

2007 Chevrolet TrailBlazer

2007 ENGINE Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

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Engine Electrical - Ascender, Envoy, Rainier & TrailBlazer

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

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

BATTERY USAGE

Battery Usage

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

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GENERATOR USAGE

Generator Usage

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

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

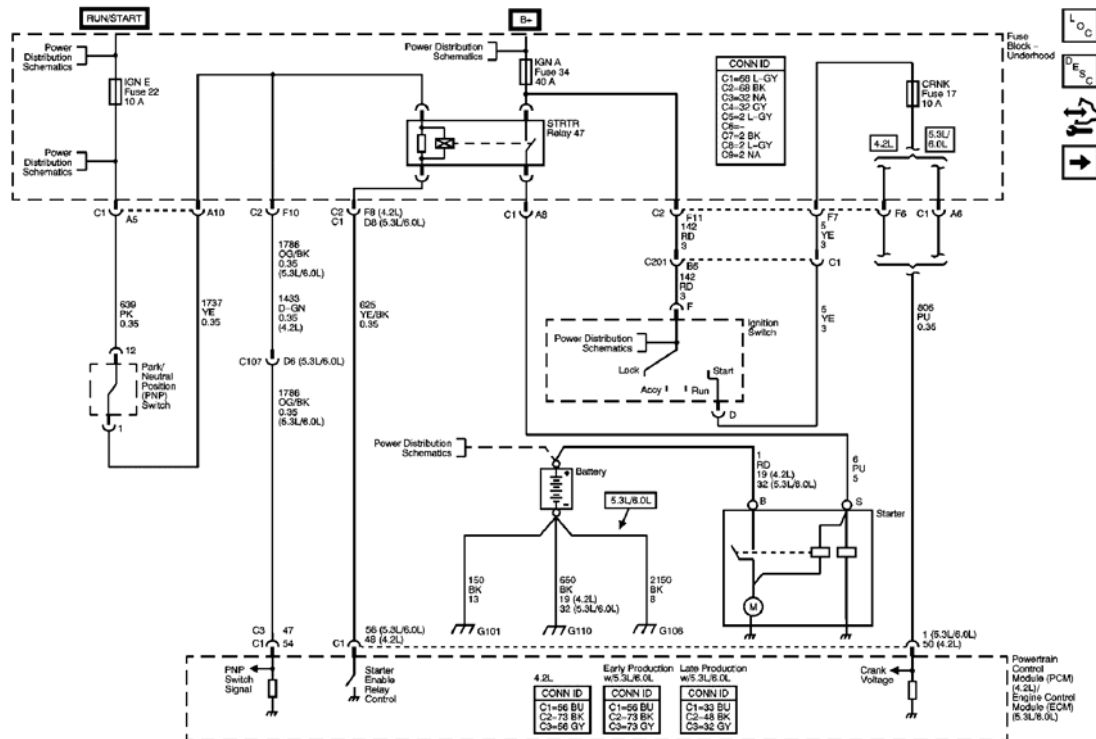


Fig. 1: Starting System Schematic

Courtesy of GENERAL MOTORS CORP.

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ENGINE ELECTRICAL COMPONENT VIEWS

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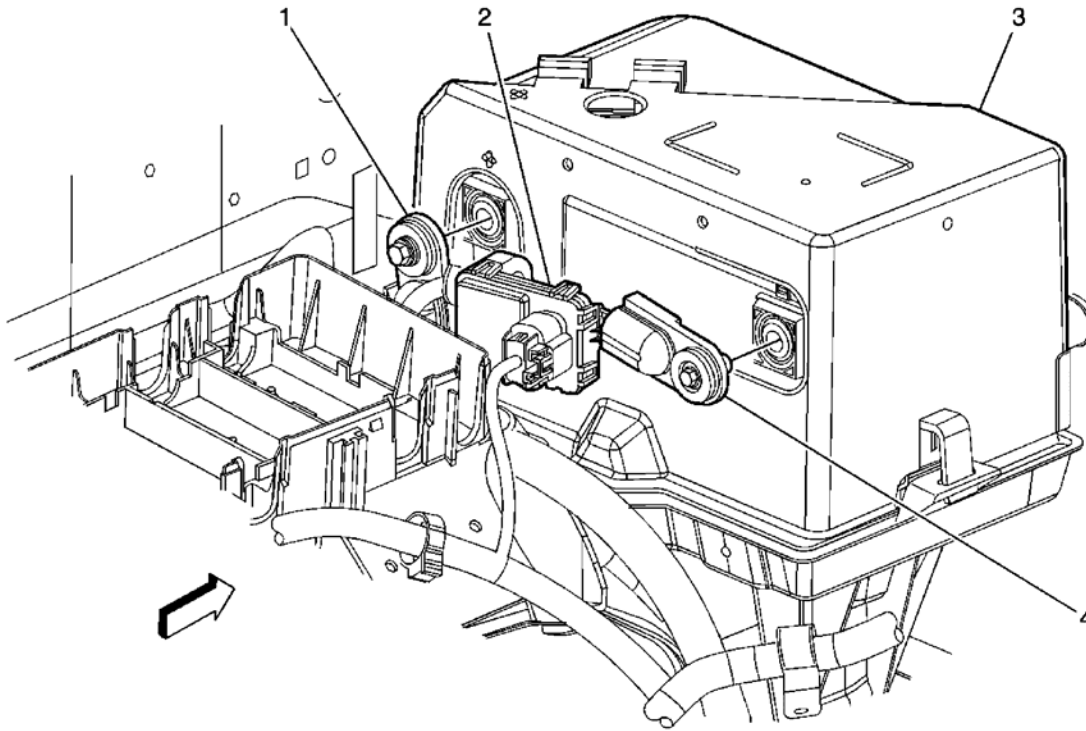


Fig. 3: Rear Of Battery - 4.2L View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Positive Battery Terminal
2	Regulated Voltage Control Module
3	Battery
4	Negative Battery Terminal

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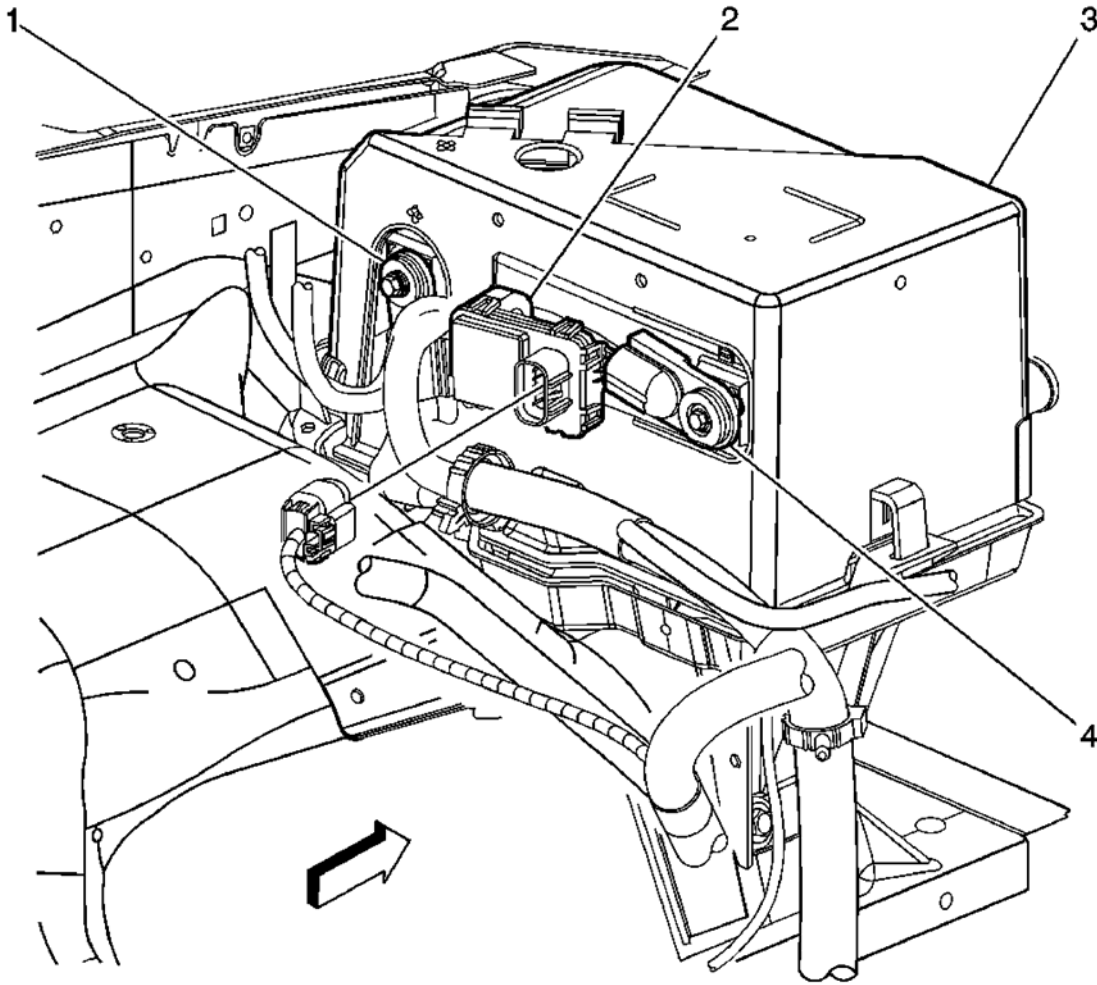


Fig. 4: View Of Rear Of Battery - 5.3L/6.0L
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Positive Battery Terminal
2	Regulated Voltage Control Module
3	Battery
4	Negative Battery Terminal

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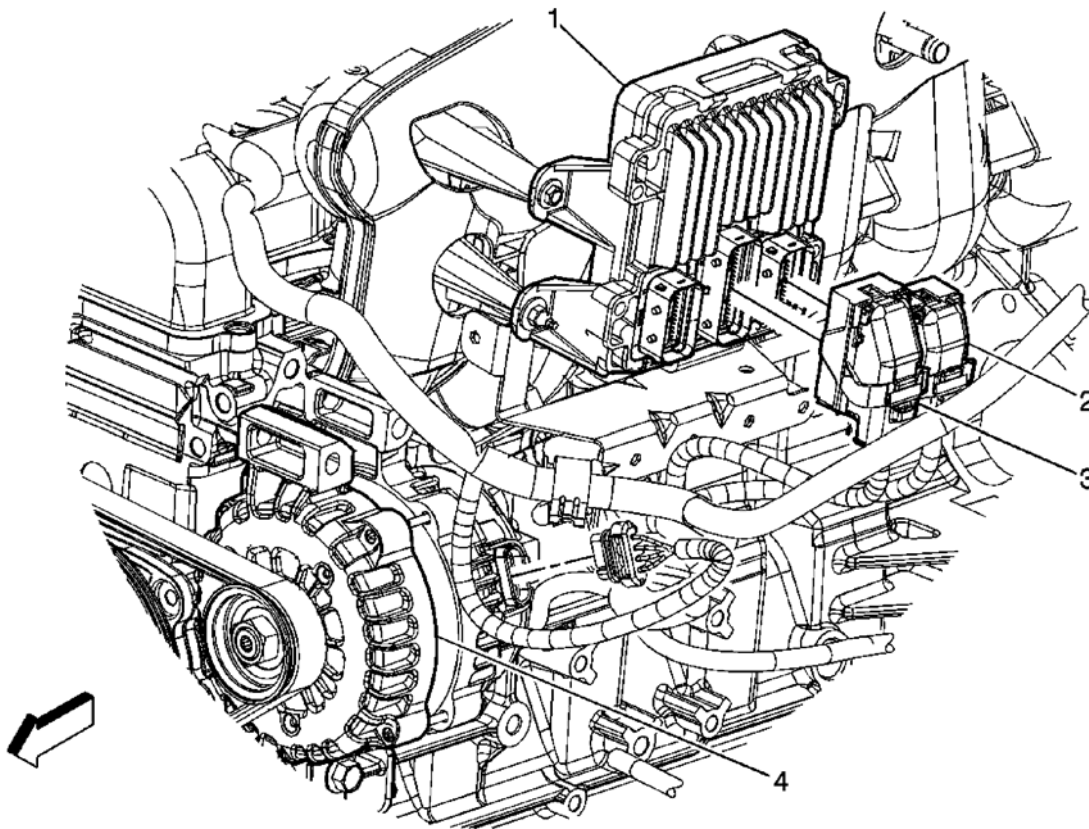


Fig. 5: View Of Upper Left Side Of Engine - Front (4.2L)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Powertrain Control Module (PCM)
2	Powertrain Control Module (PCM) C3
3	Powertrain Control Module (PCM) C2
4	Generator

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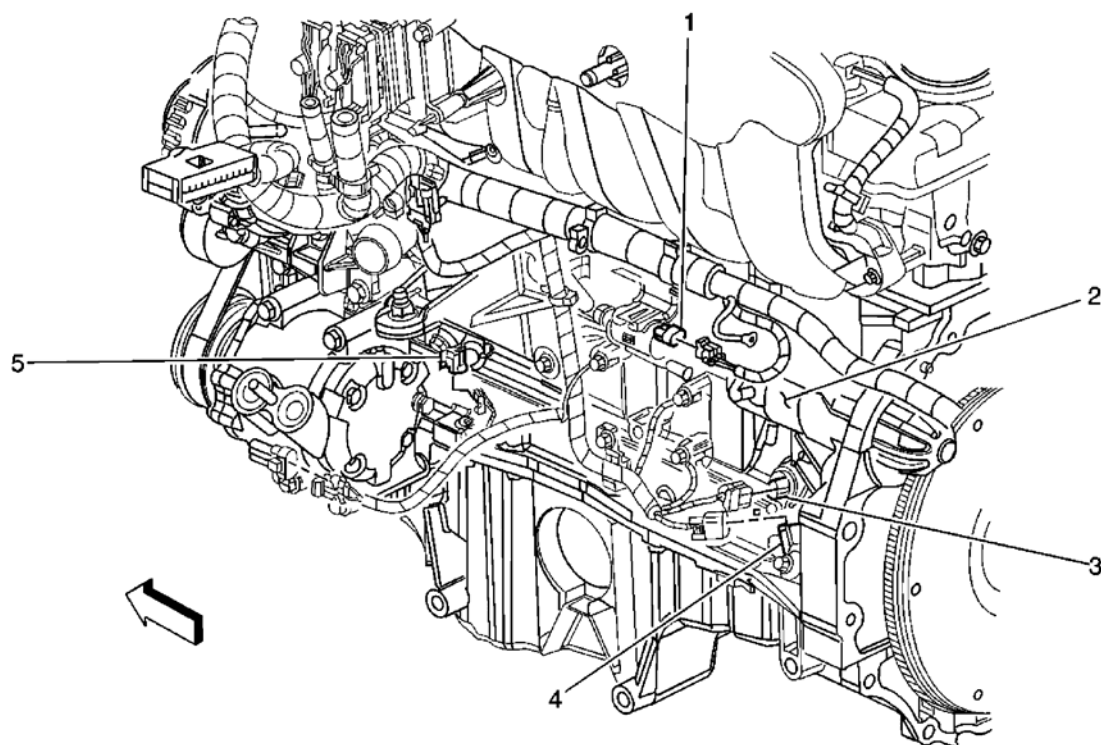


Fig. 6: View Of Lower Left Side of the Engine
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

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

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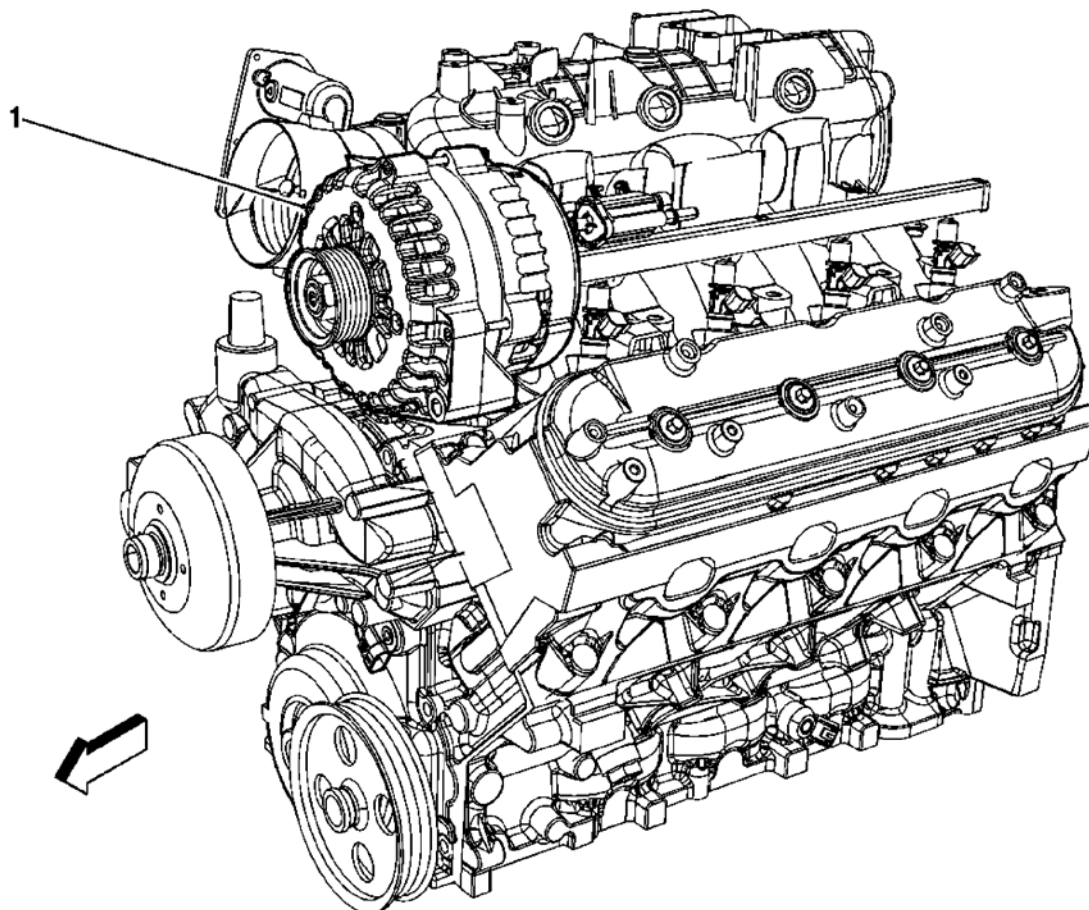


Fig. 7: Locating Generator -- 5.3L

Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	Generator

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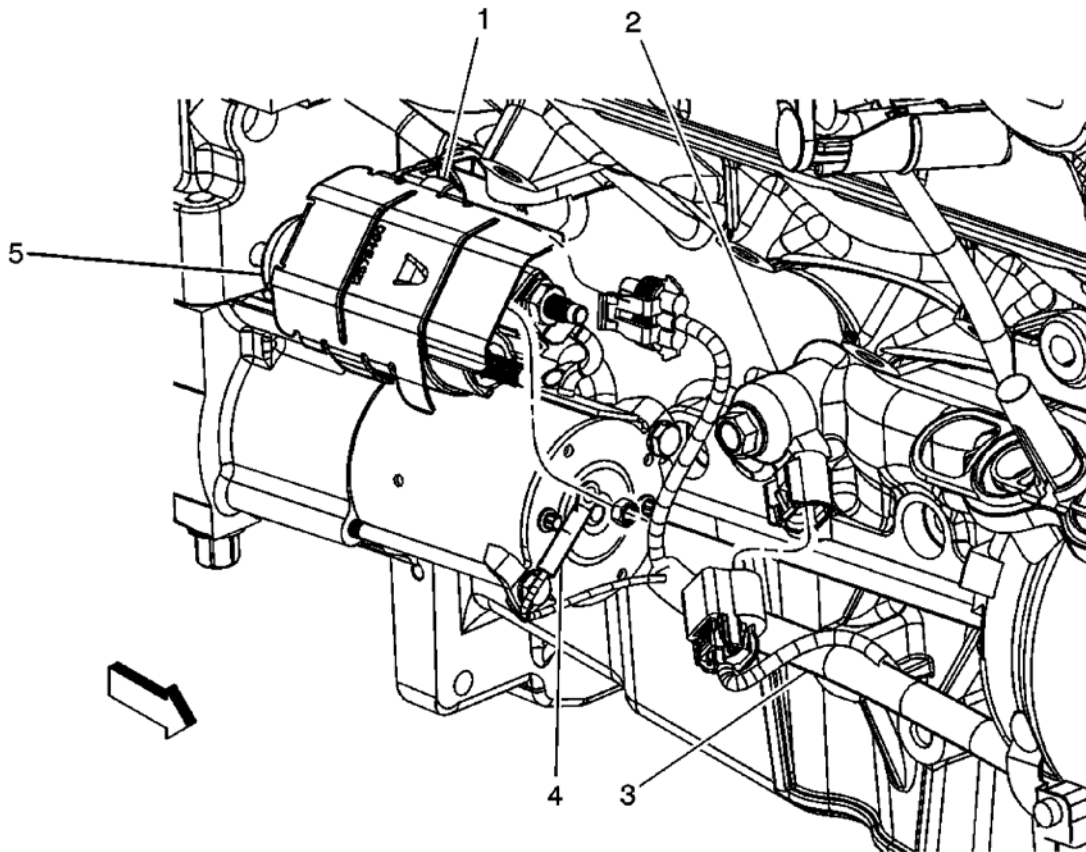


Fig. 8: View Of Lower Right Side of the Engine - Rear
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

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

ENGINE ELECTRICAL CONNECTOR END VIEWS

Generator

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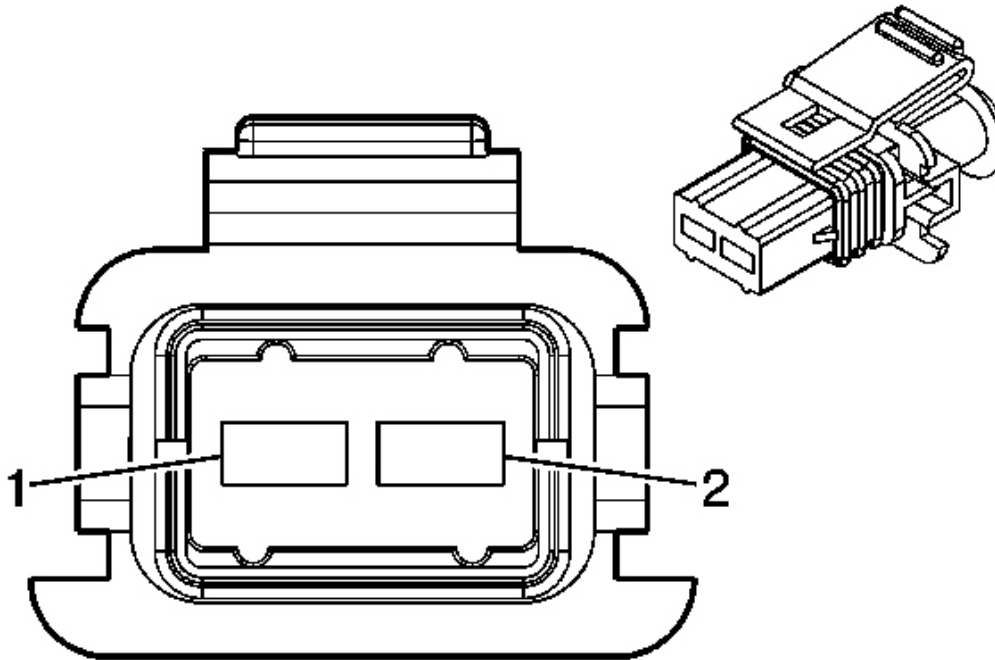


Fig. 9: Generator Connector End View
Courtesy of GENERAL MOTORS CORP.

Generator Connector Parts Information

Connector Part Information

- OEM: 12186308
- Service: 89046837
- Description: 2-Way F Timer Junior Power Timer Series 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)

Generator Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
1	RD	225	Generator Turn On Signal
2	GY	23	Generator Field Duty Cycle Signal

Regulated Voltage Control Module

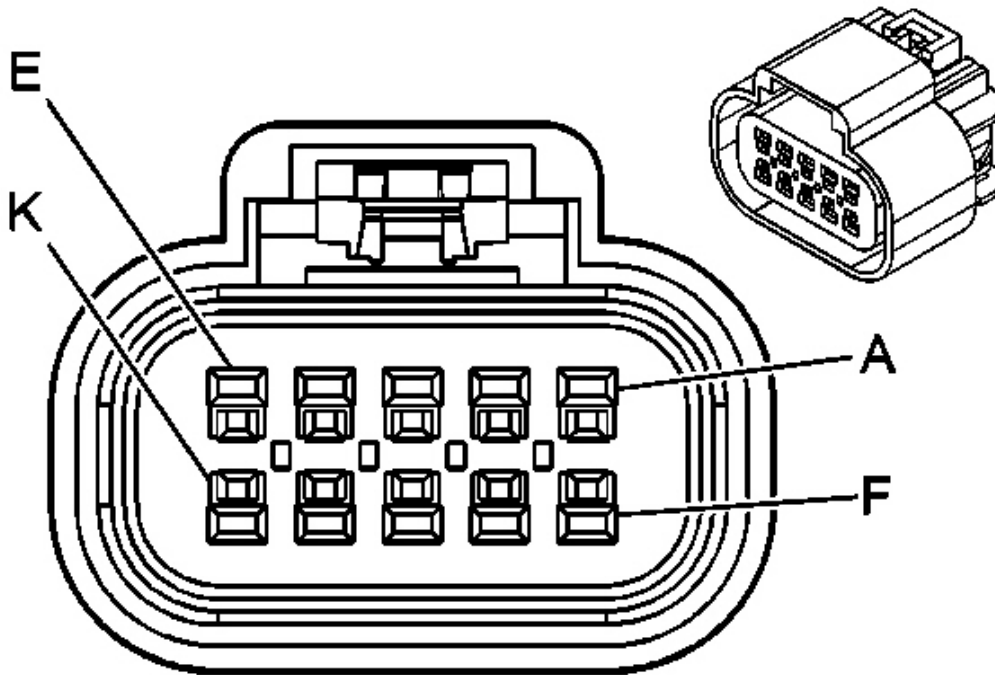


Fig. 10: Regulated Voltage Control Module Connector End View
Courtesy of GENERAL MOTORS CORP.

Regulated Voltage Control Module Connector Parts Information

Connector Part Information

- OEM: 15326842
- Service: 15326842
- Description: 10-Way F GT 150 Series Sealed (BK)

Terminal Part Information

- Pins: A, C, F, H
- Terminal/Tray: 12191819/8
- Core/Insulation Crimp: 2/A
- Release Tool/Test Probe: 15315247/J-35616-2A (GY)
- Pins: B, D, J-K

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- Terminal/Tray: 12191818/8
- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: See Terminal Repair Kit

Regulated Voltage Control Module Connector Terminal Identification

Pin	Wire Color	Circuit No.	Function
A	OG	3840	Battery Positive Voltage
B	GY	23	Generator Field Duty Cycle Signal
C	OG	3840	Battery Positive Voltage
D	RD	225	Generator Turn On Signal
E	-	-	Not Used
F	BK	450	Ground
G	-	-	Not Used
H	BK	450	Ground
J	PU	5428	Generator Regulator Control
K	WH	1038	Class 2 Serial Data

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

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

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

- The identification of the control modules which command the system

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

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

SCAN TOOL OUTPUT CONTROLS

Generator Battery Control Module (GBCM)

Scan Tool Output Control	Additional Menu Selection(s)	Description
GEN L Terminal	Body, Generator Battery Control Module, Special Functions	The GBCM commands the generator On and Off.

SCAN TOOL DATA LIST

Generator Battery Control Module (GBCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Battery Voltage Signal	Body, Generator Battery Control Module	Volts	12.3 V
Generator L Terminal Signal Command	Body, Generator Battery Control Module	Percent	0 Percent
Regulated Voltage Control Current Sensor	Body, Generator Battery Control Module	Amps	1 Amp
Running State of Charge	Body, Generator Battery Control Module	Percent	90 Percent

Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Crank Request Signal	Electrical/Theft Data	Yes/No	No
Generator L Terminal Signal Command	Electrical/Theft Data	Off/On	Off
Generator F Terminal Signal	Electrical/Theft Data	%	10 - 90%
Ignition 1 Signal	Electrical/Theft Data	volts	9.6 - 14.4v
PNP Switch	Electrical/Theft Data	Park/Neutral, In Gear	Park/Neutral
Starter Relay Command	Electrical/Theft Data	Off/On	Off

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Starter Relay Circuit Status	Electrical/Theft Data	Incomplete, Short Gnd/Open, Short to B+, OK	OK
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Powertrain Control Module (PCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Crank Request Signal	Engine Data 3	Yes/No	No
Generator L Terminal Signal Command	Engine Data 2	Off/On	Off
Generator F Terminal Signal	Engine Data 2	%	10 - 90%
Ignition 1 Signal	Engine Data 1, Engine Data 2, Engine Data 3	volts	9.6 - 14.4v
Starter Relay Command	Engine Data 3	Off/On	Off

Transmission Control Module (TCM)

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

SCAN TOOL DATA DEFINITIONS

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.

Generator L Terminal Signal Command

The scan tool displays On/Off. The scan tool displays Off until the engine is running, at which time it will display On.

Generator F Terminal Signal

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

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Ignition 1 Signal

The scan tool displays system voltage received by the module.

PNP Switch

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

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 starter relay circuit.

Starter Relay Command

The scan tool displays Off/On. The scan tool displays Off until engine start has been requested, then it displays On.

TR Sw

The scan tool displays Park, Reverse, Neutral, Drive 5, Drive 4, Drive 3, Drive and Drive 1. The scan tool displays the position of the transmission range switch.

DTC B1390

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1390 Device Voltage Reference Input 1 Circuit

Conditions for Running the DTC

- Vehicle in RUN mode and Engine Run Flag is False or True.
- This diagnostic shall be run every 100 ms.

Conditions for Setting the DTC

The difference between the low precision battery voltage circuit reading and the high precision battery voltage

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sense circuit reading is greater than or equal to 1 volt for 10 seconds.

Action Taken When the DTC Sets

The generator battery control module will request the driver information center (DIC) message of the Service Charging System. The battery tell-tale is not turned ON.

The generator battery control module uses the less accurate battery positive voltage circuit for voltage readings.

Conditions for Clearing the DTC

- During the current ignition cycle, the difference between the less precision battery positive voltage circuit reading and the high precision battery voltage sense circuit reading is less than 1 volt.
- Clear the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended action:

- Check the Batt + voltage and Batt + sense voltage wires for an open or short low condition.
- Check the Batt - ground and Batt - sense ground wires for an open or short high condition.
- Clear the codes.
- Cycle the ignition.

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

If a fault condition persists, replace the module.

DTC B1390

Step	Action	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u> Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	With a DMM, measure the voltage between both the battery positive voltage circuits of the generator battery control module and a good ground. Compare the reading between circuits.	1 V		

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	Is the DMM reading above the specified value?		Go to Step 4	Go to Step 3
3	With a DMM connected to a good battery positive source, test both the ground circuits of the generator battery control module. Compare the reading between circuits. Is the DMM reading above the specified value?	1 V	Go to Step 6	Go to Step 4
4	Inspect for poor connections at the harness connector of the generator battery control module. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	-	Go to Step 8	Go to Step 5
5	Repair the open or high resistance in the affected battery positive voltage circuit. Did you find and correct the condition?	-	Go to Step 8	Go to Step 7
6	Repair the open or high resistance in the affected generator battery control module ground circuit. Did you find and correct the condition?	-	Go to Step 8	Go to Step 7
7	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 8	-
8	<ol style="list-style-type: none"> 1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1487

Circuit Description

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

DTC Descriptor

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This diagnostic procedure supports the following DTC:

DTC B1487 Generator L-Terminal Circuit Low

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The generator battery control module will request the driver information center (DIC) message of Charging System Failure and commands ON the battery indicator.

Conditions for Clearing the DTC

- The generator field control circuit input is from 1-99 percent duty cycle, greater than 0 volts.
- Clear the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended Action:

- Correct L-Term short low condition.
- Clear the codes.
- Cycle the ignition.

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Charging System Failure and turn OFF the battery indicator.

If a fault condition persists, replace the module.

DTC B1487

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

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1		-	Go to Step 2	<u>System Check</u> <u>- Vehicle</u>
2	1. Turn ON the ignition. 2. With a DMM test the charge indicator control circuit of the generator battery control module. Is the DMM reading equal to the specified value?	0 V	Go to Step 4	Go to Step 3
3	Inspect for poor connections at the harness connector of the generator battery control module. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	-	Go to Step 6	Go to Step 5
4	Repair the short to ground of the charge indicator control circuit. Did you find and correct the condition?	-	Go to Step 6	Go to Step 5
5	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 6	-
6	1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1488

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1488 Generator L-Terminal Circuit High

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Conditions for Running the DTC

- Vehicle in RUN mode and Engine Run Flag is False.
- The engine RPM is less than or equal to 0 RPM.
- This diagnostic shall be run every 100 ms.

Conditions for Setting the DTC

The generator field control circuit is 0 percent and shorted high to battery voltage, 5 volts, for greater than 5 seconds.

Action Taken When the DTC Sets

The generator battery control module will request the driver information center (DIC) message of Service Charging System and commands ON the Battery indicator.

Conditions for Clearing the DTC

- The generator field control circuit voltage is 0 volts.
- Clear the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended Action:

- Correct L-Term short high condition.
- Clear the codes.
- Cycle the ignition.

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System and turn OFF the battery indicator.

If a fault condition persists, replace the module.

DTC B1488

Step	Action	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u> Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>

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2	With a DMM, test the charge indicator control circuit of the generator battery control module. Is the DMM reading equal to or above the specified value?	5 V	Go to Step 4	Go to Step 3
3	Inspect for poor connections at the harness connector of the generator battery control module. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	-	Go to Step 6	Go to Step 5
4	Repair the short to battery positive voltage of the charge indicator control circuit. Did you find and correct the condition?	-	Go to Step 6	Go to Step 5
5	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 6	-
6	<ol style="list-style-type: none">1. Use the scan tool in order to clear the DTC.2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1492

Circuit Description

The generator battery control module monitors the generator through the generator field duty cycle signal circuit. The signal is a pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. If the generator field duty cycle signal circuit is in the 0-5 percent range or pulled low to ground, then DTC B1492 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1492 Generator F-Terminal Circuit Low

Conditions for Running the DTC

- Vehicle in RUN mode and Engine Run Flag is True.
- The engine speed is less than 1,000 RPM.

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- DTC B1487 or B1488 is not set as a current DTC.
- This diagnostic shall be run every 100 ms.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The generator battery control module will request the driver information center (DIC) message of Service Charging System and commands ON the Battery indicator.

Conditions for Clearing the DTC

- The generator field duty cycle signal circuit input is greater than 5 percent duty cycle.
- Clear the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended Action:

- Correct F-Term short low condition.
- Clear the codes.
- Cycle the ignition.

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System and turn OFF the battery indicator.

If a fault condition persists, replace the module.

DTC B1492

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

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2	Generator F-Terminal Signal parameter in the engine control module (ECM)/powertrain control module (PCM) data display. Is the Generator F-Terminal Signal data less than the specified value?	5%	Go to Step 3	<u>Testing for Intermittent Conditions and Poor Connections</u>
3	Disconnect the generator battery control module harness connector Is the Generator F-Terminal Signal parameter still less than the specified value?	5%	Go to Step 5	Go to Step 4
4	Inspect for poor connections at the harness connector of the generator battery control module. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	-	Go to Step 7	Go to Step 6
5	Repair the short to ground of the generator field duty cycle control circuit. Did you find and correct the condition?	-	Go to Step 7	Go to Step 6
6	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 7	-
7	1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1516

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1516 Battery Current Sensor Performance

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Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

- The filtered battery current is set to 0.1 amp.
- The generator field control circuit duty cycle is set to 100 percent, battery voltage defaults to 13.8 volts.
- The generator battery control module will request the driver information center (DIC) message of Service Charging System. The battery indicator remains OFF.

Conditions for Clearing the DTC

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

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended Action:

- Clear the codes.
- Cycle the ignition.

DTC B1516

Step	Action	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>				
Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	1. Install a scan tool. 2. Clear the DTC. 3. Cycle the ignition.	-		Go to <u>Testing for Intermittent Conditions and Poor</u>

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	Does DTC B1516 reset?		Go to Step 3	<u>Connections</u>
3	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 4	-
4	1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1566

Circuit Description

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

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1566 Current Sensor Polarity Check

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

- The filtered battery current is set to 0.1 amp.
- The generator field control circuit duty cycle is set to 100 percent, battery voltage defaults to 13.8 volts.
- The generator battery control module will request the driver information center (DIC) message of Service Charging System. The battery indicator remains OFF.

Conditions for Clearing the DTC

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- The duty cycle of the internal battery current sensor is greater than 2 percent duty cycle or less than 98 percent duty cycle.
- Clear the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: You must cycle the ignition after clearing the DTC to turn OFF the DIC message of Service Charging System.

Recommended Action:

- Clear the codes.
- Cycle the ignition.

DTC B1566

Step	Action	Values	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>				
Connector End View Reference: <u>Engine Electrical Connector End Views</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	1. Install a scan tool. 2. Clear the DTC. 3. Cycle the ignition. Does DTC B1566 reset?	-	Go to Step 3	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>
3	Replace the generator battery control module. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 4	-
4	1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC, as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC P0562

DTC Descriptor

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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)/powertrain control module (PCM) 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/PCM 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/PCM will not illuminate the malfunction indicator lamp (MIL).
- The ECM/PCM will store conditions, which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The ECM/PCM 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

Circuit/System Verification

With the scan tool installed, ignition ON and the engine OFF, observe the Ignition 1 Signal parameter in the ECM/PCM 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/PCM 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/PCM for open/high resistance or replace the ECM/PCM.
2. Go to Charging System Test.

Repair Procedures

Perform the DIAGNOSTIC REPAIR VERIFICATION after completing the diagnostic procedure.

Control Module References for ECM/PCM 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.

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Circuit/System Description

The engine control module (ECM)/powertrain control module (PCM) 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/PCM detects a system voltage above 16 volts for less than 1 second.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

- The ECM/PCM 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**

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/PCM data list. Voltages should not differ by more than 1 volt.
 - If more than 1 volt, replace the ECM/PCM.

Repair Procedures

Perform the **DIAGNOSTIC REPAIR VERIFICATION** after completing the diagnostic procedure.

Control Module References for ECM/PCM 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.

Circuit/System Description

The engine control module (ECM)/powertrain control module (PCM) uses the generator turn ON signal circuit to control the load of the generator on the engine. A high side driver in the ECM/PCM applies a voltage to the voltage regulator. This signals the voltage regulator to turn ON the field circuit ON and OFF. The ECM/PCM monitors the state of the generator turn ON signal circuit. The ECM/PCM should detect low voltage on the 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/PCM should detect high voltage on the generator turn ON signal circuit. The ECM/PCM performs key ON and RUN tests to determine the status of the generator turn ON signal circuit.

Conditions for Running the DTC

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Key ON Test

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

RUN Test

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

Conditions for Setting the DTC

- During the key ON test, the ECM/PCM detects high voltage on the generator turn ON signal circuit for at least 5 seconds.

OR

- During the RUN test the ECM/PCM detects low voltage on the generator turn ON signal circuit for at least 15 seconds.

Action Taken When the DTC Sets

- The ECM/PCM 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/PCM will not illuminate the malfunction indicator lamp (MIL).
- The ECM/PCM 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.
- Using the scan tool Clear DTC Information function can clear the DTC.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

Engine Electrical Connector End Views

Electrical Information Reference

- Circuit Testing

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

Scan Tool Reference

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

Circuit/System Testing

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

Repair Procedures

Perform the **DIAGNOSTIC REPAIR VERIFICATION** after completing the diagnostic procedure.

