Spicer® Electric Chassis Systems

DANA

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Drivetrain Products

# Dana Electrification Systems Supplementary Operator's Manual

## Peterbilt Model 220EV

PBSG-0021
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# Roadside Assistance

Call toll-free to talk to someone at the PACCAR Customer Center.

**1-800-4Peterbilt** (1-800-473-8372)

The Customer Call Center is open 24 hours a day, 365 days per year, and is staffed with trained personnel (English and other languages if necessary), free of charge, to provide total roadside assistance. Their custom mapping system can locate the nearest Authorized Dealers and Independent Service Providers (ISPs) based on the vehicle's location. In addition, the customer center can dispatch services for tires, trailers, fines and permits, chains, towing, hazardous clean-up, mechanical repairs and preventive maintenance services. If they cannot answer a specific question, they will direct you to a representative who can.

## First Responder’s Guide

First Responder instructions are available through the QR code or URL below. Download and print the documentation for the Peterbilt 220EV with your current model year. Routinely check the NFPA site to ensure your first responder materials are up-to-date.

*QR Code for First Responder Instructions*

*(scan with phone camera or use URL below)*

*https://www.nfpa.org/Training-and-Events/By-topic/Alternative-Fuel-Vehicle-Safety-Training/Emergency-Response-Guides/Peterbilt*

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# Introduction

This vehicle is equipped with a 100% electric powertrain that was manufactured and installed by Dana. It is important to understand the operational characteristics and functions of this electric vehicle (EV). The supplemental manual provides information that is not part of the base OEM chassis. Please refer to the OEM operator's manual for information unrelated to the EV functions.

# Electric Powertrain

The Dana Electric Powertrain is a 100% electric drive and does not use an internal combustion engine. Some of the vehicle's systems operate differently and have different operating characteristics than vehicles equipped with an internal combustion engine. Read this manual thoroughly before you drive the electrified vehicle to ensure the operating and safety requirements are understood.

As the vehicle operates, the HV battery pack gradually discharges. If the HV battery pack is completely discharged, the vehicle will not operate until it is recharged.

**Warning**: Allowing the high voltage battery pack to discharge below specified limits may damage the HV battery pack and affect the battery pack's warranty.

This vehicle uses a low voltage (LV) lead acid battery pack and a high voltage (HV) lithium-ion battery pack. The LV battery pack uses two 12V lead acid batteries for startup of both 12V and 24V components. Similarly to internal combustion engine powertrains, the HV DC-DC converter uses energy from the high voltage battery to power auxiliary components such as the audio system, supplemental restraint system, headlights, power steering, and windshield wipers.

The HV battery pack provides power to the propulsion motor that moves the vehicle. The HV battery pack also charges the LV battery pack and powers LV components through the DC-DC converter. The vehicle must be plugged to recharge the HV battery pack. Additionally, the vehicle system can extend the vehicle range through regenerative braking. Regenerative braking converts braking power into electricity that is stored in the HV battery pack while the vehicle is decelerating or driven downhill.

**Warning:** Your vehicle contains a sealed lithium-ion high voltage battery. If lithium-ion battery is disposed of improperly, there is a risk of severe burns and electric shock that may result in serious injury or death. There is also a risk of environmental damage.

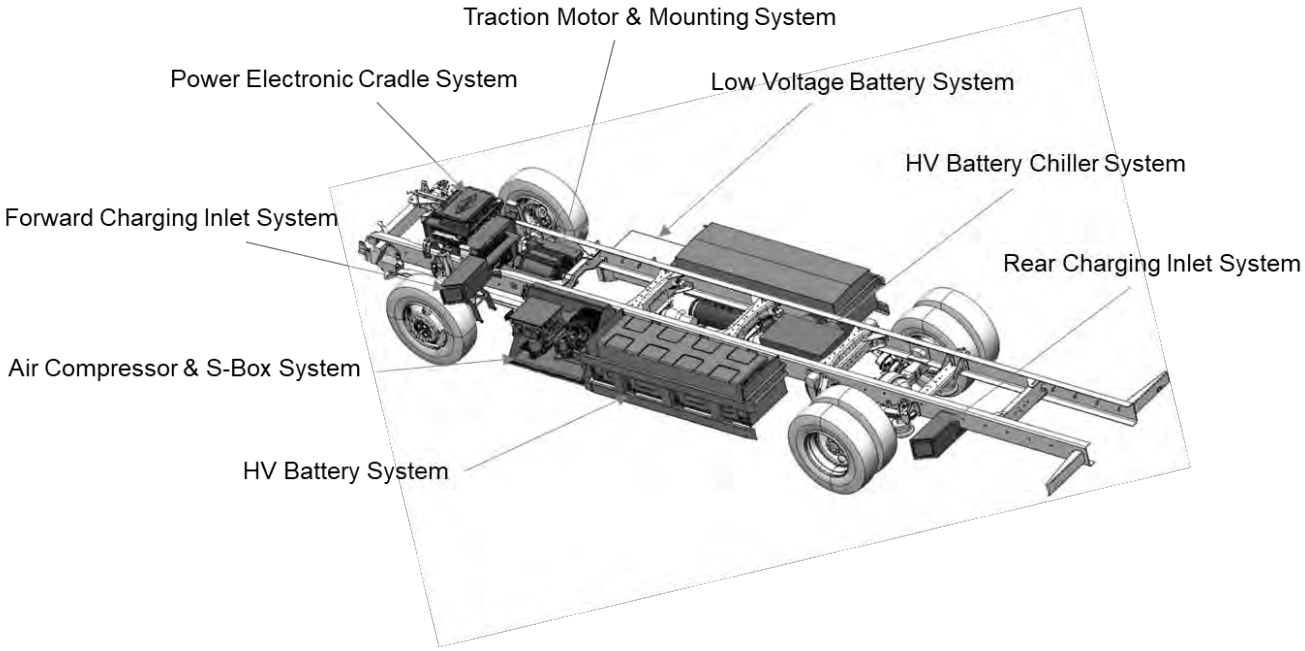
**Caution:** To prevent damage to the lithium-ion battery:

- Do not expose the vehicle to extreme ambient temperatures for extended periods.
- Do not store the vehicle in temperatures below -13 °F (-25 °C) for more than seven days.
- Do not leave the vehicle for more than 14 days where the lithium-ion battery available charge gauge displays a zero or near zero state of charge.
- Do not use the lithium-ion battery for any other purpose.

