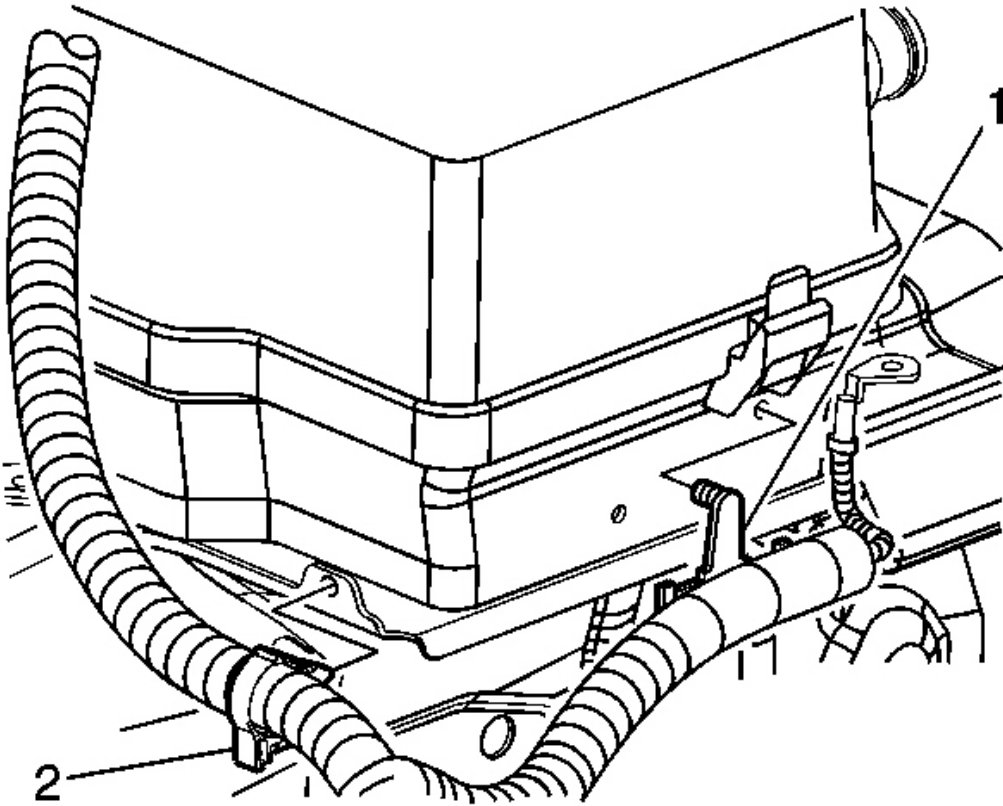


Fig. 19: Harness Clips
Courtesy of GENERAL MOTORS CORP.

6. Install the battery cable harness clips (1, 2) to the battery tray.

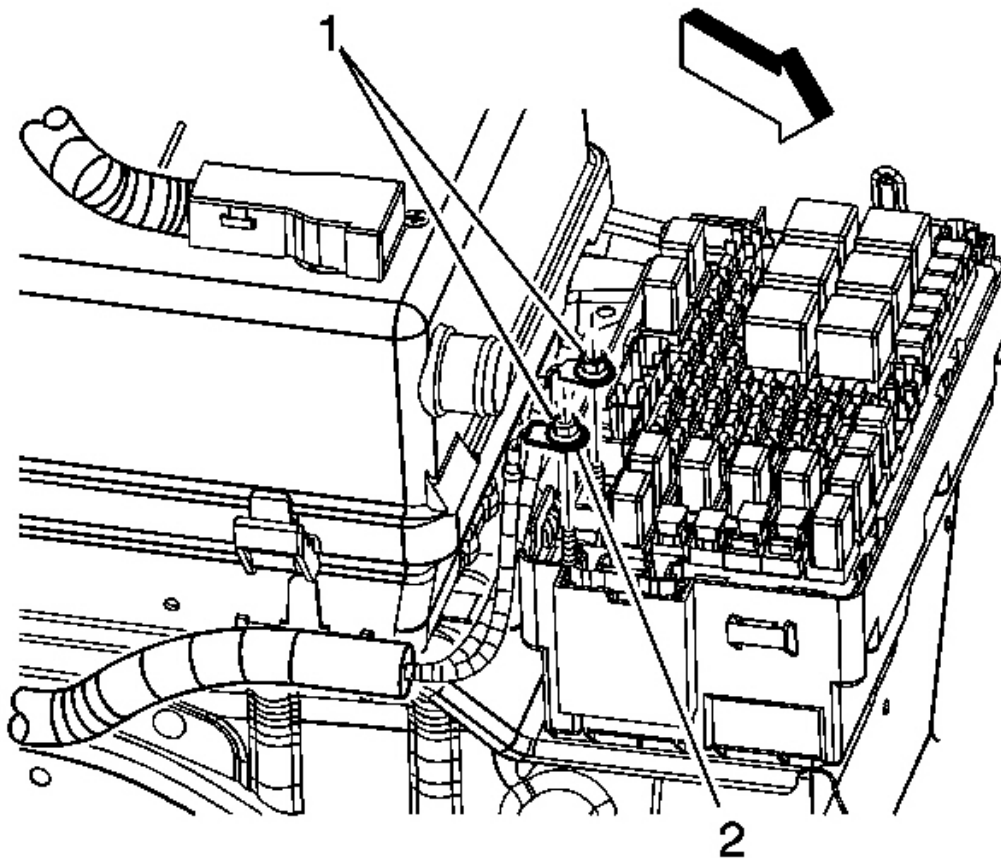


Fig. 20: Nuts Securing The Battery Cables To Underhood Fuse Block
Courtesy of GENERAL MOTORS CORP.

7. Tighten the nuts (1) securing the battery cables to the underhood fuse block.

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

8. Install the underhood fuse block cover to the underhood fuse block, engaging the locking tabs.

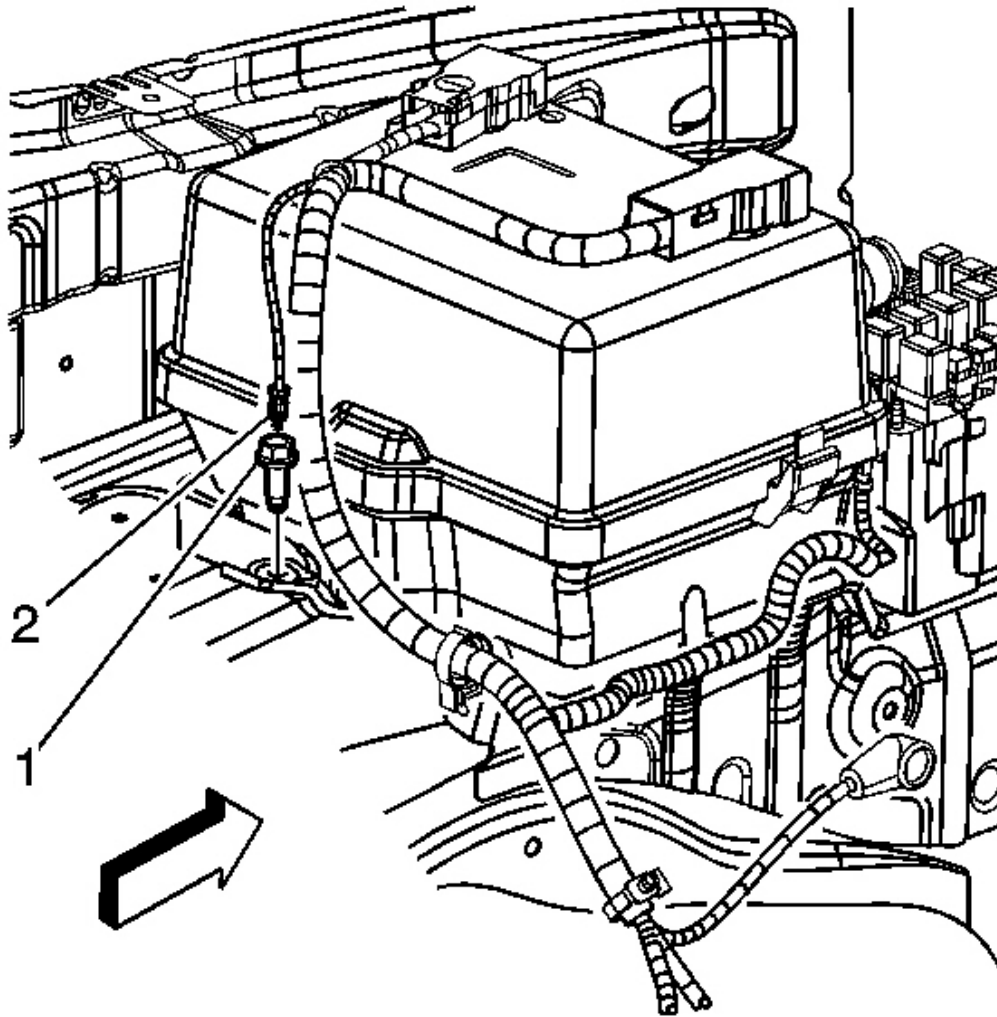


Fig. 21: Bolt Securing Negative Battery Cable Ground To Battery Tray
Courtesy of GENERAL MOTORS CORP.

9. Install the bolt (1) securing the negative battery cable ground (2) to the battery tray.

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

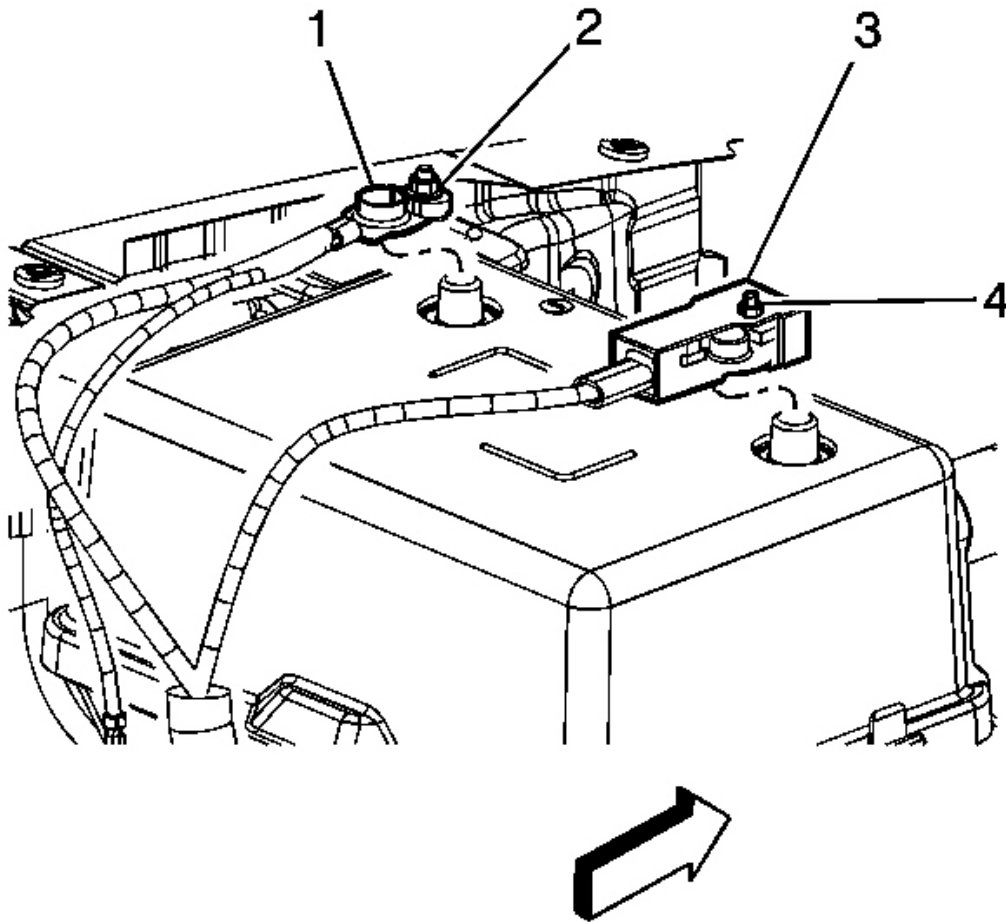


Fig. 22: View Of Battery Cables
Courtesy of GENERAL MOTORS CORP.

10. Install the positive battery cable (4) to the battery.
11. Tighten the positive battery cable nut (3).

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

12. Close the protective cover to access the positive battery cable terminal.
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

GENERATOR CABLE REPLACEMENT

- IMPORTANT:**
- Always use replacement cables that are of the same type, diameter and length of the cables that are being replaced.
 - Always route the replacement cable the same way as the original cable.

Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Remove the battery cable harness clips (1, 2) from the battery tray.

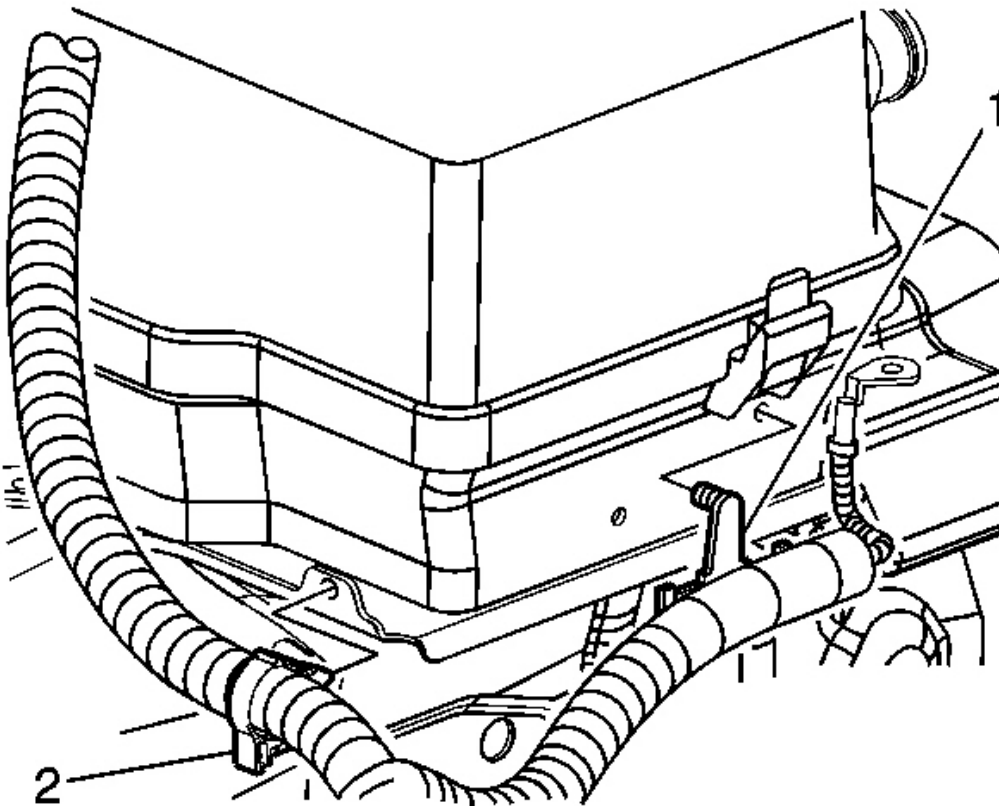


Fig. 23: Harness Clips

Courtesy of GENERAL MOTORS CORP.

