

2003-04 STARTING & CHARGING SYSTEMS

Generators & Regulators - H2

DESCRIPTION & OPERATION

WARNING: Vehicles are equipped with air bag supplemental restraint system. Before attempting any repairs involving steering column, instrument panel or related components, see **AIR BAG DEACTIVATION PROCEDURES** in **AIR BAG RESTRAINT SYSTEMS** article in **RESTRAINTS**.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See appropriate **COMPUTER RELEARN PROCEDURES** article in **GENERAL INFORMATION** before disconnecting battery.

AD-244 generators are non-repairable. They are electrically similar to earlier models. Generator features the following major components:

- A delta stator.
- Rectifier bridge.
- Rotor with slip rings and brushes.
- Conventional pulley.
- Dual internal fans.
- Voltage regulator.
- Pulley and fan cool slip ring and frame.

AD stands for air-cooled dual internal fan, 2 is an electrical design designator, 30/44 denotes outside diameter of stator laminations in millimeters, over 100 millimeters. Generator is rated at 145 amperes. Generator features permanently lubricated bearings. Service should only include tightening of mounting components. Generator is replaced as a complete unit.

Voltage regulator controls field current of rotor in order to limit system voltage. Regulator switches current on and off at a rate of 400 cycles per second in order to perform these following functions:

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

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

Instrument Panel Cluster (IPC) illuminates charge indicator on Driver's Information Center (DIC) message center when this occurs:

- Powertrain Control Module (PCM) detects that generator output is 11 volts or less or greater than 16 volts. IPC receives a class 2 message from PCM requesting illumination.
- IPC determines that system voltage is 11 volts or less or greater than 16 volts. IPC receives a class 2 message from Body Control Module (BCM) indicating system voltage.
- IPC performs displays test at start of each ignition cycle. Indicator illuminates for approximately 5 seconds.

COMPONENT LOCATIONS

For component locations, see **ELECTRICAL COMPONENT LOCATOR** article in **ELECTRICAL**.

ADJUSTMENTS

BELT ADJUSTMENT

NOTE: Drive belt tension is controlled by a belt tensioner. No adjustment is required. For drive belt routing, see **DRIVE BELT ROUTING** article in **COOLING SYSTEM SPECIFICATIONS & DRIVE BELT ROUTING - H2** .

TROUBLE SHOOTING

NOTE: For additional information, see **CHARGING SYSTEM - GENERAL TROUBLE SHOOTING** article in **GENERAL INFORMATION**.

PRELIMINARY INSPECTION

Verify customer complaint by operating suspected system. Visually inspect for obvious signs of mechanical and electrical damage. Ensure battery is fully charged and passes load test. See **BATTERY TESTING & INSPECTION** under **ON-VEHICLE TESTING**. Inspect for blown fuses. See **COMPONENT LOCATIONS** . Inspect for loose or corroded connections, damaged wiring harnesses and/or switches. Check for a broken or partially broken wire inside insulation, which could cause system malfunction but prove good in a continuity/voltage check with system disconnected. Ensure any aftermarket electronic equipment is properly installed. If fault is found, repair as necessary. If no fault is found, perform self-diagnostics. See **SELF DIAGNOSTIC SYSTEM** .

SYSTEM OPERATION CHECK

NOTE: Before making electrical checks, visually inspect all terminals for clean, tight connections. Ensure all charging system related fuses are okay. Check generator mounting bolts and drive belt tension. Ensure battery is fully charged and in good condition prior to testing charging system. See **BATTERY TESTING & INSPECTION** under **ON-VEHICLE TESTING**. Ensure battery cable connections are in good condition and free of corrosion. Ensure starting system is okay. See **STARTERS** article in **ELECTRICAL**.

SELF DIAGNOSTIC SYSTEM

NOTE: Diagnostic trouble code tests are written specifically for use with GM Tech I or Tech II scan tools. Generic scan tool can be used but may have limited functions. This article only covers the portion of those systems which relates to charging system diagnosis. For further information, see appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

RETRIEVING DIAGNOSTIC TROUBLE CODES

See RETRIEVING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM under appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

CLEARING DIAGNOSTIC TROUBLE CODES

See CLEARING DIAGNOSTIC TROUBLE CODES under SELF-DIAGNOSTIC SYSTEM under appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.

DIAGNOSTIC TROUBLE CODE DEFINITIONS

DIAGNOSTIC TROUBLE CODE DEFINITIONS

DTC ⁽¹⁾	Description
P0562	Low System Voltage
P0563	High System Voltage
P0615	Improper Voltage Level On The Output Circuit That Controls The Starter Relay
P0622	Out-Of-Range Duty Cycle Signal
P1637	Generator Turn-On Signal Circuit Voltage Out-Of-Range
P1638	Out-Of-Range Duty Cycle Signal

(1) Codes listed in this table are only for testing covered in this article. For complete DTC listing, see appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT.

DIAGNOSTIC TESTS

DTC P0562: LOW SYSTEM VOLTAGE

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Using scan tool, observe Ignition 1 Signal voltage in Powertrain Control Module (PCM) data list. If voltage is 10.5 volts or less, go to next step. If voltage is greater than 10.5 volts, go to step 4 .
3. Test ignition feed circuit to PCM for high resistance or an open. If problem exists, repair as necessary.

After repair, go to step 7 . If problem does not exist, go to step 5 .

4. Inspect PCM harness connectors for poor connections. If problem exists, repair as necessary. After repair, go to step 7 . If problem does not exist, go to step 6 .
5. Repair ignition feed circuit to PCM for an open or short to ground. After repair, go to step 7 .
6. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
7. Using scan tool, clear DTCs. Operate vehicle at more than 5 MPH, for 20 seconds at 1200 RPM. Check for DTC. If DTC P0562 resets, repeat test beginning at step 2 . If DTC P0562 does not reset, system is okay.

DTC P0563: HIGH SYSTEM VOLTAGE

Diagnostic Procedure

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Turn off all accessories. Using a DVOM, measure battery voltage while operating engine above 2000 RPM. If battery voltage is 19 volts or less, go to step 4 . If battery voltage is greater than 19 volts, go to next step.
3. Replace generator. See **GENERATOR** under REMOVAL & INSTALLATION. After repair, go to step 5 .
4. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
5. Using scan tool, clear DTCs. Operate vehicle at more than 5 MPH, for 20 seconds at 1200 RPM. Check for DTC. If DTC P0563 resets, repeat test beginning step 2 . If DTC P0563 does not reset, system is okay.

DTC P0615: IMPROPER VOLTAGE LEVEL ON OUTPUT CIRCUIT THAT CONTROLS STARTER RELAY

Circuit Description

The PCM uses Output Driver Modules (ODM) to control many functions of the engine. The ODMs supply the ground path for the PCM controlled device when the PCM commands the device ON. Each ODM is able to control several outputs. The PCM monitors the ODMs for circuit conditions that are incorrect for the commanded state of the ODM. If the PCM detects an improper circuit condition in the ODM that controls the starter relay, DTC P0615 will set.

Conditions For Running The DTC

System voltage is between 8-16 volts.

DTC Set Conditions

The PCM detects an improper voltage level on the output circuit that controls the starter relay. The condition

exists for at least 2 seconds.

NOTE: The PCM will not illuminate the Malfunction Indicator Light (MIL). The PCM will store the conditions present when the DTC set as Fail Records data only.

Conditions For Clearing MIL/DTC

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.

Diagnostic Aids

Ignition system DTC's set with the ignition switch in the START position if the starter relay or the starter is inoperative. When the PCM enables starter operation, the PCM also initiates the diagnostic test routines for DTC P0335. If a condition exists which prevents the engine from cranking, the PCM will not receive signal input from the CKP and CMP sensors, and the DTC's will set.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may assist in diagnosing the condition. The information may help determine how often the condition that set the DTC occurs.

Test Description

The list below refers to the step number(s) on the diagnostic procedure.

- 1) Listen for an audible click when the Start 1 relay operates. Turn the ignition switch back and forth from the ON to START positions. Repeat this as necessary. See step 2 in DIAGNOSTIC PROCEDURE.
- 2) Tests for voltage at the coil side of the Start 1 relay. The PCM IGN fuse supplies power to the coil side of the Start 1 relay. See step 3 in DIAGNOSTIC PROCEDURE.
- 3) Verifies that the PCM is providing ground to the Start 1 relay. See step 4 in DIAGNOSTIC PROCEDURE.
- 4) Tests if ground is constantly being applied to the Start 1 relay. See step 5 in DIAGNOSTIC PROCEDURE.

Diagnostic Procedure

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Connect scan tool to Data Link Connector (DLC). DLC is located below left side of instrument panel. Install a scan tool. See **COMPONENT LOCATIONS**. Turn ON the ignition, with the engine OFF. Turn the ignition back and forth from the ON to START positions. If Start 1 relay turns ON and OFF with each command, problem is intermittent. Check wiring and connections. If problem is detected, go to next step.
3. Turn OFF the ignition. Disconnect the Start 1 relay. Turn ON the ignition, with the engine OFF. Probe the battery positive voltage of the Start 1 relay coil circuit with a test light that is connected to a good ground. If test light illuminates, go next step. If test light does not illuminate, go to step 8.

4. Connect a test light between the control circuit of the Start 1 relay and the battery positive voltage of the Start 1 relay coil circuit. Turn the ignition back and forth from the ON to START positions. If test light turns ON and OFF with each command, go to step 6 . If test light does not turn ON and OFF with each command, go next step.
5. Test the control circuit of the Start 1 relay for a short to voltage or an open. See **WIRING DIAGRAMS** . When repair is complete, go to step 11 . If problem is not detected, go to step 7 .
6. Inspect for poor connections at the Start 1 relay. Check for intermittent and poor connections and possible connector defects. When repair is complete, go to step 11 . If problem is not detected, go to step 9 .
7. Inspect for poor connections at the PCM. Check for intermittent and poor connections and possible connector defects. When repair is complete, go to step 11 . If problem is not detected, go to step 10 .
8. Repair the battery positive voltage circuit of the Start 1 relay as necessary. See **WIRING DIAGRAMS** . When repair is complete, go to step 11 .
9. Replace the Start 1 relay. See **COMPONENT LOCATIONS** . When replacement is complete, go to step 11 .
10. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
11. Review and record the scan tool Fail Records data. Use the scan tool in order to clear the DTC. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. See **CONDITIONS FOR RUNNING THE DTC** . Using the scan tool, observe the Specific DTC Information for DTC P0615 until the test runs. If the scan tool indicates that DTC P0615 is set, go to step 2 and retest. If DTC does not set, system is OK.

DTC P0622 OR DTC P1638: OUT-OF-RANGE DUTY CYCLE SIGNAL

Circuit Description

The PCM uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to the high side of the field winding in the generator. A Pulse-Width Modulated (PWM) high side driver in the voltage regulator turns the field winding ON and OFF. The PCM uses the PWM signal input to determine the generator load on the engine. This allows the PCM to adjust the idle speed to compensate for high electrical loads.

The PCM monitors the state of the generator field duty cycle signal circuit. When the key is in the RUN position and the engine is OFF, the PCM should detect a duty cycle near zero percent. However, when the engine is running, the duty cycle should be between 5 percent and 100 percent. The PCM monitors the PWM signal using a key ON test and a RUN test. During the tests, if the PCM detects an out of range PWM signal, DTC P0622 or DTC P1638 will set. When the DTC sets, the PCM will send a class 2 serial data message to the IPC to illuminate the charge indicator.

Conditions For Running The DTC

Key ON Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The key is in the RUN position.

- The engine is not running.

Run Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The engine is less than 3000 RPM.

Conditions For Setting The DTC

- Conditions for Setting the DTC During the ignition ON test, the PCM detects a PWM signal is out of range.
- During the RUN test, the PCM detects a PWM signal less than 5 percent for more than 6 seconds.

Action Taken When The DTC Sets

- The PCM will store the conditions present when the DTC set as Fail Records data only.
- The Malfunction Indicator Light (MIL) will not illuminate.

Conditions For Clearing The DTC

- The conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.
- The Powertrain Control Module (PCM) receives the clear code command from the scan tool.

Diagnostic Procedure

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Connect scan tool to Data Link Connector (DLC). DLC is located below left side of instrument panel. Start engine. Using scan tool, observe GEN F-Terminal parameter in Powertrain Control Module (PCM) data list. If scan tool indicates GEN F-Terminal parameter is 5-95 percent, go to next step. If scan tool does not indicate GEN F-Terminal parameter is 5-95 percent, go to step 4 .
3. With the scan tool command the generator OFF. If scan tool indicates GEN F-Terminal parameter is zero percent, problem is intermittent. Check wiring and connections. If scan tool does not indicate GEN F-Terminal parameter is zero percent, go to next step.
4. Turn OFF the ignition. Disconnect the generator connector. Connect test light to battery positive voltage. Turn ON the ignition, with the engine OFF. Probe the F-Terminal in the generator connector. See **WIRING DIAGRAMS** . Observe the GEN F-Terminal Signal parameter in the PCM data list. If scan tool indicates GEN F-Terminal parameter is 100 percent, perform **TEST A: CHARGING SYSTEM TEST** under SYSTEM TESTS. If scan tool does not indicate GEN F-Terminal parameter is 100 percent, go to next step.
5. Test Gray wire for short or open between generator harness connector terminal "C" and PCM harness connector C2 terminal No. 75. See **WIRING DIAGRAMS** . If problem exists, repair as necessary. After repair, go to step 8 . If problem does not exist, go to next step.

6. Inspect PCM harness connector for poor connections. If problem exists, repair as necessary. After repair, go to step 8 . If problem does not exit, go to next step.
7. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
8. Review and record scan tool Fail Records data. Using scan tool, clear DTCs. Operate vehicle within Fail Records conditions as noted. Using scan tool, observe Specific DTC information for DTC P0622 or DTC P1638. If scan tool indicates DTC P0622 or DTC P1638 failed this ignition, repeat test beginning at step 2 . If scan tool indicates DTC P0622 or DTC P1638 passed this ignition, system is okay.

DTC P1637: GENERATOR TURN-ON SIGNAL CIRCUIT VOLTAGE OUT-OF-RANGE

Circuit Description

The Powertrain Control Module (PCM) uses the generator turn on signal circuit to control the generator. A high side driver within the PCM allows the PCM to turn the generator ON and OFF. When generator operation is desired, the PCM sends a 10-11 volt signal to the voltage regulator via the generator turn on signal circuit. This causes the voltage regulator to begin controlling the generator field circuit. Once the generator is enabled by the PCM, the voltage regulator controls generator output independently of the PCM. Under certain operating conditions, the PCM can turn Off the generator by turning Off the 10-11 volt signal on the generator turn on signal circuit. The PCM has fault detection circuitry which monitors the state of the generator turn on signal circuit. If the fault detection circuit senses a voltage other than what is expected, this DTC will set. The voltage regulator also contains fault detection circuitry. If the regulator detects a problem, the regulator will ground the generator turn on signal circuit, pulling the voltage low. This also causes the PCM to set the DTC.

Conditions For Running The DTC

- The ignition is ON.
- System voltage between 9.0-18.0 volts.

Conditions For Setting The DTC

- An improper voltage level has been detected on the generator L-terminal circuit.
- The above conditions are present for at least 30 seconds.

Action Taken When The DTC Sets

- The PCM stores conditions which were present when the DTC set as Failure Records data only.
- This information will not be stored as Freeze Frame Records.

Conditions For Clearing The MIL/DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives a clear code command from the scan tool.

Diagnostic Procedure

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Install a scan tool. Start the engine. With a scan tool, monitor the DTC information for DTC P1637 in Engine Controls. If the scan tool indicates that DTC P1637 has passed, problem is intermittent. Check wiring and connections. If the scan tool does not indicate that DTC P1637 has passed, go to next step.
3. Test the generator turn on signal circuit for a short or open. If problem exists, repair as necessary. After repair, go to step 6 . If problem does not exist, go to next step.
4. Inspect PCM harness connector for poor connections. If problem exists, repair as necessary. After repair, go to step 6 . If problem does not exist, go to next step.
5. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
6. Using scan tool, clear DTCs. Operate vehicle at more than 1000 RPM. Check for DTC. If DTC P1637 resets, repeat test beginning at step 2 . If DTC P1637 does not reset, system is okay.

SYSTEM TESTS

SYMPTOM INDEX

Symptom	Perform Test
Charging System Test	<u>A</u>
Charge Indicator Always On	<u>B</u>
Charge Indicator Inoperative	<u>C</u>
Generator Noise Diagnosis	<u>D</u>

TEST A: CHARGING SYSTEM TEST

NOTE: Ensure battery is in good condition before proceeding with charging system tests. See **BATTERY TESTING & INSPECTION** under ON-VEHICLE TESTING.

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Start engine and observe charge indicator on Instrument Panel Cluster (IPC) or message in Driver Information Center (DIC). If charge indicator illuminates or DIC displays a charging system message, go to next step. If charge indicator light does not illuminate or DIC does not display a charging system message, repair by symptom. See **SYMPTOM INDEX** table.

3.

NOTE: Green POWER light of tester should remain illuminated while tester is being used.

Turn ignition switch to OFF position. Using CS Generator Tester (J-41450-B), connect Red lead to

generator output terminal (BAT) and Black lead to metal generator housing. If Green POWER light does not illuminate, go to next step. If Green POWER light illuminates, go to step 6 .

4. Using a DVOM, measure voltage between output terminal (BAT) of generator and metal generator housing. If battery voltage exists, go to step 14 . If battery voltage does not exist, go to next step.
5. Measure voltage between generator output terminal and battery negative terminal. If battery voltage exists, go to step 12 . If battery voltage does not exist, go to step 11 .
- 6.

CAUTION: Ensure load is completely turned off before connecting or disconnecting carbon pile load tester to battery.

Connect carbon pile tester to battery. Connect inductive ammeter to output circuit of generator. Disconnect generator harness connector. Locate matching harness connector on CS Generator Tester (J-41450-B) and connect to generator. If Red DIAGNOSTIC light illuminates, go to next step. If Red DIAGNOSTIC light does not illuminate, go to step 13 .

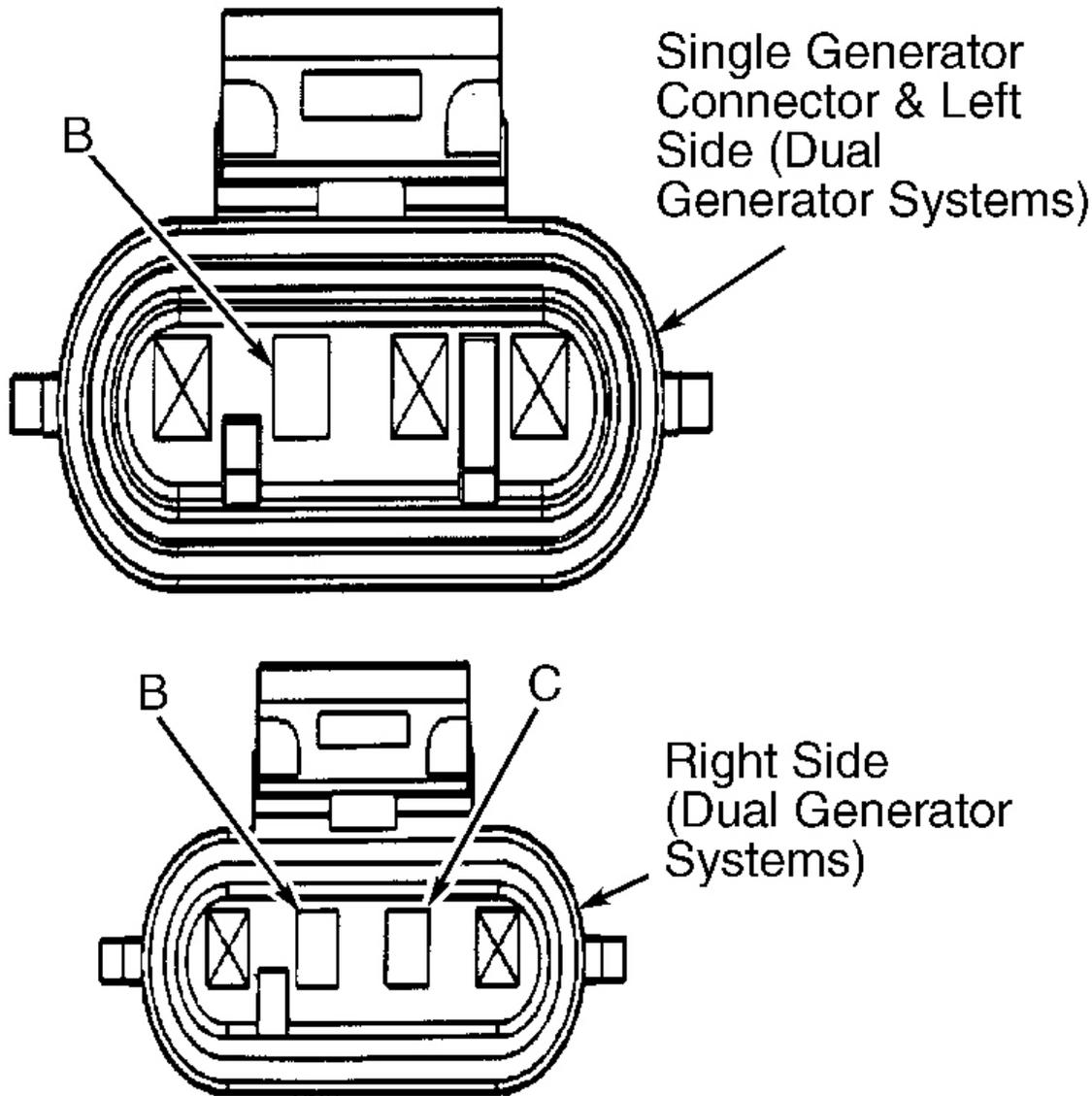
7. Increase engine speed to 2500 RPM. If Red DIAGNOSTIC light does not illuminate, go to next step. If Red DIAGNOSTIC light illuminates, go to step 15 .
- 8.

NOTE: If generator is not capable of producing Load Test amps, operate generator at maximum possible output.

Maintain engine speed at 2500 RPM. Turn on load of carbon pile tester and increase load until load is equal to test value of generator. See **GENERATOR SPECIFICATIONS** . If Red DIAGNOSTIC light illuminates, go to step 15 . If Red DIAGNOSTIC light does not illuminate, go to next step.

9. Maintain engine speed at 2500 RPM and continue to operate generator at load test value. See **GENERATOR SPECIFICATIONS** . Using a DVOM, measure voltage drop between generator output terminal and positive battery terminal. If voltage drop is 0.5 volt or less, go to next step. If voltage drop is greater than 0.5 volt, go to step 11 .
10. Maintain engine speed at 2500 RPM and continue to operate generator at load test value. See **GENERATOR SPECIFICATIONS** . Using a DVOM, measure voltage drop between generator metal housing and negative battery terminal. If voltage drop is 0.5 volt or less, go to step 16 . If voltage drop is greater than 0.5 volt, go to step 12 .
11. Repair open or high resistance in generator output circuit. See **WIRING DIAGRAMS** . After repair, go to step 16 .
12. Repair open or high resistance in generator ground circuit. See **WIRING DIAGRAMS** . After repair, go to step 16 .
13. Disconnect Generator Tester harness connector, but leave alligator clips connected so Green POWER light remains illuminated. Connect a jumper with a 100 ohm in-line resistor between generator connector terminal "B" and ground. If Red DIAGNOSTIC light illuminates, go to step 15 . If Red DIAGNOSTIC light does not illuminate, go to next step.
14. If a problem exists with CS Generator Tester (J-41450-B). Refer to manufacturer's instructions, how to test generator tester for proper operation. If tester has been repaired or replaced, go to step 3 .
15. Replace generator. See **GENERATOR** under REMOVAL & INSTALLATION. After repair, go to next step.

16. Operate system to verify repair. If system is not operating correctly, repeat test beginning at step 3 .



G00050227

Fig. 1: Identifying Generator 4-Pin Connector Terminals
Courtesy of GENERAL MOTORS CORP.

TEST B: CHARGE INDICATOR ALWAYS ON

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Turn ignition switch to RUN position. If charge indicator illuminates, go to step 3 . If charge indicator does not illuminate, repair by symptom. See **SYMPTOM INDEX** table.

3. Turn ignition switch to OFF position. Disconnect 4-pin generator harness connector. Turn ignition switch to RUN position. If charge indicator illuminates, go to next step. If charge indicator does not illuminate, perform **TEST A: CHARGING SYSTEM TEST**.
4. Test Brown wire for short to ground. See **WIRING DIAGRAMS**. If problem exists, repair as necessary. After repair, go to step 6. If problem does not exist, go to next step.
5. Replace PCM. See REMOVAL, OVERHAUL & INSTALLATION - TRUCKS article in ENGINE PERFORMANCE. Program PCM. After repair, go to next step.
6. Operate system to verify repair. If system is not operating correctly, repeat test beginning at step 3.

TEST C: CHARGE INDICATOR INOPERATIVE

1. If diagnostic system check was not performed, perform **ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK** under ON-VEHICLE TESTING. If diagnostic system check was performed, go to next step.
2. Turn ignition switch to RUN position. If charge indicator light does not illuminate, go to next step. If charge indicator light illuminates, problem is intermittent. Check wiring and connections.
3. Replace charge indicator bulb. See appropriate ANALOG INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. After repair, go to next step.
4. Operate system to verify repair. If system is not operating correctly, repeat test beginning at step 2.

TEST D: GENERATOR NOISE DIAGNOSIS

1. Test generator for proper operation. See **TEST A: CHARGING SYSTEM TEST**. If generator is operating properly, go to next step. If generator is not operating properly, go to step 11.
2. Start engine. Verify that generator noise can be heard. Turn switch to OFF position. Disconnect generator 4-pin harness connector. Start engine. Listen for generator noise. If noise does not exist, go to step 11. If noise still exist, go to next step.
3. Turn switch to OFF position. Remove drive belt. Spin generator pulley by hand. If pulley rotates smoothly and noise does not exist, go to next step. If pulley rotates roughly and/or noise exists, go to step 11.
4. Inspect pulley for looseness, or loose pulley nut. If pulley and nut are okay, go to next step. If pulley and/or nut is loose, go to step 11.
5. Loosen all generator mounting bolts. Tighten all mounting bolts to specification. See **TORQUE SPECIFICATIONS**. Install drive belt. Start engine and listen for noise. If noise has decreased or stopped, system is okay. If noise still exists, go to next step.
6. Check for stretched generator connections, or hoses or other equipment rubbing on generator. If problem exists, repair as necessary. After repair, go to next step. If problem does not exist, go to step 8.
7. Reroute electrical connections, hoses, etc., away from generator. Start engine and listen for noises. If noise has decreased or stopped, system is okay. If noise still exists, go to next step.
8. Check drive belt for proper tension. If drive belt is loose, go to next step. If drive belt is okay, go to step 10.
9. Replace drive belt tensioner. Start engine and listen for noise. If noise has decreased or stopped, system is okay. If noise still exists, go to step 11.

10. Check comparable vehicle for similar noise. If noise exists in similar vehicle, system is okay. If noise does not exist in similar vehicle, go to next step.
11. If no definite generator problems were found, ensure all other possible sources of noise are eliminated. If all possibilities have been eliminated, replace generator. See **GENERATOR** under REMOVAL & INSTALLATION. After repair, go to next step.
12. Start engine and verify that noise is reduced or eliminated. If noise is still objectionable, go to step 2 .

ON-VEHICLE TESTING

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See appropriate **COMPUTER RELEARN PROCEDURES** article in **GENERAL INFORMATION** before disconnecting battery.

NOTE: Before making electrical checks, visually inspect all terminals for clean, tight connections. Ensure all charging system related fuses are okay. Check generator mounting bolts and drive belt tension. Ensure battery is in good condition prior to testing charging system. Ensure starting system is okay. See appropriate **STARTERS** article.

NOTE: Connector Test Adapter Kit (J-35616-A) must be used whenever a test procedure requires checking or probing terminal.

BATTERY TESTING & INSPECTION

NOTE: Manufacturer recommends using Battery Tester (J-42000) for testing battery. Follow instructions provided with tester.

1. Inspect battery for a cracked, broken or damaged case. If battery case is okay, go to next step. If battery case is not okay, go to step 19 .
2. Compare battery Cold Cranking Amperage (CCA) and Reserve Capacity (RC) rating to specifications. See **BATTERY SPECIFICATIONS** . If battery meets or exceeds specifications, go to next step. If battery does not meet or exceed specifications, go to step 19 .
3. Inspect battery hydrometer display. If hydrometer display shows a Yellow dot, go to next step. If hydrometer display does not show a Yellow dot, go to step 5 .
4. Using a small screwdriver, tap the top of hydrometer display to dislodge any air bubbles inside. If hydrometer display still shows a Yellow dot, go to step 19 . If hydrometer display does not show a Yellow dot, go to next step.
5. Turn ignition switch to OFF position. Attempt to rotate negative battery cable connector clockwise with light finger pressure. If negative connector rotates, go to next step. If negative connector does not rotate, go to step 7 .
6. Using an INCH lb. torque wrench, record torque value while loosening negative battery cable bolt. If

torque is equal to or greater than 88 INCH lbs. (10 N.m), go to step 8 . If torque is less than 88 INCH lbs. (10 N.m), go to next step.

7. Disconnect negative battery cable and go to step 9 .
8. Disconnect negative battery cable. Inspect battery and cable terminals for corrosion and defects. Repair as necessary. Go to next step.
9. Attempt to rotate positive battery cable connector clockwise with light finger pressure. If battery cable rotates, go to next step. If battery cable does not rotate, go to step 11 .
10. Using an INCH lb. torque wrench, record torque value while loosening positive battery cable bolt. If torque is equal to or greater than 88 INCH lbs. (10 N.m), go to step 12 . If torque is below 88 INCH lbs. (10 N.m), go to next step.
11. Disconnect positive battery cable and go to step 13 .
12. Disconnect positive battery cable. Inspect battery and cable terminals for corrosion and defects. If problem exists, repair as necessary. After repair, go to next step.
13. Clean and wire brush lead face of both battery terminals and metal contact surfaces on both cable connectors. Remove bolts from both battery cable connectors and inspect for corrosion and defects. Repair or replace as necessary. If battery and cables terminals are clean and in good condition, go to next step.
14. Connect positive battery cable to battery and tighten bolt to 11 ft. lbs. (15 N.m). After repair, go to next step.
15. Connect negative battery cable to battery and tighten bolt to 11 ft. lbs. (15 N.m). After repair, go to next step.
16. Ensure all electrical loads are off. Follow manufacturer's instructions and install Battery Tester (J-42000) to vehicle battery. Follow any instructions displayed on Battery Tester. If Battery Tester passed battery, go to next step. If Battery Tester did not pass battery, go to step 18 .
17. Press CODE button on battery tester. Record displayed code on vehicle repair order for warranty purposes. Battery is okay.
18. Press CODE button on Battery Tester. Record displayed code on vehicle repair order for warranty purposes. Replace battery.
19. Replace battery.

BATTERY SPECIFICATIONS

BATTERY SPECIFICATIONS

Application	Specification
GM P/N 19001810	
Replacement Battery Number	79-6YR
Cold Cranking Amps	880 Amps
Reserve Capacity Rating	115 Minutes

ENGINE ELECTRICAL DIAGNOSTIC SYSTEM CHECK

1. Perform battery inspection test. See **BATTERY TESTING & INSPECTION** under ON-VEHICLE

TESTING. Go to next step.

2. Connect scan tool to Data Link Connector (DLC). DLC is located below left side of instrument panel. Turn ignition switch RUN position. If scan tool powers up, go to next step. If scan tool does not power up, perform appropriate test. See appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT.
3. Turn ignition switch to RUN position with each module on class 2 serial data circuit. If scan tool communicates with modules, go to next step. If scan tool does not communicate with any module, perform appropriate test. See appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT.
4. Using scan tool, select DISPLAY DTCs function for each module on scan tool. Record all DTCs displayed, DTC status and module which set DTC. If scan tool displayed DTCs, go to next step. If scan tool did not display DTCs, repair charging system by symptom. See **SYMPTOM INDEX** table under SYSTEM TESTS.
5. If scan tool displays DTCs which begin with "U", perform appropriate test in accordance with DTC retrieved. See appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT. If scan tool does not display DTCs which begin with "U", go to next step.
6. If scan tool does not display any DTCs which begin with "P", go to next step. If scan tool displays any DTCs which begin with "P", perform appropriate test in accordance with DTC retrieved. See appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE.
7. If scan tool displays DTCs which begin with "B", perform appropriate test in accordance with DTC retrieved. See appropriate BODY CONTROL MODULES article in ACCESSORIES & EQUIPMENT. If scan tool does not display DTCs which begin with "B", perform appropriate test in accordance with DTCs retrieved. See **DIAGNOSTIC TROUBLE CODE DEFINITIONS**.

BENCH TESTING

NOTE: Bench testing procedures are not available from manufacturer.

REMOVAL & INSTALLATION

WARNING: Vehicles are equipped with air bag supplemental restraint system. Before attempting any repairs involving steering column, instrument panel or related components, see **AIR BAG DEACTIVATION PROCEDURES** in AIR BAG RESTRAINT SYSTEMS article in RESTRAINTS.

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See appropriate **COMPUTER RELEARN PROCEDURES** article in GENERAL INFORMATION before disconnecting battery.

GENERATOR

Removal & Installation

Disconnect negative battery cable. Remove drive belt. Remove engine sight shield, if necessary. Disconnect generator harness connector. Slide protective boot down revealing terminal stud. Remove battery output BAT terminal nut. Disconnect battery output BAT cable. Remove generator mounting bolts. Remove generator. To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

OVERHAUL

NOTE: Generator is serviced by replacement only.

GENERATOR SPECIFICATIONS

SERVICE SPECIFICATIONS

Application	Specification
Generator Model	Delphi AD244
Rated Output	145 Amps
Load Test Output	102 Amps

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs (N.m)
Engine Wiring Harness Auxiliary Negative Battery Cable Bolt	12 (16)
Engine Wiring Harness Ground Bolt	12 (16)
Engine Wiring Harness Ground/Negative Cable Bolt	18 (25)
Front Axle Mounting Bracket Nut	70 (95)
Generator Bracket Bolt	37 (50)
Generator Bolt	37 (50)
Negative Battery Cable Bolt	13 (17)
Positive Battery Cable Bolt	13 (17)
Starter Bolt	37 (50)
	INCH Lbs.
Forward Light Wiring Harness Ground/Negative Cable Bolt	80 (9)
Front End Diagonal Brace Bolt	80 (9)
Generator Cable Nut	80 (9)
Ground Strap Nut	80 (9)
Positive Cable Nut	80 (9)
Positive Cable-At-Underhood Bussed Electrical Center (UBEC) Bolt	80 (9)
Starter Lead Nut	30 (3.4)
Surge Tank Bolt/Nut	80 (9)
Transmission Cover Bolt	80 (9)

WIRING DIAGRAMS

For 2003, see **SYSTEM WIRING DIAGRAMS** in ELECTRICAL.

For 2004, see **SYSTEM WIRING DIAGRAMS** in ELECTRICAL.

