AAF INTERNATIONAL

Bringing clean air to life.

MEGAcel® HEPA Filtration

Peace of Mind at Lowest Total Cost of Operation

Highest Performing HEPA Filter Technology for Life Science Applications

Media – The Heart of the Filter and the Cleanroom

Understanding the Media Options Available to You

HEPA and ULPA filters made with microglass media have stood the test of time for over 75 years. However, aside from the development of "low boron" microglass media for the microelectronics industry, the technology has seen very little innovation since its inception. While its filtration performance has been proven throughout its long history, unfortunately so has its fragility. Despite its well documented filtration performance, the delicate nature of glass fiber media continues to present a potential risk for damage that should be considered when selecting the ideal media for a given application.

Conversely, membrane media technologies have seen and experienced continuous innovation and adoption across many industries and applications over the past 30 years. In the early 1990's, increased demand from the booming microelectronics industry for HEPA and ULPA grade air filters with reduced offgassing properties and improved energy efficiency created an opportunity for innovation in HEPA and ULPA grade medias. Within that same time period, Daikin Industries discovered an ultrafine fiber structure that would enable a revolutionary change in air filter membrane media development.

Proven Alternatives to Glass Fiber Media

The development of Daikin's unique ultrafine fiber ePTFE membrane media offered an alternative option to glass fiber filters for the microelectronics industry that provided the lowest offgassing properties, lowest energy consumption, and far superior tensile strength and durability. This technological advancement enabled the industry to dramatically reduce operating costs, while also improving production yield. Since that time, ePTFE media has become the media of choice for the microelectronics industry.

Expanded Portfolio of Membrane Technologies

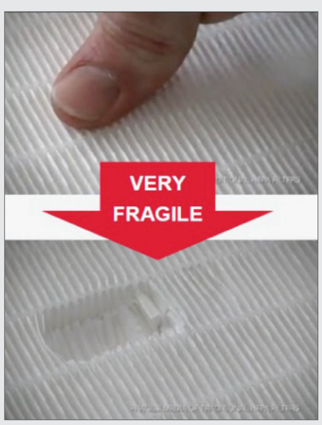
Membrane technologies have evolved since the discovery of the ultrafine fibers by Daikin Industries in 1988. The main benefits remain the same: excellent pressure drop, ultra-low emissions, and superior durability when compared to glass fiber media. However, the portfolio of available media types for specific applications has expanded.

Enter Fluororesin Membrane

Expanded fluororesin membrane, or **eFRM**, represents the next generation of membrane media technology, designed specifically for applications where high concentrations of oil-based test aerosols (i.e., PAO) and fine particulate (i.e., hydrocarbons) are present. Since 2012, this unique recipe of ultra-fine membrane layers and support structures has delivered the same low resistance and durability of first-generation membrane media in these demanding environments.

Media Resilience Comparison

AAF International HEPA/ULPA filters utilizing Daikin's ultra-fine fiber membrane media technology are the product of choice in the most demanding environments.

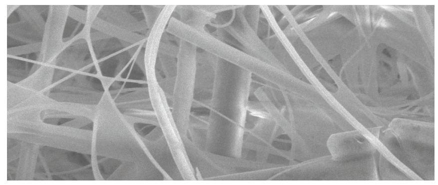


Wet laid glass fiber media is delicate and vulnerable to varying degrees of breakage, ranging from pinhole leaks to irreparable damage.

Microglass Media:

Wetlaid media made from borosilicate glass fibers and adhesive binders.

- Available in E10 –U17
- Compatible with Discrete Particle Counters (DPC) testing and photometric test methods



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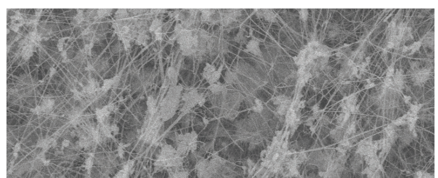
ePTFE Membrane Media:

Single layer of expanded PTFE supported by a layer of spun bonded synthetic media on the upstream and downstream side.

- Applications: Microelectronics
- Available in H13 –U17
- Compatible with Discrete Particle Counters (DPC) testing



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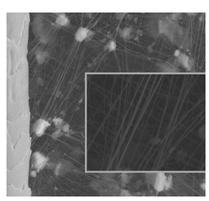
eFRM Membrane Media:

Dual layers of expanded Fluororesin membrane supported by a layer of spun bonded synthetic media on the upstream and downstream side.

