Hybrid Electric System Safety Manual

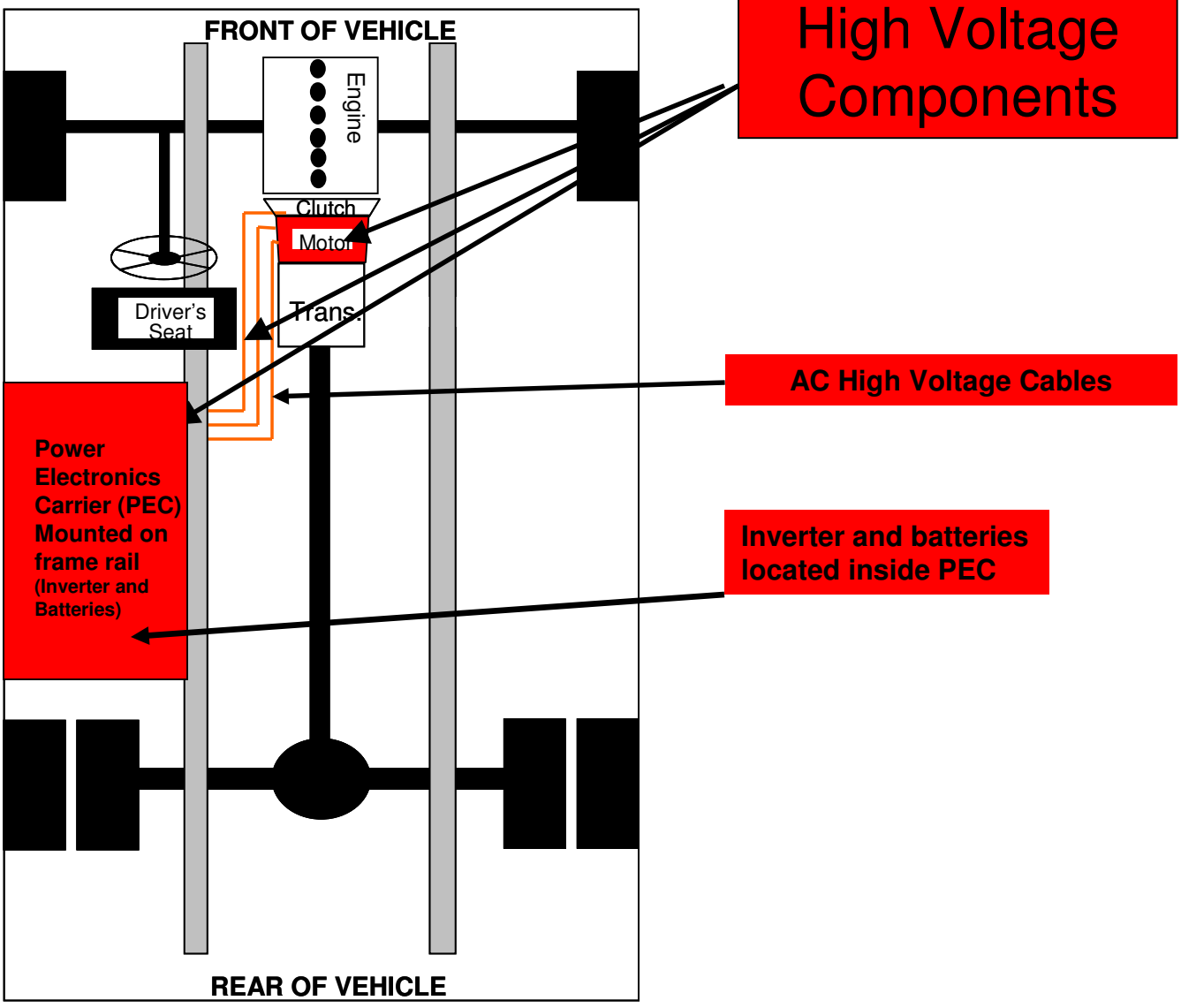
Medium Duty PACCAR Hybrid Electric Vehicle (HEV)

IMPORTANT

For the PACCAR Vehicle, this manual is supplemental to the *Operator's Manual – Chassis*. It is important to read and understand both manuals.

