

2006 Pontiac Torrent

2006 ENGINE Engine Electrical - Equinox & Torrent

2006 ENGINE**Engine Electrical - Equinox & Torrent****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS****Fastener Tightening Specifications**

Application	Specification	
	Metric	English
Air Conditioning (A/C) Evaporator Outlet Hose to Battery Box Bolt	15 N.m	11 lb ft
Battery Box Cover Screw	2 N.m	18 lb in
Battery Box Inner Bolt	15 N.m	11 lb ft
Battery Box Outer Bolt	10 N.m	89 lb in
Battery Hold Down Bolt	15 N.m	11 lb ft
Battery Negative Cable Terminal Bolt	17 N.m	13 lb ft
Battery Positive Cable Terminal Bolt	17 N.m	13 lb ft
Battery Tray Bolt	25 N.m	18 lb ft
Coolant Surge Tank Bolt	6 N.m	53 lb in
Generator Battery Positive Terminal Nut	20 N.m	15 lb ft
Generator Bolt	50 N.m	37 lb ft
Generator Bracket Bolt	50 N.m	37 lb ft
Negative Battery Cable to Inner Fender Bolt	12 N.m	106 lb in
Negative Battery Cable to Transaxle Nut	45 N.m	33 lb ft
Remote Battery Terminal Nut	17 N.m	13 lb ft
Starter Solenoid Positive Battery Terminal Nut	10 N.m	89 lb in
Starter Solenoid S Terminal Nut	3 N.m	27 lb in
Starter-to-Engine Bolt	43 N.m	32 lb ft
Torque Converter Shield Bolt	8 N.m	71 lb in
UHFB Connector Bolt	4 N.m	35 lb in
Under Hood Fuse Block (UHFB) Battery Positive Terminal Nut	15 N.m	11 lb ft

BATTERY USAGE**Battery Usage**

Application	Specification
LNJ	

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Application	Specification
Cold Cranking Amps	600 A
Reserve Capacity Rating	LNJ 90 Minutes
Amp Hour Rating	54 AH
Replacement Battery Number	75-6YR

GENERATOR USAGE

Generator Usage

Application	Specification
3.4 (LNJ) Early	
Generator Model	Valeo SG10
Rated Output	145 A
Load Test Output	69 A
3.4 (LNJ) Late	
Generator Model	Denso SC2
Rated Output	155 A
Load Test Output	75 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

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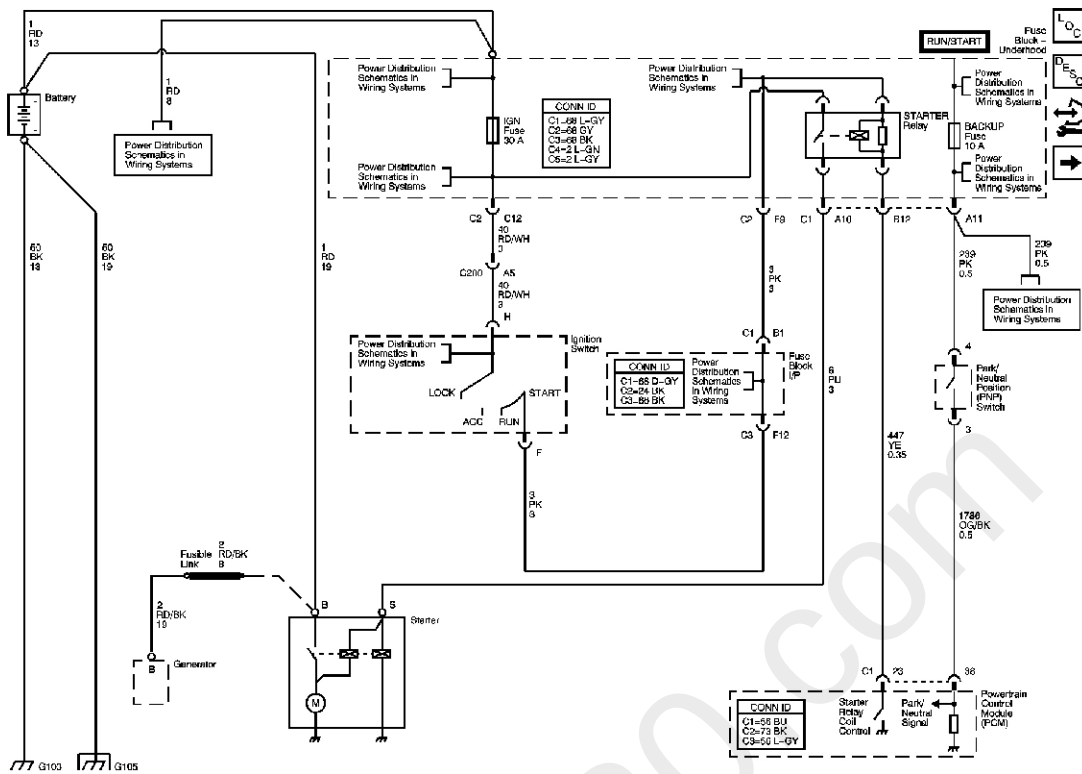


Fig. 1: Starting Schematic
Courtesy of GENERAL MOTORS CORP.



ENGINE ELECTRICAL COMPONENT VIEWS

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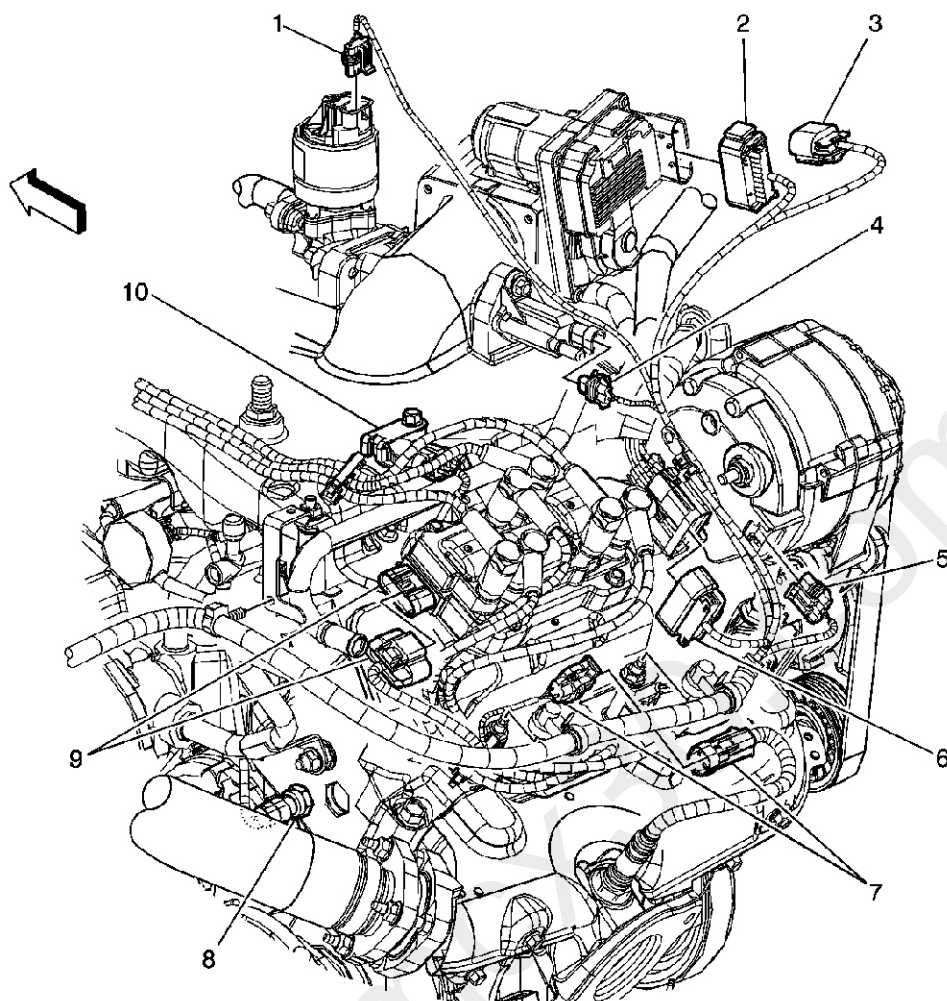


Fig. 3: View of Top Rear Side of the Engine Harness Routing
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Exhaust Gas Recirculation (EGR) Valve
2	Throttle Actuator Control (TAC) Module
3	Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor
4	Evaporative Emissions (EVAP) Canister Purge Solenoid
5	Generator
6	C150
7	Heated Oxygen Sensor (HO2S) 1
8	Engine Coolant Temperature (ECT) Sensor
9	Ignition Control Module (ICM)

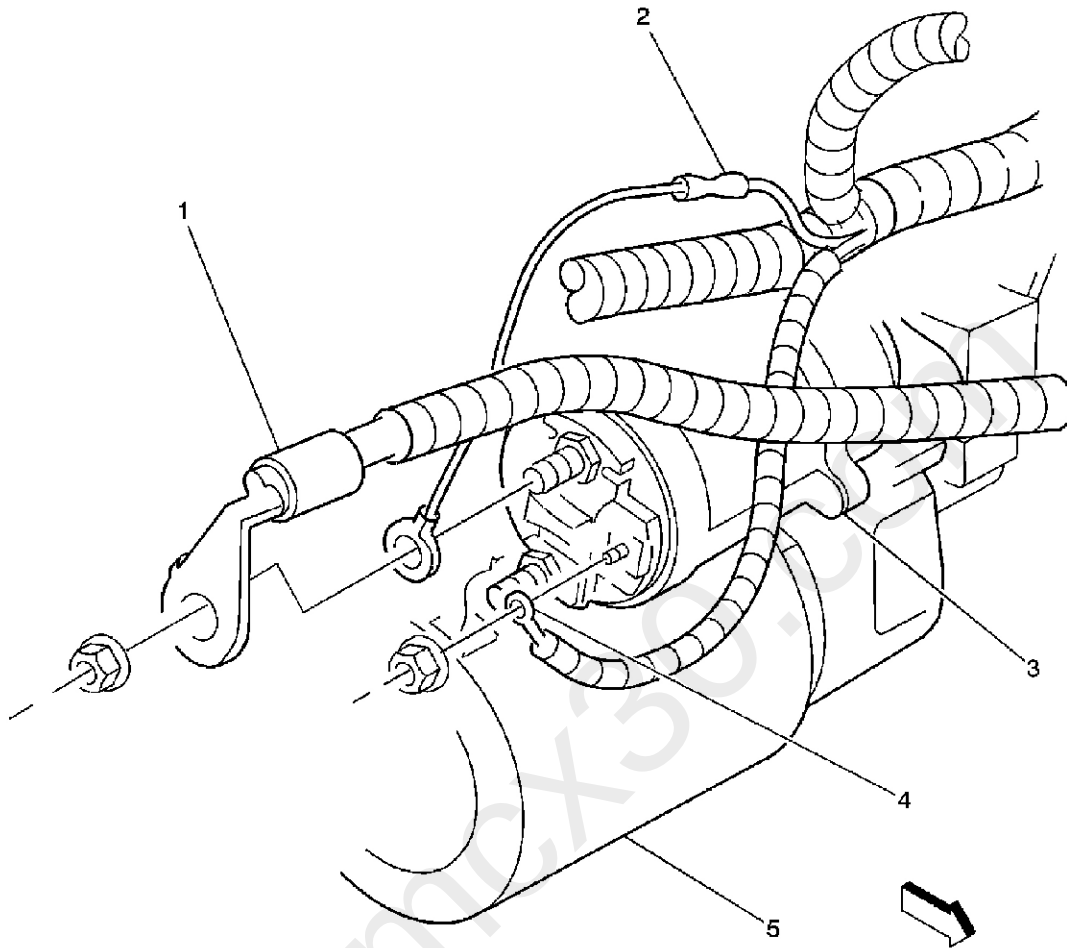


Fig. 4: Starter Component Views
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

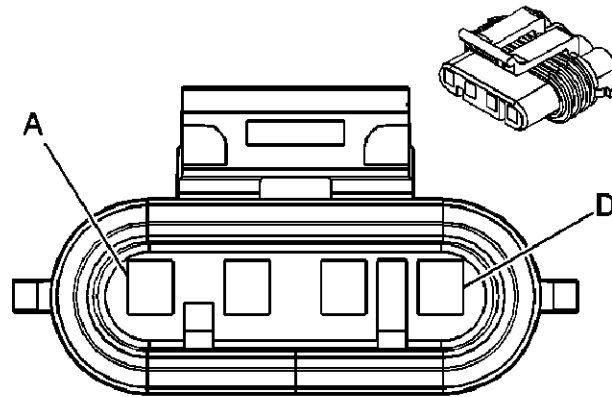
Callout	Component Name
1	Battery Positive Terminal at Starter Solenoid
2	Fusible Link
3	Starter Solenoid
4	S Terminal
5	Starter

ENGINE ELECTRICAL CONNECTOR END VIEWS

Generator

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Connector Part Information

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

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	OG	225	Generator Turn On Signal
C-D	-	-	Not Used

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1327</u>	Device Power 1 Circuit Low
<u>DTC B1328</u>	This DTC shall run only if the BCM has power, ground and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage.
<u>DTC P0560</u>	The PCM detects a system voltage out of range for 2 seconds.
<u>DTC P0621</u>	** DESCRIPTION NOT COLLECTED **

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit

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- The identification of any stored diagnostic trouble codes (DTCs) and their status

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

SCAN TOOL OUTPUT CONTROLS

Powertrain Control Module (PCM)

Scan Tool Output Control	Additional Menu Selection(s)	Description
Lamp and Gauge Check	Body, Instrument Panel, Special Function	The instrument panel cluster (IPC) illuminates all indicators to test for an inoperative indicator. The battery indicator is just to the left of the engine indicator.

SCAN TOOL DATA LIST

Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Battery 1	BCM, Switch Inputs	Volts	12.6 Volts

Powertrain Control Module (PCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF/Clutch Depressed or Transmission in Park or Neutral			
Crank Request Signal	Engine Data Display, Electrical/Theft Data	Yes/No	No
Generator L-Terminal Signal Command	Engine Data Display, Electrical/Theft Data	On/Off	Off
Ignition 1 Signal	Engine Data Display, Electrical/Theft Data	Volts	12.6 Volts
Starter Relay Command	Engine Data Display, Electrical/Theft Data	On/Off	Off
TR Sw.	Transmission Data	Invalid, Neutral, Drive, Park, Low, Reverse, Intermediate	Park

SCAN TOOL DATA DEFINITIONS

Battery 1

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received on the battery positive voltage circuit of the body control module (BCM).

Crank Request Signal

The scan tool displays Yes/No. The scan tool displays Yes when the powertrain control module (PCM) receives a crank request.

Generator L-Terminal Signal Command

The scan tool displays On/Off. The scan tool displays Off until the engine is running, then the PCM supplies then the percentage value varies depending on electrical loads

Ignition 1 Signal

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

Starter Relay Command

The scan tool displays On/Off. The scan tool displays Off until the PCM commands the starter relay On.

TR Sw.

The scan tool displays Invalid, Neutral, Drive, Park, Low, Reverse and Intermediate. The scan tool displays the position of the transaxle switch.

DTC B1327**Circuit Description**

The body control module (BCM) has an internal voltage sensor with a dedicated circuit that measures the battery voltage to determine if it is above 9.5 volts.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC B1327 Device Power 1 Circuit Low

Conditions for Running the DTC

This DTC shall run only if the BCM has power, ground and the ignition is not in START

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mode. This DTC shall execute regardless of the battery voltage.

Conditions for Setting the DTC

- This DTC shall be set as current when the voltage falls below 8.5 volts for 1,200 milliseconds.
- When the vehicle exits START the BCM shall delay checking the voltage for 2 seconds.

Action Taken When the DTC Sets

- The BCM will not illuminate the charge indicator.
- A message shall be sent out to notify all other modules of low battery voltage.

Conditions for Clearing the MIL/DTC

In order to clear the DTC from a current status the ignition must be cycled and the voltage shall be greater than 9.5 volts.

Test Description

The number below refers to the step number on the diagnostic table.

3: This step compares battery voltage with the voltage that the BCM calculates.

DTC B1327

Step	Action	Value(s)	Yes	No
Connector End View Reference: <u>Inline Harness Connector End Views</u> in Wiring Systems or <u>Computer/Integrating Systems Connector End Views</u> in Computer/Integrating Systems				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery 1 parameter in the Engine Electrical BCM data list.	8.6 V		

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	Does the scan tool indicate Diagnostic System Battery 1 parameter is greater than the specified value?		Go to Step 5	Go to Step 3
1	1. Measure the voltage across the battery terminals. 2. Compare the battery voltage with the Battery 1 parameter.		Go to Step 2	Check - le in Vehicle DTC
3	Are the voltages within the specified value?	1 V	Go to Battery Inspection/Test	Go to Step 4
4	Test the battery positive voltage and ground circuits of the body control module (BCM) for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 7	Go to Step 5
5	Inspect for poor connections at the harness connector of the BCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 7	Go to Step 6
6	IMPORTANT: Perform the setup procedure for the BCM. Replace the BCM. Refer to Control Module References in Computer/Integrating Systems 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.	-		

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Does the DTC reset?

Go to **Step 2**

System OK

DTC B1328

Circuit Description

The body control module (BCM) has an internal voltage sensor with a dedicated circuit that checks the battery positive voltage and battery negative circuit voltage to determine if it is below 17.0 volts.

DTC Descriptor

This diagnostic procedure supports the following DTC: DTC B1328 Device Power 1 Circuit High

Conditions for Running the DTC

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

Conditions for Setting the DTC

This DTC shall be set as current when the voltage raises above 17.0 volts for 1,200 milliseconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the charge indicator.
- A message shall be sent out to notify all other modules of low battery voltage.

Conditions for Clearing the MIL/DTC

In order to clear the DTC from a current status the ignition must be cycled and the voltage shall be less than 16.0 volts.

Test Description

The number below refers to the step number on the diagnostic table.

3: Compares battery voltage with the voltage that the BCM calculates.

DTC B1328

Step	Action	Value(s)	Yes	No
Connector End View Reference: <u>Inline Harness Connector End Views</u> in Wiring Systems or <u>Computer/Integrating Systems Connector End Views</u> in Computer/Integrating Systems				

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Step	Did you perform Action	Diagnostic System	Value(s)	Yes	No
	Check Vehicle Reference: Inline Harness Connector End Views in Diagnostic System Check - Vehicle in Vehicle Control Systems				
	Computer/Integrating Systems		-		
				Go to Step 2	
2	1. Install a scan tool. 2. Start the engine 3. Increase engine speed to above 1,500 RPM. 4. With a scan tool, observe the Battery 1 parameter in the engine electrical BCM data list. Does the scan tool indicate the battery voltage is less than the specified value?		16.0 V		
				Go to Step 4	Go to Step 3
3	1. Measure the voltage across the battery terminals. 2. Compare the battery voltage with the Battery 1 parameter in the engine electrical BCM data list. Are the voltages within the specified value?		1.0 V		
4	Inspect for poor connections at the harness connector of the body control module (BCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition? IMPORTANT: Perform the setup procedure for the BCM.		-	Go to Charging System Test	Go to Step 4
5	Replace the BCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup and programming. Did you complete the		-	Go to Step 6	Go to Step 5

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	Measurement? voltage across the battery		Go to Step 6	Go to Step
4	1. Inspect for poor connections at the harness connector of the body control module (BCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. 2. Operate the vehicle within the conditions for Running the DTC as specified in the supporting text. Did you find and correct the condition? Does the DTC reset?	- -	Go to Step 6	Go to Step 6

DTC P0560

Circuit Description

The powertrain control module (PCM) monitors the system voltage to ensure that the voltage stays within the proper range. Damage to components, and incorrect data input can occur when the voltage is out of range. The PCM monitors the system voltage over an extended length of time. If the PCM detects a system voltage outside an expected range for the calibrated length of time, DTC P0560 will set.

DTC Descriptor

This diagnostic procedure supports the following DTC: DTC P0560 System Voltage

Conditions for Running the DTC

- System voltage below 11 volts.
- Engine speed above 1,500 RPM.
- Vehicle speed below 40 km/h (25 mph).

Conditions for Setting the DTC

The PCM detects a system voltage out of range for 2 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

- The PCM will command the message OFF after one trip in which the diagnostic test has

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been run and passed.

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

DTC P0560

Step	Action	Values	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> in Engine Controls - 3.4L Connector End View Reference: <u>Powertrain Control Module (PCM) Connector End Views</u> in Engine Controls - 3.4L or <u>Power and Grounding Connector End Views</u> in Wiring Systems				
1	Did you perform the Diagnostic System Check - Vehicle ?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the Ignition 1 Signal parameter in the Engine Electrical powertrain control module (PCM) data list.	11.0 V		
3	Does the scan tool indicate that the Ignition 1 Signal parameter is greater than the specified range? Measure the voltage at the battery and compare it with the Ignition 1 Signal parameter.	0.8 V	Go to Step 7	Go to Step 3
4	Are the battery voltage and Ignition 1 Signal readings different by more than the value specified? Test the battery positive voltage circuit of the PCM for a high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition? Test the ground circuit of the PCM for a high resistance. Refer to <u>Circuit</u>	-	Go to Step 4 Go to Step 8	Go to <u>Charging System Test</u> Go to Step 5

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5	Testing and Wiring Repairs in Wiring Systems. 1. Install a scan tool. 2. Start the engine. 3. Did you find and correct the condition? 4. Give the Ignition 1 Signal parameter	-	Go to Step 8	Go to Step 6
2	Inspect the Engine connections at the harness connector of the PCM. Refer to Testing for Intermittent (Circuit) and Poor Connections and Connector Repairs in Wiring Systems. 5. Is the Ignition 1 Signal parameter	11.0 V		
6	6. Is the Ignition 1 Signal parameter 7. Is the Ignition 1 Signal parameter	-	Go to Step 7	Go to Step 7
	8. Measure the voltage across the battery. 9. Did you find and correct the battery condition?		8	Go to Step 7
3	Replace the PCM. Refer to Component References in Computer/Integrating Systems for replacement, setup and programming. 10. Did you complete the replacement?	0.8 V	Go to Step 8	Go to Step 4
7	11. Test the battery positive voltage circuit of the PCM for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. 12. Use the scan tool in order to clear the DTC. 13. Did you find and correct the condition?	-	Go to Step 8	Go to Step 4
4	14. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. 15. Using the scan tool, observe the Specific DTC Information for DTC P0560 until the test runs. 16. Does the scan tool indicate that DTC P0560 failed this ignition?	-	Go to Step 2	System OK
8				

DTC P0621

DTC Descriptor

DTC P0621

Generator L- Terminal Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

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

The PCM monitors the state of the generator turn on signal circuit. With the engine running, the PCM should detect a high generator turn on signal circuit, or when the charging system malfunctions. If the PCM detects a low generator turn on signal circuit, DTC P0621 will set.

Conditions for Running the DTC

Key ON Test

- The ignition is in RUN position.
- The engine is not running.

RUN Test

- The engine is running.
- The engine speed is less than 3,00 RPM.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

- The 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 PCM will not illuminate the malfunction indicator lamp (MIL).
- The 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**
- **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. With ignition ON, and the engine OFF.
2. Disconnect the generator harness and measure the voltage of the generator turn on signal circuit, should read near 0 volts.
 - If greater than 0 volts test the generator turn on signal circuit for a short to voltage, or replace the PCM.
3. With ignition ON, and the engine running, the voltage of the generator turn on signal circuit, should read near 5 volts.
 - If no voltage is measured, test the generator turn on signal circuit for a short to ground, an open or a high resistance or replace the PCM.
4. Go to **Charging System Test**.

Repair Instructions

IMPORTANT: Always perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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

SYMPTOMS - ENGINE ELECTRICAL

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

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

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

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

- **Generator Noise Diagnosis**

BATTERY INSPECTION/TEST**Tools Required**

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

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. See **Special Tools**. For instance, if the AGM batteries CCA rating is 500 amps, enter 600 into the J 42000 . See **Special Tools**. Perform this modification only if the J 42000 does not ask if you are testing an AGM battery. See **Special Tools**. 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 . See **Special Tools**.
- The battery test using the J 42000 requires correct connections to the battery terminals. See **Special Tools**. A failure to obtain the correct connections during the test may result in a failed test on a good battery.

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

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

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

- If correct connections to the battery terminal bolts in the vehicle are in doubt, perform the following steps:
 1. Disconnect the negative battery cable.
 2. Disconnect the positive battery cable.

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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.
 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.

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

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

Battery Inspection/Test

Step	Action	Values	Yes	No
CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.				
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? Compare the cold cranking amperage (CCA), and reserve capacity (RC) and/or amp hour (AH) rating of the	-	Go to Step 2	Go to Step 15

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Step	Action	Values	Yes	No
1	CAUTION: Original equipment (OE) battery specifications. Refer to Battery Disconnection Cautions and Notices. Usage. IMPORTANT: The battery must meet or exceed the specifications. Always use the test code displayed by the tester on the repair order for any warranty 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.		Go to Step 3	Go to Step 15
3	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Does the battery OK?	-	Go to Step 4	Go to Step 5
4	Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (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? IMPORTANT: Ensure that all of the electrical loads are turned OFF.	-	Go to Step 7	Go to Step 6
6	1. Install the J 42000 Battery Tester. See Special Tools. 2. Follow the directions supplied with the tester for an In-Vehicle test. 3. Follow any directions displayed on the tester. 4. If the tester calls for charging the battery, refer to Battery Charging.	-	Go to Step 14	Go to Step 8
7	Did the tester pass the battery? Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt.	10 N.m (88 lb in)		

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	Is the torque above the specified torque value?		Go to Step 10	Go to Step 8
	Turn OFF the ignition.		10	8
3	1. Disconnect the negative battery cable. 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	3. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to Step 9	Go to Step 8
5	4. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed. Attempt to rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to Step 7	Go to Step 6
6	5. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed. IMPORTANT: Ensure that all of the electrical loads are turned OFF. 1. Install the J 42000 Battery Tester. See Special Tools . Did you complete the repair?		Go to Step 11	-
9	2. Disconnect the negative battery cable. 2. Follow the directions supplied with the tester for an In-Vehicle Test. 2. Inspect for the following conditions and repair as needed: 3. Follow any directions displayed on the tester: • The cable bolt is too long or deformed at the end 4. If the tester calls for charging the battery, refer to Battery Charging . • There is foreign material present inside the nut in the battery terminal Did the tester pass the battery?	-	Go to Step 14	Go to Step 8
	• Damage to the battery terminal face or cable connector ring Did you complete the repair?		Go to Step 10	-
	1. Disconnect the positive battery cable. 2. Inspect for the following conditions and repair as needed: • The cable bolt is too long or deformed at the end			

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10	Disconnect the negative battery cable. 1. Disconnect the negative battery cable from the battery terminal. 2. Inspect the battery terminal for damage to the battery terminal face or cable. 3. If the battery terminal is damaged, replace the terminal and the metal contact rings in both cable terminals.	-				
8	Did you complete the repair? IMPORTANT: Disconnect the connectors in order to ensure that both battery cables are disconnected and proper adapters are installed in the battery terminals. 1. Install the J-42000. See Special Tools. 2. If the cable rings are excessively damaged, replace the cable rings.	-	Go to Step 11	-		
11	2. Follow the directions supplied with the tester for an Out-of-Vehicle test. 3. Inspect for the following conditions and repair as needed: 4. If the tester calls for charging the battery, refer to Battery Charging.	-				
9	There is foreign material present inside the nut in the battery terminal. Did the tester pass the battery? 1. Press the CODE button on the J-42000. See Special Tools. 2. For warranty purposes, write the displayed code on the repair order.		Go to Step 12	Go to Step 15		
12	Did you complete the repair?		Go to Step 10			
13	Did you complete this action? 1. Connect the positive battery cable to the batteries positive terminal. NOTE: Refer to Fastener Notice in Cautions and Notices. 2. Tighten the positive battery	17 N.m	Go to Step 13			-

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	Do not touch the specified value. 3. Connect the negative battery cable to the battery terminal following wiring conditions and repair as needed. 4. Tighten the negative battery cable bolt to the specified value.	(13 lb ft)				
			Go to Step 11	-		
	IMPORTANT: Ensure that both battery cables are disconnected and proper adapters are installed in the battery terminals. 1. Press the CODE button on the J 42000. 1. 42000 Set Special Tools 2. Tools For warranty purposes, write the displayed code on the repair order with the directions supplied with the tester for an Out-of-Vehicle test. Did you complete the replacement? 3. Follow any directions displayed on the tester. Replace the battery. Refer to Battery Replacement. 4. If the tester calls for charging the battery, refer to Battery.		Battery OK	-		
14						
11		-				
			Battery OK			
15		-				
			Battery OK	-		

BATTERY CHARGING

Tools Required

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

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

Battery State of Charge

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

The maintenance free batteries SOC is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery,

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the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the batteries SOC:

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

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

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

Battery Charging

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

Use the SOC information as follows:

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

Charging Time Required

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

- The battery charger capacity-The higher the chargers 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 manufacturers instructions for operating this circuitry.
- The temperature of the battery-The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

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

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

Use the following procedure to charge the battery:

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.
3. Connect the charger positive lead to the battery positive terminal on the battery or fuse block 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. See **Special Tools**.

Diagnostic Aids

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

Battery Electrical Drain/Parasitic Load Test

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

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

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

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

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

1. Disconnect the battery negative cable from the battery negative terminal.
2. Install the male end of the **J 38758** to the battery ground terminal. See Special Tools.
3. Turn the **J 38758** knob to the OFF position. See Special Tools.
4. Install the battery negative cable to the female end of the **J 38758** . See Special Tools.
5. Turn the **J 38758** knob to the ON position. See Special Tools.
6. Road test the vehicle and activate ALL of the accessories, including the radio and air conditioning. This may take up to 30 minutes.

IMPORTANT: Leaving the key in the ignition on some vehicles may cause a parasitic drain that is above the recommended

amount. Refer to Body Control System Description and Operation in Computer/Integrating Systems.