- **Generator Replacement (4.2L Engine)** or **Generator Replacement (5.3L and 6.0L Engines)**
- **Control Module References** for ECM/PCM 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.

Circuit/System Description

The engine control module (ECM)/powertrain control module (PCM) uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings ON and OFF. The ECM/PCM uses the PWM signal input to determine the

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generator load on the engine. This allows the ECM/PCM to adjust the idle speed to compensate for high electrical loads. The ECM/PCM 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/PCM 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

The ECM/PCM detects an out of range PWM signal during the KEY ON test the ECM/PCM detects, a PWM signal greater than 65 percent for at least 5 seconds or during the RUN test a PWM signal less than 5 percent for at least 15 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

- The ECM/PCM 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.
- Using the scan tool Clear DTC Information function can clear the DTC.

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

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Scan Tool Reference

- [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/PCM 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. The ignition ON, 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 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. If the circuit tests normal replace the ECM/PCM.
3. Go to [Charging System Test](#).

Repair Procedures

Perform the [DIAGNOSTIC REPAIR VERIFICATION](#) after completing the diagnostic procedure.

- [Control Module References](#) for ECM/PCM replacement, setup and programming
- [Generator Replacement \(4.2L Engine\)](#) or [Generator Replacement \(5.3L and 6.0L Engines\)](#)

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.

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 ON 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

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engine is OFF or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on signal circuit. The ECM performs key ON and RUN tests to determine the status of the generator turn on signal circuit.

Conditions for Running the DTC

Key ON Test

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

RUN Test

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

Conditions for Setting the DTC

- During the Key ON test the ECM detects a high signal voltage on the generator turn on signal circuit for at least 5 seconds.

OR

- During the RUN test the ECM detects a low signal 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 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.
- Using the scan tool Clear DTC Information function can clear the DTC.

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

Circuit/System Testing

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

Repair Procedures

Perform the DIAGNOSTIC REPAIR VERIFICATION after completing the diagnostic procedure.

- Control Module References for ECM replacement, setup and programming
- Generator Replacement (4.2L Engine) or Generator Replacement (5.3L and 6.0L Engines)

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:

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- Battery Description and Operation
- Charging System Description and Operation
- Electrical Power Management Description and Operation
- Starting System Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the starting and charging systems. Refer to Checking Aftermarket Accessories .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

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

Symptom List

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

- Battery Inspection/Test
- Battery Electrical Drain/Parasitic Load Test
- Battery Common Causes of 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

IMPORTANT:

- Failure to properly understand the battery and its function could lead to a misdiagnosis and unneeded repairs. Refer to Battery Description and

Operation and Battery Common Causes of Failure for more information.

- If testing an AGM battery with the J 42000 , add 100 to the CCA rating of the battery and enter that amount into the tester when prompted for the CCA rating. For instance, if the AGM batteries CCA rating is 500 amps, enter 600 into the J 42000 . Perform this modification only if the J 42000 does not ask if you are testing an AGM battery. If these instructions are not followed when testing an AGM battery, an invalid test result and invalid test code will be obtained on the J 42000 .
- The battery test using the J 42000 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.
- When the J 42000 inquires "has the battery been charged", answer yes only if the battery was charged on this visit to the dealership.

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 (top post battery) or terminal bolt (side terminal battery). This may cut through any coating or through any oxidation that may be present on the terminal or bolt.

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

- If correct connections to the battery terminal bolts (side terminal battery) in the vehicle are in doubt, perform the following steps:
 1. Disconnect the negative battery cable.
 2. Disconnect the positive battery cable.
 3. Install the test adapters on the terminals.
 4. Follow the instructions for an Out-of-Vehicle test.
- 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 on side terminal batteries.
 4. Follow the instructions for an Out-of-Vehicle test.
 5. Replace the battery only if the Out-of-Vehicle test shows a REPLACE BATTERY or BAD CELL-REPLACE result. This prevents battery replacements that are due only to faulty battery cable connections.
- Use the correct terminal adapters on side terminal batteries.

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

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Use the test adapters that are provided with the **J 42000** or P/N 12303040 terminal adapters. If the adapters that are provided with the **J 42000** require replacement, use 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 <u>BATTERY DISCONNECT CAUTION</u> .				
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. If the battery is replaced due to failing the test, only an Out-of-Vehicle test code is valid for warranty purposes.				
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 <u>Battery Usage</u> . 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. Is the torque above the specified value?	10 N.m (88 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
	IMPORTANT: Ensure that all of the electrical loads are turned OFF.			

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6	<ol style="list-style-type: none"> 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 <u>Battery Charging</u>. <p>Did the tester pass the battery?</p>	-	Go to Step 14	Go to Step 8
7	<p>Use a torque wrench in order to verify the torque to loosen the positive battery terminal.</p> <p>Is the torque above the specified value?</p>	10 N.m (88 lb in)	Go to Step 10	Go to Step 8
8	<ol style="list-style-type: none"> 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 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. <p>Did you complete the repair?</p>	-	Go to Step 11	-
	<ol style="list-style-type: none"> 1. Disconnect the negative battery cable. 2. Inspect for the following conditions and repair as needed: <p>Side Post Battery</p> <ul style="list-style-type: none"> • The cable bolt is too long or deformed at the end • There is foreign material present inside the nut in the 			

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9	<p>battery terminal</p> <ul style="list-style-type: none">• Damage to the battery terminal face or cable connector ring <p>Top Post Battery</p> <ul style="list-style-type: none">• There is foreign material present on the battery terminal face or cable connector ring• Damage to the battery terminal face or cable connector ring <p>Did you complete the repair?</p>	-	Go to Step 10	-
10	<ol style="list-style-type: none">1. Disconnect the positive battery cable.2. Inspect for the following conditions and repair as needed: <p>Side Post Battery</p> <ul style="list-style-type: none">• The cable bolt is too long or deformed at the end• There is foreign material present inside the nut in the battery terminal• Damage to the battery terminal face or cable connector ring <p>Top Post Battery</p> <ul style="list-style-type: none">• There is foreign material present on the battery terminal face or cable connector ring• Damage to the battery terminal face or cable connector ring <p>Did you complete the repair?</p>	-	Go to Step 11	-
	<p>IMPORTANT:</p> <p>Ensure that both battery cables are disconnected and the directions for an Out-of-Vehicle test are followed.</p>			

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11	<ol style="list-style-type: none"> 1. Install the J 42000 . 2. Follow the directions supplied with 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 <u>Battery Charging</u>. <p>Did the tester pass the battery?</p>	-	Go to Step 12	Go to Step 15
12	<ol style="list-style-type: none"> 1. Press the CODE button on the J 42000 . 2. For warranty purposes, write the displayed code on the repair order. <p>Did you complete this action?</p>	-	Go to Step 13	-
13	<ol style="list-style-type: none"> 1. Connect the positive battery cable to the batteries positive terminal. <p>NOTE: Refer to <u>FASTENER NOTICE</u> .</p> <ol style="list-style-type: none"> 2. Tighten the positive battery cable to the specified value. 3. Connect the negative battery cable to the battery negative terminal. 4. Tighten the negative battery cable to the specified value. <p>Are the cable bolts properly tightened?</p>	17 N.m (13 lb ft)	Battery OK	-
14	<ol style="list-style-type: none"> 1. Press the CODE button on the J 42000 . 2. For warranty purposes, write the displayed code on the repair order. <p>Did you complete the replacement?</p>	-	Battery OK	-
15	<p>Replace the battery. Refer to <u>Battery Replacement</u>.</p> <p>Did you complete the replacement?</p>	-	Battery OK	-

BATTERY CHARGING

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Tools Required

J 42000 Battery Tester

- 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%

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12.0 V

40%

20%

Use the SOC information as follows:

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

Charging Time Required

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

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

Charging Procedure

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

NOTE: Refer to Fastener Notice .

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

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

Use the following procedure to charge the battery:

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.

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3. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

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

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

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

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

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

Battery Electrical Drain/Parasitic Load Test

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

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

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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.
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

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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

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 ($+20^{\circ}\text{F}$). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged. As long as the green eye is visible in the hydrometer, the freezing point of the battery will be somewhere below -32°C (-25°F).

Battery Protection During Vehicle Storage

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

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. 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.

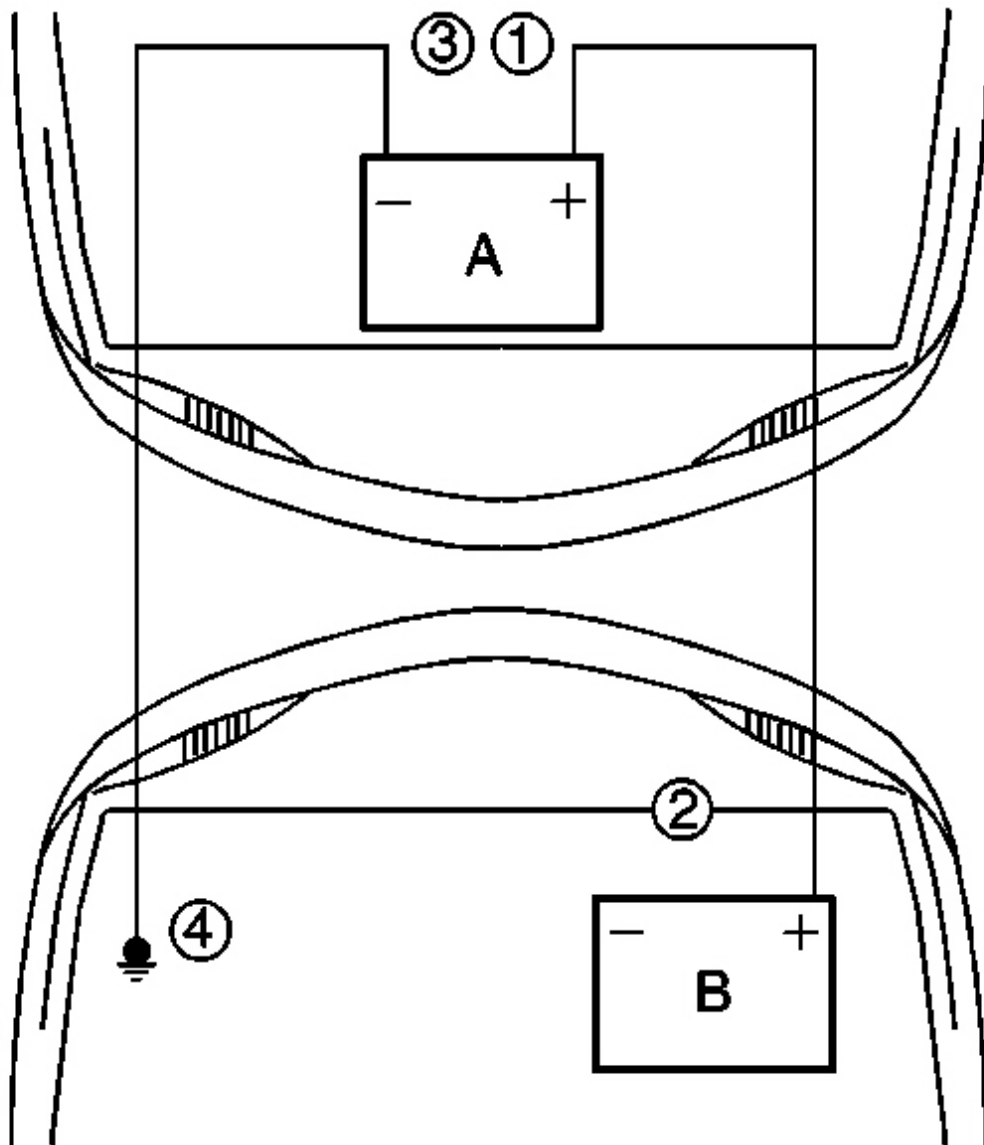


Fig. 11: Identifying Proper Jumper Cable Connection
Courtesy of GENERAL MOTORS CORP.

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 System			Go to Diagnostic

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1	Check - Vehicle?	-	Go to Step 2	<u>System Check - Vehicle</u>
2	IMPORTANT: The battery must be above a 70 percent state of charge. Did you perform the Battery Inspection Test?	-	Go to Step 3	Go to <u>Battery Inspection/Test</u>
3	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, command the GEN-L Terminal OFF and ON. 4. Observe the Ignition 1 Signal parameter. Does the voltage change with each command?	-	Go to Step 4	Go to Step 8
4	1. Turn ON the following accessories: <ul style="list-style-type: none"> • Headlights-high beams • A/C on Max • Blower fan-ON high • Heated seats, if equipped 2. With a scan tool, observe the ignition 1 signal parameter in the engine data list. 3. Increase engine speed to 2,500 RPM. Is the voltage within the specified value?	12-15.5 V	Go to Step 5	Go to Step 6
	1. Turn OFF all accessories. 2. Turn OFF the ignition. CAUTION: Make sure that the load is completely turned off before connecting or disconnecting a carbon pile load tester to the battery. Otherwise, sparking could ignite battery gasses which are extremely flammable and may explode violently.			

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5	<p>3. Connect a carbon pile tester to the vehicle.</p> <p>IMPORTANT: When measuring generator output current, be sure the inductive probe encircles the generator output wire.</p> <p>4. Connect an inductive ammeter probe to the output circuit of the generator.</p> <p>5. Start the engine.</p> <p>6. With a scan tool, command the GEN-L Terminal ON.</p> <p>7. Increase engine speed to 2,500 RPM.</p> <p>8. Adjust the carbon pile, as necessary, in order to obtain the maximum current output.</p> <p>Is the generator output greater than or equal to the load test value as specified in Generator Usage ?</p>	-	System OK	Go to Step 7
6	Is the voltage measured greater than 15.5 volts?	-	Go to Step 12	Go to Step 7
7	<p>1. Leave the vehicle accessories ON or maintain load test value.</p> <p>2. Maintain engine speed at 2,500 RPM.</p> <p>3. Measure the voltage between the generator output terminal and the generator metal housing.</p> <p>Is the voltage measured equal to the specified value?</p>	B+	Go to Step 14	Go to Step 9
8	<p>1. Turn ON the ignition, with the engine OFF.</p> <p>2. Disconnect the generator harness connector.</p> <p>3. Measure the voltage between the generator turn ON signal circuit and ground.</p>	4.7 V 0 V		

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	<p>4. Start the engine.</p> <p>5. With a scan tool, command the GEN-L Terminal ON and OFF.</p> <p>Does the voltage measure greater than the first value ON and near the second value OFF?</p>		Go to Step 14	Go to Step 11
9	<p>1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the battery negative terminal to the metal housing of the generator. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> .</p> <p>Is the voltage measured less than the specified value?</p>	0.5 V	Go to Step 10	Go to Step 15
10	<p>1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the output terminal of the generator to the positive terminal on the battery. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> .</p> <p>Is the voltage measured less than the specified value?</p>	0.5 V	Go to Step 14	Go to Step 16
11	<p>Test the generator turn on signal circuit for a short or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> .</p> <p>Did you find and correct the condition?</p>	-	Go to Step 19	Go to Step 13
12	<p>Test the generator battery voltage sense circuit, if equipped, for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> .</p> <p>Did you find and correct the condition?</p>	-	Go to Step 19	Go to Step 14
13	<p>Inspect for poor connections at the harness connector of the engine control module (ECM)/powertrain control module (PCM). Refer to <u>Testing for Intermittent Conditions and Poor</u></p>	-		

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	<u>Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?		Go to Step 19	Go to Step 17
14	Inspect for poor connections at the generator. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	-	Go to Step 19	Go to Step 18
15	Repair the high resistance or open in the ground circuit of the generator. Refer to <u>Wiring Repairs</u> . Did you complete the repair?	-	Go to Step 19	-
16	Repair the high resistance or open in the generator output circuit. Refer to <u>Wiring Repairs</u> . Did you complete the repair?	-	Go to Step 19	-
17	Replace the ECM/PCM. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	-	Go to Step 19	-
18	Replace the generator. Refer to <u>Generator Replacement (4.2L Engine)</u> or <u>Generator Replacement (5.3L and 6.0L Engines)</u> . 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	Values	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	1. Start the engine. 2. Turn OFF all accessories. -Does the battery charge indicator remain illuminated after the 5-second bulb check?	-	Go to Step 3	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>
	1. Turn OFF the engine. 2. Install a scan tool.			

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3	<p>3. Start the engine.</p> <p>4. With a scan tool, observe the Battery Voltage parameter in the instrument panel cluster (IPC) data list.</p> <p>Does the voltage measure within the normal operating range?</p>	10-15 V	Go to Step 4	Go to <u>Charging System Test</u>
4	<p>Replace the IPC. Refer to <u>Control Module References</u> for replacement, setup and programming.</p> <p>Did you complete the replacement?</p>	-	Go to Step 5	-
5	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	-	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 <u>Diagnostic System Check - Vehicle</u>
2	<p>1. Turn OFF the ignition.</p> <p>2. Turn ON the ignition, with the engine OFF.</p> <p>3. Observe the battery charge indicator on the instrument cluster (IPC) during the bulb check.</p> <p>Does the battery charge indicator illuminate during the bulb check?</p>	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>	Go to Step 3
3	<p>Replace the IPC. Refer to <u>Control Module References</u> for replacement, setup and programming.</p> <p>Did you complete the replacement?</p>	Go to Step 4	-
4	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 2

GENERATOR NOISE DIAGNOSIS

Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise magnetic whine usually varies with the electrical load placed on the generator and is a normal operating characteristic of all generators.

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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 <u>Charging System Test</u> . Is the generator operating properly?	Go to Step 2	Go to Step 11
2	<ol style="list-style-type: none"> 1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the 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	<ol style="list-style-type: none"> 1. Turn OFF the engine. 2. Remove the drive belt. Refer to <u>Drive Belt Replacement</u> for the 4.2 L engine, <u>Drive Belt Replacement - Accessory</u> for the 5.3 L engine or <u>Drive Belt Replacement - Accessory</u> for the 6.0 L engine. 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	<ol style="list-style-type: none"> 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 <u>Generator Replacement (4.2L Engine)</u> or <u>Generator Replacement (5.3L and 6.0L Engines)</u>. 3. Install the drive belt. Refer to <u>Drive Belt Replacement</u> for the 4.2 L engine, <u>Drive Belt Replacement - Accessory</u> for the 5.3 L engine or <u>Drive Belt Replacement - Accessory</u> for the 6.0 L engine. 4. Start the engine. 		

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	Has the noise decreased or stopped?	System OK	Go to Step 6
6	<p>Inspect the generator for the following conditions:</p> <ul style="list-style-type: none"> • Strained or stretched electrical connections. • Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment <p>Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?</p>	Go to Step 7	Go to Step 8
7	<ol style="list-style-type: none"> 1. Reroute the electrical connections to relieve the tension. 2. Reroute the hoses, etc. away from the generator. 3. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 8
8	<p>Inspect the drive belt for proper tension. Refer to <u>Drive Belt Tensioner Diagnosis</u> for the 4.2 L engine, <u>Drive Belt Tensioner Diagnosis</u> for the 5.3 L engine or <u>Drive Belt Tensioner Diagnosis</u> for the 6.0 L engine.</p> <p>Is the drive belt loose?</p>	Go to Step 9	Go to Step 10
9	<ol style="list-style-type: none"> 1. Replace the drive belt tensioner. Refer to <u>Drive Belt Tensioner Replacement</u> for the 4.2 L engine, <u>Drive Belt Tensioner Replacement - Accessory</u> for the 5.3 L engine or <u>Drive Belt Tensioner Replacement - Accessory</u> for the 6.0 L engine. 2. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 11
10	<p>Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?</p>	System OK	Go to Step 11
11	<p>IMPORTANT:</p> <p>If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the</p>		

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	generator mounting. Replace the generator. Refer to <u>Generator Replacement (4.2L Engine)</u> or <u>Generator Replacement (5.3L and 6.0L Engines)</u> . 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: <u>Starting and Charging Schematics</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Turn the ignition switch to the START position. Does the engine crank?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>	Go to Step 3
3	Is the security indicator flashing?	Go to <u>Diagnostic System Check - Vehicle</u>	Go to Step 4
4	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Crank Request Signal parameter in the engine control module (ECM)/powertrain control module (PCM) data list. 4. Turn the ignition switch to the START position. Does the scan tool display Yes?	Go to Step 5	Go to Step 13
5	1. Turn ON the ignition, with the engine OFF. 2. With a scan tool, observe the Starter Relay Command parameter in the ECM/PCM data list. 3. Turn the ignition switch to the START position. Does the scan tool display Yes?	Go to Step 7	Go to Step 6
	1. Turn ON the ignition, with the engine OFF.		

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6	<ol style="list-style-type: none">Verify that the transmission is in Park or Neutral.With a scan tool, observe the TR Sw. parameter in the transmission control module (TCM) data list. <p>Does the scan tool display Park or Neutral?</p>	Go to Step 7	Go to <u>Range Selector Displays Incorrect Range (4.2L)</u> or <u>Range Selector Displays Incorrect Range (5.3L and 6.0L)</u>
7	<p>Turn the ignition switch to the START position.</p> <p>Do you hear the STRTR relay click?</p>	Go to Step 10	Go to Step 8
8	<ol style="list-style-type: none">Turn OFF the ignition.Disconnect the STRTR relay.Turn ON the ignition, with the engine OFF.Connect a test lamp between the battery positive voltage circuit of the STRTR relay coil and a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 9	Go to Step 21
9	<ol style="list-style-type: none">Connect a test lamp between the battery positive voltage circuit of the STRTR relay coil and the control circuit of the STRTR relay.Turn the ignition to the START position. <p>Does the test lamp illuminate?</p>	Go to Step 17	Go to Step 15
10	<ol style="list-style-type: none">Turn OFF the ignition.Disconnect the STRTR relay.Connect a test lamp between the battery positive voltage circuit of the STRTR relay switch and a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 11	Go to Step 22
11	<p>Connect a 30-amp fused jumper between the battery positive voltage circuit of the STRTR relay switch and the starter solenoid crank voltage circuit.</p> <p>Does the engine crank?</p>	Go to Step 17	Go to Step 12
12	<p>Does the fuse in the jumper open?</p>	Go to Step 23	Go to Step 14
13	<ol style="list-style-type: none">Turn OFF the ignition.Disconnect the ECM/PCM harness connector.Connect a test lamp between the crank voltage circuit of the ECM/PCM and a good		

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	ground. 4. Turn the ignition to the START position.		
	Does the test lamp illuminate?	Go to Step 20	Go to Step 16
14	Test the starter solenoid crank voltage circuit for a high resistance or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 18
15	Test the control circuit of the STRTR relay for an open or short to battery voltage. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 20
16	Test the crank voltage circuit of the ECM/PCM for a high resistance or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 19
17	Inspect for poor connections at the STRTR relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 24
18	Inspect for poor connections at the starter solenoid. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 25
19	Inspect for poor connections at the ignition switch. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 26
20	Inspect for poor connections at the harness connector of the ECM/PCM. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> . Did you find and correct the condition?	Go to Step 28	Go to Step 27
21	Repair an open or high resistance in the battery positive voltage circuit of the STRTR relay coil. Refer to <u>Wiring Repairs</u> . Did you complete the repair?	Go to Step 28	-
22	Repair the open or high resistance in the battery positive voltage circuit of the STRTR relay switch. Refer to <u>Wiring Repairs</u> . Did you complete the repair?	Go to Step 28	-
23	Repair the short to ground in the starter solenoid crank voltage circuit. Refer to <u>Wiring Repairs</u> . Did you complete the repair?	Go to Step 28	-

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24	Replace the STRTR relay. Refer to <u>Relay Replacement (Attached to Wire Harness)</u> or <u>Relay Replacement (Within an Electrical Center)</u> . Did you complete the replacement?	Go to Step 28	-
25	Replace the starter motor. Refer to <u>Starter Motor Replacement (4.2L Engine)</u> or <u>Starter Motor Replacement (5.3L and 6.0L Engines)</u> . Did you complete the replacement?	Go to Step 28	-
26	Replace the ignition switch. Refer to <u>Ignition and Start Switch Replacement</u> . Did you complete the replacement?	Go to Step 28	-
27	Replace the ECM/PCM. Refer to <u>Control Module References</u> for replacement, setup and programming. Did you complete the replacement?	Go to Step 28	-
28	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK**Starter Solenoid Clicks, Engine Does Not Crank**

Step	Action	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	<u>Diagnostic System Check - Vehicle</u>
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to Step 3	Go to <u>Starter Solenoid Does Not Click</u>
3	Inspect the engine and belt drive system for mechanical binding seized engine, seized generator. Does the engine move freely?	Go to Step 4	Go to <u>Symptoms - Engine Mechanical</u> for the 4.2 L engine, <u>Symptoms - Engine Mechanical</u> for the 5.3 L engine or <u>Symptoms - Engine Mechanical</u> for the 6.0 L engine
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> .		

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

Inspect the following items:

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

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

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

- Inspect the flywheel 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 1 starter mounting bolt. There are 3 shims available in different shapes for clearance. All are 1 mm (0.039 in) thick.

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Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Start the engine. Does the starter operate normally?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u>	Go to Step 3
3	Start the engine while listening to the starter motor turn. Is there a loud "whoop", it may sound like a siren if the engine is revved while the starter is engaged after the engine starts, but while the starter is still held in the engaged position?	Go to Step 6	Go to Step 4
4	Do you hear a "rumble", a "growl", or, in some cases, a "knock" as the starter is coasting down to a stop after starting the engine?	Go to Step 7	Go to Step 5
5	This is often diagnosed as a starter drive gear hang-in or a weak solenoid. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to Step 6	Go to Step 7
6	Inspect the flywheel ring gear for the following: <ul style="list-style-type: none"> • Chipped gear teeth • Missing gear teeth • Milled teeth Is the flywheel bent or does it have damaged teeth?	Go to Step 8	Go to Step 9
7	1. Remove the starter motor. Refer to <u>Starter Motor Replacement (4.2L Engine)</u> or <u>Starter Motor Replacement (5.3L and 6.0L Engines)</u> . 2. Inspect the starter motor bushings and clutch gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to Step 9	Go to Step 8
8	Replace the flywheel. Refer to <u>Engine Flywheel Replacement</u> for the 4.2 L engine, <u>Engine Flywheel Replacement</u> for the 5.3 L engine or <u>Engine Flywheel Replacement</u> for the 6.0 L engine.		

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	Did you complete the replacement?	Go to Step 10	-
9	Replace the starter motor. Refer to <u>Starter Motor Replacement (4.2L Engine)</u> or <u>Starter Motor Replacement (5.3L and 6.0L Engines)</u> . Did you complete the replacement?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

Disconnecting Procedure

CAUTION: Refer to **BATTERY DISCONNECT CAUTION** .

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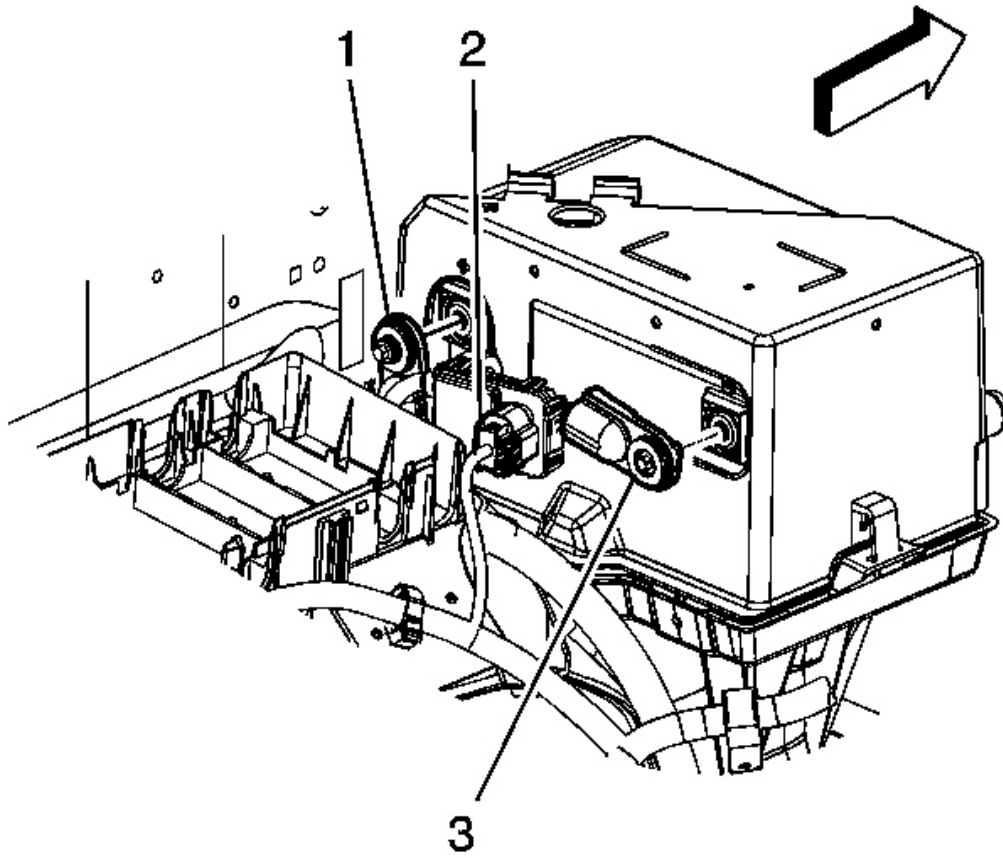


Fig. 12: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

Connecting Procedure

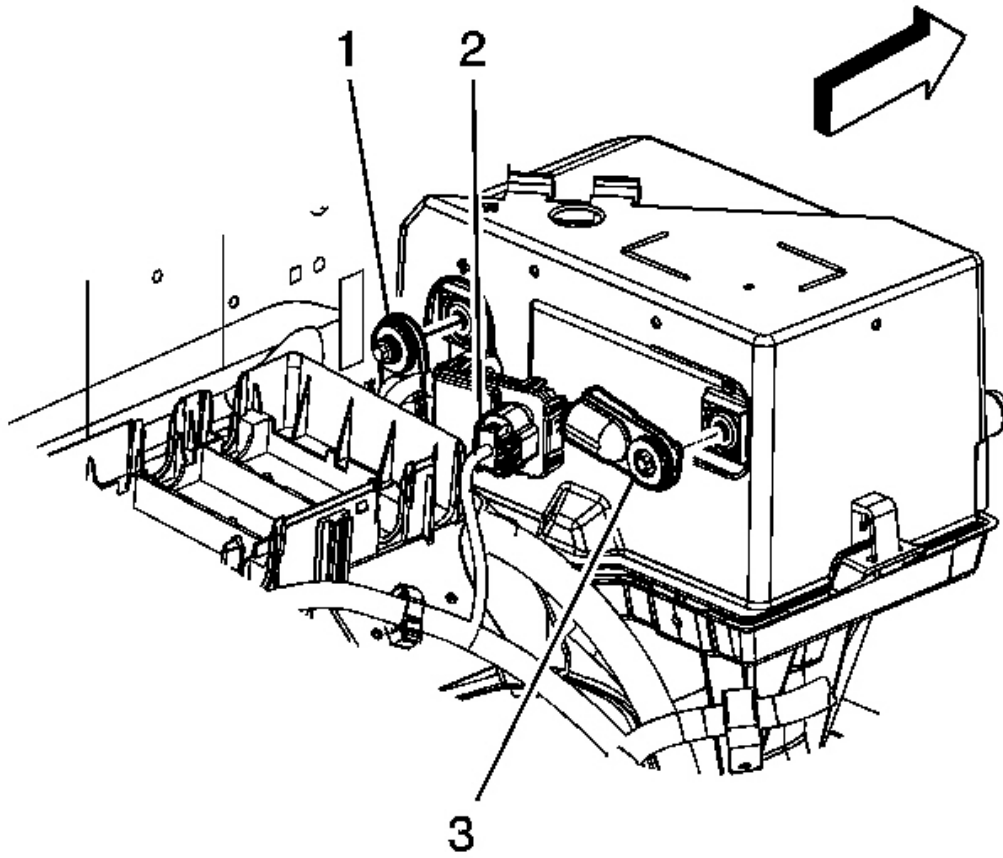


Fig. 13: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

4. Tighten negative battery cable bolt.

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

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Removal Procedure

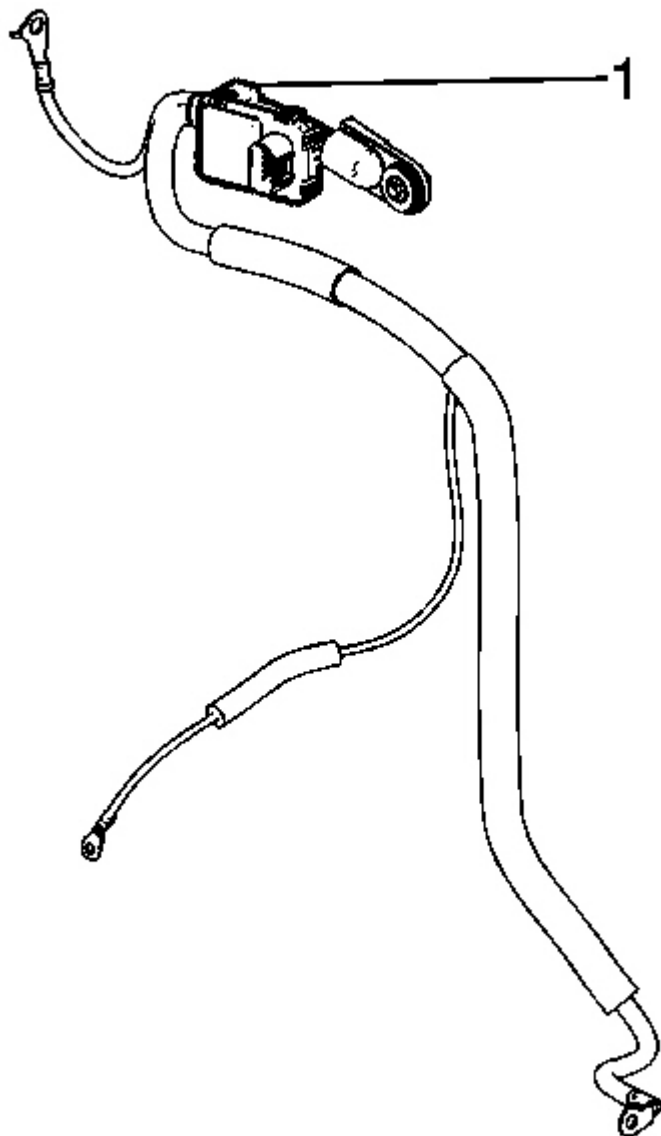


Fig. 14: Identifying Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the negative battery cable. Refer to **Battery Negative Cable Replacement (4.2L Engine)** or **Battery Negative Cable Replacement (5.3L and 6.0L Engines)**.

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2. Mark the location of the negative battery cable clips and remove the clips from the cable.
3. Remove the tape securing the generator battery current sensor to the negative battery cable.
4. Squeeze the negative battery cable branches together.

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

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

Installation Procedure

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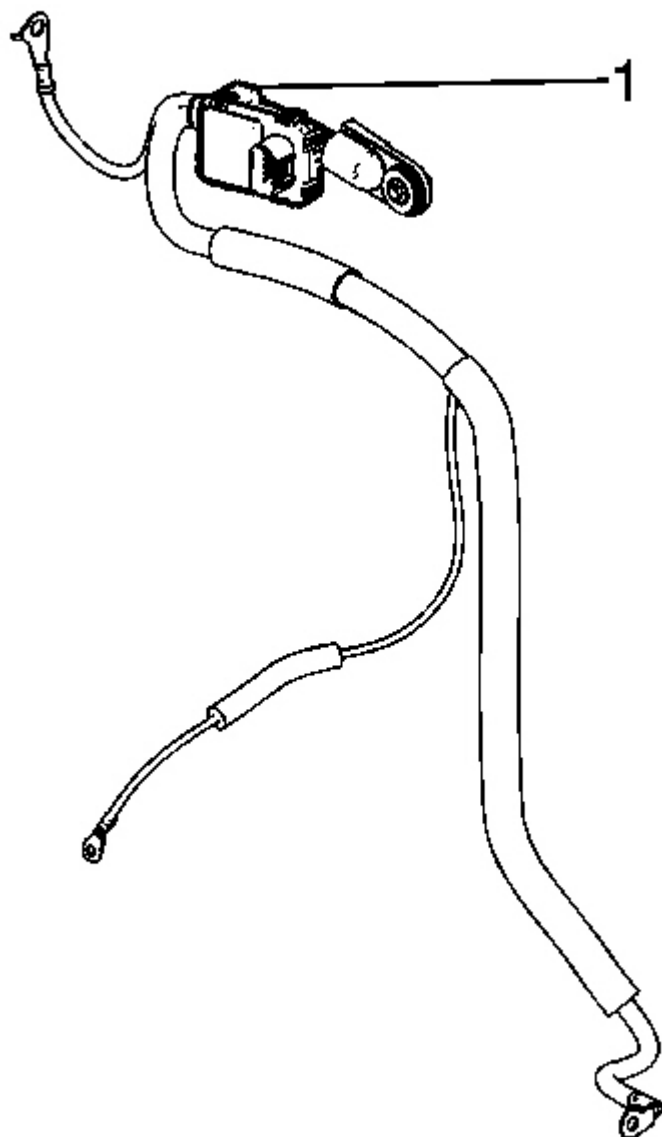


Fig. 15: Identifying Battery Cable & Current Sensor
Courtesy of GENERAL MOTORS CORP.

