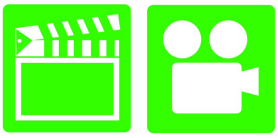
A6 Electricity & Electronics 4th Edition

Chapter 8 DIGITAL METERS

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Electricity and Electronics Systems.** 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. Discuss how to safely set up and use a fused jumper wire, a test light, and a logic probe. 2. Explain how to safely and properly use a digital meter to read voltage, resistance, and current, and compare to factory specifications. **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.

ICONS	Ch08 DIGITAL METERS
	**1. SLIDE 1 CH8 DIGITAL METERS** **2. SLIDES 2-3 EXPLAIN OBJECTIVES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**4. SLIDE 4 EXPLAIN Fused Jumper Wire** **5. SLIDE 5 EXPLAIN Figure 8-1** technician-made fused jumper lead equipped with a red 10 ampere fuse. Fused jumper wire uses terminals for testing circuits at a connector instead of alligator clips. **6. SLIDE 6 EXPLAIN Fused Jumper Wire**
	**DEMONSTRATION: SHOW STUDENTS HOW TO TEST A CIRCUIT WITH A FUSED JUMPER**
	**HOST A DISCUSSION ABOUT USES OF A FUSED JUMPER WIRE. IF A DEVICE WORKS WHEN CONNECTED TO A FUSED JUMPER WIRE, WHAT IS DETERMINED?**
	**7. SLIDE 7 EXPLAIN TEST LIGHTS** **8. SLIDE 8 EXPLAIN Figure 8-2** 12 volt test light is attached to a good ground while probing for power. **9. SLIDE 9 EXPLAIN Figure 8-3** Test light can be used to locate an open in a circuit. Test light is grounded at a different location than the circuit itself. **10. SLIDE 10 EXPLAIN TEST LIGHTS** **11. SLIDE 11 EXPLAIN Figure 8-4** Continuity light should not be used on computer circuits because applied voltage can damage delicate electronic circuits.
	**DEMONSTRATION: NON-POWERED TEST LIGHT WILL SHOW ONLY WHETHER CURRENT IS AVAILABLE. IT CANNOT DETERMINE HOW MUCH CURRENT OR EXACT VOLTAGE AVAILABLE. DEMONSTRATE A CONTINUITY TEST LIGHT FOR STUDENTS & DISCUSS WHEN IT SHOULD BE USED. TEST LAMPS SHOULD NOT BE USED ON ANY CIRCUITS CONNECTED TO A PCM DUE TO VOLTAGES USED IN ELECTRONIC COMPONENTS**
	

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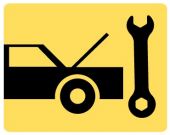
	**12. SLIDE 12** EXPLAIN **Figure 8-5** LED test light can be easily made using low cost components and an old ink pen. With the 470 ohm resistor in series with LED, this tester only draws 0.025 ampere (25 milliamperes) from circuit being tested. This low current draw helps assure technician that circuit or component being tested will not be damaged by excessive current flow.
	**HANDS-ON TASK: HAVE STUDENTS USE FIGURE 8–5 TO CONSTRUCT AN LED TEST LAMP, AND THEN HAVE THEM USE IT TO TEST A CIRCUIT OR COMPONENT.**
	**ANIMATION: TEST LIGHT OR USE PROJECT BOARD TO SIMULATE TEST LIGHT USE** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A7_ANIMATION/CHAPTER34_FIG_34_2/INDEX.HTM
	**13. SLIDE 13** EXPLAIN LOGIC PROBE
	14. SLIDE 14 EXPLAIN **Figure 8-6** logic probe connected to vehicle battery. When tip probe is connected to circuit, it can check for power, ground, or a pulse
	**DEMONSTRATION: SHOW THE STUDENTS A LOGIC PROBE AND PROPER WAY TO CONNECT IT TO A POWER AND GROUND SOURCE AND COMPONENT TO BE CHECKED.**
	**15. SLIDE 15** EXPLAIN DMM
	16. SLIDE 16 EXPLAIN **Figure 8-7** Typical digital multimeter. Black meter lead always is placed in the COM terminal. Red meter test lead should be in the volt-ohm terminal except when measuring current in amperes
	**17. SLIDE 17** EXPLAIN **Figure 8-8** Typical digital multimeter (DMM) set to read DC volts.
	18. SLIDE 18 EXPLAIN **Figure 8-9 (a)** typical autoranging digital multimeter automatically selects proper scale to read voltage being tested. The scale selected is usually displayed on meter face. Note that display indicates "4," meaning that this range can read up to 4 volts. **(b)** typical autoranging digital multimeter automatically selects proper scale to read voltage being tested. The scale selected is usually displayed on meter face. The range is now set to the 40 volt scale, meaning that the meter can read up to 40 volts on the scale. Any reading above this level will cause the meter to reset to a higher scale. If not set on autoranging, the meter display would indicate OL if a reading exceeds limit of scale selected.

