

# Air Filter Presentation

Prepared for

***ASHRAE***

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# Speaker

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**Experience:** 33 years of technical, sales and marketing experience in the air quality, activated carbon and air filtration industries.





# 60 Minute Agenda

1. History American Air Filter
2. Need for Particulate Filtration
3. ASHRAE Filtration Product Review
4. High Purity Air Filtration Product Review
5. HELIOR™ PTFE Media/ MEGAcel™ I Filters
6. Gas-Phase Filtration
7. Green Building / LEED®

# History

- Founded in Louisville, KY in 1921 by Bill Reed.
- AAF is recognized as a World Leader in Air Filtration Products and Systems offering the most comprehensive clean-air solutions in the world today.
- Today, AAF has 21 factories and 5 R&D Centers worldwide employing over 3000 associates.



# Group Structure



NIPPON MUKI CO., LTD.

**Air Filtration**

**McQuay**  
International

**HVAC Systems**

**AAF**  
INTERNATIONAL

**Air Filtration**

**J&E Hall**  
International

**Refrigeration**

Air filter products



Clean room equipment



Applied inorganic products



# Global Manufacturing



## Americas

- **Louisville, KY, USA, Head Quarters.**
- Elizabethtown, PA, USA
- Atlanta, GA, USA
- Lebanon, IN, USA
- Columbia, MO, USA
- Fayetteville, AR, USA
- Ontario, CA, USA
- Dallas, TX, USA



## Europe

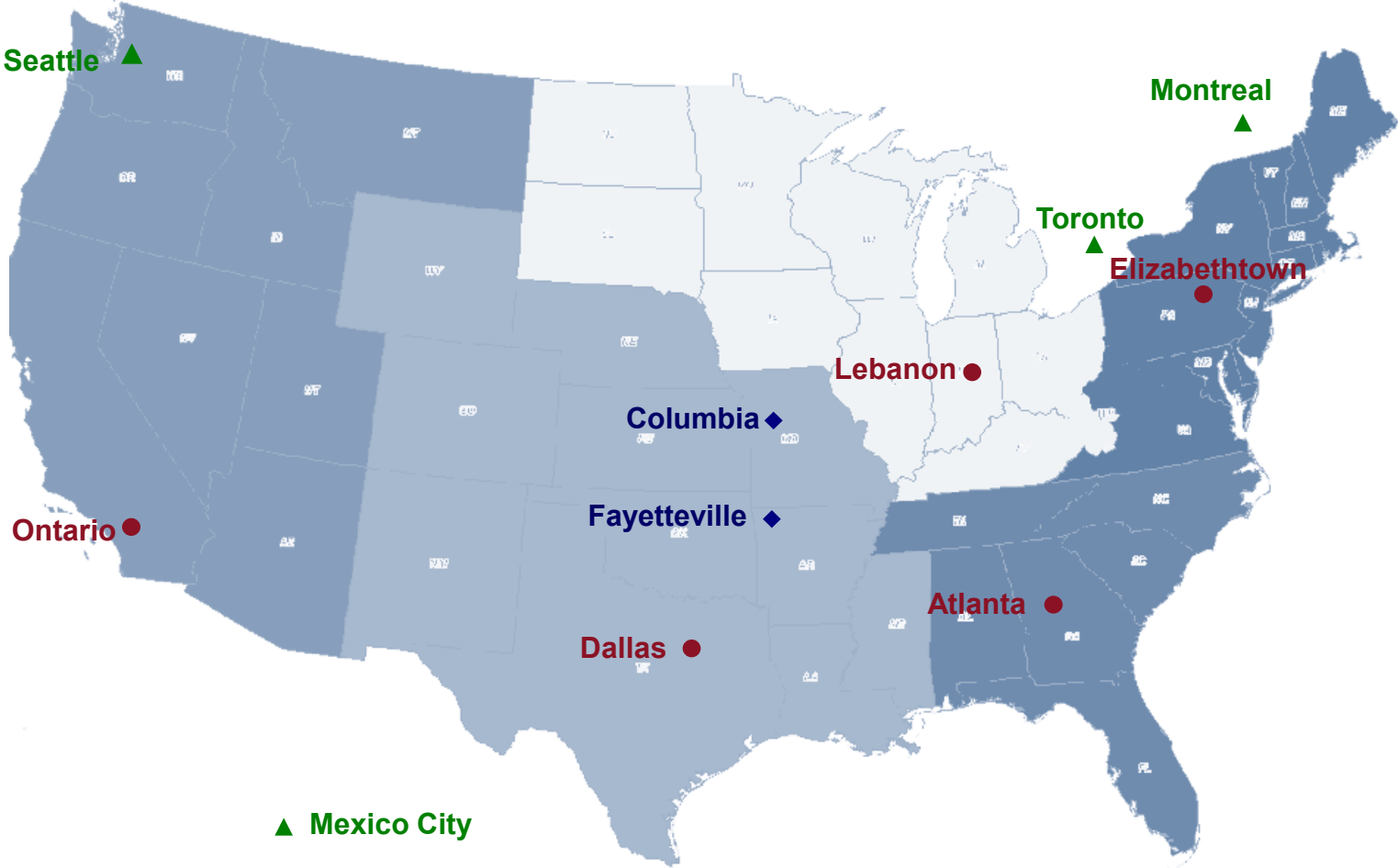
- Cramlington, UK
- Gasny, France
- Vitoria, Spain
- Ecoparc, France
- Novo Mesto, Slovakia
- Emmen, The Netherlands



## Asia

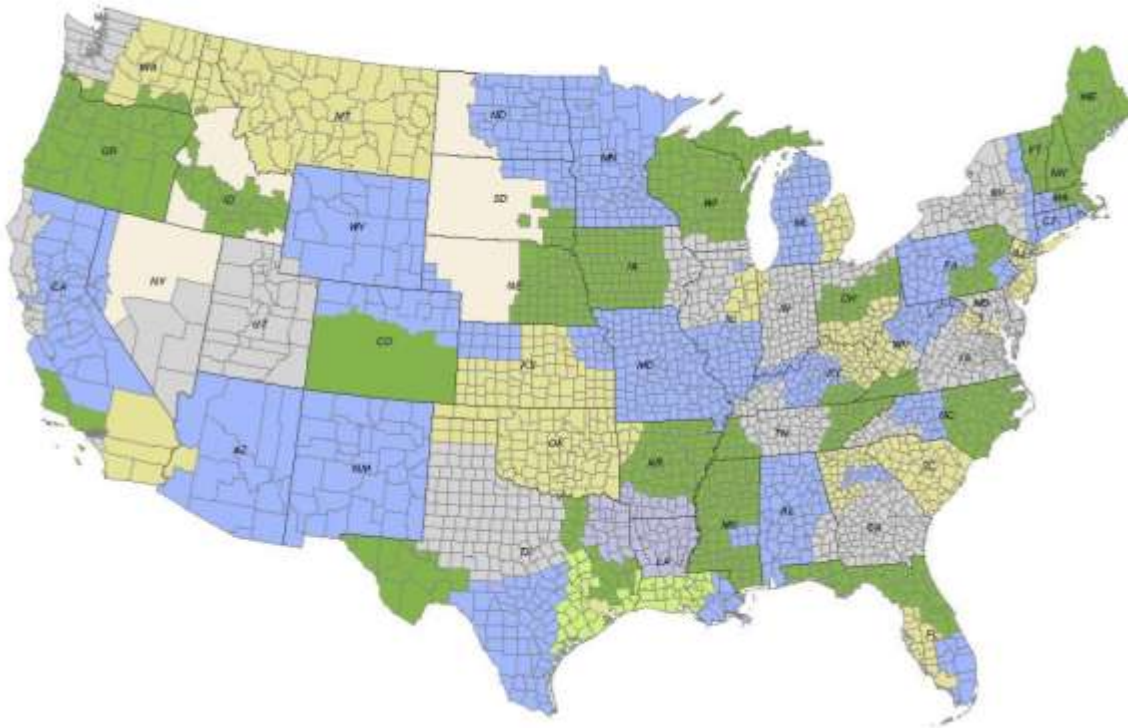
- Wuhan, China
- Riyadh, Saudi Arabia
- Shah Alam, Malaysia
- Suzhou, China
- Shenzhen, China
- Taiwan
- Karnataka, India

# Production Facilities



- Manufacturing and Customer Service Super Centers
- ◆ Specialty Products Manufacturing
- ▲ Distribution Centers

# Sales and Marketing Support



## Field Sales Force:

Director of Sales

Seven Regional Sales Mgrs

- Canada – 7 District Mgrs
- Mexico – 4 District Mgrs
- Northeast – 10 District Mgrs
- South – 13 District Mgrs
- Mid-States – 14 District Mgrs
- Southwest – 10 District Mgrs
- West – 10 District Mgrs

## National Accounts:

Director of National Accts

- National Acct Mgrs – 5
- Wholesale – 3
- OEM – 3
- Engine Filtration - 2

## Product Support Teams:

- Gas Phase - 7
- PTFE – 1
- Filtration Solutions - 3



# The Need for Particulate Filtration



*When selecting a filtration solution, energy savings plays a major roll with the cost of a kWh up substantially! AAF International will provide good, better and best filtration solutions to assist you in specifying the correct filtration products to fit your clients' air filtration and energy consumption needs...*

# Why is Particulate Filtration Necessary?

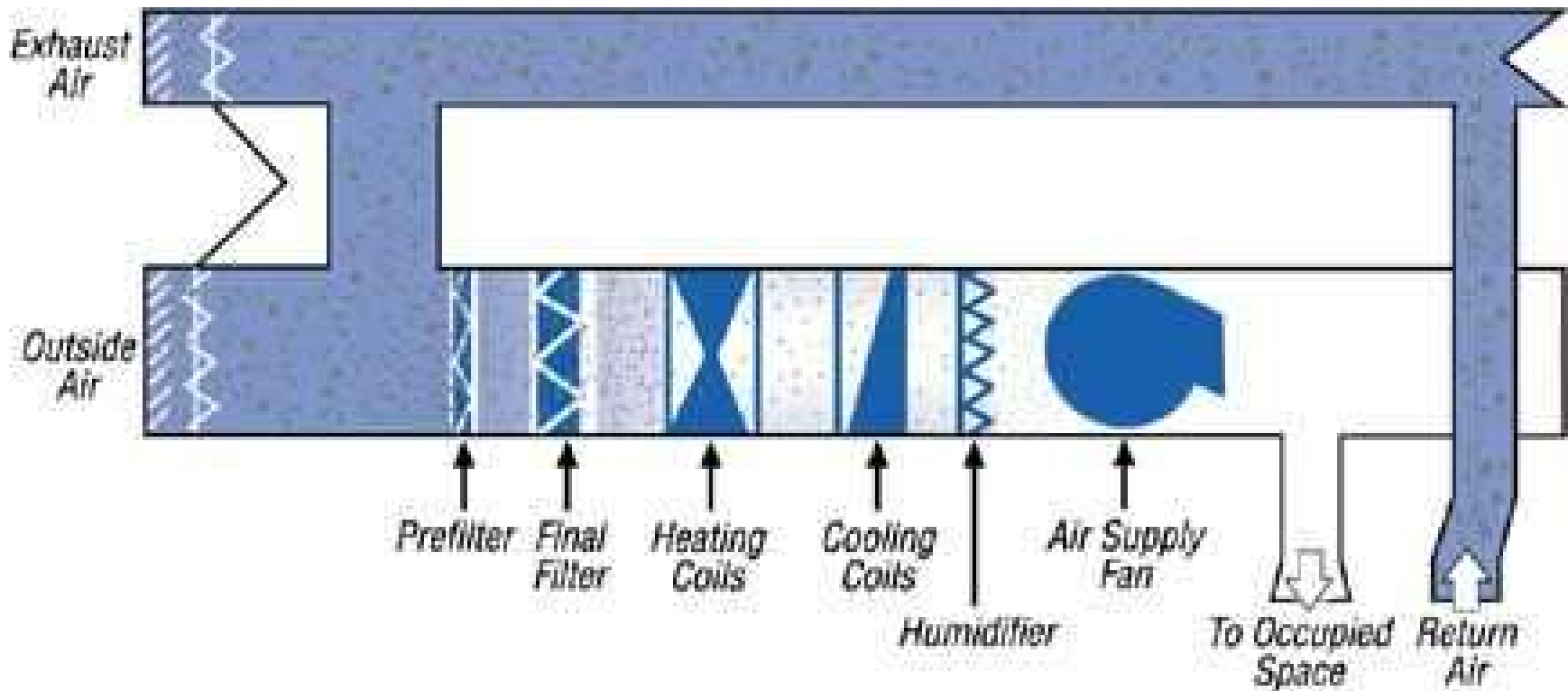
## Filter Uses

- Protect occupants from contaminant exposure (**Indoor Air Quality**)
- Protect mechanical equipment such as heating and coiling coils
- Protect systems such as air distribution ductwork, outlets and porous components
- Protect processes such pharmaceutical and micro electronic fabrication
- Protect occupied space such as wall and ceiling surfaces
- Provide clean make-up air for high quality dilution air
- Protect environment from contaminated exhaust

## Benefits

- Lower health risks/costs, increased comfort
- Reduced absenteeism, heightened productivity
- Increased system efficiency and life
- Lower operating and maintenance costs
- Reduced microbial growth
- Avoidance of product failure, reduce downtime
- Avoidance of re-entrainment.
- Compliance with clean air regulations
- Compliance with ASHRAE and NAAQS Standards

# Typical Air Handling Unit





**ASHRAE**

*Advancing HVAC&R to serve humanity  
and promote a sustainable world*

# American Society of Heating, Refrigerating And Air-Conditioning Engineers

## ASHRAE Standard 52.2 - 2007

### Purpose

- Health concerns caused by inhaling fine particles
- Protection of processes and products
- **Appendix J, added fall 2008**

### Test Method

- Efficiency by particle size:  
Resulted in the MERV rating system

# ASHRAE 52.2 - Appendix J



- Synthetic filters with coarse fibers depend on an electrostatic charge to achieve their efficiency/MERV Rating and pressure drop values.
- As humidity and fine particles (less than 1.0 micron) enter the filter, the charge dissipates and loss of efficiency occurs. **Loss of 2 to 3 MERV Rating values likely.**
- Fiberglass filters with fine fibers are mechanical filters. No electrostatic charge. **MERV Rating is Maintained.**
- **Conditioning Step** - ASHRAE dust has been substituted with a KCl (potassium chloride). KCl aerosol simulates a particle size distribution that air filters see under “ambient” conditions.
- Appendix J shows what filter efficiency will be under “actual” conditions providing design engineers with efficiency/MERV Rating values (A and B values) that substantiate filter performance.

# MERV RATING CHART ASHRAE 52.2 vs 52.1



Standard 52.2 Minimum Efficiency Reporting Value	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/ Cleaner Type
20 19 18 17	n/a n/a n/a n/a	n/a n/a n/a n/a	< 0.30 pm particle size; Virus (unattached) Carbon Dust All combustion smoke	Cleanrooms Radioactive Materials Pharmaceutical Man. Carcinogenetic Materials	<b>ULPA Filter</b> – Ultra Low Penetration Air >99.999% efficiency on 0.10 - 0.20 pm Particles <b>HEPA Filter</b> – High Efficiency Particulate Air >99.97% efficiency on 0.30 pm Particles
16 15 14 13	n/a > 95% 90-95% 89-90%	n/a n/a > 98% > 98%	0.3-1.0 pm Particle size; All Bacteria Most tobacco smoke Proplet Nuceli (Sneeze)	General Surgery Hospital Inpatient Care Smoke Lounges Superior Commercial Buildings	<b>Bag Filter</b> – Non Supported microfine fiberglass or synthetic media, 12-36” deep, 6-12 pockets <b>Box Filter</b> – Rigid Style Cartridge Filters 6 -12” deep may use lofted or paper media.
12 11 10 9	70-75% 60-65% 50-55% 40-45%	> 95% > 95% > 95% > 90%	1.0-3.0 pm Particle Size; Legionella Humidifier Dust; Lead Dust Milled Flour; Auto Emissions Welding Fumes	Better Commercial Buildings Hospital Laboratories Super Residential	<b>Bag Filter</b> – Non Supported microfine fiberglass or synthetic media, 12-36” deep, 6-12 pockets <b>Box Filter</b> – Rigid Style Cartridge Filters 6 -12” deep may use lofted or paper media.
8 7 6 5	30-35% 25-30% < 20% < 20%	> 90% > 90% > 85-90% 80-85%	3.0 – 10.0 pm Particle Size; Mold Spores; Hair Spray  Fabric protector; Dusting Aids Cement Dust; Pudding Mix	Commercial Buildings Better Residential  Industrial Workplace Paint Spray Booth inlet	<b>Pleated Filters</b> – Disposable, extended surface area, thick with virgin cotton or cotton-polyester blend media, cardboard frame <b>Cartridge Filters</b> – Graded density viscous coated cube or pocket filters, synthetic media <b>Throwaway</b> – Disposable synthetic panel filter.
4 3 2 1	< 20% < 20% < 20% < 20%	75-80% 70-75% 65-70% < 65%	>10.0 pm Particle Size; Pollen Dust Mites; Sanding dust Spray Paint Dust Textile Fibers; Carpet Fibers	Minimal Filtration Residential  Window A/C units	<b>Throwaway</b> – Disposable synthetic panel filter. <b>Washable</b> – Aluminum Mesh <b>Electrostatic</b> – Self Charging woven panel filter

# Particle Size Range vs. MERV Rating Efficiencies



Indicates the need for Prefiltration...

Particle Size Ranges (µm)	10.0 - 7.0	7.0 - 5.5	5.5 - 4.00	4.00 - 3.00	3.00 - 2.20	2.20 - 1.60	1.60 - 1.30	1.30 - 1.00	1.00 - 0.70	0.70 - 0.55	0.55 - 0.40	0.40 - 0.30
	E3 = minimum eff. % of all 4 ranges				E2 = minimum eff. % of all 4 ranges				E1 = minimum eff. % of all 4 ranges			
MERV 1	E3 < 20%				N/A				N/A			
MERV 2	E3 < 20%				N/A				N/A			
MERV 3	E3 < 20%				N/A				N/A			
MERV 4	E3 < 20%				N/A				N/A			
MERV 5	20% ≤ E3 < 35%				N/A				N/A			
MERV 6	35% ≤ E3 < 50%				N/A				N/A			
MERV 7	50% ≤ E3 < 70%				N/A				N/A			
MERV 8	E3 ≥ 70%				N/A				N/A			
MERV 9	E3 ≥ 85%				E2 < 50%				N/A			
MERV 10	E3 ≥ 85%				50% ≤ E2 < 65%				N/A			
MERV 11	E3 ≥ 85%				65% ≤ E2 < 80%				N/A			
MERV 12	E3 ≥ 90%				E2 ≥ 80%				N/A			
MERV 13	E3 ≥ 90%				E2 ≥ 90%				E1 < 75%			
MERV 14	E3 ≥ 90%				E2 ≥ 90%				75% ≤ E1 < 85%			
MERV 15	E3 ≥ 90%				E2 ≥ 90%				85% ≤ E1 < 95%			
MERV 16	E3 ≥ 95%				E2 ≥ 95%				E1 ≥ 95%			

# Underwriters Laboratories Test Standards



Underwriters  
Laboratories

## Standard 900

### UL Class 1

- Filters do not contribute fuel when attacked by flame and emit only negligible amounts of smoke

### UL Class 2

- Filters burn moderately when attacked by flame or emit moderate amounts of smoke, or both

**Note:** UL Class 2 and 1 apply only to clean filters

**Note:** Only Class UL starting 2012





# Product Review - Key HVAC Filters



# Prefiltration - Pleated Filters 1", 2" and 4" Depths

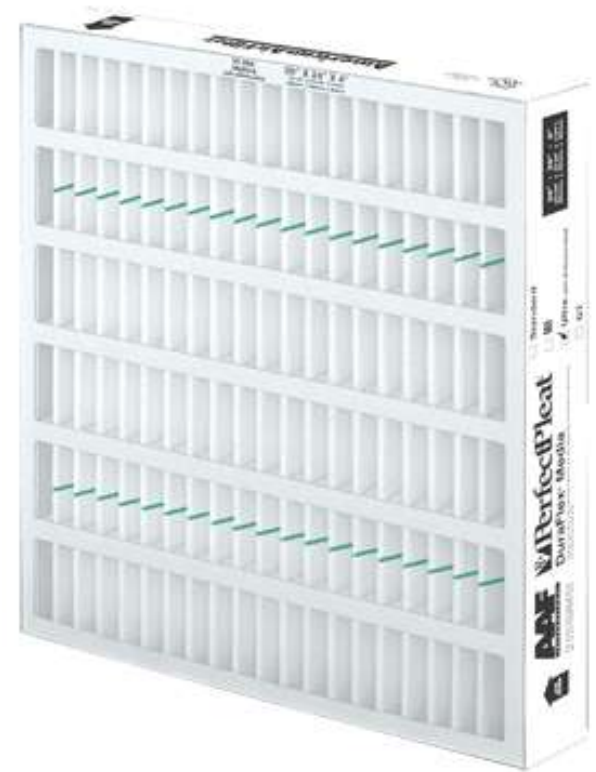
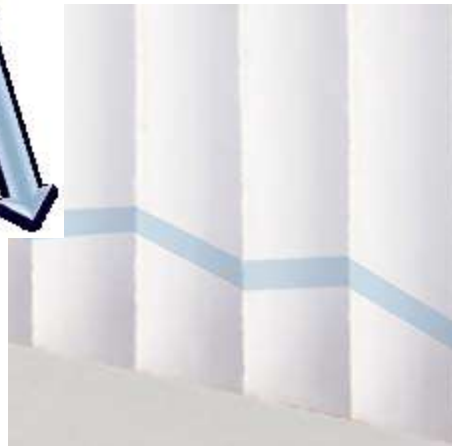




# Media Designation

*Green Stripe* – filter has antimicrobial

*Blue Stripe* – filter does not have antimicrobial



# Advantages



- **Unique DuraFlex Media\***

Self Supporting, No Metal Components, **No Rusting!**

Crush Resistant

- **Pleat Design\***

Full Media Utilization

Maximum Dust Holding Capacity

Extended Service Life, **Fewer Purchases!**

- **Frame Construction\***

High Wet Strength, Moisture Resistant

Maintains Fit and Form, Reduces By-Pass

Support Straps and Pleat Spacers

**Less Intermediate and Final Filter Change-Outs!**

\* Patented



## Final Filtration - MERV Ratings 11 to 16



# Applications



- Healthcare
- Commercial and Industrial
- Educational Institutions
- High Humidity
- High Temperature
- Variable Air Volume & Intermittent Air Flow
- Space Limitations





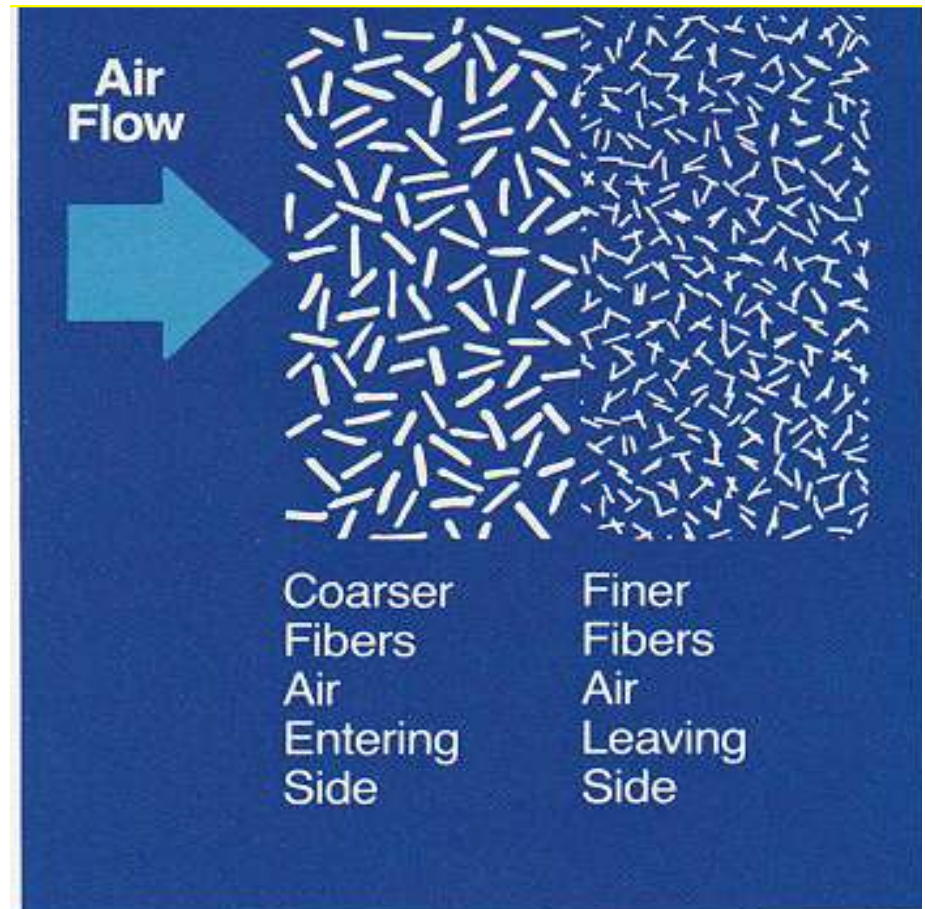
# MERV Ratings/ Efficiencies

- MERV 16    97.9% (0.3 microns)  
                  99.99% (1-5 microns)
- MERV 15    >95%
- MERV 14    90-95%
- MERV 13    80-85%
- MERV 11    60-65%

# Dual Density Media...

## Dual Density Media

- Dirt is collected throughout the entire structure of the media
- Reduces face loading and blinding
- Results in:
  - Higher dust holding capacity
  - Longer service life
  - Less change-outs
  - Fewer purchases
  - Lower operating cost





# 6" Deep Rigid Design

- Same performance as an 11.5" deep box design. Same media area (125 SF), pressure drop (0.58" w.g.), dust holding capacity (250 grams) and service life.
- Directly interchangeable with 11.5" deep single-header box filters.
- Compact 5 7/8" deep, light-weight (8 #'s) design results in large savings associated with initial AHU design, in-bound freight, storage, staging, installation, change-outs and disposal. **Real mechanical savings.**
- No metal components, unaffected by moisture, no downstream rust deposits onto coils and AHU component maintains coil integrity and efficiency.
- Suitable for **LEED** Certification Programs.





