

selected on the basis of experience or judgment, guided by the results of various test procedures.

A description of various types of air filters available commercially will be found under *air filters* in the catalog section of THE GUIDE.

DUST AND LINT

Airborne solid matter, from the viewpoint of air filtering, is considered as lint and dust. Some lint originates outdoors, as animal hair, vegetable fibers, etc., but much is generated within buildings by the wear and brushing of fabrics in the form of clothes, draperies, carpets, etc. Lint is comparatively easy to capture in an air filter because of its comparatively great length. So far as air filter performance and testing are concerned, lint is chiefly important because of its tendency to impede or stop the flow of air through the filter. In general, lint, if not captured, will accumulate in corners and under furniture in a building in areas of slight air motion, and in some cases may seriously obstruct heating and cooling coils. Dust settles, or is precipitated by heat or air motion, upon furniture, fixtures and walls, and the only satisfactory treatment is washing or re-painting. Dust is more difficult to capture than lint, and, obviously, small particles are more difficult to capture than large ones. The air cleaning problem is complicated by the vast difference in size of dust particles, the range of which is shown in Fig. 1, Chapter 8.

As a general rule, the removal of the coarser dust particles and lint from the ventilating air produces tangible results in so far as cleanliness in a house or building is concerned, because much of the finer dust remains suspended in the air and is removed from the building by the circulating air. However, since some of the fine dusts are undoubtedly deposited by means other than settling, such as electrical or thermal precipitation^{2,3} and by contact, the ability to remove small particles is desirable in an air cleaner if it can be obtained at not too great a cost.

VISCOUS IMPINGEMENT TYPE FILTERS

The medium in a viscous impingement type filter is usually a fiber pack for non-automatic types, or a series of metal plates for automatic self-cleaning types. In either case, the medium is treated with a viscous substance, often an oil or grease, called the *adhesive* or the *saturant*, intended to retain dust particles which come in contact with it. Also, in either case, the arrangement is such that the air stream is broken up into many small air streams, and these are caused to change direction abruptly a number of times in order to throw the dust particles, by momentum, against the adhesive. Several desirable characteristics of an adhesive for air cleaners of this type are: (1) its surface tension should be such as to produce a homogeneous film or coating on the filter medium; (2) the viscosity should vary only slightly with normal changes of temperature; (3) it should prevent the development of mold spores and bacteria on the filter medium; (4) the liquid should have high capillarity, or ability to wet and retain the dust at all operating temperatures; (5) evaporation should be slight; (6) it should be fire resistant; (7) it should be odorless.

Various fibrous materials have been used as filtering media in unit filters of the viscous impingement type. These include glass fiber, steel wool, similar wool of non-ferrous metals, wire screen, animal hair, hemp fibers, and other materials. In such filters, the medium is often packed more densely on the discharge than on the approach side, in order to increase the dust holding capacity. This results in a selective arrestance of dust with

the larger particles nearer the approach face. The arrangement also permits some penetration of lint into (but not through) the filter, so that the amount of lint which can be tolerated on the filter is also increased. Due to plane surface area the viscous impingement type filter, however, may be inferior to some dry types if the air carries a high percentage of lint.

The resistance of air filters obviously increases with the rate of air flow through them. Face velocities of about 300 fpm, and resistances in the range from 0.1 to 0.2 in. water, when the device is new and clean, are usual for ventilation system filters. Special filters with low resistances are available for use with gravity warm air furnaces, and for other applications where only low pressure is available.

The resistance of these filters increases with dust or lint loading, and it is the resistance due to this cause which ordinarily necessitates servicing. The rate of loading obviously depends upon the amount as well as the kind of dust in the air, and for this reason, periods between servicing cannot be predicted. Manometers are often installed to indicate the pressure drop across filter banks, and they serve to indicate when the filter requires cleaning. The pressure drop tolerated differs between operators and system designs. The resistance of a filter bank can be kept desirably low by periodically servicing some, but not all, of the units in the bank at one time.

The method of cleaning viscous impingement unit filters differs for different types of filters and kinds of dust. Much dry dust or lint can often be removed by rapping the filter.

Throw-away filters are constructed of inexpensive materials, and are designed to be discarded after one use. The frame is frequently a combination of cardboard and wire.

Cleanable filters usually have metal frames. Various cleaning methods have been recommended including: air jet, water jet, steam jet, washing in kerosene, and dipping in an oil. The latter may serve both to clean the filter and add the necessary adhesive.

Automatic Viscous Filters

In an automatic air filter, means are provided to remove the dust from the medium mechanically. Automatic filters with moving cloth media have been constructed, but are not now in wide use.

The medium in a typical automatic filter at present consists of a series of specially formed metal plates mounted on a pair of chains. The chains are mounted on sprockets located at the top and bottom of the filter housing, so that the filter medium can be moved as a continuous curtain up one side and down the other side of the sprockets. The arrangement is such that, at the bottom, the medium passes through a bath of special oil which both serves to remove the dirt from the plates, and acts as an adhesive when the cleaned plates next pass through the air stream. The plates forming the filtering medium or curtain usually overlap each other, and due to their special shape, many small air passages are formed between them. These air passages turn abruptly one or more times in order to give the impingement effect.

An electrically driven rotating device is usually supplied with an automatic filter. The device may be set to move the curtain periodically, or a special switch, actuated by pressure drop, may be used to govern its motion. In operation, the resistance of an automatic filter will remain approximately constant as long as proper operation is obtained. A resistance of $\frac{1}{2}$ in. water at a face velocity of 500 fpm is typical of this class.