2008 ENGINE

Engine Electrical - Ascender, Envoy & Trailblazer

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Air Conditioning Line Bracket Bolt (4.2L)	10 N.m	89 lb in
Battery Cable Channel Bolt (5.3L, 6.0L)	12 N.m	106 lb in
Battery Hold Down Retainer Nut	15 N.m	11 lb ft
Battery Negative Cable	15 N.m	11 lb ft
Battery Positive Cable	15 N.m	11 lb ft
Battery Positive Cable Lead to Starter Nut	9 N.m	80 lb in
Battery Tray Bolt	20 N.m	15 lb ft
Battery Tray Brace Bolt	10 N.m	89 lb in
Engine Harness to Engine Block Bolt (4.2L)	50 N.m	37 lb ft
Engine Harness to Shock Tower Bolt (4.2L)	10 N.m	89 lb in
Engine Harness to Wheelhouse Panel Bolt (4.2L)	10 N.m	89 lb in
Engine Lift Hook Bolt (4.2L)	50 N.m	37 lb ft
Generator Bolt	50 N.m	37 lb ft
Generator Bracket Bolt (5.3L, 6.0L)	55 N.m	41 lb ft
Generator Cable Nut	9 N.m	80 lb in
Ground Cable to Shock Tower Bolt (5.3L, 6.0L)	10 N.m	89 lb in
Ground Terminal to Engine Block Bolt (5.3L, 6.0L)	50 N.m	37 lb ft
Ground Terminal to Front Fender Bolt (5.3L, 6.0L)	10 N.m	89 lb in
Positive Terminal to Underhood Junction Block Bolt	10 N.m	89 lb in
Starter Bolt	50 N.m	37 lb ft
Starter Solenoid Nut	3.4 N.m	30 lb in
Transmission Cover Bolt (5.3L, 6.0L)	9 N.m	80 lb in

BATTERY USAGE

LS2, LH6, LL8	
Cold Cranking Amperage (CCA)	600 A
Reserve Capacity Rating	115 Minutes
Replacement Battery Number	78-6YR

GENERATOR USAGE

LS2, LH6, LL8	
Generator Model	DR44G
Rated Output	150 A
Load Test Output	105 A

SCHEMATIC & ROUTING DIAGRAMS

STARTING & CHARGING SCHEMATICS

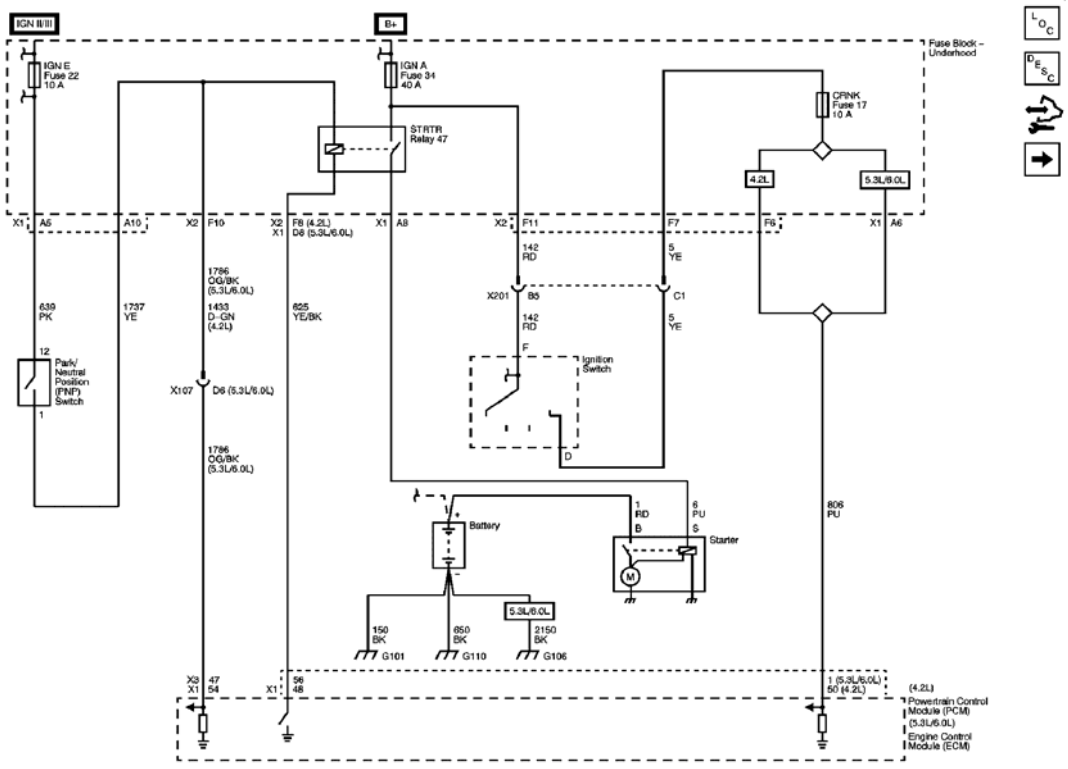


Fig. 1: Starting System Schematic
Courtesy of GENERAL MOTORS CORP.

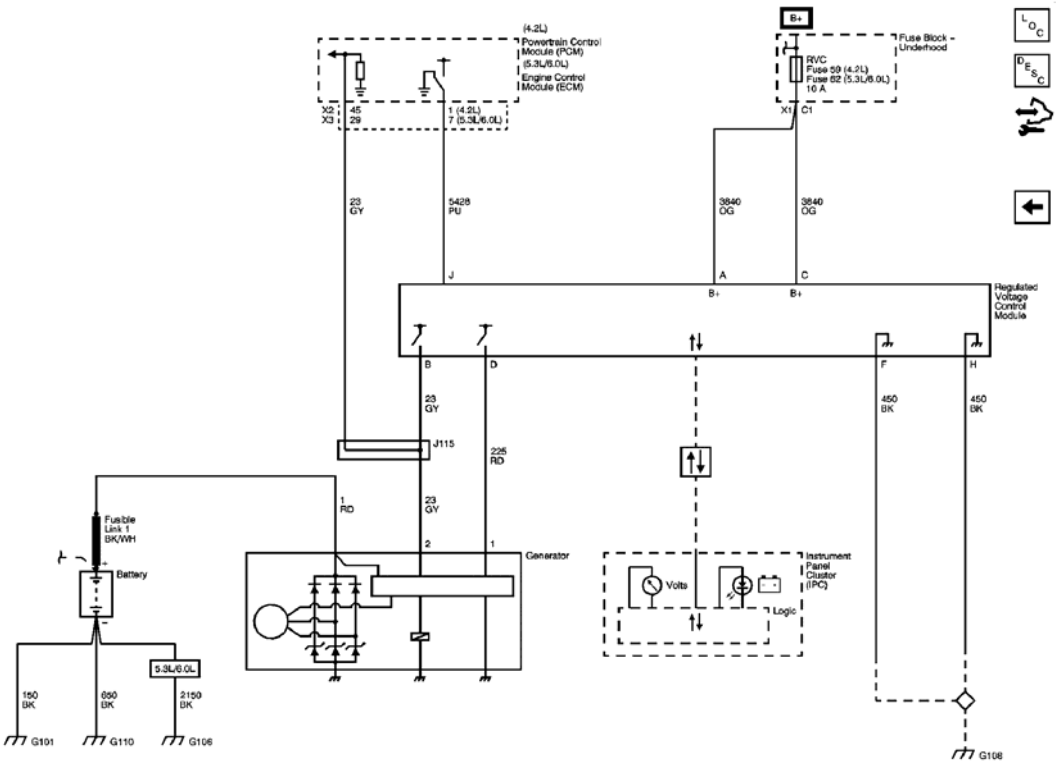


Fig. 2: Charging System Schematic
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION & PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B1390	B1390: Device Voltage Reference Input 1 Circuit
DTC B1487	B1487: Generator L-Terminal Circuit Low
DTC B1488	B1488: Generator L-Terminal Circuit High
DTC B1492	B1492: Generator F-Terminal Circuit Low
DTC B1516	B1516: Battery Current Sensor Performance
DTC B1566	B1566: Current Sensor Polarity Check
DTC P0562	P0562: System Voltage Low - ECM
DTC P0563	P0563: System Voltage High
DTC P0621	P0621: Generator L-Terminal Circuit
DTC P0622	P0622: Generator F-Terminal Circuit
DTC P1668	P1668: Generator L-Terminal Control Circuit

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

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

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

DTC B1390

Diagnostic Instructions

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

DTC Descriptor

DTC B1390

Device Voltage Reference Input 1 Circuit

Circuit/System Description

The generator battery control module (GBCM) monitors the battery voltage for precision electrical power management. The GBCM monitors both the battery sense positive voltage circuit and the battery sense negative, ground, circuit to precisely determine system voltage. If there is a difference between the less precise battery voltage, battery positive voltage circuit and ground circuit, and the more precise battery sense voltage of 1 volt or greater for 10 seconds, then DTC B1390 will set.

Conditions for Running the DTC

- The ignition switch is in the RUN position.
- This diagnostic runs every 100 ms.

Conditions for Setting the DTC

The difference between the low precision battery voltage circuit reading and the high precision battery voltage sense circuit reading is greater than or equal to 1 volt for 10 seconds.

Action Taken When the DTC Sets

- The GBCM will request the driver information center (DIC) to display the BATTERY message.
- The GBCM uses the less accurate battery positive voltage circuit for voltage readings.

Conditions for Clearing the DTC

During the current ignition cycle, the difference between the less precision battery positive voltage circuit reading and the high precision battery voltage sense circuit reading is less than 1 volt.

Diagnostic Aids

- You must cycle the ignition after clearing the DTC to turn off the BATTERY DIC message.
- Overcharging with a battery charger or jump starting could cause this DTC to set.
- A high voltage value in multiple modules indicates a concern in the charging system.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

Component Connector End Views

Description and Operation

Charging System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Measure the voltage at the battery terminals.
2. Ignition ON, observe the scan tool GBCM Battery Positive Voltage parameter. The battery terminal voltage and scan tool parameter should not differ by more than 2 volts.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the GBCM.
2. Ignition OFF, test for less than 1.0 ohm between the ground circuit terminals H and F to ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, measure between the battery positive voltage circuit terminals A and C and ground circuit terminals H and F. The readings should not differ by more than 2 volts.
   - If greater than the specified value, test the ignition voltage circuit for a short to ground or an open/high resistance.
4. If all circuits tests normal, replace the GBCM.

Repair Procedures

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

Control Module References for GBCM replacement, setup and programming.

DTC B1487

Diagnostic Instructions

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

DTC Descriptor

DTC B1487

Generator L-Terminal Circuit Low

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator Turn On Signal	B1487	B1487	B1488	-

Circuit/System Description

The generator battery control module (GBCM) controls the generator through the generator turn on signal circuit. The signal is a 5 volt pulse width modulation (PWM) signal of 128 hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. If the generator turn on signal circuit is in the 0-5 percent range, pulled low to ground or open then DTC B1487 will set.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM.
- This diagnostic shall be run every 100 ms.

Conditions for Setting the DTC

The generator turn on signal circuit is less than or equal to 5 percent duty cycle for more than 120 seconds.

Action Taken When the DTC Sets

- The charge indicator illuminates on the instrument panel cluster (IPC).
- The driver information center (DIC) displays the BATTERY message.

Conditions for Clearing the DTC

The generator turn on signal circuit input is from 5-95 percent duty cycle, greater than 0 volts.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description & Operation

Charging System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the generator.
2. Engine Running, test for greater than 3.5 volts between the generator turn on signal circuit X1 - 1 and ground.

- If less than the specified range, test the generator turn on signal circuit for a short to ground, an open or a high resistance. If the circuit tests normal, replace the GBCM.

3. Ignition ON, test for less than 1 volt between the generator turn on signal circuit X1 - 1 and ground.
   - If greater than the specified range, test the generator turn on signal circuit for a short to voltage. If the circuit tests normal, replace the GBCM.
4. If the circuit tests normal during the ignition ON/Run test, replace the generator.

Repair Procedures

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

- **Control Module References** for GBCM replacement, setup, and programming
- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**

DTC B1488

Diagnostic Instructions

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

DTC Descriptor

DTC B1488

Generator L-Terminal Circuit High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator L-Terminal Circuit	B1487	B1487	B1488	-

Circuit/System Description

The generator battery control module (GBCM) controls the generator through the generator turn on signal circuit. The signal is a 5 volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. If the generator turn on signal circuit is 65 percent or greater duty cycle or pulled high to battery positive voltage, 5 volts, then DTC B1488 will set.

Conditions for Running the DTC

- The ignition is in RUN.
- The engine is OFF.

- The engine RPM is 0.
- This diagnostic runs every 100 ms.

Conditions for Setting the DTC

The generator turn on signal circuit is greater than 95 percent or shorted to voltage for 5 seconds.

Action Taken When the DTC Sets

- The charge indicator turns ON.
- The driver information center (DIC) displays the BATTERY message.

Conditions for Clearing the DTC

The GBCM determines the fault has cleared.

Diagnostic Aids

You must cycle the ignition after clearing the DTC to turn OFF the BATTERY DIC message and turn OFF the charge indicator.

If a fault condition persists, replace the module.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description & Operation

Charging System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the generator.
2. Ignition ON, test for less than 1 volt between the generator turn on signal circuit X1 - 1 and ground.
   - If greater than the specified range, test the generator turn on signal circuit for a short to voltage. If the circuit tests normal, replace the GBCM.
3. Engine Running, test for greater than 3.5 volts between the generator turn on signal and ground.
   - If less than the specified range, test the generator turn on signal circuit for a short to ground, an open or a high resistance. If the circuit tests normal, replace the GBCM.
4. If the circuit tests normal during the ignition ON/Run test, replace the generator.

Repair Procedures

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

- **Control Module References** for GBCM replacement, setup, and programming
- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**

DTC B1492

Diagnostic Instructions

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

DTC Descriptor

DTC B1492

Generator F-Terminal Circuit Low

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator Field Duty Cycle Signal	B1492	-	-	-

Circuit/System Description

The generator battery control module (GBCM) monitors the generator through the generator field duty cycle signal circuit. The signal is a pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. If the generator field duty cycle signal circuit is in the 0-5

percent range or pulled low to ground, then DTC B1492 will set.

Conditions for Running the DTC

- Vehicle in RUN mode and Engine Run Flag is True.
- The engine speed is less that 1,000 RPM.
- DTC B1487 or B1488 is not set as a current DTC.
- This diagnostic shall be run every 100 ms.

Conditions for Setting the DTC

The generator field duty cycle signal circuit is less than or equal to 5 percent duty cycle for more than 120 seconds.

Action Taken When the DTC Sets

- The charge indicator turns ON.
- The driver information center (DIC) displays the BATTERY message.

Conditions for Clearing the DTC

The generator field duty cycle signal circuit input is greater than 5 percent duty cycle.

Diagnostic Aids

You must cycle the ignition after clearing the DTC to turn OFF the BATTERY DIC message.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description & Operation

Charging System Description and Operation

Electrical Information Reference

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

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

With the scan tool installed, ignition ON and the Engine running, observe the scan tool ECM GEN-F Terminal Signal parameter. The parameter should read between 5 and 95 percent.

Circuit/System Testing

1. Ignition OFF, disconnect the generator and GBCM harness connectors.
2. Ignition ON and engine OFF, connect a test lamp to B+ and repeatedly probe the generator field duty cycle circuit X1 - 2, harness side while monitoring the GEN-F Terminal Signal Parameter. It should change from 0 percent to above 95 percent.
    - If the parameter was not affected by the test lamp, test the circuit for a short to voltage, short to ground, or an open/high resistance.
3. If the circuit tests normal, replace the GBCM

Repair Procedures

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

- **Control Module References** for GBCM replacement, setup, and programming
- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**

DTC B1516

Diagnostic Instructions

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

DTC Descriptors

DTC B1516

Battery Current Sensor Performance

Circuit/System Description

The generator battery control module (GBCM) monitors its internal battery current sensor for many charging system operations. When the values of the battery current sensor go out of range, DTC B1516 will set.

Conditions for Running the DTC

- Vehicle in RUN mode and Engine Run Flag is True.
- This diagnostic shall be run every 50 ms.

Conditions for Setting the DTC

The duty cycle of the internal battery current sensor is less than 2 percent duty cycle or greater than 98 percent duty cycle for greater than 240 seconds.

Action Taken When the DTC Sets

- The charge indicator turns ON.
- The driver information center (DIC) displays the BATTERY message.
- The generator field control circuit duty cycle is set to 100 percent.
- The filtered battery current is set to 0.1 amp.
- The battery voltage parameter defaults to 13.8 volts.

Conditions for Clearing the DTC

The duty cycle of the internal battery current sensor is greater than 2 percent duty cycle or less than 98 percent duty cycle.

Diagnostic Aids

You must cycle the ignition after clearing the DTC to turn OFF the BATTERY DIC message.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description & Operation

Charging System Description and Operation

Electrical Information Reference

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

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B1516 is set as current.
   - If the DTC is history, refer to **Testing for Intermittent Conditions and Poor Connections** .
2. Ignition ON, clear the DTC using the scan tool and start engine.
   - If DTC resets, replace the GBCM.

Repair Procedures

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

Control Module References for GBCM replacement, setup, and programming.

DTC B1566

Diagnostic Instructions

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

DTC Descriptors

DTC B1566

Current Sensor Polarity Check

Circuit/System Description

The generator battery control module (GBCM) monitors its internal battery current sensor for many charging system operations. When the polarity of the battery current is sensed, DTC B1566 will set.

Conditions for Running the DTC

- The engine is running.
- This diagnostic runs every 50 ms.

Conditions for Setting the DTC

The duty cycle of the internal battery current sensor is less than 2 percent duty cycle or greater than 98 percent

duty cycle for 240 seconds.

Action Taken When the DTC Sets

- The charge indicator turns ON.
- The driver information center (DIC) displays the BATTERY message.
- The filtered battery current is set to 0.1 amp.
- The generator field control circuit duty cycle is set to 100 percent, battery voltage defaults to 13.8 volts.

Conditions for Clearing the DTC

The duty cycle of the internal battery current sensor is greater than 2 percent duty cycle or less than 98 percent duty cycle.

Diagnostic Aids

You must cycle the ignition after clearing the DTC to turn OFF the BATTERY DIC message.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description & Operation

Charging System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B1566 is set as current.

- If the DTC is history, refer to **Testing for Intermittent Conditions and Poor Connections** .

2. Ignition ON, clear the DTC using the scan tool and start the engine.
   - If the DTC resets, replace the GBCM.

Repair Procedures

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

Control Module References for GBCM replacement, setup, and programming.

DTC P0562

Diagnostic Instructions

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

DTC Descriptor

DTC P0562

System Voltage Low - ECM

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	P0562	P0562	-	-
Ground	-	P0562	-	-

Circuit/System Description

The engine control module (ECM) monitors the battery positive (B+) voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data may occur when the voltage is out of range. If the ECM detects low battery voltage, then DTC P0562 will set.

Conditions for Running the DTC

- The vehicle speed is greater than 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

The ECM detects a system voltage less than 10 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator to be illuminated on the instrument panel cluster (IPC).
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

Diagnostic Aids

A low voltage DTC in multiple modules indicates a concern in the charging system.

Reference Information

Schematic Reference

- **Control Module References** for ECM schematics
- **Starting and Charging Schematics**
- **Power Distribution Schematics**
- **Ground Distribution Schematics**

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Control Module References for Scan Tool Information

Circuit/System Verification

1. Measure and record the voltage at the battery terminals with the engine OFF, and again with the engine running. Verify that the battery voltage is 11-16 volts with the engine OFF and with the engine running.
    - If the battery voltage is not within the specified range, refer to **Charging System Test**.

2. Observe the scan tool Ignition 1 Signal parameter in the ECM data list. Verify that the scan tool displays a value that is within 2 volts of the battery voltage recorded in step 1.
    - If the scan tool parameter is not within the specified range, refer to **Circuit/System Testing**.
3. Refer to **Diagnostic Aids**.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector of the ECM. Verify that there is less than 1.0 ohm between the ground circuits and the negative battery terminal.
    - If greater than the specified value, test the ground circuit for an open/high resistance.
2. Ignition ON, test for 11-14 volts between the battery positive voltage and the ground circuits of the ECM.
    - If not within the specified range, test the battery positive voltage circuits for a short to ground or an open/high resistance.
3. If all circuits test normal, test or replace the ECM.

Repair Procedures

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

Control Module References for ECM replacement, setup, and programming

DTC P0563

Diagnostic Instructions

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

DTC Descriptor

DTC P0563

System Voltage High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	P0562	P0562	-	-
Ground	-	P0562	-	-

Circuit/System Description

The engine control module (ECM) monitors the system voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data may occur when the voltage is out of range.

Conditions for Running the DTC

- The vehicle speed is greater than 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

The ECM detects a system voltage above 16 volts for 1 second.

Action Taken When the DTC Sets

- The ECM will command the charge indicator to be illuminated on the instrument panel cluster (IPC).
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The ECM will command the indicator OFF after one trip in which the diagnostic test has been run and passed.
- A history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

- This DTC could be set by overcharging with a battery charger or jump starting.
- A high voltage DTC in multiple modules indicates a concern in the charging system.

Circuit/System Verification

1. Ignition ON. Measure and record the voltage at the battery terminals. Verify that the battery voltage is 11-15 volts. Repeat with the engine running.
    - If the battery voltage is not within the specified range, go to **Charging System Test**.
2. Engine running. Observe the scan tool Ignition 1 Signal parameter in the ECM data list. Verify that the scan tool displays a value that is within 2 volts of the battery voltage recorded in step 1.
    - If the scan tool parameter is not within the specified range, replace the ECM.
3. Go to Diagnostic Aids.

Repair Procedures

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

Control Module References for ECM replacement, setup, and programming

DTC P0621

Diagnostic Instructions

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

DTC Descriptor

DTC P0621

Generator L-Terminal Circuit

Circuit/System Description

The engine control module (ECM) uses the generator turn ON signal circuit to control the load of the generator on the engine. A high side driver in the ECM applies a voltage to the voltage regulator. This signals the voltage regulator to turn the field circuit ON and OFF. The ECM monitors the state of the generator turn ON signal circuit. The ECM should detect low voltage on generator turn on signal circuit when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs key ON and RUN tests to determine the status of the generator turn on signal circuit.

Conditions for Running the DTC

Key ON Test

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

RUN Test

- No generator, CKP sensors, CMP sensor DTCs are set.
- The engine is running.

Conditions for Setting the DTC

- During the key ON test, the ECM detects high voltage on the generator turn on signal circuit for 5 seconds.
- During the RUN test, the ECM detects low voltage on the generator turn on signal circuit for 15 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator and or warning message to be illuminated on the instrument panel cluster (IPC) and the driver information center (DIC), if equipped.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer met.
- A history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the generator.
2. Ignition ON, test for less than 1 volt between the generator turn on signal and ground.
   - If greater than the specified range, test the generator turn on signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.
3. Engine running, test for greater than 3.5 volts between the generator turn on signal and ground.
   - If less than the specified range, test the generator turn on signal circuit for a short to ground, an open or a high resistance. If the circuit tests normal, replace the ECM.
4. If the circuit tests normal during the ignition ON/RUN tests, replace the generator.

Repair Procedures

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

- **Control Module References** for ECM replacement, setup, and programming
- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**

DTC P0622

Diagnostic Instructions

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

DTC Descriptor

DTC P0622

Generator F-Terminal Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator Field Duty Cycle Signal	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator field duty cycle signal circuit, or F-terminal circuit, to

monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings ON and OFF. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the key is in the RUN position and the engine is OFF, the ECM should detect a duty cycle near 0 percent. However, when the engine is running, the duty cycle should be between 5-95 percent.

Conditions for Running the DTC

- The vehicle speed is greater than 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

- The ECM detects a PWM signal greater than 65 percent for 5 seconds during the KEY ON test.
- The ECM detects a PWM signal less than 5 percent for 15 seconds during the RUN test.

Action Taken When the DTC Sets

- The ECM will command the charge indicator to be illuminated on the instrument panel cluster (IPC).
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The ECM will command the charge indicator OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

With the scan tool installed, ignition ON and the engine running, observe the GEN-F Terminal Signal parameter in the ECM data list. The GEN-F Terminal Signal scan tool parameter should read between 5 and 95 percent.

Circuit/System Testing

1. Ignition OFF, disconnect the generator harness X1 connector.
2. Ignition ON, connect a test lamp to battery positive voltage and repeatedly probe the generator field duty cycle signal circuit, harness side terminal 2, while monitoring the GEN-F Terminal Signal Parameter in the ECM data list with a scan tool. Verify that the scan tool parameter changes from 0 percent to greater than 95 percent.
    - If the GEN-F Terminal Signal scan tool parameter was not affected by the test lamp, then test the generator field duty cycle signal circuit for a short to voltage, a short to ground, a high resistance, or an open circuit. If OK, then replace the ECM.
3. If the circuit tests normal, then replace the generator.

Repair Procedures

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

- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**
- **Control Module References** for ECM replacement, setup, and programming

DTC P1668

Diagnostic Instructions

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

DTC Descriptor

DTC P1668

Generator L-Terminal Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator L-Terminal Circuit	P1668	P1668	P1668	-

Circuit/System Description

The engine control module (ECM) uses the generator turn on signal circuit, or L-terminal circuit, to control the load of the generator on the engine. A high side driver in the ECM applies a voltage to the voltage regulator. This signals the voltage regulator to turn the field circuit ON and OFF. The ECM monitors the state of the generator turn ON signal circuit. The ECM should detect low voltage on generator turn on signal circuit when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs tests to determine the status of the generator turn on signal circuit.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- During the Key ON test the ECM detects high voltage on the generator turn on signal circuit for 5 seconds.
- With the engine running the ECM detects low voltage on the generator turn on signal circuit for 15 seconds.

Action Taken When the DTC Sets

- The ECM will command the charge indicator to be illuminated on the instrument panel cluster (IPC).
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the generator.
2. Ignition ON, test for less than 1 volt between the generator turn on signal circuit terminal 1 and ground.
    - If greater than the specified range, test the generator turn on signal circuit for a short to voltage. If the circuit tests normal, replace the ECM.
3. Engine running, test for greater than 3.5 volts between the generator turn on signal circuit and ground.
    - If less than the specified range, test the generator turn on signal circuit for a short to ground, an open or a high resistance. If the circuit tests normal, replace the ECM.
4. If the circuit tests normal, replace the generator.

Repair Procedures

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

- **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**
- **Control Module References** for ECM replacement, setup, and programming

SYMPTOMS - ENGINE ELECTRICAL

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

- Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
    - **Battery Description and Operation**
    - **Charging System Description and Operation**
    - **Electrical Power Management Description and Operation**
    - **Starting 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** .

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

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

Symptom List

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

- **Battery Inspection/Test**
- **Battery Electrical Drain/Parasitic Load Test**
- **Battery Common Causes of Malfunction**
- **Charging System Test**
- **Generator Noise Diagnosis**
- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**
- **Engine Cranks Slowly**
- **Starter Motor Noise Diagnosis**

BATTERY INSPECTION/TEST

Special Tools

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

Diagnostic Aids

CAUTION: Refer to Battery Disconnect Caution .

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.

- 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.

Circuit/System Testing

CAUTION: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position, and all electrical loads must be OFF before servicing

any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

1. Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage.
    - If there is any apparent damage, replace the battery.
2. Verify the cold cranking amperage (CCA), and reserve capacity (RC) and/or amp hour (AH) rating of the battery to the original battery or original equipment (OE) specification. Refer to **Battery Usage**.
    - If the battery does not meet or exceed specifications, replace the battery.
3. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in **Fastener Tightening Specifications**.
    - If the battery cable(s) need to be cleaned, clean as required and tighten as specified.
    - If the battery cable(s) are damaged, replace then tighten as specified.
4. Install the **J 42000** and follow directions supplied by the tester. See **Special Tools**.
    - If the tester calls for charging the battery, refer to **Battery Charging**.

Repair Procedures

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

- **Battery Positive Cable Replacement (4.2L Engine)** or **Battery Positive Cable Replacement (5.3L and 6.0L Engines)**
- **Battery Negative Cable Replacement (4.2L Engine)** or **Battery Negative Cable Replacement (5.3L and 6.0L Engines)**
- **Battery Replacement**

BATTERY CHARGING

Special Tools

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 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 ECM/PCM or other electronic components.

NOTE: Refer to Fastener Notice .

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**.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

Special Tools

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** 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** for the system description and operation.

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.

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

Load Test

CAUTION: Refer to Battery Disconnect Caution .

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 test switch on the J 38758 is marked ON and OFF. See Special Tools. When the test switch is in the ON position, the circuit is closed and electrical current will pass through the switch. When the test switch 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. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Install the male end of the **J 38758** to the battery ground terminal. See **Special Tools**.
3. Turn the **J 38758** test switch 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. Turn the **J 38758** test switch to the ON position. See **Special Tools**.
6. Road test the vehicle and activate ALL of the accessories, including the radio and air conditioning. This may take up to 30 minutes.
7. Park the vehicle. Turn the ignition switch to the OFF position and remove the ignition switch key.
8. Connect a 10A fused jumper wire to the test switch tool terminals.
9. Turn the **J 38758** test switch 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 to locate the current draw.
11. Turn the test switch to ON and then 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** test switch 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 of 2A or less, turn the **J 38758** test switch 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** test switch is turned OFF. See **Special Tools**.

16. Turn the **J 38758** test switch to the OFF position. See **Special Tools**. Wait up to 45 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 milliampere 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:
    1. 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.**

    2. 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** 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.
    3. 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.
    4. When the cause of the excessive current drain has been located and repaired, remove the **J 38758** . See **Special Tools**.
20. Connect the battery negative cable to the battery negative terminal.

BATTERY COMMON CAUSES OF MALFUNCTION

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, stop-and-go driving, 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** .

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°F). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged above 80 percent state of charge, 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, parasitic load, 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**.

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

CAUTION: Refer to Battery Disconnect Caution .

Disconnect the battery ground cable 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.

CHARGING SYSTEM TEST

Diagnostic Instructions

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

Reference Information

Description and Operation

Charging System Description and Operation

Electrical Information Reference

Testing for Intermittent Conditions and Poor Connections

Circuit/System Verification

Engine ON, observe the charge indicator on the instrument panel cluster (IPC) or message in the driver information center (DIC). The charge indicator on the IPC should be turned OFF and the DIC should not display charging system message.

- If the charge indicator is not on the IPC or a charging system message is not displayed on the DIC, refer to **Testing for Intermittent Conditions and Poor Connections** .
- If the charge indicator is on the IPC or a charging system message is displayed on the DIC, refer to **Circuit/System Testing**.

Circuit/System Testing

1. Ignition ON, verify that no generator or battery current sensor DTCs are set that would cause a charging system concern.
   - If DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition OFF, measure the voltage across the battery terminals. The voltage should read 12.0 volts or greater at room temperature.
   - If not within specified value, refer to **Battery Inspection/Test**.
3. Connect a carbon pile tester to the battery.
4. Start the engine and increase the engine speed to 2,500 RPM. Observe the voltage reading on the tester. The voltage should read between 12.6-15.0 volts.
   - If not within specified range, replace the generator.
5. Adjust the carbon pile tester to the specified load test output value, refer to **Generator Usage**.
   - If not within specified value, replace the generator.

Repair Procedures

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

Generator Replacement (With 4.2L Engine) or **Generator Replacement (With V8 Engine)**

GENERATOR NOISE DIAGNOSIS

Diagnostic Instructions

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

Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise or 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.

Circuit/System Testing

1. Start the engine. Verify the noise can be heard. Compare the concern to a similar vehicle.
2. Perform a charging system test. Verify that the generator is charging properly. Refer to **Charging System Test**.
    - If the battery is discharged, charge the battery.
    - If the generator fails the charging system test, replace the generator.
3. Verify that the power steering fluid level is not low, if equipped. Refer to **Checking and Adding Power Steering Fluid** .
    - If the power steering fluid level is low, go to **Power Steering Fluid Leaks** .
4. Inspect the generator, generator mounting, wiring harness, heater hoses, A/C lines, or other accessory equipment that may be misrouted or be the cause of noise being transmitted into the passenger compartment.
5. Ignition OFF, remove the engine drive belt(s). Refer to one of the following:
    - **Drive Belt Replacement** for the 4.2L (LL8)
    - Drive Belt Replacement - Accessory for the 5.3L and 6.0L only V-8 (w/o LL8)
    - Air Conditioning Compressor Belt Replacement for the 5.3L and 6.0L only V-8 (w/o LL8)
6. Verify the generator, A./C compressor (if equipped), water pump pulley, power steering pump (if equipped), idler pulleys, and tensioner pulleys spin freely, and that the pulley bearings are not loose.
    - If any of the pulleys do not spin freely, or has a loose bearing, replace the affected component.
7. Start the engine, with the drive belt(s) removed. Verify that the noise goes away. Operate the engine for no longer than 30 seconds.
    - If the noise is still present, the generator is not the cause of the noise.
8. Loosen all generator mounting bolts and ensure the generator is properly aligned. Tighten the mounting bolts to specification, refer to **Generator Replacement (With 4.2L Engine)** or **Generator Replacement**

(With V8 Engine).

9. If the noise is still present, replace the generator.

Repair Procedures

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

Generator Replacement (With 4.2L Engine) or **Generator Replacement (With V8 Engine)**

STARTER SOLENOID DOES NOT CLICK

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Underhood Fuse Block B+	1	1	-	-
175 A MEGA Fuse	-	1	-	-
STRTR Fuse	-	1	-	-
Park Neutral Signal Circuit	2	1	1	-
Starter Relay Coil Control Circuit	1	1	3	-
Starter Solenoid Crank Voltage Circuit	1	1	3	-
Underhood Fuse Block Ground	-	1	-	-

1. No crank
2. Cranks in any gear
3. Cranks all the time

Circuit/System Description

The engine control module (ECM) controls engine cranking based on a power mode input and the status of the park/neutral position (PNP) switch. With the transmission in Park/Neutral, voltage at the ECM PNP switch signal circuit is low. This indicates to the ECM that conditions are acceptable for cranking. When a power mode crank request is seen, the ECM applies voltage to the starter relay coil control circuit. This energizes the coil side of the relay, which pulls the switch side of the relay closed, applying voltage to the starter X2-S terminal and engaging the starter solenoid.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Automatic Transmission Controls Schematics (4.2L)** or **Automatic Transmission Controls Schematics (5.3L/6.0L)**

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Starting System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for Scan Tool Information

Diagnostic Aids

- Inspect the STRTR Fuse and the 175 A MEGA Fuse for an open.
- A misadjusted PNP switch or range selector lever cable may result in a starter solenoid does not click condition.

Circuit/System Verification

1. Ignition ON, transmission in Park or Neutral. Observe the PNP Switch parameter with a scan tool, in Engine Control Module, Data Display, Engine Data. Verify that the scan tool PNP Switch parameter is Park/Neutral.
    - If the scan tool PNP Switch parameter is not Park/Neutral, refer to **Circuit/System Testing: PNP Switch Circuit Malfunction**.
2. Command the Starter Relay ON with the scan tool, or turn the ignition switch to the START position. The starter solenoid should engage and the engine should crank.
    - If the solenoid does not engage, refer to **Circuit/System Testing: STRTR Relay Circuit Malfunction**.
    - If the solenoid engages but the engine does not crank, refer to **Starter Solenoid Clicks, Engine**

Does Not Crank.

Circuit/System Testing

PNP Switch Circuit Malfunction

1. Inspect the range selector lever cable for proper adjustment. Refer to **Range Selector Lever Cable Adjustment** .
2. Inspect the park/neutral position switch for proper adjustment. Refer to **Park/Neutral Position Switch Adjustment** .
3. Ignition OFF. Disconnect the harness connector from the park/neutral switch. Refer to **Park/Neutral Position Switch Replacement** .
4. Ignition ON. Probe the ground circuit terminal 7 with a test lamp that is connected to B+. Verify that the test lamp illuminates.
    - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
5. Verify that the scan tool PNP Switch parameter is In Gear.
    - If not the specified value, test the signal circuit terminal 3 for a short to ground. If the circuit tests normal, replace the ECM.
6. Install a 3A fused jumper wire between the ground circuit terminal 7 and the signal circuit terminal 3. Verify that the scan tool PNP Switch parameter is Park/Neutral.
    - If not the specified value, test the signal circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
7. If all circuits test normal, test or replace the park/neutral position switch.

STRTR Relay Circuit Malfunction

1. Ignition OFF, disconnect the STRTR relay.
2. Ignition ON, transmission in Park/Neutral. Verify that a test lamp illuminates between the relay coil ground circuit terminal and B+.
    - If the test lamp does not illuminate, test the ground circuit for an open/high resistance.
3. Probe the STRTR Relay switch B+ circuit terminal with a test lamp that is connected to ground. Verify that the test lamp illuminates.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. Inspect the 175 A MEGA fuse for an open. If the circuit tests normal and the 175 A MEGA fuse is open, test the relay controlled output circuit for a short to ground.
4. Connect a test lamp between the relay coil ground circuit terminal and the relay coil control circuit terminal.

IMPORTANT: The engine may begin to crank.

5. Ignition ON, transmission in Park/Neutral. Command the Starter Relay ON and OFF with a scan tool, or turn the ignition switch between the START and RUN positions. The test lamp should turn ON and OFF when changing between the commanded states.

- If the test lamp is always ON, test the relay coil control circuit for a short to voltage. If the circuit tests normal, replace the ECM.
- If the test lamp is always OFF, test the relay coil control circuit for a short to ground or and open/high resistance. Inspect the STRTR fuse for an open. If the STRTR fuse is open, test the relay controlled output circuit for a short to ground, or replace the starter. If the circuit and fuse test normal, replace the ECM.

6. Connect the STRTR relay.
7. Install a test lamp between the starter X2-S terminal and ground.

IMPORTANT: The engine may begin to crank.

8. Ignition ON, transmission in Park/Neutral, command the Starter Relay ON with a scan tool, or turn the ignition switch to the START position. The test lamp should illuminate.
   - If the test lamp does not illuminate, test the relay controlled output circuit for an open/high resistance. If the circuit tests normal, test or replace the STRTR relay.
9. If all circuits test normal, test or replace the starter.

Component Testing

PNP Switch

1. Inspect the range selector lever cable for proper adjustment. Refer to **Range Selector Lever Cable Adjustment** .
2. Inspect the park/neutral position switch for proper adjustment. Refer to **Park/Neutral Position Switch Adjustment** .
3. Ignition OFF. Disconnect the harness connector from the park/neutral switch. Refer to **Park/Neutral Position Switch Replacement** .
4. With the PNP switch in the following positions, test for infinite resistance between the ground terminal 7 and the signal terminal 3.
   - R
   - OD
   - D
   - 2
   - 1
   - If not the specified value, replace the PNP switch.
5. With the PNP switch in the following positions, test for less than 2.0 ohms between the ground terminal 7 and the signal terminal 3.
   - P
   - N
   - If greater than the specified range, replace the PNP switch.

STRTR Relay

1. Ignition OFF, remove the STRTR relay. Refer to **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)** .
2. Test for 60-180 ohms between terminals 85 and 86.
    - If not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:
    - 30 and 86
    - 30 and 87
    - 30 and 85
    - 85 and 87
    - If not the specified value, replace the relay.
4. Install a 20A fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Test for less than 2.0 ohms between terminals 30 and 87.
    - If greater than specified range, replace the relay.

Repair Procedures

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

- **Range Selector Lever Cable Adjustment**
- **Park/Neutral Position Switch Adjustment**
- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Park/Neutral Position Switch Replacement**
- **Starter Motor Replacement (4.2L Engine)** or **Starter Motor Replacement (5.3L and 6.0L Engines)**
- **Control Module References** for BCM or ECM replacement, setup and programming

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Diagnostic Instructions

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

Circuit/System Description

When the ignition switch is placed in the START position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the START position. The BCM then sends a serial data message to the engine control module (ECM) that crank has been requested. The ECM monitors the park/neutral position switch. If the transmission is in Park or Neutral, and there are no DTCs that inhibit engine starting, then the ECM supplies voltage to the control circuit of the STRTR relay. When this occurs, battery voltage is supplied through the STRTR relay to the X2-S terminal of the starter solenoid. The starter solenoid energizes, and supplies battery voltage to the starter from the B terminal to crank the engine.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Starting System Description and Operation

Electrical Information Reference

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

Circuit/System Verification

1. Attempt to start the engine. Verify that the starter solenoid clicks.
   - If the starter solenoid does not click, refer to **Starter Solenoid Does Not Click**.
   - If the engine cranks slowly, refer to **Engine Cranks Slowly**.
2. Go to Circuit/System Testing.

