

**Automotive Heating And Air Conditioning**  
Eighth Edition

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Eighth Edition  
James D. Halderman

## Chapter 6

### Air Management System

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**Learning Objectives (1 of 2)**

**6.1** Prepare for the ASE Heating and Air Conditioning (A7) certification test content area “B” (Refrigeration System Component Diagnosis and Repair).

**6.2** Discuss the different components of an air management system.

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**Learning Objectives (2 of 2)**

**6.3** Explain airflow control and air temperature control in an A/C system.

**6.4** Discuss plenum and control doors.

**6.5** Explain nonelectrical and electronic HVAC controls.

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## Introduction (1 of 2)

- Outside air
- Inside air
- Air inlet
- Temperature-blend door
- Mode door

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## Introduction (2 of 2)

- Heat
- Air conditioning
- Ventilation
- Defogging or defrosting the inside of the windshield
- HVAC control head

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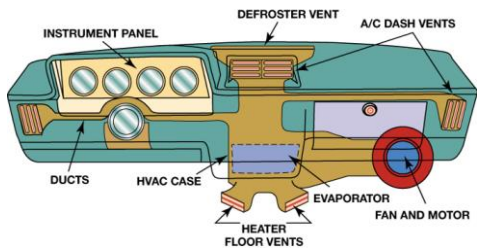
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**FIGURE 6-1** The HVAC airflow is directed toward the windshield, dash or floor vents, or combinations depending on the system settings.



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## Airflow Control

- A multispeed blower is used to force air through the ductwork when the vehicle is moving at low speeds or to increase the airflow at any speed
- Most systems use a flap door that swings about 45° to 90°

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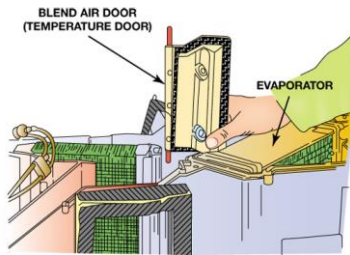
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FIGURE 6-6 Many air control doors swing on their upper and lower pivots, in red.



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## Air Temperature Control

- Most HVAC systems are considered reheat systems in that the incoming air is chilled as it passes through the evaporator.
- There is an increasing trend to use an electronically controlled variable displacement compressor with an air temperature sensor after the evaporator.

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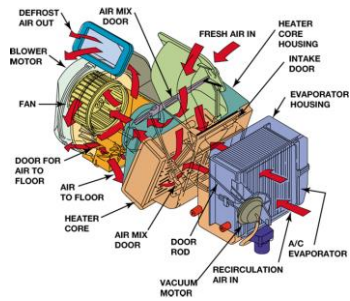
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**FIGURE 6-8** The blower motor forces air to flow through the A/C evaporator to remove moisture from the air before it is sent through the heater core where the air is heated before being directed to the defrost and floor vents.



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## Air Filtration

- HVAC air filter
- Interior ventilation filter
- Micron filter
- Particulate filter
- Pollen filter

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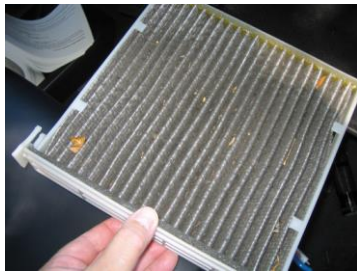
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**FIGURE 6-9** A cabin filter being removed from behind the glove compartment. The dark color is part of the filter and is activated charcoal used to help remove odors.



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## Cases and Ducts

- Plenum
  - Connected to the air inlets and outlets using formed plastic. These parts are required to contain and direct airflow, reduce noise, keep outside water and debris from entering, and isolate engine fumes and noises

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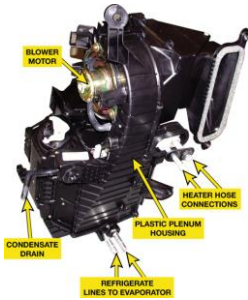
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**FIGURE 6-10** A typical HVAC housing that often has to be removed from the vehicle as an assembly to get access to the heater core and evaporator.



