

Automotive Heating and Air Conditioning, 8e

Chapter 10 HVAC Electricity and Electronics

Opening Your Class



KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of Automotive Heating and Air Conditioning, 8e . It correlates material to task lists specified by ASE and NATEF/ASEEducation.
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. <ol style="list-style-type: none">1. Prepare for the ASE Heating and Air Conditioning (A7) certification test content area "A" (A/C System Service, Diagnosis and Repair).2. Explain the characteristics of electricity.3. Differentiate between conductors, insulators, and semiconductors.4. Explain the units of electrical measurement.5. List the parts of a complete circuit.6. Discuss the types of electrical circuit faults.7. Explain how to detect and measure electrical voltage, current, and resistance using digital meters.8. Discuss wire repair.9. Discuss the purpose of terminals, connectors, relays, and switches.10. Discuss networks and network classifications.
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.

NOTE: This lesson plan is based on the 8th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com


LINK CHP 10:




<http://www.jameshalderman.com/links/book hvac/ci/hvac ci ch 10.pptx>



These Power Point files contain more than just the images

ICONS	Ch10 HVAC Electricity and Electronics
 	<p>1. SLIDE 1 HVAC ELECTRICITY/ELECTRONICS</p> <p>2. SLIDES 2-4 EXPLAIN OBJECTIVES Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p><u>Chapter 10 Electrical</u> <u>Videos</u></p> <p>Crossword Puzzle (<u>Microsoft Word</u>) (<u>PDF</u>) Word Search Puzzle (<u>Microsoft Word</u>) (<u>PDF</u>)</p> <p>5. SLIDE 5 EXPLAIN Introduction</p> <p>6. SLIDES 6-7 EXPLAIN Electricity</p> <p>8. SLIDE 8 EXPLAIN Figure 10–2 nucleus of an atom has a positive (+) charge and the surrounding electrons have a negative (–) charge.</p> <p><u>ELECTRON FLOW</u></p> <p><u>DISCUSSION:</u> DISCUSS ELECTRON ORBIT AROUND NUCLEUS & SHELLS ELECTRONS ORBIT WITHIN. HOW MANY SHELLS FORM AROUND A NUCLEUS? DISCUSS VALENCE RING & HOW MOVEMENT OF ELECTRONS FROM THIS RING CREATES CURRENT. DESCRIBE DIFFERENCE BETWEEN FREE & BOUND ELECTRONS.</p> <p><u>DEMONSTRATION:</u> USE MAGNETS TO DEMO HOW OPPOSITES FORCES ATTRACT AND LIKE FORCES REPEL. SHOW HOW MAGNETS ATTRACT & REPEL EACH OTHER DEPENDING ON POLE ORIENTATION</p> <p>9. SLIDE 9 EXPLAIN Figure 10–7 Insulators are elements with five to eight electrons in the outer orbit.</p> <p>10. SLIDE 10 EXPLAIN How Electrons Move Through a Conductor</p>

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	<p><u>DISCUSSION:</u> DISCUSS DIFFERENT CONDUCTORS. WHY IS COPPER MOST COMMONLY USED CONDUCTOR IN ELECTRICAL SYSTEMS?</p> <p><u>DISCUSSION:</u> DISCUSS INSULATORS & REASON THEY MAKE POOR CONDUCTORS. WHAT IS RELATIONSHIP BETWEEN NUMBER OF ELECTRONS AN INSULATOR MATERIAL HAS & ITS ABILITY TO ACQUIRE & RELEASE ELECTRONS?</p> <p><u>HANDS-ON TASK:</u> HAVE BATTERY CABLES AND COMMON ELECTRICAL WIRING AVAILABLE TO PROVIDE STUDENTS A HANDS-ON EXPERIENCE WITH DIFFERENCES IN RESISTANCE THAT RESULT FROM CONDUCTORS OF DIFFERENT LENGTHS, DIAMETERS, AND MATERIALS.</p> <ol style="list-style-type: none"> 11. SLIDE 11 <u>EXPLAIN</u> FIGURE 10–10 Conventional theory states that current flows through a circuit from positive (+) to negative (-). Automotive electricity uses conventional theory in all electrical diagrams and schematics 12. SLIDE 12 <u>EXPLAIN</u> Units of Electricity 13. SLIDE 13 <u>EXPLAIN</u> Electrical Circuits <p><u>DEMONSTRATION:</u> SHOW HOW DMM MEASURES VOLTAGE. USE <u>TRAINER</u> TO SHOW STUDENTS MEASURING VOLTAGE</p> <p><u>OHM'S LAW, CURRENT</u></p> <p><u>OHM'S LAW, RESISTANCE</u></p> <p><u>OHM'S LAW, VOLT</u></p> <p><u>DEMONSTRATION:</u> SHOW HOW DMM MEASURES VOLTAGE. USE <u>PROJECT BOARD</u> TO SHOW MEASURING RESISTANCE</p> <p><u>DISCUSSION:</u> HAVE STUDENTS TALK ABOUT RESISTANCE TO ELECTRON FLOW, OR OHMS. HOW DOES MATERIAL USED AS A CONDUCTOR AFFECT RESISTANCE?</p> <p><u>MEASURE AC RIPPLE</u></p> <p><u>MEASURE BATTERY VOLTAGE DROP</u></p> <p><u>METER USAGE BATTERY VOLT CHECK</u></p> <p><u>METER USAGE CHECK CAN CIRCUIT</u></p>