2004 ELECTRICAL

Engine Electrical - Hummer H2

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Cable Bracket Bolt	25 N.m	18 lb ft
Battery Cable Channel Bolt	12 N.m	106 lb in
Battery Hold Down Retainer Bolt	25 N.m	18 lb ft
Battery Tray Bolt	9 N.m	80 lb in
Battery Tray Nut	25 N.m	18 lb ft
Engine Wiring Harness Auxiliary Negative Battery Cable Bolt	16 N.m	12 lb ft
Engine Wiring Harness Ground Bolt	16 N.m	12 lb ft
Engine Wiring Harness Ground/Negative Cable Bolt	25 N.m	18 lb ft
Front Axle Mounting Bracket Nut	95 N.m	70 lb ft
Forward Lamp Wiring Harness Ground/Negative Cable Bolt	9 N.m	80 lb in
Front End Diagonal Brace Bolt	9 N.m	80 lb in
Generator Bracket Bolt	50 N.m	37 lb ft
Generator Bolt	50 N.m	37 lb ft
Generator Cable Nut	9 N.m	80 lb in
Ground Strap Nut	9 N.m	80 lb in
Negative Battery Cable Bolt	17 N.m	13 lb ft
Positive Battery Cable Bolt	17 N.m	13 lb ft
Positive Cable Nut	9 N.m	80 lb in
Positive Cable at Underhood Bussed Electrical Center (UBEC) Bolt	9 N.m	80 lb in
Starter Bolt	50 N.m	37 lb ft
Starter Lead Nut	3.4 N.m	30 lb in
Surge Tank Bolt/Nut	9 N.m	80 lb in
Transmission Cover Bolt	9 N.m	80 lb in

BATTERY USAGE

Battery Usage

Base	
Cold Cranking Amperage (CCA)	880 A
Reserve Capacity Rating	115 Minutes
Replacement Battery Number	79-6YR

STARTER MOTOR USAGE

Starter Motor Usage

Applications	Starter Model
6.0L (LQ4)	PG-260L

GENERATOR USAGE

Generator Usage

Base	
Generator Model	Delphi AD244
Rated Output	145 A
Load Test Output	102 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

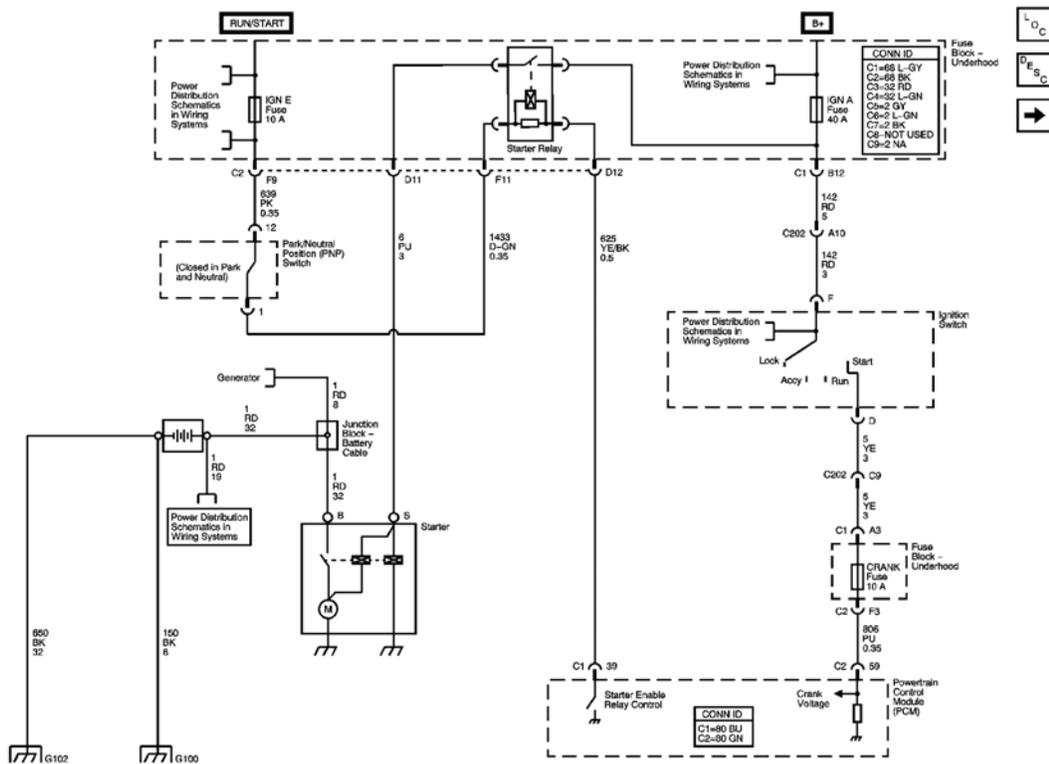


Fig. 1: Starting Schematics

Courtesy of GENERAL MOTORS CORP.

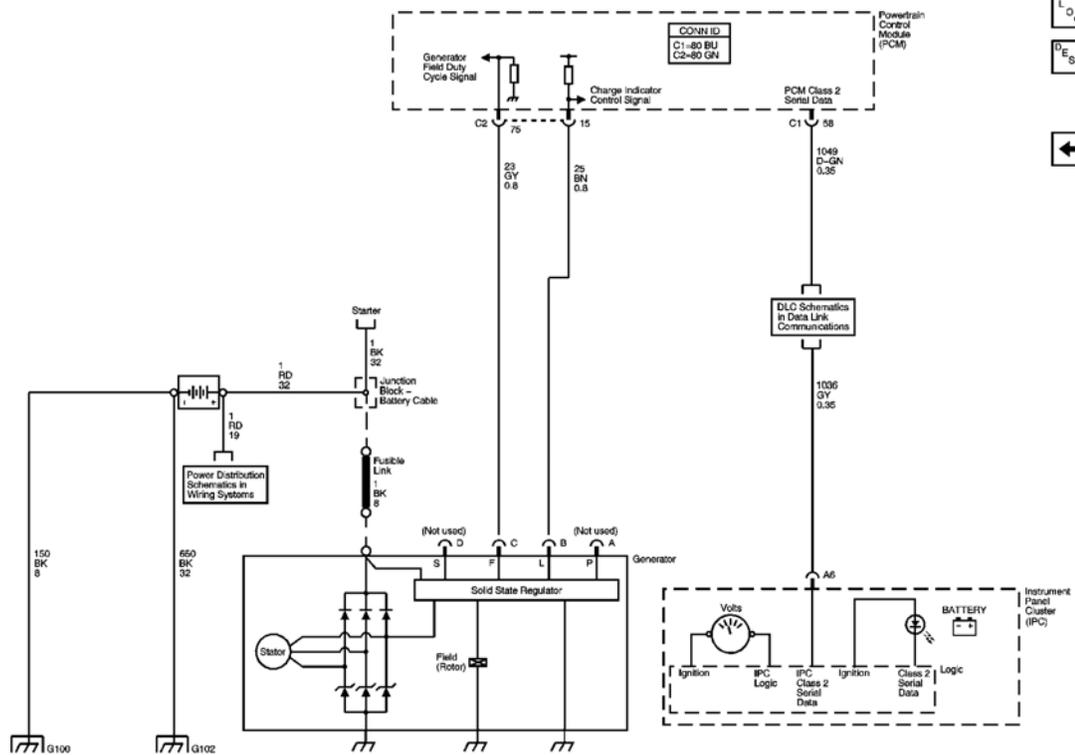


Fig. 2: Charging Schematics
 Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE ELECTRICAL COMPONENT VIEWS

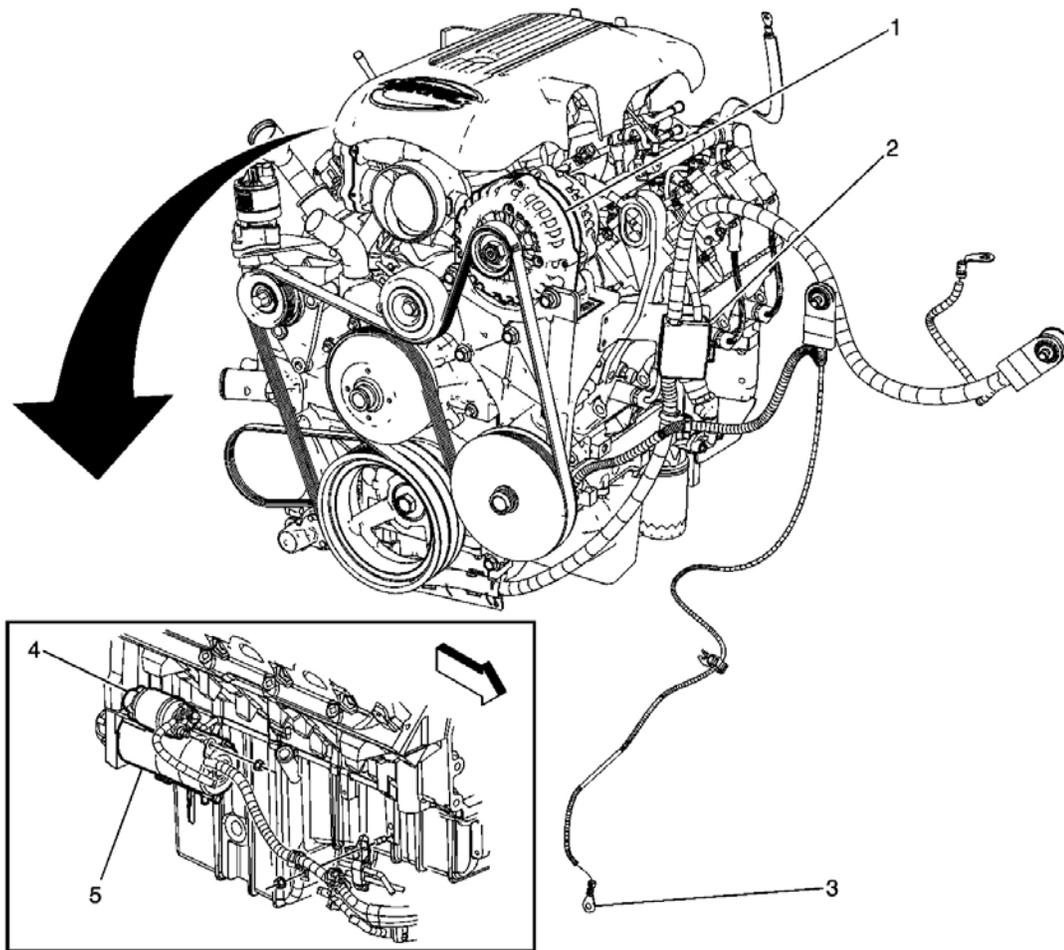


Fig. 3: Engine Electrical Component Views
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 3

Callout	Component Name
1	Generator
2	Junction Block - Battery Cable
3	G100
4	Starter Solenoid
5	Starter

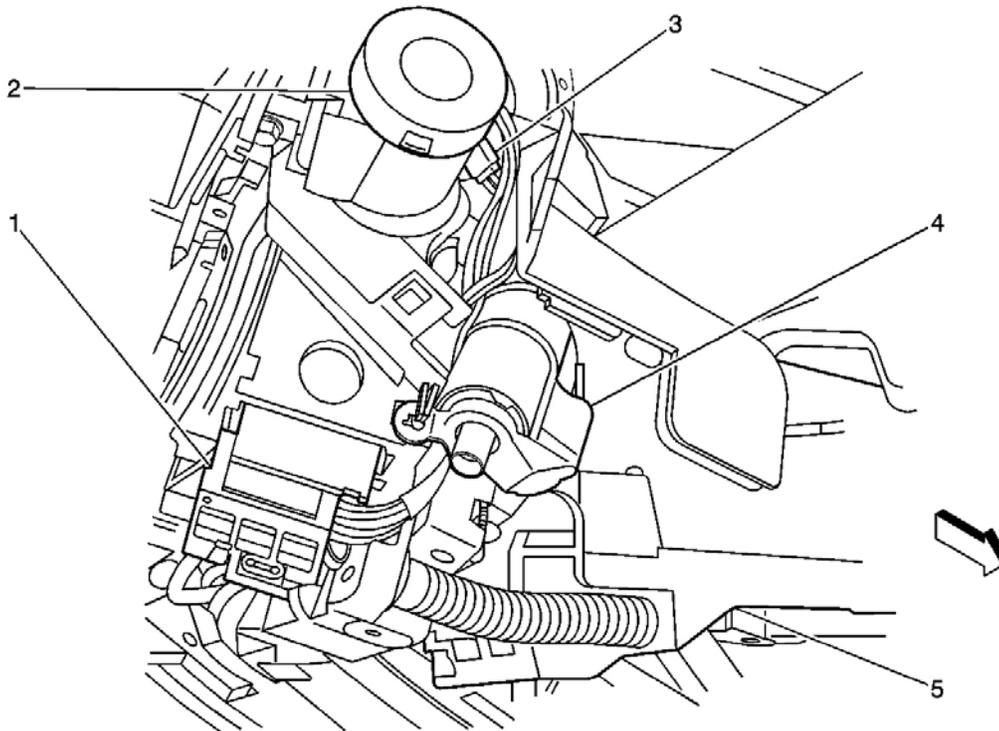


Fig. 4: Top Of Steering Column Component Views
 Courtesy of GENERAL MOTORS CORP.

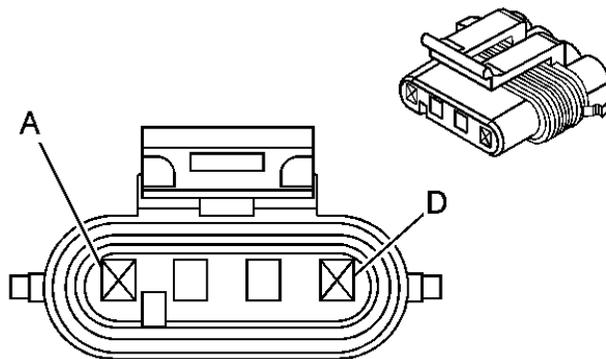
Callouts For Fig. 4

Callout	Component Name
1	Ignition Switch
2	Passlock Sensor
3	Ignition Key Alarm Switch
4	Ignition Lock Cylinder Control Actuator
5	Steering Column

ENGINE ELECTRICAL CONNECTOR END VIEWS

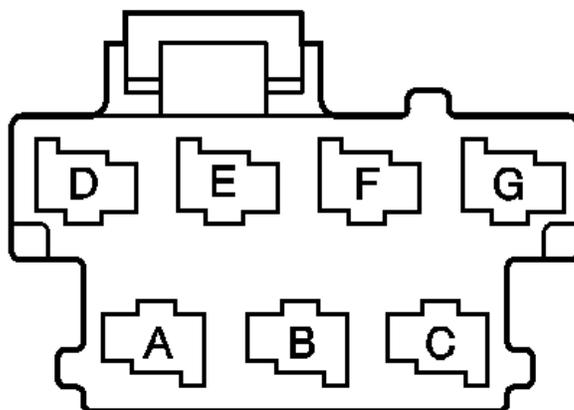
Generator Terminal Identification

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Connector Part Information		<ul style="list-style-type: none"> • 15355066 • 2-Way F Metri-Pack 150 Series Sealed (TN) 	
Pin	Wire Color	Circuit No.	Function
A	-	-	Plugged
B	BN	25	Charge Indicator Control Signal
C	GY	23	Generator Field Duty Cycle Signal
D	-	-	Plugged

Ignition Terminal Identification Switch



Connector Part Information		<ul style="list-style-type: none"> • 10400853490 • 7-Way F Kostal N Series (BK) 	
Pin	Wire Color	Circuit No.	Function

A	BN	4	Accessory Voltage
B	RD/WH	342	Battery Positive Voltage
C	PK	3	Ignition 1 Voltage
D	YE	5	Crank Voltage
E	WH	1390	Acc/Run/Crank Voltage
F	RD	142	Battery Positive Voltage
G	OG	300	Ignition 3 Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

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

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

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

DIAGNOSTIC SYSTEM CHECK - ENGINE ELECTRICAL

Diagnostic System Check - Engine Electrical

Step	Action	Yes	No
1	Did you perform the Battery Inspection/Test?	Go to Step 2	Go to Battery Inspection/Test (Non-HP2)
2	Install a scan tool. Does the scan tool power up?	Go to Step 4	Go to Scan Tool Does Not Power Up
3	<p>IMPORTANT: The engine may start during the following step. Turn OFF the engine as soon as you have observed the Crank power mode.</p> <ol style="list-style-type: none"> 1. Access the Class 2 Power Mode in the Diagnostic Circuit Check on the scan tool. 2. Rotate the ignition switch through all positions while observing the ignition switch power mode parameter. <p>Does the ignition switch parameter reading match the ignition switch position for all switch positions?</p>	Go to Step 4	Go to Power Mode Mismatch in Body Control System

4	<p>1. Turn ON the ignition, with the engine OFF.</p> <p>2. Attempt to communicate with each module on the class 2 serial data circuit.</p> <p>If using a Tech 2, obtain this information using the Class 2 Message Monitor feature.</p> <p>Does the scan tool communicate with any module on the class 2 serial data circuit?</p>	Go to Step 5	Go to <u>Scan Tool Does Not Communicate with Class 2 Device</u>
5	<p>1. Select the Display DTCs function for each module.</p> <p>If using a Tech 2, use the Class 2 DTC Check feature in order to determine which modules have DTCs set.</p> <p>2. Record all of the displayed DTCs the DTC status and the module which set the DTC.</p> <p>Does the scan tool display any DTCs?</p>	Go to Step 6	Go to <u>Symptoms - Engine Electrical</u>
6	Does the scan tool display any DTC beginning with "U"?	Go to <u>Diagnostic Trouble Code (DTC) List</u>	Go to Step 7
7	Does the scan tool display any DTC beginning with "P"?	Go to Powertrain DTC list in Engine Controls	Go to Step 8
8	Does the scan tool display any DTC beginning with "B"?	Go to <u>Diagnostic Trouble Code (DTC) List</u>	Go to <u>Diagnostic Trouble Code (DTC) List</u>

SCAN TOOL DATA LIST

Powertrain Control Module (PCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF			
Ignition 1 Signal	Engine 1,2 Data	Volts	9-14v
GEN L-Terminal Signal Command	Engine 2 Data	OK/No Output	OK
GEN F-Terminal Signal	Engine 2 Data	%	10-90%

SCAN TOOL DATA DEFINITIONS

Ignition 1 Signal

The scan tool displays the current voltage at the battery.

GEN L-Terminal Signal Command

The scan tool displays OK/No Output. The scan tool displays OK until malfunction is detected on the generator L terminal circuit, then it reads No Output.

GEN F-Terminal Signal

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

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Modules
B1327	<u>DTC B1327</u>	BCM
B1328	<u>DTC B1328</u>	BCM
P0562	<u>DTC P0562</u>	PCM
P0563	<u>DTC P0563</u>	PCM
P1637	<u>DTC P1637</u>	PCM
P0622	<u>DTC P0622</u>	PCM
P0615	<u>DTC P0615</u>	PCM

DTC B1327

Circuit Description

All vehicle modules monitor system voltage. The system voltage message is sent to other modules via Class 2 message. When the system voltage drops below the specified range DTC B1327 shall set within the affected module.

Conditions for Running the DTC

This DTC shall run only if the module has power, ground and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage, except when the DTC B1390 is set current.

Conditions for Setting the DTC

- This DTC shall be set as current when the voltage falls below 9.0 volts for 1.2 seconds.
- When the vehicle exits START the module shall delay checking the voltage for 2 seconds.

Action Taken When the DTC Sets

- A message shall be sent out on the class 2 lines to notify all other modules of low battery voltage.
- The modules disable the setting of U codes and other DTCs.

Conditions for Clearing the DTC

- The DTC will clear current status when the voltage is greater than 9.5 volts for 1.2 seconds.
- A history DTC will clear after 50 consecutive ignition cycles if the condition for the malfunction is no longer present.
- Use the ON-Board clearing DTCs feature.
- Use a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: Tests for the proper voltage at battery positive voltage sense circuit of the module, if voltage is not within the proper operating range, the voltage sense circuit needs to be tested.

4: Tests the circuit for high resistance.

5: Tests for the proper ground circuit for the module.

DTC B1327

Step	Action	Value (s)	Yes	No
Schematic Reference: <u>Starting and Charging Schematics</u> or <u>Power Distribution Schematics</u> in Wiring Systems Connector End View Reference: <u>Master Electrical Component List</u> in Wiring Systems				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the battery voltage parameter in the affected module data list. Or with a DMM, measure the battery voltage at the appropriate circuit of the module. Does the voltage measure greater than the specified value?	9.4 V	Go to Step 6	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the harness connector of the module setting the DTC B1327. 3. Measure the voltage between the battery positive voltage circuit of the module setting the DTC B1327 and the ground circuit of the module setting the DTC	9.4 V		

	B1327.			
	Does the voltage measure greater than the specified value?		Go to Step 6	Go to Step 4
4	Test the batter positive voltage circuit of the module setting the code for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 5
5	Test the ground sense circuit of the module setting the code for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the harness connector of the module setting the DTC. 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	IMPORTANT: Perform the setup procedure for the module setting the code, if necessary. Replace the module setting the DTC. Refer to Control Module References in Body Control System. Did you complete the replacement?	-	Go to Step 8	-
8	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC reset?	-	Go to Step 2	System OK

DTC B1328

Circuit Description

All vehicle modules monitor system voltage. The system voltage message is sent to other modules via Class 2 message. When the system voltage is above the specified range DTC B1328 shall set within the affected module.

Conditions for Running the DTC

This DTC shall run only if the module has power, ground and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage, except when the DTC B1390 is set current.

Conditions for Setting the DTC

This DTC will set as current when the voltage is greater than 15.9 volts for 1.2 seconds and DTC B1390 is not

set current in the affected module.

Action Taken When the DTC Sets

- A message shall be sent out on the class 2 lines to notify all other modules of high than normal battery voltage.
- The modules disable the setting of U codes and other DTCs.

Conditions for Clearing the DTC

- The DTC will clear current status when the voltage is less than 15.5 volts for 1.2 seconds.
- A history DTC will clear after 50 consecutive ignition cycles if the condition for the malfunction is no longer present.
- Use a scan tool.

Diagnostic Aids

Using a battery charger to jumpstart the vehicle may set DTC B1328 as a history code.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: Tests for the proper voltage at the affected module. If the voltage is not within the proper operating range, the charging system needs to be checked.

4: Setup procedure for the module replacement.

DTC B1328

Step	Action	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, monitor the DTC Information for DTC B1328 in the affected module. Does the scan tool indicate that DTC B1328 is current?	Go to Step 4	Go to Step 3
3	With a scan tool, monitor the DTC Information for DTC B1328 in the affected module. Does the scan tool indicate that DTC B1328 is current?	Go to Step 4	Go to Diagnostic Aids
4	IMPORTANT: Perform the setup procedure for the module setting the code, if necessary.		

	Replace the module setting the code. Refer to Control Module References in Body Control System. Did you complete the replacement?	Go to Step 5	-
5	<ol style="list-style-type: none"> 1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. <p>Does the DTC reset?</p>	Go to Step 2	System OK

DTC P0562

Circuit Description

The PCM monitors the system voltage to make sure that the voltage stays within the proper range. If the PCM detects an excessively low system voltage, DTC P0562 will set.

When the charging system detects a fault, the instrument panel cluster (IPC) displays a message or the charge indicator will light.

Conditions for Running the DTC

- Engine run time more than 20 seconds and above 1200 RPM.
- Vehicle speed above 8 km/h (5 mph).

Conditions for Setting the DTC

The PCM detects an improper voltage below 11 volts for 5 seconds.

Action Taken When the DTC Sets

- The PCM stores the DTC information into memory when the diagnostic runs and fails.
- The PCM will store conditions which were present when the DTC set as Failure Records data only.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The instrument panel cluster (IPC) displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.
- The powertrain control module (PCM) receives the clear code command from the scan tool.

DTC P0562

Step	Action	Value (s)	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	With the scan tool monitor the Ignition 1 signal voltage in the PCM data list. Does the scan tool display Ignition 1 voltage greater than the specified value?	11 V	Go to Step 4	Go to Step 3
3	Test the ignition feed circuit to the PCM for high resistance or open. 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
4	<ol style="list-style-type: none"> Inspect for poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. If you find a poor connection, repair the condition as necessary. Refer to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 7	Go to Step 6
5	Repair the ignition feed circuit to the PCM for an open or a short to ground. Refer to Wiring Repairs in Wiring Systems. Is the action complete?	-	Go to Step 7	-
6	IMPORTANT: The replacement PCM must be programmed. Replace the PCM. Refer to Powertrain Control Module (PCM) Replacement in Engine Controls. Is the action complete?	-	Go to Step 7	-
7	<ol style="list-style-type: none"> Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text, if applicable. Does the DTC reset?	-	Go to Step 2	System OK

DTC P0563

Circuit Description

The powertrain control module (PCM) continuously monitors that the system voltage stays within the proper range. If the PCM detects an excessively high system voltage, DTC P0563 will set. A high voltage condition may cause a stalling condition or other driveability concerns.

Conditions for Running the DTC

- The engine run time is more than 20 seconds.
- Engine running above 1200 RPM.
- Vehicle speed above 8 km/h (5 mph).

Conditions for Setting the DTC

- The PCM senses the system voltage is above 19 volts.
- All of the conditions are present for 5 seconds.

Action Taken When the DTC Sets

- The PCM stores DTC P0563 in the PCM memory when the diagnostic runs and fails.
- The PCM will record the operating conditions at the time the diagnostic fails. The PCM stores this information in Failure Records.
- The PCM disables most outputs.
- The transmission defaults to a predetermined gear.
- The torque converter clutch (TCC) operation is inhibited.
- The instrument panel cluster (IPC) displays a message.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.
- The Powertrain Control Module (PCM) receives the clear code command from the scan tool.

DTC P0563

Step	Action	Value (s)	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
	1. Turn OFF all the accessories.			

2	<ol style="list-style-type: none"> 2. Measure the battery voltage at the battery using the DMM. 3. Operate the engine speed above 2000 RPM. <p>Is the battery voltage less than the specified value?</p>	19 V	Go to Step 4	Go to Step 3
3	<p>Replace the generator. Refer to <u>Generator Replacement</u> .</p> <p>Is the action complete?</p>	-	Go to Step 5	-
4	<p>IMPORTANT: The replacement PCM must be programmed.</p> <p>Replace the PCM. Refer to <u>Powertrain Control Module (PCM) Replacement</u> in Engine Controls. Is the action complete?</p>	-	Go to Step 5	-
5	<ol style="list-style-type: none"> 1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text, if applicable. <p>Does the DTC reset?</p>	-	Go to Step 2	System OK

DTC P0615

Circuit Description

The PCM uses Output Driver Modules (ODMs) to control many functions of the engine. The ODMs supply the ground path for the PCM controlled device when the PCM commands the device ON. Each ODM is able to control several outputs. The PCM monitors the ODMs for circuit conditions that are incorrect for the commanded state of the ODM. If the PCM detects an improper circuit condition in the ODM that controls the starter relay, DTC P0615 will set.

Conditions for Running the DTC

System voltage is between 8-16 volts.

Conditions for Setting the DTC

- The PCM detects an improper voltage level on the output circuit that controls the starter relay.
- The condition exists for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the Malfunction Indicator Lamp (MIL).

- The PCM will store the conditions present when the DTC set as Fail Records data only.

Conditions for Clearing the MIL/DTC

- 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.

Diagnostic Aids

Ignition system DTCs set with the ignition switch in the START position if the starter relay or the starter is inoperative. When the PCM enables starter operation, the PCM also initiates the diagnostic test routines for DTC P0335. If a condition exists which prevents the engine from cranking, the PCM will not receive signal input from the CKP and CMP sensors, and the DTCs will set.

Reviewing the Fail Records vehicle mileage since the diagnostic test last failed may assist in diagnosing the condition. The information may help determine how often the condition that set the DTC occurs.

Test Description

The number(s) below refer to the step number(s) on the diagnostic table.

- 2:** Listen for an audible click when the Start 1 relay operates. Turn the ignition switch back and forth from the ON to START positions. Repeat this as necessary.
- 3:** Tests for voltage at the coil side of the Start 1 relay. The PCM IGN fuse supplies power to the coil side of the Start 1 relay.
- 4:** Verifies that the PCM is providing ground to the Start 1 relay.
- 5:** Tests if ground is constantly being applied to the Start 1 relay.

DTC P0615

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			
Connector End View Reference: Engine Electrical Connector End Views			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Turn the ignition back and forth from the ON to START positions. Does the Start 1 relay turn ON and OFF with each command?	Go to <u>Testing for Intermittent Conditions and Poor Connections in Wiring Systems</u>	Go to Step 3
	1. Turn OFF the ignition.		

3	<ol style="list-style-type: none"> 2. Disconnect the Start 1 relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage of the Start 1 relay coil circuit with a test lamp that is connected to a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 4	Go to Step 8
4	<ol style="list-style-type: none"> 1. Connect a test lamp between the control circuit of the Start 1 relay and the battery positive voltage of the Start 1 relay coil circuit. 2. Turn the ignition back and forth from the ON to START positions. <p>Does the test lamp turn ON and OFF with each command?</p>	Go to Step 6	Go to Step 5
5	<p>Test the control circuit of the Start 1 relay for a short to voltage or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 11	Go to Step 7
6	<p>Inspect for poor connections at the Start 1 relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 11	Go to Step 9
7	<p>Inspect for poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 11	Go to Step 10
8	<p>Repair the battery positive voltage circuit of the Start 1 relay. Refer to Connector Repairs in Wiring Systems.</p> <p>Did you complete the repair?</p>	Go to Step 11	-
9	<p>Replace the Start 1 relay. Refer to Relay Replacement (Within an Electrical Center) or Relay Replacement (Attached to Wire Harness) in Wiring Systems.</p> <p>Did you complete the replacement?</p>	Go to Step 11	-
10	<p>IMPORTANT: The replacement PCM must be programmed.</p>		

	Replace the PCM. Refer to Powertrain Control Module (PCM) Replacement in Engine Controls. Did you complete the replacement?	Go to Step 11	-
11	<ol style="list-style-type: none"> 1. Review and record the scan tool Fail Records data. 2. Use the scan tool in order to clear the DTC. 3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. 4. Using the scan tool, observe the Specific DTC Information for DTC P0615 until the test runs. <p>Does the scan tool indicate that DTC P0615 failed this ignition?</p>	Go to Step 2	System OK

DTC P0622

Circuit Description

The PCM uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to the high side of the field winding in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field winding ON and OFF. The PCM uses the PWM signal input to determine the generator load on the engine. This allows the PCM to adjust the idle speed to compensate for high electrical loads.

The PCM monitors the state of the generator field duty cycle signal circuit. When the key is in the RUN position and the engine is OFF, the PCM should detect a duty cycle near 0 percent. However, when the engine is running, the duty cycle should be between 5 percent and 100 percent. The PCM monitors the PWM signal using a key ON test and a RUN test. During the tests, if the PCM detects an out of range PWM signal, DTC P0622 will set. When the DTC sets, the PCM will send a class 2 serial data message to the IPC to illuminate the charge indicator.

or

Conditions for Running the DTC

Key ON Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The key is in the RUN position.
- The engine is not running.

Run Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The engine is less than 3000 RPM.

Conditions for Setting the DTC

- During the ignition ON test, the PCM detects a PWM signal is out of range.
- During the RUN test, the PCM detects a PWM signal less than 5 percent for more than 6 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

- The Conditions for Setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.
- The Powertrain Control Module (PCM) receives the clear code command from the scan tool.

DTC P0622

Step	Action	Value (s)	Yes	No
Schematic Reference: Starting and Charging Schematics				
Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the GEN - F Terminal parameter in the PCM data list. <p>Does the scan tool indicate that the GEN - F Terminal parameter is within the specified range?</p>	5-95%	Go to Step 3	Go to Step 4
3	With the scan tool command the generator OFF. Does the GEN - F Terminal equal the specified value?	0%	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 4
	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the generator connector. 			

4	<ol style="list-style-type: none"> 3. Connect test lamp to battery positive voltage. 4. Turn ON the ignition, with the engine OFF. 5. Probe the F-Terminal in the generator connector. 6. Observe the GEN - F Terminal Signal parameter in the PCM data list. <p>Is the GEN - F Terminal Signal parameter near the specified value?</p>	100%	Go to <u>Charging System Test (CS/AD/SI Generators)</u>	Go to Step 5
5	<p>Test the generator field duty cycle signal circuit for a short or open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in <u>Wiring Systems</u>.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 8	Go to Step 6
6	<p>Inspect for poor connections at the harness connector of the PCM. Refer to <u>Connector Repairs</u> in <u>Wiring Systems</u>.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 8	Go to Step 7
7	<p>Replace the PCM. Refer to <u>Powertrain Control Module (PCM) Replacement</u> in <u>Engine Controls - 4.8L, 5.3L or 6.0L</u>.</p> <p>Did you complete the repair?</p>	-	Go to Step 8	-
8	<ol style="list-style-type: none"> 1. Review and record the scan tool Fail Records data. 2. Clear any DTCs. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for this DTC. <p>Does the scan tool indicate that this DTC failed this ignition?</p>	-	Go to Step 2	System OK

DTC P1637

Circuit Description

The powertrain control module (PCM) uses the generator turn on signal circuit to control the generator. A high side driver within the PCM allows the PCM to turn the generator ON and OFF. When Generator operation is desired, the PCM sends a 10-11 volt signal to the voltage regulator via the generator turn on signal circuit. This causes the voltage regulator to begin controlling the generator field circuit. Once the Generator is enabled by the

PCM, the voltage regulator controls generator output independently of the PCM. Under certain operating conditions, the PCM can turn Off the generator by turning Off the 10-11 volt signal on the generator turn on signal circuit. The PCM has fault detection circuitry which monitors the state of the generator turn on signal circuit. If the fault detection circuit senses a voltage other than what is expected, this DTC will set. The voltage regulator also contains fault detection circuitry. If the regulator detects a problem, the regulator will ground the generator turn on signal circuit, pulling the voltage low. This also causes the PCM to set the DTC.

Conditions for Running the DTC

- The ignition is ON.
- System voltage between 9.0-18.0 volts.

Conditions for Setting the DTC

- An improper voltage level has been detected on the generator L-terminal circuit.
- The above conditions are present for at least 30 seconds.

Action Taken When the DTC Sets

The PCM stores conditions which were present when the DTC set as Failure Records only. This information will not be stored as Freeze Frame Records.

Conditions for Clearing the MIL/DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives a clear code command from the scan tool.

DTC P1637

Step	Action	Value	Yes	No
Schematic Reference: Starting and Charging Schematics				
Connector End View Reference: Engine Electrical Connector End Views				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Start the engine. 3. With a scan tool, monitor the DTC information for DTC P1637 in Engine Controls. Does the scan tool indicate that DTC P1637 has passed?	-	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
	<ol style="list-style-type: none"> 1. Turn ON the ignition, leaving the 			

3	<p>engine OFF.</p> <ol style="list-style-type: none"> Disconnect the generator harness connector. Measure the voltage between the generator turn on signal circuit and ground. <p>Does the voltage measure near the specified value?</p>	10-11 volts	Go to Step 5	Go to Step 4
4	<p>Test the generator turn on signal circuit for a short or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 8	Go to Step 6
5	<p>Inspect for poor connections at the harness connector of the generator. Refer to Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 8	Go to Charging System Test (CS/AD/SI Generators)
6	<p>Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 8	Go to Step 7
7	<p>IMPORTANT: The replacement PCM must be programmed.</p> <p>Replace the PCM/ECM. Refer to Powertrain Control Module (PCM) Replacement in Engine Controls 4.8L, 5.3L, and 6.0L. Is action complete?</p>	-	Go to Step 8	-
8	<ol style="list-style-type: none"> Use the scan tool in order to clear the DTCs. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. <p>Does the DTC reset?</p>	-	Go to Step 2	System OK

SYMPTOMS - ENGINE ELECTRICAL

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

- Perform **Diagnostic System Check - Engine Electrical** before using the Symptom Tables in order to

verify that all of the following are true:

- There are no DTCs set.
- The control module(s) can communicate via the serial data link.
- Review the system operation in order to familiarize yourself with the system functions. Refer to one of the following system operations:
 - **Battery Description and Operation**
 - **Starting System Description and Operation**
 - **Charging System Description and Operation**

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**
- **Engine Cranks Slowly**
- **Battery Inspection/Test (Non-HP2)**
- **Charge Indicator Always On**
- **Charge Indicator Inoperative**
- **Charging System Test (CS/AD/SI Generators)**
- **Generator Noise Diagnosis**

BATTERY INSPECTION/TEST (NON-HP2)

Diagnostic Aids

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

IMPORTANT: ● The battery test using the J 42000 Battery Tester requires correct

connections to the battery terminals. A failure to obtain the correct connections during the test may result in a failed test on a good battery. See Special Tools and Equipment .

- **Use the Out of Vehicle test for each battery when testing a vehicle with dual batteries.**

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

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

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

- If correct connections to the battery terminal bolts in the vehicle are in doubt, perform the following steps:
 1. Disconnect the negative battery cable.
 2. Disconnect the positive battery cable.
 3. Install the test adapters on the terminals.
 4. Follow the instructions for testing a removed battery.
- If the tester displays a REPLACE BATTERY or BAD CELL-REPLACE result for a battery tested in the vehicle with the battery cables connected, perform the following steps:
 1. Disconnect the negative battery cable.
 2. Disconnect the positive battery cable.
 3. Install the tester adapters.

IMPORTANT: Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the second, or Out of Vehicle test.

4. Follow the instructions for testing a removed battery.
5. Replace the battery only if the second test shows a REPLACE BATTERY or BAD CELL-REPLACE result.

Use the test code from the second test for any warranty purposes.

- Use the correct terminal adapters.