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	**19. SLIDE 19 EXPLAIN Figure 8-10** Using a digital multimeter set to read ohms (Ω) to test this light bulb. The meter reads the resistance of the filament. **20. SLIDE 20 EXPLAIN Figure 8-11** Many digital multimeters can have the display indicate zero to compensate for test lead resistance. (1) Connect leads in the V Ω and COM meter terminals. (2) Select the Ω scale. (3) Touch the two meter leads together. (4) Push the "zero" or "relative" button on the meter. (5) The meter display will now indicate zero ohms of resistance. **21. SLIDE 21 EXPLAIN Figure 8-12** Measuring the current flow required by a horn requires that the ammeter be connected to the circuit in series and the horn button be depressed by an assistant.
	**Measure AC Ripple** **Measure Battery Voltage Drop** **Meter Usage Battery Volt Check** **Meter Usage Check CAN Circuit** **Meter Usage Measure Amps** **Meter Usage Measure Frequency** **Meter Usage Measure Ohms** **Meter Usage Measure Volts** **Meter Usage Testing Diode**
	**22. SLIDE 22 EXPLAIN Figure 8-13** Note blade-type fuse holder soldered in series with one of meter leads. 10 ampere fuse helps protect internal meter fuse (if equipped) & meter itself from damage that may result from excessive current flow if used incorrectly **23. SLIDE 23 EXPLAIN Inductive Ammeters** **24. SLIDE 24 EXPLAIN Figure 8-14** inductive ammeter clamp is used with all starting and charging testers to measure the current flow through battery cables. **25. SLIDE 25 EXPLAIN Figure 8-15** Typical mini clamp-on-type digital multimeter. This meter is capable of measuring alternating current (AC) & direct current (DC) without requiring that circuit be disconnected to install meter in series. Jaws are simply placed over wire and current flow through the circuit is displayed.
	**DEMONSTRATE PROPER WAY TO CONNECT TEST LEADS TO DMM. POINT OUT INPUT TERMINALS ON DMM & FUNCTIONS. TELL STUDENTS THAT**

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	READING ON WRONG INPUT COULD DESTROY METER
	**26. SLIDES 26-27** EXPLAIN Diode Check, Pulse Width, and Frequency
	28. SLIDE 28 EXPLAIN **FIGURE 8–16** Typical digital multimeter showing OL (over limit) on the readout with the ohms (Ω) unit selected. This usually means that the unit being measured is open (infinite resistance) and has no continuity
	**29. SLIDE 29** EXPLAIN Electrical Unit Prefixes
	30. SLIDE 30 EXPLAIN **Figure 8-17** Always look at the meter display when a measurement is being made, especially if using an autoranging meter
	**DISCUSSION: HAVE STUDENTS DISCUSS VARIOUS SCALES AND SETTINGS ON A DMM. WHAT IS REASON THAT TEST RESULTS USING A DMM ARE MORE ACCURATE? DISCUSS THE AUTORANGE FEATURES**
	**31. SLIDES 31-32** EXPLAIN How to Read Digital Meters
	**ANIMATION: METER READINGS INTERPRET METER READINGS 42.3** **ANIMATION: DIGITAL MULTIMETER - LABELING EXERCISE**HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A7_ANIMATION/CHAPTER34_FIG_34_18/INDEX.HTM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A6_ANIMATION/CHAPTER08_FIG_08_7/INDEX.HTM
	**33. SLIDE 33** EXPLAIN **Figure 8-18** When reading AC voltage signals, a true RMS meter (such as a Fluke 87) provides different reading than an average responding meter (such as Fluke 88). Only place this difference is important is when a reading is to be compared with a specification.
	34. SLIDE 34 EXPLAIN **Figure 8-19** This meter display shows 052.2 AC volts. Notice that the zero beside the 5 indicates that the meter can read over 100 volts AC with a resolution of 0.1 volt.
	35. SLIDE 35 EXPLAIN **Figure 8-20** Be sure to only use a meter that is CAT III rated when taking electrical voltage measurements on a hybrid vehicle **& FIGURE 8-21**

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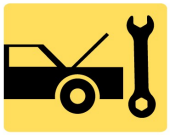
	Always use meter leads that are CAT III rated on a meter that is also CAT III rated, to maintain the protection needed when working on hybrid vehicles
	**36. SLIDES 36-58 EXPLAIN OPTIONAL DMM DEMO**
	**STUDENTS COMPLETE NATEF TASK SHEET CHECK ELECTRICAL CIRCUITS WITH A TEST LIGHT; DETERMINE NECESSARY ACTION.**
	**STUDENTS COMPLETE NATEF TASK SHEET CHECK ELECTRICAL CIRCUITS USING FUSED JUMPER WIRES; DETERMINE NECESSARY ACTION**
	**STUDENTS DO NATEF TASK SHEET DEMONSTRATE PROPER USE OF DIGITAL MULTIMETER (DMM) DURING DIAGNOSIS OF ELECTRICAL CIRCUIT PROBLEMS, INCLUDING: SOURCE VOLTAGE, VOLTAGE DROP, CURRENT FLOW, & RESISTANCE**
	**HOMEWORK 2: HAVE STUDENTS USE INTERNET TO RESEARCH DIGITAL MULTIMETERS USED IN THE AUTOMOTIVE REPAIR FIELD. ASK THEM TO LIST FOUR TO FIVE METERS, THEIR MAIN FEATURES, AND THE COST OF EACH METER. HAVE STUDENTS DETERMINE WHICH METER THEY THINK WOULD BE THE BEST PURCHASE AND EXPLAIN THEIR CHOICE AND REASONING TO THE CLASS.**
	**59. SLIDE 59 EXPLAIN SUMMARY**