# 2015-06 – Electric-Drive Commercial Motor Vehicle Inspections

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## Summary

This safety bulletin is to educate inspectors about the hazards of high voltage (HV) in electric-drive commercial motor vehicles.

## Background

There are an increasing number of electric-drive medium-duty (Class 4-6) and heavy-duty (Class 7-8) trucks and buses in North America. Electric-drive commercial motor vehicles (CMVs) have been in use since the late 1990s. With many potential environmental, functional and economic benefits, electric-drive systems are becoming more popular in CMVs. There are several different types of electric-drive CMVs:

- Battery (also called a rechargeable energy storage system)
- Hybrid-electric
- Plug-in hybrid-electric
- Fuel cell

## Difference between Low Voltage and High Voltage Electrical Systems

It is not possible to describe each type of electric-drive CMV in this bulletin; however, virtually all types of electric-drive CMVs have a high voltage electrical system and a low voltage electrical system. The main difference between the electrical systems of an electric-drive and a conventional CMV is that the electric-drive CMV uses both high and low voltage electricity and the conventional CMV uses only low voltage electricity. The typical low voltage system in a CMV is 12/24 volts direct current (VDC) and can run as high as 42 VDC. Human contact with low voltage does not cause serious injury or death. A high voltage system is defined as an electrical system with 60 or higher VDC or 30 or higher volts alternating current (VAC). The typical electric-drive CMV includes a high-voltage system operating anywhere between 300 and 800 VAC. Human contact with high voltage (VDC or VAC) can result in serious injury or death (i.e., electrocution). This is why inspectors need to be aware of potential hazards when dealing with an electric-drive CMV and take precautions to avoid electrocution.

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## Identifying an Electric-Drive Commercial Motor Vehicle

There is no regulation that requires electric-drive CMVs to be labeled to alert first responders of potential electric shock hazards, except in the state of New York. The state of New York requires the label shown in Figure 1 for electric-drive transit buses; however, this label may not necessarily be perceived as a warning.


Figure 1

Industry best practices call for manufacturers and fleet owner/operators to label such vehicles. For example, the Society of Automotive Engineers (SAE) J2910 calls for electric-drive heavy-duty trucks and buses to bear a warning label on the front and side of the cab (International Electromechanical Commission label (IEC60417) for high voltage) which consists of a yellow triangle with a black thunderbolt (see Figure 2).

Figure 2

This is one way that inspection personnel may use to infer that a CMV has a high voltage.

Another way to identify electric-drive vehicles is via manufacturer badging or company branding.

Figure 3 is an example of badging (circular blue-green hybrid badge) affixed to the truck cab door by the original equipment manufacturer of the truck.


Figure 3


Figure 4

Figure 4 is an example of electric-hybrid vehicle branding by the fleet owner/operator of the truck.

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Additional indicators that inspectors may use to determine that a CMV has high voltage are labels on compartments that bear a high voltage warning (see Figures 5 and 6).


Figure 5

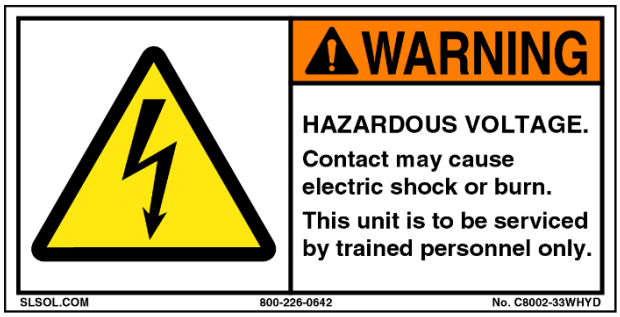


Figure 6

## Inspecting an Electric-Drive Commercial Motor Vehicle

The presence of orange-colored insulation on electrical conduits or cables (see Figure 7) is an indicator for inspectors that a CMV is equipped with high voltage. These cables can be found in the engine compartment, inside or outside of frame rails, under or behind the cab, or in the drive axle area.

SAE J 1673 calls for the orange color to be used on all high-voltage cables on all vehicles. This is not to be confused with orange-colored extension cords, which are for purposes of visibility to denote a potential trip hazard, or orange-colored electrical outlets, which denote isolated-ground circuits where sensitive electronics can be plugged in.

Additional vehicle indicators include unique sound or lighting, no exhaust, charging port or visual battery packs.


Figure 7

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When visually inspecting the vehicle, ensure that:

- Connectors are not damaged or not secure
- Wiring is not exposed, corroded, damaged, loose or improperly protected against chafing
- Other equipment is not damaged or loose, the cover is not bulged, fluid is not leaking, and there is no indication of burning, arcing or overheating

E-axle showing high voltage label, ground strap and HV cables protected with orange loom


Inverter with high voltage label, secured orange HV cables and cooling unit

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## Precautions to Take in the Presence of Electric-Drive Commercial Motor Vehicles

To avoid the danger of electric shock, inspectors should take the following precautions when inspecting around electric-drive CMVs:

- Do not touch or come in contact with any exposed copper wires from orange cable or conduit, or inside compartments marked “High Voltage” (Figures 5 and 6) or labeled with a yellow triangle bearing a black thunderbolt (Figure 2).
- Do not pull or tug on any wires coming out of orange conduit or out of compartments marked “High Voltage” or labeled with a yellow triangle bearing a black thunderbolt (Figure 2).
- Do not touch, manipulate or slide your hand along orange cable or conduit.
- Avoid wearing jewelry, rings or other metal accessories that could create an arc hazard.
- Do not attempt to open any compartment marked “High Voltage” (Figures 5 and 6) or labeled with a yellow triangle bearing a black thunderbolt (Figure 2).
- Do not poke fingers, screwdrivers or other tools into any holes, cracks, crevices or openings in compartments marked “High Voltage” (Figures 5 and 6) or labeled with a yellow triangle bearing a black thunderbolt (Figure 2).
- Do not touch any liquid that may be exuding from a battery (also called rechargeable energy storage system) regardless of low or high voltage.
- Do not smoke or use any heat-generating igniters or sparking devices near a battery because the electrolyte in the battery (some types of rechargeable energy storage systems) may be a flammable liquid.
- Do not inspect a vehicle that has a “High Voltage Fault” or “Stop Hybrid” or “Stop System” red light illuminated on the dashboard that could indicate loss of electrical isolation in the high voltage system. These vehicles should not be operated.

**NOTE**: Nikola commercial motor vehicles have an added safety feature. Drivers must have a PIN number to start the vehicle. The fuel cell electric vehicle (FCEV) master disconnect switch should not be turned off for an inspection, but the vehicle cannot be started without the driver PIN being entered.

## Inspection Guidance

Only a person who is trained in the operation and potential hazards of EV systems can safely conduct in-depth inspections. CVSA inspectors are only required to conduct visual inspections of electric vehicles.

Visually inspect all accessible parts outlined in this bulletin and always wear the recommended personal protective equipment issued by your department (e.g., gloves, boots, etc.).