TABLE 6. WEIGHTS OF SHEET METAL USED FOR DUCT CONSTRUCTION

U. S. Std. Gage	Black Sheets				Galvanized Sheets[a]			
	Approximate Thickness, In.		Weight Per Square Foot		Approximate Thickness, In.		Weight Per Square Foot	
	Steel	Iron	Ounces	Pounds	Steel	Iron	Ounces	Pounds
30	0.0123	0.0125	8	0.500	0.0163	0.0165	10.5	0.656
28	0.0153	0.0156	10	0.625	0.0193	0.0196	12.5	0.781
26	0.0184	0.0188	12	0.750	0.0224	0.0228	14.5	0.906
24	0.0245	0.0250	16	1.000	0.0285	0.0290	18.5	1.156
22	0.0306	0.0313	20	1.250	0.0346	0.0353	22.5	1.406
20	0.0368	0.0375	24	1.500	0.0408	0.0415	26.5	1.656
18	0.0490	0.0500	32	2.000	0.0530	0.0540	34.5	2.156
16	0.0613	0.0625	40	2.500	0.0653	0.0665	42.5	2.656
14	0.0766	0.0781	50	3.125	0.0806	0.0821	52.5	3.281
12	0.1072	0.1094	70	4.375	0.1112	0.1134	72.5	4.531
11	0.1225	0.1250	80	5.000	0.1265	0.1290	82.5	5.156
10	0.1379	0.1406	90	5.625	0.1419	0.1446	92.5	5.781

[a]Galvanized sheets are gaged before galvanizing and are therefore approximately 0.004 in. thicker.

run for different gages of metal. In calculating the weights of duct, it is considered good practice to allow 20 per cent additional for weights of joints and bracings. Various weights and thicknesses of standard copper sheets will be found in Table 7.

HEAT LOSSES FROM DUCTS

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

$$U = \frac{1}{\frac{1}{f_i} + \frac{1}{f_o}} \tag{8}$$

In the case of non-metallic ducts the formula in Equation 8 will become:

$$U = \frac{1}{\frac{1}{f_i} + \frac{x}{k} + \frac{1}{f_o}} \tag{9}$$

where U, f_i, f_o, x and k are as given on pages 81 and 82, Chapter 4.

TABLE 7. WEIGHTS AND THICKNESSES OF STANDARD COPPER SHEETS[a]
Rolled to Weight

Weight per Square Foot		Thickness, Inches		Nearest Gage No.		
Ounces	Pounds	Decimal Equivalent	Nearest Fraction	B. & S.	Stubs	U. S. Std.
10	0.625	0.0135	1/64	27	29	29
12	0.750	0.0162	1/64	26	27	28
14	0.875	0.0189	1/64	25	26	26
16	1.000	0.0216	1/32	23	24	25
18	1.125	0.0243	1/32	22	23	24
20	1.250	0.0270	1/32	21	22	23
24	1.500	0.0324	1/32	20	21	22
28	1.750	0.0378	1/32	19	20	20
32	2.000	0.0432	3/64	17	19	19
36	2.250	0.0486	3/64	16	18	18
40	2.500	0.0540	3/64	15	17	17
44	2.750	0.0594	1/16	15	17	17
48	3.000	0.0648	1/16	14	16	16
56	3.500	0.0756	5/64	13	15	14
64	4.000	0.0864	5/64	11	14	13

[a]Variations from these weights must be expected in practice.

Where x is small and k is large, however, this factor $\frac{x}{k}$ is of little importance and may be neglected.

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:

$$f_i = \frac{0.32\, V_o^{0.8}}{D^{0.25}} \tag{10}$$

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:

$$Q = UPL \left[\left(\frac{t_1 + t_2}{2} \right) - t_3 \right] \tag{11}$$

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

$$Q = 0.24\, M\,(t_1 - t_2) = 14.4\, A\, V\rho\,(t_1 - t_2) \tag{12}$$

Equating 11 and 12 enables the determination of the temperature drop in the duct:

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

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

$$t_1 = \frac{t_2\,(y + 1) - 2t_3}{(y - 1)} \tag{13}$$

$$t_2 = \frac{t_1\,(y - 1) + 2t_3}{(y + 1)} \tag{14}$$

For low velocities and long ducts of small cross-section, a somewhat more accurate formula may be used as follows:

$$t_2 = \frac{t_1 - t_3}{e^{\left(\frac{UPL}{14.4\, A\rho V}\right)}} + t_3 \tag{15}$$

In these equations

Q = heat loss through duct walls, Btu per hour.
U = thermal transmission coefficient, Btu per square foot per hour per degree Fahrenheit.
P = perimeter of duct, feet.
L = length of duct, feet.
t_1 = temperature of air entering duct, degree Fahrenheit.
t_2 = temperature of air leaving duct, degree Fahrenheit.
t_3 = temperature of air surrounding duct, degree Fahrenheit.
M = weight of air per hour, through the duct, pounds.