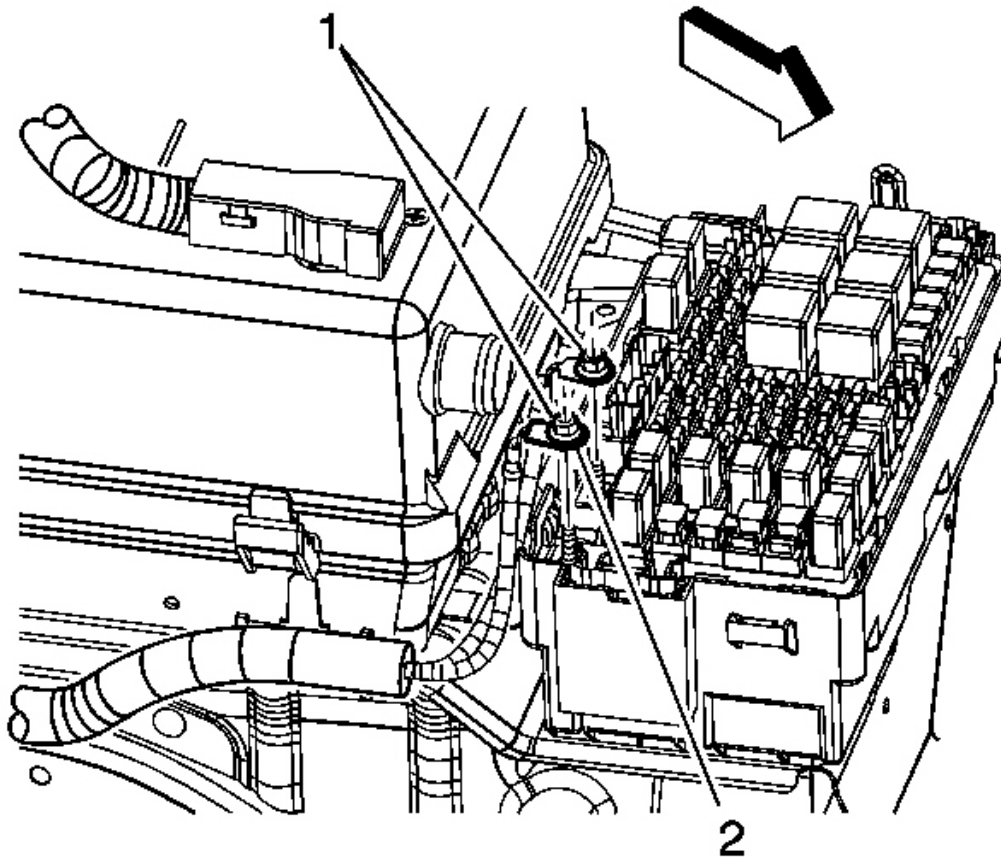


Fig. 24: Nuts Securing The Battery Cables To Underhood Fuse Block
Courtesy of GENERAL MOTORS CORP.

3. Press the locking tabs inward in order to remove the underhood fuse block cover from the underhood fuse block.
4. Remove the nut (1) securing the generator positive cable inner terminal to the underhood fuse block.

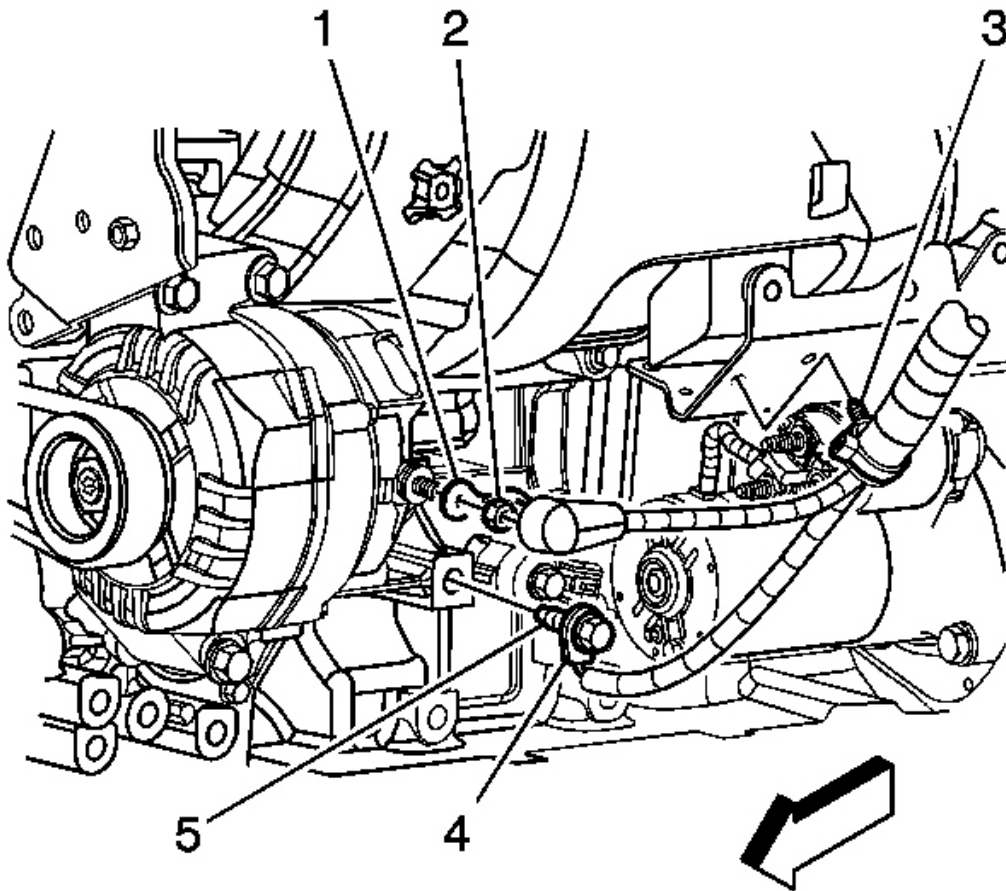


Fig. 25: Starter Wiring
Courtesy of GENERAL MOTORS CORP.

5. Reposition the protective boot from the generator output BAT terminal for access.
6. Remove the generator output BAT terminal nut (2) and disconnect the generator positive lead (1) from the generator.
7. Remove the positive cable clip (3) from the engine wiring harness bracket.
8. Remove the generator positive cable from the battery cables harness conduit.

Installation Procedure

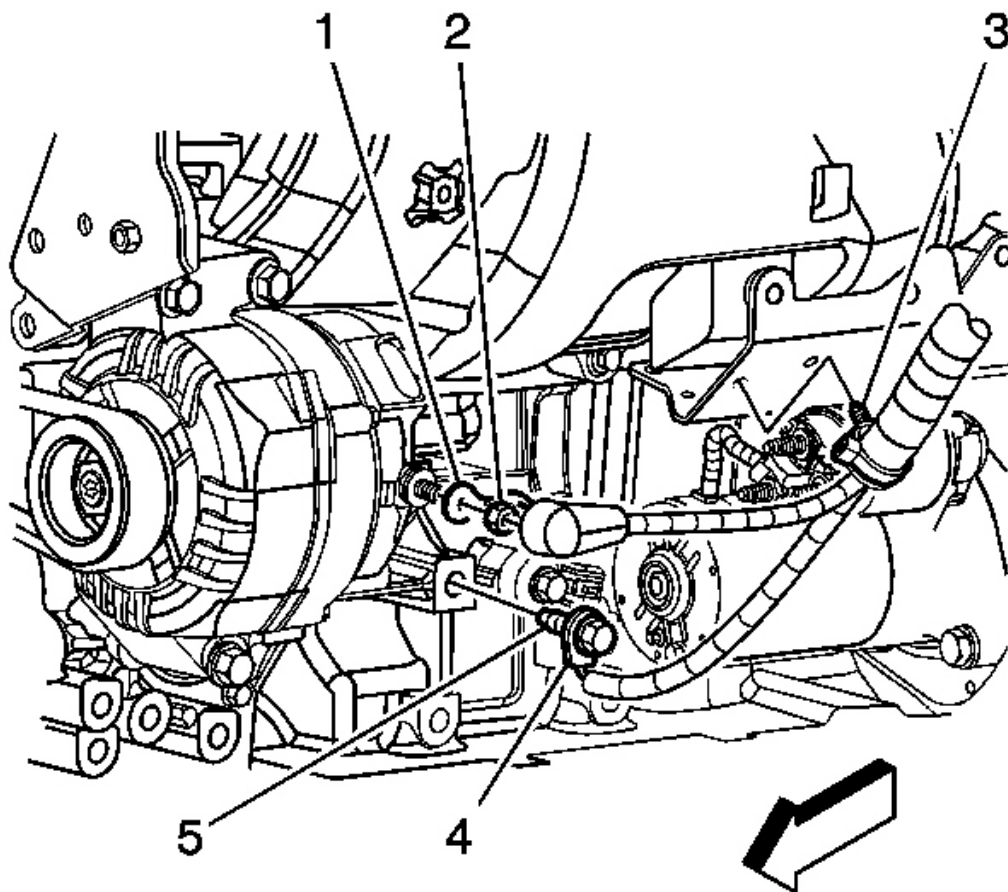


Fig. 26: Starter Wiring

Courtesy of GENERAL MOTORS CORP.

1. Insert the generator positive cable into the battery cables harness conduit.
2. Install the positive cable clip (3) to the engine wiring harness bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Connect the generator positive lead (2) to the generator and install the generator output BAT terminal nut (1).

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

4. Position the protective boot onto the generator output BAT terminal.

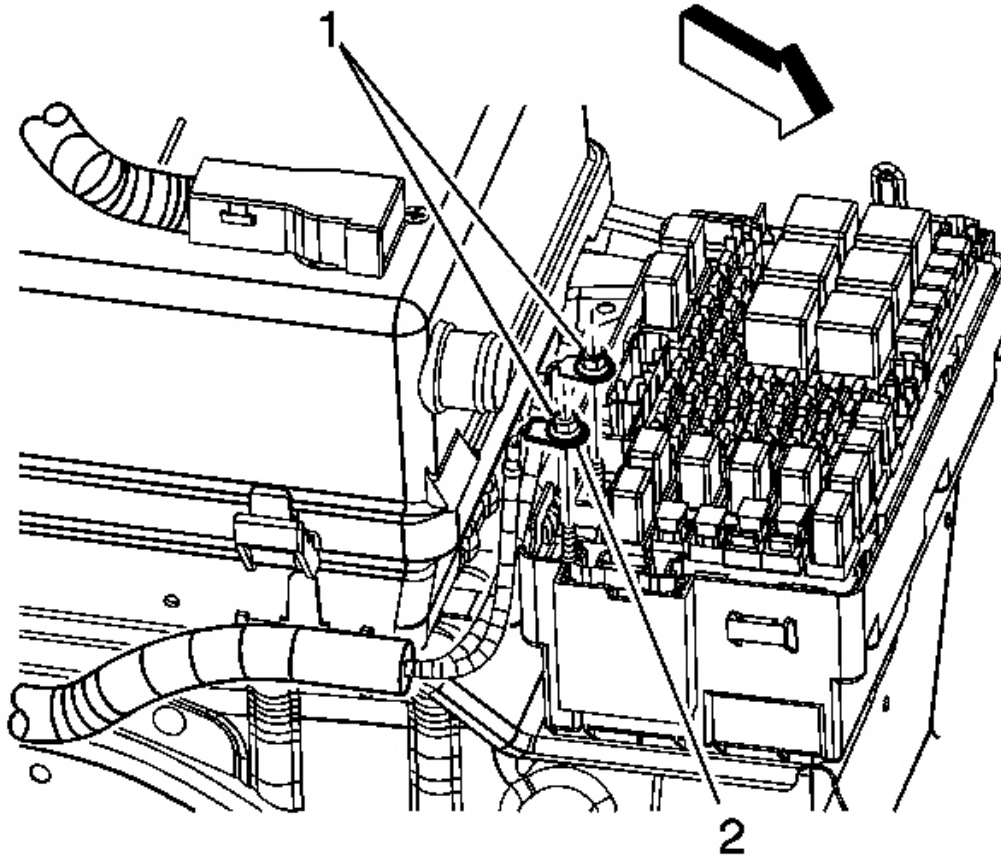


Fig. 27: Nuts Securing The Battery Cables To Underhood Fuse Block
Courtesy of GENERAL MOTORS CORP.

5. Install the nut (1) securing the generator positive cable inner terminal to the underhood fuse block.

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

6. Install the underhood fuse block cover to the underhood fuse block, engaging the locking tabs.

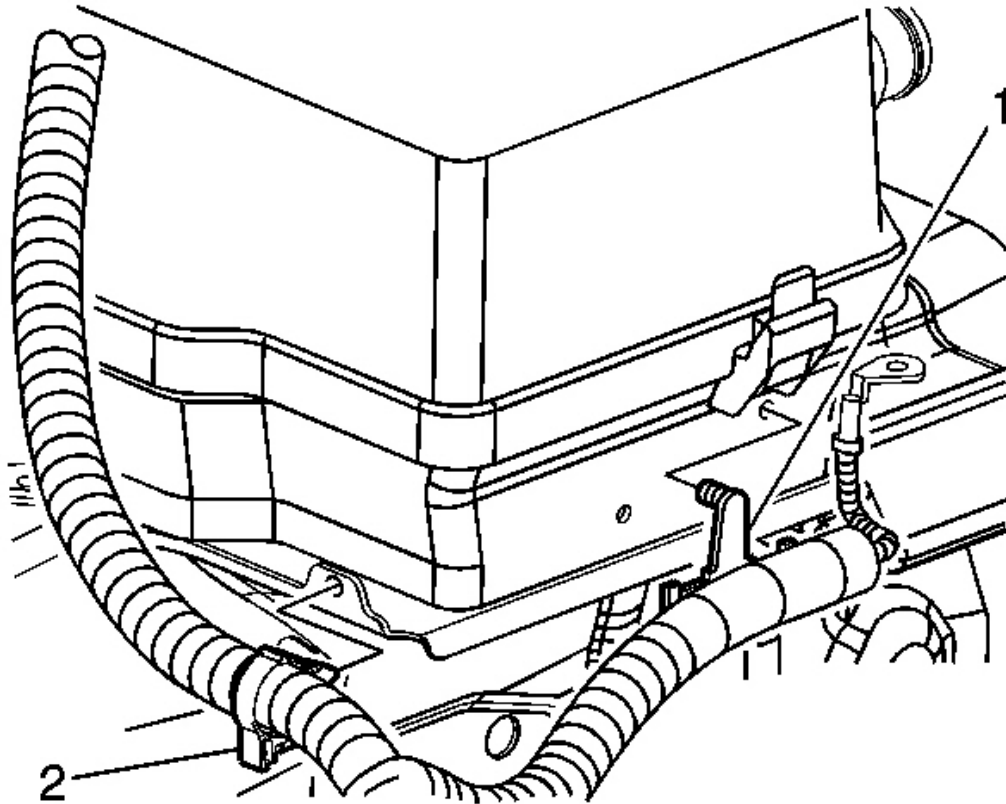


Fig. 28: Harness Clips

Courtesy of GENERAL MOTORS CORP.

