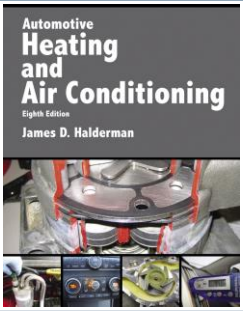
Automotive Heating And Air Conditioning

Eighth Edition



Chapter 5

A/C System Components, Operation, and Service

Learning Objectives (1 of 3)

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

5.2 Discuss the purpose and function of compressors and condensers.

5.3 Describe the operation of thermal expansion valves.

Learning Objectives (2 of 3)

5.4 Explain the construction and operation of orifice tubes.

5.5 Explain the purpose and function of evaporators and accumulators.

5.6 Discuss the use of lines and hoses in refrigeration.

Learning Objectives (3 of 3)

5.7 Describe electrical switches and evaporator temperature controls used in A/C systems.

5.8 Explain component replacement procedures.

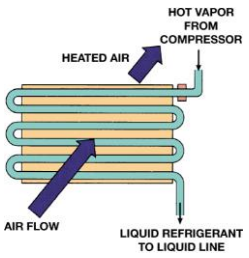
Background

- What is the background of early air conditioning?

Compressors and Condensers

- The compressor is the pump in the system that circulates the refrigerant.
- The condenser is a heat exchanger that is used to get rid of the heat removed from the passenger compartment.

FIGURE 5–1 A condenser is a heat exchanger that transfers heat from the refrigerant to the air flowing through it.



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Thermal Expansion Valves (1 of 2)

- In most TXV systems, the evaporator outlet is connected to the compressor inlet by the suction line with an internal diameter (ID) of about 5/8 inch or 3/4 inch.
- The outlet from the high-pressure side to the low-pressure side is a variable-diameter hole.

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Thermal Expansion Valves (2 of 2)

- The expansion valve uses the pintle valve to control how rapidly refrigerant enters the evaporator.
- The expansion valve controls the refrigerant flow in response to the temperature of the evaporator outlet.

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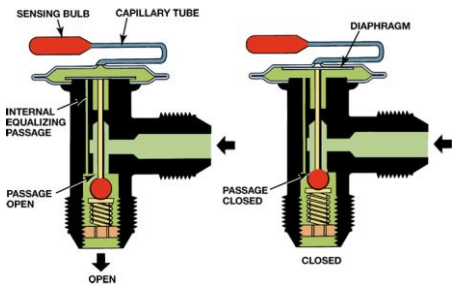
FIGURE 5–9 Pressure from the capillary tube pushes on the spring-loaded diaphragm to open the expansion valve. As the pressure in the capillary tube contracts, the reduced pressure on the diaphragm allows the valve to close.



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Orifice Tube Systems

- Some orifice tubes use a filter made up of many small plastic beads in place of the screen.
- The orifice tube floods the evaporator during light cooling loads, so a low-side accumulator is always used with an orifice.

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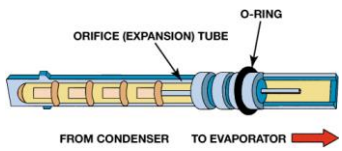
FIGURE 5–13 A typical orifice tube. The refrigerant flow is from the left toward the right.



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Evaporators

- The purpose and function of the evaporator is to remove heat from the air being forced through it to cool the inside of the vehicle.

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FIGURE 5–17 The evaporator is part of the low pressure side of the refrigeration cycle and is used to transfer the heat from inside the vehicle to the refrigerant flowing through the internal tubes.

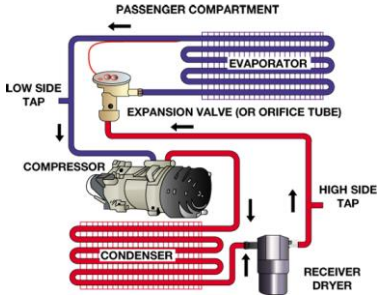

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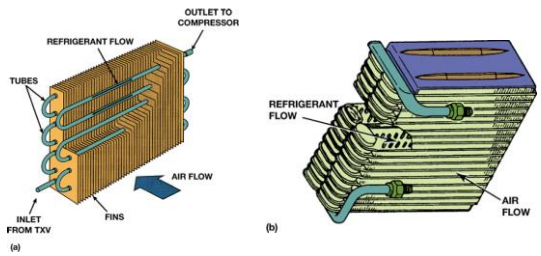
FIGURE 5–18 (a) An older design tube-and-fin evaporator. (b) A plate evaporator. Each type has a large contact area for heat to leave the air and enter the refrigerant.



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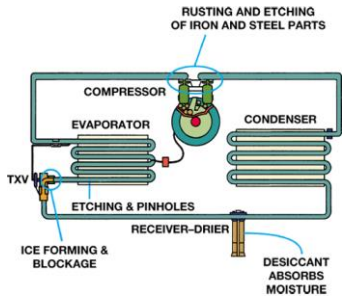
Receiver-Driers and Accumulators

- The purpose of refrigerant storage is to compensate for volume changes due to temperature change or refrigerant loss.
  - Desiccant is needed to remove moisture or water, which can cause rusting or corrosion.

