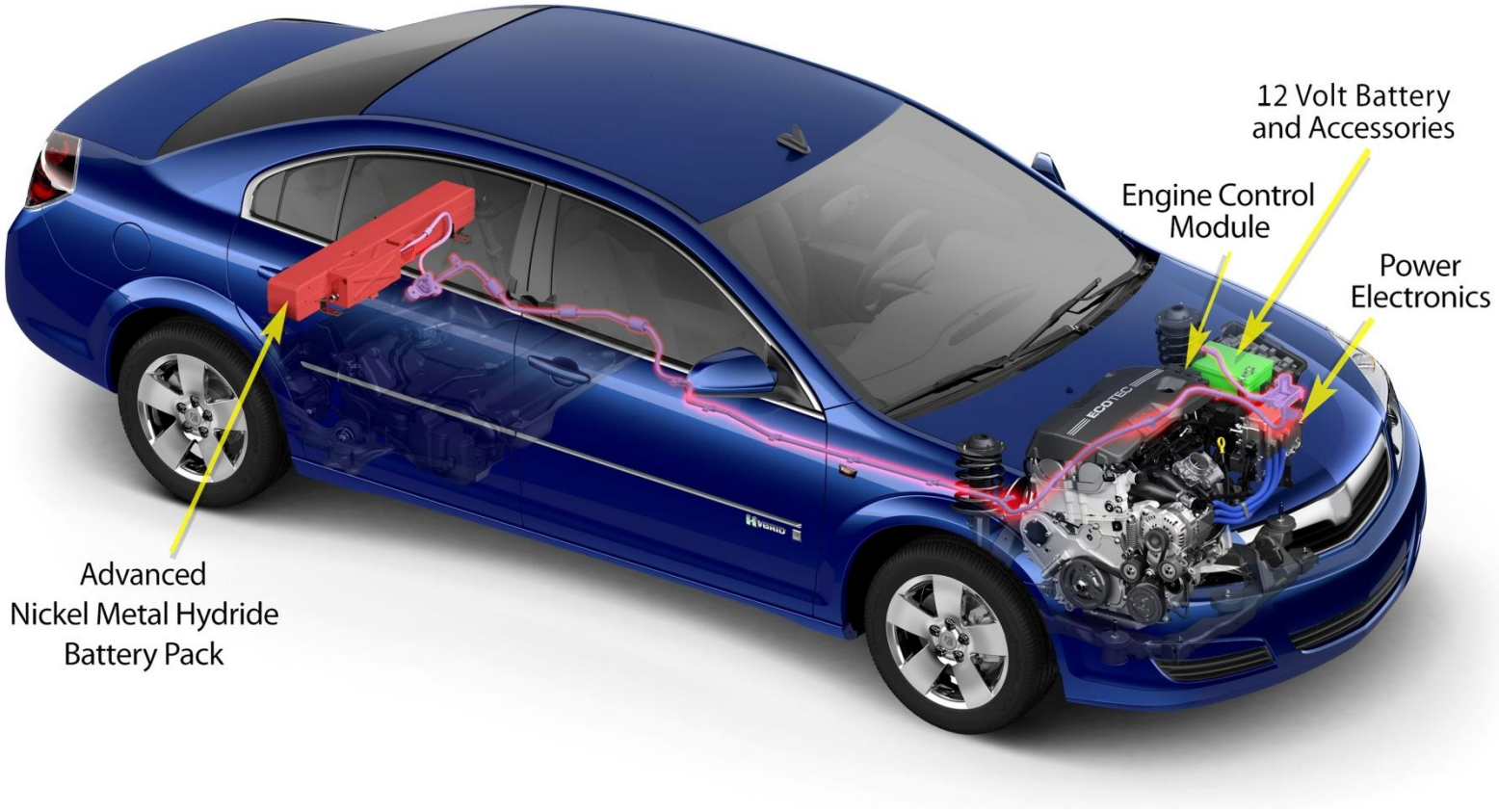
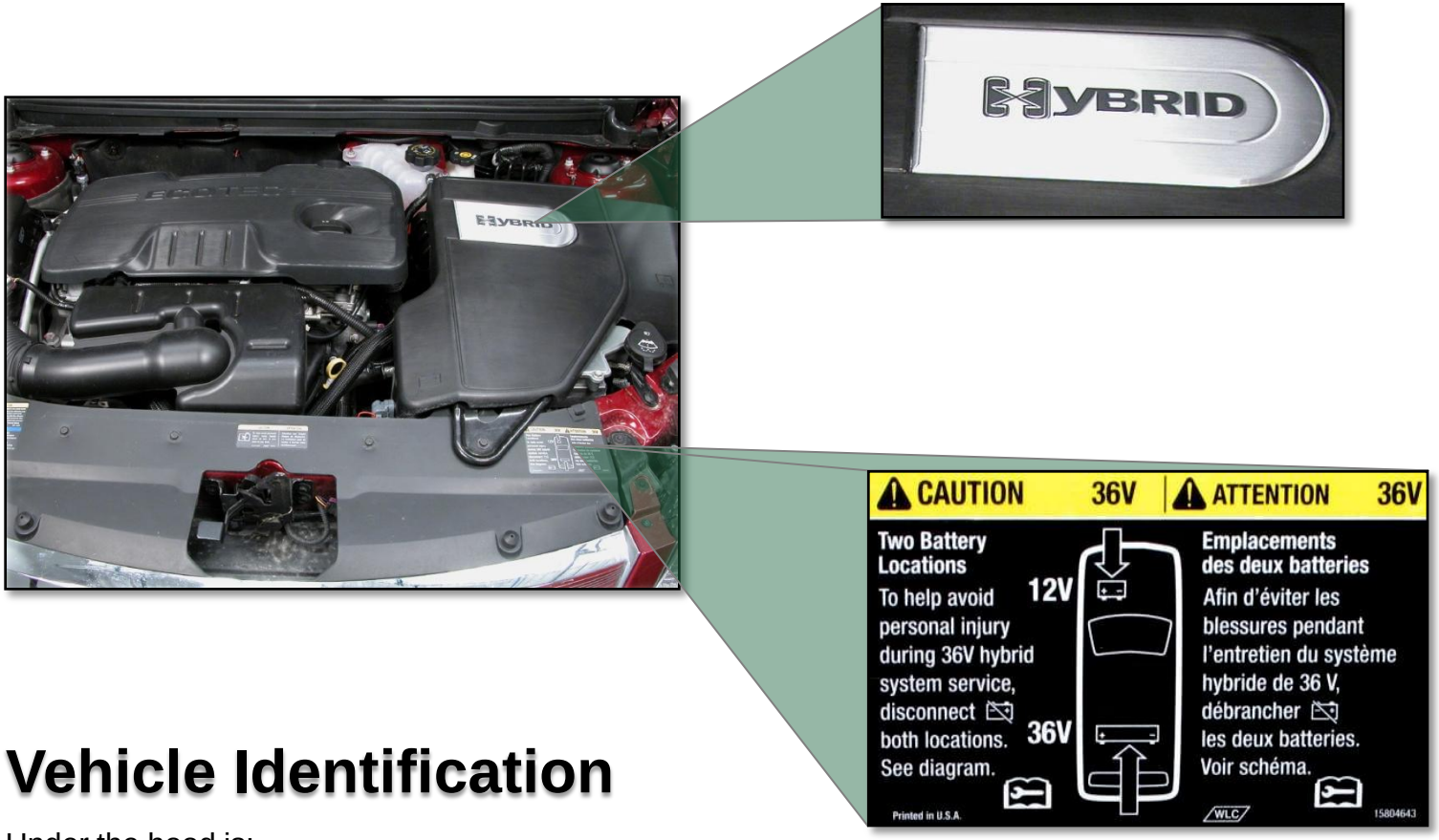
Hybrid Collision Awareness

Collision
Awareness
Guide

The intent of this guide is to provide the collision repair technician information to properly handle and repair GM's hybrid vehicles in the safest manner possible. This guide contains a general description of how the Hybrid vehicle systems operate. The guide also describes methods of disabling the high voltage system and identifies key Hybrid components and cut zone information.

