bestos paper, deep, sand beds, composite glass wool layers, compressed glass fiber in the form of paper or batts and resin wool. The use of this type of filter is limited to concentrations in the range of outdoor air where very high efficiencies, greater than 99.95 percent are required.

Fabric filters are not suitable for high temperatures, above 300 F, acid mists or vapors, or mixed contaminants such as wet corrosive gases and solid or liquid particles. Cotton fabrics are limited to 180 F, whereas wool is limited to temperatures under 200 F. A wide variety of natural and synthetic filter medias is available for various temperature and corrosion conditions but caution must be exercised relative to rupture, high temperatures, and corrosive gases. When properly selected, efficiencies are often high enough to permit recirculation of air except, possibly, when handling toxic contaminants.

TABLE 3. CHARACTERISTICS OF FABRIC FILTERS

	Efficiency			Resistance In Water	Filtering Velocity fpm	Maintenance
	Particle Size Range in Microns					
	>10	10 to 1	<1			
Cloth collector (shaken or rapped)[a]	High	High	Moderate to high	Medium	1–6	Medium to high (periodic)
Cloth collectors (reverse air or jet cleaning)[b]	High	High	Moderate to high	Medium to high	10–35	Medium to low
Absolute type[c]	High	High	High	Medium	3–14	None (see remarks)[c]

[a] Space requirements large. Requires scheduled cleaning.
[b] Space requirements medium. Cleaning constant during operating cycle. Added horsepower used for reverse jet action.
[c] Space requirement small. Requires replacement of unit when predetermined resistance is attained. Ordinary cleaning not possible.

On the basis of their important characteristics, fabric filters may be classified according to Table 3.

ELECTROSTATIC PRECIPITATORS

Electrostatic precipitators for industrial air and gas cleaning differ materially from the low voltage designs described in Part I of this chapter, although the principles of operation are similar. For industrial concentrations, it is obvious that more severe demands are made upon methods of cleaning the collector, disposal of collected material, and servicing practices. Low voltage cleaners for industrial loadings to date do not have sufficient inherent dust holding capacity. One exception in the field of exhaust systems is that of the oil mist collector, which functions satisfactorily on a liquid aerosol with the conventional low voltage type (2 stage) electrostatic precipitator.

Industrial precipitators employ an assembly of parallel collector electrodes of various constructions, including corrugated plate, rod curtains, or perforated plate. Air flow is usually horizontal, although special construction may permit vertical air flow. High voltage collectors were made in the form of vertical pipes, and are used for high operating pressures and for *wet collector* designs where water continuously flows downward inside

the pipe walls of the collector electrode. The negative discharge electrodes or rods are accurately centered between the usual 9 in. collector electrode spacing, the latter being of positive charge. Precipitation occurs in a single stage wherein ionization and collection are carried on simultaneously throughout the unit, and depend on high potentials of 25,000 to 75,000 volts. The high voltage direct current is supplied by either mechanical or electronic rectifiers.

High efficiencies are obtained by allowing suitable time for contact in the collector zone, and by proper ratio of air flow velocity to that of transverse velocity of the negatively charged particles toward the positive charged collector plates.

Air velocities vary from 240 fpm to 480 fpm with a constant pressure drop of less than ½ in. water. Since the maximum efficiency is obtained with the finer particles at low concentrations, and the precipitation is not effective for large particles, inertial separators are frequently used in series with these units.

Attention should be directed to the prohibition of air recirculation to occupied spaces. High voltage cleaning equipment produces ozone and nitrogen oxides in excessive quantities. The major source of maintenance usually will be in conjunction with the high voltage rectifying equipment rather than the collector. Although usually used for elevated temperature work, unless the gases are pre-conditioned, temperatures in excess of 700 F should be avoided.

Collector electrode cleaning is accomplished by a rapping device, either electrical or pneumatic, without interrupting operation. The dry plate surfaces release the dust into hoppers below the plates. Some wet cleaning methods are also used.

Electronic precipitators require large spaces, maintenance may vary widely, and initial costs are high. Efficiency is a function of the aerosol encountered and usually ranges above 90 per cent.

ABSORBERS, ADSORBERS, AND COMBUSTION DEVICES

One of the important problems in industrial air and gas cleaning is the removal of soluble, insoluble, or combustible gases and vapors from fluid streams before their discharge to the atmosphere. These contaminants may create problems which are distinct from the particulate removal discussed previously. It has been pointed out that scrubbers and other wet collectors may remove gases and particulate matter from contaminated air streams. However, the units described are intended primarily for particulate removal with the exception of the spray or packed towers or wet cell devices.

Absorption devices are intended primarily for the removal of readily soluble gases which can be removed by simple absorbing agents such as water or alkali; for example, the removal of hydrochloric acid gas by a caustic spray.

Adsorption apparatus is intended primarily for removal of organic vapors in either high concentration (solvent recovery) or low concentration (odor removal). The first process is usually carried on as a matter of economic recovery. In the second process, the concentration of the contaminant must be low enough so that the adsorbent will have a reasonable life before replacement or reactivation.

Combustion, either total or catalytic, may be used to destroy organic