**Note:** If the outside temperature is -13 °F (-25 °C) or colder, the HV battery pack may freeze, and it cannot be charged or provide power to run the vehicle. Move the vehicle to a warmer location.

The capacity of the HV battery pack to hold a charge will decrease with time and usage. As the battery pack ages and capacity decreases the driving range will decrease. This is normal, expected, and not indicative of any defect in your HV battery. Testing has indicated that battery capacity will be up to 80% of original capacity after six years. This is only an estimate, and this percentage may vary significantly depending on individual vehicle and HV battery pack usage. The HV battery pack has limited service life.

The image below identifies each major component of the electrification system. Your truck will have either a forward charging inlet or a rear charging inlet.



# TELEMATICS

This vehicle is equipped with electronic modules that monitor and record data for several vehicle systems, including the traction motor, battery packs, braking and other electrical systems. Other electronic modules record information concerning driving conditions, including parking operation, braking, acceleration, trip distance and other related information about your use of the vehicle. Features such as air conditioner or headlight usage, diagnostic trouble codes, vehicle charging, vehicle speed, direction and/or location are also recorded to provide feedback depending on the vehicle driving state.

Some data is stored by the vehicle for vehicle servicing. Other data concerning your vehicle's operation and performance is wirelessly transmitted through the vehicle onboard telematics system upon vehicle start-up or at other intervals to Dana. This data may be used by Dana for various purposes, including: to provide you with EV services troubleshooting; evaluation of your vehicle's quality, functionality and performance; analysis and research by Dana designed to, among other things, optimize performance of future electric vehicles including improvements in future battery life; and as otherwise may be required by law. Such data may be shared with Dana's parents, subsidiaries, affiliates, successors or assignees, authorized PACCAR certified DEP dealers, PACCAR's marketing partners, your fleet company (if your vehicle is a fleet vehicle), your rental company (if your vehicle is a rental vehicle), and third-party service providers such as cellular information systems and data management providers.

Telematics features are dependent on cellular data transmission. Some areas may have limited or no cellular connectivity, resulting in a loss or interruption of data transmission. As a result, certain features may be temporarily unavailable. Even in areas with good reception, cellular connectivity can be adversely affected by tall buildings, apartments, tunnels, underground parking, mountains, etc. Even if the signal strength bar of the in-vehicle data communication module indicates good reception, connectivity may be disrupted. This does not indicate a malfunction. Operate the system again after a few minutes to restore connectivity.

# Chapter 1 - Safety

## Safety Alerts and Warnings

### SAFETY ALERTS

Please read and follow all safety alerts in this manual. They are for your protection and information. The alerts can also help you avoid injury to yourself and your passengers. The alerts can also help prevent costly damage to the vehicle. Safety alerts are highlighted by safety alert symbols and signal words such as "Warning", "Caution", or "Note." Do not ignore any of these alerts.

### Warning

The safety message following this symbol and word provides a warning against operating procedures that could cause serious injury or even death. Failure to follow these warnings could also cause equipment or property damage. The alert will identify a hazard, how to avoid it, and the probable consequence of not avoiding the hazard.

### Caution

The safety alert following this symbol and word provides a caution against operating procedures that could cause equipment or property damage. The alert will identify a hazard, how to avoid it, and the probable consequence if ignored.

### Note

The alert following this symbol and word provides important information that is not safety related but should be followed. The alert will highlight things that may not be obvious and is useful to your efficient operation of the vehicle.

### Warnings and Safety Regulations

**Warning:** The following warning and safety regulations must be strictly observed for your safety, for bystanders' safety, and to prevent vehicle damage.

Read the instructions and warnings on the labels on all components. Failure to follow these warnings could cause equipment damage, property damage, injury, and death. The instructions and warnings are for your health and safety.

## Modification of the Vehicle

Modifying your vehicle could make it unsafe. Some modifications could affect your vehicle's electrical system, stability, or other important functions. For no reason should the electric powertrain be modified. Modification to any of Dana's components will void your warranty. Modifications to the electric chassis could cause death or personal injury.

**Warning:** Connecting to an unapproved CAN (Controller Area Network) bus may trigger CAN fault codes. The manufacturer will not warrant failures or damage caused to the CAN bus components or vehicle if the failure or damage is caused by to improper connections to the CAN bus or improper messages.

## Cooling System Fill Cap

**Warning**: Do not remove the radiator fill cap while the powertrain is hot. Scalding steam and fluid under pressure may escape. You could be severely burned. Failure to comply may result in death or personal injury.

## Fire Extinguisher

Ensure that an approved fire extinguisher is securely fastened under the driver's seat, within the driver's reach and easily accessible for first responders. Routinely check the fire extinguisher according to its manufacturer's instructions. If the fire extinguisher has been used, it must be replaced with a new fire extinguisher or refilled according to the manufacturer's instructions before the truck can be returned to service.

### Fire Instructions:

During a fire, certain plastic seals can produce gases, which with water form a corrosive acid. Do not touch any fluid on the vehicle.

1. Contact firefighters.

**Note:** Do not attempt to put out a battery pack fire with the provided fire extinguisher.

2. If it is possible, take the keys out of the ignition and turn the 12V Disconnect to the "OFF" position.
3. Engage the park brake
4. Create a safety perimeter of at least 100 feet (31 m) around the vehicle, per NFPA guidelines.

## Oils and Lubricants

Various kinds of oil and other lubricants used on the vehicle may constitute a health hazard if they contact the skin. This also applies to electric powertrain coolant, refrigerant in air conditioning systems, and battery acid. Do not contact vehicle liquids without the appropriate personal protective equipment.

