Q8) <u>Write **an** expression for the heat transfer coefficient of air pass over finned coil</u>

$$h_f = 38V^{0.5} \qquad (12\text{-}21)$$

where V is the face velocity in meters per second.

Q9) <u>Draw a diagram for a pressure drop of air flowing over finned coil.</u>

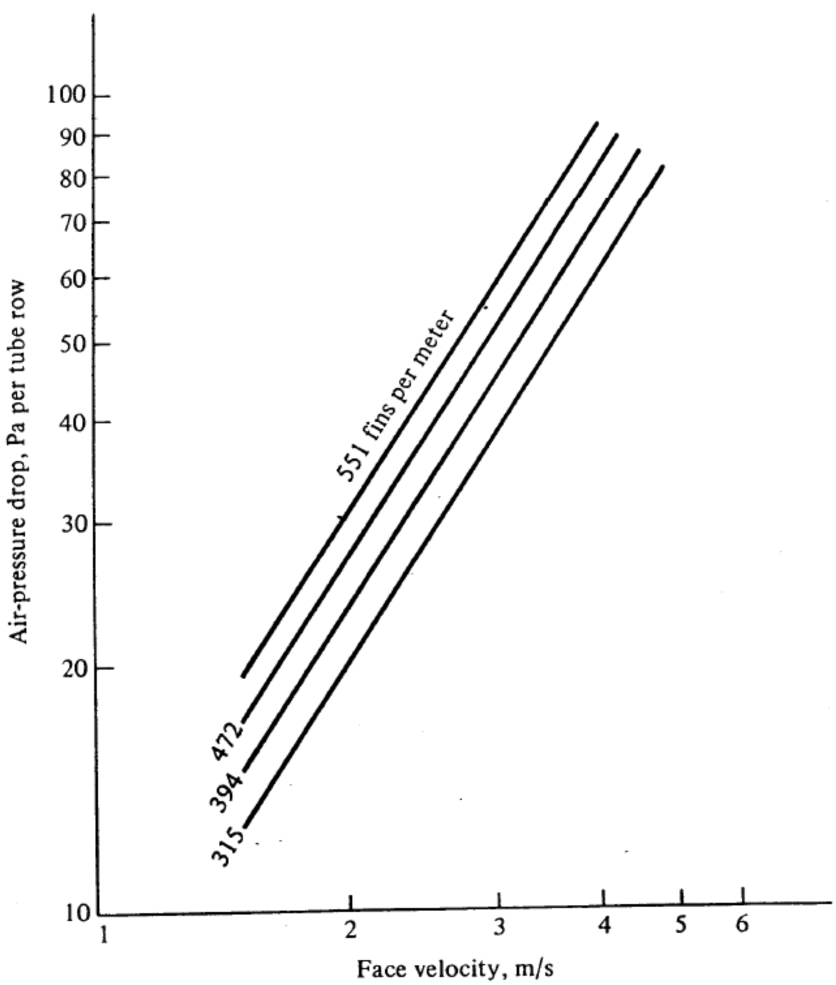


Figure 12-10 Pressure drop of air flowing through a **finned coil** *(Bohn Heat Transfer Division of*

The figure above shows that the air pressure drop will be increase when the face velocity increase also when the number of fins per meter increase.

12-8 Required condensing capacity The required rate of heat transfer in the condenser is predominately a function of the refrigerating capacity and the temperatures

