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Hybrid Truck



Introduction

In 2004, the hybrid truck option became available on the Chevrolet Silverado and GMC Sierra. This option, offered on both two-wheel and four-wheel drive full size pickup trucks, results in improved fuel economy and reduced carbon dioxide emissions as compared to other GM pickup trucks.

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Silverado/Sierra Hybrid Truck Features

The Chevrolet Silverado and GMC Sierra hybrid trucks utilize a standard production V8 gasoline engine for 2004, but they incorporate several new sub-systems:

- Electro-hydraulic power assist
- Automatic engine stop-start:
 - Improved fuel economy
 - 42 volt battery pack
- 2.4 kilowatt portable generator
- 120 volt A/C (VAC) electrical outlets



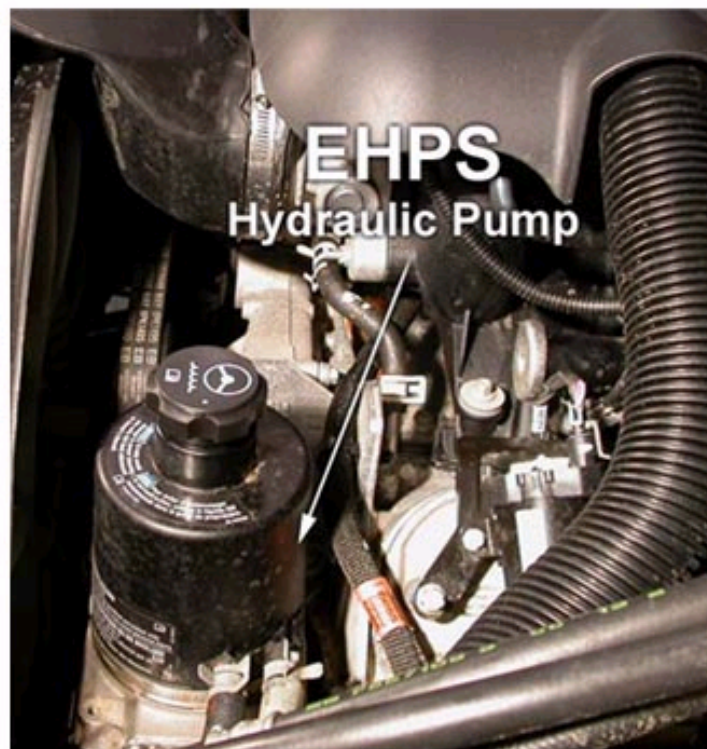
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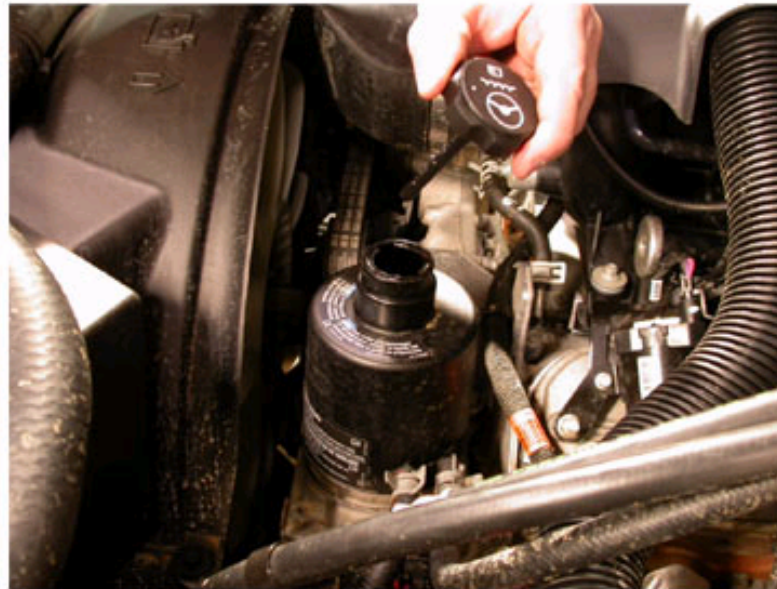
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Electro-Hydraulic Power Steering (EHPS) and Brake Assist

The standard power steering pump has been replaced by a 42 volt electro-hydraulic power steering pump that generates hydraulic pressure for steering and brake assist.



