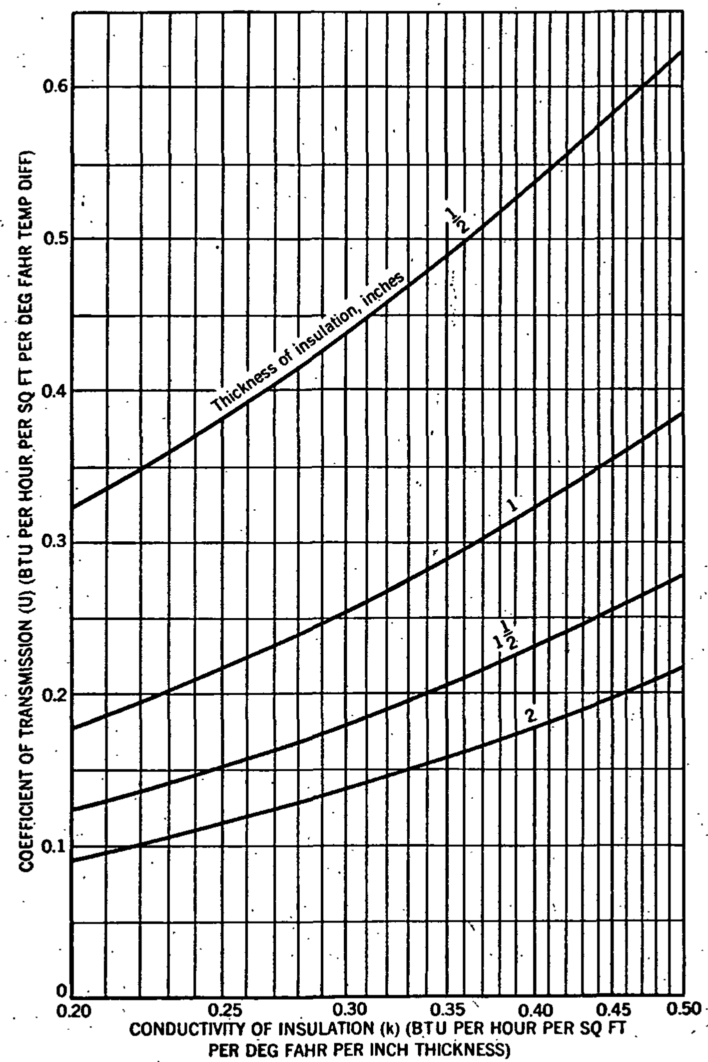

FIG. 7. HEAT LOSS COEFFICIENTS FOR INSULATED DUCTS[a]

[a]For round ducts less than 30 in. diameter, increase heat transmission values by the following percentages:

THICKNESS OF INSULATION (Inches)	½	1	1½	2
21 to 30 in. Duct Diameter	1%	2%	3%	4%
12 to 21 in. Duct Diameter	3%	5%	7%	9%

HEAT LOSSES FROM DUCTS

The thermal transmission coefficient U for an uninsulated metal duct can be obtained from the equation:

$$U = \frac{1}{\frac{1}{f_i} + \frac{1}{f_o}} \tag{1}$$

where

U = thermal transmittance, Btu per square foot per hour per degree Fahrenheit difference in temperature between the average temperature inside the duct and the air outside the duct.

f_i = film conductance inside the duct, Btu per hour per square foot per degree Fahrenheit.

f_o = film conductance outside the duct, Btu per hour per square foot per degree Fahrenheit.

Film conductance f_i for air flowing in ducts apparently depends only on the velocity of the air and the diameter of the duct. A fairly reliable inside coefficient can be calculated from Schultz's modified equation:

$$f_i = \frac{0.32\,V_o^{0.8}}{D^{0.25}} \tag{2}$$

where

V_o = velocity of air in duct, feet per second.

D = diameter of duct, feet.

Film conductance f_o depends on a number of variables including temperature, diameter, and emissivity of the outer surface and can readily be calculated from data in Chapter 3. From this explanation, it is seen that it is unwise to recommend a given value of U for all uninsulated metal ducts.

The heat loss from a given length of duct can be expressed by:

$$Q = UPL\left[\left(\frac{t_1 + t_2}{2}\right) - t_3\right] \tag{3}$$

The heat given up by the air in the duct is:

$$Q = 0.24\,M\,(t_1 - t_2) = 14.4\,A\,Vd\,(t_1 - t_2) \tag{4}$$

Equating 3 and 4 enables the determination of the temperature drop in the duct:

$$\frac{t_1 + t_2 - 2t_3}{t_1 - t_2} = \frac{28.8\,A\,Vd}{UPL}$$

Let $x = \frac{28.8\,A\,Vd}{UPL}$ for rectangular ducts, $= \frac{7.2\,D\,Vd}{UL}$ for round ducts, solving for t_1 and t_2:

$$t_1 = \frac{t_2\,(x + 1) - 2t_3}{(x - 1)} \tag{5}$$

$$t_2 = \frac{t_1\,(x - 1) + 2t_3}{(x + 1)} \tag{6}$$