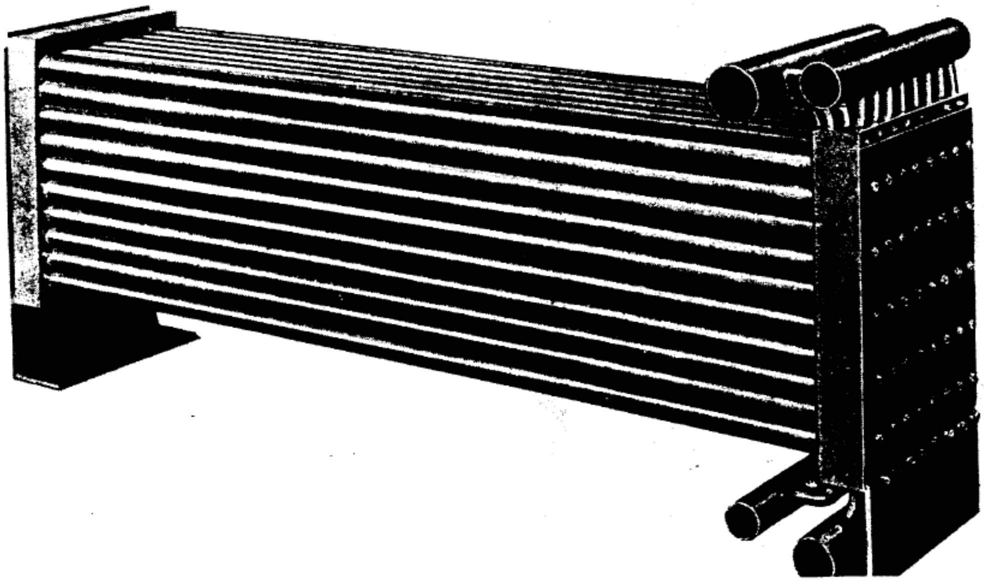


Figure 12-11 Water-cooled condenser with cleanable tubes. *(Halstead and Mitchell, a Division of Halstead Industries, Inc.)*

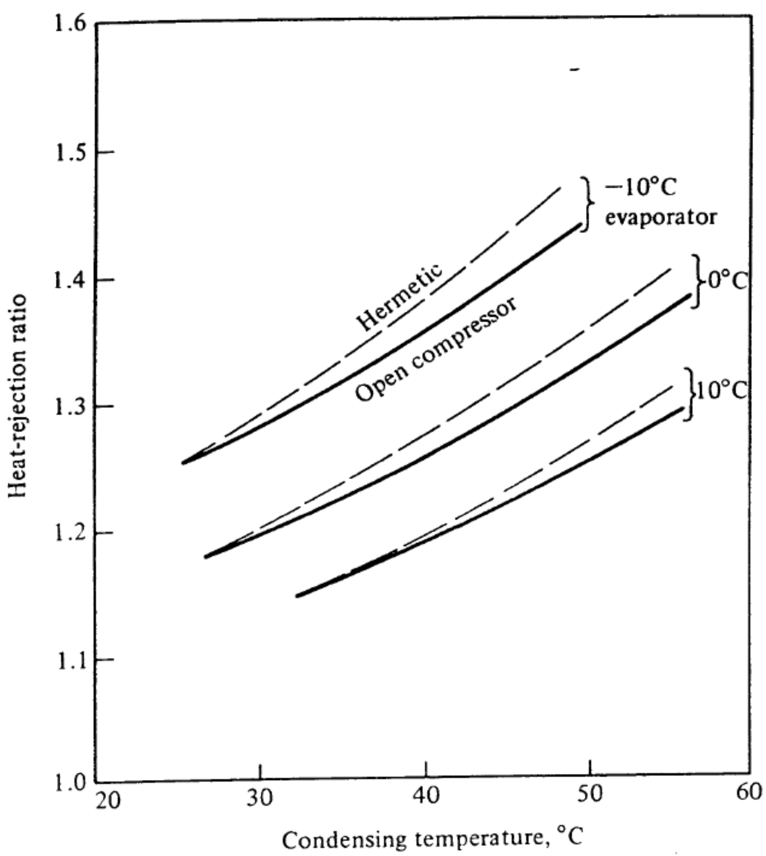


Figure 12-12 Typical values of the ratio of the heat rejected at the condenser to the capacity for refrigerants 12 and 22.

