

Hence, use the values 2.23, and 0.41 for the heat to be supplied in B.t.u. per hour, per foot of crack for an average wind velocity of 15 miles per hour for each of the two kinds of cracks respectively. In case of very good double hung plain windows use $\frac{2.23}{2} = 1.11$.

For special cases, select proper values from Table 14 or 15 and compute the B.t.u. per foot of crack as already shown for the average case, using the proper wind velocity in miles per hour.

HEAT SOURCES

Heat Available from Sources other than Heating Plant

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 later. 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 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 deg. fahr. in the building. The following allowances may be made when required:

TABLE 16. HEAT GIVEN UP BY PERSONS AND LIGHTS

*PERSONS:	
Man at rest.....	400 B.t.u. per hr.
Man at work.....	500 B.t.u. per hr.

LIGHTS:	
Electric lamps, B.t.u. per hr. equals watts per lamp $\times$ number of lamps $\times$ 3.415	

Gas lighting:	
1 cu. ft. producer gas.....	150 B.t.u.
1 cu. ft. illuminating gas.....	700 B.t.u.
1 cu. ft. natural gas.....	1000 B.t.u.

A Welsbach burner averages 3 cu. ft. of gas per hour and a fish tail burner 5 cu. ft. per hour.

*For more detailed information see Table 17, Heat Emitted by Persons per Hour at Different Room Temperatures.

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 the first case the B.t.u. supplied per hour = $\frac{\text{Motor horsepower}}{\text{Efficiency of motor}} \times 2546$, and in the second case B.t.u. per hr. = b.hp. $\times$ 2546, in which 2546 is the

CHAPTER I—CALCULATING THE HEAT LOSSES FROM BUILDINGS

B.t.u. equivalent of 1 hp. hour. In high-powered mills this is the chief source of heating and is frequently sufficient to overheat the building even in zero weather, thus requiring cooling by ventilation the year round.

For intermittent heating allow 10 per cent additional for rooms heated in the day time only, and for longer intervals of several days or more, add 25 per cent in determining minimum heating requirements, and size of plant.

TABLE 17. HEAT EMITTED BY PERSONS PER HOUR AT DIFFERENT ROOM TEMPERATURES

H = Heat emitted by man at rest per hour.
 Hl = Heat emitted by man at light labor per hour.
 Ha = Heat emitted by man at average labor per hour.
 Hh = Heat emitted by man at hard labor per hour.

HE = Heat Energy = $\left(\frac{\text{Foot-Pounds per hour}}{778} \right) = 84 \text{ B.t.u., } 168 \text{ B.t.u. and } 252 \text{ B.t.u. respectively for light, average and hard labor.}$

T = Room Temperature.

$H = 13.2 (98.6 - T)$ Heat due labor = $\frac{T \times HE}{100}$

$Hl, Ha, \text{ or } Hh = 13.2 (98.6 - T) \text{ plus } \frac{T \times HE}{100}$

Room Temp. Deg. Fahr.	Heat Emitted by Man* B.t.u. per Hour at				Condition Required to Balance Excess and Shortage in Heat Emission
	84 B.t.u. Rest	168 B.t.u. Light Labor	252 B.t.u. Average Labor	Hard Labor	
30	905	931	954	981	Increasing Humidity
40	773	807	838	874	Heavy Clothing for Reduction or Prevention of Radiation
50	642	684	723	768	
60	509	559	606	660	Normal Condition
68	404	461	518	575	
70	378	436	491	554	
75	312	375	438	501	Decreasing Humidity
80	246	313	375	447	Air Currents for Producing Evaporation of Perspiration
85	180	251	322	394	
90	114	189	259	342	

*For children use one-half of table values.

Application to Factory Heating* (See Fig. 7)

Lowest outside temperature for Philadelphia, Pa. = -6 deg. fahr. (Table 2), hence use $(-6 + 10) = +4$ for heat loss computations. Average wind movement (Table 2) for December, January, February = 11.0 miles per hour from the Northwest. Long axis of building is north and south.

Inside breathing line temperature = 60 deg. fahr.

Walls: 9 in. concrete (stone), $\frac{1}{2}$ in. cement mortar, 2 in. tile, plastered $\frac{1}{2}$ in.

- $K_1 = 1.34$ Average for surface in still air (Table 3).
- $K_2 = 3 \times 1.34 = 4.02$ Average for surface exposed to moving air (Tables 3 and 5).
- $C_1 = 8.3$ for stone concrete (Table 4).
- $C_2 =$ for tile as shown use 1.14 (not per 1 in.), (Table 4).
- $C_3 = 8.0$ for cement mortar (Table 4).
- $C_4 = 2.32$ for gypsum plaster (Table 4).

*In this example a design temperature only 10 deg. fahr. above lowest on record instead of 15 deg. fahr. above was used. Infiltration values were taken from Table 14 for a plain window.