2007 ENGINE

Engine Electrical - Avalanche, Escalade, Suburban, Tahoe & Yukon

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Cable Channel Nut	3 N.m	27 lb in
Battery Hold Down Retainer Bolt	25 N.m	18 lb ft
Battery Tray to Battery Tray Bracket Nut	9 N.m	80 lb in
Battery Tray to Front Fender Inner Panel Nut	9 N.m	80 lb in
Battery Tray Front Support Bolt	9 N.m	80 lb in
Engine Ground Strap to Front Plenum Panel Nut	9 N.m	80 lb in
Engine Ground Strap to Left Cylinder Head Bolt	16 N.m	12 lb ft
Engine Wiring Harness Clip to Generator Bracket Bolt	9 N.m	80 lb in
Engine Wiring Harness Lead Nut	3.4 N.m	30 lb in
Forward Lamp Wiring Harness Ground Bolt	25 N.m	18 lb ft
Front Fender Rear Upper Brace Bolt	9 N.m	80 lb in
Generator Battery Jumper Cable to Generator Nut	9 N.m	80 lb in
Generator Battery Jumper Cable to Mega Fuse Nut	9 N.m	80 lb in
Generator Bolt	55 N.m	41 lb ft
Generator Bracket Bolt	50 N.m	37 lb ft
Negative Battery Cable Nut	17 N.m	13 lb ft
Negative Battery Cable Stud	25 N.m	18 lb ft
Oil Pan Skid Plate Bolt	28 N.m	21 lb ft
Starter Bolt	50 N.m	37 lb ft
Starter Solenoid Cable to Battery Nut	17 N.m	13 lb ft
Starter Solenoid Cable to Starter Nut	9 N.m	80 lb in
Transmission Cover Bolt	9 N.m	80 lb in

BATTERY USAGE

Battery Usage

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

GENERATOR USAGE

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Generator Usage

Generator Model	DR44M Remy
Rated Output	160 A
Load Test Output	112 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

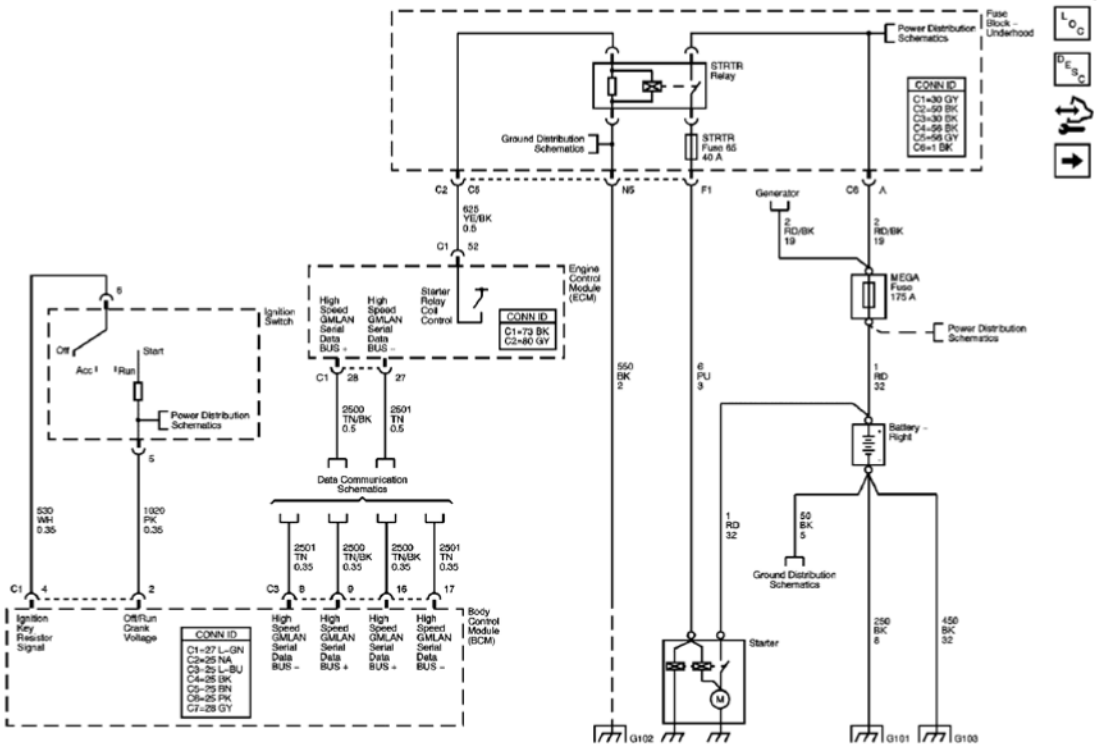


Fig. 1: Starting Schematic
Courtesy of GENERAL MOTORS CORP.

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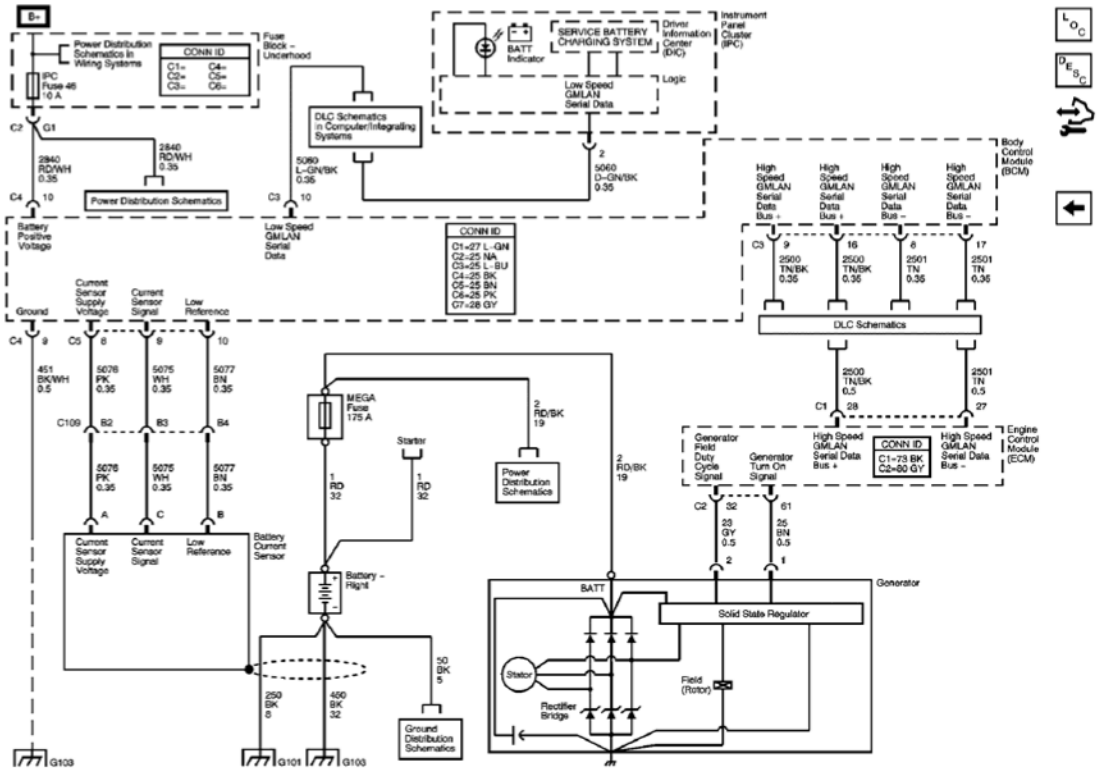


Fig. 2: Charging Schematic
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE ELECTRICAL COMPONENT VIEWS

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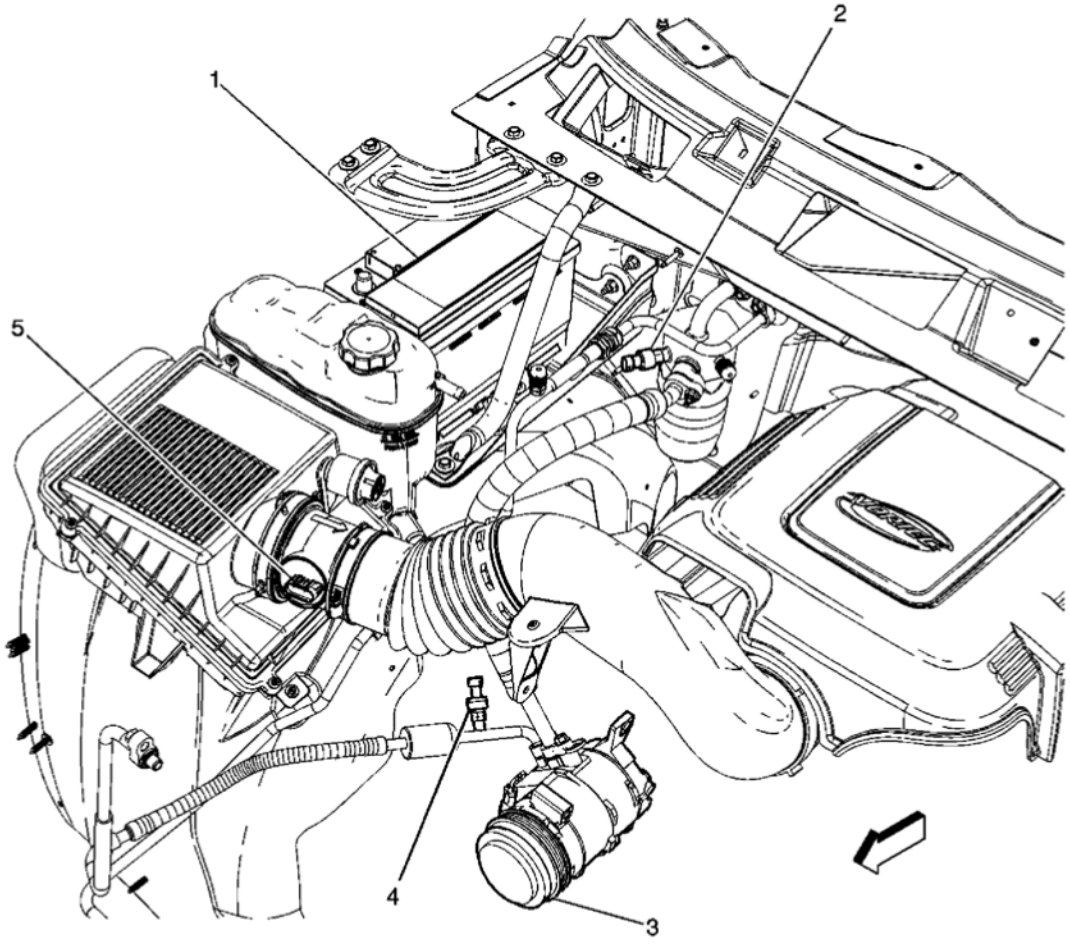


Fig. 3: RR of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Battery
2	A/C Low Pressure Sensor
3	A/C Compressor Clutch
4	A/C Refrigerant Pressure Switch
5	Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor

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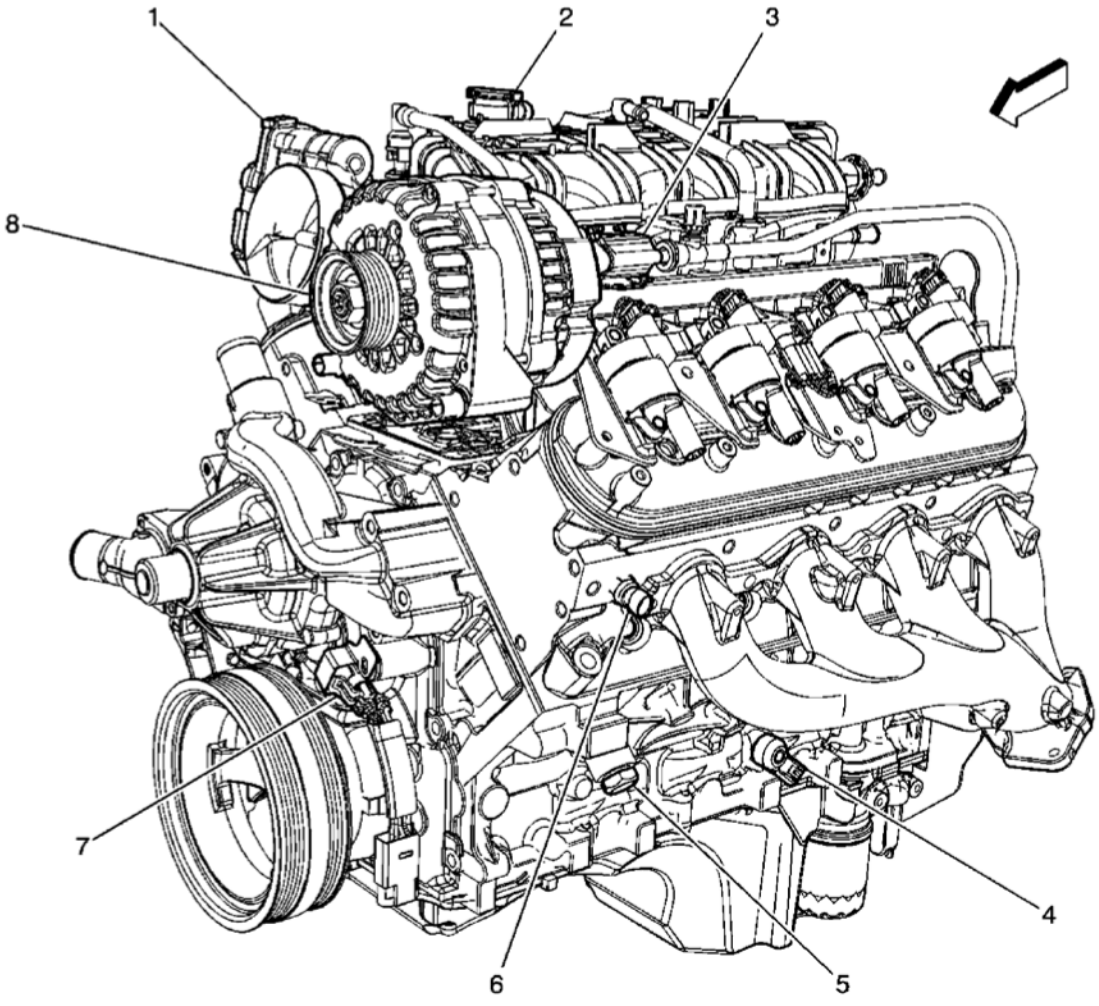


Fig. 4: Front of the Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Throttle Body
2	Manifold Absolute Pressure (MAP) Sensor
3	Evaporative Emission (EVAP) Canister Purge Solenoid Valve
4	Knock Sensor (KS) - 1
5	Engine Block Heater
6	Engine Coolant Temperature (ECT) Sensor
7	Camshaft Position (CMP) Sensor
8	Generator

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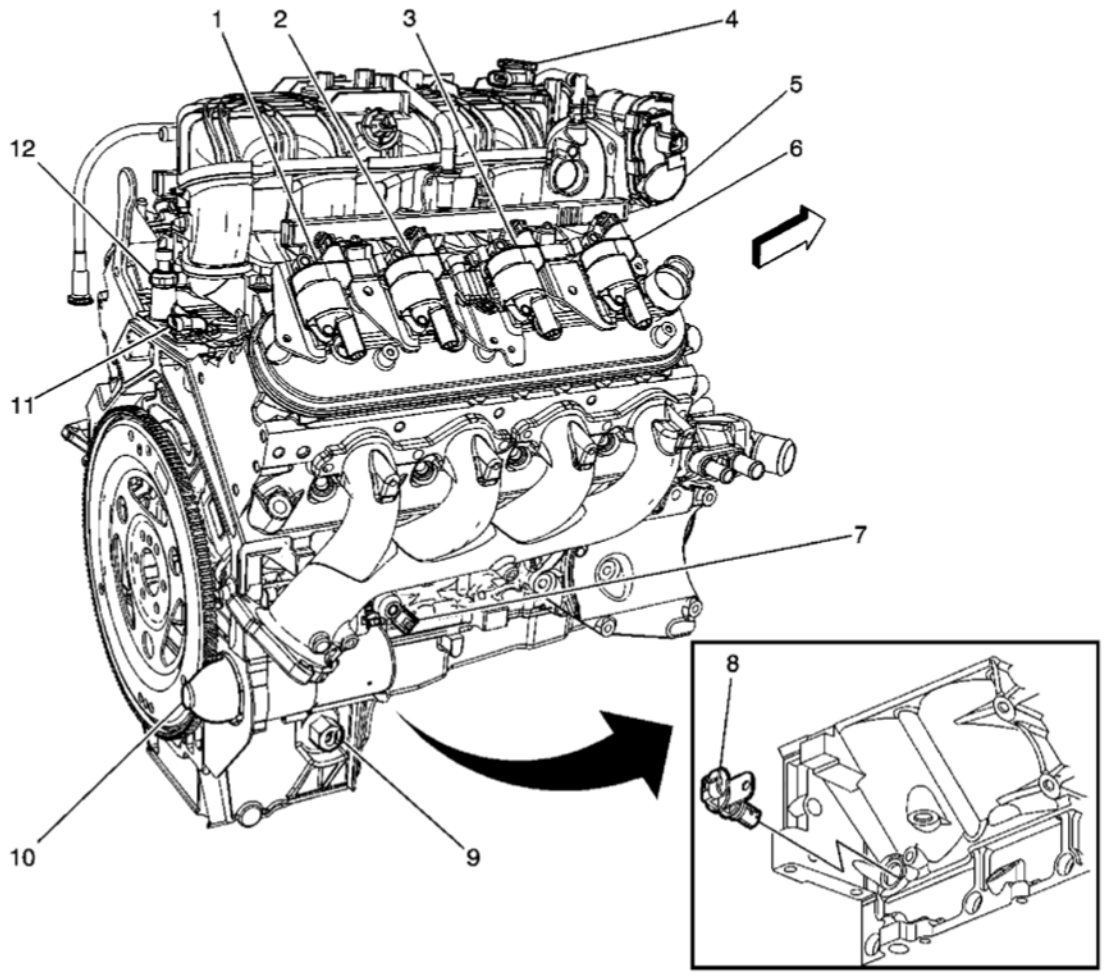


Fig. 5: Right Side of the Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Ignition Coil 8
2	Ignition Coil 6
3	Ignition Coil 4
4	Manifold Absolute Pressure (MAP) Sensor
5	Throttle Body
6	Ignition Coil 2
7	Knock Sensor (KS) - 2
8	Oil Level Switch
9	Starter
10	Valve Lifter Oil Manifold (VLOM) Assembly (DOD)
11	Engine Oil Pressure (EOP) Sensor

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ENGINE ELECTRICAL CONNECTOR END VIEWS

Battery Current Sensor

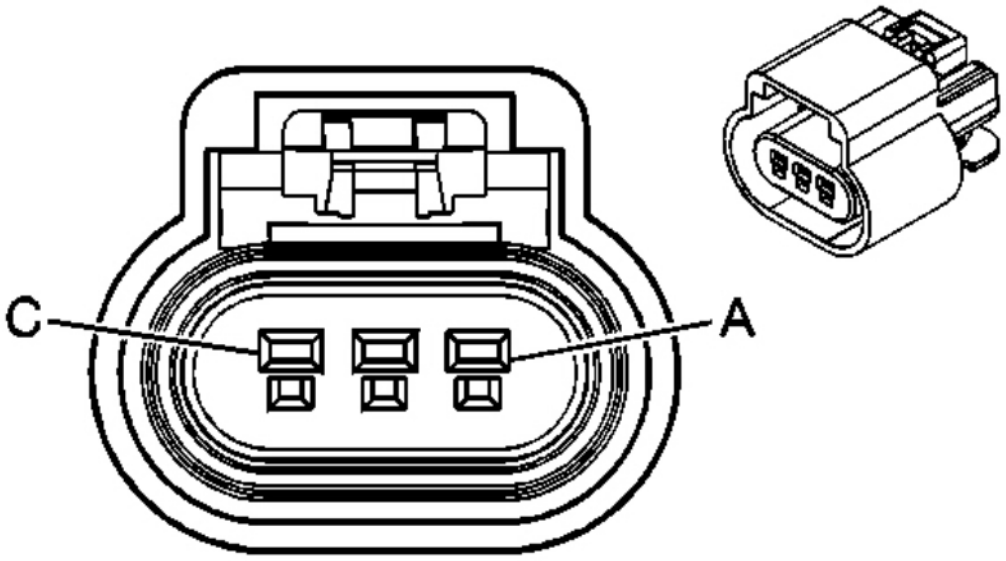


Fig. 6: Battery Current Sensor Connector End View
Courtesy of GENERAL MOTORS CORP.

Battery Current Sensor Connector Parts Information

Connector Part Information

- OEM: 15326808
- Service: 15306388
- Description: 3-Way F GT 150 Sealed 4.5 (BK)

Terminal Part Information

- Terminal/Tray: 12191819/8
- Core/Insulation Crimp: E/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)

Battery Current Sensor Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
A	PK	5076	Current Sensor Supply Voltage

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B	BN	5077	Low Reference
C	WH	5075	Current Sensor Signal

Generator

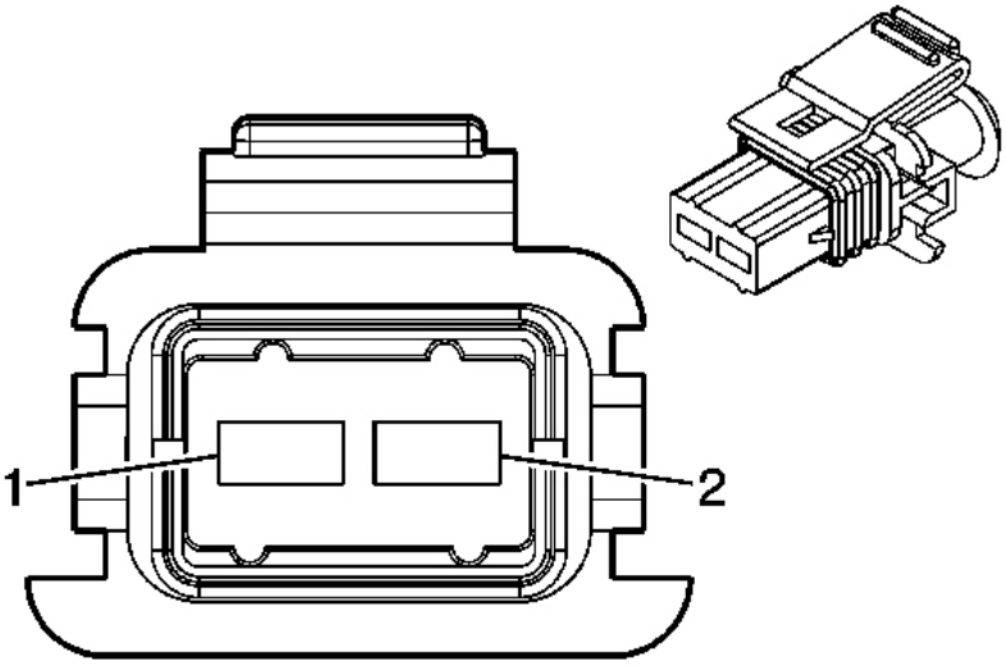


Fig. 7: Generator Connector End View
Courtesy of GENERAL MOTORS CORP.

Generator Connector Parts Information

Connector Part Information

- OEM: 12186308
- Service: 89046837
- Description: 2-Way F JPT, Sealed (BK)

Terminal Part Information

- Terminal/Tray: 4-964286-1/16
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12093647/J-35616-4A (PU)

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Generator Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
1	BN	25	Charge Indicator Control/Charge Indicator Signal
2	GY	23	Generator Field Duty Cycle Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B1325	Device Power Circuit Voltage
DTC B1424	Device Voltage Low - Theft Deterrent Module
DTC B1516	Battery Current Sensor Performance
DTC B1517	Battery Voltage
DTC B1527	High Parasitic Load Detected
DTC C0895	Device Voltage
DTC C0899	Device Voltage Low
DTC C0900	Device Voltage High
DTC P0562	System Voltage Low - ECM
DTC P0563	System Voltage High - ECM
DTC P0621	Generator L-Terminal Circuit
DTC P0622	Generator F-Terminal Circuit
DTC P1668	Generator L-Terminal Control Circuit

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

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

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

SCAN TOOL OUTPUT CONTROLS

Engine Control Module (ECM)

Scan Tool Output Control	Additional Menu Selection(s)	Description

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GEN L-Terminal	Engine Control Module, Special Functions	Commands the generator L terminal On and Off.
Starter Relay	Engine Control Module, Special Functions	Commands the starter relay On and Off.

Instrument Panel Cluster (IPC)

Scan Tool Output Control	Additional Menu Selection(s)	Description
Segment Check	Instrument Panel Cluster, Special Functions	The IPC illuminates all indicators for 7 seconds.

SCAN TOOL DATA LIST

Amplifier (AMP)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Voltage	Data Display	Volts	13.9 Volts

Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Low at Start	Data Display/ Charging Info	Yes/No	No
Batt. Open Ckt. Tested	Data Display/ Charging Info	Yes/No	No
Batt. Open Ckt. Voltage	Data Display/ Charging Info	Volts	13.03 Volts
Battery Voltage	Data Display/ Charging Info	Volts	13.9 Volts
Batt. Voltage High Res.	Data Display/ Charging Info	Volts	12.417 Volts
Parasitic Current	Data Display/ Charging Info	Amps	0.0 Amps
Prev. State of Charge	Data Display/ Charging Info	%	90%
Start Up State of Charge	Data Display/ Charging Info	%	80%
State of Charge	Data Display/ Charging Info	%	85%
State of Charge Low	Data Display/ Charging Info	Yes/No	No

Digital Radio Receiver (DRR)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value

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Operating Conditions: Ignition ON/Engine Running			
Battery Voltage	Data Display	Volts	13.9 Volts

Drivers Door Switch

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Voltage Signal	Data Display/Data	Volts	13.9 Volts

Electronic Brake Control Module (EBCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Voltage Signal	Data Display/ABS Data	Volts	13.9 Volts

Electronic Suspension Control (ESC) Module

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Voltage Signal	Data Display	Volts	13.9 Volts

Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine OFF			
Crank Request Signal	ECM, Data Display, Electrical/Theft Data	Yes/No	No
EPM Inhibit Reason	ECM, Data Display, Electrical/Theft Data	None, DLC Override, Fuel Demand, OBD Demand, MAF Demand, Deact Demand, TCM Demand	None
GEN F-Terminal Signal	ECM, Data Display, Electrical/Theft Data	%	0%
GEN L-Terminal Command	ECM, Data Display, Electrical/Theft Data	%	0%
Ignition 1 Signal	ECM, Data Display, Electrical/Theft Data	Volts	Varies
Ignition Accessory Signal	ECM, Data Display, Electrical/Theft Data	On/Off	On
PNP Switch (If Equipped)	ECM, Data Display, Electrical/Theft Data	Park/Neutral/In Gear	Park
Starter Relay Command	ECM, Data Display, Electrical/Theft Data	On/Off	Off

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Instrument Panel Cluster (IPC)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition ON/Engine Running			
Battery Voltage	Data Display	Volts	13.9 Volts

Liftgate Module

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions : Ignition ON/Engine Running			
Battery Voltage Signal	Data Display/Data	Volts	13.9 Volts

Park Assist Module

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions : Ignition Cranking			
Battery Voltage	Data Display/Battery Data	Volts	13.9 Volts

Passenger Door Switch

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions : Ignition ON/Engine Running			
Battery Voltage Signal	Data Display/Data	Volts	13.9 Volts

Supplemental Inflatable Restraint

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions : Ignition ON/Engine Running			
Battery Voltage Signal	Data Display/Data	Volts	13.9 Volts

Transmission Control Module (TCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions : Ignition ON/Transmission in Park			
TR Sw.	Engine Electrical	Park, Reverse, Neutral, Drive 5, Drive 4, Drive 3, Drive 2, Drive 1	Park

Theft Deterrent Module (TDM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Operating Conditions: Ignition Cranking			
Ignition Voltage Signal	Data Display/TDM Data	Present/Not Present	Present
Start Disabled	Data Display/TDM Data	Yes/No	Yes

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SCAN TOOL DATA DEFINITIONS

Battery Voltage

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received by the Module.

Battery Voltage Signal

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received by the Module.

Crank Request Signal

The scan tool displays Yes/No. The scan tool displays No until the ignition is placed into the START position then Yes is displayed.

GEN F-Terminal Signal

The scan tool displays 0-100%. The scan tool displays 0-100% until the engine is started and the engine control module (ECM) receives a signal from the generator then OK is displayed.

GEN L-Terminal Command

The scan tool displays 0-100%. The scan tool displays the percentage of the output voltage of the generator.

GEN L-Terminal Circuit Status

The scan tool displays Incomplete, Short Gnd / Open, Short to B+, or OK. The scan tool displays the status of the GEN-L Terminal circuit.

Ignition 1 Signal

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received on the Ignition 1 circuit to the module.

Ignition Accessory Signal

The scan tool displays ON/OFF. The scan tool displays if the ignition 0 signal is On or OFF.

Ignition Voltage Signal

The scan tool displays Present/Not Present. The scan tool displays the status of the ignition voltage signal on the theft deterrent module (TDM).

PNP Switch (If Equipped)

The scan tool displays Park/Neutral or In Gear. The scan tool displays the position of the transmission

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setting.

Start Disabled

The scan tool displays YES/NO. The scan tool displays YES if the TDM has disabled the starting function.

Starter Relay Command

The scan tool displays ON/OFF. The scan tool displays Off until the ignition is placed into the CRANK position, then it reads On.

Starter Relay Circuit Status

The scan tool displays Incomplete, Short Gnd/Open, Short to B+, or OK. The scan tool displays the status of the STRTR relay.

Start Up State of Charge

The scan tool displays 1-100%. The scan tool displays the state of charge at initial key up.

Prev. State of Charge

The scan tool displays 0-100%. The scan tool displays the state of charge from the previous ignition cycle.

State of Charge

The scan tool displays 0-100%. The scan tool displays the present state of charge.

State of Charge Low

The scan tool displays YES/NO. The scan tool displays YES if the present state of charge is low.

DTC B1325

DTC Descriptors

DTC B1325 03

Voltage Below Threshold

DTC B1325 07

Voltage Above Threshold

Diagnostic Fault Information

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Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC B1325

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Positive Voltage Circuit	B1325	B1325	B1325	B1325

Circuit/System Description

The control modules on this vehicle monitor the battery voltage through the battery positive voltage circuits. This vehicle has multiple modules that will set the DTC. For more information on which modules, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

Conditions for Running the DTC

- The voltages supplied to the control modules are in the range of 7-26 volts.
- The ignition is ON.
- The engine is running.

Conditions for Setting the DTC

B1325 03

The control module detects a system voltage below the calibrated value usually 9 volts for at least 5 seconds.

B1325 07

The control module detects a system voltage above the calibrated value usually 18 volts for at least 5 seconds.

Action Taken When the DTC Sets

- The control module immediately disables all outputs when an out of range voltage condition has been detected, with the exception of GMLAN and Run/Crank relay that are disabled after a 3 minute delay.
- The setting of other DTCs is inhibited.

Conditions for Clearing the DTC

The DTC clears when the malfunction is no longer present.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Engine Electrical Connector End Views

Electrical Information Reference

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

Diagnostic Aids

- A possible cause of this DTC could be overcharging with a battery charger or jump starting.
- A high voltage value in multiple modules indicates a concern in the charging system.

Circuit/System Verification

With the scan tool installed, ignition ON and the engine OFF, observe the Battery Positive Voltage parameter in the data list of the module setting the DTC. The reading should be between 9-18 volts.

Circuit/System Testing

1. If the DTC is history, refer to **Charging System Test**.
2. If the DTC is current, turn ON the ignition, and with a DMM, measure the voltage between the battery positive voltage circuits of the affected module and the ground circuits of the affected module.
    - If the voltage is within 9-18 volts, replace the affected module.
    - If the voltage is not within 9-18 volts, measure the voltage between the battery positive voltage circuits of the affected module and a separate good ground.
    - If the voltage is within 9-18 volts, test the battery positive ground circuits of the affected module for high resistance or an open, and repair as necessary.

Repair Procedures

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

Control Module References for the affected module replacement, setup, and programming

DTC B1405

DTC Descriptor

DTC B1405

Device Voltage Reference Output 2 Circuit

Diagnostic Fault Information

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Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC B1405

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Current Sensor Supply Voltage Circuit	B1405	B1405	-	B1405
Battery Current Sensor Signal Circuit	B1405	B1405	-	B1405
Battery Current Sensor Low Reference Circuit	-	B1405	-	B1405

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the body control module (BCM). It creates 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. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Conditions for Running the DTC

- The ignition is ON.
- The engine is running.

Conditions for Setting the DTC

The BCM detects a duty cycle of PWM input signal is less than 4 percent or more than 96 percent for more 33 seconds.

Action Taken When the DTC Sets

The driver information center (DIC) displays the SERVICE BATTERY CHARGING SYSTEM warning message.

Conditions for Clearing the DTC

The DTC clears as current status when the battery sensed current returns to normal range for more than 5 seconds.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

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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 battery current sensor.
2. Ignition OFF, test for less than 1 ohm of resistance between the low reference circuit terminal B and ground.
   - If greater than the specified range, test the low reference circuit for an open/high. If the circuit tests normal, replace the BCM.
3. Ignition ON, test for 5 volts between the battery current sensor supply voltage circuit terminal A and ground.
   - If less than the specified range, test the battery current sensor supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests, normal replace the BCM.
4. Test for 5 volts between the battery current sensor signal circuit and ground.
   - If less than 5 volts, test the battery current sensor signal circuit terminal C for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the battery current sensor.

Repair Procedures

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

- **Control Module References** for BCM replacement, setup, and programming
- **Battery Current Sensor Replacement**

DTC B1424

DTC Descriptor

DTC B1424

Device 1 Voltage Low

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

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Voltage at Pass Key 3 module is lower than the voltage being reported on the serial data line.

Conditions for Running the DTC

The ignition must be in Accessory or Run mode for this code to set.

Conditions for Setting the DTC

Module battery voltage between low voltage limits 6-9 volts for a minimum of 2 seconds and serial data voltage is greater than normal low voltage 9 volts.

Action Taken When the DTC Sets

Security telltale ON.

Conditions for Clearing the DTC

Module battery voltage is greater than normal voltage low limit 9 volts.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

Immobilizer 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 theft deterrent module (TDM) harness connector.
2. Measure and record the voltage at the battery terminals. Ignition in ON position, measure the voltage between the accessory voltage circuit and the ground circuit of the TDM. Verify that the voltage readings do not differ more than 1 volt.
    - If greater than 1 volt, test the accessory voltage circuit and the ground circuit of the TDM for an open/high resistance. If the circuits test normal, replace the TDM.
3. Refer to **Charging System Test**.

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Repair Procedures

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

Control Module References for TDM replacement, setup, and programming

DTC B1516

DTC Descriptors

DTC B1516 08

Battery Current Sensor Signal Invalid

DTC B1516 66

Battery Current Sensor Wrong Mounting Position

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC B1516

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Current Sensor Supply Voltage	B1516 08	B1516 08	-	-
Battery Current Sensor Signal Circuit	B1516 08	B1516 08	-	-
Battery Current Sensor Low Reference Circuit	-	B1516 08	-	-

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the body control module (BCM). It creates 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. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Conditions for Running the DTC

- The ignition is ON.
- The engine is running.

Conditions for Setting the DTC

B1516 08

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The BCM detects a duty cycle of the PWM input signal is less than 3 percent or more than 97 percent for more than 60 seconds.

B1516 66

The BCM detects the battery current sensor is improperly installed.

Action Taken When the DTC Sets

There is no battery telltale illuminated or driver information center (DIC) message displayed.

Conditions for Clearing the DTC

The DTC clears as current status when the battery sensed current returns to normal range for more than 5 seconds.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Body Control System Schematics**

Connector End View Reference

- **Engine Electrical Connector End Views**
- **Data Communication Connector End Views**

Electrical Information Reference

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

Circuit/System Testing

B1516 08

1. Ignition OFF, disconnect the harness connector at the battery current sensor.
2. Ignition OFF, test for less than 1 ohm of resistance between the low reference circuit terminal B and ground.
    - If greater than the specified range, test the low reference circuit for an open/high. If the circuit tests normal, replace the BCM.
3. Ignition ON, test for 5 volts between the battery current sensor supply voltage circuit terminal A and

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ground.

- If less than the specified range, test the battery current sensor supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.

4. Test for 5 volts between the battery current sensor signal circuit and ground.
   - If less than 5 volts, test the battery current sensor signal circuit terminal C for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
5. If all circuits test normal, test or replace the battery current sensor.

B1516 66

Verify that the battery current sensor is installed securely and positioned in the correct current flow direction.

- If the battery current sensor is not, remove and reinstall the sensor properly.

Repair Procedures

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

- **Control Module References** for BCM replacement, setup, and programming
- **Battery Current Sensor Replacement**

DTC B1517

DTC Descriptors

DTC B1517 03

Battery Voltage Below Threshold

DTC B1517 07

Battery Voltage Above Threshold

DTC B1517 5A

Battery Voltage Plausibility Failure

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC B1517

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Positive Voltage	B1517 03	B1517 03	B1517 07	B1517 5A

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Circuit				

Circuit/System Description

The body control module (BCM) has designated circuits for monitoring vehicle system voltage. The BCM 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. The BCM monitors the system voltage over an extended length of time. If the BCM detects the system voltage is outside an expected range for the calibrated length of time, or the BCM battery sense circuits differ by 2 volts, DTC B1517 will set. Other modules also monitor system voltage the system voltage message is sent to the other modules and will default to 12.9 volts.

Conditions for Running the DTC

The DTC shall run only if the BCM has power, ground, and the ignition is not in the START mode. This DTC shall execute regardless of battery voltage.

Conditions for Setting the DTC

B1517 03

The battery voltage falls below 12 volts, engine speed greater than 1,100 RPM for 120 seconds or the battery voltage falls below 11 volts, engine speed less than 1,100 RPM for 120 seconds.

B1517 07

The battery voltage rises above 16 volts for 15 seconds.

B1517 5A

The battery voltage differs by 2 volts on the BCM battery sense circuits for 10 seconds.

Action Taken When the DTC Sets

The driver information center (DIC) displays the SERVICE BATTERY CHARGING SYSTEM warning message and the Charge Indicator on the instrument panel cluster (IPC) illuminates.

Conditions for Clearing the DTC

- The DTC will clear current status when fault is no longer present.
- The history DTC will clear after 50 consecutive ignition cycles have occurred without a malfunction.

Diagnostic Aids

IMPORTANT: With any module voltage performance DTC, always perform the Charging System Test to ensure the charging system is functioning properly.

Reference Information

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Schematic Reference

Body Control System Schematics

Connector End View Reference

Data Communication Connector End Views

Electrical Information Reference

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

Circuit/System Testing

1. If the DTC is history, refer to **Charging System Test**.
2. If the DTC is current, turn ON the ignition, and with a DMM, measure the voltage between the battery positive voltage circuits of the BCM and the ground circuits of the BCM.
    - If the voltage is within 9.5-15 volts, replace the BCM.
    - If the voltage is not within 9.5-15 volts, measure the voltage between the battery positive voltage circuits of the BCM and a separate ground.
    - If the voltage is within 9.5-15 volts, test the battery positive and ground circuits of the BCM for high resistance or an open, and repair as necessary.
    - If the voltage differs by more than 2 volts, repair the circuit as necessary.

Repair Procedures

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

Control Module References for BCM replacement, setup, and programming

DTC B1527

DTC Descriptor

DTC B1527

High Parasitic Load Detected

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

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The body control module (BCM) monitors the state of charge (SOC) of the electrical system. If the BCM senses that the SOC at key-on is 30 percent lower than what it was when the engine was running, DTC B1527 will set.

Conditions for Running the DTC

The ignition must be in Accessory or Run mode for this code to set.

Conditions for Setting the DTC

The SOC at key-on is 30 percent lower than when the engine was running and battery drain is more than 2 amps.

Action Taken When the DTC Sets

There is no battery telltale illuminated or driver information center (DIC) message displayed.

Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run SOC is greater than or equal to 80 percent.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

Ignition ON, with scan tool compare the Prev. State of Charge and Start Up State of Charge parameters. The

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readings should not differ by more than 30 percent.

- If the readings differ by more than 30 percent, refer to **Battery Electrical Drain/Parasitic Load Test**.

Repair Procedures

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

DTC C0895

DTC Descriptor

DTC C0895

Device Voltage

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

Voltage is supplied to the electronic suspension control (ESC) module in the battery positive voltage circuit and the ignition voltage circuit. The ESC module monitors the supplied voltage to determine if it is within a valid operating range.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

The DTC is set when the battery voltage is outside the normal range of 9-15.5 volts.

Action Taken When the DTC Sets

Disable All Functionality

Conditions for Clearing the DTC

The DTC is saved as history when the ESC module no longer sees battery voltage outside the normal range of 9-15.5 volts. The DTC will clear if the fault does not return after 50 consecutive ignition cycles.

Diagnostic Aids

DTC C0895 may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time. It may also be set by an intermittent charging system malfunction.

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Reference Information

Schematic Reference

Electronic Suspension Control Schematics

Connector End View Reference

Electronic Suspension Control Connector End Views

Electrical Information Reference

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

Circuit/System Testing

1. If the DTC is history, refer to **Charging System Test**.
2. If the DTC is current, turn ON the ignition, and with a DMM, measure the voltage between the battery positive voltage circuits of the ESC and the ground circuits of the ESC.
    - If the voltage is within 9.5-15 volts, replace the ESC.
    - If the voltage is not within 9.5-15 volts, measure the voltage between the battery positive voltage circuits of the ESC and a separate good ground.
    - If the voltage is within 9.5-15 volts, test the battery positive ground circuits of the ESC for high resistance or an open, and repair as necessary.

Repair Procedures

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

Control Module References for ESC replacement, setup and programming

DTC C0899

DTC Descriptor

DTC C0899

Device Voltage Low

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

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DTC C0899

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Signal	C0899	C0899	-	-

Circuit/System Description

The electronic brake control module (EBCM) monitors the ignition voltage level available for system operation. A low voltage condition prevents the system from operating properly.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

This fault will be set if the ignition voltage to EBCM is less than 9 volts for 100 msec.

Action Taken When the DTC Sets

- Traction Control System (TCS) and Vehicle Stability Enhancement System (VSES) for the duration of the ignition cycle.
- The TCS indicator turns ON.
- The driver information center (DIC) displays the Service Stability System message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Antilock Brake System Connector End Views

Electrical Information Reference

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

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- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Testing

1. Measure and record the voltage at the battery terminals. With scan tool, observe the battery voltage signal parameter. Verify that battery terminal voltage and battery voltage signal readings do not differ more than 1 volt.
    - If more than 1 volt, test the battery positive voltage and ground circuits of the EBCM for an open/high resistance or replace the EBCM.
2. Refer to **Charging System Test**.

Repair Procedures

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

Control Module References for EBCM replacement, setup and programming

DTC C0900

DTC Descriptor

DTC C0900

Device Voltage High

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors the ignition voltage. If the voltage level is too high, damage may result in the system. When a high voltage condition is detected the EBCM turns OFF the system relay which removes battery voltage from the solenoid valves and pump motor.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

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The system voltage is greater than 16 volts for 100 msec.

Action Taken When the DTC Sets

- Traction Control System (TCS) and Vehicle Stability Enhancement System (VSES) disabled for the duration of the ignition cycle.
- ABS disabled if ignition voltage exceeds 19.5 volts.
- The TCS indicator turns ON.
- The Antilock Brake System (ABS) indicator turns ON if voltage exceeds 19.5 volts.
- The driver information center (DIC) displays the Service Stability System message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Antilock Brake System Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Diagnostic Aids

- A possible cause of this DTC could be overcharging with a battery charger or jump starting.
- A high voltage value in multiple modules indicates a concern in the charging system.

Circuit/System Verification

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1. If the DTC is history, refer to **Charging System Test**.
2. Start the engine, record the voltage at the battery terminals. Observe the battery voltage signal parameter in the EBCM data list. Voltages should not differ by more than 1 volt.
    - If more than 1 volt, replace the EBCM.

Repair Procedures

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

Control Module References for EBCM replacement, setup and programming

DTC P0562

DTC Descriptor

DTC P0562

System Voltage Low

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC P0562

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Signal	P0562	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 above 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 below 10 volts for 5 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).

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- 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.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Circuit/System Verification

With the scan tool installed, ignition ON and the engine OFF, observe the Ignition 1 Signal parameter in the ECM data list. The Ignition 1 Signal parameter should read 10.5 volts or greater.

Circuit/System Testing

1. Measure the voltage at the battery terminals and compare it with the Ignition 1 Signal parameter in the ECM data list. Verify that battery and Ignition 1 signal readings do not differ more than 1 volt.
    - If greater than 1 volt test the Ignition 1, ground circuits of the ECM for open/high resistance or replace the ECM.
2. Go to **Charging System Test**.

Repair Procedures

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

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Control Module References for ECM replacement, setup, and programming

DTC P0563

DTC Descriptor

DTC P0563

System Voltage High

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

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 above 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 less than 1 second.

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

- 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.

Reference Information

Schematic Reference

Starting and Charging Schematics

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Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

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

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

Diagnostic Aids

- A possible cause of this DTC could be overcharging with a battery charger or jump starting.
- A high voltage value in multiple modules indicates a concern in the charging system.

Circuit/System Verification

1. If the DTC is history, refer to **Charging System Test**.
2. Start the engine, record the voltage at the battery terminals. Observe the Ignition 1 Signal parameter in the ECM data list. Voltages should not differ by more than 1 volt.
    - If more than 1 volt, 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 P0621

DTC Descriptor

DTC P0621

Generator L-Terminal Circuit

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

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DTC P0621

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator L- Terminal Circuit	P0621	P0621	P0621	P0621

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

The engine is running.

Conditions for Setting the DTC

With the engine running, the ECM detects low voltage on the generator turn on signal circuit for at least 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

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

Engine Electrical Connector End Views

Electrical Information Reference

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

Circuit/System Testing

1. With ignition ON, and the engine OFF, disconnect the generator harness and measure the voltage of the generator turn on signal circuit, should read near 0 volts.
    - If greater than 0 volts test the generator turn on signal circuit for a short to voltage, or replace the ECM.
2. With ignition ON, and the engine running, the voltage of the generator turn on signal circuit, should read over 3.5 volts.
    - If no voltage is measured, test the generator turn on signal circuit for a short to ground, an open or a high resistance or replace the ECM.
3. Go to **Charging System Test**.

Repair Procedures

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

Control Module References for ECM replacement, setup, and programming

DTC P0622

DTC Descriptor

DTC P0622

Generator F-Terminal Circuit

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC P0622

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Generator F-Terminal Circuit	P0622	P0622	P0622	P0622

Circuit/System Description

The engine control module (ECM) uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to 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

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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 above 8 km/h (5 mph).
- The system voltage is between 9.5-18 volts.

Conditions for Setting the DTC

With the engine running, the ECM detects a PWM signal less than 5 percent for at least 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

- 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.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

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

Scan Tool Reference

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- **Scan Tool Data List**
- **Scan Tool Data Definitions**

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 parameter should read between 5-95 percent.

Circuit/System Testing

1. Ignition OFF, disconnect the generator harness connector.
2. With the ignition ON, and the engine OFF, connect a test lamp to battery positive voltage and repeatedly probe the generator field duty cycle circuit, harness side while monitoring the GEN-F Terminal Signal Parameter in the ECM data list. It should change from 0 percent to above 95 percent.
    - If the GEN-F Terminal Signal parameter was not affected by the test lamp, test the GEN-F terminal signal circuit for a short to ground, a high resistance, an open circuit or replace the ECM.
3. Refer to **Charging System Test**.

Repair Procedures

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

Control Module References for ECM replacement, setup, and programming

DTC P1668

DTC Descriptor

DTC P1668

Generator L-Terminal Control Circuit

Diagnostic Fault Information

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DTC P1668

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 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

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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

With the engine running the ECM detects a low voltage on the generator turn ON signal circuit for at least 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

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

Engine Electrical Connector End Views

Electrical Information Reference

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

Circuit/System Testing

1. With ignition ON, and the engine OFF, disconnect the generator harness and measure the voltage of the generator turn ON signal circuit, should read near 0 volts.

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- If greater than 0 volts, test the generator turn ON signal circuit for a short to voltage or replace the ECM.

2. With ignition ON, and the engine running, the voltage of the generator turn ON signal circuit, should read over 3.5 volts.
   - If no voltage is measured, test the generator turn ON signal circuit for a short to ground, an open or a high resistance or replace the ECM.
3. Refer to **Charging System Test**.

Repair Procedures

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

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:

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- Battery Inspection/Test
- Battery Electrical Drain/Parasitic Load Test
- Battery Common Causes of Failure
- Charging System Test
- Charge Indicator Always On
- Charge Indicator Inoperative
- Generator Noise Diagnosis
- Starter Solenoid Does Not Click
- Starter Solenoid Clicks, Engine Does Not Crank
- Engine Cranks Slowly
- Starter Motor Noise Diagnosis

BATTERY INSPECTION/TEST

Tools Required

J 42000 Battery Tester

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. 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. 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.

