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Hvac air filtration: Choices for today

by Rick Peckham, Airguard Industries

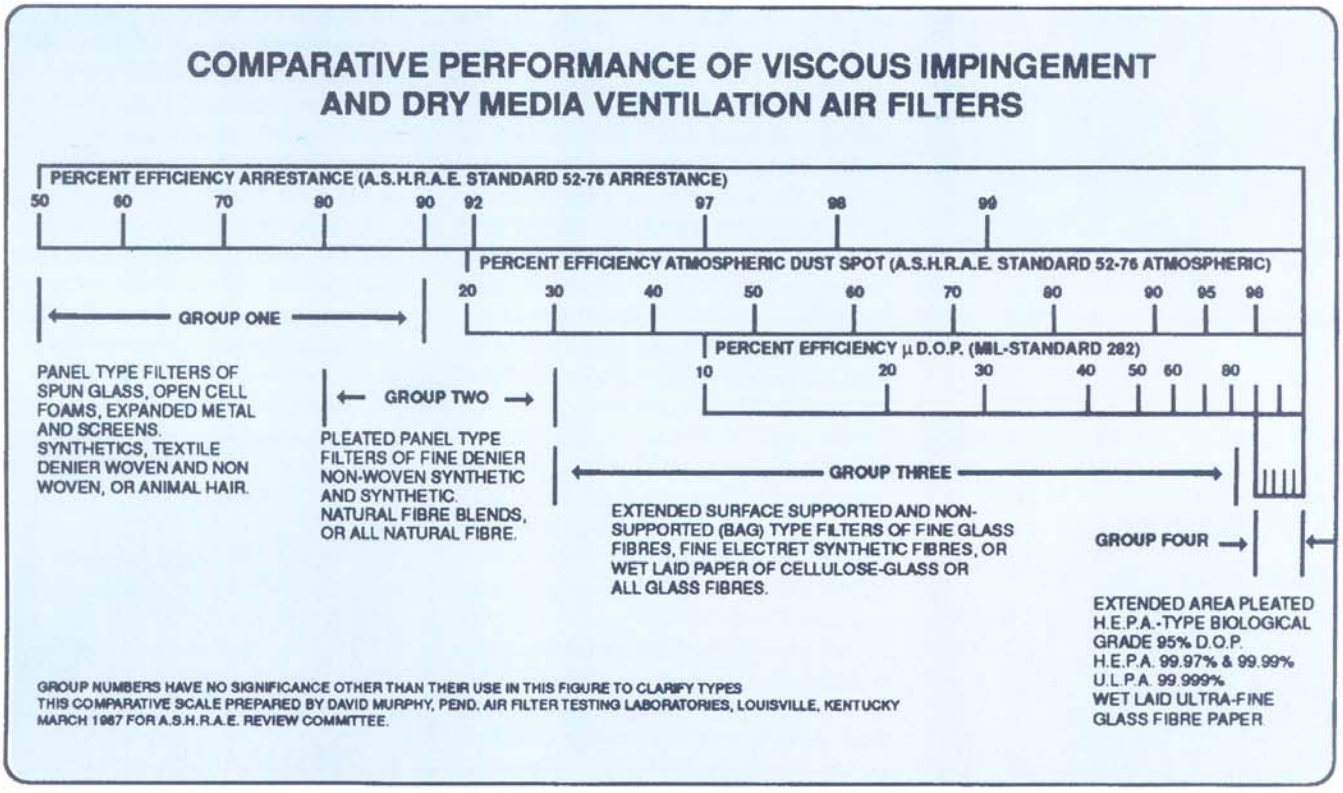


TABLE 1

It is important to consider a number of factors when selecting an air filtration system. Care should be taken that the system will serve the long range needs of the building, since it is sometimes quite difficult to justify changes after the system is installed.

When filter upgrades are implemented, system balance can be affected, which could be a problem. In addition, a different filter can mean a different hardware system may be needed. Getting it right the first time is much better!