***The Safety Manual – Chassis* provides Safety information that is necessary for complete understanding of this vehicle.**

High Voltage Component Locations Viewed from Above



Hybrid System Emergency Shut-Down

Turn Ignition (Key) off on Dash (Figure 1)

Figure 1

- Engine will shut down
- Dash lights will shut down
- HEV system will shut down
- HEV batteries are still “live” but are isolated in PEC

Note: See the “Servicing the Vehicle” section in this manual for service instructions.

In Case of Fire or Emergency

If the Vehicle becomes involved in a fire:

- **Do not use water to extinguish a fire on this truck!** The use of water may lead to electrocution from the high voltage components.
- **Use CO_2 or Dry Chemical Fire Extinguishers**! Do **NOT** cut into the orange high voltage cables: see vehicle diagram on page 4 for high voltage component locations.
- Do **NOT** cut into or remove the PEC in the bed of the truck.
- Refer to the Hybrid System Emergency Shutdown section in this manual.

Warning: Service should only be performed by a trained technician.

In Case of Accident

When Conditions allow, pull the vehicle to the shoulder of the road and stop.

1. Push “N” on the shift console (figure 2)
2. Apply the parking brake (figure 3)
3. Turn the key to the “OFF” position on the dash (figure 4)
4. Exit the vehicle if it is safe to do so

- Refer to the High Voltage Component location Diagram on page 3 of this manual for the location of high voltage components.
- Refer to the Hybrid System Emergency Shutdown on page 4 of this manual.

Figure 2

Figure 3

Figure 4

Hybrid System Operating Instructions

Operating Instructions: Startup Procedure

These instructions supercede *vehicle operation section* of the Chassis operator's Manual

1. Place key in ignition and turn clockwise to ON position. (figure 5)
2. Wait for instrument panel gauges to complete two sweeps (one from left to right, one from right to left) and return to their normal ranges.
3. Rotate switch clockwise to the START position. The engine will crank after a brief delay. As soon as the engine starts, release key and switch will return to the ON position. Engine will continue to run with key in ON position. (figure 6)

Figure 5

Figure 6

WARNING: Never start the engine unless you're sure the transmission is in neutral and the brake is applied, otherwise accidental movement of the vehicle can occur which could result in property damage, personal injury or death.

Operating Instructions: Startup Procedure

Note:

The primary cranking system is the hybrid drive electric motor. It will crank the engine very quickly. The back-up cranking system is the standard 12-volt starter on the engine. If the Hybrid System is off-line or the hybrid batteries are not sufficiently charged, the truck will automatically default to the 12-volt cranking system and crank in a standard fashion.

Note:

12-volt cranking may occur in some instances when the State of charge of the high voltage batteries is low. The batteries will recharge once the vehicle is started and driven for a short time.

Operating Instructions: Shutdown Procedure

1. Place the transmission in neutral by selecting N on the push-button shifter (figure 7). The transmission must be in neutral for proper shut down. The transmission may become torque locked if shut down in gear. If the transmission becomes torque locked, refer to Page 20 in the service section of this manual.
2. Set the parking brake by pulling the air brake knob out (figure 8).
3. Turn the key counter-clockwise to the “OFF” position and remove key (figure 9). The automated manual transmission will take an additional 20 seconds to commence a self-test and shut down. Intermittent noises such as clicking and transmission shifting may be heard from the transmission during this time.