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

Battery Inspection/Test

Step	Action	Values	Yes	No
CAUTION: Refer to **Battery Disconnect Caution** .				
1	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to **Step 2**	Go to **Step 15**
2	Compare 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**.	-		

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	Does the battery meet or exceed the specifications?		Go to **Step 3**	Go to **Step 15**
3	1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector clockwise with light finger pressure. Does the negative connector rotate?	-	Go to **Step 4**	Go to **Step 5**
4	Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (89 lb in)	Go to **Step 9**	Go to **Step 8**
5	Attempt to rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to **Step 7**	Go to **Step 6**
6	**IMPORTANT:** **Ensure that all of the electrical loads are turned OFF.** 1. Install the **J 42000** Battery Tester. 2. Follow the directions supplied with the tester for an In-Vehicle test. 3. Follow any directions displayed on the tester. 4. If the tester calls for charging the battery, refer to **Battery Charging**. Did the tester pass the battery?	-	Go to **Step 14**	Go to **Step 8**
7	Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt. Is the torque above the specified value?	10 N.m (89 lb in)	Go to **Step 10**	Go to **Step 8**
8	1. Disconnect the negative battery cable. 2. Disconnect the positive battery cable. 3. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. 4. Remove the bolts from the cable connectors in order to provide	-		

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	access to the connector rings as needed. 5. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed. Did you complete the repair?		Go to **Step 11**	-
9	1. Disconnect the negative battery cable. 2. Inspect for the following conditions and repair as needed: • The cable bolt is too long or deformed at the end • There is foreign material present inside the nut in the battery terminal • Damage to the battery terminal face or cable connector ring Did you complete the repair?	-	Go to **Step 10**	-
10	1. Disconnect the positive battery cable. 2. Inspect for the following conditions and repair as needed: • The cable bolt is too long or deformed at the end • There is foreign material present inside the nut in the battery terminal • Damage to the battery terminal face or cable connector ring Did you complete the repair?	-	Go to **Step 11**	-
11	**IMPORTANT:** **Ensure that both battery cables are disconnected and proper adapters are installed in the battery terminals.** 1. Install the **J 42000** . 2. Follow the directions supplied with	-		

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	the tester for an Out-of-Vehicle test. 3. Follow any directions displayed on the tester. 4. If the tester calls for charging the battery, refer to **Battery Charging**. Did the tester pass the battery?		Go to **Step 12**	Go to **Step 15**
12	1. Press the CODE button on the **J 42000** . 2. For warranty purposes, write the displayed code on the repair order. Did you complete this action?	-	Go to **Step 13**	-
13	1. Connect the positive battery cable to the batteries positive terminal. **NOTE:** **Refer to Fastener Notice .** 2. Tighten the positive battery cable bolt to the specified value. 3. Connect the negative battery cable to the battery negative terminal. 4. Tighten the negative battery cable bolt to the specified value. Are the cable bolts properly tightened?	17 N.m (13 lb ft)	Battery OK	-
14	1. Press the CODE button on the **J 42000** . 2. For warranty purposes, write the displayed code on the repair order. Did you complete the replacement?	-	Battery OK	-
15	Replace the battery. Refer to **Battery Replacement**. Did you complete the replacement?	-	Battery OK	-

BATTERY CHARGING

Tools Required

J 42000 Battery Tester

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- 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.

Battery State of Charge

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

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

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

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

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

Battery Charging

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

Use the SOC information as follows:

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

Charging Time Required

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

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

Charging Procedure

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

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

Use the following procedure to charge the battery:

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

NOTE: Do not connect the negative charger lead to the housings of other vehicle

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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

Tools Required

J 38758 Parasitic Draw Test Switch

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.

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Battery Electrical Drain/Parasitic Load Test

Current Drain	Days
25 mA	30.5
50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

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 switch knob on the J 38758 is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Disconnect the battery negative cable from the battery negative terminal. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Install the male end of the **J 38758** to the battery ground terminal.
3. Turn the **J 38758** knob to the OFF position.
4. Install the battery negative cable to the female end of the **J 38758** .
5. Turn the **J 38758** knob to the ON position.
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** knob to the OFF position. The current now flows through the jumper wire.

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10. Wait 1 minute. If the fuse blows, install an inductive ammeter and go to step 19.
11. Remove the fused jumper wire.
12. Set a digital multimeter to the 10A scale.
13. Connect the digital multimeter to the test switch tool terminals.
14. Turn the **J 38758** knob to the OFF position. 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** knob to the ON position. The electrical current will now pass through the switch.
    2. Then switch the digital multimeter down to the 2A scale for a more accurate reading when the **J 38758** knob is turned OFF.
16. Turn the **J 38758** knob to the OFF position. Wait 15 minutes for most vehicles.
17. Check and record the current reading.
18. Note the battery reserve capacity, amp hour rating. Refer to **Battery Usage**.
    1. Divide the reserve capacity by 4, amp hour rating by 2.4.
    2. Compare this to the multimeter 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** .
20. Connect the battery negative cable to the battery negative terminal.

BATTERY COMMON CAUSES OF FAILURE

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

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

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. As long as the green eye is visible in the hydrometer, the freezing point of the battery will be somewhere below -32°C (-25°F).

Battery Protection During Vehicle Storage

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

In order to maintain a battery state of charge while storing the vehicle for more than 30 days, disconnect the battery ground to protect the battery from discharge by parasitic current drains.

When the battery cannot be disconnected:

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

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

JUMP STARTING IN CASE OF EMERGENCY

CAUTION: Batteries produce explosive gases. Batteries contain corrosive acid.

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Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe the following guidelines:

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

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

1. Position the vehicle with the booster battery so that the jumper cables will reach.
   - Do not let the 2 vehicles touch.
   - Make sure that the jumper cables do not have loose ends, or missing insulation.
2. Place an automatic transmission in PARK. If equipped with a manual transmission, place in NEUTRAL and set the parking brake.
3. Turn OFF all electrical loads on both vehicles that are not needed. Leave the hazard flashers ON, if required.
4. Turn OFF the ignition on both vehicles.

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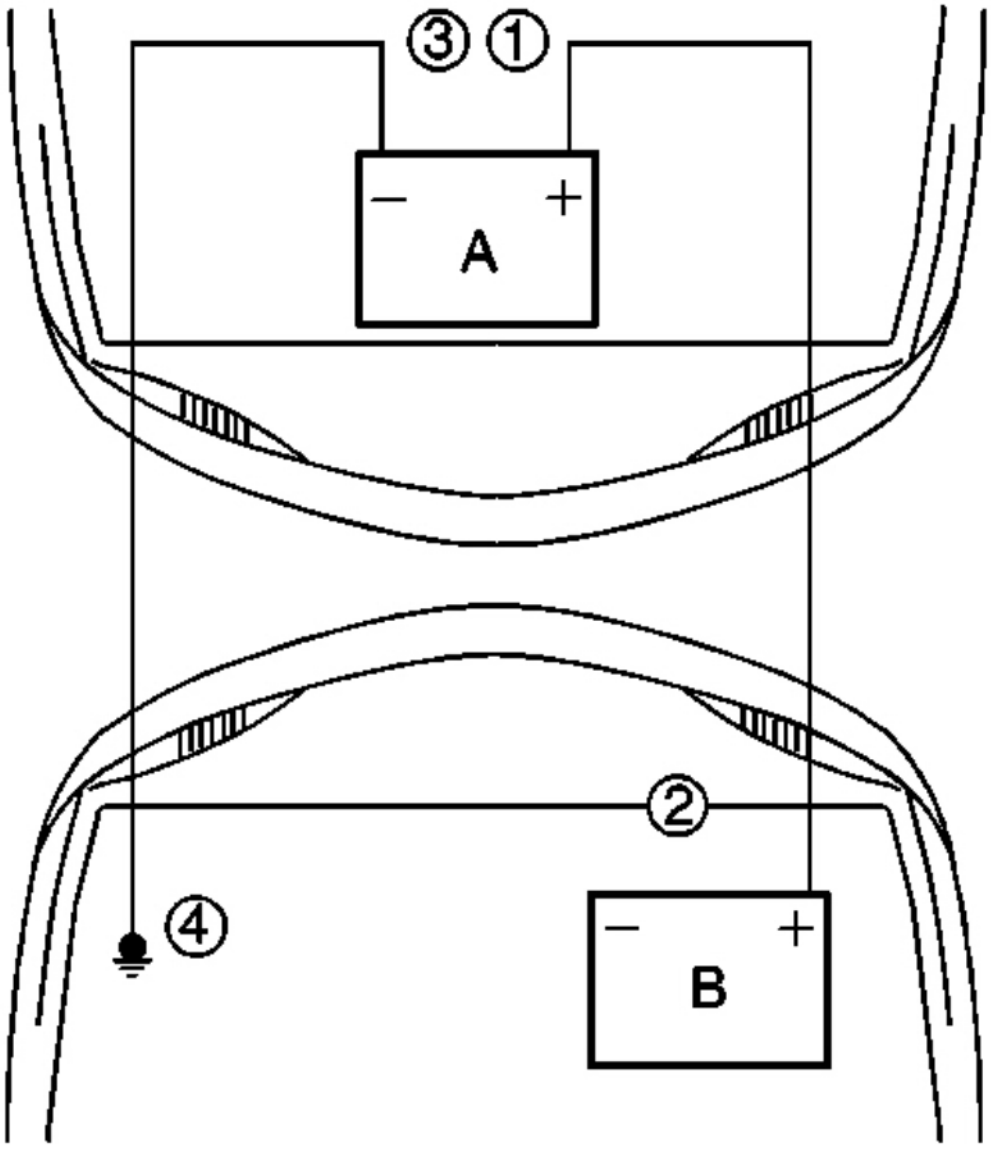


Fig. 8: Identifying Proper Jumper Cable Connection
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Some vehicles have a battery remote positive stud. ALWAYS use the battery remote positive stud in order to give or to receive a jump start.

5. Connect the red positive (+) cable to the battery positive (+) terminal (2) of the vehicle with the

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discharged battery.

6. Connect the red positive (+) cable to the positive (+) terminal (1) of the booster battery.
7. Connect the black negative (-) cable to the negative (-) terminal (3) of the booster battery.

CAUTION: Do not connect a jumper cable directly to the negative terminal of a discharged battery to prevent sparking and possible explosion of battery gases.

8. The final connection is made to a heavy, unpainted metal engine part (4) of the vehicle with the discharged battery.

   This final attachment must be at least 46 cm (18 in) away from the dead battery.

9. Start the engine of the vehicle that is providing the boost and perform the following:
   - Turn OFF all accessories.
   - Raise the engine RPM to approximately 1,500 RPM for 5 minutes.

NOTE: Never operate the starter motor more than 15 seconds at a time without pausing in order to allow it to cool for at least 2 minutes. Overheating will damage the starter motor.

10. Crank the engine of the vehicle with the discharged battery. If the engine does not crank or cranks too slowly, perform the following:
    - Turn the ignition OFF.
    - Allow the booster vehicle engine to run at approximately 1,500 RPM for an additional 5 minutes.
    - Attempt to start the engine of the vehicle with the discharged battery.
11. After the engine of the vehicle with the discharged battery starts, remove the jumper cables as follows:
    - The black negative (-) cable must be first disconnected from the vehicle that was boosted (4).
    - Disconnect the black negative (-) cable from the negative (-) terminal (3) of the booster battery.

NOTE: Do not let the cable end touch any metal. Damage to the battery and other components may result.

- Disconnect the red positive (+) cable from the positive (+) terminal (1) of the booster battery.
- Disconnect the red positive (+) cable from the remote positive (+) terminal (2) of the vehicle with the discharged battery.

CHARGING SYSTEM TEST

Charging System Test

Step	Action	Value(s)	Yes	No
	Did you perform the Diagnostic			Go to **Diagnostic**

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1	System Check - Vehicle?	-	Go to **Step 2**	**System Check - Vehicle**
2	With ignition OFF, install the **J 42000** Midtronics Digital Battery Analyzer and verify the condition of the battery. Is the battery sufficiently charged for testing?	-	Go to **Step 3**	Go to **Battery Inspection/Test**
3	1. Disconnect the **J 42000** Midtronics Digital Battery Analyzer. 2. Connect the Sun Vat 40 tester or equivalent to the battery. 3. Turn the ignition to the OFF/LOCK position. 4. Observe and record the battery voltage reading at the battery terminals on the Sun Vat 40 tester. 5. Start the engine and observe the system voltage reading on the tester. Does the voltage increase from the first specified (engine OFF) to the second (engine ON specified range)?	Engine Off = B+ Engine On = 13.9-15.5 V	Go to **Step 4**	Go to **Step 6**
4	1. Turn ON the following accessories: • Headlights - HI beams • A/C on Max • Blower Fan - On high • Rear window defogger • Heated seats, if equipped 2. Maintain engine speed at 2,500 RPM. Is voltage still within the specified value?	13.9-15.5 V	Go to **Step 5**	Go to **Step 6**
	1. Turn OFF all accessories. 2. Turn OFF the ignition. 3. Connect a carbon pile tester to the vehicle.			

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5	**IMPORTANT:** **When measuring generator output current, be sure the inductive probe encircles the generator output wire.** 4. Connect an inductive ammeter probe to the output circuit of the generator. 5. Start the engine. 6. Increase engine speed to 2,500 RPM. 7. Adjust the carbon pile as necessary in order to obtain the maximum current output. Is the generator output greater than or equal to the load test value as specified in **Generator Usage** ?	-	System OK	Go to **Step 10**
6	1. Turn the engine OFF. 2. Disconnect the generator harness connector. 3. Turn the ignition to the ON position. 4. Using a DMM, measure the voltage on the L terminal circuit. Is the voltage greater than the specified value?	0 V	Go to **Step 11**	Go to **Step 7**
7	1. Turn the engine OFF. 2. Start the engine and check the voltage on the L terminal. Is the voltage within the specified value?	5 V	Go to **Step 8**	Go to **Step 12**
8	1. Turn engine OFF. 2. Turn ignition switch to ON position. 3. Using the scan tool, observe the duty cycle in the F-terminal signal parameter. Does the scan tool display the indicated	0%		

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	value?		Go to **Step 9**	Go to **Step 13**
9	Connect a test lamp to B+ and repeatedly touch the F-terminal at the generator harness connector while monitoring the GEN-F terminal signal parameter on the scan tool. Does the scan tool indicate that the generator pulse width modulation (PWM) is above the specified range?	90%	Go to **Step 10**	Go to **Step 14**
10	1. Turn the engine OFF. 2. Inspect the generator B+ output terminal at the generator for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 15**
11	Test the L terminal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
12	Test the L terminal circuit for open or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
13	Test the GEN-F terminal for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
14	Test the GEN-F terminal circuit for an open or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
15	Inspect for poor connections at the generator. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
16	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
	IMPORTANT: **The replacement ECM must be**			

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	programmed.			
17	Replace the ECM. Refer to **Control Module References** .Did you complete the replacement?	-	Go to **Step 19**	-
18	Replace the generator. Refer to **Generator Replacement**. Did you complete the replacement?	-	Go to **Step 19**	-
19	Operate the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

CHARGE INDICATOR ALWAYS ON

Charge Indicator Always On

Step	Action	Value(s)	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views, Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Start the engine. 2. Turn OFF all accessories. Does the battery charge indicator remain illuminated?	-	Go to **Step 3**	Go to **Testing for Intermittent Conditions and Poor Connections**
3	1. Install a scan tool. 2. Start the engine. 3. Turn OFF all accessories. 4. Increase engine speed to 1,500 RPM. 5. With a scan tool, observe the Battery Voltage parameter in the body control module (BCM) data list, engine control module (ECM) data list, and the instrument panel cluster (IPC) data list. 6. Compare the voltages. Are all of the voltages within the specified range?	0.9-1.1 V	Go to **Step 4**	Go to **Step 5**
4	Are the voltages displayed within	11-16 V		Go to **Charging System**

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	the specified range?		Go to **Step 5**	**Test**
5	Test the battery positive voltage and ground circuits of the affected module for a high resistance or open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 6**
6	Inspect for poor connections at the harness connector of the affected module. Refer to **Connector Repairs** . Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
7	Replace the affected module. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	-	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	1. Turn OFF the ignition. 2. Turn ON the ignition, with the engine OFF. 3. Observe the battery charge indicator on the instrument cluster (IPC) during the bulb check. Does the battery charge indicator illuminate during the bulb check?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Replace the IPC. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 4**	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

GENERATOR NOISE DIAGNOSIS

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Diagnostic Aids

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

Generator Noise Diagnosis

Step	Action	Yes	No
1	Test the generator for proper operation using the Generator Tester. Refer to **Charging System Test**. Is the generator operating properly?	Go to **Step 2**	Go to **Step 11**
2	1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the generator harness connector. 4. Start the engine. 5. Listen for the noise. Has the noise stopped?	Go to **Step 11**	Go to **Step 3**
3	1. Turn OFF the engine. 2. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** . 3. Spin the generator pulley by hand. Does the generator shaft spin smoothly and without any roughness or grinding noise?	Go to **Step 4**	Go to **Step 11**
4	Inspect the generator for a loose pulley and/or pulley nut. Is the generator pulley or pulley nut loose?	Go to **Step 11**	Go to **Step 5**
5	1. Loosen all of the generator mounting bolts. 2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to **Generator Replacement**. 3. Install the drive belt. Refer to **Drive Belt Replacement - Accessory** . 4. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 6**
	Inspect the generator for the following conditions: • Strained or stretched electrical connections		

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6	• Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?	Go to **Step 7**	Go to **Step 8**
7	1. Reroute the electrical connections to relieve the tension. 2. Reroute the hoses, etc. away from the generator. 3. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 8**
8	Inspect the drive belt for proper tension. Refer to **Drive Belt Tensioner Diagnosis** . Is the drive belt loose?	Go to **Step 9**	Go to **Step 10**
9	1. Replace the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** . 2. Start the engine. Has the noise decreased or stopped?	System OK	Go to **Step 11**
10	Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?	System OK	Go to **Step 11**
11	**IMPORTANT:** **If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.** Replace the generator. Refer to **Generator Replacement**.Has the noise decreased or stopped?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Master Electrical Component List			
1	Did you perform the Diagnostic System Check -		Go to **Diagnostic System Check -**

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	Vehicle?	Go to **Step 2**	**Vehicle**
2	Turn the ignition switch to the start position. Does the engine crank?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Starter Relay Command parameter in the engine control module (ECM) data list. 4. Turn the ignition switch to the start position. Does the scan tool display ON?	Go to **Step 5**	Go to **Step 4**
4	1. Turn ON the ignition, with the engine OFF. 2. Verify that the transmission is in Park or Neutral. 3. With a scan tool, observe the TR Sw parameter in the transmission control module (TCM) data list. Does the scan tool display Park or Neutral?	Go to **Step 6**	Go to **Range Selector Displays Incorrect Range** for the 4L60-E/4L65-E/4L70-E transmission or **Range Selector Displays Incorrect Range** for the 4L80-E/4L85-E transmission
5	Turn the ignition switch to the start position. Did the crank relay click?	Go to **Step 8**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Remove the crank relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the control circuit of the crank relay coil and a good ground. 5. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 15**
7	1. Connect a test lamp between the control circuit of the crank relay coil and the ground circuit of the crank relay. 2. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 12**
	1. Turn ON the ignition.		

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8	2. Connect a test lamp between the battery positive voltage circuit of the crank relay switch circuit and a good ground. 3. Turn the ignition switch to the start position. Does the test lamp illuminate?	Go to **Step 9**	Go to **Step 17**
9	**IMPORTANT:** **Ensure the parking brake is applied and the transmission is in park.** Connect a 30-amp fused jumper between the battery positive voltage circuit of the crank relay switch circuit and the supply voltage circuit of the starter solenoid.Does the engine crank?	Go to **Step 13**	Go to **Step 10**
10	Does the fuse in the jumper open?	Go to **Step 18**	Go to **Step 11**
11	Test the supply voltage circuit of the starter solenoid for a high resistance or open. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 14**
12	Test the ground circuit of the crank relay for an open or a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	-
13	Inspect for poor connections at the crank relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 19**
14	Inspect for poor connections at the starter solenoid. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	Go to **Step 20**
15	Repair an open or high resistance in the control circuit of the crank relay coil. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	Go to **Step 16**
16	Inspect for poor connections at the harness connector of the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** . Did you find and correct the condition?	Go to **Step 22**	**Step 21**
17	Repair the open or high resistance in the battery positive voltage circuit of the crank relay switch. Refer to **Wiring Repairs** . Did you complete the repair?	Go to **Step 22**	-
18	Repair the short to ground in the supply voltage circuit of the starter solenoid. Refer to **Wiring Repairs** .		

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	Did you complete the repair?	Go to **Step 22**	-
19	Replace the crank relay. Did you complete the replacement?	Go to **Step 22**	-
20	Replace the starter motor. Refer to **Starter Motor Replacement**. Did you complete the replacement?	Go to **Step 22**	-
21	Replace the ECM. Refer to **Control Module References** for replacement, setup, and programming. Did you complete the replacement?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Starter Solenoid Clicks, Engine Does Not Crank

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

ENGINE CRANKS SLOWLY

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Perform the following checks:

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

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**.

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

- Inspect the flexplate ring gear for damage or unusual wear.
- Shim the starter if applicable.
- In order to add pinion to ring gear clearance a full size shim must be used. Do not shim only one starter mounting bolt. There are 3 shims available in different shapes for clearance. All are 1 mm (0.039 in) thick.

Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Start the engine. Does the starter operate normally?	Go to **Testing for Intermittent Conditions and Poor Connections**	Go to **Step 3**
3	Start the engine while listening to the starter motor turn. Is there a loud "whoop", it may sound like a siren if the engine is revved while the starter is engaged after the engine starts, but while the starter is still held in the engaged position?	Go to **Step 6**	Go to **Step 4**
4	Do you hear a "rumble", a "growl", or, in some cases, a "knock" as the starter is coasting down to a stop after starting the engine?	Go to **Step 7**	Go to **Step 5**
5	This is often diagnosed as a starter drive gear hang-in or a weak solenoid. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to **Step 6**	Go to **Step 7**
	Inspect the flexplate ring gear for the following:		

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6	• Chipped gear teeth • Missing gear teeth • Milled teeth Is the flexplate bent, or does it have damaged teeth?	Go to **Step 8**	Go to **Step 9**
7	1. Remove the starter motor. Refer to **Starter Motor Replacement**. 2. Inspect the starter motor bushings and clutch gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to **Step 9**	Go to **Step 8**
8	Replace the flexplate. Refer to **Automatic Transmission Flex Plate Replacement** . Did you complete the replacement?	Go to **Step 10**	-
9	Replace the starter motor. Refer to **Starter Motor Replacement**. Did you complete the replacement?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

Disconnect Procedure

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

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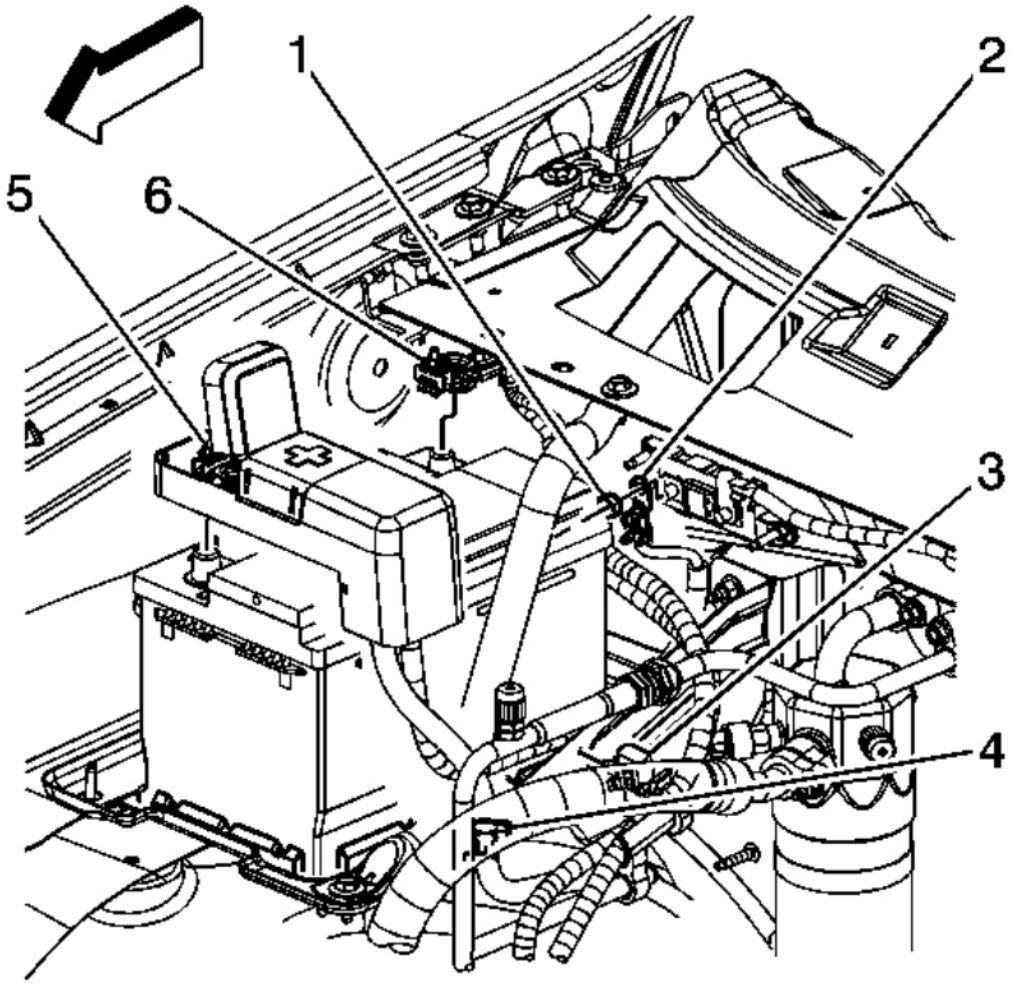


Fig. 9: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

1. Turn off all the lamps and accessories.
2. Turn the ignition OFF.
3. Open the hood.
4. Loosen the negative cable nut (1).
5. Remove the negative battery cable from the battery terminal.
6. Reposition the negative battery cable away from the battery.

Connect Procedure

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

IMPORTANT: Clean any existing corrosion from the battery terminal and the battery cable end.

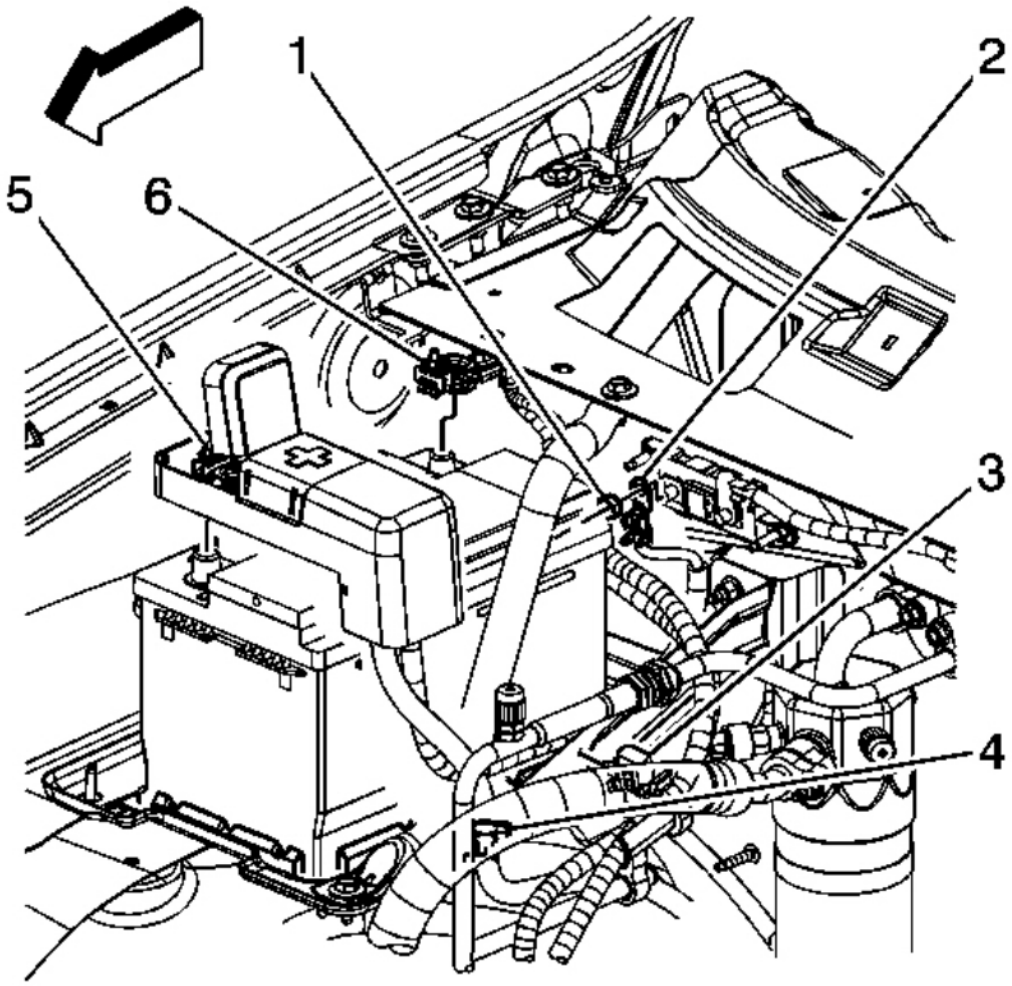


Fig. 10: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

1. Position the negative battery cable to the battery.

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NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the negative battery cable onto the battery terminal.
3. Tighten the negative cable nut (1)

   Tighten: Tighten the nut to 17 N.m (13 lb ft).

4. Close the hood.

BATTERY CURRENT SENSOR REPLACEMENT

Removal Procedure

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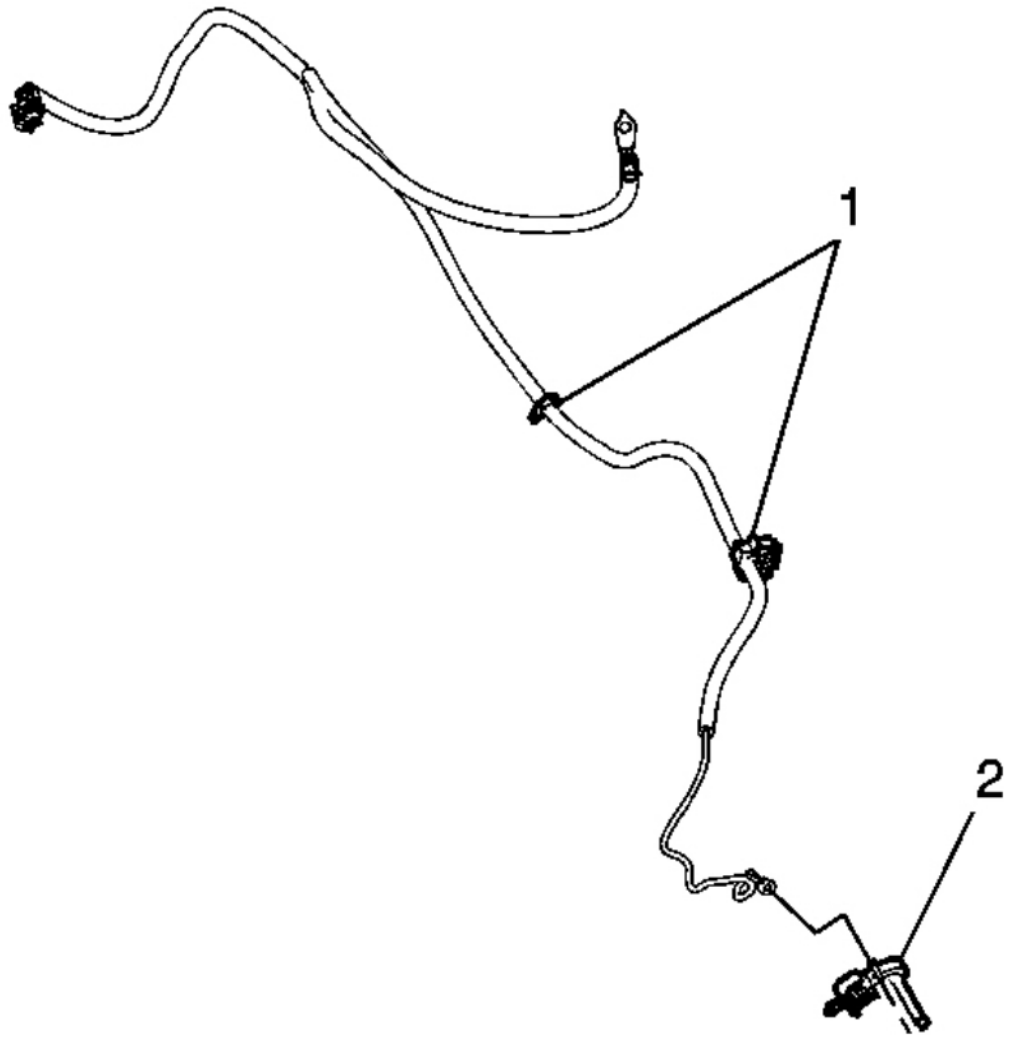


Fig. 11: View Of Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the negative battery cable. Refer to **Battery Negative Cable Replacement**.
2. Mark the location of the battery current sensor on the battery cable with tape for reference during installation.
3. Remove the tape securing the battery current sensor to the negative battery cable.
4. Mark the location of the negative battery cable clips (1) and remove the clips from the cable.
5. Squeeze the negative battery cable branches together.

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

6. Slide the battery current sensor (2) off of the negative battery cable.

Installation Procedure

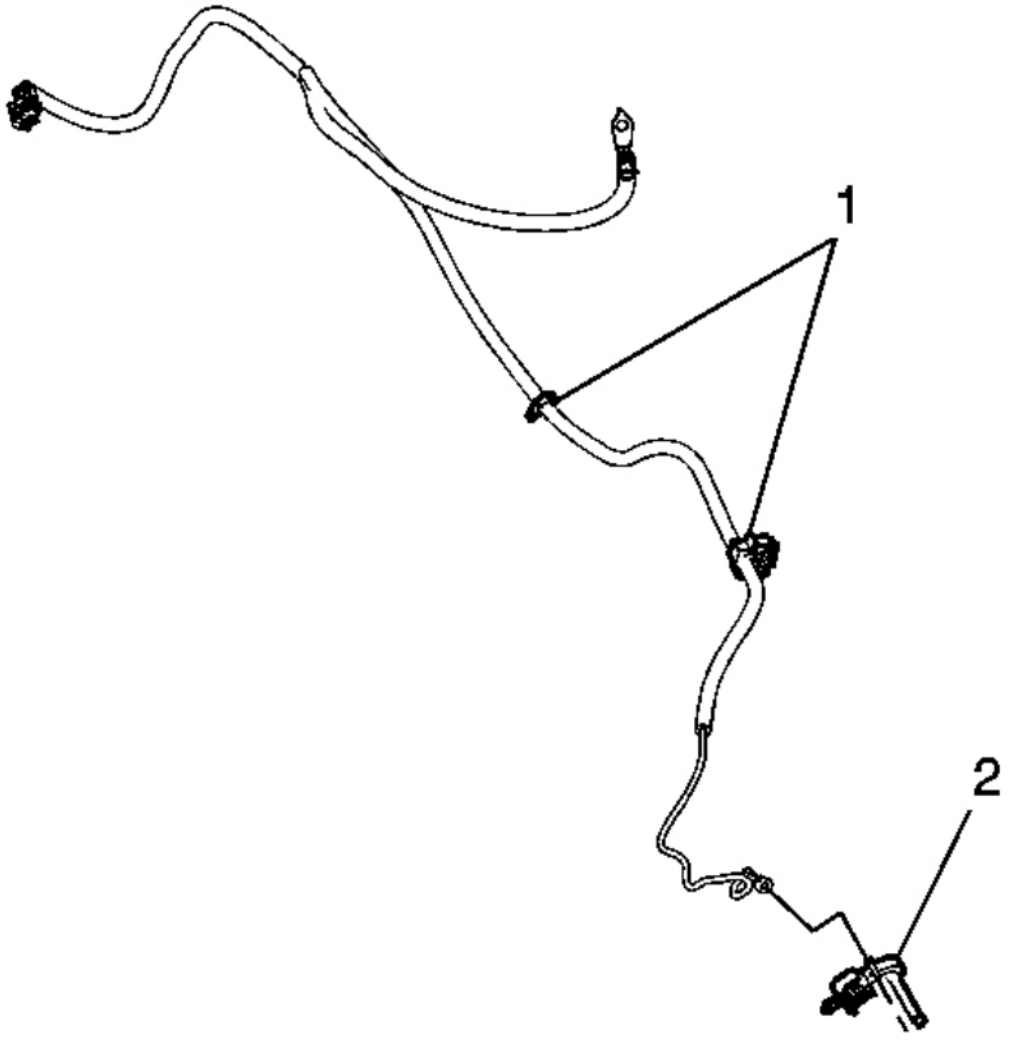


Fig. 12: View Of Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Squeeze the negative battery cable branches together.

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

2. Slide the NEW battery current sensor (2) up onto the negative battery cable to the location previously marked during removal.
3. Wrap electrical tape around the battery current sensor leg in order to secure the sensor to the negative battery cable.
4. Install the negative battery cable clips (1) to the cable to the locations previously marked during removal.
5. Install the negative battery cable. Refer to **Battery Negative Cable Replacement**.

BATTERY NEGATIVE CABLE REPLACEMENT

Removal Procedure

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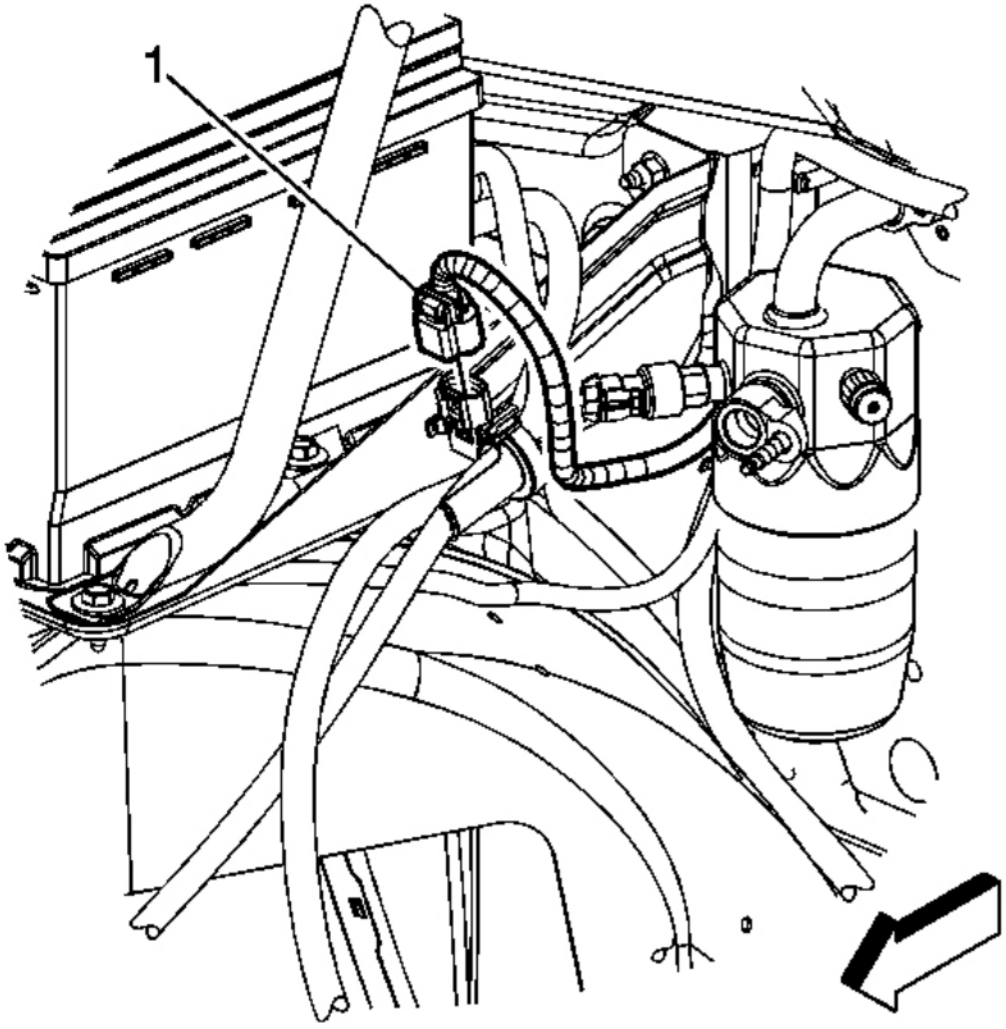


Fig. 13: View Of Engine Harness Electrical Connector & Battery Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Disconnect the engine harness electrical connector (1) from the battery current sensor.

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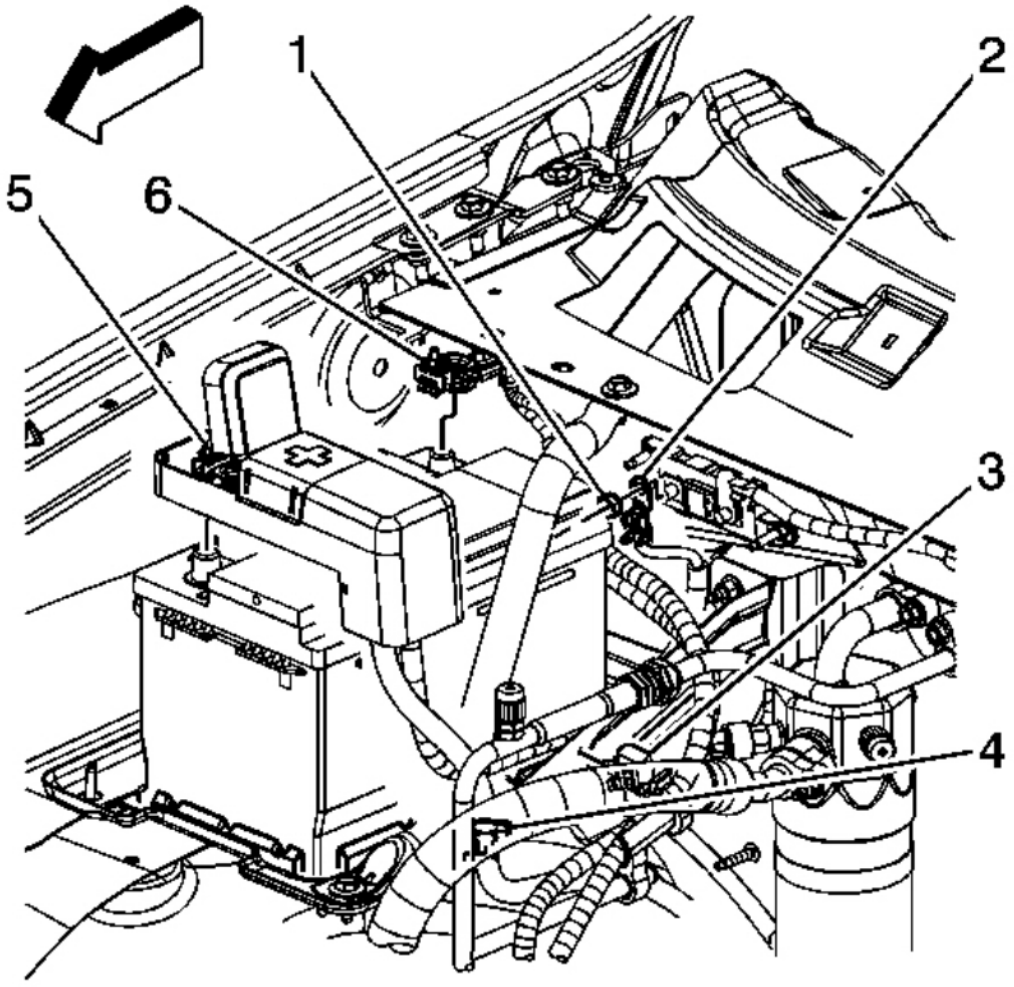


Fig. 14: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the battery current sensor (3) clip from the battery tray, if equipped with a battery current sensor.

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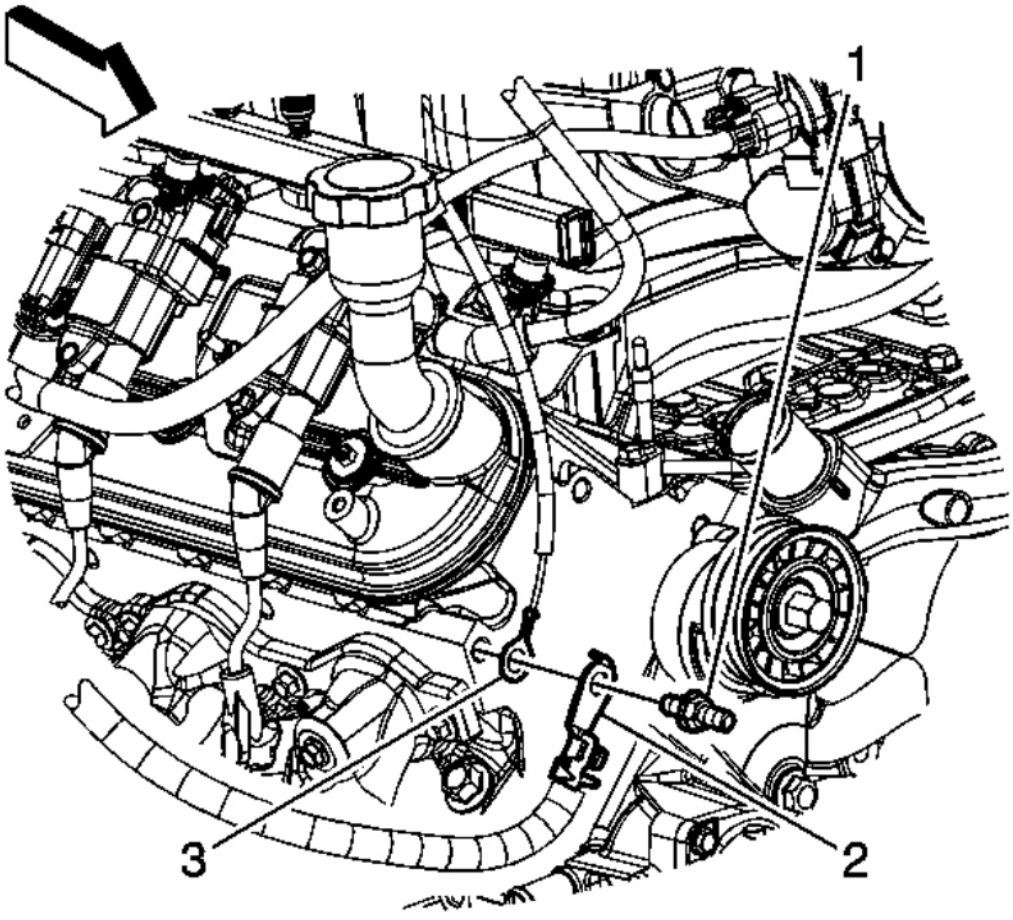


Fig. 15: View Of Battery Cable Terminals & Stud
Courtesy of GENERAL MOTORS CORP.

5. Remove the negative battery cable stud (1) from the front of the right cylinder head.
6. Remove the negative battery cable terminal (2) from the cylinder head.

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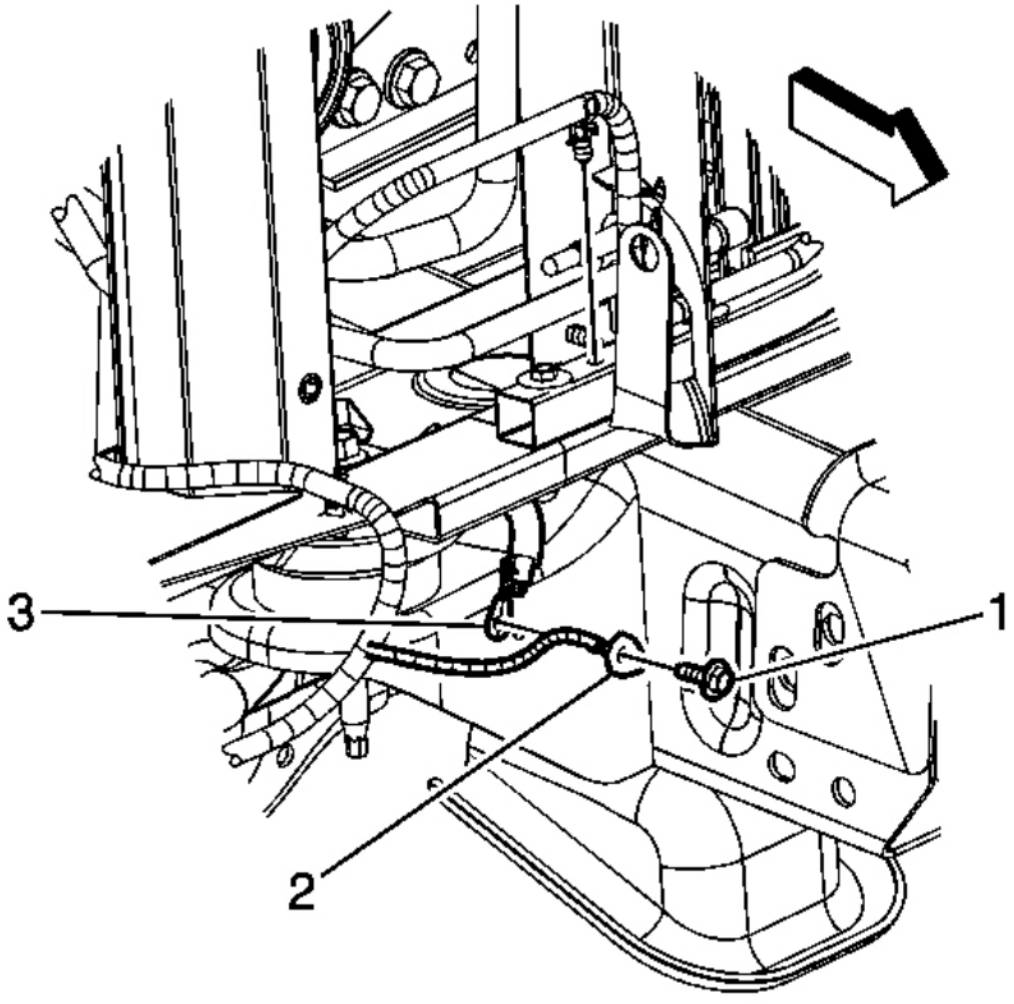


Fig. 16: View Of Negative Battery Cable Terminal, Forward Lamp Wiring Harness Terminal & Ground Bolt
Courtesy of GENERAL MOTORS CORP.

7. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
8. Remove the forward lamp wiring harness ground bolt (1).
9. Remove the forward lamp wiring harness terminal (2) from the frame.
10. Remove the negative battery cable terminal (3) out through the opening between the radiator support and frame.