GM Hybrid System





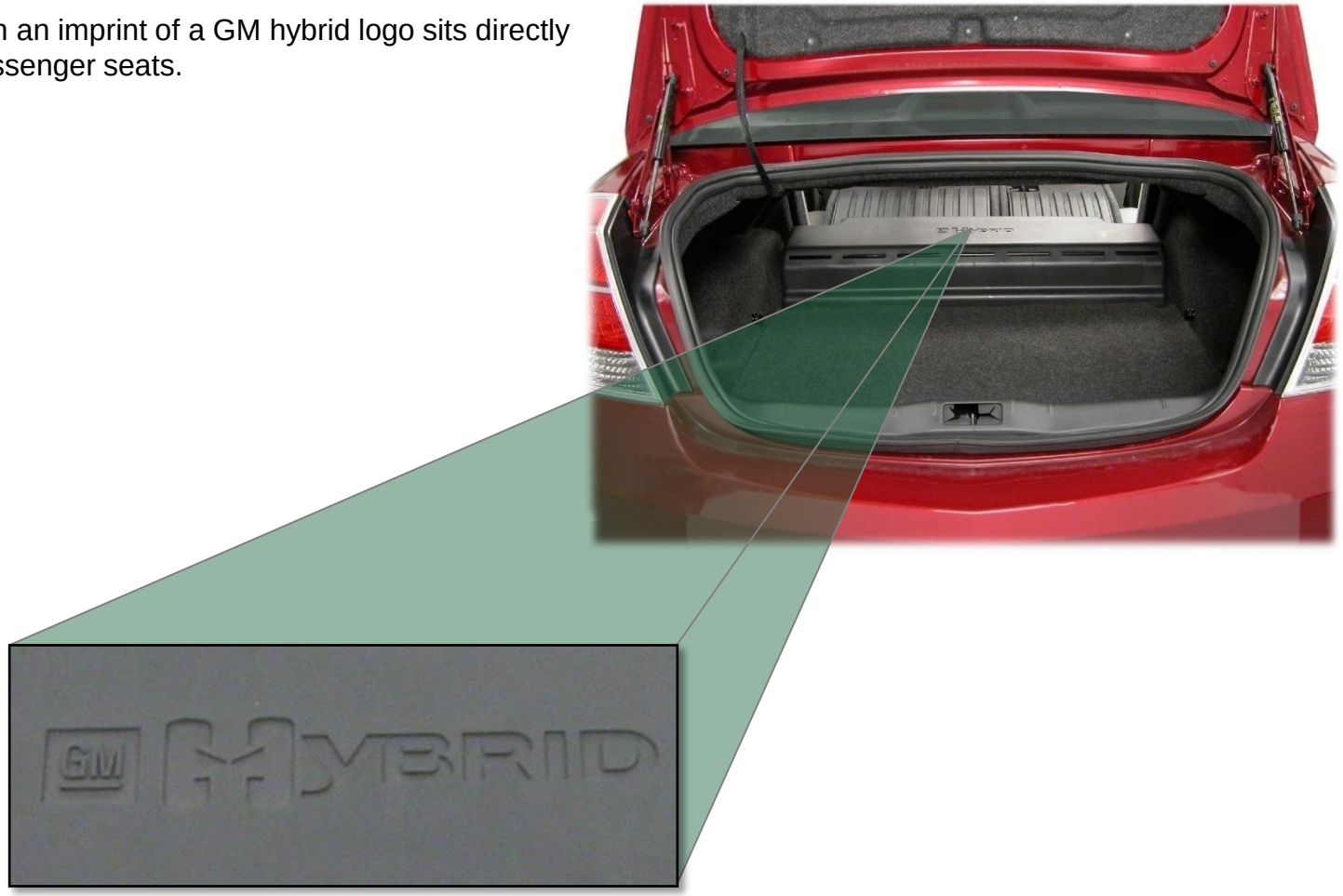
Vehicle Identification

Under the hood is:

- A hybrid badge attached to the 12 volt battery cover
- A label showing the battery locations (attached to the radiator core support)

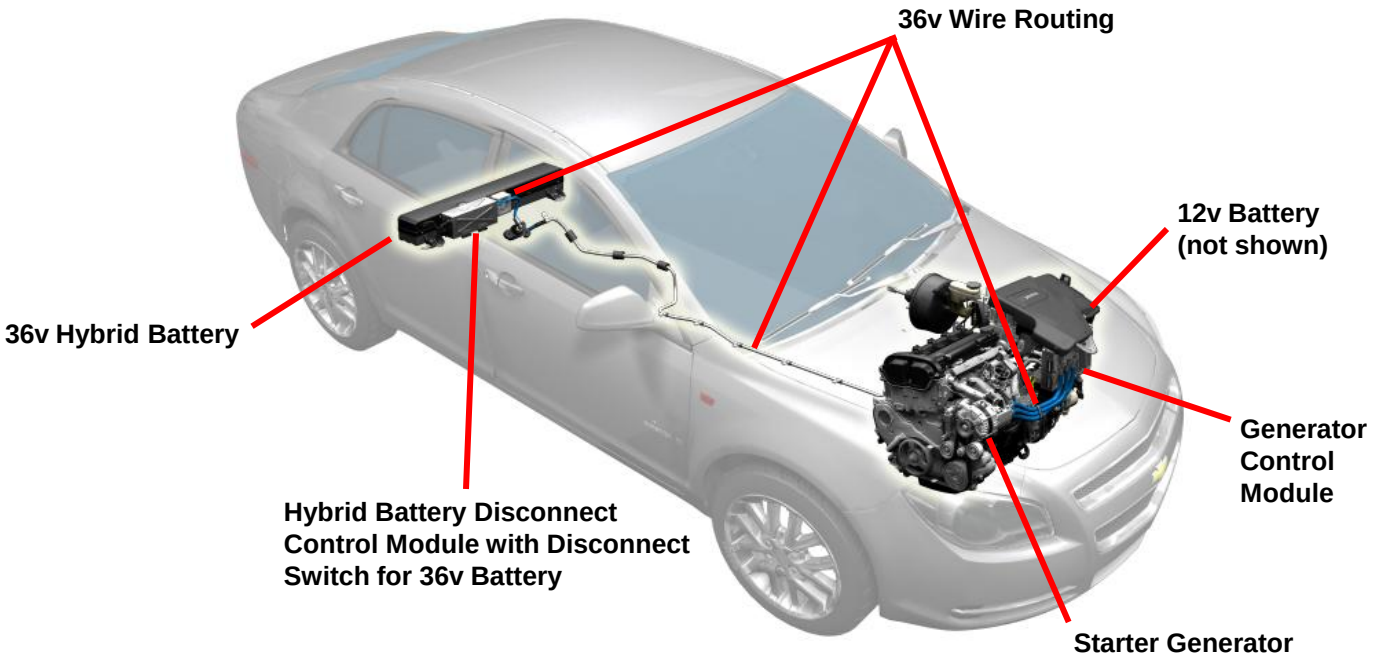
Vehicle Identification (cont.)

A battery cover with an imprint of a GM hybrid logo sits directly behind the rear passenger seats.



Key Hybrid Components

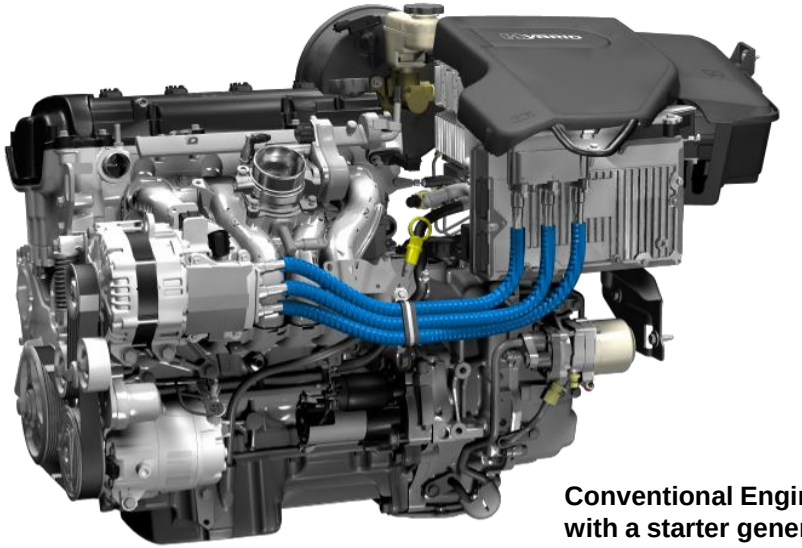
This illustration shows the location of the hybrid components.



Key Hybrid Components (cont.)

The Chevrolet Malibu and Saturn AURA Green Line Hybrid use a conventional internal combustion engine coupled with a starter generator to efficiently power the vehicle.

Note that all intermediate voltage cables used on the hybrid model are covered in blue sheathing for easy identification. The exception is when the hybrid battery cable is routed beneath the vehicle in a rigid, metal conduit tubing.