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Electro-Hydraulic Power Steering (EHPS) and Power Assist (Continued)

The hydraulic system utilizes a mineral based oil manufactured by Pentosin, which has been used in other vehicles for a number of years.

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Automatic Engine Start-Stop

This feature improves fuel economy and reduces vehicle carbon dioxide emissions by shutting the engine off:

- During coasting, when the vehicle is traveling below 15 mph
- During braking
- While in Drive with the vehicle stopped
- While in Park

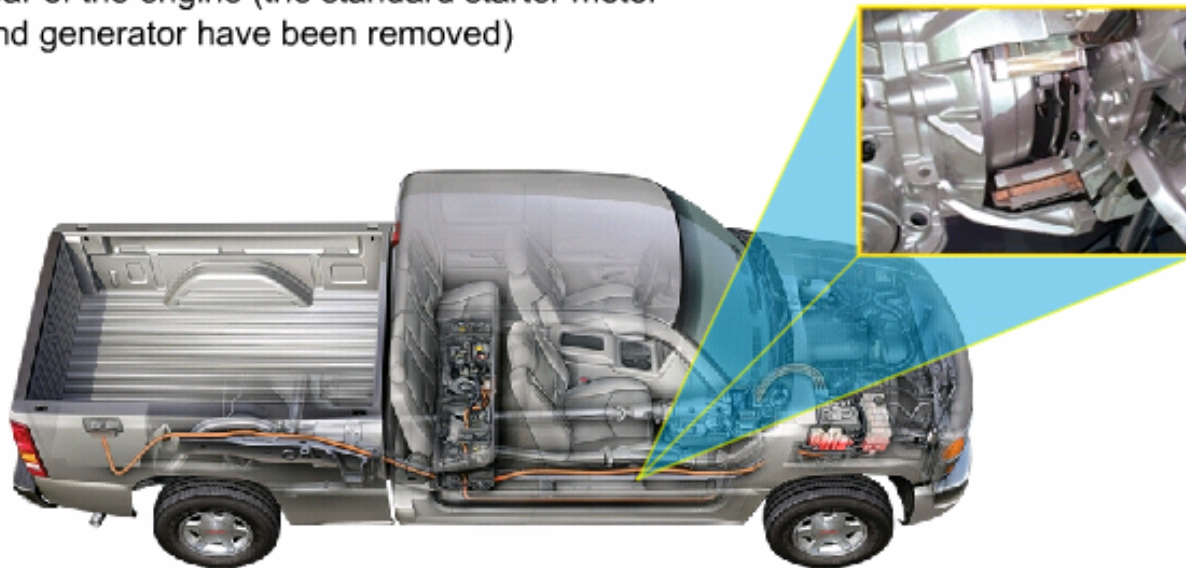


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Starter/Generator (SG)

- Electric machine that functions as a starter and a generator
- Generates electricity
- Located inside transmission bell housing at the rear of the engine (the standard starter motor and generator have been removed)



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120 VAC Auxiliary Power Outlet (APO) Button – The main control of the 120 volt system is located to the right of the heating, vent and air conditioning controls in the center of the instrument panel.

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120 VAC Auxiliary Power Outlet (APO) Button (Continued)

- Press button to turn auxiliary power outlets ON; press it again to turn them OFF
- Indicator light illuminates when 120 VAC APO system is activated



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120 VAC Auxiliary Power Outlet (APO) Operation



Two modes of APO operation:

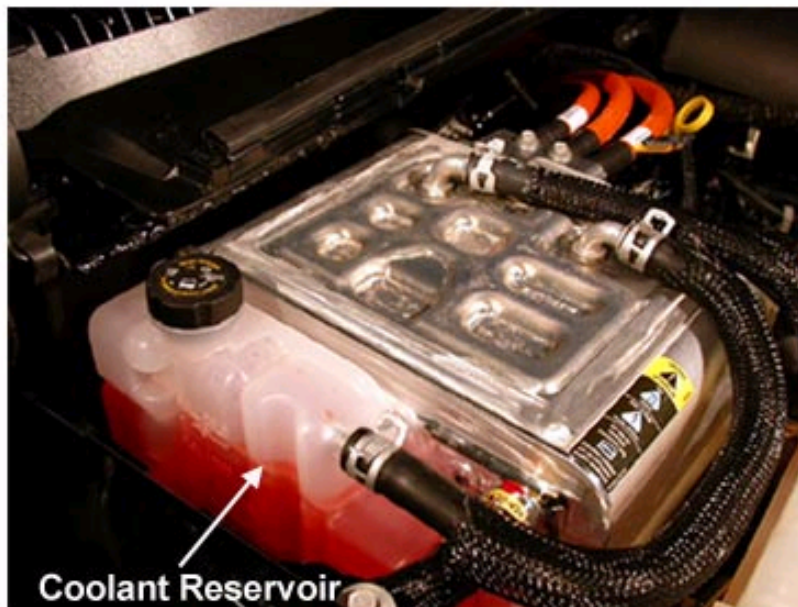
- Normal operation: generates 120 volts A/C while the vehicle is being driven down the road
- Continuous mode: generates 120 volts A/C while the vehicle is parked with the ignition locked;

- Ignition key can be removed from the vehicle



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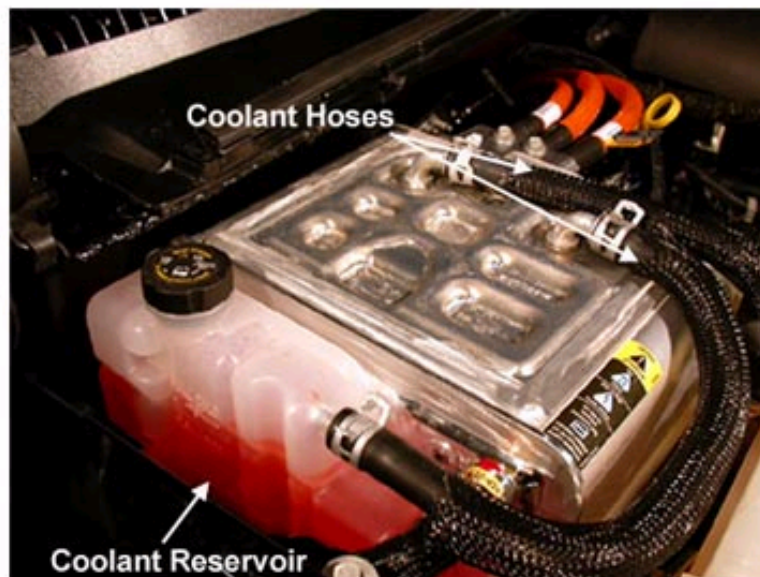


Starter/Generator Control Module (SGCM) and Cooling System

- Contains an independent cooling system
- Uses Dex-Cool coolant, the same as that used in the engine and mixed in the same ratio (50/50)

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Independent Cooling System for SGCM

- Use the same safety procedures as when working with engine coolant
- Use caution if disconnecting or cutting hoses, as the system may:
 - Be under pressure (approximately 5 psi)
 - Coolant may be hot

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**CAUTION!**

To avoid being burned, do not remove the starter/generator control module (SGCM) cap while the SGCM is hot. The cooling system will release scalding fluid and steam under pressure if the SGCM cap is removed while the SGCM is still hot.

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Starter/Generator Control Module (SGCM) Electrical System Connections

- Located on the passenger side of the engine compartment
- Inverts 42-volt electrical power to 120 volts A/C
- Note the location of the 120 volt circuit; circuit wires are contained within a protective orange covering



