final temperature of the air leaving the grille while the unit is delivering outdoor air and room air in the proper proportion and the heating element is supplied with steam or hot water as specified.

The standard air rating is obtained in accordance with the A.S.H.V.E. Standard Code for Testing and Rating Steam Unit Ventilators.[5] This code requires that the following rating information be supplied:

Rating Factors to be Specified. The rating of the unit ventilator shall specify:

a. Final temperature at different entering air temperatures.

b. Total EDR at different entering air temperatures.

c. Air delivered by the unit in cubic feet per minute at the *standard basis of rating* with the fans operated at rated speed, with all air being blown through the heating unit, and with the standard louver and grille on the outlet.

The Standard Basis of Rating shall be as follows:

a. Dry saturated steam at a temperature at the unit corresponding to an absolute pressure of 16.7 psi (218.5 F).

b. Entering air temperature of zero Fahrenheit degrees.

c. Volume delivered in cubic feet per minute converted to standard air at 70 F.

Rating Tables for unit ventilators shall contain the following data in addition to the standard rating, for entering air temperatures from −30 F to +60 F:

a. Inlet temperature, Fahrenheit degrees.

b. Final temperature, Fahrenheit degrees.

c. Total EDR at the specified entering temperature.

d. Surplus or heating EDR at the specified entering temperature.

Surplus or Heating Equivalent Direct Radiation for the purposes of this code shall be construed to mean difference between the total EDR at a specified inlet temperature and the EDR required to heat the air from that temperature to 70 F.

Table 2 shows the air handling capacities by the two methods of rating and the approximate room heating equivalent in EDR of an intermediate size of heating element. Heating elements are available for either a higher or lower capacity.

Heating Capacity Requirements for Unit Ventilators

Since a unit ventilator has the dual function of introducing outdoor air for ventilation and maintaining a specified room temperature, the heat required by the unit may be similarly divided as (1) *heat required for ventilation* (H_v) and (2) *surplus heat* (H_s). The *surplus heat* is available for maintaining room temperatures. If auxiliary radiation is installed, the *surplus heat* requirement may be reduced by a corresponding amount. The sum of H_v and H_s is the total heat (H_t) to be supplied by the unit ventilator.

These quantities of heat are related by the following equations:

$$H_v = 0.24\ W\ (t - t_o) \quad (1)$$

$$H_t = 0.24\ W\ (t_f - t_o) \quad (2)$$

$$H_s = H_t - H_v = 0.24\ W\ (t_f - t) \quad (3)$$

$$W = d\ 60\ Q \quad (4)$$

$$H_t = H_s + 0.24\ d\ 60\ Q\ (t - t_o). \quad (5)$$

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_f = 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).

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:

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

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

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

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 would be as follows:

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

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

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.

The *combined* system employs a unit ventilator with sufficient heating