insulation to a point slightly higher than the dew-point for the corresponding air temperature and relative humidity. The difference in temperature between the air and the dew-point for various humidities can be readily ascertained from a psychrometric chart.

The thickness of insulation required to prevent sweating for rectangular ducts will be slightly greater than the value obtained by solving the equation:

$$L = k\left[\frac{T_1 - T_3}{q} - \left(\frac{1}{f_o} + \frac{1}{f_i}\right)\right] \qquad (11)$$

where

L = thickness of insulation for flat surfaces, inches.
T_1 = temperature of air in room, degrees Fahrenheit.
T_2 = temperature of surface of insulation, degrees Fahrenheit.
T_3 = average temperature of cooler air in duct, degrees Fahrenheit.
k = conductivity of insulation, Btu per hour per square foot per degree Fahrenheit per inch.
q = heat loss per square foot of outer surface of insulation, Btu per hour.
f_o and f_i have the same values as given in Formula 4.

In any practical case T_1 and T_3 will be known, and, for any assumed value of relative humidity ($T_1 - T_2$) can be obtained from a psychrometric chart. Values of q and f_o can be obtained from Tables 1, 2, 3, and 4; f_i from Formula 5; and k from conductivity Table 2 of Chapter 3.

The approximate thickness of insulation used to prevent condensation on pipes and flat metallic surfaces may be obtained from Fig. 5. The maximum permissible temperature drop is indicated at the point where the guide line passes through the horizontal scale at the left center of the

TABLE 16. HEAT GAINS FOR INSULATED COLD PIPES

Rates of heat transmission given in Btu per hour per degree Fahrenheit temperature difference between fluid in pipe and surrounding still air

Based on materials having conductivity, k = 0.30

Nominal Pipe Size (Inches)	Ice Water Thickness			Brine Thickness			Heavy Brine Thickness		
	Thickness of Insulation (Inches)	Btu Per Linear Foot	Btu Per Sq Ft Pipe Surface	Thickness of Insulation (Inches)	Btu Per Linear Foot	Btu Per Sq Ft Pipe Surface	Thickness of Insulation (Inches)	Btu Per Linear Foot	Btu Per Sq Ft Pipe Surface
½	1.5	0.110	0.502	2.0	0.098	0.446	2.8	0.087	0.394
¾	1.6	0.119	0.431	2.0	0.111	0.405	2.9	0.094	0.340
1	1.6	0.139	0.403	2.0	0.124	0.352	3.0	0.104	0.294
1¼	1.6	0.155	0.357	2.4	0.131	0.300	3.1	0.113	0.260
1½	1.5	0.174	0.351	2.5	0.134	0.270	3.2	0.118	0.238
2	1.5	0.200	0.322	2.5	0.151	0.244	3.3	0.134	0.214
2½	1.5	0.228	0.303	2.6	0.170	0.226	3.3	0.147	0.197
3	1.5	0.269	0.293	2.7	0.186	0.202	3.4	0.162	0.176
3½	1.5	0.295	0.282	2.9	0.191	0.183	3.5	0.176	0.167
4	1.7	0.294	0.248	2.9	0.209	0.176	3.7	0.182	0.154
5	1.7	0.349	0.239	3.0	0.241	0.165	3.9	0.202	0.138
6	1.7	0.404	0.233	3.0	0.259	0.150	4.0	0.228	0.130
8	1.9	0.455	0.201	3.0	0.318	0.140	4.0	0.263	0.116
10	1.9	0.559	0.198	3.0	0.383	0.135	4.0	0.309	0.110
12	1.9	0.648	0.194	3.0	0.438	0.131	4.0	0.364	0.108

chart. This temperature drop represents the difference between the dry-bulb temperature and the dew-point temperature for the conditions involved. (See discussion of Condensation in Chapter 3.) The surface resistances used for calculating the family of curves in Fig. 5 are based on tests made on canvas covered pipe insulation surfaces at *Mellon Institute*. However, it has been found that the resistance for asphaltic and roofing

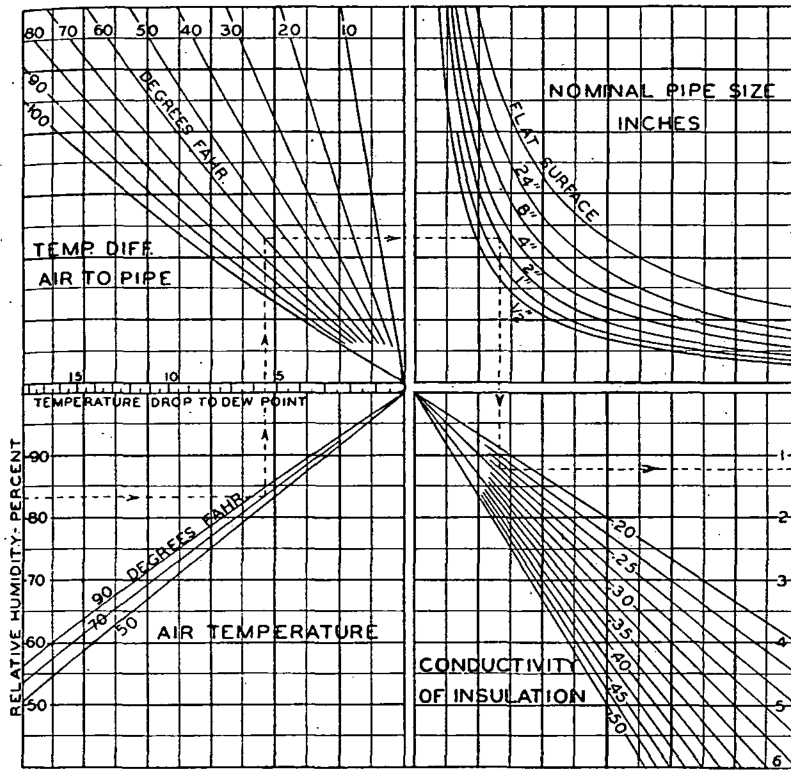

FIG. 5. THICKNESS OF PIPE INSULATION TO PREVENT SWEATING[a]

[a]Solve problems by drawing lines as indicated by dotted line, entering chart at lower left hand scale.

surfaces is practically the same as for canvas surfaces, so that the curves may be followed with no alteration for surfaces commonly used.

Heat gains for pipes insulated with a material having a conductivity of 0.30 Btu per square foot per hour per degree Fahrenheit difference per inch thickness are given in Table 16.

Heat gains for insulated ducts are given in the cold air column of Table 15. The heat gains are based on a uniform series of conductivities at 86 F mean temperature and an air temperature of 90 F outside of the duct. The gains may be interpolated for odd material conductivities and