

# Automotive Fuel and Emissions Control Systems 4/E

## Chapter 31 Hybrid Safety & Service Procedures

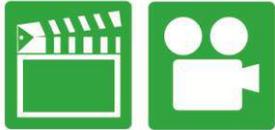
### Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of <b>Automotive Fuel and Emissions Control Systems</b> . It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending session or class.	Explain learning objectives to students as listed BELOW: <ol style="list-style-type: none"> <li>1. Identify the safety equipment to be used with high-voltage circuits.</li> <li>2. Explain how to de-power high-voltage systems.</li> <li>3. Explain the procedure to move and tow a hybrid electric vehicle (HEV).</li> <li>4. Discuss the steps to perform for routine services on hybrid electric vehicles.</li> </ol>
Establish the Mood or Climate	Provide a <b>WELCOME</b> , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

**NOTE: This lesson plan is based on Fuel & Emission Control 4<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**LINK CHP 31: [Chapter Images](#)**

## ICONS



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### 1. SLIDE 1 CH31 HYBRID SAFETY & SERVICE PROCEDURES

Check for **ADDITIONAL VIDEOS & ANIMATIONS**  
@ <http://www.jameshalderman.com/>  
**WEB SITE REGULARLY UPDATED**

### Videos

At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them

[Crossword Puzzle \(Microsoft Word\) \(PDF\)](#)

[Word Search Puzzle \(Microsoft Word\) \(PDF\)](#)

### **EXPLAIN WARNING**

2. **SLIDE 2 EXPLAIN FIGURE 31-1** Rubber lineman's gloves protect the wearer from a shock hazard.
3. **SLIDE 3 EXPLAIN FIGURE 31-2** Wearing leather gloves over the lineman's gloves helps protect the rubber gloves from damage
4. **SLIDE 4 EXPLAIN FIGURE 31-3** Checking rubber lineman's gloves for pinhole leaks.

**DISCUSSION:** Have students talk about importance of using leather gloves over insulated gloves. Remind them that when purchasing leather gloves, they must be large enough to fit over insulated safety gloves. What should be done before each use of gloves?

### **FIGURES 31-1 to 31-3**

### **EXPLAIN WARNING**

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**SAFETY** Have students talk about need for safety precautions when working around & with hybrid electric vehicles. Both hybrid electric vehicles & all-electric vehicles use high-voltage circuits that cannot be touched without protection.

**DEMONSTRATION:** Show students materials necessary to create a "High Voltage: DO NOT TOUCH" sign that can be placed on roof of HEV that is being stored.

### DISCUSS FREQUENTLY ASKED QUESTION

5. **SLIDE 5 EXPLAIN FIGURE 31-4** Be sure to only use meter that is CAT III-rated when taking electrical voltage measurements on hybrid electric or electric vehicle &
6. **SLIDE 6 EXPLAIN FIGURE 31-5** The meter leads should also be CAT III-rated when checking voltages on a hybrid electric vehicle.

**DISCUSSION:** Discuss CAT III-rated DMM. Why is a CAT III-certified DMM required for taking measurements on HEVs? **FIGURES 31-4 & 5**

**DEMONSTRATION:** Using a CAT III DMM, show students how to check a floating ground to identify a high-voltage leak. **FIGURES 31-4 & 5**

**DISCUSSION:** Discuss identifying colors used for high voltage cables. What does blue or yellow plastic conduit mean? What does orange plastic conduit mean?

**DISCUSSION:** Discuss insulation testers (Fluke 1587). When is an electrical insulation tester used?

**HANDS-ON TASK:** Have the students wear insulated and leather gloves while trying to take a voltage reading using a CAT III DMM. Ask students to share their experience with the task.

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**ON-VEHICLE NATEF TASK:** Identify location of **hybrid** vehicle high-voltage circuit disconnect (service plug) location and safety precautions.

**DISCUSSION:** Discuss **auxiliary batteries**. Where are flood-type and AGM type batteries located? **CHART 31-1**

### EXPLAIN TECH TIP

7. **SLIDE 7 EXPLAIN FIGURE 31-6** Ford Escape Hybrid instrument panel showing vehicle in park and tachometer on “EV” instead of 0 RPM. This means that gasoline engine could start at any time depending on state-of-charge of high-voltage batteries & other factors.

### EXPLAIN WARNING

**DEMONSTRATION: DEMO de-powering procedure on a Hybrid Electric Vehicle**

Use a cooking timer with a bell alarm or some other audible signal as a way to know when the 10-minute waiting period for HV battery shutdown has passed.

