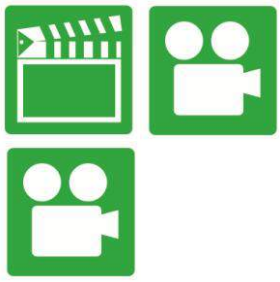
Hybrids & Alternative Fuel Vehicles

Chapter 19 Hybrid Safety and Service Procedures

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Hybrid and Alternative Fueled Vehicles**. 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 this session or class.	Explain the chapter learning objectives to the students. 1. Safely de power a hybrid electric vehicle. 2. Safely perform high-voltage disconnects. 3. Understand the unique service issues related to HEV high-voltage systems. 4. Correctly use appropriate personal protective equipment (PPE). 5. Perform routine vehicle service procedure on a hybrid electric vehicle. 6. Explain hazards while driving, moving, and hoisting a hybrid electric vehicle.
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 Hybrids 4th Edition
Chapter Images found on Jim's web site @
www.jameshalderman.com
LINK CHP 19: Chapter Images

ICONS	Ch19 Hybrid Safety & Service Procedures
	1. SLIDE 1 CH19 HYBRID SAFETY & SERVICE PROCEDURES
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY 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)
	DISCUSS WARNING ICON
	2. SLIDE 2 EXPLAIN Figure 19-1 Rubber lineman's gloves protect the wearer from a shock hazard. 3. SLIDE 3 EXPLAIN Figure 19-2 Wearing leather gloves over the lineman's gloves helps protect the rubber gloves from damage 4. SLIDE 4 EXPLAIN FIGURE 19-3 Checking rubber lineman's gloves for pinhole leaks.
	DISCUSSION: DISCUSS 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?
	DISCUSSION:DISCUSS THE STORAGE AND CARE OF SAFETY GLOVES. WHAT KINDS OF MATERIALS AND PRODUCTS CAN DAMAGE RUBBER GLOVES?

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	**DISCUSS WARNING ICON**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**DISCUSSION: DISCUSS AUXILIARY BATTERIES. WHERE ARE FLOOD-TYPE AND AGM TYPE BATTERIES LOCATED? CHART 19-1**
	5. **SLIDE 5 EXPLAIN FIGURE 19-4** Be sure to only use a meter that is CAT III-rated when taking electrical voltage measurements on a hybrid electric or electric vehicle.
	6. **SLIDE 6 EXPLAIN FIGURE 19-5** meter leads should also be CAT III-rated when checking voltages on a hybrid electric vehicle.
	**DISCUSSION: DISCUSS CAT III-RATED DMM. WHY IS CAT III-CERTIFIED DMM REQUIRED FOR TAKING VALUES ON HEVS? FIGURES 19-4 & 5**
	**DEMONSTRATION: USING A CAT III DMM, SHOW STUDENTS HOW TO CHECK A FLOATING GROUND TO IDENTIFY A HIGH-VOLTAGE LEAK. FIGURES 19-4 & 5**
	**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.**
	**DISCUSS WARNING ICON**

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       	**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 **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? EXPLAIN TECH TIP **DEMONSTRATION:** DEMO **DE-POWERING PROCEDURE ON A HYBRID ELECTRIC VEHICLE** **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 SAFETY PRECAUTIONS. 7. **SLIDE 7 EXPLAIN FIGURE 19-6** HV disconnect plug has two small terminals used to signal the HV controller that the safety/ service plug has been removed 8. **SLIDE 8 EXPLAIN FIGURE 19-7** insulation tester showing where the meter leads should be attached and where to select the voltage level to be used to test the insulation (usually 1,000 volts). The resistance between the insulated HV circuit and ground should be higher than one million ohms (1.0 to 2.2 MΩ). 9. **SLIDE 9 EXPLAIN FIGURE 19-8** Ford Escape Hybrid instrument panel showing the vehicle in park and tachometer on "EV" instead of 0 RPM. This means that

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  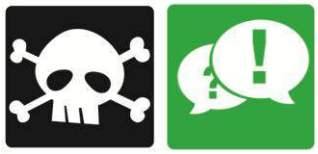  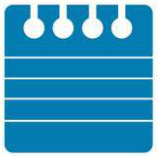    	gasoline engine could start at any time depending on state-of-charge of high-voltage batteries & other factors. **EXPLAIN TECH TIP** **DISCUSS CAUTION** **DISCUSS WARNING** **DISCUSSION: HAVE STUDENTS TALK ABOUT WHEN HIGH VOLTAGE SYSTEM NEEDS TO BE DE-POWERED & WHEN IT DOESN'T. WHEN SERVICING A SYSTEM THAT MAY CONTAIN HIGH VOLTAGE, HOW CAN YOU BE SURE OF WHETHER OR NOT IT NEEDS TO BE DE-POWERED?** **USE COOKING TIMER WITH BELL ALARM OR SOME OTHER AUDIBLE SIGNAL AS A WAY TO KNOW WHEN 10-MINUTE PERIOD FOR HV BATTERY SHUTDOWN HAS PASSED.** **HANDS-ON TASK: SUPERVISE STUDENTS AS THEY DE-POWER VEHICLE.** **DISCUSS FREQUENTLY ASKED QUESTION** **10. SLIDE 10 EXPLAIN FIGURE 19-9** To enter the inspection mode, select this feature on a scan tool and follow the on-screen procedure **Jump Starting Hybrids**