1. Squeeze the negative battery cable together.

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

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

BATTERY NEGATIVE CABLE REPLACEMENT (4.2L ENGINE)

Removal Procedure

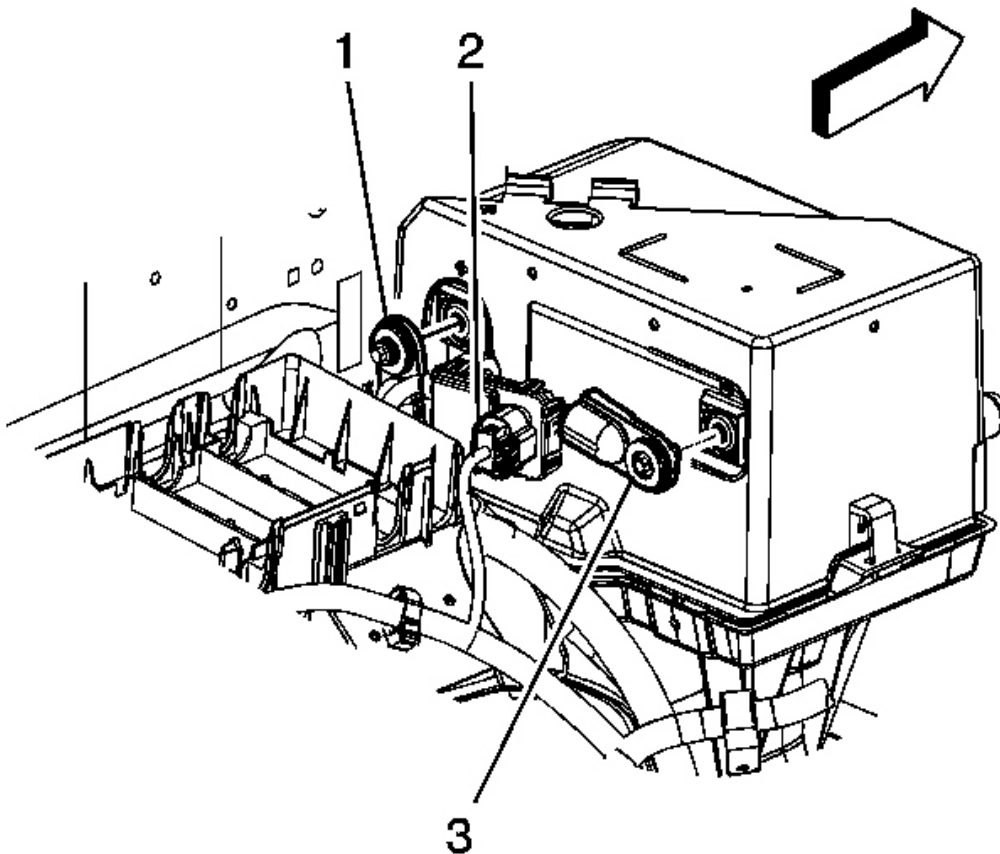


Fig. 16: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

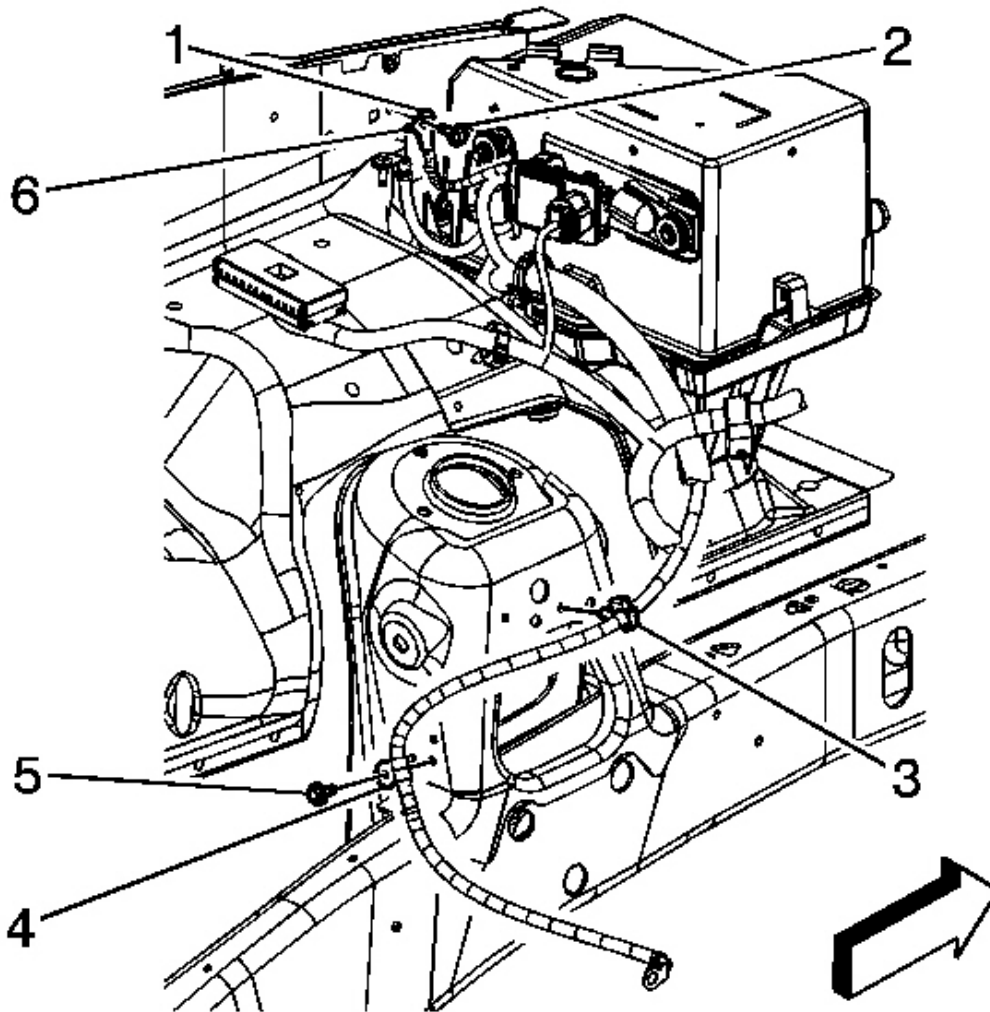


Fig. 17: Identifying Batter Cables & Related Components
Courtesy of GENERAL MOTORS CORP.

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

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

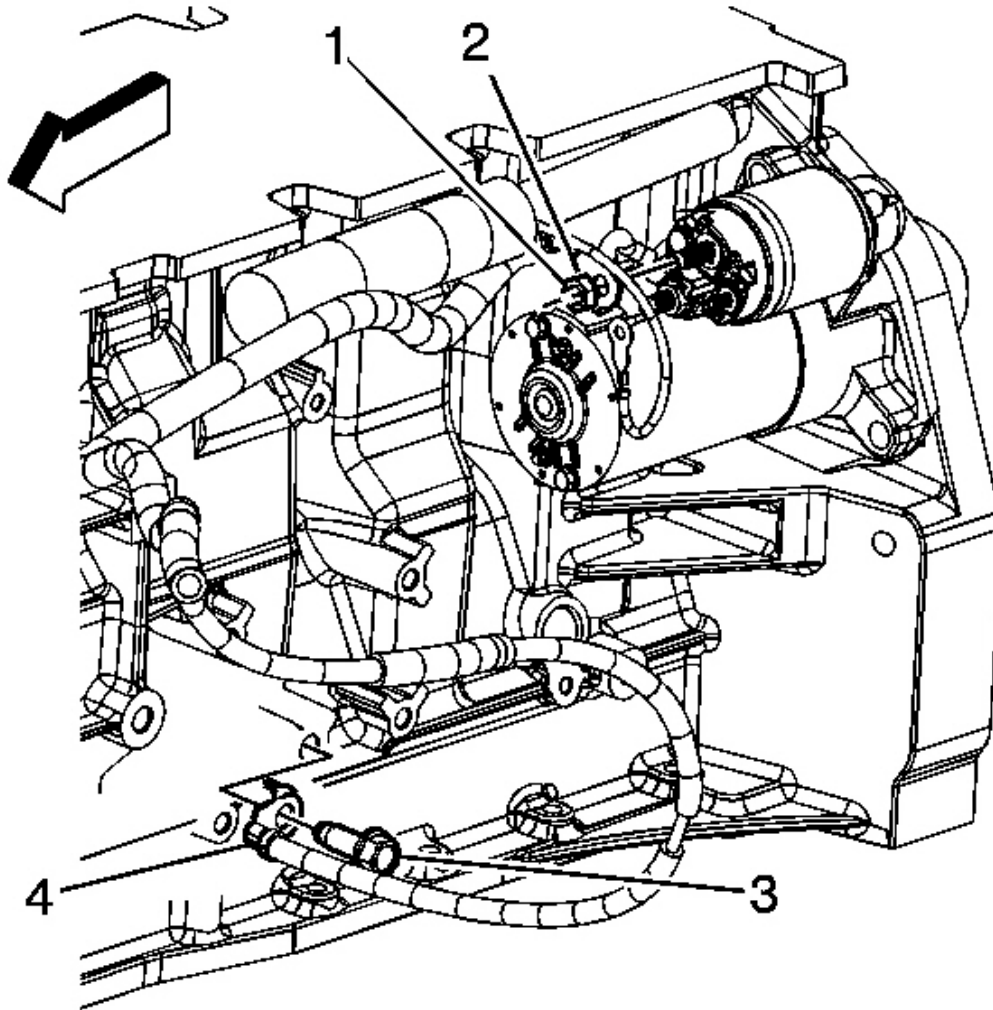


Fig. 18: Locating Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

IMPORTANT:

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

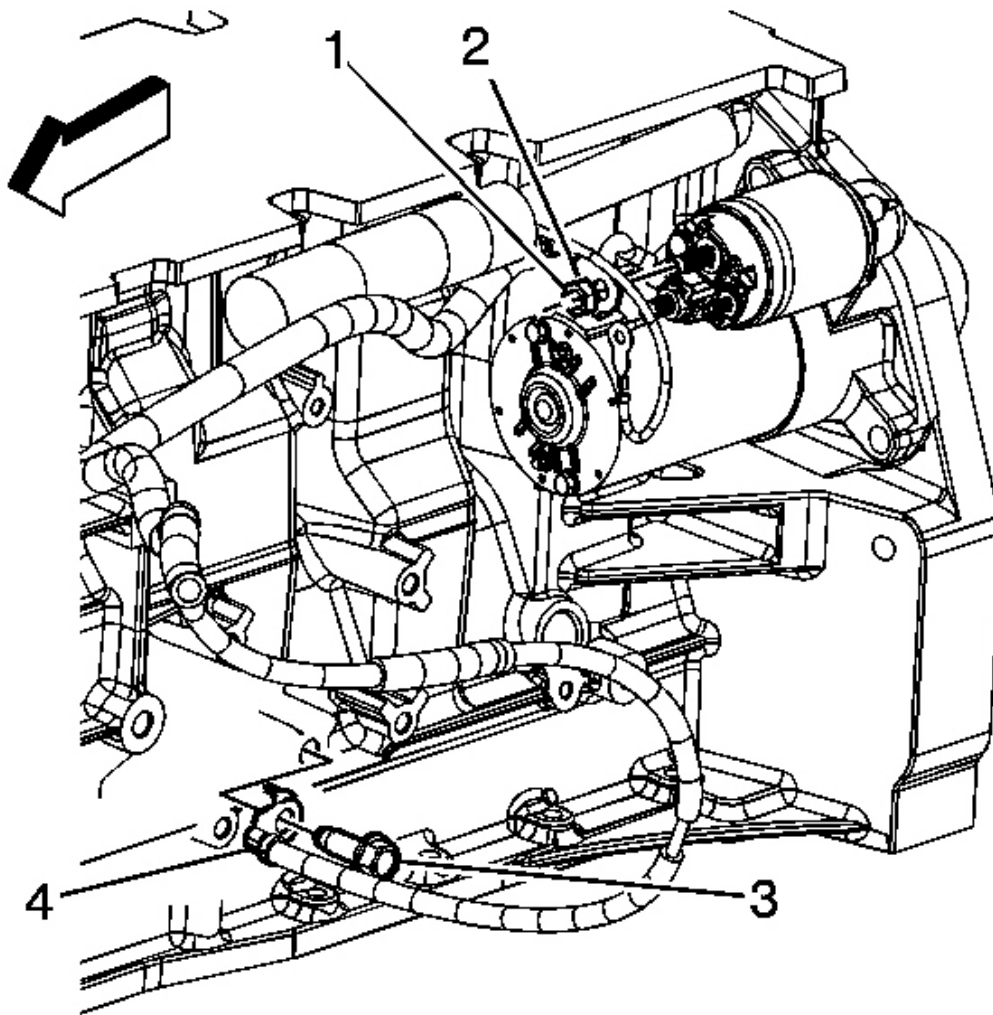


Fig. 19: Locating Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

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

NOTE: Refer to Fastener Notice .

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

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

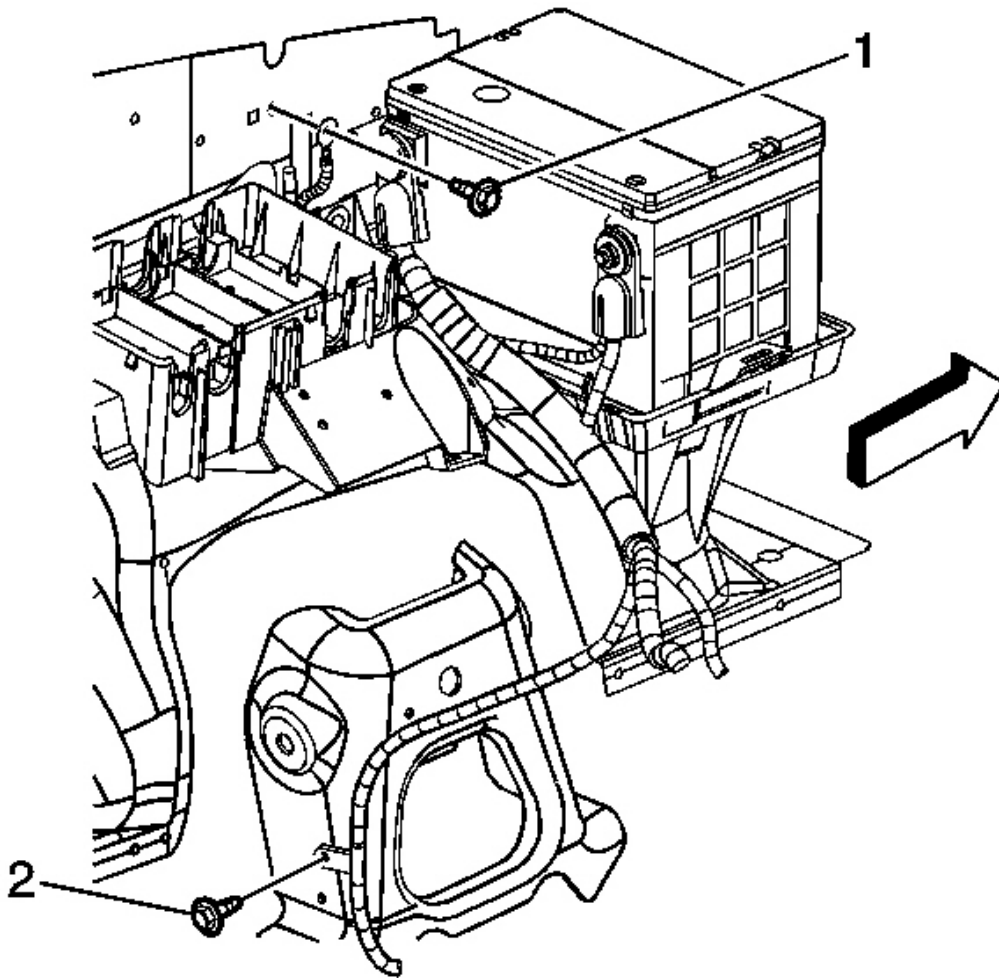


Fig. 20: View Of Front Wheelhouse Panel Bolt & Shock Tower Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the negative battery cable ground terminal to the shock tower. Ensure that the anti-rotation tab is

inserted into the hole in the shock tower.

5. Install the negative battery cable ground terminal bolt (5) to the shock tower.

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

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

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

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

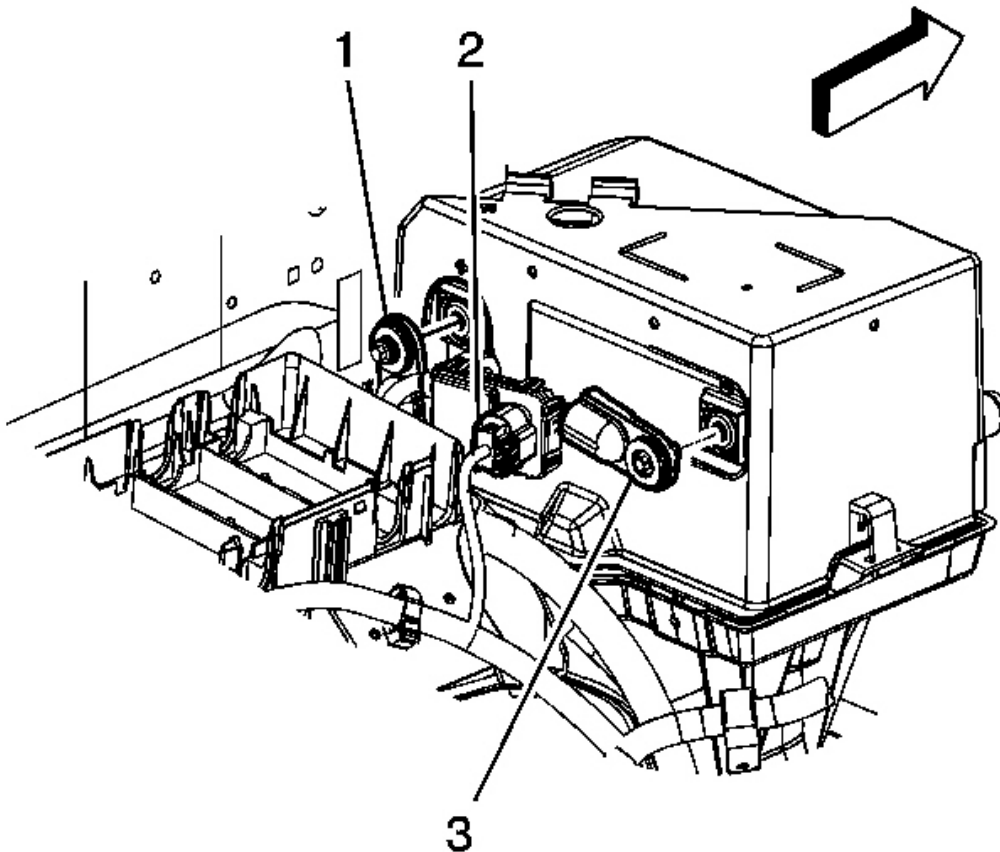


Fig. 21: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

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

Removal Procedure

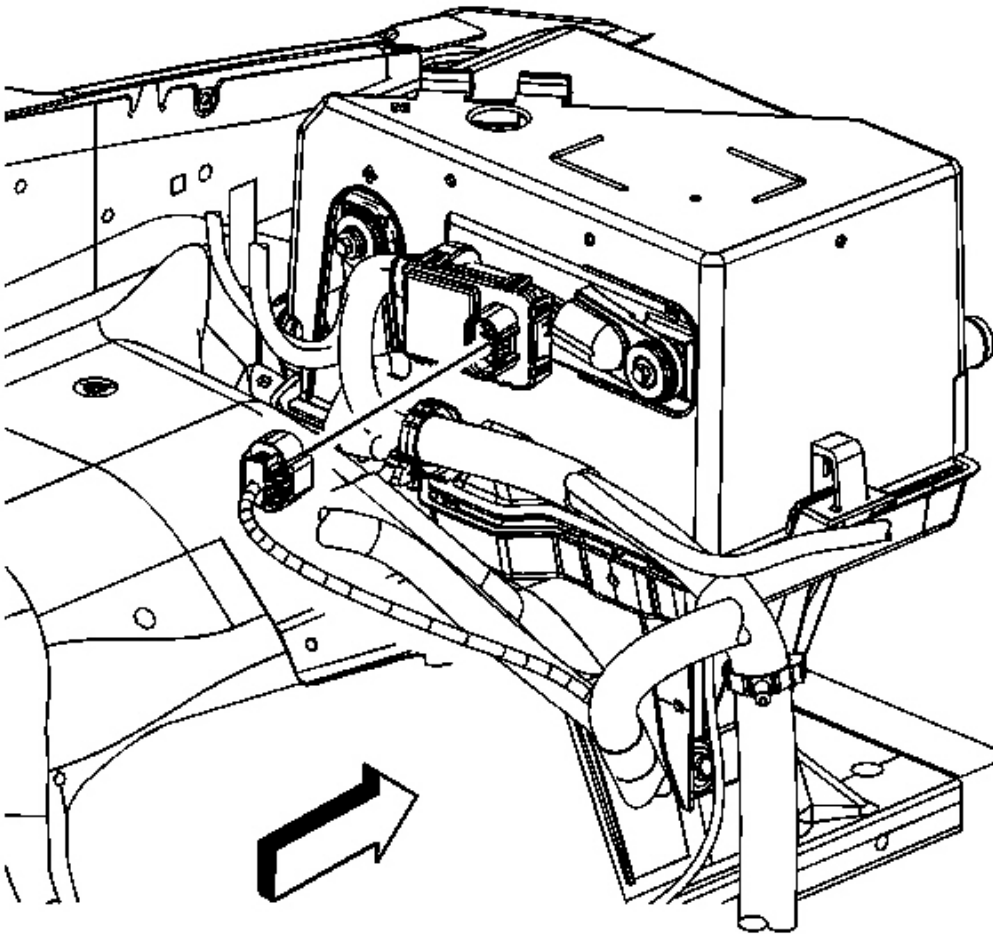


Fig. 22: Identifying Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

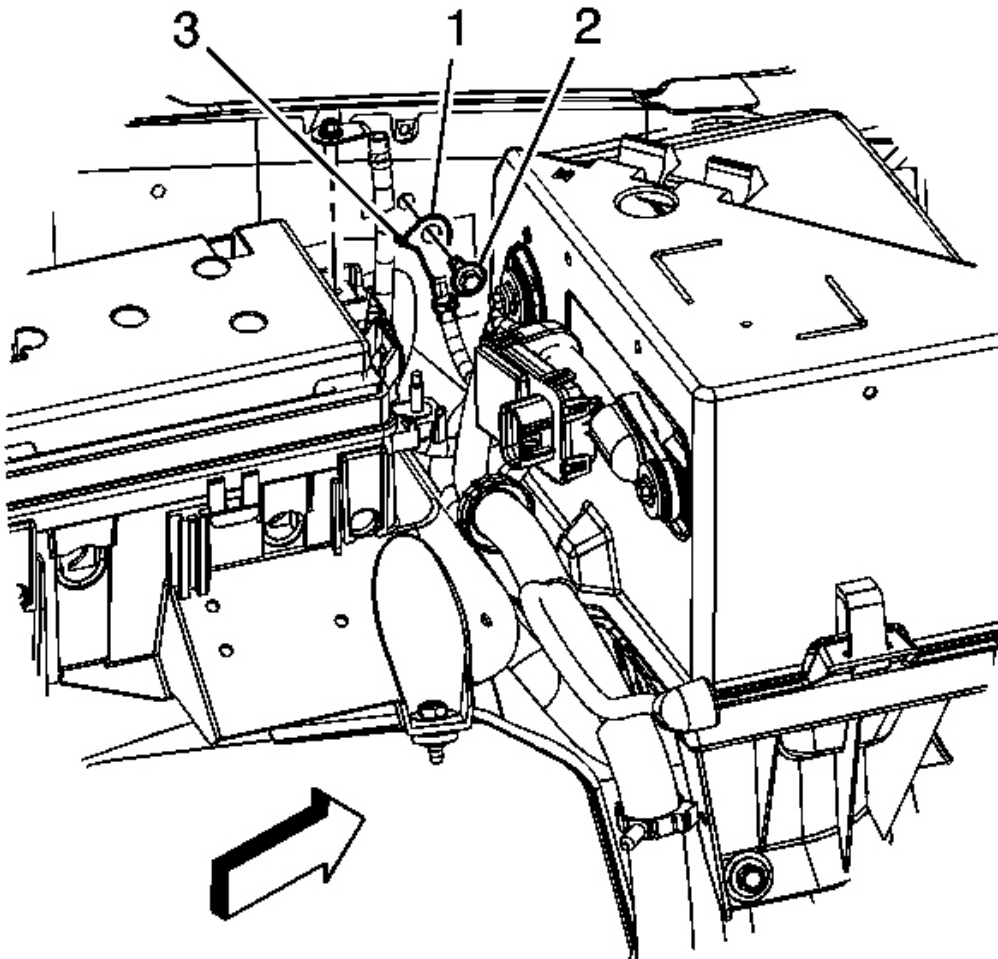


Fig. 23: Identifying Negative Battery Cable Ground Terminal Bolt
Courtesy of GENERAL MOTORS CORP.

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

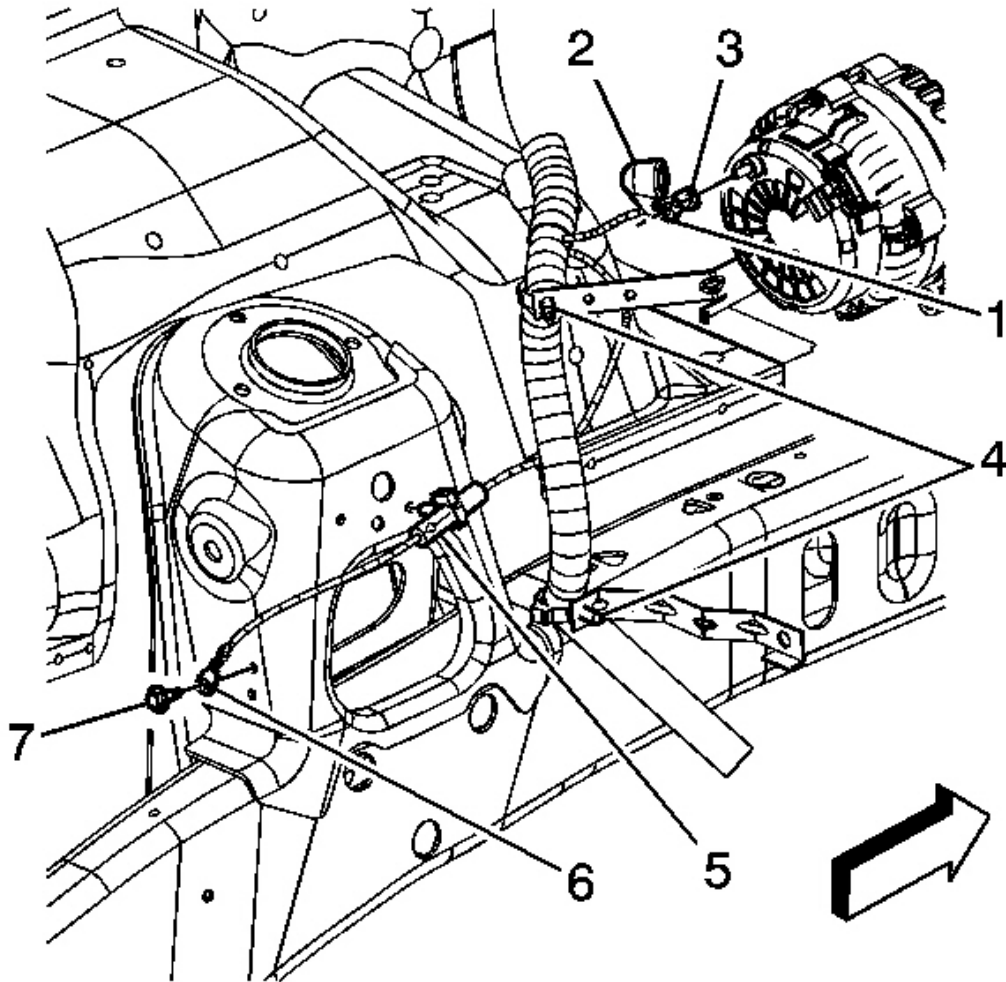


Fig. 24: View Of Negative Battery Cable Ground Terminal Bolt At Shock Tower
Courtesy of GENERAL MOTORS CORP.

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

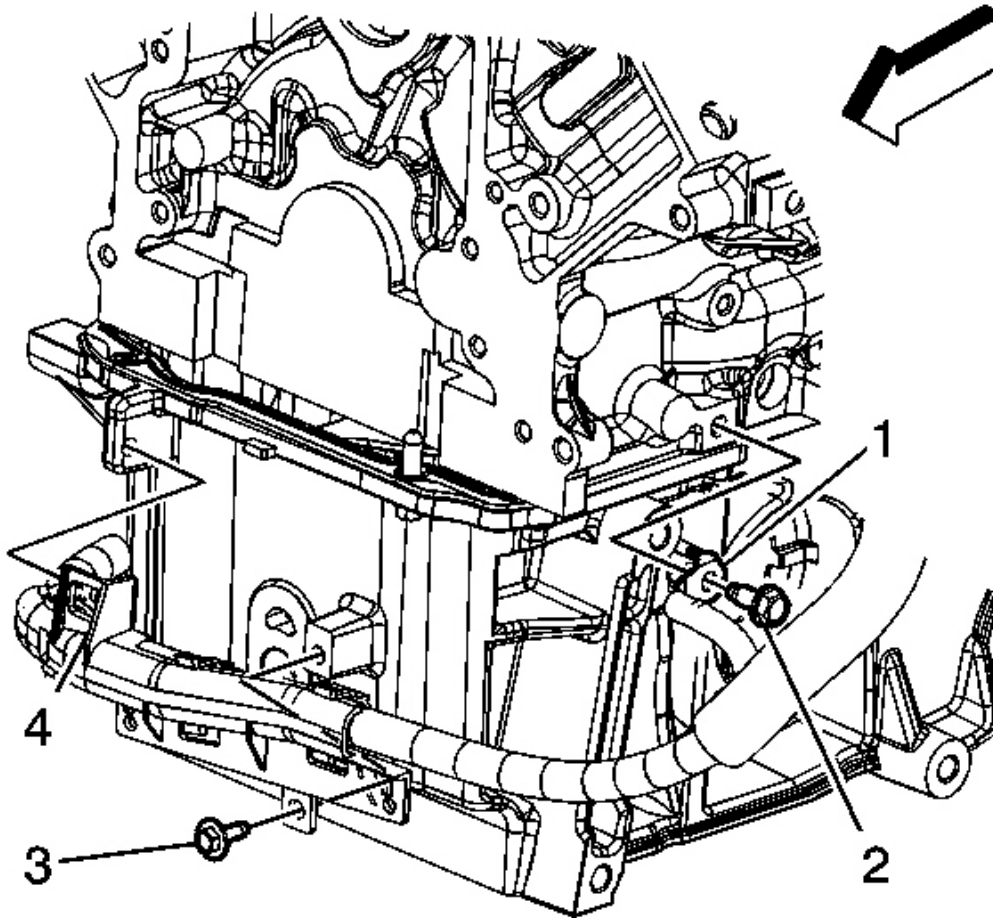


Fig. 25: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

IMPORTANT:

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

the powertrain control module.

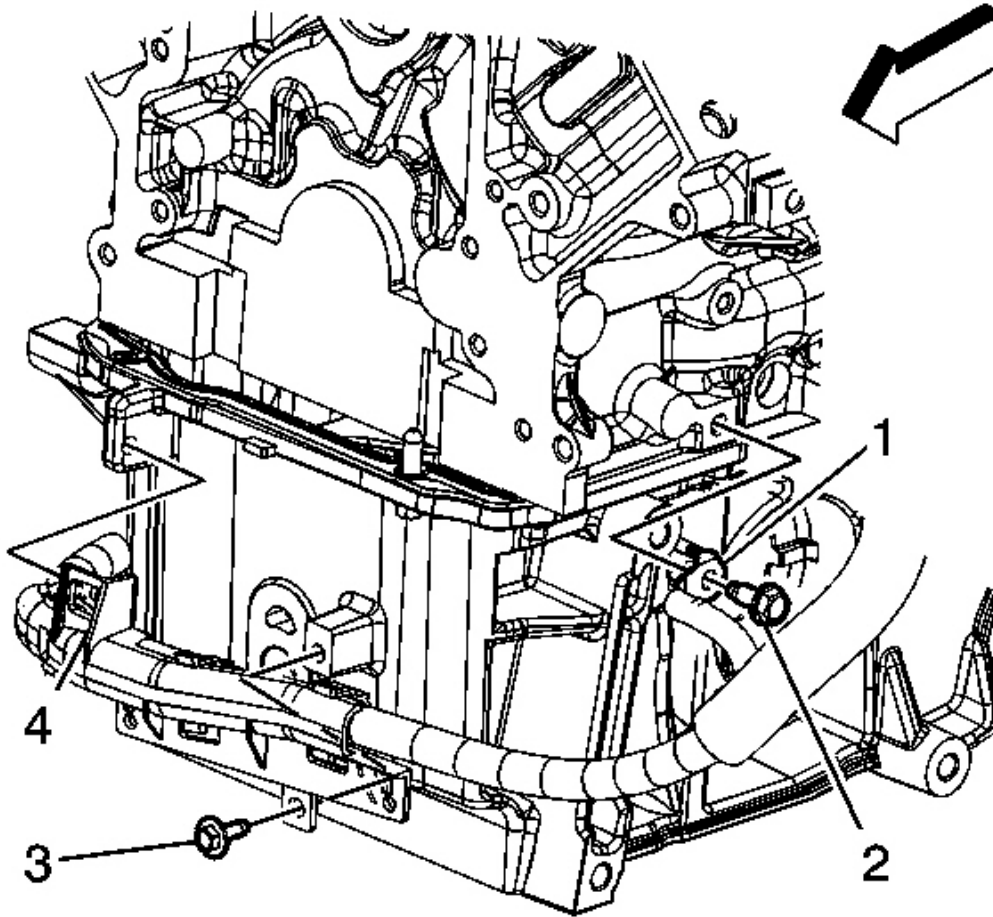


Fig. 26: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

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

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

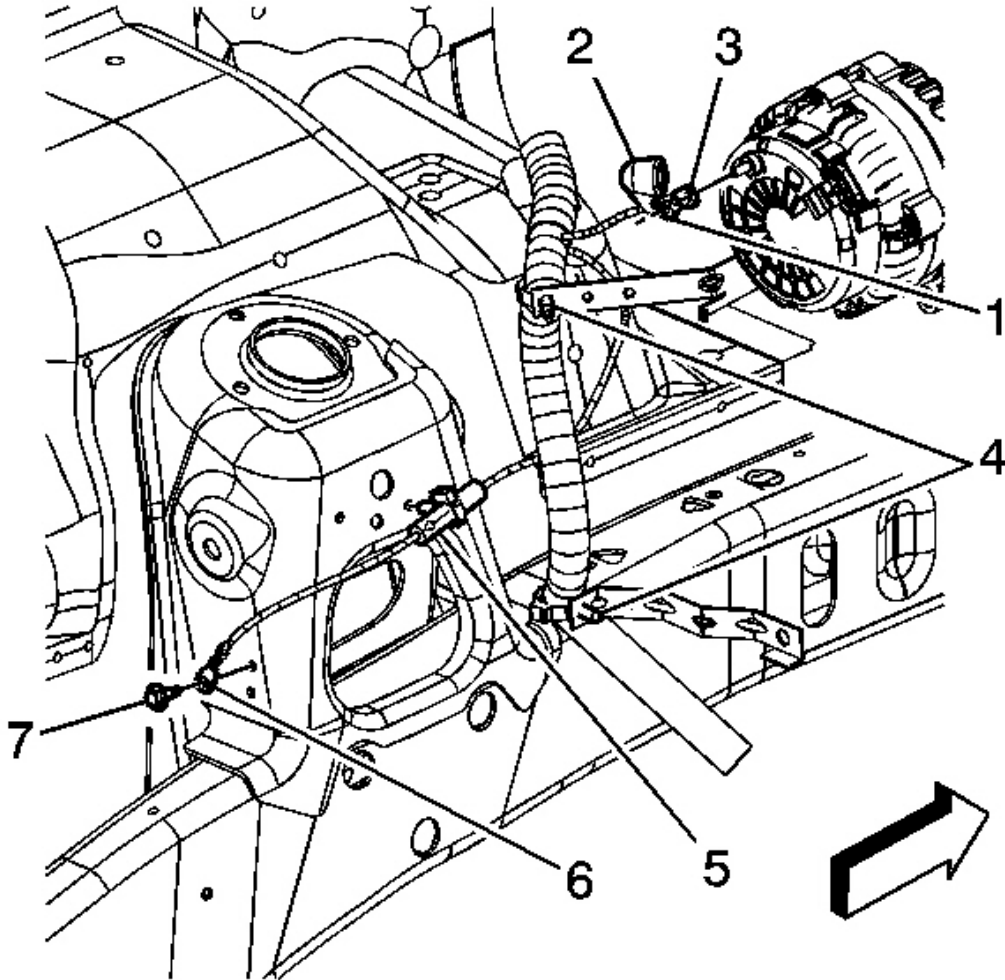


Fig. 27: View Of Negative Battery Cable Ground Terminal Bolt At Shock Tower
Courtesy of GENERAL MOTORS CORP.