7. Install the battery cable harness clips (1, 2) to the battery tray.
8. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

BATTERY REPLACEMENT

Removal Procedure

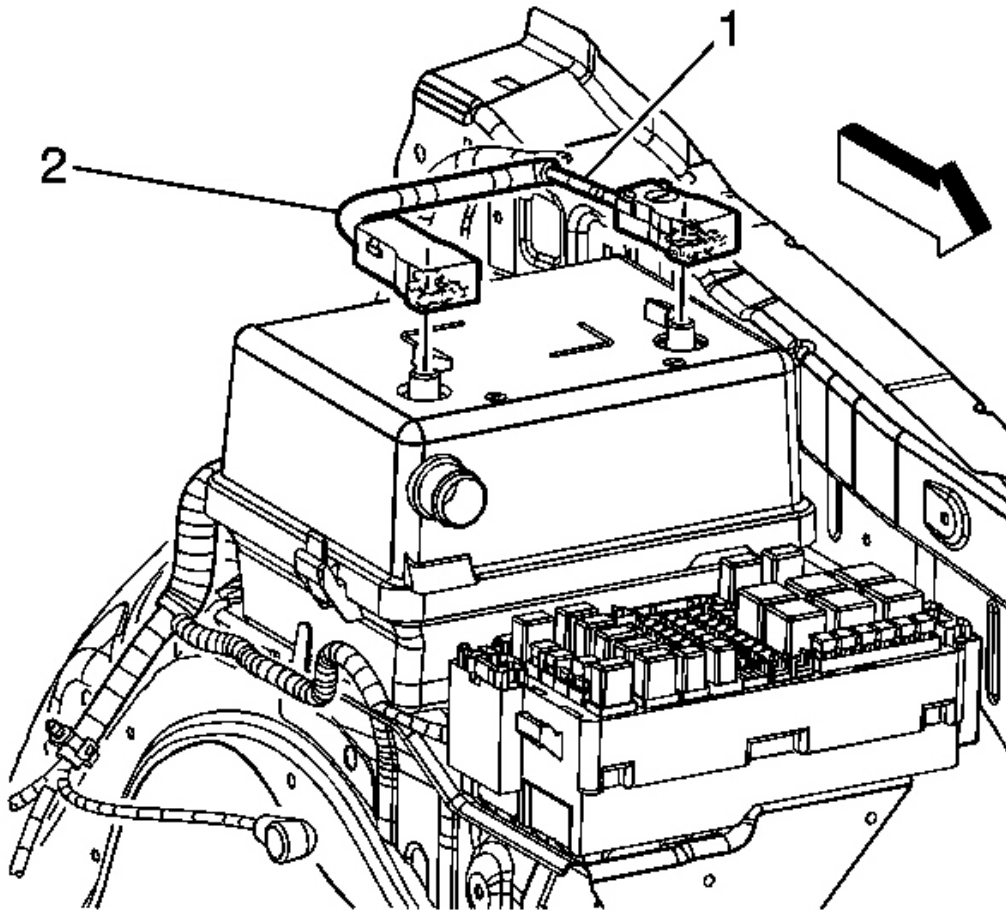


Fig. 29: Battery Cables

Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Open the protective cover to access the positive battery cable terminal.
3. Loosen the positive battery cable nut.
4. Remove the positive battery cable (2) from the battery.
5. Disconnect the battery vent duct from the upper battery box (1).

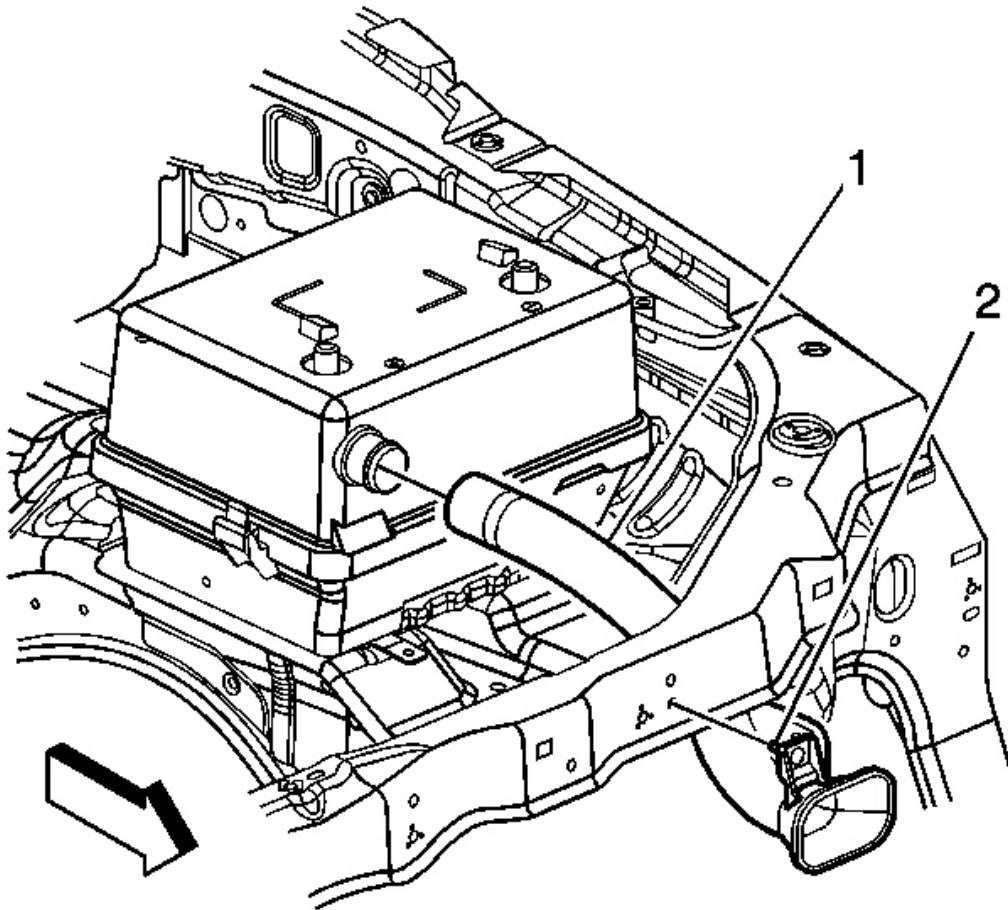


Fig. 30: Battery Vent Duct
Courtesy of GENERAL MOTORS CORP.

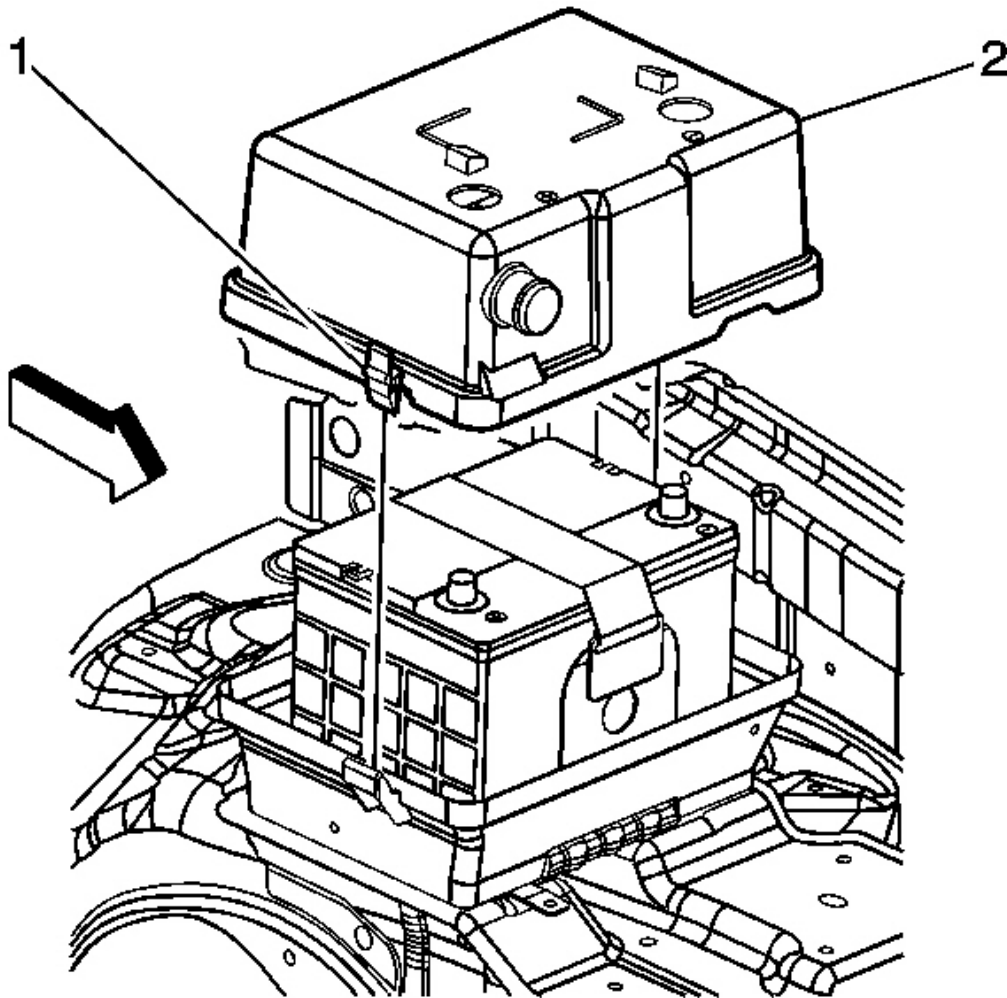


Fig. 31: Upper Battery Box
Courtesy of GENERAL MOTORS CORP.

6. Press the locking tabs (1) inward in order to remove the upper battery box (2) from the lower battery box.

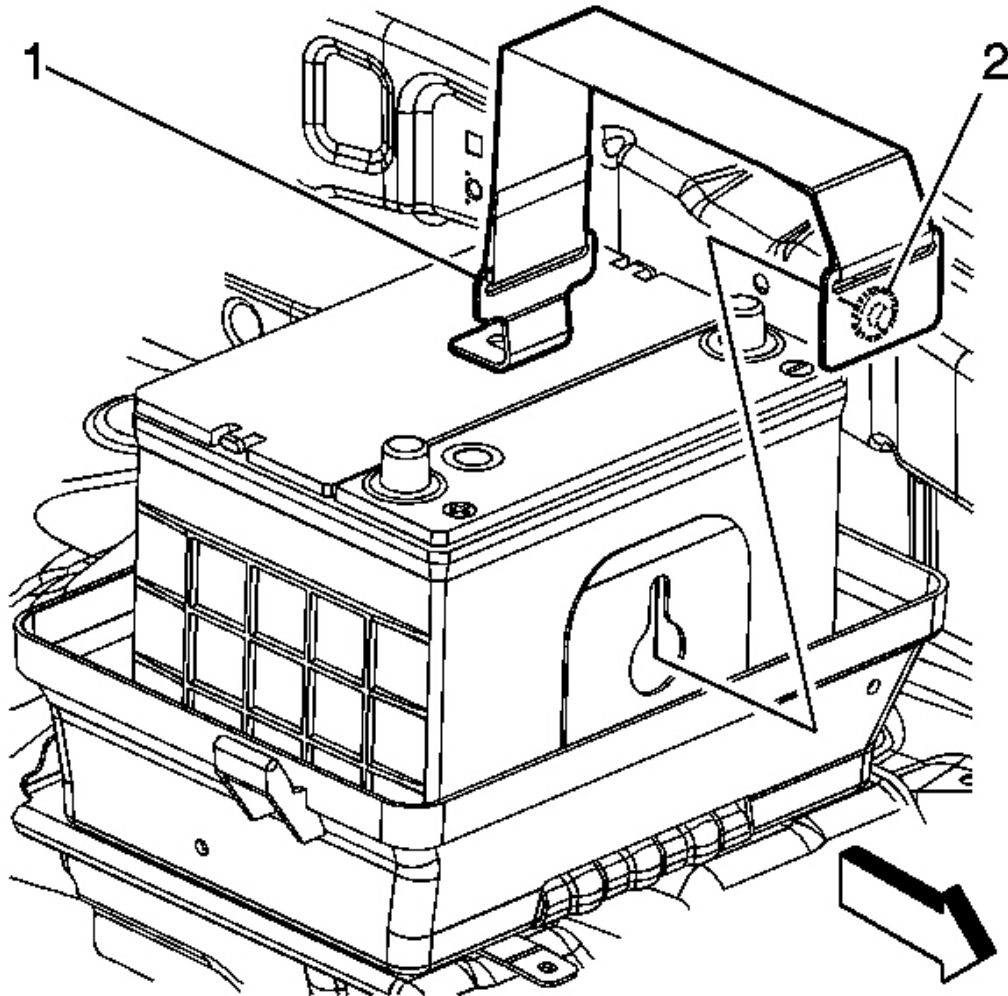


Fig. 32: Battery Strap
Courtesy of GENERAL MOTORS CORP.