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

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

Battery Inspection/Test (Non-HP2)

Step	Action	Value(s)	Yes	No
CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices .				
1	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to Step 2	Go to Step 19
2	Compare the Cold Cranking Amperage (CCA) and Reserve Capacity (RC) of the battery to the original battery or Original Equipment (OE) specification. Refer to Battery Usage . Does the battery meet or exceed the specifications?	-	Go to Step 3	Go to Step 19
3	Does the hydrometer display a yellow dot?	-	Go to Step 4	Go to Step 5
4	Tap the hydrometer lightly on top with the handle of a small screwdriver in order to dislodge any air bubbles inside the battery. Does the hydrometer still display a yellow dot?	-	Go to Step 19	Go to Step 5
5	1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector clockwise with light finger pressure. Does the negative connector rotate?	-	Go to Step 6	Go to Step 7
6	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 8	Go to Step 7
7	Disconnect the negative battery cable. Is the cable disconnected?	-	Go to Step 9	-
8	1. Disconnect the negative battery cable. 2. Inspect for the following conditions and repair as needed: <ul style="list-style-type: none"> • The cable bolt is too long or deformed at the end. • There is foreign material present inside the nut in the battery terminal. • Damage to the battery terminal face or cable connector ring. Is the repair complete?	-	Go to Step 9	-
9	Rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to Step 10	Go to Step 11

10	Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to Step 12	Go to Step 11
11	Disconnect the positive battery cable. Is the cable disconnected?	-	Go to Step 13	-
12	<ol style="list-style-type: none"> 1. Disconnect the positive battery cable. 2. Inspect for the following conditions and repair as needed: <ul style="list-style-type: none"> • The cable bolt is too long or deformed at the end. • There is foreign material present inside the nut in the battery terminal. • Damage to the battery terminal face or cable connector ring. <p>Is the repair complete?</p>	-	Go to Step 13	-
13	<ol style="list-style-type: none"> 1. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. 2. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed. 3. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed. <p>Are the metal connecting parts clean and in good condition?</p>	-	Go to Step 14	-
14	<ol style="list-style-type: none"> 1. Connect the positive battery cable to the battery positive terminal. 2. Tighten the cable bolt to the specified value. <p>Is the cable bolt properly tightened?</p>	15 N.m (11 lb ft)	Go to Step 15	-
15	<ol style="list-style-type: none"> 1. Connect the negative battery cable to the battery negative terminal. 2. Tighten the cable bolt to the specified value. <p>Is the cable bolt properly tightened?</p>	15 N.m (11 lb ft)	Go to Step 16	-
16	<p>IMPORTANT: Ensure that all of the electrical loads are turned OFF.</p> <ol style="list-style-type: none"> 1. Install the J 42000 Battery Tester. See <u>Special Tools and Equipment</u> . 2. Follow the directions supplied with the tester. 3. Follow any direction displayed on the tester. <p>Did the tester pass the battery?</p>	-	Go to Step 17	Go to Step 18

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

BATTERY CHARGING

Tools Required

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

- 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 and Equipment** .

Battery State of Charge

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

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

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
 - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.

- If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

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

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

Battery Charging

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

Use the SOC information as follows:

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

Charging Time Required

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

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

Charging Procedure

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

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

Use the following procedure to charge the battery:

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

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

4. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
5. Turn ON the charger and set to the highest setting for normal charging.
6. Inspect the battery every half hour after starting the battery charger.
 - Charge the battery until the taper-rate charger indicates that the battery is fully charged.
 - Estimate the battery temperature by feeling the side of the battery. If it feels hot to the touch or its temperature is over 45° C (125° F), discontinue charging and allow the battery to cool before resuming charging.
7. After charging, test the battery. Refer to **Battery Inspection/Test (Non-HP2)** .

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST (W/BCM)

Tools Required

- **J 38758** Parasitic Draw Test Switch. See **Special Tools and Equipment** .
- **J 39200** Digital Multimeter

Battery Electrical Drain

If the vehicle exhibits a low or dead battery after an overnight period, or discharges over a period of 2 or 3 days, the electrical system should be checked for an excessive electrical drain. This is referred to as Parasitic Current Drain.

If a battery needs recharging and no cause is evident, check the vehicle for excessive parasitic current drain.

One or more on-board solid state control modules, such as the body control module (BCM) may at some time exhibit a failure mode that causes a high parasitic drain on the vehicle's battery. When the battery is disconnected to install an ammeter, etc., the excessive current drain may not occur once the circuit continuity is restored. Even though cycling the ignition key to the RUN and then to the OFF position may cause such a drain to recur, there may be drains that will not recur unless the vehicle systems are reactivated in a road test. Since the ignition switch must not be rotated to the ACCESSORY, RUN or START position with an ammeter installed between the battery terminal and the battery cable, a current drain test tool must be used as described in the following procedures.

Before starting this procedure, ensure that the ignition switch is in the LOCK position, all electrical accessories are turned OFF, the underhood lamp is disconnected, the door glass is open and the doors are closed.

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.

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

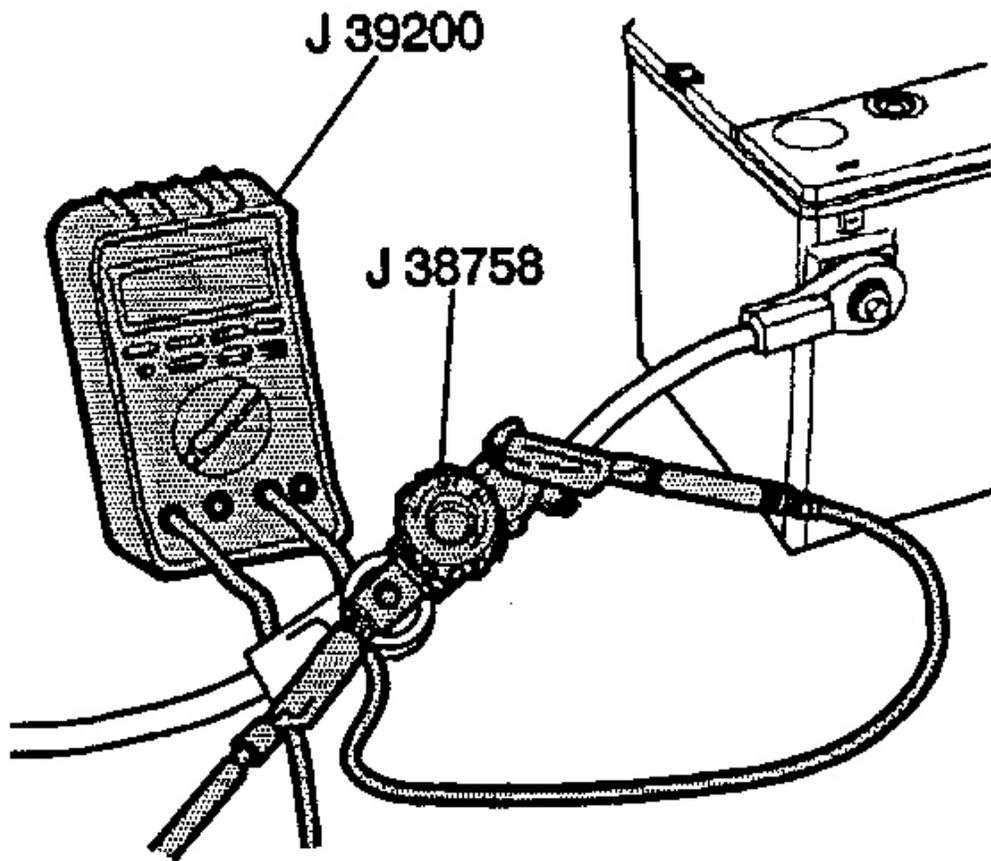


Fig. 5: Connecting J 39200 & J 38758 To Battery Cable
Courtesy of GENERAL MOTORS CORP.

2. Install the male end of the **J 38758** Parasitic Draw Test Switch to the battery negative terminal. See **Special Tools and Equipment** .
3. Turn OFF the test switch.
4. Install the battery negative cable to the female end of the test switch.
5. Turn ON the test switch.
6. Road test the vehicle while activating all accessories, including the radio and the air conditioning.
7. Turn OFF the ignition switch. Remove the key.

IMPORTANT: From this point on, electrical continuity must be maintained in the ground circuit of the battery through the **J 38758** in the ON position or through the **J 39200** . The BCM can draw several amps of current after the ignition

is turned off. Refer to Body Control System Description and Operation in Body Control System. See Special Tools and Equipment .

8. Install the scan tool and perform the power down now feature from the BCM output menu. After performing this function the scan tool can be powered off or disconnected, then wait an additional 5 minutes before continue testing.
9. Set the **J 39200** Digital Multimeter to the 10 A scale.

IMPORTANT: If an ammeter other than the J 39200 is used, ensure that the vehicle does not have a high current drain that would damage the ammeter when connected to the circuit. This can be done using the following procedure:

1. Connect a jumper wire with an in-line 10 A fuse **J 36169-A** to the terminals of the test switch.
 2. Turn the test switch to the OFF position.
 3. Wait 10 seconds.
 4. If the fuse does not blow, the current is less than 10 A and the ammeter can be used safely.
 5. Turn the test switch to the ON position before the fused jumper wire is removed and the multimeter is installed.
10. Connect the ammeter to the test switch terminals.
 11. Turn OFF the test switch. This allows the current to flow through the ammeter.
 12. Wait at least 60 seconds, then check the current reading.
 - When there is a current reading of 2 A or less, turn ON the test switch, this maintains continuity in the electrical system.
 - Then, switch the meter down to the 2 A scale, for a more accurate reading, when the test switch is reopened.
 13. Take the reading in milli-amps.
 14. Note the battery reserve capacity. Refer to **Battery Usage** .
 - Divide this number by 4.
 - Compare this to the multimeter reading.
 - The current drain should not exceed this number.
 - Example: If a battery has a reserve capacity of 100 minutes, the current drain should not exceed 25 milli-amps. If the vehicle has 2 batteries, add the reserve capacities together and divide this total by 4.

NOTE: Always turn the test switch knob to the ON position before removing each fuse to maintain continuity in the electrical system and to avoid damaging the meter due to accidental overloading, such as opening a door to change a fuse.

15. When the current draw is too high, remove the electrical system fuses one at a time until the draw returns to a value less than or equal to specifications.

16. Repeat the parasitic current drain test procedure after any repair has been completed.
17. When the cause of the excessive current draw has been located and repaired, remove the meter and the parasitic draw test switch and terminal adapters.
18. Connect the negative cable to the battery negative terminal. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** .

BATTERY COMMON CAUSES OF FAILURE

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

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

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. A fully charged battery will not freeze until the ambient temperature gets below -54°C (-65°F). However, a battery with a low state of charge may freeze at temperatures as high as -7°C ($+20^{\circ}\text{F}$). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged. As long as the green eye is visible in the hydrometer, the freezing point of the battery will be somewhere below -32°C (-25°F).

Battery Protection During Vehicle Storage

Certain devices on the vehicle maintain a small continuous current drain on the battery. A battery that is not used for an extended period of time will discharge. Eventually permanent damage will result. Discharged batteries will also freeze in cold weather. Refer to **Battery Inspection/Test (Non-HP2)** .

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

IMPORTANT: If a green dot is not visible in the hydrometer, charge the battery. Refer to Battery Charging .

1. Ensure that the green dot is visible in the built-in hydrometer.

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

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

When the battery cannot be disconnected:

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

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

JUMP STARTING IN CASE OF EMERGENCY (NON HP2)

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

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

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

This vehicle has a 12-volt positive, negative ground electrical system. Do not try to jump start a vehicle, if you are unsure of the other vehicle's positive voltage or ground position. The booster battery and the discharged battery should be treated carefully when using jumper cables.

1. Position the vehicle with the booster battery so that the jumper cables will comfortably reach the battery of the other vehicle.
 - Do not let the 2 vehicles touch.
 - Make sure that the jumper cables do not have loose clamps or missing insulation.

2. Perform the following steps on both vehicles:
 1. Place the automatic transmission in PARK.
 2. Block the wheels.
 3. Set the parking brake.
 4. Turn off all electrical loads that are not needed. Leave the hazard flashers ON.
 5. Turn OFF the ignition switch.

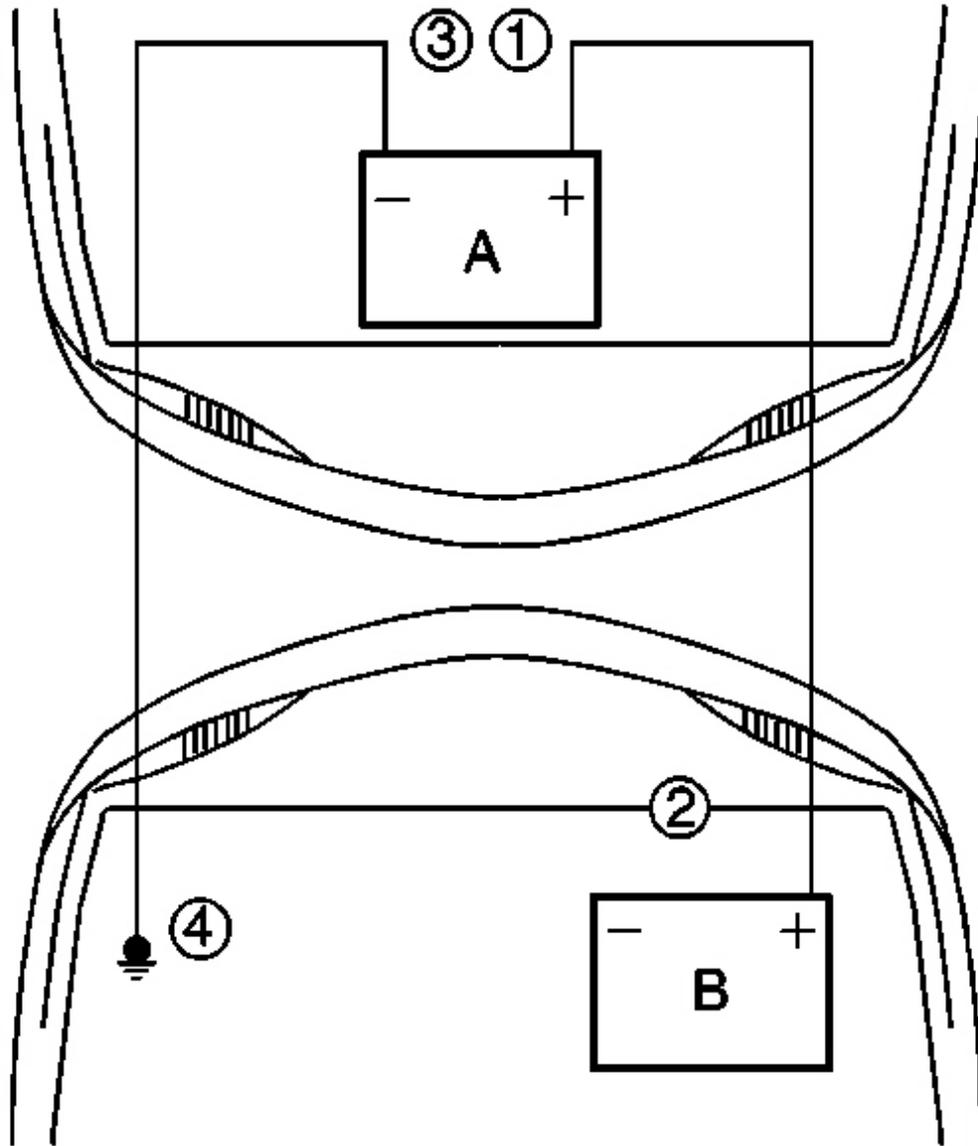


Fig. 6: Connecting Battery Terminal Jumpers
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Some vehicles have a battery remote positive stud. **ALWAYS** use the battery remote positive stud in order to give or to receive a jump start. Consult the vehicle's owner's manual for proper connections.

3. Attach the end of one jumper cable to the positive terminal of the discharged battery.
4. Attach the other end of the first cable to the positive terminal of the booster battery.
5. Attach one end of the remaining jumper cable to the negative terminal of the booster battery.

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

6. Make the final connection of the negative jumper cable to the block or suitable bracket connected directly to the block, away from the battery.
7. Start the engine of the vehicle that is providing the jump start and turn off all electrical accessories. Raise the engine RPM to approximately 1,500 RPM.
8. Crank the engine of the vehicle with the weak battery.

If the engine does not crank or cranks too slowly, perform the following steps:

1. Turn the ignition OFF.
2. Allow the booster vehicle engine to run at approximately 1,500 RPM for 5 minutes.
3. Attempt to start the engine of the vehicle with the discharged battery.
9. Reverse the steps exactly when removing the jumper cables. The negative battery cable must first be disconnected from the engine that was jump started.

CHARGING SYSTEM TEST (CS/AD/SI GENERATORS)

Charging System Test (CS/AD/SI Generators)

Step	Action	Value (s)	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
2	Start the engine. Observe the charge indicator on the instrument cluster (IPC). Does the charge indicator illuminate or message center (DIC) display a charging system message?	-	Go to Step 3	Go to <u>Symptoms - Engine Electrical</u>
3	IMPORTANT: The green POWER lamp of the tester should remain illuminated while the tester is being used. 1. Turn OFF the ignition. 2. Connect the red lead of the J 41450-B Universal CS Generator Test Harness to the generator output terminal. 3. Connect the black lead of the J 41450-B to the metal	-		

	generator housing. Does the green POWER lamp on the tester illuminate?		Go to Step 6	Go to Step 4
4	Measure the voltage from the output terminal of the generator to the generator metal housing. Does the voltage measure equal to the specified value?	12.0 V	Go to Step 14	Go to Step 5
5	Measure the voltage from the output terminal of the generator to the battery negative terminal. Does the voltage measure equal to the specified value?	12.0 V	Go to Step 12	Go to Step 11
6	<ol style="list-style-type: none"> 1. Turn OFF completely the load tool before connecting or disconnecting a carbon pile load tester to the battery. Otherwise, sparking at the terminals could cause battery gasses to explode. 2. Connect a carbon pile tester to the vehicle. <p>IMPORTANT: Ensure that all generator output circuit wires pass through the inductive probe.</p> <ol style="list-style-type: none"> 3. Connect an inductive ammeter to the output circuit of the generator. 4. Disconnect the generator harness connector. 5. Locate the matching harness connector on the J 41450-B , and connect the connector to the generator. Does the red DIAGNOSTIC lamp on the tester illuminate?	-	Go to Step 7	Go to Step 13
7	<ol style="list-style-type: none"> 1. Start the engine and allow it to idle for 30 seconds. 2. Increase the engine speed to 2,500 RPM. Does the red DIAGNOSTIC lamp on the tester illuminate?	-	Go to Step 15	Go to Step 8
8	<ol style="list-style-type: none"> 1. Maintain the engine speed at 2,500 RPM. <p>IMPORTANT: If the generator is not capable of producing the Load Test amps, operate the generator at it's maximum possible output.</p> <ol style="list-style-type: none"> 2. Turn ON the load of the carbon pile tester and increase the load until the generator output is equal to the Load Test value given in Generator Usage. Does the red DIAGNOSTIC lamp on the tester illuminate?	-	Go to Step 15	Go to Step 9
	<ol style="list-style-type: none"> 1. Maintain the engine speed at 2,500 RPM and continue 			

9	<p>to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the output terminal of the generator to the positive terminal on the battery. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems.</p> <p>Does the voltage measure greater than the specified value?</p>	0.5 V	Go to Step 11	Go to Step 10
10	<p>1. Maintain the engine speed at 2,500 RPM and continue to operate the generator at the load test value.</p> <p>2. Measure the voltage drop from the battery negative terminal to the metal housing of the generator. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems.</p> <p>Does the voltage measure greater than the specified value?</p>	0.5 V	Go to Step 12	Go to Step 16
11	<p>Repair the high resistance or an open in the output circuit of the generator. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems.</p> <p>Did you complete the repair?</p>	-	Go to Step 16	-
12	<p>Repair the high resistance or open in the ground circuit of the generator. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems.</p> <p>Did you complete the repair?</p>	-	Go to Step 16	-
13	<p>1. Disconnect the J 41450-B tester harness connector from the generator, but leave the alligator clips connected so that the green POWER lamp remains illuminated.</p> <p>2. Connect a jumper lead, with an in-line 100-ohm resistor between the J 41450-B tester harness connector terminal B of the generator and a good ground. Refer to Engine Electrical Connector End Views .</p> <p>Does the red DIAGNOSTIC lamp illuminate?</p>	-	Go to Step 15	Go to Step 14
14	<p>There is a problem with the J 41450-B . Refer to the manufacturers instructions, how to test the J 41450-B for proper operation.</p> <p>Has the J 41450-B tester been replaced?</p>	-	Go to Step 3	-
15	<p>Replace the generator. Refer to Generator Replacement .</p> <p>Did you complete the replacement?</p>	-	Go to Step 16	-
16	<p>Operate the vehicle in order to verify the repair.</p> <p>Did you correct the condition?</p>	-	System OK	Go to Step 2

CHARGE INDICATOR ALWAYS ON

Charge Indicator Always On

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check for Starting and Charging?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
2	<ol style="list-style-type: none"> 1. Turn ON the ignition, with the engine OFF. 2. Observe the Charge indicator on the instrument cluster (IPC). Does the charge indicator illuminate?	Go to Step 3	Go to <u>Symptoms - Engine Electrical</u>
3	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the generator connector. 3. Turn ON the ignition, with the engine OFF. Does the charge indicator illuminate?	Go to Step 4	Go to <u>Charging System Test (CS/AD/SI Generators)</u>
4	Test the charge indicator control circuit for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	IMPORTANT: The replacement PCM must be programmed. Replace the PCM. Refer to <u>Powertrain Control Module (PCM) Replacement</u> in Engine Controls. Is the action complete?	Go to Step 6	-
6	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check for Starting and Charging?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
2	Turn ON the ignition, with the engine OFF. Does the battery charge indicator illuminate during the bulb check?	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 3
3	Replace the charge indicator bulb. Refer to <u>Instrument Panel Cluster (IPC) Replacement</u> in Instrument Panel, Gauges and Console. Did you complete the replacement?	Go to Step 4	-

4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
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GENERATOR NOISE DIAGNOSIS

Diagnostic Aids

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

Generator Noise Diagnosis

Step	Action	Yes	No
1	Test the generator for proper operation using the Generator Tester. Refer to <u>Charging System Test (CS/AD/SI Generators)</u> . Is the generator operating properly?	Go to Step 2	Go to Step 11
2	<ol style="list-style-type: none"> 1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the 4-way connector from the generator. 4. Start the engine. 5. Listen for the noise. Has the noise stopped?	Go to Step 11	Go to Step 3
3	IMPORTANT: The replacement PCM must be programmed. Replace the PCM. Refer to <u>Powertrain Control Module (PCM) Replacement</u> in Engine Controls. Is the action complete?	Go to Step 4	Go to Step 11
4	Inspect the generator for a loose pulley and/or pulley nut. Is the generator pulley or pulley nut loose?	Go to Step 11	Go to Step 5
5	<ol style="list-style-type: none"> 1. Loosen all of the generator mounting bolts. 2. Tighten the generator mounting bolts to specifications and in the proper sequence (if necessary). Refer to <u>Generator Replacement</u> . 3. Install the drive belt. Refer to <u>Drive Belt Replacement - Accessory</u> in Engine Mechanical. 4. Start the engine. Has the noise decreased or stopped?	System OK	Go to Step 6
	Inspect the generator for the following conditions:		

6	<ul style="list-style-type: none"> • Strained or stretched electrical connections. • Hoses or other vehicle equipment resting on the generator, (which may cause the noise to be transmitted into the passenger compartment) <p>Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?</p>	Go to Step 7	Go to Step 8
7	<ol style="list-style-type: none"> 1. Reroute the electrical connections to relieve the tension. 2. Reroute the hoses, etc. away from the generator. 3. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 8
8	<p>Inspect the drive belt for proper tension. Refer to <u>Drive Belt Tensioner Diagnosis</u> in Engine Mechanical.</p> <p>Is the drive belt loose?</p>	Go to Step 9	Go to Step 10
9	<ol style="list-style-type: none"> 1. Replace the drive belt tensioner. Refer to <u>Drive Belt Tensioner Replacement - Accessory</u> in Engine Mechanical. 2. Start the engine. <p>Has the noise decreased or stopped?</p>	System OK	Go to Step 11
10	<p>Compare the vehicle with a known good vehicle.</p> <p>Do both vehicles make the same noise?</p>	System OK	Go to Step 11
11	<p>IMPORTANT: If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.</p> <p>Replace the generator. Refer to <u>Generator Replacement</u> .Has the noise decreased or stopped?</p>	Go to Step 12	-
12	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 2

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			
1	Did you preform the Engine Electrical Diagnostic System Check?		Go to <u>Diagnostic System Check - Engine</u>

		Go to Step 2	<u>Electrical</u>
2	Turn the ignition switch to the START position. Does the engine crank?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Turn the ignition switch to the START position. Does the starter motor relay click?	Go to Step 11	Go to Step 4
4	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM) harness connector. 3. Connect a test lamp between the Crank Voltage circuit of the PCM harness and a good ground. 4. With the transmission in park, turn the ignition switch to the START position. <p>Does the test light illuminate?</p>	Go to Step 7	Go to Step 5
5	Inspect for poor connections at the PCM connector, Underhood Fuse Block or ignition switch harness connector. 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 29	Go to Step 6
6	Test the supply voltage circuit of the crank voltage circuit and Crank fuse for an open or high resistance. 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 29	Go to Step 27
7	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the PCM harness connector. 3. Connect a test lamp between the starter enable relay control circuit of the PCM harness and a good ground. 4. Turn the ignition to the START position. <p>Does the test lamp illuminate?</p>	Go to Step 19	Go to Step 8
8	<ol style="list-style-type: none"> 1. Remove the starter motor relay. 2. Connect a test light from the supply voltage circuit of the starter motor relay coil circuit to ground. 3. With the transmission in park, turn the ignition switch to the START position. <p>Does the test light illuminate?</p>	Go to Step 9	Go to Step 10

9	<ol style="list-style-type: none"> 1. Connect a test light from the supply voltage circuit of the starter motor relay coil circuit to the control circuit of the starter motor relay coil circuit. 2. With the transmission in park, turn the ignition switch to the START position. <p>Does the test light illuminate?</p>	Go to Step 17	Go to Step 14
10	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the park neutral position (PNP) switch. Refer to <u>Park/Neutral Position Switch Replacement</u> in Automatic Transmission - 4L60-E/4L65-E. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 10-amp fused jumper between the starter motor relay coil control circuits of the PNP switch. 5. With the transmission in PARK, turn the ignition switch to the START position. <p>Does the test lamp illuminate?</p>	Go to Step 18	Go to Step 15
11	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the starter motor relay. 3. Connect a test lamp between the battery positive voltage circuit of the starter motor relay switch circuit and a good ground. <p>Does the test lamp illuminate?</p>	Go to Step 12	Go to Step 23
12	<p>Connect a 30-amp fused jumper between the battery positive voltage circuit of the starter motor relay switch circuit and the supply voltage circuit of the starter solenoid.</p> <p>Does the engine crank?</p>	Go to Step 17	Go to Step 13
13	<p>Does the fuse in the jumper open?</p>	Go to Step 24	Go to Step 16
14	<p>Test the control circuit of the starter motor relay for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 29	Go to Step 25
15	<p>Test the supply voltage circuit of the starter motor relay coil circuit for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 29	Go to Step 21
16	<p>Test the supply voltage circuit of the starter solenoid for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.</p>		

	Did you find and correct the condition?	Go to Step 29	Go to Step 22
17	Inspect for poor connections at the starter motor relay. 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 29	Go to Step 25
18	If equipped with an automatic transmission, inspect for poor connection at the PNP switch harness connector. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. If OK, perform the Park/Neutral Position Switch Adjustment in Automatic Transmission - 4L60-E/4L65-E. Did you find and correct the condition?	Go to Step 29	Go to Step 26
19	Inspect for poor connections at the harness connector of the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 20
20	IMPORTANT: The replacement PCM must be programmed. Replace the PCM/engine control module (ECM). Refer to Powertrain Control Module (PCM) Replacement in Engine Controls - 4.8L, 5.3L, and 6.0L. Is action complete?	Go to Step 29	-
21	Inspect for poor connections at the ignition switch harness connector. 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 29	Go to Step 27
22	Inspect for poor connections at the starter solenoid. 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 29	Go to Step 28
23	Repair the open or high resistance in the battery positive voltage circuit of the Starter Motor relay switch circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 29	-
24	Repair the short to ground in the supply voltage circuit of the starter solenoid. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 29	-
25	Replace the Starter Relay. Refer to Relay Replacement (Within an Electrical Center) or Relay Replacement (Attached to Wire Harness) in Wiring Systems. Did you complete the replacement?	Go to Step 29	-
	Replace the PNP switch. Refer to Park/Neutral Position		

26	Switch Replacement in Automatic Transmission - 4L60-E/4L65-E. Did you complete the replacement?	Go to Step 29	-
27	Replace the ignition switch. Refer to Ignition Switch Replacement in Steering Wheel and Column. Did you complete the replacement?	Go to Step 29	-
28	Replace the starter. Refer to Starter Motor Replacement . Did you complete the replacement?	Go to Step 29	-
29	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to Step 2

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Diagnostic System Check - Engine Electrical
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to Step 3	Go to Starter Solenoid Does Not Click
3	Inspect the engine and belt drive system for mechanical binding (seized engine, seized generator). Does the engine move freely?	Go to Step 4	Go to Symptoms - Engine Mechanical in Engine Mechanical.
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to Circuit Testing and Wiring Repairs 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	-
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to Step 2

ENGINE CRANKS SLOWLY

Perform the following checks:

- Battery - Battery Inspection/Test. Refer to **Battery Inspection/Test (Non-HP2)** .

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

If the battery, the wiring and the engine are functioning properly and the engine continues to crank slowly, replace the starter motor. Refer to **Starter Motor Replacement** .

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

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

Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to <u>Diagnostic System Check - Engine Electrical</u>
2	Start the engine. Does the starter operate normally?	Go to <u>Testing for Intermittent Conditions and Poor 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	This is often diagnosed as a starter drive gear hang-in or a weak solenoid. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to Step 8	Go to Step 7
	Inspect the flywheel ring gear for the following: <ul style="list-style-type: none"> • Chipped gear teeth 		

6	<ul style="list-style-type: none"> • Missing gear teeth • Milled teeth <p>Is the flywheel bent, or does it have damaged teeth?</p>	Go to Step 9	Go to Step 10
7	<ol style="list-style-type: none"> 1. Remove the starter motor. Refer to <u>Starter Motor Replacement</u> . 2. Inspect the starter motor bushings and clutch gear. <p>Does the clutch gear have chipped or milled teeth or worn bushings?</p>	Go to Step 10	Go to Step 9
8	<p>Shim the starter motor away from the flywheel by adding shims between the starter motor and the engine block one at a time.</p> <p>Flywheel runout may make this noise appear to be intermittent.</p> <p>Did you complete the repair?</p>	Go to Step 11	-
9	<p>Replace the flywheel. Refer to <u>Engine Flywheel Replacement</u> in Engine Mechanical.</p> <p>Did you complete the replacement?</p>	Go to Step 11	-
10	<p>Replace the starter motor. Refer to <u>Starter Motor Replacement</u> .</p> <p>Did you complete the replacement?</p>	Go to Step 11	-
11	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 3

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE (SINGLE BATTERY)

Removal Procedure

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

1. Turn off all the lamps and accessories.
2. Turn the ignition OFF.

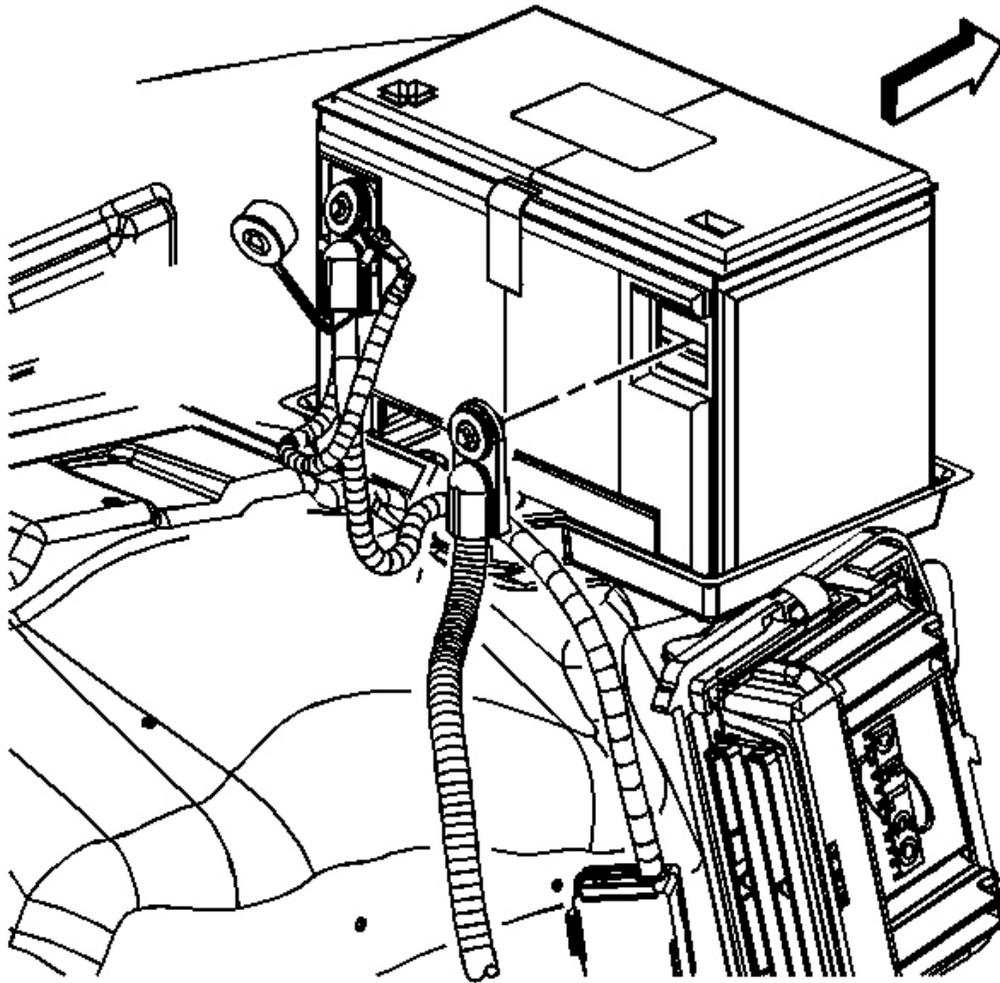


Fig. 7: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the battery ground negative cable and bolt from the battery.

Installation Procedure

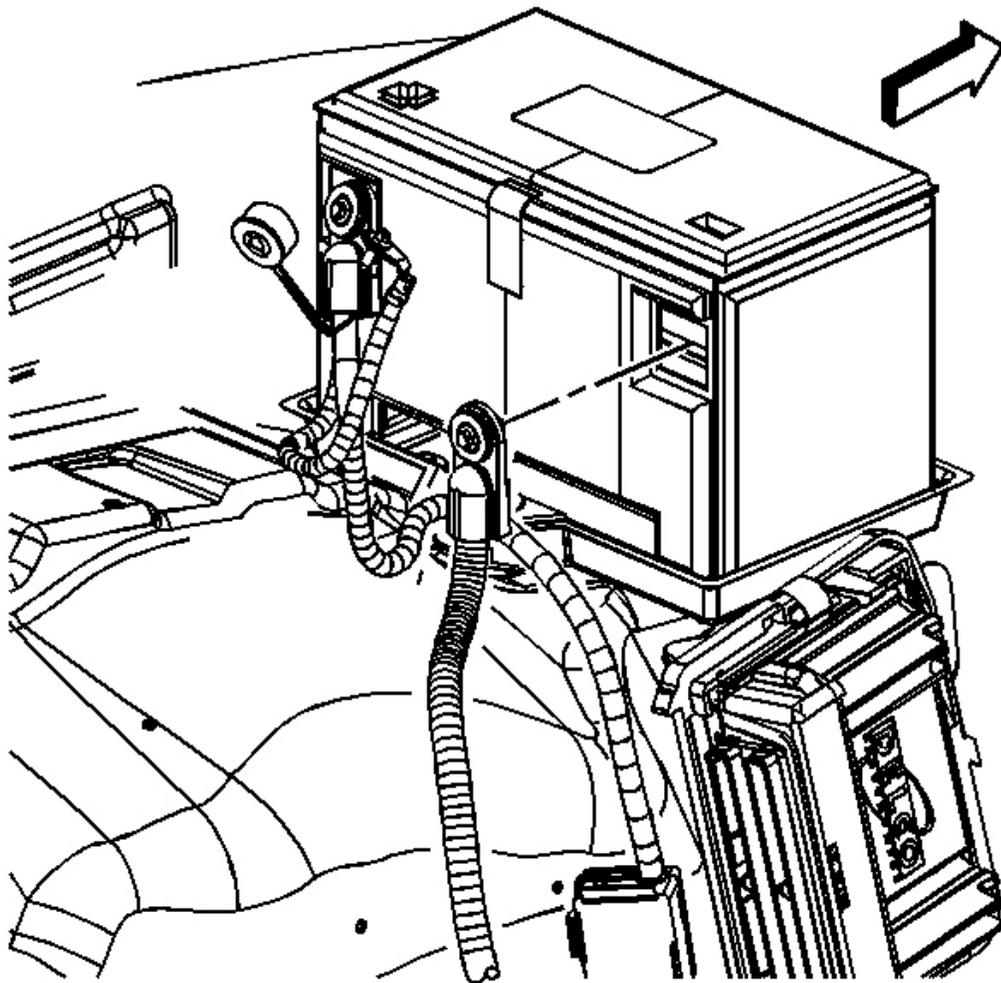


Fig. 8: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

Install the battery ground negative cable and bolt to the battery.

