

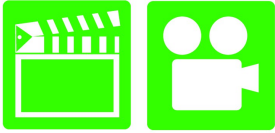
Automotive Maintenance and Light Repair, 1ST Edition

Chapter 26 Circuit Testers and Digital Meters

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">— Discuss how to safely set up and use a fused jumper wire, a test light, and a logic probe.— 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 <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 **Ch26 Circuit Testers and Digital Meters**



1. SLIDE 1 CH26 Circuit Testers and Digital Meters

2. SLIDES 2-3 EXPLAIN OBJECTIVES

Check for ADDITIONAL VIDEOS & ANIMATIONS @ <http://www.jameshalderman.com/> WEB SITE REGULARLY UPDATED

4. SLIDE 4 EXPLAIN Fused Jumper Wire

5. SLIDE 5 EXPLAIN Figure 26-1 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 26-2 12 volt test light is attached to a good ground while probing for power.

9. SLIDE 9 EXPLAIN Figure 26-3 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 26-4 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 26-5 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](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 26-6 logic probe connected to battery. When tip probe is connected to circuit, can check for power, ground, or a pulse

DEMONSTRATION: SHOW LOGIC PROBE AND PROPER WAY TO CONNECT IT TO A POWER & GROUND SOURCE & COMPONENT TO BE CHECKED.

15. **SLIDE 15 EXPLAIN DMM**

16. **SLIDE 16 EXPLAIN** Figure 26-7 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** chart 26-1

18. **SLIDE 18 EXPLAIN** Figure 26-8 Typical digital multimeter (DMM) set to read DC volts.

19. **SLIDE 19 EXPLAIN** Figure 26-9 (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

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would indicate OL if a reading exceeds limit of scale selected.

20. **SLIDE 20 EXPLAIN Figure 26-10** Using a digital multimeter set to read ohms (Ω) to test this light bulb. The meter reads the resistance of the filament.
21. **SLIDE 21 EXPLAIN Figure 26-11** 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.
22. **SLIDE 22 EXPLAIN Figure 26-12** 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



23. **SLIDE 23 EXPLAIN Figure 26-13** 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
24. **SLIDE 24 EXPLAIN Inductive Ammeters**
25. **SLIDE 25 EXPLAIN Figure 26-14** inductive ammeter clamp is used with all starting and charging testers to measure the current flow through battery cables.
26. **SLIDE 26 EXPLAIN Figure 26-15** 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.

ICONS**Ch26 Circuit Testers and Digital Meters****DEMO**

DEMONSTRATE PROPER WAY TO CONNECT TEST LEADS TO DMM. POINT OUT INPUT TERMINALS ON DMM & FUNCTIONS. TELL STUDENTS THAT READING ON WRONG INPUT COULD DESTROY METER

- 27. SLIDES 27-28 EXPLAIN Diode Check, Pulse Width, and Frequency
- 29. SLIDE 29 EXPLAIN FIGURE 26-16 Typical digital multimeter showing OL (over limit) on readout with ohms (Ω) unit selected. This means that unit being measured is open (infinite resistance) & has no continuity
- 30. SLIDE 30 EXPLAIN Electrical Unit Prefixes
- 31. SLIDE 31 EXPLAIN Figure 26-17 Always look at the meter display when a measurement is being made, especially if using an autoranging meter

DISCUSSION: DISCUSS VARIOUS SCALES AND SETTINGS ON A DMM. WHAT IS REASON THAT TEST RESULTS USING A DMM ARE MORE ACCURATE? DISCUSS AUTORANGE FEATURES

- 32. SLIDE 32 EXPLAIN CHART 26-2
- 33. SLIDES 33-34 EXPLAIN How to Read Digital Meters
- 35. SLIDE 35 EXPLAIN CHART 26-3

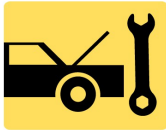
ANIMATION: METER READINGS INTERPRET METER READINGS ANIMATION: DIGITAL MULTIMETER - LABELING EXERCISE

[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/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](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a6_animation/chapter08_fig_08_7/index.htm)

- 36. SLIDE 36 EXPLAIN Figure 26-18 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.
- 37. SLIDE 37 EXPLAIN Figure 26-19 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.
- 38. SLIDE 38 EXPLAIN Figure 26-20 Be sure to only use a meter that is CAT III rated when taking electrical voltage measurements on a hybrid vehicle & FIGURE 8-21 Always use meter leads that are CAT III rated on a meter that is also CAT III rated, to maintain the

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protection needed when working on hybrid vehicles

39. SLIDES 39-61 **EXPLAIN OPTIONAL DMM DEMO**

NATEF MLR TASK A6A6 CHECK OPERATION OF ELECTRICAL CIRCUITS WITH A TEST LIGHT.

NATEF MLR TASK A6A7 CHECK OPERATION OF ELECTRICAL CIRCUITS WITH FUSED JUMPER WIRES.

NATEF MLR TASK A6A4 DEMONSTRATE PROPER USE OF A DIGITAL MULTIMETER (DMM) WHEN MEASURING SOURCE VOLTAGE, VOLTAGE DROP (INCLUDING GROUNDS), CURRENT FLOW, AND 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.