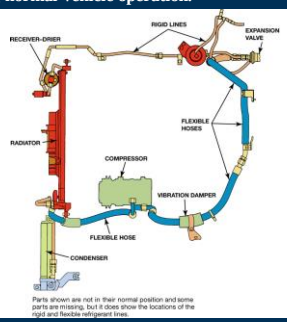
FIGURE 5–20 Water in an A/C system can combine with the refrigerant to form acid. These acids can etch and dissolve components, causing rusting of metal parts, and ice blockage at the expansion device.



Lines and Hoses

- The various system components must be interconnected so that refrigerant can circulate through the system.
- The components are connected using hoses and tubing (also called pipes).

FIGURE 5–24 Rigid lines and flexible hoses are used throughout the air-conditioning system. The line to and from the compressor must be flexible because it is attached to the engine, which moves on its mounts during normal vehicle operation.



Parts shown are not in their normal position and some parts are missing, but it does show the locations of the rigid and flexible refrigerant lines.

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Electrical Switches and Evaporator Temperature Controls (1 of 9)

- Control switches can be located anywhere in the system, such as at the:
  - compressor discharge
  - suction cavities
  - receiver–drier
  - accumulator

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Electrical Switches and Evaporator Temperature Controls (2 of 9)

- A sensor is usually an input to an electronic control module (ECM) or body control module (BCM).
- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - A/C clutch relay
  - Ambient sensor or switch

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Electrical Switches and Evaporator Temperature Controls (3 of 9)

- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - Compressor high-pressure sensor or switch
  - Compressor low-pressure sensor or switch
  - Compressor RPM sensor

Electrical Switches and Evaporator Temperature Controls (4 of 9)

- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - Compressor superheat sensor or switch
  - Compressor high-temperature switch
  - Power Steering Compressor cutoff switch
  - Engine coolant temperature (ECT)
  - Evaporator pressure sensor

Electrical Switches and Evaporator Temperature Controls (5 of 9)

- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - Evaporator temperature sensor
  - High-pressure cutout switch
  - High-temperature cutoff sensor or switch

Electrical Switches and Evaporator Temperature Controls (6 of 9)

- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - Low-pressure cutout sensor or switch
  - Master switch
  - Pressure cycling switch
  - Thermostatic cycling switch
  - Trinary pressure switch

Electrical Switches and Evaporator Temperature Controls (7 of 9)

- Any one A/C system will have some but not all of these, depending on the type of system and manufacturer:
  - Blower relay
  - Clutch cutoff relay
  - Condenser fan relay
  - Radiator fan relay

Electrical Switches and Evaporator Temperature Controls (8 of 9)

- Evaporator temperature in a cycling clutch system is sometimes controlled by either a thermostatic (thermal) switch or pressure switch.

Electrical Switches and Evaporator Temperature Controls (9 of 9)

- A thermistor is commonly used to sense temperatures.
- A transducer senses pressure and changes a variable pressure signal into a variable electrical signal.

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FIGURE 5–32 Many early A/C systems used a simple electrical circuit.

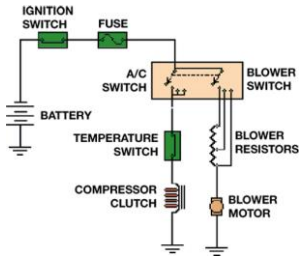

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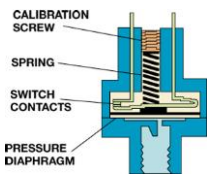
FIGURE 5–33 A pressure switch is either on or off. The contacts are closed by gas pressure on the diaphragm; they are opened by the spring.



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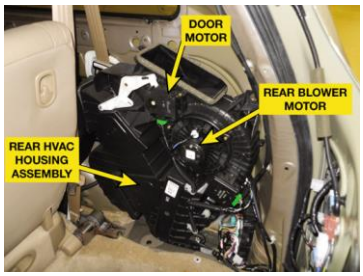
Rear A/C Systems

- Parts and Operation
  - Some larger vehicles (vans and small buses) have dual heat and A/C assemblies, with the rear unit mounted in a rear side panel or in the roof
  - Tee fittings are placed in the liquid and suction lines so that refrigerant can flow through both units, with the flow through the rear unit dependent on the cooling load

FIGURE 5–35 The rear HVAC module assembly used on a Honda Odyssey minivan.



Component Replacement Procedures (1 of 3)

- If the fitting is tight and still leaks, it must be taken apart and inspected for damage and a new O-ring must be installed.
- A faulty hose or metal line is often repaired by replacing it with a new or repaired line.

Component Replacement Procedures (2 of 3)

- Inside-out failure is caused by acids inside of the system, and the accumulator or receiver–drier must be replaced and the refrigerant recycled to remove these acids.

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Component Replacement Procedures (3 of 3)

- Special puller that attaches to the orifice tube or needle-nose pliers is normally used to remove it.
- When replacing a TXV (other than a H-block-type TXV), the thermal bulb must be securely attached to the evaporator outlet tube.
  - This area must be clean to ensure good heat transfer.

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FIGURE 5–36 The line to the condenser from the compressor includes a flange mount with an O-ring. This line is being replaced with a new original equipment line as a result of an accident, which caused the line to be kinked.

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Summary

- Orifice tubes divide the high side from the low side and are used with accumulators located in the low side.
- Various line fitting types are used to connect the components.
- Various switches, sensors, and controls are used to control compressor, blower, and fan operation.

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