viledon®

VILEDON® AIR FILTRATION IN COMMERCIAL APPLICATIONS

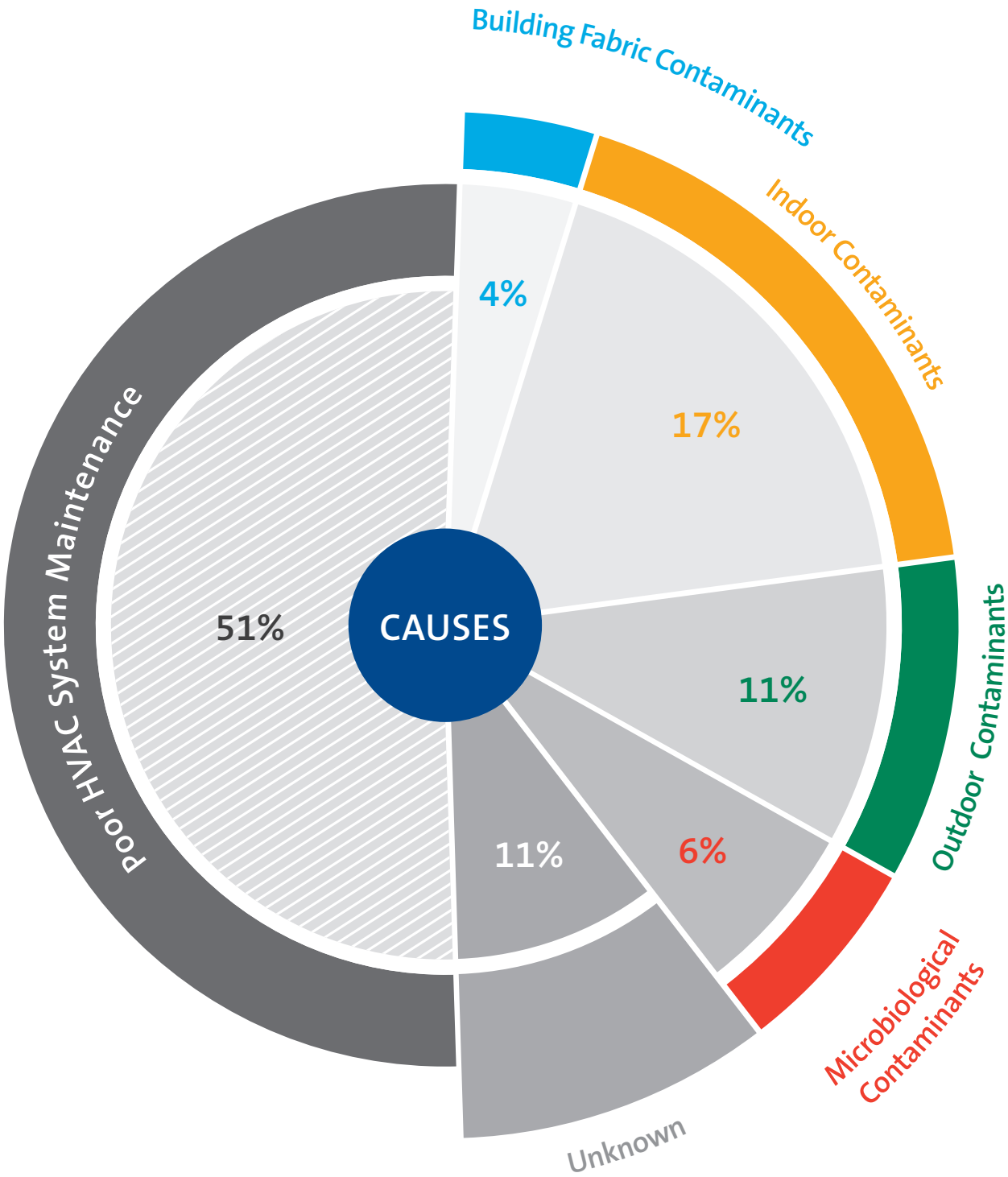
FREUDENBERG
FILTRATION TECHNOLOGIES

FREUDENBERG
INNOVATING TOGETHER

INTRODUCTION: USING THIS GUIDE

This guide is meant to be used as a reference tool and describes contaminants found in commercial buildings. In this guide, Commercial Buildings refers to any building in which commerce takes place. The guide also summarizes key sections of pertinent building codes, their filtration requirements, and other factors that should be considered when choosing air filters.

