

As stated previously, the value of U in the tables of Chapter 6 is based on a wind velocity of 15 mph and the surface resistance for this wind velocity (0.17) is sufficiently low so that higher wind velocities will decrease the surface resistance to a negligible degree and therefore have only a slight effect on the average over-all coefficient. On the other hand, infiltration losses vary almost directly as the wind velocity, as will be apparent from the factors in Table 2 of Chapter 8. The more exact method therefore would be to differentiate among the various exposures more accurately by calculating the infiltration and transmission losses separately for the different sides of the building, using different assumed wind velocities for the infiltration losses on the various sides.

AUXILIARY HEAT SOURCES

The heat supplied by persons, lights, motors and machinery should always 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 be allowed to affect the size of the installation at all, although they may have a marked effect on the operation and control of the system. In general, it is safe to say that where audiences are involved, the heating installation must have sufficient capacity to bring the building up to the stipulated inside temperature before the audience arrives. In industrial plants, quite a different condition exists; and heat sources, if they are always available during the period of human occu-

TABLE 4. 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.

^aAdditional values are given in Chapter 15, Table 23.

pancy, 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.

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, which is retained in the room if the product being 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 4 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 12. For appliances see Table 23, Chapter 15.

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 heated⁸.

This additional heat may be figured 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 per cent 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 is usually 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

Example 5. 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 37) 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 are to have storm sash. The building is constructed as follows (heat transmission coefficients U are in parentheses):

Walls: Brick veneer, building paper, wood sheathing, studding, metal lath and plaster (0.28). Walls of dormer over garage, same except wood siding in place of brick veneer (0.26).

Attic Walls: Brick veneer, building paper, wood sheathing on studding (0.42).

Basement Walls: 10 in. concrete (0.10).

Roof: Asphalt shingles on wood sheathing on rafters (0.53).

Ceiling (Second floor): Metal lath and plaster (0.69).

Windows: Double-hung wood windows with storm sash (0.45). Steel casement sash in basement (1.13).

Floor (Bedroom D): Maple finish flooring on yellow pine sub-flooring; metal lath and plaster ceiling below (0.25).

Floor (Basement and Garage): 4 in. stone concrete on 3 in. cinder concrete (0.10).

Solution: The calculations for this problem are given in Table 5, and a summary of the results in Table 6. The values in column F of Table 5 were obtained by multiplying together the figures in columns C, D, and E. The heat losses are calculated to the nearest 10 Btu. See reference notes for Table 5 for further explanation of data.

Attention is called to the summary of heat losses (Table 6) for the uninsulated residence. As storm windows are used in this instance the glass and door transmission heat losses of 20.7 per cent are relatively small. The infiltration losses of 14.1 per cent are also comparatively small because the storm windows are equivalent to weatherstripping. In this problem, the wall, ceiling and floor transmission losses comprise 65.2 per cent of the total.

Example 6. Calculate the heat loss of residence shown in Fig. 2 based on the same conditions as in *Example 5* but having construction improved or insulated to obtain coefficients as follows:

Walls, 0.13; Walls of Dormer over Garage, 0.12; Attic Walls, 0.28; Walls Adjoining Garage, 0.18; Basement Walls (Recreation Room), 0.10.

Roof, 0.53.

Ceiling (Second Floor), 0.15

Windows (Same as in Example 5).

Floor (Bedroom D), 0.18.

Solution: The procedure for calculating the heat losses is similar to that for *Example 5*. A summary of the results is given in Table 7.