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

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

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

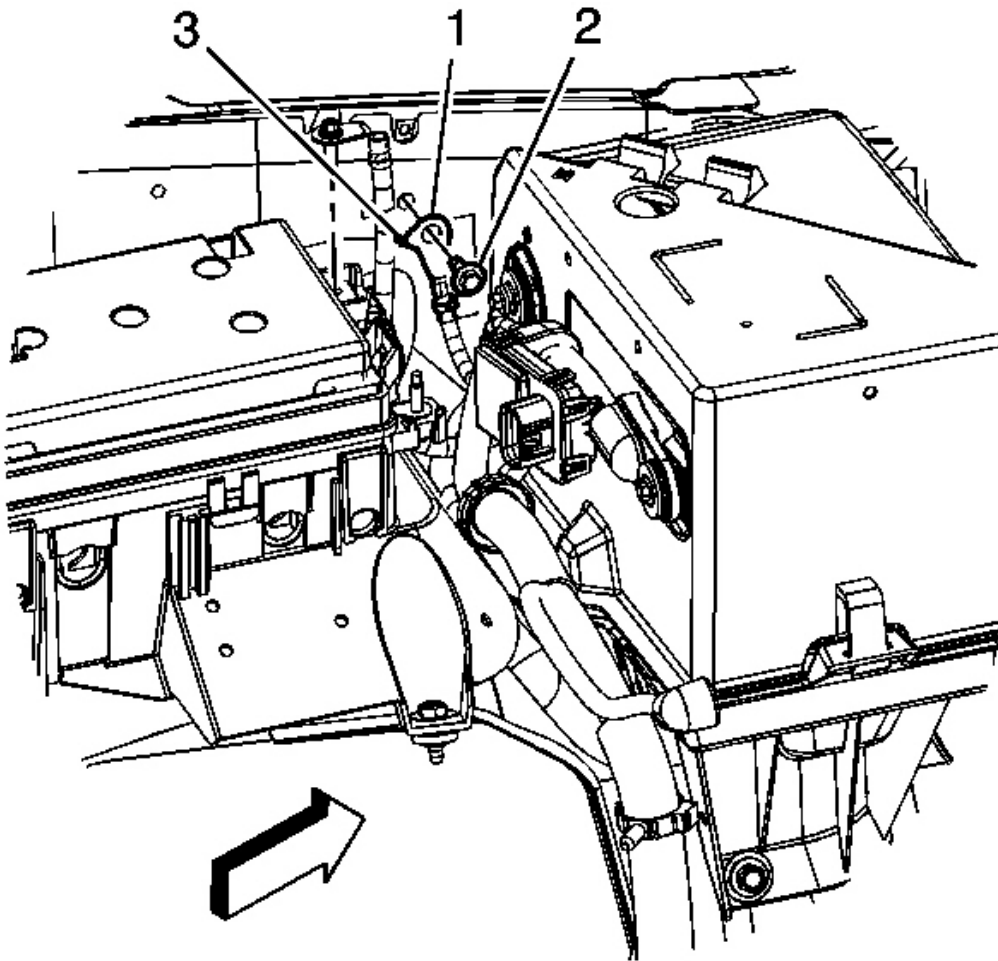


Fig. 28: Identifying Negative Battery Cable Ground Terminal Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

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

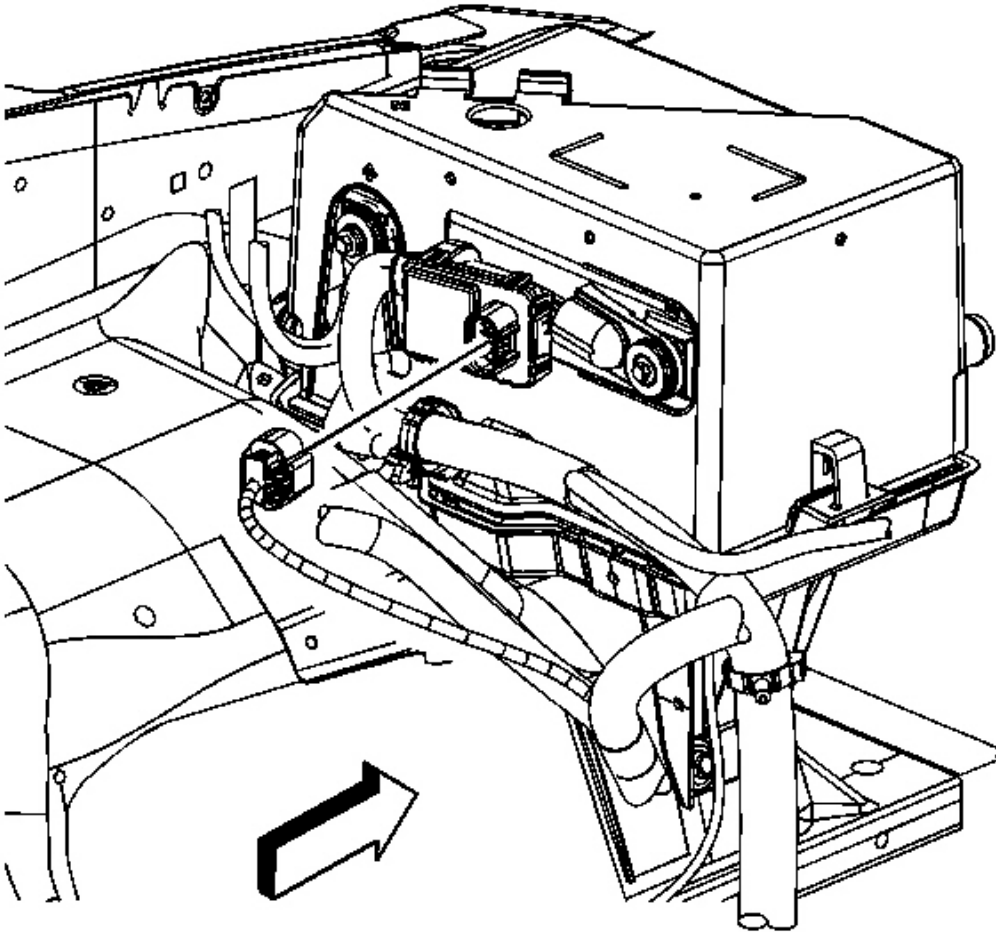


Fig. 29: Identifying Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

BATTERY POSITIVE CABLE REPLACEMENT (4.2L ENGINE)

Removal Procedure

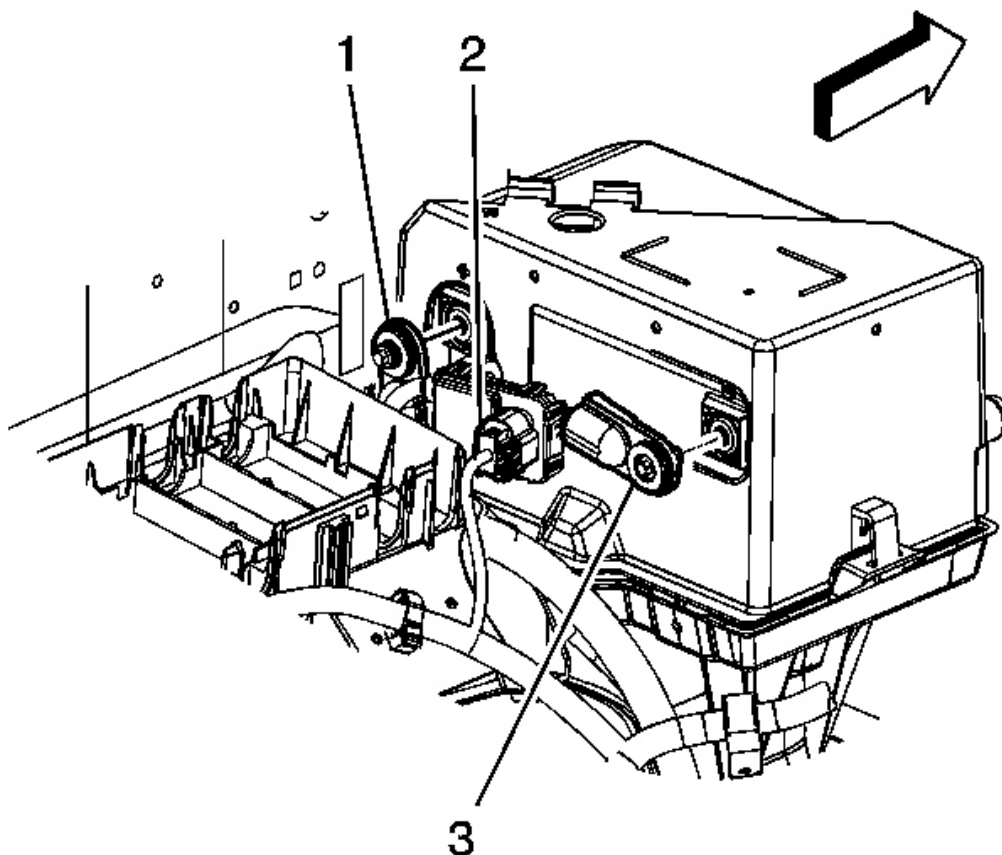


Fig. 30: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

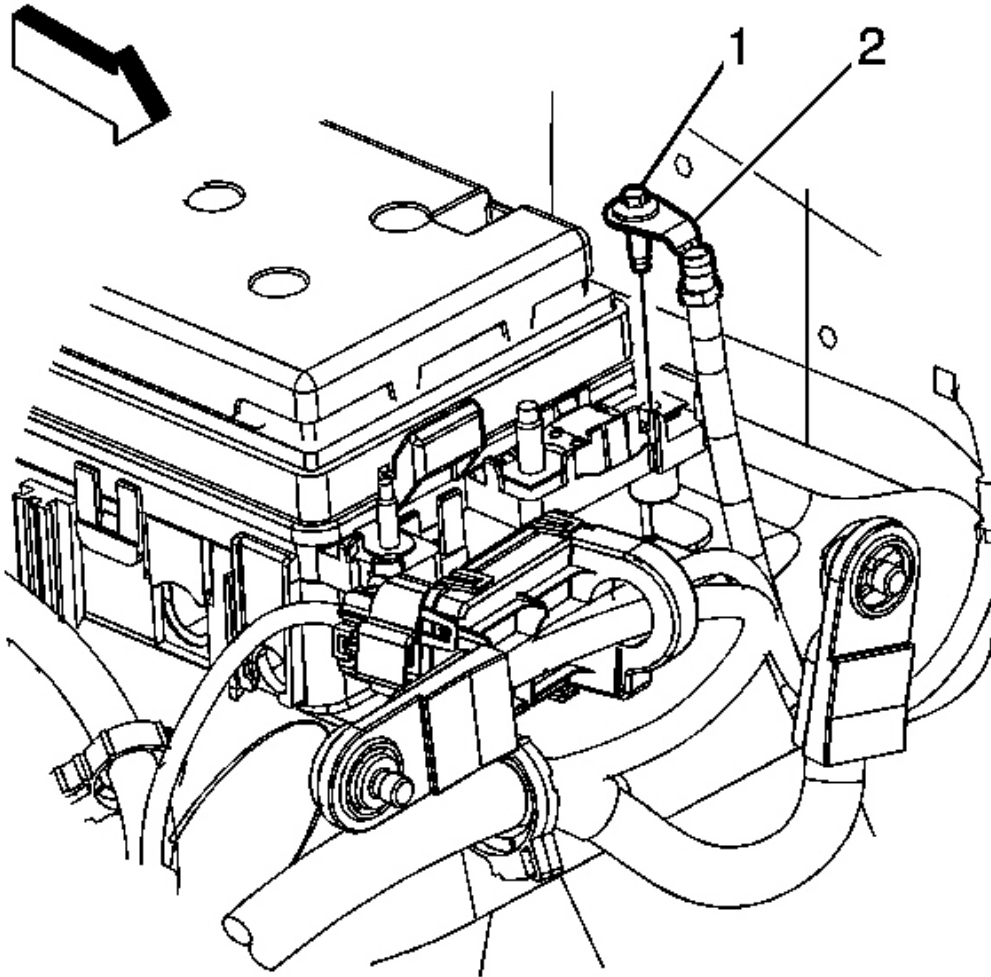


Fig. 31: Locating Positive Battery Cable Terminal Bolt & Junction Block
Courtesy of GENERAL MOTORS CORP.

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

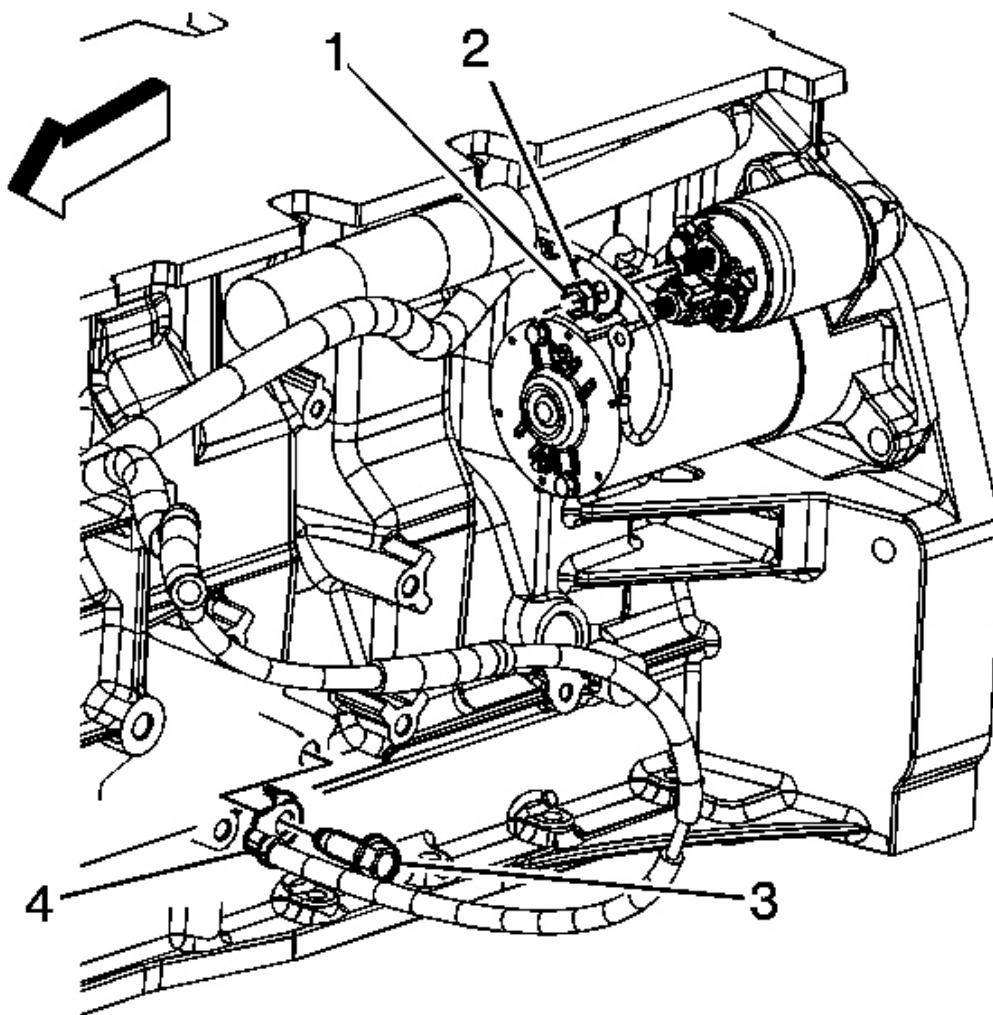


Fig. 32: Locating Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

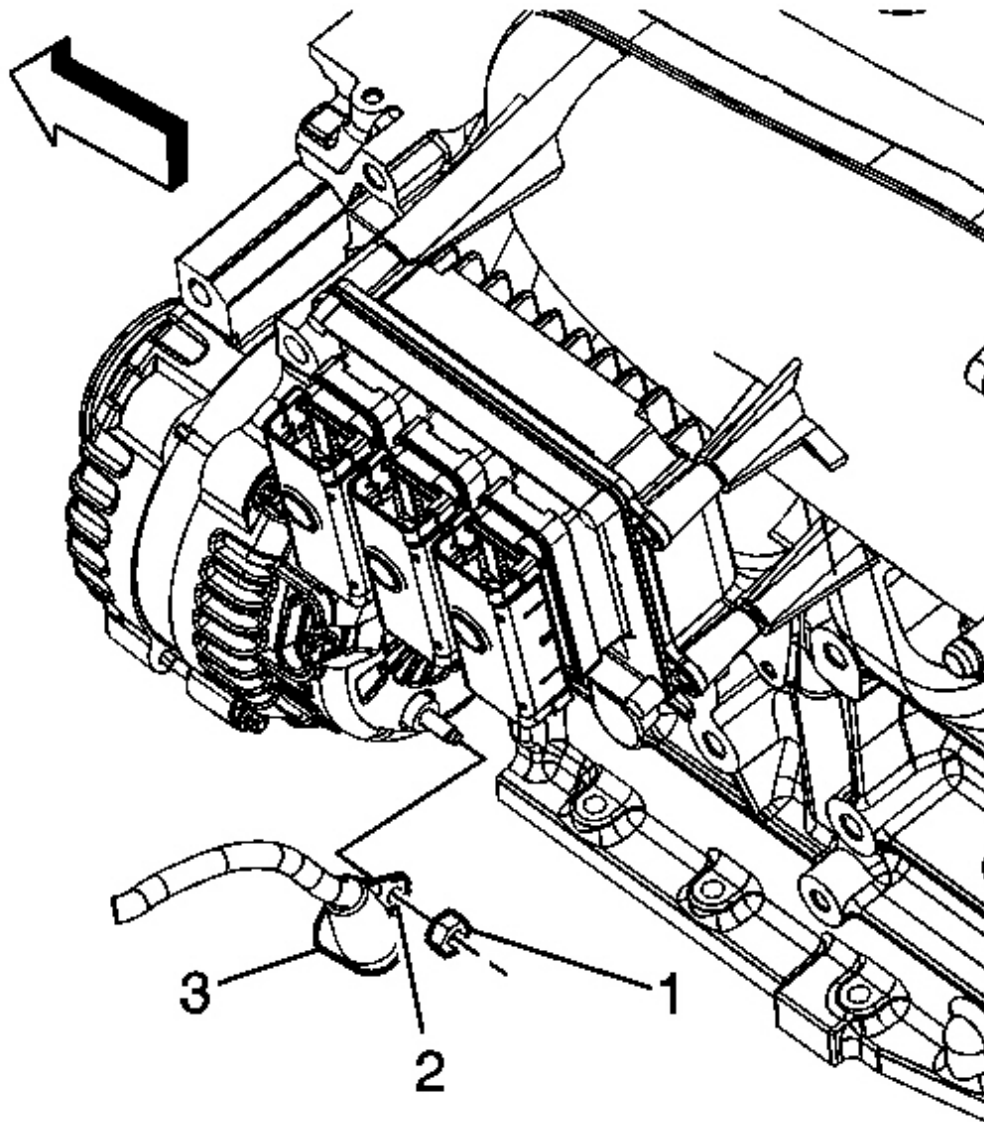


Fig. 33: View Of Positive Battery Cable Boot
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

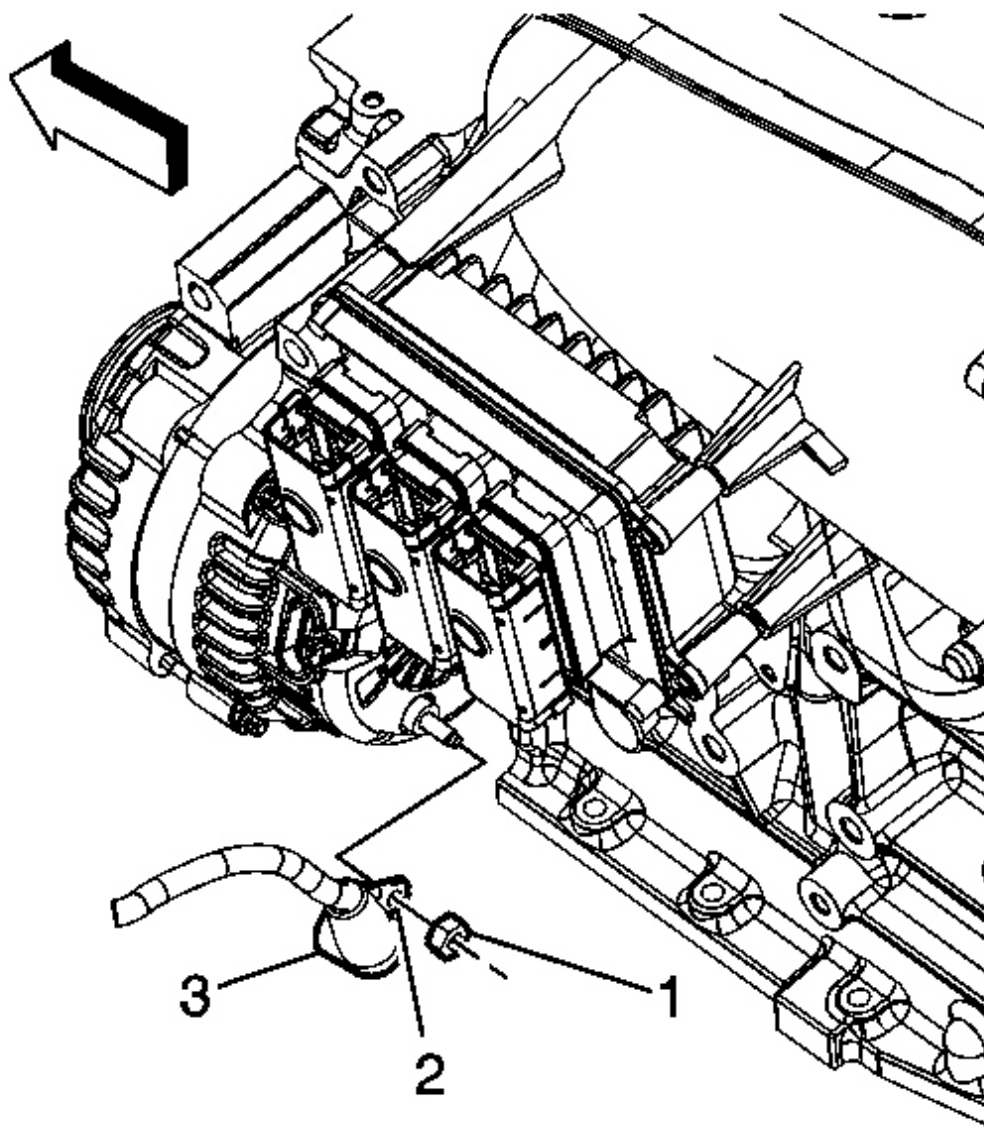


Fig. 34: View Of Positive Battery Cable Boot
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

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

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

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

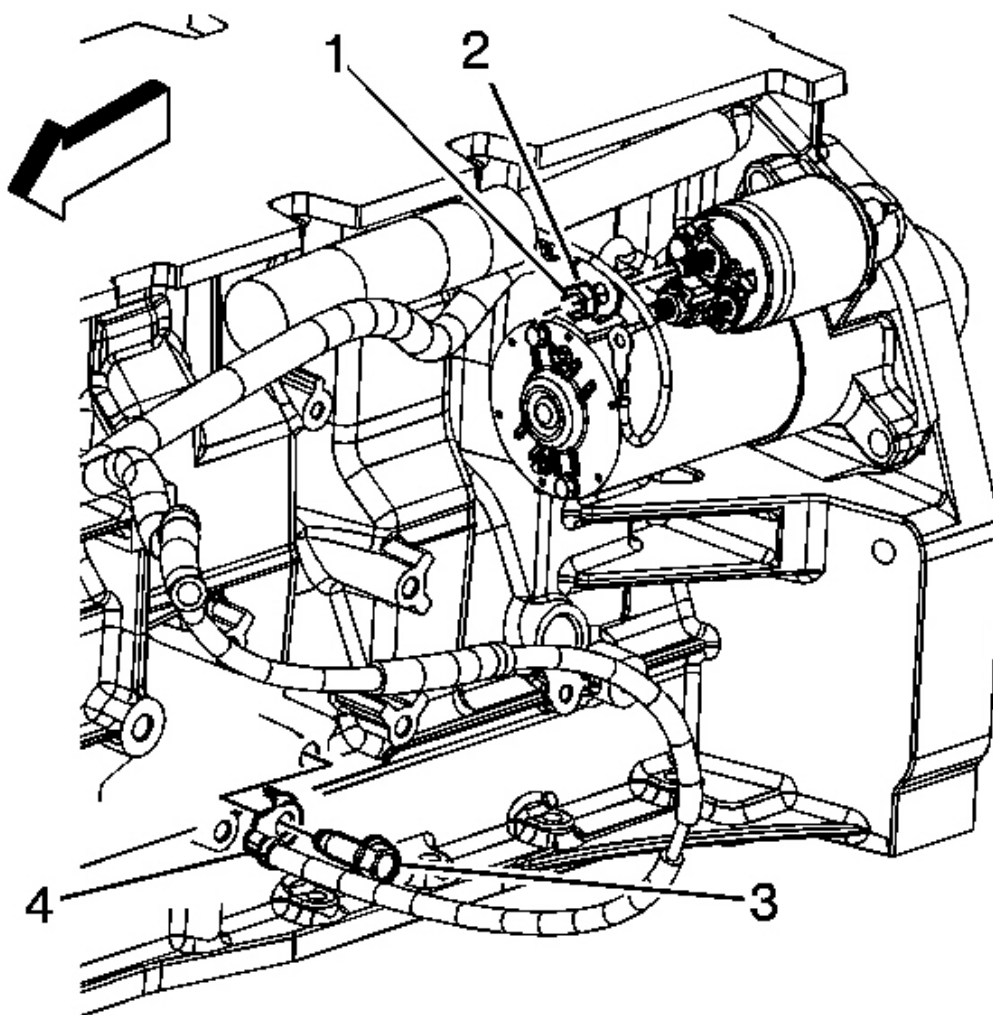


Fig. 35: Locating Negative Battery Cable
Courtesy of GENERAL MOTORS CORP.

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

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

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

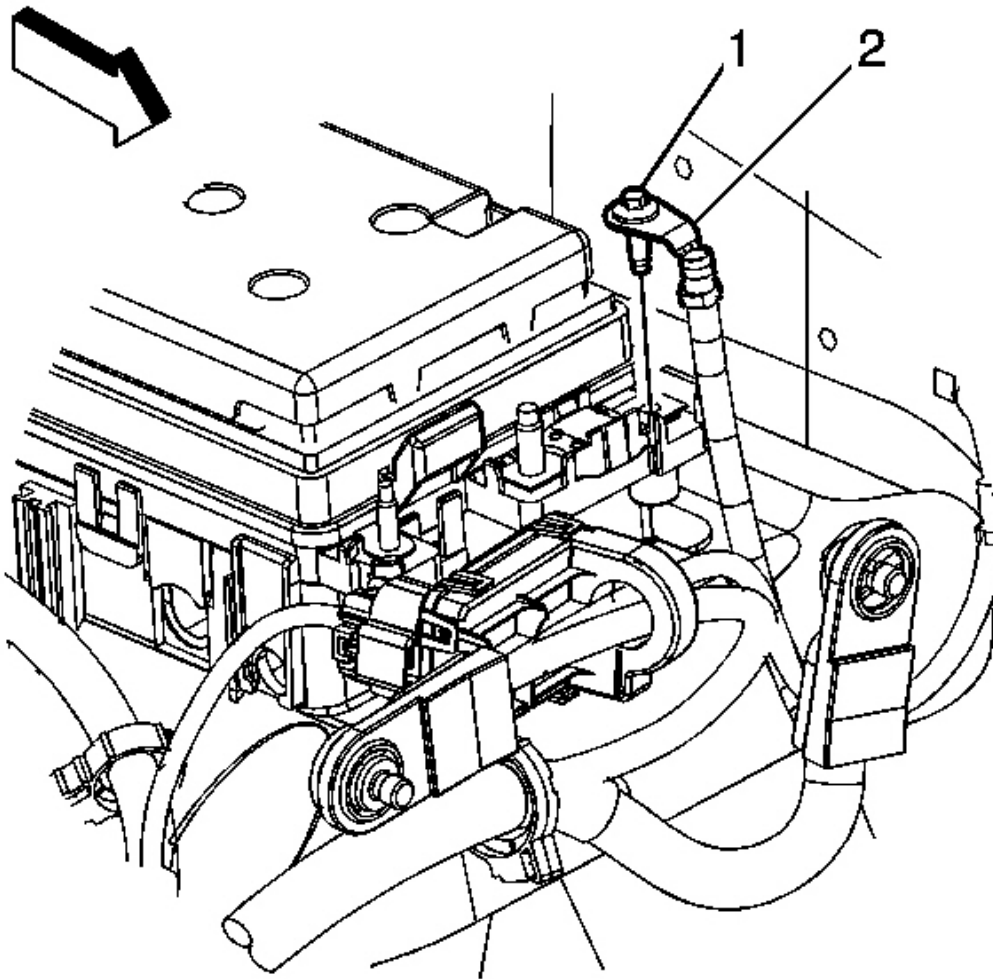


Fig. 36: Locating Positive Battery Cable Terminal Bolt & Junction Block
Courtesy of GENERAL MOTORS CORP.

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

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

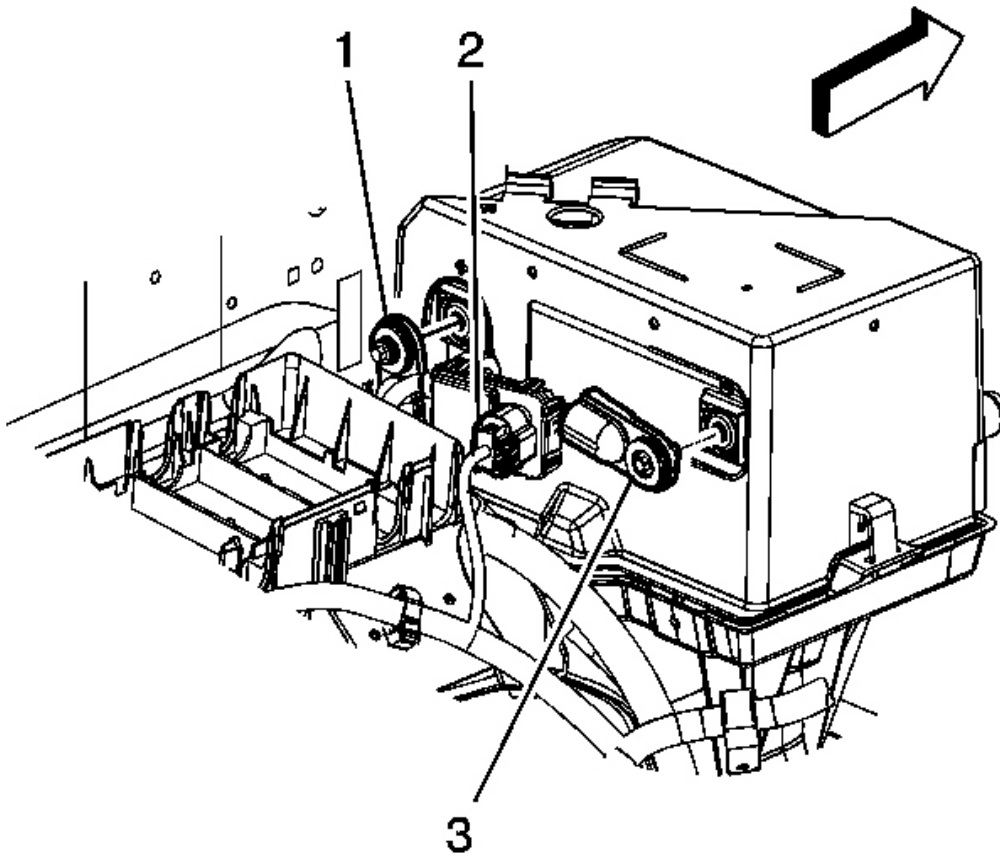


Fig. 37: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

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

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

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

Removal Procedure

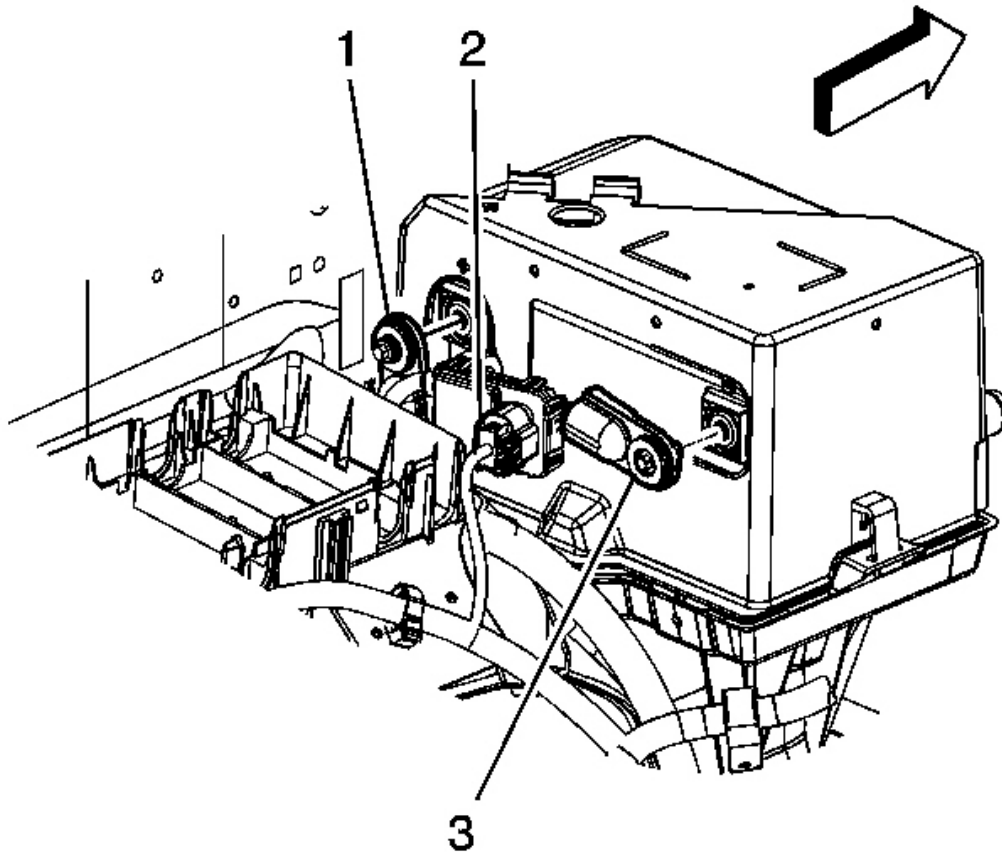


Fig. 38: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

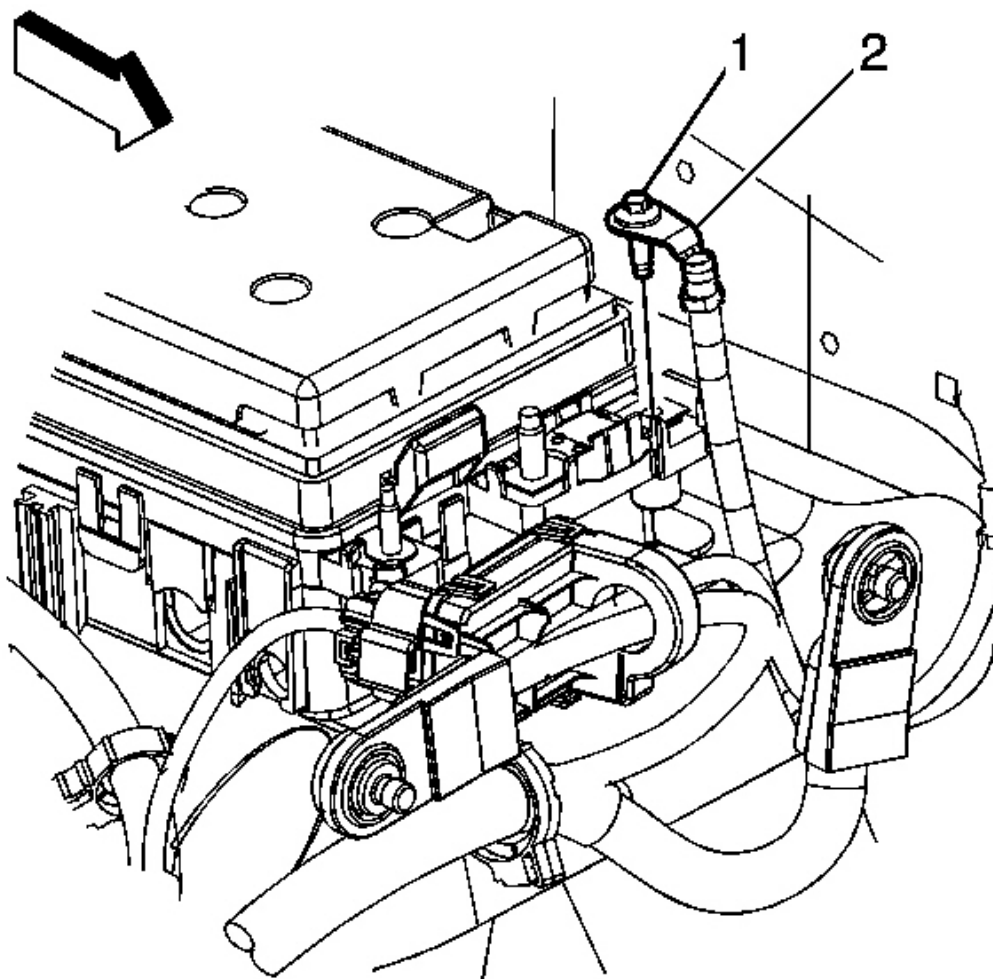


Fig. 39: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

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

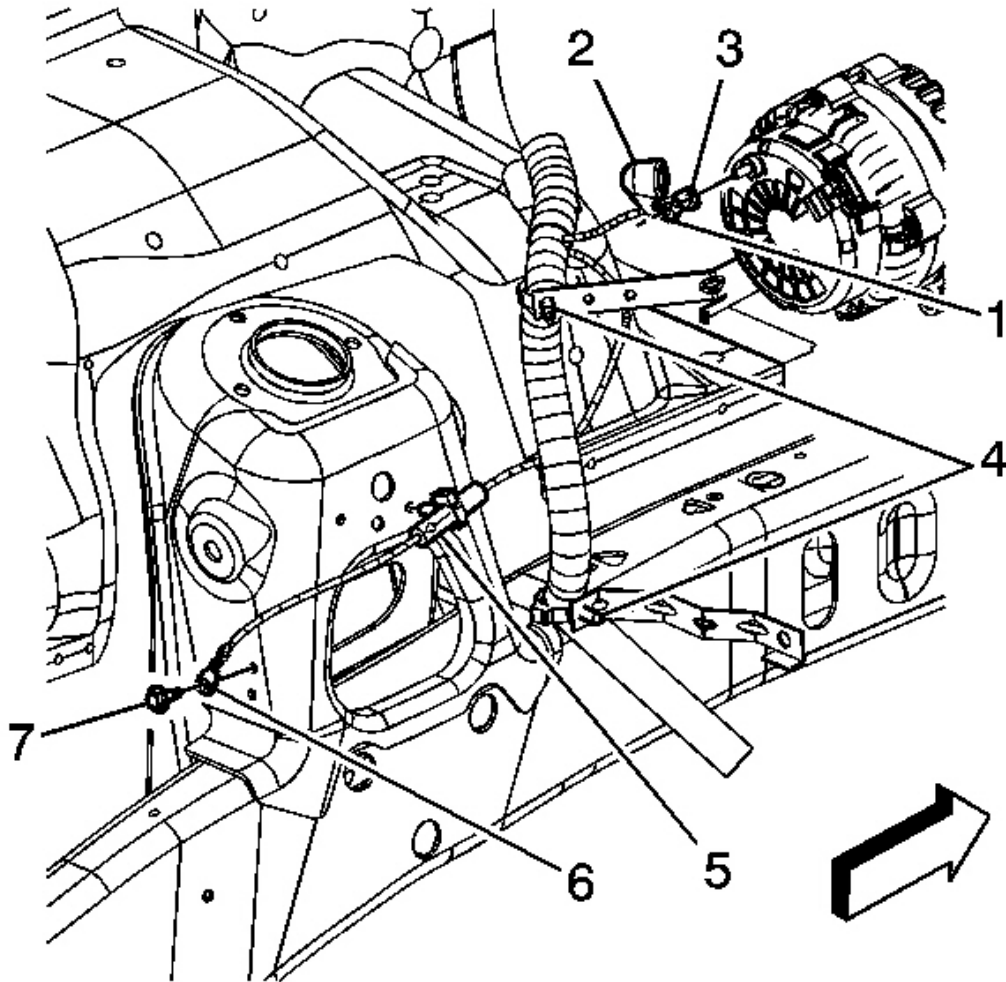


Fig. 40: View Of Negative Battery Cable Ground Terminal Bolt At Shock Tower
Courtesy of GENERAL MOTORS CORP.

