

Automotive Technology 6th Edition

Chapter 65 Air Management

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: <ol style="list-style-type: none"> 1. Discuss the different components of an air management system. 2. Explain airflow control and air temperature control in an A/C system. 3. Discuss air filtration, air ducts, and plenum and control doors. 4. Explain nonelectrical and electronic HVAC controls.
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.

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NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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

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1. SLIDE 1 Chapter 65 AIR MANAGEMENT

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2. **SLIDE 2 EXPLAIN FIGURE 64–1** HVAC airflow is directed toward the windshield, dash or floor vents, or combinations, depending on the system settings.
3. **SLIDE 3 EXPLAIN FIGURE 64–2** three major portions of the A/C and heat system are air inlet, plenum, and air distribution. The shaded portions show the paths of four control doors.
4. **SLIDE 4 EXPLAIN FIGURE 64–3** In defog or defrost mode position, the air is directed through the evaporator to remove the moisture from the air before being sent through the heater core to warm the air.
5. **SLIDE 5 EXPLAIN FIGURE 64–4** Most HVAC control heads include a control for turning units on and setting the mode of operation, a control for adjusting the temperature, and a control for the fan speed.

DISCUSS FREQUENTLY ASKED QUESTION:

What Does the Snowflake Button on the Dash Do? Some people, such as those who drive vehicles that are equipped with automatic climate control systems, sometimes find it hard to figure out how to engage A/C compressor on a rental car or a vehicle that they have not driven before. Often the driver turns the fan to high and the mode selector to the dash vent position, but no cool air is being delivered. For the compressor to function, the button that looks like a snowflake has to be

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pushed. The snowflake button is actually the air-conditioning on/off button. • SEE FIGURE 64-5.

6. **SLIDE 6 EXPLAIN FIGURE 64-5** A/C compressor is turned on or off by depressing “snowflake” button on the dash.
7. **SLIDE 7 EXPLAIN FIGURE 64-6** Many air control doors swing on their upper and lower pivots, in red.
8. **SLIDE 8 EXPLAIN FIGURE 64-7** (a) A typical rolling-door type HVAC door that is shown almost fully closed. (b) The same door is shown about half open.
9. **SLIDE 9 EXPLAIN FIGURE 64-8** The blower motor forces air to flow through the A/C evaporator to remove moisture from the air before it is sent through the heater core where the air is heated before being directed to the defrost and floor vents.
10. **SLIDE 10 EXPLAIN FIGURE 64-9** An extremely dirty cabin filter removed from a Subaru Legacy. The owner had complained about a lack of airflow from the air-conditioning vents. A new cabin filter Corrected **concern.**



EXPLAIN TECH TIP: Keep the Air Screen Clean

The outside air inlet screen must be kept in good condition to prevent debris and small animals from entering the HVAC case Leaves and pine needles can enter, decay, and mold. Mice have been known to enter and build nests and/or die. Any of these conditions can create a bad smell and are very difficult to clean.



11. **SLIDE 11 EXPLAIN FIGURE 64-10** A typical HVAC housing that often has to be removed from vehicle as an assembly to get access to the heater core and evaporator.



12. **SLIDE 12 EXPLAIN FIGURE 64-11** The air inlet to the HVAC system is usually at the base of the windshield and covered with a plastic screen (grille) to help keep debris, such as leaves, from entering the system.



13. **SLIDE 13 EXPLAIN FIGURE 64-12** (a) The temperature and mode doors swing to direct all of the cool air past the heater core, (b) through the core to become hot, (c) or to blend hot and cool air.

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DISCUSSION: Host a discussion on the operation of the blend doors. What kind of concerns could take place?

14. **SLIDE 14 EXPLAIN FIGURE 64–13** (a) In a blend-air system, all of the air is cooled. Then some of it is reheated and blended with the cool air to get the right temperature. (b) In a reheat system, all of the air is cooled and then reheated to the correct temperature.
15. **SLIDE 15 EXPLAIN FIGURE 64–14** Ducts are placed in the center console or on the floor under the front seats to provide heated and cooled air to the rear seat passengers.
16. **SLIDE 16 EXPLAIN FIGURE 64–15** (a) (With no vacuum signal, the spring extends the actuator shaft to place the door in a certain position. (b) A vacuum signal pulls the shaft inward and moves the door to the other position.
17. **SLIDE 17 EXPLAIN FIGURE 64–16** Many older vehicles used vacuum actuators to move the HVAC doors. When vacuum actuators operate, they alter air–fuel mixture in the engine. Because vacuum controls affect engine operation and, therefore, emissions, recent vehicles use electric control systems.

DISCUSSION: Host a discussion on the operation of the pneumatic blend doors. What kind of concerns could take place?