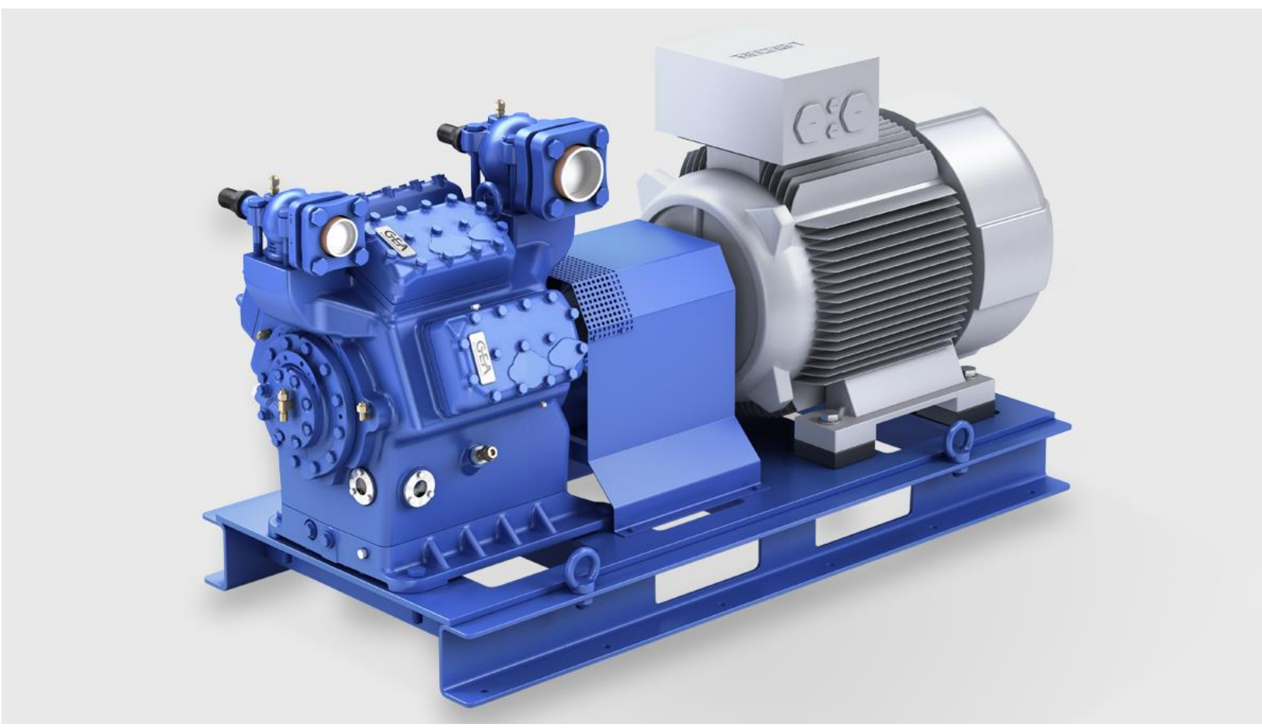
$$Q_{condenser} = Q_{evaporator} + \text{Compression Power}$$

of evaporation and condensation. The condenser must reject both the energy absorbed by the evaporator and the heat of compression added by the compressor. A term often used to relate the rate of heat flow at the condenser to that of the evaporator is the *heat-rejection ratio*