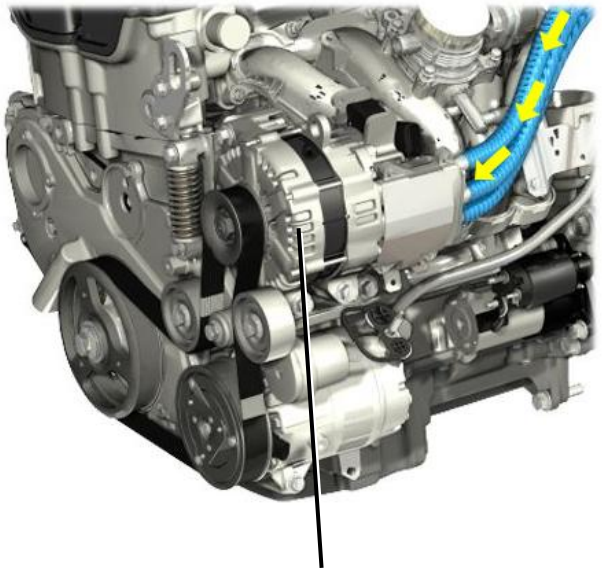
Conventional Engine with a starter generator

Key Hybrid Components (cont.)

A 3-phase starter generator, capable of generating more than 5000 Watts of electrical power, starts the engine when the vehicle is in the Auto Stop mode. The unit is mounted on the right side of the engine and replaces the standard generator used on non-hybrid models.

Intermediate voltage cables are routed through the back of the starter generator. The cables carry 36-42 volts of electricity.

Always use caution when you are near these cables until you are sure the hybrid electrical system is disabled!



Starter generator

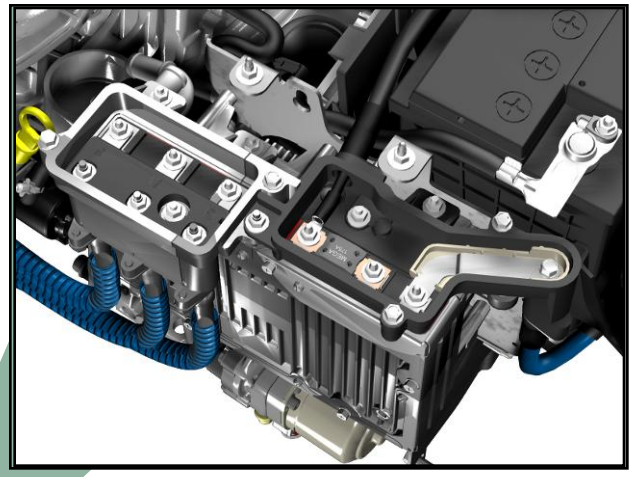
Key Hybrid Components (cont.)

The generator control module, which is mounted on the left side of the engine, manages the routing of the 36 volt electrical system.

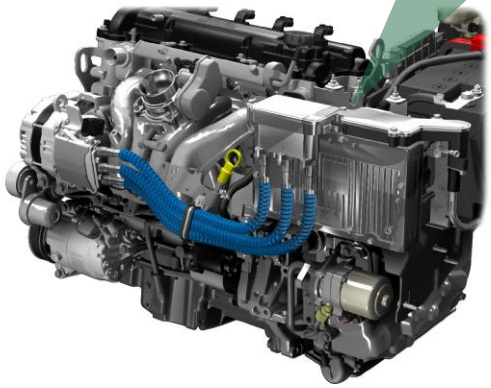
The generator control module receives the electrical current through two central terminal blocks that contain the 3-phase, 12 volt battery and 36 volt generator battery cables. These cables enter the blocks from the bottom and side. A protective plate covers the terminal blocks and cables.

Two coolant hoses, attached to the back of the module, connect the generator control module with the engine's cooling system. These hoses may contain hot coolant that could scald if they are disconnected or cut.

Note that blue wiring is used to indicate intermediate voltage.

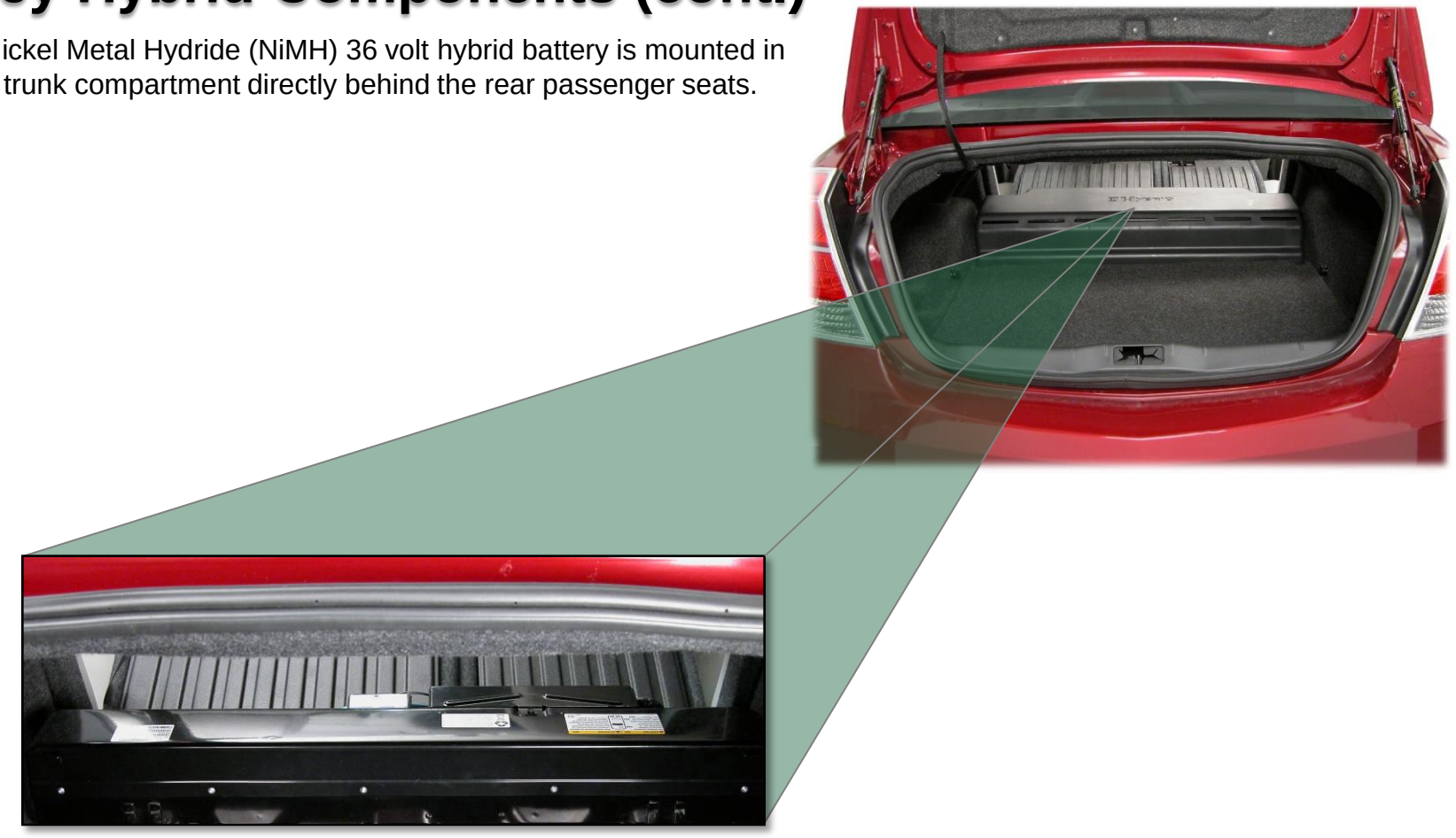


Cables from the starter generator, 12v battery and 36v battery enter the side and bottom of the generator control module (cover removed for clarity)



Key Hybrid Components (cont.)

A Nickel Metal Hydride (NiMH) 36 volt hybrid battery is mounted in the trunk compartment directly behind the rear passenger seats.



Battery cover removed for clarity

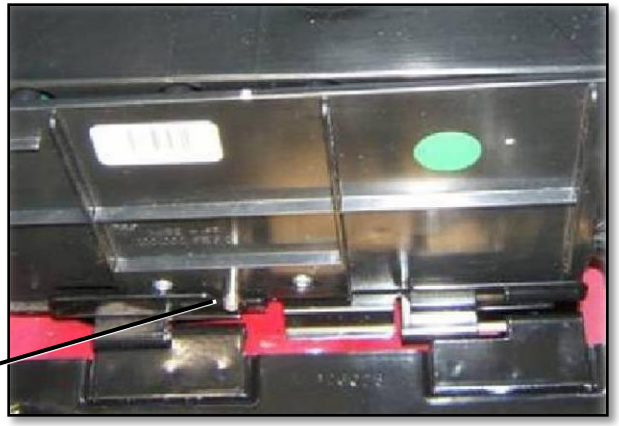
Key Hybrid Components (cont.)

