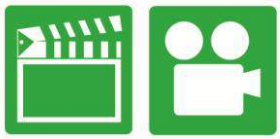
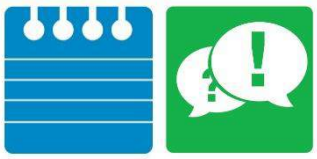
Automotive Electrical & Engine Performance 7/E

Chapter 16 Battery Testing & Service

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	**This course or class covers Automotive Electrical & Engine Performance. 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. List the precautions necessary when working with batteries. 2. Describe how to inspect and clean battery cables, connectors, clamps, and hold-downs. 3. Discuss how to test batteries for open-circuit voltage and specific gravity. 4. Describe how to perform a battery load test and a conductance test. 5. Explain how to safely charge or jump start a battery. 6. Discuss how to perform a battery drain test. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "B" (Battery Diagnosis and Service).
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 Automotive Electrical & Engine Performance 7/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 16: Chapter Images

ICONS	Ch16 Battery Testing & Service
	**1. SLIDE 1 CH16 Battery Testing & Service**
	**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)**
	
	2. **SLIDE 2 EXPLAIN Figure 16-1** visual inspection on this battery shows the electrolyte level was below the plates in all cells 3. **SLIDE 3 EXPLAIN Figure 16-2** Corrosion on a battery cable could be an indication that the battery itself is either being overcharged or is sulfated, creating a lot of gassing of the electrolyte.
	**DEMONSTRATION: USING A VOLTMETER, DEMONSTRATE HOW TO FIND CORRODED AND/OR POOR CONNECTIONS BY MEASURING VOLTAGE DROP (FIGURE 16-2).**
	**EXPLAIN TECH TIP**
	4. **SLIDE 4 EXPLAIN**: BATTERY MAINTENANCE & **EXPLAIN Figure 16-3** Besides baking soda and water, a sugar-free diet soft drink can also be used to neutralize the battery acid.
	**DEMONSTRATION: SHOW PROPER PROCEDURE FOR REMOVING SURFACE CHARGE. LOAD BATTERY WITH FIXED LOAD FOR 15 SEC. TO REMOVE SURFACE CHARGE, USING AVR FIGURE 16-3**

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	5. **SLIDE 5 EXPLAIN Figure 16-4 (a)** A voltage reading of 12.28 volts indicates that the battery is not fully charged and should be charged before testing 6. **SLIDE 6 EXPLAIN Figure 16-4 (b)** battery that measures 12.6 volts or higher after the surface charge has been removed is 100% charged.
	**DEMONSTRATION: DEMO OPEN CIRCUIT VOLTAGE (OCV) TEST FIGURE 16-4**
	**EXPLAIN CHART 16-1** 7. **SLIDE 7 EXPLAIN Figure 16-5** When testing a battery using a hydrometer, the reading must be corrected if the temperature is above or below 80° F (27° C).
	**DISCUSSION: DISCUSS CORRELATION BETWEEN SPECIFIC GRAVITY, OPEN-CIRCUIT VOLTAGE, & BATTERY STATE OF CHARGE. HOW DO YOU DETECT DEFECTIVE BATTERY? TALK ABOUT DIFFERENCES BETWEEN OPEN-CIRCUIT VOLTAGE AND SPECIFIC GRAVITY WHEN DETERMINING BATTERY STATE OF CHARGE. WHY MIGHT A TECHNICIAN PREFER ONE OR THE OTHER?**
	**EXPLAIN CHART 16-2**
	**DISCUSS FREQUENTLY ASKED QUESTION & NOTE**
	**DEMONSTRATION: SHOW STUDENTS HOW TO LOAD TEST BATTERY. TYPICALLY DONE AT ½ CCR.**
	8. **SLIDE 8 EXPLAIN Figure 16-6** battery has cold-cranking amperes (CCA) of 550 A, cranking amperes (CA) of 680 A, & load test amperes of 270 A listed on the top label. Not all batteries have this information.
	9. **SLIDE 9 EXPLAIN Figure 16-7** alternator regulator battery starter tester (**ARBST**) automatically **loads battery with fixed load for 15 sec. to remove surface charge**, then removes load for 30 sec. to allow battery to recover, then reapplies load for another 15 sec. Results of test are then displayed

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	**DISCUSS FREQUENTLY ASKED QUESTION & NOTE**
	**10. SLIDE 10 EXPLAIN Figure 16-8** Most light-duty vehicles equipped with 2 batteries are connected in parallel. Two 500 A, 12 volt batteries are capable of supplying 1,000 A at 12 volts, needed to start diesels. **11. SLIDE 11 EXPLAIN FIGURE 16–9** Many heavy-duty trucks and buses use two 12 volt batteries connected in series to provide 24 volts.
	**DISCUSS SAFETY TIP**
	EXPLAIN: **ELECTRONIC CONDUCTANCE TESTING** **12. SLIDE 12 EXPLAIN Figure 16-10** conductance tester is very easy to use and has proved to accurately determine battery condition if the connections are properly made. Follow instructions on the display exactly for best results
	**DISCUSSION: HAVE STUDENTS DISCUSS DIFFERENCE BETWEEN BATTERY LOAD TESTING AND CONDUCTANCE TESTING. WHAT ARE PROS & CONS OF EACH?**
	**DEMONSTRATION: SHOW STUDENTS HOW TO PROPERLY TEST A BATTERY USING CONDUCTANCE TESTER FIGURE 16-10 CONDUCTANCE TESTING**
	**13. SLIDE 13 EXPLAIN Figure 16-11** A typical industrial battery charger. Be sure that the ignition switch is in the off position before connecting any battery charger. Connect the cables of the charger to the battery before plugging the charger into the outlet. This helps prevent a voltage spike and spark that could occur if the charger happened to be accidentally left on. Always follow the battery charger manufacturer's instructions.
	**DEMONSTRATION: SHOW HOW TO PROPERLY DISABLE HIGH-VOLTAGE BATTERY TO DECREASE RISK OF INJURY/DEATH WHEN WORKING AROUND HIGH VOLTAGE SYSTEMS.**

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	**EXPLAIN BATTERY CHARGING**
	**EXPLAIN TECH TIP**
	**14. SLIDE 14 EXPLAIN FIGURE 16–12** Adapters should be used on side terminal batteries whenever charging. **36. SLIDE 36 EXPLAIN**: BATTERY CHARGE TIME
	**DISCUSS FREQUENTLY ASKED QUESTION & NOTE**
	**15. SLIDE 15 EXPLAIN Figure 16-13** A typical battery jump box used to jump start vehicles. These hand-portable units have almost made jumper cables obsolete.
	**Jump Box Usage** **Jump Starting Hybrids** **Jumper Cable Usage**
	**16. SLIDE 16 EXPLAIN FIGURE 16–14** Jumper cable usage guide. Notice that the last connection should be the engine block of the disabled vehicle to help prevent the spark that normally occurs from igniting the gases from the battery
	**EXPLAIN TECH TIP**
	**17. SLIDE 17 EXPLAIN FIGURE 16–15** The code on the Delphi battery indicates that it was built in 2005 (5), in February (B), on the eleventh day (11), during third shift (C), and in the Canadian plant (Z)
	EXPLAIN BATTERY ELECTRICAL DRAIN TEST
	18. SLIDE 18 EXPLAIN Figure 16-16 This mini clamp-on digital multimeter is being used to measure the amount of battery electrical drain that is present. In this case, a reading of 20 Ma (displayed on the meter as 00.02 A) is within the normal range of 20 to 30 Ma. Be sure to clamp around all of the positive battery cable or all of the negative battery cable, whichever is easiest to get the clamp around.