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## Plenum and Control Doors (1 of 6)

- Ducts
  - Air can enter the duct system from either the plenum chamber in front of the vehicle's windshield (outside air) or from the recirc (short for recirculation) or return register (inside air).
- Air doors
  - This door is normally positioned so it allows airflow from one source while it shuts off the other

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### Plenum and Control Doors (2 of 6)

- The air inlet control door is also called
  - Fresh air door
  - Recirculation door
  - Outside air door

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### Plenum and Control Doors (3 of 6)

- Temperature-Blend Door is also called
  - Air-mix door
  - Temperature door
  - Blend door
  - Diverter door
  - Bypass door

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### Plenum and Control Doors (4 of 6)

- Air from the plenum can flow into one or two of three outlet paths:
  - The A/C registers (vents) in the face of the instrument panel
  - The defroster registers at the base of the windshield
  - The heater outlets at the floor under the instrument panel.

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### Plenum and Control Doors (5 of 6)

- Mode doors are also called function, floor-defrost, and panel-defrost doors.
- Mode/function control sets the doors as follows:
  - A/C: in-dash registers with outside air inlet
  - Max A/C: in-dash registers with recirculation
  - Heat: floor level with outside air inlet

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### Plenum and Control Doors (6 of 6)

- Mode/function control sets the doors as follows:
  - Max Heat: floor level with recirculation
  - Bi-level: both in-dash and floor discharge
  - Defrost: windshield registers

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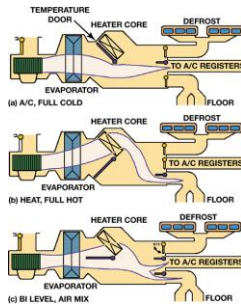
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FIGURE 6-12 (a) The temperature and mode doors swing to direct all of the cool air past the heater core, (b) through the core to become hot, (c) or to blend hot and cool air.



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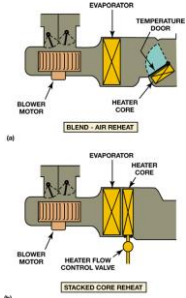
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**FIGURE 6-13** (a) In a blend-air system, all of the air is cooled. Then some of it is reheated and blended with the cool air to get the right temperature. (b) In a reheat system, all of the air is cooled and then reheated to the correct temperature.



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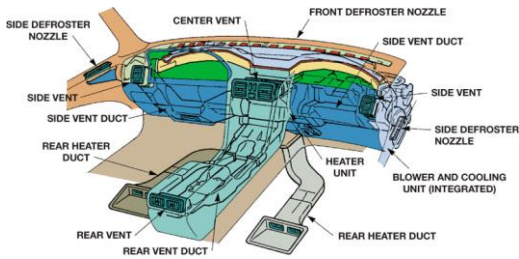
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**FIGURE 6-14** Ducts are placed in the center console or on the floor under the front seats to provide heated and cooled air to the rear seat passengers.



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## Nonelectrical and Electronic HVAC Controls (1 of 6)

- Nonelectrical HVAC Controls
  - Cable-Operated Systems
    - Mechanical systems are the least expensive
    - Tended to bind and could require a good deal of effort to operate
  - Vacuum-Operated Systems
    - Many vehicles use vacuum actuators, sometimes called vacuum motors, to operate the air inlet and mode doors

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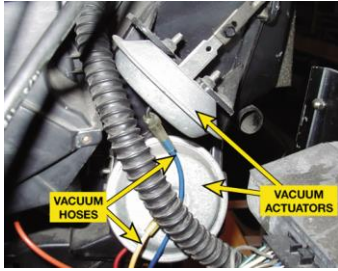
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**FIGURE 6–16** Many older vehicles used vacuum actuators to move the HVAC doors. When vacuum actuators operate, they alter the air–fuel mixture in the engine. Because vacuum controls affect engine operation and therefore emissions, recent vehicles use electric control systems.