**Caution:** The refrigerant lube used on this truck is different from the typical refrigerant lube used for PACCAR vehicles. Failure to use the correct refrigerant lube could

result in isolation failures.

## Maintenance Activities

When carrying out maintenance work under the cab, make sure the cab is fully tilted and locked to prevent it from falling back accidentally.

Following a collision, only tilt the cab in an emergency. The tilting mechanism may be damaged and a high voltage hazard might exist. (The end stop may no longer be on the lifting cylinder.)

**Warning:** Always support the vehicle with appropriate safety stands if it is necessary to work underneath the vehicle. A jack is not adequate for this purpose.

## Environment

Pollution is a serious threat to the environment. To keep pollution to a minimum, follow the below rules:

- Do not dump used oil, lubricants, hydraulic fluid or coolants in drains, in sewers, in landfills or on the ground. This is illegal. Return these fluids to the designated authority or appropriate chemical waste collection company for recycling or destruction. All used fluids must be stored separately.
- Service the vehicle regularly according to the instructions and recommendations in this manual. If component service intervals are not provided in this manual, check the truck manufacturer's operator's manual.

## High Voltage (HV) System

**Note:** The high voltage system on this vehicle has no components that require service by the user. Do not disassemble, remove or replace high voltage components, cables, or connectors. All high voltage cables are colored orange for easy identification.

**Note:** If a collision occurs, remove the keys from the ignition (if they are safely accessible) and do not touch any high voltage cables, connectors, or components.

**Note:** In the unlikely event of a fire, immediately contact your local fire emergency responders.

**Warning:** Do not touch or attempt to remove any orange colored high voltage cables, connectors, or components.

**Warning:** The high voltage system on this vehicle has no parts that an owner or unauthorized service technician can service. Under no circumstances should you open or tamper with the battery or other HV components. Always contact a certified service dealer.

**Caution:** The HV battery pack requires no routine owner maintenance. If the battery service icon illuminates, contact a PACCAR Dealership.

**Warning:** Repair of HV components or the HV battery is very dangerous and could cause severe burns and electric shock. Never remove or disassemble any HV components in this vehicle. All inspections and repairs must be conducted by an authorized and trained service dealer.

## Low Voltage (LV) System

The cab system of this vehicle operates on 24V while other areas operate on 12V. When replacing or fitting electrical or electronic components, always verify that they are suitable for the system voltage.

## LV Batteries

**Warning**: Always disconnect the battery negative (ground) lead before carrying out repairs or service on the electrical system.

**Warning:** Before attempting any work on the batteries or electrical system, remove all jewelry. If metal jewelry or other metal contacts with electrical circuits, a short circuit may occur, causing personal injury and causing electrical system failure and damage.

## Welding

**Caution:** Frame rails are heat-treated and must not be welded. Electrical components nearby welding could also be damaged. Dana's warranty does not cover damage to components caused by any type of welding.

**Warning:** Prior to performing any maintenance on the electric vehicle, always perform the HV voltage shutdown procedure.

**Warning:** High Voltage Shutdown
The high voltage system on this vehicle has no parts that an owner or unauthorized service technician can service. Under no circumstances should you attempt to perform any part of this procedure. This procedure should only be performed by a trained and certified service provider.

## Jump-Starting Introduction

Jump-starting a vehicle is not a recommended practice due to the various LV battery installations and electrical options. However, if your LV battery is discharged (dead), you may be able to start it by using energy from a good LV battery in another vehicle. This is termed jump-starting. Be sure to follow the precautions and instructions below.

## LV Charging Reminders

- Use protective eyewear.
- Keep all batteries away from children.
- Never reverse LV battery poles.
- Never attempt to place the vehicle in motion with LV batteries disconnected.
- Keep the LV battery clean and dry.
- Look for any signs of damage. Replace damaged 12V batteries according to the battery manufacturer's guidelines.
- Do not coat LV battery terminals with an improper grease. Use petroleum jelly or commercially available, noncorrosive, nonconducting terminal coatings.

**Warning:** Thaw frozen LV batteries at room temperature before charging them. Remove all the filler caps before charging.

**Warning:** Charger cables must be connected positive to positive (+ to +) and negative to negative (- to -). If connected improperly, LV batteries could explode. Failure to comply may result in personal injury, death, equipment, or property damage**.**

**Warning:** Always ensure the LV battery charger is OFF before connecting or disconnecting the cable clamps. To reduce the danger of explosions and resulting death or personal injury, do not connect or disconnect charger cables while the charger is operating.

**Warning:** Never use a fast charger as a booster to start the system. This can seriously damage sensitive electronic components such as relays, radio, as well as the LV battery charger. Fast charging a LV battery is dangerous and should only be attempted by a competent mechanic with the proper equipment.

**Warning:** LV batteries contain acid that can burn and gasses that can explode. Ignoring safety procedures may result in death, personal injury, equipment, or property damage.

**Warning:** Never jump-start a LV battery near fire, flames, or electrical sparks. LV batteries generate explosive gases that could explode. Keep sparks, flame, and lighted cigarettes away from LV batteries. Failure to comply may result in death, personal injury, equipment, or property damage.

**Warning:** Never remove or tamper with LV battery caps. Ignoring this could allow LV battery acid to contact the eyes, skin, fabrics, or painted surfaces. Failure to comply may result in death, personal injury, equipment, or property damage. Be careful that metal tools (or any metal in contact with the positive terminal) do not contact the positive battery terminal and any other metal on the vehicle at the same time. Remove metal jewelry and avoid leaning over the LV battery.

**Caution**: Using higher voltage booster for the LV batteries will cause expensive damage to sensitive electronic components such as relays, sensors, and control units. Always charge the LV batteries at the proper voltage. Failure to comply may result in equipment damage. Improper use of jumper cables or not following these procedures can damage the electrical system or cause serious damage to both vehicles.