# In-Bound Freight Reduction

			Savings	
	200 VariCel I SH*	200 M-Pak SH*	%	\$/Filter
Riverside, CA	\$1,007.18	\$607.15	39.72%	\$2.00
Ft. Worth, TX	\$770.64	\$450.84	41.50%	\$1.60
Baltimore, MD	\$916.49	\$525.03	42.71%	\$1.96
Des Moines, IA	\$577.04	\$320.70	44.42%	\$1.28
*Shipped from Columbia, MO				



# Disposal Cost Reduction

## 20 Yard Dumpster Typically Costs up to \$400

- Holds **200 24"x24"x12"** filters  
(approx. \$2.00 disposal cost/filter)
- Holds **400 24"x24"x6"** filters  
(approx. \$1.00 disposal cost/filter)
- Less dumpster space required for conventional disposal
- Reduced dumpster purchases / landfill costs

# 8 Panel V-Bank Rigid Design



## *High Efficiency Filter for use in Tough Commercial and Industrial HVAC Installations such as:*

- High air volumes, up to 3000 CFM
- Variable air flows
- Turbulent airflows
- Moderate to high humidity

### **Features / Benefits:**

- 197 sq. ft. of media (24x24x12)
- Low resistance of 0.38" w.g. at 2000 CFM
- High Dust Holding Capacity – 486 grams
- No metal components, no rust deposits downstream
- Results in longer service life, fewer change-outs and much lower energy /operational costs compared to a standard 11.5" deep box filter
- Suitable for **LEED** Certification Programs
- **Best dollar cost per CFM!**



# MERV 16 8 Panel V-Bank Design

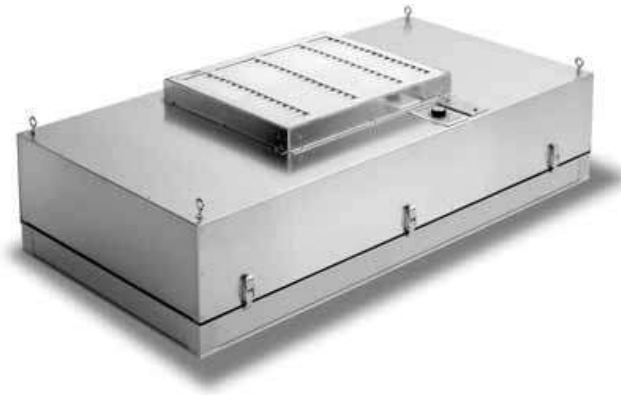


## Features and Benefits:

- MERV 16 (ASHRAE Test Method 52.2) - 99.99% initial efficiency on 1-5 micron particles (which includes the sizes of most bacteria harmful to human health)
- 97.9% initial efficiency on 0.3 micron particles
- 0.60 " w.g. initial pressure drop
- 200 sq. ft. of media.
- HIPS - Lightweight, easier to handle, faster staging and installation
- Fully incinerable
- No. 6 recyclable plastic
- Fills gap between ASHRAE high efficiency filters and HEPA grade filters without the need for upgrading framing or increasing fan capacity.



# High Purity Air Filtration



# High Purity Filtration Efficiencies...

## High Efficiency Particulate Air Filter (HEPA)

99.97% minimum efficiency on 0.3 micron particles

## Ultra Low Penetration Air Filter (ULPA)

99.999% minimum efficiency on 0.12 micron particles

## MEGA Filter

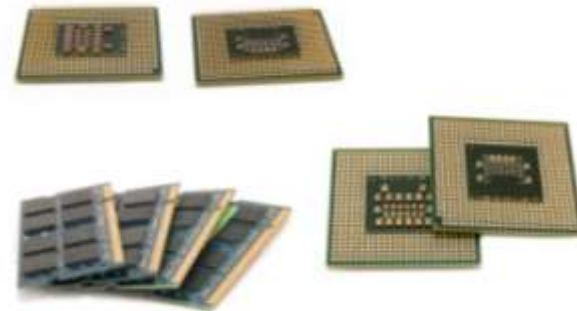
99.999995% minimum efficiency on 0.1 micron particles (Most Penetrating Particle Size)



# Applications



- Semiconductor
- Electronics
- Pharmaceutical
- Nuclear Power Stations
- Departments of Defense and Energy
- Photo Film
- Hospitals
- Laboratories
- Food Processing
- Asbestos Abatement





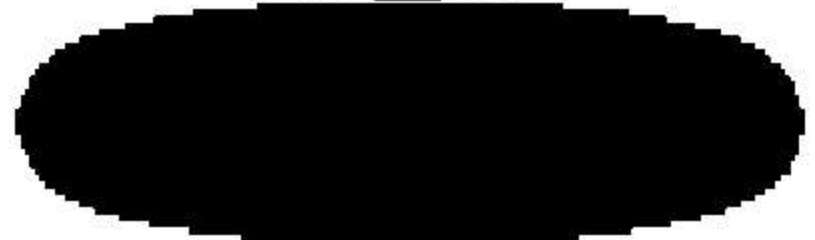
# Prefiltration High Purity and ASHRAE Filtration



- **PerfectPleat® Filter**
  - MERV Ratings: 7 and 8
- **DriPak® or DriPak® 2000 Bag Type Filters**
  - MERV Ratings: 11 to 15
- **VariCel® Box Type Filter**
  - MERV Ratings: 11 to 16
- **AstroCel® HEPA Filter**
  - minimum 99.97% on 0.3 micron particles

# High Purity Media

- Typical Media is made from sub-micron glass fibers formed into a high-density paper.
- Lydall Products manufactures media for most industry vendors.

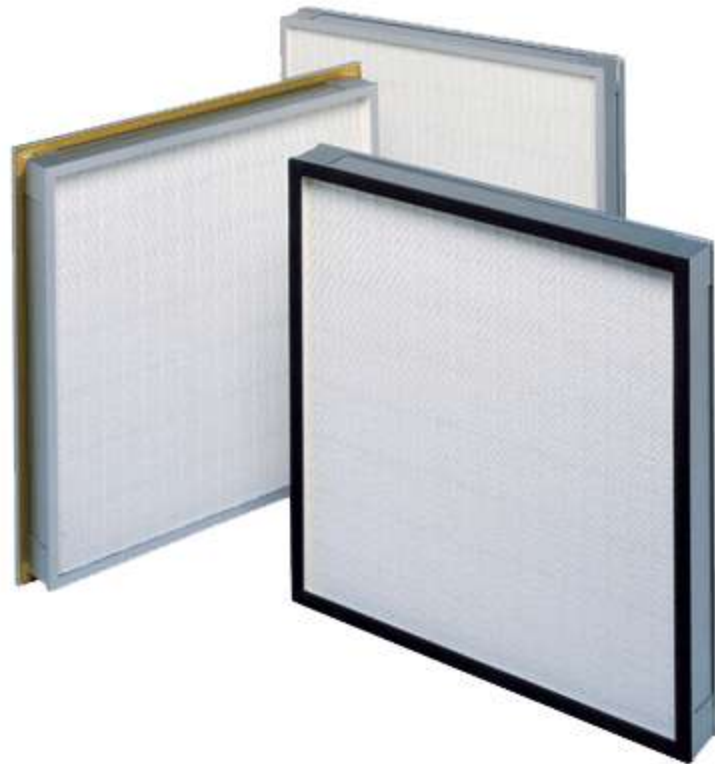


# HEPA Box Style

- Offered in a wide variety of Efficiencies, Std./Special Sizes and Construction Materials. **Style Code.**
- Minimum 99.97% efficient on 0.3 micron particles
- High Air Volume Model - up to 2000 CFM at 500 FPM
- High Temperature Operation - up to 750° F
- Individually Tested for Leaks, Eff., Moisture, Temp., and Flame
- Accommodate the many framing systems and applications



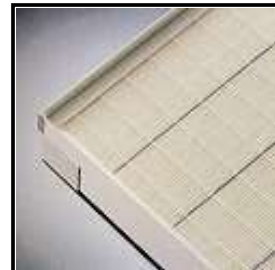
# Mini-Pleat Plenum Filters



**Gel Seal**



**Neoprene Gasket Seal**



**Knife-edge Seal**

# Media - Pleats/Separators

- Ribbons of media maintain even pleat separation
- 7.5 to 8 pleats per inch
- Results in:
  - increased airflow
  - full media utilization
  - higher dust holding capacity
  - longer service life, less change-outs
  - lower initial static pressure
  - lower operating / energy costs



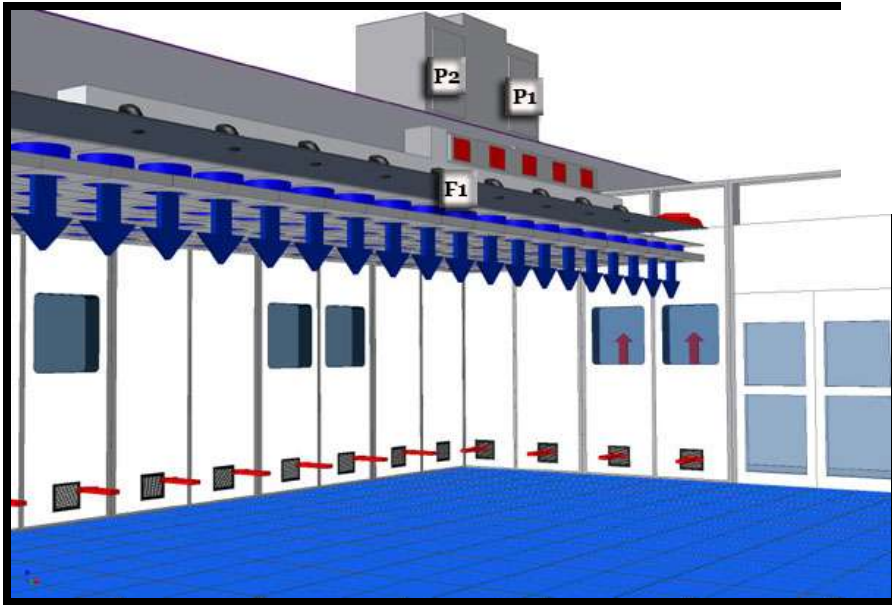
# Features



- HEPA 99.99% efficient on 0.3 micron particles, ULPA 99.9995% to MEGA 99.999995% efficient on 0.12 micron particles
- 2 to 4 inch deep media packs
- Lightweight construction, anodized extruded aluminum frame
- Low initial pressure drop (0.25" w.g. at 100 FPM, 4" Pack), reduces energy / operating costs
- Individually PSL, Laser and Scan Tested for leaks
- UL 900 Class 1, UL 586, Factory Mutual Approved

# Cleanroom Product Review

- Pharmaceutical
- Food Processing
- Semi-conductor



# Disposable Filter Modules



- Designed for optimum filter performance in cleanrooms with individually ducted modules
- TM-2 Module is a commercial, cost effective module suited for Class 100,000 to Class 10 Cleanrooms. Offered with a 2" deep filter pack. Applications include electronics, healthcare and food processing
- TM-4 Module is a an air filtration module designed for Class 100 to Class 1 Cleanrooms. Offered with a 4" deep media pack.
- The TM-4 features an AstroCel II Mini-pleat Filter Pack which provides a high ratio of media surface area to pack depth. This results in reduced operating pressure drop and an improvement in efficiency, while lowering energy costs substantially.



