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New Vehicle Extrication: 2010 Toyota Highlander Hybrid

by [Jason Emery](#)

First released in the 2006 model year, the Toyota Highlander hybrid is now in its second generation, which started with the 2008 model year. From the perspective of the emergency responder, there are two changes in the second generation that should be noted. They include the ignition system function and the identification logos, which will be discussed later. Both of these versions operate on a “full” hybrid system.

Vehicle Identification

The physical design and outward appearance are essentially the same as the non-hybrid versions (figure 1). External logos can be used to identify the vehicle, and can be found on the front fenders and the right side of the rear tailgate (figure 2) and also on the front fenders (figure 3). Additionally, the second generation has the words “Highlander Hybrid” imprinted on the front door sill/scuff plate (figure 4). The cooling vents for the high-voltage battery can be found below the front edge of the second-row seating (figure 5).



(1)



(2)



(3)



(4)



(5)

The dashboard area and instrument clusters differ slightly between the two generations, but the location of the vehicle's "ready" light remains essentially the same. The "ready" light, which indicates if the

vehicle is ready to move, even if the gasoline engine is shut down, can be found on the left side of the dash (figure 6). Additionally, the tachometer, which can be found in the standard hybrid, has been replaced with a power meter that indicates the kW output of the vehicle. Other hybrid indicators that can be observed in the engine compartment include orange wiring, high-voltage warning labels, and the hybrid logo on the plastic engine cowling (figure 7). The second-generation models also have a label on the underside of the hood in the area of the latching mechanism, which indicates the location of the 12v and HV batteries (figure 8).



(6)



(7)



(8)

Hybrid Systems and Operation

Both Highlander Hybrid generations operate using a 288v high-voltage battery to power its electric motors. The battery is comprised of 30 low-voltage (9.6v) modules connected in series. They are “dry cell” NiMh batteries and do not pose a leak hazard. The high-voltage battery can be found under the second-row passenger seat. As with other hybrids on the road, battery charging is accomplished through a process known as “regenerative braking” as well as using power from the gasoline engine to create electricity. This hybrid is considered a “full hybrid” and, as such, has the ability to run only on its electric motor at lower speeds; it also uses the motor to assist the gasoline engine, depending on the acceleration needs. The Highlander utilizes both DC and AC current in its hybrid system; the high-voltage system is also used to run the vehicle’s air-conditioning system. In addition, the high-voltage system is used to power the electric power steering system using stepped-down voltages of 42v – first generation (yellow wiring) or 12v - second generation.

Response Considerations

Controlling Hazards

Consistent with other vehicles, especially when dealing with hybrids, responders must be sure to approach the vehicle in a manner that does not place them in the potential path of travel. Approach vehicles involved in an accident from the sides. Hybrids present a unique danger in this manner, as it is possible for the vehicle’s gasoline engine to be off and still be able to move forward or backward if it is in its “ready” state. If the vehicle is in gear and the driver removes his foot from the brake or depresses the accelerator, the vehicle will move without warning. It is strongly recommended that you secure any vehicle involved in a motor vehicle accident by placing it in “park” and securing the parking brake. Chocking the wheels upon approach to the vehicle is a good concept to abide by, especially if the interior of the vehicle is not immediately accessible.

It is an important next step to shut down the vehicle’s high-voltage system as well as the occupant protection systems. The first recommended method can be achieved by turning off the vehicle’s ignition and disconnecting the negative side of the 12v battery. Note, however, that the first and second generation Highlander have different types of ignition system controls. From 2006-2007 (first generation), the ignition system uses the traditional ignition on the steering column. From 2008-current (2010 model year) (second generation), Toyota’s smart key system is utilized. This consists of a key fob that communicates bi-directionally with the vehicle (figure 9). The vehicle detects the presence of the operator with the key and allows the ignition to be started with the push of the ignition button located on the dash to the right of the steering column (figure 10). These keys should be removed to a distance of 16 feet from the vehicle to ensure that they cannot be recognized by the vehicle. If possible, ask all of the vehicle occupants if they have a key to ensure that you have control of them.



(9)