**Warning**: Heed all warnings and instructions from the jumper cable manufacturer. Failure to comply may result in personal injury, death and equipment or property damage.

**Note**: Review the warranty policy before performing any maintenance procedures. An extended warranty may be voided if unauthorized maintenance is performed during this period.

**Caution:** Do not modify or improperly repair the vehicle's electrical system or electric powertrain. All electrical repairs should be performed by an authorized dealer. Improper repair or modifications will void your warranty and/or cause serious damage to your vehicle.

**Warning:** When jump-starting with a booster LV battery, it is best to jump-start with an equivalently powered vehicle. Verify that the booster vehicle's LV battery has the same volt and CCA specifications as the dead LV battery before attempting to jump-start. Failure to comply may cause an explosion resulting in death, personal injury, equipment, or property damage.

**Warning:** When connecting and disconnecting jumper cables, ensure they are not caught on any moving parts under the hood. Failure to comply may result in death, personal injury, equipment or property damage.

## Jump-Starting Instructions

To jump-start your EV system with a booster battery, the instructions and precautions below must be followed. Jump-starting provides power to the LV system for the electrical systems to operate. The electrical systems must be operating to allow the HV battery pack to be charged. Jump-starting does not charge the HV battery pack. The HV battery pack must be charged before the vehicle can be driven.

Ensure that the 12V battery disconnect switch is in the connected position and all LV cables are secure before attempting to jump-start the vehicle.

## Preparing the Vehicles

1. Remove any jewelry that may contact the battery terminals.
2. Select a jumper cable that is long enough to attach to both vehicles in a way that ensures neither vehicle touches each other.
3. Position the two vehicles together, but do not allow them to touch.
4. Turn OFF all lights, heater, radio, and any other accessory on both vehicles.
5. Set the parking brakes by pulling the park brake knob back. The park brake knob is located behind the push button shifter.
6. Ensure the vehicle with the Dana electric powertrain has the 12V disconnect in the “OFF” position. If the other vehicle has a battery disconnect, ensure it is also in the “OFF” position prior to connecting the two vehicles.

### Connect the LV Batteries

7. Attach one end of a jumper cable to the positive (+) terminal of the discharged (dead) battery. This will have a large red + or P on the battery case, post, or clamp.
8. Attach the other end of the same cable to the positive (+) terminal of the good (booster) battery.
9. Attach the remaining jumper cable FIRST to the negative (-) terminal (black or N) of the good battery.
10. Attach the other end of the negative cable to a bare metal part.

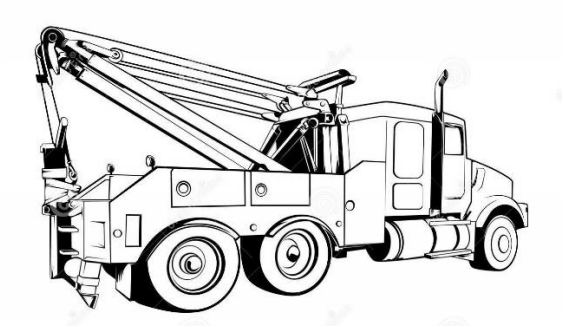
**Note:** Always connect the battery terminals from positive (+) to positive (+) and from negative (-) to negative (-).

11. If either vehicle is equipped with battery disconnects, ensure that they are in the "ON" position.
12. Start the vehicle that has the good battery first, and run the vehicle for 5 minutes.
13. Start the vehicle that has the discharged (dead) battery. If you do not get a “READY” indication, contact the nearest authorized dealer.

### Removing Jumper Cables

14. Perform steps 4 through 1 in reverse. Ensure the negative cable is removed from the vehicle with the discharged battery first. During these steps, keep the vehicles running.

# Towing Instructions



**Warning:** Shutdown the HV system before towing electric commercial vehicles for ANY distance. HV Shutdown should never be performed by anyone that has not been trained and certified.

**Warning:** After an accident, follow the first responder's manual special instructions for towing.

**Warning:** Both axle shafts must be removed from the drive axle housing to ensure the propulsion motor will not rotor during the towing process. Otherwise, it may generate unsafe voltage even with the HV bus shutdown.

**Note:** Only follow the shutdown procedures found in Dana's manuals for this electric chassis.

## Towing Procedure

1. **Remove the key from the ignition and turn the 12V disconnect to the "OFF" position then wait for 2 minutes.**
2. Block the front and back of at least one of the vehicles tires so the truck cannot move during this procedure.
3. Starting on the driver's side, place a drip pan under the end of the drive axle wheel hub to catch the lube.
4. With an impact gun, remove the axle shaft nuts, washers and tapered dowels if used.
5. Remove the axle shaft from the drive axle housing.

**Note:** Do not use a chisel or any other wedge device to loosen the shaft. Chisels and wedges will damage the flange of the wheel hub.

6. Wipe the end of the wheel hub to remove any oil.
7. Install a wheel end cover over the axle shaft studs.
8. Reinstall the wheel end fasteners and tighten in a crisscross pattern. Do not over tighten.
9. Repeat steps 2-7 on the passenger's side of the drive axle.

# Chapter 2 - Emergency

## Emergency Operation

- Proper techniques and standard protocols are essential for safety during an emergency operation involving an electric vehicle (EV).
- Shut down procedures will vary between OEM's and even vehicle models.
- Because EV's can move with little or no sound, conventional methods of determining if a vehicle can be moved under its own power will be difficult to do. Making assumptions that the vehicle is not powered up can be dangerous.
- Always be prepared to deal with hazardous conditions when working with EV's by wearing the proper safely equipment. Failure to follow this warning could result in severe personal injury or death.

## After a Crash or Impact

1. Turn off the vehicle key switch.
2. Exit the vehicle.
3. Turn off the 12V disconnect switch if it can be safely accessed.
4. If there is not a fire, check for visible battery damage while maintaining a distance of 6 feet (2 meters) or more.