Even if great care is used in making the decision, future legislation may require filter upgrades that cannot now be fully anticipated. It is for this reason that making a good hardware selection is so important.

With the right hardware and some flexibility in fan capacity, future changes can be accomplished economically. All in all, there is a great deal that can be done to ensure a good system for the building owner.

Understanding some of the specific reasons for the use of air filters will be helpful. Here are a few:

- Protecting heating-cooling coils;
- Protecting the decor of occupied spaces;
- Reducing building maintenance;
- Limiting ductwork fire hazards;
- Protecting the general well-being of building occupants; and
- Removing airborne bacteria from operating rooms.

The first four items deal with mechanical and material items; the last two deal directly with the protection of people. Because of these distinctions, it is incumbent to know what you want to accomplish when making filter hardware and efficiency choices.

Filter efficiencies

One must have a general understanding of the testing methods upon which filter efficiency rating is based. There are two basic methods in use today.

ASHRAE Standard 52.1 (formerly 52-76): This method was created by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) to provide the end-user with information that could be used to evaluate low, medium, and high efficiency air filters, up to but not including HEPAs, which will be discussed later.

It tests a filter's ability to remove particulate matter from outside air, its ability to remove synthetic test dust, and its capacity to hold an amount of synthetic test dust.

The "dust spot efficiency" is the value assigned based on a filter's performance on outside air. It is the value that is normally referenced in manufacturers' printed literature, filter labeling, and specifications. It is expressed as a percentage.

The "arrestance" value is determined by measuring how much synthetic test dust is removed by a filter. It is also expressed as a percentage.

The "dust holding capacity" is the amount of synthetic test dust held, expressed in grams. This value can be helpful in determining how long one filter may last versus another.

It cannot take into account, however, all the variables that are encountered by an actual system. Keep this in mind when referring to this number in evaluating various products.

It is important to note that when ASHRAE updated Standard 52-76 in 1993, the new Standard 52.1 did not invalidate its predecessor. It simply allowed an alternate method of calculation to save time in conducting the test.

The DOP efficiency test: This is the method used to evaluate the performance of HEPA filters. DOP (dioctylphthalate) is a liquid that, once exposed to compressed air, forms an aerosol with an approximate particle-size distribution of 0.3 to 3 microns.

The actual DOP efficiency test calls for the DOP to be heated, which creates an aerosol with a particle size of approximately 0.3 microns. The method is outlined in MIL-STD-282. A DOP tester measures the penetration of the DOP.

For example, if the penetration is measured at 0.03%, then 100 minus 0.03 equals 99.97% efficiency.

The question of what medium to use for hvac filtration cannot be separated from what product to use. There are many more types of filters than there are media. For each type of filter medium, there are many product configurations.

One must know what efficiency level is called for, which type of medium may be preferred, and, ultimately, which style filter product containing that medium will be selected.

Group one: Within this group are a number of products including the automatic roll filter, pre-cut pads, and common fiber glass furnace filters.

Also in this group is the open-cell foam material that can typically be found in window air conditioning units. Many times, these come in oversize pads or rolls and are normally cut-to-fit. Synthetic products fit within this product group as well, and are available as internally supported "ring" panels, where a heavy-gauge wire is sandwiched between two layers of synthetic material.

This product is self-supporting and can be especially useful in areas of high humidity. While polyester is the most-common synthetic fiber, polypropylene, nylon, and modacrylic are also used for some applications.

Finally, there is the metal wire screen-style filter that is normally used when high airflow and/or heavy dust loads are encountered. These, along with the open-cell foam, are the only two media in this category that are meant to be washed and reused.

Filters in this group generally perform better when coated with a tackifier. Tackifiers make the medium "sticky," which helps it to capture and retain dust particles. Different materials are used for this purpose, including simple 30-weight motor oil and the more specialized non-migrating types.

When properly coated with a tackifer, these products can be effective on particles as small as 5 microns. Their prime target is in the size range of 10 to 50 microns and larger.

These products are often used as prefilters for higher efficiency filters. Their low cost and ability to trap and hold large amounts of dust and dirt make them ideal for helping to extend the life of the more expensive final filter.

