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 250 per cent of pipe diameter, the loss may be estimated from Table 6.

TABLE 6. LOSS THROUGH 90-DEG ELBOWS

RATIO OF ELBOW CENTER LINE RADIUS TO PIPE DIAMETER OR DEPTH	APPROXIMATE LOSS IN PER CENT OF VELOCITY HEAD
1	80
1½	31
2	22
2½	19

RESISTANCE OF SYSTEM

The 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 one-half the suction at the hoods. Where possible the resistance of the particular collector to be used should be obtained from the manufacturer.

Friction drop in the pipes must be computed for each section where there is a change in area or in velocity. The velocities should be found in each section of pipe starting with the branch most remote from the fan. The friction drop for these sections can be determined by reference to Table 6 in this chapter and Fig. 2, Chapter 41. Total friction loss in the piping system is the friction drop in the most remote branch plus the drop in the various sections of the main, plus the drop in the discharge pipe.

EFFICIENCY OF EXHAUST SYSTEMS

The efficiency of an exhaust system depends upon its effectiveness in reducing the concentration of dusts, fumes, vapors and gases below the safe or threshold limits[18].

Too much emphasis cannot be placed on the necessity of testing exhaust systems frequently by determining the concentration of atmospheric contamination at the worker's breathing level[19]. Commonly accepted values of threshold limits for usual atmospheric contaminants will be found in Tables 3, 4 and 5, Chapter 10.

AIR FLOW PRODUCING EQUIPMENT

In any type of exhaust system some form of air flow producing equipment is required to create the pressure necessary to cause the air to flow through the system to the discharge stack. The principal types of air moving equipment are centrifugal exhaust fans, disc or propeller fans, axial flow fans and venturi ejectors.

TABLE 7. CORROSION RESISTING MATERIALS FOR EXHAUST SYSTEMS[a]

MATERIAL	ACID[b]							
	ACETIC	CHROMIC	HYDRO-CHLORIC	HYDRO-FLUORIC	NITRIC	PHOS-PHORIC	SUL-PHUROUS	SUL-PHURIC
METALS	Dil. | Conc.	Dil. | Conc.	Dil. | Conc.	Dil. | Conc.	Dil. | Conc.	Dil | Conc.	Dil. | Conc.	Dil | Conc.
Aluminum	Good	Fair	Poor	No Data	Poor | Good	Poor	Poor	Poor
Magnesium and Alloys	No Data	Good | Poor	No Data	Poor | Good	No Data	No Data	No Data	No Data
Lead and Lead-Coated	Poor	Good	Poor	Poor	Poor	Poor	Good	Good | Poor
Moly Alloy (60 *Ni*—20*Mo*—20 *Fe*)	Good	No Data	Fair	No Data	Poor	Poor	No Data	Good
Monel Metal	Fair	Poor	Fair | Poor	Good[d]	Fair | Poor	Fair	Poor	Good[e] | Poor
Bronze	Poor						Good	
Silicon Iron	Fair | Good	No Data	Fair	Poor	Good	Good	No Data	Good
Stainless Steel[c] (18 *Cr*-8 *Ni*)	Good	Good	Poor	No Data	Good	Poor	Good	Poor | Good[e]
Enameled Steel	No Data	No Data	Good	Poor	Good	Poor	No Data	Good
MISCELLANEOUS								
Asbestos Comp			Good except against strong acids and alkalies					
Wood	Some woods are decomposed or softened faster than others.							
Rubber					Poor			Poor
Plastics	In general plastics resist weak acids and are decomposed by concentrated acid.							

[a] Standard Practice Sheet No. 115 (Division of Industrial Hygiene; New York State Labor Department).
[b] Acid mists in air are more corrosive than as liquid in storage tank. Galvanized iron not resistant to acid.
[c] Stainless steel of (24 *Cr*—10 *Ni*) fairly resistant at low temperature for HCl and H_3PO_4.
[d] Under most conditions.
[e] At room temperatures.

PROTECTION AGAINST CORROSION AND ABRASION

Manufacturers generally provide special fans for the handling of various industrial wastes. When corrosive or abrasive materials are conveyed, the fan blades and interior of the fan housing should be protected from wear. This may be accomplished by placing the collector on the suction side of the fan. Excellent protection against many corrosive acids may be obtained by lining the interior surfaces of the ducts and fans, including wheels, with rubber.

The removal of gases and fumes in many chemical plants requires that metals used in the construction of the exhaust system be resistant to chem-