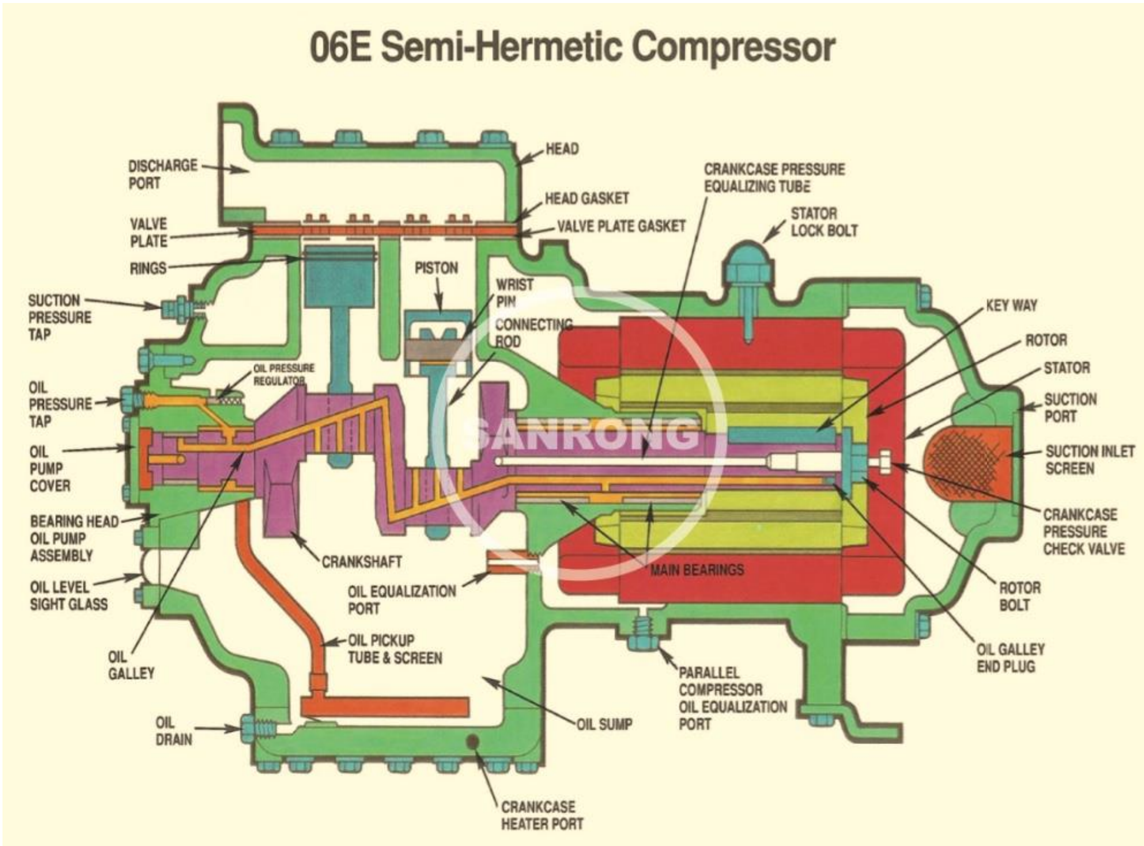
$$\text{Heat-rejection ratio} = \frac{\text{rate of heat rejected at condenser, kW}}{\text{rate of heat absorbed at evaporator, kW}}$$

$$HRR = \frac{Q_{condenser}}{Q_{evaporator}}$$

<u>Open Compressor </u>(الضاغط المفتوح يكون المحرك الكهربائي مفصول عن الضاغط ويتصل معه عن طريق رابط ميكانيكي)



Hermetic Compressor



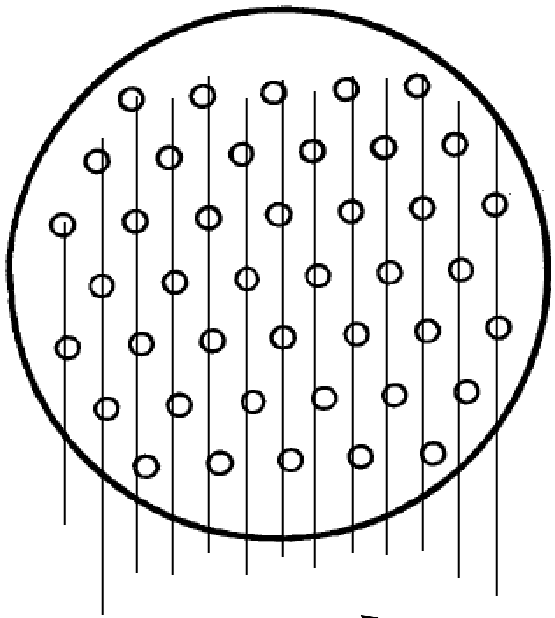
Q10) Write the equation for mean condensing coefficient for vapor condensing over horizontal tubes