Group two: Here the focus is on pleated panel type filters (see Figure 1). The medium is normally polyester or polyester-cotton blends, and is characterized by smaller diameter fibers than group one.

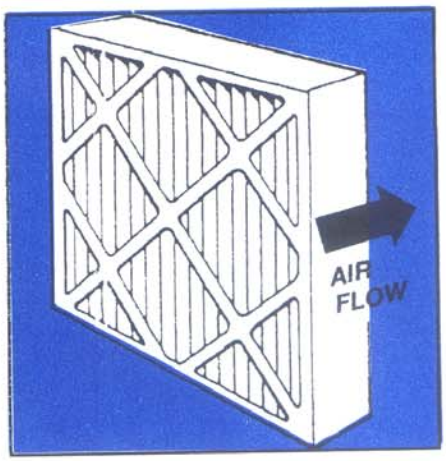


FIGURE 1 – Pleated filter

Because the medium is more dense its resistance to airflow is higher. This is overcome by pleating the medium to allow for more surface area within a

given space. The media area is several times larger than that of the filters in group one.

A 24" x 24" x 2" flat panel filter contains 4 sq. ft. of media area, whereas a 24" x 24" x 2" pleated filter can contain as much as 18 sq. ft.

As we continue through groups three and four, it will become obvious that as the medium becomes denser to provide higher efficiencies, the media area must be increased to allow for acceptable performance in terms of airflow resistance values (pressure drop).

Pleated filters are normally rated by their ASHRAE atmospheric dust spot efficiency. They have a higher efficiency than most flat panel filters, and while they too can be used as prefilters, it is common to see them used as the only filter in a system.

Their ability to remove smaller dust particles makes them quite popular. They are highly effective on particles in the 5 to 10 micron size range, which means that they can stop all pollens, which run in the 10 to 100 micron size range. They also do a creditable job on mold dust and spores, which are 3 to 15 microns in size.

Group Two products have become the most popular filters in America due to their versatility and performance capabilities. They are now offered in many home improvement and hardware stores for the homeowner.

Whether at home or in the workplace, these filters are generally felt to be the minimum standard for new installations.

Group three: This group contains the medium to high efficiency products up to but not including HEPA filters.

They are rated by their ASHRAE atmospheric dust spot efficiency but, as the chart in Table 1 (see front cover) shows, can also be quite effective on 0.3 micron particles.

There are three specific types of media used to produce the products that fall within this group: ultra-fine glass microfibers; electret-type synthetic fibers; and wet-laid paper mat glass fibers. There are a number of different products that are produced from each of these media types.

Ultra-fine glass – This media is used to produce the non-supported bag-type filters (Figure 2) that have been available to the commercial, industrial, and health care markets for a number of years. It is also used to produce rigid box-type filters (Figure 3).

The efficiency range of these products is 30% to 95% ASHRAE dust spot. They are available in a variety of sizes and contain different amounts of media, depending on the product, ranging from 50 to 120 sq. ft.