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

BATTERY NEGATIVE CABLE REPLACEMENT

Removal Procedure

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

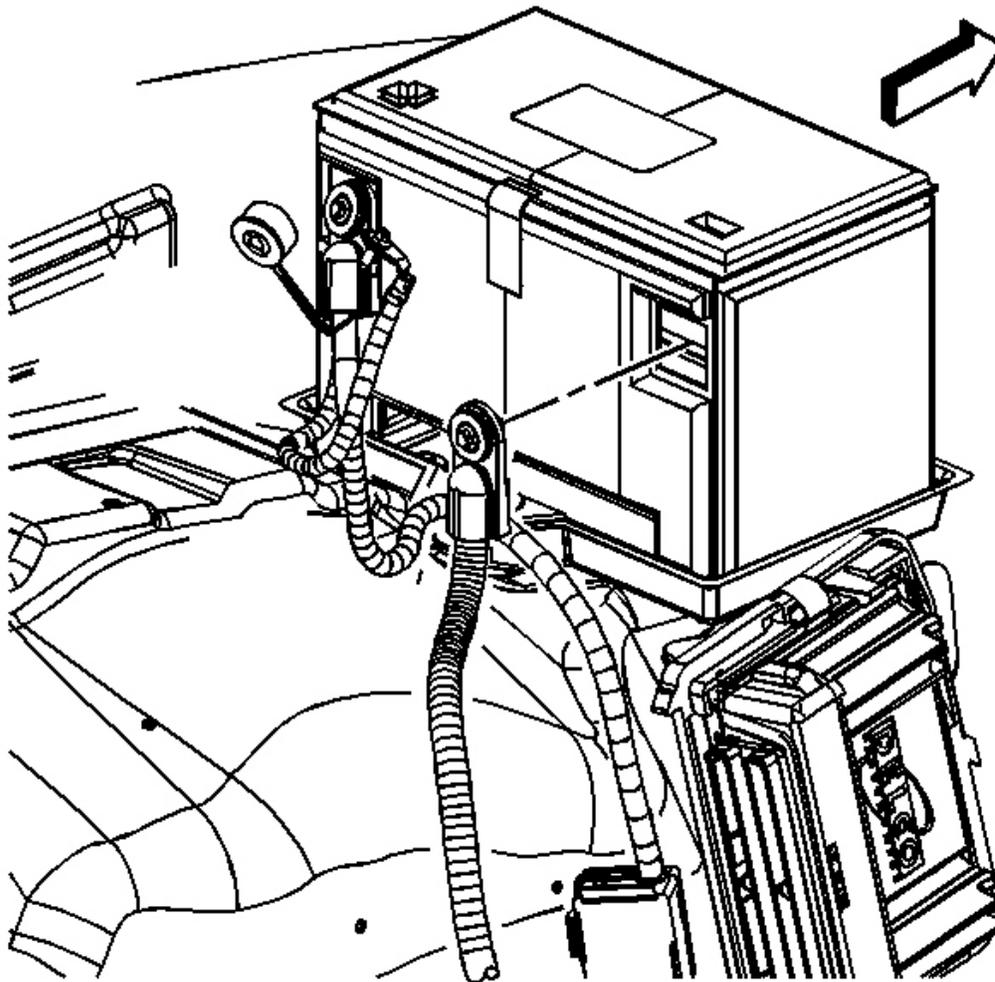


Fig. 9: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

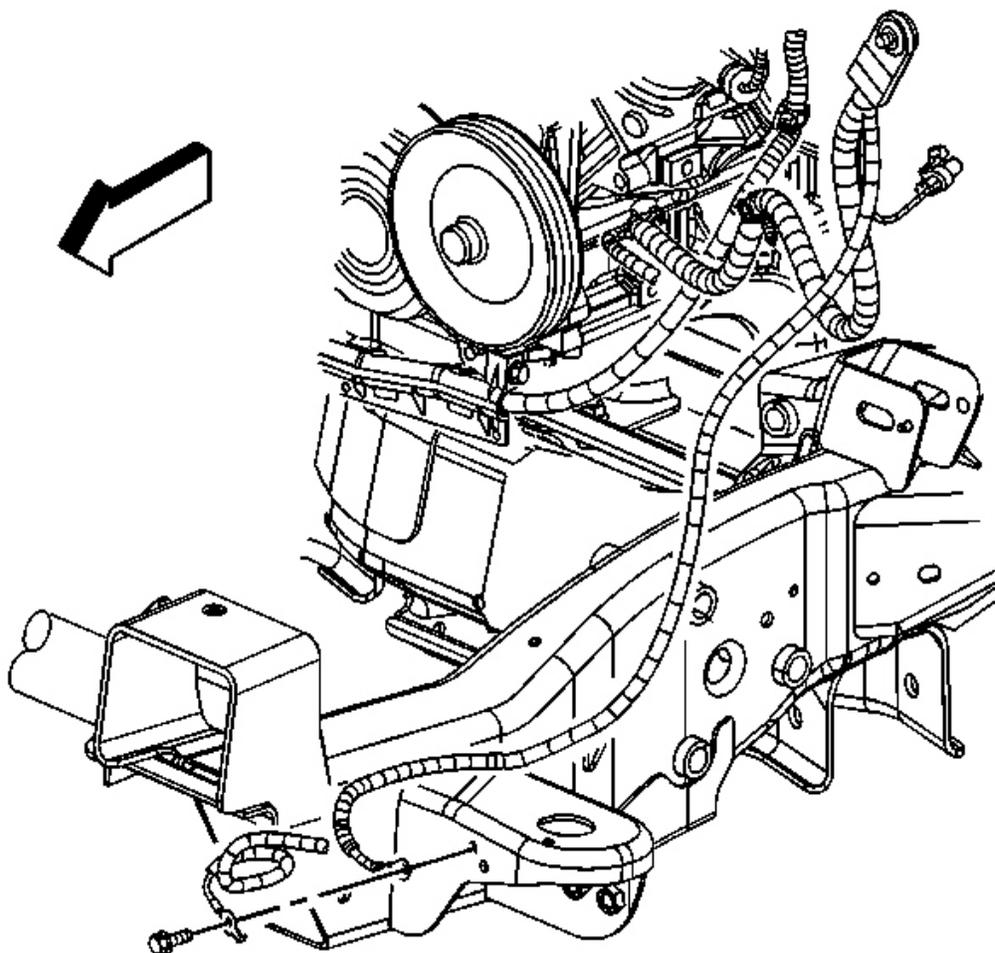


Fig. 10: Forward Lamp Wiring Harness Ground/Negative Cable Bolt
Courtesy of GENERAL MOTORS CORP.

2. Raise and suitably support the vehicle with safety stands. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.
4. Remove the forward lamp wiring harness ground/negative cable bolt.
5. Remove the engine wiring harness ground/negative cable bolt.

6. Remove the negative battery cable.

Installation Procedure

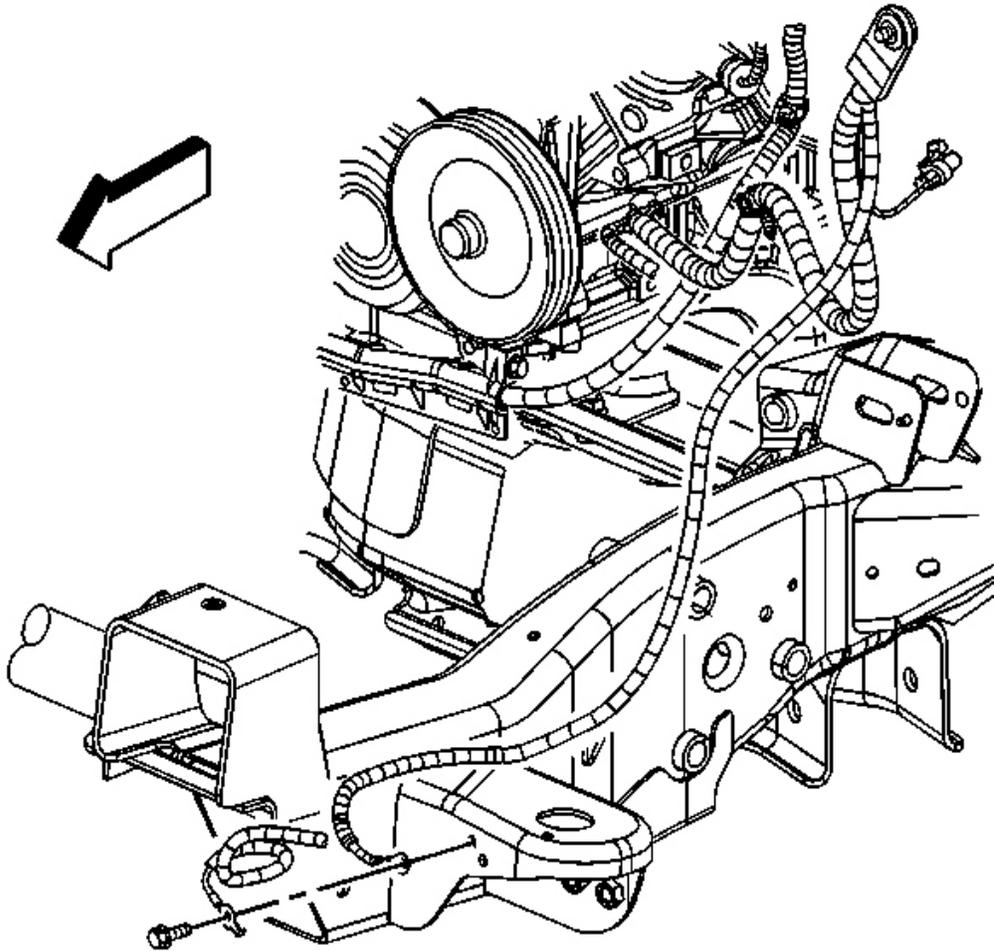


Fig. 11: Forward Lamp Wiring Harness Ground/Negative Cable Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable.
2. Position the negative cable and forward lamp wiring harness ring terminals to the frame.

Insert the anti-rotation tab on the forward lamp wiring harness into the hole in the frame.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the forward lamp wiring harness ground/negative cable bolt.

Tighten: Tighten the forward lamp wiring harness ground/negative cable bolt to 9 N.m (80 lb in).

4. Position the negative cable and engine wiring harness ring terminals to the engine block. Position the anti-rotation tab on the negative cable in the correct location.
5. Install the engine wiring harness ground/negative cable bolt.

Tighten: Tighten the engine wiring harness ground/negative cable bolt to 25 N.m (18 lb ft).

6. Install the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.
7. Lower the vehicle.
8. Install the negative cable clip to the positive cable clip.

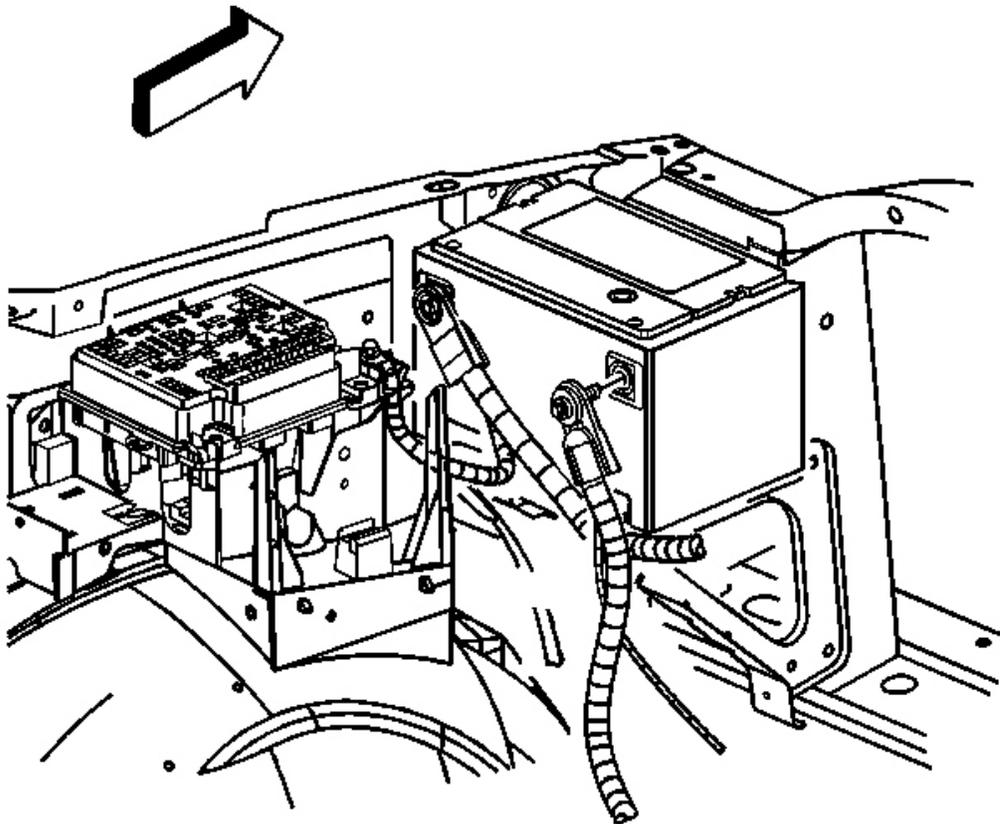


Fig. 12: View Of Battery Cables

Courtesy of GENERAL MOTORS CORP.

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

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

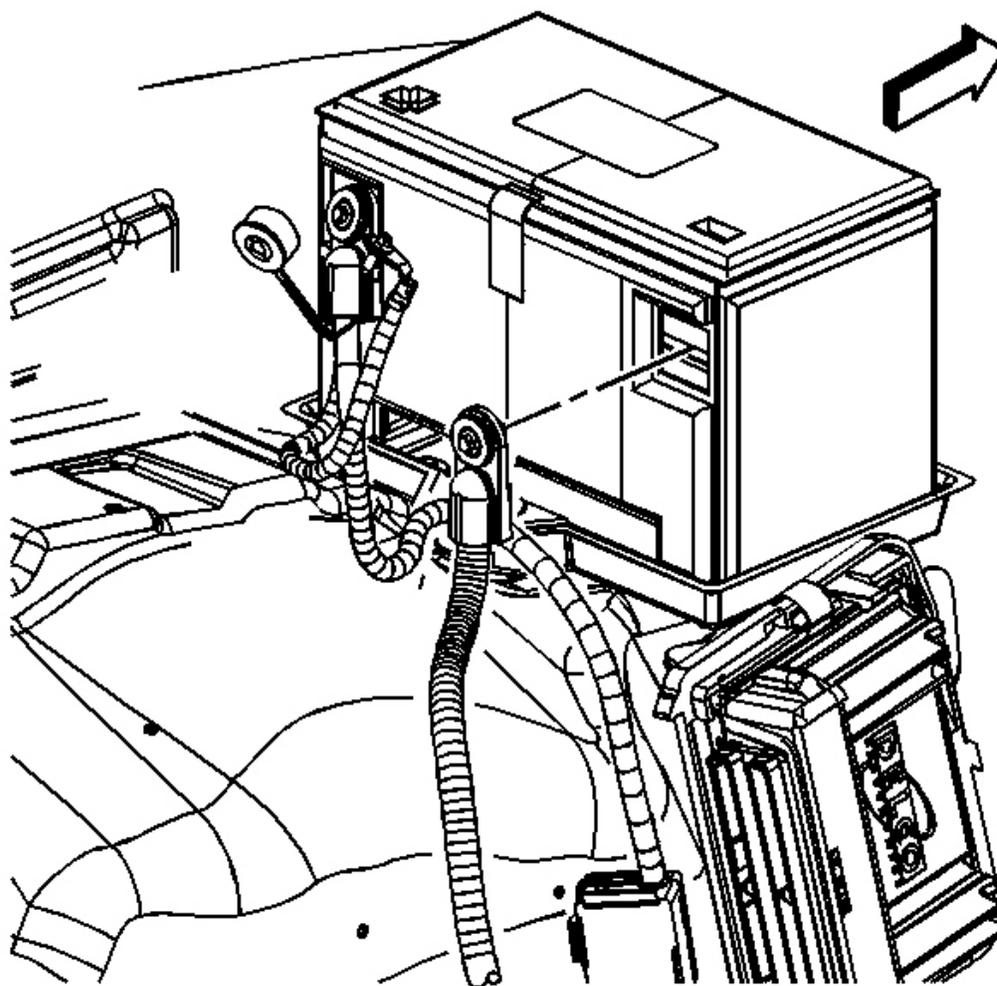


Fig. 13: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)**.
2. Unsnap the positive battery cable cap.
3. Disconnect the positive battery cable.
4. Remove the underhood busse electrical center (UBEC) cover. Position the lower cover to the side.

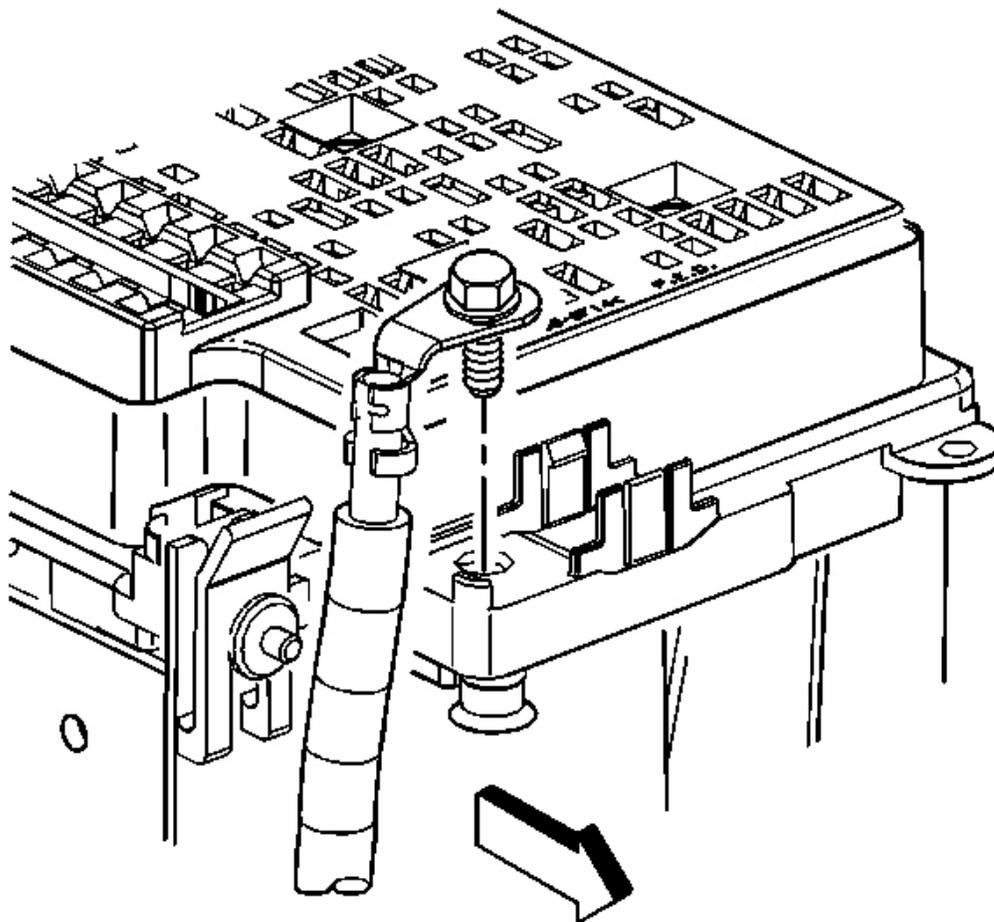


Fig. 14: Positive Battery Cable Bolt
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The bolt is integral to the battery cable and is not removable.

5. Remove the positive battery cable bolt at the UBEC.

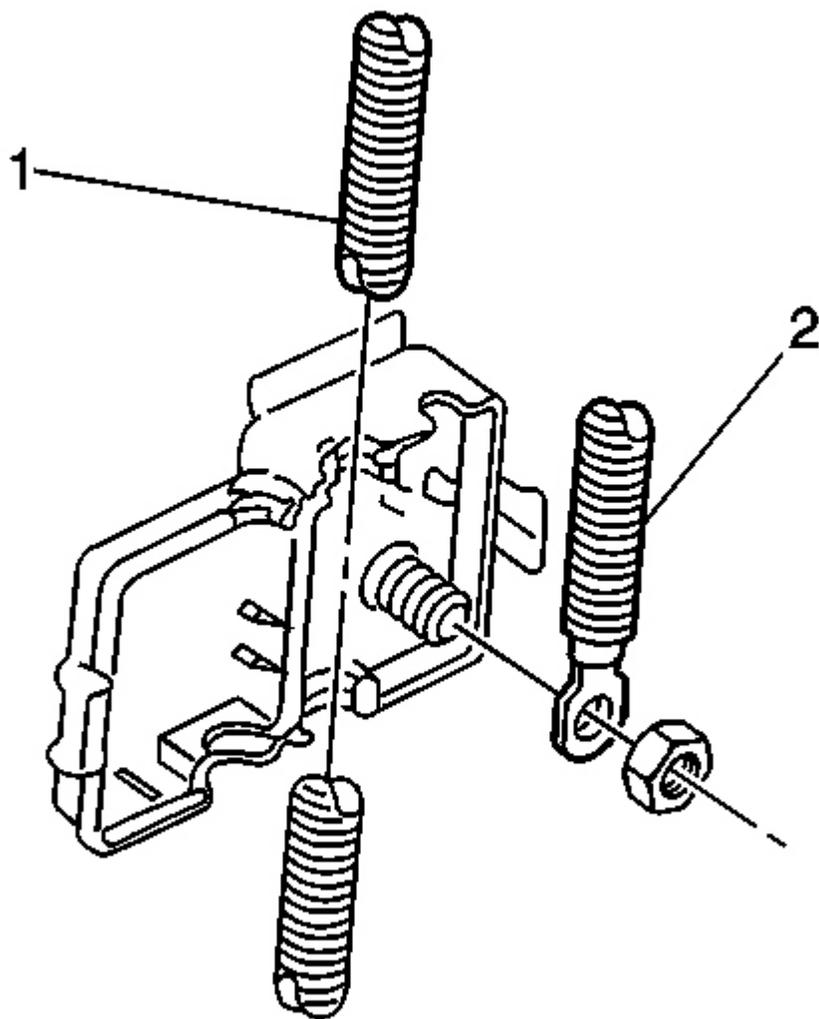


Fig. 15: Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

6. Unsnap the junction block cover.
7. Remove the positive battery cable (1) from the junction block.

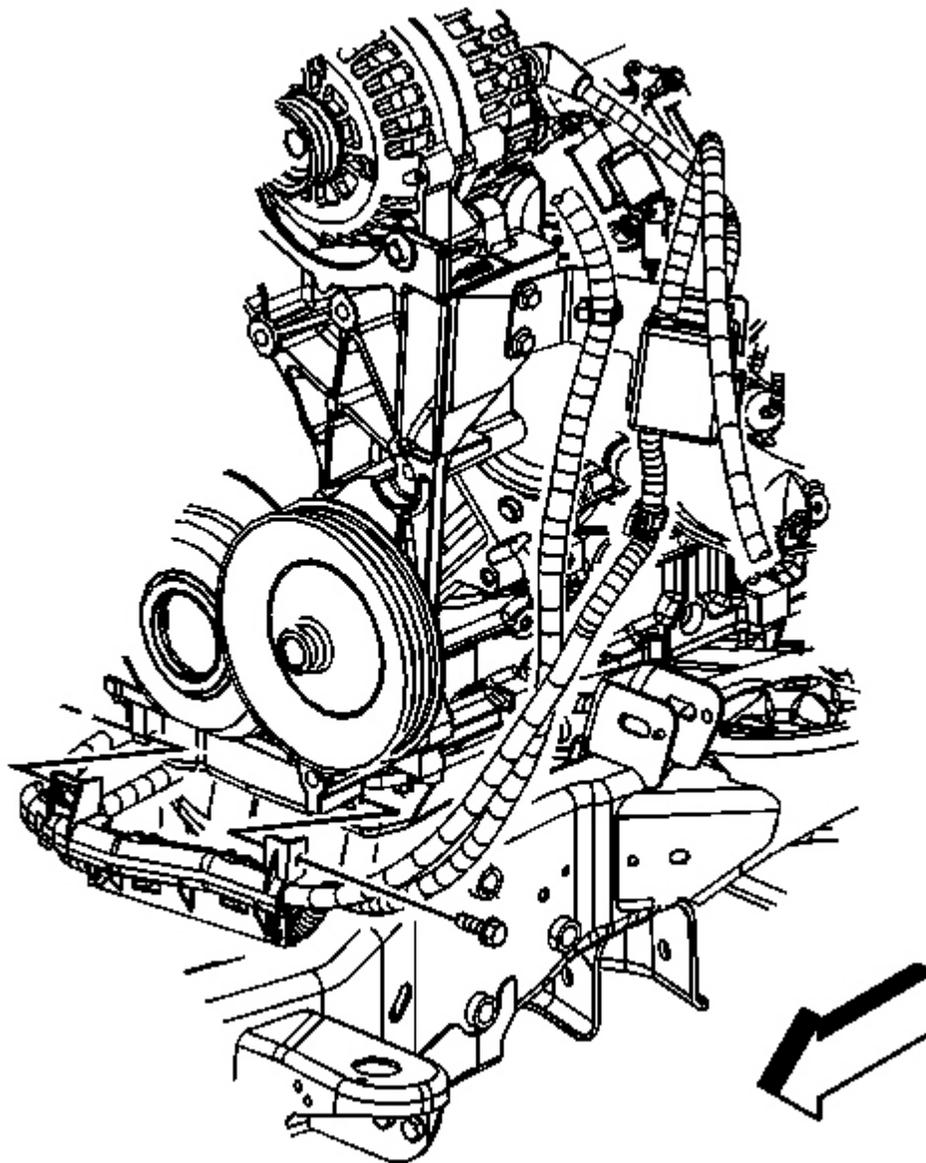


Fig. 16: Positive Battery Cable Channel Bolt
Courtesy of GENERAL MOTORS CORP.

8. Raise and suitably support the vehicle with safety stands. Refer to **Lifting and Jacking the Vehicle** in General Information.
9. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and

Underbody.

10. Remove the positive battery cable channel bolt.
11. Slide the channel pin out of the oil pan tab.
12. Remove the positive battery cable from the channel.

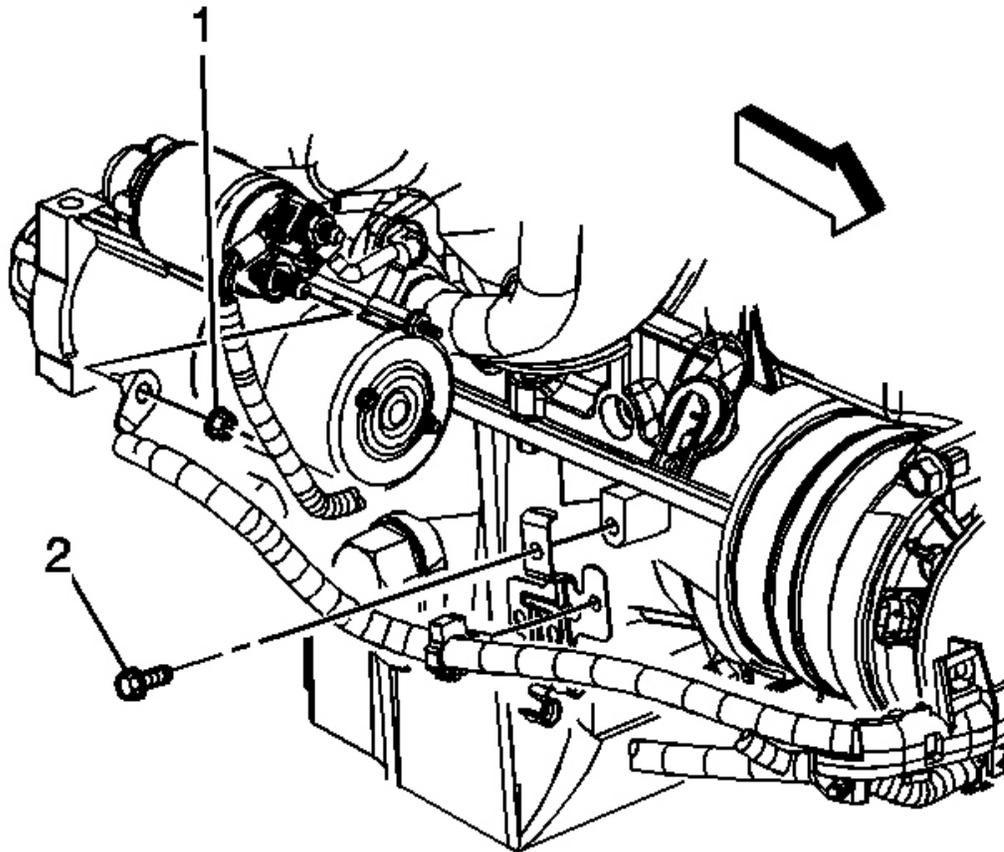


Fig. 17: Positive Cable Nut
Courtesy of GENERAL MOTORS CORP.

13. Remove the positive cable nut (1).
14. Remove the positive cable from the starter.
15. Remove the positive cable clip from the clip on the oil pan.
16. Remove the positive cable from the clip on the oil pan.
17. Remove the positive battery cable.

Installation Procedure

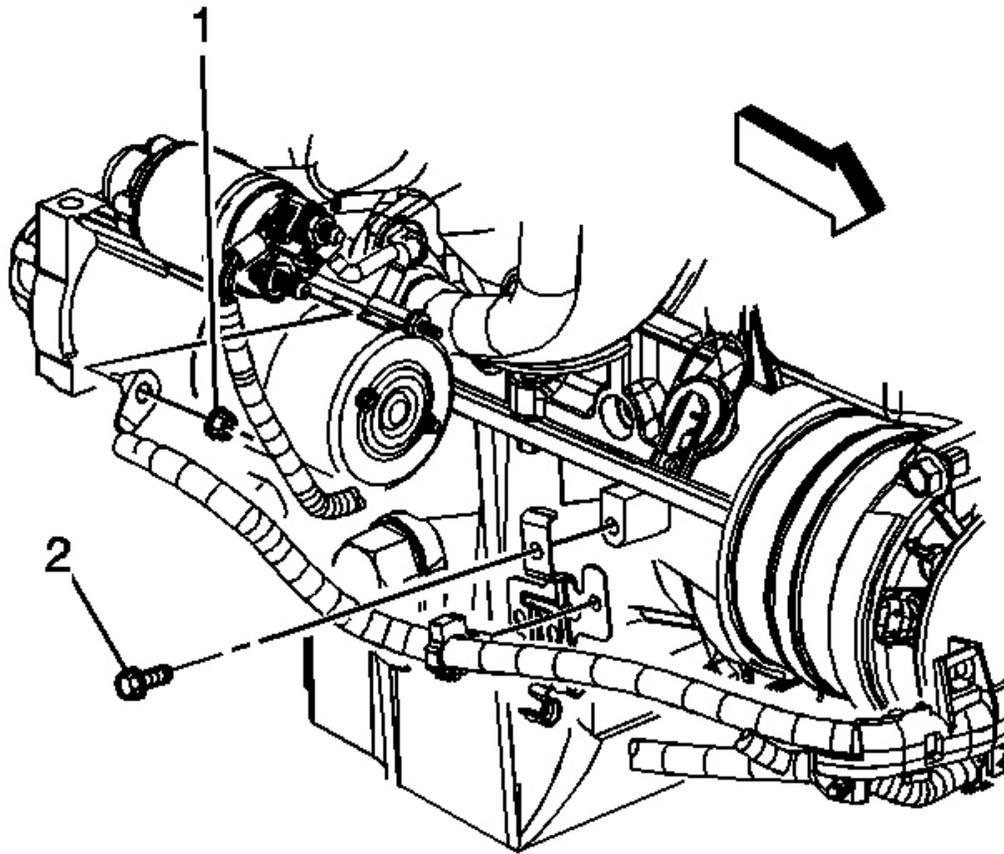


Fig. 18: Positive Cable Nut
Courtesy of GENERAL MOTORS CORP.

1. Install the positive battery cable.
2. Install the positive cable to the clip on the oil pan.
3. Install the positive cable to the starter.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the positive cable nut (1).

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

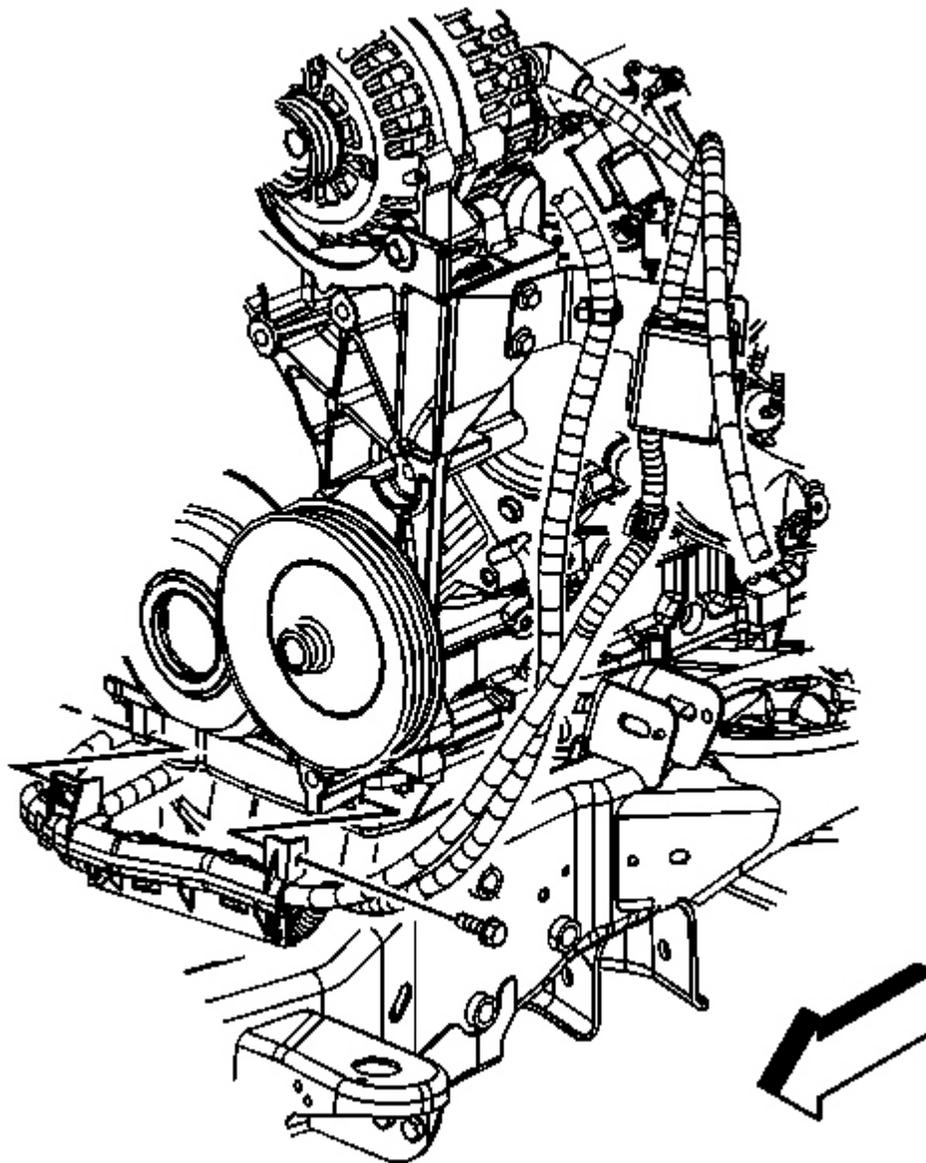


Fig. 19: Positive Battery Cable Channel Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the positive battery cable to the channel.
6. Slide the channel pin into the oil pan tab.
7. Install the positive battery cable channel bolt.

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

8. Install the engine protection shield. Refer to **Engine Protection Shield Replacement** in Frame and Underbody.
9. Lower the vehicle.

