maximum distance between supports should be 12 ft for 8 in. or smaller ducts and 20 ft for larger ducts. Six in. 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 firewalls 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 any 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

[a]Fundamentals of Design, Construction, Operation and Maintenance of Exhaust Systems (*American Foundrymen's Association*, p. 53).

10 diameters long, while with a center line radius 1½ times the diameter, the resistance is apparently the same as that of seven diameters of straight pipe.

AIR CLEANING EQUIPMENT

Primary dust separators depend for their air cleaning action on centrifuging out the dust particles or on imparting to the transporting air stream a quick change in direction, accompanied by a sudden reduction in velocity. They may be applied to exhaust systems from polishing and buffing wheels and, in some cases, as a preliminary separator ahead of a final dust arrester.

Dust particles which cannot be caught in inertia type separators are usually removed by one of the following methods:

1. *Filtration.* Of the filter arresters the cloth type, either of the screen, envelope, or bag construction, is most generally used for industrial exhaust systems. Cloth arresters properly engineered for this job and handling dust for which they are suited operate at a good efficiency.

2. *Wet Collectors.* Wet collectors have been in use for many years, but only recently have been introduced for collection of industrial dust from exhaust systems. They are particularly applicable where moisture is present in the air being exhausted. The resistance is relatively low in wet collectors suitable for dust removal and remains constant for a given exhaust system.

3. *High-tension Electrical Precipitation.* High-tension electrical precipitation has been applied to removal of dust, fumes, and mists from air and other gases. (See section on Electric Precipitators in Chapter 33.)

4. *Dynamic Precipitators.* This equipment effects removal of entrained dusts by means of a specially designed fan in which the rotating element imparts a centrifugal force to the dust particles. Originally these precipitators were intended for the collection of dry dust, but recently the construction has been modified to permit the introduction of water into the dirty air intake, thus increasing its application to more kinds of dust. Consideration must be given to the type of dust handled[13].

For additional information on dust and cinders, see Chapter 33, Air Cleaning Devices.

RESISTANCE OF SYSTEM

The maintained resistance of the exhaust system is composed of three factors: (1) loss through the hoods, (2) collector drop, and (3) friction drop in the duct system.

The loss through the hoods is usually assumed to be equal to the suction maintained at the hoods. Where possible the resistance of the particular collector to be used should be obtained from the manufacturer.

TABLE 8. LOSS THROUGH 90-DEG ELBOWS

ELBOW CENTER LINE RADIUS IN PER CENT OF PIPE DIAMETER OR DEPTH	APPROXIMATE LOSS IN PER CENT OF VELOCITY HEAD
50	75
100	26
150	17
200–300	14