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. See **Special Tools**. The current now flows through the jumper wire.
10. Wait 1 minute. If the fuse blows, install an inductive ammeter and go to step 20.
11. Remove the fused jumper wire.
12. Set a digital multimeter to the 10A scale.
13. Connect the digital multimeter to the test switch tool terminals.
14. Turn the **J 38758** knob to the OFF position. See **Special Tools**. The current flows now through the digital multimeter.
15. Wait 1 minute. Check and record the current reading.
 1. When there is a current reading on 2A or less, turn the **J 38758** knob to the ON position. See **Special Tools**. The electrical current will now pass through the switch.
 2. Then switch the digital multimeter down to the 2A scale for a more accurate reading when the **J 38758** knob is turned OFF. See **Special Tools**.
16. Turn the **J 38758** knob to the OFF position. See **Special Tools**. Wait 15 minutes for most vehicles.
17. Check and record the current reading.
18. Note the battery Reserve Capacity (Amp Hour rating). Refer to **Battery Usage**.
 1. Divide the reserve capacity by 4 (Amp hour rating by 2.4).
 2. Compare this to the multimeter milliamp 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** in Wiring Systems to diagnose exactly which part of the suspect circuit is causing the parasitic drain. In some cases a non-fused circuit or component, such as a relay, is the cause of excessive parasitic current drain. If it has been determined that the OnStar system is the source of parasitic load.
 3. Repeat the parasitic current drain test procedure after any repair has been completed to make sure that the parasitic current drain is at an acceptable level.
 4. When the cause of the excessive current drain has been located and repaired, remove the **J 38758**. See **Special Tools**.
20. Connect the battery negative cable to the battery negative terminal.

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

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. A fully charged battery will not freeze until the ambient temperature gets below -54°C (-65°F). However, a battery with a low state of charge may freeze at temperatures as high as -7°C (20°F). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged above 80 percent state of charge, the freezing point of the battery will be somewhere below -32°C (-25°F).

Battery Protection During Vehicle Storage

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

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

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

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

When the battery cannot be disconnected:

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

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

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 block the wheels.
3. Turn OFF all electrical loads on both vehicles that are not needed.
4. Turn OFF the ignition on both vehicles.

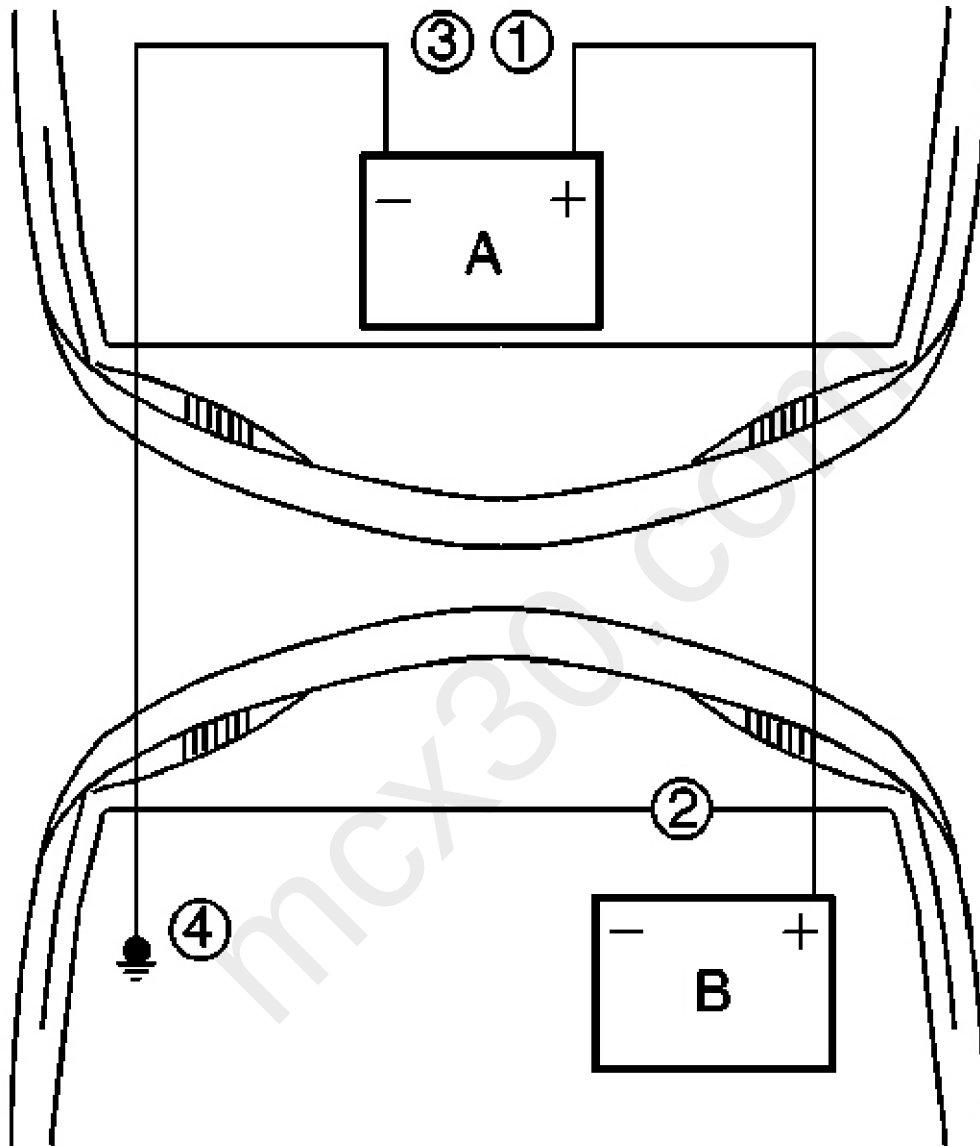


Fig. 5: Identifying Proper Jumper Cable Connection
Courtesy of GENERAL MOTORS CORP.

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

Use a remote positive (+) terminal if the vehicle has one.

6. Connect the red positive (+) cable to the positive (+) terminal (1) of the booster battery.

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Use a remote positive (+) terminal if the vehicle has one.

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.

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.
11. The black negative (-) cable must be first disconnected from the vehicle that was boosted (4).
12. 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.

13. Disconnect the red positive (+) cable from the positive (+) terminal (1) of the booster battery.
14. 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	
1	Did you perform the Diagnostic System Check - Vehicle?	-		Go to <u>Diagnostic System Check</u> - Vehicle in	

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			Go to Step 2	Vehicle DTC Information	
2	With ignition OFF, install the Midtronics Digital Battery Analyzer and verify the condition of the battery. Is the battery sufficiently charged for testing?	-	Go to Step 3	Go to Battery Inspection/Test	
3	1. Disconnect the Midtronics Digital Battery Analyzer. 2. Connect the Sun Vat 40 tester or equivalent to the battery. 3. Turn the ignition to the OFF/LOCK position. 4. Observe and record the battery voltage reading at the battery terminals on the Sun Vat 40 tester. 5. Start the engine and observe the system voltage reading on the tester. Does the voltage increase from the first specified (engine OFF) to the second (engine ON) specified range?	Engine Off = B+ Engine On = 13.9 - 15.5 V	Go to Step 4	Go to Step 6	
4	1. Turn on the following accessories: • Headlights - Hi beams • A/C on Max • Blower Fan - On high • Rear window defogger • Heated seats (If equipped) 2. Maintain engine speed at 2500 RPM.	13.9 - 15.5 V			

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Step	Is voltage still within the specified value?	Action	Value(s)	Go Yes	No
1	Do you perform the Diagnostic System Check - Vehicle? 1. Turn OFF all accessories. 2. Turn OFF the ignition. 3. Connect a carbon pile tester to the vehicle.	Go to Step 5 Go to Step 2	-	Go to Step 6	Go to Step 6
2	With ignition OFF, install the Midtronics Digital Battery Analyzer and verify the condition of the battery. Is the generator sufficiently charged for testing? IMPORTANT: When measuring generator output current, be sure the inductive probe encircles the generator output wire.	Go to Step 3 Go to Battery Inspection/Test	-		
3	4. Connect an inductive ammeter probe to the output circuit of the generator. 1. Disconnect the Midtronics Digital Battery Analyzer. 2. Connect the Sun Vat 40 tester or equivalent to the battery. 5. Start the engine. 6. Increase engine speed to 2500 RPM. 3. Turn the ignition to the OFF/LOCK position. 7. Adjust the carbon pile as necessary in order to obtain the maximum battery voltage reading at the battery terminals on the Sun Vat 40 tester. 5. Start the engine and observe the system voltage reading on the tester. Is the generator output greater than or equal to the test value as specified in Generator Usage? Does the voltage increase from the first specified (engine OFF) to the second (engine ON) generator range?	Engine Off = B+ Engine On = 13.9 - 15.5 V System OK Go to Step 4 Go to Step 6			Go to Step 8
6	3. Turn the ignition to the ON position. 4. Using a DMM, measure the voltage on the L terminal circuit. Is the voltage greater than the specified value? 1. Turn the engine OFF.	0 V Go to Step 9 Go to Step 7			

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7 4	2. Start the engine and check the voltage on the L terminal accessories: headlights - Hi beams Is the voltage within the specified value? Turn the engine OFF. (If equipped) Inspect the generator B+ output terminal at the generator for an open or high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. IMPORTANT: When measuring generator output current, be sure the inductive probe encircles the generator output wire. Test the L terminal circuit for a short to voltage. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Connect an inductive ammeter probe to the output circuit of the generator. Did you find and correct the condition? Test the L terminal circuit for open or short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Adjust the carbon pile as necessary in order to obtain the maximum current output. Did you find and correct the condition? Inspect for poor connections at the generator. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Turn the engine OFF. Disconnect the generator harness connector. Did you find and correct the condition? Turn the ignition to the ON position. Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for	5 V 13.9 - 15.5 V	Go to Step 15	Go to Step 10	Go to Step 6
8 9 5 10 11	1. Turn OFF all accessories. 2. Turn OFF the ignition. 3. Connect a carbon pile tester to the vehicle. Did you find and correct the condition? Test the generator output wire for a short to voltage. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Connect an inductive ammeter probe to the output circuit of the generator. Did you find and correct the condition? Test the L terminal circuit for open or short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Adjust the carbon pile as necessary in order to obtain the maximum current output. Did you find and correct the condition? Inspect for poor connections at the generator. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Turn the engine OFF. Disconnect the generator harness connector. Did you find and correct the condition? Turn the ignition to the ON position. Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for	-	Go to Step 15	Go to Step 11	Go to Step 12
	1. Turn the engine OFF. 2. Disconnect the generator harness connector. Did you find and correct the condition? Turn the ignition to the ON position. Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for	-	Go to Step 15	Go to Step 14	Go to Step 14

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12 6	<u>Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems</u> Using a DMM, measure the voltage on the L terminal circuit. Did you find and correct the condition? Is the voltage greater than the specified value?	0 V	Go to Step 15	Go to Step 9	Go to Step 7	Go to Step 13
13	<u>The replacement PCM must be programmed.</u> 1. Turn the engine OFF. 2. Start the engine and check the voltage on the L terminal. Replace the PCM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for the voltage within the specified value for replacement, setup, and programming. Did you complete the replacement?	5 V	Go to Step 15	Go to Step 15	Go to Step 10	
14 8 15	<u>Generator Replacement</u> 1. Turn the engine OFF. Replace the generator. Refer to <u>Generator Replacement</u> in Computer/Integrating Systems for the open or replacement resistance. Refer to <u>Circuit Testing and Wiring Repairs</u> in Wiring Systems. Did you correct the condition?	- - -	Go to Step 15 Go to Step 15 System OK	- -	- -	Go to Step 2

CHARGE INDICATOR ALWAYS ON

Charge Indicator Always On

Step	Action	Value(s)	Yes	No
Connector End View Reference: <u>Engine Electrical Connector End Views</u>, <u>Engine Controls Component Views</u> in Engine Controls - 3.4L or <u>Powertrain Control Module (PCM) Connector End Views</u> in Engine Controls - 3.4L				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Start the engine. 2. Turn OFF all accessories. Does the battery charge indicator	-		Go to <u>Testing for Intermittent Conditions</u>

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Step	Action	Value(s)	Yes	No
Connector End View Reference: Engine Electrical Connector End Views - Engine Wiring Systems				
3	1. Install a scan tool. 2. Start the engine. 3. Turn OFF all accessories. 4. Increase engine speed to 1,500 RPM. 5. With a scan tool, observe the Battery 1 parameter in the body control module (BCM) data list, powertrain control module (PCM) data list, and the instrument panel cluster (IPC) data list. 6. Compare the voltages.	0.9-1.1 V	3	Go to Step 4
4	Are all of the voltages within the specified range? Are the voltages displayed within the specified range?	11.0-16.0 V	Go to Step 4	Go to Step 5
5	Test the battery positive voltage and ground circuits of the affected module for a high resistance or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 5	Go to Charging System Test
6	Inspect for poor connections at the harness connector of the affected module. Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 6
7	Replace the affected module. Refer to Control Module References in Computer/Integrating Systems. Did you complete the replacement?	-	Go to Step 8	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2

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CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
Connector End View Reference: <u>Engine Electrical Connector End Views</u>, <u>Engine Controls Component Views</u> in Engine Controls - 3.4L, or <u>Powertrain Control Module (PCM) Connector End Views</u> in Engine Controls - 3.4L			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	Turn ON the ignition, with the engine OFF. Does the battery charge indicator illuminate?	Go to Step 2 Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	
3	1. Install a scan tool. 2. With a scan tool, while observing the charge indicator, command the lamp and gages On and Off.		Go to Step 3
4	Does the charge indicator turn On and Off with each command? Test the generator turn on signal circuit for a short to ground or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 4 Go to Step 8	Go to Step 7 Go to Step 5
5	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	Replace the PCM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup and programming. Did you complete the replacement?	Go to Step 8	-

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Step	Action	Yes	No
7	Replace the instrument cluster (IPC). Refer to Control Module Reference in Engine Electrical Connector End Views, Engine Controls Components Views, Instrument Controls - 3.4L, or Powertrain Control Module (PCM) Connector End Views in Engine Controls - 3.4L .		
8	Did you complete the replacement, setup and programming?	Go to Step 8	Go to Diagnostic System Check - Vehicle
1	Did you perform the Diagnostic System Check - Vehicle?	System OK	Go to Step 2
	Did you correct the condition?		

GENERATOR NOISE DIAGNOSIS

Diagnostic Aids

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

Generator Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?		Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Test the generator for proper operation using the Generator Tester. Refer to Charging System Test . Is the generator operating properly?	Go to Step 2 Go to Step 3	Go to Step 12
3	1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the harness connector from the generator. 4. Start the engine. 5. Listen for the noise. Has the noise stopped?	Go to Step 12	Go to Step 4
	1. Turn OFF the engine.		

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Step	Action	Yes	No
2.	Remove the drive belt. Refer to <u>Drive Belt Replacement</u> in Engine Mechanical - 3.4L.		
4	3. Spin the generator pulley by hand.		
	Does the generator shaft spin smoothly and without any roughness or grinding noise?	Go to Step 5	Go to Step 12
5	Inspect the generator for a loose pulley and/or pulley nut.		
	Is the generator pulley or pulley nut loose?	Go to Step 12	Go to Step 6
	1. Loosen all of the generator mounting bolts.		
6	2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to <u>Generator Replacement</u> .		
	3. Install the drive belt. Refer to <u>Drive Belt Replacement</u> in Engine Mechanical - 3.4L.		
	4. Start the engine.		
	Has the noise decreased or stopped?	System OK	Go to Step 7
	Inspect the generator for the following conditions:		
7	• 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		
	Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?	Go to Step 8	Go to Step 9
8	1. Reroute the electrical connections to relieve the tension.		
	2. Reroute the hoses, etc. away from the generator.		

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1	3. Start the engine. Did you perform the Diagnostic System Check - Vehicle? Has the noise decreased or stopped? Inspect the drive belt for proper tension. Refer to Drive Belt Tensioner Diagnosis in the Generator for proper operation using the Generator Test. Refer to Charging System Test .	System OK Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information.
2	1. Replace the drive belt tensioner. Refer to Drive Belt Tensioner Replacement . Is the generator operating properly?	Go to Step 10 Go to Step 3	Go to Step 11 Go to Step 12
10	1. Start the engine. Verify that the noise can be heard. 2. Start the engine. 2. Turn OFF the engine. Has the noise decreased or stopped? 3. Disconnect the harness connector from the generator. Compare the vehicle with a known good vehicle. 4. Start the engine. Do both vehicles make the same noise? 5. Listen for the noise. IMPORTANT: If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.	System OK System OK Go to Step 12 Go to Step 12 Go to Step 12	Go to Step 12 Go to Step 12 Go to Step 4
12	1. Turn OFF the engine. 2. Remove the drive belt. Refer to Drive Belt Replacement in the Generator or the Generator mounting. 3. Spin the generator pulley by hand. Replace the generator. Refer to Generator Replacement . Does the generator shaft spin smoothly and without any roughness or grinding noise?	Go to Step 13 Go to Step 5	Go to Step 13 Go to Step 13
13	Operate the system in order to verify the repair. Inspect the generator for a loose pulley and/or pulley nut. Did you correct the condition? Is the generator pulley or pulley nut loose?	System OK Go to Step 12	Go to Step 2 Go to Step 6

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Power and Grounding Connector End Views in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?		Go to Diagnostic System Check - Vehicle in Vehicle

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2 3 4 5	Turn the ignition switch to the START position. Is the security indicator On? Turn the ignition switch to the START position. Does the starter solenoid click? 1. With a scan tool, observe the Crank Request Signal parameter in the Engine Electrical powertrain control module (PCM) data list. 2. Turn the ignition to the START position. Does the scan tool display that the Crank Request Signal parameter is Yes? 1. With a scan tool, observe the Starter Relay Command parameter in the PCM data list. 2. Turn the ignition switch to the START position. Does the scan tool display that the Starter Relay Command parameter is ON?	Go to Step 2 Go to <u>Security Indicator Always On or Flashing</u> in Theft Deterrent Go to <u>Starter Solenoid Clicks, Engine Does Not Crank</u> Go to Step 5 Go to Step 7	DTC Information Go to Step 3 Go to Step 4 Go to <u>Power Mode Mismatch</u> in Computer/Integrating Systems Go to Step 6
6	1. Turn ON the ignition, with the engine OFF. 2. Verify that the transmission is in Park or Neutral. 3. With a scan tool, observe the TR Sw. parameter in the PCM data list. Does the scan tool display Park or Neutral?	Go to Step 7	Go to <u>Range Selector Displays Incorrect Range</u> in Automatic Transaxle - AF33-5
	1. Disconnect the starter relay. 2. Turn the ignition ON. 3. Connect a test light between the		

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Step	starter relay circuit and a good ground.	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Power and Grounding Connector End Views in Wiring Systems			
	Does the test light illuminate?	Go to Step 8	Go to Step 13
1 8	Did you connect the Diagnostic System battery positive voltage circuit and the starter relay coil control circuit of the starter relay. Go to Step 2	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Turn the ignition switch to the START position. Is the security indicator On? Does the test light illuminate? 1. Disconnect the starter relay.	Go to Security Indicator Always On or Flashing in Theft Deterrent Go to Step 9	Go to Step 12 Go to Step 3
9	Turn the ignition switch to the START position. 2. Turn the ignition ON. 3. Connect a test light between the starter relay switch supply voltage circuit and good ground. Does the starter solenoid click?	Go to Starter Solenoid Clicks, Engine Does Not Crank	Go to Step 4
	Does the test light illuminate?	Go to Step 10	Go to Step 14
10	1. With a scan tool, observe the Crank Request Signal parameter in the battery positive voltage circuit and the starter solenoid crank voltage circuit of the starter relay. Does the engine crank?	Go to Step 17	Go to Step 11
11	Does the fuse in the jumper open?	Go to Step 16	Go to Step 15
12	Test the STARTER relay coil control circuit of the PCM for an open or high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 23	Go to Step 18
13	Repair the battery positive voltage circuit of the relay coil. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 23	-
14	Repair the starter relay switch supply voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 23	-
15	Test the starter solenoid crank voltage circuit of the starter relay for an open or high resistance. Refer to Circuit Testing		

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	and Wiring Repairs in Wiring Systems.		
4	Did you find a PCM data list condition?	Go to Step 23	Go to Step 19
16	Test the starter solenoid to the STAGE circuit of the starter relay for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.		Go to Power Mod Mismatch in Computer/Integrati
	Did the scan tool display that the Crank Request signal parameter is Yes?	Go to Step 5	Go to Step 22
17	Inspect for poor conditions at the starter relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.		
5	2. Turn the ignition switch to the START position. Did you find and correct the condition?	Go to Step 23	Go to Step 20
	Inspect for poor connections at the harness connectors of the plodisplay that the Starter Relay C PCM and Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.	Go to Step 7	Go to Step 6
18	1. Turn ON the ignition, with the engine OFF. 2. Verify that the transmission is in Park or Neutral. Did you find and correct the condition?	Go to Step 23	Go to Step 21
6	Inspect for poor connections at the harness connector of the starter solenoid. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.		Go to Range Selector Display Incorrect Range Automatic Transax - AF33-5
19	3. With a scan tool, observe the TR Sw. parameter in the PCM data list. Does the scan tool display Park or Neutral?	Go to Step 7	
	Did you find and correct the condition?	Go to Step 23	Go to Step 22
7	Replace the starter relay. Refer to Relay Replacement (Within an Electrical Center) or Relay Replacement (Attached to Wire Harness) in Wiring Systems.		
20	Did the test light the replacement?	Go to Step 8	Go to Step 13
21	1. Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup and programming.		
8	Did you complete the replacement?	Go to Step 23	-
22	2. Turn the ignition switch to the START position. Replace the starter. Refer to Starter Motor Replacement . Did you complete the replacement?	Go to Step 23	-
23	Operate the system for which the symptom occurred.		

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Did you test the condition?

System Step 9

Go to Step 12

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> Connector End View Reference: <u>Power and Grounding Connector End Views</u> in Wiring Systems			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to Step 3	Go to Starter Solenoid Does Not Click
3	Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator. Does the engine move freely?	Go to Step 4	Go to Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical-3.4L
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 5
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the starter. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the starter. Refer to Starter Motor Replacement . Did you complete the replacement?	Go to Step 8	-

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Step	Action	Yes	No
8	Operate the system for which the symptom occurred.	System OK	Go to Step 2
Schematic Reference: <u>Starting and Charging Systems</u>			

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** , and **Connector Repairs** in Wiring Systems.
- 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**.

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

- Inspect the flywheel ring gear for damage or unusual wear.
- Stuck relays or other electrical problems may also cause the starter drive to remain engaged.
- Shim the starter as required.
- In order to add pinion to ring gear clearance a full size shim must be used. Do not shim only one starter mounting bolt. There are 3 shims available in different shapes, for clearance, all are 1 mm (0.039 in) thick.

Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	Start the engine. Does the starter operate normally?	Go to <u>Testing for Intermittent Conditions and Poor</u>	

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		<u>Connections</u> in Wiring Systems	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	IMPORTANT: This is often diagnosed as a starter drive gear hang-in or a weak solenoid. Refer to Diagnostic Aids. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to Step 8	Go to Step 7
6	Inspect the flywheel ring gear for the following: • Chipped gear teeth • Missing gear teeth • Milled teeth Is the flywheel bent, or does it have damaged teeth?	Go to Step 9	Go to Step 10
7	1. Remove the starter motor. Refer to <u>Starter Motor Replacement</u> . 2. Inspect the starter motor bushings and clutch gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to Step 10	Go to Step 9
8	Shim the starter motor away from the flywheel by adding shims between the starter motor and the engine block one at a time. Flywheel runout may make this noise appear		

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Step	to be intermittent. Action	Yes	No
9	Did you complete the repair? Replace the flywheel. Refer to Engine Flywheel Replacement in Engine Mechanical - 3.4L. Did you complete the replacement?	Go to Step 11	Go to Diagnosis System Check Vehicle in Vehicle DTC Information
10	Replace the starter motor. Refer to Starter Motor Replacement . Did you complete the replacement?	Go to Testing for Intermittent Conditions and Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	Poor Connections in Wiring Systems	Go to Step 3

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE

Removal Procedure

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

1. Record all of the customers radio station presets.
2. Turn OFF all the lamps and accessories.
3. Make sure the ignition switch is in the OFF position.

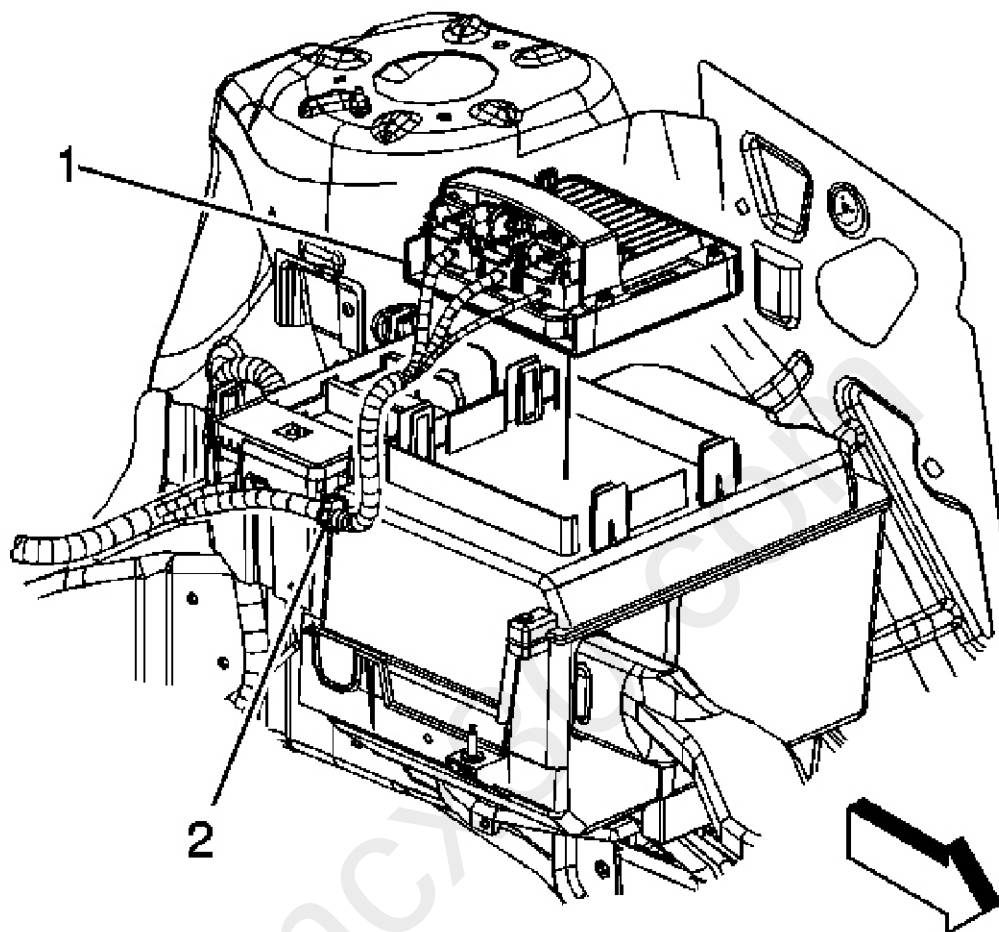


Fig. 6: View Of PCM, Bracket & Wire Harness
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the powertrain control module (PCM) wire harness (2) from the battery box cover.
5. Remove the PCM bracket with PCM (1) from the top of the battery box cover.
6. Carefully position the PCM and bracket out of the way.

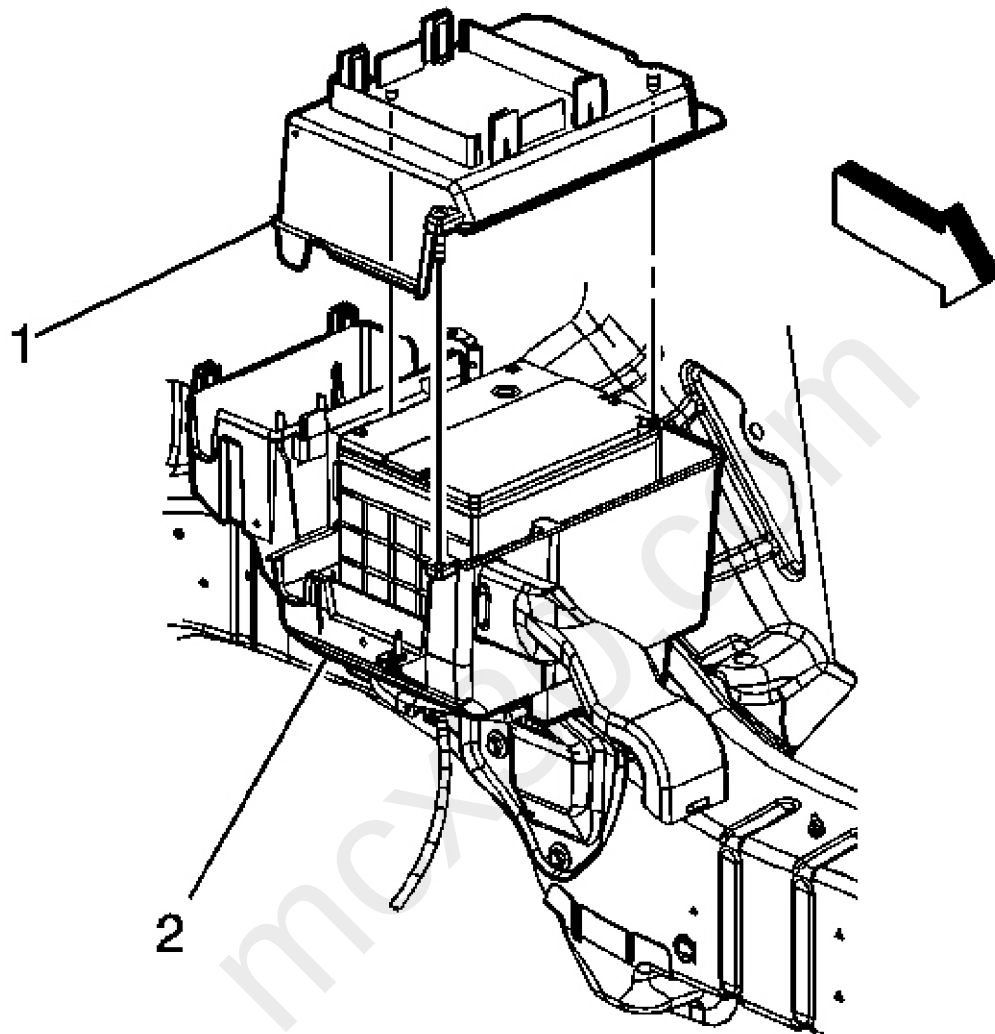


Fig. 7: View Of Battery Box Cover
Courtesy of GENERAL MOTORS CORP.