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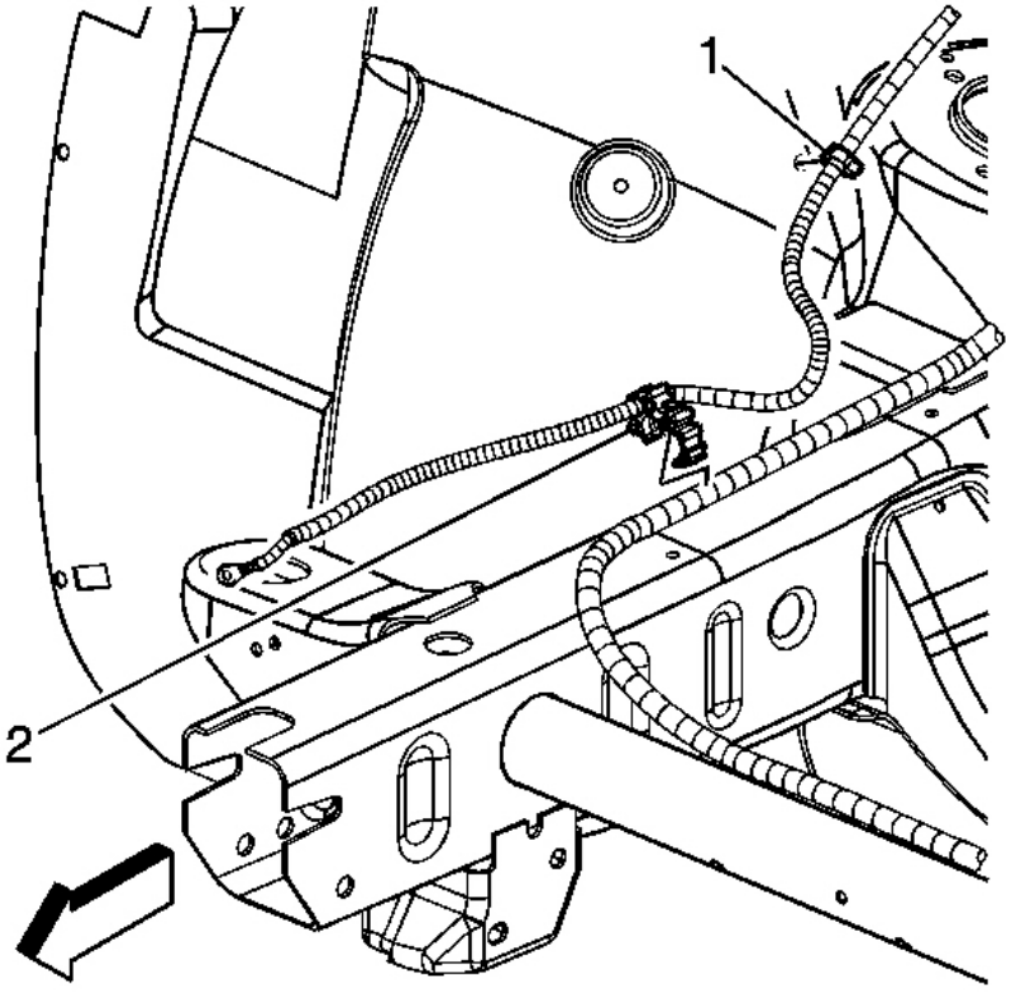


Fig. 17: Locating Battery Cable Clips
Courtesy of GENERAL MOTORS CORP.

11. Remove the negative battery cable clip (2) from the chassis harness.
12. Lower the vehicle.
13. Remove the negative battery cable clip (1) from the right wheelhouse liner.

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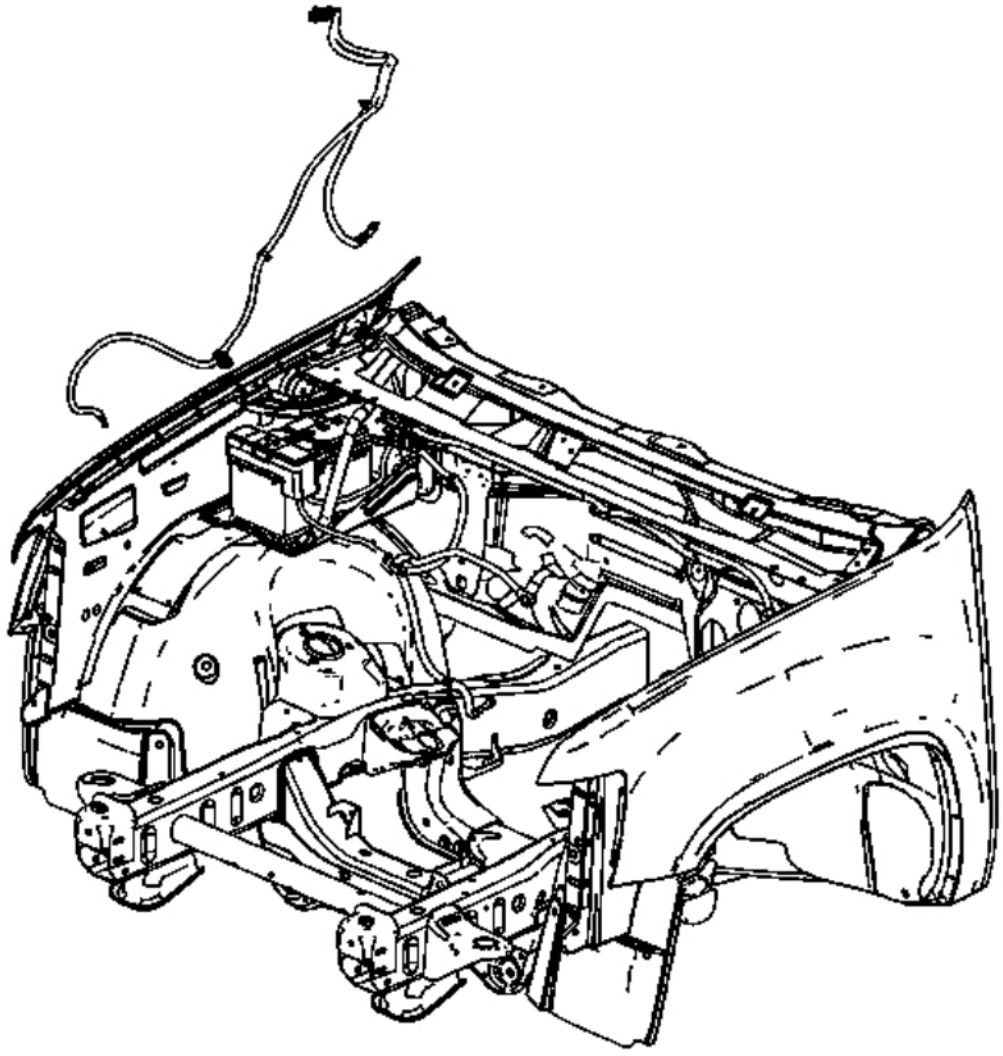


Fig. 18: View Of Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

14. Remove the negative battery cable from the vehicle, if equipped without a battery current sensor.

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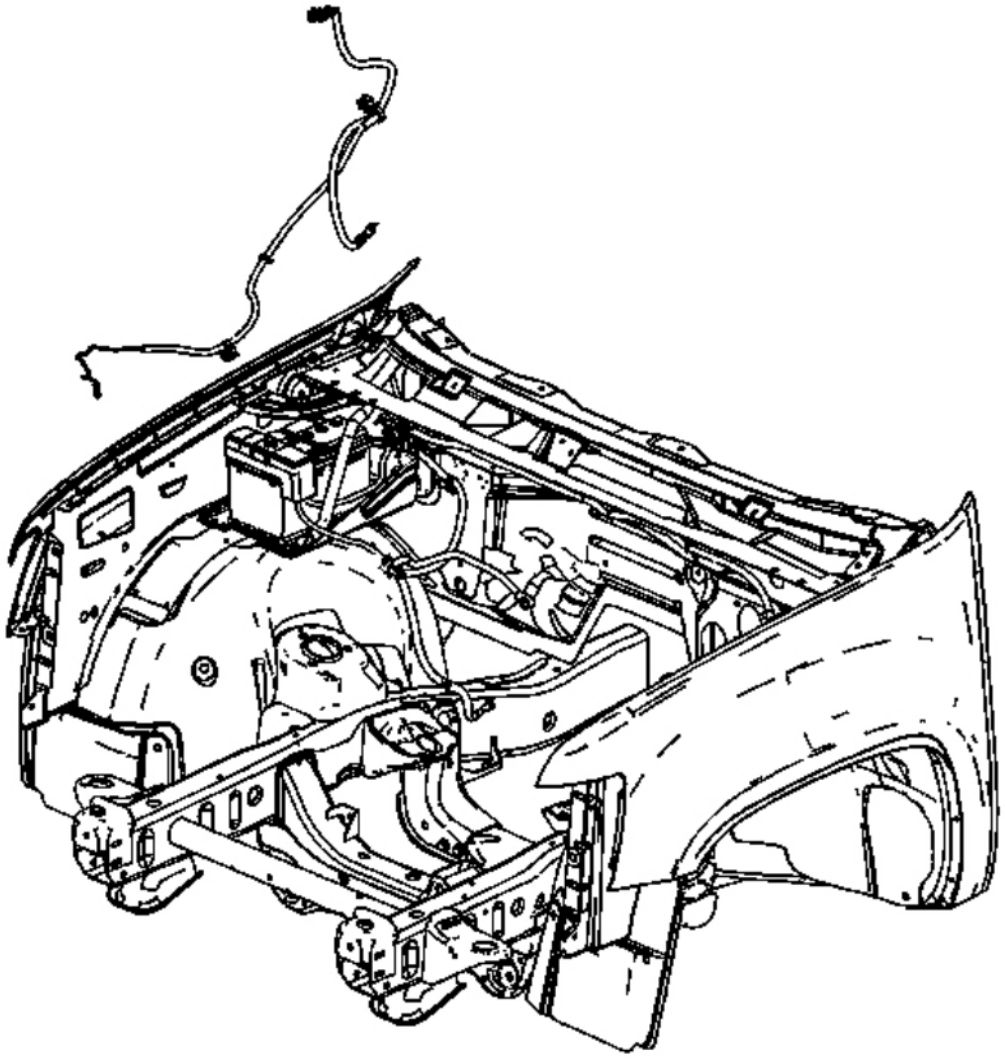


Fig. 19: View Of Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

15. Remove the negative battery cable from the vehicle, if equipped with a battery current sensor.
16. If replacing the negative battery cable, remove the battery current sensor, if equipped. Refer to **Battery Current Sensor Replacement**.

Installation Procedure

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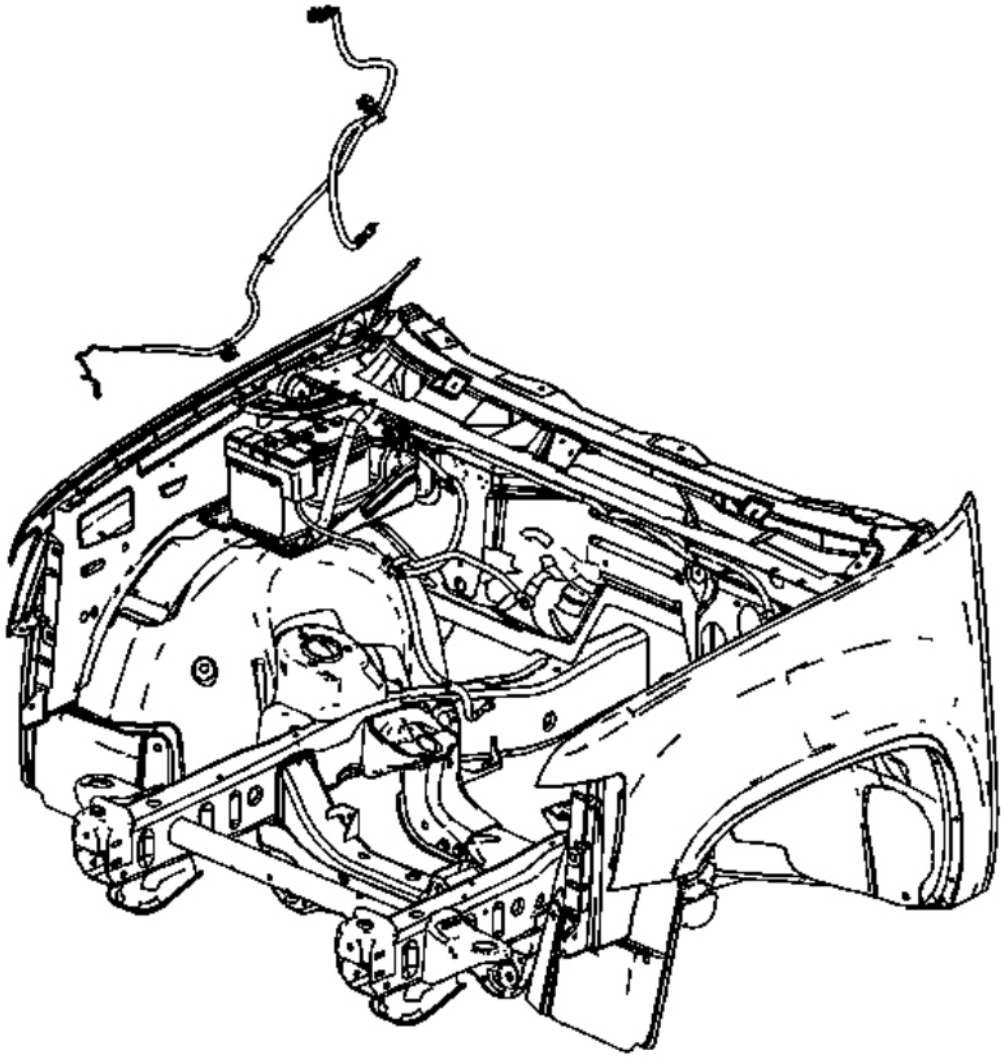


Fig. 20: View Of Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

1. If the negative battery cable was replaced, install the battery current sensor, if equipped. Refer to **Battery Current Sensor Replacement**.
2. Install the negative battery cable to the vehicle, if equipped with a battery current sensor.

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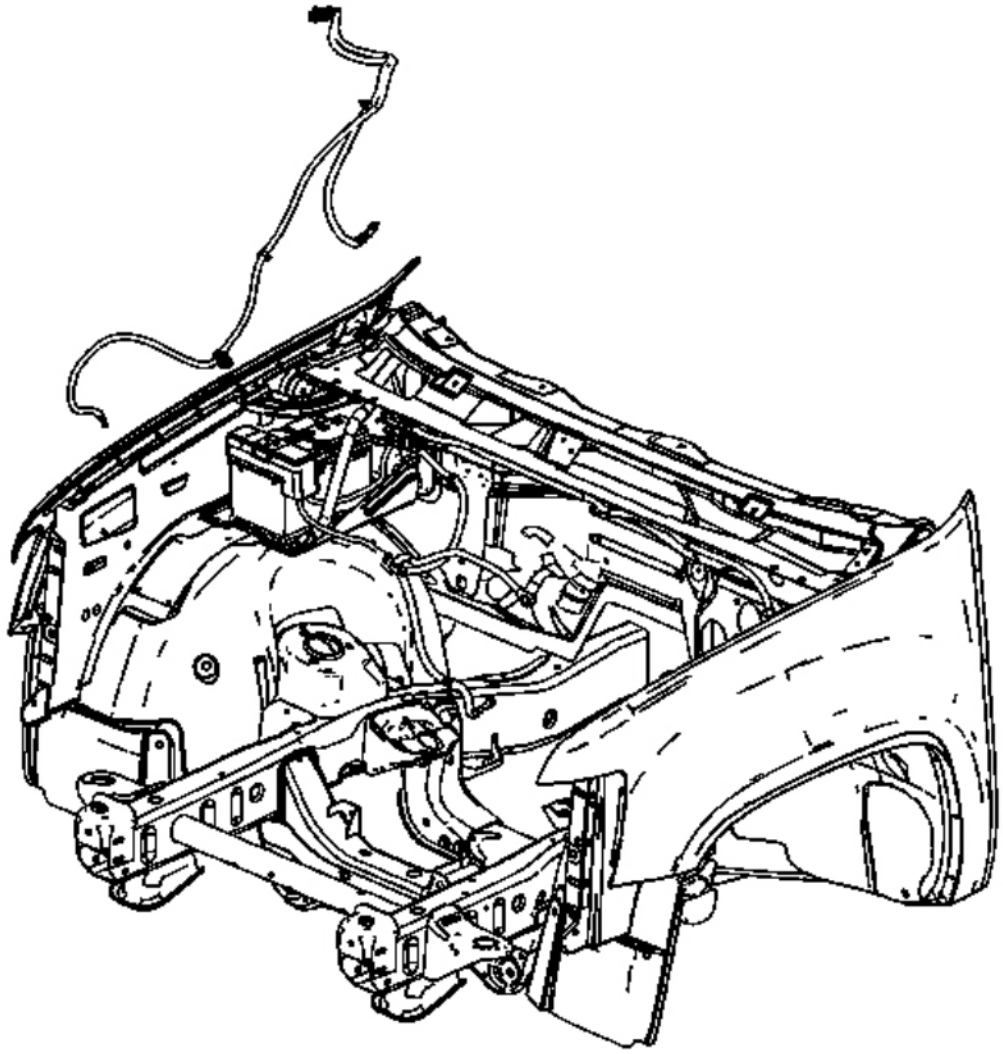


Fig. 21: View Of Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

3. Install the negative battery cable to the vehicle, if equipped without a battery current sensor.

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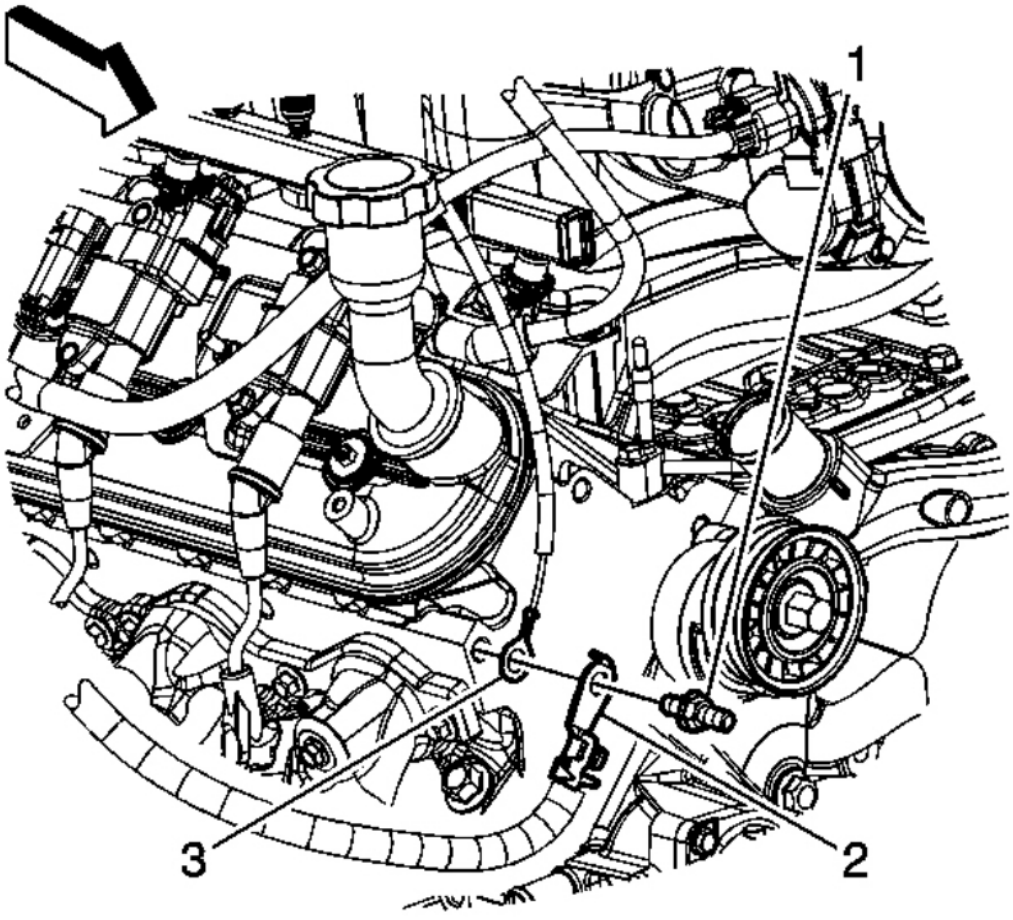


Fig. 22: View Of Battery Cable Terminals & Stud
Courtesy of GENERAL MOTORS CORP.

4. Ensure that the engine harness terminal (3) is position behind the negative battery terminal (2).
5. Position the negative battery cable terminal (2) to the cylinder head.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the negative battery cable stud (1) to the front of the right cylinder head.

Tighten: Tighten the stud to 25 N.m (18 lb ft).

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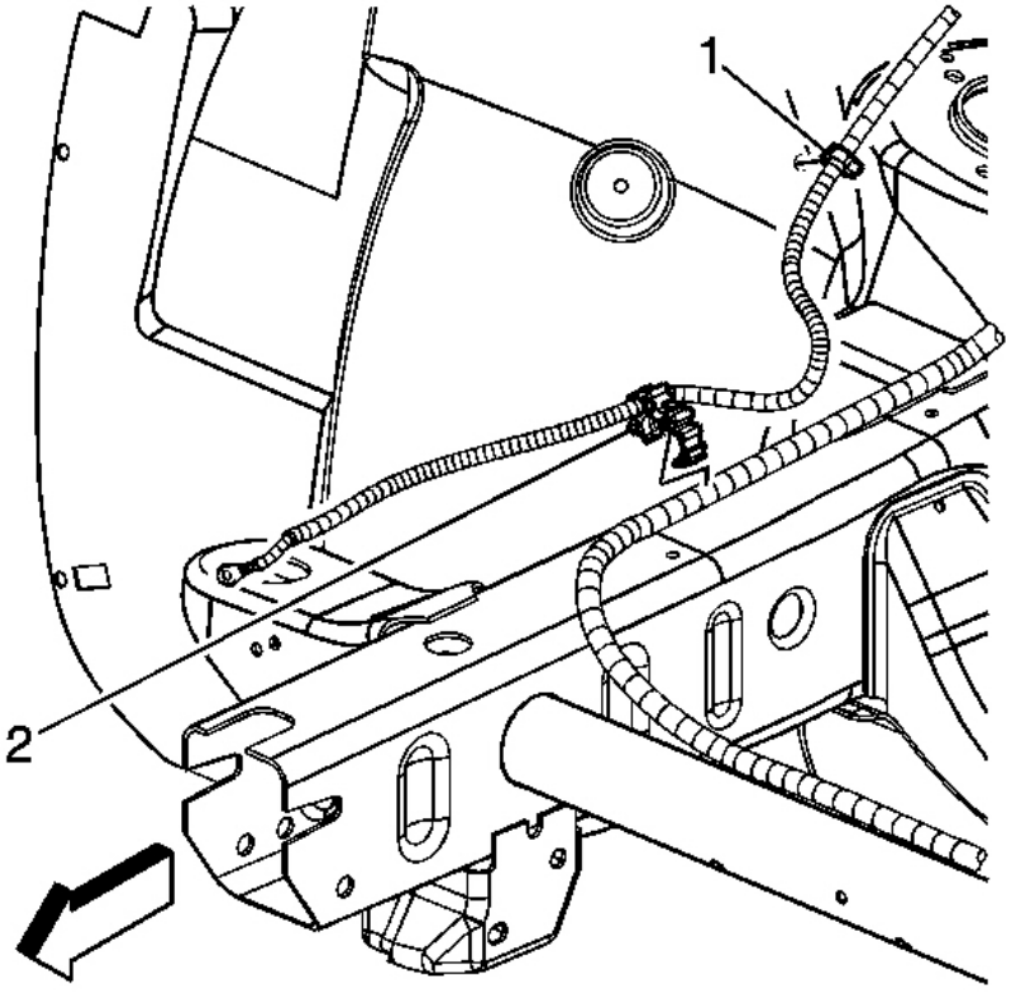


Fig. 23: Locating Battery Cable Clips
Courtesy of GENERAL MOTORS CORP.

7. Install the negative battery cable clip (1) to the right wheelhouse liner.
8. Raise the vehicle.
9. Install the negative battery cable clip (2) to the chassis harness.

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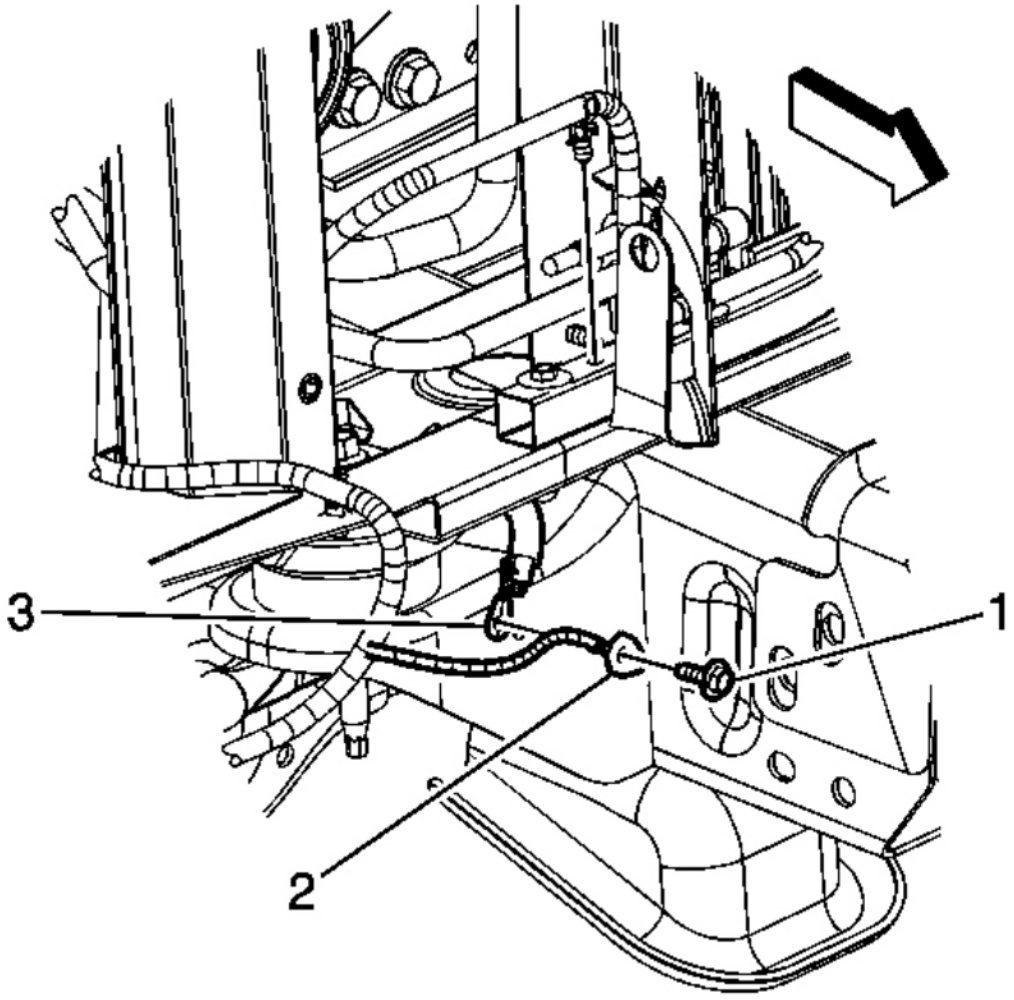


Fig. 24: View Of Negative Battery Cable Terminal, Forward Lamp Wiring Harness Terminal & Ground Bolt
Courtesy of GENERAL MOTORS CORP.

10. Route the negative battery cable terminal (3) through the opening between the radiator support and frame.
11. Ensure that the negative battery cable is positioned behind the forward lamp harness.
12. Install the forward lamp wiring harness terminal (2) to the frame. Ensure that the anti-rotation tab is inserted into the hole in the frame.
13. Install the forward lamp wiring harness ground bolt (1).

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

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14. Lower the vehicle.

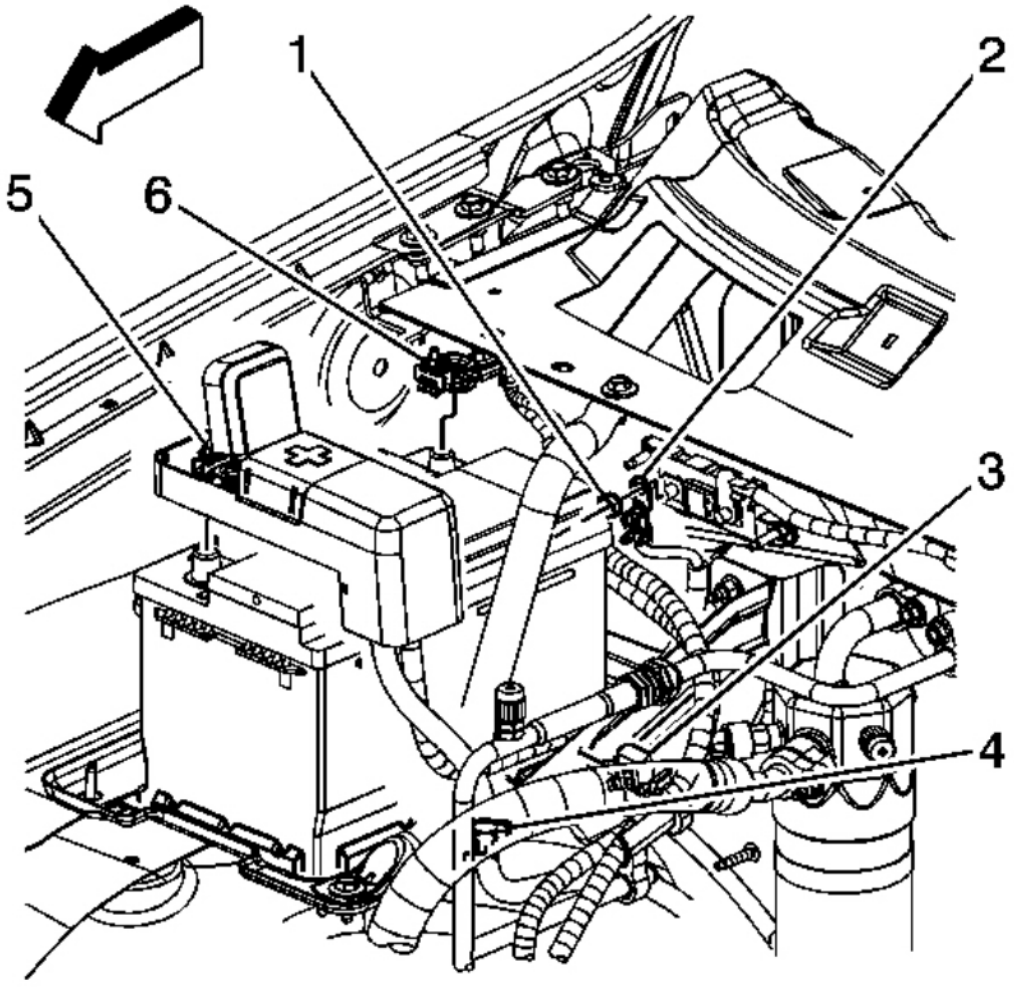


Fig. 25: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

15. Install the battery current sensor (3) clip to the battery tray, if equipped with a battery current sensor.

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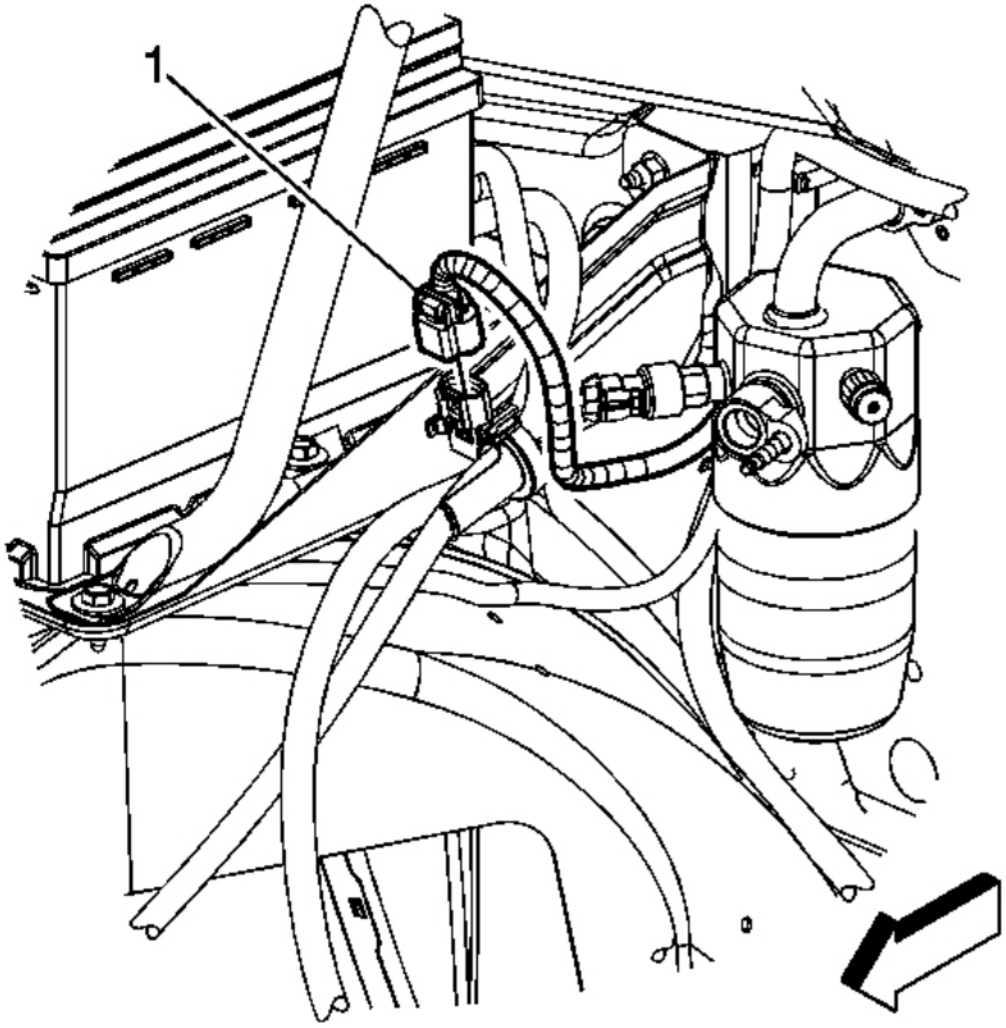


Fig. 26: View Of Engine Harness Electrical Connector & Battery Current Sensor
Courtesy of GENERAL MOTORS CORP.

16. Connect the engine harness electrical connector (1) to the battery current sensor.
17. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
18. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

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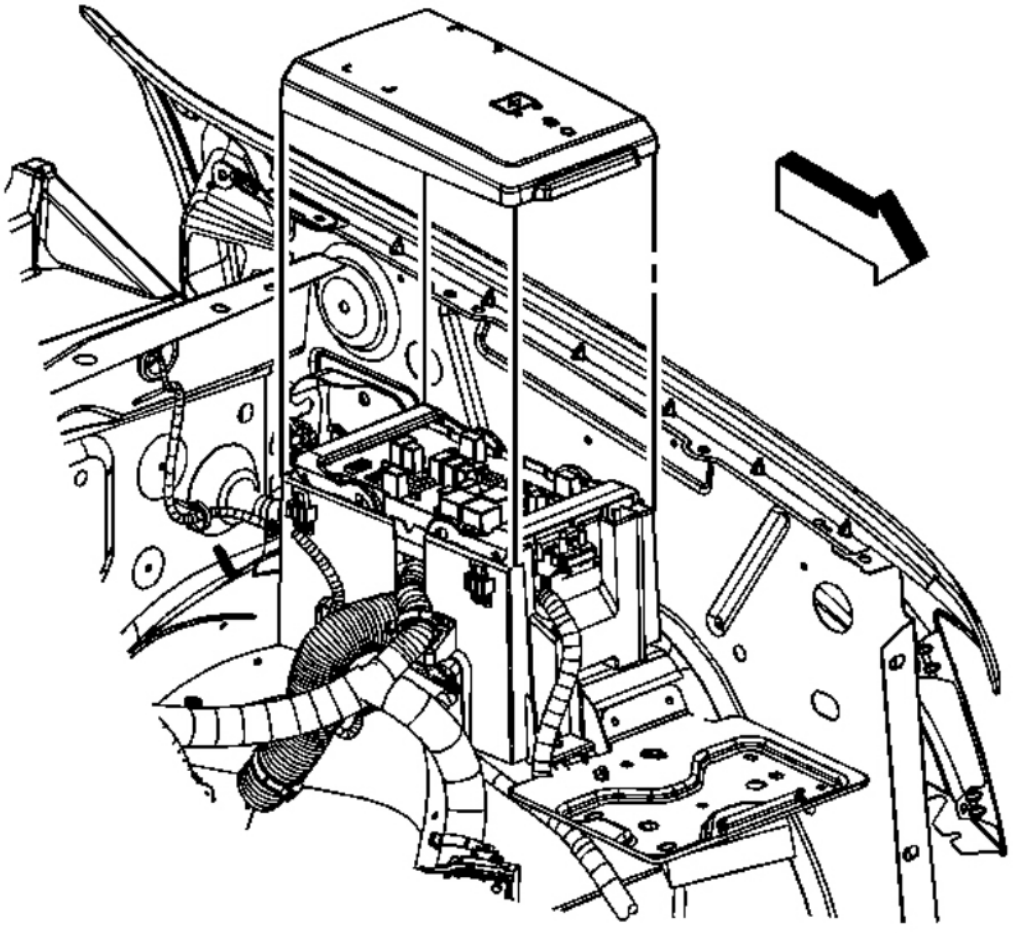


Fig. 27: View Of Under Hood Junction Block Cover
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the under hood junction block cover.

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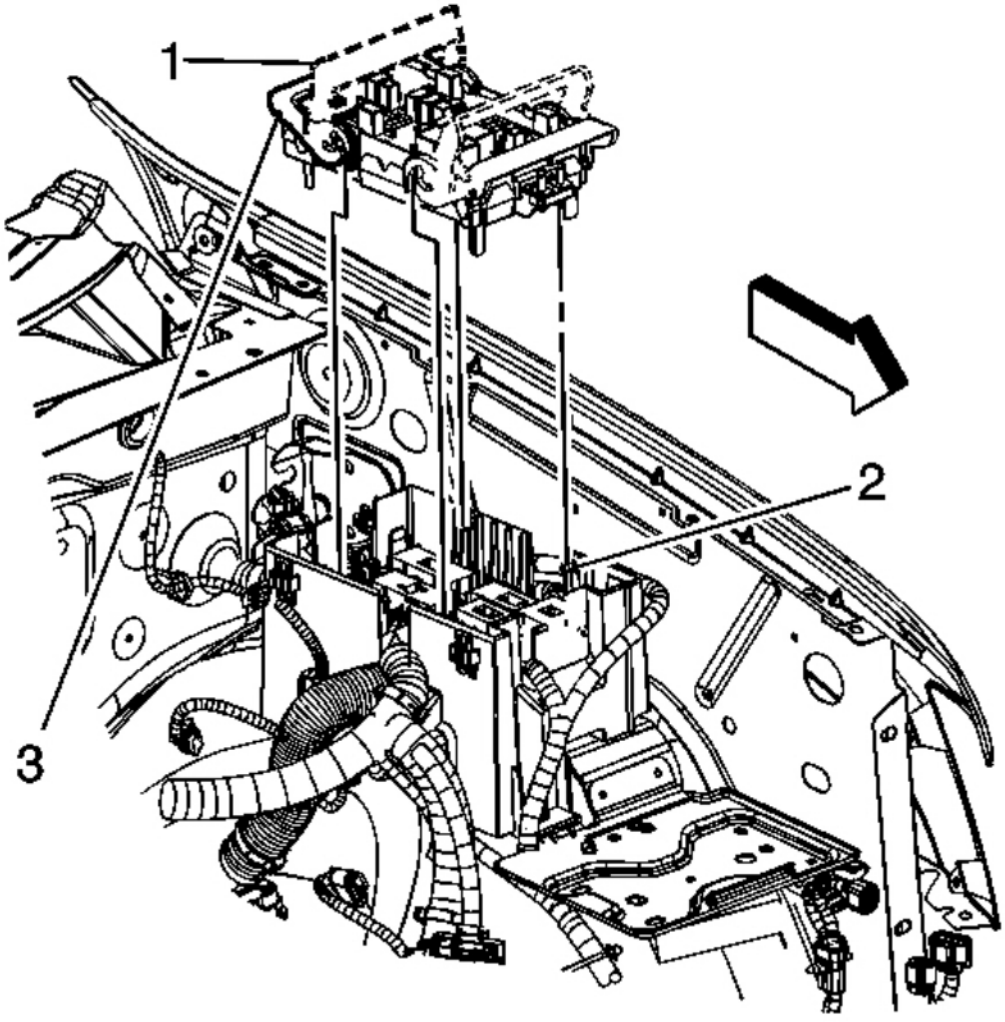


Fig. 28: View Of Junction Block & Retainers
Courtesy of GENERAL MOTORS CORP.

3. Lift the junction block retainers from the locked position (3) and rotate the retainers to the open position (1).
4. Remove the junction block.

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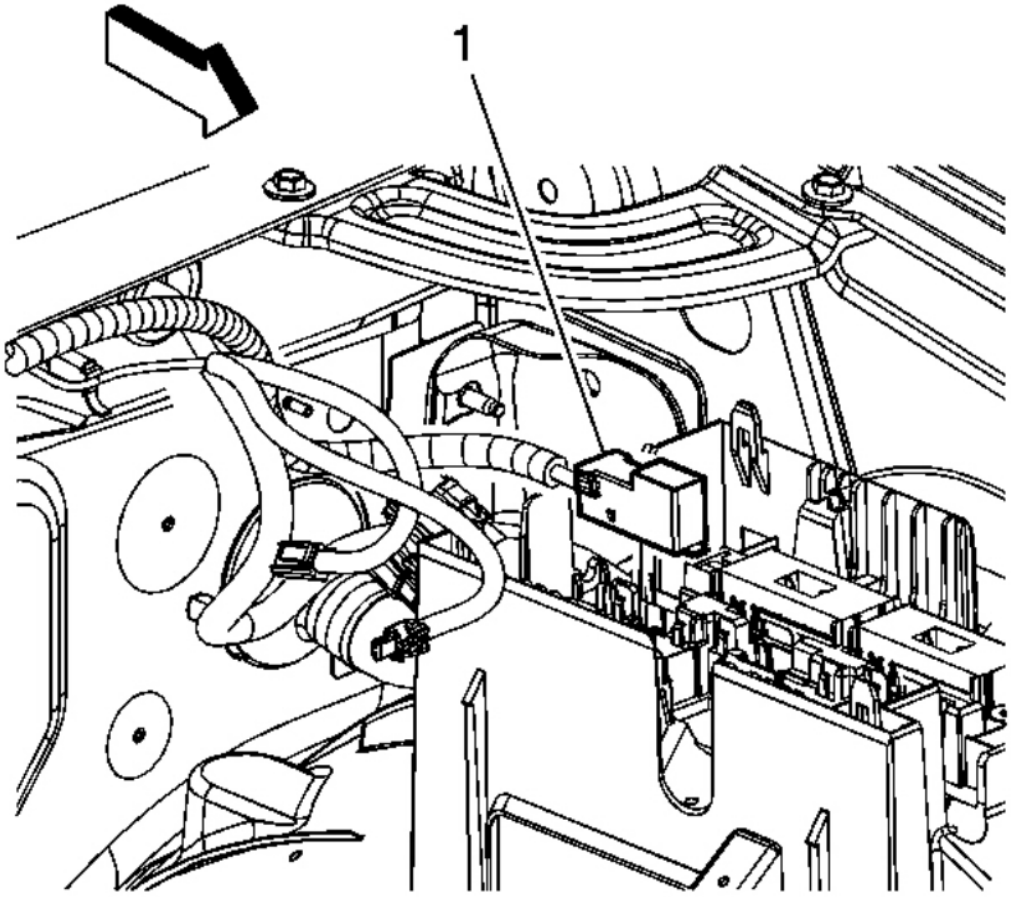


Fig. 29: View Of Positive Battery Cable Connector & (UBEC)
Courtesy of GENERAL MOTORS CORP.

5. Remove the positive battery cable connector (1) from the underhood bussed electrical center (UBEC).

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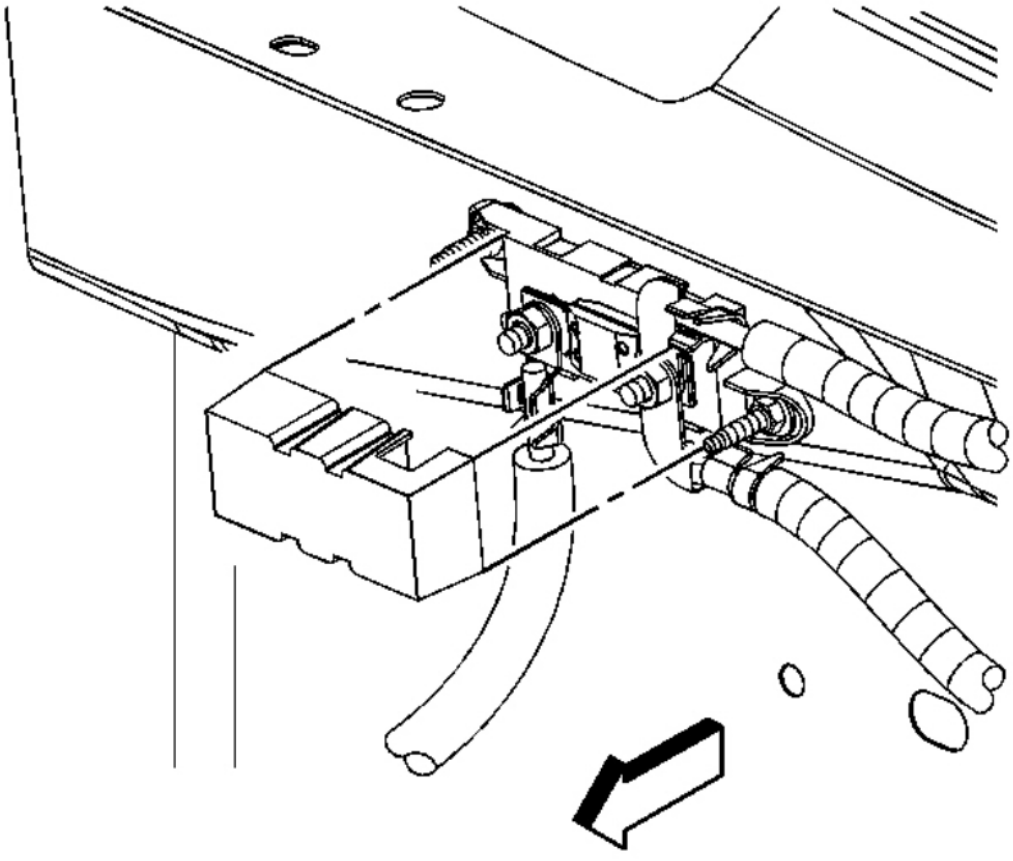


Fig. 30: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

6. Remove the mega fuse cover.

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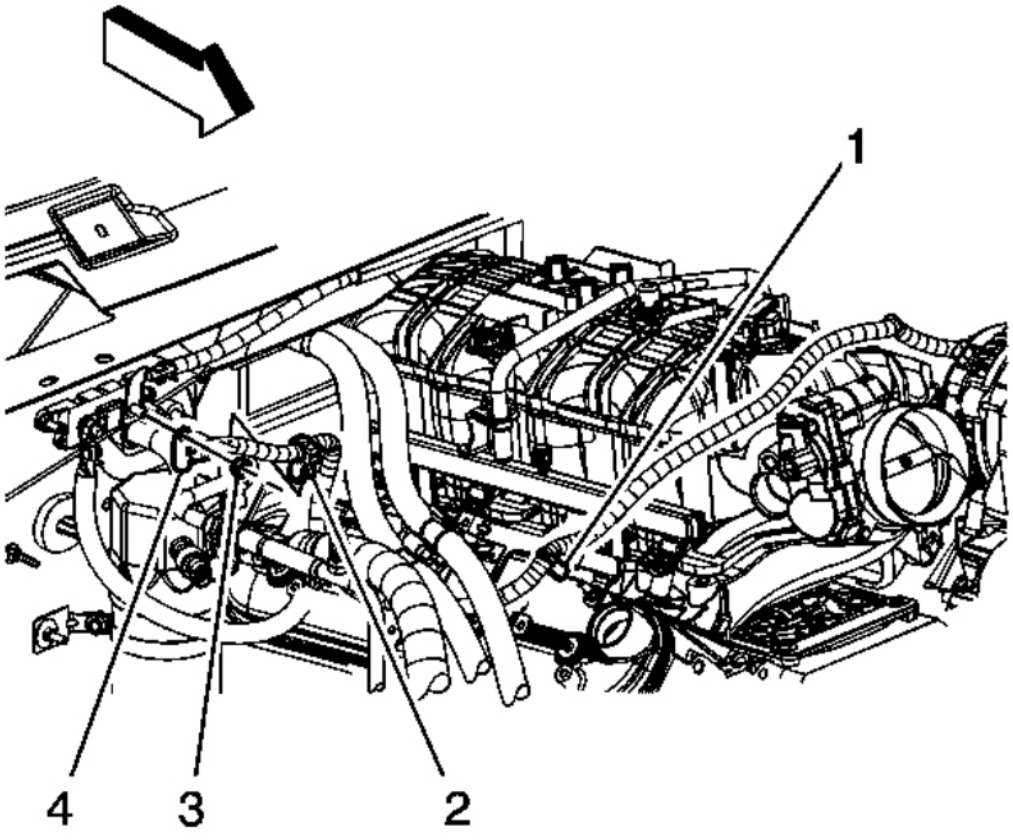


Fig. 31: View Of Generator Battery Jumper Cable & Components
Courtesy of GENERAL MOTORS CORP.

7. Remove the generator battery jumper cable to mega fuse nut (3).
8. Remove the generator battery jumper cable terminal (4) from the mega fuse stud.

