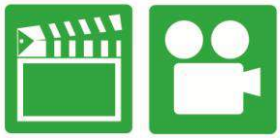
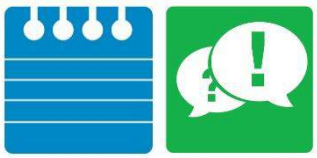
Automotive Electrical & Engine Performance 7/E

Chapter 8 Automotive Wiring and Wire Repair

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. Explain the wire gauge numbering system. 2. Describe how fusible links and fuses protect circuits and wiring. 3. List the steps for performing a proper wire repair. 4. Perform solder repair of electrical wiring. 5. Discuss circuit breakers and PTC electronic circuit protection devices. 6. Explain the types of electrical conduit. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).
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 8: Chapter Images

ICONS	Ch08 Automotive Wiring and Wire Repair
	**1. SLIDE 1 CH6 Automotive Wiring and Wire Repair**
	**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 FREQUENTLY ASKED QUESTION**
	
	**7. SLIDE 7 EXPLAIN CHART 8.3** Metric wire size in squared millimeters (mm2) conversion chart to American wire gauge (AWG). **8. SLIDE 8 EXPLAIN CHART 8.4** Recommended AWG wire size increases as the length increases because all wire has internal resistance. Longer wire is, greater resistance. The larger the diameter is, the lower the resistance.
	**SOME WIRE GAUGES HAVE BOTH AWG & METRIC SCALES**
	**DEMONSTRATION: SHOW STUDENTS HOW TO USE A STANDARD WIRE GAUGE**
	**DEMONSTRATION: DISCUSS RECOMMENDATIONS SHOWN IN CHART 8–4. WHAT IS RELATIONSHIP BETWEEN LENGTH AND RESISTANCE? WHAT IS THE RELATIONSHIP BETWEEN DIAMETER &**

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	**RESISTANCE?** 2. **SLIDE 2 EXPLAIN Figure 8-1** All lights and accessories ground to body of vehicle. Body ground wires such as this one are needed to conduct all of current from these components back to negative terminal of battery. Body ground wire connects body to engine. Most battery negative cables attach to engine.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	3. **SLIDE 3 EXPLAIN Figure 8-2** Battery cables are designed to carry heavy starter current & usually 4 gauge or larger wire. This battery has a thermal blanket covering to help protect battery from high temperatures. Wiring covered with plastic conduit called split-loom tubing
	**DEMONSTRATION: DEMONSTRATE PROPER WAY TO ATTACH JUMPER CABLES AND DISCUSS NEED TO CHECK THE WIRE GAUGE OF JUMPER CABLES & NOT RELY ON OUTSIDE DIAMETER OF THE WIRE.**
	4. **SLIDE 4 EXPLAIN Figure 8-3 fuse panel**
	5. **SLIDE 5 EXPLAIN Figure 8-4** Blade-type fuses can be tested through openings in plastic at top of fuse 6. **SLIDE 6 EXPLAIN Figure 8-5** Three sizes of blade-type fuses: mini on the left, standard or ATO type in the center, and maxi on the right 7. **SLIDE 7 EXPLAIN Figure 8-6** comparison of the various types of protective devices used in most vehicles. 8. **SLIDE 8 EXPLAIN Figure 8–7** To test a fuse, use a test light to check for power at the power side of the fuse. The ignition switch and lights may have to be on before some fuses receive power. If the fuse is good, the test light should light on both sides (power side and load side) of the fuse
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE DIFFERENT COLORS FOR AMPERAGE RATINGS. WHY ARE COLORS A GOOD IDEA?**

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	9. **SLIDE 9 EXPLAIN Figure 8-8** Typical blade circuit breaker fits into the same space as a blade fuse. If excessive current flows through the bimetallic strip, the strip bends and opens the contacts and stops current flow. When the circuit breaker cools, the contacts close again, completing the electrical circuit. 10. **SLIDE 10 EXPLAIN Figure 8-9** Electrical symbols used to represent circuit breakers. 11. **SLIDE 11 EXPLAIN Figure 8-10** (a) normal operation of a PTC circuit protector such as in a power window motor circuit showing the many conducting paths. With normal current flow, the temperature of the PTC circuit protector remains normal. (b) When current exceeds the amperage rating of the PTC circuit protector, the polymer material that makes up the electronic circuit protector increases in resistance. As shown, a high-resistance electrical path still exists even though the motor will stop operating as a result of the very low current flow through the very high resistance. The circuit protector will not reset or cool down until voltage is removed from circuit. 12. **SLIDE 12 EXPLAIN Figure 8-11** PTC circuit protectors are used extensively in the power distribution center of this Chrysler vehicle. 13. **SLIDE 13 EXPLAIN Figure 8-12** Fusible links are usually located close to battery and are usually attached to a junction block. Notice that they are only 6 to 9 in. long and feed more than one fuse from each fusible link. 14. **SLIDE 14 EXPLAIN Figure 8-13** 125 ampere rated mega fuse used to control the current from alternator
	**COMPLETE NATEF TASK SHEET INSPECT AND TEST FUSIBLE LINKS, CIRCUIT BREAKERS, & FUSES; DETERMINE NECESSARY ACTION**
	**COMPLETE NATEF TASK SHEET INSPECT AND TEST SWITCHES, CONNECTORS, RELAYS, SOLENOID SOLID STATE DEVICES, AND WIRES OF ELECTRICAL/ELECTRONIC CIRCUITS; PERFORM NECESSARY ACTION**
	**OPTIONAL HOMEWORK: USE INFORMATION IN CHART 8–4 TO CREATE A TABLE IN WHICH YOU ASSIGN RANDOM CIRCUIT LENGTHS AND AMPERAGE LOADS. HAVE STUDENTS SELECT PROPER WIRE SIZE TO SAFELY CARRY CIRCUIT**