# Disposable Modules - Features



- AstroCel® II Mini-Pleat LPD HEPA, ULPA or MEGA Filters
- 2"-4" Media Pack Depths
- High Efficiency: Up to 99.999995% on 0.1 micron particles
- Room-side air sampling port for the checking of static pressure, air contamination levels and adjustment of the damper-diffuser
- Meet UL 586 and UL Class 1 Standards
- Factory tested for leaks
- Adjustable room-side distribution plate
- By-pass leakage virtually eliminated. Bonded metal to metal joints. Factory sealed units.

# Room-Side Replaceable Ceiling Module

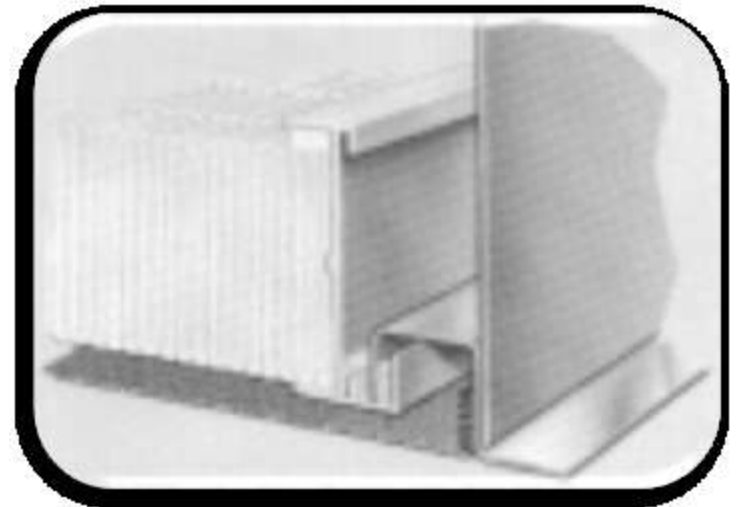


- Designed for Pharmaceutical Fill Lines, Hospital Surgical Suites and Biotech applications
- *Room-side replaceable HEPA / ULPA Cartridge where frequent change-outs occur without risk of by-pass leakage*
- Maximum air volume of 550 CFM @ 0.47" w.g.

# Features

- Welded air-tight aluminum housing (0.063 gauge)
- Stainless Steel Perforated Grill
- Room-side adjustable 10" damper and perforated diffuser plate
- High Efficiency: 2", 3" and 4" AstroCel® II Mini-Pleat HEPA and ULPA filters
- **Easy Testing:** Static pressure port provides easy measurement of pressure drop and serves as an upstream aerosol sample test port
- **Gel Seal:** Down-stream gel sealant channel and four sided knife-edge prevents by-pass leakage.

*Gel sealant in a pocket along the perimeter of the AstroCel II filter cartridge forms an airtight seal.*



# Self Contained Energy Efficient Fan/Filter Module



- For cleanroom upgrades or to create an existing space into a cleanroom without adding ductwork or air handling equipment
- Can be used in most ceiling grids or can be suspended independently
- Maximum air volume of 720 CFM (90 FPM)

# Features

- Efficient rugged motorized AC impeller rated 2.4 amps at start-up and 2.0 amps while operating
- Extruded aluminum filter cell sides
- AstroCel® II HEPA, meets UL 586 and UL 900 standards
- 16 gauge mill finish aluminum pressure housing with four support points for hanging
- 115V, 60Hz, single-phase motorized impeller junction box
- Variable speed control
- Electrical components UIL Classified
- PerfectPleat® M8 1" Deep Prefilter with DuraFlex® Media MERV 8





## PTFE Media

High Efficiency Low Initial Operating Resistance

# Helior™ PTFE HEPA Media



- Media production, filter assembly, testing and packaging in an **ISO Class 7 environment**
- Eliminates potential for contamination
- Guarantees high performance – *Only* HEPA/ULP manufacturer to fully manufacture filters in a Class ISO 7 cleanroom

# PTFE Media vs. Glass Media

0.05 – 0.2mm

**PTFE Media**

at 10,000x magnification

0.5 – 1.0mm

**Glass Media**

at 10,000x magnification

**VS**

Finer fibers



significantly  
lower  
pressure  
drop

*Much  
smaller average  
pore size (0.7mm)*

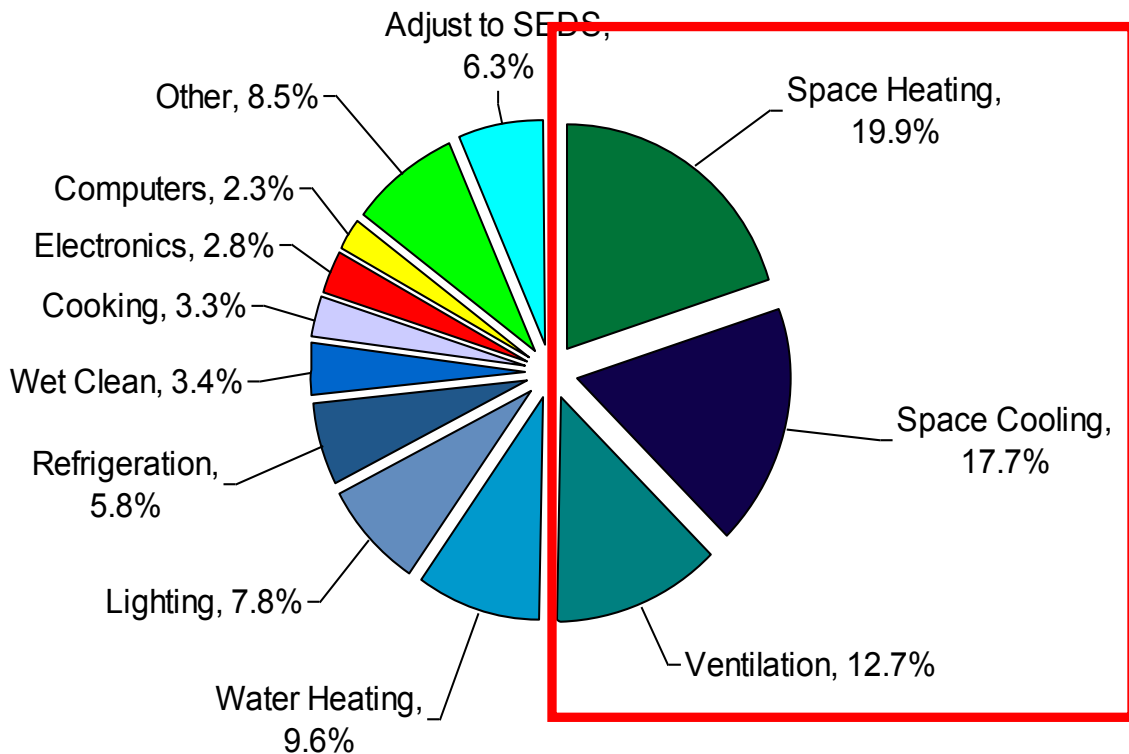
*Over 4 times greater  
space between fibers  
than AAF's Heliör  
media. (3.0mm)*

PTFE Media  
uses LESS  
ENERGY to  
achieve the  
same  
collection  
efficiency as  
glass media

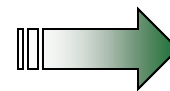
PTFE Media provides the  
highest efficiency at  
the lowest possible  
pressure drop



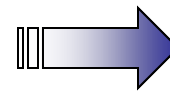
# Building Energy Consumption



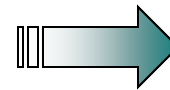
**50% of energy goes to:**



Heat air



Cool air

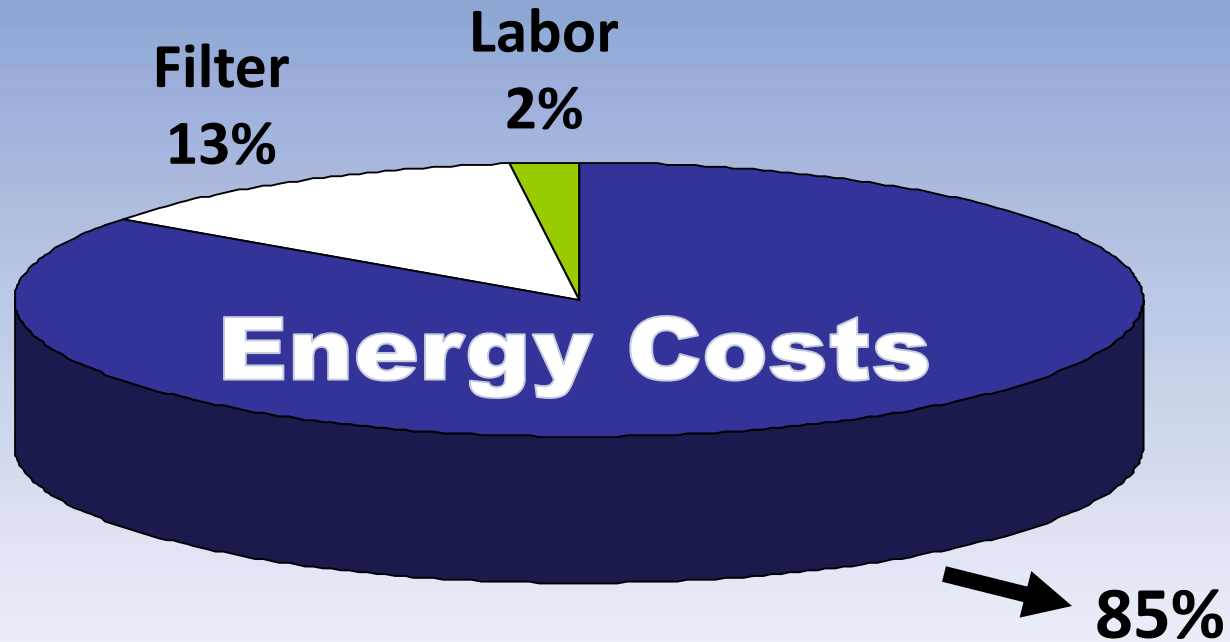


Move air

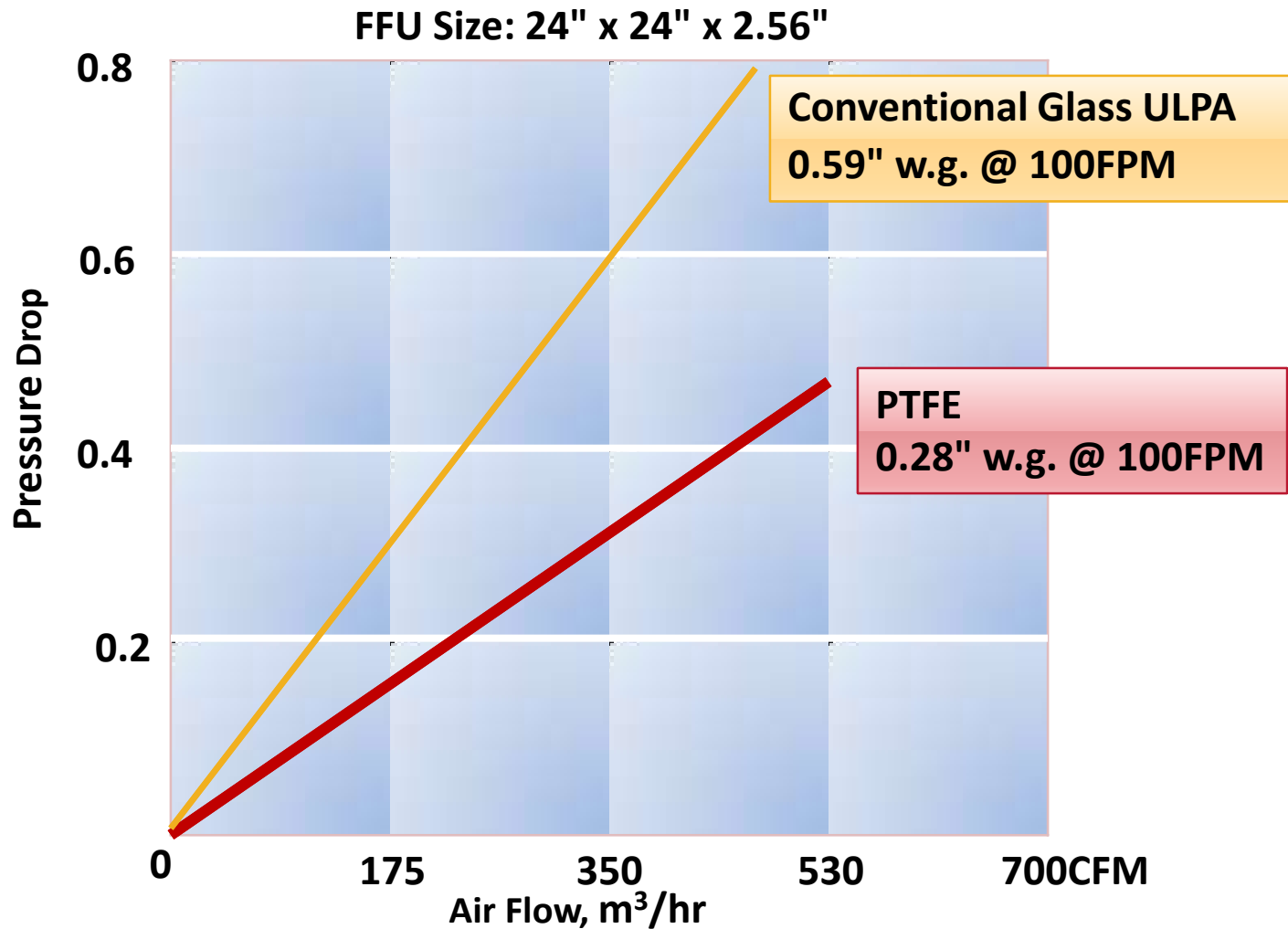
Source: Department of Energy, 2006 Buildings Energy Data Book

