

# **Don't be Shocked — Be Informed**

## **Basics of Hybrid Safety for the Service Technician**

Second in a 3-part Series by Peter Zaidel

As a vehicle service technician, you are undoubtedly professionally excited about hybrid vehicles, which represent new engineering innovations that will be interesting to service. With hybrid vehicles expected to increase to 11% of all new car sales in the U.S. by 2012, hybrid vehicle training will be an increasing part of your professional education.

You are probably aware of the new dangers that hybrid vehicles can bring to the service technician. The high-voltage battery responsible for the outstanding mileage of the vehicles packs enough juice to kill, quickly. The electrolyte in the high-voltage battery will dissolve human tissue.

Fortunately, manufacturers designed hybrid vehicles not only with an eye on fuel efficiency and overall attractiveness to the buyer, but also with strong consideration for the safety of service technicians and emergency responders. In Japan, where many of the first hybrid cars were developed, the government required that hybrid vehicles be designed so that use of the “Jaws of Life” on a crashed and mangled vehicle could not penetrate the high-voltage circuit. Likewise, in the U.S., hybrid vehicles must comply with strict DOT standards to be allowed on the road.



### **Eight Basics of Hybrid Safety**

Vehicle manufacturers and third-party training centers have developed extensive programs for service technicians. Many technicians have not yet been trained, however, because hybrid vehicles are still rare at your place of work. Here's a list of some of the basics that every service technician should know:

1. Identifying a vehicle as a hybrid
2. Is the vehicle really turned off?
3. Protecting yourself from high voltage
4. Protecting yourself from corrosive liquids
5. Disposing of high-voltage batteries
6. Towing and in-shop vehicle movement
7. In case of fire
8. Getting trained

## 1. Identifying a vehicle as a hybrid

If it's a Prius, it's a hybrid – they are simple to identify. But what if the vehicle is a Lexus 400, or a Honda Civic, a Ford Escape, a Nissan Altima, a Saturn VUE, a GMC Sierra, or a Dodge Durango? Of the more than 25 hybrid vehicles sold in the U.S. today, over 20 have both hybrid and gasoline-only options with the same external appearance.

Your personal safety depends on being aware of all hybrids in the service area, even if you are not personally working on them. Almost all hybrids share these common identifiers:

- ✓ Hybrid badging on the body of the vehicle, typically including the rear right section and under-hood identifiers including the extra motor, the inverter, and additional “hybrid” badges
- ✓ READY indicator inside the vehicle, in the ignition area
- ✓ Orange high-voltage power cables

## 2. Is the vehicle really turned off?

This may be the single most important safety factor for service technicians working in a shop where there are hybrid vehicles, because the hybrid system is silent when running on battery. Hybrid systems can automatically turn themselves off and on, switching between the high-voltage battery and the gasoline engine, so it is easy for the technician to be unpleasantly surprised that a vehicle thought to be “off” is in fact “on.”

Many hybrids have keyless ignition, with on/off sensitivity up to 20 feet away from the vehicle. As a service technician, for your own safety, you need to observe the following service protocols:

- ✓ Whether you service hybrid vehicles or not, be aware that a silent hybrid is not necessarily powered off until it is verified that the vehicle is powered down.
- ✓ Keep vehicle keys a safe distance from the hybrid (more than 20 feet).
- ✓ Always check the vehicle dashboard hybrid indicator to ensure the vehicle is truly “off” before you begin any kind of work on the vehicle.
- ✓ Do not leave the key in the “on” position with the vehicle “off” for an extended period of time. This will cause the auxiliary 12 volt battery to rapidly discharge.

Shutting the vehicle “off” will accomplish the following safety objectives:

- ✓ Shuts down the hybrid system
- ✓ Isolates the high voltage current
- ✓ Stops (low-voltage) power to the SRS electric control unit (ECU)
- ✓ Shuts down the internal combustion engine and fuel pump

## 3. Protecting yourself from high voltage



You may be concerned that you can be electrocuted by simply touching the body of a hybrid vehicle because of the high-voltage circuitry inside. It is true that the amount of voltage and amperage in these vehicles is enough to be fatal if a technician comes in contact with the high-voltage circuits.

However, the high voltage system on hybrid vehicles does not ground to the body or the chassis. The high-voltage system is isolated from the car body completely.

A technician would have to touch pole-to-pole or become part of the circuit for an injury to occur.