## Turn-On Procedure for No HV Battery Pack Damage (including the enclosure):

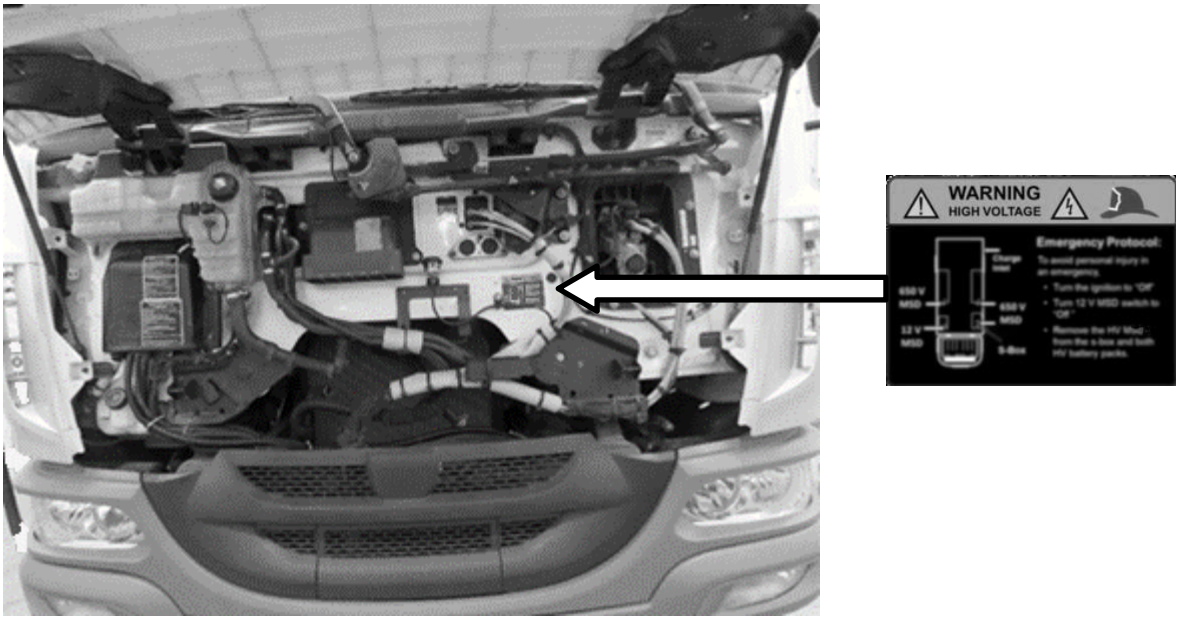
1. Turn the 12V disconnect switch back to ON.
2. Turn the key to the START position.

## Safety Procedures for HV Battery Pack Damage or Nearby Fire

1. Contact firefighters.
2. Provide fire fighters a copy of the first responders field guide and direct them to the first responders label under the hood (see image below).Create a safety perimeter of at least 100 feet (31 meters) around the vehicle, per NFPA guidelines.
3. Move to an area upwind and far enough away from the accident site to avoid breathing any hazardous smoke or gases.

Note: Always assume that the HV battery packs could be damaged after an accident and have it inspected by a service technician.

**Warning:** Do not enter the vehicle or touch the chassis until receiving approval from first responders.




First Responders Label Location

# Chapter 3 - Truck Operation

## Vehicle Display and Instruments

This vehicle is equipped with a PACCAR cluster behind the steering wheel and a battery electric truck display to the right of the steering wheel. The new telltale and gauge locations (relative to the previous diesel cluster) are noted below.

### Overheat Warning Light

**Caution:** If a coolant temperature warning shows an overheat condition, or you have any other reason to suspect the EV powertrain may be overheating, continued operation, even for a short time, may result in a fire and the risk of personal injury and severe vehicle damage. Take immediate action as explained in "When the Coolant Overheats".

### When the Coolant Overheats

1. Turn on the hazard-warning flasher, immediately pull over to a safe place that does not impede traffic, and place the truck in park.
2. Turn off the vehicle and contact the PACCAR Customer Center for direction.

### Stop Telltale


Instrument Check: Yes
Location: Cluster
Color: Red

Pull over as soon as possible when the “STOP Sign” telltale on the cluster is activated. Permanent damage to the truck or personal injury could occur with continued driving. After pulling over, call the PACCAR Customer Center.

### Service Vehicle Soon Telltale

Instrument Check: Yes
Location: Cluster
Color: Yellow

The Service telltale will activate when the vehicle needs to be serviced soon.

## High Voltage Hazard Telltale

Instrument Check: Yes
Location: Electrification Display
Color: Red

This telltale appears with a popup message when high voltage components are not functioning as required. Pull over as soon as possible when this telltale on the digital display is activated. Permanent damage to the truck or personal injury could occur with continued driving. After pulling over, call Dana's Real Time Warranty Group.

**Warning:** If "Insulation Fault," "HVIL Fault," or other High Voltage System Faults appear on the Dana display, follow the below instructions. Personal injury, death or permanent truck damage could occur if the below instructions are not followed.

High Voltage Hazard Procedure:

1. Pull over as soon as possible.
2. Remove the keys from the ignition.
3. Exit the truck.
4. Call the PACCAR Customer Center for guidance.

## Regenerative Braking Retarder Telltale

Instrument Check: Yes
Location: Cluster
Color: Green

The regenerative braking retarder telltale will activate after every key cycle or when the retarder ON switch located on the steering wheel is pressed. When the telltale is activated, regenerative braking will imitate the engine braking events typically experienced when the retarder is enabled. Regenerative braking automatically turns on after every key cycle.

**Warning:** Drivers should disable regen braking under low traction road conditions (e.g. ice, rain).

## Charging Telltale

Instrument Check: Yes
Location: Cluster
Color: Green

This telltale illuminates when the truck is charging, and a key is in the ignition. It will let the driver know when the charger cable is connected, and vehicle safety functions are preventing the truck from drive off.

