Automotive Technology 6th Edition
Chapter 67 Heating & Air-Conditioning System Service
Opening Your Class

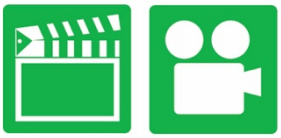
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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. Discuss blower motor service, cooling system service, and refrigerant recovery procedures. 2. Explain how to recycle refrigerants, recharge a system, and retrofit a CFC-12 system to a HFC-134A system. 3. Describe how to service the compressor, condenser, evaporator, receiver/drier or accumulator/drier, and orifice tube/expansion valve.
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 67 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 67 HVAC SERVICE
	**1. SLIDE 1 Chapter 65 HEATING & AIR-CONDITIONING SYSTEM SERVICE**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**http://www.jameshalderman.com/automotive_principles.html DOWNLOAD Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF** **Videos**
	
	**2. SLIDE 2 EXPLAIN Figure 67-1** Some heater hoses are best inspected by hoisting the vehicle and inspecting them from underneath the vehicle as shown.
	**DISCUSSION: Ask students to discuss malfunctioning heater symptoms that point to a defective thermostat.**
	**DEMONSTRATION: demo the below NATEF TASKS**
	**3. SLIDE 3 EXPLAIN FIGURE 67–2** HFC-134a systems use quick-disconnect fittings that are larger than those used for CFC-12 systems.
	**DEMONSTRATION: Show students an example of a quick disconnect service valve for R-134a system, and discuss the purpose and function of service valves. FIGURE 67-2** Refrigerant Service, Charge (View) (Download) Refrigerant Service, Evacuation (View) (Download) Refrigerant Service, Recovery (View) (Download) Service Fitting and Quick-Connect Coupler (View) (Download)
	
	**4. SLIDE 4 EXPLAIN FIGURE 67–3** (a) Refrigerant oil must be retrieved and measured when the refrigerant is recovered from the system. (b) A rubber O-ring is used to

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	indicate the level of refrigerant oil already in the container. The exact same amount of refrigerant oil must be installed as was removed when the system is recharged.
QUESTION	**DISCUSSION: Ask students to talk about impact of mixing refrigerants on high-side pressure. What are the results of such contamination?**
DEMO	**DEMONSTRATION: DEMO below NATEF TASKS**
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK A7** **Inspect condition of refrigerant oil removed from A/C system; determine needed action.**
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK A8.** **Determine recommended oil and oil capacity for system application.**
	5. **SLIDE 5 EXPLAIN FIGURE 67-4** O-rings are usually made of neoprene rubber or highly saturated nitriles (HSN) to withstand high temperatures and flexing. O-rings should be changed during a retrofit procedure. 6. **SLIDE 6 EXPLAIN FIGURE 67-5** Ford spring-lock coupling 7. **SLIDE 7 EXPLAIN FIGURE 67-6** special tool is needed to remove and install the Ford spring-lock coupling.
DEMO	**DEMONSTRATION: Show students how to check and replace the O-ring seals on refrigerant line connectors. FIGURE 67-6**
	HANDS-ON TASK: Have students check and replace O-ring seals on refrigerant line connectors. FIGURE 67-6
	8. **SLIDE 8 EXPLAIN Figure 67-7** The service cap O-ring becomes the primary seal if the service valve leaks.

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	**WARNING:** Refrigerant Can Be Hazardous Always wear safety glasses and protective gloves when servicing any automotive air-conditioning system. If any refrigerant escapes, it can cause skin to freeze or cause blindness if liquid refrigerant were to get into the eyes.
	**EXPLAIN TECH TIP:** ***Use a Micron Vacuum Gauge for Best Results:*** A typical vacuum gauge reads in inches of Mercury (in. Hg) and the recommended vacuum level needed to remove moisture from the system is considered to be 27-in. Hg or less. However, many experts recommend using a vacuum gauge that measures amount of air remaining in system. This type of gauge measures vacuum in microns. A micron is one millimeter of a meter and there are about 760,000 microns of air at atmospheric pressure. A vacuum reading of 29.72-in. Hg is about 5,000 microns. Many experts recommend that micron level be 500 or less for best results. This is particularly important when evacuating a dual-climate control system where two evaporators are used and there are long lengths of refrigerant lines. • **SEE FIGURE 67–8.**
	9. **SLIDE 9 EXPLAIN FIGURE 67–8** An air-conditioning vacuum gauge that reads in microns.
	**DEMONSTRATION:** Show students how to use a **MICRON gauge when evacuating** an A/C system. **FIGURE 67-8**
	**HANDS-ON TASK:** Have students perform procedures to check refrigerant for the presence of **air**. What problems can result from the presence of this **non-condensable gas** in the refrigerant? How can its presence be remedied?
	10. **SLIDE 10 EXPLAIN FIGURE 67–9** A typical under-hood sticker that identifies refrigerant and amount needed to change the system in kilograms (0.96 kg is equal to 0.44 pounds). 11. **SLIDE 11 EXPLAIN FIGURE 67–10** A temperature and humidity gauge is a useful tool for air-conditioning

