FIRST RESPONDER SAFETY: ELECTRIC DRIVE VEHICLES

ELECTRIC DRIVE TECHNOLOGY

Electric drive vehicles use advanced technology batteries to power the vehicle. The energy required to recharge these batteries comes from either the electric power grid or from the vehicles on-board systems (e.g., regenerative braking or electric drive motor/generators). This energy is then converted to mechanical energy to move the vehicle.

ELECTRIC DRIVE VEHICLES

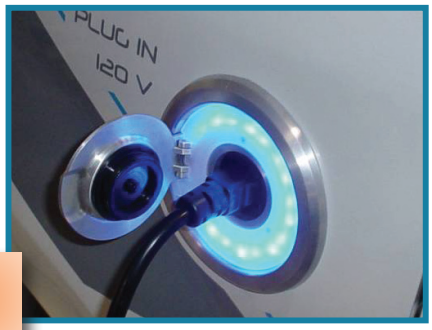
Electric drive technology is currently featured in four different vehicles types.

Battery Electric Vehicle (BEV). BEVs run exclusively on battery power. The energy to recharge the high-voltage battery comes from the power grid. This energy is converted from a charging station to the on-board high-voltage charger. Primary components consist of the high-voltage battery pack, power converter and electric drive motor/generator. The electric drive motor uses energy from the high-voltage battery pack (only power source of energy on the vehicle) to mechanically drive the wheels. In some drive situations, regenerative braking is used to capture some of the forward motion of the vehicle and converter this energy into electrical power to drive the vehicle or recharge the high voltage battery. Since the BEV is powered only by a battery, it is considered a zero emissions vehicle.

Hybrid Electric Vehicle (HEV). The HEV combines the benefits of an electric drive with the range of a gasoline vehicle. By utilizing the internal combustion engine (ICE) with a high-voltage battery pack fuel economy is increased and emissions are reduced. The blending of the two power sources within the transaxle assembly provides a seamless power flow to the drive wheels. Recharging of the high-voltage battery pack is accomplished from the on-board motor/generator. Regenerative braking is also used to recapture some of the forward motion of the vehicle to help recharge the battery pack. HEVs can be either a Parallel or Series hybrid. The most common HEV (Parallel) design has the engine and the electric motor/generator connected mechanically to the drive wheels. In a Series hybrid, only the electric motor drives the front wheels. The engine is producing power only to recharge the high-voltage battery. Driver/operators also have the benefit of 'start-stop' and 'launch assist' functions. The engine will turn off during stops and idle times to save fuel. During launch/acceleration the electric drive can provide all or part of the power needed to move the vehicle forward, thus saving fuel.

Plug-In Hybrid Electric Vehicle (PHEV). A PHEV can be charged with electricity like a BEV and run under engine power like an HEV, giving the vehicles optimum range, fuel economy, and emission reduction capabilities.

PHEVs are outfitted with on-board chargers that can recharge the battery pack when plugged into an standard electrical outlet. Like HEVs, PHEVs are powered by two energy sources—an ICE and a larger high-voltage battery. PHEVs use fuel more efficiently (smaller displacement engine) and produce fewer harmful emissions as compared to conventional vehicles.



PHEV battery charging. *Source: Ford*

Fuel Cell Electric Vehicle (FCEV). FCEVs are an advanced technology vehicle that uses a hydrogen fuel cell to generate electricity. The FCEVs have an efficiency rating > 65% compared to a conventional internal combustion engine at approximately 18%. During the process of creating electricity from the fuel cell unit, the compressed hydrogen gas that is stored on-board the vehicle is chemically changed within the fuel cell stack to create power. The FCEV is considered a zero emissions vehicle since there is only air, heat and water coming out the tailpipe. Some of the primary components on the FCEV are the high-voltage battery pack, high pressure hydrogen fuel tank, electric motor/generator and the Fuel Cell stack. Recharging of the high-voltage battery comes primarily from the fuel cell stack, however as with other types of electric vehicles the FCEV also has the ability to recapture some of the forward motion of the vehicle in the form of regenerative braking.