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

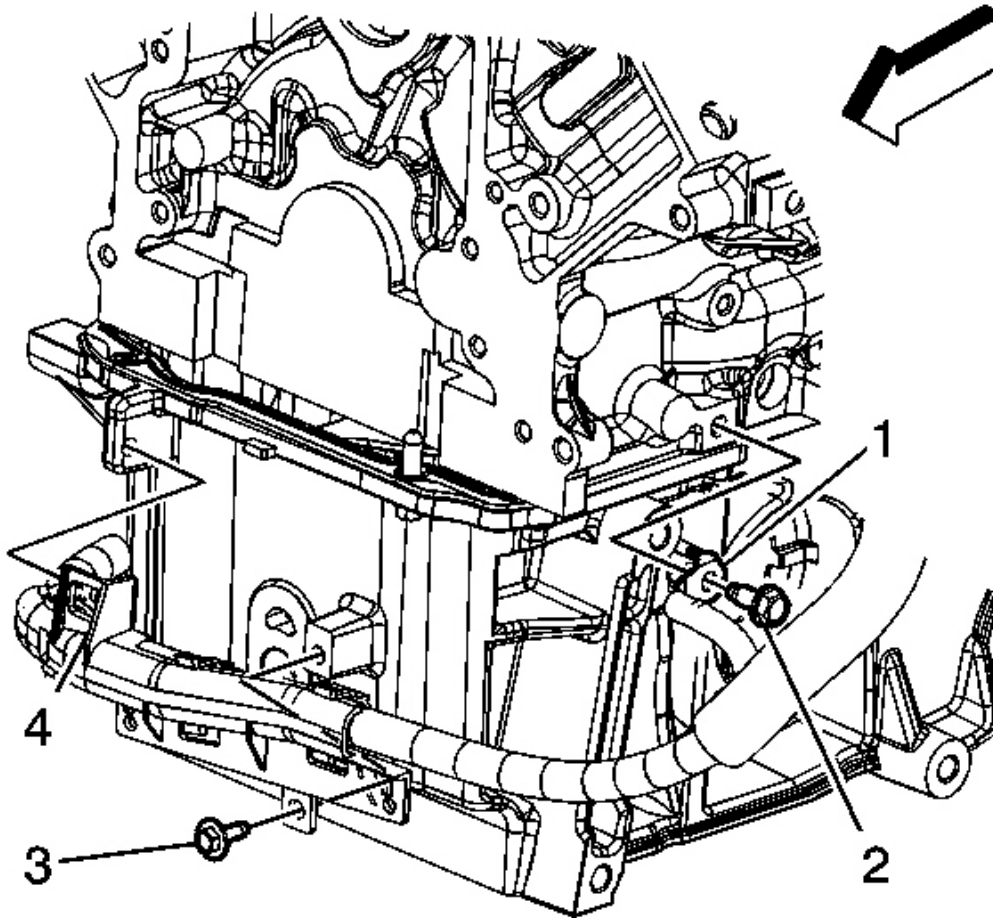


Fig. 41: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

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

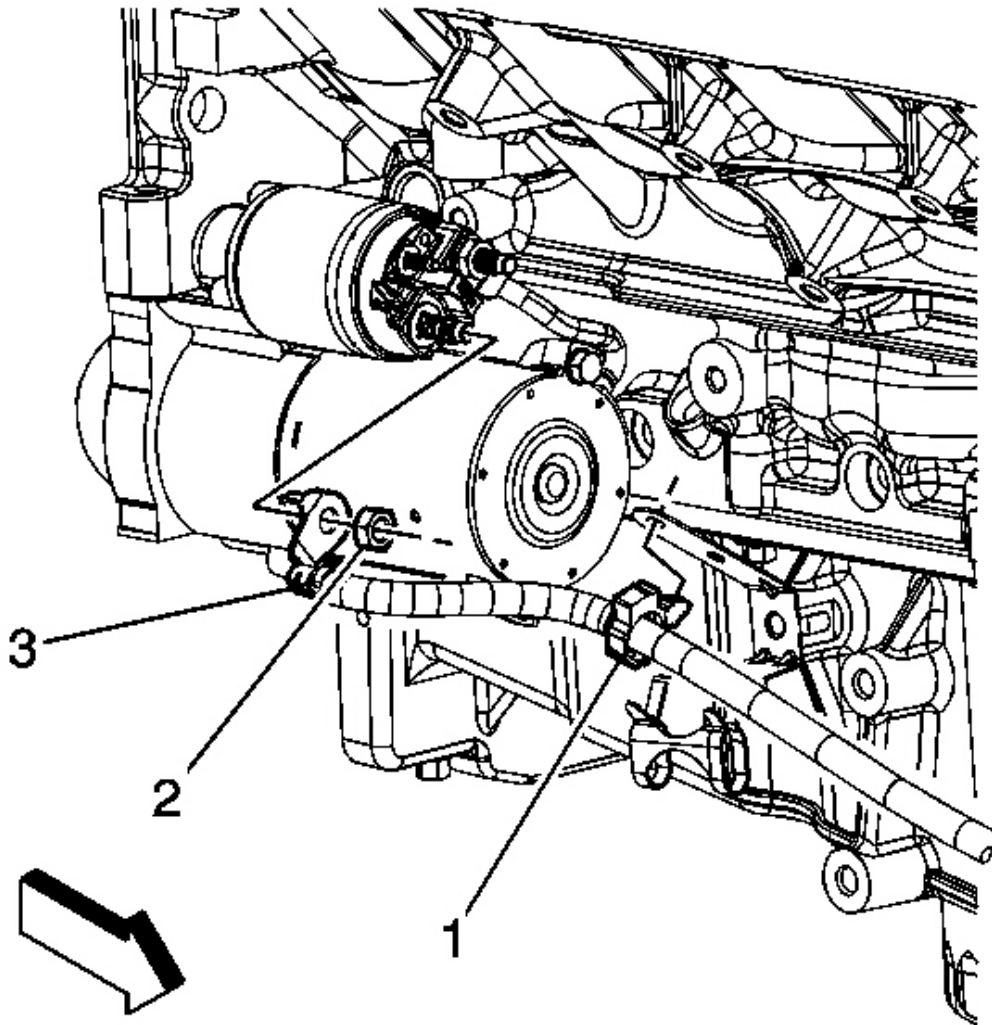


Fig. 42: View Of Cable Connections At Starter
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

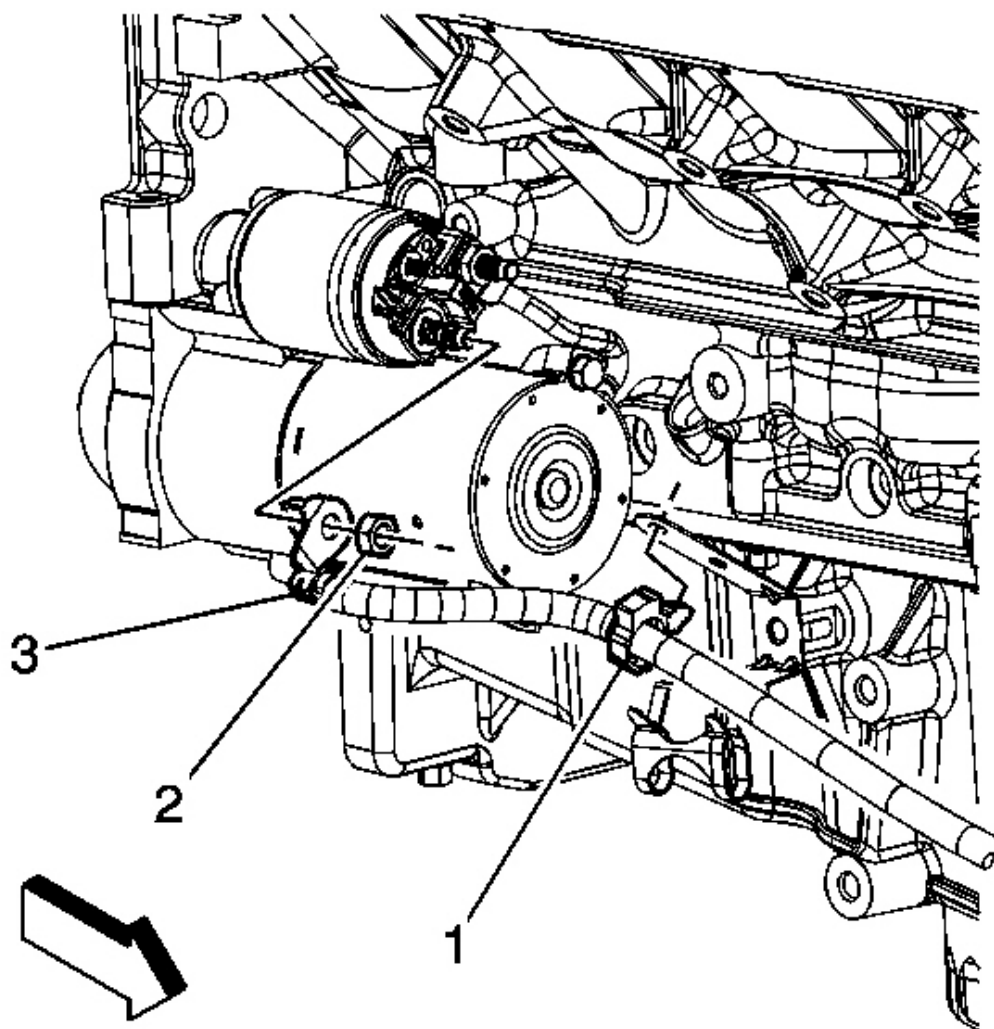


Fig. 43: View Of Cable Connections At Starter
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to **Fastener Notice** .

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

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

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

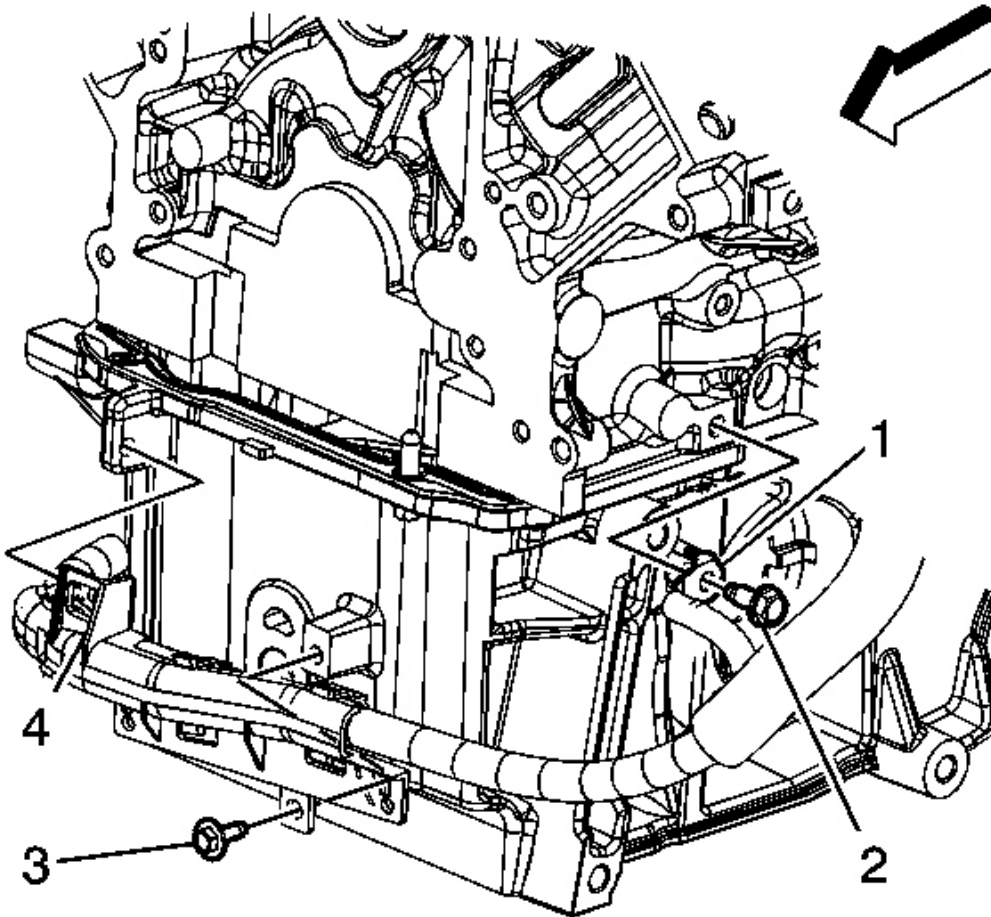


Fig. 44: View Of Negative Battery Cable Ground Terminal At Engine Block
Courtesy of GENERAL MOTORS CORP.

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

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

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

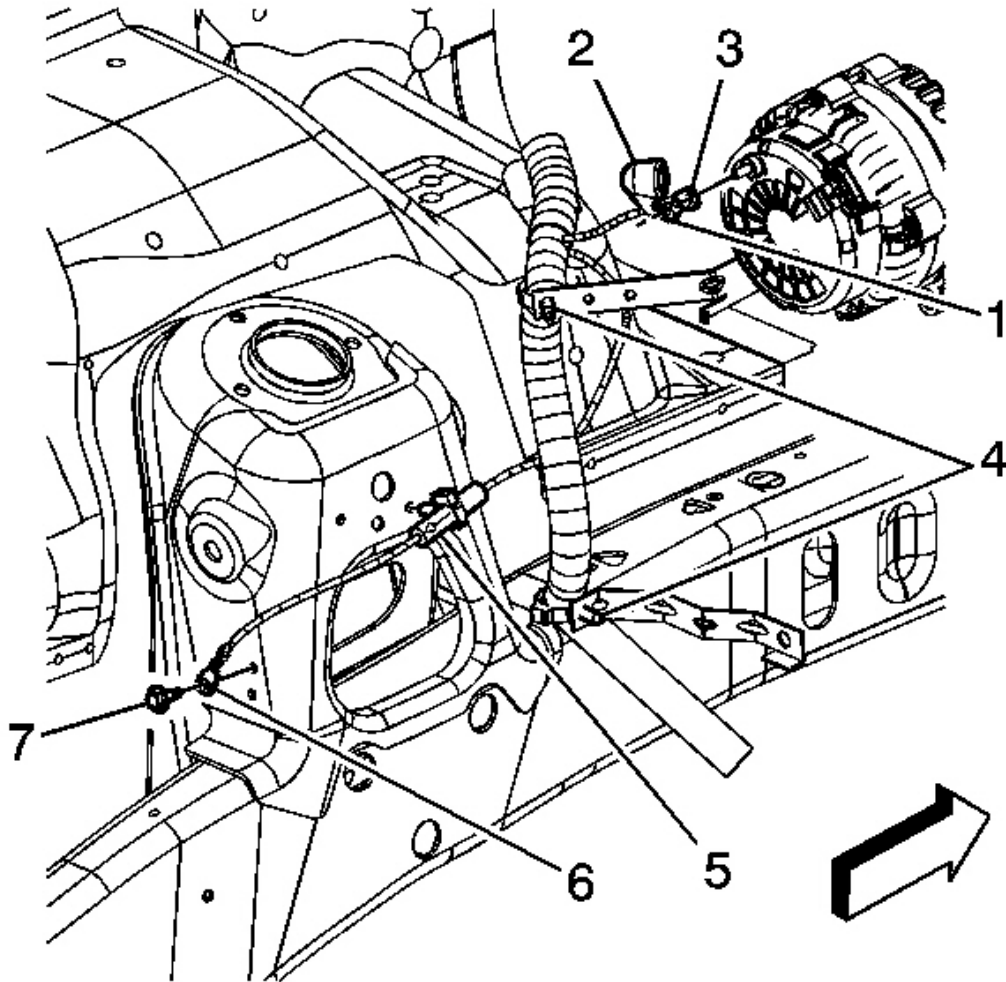


Fig. 45: View Of Negative Battery Cable Ground Terminal Bolt At Shock Tower
Courtesy of GENERAL MOTORS CORP.

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

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

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

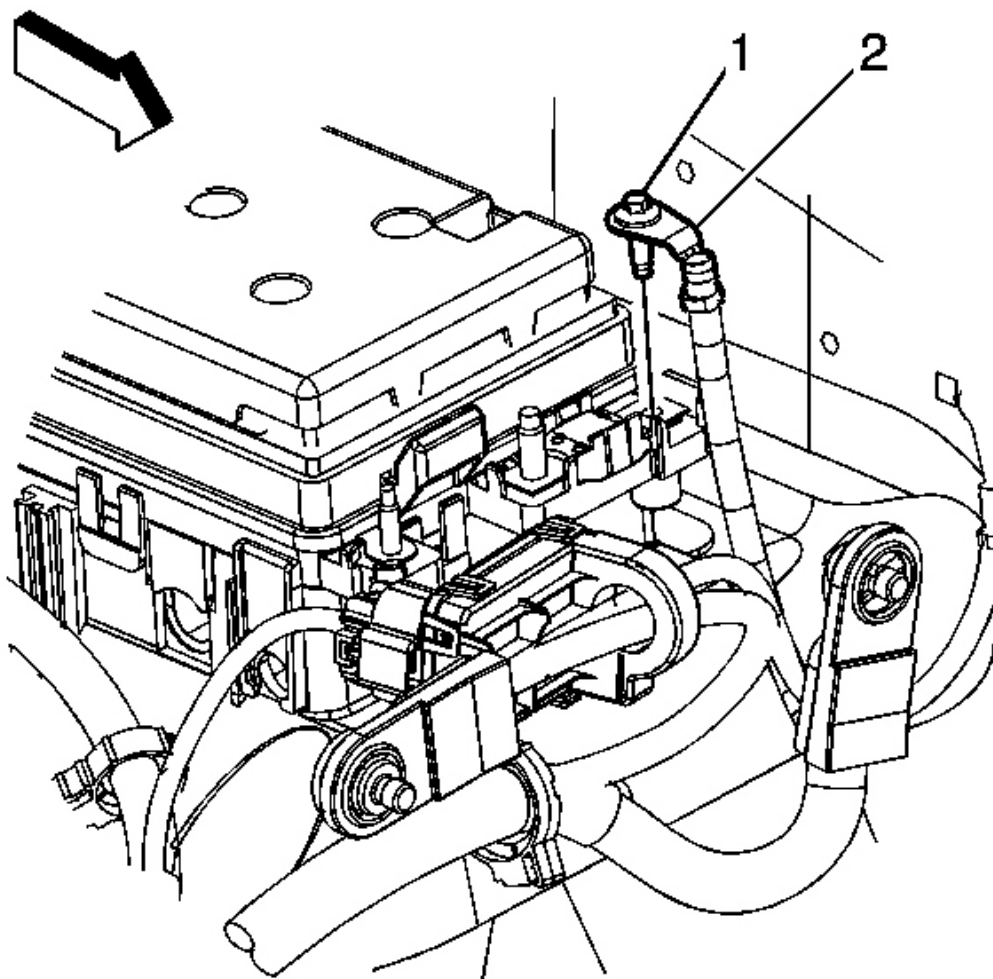


Fig. 46: Identifying Positive Battery Cable Terminal At Junction Block
Courtesy of GENERAL MOTORS CORP.

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

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

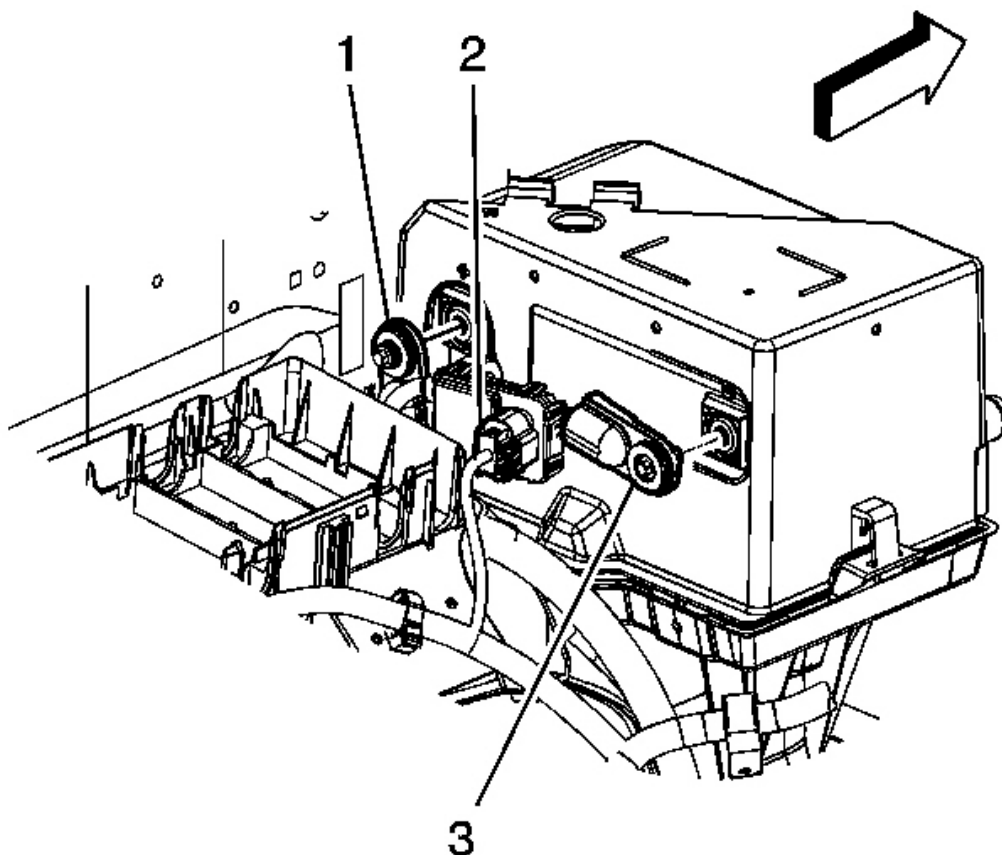


Fig. 47: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

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

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

BATTERY REPLACEMENT

Removal Procedure

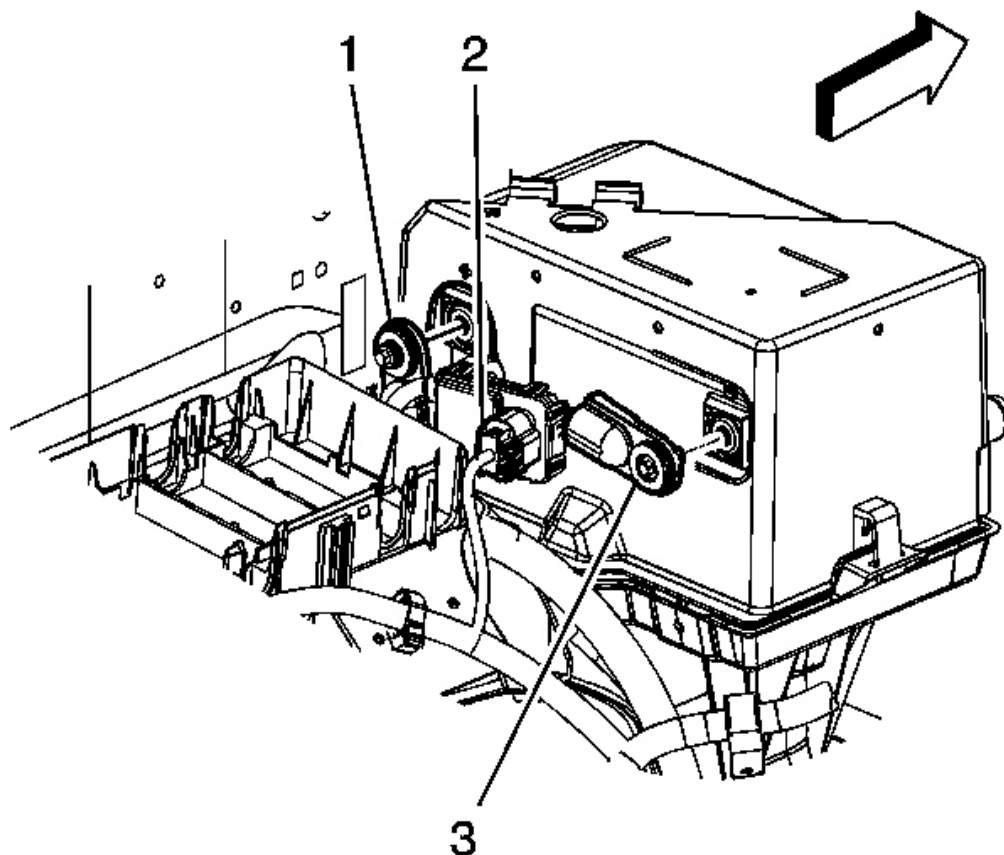


Fig. 48: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

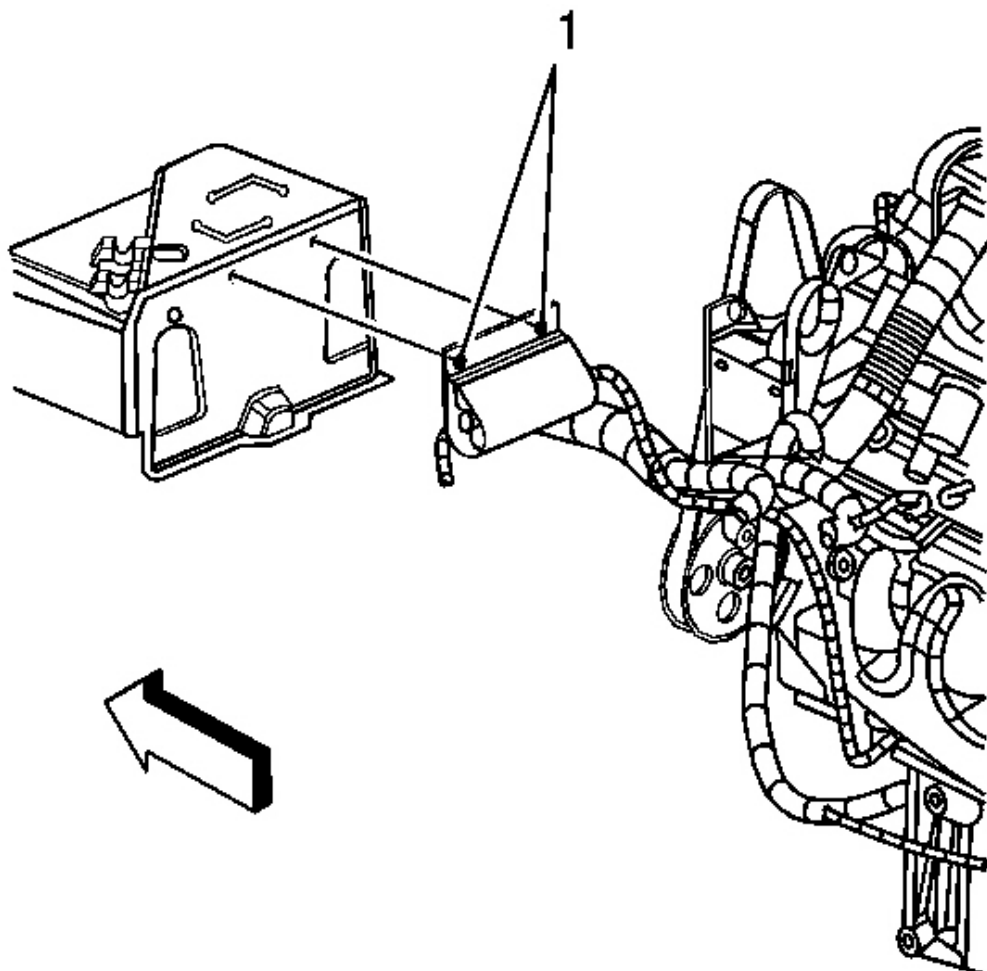


Fig. 49: View Of Coolant Heater Cord Retainers
Courtesy of GENERAL MOTORS CORP.

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

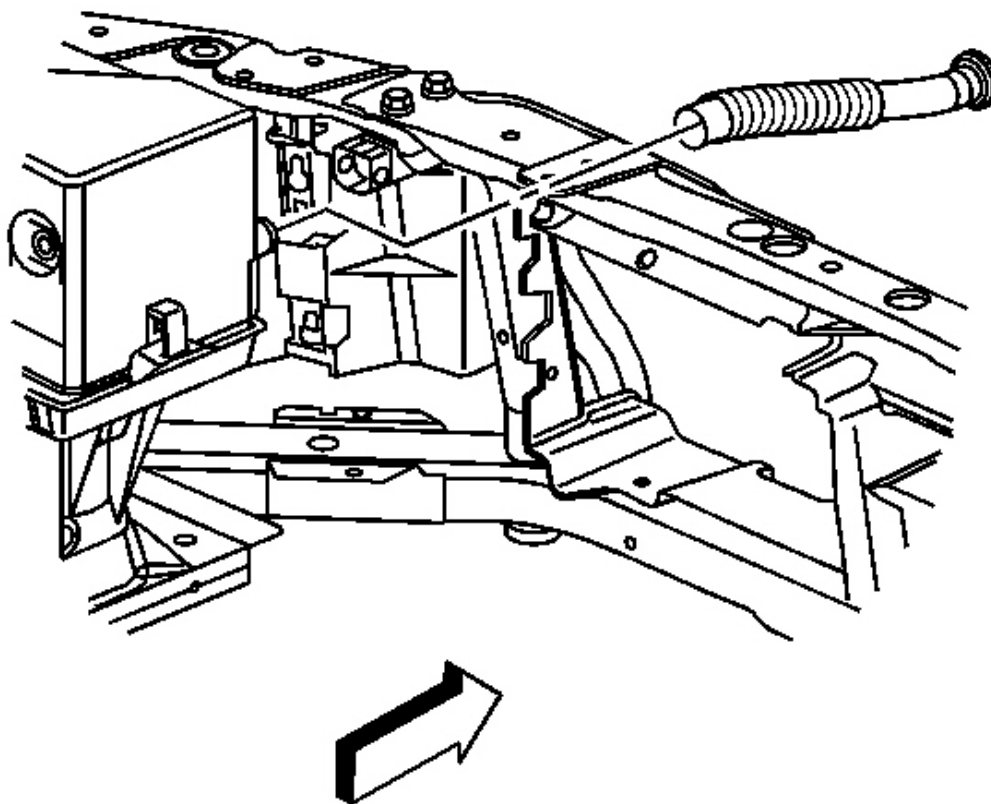


Fig. 50: View Of Battery Air Duct
Courtesy of GENERAL MOTORS CORP.

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

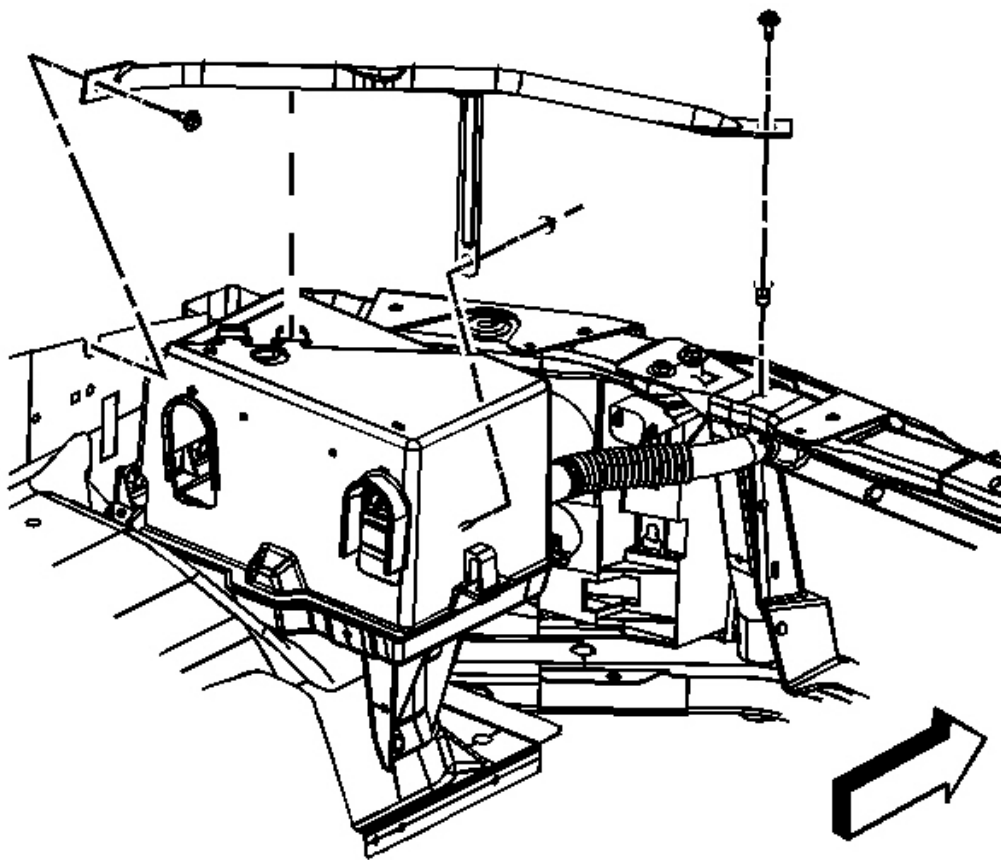


Fig. 51: Radiator Support Diagonal Brace
Courtesy of GENERAL MOTORS CORP.

6. Remove the battery tray brace bolts/nut.

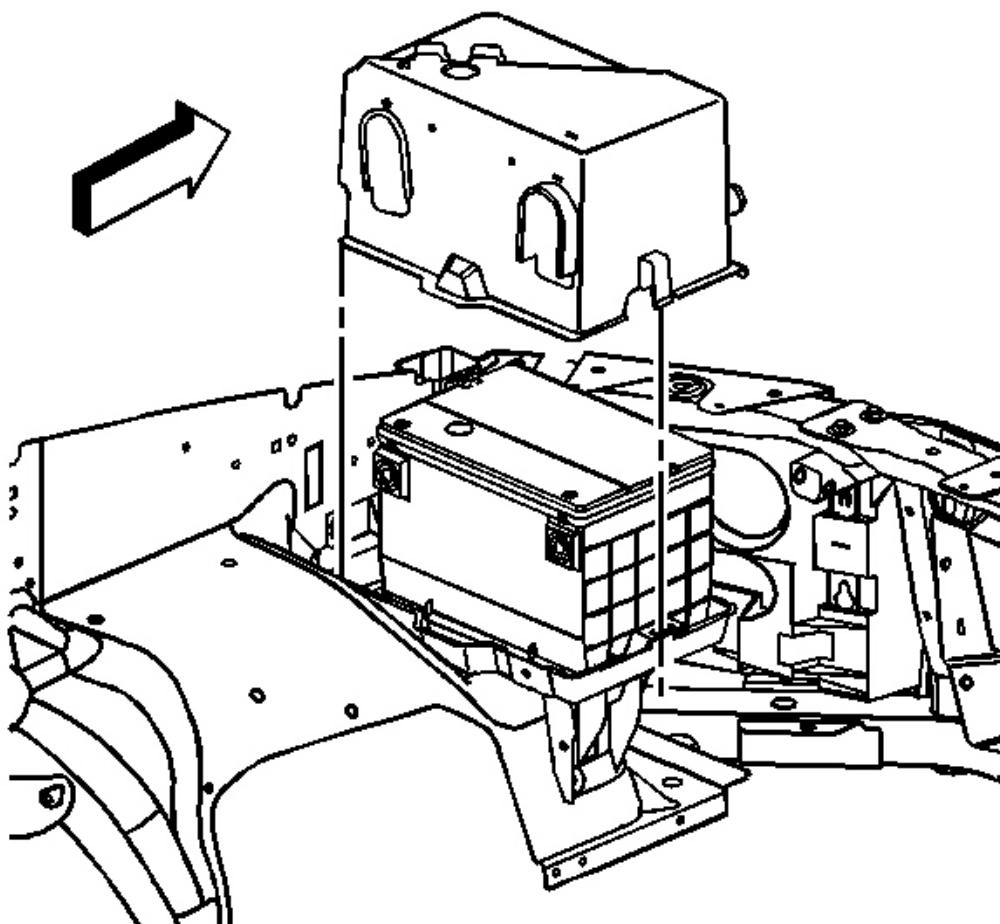


Fig. 52: View Of Battery Cover
Courtesy of GENERAL MOTORS CORP.

7. Remove the battery cover.

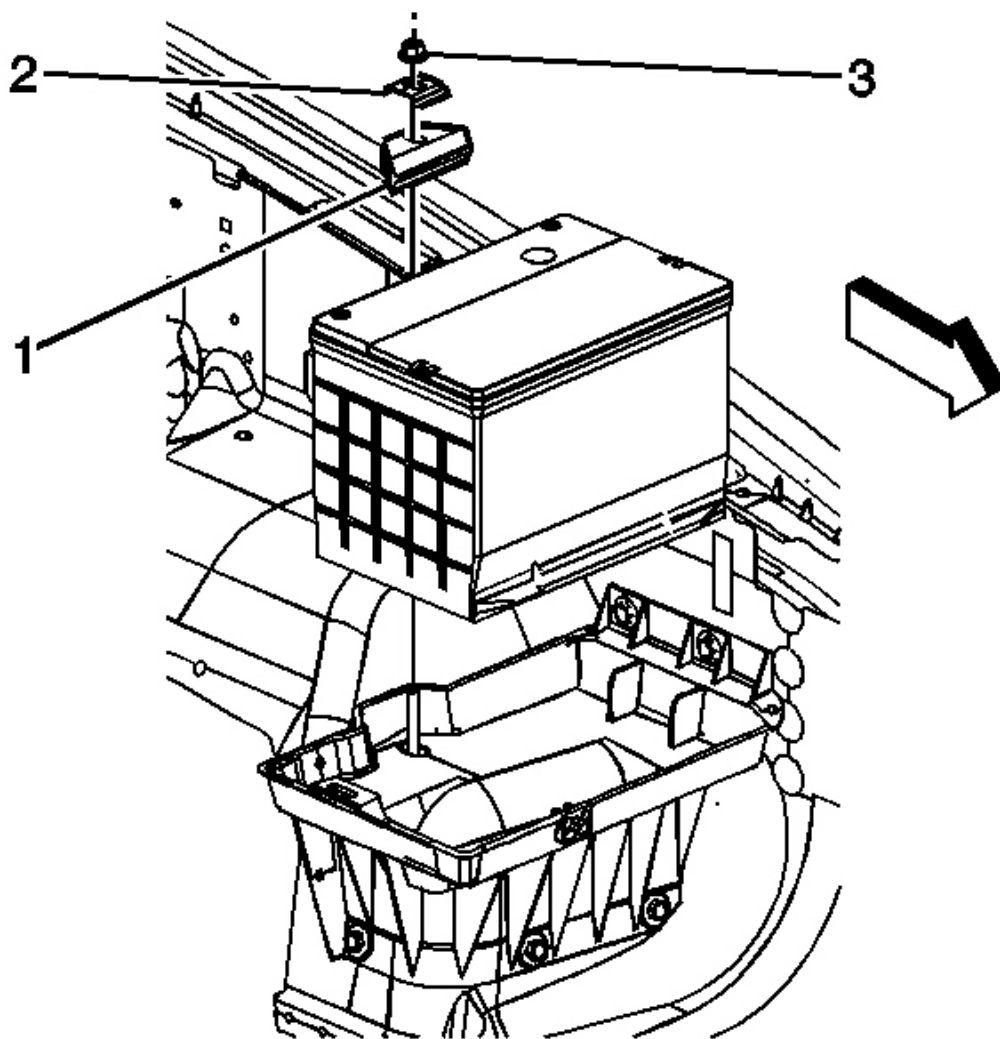


Fig. 53: View Of Battery Hold Down Nut, Washer & Retainer
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

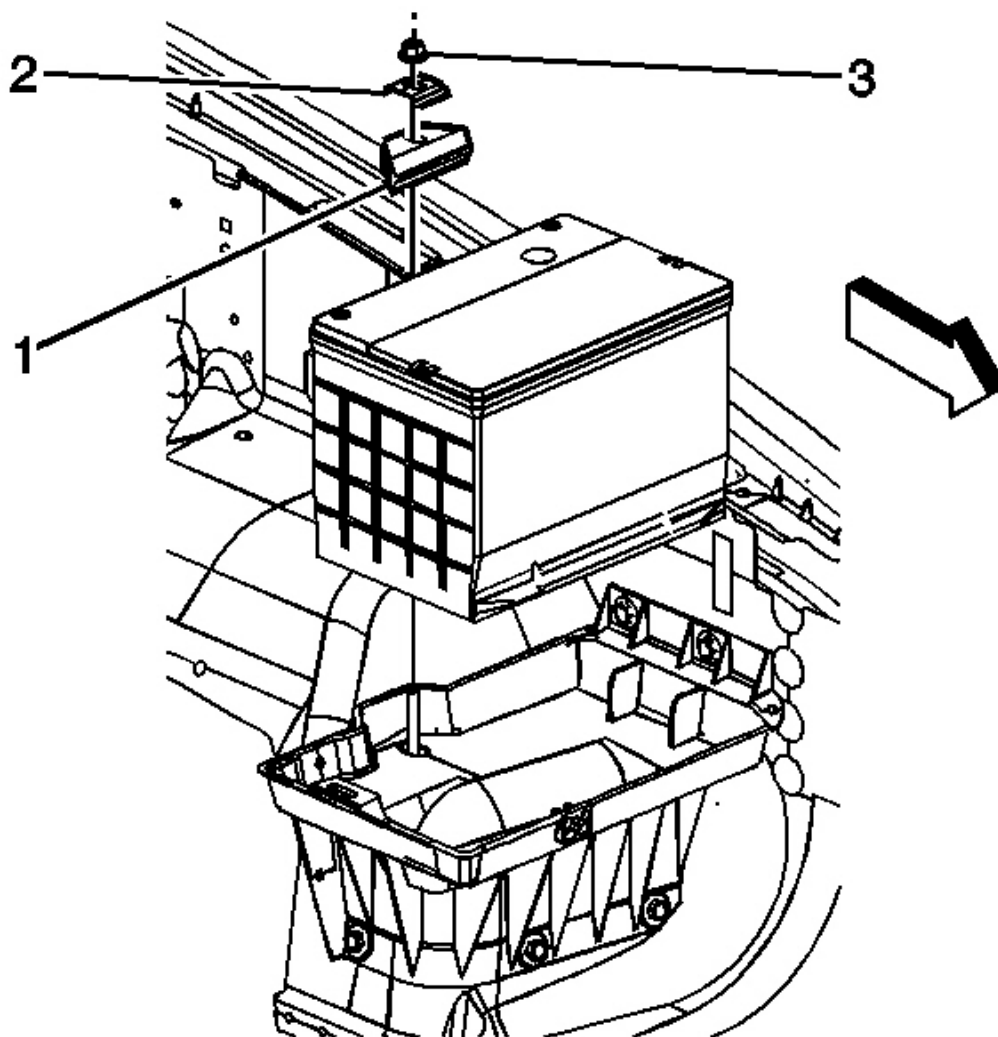


Fig. 54: View Of Battery Hold Down Nut, Washer & Retainer
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

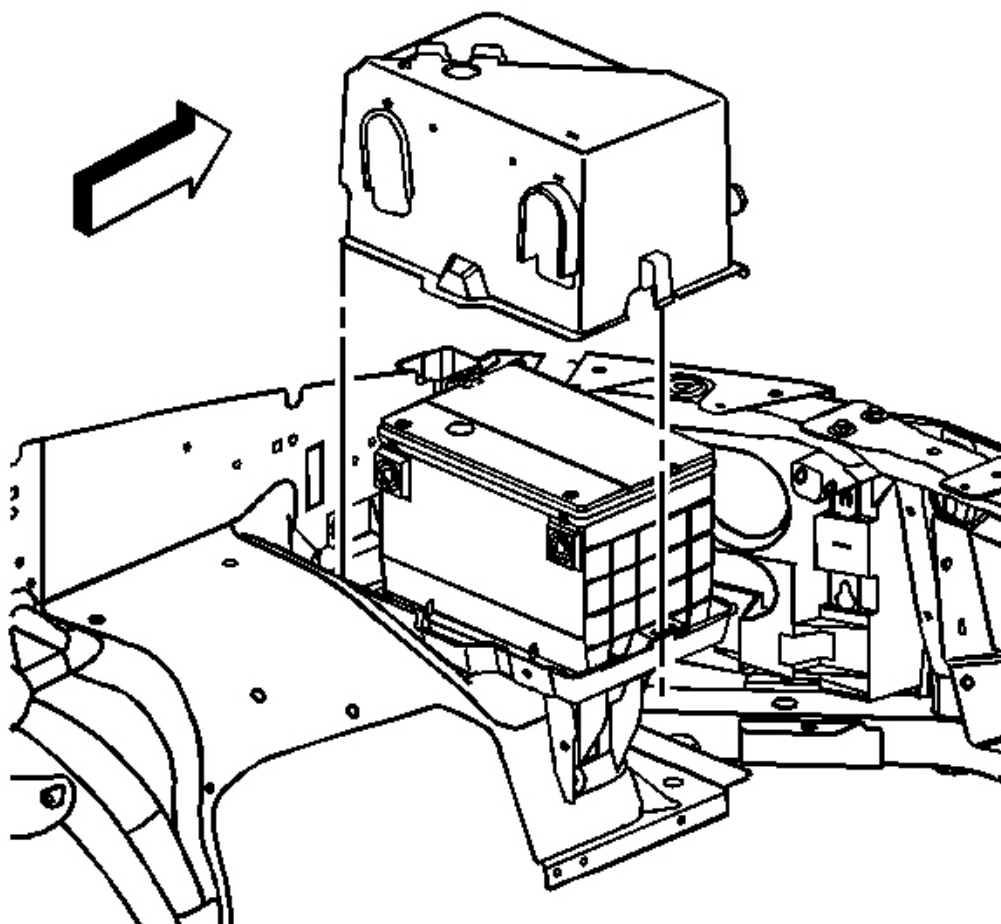


Fig. 55: View Of Battery Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the battery cover.