## Limited Performance Mode Telltale

Instrument Check: Yes
Location: Cluster
Color: Yellow

The limited performance mode telltale will illuminate when severe derating is occurring on the powertrain. Refer to electric truck display for more information when events such as this occur. If the STOP telltale is not activated, it is possible to continue driving the truck, but the truck's acceleration and deceleration capabilities will be very limited.

## Regenerative Braking System Telltale


Instrument Check: Yes
Location: Cluster
Color: Yellow

The regenerative braking system (RBS) telltale will activate when severe derating to the trucks regenerative braking system is occurring. The foundation brakes will still work without RBS function to allow continued driving without the retarder functionality.

## DC-DC Converter Telltale

Instrument Check: No
Location: Cluster
Color: Yellow

The DC-DC converter is equivalent to an alternator since it supplies low voltage power to the truck. This telltale illuminates when the DC-DC converter malfunctions, and low voltage components could be impacted.

## PTO Enabled Telltale


Instrument Check: Yes
Location: Cluster
Color: Yellow

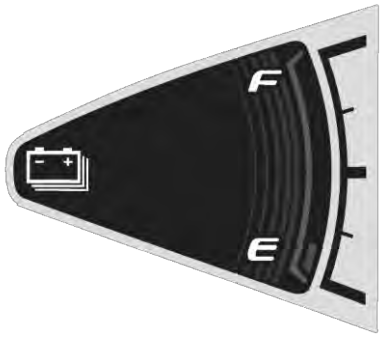
The PTO telltale will illuminate if you have an electric PTO on your truck and it is enabled.

## Low Charge Level Telltale

Instrument Check: Yes
Location: Cluster
Color: Yellow

The Low Charge Level telltale is located in the charge level gauge. This telltale will have a yellow illumination when the truck is close to entering Limited Performance Mode and needs to be recharged. When the charge level is within normal operating bounds, this telltale will have white backlighting.

## Charge Level Gauge




Location: Cluster

The Charge Level gauge shows the high voltage battery pack's state of charge from 0% (Empty) to 100% (Full) useable energy. When the state of charge is low, the battery telltale on this gauge will have orange illumination.

## Power Output Gauge


Location: Cluster

The Power Output gauge shows the power output from the high voltage battery pack. This includes auxiliary components (e.g. cab climate control, powertrain fan, HV battery heater, HV battery chiller, lights, etc.).

### Gauge Values

**OFF:** When the truck is not ready to drive, the gauge's needle will stay at OFF.
**READY:** When the truck has started up and ready to move, the needle will initially move to READY.
**CHARGE** (green region): During regenerative braking events, the needle will hover in the green CHARGE region. AS regen braking power increases, the needle will move further counter-clockwise into the green CHARGE region.
**POWER** (blue region): While the truck is ready to move but staying at 0 mph, the auxiliary component operation will keep the needle in the blue POWER region. While driving, especially during acceleration events, the needle will move further clockwise into the blue region.

# Electrification Display

Three System State Modes (Vehicle state is always display in the top right of the display

**OFF** – 12V ACC is present, but HV is off.


**DRIVING** – The HV bus is ON and the truck is fully operational.

**Caution**: Beware of pedestrians. This vehicle is much quieter than diesel powered models.

**Warning:** Do not assume the vehicle is off if the vehicle is silent!


**CHARGE** – The HV bus is ON and CCS1 connector is plugged into the vehicle's inlet.

**Auxiliary Power** – The auxiliary power gauge monitors usage of other chassis components.

The truck range loss due to auxiliary power usage is shown in miles per hour of truck operation.

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Energy Screen Button

Auxiliary Power Gauge

# Chapter 4 - Quick Start Guide

## Charging the High Voltage Battery Pack

**Warning:** Never spray liquid at high pressure towards the charging port while charging. Failure to follow these instructions can result in serious personal injury or damage to the vehicle, charging equipment or property.

**Caution:** Use a compatible charger when charging the HV battery. Using different types of chargers that are not listed by Dana as compatible may have serious effect on the vehicle's durability.

Note: During extreme hot or cold ambient conditions, keep the truck plugged in after charging is complete. This will enable the High Voltage battery pack temperature management systems to help keep the battery packs in their optimal operating temperatures for quick startup and to prevent damage from extreme cold for long time periods.

Note: During long-term storage, follow the below steps:

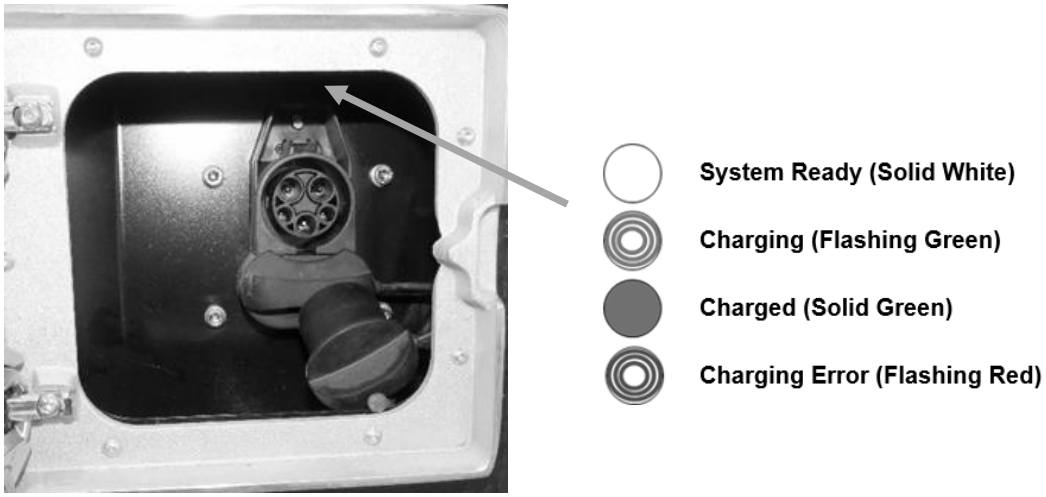
1. Charge the HV battery to 50% SoC and verify the cells are balanced.
2. Recharge the battery pack to 50% State of Charge and verify the cells are balanced every 3 months.
3. Keep ambient temperatures between 32 °F (0 °C) and 77 °F (25 °C).

