Eaton Hybrid
First Responder Training

Outline

- Identifying a Hybrid
- High-Voltage Components
- Emergency Procedures
- Emergency Contact and Recycling
- Built-In Safety Features
- Towing or Jumpstarting

Identifying Hybrid Vehicles

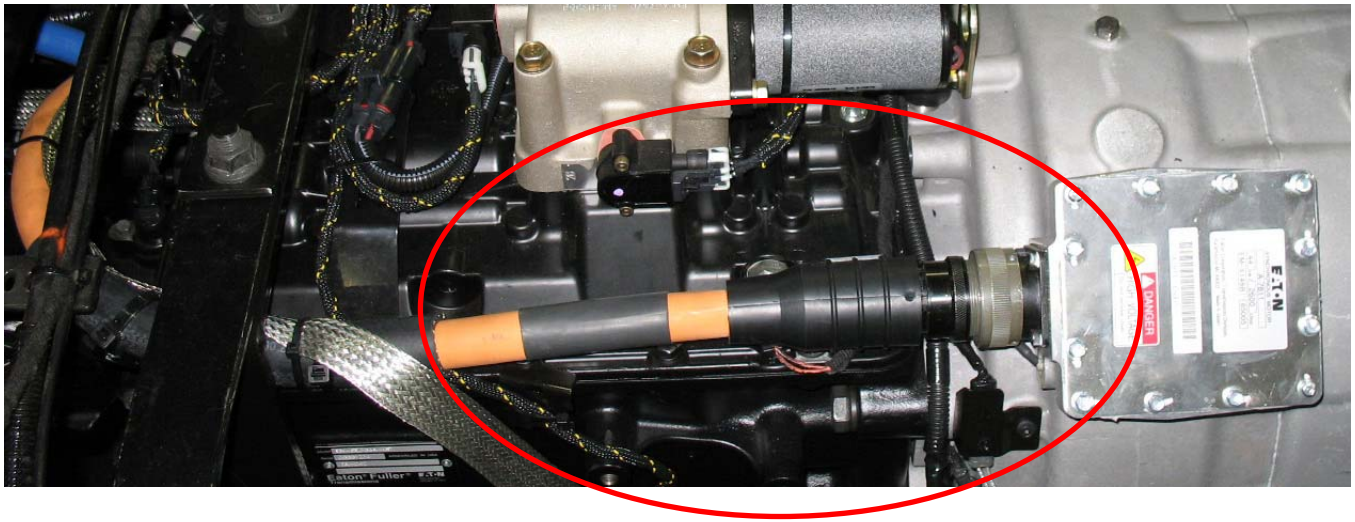
There are several methods to identify a vehicle equipped with an Eaton Hybrid system.

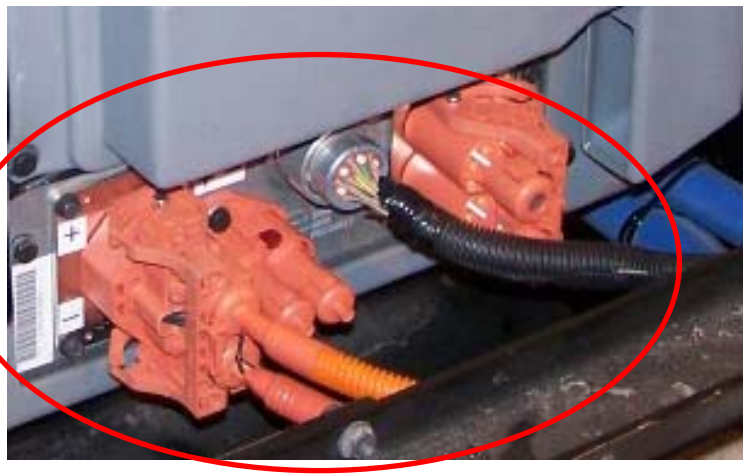
- The outside of vehicle will contain the word “Hybrid”
- The shift label on the dash states “Eaton Hybrid”
- The presence of bright orange high-voltage cables.