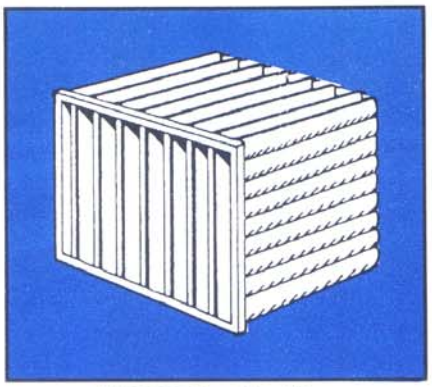


FIGURE 2 – Bag filter

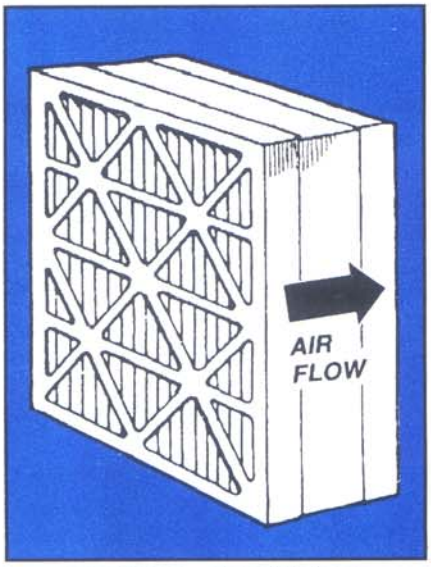


FIGURE 3 – Box style filter

Electret-type synthetic – This media is available in the same bag and box-style filters as the ultra-fine glass media. These products were developed in Europe and have gained much acceptance in America. They are also available in the same basic efficiency range of 30% to 95%.

The media is said to have an electrostatic charge, which is designed to enhance initial efficiency capabilities. Overall, its performance is similar to that of glass-type media, as evidenced by the fact that they both test in the same ASHRAE dust spot range. Media area is normally below 100 sq. ft.

Wet-laid paper mat – There are two basic types of filter products produced using this media – the box style with pleated paper mat and corrugated separators (Figure 4), and the newer narrow-pack, close-pleated rigid style (Figure 5).

The box style contains 100 to 140 sq. ft. of media, whereas the narrow-pack product contains nearly 200 sq. ft. of media. These products are characterized by low media velocity and long service life.

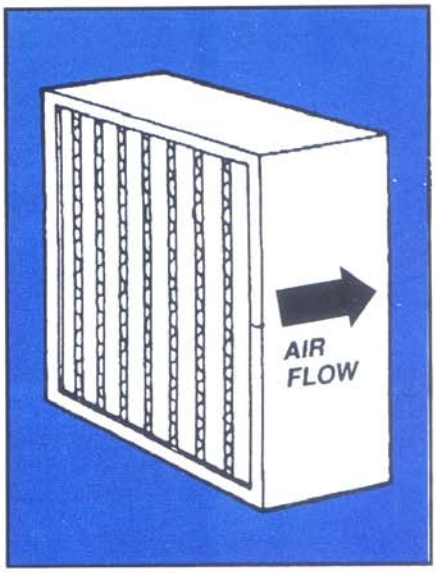


FIGURE 4 – Box filter

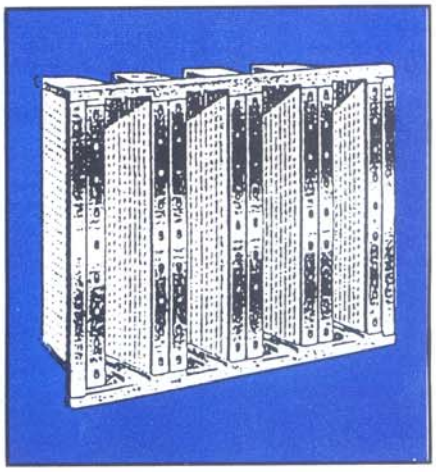


FIGURE 5 – Close-pleated rigid style

In the case of the new-style product, there is also the added benefit of very low pressure drop, allowing this filter to be used in older systems that may have a limited ability to handle more-restrictive types.

All three types of media are popular. While there has been much discussion about the relative merits of each, it is fair to say that when used according to the manufacturer's suggested airflow ratings, all three perform well.

It should be noted that the rigid-style box filters are generally better suited to variable-volume systems than are the non-supported bag style.

Bag filters can, however, be used in variable-volume systems if the pocket length is left on the short side (22 in. or less is desirable), or if the pockets are held in place by an optional support wire that is available from most manufacturers.

In addition, if a given unit is plagued by turbulent airflow, the rigid style would be a better choice. For all other standard applications, a well-built bag filter will work quite well.

As you can see from the data given, these products contain very high amounts of media. The dense nature of all three media makes them restrictive to airflow unless these high media amounts are used.

Group four: These are the most-efficient particulate filters available today. They are called HEPAs (Figure 6), for High Efficiency Particulate Air. These products utilize a wet-laid ultra-fine fiber glass paper media. This differs from the wet-laid paper type in group three, in that it contains fibers of much smaller diameter.