THE MOST COMMON CAUSES OF INDOOR AIR QUALITY COMPLAINTS



THE ROLE OF AIR FILTERS

Air filters are commanding new and expanded roles in today's tight, energy efficient buildings. Where previously air filters were only installed to protect mechanical equipment, filters are now being installed to protect personnel and customers. This is mainly due to recent Indoor Air Quality (IAQ) concerns that have pushed filtration to the forefront. For many building owners, improving filtration has been stressed as a high priority issue. Apart from the concern for the health of the building users, there are tremendous economic considerations as well. The United States Environmental Protection Agency (EPA) provided the following estimates on the effect of IAQ problems on our economy:

- The United States alone spends more than $1 billion in direct medical costs.
- The United States economy loses $60 billion annually due to decreased productivity and increased absenteeism. This is much more than the $4.7 to $5.4 billion annually due to non IAQ related major illnesses.

Today, high quality filtration must be used to protect building users from airborne particulate and microorganisms that can cause sickness, dizziness and allergic reactions. Air filters are the first line of defense and must perform the following functions:

- Prevent microorganisms and particulate from entering the system.
- Protect building users from recirculated air that has been contaminated by microorganisms which may have either grown in the building or entered through unfiltered openings.
- Arrest particulate from the air, thereby removing a transport mechanism for smaller microorganisms and protecting equipment from damage.

THE EFFECTS OF TYPICAL INDOOR AIR CONTAMINANTS

WHAT EFFECTS CAN THESE CONTAMINANTS HAVE?

When particles enter HVAC systems, they can affect both the cleanliness & efficiency of the system as well as the health & comfort of the building users. Until these particles are removed from the building, the building as a whole is at risk whether bacterial, fungal or dust related. Proper filtration captures these particles at the inlet, preventing them from entering and affecting the system. However, when inefficient, poor quality filters are used, particles penetrating the building's first line of defense can have the following negative impacts:

HEALTH & COMFORT

Infectious Disease—In commercial applications, the risk of transmitting infectious diseases is low. However, this can be a problem for immune compromised individuals like asthmatics, chemotherapy patients, organ transplant recipients and the HIV infected.

Allergic Illness—This is the most common reaction, and persons with allergic illnesses will tend to have decreased productivity. The symptoms usually exhibited are sneezing, itching of nose and eyes, nasal obstruction and congestion, fatigue, irritability, depression, dermatitis and asthma.

Toxic Reactions — Although these are rare, they can be very dangerous. Toxic effects can range from skin or eye inflammation up to central nervous system and respiratory tract disorders.

CLEANLINESS AND EFFICIENCY

Coil Efficiency—Fouling of cooling coils is usually a substantial hidden cost of poor filtration. Therefore keeping the air side of the coil clean is extremely important. Even a small amount of dirt can decrease the efficiency of the coils, e.g. a 0.036" thin layer of dust built up on the coils can reduce heat transfer by as much as 33%.

Fan Efficiency—Fan performance is negatively affected when the blades are dirty. As the fan blades become soiled, they increase in weight and more energy must be used. In addition, smaller particles adhere to the blades (fouling) and disrupt the aerodynamics of the blade, while larger particles wear at the blades (erosion).

Duct Cleanliness—Dirty ductwork can become a breeding ground for microorganisms. This is especially true for humidified and lined ductwork.

Area Cleanliness—Particulate that penetrates filters can soil diffusers, ceiling tiles, walls, floors and office furniture. Not only will these have to be cleaned, but until they are cleaned, their appearance reflects negatively on the occupants.


SAFETY
FIRST
@ FREUDENBERG
FILTRATION TECHNOLOGIES

PREVENTING THE GROWTH OF MICROORGANISMS IN HVAC SYSTEMS

Most microorganisms thrive in environments like commercial buildings which often provide the perfect conditions for growth. To grow, microorganisms need the following conditions:

- **Oxygen** — A necessary part of most chemical reactions, although some microorganisms are anaerobic.
- **Food** — Usually traces of formed carbohydrates are required, although some microorganisms only require inorganic nitrogen sources like filter media binders to grow. This may be why we see growth on fiberglass filters and not on synthetic filters.
- **Temperature** — Most microorganisms grow best between 64*F and 90*F. Temperatures exceeding 160*F are generally lethal.
- **Moisture** — When substrate moisture is limited, a relative humidity exceeding 65% is generally essential.

To prevent the growth of microorganisms, one of these ingredients must be removed from the growth circle. As soon as the circle is broken, most microorganisms will not grow.

To be effective, microbiological control practices must be an integral part of maintenance activities. Decontaminating HVAC systems is time consuming, expensive and the effects are only temporary. The following strategies should be employed as part of an effective maintenance and control program:

1. **Use high quality filters to prevent the introduction of outdoor aerosols;**
2. **Eliminate sources of water**
3. **Eliminate sources of microbial growth**
   - Disinfect surfaces
   - Remove dirt with vacuums equipped with high quality filters.

CHOOSING THE RIGHT FILTERS

WHAT DO THE BUILDING CODES SAY?

Any renovation, new construction, or maintenance project requires adherence to prevailing state and local building codes. Except for states that either write their own or have no state-wide code (municipal jurisdiction only), the majority of building codes are modeled after one or more of the national codes (BOCA National Mechanical Code, ICBO & IAPMO Uniform Mechanical Code, or the SBCCI Standard Building Code). However, since these documents are meant to be basic mechanical codes, for the vast majority of commercial applications, these codes contain no specific information on filtration efficiency. To find additional requirements, federal and state regulations must be consulted, and usually, they refer to the following documents:

- **ASHRAE Handbook** — HVAC Systems and Equipment, Chapter 29, Air Cleaners for Particulate Contaminants
- **ASHRAE Standard 62.1-2016** — Ventilation for Acceptable Indoor Air Quality

FILTER TEST STANDARD ASHRAE 52.2-2012

The 52.2-2012 test standard uses particle size efficiency to classify filters. Filters are grouped in 16 different MERV (Minimum Efficiency Reporting Value) classes based on their capability to remove a certain percentage of specific size particles (particle size efficiency). Particle size efficiency testing is conducted on a new filter with a synthetic dust and again after loading in increments up to a predetermined final pressure drop. The particle size efficiency is measured for 12 different particle sizes between 0.3 and 10 microns with artificially generated Potassium Chloride aerosol. The rating of the filter is based upon the minimum efficiency measured in the test.

Minimum efficiency values are calculated for 3 different particle size ranges:

RANGE 1: 0.3 – 1.0 MICRONS
RANGE 2: 1.0 – 3.0 MICRONS
RANGE 3: 3.0 – 10 MICRONS

The minimum efficiency is reported as the MERV (Minimum Efficiency Reporting Value).

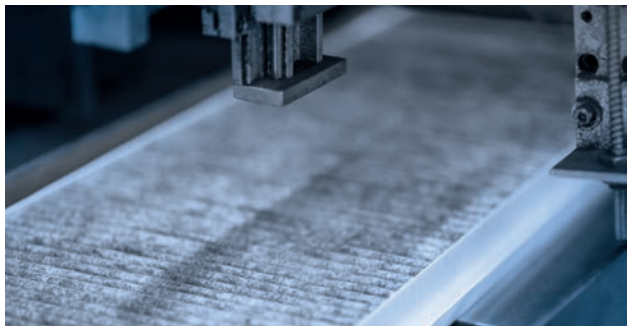
The test report shows the initial efficiency at 1968 CFM per filter element.

The ASHRAE 52.2 test, however, does not address present day operational characteristics of mechanical systems. The test is carried out at constant volume airflows and makes no allowance to evaluate filter efficiencies in daily shut down and start up, variable air volume or variable frequency drive installed applications.

WHAT IS SICK BUILDING SYNDROME?

In a nutshell, Sick Building Syndrome (SBS) is a term used to describe a building in which occupants are suffering from a variety of symptoms, but no particular cause can be found.

