Automatic dry filters which utilize a web-like material supplied in roll form are available. While generally not recommended for the handling of atmospheric dust, they are particularly suitable for the removal of lint associated with operation of textile mills and dry cleaning establishments and for collection of ink mist resulting from press room operation.

Charged-Media Electronic Air Cleaners

The charged-media type air cleaner consists of a dielectric filtering medium, usually arranged in pleats as in typical dry filters. No ionization means are employed. The dielectric filtering medium may consist of glass fiber mat, cellulose mat, or other similar material, and is supported on or in contact with a gridwork consisting of alternately grounded and charged members, the latter usually being held at a potential of 12,000 volts d-c. An intense and non-uniform electrostatic field is thus created through the dielectric medium. Airborne particles approaching the field are polarized and drawn toward filaments or fibers of the media. The general arrangement illustrating this type of filter is shown in Fig. 3.

The precipitator of this type offers resistance to air flow, when clean, on the order of 0.10 in. of water at 250 fpm velocity and, unlike the ionizing type, the resistance of the charged-media type electronic cleaner rises as dust is accumulated on the media. Because of these characteristics the filter tends to equalize the air distribution over the face of the filter. Like typical replaceable-media mechanical filters, the charged-media precipitator is serviced by replacing the filtering medium. The dielectric properties of the media are impaired when the relative humidity exceeds 70 percent.

RELATIVE PERFORMANCE OF DIFFERENT TYPES OF FILTERS

Group I—Viscous Impingement, Unit or Panel Type

In this type of flat, shallow filter assembly, the approach velocity of the air stream equals the velocity through the filter media. The filter media is characterized by high porosity, high dust-holding capacity, relatively low efficiency, and low cost. Thickness ranges mostly from ¼ to 4 in.

This class includes filters of the permanent washable type or of the disposable type, both of which are usually coated with oil for dust retention. The filter media may include metal screen, crimped or corrugated in various ways; deformed perforated metal sheet in multiple layers; netted wire or other metal filaments, and other matted metal filamentous configurations; relatively coarse glass fibers (15 to 60 micron diameters); animal hair; cellulose; and synthetic fibers, i.e., Dynel, Dacron and Nylon.

Initial resistance at the common ratings of 800 and 1200 cfm (20 × 20 in.) range from 0.02 in. for the thinnest to about 0.20 in. for the thickest. Filters of this group are usually operated to a final resistance of 0.4 to 0.6 in. of water. Average performance of some types of filters in this group when operated within rated limits is given in the following tabulation:

Thickness, Inches (Approx.)	Weight Efficiency,[a] Percent	AFI Code Dust-Holding Capacity,[a] Grams/1000 cfm Rated Air Flow	Dust Spot Efficiency, Percent (Atmosphere)[b]
<1	20–50	70–140	5–10
1–1¾	50–75	120–360	5–15
1¾–2½	60–80	180–540	5–20
2½–4	70–85	240–760	10–25

[a] By *AFI Test Code*, Section 1 (1953).[3]
[b] By *AFI Dust Spot Test Code* (1960).[4]

Group II—Extended Surface, Dry Type, Medium Efficiency Filters

This class includes extended surface panel or cartridge units of pleated or deep-folded configuration, wherein the approach velocity of the air stream is substantially greater than the velocity through the filter media, i.e., the filter area is much greater than the surface area. Media filtration velocities range from 30 to 90 fpm, although approach velocity is usually around 250 to 625 fpm. Depth in direction of air flow of this group is under 12 in.

Filter media include those of fine glass fibers, 6 to 20 microns in diameter, in mat form up to ½ in. thick; thin paper-like, nonwoven mats of fine glass fibers, cellulose, or cotton wadding; wool felt; synthetic sponge or foam having a resilient structure of interconnecting pores; and nonwoven mats of comparatively large diameter fibers (more than 30 microns) of varying thicknesses up to 1 in.

Media of lowest efficiency and highest dust-holding capacity include the coarser foams and nonwoven mats of large diameter fibers. Those having higher efficiency and lower dust-holding capacity are thin, paper-like mats of fine glass, cellulose, felt, etc.

In some instances, a dust adhesive is applied to media in this group to enhance dust collection and retention. Initial resistance of this group, at rated air flow, lies mostly between 0.05 and 0.25 in. of water. They are usually operated to a final resistance of 0.5 to 0.7 in. of water. Average performance of some types of filters in this group when operated within rated limits, is given in the following tabulation:

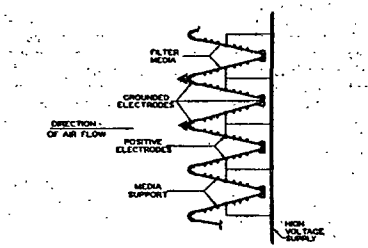


Fig. 3 .... Cross-Section Diagram of Charged Media Type Electronic Air Cleaner

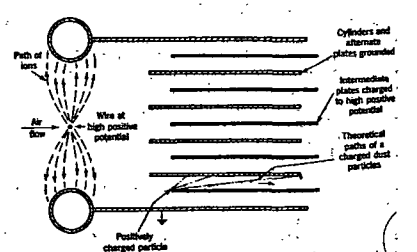


Fig. 4 .... Diagrammatic Cross-Section of Ionizing Type Electronic Air Cleaner

Filter Media Types	Wt Efficiency,[a] Percent	AFI Code Dust-Holding Capacity,[a] Grams/1000 cfm Rated Air Flow	Dust Spot Efficiency, Percent (Atmosphere)[b]
Coarse foam and large fibered nonwovens	55–65	360–720	5–15
Finer pored foams and finer fibered nonwovens	70–80	180–360	10–25
Thin, paper-like mats of glass fibers, cellulose	80–90	90–180	20–30
Mats of fine glass fiber, multi-ply cellulose, wool felt	85–95	90–180	25–40

