Some of the methods now used require trial and error solutions and others are of very questionable accuracy, although the error may be small when applied within narrow limits of the several variables.

In rating dehumidifying coils, there are two requirements. The total capacity must be determined and the proportion of sensible and latent heat transfer ascertained. These determinations often involve an average coil surface temperature. This may be determined experimentally by the use of thermocouples or calculated theoretically from other test data. Sometimes, a fictitious effective temperature is used, determined by the point of intersection between the saturation curve on the psychrometric chart and a straight line drawn through points representing the entering and leaving air conditions.

The total cooling capacity is determined in a variety of ways, of which the following are the most usual:

1. The use of surface or overall heat transfer coefficients in conjunction with dry-bulb mean temperature differences. The result is corrected for dehumidification by means of functions for: (1) the temperature differences, (2) the expected total to sensible load ratio, and (3) empirical factors determined from test.

2. The use of surface or overall coefficients for combined sensible and latent heat removal with a wet coil, using as the driving force the difference between enthalpy of the entering air and that of saturated air at either the surface or the refrigerant temperature.

3. The calculation of sensible and latent capacities separately. The sensible is based on dry-bulb mean temperature difference and heat transfer coefficient while the latent is determined using a dew-point mean difference and a corresponding latent heat transfer coefficient.

4. The use of a *contact factor* or ratio of heat removed to heat removable. This factor is a function of coil depth and air velocity, is experimentally determined for each design and used in conjunction with a so-called *surface temperature.*

Average Effective Coil Temperature

The relationship between the average external coil surface temperature and the dehumidifying capacity of cooling coils has been studied by several investigators and their studies have established an empirical but practically accurate rule:

If air at given conditions of dry- and wet-bulb temperature is passed over a cooling coil of *constant external surface temperature,* then the latent heat removed by the coil is always a definite percentage of the total heat removed—this is practically so regardless of the air velocity over the coil, the coil design, the kind of cooling medium within the coil or its flow characteristics.

It is obvious that coil designs and the common cooling mediums employed do not result in a uniform external coil surface temperature; however this uniform condition is not necessary for the rule to be usefully applied. All that is needed is that a method be found for determining the average integrated *effective* external overface temperature. The actual temperatures of the various parts of fins or tubes have relatively little effect upon the ratio of latent to total heat transfer. This rule is of importance in the testing, rating and selection of cooling and dehumidifying coils, when the *straight line method* is used for finding the average effective coil surface temperature.

If a psychrometric chart is constructed so that equal increments along the horizontal axis represent equal changes in sensible heat content and equal increments along the vertical axis represent equal changes in latent

heat content of air, then on such a chart the performance of a dehumidifying cooling coil may be conveniently represented by a straight line, as shown in Fig. 13. Point *A* represents the condition of return or recirculated air, point *B* that of outside air, point *C* the mixture of ⅔ recirculated air with ⅓ outside air, point *D* represents the condition of air leaving the cooling coil, and point *E* represents the average effective temperature of the external cooling coil surface. On Fig. 13 the horizontal distance between points *C* and *D* represents the sensible heat removed from the air, while the vertical distance represents the weight of moisture or the latent heat removed from the air. Another important practical feature is that a line drawn anywhere else within the body of the chart parallel to the line *C-E* represents the same ratio of latent to total heat removal

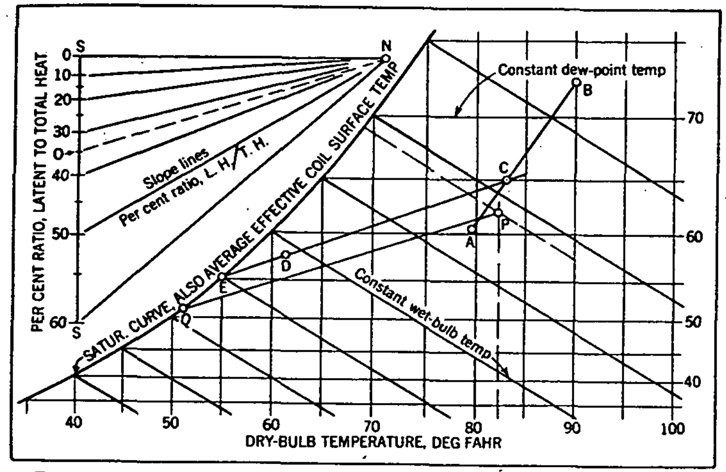

FIG. 13. PSYCHROMETRIC CHART SHOWING STRAIGHT-LINE METHOD FOR REPRESENTING COIL PERFORMANCE

as does line *C-E*. This is due to the fact that equal vertical distances anywhere on the chart represent equal quantities of latent heat and equal horizontal distances represent equal quantities of sensible heat.

To enhance the practical usefulness of the psychrometric chart illustrated in Fig. 13, a set of marked master slope lines are included. The value of this arrangement is easily illustrated by the graphical example shown.

Example 1. To determine the required average effective external coil surface temperature. *Given:* (1) Air entering cooling coil at temperature of 83 F dry-bulb and 69 F wet-bulb. (2) Ratio of latent to total heat that must be removed from air is 35 per cent. *Required:* To find the average external coil surface temperature.

Solution. (1) Draw through point *N*, at the origin of the heat load ratio lines, a line *N-O* with a slope of 35 per cent in accordance with scale *S*. (2) Mark in the body of the chart, point *P* representing the condition of air entering the cooling coil at 83 F dry-bulb and 69 F wet-bulb. (3) Through point *P* draw a line *P-Q* parallel to line *N-O*. (4) The line *P-Q* intersects the saturation curve at 51 F, which means that the effective external coil surface temperature must be maintained at 51 F in order to obtain the desired 35 per cent latent to total ratio of heat removal from the air passing over the given cooling coil.