

Automotive Maintenance and Light Repair, 1ST Edition

Chapter 27 Automotive Wiring and Wire Repair

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers Automotive Maintenance and Light Repair . 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. <ul style="list-style-type: none">— Explain the wire gauge numbering system.— Describe how fusible links and fuses protect circuits and wiring.— List the steps for performing a proper wire repair.— Perform solder repair of electrical wiring.— Discuss circuit breakers and PTC electronic circuit protection devices.— 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 <i>WELCOME</i> , 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	Ch27 Automotive Wiring and Wire Repair
	<p>1. SLIDE 1 Ch27 Automotive Wiring and Wire Repair</p>
	<p>2. SLIDES 2-4 EXPLAIN OBJECTIVES</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/</p> <p>WEB SITE REGULARLY UPDATED</p>
	<p>5. SLIDE 5 EXPLAIN AUTOMOTIVE WIRING</p> <p>6. SLIDE 6 EXPLAIN Chart 27-1</p> <p>7. SLIDE 7 EXPLAIN Chart 27-2</p>
	<p>8. SLIDE 8 EXPLAIN Chart 27-3</p> <p>9. SLIDE 9 EXPLAIN Chart 27-4</p>
 <p>QUESTION</p>	<p>10. SLIDE 10 EXPLAIN Ground Wires</p> <p>DEMONSTRATION: DISCUSS RECOMMENDATIONS SHOWN IN CHART 27-4. WHAT IS RELATIONSHIP BETWEEN LENGTH & RESISTANCE? WHAT IS RELATIONSHIP BETWEEN DIAMETER & RESISTANCE?</p>
	<p>OPTIONAL HOMEWORK: USE INFORMATION IN CHART 27-4 TO CREATE A TABLE IN WHICH YOU ASSIGN RANDOM CIRCUIT LENGTHS AND AMPERAGE LOADS. HAVE STUDENTS SELECT PROPER WIRE SIZE TO SAFELY CARRY CIRCUIT LOAD. GRADE THEM ON THEIR UNDERSTANDING OF RELATIONSHIP BETWEEN WIRE SIZE AND LOAD AND THEIR SELECTION OF SIZE TO USE.</p>
	<p>VIDEO: WIRING HARNESS INSTALLATION</p> <p>http://media.pearsoncmg.com/ph/chet/chet_mymlabs/akamai/template/video640x480.php?title=Wiring%20Harness%20Installation&clip=pandc/chet/2012/automotive/Installing_EFI_System/T12CD9.mov&caption=chet/chet_mymlabs/akamai/2012/automotive/Installing_EFI_System/xml/T12CD9.xml</p>
	<p>SOME WIRE GAUGES HAVE BOTH AWG & METRIC SCALES</p>
 <p>DEMO</p>	<p>DEMONSTRATION: SHOW STUDENTS HOW TO USE A STANDARD WIRE GAUGE</p>

ICONS

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11. **SLIDE 11 EXPLAIN Figure 27-1** 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.

12. **SLIDE 12 EXPLAIN** Battery and Jumper Cables

13. **SLIDE 13 EXPLAIN Figure 27-2** Battery cables are designed to carry heavy starter current & usually 4 gauge or larger wire. This battery has 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.

14. **SLIDE 14: EXPLAIN FUSES & CIRCUIT PROTECTION DEVICES**

VIDEO: FUSES & CIRCUIT BREAKERS VIDEO

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLIBS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=FUSES%20AND%20CIRCUIT%20BREAKERS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/CLIP18FUSES1.MOV&CAPTION=CHET/CHET_MYLIBS/AKAMAI/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/XML/CLIP18FUSE1.XML](http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=fuses%20and%20circuit%20breakers&clip=pandc/chet/2012/automotive/auto_shop_safety/clip18fuses1.mov&caption=chet/chet_mylibs/akamai/2012/automotive/auto_shop_safety/xml/clip18fuse1.xml)

15. **SLIDE 15 EXPLAIN Figure 27-3** fuse panel.

16. **SLIDE 16 EXPLAIN CHART 27-5**

17. **SLIDE 17 EXPLAIN CHART 27-6**

18. **SLIDE 18 EXPLAIN CHART 27-7**

19. **SLIDE 19 EXPLAIN CHART 27-8**

20. **SLIDE 20 EXPLAIN Figure 27-4** Blade-type fuses can be tested through openings in the plastic at top of fuse.

