



HVAC - Chilling Systems

An Online Continuing Education Course for Engineers

Course Number: HV-3008

Credit: 3 Hours / 3 PDH / 3 CPD

HVAC: Chilling Systems

INTRODUCTION

Chillers are devices that remove the heat that is gained by a recirculating chilled water system as it cools a building. Two types of refrigeration cycles can be used by chillers: either the compression cycle or the absorption cycle.

The term "chiller" is used in connection with a complete chiller package, which includes the following: compressor, condenser, evaporator, internal piping, and controls. "Chiller" is also used when all these components are used with a cooling tower.

Compression Cycle

Liquid refrigerant, at a relatively high pressure and temperature, flows through a restriction called the flow control device or expansion valve. The flow control device separates the high-pressure side of the system from the low-pressure side. It acts as a pressure reducing valve because the pressure of the liquid flowing through it is lowered, and only a small portion of the refrigerant flows through the valve into the evaporator.

The refrigerant that flows through the evaporator is vaporized by the heat flowing through the walls of the evaporator. After leaving the evaporator, the refrigerant is a gas at a low temperature and pressure. To be able to use it again to achieve the refrigerating effect, it must be brought back to a high-pressure liquid. Refrigerant flows from the evaporator to a compressor where the pressure is increased. Compressing the gas also increases the temperature. The refrigerant travels to a condenser after leaving the compressor and flows through one circuit in the condenser. In the other circuit, a cooling fluid (either air or water) flows at a temperature lower than the refrigerant. Heat transfers from the refrigerant to the cooling fluid, and the refrigerant condenses to a liquid. Figure 1 shows the compression cycle.

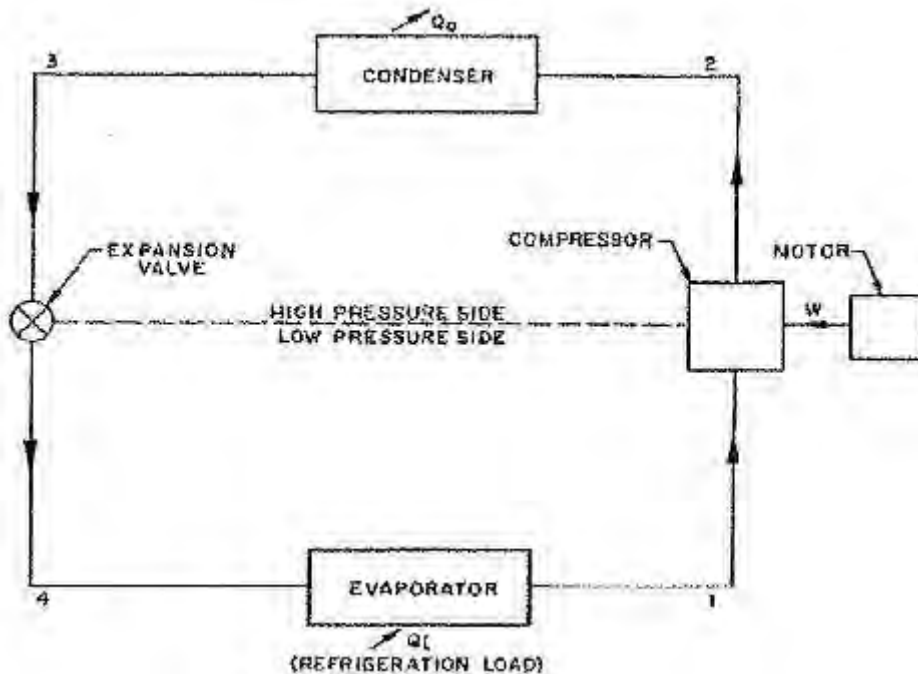


Figure 1. Compression Refrigeration Cycle.

Reprinted with permission from 1997 ASHRAE Handbook.

Centrifugal Compressors

Centrifugal compressors are variable displacement machines that provide pressure through the action of rotating impellers. The fundamental design of the centrifugal compressor is similar to that of a centrifugal pump (Figure 2).

Refrigerant vapor enters the compressor through suction passages, and passes into the impeller. The impellers increase the velocity of the vapor. The velocity energy resulting from this increase is converted to a pressure increase. Centrifugal compressors are designated by their number of stages, with one stage for each impeller.

