

Service Clinic: How to Maintain Air Filters for Optimum IAQ and Lower Operating Costs

Effective HVAC filtration is at the heart of indoor air quality (IAQ). It provides an important service in keeping indoor environments clean and free from the dust and particulates that may reduce productivity, affect the health of building occupants or cause other potential problems. However, it is important to remember that filters will only support good IAQ and perform as specified when they are maintained correctly.

Proper filter installation and maintenance are crucial to keeping HVAC ductwork clean. If dirt accumulates in the ductwork, and if the relative humidity reaches the dew point so that condensation occurs, then the ductwork can become a breeding ground for bacteria and mold.

For all of these reasons and more, it is important to establish the appropriate filter change-out frequency. However, in the event a filter becomes wet, if microbial growth is visible on the filter, or when a filter collapses or becomes damaged to the extent that air bypasses the media, you should consider changing out the affected filter(s) as soon as possible.

Filter Installation

After specifying the filter media and selecting a filter, it's important to pay close attention to proper filter installation. The goal is to avoid bypass air, which causes contamination in housings, coils, fans and ducts, thus increasing operating costs through inefficient operation and increased maintenance. Bypass occurs when filter media is not properly sealed in the filter frame, when filters are not properly installed and gasketed in filter racks, or when air handler doors and ducts are not properly sealed.

For high efficiency filters, small gaps around the filter or filter housing can decrease filter performance and affect IAQ, and large gaps substantially decrease filter performance. For a 1 mm gap, bypass flows may be less than 5 percent of the total flow; for a 10mm gap, bypass flows can increase to 25-35 percent of the total flow. Because higher efficiency filters also typically have a greater airflow resistance, bypass air tends to have a larger effect on high performance filters. (Ward, Siegel)

The net result of bypass air is a reduction in MERV (Minimum Efficiency Reporting Value – a filter rating system based on the filter's ability to remove airborne particles of different sizes). For example, models have shown that a 1mm gap causes a MERV 15 filter to perform as a MERV 14 filter, while a 10mm gap (slightly



larger than the diameter of a pencil) results in the MERV 15 filter performing as a MERV 8 filter. (Ward, Siegel)

Reduced filtration efficiencies may allow harmful particles to enter the breathing air. Lung-damaging dust can be as small as 0.5 micrometers, making high filtration efficiencies critical to providing for safe and healthy indoor air. For example, gaps in and around filter banks and heavy soil and debris upstream of poorly maintained filters have been implicated in healthcare-associated outbreaks of infectious diseases.

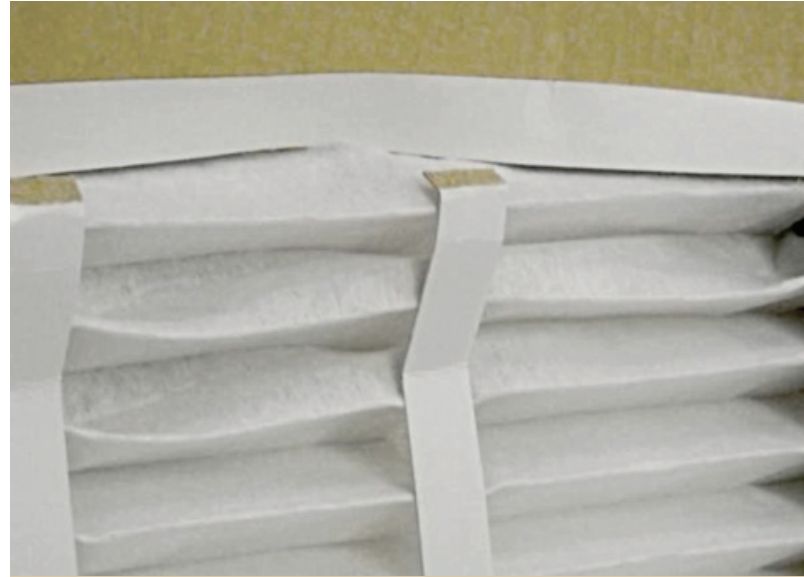
The best way to avoid bypass air is to make sure that all the air in the system goes through the filter. To avoid problems later on, consider these tips:

- Check for filter media damage such as rips or holes and replace damaged filters.
- Make sure media is sealed in the frame to avoid bypass air.
- Install the filter according to the air flow direction indicated on the frame.
- Ensure that the filter fasteners are in place and correctly installed, especially if filters are serviced from the downstream side.
- Check to ensure that the bank of filter frames is rigid and well reinforced to avoid collapse.
- Caulk any cracks between filter frames or between the bank of frames and the duct wall to prevent leaking of unfiltered air.
- Pay special attention to filter holding frame seals, gaskets and filters that don't match the filter holding frame size – all of which can cause bypass air.