Figure 7

Figure 8

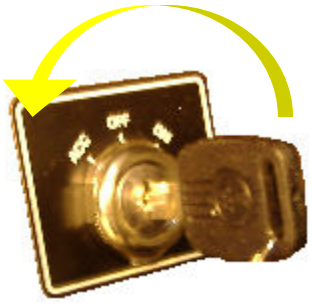
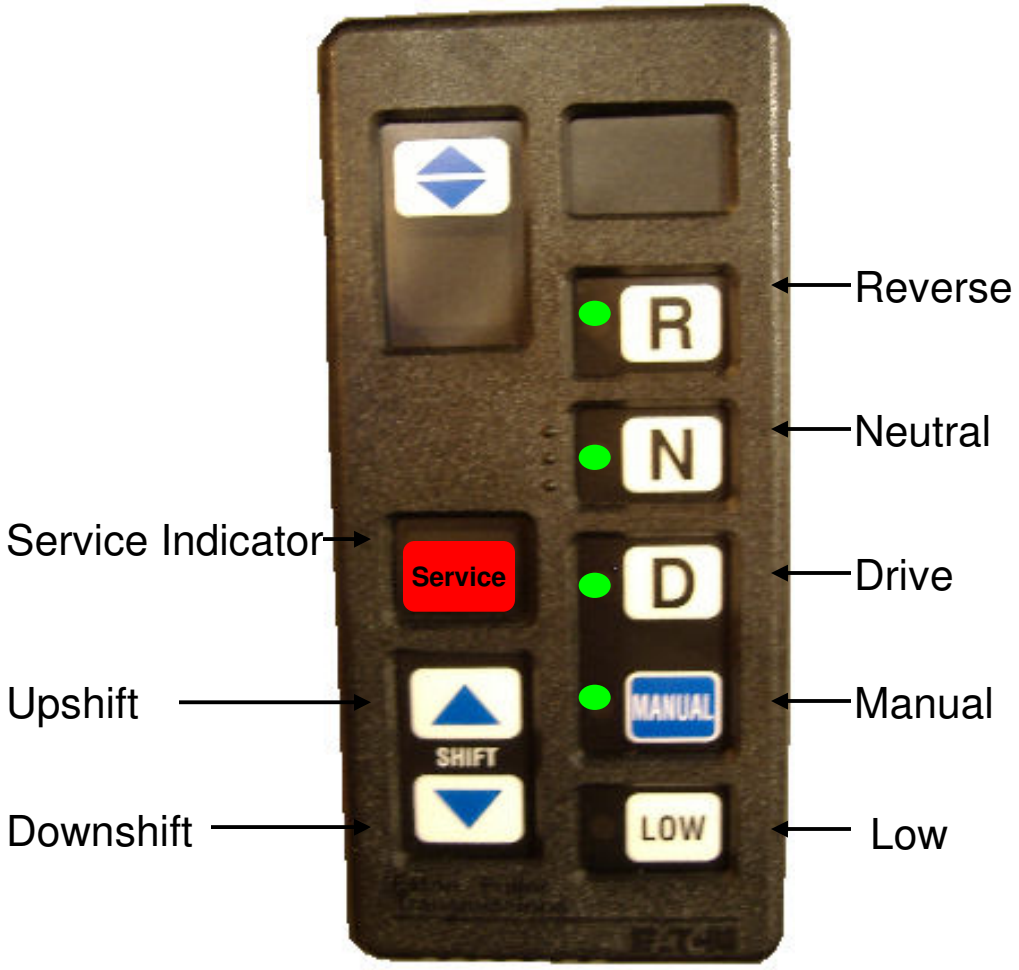


Figure 9

Operating Instructions: Shift Console



This page and the following page supercede the *vehicle controls section* of the Chassis Operator's Manual.

Operating Instructions: Shift Console

R Selects Reverse gear once vehicle speed is less than 2 mph.

N Selects Neutral

D Selects the default forward starting gear and automatically shifts gears as appropriate.

MANUAL

Allows the driver to hold the current gear and manually select the appropriate gear for road conditions using the up/down buttons. MANUAL mode should be used whenever the driver wants to select the gear instead of letting the transmission select the gear automatically. For example, the driver may use this when moving around the yard, over railroad tracks, or on steep grades. (See the “Manual Mode” section for more details.)

LOW

Allows the driver to down shift to first gear for hill start.

UP/DOWN BUTTONS

Used in the MANUAL mode to select up shifts and down shifts.

Note: Transmission will up shift or downshift to prevent excessive engine speed or stalling

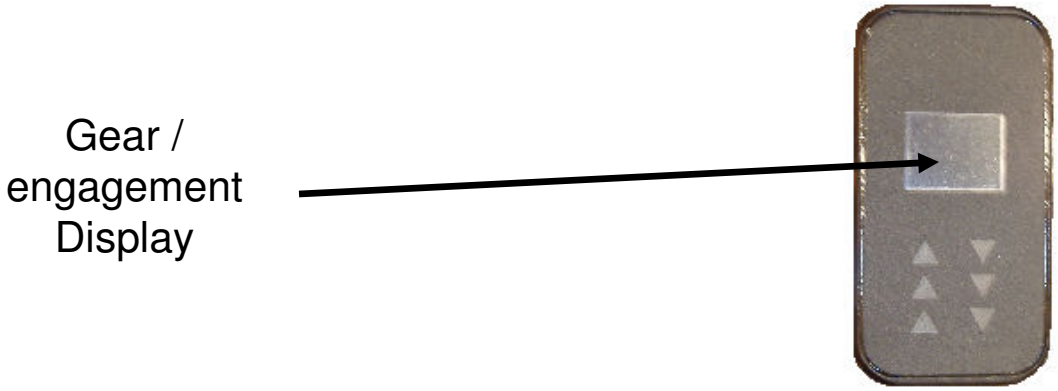
Service indicator light

Alerts the driver to potential problems with the transmission.