# HEPA Filtration Costs...

85% of the Cost over the Life of a HEPA Filter is *Energy*



# PTFE vs Glass Media HEPA



# Energy Savings

*Reduce Operating Costs and Environmental Impact with Lower Pressure Drop...*

## Replacing Conventional Glass Media HEPA with PTFE HEPA:

- Filter Size: 24"x 24" x 11 1/2"
- Reduction in Resistance: 0.7 in. w.g. (1.4" to 0.7" w.g.)
- Fan: 70% drive system efficiency
- kWh Reduced in 1 year: 2056
- Operating Hours: 24/7
- Airflow: 2000 CFM (500 FPM face velocity)

## Operating Costs:

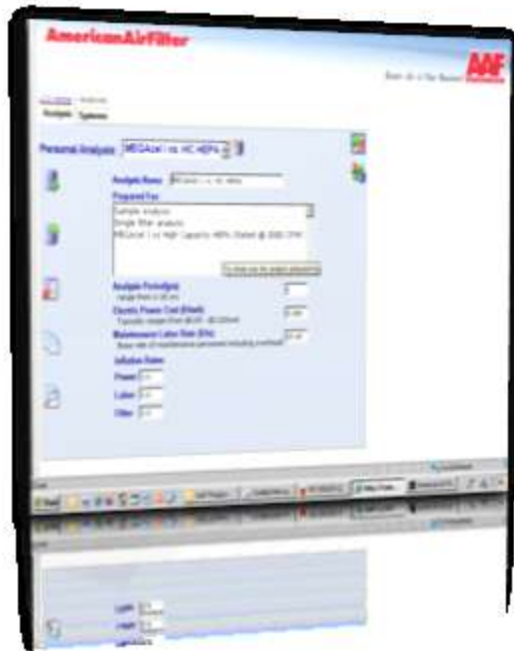
- Energy Saved: 2056 kWh
- Energy Rate: \$0.08
- **\$ Saved: \$164.50 per filter annually**

## Environmental Impact:

- Energy Saved: 2056 kWh
- Average CO2 Emissions Rate (U.S.): 1.329 lbs./kWh
- **Emission Saved: 2,732 lbs.**



# Life Cycle Valuation Tools



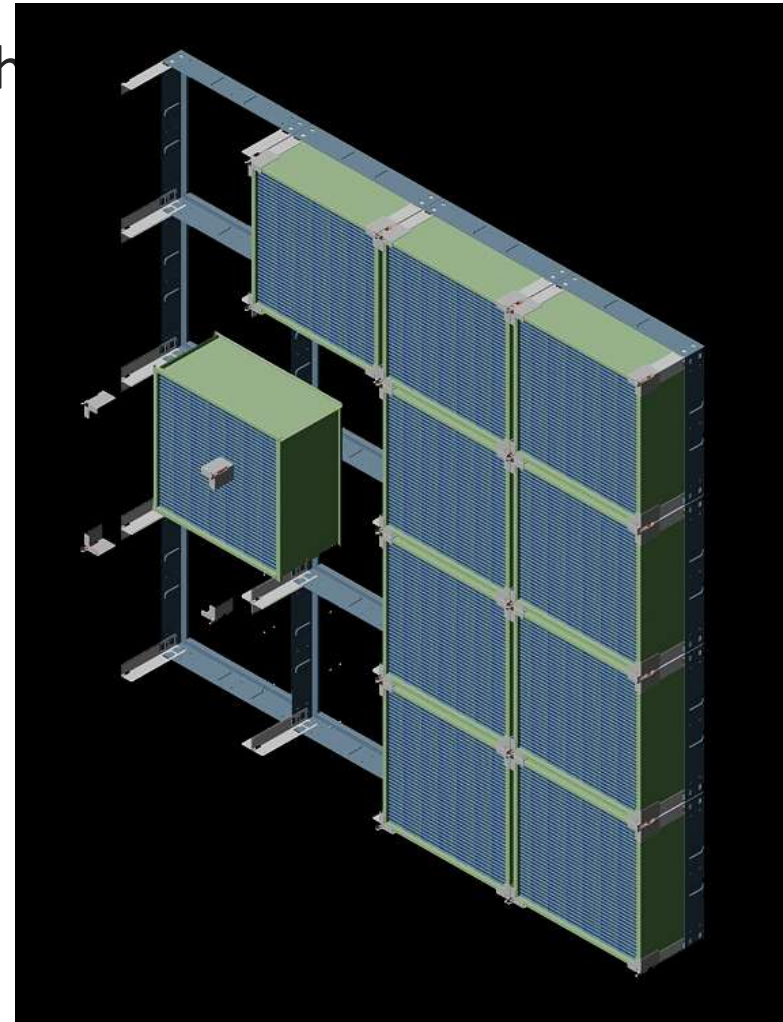
# HVAC Retrofit Solutions

Easily retrofit existing HVAC systems with HEPA holding frames

Upgrade without increasing **energy** use or modifying costly blowers

Designed for a tight seal to the MEGAcel™ I HEPA filter, eliminating bypass leakage

Help prevent the spread of infectious particles in building's critical areas



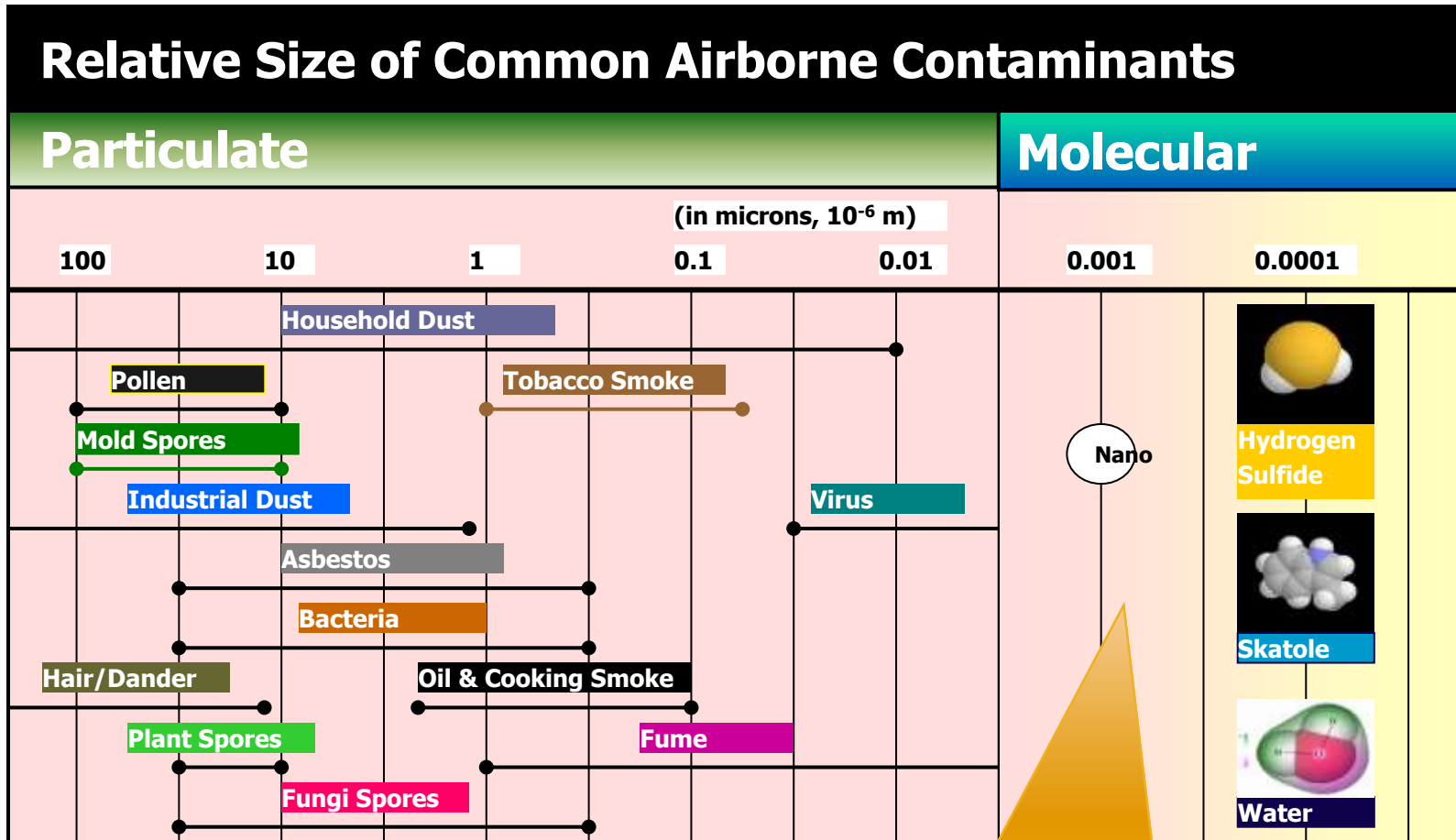


# Gas-Phase Filtration



*Better Air is Our Business®*

# Size Range of Airborne Contaminants...



**GASEOUS CONTAMINANTS  
OCCUR AT THE  
MOLECULAR LEVEL**





# Origin of Gaseous Contaminants

Gaseous Contaminants are Atmospheric Molecular Contaminants

## ODOROUS



## CORROSIVE



## TOXIC



- Typical Sources: Wastewater Treatment Plants, Food Courts, Hospitals, Air Conditioning Units, Cleaning Products, etc.

- Typical Contributing Gases: Hydrogen Sulfide, VOC's, Ammonia, Sulphur Dioxide, Chlorine, Phosgene, Iodine, formaldehyde, ozone, etc.

ding L...nts,  
s/Gase

# Commercial Applications

Application	Location (Problem)
Airports	Food courts (odors)
	Maintenance Areas & Hangars (odors, harmful pollutants, general IAQ)
	Outdoor air intakes (pollutants from cooling towers, jet fumes, automobile exhaust)
	Smoking rooms (odor & pollutant migration)
Data Centers / Server rooms	CRAC units (corrosive gasses)
	Outdoor air intakes (corrosive gases)
	Recirculation air (corrosive gases)
Entertainment	Casinos smoking areas (odor, general IAQ)
	Cinema Houses (odors & energy savings)
Healthcare	Exhausts & recirculation at morgues, laboratories, medical examiner facilities, animal research laboratories (odors, harmful pollutants, and general IAQ)
	Nursing Homes (odors and general IAQ)
	Retirement Homes (odors and general IAQ)
Hospitals	IVF Labs (pollutants lower success rates)
	Outdoor air intakes (ambulance dock & helipads pollutants)
	Operating Theatres (susceptible patients)
Hotels	Bathroom exhausts (wasted energy)
	Restaurant exhausts (odor)



