Introduction to Automotive Service

Chapter 23 Starting & Charging System

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class serves as an introduction to the world of automotive service. 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. Prepare for ASE Engine Performance (A8) certification test content area "F" (Engine Electrical Systems Diagnosis and Repair). Discuss methods that can be used to check the condition of a battery. 2. Discuss battery rating system. 3. Conduct a battery state-of-charge (SOC) test. 4. Conduct a battery load test. 5. Perform a charging voltage test. 6. Perform a battery conductance test. 7. Describe starting circuit components. 8. Perform routine battery service procedures. 9. Describe how to properly charge a battery. 10. Describe how to safely jump-start a vehicle. 11. Explain how to test the alternator.
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.

ICONS	Chapter 23 Starting & Charging System
	**1. TITLE SLIDE 1 CHAPTER 23 STARTING & CHARGING SYSTEM**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**2. SLIDE 2 EXPLAIN** Batteries **3. SLIDE 3 EXPLAIN FIGURE 23-1** cold-cranking amperes (CCA) is the rating that is most commonly used to rate batteries. **4. SLIDE 4 EXPLAIN** Batteries
	**DEMONSTRATION: Use AA batteries & voltmeter to demonstrate battery construction. Show students how voltage increases when batteries are connected in series versus parallel.**
	**SAFETY TIP: Have students access MSDS for an automotive battery to find safe handling instructions, first aid procedures, reactivity data, and so forth. Ask students to write a summary of properties and procedures detailed in MSDS and share their work with class.**
	**5. SLIDE 5 EXPLAIN** Battery Service
	**DEMONSTRATION: Show students proper procedure for removing a surface charge. Load battery with fixed load for 15 sec. to remove surface charge, using AVR.**
	**DEMONSTRATION: Using a voltmeter, demonstrate how to find corroded or poor connections by measuring voltage drop.**
	**6. SLIDE 6 EXPLAIN FIGURE 23-2** 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 **7. SLIDE 7 EXPLAIN** Battery Service

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	**8. SLIDE 8 EXPLAIN FIGURE 23-3** visual inspection on this battery shows the electrolyte level was below the plates in all cells. **9. SLIDE 9 EXPLAIN FIGURE 23-4 (a)** A voltage reading of 12.28 volts indicates that the battery is not fully charged and should be charged before testing **10. SLIDE 10 EXPLAIN CHART 23-1** Battery voltage can indicate the state of charge (SOC) of a battery after the surface charge has been removed **11. SLIDE 11 EXPLAIN FIGURE 23.4 (b)** A battery that measures 12.6 volts or higher after the surface charge has been removed is 100% charged **12. SLIDE 12 EXPLAIN** Battery Service **13. SLIDE 13 EXPLAIN FIGURE 23-5** An alternator regulator battery starter tester (ARBST) automatically loads the battery with a fixed load for 15 seconds to remove the surface charge, then removes the load for 30 seconds to allow the battery to recover, and then reapplies the load for another 15 seconds. The results of the test are then displayed
	**DEMONSTRATION: Show students how to load test battery. Typically done at ½ CCR.**
	**DISCUSSION: Have students 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?**
	**14. SLIDE 14 EXPLAIN** Battery Service **15. SLIDE 15 EXPLAIN FIGURE 23.6** conductance tester is very easy to use and has proved to accurately determine battery condition if the connections are properly made. Follow the 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?**

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	**DEMONSTRATION: Show students how to properly test a battery using Conductance Tester**
	**SHOW VIDEO: Battery Load Testing** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Load%20Testing%20The%20Battery&clip=pandc/chet/2012/automotive/Starting_charging_elect/A6T3.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Starting_charging_elect/xml/A6T3.xml
	**Students complete NATEF Task Sheet A6B1 & A6B2** **B1 Perform battery state-of-charge (conductance) test; determine necessary action. (P-1)** **B2 Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action. (P-1)**
	16. **SLIDE 16 EXPLAIN FIGURE 23.7** Jumper cable usage guide. Note 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. 17. **SLIDE 17 EXPLAIN FIGURE 23-8** 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 18. **SLIDES 18-19 EXPLAIN** Battery Service 20. **SLIDE 20 EXPLAIN** Battery Service
	**SHOW VIDEO: Battery Removal** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Battery%20Removal&clip=pandc/chet/2012/automotive/Auto_Shop_Safety/clip15battremov1.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Auto_Shop_Safety/xml/clip15battremov1.xml
	**DEMONSTRATION: Use two bar magnets to show the students how like magnetic charges repel while opposite charges attract.**
	**DISCUSSION: Have the students discuss the principles of magnetism. What causes a stronger magnetic field?**

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	**DEMONSTRATION: Show how to use service information to look up starting system control circuit. Have them help you identify different components of starting system control circuit.**
	**21. SLIDE 21 EXPLAIN Figure 23-9** typical solenoid-operated starter. **22. SLIDE 22 EXPLAIN Figure 23-10** To prevent engine from cranking, an electrical switch is usually installed to open circuit between ignition switch & starter solenoid.
	**Starter Circuit Animation** **Show Starting System Animation**
	**DISCUSSION: Have the students discuss difference between engine cranking and engine starting. What is required for an engine to start?**
	**HANDS-ON TASK: Have half the students locate and label system components with numbers. Have other half identify the components by number.**
	**ON-VEHICLE TASK: Use Vocabulary Scavenger Hunt Task Sheet to identify parts on vehicle related to Starting System that correspond with letter on the task sheet & describe purpose of each part.**
	**23. SLIDE 23 EXPLAIN FIGURE 23-11 All battery cables and connections have to be clean and tight for the starter to be able to operate correctly.** .
	**Charging System Animation** **Show Charging System Animation** **AC, Alternating Current Animation**
	**24. SLIDE 24 EXPLAIN** Charging Circuit

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	**HANDS-ON TASK:** Have the students locate the sticker or stamp that shows the alternator amperage rating on several different alternators.
	**25. SLIDE 25 EXPLAIN FIGURE 23-12** The end frame toward the drive belt is called the drive-end housing and the rear section is called slip-ring-end housing **26. SLIDE 26 EXPLAIN FIGURE 23-13** The digital multimeter should be set to read DC volts, with the red lead connected to positive (+) battery terminal and black meter lead connected to negative (–) battery terminal
	**DEMONSTRATION: Show how to perform a quick check on a charging system by checking static and dynamic voltages with a DMM. Engine OFF, 12.6 volts. Engine Running at 1500 RPM: 14.5 volts.**
	**DEMONSTRATION: Demonstrate ways to do an Alternator Output Test. Show students how to perform carbon pile test with AVR or equivalent tool. Have students interpret results by comparing them to OEM specifications.**
	**Students complete NATEF Task Sheet A6A3, Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins. (P-1)**
	**Students complete NATEF Task Sheet A6B4, Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs (P-1)**
	**Students complete NATEF Task Sheet A6B5, Perform battery charge (P-1)**
	**Students complete NATEF Task Sheet A6B6, Start a vehicle using jumper cables or an auxiliary power supply (P-1)**
	**Students complete NATEF Task Sheet A6D1: Perform charging system output test; determine necessary action. (P-1)**

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	**HOMEWORK: SEARCH INTERNET: Ask students to research history of starter motor on the Internet. Ask them to identify the first car company to offer electric start, and when it was offered. Ask students to present their findings to the class.**
	**Homework: complete Ch23 crossword puzzle: http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_23.pdf**