7. Disengage the battery strap pin (2) from the battery tray bracket stopper.

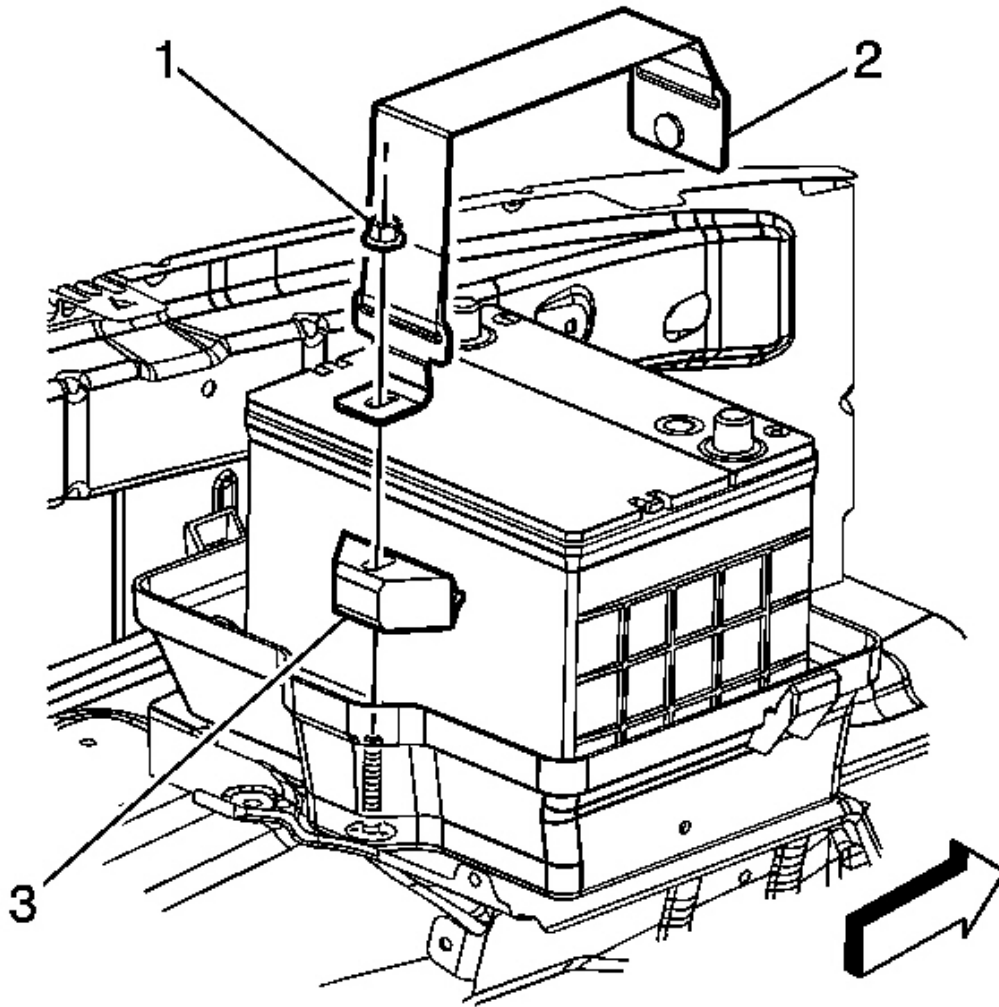


Fig. 33: Battery Strap & Nut
Courtesy of GENERAL MOTORS CORP.

8. Remove the battery retainer nut (1).
9. Remove the battery tray strap (2).
10. Remove the battery retainer (3).

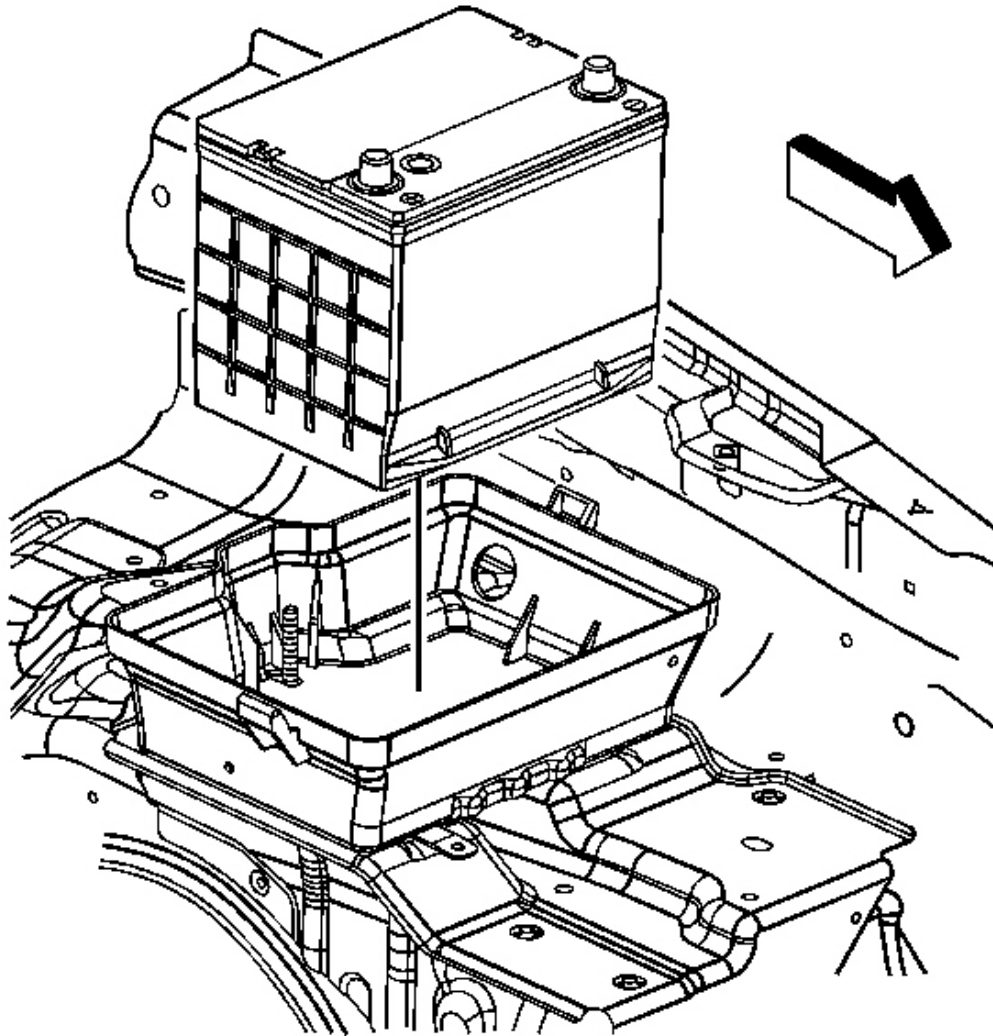


Fig. 34: Remove/Install Battery
Courtesy of GENERAL MOTORS CORP.

11. Remove the battery from the lower battery box.

Installation Procedure

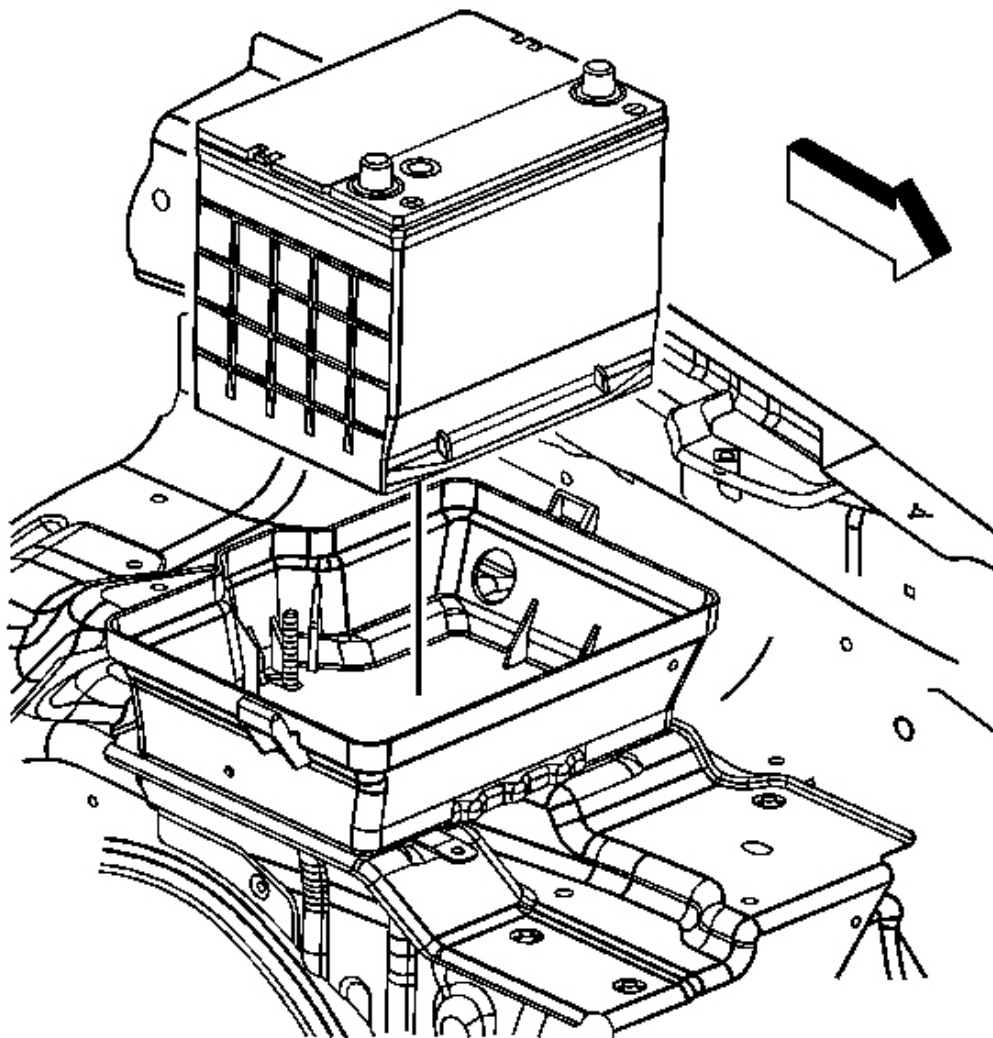


Fig. 35: Remove/Install Battery
Courtesy of GENERAL MOTORS CORP.

1. Install the battery to the lower battery box.

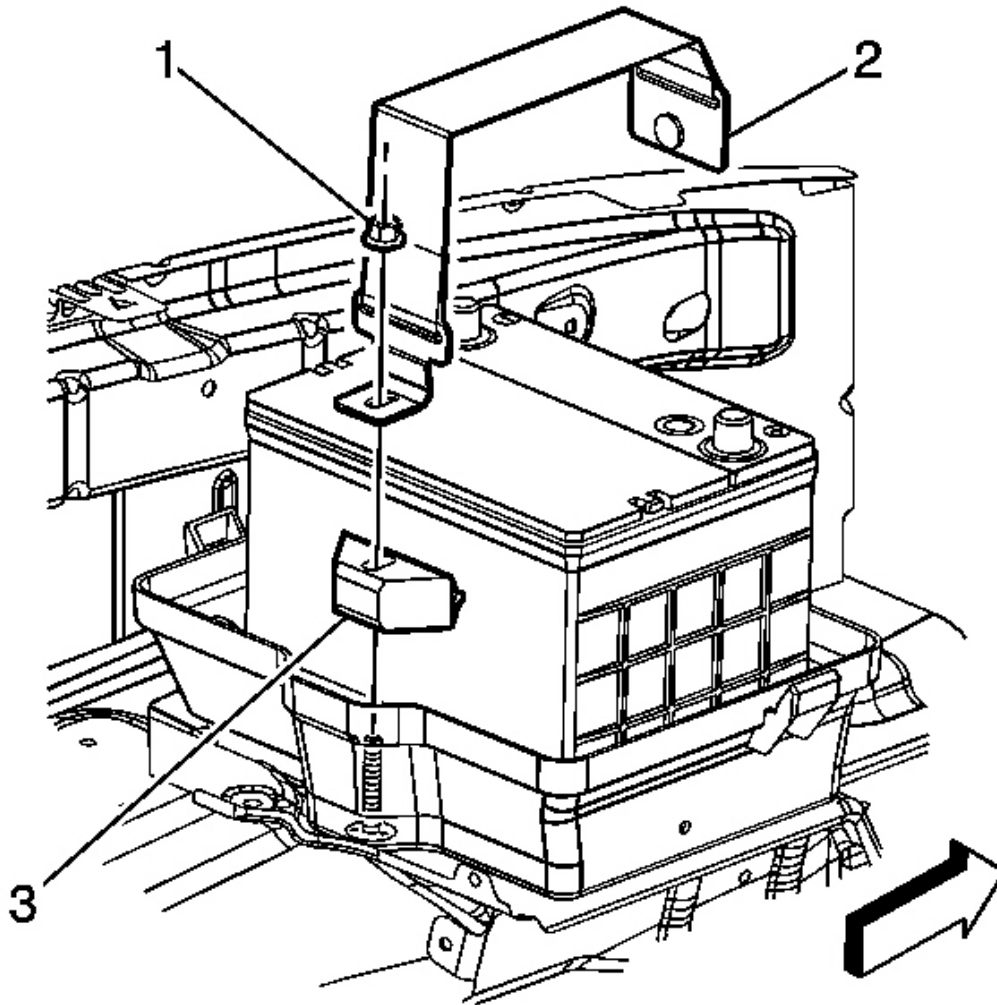


Fig. 36: Battery Strap & Nut
Courtesy of GENERAL MOTORS CORP.

2. Install the battery retainer (3).
3. Install the battery tray strap (2).

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the battery retainer nut (1).

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

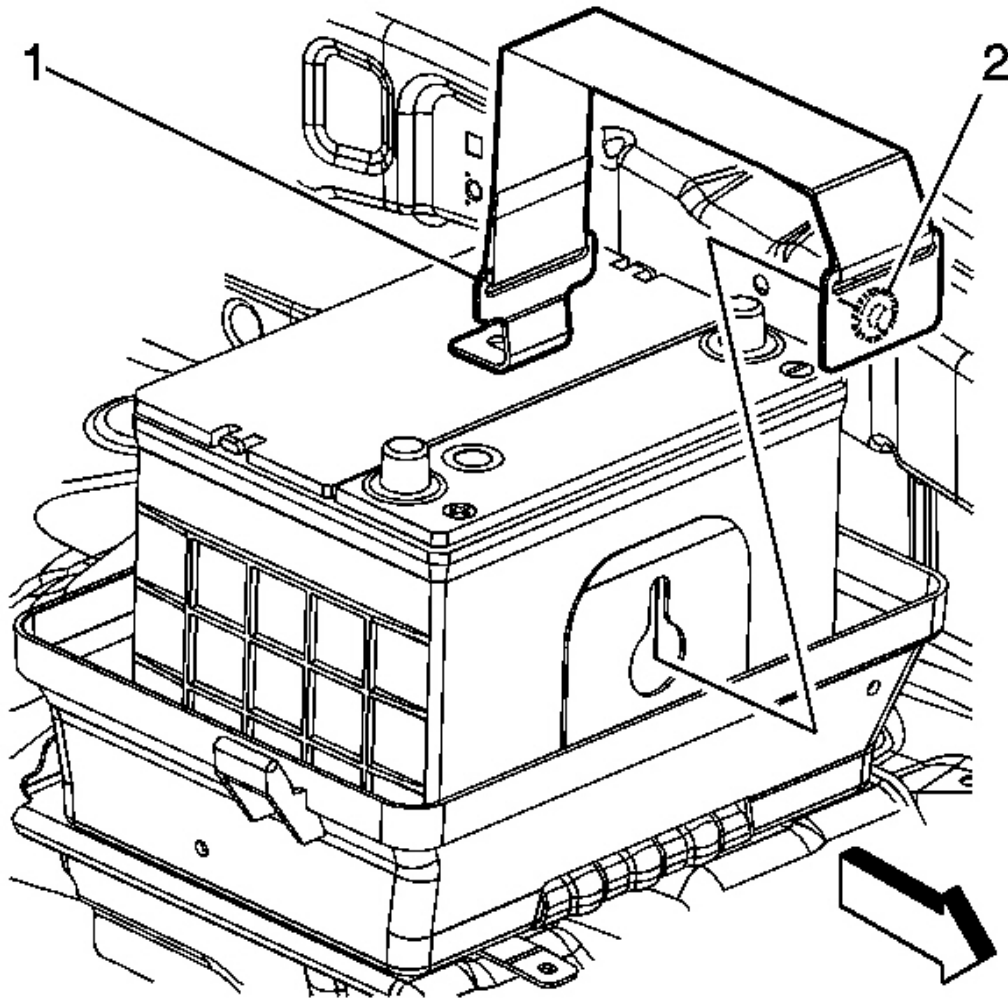


Fig. 37: Battery Strap
Courtesy of GENERAL MOTORS CORP.