Circuit/System Testing

1. Verify that the battery is sufficiently charged and that the battery cables are clean and tight. Refer to **Charging System Test**.
   - If the battery is not sufficiently charged, refer to **Battery Charging**.
   - If the battery cables are not clean and tight, refer to **Fastener Tightening Specifications**.
2. Using a DMM, measure voltage between the positive battery terminal and X1 terminal B at the solenoid as the ignition switch is turned to the START position. Voltage should be less than 0.5 volt.
   - If greater than the specified value, replace the starter solenoid cable.
3. Using a DMM, measure voltage between the negative battery terminal and the starter motor case as the ignition switch is turned to the START position. Voltage should be less than 0.5 volt.
   - If greater than the specified value, replace the negative battery cable.
4. Remove the drive belts. Refer to one of the following:
   - **Drive Belt Replacement** for the 4.2L (LL8)
   - Drive Belt Replacement - Accessory for the 5.3L and 6.0L only V-8 (w/o LL8)

- Air Conditioning Compressor Belt Replacement for the 5.3L and 6.0L only V-8 (w/o LL8)

5. Attempt to start the engine, with the drive belts removed.
    - If the engine cranks, inspect the engine accessories and belt drive system for mechanical binding.
6. Attempt to rotate the crankshaft using a breaker bar, or other suitable tool. Verify that the engine is not seized.
    - If the engine is seized, refer to one of the following:
        - **Engine Will Not Crank - Crankshaft Will Not Rotate** for 4.2L (LL8)
        - Engine Will Not Crank - Crankshaft Will Not Rotate for the 5.3L or 6.0L only V-8 (w/o LL8)
7. If all circuits test normal, replace the starter motor.

Repair Procedures

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

- **Battery Charging**
- **Battery Negative Cable Replacement (4.2L Engine)** or **Battery Negative Cable Replacement (5.3L and 6.0L Engines)**
- **Starter Motor Replacement (4.2L Engine)** or **Starter Motor Replacement (5.3L and 6.0L Engines)**

ENGINE CRANKS SLOWLY

Inspect the following items:

- Battery-Perform the Battery Inspection/Test. Refer to **Battery Inspection/Test**.
- Wiring-Inspect the wiring for damage. Inspect all connections to the starter motor, the solenoid, the battery, and all ground connections. Refer to:
    - **Circuit Testing**
    - **Wiring Repairs**
    - **Testing for Intermittent Conditions and Poor Connections**
    - **Connector Repairs**
- Engine-Verify that the engine is not seized.

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

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Instructions

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

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The PG starter motors are non-repairable. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull 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. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

Reference Information

Description and Operation

Starting System Description and Operation

Circuit/System Verification

Start the engine. Listen to the starter noise while the engine is cranking. Compare the concern to a similar vehicle.

Circuit/System Testing

1. Remove the flywheel inspection cover.
2. Inspect the flywheel for the following:
    - Loose flywheel bolts
    - Chipped gear teeth
    - Missing gear teeth
    - Bent flywheel
    - Debris in the bell housing
    - If not within specifications, remove the debris, tighten the flywheel bolts, or repair or replace the flywheel.
3. If all inspections were within specification, replace the starter motor.

Repair Procedures

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

- **Fastener Tightening Specifications** 4.2L (LL8)
- Fastener Tightening Specifications (5.3L) or Fastener Tightening Specifications (6.0L) V-8 (w/o LL8)
- **Engine Flywheel Replacement** 4.2L (LL8)
- **Starter Motor Replacement (4.2L Engine)** or **Starter Motor Replacement (5.3L and 6.0L Engines)**

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION & CONNECTION

Disconnecting Procedure

CAUTION: Refer to Battery Disconnect Caution .

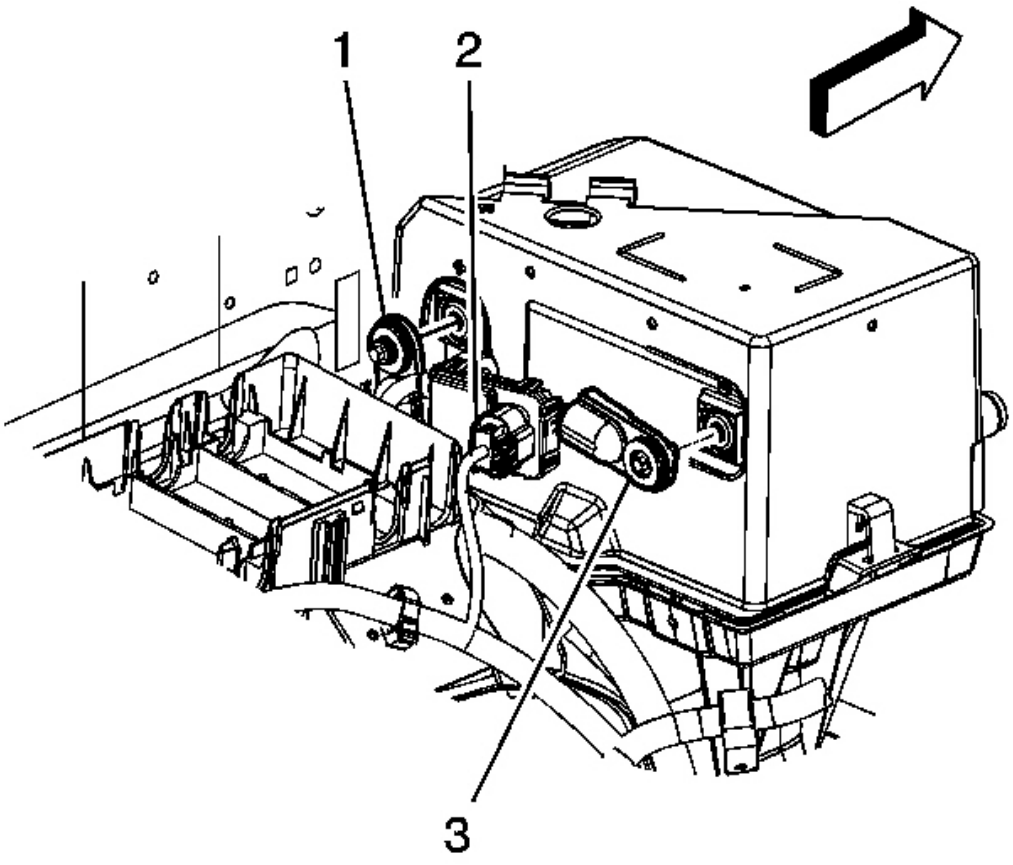


Fig. 3: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

1. Record all preset and theft codes from the radio.
2. Turn the ignition switch to the LOCK position.
3. Verify that all the electrical components are off such as interior lights, all doors are closed, the underhood

lamp, etc.

4. Loosen the negative battery cable bolt.
5. Remove the negative battery cable (2) from the battery.
6. Position the negative battery cable away from any body ground.

Connecting Procedure

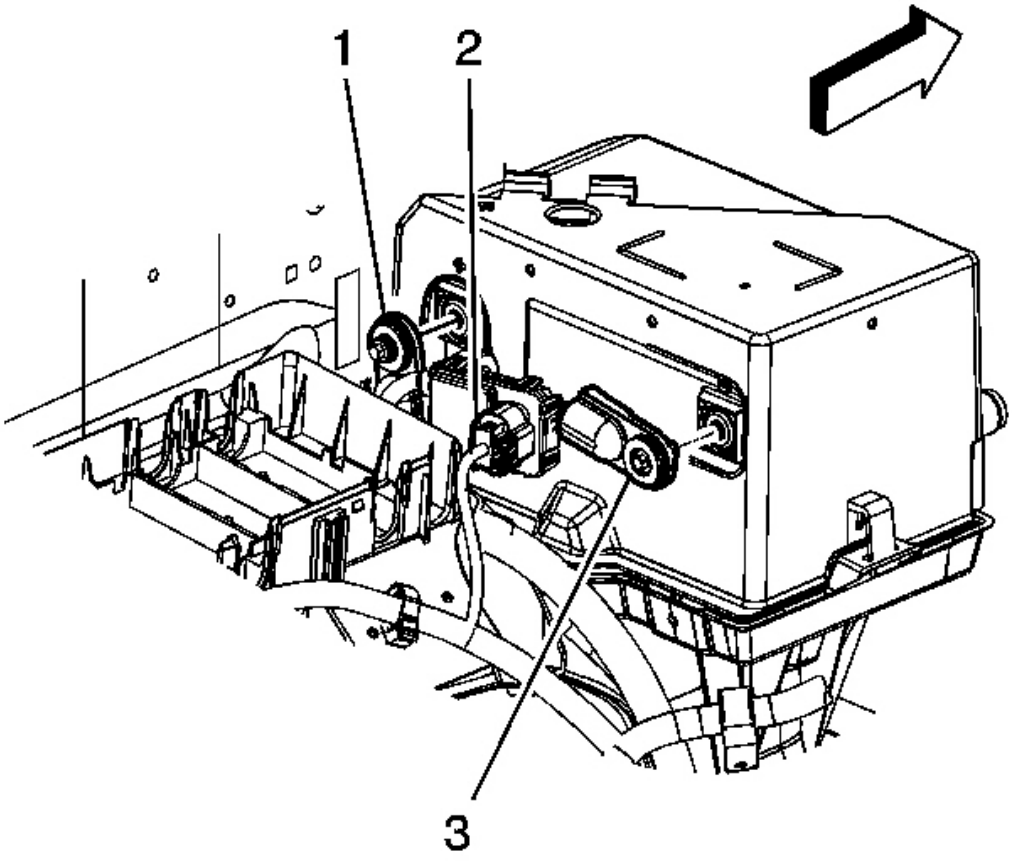


Fig. 4: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

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

NOTE: **Refer to Fastener Notice .**

4. Tighten negative battery cable bolt.

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

GENERATOR BATTERY CONTROL MODULE REPLACEMENT

Removal Procedure

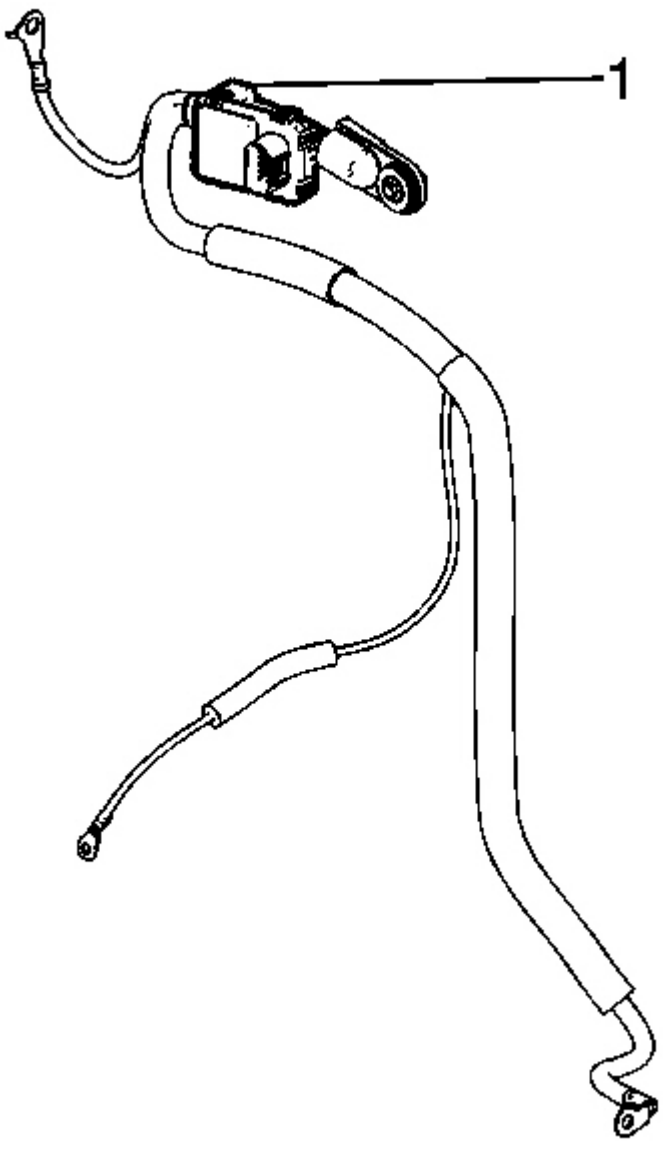


Fig. 5: Identifying Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the negative battery cable. Refer to **Battery Negative Cable Replacement (4.2L Engine)** or **Battery Negative Cable Replacement (5.3L and 6.0L Engines)**.
2. Mark the location of the negative battery cable clips and remove the clips from the cable.
3. Remove the tape securing the generator battery current sensor to the negative battery cable.

4. Squeeze the negative battery cable branches together.

IMPORTANT: Note the orientation of the generator battery current sensor prior to removal.

5. Slide the generator battery current sensor (1) off of the negative battery cable.

Installation Procedure

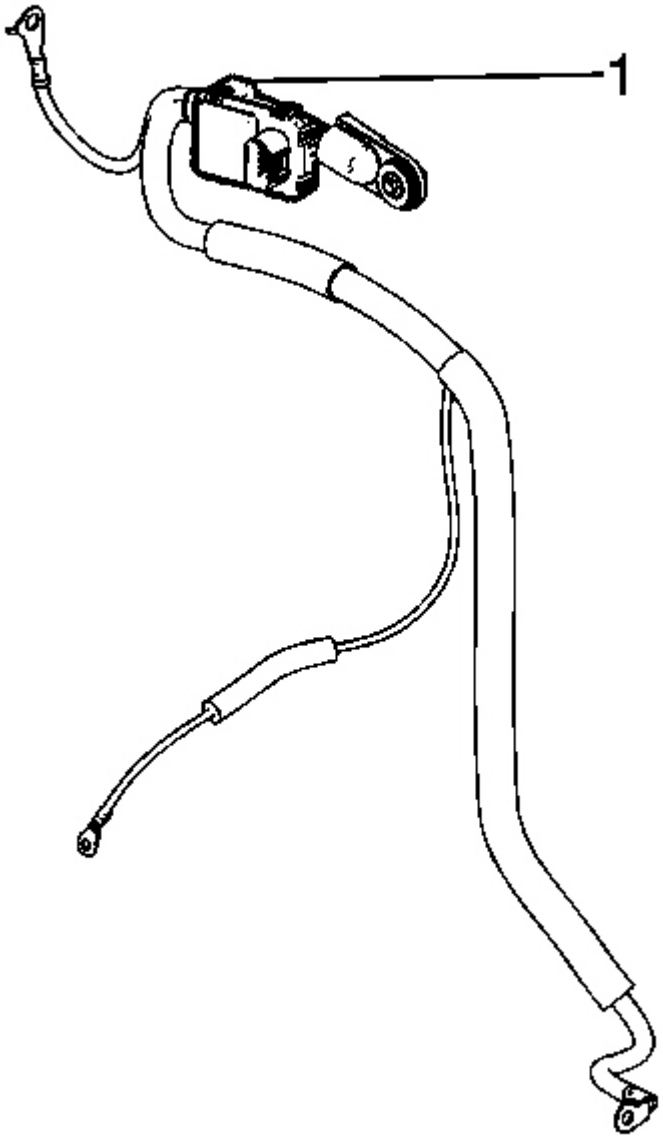


Fig. 6: Identifying Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Squeeze the negative battery cable together.

IMPORTANT: Ensure the generator battery current sensor is installed in the correct direction and location on the negative battery cable.

2. Slide the NEW generator battery current sensor (1) up onto the negative battery cable and insert the tab under the negative battery cable terminal cover.
3. Wrap electrical tape around the generator battery current sensor leg in order to secure the sensor to the negative battery cable.
4. Install the negative battery cable clips to the cable to the locations previously marked during removal.
5. Install the negative battery cable. Refer to **Battery Negative Cable Replacement (4.2L Engine)** or **Battery Negative Cable Replacement (5.3L and 6.0L Engines)**.

BATTERY NEGATIVE CABLE REPLACEMENT (4.2L ENGINE)

Removal Procedure

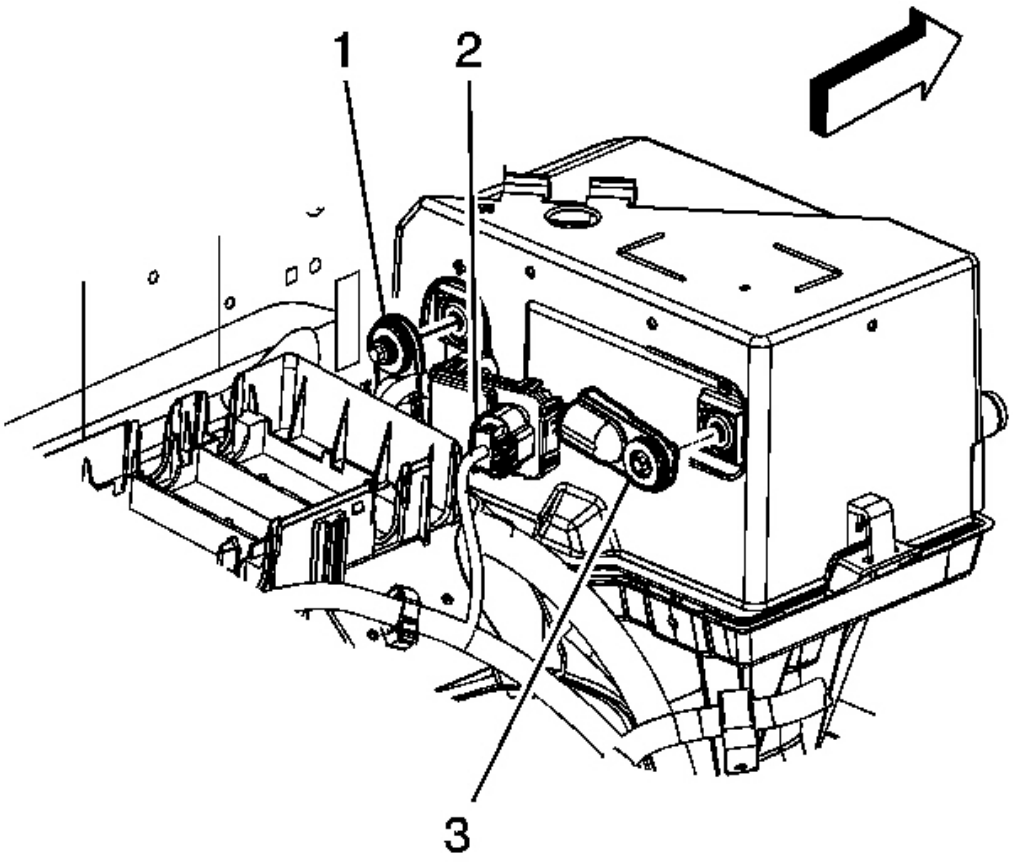


Fig. 7: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Disconnect the engine wiring harness electrical connector (2) from the generator battery control module.

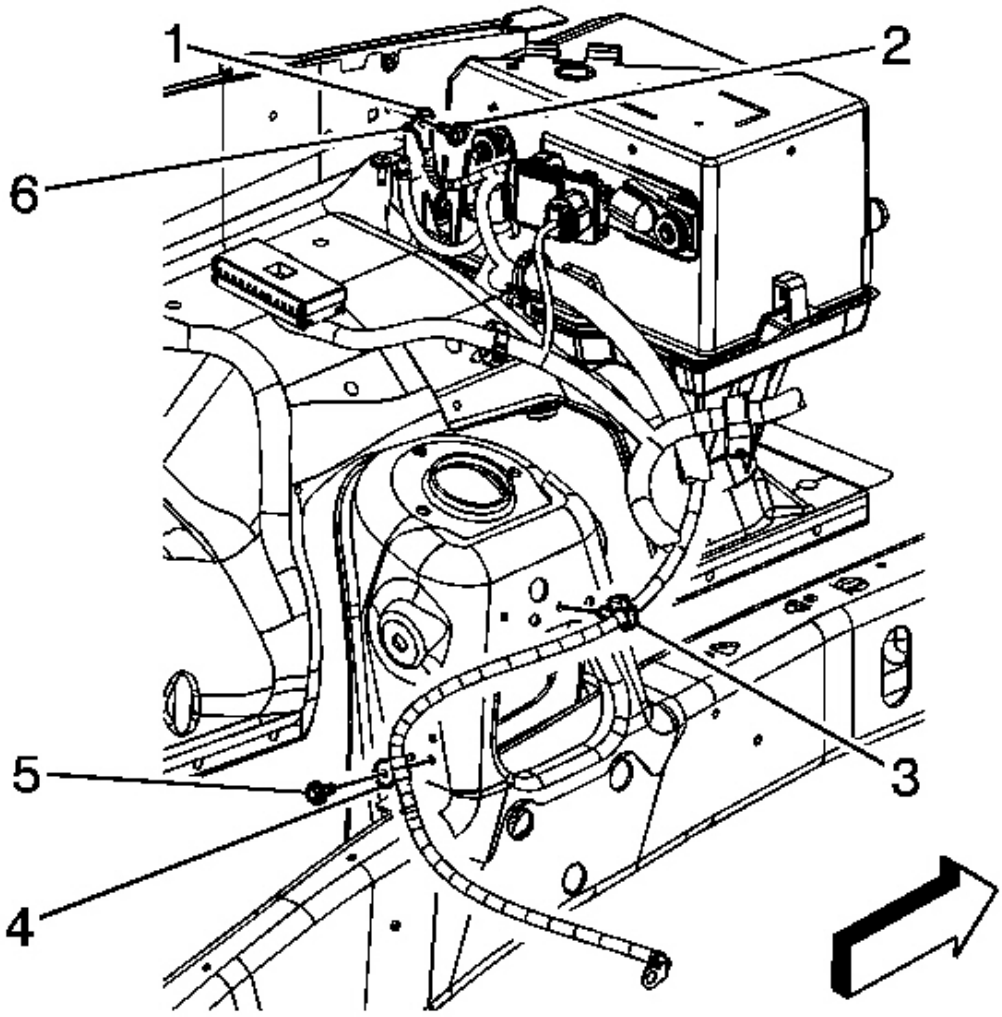


Fig. 8: Identifying Battery Cables & Related Components
Courtesy of GENERAL MOTORS CORP.

3. Remove the negative battery cable ground terminal bolt (2) at the left wheelhouse panel.
4. Remove the negative battery cable ground terminal (1) from the left wheelhouse panel.
5. Remove the negative battery cable ground terminal bolt (5) from the shock tower.
6. Remove the negative battery cable ground terminal from the shock tower.

7. Remove the negative battery cable clip (3) from the shock tower.

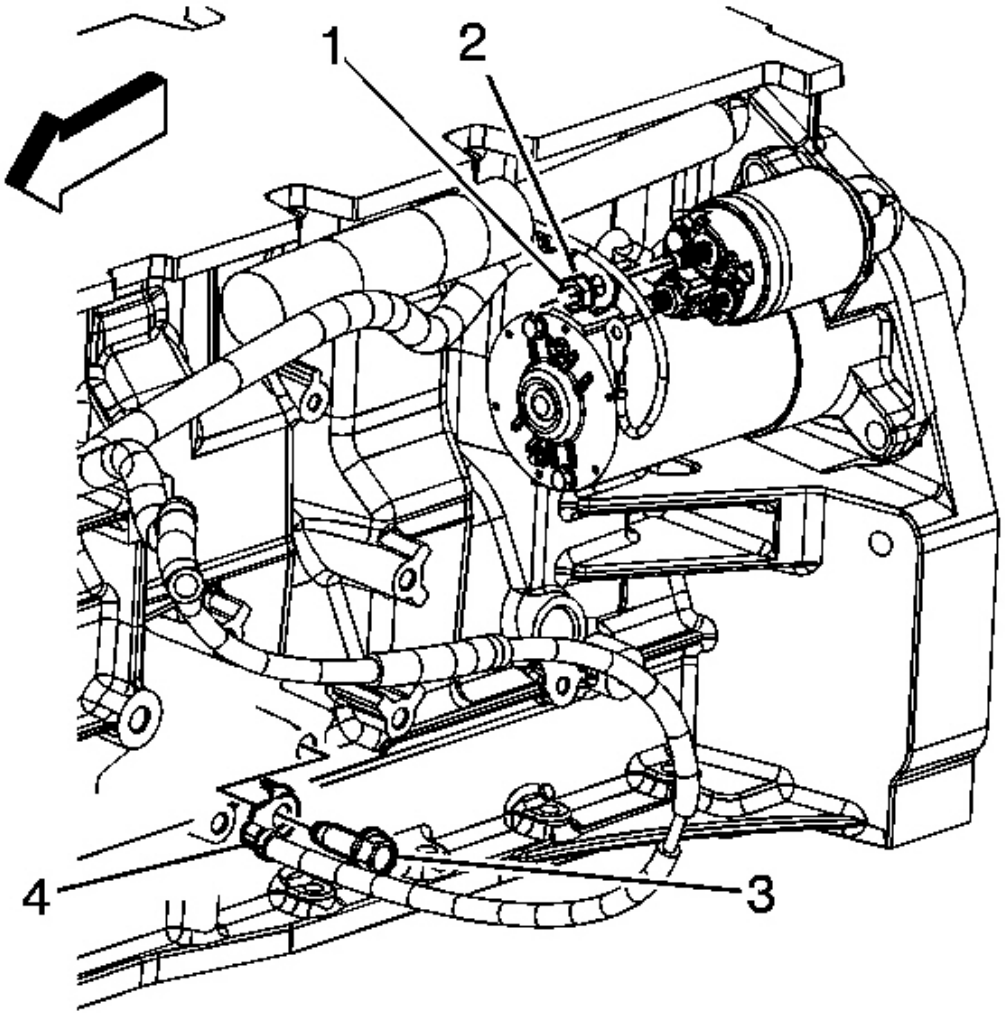


Fig. 9: Locating Negative Battery Cable At Block & Positive At Starter
Courtesy of GENERAL MOTORS CORP.

8. Remove the negative battery cable ground terminal bolt (3) from the engine block.
9. Remove the negative battery cable ground from the engine block.
10. Cut the tape wrapped around the conduit and remove the negative battery cable.

Installation Procedure

IMPORTANT:

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

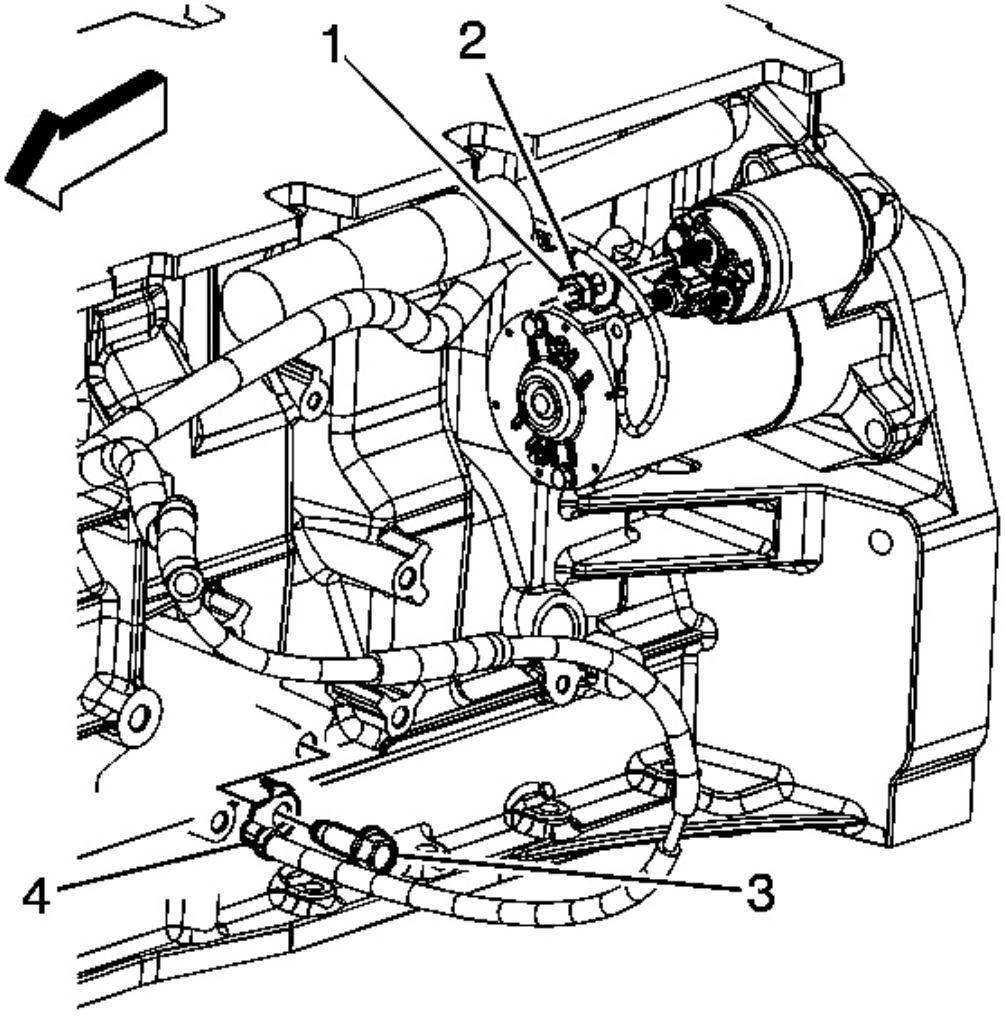


Fig. 10: Locating Negative Battery Cable At Block & Positive At Starter
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable and re-tape the conduit.

2. Position the negative battery cable ground to the engine block.

NOTE: **Refer to Fastener Notice .**

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

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

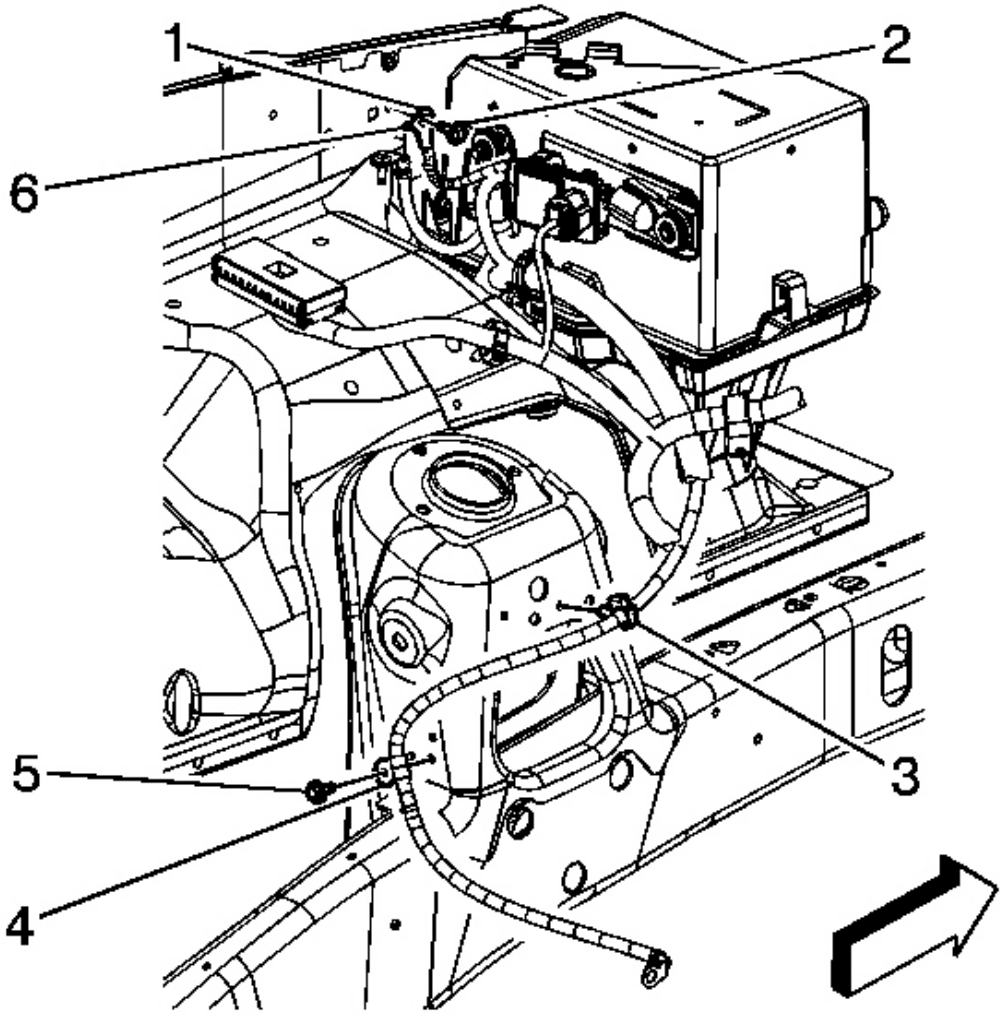


Fig. 11: Identifying Battery Cables & Related Components
Courtesy of GENERAL MOTORS CORP.

4. Install the negative battery cable ground terminal to the shock tower. Ensure that the anti-rotation tab is inserted into the hole in the shock tower.
5. Install the negative battery cable ground terminal bolt (5) to the shock tower.

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

6. Install the negative battery cable ground terminal (1) to the left wheelhouse panel. Ensure that the anti-rotation tab (6) is inserted into the hole in the wheelhouse panel.
7. Install the negative battery cable ground terminal bolt (2) at the left wheelhouse panel.

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

8. Install the negative battery cable clip (3) to the shock tower.

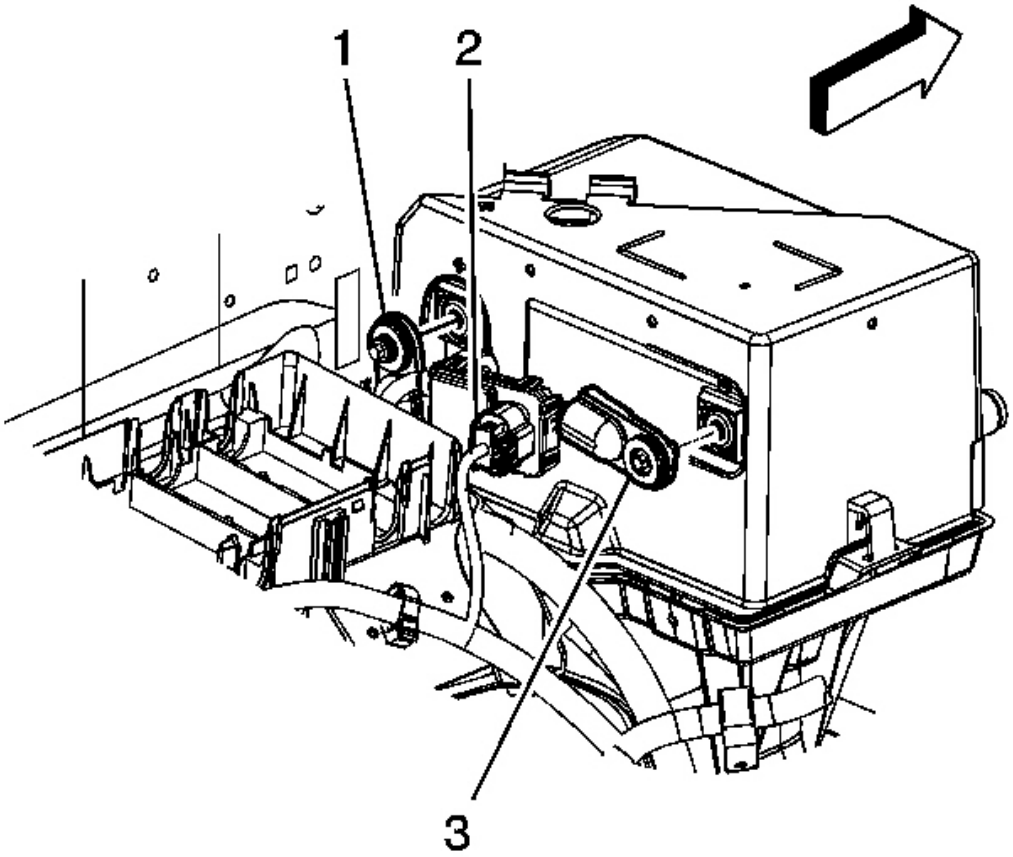


Fig. 12: View Of Battery, Cables & Battery Control Module

Courtesy of GENERAL MOTORS CORP.

9. Connect the engine wiring harness electrical connector (2) to the generator battery control module.
10. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

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

Removal Procedure

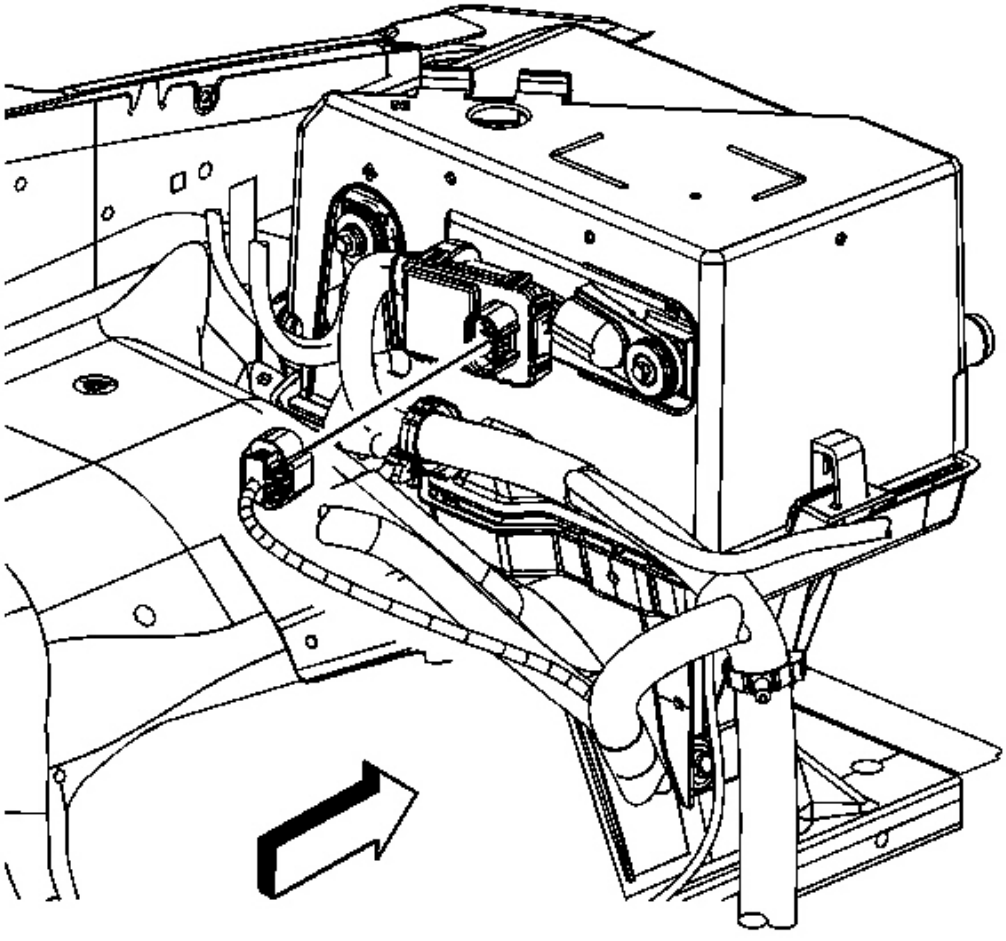


Fig. 13: Identifying Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

2. Disconnect the engine wiring harness electrical connector from the generator battery control module.

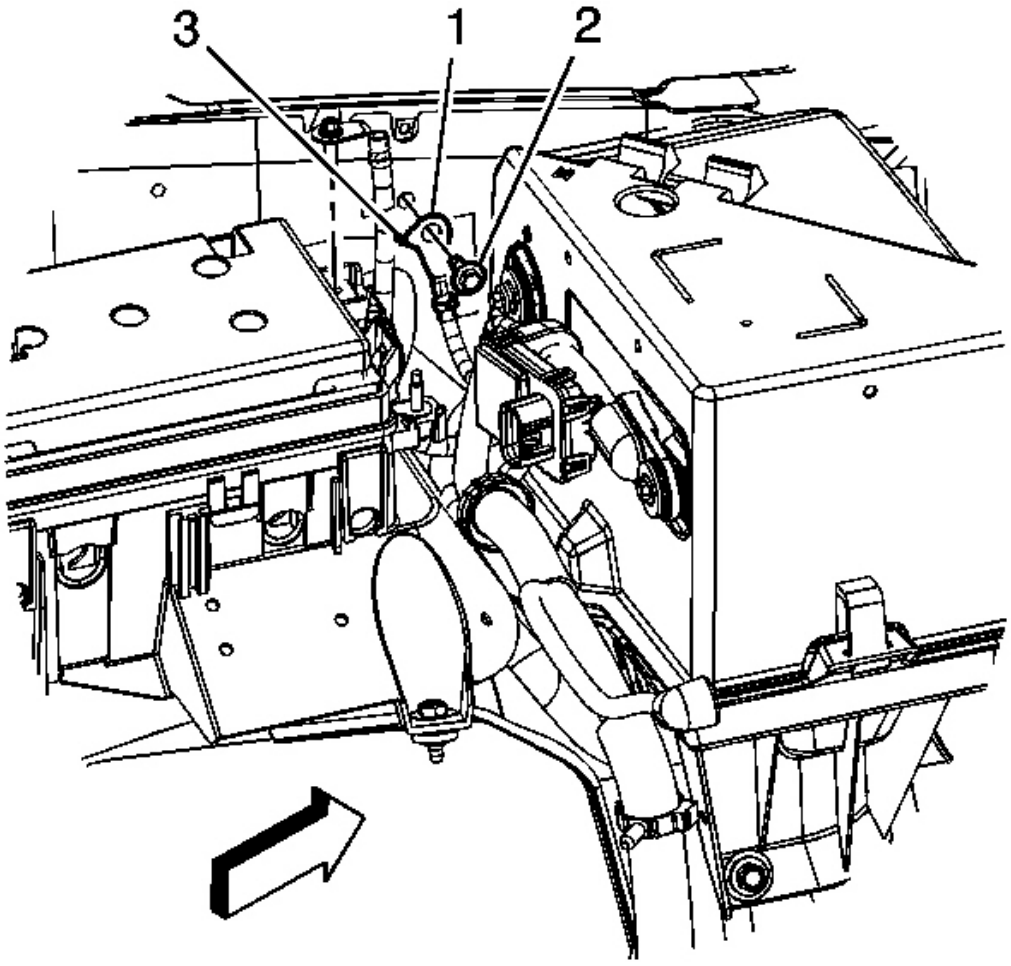


Fig. 14: Identifying Negative Battery Cable, Ground Terminal & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the negative battery cable ground terminal bolt (2) at the left wheelhouse panel.
4. Remove the negative battery cable ground terminal (1) from the left wheelhouse panel.
5. Remove the battery cable from the battery cable clip attached to the junction block bracket.

