

walls, ceilings and floors next to cold or unheated spaces are found, of course, by taking the inside dimensions of such areas, measured on the heated side.

CALCULATIONS FOR TRANSMISSION LOSSES

The calculations for heat transmission losses are made by multiplying the area A in square feet of wall, glass, roof or floor through which the loss takes place, by the proper coefficient U for such construction (Tables 9 to 33, or by computation as described under Transmission Coefficients by Computation) and by the temperature difference between the inside air temperature t at the proper level (in many cases not the *breathing line*) and the outside air temperature t_o . Therefore,

$$H_t = AU(t - t_o) \quad (12)$$

where

H_t = Btu per hour transmitted through the material of the wall, glass, roof or floor.

A = area in square feet of wall, glass, roof or floor, taken from building plans or actually measured. (Use the net inside or heated surface dimensions in all cases).

$t - t_o$ = temperature-difference between inside and outside air, in which t must always be taken at the proper level. Note that t may not be the *breathing-line* temperature in many cases.

TABLE 33. COEFFICIENTS OF TRANSMISSION (U) OF DOORS, WINDOWS AND SKYLIGHTS

Note.—THESE COEFFICIENTS ARE BASED ON A WIND EXPOSURE OF 15 MILES PER HOUR, AND ARE EXPRESSED IN BTU PER HOUR, PER SQUARE FOOT, PER DEG FAHR DIFFERENCE IN TEMPERATURE BETWEEN THE AIR INSIDE AND OUTSIDE OF THE DOOR, WINDOW OR SKYLIGHT.

A. Windows and Skylights

	U
Single.....	1.13 ^{a,c}
Double.....	0.45 ^a
Triple.....	0.281 ^a

B. Solid Wood Doors^{b,c}

NOMINAL THICKNESS INCHES	ACTUAL THICKNESS INCHES	U
1	2 $\frac{5}{8}$ ₂	0.563
1 $\frac{1}{4}$	1 $\frac{1}{16}$	0.485
1 $\frac{1}{2}$	1 $\frac{5}{16}$	0.432
1 $\frac{3}{4}$	1 $\frac{3}{8}$	0.421
2	1 $\frac{5}{8}$	0.382
2 $\frac{1}{2}$	2 $\frac{1}{8}$	0.321
3	2 $\frac{5}{8}$	0.277

^aSee page 212, Volume I, *Mechanical Equipment of Buildings*, by Harding and Willard, second edition, 1920.

^bComputed using $C = 1.0$ for wood; $f_1 = 1.34$ and $f_o = 4.02$.

^cIt is sufficiently accurate to use the same coefficient of transmission for doors containing thin wood panels, as that of single panes of glass, namely, 1.13 Btu per hour per square foot per degree difference between inside and outside air temperature.

CONDENSATION ON BUILDING SURFACES¹

Condensation on the interior surfaces of buildings is often a serious problem. Water dripping from a ceiling may cause irreparable damage to manufactured articles and machinery. It often results in short-circuiting of electric power and lighting systems, necessitating shut-downs and incurring costly repairs. It also causes rotting of wood roof structures, corrosion of metal roofs, and spalling and disintegration of gypsum and other types of roof decks not properly protected.

Condensation is caused by the contact of the warm humid air in a building with surfaces below the dew-point temperature, and can be remedied in two ways, (1) by increasing the temperature of such surfaces above the dew-point temperature, or (2) by lowering the humidity.

Dehumidification, of course, is not permissible where a high relative humidity is necessary for manufacturing processes. Hence, the only alternative is to increase the surface temperature by decreasing the inside surface resistance. This can be accomplished by increasing the velocity of air passing over the surface, or by increasing the over-all resistance of the wall or roof by installing a sufficient thickness of insulation.

The latter method is generally used, and the thickness of insulation is determined by ascertaining the amount of resistance to be added to increase the temperature of the interior surface above the dew-point temperature for the maximum conditions involved. This in turn is based on the fundamental principle that the drop in temperature is proportional to the resistance.

Condensation Chart

The chart (Fig. 3) can be used for approximating the thickness of insulation required to prevent condensation on the interior wall or roof surfaces of a building. Although this chart is intended primarily for roofs, it can be used for walls by taking the dry-bulb temperature and the corresponding relative humidity near the walls at the point which will necessitate the maximum heat resistance to prevent condensation, instead of using the temperature and humidity near the ceiling.

Example 1. Determine the thickness of insulation required to prevent ceiling condensation for the following conditions: Dry-bulb temperature near ceiling, 85 F; Relative humidity, 70 per cent; Lowest outside temperature, - 10 F; Construction of uninsulated roof, 1 in. yellow pine sheathing and built-up roofing; Coefficient of transmission of roof, 0.485; Conductivity of insulation to be used, 0.30.

Solution. The solution of this problem is indicated on the chart (Fig. 3) by the dotted line:

1. Locate the inside dry-bulb temperature of 85 F on scale A , and draw a line horizontally to the 70 per cent relative humidity curve, indicated on scale B .
2. Draw line 2 vertically downward from the intersection located as per paragraph 1.
3. Locate on scale D the temperature difference of 95 F between the ceiling temperature of 85 F and the lowest outside temperature of - 10 F, and draw a line horizontally until it intersects with line 2.
4. From the point of intersection of lines 2 and 3, draw a line to the point P .

¹For additional information on this subject see, *Preventing Condensation on Interior Building Surfaces*, by Paul D. Close (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930).