Better indoor air through filtration

■ **Indoor Air Quality** ■ **Tests and Terms** ■ **Types of Filters**

Energy fact sheet **3**

Many people mistakenly assume the term *air conditioning* means strictly temperature control of the living space; however conditioning also involves controlling the humidity, distribution, *and* cleanliness of the air. Filtration is an excellent way to accomplish air cleaning and provide enhanced levels of comfort to the building occupants.

One of the hottest topics in today's construction arena concerns the issue of **I**ndoor **A**ir **Q**uality or IAQ. Controlling indoor air quality can be accomplished by three methods:

Source Control — eliminating or removing the cause of pollutants, such as moisture which can result in mold and mildew.

Dilution — controlled ventilation of outdoor air into the living space to dilute interior pollutants.

Extraction — filtration and cleaning of circulated room air.

While source control is the most important technique, *extraction or filtration* is perhaps the most under utilized of the three.

A *filter*, removes particles that are not visible to the human eye. Thus, the standard panel filters installed in a furnace or HVAC system are really "non-filters" from an IAQ standpoint because they only remove lint and other larger, visible particles (Simply pouring table salt through a new filter will demonstrate this). Their purpose is primarily to protect the air conditioning coils or blower motor of the HVAC system and their effectiveness at this task is marginal.

Filter Efficiency

The three commonly used methods to determine filter efficiency are:

1. **Weight-arrestance test —** Measures (by weight) how much dust has been removed by a filter. This test is misleading because it only tells how well a filter will remove relatively large and heavy particles, not the smaller particles found in common household dust (which can easily be inhaled into the lungs). A standard panel filter's 80% efficient arrestance rating sounds good but actually means very little.
2. **Atmospheric dust-spot test —** A highly useful test which measures a filter's ability to capture particles between 0.3 and 6 microns in size (a micron is one millionth of a meter; a human hair can be 50 microns in diameter). If a filter's advertisement claims "80% efficient by ASHRAE Standard 52-76," be sure to look for the words "atmospheric-dust-spot" and not "arrestance" to determine if it is a good filter or not. The common panel filter will only measure 3-5% on the atmospheric-dust-spot test.
3. **DOP-smoke penetration test —** A test only used for very high efficiency air filters—generally those that are rated above 98% efficiency on the atmospheric-dust-spot test. A special smoke-like gas is used to perform this test.

Kinds of Filtration

The most common HVAC or furnace-type **panel filters** are the disposable spun glass or fiberglass type and the washable "hog's hair" products. Both are inexpensive (between $0.50 and $5) and actually improve their filtering capability as they get dirty, ***but***, this is accomplished at the costly expense of restricting air flow. To avoid restricting airflow, they should be changed every 1 to 3 months.

Particle removal at various filter efficiencies

Atmospheric Dust-Spot Efficiency	Particles removed
10%	Good for capturing lint. Somewhat helpful for ragweed pollen. Not very good for smoke and staining particles.
20%	Fairly good at capturing ragweed pollen. Not very good for smoke and staining particles.
40%	Good at capturing pollen and airborne dust, some smudging and staining particles. Not very good for tobacco smoke particles.
60%	Very good for all pollens and most particles that cause staining and smudging. Partially helpful for tobacco smoke particles.
80%	Very good at removing smudging and staining particles, coal dust, oil smoke particles, and tobacco smoke particles.
90%	Excellent protection for all particles.

Source: Understanding Ventilation, John Bower, 1995

Electrostatically enhanced panel filters are more effective. These are typically 1-inch thick and have low airflow resistance so they can easily be substituted for a standard panel filter. These filters operate by employing pre-charged electrets - a plastic material with a permanent static charge. As the moving air flows past the filter material, the oppositely charged particulates in the airstream cling to the filter's fibers.

While electrostatic air filters are only fairly effective at capturing very small particles (1 micron or less), they are better than the standard panel, plus, they do a reasonably acceptable job with larger particles (>10 microns) such as mold spores and pollen. These filters typically cost around $9 to $50 but can last from 3 months to an entire season of heating or cooling.

Medium efficiency filters offer improvement by forcing the air to pass through smaller openings. However, this causes an increase in air restriction which is only somewhat overcome by creating more overall surface area by using accordion type pleating. These extended surface filters offer a longer service life, often up to a year, but are usually several inches thick and thus

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cannot be used to simply replace a standard 1" panel filter. They are supplied in a special housing that must be incorporated into the ductwork. There are lower priced pleated filters that will fit into the standard 1" track, however these are not as effective as the thicker (with greater surface area), medium efficiency ones and must be changed more often.

High efficiency filters

Pleated filters are taken to the next level in the HEPA-type filters. These state-of-the-art, *High Efficiency Particulate Air* filters are often found in hospital clean rooms, but some residential versions are available. For example, the **minipleat high performance HEPA-type** filter employs patented minipleating technology to create 193 square feet of media area in a 24″ square by 12″ thick filter cartridge. The result is reasonable air resistance and excellent filtration for up to several years of service. The replacement cartridge is around $160. This technique often employs some form of upstream pre-filtration to remove the larger pollutants, thus the larger, easy-to-capture particles won't waste the high efficiency media. The higher filtration of HEPA filters restricts air flow, so the HVAC blower must be designed accordingly.

Electronic air cleaners

Finally, **electronic air cleaners**, with an $800 to $1000 price tag, are available to achieve a premium level of high efficiency filtration. These devices, properly known as *electrostatic precipitators*, generate approximately 20,000 volts to give dust particles a static-electric charge. These particles are then attracted to oppositely charged metal plates (which must be periodically cleaned after the plates become full of particulates). Because the electrically charged plates can short-out and cause an annoying popping and snapping sound, pre-filtration is required. There are, however, no additional costs in terms of maintenance.