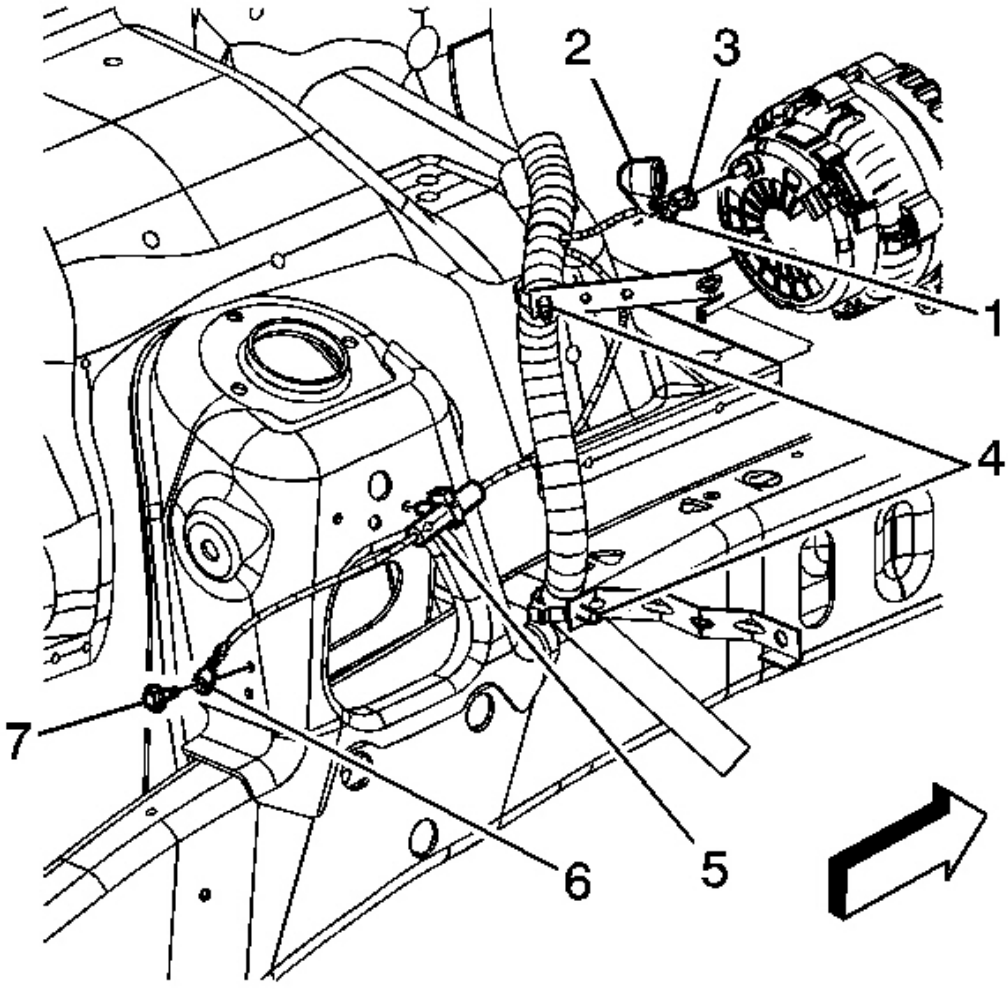


Fig. 15: View Of Negative Battery Cable Ground Terminal Components At Shock Tower
Courtesy of GENERAL MOTORS CORP.

6. Remove the negative battery cable ground bolt (7) from the shock tower.
7. Remove the negative battery cable ground terminal (6) from the shock tower.
8. Remove the negative battery cable clip (5) from the shock tower.

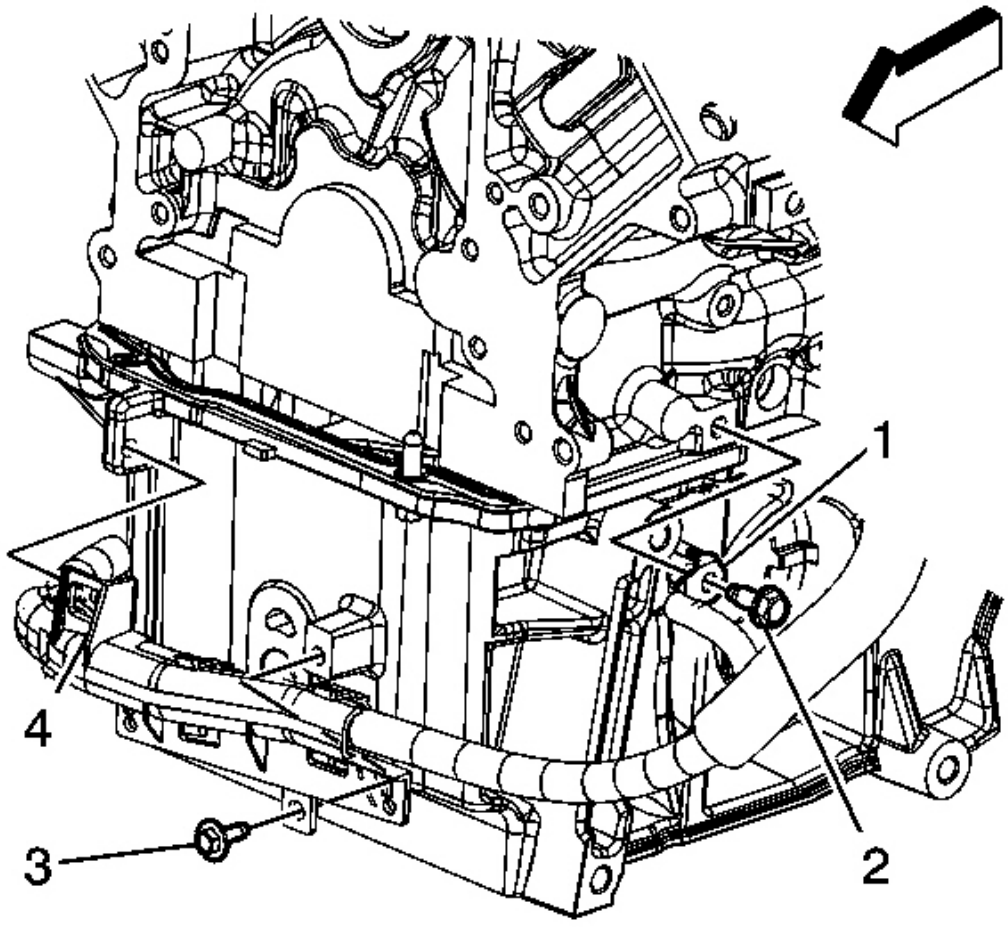


Fig. 16: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

9. Remove the negative battery cable terminal bolt (2) from the engine block.
10. Remove the negative battery cable ground (1) from the engine block.
11. Cut the tape wrapped around the conduit and remove the negative battery cable.

Installation Procedure

IMPORTANT:

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

the powertrain control module.

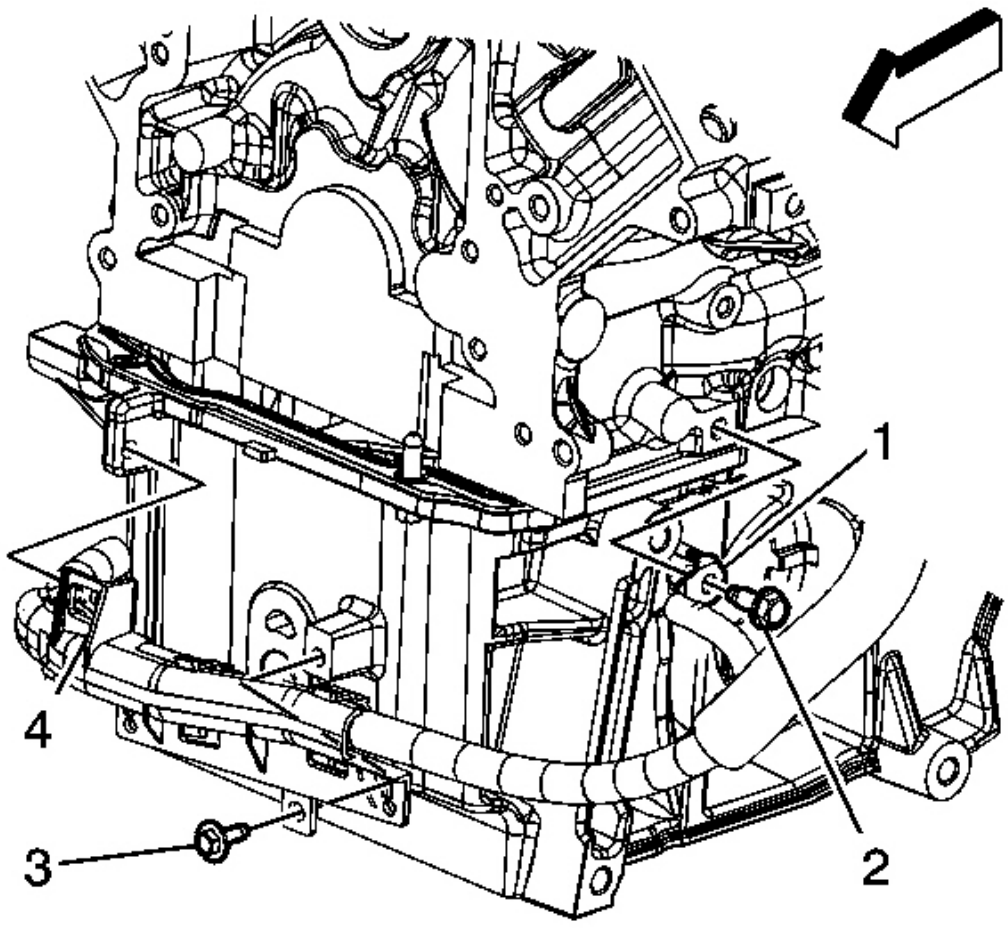


Fig. 17: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable and re-tape the conduit.
2. Position the negative battery cable ground (1) to the engine block.

NOTE: Refer to Fastener Notice .

3. Install the negative battery cable ground terminal bolt (2) to the engine block.

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

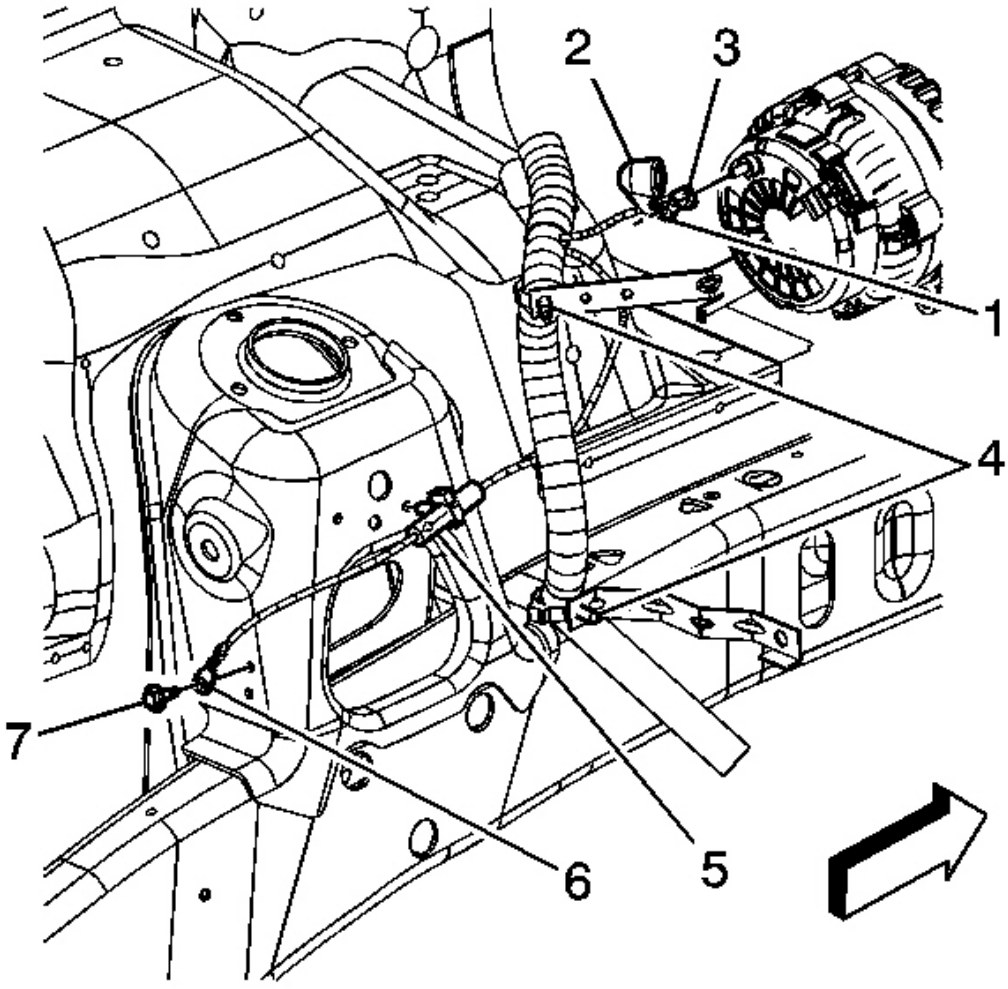


Fig. 18: View Of Negative Battery Cable Ground Terminal Components At Shock Tower
Courtesy of GENERAL MOTORS CORP.

4. Position the negative battery cable ground terminal (6) to the shock tower.
5. Install the negative battery cable ground bolt (7) to the shock tower.

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

6. Install the negative battery cable clip (5) to the shock tower.

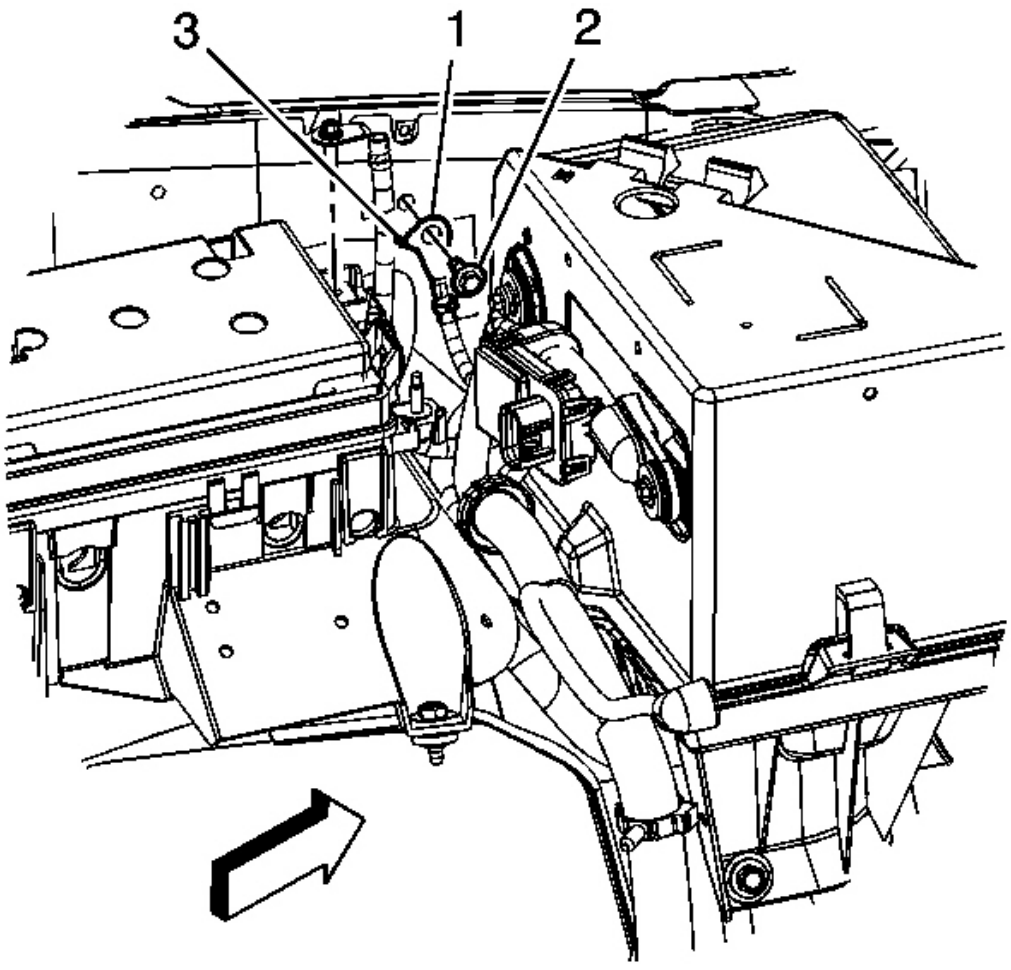


Fig. 19: Identifying Negative Battery Cable Ground Terminal Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the negative battery cable ground terminal (1) to the left wheelhouse panel. Ensure that the anti-rotation tab (3) is inserted into the hole in the wheelhouse panel.
8. Install the negative battery cable ground terminal bolt (2) at the left wheelhouse panel.

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

9. Install the battery cable to the battery cable clip attached to the junction block bracket.

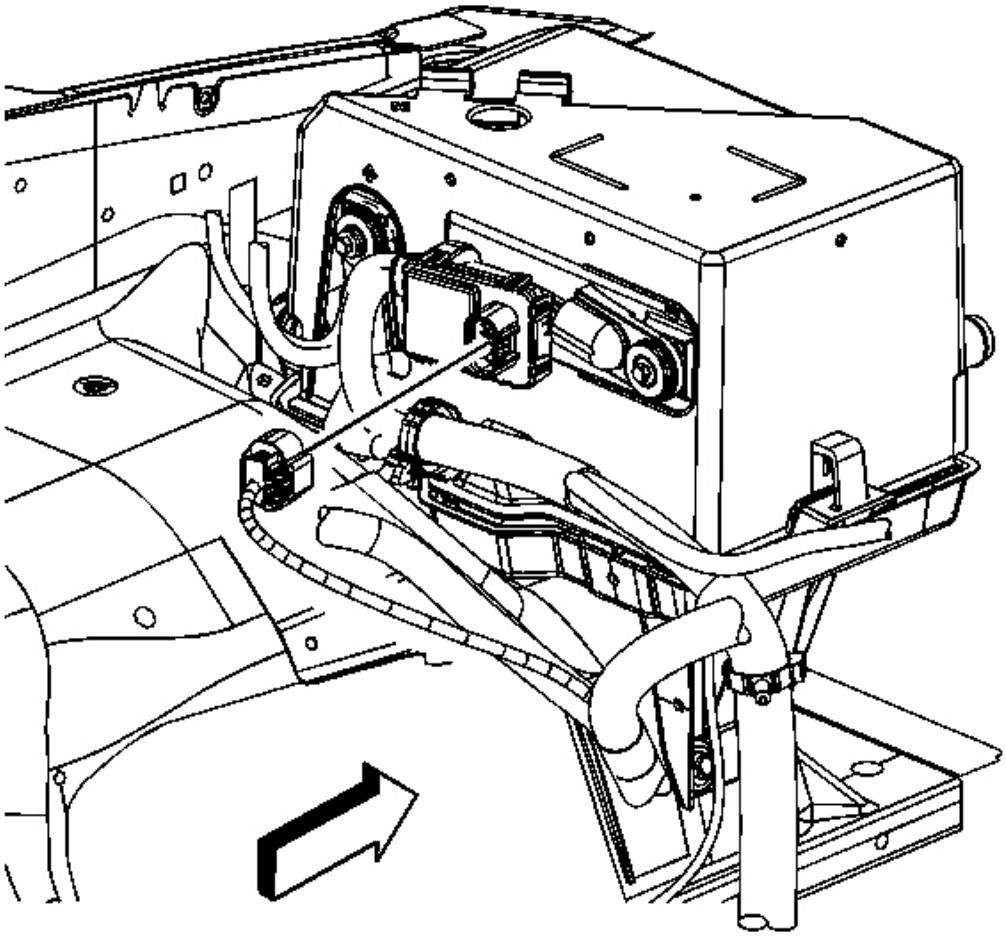


Fig. 20: Identifying Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

10. Connect the engine wiring harness electrical connector to the generator battery control module.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY POSITIVE CABLE REPLACEMENT (4.2L ENGINE)

Removal Procedure

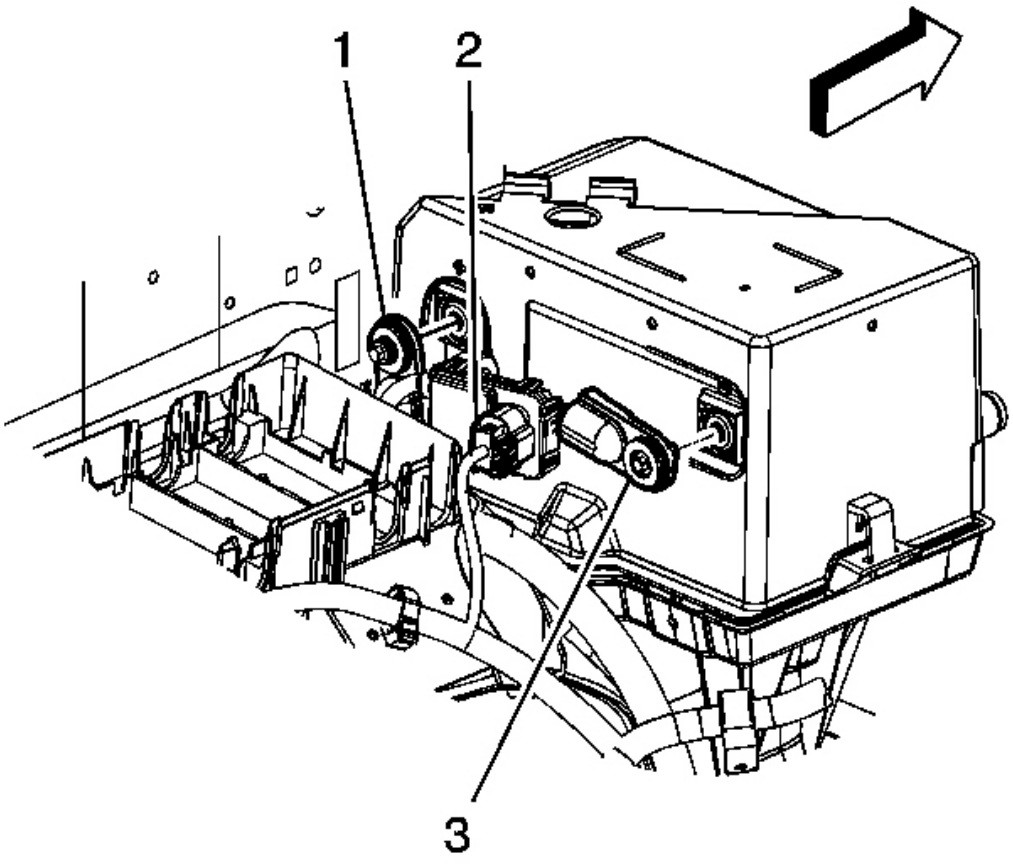


Fig. 21: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Loosen the battery positive cable bolt.
3. Remove the positive battery cable (1) from the battery.

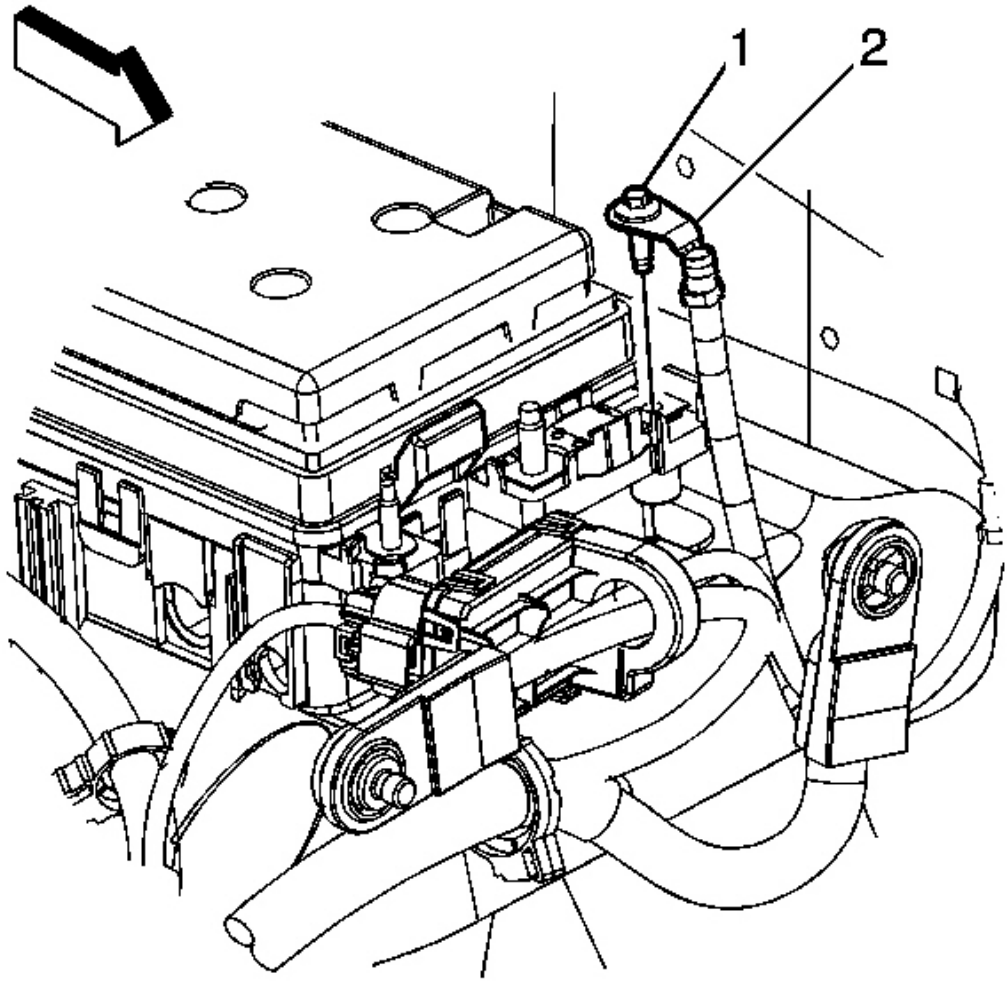


Fig. 22: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

4. Loosen the positive battery cable terminal bolt (1) at the junction block.
5. Remove the positive battery cable terminal (2) from the junction block.
6. Disconnect the battery cable conduit from the conduit retaining clip.
7. Remove the battery positive cable from the conduit.
8. Remove the battery positive cable harness from the fir-tree retainer on the powertrain control module (PCM) bracket.

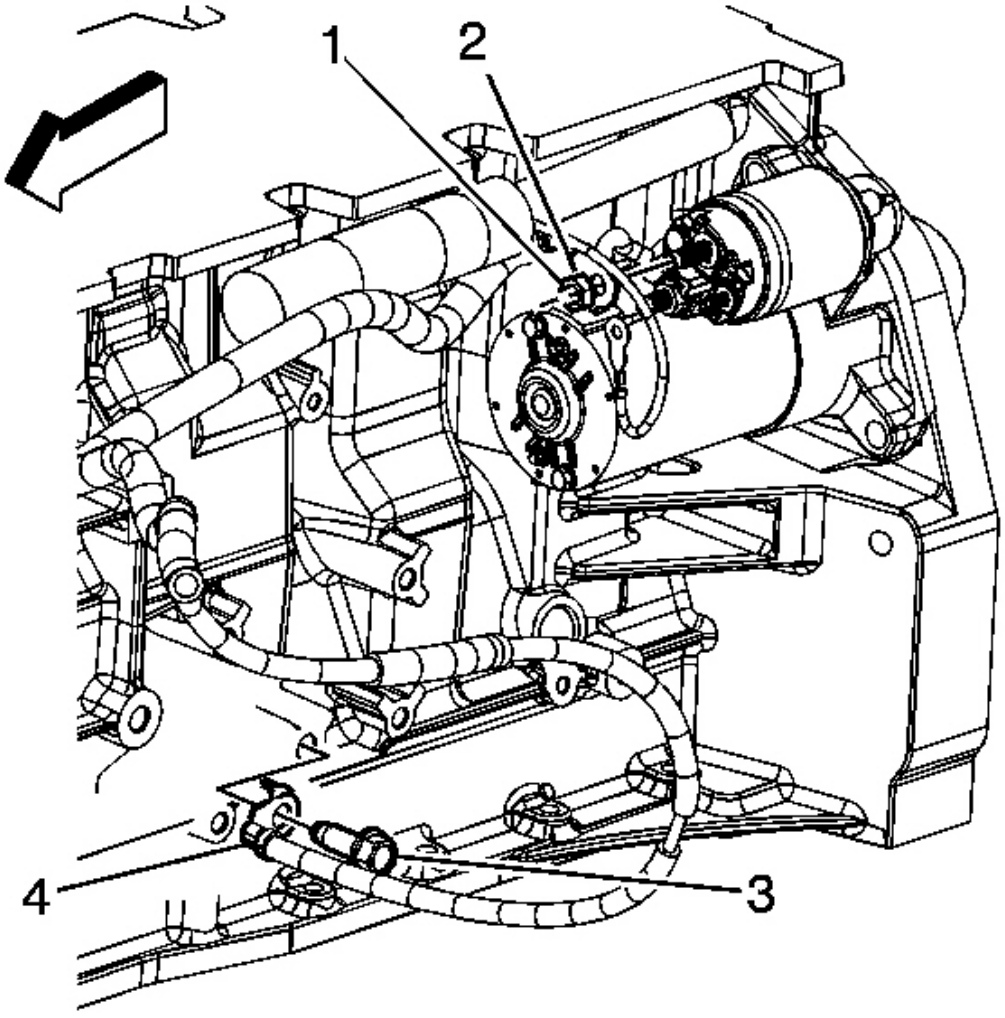


Fig. 23: Locating Negative Battery Cable At Block & Positive At Starter
Courtesy of GENERAL MOTORS CORP.

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

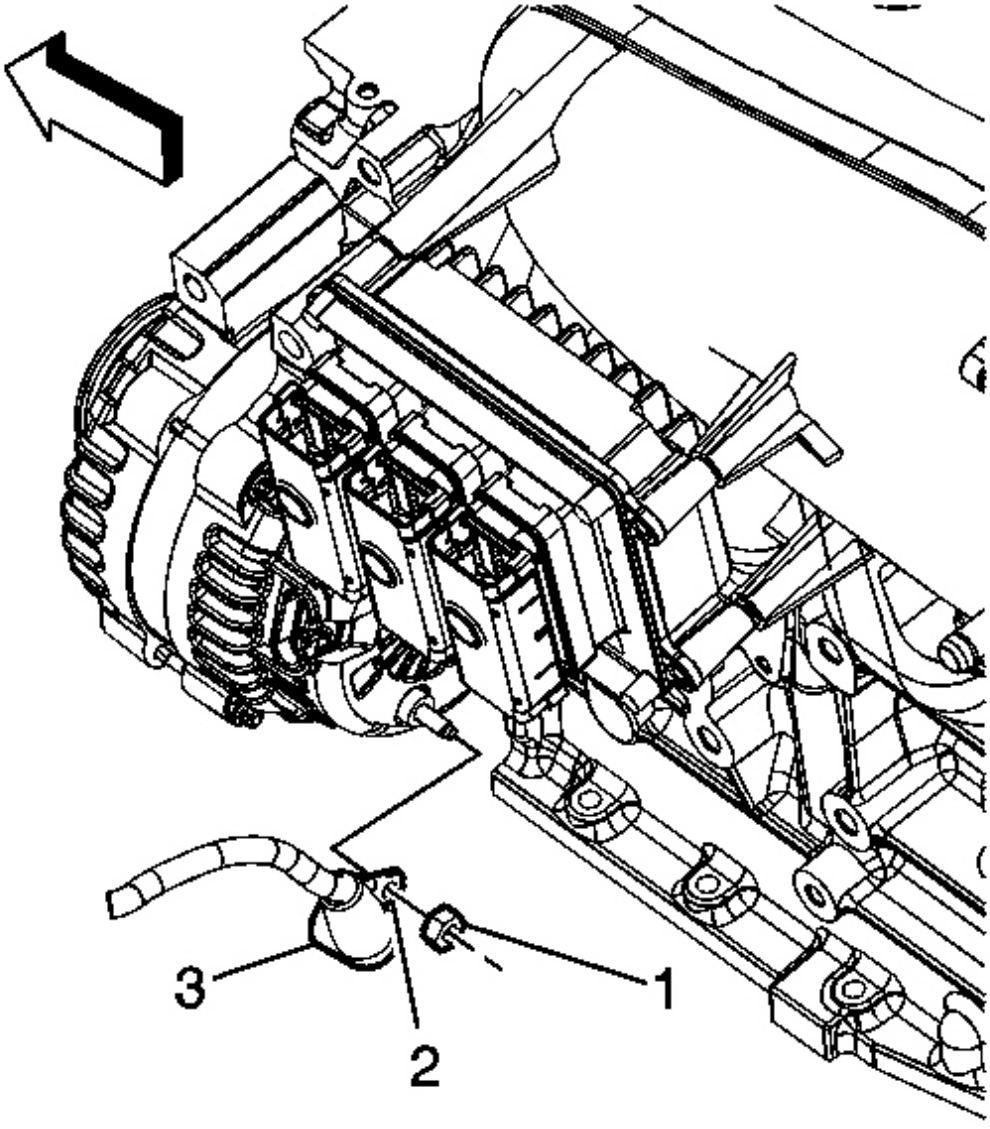


Fig. 24: View Of Positive Battery Cable Boot
Courtesy of GENERAL MOTORS CORP.

11. Reposition the positive battery cable boot (3).
12. Remove the positive battery cable terminal nut (1).
13. Remove the positive battery cable from the generator.
14. Remove the battery positive cable from the vehicle.

Installation Procedure

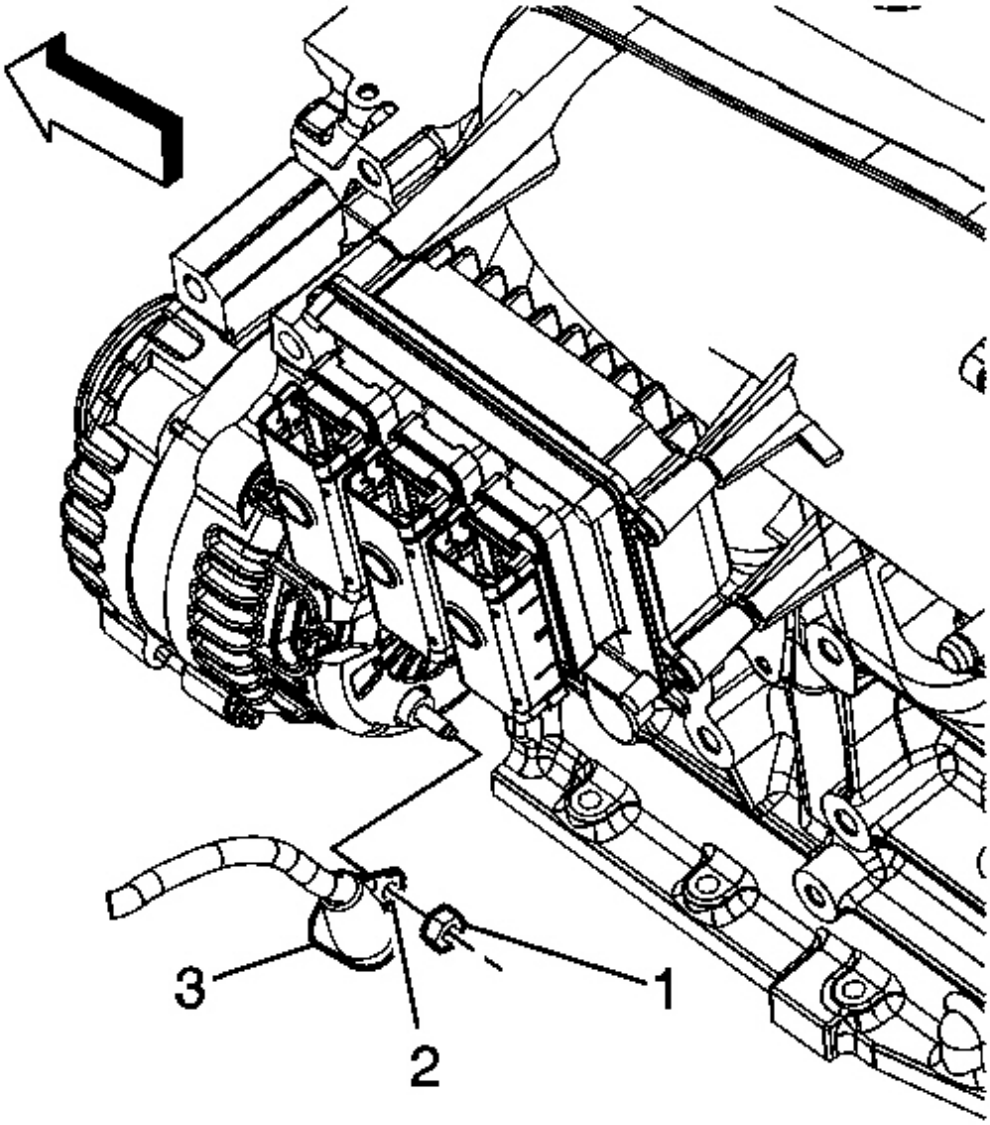


Fig. 25: View Of Positive Battery Cable Boot
Courtesy of GENERAL MOTORS CORP.