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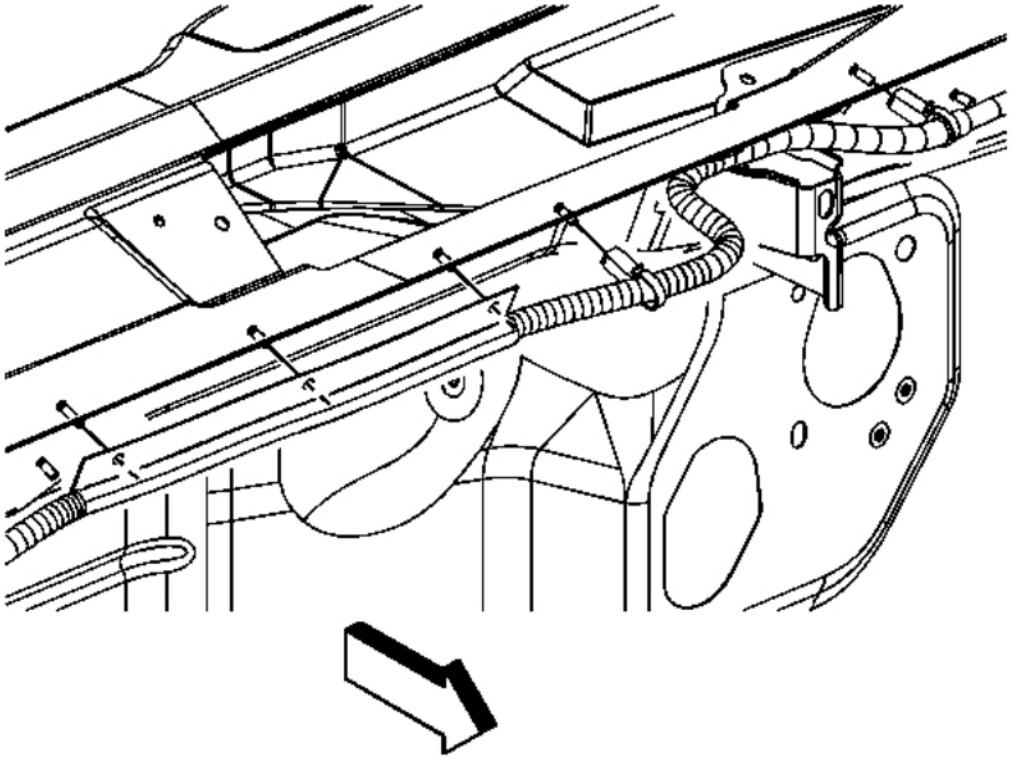


Fig. 32: View Of Positive Battery Cable Channel, Clips & Studs
Courtesy of GENERAL MOTORS CORP.

9. Remove the positive battery cable channel from the studs on the plenum front panel.
10. Remove the positive battery cable clips from the studs on the plenum front panel.

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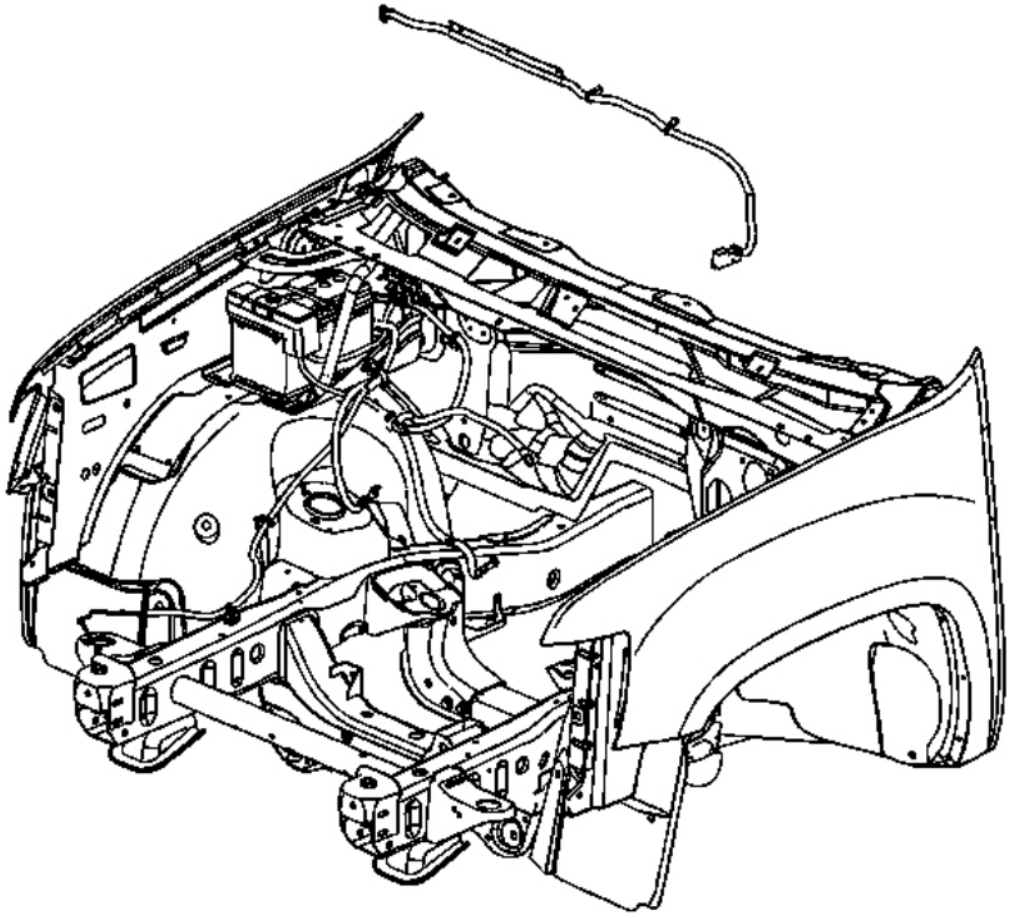


Fig. 33: View Of Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

11. Remove the positive battery cable terminal from the mega fuse stud.
12. Remove the positive battery cable channel from the studs.
13. Remove the positive battery cable from the vehicle.

Installation Procedure

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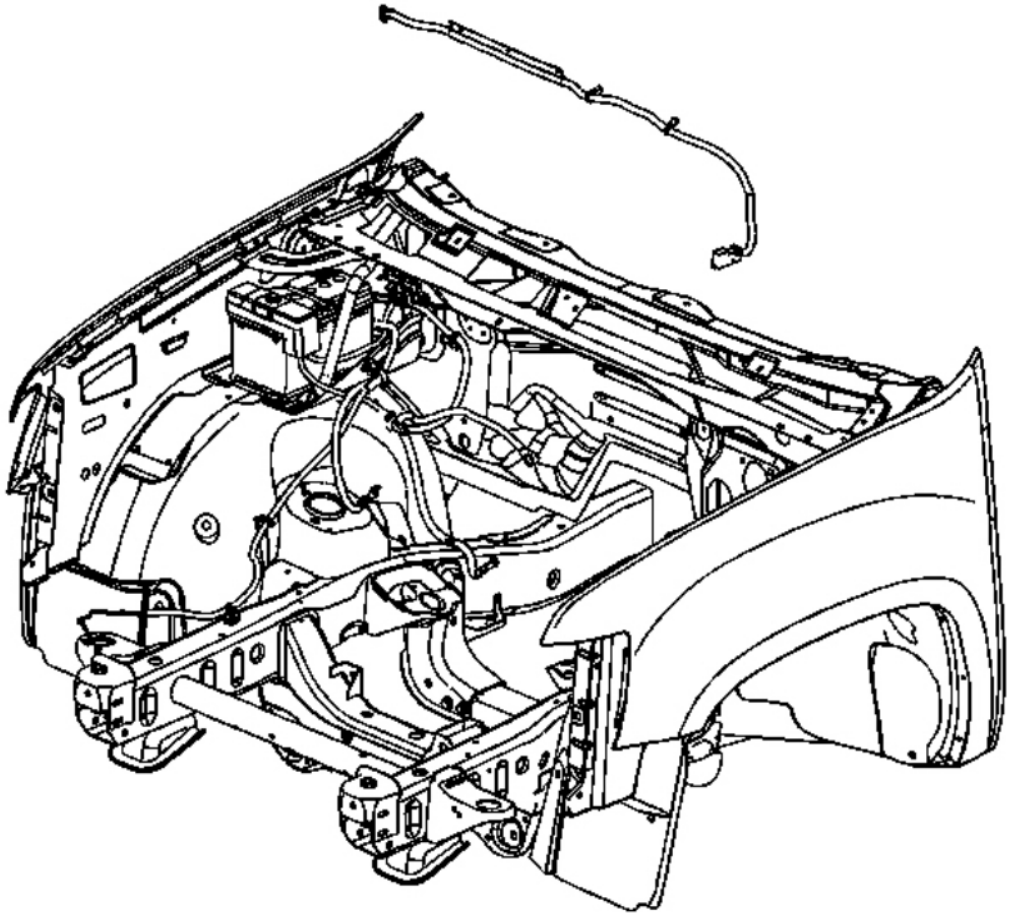


Fig. 34: View Of Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the positive battery cable to the vehicle.
2. Install the positive battery cable terminal to the mega fuse stud.

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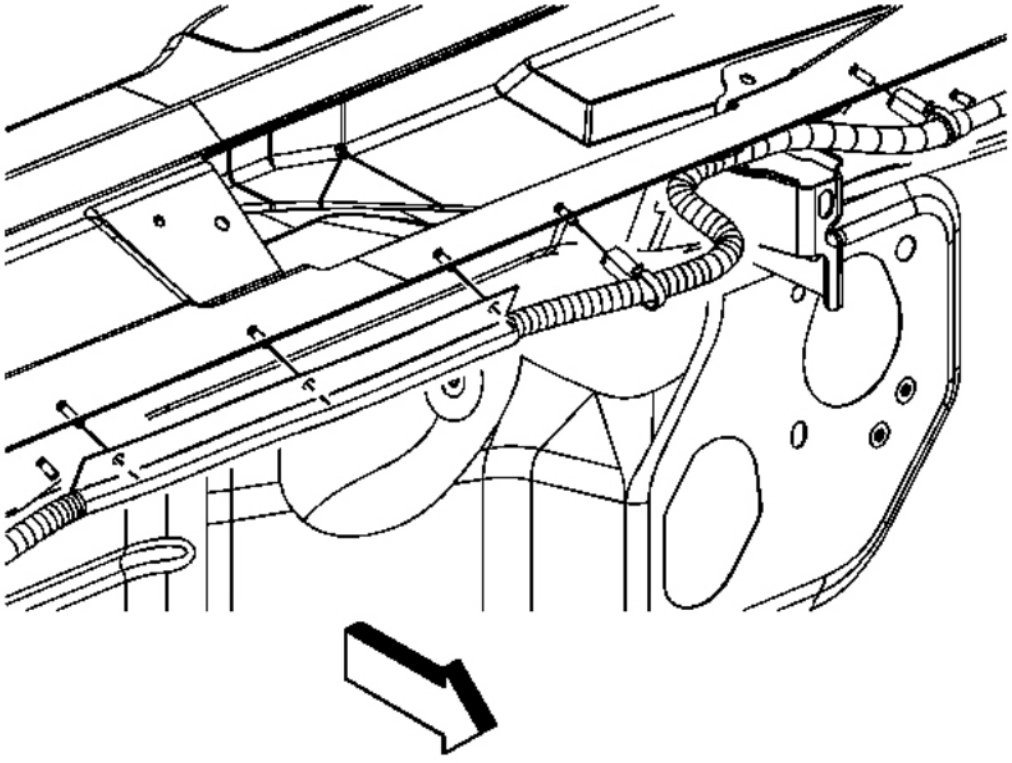


Fig. 35: View Of Positive Battery Cable Channel, Clips & Studs
Courtesy of GENERAL MOTORS CORP.

3. Install the positive battery cable channel at the plenum front panel.
4. Install the positive battery cable clips to the studs on the plenum front panel.

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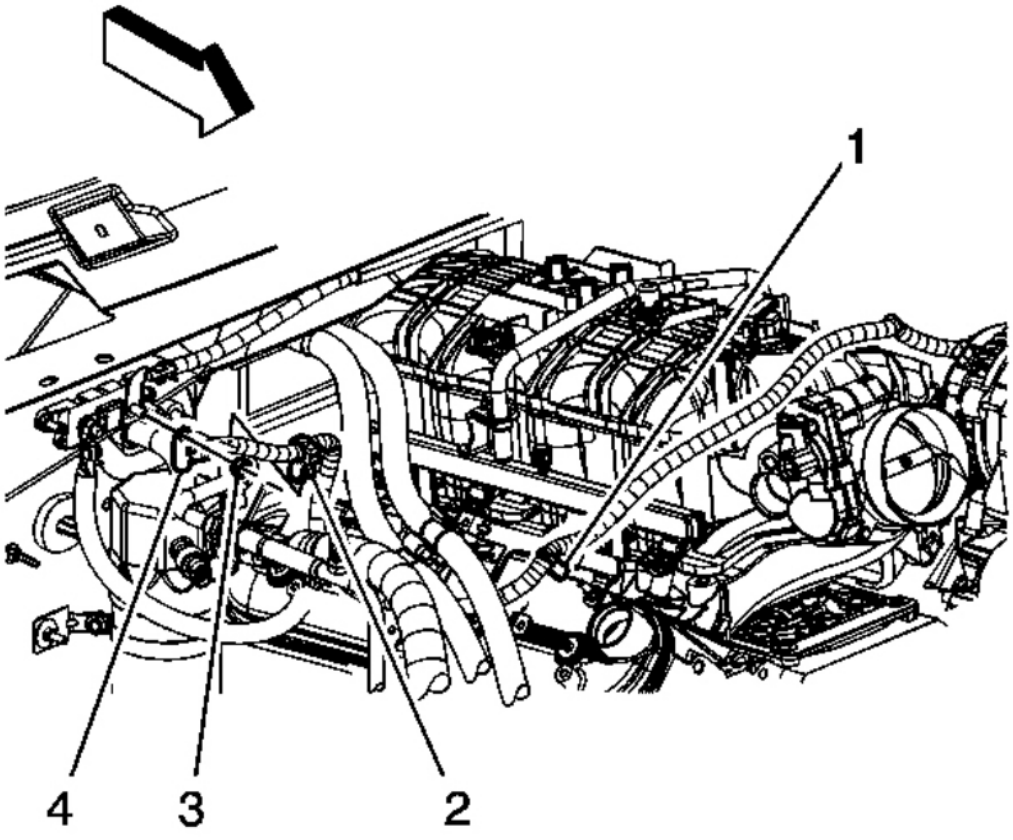


Fig. 36: View Of Generator Battery Jumper Cable & Components
Courtesy of GENERAL MOTORS CORP.

5. Install the generator battery jumper cable terminal (4) to the mega fuse stud.
6. Install the generator battery jumper cable to mega fuse nut (3).

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

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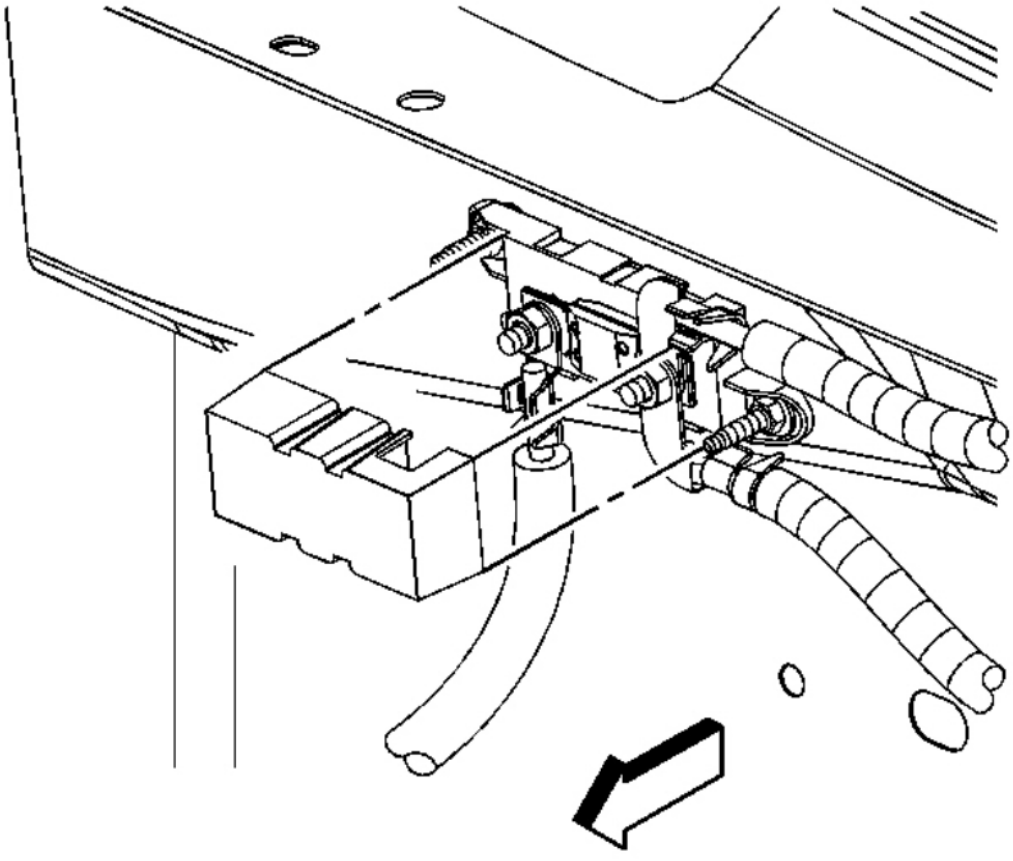


Fig. 37: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

7. Install the mega fuse cover.

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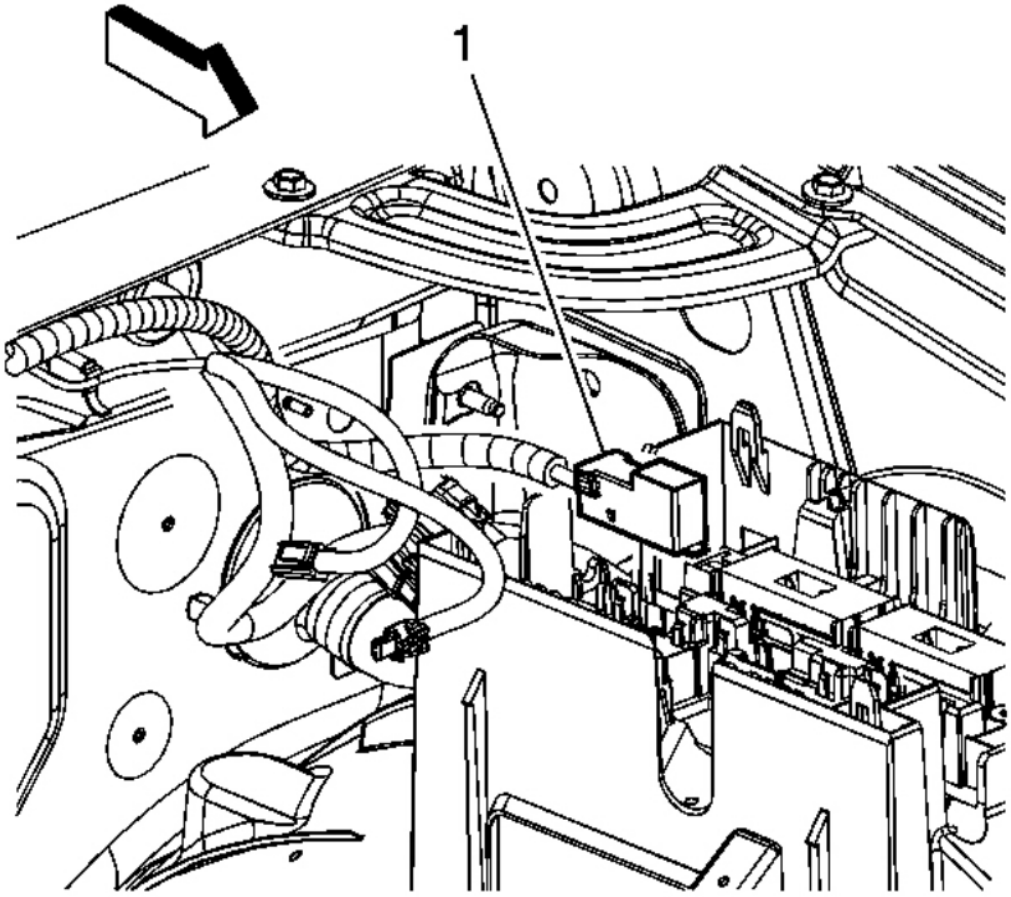


Fig. 38: View Of Positive Battery Cable Connector & (UBEC)
Courtesy of GENERAL MOTORS CORP.

8. Install the positive battery cable connector (1) to the UBEC.

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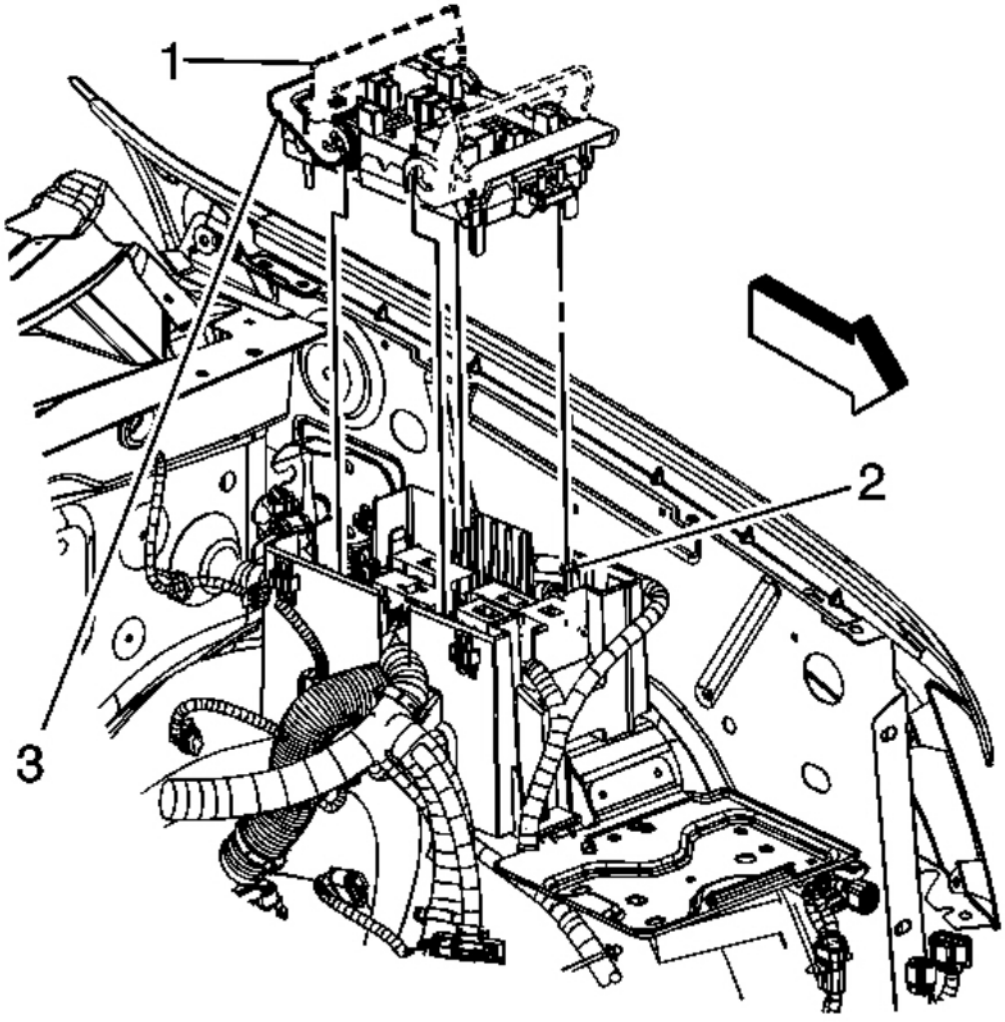


Fig. 39: View Of Junction Block & Retainers
Courtesy of GENERAL MOTORS CORP.

9. Ensure the junction block retainers are in the open position (1).
10. Position and align the junction block to the 4 bracket pivots (2), once the pivots are engaged, push the retainer down into the locked position (3).

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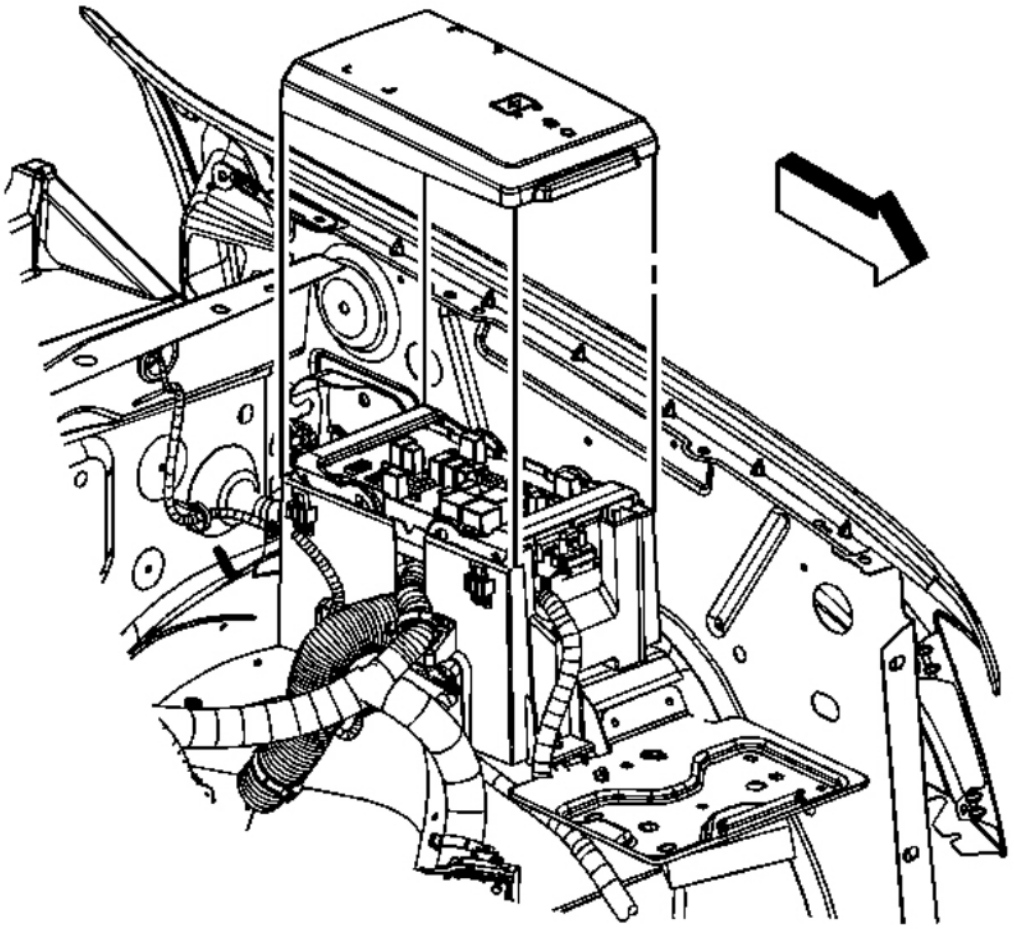


Fig. 40: View Of Under Hood Junction Block Cover
Courtesy of GENERAL MOTORS CORP.

11. Install the under hood junction block cover.
12. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

GENERATOR BATTERY JUMPER CABLE REPLACEMENT

Removal Procedure

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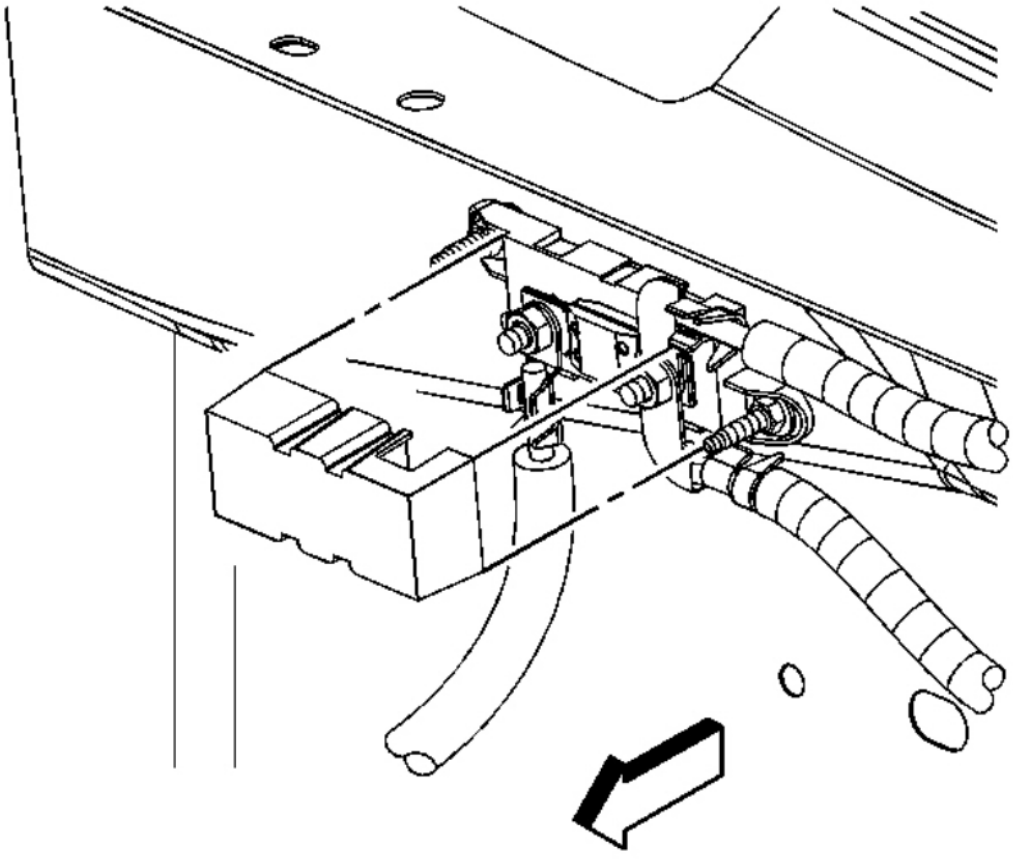


Fig. 41: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Remove the mega fuse cover.

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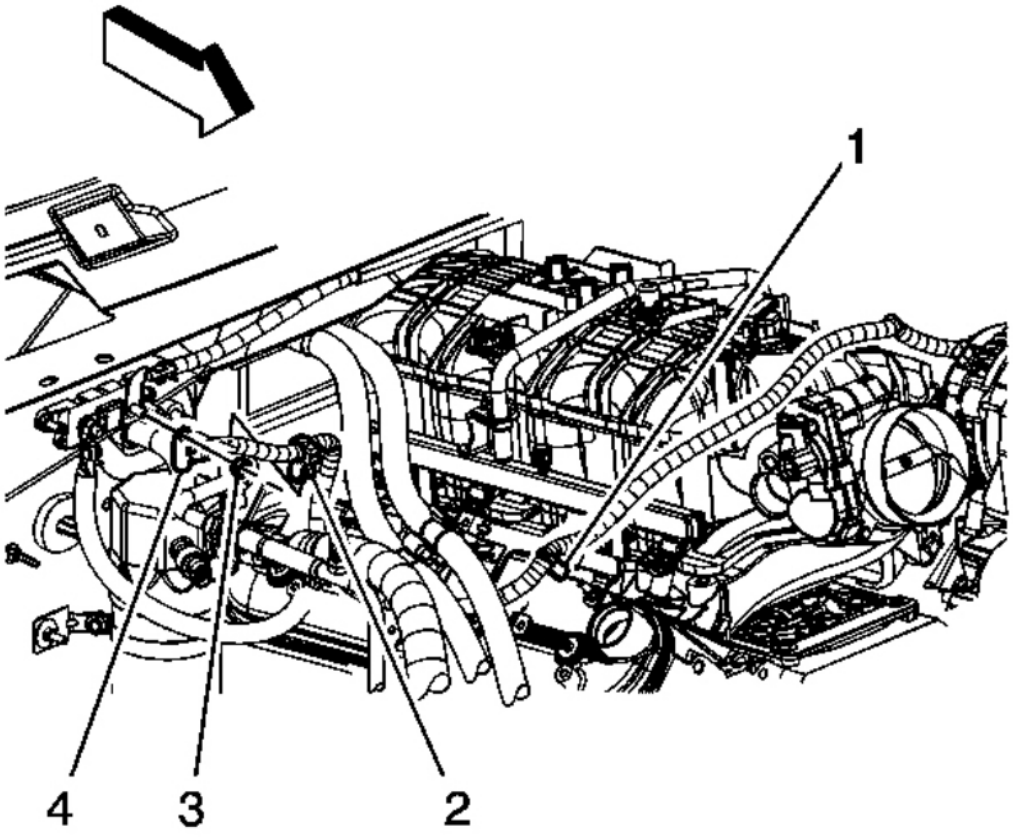


Fig. 42: View Of Generator Battery Jumper Cable & Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the generator battery jumper cable to mega fuse nut (3).
5. Remove the generator battery jumper cable terminal (4) from the mega fuse stud.
6. Remove the generator battery jumper cable clip (2) from air conditioning (A/C) evaporator tube.
7. Remove the generator battery jumper cable clip (1) from the stud.

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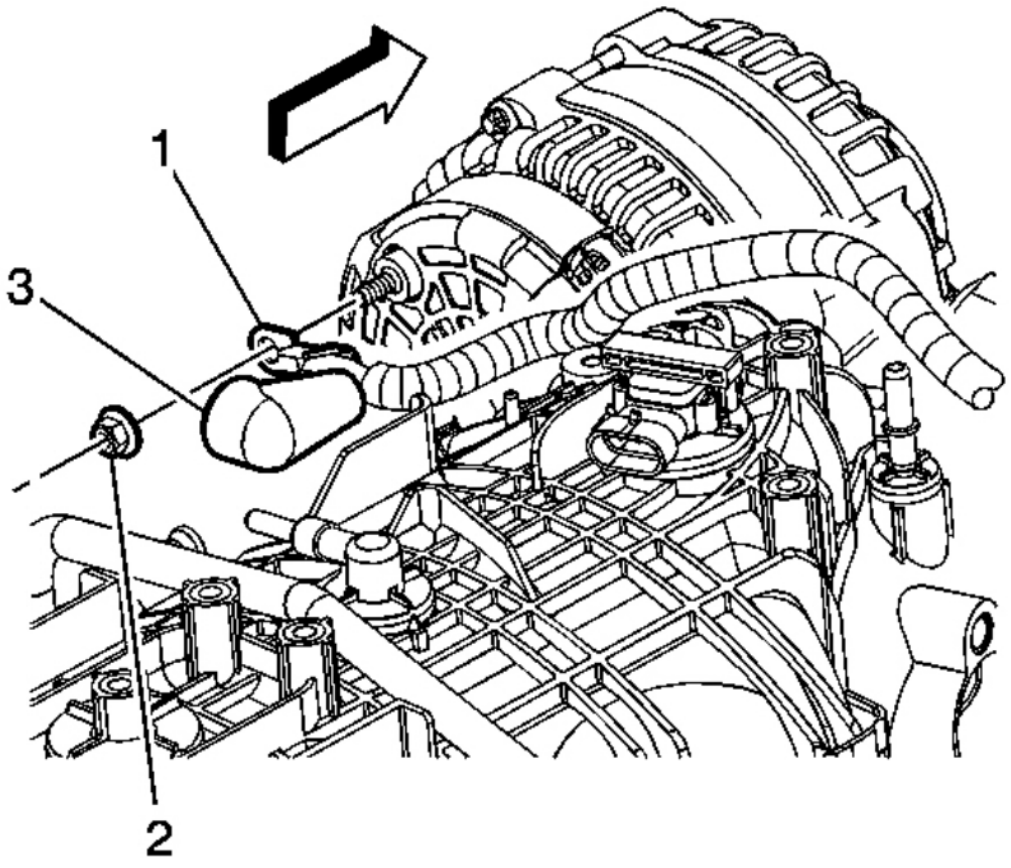


Fig. 43: View Of Battery Jumper Cable Terminal, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Reposition the generator battery jumper cable boot (3).
9. Remove the generator battery jumper cable nut (2) from the generator.
10. Remove the generator battery jumper cable terminal (1) from the generator stud.

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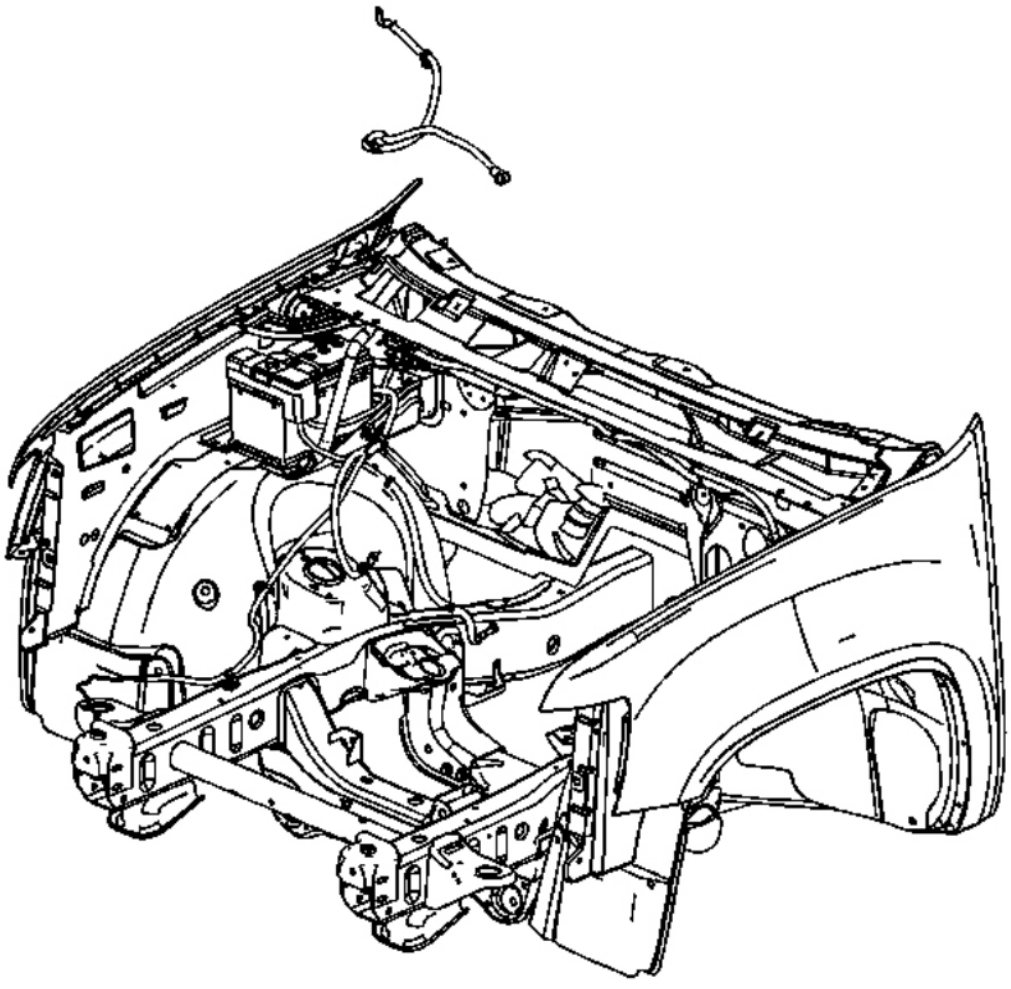


Fig. 44: View Of Generator Battery Jumper Cable
Courtesy of GENERAL MOTORS CORP.

11. Remove the generator battery jumper cable from the vehicle.

Installation Procedure

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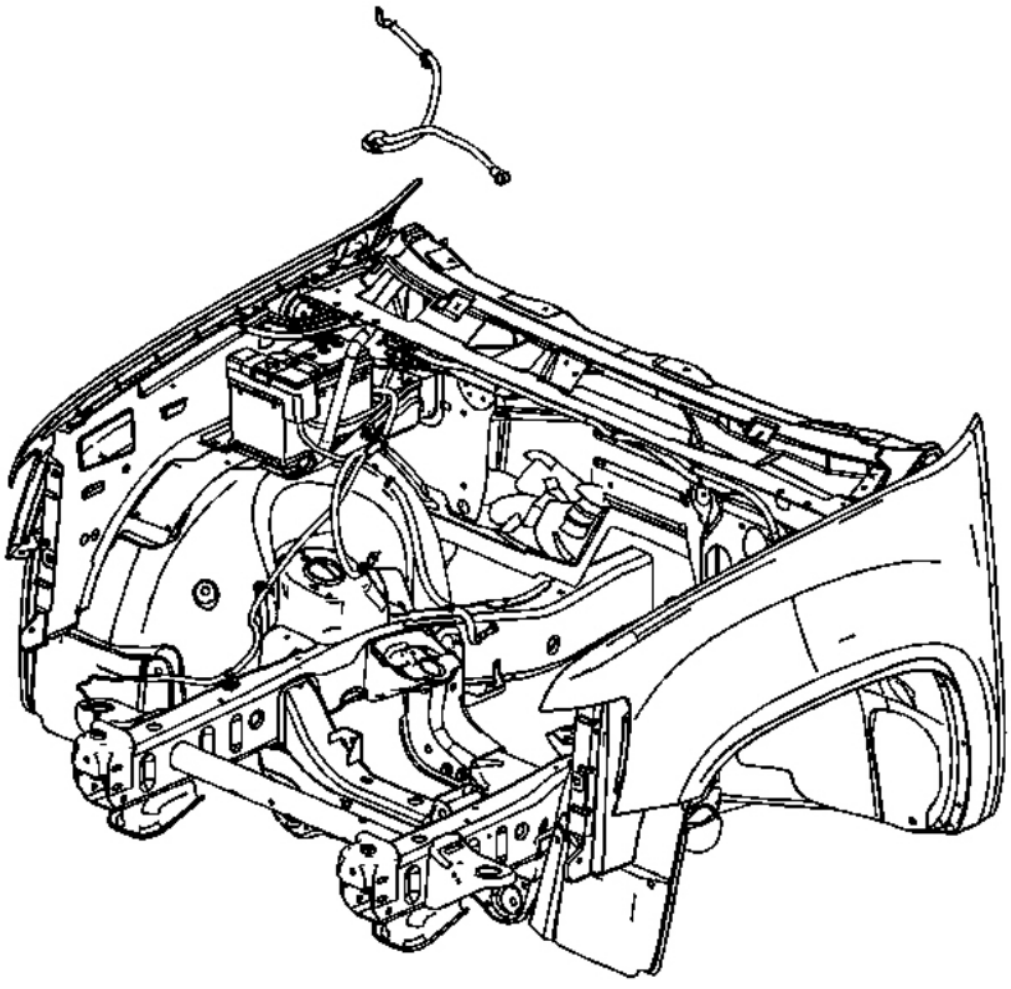


Fig. 45: View Of Generator Battery Jumper Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the generator battery jumper cable to the vehicle.

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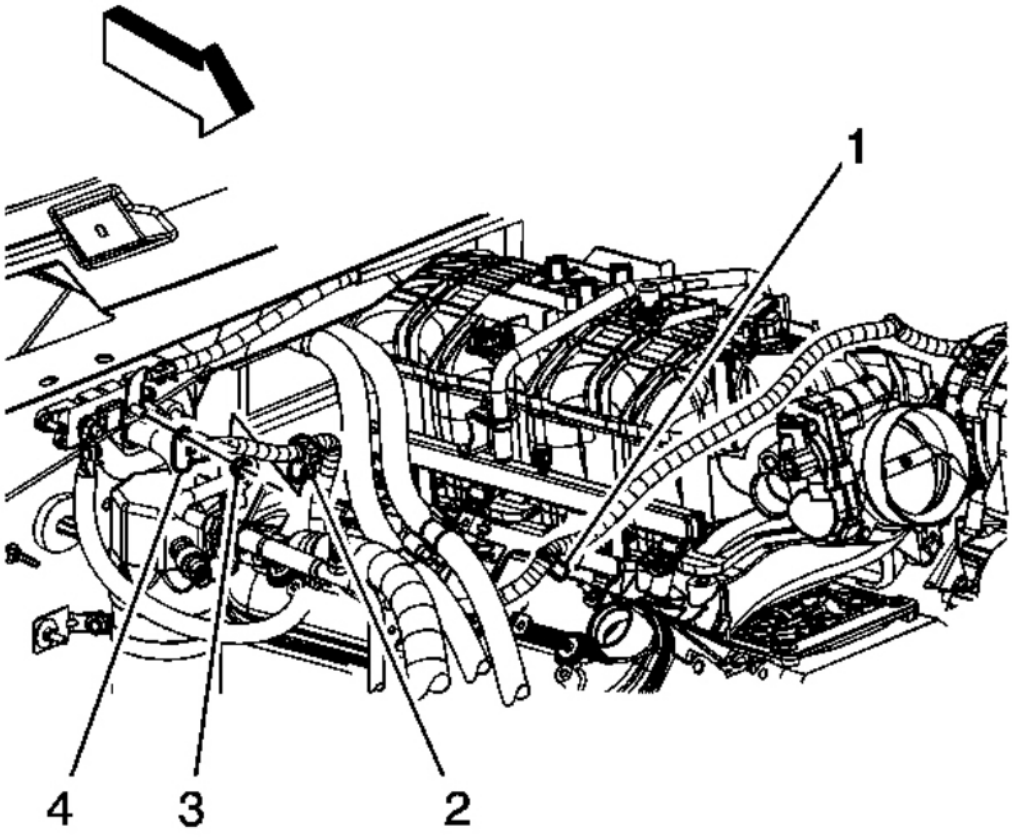


Fig. 46: View Of Generator Battery Jumper Cable & Components
Courtesy of GENERAL MOTORS CORP.

2. Install the generator battery jumper cable terminal (4) to the mega fuse stud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the generator battery jumper cable to mega fuse nut (3).

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

4. Install the generator battery jumper cable clip (2) to A/C evaporator tube.
5. Install the generator battery jumper cable clip (1) to the stud.

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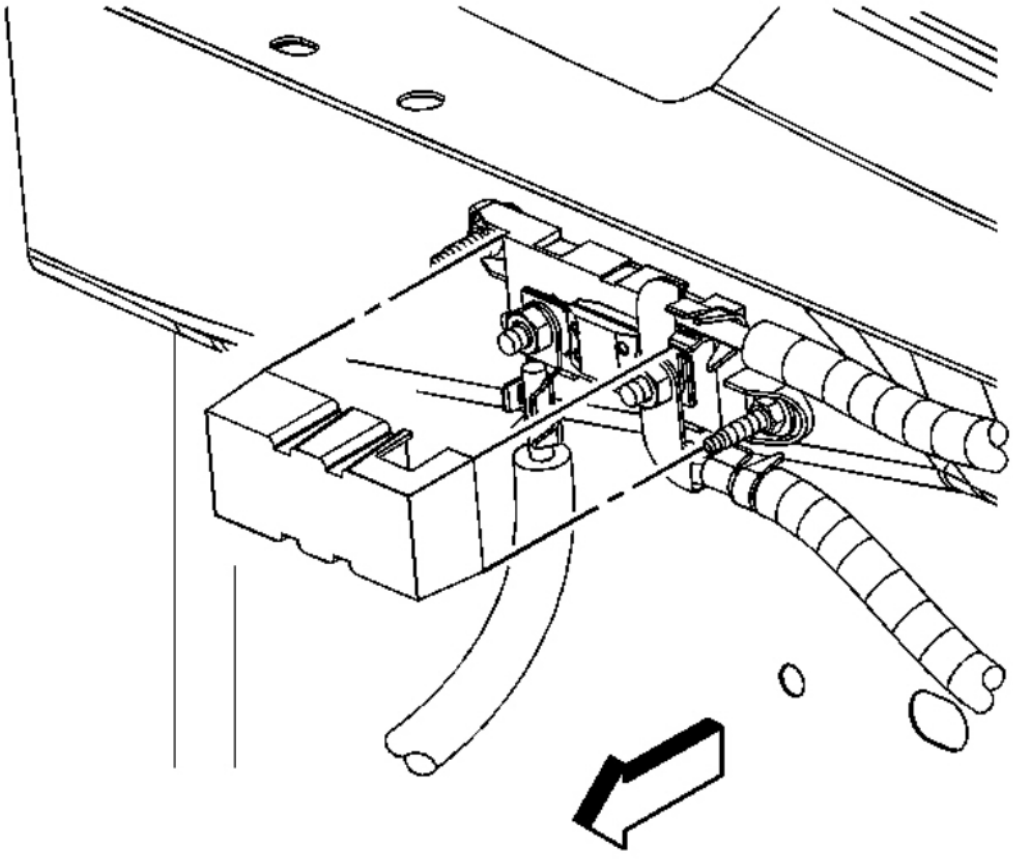


Fig. 47: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

6. Install the mega fuse cover.

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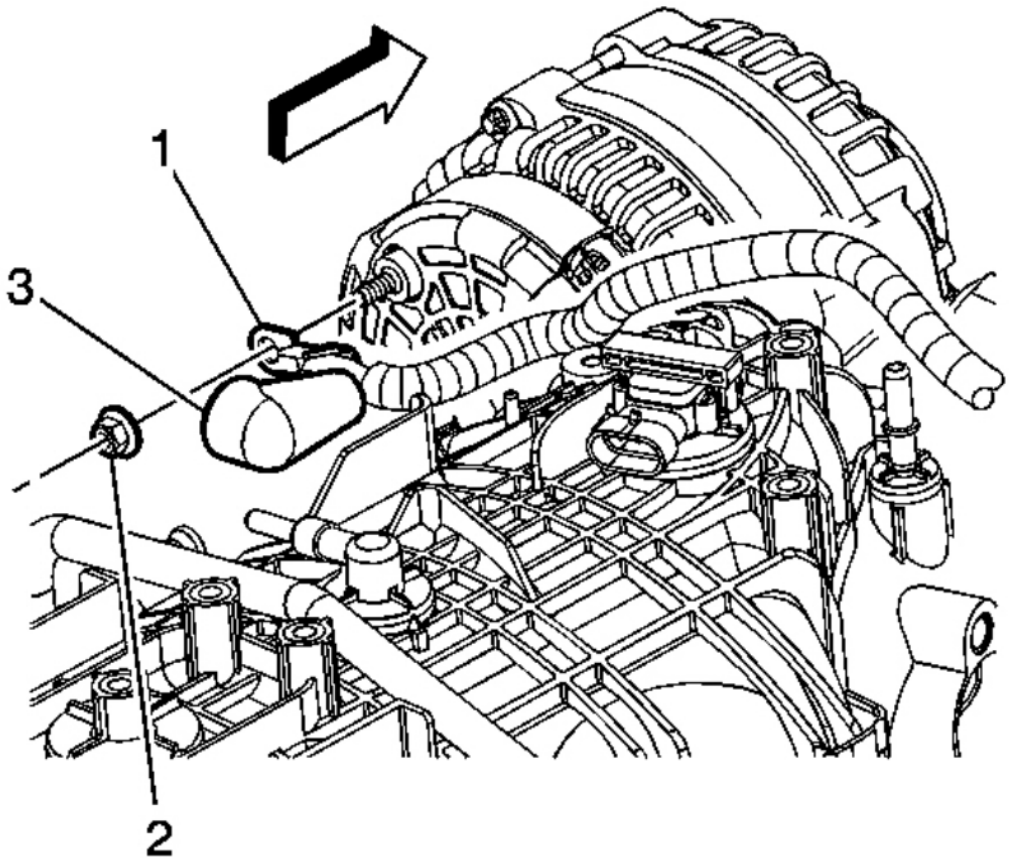


Fig. 48: View Of Battery Jumper Cable Terminal, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the generator battery jumper cable terminal (1) to the generator stud.
8. Install the generator battery jumper cable nut (2) to the generator.

