ELECTRIC AND HYBRID VEHICLE SAFETY

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Electric and hybrid vehicles are changing the field of transportation. As the world's dependence upon fossil energy slowly decreases, many believe that the traditional combustion engine will be replaced in the not too distant future. Technological advances in the field, in conjunction with governmental incentive programs, are conducive to the increasing popularity of electric and hybrid vehicles.

Since the 1997 Kyoto Protocol, automobile manufacturers are under pressure to decrease damaging emissions, and many now offer new types of vehicles with decreased fuel consumption and emissions.

However, with more of these electric and hybrid vehicles on our roads, first responders must change the way they handle emergency situations involving these vehicles, such as accidents, fires, and immersion in water. Electric and hybrid vehicles often contain certain unique components that require special attention in order to ensure the safety of the occupants and first responders.

This document provides a general description of the special components of electric and hybrid vehicles and an overview of the information required to understand and handle electric and hybrid vehicles in an emergency situation. It is our belief that not only first responders must understand these safety considerations, but also the owners of these vehicles due to the potential of being exposed to unique risks.

In an electric vehicle, the propulsion from the engine is derived from strictly electrical energy. In these vehicles, it is important to note that both alternating and direct current travel in the vehicle wiring.

Hybrid vehicles utilize more than one energy source: a heat engine as well as an electrical one. The heat engine in a hybrid vehicle can not only propel the vehicle, but also recharge its batteries utilizing a generator.

Batteries in electric and hybrid vehicles are called "traction batteries". These contain cells that chemically store the energy, which makes it available electrically. Different technologies of batteries exist, including lithium-ion (Li ion), nickel-metal hybrid (Ni-MH), and lithium-metal-polymer battery (LMP).

In electric and hybrid vehicles, high voltage cables and connectors are color-coded bright orange, which allows identification of cables connected to the high-voltage traction battery, relative to the ones connected to a 12-volt battery.

Some vehicles have devices that allow power coming from the traction battery to be shut off. These devices can be manual or automatic and can be placed anywhere in the vehicle.

Of course, in addition to the components mentioned above, a number of other secondary components form the traction system.

The first responders to a scene must be knowledgeable of the risks of electric and hybrid vehicles, which include:

- Toxic risks;
- Electrical risks;
- Mechanical risks;
- Thermal risks.

The toxic risks are largely due to potential battery electrolyte leakage if the outer battery envelope is ruptured. Manufacturers have designed sturdy battery envelopes, making the risk of leakage relatively unlikely. However, certain high-impact accidents can still lead to battery damage. Another toxic risk can result from exposure of a battery to fire. This can create toxic fumes, which can be inhaled by the occupants and first responders. In addition, certain electric and hybrid vehicles have "super-capacitors" which allow "stop-and-start" driving. These capacitors may contain toxic substances.

The electrical risks are largely due to potential electrocution of people in or near the vehicle. These risks are particularly of note when the vehicle is connected to an electrical power grid at 240 or 480 volts, or while parked and power is provided only by the traction battery. When a vehicle is supplied power only by its traction battery, there are risks not only if the two poles of the battery are touched, but also if there is contact with the battery and metallic components after an accident. Vehicles are normally electrically isolated from the road by rubber tires, but following puncture of the tires, there can be current passing from the traction battery to the ground and metallic components of the vehicle. The electrical risk is a danger that is generally present during the first minutes of a fire, when the integrity of the traction battery has not yet been affected. The heat from a fire will typically destroy the insulation on electrical cables and lead to wire contact, which usually drains the battery fairly rapidly.

Mechanical risks are the result of the potential ejection of heated metal particles from metals reactive with oxygen and water. This is the case for sodium, lithium, and in some contexts, aluminum. In the case where the envelope of a traction battery is affected by a fire, metal particles can be ejected meters away from the vehicle.

Thermal risks are due to burns through fire or an electrical event. Electric and hybrid vehicles must conform to the Motor Vehicle Safety Act and its associated guidelines. The guidelines state that the vehicles must also conform to Technical Standards Document (TSD) 305 entitled "Electrolyte Spillage and Electrical Shock Protection". This TSD states ways to limit electrolyte leakage, retain a battery during a collision, and install high-voltage electrical insulation on the vehicle's frame.

Another risk posing a danger to occupants and first responders is the possibility of accidental vehicle energization and re-ignition. As such, first responders must know where the cut-off for traction battery power is located.
While helping occupants of a vehicle in an accident, the first responders must be aware that even if electrical power to the vehicle is deactivated, the airbags could potentially deploy, even up to 30 minutes after the ignition is shut off.

In a fire, it is suggested that first responders use liberal amounts of water as this minimizes the risks of a chemical reaction and will allow prompt cooling of the battery module.

In the case of immersion under water of electric and hybrid vehicles, the electrocution risks are basically nonexistent. Even touching the frame of the vehicle will not present any danger.

The extraction of occupants in electric and hybrid vehicles presents a special challenge. Extraction devices used in the upper region of the vehicle must not touch the floor level, or the firewall separating the passenger compartment from the engine compartment, or the partition at the trunk. First responders must also limit their frame-cutting to a zone that is specified by each vehicle manufacturer. Each vehicle has its own extrication diagram on which all critical components are indicated so that the safety of the first responders and occupants is ensured. Each manufacturer must clearly indicate on the extrication diagrams all the pertinent risks of their electric or hybrid vehicles.

It is clear that technologies associated with electric or hybrid vehicles will progress rapidly in the next few years. Ideally, all parties possibly affected by hybrid and electric vehicles will be knowledgeable of the specificities of these types of vehicles. This will lead to responsible knowledge of risks to users and first responders. Knowledge of these technologies will facilitate – in case of critical events – optimal cooperation between first responders and the occupants, so that detrimental effects and injuries are mitigated or eliminated.

If you have any questions or to learn more about this topic, please contact Philippe Bouchard, P. Eng., CFEI, CVFI at 877 686-0240 or *bouchard@expcep.com*.

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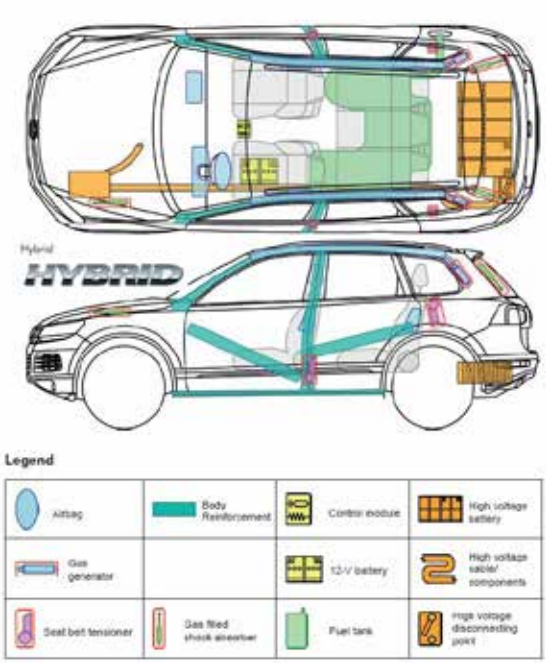

Example of vehicle safety information for the Touareg, (extract from the 2013 Hybrid and Electrical Vehicle Emergency Field Guide by NAFI)