1. Position the battery positive cable in the engine compartment.
2. Install the positive battery cable to the generator.

NOTE: **Refer to Fastener Notice .**

3. Install the positive battery cable terminal nut (1).

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

4. Position the positive battery cable boot (3).

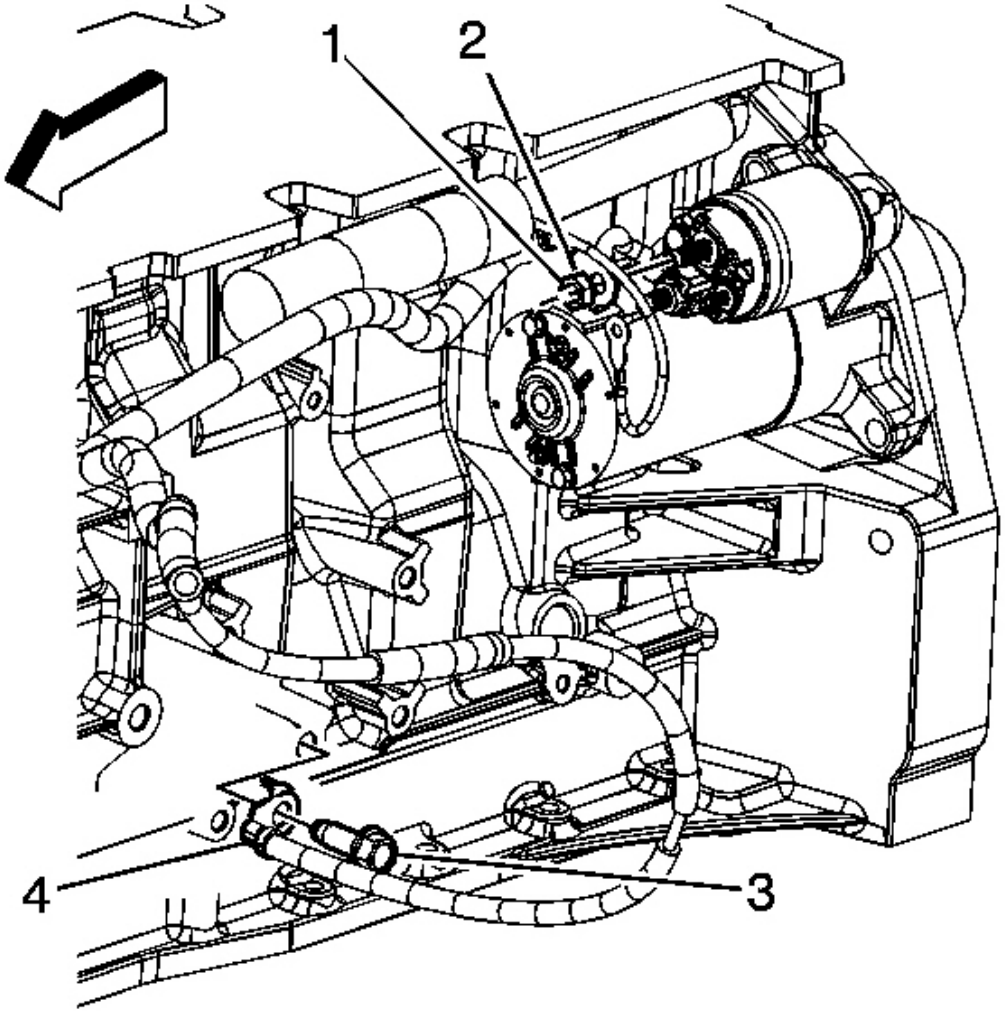


Fig. 26: Locating Negative Battery Cable At Block & Positive At Starter
Courtesy of GENERAL MOTORS CORP.

5. Install the positive battery cable terminal (2) to the starter.
6. Install the positive battery cable nut (1) to the starter.

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

7. Install the battery positive cable harness to the fir-tree retainer on the PCM bracket.
8. Install the battery positive cable into the conduit.
9. Connect the battery cable conduit to the conduit retaining clip.

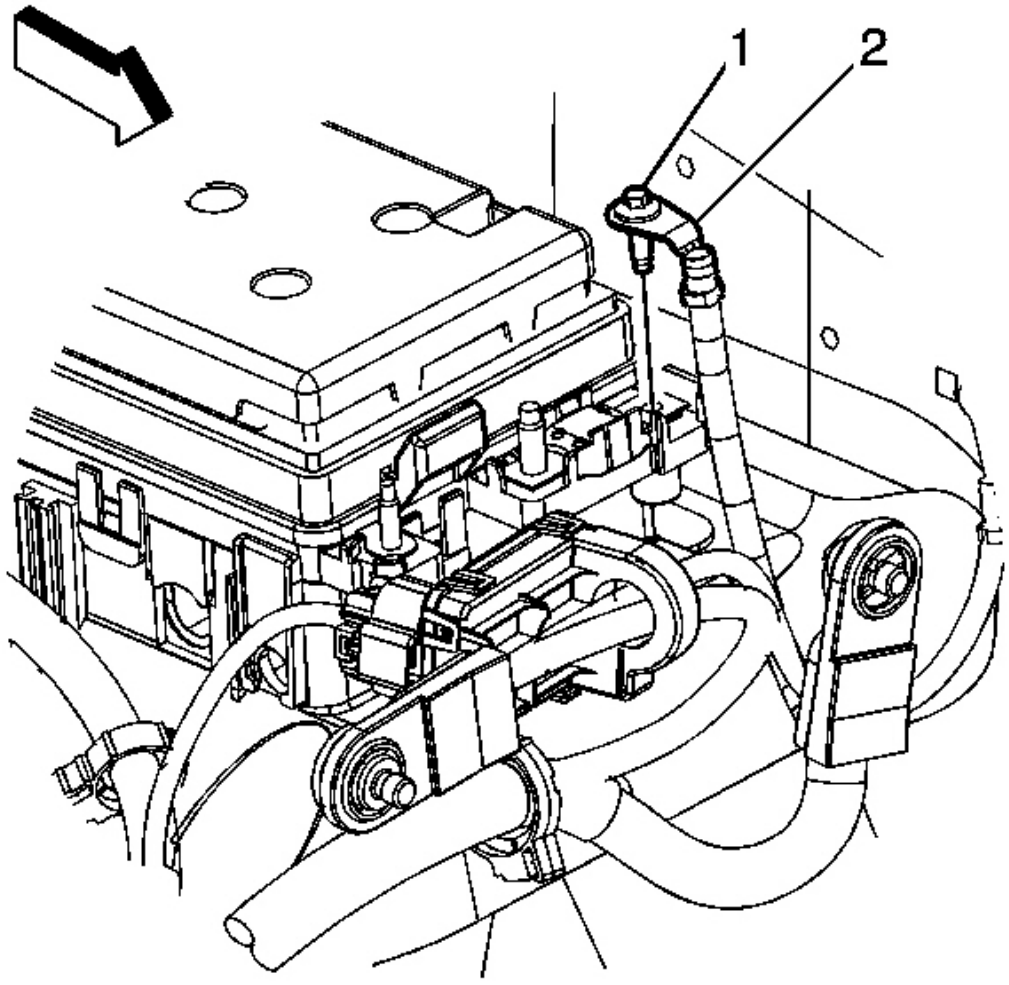


Fig. 27: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

10. Install the positive battery cable terminal (2) to the junction block.
11. Tighten the positive battery cable terminal bolt (1) at the junction block.

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

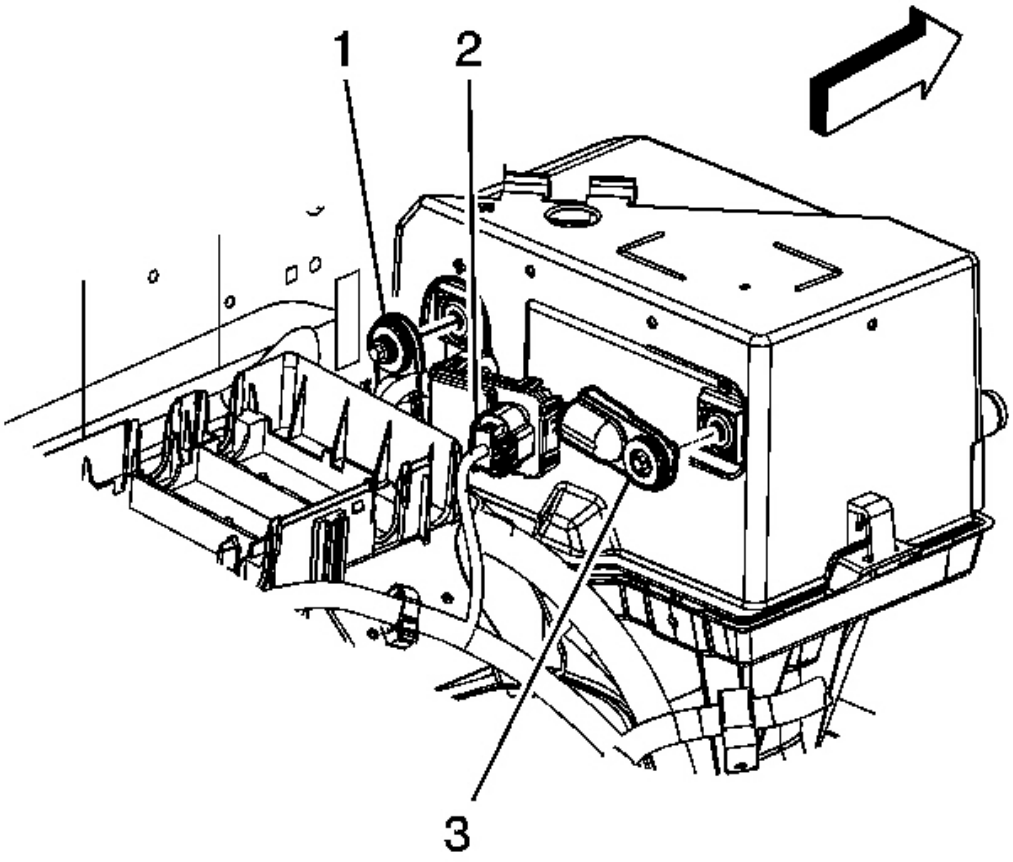


Fig. 28: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

12. Install the positive battery cable (1) to the battery.
13. Tighten the battery positive cable bolt.

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

14. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY POSITIVE CABLE REPLACEMENT (5.3L & 6.0L ENGINES)

Removal Procedure

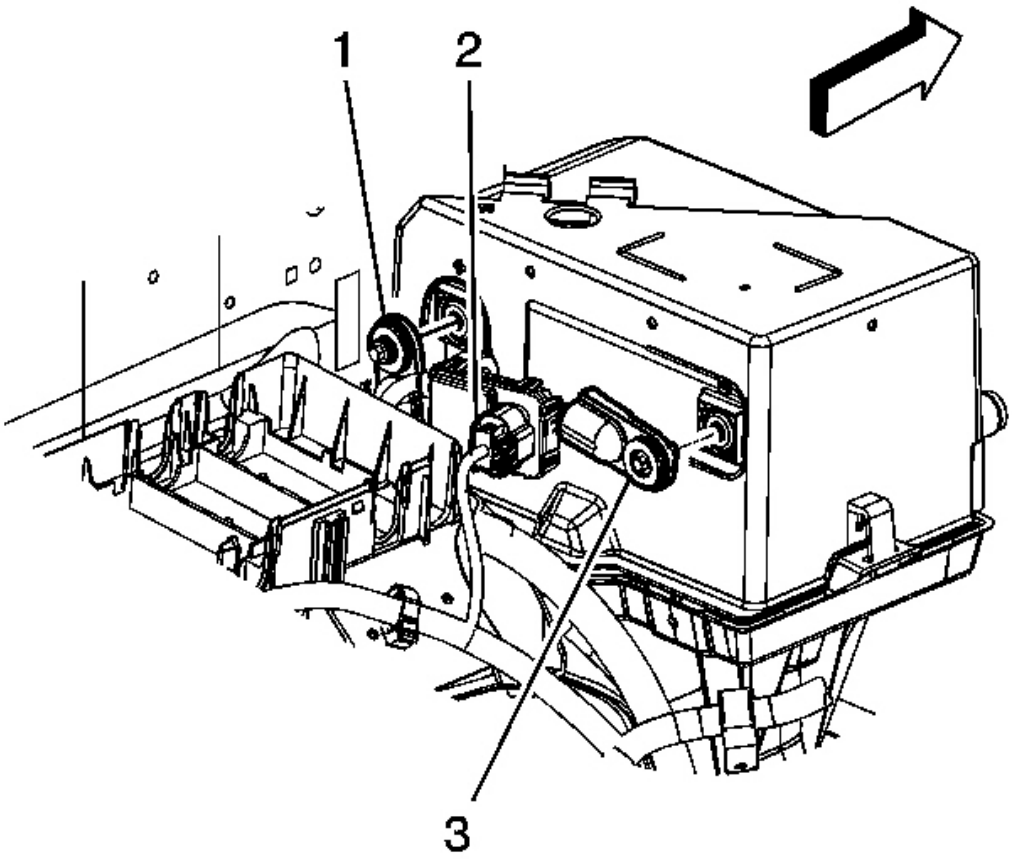


Fig. 29: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Loosen the battery positive cable bolt.
3. Remove the positive battery cable (1) from the battery.

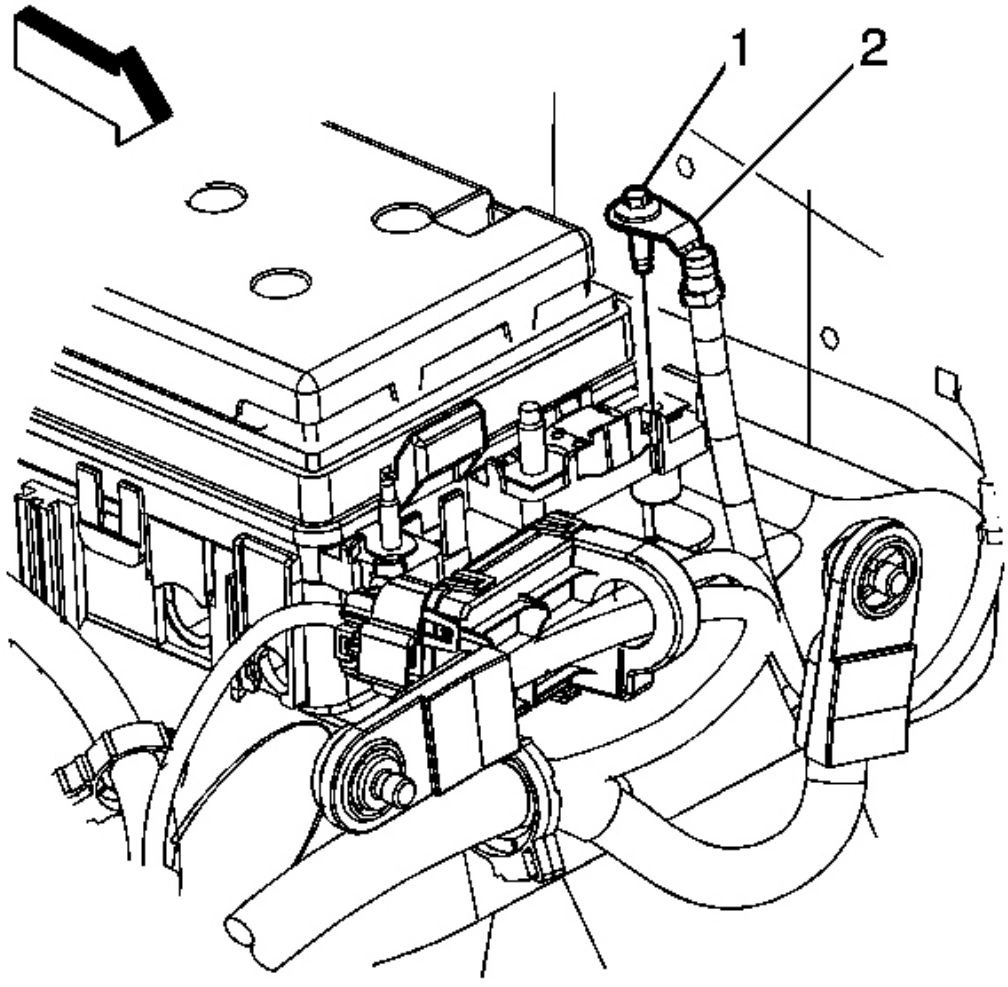


Fig. 30: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

4. Loosen the positive battery cable terminal bolt (1) at the junction block.
5. Remove the positive battery cable terminal (2) from the junction block.

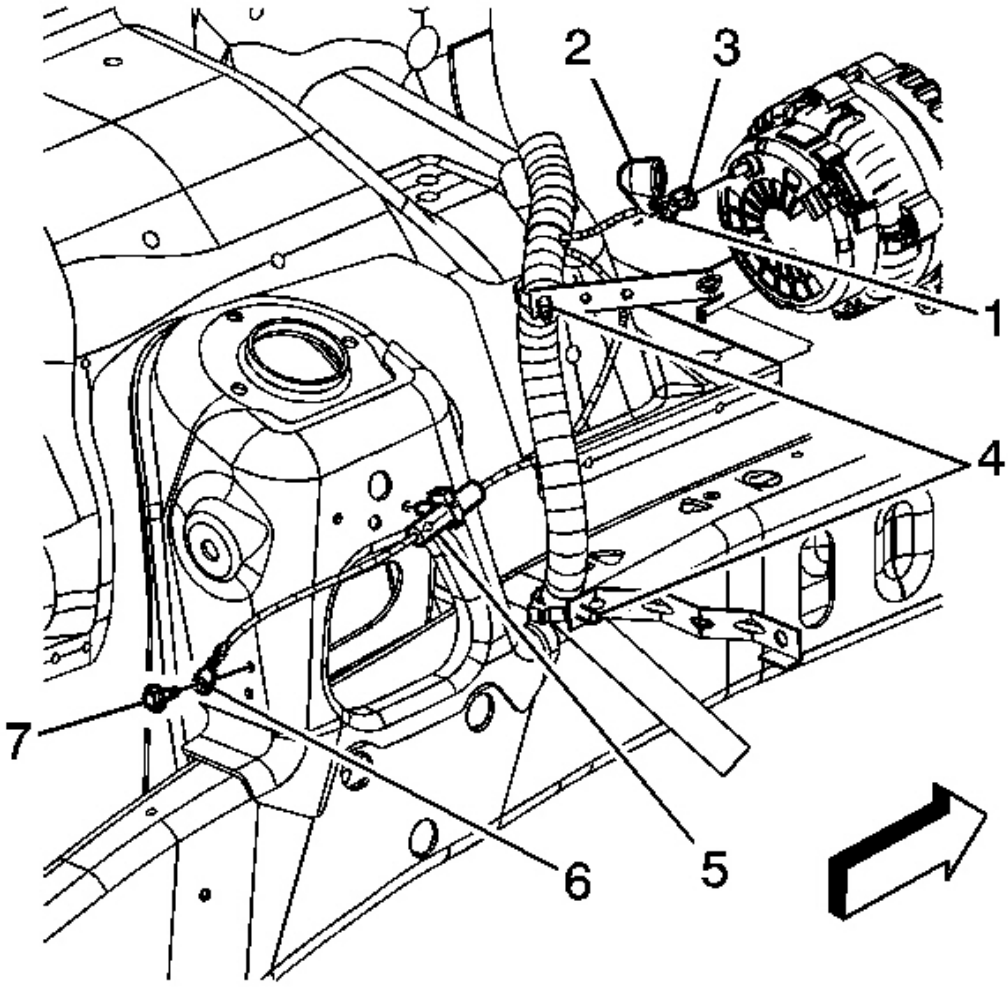


Fig. 31: View Of Negative Battery Cable Ground Terminal Components At Shock Tower
Courtesy of GENERAL MOTORS CORP.

6. Reposition the positive battery cable boot (2).
7. Remove the positive battery cable nut (1).
8. Remove the positive battery cable terminal (3) from the generator.
9. Open the clips (4) on the retaining brackets.
10. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** .

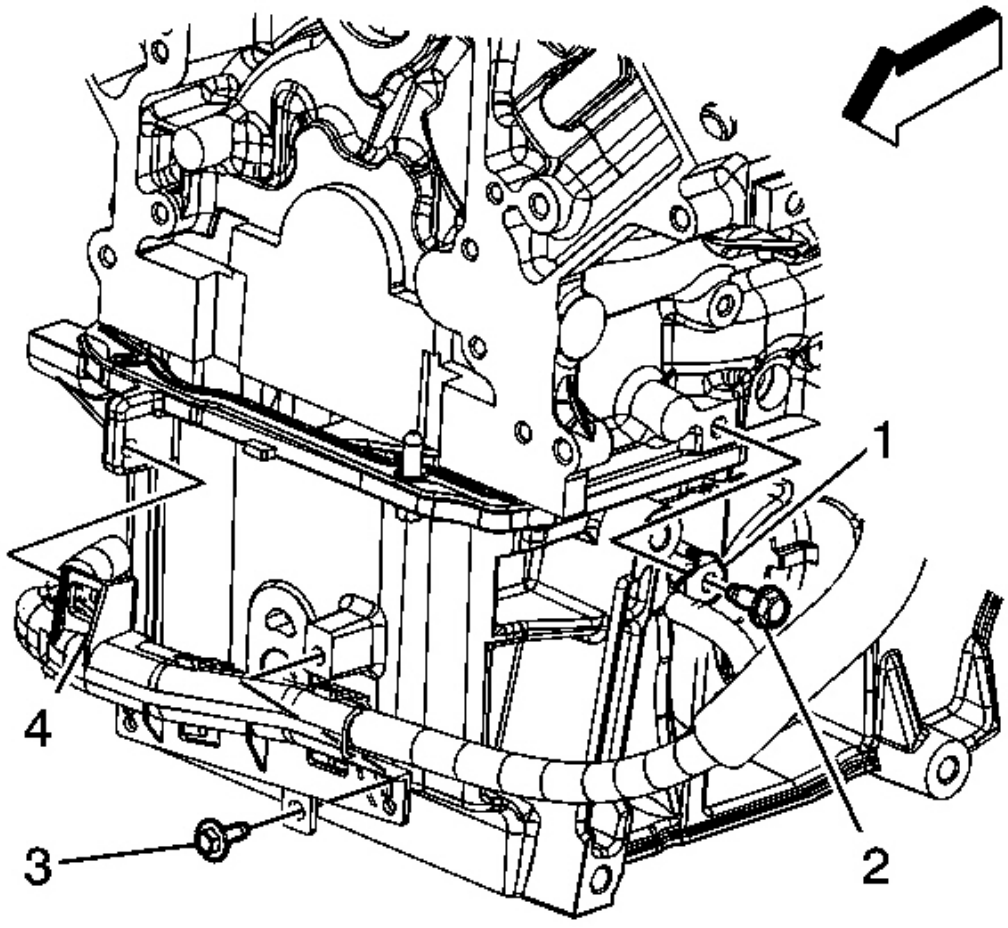


Fig. 32: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

11. Remove the positive battery cable channel bolt (3).
12. Remove the positive battery cable channel locating pin (4) from the oil pan.

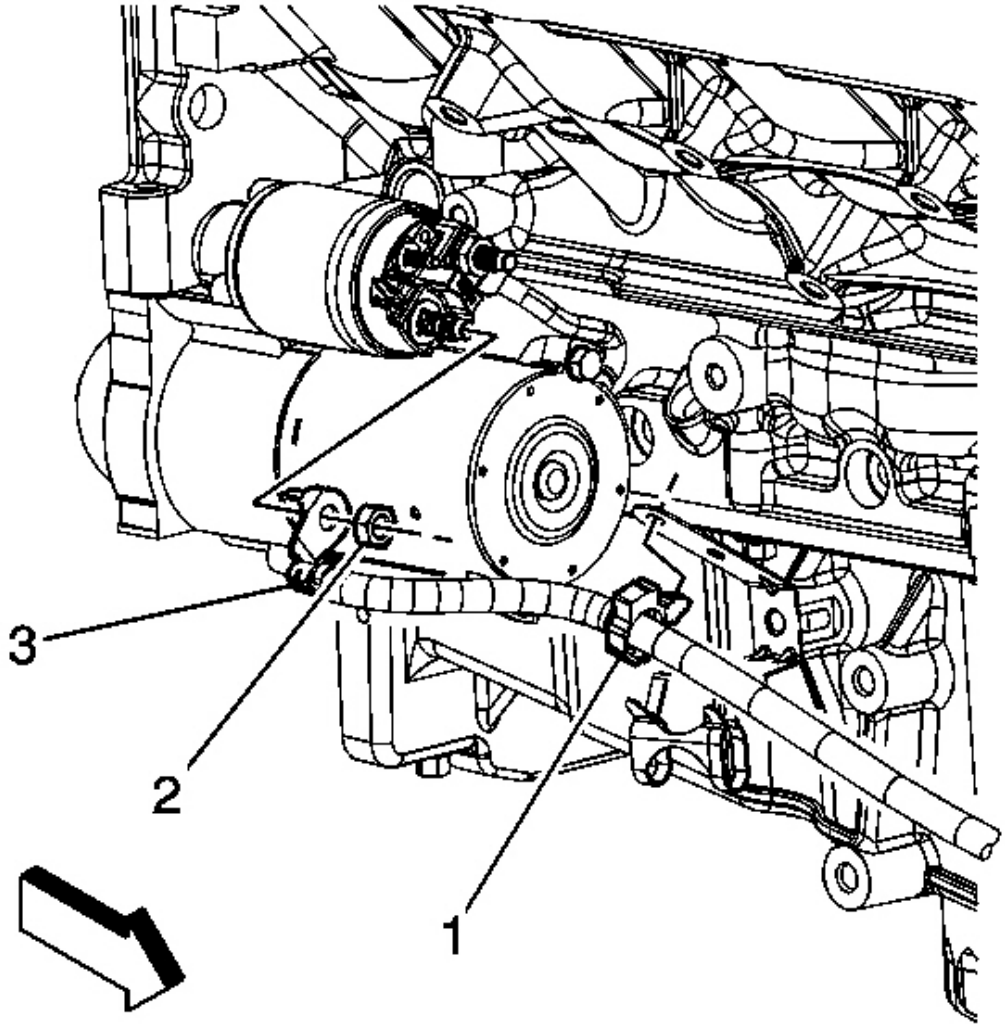


Fig. 33: View Of Cable Connections At Starter
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

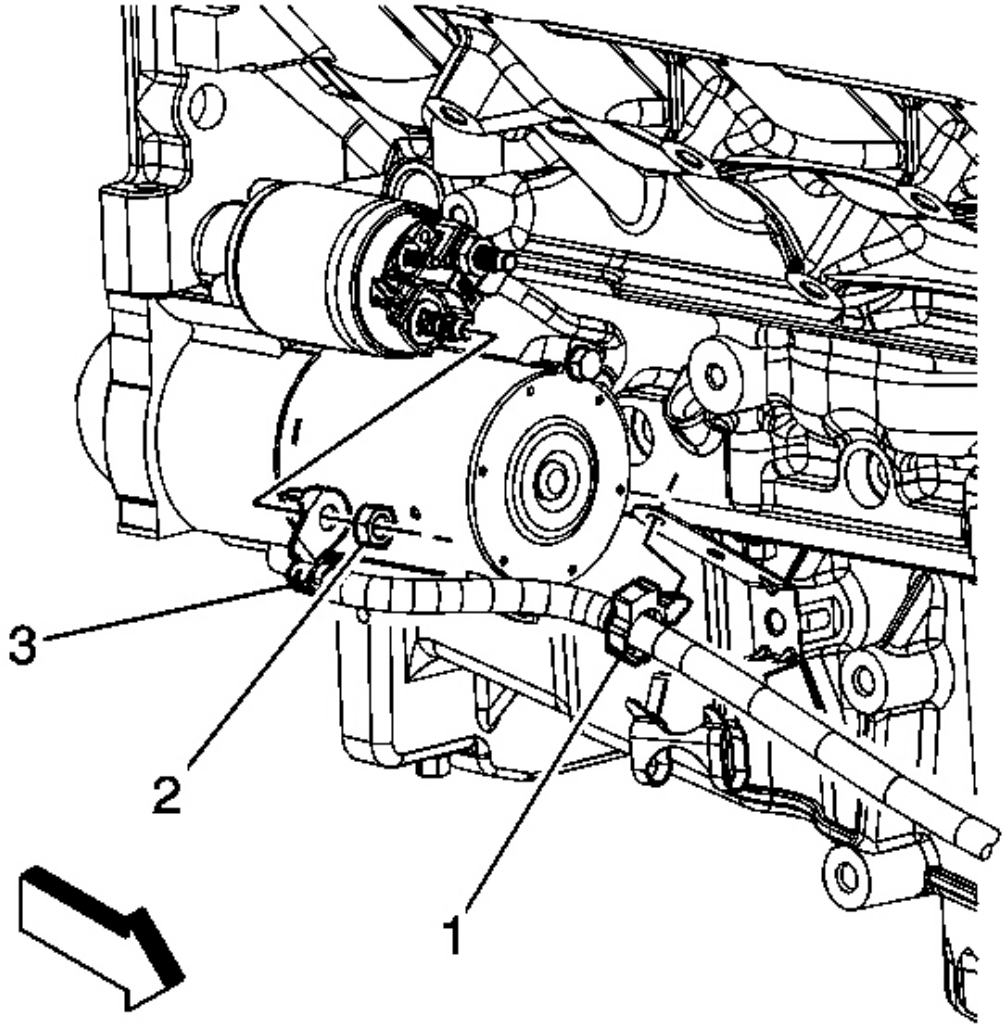


Fig. 34: View Of Cable Connections At Starter
Courtesy of GENERAL MOTORS CORP.

1. Install the positive battery cable to the conduit.
2. Install the positive battery cable terminal (3).

NOTE: Refer to Fastener Notice .

3. Install the positive battery cable terminal nut (2) to the starter.

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

4. Install the positive battery cable clip (1) to the bracket.

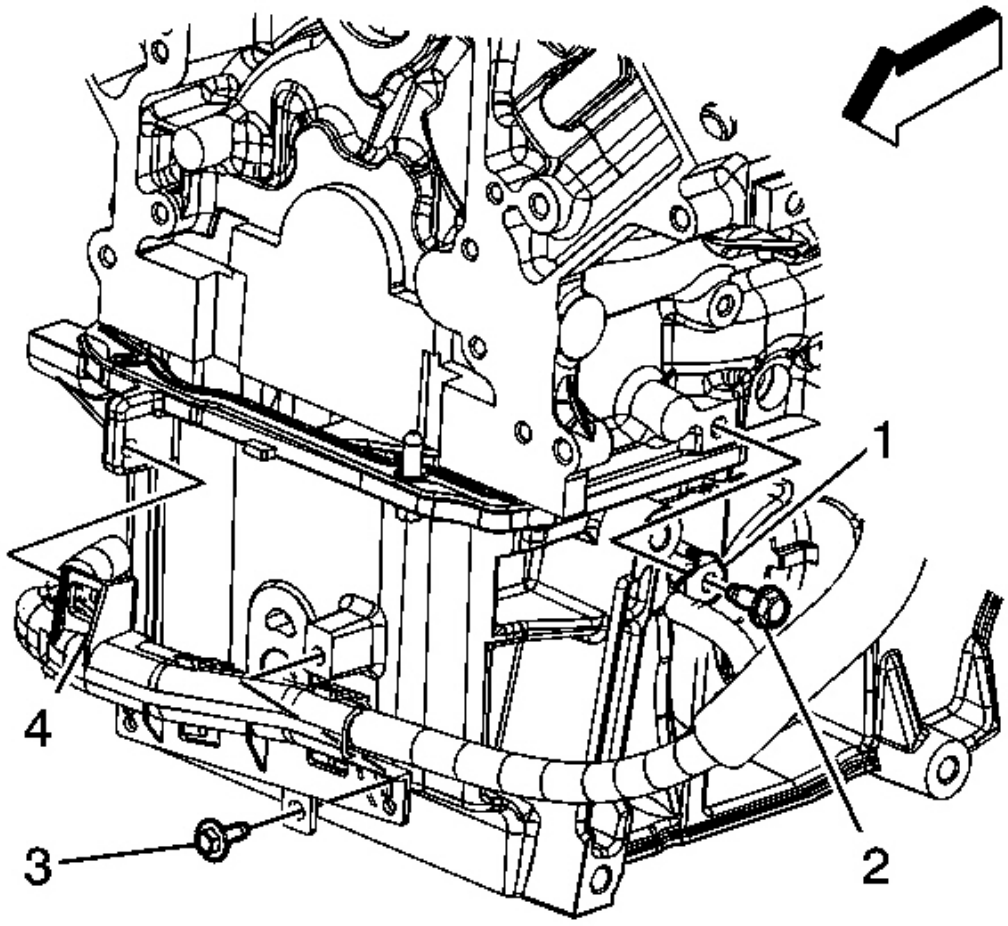


Fig. 35: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

5. Install the positive battery cable channel locating pin (4) to the oil pan.
6. Install the positive battery cable channel bolt (3).

Tighten: Tighten the bolt to 12 N.m (106 lb in).

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

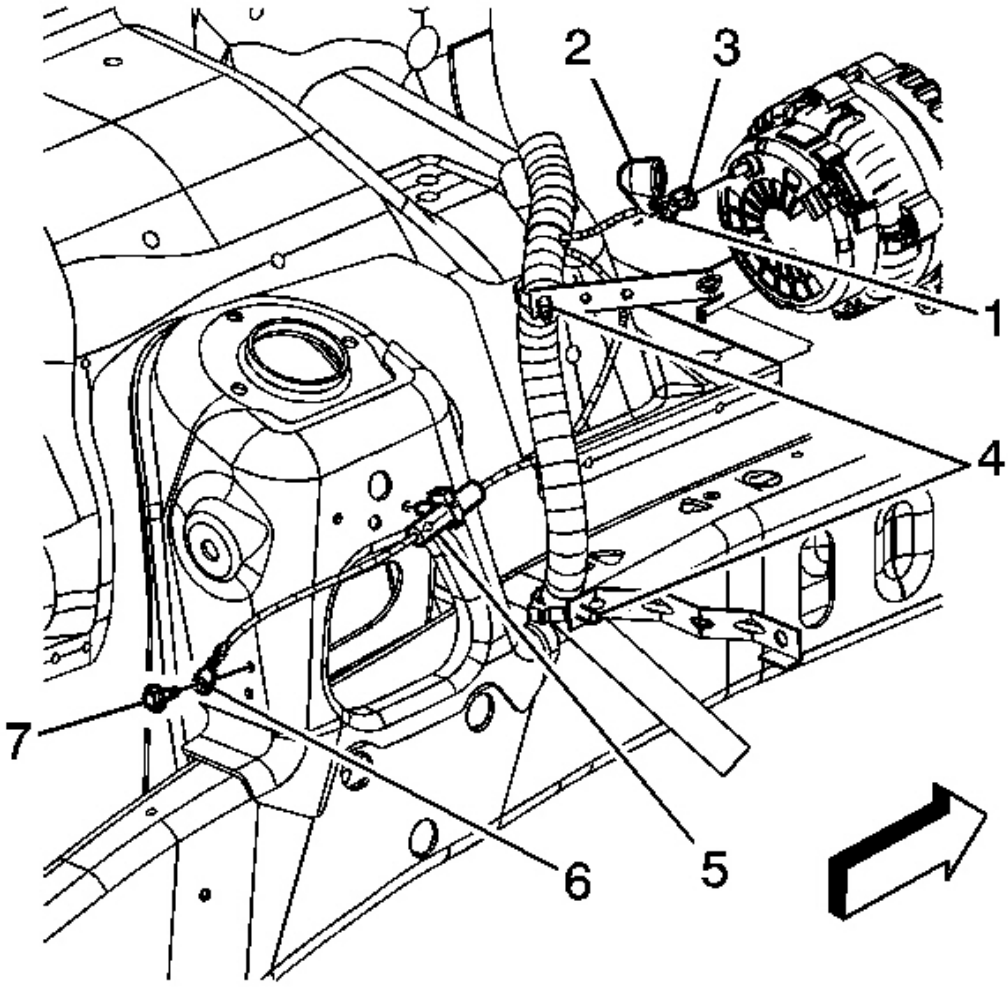


Fig. 36: View Of Negative Battery Cable Ground Terminal Components At Shock Tower
Courtesy of GENERAL MOTORS CORP.

8. Install the positive battery cable terminal (3) to the generator.
9. Install the positive battery cable nut (1).

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

10. Position the positive battery cable boot (2).
11. Close the clips (4) on the retaining brackets.

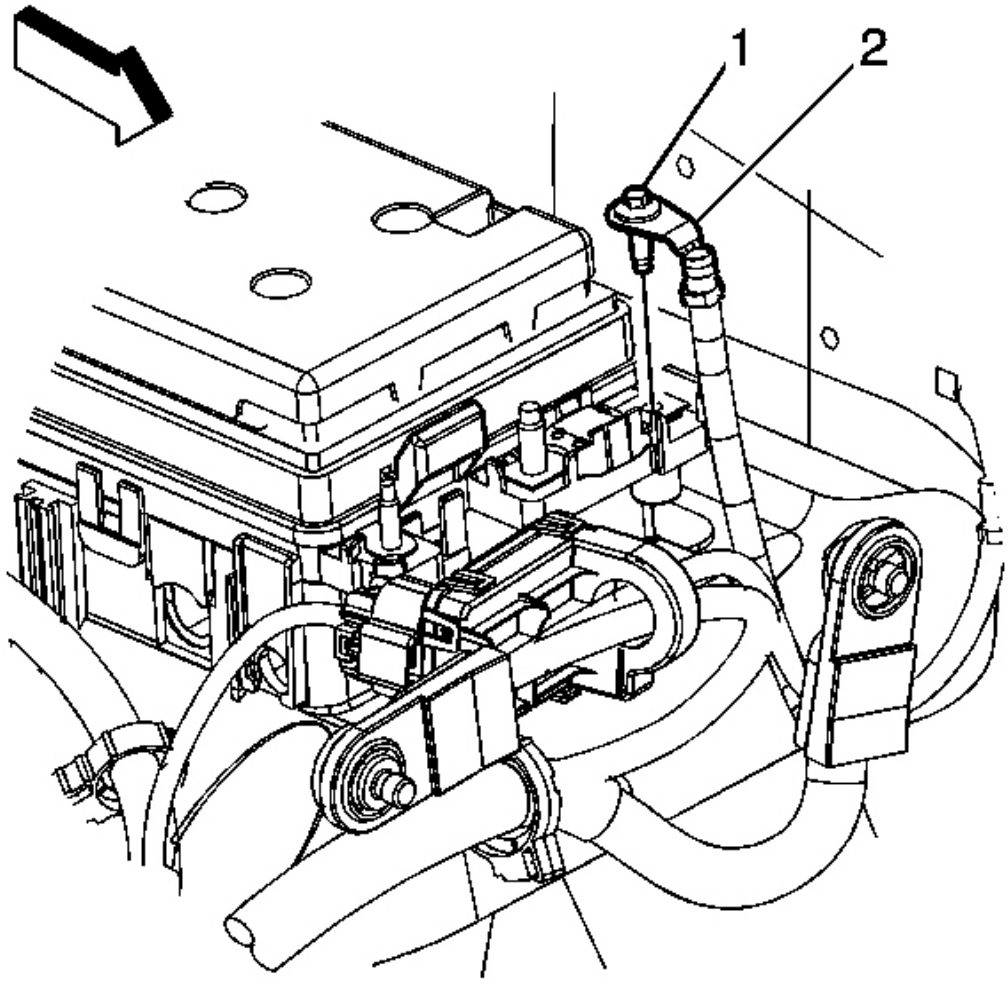


Fig. 37: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

12. Install the positive battery cable terminal (2) to the junction block.
13. Tighten the positive battery cable terminal bolt (1) at the junction block.