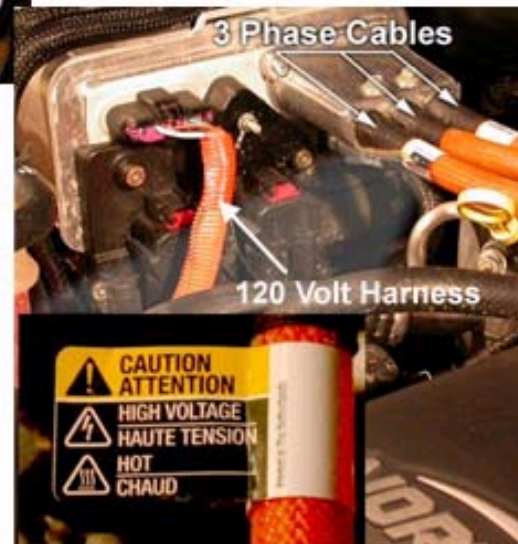
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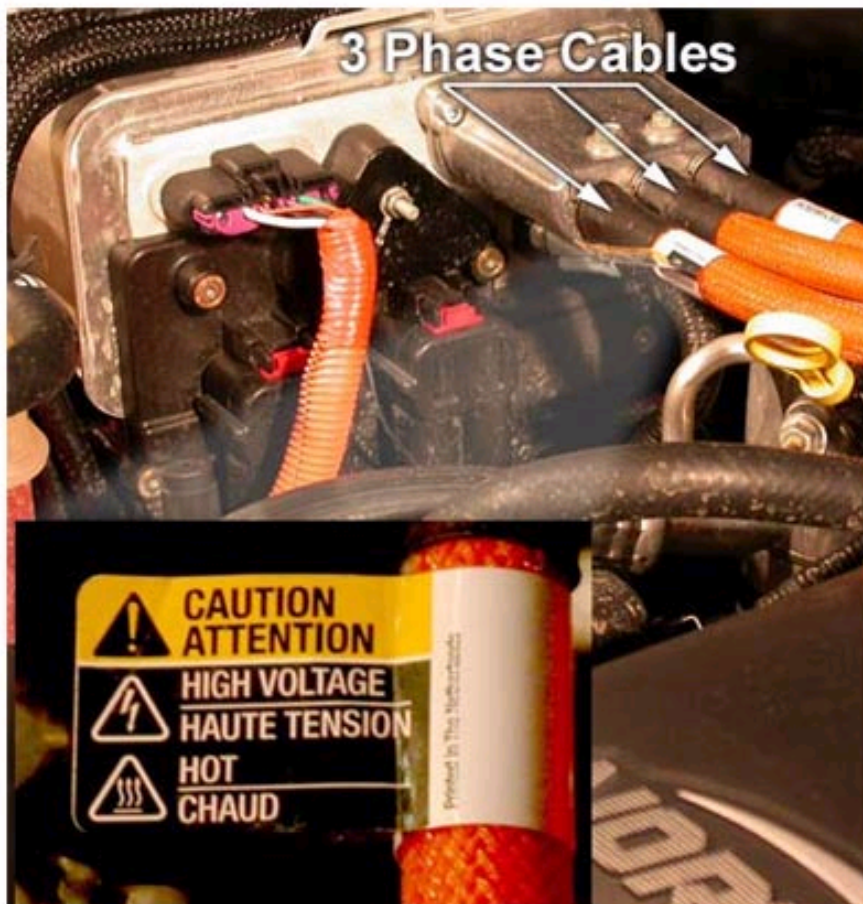
Starter/Generator Control Module (SGCM) Electrical System Connections (Continued)

- 3 phase cables from the starter/generator carry up to 50 volts A/C



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3 Phase Cables

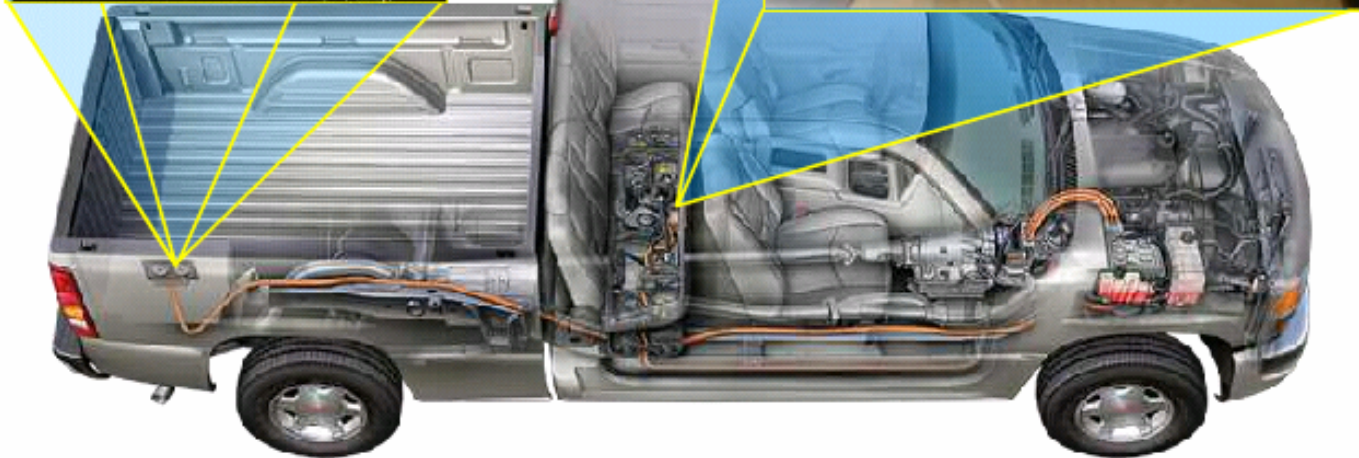
Caution: To reduce the risk of severe shock and burns, always treat the 3 phase cable and connectors as if the voltage is present.