A separate box, called the hybrid battery disconnect control module, is attached to the hybrid battery case.

Within the box are the negative and positive battery cables for the hybrid battery. Opening the hinged cover causes a spring-loaded disconnect switch to interrupt electrical flow from the hybrid battery and quickly discharge stored electrical energy in the generator control module.

A 10 mm hex head bolt secures the Hybrid Battery Disconnect Control Module

Hinges attached to the battery hold the cover in place

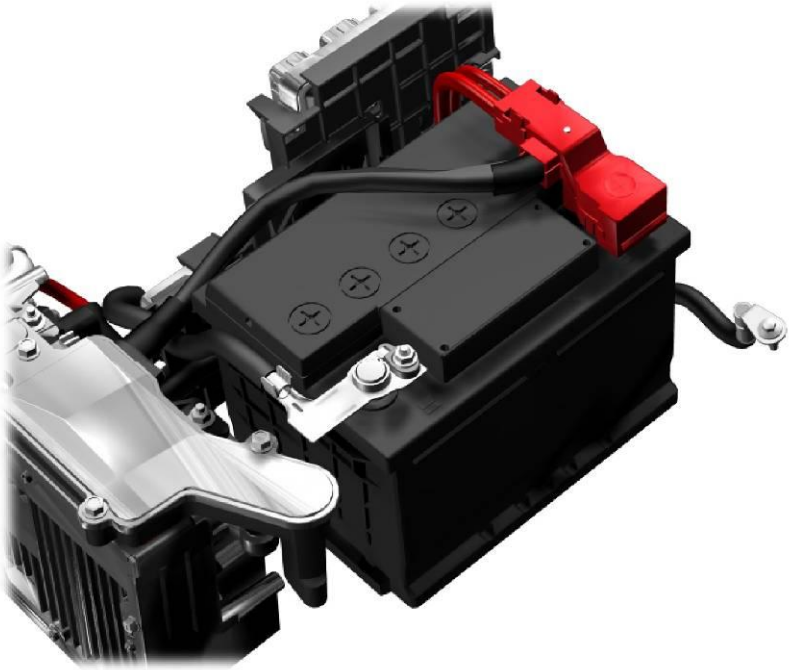


Disconnect Switch (shown with Hybrid Battery Disconnect Control Module cover open)

Key Hybrid Components (cont.)

A 12 volt battery provides power for the vehicle's accessories such as the radio, HVAC, and lighting. It is also used during the initial start-up of the vehicle.

Two negative (-) cables attach to the negative (-) battery terminal.



Disabling 12 Volt Power

Perform EACH of the following steps to disable the 12 volt electrical system. This includes power to the airbag system.

1. Turn the ignition key to the OFF position

   OR if the ignition key is not accessible, remove the run/ crank relay located in the underhood fuse block

2. Disconnect or cut BOTH 12v negative (-) battery cables
3. Verify tachometer needle is pointing to OFF

WAIT a minimum of **60 seconds** to allow any undeployed airbag reserve energy to dissipate.

WARNING: WAIT a minimum of 10 seconds to allow the undeployed airbag reserve energy to dissipate.

36 Volt Electrical System

Do NOT cut the intermediate voltage (36v) cable, because there is a higher arc potential.

First perform the “Disabling 12 Volt Power” procedure on the previous page to eliminate current flow on the 12 volt electrical system. This also reduces the 36 volt current flow to a low level in the intermediate voltage (36v) cable. No further action is required.

CAUTION: Cutting the intermediate voltage cable may result in an arc hazard.

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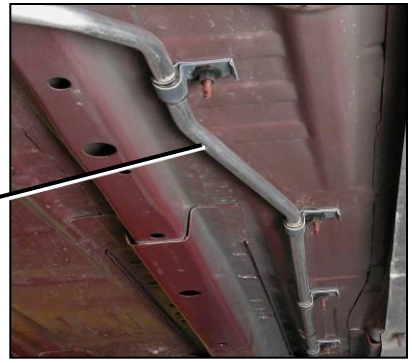


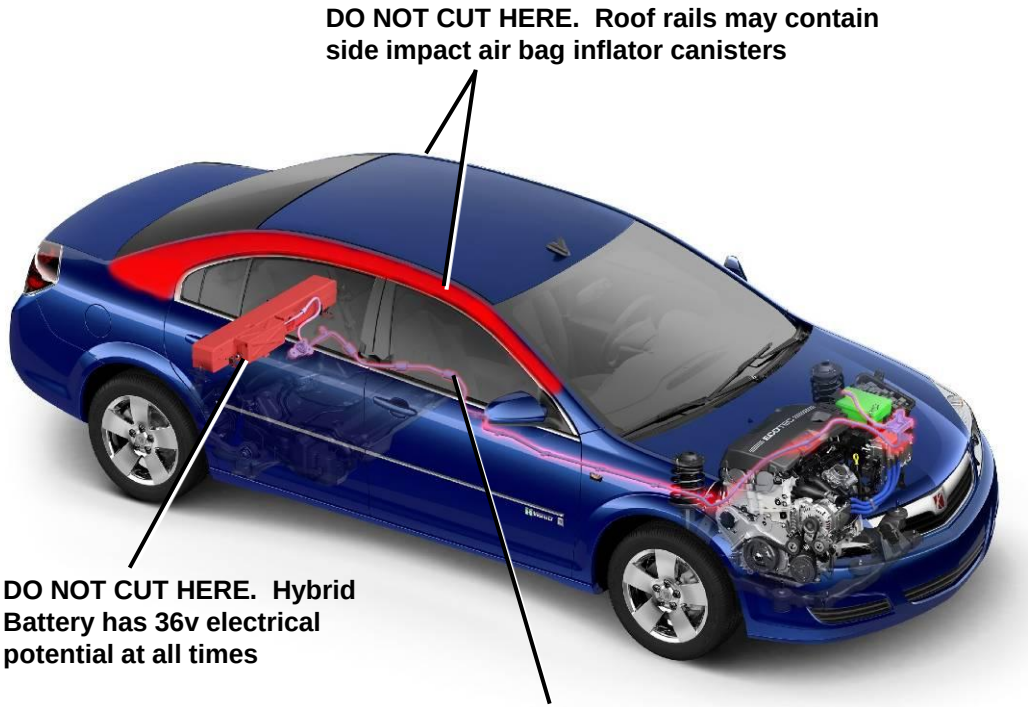
Note: The intermediate voltage cable routed under vehicle is not colored blue but is housed in a metal conduit

Cut Zones

CAUTION: DO NOT cut the vehicle until all of the electrical systems have been deactivated and isolated. Cutting into the vehicle prior to disconnecting and isolating the electrical energy sources may cause an electrical arc and/or personal injury.

