Filter Selection

A Guide to Understanding HVAC Filter Selection

Effective air filtration provides the primary defense for building occupants and HVAC equipment against pollutants generated within a building as well as pollutants from air drawn into a building from the HVAC system. That's why selecting the right HVAC filter is so critical. With today's higher standards in filtration, it's possible to produce cleaner, purer air and reduce indoor air quality (IAQ) problems.

Did You Know...

The average human breathes in about 16,000 quarts of air each day. And each quart of air has about 70,000 visible and invisible particles. The Environmental Protection Agency (EPA) notes that indoor air is often more polluted (typically two to five times more and occasionally 100 times more) than outdoor air. Most of the respirable dust and other particles people breathe into their lungs are approximately three microns or smaller – a fraction of the size of a grain of sand.

The Filtration Efficiency Equation

The first step in determining the best type of HVAC filter needed is to identify the types and sizes of particular pollutants in the building. Figure 1 shows sizes of various particles that may cause IAQ problems – from submicron smoke and fumes to larger dust particles.

Removal of all airborne contaminants is simply not practical in most facilities, so once problematic pollutants are identified, it's time to look at filter efficiency. Filtration efficiency defines how well the filter cleans indoor air by removing airborne particles.

Initial and sustained efficiency are the primary performance indicators for HVAC filters. Initial efficiency refers to the filter's efficiency "out-of-the-box," while sustained efficiency refers to efficiency levels maintained throughout the service life of the filter. Some filters have lower initial efficiency that will not increase until a "dirt cake" has built up on the filter – typically after approximately 30 days. Other filters offer both high initial as well as sustained efficiency, meaning they begin with the desired performance level and maintain that performance level over time.

Did You Know...

Low-efficiency filters (in the range of 25 percent efficiency) are typically used to keep lint and dust from clogging the heating and cooling coils of an HVAC system. Medium- and high-efficiency filters (up to 95 percent efficiency) are typically used to remove bacteria, pollen, soot and other small particulates.

ASHRAE HVAC Standards

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has developed two HVAC filter test standards that quantify the efficiency of filters. The ASHRAE 52.1-1992 standard measures:

- Pressure drop – how much air flow the filter restricts. A low pressure drop typically translates into higher energy efficiency. A high pressure drop means reduced air flow to the HVAC unit, requiring more energy to operate the unit.
- Arrestance – the amount of synthetic dust a filter is able to capture.
- Dust spot efficiency – a measure of the ability of the filter to remove atmospheric dust from the test air.
- Dust holding capacity – the amount of dust a filter can hold until a specified pressure drop is reached.

Tip: When evaluating dust holding capacity, it's important to compare dust holding capacities between filters at the same final pressure drop to make an accurate comparison.

The ASHRAE 52.2-1999 standard measures the fractional particle size efficiency (PSE) of an HVAC filter. This indicates the filter's ability to remove airborne particles of differing sizes between 0.3 and 10 microns in diameter. A Minimum Efficiency Reporting Value (MERV) rating is assigned to the filter media depending on the PSE in three different particle size ranges (0.3 to 1 micron, 1 to 3 microns, and 3 to 10 microns). The MERV rating is a numerical system based on minimum PSE. A rating of five is least efficient, while a rating of 16 is most efficient.

In addition to the performance factors measured under ASHRAE 52.1 and 52.2 standards, consider these additional variables when selecting a filter:

- Moisture resistance – how high humidity and moisture affect the filter.
- Temperature limitations – how the filter performs at application temperatures.
- Flammability – how the filter performs in flammability tests. Check to see if UL Class I or Class II rated filters are needed to conform to local building codes.

Tip: To make the right filter choice do not simply focus on MERV, as the MERV scale is non-linear. To make the best choice, review the Fractional Particle Size vs. Particle Diameter curve that is included with the test report. The curve will tell you the efficiency of the filter for the specific particle size you're interested in. Refer to Figure 1 to determine the size of the particles you are interested in capturing.

Filter Technology

There are many types of HVAC filters on the market today. In most buildings, the best filter choice is a medium-efficiency pleated filter (MERV 7-8), which has a large filter area. Keep in mind that large filter areas tend to be more cost-effective than smaller ones. Large filter areas mean lower pressure drop and greater contaminant-holding capacity. Lower pressure drop reduces fan energy requirements, and greater contaminant-holding capacity may mean fewer filter changes.

Advanced Synthetic Filter Media

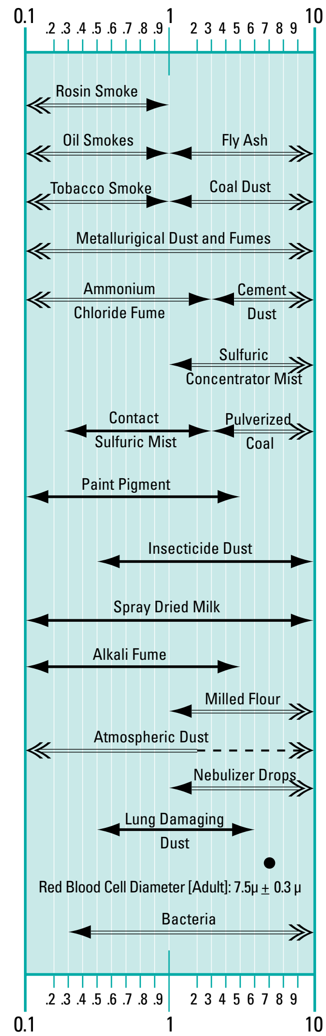
Pleated air filters used in HVAC systems are made with a wide range of materials (filter media), including fiberglass, polyester, paper and synthetic nonwoven materials. Recent advances in nonwoven technologies have allowed for improvement in both performance and value of synthetic filter media over the standard cotton/poly blends used for years in HVAC filters.

Unlike traditional cotton/poly media, the synthetic filter media in more modern filters can be made of thermally bonded, continuous, hydrophobic (moisture-repelling), polyolefin fibers that resist shedding and do not absorb moisture. This is important in resisting bacterial growth, and it keeps shed fibers from getting into the HVAC coils or into the air space of the building. Moreover, synthetic filter media can be manufactured without the use of chemical binders, meaning that humidity will not affect the web structure and will not cause the glue to soften, and thus the fibers to shed. Unlike cotton/poly filter media, which are made with a surface-loading structure, synthetic filter media can be made with a gradient density structure that provides a solid mechanical foundation to maintain high efficiency over the useful life of the filter.

Figure 1

Typical Particles & Dispersoids

[As per ANSI/ASHRAE Standard 62-1989]



Particle Diameter

microns (µm)

Electrostatic Charging For Better Efficiency

Synthetic filter media have another benefit over standard cotton/poly filter media: the ability to apply an electrostatic charge. This yields a higher initial efficiency and enhances the filter's capture efficiency, especially in the attraction of smaller diameter particles.

Electrostatic filtration is different than mechanical filtration, which depends on the size of the fiber, size of the particles being filtered and the physical structure of the filter media. With mechanical filtration, efficiency tends to build over time as particulates are collected, i.e. the filtration efficiency increases as the filter gets dirty.

With electrostatic filtration, filter fibers are charged, thus creating a force that attracts particles. This provides high initial efficiency, and when coupled with a strong mechanical structure, high sustained efficiency can be obtained.

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