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120 Volt Alternating Current (VAC) Outlet Locations

- Near the floor under the center of the rear passenger seat
- At the rear of the pickup box on the passenger side



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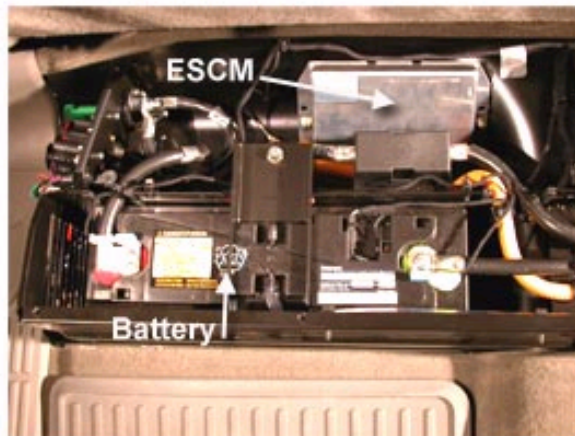


Energy Storage Box (ESB)

- Located under the rear passenger seat
- A manually operated battery disconnect switch is located on the passenger side of the ESB behind an access panel

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Energy Storage Box (ESB) (Continued)

- A trim cover is secured with push-pin rivets
- Contains 42-volt battery pack (three 12-volt starved electrolyte AGM batteries wired in series)
 - AGM technology utilizes a minimal amount of electrolyte. Should the integrity of a battery case be compromised, the amount of electrolyte that will exit the case is very small.
- The 42-volt batteries are enclosed in a metal box whose lid is secured with Torx bit bolts
- Contains the energy storage control module (ESCM):
 - Monitors the battery's state of charge
 - Alerts the driver on the instrument panel, if necessary
- The physical characteristics of the ESB have been engineered to meet crash worthiness tests and standards

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Disabling Procedures

Today, “rip and tear” techniques to gain entry are less effective and potentially dangerous. Access is often much easier than it appears. A more appropriate adage is “Try before you pry.”

Avoid cutting the vehicle until all of the electrical systems have been deactivated and isolated. Cutting into the areas of the vehicle prior to disconnecting and isolating the electrical energy sources may cause an electrical arc and/or personal injury.