5. Engage the battery strap pin (2) to the battery tray bracket stopper.
6. Install the upper battery box (2) over the battery, engage the locking tabs (1) into the lower battery box.

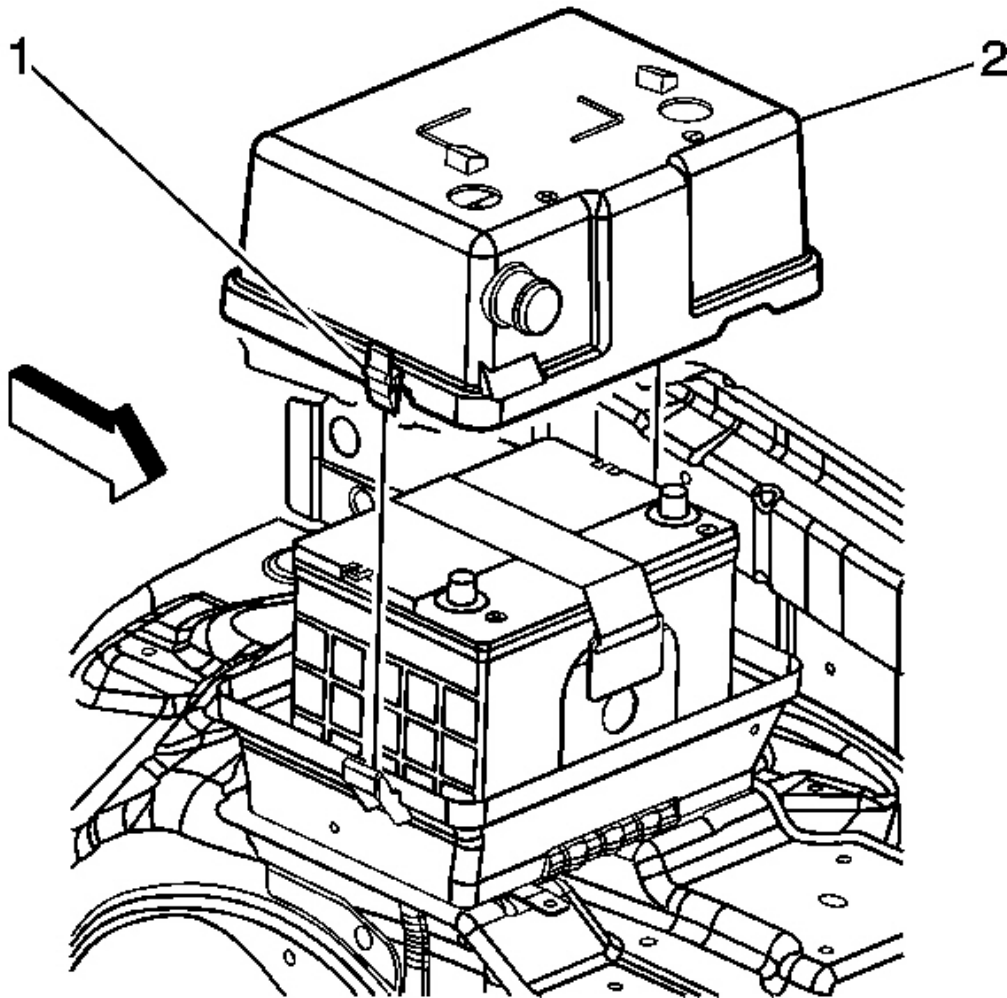


Fig. 38: Upper Battery Box
Courtesy of GENERAL MOTORS CORP.

7. Connect the battery vent duct to the upper battery box (2).
8. Connect the battery vent duct to the upper battery box (1).

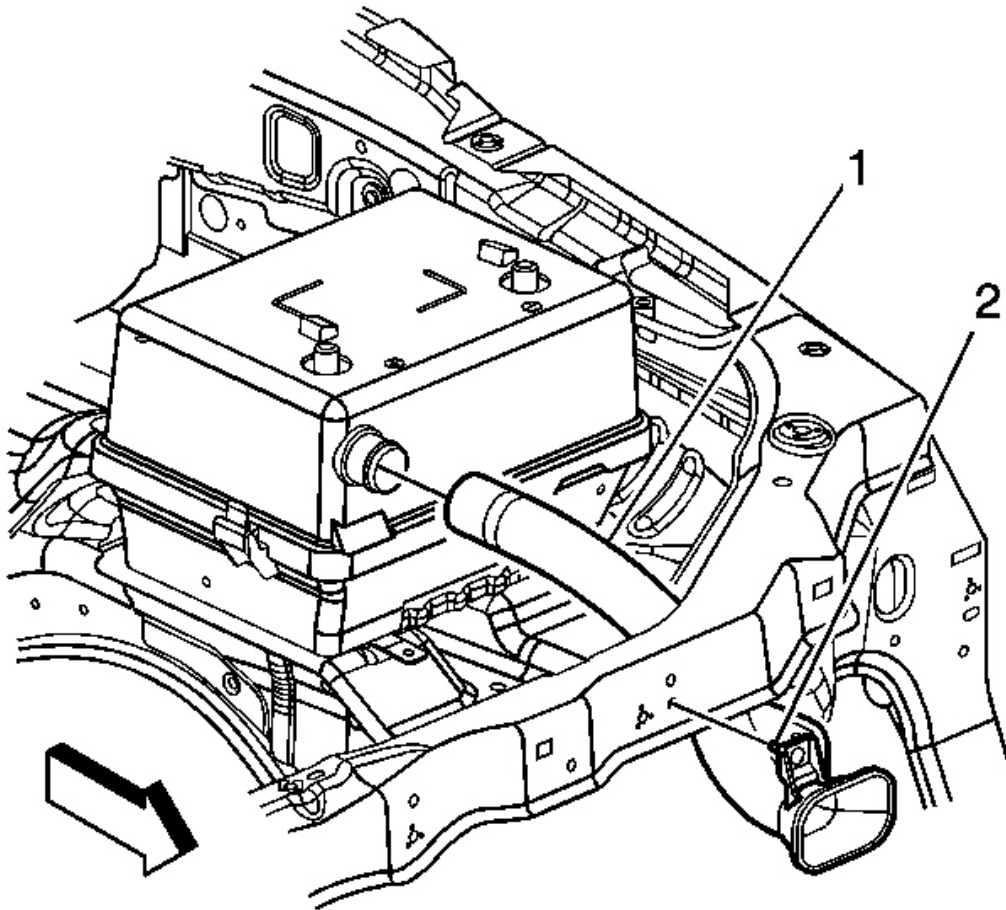


Fig. 39: Battery Vent Duct
Courtesy of GENERAL MOTORS CORP.

9. Clean any existing corrosion from the battery terminal and battery cable using a wire brush.

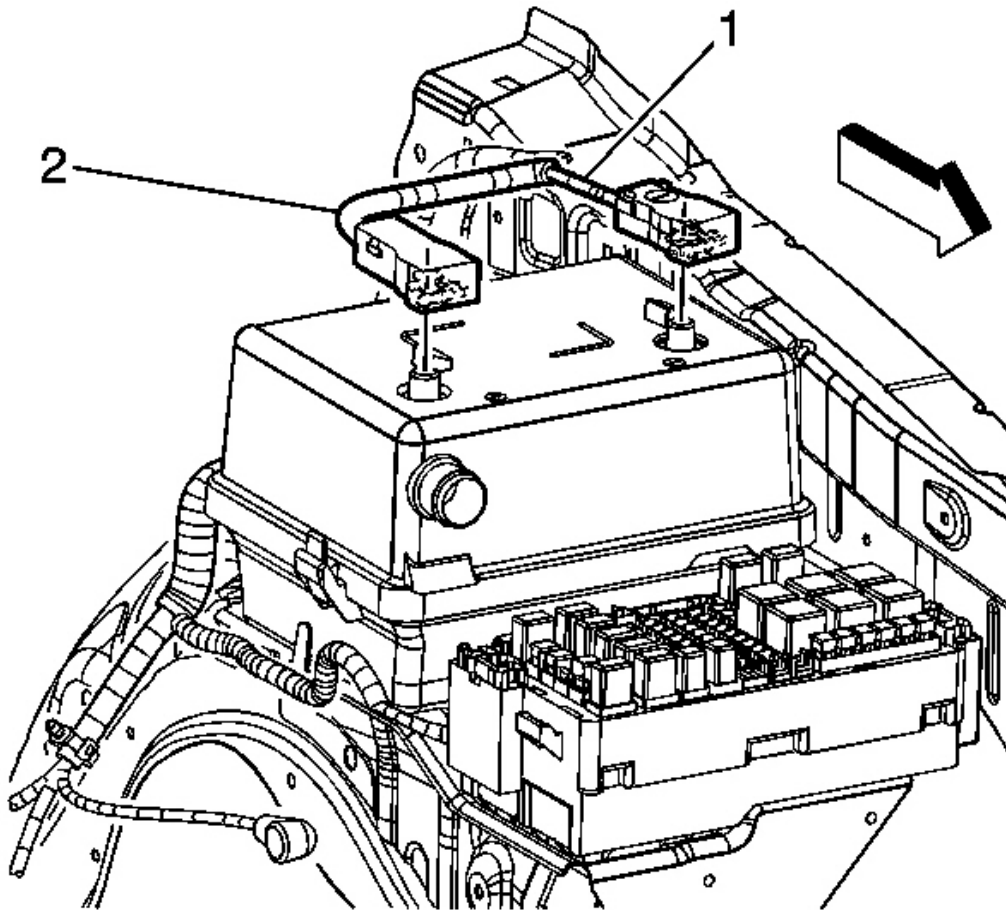


Fig. 40: Battery Cables

Courtesy of GENERAL MOTORS CORP.

10. Connect the positive battery cable (2) to the battery.

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

11. Close the protective cover over the positive battery cable terminal.
12. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

Removal Procedure

1. Remove the battery. Refer to **Battery Replacement**.
2. Remove the battery cable harness clips (1, 2) from the battery tray.

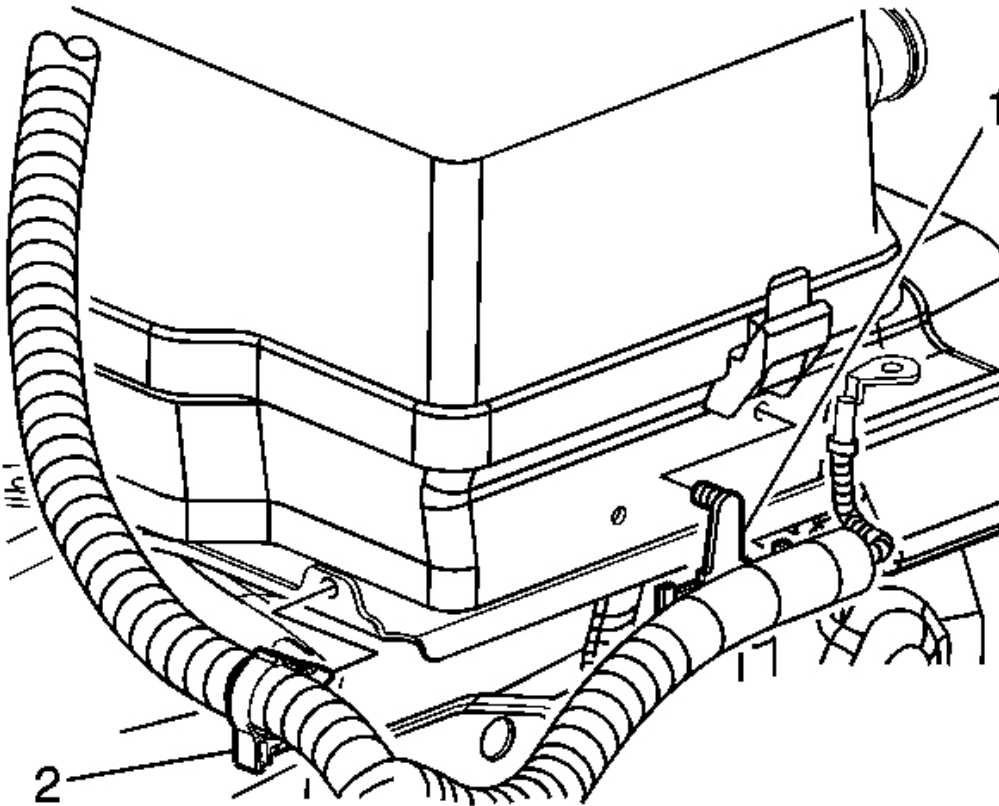


Fig. 41: Harness Clips
Courtesy of GENERAL MOTORS CORP.