Reciprocating Compressors

The definition of reciprocating is a back and forth motion in a straight line. Reciprocating compressors are positive displacement machines that provide compression through the action of a piston squeezing refrigerant in a cylinder. Construction is similar to the reciprocating engine of a vehicle, with pistons, cylinders, valves, connecting rods, and crankshaft (Figure 3).

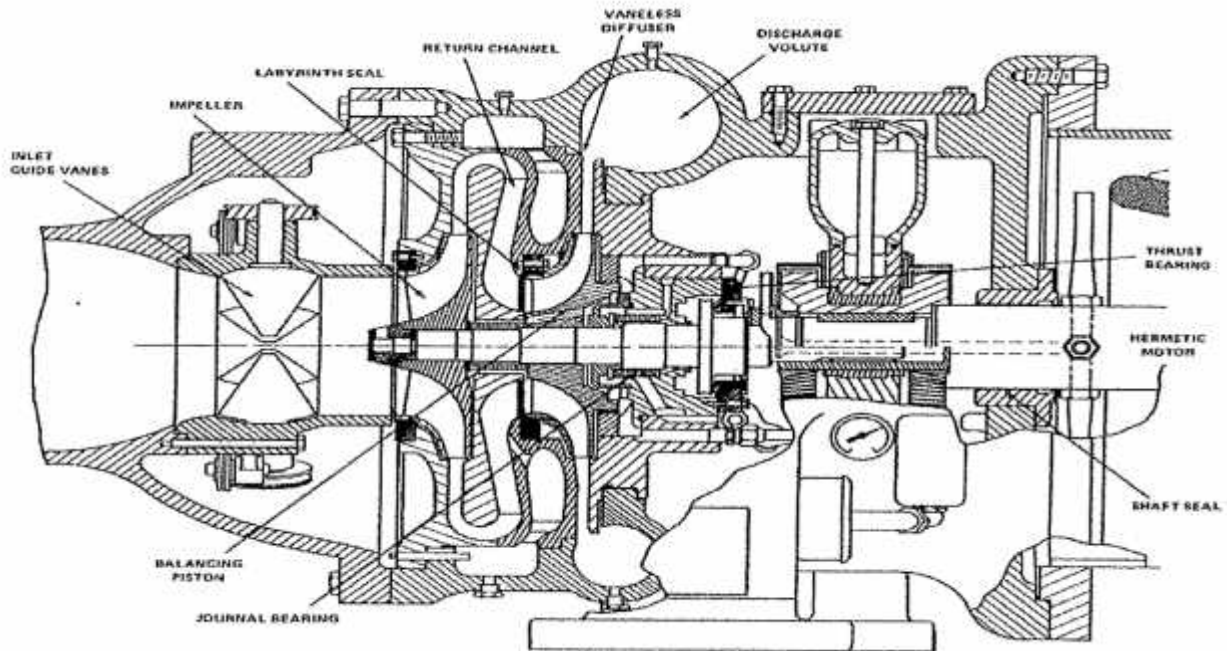


Figure 2. Centrifugal Compressor.

Reprinted with permission from the 1992 *ASHRAE HVAC Systems and Equipment Handbook*.

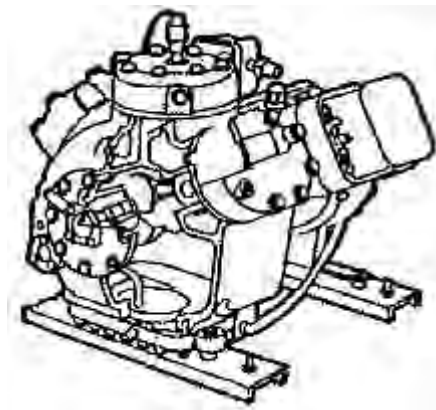


Figure 3. Reciprocating Compressor.

Carrier Corporation, Syracuse, NY. Used with permission.

As the piston moves out of the cylinder, refrigerant vapor is drawn in. As the piston moves in, the refrigerant is compressed. In most cases, the suction and discharge valves are either thin plates or reeds that will open and close easily and quickly.