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

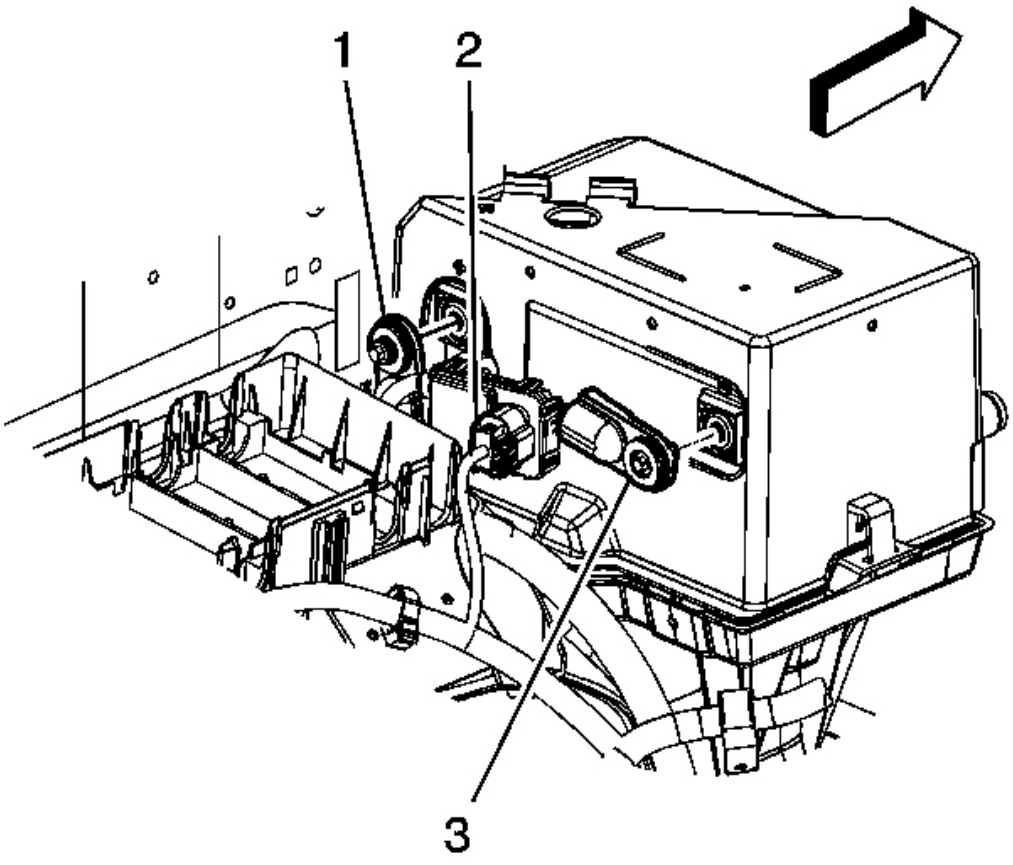


Fig. 38: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

14. Position the positive battery cable (1) to the battery.
15. Tighten the battery positive cable bolt.

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

16. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY REPLACEMENT

Removal Procedure

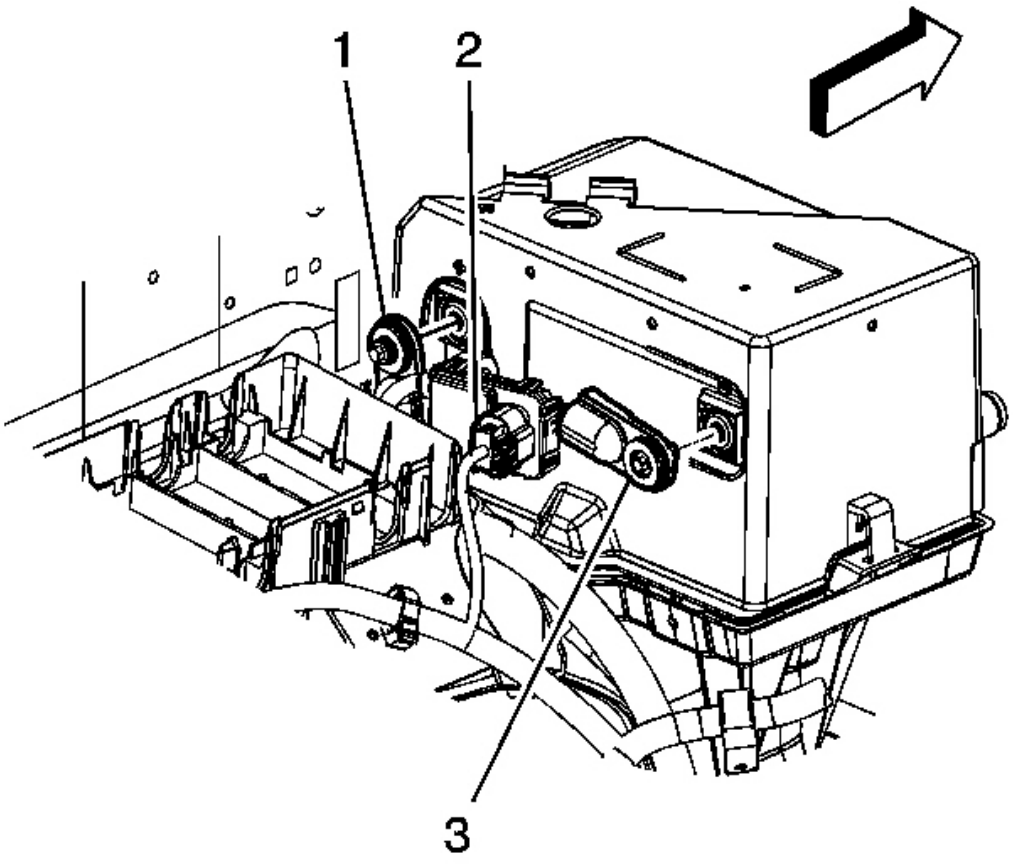


Fig. 39: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Loosen the positive battery cable bolt.
3. Remove the positive battery cable (1) from the battery.

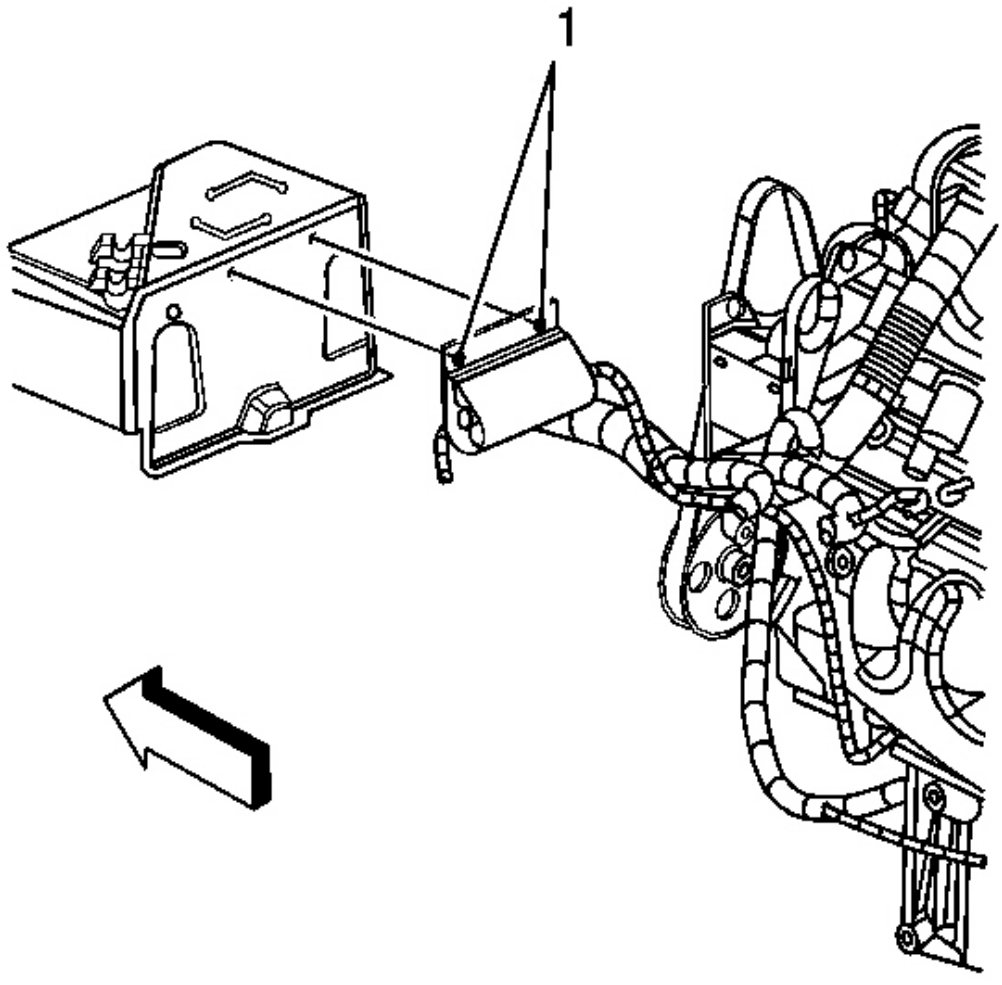


Fig. 40: View Of Coolant Heater Cord Retainers
Courtesy of GENERAL MOTORS CORP.

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

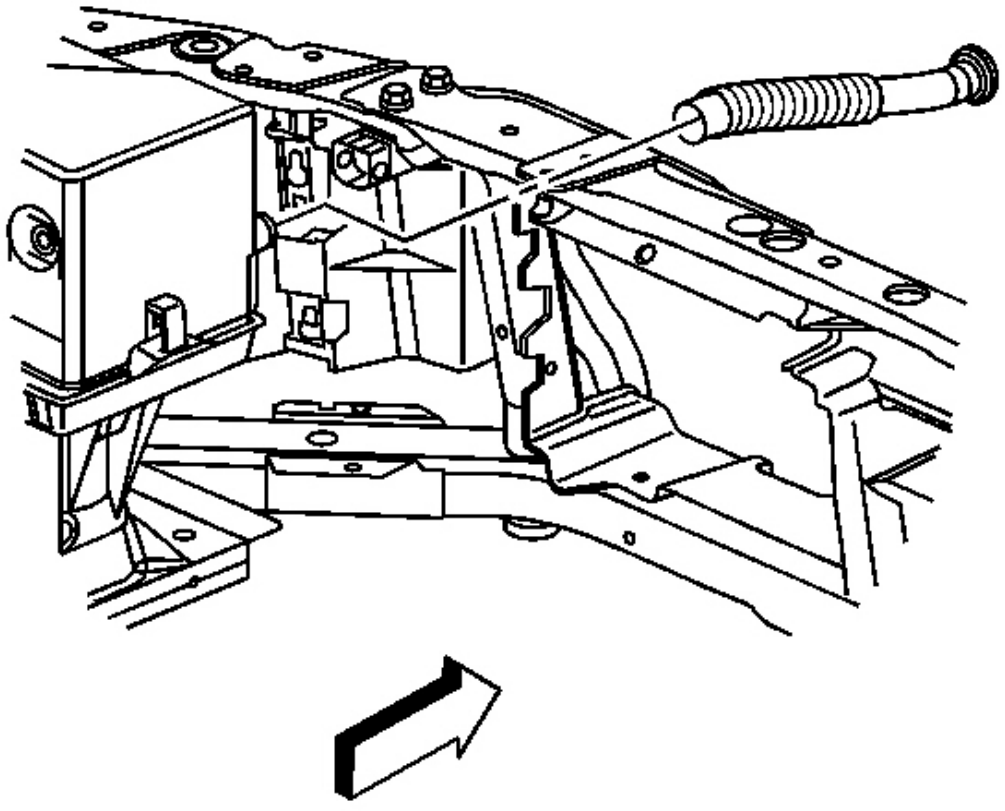


Fig. 41: View Of Battery Air Duct
Courtesy of GENERAL MOTORS CORP.

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

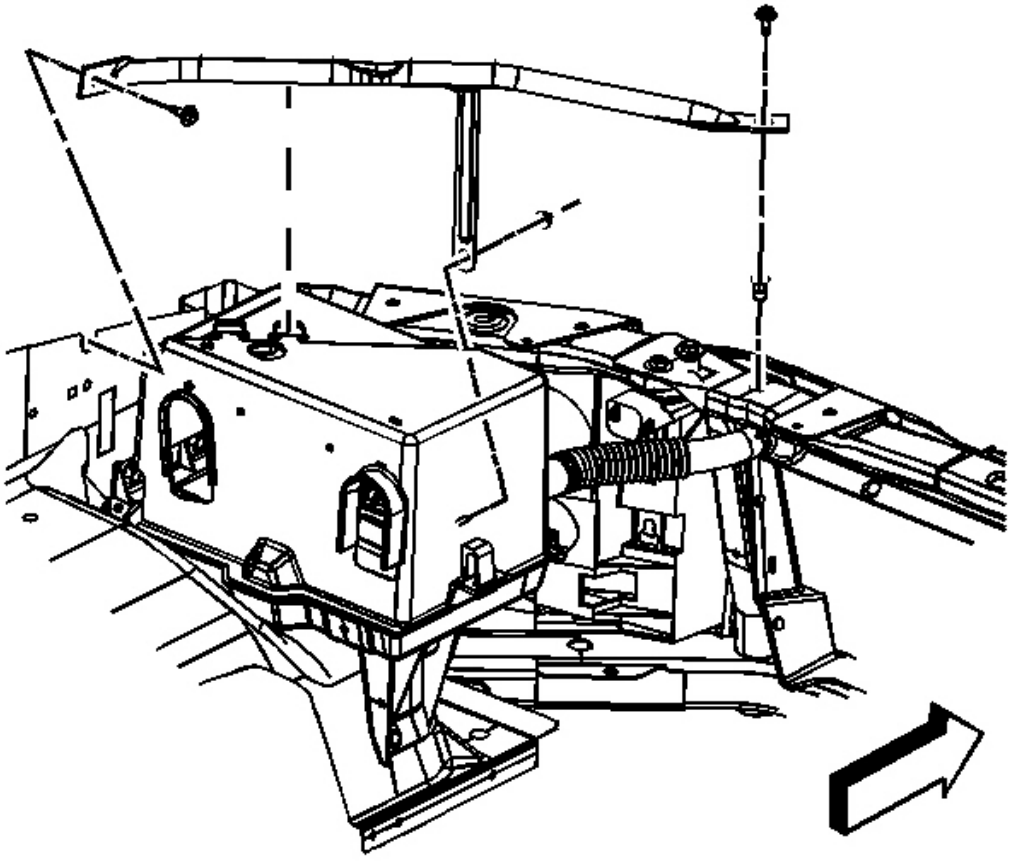


Fig. 42: View Of Radiator Support Diagonal Brace
Courtesy of GENERAL MOTORS CORP.

6. Remove the battery tray brace bolts/nut.

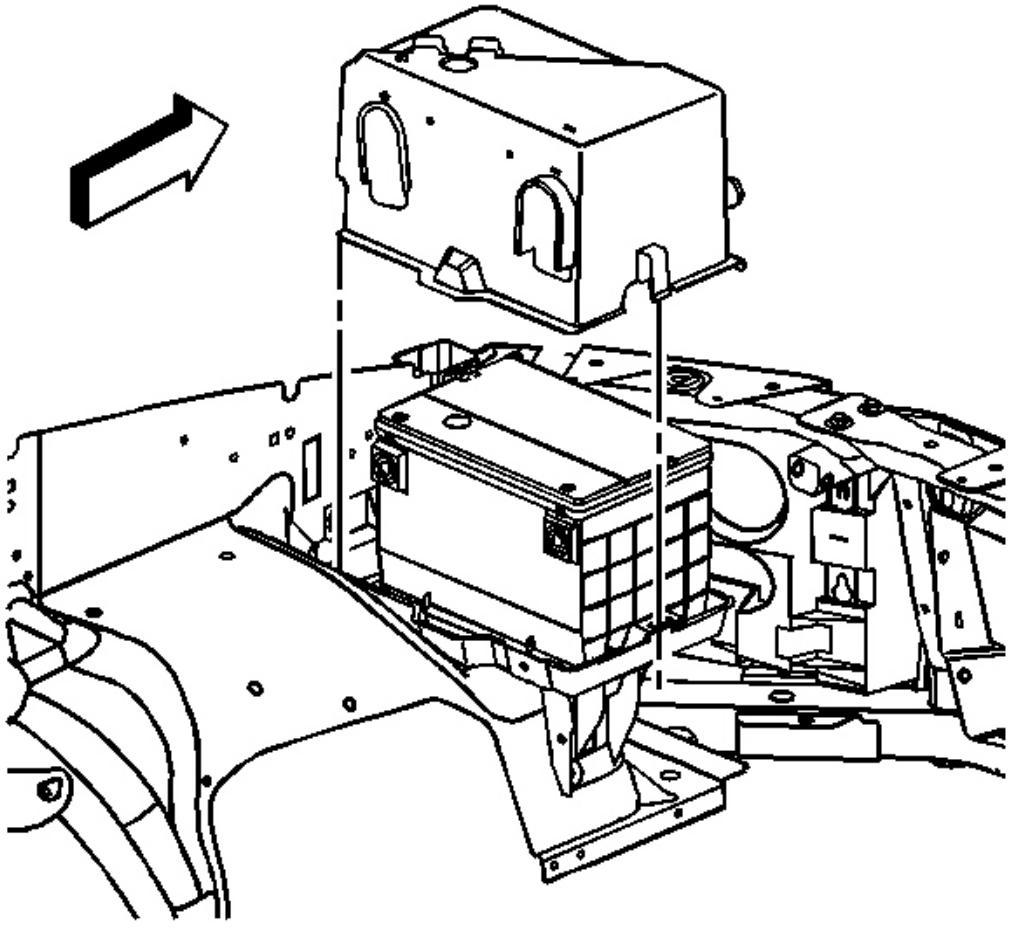


Fig. 43: View Of Battery Cover
Courtesy of GENERAL MOTORS CORP.

7. Remove the battery cover.

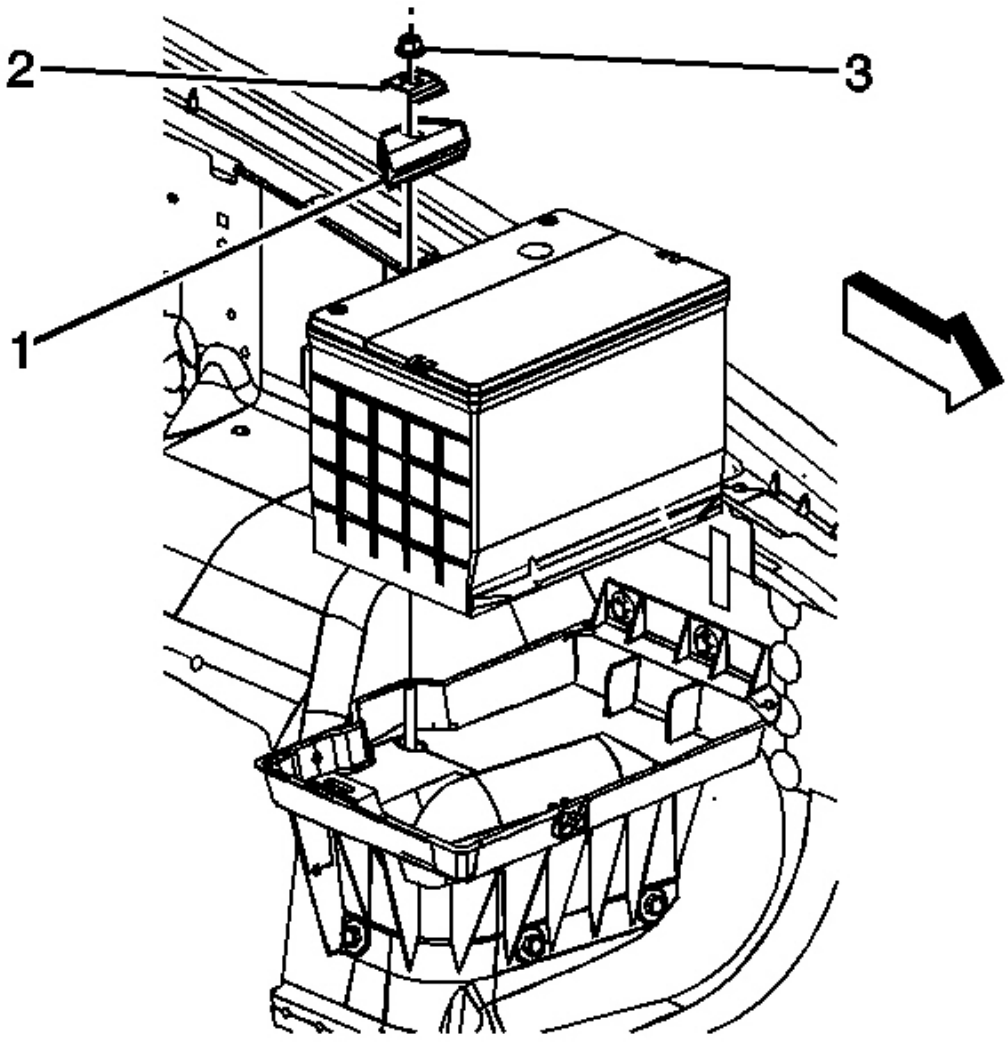


Fig. 44: View Of Battery Hold Down Nut, Washer & Retainer
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

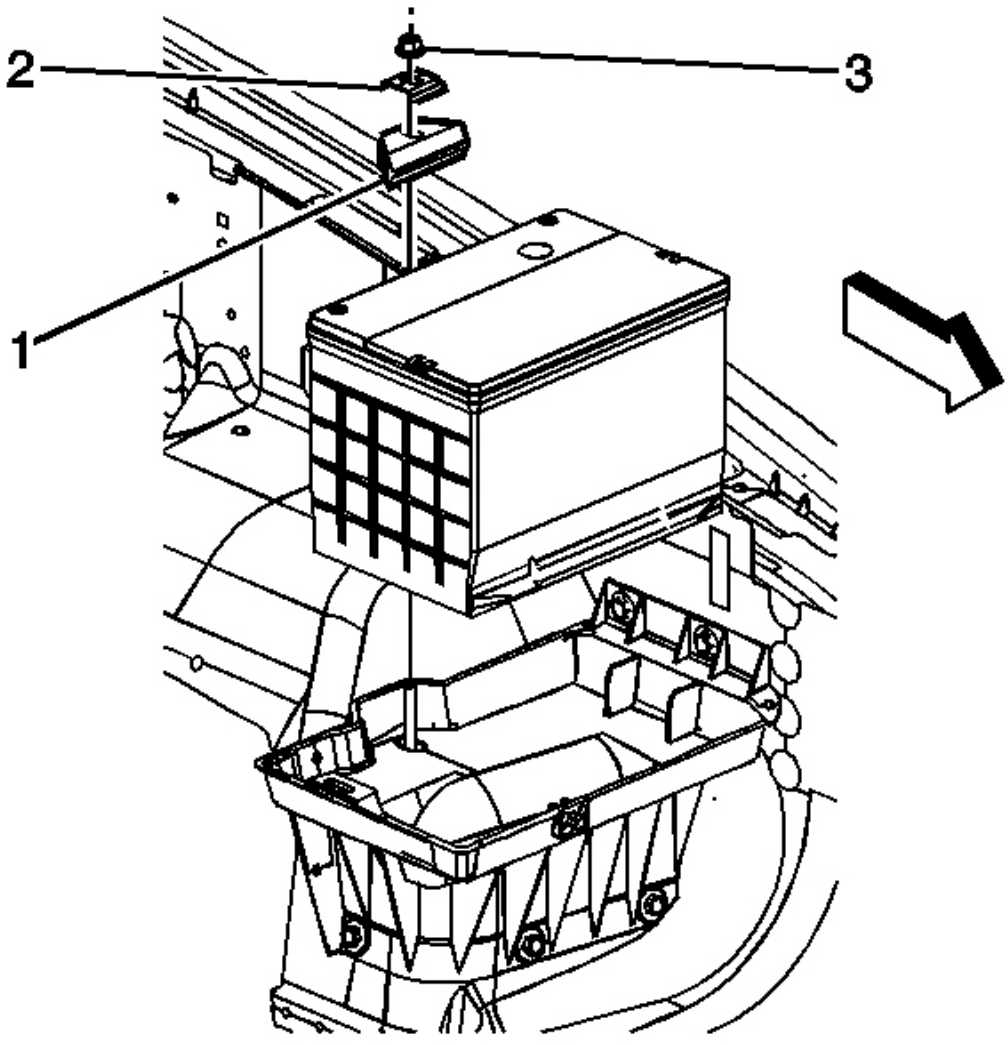


Fig. 45: View Of Battery Hold Down Nut, Washer & Retainer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

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

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

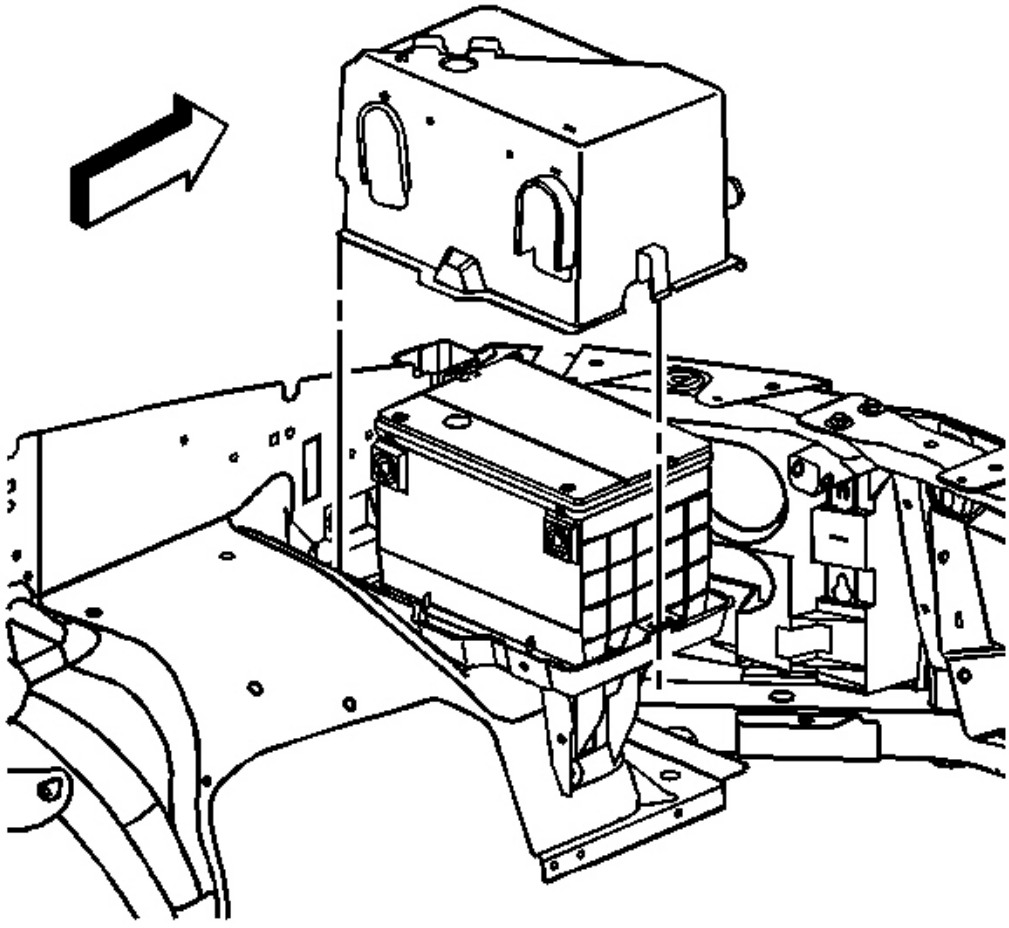


Fig. 46: View Of Battery Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the battery cover.

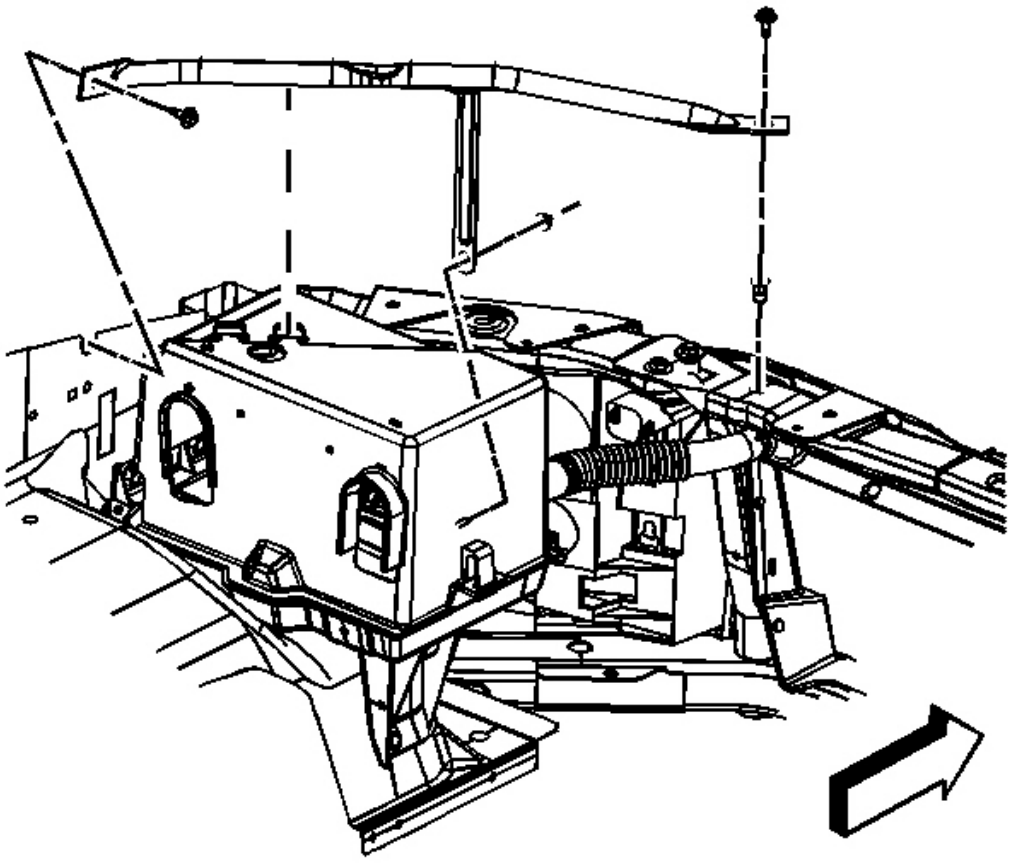


Fig. 47: View Of Radiator Support Diagonal Brace
Courtesy of GENERAL MOTORS CORP.

4. Install the battery tray brace bolts/nut.

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

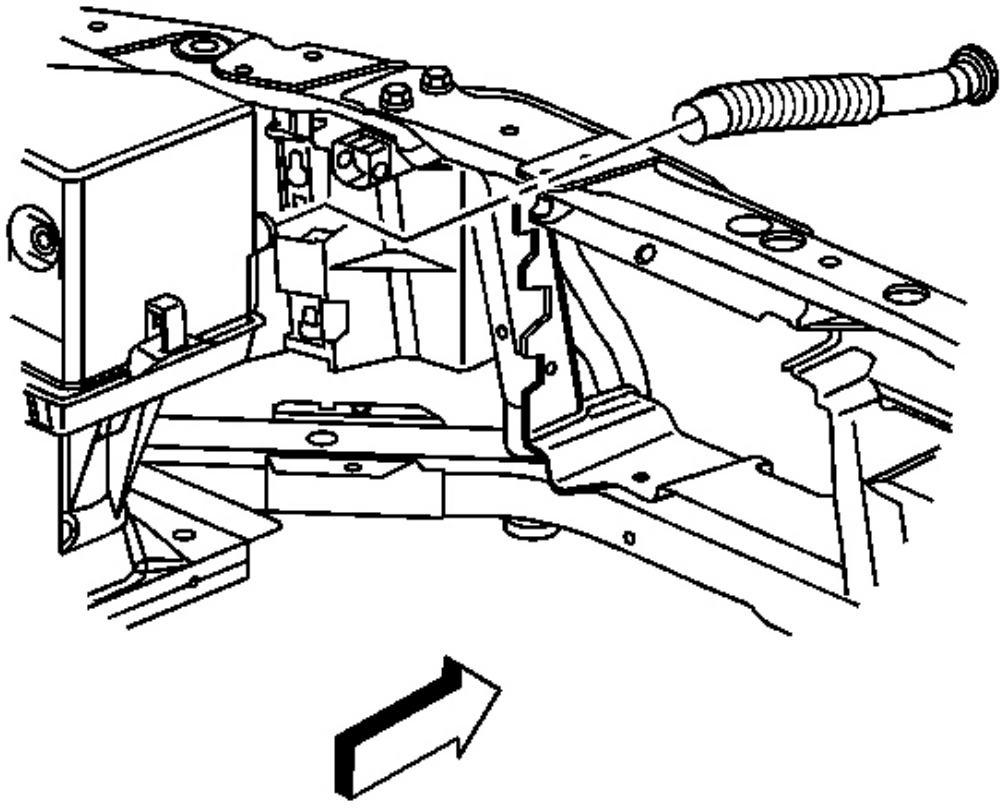


Fig. 48: View Of Battery Air Duct
Courtesy of GENERAL MOTORS CORP.

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

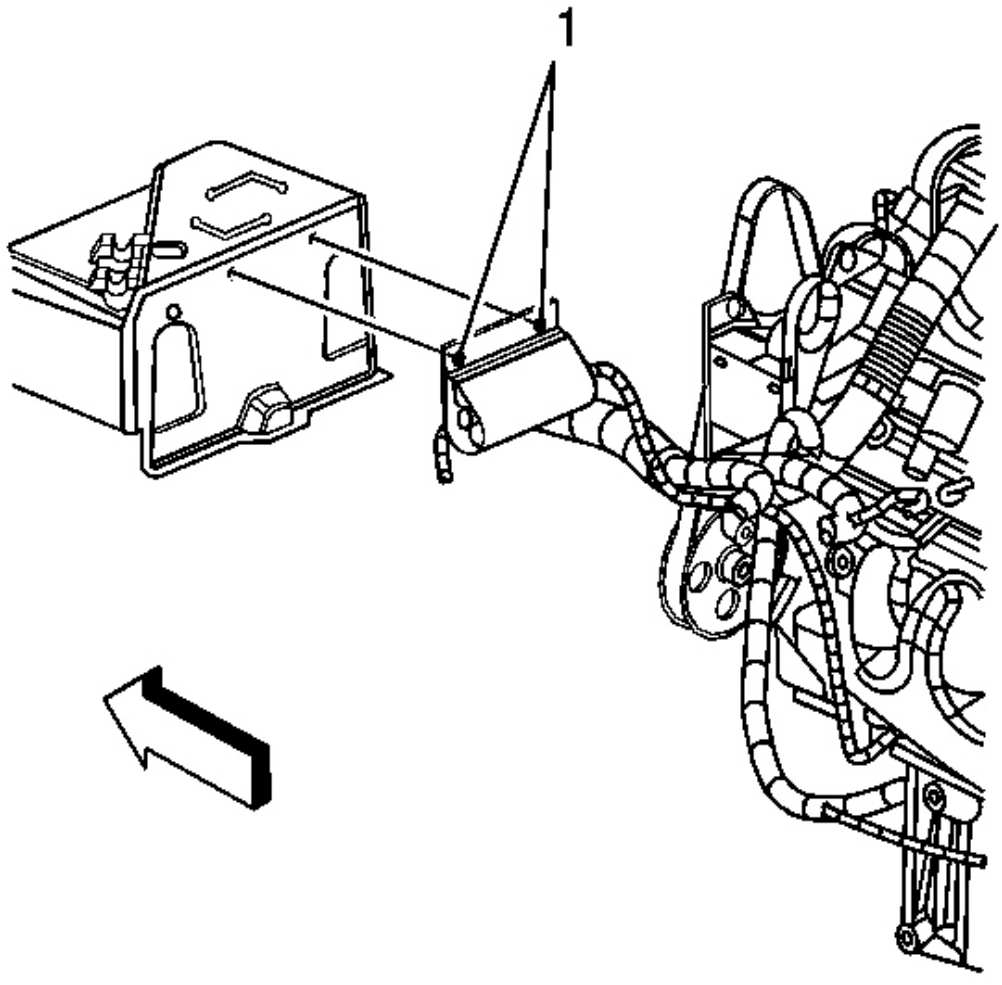


Fig. 49: View Of Coolant Heater Cord Retainers
Courtesy of GENERAL MOTORS CORP.

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

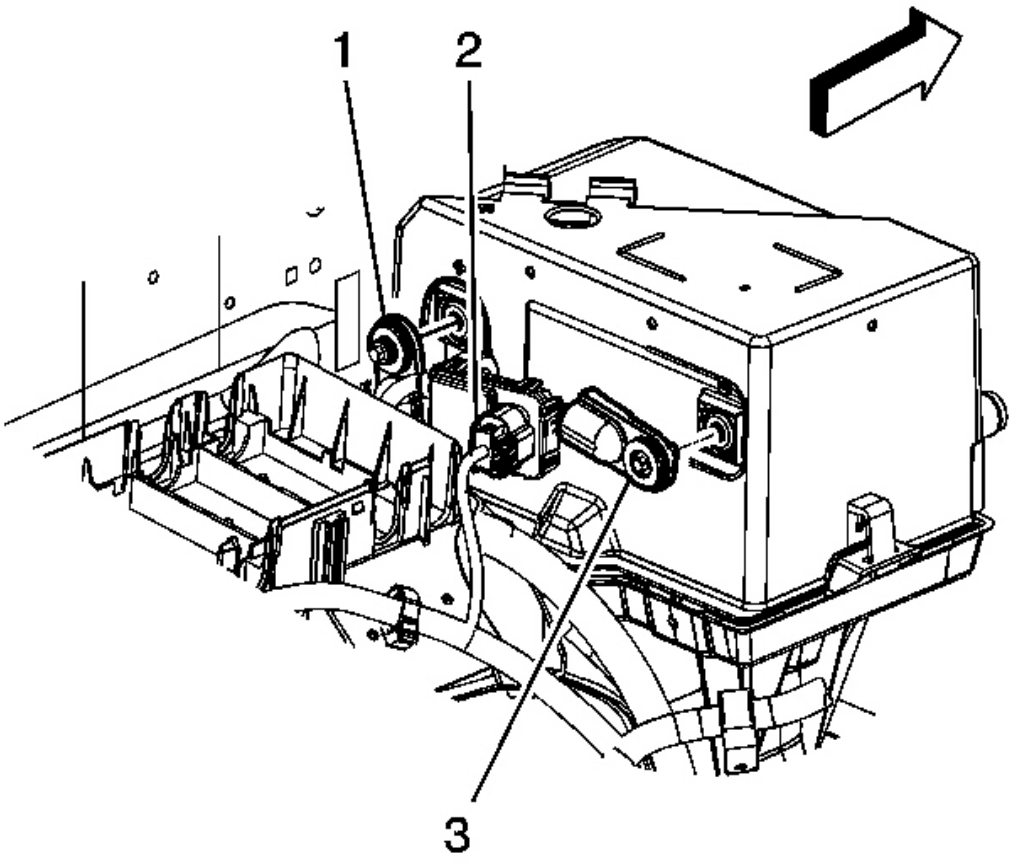


Fig. 50: View Of Battery, Cables & Battery Control Module
Courtesy of GENERAL MOTORS CORP.