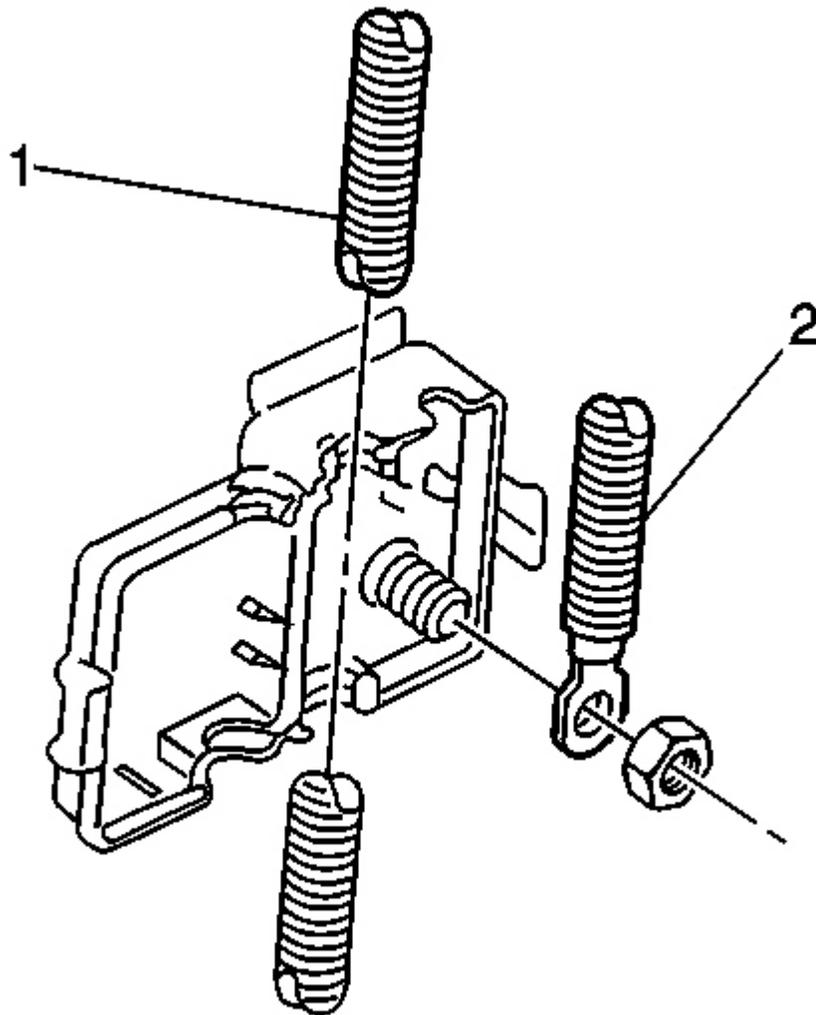


Fig. 20: Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

10. Install the positive battery cable (1) into the junction block.

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

11. Snap the junction block cover closed.

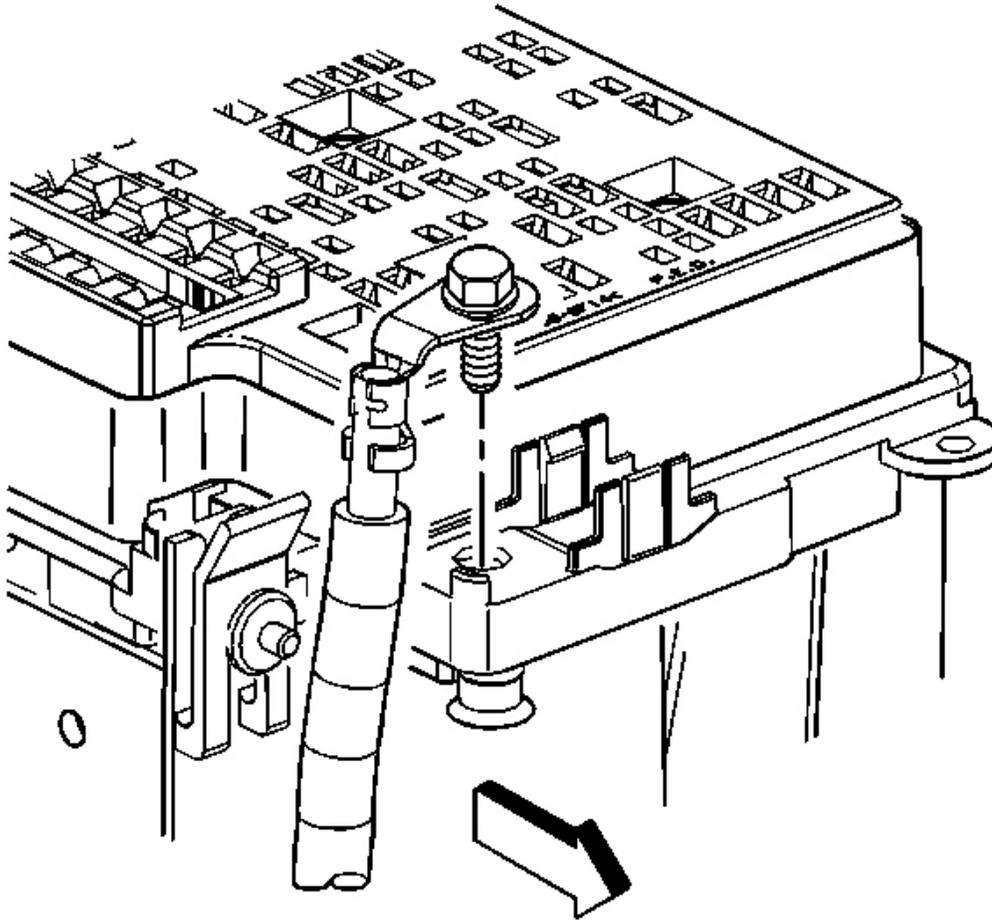


Fig. 21: Positive Battery Cable Bolt
Courtesy of GENERAL MOTORS CORP.

12. Tighten the positive cable bolt at the UBEC.

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

13. Position the UBEC lower cover.
14. Install the UBEC cover.

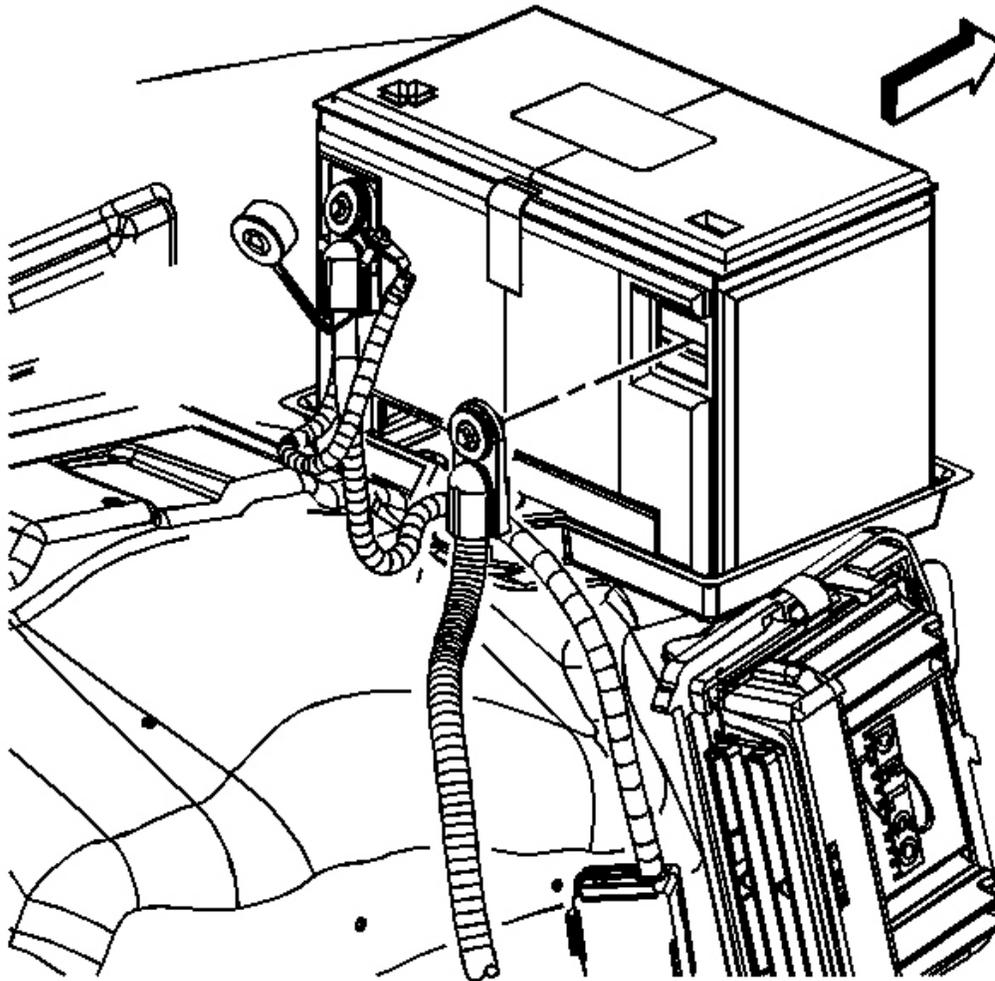


Fig. 22: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

15. Connect the positive battery cable.

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

16. Snap the positive battery cable cap closed.
17. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** .

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

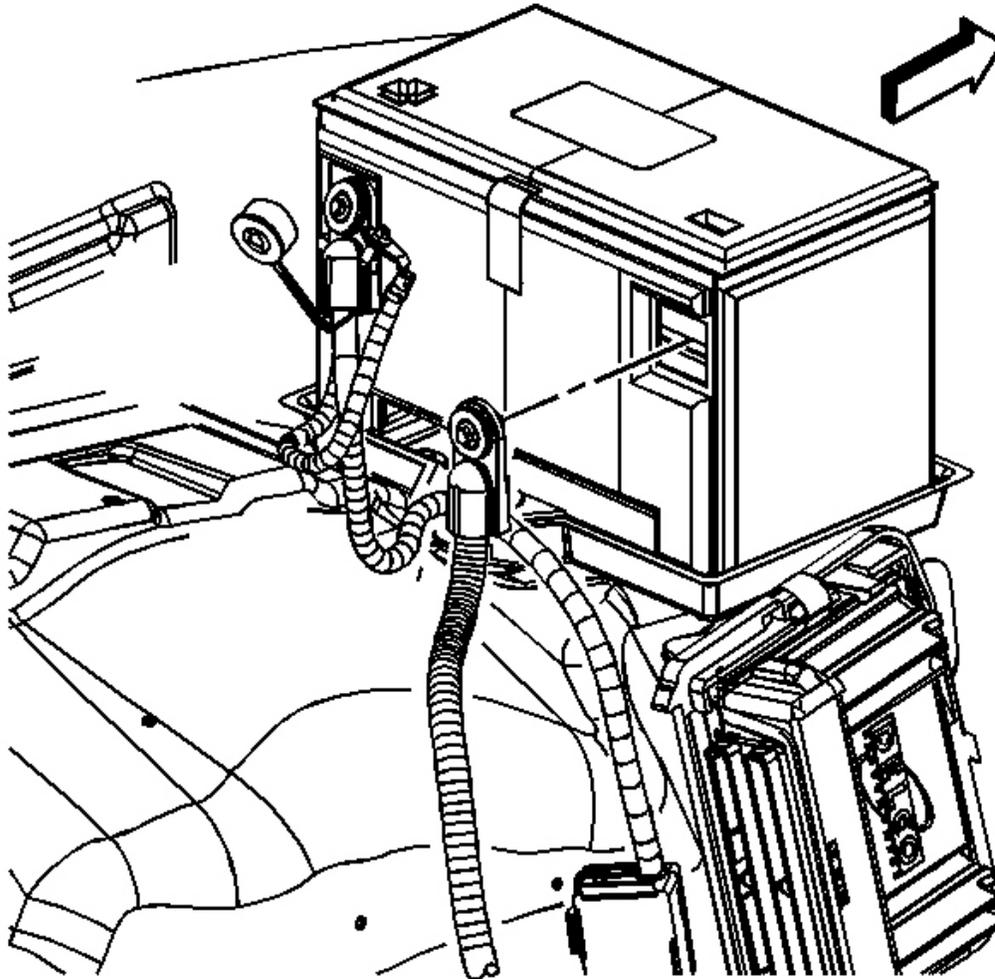


Fig. 23: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

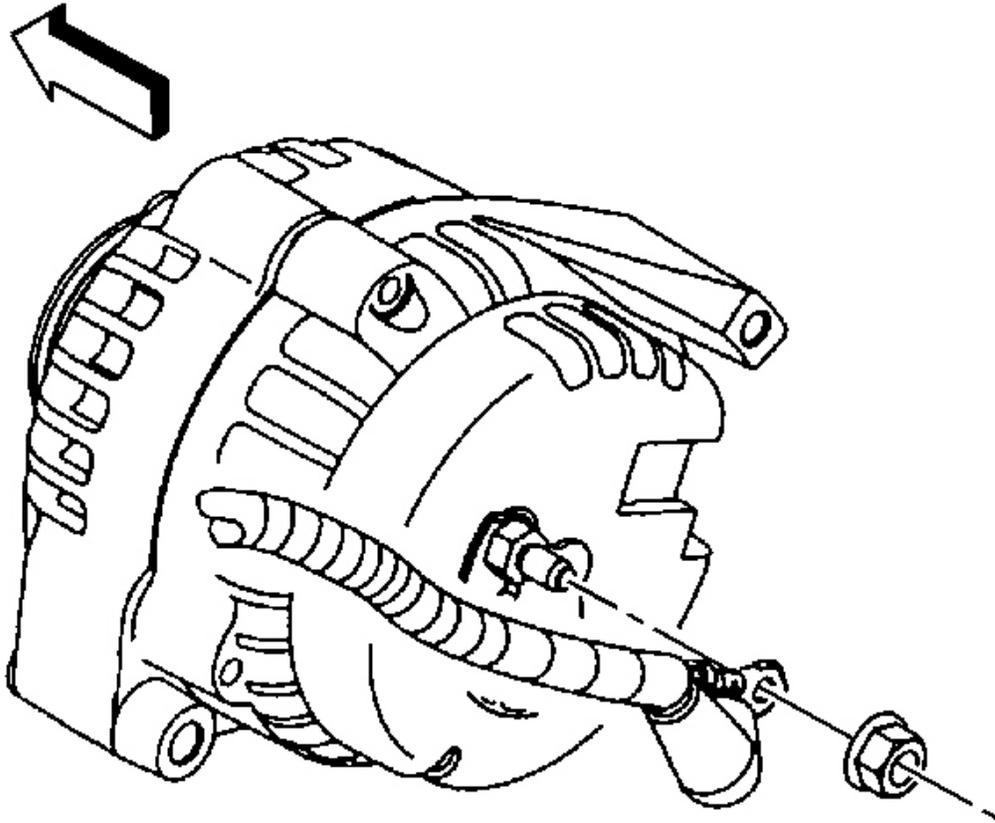


Fig. 24: View Of Generator Cable & Nut
Courtesy of GENERAL MOTORS CORP.

2. Remove the generator cable from the generator, perform the following:
 1. Reposition the boot to expose the stud.
 2. Remove the generator cable nut.
 3. Remove the generator cable from the stud.

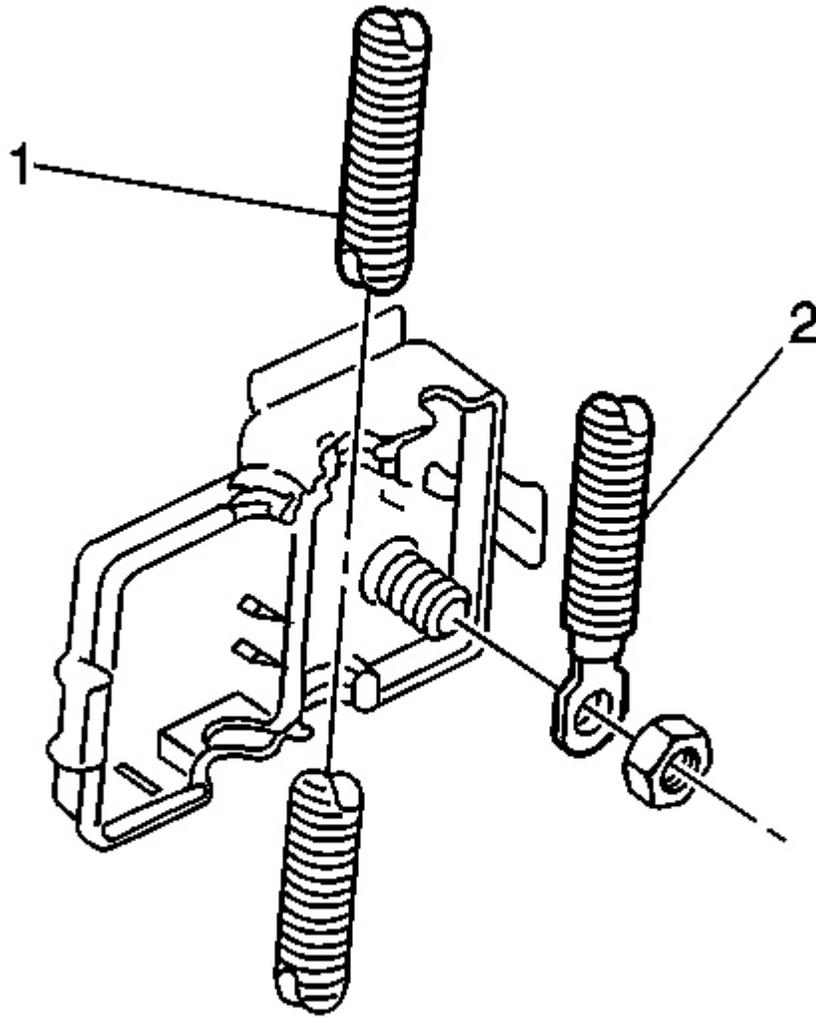


Fig. 25: Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

3. Open the positive cable junction block.
4. Remove the generator cable nut.
5. Remove the generator cable (2) from the junction block.

Installation Procedure

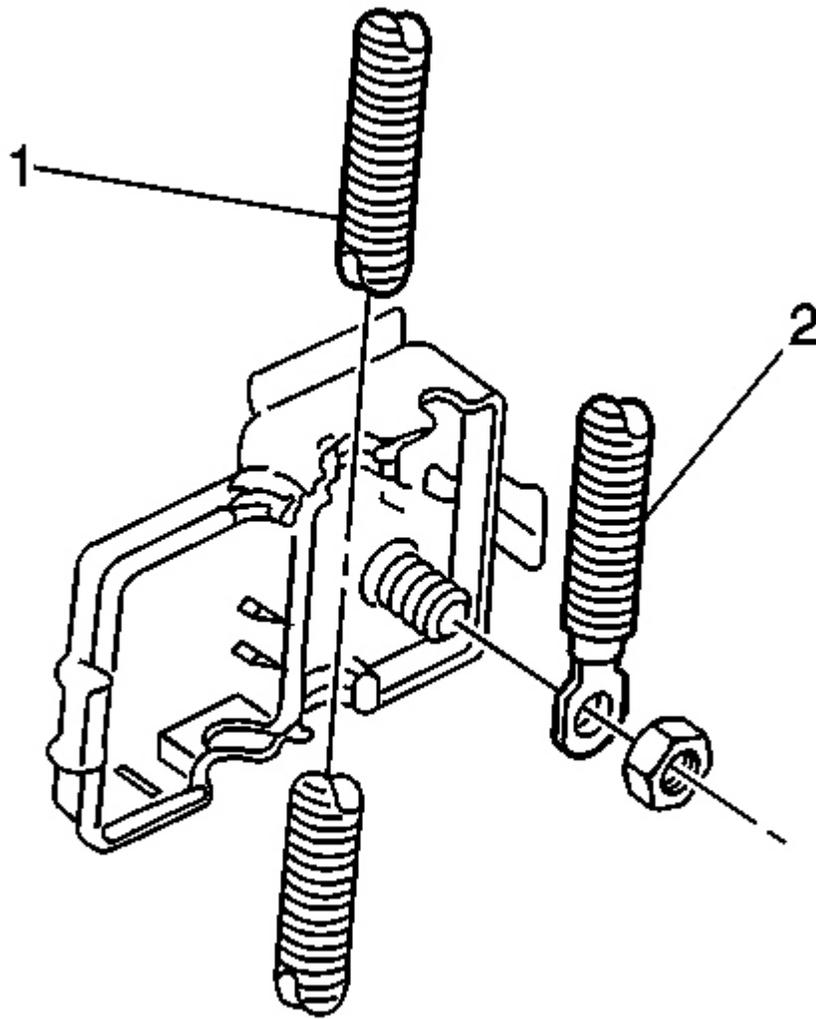


Fig. 26: Positive Battery Cable
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the generator cable (2) to the junction block.
2. Install the generator cable nut.

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

3. Close the positive cable junction block.

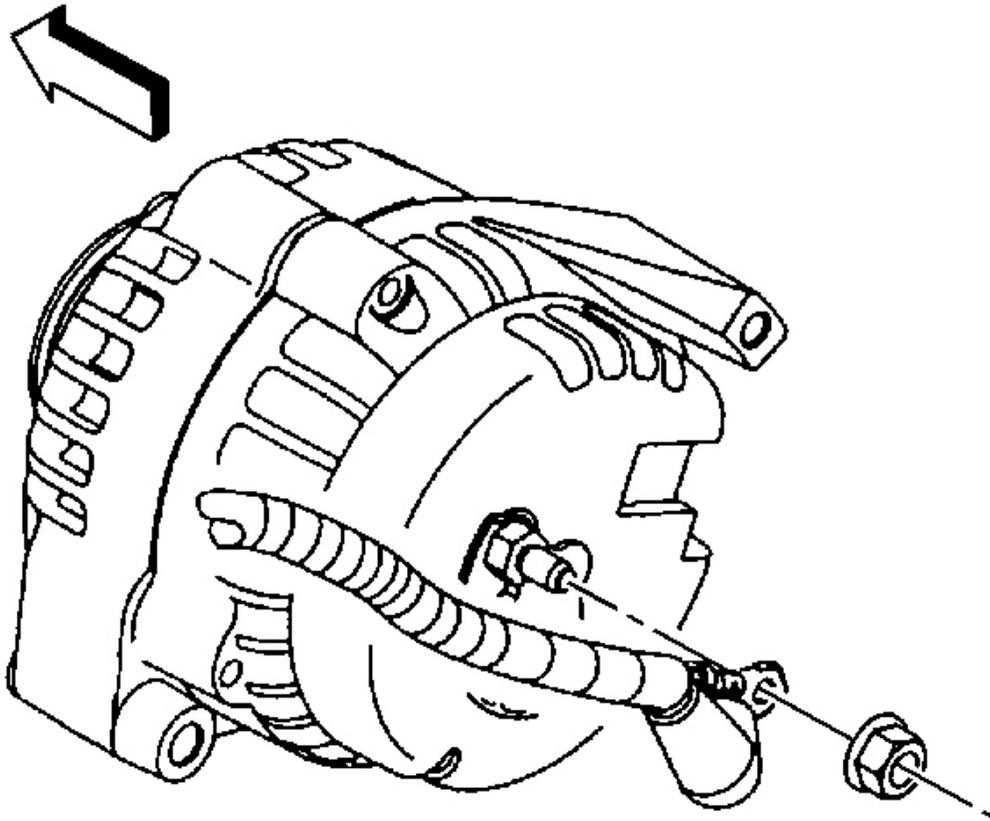


Fig. 27: View Of Generator Cable & Nut
Courtesy of GENERAL MOTORS CORP.

4. Install the generator cable to the generator, perform the following:
 1. Install the generator cable to the stud.
 2. Install the generator cable nut.

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

3. Position the boot to cover the stud.

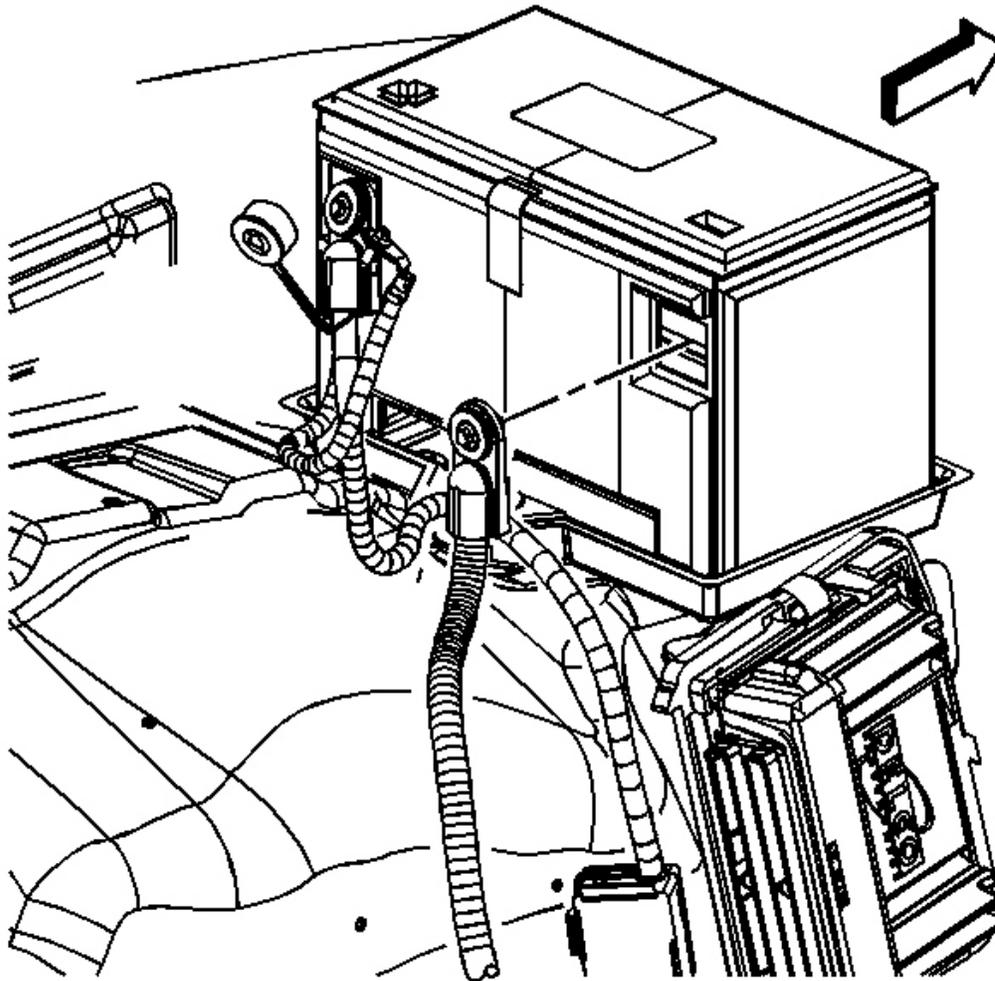


Fig. 28: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

BATTERY REPLACEMENT

Removal Procedure

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

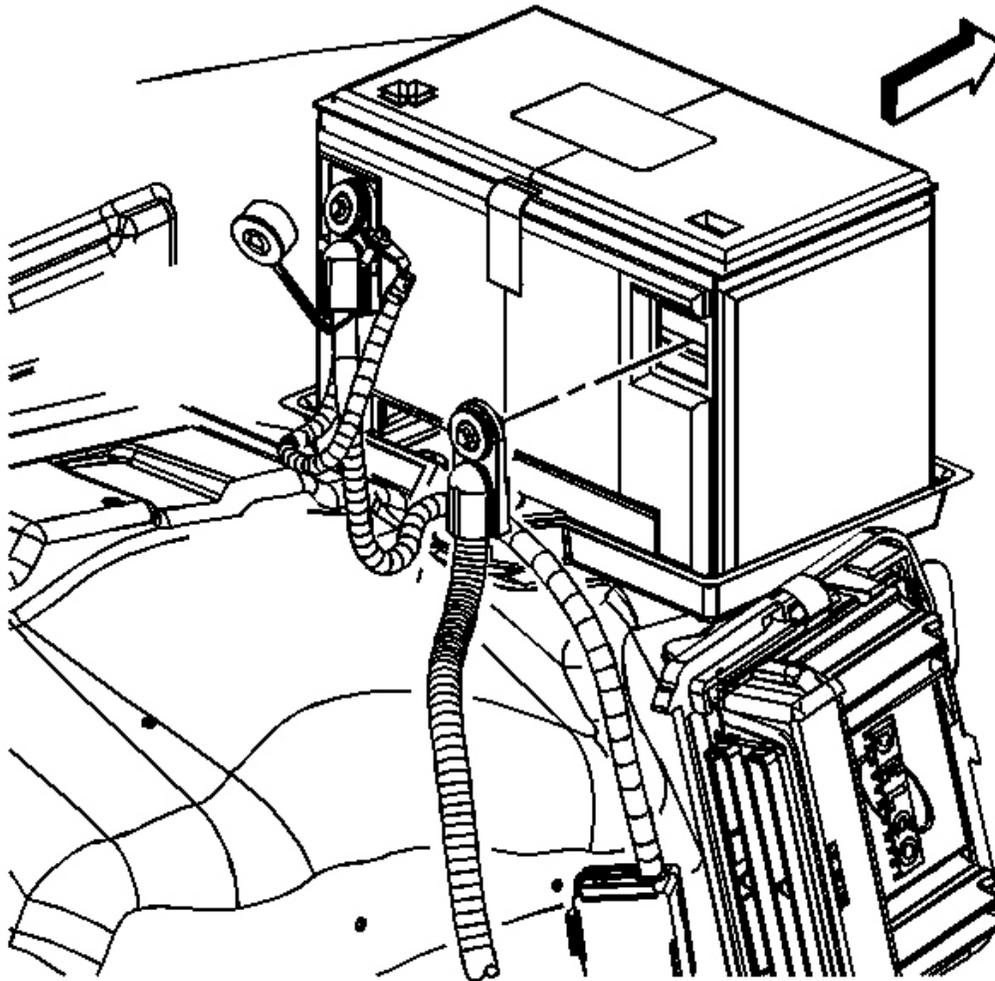


Fig. 29: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

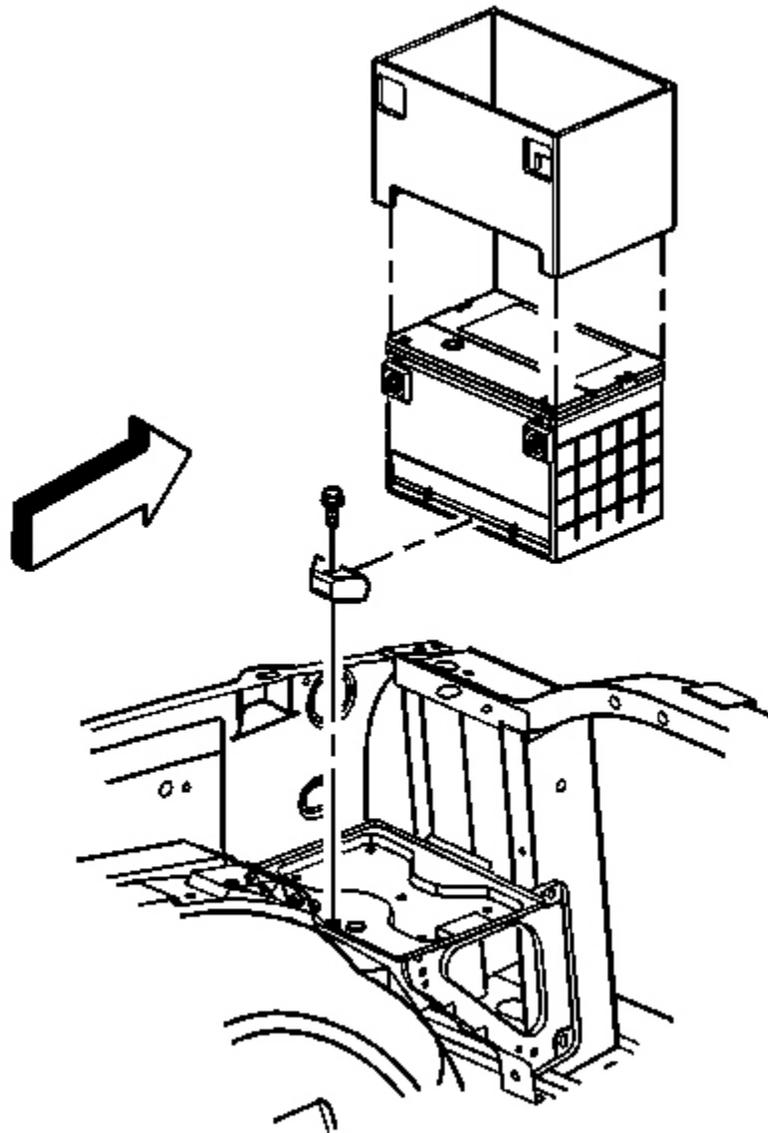


Fig. 30: Battery & Battery Insulator
Courtesy of GENERAL MOTORS CORP.

3. Remove the battery hold down retainer bolt and retainer.
4. Remove the battery.
5. Remove the battery insulator.

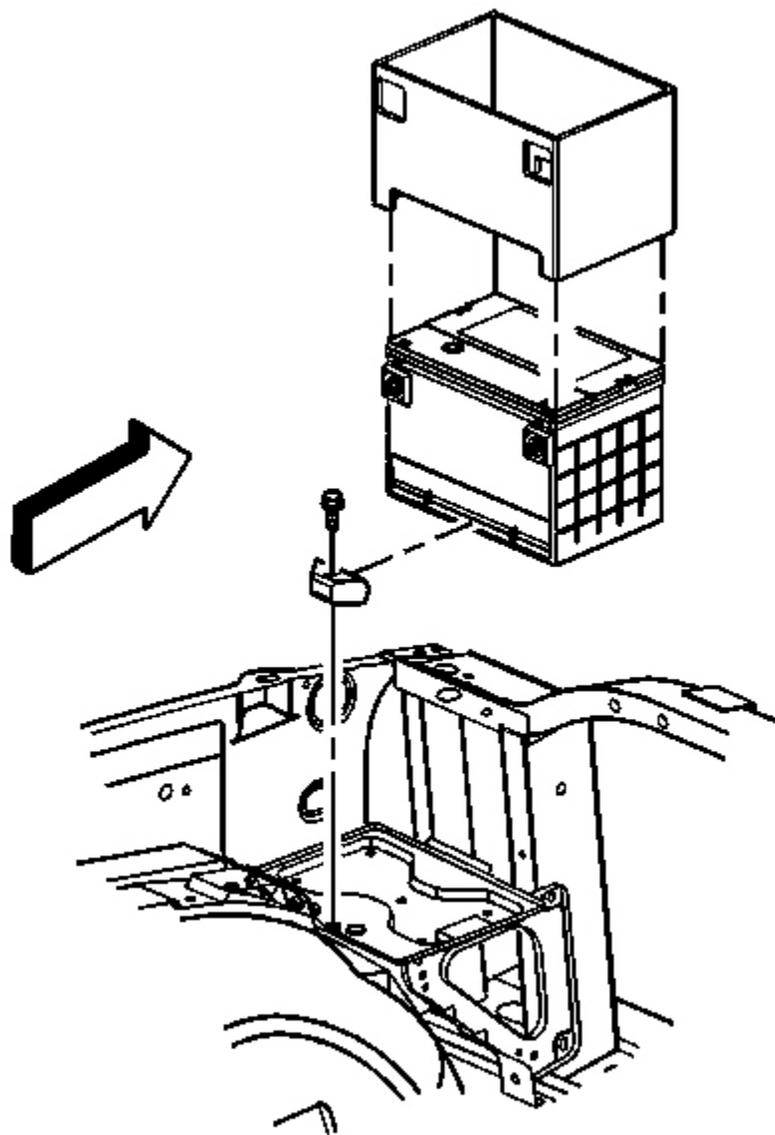


Fig. 31: Battery & Battery Insulator
Courtesy of GENERAL MOTORS CORP.

1. Install the battery insulator, if necessary.
2. Install the battery.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the battery hold down retainer and bolt.

Tighten: Tighten the battery hold down retainer bolt to 25 N.m (18 lb ft).

