contractor may be expected to build the ducts by the least expensive methods, and the engineer must anticipate this. For further information on noise reduction, see Chapter 18.

Duct Construction Details

If panel construction is used with standing seams or similar reinforcement, and the panels are cross-broken to give rigidity, there is less likelihood of vibration due to air flow, or deflection due to air pressure. Elbows made without splitters, and improperly shaped transformation sections produce high local velocities which are the cause of noise in duct work. The use of first-class duct construction with well-designed transformation sections and splitters in elbows tends to maintain relatively uniform velocities with decrease in turbulence and in the noise produced.

TABLE 4. SHEET METAL GAGES FOR RECTANGULAR DUCT CONSTRUCTION[a]

GAGE	WIDTH OF DUCT	SEAM	REINFORCED SEAM
26	Up to 12 in.		
24	13 in. to 30 in.	1	
22	31 in. to 48 in.	1	
22	49 in. to 60 in.	1½	⅛ in. x 1⅜ in.
20	61 in. to 90 in.	1½	⅛ in. x 1⅜ in.

[a] If panels are not cross-broken two gages heavier material should be used.

Figs. 8 to 12 show acceptable construction details for rectangular ducts, elbows, and transformation pieces or connections. Other methods are also acceptable, such as the use of angle iron stiffeners for large ducts. Good construction is essential to the elimination of duct noises and for the prevention of a flimsy installation.

Fig. 8 is an isometric view of a duct showing the location of the stiffening seams on the top and side panels. The cross seams should not occur at the same place but should be staggered as indicated. Heating units should be installed as shown in Fig. 10 with the duct connections making an angle of not less than 45 deg, but preferably 60 deg. Fan discharge connections should have a maximum slope of 1 in 7, as indicated in Fig. 12. Whenever a pipe or other obstruction passes through a duct an easement should be placed around the pipe as indicated in Fig. 11. The recommended gages for rectangular sheet metal duct construction are given in Table 4.

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The Flow of Liquids, by W. H. McAdams, *Refrigerating Engineering*, February, 1925, p. 279.

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PROBLEMS IN PRACTICE

1 ● Determine the equivalent number of diameters of straight pipe equivalent to a 90 deg elbow having center line radii of (a) 100 per cent, (b) 150 per cent, abd (c) 200 per cent of the pipe diameter.

Assume 1 velocity head lost in 50 diameters.

From Fig. 1 the per cent of velocity head lost:

a. For 100 per cent radius is 25.5 per cent × 50 = 12.8 diameters straight pipe.
b. For 150 per cent radius is 17.0 per cent × 50 = 8.5 diameters straight pipe.
c. For 200 per cent radius is 14.5 per cent × 50 = 7.3 diameters straight pipe.

2 ● Why is it desirable to make elbows with a radius equal to one and one-half times the pipe diameter?

Reference to Figs. 1 and 2 will show that while the loss of velocity head, as indicated by the curves, shows considerable variation for elbows between the range of 50 and 150 per cent radius, the line is practically straight after 150 per cent, indicating very little variation in loss of head for elbows of larger radius.

3 ● What is the best shape to use for ducts?

The shapes to be used in designing ducts, in the order of their preference, are round, square, and rectangular.

4 ● What determines which shape to use?

Structural and space conditions. Because ducts are as a rule part of the building or structure, it is necessary to proportion their sizes to fit the spaces available.

5 ● What is meant by "arbitrarily fix the velocity in the various sections?"

When using the velocity method as a basis for design, the maximum allowable velocity is fixed for the main supply duct at the fan, and this velocity is gradually decreased as each branch or outlet is taken off the main supply duct.

6 ● Which system of duct design is to be preferred, the velocity method or the friction pressure loss method?

The friction pressure loss method can be used to advantage where no structural or building conditions limit the shape of the ducts. Where these limiting conditions exist the velocity method is to be preferred.

7 ● Are the grille sizes figured on the same basis as the outlets?

The free area through the grilles is figured the same as the outlets, and this area is increased from 20 to 50 per cent, depending on the design of the grille, to allow for the loss of area caused by the construction of the face of the grille.

8 ● Where it is necessary to provide steel angle braces, how far apart should they be spaced?

Angle braces for large ducts should be placed on 3-ft 0-in. centers.

9 ● How much air will a 10-in. by 24-in. duct handle if it is part of a system designed on a pressure drop of 0.1 in. per 100 feet of run?

1450 cfm (Table 1 and Fig. 3).

10 ● How does a splitter at a duct junction influence the volume of the air going through each branch?