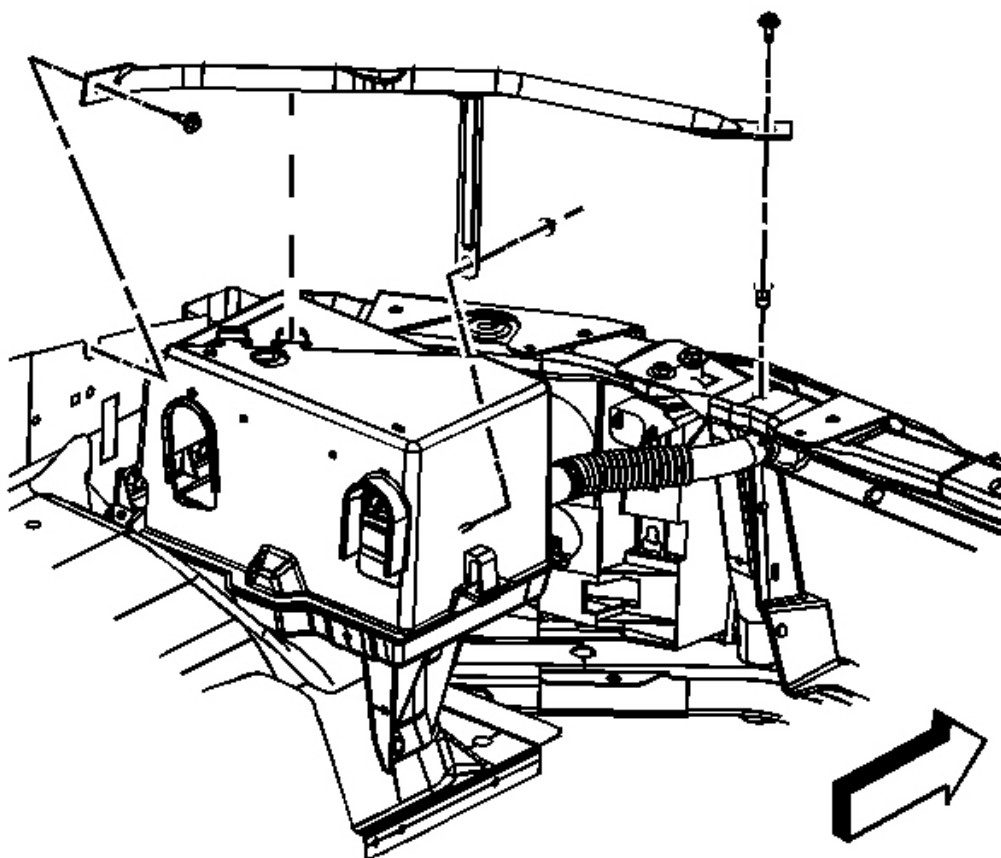


Fig. 56: Radiator Support Diagonal Brace
Courtesy of GENERAL MOTORS CORP.

4. Install the battery tray brace bolts/nut.

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

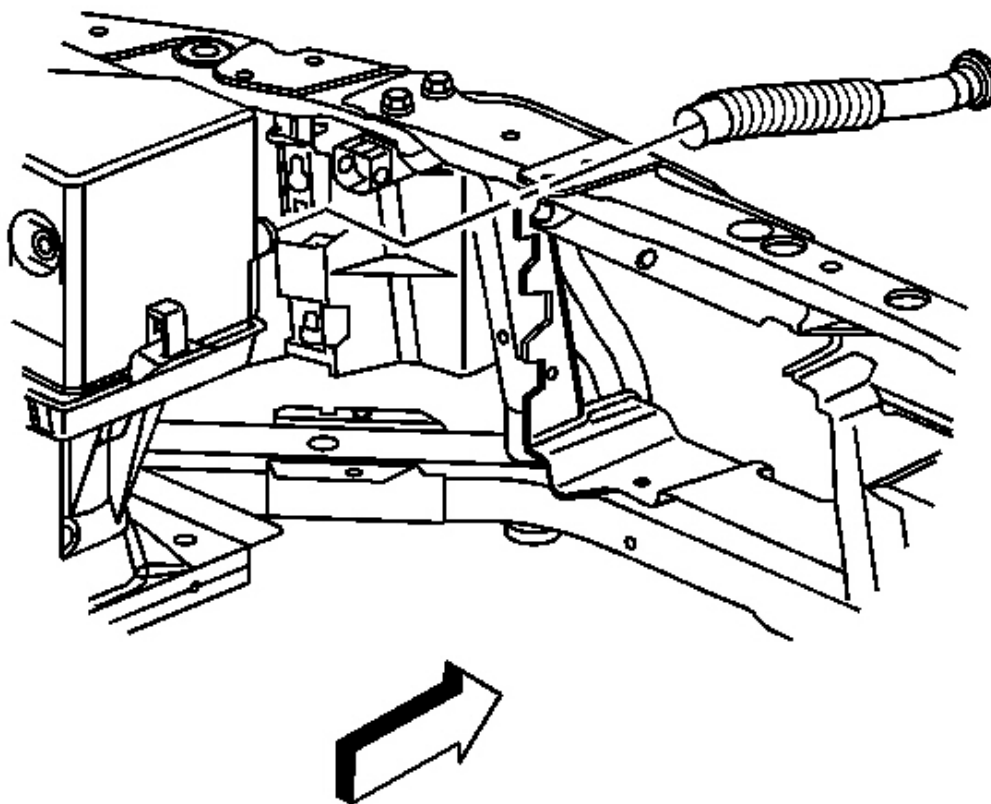


Fig. 57: View Of Battery Air Duct
Courtesy of GENERAL MOTORS CORP.

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

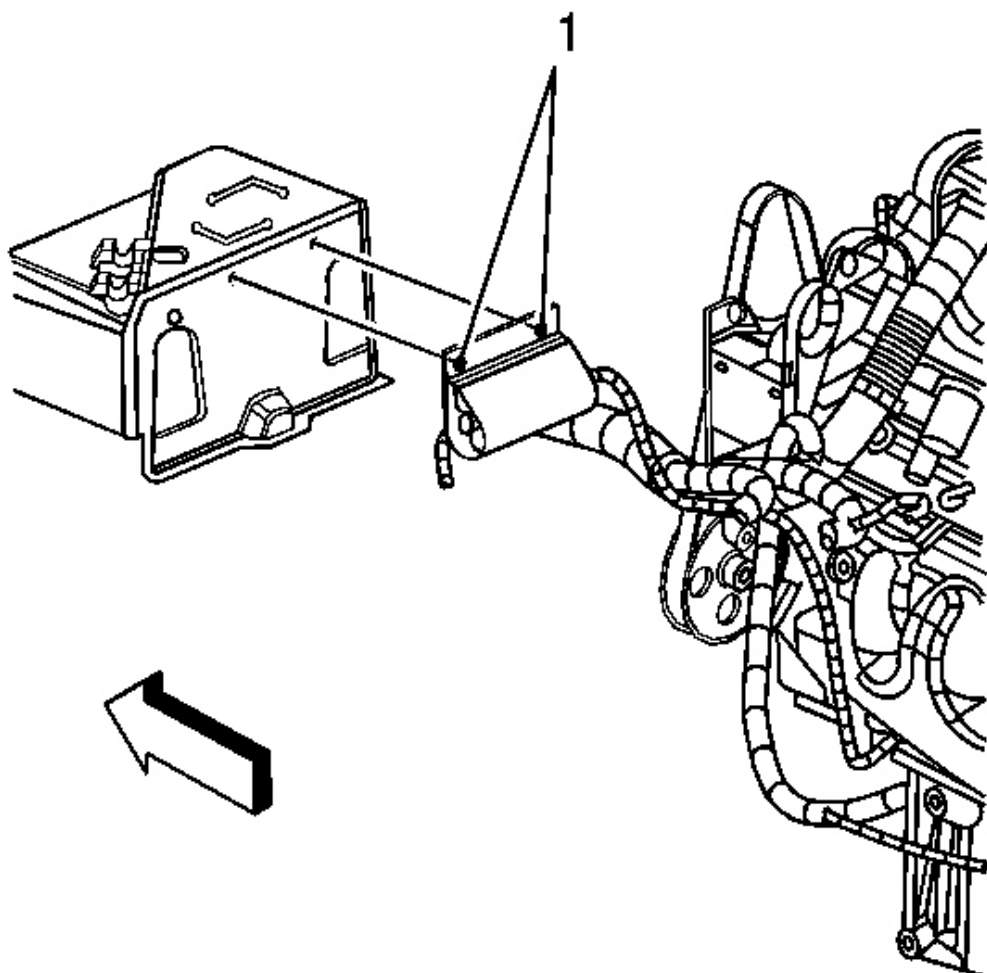


Fig. 58: View Of Coolant Heater Cord Retainers
Courtesy of GENERAL MOTORS CORP.

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

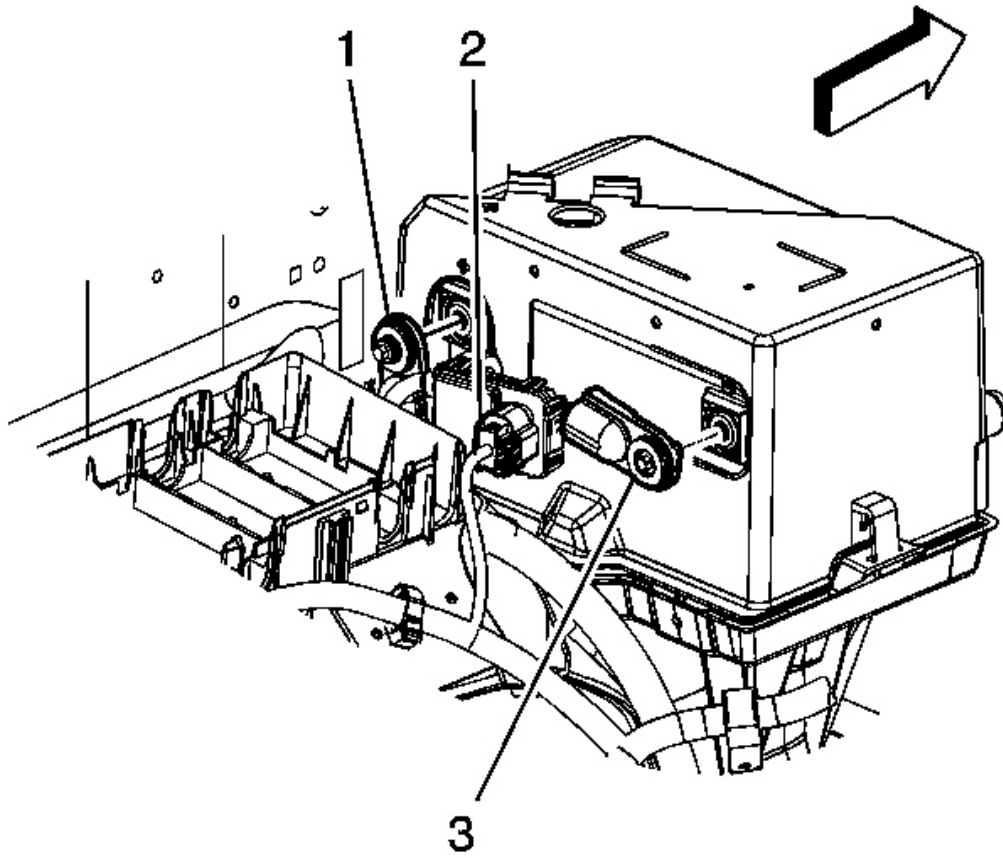


Fig. 59: View Of Battery & Cables
Courtesy of GENERAL MOTORS CORP.

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

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

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

BATTERY TRAY REPLACEMENT

Removal Procedure

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

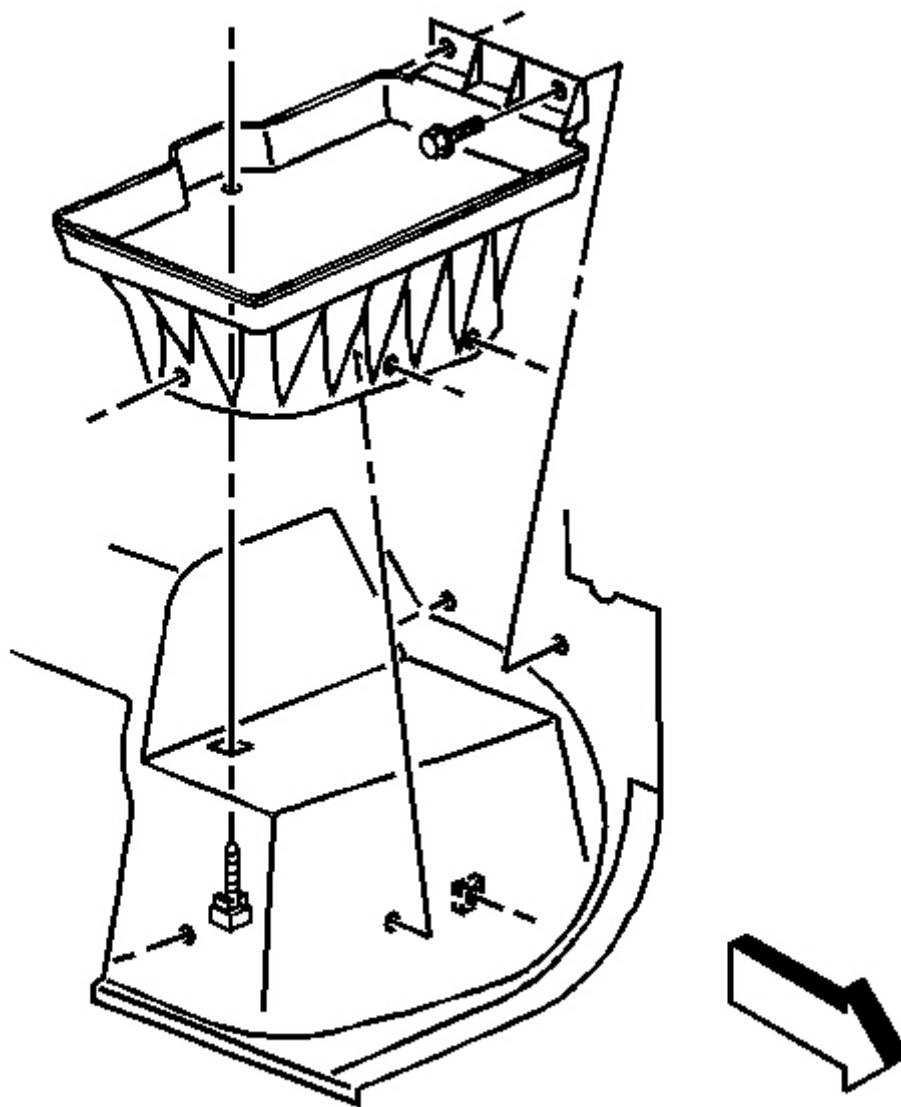


Fig. 60: View Of Battery Tray Bolts
Courtesy of GENERAL MOTORS CORP.

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

1. Install the battery tray.

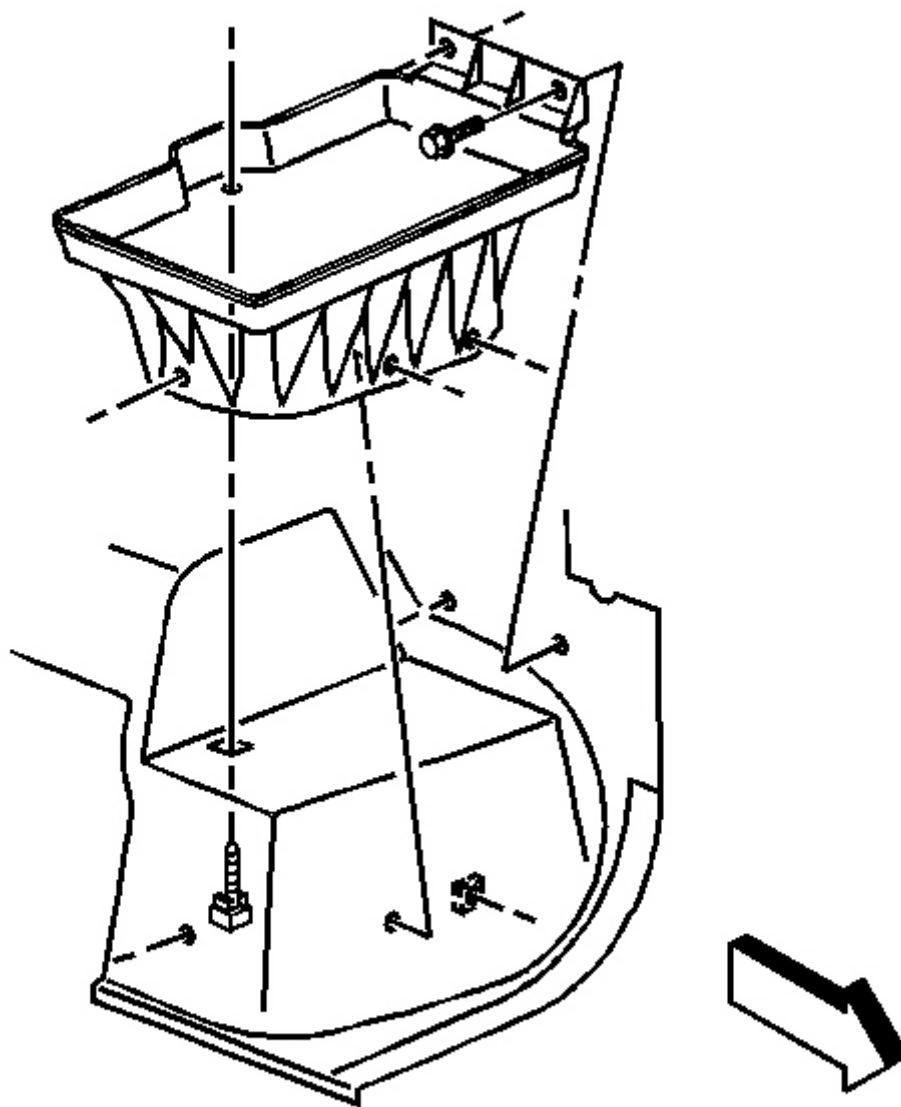


Fig. 61: View Of Battery Tray Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to FASTENER NOTICE .

2. Install the 5 bolts to the battery tray.

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

3. Install the battery.

STARTER MOTOR REPLACEMENT (4.2L ENGINE)

Removal Procedure

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

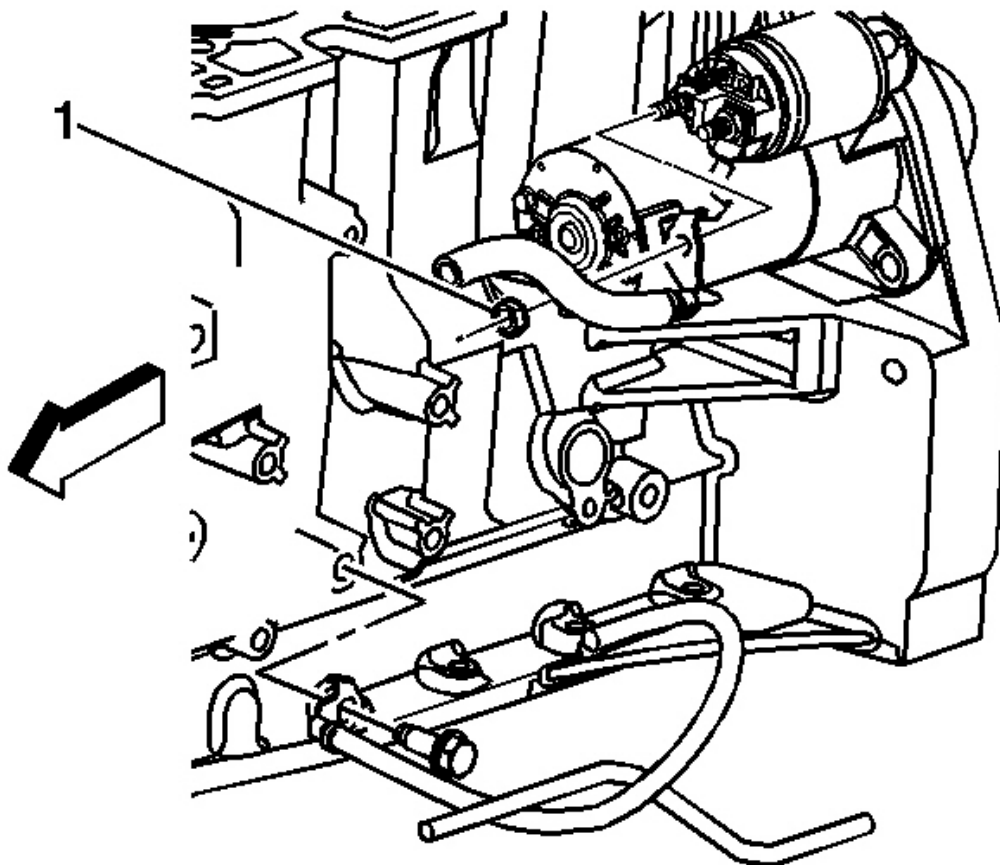


Fig. 62: View Of Starter & Related Components

Courtesy of GENERAL MOTORS CORP.

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

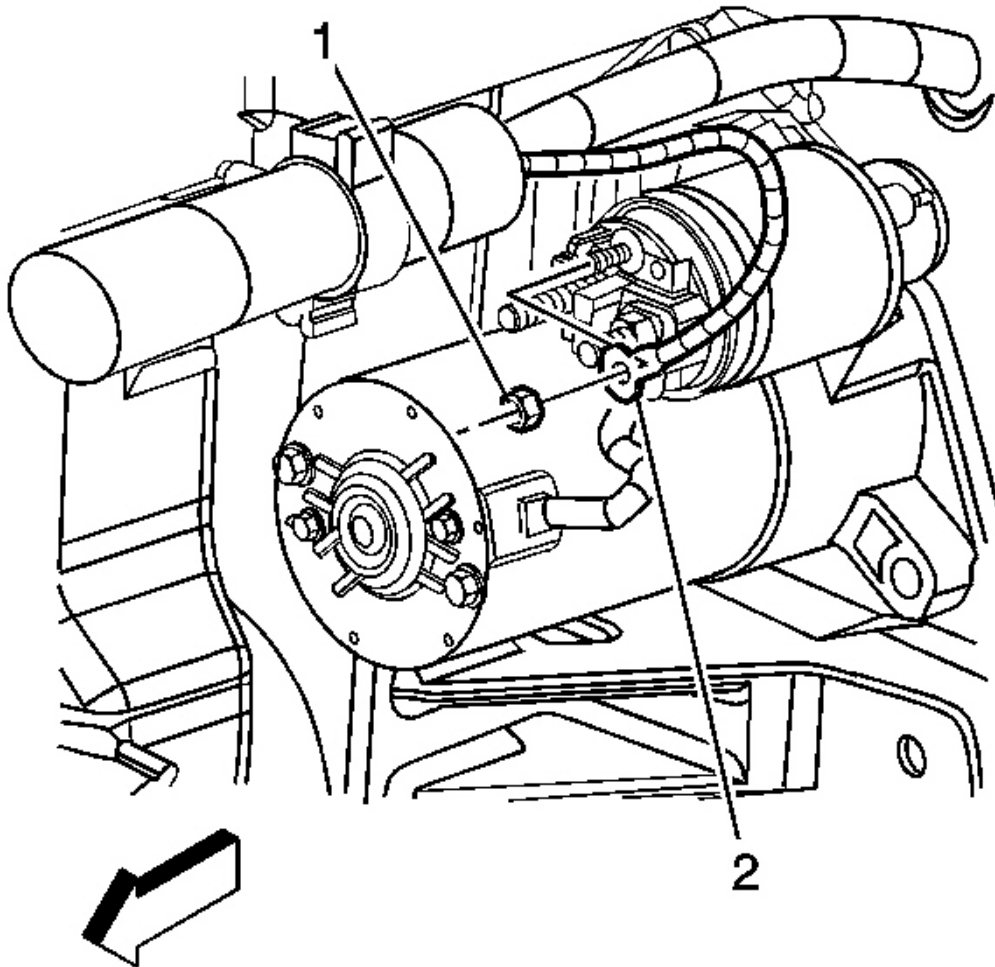


Fig. 63: View Of Starter Solenoid S-Terminal Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

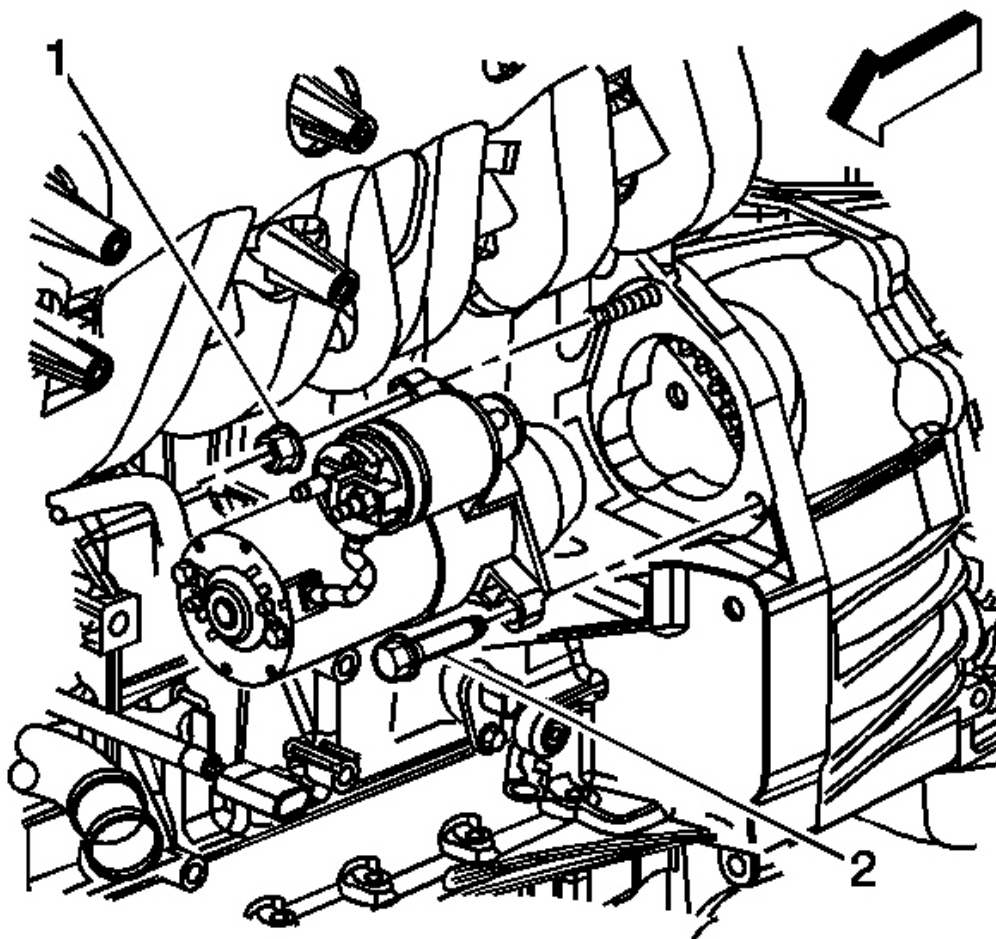


Fig. 64: View Of Starter Mount Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

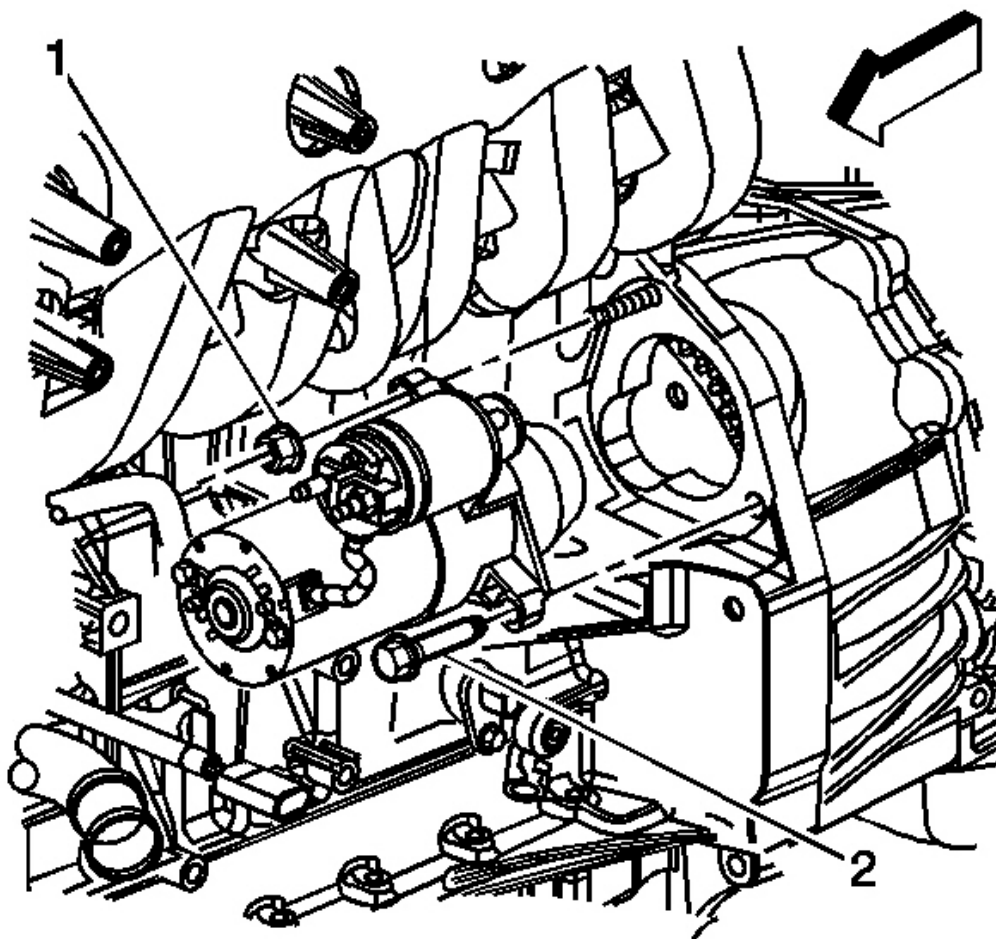


Fig. 65: View Of Starter Mount Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

1. Install the starter motor.

NOTE: Refer to Fastener Notice .

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

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

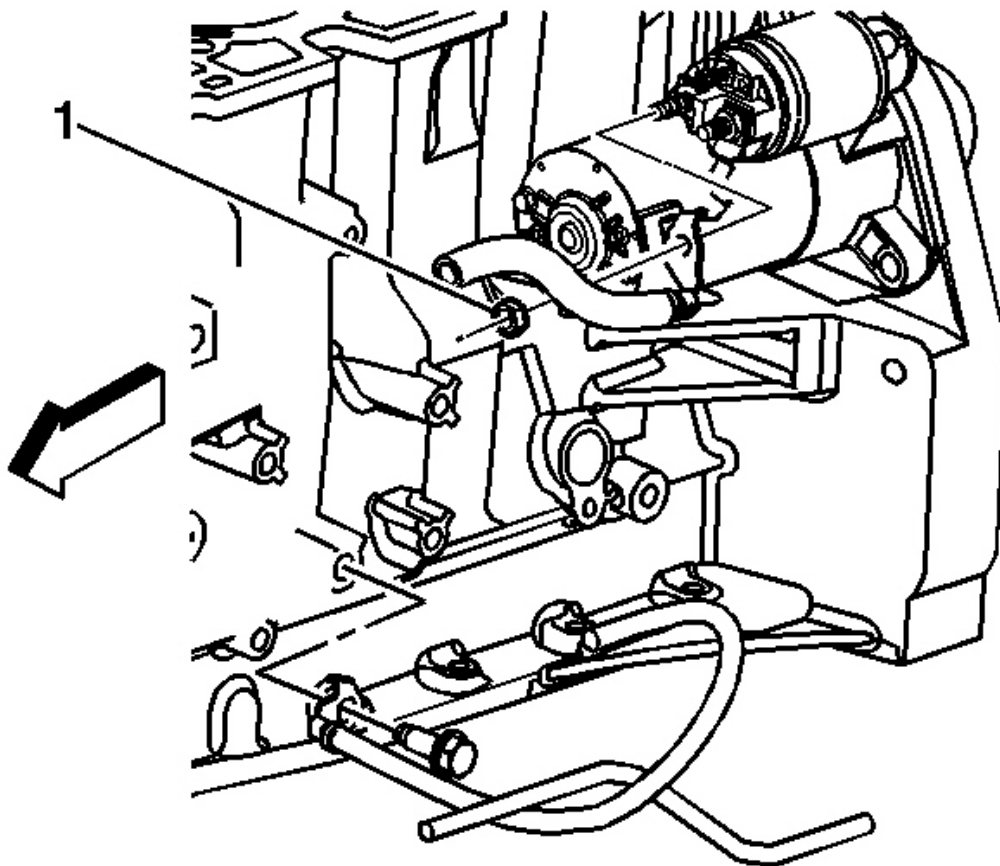


Fig. 66: View Of Starter & Related Components
Courtesy of GENERAL MOTORS CORP.

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

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

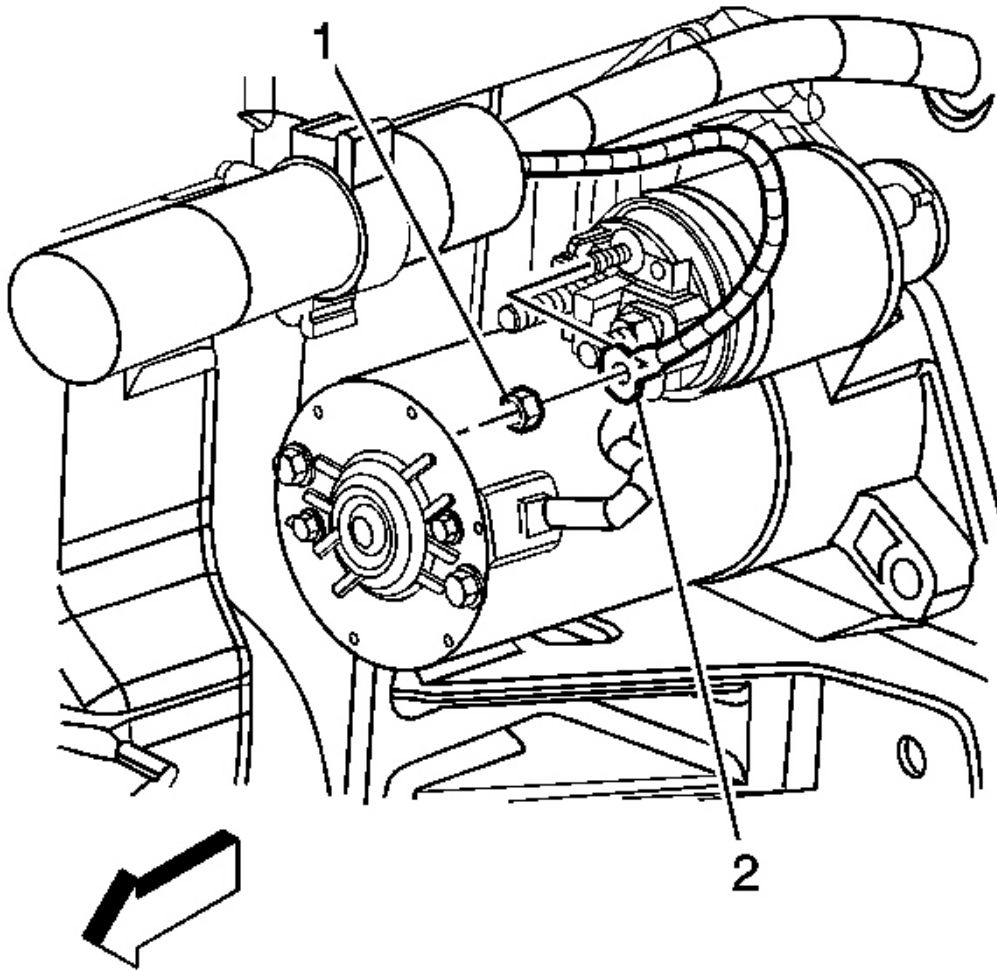


Fig. 67: View Of Starter Solenoid S-Terminal Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

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

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

STARTER MOTOR REPLACEMENT (5.3L AND 6.0L ENGINES)

Removal Procedure

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

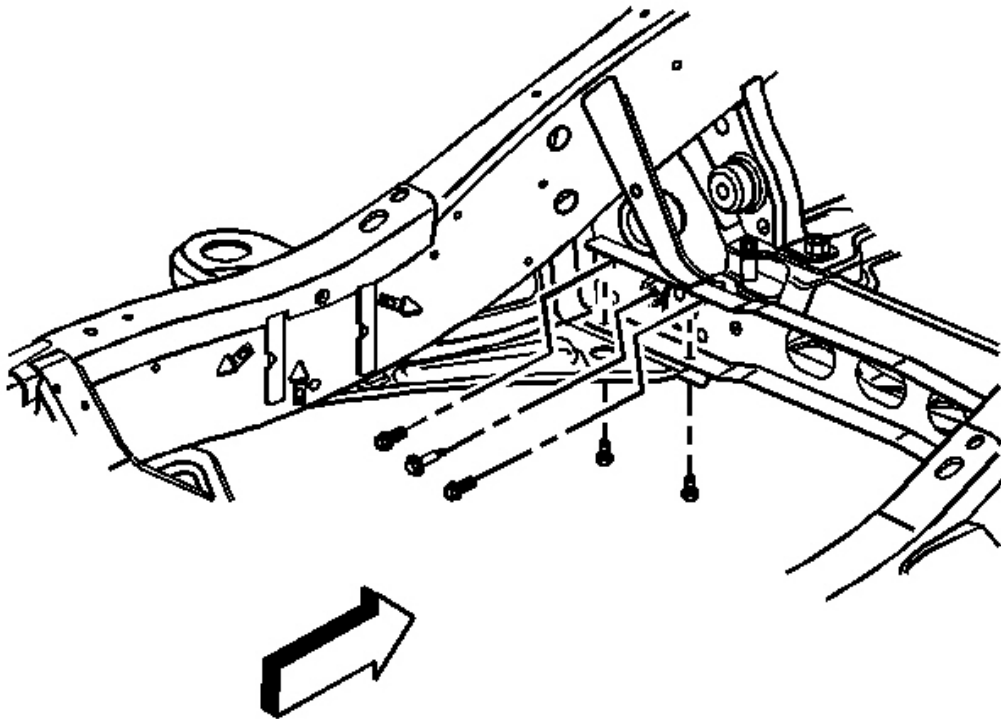


Fig. 68: Removing Rear Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

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

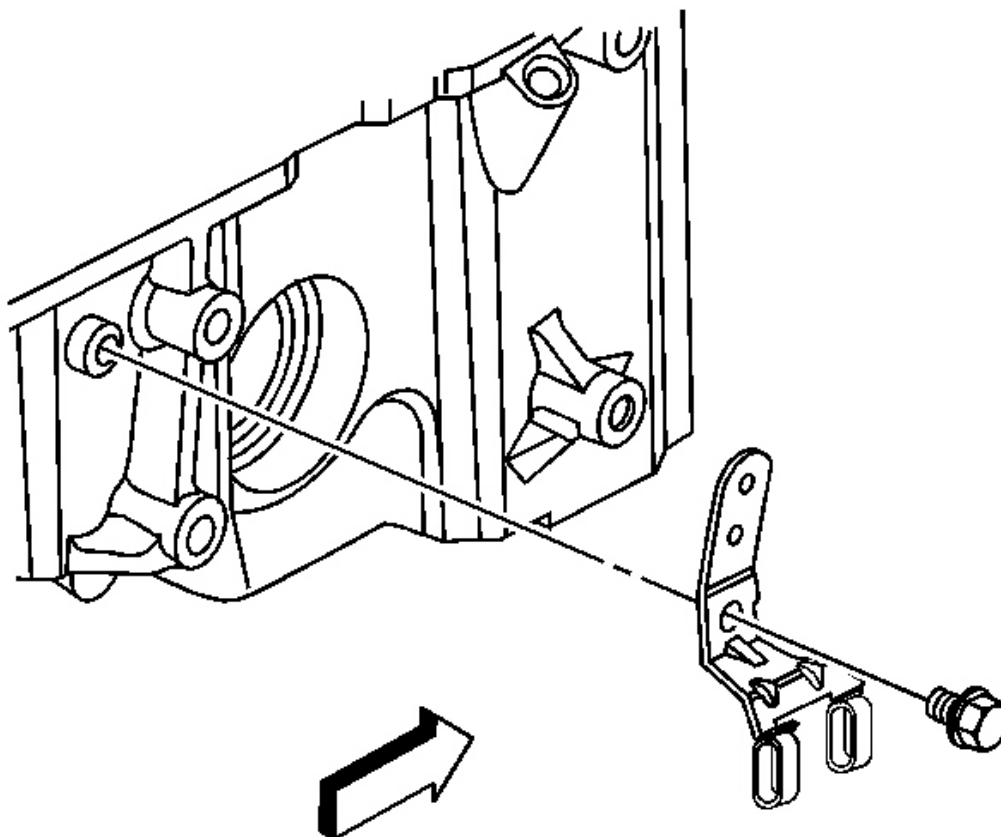


Fig. 69: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the transmission oil cooler line bracket bolt.