Identifying Hybrid Vehicles – External Lettering

Identifying Hybrid Vehicles – In Cab Shift Label

Identifying Hybrid Vehicles – High Voltage Cables





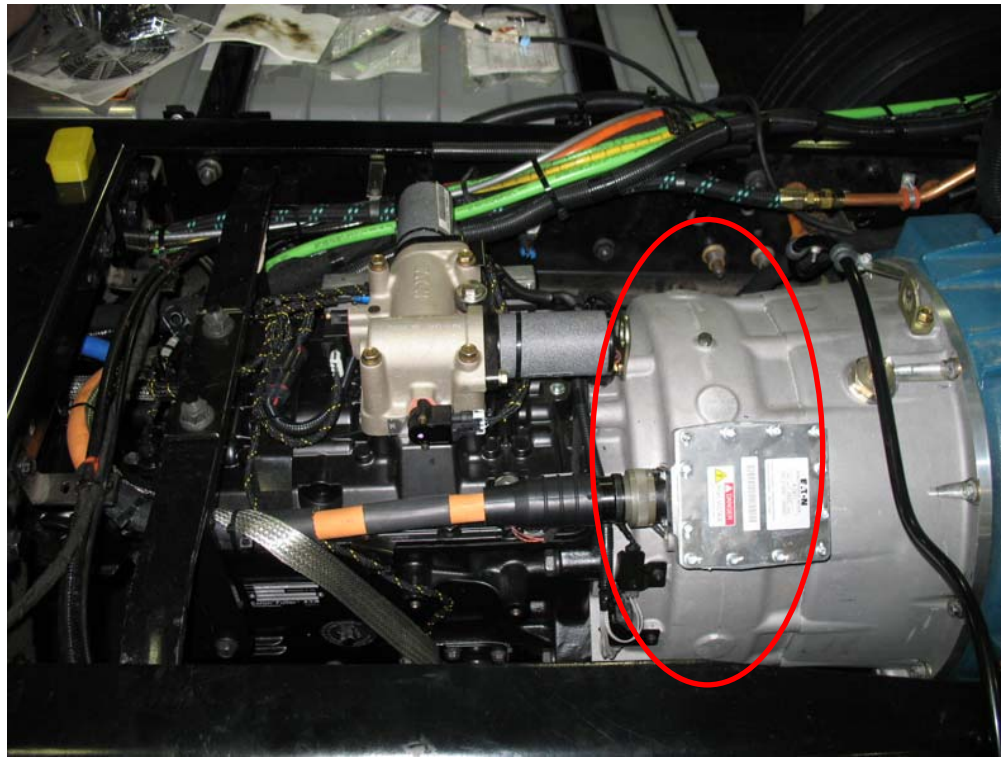
High Voltage Components – Motor/Generator

Location

- Always located between engine flywheel and transmission

Function

- Produces a peak of 44kw and a continuous 26kw
- The Motor/Generator uses and produces 3-phase AC up to 500 volts



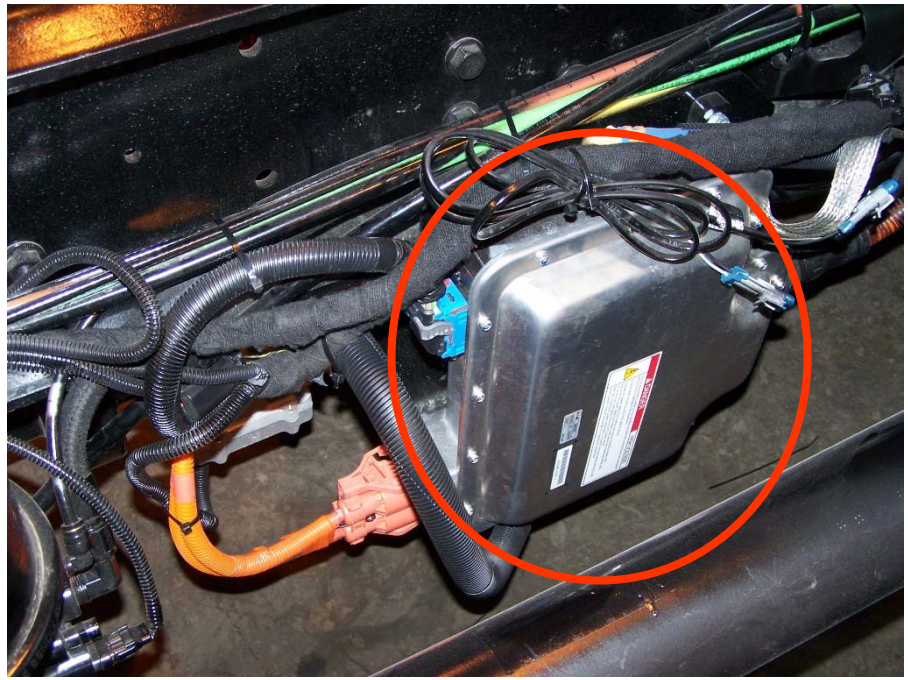
High Voltage Components – Inverter

Location

- Varies by make and model of the vehicle.