# Commercial Applications cont'd...

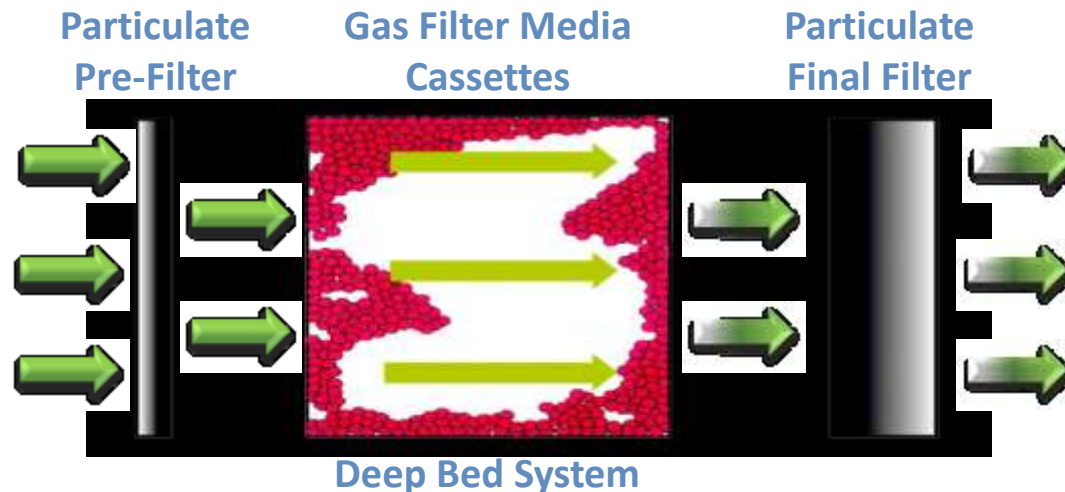
Application	Location (Problem)
Museums and Archives	Outdoor air intakes (urban pollutants)
	Recirculation air (internal and outdoor pollutants)
	Storage cabinets (internal and outdoor pollutants)
	Storage Rooms (internal and outdoor pollutants)
Office Buildings	Outdoor air intakes (urban pollutants)
	Trash / Garbage collection areas (odors)
Other	Gun Shooting Ranges (pollutants from shooting)
Printing facilities	Currency Note and Security paper printing (process pollutants & odors)
	Other printing (printing solvents & pollutants)
Restaurants	Exhausts (odor)
	Neighboring intakes or Exhausts (odor)
Retail establishments	Clothing megastores (odors & IAQ)
	Food courts (odors)
	Food supermarkets (odors)
	Pet stores (odors)
Schools and Universities	Exhausts and/or recirculation at laboratories (odors, harmful pollutants, and general IAQ)
	Outdoor air intakes (auto exhaust, diesel exhaust)
Transportation Facilities	Fire Stations (odorous diesel exhaust)
	Parking Lots contained in Buildings (odorous auto exhaust)
	Repair shops (odors)



# How to Remove Gaseous Contaminants

## Effective removal with Gas Filtration

- Scrub the problem gases out of the air stream
- Industry name for this technology:  
***Gas-Phase Air Filtration or Chemical Air Filtration***

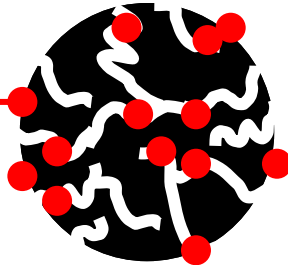


# Adsorption



- Surface adhesion (physical bond) of Atmospheric Molecular Contaminants (AMCs) to **granular activated carbon (GAC) media surface and pore structure**
- Reversible reaction. Desorption possible by steam or hi-temp. inert gas
- Rate of adsorption dependant on temperature and humidity (**water vapor competes for surface area and may displace AMC's previously adsorbed**)
- **Capacity** is dependant on total adsorbent surface area (pore structure).

## Adsorption



- Contaminants are Captured and Retained in Carbon Pellet Pores

- Process Stops when media is saturated





# Effect of Humidity on Carbon

<b>% Relative Humidity</b>	<b>% Adsorptive Capacity (Trichloroethylene)</b>
18%	21%
40%	18%
55%	17%
70%	8%



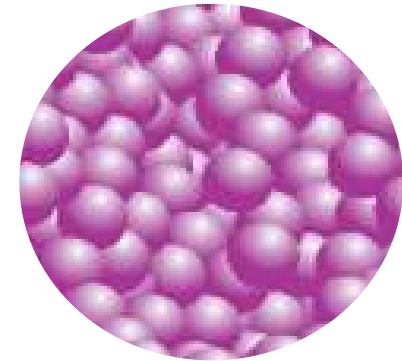
**At high RH levels, water vapor is competing  
gases and chemicals for adsorption sites.**

# Chemical Reaction (Chemisorption)

- Adsorbed gas is trapped and oxidized (chemical bond) by chemical media to convert target gases into harmless solids (salts) while eliminating desorption
- This is not a reversible reaction
- Common media is **activated alumina pellets impregnated with Potassium Permanganate ( $\text{KMnO}_4$ )**.
- Reaction speed is temperature dependent
- **Capacity** depends on amount of impregnate.

## Chemical Reaction

- Contaminants are Destroyed by Reaction and By-Product Retained
- Process Stops when Chemical Impregnate in solution on surface is depleted



# Gas List

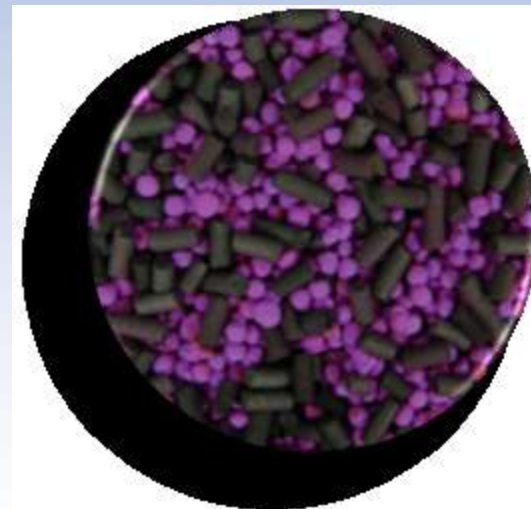


Chemical Name	Formula	Odor Characteristics	AAF chemical media to be used
Acetaldehyde	CH <sub>3</sub> CHO	Pungent, fruity	SAAF:Oxidant
Acetic Acid	CH <sub>3</sub> COOH	Strong vinegar-like	SAAF:Carb (or) SAAF:Blend
Acetone	CH <sub>3</sub> COCH <sub>3</sub>	Characteristic odor	SAAF:Carb (or) SAAF:Blend
Acetylene	HCCCH	Not unpleasant when pure but disagreeable when impure	SAAF:Oxidant
Acrolein	CH <sub>2</sub> CHCHO	Piercing, disagreeable; causes tears	SAAF:Carb (or) SAAF:Blend
Acrylonitrile	CH <sub>2</sub> CHCN	Mild	SAAF:Blend
Ammonia	NH <sub>3</sub>	Penetrating, pungent, suffocating	SAAF:Carb:MB
Arsine	AsH <sub>3</sub>	Disagreeable garlic	SAAF:Oxidant
Benzene	C <sub>6</sub> H <sub>6</sub>	Characteristic	SAAF:Carb
1,3-Butadiene	CH <sub>2</sub> CHCHCH <sub>2</sub>	Mild aromatic	SAAF:Blend
Butane	C <sub>4</sub> H <sub>10</sub>	Odorless	SAAF:Carb
Butyric Acid	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> COOH	Unpleasant, rancid	SAAF:Blend
Carbon Dioxide	CO <sub>2</sub>	Odorless	-
Carbon Disulfide	CS <sub>2</sub>	Strong, disagreeable, or sweetish	SAAF:Blend
Carbon Monoxide	CO	Odorless	-
Carbon Tetrachloride	CCl <sub>4</sub>	Ether-like	SAAF:Carb
Chlorine	Cl <sub>2</sub>	Suffocating, irritating	SAAF:Carb:MC (or) SAAF:Carb (or) SAAF:Carb:MA
Chlorine Dioxide	ClO <sub>2</sub>	Unpleasant, similar to that of chlorine and reminiscent of nitric acid	SAAF:Carb:MC (or) SAAF:Carb (or) SAAF:Oxidant
Chloroform	CHCl <sub>3</sub>	Pleasant, sweet	SAAF:Carb
Chloropicrin	CCl <sub>3</sub> NO <sub>2</sub>	Sharp, penetrating, causes tears	SAAF:Carb
Cresol	HOC <sub>6</sub> H <sub>4</sub> CH <sub>3</sub>	Phenolic	SAAF:Blend
Cyclohexane	C <sub>6</sub> H <sub>12</sub>	Mild, sweet, resembling chloroform or benzene	SAAF:Carb
Cyclohexanone	C <sub>6</sub> H <sub>10</sub> O	Reminiscent of peppermint and acetone	SAAF:Blend
1,1 Dichloroethane	CH <sub>3</sub> CHCl <sub>2</sub>	Chloroform-like	SAAF:Carb
Diethylamine	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> NH	Fishy, ammonia-like	SAAF:Blend
Dimethylamine	(CH <sub>3</sub> ) <sub>2</sub> NH	Pungent, fishy or ammonia-like	SAAF:Blend
Ethane	C <sub>2</sub> H <sub>6</sub>	Odorless	-
Ethanol	C <sub>2</sub> H <sub>5</sub> OH	Pleasant	SAAF:Blend
Ethyl Acetate	CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub>	Pleasant, fruity	SAAF:Blend
Ethyl Acrylate	CH <sub>2</sub> CHCOOC <sub>2</sub> H <sub>5</sub>	Sharp, acid	SAAF:Blend
Ethylamine	C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub>	Ammonia-like	SAAF:Blend
Ethylene	CH <sub>2</sub> CH <sub>2</sub>	Sweet	SAAF:Oxidant
Ethylene Oxide	CH <sub>2</sub> CH <sub>2</sub> O	---	SAAF:Carb
Formaldehyde	HCHO	Pungent, suffocating	SAAF:Oxidant
Formic Acid	HCOOH	Pungent, penetrating	SAAF:Blend
Freon 11	CCl <sub>3</sub> F	Faint ether-like	SAAF:Carb
Hydrazine	H <sub>2</sub> NNH <sub>2</sub>	Penetrating, resembling that of ammonia	SAAF:Oxidant
Hydrogen Chloride	HCl	Irritating, pungent	SAAF:Blend



# Chemical Media - Specific Gas Solutions

- Ideal for systems that have been designed for a narrow spectrum of targeted gas removal
- Serve as enhanced value replacements for existing and older chemical filtration systems
- Certified to the most rigid quality standards
- Life test indicators
- Backed by SAAF Technical Services teams
- Backed by AAF's comprehensive warranties and guarantees

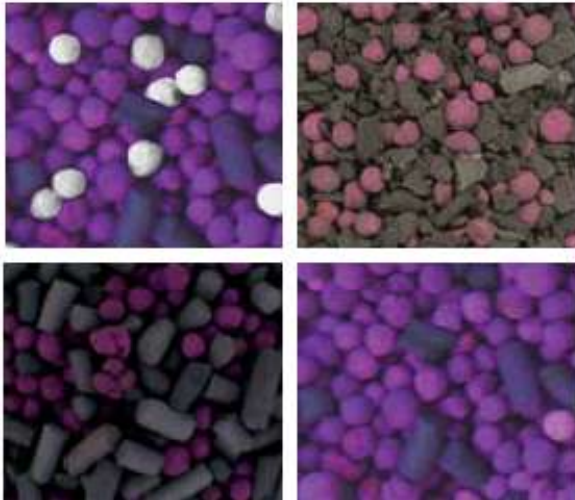


# Custom Blends



**for use when multiple contaminants are present...**

- Proprietary blends designed for air quality treatment within specific applications.
- Contain different compositions of chemical media
- Provide a comprehensive environmental air quality solution.



## *SAAF Custom Blend and Typical Applications*

### **SAAFBlend GP**

General purpose air quality control



### **SAAFBlend WS**

Wide spectrum air quality control applications



### **SAAFBlend Odor**

Refuse odor removal

### **SAAFBlend Corrosion**

Corrosive gas removal in industrial and cleanroom applications

### **SAAFBlend Protect**

Heritage protection in museums, archives and historical storage applications

### **SAAFBlend City**

Air quality control in urban environments

### **SAAFBlend Healthcare**

RA applications in acute care facilities

Other custom blends are available.

# Tech Tools



## Quick Look Report

Prepared By: AAF Application  
 Company: AAF International  
 For Questions contact the preparer by:  
 Email: x

Air Quality is defined on the basis of the following components -

1. Airborne Liquids (e.g. aerosols, mist, etc.)
2. Airborne Particulates
3. Airborne Molecular Contaminants (Airborne Gases)
4. Temperature and
5. Relative Humidity

Various companies offer products to address a component of air quality. American Air Filter™ (AAFI™ International) and its group companies - McQuay™ and Daikin™ Air Conditioning possess unique capabilities and technologies to provide complete, ENERGY EFFICIENT and customized air quality innovations.

This SAAF Selection Tools™ Quick Look report focuses on Airborne Molecular Contaminants (AMCs) chosen within the Refuse / Waste Treatment environment. The table below lists the expected AMCs, their concentrations, the AAF™ chemical media required to eliminate the AMCs and the chemical media quantity for the desired replacement frequencies (service life). Other gases can be present that will affect the results of these calculations or the appropriate application solution. Therefore, AAF strongly recommends testing to determine application concentrations. If a user is unsure of the media or system solution for an application, he should contact the local AAF sales representative.