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### Nonelectrical and Electronic HVAC Controls (2 of 6)

- Electronic HVAC Controls
  - Most recent vehicles use electrical function switches at the HVAC control head.
  - These switches operate a group of solenoid valves that control the vacuum flow to the vacuum motors or use an electric actuator (motor) to operate the air distribution and temperature-blend doors

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### Nonelectrical and Electronic HVAC Controls (3 of 6)

- Electronic HVAC Controls
  - A typical two-wire actuator rotates when electric impulses are sent to the brushes by the HVAC control head
  - A typical three-wire actuator uses a power, ground, and an input signal wire from the HVAC control module

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## Nonelectrical and Electronic HVAC Controls (4 of 6)

- Electronic HVAC Controls
  - A five-wire actuator uses two wires to power the motor (power and ground) and three wires for a potentiometer that is used to signal the HVAC control module of the motor's location

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## Nonelectrical and Electronic HVAC Controls (5 of 6)

- Electronic HVAC Controls
  - Actuator Calibration Procedures
    - STEP 1 Clear all diagnostic trouble codes (DTCs)
    - STEP 2 Turn the ignition switch to the off position
    - STEP 3 Install the replacement actuator and reconnect all mechanical and electrical connections

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## Nonelectrical and Electronic HVAC Controls (6 of 6)

- Electronic HVAC Controls
  - Actuator Calibration Procedures
    - STEP 4 Start the engine and select motor recalibration program on the scan tool under the functions menu
    - STEP 5 Verify that no diagnostic trouble codes have been set.

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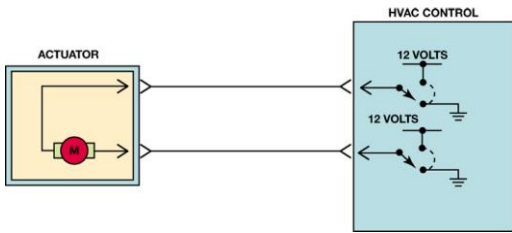
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**FIGURE 6-18** A two-wire HVAC electronic actuator where the direction of rotation is controlled by the HVAC control head or module, which changes the direction of rotation by changing the polarity of the power and ground connection at the motor.



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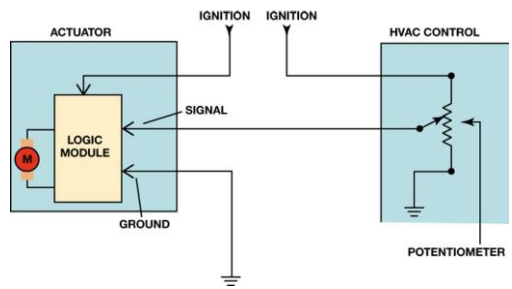
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**FIGURE 6-19** Three-wire actuators include a logic chip inside the motor assembly. The HVAC control module then sends a 0 volt to 5 volt signal to the motor assembly to control the direction of rotation.



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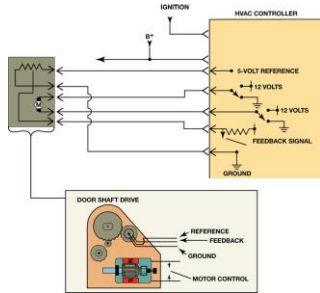
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**FIGURE 6-20** A typical five-wire HVAC actuator showing the two wires used to power the motor and the three wires used for the motor position potentiometer.



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## Blower Motor Control

- Blower speed control in many of these systems is through a multiposition electrical switch and a group of resistors or electronic controls.

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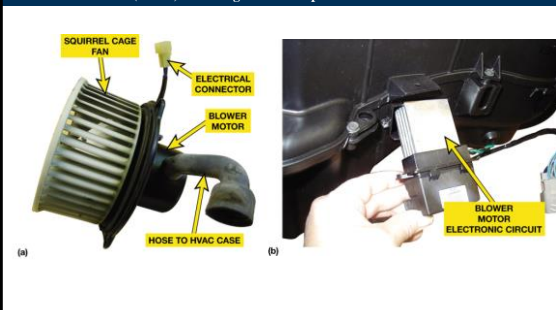
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FIGURE 6-21 (a) A typical blower motor assembly with a squirrel-cage fan attached. The hose to the HVAC case is used to bring clean cabin air, instead of dirty outside air, to cool the motor. (b) Blower motor speed is controlled through an electronic circuit (shown) or through a resistor pack.



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## Summary

- Air flows into the case that contains the evaporator and heater core
- The HVAC case contains a blower, A/C evaporator, the heater core, and doors to control the air temperature and flow.
- Most HVAC systems include a filter to remove particles and odors from the air.

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