Function

- Changes high-voltage DC to AC during Hybrid motor usage.
- Changes high-voltage AC to DC during Hybrid generator mode.



High Voltage Components – Power Electronics Carrier (PEC)

Location

- Varies by make and model of the vehicle.

Function

- Stores on average 340 volts DC in two sealed Lithium Ion batteries

High Voltage Components – DC/DC Converter

Location

- Varies by make and model of the vehicle.

Function

- Converts high-voltage DC to 12 volts, which maintains the standard 12 volt system in ‘ePTO’ mode

Emergency Procedure - Shutdown

Option 1 (Preferred)

- Turn ignition key off.
- High-voltage batteries are still live but are isolated in the PEC.

Option 2

- Disconnect Low Voltage 12 volt batteries.
- High-voltage batteries are still live but are isolated in the PEC.

Option 3

- Push in the “Service Switch” on the PEC and shut down the engine.
- High-voltage batteries are still live but are isolated in the PEC.

Emergency Procedure – Spill

- Protective Equipment
  - Safety Glasses
  - Rubber Gloves rated for Class 0
  - Towel
  - Respiratory protection
- Spills
  - Chemical system: Lithium Manganese Oxide (Partially substituted by nickel and cobalt)/Carbon. (Li-Mn-Ni-Co-O / C).
  - Electrolyte: Lithium Salt in an Organic Solvent (non-aqueous liquid). The electrolyte is absorbed into 48 individual cells per battery and will not normally spill or leak if the battery is damaged.
  - If electrolyte leaks from a cell, use a towel to wipe it up
  - Max Electrolyte for two battery system is 4000cc (1.20 Gallons).

Emergency Procedure – Contact Information

During an emergency, Eaton Material Safety Data Sheets (MSDS) may be requested by contacting **CHEMTREC**.

- DOMESTIC NORTH AMERICA 800-424-9300
- INTERNATIONAL, CALL 703-527-3887

You will need to following when calling CHEMTREC

- COMPANY: Eaton Corporation (REQUIRED)
- COMPANY CODE: C371 (OPTIONAL)

Emergency Procedure – First Aid

Electrolyte Exposure

- If electrolyte comes into contact with the eyes, rinse with tap water for 15 minutes and seek medical attention
- If the electrolyte comes into contact with the skin wash with soap and water

Inhalation – Non Fire Situation

- No toxic gases are emitted under normal conditions

Inhalation – Fire Situation

- If gas is inhaled, move immediately to fresh air and seek medical attention

Recovery/Recycling of Lithium Ion Batteries

- Clean up of the Lithium Ion battery can be performed following the appropriate “Emergency Procedures”

- If the high-voltage PEC is removed from the truck during an accident, it is considered hazardous material and much be shipped under the appropriate DOT regulations for Lithium Ion batteries.

Emergency Procedure – Do's and Don'ts

- Do's
  - Always assume the vehicle is "live" when you approach a Hybrid
  - Always perform one of the three "Emergency Shutdown Procedures" and allow the vehicle to set for 5 minutes prior to working on a Hybrid
- Don'ts
  - Never work on the vehicle if you haven't performed one of the three "Emergency Shutdown Procedures" and allowed the vehicle to set for 5 minutes
  - If at all possible, never cut the orange high-voltage cables
  - If at all possible never cut into or open the Inverter, PEC, or DC/DC Converter

Built-in Safety Features

- All high-voltage cables are covered in orange insulation.
- Each high-voltage component is clearly marked with a warning or danger label.
- High-voltage DC cables contain an interlock loop that will shut down the high-voltage system if they become loose or disconnected.
- The AC cable is continuously monitored to detect an open or short to ground fault.
- An inertia switch mounted in the PEC will open the high-voltage relay circuit in the event of an accident

Built-in Safety Features

- The high-voltage cables coming from the PEC are controlled by relays that are normally open. When the ignition key is turned off, the relays open, which contains the voltage inside the Power Electronics Carrier (PEC).
- All positive and negative high-voltage cables are isolated from the metal chassis to prevent shock by touching the metal chassis.

Towing or Jumpstarting

Jumpstarting

- Jumpstarting vehicles equipped with the Eaton Hybrid system is identical to Non-Hybrid vehicles, which uses the standard 12 volt battery system.

Towing

- Same as a Non-Hybrid vehicle
- Preferred method is to tow the vehicle with just the front wheels touching the ground.
- If drive wheels touch the ground, the driveshaft must be disconnected.