### Refuse / Waste Treatment Media Usage Volume (ft³)

Air Flow (cfm): 1000

Environment: Refuse / Waste Treatment

Contaminant	PPMv	Media							
		1	2	3	4	5	6	8	10
Acetic Acid (VOC)	0.1992	1.00	1.27	1.55	1.82	2.10	2.37	2.65	2.92
Acetylene	0.0851	0.06	0.77	0.26	0.53	0.79	1.05	1.31	1.40
Alcohol	0.0847	0.06	0.76	0.31	0.47	0.63	0.84	1.06	1.36
Acetylene (VOC)	0.01	0.01	0.04	0.06	0.13	0.19	0.24	0.31	0.37
Acetylene	0.0176	0.01	0.04	0.06	0.11	0.15	0.21	0.26	0.30
Acetylene	0.0840	0.01	0.03	0.04	0.05	0.06	0.07	0.10	0.10
Alcohol	0.0023	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<b>SAAFBlend OF Total Usage</b>		1.24	0.71	1.40	1.14	1.46	1.78	2.11	2.11

AAFI International  
 15500 Trinity Park Plaza Suite 400  
 Littleton, Colorado 80120  
 www.aafintl.com  
 Customer Service 800-471-1214  
 Fax 800-555-8276 - us@aafl.com

1671889 Dallas TX 11/01  
 AAF has a variety of air filters product lines and is constantly adding new products. We offer a range of design and manufacturing solutions for all your air filtration needs.  
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Date Prepared: 12 Jun 2008  
 and Revised by:

Issued By: AAF Application  
 Page: 1

# Technical Support

## Colorimetric Screening

### SAAFDETECT<sup>SM</sup> Visual Air Quality Indicator

- Determines gas presence or absence
- Visual color change indication
- Estimates gas concentrations (in ppb)
- Estimates gas-phase filter efficiency
- Excellent cost to benefit ratio
- Optional web based reporting
- Immediate results — within 2 to 24 hours
- Patent pending

**SAAFDETECT<sup>SM</sup> VISUAL AIR QUALITY INDICATOR**

Date/Time Placed: \_\_\_\_\_ Date/Time Removed: \_\_\_\_\_ Hours Exposed: \_\_\_\_\_

ID: \_\_\_\_\_

Upstream  Downstream  In-room

Customer: \_\_\_\_\_

Location/Area: \_\_\_\_\_

Phone: \_\_\_\_\_ Email: \_\_\_\_\_

**Instructions:**

1. Remove SAAFDetect from plastic pouch. Place in a dry environment away from rain or direct sunlight. Note date and time of placement in the space provided above.
2. Expose the SAAFDetect Visual Air Quality Indicator to the environment between 2 and 24 hours. Use closer to 24 hours in low concentration environments to achieve a more significant color change.
3. At the end of the desired exposure time, retrieve, peel off the protective non-woven layer covering the SAAFDetect color wheels, immediately note ppb-hr range from corresponding color scale for each target gas, the date and time removed, and the hours exposed.
4. Calculate the appropriate average ppb exposure range using this equation:  

$$\text{Target Gas Concentration (ppb)} = \frac{\text{Average Exposure Range (ppb-hr)}}{\text{Exposure Time (hr)}}$$
5. Login to <http://saafdetect.aafintl.com> to obtain a customized report.

AAF Contact: \_\_\_\_\_  
Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Refer to specification sheet for further details.

**Average Exposure (ppb-hr)**

<b>Chlorine<sup>*</sup></b> Color Scale: 0-1000 Calculated Exposure Range (ppb): _____	<b>Ammonia</b> Color Scale: 0-100 Calculated Exposure Range (ppb): _____
<b>Nitrogen Dioxide<sup>*</sup></b> Color Scale: 0-100 Calculated Exposure Range (ppb): _____	<b>Hydrogen Sulfide</b> Color Scale: 0-100 Calculated Exposure Range (ppb): _____
<b>Ozone<sup>*</sup></b> Color Scale: 0-100 Calculated Exposure Range (ppb): _____	<b>Sulfur Dioxide</b> Color Scale: 0-100 Calculated Exposure Range (ppb): _____

\*Color change in any one of these three indicates the presence of an oxidizer gas. If indicator color does not match the color wheel, choose the closest match and disregard the other two.

## Reactivity Monitoring



## Media Life Monitoring



# Gas-Phase Products

for low as well as high gaseous contaminant concentrations cont'd...

Industrial Applications



AmAir C series



VariSorb XL



SAAF Cassette CG



SAAF Cassette HD



SAAF DBS

Low

Contaminant Concentration & Capacity

High



AmAir CE



VariCel RFC series



VariSorb HC series



SAAF Cassette MD



PORTA-Scrubber

# Gas-Phase Product Choices

for **LOWEST** gaseous contaminant concentrations



- Available in 1", 2", and 4"
- UL900 Class 2
- MERV 7 (except CE; MERV 6)

## Typical Odor Applications and Problems

Applications	AmAir/C Filters	AmAir/C+ SAAFoxi Filters
Nursing Homes	•	
Loading Docks: diesel odors		•
Refuse: trash, dumpsters		•
Cooking Odors: restaurants, cafeterias	•	
Ozone: may be needed for urban areas during periods when ozone levels are elevated	•	
Chemical Odors: cleaning chemicals and solvents	•	
Sewer Odors		•
Common Indoor Air Contaminants Associated with Furnishings and Electronic Equipment: formaldehyde and volatile organic compounds (VOCs)		•
Data Centers and Server Rooms, Corrosion Protection of Electronic Equipment		•
Roof Renovation Odors: tar odor		•
Construction and Renovation Odors: sealants, paints, solvents, and adhesives	•	

# Gas-Phase Product Choices

for **LOW** to **MODERATE** gaseous contaminant concentrations



**VariCel® RF/C**

with SAAFWeb™  
Gas and Particulate Filter

**VariCel® RF/C+SAAFoxi™**

with SAAFWeb™  
Gas and Particulate Filter

- 12" Single header and no header
- RF/C = carbon only
- RF/C+SAAFoxi = carbon and SAAFoxi
- HVAC application
- MERV 8 particulate scrim
- UL900 Class 2



**VariSorb™ XL**

- 12" Single header only
- Carbon only
- Mini-pleated V-bank adsorber
- Completely incinerable (no metal)
- No particulate scrim
- Low pressure drop (0.27 iwg initial)

# Gas-Phase Product Choices

for **LOW** to **MODERATE** gaseous contaminant concentrations



**VariSorb® HC**

- 12" Single header only
- Media Options:
  - Carbon
  - SAAFOxidant
  - Carbon and SAAFOxidant
- Completely incinerable (no metal)
- No particulate scrim
- Low pressure drop (0.25 iwg initial)



*MD*

*CG*

**SAAF™ Cassette**

- 12" or 18" deep, used in FAH or SAH equipment
- All media options
- UL900 Class 2



# Cassettes



Medium Duty (MD)



Heavy Duty (HD)



Cleanroom Grade (CG)

# Differentiations

## Cassettes

- **Airflow and Pressure Drop**
  - Lowest pressure drop equals lowest energy usage
- **Media Bed Design**
  - More media contacts the air
  - No media leaks from fill ports
  - More accurate media life testing
- **Sealing**
  - More air contacts the media, bypass is minimized
- **Solvents & Glues**
  - No off-gassing from solvents and glues



Cleanroom Grade (CG)



Medium Duty (MD)



Heavy Duty (HD)



Responsibly designed for optimum energy savings and performance.

# Differentiations cont'd...

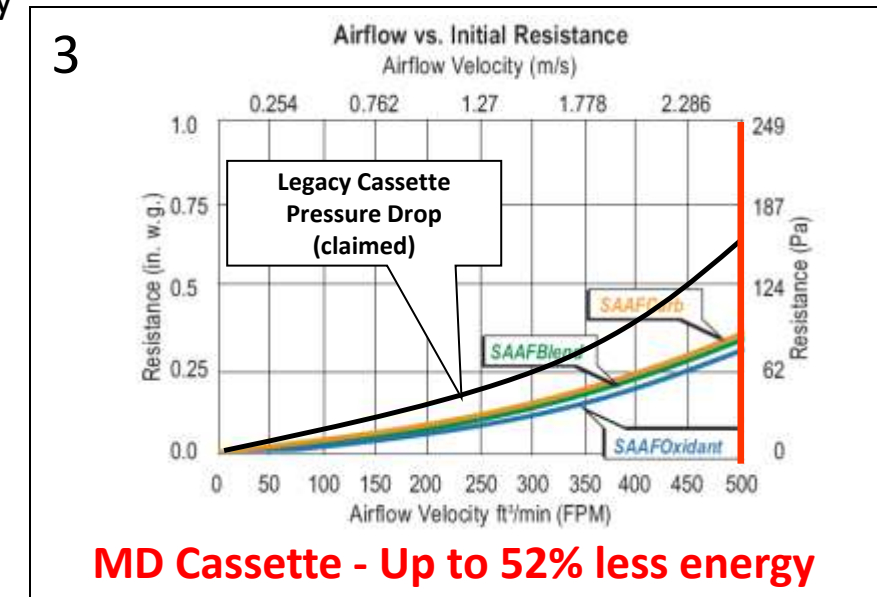
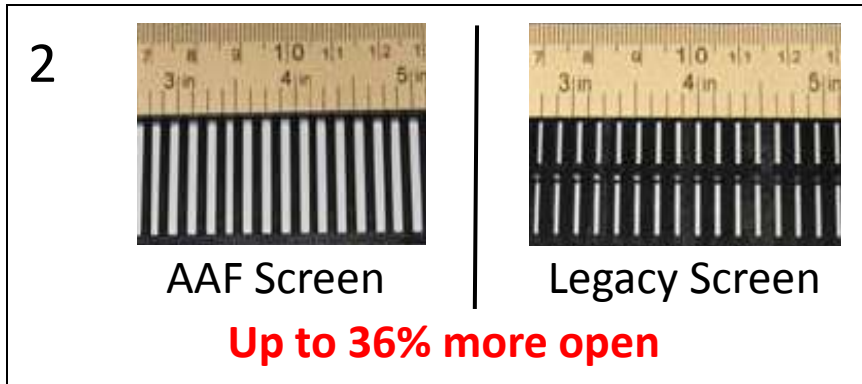
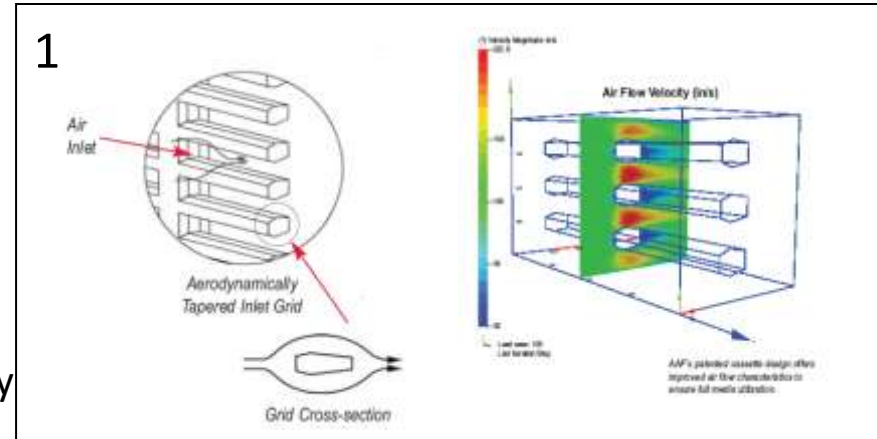
## Cassettes – Airflow and Pressure Drop

### SAAF-T-Screens

- CFD analysis used to design media screens and remove drag intensive features
- Open Area: Up to 36% more open area
- Pressure Drop: Lower pressure drop performance equals saved energy

**MD Cassette example** = Up to 52% less energy  
 - **\$26 per cassette**

**HD Cassette example** = Up to 31% less energy  
 - **\$26 per cassette**



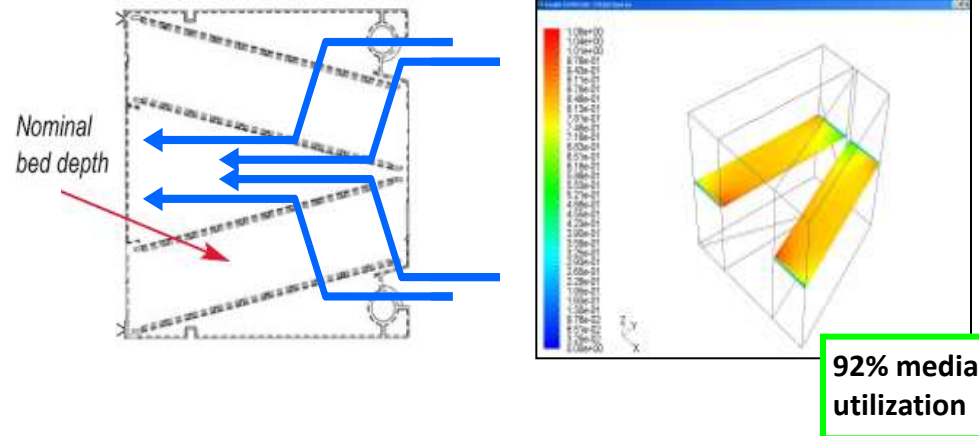
# Differentiations cont'd...

