d = density of air at temperature t_i, pounds per cubic foot.
W_i = vapor density of inside air, pounds per pound of dry air.
W_o = vapor density of outside air, pounds per pound of dry air.
h_{fg} = latent heat of vapor at m_i, Btu per pound.

If the latent heat of vapor h_{fg} is assumed to be 1060 Btu per lb, Equation 6 reduces to:

$$H_l = 79.5\ Q\ (W_i - W_o) \qquad (6a)$$

Equations 5a, 5b and 6a may also be used for determining the sensible and latent heat gains due to infiltration in cooling load computations.

SELECTION OF WIND VELOCITIES

The effect of wind on the heating requirements of any building should be given consideration for two reasons:

1. Wind movement increases the heat transmission of walls, glass, and roof, affecting poor walls to a much greater extent than good walls.
2. Wind increases materially the infiltration of cold air through the cracks around doors and windows, and even though the building materials themselves (see Tables 1 and 2, Chapter 10).

Theoretically, as a basis for design, the most unfavorable combination of temperature and wind velocity should be chosen. It is entirely possible that a building might require more heat on a windy day with a moderately low outside temperature, than on a quiet day with a much lower outside temperature. However, the combination of wind and temperature, which is the worst, would differ with different buildings, because wind velocity has a greater effect on buildings which have relatively high infiltration losses. It would be possible to compute the heating load for a building for several different combinations of temperature and wind velocity which records show to have occurred, and to select the worst combination, but designers generally do not feel that such a degree of refinement is justified.

Therefore, since Table 1 lists the average velocity of winds occurring at temperatures equalled or exceeded 97½ percent of the winter period for each locality, this value should be the basis for estimating infiltration losses. When using the air change method it will not be necessary to consider the wind velocities. Designers employing the crack method generally use values corresponding to a 15-mile wind. Due to the small effect of the wind velocity on the transmission coefficient, the values in Chapter 9, based on a 15-mile wind may be used with sufficient accuracy for all ordinary conditions.

Exposure Factors

Many designers use empirical *exposure* factors to increase the calculated heat loss of rooms or spaces on the side or sides of the building exposed to the prevailing winds. However, the use of exposure factors is unnecessary when the GUIDE method of calculating heat losses is used. Therefore, exposure factors may be regarded as *factors of safety* for the rooms or spaces exposed to the prevailing winds, to allow for additional capacity for these rooms or spaces, or to *balance the radiation*, particularly in the case of multi-story buildings. Tall buildings may have severe infiltration heat losses, induced by their stack effect (see Chapter 10), which will require special consideration. Although the exposure allowance frequently is assumed to be 15 percent, the actual allowance to be made, if any, must to

a large extent be a matter of experience and judgment of the designer, since there are at present no authentic test data available from which rules could be developed for the many conditions encountered in practice.

AUXILIARY HEAT SOURCES

The heat supplied by persons, lights, motors and machinery always should be ascertained in the case of theaters, assembly halls, and industrial plants, but allowances for such heat sources must be made only after careful consideration of all local conditions. In many cases, these heat sources should not affect the size of the heating plant at all, although they may have a marked effect on the operation and control of the system. In general, where audiences are present, the heating system must have sufficient capacity to bring the building to the stipulated inside temperature before the audience arrives. In industrial plants, quite a different condition exists, and heat sources, if always available during occupancy, may be substituted for a portion of the heating installation. In no case should the actual heating installation (exclusive of heat sources) be reduced below that required to maintain at least 40 F in the building.

TABLE 5. HEAT EQUIVALENTS OF VARIOUS SOURCES[a]

Machinery (Motor in room = Motor Hp/efficiency x 2544	Btu/hr.
Machinery (Motor outside room) = Motor Hp x 2544	Btu/hr.
Electric Lights = Kilowatts x 3413	Btu/hr.
Gas (Producer = 150) (Manufactured = 535) (Natural = 1000)	Btu/cu ft.

[a] Additional values are given in Chapter 12, Table 29.

Electric Motors and Machinery

Motors and the machinery which they drive, if both are located in the room, convert all of the electrical energy supplied into heat. This heat is retained in the room if the product manufactured is not removed until its temperature is the same as the room temperature.

If power is transmitted to the machinery from the outside, then only the heat equivalent of the brake horsepower supplied is used. In some mills this is the chief source of heating, and it is frequently sufficient to overheat the building even in zero weather, thus requiring cooling by ventilation the year 'round. Table 5 shows the heat output equivalent of various sources of heat in a factory. For information concerning the heat supplied by persons, refer to data given in Chapter 6, and also Table 28, Chapter 12. For appliances see Table 29, Chapter 12.

INTERMITTENTLY HEATED BUILDINGS

In the case of intermittently heated buildings additional heat is required for raising the temperature of the air, the building materials and the material contents of the building to the specified inside temperature. The rate at which this additional heat must be supplied depends upon the heat capacity of the structure and its material contents, and upon the time in which these are to be heated.[13]

This additional heat may be computed and allowed for as conditions require, but inasmuch as the heating system proportioned for taking care of the heat losses will usually have a capacity about 100 percent greater than that required for average winter weather, and inasmuch as most