Warnings and Cautions

Warnings & Cautions

Throughout this manual there are paragraphs that are marked with a title of DANGER, WARNING, or CAUTION. These special paragraphs contain specific safety information, and must be read, understood, and heeded before continuing the procedure, or performing the step(s).

DANGER: DANGER INDICATES YOU WILL BE SEVERLY INJURED OR KILLED IF YOU DO NOT FOLLOW THE INDICATED PROCEDURE

WARNING: WARNING INDICATES AN IMMEDIATE HAZARD, WHICH COULD RESULT IN SEVERE PERSONAL INJURY IF YOU DO NOT FOLLOW THE INDICATED PROCEDURE.

CAUTION: CAUTION INDICATES VEHICLE OR PROPERTY DAMAGE COULD OCCUR IF YOU DO NOT FOLLOW THE INDICATED PROCEDURE.

Note: NOTE INDICATES ADDITIONAL DETAIL THAT WILL AID IN THE DIAGNOSIS OR REPAIR OF A COMPONENT/SYSTEM.
Warnings and Cautions

Read the entire driver instructions before operating this transmission.

Before starting a vehicle always be seated in the driver's seat, select “N” on the shift control, and set the parking brakes.

If engine cranks in any gear other than neutral, service your vehicle immediately!

The vehicle should never be worked on while in Hotel mode, since the engine can start.

Anytime you will be working on a vehicle, parking a vehicle, or leaving the cab with the engine running, place the transmission in neutral, set the parking brakes, and block the wheels.

For safety reasons, always engage the service brakes prior to selecting gear positions from "N".

Battery (+) and (-) must be disconnected prior to any type of welding on any Hybrid equipped vehicle.

It is a requirement that the driver of a commercial vehicle specified under paragraph A sections 1-6 of FMCSA regulation 392.10 must only cross railroad grade crossings in a gear that permits the vehicle to complete the crossing without a change of gears.

This can only be achieved by utilizing the Manual “M” mode. Please refer to the “Manual Mode” section in the book for correct operation.
Use CO2 or Dry Chemical Fire Extinguishers. The battery or batteries in the Power Electronics carriers (PEC) are Lithium ion.

The high-voltage wiring is covered in orange insulation or convoluted tubing and marked with warning labels at the connectors.

All Eaton® Hybrid Diesel/Electric vehicles will be marked 'Hybrid' on the outside of the vehicle, as well as the shift label on the dash.

Do NOT cut into or remove any of the orange high-voltage cables. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the PEC. Refer to the high-voltage diagram in vehicle.

Do NOT cut into or open the DC/DC converter. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the Inverter. Refer to the high-voltage diagram in the vehicle.

Do NOT work on a Eaton Hybrid vehicle until it has be properly powered down. Refer to the ‘Emergency Shutdown Procedures’ section.

The high-voltage system may remain powered for up to 5 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching any high-voltage cable/component for a minimum of 5 minutes.

The "Emergency Shutdown Procedures" section of this manual explains how to power down in an emergency.
Warnings and Cautions
Table of Contents

Warnings & Cautions .................................................................................. i
Foreword .................................................................................................. 1
Identifying a Hybrid Vehicle.................................................................... 2
High-Voltage Batteries........................................................................... 13
Built-In Safety Features .......................................................................... 15
Hybrid System Emergency Procedures ................................................. 16
Recycling and Emergency Contact Information for the Lithium Ion
Batteries ................................................................................................. 23
Do's and Don'ts ...................................................................................... 24
Vehicle Towing and Jumpstarting ............................................................ 25
Foreword

This manual has been created to assist the first responders in identifying and responding to vehicles equipped with Eaton® Hybrid systems. Emergency response procedures are similar to current methods used for non-Hybrid trucks.

The Eaton Hybrid system equipped vehicle uses high-voltage AC to power an electric motor in combination with a diesel engine to improve fuel economy and reduce emissions. A high-voltage battery pack stores energy until it is required to power the vehicle. Some applications also use a DC/DC Converter to maintain the 12v batteries during engine off PTO mode.

The Eaton Hybrid system has been designed with many features for user protection, to ensure safe access to and from the vehicle under various conditions. It is important to read and understand the “Emergency Shutdown Procedures”, and you should ALWAYS assume the vehicle is powered up.
Identification

Identifying a Hybrid Vehicle

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

- First, the outside of an Eaton Hybrid vehicle will contain the word “HYBRID.”
- Second, the shift label located on the dash states “Eaton Hybrid Transmission.”
- And last, the vehicle will have a large orange cable going to the transmission along with several other components mounted to the frame rails towards the front of the vehicle.
Component Description and Location

All vehicles equipped with an Eaton Hybrid system will contain a high-voltage location diagram in the truck cab for reference. The following components comprise the Eaton Hybrid system.

