

The equal friction method is generally used for designing a duct system as this insures equal resistance to air flow in all branches throughout the system (see Chapter 41). Long main ducts do not generally provide the most economical layout. Where it is necessary to ventilate a large number of machines, or machines which are widely separated, it is desirable to locate the fan at approximately the center of the system. With this arrangement it is possible to choose a fan which will deliver the required air quantity against a lower resistance pressure, and this will generally result in a horsepower saving.

When a system carrying dust is designed with an oversize main duct to allow for future extension, the air velocity may be found to be too low to carry the dust, and serious plugging may occur. In this case it is desirable to install an orifice in the end of the pipe to allow for the lower air quantity.

Construction

The interior of all ducts should be smooth and free from obstructions at joints and soldered air-tight. Other sealing mediums are permissible where soldering is impracticable.

Ducts should be constructed of galvanized sheet metal except when the presence of corrosive fumes or gases, temperatures above 400 F, or other factors would make galvanized material impractical. For the usual exhaust systems the metal thicknesses shown on Table 7 are recommended. Elbows and angles should be a minimum of two gages heavier than straight lengths of equal diameter. Hoods should be a minimum of two gages heavier than straight sections of a connecting branch.

Longitudinal joints of ducts should be lapped and riveted or spot-welded on 3-in. centers maximum. Girth joints or ducts should be made with lap in direction of air flow, with 1 in. lap for duct diameters through 19 in. and 1 1/4 in. lap for diameters over 19 in. Elbows and angles should have an inside or throat radius of two pipe diameters whenever possible. Large radii are recommended for heavy concentrations of highly abrasive dusts. Elbows 6 in. or less in diameter should be constructed of at least 5 sections and, if over 6 in. in diameter, of 7 sections, with angles pieced proportionally. Hoods should be free of sharp edges or burrs and reinforced to provide necessary stiffness. Transitions in mains and sub-mains should be tapered with a taper 5 in. long for each 1 in. change in diameter whenever possible. All branches should enter the main at the large end of the transition at an angle not to exceed 45 deg or preferably 30 deg. Branches should be connected only to the top or sides of mains, with no two branches entering diametrically opposite to each other. Dead end caps should be provided within 6 in. from last branch of all mains and sub-mains. Cleanouts should be provided every 10 ft and near each elbow, angle, or duct junction in horizontal sections. Ducts should be supported sufficiently to place no loads on connected equipment and to carry weight of a system plugged with material. The

TABLE 6. APPROXIMATE CONVEYING VELOCITIES

MATERIAL CONVEYED	DESIGN VELOCITY FPM
Vapors, gases, fumes, very fine dust.....	2,000
Fine dry dusts.....	3,000
Average industrial dusts.....	3,500
Coarse particles.....	3,500-4,500
Large particles, heavy loads, moist materials.....	4,500 and over

maximum distance between supports should be 12 ft for 8 in. or smaller ducts and 20 ft for larger ducts. Six inches minimum clearance should be provided between ducts and the ceiling, wall or floor. Blast gates for adjustment of the system should be placed near the connection of a branch to the main and means of locking gates after the adjustments have been made should be included. Rectangular ducts should be used only when clearances prevent the use of round construction. Rectangular ducts should be as nearly square as possible. The weight of metal and the lap, and other construction details, should be the equal of round duct construction having a diameter equal to the longest side. All pipes passing through roofs should be equipped with collars so arranged as to prevent water from leaking into the building.

The main trunks and branch pipes should be as short and straight as possible.

Cleanout openings having suitable covers should be placed in the main and branch pipes so that every part of the system can be easily reached in case the system clogs. Either a large cleanout door should be placed in the main suction pipe near the fan inlet, or a detachable section of pipe, held in place by lug bands, may be provided.

Every pipe should be kept open and unobstructed throughout its entire length, and no fixed screen should be placed in it, although the use of a trap at the junction of the hood and branch pipe is permissible, provided it is not allowed to fill up completely. The passing of pipes through fire-walls should be avoided wherever possible, and floor sweep connections should be so arranged that foreign material cannot be easily introduced into them.

At the point of entrance of a branch pipe with the main duct, there should be an increase in the latter equal to their sum. Some state codes specify that the combined area be increased by 25 per cent. While this is not always good practice and is frequently done at the expense of a reduced air velocity, it is often done where future expansion of the exhaust system is contemplated.

Duct Resistance

The resistance to flow in round galvanized duct riveted and soldered at the joints may be obtained from Fig. 2, Chapter 41. The pressure drop through elbows depends upon the radius of the bend. For elbows whose centerline radii vary from 100 to 300 per cent of pipe diameter, the loss may be estimated from Table 8. It is sometimes convenient to express the resistance of an elbow in terms of an equivalent length of duct of the same diameter. Thus with a center line radius equal to the pipe diameter the resistance is equivalent to a section of straight pipe approximately

TABLE 7. GAGES OF METALS FOR EXHAUST SYSTEMS^a

DIAMETER OF ROUND PIPE OR GREATEST DIMENSION OF RECTANGULAR PIPE, INCHES	THICKNESS OF DUCT MATERIAL U. S. GAGE NUMBER	
	For Highly Abrasive Matter	For Other Matter
Up to 8 inclusive.....	20	22
Over 8 to 18 inclusive.....	18	20
Over 18 to 30 inclusive.....	16	18
Over 30.....	14	16

^aFundamentals of Design, Construction, Operation and Maintenance of Exhaust Systems (American Foundrymen's Association, p. 53).