

Illustration of the basic refrigeration cycle.

Mechanical refrigeration is accomplished by continuously circulating, evaporating, and condensing a fixed supply of refrigerant in a closed system. Evaporation occurs at a low temperature and low pressure while condensation occurs at a high temperature and high pressure. Thus, it is possible to transfer heat from an area of low temperature (i.e., refrigerator cabinet) to an area of high temperature (i.e., kitchen).

Referring to the illustration below, beginning the cycle at the evaporator inlet (1), the low-pressure liquid expands, absorbs heat, and evaporates, changing to a low-pressure gas at the evaporator outlet (2).

The compressor (4) pumps this gas from the evaporator through the accumulator (3), increases its pressure, and discharges the high-pressure gas to the condenser (5). The accumulator is designed to protect the compressor by preventing slugs of liquid refrigerant from passing directly into the compressor. An accumulator should be included on all systems subjected to varying load conditions or frequent compressor cycling. In the condenser, heat is removed from the gas, which then condenses and becomes a high-pressure liquid. In some systems, this high-pressure liquid drains from the condenser into a liquid storage or receiver tank (6). On other systems, both the receiver and the liquid line valve (7) are omitted.

Between the condenser and the evaporator an expansion device (10) is located. Immediately preceding this device is a liquid line strainer/drier (9), which prevents plugging of the valve or tube by retaining scale, dirt, and moisture. The flow of refrigerant into the evaporator is controlled by the pressure differential across the expansion device or, in the case of a thermal expansion valve, by the degree of superheat of the suction gas.

Thus, the thermal expansion valve shown requires a sensor bulb located at the evaporator outlet. In any case, the flow of refrigerant into the evaporator normally increases as the evaporator load increases.

As the high-pressure liquid refrigerant enters the evaporator, it is subjected to a much lower pressure due to the suction of the compressor and the pressure drop across the expansion device. Thus, the refrigerant tends to expand and evaporate. In order to evaporate, the liquid must absorb heat from the air passing over the evaporator.

Eventually, the desired air temperature is reached and the thermostat or cold control (11) will break the electrical circuit to the compressor motor and stop the compressor.

As the temperature of the air through the evaporator rises, the thermostat or cold control remakes the electrical circuit. The compressor starts, and the cycle continues.

In addition to the accumulator, a compressor crankcase heater (12) is included on many systems. This heater prevents accumulation of refrigerant in the compressor crankcase during the non-operating periods and prevents liquid slugging or oil pumpout on startup.

Additional protection to the compressor and system is afforded by a high- and low-pressure cutout (13). This control is set to stop the compressor in the event that the system pressures rise above or fall below the design operating range.

Other controls not indicated on the basic cycle which may be part of a system include: evaporator pressure regulators, hot gas bypass regulators, electric solenoid valves, suction pressure regulators, condenser pressure regulators, low-side or high-side float refrigerant controllers, oil separators, etc.

It is extremely important to analyze completely every system and understand the intended function of each component before attempting to determine the cause of a malfunction or failure.