The reciprocating compressor is the most widely used type, available in sizes from fractional horsepower and tonnage up to a few hundred tons.

Screw Compressors

Screw compressors can be used in the compression cycle in a complete chiller package. They come in two main types: single screw and twin screw.

Single screw. The single screw compressor (Figure 4) consists of a single cylindrical main rotor that works with a pair of gate rotors. The compressor is driven through the main rotor shaft and the gate rotors follow. Refrigerant vapor enters the suction chamber. As the main rotor turns, vapor is trapped in the space formed by the three sides of the flutes, casing, and gate rotor tooth. As rotation continues, the flute volume decreases and compression occurs as illustrated in Figure 5.

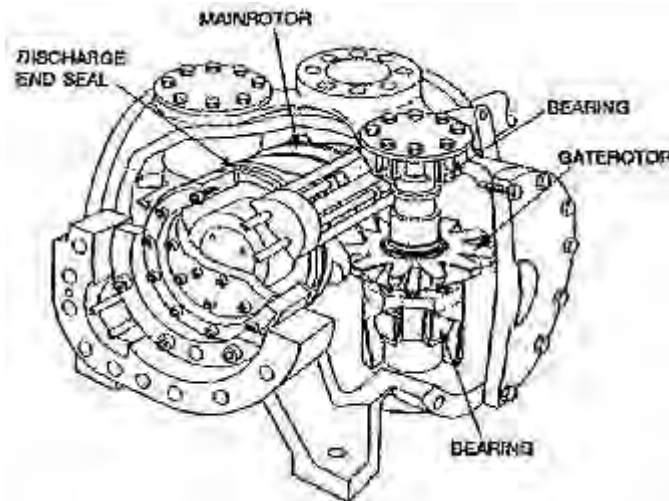
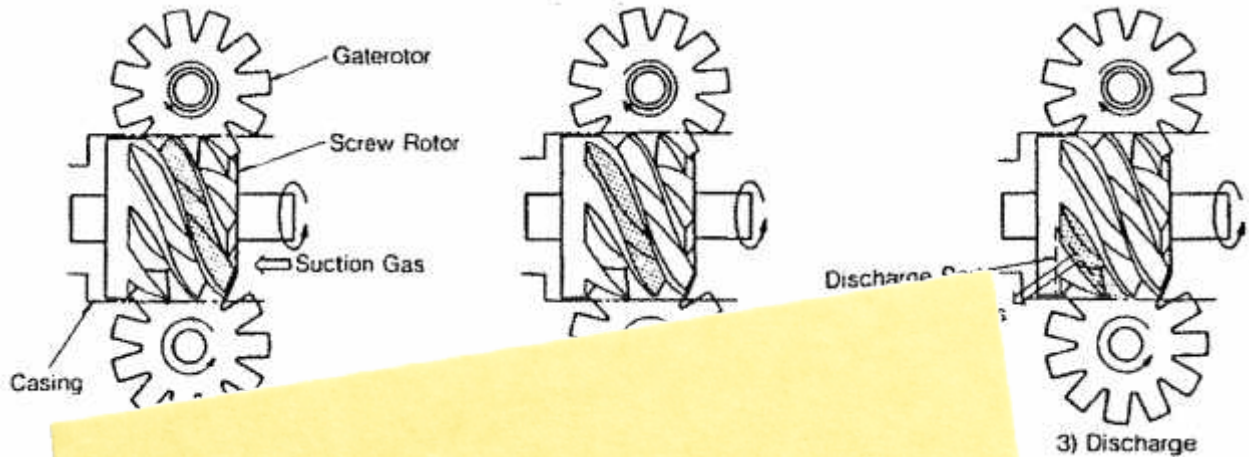


Figure 4. Single-Screw Compressors.

Reprinted with permission from 1996 ASHRAE *HVAC Systems and Equipment Handbook*.



Twin s
rotors,
(screws
is comp

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

Close this window and click "Add to cart" on the product page.

ndbook.

grooved
he two rotors
and the vapor

Figure 6. Twin Screw Compressor.

Reprinted with permission from the 1996 ASHRAE *Systems and Equipment Handbook*.