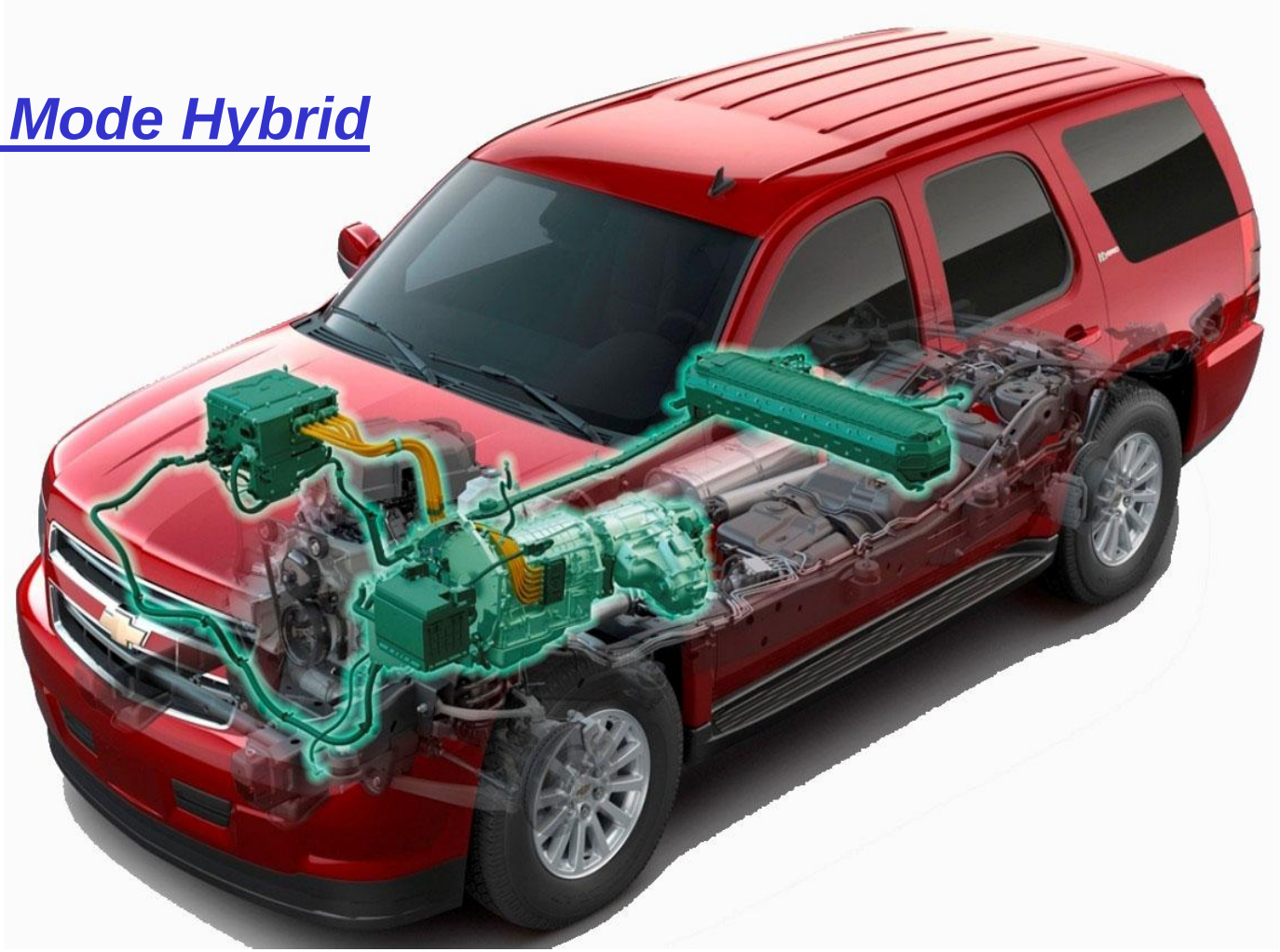
Do not cut the:

- Center of the vehicle. Intermediate 36 volt wiring is routed in a conduit tube beneath the vehicle.
- Roof rails between the windshield pillars and 'sail' panels.
- Hybrid battery. The hybrid battery has 36 volt electrical potential at all times.



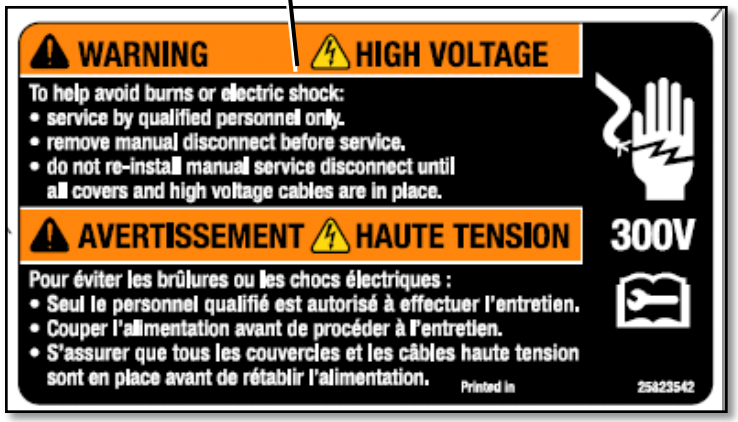
Highlighted areas indicate DO NOT CUT Zones

Two Mode Hybrid



Vehicle Identification

When the hood is opened, indications that a Two-mode Hybrid system is present include a Hybrid badge and a HIGH VOLTAGE WARNING label on the power electronics cover.

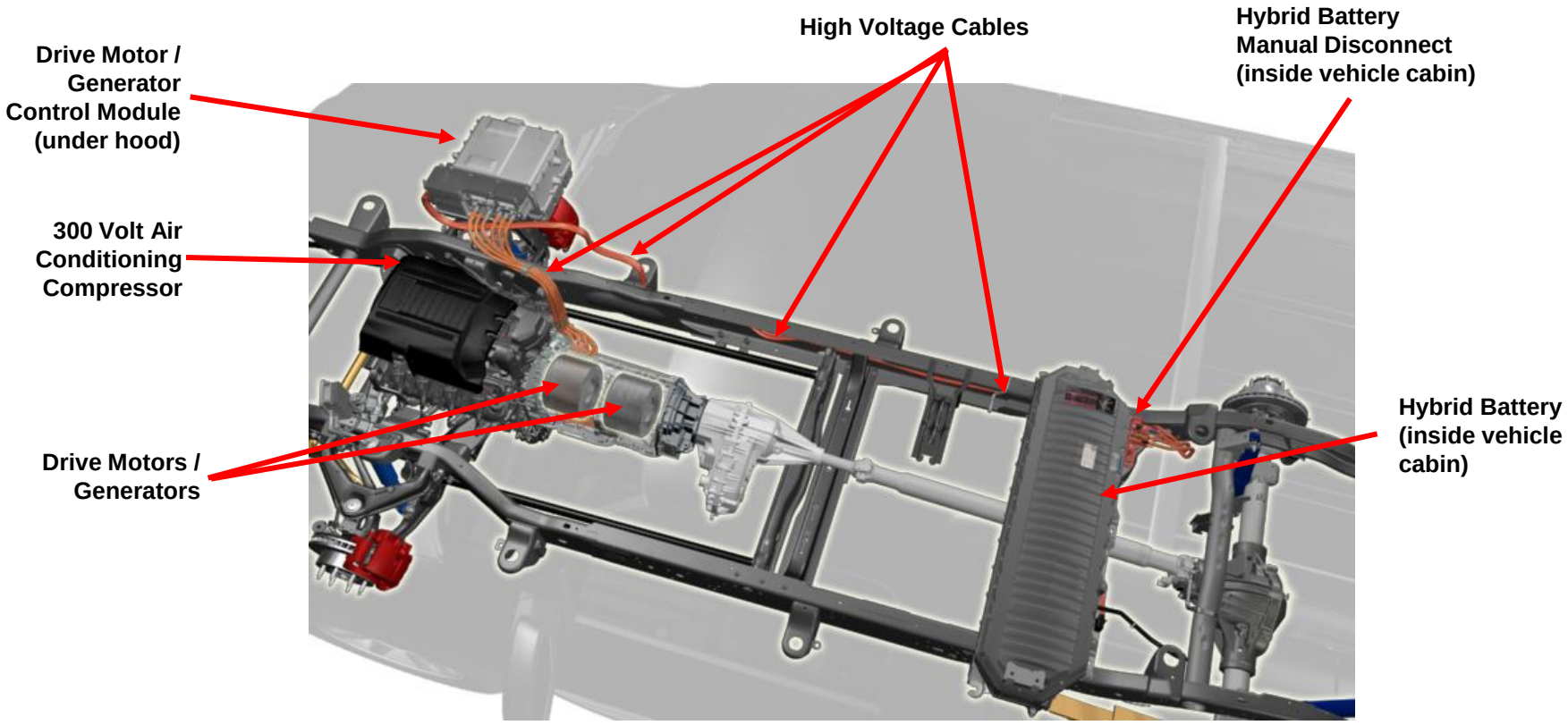


Vehicle Identification (cont.)

Under the second row, rear seat sub-floor is a DANGER HIGH VOLTAGE label attached to the Hybrid battery case, indicating high voltage.

Key Hybrid Components

This illustration shows the location of the key GMC Yukon and Sierra, Chevrolet Tahoe and Silverado, and Cadillac Escalade Two-mode Hybrid vehicle components.



Key Hybrid Components (cont.)

Conventional Engine with an Electronically Variable Transmission (EVT)

The GMC Yukon and Sierra, Chevrolet Tahoe and Silverado, and Cadillac Escalade Two-mode Hybrid Vehicles use a conventional internal combustion engine coupled with an Electronically Variable Transmission (EVT) that includes two 60 Kilowatt electric motors to efficiently power the vehicle.

Note: All high voltage cables used in Two-mode Hybrid models are colored orange for easy identification.

Key Hybrid Components (cont.)