The equation for the mean condensing coefficient for vapor condensing on the outside of horizontal tubes is

$$h_{ct} = 0.725 \left(\frac{g\rho^2 h_{fg} k^3}{\mu \, \Delta t \, ND} \right)^{1/4} \quad \text{W/m}^2 \cdot \text{K} \qquad (12\text{-}24)$$

g = Gravity acceleration 9.81 m/s^2
h_{fg}= Latent heat of vaporization (h_g –h_f) J/kg
ρ = Refrigerant density (1/ν_f) kg/m^3
k = Refrigerant thermal conductivity W/m.K
μ = Refrigerant viscosity (liquid viscosity) Pa.s
Δt = Temperature difference between refrigerant vapor and outer surface of tube. K
D= Outside diameter of tube (OD) m.

N= number of tubes in a vertical row (N= number of tubes/ number of vertical rows)



12-10 Fouling factor After a water-cooled condenser has been in service for some time its U value usually degrades somewhat because of the increased resistance to heat transfer on the water side due to fouling by the impurities in the water from the cooling tower. The new condenser must therefore have a higher U value in anticipation of the reduction that will occur in service. The higher capacity with new equipment is provided by specifying a *fouling factor* $1/h_{ff}$ $m^2 \cdot K/W$. This term expands Eq. (12-8) for the U value into

$$\frac{1}{U_o} = \frac{1}{h_o} + \frac{xA_o}{kA_m} + \frac{A_o}{h_{ff}A_i} + \frac{A_o}{h_i A_i} \qquad (12\text{-}25)$$

Several different agencies have established standards for the fouling factor to be used. One trade association[12] specifies 0.000176 $m^2 \cdot K/W$, which means that the condenser should leave the factory with a $1/U_o$ value 0.000176 A_o/A_i less than the minimum required to meet the quoted capacity of the condenser.

12-11 Desuperheating Even when the refrigerant condenses at a constant pressure, its temperature is constant only in the condensing portion. Because the vapor coming from the compressor is usually superheated, the distribution of temperature will be as shown in Fig. 12-14. Because of the distortion in the temperature profile caused by the desuperheating process, the temperature difference between the refrigerant and the cooling fluid is no longer correctly represented by the LMTD

$$\mathrm{LMTD} = \frac{(t_c - t_i) - (t_c - t_o)}{\ln\,[(t_c - t_i)/(t_c - t_o)]} \tag{12-26}$$

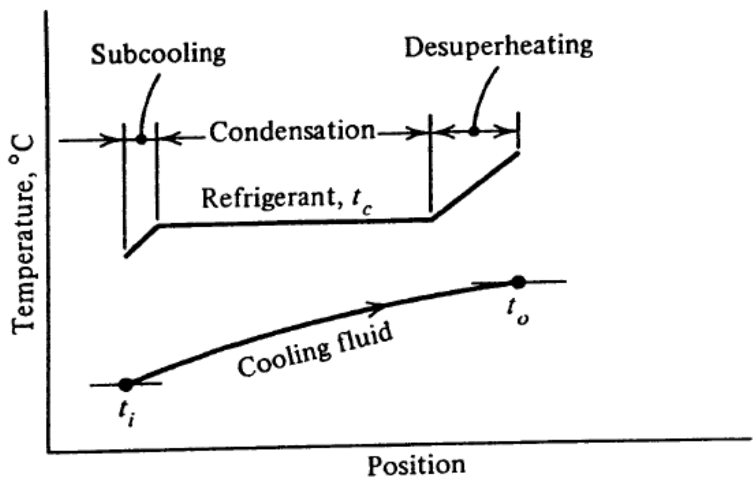


Figure 12-14 Temperature distributions in a condenser.