The paper is much more dense and able to remove all particles in the 0.3 micron range. New and improved media allow even better removal of microscopic particles, down to 0.12 microns and smaller.

These media are used in the production of ULPA (Ultra-Low-Penetration Air) and SULPA (Super-Ultra-Low-Penetration Air) filters.

While most standard hvac applications do not call for the use of this level of filtration, some specific applications do. Examples are:

- Filtering supply air for critical surgery rooms;
- Temporary filtering of buildings undergoing asbestos abatement procedures;
- Filtering of supply air to commercial jetliners; and
- Preventing process contamination during critical manufacturing procedures.

The high efficiency levels attained by this group make them effective at reducing airborne levels of microorganisms. This is due primarily to the fact that many of these organisms are attached to microscopic airborne particles.

A 24" x 24" x 11½" HEPA filter will contain approximately 200 sq. ft. of media, but is designed to operate at only about half of the airflow capacity of the group three products.

It is likely that we are a long way away from any trend towards HEPA filtration for standard hvac applications. However, it remains a valuable tool for the future.

Rick Peckham is a National Air Filtration Association certified air filtration specialist with Airguard Industries, Corona, Calif. This article is excerpted from a paper for the "Filtration 94" conference and exposition, sponsored by American Filtration and Separations Society and INDA.

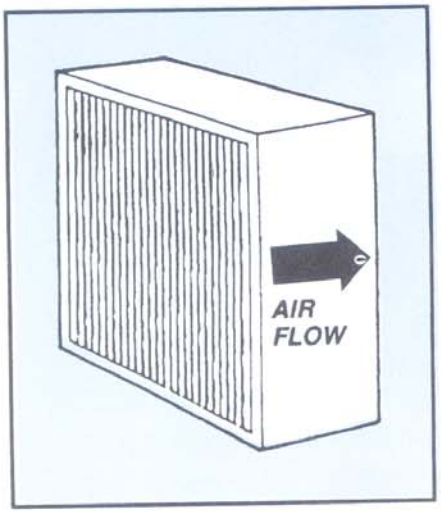
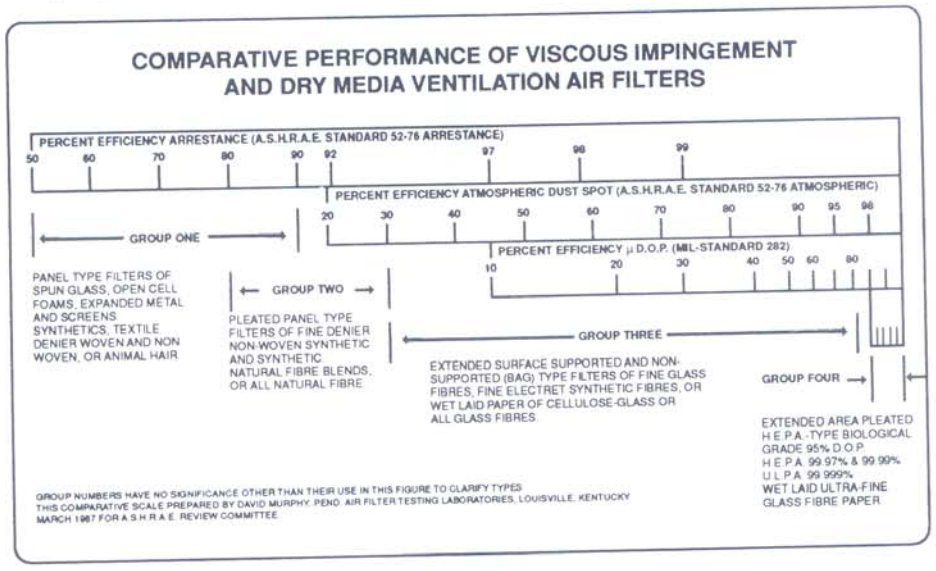


FIGURE 6 – HEPA filter



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