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	work. The higher the relative humidity, more difficult it is for the air-conditioning system to lower temperature inside the vehicle.
	**EXPLAIN TECH TIP*: Because It Fits, Does Not Mean It Is Correct!*** **Many air-conditioning systems use orifice tubes that look similar, if not identical. They are usually color-coded for identification. Always use the recommended orifice tube for vehicle you are servicing. Some examples of various colors and sizes available include:** **Make Color Orifice Size (Inches)** • **Chrysler purple 0.0605** • **Ford red 0.0605** • **Ford orange 0.0560** • **Ford brown 0.0470** • **Ford green 0.0505** • **GM yellow 0.0605**
	**12. SLIDE 12 EXPLAIN FIGURE 67–11** (a) When a system is retrofitted from CFC-12 to HFC-134a, proper service fittings have to be used to help assure that cross-contamination does not occur. (b) An underhood sticker is also installed indicating that the system was retrofitted to HFC-134a and when it was done and by whom.
	**DISCUSSION: Ask students to discuss procedures for retrofitting a CFC-12 system on older vehicle to HFC-134a system. How can you determine amount of HFC-134a required to recharge system?**
	**FIGURE 67-11** **Some shops add yellow dye to AC system during a recharge to help locate a leak**
	**13. SLIDE 13 EXPLAIN FIGURE 67–12** A special tool is needed to remove and install magnetic clutch on the air-conditioning compressor.
	**Check the under-hood sticker to determine the correct refrigerant to use & amount.**

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	**DISCUSSION:** Ask students to talk about the major components of a **compressor** system. What should be checked on each component when the compressor fails? **FIGURE 67-13**
	**HANDS-ON TASK:** Have students follow procedures to remove a **compressor**. What safety precautions should be taken prior to removing compressor?
	**Any time you replace a compressor due to mechanical problems, flushing AC system is recommended. This helps ensure that new compressor is free from metal debris that could shorten its life.**
 	**ON-VEHICLE ASEEDUCATION TASK B1.** Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners and visually inspect A/C components for signs of leaks; determine needed action.
 	**ON-VEHICLE ASEEDUCATION TASK B2.** Inspect, test, service and/or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap; adjust as needed.
 	**ON-VEHICLE ASEEDUCATION TASK B3.** Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.
	**EXPLAIN TECH TIP:** ***An Additional Filter Is Insurance:*** **If the air-conditioning compressor is found to be damaged mechanically, many experts recommend that an additional filter be installed in the refrigerant line to trap any debris that may have gotten into the system. This additional filter helps prevent the new compressor from being harmed by the debris as it circulates through system.**
	**DISCUSSION:** Ask students to talk about the procedures for **recycling refrigerant**. What are the consequences for failing to follow proper recycling procedures?

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	**DEMONSTRATION:** Show students proper procedures for refrigerant recovery.
 	**DISCUSSION:** Ask students to discuss evacuation procedures for refrigerant. What is purpose of applying a vacuum to A/C system during this procedure?
 	**ON-VEHICLE ASEEDUCATION TASK E1** Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards.
 	**ON-VEHICLE ASEEDUCATION TASK E2** Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
 	**ON-VEHICLE ASEEDUCATION TASK E3.** Recycle, label, and store refrigerant.
 	**ON-VEHICLE ASEEDUCATION TASK B5.** Determine need for an additional A/C system filter; perform needed action.
 	**ON-VEHICLE ASEEDUCATION TASK B6.** Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform needed action
 	**ON-VEHICLE ASEEDUCATION TASK B8.** Remove, inspect, and replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.

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 	**ON-VEHICLE ASEEDUCATION TASK B9.** **Remove, inspect, and install expansion valve or orifice (expansion) tube.**
 	**ON-VEHICLE ASEEDUCATION TASK B10** **Inspect evaporator housing water drain; perform needed action.**
	**Use a biocide to get rid of mildew that forms in the evaporator.**
	**DEMONSTRATION:** **Show students how to use a fin comb to straighten fins of condenser. Why might this action be necessary? FIGURE 67-13**
	14. **SLIDE 14 EXPLAIN FIGURE 67–13** A fin comb is used to straighten the fins on condenser to help increase airflow and heat transfer. 15. **SLIDE 15 EXPLAIN FIGURE 67–14** Always be sure that the service valves are snug before evacuating the system. They are a common place for small refrigerant leaks.
 	**ON-VEHICLE ASEEDUCATION TASK B13** **Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.**
	**EXPLAIN TECH TIP:** ***Might as Well Do It Now*** **Whenever an evaporator is being replaced, many service technicians recommend that the heater core also be replaced. This is especially true if the vehicle had a neglected cooling system. Most heater cores are close to, or even have to be removed, to replace an evaporator. The only additional cost to the vehicle owner is the cost of the heater core itself.**

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     	**ON-VEHICLE ASEEDUCATION TASK B12** **Determine procedure to remove and reinstall evaporator; determine required oil type and quantity** **DISCUSSION: Ask students to discuss recommended servicing procedures for evaporator, receiver/drier or accumulator drier, & orifice tube or expansion valve** **ON-VEHICLE ASEEDUCATION TASK Remove, inspect, and reinstall evaporator; determine required oil quantity.**