**DISCUSSION:** Have students talk about when high voltage system needs to be **de-powered** & when it doesn't. When servicing a system that may contain high voltage, how can you be sure of whether or not it needs to be de-powered?

**HANDS-ON TASK:** Supervise students as they **de-power vehicle**.

### EXPLAIN TECH TIP

8. **SLIDE 8 EXPLAIN Figure 31-7** Jump starting a 2001–2003 Toyota Prius using a 12-volt supply to boost the 12-volt auxiliary battery in the trunk.

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9. **SLIDE 9 EXPLAIN Figure 31-8** The underhood 12-volt jump-start terminal on this 2004+\_ Toyota Prius has a red plastic cover with a “+” sign. The positive booster cable clamp will attach directly to the vertical metal bracket

**DEMONSTRATION:** Show students **jump starting procedures** on HEV. Review safety procedures for connecting & disconnecting **jumper cables**. Can jump box or jumper cable from another vehicle be used on high-voltage HV battery pack? **FIGURES 31-7 & 8**

10. **SLIDE 10 EXPLAIN FIGURE 31-9** Using a warning cover over the steering wheel helps others realize that work is being performed on the high-voltage system and that no one is to attempt to start or move the vehicle

11. **SLIDE 11 EXPLAIN FIGURE 31-10** lock box is a safe location to keep the ignition keys of a hybrid electric vehicle while it is being serviced.

**DEMONSTRATION:** Show procedure for moving & storing HEV waiting for parts to arrive.

**HANDS-ON TASK:** Have the students **describe safety precautions** that should be taken to work on **HEVs**. Grade them on thoroughness and a clear understanding of **dangers** that **HEVs** present and how those dangers can be addressed.

**HANDS-ON TASK:** Review importance of separating the keys from a hybrid vehicle to prevent an accidental start-up that could lead to personal injury. Have students create a metal lock box or research the cost of purchasing one.

**ON-VEHICLE NATEF TASK:** Identify **high-voltage** circuits of **hybrid** electric vehicles and related safety precautions.

**ON-VEHICLE NATEF TASK:** Identify hybrid vehicle A/C system electrical circuits

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12. **SLIDE 12 EXPLAIN** Figure 31-11 Insulated tools, such as this socket set, would provide an additional margin of safety to the service technician when working around high-voltage components and systems
13. **SLIDE 13 EXPLAIN** Figure 31-12 The high-voltage wiring on this Honda hybrid is colored orange for easy identification

**SAFETY** Gather materials necessary for the students to create a **"High voltage—Do not touch" sign** that can be placed on roof of HEV that is being stored. **FIGURES 31-10, 11, & 12 DEMONSTRATION:** Show how to **identify lift points** for HEV from on-line service information. Using a floor jack/lift, raise vehicle and have the students take note of **areas of concern** on vehicle: **FIGURE 31-12**

**HANDS-ON TASK:** create a **"High voltage—Do not touch" sign** that can be placed on the roof of a hybrid vehicle that is being stored..

**DISCUSS FREQUENTLY ASKED QUESTION**

**EXPLAIN TECH TIP**

**DISCUSS REAL WORLD FIX**

**DISCUSSION:** Have the students review the **eight-step diagnosis procedure**. Is diagnosing a hybrid electric vehicle different from diagnosing any other type of vehicle?

**HANDS-ON TASK:** Have students **lift an HEV** supervised by the instructor

**ON-VEHICLE NATEF TASK:** Identify hybrid engine service precautions

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**DISCUSSION:** Have students talk about cooling system service for HEVs. What considerations for servicing an HEV cooling system may differ from those for servicing ICE cooling system?

**DISCUSSION:** Have the students discuss servicing the air conditioning of an HEV. What does the service technician need to know about the air conditioning compressor on HEV

**DISCUSSION:** Have the students talk about the regenerative braking system and base brakes used on hybrid electric cars. Why do base brakes on HEVs often get stuck or function incorrectly?

**ON-VEHICLE NATEF TASK:** Describe the operation of HEV regenerative braking system

**DISCUSSION:** Have the students discuss rolling resistance. How does replacing tires affect fuel economy?

**DISCUSSION:** Have the students talk about auxiliary battery service. What is the proper charger to use when recharging an AGM battery? Can this charger also be used on regular lead acid battery?

14. SLIDES 14-25 REVIEW SLIDE SHOW ON LINEMAN'S GLOVES

**DEMONSTRATION:** Show the students how to inspect, test, and store HV safety gloves and leather protectors.

**DISCUSSION:** Have the students discuss the storage and care of safety gloves. What kinds of materials and products can damage rubber gloves?