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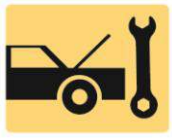
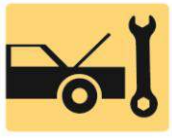
	11. **SLIDE 11 EXPLAIN FIGURE 19-10** Jump starting a 2001–2003 Toyota Prius using a 12-volt supply to boost the 12-volt auxiliary battery in the trunk. 12. **SLIDE 12 EXPLAIN FIGURE 19-11** underhood 12-volt jump-start terminal on 2004+_ Toyota Prius has red plastic cover with a "+" sign. The positive 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 1917-7 & 8**
	13. **SLIDE 13 EXPLAIN FIGURE 19-12** 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. 14. **SLIDE 14 EXPLAIN FIGURE 19-13** 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 STUDENTS DESCRIBE SAFETY PRECAUTIONS THAT SHOULD BE TAKEN TO WORK ON HEVS.**
	**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**

ICONS	Ch19 Hybrid Safety & Service Procedures
	**ON-VEHICLE NATEF TASK** IDENTIFY HYBRID VEHICLE A/C SYSTEM ELECTRICAL CIRCUITS
	**DISCUSS FREQUENTLY ASKED QUESTION**
	EXPLAIN TECH TIP
	**SAFETY** GATHER MATERIALS NECESSARY FOR STUDENTS TO CREATE **"HIGH VOLTAGE—DO NOT TOUCH" SIGN** THAT CAN BE PLACED ON ROOF OF HEV THAT IS BEING STORED. **FIGURES 19-10, 11, & 12**
	**DEMONSTRATION:** SHOW HOW TO **IDENTIFY LIFT POINTS** FOR HEV FROM ON-LINE SERVICE INFORMATION. RAISE VEHICLE AND HAVE STUDENTS TAKE NOTE OF **AREAS OF CONCERN** ON VEHICLE: **FIGURE 19-12**
	15. **SLIDE 15 EXPLAIN Figure 19-14** 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 16. **SLIDE 16 EXPLAIN Figure 19-15** The high-voltage wiring on this Honda hybrid is colored orange for easy identification.
	**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..
	17. **SLIDE 17 EXPLAIN Figure 19-16** scan tool display showing 2 hybrid-related faults in Ford Escape hybrid.
	**DISCUSSION:** HAVE THE STUDENTS REVIEW **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 19-14**
	**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: DISCUSS SERVICING THE AIR CONDITIONING OF AN HEV. WHAT DOES THE SERVICE TECHNICIAN NEED TO KNOW ABOUT THE AIR CONDITIONING COMPRESSOR ON HEV**
	18. **SLIDE 18 EXPLAIN FIGURE 19-17** Always use specified viscosity of oil in a hybrid electric vehicle not only for best fuel economy but also because of need for fast lubrication because of the engine (idle) stop feature **DISCUSS REAL WORLD FIX**
	19. **SLIDE 19 EXPLAIN FIGURE 19–18** The radiation emitted from a hybrid electric vehicle is very low, as shown being measured in units of milligauss. **DISCUSS FREQUENTLY ASKED QUESTION**
	**ON-VEHICLE NATEF TASK DESCRIBE THE OPERATION OF HEV REGENERATIVE BRAKING SYSTEM. PAGE 278**

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	**20. SLIDE 20 EXPLAIN FIGURE 19-19** This 12 volt battery under the hood on a Ford Fusion hybrid is a flooded cell type auxiliary battery
	**DISCUSSION: 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 19-19**
	**DISCUSSION: 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 19-19**
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO INSPECT, TEST, AND STORE HV SAFETY GLOVES AND LEATHER PROTECTORS.**
	**Have students search INTERNET to research high voltage. What is classified as "high voltage"? What voltage levels are dangerous? Have students report their findings to the class.**
	**Have students search INTERNET to research astm standard f496. What is the organization that sets this standard? What is the recommended sequence of testing for gloves? Ask students to report their findings to the class.**