U.S. STATISTICS

- From 1999-2009, 1.6 million HEVs were sold, including approximately 290,000 in 2009 alone.[1]
- As of 2008, 56,901 BEVs were in use.[2]
- Approximately 5,050,000 gasoline gallon equivalents (GGEs) of electricity were used in electric drive vehicles in 2008.[2]
- As of May 2010, there were 538 electric vehicles supply equipment (EVSE) locations in the U.S.[3]

[1] HybridCars.com, Hybrid Market Dashboard, 2009.
[2] U.S. Energy Information Administration, Alternatives to Traditional Transportation Fuels 2008.
[3] U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center (AFDC).

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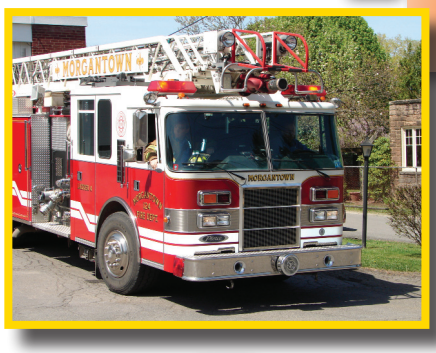
VEHICLE SAFETY

Electric drive vehicles undergo the same rigorous testing as conventional vehicles and must meet all the same standards for safety, including crash testing and airbags. First responders must understand the different components that make these vehicles unique in an emergency situation, such as high-voltage battery systems and cables. First responders must also be prepared to deal with battery fires as well as battery pack spills or leaks.



FIRST RESPONDER INFORMATION

Important considerations when responding to an incident involving an electric drive vehicle:

- Be sure to identify whether the vehicle uses electric drive technology.
- Be aware of vehicles in silent/electric drive mode.
- Isolate proximity key system.
- Approach the vehicle with caution and only with the appropriate training.
- Disable the high-voltage system.
- Eliminate all ignition sources.

In the case of a vehicle or battery fire:

- Isolate the fire, if possible.
- Extinguish the fire.

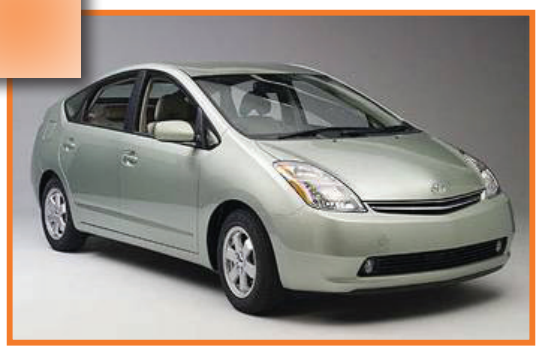
In the case of battery pack leaks, be aware that high-voltage batteries contain chemicals that have inherent dangers, including damage to human tissues.

If extrication is necessary:

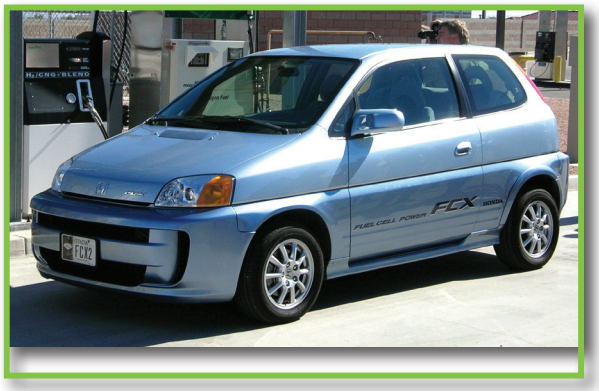
- Follow manual shut-down procedures for high-voltage systems.
- Know cribbing points and cut zones before cutting into a vehicle.
- Avoid cutting critical components.

ADDITIONAL RESOURCES

- U.S. Department of Energy, Alternative Fuels & Advanced Vehicles Data Center: http://www.afdc.energy.gov/afdc/
- Electric Drive Transportation Association: http://www.electricdrive.org/
- National Fire Protection Association: http://www.nfpa.org/



Toyota Prius HEV. Source: NAFTC



Honda FCX FCHEV. Source: NAFTC

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy Clean Cities Program under Award Number DE-EE0001696.