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

9. Position the generator battery jumper cable boot (3).
10. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

STARTER SOLENOID CABLE REPLACEMENT

Removal Procedure

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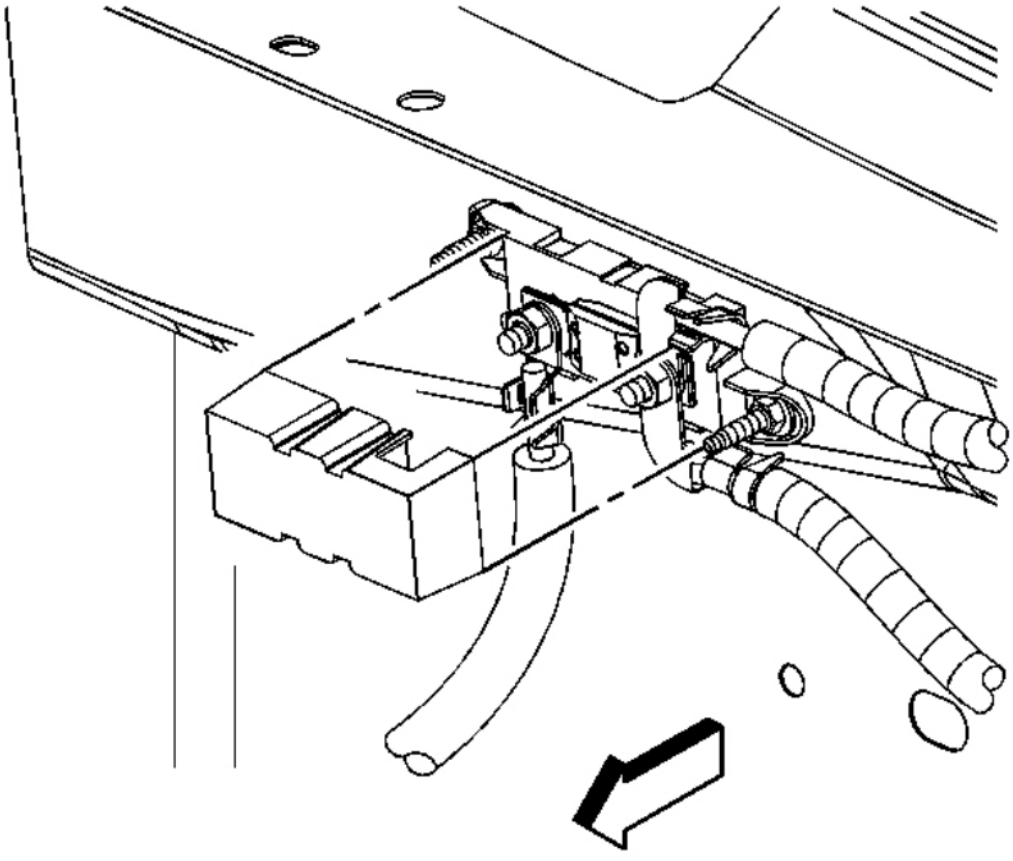


Fig. 49: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
3. Remove the mega fuse cover.

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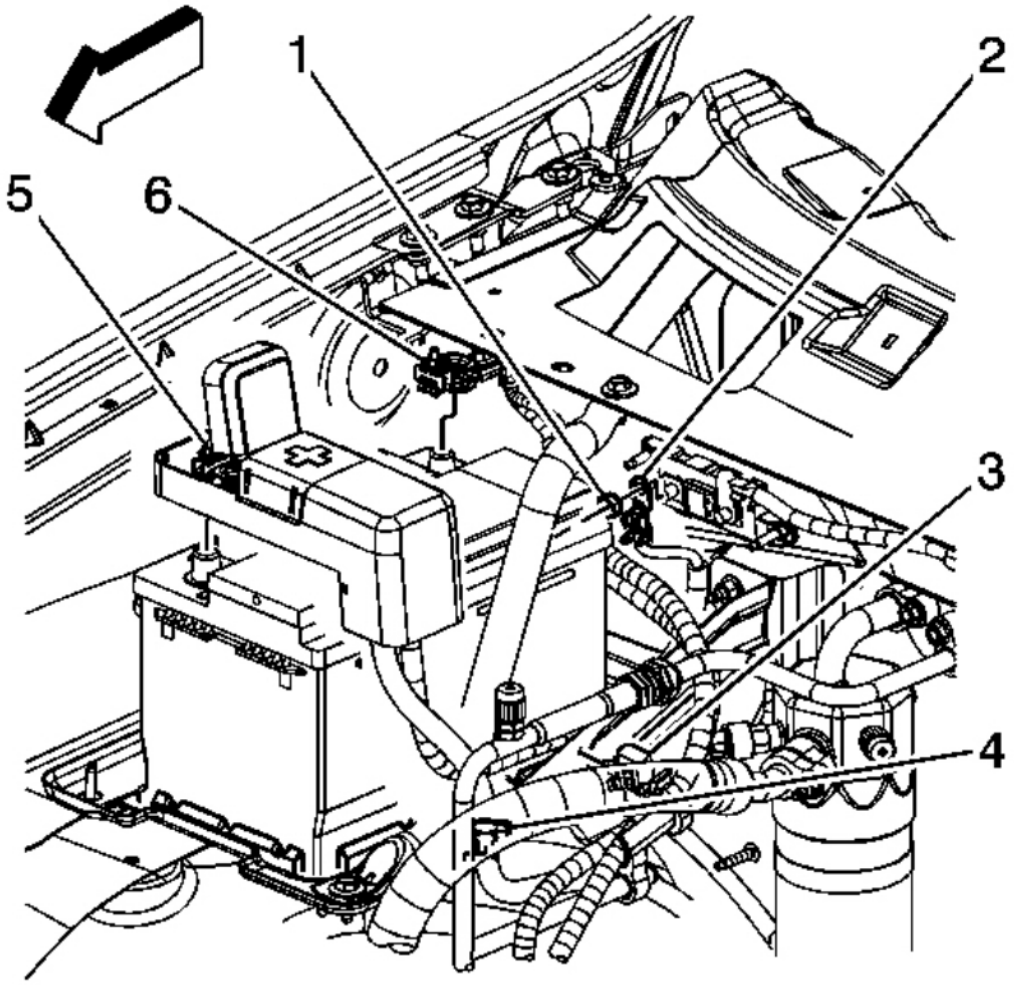


Fig. 50: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the starter solenoid cable nut (1) from the mega fuse stud.
5. Remove the starter solenoid cable terminal (2) from the mega fuse stud.
6. Open the starter solenoid cable cover at the positive battery terminal.
7. Loosen the starter solenoid cable nut (5).
8. Remove the starter solenoid cable from the positive battery terminal.
9. Remove the starter solenoid cable clip (4) from the air conditioning (A/C) evaporator tube.

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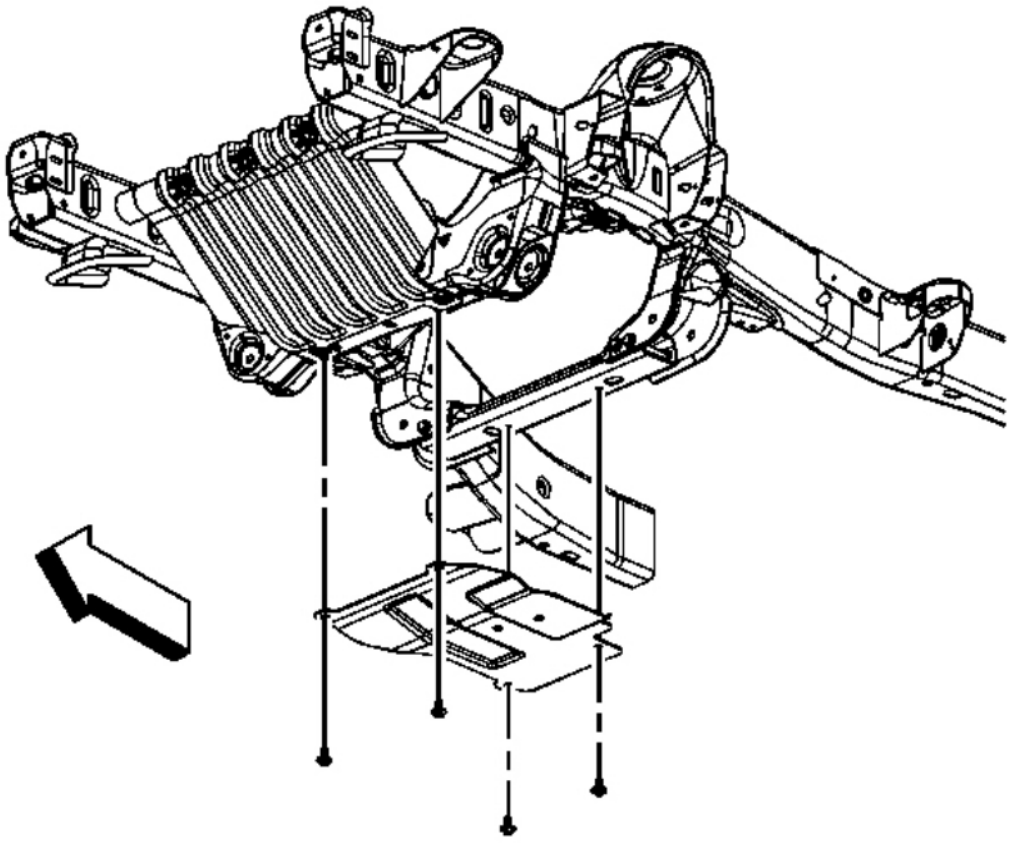


Fig. 51: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
11. For 1500 series vehicles, remove the oil pan skid plate bolts and plate.

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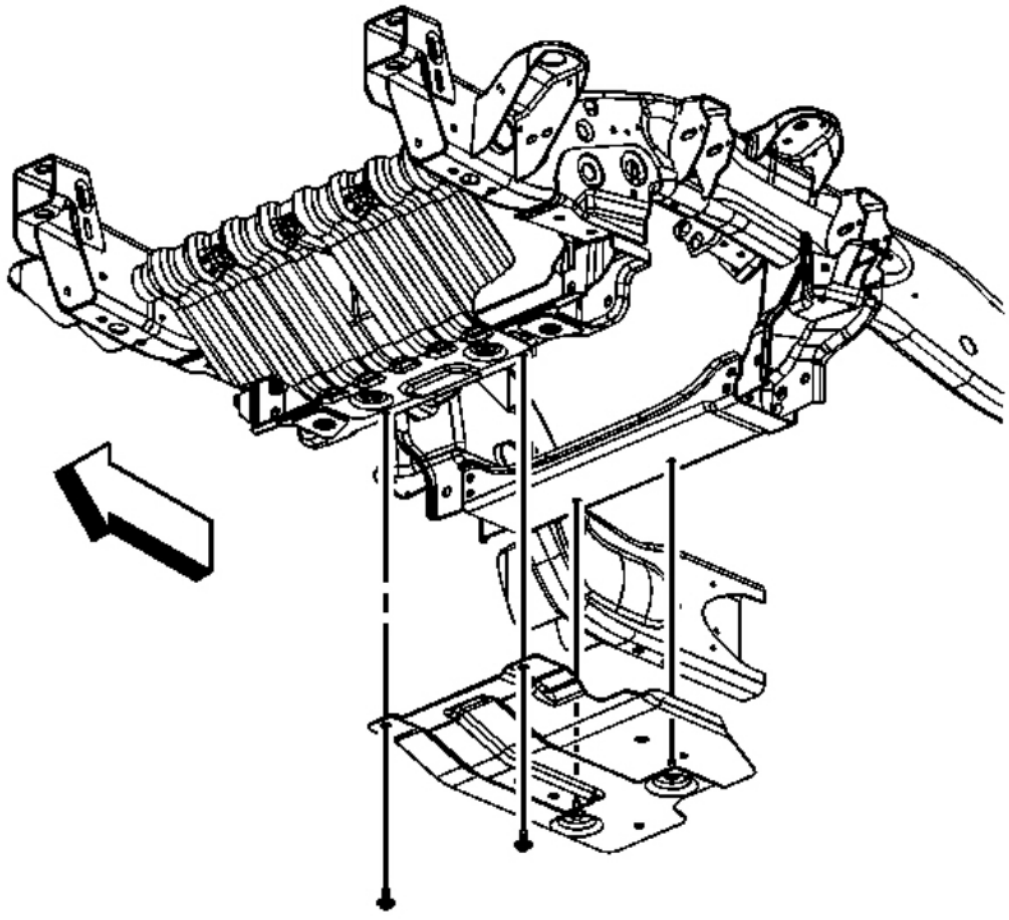


Fig. 52: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

12. For 2500 series vehicles, remove the front 2 oil pan skid plate bolts, loosen the rear 2 bolts and remove the skid plate.

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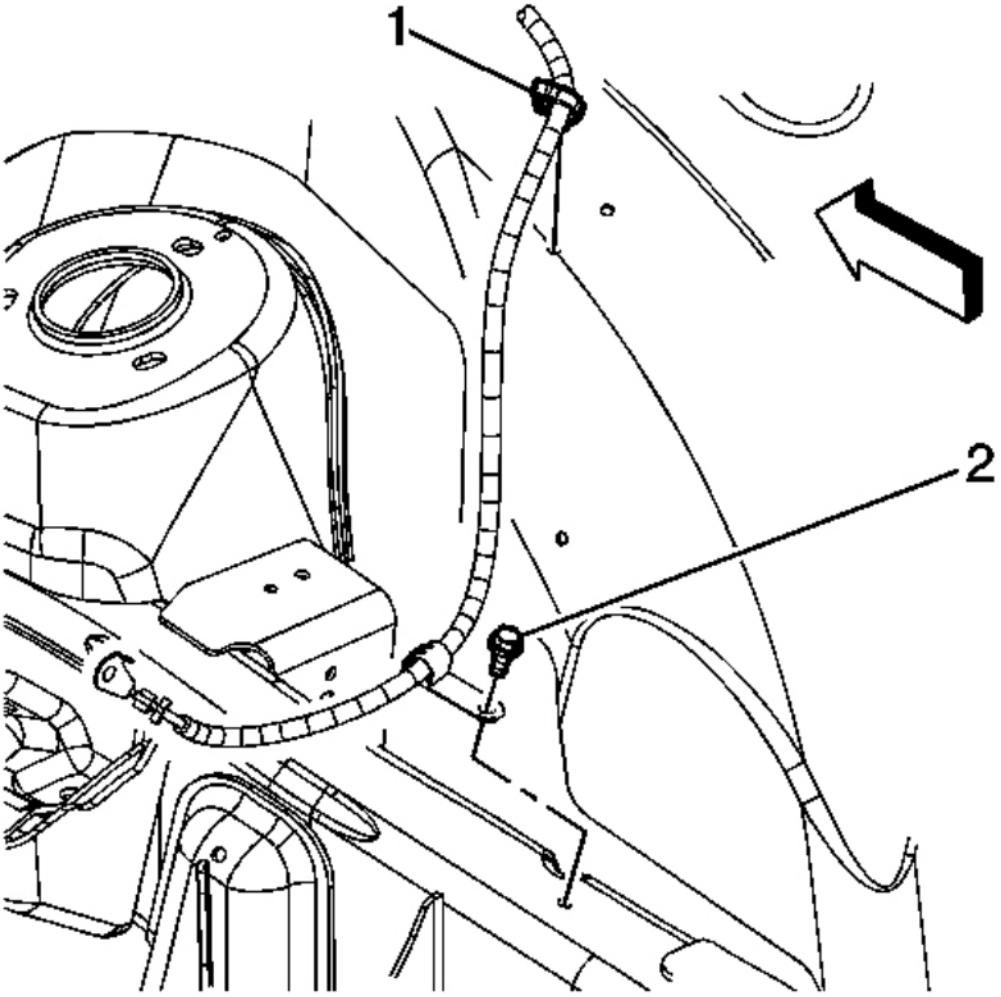


Fig. 53: View Of Starter Solenoid Cable Clip & Bolt
Courtesy of GENERAL MOTORS CORP.

13. Remove the starter solenoid cable clip (1) from the wheelhouse panel.
14. Remove the starter solenoid cable clip bolt (2) from the frame.

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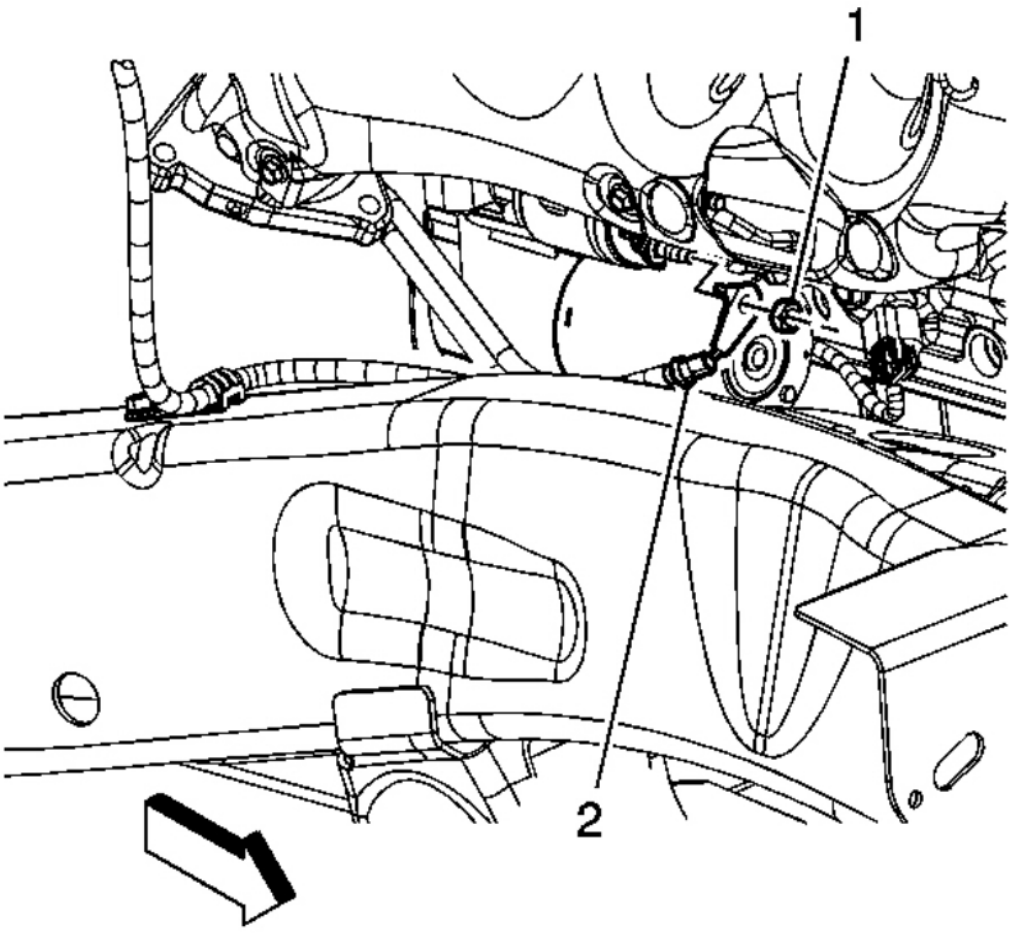


Fig. 54: View Of Starter Solenoid Cable & Nut
Courtesy of GENERAL MOTORS CORP.

15. Remove the starter solenoid cable nut (1) from the starter.
16. Remove the starter solenoid cable (2) from the starter.
17. Lower the vehicle.

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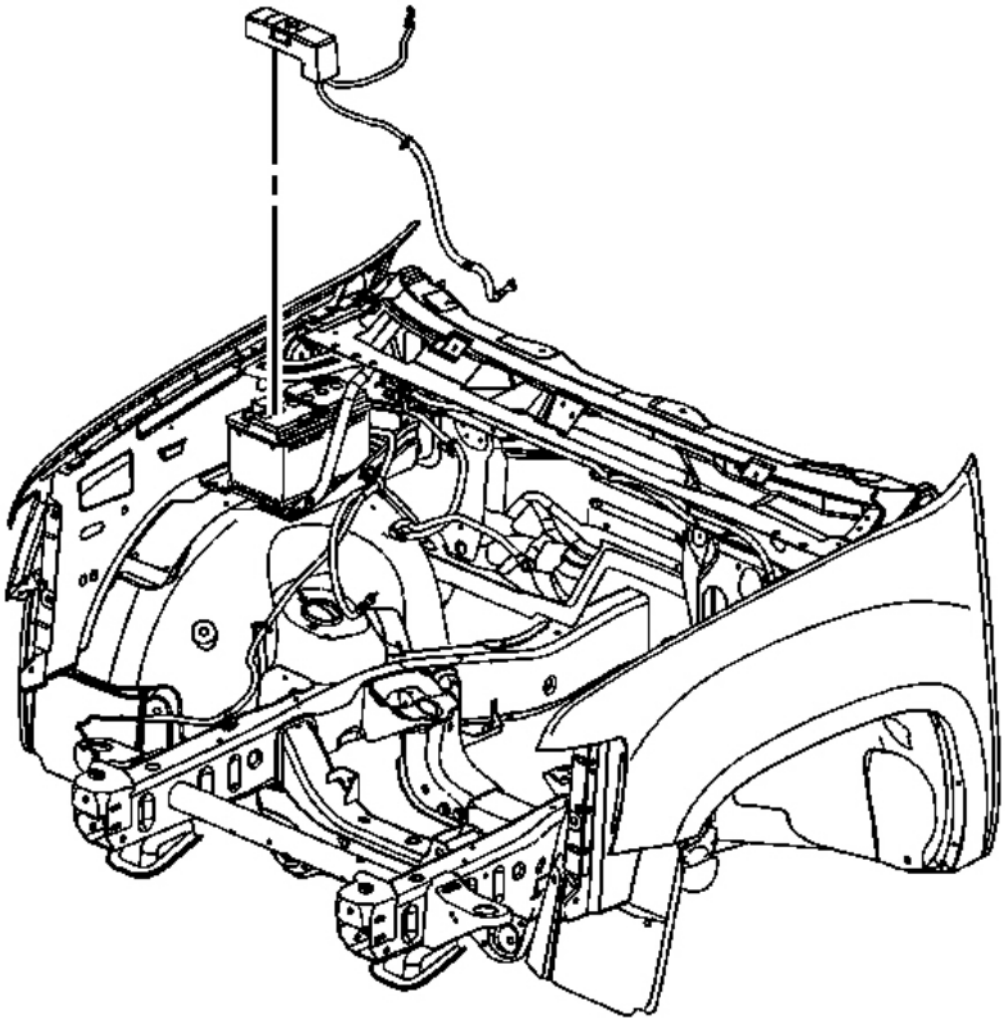


Fig. 55: View Of Starter Solenoid Cable
Courtesy of GENERAL MOTORS CORP.

18. Remove the starter solenoid cable from the vehicle.

Installation Procedure

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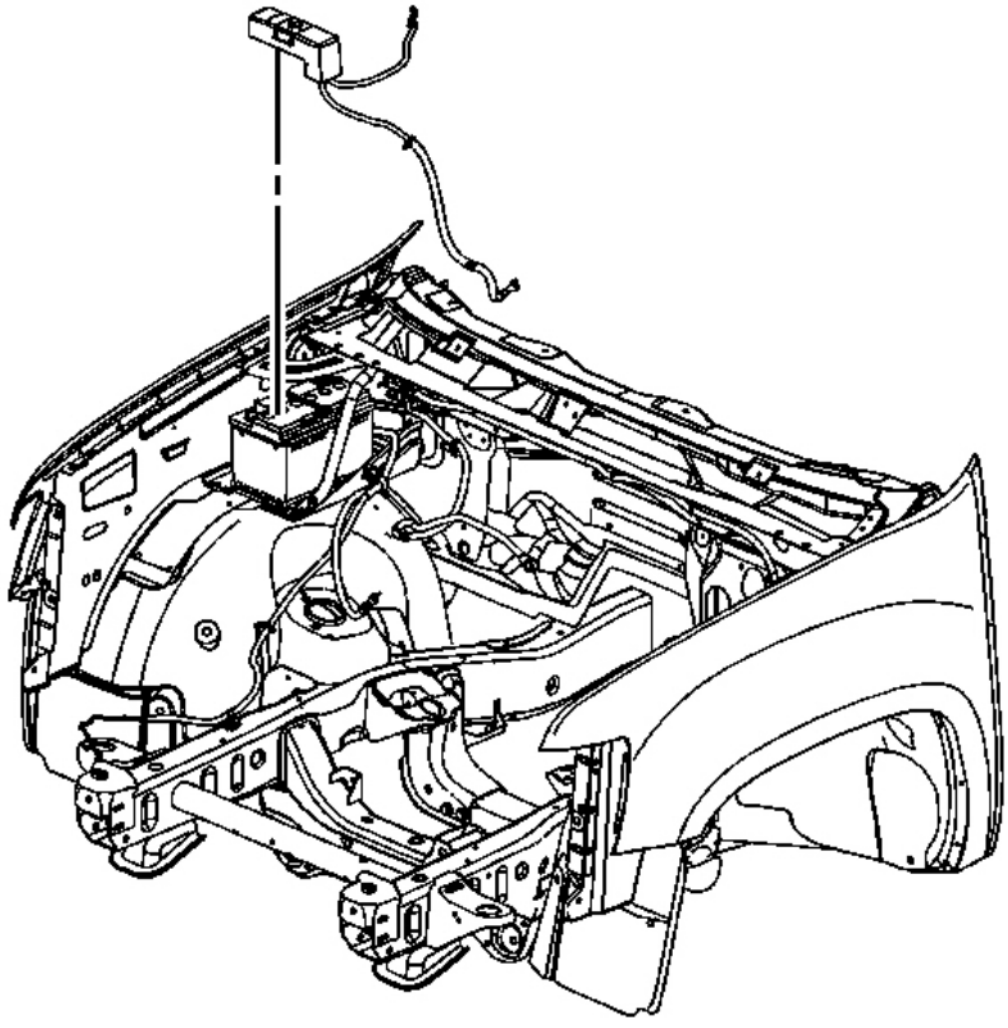


Fig. 56: View Of Starter Solenoid Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the starter solenoid cable to the vehicle.

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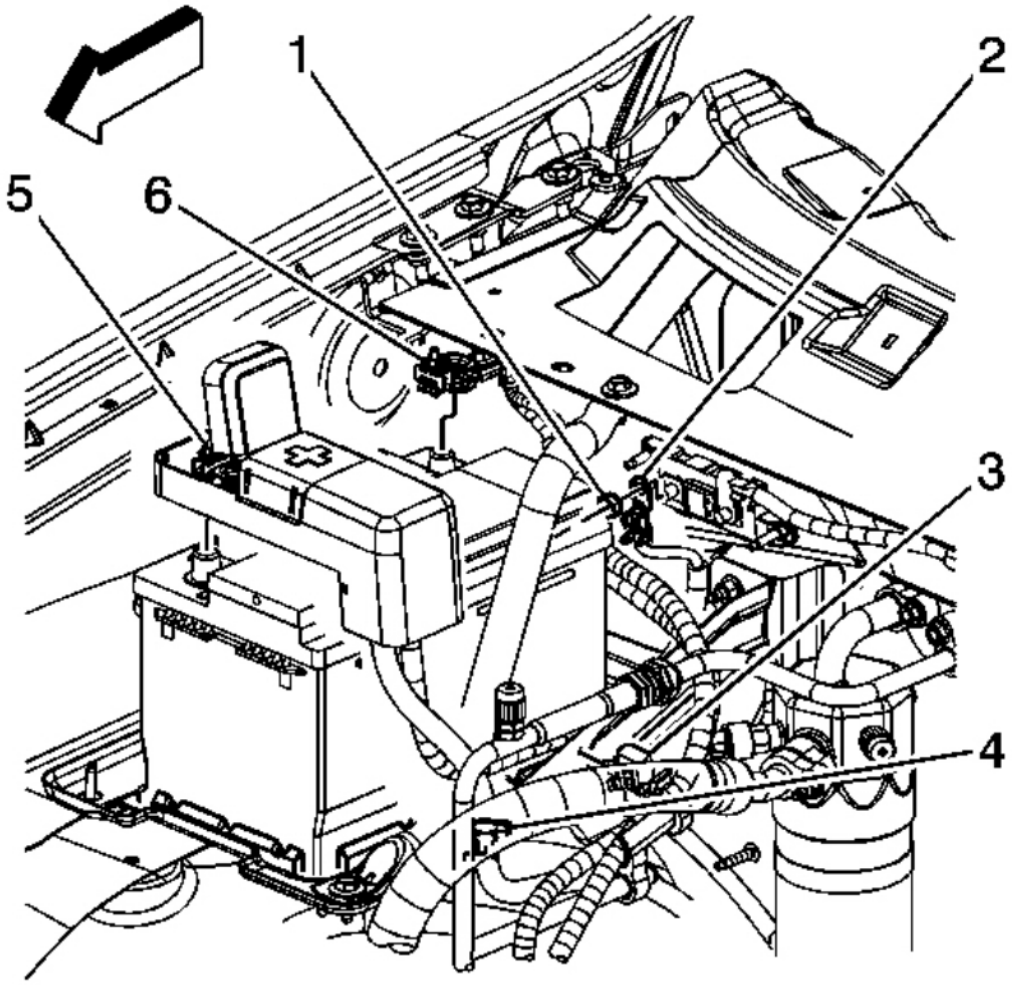


Fig. 57: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

2. Install the starter solenoid cable to the positive battery terminal.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Tighten the starter solenoid cable nut (5).

Tighten: Tighten the nut to 17 N.m (13 lb ft).

4. Close the starter solenoid cable cover at the positive battery terminal.

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5. Install the starter solenoid cable terminal (2) to the mega fuse stud.
6. Install the starter solenoid cable nut (1) to the mega fuse stud.

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

7. Install the starter solenoid cable clip (4) to the A/C evaporator tube.

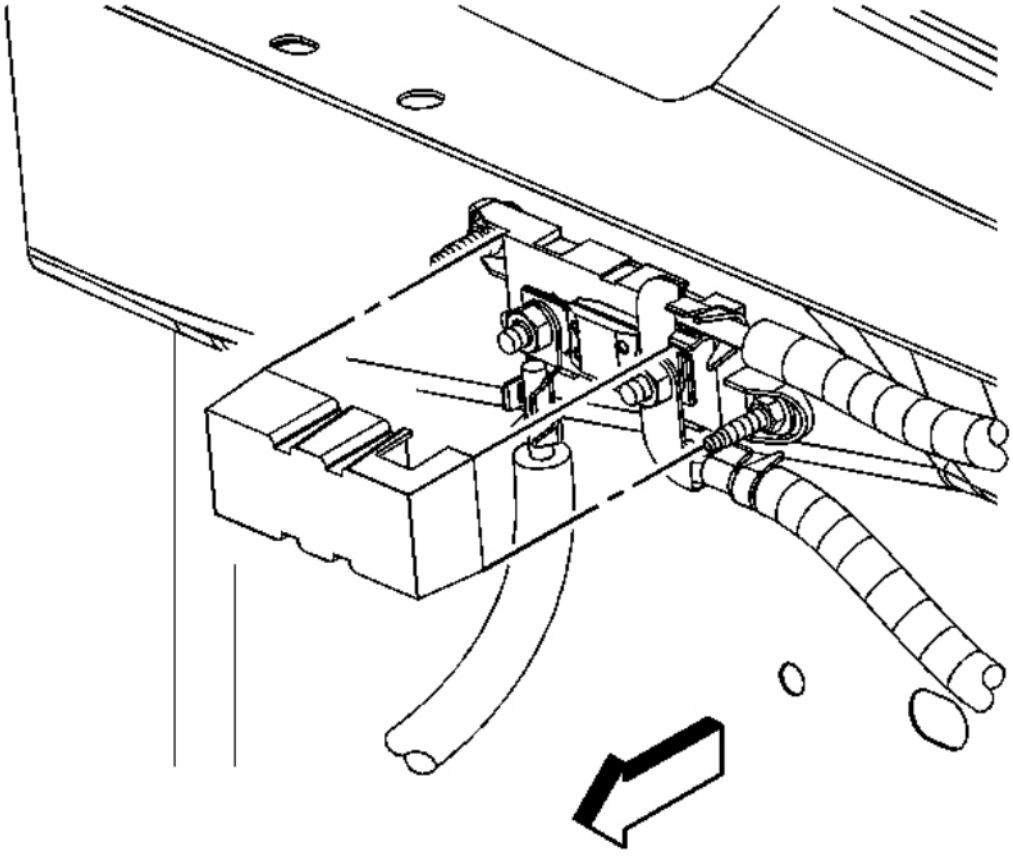


Fig. 58: View Of Mega Fuse Cover
Courtesy of GENERAL MOTORS CORP.

8. Install the mega fuse cover.
9. Raise the vehicle.

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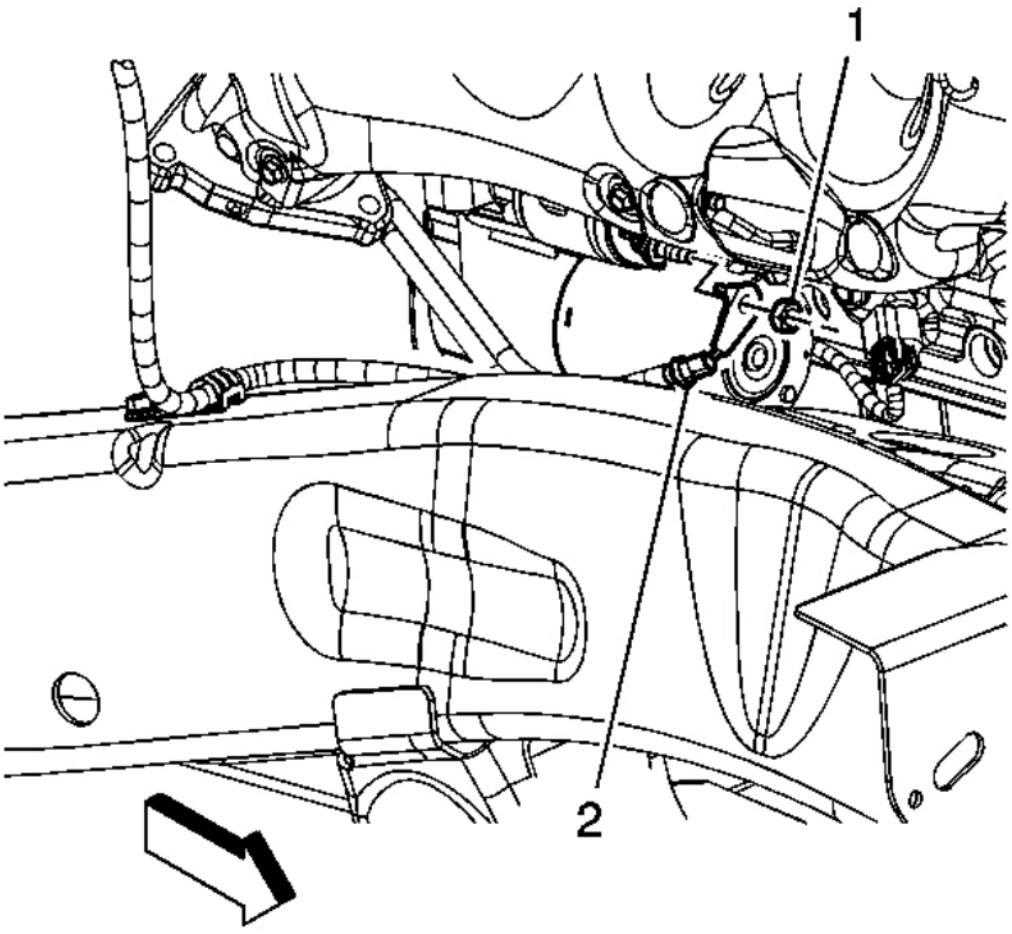


Fig. 59: View Of Starter Solenoid Cable & Nut
Courtesy of GENERAL MOTORS CORP.

10. Install the starter solenoid cable (2) to the starter.
11. Install the starter solenoid cable nut (1) to the starter.

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

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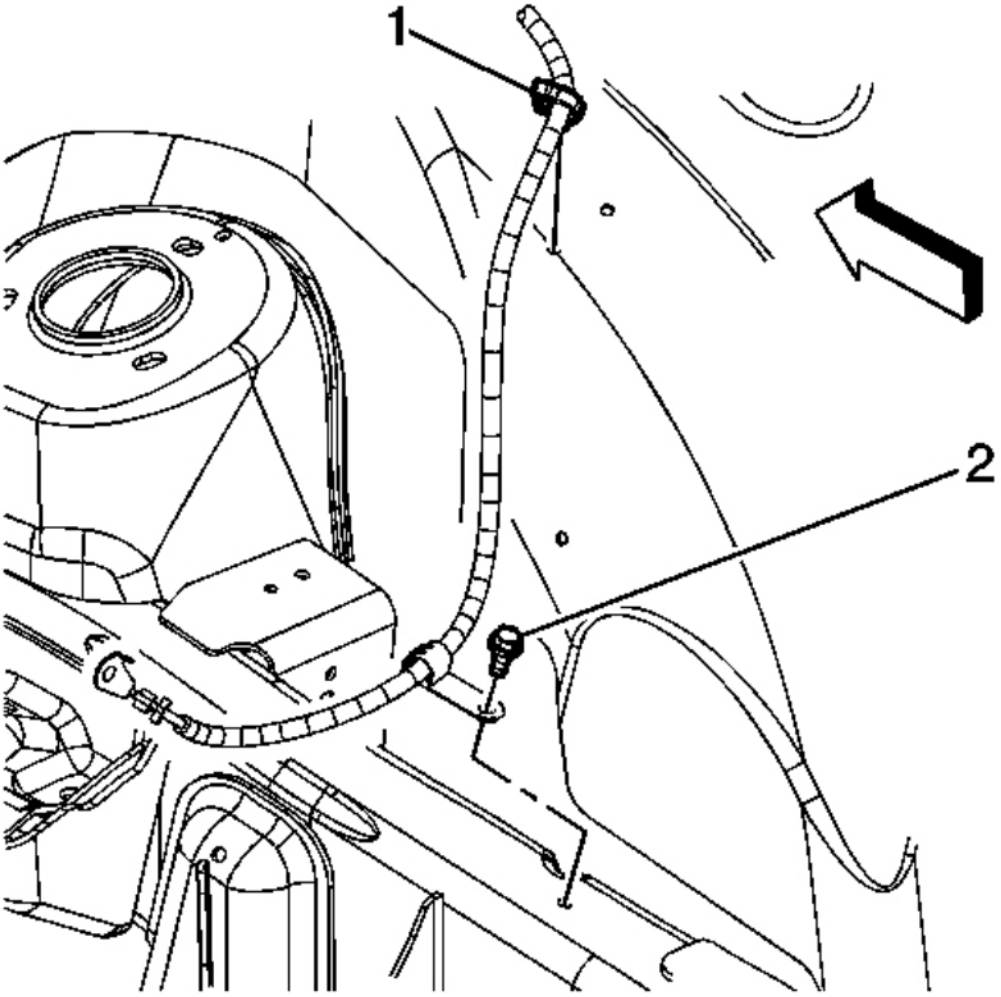


Fig. 60: View Of Starter Solenoid Cable Clip & Bolt
Courtesy of GENERAL MOTORS CORP.

12. Position the starter solenoid cable clip to the frame and install the starter solenoid cable clip bolt (2).
13. Install the starter solenoid cable clip (1) to the wheelhouse panel.

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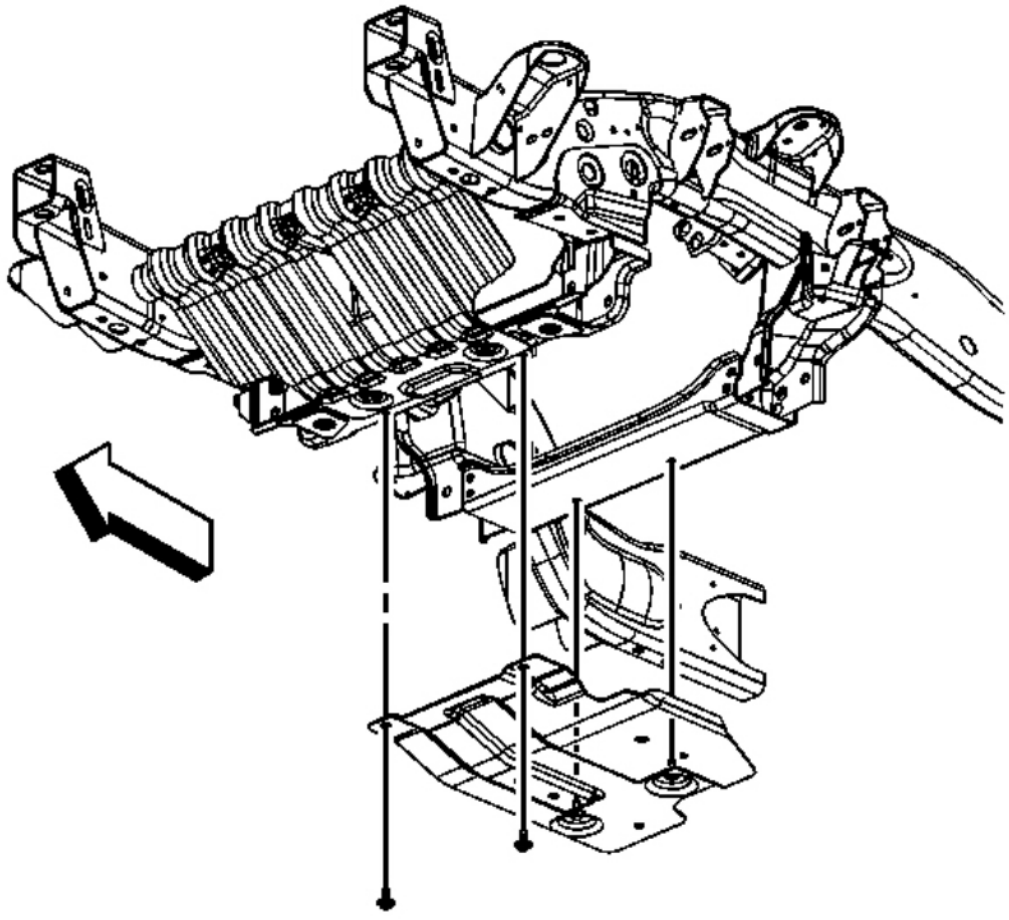


Fig. 61: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

14. For 2500 series vehicles, install the oil pan skid plate and tighten the rear 2 bolts and install and tighten the front 2 bolts.

    Tighten: Tighten the bolts to 28 N.m (21 lb ft).

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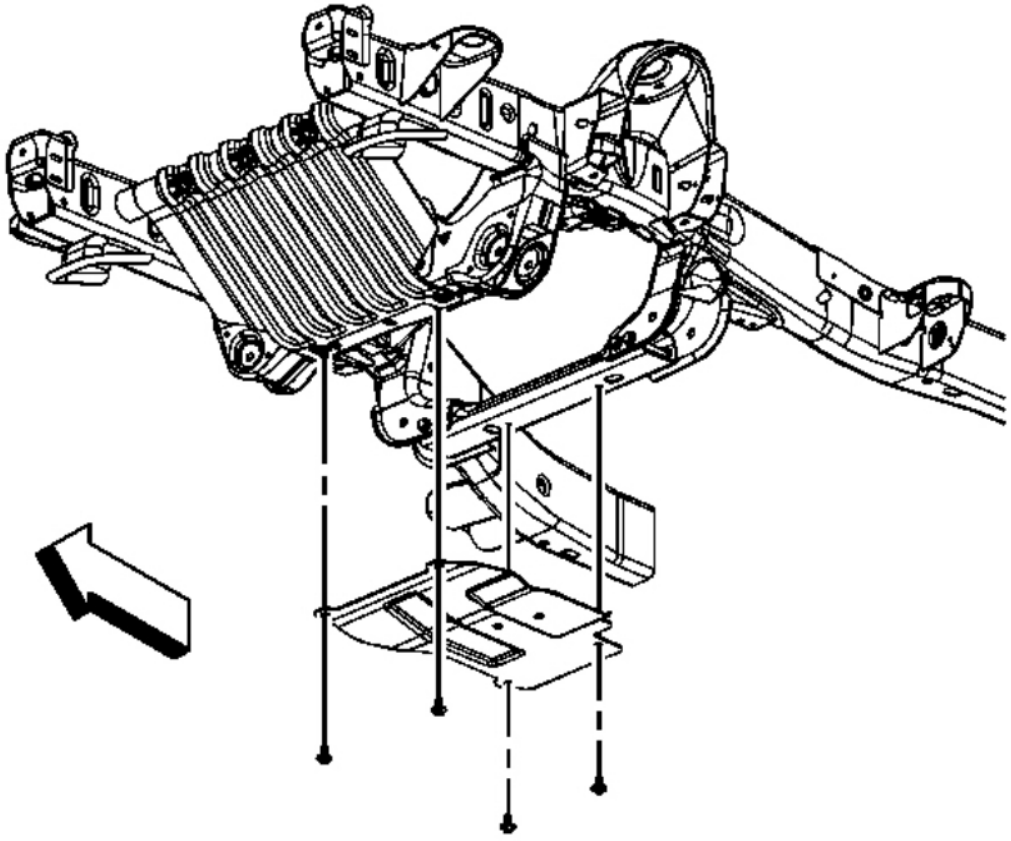


Fig. 62: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

15. For 1500 series vehicles, install the oil pan skid plate and bolts.

    Tighten: Tighten the bolts to 28 N.m (21 lb ft).

16. Lower the vehicle.
17. Install the air cleaner outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
18. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

BATTERY REPLACEMENT

Removal Procedure

CAUTION: Refer to Battery Disconnect Caution .

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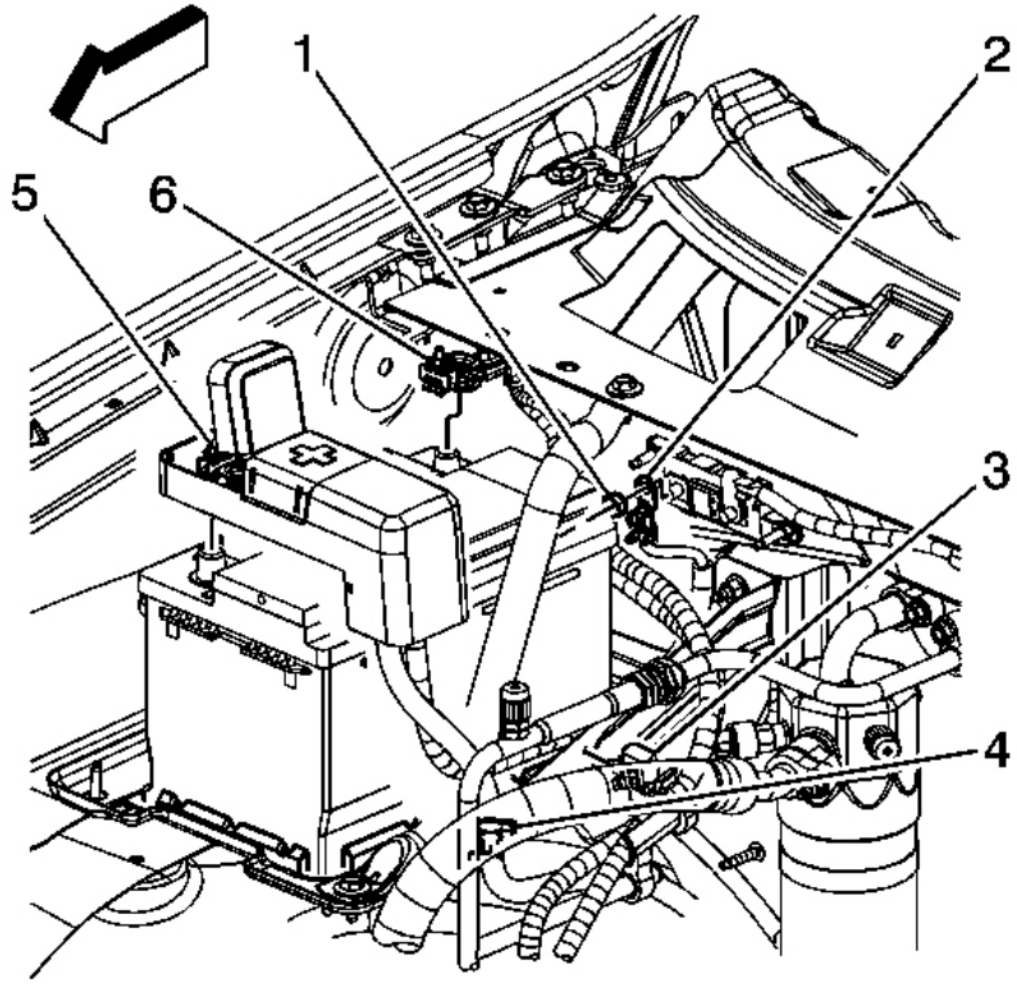


Fig. 63: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Open the starter solenoid cable cover at the positive battery terminal.
3. Loosen the starter solenoid cable nut (5).
4. Remove the starter solenoid cable from the positive battery terminal.
5. Reposition the starter solenoid cable out of the way.