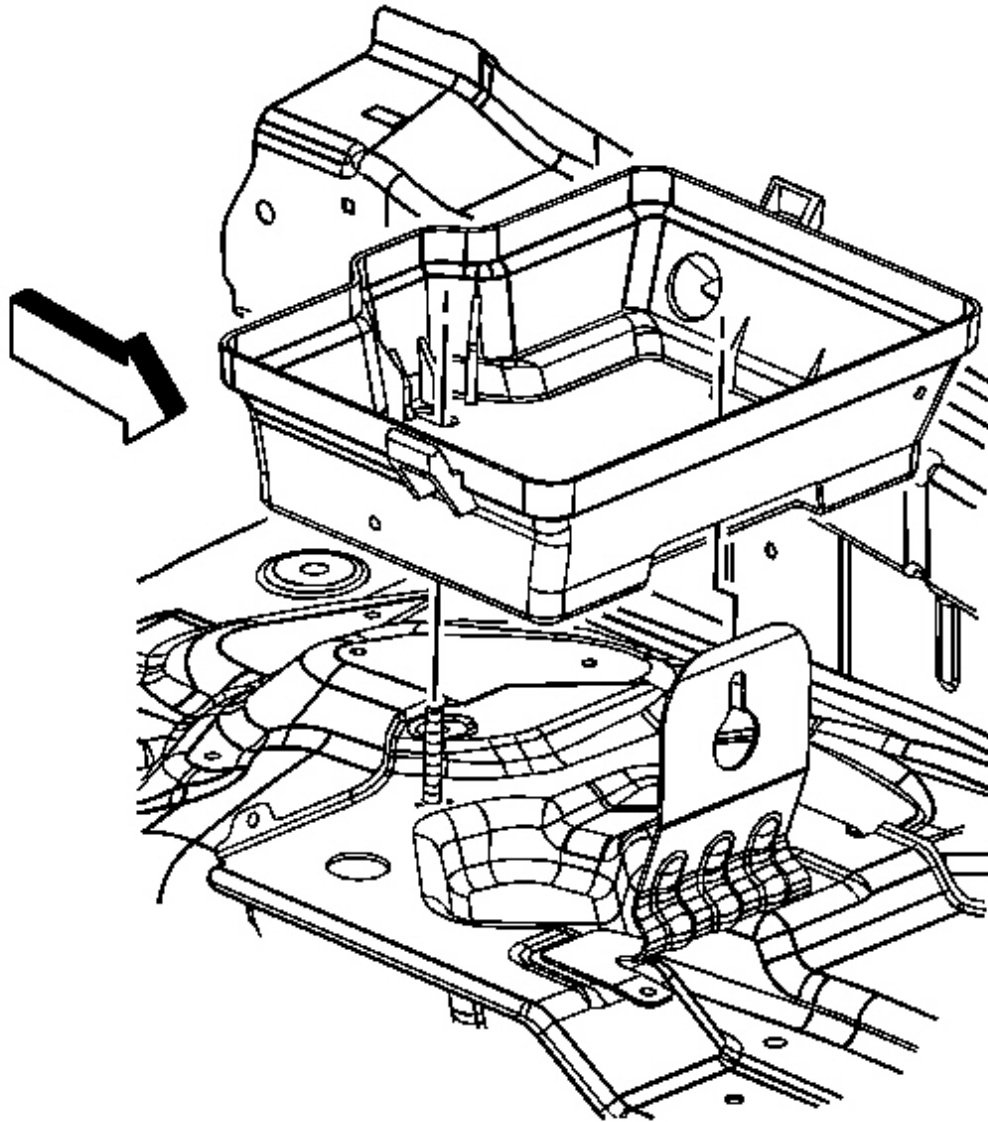


Fig. 42: Lower Battery Box
Courtesy of GENERAL MOTORS CORP.

3. Lift the lower battery box upward from the battery tray.

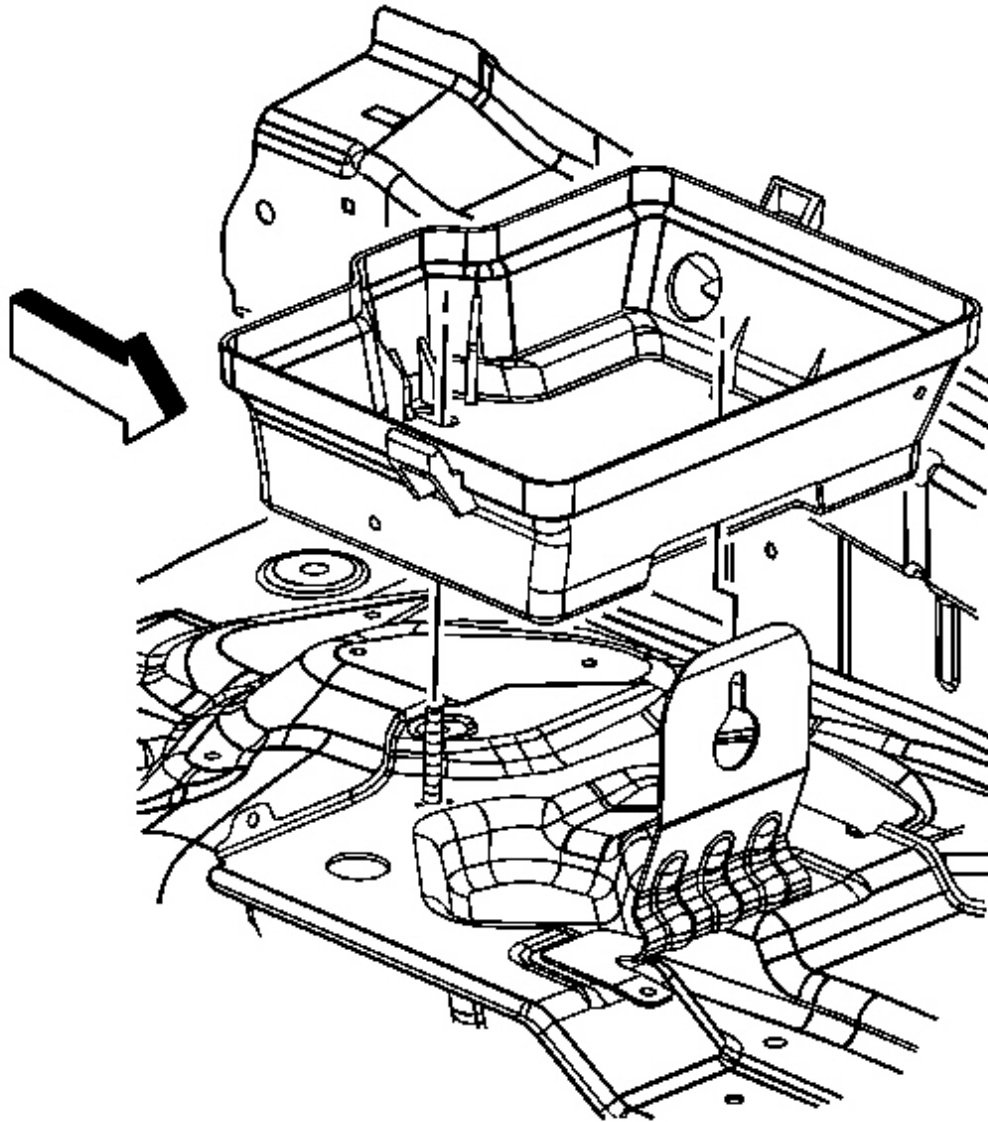


Fig. 43: Lower Battery Box
Courtesy of GENERAL MOTORS CORP.

1. Install the lower battery box to the retainer stud and battery tray.
2. Install the battery cable harness clips (1, 2) to the battery tray.

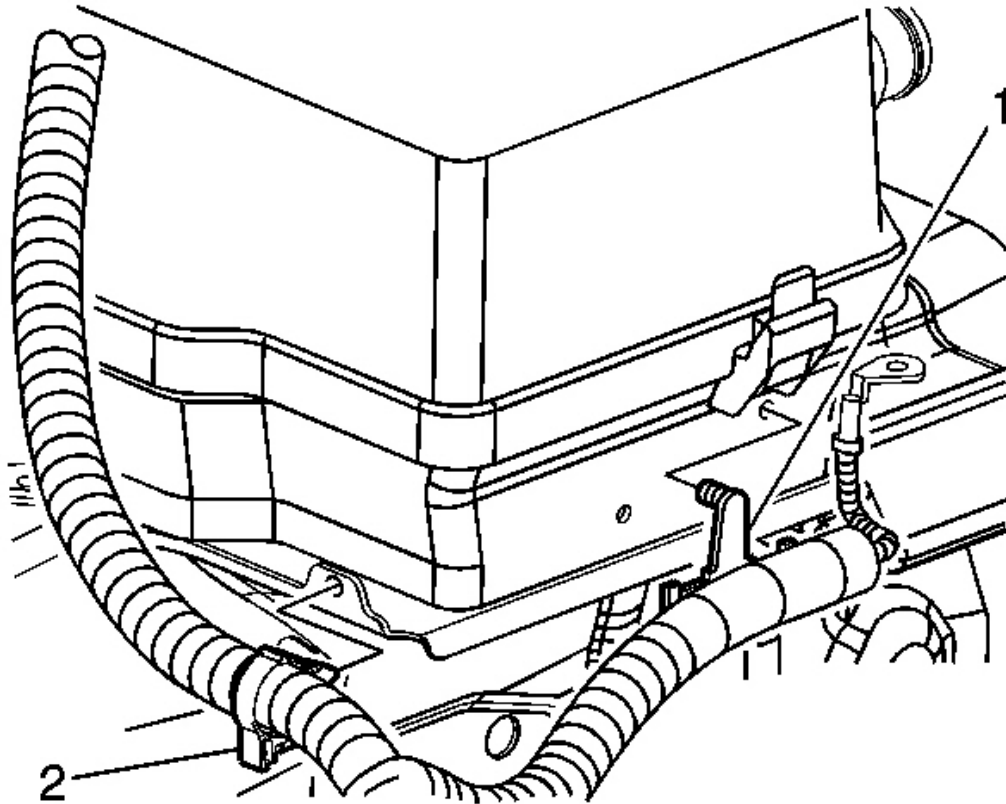


Fig. 44: Harness Clips
Courtesy of GENERAL MOTORS CORP.

3. Install the battery. Refer to **Battery Replacement**.

STARTER MOTOR REPLACEMENT

Removal Procedure

1. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical - 3.5L (L52).

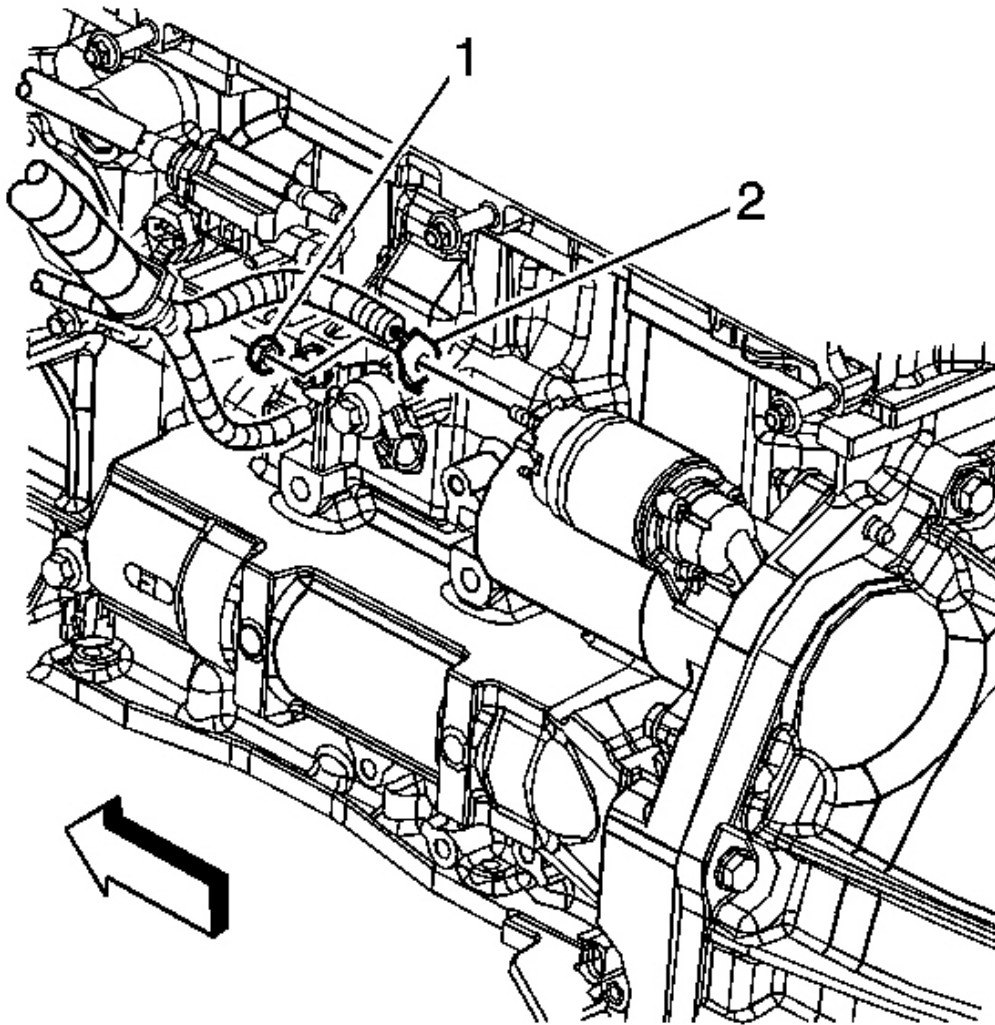


Fig. 45: Starter Wiring
Courtesy of GENERAL MOTORS CORP.

2. Remove the starter solenoid S terminal nut and disconnect the lead from the starter.
3. Remove the starter terminal nut (1) and disconnect the positive battery cable (2) from the starter.

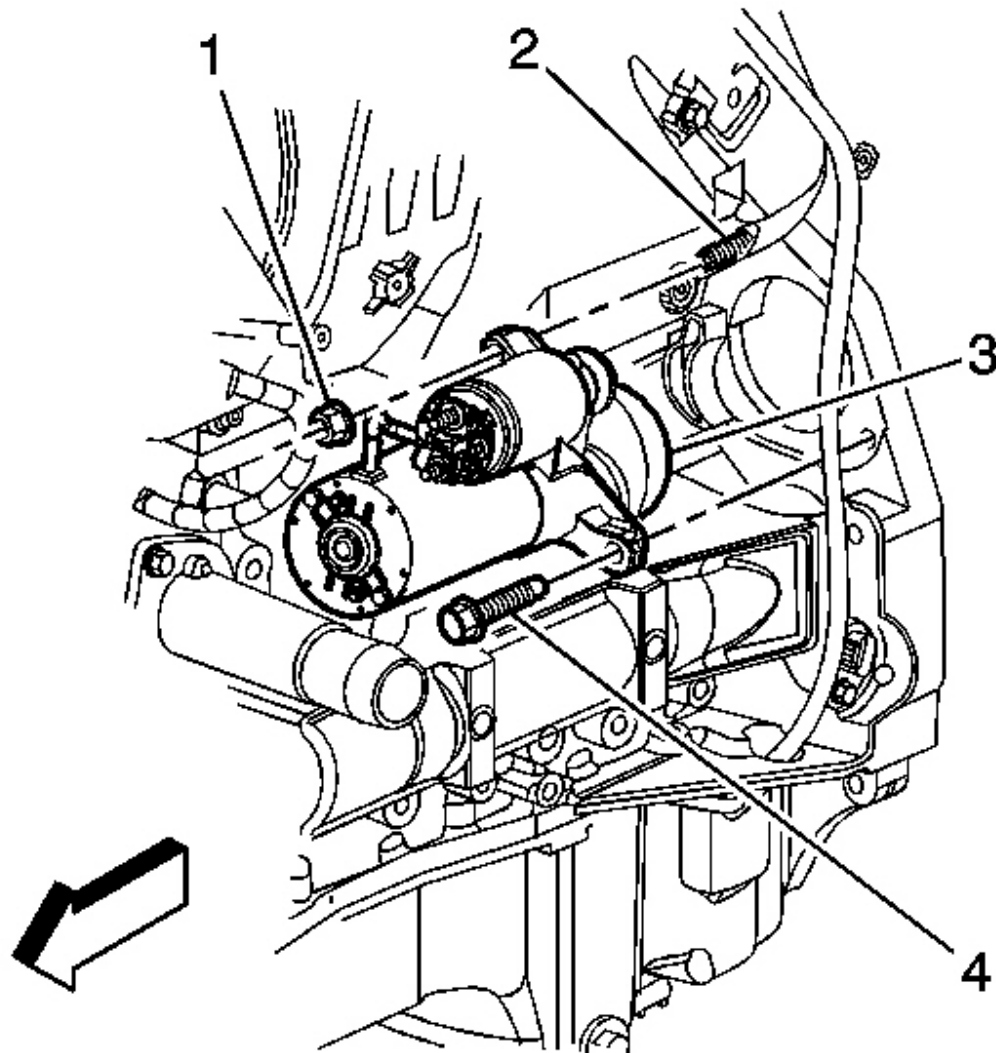


Fig. 46: View Of Starter Motor
Courtesy of GENERAL MOTORS CORP.

