of these require rather detailed calculations. Refer to Chapter 3, Page 59, under section on Cooling Load and Chapter 43 in section on Apparatus Dew Point. The following equations are considered to be sufficiently accurate for use at usual design conditions as their accuracy is within 1 per cent.

Sensible Load $$q_s = Q \times 60 \times 0.244 \times 0.075 \left(1 - \frac{0.00923}{0.62}\right)(t_o - t_i) = Q \times 1.08\,(t_o - t_i), \text{ Btu per hour} \quad (15)$$

Latent Load $$q_e = Q \times 60 \times 0.075 \times 1076\,(W_o - W_i) = Q \times 4840\,(W_o - W_i), \text{ Btu per hour} \quad (16)$$

Total Load $$q_t = q_s + q_e \quad (17)$$

where Q = Rate of entry of outside air, cubic feet per minute.

t_o = Outdoor dry-bulb temperature, Fahrenheit degrees.

t_i = Indoor dry-bulb temperature, Fahrenheit degrees.

W_o = Outdoor humidity ratio, pounds moisture per pound of dry air.

W_i = Indoor humidity ratio, pounds moisture per pound of dry air.

0.075 = Standard air density, pounds per cubic foot.

0.244 = A constant approximating the specific heat of dry air corrected for moisture Btu per (pound) (Fahrenheit degree).

1076 = A factor approximating the average Btu released in condensing one pound of water vapor from air.

Standard air weight (0.075 lb per cu ft) is recommended for use in all calculations as this is the basis for rating fans and its consistent use keeps all parts of the calculations in conformity.

Actually the outdoor air used for ventilation would pass through the conditioning equipment and be cooled and dehumidified to a lower temperature and humidity ratio than room conditions before entering the room; but for heat-balance purposes the cooling load chargeable to the outdoor air is that corresponding to the difference between the outdoor and indoor air conditions.

Example 10. For outdoor design conditions of 95 F dry-bulb and 75 F wet-bulb and indoor design conditions of 80 F dry-bulb and 67 F wet-bulb and for the supply of outdoor air at the rate of 1000 cfm and the exhaust of room air at the corresponding rate, calculate the total, sensible and latent heat gains substituting in Equation 15:

$$q_s = 1000 \times 1.08\,(95 - 80) = 16{,}200 \text{ Btu per hr.}$$

From psychrometric data $W_o = 0.01413$, $W_i = 0.01122$.

Substituting in Equations 15 and 16:

$$q_e = 1000 \times 4840\,(0.01413 - 0.01122) = 14{,}100 \text{ Btu per hr.}$$

$$q_t = q_s + q_e = 30{,}300 \text{ Btu.}$$

HEAT SOURCES WITHIN THE CONDITIONED SPACE

People. The rates at which heat and moisture are given off by human beings under different states of activity are given in Chapter 12. In many applications these sensible and latent heat gains become a large fraction of the total load. Appreciable variations in heat-emission rates must be recognized according to the age and sex of the individual, state of activity, environmental influences, and duration of occupancy (since for short occupancy the extra heat and moisture brought in by people may be a significant factor).

TABLE 22. RATES OF HEAT GAIN FROM OCCUPANTS OF CONDITIONED SPACES[a]

Degree of Activity	Typical Application	Total Heat Adults, Male Btu/Hr	Total Heat Adjusted[b] Btu/Hr	Sensible Heat Btu/Hr	Latent Heat Btu/Hr
Seated at Rest	Theater-Matinee	390	330	180	150
	Theater-Evening	390	350	195	155
Seated, Very Light Work	Offices, Hotels, Apartments	450	400	195	205
Moderately Active Office Work	Offices, Hotels, Apartments	475	450	200	250
Standing, Light Work; or Walking Slowly	Department Store, Retail Store Dime Store	550	450	200	250
Walking; Seated;	Drug Store	550	500	200	300
Standing; Walking Slowly	Bank	490	550	220	330
Sedentary Work	Restaurant[c]	800	750	220	530
Light Bench Work	Factory	900	850	245	605
Moderate Dancing	Dance Hall				
Walking 3 mph; Moderately Heavy Work	Factory	1000	1000	300	700
Bowling[d]	Bowling Alley	1500	1450	465	985
Heavy Work	Factory				

[a]*Note:* Tabulated values are based on 80 F room dry-bulb temperature. For 78 F room dry-bulb, the total heat remains the same, but the sensible heat values should be increased by approximately 10 per cent and the latent heat values decreased accordingly.

[b]*Adjusted total heat gain* is based on normal percentage of men, women, and children for the application listed, with the postulate that the gain from an adult female is 85 per cent of that for an adult male and that the gain from a child is 75 per cent of that for an adult male.

[c]Adjusted total heat value for *sedentary work, restaurant*, includes 60 Btu per hour for food per individual (30 Btu sensible and 30 Btu latent).

[d]For *bowling* figure one person per alley actually bowling and all others as sitting (400 Btu per hour) or standing (550 Btu per hour).

The *use factor* is the ratio of the wattage in use, for the conditions under which the load estimate is being made, to the total installed wattage. For commercial applications such as stores, the use factor would be unity.

While Chapter 12 should be referred to for detailed information, Table 22 in this chapter summarizes the most useful data representing conditions commonly encountered.

Lighting. In general, the instantaneous rate of heat gain from electric lighting [15] may be calculated from the following relation:

$$q_{el} = \begin{Bmatrix}\text{total light} \\ \text{wattage}\end{Bmatrix} \times \begin{Bmatrix}\text{use} \\ \text{factor}\end{Bmatrix} \times \begin{Bmatrix}\text{special allow-} \\ \text{ance factor}\end{Bmatrix} \times 3.41, \text{ Btu per hour.} \quad (18)$$

The *total light wattage* is obtained from the ratings of all fixtures installed, both for general illumination and for display use.

The *special allowance factor* is introduced to care for fluorescent fixtures and for fixtures which are either ventilated or installed so that only part of their heat goes to the conditioned space. For *fluorescent fixtures*, the special allowance factor is recommended to be taken as 1.20 in order to allow for power consumed in the *ballast*. For *ventilated fixtures, recessed fixtures*, and the like, manufacturer's or other data [15] must be sought to establish the fraction of the total wattage which may be expected to enter the conditioned space.

Power. When equipment of any sort is operated within the conditioned space by electric motors, the heat equivalent of this operation must be considered in the cooling load. The general equation for calculating this load is:

$$q_{em} = \left(\frac{\text{Horsepower Rating}}{\text{Motor Efficiency}}\right) \times \left(\frac{\text{Load}}{\text{Factor}}\right) \times 2544, \text{ Btu per hour.} \quad (19)$$