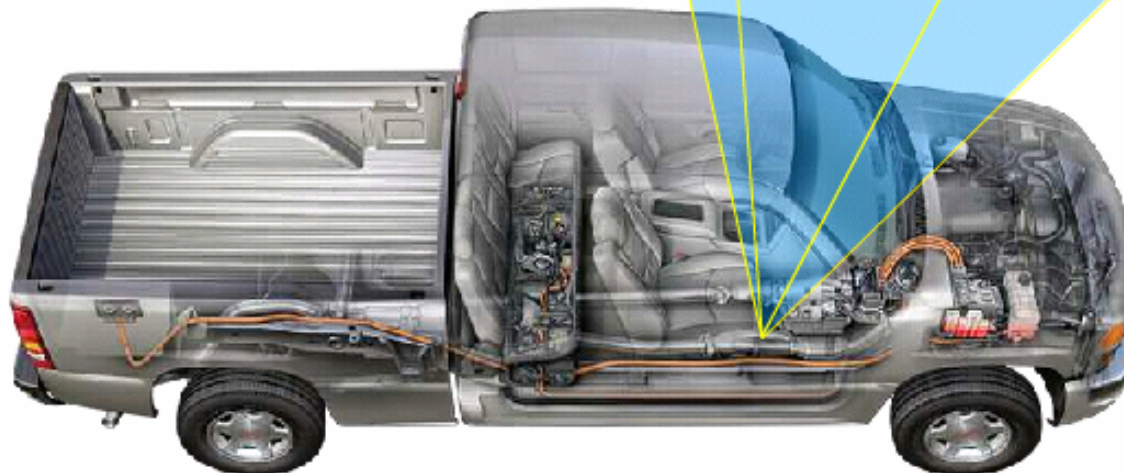
Response Guidelines

First Responders should recall their training and practice the same safety procedures and caution when approaching or working with the Silverado or Sierra Hybrid Truck during an emergency situation. Approach the scene slowly in order to fully develop a mental picture and check for hazards.

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Hybrid Vehicle Identification

The Chevrolet Silverado and GMC Sierra hybrid trucks have a small badge on the door to identify them as hybrid vehicles.



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Hybrid Vehicle Identification (Continued)

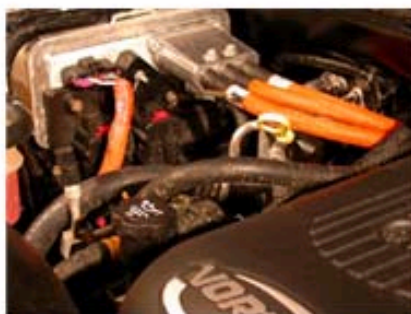
In the event that you are not able to readily identify the hybrid vehicle badge or caution labels, you will need to inspect any Silverado or Sierra to determine if it is a hybrid truck. Ask yourself:



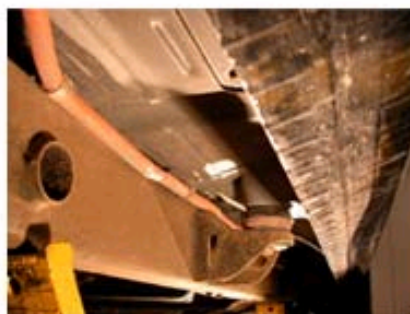
Are there 120-volt outlets visible in the bed of the truck?



Is the APO switch visible on the instrument panel?



Is the vehicle equipped with an SGCM and 3 phase cables?



Is the 120-volt harness visible on the bottom of the vehicle? **NOTE: Orange loom used only by high voltage systems.**

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Stabilize the scene by addressing the hazards. Secure the vehicle prior to vehicle entry. Ensure that: the transmission is in Park or Neutral, the parking brake is applied, the ignition is off, the key is removed, and the wheels are chocked (blocked) in some way so that there is no other means by which the vehicle can become mobile.

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Neutralizing the 120 VAC Outlets

- If the 120 VAC APO indicator is ON, depress the APO button momentarily
- Turn off the engine
- Remove the key



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42-Volt System:

To neutralize the batteries in the ESB, use the service disconnect switch (SDS) located behind a marked removable cover on the right end of the ESB. No tools are needed to remove the cover. **DO NOT** cut the battery cables, because the higher voltage system has a higher arc energy.



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Cautions

Be sure both the 12 volt and 42 volt sources are disconnected before beginning extrication and/or rescue procedures.