<table>
<thead>
<tr>
<th>Component</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor / Generator</td>
<td>Mounted between engine and transmission</td>
<td>3-phase AC high-voltage permanent magnet Motor/Generator</td>
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</table>

Models EH-X0000A-XXX and EH-X00000A-XXX
**Identification**

**Component Description and Location**

All vehicles equipped with an Eaton Hybrid system will contain a high-voltage location diagram in the truck cab for reference. The following components comprise the Eaton Hybrid system.

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Models EH-XXXXXB-XXX and EH-XXXXXXB-XXX
Identification

<table>
<thead>
<tr>
<th>Component</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MY08 Inverter</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Inverts high-voltage DC to 3-phase AC to power the Motor / Generator and rectifies AC to DC to recharge the high-voltage batteries.</td>
</tr>
</tbody>
</table>
### Identification

<table>
<thead>
<tr>
<th>Component</th>
<th>Location</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MY09 Inverter</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Inverts high-voltage DC to 3-phase AC to power the Motor / Generator and rectifies AC to DC to recharge the high-voltage batteries.</td>
</tr>
</tbody>
</table>

![Diagram of MY09 Inverter with labels for Coolant Port Outlet, Coolant Port Inlet, High-Voltage 3-Way AC Connector, Low-Voltage 48-Way Connector, and High-Voltage DC Connector to FEC.]
### Identification

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</tr>
</thead>
<tbody>
<tr>
<td>MY08 Power Electronics Carrier (PEC)</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Contains the high-voltage batteries, wiring and relays. 2 sealed Lithium Ion batteries connected in series produce 340 volts.</td>
</tr>
</tbody>
</table>

**Air Exhaust (not shown)**

**19-Pin Low-Voltage Connector**

**Air Intake**

**Red Service Switch with Cover**

**DC Connector to Inverter**

**DC Connector to DC/DC Converter**

**DC Connector to APG (Optional)**
# Identification

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<tbody>
<tr>
<td>MY09 Power Electronics Carrier (PEC)</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Contains the high-voltage batteries, wiring and relays. 2 sealed Lithium Ion batteries connected in series produce 340 volts.</td>
</tr>
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![Diagram of MY09 Power Electronics Carrier (PEC)](diagram.png)
## Identification

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<tr>
<th>Component</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Battery Power Electronics Carrier (PEC)</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Contains the high-voltage batteries, wiring and relays. 4 sealed Lithium Ion batteries connected in series produce 340 volts.</td>
</tr>
</tbody>
</table>

![Diagram showing components](image.png)
## Identification

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<thead>
<tr>
<th>Component</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Power Electronics Carrier (PEC)</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Contains the high-voltage batteries, wiring and relays. 96 Lithium Ion polymer cells connected in series to produce 360 volts.</td>
</tr>
</tbody>
</table>
## Identification

<table>
<thead>
<tr>
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<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Voltage Wiring</td>
<td>Frame rail and transmission mounted. Some applications have body mounted cables if the components are located the truck bed.</td>
<td>Orange colored power cables that carry high-voltage AC (500v) and high-voltage DC (340v). Cables are connected to the Motor/Generator, Inverter, PEC, DC/DC Converter (Optional), and APG (Optional).</td>
</tr>
</tbody>
</table>

**DC High-Voltage Connector**

![DC High-Voltage Connector Image](image-url)
## Identification

### AC High-Voltage Connector

<table>
<thead>
<tr>
<th>Component</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC / DC Converter</td>
<td>Frame rail near cab or bed mounted depending on OEM.</td>
<td>Used high-voltage to provide 12 volts DC to maintain the low voltage electrical system during ePTO mode only.</td>
</tr>
</tbody>
</table>

![Diagram of AC High-Voltage Connector](image)
High-Voltage Batteries

MY08/MY09, 4-Battery, and Alternative PEC High-Voltage Batteries

The high-voltage batteries are located inside the Power Electronics Carrier (PEC). The MY08 PEC is a plastic composite shell with a metal reinforcement. The MY09, 4-Battery, and Alternative PECs are metal shell compositions. The mountings of the PECs are currently frame rail mounted or bed mounted options.