7. Loosen the screws securing the battery box cover.
8. Remove the battery box cover (1).

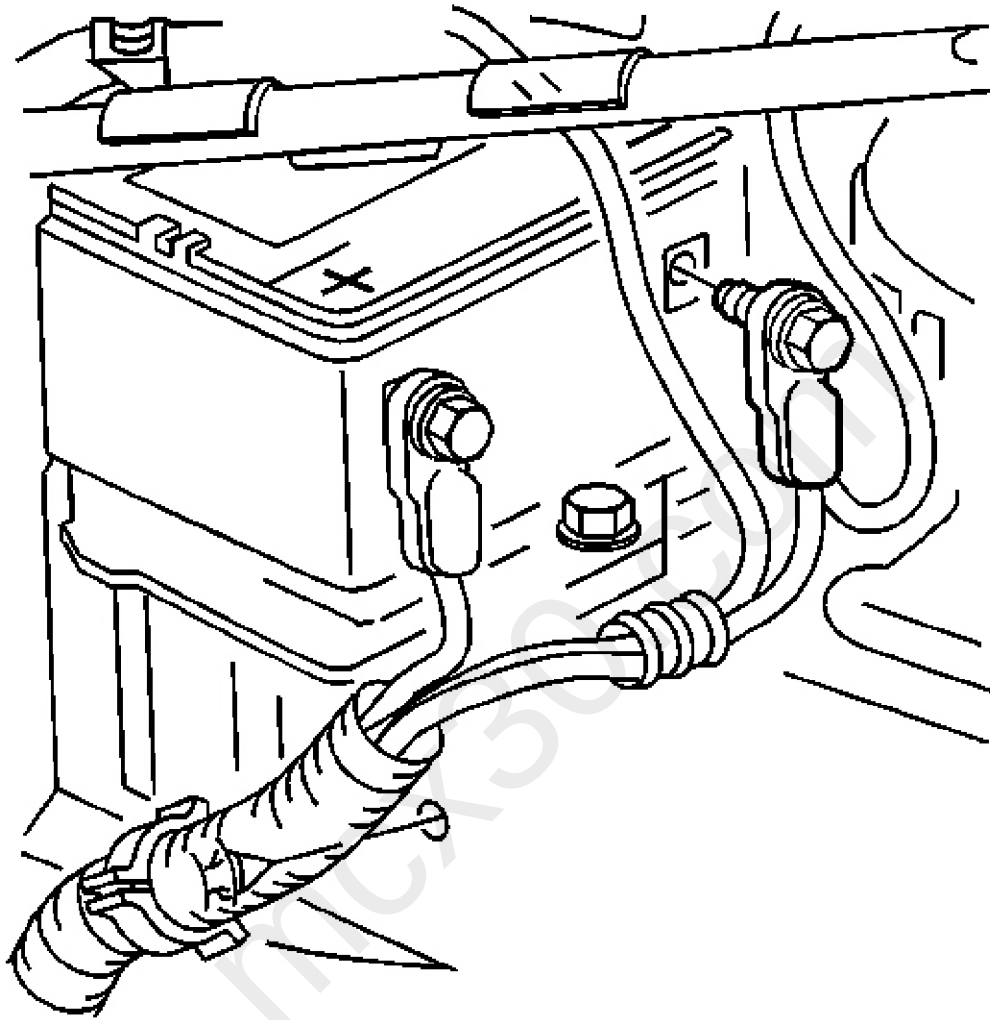


Fig. 8: View Of Battery Ground (Negative) Cable And Bolt
Courtesy of GENERAL MOTORS CORP.

9. Loosen the battery negative cable terminal bolt.
10. Remove the battery negative cable from the battery.

Installation Procedure

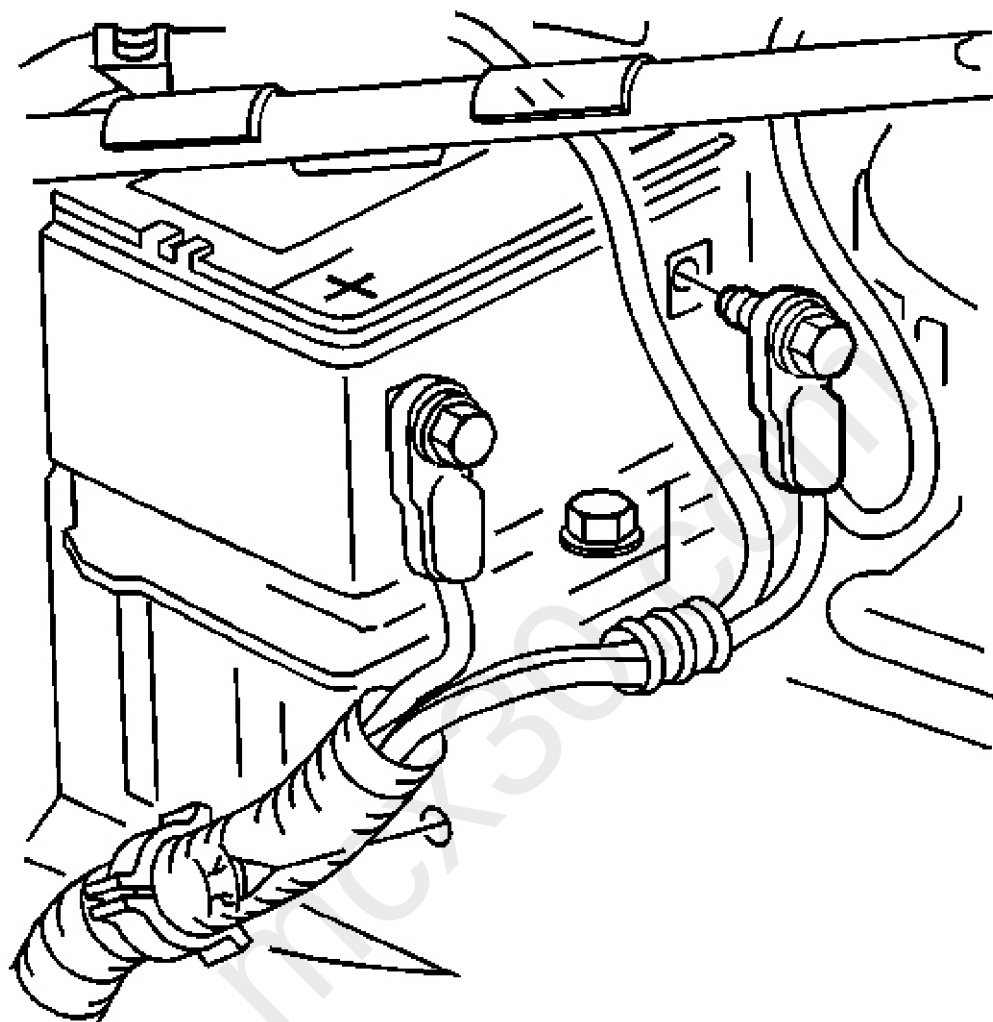


Fig. 9: View Of Battery Ground (Negative) Cable And Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

1. Install the battery negative cable to the battery.

Tighten: Tighten the battery negative cable terminal bolt to 17 N.m (13 lb ft).

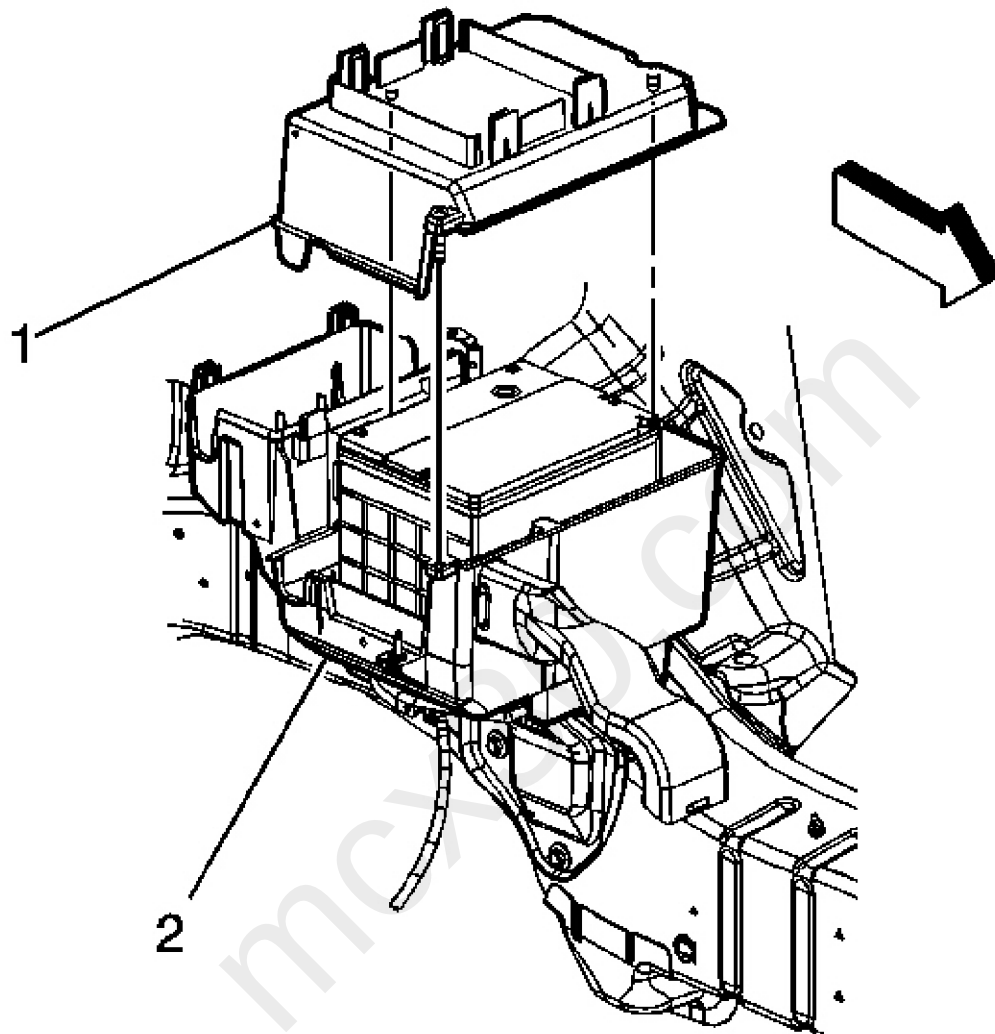


Fig. 10: View Of Battery Box Cover
Courtesy of GENERAL MOTORS CORP.

2. Install battery box cover (1).

Tighten: Tighten the battery box cover screws to 2 N.m (18 lb in).

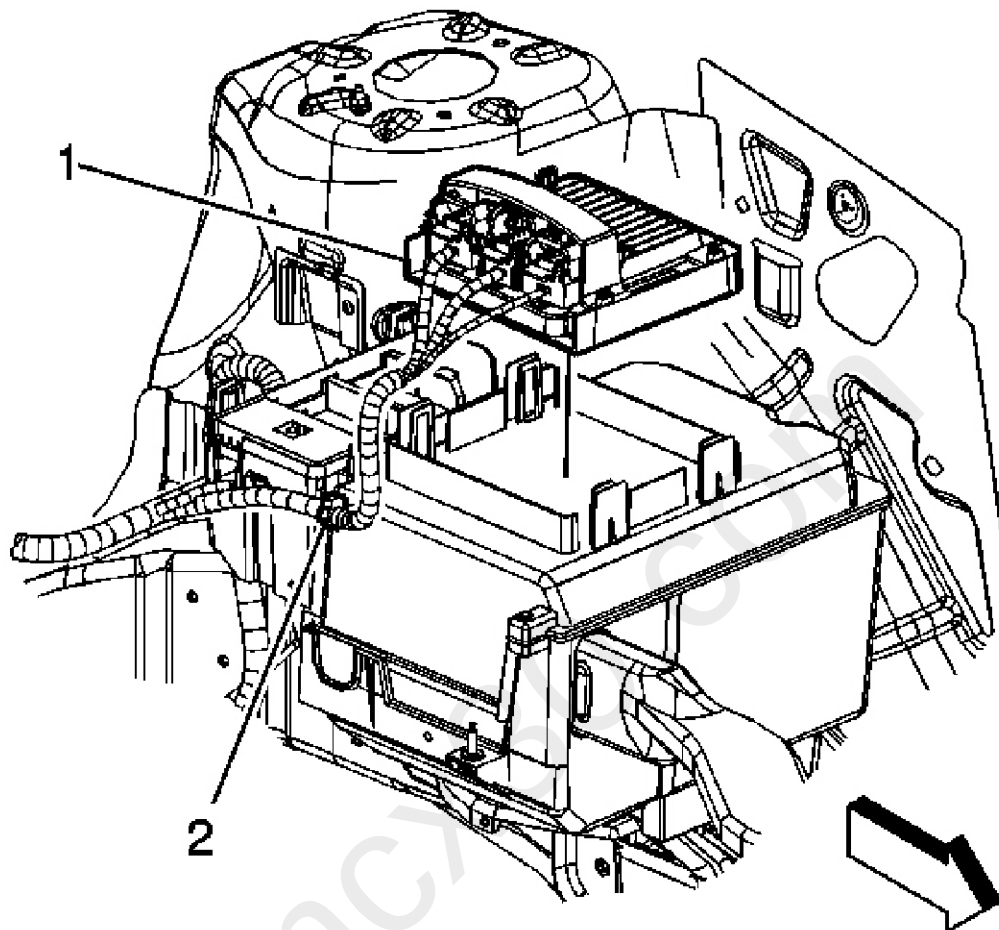


Fig. 11: View Of PCM, Bracket & Wire Harness
Courtesy of GENERAL MOTORS CORP.

3. Install the PCM and bracket to the battery box cover.
4. Connect the PCM wire harness (2) to the battery box cover.
5. Program all of the customer's radio station presets and set the radio clock to the current time.

BATTERY NEGATIVE CABLE REPLACEMENT

Removal Procedure

IMPORTANT:

- Always use replacement cables that are of the same type, diameter and length of the cables that you are replacing.

- Always route the replacement cable the same way as the original cable.

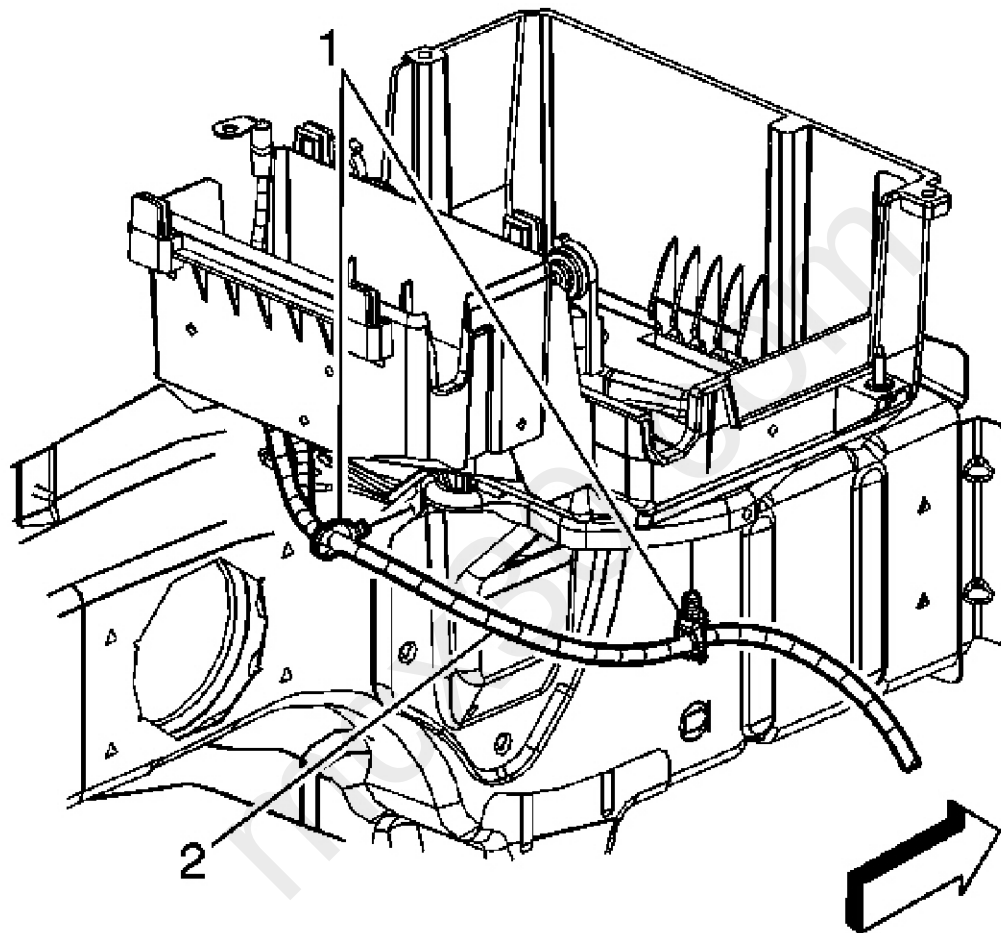


Fig. 12: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery box. Refer to **Battery Box Replacement**.
2. Disconnect the battery cable retainers (1) from the battery tray.

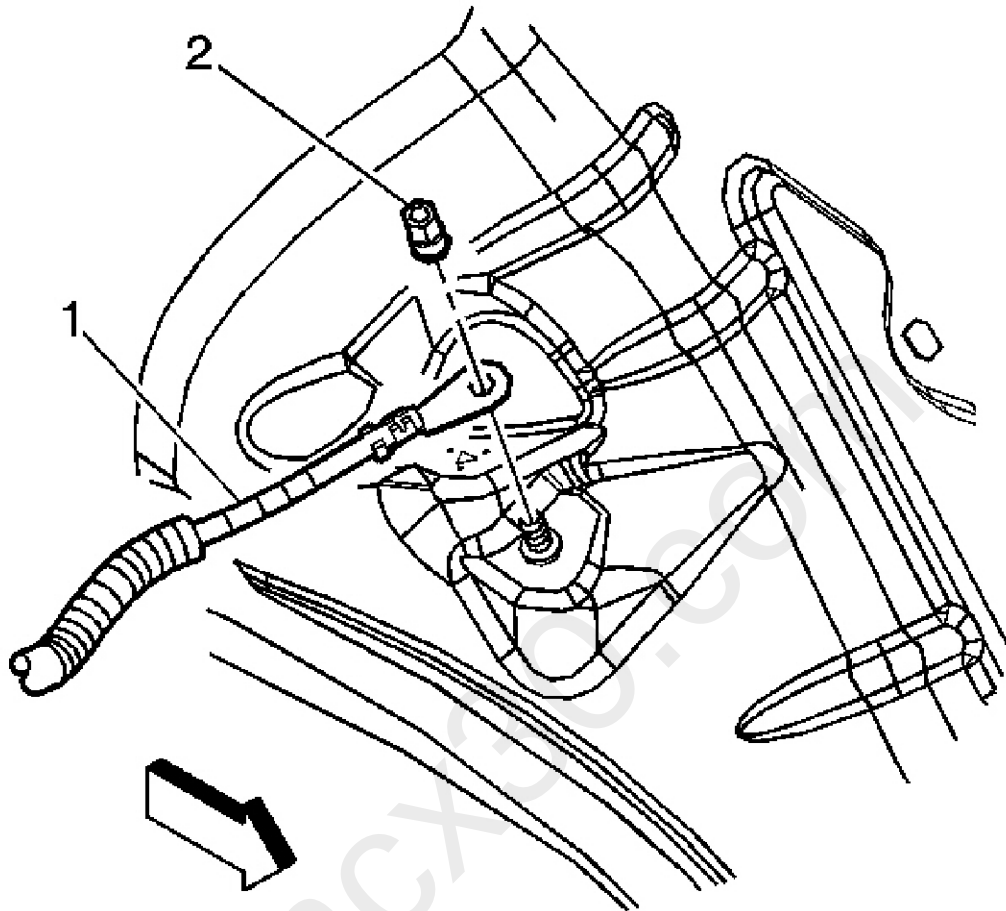


Fig. 13: View Of Negative Battery Cable At Inner Fender Body Ground Stud
Courtesy of GENERAL MOTORS CORP.

3. Remove the negative battery cable nut (2) and cable (1) from the inner fender body ground stud.

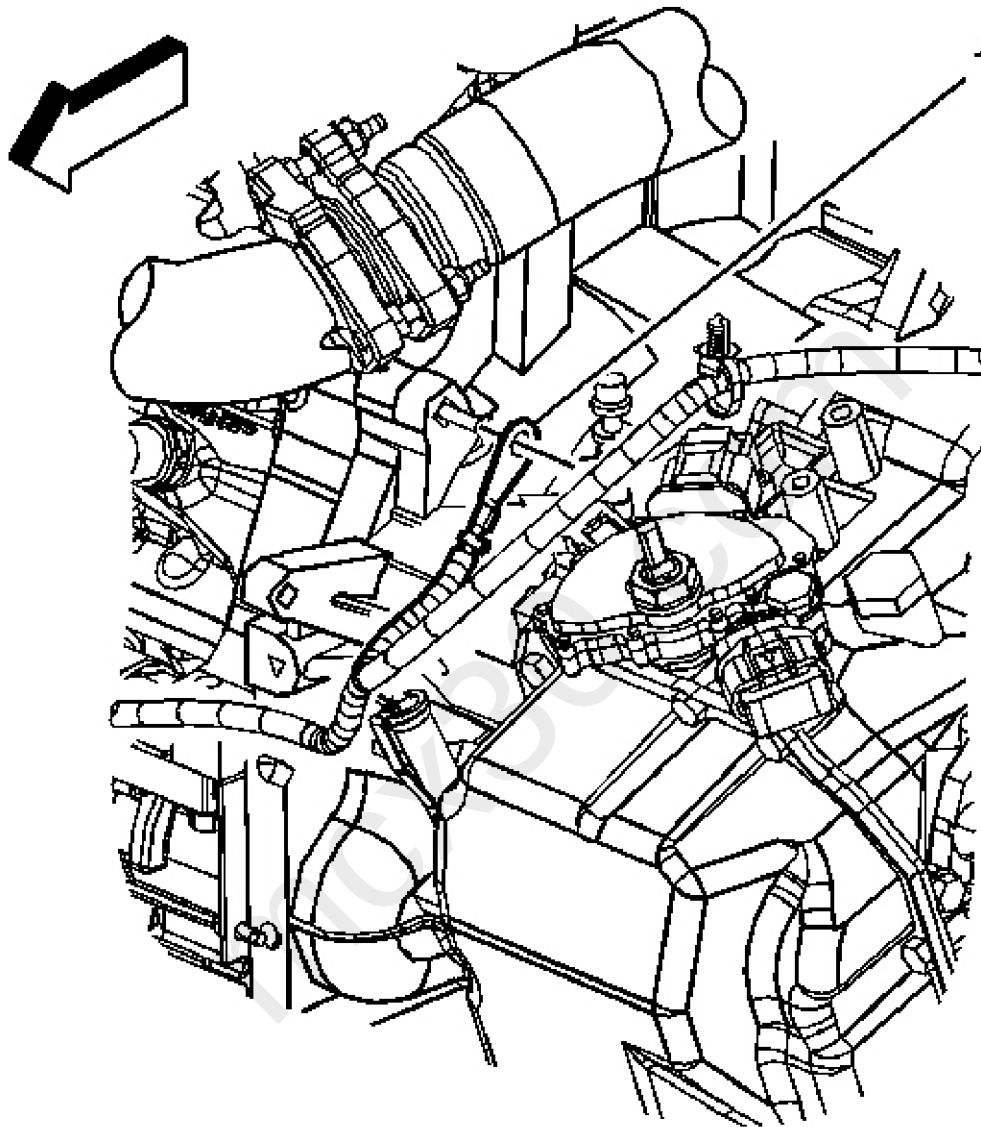


Fig. 14: View Of Negative Battery Cable At Transaxle Stud
Courtesy of GENERAL MOTORS CORP.

4. Remove the negative battery cable nut and cable (1) from the transaxle stud.
5. Remove the negative battery cable from the wire loom.

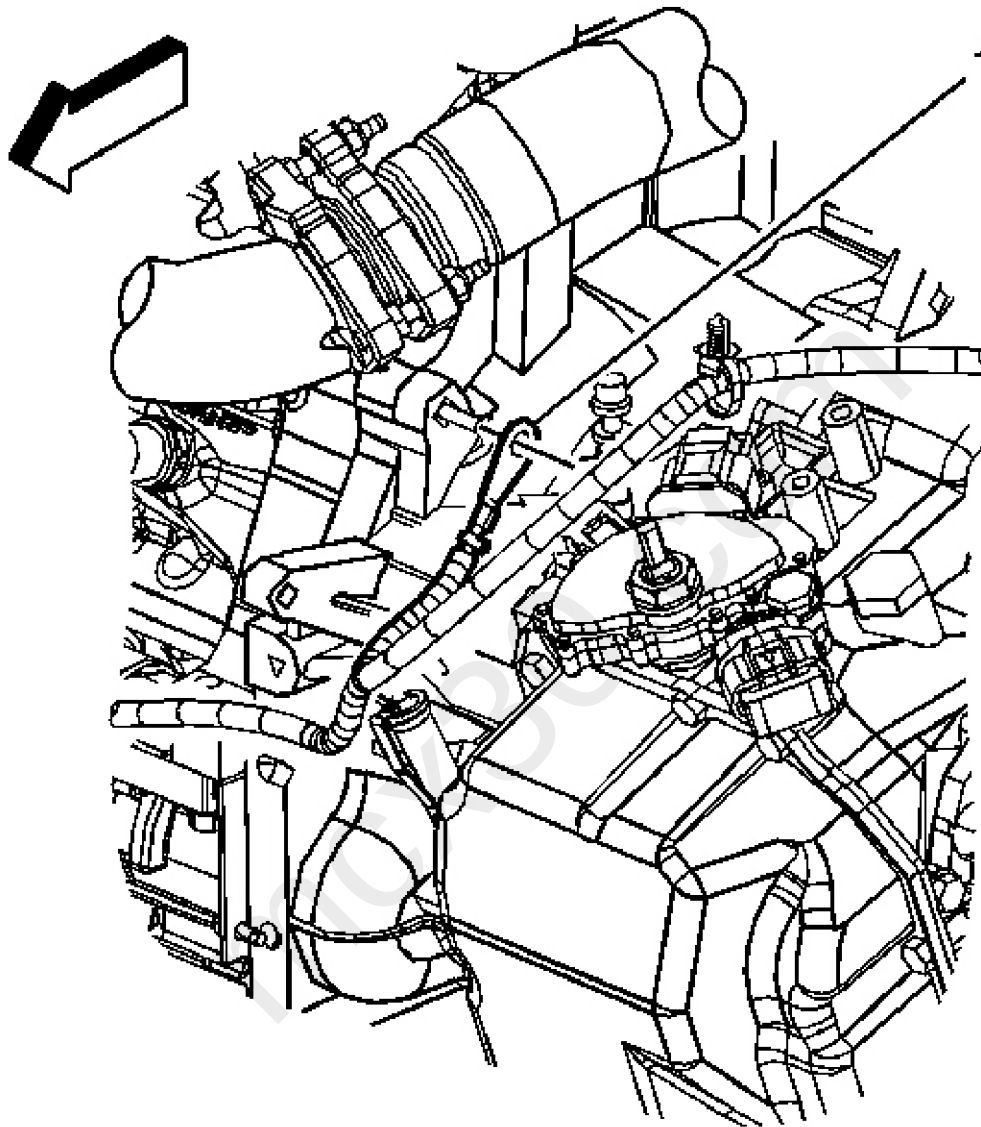


Fig. 15: View Of Negative Battery Cable At Transaxle Stud
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable into the wire loom.
2. Connect the negative battery cable (1) to the transaxle stud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the negative battery cable nut to the transaxle stud.

Tighten: Tighten the nut to 45 N.m (33 lb ft).

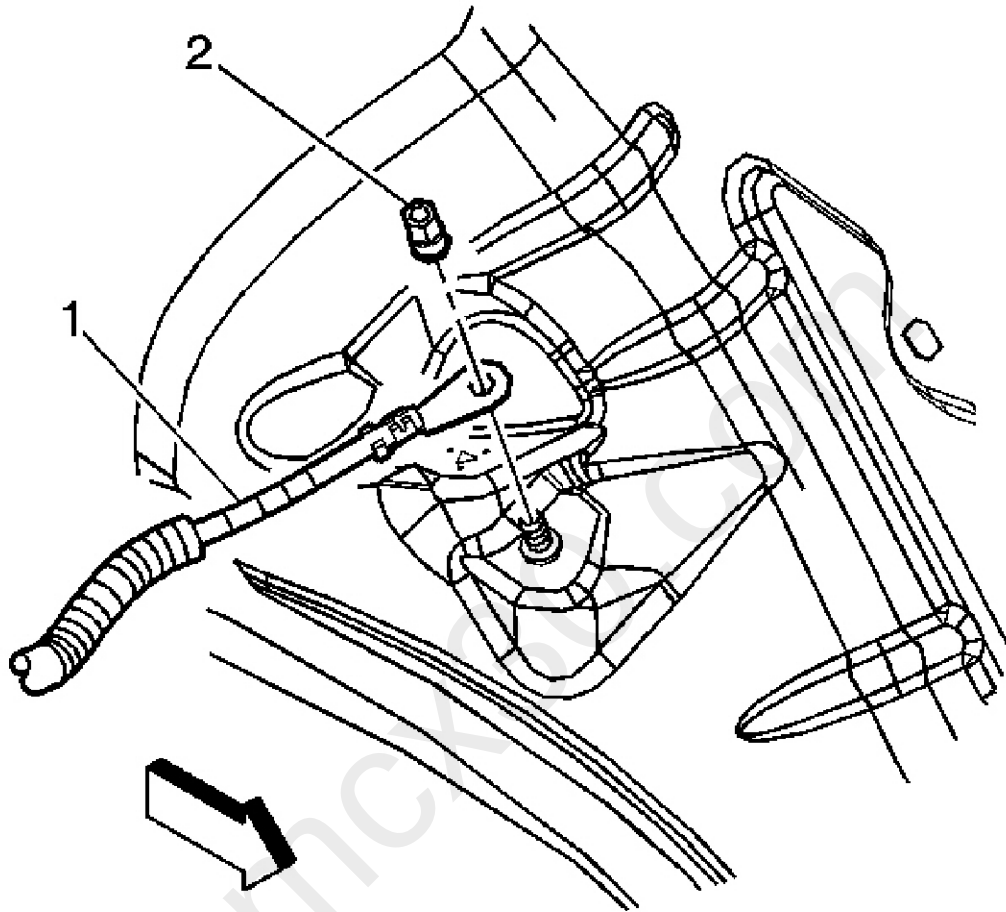


Fig. 16: View Of Negative Battery Cable At Inner Fender Body Ground Stud
Courtesy of GENERAL MOTORS CORP.