4. Connect the positive battery cable.

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

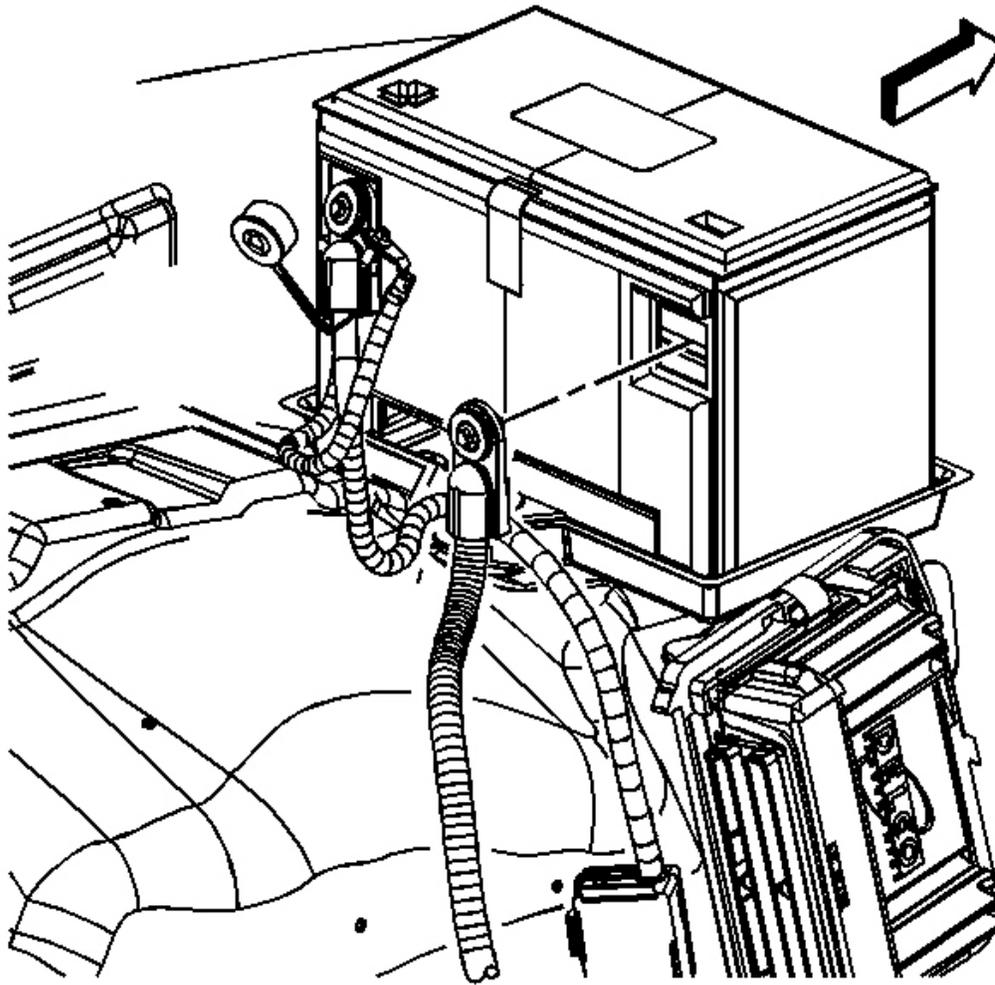


Fig. 32: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

BATTERY TRAY REPLACEMENT

Removal Procedure

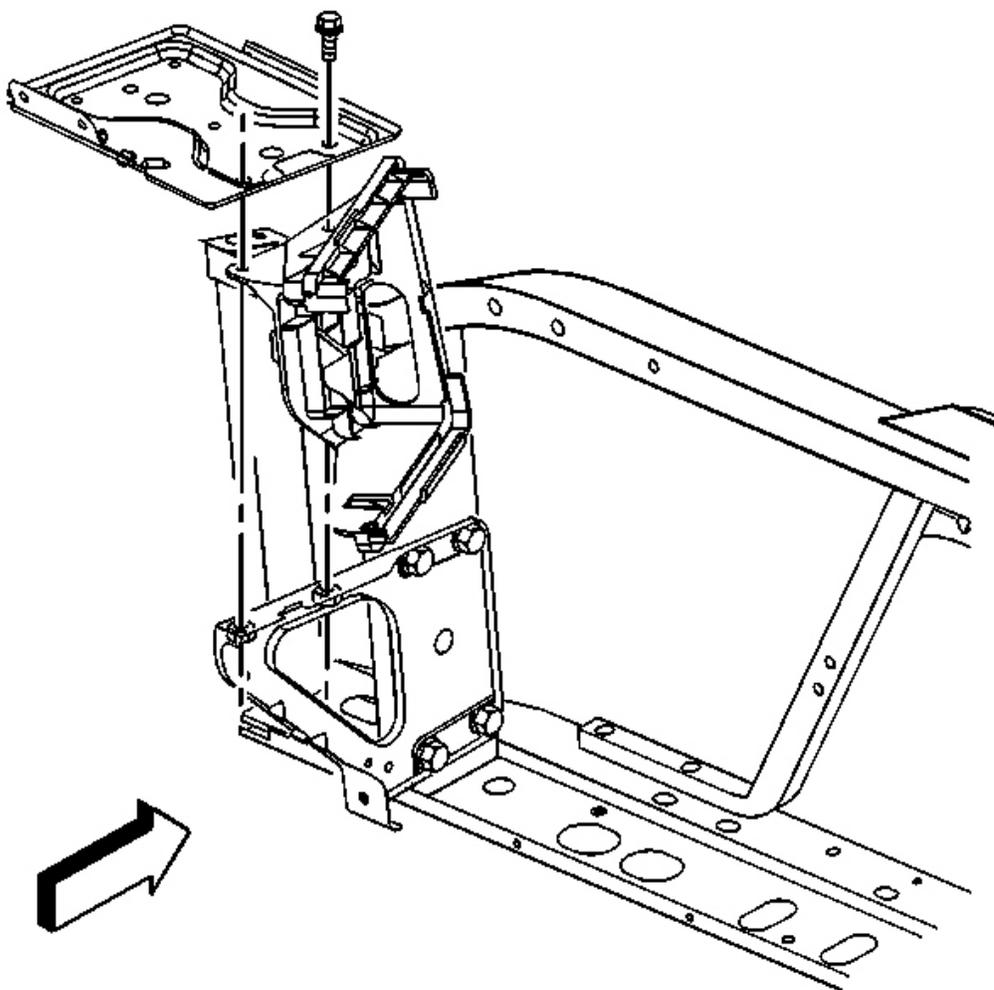


Fig. 33: Battery Tray
Courtesy of GENERAL MOTORS CORP.

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

3. Remove the battery tray.

Installation Procedure

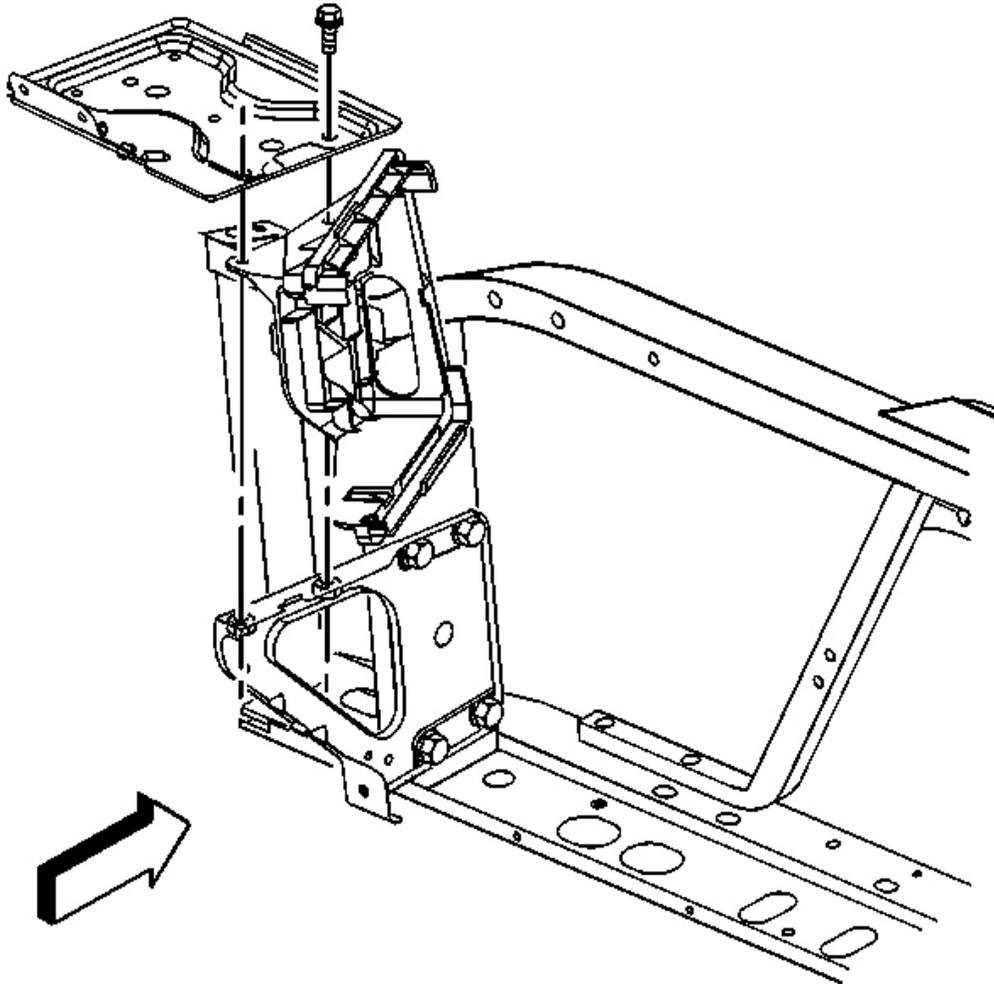


Fig. 34: Battery Tray
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices

1. Install the battery tray.

Install the bolts to the battery tray support until snug.

2. Tighten the battery tray bolts.

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

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

GROUND STRAP REPLACEMENT

Removal Procedure

1. Remove the left hand catalytic convert. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.

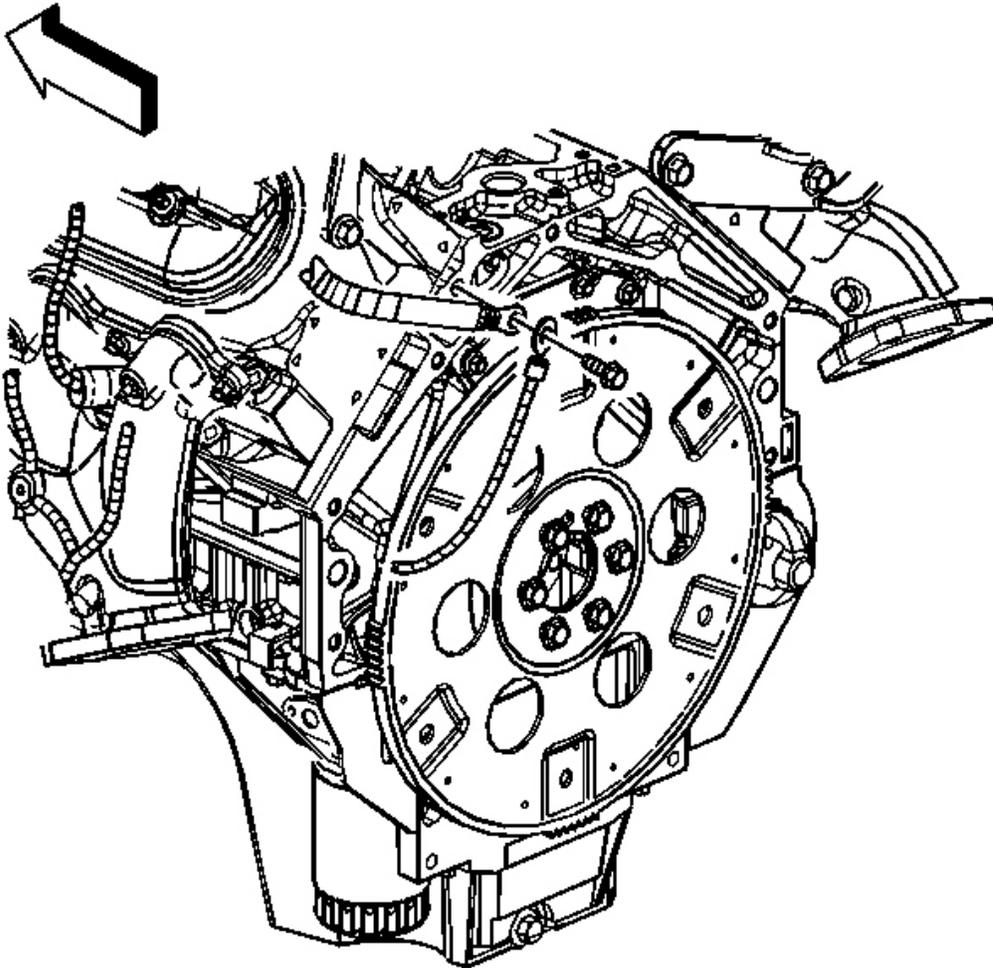


Fig. 35: Ground Cable Bolt At Engine Block
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine wiring harness ground bolt.
3. Lower the vehicle.

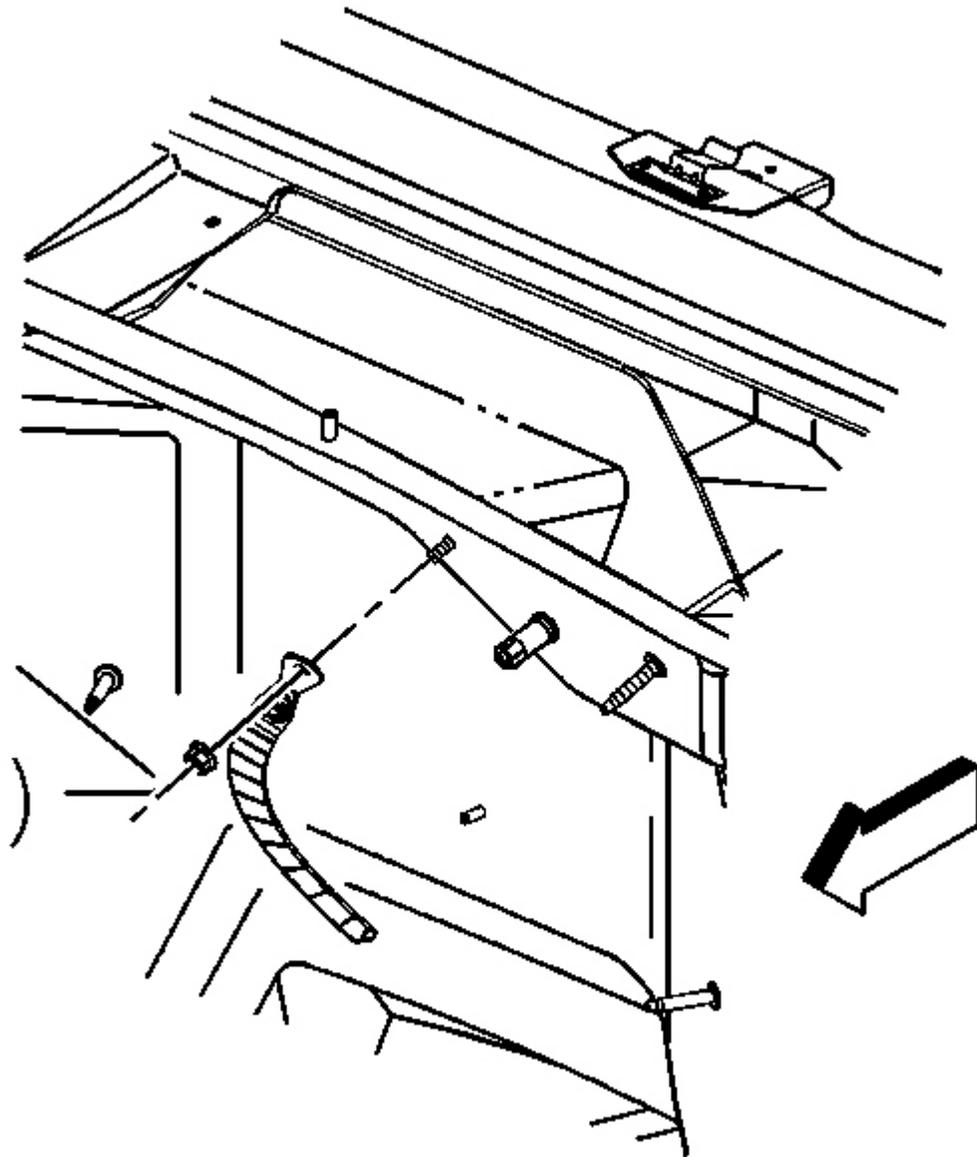


Fig. 36: Ground Strap Nut
Courtesy of GENERAL MOTORS CORP.

4. Remove the ground strap nut from the stud at the front of dash.
5. Remove the ground strap from the stud.

Installation Procedure

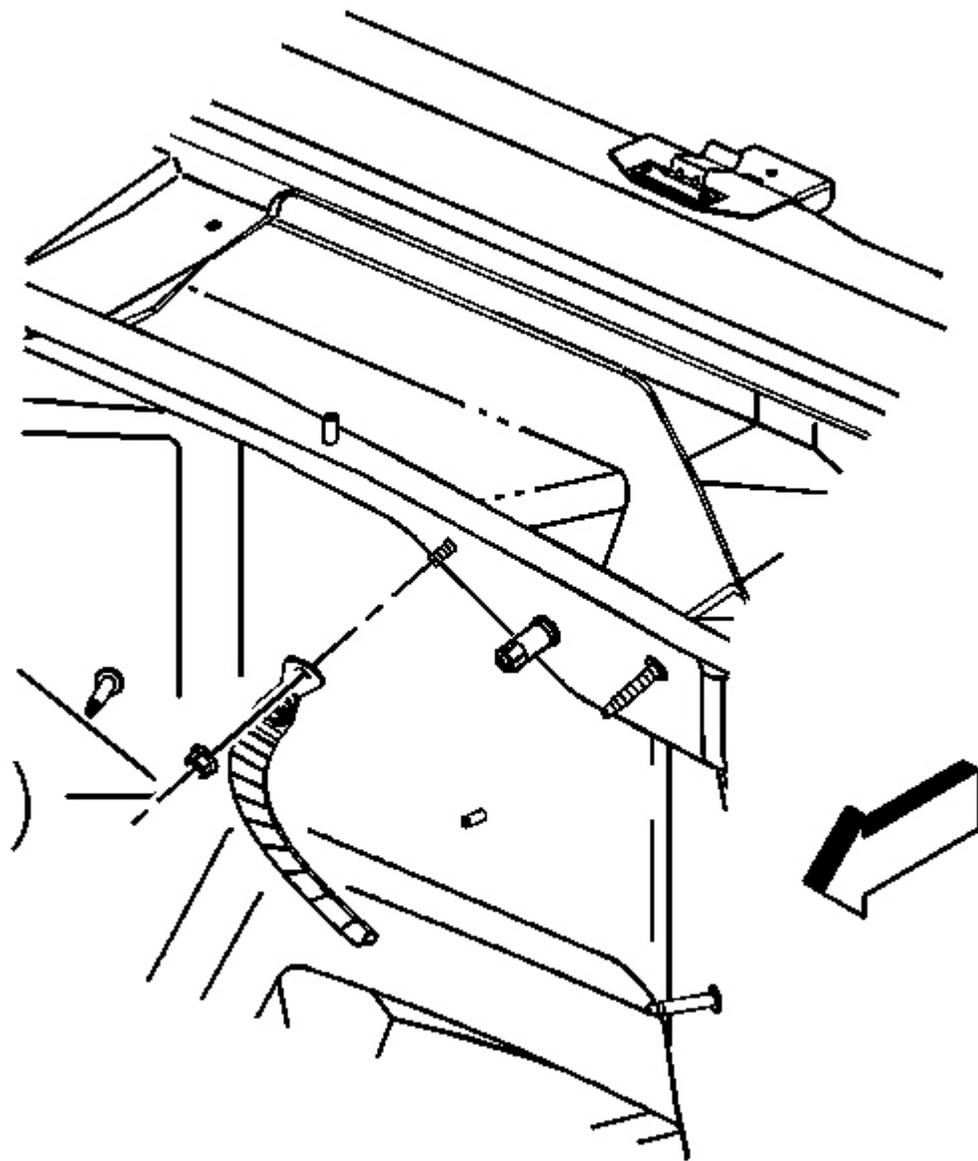


Fig. 37: Ground Strap Nut
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the ground strap to the stud.

2. Install the ground strap nut to the stud at the front of dash.

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

3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

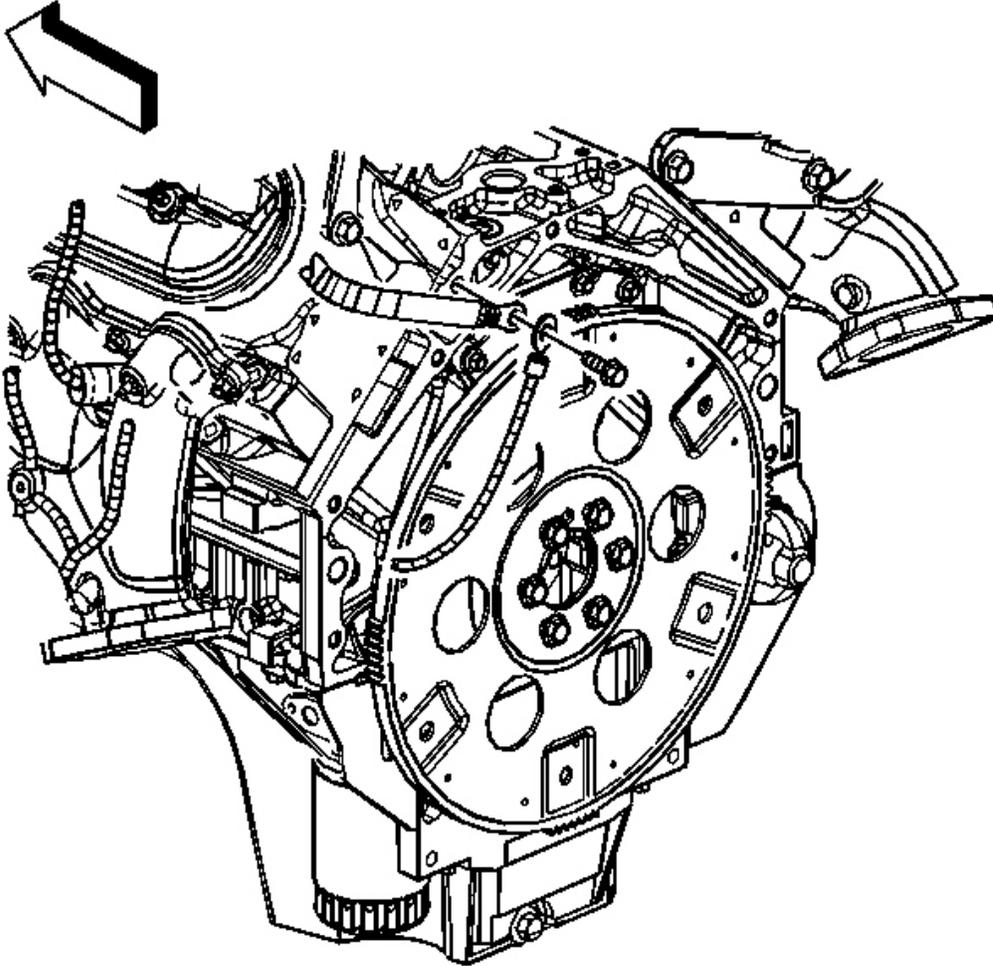


Fig. 38: Ground Cable Bolt At Engine Block
Courtesy of GENERAL MOTORS CORP.

4. Position the ground strap and engine wiring harness ground.

5. Install the engine wiring harness ground bolt.

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

6. Install the left hand catalytic convert. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
7. Lower the vehicle.

STARTER MOTOR RELAY REPLACEMENT

Removal Procedure

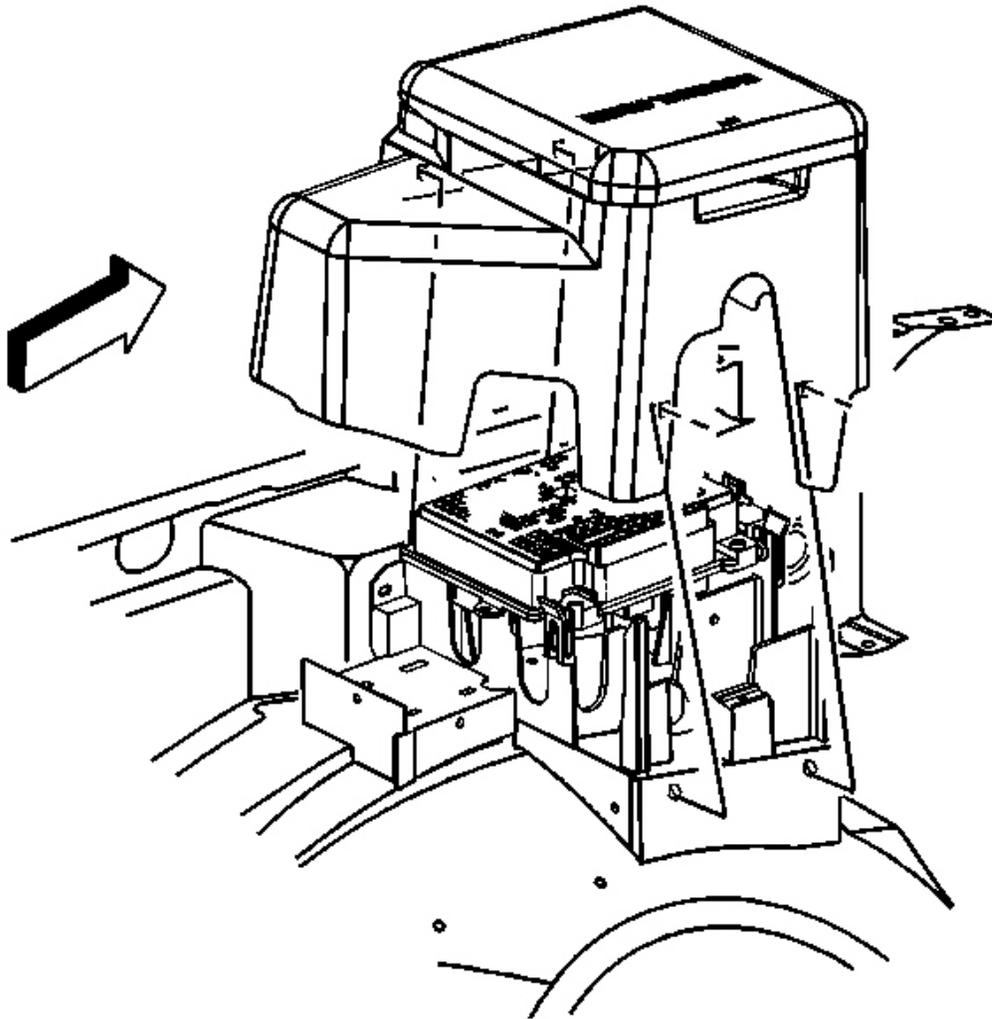


Fig. 39: Starter Motor Relay

Courtesy of GENERAL MOTORS CORP.

1. Remove the underhood bussed electrical center (UBEC) cover.
2. Remove the starter motor relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems.

Installation Procedure

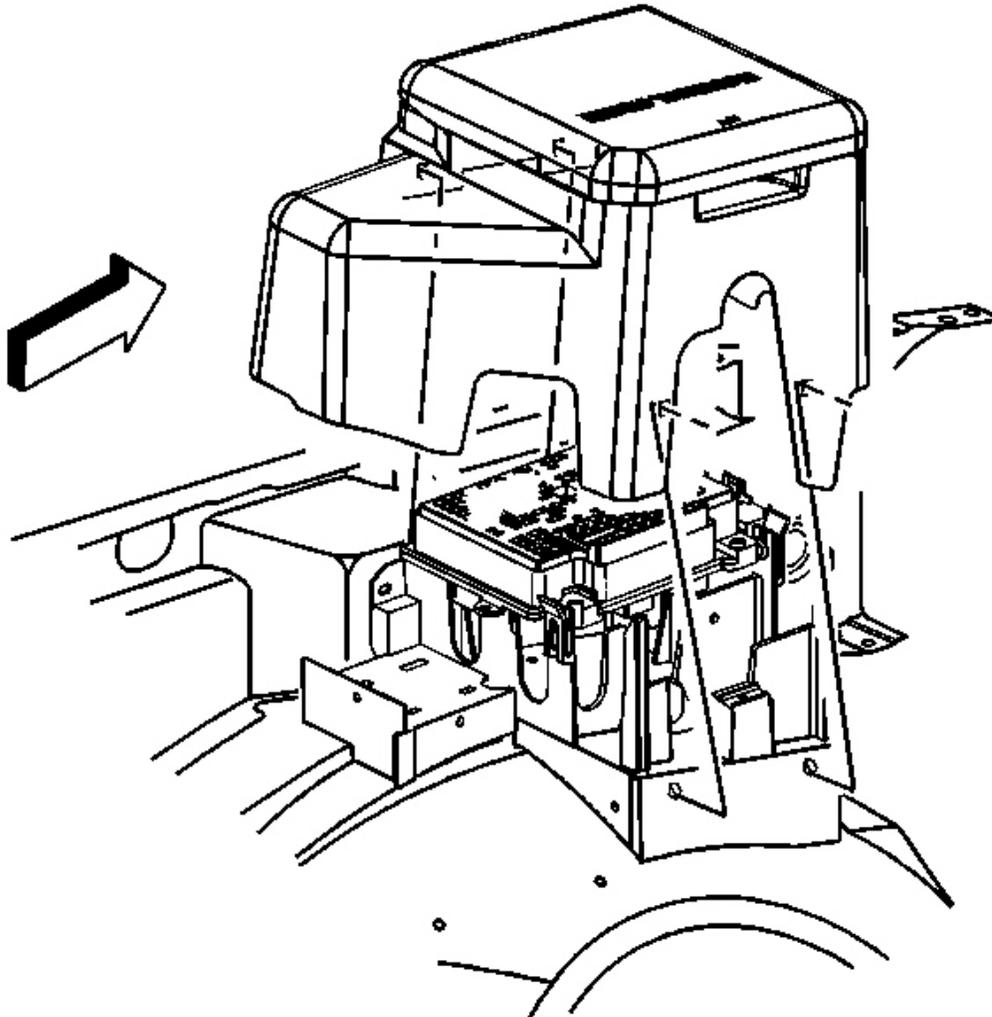


Fig. 40: Starter Motor Relay
Courtesy of GENERAL MOTORS CORP.

1. Install the starter motor relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems.
2. Install the underhood bussed electrical center (UBEC) cover.

STARTER MOTOR REPLACEMENT

Removal Procedure

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

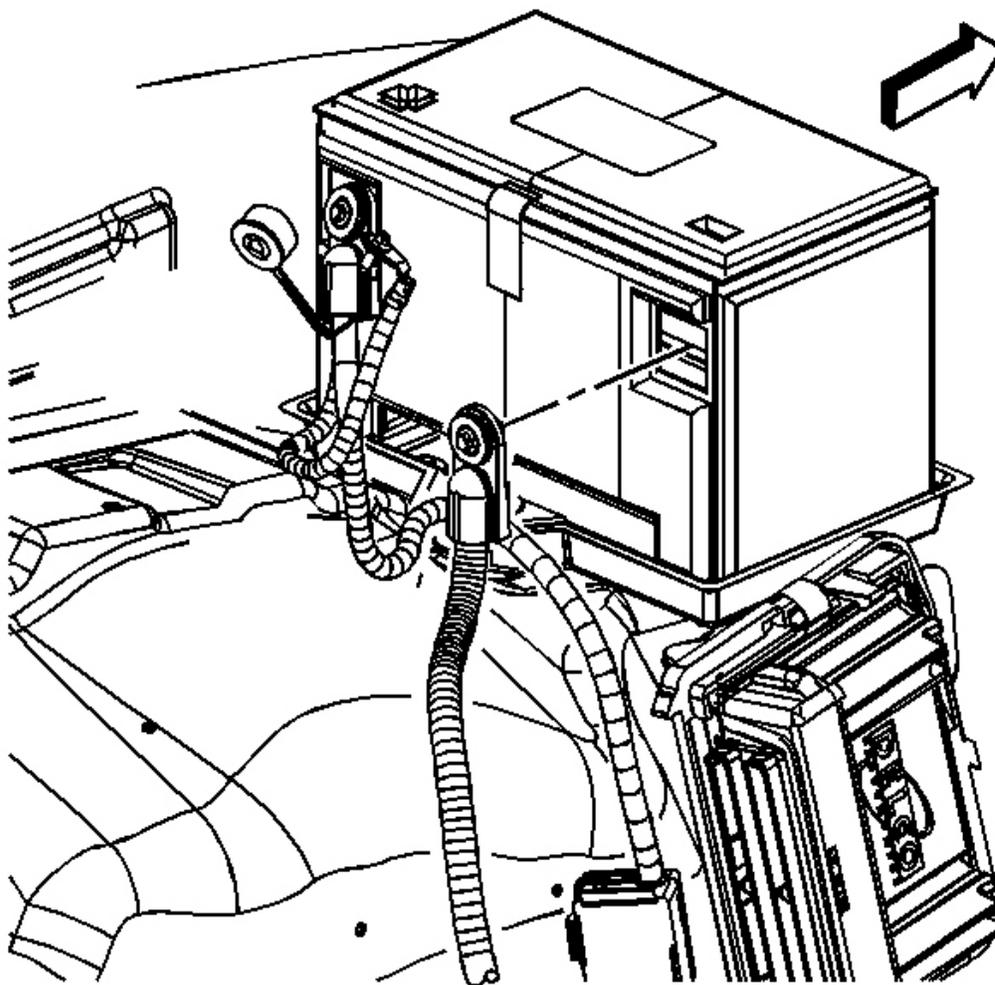


Fig. 41: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

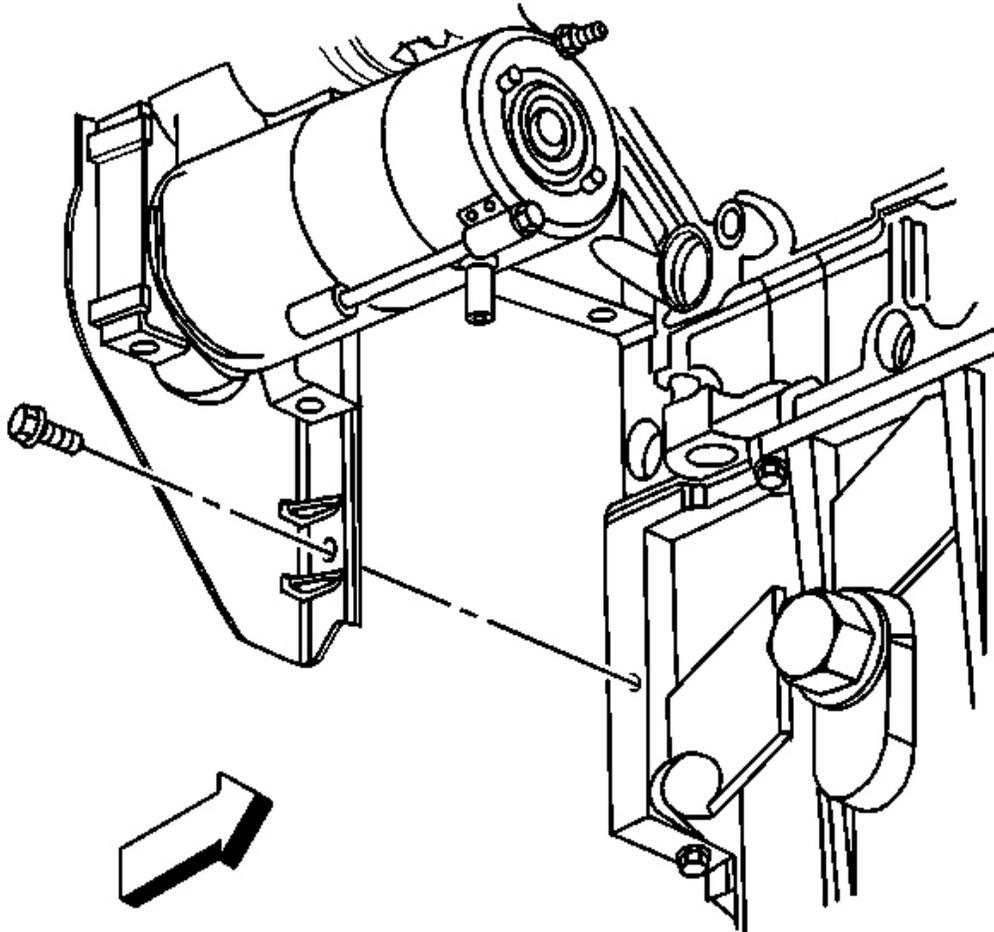


Fig. 42: Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine protective shield. Refer to **Engine Protection Shield Replacement**.
4. Remove the transmission cover bolt.

