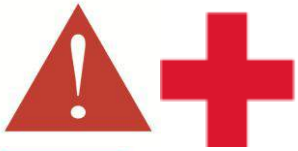
Automotive Technology 5th Edition
Chapter 64 Heating & Air-Conditioning System Diagnosis
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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 learning objectives to students as listed below: 1. Explain how to diagnose a heating system problem. 2. Diagnose lack of heat problems. 3. Describe how to check the performance of the A/C system. 4. Explain the procedures to measure temperature and pressure in AC systems.
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 the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 64: ATE5 Chapter Images

ICONS	Chapter 64 HVAC System Diagnosis
	1. **SLIDE 1 Chapter 64 HEATING & AIR-CONDITIONING SYSTEM DIAGNOSIS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	**Heater Operation (View) (Download)**
 	**DISCUSSION: Ask students to discuss HVAC diagnostic procedures. Have them explain why all the steps are necessary.**
	**DEMONSTRATION: Show heater core and plenum assembly and discuss how each functions.**
	**ON-VEHICLE NATEF TASK Identify and interpret heating and A/C concerns; determine necessary action. Page 206**
	2. **SLIDE 2 EXPLAIN Figure 64-1** heater core is mounted inside a heater plenum chamber where air passes over it to absorb heat from warmed engine coolant.
	3. **SLIDE 3 EXPLAIN Figure 64-2** A cable controlled heater control valve. This valve is normally open, allowing engine coolant to flow through the heater core. When the air conditioning is switched to maximum cooling, the valve shuts off the flow of coolant to the heater 4. **SLIDE 4 EXPLAIN FIGURE 64-3** Many engines are equipped with bleeder valve to permit a technician to bleed any trapped air from the cooling system.
	**DEMONSTRATION: Show examples of a heater control and a bleeder valve and explain how they work: FIGURE 64-3**

ICONS	Chapter 64 HVAC System Diagnosis
	**HANDS-ON TASK: Students studied operation of the thermostat in Ch21, "Cooling System Operation and Diagnosis." Ask them to review relevant reading as it applies here to heater problem diagnosis.**
	**HANDS-ON TASK: Have students follow steps to diagnose a heater problem and report conclusions.**
	**If water appears on passenger-side carpet, check for clogged evaporator drip tube.**
	**SAFETY Remind students never to remove the radiator cap when the engine is hot.**
	**DEMONSTRATION: Show how to perform hand test to check a radiator or condenser for possible clogged or restricted areas.**
	**HANDS-ON TASK: Have students perform a visual inspection of a heater problem and report their results.**
	**ON-VEHICLE NATEF TASK Inspect and test heater control valve(s); perform necessary action. Remove heater core Page 202**
	**ON-VEHICLE NATEF TASK Diagnose temperature control problems; determine necessary action. Page 198**
	**Most A/C Problems relate to a low charge due to a leak.**
	5. **SLIDE 5 EXPLAIN Figure 64-4** Many older CFC-12 systems are equipped with a sight glass either on or near the receiver-drier. A fully-charged (or completely empty) system is indicated by a clear sight glass. Bubbles or foam indicate that the system is not fully charged. An empty system may have oil streaks on the sight glass being moved by the vapor remaining in the system.

ICONS	Chapter 64 HVAC System Diagnosis
DEMO	**DEMONSTRATION: Show Sight Glass On A Receiver-Drier on CFC-12 System and discuss how it was used to check condition of the cooling system refrigerant: FIGURE 64-4**
	6. **SLIDE 6 EXPLAIN Figure 64-5** A typical refrigerant identification machine. The readout indicates what kind of refrigerant is in the system. If a blend or some other contaminated refrigerant is discovered, it should be recovered and stored in a separate container to keep it from contaminating fresh refrigerant.
DEMO	**DEMONSTRATION: Point out high-pressure & low-pressure hoses and lines in a HVAC system and discuss their significance.**
	7. **SLIDE 7 EXPLAIN Figure 64-6 (a)** Both high-pressure (red) and low-pressure (blue) hoses have been attached to the vehicle. 8. **SLIDE 8 EXPLAIN Figure 64-6 (b)** High-side pressure can be compared to the temperature of the outlet from the compressor. Here a service technician is using an infrared pyrometer to measure the temperature. 9. **SLIDE 9 EXPLAIN Figure 64-7** Hot refrigerant condenses in the condenser when it loses its heat to the outside air. Note how the level of the liquid line changes when undercharged or overcharged.
	**ON-VEHICLE NATEF TASK Performance test the A/C system and diagnose using principles of refrigeration Page 190**
	**ON-VEHICLE NATEF TASK Diagnose abnormal operating noise; determine necessary action. Page 191**
	**ON-VEHICLE NATEF TASK Perform test of air conditioning system. (P-1) Page 197**
DEMO	**DEMONSTRATION: Show students how to use a pyrometer to measure temperature of upper radiator hose & area around thermostat housing.**