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	**LOAD. GRADE THEM ON THEIR UNDERSTANDING OF RELATIONSHIP BETWEEN WIRE SIZE AND LOAD AND THEIR SELECTION OF SIZE TO USE.** **SEARCH INTERNET: HAVE STUDENTS USE INTERNET TO RESEARCH LOCATIONS OF FUSE PANELS. WHERE PANELS ARE TYPICALLY LOCATED? HAVE STUDENTS WRITE GUIDELINES FOR LOCATING FUSE PANELS**
	**EXPLAIN TECH TIP**
	**15. SLIDE 15 EXPLAIN Terminals and Connectors & EXPLAIN Figure 8-14** Some terminals have seals attached to help seal the electrical connections. **16. SLIDE 16 EXPLAIN Figure 8-15** Separate a connector by opening the lock and pulling the two apart **17. SLIDE 17 EXPLAIN Figure 8-16** secondary locks help retain the terminals in the connector. **18. SLIDE 18 EXPLAIN Figure 8-17** Use small removal tool, sometimes called a pick, to release terminals from the connector.
	**EXPLAIN TECH TIP**
	**19. SLIDE 19 EXPLAIN Figure 8-18 Always** use rosin-core solder for electrical or electronic soldering. Also, use small-diameter solder for small soldering irons. Use large-diameter solder only for large-diameter (large-gauge) wire and higher-wattage soldering irons (guns) **20. SLIDE 20 EXPLAIN Figure 8-19** butane-powered soldering tool. Cap has a built-in striker to light a converter in the tip of the tool. This handy soldering tool produces the equivalent of 60 watts of heat. It operates for about 1/2 hour on one charge from commonly available butane refill dispenser.
	**DEMONSTRATION: DEMO SEVERAL DIFFERENT TYPES OF CONNECTORS, INCLUDING THOSE WITH CONNECTOR POSITION ASSURANCE CLIPS. EXPLAIN THAT IT'S NECESSARY TO GUARANTEE THAT CONNECTORS WILL STAY TOGETHER IN SUPPLEMENTAL RESTRAINT SYSTEMS. DEMONSTRATE REMOVAL OF TERMINALS FROM SEVERAL DIFFERENT TYPES OF CONNECTORS.**

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	**MAKE SURE TO HAVE PROPER TERMINAL REMOVAL TOOLS AVAILABLE FOR TEACHING STUDENTS ABOUT DIFFERENT CONNECTORS.**
	21. **SLIDE 21 EXPLAIN Figure 8-20** Notice that to create a good crimp the open part of the terminal is placed in the jaws of the crimping tool toward the anvil or the W-shape part. 22. **SLIDE 22 EXPLAIN Figure 8-21** All hand-crimped splices or terminals should be soldered to be assured of a good electrical connection.
	**DISCUSSION: DISCUSS PROCESS OF SOLDERING WIRES AND THE TYPE OF SOLDER USED. WHAT DO THE PERCENTAGES OF EACH ALLOY IN A SOLDER DETERMINE?**
	**DEMONSTRATION: DEMONSTRATE USE OF A SOLDERING IRON TO CONNECT WIRING. POINT OUT TO THE STUDENTS THAT THEY SHOULD MAKE SURE THAT THE SOLDER JOINT IS SMOOTH; OTHERWISE, A SHARP POINT COULD PUNCTURE SHRINK WRAP AND CAUSE A SHORT CIRCUIT**
	23. **SLIDE 23 EXPLAIN FIGURE 8–22** A butane torch especially designed for use on heat shrink applies heat without an open flame, which could cause damage
	24. **SLIDE 24 EXPLAIN Figure 8-23** typical crimp-and-seal connector. This type of connector is first lightly crimped to retain the ends of the wires and then it is heated. The tubing shrinks around the wire splice, and thermoplastic glue melts on the inside to provide an effective weather-resistant seal. 25. **SLIDE 25 EXPLAIN Figure 8-24** Heating crimp-and-seal connector melts the glue and forms an effective seal against moisture.
	**DISCUSS FREQUENTLY ASKED QUESTIONS**
	26. **SLIDE 26 EXPLAIN Figure 8-25** Conduit that has a paint strip is constructed of plastic that can withstand high underhood temperatures. 27. **SLIDE 27 EXPLAIN Figure 8-26 (a)** Blue conduit is used to cover circuits that carry up to 42 volts.

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  	28. **SLIDE 28 EXPLAIN Figure 8-26 (b)** Yellow conduit can also be used to cover 42 volt wiring. 29. **SLIDE 29 EXPLAIN Figure 8-27** Always follow OEM instructions which include use of linesman's (high-voltage) gloves if working on circuits in orange conduit. **STUDENTS COMPLETE NATEF TASK SHEET REMOVE AND REPLACE TERMINAL END FROM CONNECTOR; REPLACE CONNECTORS AND TERMINAL ENDS** **COMPLETE NATEF TASK SHEET REPAIR WIRING HARNESS (INCLUDING CAN/BUS SYSTEMS)** **COMPLETE NATEF TASK SHEET PERFORM SOLDER REPAIR OF ELECTRICAL WIRING**