**Warning:** Do not store the battery pack above 95 °F (35 °C) for extended time periods. Permanent HV battery damage will occur.

Follow the instructions below to charge the vehicle batteries when not in use.

## Charging Procedure

1. Turn off the vehicle and remove the ignition key.
2. Open the charging port cover, and the charge port LEDs will illuminate WHITE.
3. A single ‘chirp’ will be heard, inside the cabin.
4. The system will run a self-check and activate.
5. A double ‘chirp’ will be heard; the electrification display will show READY; and the charge port LEDs will turn GREEN.
6. When the charge port LEDs begin flashing GREEN, the vehicle is charging.




7. A flashing red light indicates a charging error.
8. A steady green light means the charge is complete.

# Driving the Vehicle

## Operating Procedure – Starting the Vehicle

1. With foot on brake pedal, turn the key to start position.
2. After single ‘chirp’ heard, released the key.
3. The system will run a self-check and activate.
4. After double ‘chirp’ heard, the display will show READY


5. With foot on brake, select a gear.
   (D-N-R on the PACCAR gear selector)
6. The gear will be show in the PACCAR cluster
7. Remove park brake and drive.

**Warning:** Vehicle noise may be reduced in some operation modes. The vehicle operator must remain aware of nearby vehicles or pedestrians at all times. Failure to comply may result in death, injury, or property damage.

# Turning the Vehicle Off

1. With vehicle at a standstill, enable the park brake via parking brake knob.
2. Turn the key to the OFF position, system will initiate shutdown
3. System will run a self-check and disable itself
4. The vehicle state will momentarily change to OFF before the display turns off.


# Turning on Cabin Heating

1. To turn on Cabin Heating, first press the Cabin Heating button shown in the image below with the red arrow.
2. A green LED in the center of the Cabin Heating button will illuminate, indicating that the Cabin Heating has been switched on.
3. Change the remaining HVAC controls (temperature knob, fan speed, fan direction) as usual for heating.

# Chapter 5 - Maintenance

## NORMAL EV POWERTRAIN MAINTENANCE

**Warning:** Prior to performing any maintenance on the electric vehicle, always perform the HV voltage shutdown procedure. Lockout the 12V switch to ensure the system cannot be accidentally powered on prior to completing any maintenance.

The electric powertrain requires coolant inspections and to be changed at regular intervals. See chart below. Do not attempt to perform any type of maintenance or disassembly of the EV power control unit or EV motor assembly. Doing so may damage the component and/or electrical system.

| Component | Fluid | Fill Volume | Check Frequency | Change Frequency (mi) |
|---|---|---|---|---|
| Drive Axle Lube | BASF 2986 FE 75W90 (Synthetic) | 3.1gal (11.8L) | 25,000 mi | 100,000 mi |
| Powertrain Coolant | TRP Extended Life Coolant Prediluted 50/50 | **6gal (22.7L)** | Daily | 100,000 mi |
| Cabin Heating Loop | | 3gal (11.4L) | Monthly | 100,000 mi |
| Battery Pack Chiller Coolant | | 141kWh: 6gal (22.7L)<br>209kWh: 8gal (30.3L)<br>282kWh: 9gal (34.1L) | Daily | 100,000 mi (change fluid)<br>50,000 mi (replace vent) |
| Air Compressor System Maintenance Oil | Castrol Alphasyn T46 or Chevron Cetus PAO 46 | 0.4gal (1.4L) | Find info in Bendix manual. | 50,000 mi |
| Air Compressor/Dryer Filters | See service manual | See service manual | See service manual | See service manual |
| HV Battery Chiller Refrigerant | R134a | See service manual | As needed/required | N/A |
| HV Battery Chiller Lubricant | See service manual | See service manual | As needed/required | N/A |
| Air Conditioning Refrigerant | R134a | See service manual | As needed/required | N/A |
| HV Air Conditioning Condenser Lubricant | Check fill port label | 0.26gal (1L) | As needed/required | N/A |

## NORMAL VEHICLE CHASSIS MAINTENANCE

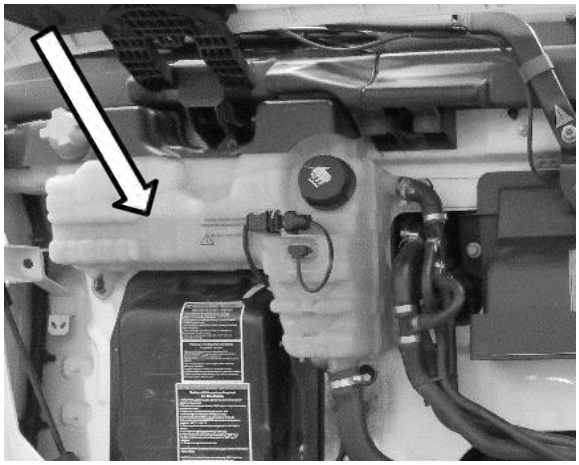
Follow the maintenance intervals as outlined in the truck OEM owner's manual for all necessary chassis inspections and maintenance.

**Note:** In a ELC-filled cooling system, the freezing point should be maintained between -30 °F (-34 °C) and -43 °F (-42 °C).