[a] By *AFI Test Code*, Section 1 (1953).[3]
[b] By *AFI Dust Spot Test Code* (1960).[4]

Group III—Extended Surface, Dry Type, High Efficiency Filters

Physical characteristics of these filters are similar to Group II except that their lower porosity and ultra-fine fiber composition require no oil for dust retention. They are all of the disposable type and are characterized by relatively higher efficiency. Media filtration velocities usually range from 15 to 30 fpm, approach velocities from 250 to 625 fpm. Depth in direction of air flow of filters ranges from 12 to 36 in.

Initial resistance of filters, at rated air flow ranges generally from 0.10 to 0.50 in. They are usually operated to a final resistance of 0.6 to 1.0 in. W.G. Average performance of some types of filters, when operated within rated limits, is given in the following tabulation:

Filter Media Types	AFI Code Dust-Holding Capacity, Grams/1000 cfm Rated Air Flow	Dust Spot Efficiency, Percent (Atmosphere)[a]
Mats of 5 to 10 micron fibers, ¼ to ½ in. thickness	270–540	40–60
Mats of fibers somewhat finer than above, or of greater thickness	180–450	70–80
Mats of 1 to 4 micron fibers, mixture of various fibers and asbestos	180–360	80–90
Mats of ½ to 2 micron fibers, usually glass fibers	90–270	90–98

[a] By *AFI Dust Spot Test Code* (1960).[4] Weight efficiency, in the high nineties, is nondiscriminating, hence inappropriate for this class of filter.

Group IV—Viscous Impingement, Moving Curtain Type

The permanent, metal panel type of moving curtain filter is usually designed for and operated at 500 fpm face velocity at a resistance of 0.4 to 0.5 in. of water. Dust-holding capacity is not a critical factor in performance rating as the metallic medium is automatically cleaned, usually by passage through an oil bath. Efficiency or arrestance values offered by the permanent moving curtain type media, usually arranged so that the air stream passes through two curtains, range generally from 75 to 85 percent by the AFI weight procedure. Dust spot efficiency, atmosphere, is generally in the 10 to 25 percent range.

The moving curtain filter with replaceable media, usually in roll form, is also usually designed for and operated at 500 fpm face velocity. Initial resistance generally ranges from 0.12 to 0.25 in. of water. Under operating conditions, *steady state* resistance ranges generally from 0.3 to 0.6 in. of water. Various types and thicknesses of media are used; the usual thicknesses range from 1½ to 2½ in.

Both dust-holding capacity and arrestance are critical factors in performance ratings. A modification of the AFI weight method is commonly used for obtaining performance data. This modification pertains to moving of the curtain in the test air stream when resistance reaches prescribed levels, usually 0.4 to 0.5 in. of water, and continuing dust feeding until several face loadings of curtain have been used. Efficiency values are obtained at regular intervals during dust loading to establish *steady state* efficiency values. Dust-received values, established on the basis of steady state conditions, are usually expressed in grams per sq ft of media used. Dust-holding capacity for the AFI weight procedure is obtained by multiplying weight of dust received by steady state efficiency.

Under steady state conditions, efficiency by the modified AFI weight method for the various media commonly used is generally in the 70 to 85 percent range. Dust-holding capacity by the weight method, AFI dust, ranges generally from 50 to 150 grams per sq ft. All values are based on the conditions of test described above.

Group V—Electronic (Ionizing Type) Air Cleaner[1]

Electronic air cleaners use electrostatic precipitation principles to collect particulate matter (see Fig. 4) but operate on much lower voltages than the type commonly used on industrial stacks. The designation *Electronic Air Cleaner* has been standardized to distinguish the class of electrostatic precipitator which alone is suitable for cleaning ventilating air.

In a typical case, a potential of 12,000 volts may be used to create the ionizing field, and some 6000 volts between the plates upon which the precipitation of dust occurs. These voltages, which are capable of momentary shock to personnel similar to that of a spark plug, necessitate some safety measures. A typical arrangement provides means for making the equipment inoperative when any door affording access to high-voltage parts is opened. Operation can be resumed only after all doors are closed. The voltages necessary for operation of the equipment are usually obtained by means of high-voltage direct-current power packs operating from a 110–120 volt, 60-cycle, single-phase building service. Electric power consumption is about 12 to 15 watts per 1000 cfm, plus the approximately 40 watts required to energize the rectifier tube heaters.

Air cleaners of this type offer negligible resistance to air flow and, therefore, care must be exercised in arranging the duct approaches on the entering and leaving sides of the cleaners in order that the air flow may be distributed uniformly over the cross-sectional area. The efficiency of the electronic air cleaner is sensitive to air velocity, and the device itself has much less tendency to rectify the air stream