4. Install the negative battery cable (1) to the inner fender body ground stud.
5. Install the negative battery cable body ground nut (2).

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

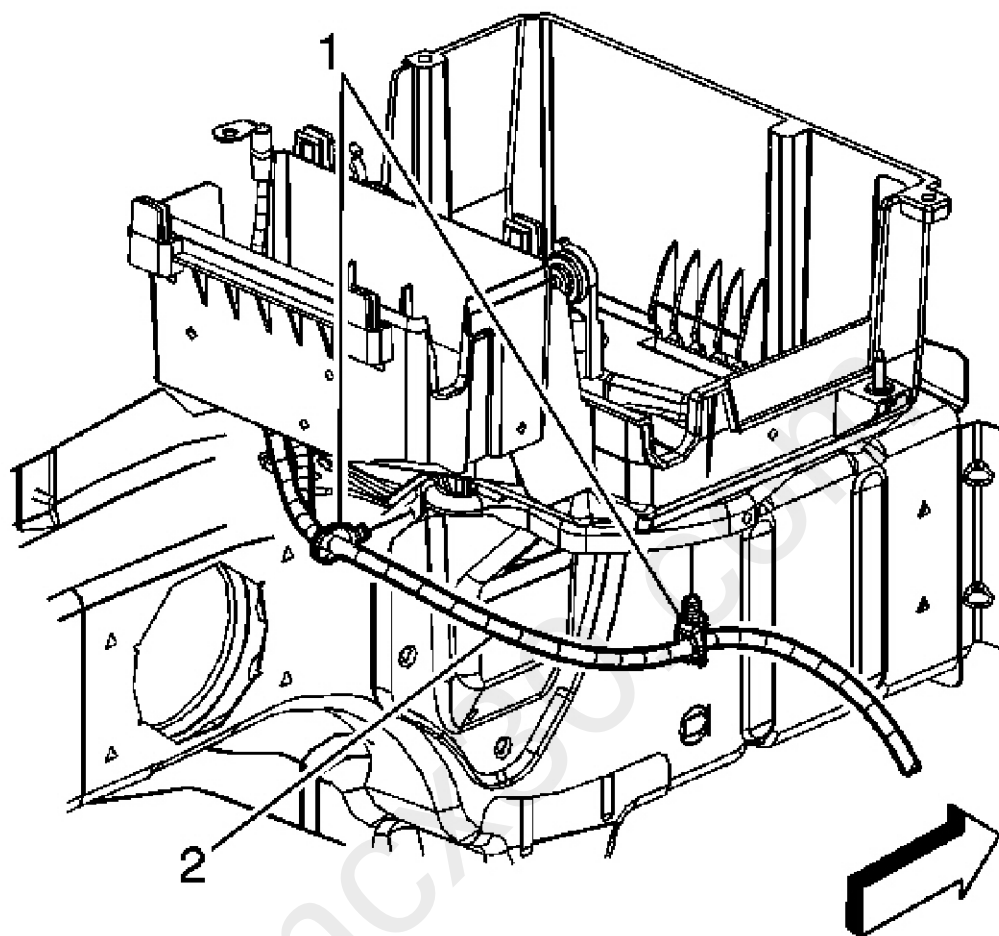


Fig. 17: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

6. Connect the battery cable retainers (1) to the battery tray.
7. Install the battery box. Refer to **Battery Box Replacement**.

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

IMPORTANT:

- Always use replacement cables that are of the same type, diameter and length of the cables that you are replacing.
- Always route the replacement cable the same way as the original cable.

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

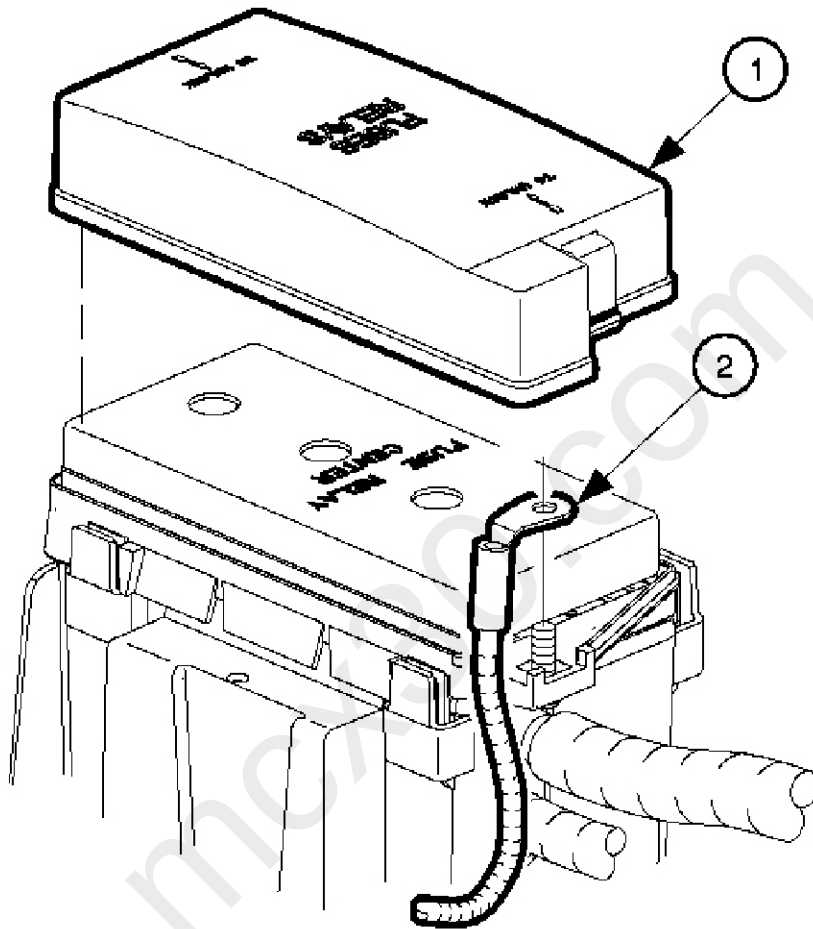


Fig. 18: Removing/Installing Underhood Electrical Wiring
Courtesy of GENERAL MOTORS CORP.

2. Remove the underhood fuse block (UHFB) cover.
3. Remove the positive battery cable nut from the UHFB.
4. Remove the positive battery cable (2) from the UHFB.

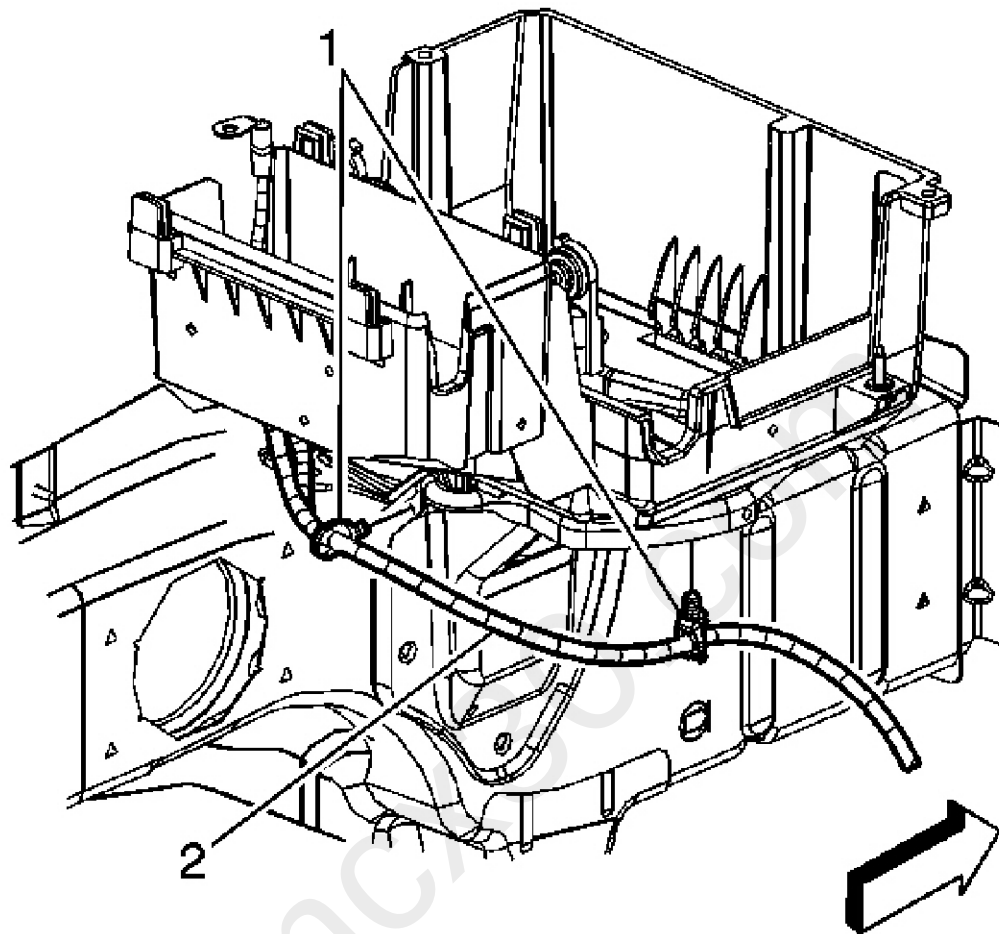


Fig. 19: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

5. Remove the battery box. Refer to **Battery Box Replacement**.
6. Disconnect the battery cable retainers (1) from the battery tray.

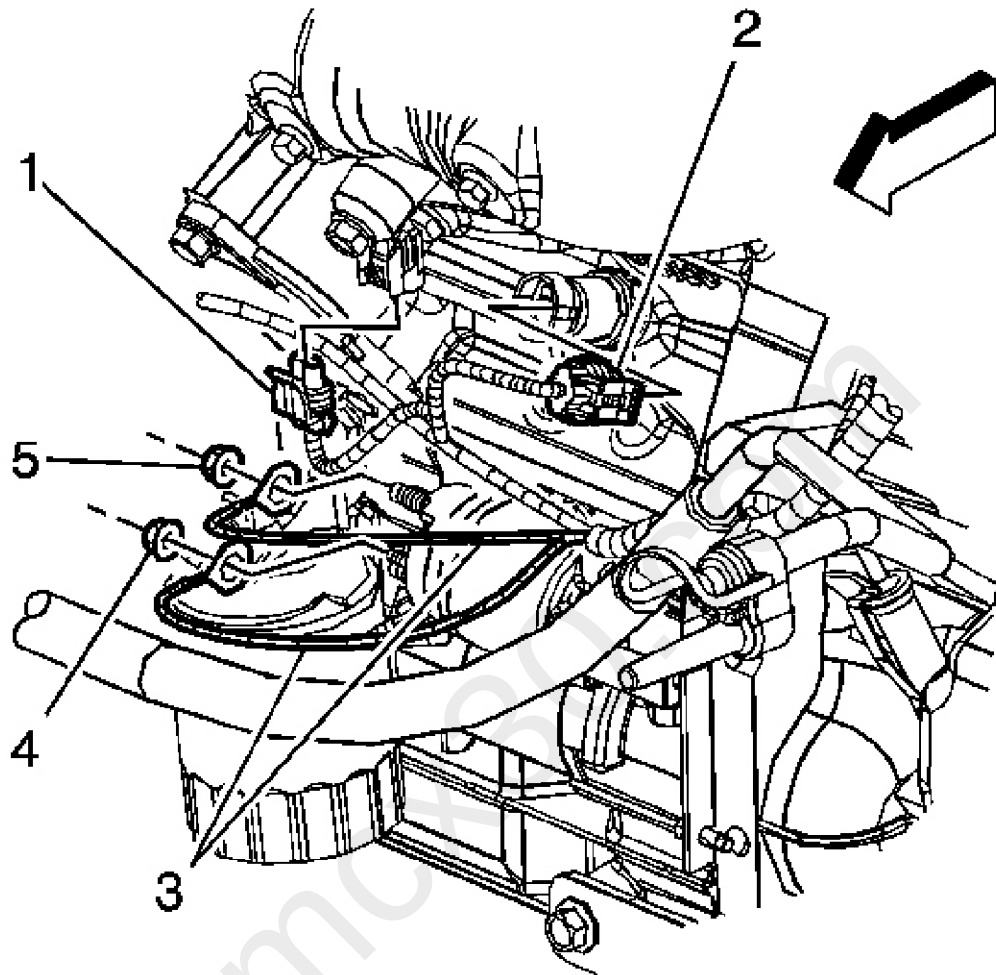


Fig. 20: View Of Knock Sensor & Oil Pressure Indicator Switch Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

7. Remove the positive battery terminal nut (5) from the starter solenoid.

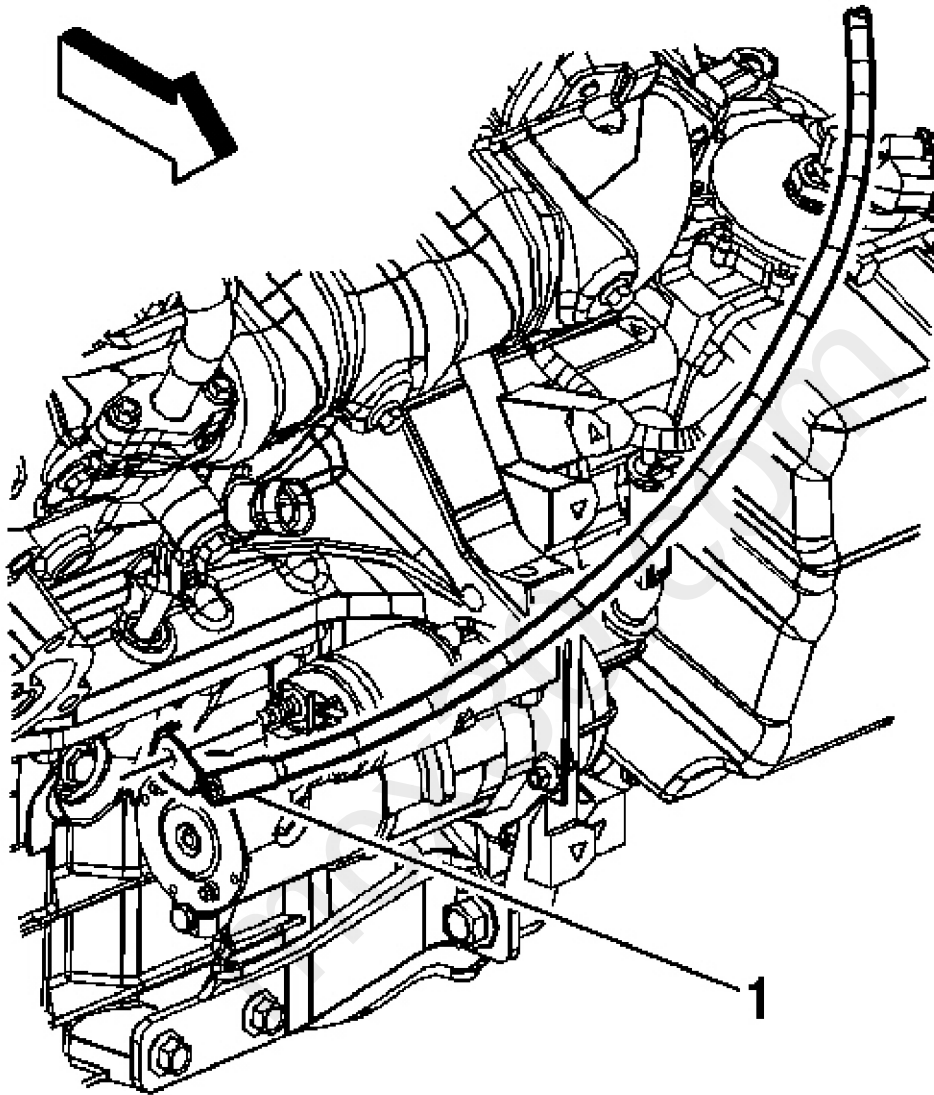


Fig. 21: View Of Positive Battery Cable At Starter Solenoid
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the positive battery cable (1) from the starter solenoid.
9. Remove the positive battery cable from the wire loom.

Installation Procedure

1. Install the positive battery cable into the wire loom.

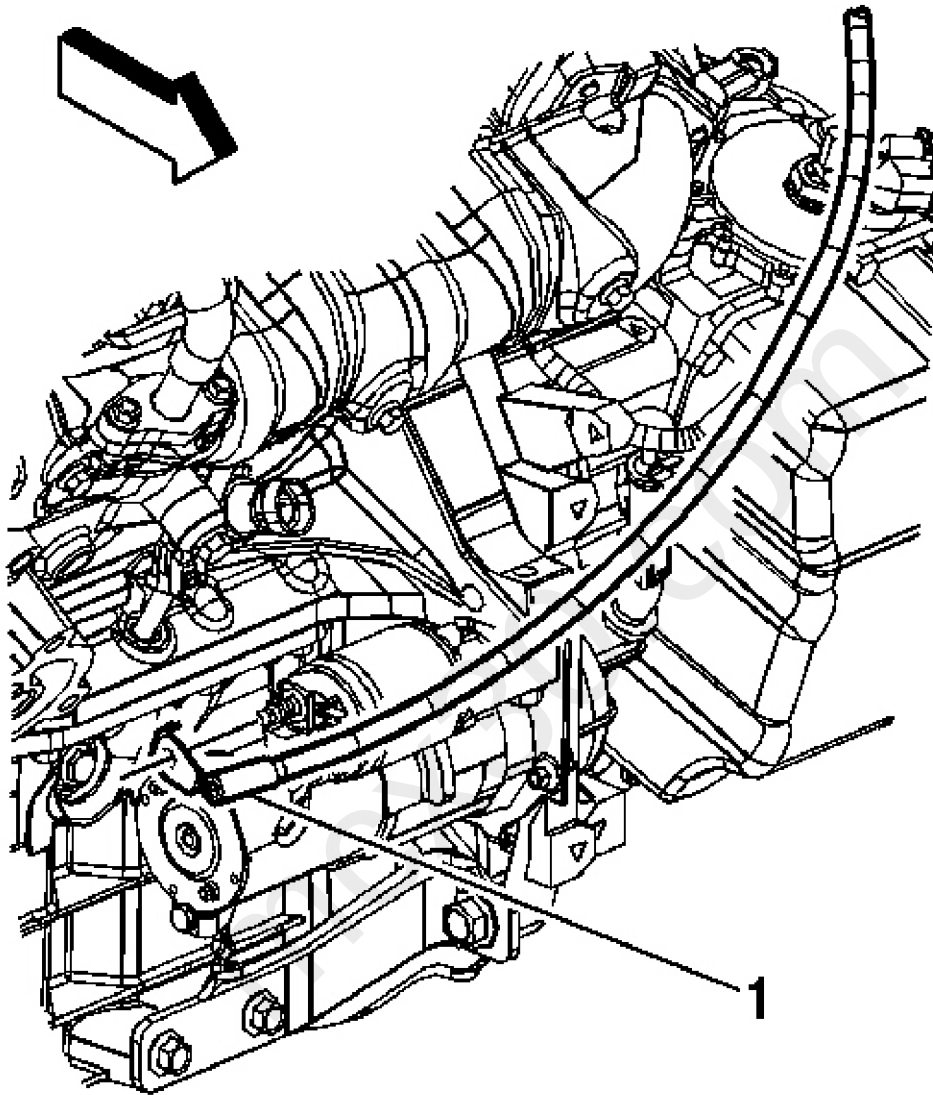


Fig. 22: View Of Positive Battery Cable At Starter Solenoid
Courtesy of GENERAL MOTORS CORP.

2. Connect the positive battery cable (1) to the starter solenoid.

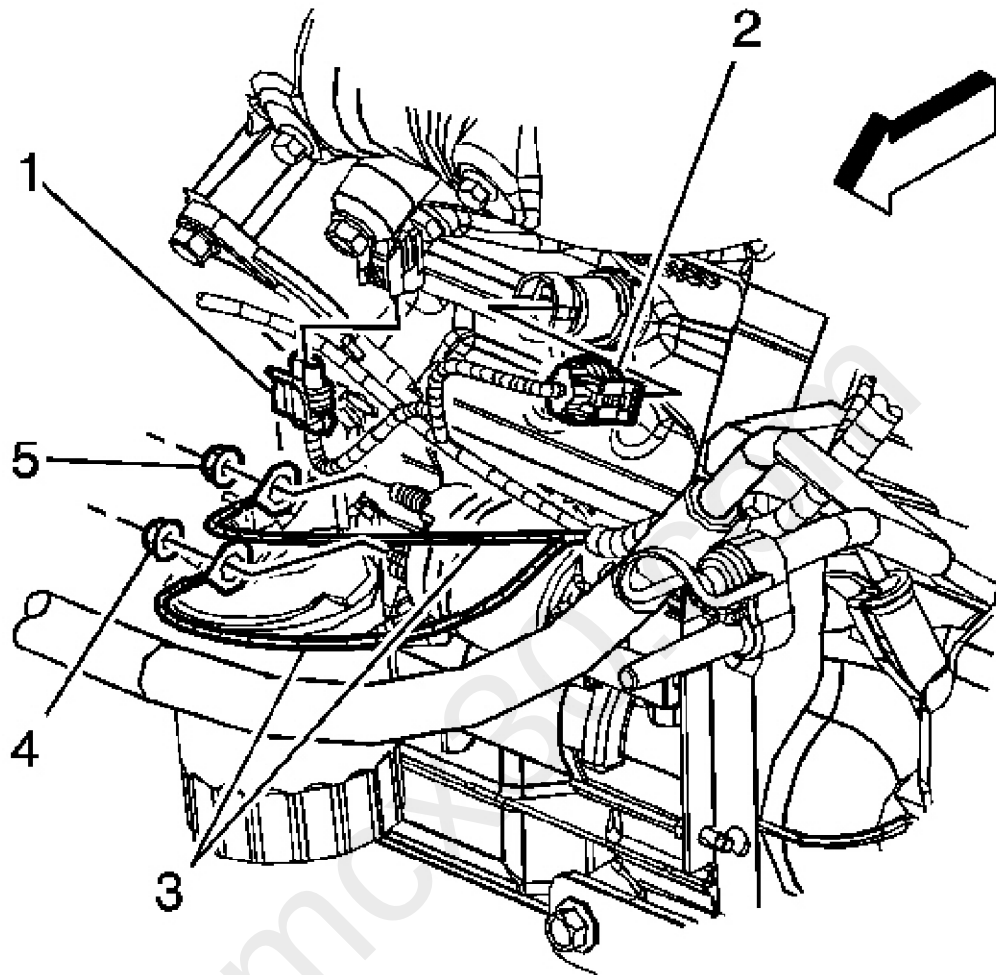


Fig. 23: View Of Knock Sensor & Oil Pressure Indicator Switch Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the positive battery terminal nut (5) to the starter

Tighten: Tighten the nut to 10 N.m (89 lb ft).

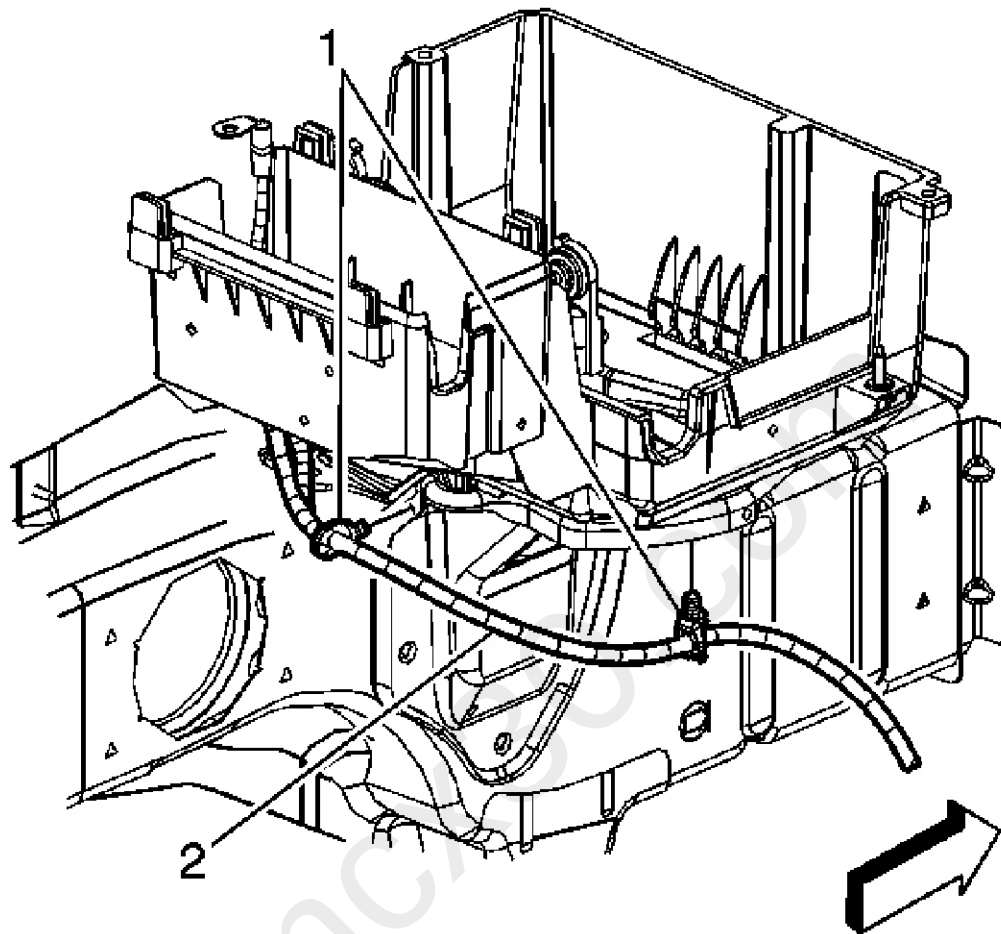


Fig. 24: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

4. Connect the battery cable retainers (1) to the battery tray.
5. Install the battery box. Refer to **Battery Box Replacement**.

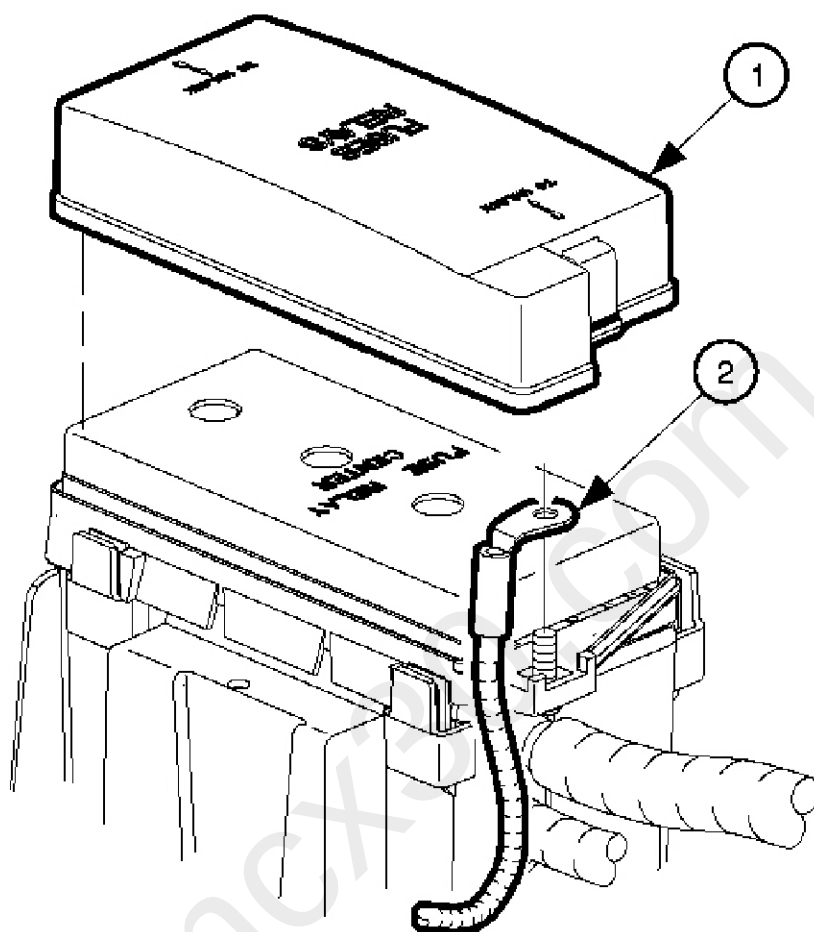


Fig. 25: Removing/Installing Underhood Electrical Wiring
Courtesy of GENERAL MOTORS CORP.