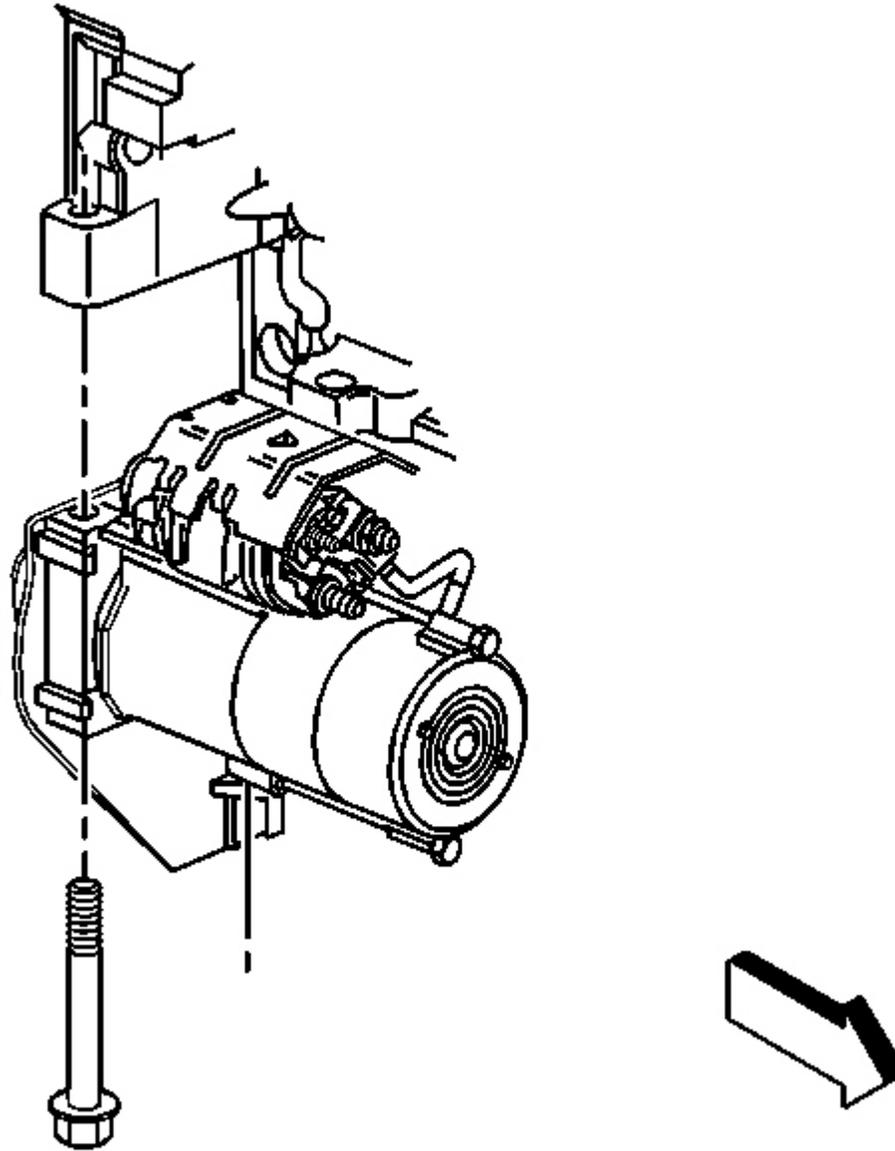


Fig. 43: Starter Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the starter bolts.
6. Disconnect the oil level sensor electrical connector.
7. Slide the starter forward until the starter clears the transmission.

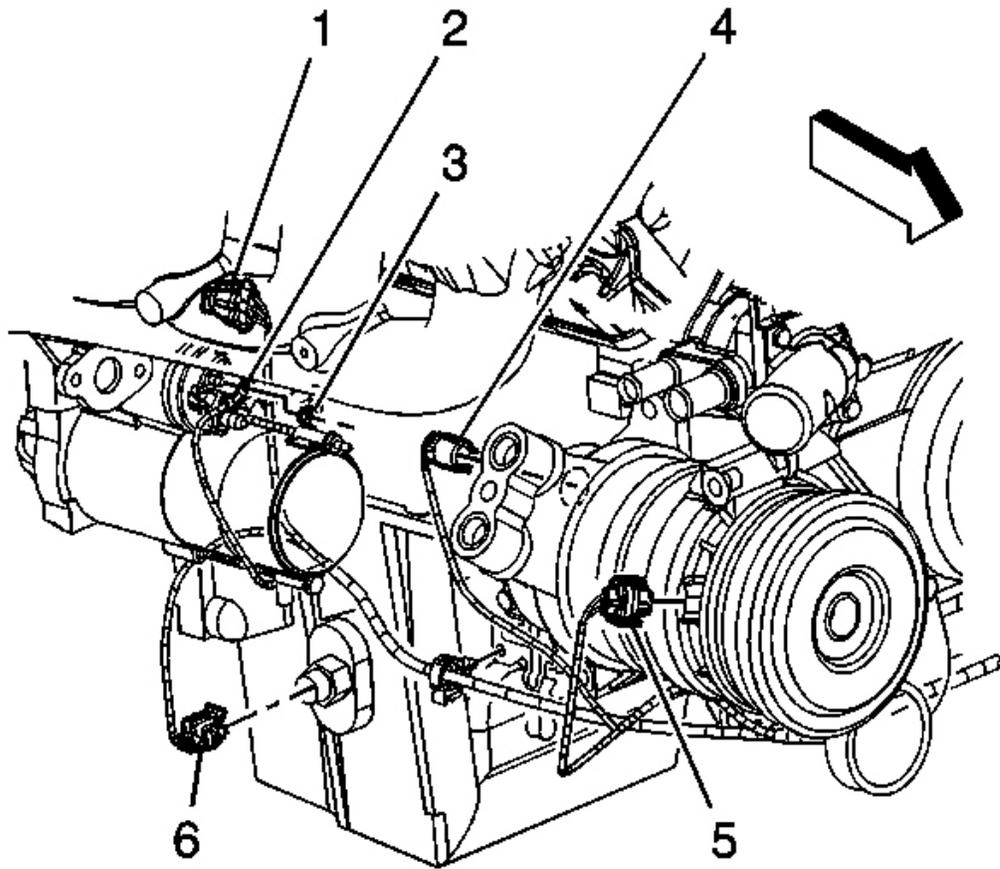


Fig. 44: Starter Lead Nut
Courtesy of GENERAL MOTORS CORP.

8. Remove the starter lead nut (3).
9. Remove the starter lead (2) from the starter.

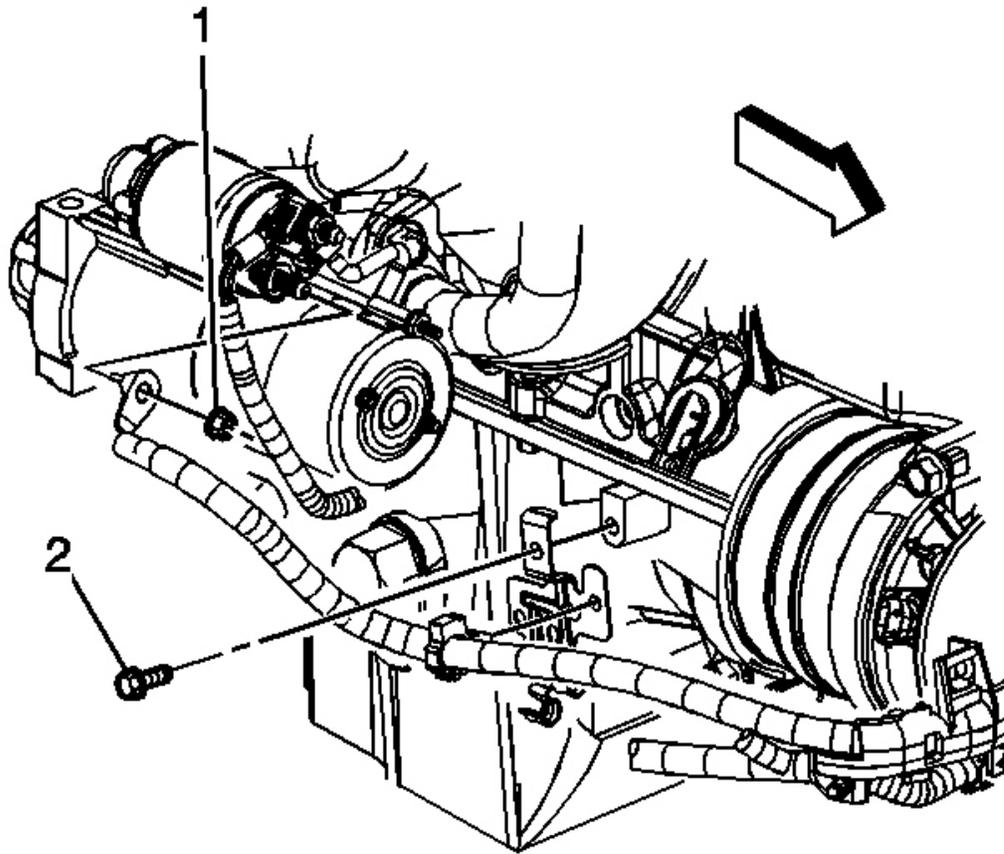


Fig. 45: Positive Cable Nut
Courtesy of GENERAL MOTORS CORP.

10. Remove the positive cable nut (2).
11. Remove the positive cable from the starter.

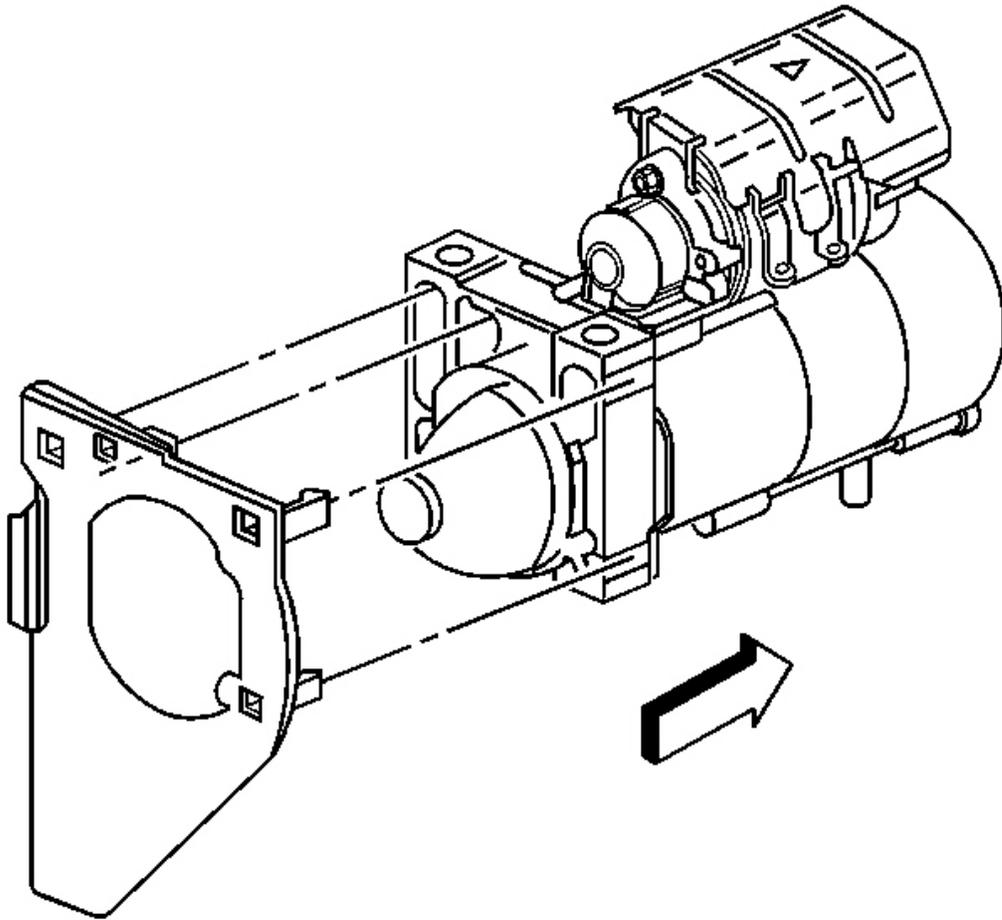


Fig. 46: Transmission Cover & Starter
Courtesy of GENERAL MOTORS CORP.

12. Place the starter on a workbench.
13. Unsnap the transmission cover from the starter.

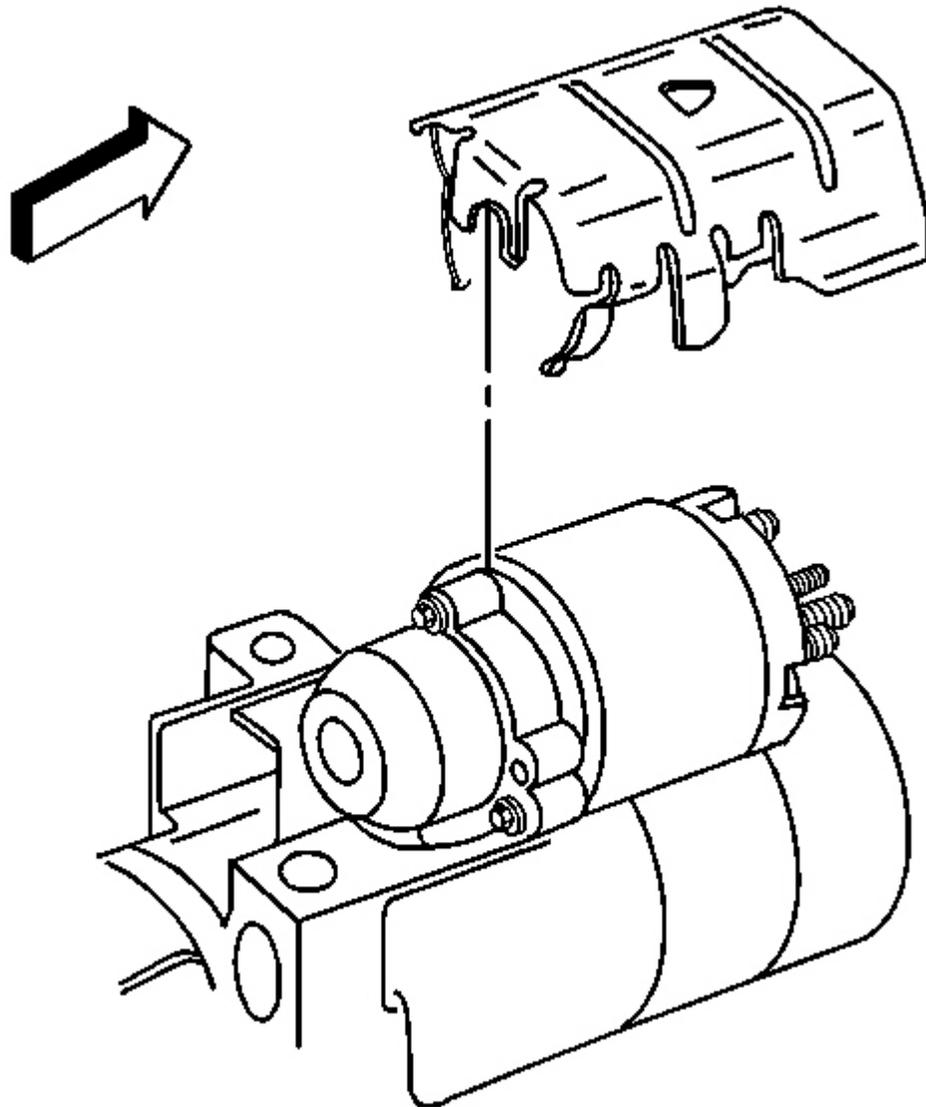


Fig. 47: Starter Heat Shield
Courtesy of GENERAL MOTORS CORP.

14. Remove the starter heat shield.

Installation Procedure

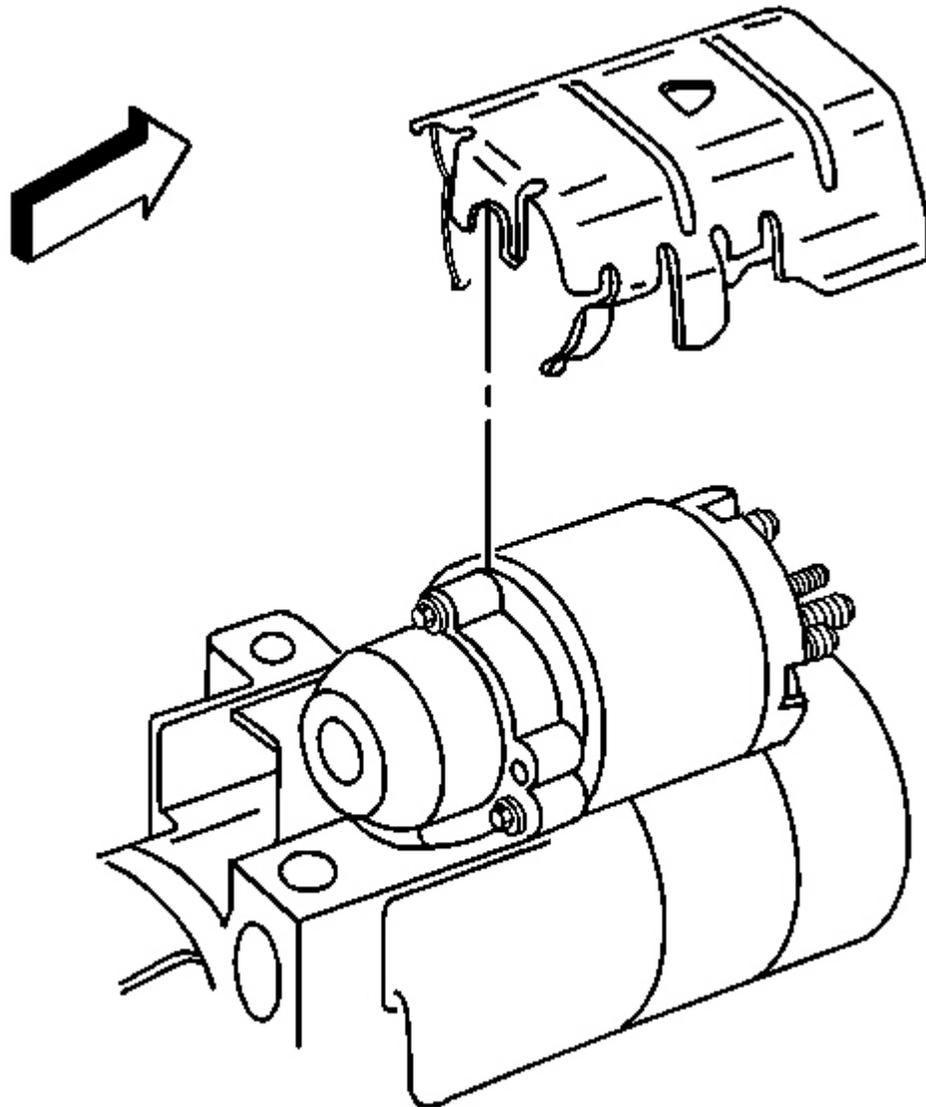


Fig. 48: Starter Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Install the starter heat shield.

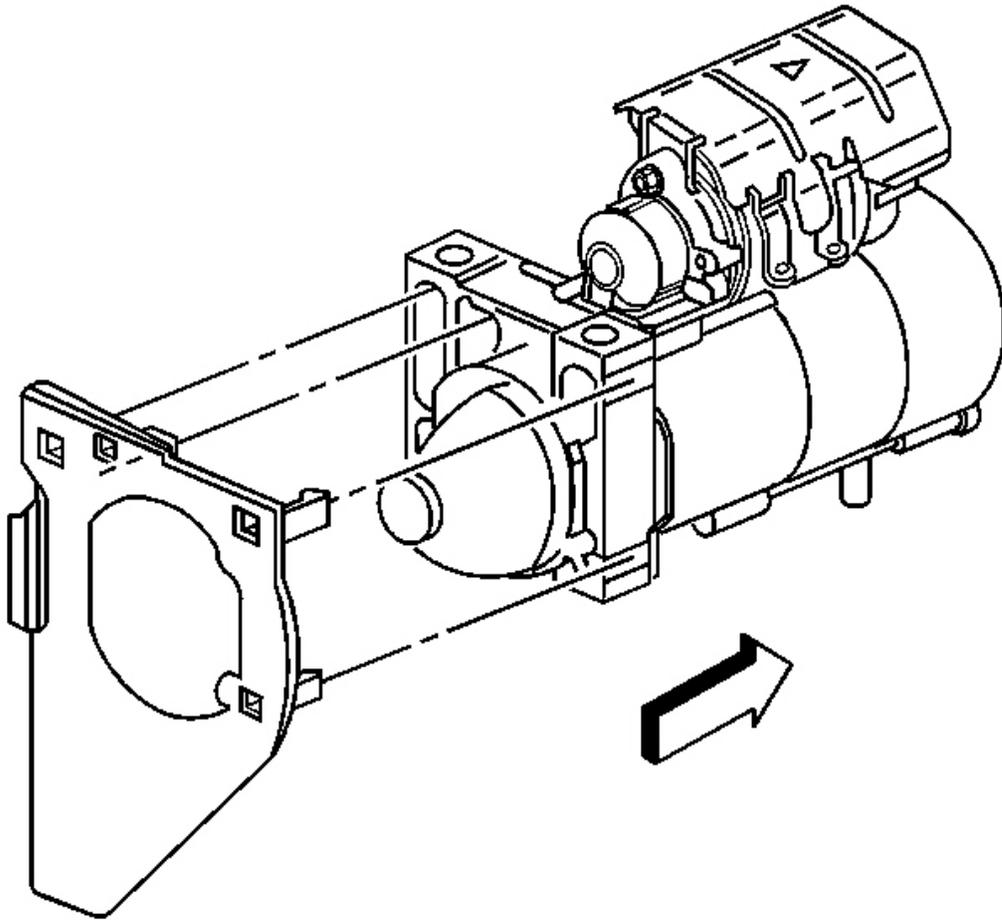


Fig. 49: Transmission Cover & Starter
Courtesy of GENERAL MOTORS CORP.

2. Snap the transmission cover to the starter.

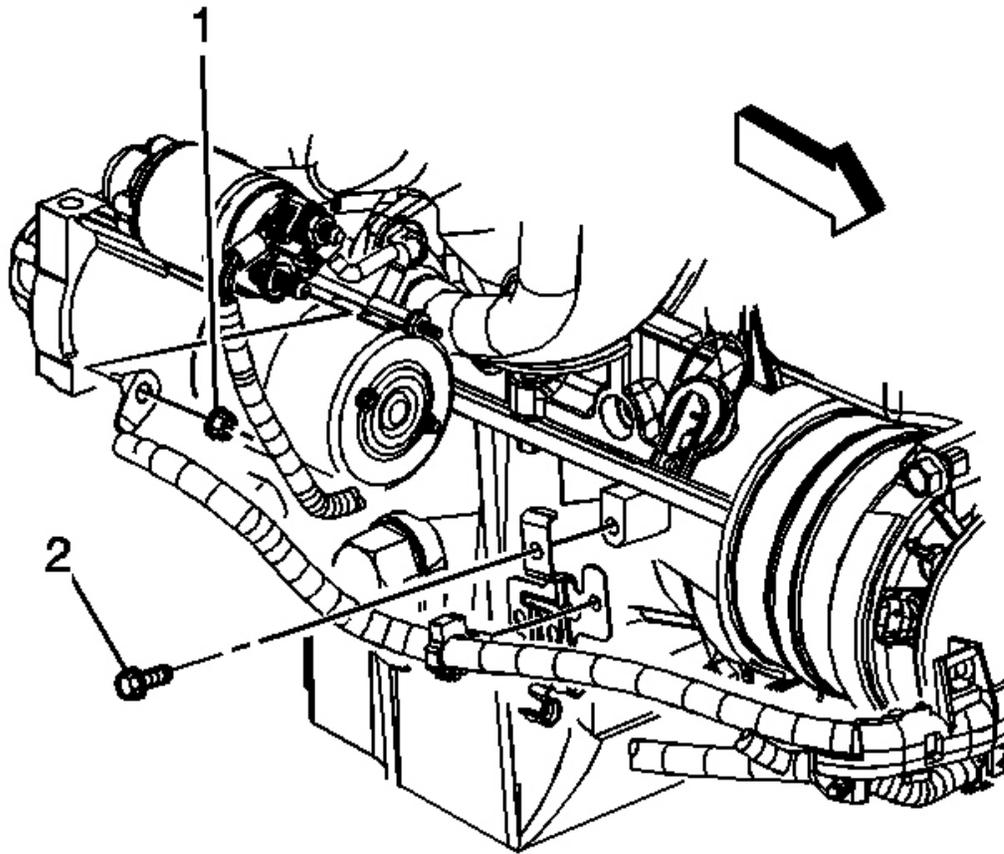


Fig. 50: Positive Cable Nut
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

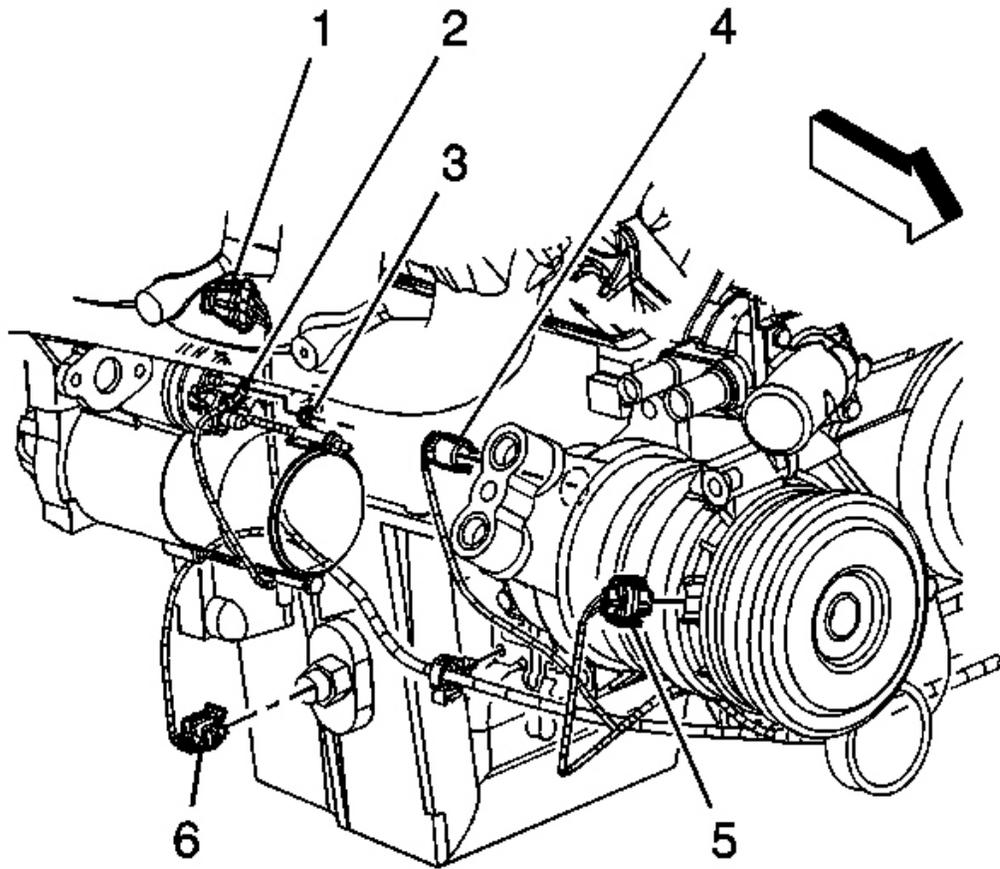


Fig. 51: Starter Lead Nut
Courtesy of GENERAL MOTORS CORP.

5. Install the starter lead (2) to the starter.
6. Install the starter lead nut (3).

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

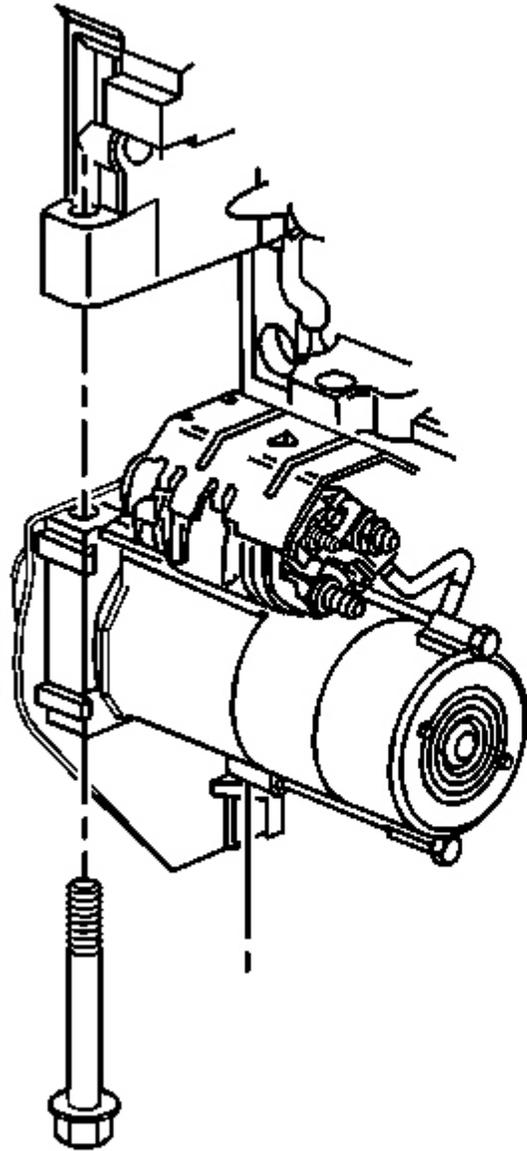


Fig. 52: Starter Bolts
Courtesy of GENERAL MOTORS CORP.

7. Position the starter into place.
8. Install the starter bolts.

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

9. Connect the oil level sensor electrical connector.

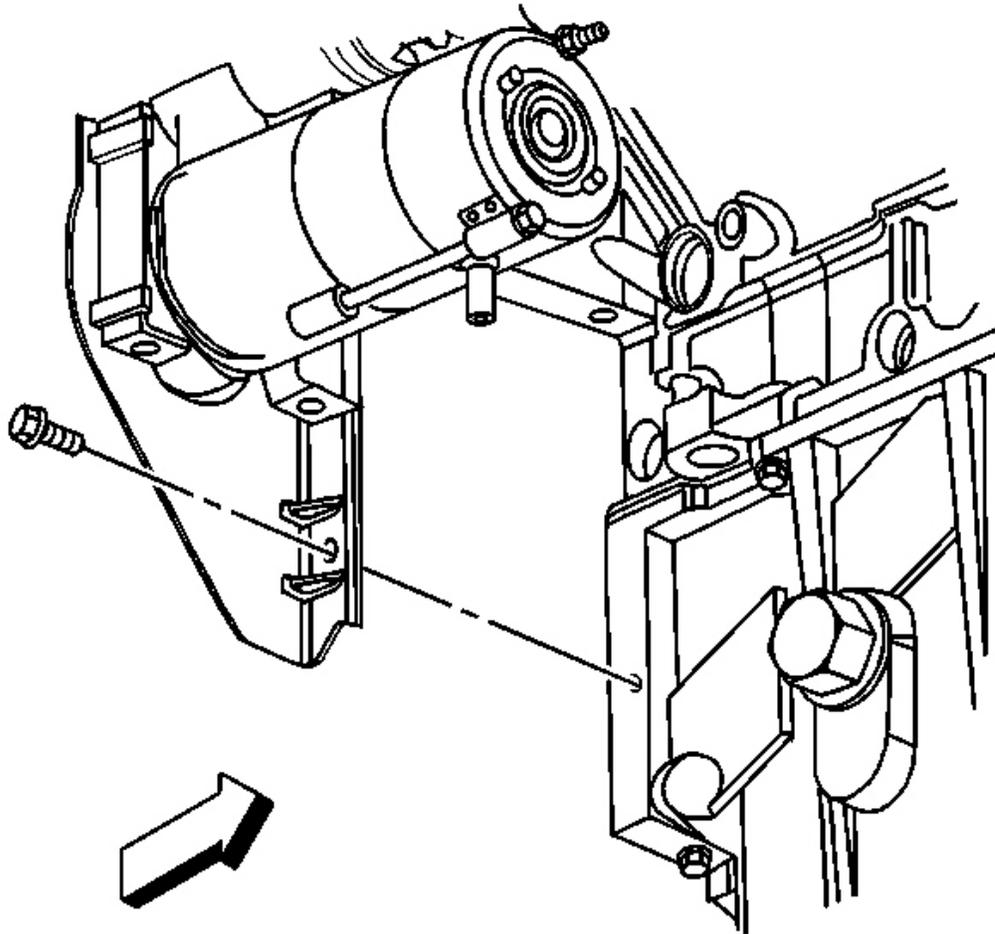


Fig. 53: Transmission Cover Bolt
Courtesy of GENERAL MOTORS CORP.

10. Install the transmission cover bolt.

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

11. Install the engine protective shield. Refer to **Engine Protection Shield Replacement**.
12. Lower the vehicle.

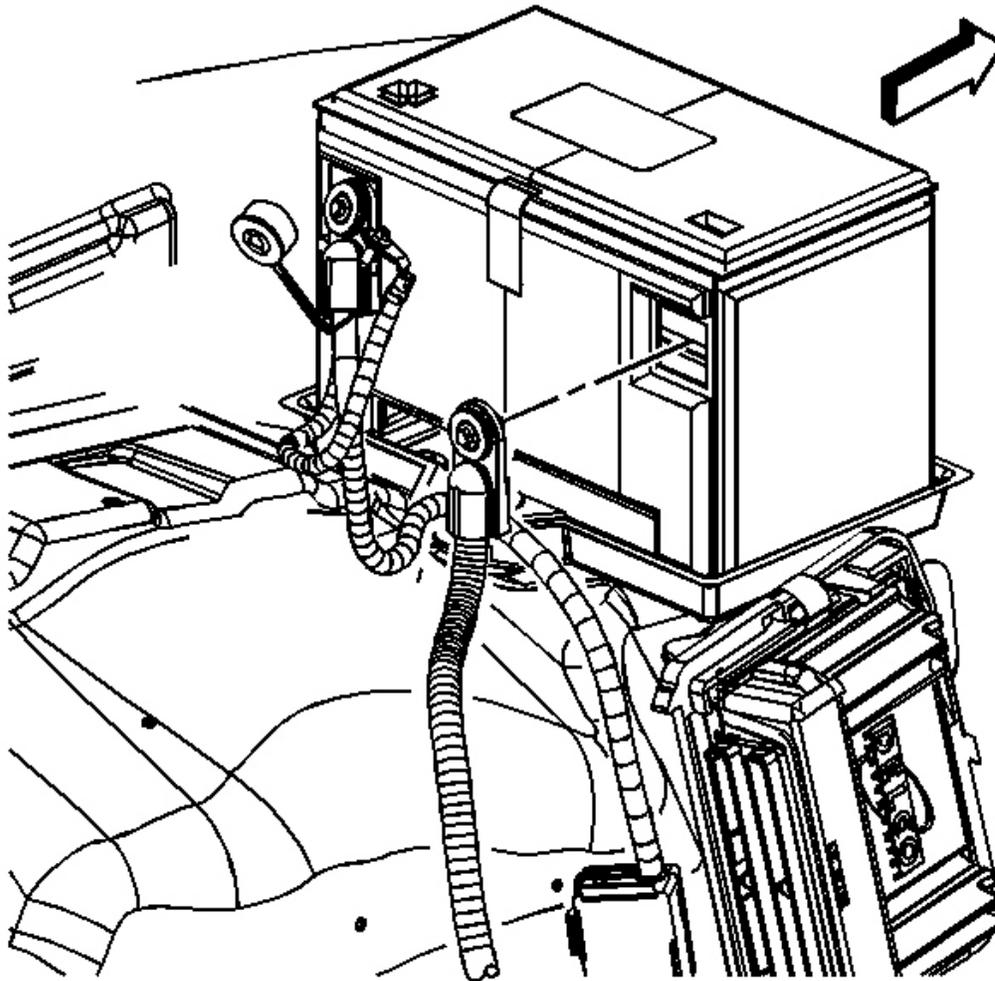


Fig. 54: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

GENERATOR BRACKET REPLACEMENT

Removal Procedure

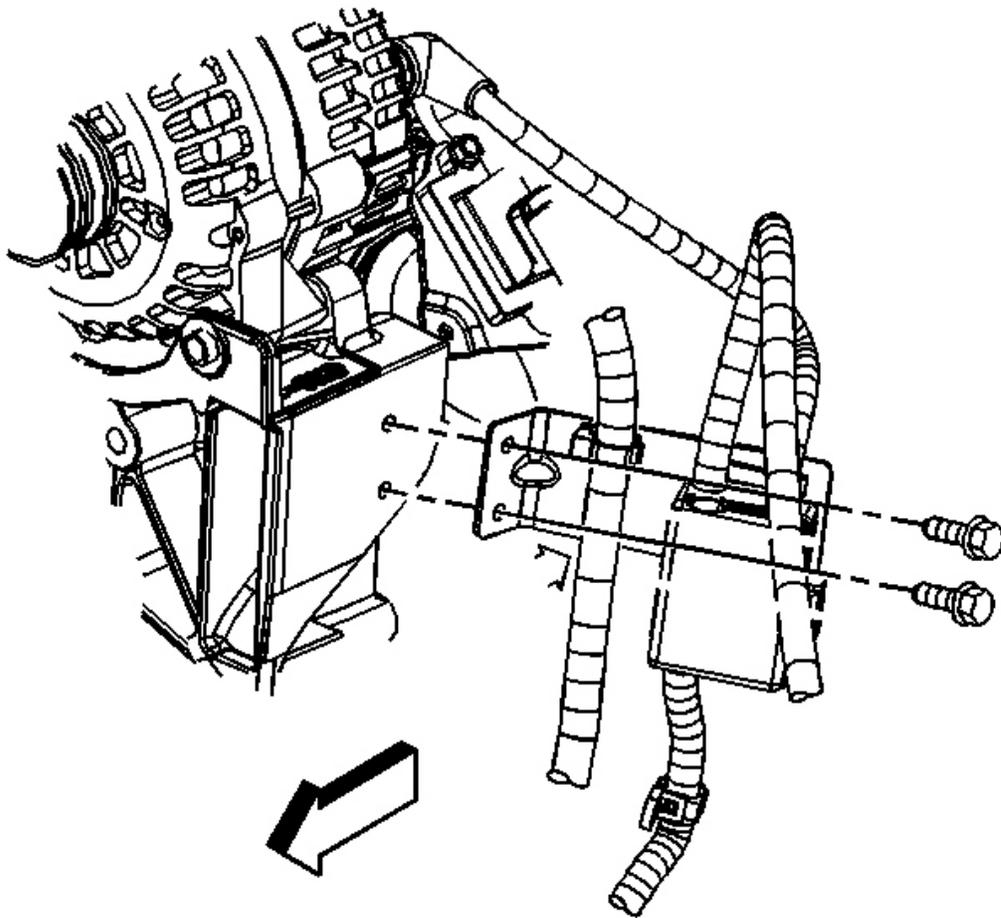


Fig. 55: Battery Cable Junction Block Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the battery cable junction block bracket bolts.