7. Position the positive battery cable (1) to the battery.
8. Tighten the positive battery cable bolt.

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

9. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY TRAY REPLACEMENT

Removal Procedure

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

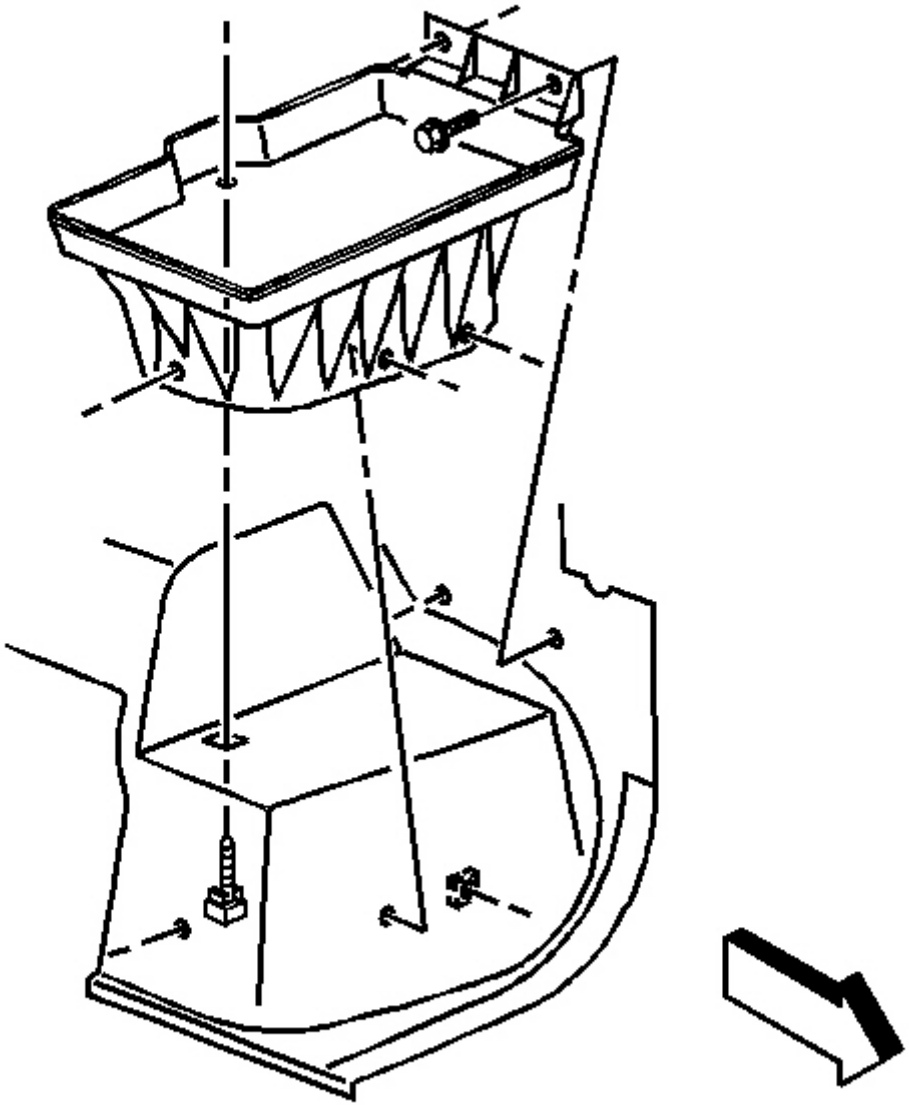


Fig. 51: View Of Battery Tray Bolts
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

1. Install the battery tray.

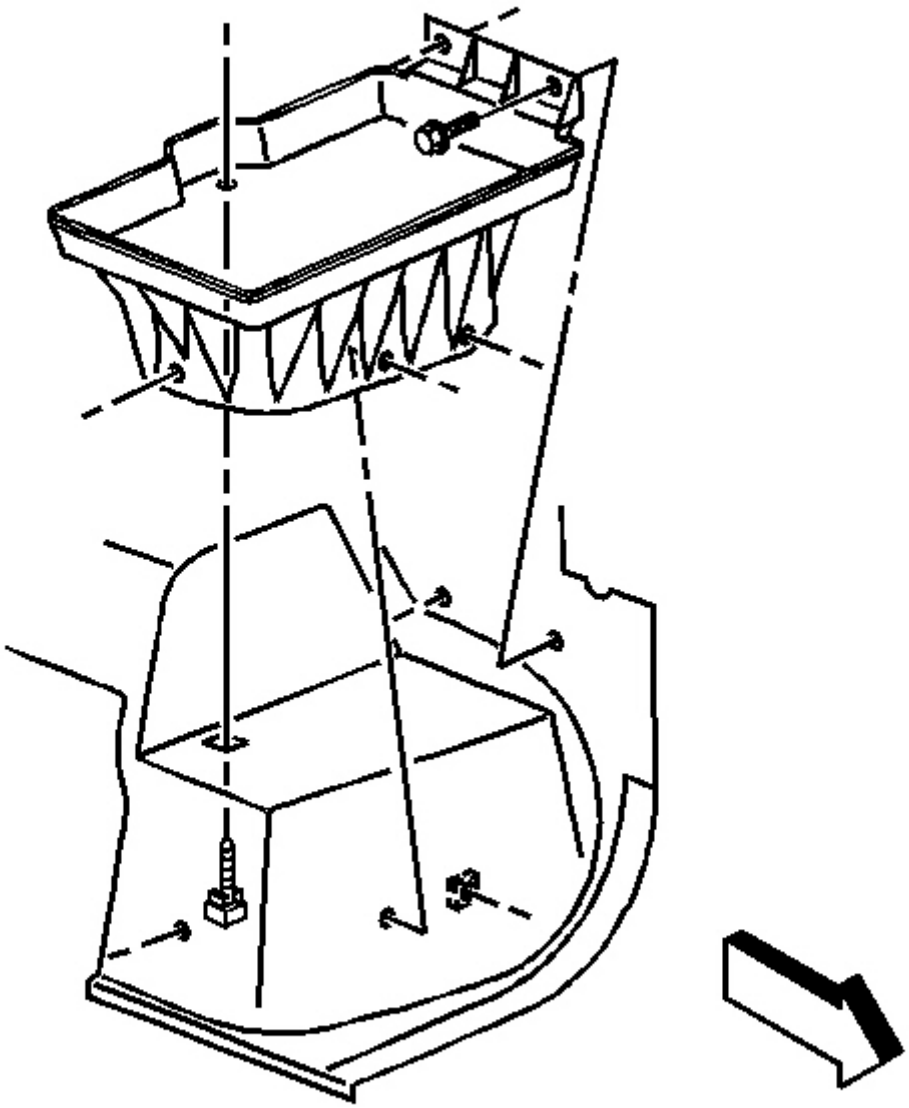


Fig. 52: View Of Battery Tray Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

2. Install the 5 bolts to the battery tray.

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

3. Install the battery.

STARTER MOTOR REPLACEMENT (4.2L ENGINE)

Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the vacuum brake booster hose. Refer to **Vacuum Brake Booster Check Valve and/or Hose Replacement** .

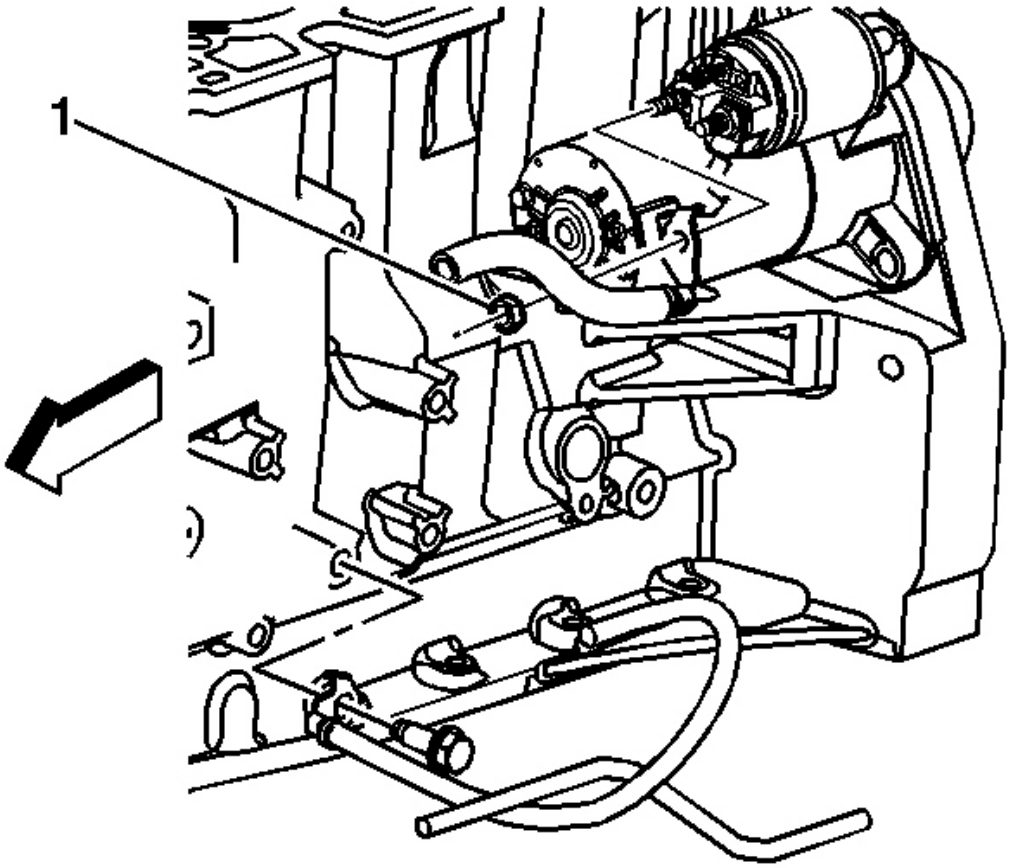


Fig. 53: View Of Starter & Related Components

Courtesy of GENERAL MOTORS CORP.

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

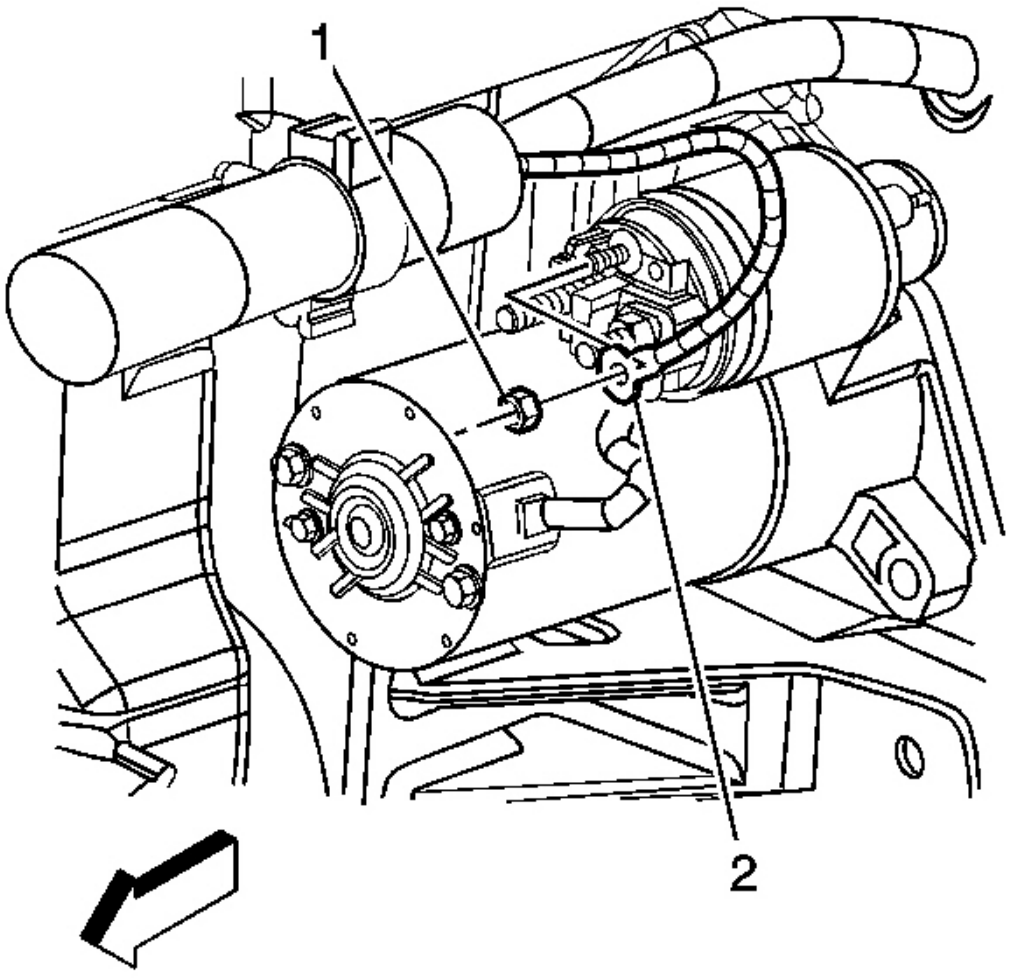


Fig. 54: View Of Starter Solenoid S-Terminal Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

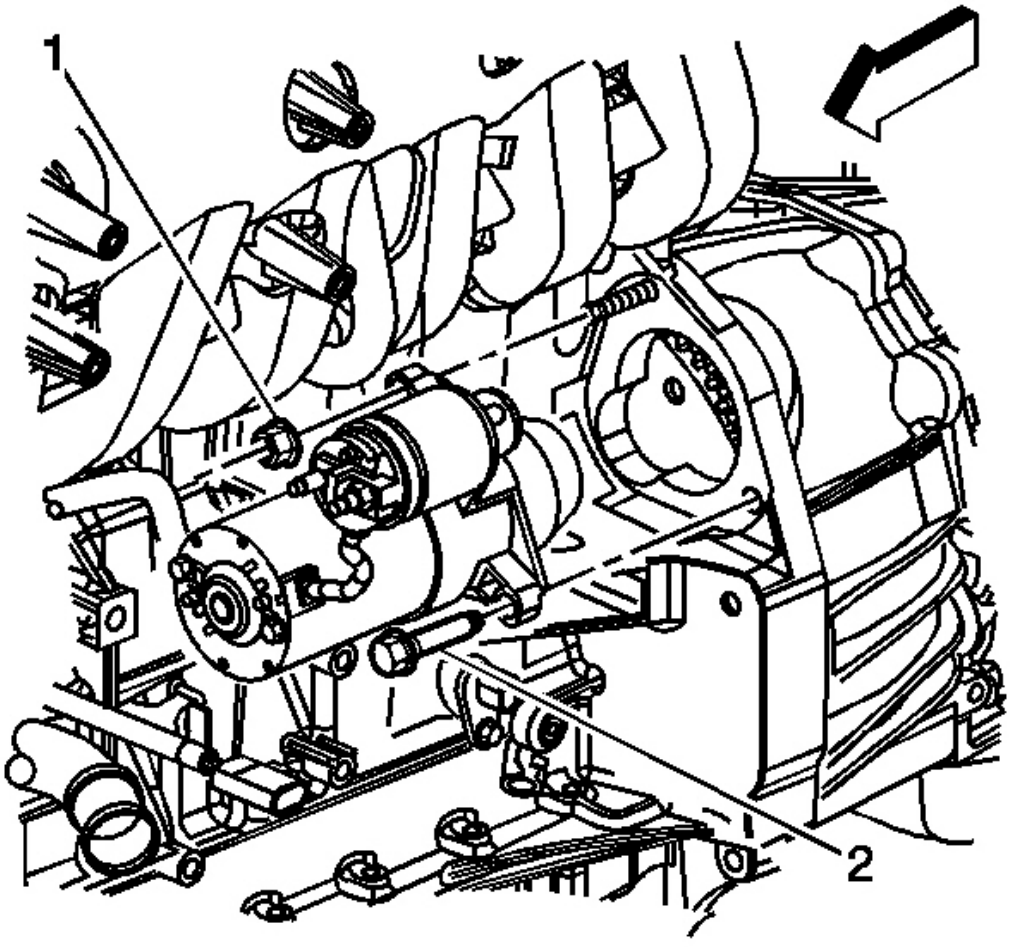


Fig. 55: View Of Starter Mount Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

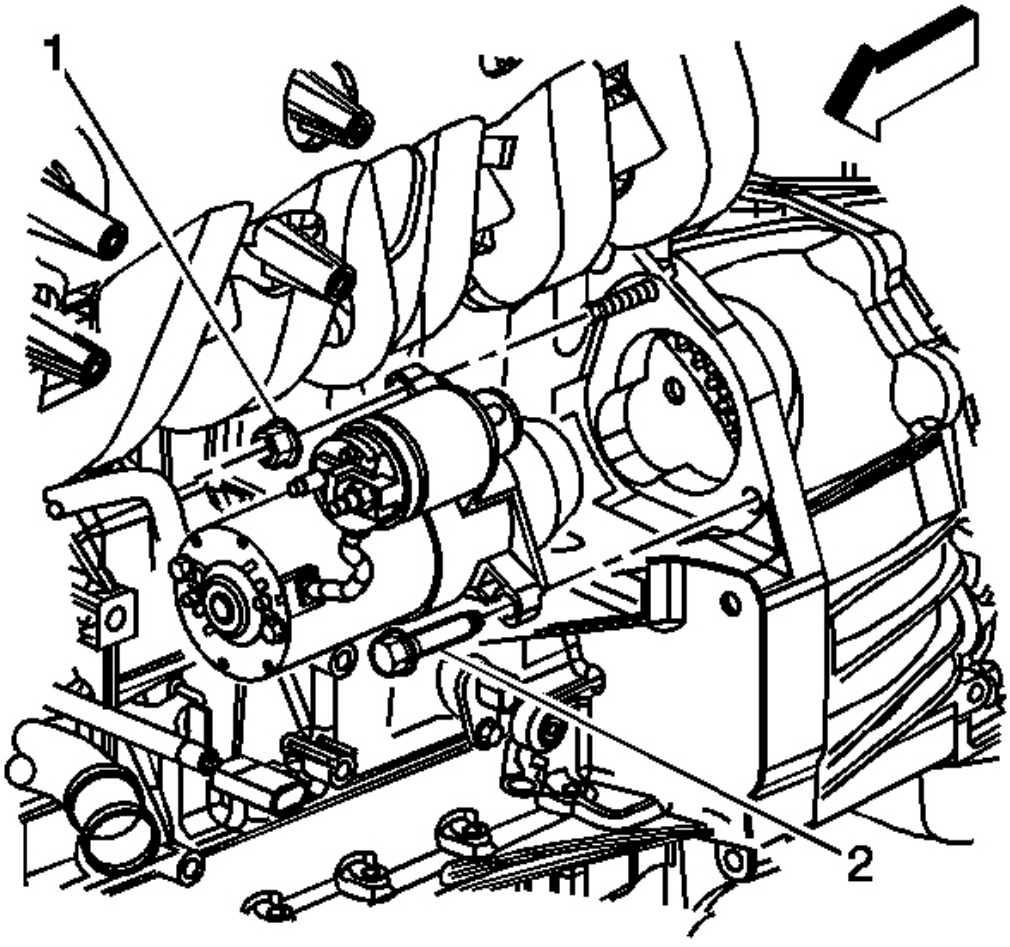


Fig. 56: View Of Starter Mount Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

1. Install the starter motor.

NOTE: **Refer to Fastener Notice .**

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

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

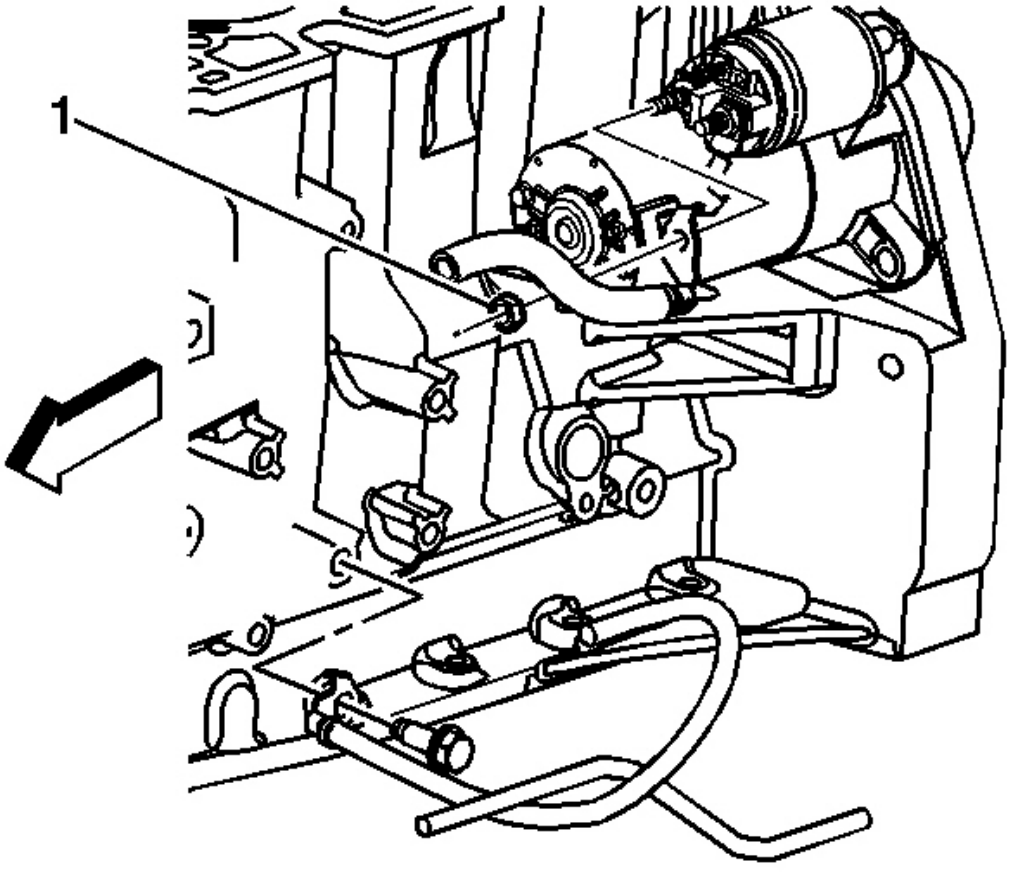


Fig. 57: View Of Starter & Related Components
Courtesy of GENERAL MOTORS CORP.

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

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

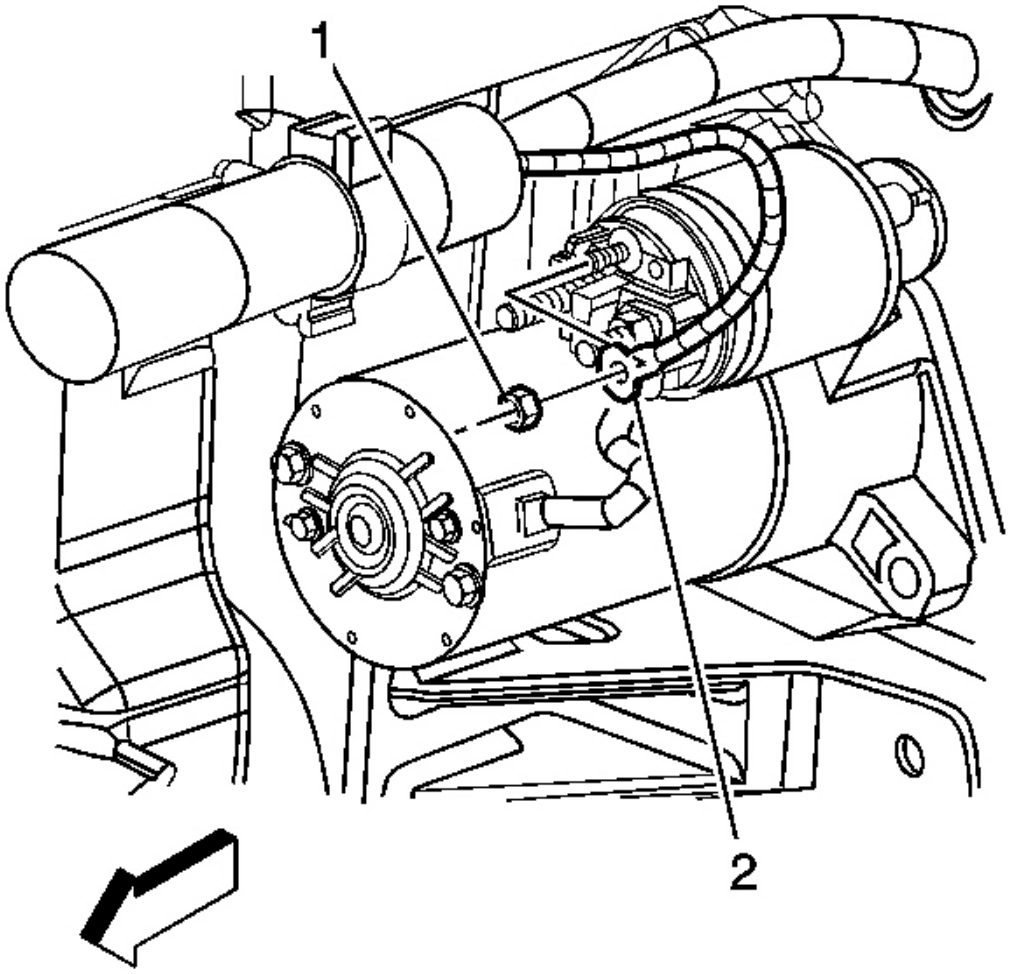


Fig. 58: View Of Starter Solenoid S-Terminal Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

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

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

STARTER MOTOR REPLACEMENT (5.3L & 6.0L ENGINES)

Removal Procedure

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

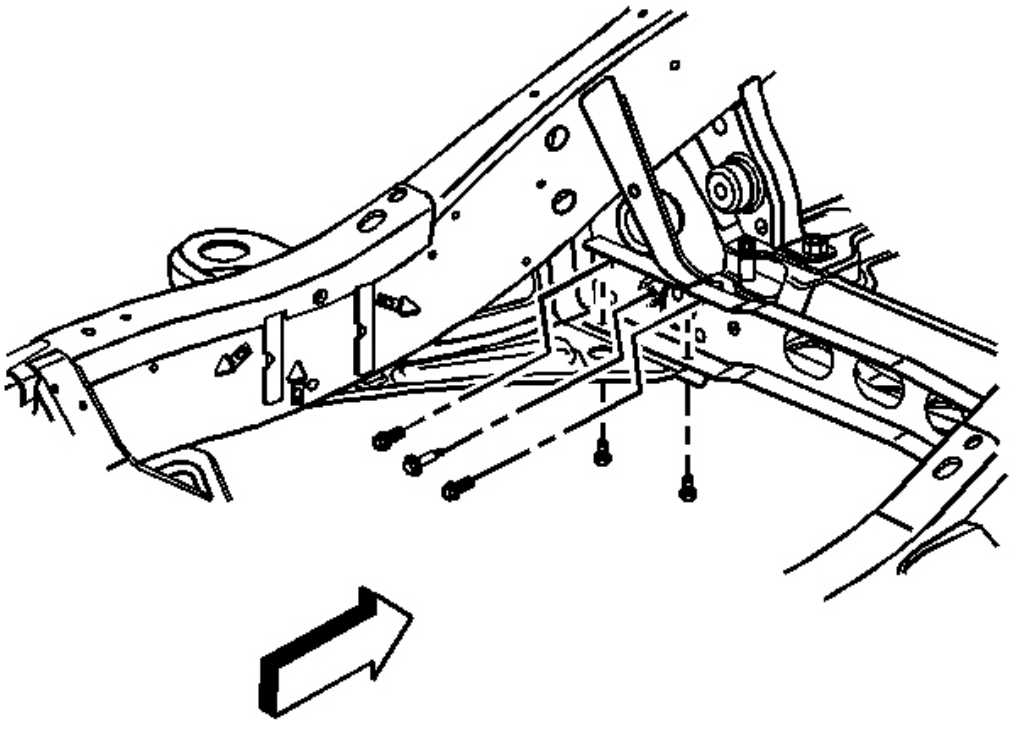


Fig. 59: Identifying Rear Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

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

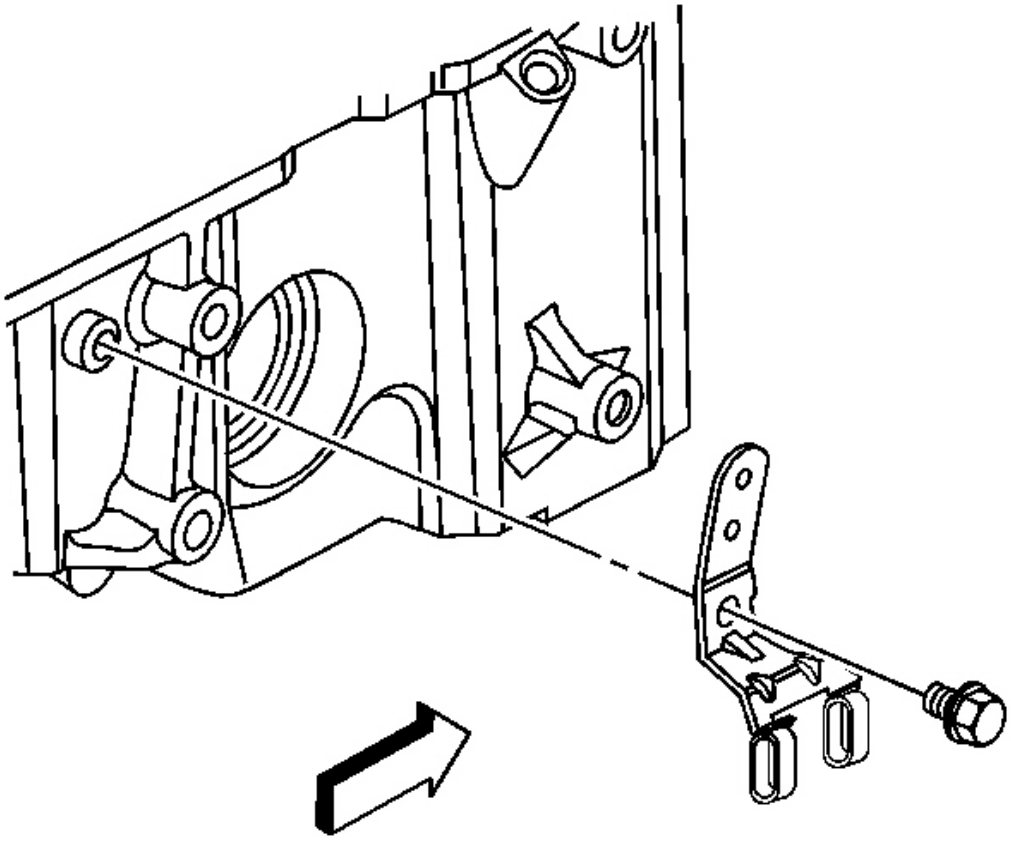


Fig. 60: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the transmission oil cooler line bracket bolt.

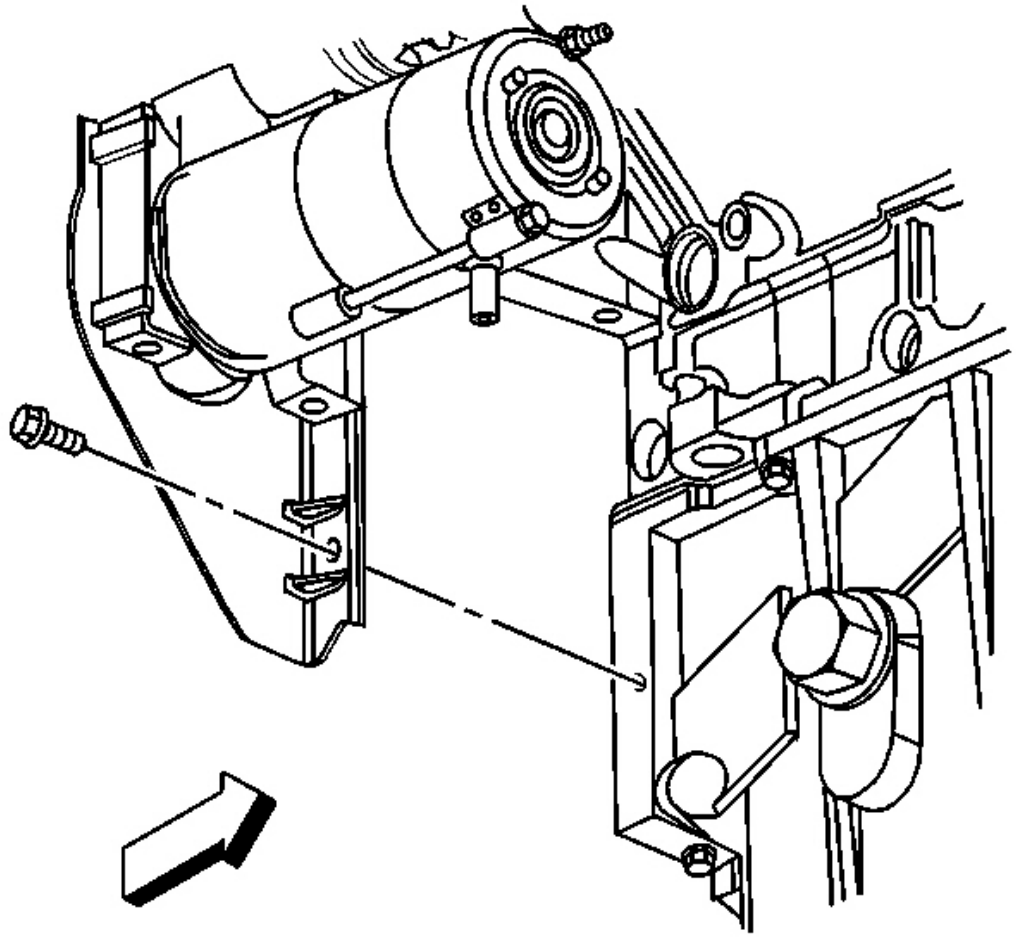


Fig. 61: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the right transmission cover bolt.

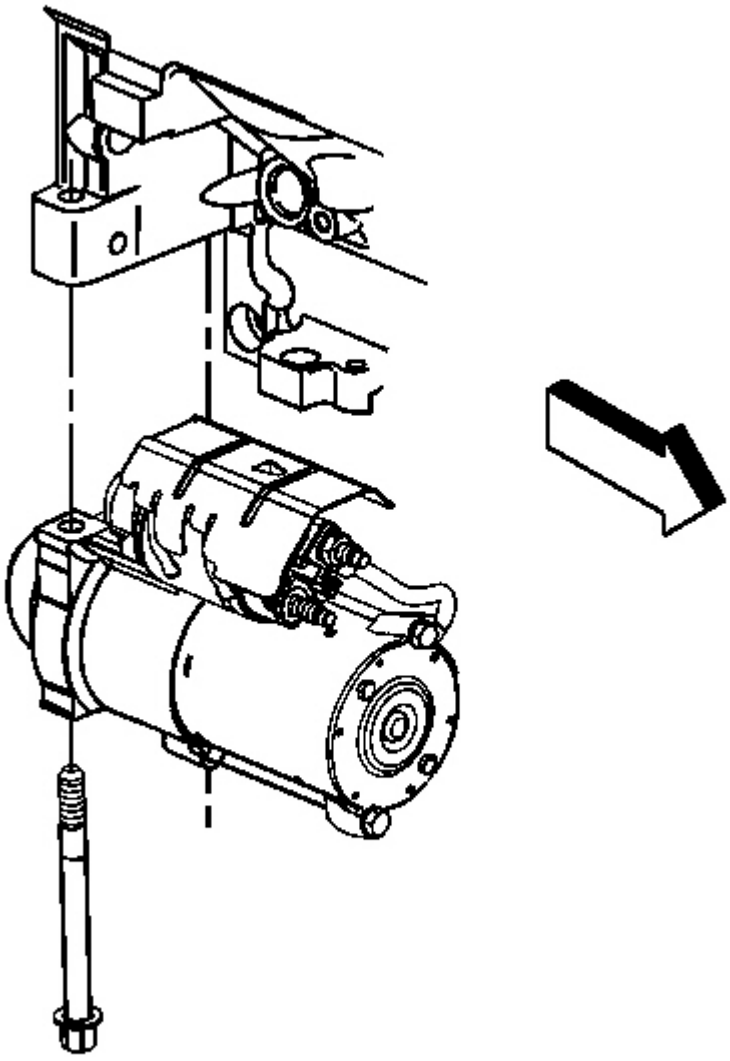


Fig. 62: View Of Starter & Bolts
Courtesy of GENERAL MOTORS CORP.