# Fluid Level Inspection

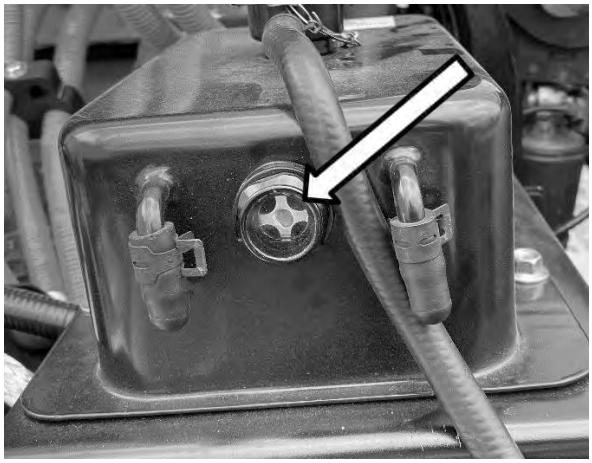
## Electric Powertrain Coolant Level Inspection

1. The fuild level should be between the MIN and MAX fill lines marked on the surge tank.
2. Fill levels below the MIN fill line should be top off using the procedure below.



## HV Battery Chiller Coolant Level Inspection

1. The fuild level should be between the MIN and MAX fill lines marked on the surge tank site glass.
2. Fill levels below the MIN fill line should be top off using the procedure below.



## Coolant Top Off

**Warning:** Removing the fill cap from a hot radiator can cause scalding coolant to spray out and burn you badle. Protect face, hands, and arms against escaping fluid and steam by covering the cap with a large, thick rag. Do not try to remove the cap until the surge tank cools down or if you see any steam or coolant escaping. In all situations, remove the cap slowly and carefully.

Top off the cooling system when coolant does not rise to the level indicated as “MIN” on the surge tanks for both coolant systems. The powertrain surge tank is transucent which allows the coolant level to be seen. The HV battery pack chiller surge tank uses a sight glass to visualy monitor fluid levels.

1. Remove the surge tank cap (do not remove the surge tank coolant level sensor cap)
2. Fill system with premixed coolant to “MAX” level on the surge tank.

**Note:** Failure to follow this procedure and maintain proper coolant level can cause system failure.

**Note**: Do not over fill a cooling system. Excess coolant may result in overflow, loss of antifreeze and reduced corrosion protection.

**Note**: Do not use the pressure cap opening to fill the surge tank with fluid.

**Note**: Maximum recommended ELC concentration is 60% ELC and 40% water by volume.

**Caution:** When adding fluid, be sure to use fluid of the same type. While many fluids have the same description and intended purpose, they should not be mixed due to incompatible additives. Mixing incompatible fluids may lead to equipment damage.

### Electric Powertrain Coolant Change Instructions

Dana recommends that a vacuum purge and refill tool be used to drain and refill the cooling system to ensure the removal of air that may cause damage to the circulation pump.

**Important:** Carefully read the safety instructions that comes with your vacuum tool.

### HV Battery Chiller Coolant Change Instructions

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# Chapter 6 - Warranty

## Warranty Limitations of Liability

Dana warrants that the battery systems shall be exempt of defects of material and workmanship for a period of six (6) years from the date of delivery.

## Warranty Exclusions

- Damage or failure resulting from negligence, improper use (including use that would not be consistent with the User manual provided by Dana).
- Normal wear and tear of parts and lubricants, including hydraulic oil and filters, heating and cooling fluids, fuses.
- Repairs or part replacement not specifically authorized by Dana.
- If client does not inform Dana of a product defect on a timely basis.

The warranty does not cover any damage caused by abuse by using the vehicle outside its suggested operating parameters, mishandling, dropping or otherwise abusing the battery pack, or by opening or disassembling any component. The BMS Blackbox will log any use outside the suggested temperature range, any abuse of charge/discharge limits and all opening of contactors under load. If any abuse or misuse is detected either by the BMS Blackbox or the engineers at Dana, the warranty will be void. The warranty does not cover the replacement of the MSD with built-in fuse if it is determined to be defective due to abuse or client error (blown fuse). The warranty will not cover the parts nor labor of replacement of contactors, pre-charge circuit or other systems if they are misused outside of agreed upon scope and operating parameters.

- In case one of the parts or product components ceases to function, or becomes defective during the warranty period, Client must inform Dana immediately and provide a period of thirty (30) working days thereafter to allow Dana to execute the repair at client locations.
- Dana's obligations and client recourse hereunder are limited to the reimbursement described above and Dana shall not be responsible of damages exceeding the price of the products or services nor punitive or exemplary, indirect, accessories, related or any similar damage, whether predictable or nonpredictable, that could result from the products or services.
- The warranty supersedes and replaces any other warranty whether express or implicit, including without limitation usual warranties. No employee or representative of Dana is authorized to modify this warranty in any way or provide any other warranty.
- Client may have access to confidential information of Dana. The term « Confidential Information » means any information or knowledge considered by Dana as being secret and confidential in nature, including knowledge or information relating to formulas, processes, components, ingredients, test equipment, methodology, special equipment, devices, tools, experimental work or research, inventions, drawings, sketches, books, technical and scientific data of Dana, software, know-how, trade secrets and financial information relating to the business of Dana.
- The term «Confidential Information» does not include information that (a) are or become part of the public domain without negligence or omission of Client; (b) were already in legal possession of Client before being obtained from Dana and was not obtained by Client, directly or indirectly from Dana; (c) were legally communicated to client by a third party without limitations; or (d) were developed

independently by Client. Client agrees to maintain confidential Dana Confidential Information, and to use this Confidential Information solely for the purposes contemplated and will forbid its use or divulgation by or to any person outside of its organization.

- In addition, Client agrees to protect the confidential information against any accidental or unauthorized divulgation by taking the same reasonable precautions, he would take to protect its own exclusive confidential of similar importance and with a level of care at least equal to the one generally applied in the industry. All confidential Information will always remain the property of Dana. When Confidential Information is transmitted in writing, Client will retain such in a secure manner until advised otherwise. All Confidential Information on any physical support shall be returned to Dana on demand, including all copies of those. 6) All intellectual property rights on the product and all information and data, developed, prepared or compiled by Dana shall remain the exclusive property of Dana and Client agrees to sign any document necessary or useful to relinquish any right of intellectual property arising from Dana's products and services. Client agrees not to, directly or indirectly, in any way possible, engage in reverse engineering on Dana products.