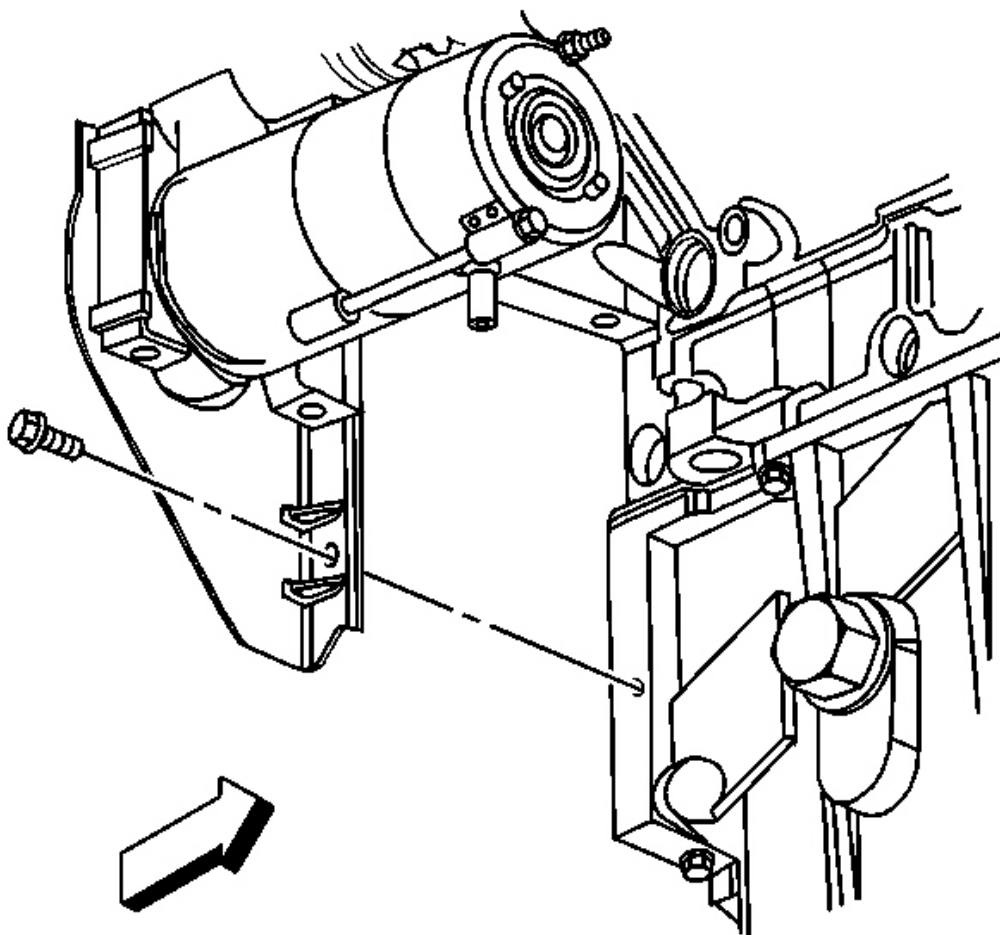


Fig. 70: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the right transmission cover bolt.

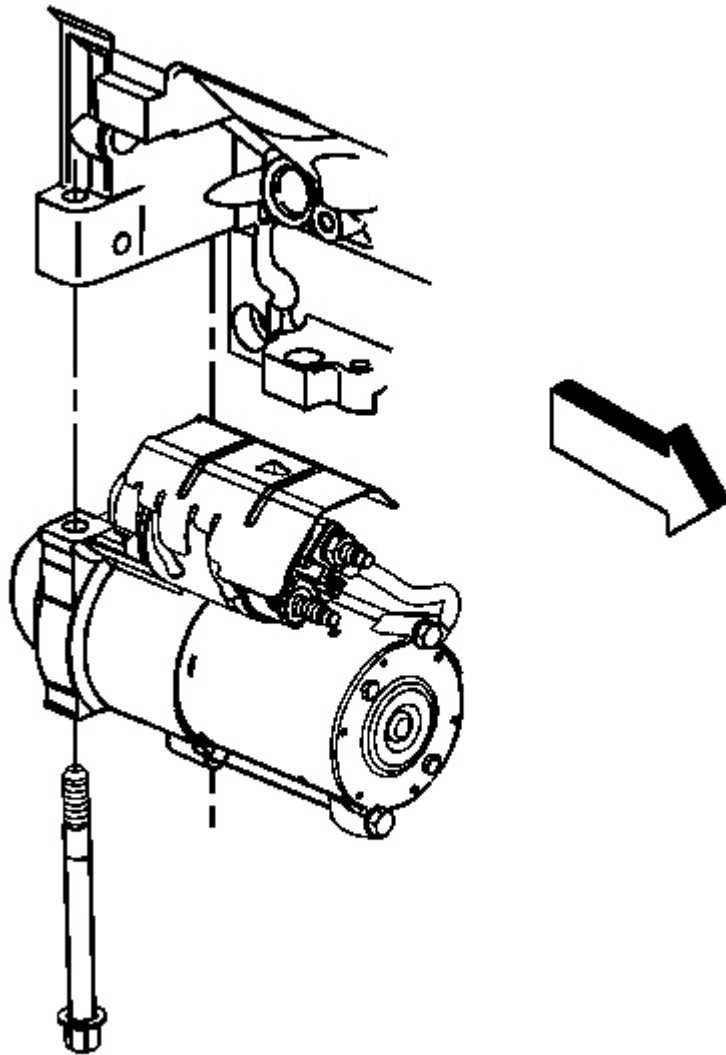


Fig. 71: View Of Starter & Bolts
Courtesy of GENERAL MOTORS CORP.

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

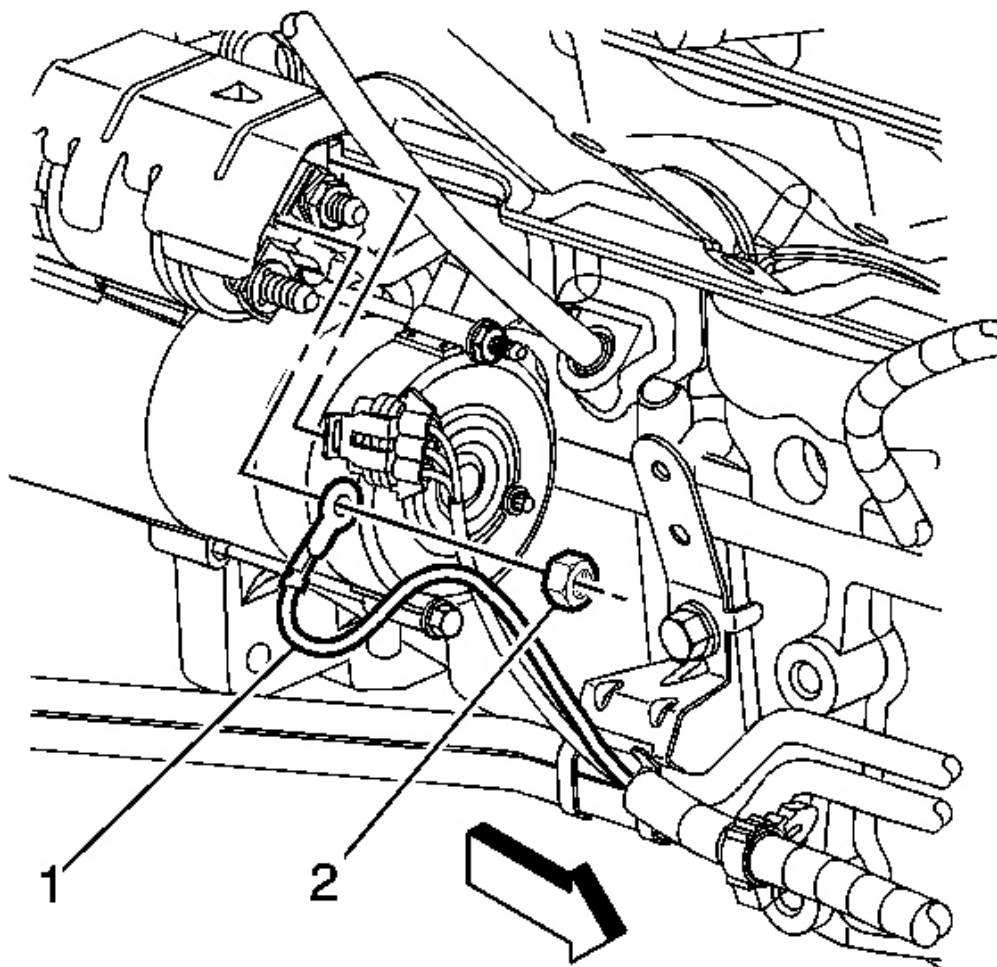


Fig. 72: View Of Starter Solenoid Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

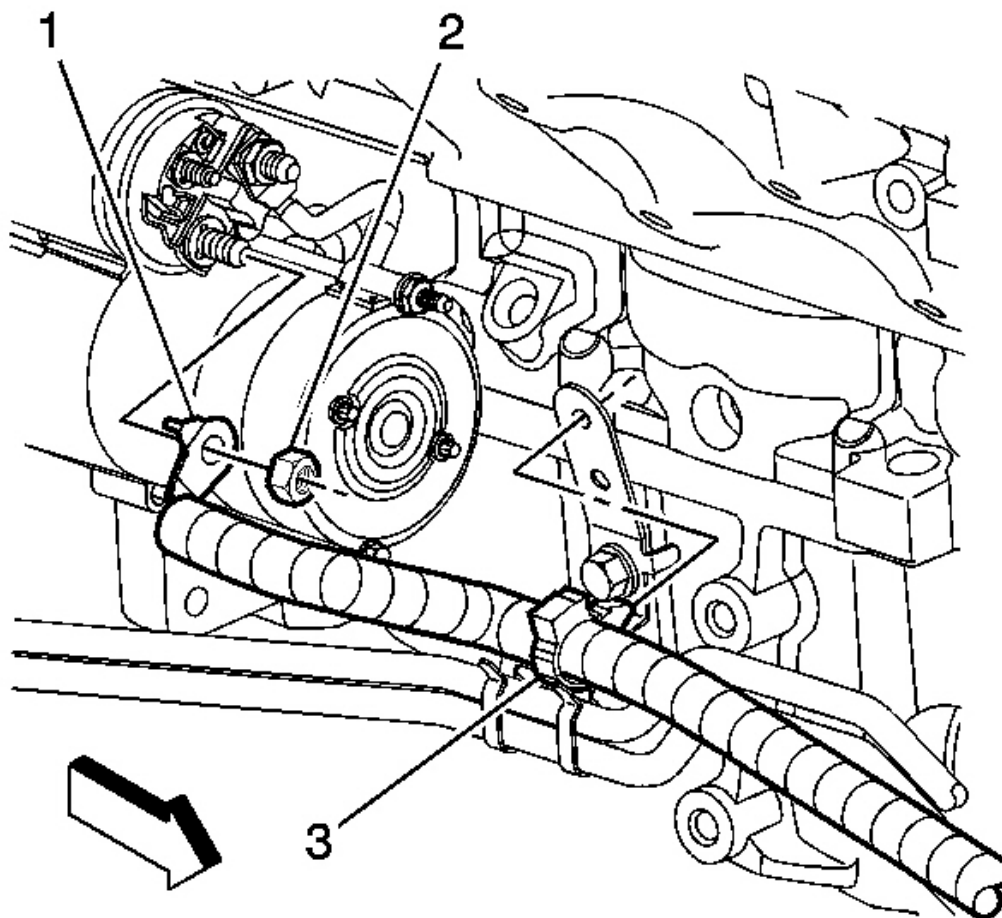


Fig. 73: View Of Positive Cable Lead, Nut & Cable Clip
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

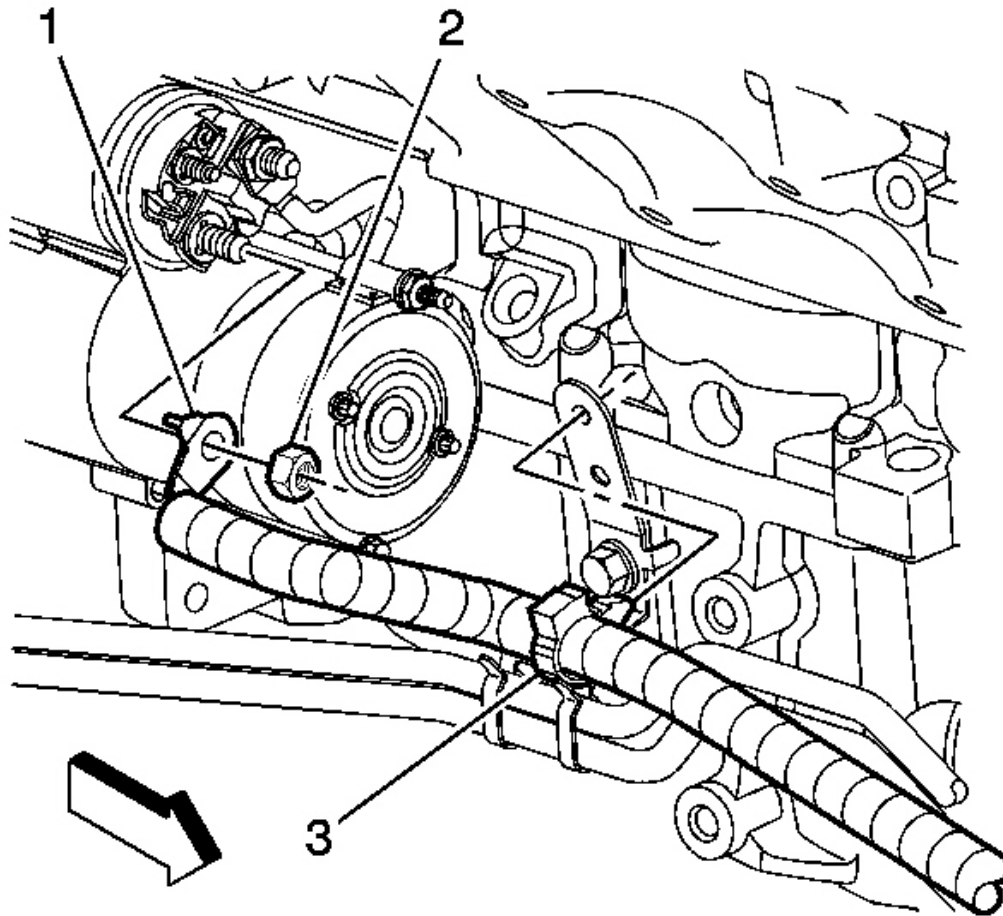


Fig. 74: View Of Positive Cable Lead, Nut & Cable Clip
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to **Fastener Notice** .

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

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

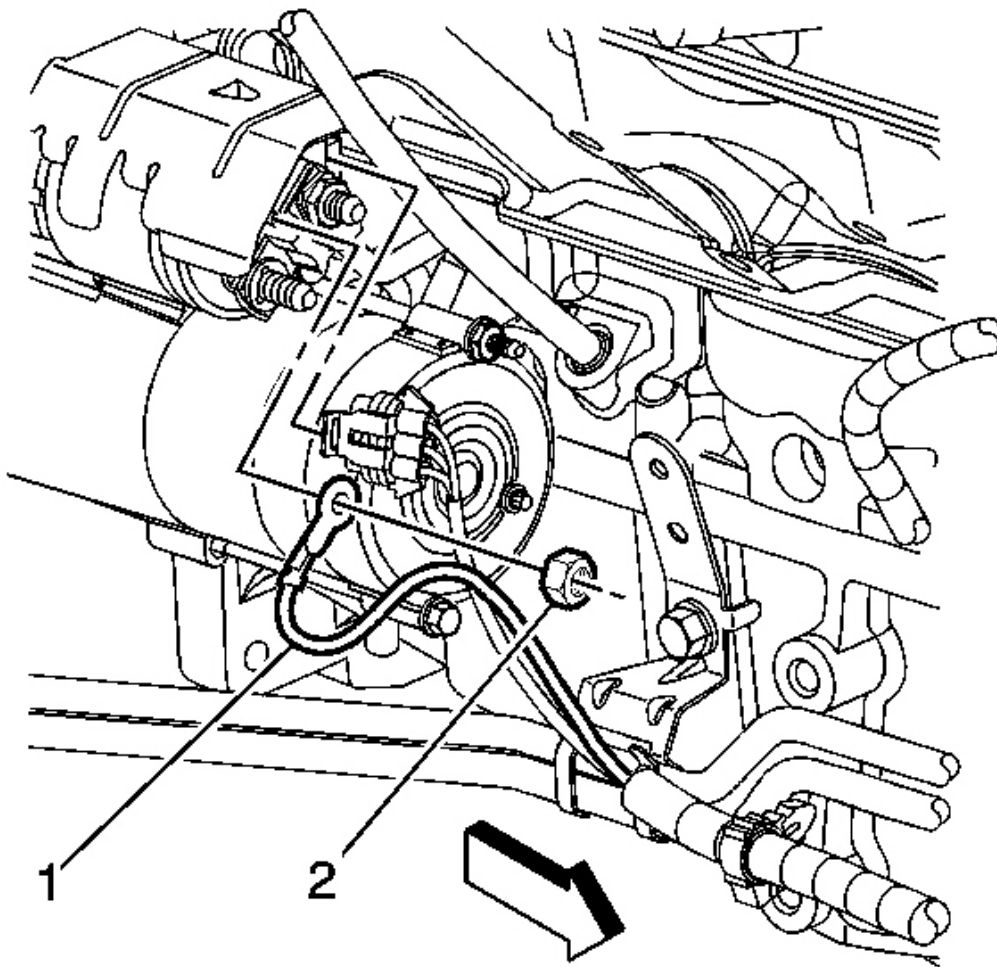


Fig. 75: View Of Starter Solenoid Lead & Nut
Courtesy of GENERAL MOTORS CORP.

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

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

6. Install the starter solenoid heat shield.

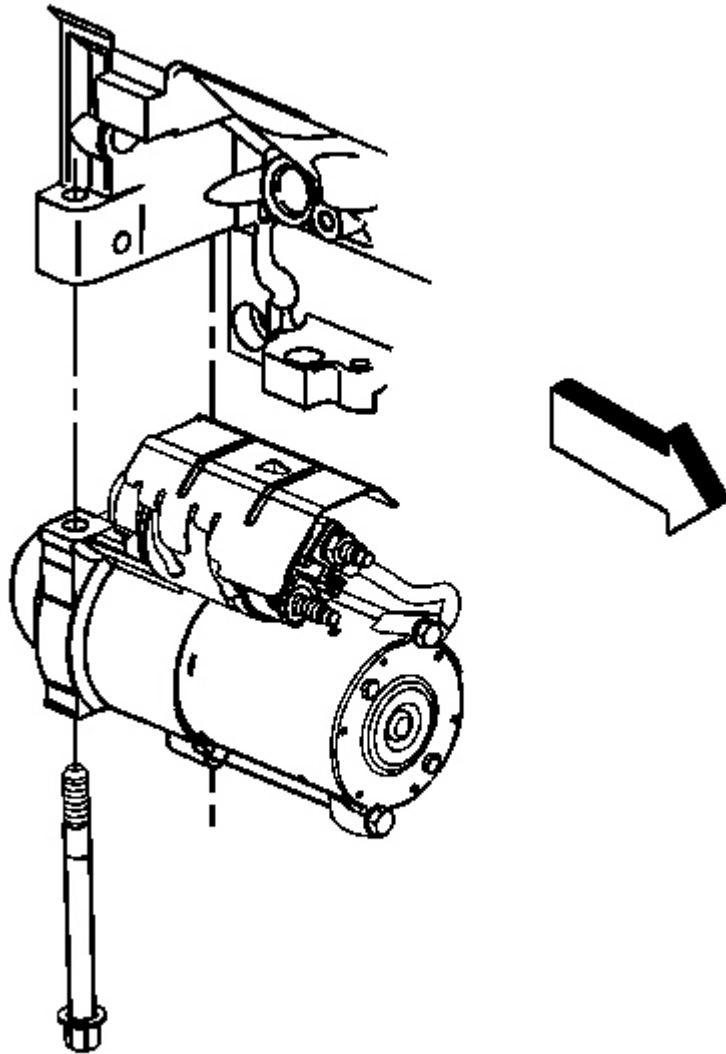


Fig. 76: View Of Starter & Bolts
Courtesy of GENERAL MOTORS CORP.

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

Position the transmission cover to the transmission.

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

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

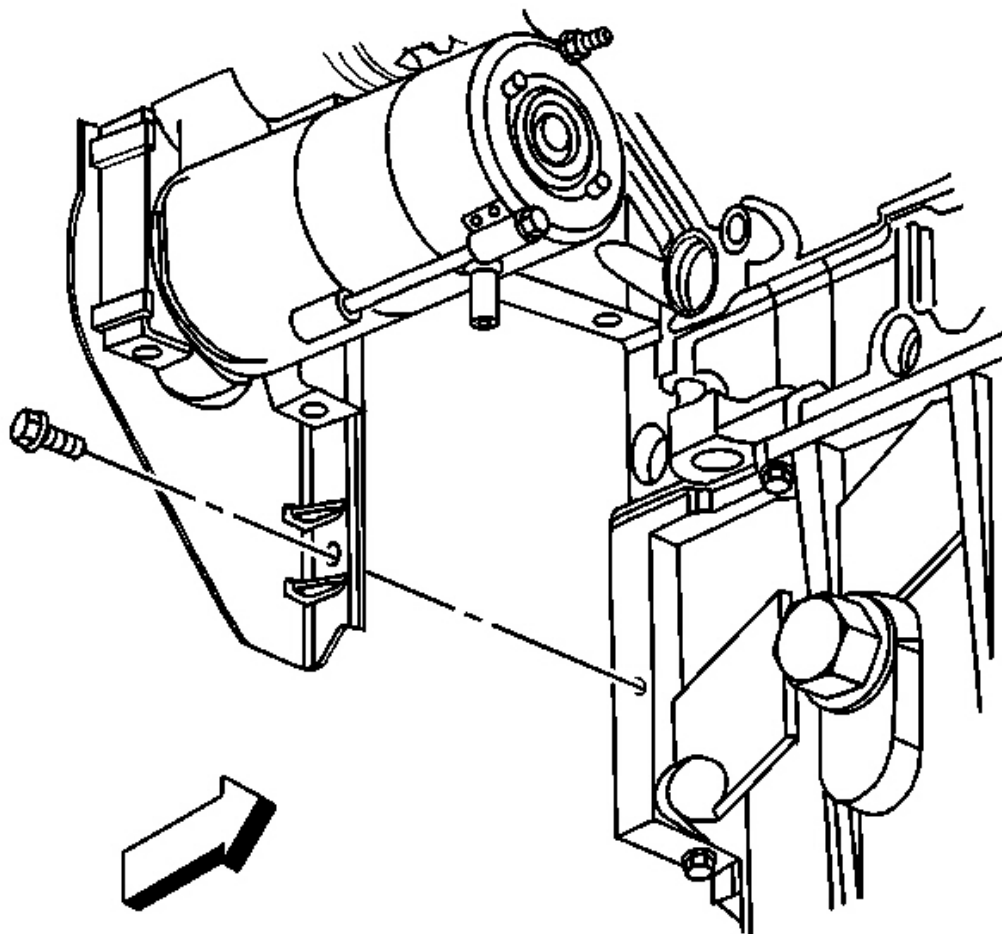


Fig. 77: View Of Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

10. Install the right transmission cover bolt.

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

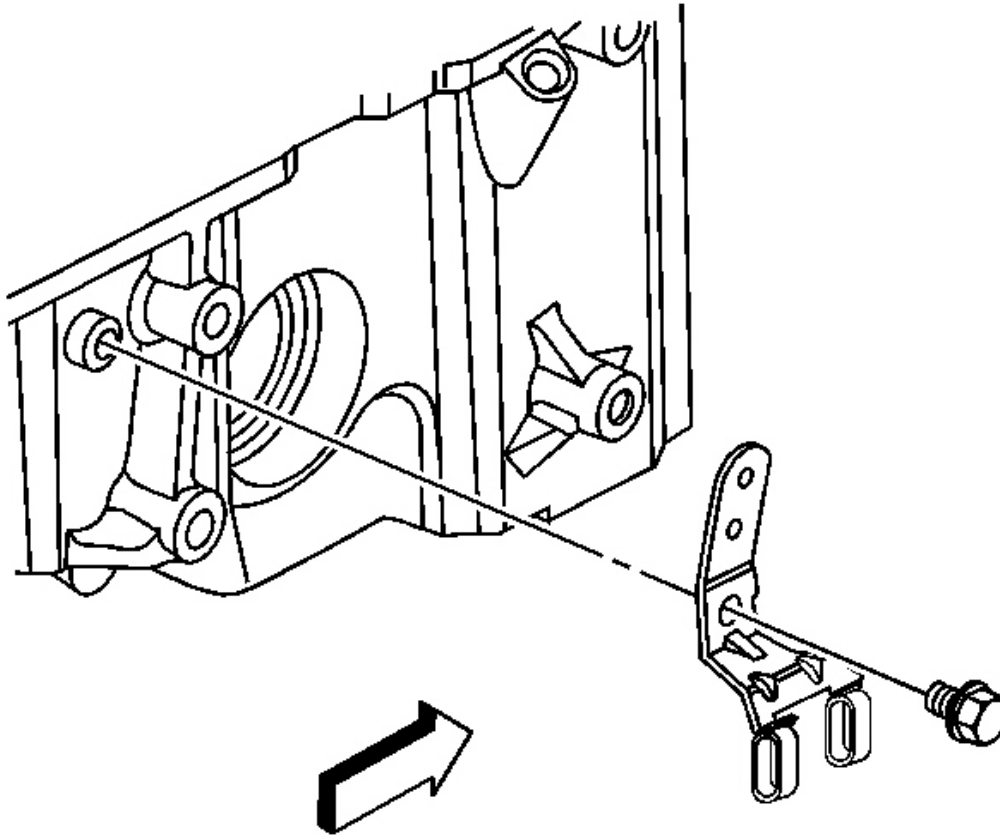


Fig. 78: View Of Transmission Oil Cooler Line Retaining Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

11. Install the transmission oil cooler line bracket bolt.

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

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

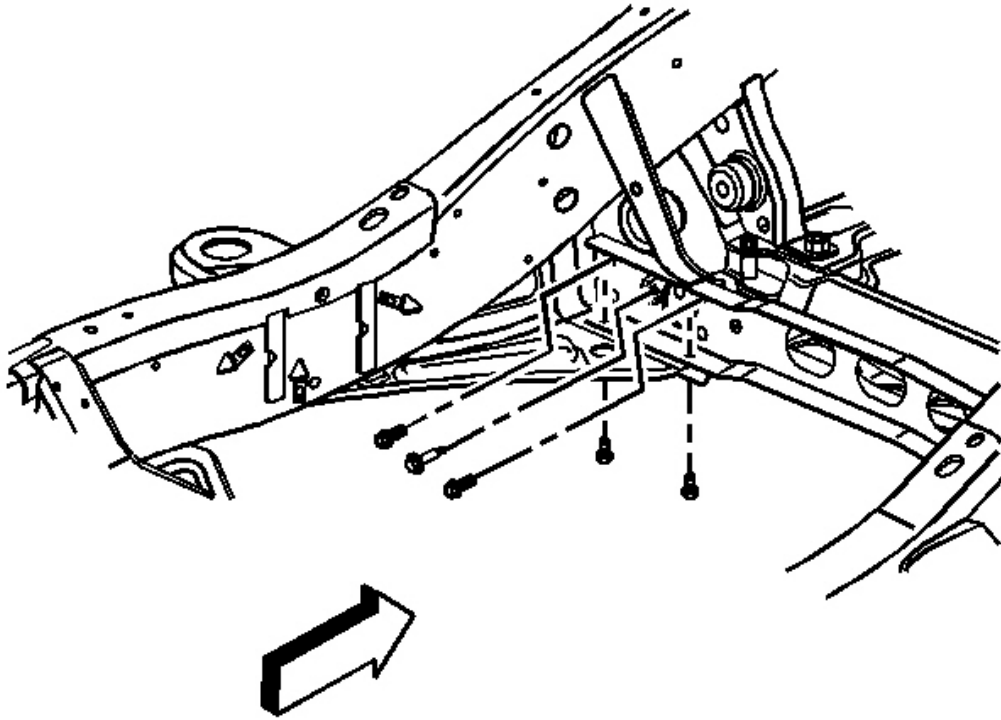


Fig. 79: Removing Rear Steering Gear Crossmember
Courtesy of GENERAL MOTORS CORP.

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

GENERATOR BRACKET REPLACEMENT (5.3L AND 6.0L ENGINES)

Removal Procedure

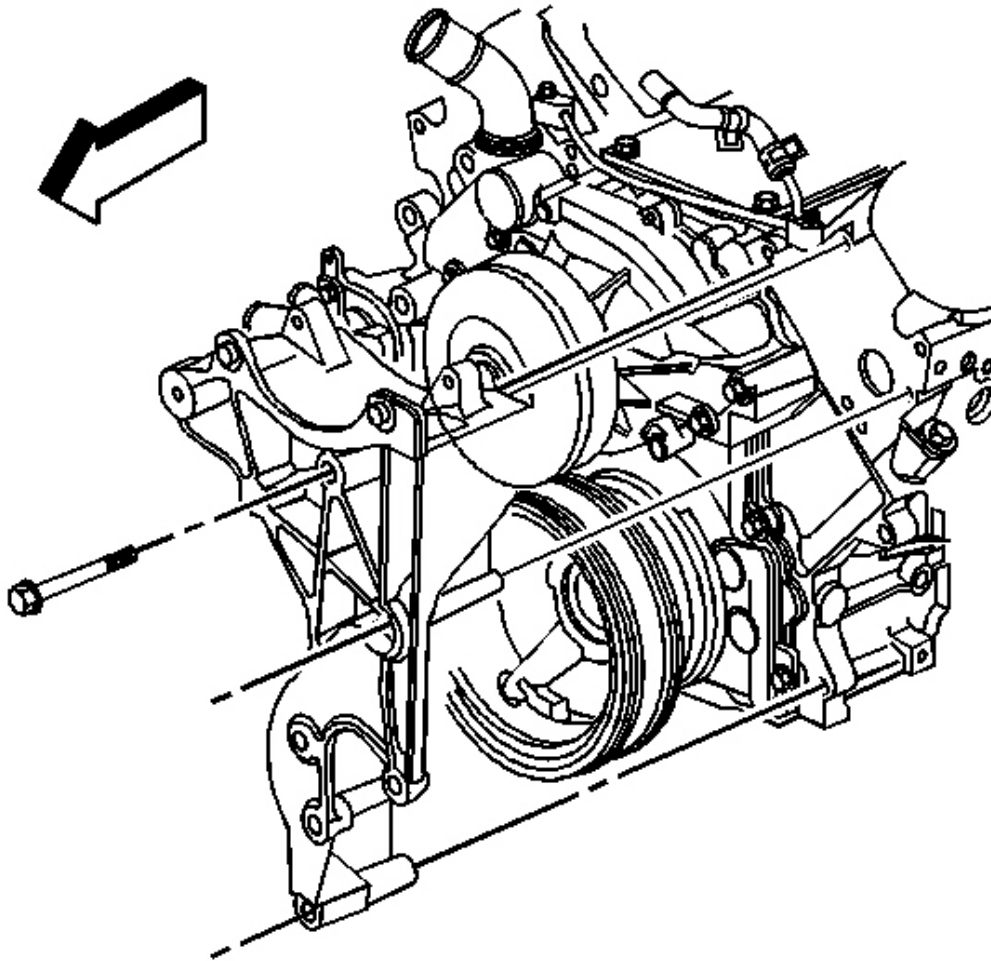


Fig. 80: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

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

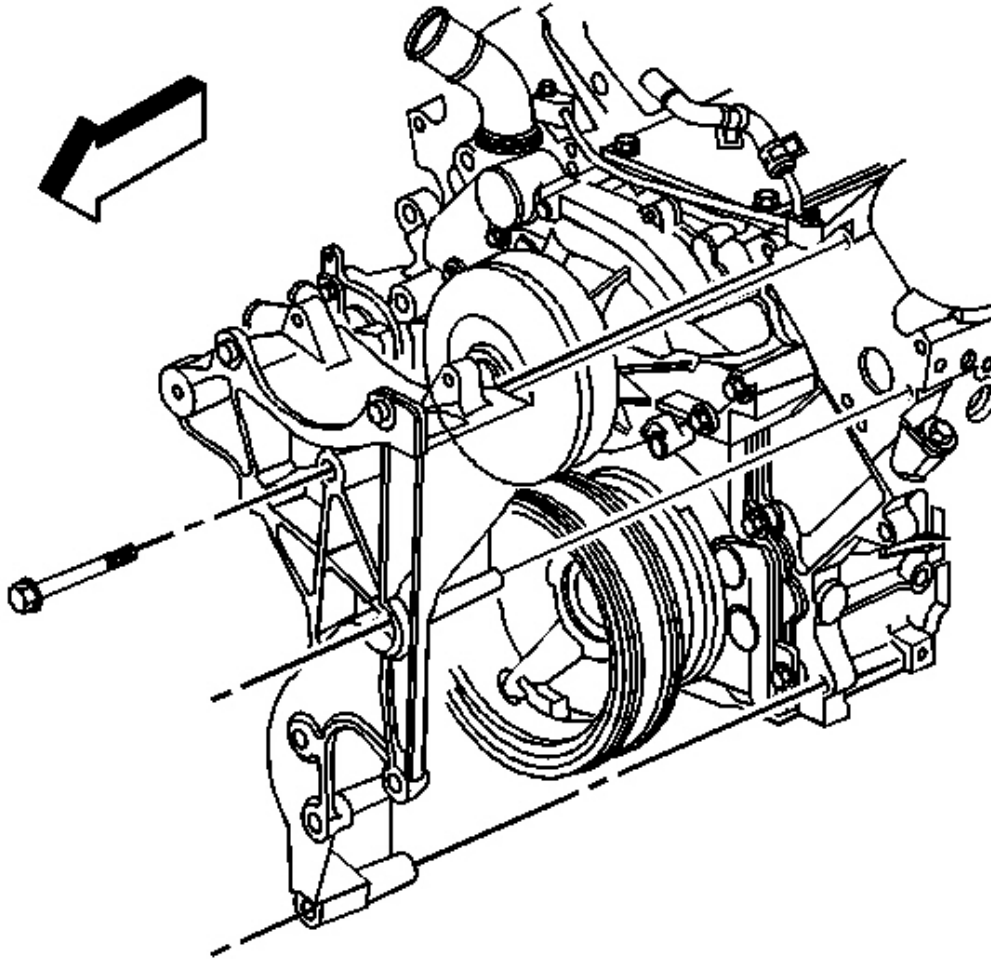


Fig. 81: View Of Generator Bracket & Bolts (4.8L, 5.3L & 6.0L)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **FASTENER NOTICE** .

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

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

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

4. Install the generator. Refer to **Generator Replacement (4.2L Engine)** or **Generator Replacement (5.3L and 6.0L Engines)**.