Operating Instructions: Dash/Gear Display

Dash/Gear Display

The current gear position of the transmission is shown on the digital display on the dash board.



Operating Instructions: Vehicle Driving Procedure

1. Press and hold brake pedal (service brake, figure 10).
2. Release parking brake (figure 11).
3. Continue to press the service brake pedal, then press “R”, “D”, “Low” or “Manual” on the pushbutton shifter (figure 12).
4. Slowly release the service brake. The truck will begin creeping forward much like an automatic automotive transmission.
5. The vehicle may be powered by the electric motor or the diesel engine depending on the battery state of charge and the demand for driveline torque. If the electric motor alone is powering the driveline, the diesel engine will stay at idle.

Caution: The batteries cannot move the truck for long distances at highway speeds. In the event of a diesel engine failure the truck should be moved to a safe location as quickly as possible.

Figure 10

Figure 11

Figure 12

Warning: The transmission is not intended to provide hill-hold capability. The service brakes should be used to stop and hold the vehicle on an incline. The clutch may become excessively hot if the transmission is used for hill hold for a long period of time. Repeated use of the transmission for hill-holding can lead to premature transmission failure.

Operating Instructions:
Hybrid Regenerative Braking

The Eaton Hybrid Control Unit on this truck uses regenerative braking to charge the hybrid batteries. When throttle is at idle while coasting or the service brake is depressed to slow the vehicle, the hybrid system uses the electric motor to charge the batteries. The regeneration will feel as if the brake is being lightly applied. This charging helps slow down the vehicle. The full power of the service brake is always available to the driver. The regenerative braking is available in addition to the standard service brake.

The Eaton Hybrid Control Unit will automatically shut off regenerative braking when the batteries fully charged. This can occur after continuous braking (long grades, mountain driving) has charged the batteries to their maximum capacity. The chassis service brakes are always available.

Eaton Hybrid System Regenerative braking is automatically shut off during an ABS (anti-lock brake) event, i.e. skidding on black ice while trying to brake the vehicle.

Please refer to the *Vehicle Operation* section of the Chassis Operator's Manual for a description of the base chassis air brake and ABS systems.

Hybrid Cooling System

Reservoir:

The coolant reservoir for the hybrid cooling system is located under the hood, on the side of the body

Keep the coolant level at the center of the sight glass and do not top off the reservoir. It should be checked at the beginning of each day as part of the pre-trip inspection.

Heat Exchanger:

The heat exchanger is located on the driver side of the vehicle between the frame rail and the body. The fins must be kept straight and clean for the system to work.

Coolant type:

The hybrid cooling system uses extended life coolant mixed 50/50 with water. Refill only with a quality extended life coolant.

Preventative Maintenance

Eaton will be responsible for all service to the hybrid system with the exception of maintaining the hybrid system coolant level.

Eaton Responsibility

- HEV system including:
  - Batteries
  - Electric Motor
  - Inverter
  - HEV cooling system
  - Pushbutton shifter
  - High voltage cables
  - Transmission
  - Clutch
  - HEV wire harnesses

OEM Responsibility:

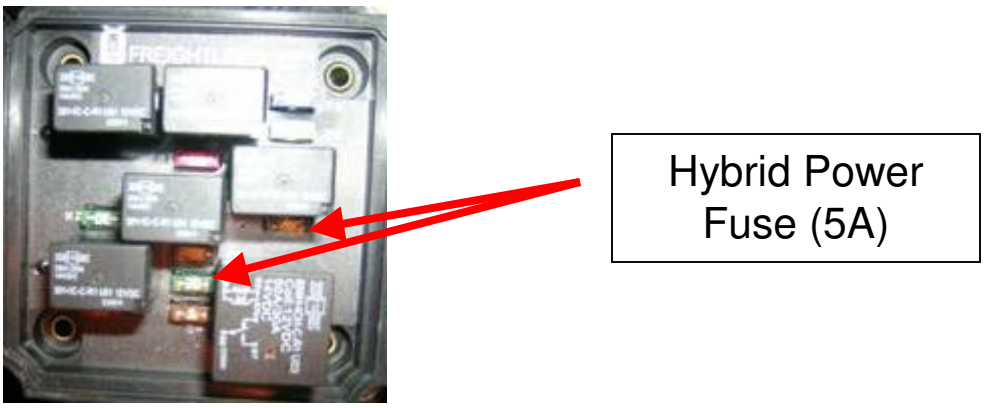
- Conventional vehicle preventative maintenance
- Oil changes
- Engine maintenance
- Chassis maintenance
- Body maintenance
- Interior maintenance
- Maintain Hybrid System Coolant level

Servicing the Vehicle

Conventional Preventative Maintenance can be performed in the usual fashion. Only Eaton is to service the High Voltage Hybrid Components

The safest way to service the vehicle is with the key in the “OFF” position. This simple action disables the high voltage components and contains the high voltage electricity to the Power Electronics Carrier. If the engine must be running to perform maintenance, the following procedures **MUST** be followed:

1. Start with the vehicle in the key off position.
2. Remove the Hybrid Power Fuse located in the under-hood fuse box.
3. Turn the key to the “start” position. The engine will start with the 12-volt starter.
4. Commence service. The inverter is disabled. High voltage is limited to the power electronics carrier. This procedure disables the hybrid system.
5. To enable the hybrid system, turn the key to off position and replace the fuse.



Servicing the Vehicle
Transmission torque-locked

If the truck is shut down or stalls in gear, the transmission may become locked in gear. The transmission will attempt to shift into neutral during the next power up if the shifter is in neutral gear. If neutral is achieved, a solid “N” appears on the dash. If neutral cannot be achieved, a “DASH” will appear on the display and the engine will not start. If a dash appears during power up and the push button console is in neutral try the following:

1. **Turn the key OFF and let the transmission power down for a least 2 minutes**
2. Depress the brake pedal.
3. Release the parking brake
4. Make sure the push button console is in Neutral
5. Turn the key to the ON position
6. The transmission will attempt to shift into Neutral once you turn the key ON. You may need to slightly release the brake pedal to relieve the torque from the driveline.

Servicing the Vehicle
Product Diagnostic Mode

Product Diagnostic Mode "PD"

Product Diagnostic Mode (PDM) is used to help diagnose inactive codes that may have been set during normal driving. This diagnostic mode increases the sensitivity of the fault sensing capability. **PDM is only to be used by Eaton service personnel.**

To enter PDM mode:

1. The vehicle must be stationary, the engine must not be running, the vehicle parking brake must be set.

2. Perform two key clicks of the ignition switch starting in the "ON" position and ending in the "ON" position

The engine must be disable first.

In the event the transmission is put in Product Diagnostic Mode, a "PD" will be displayed on the gear display, and the **truck will not start.** Use the following procedure to exit Product Diagnostic Mode:

1. Select Neutral "N" and turn the key off.

2. **Wait at least 2 minutes.**

3. Turn the key on and power the system up.

4. Verify that there is an "N" on the gear display.

5. Start the engine.

Glossary of Terms

ABS (Anti-lock Braking System)- braking system that applied and releases the brakes rapidly to prevent the wheel from skidding.

HEV (Hybrid Electric Vehicle)- a vehicle that combines an electric motor with a conventional engine.

PEC (Power Electronics Carrier)- Plastic box located in bed of truck that contains high voltage hybrid batteries.

TRAINING RELEASE FORM

I have received Hybrid Electric Vehicle (HEV) training for the Hybrid Truck User Forum (HTUF) Utility Truck Program.

By signing this document, I am certifying that I agree with the following statements:

- I have received HEV training from an authorized trainer (from Eaton, Customer manager, or Customer training manager).
- I fully understand the training material provided to me.
- I have been adequately trained to operate the HEV truck safely.
- I feel qualified to operate the HEV truck and feel no additional training is required.
- I agree to operate the HEV truck as specified by the training material.

Name (printed): _____

Employee #: _____

Customer Name: _____

Date of Training: _____

Instructor Name: _____

Location of Training: _____

Signature: _____

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