Filter Monitoring

After filters are installed and operating, they should be monitored and maintained to provide maximum filtration, while not overtaxing the supply fan capability, which can lead to filter “blow-out” situations with no air filtration. Scheduled maintenance or established pressure drops can be determining factors, along with specific variations in environmental conditions such as humidity and seasonal changes.

A differential pressure measurement device can be installed across the filter bank to identify the appropriate change-out times. Pressure drop switches may be used to provide an alarm input to a Building Automation System that alerts operators to change the filter. Don't rely on a visual inspection alone, since medium- and high-efficiency filters that appear “dirty” often have not reached their optimum efficiency levels due to depth loading.



QUICK TIP:
IF THE FILTER LOOKS LIKE THIS OUT OF THE BOX, DON'T INSTALL IT.

In fact, filters should appear dirty; this is a good indication they are doing their job.

As a filter loads up with particles, it becomes more efficient at particle removal, but increases pressure drop through the system, thus reducing air flow while consuming more energy. All filters – if loaded to excess – will become deformed, unload dust, and even “blow out” of their filter rack. When filters blow out, bypass of unfiltered air can quickly lead to problems such as clogged coils and dirty air ducts. Flow capabilities of the system fan may also be affected.

Filters should be monitored for bacterial growth. It's a good idea to remove selected filter elements periodically and send them to a lab for testing when bacteria growth is found.

Make the Job Easy

Using an HVAC filter that has depth-loading media with a density gradient structure can help to reduce airflow resistance, enhance dust loading and prevent face loading of the filter – all of which help make maintenance easier and less time-consuming. When choosing pleated filters, select those that contain an expanded metal backing, which keeps the pleats and media stable during use, especially when the filter begins to load.

Some filter manufacturers use a two-color filter media construction to help in installation by making it easy to see that, for example, the gold side faces upstream while the white side faces downstream.

Another tip for making the job of managing filter maintenance easier is to place labels on the housing units with information such as the number and type of filters, date changed, as well as initial and final pressure drop. Air handlers that are located in difficult-to-access places will be more likely to suffer from poor air filter maintenance as well as overall poor maintenance. Therefore, consider making appropriate equipment changes such as quick release and hinged access doors versus more time-consuming bolted access panels when security is not an issue.

Check the Details

When changing the filter, make sure that the replacement filter is of the correct size and compatible with your housing. Review the performance value of the filter to ensure the pressure drop across the filter will not be too great, especially as the filter loads. The greater resistance will negatively impact the unit's heating/cooling efficiency and energy efficiency.

Protect the HVAC System and Occupants

If schedules allow, time filter change-outs so they occur when the facility is unoccupied. This will help to avoid problems associated with disruptions in the HVAC system and possible distribution of particulates that may occur as dust-loaded filters are disturbed.

Bottom line for Building Professionals and HVAC Contractors:

Pay special attention to proper filter installation techniques to avoid bypass air, which can negatively affect indoor air quality and HVAC system operations. Superior IAQ pays dividends in terms of better occupant health and productivity, while efficient HVAC system operations can help reduce energy and maintenance costs.

Bottom line for Air Filter Manufacturers and Distributors:

Continue to educate your end-users about the importance of proper filter installation. Proper installation helps ensure the filter performs at advertised MERV levels while providing the end-user the full value and benefit of their purchase. Providing this type of education will help bolster your customer relationships and add value to the products you offer.

If it's not possible to time filter change-outs so they occur when the facility is unoccupied, it is critical to turn off the supply fans to prevent debris from entering the ductwork downstream of the filters. Similarly, the entire filter area should be cleaned and washed down while fans are off. Use a clean rag instead of compressed air to wipe dust from the inside of the filter housing and around gasket surfaces. When removing a used filter, take care to avoid dropping contaminants in the ductwork.

At the end of the day, it is important to follow the recommendations of the filter manufacturer to determine the proper procedures and frequencies for maintaining and changing filters. And don't forget to fully document all inspections and corrective actions.

For further help and guidance in HVAC filter installation and maintenance, the National Air Filtration Association offers several resources, including a manual titled *Installation, Operation and Maintenance of Air Filtration Systems* (3rd Edition, 2012), the *NAFA Guide to Air Filtration* (4th Edition, 2007), and the NAFA Certified Technician (NCT) Program, which is available to service companies and in-house HVAC professionals. For more information on these programs, visit www.nafahq.org.



Reference

Ward, M. and Siegel, J.A., "Filter Bypass: Implications for Filter Efficiency," *ASHRAE Transactions*. 111(2), 1091-1100.