18. **SLIDE 18 EXPLAIN FIGURE 64–17** Three compact, electric actuators/servomotors operate the doors in this part of the HVAC case.
19. **SLIDE 19 EXPLAIN FIGURE 64–18** two-wire HVAC electronic actuator where the direction of rotation is controlled by the HVAC control head or module, which changes the direction of rotation by changing the polarity of the power and ground connection at the motor.

EXPLAIN TECH TIP: Defrost All the Time? Check the Vacuum: A common problem with older vehicles that use vacuum actuators involves airflow from the defroster ducts, even though selector lever is in other positions. The defrost setting is the default position in the event of a failure with the vacuum supply. The defrost

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  	<p>position is used because it is the safest position. For safety, the windshield must remain free from frost. Heat is also supplied to the passenger compartments not only through defrost ducts, but also through the heater vents at floor level. <i>If airflow is mostly directed to the windshield, check under the hood for a broken, disconnected, or missing vacuum hose. Check the vacuum reserve container for cracks or rust (if metal) that could prevent the container from holding vacuum. Check all vacuum hose connections at the intake manifold and trace each carefully, inspecting for cracks, splits, or softened areas that may indicate a problem.</i></p> <p>NOTE: This problem of incorrect airflow inside vehicle often occurs after another service procedure has been performed, such as air filter or cabin filter replacement. The movement of the technician's body and arms can cause a hose to be pulled loose or a vacuum fitting to break without the service technician being aware that anything wrong has occurred.</p> <p>20. SLIDE 20 EXPLAIN FIGURE 64–19 Three-wire actuators include a logic chip inside motor assembly. The HVAC control module then sends a 0-volt to 5-volt signal to the motor assembly to control the direction of rotation.</p> <p>21. SLIDE 21 EXPLAIN FIGURE 64–20 A typical five-wire HVAC actuator showing the two wires used to power the motor and the three wires used for the motor position potentiometer.</p> <p><u>Blower (View) (Download)</u> <u>Blower Control, Manual (View) (Download)</u> <u>Blower Control, PWM (View) (Download)</u></p> <p>22. SLIDE 22 EXPLAIN FIGURE 64–21 squirrel cage blower motor. A replacement blower motor usually does not come equipped with the squirrel cage blower, so it has to be switched from the old motor.</p>

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DISCUSSION: Have the students discuss methods used to control blower motor speed. What usually causes failure of high-speed fuse on relay?

23. **SLIDE 23 EXPLAIN FIGURE 64–22 EXPLAIN** A blower motor circuit with four speeds controlled by resistors. The three lowest fan speeds (low, medium-low, and medium high) use the blower motor resistors to drop the voltage to the motor and reduce current to the motor. On high, the resistors are bypassed. The “high” position on the fan switch energizes a relay, which supplies the current for the blower on high through a fusible link or maxi fuse.
24. **SLIDE 24 EXPLAIN FIGURE 64–23 EXPLAIN** A blower motor resistor pack used to control blower motor speed. Some blower motor resistors are flat and look like a credit card and are called “credit card resistors.”
25. **SLIDE 25 EXPLAIN FIGURE 64–24 EXPLAIN** A brushless DC motor that uses the body computer to control the speed.
26. **SLIDE 26 EXPLAIN FIGURE 64–25 EXPLAIN** Using a mini AC/DC clamp-on multimeter to measure the current drawn by a blower motor.

DEMONSTRATION: Show the students how to properly test blower motor resistor packs using a DMM

HANDS-ON TASK: Provide the students with a blower motor circuit complaint and a wiring diagram of the circuit. Have them determine possible causes, using only their knowledge of circuit operation and the wiring diagram. Grade students on their ability to narrow down possible causes without performing circuit tests.

DEMONSTRATION: Show the students how to use a voltmeter to measure voltage drop throughout a blower motor circuit.

HANDS-ON TASK: Have the students locate, inspect, and test a blower motor using common test equipment.

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	<p><u>DEMONSTRATION: DEMO BELOW</u></p> <p>ASE EDUCATION TASKS</p>
	<p><u>ASE EDUCATION D1 TASK:</u> Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.</p>
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	<p><u>ASE EDUCATION D3 TASK:</u> Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine needed action.</p>
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	<p><u>ASE EDUCATION D4 TASK:</u> Inspect and test HVAC system control panel assembly; determine needed action.</p>
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	<p><u>ASE EDUCATION D5 TASK</u> Inspect and test HVAC system control cables, motors, and linkages; perform needed action.</p>
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	<p><u>ASE EDUCATION D6 TASK.</u> Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; perform needed action.</p> <p><u>ASE EDUCATION D7 TASK.</u> Identify the source of HVAC system odors.</p>