6. Install the positive battery cable (2) to the UHFB.
7. Install the positive battery cable nut to the UHFB.

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

8. Install the UHFB cover.
9. Install the battery. Refer to **Battery Replacement**.

BATTERY REPLACEMENT

Removal Procedure

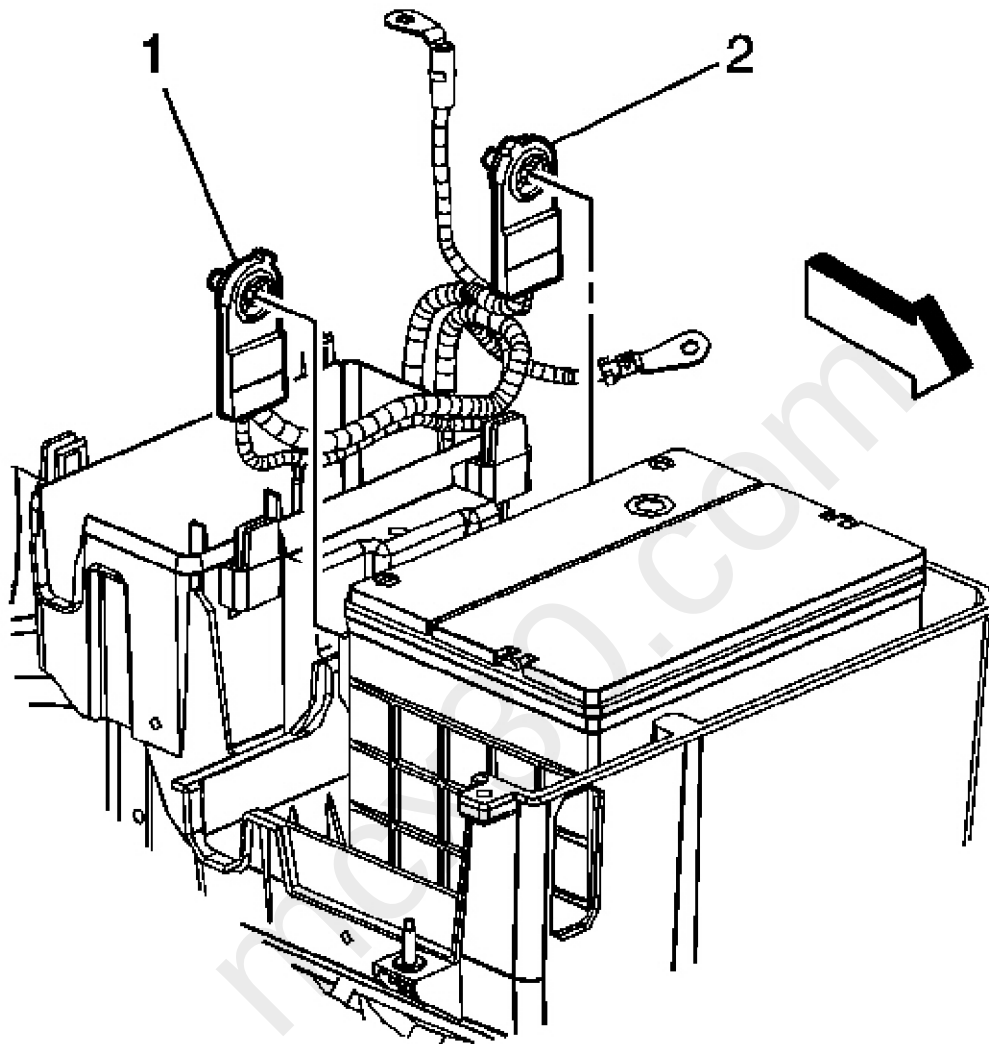


Fig. 26: View Of Negative & Positive Battery Cables
Courtesy of GENERAL MOTORS CORP.

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

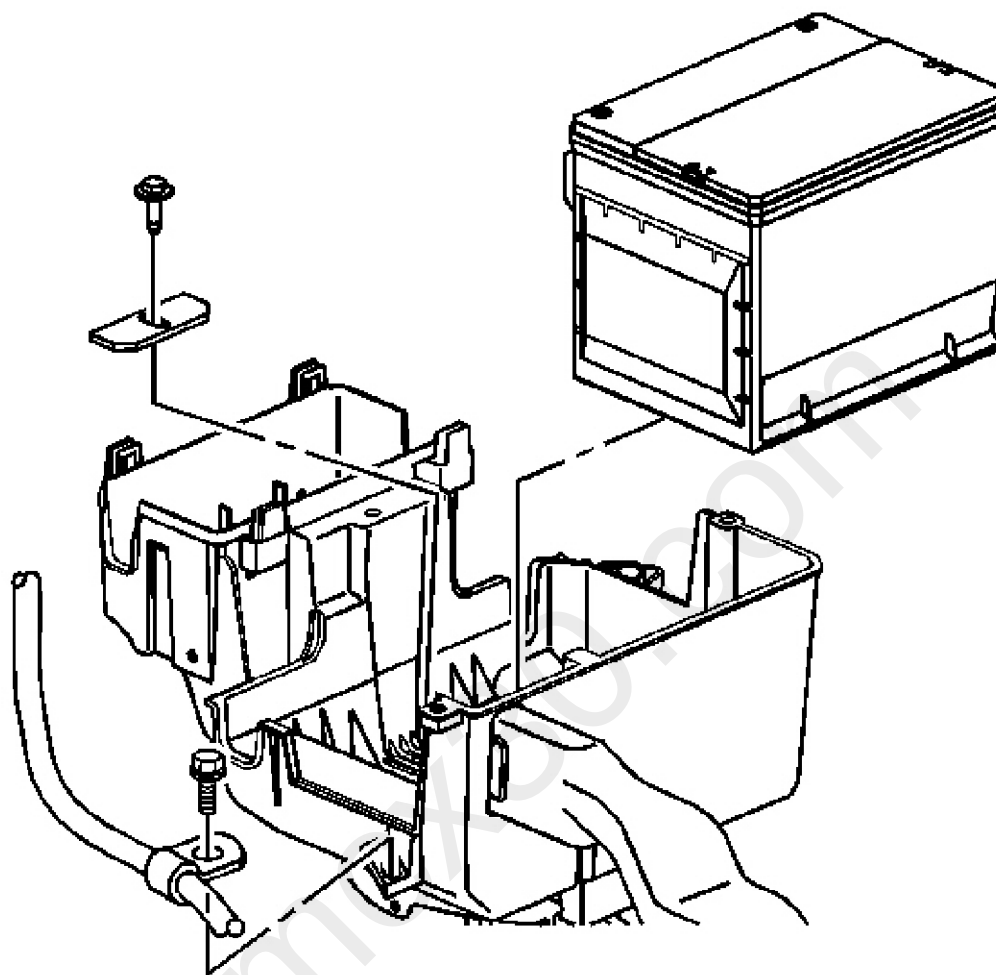


Fig. 27: View Of Battery & A/C Evaporator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.

4. Loosen the battery hold down bolt.
5. Remove the battery from the battery box.

Installation Procedure

CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.

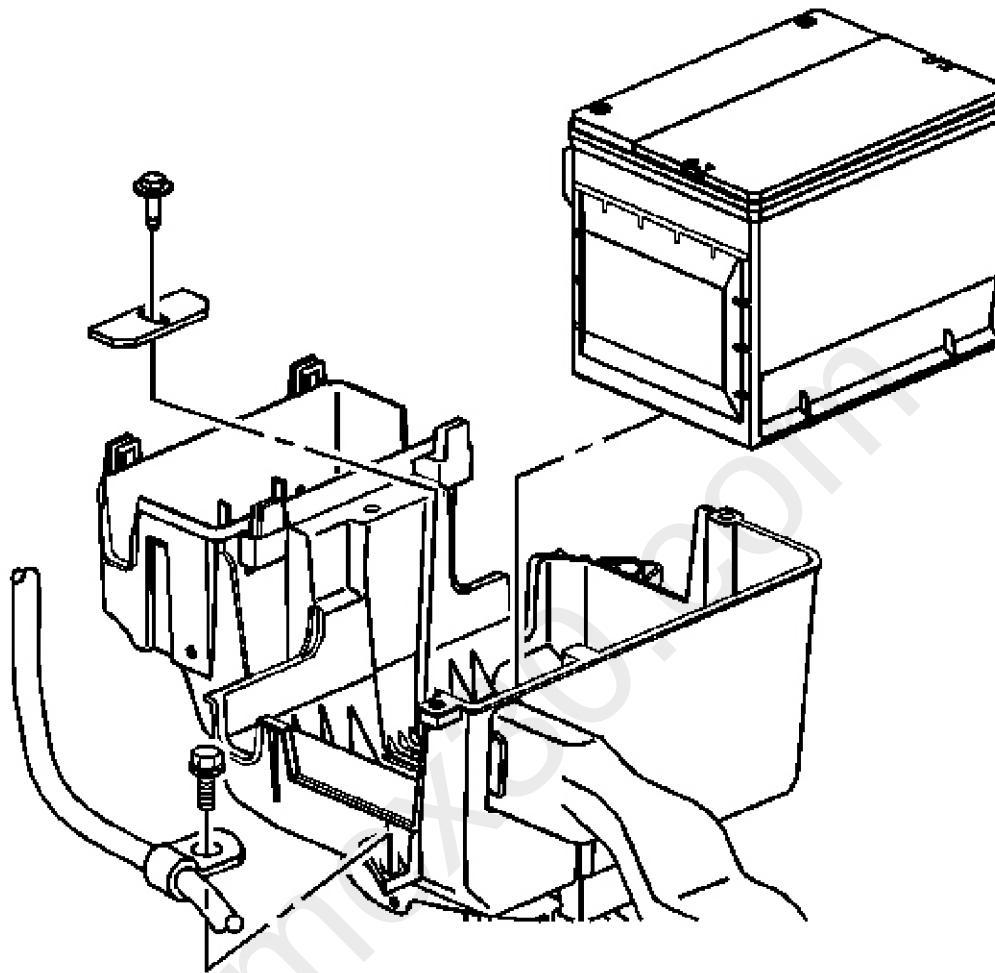


Fig. 28: View Of Battery & A/C Evaporator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the battery to the battery box.

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

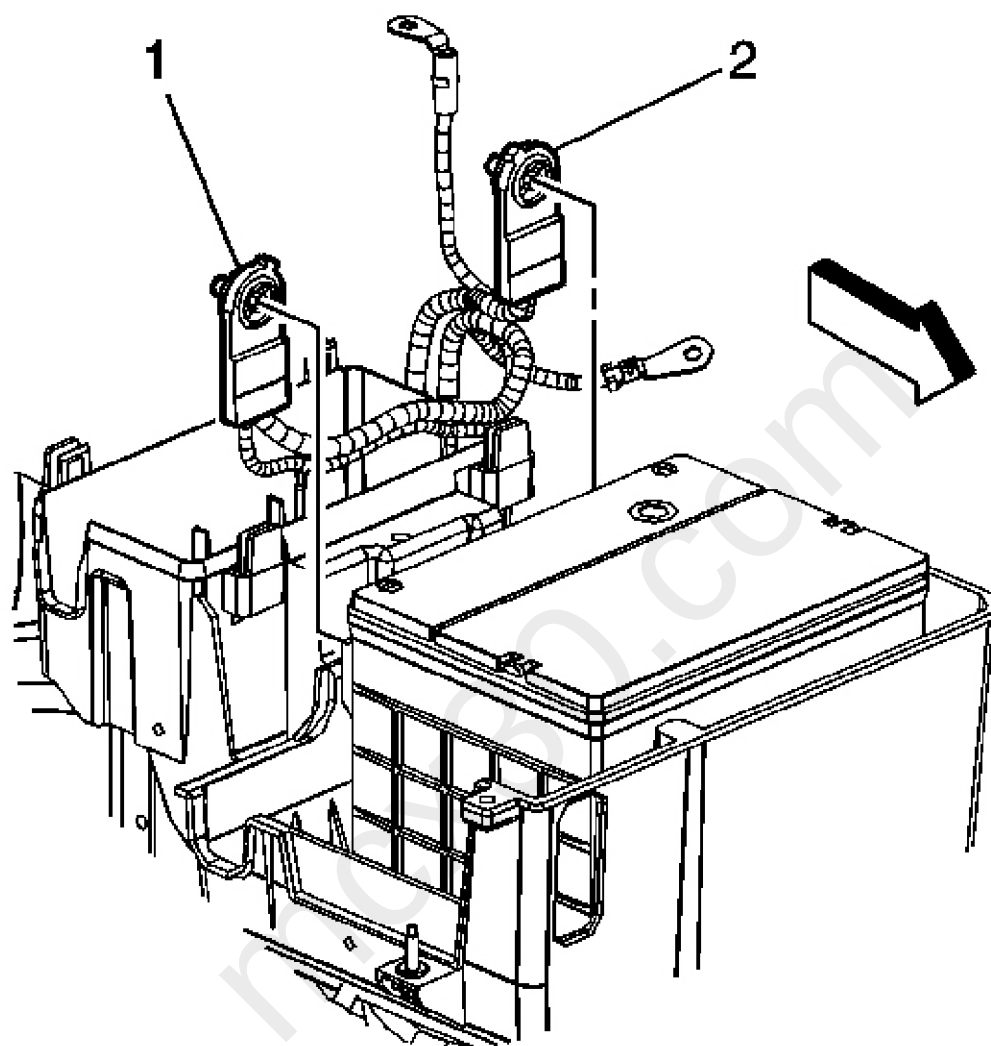


Fig. 29: View Of Negative & Positive Battery Cables
Courtesy of GENERAL MOTORS CORP.

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

Tighten: Tighten the positive battery terminal bolt to 17 N.m (13 lb ft).

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

BATTERY TRAY REPLACEMENT

Removal Procedure

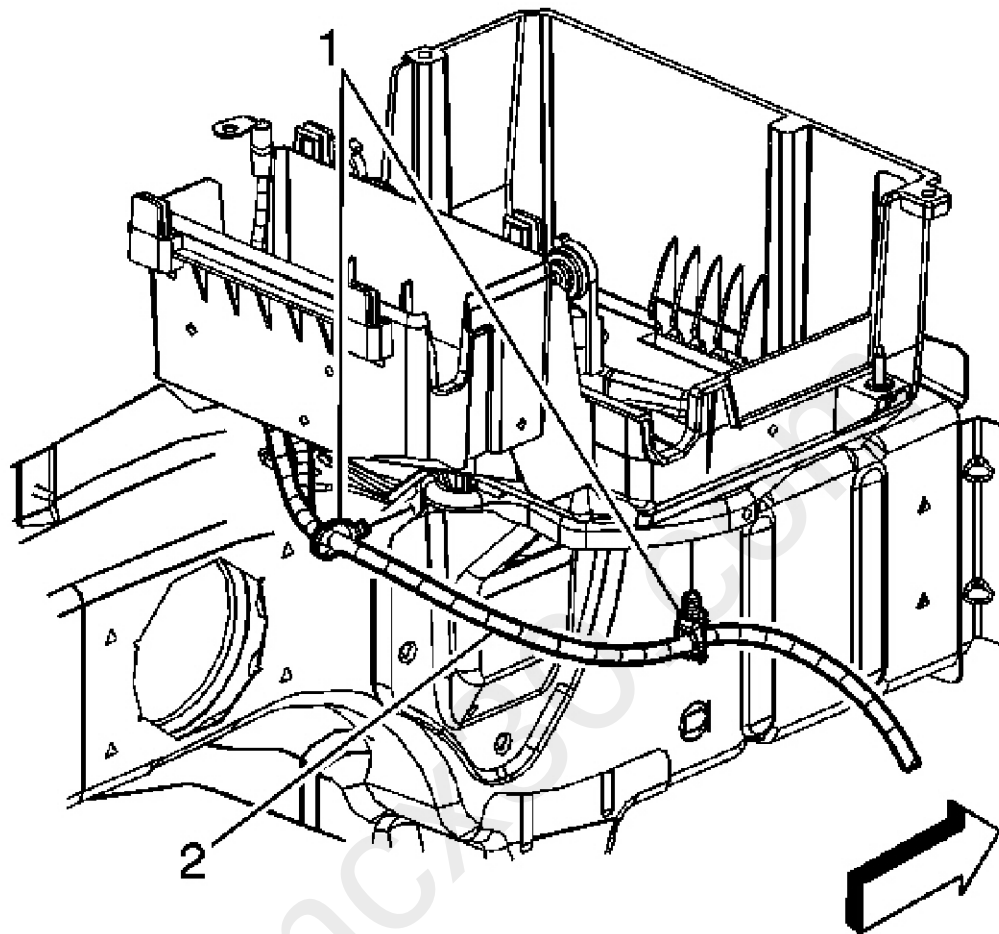


Fig. 30: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery box. Refer to **Battery Box Replacement**.
2. Disconnect the battery cable retainers (1) from the battery tray.

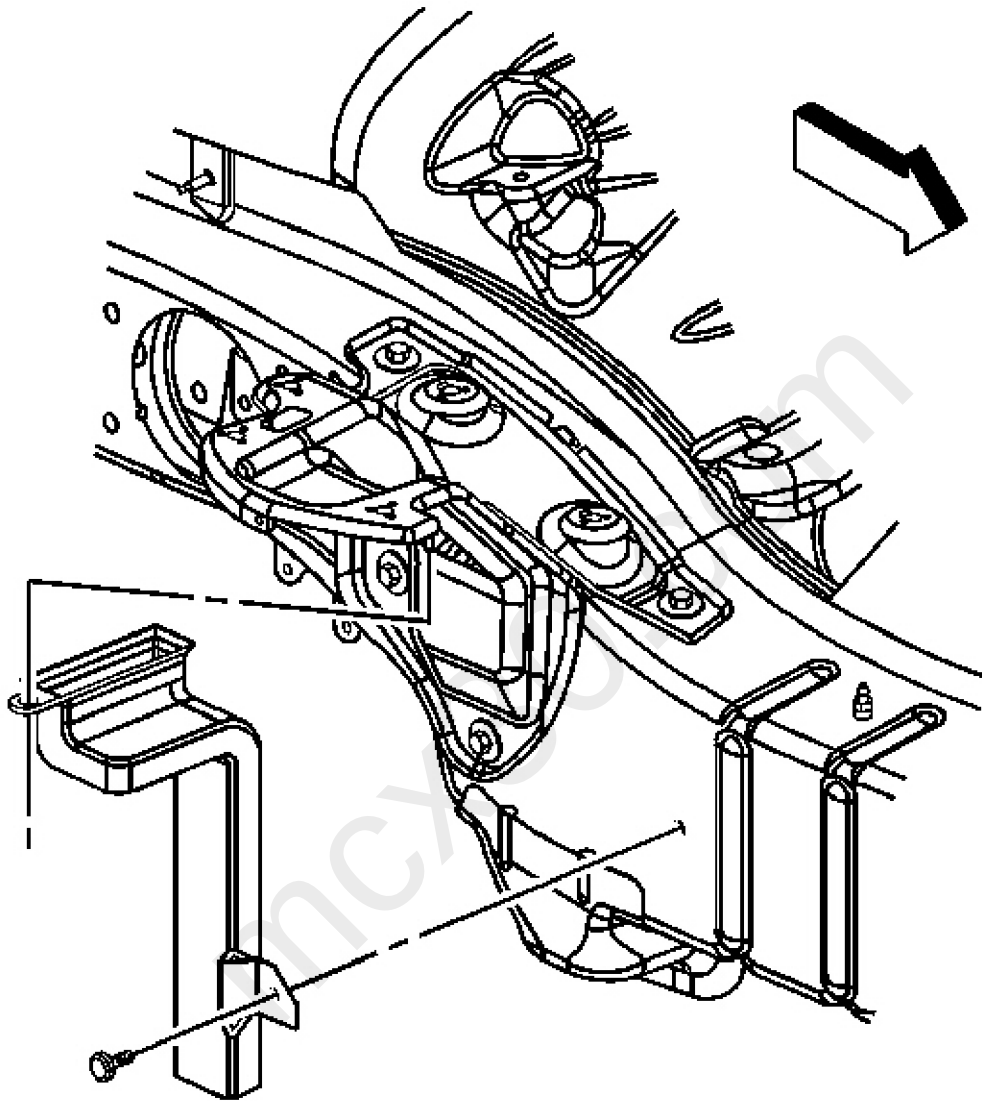


Fig. 31: View Of Battery Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

3. Remove the battery air outlet duct fastener.
4. Remove the battery air outlet duct from the battery tray.

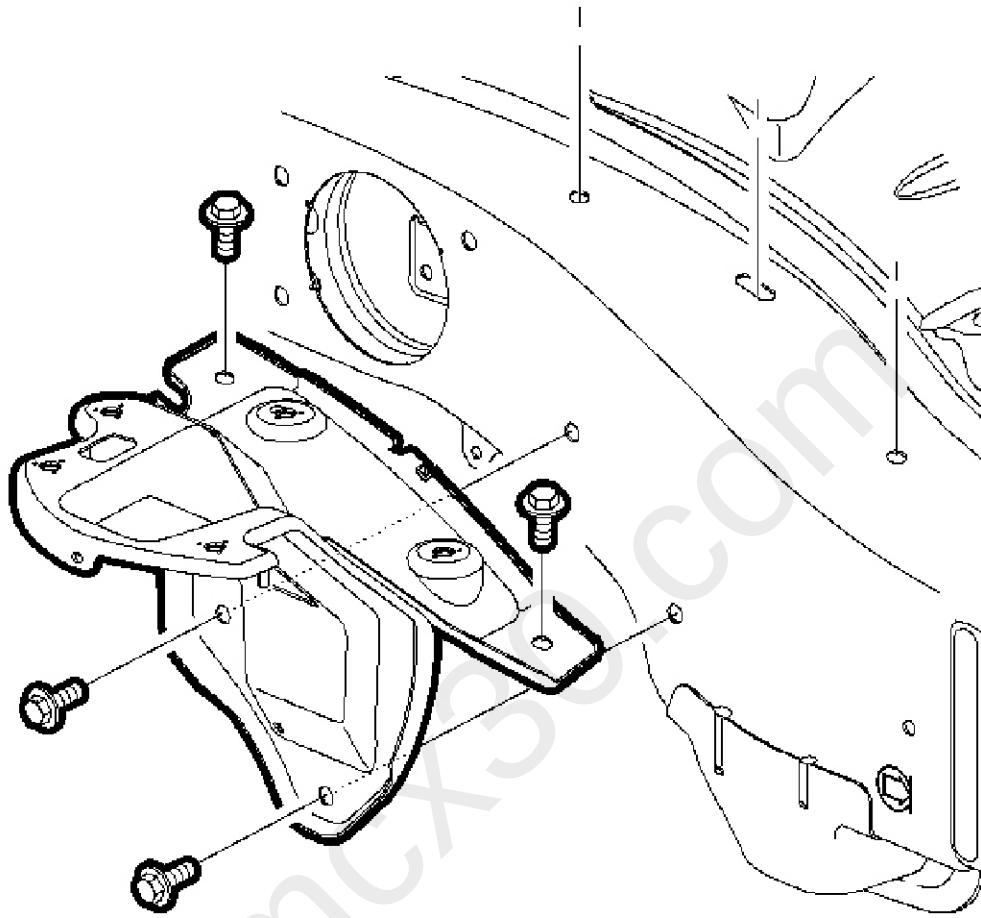


Fig. 32: View Of Battery Tray Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the battery tray bolts.
6. Remove the battery tray from the inner fender.

Installation Procedure

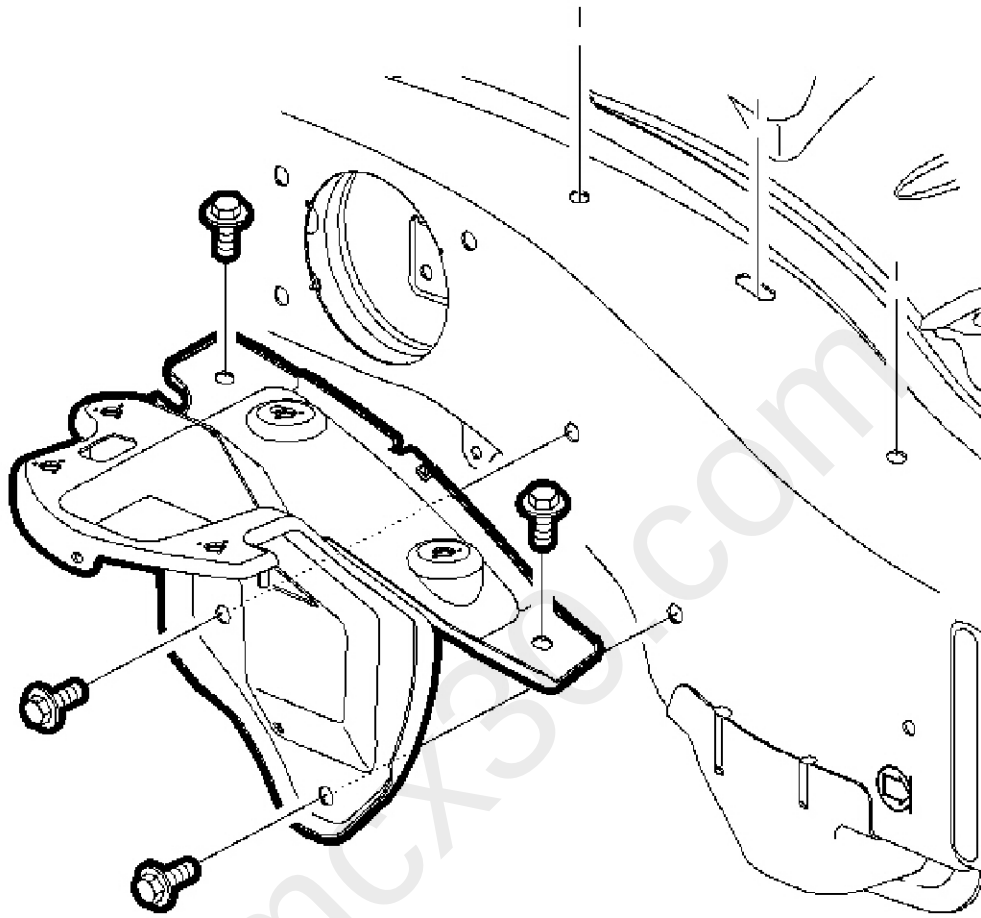


Fig. 33: View Of Battery Tray Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the battery tray to the inner fender.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the battery tray bolts.

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

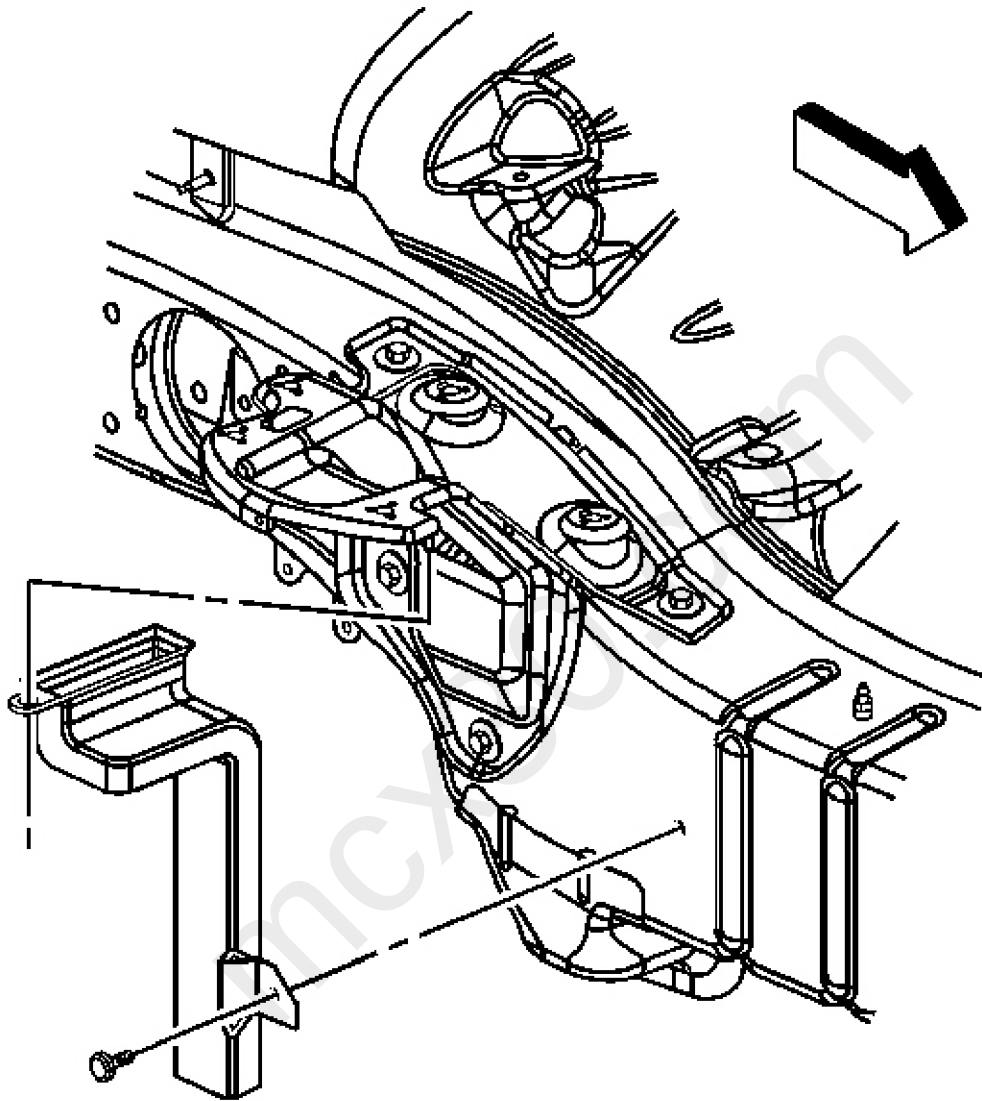


Fig. 34: View Of Battery Air Outlet Duct
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the outlet duct is properly aligned with the battery tray and that it is securely fastened to the rail.