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

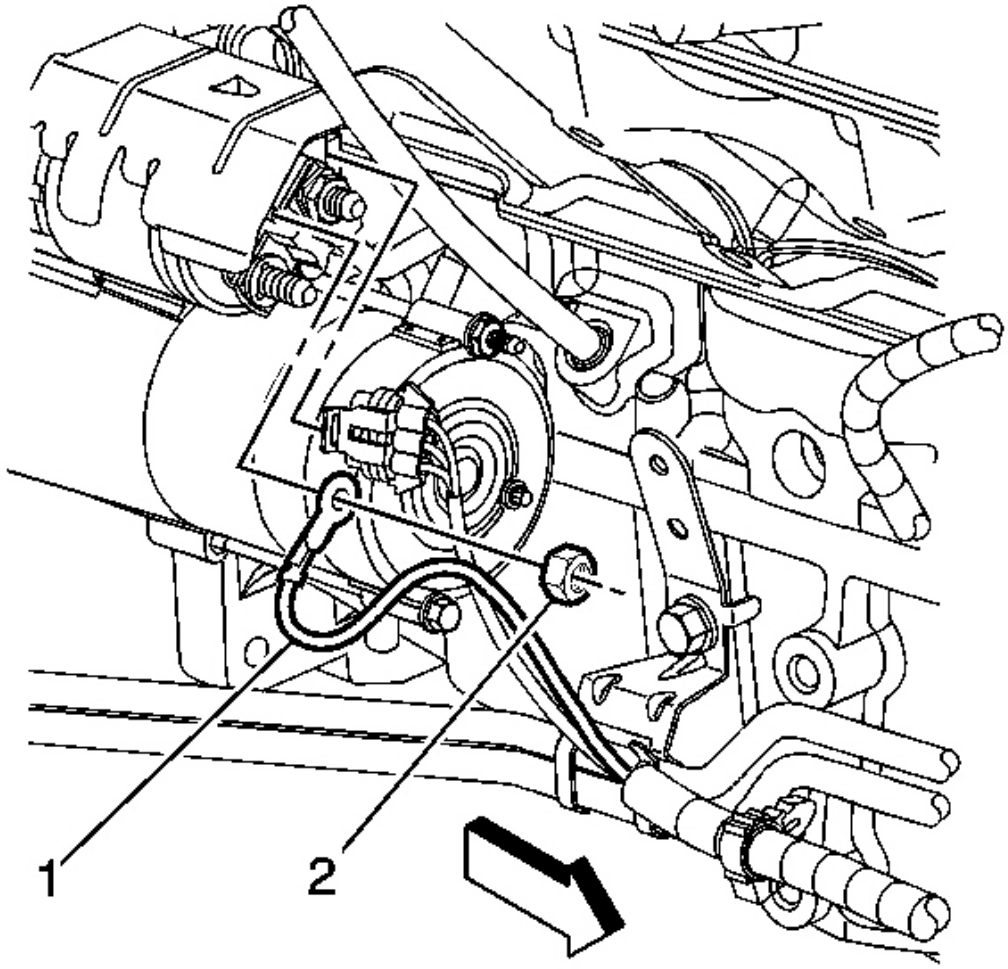


Fig. 63: View Of Starter Solenoid Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

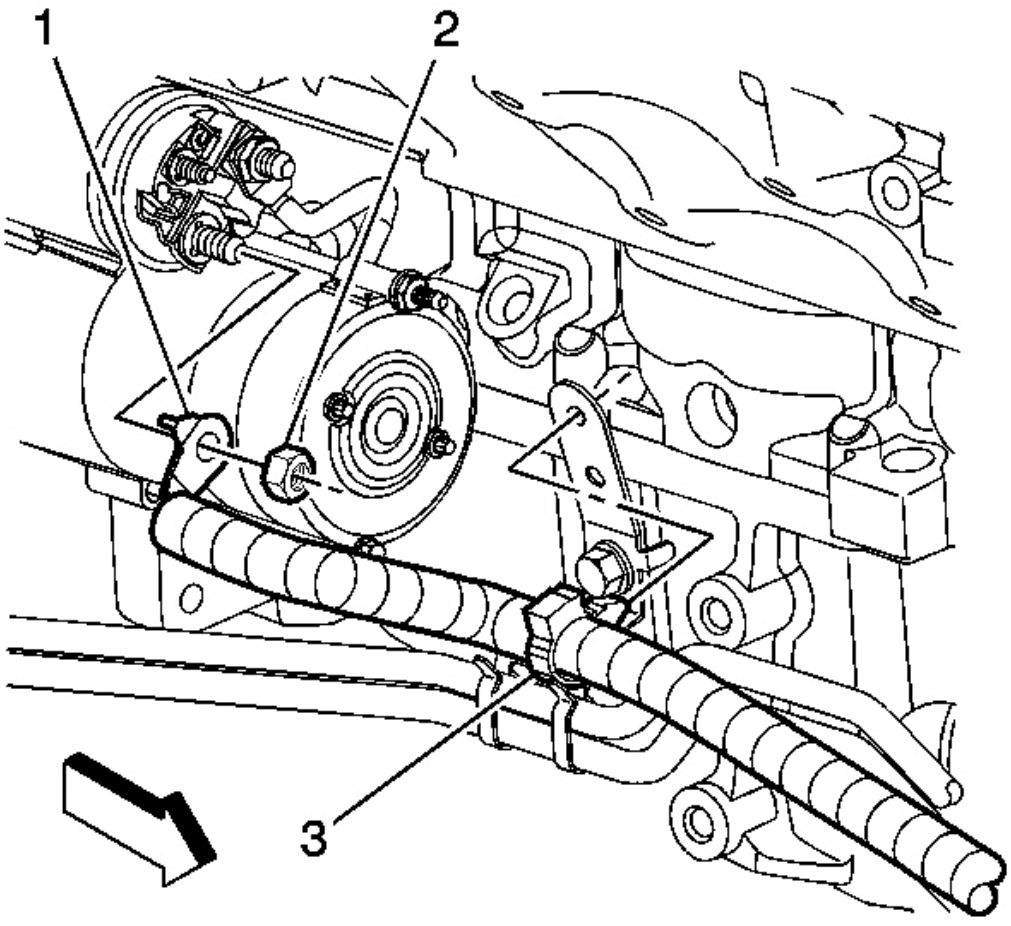


Fig. 64: View Of Positive Cable Lead, Nut & Cable Clip
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

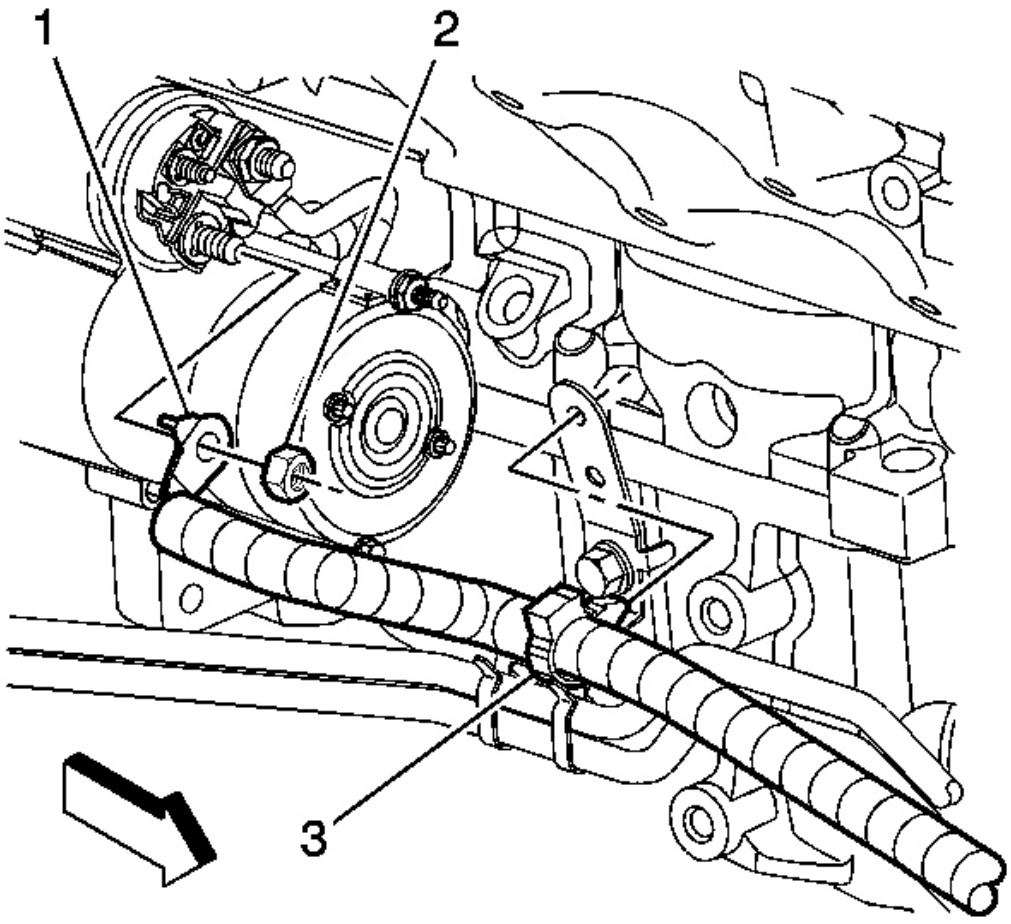


Fig. 65: View Of Positive Cable Lead, Nut & Cable Clip
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

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

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

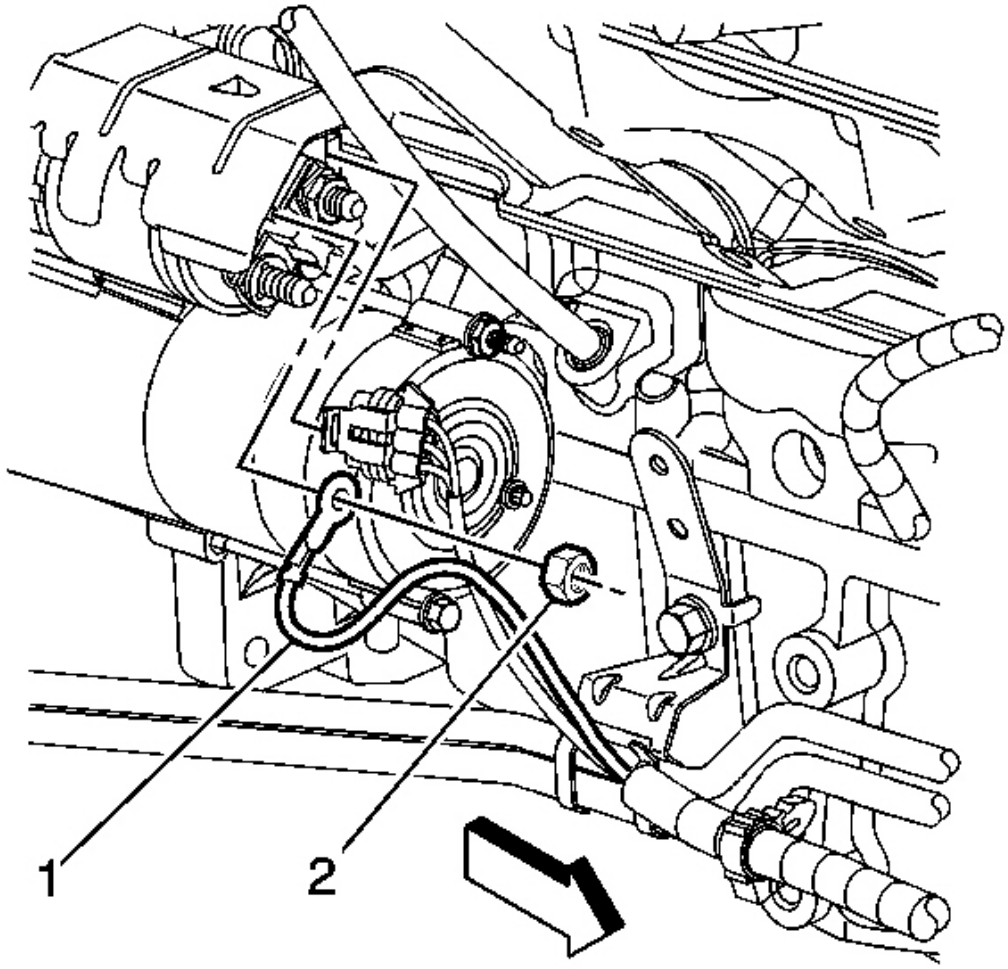


Fig. 66: View Of Starter Solenoid Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

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

6. Install the starter solenoid heat shield.

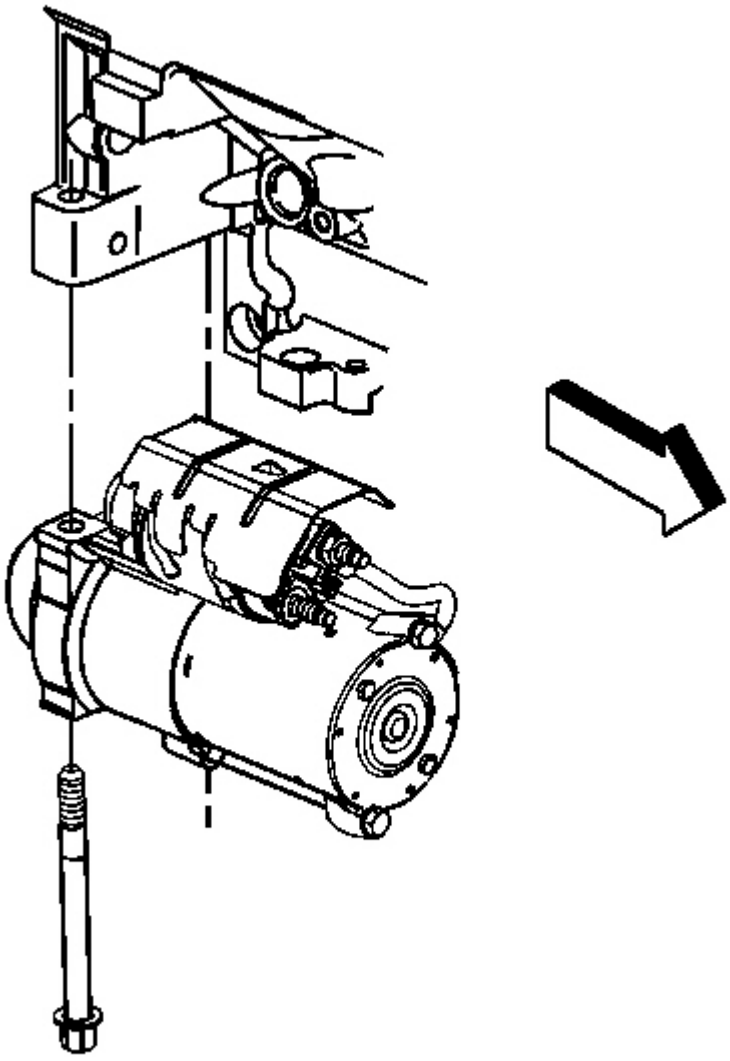


Fig. 67: View Of Starter & Bolts
Courtesy of GENERAL MOTORS CORP.

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

   Position the transmission cover to the transmission.

8. Position the starter to the engine
9. Install the starter bolts.

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

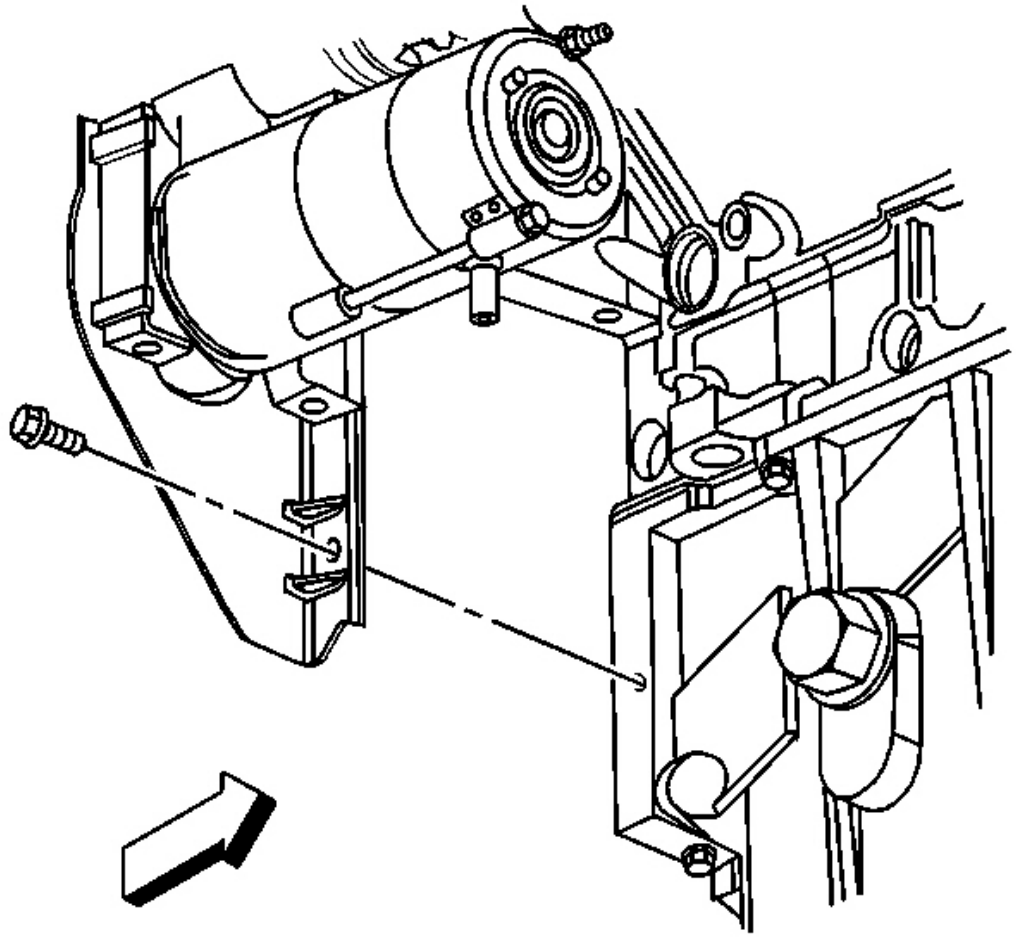


Fig. 68: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

10. Install the right transmission cover bolt.

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

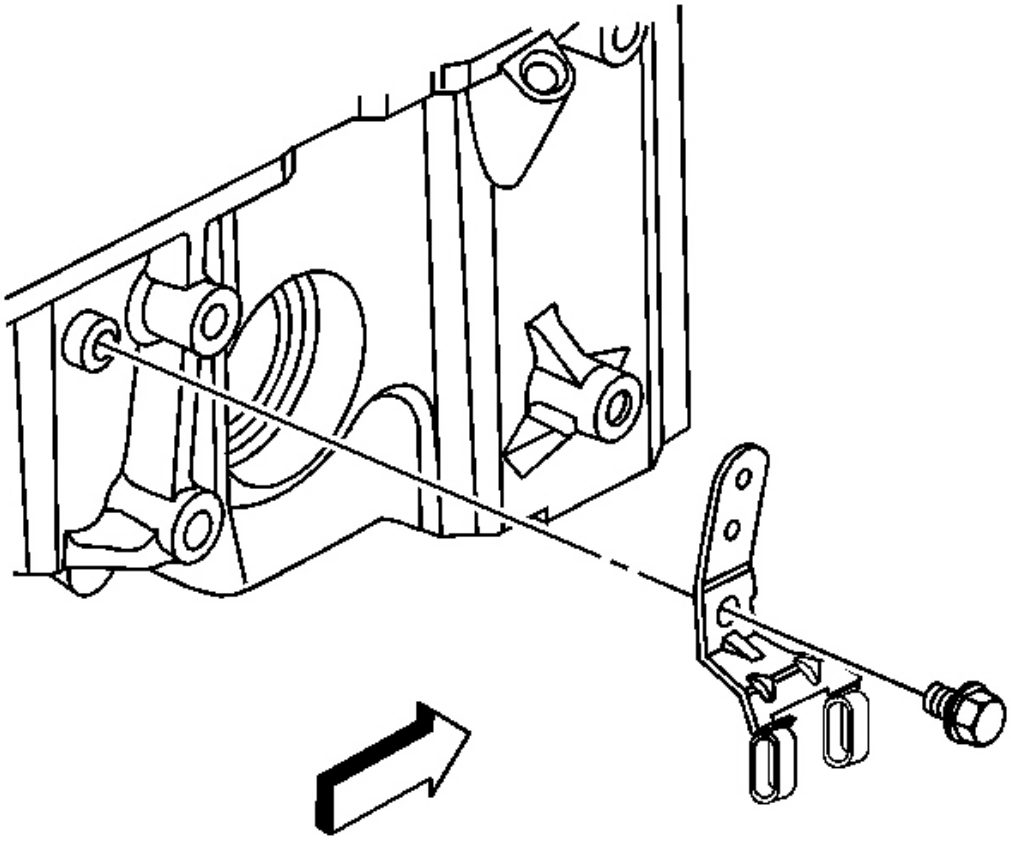


Fig. 69: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

11. Install the transmission oil cooler line bracket bolt.

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

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

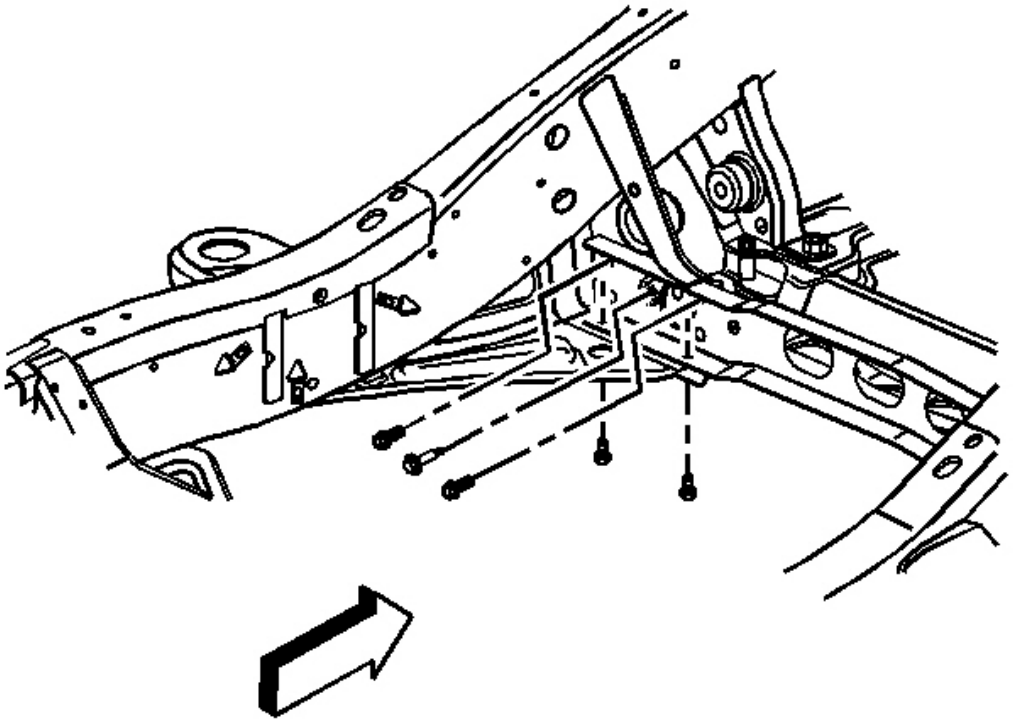


Fig. 70: Identifying Rear Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

13. Install the rear steering gear crossmember. Refer to **Rear Steering Gear Crossmember Replacement** .
14. Lower the vehicle.
15. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

GENERATOR BRACKET REPLACEMENT (5.3L & 6.0L ENGINES)

Removal Procedure

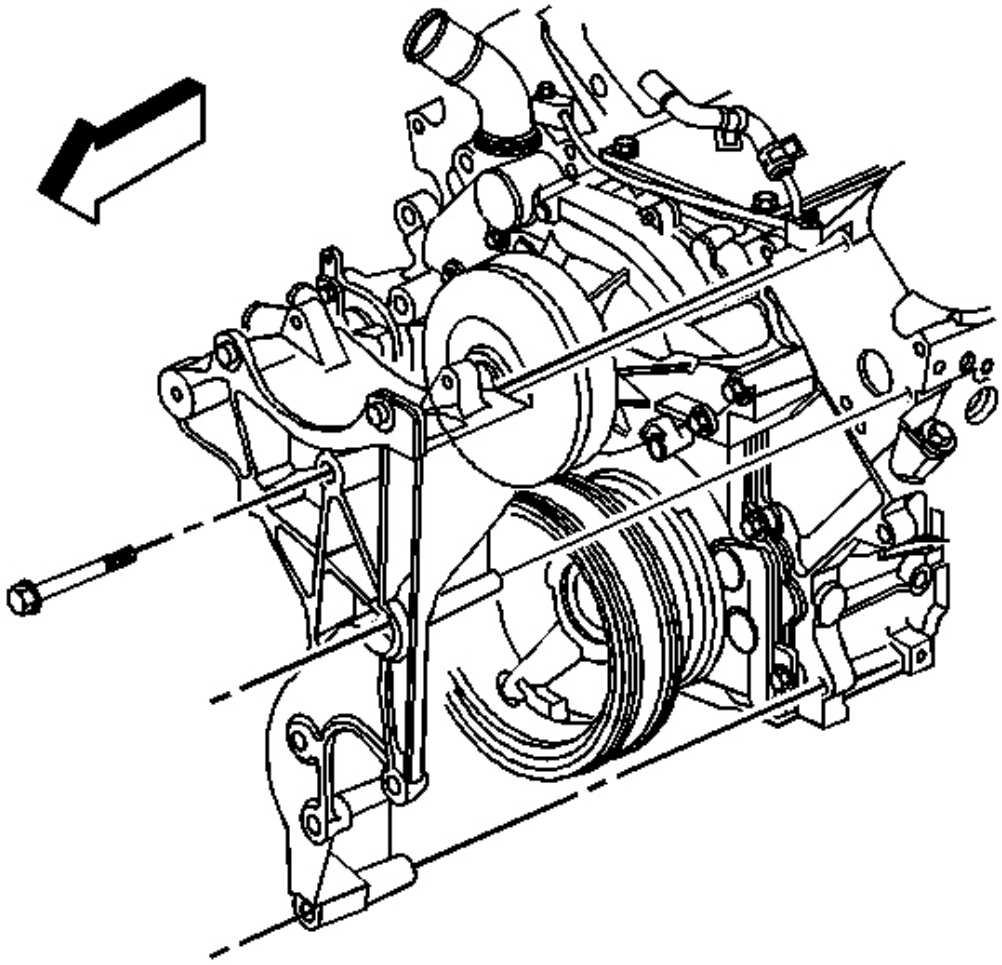


Fig. 71: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**.
2. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)** .
3. Remove the generator bracket bolts.
4. Remove the generator bracket.

Installation Procedure

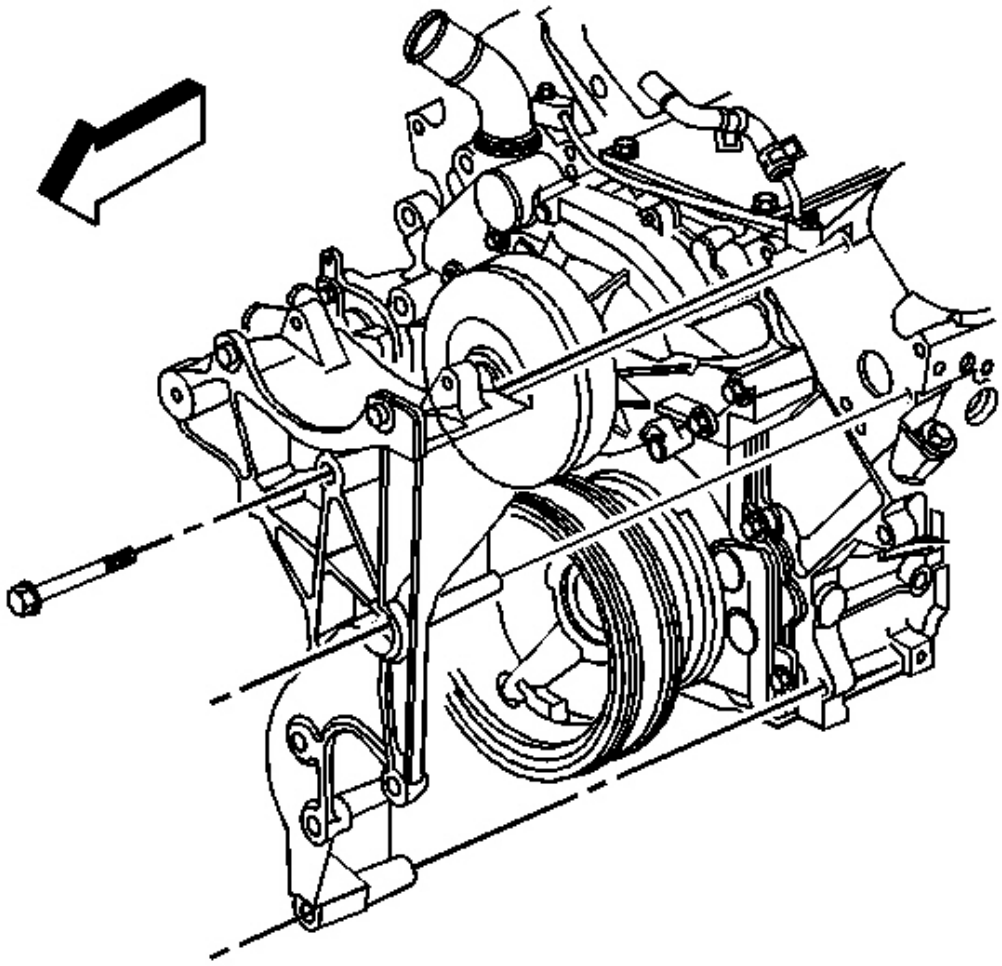


Fig. 72: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

   Tighten: Tighten the bolts to 55 N.m (41 lb ft).

3. Install the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)** .

4. Install the generator. Refer to **Generator Replacement (With 4.2L Engine)** or **Generator Replacement (With V8 Engine)**.

GENERATOR REPLACEMENT (WITH 4.2L ENGINE)

Removal Procedure

1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the drive belt. Refer to **Drive Belt Replacement** .

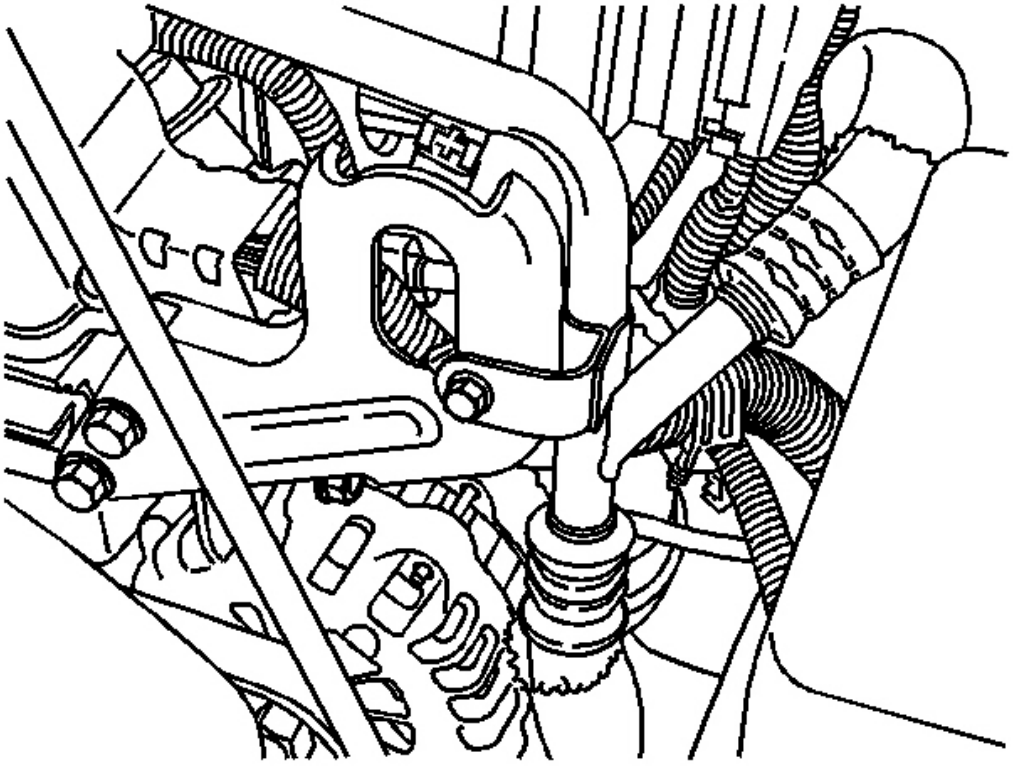


Fig. 73: View Of Engine Lift Hook & A/C Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the air conditioning (A/C) line mounting bracket bolt at the engine lift hook.

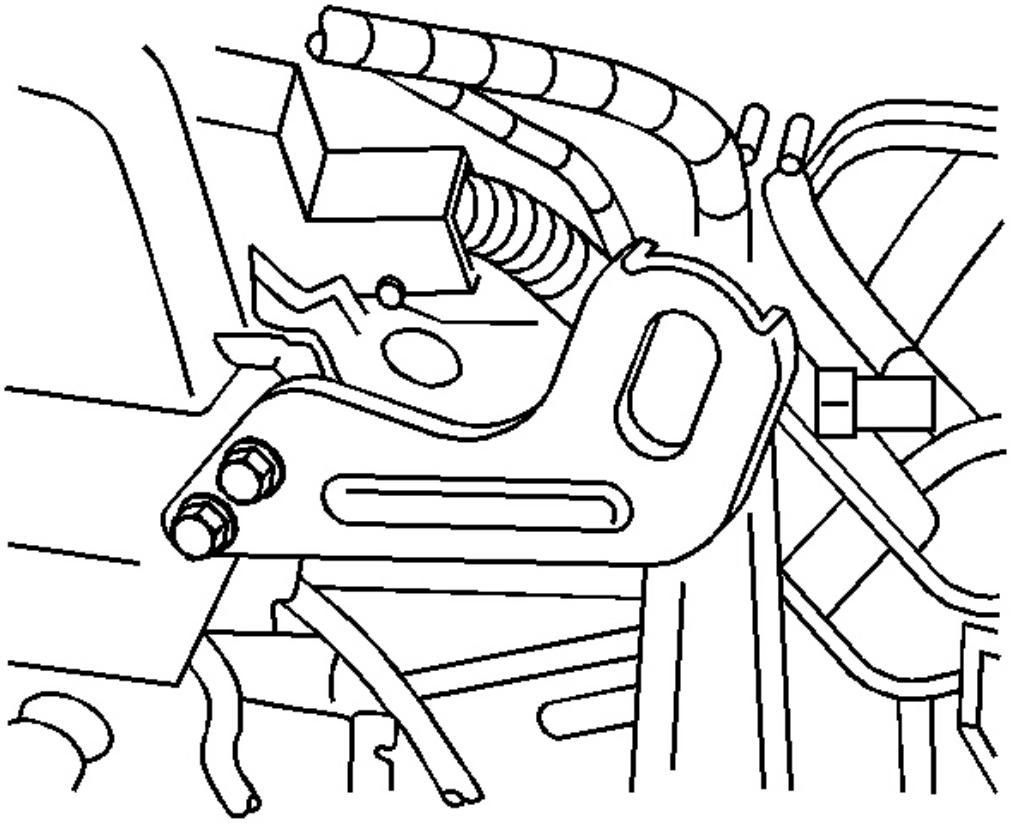


Fig. 74: View Of Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

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

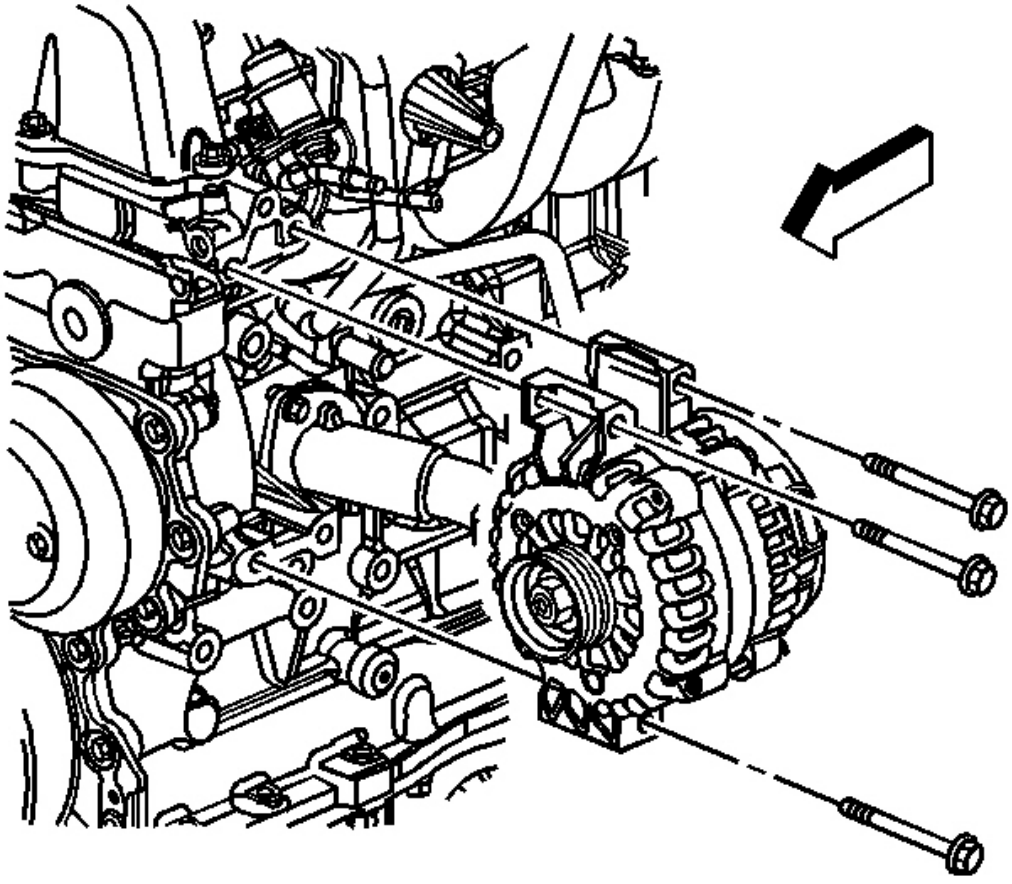


Fig. 75: View Of Generator & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

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

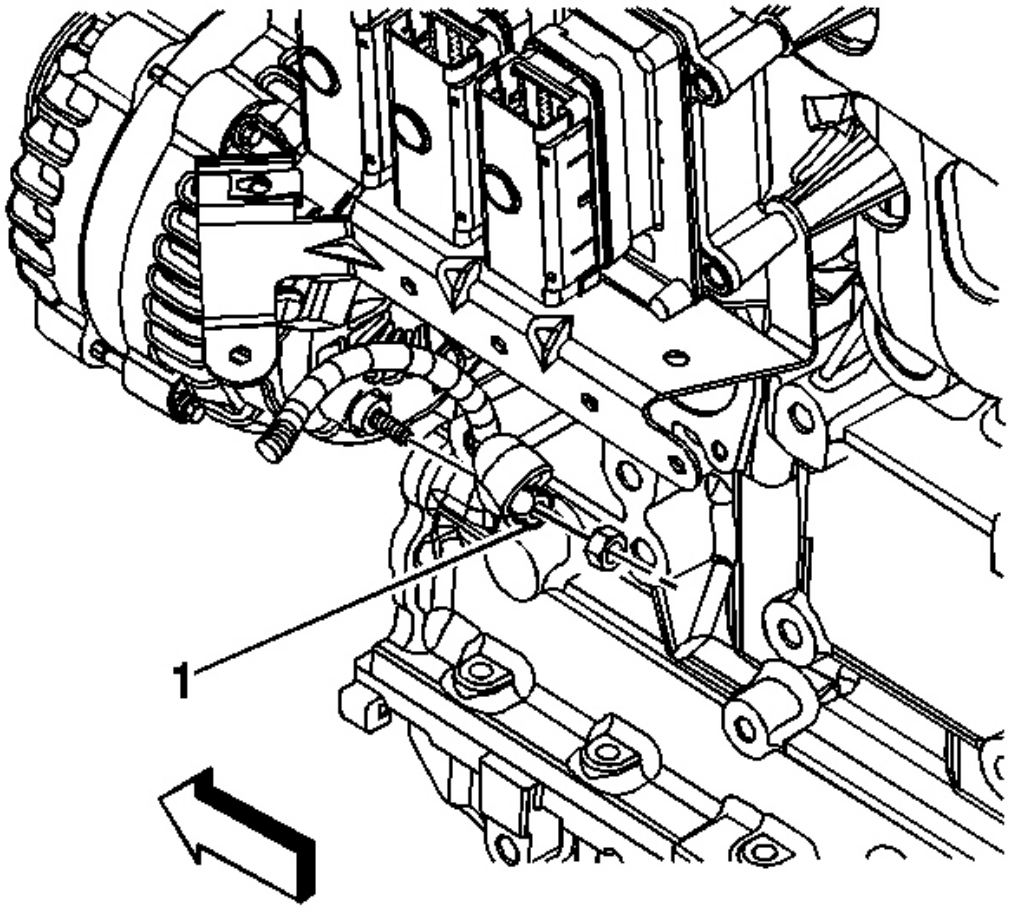


Fig. 76: View Of Rear Generator (Alternator)
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

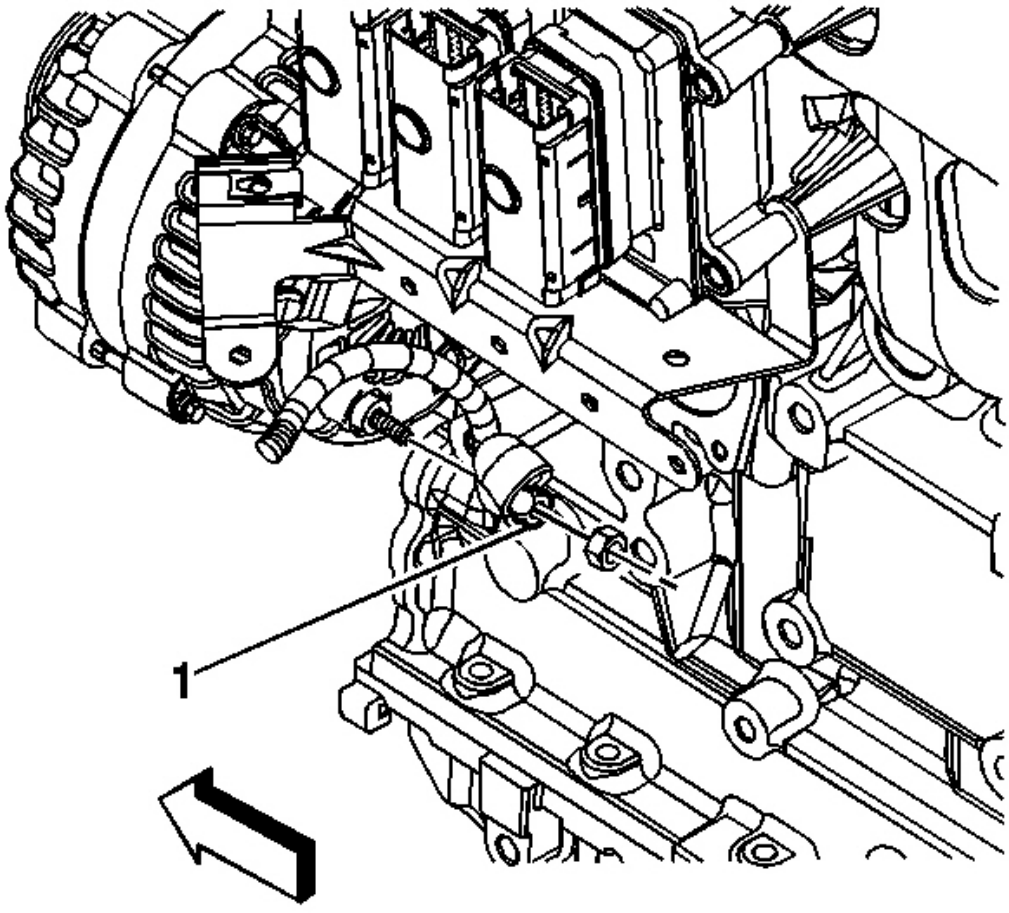


Fig. 77: View Of Rear Generator (Alternator)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

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

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

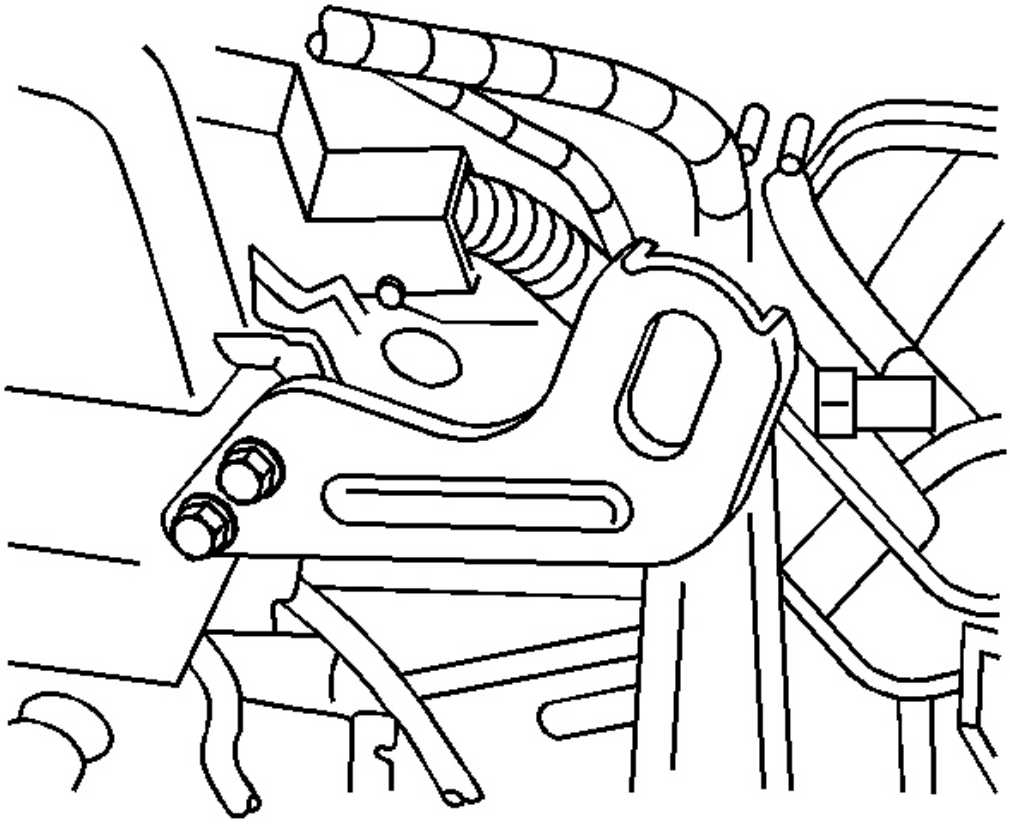


Fig. 78: View Of Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

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

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

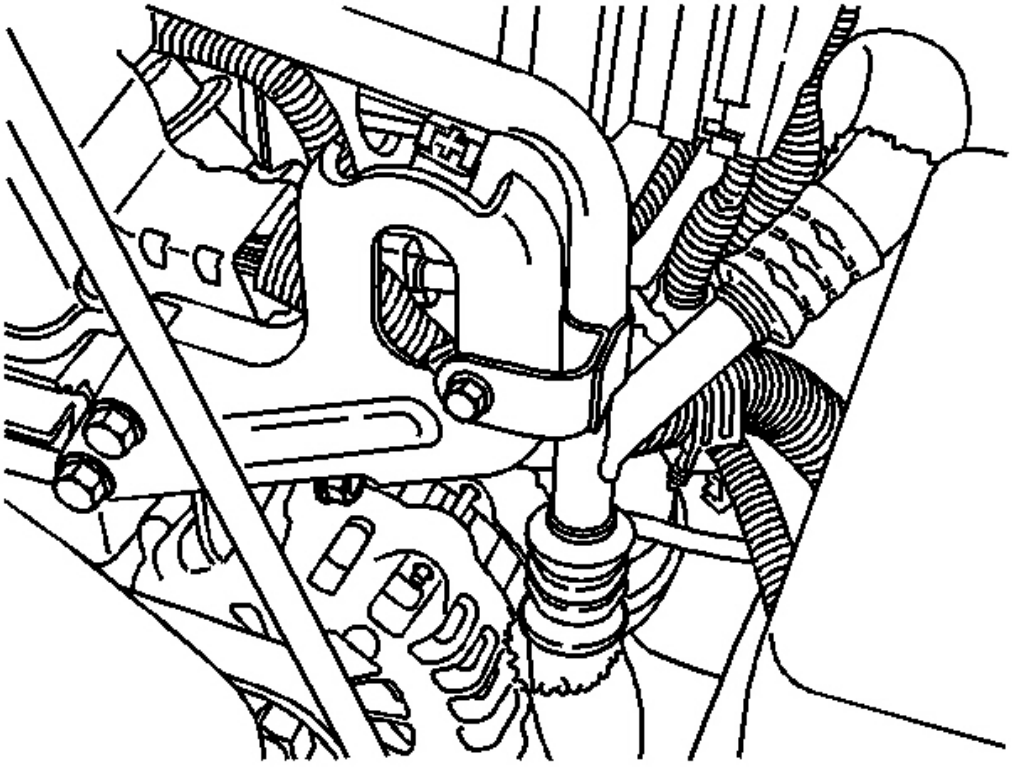


Fig. 79: View Of Engine Lift Hook & A/C Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

5. Install the drive belt. Refer to **Drive Belt Replacement** .
6. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**.