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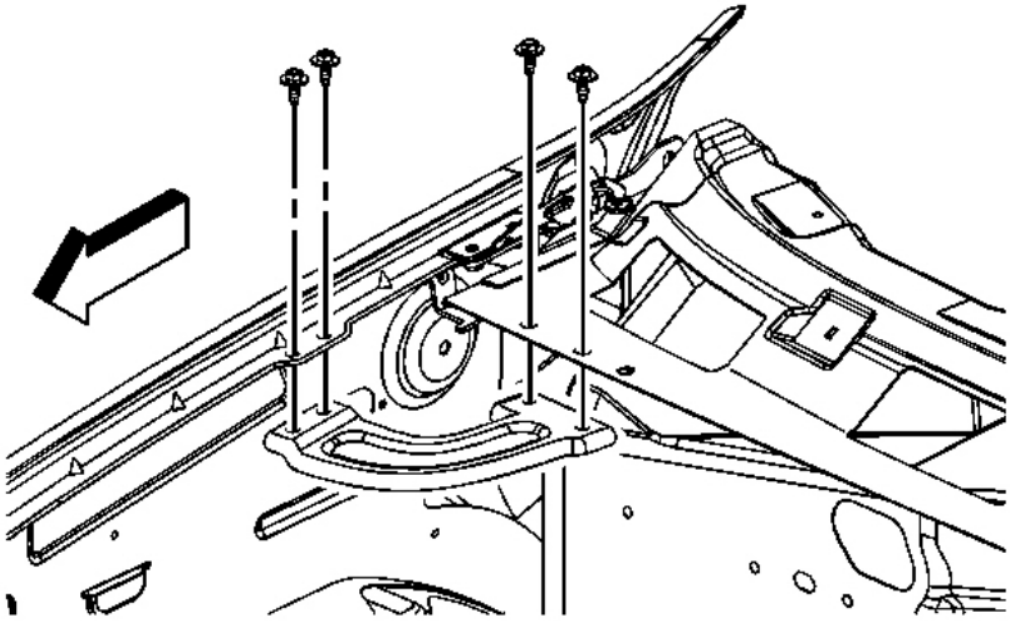


Fig. 64: View Of Front Fender Rear Upper Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the front fender rear upper brace bolts and brace.

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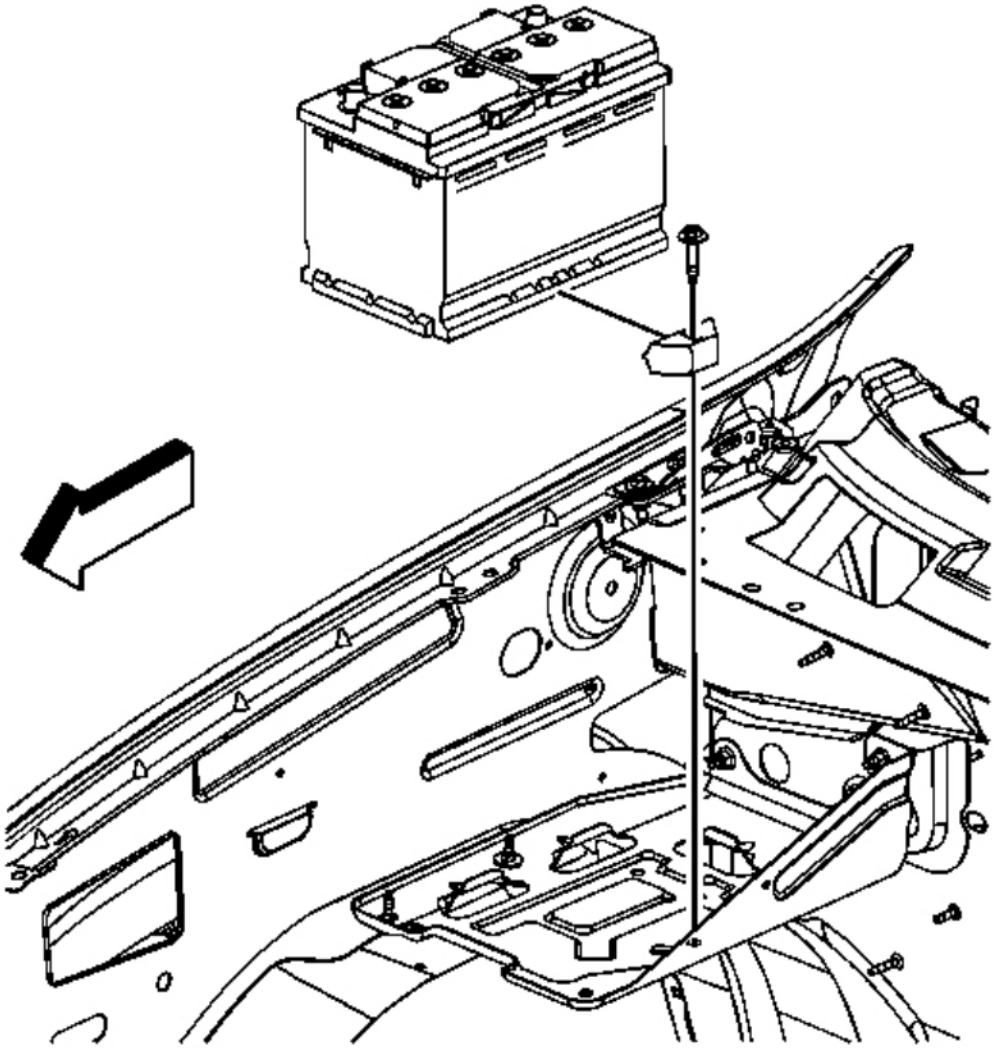


Fig. 65: View Of Battery Hold Down Retainer & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the battery hold down retainer bolt and retainer.
8. Remove the battery.

Installation Procedure

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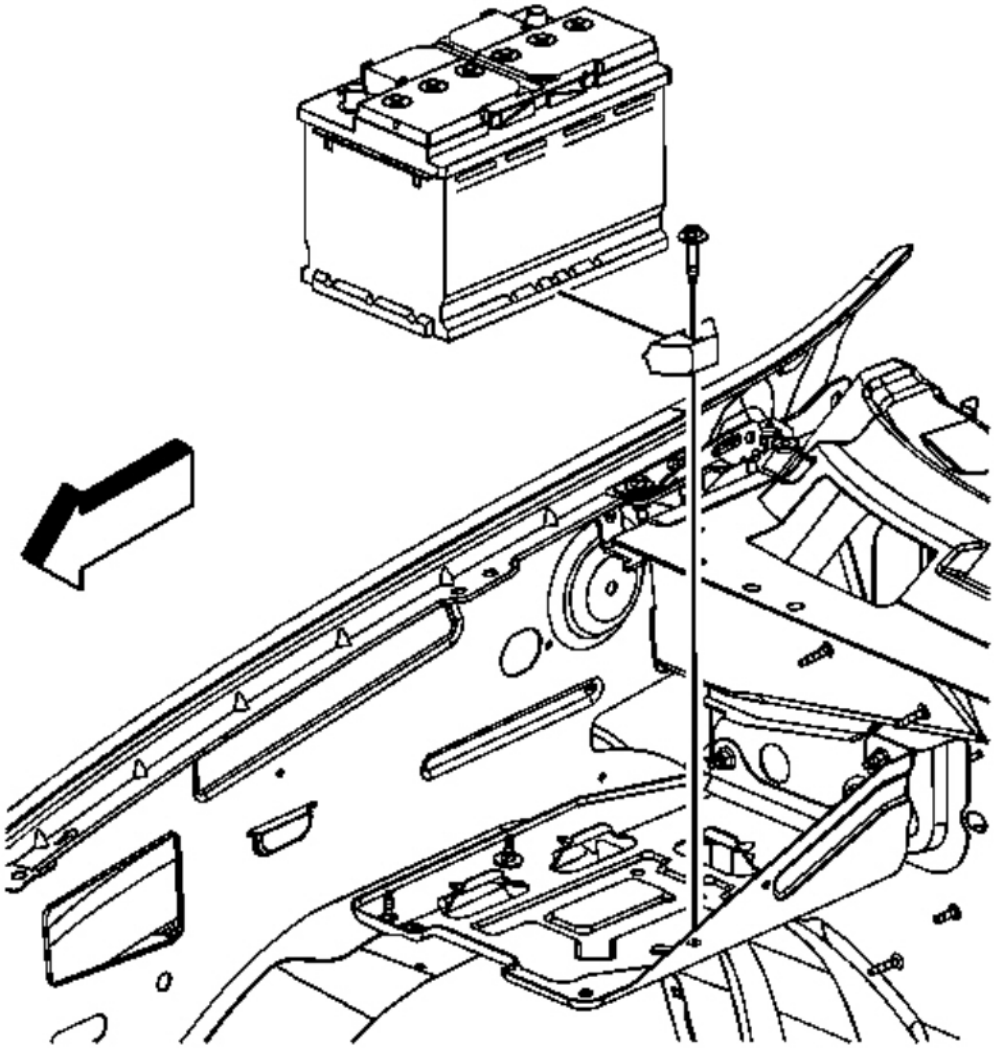


Fig. 66: View Of Battery Hold Down Retainer & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the battery.

NOTE: **Refer to Fastener Notice .**

2. Install the battery hold down retainer and bolt.

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Tighten: Tighten the bolt to 25 N.m (18 lb ft).

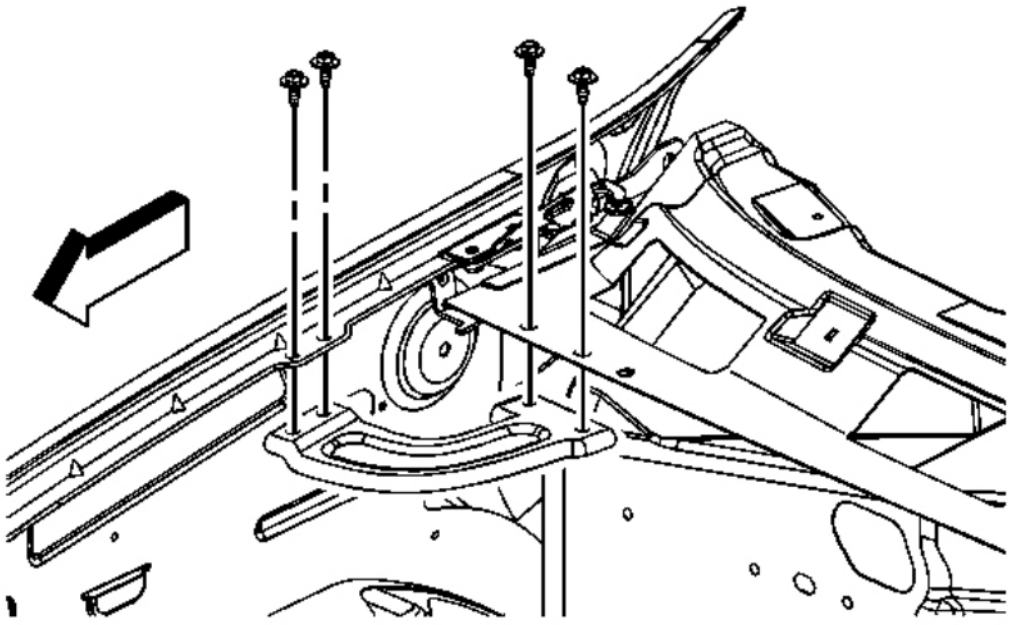


Fig. 67: View Of Front Fender Rear Upper Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the front fender rear upper brace and bolts.

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

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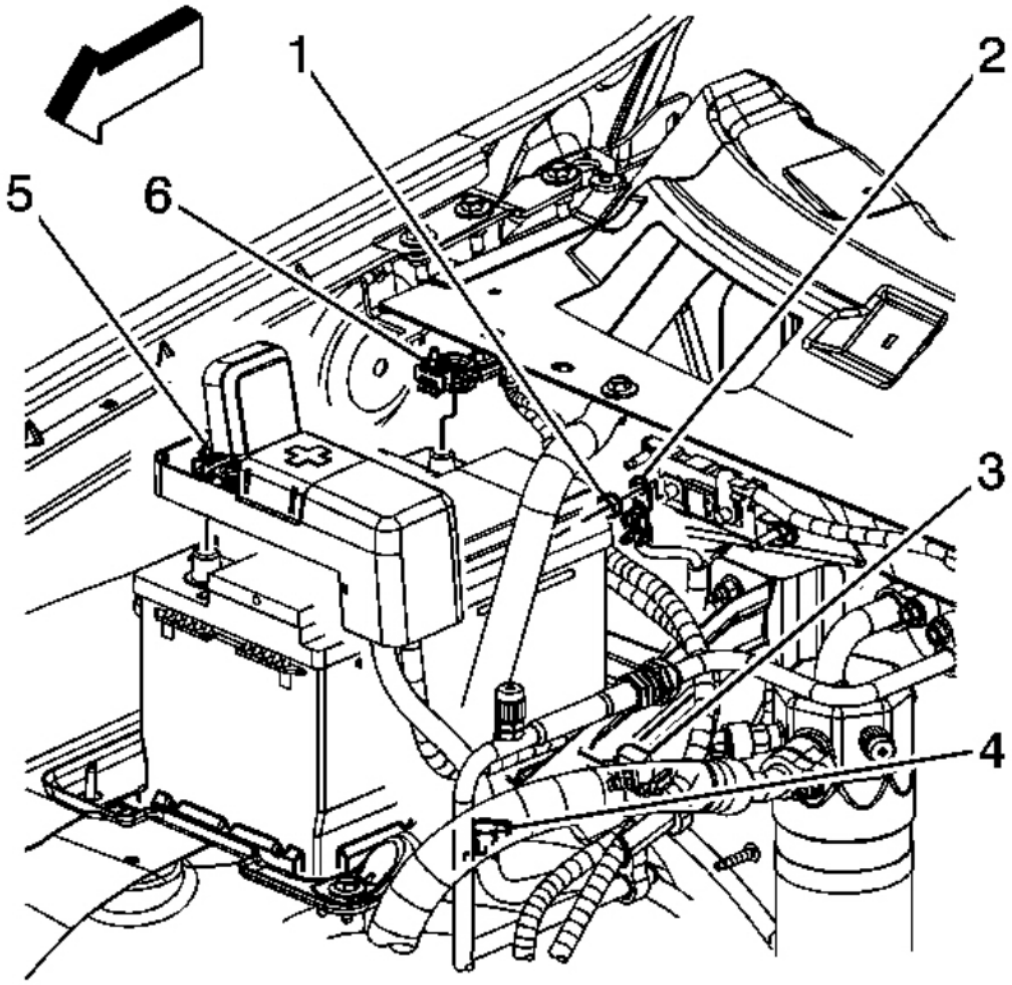


Fig. 68: View Of Battery Cable Components
Courtesy of GENERAL MOTORS CORP.

4. Position the starter solenoid cable to the battery.
5. Install the starter solenoid cable to the positive battery terminal.
6. Tighten the starter solenoid cable nut (5).

   Tighten: Tighten the nut to 17 N.m (13 lb ft).

7. Close the starter solenoid cable cover at the positive battery terminal.
8. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

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BATTERY TRAY REPLACEMENT

Removal Procedure

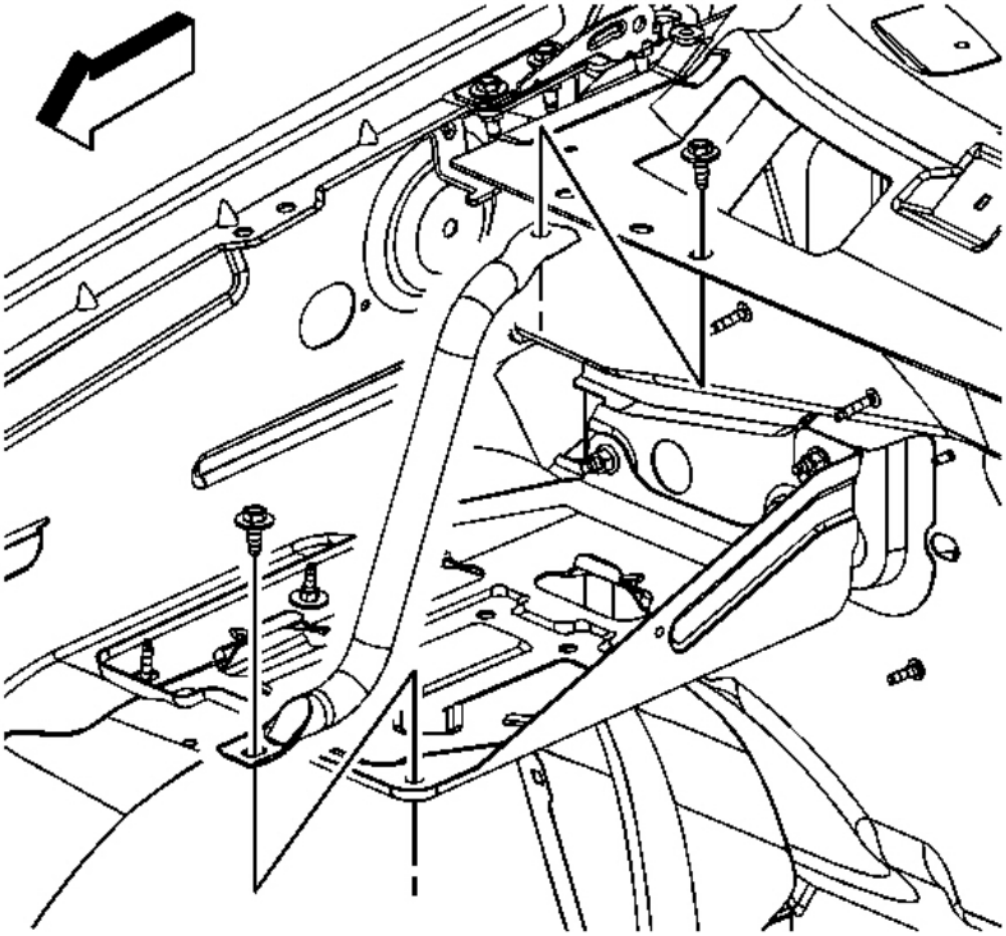


Fig. 69: View Of Battery Tray Front Support & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery. Refer to **Battery Replacement**.
2. Remove the battery tray front support bolts.
3. Remove the battery tray front support.

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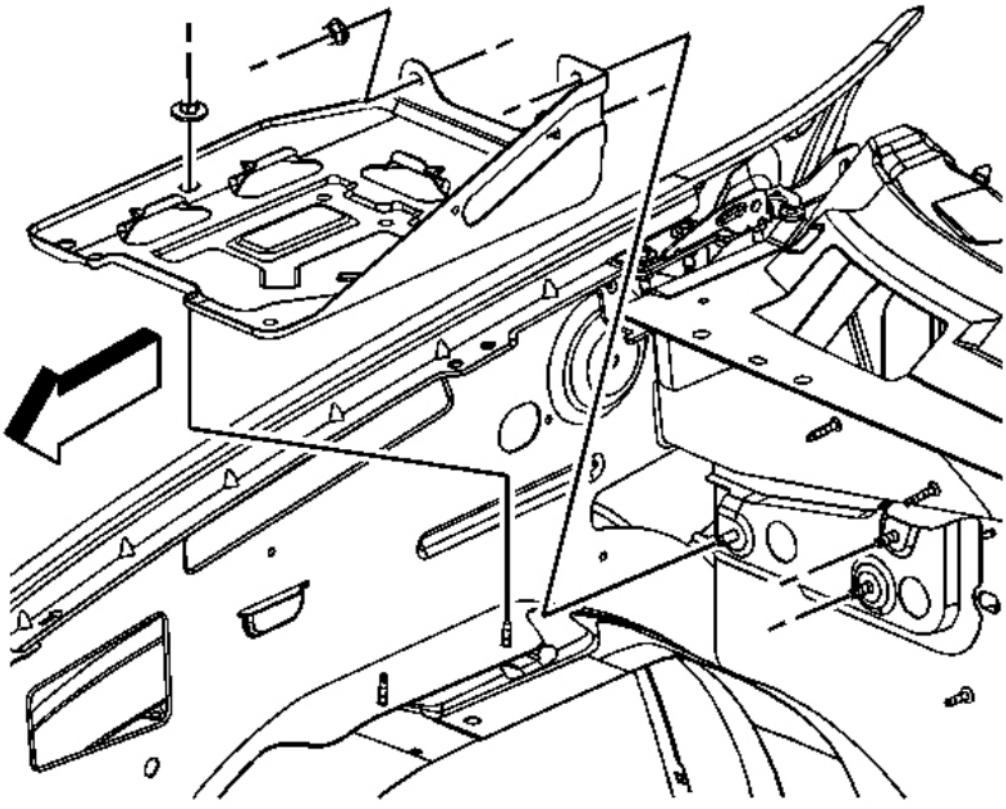


Fig. 70: View Of Battery Tray, Brackets & Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the nut securing the battery tray to the front fender inner panel.
5. Remove the 3 nuts securing the battery tray to the battery tray bracket.
6. Remove the battery tray from the vehicle.

Installation Procedure

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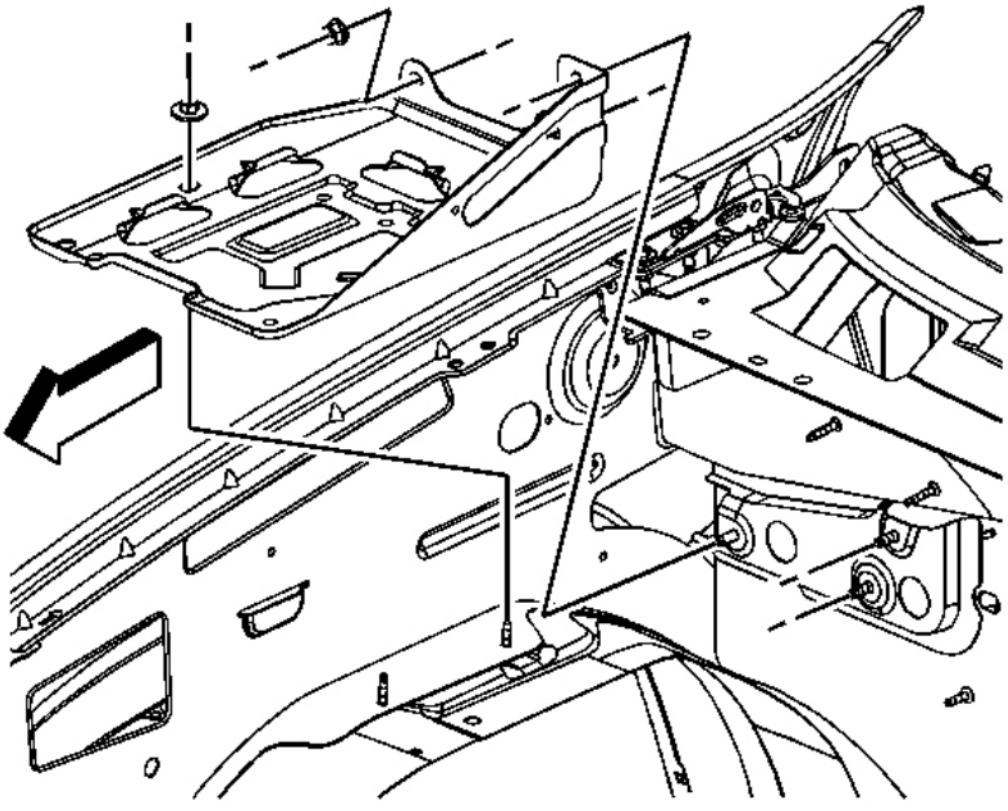


Fig. 71: View Of Battery Tray, Brackets & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Install the battery tray to the vehicle.

NOTE: **Refer to Fastener Notice .**

2. Install the 3 nuts securing the battery tray to the battery tray bracket.

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

3. Install the nut securing the battery tray to the front fender inner panel.

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

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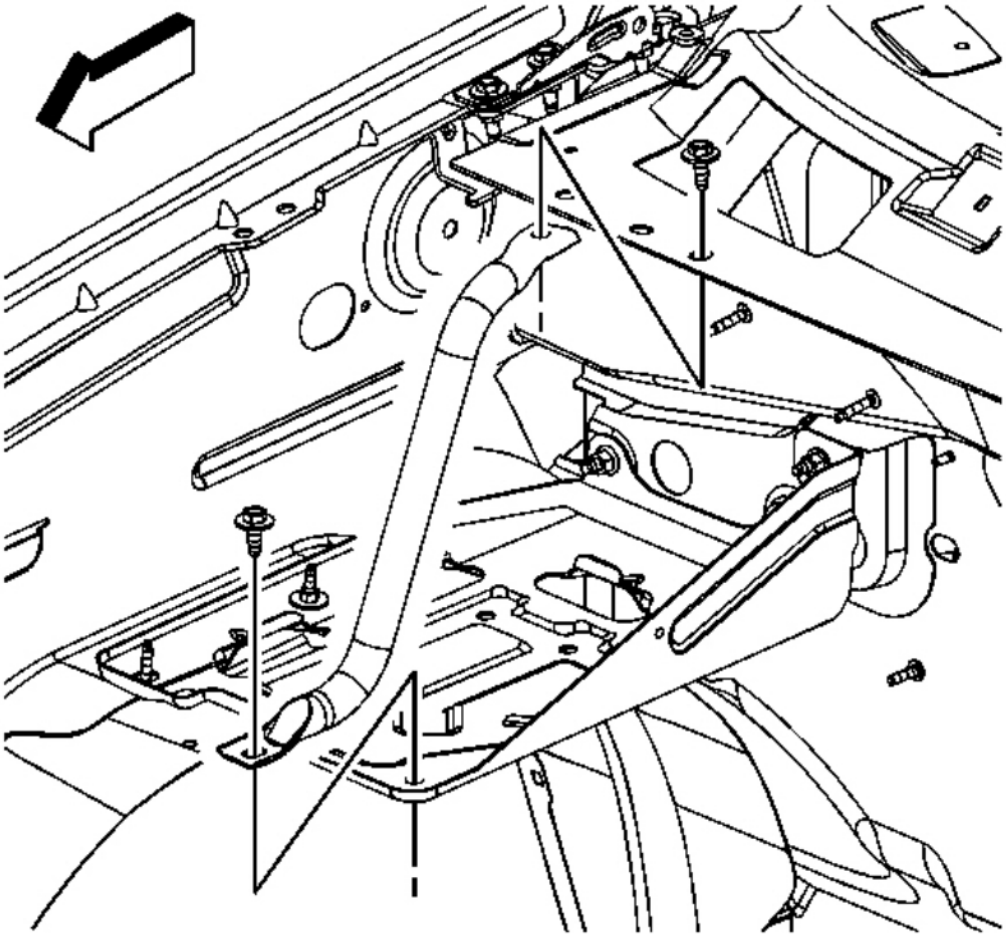


Fig. 72: View Of Battery Tray Front Support & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the battery tray front support.
5. Install the battery tray front support bolts.

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

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

ENGINE GROUND STRAP REPLACEMENT

Removal Procedure

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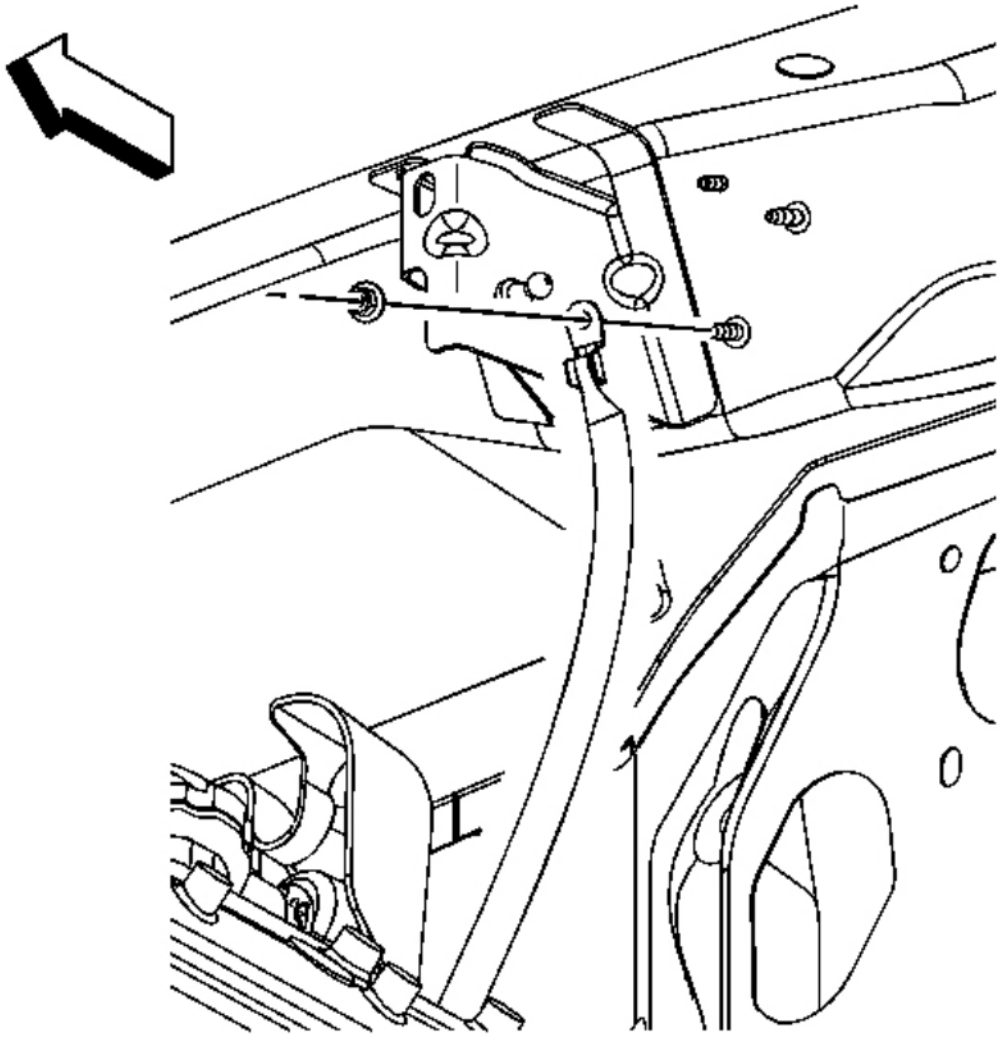


Fig. 73: View Of Engine Ground Strap Terminal & Nut
Courtesy of GENERAL MOTORS CORP.

1. Remove the upper intake manifold sight shield. Refer to **Upper Intake Manifold Sight Shield Replacement** .
2. Remove the engine ground strap nut at the front plenum panel.
3. Remove the ground strap terminal from the stud.

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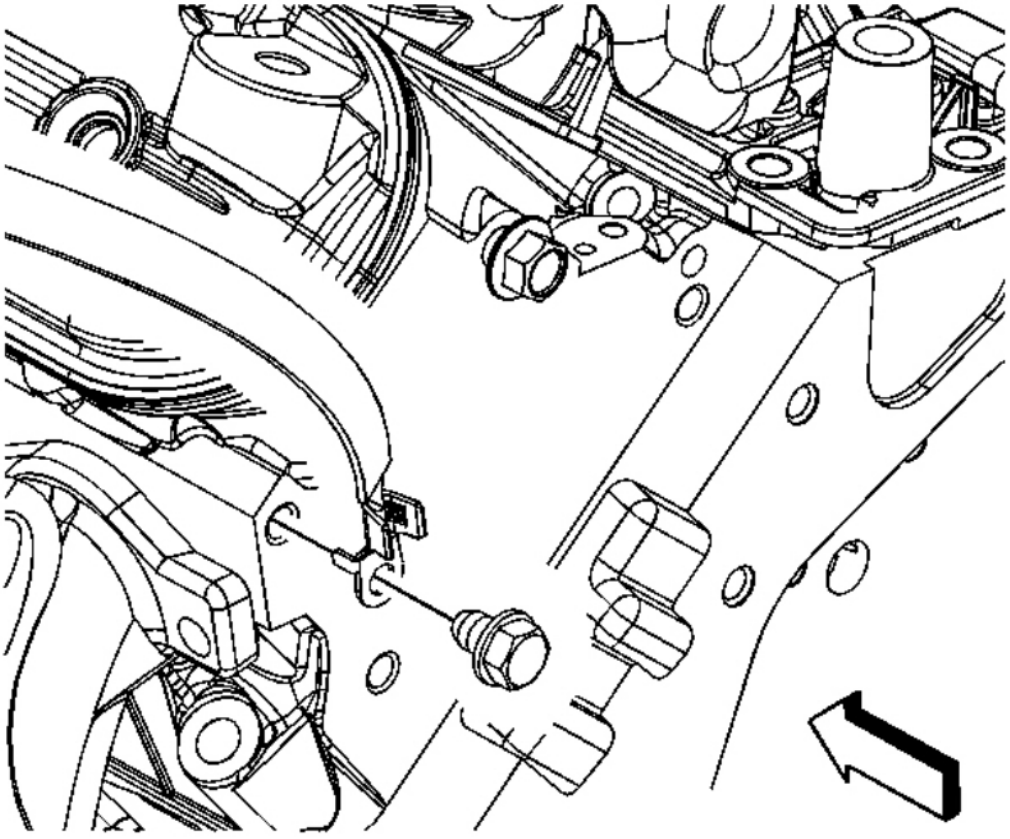


Fig. 74: View Of Engine Ground Strap & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine ground strap bolt from the rear of the left cylinder head.
5. Remove the ground strap from the vehicle.

Installation Procedure

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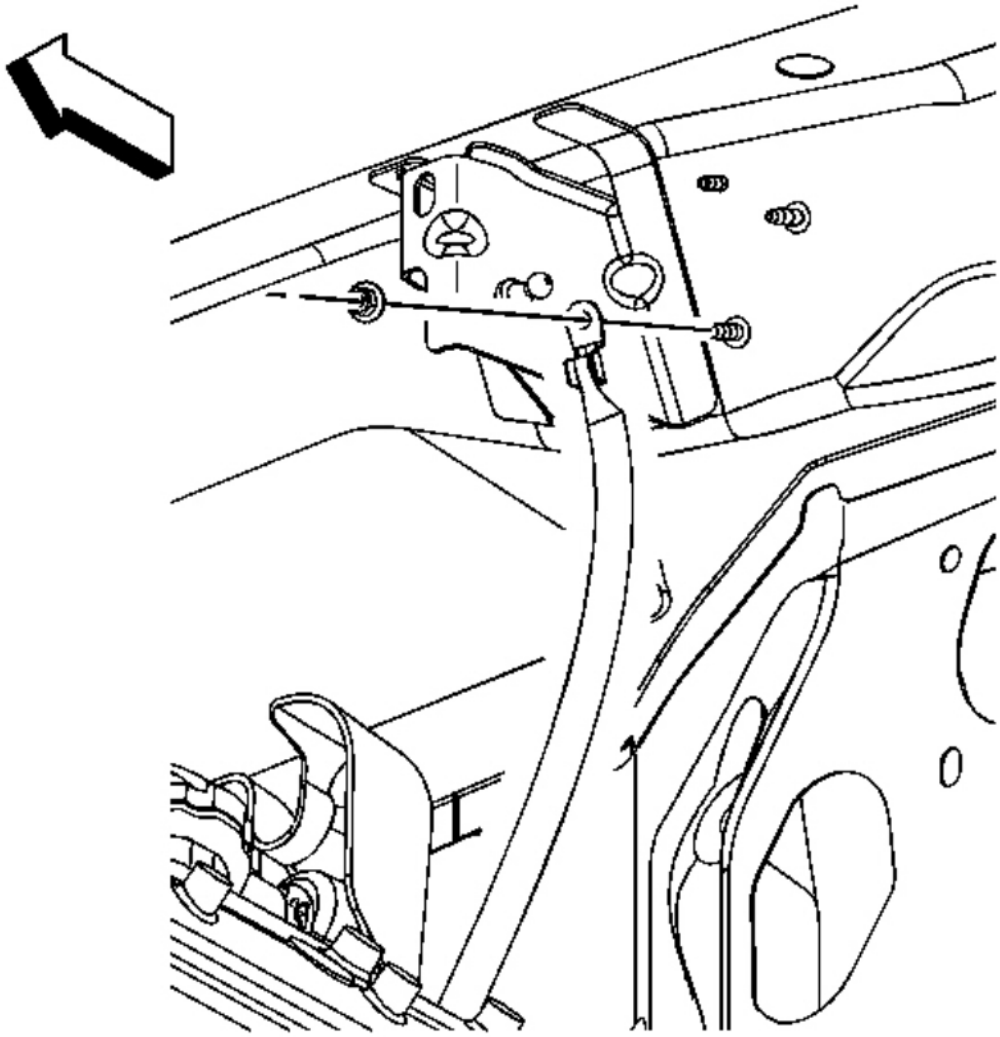


Fig. 75: View Of Engine Ground Strap & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the ground strap to the vehicle.
2. Install the ground strap terminal to the stud.

NOTE: **Refer to Fastener Notice .**

3. Install the engine ground strap nut at the front plenum panel.

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

4. Position the ground strap to the rear of the left cylinder head.

   Tighten: Tighten the bolt to 16 N.m (12 lb ft).

5. Install the engine ground strap bolt to the rear of the left cylinder head.
6. Install the upper intake manifold sight shield. Refer to **Upper Intake Manifold Sight Shield Replacement** .

STARTER MOTOR REPLACEMENT

Removal Procedure

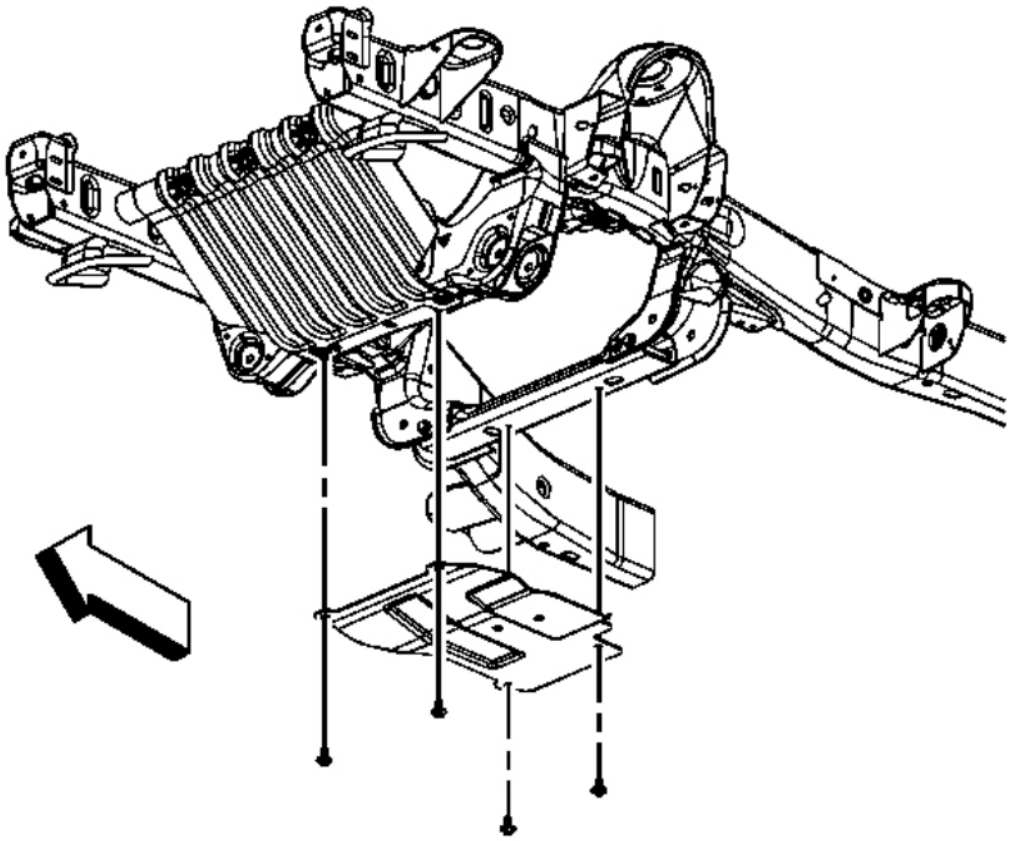


Fig. 76: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

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1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. For 1500 series vehicles, remove the oil pan skid plate bolts and plate, if equipped.

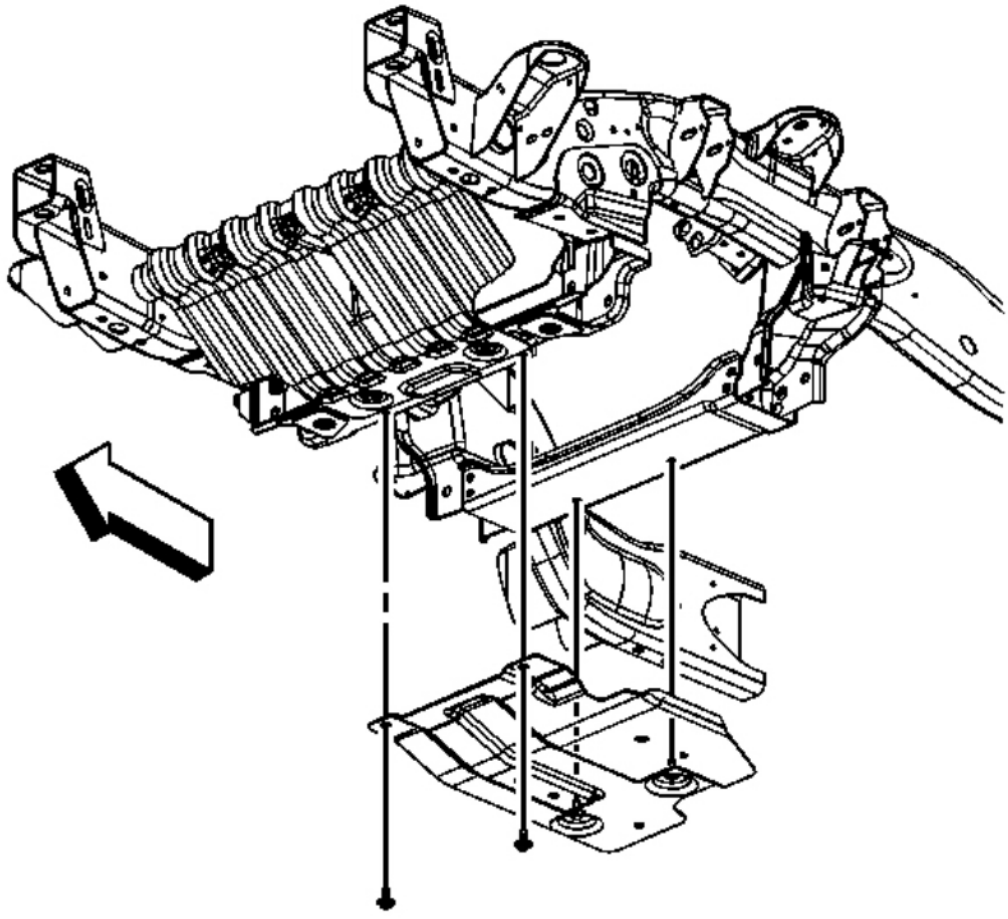


Fig. 77: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

4. For 2500 series vehicles, remove the front 2 oil pan skid plate bolts, loosen the rear 2 bolts and remove the skid plate, if equipped.

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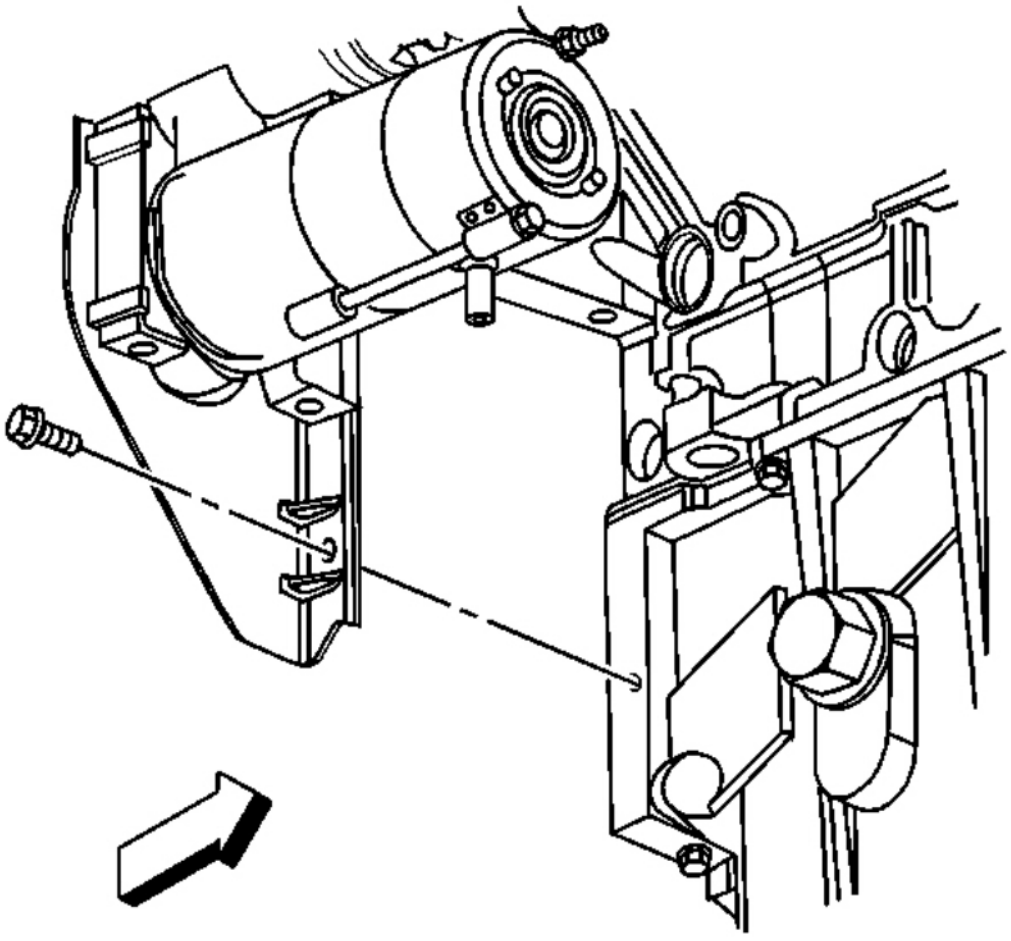


Fig. 78: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the transmission cover bolt.

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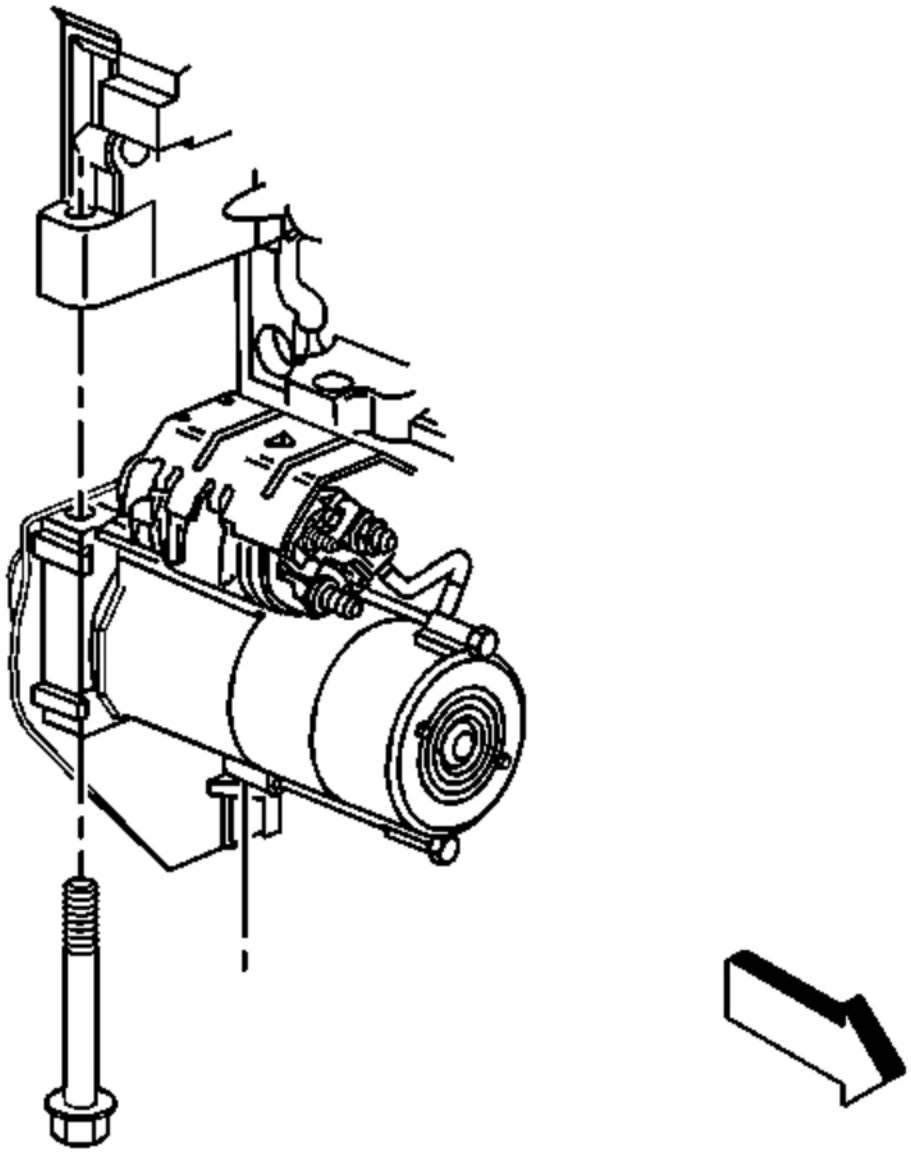


Fig. 79: View Of Starter & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

6. Remove the starter bolts.

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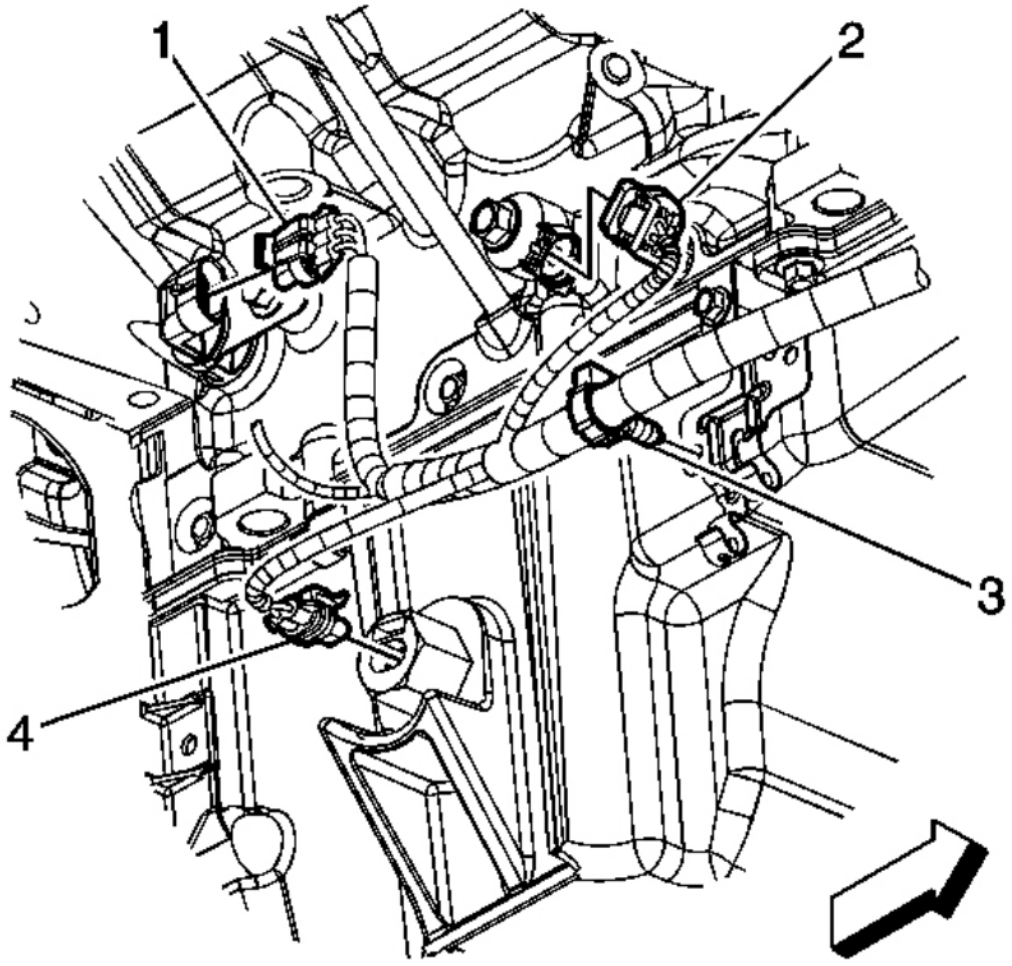


Fig. 80: View Of Engine Wiring Harness Electrical Connector & Components
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the engine wiring harness electrical connector (4) from the oil level sensor.
8. Slide the starter forward until the starter clears the transmission.
9. Lower the vehicle half way.
10. Remove the right front wheel and tire. Refer to **Tire and Wheel Removal and Installation** .