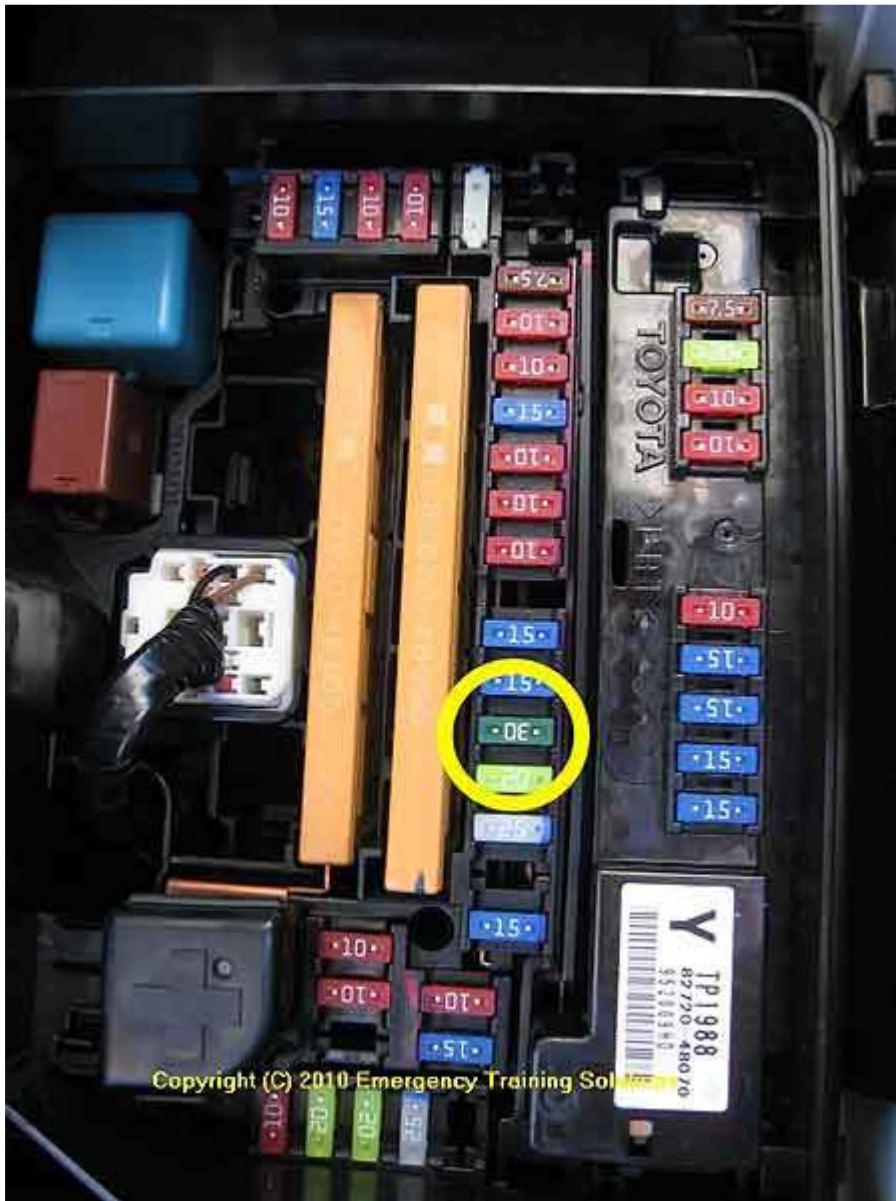
(10)

Additionally, keep in mind that hybrid systems require that you to shut off the vehicle's ignition first and then disconnect the 12v battery; otherwise, you will not be successful in shutting down the 12v power. If you disconnect the 12v battery while the vehicle is still on it, such as when the vehicle is in its ready mode and the engine is off, it will not shut down any of the 12v systems in the vehicle, because. when the vehicle is on, the 12v power comes from the highvoltage system where a DC to DC converter steps it

down to 12v.

Disconnecting the 12v power opens the relays in the high-voltage system and prevents power from flowing through it. Advertised bleed downtimes for the capacitors in the high-voltage system are five to 10 minutes on Toyota models. The Occupant Protection Systems can remain active for up to 90 seconds after shutting down the 12v power.

The second recommended procedure for the Highlander is utilized if the vehicle's ignition cannot be reached. This consists of disconnecting the 12v battery as previously described and pulling the IGCT fuse in the engine compartment fuse box. On both generations the fuse box can be found on the driver's side of the compartment. The fuse amperages, colors, and layouts of the fuse box, however, are different. In the first generation, it is a red 10A (IGCT No. 4) fuse; in the second generation, it is a green 30A (IGCT) fuse (figure 11).



(11)

Extrication Operations

There are no specific techniques for extrications involving the Toyota Highlander Hybrid. As with all hybrids care must be taken not to cut through high or medium-voltage cables. The high-voltage cables run underneath the center of the vehicle from the battery to the engine compartment. The orange cabling can be difficult to visualize; however, as it is in large part covered by black plastic. Responders should also use standard Occupant Protection Systems visual identification procedures to ensure that they operate safely around them. Standard types of air bags and seat belt pretensioners can be found in the Highlander, including side curtain airbags.

The basic concepts for handling the Toyota Highlander follow many of the other full hybrid models that are currently on the road. Prior to extrication operations, always be on the lookout for indicators of a hybrid or other types of alternative fueled vehicles to account for how their features may impact extrication operations. Responders should also be able to identify the differences between the first- and second-generation models and handle those differences accordingly.

If you have been involved with an incident involving hybrid or alternative fuel vehicles, please contact me at Jason@etsrescue.com. Case studies involving specific incidents will help further educate firefighters on the proper methodology for dealing with hybrids and other alternative fueled vehicles.

For a more in-depth look at the principles of hybrid vehicles reference [“Hybrid Vehicles: Separating Fact from Fiction.”](#) *Fire Engineering*, July 2009.

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