## Cassettes – Media Bed Design

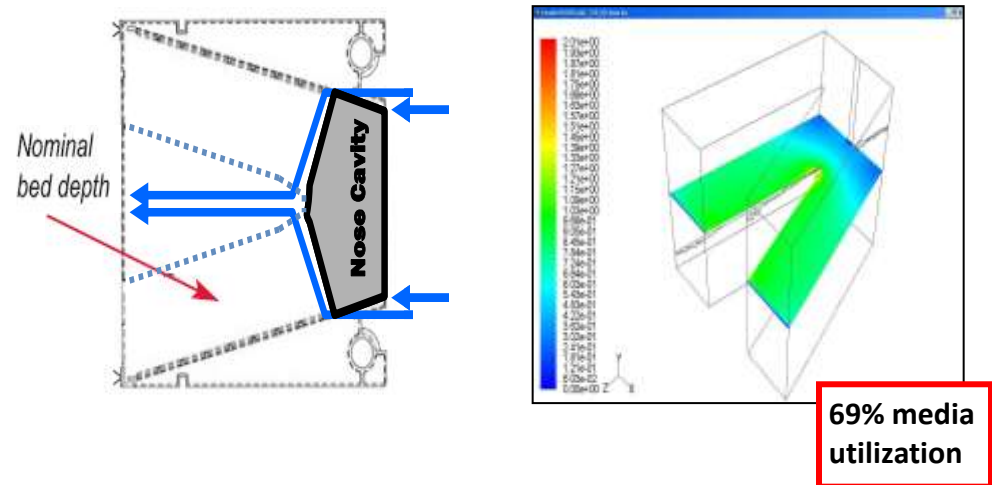
- **SAAF-V**
  - Elimination of the “Nose Cavity” provides higher media utilization & more evenly distributed airflow.
  - 92% vs. 69% media utilization
- **SAAF-T-Seal**
  - Fill port is secure and provides access to take a well mixed media sample.



## Design



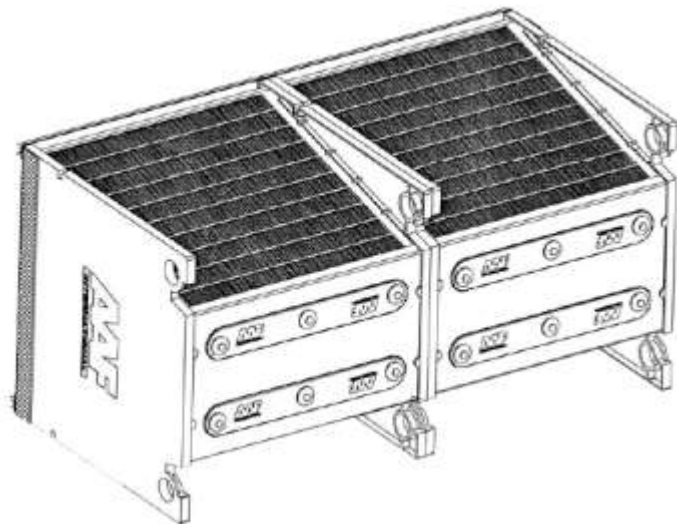
## Legacy Design



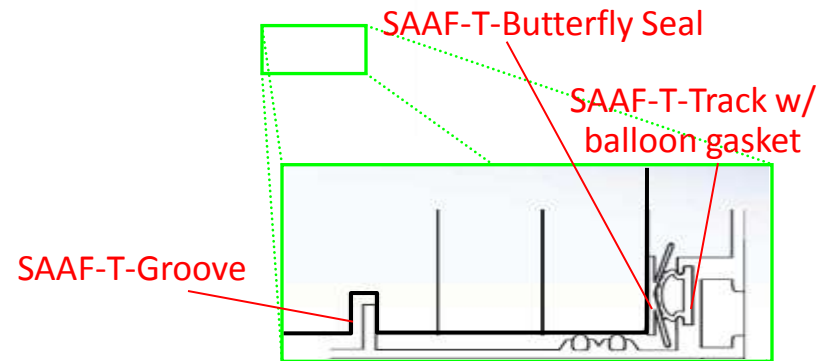
# Differentiations cont'd...

## Cassettes - Sealing

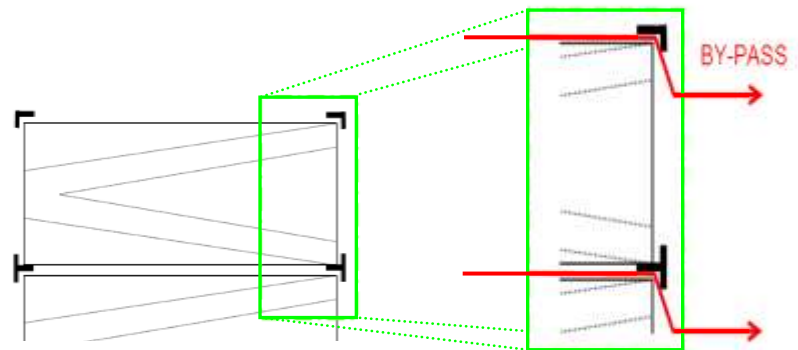
- **SAAF-T-Track, Groove, & Butterfly Seal**
  - Forms positive seal between cassette and track
  - Eliminates track to cassette bypass
- **Cassette-to-Cassette Mating:**
  - Flat surfaces & tight fitting components provide good cassette to cassette seal



## Design



## Legacy Design



# Differentiations cont'd...

## Media Effectiveness



	Conventional Media		SAAFCarb MA.HT	
Media Density		40 lbs/ft <sup>3</sup>		35 lbs/ft <sup>3</sup>
100 ft <sup>3</sup> requirement		4,000 lbs		3,500 lbs
Probable PRICE per lb	\$	1.20 per lb	\$	2.00 per lb
PRICE for 100 ft <sup>3</sup> requirement	\$	4,800	\$	7,000
H <sub>2</sub> S removal capacity		20%		80%
<b>lbs of H<sub>2</sub>S removed</b>		<b>800 lbs</b>		<b>2,800 lbs</b>
Cost per lb of H <sub>2</sub> S removed	\$	6.00 per lb of H <sub>2</sub> S removed	\$	2.50 per lb of H <sub>2</sub> S removed
Additional advantages				
Where would you use this media?	Waste water treatment plants, waste odor control, kitchen exhausts, etc			



# Differentiations cont'd...

## Cassettes – Solvents & Glue

- **SAAF-T-Snap**
  - Patent pending design provides a high pressure, no-glue snap assembly. This rigid construction excludes harmful glues, solvents, or MEK's from the manufacturing process. No off-gassing.
  - SAAF Cassettes are the ideal choice in cleanroom or high-precision applications where zero off-gassing products are mandatory.

**Design**



**Legacy Design**



# Differentiations cont'd...

## Housings

- **SAAF:FAH (Front Access Housing) Design**
  - SAAF Seal High Integrity Sealing System
    - Cassettes are held in place by a combination of channels and locking handles which compress the cassettes firmly against the face gaskets.
    - This prevents by-pass of contaminated air around the filter and ensures exceptional filter system efficiency.
- **SAAF:SAH (Side Access Housing )**
  - SAAF-Seal components as standard design
  - Built to structurally tolerate up to 4 iwg positive pressure and 6 iwg negative pressure
  - Built with 1" thick foam filled double wall panel provides thermal and acoustical insulation benefits

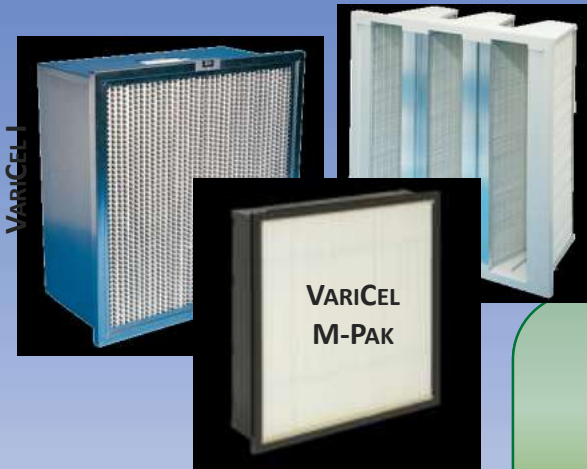




# Green Building



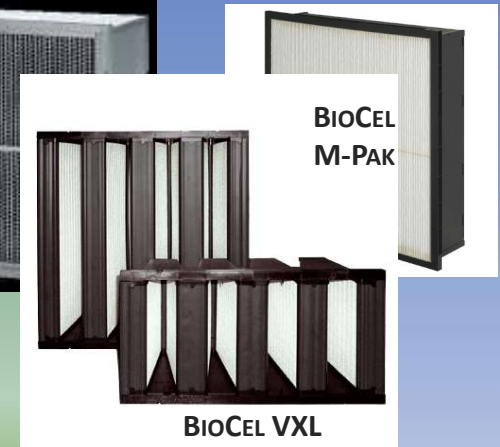
# Green Building Solutions...



VARICEL V



BIOCEL I



**Filters Rated  
MERV 13 and Higher  
May Contribute to LEED  
Project Certification**



VARICEL RF



VARICEL VXL



VARICEL T














DRIPAK 2000



AMAIR 1300

## Particulate Air Filtration Solutions

AAF Filter	Green Rating
<p><b>BioCel™ M-Pak</b> - 6"-deep filter with the same media area, performance, and efficiency as the 12"-deep BioCel. Non-metal construction. Fully incinerable. MERV 16. Brochure AFP-1-117</p>	
<p><b>BioCel™ VXL</b> - 8-panel high efficiency filter. Excellent performance in difficult operating conditions. Lowest pressure drop available. Non-metal construction. Fully incinerable. MERV 16. Brochure AFP-1-118</p>	
<p><b>VariCel™ VXL</b> - 8-panel high efficiency filter in an all plastic configuration. Non-metal construction. Fully incinerable. MERV 15, 14, 13, and 11. Brochure AFP-1-162</p>	
<p><b>VariCel™ V</b> - 6-panel high efficiency filter. Mini-pleat media packs, assembled into a series of V-banks, permit substantially more media. MERV 15, 14, 13, and 11. Brochure AFP-1-258</p>	
<p><b>VariCel™ II</b> - 4"-deep microglass paper media filters made with AAF's exclusive Slim Line Design, mini-pleat separator concept. Non-metal construction. Fully incinerable. MERV 15, 14, and 11. Brochure AFP-1-237</p>	
<p><b>VariCel™ M-Pak</b> - 6"-deep filter with the same media area, performance, and efficiencies, as the 12"-deep VariCel. Non-metal construction. Fully incinerable. MERV 15, 14, 13, and 11. Brochure AFP-1-161</p>	
<p><b>VariCel™ II M &amp; MH</b> - Combines the efficiency and performance of VariCel II media with our unique interlocked cell sides and header. The VariCel II M uses a U-channel frame to fit in 4" side access and front access systems. MERV 15, 14, and 11. Brochure AFP-1-239</p>	
<p><b>VariCel™ RF</b> - Ideal for VAV systems. Layered synthetic media with plastic pleat spacers on both sides and heavy-duty expanded metal media support grid make VariCel RF a durable, highly efficient filter. MERV 15, 14, 12, and 11. Brochure AFP-1-105</p>	
<p><b>DrillPak™ 2000</b> - IAQ engineered, extended surface, non-supported pocket filter. Outstanding dust holding capacity for longer service life in each efficiency category. MERV 15, 14, 11, and 8. Brochure AFP-1-114</p>	
<p><b>BioCel™ I*</b> - Provides significantly higher efficiency filtration than other extended surface filters. Suitable for critical applications, such as hospitals and other installations, where HEPA filters are not required. Ultra-fine glass fiber media. MERV 16. Brochure AFP-1-116</p>	
<p><b>VariCel™</b> - Rigid, self supporting filters with dual density media. MERV 14, 13, and 11. Brochure AFP-1-158</p>	

### Environmental Impact

The AAF filters listed above are ranked in regards to their environmental impact. (🌍🌍🌍🌍🌍) Five globes is the highest rating, indicating the smallest impact on the environment. The level of impact for each filter was determined using the following factors:

**Performance:** MERV rating, energy efficiency, and durability of the filter. All AAF High Efficiency Pleated Filters rated MERV 13 and above are products that may contribute to the achievement of LEED® Project Certification.

**Source Material:** Impact of raw materials used to make the filter.

**Manufacturing:** Energy consumption and pollution generated by constructing, packaging, and shipping the filter.

**Disposal:** Method and impact of disposing the filter at end of service.





Questions?



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