These quantities of heat are related by the following equations:

$$H_v = 0.24\, W\, (t - t_o) \quad (1)$$
$$H_t = 0.24\, W\, (t_l - t_o) \quad (2)$$
$$H_s = H_t - H_v = 0.24\, W\, (t_l - t) \quad (3)$$
$$W = d\, 60\, Q \quad (4)$$
$$H_t = H_s + 0.24\, d\, 60\, Q\, (t - t_o). \quad (5)$$

where

d = density of air, pounds per cubic foot (0.075 lb per cu ft for Standard Air by definition).
H_s = surplus heat, Btu per hour.
H_v = heat required to warm air for ventilation, Btu per hour.
H_t = total heat requirements for both heating and ventilation, Btu per hour.
Q = volume of air handled by the ventilating equipment, cubic feet per minute.
t = temperature to be maintained in the room, Fahrenheit degrees.
t_o = outside temperature, Fahrenheit degrees.
t_l = temperature of the air leaving the unit, Fahrenheit degrees.
W = weight of air circulated, pounds per hour.
0.24 = specific heat of air at constant pressure (approximate value).

Table 2. Typical Capacities of Unit Ventilators for an Entering Air Temperature of Zero

Cubic Feet of Air per Minute		Total Capacity in Square Feet, Equivalent Direct Radiation	Capacity Available for Heating the Room, Square Feet Equivalent Direct Radiation	Final Air Temperature F Deg
Anemometer Rating	Standard Air Rating			
750	500	214	56	95
1000	750	320	84	95
1260	1000	427	112	95
1560	1250	534	141	95

Example 1: The heat loss of a certain room is 24,000 Btu per hour, and the ventilating requirements are 1000 cfm. If the room temperature is to be 70 F and all air is taken from the outside at zero, what will be the total heat demand on the unit if it is required to provide for both the heating and ventilating requirements (combined system)?

Solution: Since the surplus heat is available to replace the heat loss of the room,

$$H_s = 24{,}000 \text{ Btu per hour.}$$

Substituting in Equation 5:

$$H_s = 24{,}000 + 0.24 \times 0.075 \times 60 \times 1000\ (70 - 0) = 99{,}600 \text{ Btu per hour}$$

$$t_l = \frac{24{,}000}{0.24 \times 0.075 \times 60 \times 1000} + 70 = 92.2 \text{ F}$$

If in *Example 1* a 1000 cfm (Standard Air) unit were required, but only 25 percent of the air introduced were outdoor air, the solution is:

$$H_t = 24{,}000 + 0.24 \times 0.075 \times 60 \times 0.25 \times 1000\ (70 - 0) = 42{,}900$$

$$t_l = \frac{24{,}000}{0.24 \times 0.075 \times 60 \times 1000} + 70 = 92.2$$

The only difference from *Example 1* is that, in the latter case, the ventilation load has been reduced.

Applications of Unit Ventilators

Items to be considered in the application of unit ventilators are: (1) combination with other means of heating, (2) selection of unit ventilator size, (3) cycle of control, (4) location of units, and (5) method of venting and exhausting.

In a *split* system the unit ventilator heat output is supplemented by that of additional radiators or convectors, and consequently a corresponding reduction in required unit ventilator heating capacity may be made. With the split system, temperature control equipment should operate to close the supply to auxiliary radiation or convectors as the first step in the control cycle on a rising room temperature.

The *combined* system employs a unit ventilator with sufficient heating capacity for both ventilation and normal heat losses. In such a case no direct radiation is required. The cost of installation of a combined system is usually less than that of a split system. The unit ventilator is normally arranged to circulate outdoor air constantly or to circulate room air constantly up to full capacity; or to circulate mixed and variable quantities of room air and outdoor air automatically, depending on the thermal requirement of the room. The minimum amount of outdoor air for ventilation purposes may be governed by state or local codes or may be calculated by the engineer to meet the ventilating air needs of the particular application.

Selection of Unit Ventilator Size

The primary consideration in the selection of the size of unit ventilator is the number of occupants in the space. Other factors to be considered are state and local code requirements, volume of the room, density of occupancy, and the usage of the room. A safe rule for determining air capacity is to allow a total air quantity of 30 cfm per person, or six to nine room air changes through the unit, whichever is greater. With this quantity of air handled, it is possible to obtain satisfactory cooling in mild weather. Since cooling is an important function, the unit ventilator must be selected to supply adequate air quantities.

After selecting the basic size of unit, the coil capacity to meet the heating requirement can be determined from the manufacturer's tables.

Control of Unit Ventilators

Three cycles of control are available for use with unit ventilators. These cycles of control determine the sequence of operation of the dampers and heating element as described in Chapter 38, Automatic Controls.

Location of Unit Ventilator

The location of the unit ventilator in a room is important. Wherever possible it should be placed against an outside wall and on the center line of the room. It is difficult to obtain proper air distribution if the unit is installed either on an inside wall or in a corner of the room. Standard units discharge the air stream upward, but for special cases units may be installed to discharge air horizontally. Units may be set against the wall or par-