4. Remove the starter motor nut (1) and bolt (4).
5. Remove the starter motor (3).

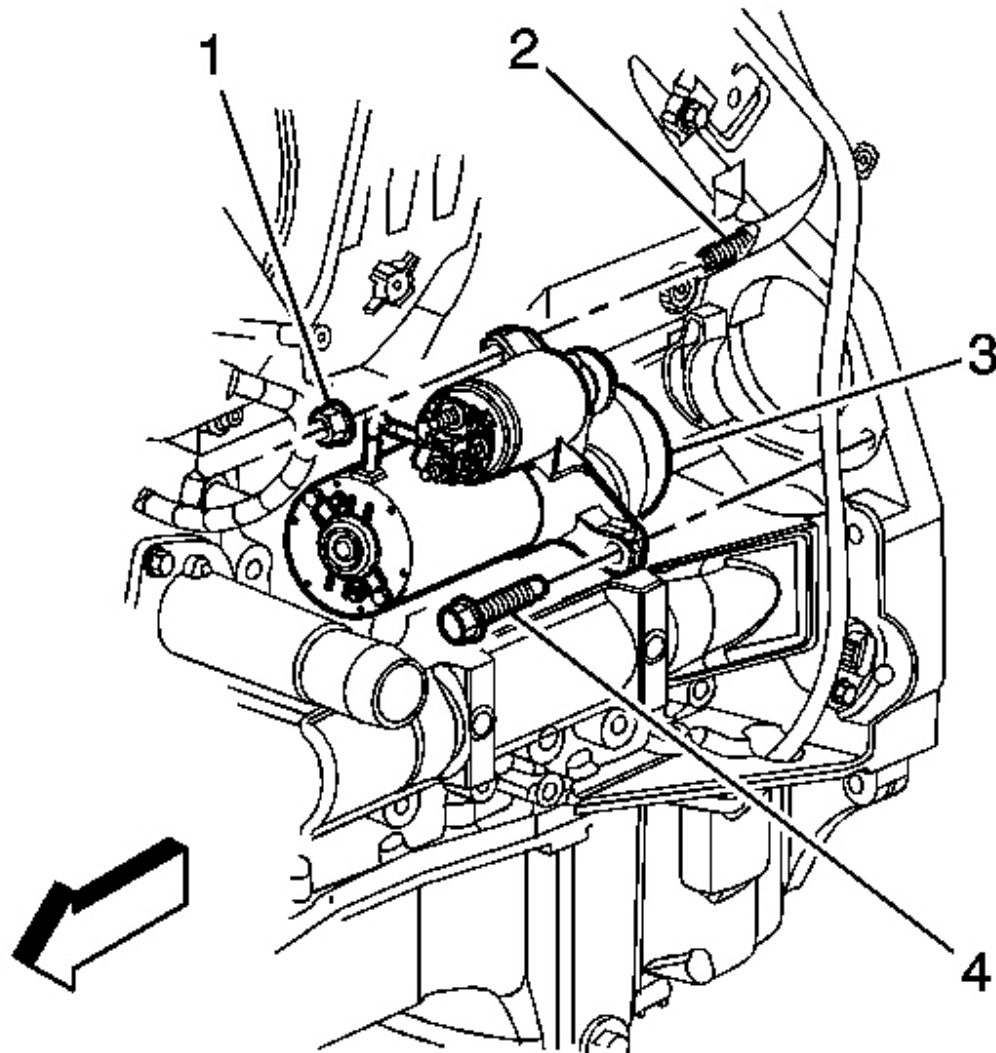


Fig. 47: View Of Starter Motor
Courtesy of GENERAL MOTORS CORP.

1. Position the starter motor (3) over the stud (2).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the starter motor nut (1) and bolt (4).

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

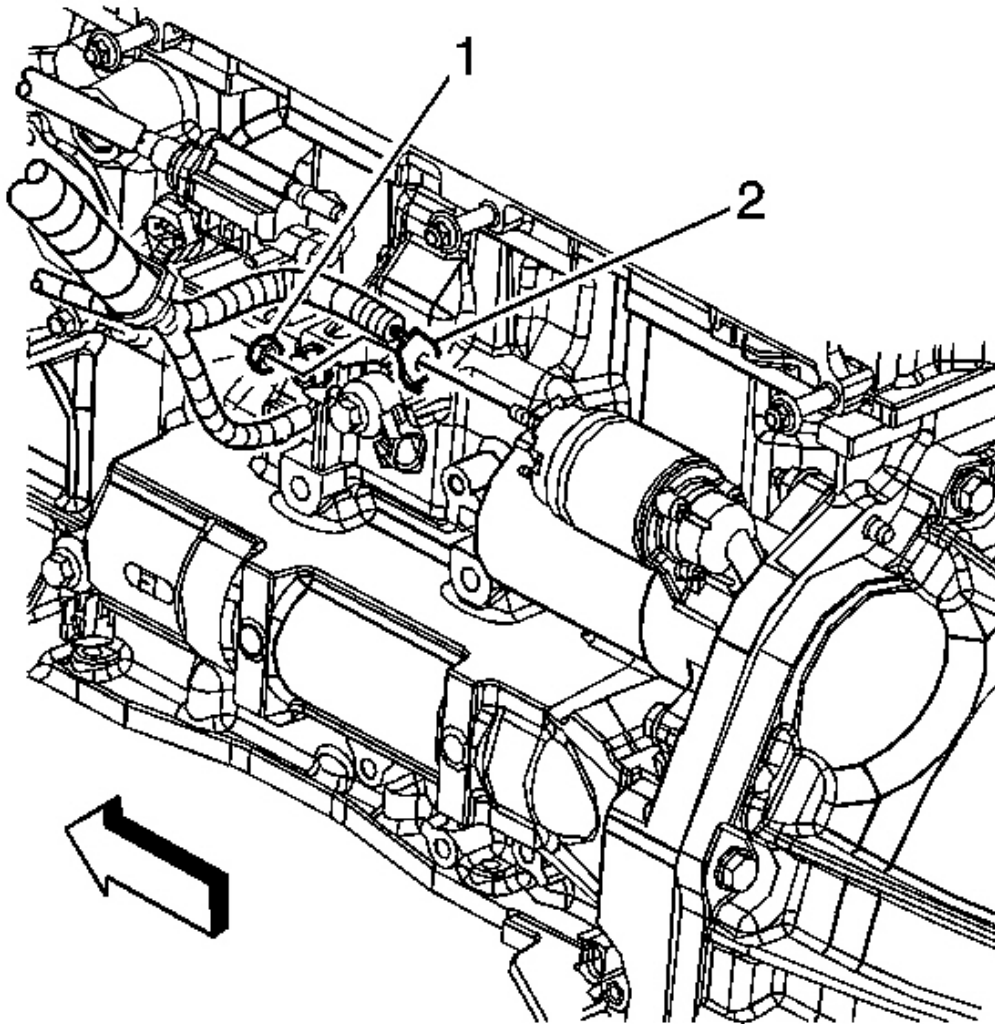


Fig. 48: Starter Wiring
Courtesy of GENERAL MOTORS CORP.

3. Connect the battery positive cable (2) to the starter and install the starter terminal nut (1)

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

4. Connect the lead to the starter solenoid and install the starter solenoid S terminal nut.

Tighten: Tighten the nut to 3.5 N.m (31 lb in).

5. Install the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical - 3.5L (L52).

GENERATOR REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Remove the drive belt. Refer to **Drive Belt Replacement (Without A/C)** or **Drive Belt Replacement (With A/C)** in Engine Mechanical - 3.5L (L52).
3. Raise and support the vehicle only high enough to access the A/C compressor through the wheelhouse. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the left front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Remove the left wheelhouse liner. Refer to **Wheelhouse Panel Replacement** in Body Front End.

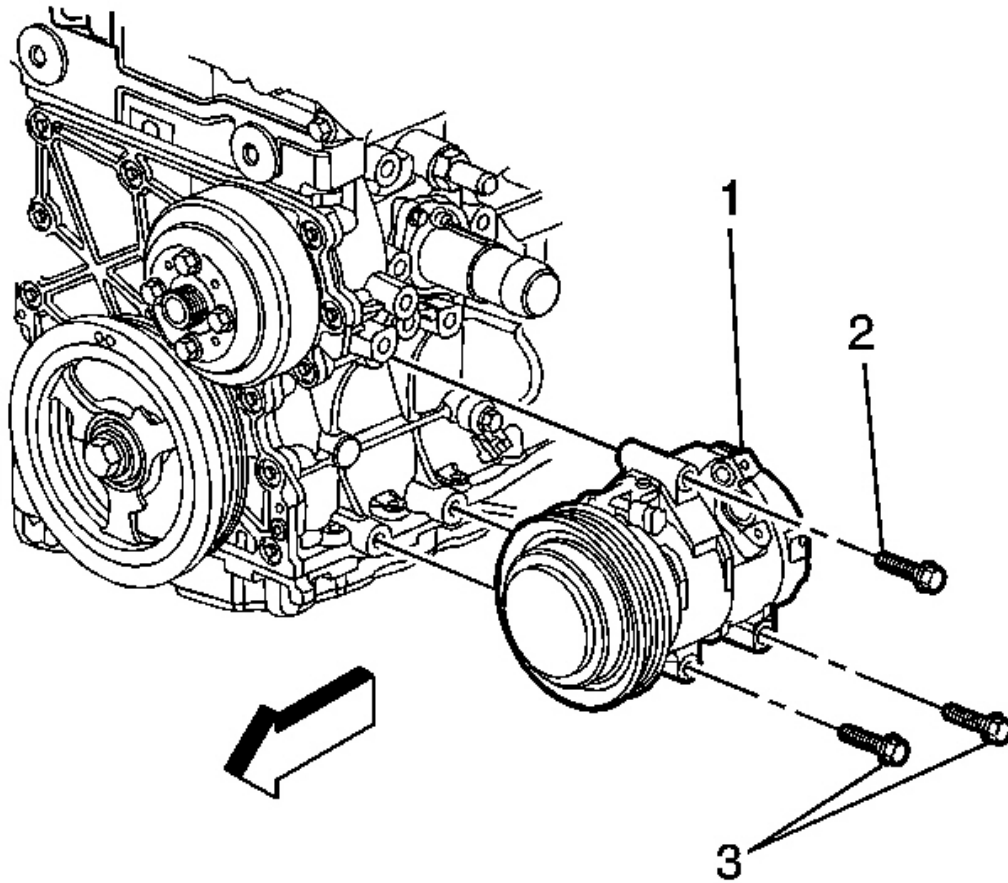


Fig. 49: View Of A/C Compressor
Courtesy of GENERAL MOTORS CORP.

6. Disengage the A/C compressor electrical connector from the bracket.

IMPORTANT: Evacuation of the A/C refrigerant will not be necessary.

7. Remove the A/C compressor mounting bolts (2, 3) ONLY.

The upper mounting bolt (2) will remain with the A/C compressor (1).

8. Lower the vehicle.

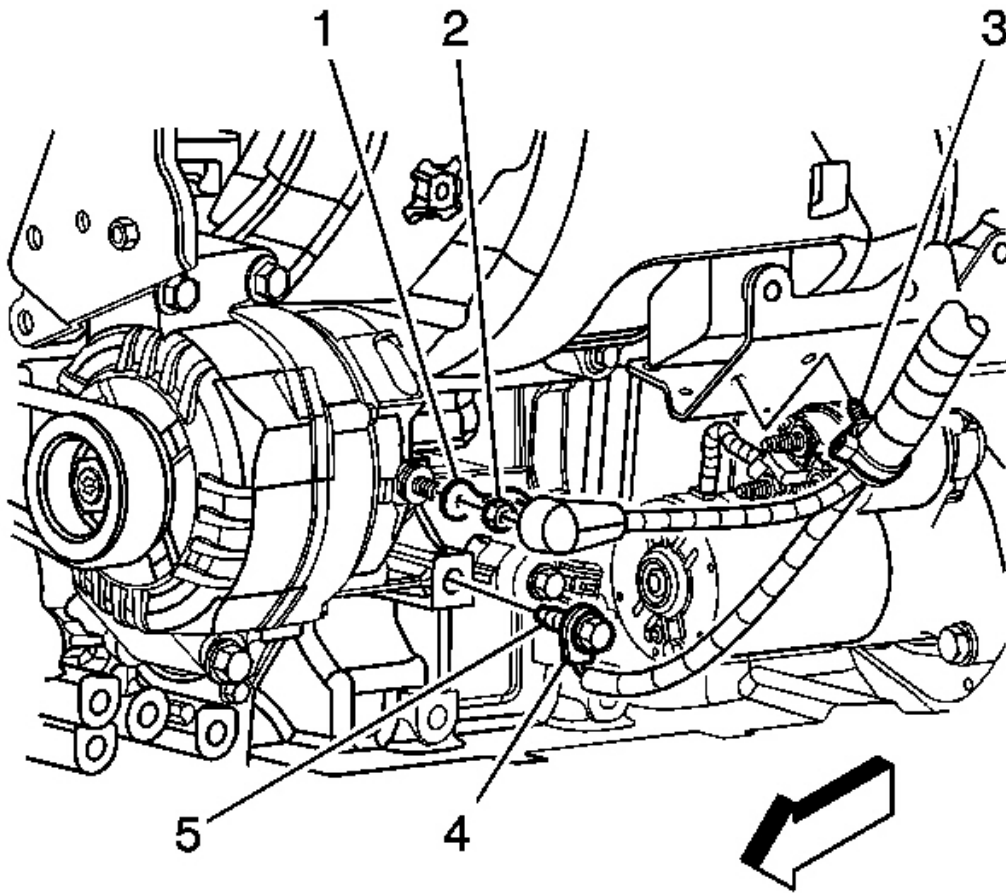


Fig. 50: Starter/Generator Wiring
Courtesy of GENERAL MOTORS CORP.

9. Reposition the protective boot from the generator output BAT terminal.
10. Remove the generator output BAT terminal nut (2) and remove the generator lead (1) from the generator.
11. Disconnect the generator electrical connector.