3. Install the battery air outlet duct to the battery tray.
4. Install the battery air outlet duct fastener.

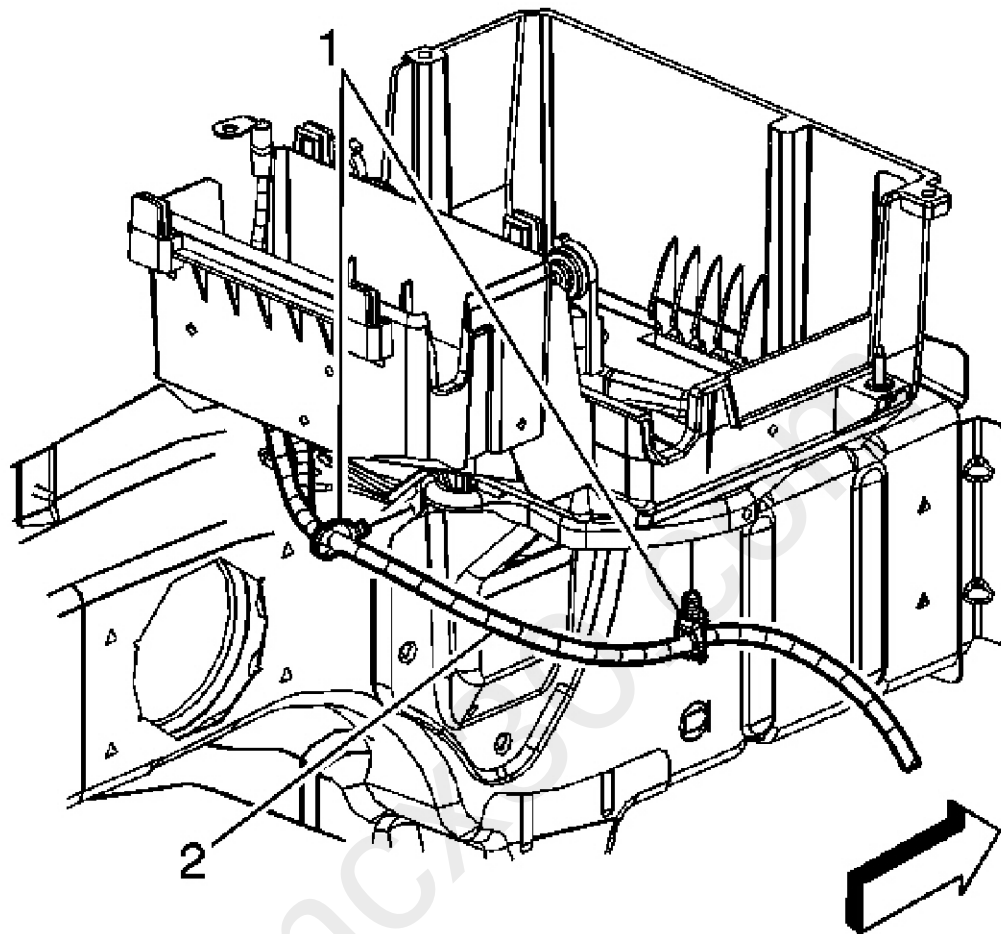


Fig. 35: View Of Battery Cable Retainers At Battery Tray
Courtesy of GENERAL MOTORS CORP.

5. Connect the battery cable retainers (1) to the battery tray.
6. Install the battery box. Refer to **Battery Box Replacement**.

BATTERY BOX REPLACEMENT

Removal Procedure

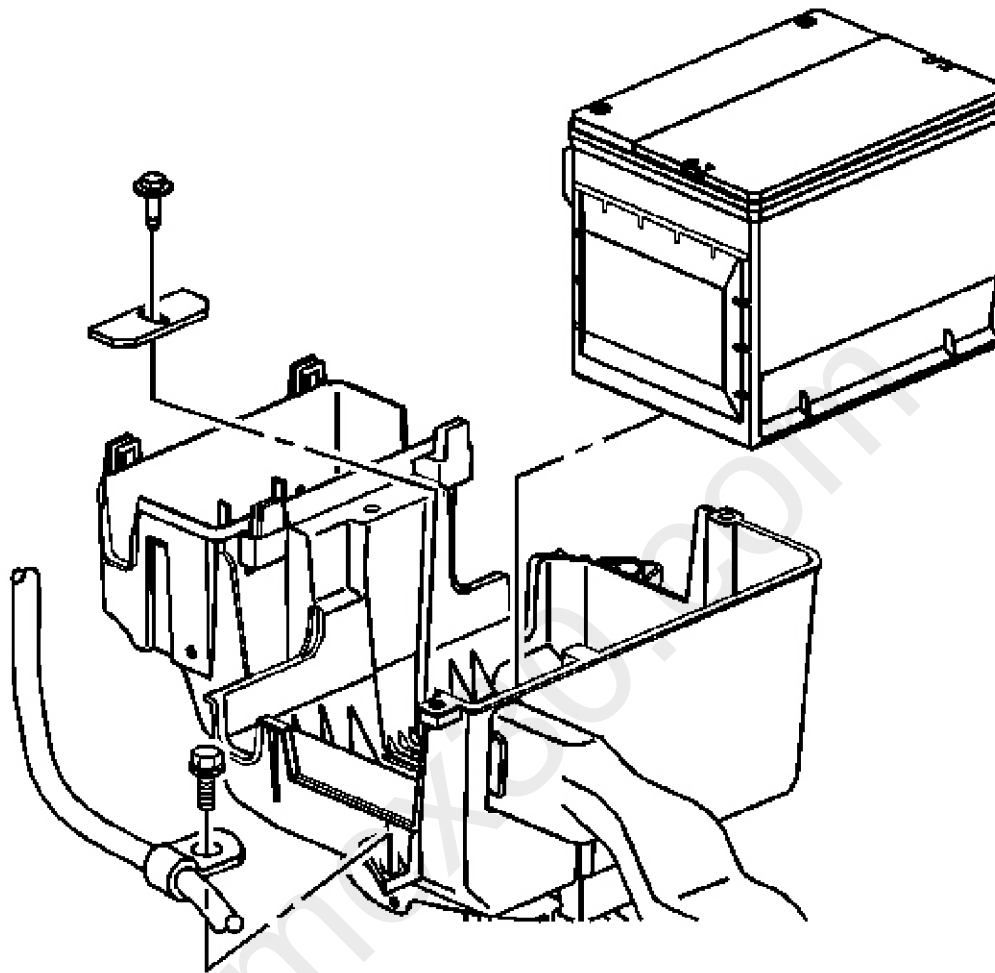


Fig. 36: View Of Battery & A/C Evaporator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery. Refer to **Battery Replacement**.
2. Remove the air conditioning (A/C) evaporator outlet hose bolt from the battery box.
3. Position the A/C evaporator outlet hose out of the way.

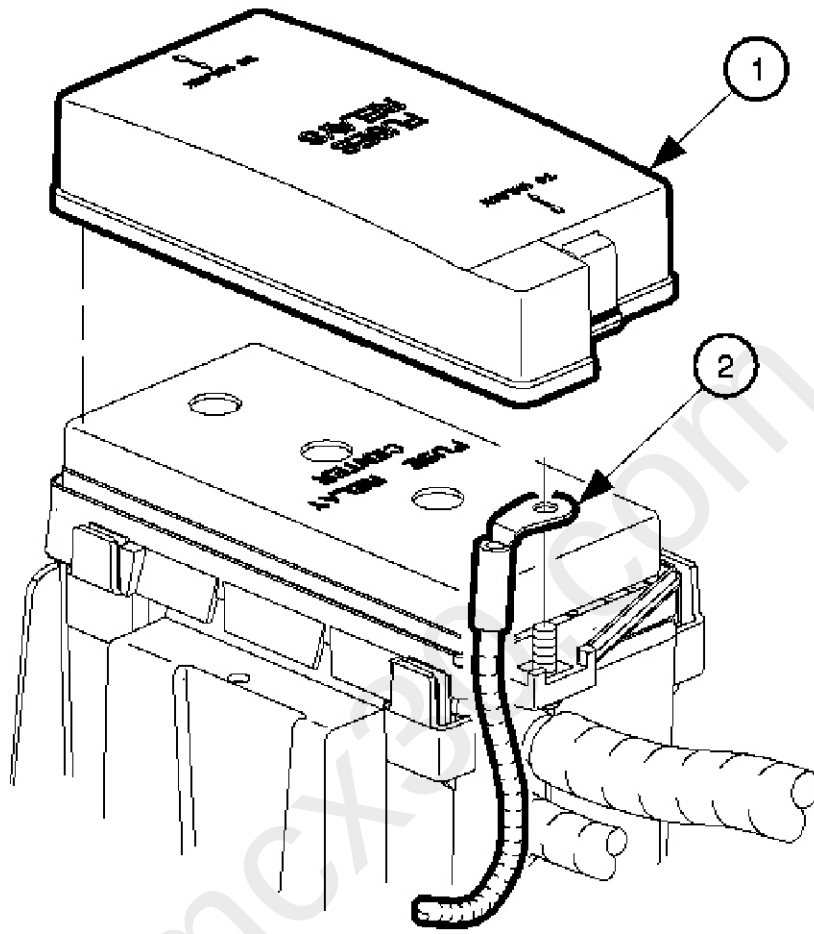


Fig. 37: Removing/Installing Underhood Electrical Wiring
Courtesy of GENERAL MOTORS CORP.

4. Remove the underhood fuse block (UHFB) cover (1).
5. Remove the positive battery cable and electronic power steering (EPS) wire connection nut.
6. Remove the positive battery cable and electronic power steering (EPS) wire (2) from the B+ terminal at UHFB.

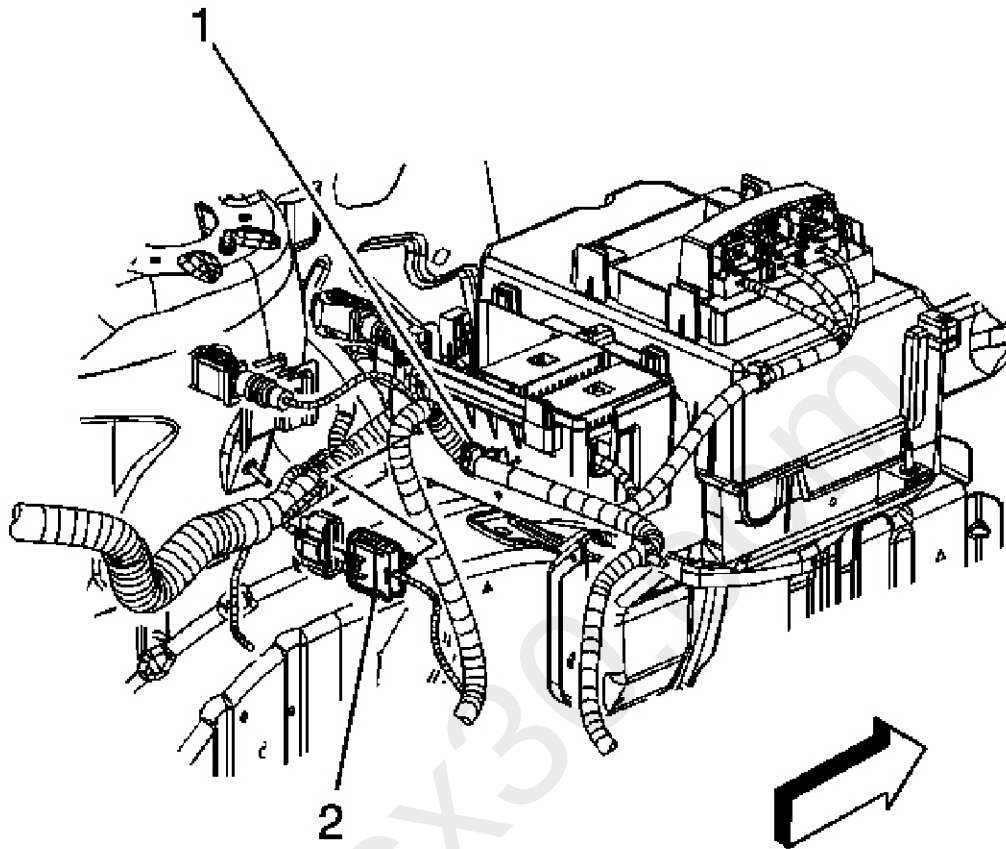


Fig. 38: View Of Engine Wire Harness Retainer & Connector
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine wire harness retainer (1) from the battery box.
8. Remove the engine wire harness connector (2) from the battery box.

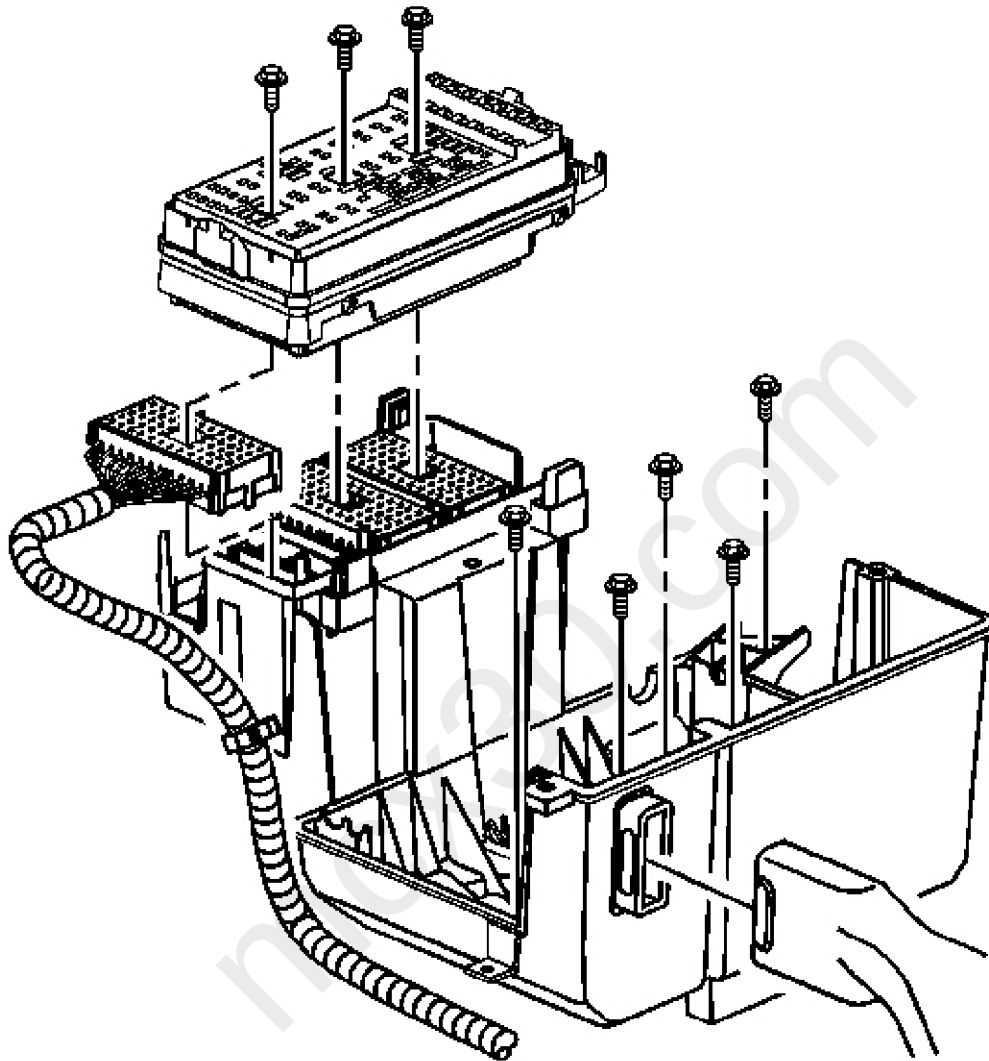


Fig. 39: View Of UHFB, Housing, Connectors & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Loosen the UHFB connector retaining bolts.
10. Unclip and remove the UHFB from the UHFB housing.
11. Disconnect the forward lamp harness connectors from the UHFB.
12. Disconnect the UHFB connectors from the UHFB.

IMPORTANT: Protect the disconnected harness from contamination during service.

13. Remove the UHFB connectors from the UHFB housing.
14. Position all the electrical harnesses/connectors and battery cables out of the way of the battery box.

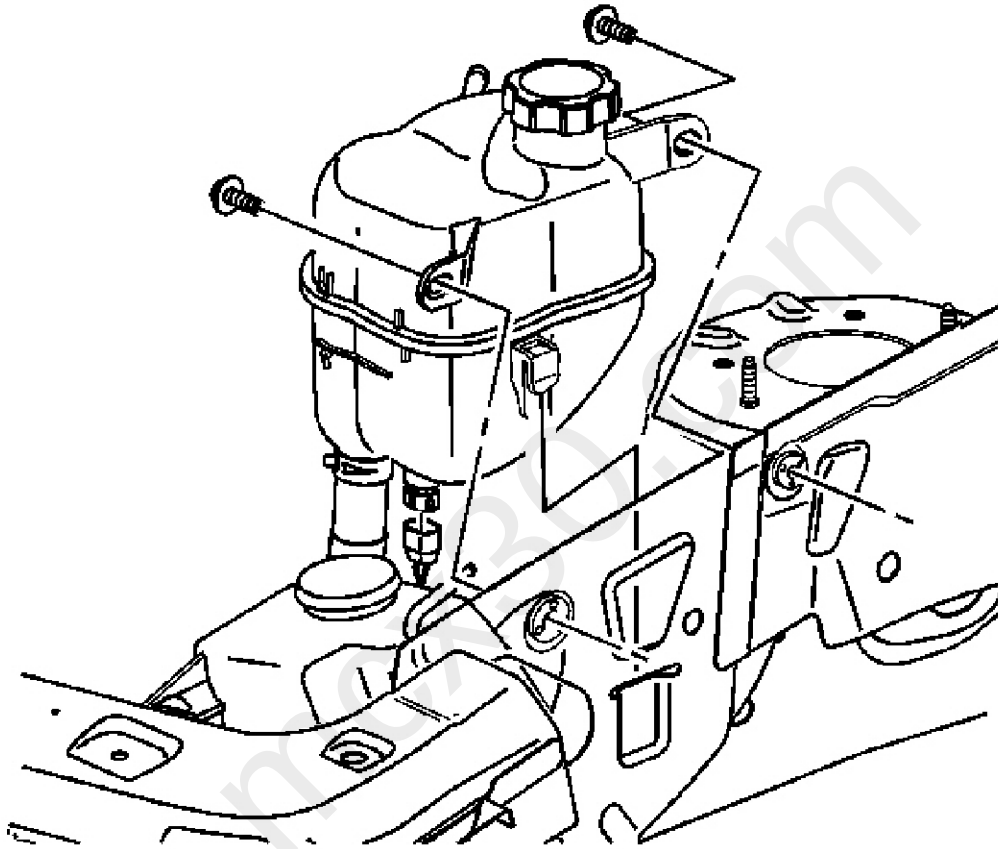


Fig. 40: View Of Coolant Surge Tank
Courtesy of GENERAL MOTORS CORP.

15. Remove the coolant surge tank bolts from the inner fender.
16. Lift the coolant surge tank up to gain access to the battery box bolt on the inner fender.

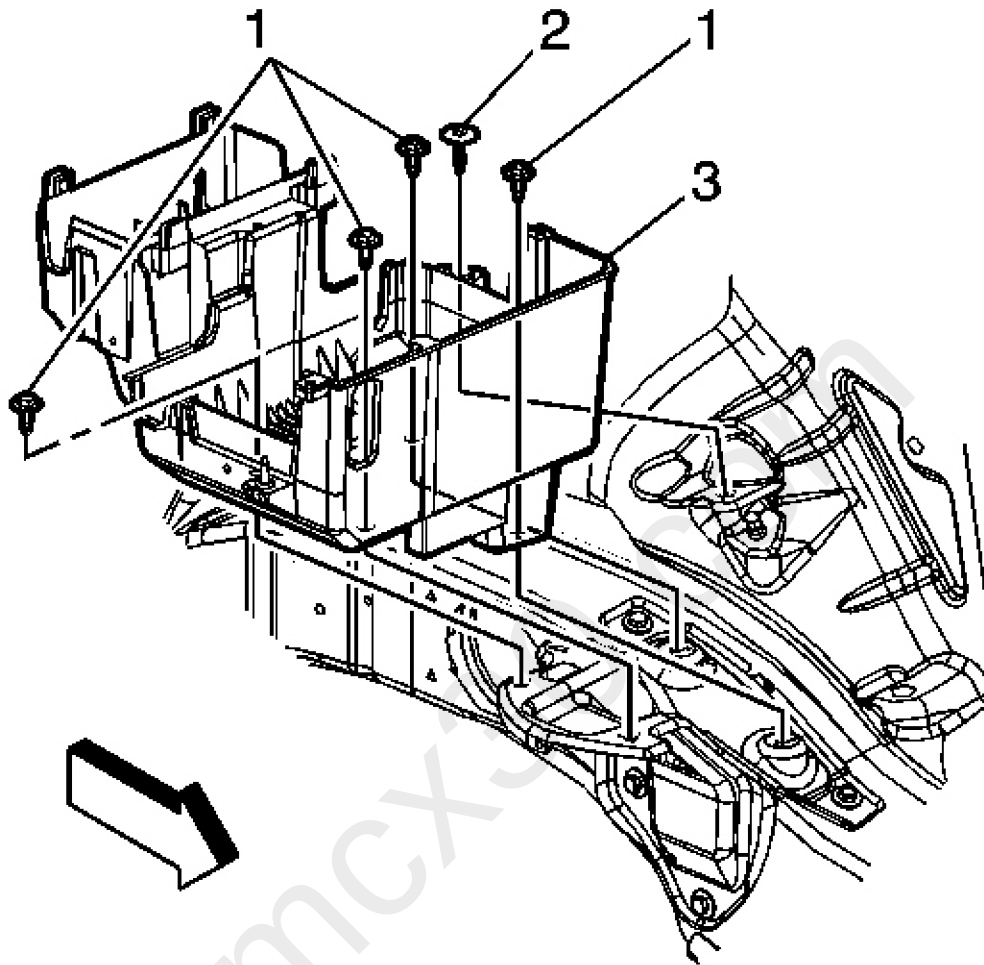


Fig. 41: View Of Battery Box & Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the battery box bolt (2) from under the coolant surge tank.
18. Remove the battery box bolts (1) from inside the battery box.

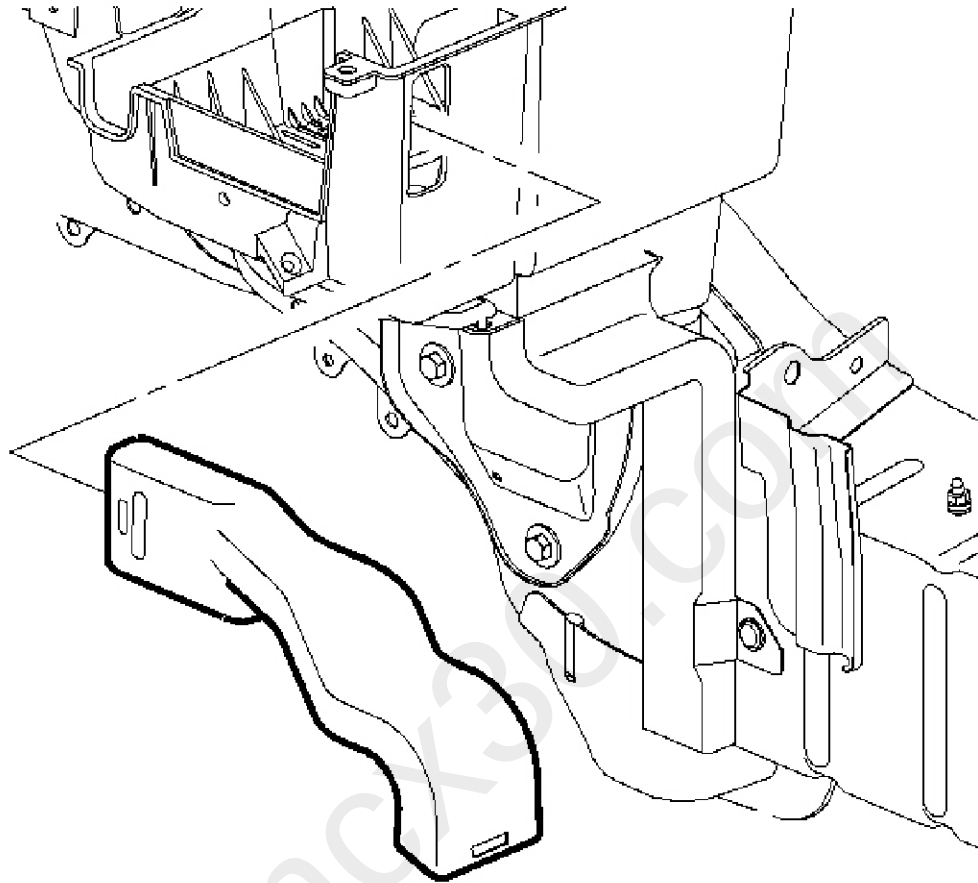


Fig. 42: View Of Inlet & Outlet Ducts With The Battery Cooling Box
Courtesy of GENERAL MOTORS CORP.

19. Separate the air inlet duct from the battery box.
20. Remove the battery box from the vehicle.

Installation Procedure

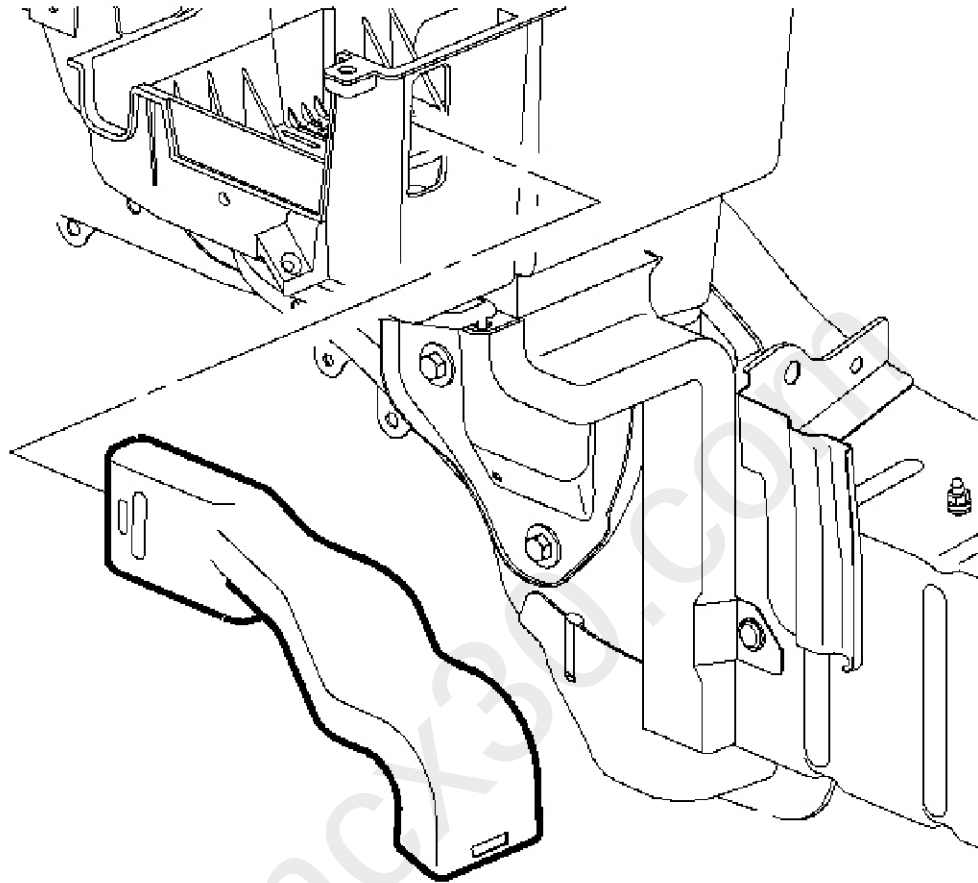


Fig. 43: View Of Inlet & Outlet Ducts With The Battery Cooling Box
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Alignment of the air inlet and outlet ducts with the battery box is critical to ensure proper airflow to the battery.

1. Install the battery box to the vehicle while aligning the air inlet and outlet ducts to the battery box.

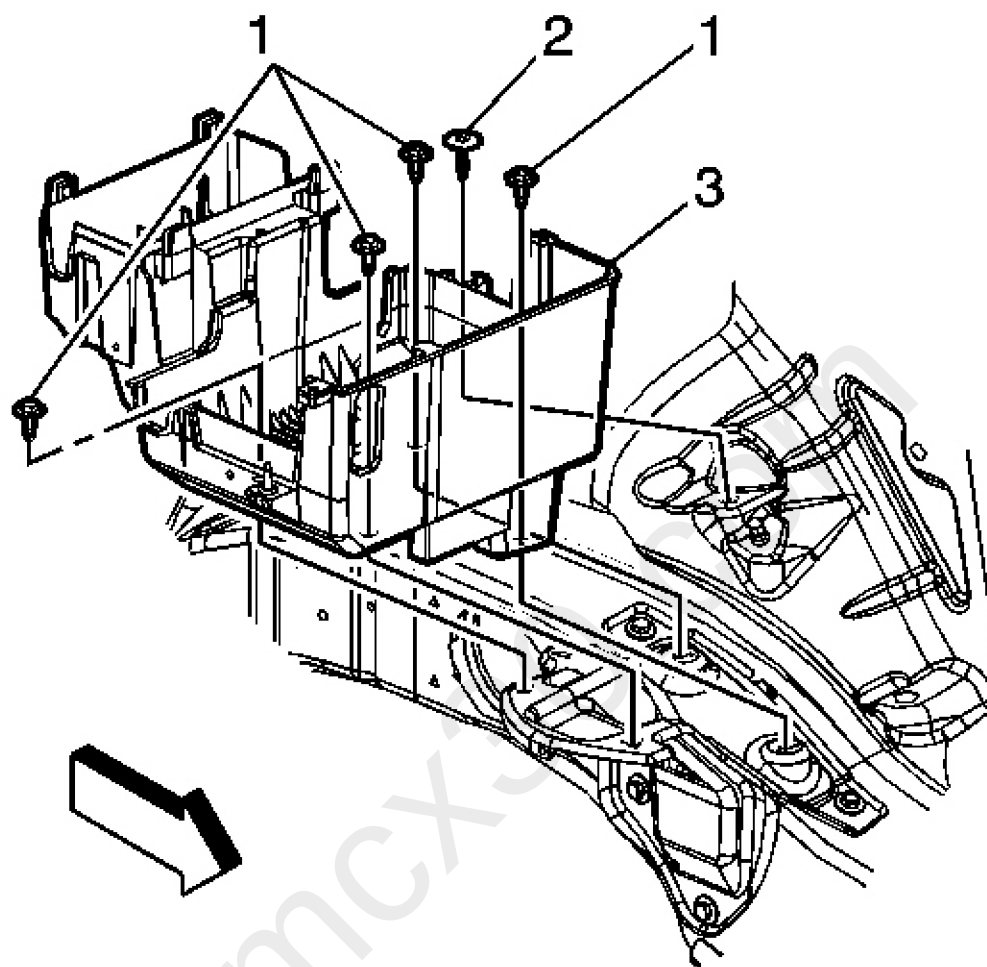


Fig. 44: View Of Battery Box & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Insure the battery box is sitting properly on the battery tray and the air inlet and outlet ducts are properly installed to the battery box.

