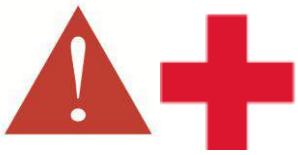
Automotive Technology 5th Edition
Chapter 90 Hybrid Safety & Service Procedures
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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 this session or class.	Explain learning objectives to students as listed below: 1. Discuss how to identify high-voltage circuits. 2. Explain the procedure to de-power high-voltage systems. 3. Explain how to move and tow a hybrid. 4. Discuss the procedure to be followed to perform routine service of hybrid vehicles.
Establish the Mood or Climate	Provide a ***WELCOME,*** 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 the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 90: ATE5 Chapter Images

ICONS	Ch 90 Hybrid Safety & Service Procedures
	1. **SLIDE 1 CH90 HYBRID SAFETY & SERVICE PROCEDURES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	2. **SLIDE 2 EXPLAIN Figure 90-1** Rubber lineman's gloves protect the wearer from a shock hazard. 3. **SLIDE 3 EXPLAIN Figure 90-2** Wearing leather gloves over the lineman's gloves helps protect the rubber gloves from damage
	**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 90-1 to 90-3**
	**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.**
	**DISCUSSION: Discuss auxiliary batteries. Where are flood-type and AGM type batteries located? CHART 90-1**
	**DISCUSSION: Discuss CAT III-rated DMM. Why is a CAT III-certified DMM required for taking measurements on HEVs? FIGURES 90-4 & 5**

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	**DEMONSTRATION:** Using a **CAT III DMM,** show students how to check a floating ground to identify a high-voltage leak. **FIGURES 90-4 & 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.
	**ON-VEHICLE NATEF TASK:** Identify location of **hybrid** vehicle high-voltage circuit disconnect (service plug) location and precautions. **Page 279**
	**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.**
	

4. **SLIDE 4 EXPLAIN FIGURE 90-3** Checking rubber lineman's gloves for pinhole leaks.
5. **SLIDE 5 EXPLAIN FIGURE 90-4** Be sure to only use a meter that is CAT III-rated when taking electrical voltage measurements on a hybrid electric or electric vehicle.

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	6. **SLIDE 6 EXPLAIN FIGURE 90-5** The meter leads should also be CAT III-rated when checking voltages on a hybrid electric vehicle. 7. **SLIDE 7 EXPLAIN FIGURE 90-6** Ford Escape Hybrid instrument panel showing the vehicle in park and the tachometer on "EV" instead of 0 RPM**.**
	8. **SLIDE 8 EXPLAIN Figure 90-7** Jump starting a 2001–2003 Toyota Prius using a 12-volt supply to boost the 12-volt auxiliary battery in the trunk. 9. **SLIDE 9 EXPLAIN Figure 90-8** 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 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?**
	
	**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. Page 280**

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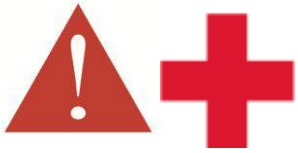
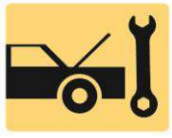
	**ON-VEHICLE NATEF TASK:) Identify hybrid vehicle A/C system electrical circuits. Page 282**
	10. **SLIDE 10 EXPLAIN FIGURE 90-9** Using a warning cover over the steering wheel helps others realize that work is being performed on the high-voltage system and that no one is to attempt to start or move the vehicle. 11. **SLIDE 11 EXPLAIN FIGURE 90-10** A lock box is a safe location to keep the ignition keys of a hybrid electric vehicle while it is being serviced.
	12. **SLIDE 12 EXPLAIN Figure 90-11** 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 90-12** 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 90-10, 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 90-12**
	**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..**
	14. **SLIDE 14 EXPLAIN Figure 90-13** scan tool display showing two hybrid-related faults in this Ford Escape hybrid.
	**DISCUSSION: Have the students review the eight-step diagnosis procedure. Is diagnosing a hybrid electric vehicle different from diagnosing any other type of vehicle?**

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	**HANDS-ON TASK:** Have students lift an HEV supervised by the instructor
	**ON-VEHICLE NATEF TASK:** Identify hybrid engine service precautions. **Page 281**
	**DISCUSSION:** discuss oil changes for HEVs. Why do most hybrid electric vehicles require either **SAE 0W-20 or SAE 5W-20**? **FIGURE 90-14**
	**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. **Page 278**
	**DISCUSSION:** Have the students discuss **rolling resistance.** How does replacing tires affect fuel economy?
	16. **SLIDE 16 EXPLAIN Figure 90-15** This 12 volt battery under the hood on a Ford Fusion hybrid is a flooded cell type auxiliary battery
	**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? **FIGURE 90-15**

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	17. SLIDES 17-28 OPTIONAL EXPLAIN HV GLOVE
	**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?
	Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF)