

temperature as previously described, and then using the difference between the external film temperature and the refrigerant for evaluating h_r in Equation 15.

$$h_r = \frac{q}{\frac{A}{R} (t_s - t_r)} \quad (15)$$

The term $(t_s - t_r)$ is commonly written Δt . The usefulness of the foregoing equation is impaired by the fact that both h_r and Δt must be evalu-

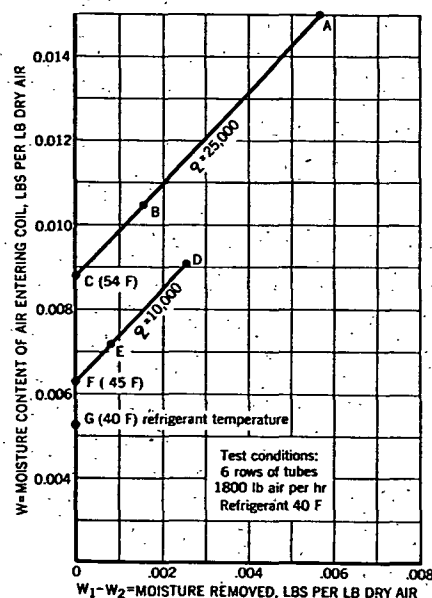


FIG. 14. DETERMINATION OF SURFACE TEMPERATURE

ated experimentally. More direct results can be obtained by ignoring h_r and determining the relation between Δt and total coil capacity:

$$\Delta t = t_s - t_r = m q^n \quad (16)$$

where

m and n = constants determined by tests.

When water is used as a cooling medium in tubes, the rate of heat transfer is a function of water velocity, because this results in an increase in the number of contacts of the water molecules with the tube surface, per unit of time. Thus increased water velocity and reduced tube diameter cause increased heat transfer. Heat transfer is also greater at higher temperatures of the water. The basic formula for the film coefficient of heat transfer for flow of water is as follows:

$$h_w = 1.5 (t + 100) \frac{V^{0.8}}{D^{0.2}} \quad (17)$$

where

h_w = internal film coefficient of heat transfer, Btu per (hour) (square foot of internal tube surface) (degree Fahrenheit).

V = water velocity, feet per second.

D = internal diameter of tube, inches.

t = average water temperature, degrees Fahrenheit.

In the case of finned tubes, values of h_w may be lower than those obtained by use of Equation 17. Accurate results can be obtained by using Equation 15, if the logarithmic mean temperature difference between surface and water is used in place of Δt .

When saturated steam is condensed in the tubes of coils, the film

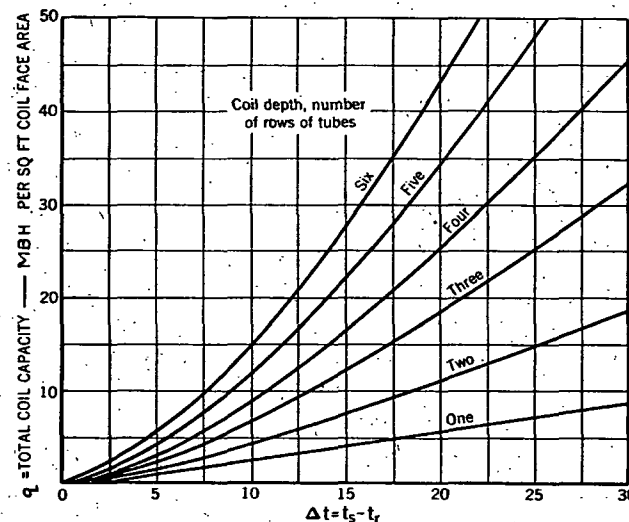


FIG. 15. TYPICAL CURVES SHOWING RELATION BETWEEN TOTAL CAPACITY AND TEMPERATURE DIFFERENCE FOR REFRIGERANTS

coefficient h_r varies from 1000 to 2000, depending on freedom from air in the steam, and upon good drainage of the tubes. The coefficient is fairly constant for a particular coil, giving values of Δt that are directly proportional to q .

GRAPHICAL ANALYSIS OF COIL PERFORMANCE

In testing coils, determination of surface temperatures is most important. A convenient way of determining surface temperatures is illustrated in Fig. 14. Test points A and B are made without varying the wet-bulb temperature of entering air, the air velocity, the refrigerant temperature, and the total capacity of the coil. Only the dry-bulb and dew-point temperatures of the entering air are varied. A straight line is drawn between points A and B, and is extended to the ordinate of zero moisture removal, giving point C which represents the moisture content of saturated air that corresponds to the surface temperature. Points D and E are similarly plotted, the only difference being that another