IMPORTANT CHARACTERISTICS FOR FILTERS IN COMMERCIAL BUILDING APPLICATIONS



ASIDE FROM THE MINIMUM EFFICIENCY REQUIREMENTS DICTATED BY THE BUILDING CODES, FILTERS INSTALLED IN COMMERCIAL APPLICATIONS SHOULD HAVE THE FOLLOWING ADDITIONAL CHARACTERISTICS:

1. **High Efficiency** — Filters used in general HVAC systems should demonstrate immediate high efficiency without undue burdens of pressure drops to the system.

2. **Low Energy Requirements** — Filters with high efficiencies and low pressure drops use less energy to operate, resulting in significant energy savings.

3. **Long Service Life** — Fewer change outs and less frequent maintenance checks mean less chance of contamination and better use of manpower.

4. **Non-Shedding Media** — A filter should not shed fibers or binders to the airstream. Respirable fibers can be dangerous and can transport bacteria.

5. **High Particle Retention** — Once particles are captured, they should not be released back into the airstream.

6. **Moisture Resistant Materials** — Air filters are often subject to wetting and drying cycles during their lifetimes. While low levels of moisture do not usually present many problems, high levels of moisture can have the following undesired effects on filters:

   - The pressure drop will increase and the efficiency will decrease
   - The fibers can mat with air/wet-laid microfiberglass
   - The weight of the filter media will increase
   - The binders may begin to dissolve
   - The moisture will promote the growth of fungi
   - Metal parts may start to corrode or oxidize

   While any filter subjected to excess moisture will show some negative effects, care should be taken to choose filters that have been engineered to minimize these effects.

7. **High Degree of Structural Integrity** — A bag filter should not develop holes, rips, or blowouts while in use. Mini pleated extended surface filters should not fail because of moisture or fracture on the pleated edge. This is especially critical when supplying air to surgical operating suites and air recirculating systems.

8. **Retain Particulate During Change outs** — A filter that releases most of the captured particles back into the supply plenum during change out is of little use. Such occurrences can add endanger service maintenance personnel.

9. **Filter Media Should Be Safe to Handle** — No special handling or maintenance procedures should be required to install or service filters. File and read MSDS Sheets for all air filters used.

10. **Microbial Resistant Media** — Media should be manufactured free from any media binder systems used to chemically bond or fuse the fibers together; binders typically promote microbial growth as they are a food source.

11. **GREENGUARD® Certified** — All filter products should be certified by Greenguard® to insure harmful V.O.C.'s are not emitted from the product that can travel downstream of the filter. **www.greenguard.org**.

WHAT IS GREENGUARD®?

GreenGuard® Environmental Institute (GEI) is the world's largest guide for selecting non or low emitting products and materials.

GEI is an industry-independent, not-for-profit organization that is not affiliated with any manufacturer or product.

GEI was founded with the mission of protecting human health and quality of life by reducing chemical exposure and improve indoor air quality.

GEI oversees third party certification programs that identify acceptable product emission standards and certifies low emitting and microbial resistant products.

The GreenGuard® IAQ certification program offers assurance that products designed for use in indoor spaces must meet stringent chemical emission standards based upon established criteria from key health agencies.

Achieving GreenGuard® Certification gives credence to manufacturer's sustainability claims by backing those claims with irrefutable scientific data from an unbiased, third party organization.

VILEDON® Air Filter Products are the ONLY air filter products which have attained GreenGuard® Certification.

UL 900 CLASS 1 OR CLASS 2? WHAT'S THE DIFFERENCE?

One of the most commonly asked questions during any discussion about air filters usually regards the filter's UL 900 classification. The UL 900 classification of an air filter is a measure of the manner in which a clean filter burns when exposed to a flame. The UL classifications are defined as follows:

CLASS 1

Those that, only when clean, do not contribute fuel when attacked by flame, and emit only negligible amounts of smoke. A Class 1 air filter unit shall not produce flame or sparks when subjected to the flame exposure and spot flame tests, and during the flame-exposure test, shall not cause the development of an area of more than 9 in2 as measured below the smoke-density time curve.

CLASS 2

Those that, only when clean, burn moderately when attacked by flame or emit moderate amounts of smoke, or both. A Class 2 air filter unit shall not produce flame or extensive sparks which are sustained beyond the discharge end of the test duct when subjected to the flame exposure test.