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	**19. SLIDE 19 EXPLAIN Figure 16-17** After connecting the shut-off tool, start the engine and operate all accessories. Stop the engine and turn off everything. Connect the ammeter across the shut-off switch in parallel. Wait 20 minutes. This time allows all electronic circuits to "time out" or shut down. Open the switch—all current now will flow through the ammeter. A reading greater than specified (usually greater than 50 Ma, or 0.05 A) indicates a problem that should be corrected.
	**DISCUSS REAL WORLD FIX**
	**DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A PARASITIC DRAW TEST USING AN AMMETER WITH AN INDUCTIVE LEAD.**
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO PERFORM A PARASITIC DRAW TEST USING AN AMMETER HOOKED UP IN SERIES.**
	**EXPLAIN Battery Electrical Drain Test**
	20. SLIDE 20 EXPLAIN Figure 16-18 battery was replaced in this Acura and the radio displayed "code" when the replacement battery was installed. Thankfully, the owner had the five-digit code required to unlock the radio.
	**DISCUSSION: DISCUSS WHY VEHICLE MANUFACTURERS USE RADIOS THAT REQUIRE CODES AFTER THE BATTERY HAS BEEN DISCONNECTED. WHAT SHOULD BE CHECKED BEFORE DISCONNECTING BATTERY?**
	**EXPLAIN TECH TIP**
	**21. SLIDE 21 EXPLAIN FIGURE 16–19** (a) Memory saver. The part numbers represent components from Radio Shack.
	22. SLIDE 22 EXPLAIN FIGURE 16–19 (b) A schematic drawing of same memory saver. Some experts recommend using a 12 volt lantern battery instead of a small 9 volt battery to help ensure that there will be enough voltage in the event that a door is opened while the vehicle battery is disconnected. Interior lights could quickly drain small 9 volt

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	**DEMONSTRATION: SHOW HOW TO USE A MEMORY SAVER TO RETAIN RADIO MEMORY. FIGURE 16-19**
	**DISCUSS FREQUENTLY ASKED QUESTION & NOTE**
	**23. SLIDE 23 EXPLAIN FIGURE 16–20** Many newer vehicles have batteries that are sometimes difficult to find. Some are located under plastic panels under the hood, under the front fender, or even under the rear seat. The jump-start instructions indicate that the spare tire hold-down bolt is to be used as the ground connection if jump starting is necessary
	**EXPLAIN TECH TIP**
	**EXPLAIN BATTERY SYMPTOM GUIDE**
	**NATEF TASK SHEET: MEASURE AND DIAGNOSE THE CAUSE (S) OF EXCESSIVE PARASITIC DRAW; DETERMINE NECESSARY ACTION.**
	**NATEF TASK SHEET: MAINTAIN OR RESTORE ELECTRONIC MEMORY FUNCTIONS.**
	**NATEF TASK SHEET PERFORM BATTERY STATE-OF-CHARGE (CONDUCTANCE) TEST; DETERMINE NECESSARY ACTION. PERFORM BATTERY CAPACITY TEST; CONFIRM PROPER BATTERY CAPACITY FOR VEHICLE APPLICATION; DETERMINE NECESSARY ACTION.**
	**NATEF TASK SHEET: INSPECT, CLEAN, FILL, AND/OR REPLACE BATTERY, BATTERY CABLES, CONNECTORS, CLAMPS, AND HOLD-DOWNS**
	**NATEF TASK SHEET: PERFORM BATTERY CHARGE**

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	NATEF TASK SHEET: START A VEHICLE USING JUMPER CABLES OR AN AUXILIARY POWER SUPPLY
	NATEF TASK SHEET: IDENTIFY ELECTRONIC MODULES, SECURITY SYSTEMS, RADIOS, AND OTHER ACCESSORIES THAT REQUIRE REINITIALIZATION OR CODE ENTRY FOLLOWING BATTERY DISCONNECT.
	NATEF TASK SHEET: IDENTIFY HYBRID VEHICLE AUXILIARY (12V) BATTERY SERVICE, REPAIR AND TEST PROCEDURES.