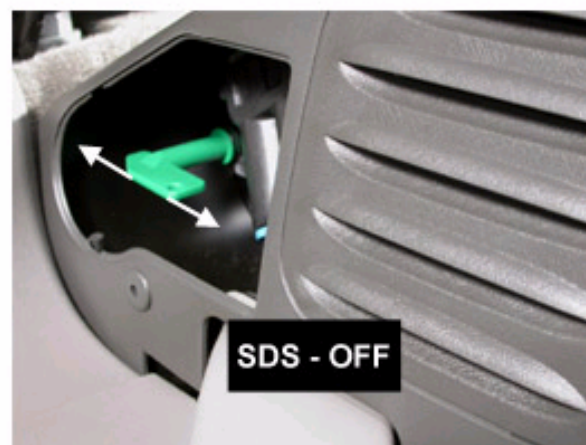
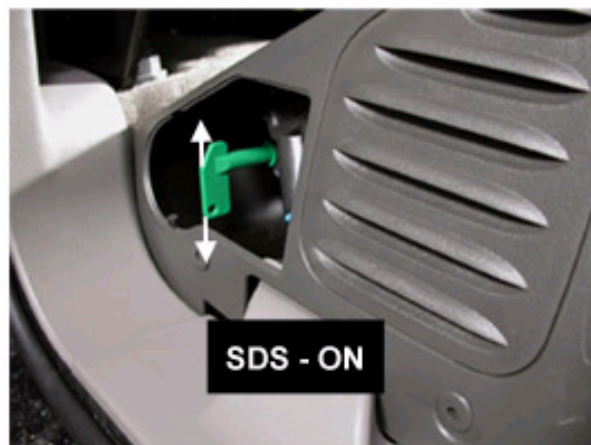
CAUTION

To reduce risk of personal injury from electrical shock, burns, and damage to any electrical components by always disconnecting 12 and 42 volt system batteries when performing service procedures under the vehicle hood, within or around energy storage box, and/or related to hybrid vehicle systems.



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Disconnects 42 volt battery from vehicle electrical system:

- Operated by turning key
- Switch ON = vertical
- Switch OFF = horizontal

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12 Volt System

Neutralizing (de-energizing) the supplemental impact restraint system (i.e., airbags) in a 12-volt vehicle requires *disconnecting* the negative battery cable before disconnecting the positive battery cable.

The 42 volt system must be disconnected to fully neutralize the supplemental impact restraint system.

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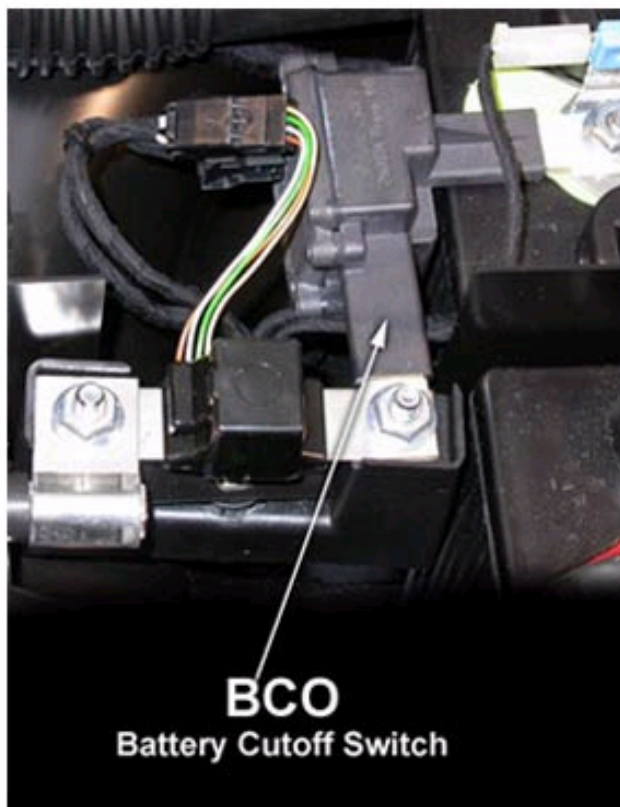
The Sierra/Silverado hybrid truck has safety systems designed to shut down and prevent vehicle operation should an unsafe situation occur. First responders should be aware of the following safety systems on the hybrid truck option:

- Automatic operation of the battery cut off switch for 42 volt system
- APO system:
 - High voltage interlock loop
 - Hood ajar switch
 - Door ajar switch
 - Ground fault detection circuit
- OnStar

The following screens will further explain the safety features.

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Battery Cut Off (BCO) Switch

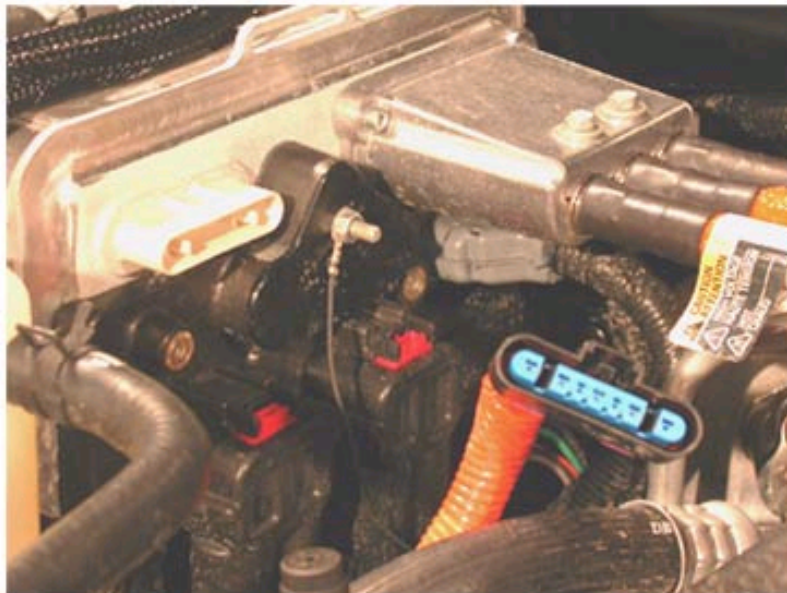
- Automatically triggered when:
 - An airbag is deployed from a frontal impact
 - An impact to the passenger door is detected
- Note that a passenger side impact will not deploy the front airbags

Side Impact Sensor

- Activates the battery cut-off switch to disable energy flow and terminate the operation of the SGCM, which will terminate the APO circuit
- Enables the detection of an impact to the passenger door
- Located in the passenger door due to the location of:
 - The SGCM power cables
 - A 120-volt wiring harness located in the body sill plate
 - The Service Disconnect Switch

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High Voltage Interlock Loop

- Provides a means for the SGCM to determine and monitor the integrity of the 120-volt wiring harness
- The interlock signal creates a continuous electrical loop starting from the SGCM, going through both power outlets, and ending back at the SGCM
- Should a 120-volt harness connector be disconnected, the SGCM:
 - Issues an auxiliary power outlet fault
 - Terminates electrical operation of the 120-volt circuit

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Hood Ajar
Switch

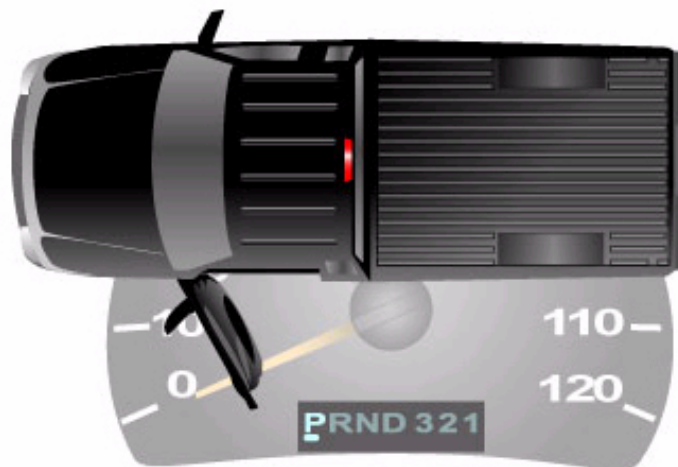
The hood ajar switch communicates whether the hood is open or closed. The engine cannot auto-start if the hood is either ajar or open. This ensures that the engine does not start unexpectedly when someone is servicing the vehicle. Note that the hood can be opened after the engine is running and the engine will remain running, as with other vehicles.

NOTE: if the engine is off, it can still be started by turning the ignition key to the crank position, just as you would do normally.

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Door Ajar Switch



If the vehicle is in the automatic engine start-stop mode and in Park with the engine off, the engine will start if either vehicle door is opened.

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Ground Fault Detection Circuit

- Contained within the SGCM
- Monitors current flowing between the Neutral and Hot wire
- When a circuit imbalance of more than several milliamps is detected:
 - Operation of the 120-volt auxiliary power outlet circuit is terminated
 - The APO indicator flashes





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OnStar

Either airbag deployment or a side impact will cause **OnStar** to send a signal to the OnStar Center