



AR&D

## Automotive Research and Design

*Technology and Training Since 1987*



### *HEV Tip of the Month*

HEV High Voltage Class 0 electrical gloves that are "in service" are required to be retested every 6 months, according to the American Society for Testing and Materials (ASTM) Standard: F496, 7.1

### *Take a Guess!*

**Hint:** Most people rarely use me; San Francisco may be a city that would appreciate me; D.C. is a city that requires me. What am I?

[Email](#) your guess to win one of five tool pens! (Please include your name and a valid shipping address; UPS will not ship to a PO Box)

### **What is this HEV, PHEV, EREV, and EV Technology Stuff Anyway?**

In our first newsletter we thought it would be appropriate to provide some definitions around the many different electrically based propulsion technologies offered by automotive manufacturers. Moreover, it is vitally important to know what these technologies are (and are not) to ensure that instructors, students, businesses, and technicians are aware of how these technologies will impact them. Our company has been in the electric propulsion business for almost 25 years and understanding the technology always begins with knowing the terms.



We have seats available in two of the remaining HEV TTT courses for year 2011.

## The Acronyms

To understand how the technologies relate will determine how to instruct, analyze, diagnose, and repair these advanced electric propulsion systems...so let's cover the basic terms. You may already know several or all of these terms but, for the uninitiated it is an important element to learning these systems. Our intention is not only to provide you our insight into advanced electric propulsion systems, but also provide links to credible websites that will provide additional information in support of our newsletters. In future newsletters, we will be using these terms regularly to discuss the different operating modes and technologies.

### Website links to assist you:

[HEV- Hybrid Electric Vehicle](#)

[PHEV- Plug-In Hybrid Electric Vehicle](#)

[EREV- Extended Range Electric Vehicle](#)

[EV- Electric Vehicle](#)

### What Do All of These Technologies Mean to You?

With all of the acronyms and systems definitions with the various systems it could become rather confusing to someone just beginning their study of the advanced electric propulsion systems. However, here are some tips on how to view the systems to keep things simple:

All HEV, PHEV, EREV, and EV electric propulsion systems share very similar components and operating strategies. All of these systems use electric machines, power inverters, dc-dc converters, and energy management (i.e., battery pack) systems. Therefore, if you understand how these components operate in one of the technologies- the fundamentals can be applied to all of the technologies. This could be similar to the fuel injection system in a traditional engine fuel management system. All manufacturers use either port or direct injection systems and the components may look very similar. Even the operation, analysis, and repair of the systems is very similar. The same general rules can be applied to the electric traction system.

The primary hardware difference between these systems is the power level, energy capacity, volume, and mass of the battery pack. The only significant difference is the battery technology (Nickel-Metal Hydride or Lithium Ion). It should be noted that in automotive applications there is at least two (2) major Lithium Ion technologies that are used and the operation & diagnostics of each technology is very, very different.

The primary software/operating difference between these systems are how the engine is used

[Click here](#) for registration info

To view the complete 2011 and 2012 training schedules, [click here](#).

**AR&D has two satellite schools we schedule HEV TTT courses to support summer availability.**



Madison Area Technical College

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Portland Community College

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(EV system not included). In an HEV system, the battery pack has very little energy capacity, but significant levels of power. Therefore, the electric propulsion system is used primarily for short periods at low vehicle speed when the engine is inefficient.

In a PHEV system a battery pack with more energy is used, but with about the same power level as an HEV. This will permit the hybrid system to operate the system for a longer period on pure electric propulsion and blend more electrical power with the engine (i.e., electric system is the primary system for propelling the vehicle) for a longer period. This results in higher engine fuel economy. The EREV system is entirely different (in operating modes, software controls, and in some hardware components) from the PHEV system. See Tip #4.

The EREV (Chevrolet Volt) system is a very unique and brilliant system developed by General Motors. This strategy permits 100% electric only propulsion (regardless of vehicle speed) for 25-50 miles (vehicle operator and battery pack temperature dependent). This will allow most daily commutes to be driven electrically and, if necessary, longer commutes can easily be driven with the engine generating electricity to power the electric traction system. After the battery pack and state-of-charge (SOC) is reduced to approximately 20% the engine is seamlessly cranked/started. Once started, the engine is connected (through a clutch) to a generator, and the generator is used to maintain the battery SOC at approximately 20%.

From a high level, the EREV/Volt transmission contains three (3) clutches and one planetary gear set to permit the control system to use one or two electric machines to propel the vehicle in pure electric mode, or the engine/generator combination to provide energy to one or two electric machines to propel the vehicle. Although there is one drive mode that permits the engine to assist the drive motor to propel the vehicle directly, the predominant propulsion method is to propel the vehicle with one or two electric machines electric-only. The EREV operation is very different from the PHEV system.

The EV system is the least complicated of all the technologies. There is no engine, only an electric propulsion system. The range of the EV is determined by the battery pack energy capacity, the control system, and how aggressively the vehicle is driven. The major cost of the vehicle is driven by the energy capacity of the battery pack (i.e., many battery modules and the volumetric size of the battery pack).

In general, the electric propulsion systems can be analyzed and diagnosed using the same methods/techniques/processes irrespective of the technology. So, whether you are instructing or analyzing an HEV, PHEV, EREV, or EV system the diagnostic processes are very similar and, in most cases, the same. This should ease your concerns about how much you will need to learn or how much equipment will need to be purchased to interface with these systems.

**Next month:** *Basic things your customer needs to know about Hybrid Vehicles.*



We provide you with equipment specifically designed to analyze and diagnose Hybrid and Electric Vehicle Systems.

[Click here](#) for more information.



Are you looking to implement HEV curriculum into your class offerings?

[Click here](#) to complete the online request form with our publisher to receive a **complimentary** instructor review copy of our Hybrid Electric Vehicle Technology Student Textbook

To support increased demand in the educational & aftermarket industries, we will be adding webinars to our training products (September 2011), providing you the opportunity to interact with the instructor. The schedule will be released May/June 2011. More information will be available in future newsletters, or [click here](#).

Currently, we provide e-Learning training modules through our partner NAPA. For more

Until next time remember - knowledge is **POWER**



*AR&D Tech Team*

information [click here](#).

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