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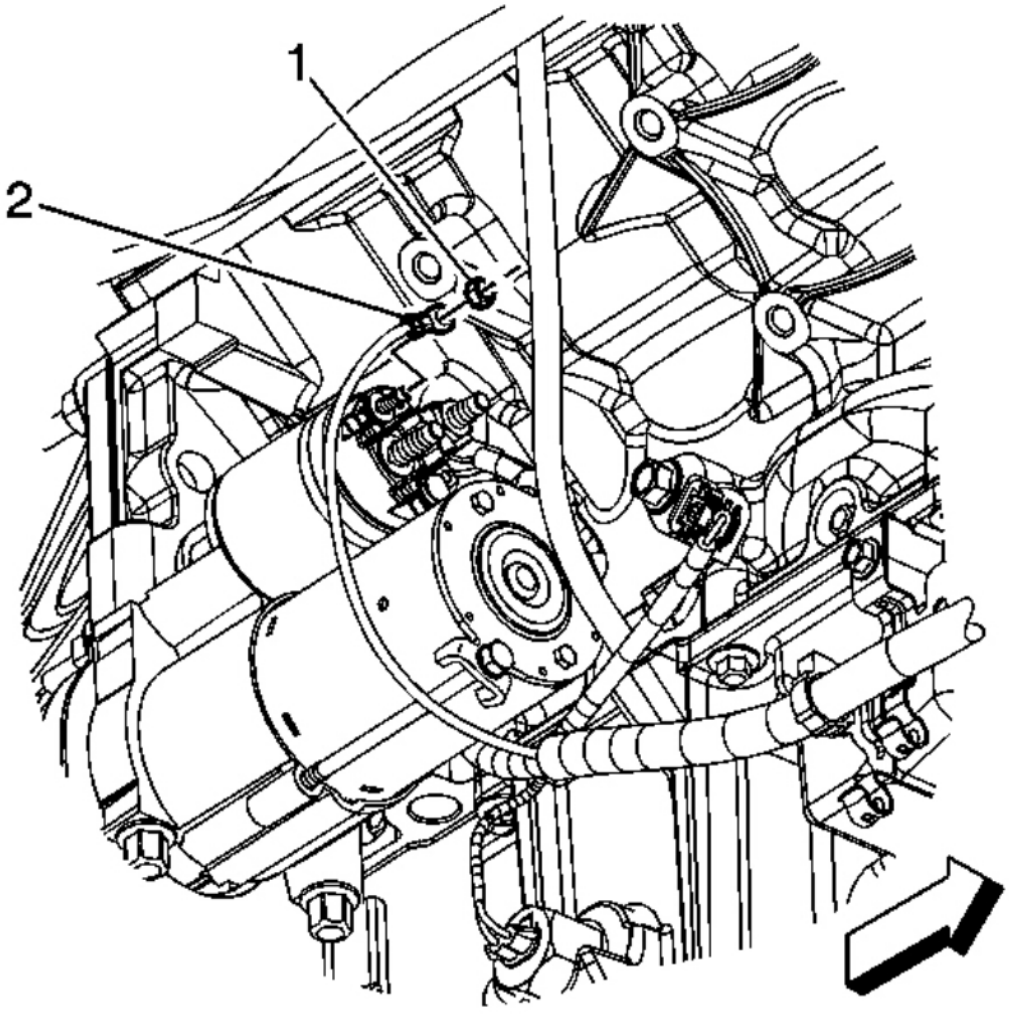


Fig. 81: View Of Engine Wiring Harness Lead Terminal & Nut
Courtesy of GENERAL MOTORS CORP.

11. Remove the engine wiring harness lead nut (1).
12. Remove the engine wiring harness lead terminal (2) from the starter.

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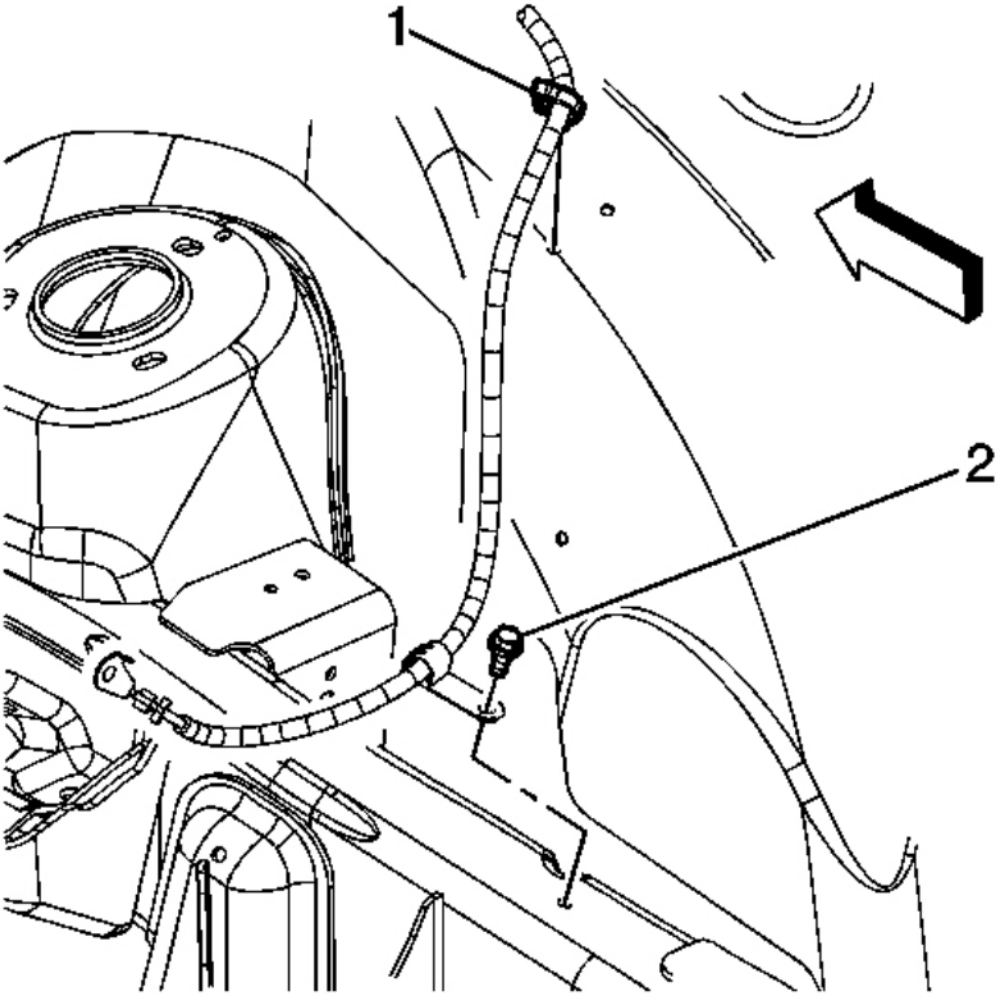


Fig. 82: View Of Starter Solenoid Cable Clip & Bolt
Courtesy of GENERAL MOTORS CORP.

13. Remove the starter solenoid cable clip bolt (2) from the frame.

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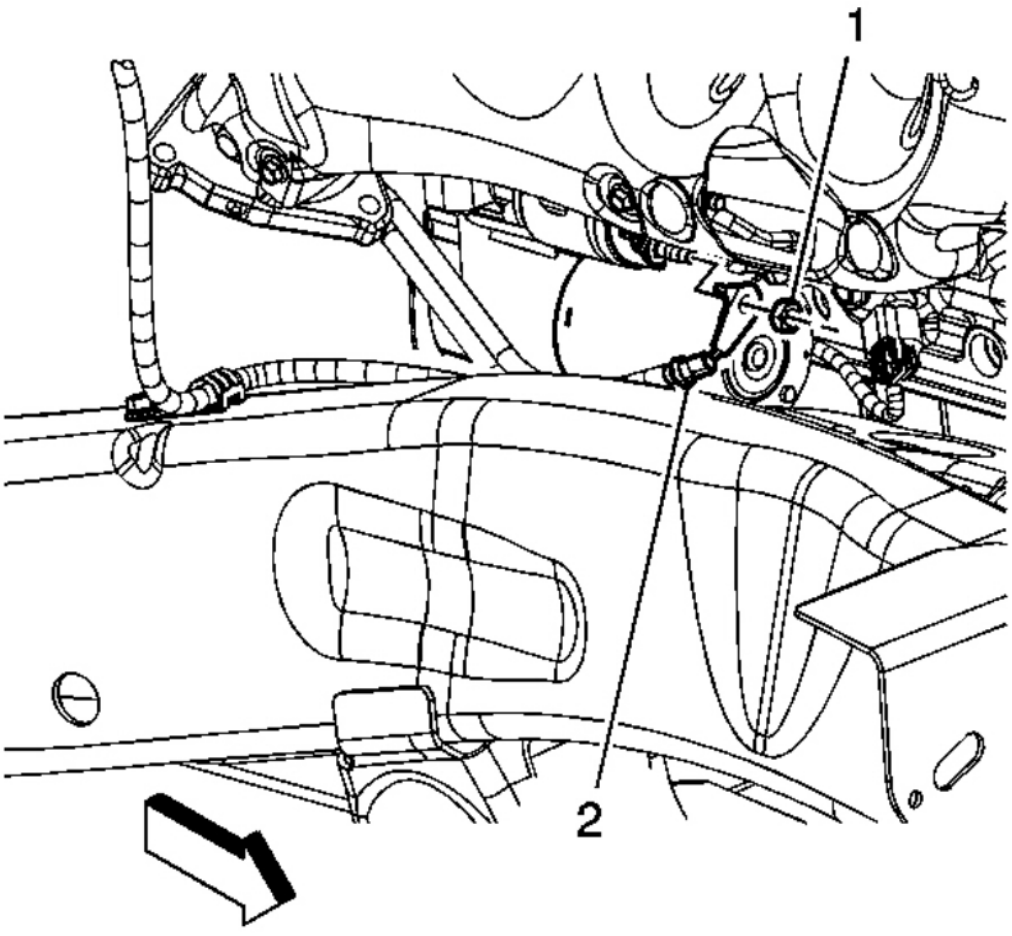


Fig. 83: View Of Starter Solenoid Cable & Nut
Courtesy of GENERAL MOTORS CORP.

14. Remove the starter solenoid cable nut (1).
15. Remove the starter solenoid cable (2) from the starter.
16. Remove the starter out through the wheel well opening.

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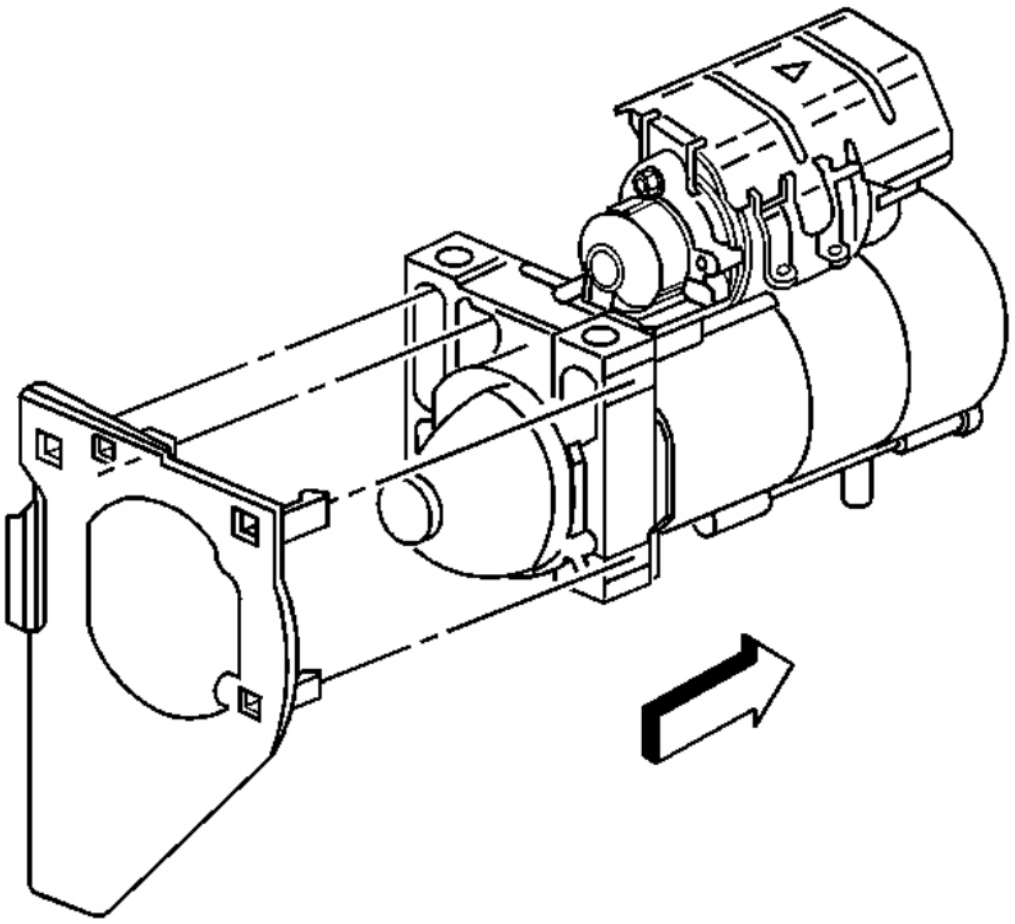


Fig. 84: View Of Transmission Cover & Starter
Courtesy of GENERAL MOTORS CORP.

17. If replacing the starter, unsnap the transmission cover from the starter.

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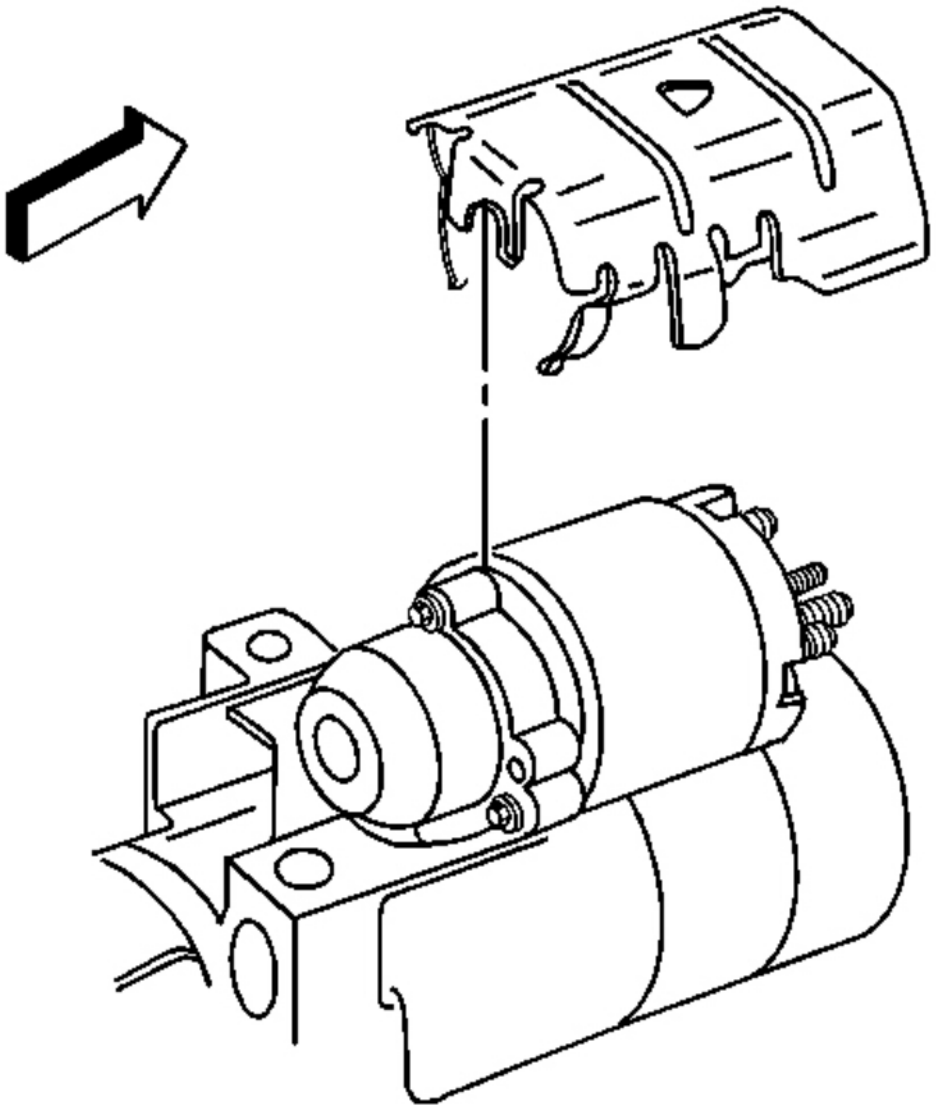


Fig. 85: View Of Starter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

18. If replacing the starter, remove the starter heat shield.

Installation Procedure

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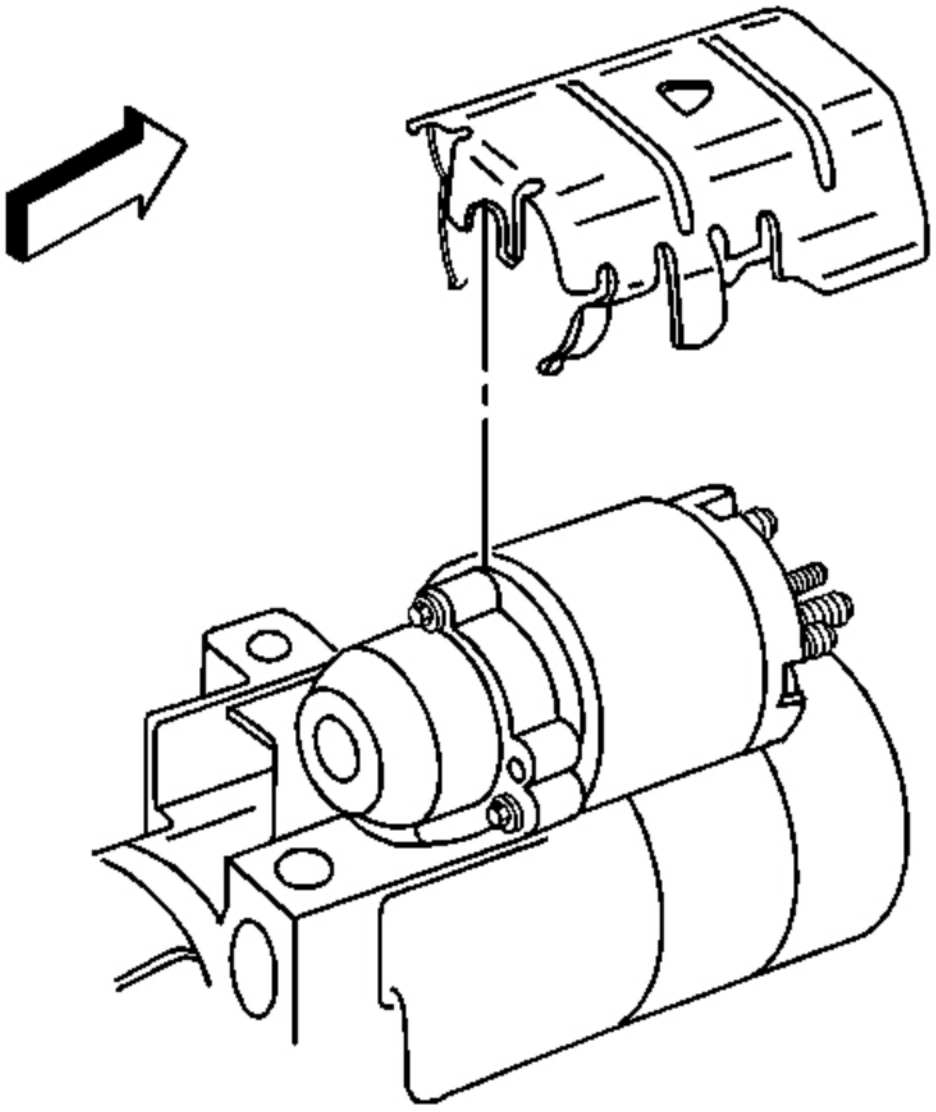


Fig. 86: View Of Starter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. If the starter was replaced, install the starter heat shield.

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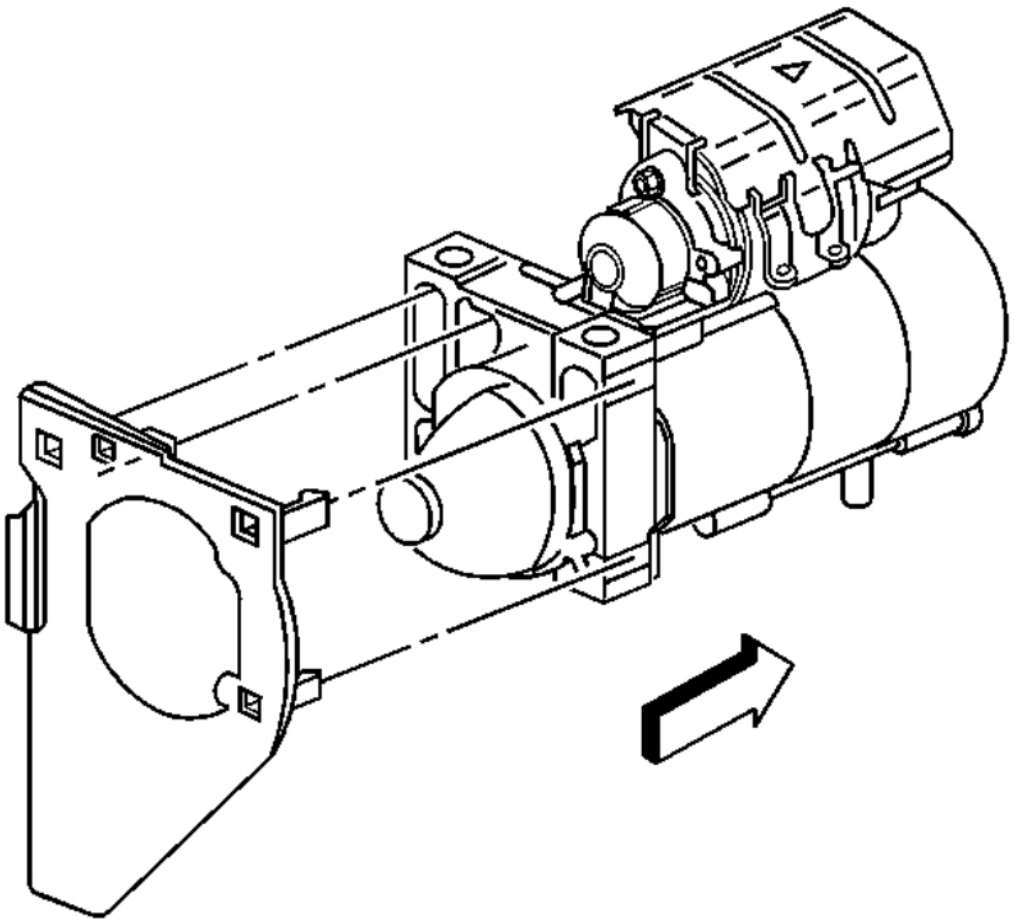


Fig. 87: View Of Transmission Cover & Starter
Courtesy of GENERAL MOTORS CORP.

2. If the starter was replaced, snap the transmission cover onto the starter.

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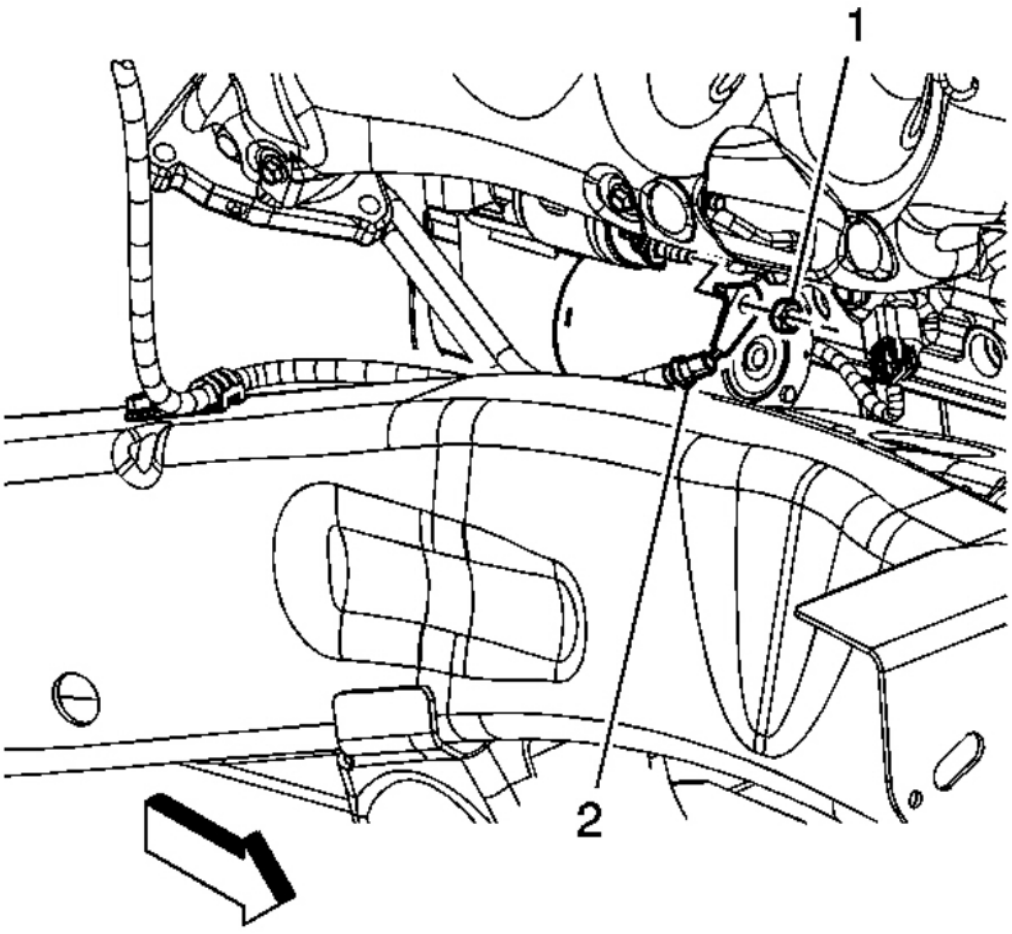


Fig. 88: View Of Starter Solenoid Cable & Nut
Courtesy of GENERAL MOTORS CORP.

3. Install the starter in through the wheel well opening.
4. Install the starter solenoid cable to the starter.

NOTE: **Refer to Fastener Notice .**

5. Install the starter solenoid cable nut (1).

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

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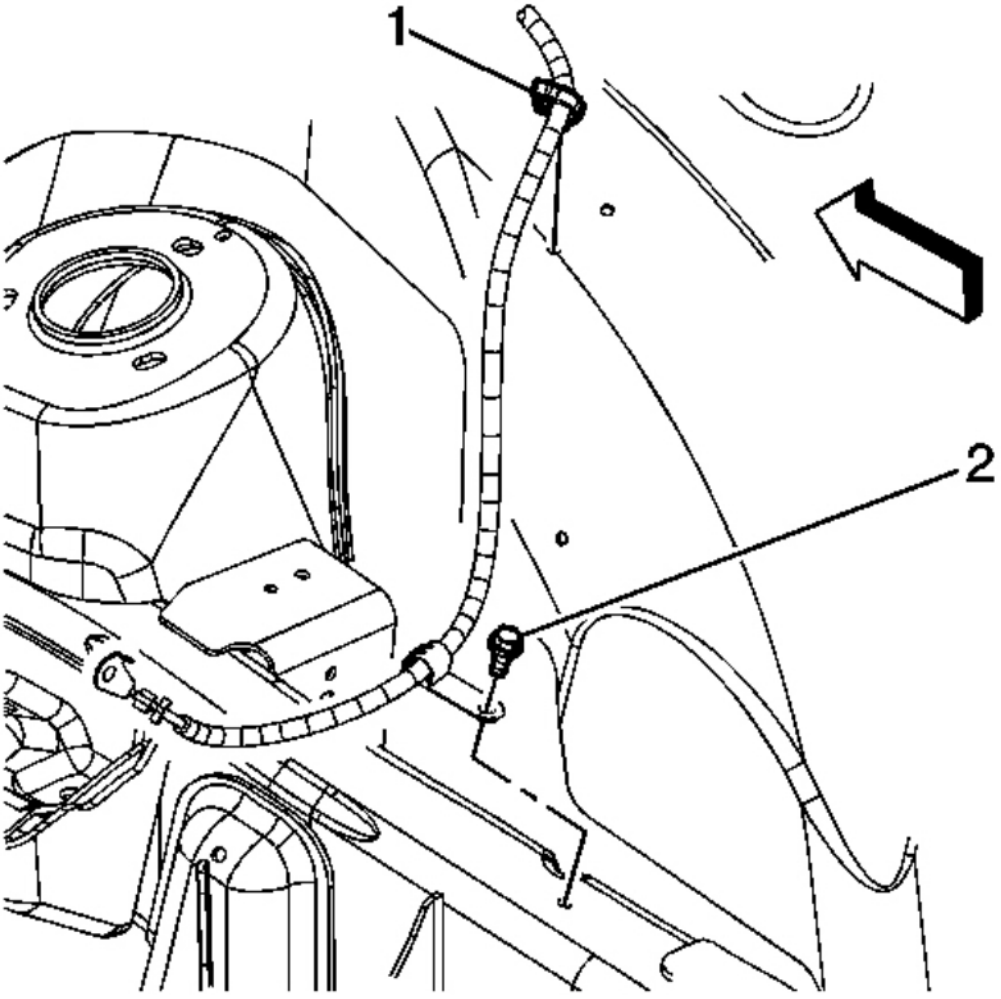


Fig. 89: View Of Starter Solenoid Cable Clip & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Position the starter solenoid cable clip to the frame and install the starter solenoid cable clip bolt (2).

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

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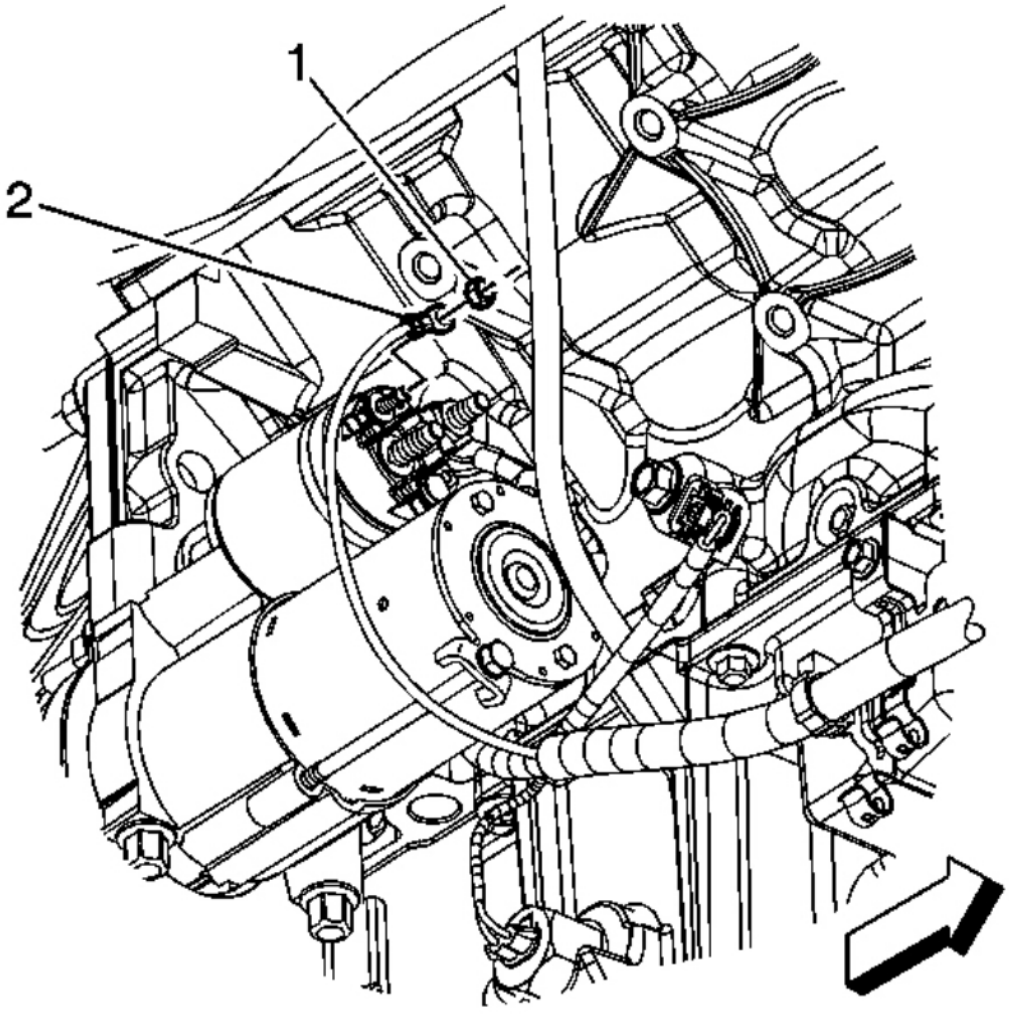


Fig. 90: View Of Engine Wiring Harness Lead Terminal & Nut
Courtesy of GENERAL MOTORS CORP.

7. Install the engine wiring harness lead terminal (2) to the starter.
8. Install the engine wiring harness lead nut (3).

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

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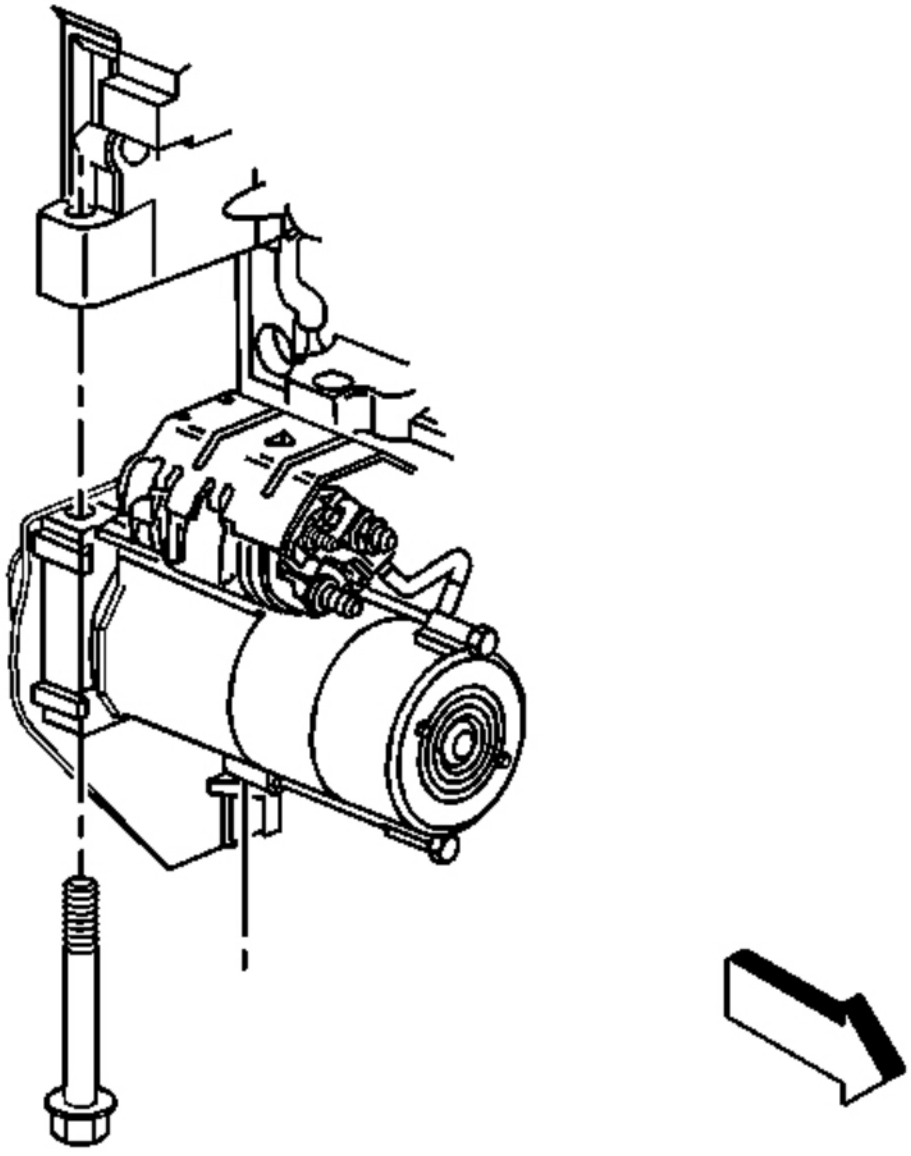


Fig. 91: View Of Starter & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

9. Position the starter into place.
10. Install the starter bolts.

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

11. Install the right front wheel and tire. Refer to **Tire and Wheel Removal and Installation** .
12. Raise and support the vehicle.

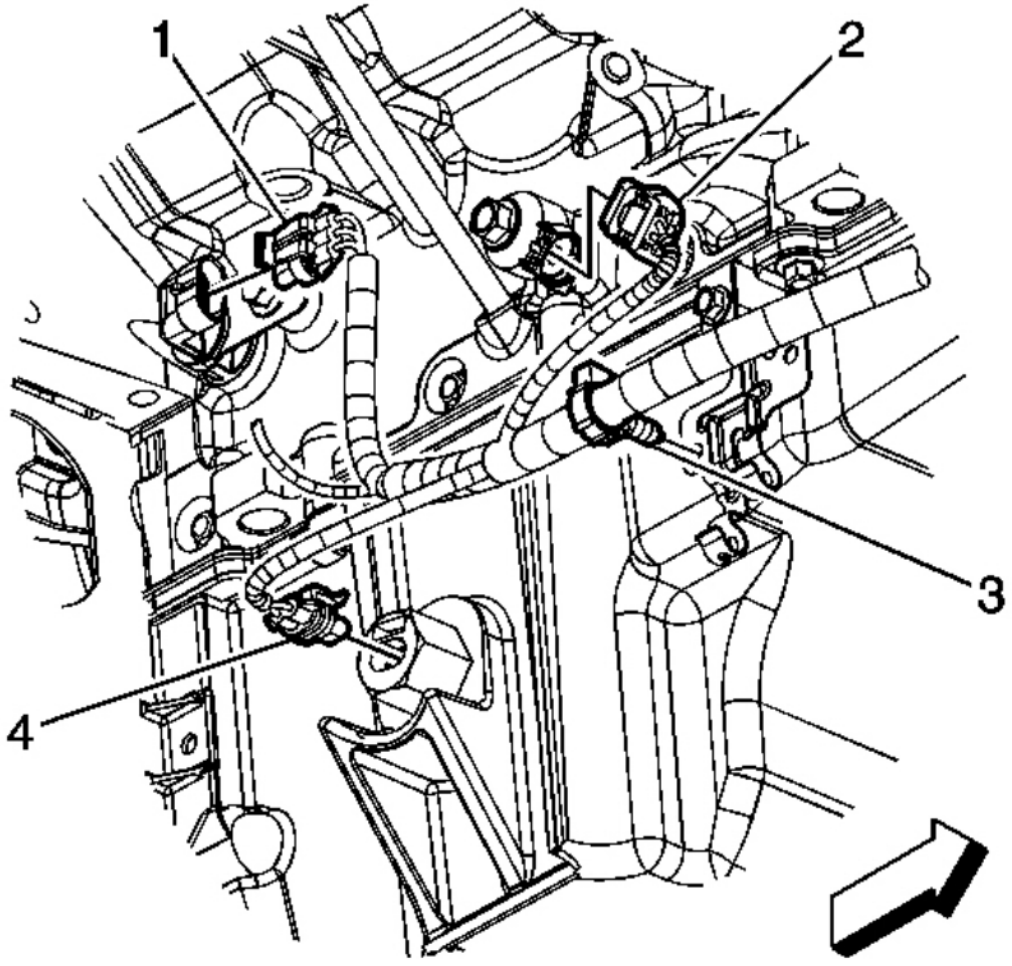


Fig. 92: View Of Engine Wiring Harness Electrical Connector & Components
Courtesy of GENERAL MOTORS CORP.

13. Connect the engine wiring harness electrical connector (4) to the oil level sensor.

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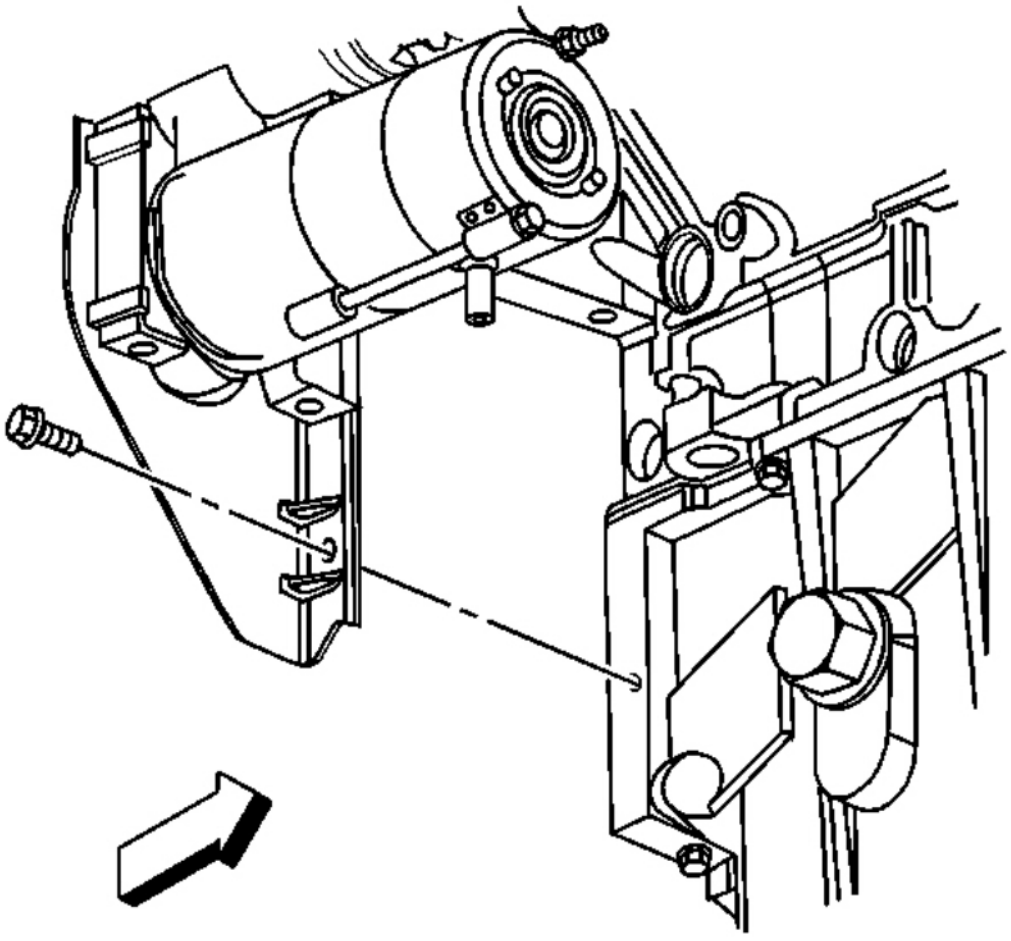


Fig. 93: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

14. Install the transmission cover bolt.

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

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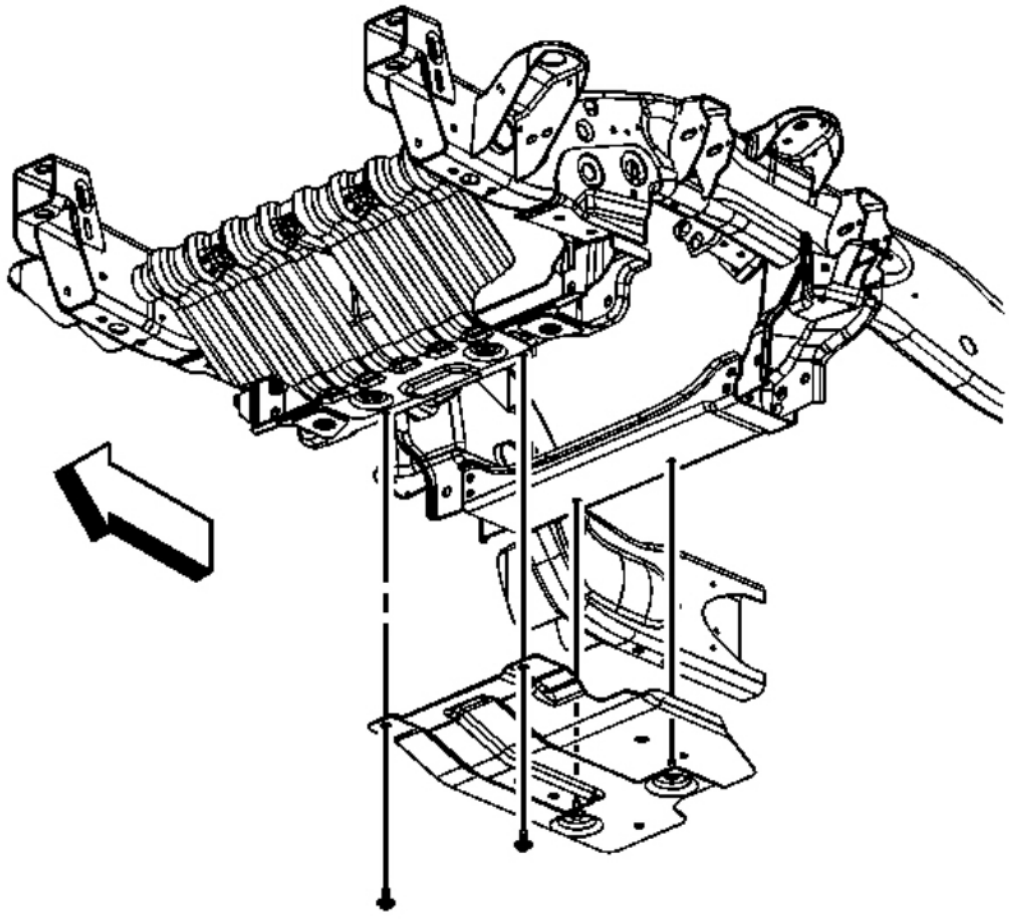


Fig. 94: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

15. For 2500 series vehicles, install the oil pan skid plate and tighten the rear 2 bolts and install and tighten the front 2 bolts, if equipped.

    Tighten: Tighten the bolts to 28 N.m (21 lb ft).

