where

t_r = room dry-bulb temperature, degrees Fahrenheit.
t_e = supply air temperature (or apparatus dew-point temperature), degrees Fahrenheit.
c_p = specific heat of air (constant pressure).
d = density of air, lb per cubic foot.
H_{sr} = room sensible heat gain, Btu per hour.
Q = quantity of supply air, cubic feet per minute.

For standard air this Equation may be expressed:

$$Q = \frac{H_{sr}}{(t_r - t_e)\,1.08} \tag{2}$$

Similarly, if the room latent heat is to be absorbed by the supply air as it occurs within the space, then the relation between the supply air quantity, room air moisture content, supply air moisture content, and room latent heat content is as follows:

$$Q = \frac{h_{lr} \times 7000}{h_v \times d\,(g_r - g_e) \times 60}$$

where

h_{lr} = room latent heat, Btu per hour.
h_v = heat of vaporization, Btu per pound.
d = density of air, pounds per cubic foot.
g_r = room moisture content, grains per pound of dry air.
g_e = supply air moisture content, grains per pound of dry air.

For standard air this equation becomes:

$$Q = \frac{h_{lr}}{0.67\,(g_r - g_e)} \tag{3}$$

If a dehumidifier is used that will produce a saturated condition of leaving air, then Equations 2 and 3 can be solved for H_{sr} and h_{lr} and these substituted in Equation 1, resulting in Equation 4.

$$\text{S.H.F.} = \frac{0.241\,(t_r - t_e)}{(z_r - z_e)} \tag{4}$$

where

z_r = heat content of room air, Btu per pound.
z_e = heat content of supply air, Btu per pound.
t_r = room dry-bulb temperature, degrees Fahrenheit.
t_e = apparatus dew-point temperature, degrees Fahrenheit.

From Equation 4, it will be noted that only one temperature of supply air can be used to maintain the design room conditions if the supply air is saturated. This equation involving two unknowns requires a cut-and try solution or graphical solution in order to obtain the apparatus dew-point. Several types of charts have been prepared to present a simple graphical solution. One of the forms of this chart is shown in Fig. 12. In addition to this, a psychrometric chart in which the dry-bulb temperature (sensible heat) and moisture content (latent heat) are represented by the abscissae and ordinates may be used since the slope of the

hypotenuse connecting the base of a triangle as represented by the temperature change, $t_r - t_e$ of the air supplied and the leg of the triangle as represented by the change in moisture content, $g_r - g_e$ of the supply air is a measure of the sensible heat factor. Such a chart with the sensible heat factor lines is shown in Fig. 13. The determination of the apparatus dew-point with such a chart is simple. A line, parallel to the proper sensible heat factor line, is drawn from the room or space condition through the saturation line as indicated and the point of intersection is the apparatus dew-point.

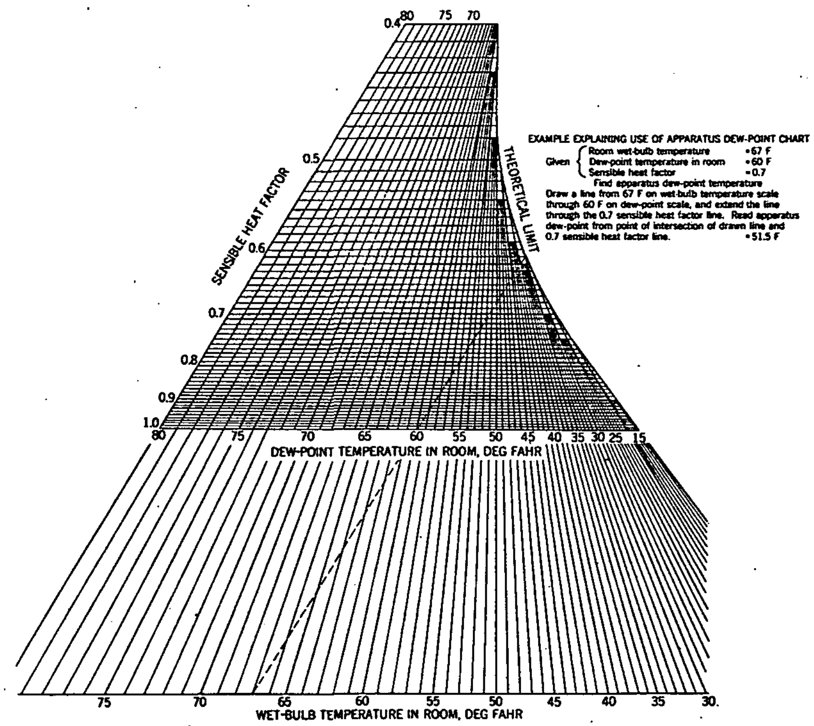

FIG. 12. APPARATUS DEW-POINT CHART

All of the foregoing is based on a dehumidifier that will produce a saturated condition of leaving air. As pointed out, this situation is infrequent due to the fact that in the majority of dehumidifiers some percentage of the air handled passes through the dehumidifier without coming in contact with the cooling surface or cooling medium. In the case where room air is recirculated through the dehumidifier or conditioner, the quantity of air that passes through without being contacted has no more effect on the heat balance than taking air from the room and reintroducing it to the room without treatment. On the other hand outdoor air that