- ✓ As a highly visible safety warning for drivers, technicians, and emergency responders, all high voltage hybrid vehicle circuits are encased and heavily insulated and normally identified by the SAE standard color-coding of bright orange.
- ✓ The vehicle manufacturers' maintenance books repeatedly remind you to never cut into, touch, mangle, or otherwise disturb the big Orange Cables that carry the high voltage from the batteries (in the back) to the controller (in the front).
- ✓ Always wear class "O" heavy-duty gloves (lineman's gloves) rated to withstand 1,000 volts when disconnecting high-voltage components, such as the battery. These gloves should be maintained in excellent condition and checked prior to each use to ensure there are no leaks. Even a small opening can draw current that is seeking a ground.
- ✓ Always disconnect the high-voltage hybrid battery before doing any major repair work or electrical work. See the instructions in the manufacturer's manual. Most manufacturers also recommend waiting at least 10 minutes before working on the vehicle after the battery has been isolated or disconnected. The high-voltage capacitors need time to discharge so there is no residual voltage to pose a shock hazard.

#### 4. Protect yourself from corrosive liquids

While most service technicians, even if untrained in hybrids, are aware of the danger of high voltage, there is another major safety difference that you need to be aware of. Lead acid batteries used in gasoline-powered vehicles are, as the name implies, acidic. With a pH around "0" most Service technicians have been trained in neutralization techniques. The high-voltage batteries of hybrids are completely different. They contain a corrosive electrolyte fluid that is a caustic alkaline (pH 13.5), so it's on the completely opposite side of the pH scale. The fluid is in a self-contained enclosure, so the risk of accidental spillage is reduced.

- ✓ Hybrid battery electrolyte fluid can dissolve human tissue.
- ✓ Neutralization techniques in case of a spill are completely different from those of lead acid battery fluids, because the hybrid battery electrolyte is a caustic alkaline solution. Learning the neutralization techniques is part of a hybrid training program.
- ✓ The high-voltage nickel-metal hydride (NiMH) battery pack is considered a hazardous material, and employees shipping the battery pack must be DOT HazMat certified.
- ✓ To avoid injury by coming in contact with the electrolyte, wear proper personal protective equipment including
  - Splash shield or safety goggles

- Rubber, latex or Nitrile gloves
- Apron suitable for alkaline
- Rubber boots

## 5. Disposing of high-voltage batteries

The high-voltage hybrid batteries are handled very differently than conventional batteries for gasoline-powered vehicles.

- ✓ The high-voltage NiMH battery pack is considered a hazardous material.
- ✓ Employees preparing the battery pack for shipment must be DOT HazMat certified.
- ✓ Hybrid battery packs are returned to the manufacturer for disposal. Most hybrid batteries have a core charge as a way for the manufacturer to ensure their return in order to collect the deposit. As hybrid batteries are now designed to last for the life of the vehicle, disposal will be rare for the next few years, until more vehicles reach end-of-life.

## 6. Towing and in-shop movement

Regenerative brakes can generate electricity if the vehicle is moved with all four wheels on the ground.

- ✓ Do not physically push hybrids around the shop. Either drive them or push them around on rollers.
- ✓ Do not tow hybrids with all four wheels on the ground. When towing vehicle hybrid, pick up the front wheels or carry it on a flat bed.

## 7. In case of fire

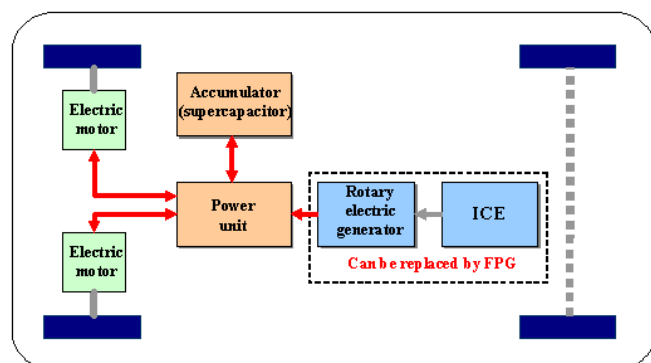
At last, something simple about the hybrid:

- ✓ Water is a suitable extinguishing agent for hybrid fires.

## 8. Getting trained

If your service department is planning to have hybrids in the shop, all employees should have some level of training, including oil-change technicians and lot personnel.

- ✓ All service department staff needs basic hybrid training, including hybrid identification.