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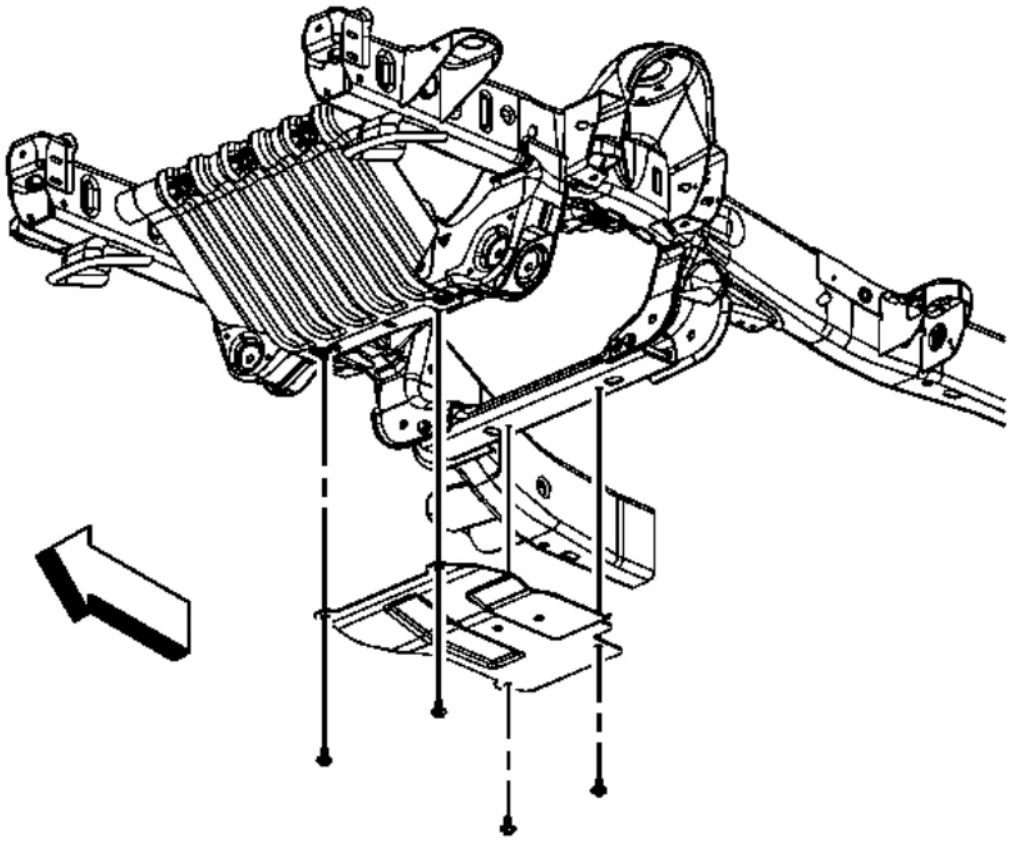


Fig. 95: View Of Oil Pan Skid Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

16. For 1500 series vehicles, install the oil pan skid plate and bolts, if equipped.

    Tighten: Tighten the bolts to 28 N.m (21 lb ft).

17. Lower the vehicle.
18. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

STARTER SHIELD REPLACEMENT

Removal Procedure

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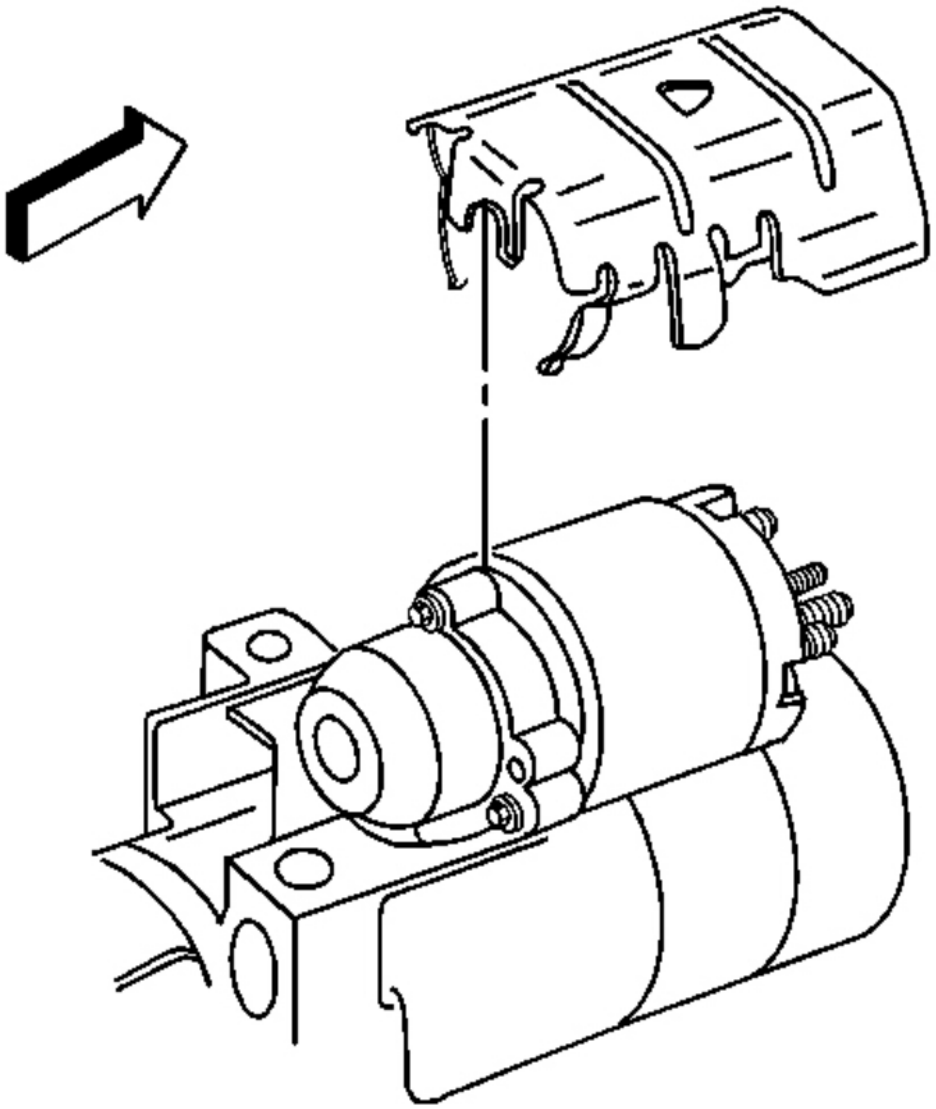


Fig. 96: View Of Starter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .
2. Remove the starter heat shield.

Installation Procedure

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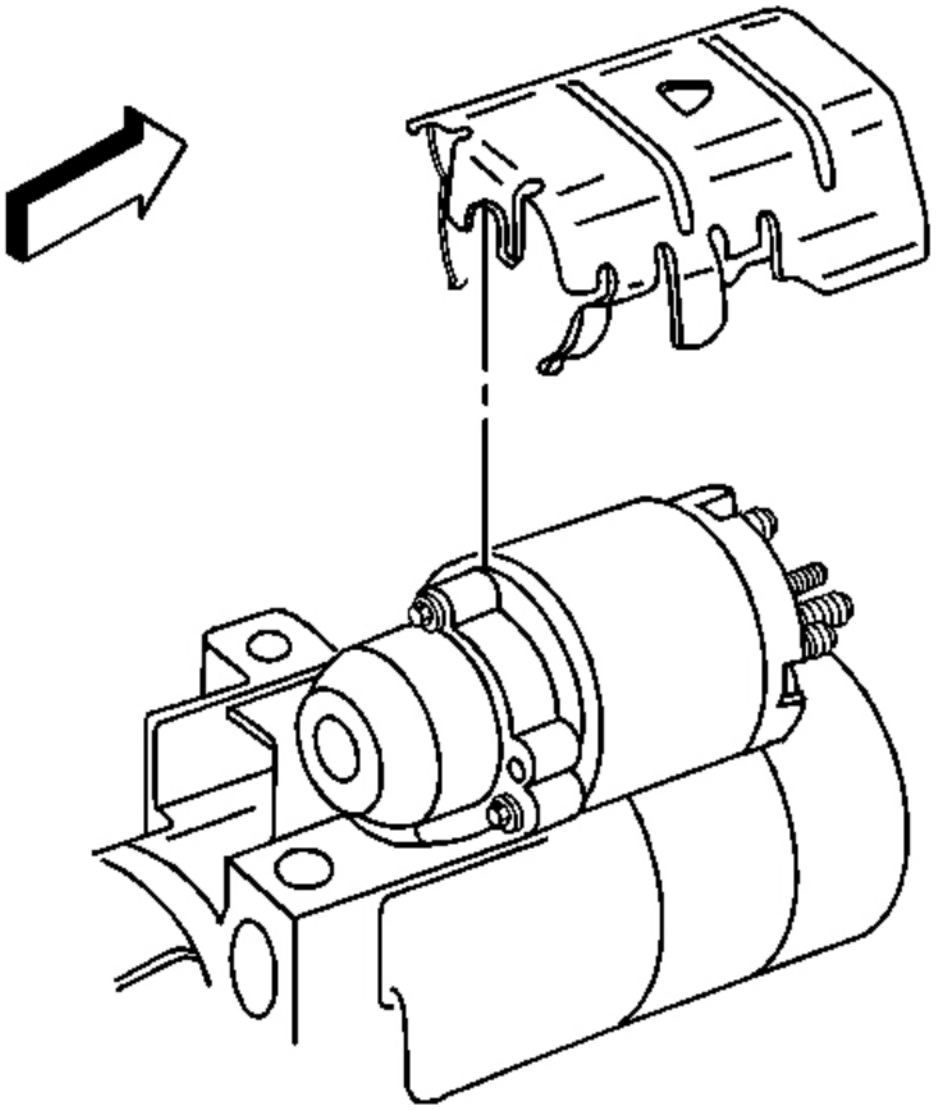


Fig. 97: View Of Starter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Install the starter heat shield.
2. Install the wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** .

GENERATOR BRACKET REPLACEMENT

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Removal Procedure

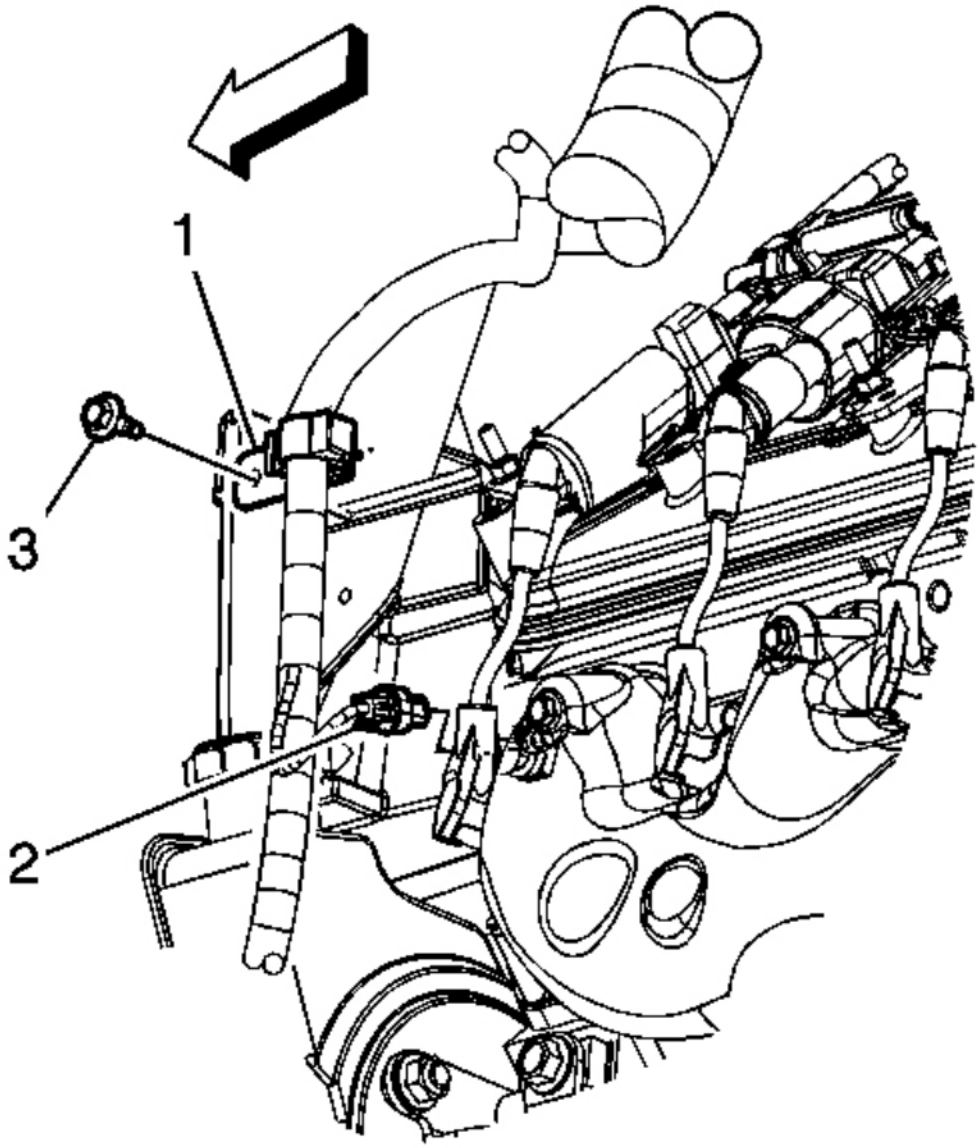


Fig. 98: View Of Engine Wiring Harness, Clip, Bolt & Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement**.
2. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.8L, 5.3L, 6.0L, and**

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6.2L) .

3. Remove the engine wiring harness clip bolt (3) are reposition the clip (1) away from the generator bracket.

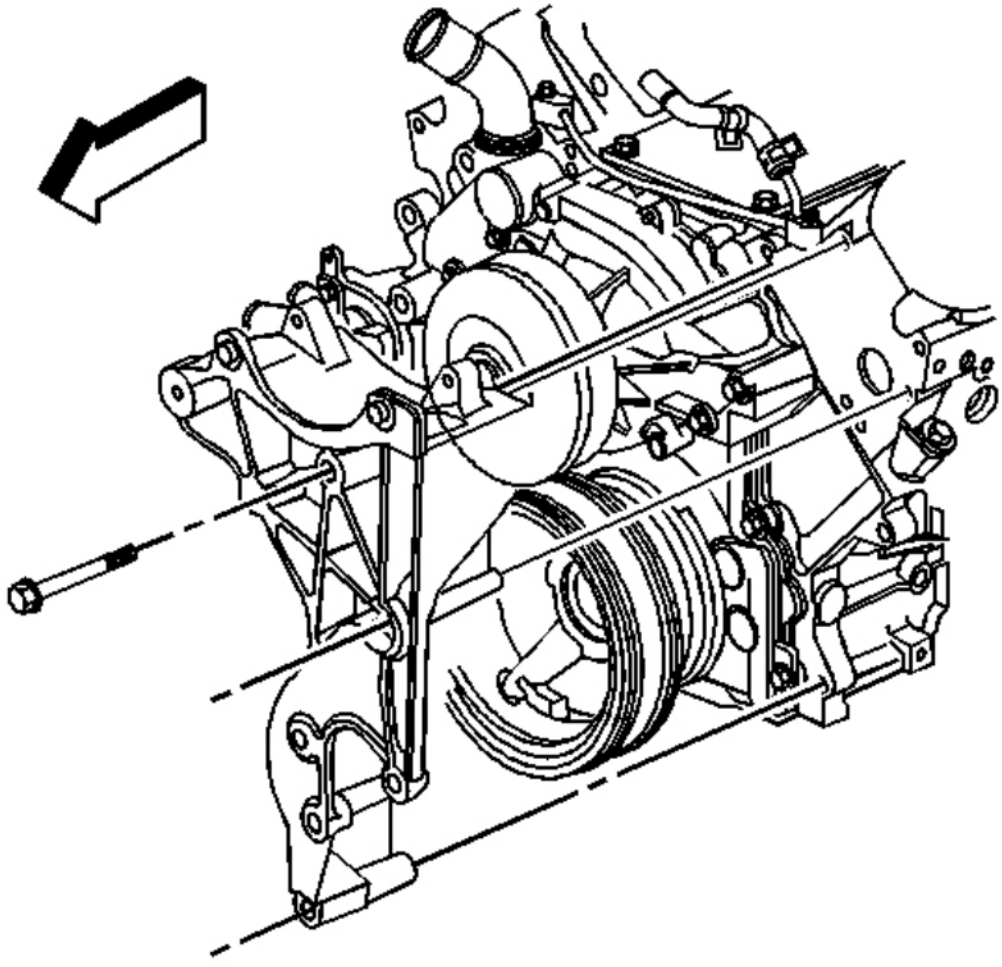


Fig. 99: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

4. Remove the generator bracket bolts.
5. Remove the generator bracket.

Installation Procedure

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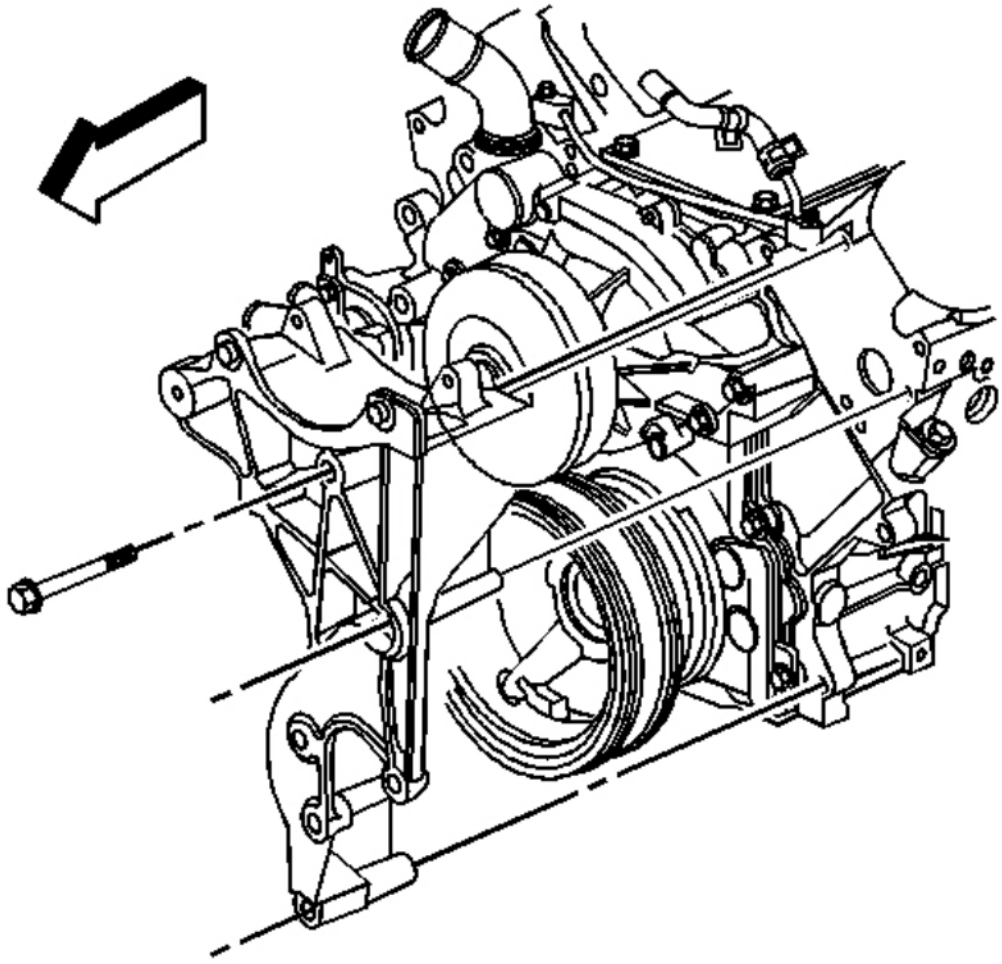


Fig. 100: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

1. Position the generator bracket to the engine.

NOTE: **Refer to Fastener Notice .**

2. Install the generator bracket bolts.

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

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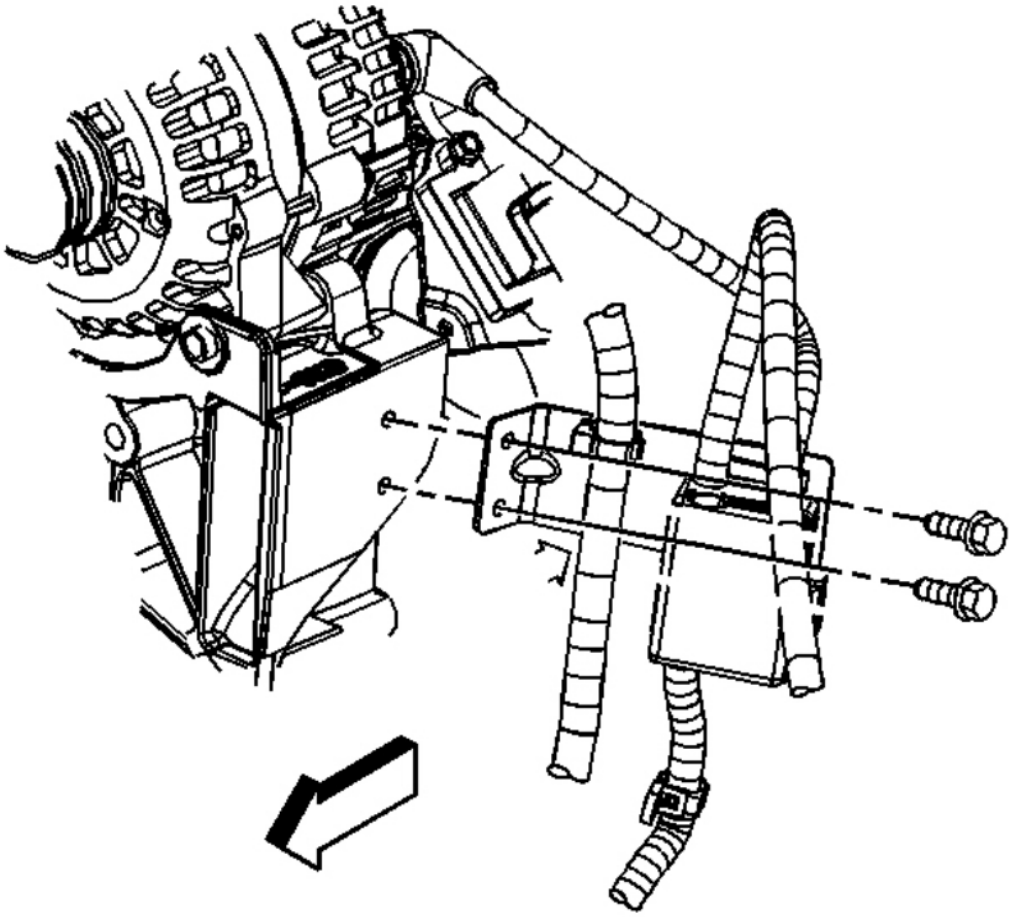


Fig. 101: View Of Battery Cable Junction Block Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Position the engine wiring harness clip to the generator bracket and install the engine harness clip bolt.

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

4. Install the power steering pump. Refer to **Power Steering Pump Replacement (4.8L, 5.3L, 6.0L, and 6.2L)** .
5. Install the generator. Refer to **Generator Replacement**.

GENERATOR REPLACEMENT

Removal Procedure

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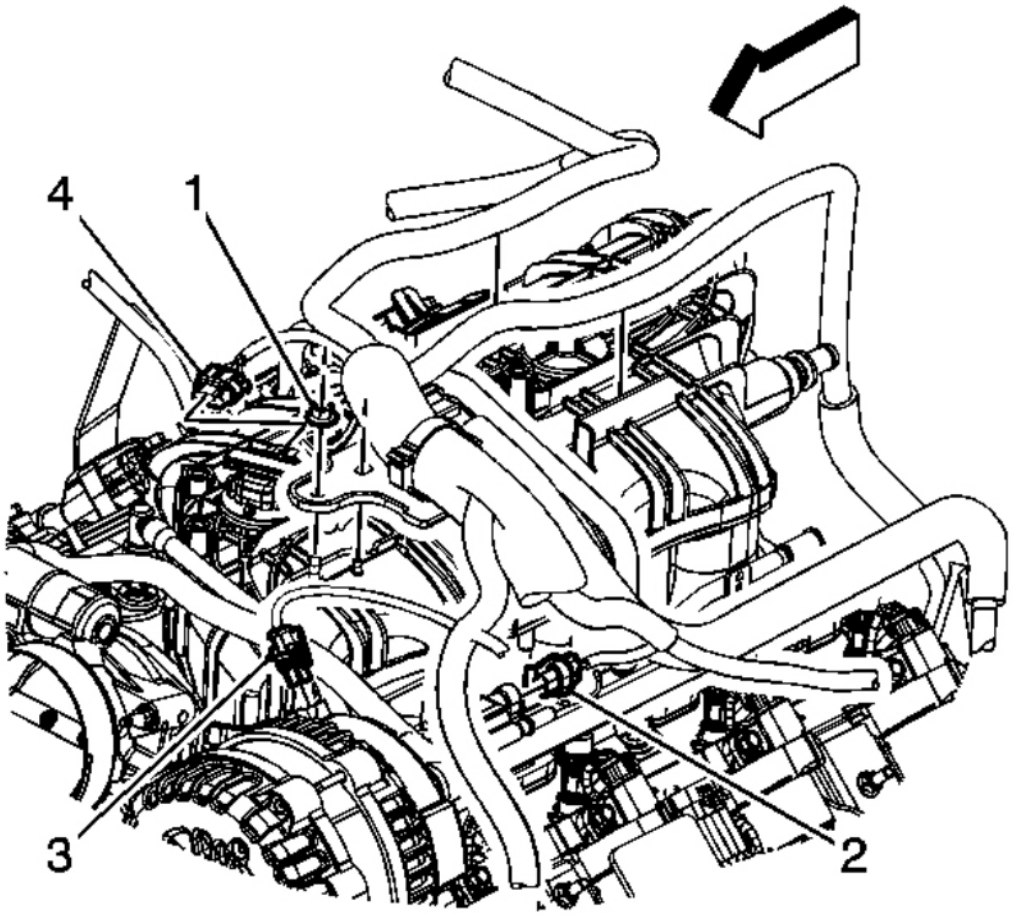


Fig. 102: View Of Generator & Related Connectors
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the intake manifold sight shield. Refer to **Upper Intake Manifold Sight Shield Replacement** .
3. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .
4. Disconnect the engine harness electrical connector (3) from the generator.

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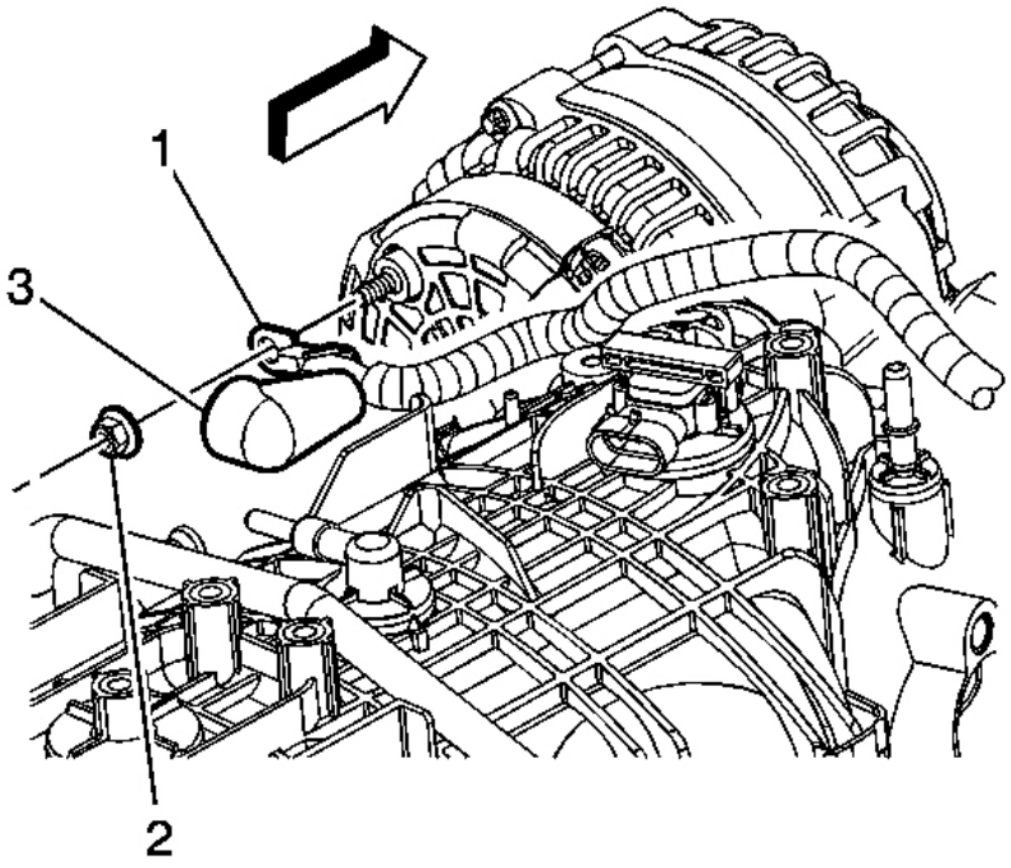


Fig. 103: View Of Battery Jumper Cable Terminal, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Reposition the generator battery jumper cable boot (3).
6. Remove the generator battery jumper cable nut (2) from the generator.
7. Remove the generator battery jumper cable terminal (1) from the generator stud.

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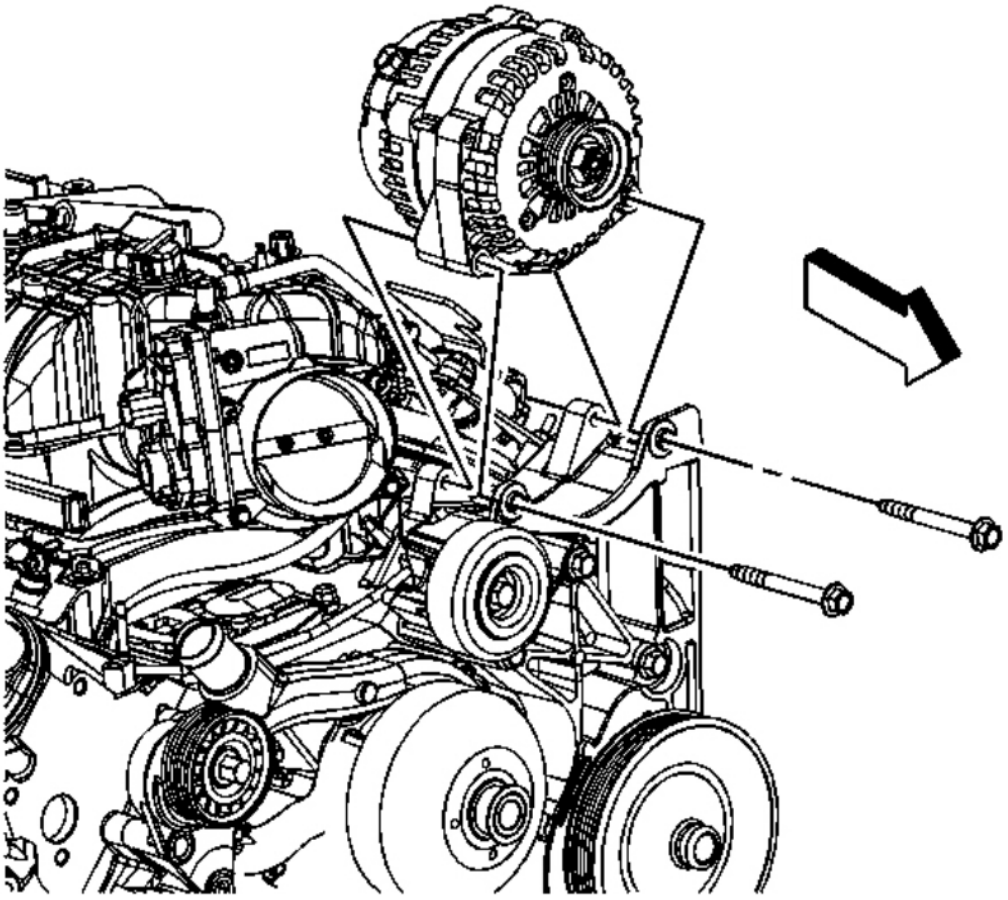


Fig. 104: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the generator bolts.
9. Remove the generator.

Installation Procedure

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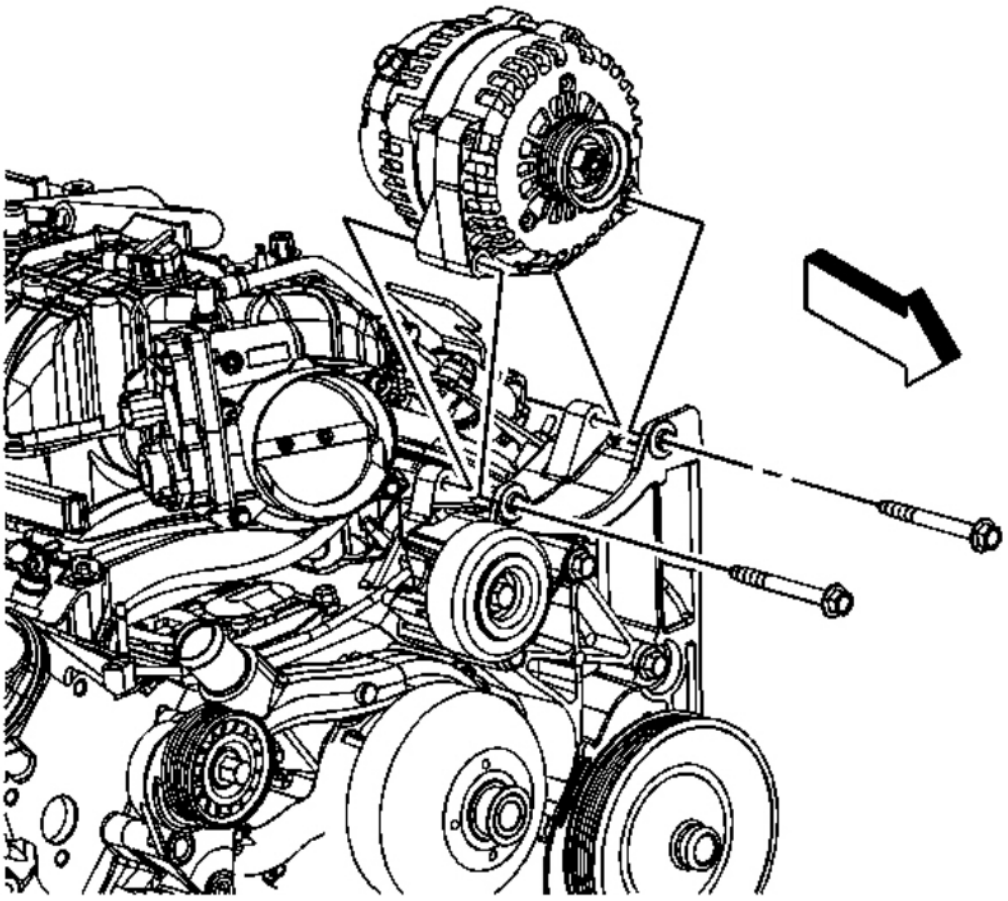


Fig. 105: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the generator.

NOTE: **Refer to Fastener Notice .**

2. Install the generator bolts.

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

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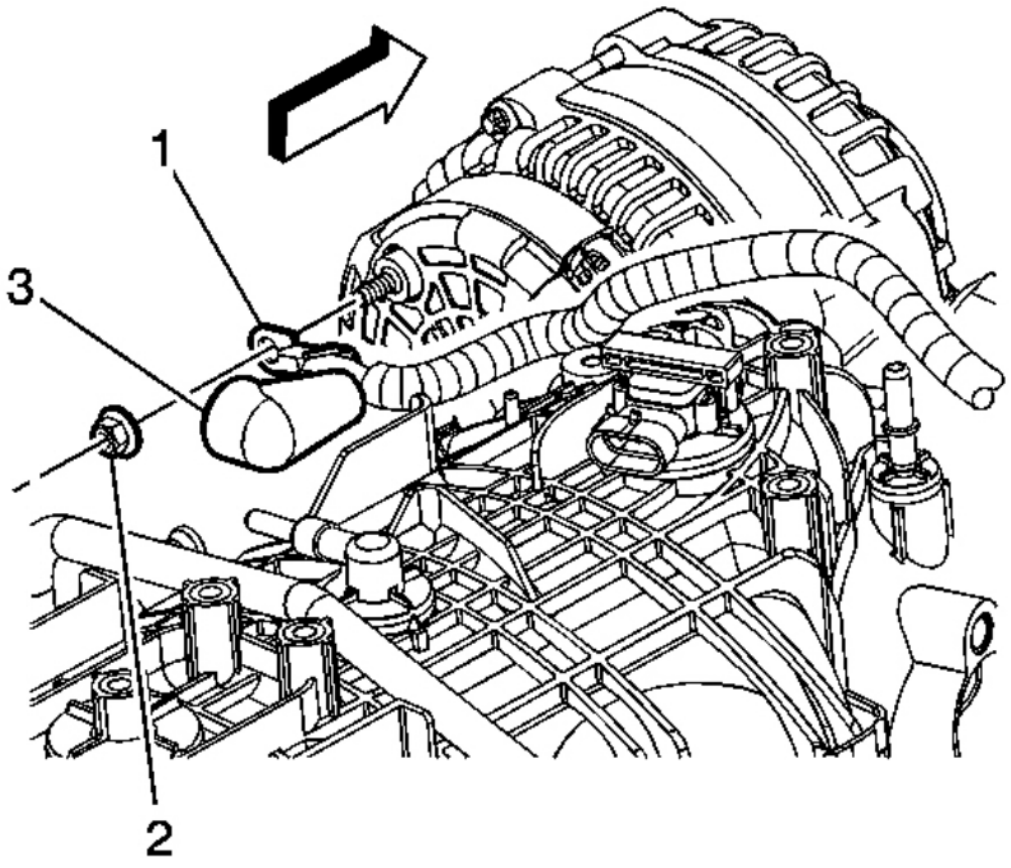


Fig. 106: View Of Battery Jumper Cable Terminal, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Install the generator battery jumper cable terminal (1) to the generator stud.
4. Install the generator battery jumper cable nut (2) to the generator.

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

5. Position the generator battery jumper cable boot (3).

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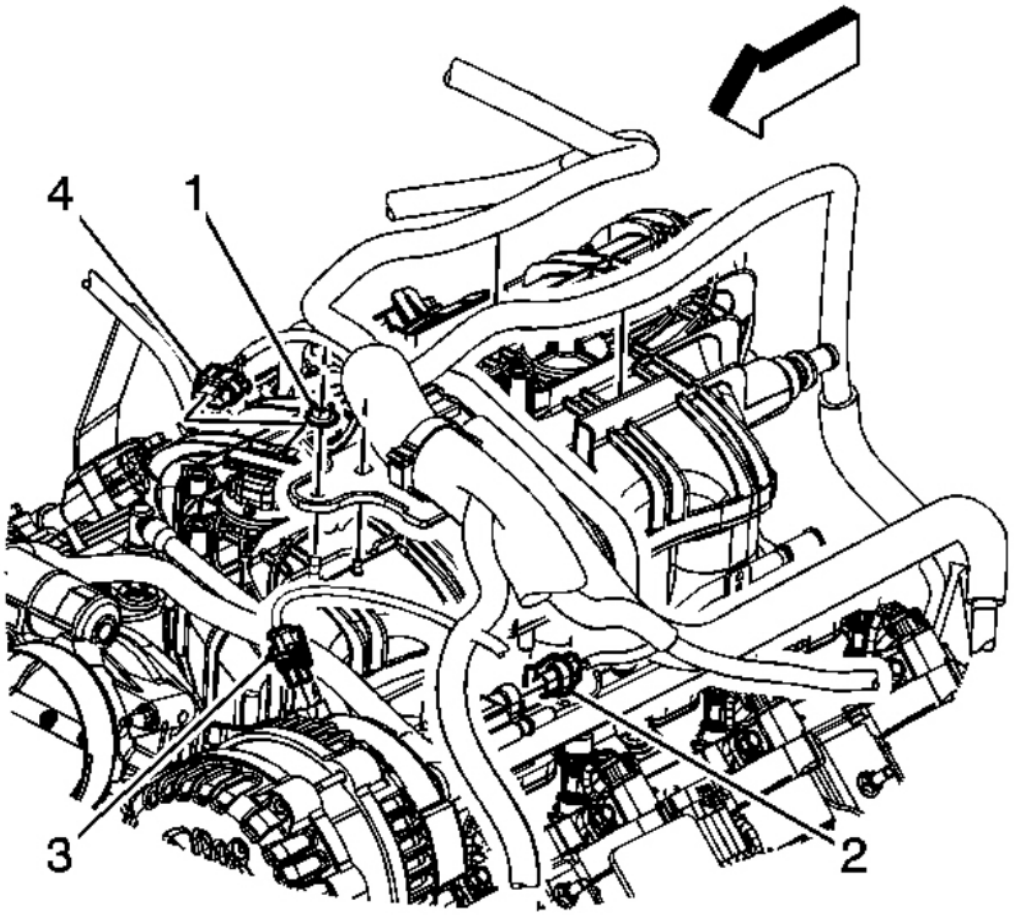


Fig. 107: View Of Generator & Related Connectors
Courtesy of GENERAL MOTORS CORP.

6. Connect the engine harness electrical connector (3) to the generator.
7. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** .
8. Install the intake manifold sight shield. Refer to **Upper Intake Manifold Sight Shield Replacement** .
9. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

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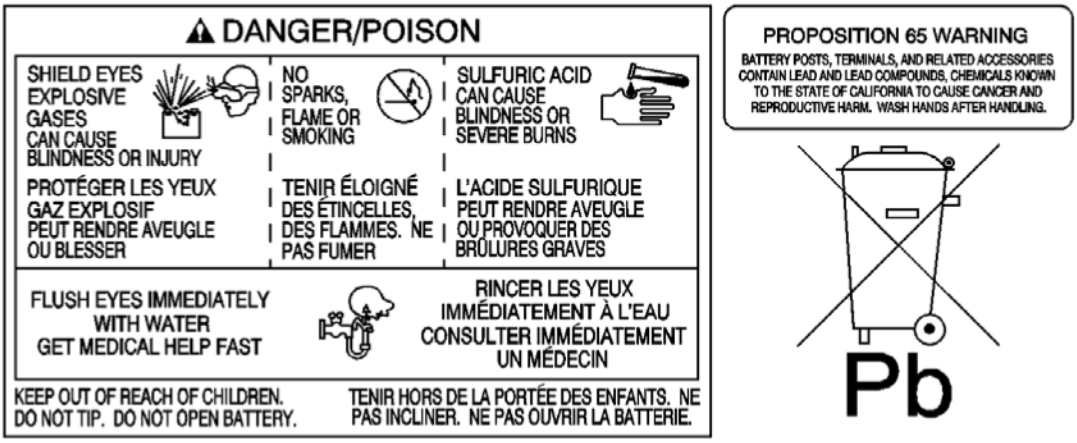


Fig. 108: View Of Battery Danger Label
Courtesy of GENERAL MOTORS CORP.

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

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

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,

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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

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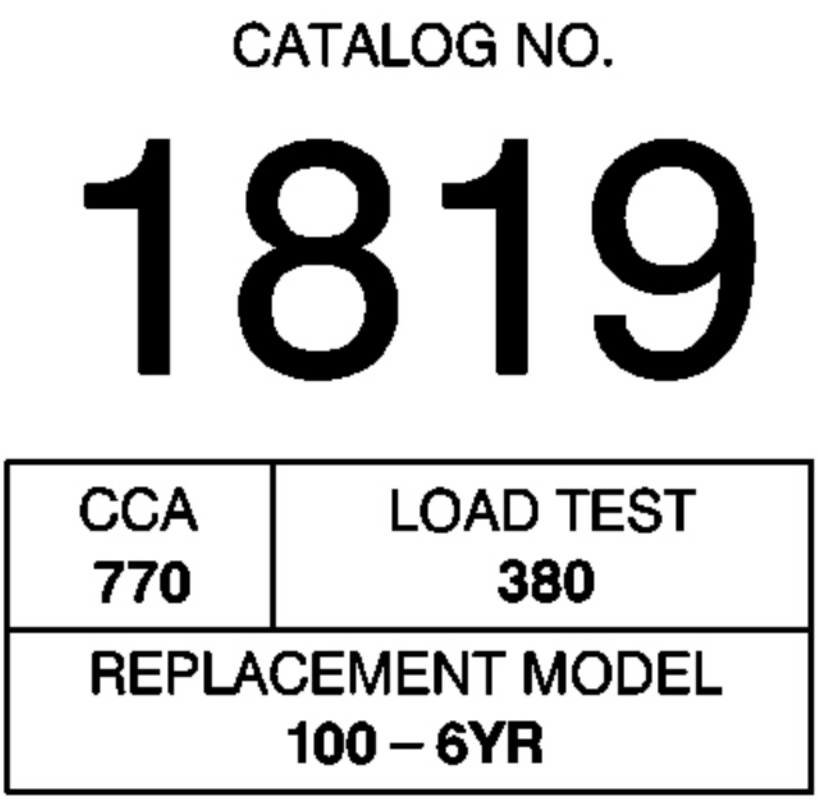


Fig. 109: View Of Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

A battery may have 3 ratings:

- Amp hour (AH)
- Reserve capacity (RC)
- Cold cranking amperage (CCA)

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 (AH)

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

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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 (RC)

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 (CCA)

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

Auxiliary Battery

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

CHARGING SYSTEM DESCRIPTION AND OPERATION

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 and life, and minimize the system's 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 boosting idle speeds, and adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during ignition-off and during ignition-on. During ignition-off the state-of-charge (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 ignition-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.

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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 battery 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 (IPC) operation of the charge indicator, driver information center (DIC) 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.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster (IPC) for electrical power management (EPM) operation. The BCM determines the output of the generator and sends the information to the ECM for control of the generator field control circuit. It monitors the generator field duty cycle signal circuit information sent from the ECM for control of the generator. It monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge (SOC). The BCM sends idle boost requests to the ECM.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates 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. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM directly controls the generator field control circuit input to the generator. The ECM receives control decisions based on messages from the BCM. It monitors the generators generator field duty cycle signal circuit and sends the information to the BCM.

Instrument Panel Cluster (IPC)

The IPC provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of

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notification, a charge indicator and a driver information center (DIC) message of SERVICE BATTERY CHARGING SYSTEM.

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Battery Sulfation Mode
- Charge Mode
- Fuel Economy Mode
- Headlamp Mode
- Start Up Mode
- Voltage Reduction Mode

The engine control module (ECM) controls the generator through the generator turn on signal. It monitors the generator performance though the generator field duty cycle 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. Between 0-5 percent and 95-100 percent are for diagnostic purposes. The following table shows the commanded duty cycle and output voltage of the generator:

Charging System Description and Operation

Commanded Duty Cycle	Generator Output Voltage
10%	11 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 ECM. This information is sent to the body control module (BCM). 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.

Battery Sulfation Mode

The BCM will enter this mode when the interpreted generator output voltage is less than 13.2 volts for 45 minutes. When this condition exists the BCM will enter Charge Mode for 2-3 minutes. The BCM will then determine which mode to enter depending on voltage requirements.

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Charge Mode

The BCM will enter Charge Mode when ever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN (Climate Control Voltage Boost Mode Request) is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0°C (32°F).
- Battery State of Charge is less than 80 percent.
- Vehicle Speed is greater than 145 kph (90 mph)
- Current Sensor Fault Exists
- System Voltage was determined to be below 12.56 volts
- Tow/Haul Mode is enabled

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9-15.5 volts, depending on the battery state of charge and estimated battery temperature.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the ambient air temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is less than 15 amps and greater than -8 amps, and the battery state of charge (SOC) is greater than or equal to 80 percent. Its targeted generator output voltage is the open circuit voltage of the battery and can be between 12.5-13.1 volts. The BCM will exit this mode and enter Charge Mode when any of the conditions described above are present.

Headlamp Mode

The BCM will enter Headlamp Mode when ever the headlamps are ON (high or low beams). Voltage will be regulated between 13.9-14.5 volts

Start Up Mode

When the engine is started the BCM sets a targeted generator output voltage of 14.3 volts for 30 seconds.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated battery temperature is above 0°C (32°F). The calculated battery current is less than 1 amp and greater than -7 amps, and the generator field duty cycle is less than 99 percent. Its targeted generator output voltage is 13 volts. The BCM will exit this mode once the criteria are met for Charge Mode.

Instrument Panel Cluster (IPC) Operation

Charge Indicator Operation

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The instrument panel cluster (IPC) illuminates the charge indicator and displays a warning message in the driver information center (DIC) when the one or more of the following occurs:

- The engine control module (ECM) detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a GMLAN message from the ECM requesting illumination.
- The BCM determines that the system voltage is less than 11 volts or greater than 16 volts.
- The IPC receives a GMLAN 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.

Battery Voltage

The IPC displays the system voltage as received from the BCM over the GMLAN serial data circuit. If there is no communication with the BCM then the gauge will indicate minimum.

Service Battery Charging System

The BCM and the ECM will send a GMLAN message to the DIC for the SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is commanded ON when a charging system DTC is a current DTC. The message is turned OFF when the conditions for clearing the DTC have been met.

ELECTRICAL POWER MANAGEMENT DESCRIPTION AND 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.

Electrical Power Management Description and Operation

Function	Battery Temperature Calculation	Battery Voltage Calculation	Amp-hour Calculation	Action Taken
Idle Boost 1 Start	Less Than -15°C (5° F)	Less Than 13 V	-	First level Idle boost requested
Idle Boost 1 Start	-	-	Battery has a net loss greater than 0.6 AH	First level Idle boost requested

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Idle Boost 1 Start	-	Less Than 10.9 V	-	First level Idle boost requested
Idle Boost 1 End	Greater Than -10°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 10.9 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 10.0 AH	Third level Idle boost requested
Idle Boost 3 Start	-	Less Than 10.9 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 AND 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.

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Circuit Description (Key Start)

When the ignition switch is placed in the Start position, a discrete 12-volt 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 transmission is in Park or Neutral. If it is, the ECM then supplies 12 volts to the control circuit of the crank 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.

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