The Electronically Variable Transmission (EVT) contains two 60 Kilowatt motors / generators that are utilized to:

- Propel the vehicle
- Generate / recapture energy
- Start the Internal Combustion Engine (ICE)

Motors / Generators

Key Hybrid Components (cont.)

The Drive Motor / Generator Control Module performs the following operations:

- Inverts 300 volts DC to AC for vehicle propulsion
- Inverts 300 volts AC to DC for Hybrid battery recharging
- Provides 300 volts to Air Conditioning Compressor
- Converts 300 volts DC to 42 volts DC for the Electronic Power Steering (EPS) system operation
- Converts 300 volts DC to 12 volts DC for conventional 12 volt accessory operation

Note: Orange wiring is used to indicate high voltage. Blue wiring is used to indicate intermediate voltage.

Key Hybrid Components (cont.)

A Nickel Metal Hydride (NiMH) 300 volt Hybrid battery is enclosed in a metal case located under the second row, rear seat sub-floor. This 300V Hybrid battery supplies and stores energy for the vehicle and is also equipped with a manual disconnect.

300V Hybrid Battery Manual Disconnect

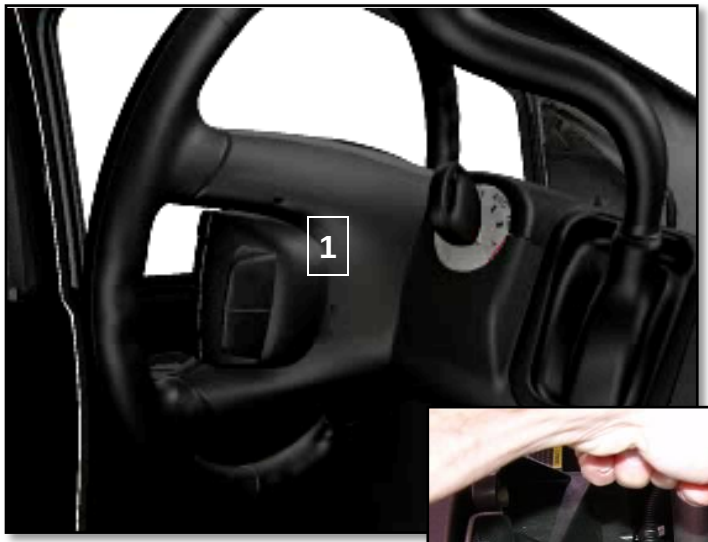
Key Hybrid Components (cont.)

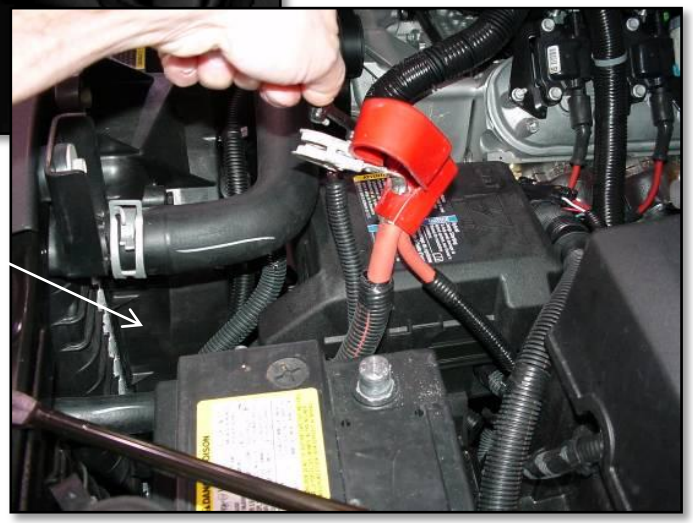
A hood ajar switch is part of the hood latch and prevents Auto Stop Mode from occurring if the hood of the vehicle is open.

If the hood is opened while the vehicle is in Auto Stop Mode, the engine will restart.

Note: The hood ajar switch will NOT prevent current flow through the 300 volt electrical system.

To disable 12V power you must:





Note: The 12 volt battery cables have lever type, quick release terminals.

1. Turn the ignition key to the OFF position.

- And -

2. Remove the 12 volt (+) positive battery cable from the battery post. Ensure the terminal cannot contact the battery post.

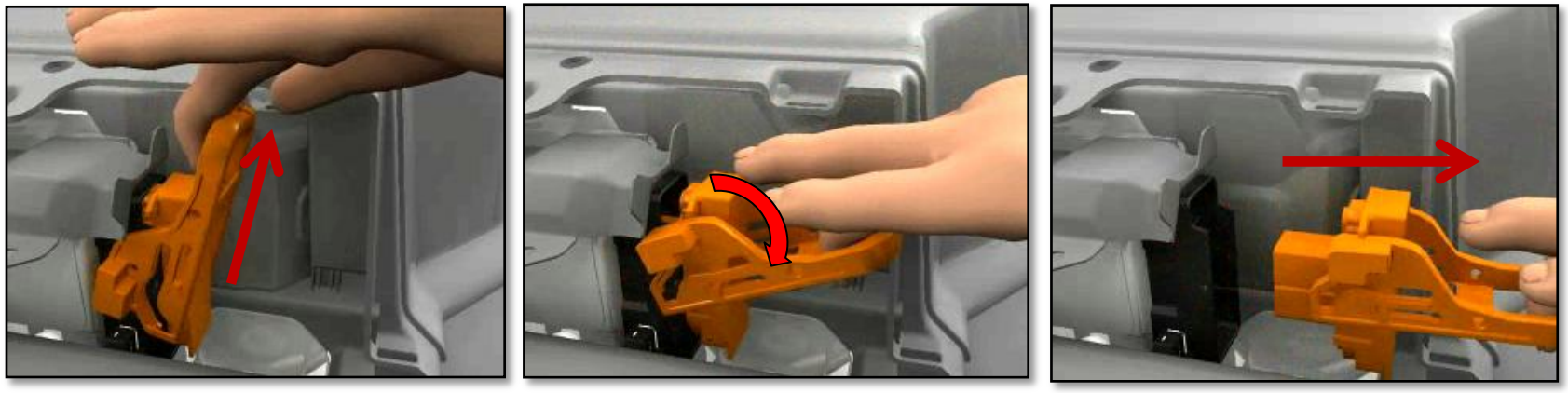
Note: After disabling 12V power, wait at least 60 seconds to allow any un-deployed air bag reserve energy to dissipate.

First Responder Labels

GM has implemented the labels shown here to help First Responders safely disable the vehicle in an emergency situation.

High Voltage Manual Disconnect

If accessible, you can minimize the potential for 300V current flow by removing the manual disconnect lever from the 300 volt Hybrid battery. The hybrid battery is located under the second row, rear seat sub-floor.



DANGER: The manual disconnect lever is designed to facilitate servicing of the vehicle. The energy potential within the 300V battery cannot be disabled. Even with the disconnect removed, assume the high voltage cables and components contain high voltage. If the 300 volt battery is exposed, it should only be handled by a properly trained technician - Otherwise, serious injury or death may occur.

Vehicle DO NOT CUT ZONES

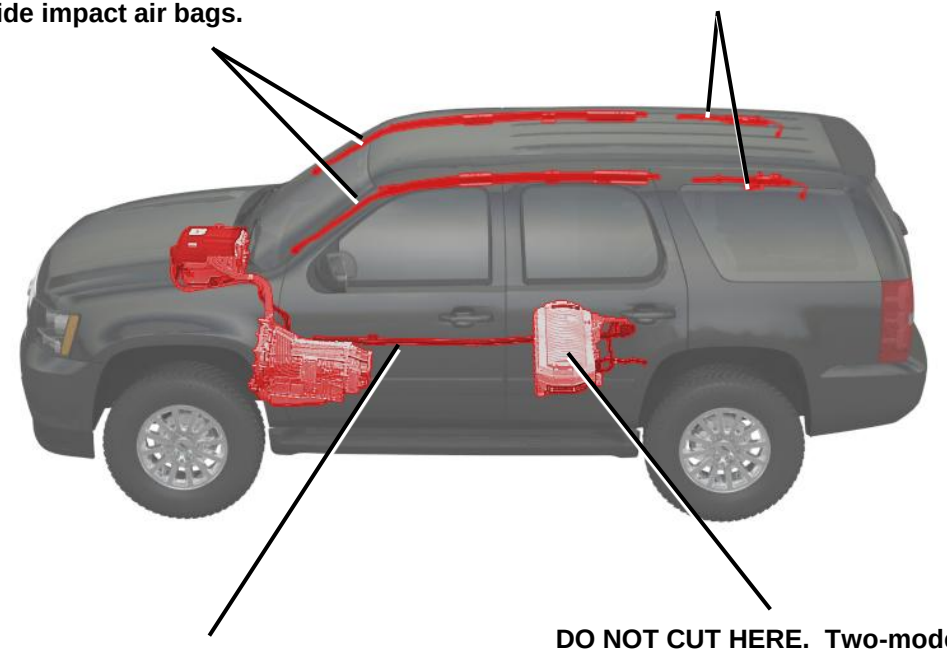
Do NOT cut the:

- Area near the passenger side frame rail. High voltage 300 volt wiring is routed near the frame rail on the passenger side of the vehicle.
- Roof rails between the windshield and ‘D’ pillars (rear pillars). GMC Yukon and Sierra, Chevrolet Tahoe and Silverado, and Cadillac Escalade Two-mode Hybrid vehicles are equipped with side impact air bags.
- Two-mode Hybrid battery. The Two-mode Hybrid battery has 300 volt electrical potential at all times.