The MY08, MY09, and 4-battery PEC contain two or four high-voltage batteries that are connected in series with each battery producing 172 volts. Each battery consists of 48 individual cells that contain 3.6 volts and are connected in series to produce 172 volts.

Each cell is contained in a sealed container. The batteries contain Lithium Manganese Oxide. The electrolyte used in the battery is a Lithium Salt in an organic solvent.

The alternative PEC contains 96 individual Lithium Ion polymer cells that contain 3.75 volts connected in series producing 360 volts.

If skin comes in contact with electrolyte wash skin with soap and water.

If eyes come in contact with electrolyte immediately wash eyes with water for 15 minutes and seek medical attention.

MY08/MY09 and 4-Battery PEC Battery Composition

- 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 2-Battery system is 4000cc (1.2 Gallons).
- Max Electrolyte for 4-Battery system is 8000cc (2.4 Gallons).
High-Voltage Batteries

Alternative PEC Battery Composition

- Lithium Ion polymer technology.
- Safety reinforced separator (SRS).
- Prismatic laminated package.
- 96 individual cells containing a proprietary metal.
- Max Electrolyte is proprietary.

**WARNING:** The batteries should be kept away from heat, ignition sources, and water.
Built-In Safety Features

All high-voltage cables are covered in orange insulation and clearly labeled near each connector end. Each high-voltage component is clearly tagged with a warning or danger label.

A high-voltage fuse located in the Power Electronics Carrier (PEC) provides protection in high-voltage battery system.

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.

A ground fault monitor continuously checks for high-voltage leakage to the metal chassis while the vehicle is running. If a malfunction is detected the Amber “Check Hybrid” lamp is lit, and the high-voltage system is shut off.

An inertia switch mounted in the MY08 and MY09 PECs will open the high-voltage relay circuit in the event of an accident.

All 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. If a fault is detected at key on the vehicle will not crank. If the vehicle is moving the red ‘Stop Hybrid’ lamp will illuminate.
Emergency Procedures

Hybrid System Emergency Procedures

High-Voltage Shutdown

Note: After disabling the vehicle, power is maintained up to 5 minutes in the high-voltage electrical system.

Option 1 (Preferred) Turn Ignition Key off on Dash

1. Engine will shut down.
2. Dash lights will shut down.
3. HEV system will shut down.
4. HEV batteries are still “live” but are isolated in the PEC.

Option 2 Disconnect Low Voltage (12v) Vehicle Batteries

1. Engine will shut down.
2. Dash lights will shut down.
3. HEV system will shut down.
4. HEV batteries are still “live” but are isolated in the PEC.

Note: If applicable, the service switch on the PEC may be pushed in, which will shut down the HEV system and isolate the “live” HEV batteries in the PEC.

The high-voltage system may remain powered for up to 5 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching any high-voltage cable/component for a minimum of 5 minutes.

If you will be working around or removing any high-voltage cables or components, you MUST use Class 0 insulated rubber gloves.
Emergency Procedures

Emergency Procedure in Case of Accident or Extrication

1. Ensure the wheels are chocked.
2. Follow one of the ‘Emergency Shutdown Procedures’. After disabling the vehicle, power is maintained up to 5 minutes in the high-voltage electrical system
3. Use Class 0 insulated rubber gloves to work on or near any of the high-voltage wiring or components.
4. If the vehicle must be altered to gain access, ensure that you check to make sure you won’t cut or puncture a high-voltage component.
5. If the batteries are damaged, such that a spill is present refer to the “Emergency Procedures for Spills” section.

**WARNING**

The high-voltage wiring is covered in orange insulation or convoluted tubing and marked with warning labels at the connectors.

All Eaton® Hybrid Diesel/Electric vehicles will be marked ‘Hybrid’ on the outside of the vehicle, as well as the shift label on the dash.

Do NOT cut into or remove any of the orange high-voltage cables. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the PEC. Refer to the high-voltage diagram in vehicle.

Do NOT cut into or open the DC/DC converter. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the Inverter. Refer to the high-voltage diagram in the vehicle.

Do NOT work on a Eaton Hybrid vehicle until it has be properly powered down. Refer to the ‘Emergency Shutdown Procedures’ section.
Emergency Procedures

The high-voltage system may remain powered for up to 5 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching any high-voltage cable/component for a minimum of 5 minutes.