ICONS	Chapter 64 HVAC System Diagnosis

10. **SLIDE 10 EXPLAIN Figure 64-8** The average R-134a pressure–temperature readings during a performance test. The high-side pressure of R-12 systems will be lower at higher temperatures.
11. **SLIDE 11 EXPLAIN Figure 64-9** When both low- and high-side pressures are low, the system is undercharged with refrigerant.
12. **SLIDE 12 EXPLAIN Figure 64-10** Both low- and high-side pressures higher than normal indicate that the system is overcharged with refrigerant.
13. **SLIDE 13 EXPLAIN Figure 64-11** Lack of proper airflow across the condenser is usually the cause of this condition

DISCUSSION: Ask students to discuss cause of low readings for both Low Side & High-Side pressure? What about high readings for both Low-Side & High-Side pressure?

FIGURES 64-9, 10, 11

OPTIONAL HANDS-ON TASK: Have students create a chart for symptoms of Low Side & High-Side pressure

Low-Side Pressure	High-Side Pressure	Causes
25-35 psi	170 - 200	Normal
LOW	LOW	Low refrigerant charge
LOW	LOW	Obstruction in the suction line
LOW	LOW	Clogged orifice tube
LOW	LOW	TXV valve stuck closed
LOW	LOW	Restricted line from condenser to evaporator
LOW	HIGH	Restricted evaporator airflow
HIGH	LOW	Internal compressor damage
HIGH	HIGH	Refrigerant overcharge
HIGH	HIGH	Restricted condenser airflow
HIGH	HIGH	High engine coolant temperature
HIGH	HIGH	TXV valve stuck open
HIGH	HIGH	Air or moisture in the refrigerant

DEMONSTRATION: Show students how to perform fire extinguisher test to check for a faulty expansion valve in an A/C . FIGURE 64-14

DISCUSSION: Ask students to talk about how to repair most common refrigerant leaks. What parts should always be replaced?

ICONS	Chapter 64 HVAC System Diagnosis
	14. **SLIDE 14 EXPLAIN Figure 64.12 clogged orifice tube.** 15. **SLIDE 15 EXPLAIN Figure 64-13 Assortment of orifice tubes.** 16. **SLIDE 16 EXPLAIN Figure 64-14A** A CO_2 fire extinguisher equipped with the fittings necessary to test the operation of an expansion valve**.** 17. **SLIDE 17 EXPLAIN Figure 64-14B** size of opening at the end of hose determines how much CO_2 is released to cool expansion valve temperature sensor bulb. 18. **SLIDE 18 EXPLAIN Figure 64-15** A partially clogged evaporator. 19. **SLIDE 19 EXPLAIN Figure 64.16** If the system is fully charged, the outlet temperature of the line leaving the evaporator should be about the same as the temperature of the line entering the evaporator after expansion valve**.** 20. **SLIDE 20 EXPLAIN Figure 64-17** Typical electronic refrigerant leak detector. Many are capable of detecting either CFC-12 or HFC-134a. 21. **SLIDE 21 EXPLAIN Figure 64-18** A black light being used to look for refrigerant leaks after a fluorescent dye was installed in the system.
	**DISCUSSION: Ask students to discuss methods for detecting leaks in an A/C system. FIGURES 64-17**
	**HANDS-ON TASK: Have students use fluorescent dye and a black light to detect refrigerant leaks. FIGURES 64-18**
	**OPTIONAL HANDS-ON TASK: Have students use a soap-and-water solution to detect a refrigerant leak in an air-conditioning system.**
	**HANDS-ON TASK: Have students perform a refrigerant leak test on evaporator by removing blower motor resistor pack and using a leak detector in open area.**
	**ON-VEHICLE NATEF TASK Leak test the air conditioning system; determine necessary action.** **Page 193**

ICONS	Chapter 64 HVAC System Diagnosis
 	**ON-VEHICLE NATEF TASK Diagnose faults in the A/C, HVAC system; determine necessary action.** **Page 205** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**