- ✓ Hybrid manufacturers are a necessary and excellent source of training and documentation for service personnel.
- ✓ Training for technicians requires both hands-on training from the manufacturer and computer-based training.
- ✓ Many independent courses for teaching technicians about working on these vehicles can be found with an Internet search for “hybrid vehicle training technicians.” These are especially valuable for body shops, standalone service shops, and dealerships that want to service hybrids that are not in their franchise.
- ✓ For franchise dealerships, manufacturers generally require Master Technician certification and additional training in order to work on hybrid vehicles, including being current on OBD-II, scan tools, lab scopes, and electrical analysis.
- ✓ Special training is also required for collision centers.

Hybrid vehicles may seem similar to gasoline-powered engines, and indeed there is much in common. But the differences are important ones from a safety perspective, bringing risks of injury and even death to the untrained or careless service technician.



Proper training, adherence to your department’s service operations protocols, and constant vigilance around these “silent while on” vehicles will ensure a safe environment.

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#### Sidebar – Sources of hybrid vehicle training

##### Hybrid Electric Vehicle Information

- California Cars Initiative — <http://www.calcars.org/>
- EV World (news) — [www.evworld.com/](http://www.evworld.com/)
- Electric Drive Transportation Association <http://www.electricdrive.org/>
- Fuel Economy — [http://www.fueleconomy.gov/feg/hybrid\\_sbs.shtml](http://www.fueleconomy.gov/feg/hybrid_sbs.shtml)
- How Stuff Works — <http://auto.howstuffworks.com/hybrid-car.htm>
- Hybrid Cars — <http://www.hybridcars.com/>
- Hybrid Car Online — <http://www.hybridcar.com/>
- Hybrid Vehicle Consortium — <http://www.hybridconsortium.org/>
- Hybrid Jungle — <http://www.hybridjungle.net/>

- National Renewable Energy Lab — <http://www.nrel.gov/vehiclesandfuels/hev/>
- NE Vehicle Consort. — [www.navc.org/](http://www.navc.org/)
- SAE — [www.sae.org/servlets/techtrack?PROD\\_TYP=PAPER](http://www.sae.org/servlets/techtrack?PROD_TYP=PAPER) (search: hybrid vehicles)
- SoulTek — [http://www.soultek.com/clean\\_energy/hybrid\\_cars/hybrid\\_cars.htm](http://www.soultek.com/clean_energy/hybrid_cars/hybrid_cars.htm)
- SW Research Inst. — [www.swri.org/4org/d03/vehsys/home.htm](http://www.swri.org/4org/d03/vehsys/home.htm)
- U.S Dept. of Energy — [http://www.eere.energy.gov/afdc/vehicles/hybrid\\_electric.html](http://www.eere.energy.gov/afdc/vehicles/hybrid_electric.html)
- Union of Concerned Scientists -- <http://www.hybridcenter.org/>
- Wikipedia — [http://en.wikipedia.org/wiki/Hybrid\\_vehicle](http://en.wikipedia.org/wiki/Hybrid_vehicle)

#### Vehicle-Specific HEV Sites

- DaimlerChrysler — [www.daimlerchrysler.com/index\\_e.htm?/products/products\\_e.htm](http://www.daimlerchrysler.com/index_e.htm?/products/products_e.htm)
- Ford — [www.ford.com/](http://www.ford.com/) (click on: environmental vehicles)
- GM — [www.gm.com/](http://www.gm.com/)
- Honda — [www.automobiles.honda.com/](http://www.automobiles.honda.com/)
- Nissan — [http://www.nissanusa.com/altima/#/key-features/hybrid/?intcmp=Altima\\_HEV.Promo.Altima.Home.P3](http://www.nissanusa.com/altima/#/key-features/hybrid/?intcmp=Altima_HEV.Promo.Altima.Home.P3)
- Solectria — [www.solectria.com](http://www.solectria.com)
- Toyota — [prius.toyota.com/](http://prius.toyota.com/)

#### Aftermarket training

- Automotive Career Development Center — [www.auto-careers.org/](http://www.auto-careers.org/)
- Mid-Del Technology Center — [www.evtraining.com/](http://www.evtraining.com/) (click on “hybrid technology”)
- i-car (for body shops) — [www.i-car.com](http://www.i-car.com) (also required by Toyota body shops)
- SAE Hybrid Symposium — <http://www.sae.org/events/training/symposia/hybrid/>
- National Alternative Fuels Training Consortium — <http://www.naftc.wvu.edu/>
- Automotive Technician Training Services -- <http://www.attstraining.com/Classes.html>

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