If you will be working around or removing any high-voltage cables or components, you MUST use Class 0 insulated rubber gloves.
Emergency Procedure in Case of Fire

If the vehicle becomes involved in a fire:

1. Use self-contained breathing apparatus (SCBA).
2. Battery fire - Dry chemical (ABC), carbon dioxide (CO2), or fire extinguishers rated for class D fires.
3. Follow one of the ‘Emergency Shutdown Procedures’. After disabling the vehicle, power is maintained up to 5 minutes in the high-voltage electrical system.

WARNING

The high-voltage wiring is covered in orange insulation or convoluted tubing and marked with warning labels at the connectors.

All Eaton® Hybrid Diesel/Electric vehicles will be marked ‘Hybrid’ on the outside of the vehicle, as well as the shift label on the dash.

All Eaton Hybrid Diesel/Electric vehicles will contain a high-voltage component location diagram in the truck.

Do NOT cut into or remove any of the orange high-voltage cables. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the PEC. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the DC/DC converter. Refer to the high-voltage diagram in the vehicle.

Do NOT cut into or open the Inverter. Refer to the high-voltage diagram in the vehicle.

Do NOT work on a Eaton Hybrid vehicle until it has be properly powered down. Refer to the ‘Emergency Shutdown Procedures’ section.
Emergency Procedures

Emergency Procedure for Submerged or Partially Submerged Vehicle

Note: There is no risk of electric shock from touching the vehicle's body or framework - in or out of the water. The entire high-voltage system is isolated from the vehicle chassis.

1. Remove the vehicle from the water.
2. Drain water from vehicle if possible.
3. Ensure wheels are chocked.
4. Follow one of the ‘Emergency Shutdown Procedures’. After disabling the vehicle, power is maintained up to 5 minutes in the high-voltage electrical system.
5. Use Class 0 insulated rubber gloves to work on or near any of the high-voltage wiring or components.

WARNING: The batteries should be kept away from heat, ignition sources, and water.

Emergency Procedure for Spills

The high-voltage battery or batteries contain an organic solvent. The electrolyte will not normally spill or leak if the PEC is damaged. If the electrolyte is spilled, wipe up the spill with a towel and dispose of properly.

Note: Refer to “First Aid” section if you do come in contact with the battery contents.

Wear protective equipment:
- Safety glasses
- Rubber gloves rated for Class 0
- Towel
- Respiratory protection
Emergency Procedures

MY08/MY09 and 4-Battery PEC Battery Composition
- 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 2-Battery system is 4000cc (1.2 Gallons).
- Max Electrolyte for 4-Battery system is 8000cc (2.4 Gallons).

Alternative PEC Battery Composition
- Lithium Ion polymer technology.
- Safety reinforced separator (SRS).
- Prismatic laminated package.
- 96 individual cells containing a proprietary metal.
- Max Electrolyte is proprietary.
Emergency Procedures

First Aid

Exposure to electrolyte is very unlikely except in a catastrophic crash or through improper handling. Follow the guidelines below in the event of exposure.

Absorption

- **Skin Contact** Remove contaminated clothing and rinse affected area with soap and water for 20 minutes.
- **Eye Contact** If eyes come in contact with electrolyte wash eyes for 15 minutes with water.

Inhalation Non-Fire Situations

- No toxic gases are emitted under normal conditions

Inhalation Fire Situations

- Toxic gases are produced from combustion by-products. All responders should wear the proper PPE for fire including SCBA. Move patient from hazardous environment to safe area to administer oxygen, then transport to hospital.
Emergency Procedures

Recycling and Emergency Contact Information for the Lithium Ion Batteries

Emergency Contact Information
During an emergency, Eaton Material Safety Data Sheets (MSDS) may be requested by contacting 3E.

Call -
- Americas (US, Canada, Mexico, South America): 1-760-476-3962
- Europe, Middle East and Africa: 1-760-476-3961
- Asia Pacific: 1-760-476-3960

You will need to following when calling 3E:
- COMPANY: Eaton Corporation (REQUIRED)
- COMPANY CODE: 333100

Recycling
For information regarding recycling of the high-voltage battery pack located in the Power Electronics Carrier (PEC), contact Eaton at 1-800-826-HELP (4357).
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.
Vehicle Towing

Vehicle Towing and Jumpstarting

When towing the vehicle, the output shaft of the transmission must not be allowed to spin or turn. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or driveline must be removed or disconnected.

WARNING

Serious Internal transmission damage can result from improper vehicle towing.

Correct

INCORRECT

Jumpstarting (12 volt)

Jump starting vehicles equipped with the Eaton® Hybrid System is identical to Non-Hybrid vehicles, which uses the vehicle 12 volt battery system.