2. Install the battery box bolts (1) inside the battery box.

Tighten: Tighten the bolts (1) to 15 N.m (11 lb ft).

3. Install the battery box outer bolt (2) under the coolant surge tank.

Tighten: Tighten the bolt (2) to 10 N.m (89 lb in).

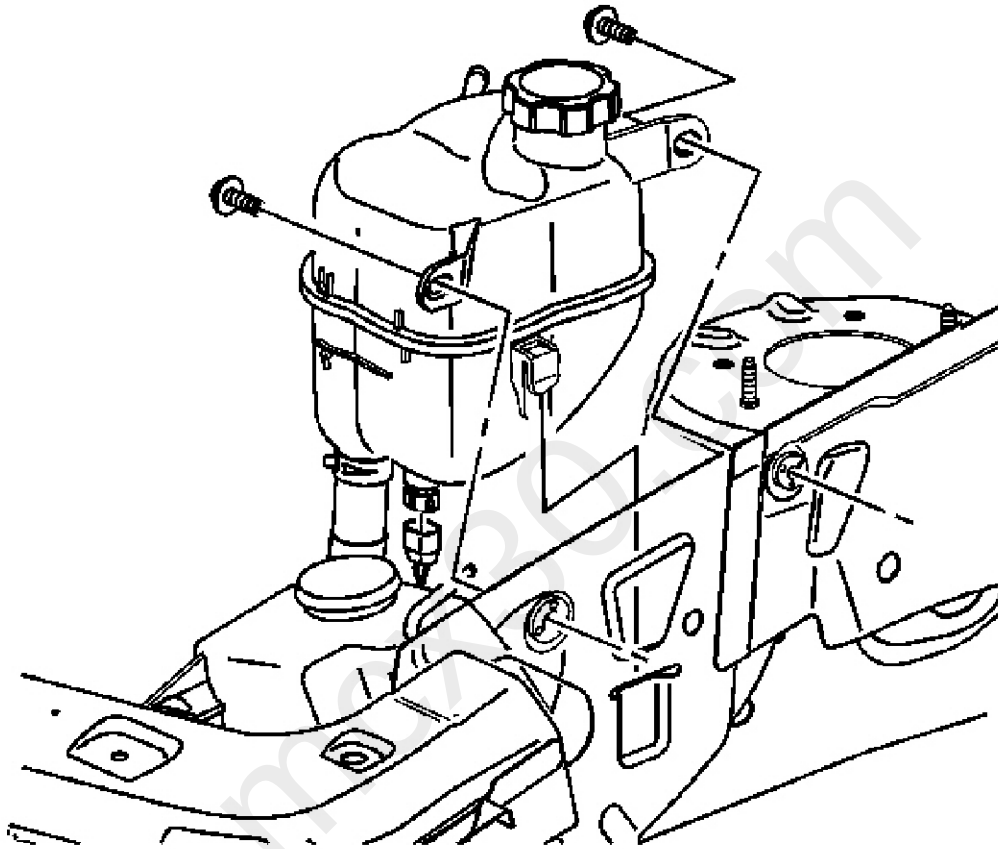


Fig. 45: View Of Coolant Surge Tank
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Insure the coolant surge tank alignment tab is inserted into the inner fender slot when installed.

4. Install the coolant surge tank to the inner fender.
5. Install the coolant surge tank bolts

Tighten: Tighten the bolts to 6 N.m (53 lb in).

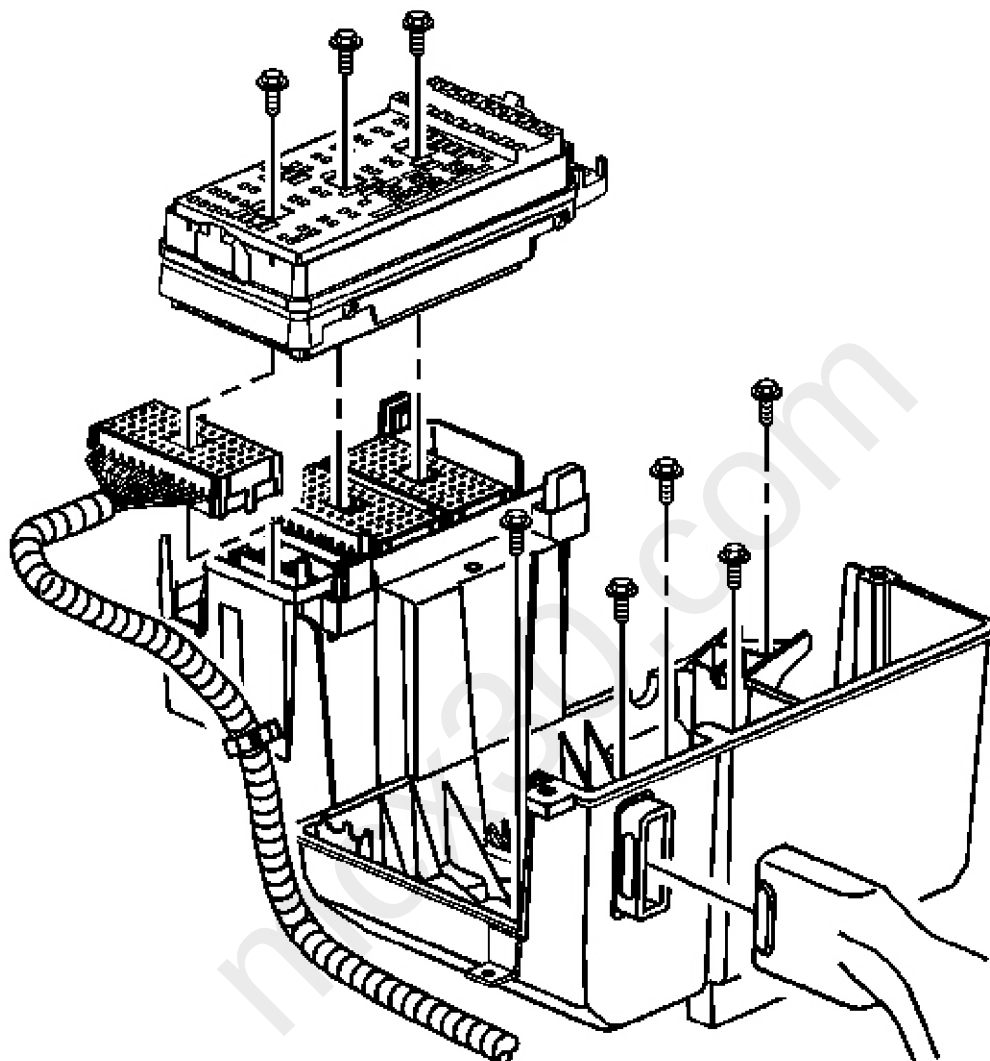


Fig. 46: View Of UHFB, Housing, Connectors & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Position the battery cables into the battery box.
7. Install the UHFB connectors to the UHFB housing.
8. Connect the forward lamp harness connectors to the UHFB.
9. Install the UHFB to the UHFB housing while insuring that all UHFB electrical connectors are properly aligned.
10. Insure the UHFB is fully installed and clipped into the UHFB housing.

Tighten: Tighten the UHFB connector bolts to 4 N.m (35 lb in).

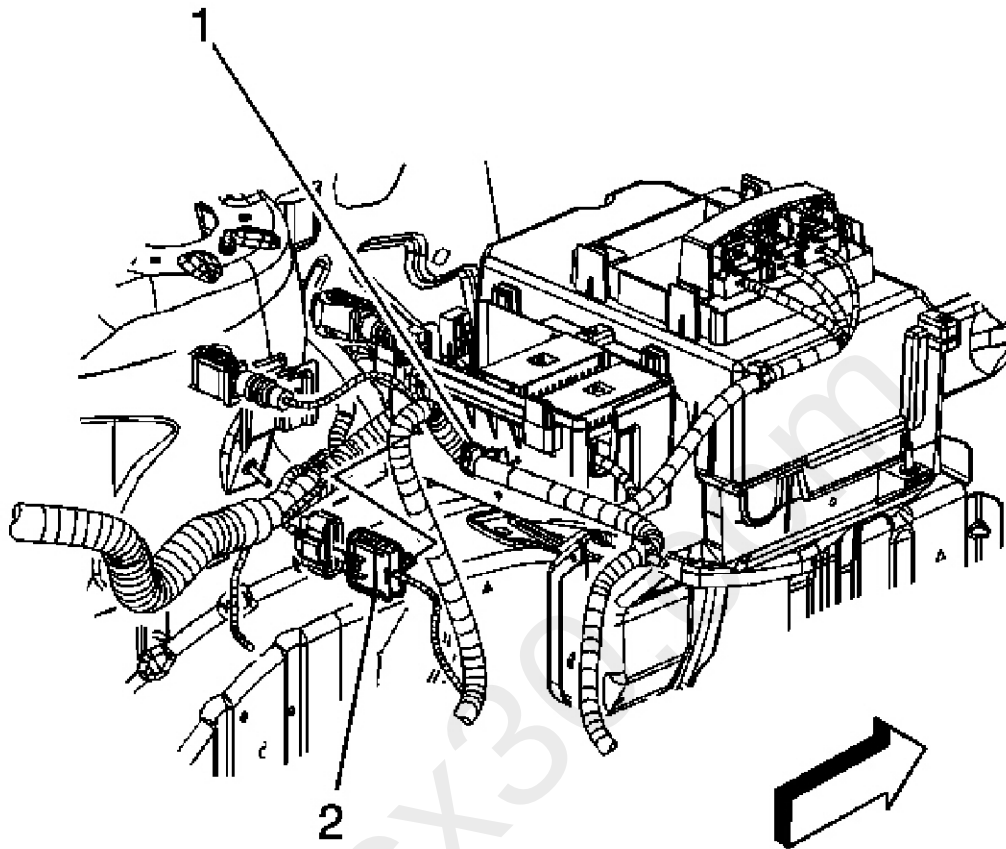


Fig. 47: View Of Engine Wire Harness Retainer & Connector
Courtesy of GENERAL MOTORS CORP.

11. Install the engine wire harness connector (2) to the battery box.
12. Install the engine wire harness retainer (1) to the battery box.

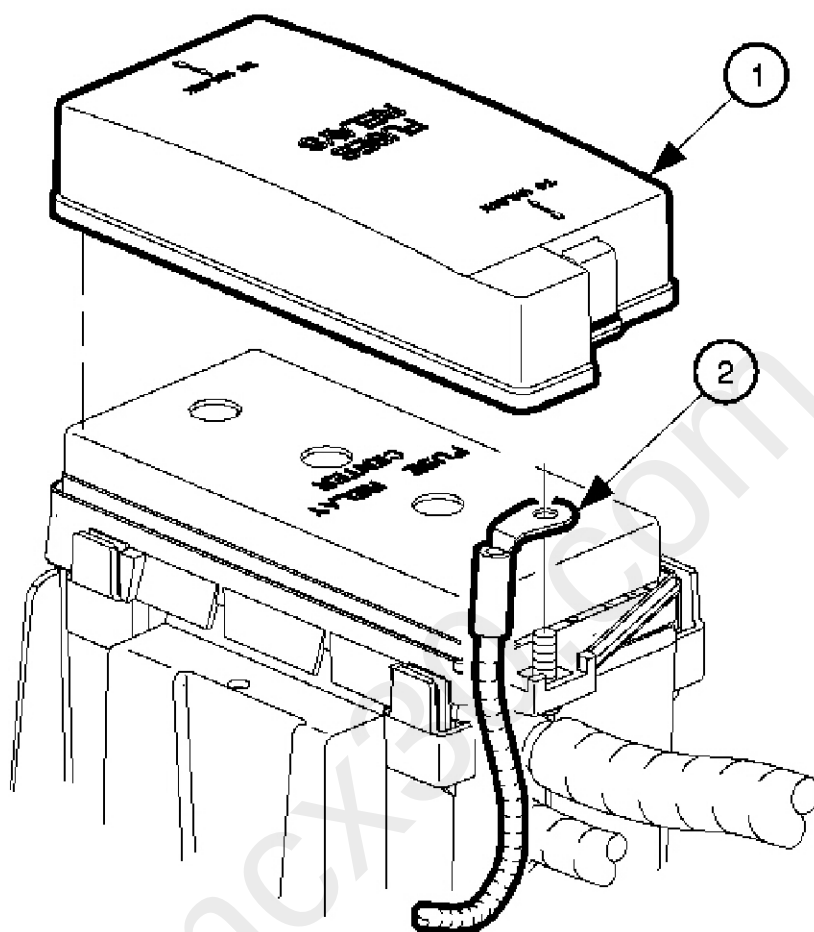


Fig. 48: Removing/Installing Underhood Electrical Wiring
Courtesy of GENERAL MOTORS CORP.

13. Install the positive battery cable and electronic power steering (EPS) wire (2) to the B+ terminal at UHFB.
14. Install the positive battery cable and electronic power steering (EPS) wire connection nut.

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

15. Install the underhood fuse block (UHFB) cover (1).

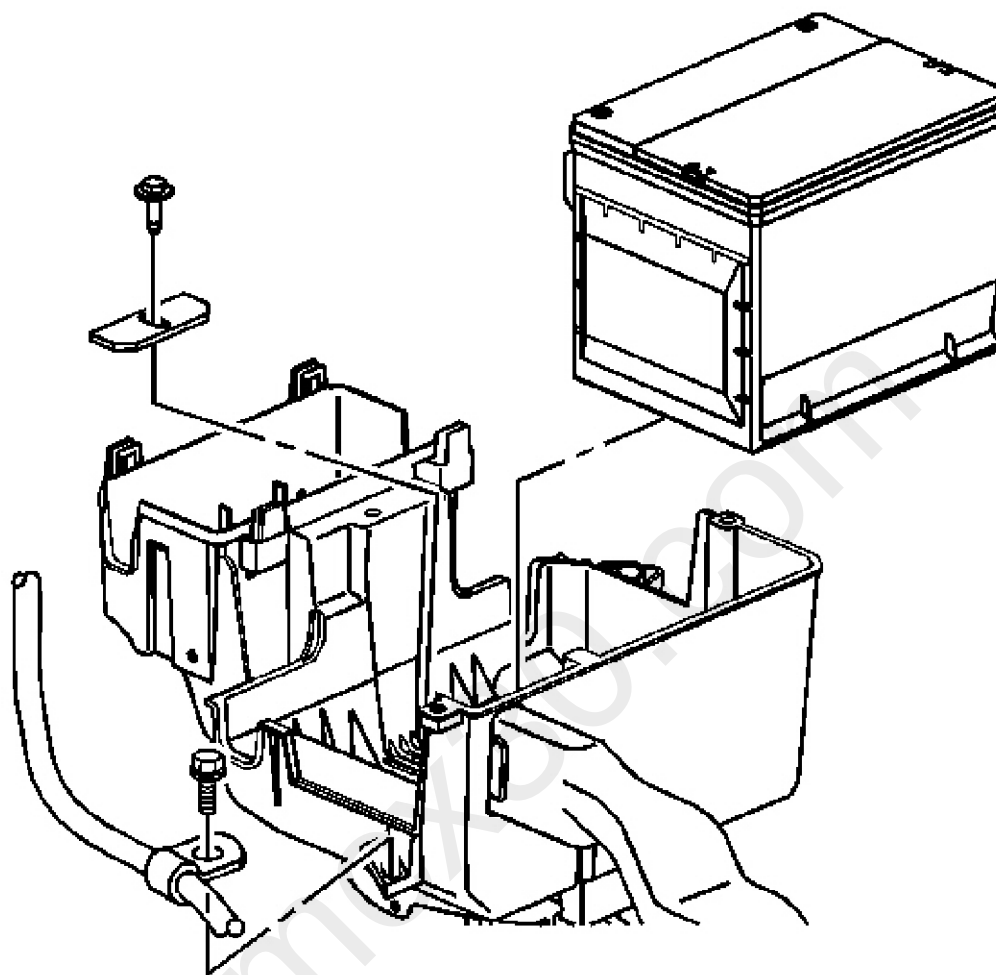


Fig. 49: View Of Battery & A/C Evaporator Outlet Hose
Courtesy of GENERAL MOTORS CORP.

16. Position the A/C evaporator outlet hose to the battery box.
17. Install the A/C evaporator outlet hose bolt to the battery box.

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

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

STARTER MOTOR REPLACEMENT

Removal Procedure

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

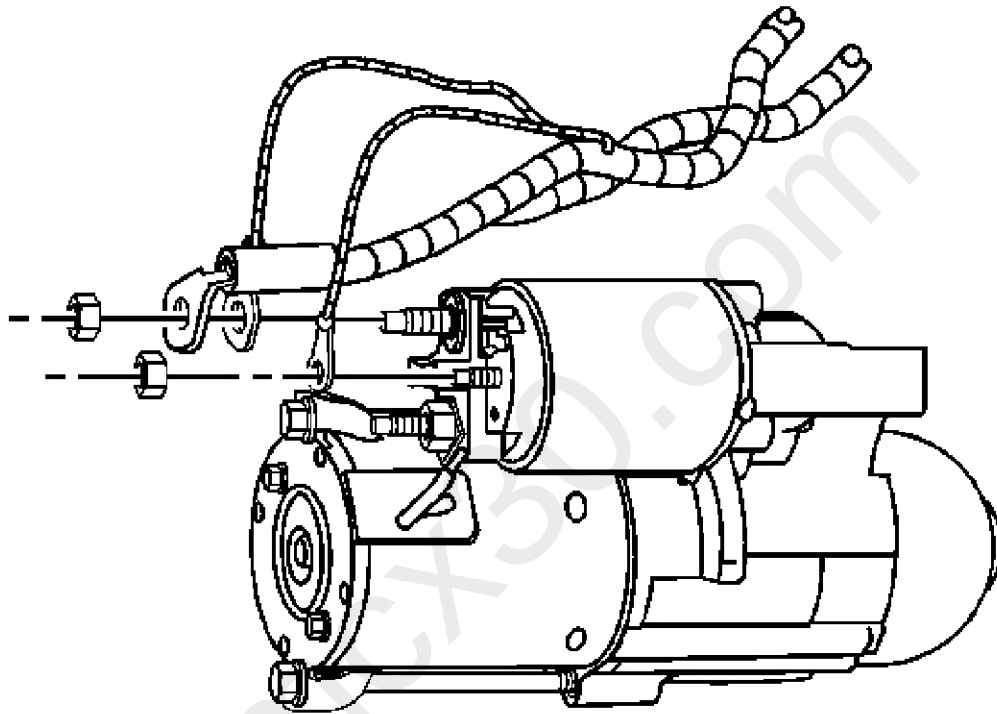


Fig. 50: View Of Starter Motor Solenoid Positive Terminal Nut, S Terminal Nut & Electrical Wires

Courtesy of GENERAL MOTORS CORP.

3. Remove the starter motor solenoid positive terminal nut and electrical wires.
4. Remove the starter motor solenoid S terminal nut and electrical wire.

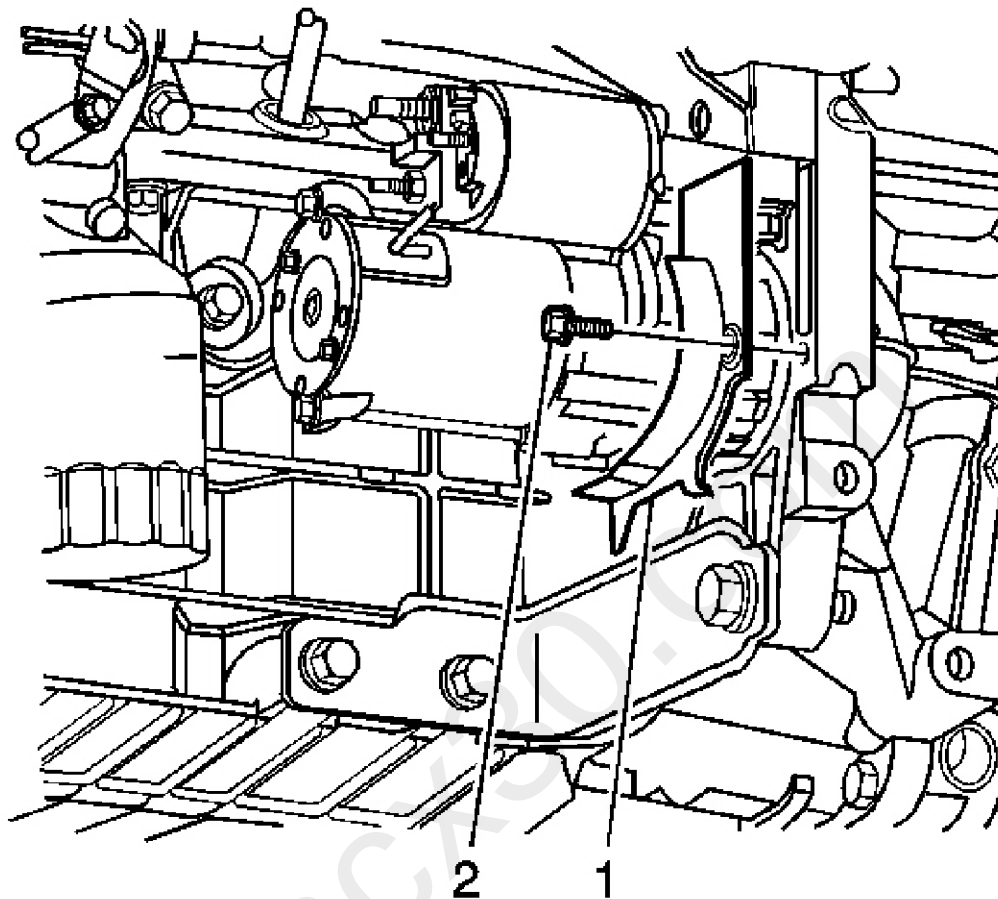


Fig. 51: View Of Torque Converter Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the torque converter cover bolt (2).
6. Remove the torque converter cover (1).

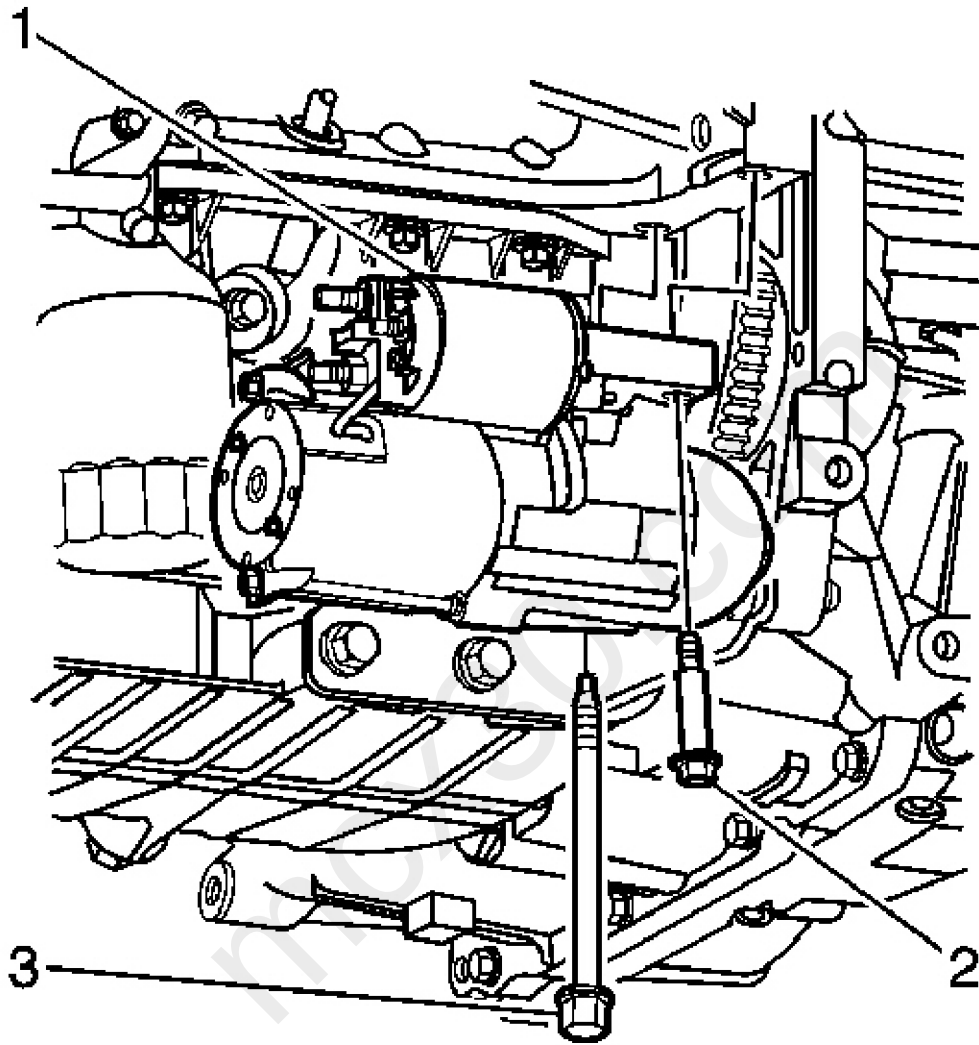


Fig. 52: View Of Starter Motor & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the starter motor bolts (2, 3).
8. Remove the starter motor (1).

Installation Procedure

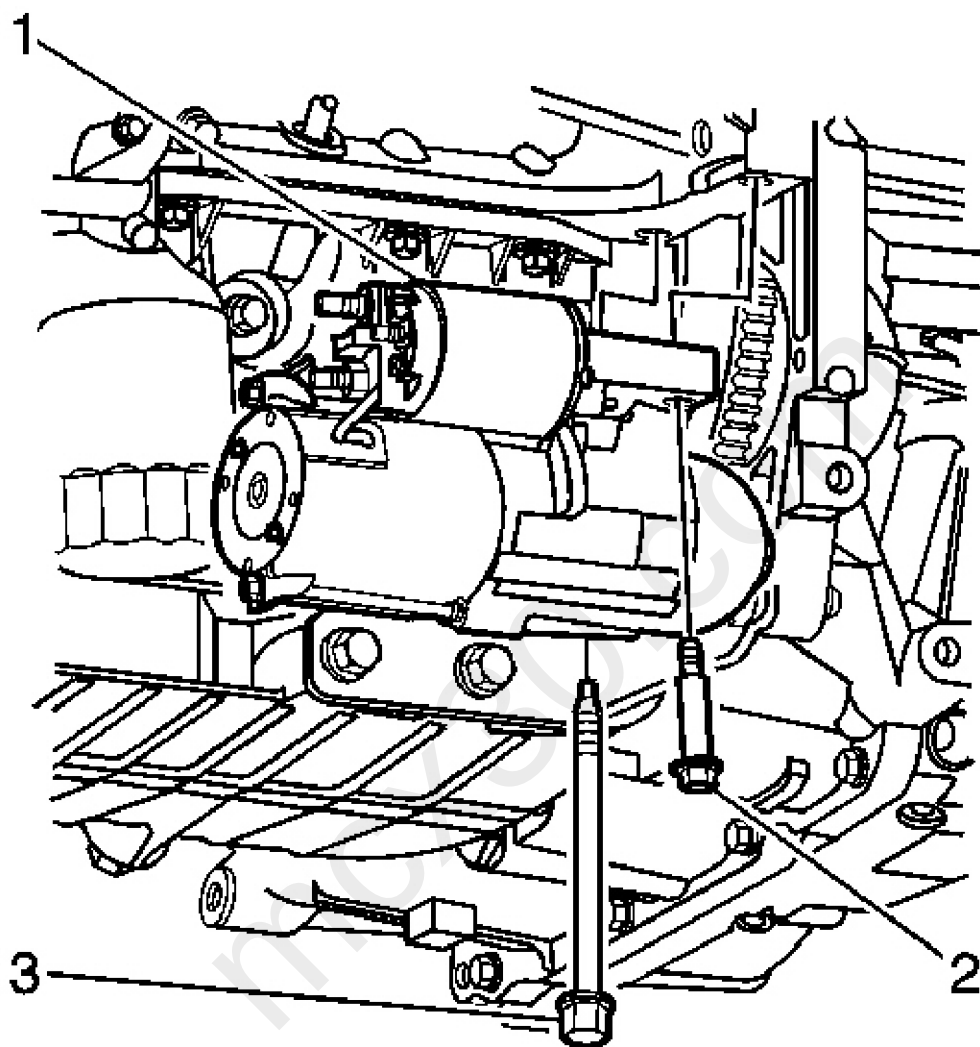


Fig. 53: View Of Starter Motor & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the starter motor (1).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the starter motor bolts (2, 3).

Tighten: Tighten the starter motor bolts to 43 N.m (32 lb ft).

