

dampers and other fire protective details, see Pamphlet No. 90 of the *National Board of Fire Underwriters*.<sup>22</sup>

The recommended gages for steel (or iron) and aluminum sheet metal rectangular ducts are given in Table 8. Steel or iron sheets are specified according to the Manufacturers or U. S. Standard Gage System. Aluminum sheets are specified according to the American or Brown & Sharpe Gage System. Weights of black and galvanized steel and iron sheets per square foot of surface for various gages are given in Table 9. Similar data for 2S aluminum sheets will be found in Table 10. Weights of standard

TABLE 8. RECOMMENDED SHEET METAL GAGES FOR RECTANGULAR DUCT CONSTRUCTION<sup>a</sup>

| ALUMINUM B. & S. GAGE | STEEL U. S. STD. GAGE | MAXIMUM SIZE, INCHES | TYPE OF TRANSVERSE JOINT CONNECTIONS <sup>b</sup>                                                                                                    | BRACING                                                                                    |
|-----------------------|-----------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 24                    | 26                    | Up to 12             | S, Drive, Pocket or Bar Slips, on 7 ft 10 in. centers                                                                                                | None                                                                                       |
| 22                    | 24                    | 13 to 24             | S, Drive, Pocket or Bar Slips, on 7 ft 10 in. centers                                                                                                | None                                                                                       |
|                       |                       | 25 to 30             | S, Drive, 1 in. Pocket or 1 in. Bar Slips, on 7 ft 10 in. centers <sup>c</sup>                                                                       | 1 x 1 x 1/2 in. angles 4 ft from joint                                                     |
| 20                    | 22                    | 31 to 40             | Drive, 1 in. Pocket or 1 in. Bar Slips, on 7 ft 10 in. centers <sup>c</sup>                                                                          | 1 x 1 x 1/2 in. angles 4 ft from joint                                                     |
|                       |                       | 41 to 60             | 1 1/2 in. Angle Connections, or 1 1/2 in. Pocket or 1 1/2 in. Bar Slips with 1 1/2 in. x 1/2 in. bar reinforcing on 7 ft 10 in. centers <sup>c</sup> | 1 1/2 x 1 1/2 x 1/2 in. angles 4 ft from joint                                             |
| 18                    | 20                    | 61 to 90             | 1 1/2 in. Angle Connections, or 1 1/2 in. Pocket or 1 1/2 in. Bar Slips 3 ft 9 in. maximum centers with 1 1/2 x 1/2 in. bar reinforcing              | 1 1/2 x 1 1/2 x 1/2 in. diagonal angles, or 1 1/2 x 1 1/2 x 1/2 in. angles 2 ft from joint |
| 16                    | 18                    | 91 and up            | 2 in. Angle Connections or 1 1/2 in. Pocket or 1 1/2 in. Bar Slips 3 ft 9 in. maximum centers with 1 1/2 x 1/2 in. bar reinforcing <sup>d</sup>      | 1 1/2 x 1 1/2 x 1/2 in. diagonal angles, or 1 1/2 x 1 1/2 x 1/2 in. angles 2 ft from joint |

<sup>a</sup> For normal pressures and velocities (see Table 4) utilized in typical ventilating and air conditioning systems. Where special rigidity or stiffness is required, ducts should be constructed of metal two gages heavier. All uninsulated ducts 18 in. and larger should be cross-braced. Cross-bracing may be omitted on uninsulated ducts if two gages of heavier metal are used.

<sup>b</sup> Other joint connections of equivalent mechanical strength and air tightness may be used.

<sup>c</sup> Duct sections of 3 ft 9 in. may be used with bracing angles omitted, instead of 7 ft 10 in. lengths with joints indicated.

<sup>d</sup> Ducts 91 in. and larger require special field study for hanging and supporting methods.

copper sheets are given in Table 11. In calculating the total weight of a given length of duct work from these tables, it is customary to add 20 percent for the weight of joints and bracings.

Aluminum sheets of the 2S and 3S type alloy and 3/4 hard temper are readily workable, and can be used for practically all duct work. The 2S type (commercially pure aluminum) is suitable for all, except very large ducts. For large ducts, where more strength is desired, the 3S alloy with 3/4 or 1/2 hard temper is frequently used. The higher tempers, particularly full hard, do not have the formability of the lower tempers. For very large ducts, where considerable strength is required, aluminum sheets

TABLE 9. WEIGHTS OF BLACK AND GALVANIZED SHEETS

| U. S. STD. GAGE | BLACK SHEETS               |        |                        |        | GALVANIZED SHEETS <sup>a</sup> |        |                        |        |
|-----------------|----------------------------|--------|------------------------|--------|--------------------------------|--------|------------------------|--------|
|                 | 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  |

<sup>a</sup> Galvanized sheets are gaged before galvanizing and are therefore approximately 0.004 in. thicker.

should be 2 gages heavier than indicated in Table 8, and should be amply stiffened. Joints can be of any of the standard designs, and can be fabricated in the same manner as iron. Repeated sharp bending and rebending should be avoided, as aluminum has a tendency to crack under such treatment. Aluminum of 16 B. & S. gage or heavier can readily be welded by the metallic arc or acetylene process. Soldering is difficult and is not generally recommended. Riveting is done in the same manner as in iron or steel sheet. Self-tapping screws tend to loosen because of the softness of aluminum.

### HEAT LOSSES FROM DUCTS

In designing duct systems, the heat gains or losses of ducts should not be neglected. Heat gains in large duct systems can be quite considerable, not only if the duct passes through unconditioned space, but also on long duct runs within conditioned space. Proper insulation will remedy this situation considerably, but sometimes a redistribution of the supply air to the various supply outlets is necessary in order to compensate for the heating effect of the duct surface.

The thermal transmittance  $U$  for ducts can be found as follows:

$$\text{For uninsulated metal duct, } U = \frac{1}{\frac{1}{f_i} + \frac{1}{f_o}} \quad (20)$$

TABLE 10. WEIGHTS AND THICKNESSES OF 2S ALUMINUM (DENSITY 0.098 LB/CU IN.)

| B. & S. GAGE | THICKNESS, INCHES |                  | WEIGHT PER SQUARE FOOT |        |
|--------------|-------------------|------------------|------------------------|--------|
|              | Decimal           | Nearest Fraction | Ounces                 | Pounds |
| 28           | 0.012             | 1/64             | 2.7                    | 0.169  |
| 26           | 0.016             | 1/64             | 3.6                    | 0.226  |
| 24           | 0.020             | 1/64             | 4.5                    | 0.282  |
| 22           | 0.025             | 1/32             | 5.4                    | 0.353  |
| 20           | 0.032             | 1/32             | 7.2                    | 0.452  |
| 18           | 0.040             | 3/64             | 9.0                    | 0.563  |
| 16           | 0.051             | 3/64             | 11.5                   | 0.720  |
| 14           | 0.064             | 1/16             | 14.4                   | 0.903  |