GENERATOR REPLACEMENT (WITH V8 ENGINE)

Removal Procedure

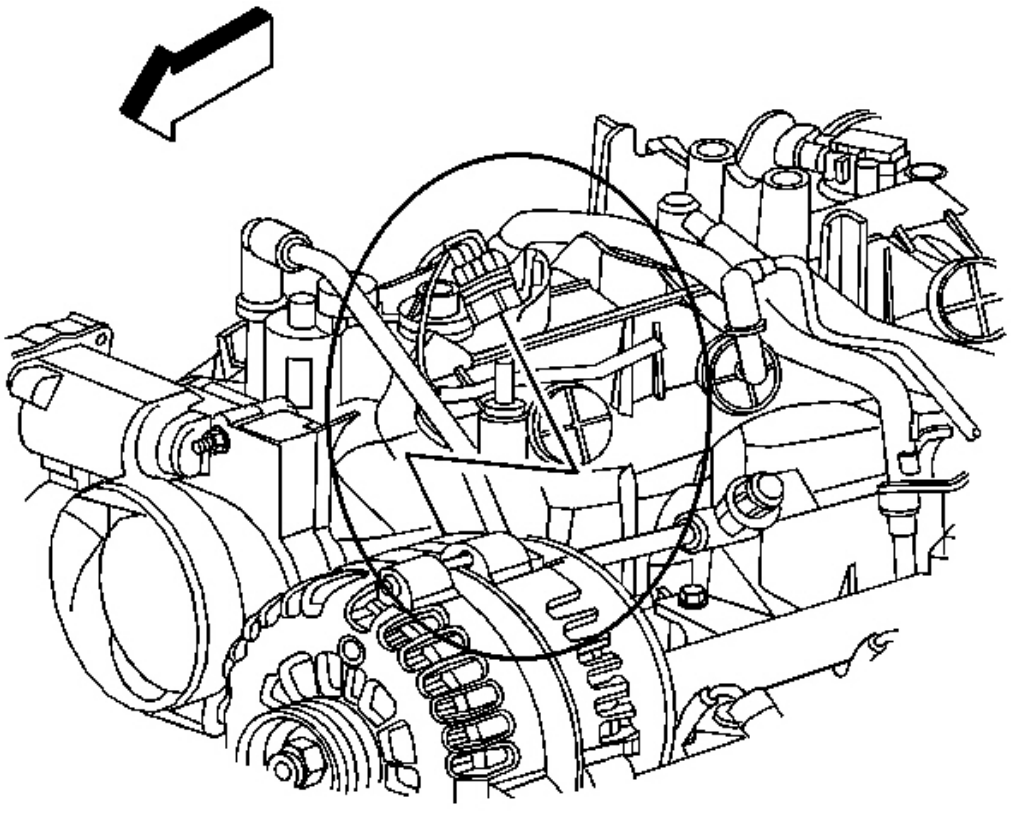


Fig. 80: View Of Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the accessory drive belt. Refer to Drive Belt Replacement - Accessory .
3. Disconnect the generator electrical connector.

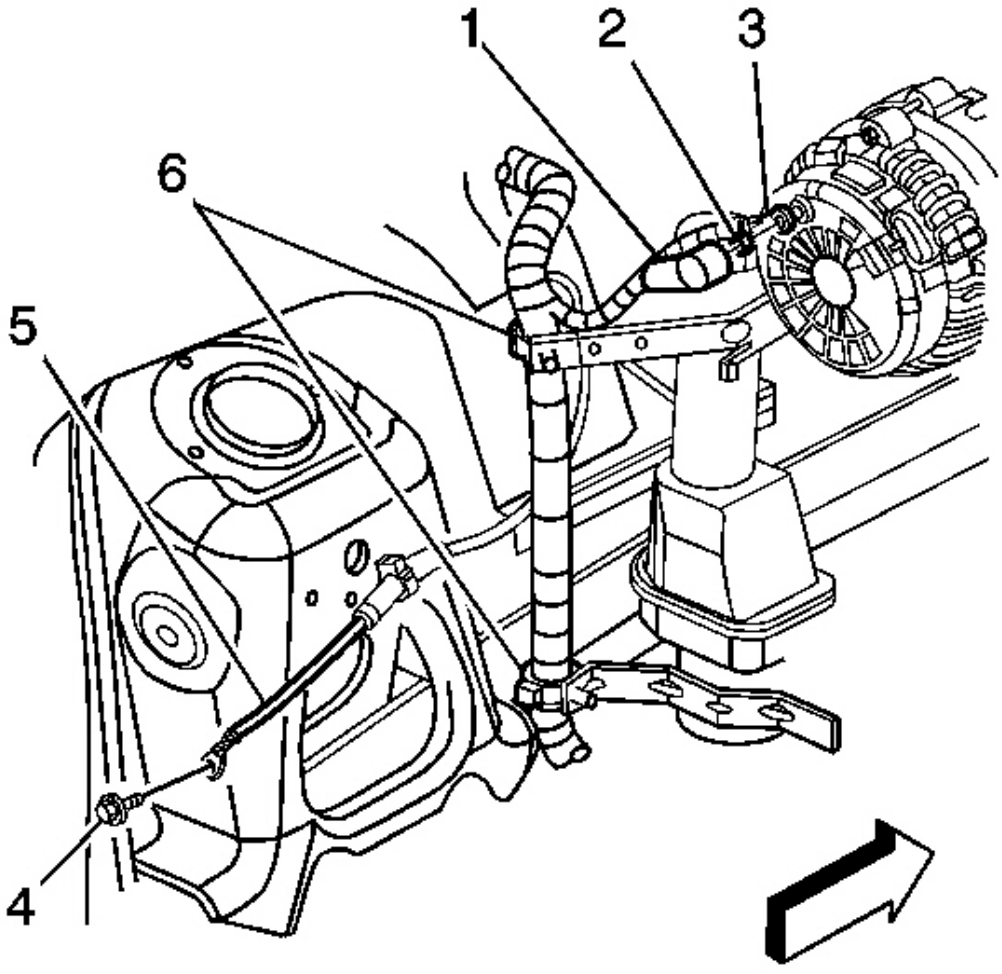


Fig. 81: View Of Generator Cable Boot, Head, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

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

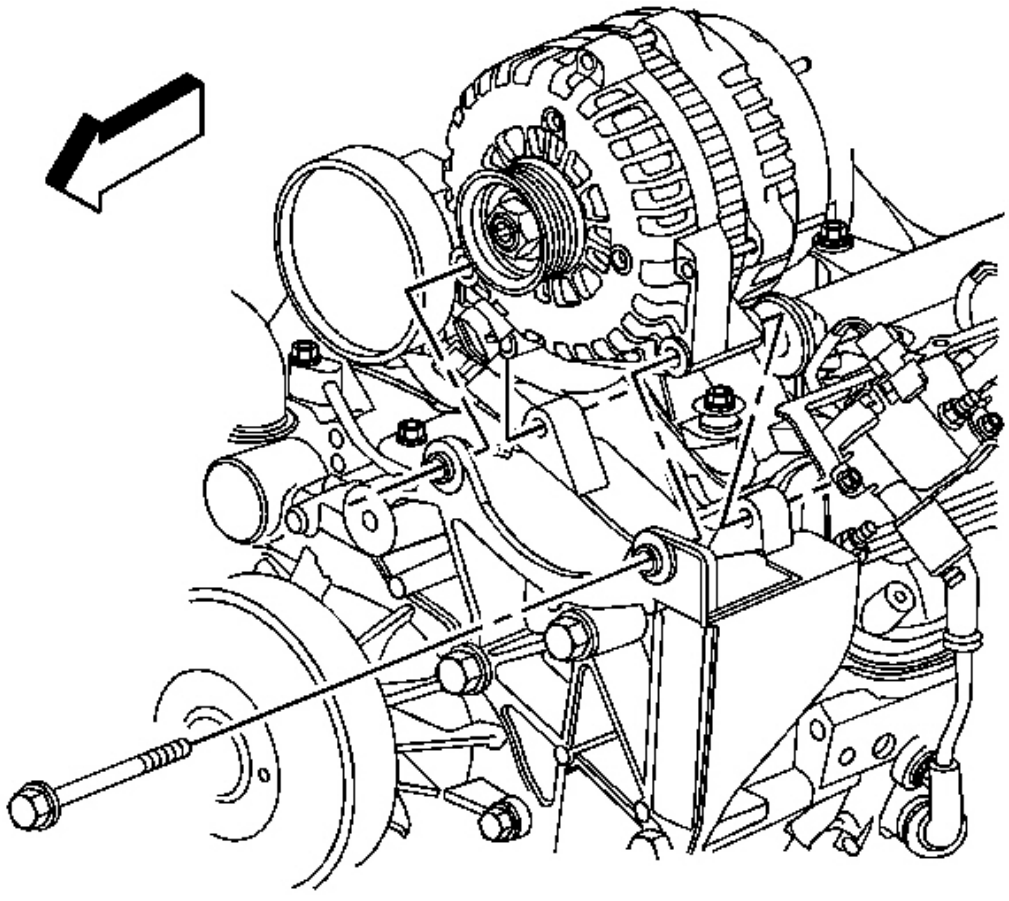


Fig. 82: View Of Generator & Bolts (5.3L)
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

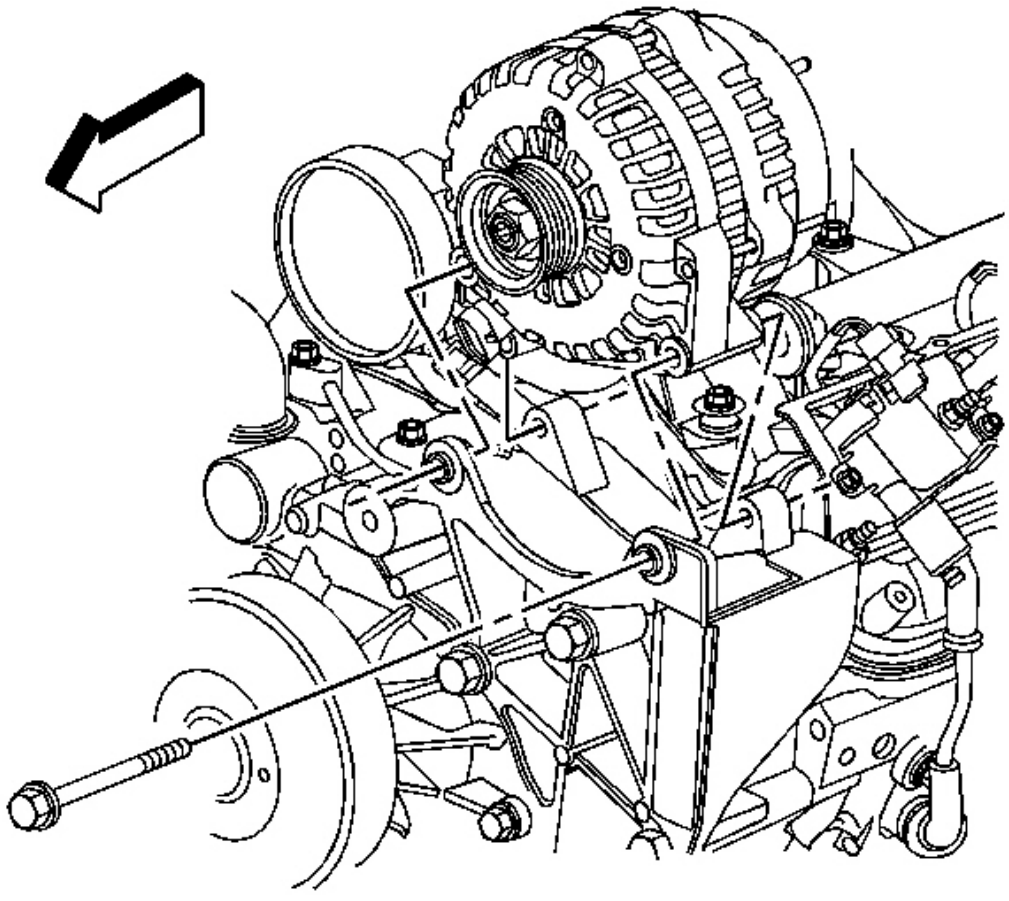


Fig. 83: View Of Generator & Bolts (5.3L)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice .**

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

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

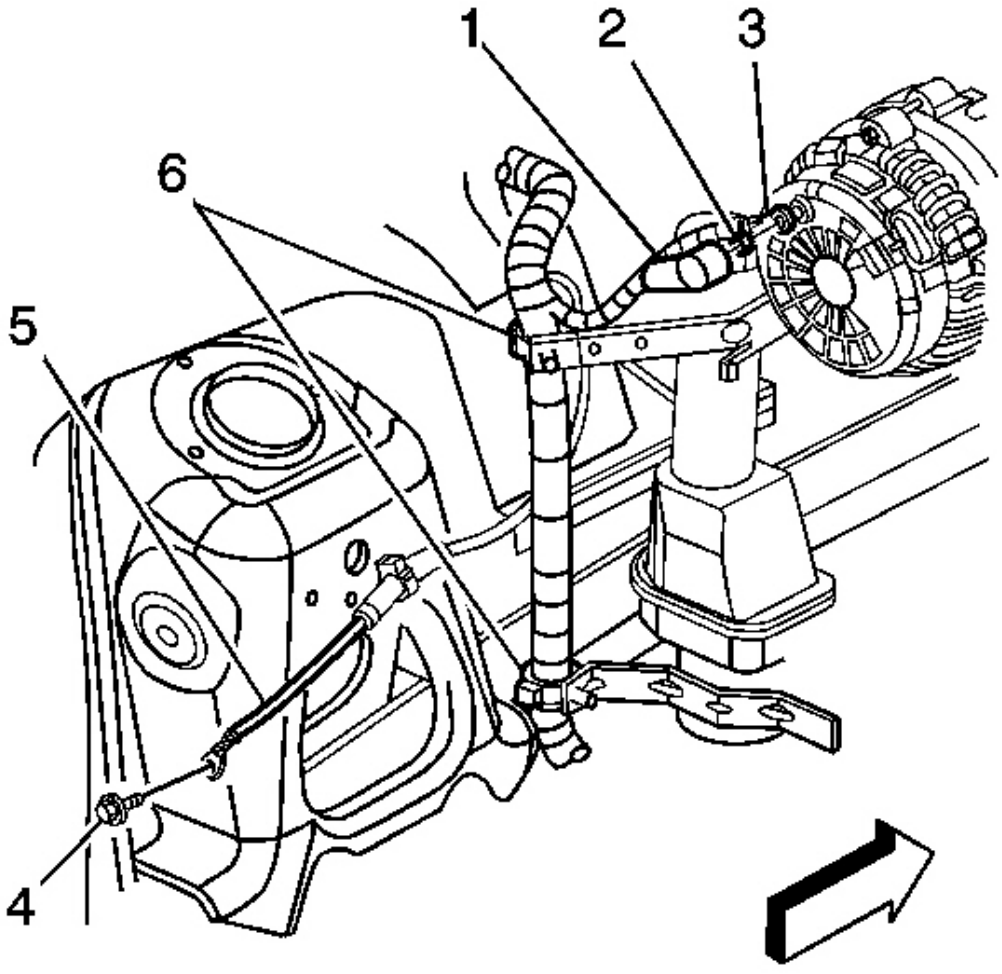


Fig. 84: View Of Generator Cable Boot, Head, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

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

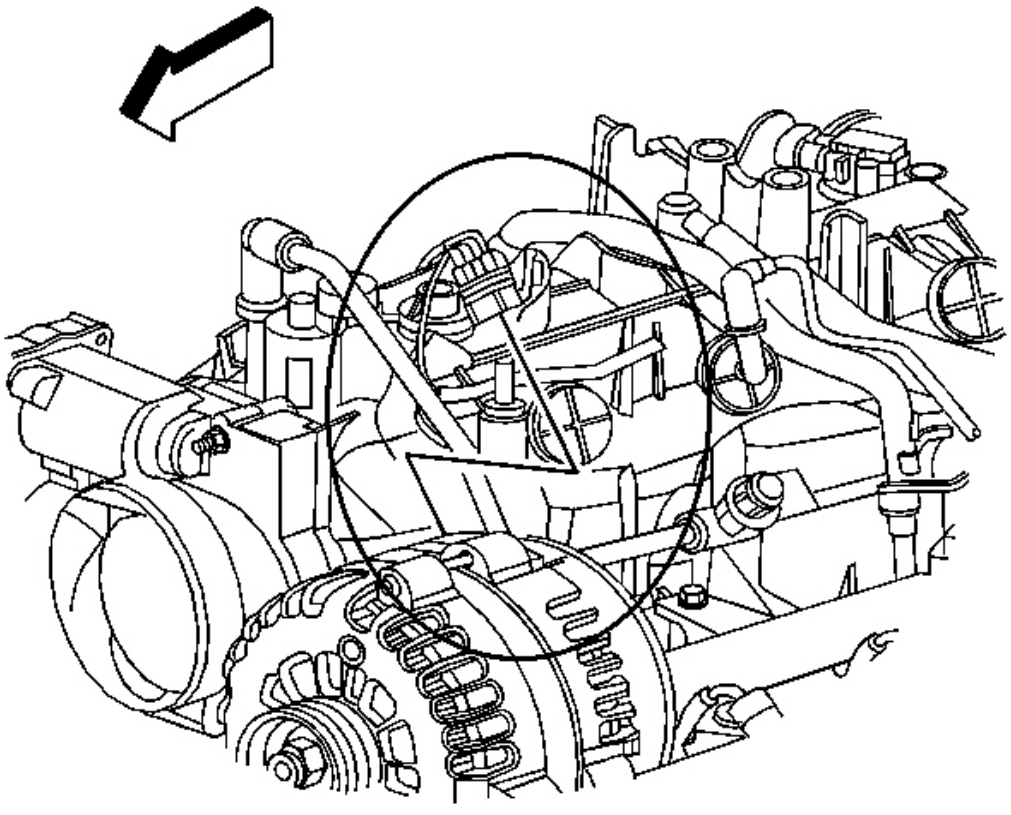


Fig. 85: View Of Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator electrical connector.
5. Install the accessory drive belt. Refer to Drive Belt Replacement - Accessory .
6. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

DESCRIPTION & OPERATION

BATTERY DESCRIPTION & OPERATION

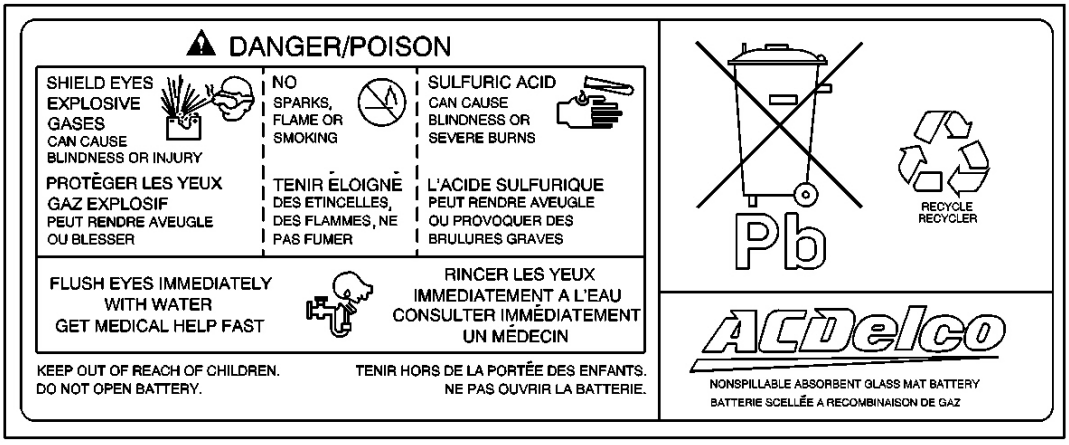


Fig. 86: Battery Warning Label
Courtesy of GENERAL MOTORS CORP.

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.**

IMPORTANT: Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging, and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

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

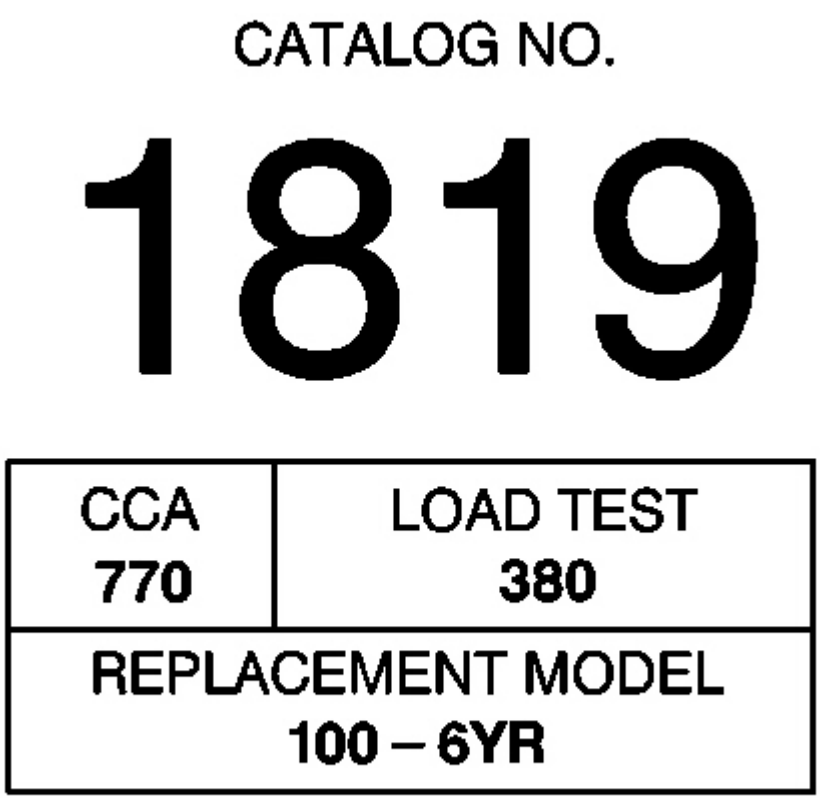


Fig. 87: View Of Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

A battery may have 3 ratings:

- Amp hour
- 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**.

Amp Hour

The amp hour rating of a battery is the amount of time it takes a fully charged battery, being discharged at a

constant rate of 1 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 amp hour rating of the original equipment battery.

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.

CHARGING SYSTEM DESCRIPTION & OPERATION

Electrical Power Management (EPM) Overview

The Electrical Power Management (EPM) System is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems with the battery and generator. This EPM System primarily utilizes existing on-board computer capability to maximize the effectiveness of the generator, to manage the load, improve battery state-of-charge (SOC) and life, and minimize the systems impact on fuel economy. The EPM System performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during key-off and during key-on. During key-off the SOC of the battery is determined by measuring the open-circuit voltage. The SOC is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open-circuit-voltage when the battery has been at rest for several hours.

The SOC can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. Throughout key-on the algorithm continuously estimates SOC based on adjusted net amp hours, battery capacity, initial SOC, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the EPM function is designed to perform regulated voltage control (RVC) to improve battery SOC, battery life, and fuel economy. This is accomplished by using knowledge of the batteries SOC and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

The Charging System Description and Operation is divided into 3 sections. The first section describes the

charging system components and their integration into the EPM. The second section describes charging system operation. The third section describes the instrument panel cluster operation of the charge indicator, driver information center messages and voltmeter operation.

Charging System Components

Generator

The generator is a serviceable component. If there is a diagnosed failure of the generator it must be replaced as an assembly. The engine drive belt drives the generator. When the rotor is spun it induces an alternating current (AC) into the stator windings. The AC voltage is then sent through a series of diodes for rectification. The rectified voltage has been converted into a direct current (DC) for use by the vehicles electrical system to maintain electrical loads and the battery charge. The voltage regulator integral to the generator controls the output of the generator. It is not serviceable. The voltage regulator controls the amount of current provided to the rotor. If the generator has field control circuit failure, the generator defaults to an output voltage of 13.8 volts.

Generator Battery Control Module

The generator battery control module is a class 2 device. It communicates with the engine control module (ECM), instrument panel cluster and the body control module for electrical power management (EPM) operation. It is a serviceable component that is connected to the negative battery cable at the battery. It directly controls the generator field control circuit, charge indicator control, input to the generator. It continuously monitors the generator field duty cycle signal circuit and the battery voltage. If the generator battery control module loses communication with the ECM, the default voltage will be set to 13.8 volts and the module will set U1016. If the generator battery control module loses communication with the body control module (BCM), the module will set U1064.

Engine Control Module (ECM)

The ECM provides information over the serial data circuit to the generator battery control module. The generator battery control module monitors the following data parameters provided by the ECM:

- Intake air temperature
- Fuel grams per second
- Throttle position
- Engine cooling fan speed
- Engine coolant temperature
- Exterior Environment - Outside Air Temperature

The generator battery control module uses these data parameters for different charging system modes depending on the required voltage needed.

Instrument Panel Cluster (IPC)

The instrument panel cluster (IPC) provides a means of customer notification in case of a failure. There are two means of notification, a battery charge indicator and a driver information center message of SERVICE

CHARGING SYSTEM FAILURE and CHARGING SYSTEM FAULT.

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 9 modes of operation and they include:

- Charge Mode
- Fuel Economy Mode
- Voltage Reduction Mode
- Start Up Mode
- Headlamp Mode
- Battery Sulfation Protection Mode
- Windshield Wiper Voltage Boost Mode
- Fuel Pump Voltage Boost Mode
- De-Ice Voltage Boost Mode

The generator battery control module monitors the generator performance though the generator field duty cycle signal circuit, the generator field control circuit, and the battery positive voltage circuit. The generator battery control module controls the generator through the generator field control, charge indicator control, circuit. The signal is a 5-volt pulse width modulation (PWM) signal of 128 Hz +/- 5 percent with a duty cycle of 0-100 percent. The duty cycle sent by the generator battery control module is limited between 36-90 percent. When the engine is turned OFF, the module will send 0 percent duty cycle, low voltage. When there is loss of communication with the ECM, the module will send 100 percent duty cycle, 13.8 volts. The following table shows the commanded duty cycle and output voltage of the generator:

Commanded Duty Cycle	Generator Output Voltage
10%	11.0 V
20%	11.56 V
30%	12.12 V
40%	12.68 V
50%	13.25 V
60%	13.81 V
70%	14.37 V
80%	14.94 V
90%	15.5 V

The generator provides a feedback signal of the generator voltage output through the generator field duty cycle signal circuit to the generator battery control module. The signal is a 5-volt PWM signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-99 percent. Between 0-5 percent and 100 percent are for diagnostic purposes.

Charge Mode

The generator battery control module will enter Charge Mode when at least one of the following conditions is met:

- The electric cooling fans are on high speed.
- The rear defogger is ON.
- The battery state of charge is less than 80 percent.
- The battery current is not between -8 and +15 amps.
- The estimated ambient air temperature is less than 0°C (32°F).
- DTC B1516 is set.

Once one of these conditions are met the generator battery control module will set the targeted generator output voltage to the nominal optimum battery voltage which is from 13.9-15.5 volts, the voltage set point is based on the batteries state of charge and estimated battery temperature. The battery voltage ramps up to the targeted set point at a rate of 20 mV per second.

Fuel Economy Mode

The generator battery control module will enter Fuel Economy Mode when all of the following conditions are true:

- Estimated ambient air temperature is equal to or greater than 0°C (32°F).
- The calculated battery current is less than +15 amperes and greater than -8 amperes.
- The battery state of charge is greater than or equal to 80 percent.
- The rear defoggers are turned OFF.
- The electric cooling fans are on low speed or OFF.

The targeted generator output voltage is 13 volts. The generator battery control module will exit this mode once the criteria are met for Charge Mode or it will boost voltage to a pre-determined set point for the fuel pump, headlamps, or windshield wipers.

Voltage Reduction Mode

The generator battery control module will enter Voltage Reduction Mode when the calculated ambient air temperature is above 0°C (32°F). The calculated battery current is less than 2 amperes and greater than -7 amperes, the generator field duty cycle is less than 99 percent. The rear defoggers are turned OFF, and the electric cooling fans are on low speed or OFF. Its targeted generator output voltage is 87 percent of the Charge Mode set point but limited to 12.9 volts. The generator battery control module will exit this mode once the criteria are met for Charge Mode or it will boost voltage to a pre-determined set point for the fuel pump, headlamps, or windshield wipers.

Start Up Mode

After the engine has started the generator battery control module sets a targeted generator output voltage of 14.5 volts for 30 seconds.

Headlamp Mode

The generator battery control module will enter the Headlamp Mode when the headlamps, low or high beams, are turned ON. The voltage will ramp up or down to 14.5 volts at a rate of 10 mV/second. The module will exit this mode once the headlamps are turned OFF and enter Charge Mode, Fuel Economy Mode, or Voltage Reduction Mode.

Battery Sulfation Mode

The generator battery control module will enter this mode when the interpreted generator output voltage is less than 13.2 volts for 45 minutes. Once in this mode the generator battery control module will set the targeted output voltage to the nominal optimum battery voltage, see Charge Mode, for 3 minutes. The generator battery control module will then determine which mode to enter depending on vehicle conditions.

Windshield Wiper Voltage Boost Mode

When the generator battery control module is in Fuel Economy Mode or Voltage Reduction Mode, the module will boost battery voltage to 14.5 volts when the windshield wipers are ON, intermittent, low, or high speed, after 8 seconds. The voltage will ramp to 14.5 volts at a rate of 50 mV/second. The module will exit this mode once the Windshield Wipers are OFF for 5 seconds and the module will enter Charge Mode, Fuel Economy Mode, or Voltage Reduction Mode.

Fuel Pump Voltage Boost Mode

When the generator battery control module is in Fuel Economy Mode or Voltage Reduction Mode, the module will immediately boost battery voltage to 13.4 volts when the instantaneous fuel flow is greater than 21k grams/second and the throttle position sensor pedal position is greater than 90 percent. The module will exit this mode once the instantaneous fuel flow is less than 5k grams/second and enter Charge Mode, Fuel Economy Mode, or Voltage Reduction Mode.

De-Ice Voltage Boost Mode

The generator battery control module will enter De-Ice Voltage Boost Mode when the estimated ambient air temperature is less than or equal to -1°C (+30°F) and the engine coolant temperature is less than or equal to 75° C (167°F). The module will be in Charge Mode if the above conditions are true. Once the engine coolant temperature becomes greater than 75°C (167°F), the module will remain in Charge Mode or enter Fuel Economy Mode or Voltage Reduction Mode based on the vehicle conditions.

Instrument Panel Cluster (IPC) Operation

Charge Indicator Operation

The instrument panel cluster (IPC) illuminates the charge indicator in the message center when the one or more of the following occurs:

IMPORTANT: The generator battery control module is not set up to set a DTC if the battery voltage is too high or too low. Check with the ECM to see if they set a DTC when the battery voltage is too high or too low.

- 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 there is a system voltage range concern.
- 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.
- The generator battery control module determines there is a fault and sends a class 2 message to the IPC to illuminate the charge indicator.

Charging System Failure

The generator battery control module will send a message to the IPC for the CHARGING SYSTEM FAILURE message to be displayed. It is commanded ON when DTC B1487 sets. The message is turned off when the conditions for clearing the DTC have been met and after an ignition cycle.

Service Charging System

The generator battery control module will send a class 2 message to the IPC for the SERVICE CHARGING SYSTEM message to be displayed. It is commanded ON when DTC B1390, B1488, B1492, or B1516 sets. The message is turned OFF when the conditions for clearing the DTC have been met and after an ignition cycle.

Voltmeter Operation

The IPC displays the system voltage as detected at the ignition 1 input of the IPC. When the engine is ON, the gage should be between 10-16 volts. The voltmeter will be noticeably different than previous model year vehicle as far as voltage fluctuations. If there is a concern with gage operation ensure to compare to a known good like vehicle.

ELECTRICAL POWER MANAGEMENT DESCRIPTION & OPERATION

Electrical Power Management

The electrical power management (EPM) is used to monitor and control the charging system and alert the driver of possible problems within the charging system. The EPM system makes the most efficient use of the generator output, improves the battery state of charge (SOC), extends battery life.

The idle boost operation is a means of improving generator performance during a low voltage or low battery SOC condition.

Idle boost is activated in incremental steps, idle boost 1 must be active before idle boost 2 can be active. The criteria used by the body control module (BCM) to regulate EPM are outlined below:

Function	Battery Temperature Calculation	Battery Voltage Calculation	Amp-hour Calculation	Action Taken
Idle Boost 1 Start	Less Than -15°C (5°	Less Than 13 V	-	First level Idle

	F)			boost requested
Idle Boost 1 Start	-	-	Battery has a net loss greater than 0.6 AH	First level Idle boost requested
Idle Boost 1 Start	-	Less Than 11 V	-	First level Idle boost requested
Idle Boost 1 End	Greater Than -15°C (5°F)	Greater Than 12 V	Battery has a net loss less than 0.2 AH	First level Idle boost request cancelled
Idle Boost 2 Start	-	-	Battery has a net loss greater than 1.6 AH	Second level Idle boost requested
Idle Boost 2 Start	-	Less Than 11 V	-	Second level Idle boost requested
Idle Boost 2 End	-	Greater Than 12 V	Battery has a net loss less than 0.8 AH	Second level Idle boost request cancelled
Idle Boost 3 Start	-	-	Battery has a net loss of 10 AH	Third level Idle boost requested
Idle Boost 3 Start	-	Less Than 11 V	-	Third level Idle boost requested
Idle Boost 3 End	-	Greater Than 12 V	Battery has a net loss of less than 6 AH	Third level Idle boost request cancelled

STARTING SYSTEM DESCRIPTION & OPERATION

The starter motors are non-repairable starter motors. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull 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. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is 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 because battery voltage is 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, pinion overrun protects the armature from excessive speed until the switch is opened.

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

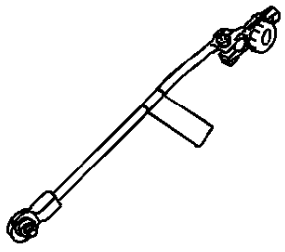
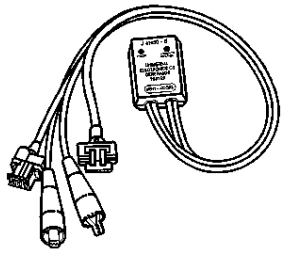
The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, causes the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter circuit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

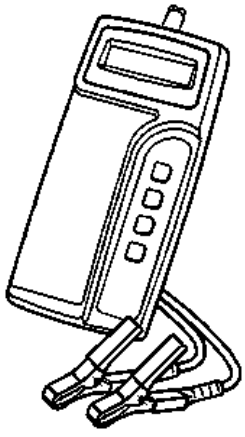
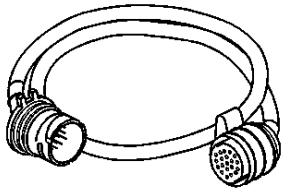
Circuit Description (Key Start)

When the ignition switch is placed in the Start position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the Start position. The BCM then sends a message to the engine control module (ECM) notifying it that CRANK has been requested. The ECM verifies that the clutch pedal has been depressed or the transmission is in Park or Neutral. If it is, the ECM then supplies 12 volts to the control circuit of the STRTR relay. When this occurs, battery positive voltage is supplied through the switch side of the crank relay to the S terminal of the starter solenoid.

SPECIAL TOOLS & EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	J 38758 Parasitic Draw Test Switch
	J 41450-B Universal CS Generator Tester Harness

	J 42000 Battery Tester
	J 45681 Jumper Harness