**Changes in the Air Filtration Technology**

*by Henry Shir*

**A new generation of air filters gives  
managers more options when specifying to  
meet facility needs.**

Today more than ever, state-of-the-art air filtration technologies are being used to meet the challenges in a variety of commercial and institutional settings. The requirements for higher efficiency in these facilities have been driven by a concern for indoor air quality (IAQ).

For example, areas such as cleanrooms have always had stringent filtration requirements, while several innovative products have been developed for health care facilities to combat the transmission of tuberculosis.

Recent changes HVAC systems for facilities such as schools and office buildings formerly used filters with efficiencies in the range of 30 percent. Heightened concerns over IAQ, however, have led designers to specify filters with efficiencies in the 65-95 percent range.

These filters are typically cartridge type and are 12 inches deep. They require a separate section in an air handling unit. While these filters provide cleaner air, some also can impose a penalty on the energy used by fans, because they have increased resistance to airflow, especially when dirty, as compared to a standard 30 percent efficient throw-away filter.

Thirty percent filters typically are specified as prefilters for cartridge units to prolong the more efficient filter’s life. Some cartridge filters now are made with polypropylene rather than fiberglass filter media, which is said to decrease pressure drop.

Gas-phase adsorbers, such as carbon filters, formerly seen only in industrial applications are also being used more often in commercial and institutional facilities where outdoor air is contaminated by automobile or diesel fumes, paint vapors or other gaseous contaminants. The adsorbers typically are available in throw-away and reusable versions.

Absorbers often are installed in manufactured filter racks - they can be fitted to air handlers but typically are not a standard feature listed in manufacturer catalogs.

Managers and specifiers should consult with the filter manufacturer to determine the appropriate adsorbent for the type of contaminant to be protected against.

Potassium permanganate and alumina also are used in some filter applications, especially those involving formaldehyde and ethylene fumes. A throw-away filter should be used upstream of the adsorber to protect against particulates.

Another recent advance is to have a standard pleated air filter impregnated with activated carbon. This type of filter can fit in a standard filter rack and replaces standard throw-away filters. This development allows adsorbers to be retrofitted to standard commercial-grade air handlers and rooftop units.

**HEPA filters**  
Facilities with components such as clean rooms and laboratories have long required high-efficiency particulate (HEPA) filters. These filters are often supplied as HEPA filter diffusers in the ceiling. The diffuser has a laminar air flow pattern, which is suitable to handle the very high levels of airflow in these applications.  
The HEPA filter fits behind the diffuser face and is linked to the ductwork through a round connection. Maintenance managers and crews must be sure to carefully tighten draw bands between flexible ductwork and the HEPA filter diffuser’s neck. If the flex is not tightened adequately, the high static resistance of the HEPA filter will cause the flex duct to blow off, and the supply air will dump into the ceiling plenum. The seal between the HEPA filter diffuser and the ceiling system also must be fabricated to ensure that the appropriate cleanroom class will not be violated.

A recent development in HEPA filter ceiling diffusers is a product developed in Europe that imparts a swirl, rather than a laminar, flow pattern to the discharge air. The advantage of this type of diffuser is that there is no air movement noticeable at the work surface.

These diffusers are significantly more expensive than standard HEPA filter modules and are about 12 inches deep, which might make them unsuitable for some tight ceilings. The high costs of the swirl-pattern HEPA filters make it economical to use a cartridge filter as a pre-filter, rather than a standard throw-away filter.

HEPA filters also are used in industrial exhaust applications, such as radioactive fume hoods. The filters are typically housed in a weatherproof bag-in-bag-out filter housing and are changed through a thick PVC bag with ports for gloves. The bag prevents individuals changing the filters from coming into contact with contaminated media. The filter housings typically have doors sealed with a knife-edge fluid seal that provides an airtight closure to prevent contamination.

Final filters with efficiencies of at least 90 percent have been required for some years for air handlers serving hospitals. These final filters are also a requirement for outpsltient facilities that are built in accordance with the American Institute of Architects (AIA) Guidelines for Construction and Equipment of Hospitals and Medical Facilities. These guidelines have the force of law in some states.

The requirement for final filters significantly complicates the HVAC design of small outpatient facilities because the vast majority of commercial-grade DX rooftop units under 18 tons cannot accommodate final filters. Their fans typically cannot overcome the resistance of filters mounted downstream in the supply ductwork. As a result, an air handler with a separate chiller must be used, significantly raising costs.

HEPA filters also are used in hospital applications for operating rooms serving bone marrow transplant patients and those with compromised immune systems.

Some regular operating rooms also have HEPA filter ceiling modules installed, although this is not a requirement of the AIA guidelines. HEPA filters are used in medical exhaust applications where the exhaust streams are contaminated or radioactive. Bag-in-bag-out housings are employed as described above.

**Self-powered HEPA**  
Hospital and medical office waiting rooms more often are seeing a significant increase in the use of self-powered HEPA filters. The reason for the increase? The upsurge in the occurrence of tuberculosis (TB). The primary means of treating patients suspected of having TB is to confine them to isolation rooms, where maintaining negative pressure differentials is the primary means of confining the spread of bacteria.  
In waiting rooms, fan-powered HEPA filters are installed to draw room air over the filter and to supply the clean air back into the space. In some cases, the air may be ducted outside for exhaust.

These self-powered filters may be installed in the ceiling or in cabinet-style units. The latter type of filter often can be moved between rooms. Among the disadvantages of self-powered HEPA filters are noise level - caused by the fan having to move large amounts of air over the high resistance of the filter - and high energy costs. The filters, however, can be effective against some allergens and airborne viruses that are less dangerous than TB.

The future of air filtration will include the development of high-efficiency filters with lower pressure drops to decrease the energy penalty these filters presently impose. More effective filtration may allow conditioned outdoor air quantities to be reduced, which also will reduce energy costs for facilities.

**Suppliers See Ripple Effects from New Standard**  
A new standard from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is prompting air filter manufacturers to take notice.

The standard is 52.2P Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size, and manufacturers say the standard will have a ripple effect throughout the air filtration industry.

"By creating the standard, it raises the level of importance of filtration from a minimum efficiency standpoint," he says. "Therefore, the filter media manufacturers are having to create and maintain higher levels of efficiency for medium- to high-efficiency requirements in the HVAC industry."

The standard gives the efficiency of the filter when it is clean by particle size, from 0.3 to greater than 10 microns.

Charles Seyffer, national marketing manager for the Farr Co., says the standard will make the end user’s life much easier.  
"This standard will eliminate a lot of the confusion," Seyffer says. "You will know how specific that filter is to removing that contaminant. You can select the filter based on the size of the offending contaminant."

Doug Lange, west coast regional sales manager for Glassfloss Industries, agrees that the standard is important, adding that new pleated air filters are additional evidence of advances air filter technology.

"The pleated filters have been made with a blend of cotton and polyester materials to make the media," Lange says. "A new generation is being offered with electrostatic charging."

"Pleats are a bread-and-butter product, and this is a significant step toward better efficiency without restricting air flow. It costs a little more, but nothing significant."