WARNING: Do NOT cut into the vehicle until the 12V electrical system has been deactivated. Cutting into the vehicle prior to disconnecting and isolating the 12V electrical energy sources may cause air bag deployment resulting in serious injury.

DO NOT CUT HERE. Roof rails between the windshield and ‘D’ pillars (rear pillars). Side impact air bags.

DO NOT CUT HERE. Side curtain air bags (with optional third row seat)



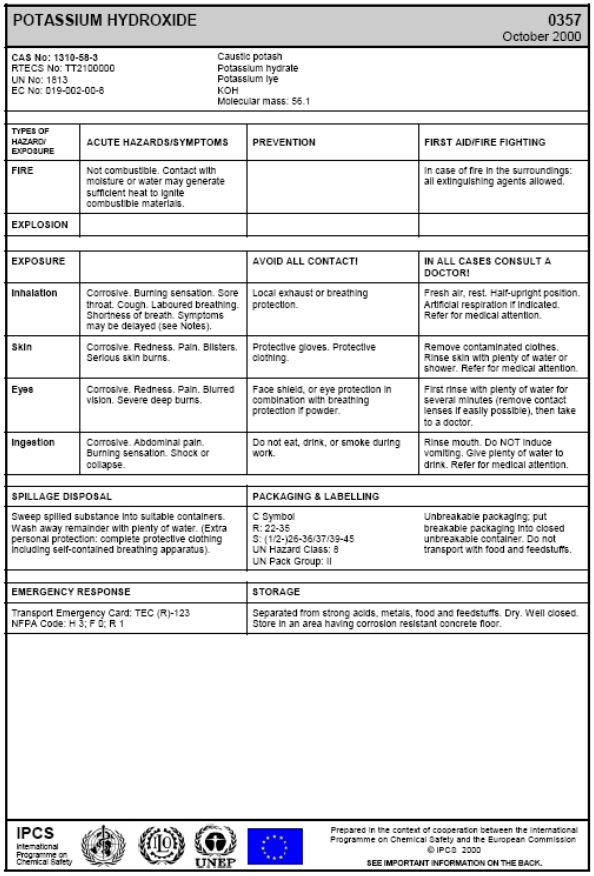
DO NOT CUT HERE. Under vehicle area near passenger side frame rail contains high voltage 300 volt electrical cables.

DO NOT CUT HERE. Two-mode Hybrid battery has 300 volt electrical potential at all times.

Neutralizing a Battery Leak

The Nickel Metal Hydride (NiMH) battery contains Potassium Hydroxide and if a leak is detected, a mixture of Borax™ and water, or a Class D fire extinguisher should be used to neutralize the spill.

Refer to your MSDS sheet for more information.



POTASSIUM HYDROXIDE 0357 October 2000

CAS No: 1310-58-3
RTECS No: TT2100000
UN No: 1813
EC No: 019-002-00-8

Caustic potash
Potassium hydrate
Potassium lye
KOH
Molecular mass: 56.1

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/SYMPTOMS	PREVENTION	FIRST AID/FIRE FIGHTING
FIRE	Not combustible. Contact with moisture or water may generate sufficient heat to ignite combustible materials.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
Inhalation	Corrosive. Burning sensation. Sore throat. Cough. Laboured breathing. Shortness of breath. Symptoms may be delayed (see Notes).	Local exhaust or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
Skin	Corrosive. Redness. Pain. Blisters. Serious skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Corrosive. Redness. Pain. Blurred vision. Severe deep burns.	Face shield, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	Corrosive. Abdominal pain. Burning sensation. Shock or collapse.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	PACKAGING & LABELLING	
Sweep spilled substance into suitable containers. Wash away remainder with plenty of water. (Extra personal protection: complete protective clothing including self-contained breathing apparatus).	C Symbol R: 22-35 S: (1/2-)26-36/37/39-45 UN Hazard Class: 8 UN Pack Group: II	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.

EMERGENCY RESPONSE	STORAGE
Transport Emergency Card: TEC (R)-123 NFPA Code: H 3; F 0; R 1	Separated from strong acids, metals, food and feedstuffs. Dry. Well closed. Store in an area having corrosion resistant concrete floor.

IPCS International Programme on Chemical Safety

Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission

SEE IMPORTANT INFORMATION ON THE BACK.

Thermal Management Systems

Hybrid cooling systems maintain the proper operating temperature of the components. Some Hybrid cooling systems require a pre-mixed 50/50 solution of DEX-COOL® coolant. Refer to vehicle service information for specific coolant requirements.

Air Bag Deployment

The contactors inside the Hybrid battery are designed to open if one or more air bags deploy. This causes an interruption of the electrical system and discontinues current flow in the high voltage cables.

This vehicle may have dual-stage airbags and the appearance of deployed airbags does not ensure that all parts of the airbags have deployed.

Therefore, disabling 12 volt power is essential to ensure personal safety even if the airbags in the vehicle appear to have been deployed. After disabling 12V power, wait at least 10 seconds to allow any un-deployed air bag reserve energy to dissipate.

Vehicle Collision Detection

These vehicles contain a high voltage circuit impact detection (HVCID) sensor in addition to the supplemental inflatable restraint (SIR) impact sensors. The SIR sensors are designed to identify the severity of a collision and from what direction a collision has occurred. The SIR sensors typically detect collision conditions for occupant impact-protection reasons. The HVCID sensor is located in the front of the vehicle and is designed to detect an offset collision that may have damaged the high voltage system. The drive motor generator control module, also called the hybrid powertrain control module (HPCM), will open the high voltage contactor relays and disable the vehicle whenever an SIR deployment occurs or the HVCID sensor detects a collision event. The HVCID sensor detection of a vehicle impact does not cause SIR deployment.

The serial data gateway module (SDGM) monitors the HVCID sensor for collision/impact detection and operational status. The SDGM transmits a GMLAN message to the HPCM whenever an HVCID impact event or sensor fault is detected.

A complete inspection of the high voltage (HV) system and components must be performed if the vehicle has been involved in a collision. The HVCID sensor and/or SIR Deployed vehicle-disable condition will remain active until cleared by the HPCM output control function of the scan tool.

High Voltage Disabling

Full disabling and removal procedures are located in the GM service manual for the vehicle.

Danger: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
Safety glasses with appropriate side shields when within 15.24 meters (50 feet) of the vehicle, either indoors or outdoors.

- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  - Visually and functionally inspect the gloves before use.
  - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures exactly as written may result in serious injury or death.

Air Bag Repairs and Inspections Required After a Collision

Warning: Proper operation of the Supplemental Inflatable Restraint (SIR) sensing system requires that any repairs to the vehicle structure return the vehicle structure to the original production configuration. Not properly repairing the vehicle structure could cause non-deployment of the air bag(s) in a frontal collision or deployment of the air bag(s) for conditions less severe than intended.

After any collision, inspect the following components as indicated. If you detect any damage, replace the component. If you detect any damage to the mounting points or mounting hardware, repair the component or replace the hardware as needed.

- The steering column--Inspect the steering column for bending, twisting, buckling or any type of damage.
- The instrument panel knee bolsters and mounting points-
- The instrument panel brackets, braces, etc.
- The seat belts--Perform the seat belt operational and functional checks.
- The instrument panel cross car beam.
- The instrument panel mounting points and brackets.
- The seats and seat mounting points.
- The roof and headliner mounting points.

Air Bag Repairs and Inspections Required After a Collision (cont.)

After a frontal collision involving air bag deployment, replace the following components.