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	<p><u>METER USAGE MEASURE AMPS</u></p> <p><u>METER USAGE MEASURE FREQUENCY</u></p> <p><u>METER USAGE MEASURE OHMS</u></p> <p><u>METER USAGE MEASURE VOLTS</u></p> <p><u>METER USAGE TESTING DIODE</u></p> <p>14. SLIDE 14 EXPLAIN Figure 10–16 return path back to the battery can be any electrical conductor, such as a copper wire or the metal frame or body of the vehicle.</p> <p>DISCUSSION: DISCUSS GROUND PATH. WHY DOESN'T A SEPARATE GROUND WIRE HAVE TO BE RUN FROM BATTERY TO EACH ELECTRICAL LOAD? DISCUSS HOW AND WHY A SHORT-TO-VOLTAGE OCCURS. WHAT IS THE REASON THAT SHORT-TO-VOLTAGE MAY OR MAY NOT BLOW A FUSE?</p> <p>15. SLIDES 15-16 EXPLAIN Electrical Schematics</p> <p>17. SLIDE 17 EXPLAIN FIGURE 10–18 center wire is a solid color wire, meaning that the wire has no other identifying tracer or stripe color. The two end wires could be labeled “BLU/WHT,” indicating a blue wire with a white tracer or stripe.</p> <p>18. SLIDES 18-19 EXPLAIN Types of Electrical Circuit Faults</p> <p>20. SLIDE 20 EXPLAIN FIGURE 10–21 Examples of common causes of open circuits. Some of these causes are often difficult to find.</p> <p>DEMONSTRATION: DEMONSTRATE BASIC ELECTRICAL CIRCUIT ON TRAINER. SHOW (FIGURE 4-1)WHAT HAPPENS WHEN CIRCUIT IS SHORTED TO GROUND</p> <p>TRAINER TASK: ALLOW STUDENTS TO BLOW FUSE BY CREATING A SHORT CIRCUIT, OBSERVING WHAT IT TAKES TO CREATE SHORT CIRCUIT AND WHAT RESULTS ARE FOUND</p> <p>21. SLIDE 21 EXPLAIN Fused Jumper Wire</p> <p>22. SLIDE 22 EXPLAIN FIGURE 10–25 technician-made fused jumper lead, which is equipped with a red 10-ampere fuse. This fused jumper wire uses terminals for testing circuits at a connector instead of alligator clips.</p>

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  	<p>23. SLIDE 23 EXPLAIN Test Light</p> <p>24. SLIDE 24 EXPLAIN FIGURE 10–26 Testing a fuse with a test light. If the fuse is good, the test light should light on both sides (power side and load side) of the fuse.</p> <p>25. SLIDE 25 EXPLAIN Digital Meters</p> <p>26. SLIDE 26 EXPLAIN FIGURE 10–31 Using a digital multimeter set to read ohms (Ω) to test this light bulb. The meter reads the resistance of the filament.</p> <p>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</p> <p>27. SLIDE 27 EXPLAIN Inductive Ammeters</p> <p>28. SLIDE 28 EXPLAIN Terminals, Connectors</p> <p>29. SLIDE 29 EXPLAIN FIGURE 10–37 Some terminals have seals attached to help seal the electrical connections.</p> <p>30. SLIDE 30 EXPLAIN FIGURE 10–39 The secondary locks help retain the terminals in the connector.</p> <p>SOME WIRE GAUGES HAVE BOTH AWG & METRIC SCALES</p> <p>31. SLIDES 31-32 EXPLAIN Wire Repair</p> <p><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT THE DIFFERENT COLORS FOR AMPERAGE RATINGS. WHY ARE COLORS A GOOD IDEA?</p> <p><u>DISCUSSION:</u> DISCUSS PROCESS OF SOLDERING WIRES AND THE TYPE OF SOLDER USED. WHAT DO THE PERCENTAGES OF EACH ALLOY IN A SOLDER DETERMINE?</p>

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 	<p><u>DEMONSTRATION:</u> 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</p> <p>OPTIONAL: NATEF TASK SHEET REMOVE AND REPLACE TERMINAL END FROM CONNECTOR; REPLACE CONNECTORS AND TERMINAL ENDS</p> <p>OPTIONAL: NATEF TASK SHEET REPAIR WIRING HARNESS (INCLUDING CAN/BUS SYSTEMS)</p> <p>OPTIONAL: NATEF TASK SHEET PERFORM SOLDER REPAIR OF ELECTRICAL WIRING</p> <p>33. SLIDE 33 EXPLAIN Relays</p> <p>34. SLIDE 34 EXPLAIN FIGURE 1–47 A relay uses a movable arm to complete a circuit whenever there is a power at terminal 86 and a ground at terminal 85. A typical relay only requires about 1/10 ampere through the relay coil. The movable arm then closes the contacts (#30 to #87) and can often handle 30 amperes or more</p> <p>35. SLIDE 35 EXPLAIN Networks</p> <p>36. SLIDE 36 EXPLAIN FIGURE 10–53 A network allows all modules to communicate with other modules</p> <p>37. SLIDE 37 EXPLAIN Network Classifications</p> <p>38. SLIDE 38 EXPLAIN Controller Area Network</p> <p>39. SLIDE 39 EXPLAIN FIGURE 10–55 A schematic of a Chevrolet Equinox shows that the vehicle uses a GMLAN BUS (DLC pins 6 and 14), plus a Class 2 (pin 2). A scan tool can therefore communicate to transmission control module (TCM) through high-speed network. Pin 1 connects to low-speed GMLAN network</p> <p>40. SLIDES 40-42 EXPLAIN Summary</p>