The present UL Class 1, and Class 2 designations will no longer be effective as of.... After this date UL Classification for air filter products will be documented simply as UL 900 Classified. The reason to remove the separate classifications is that a low filter may have a class designation when clean, it fails to maintain it's Class 1 rating as the filter load with dust. A dust loaded filter cannot obtain UL 900 Class 1 rating.

WHAT IS LEED?

LEED (Leadership in Energy and Environmental Design) consists of voluntary, internationally recognized, market-driven Green Building Rating Systems developed by the US Green Building Council that defines high performance green buildings which are healthier, environmentally responsible and more profitable structures. The systems evaluate environmental performance from a whole building perspective over a building's life cycle providing a definitive standard for what constitutes a green building in design, construction and operation.

THE LEED RATING SYSTEMS ARE DESIGNED FOR RATING NEW AND EXISTING COMMERCIAL, INSTITUTIONAL AND RESIDENTIAL BUILDINGS AND INCLUDE THE FOLLOWING CATEGORIES:

New Construction (LEED-NC)

(Includes LEED for Commercial Interiors, LEED for Core and Shell Development, LEED for Healthcare, LEED for Schools)

LEED-NC was developed for application to new construction and major renovation projects. Projects include office buildings, government facilities, hospitals, laboratories, schools and universities and sports arenas.

Existing Buildings (LEED-EB)

LEED-EB was developed for application to existing buildings and addresses the operations and maintenance phase of the building's life cycle including facility upgrades and performance improvements. Certification and re-certification create an incentive for maintaining optimal performance for long-term cost savings and increased occupant health and productivity.

LEED-NC AND LEED-EB LEVELS OF CERTIFICATION:

LEED has four levels of certification which measure achievements in green buildings based upon the number of points awarded to a project.

CERTIFIED: 40–49 points **SILVER: 50–59 points** **GOLD: 60–79 points** **PLATINUM: 80+ points**

Each rating system is organized into 5 environmental categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, materials and Resources and Indoor Environmental Quality. Additional categories Innovation in Design and Regional Priority may be utilized to gain extra rating system points.

Proper selection and installation of air filter products can be utilized towards achieving desired LEED certification level.

GAS PHASE FILTRATION

Many buildings have fresh air intakes located close to truck delivery areas, bus loading areas, etc. resulting in offensive odors entering into interior spaces. In addition to the expanded role of high efficiency air filters for particle removal is the emergence of gas phase filter products to capture these unwanted gases and prevent them from entering or being re-circulated in indoor spaces. Common gases found in urban environments that require elimination are Volatile Organic Compounds (VOCs), Acid Gases, and Formaldehyde. The most effective method to remove these gases is to install carbon sorbent media filters in the HVAC air intakes. The gases attach to the exposed surfaces of the carbon sorbents are adsorbed and removed from the airstream before entering the interior space.

Standard activated carbon is very effective in removing VOCs but air containing a combination of VOCs, Acid Gases, and Formaldehyde require the installation of a blend of activated and impregnated carbons.

As VOCs, Acid Gases, and Formaldehyde are adsorbed by the carbon sorbents the adsorption capacity and life expectancy levels increase proportionally as the total surface area exposed to the gases is increased. A high concentration of small particle size carbon sorbents demonstrates significantly greater surface area than larger sorbent particles offering equivalent adsorption efficiency and life expectancy while requiring only a fraction of the weight.

All Viledon® gas phase products incorporate highly concentrated small particle size carbon sorbents.

SMALL PARTICLE SIZE SORBENTS	VS	US STANDARD PARTICLE SIZE SORBENTS

Small Particle Size Sorbents Offer:

- Many times more surface area to weight ratio
- Same Surface Area:
  - — Less Weight
  - — Equivalent Adsorption Capacity
  - — Equivalent Life
  - — Greatest Cost Performance

Note: the collection mechanisms for particle filtration and gas phase air cleaning are entirely different, however products are available that can arrest both particulate in one duel stage filter.

ENERGY CONSUMPTION FOR HVAC FILTERS

Energy costs are the most overlooked facet of filter purchasing. Energy costs can far exceed filter purchase costs.

Air filtration products offer a significant resistance to air flow due to the density and composition of the media and the design of the product. Even though products may appear to be similar, their energy losses over an operating cycle may vary. Using the formulas below, it is possible to evaluate energy requirements and costs in order to compare different filter products under identical operating parameters.

