centage of total load. Metabolic rates are markedly variable for some extreme environmental conditions and this is another important factor which must be considered in cooling load computations.

Heat Introduced by Outside Air

An allowance must be made for the heat and moisture in the outside air introduced for ventilation purposes or entering the building through cracks, doors, and other places where infiltration might occur.

The volume of air entering due to infiltration may be estimated from data given in Chapter 4. Information on the amount of outside air required for ventilation will be found in Chapter 2.

In the event the volume of air entering an enclosure due to infiltration exceeds that required for ventilation, the former should be used as a basis for determining the portion of the load contributed by outside air. Where volume of air required for ventilation exceeds that due to infiltration it is assumed that a slight positive pressure will exist within the enclosure with a resulting exfiltration instead of infiltration. In this case the air required for ventilation is used in determining outside air load.

The heat gain resulting from outside air introduced may be determined by the following formula:

$$H = \frac{Q}{v}(h_o - h_i) \tag{3}$$

where

H = heat to be removed from outside air entering the building, Btu per hour.
Q = volume of outside air entering building, cubic feet per hour.
v = cubic feet of outside air per pound of dry air.
h_o = enthalpy of outside air, Btu per pound of dry air.
h_i = enthalpy of inside air, Btu per pound of dry air.

The latent heat gain resulting from outside air introduced may be determined by the following formula:

$$H_l = \frac{Q}{v} h_{fg}(W_o - W_i) \tag{4}$$

where

H_l = latent heat to be removed, Btu per hour.
h_{fg} = latent heat of evaporation at temperature at which water is condensed, Btu per pound.
W_o = humidity ratio of outside air, pounds water per pound dry air.
W_i = humidity ratio of inside air, pounds water per pound dry air.

Heat Emission of Appliances

Heat generating appliances which give off either sensible heat or both sensible and latent heat in an air conditioned enclosure may be divided into three general classes of equipment or devices:

1. Electrical appliances.
2. Gas appliances.
3. Steam heating appliances.

In the first group may be found such devices as lights, motors, toasters, waffle irons, etc. The capacities of most electrical devices may be determined from the watt capacity indicated on their name plates. The Btu equivalent of heat generated per hour is determined by multiplying the watt capacity by 3.4 (one watthour is equivalent to 3.413 Btu).

The capacities of electric motors are usually expressed in terms of horsepower instead of watts. If the motor efficiency is known, the watts input may be calculated from the formula:

$$P = \frac{746\,(hp)}{n} \tag{5}$$

where

P = motor input, watts.
hp = motor load, horsepower.
n = motor efficiency (expressed as a decimal).

When the motor efficiency is not known the heat equivalent of electrical input can be approximately determined by applying data given in Table 9.

TABLE 9. HEAT GENERATED BY MOTORS

Nameplate Rating Horsepower	Heat Gain in Btu per Hour per Horsepower	
	Connected Load in Same Room	Connected Load Outside of Room
⅛ to ½	4250	1700
½ to 3	3700	1150
3 to 20	2950	400

In the second group belong such appliances as coffee urns, gas ranges, steam tables, broilers, hot plates, etc. For heat generating capacities of such appliances refer to Table 10.

Considerable judgment must be exercised in the use of data given in Table 10. Consideration must be given to time of day when appliances are used and the heat they contribute at time of peak load. Only those appliances in use at the time of the peak load need be considered. Consideration must also be given to the way appliances are installed, whether products of combustion are vented to a flue, whether they escape into the space to be conditioned, or whether appliances are hooded allowing part of the heat to escape through a stack. There are no generally accepted data available on the effects of venting and shielding heating appliances but it is believed that, when they are properly hooded with a positive fan exhaust system through the hood, 50 per cent of the heat will be carried away and 50 per cent dissipated in the space to be conditioned. Where latent as well as sensible heat is given off, it is usually safe to assume that all latent heat will be removed by a properly designed and operated vent or hood.

ILLUSTRATION

From the foregoing discussion it is obvious that the determination of the maximum cooling load is rather complicated by reason of the variable nature of contributing load components.