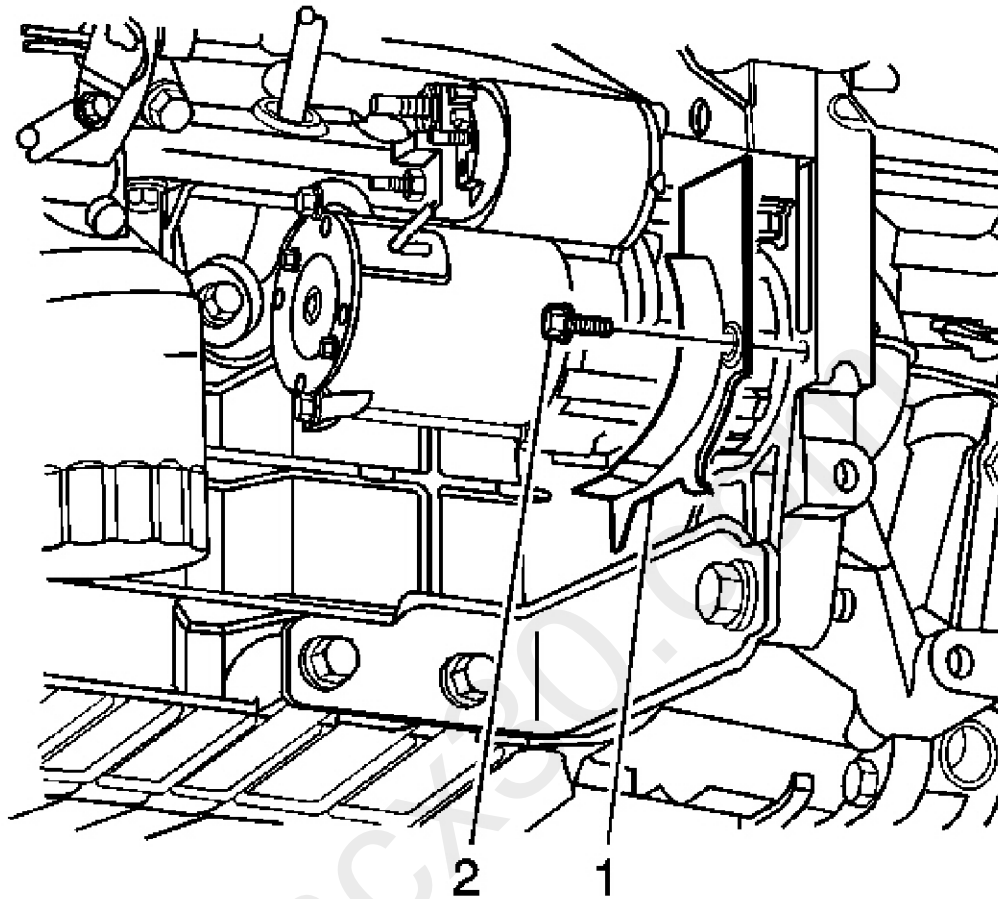


Fig. 54: View Of Torque Converter Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Install the torque converter cover (1).
4. Install the torque converter cover bolt (2).

Tighten: Tighten the bolt to 8 N.m (71 lb in).

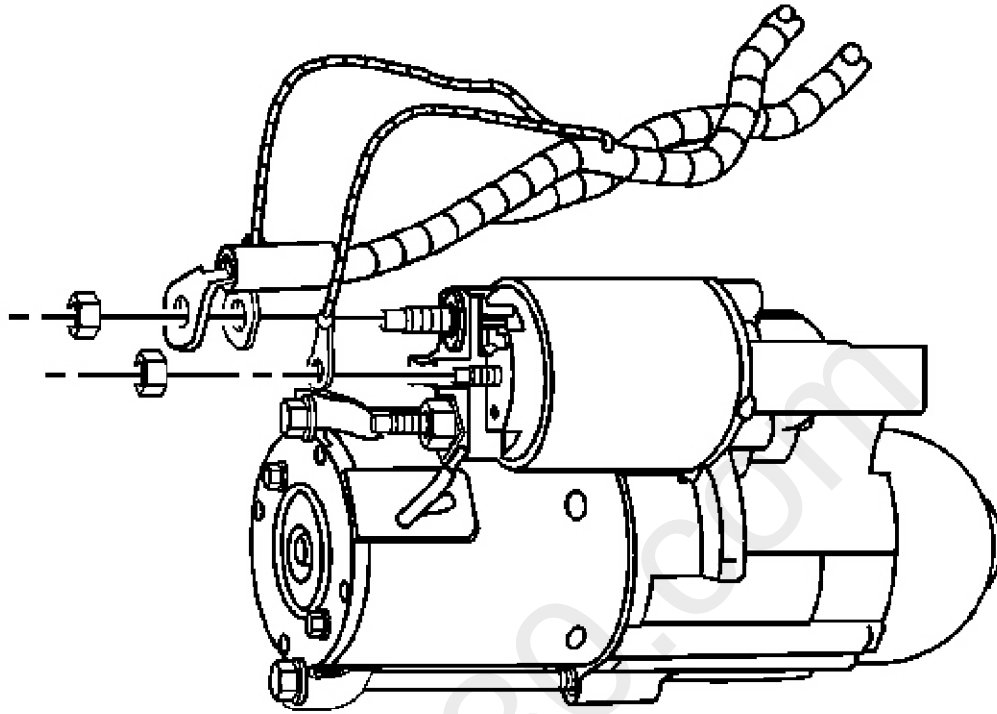


Fig. 55: View Of Starter Motor Solenoid Positive Terminal Nut, S Terminal Nut & Electrical Wires

Courtesy of GENERAL MOTORS CORP.

5. Install the starter motor solenoid S terminal electrical wire and nut.

Tighten: Tighten the solenoid S terminal nut to 3 N.m (27 lb in).

6. Install the starter motor solenoid positive terminal electrical wires and nut.

Tighten: Tighten the solenoid positive terminal nut to 10 N.m (89 lb in).

7. Lower the vehicle.
8. Install the battery negative cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

GENERATOR BRACKET/ENGINE LIFT BRACKET REPLACEMENT

Removal Procedure

1. Remove the generator. Refer to **Generator Replacement**.

2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** in Engine Mechanical - 3.4L.

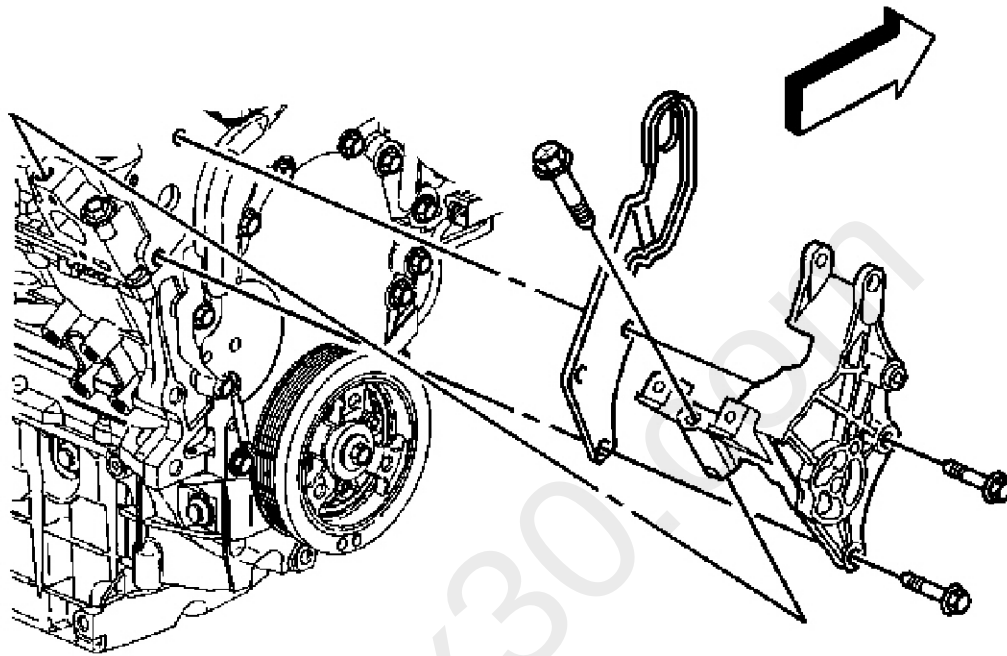


Fig. 56: View Of Generator Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the generator bracket bolts.
4. Remove the generator bracket.

Installation Procedure

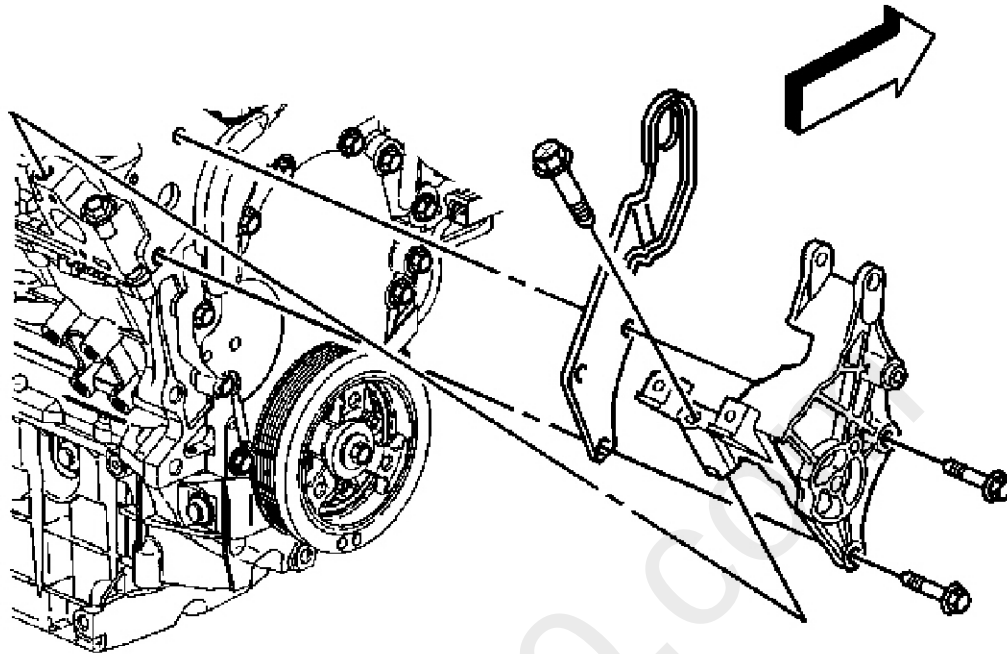


Fig. 57: View Of Generator Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the generator bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the generator bracket bolts.

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

3. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** in Engine Mechanical - 3.4L.
4. Install the generator. Refer to **Generator Replacement**.

GENERATOR REPLACEMENT

Removal Procedure

1. Remove the battery ground (negative) cable from the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

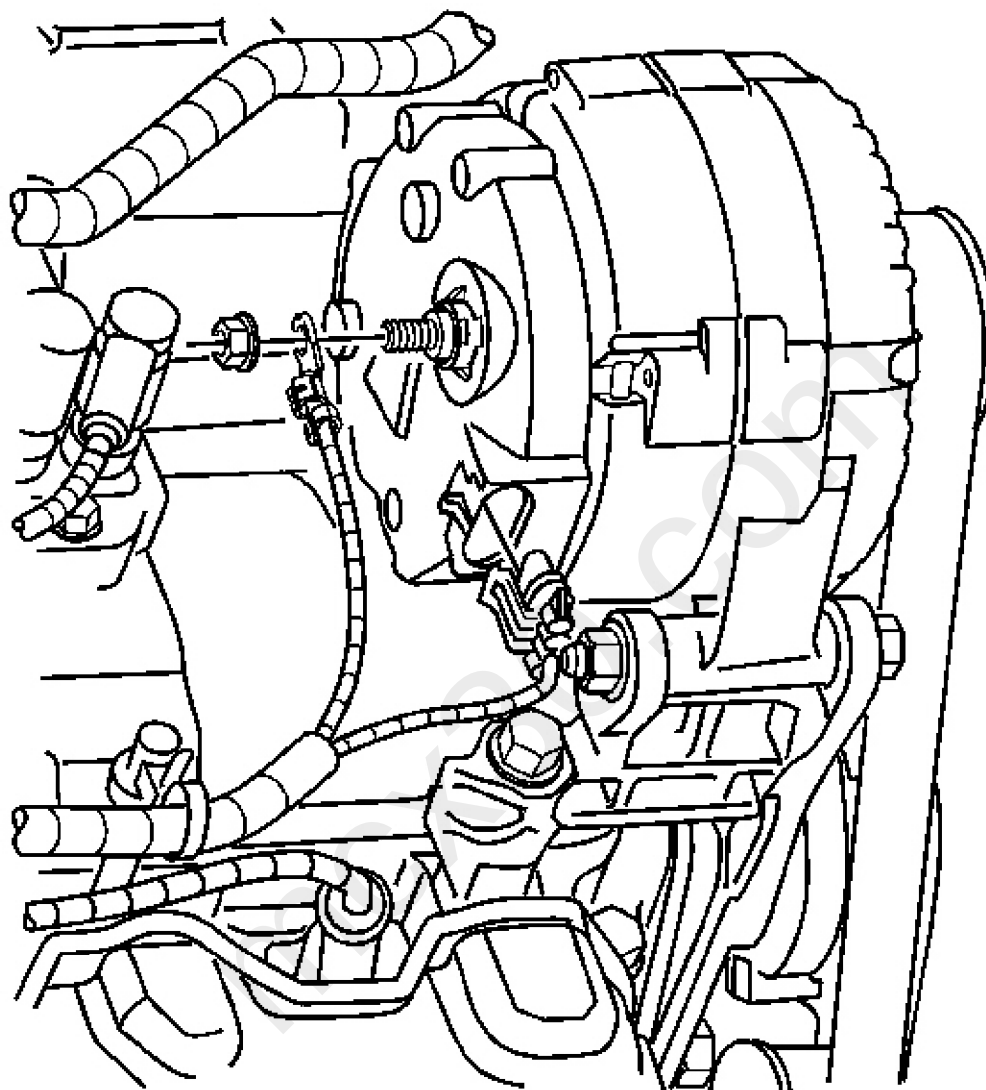


Fig. 58: View Of Generator B+ Terminal Nut, B+ Lead & Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Remove the generator B+ terminal nut.
3. Remove the generator B+ lead.
4. Remove the generator electrical connector.
5. Remove the drive belt from the generator. Refer to **Drive Belt Replacement** in Engine Mechanical - 3.4L.

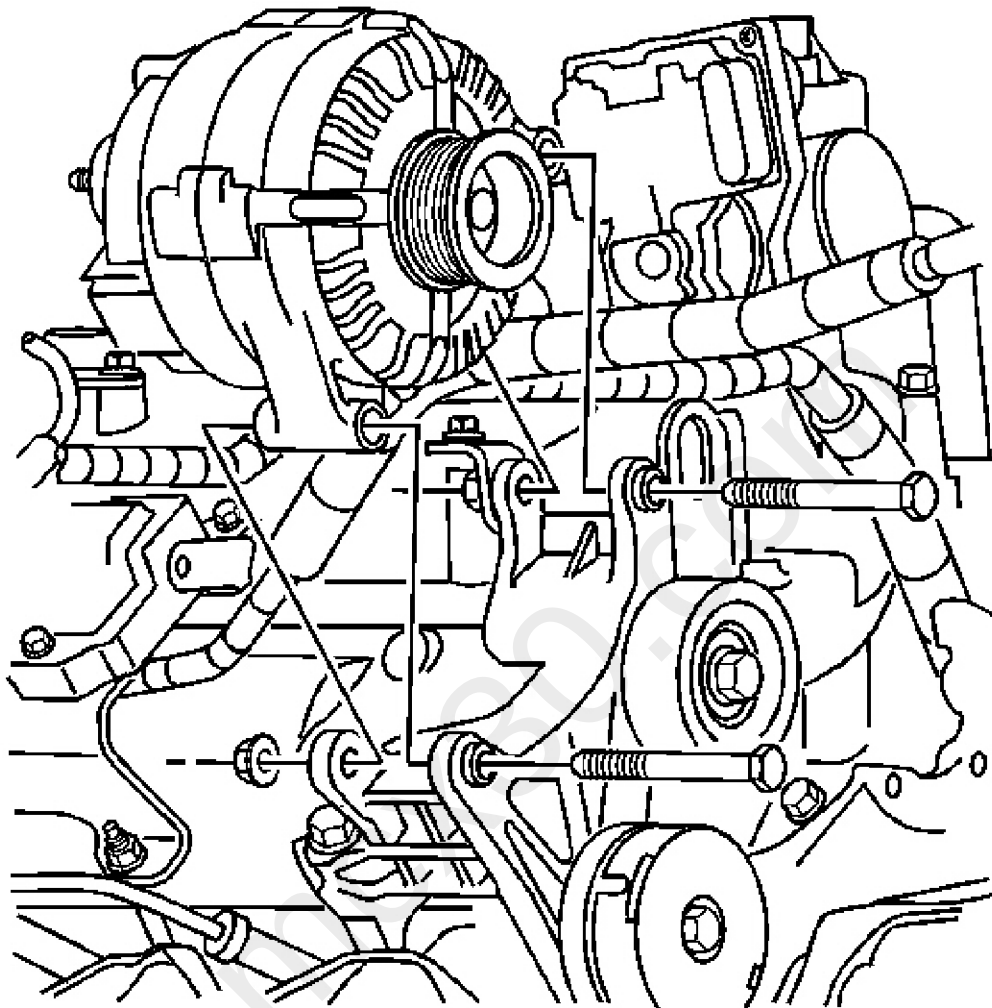


Fig. 59: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the generator bolts.
7. Remove the generator from the vehicle.

Installation Procedure

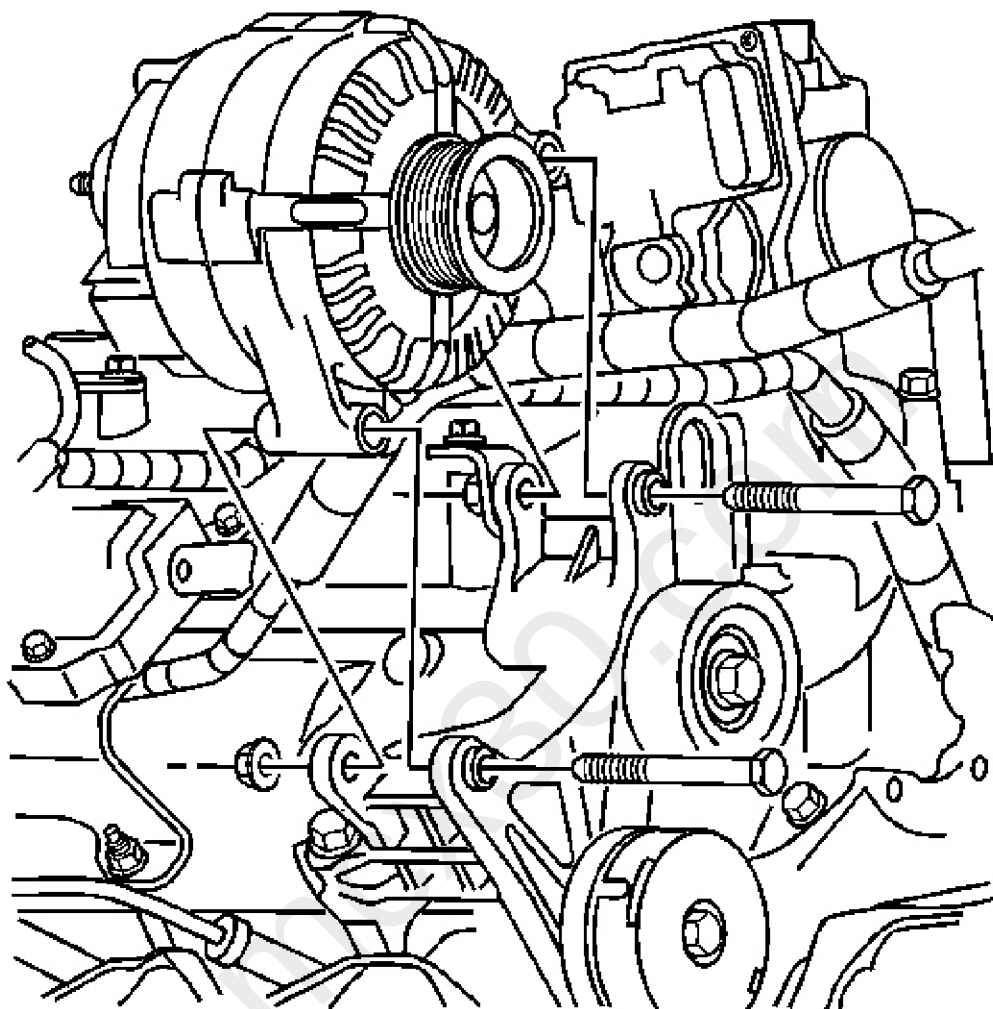


Fig. 60: View Of Generator & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the generator to the generator bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the generator bolts.

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

3. Install the drive belt. Refer to Drive Belt Replacement in Engine Mechanical - 3.4L.

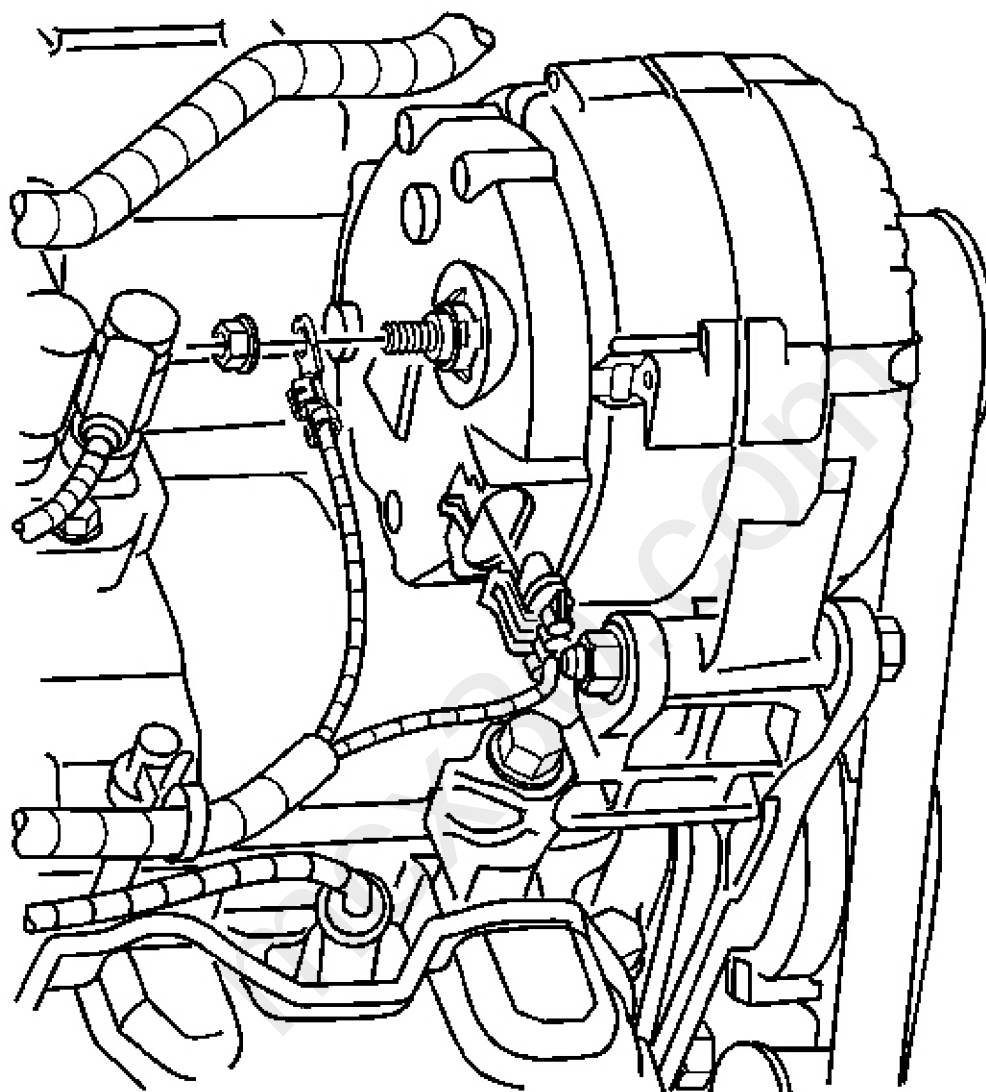
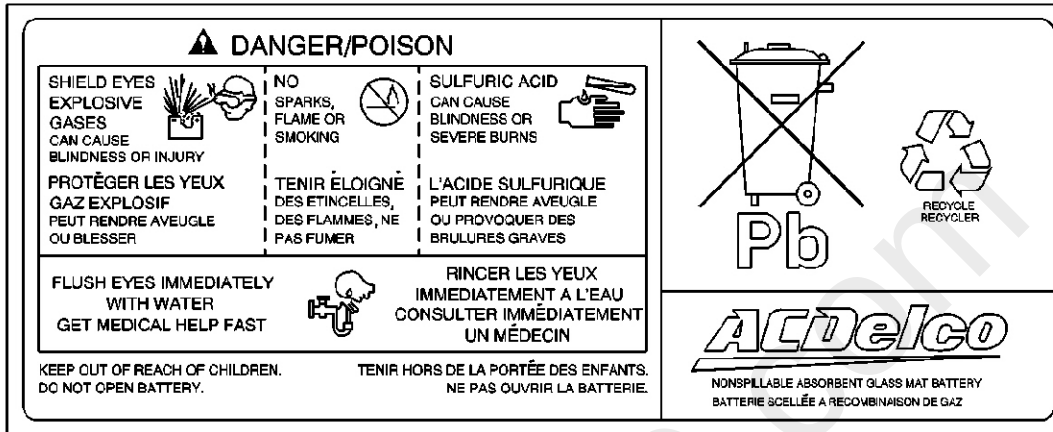


Fig. 61: View Of Generator B+ Terminal Nut, B+ Lead & Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Install the generator electrical connector.
5. Install the generator B+ lead.
6. Install the generator B+ terminal nut.

Tighten: Tighten the generator B+ terminal nut to 20 N.m (15 lb ft).

7. Install the battery ground (negative) cable to the battery. Refer to **Battery Negative**

Cable Disconnect/Connect Procedure.**DESCRIPTION AND OPERATION****BATTERY DESCRIPTION AND OPERATION****Fig. 62: Battery Warning Label**Courtesy of **GENERAL MOTORS CORP.**

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

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

IMPORTANT: Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by

OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

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

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

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

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

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

- Engine cranking
- Voltage stabilizer
- Alternate source of energy with generator overload

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

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

CATALOG NO.

1819

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100 – 6YR	

Fig. 63: View Of Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

A battery may have 3 ratings:

- Amp hour
- Reserve capacity
- Cold cranking amperage

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

Amp Hour

The amp hour rating of a battery is the amount of time it takes a fully charged battery, being discharged at a constant rate of 1 amperes and a constant temperature of 27°C (80°F) to reach

a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the amp hour rating of the original equipment battery.

Reserve Capacity

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

Cold Cranking Amperage

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

CHARGING SYSTEM DESCRIPTION AND OPERATION**Generator**

The generator features the following major components:

- The delta stator
- The rectifier bridge
- The rotor with slip rings and brushes
- A conventional pulley
- The regulator

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

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

Regulator

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

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

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

Circuit Description

The generator provides DC voltage to operate the vehicle's electrical system and to charge the battery. A magnetic field is created when current flows through the rotor windings. The rotor is belt driven by the engine creating an AC voltage as this field rotates within the stator windings. The AC voltage is converted to DC voltage by the rectifier bridge and is then supplied to the electrical system at the generator battery terminal.

When the engine is running, the generator turn-on signal is sent to the generator from the powertrain control module (PCM), turning on the regulator. The generator's voltage regulator controls the current flow to the rotor, thereby controlling the generator output voltage. The rotor current is proportional to an electrical pulse width modulated voltage supplied by the regulator. When the engine is started, the regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the regulator varies the field current by controlling the pulse width. This regulates the generator's output voltage for proper battery charging and electrical system operation. The system voltage sense circuit receives B+ voltage that is Hot At All Times. This voltage is used by the regulator as the reference for system voltage control.

The PCM controls the Charge indicator on the instrument panel cluster (IPC) by sending a GM LAN message to the data link connector (DLC) which then sends the message to the IPC as class 2 serial data. The Charge indicator will turn on whenever the PCM detects the following condition:

- Undervoltage
- Overvoltage
- A stopped generator

STARTING SYSTEM DESCRIPTION AND OPERATION

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

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

opened.

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

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

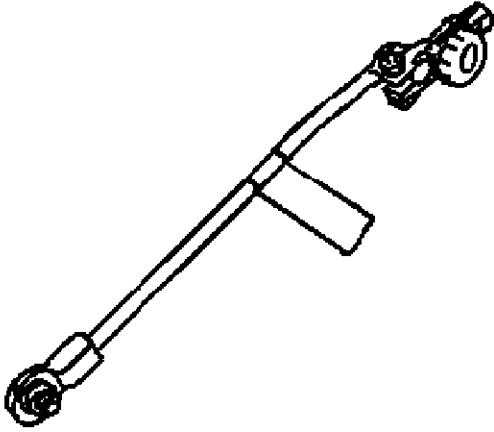
Circuit Description

Moving the ignition switch to the start position applies ignition voltage to the switch side of the STARTER relay. The powertrain control module (PCM) verifies that the transmission is in the Park or Neutral position and that theft is not active and grounds the control circuit of the STARTER relay. Battery voltage will then flow through the switch side of the STARTER relay to the S terminal of the starter solenoid, cranking the engine. Ground for the starter is supplied through the engine block.

SPECIAL TOOLS AND EQUIPMENT

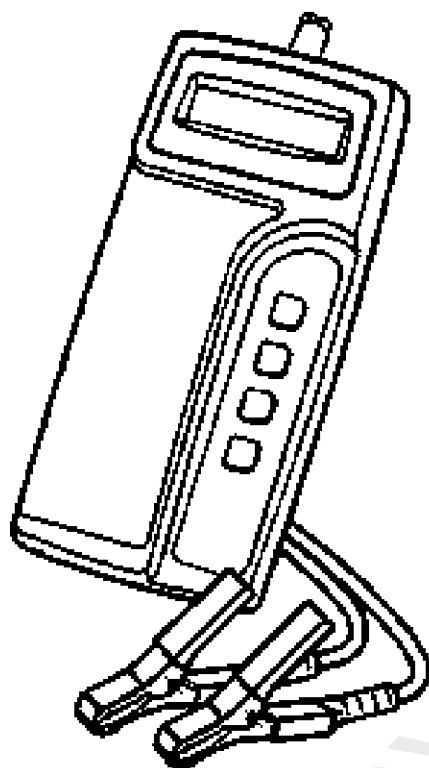
SPECIAL TOOLS

Special Tools

Illustration	Tool Number/Description
	J 38758 Parasitic Draw Test Switch

2006 Pontiac Torrent

2006 ENGINE Engine Electrical - Equinox & Torrent



J 42000
Battery Tester

2006 Pontiac Torrent

2006 ENGINE Engine Electrical - Equinox & Torrent

mcx30.com

2006 Pontiac Torrent

2006 ENGINE Engine Electrical - Equinox & Torrent

mcx30.com

2006 Pontiac Torrent

2006 ENGINE Engine Electrical - Equinox & Torrent

mcx30.com