- Passenger instrument panel air bag, if deployed
- Driver steering wheel air bag
- Inflatable restraint sensing and diagnostic module (SDM)
- Front and/or side impact sensors, impact sensor replacement policy requires replacing sensors in the area of the accident damage
- Driver/Passenger seat side air bag, if deployed
- Seat back cover on if side seat air bag is deployed
- Driver/Passenger seat belt anchor and/or retractor pretensioners
- Steering wheel air bag coil and the coil wiring pigtail—If melted, scorched, or other damaged due to excessive heat.

Air Bag Repairs and Inspections Required After a Collision (cont.)

After a collision involving driver/passenger side seat air bag deployment, replace the following components.

- Left/right side impact sensors on the side of the impact.
- Left/right roof rail air bag on the side of the impact.
- Inflatable restraint sensing and diagnostic module (SDM), if SDM has DTC B0052 56.
- Inflatable restraint seat belt anchor and/or retractor pretensioner.
- Driver or passenger seat back cushion cover replacement.

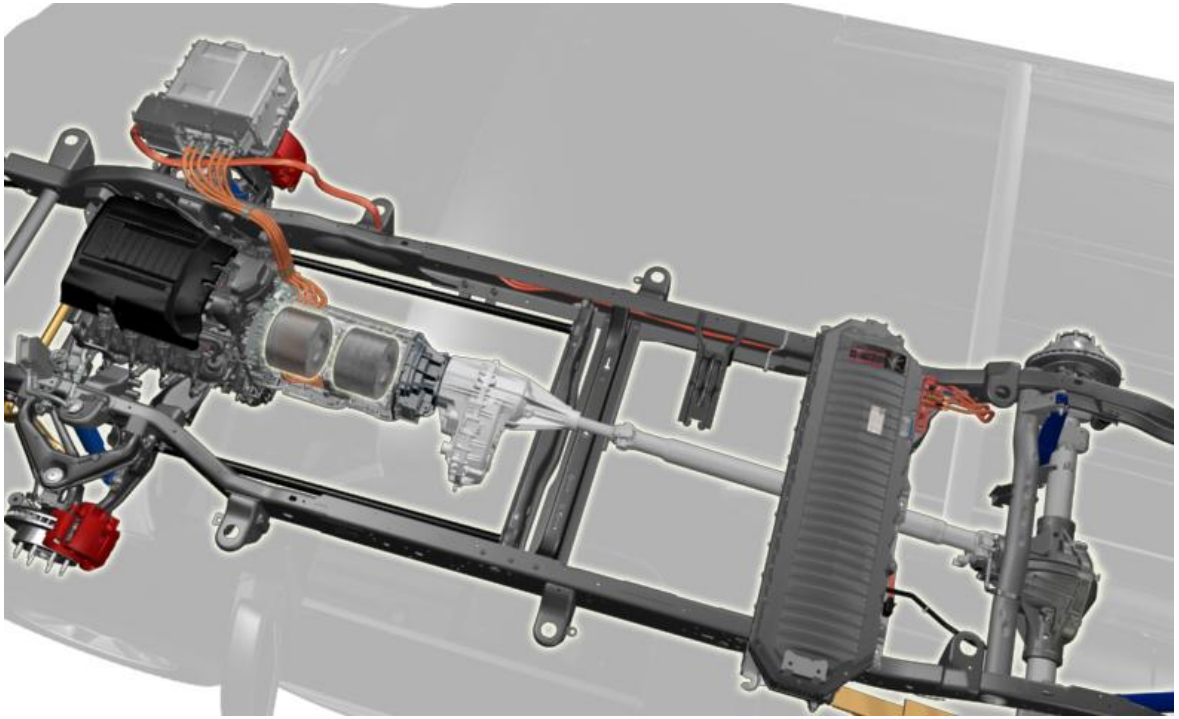
Warning: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury.

Perform additional inspections on the following components.

- The seat cushion frame
- The seat recliner and cover, if equipped
- The seat adjuster
- The seat back frame
- Door trim assembly
- Impacted seat cushion side covers and switches

Inspection

A complete inspection of the high voltage system and components must be performed if the vehicle has been involved in a collision. The Crash Event Detected condition will remain active until cleared by the hybrid powertrain control module 2



High Voltage System Inspection

1. Perform the high voltage disable procedure at the drive motor generator battery cable connections. Refer to High Voltage Disabling.
   - If vehicle damage does not allow access to the high voltage manual disconnect, disconnect the 12V battery and remove the damaged portion of the vehicle until such time as the HV manual disconnect can be removed and the High Voltage Disabling procedure can be completed.

2. Perform a visual inspection of the HV DC 300V cables between the drive motor generator power inverter module (PIM) and the drive motor generator battery assembly. Inspect for pinched, cut or frayed cables.
3. Perform a visual inspection of the HV DC 300V cables between the PIM and the air conditioning compressor. Inspect for pinched, cut or frayed cables.
4. Perform a visual inspection of the 3 phase cables between the PIM and the transmission case. Inspect for pinched, cut or frayed cables. Inspect the conduit for kinks or dents.
5. Perform a visual inspection of the 42V power steering cables between the accessory DC power control module (APM) and the power steering control module (PSCM). Inspect for pinched, cut or frayed cables.
6. Perform a visual inspection of the drive motor generator control module assembly. Inspect the assembly for cracks, dents or other physical damage.
7. Perform a visual inspection of the air conditioning compressor assembly. Inspect the assembly for cracks, dents or other physical damage.
8. Perform a visual inspection of the transmission assembly. Inspect the assembly for cracks, dents or other physical damage.
9. Perform a visual inspection of the drive motor generator battery assembly. Inspect the assembly for cracks, dents or other physical damage.
10. Replace all components identified as damaged.
11. With a scan tool clear the HVCID and/or SIR Deployed vehicle disable condition only after all high voltage components identified as damaged have been replaced.

HVCID and/or SIR Deployed Vehicle Disable Condition Clearing Procedure

1. Perform the Inspection Procedure if the vehicle has been involved in a collision.
2. Ignition ON, clear the SDGM vehicle disable condition with a scan tool.

   - If the SDGM had a HVCID sensor fault DTC, repair the condition and clear SDGM DTC Information.
   - If the SDGM had an HVCID collision detection condition, perform the SDGM Crash Sensor Reset special function.

3. Ignition OFF, wait 2 minutes.
4. Ignition ON, clear the HPCM vehicle disable condition with the scan tool HPCM Clear 300V Impact Detection Status special function.
5. Ignition OFF, wait 2 minutes.
6. Perform the HV Enable Procedure. Refer to High Voltage Enabling.

Paint Baking

General Motors does not recommend baking the Hybrid vehicles for more then 40 minutes at 140° Fahrenheit or 60° Celsius. Damage to the high voltage battery may occur.

Welding

GM recommends removing and disconnecting the 12volt battery and any modules If welding with-in 12 inches or 300mm of them. GM also recommends disabling the high voltage system if welding with-in 12 inches or 300mm of the high voltage battery

Verify battery pack voltage is not present:

First, verify the voltmeter works.

1. Set the meter to “DC” mode
2. Measure the vehicle’s 12V battery
3. The meter should read >+12Vdc

Always re-check voltmeter for proper operation after making voltage checks

HV Battery Shipment

Lithium-ion batteries are considered hazardous materials and require special shipping regulations. Lithium-ion batteries are classified as Class 9 hazardous material. Identifications (referred to as UN numbers) exist for the various battery packs based on chemistry and configuration. Refer to the return shipping instructions included with the replacement battery for specific identification needed for transportation.

Make sure that the shipping paperwork is filled out correctly and that the shipment is properly labeled per federal, state, and local laws and regulations. Check to make sure that you are complying with any recordkeeping requirements. . Only certified hazardous material personal should handle hazardous material.

Batteries should be shipped by ground or vessel only. Do not ship batteries for recycling by air.

Note: A damaged battery (one that is leaking electrolyte from the battery pack) might need to be shipped differently as a hazardous waste depending on your geographic location. Check your local regulations.

Handling

Fire

If battery cells reach high enough temperature, they vent and release electrolyte. Battery electrolyte is flammable. Use copious amounts of water to cool the battery and extinguish the fire. ABC dry chemical extinguisher will not extinguish a battery fire.

Water

The high voltage battery is sealed and isolated from the vehicle chassis. If the vehicle is immersed in water, you will not be electrocuted by touching the vehicle.

Locate and review the Lithium-Ion Battery Chemistry Material Safety Data Sheet for more information.

Conclusion

General Motors is committed to making your job as safe as possible.

We are confident the information contained in this guide will prove useful.