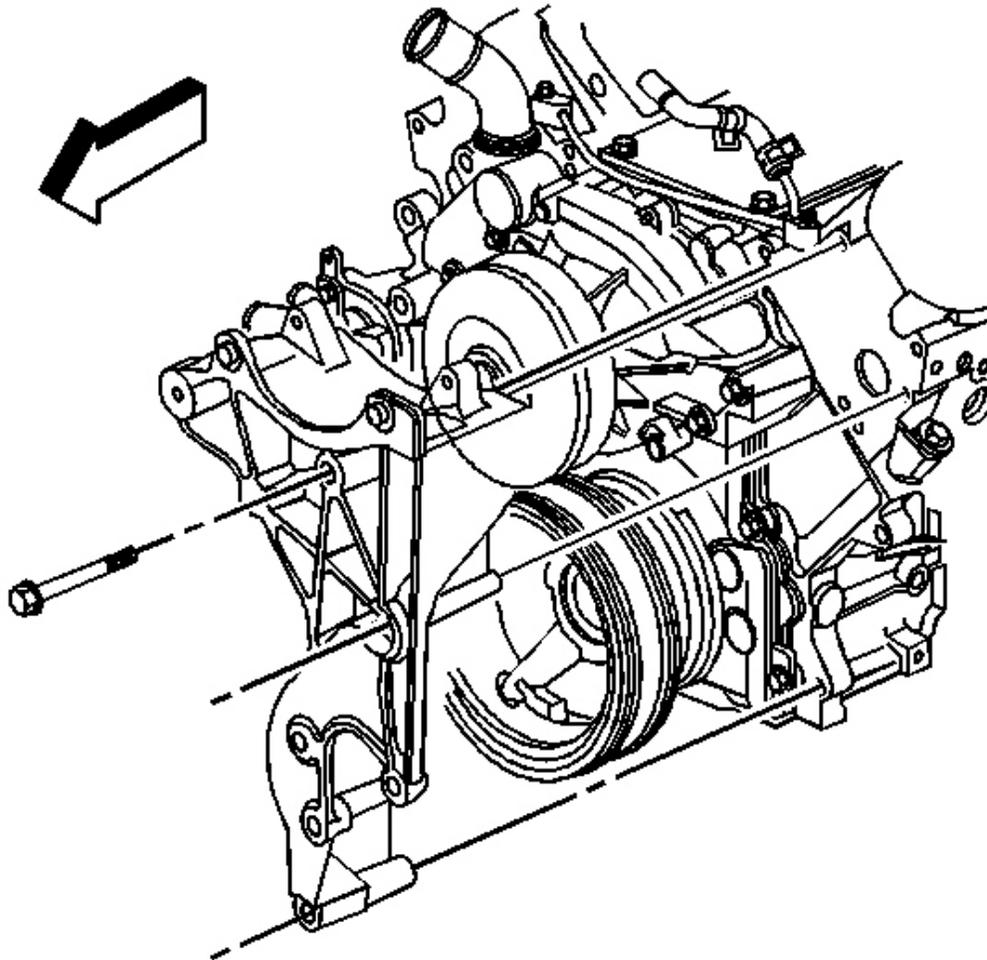


Fig. 56: Generator Bracket
Courtesy of GENERAL MOTORS CORP.

2. Remove the generator. Refer to **Generator Replacement** .
3. Remove the power steering pump. Refer to **Power Steering Pump Replacement** in Power Steering System.
4. Remove the generator bracket bolts.
5. Remove the generator bracket.

Installation Procedure

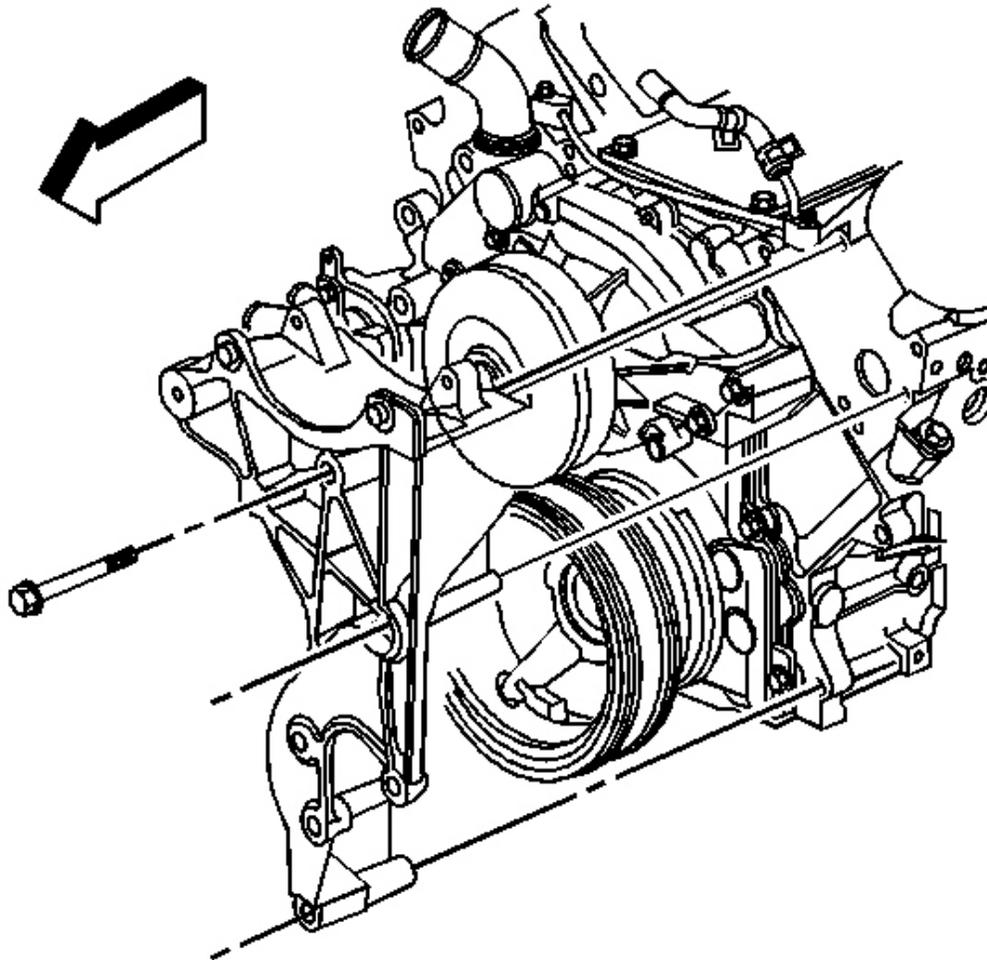


Fig. 57: Generator Bracket
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

3. Install the power steering pump. Refer to **Power Steering Pump Replacement** in Power Steering System.

4. Install the generator. Refer to Generator Replacement .

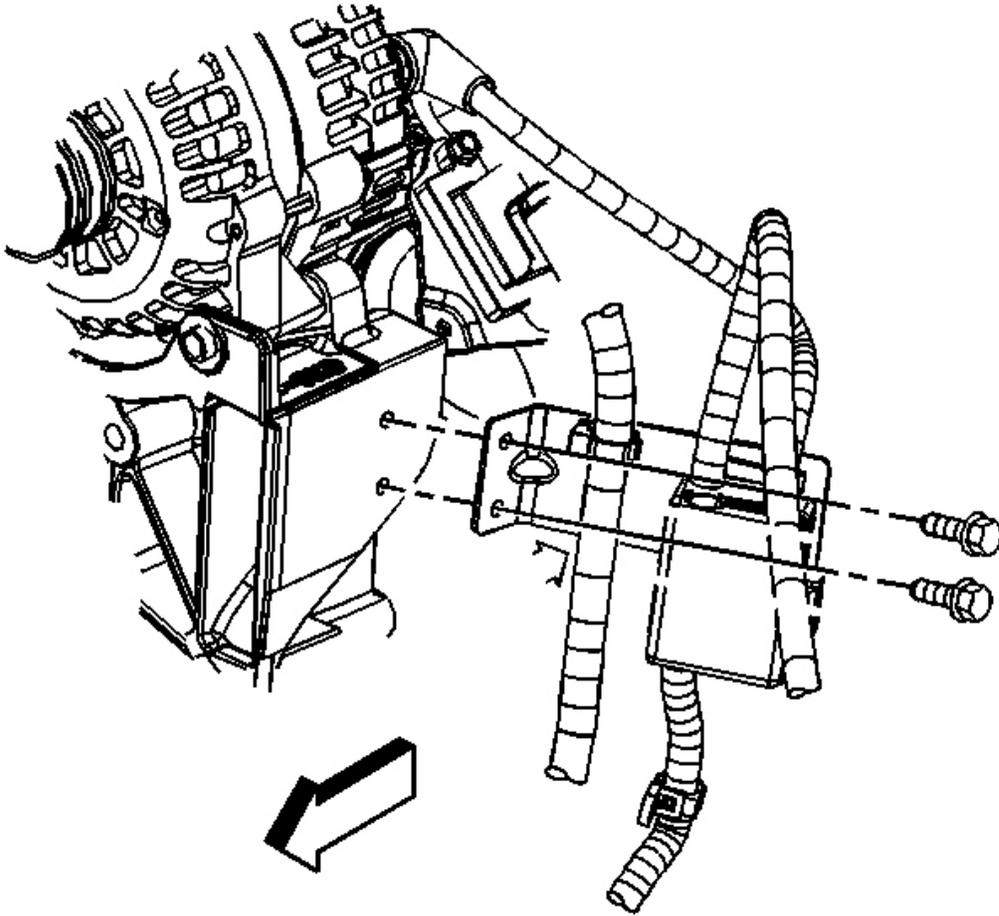


Fig. 58: Battery Cable Junction Block Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the battery cable junction block bracket bolts.

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

GENERATOR REPLACEMENT

Removal Procedure

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

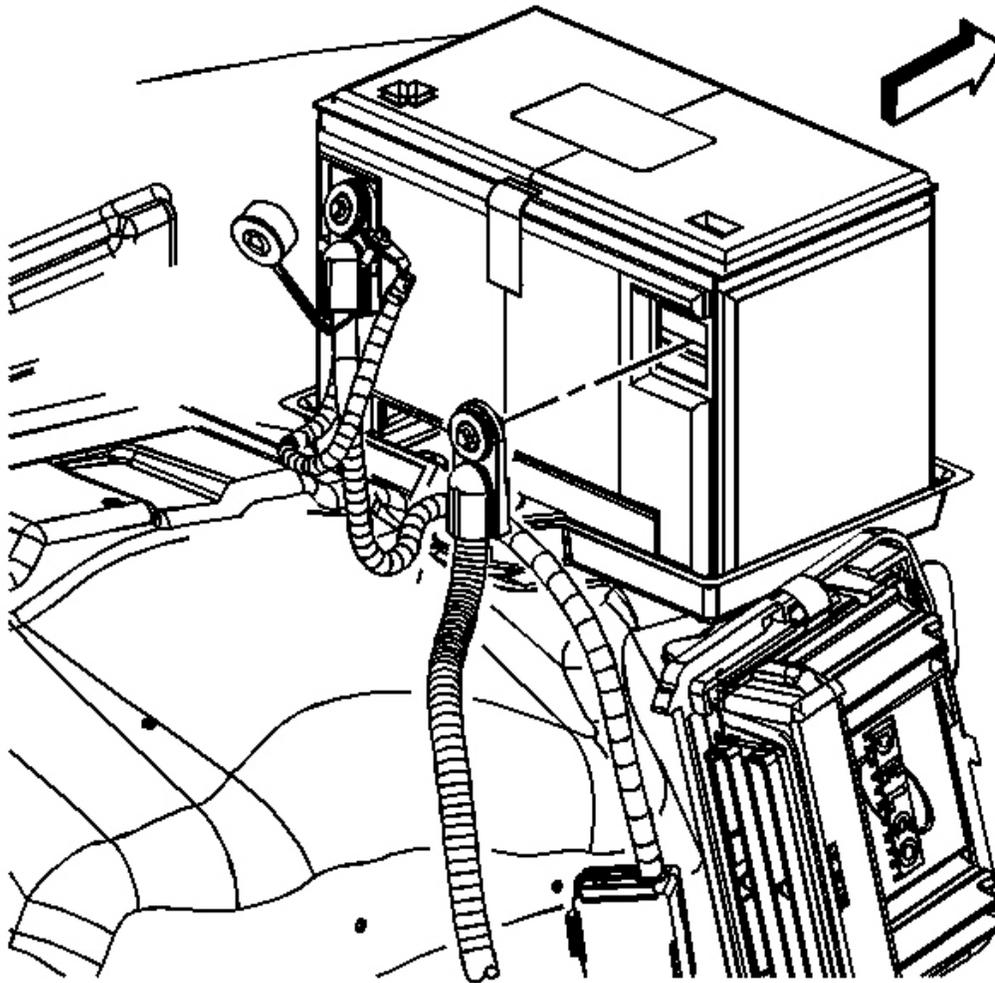


Fig. 59: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)**.
2. Remove the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** in Engine Mechanical - 6.0L (LQ4).
3. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement 6.0L (LQ4)** in Engine Mechanical - 6.0L (LQ4).

4. Disconnect the generator electrical connector.

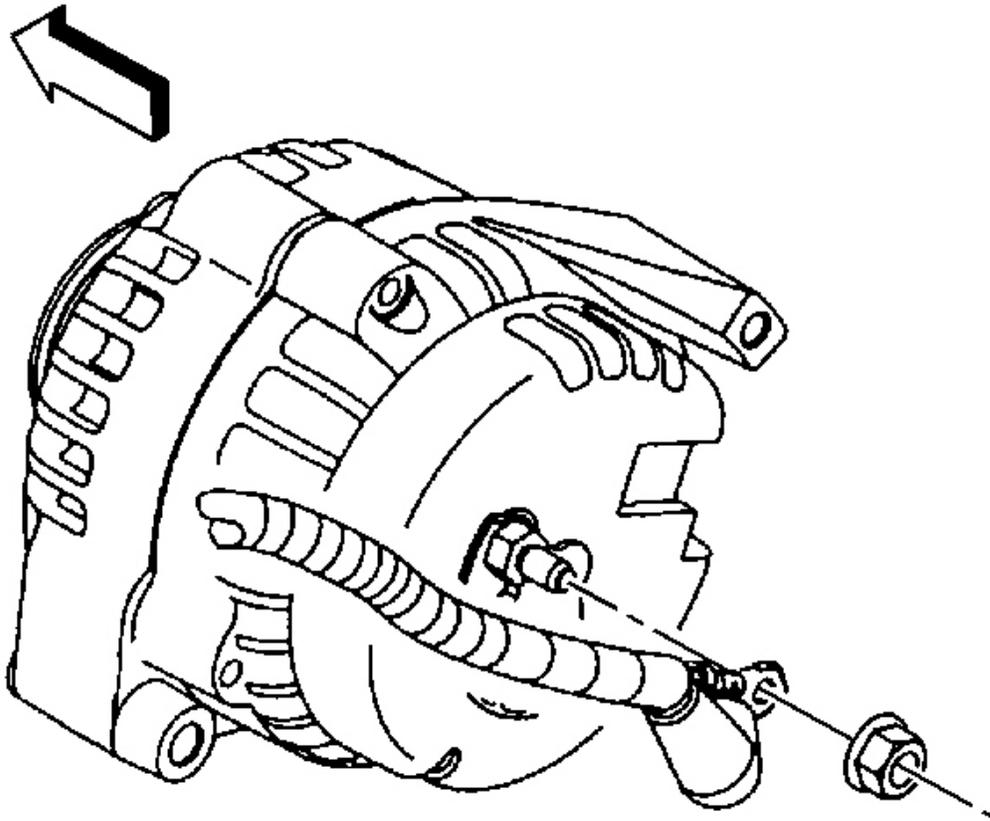


Fig. 60: View Of Generator Cable & Nut
Courtesy of GENERAL MOTORS CORP.

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

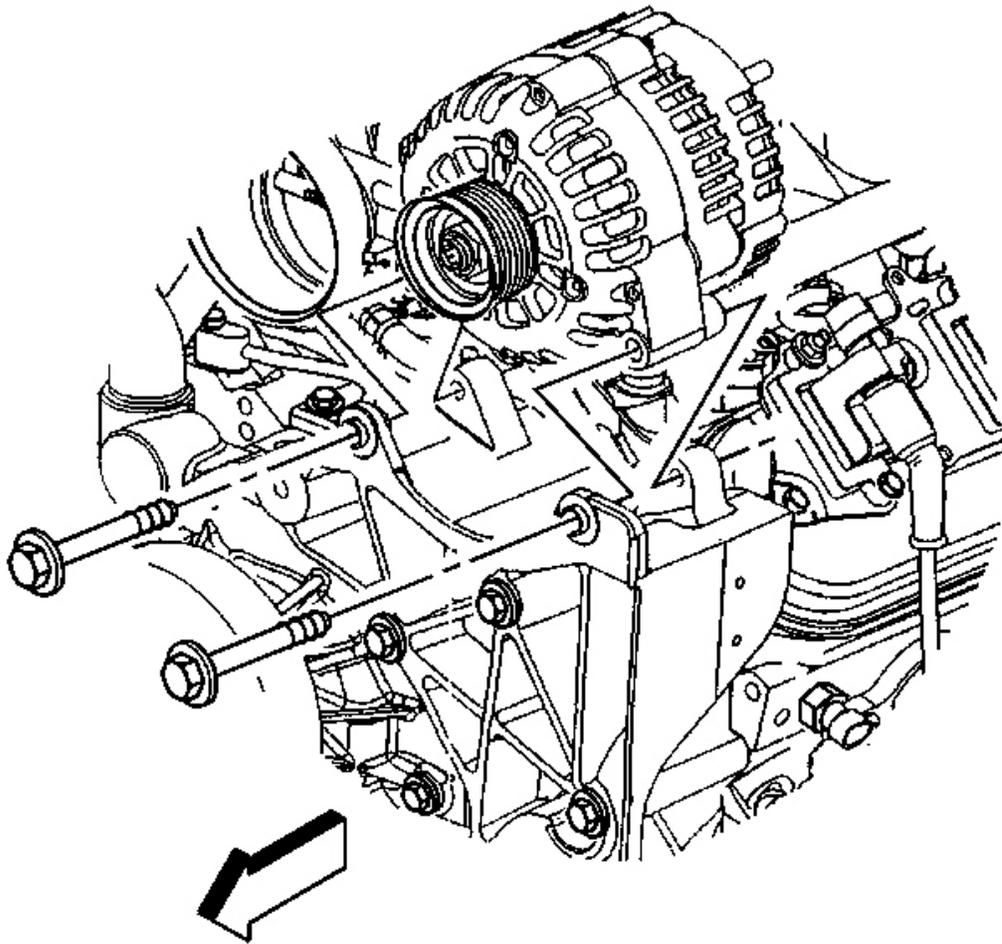


Fig. 61: Generator Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the generator bolts.
7. Remove the generator.

Installation Procedure

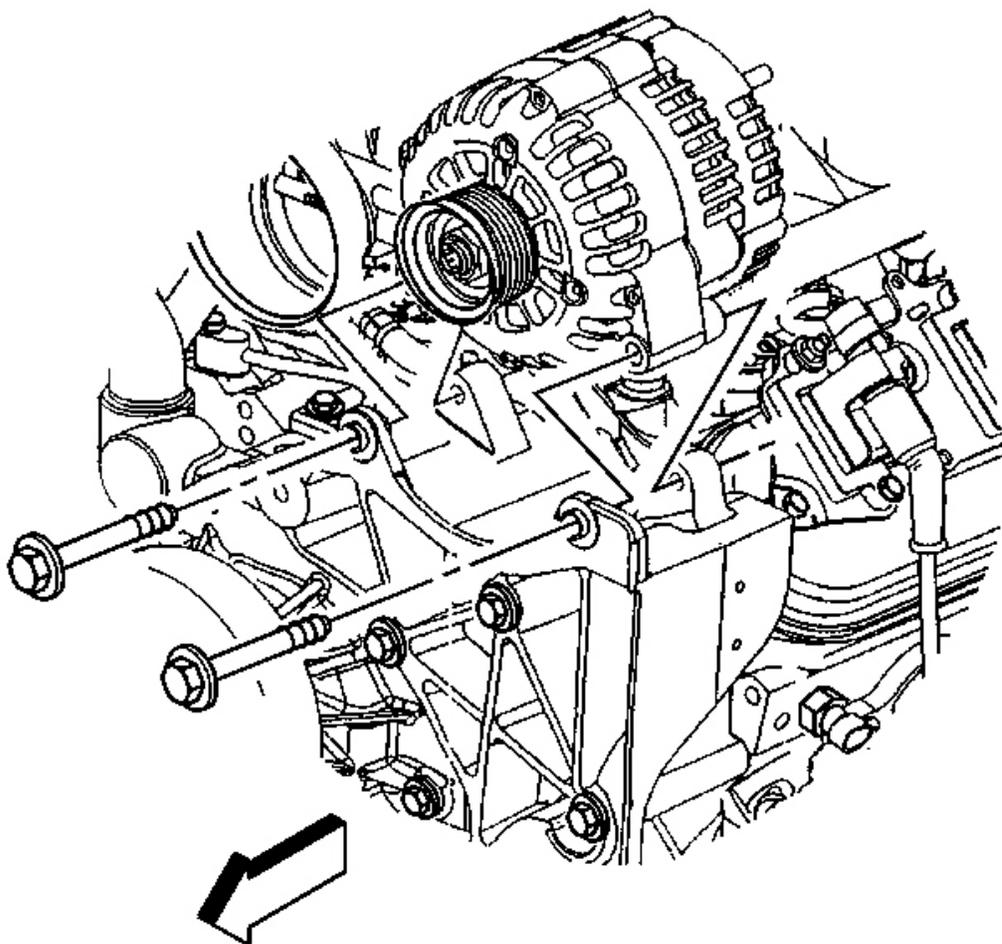


Fig. 62: Generator Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

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

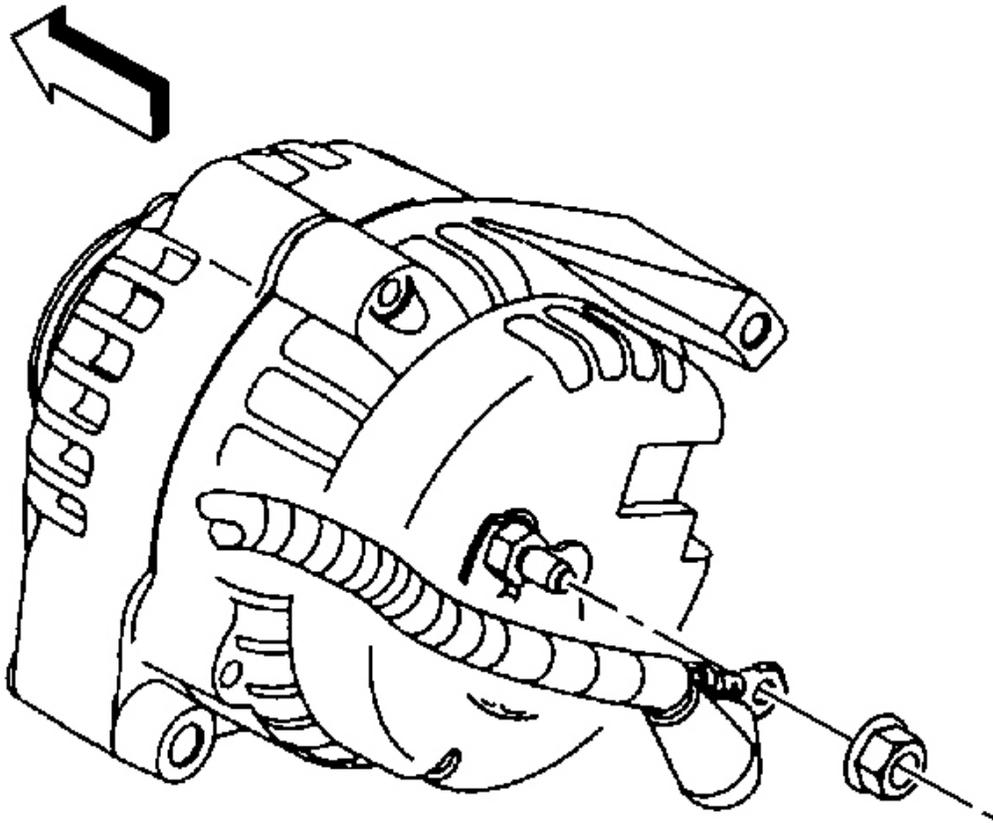


Fig. 63: View Of Generator Cable & Nut
Courtesy of GENERAL MOTORS CORP.

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

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

3. Slide the boot over the terminal stud.

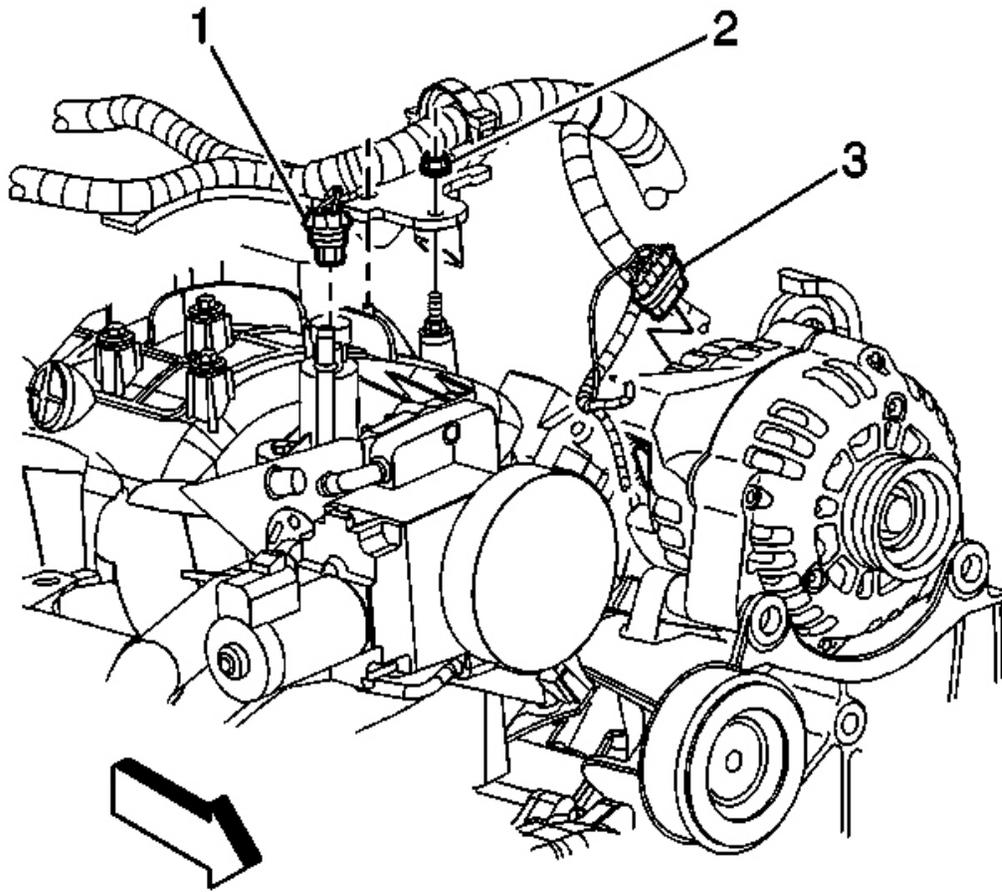


Fig. 64: Generator Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the generator electrical connector (3).
5. Install the engine sight shield. Refer to **Engine Sight Shield Replacement 6.0L (LQ4)** in Engine Mechanical - 6.0L (LQ4).
6. Install the accessory drive belt. Refer to **Drive Belt Replacement - Accessory** in Engine Mechanical - 6.0L (LQ4).

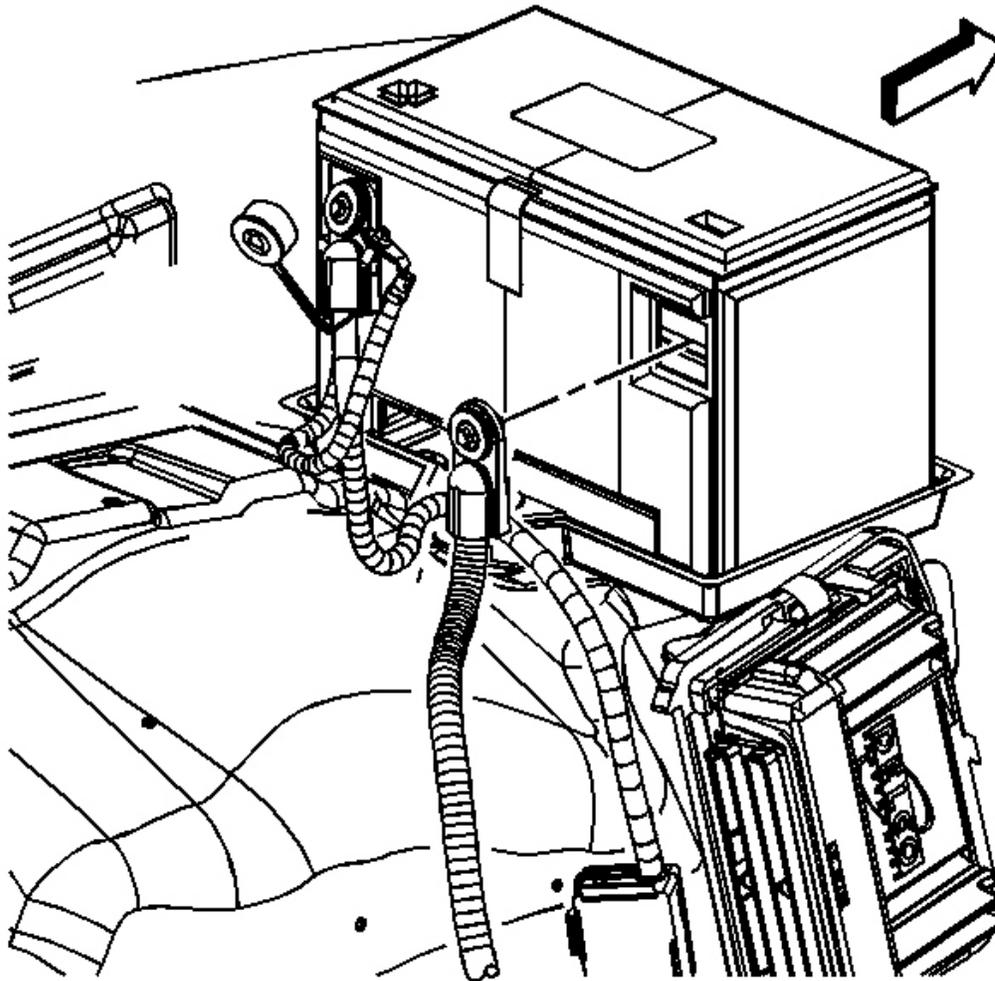


Fig. 65: Battery Ground Negative Cable & Bolt
Courtesy of GENERAL MOTORS CORP.

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

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

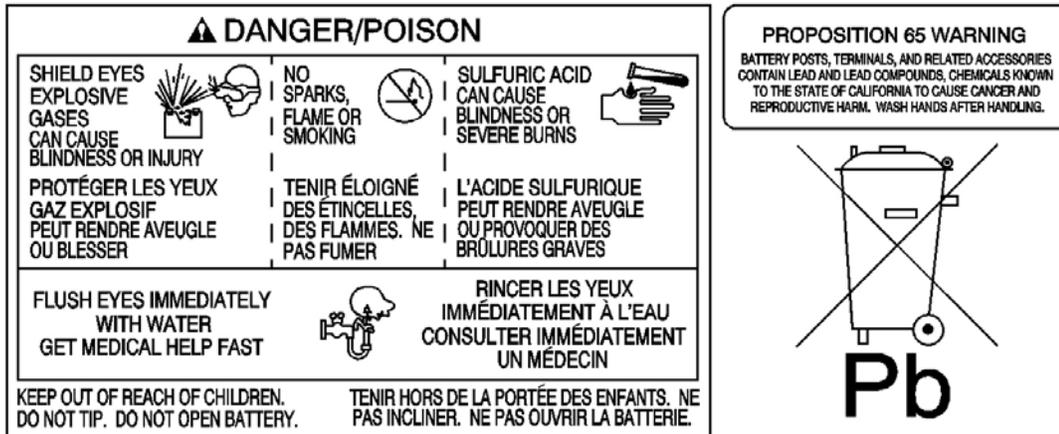


Fig. 66: View Of Battery Danger Label
 Courtesy of GENERAL MOTORS CORP.

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

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

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

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

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

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

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

CATALOG NO.

1819

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100 – 6YR	

Fig. 67: Battery Specification Label
Courtesy of GENERAL MOTORS CORP.

Battery Ratings

A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

Reserve Capacity

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

Cold Cranking Amperage

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

CHARGING SYSTEM DESCRIPTION AND OPERATION

Generator

The AD-244 generator is non-repairable. They are electrically similar to earlier models. The generators feature the following major components:

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

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

The AD stands for Air-cooled Dual internal fan; the 2 is an electrical design designator; the 30/44 denotes the outside diameter of the stator laminations in millimeters, over 100 millimeters. The generators is rated at 145 amperes.

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

Regulator

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

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

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

be 90 percent and the off-time 10 percent.

Charging System Indicator

The IPC illuminates the charge indicator in the message center when the following occurs:

- The PCM detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the PCM requesting illumination.
- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts. The IPC receives a class 2 message from the body control module (BCM) indicating the system voltage.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.
- The ignition is on, with the engine off.

STARTING SYSTEM DESCRIPTION AND OPERATION

The PG-260L is a non-repairable starter motor. It has pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. At the same time, the plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

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

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

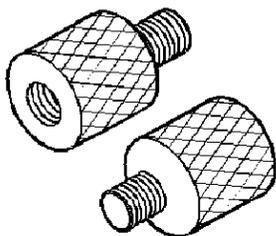
The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, cause the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter motor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

SPECIAL TOOLS AND EQUIPMENT

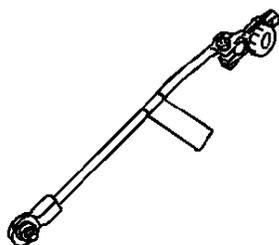
SPECIAL TOOLS

Special Tools

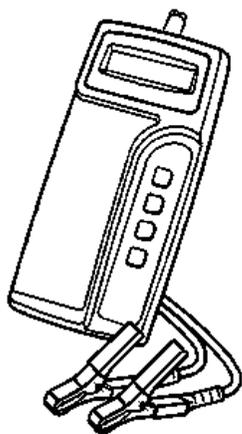
Illustration	Tool Number/Description



GM P/N 12303040
Battery Side Terminal Adapters

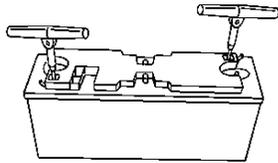
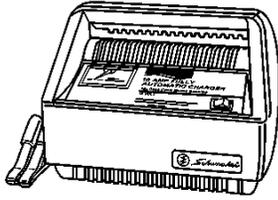


J 38758
Parasitic Draw Test Switch

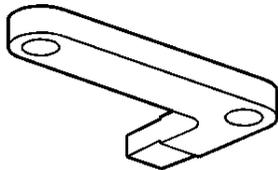


J 42000
Battery Tester

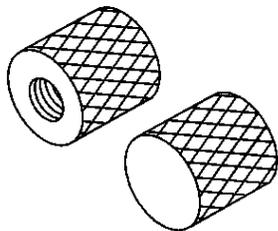
J 42634
Battery Module Charger (HP2)



J 43679
Panasonic Battery Removal Tool (HP2)



J 46093
Rotor and Flexplate Holding Tool (HP2)



Panasonic Battery Test Terminals (HP2)