

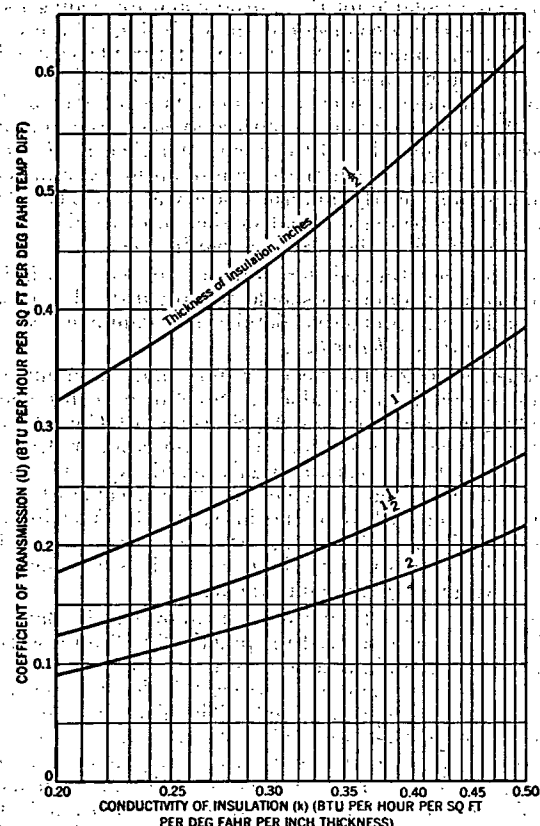


FIG. 17. HEAT LOSS COEFFICIENTS FOR INSULATED DUCTS*

* For round ducts less than 30 in. diameter, increase heat transmission values by the percentages shown below.

THICKNESS OF INSULATION (Inches)	$\frac{1}{4}$	$\frac{1}{2}$	$1\frac{1}{2}$	2
12 to 21 in. Duct Diameter.....	3%	5%	7%	9%
21 to 30 in. Duct Diameter.....	1%	2%	3%	4%

where

Q_w = heat loss through duct walls, Btu per hour..

P = perimeter of duct, feet.

l = length of duct, feet.

t_1 = temperature of air entering duct, Fahrenheit.

t_2 = temperature of air leaving duct, Fahrenheit.

t_3 = temperature of air surrounding duct, Fahrenheit.

To obtain the temperature drop in warm air for a given distance of trans-

mission, or the temperature rise if the duct carries air cooler than the room through which it passes, the following formulas can be used:

$$t_1 = \frac{t_2(y+1) - 2t_3}{(y-1)} \quad (15) \quad t_2 = \frac{t_1(y-1) + 2t_3}{(y+1)} \quad (16)$$

where

$$y = \frac{28.8AV\rho}{UPl} \text{ for rectangular ducts or,}$$

$$y = \frac{7.2DV\rho}{Ul} \text{ for round ducts,}$$

A = cross-sectional area of duct, square feet.

ρ = density of air, pounds per cubic foot.

V = mean velocity of fluid, feet per minute.

D = diameter of round duct, feet.

In using Equations 15 and 16, one of the duct air temperatures will be unknown and will be obtained by substitution of the other known or assumed values.

Heat loss coefficients for insulated ducts with various conductivities are given in Fig. 17. The conductivities of various materials, which are based on mean temperatures, about 70 F, will be found in Table 4 of Chapter 9. For cases where the mean temperature is other than that at which the test was conducted, a correction should be made. However, in most cases the effect of this factor will be small and may be neglected.

Example 8: Determine the entering air temperature and heat loss for a duct 24 X 36 in. cross section and 70 ft in length, insulated with $\frac{1}{4}$ in. of a material having a conductivity of 0.35 Btu at 86 F mean temperature, carrying air at a velocity of 1200 fpm, measured at 70 F, to deliver air at 120 F with air surrounding the duct at 40 F.

Solution: Referring to Fig. 17, the overall heat transmission coefficient is found to be 0.49 Btu. From Table 2, Chapter 3 the density of air at 70 F and 29.921 in. Hg is found to be 1/13.348 = 0.0749 lb per cu ft. Substituting these and the other given values in Equation 16, y and t_1 will be as follows:

$$y = \frac{28.8 \times 6 \times 1200 \times 0.0749}{0.49 \times 10 \times 70} = 45.3$$

$$t_1 = \frac{120(45.3 + 1) - 80}{45.3 - 1} = 123.7 \text{ F}$$

Substituting in Equation 14:

$$Q_w = 0.49 \times 10 \times 70 \left[\left(\frac{123.7 + 120}{2} \right) - 40 \right] = 28,100 \text{ Btu per hr.}$$

For special considerations which apply to insulation of ducts in marine installations see Chapter 48.

REFERENCES

- ¹ A.S.H.V.E. RESEARCH PAPER No. 1280—A New Friction Chart for Round Ducts, by D. K. Wright, Jr. (A.S.H.V.E. TRANSACTIONS, Vol. 51, 1945, p. 303).
- ² Friction Factors for Pipe Flow, by L. F. Moody (A.S.M.E. Transactions, Vol. 66, 1944, p. 671).
- ³ Friction Charts for Gases Including Correction for Temperature, Viscosity and