

2. Wind increases materially the infiltration of cold air through the cracks around doors and windows, and even through the building materials themselves (see Tables 1 and 2, Chapter 11).

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 maximum wind velocity occurring during the coldest 2½% of the winter hours 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. The effect of the wind velocity on the transmission coefficient can be evaluated from Table 21 of Chapter 9.

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 Gurne 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 11), 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.

Heating Load

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 7 shows the heat output equivalent

TABLE 7. HEAT EQUIVALENTS OF VARIOUS SOURCES*

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.

* Additional values are given in Chapter 13, Table 26.

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 25, Chapter 13. For appliances see Table 26, Chapter 13.

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.¹⁵

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 buildings may either be continuously heated or have more time allowed for heating up during the few minimum temperature days, no allowance usually is made, except in the size of boilers or furnaces. For churches, auditoriums and other intermittently heated buildings, additional capacity should be provided.

RESIDENCE HEAT LOSS PROBLEMS

The following *Examples 6* and *7* will illustrate the procedure for calculating the heat loss of a residence, uninsulated and insulated, in accordance with the recommendations given in this chapter.

Example 6: Calculate the heat loss of the residence shown in Fig. 2 located in the vicinity of Chicago. From Table 1, design outdoor conditions are -10 F and 12 mph wind velocity. Inside temperature from Table 2 is assumed to be 70 F. The attic is unheated. Assume ground temperature to be 50 F (see Fig. 3, Chapter 35) under basement and garage floors and 32 F adjoining basement walls. Estimate infiltration losses by the air change method. No wall, ceiling or roof insulation is to be considered in this problem, but all first and second floor windows, except in the garage,