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5.0 VAPOR COMPRESSION CYCLE

The vapor compression cycle is the primary cycle used in commercial refrigeration systems. This cycle is shown below in Figure 2.

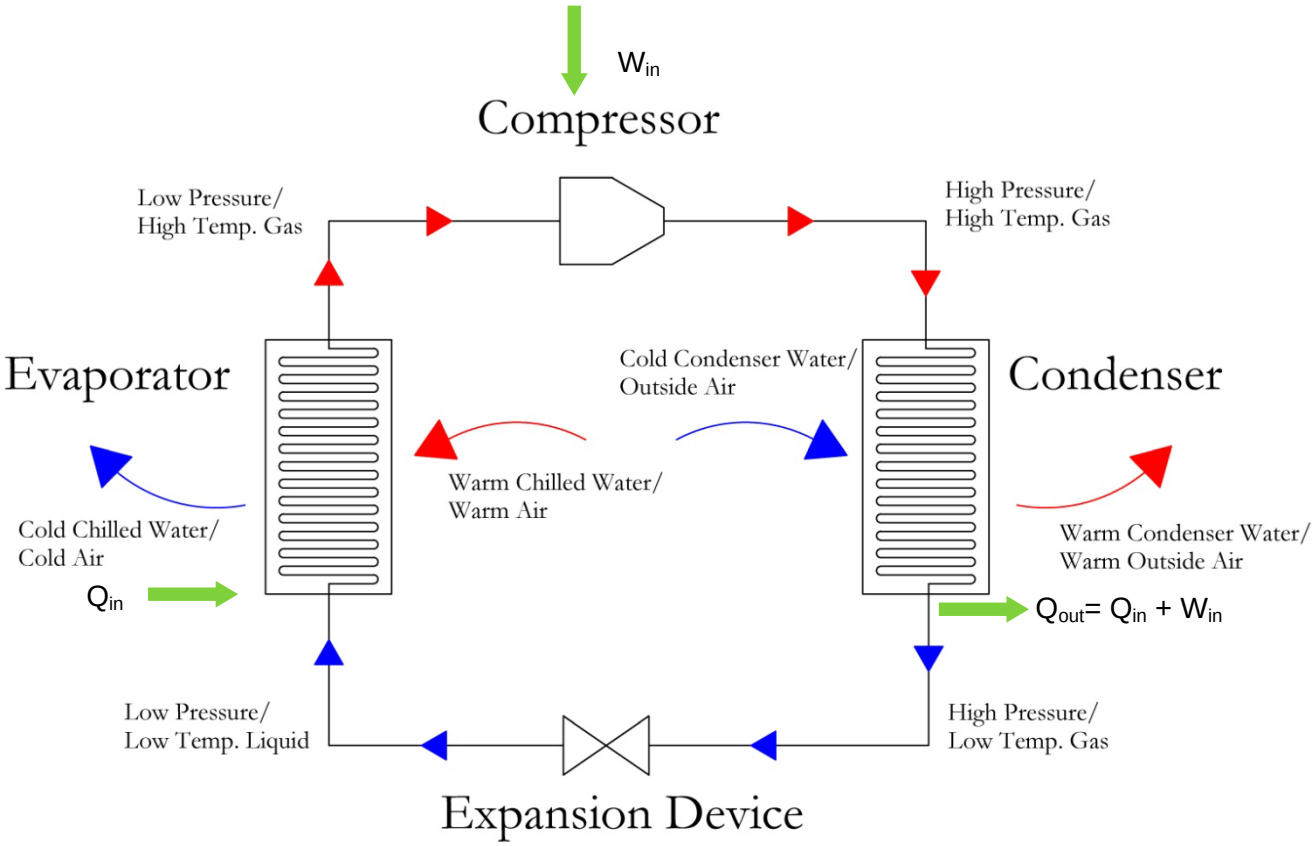

FIGURE 2: VAPOR COMPRESSION CYCLE

The vapor compression cycle starts at (Step 1) the evaporator, with cold, low-pressure, liquid refrigerant. It absorbs heat and evaporates to a low-pressure gas. Then the gas is (Step 2) Compressed to a high-pressure, high-temperature gas and (Step 3) condensed to a high pressure gas. Finally, the gas is condensed at the (Step 4) expansion device to a cold, low-pressure liquid refrigerant.

8.0 Refrigeration Practice Problems

Problem 1 – Evaporator

Background: A chiller uses R-134a refrigerant, with a flow rate of 50 lb/min and has a suction pressure of 40 PSIA and a discharge pressure of 200 PSIA, with no sub-cooling and no super heating.

Problem: What is the net refrigeration effect of the evaporator?

(a) 10 Tons

(b) 11.5 Tons

(c) 13.5 Tons

(d) 16 Tons

SOLUTION 1 - EVAPORATOR

$$Q_{net\ refrigeration\ effect}\ [Btuh] = (H_1 - H_4)\left[\frac{Btu}{lb}\right] * (Refrig\ Flow\ Rate)\left[\frac{lb}{min}\right] * (60)\left[\frac{min}{hr}\right]$$

$$H_1 = leaving\ evaporator\ enthalpy\ \left[\frac{Btu}{lb}\right] = 107\ Btu/lb$$

$$H_4 = entering\ evaporator\ enthalpy\ \left[\frac{Btu}{lb}\right] = 54\ Btu/lb$$

$$Q_{net\ refrigeration\ effect}\ [Btu] = (107 - 54)\left[\frac{Btu}{lb}\right] * 50\left[\frac{lb}{min}\right] * 60\left[\frac{min}{hr}\right]$$

$$Q_{net\ refrigeration\ effect} = 159{,}000\ Btuh * \frac{1\ ton}{12{,}000\ Btuh} = 13.25\ Tons$$