21. **SLIDE 21 EXPLAIN Figure 27-5** Three sizes of blade-type fuses: mini on the left, standard or ATO type in the center, and maxi on the right

22. **SLIDE 22 EXPLAIN** Fuses & Circuit Protection Devices

23. **SLIDE 23 EXPLAIN Figure 27-6** comparison of the various types of protective devices used in most vehicles.

24. **SLIDE 24 EXPLAIN Figure 27-7** 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



QUESTION



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

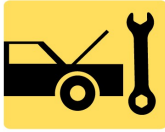
DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE DIFFERENT COLORS FOR AMPERAGE RATINGS. WHY ARE COLORS A GOOD IDEA?

- 25. **SLIDE 25 EXPLAIN Figure 27-8** 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.
- 26. **SLIDE 26 EXPLAIN Figure 27-9** Electrical symbols used to represent circuit breakers.
- 27. **SLIDE 27 EXPLAIN Figure 27-10** (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.
- 28. **SLIDE 28 EXPLAIN Figure 27-11** PTC circuit protectors are used extensively in the power distribution center of this Chrysler vehicle.
- 29. **SLIDE 29 EXPLAIN Figure 27-12** 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.
- 30. **SLIDE 30 EXPLAIN Fuses and Circuit Protection Devices**
- 31. **SLIDE 31 EXPLAIN Figure 27-13** 125 ampere rated mega fuse used to control the current from alternator

NATEF MLR TASK A6A9 INSPECT AND TEST FUSIBLE LINKS, CIRCUIT BREAKERS, AND FUSES; DETERMINE NECESSARY ACTION.

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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

32. SLIDE 32 EXPLAIN Terminals and Connectors

33. SLIDE 33 EXPLAIN Figure 27-14 Some terminals have seals attached to help seal the electrical connections.

34. SLIDE 34 EXPLAIN Figure 27-15 Separate a connector by opening the lock and pulling the two apart

35. SLIDE 35 EXPLAIN Terminals and Connectors

36. SLIDE 36 EXPLAIN Figure 27-16 secondary locks help retain the terminals in the connector.

37. SLIDE 37 EXPLAIN Figure 27-17 Use small removal tool, sometimes called a pick, to release terminals from the connector.

38. SLIDE 38 EXPLAIN WIRE REPAIR

39. SLIDE 39 EXPLAIN Figure 27-18 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) & **EXPLAIN Figure 27-19** 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: DEMONSTRATE 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.

MAKE SURE TO HAVE PROPER TERMINAL REMOVAL TOOLS AVAILABLE FOR TEACHING STUDENTS ABOUT DIFFERENT CONNECTORS.

ICONS

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40. **SLIDE 40 EXPLAIN Figure 27-20** 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.
41. **SLIDE 41 EXPLAIN Figure 27-21** 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

42. **SLIDE 42 EXPLAIN WIRE REPAIR**
43. **SLIDE 43 EXPLAIN FIGURE 27-22** A butane torch especially designed for use on heat shrink applies heat without an open flame, which could cause damage
44. **SLIDE 44 EXPLAIN Figure 27-23** 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.
45. **SLIDE 45 EXPLAIN Figure 27-24** Heating crimp-and-seal connector melts the glue and forms an effective seal against moisture.
46. **SLIDE 46 EXPLAIN TEXT ELECTRIC CONDUIT**
47. **SLIDE 47 EXPLAIN Figure 27-25** Conduit that has a paint strip is constructed of plastic that can withstand high underhood temperatures.
48. **SLIDE 48 EXPLAIN Figure 27-26 (a)** Blue conduit is used to cover circuits that carry up to 42 volts. **(b)** Yellow conduit can also be used to cover 42 volt wiring.
49. **SLIDE 49 EXPLAIN Figure 27-27** Always follow OEM instructions which include use of linesman's (high-voltage) gloves if working on circuits in orange conduit.

ICONS		Ch27 Automotive Wiring and Wire Repair
		<u>NATEF MLR TASK A6A10</u>. PERFORM SOLDER REPAIR OF ELECTRICAL WIRING.
		<u>NATEF MLR TASK A6A11</u> REPLACE ELECTRICAL CONNECTORS AND TERMINAL ENDS.