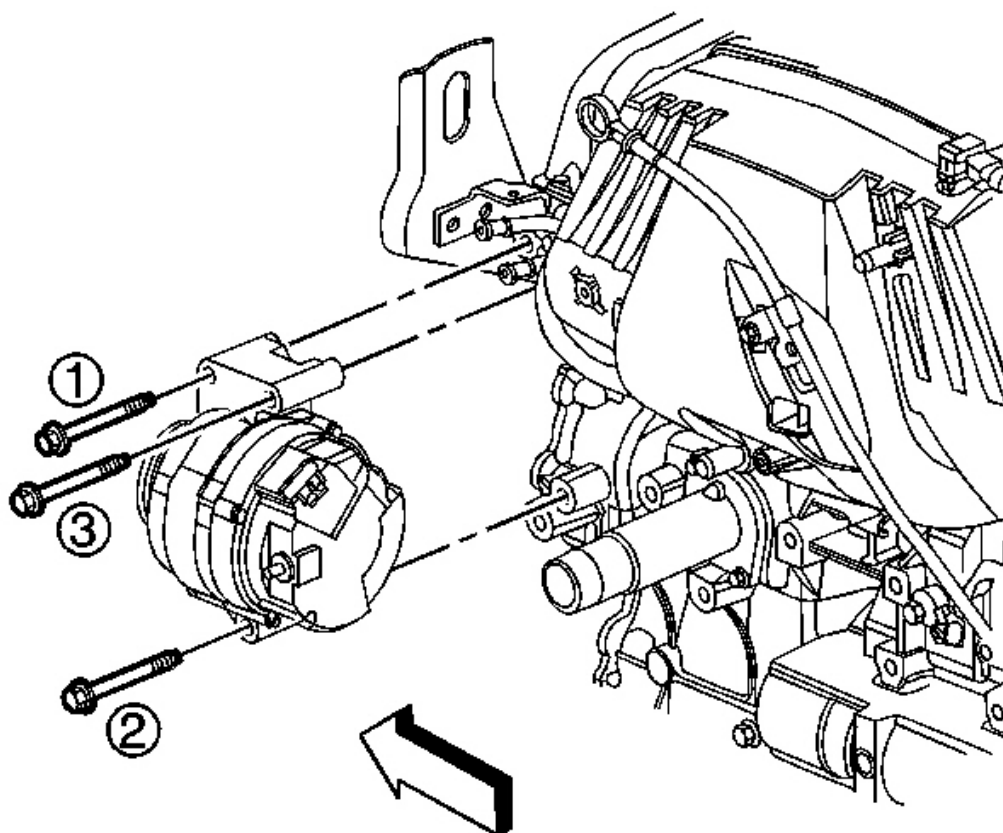


Fig. 51: View Of Generator Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the 3 generator bolts.
13. Remove the engine lift bracket, in order to gain clearance to remove the generator. Refer to **Engine Lift Bracket Replacement** in Engine Mechanical - 3.5L (L52).
14. Position the A/C compressor forward, in order to gain clearance to remove the generator.
15. Remove the generator.

Installation Procedure

1. Position the generator to the engine.
2. Install the engine lift bracket. Refer to **Engine Lift Bracket Replacement** in Engine Mechanical - 3.5L (L52).

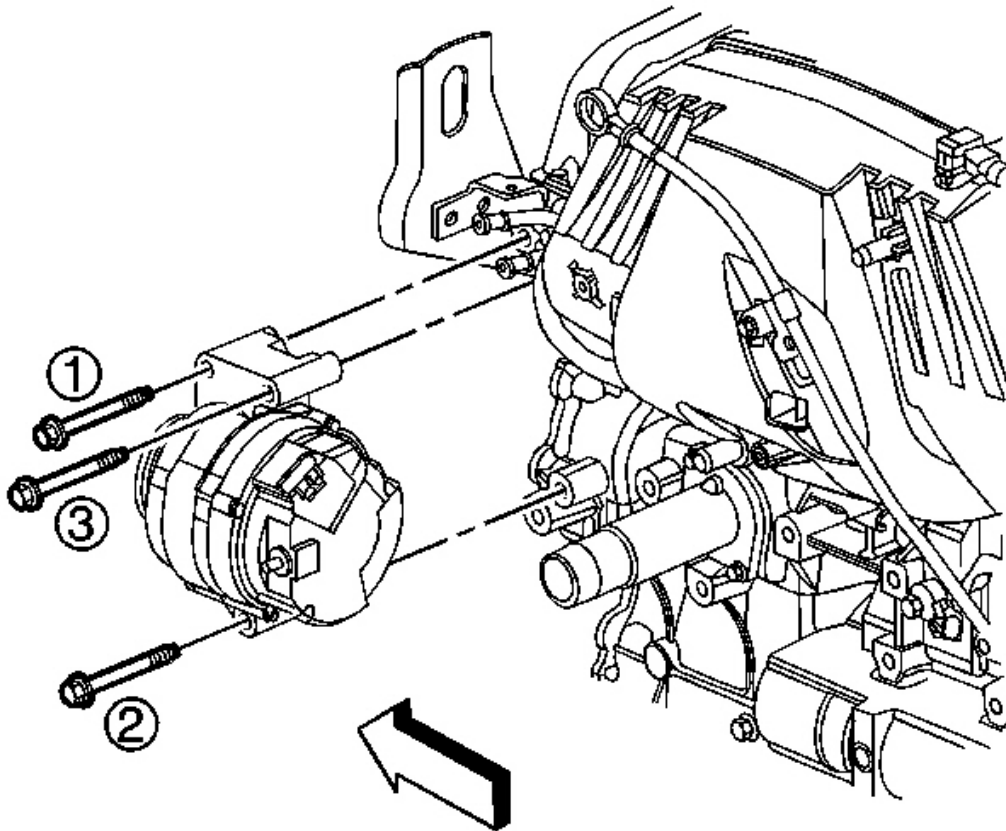


Fig. 52: View Of Generator Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the 3 generator bolts.

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

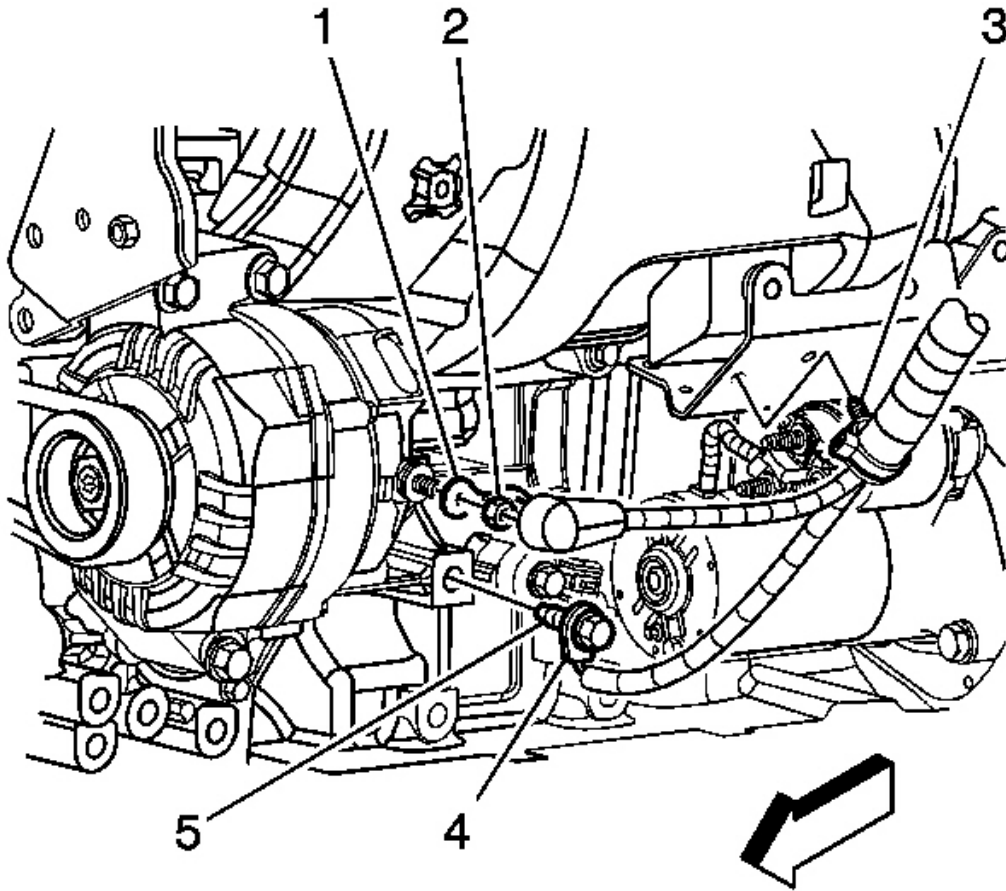


Fig. 53: Generator/Starter Wiring
Courtesy of GENERAL MOTORS CORP.

4. Install the generator lead (1) to the generator and install the generator output BAT terminal nut (2).

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

5. Position the protective boot onto the generator output BAT terminal.
6. Connect the generator electrical connector.
7. Raise and support the vehicle only high enough to access the A/C compressor through the wheelhouse. Refer to **Lifting and Jacking the Vehicle** in General Information.

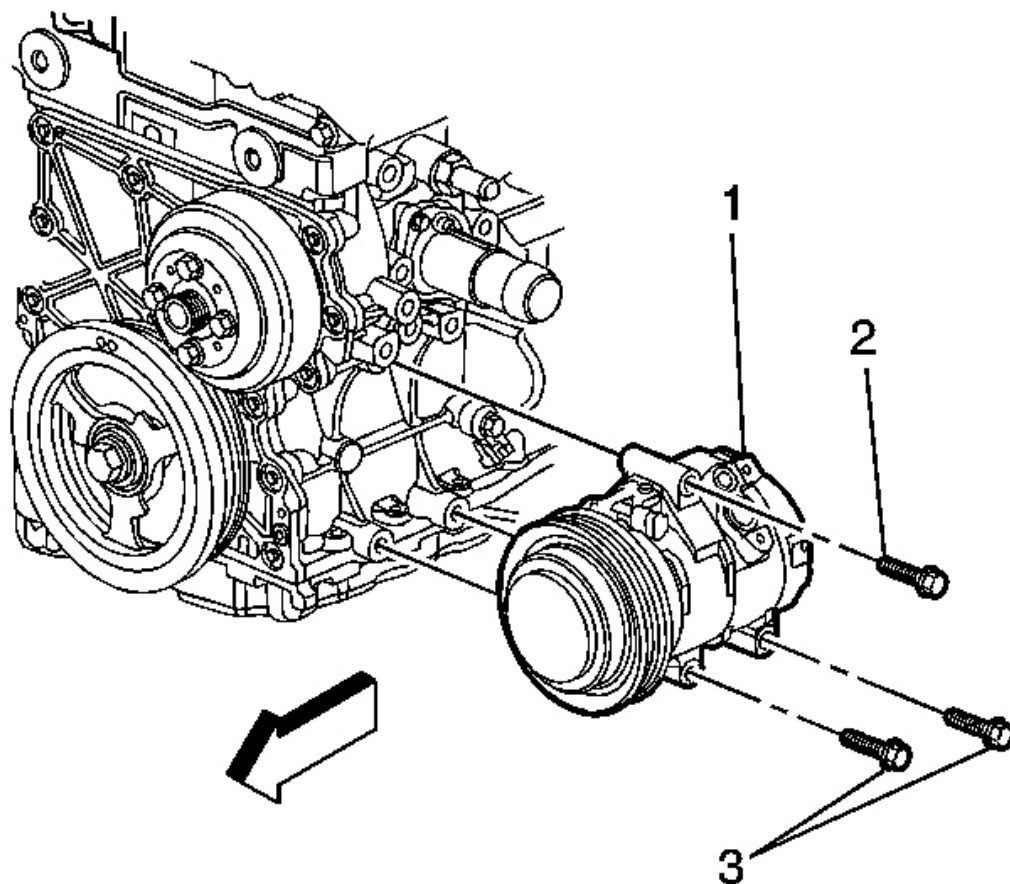


Fig. 54: View Of A/C Compressor
Courtesy of GENERAL MOTORS CORP.

8. Position the A/C compressor (1) to the engine.
9. Install the A/C compressor mounting bolts (2, 3).





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

10. Attach the A/C compressor electrical connector to the bracket.
11. Install the left wheelhouse liner. Refer to Wheelhouse Panel Replacement in Body Front End.
12. Install the left front wheel. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

13. Lower the vehicle.
14. Install the drive belt. Refer to **Drive Belt Replacement (Without A/C)** or **Drive Belt Replacement (With A/C)** in Engine Mechanical - 3.5L (L52).
15. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

▲ DANGER/POISON		
SHIELD EYES EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY 	NO SPARKS, FLAME OR SMOKING 	SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS 
PROTÉGER LES YEUX GAZ EXPLOSIF PEUT RENDRE AVEUGLE OU BLESSER	TENIR ÉLOIGNÉ DES ÉTINCELLES, DES FLAMMES. NE PAS FUMER	L'ACIDE SULFURIQUE PEUT RENDRE AVEUGLE OU PROVOQUER DES BRÛLURES GRAVES
FLUSH EYES IMMEDIATELY WITH WATER GET MEDICAL HELP FAST		RINCER LES YEUX IMMÉDIATEMENT À L'EAU CONSULTER IMMÉDIATEMENT UN MÉDECIN
KEEP OUT OF REACH OF CHILDREN. DO NOT TIP. DO NOT OPEN BATTERY.		TENIR HORS DE LA PORTÉE DES ENFANTS. NE PAS INCLINER. NE PAS OUVRIR LA BATTERIE.

PROPOSITION 65 WARNING

BATTERY POSTS, TERMINALS, AND RELATED ACCESSORIES CONTAIN LEAD AND LEAD COMPOUNDS, CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND REPRODUCTIVE HARM. WASH HANDS AFTER HANDLING.

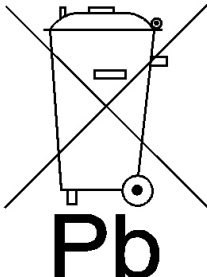


Fig. 55: View Of Battery Danger Label
 Courtesy of GENERAL MOTORS CORP.

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

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100 – 6YR	

Fig. 56: View Of Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

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
- 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

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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.

SPECIAL TOOLS AND EQUIPMENT

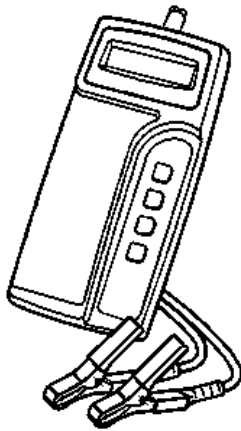
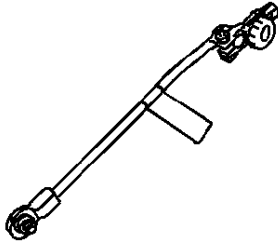
SPECIAL TOOLS

Special Tools

Illustration	Tool Number/ Description
	J 38758 Parasitic Draw Test Switch

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J 42000
Battery Tester