GENERATOR REPLACEMENT (4.2L ENGINE)

Removal Procedure

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

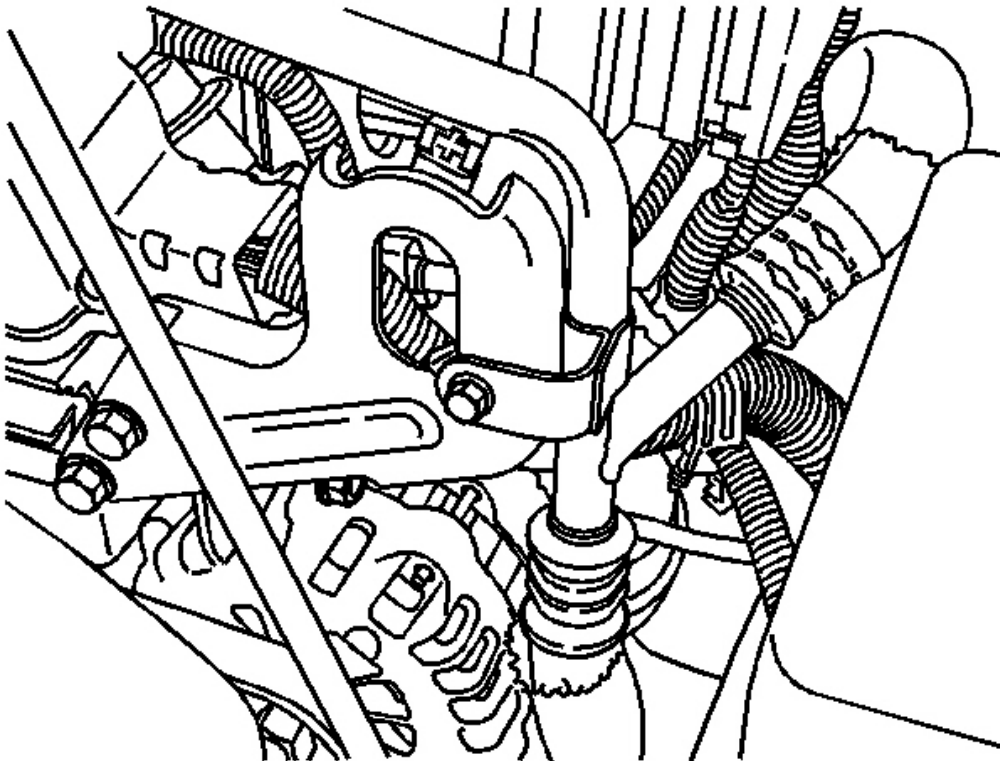


Fig. 82: View Of Engine Lift Hook & A/C Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

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

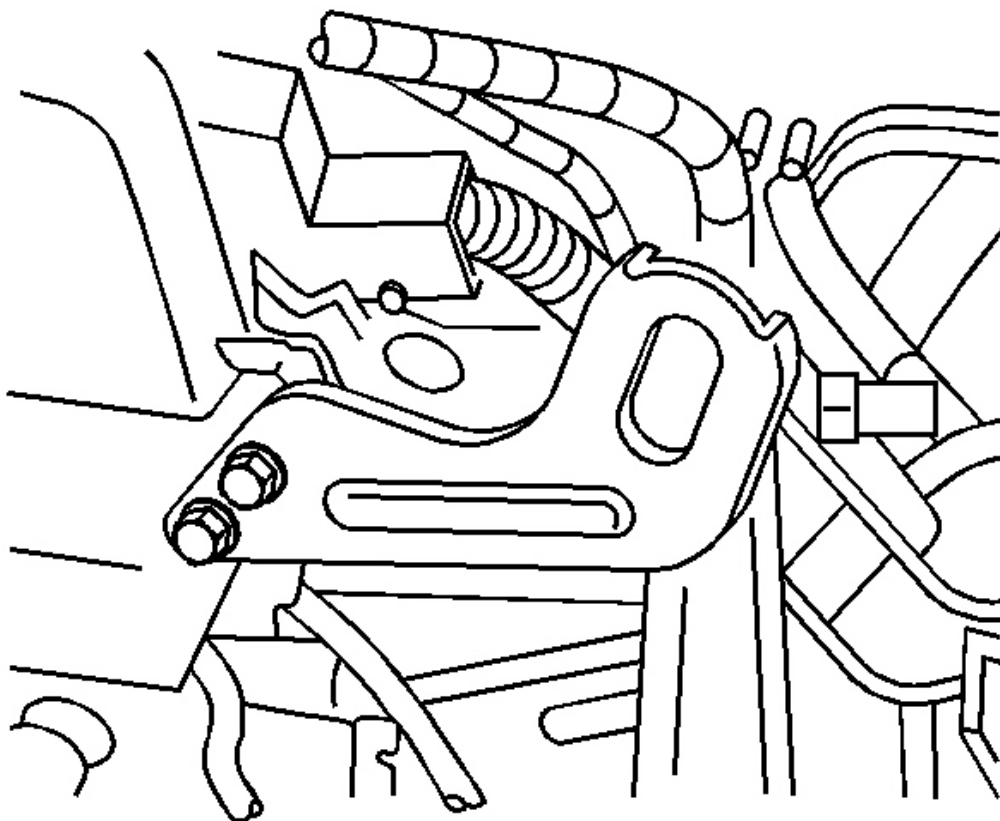


Fig. 83: View Of Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

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

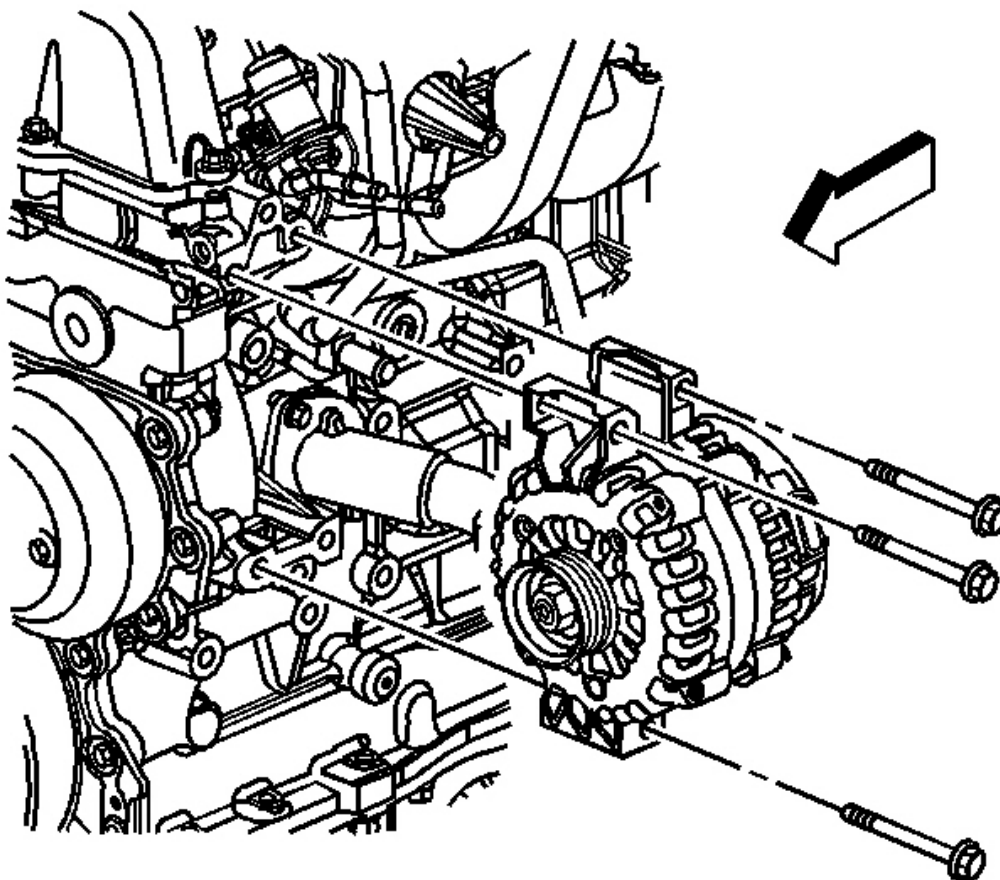


Fig. 84: View Of Generator & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

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

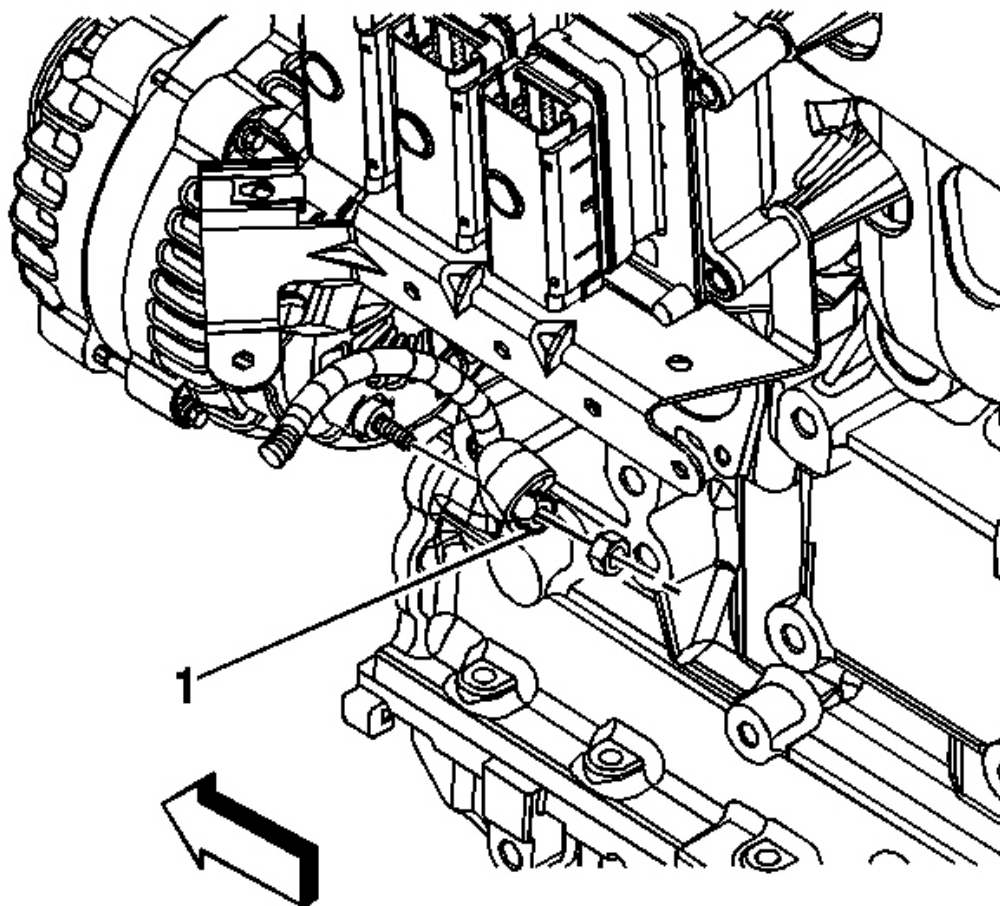


Fig. 85: Rear Of Generator (Alternator) View
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

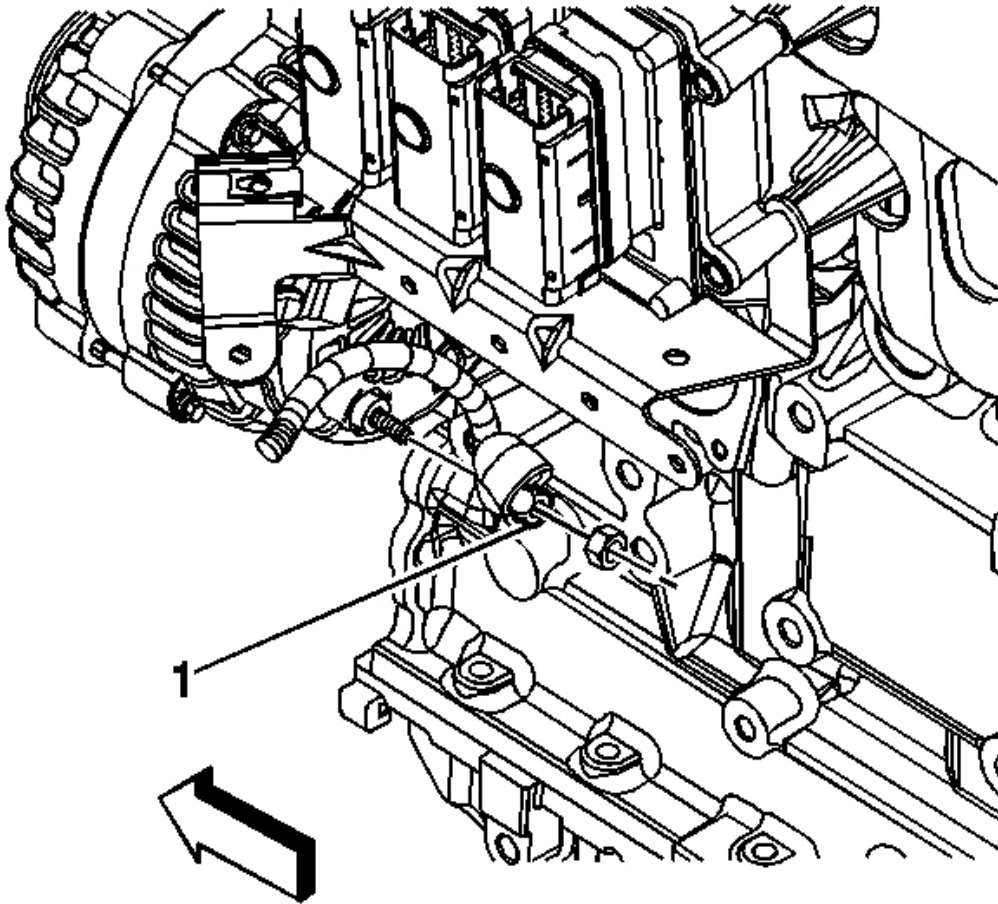


Fig. 86: Rear Of Generator (Alternator) View
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

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

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

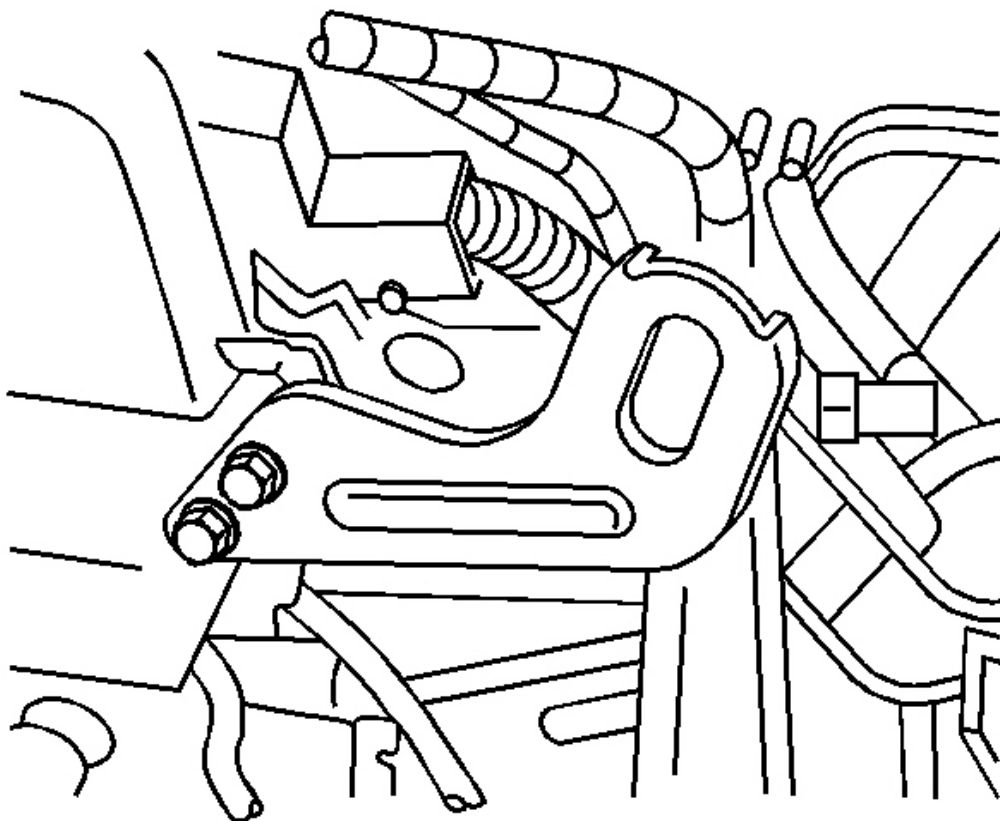


Fig. 87: View Of Engine Lift Bracket
Courtesy of GENERAL MOTORS CORP.

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

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

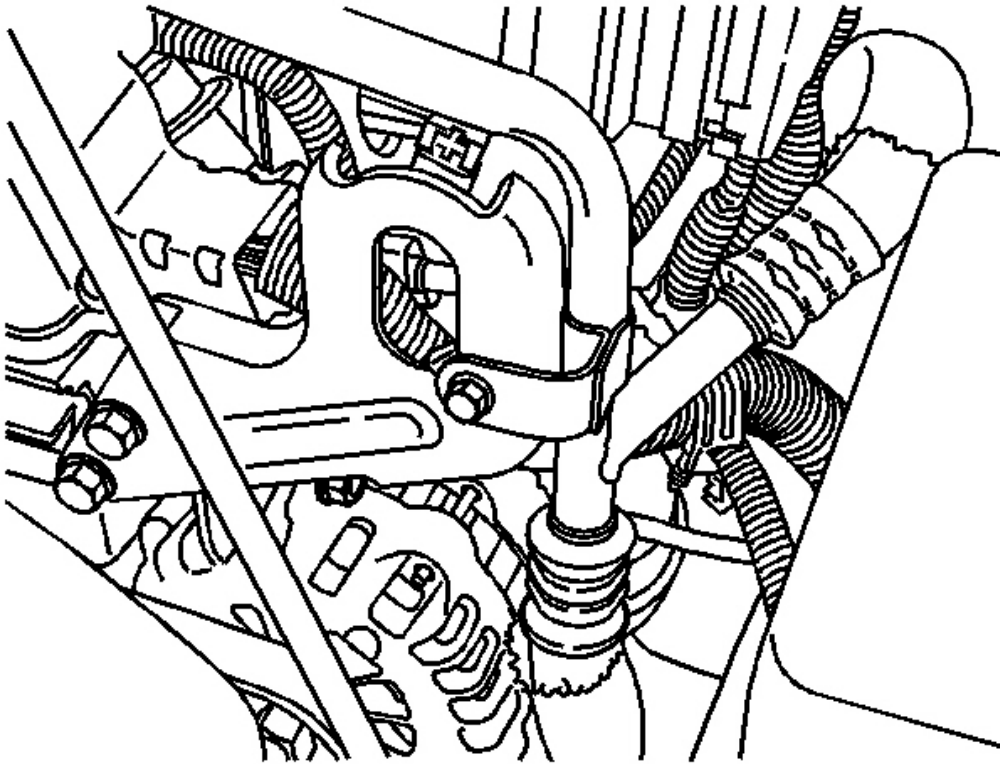


Fig. 88: View Of Engine Lift Hook & A/C Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

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

GENERATOR REPLACEMENT (5.3L AND 6.0L ENGINES)

Removal Procedure

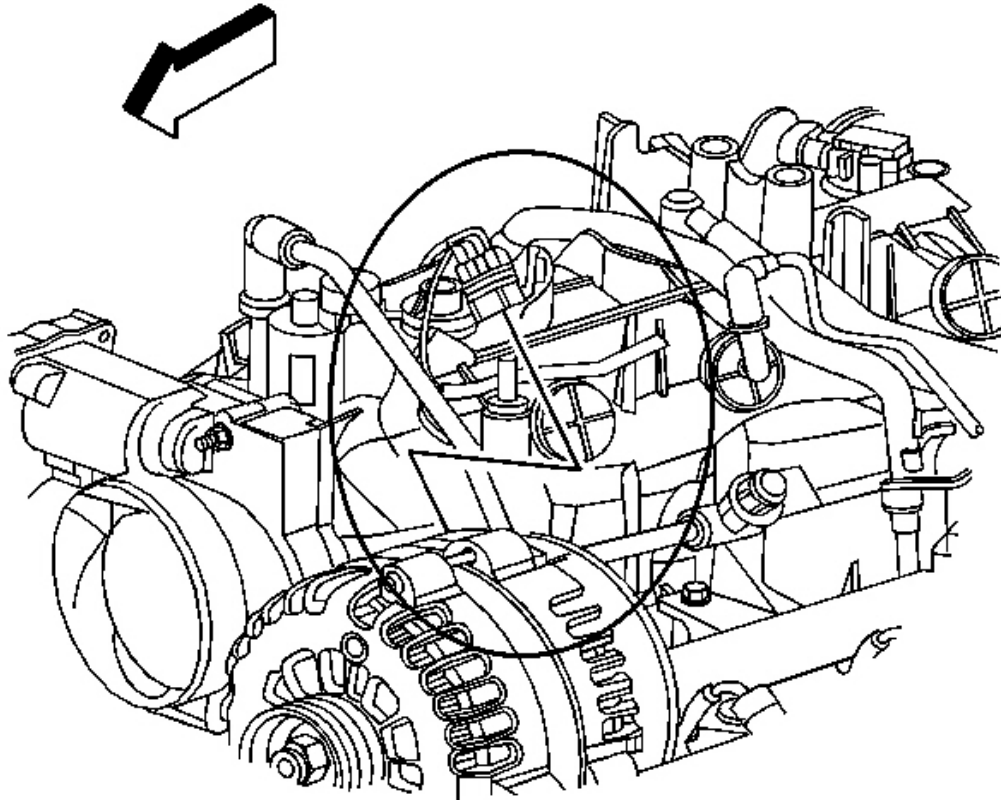


Fig. 89: View Of Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

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

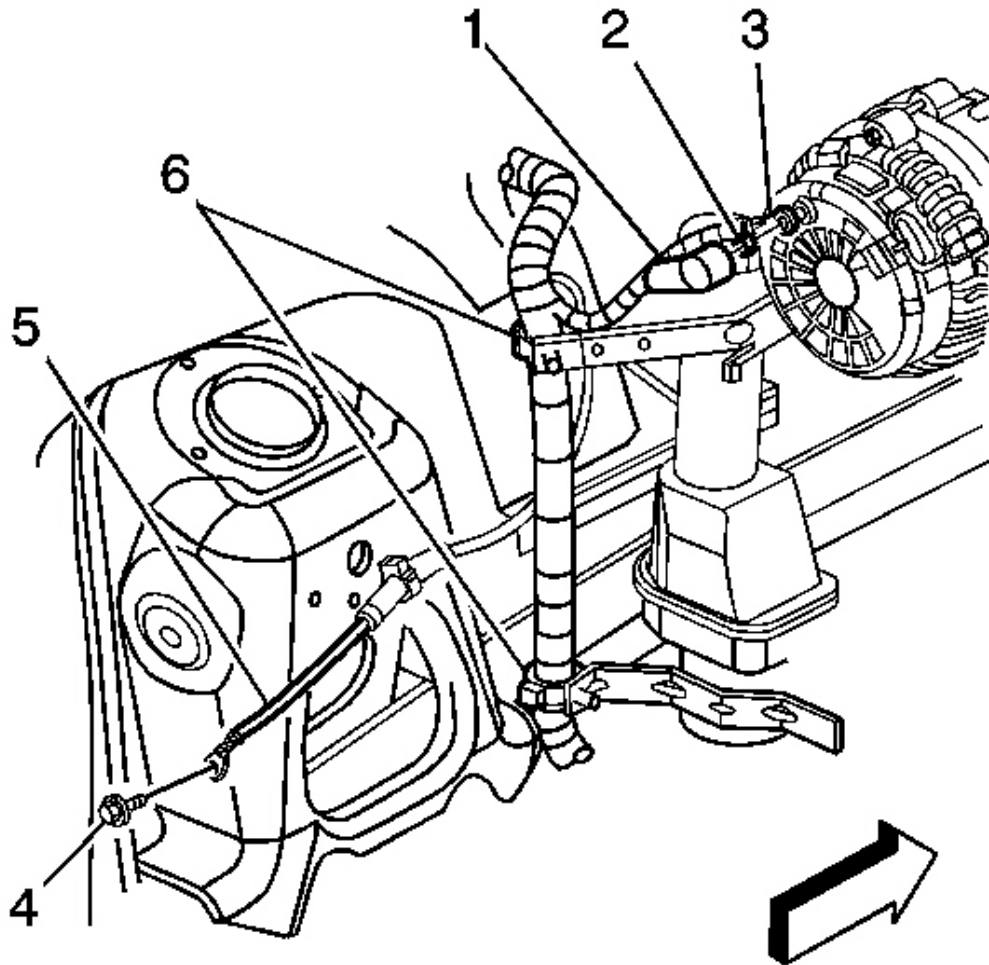


Fig. 90: View Of Generator Cable Boot, Head, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

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

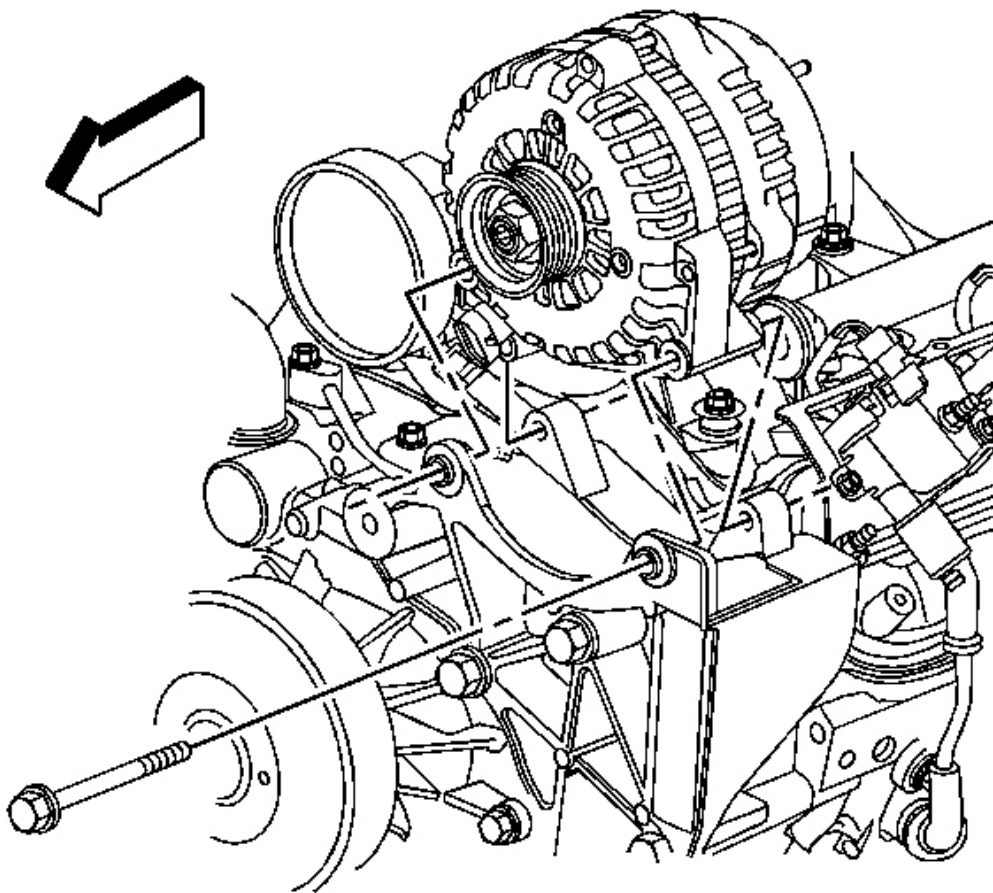


Fig. 91: View Of Generator & Bolts (5.3L)
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

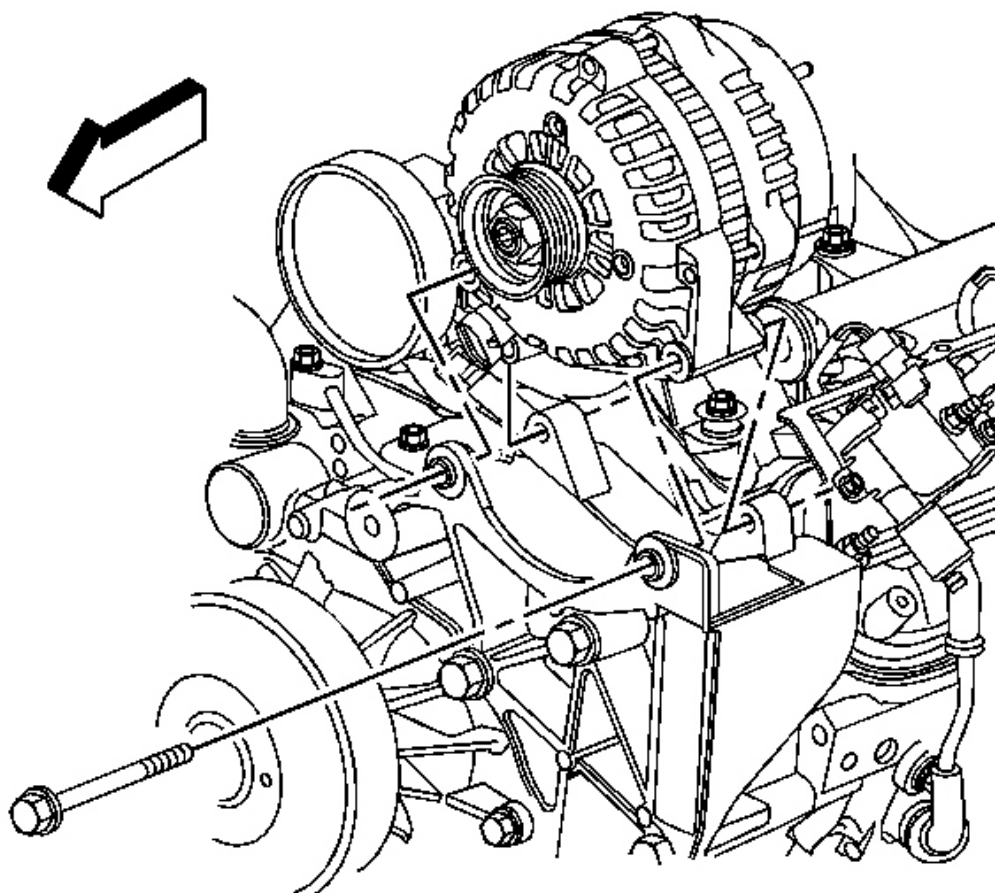


Fig. 92: View Of Generator & Bolts (5.3L)
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

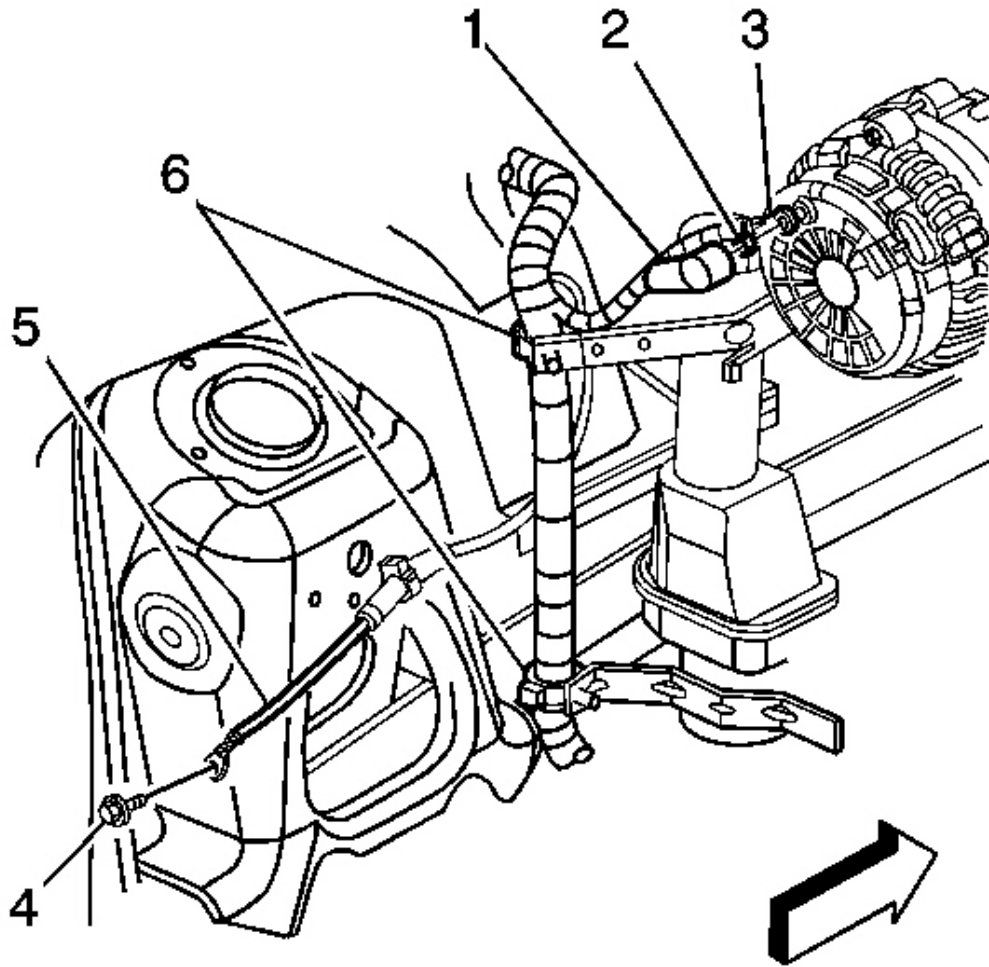


Fig. 93: View Of Generator Cable Boot, Head, Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

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

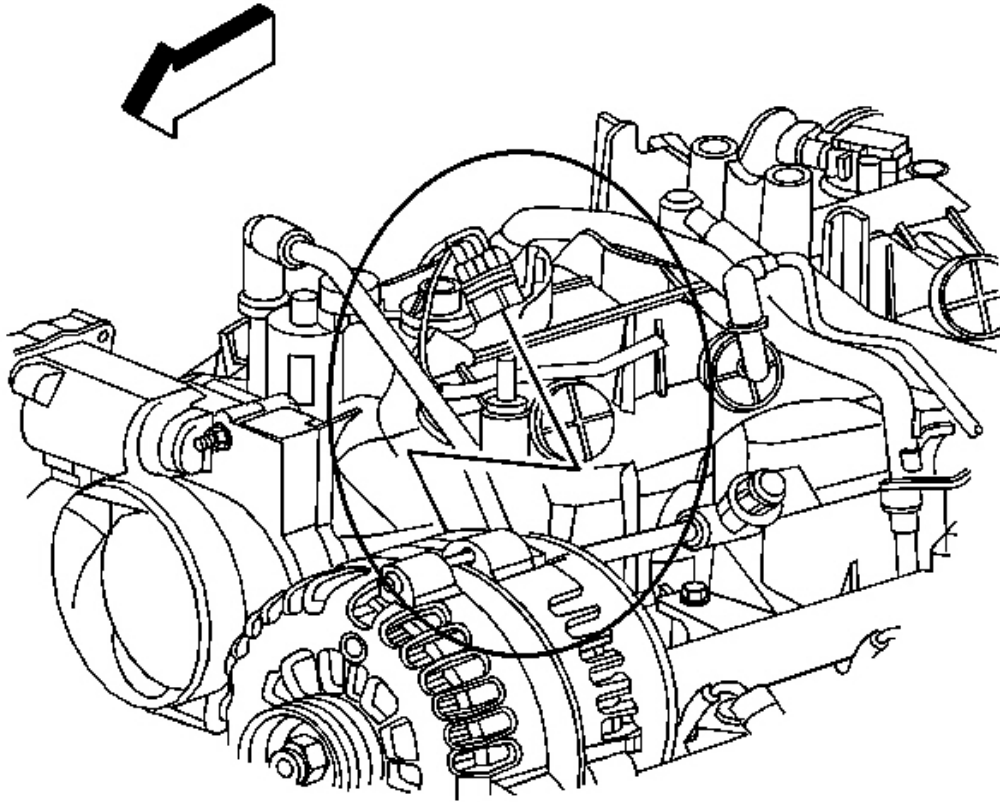


Fig. 94: View Of Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

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

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

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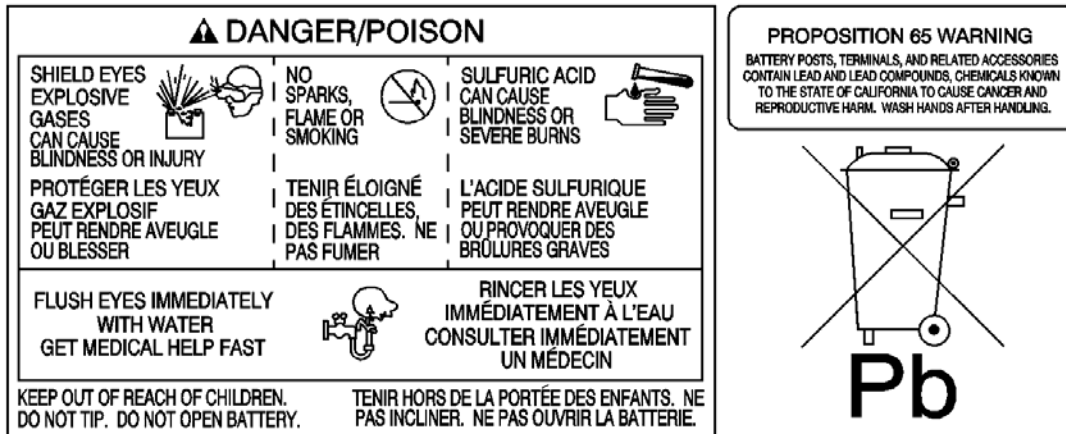


Fig. 95: View Of Battery Danger Label
Courtesy of GENERAL MOTORS CORP.

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

CATALOG NO.

1819

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100 – 6YR	

Fig. 96: 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.

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 (SOC) and life and minimize the systems impact on fuel economy. The EPM System performs 3 functions:

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

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

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

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

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

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

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

Charging System Components

Generator

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

Generator Battery Control Module

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

Engine Control Module (ECM)/Powertrain Control Module (PCM)

The ECM/PCM provides information over the class 2 serial data circuit to the generator battery control module. The generator battery control module monitors the following data parameters provided by the ECM/PCM:

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

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

Instrument Panel Cluster (IPC)

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

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CHARGING SYSTEM FAILURE and CHARGING SYSTEM FAULT.

Charging System Operation

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

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

The generator battery control module monitors the generator performance through the generator field duty cycle signal circuit, the generator field control circuit and the battery positive voltage circuit. The generator battery control module controls the generator through the generator field control, charge indicator control, circuit. The signal is a 5-volt pulse width modulation (PWM) signal of 128 Hz +/- 5 percent with a duty cycle of 0-100 percent. The duty cycle sent by the generator battery control module is limited between 36-90 percent. When the engine is turned OFF, the module will send 0 percent duty cycle, low voltage. When there is loss of class 2 communication with the ECM/PCM, the module will send 100 percent duty cycle, 13.8 volts. The following table shows the commanded duty cycle and output voltage of the generator:

Charging System Description and Operation

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

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

Charge Mode

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

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

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

Fuel Economy Mode

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

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

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

Voltage Reduction Mode

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

Start Up Mode

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

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Headlamp Mode

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

Battery Sulfation Mode

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

Windshield Wiper Voltage Boost Mode

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

Fuel Pump Voltage Boost Mode

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

De-Ice Voltage Boost Mode

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

Instrument Panel Cluster (IPC) Operation

Charge Indicator Operation

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

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

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- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the body control module (BCM) indicating there is a system voltage range concern.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.
- The ignition is ON, with the engine OFF.
- The generator battery control module determines there is a fault and sends a class 2 message to the IPC to illuminate the charge indicator.

Charging System Failure

The generator battery control module will send a class 2 message to the IPC for the CHARGING SYSTEM FAILURE message to be displayed. It is commanded ON when DTC B1487 sets. The message is turned off when the conditions for clearing the DTC have been met and after an ignition cycle.

Service Charging System

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

Voltmeter Operation

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

ELECTRICAL POWER MANAGEMENT DESCRIPTION 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

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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
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 on these vehicles 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.

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

Circuit Description

Moving the ignition switch to the START position sends a 12 volt signal to the engine control module (ECM)/powertrain control module (PCM) Crank Request circuit. The ECM/PCM verifies that the transmission is in the PARK or NEUTRAL position. With the transmission in Park, voltage flows through the Park/Neutral position switch and feeds the starter relay coil. The ECM/PCM then grounds the control circuit of the starter relay. When the starter relay is energized it allows battery positive voltage to the starter solenoid S terminal. On some vehicles the starter will continue to crank the engine with the key released until it starts or the crank command has timed out to prevent excessive heat build up in the starter circuitry or the ECM/PCM receives an engine run flag.