THE FOLLOWING FORMULATION IS USED IN THE CALCULATIONS: (1989 ASHRAE Handbook-Fan Horsepower)

Average pressure drop over the life of the filter:
Initial Static Pressure ("W.C.) + Final Static Pressure ("W.C.) divided in half = Average Static Pressure Drop ("W.C.)

Required Horsepower:
Average Flow Rate (cfm) X Average Static Pressure Drop ("W.C.) = Total Horsepower

Energy Consumption:
Total Horsepower X Hours of Operation X 0.746 kW/HP = Kilowatt Hours (kWh)
*746 watts per horsepower or 0.746 kW per horsepower

Energy Cost:
kWh X Cost of Electrical Power (in dollars/kWh)+ kWh x Demand Charge (in dollars) = Estimated Cost of Operation (in dollars)

Notes: Evaluation will be more accurate if fan, motor and drive efficiencies can be obtained for each specific air handling system.

THE TRUE COST OF HIGH QUALITY FILTERS

The true cost of a filter is much more than its initial purchase price. There are many other factors that should be considered, Example; A customer desires to replace twenty 2" 30% pleated prefilters and 80% fiberglass bag filters with a single stage Viledon® T60 filter. The service life of the pleated filter is 4 months; the service life of the fiberglass filter is 1 year; and the T60 is 2 years. What is the true cost?

Initial Purchase Cost — The initial cost of the filters installed is determined by multiplying the number of changes necessary for a 2 year period by the purchase price per filter.

Installation Cost — Each replacement of a filter bank results in labor expenses. Many times this is done by an outside contractor. Each replacement requires transporting filters to the unit, changing filters, and hauling the old filters away for disposal.

FILTER INSTALLATION & MAINTENANCE TIPS — HOW TO PROTECT YOUR INVESTMENT

- Install filters correctly. Poorly fitting filters and pinched filter pockets create gaps that allow unfiltered air to pass through and decrease the filter's efficiency. Four filter holding clips are recommended to hold the filters securely in place. To hold the filter without warping, the clips should be placed at 2 o'clock, 4 o'clock, 7 o'clock, and 10 o'clock.

- Use proper gasketing. Install gasketing on the filters and not on the holding frames. With gaskets applied on the filter, new gaskets are automatically used each time the filter is replaced. Never again will the gasketing have to be checked or replaced before a change-out. Also, for side access systems, always ensure that gasketing has been applied to one of the edges between the filters.

- Seal all access openings. This is especially critical for negative pressure areas.

- Avoid using duct tape. Duct tape is only a temporary solution. When subjected to constant air flows, it will quickly lose its effectiveness. It is better to take the time to use the proper gasketing or sealant.

- Look for moisture. Perform regularly scheduled checks for condensed moisture, and prime the traps for condensate pans and floor drains. Standing water can become a breeding ground for microorganisms.

- Install filler pieces to seal gaps. If the filters do not fit snugly, use pieces of metal, polystyrene or urethane foam to close gaps.

- Replace missing hardware. Holding clips, screws and caulking on sheet metal sections and panels should be replaced as required.

- Secure a permanent record to the air handler. A record that specifies when the filters were changed and inspected should be adequate.

Editorial Information

Freudenberg Filtration Technologies, L.P.
2975 Pembroke Road, Hopkinsville, KY, 42240, USA
Phone 1 (800) 542-2804 | Fax +1 (270) 890-0743
info-us@freudenberg-filter.com | www.freudenberg-filter.us

Freudenberg Filtration Technologies, Inc.
649 Wilton Grove Road, London, ON, N6N 1N7, Canada
Phone +1 (519) 686 9888 | Fax +1 (519) 686-4533
info-cananda@freudenberg-filter.com | www.freudenberg-filter.us

Freudenberg Filtration Technologies, S.A. de C.V.
Blvd. Aeropuerto 1811 Bodega 10, Col. San Carlos
León, Gto, CP 37670, México
Phone +52 (477) 740-9999 | Fax +52 (477) 740-9999 Ext. 117
info-mex@freudenberg-filter.com | www.freudenberg-filter.us

May 2016

FREUDENBERG
FILTRATION TECHNOLOGIES

FREUDENBERG
INNOVATING TOGETHER