- Applications: Life Sciences
- Available in H13 –H14
- Compatible with photometric test methods

1st eFRM Layer (Low Fibril Density)



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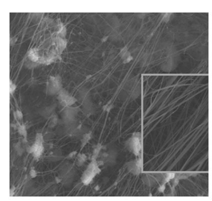
2nd eFRM Layer (High Fibril Density)



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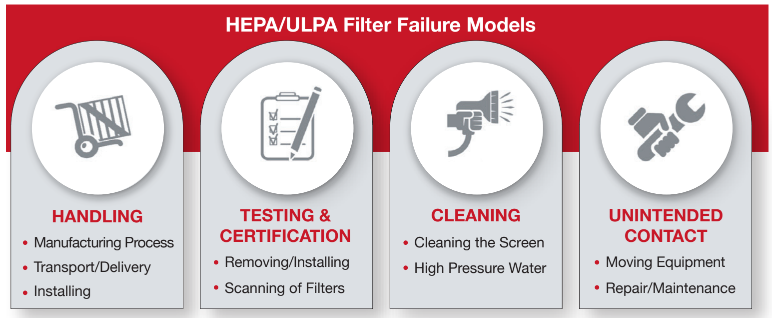
Selecting the Right HEPA/ULPA Filter

Key Risk Based Considerations: Modes of HEPA/ULPA Filter Failure

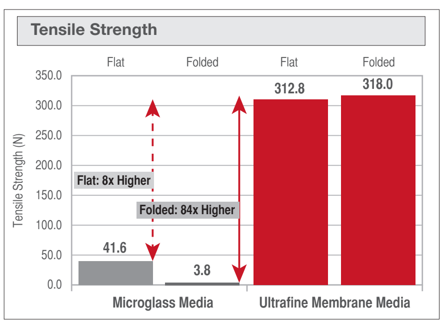
Now that we understand the critical role of media selection in the choice of HEPA/ULPA filters for a given application, it's important to also review some of the in-situ risk that the filter will be confronted with in the clean space.



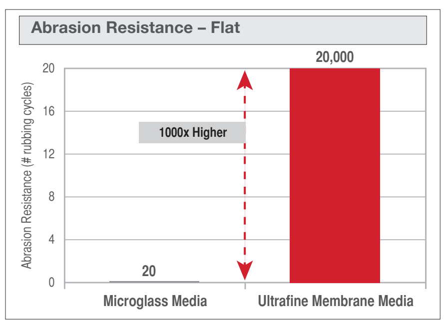
HEPA Filters typically fail due to some form of contact combined with the poor mechanical strength of the media.

Comparing Glass Fiber and Membrane Media Options

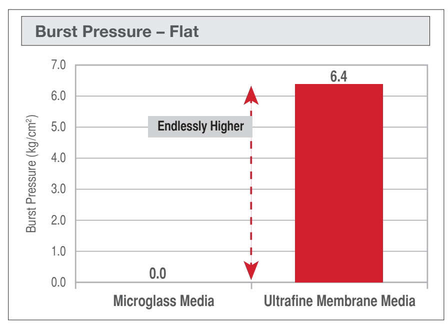
The risks listed above can be mitigated by the use of durable PTFE or FRM membrane-based HEPA/ULPA filters. The table below shows a comparison of physical properties of ePTFE, eFRM, and glass fiber HEPA filters for consideration when durability and reliability are key concerns.



Results based on Test Standard DIN EN 29073-3.



Results based on Test Standard DIN EN 12947-2.



Results based on Test Standard DIN EN 13938-2.

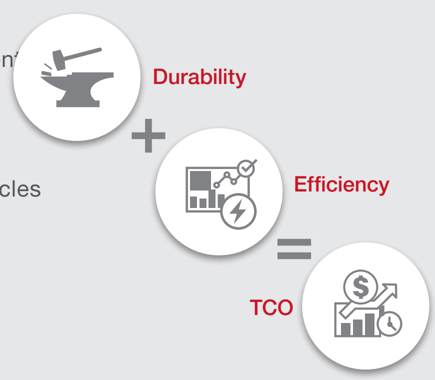
Summary of Considerations for HEPA/ULPA Filter Selection

This product guide contains multiple product options and configurations for your review and selection. Below is a helpful checklist of items to consider as you make your final selection.

What to Look for in HEPA/ULPA Filters

Media Integrity

- Highest level of mechanical strength for resistance to damage, leaking, or failure
- Chemically inert, which reduces media degradation in highly corrosive environments
- Hydrophobic (water resistant)



Economy and Testing

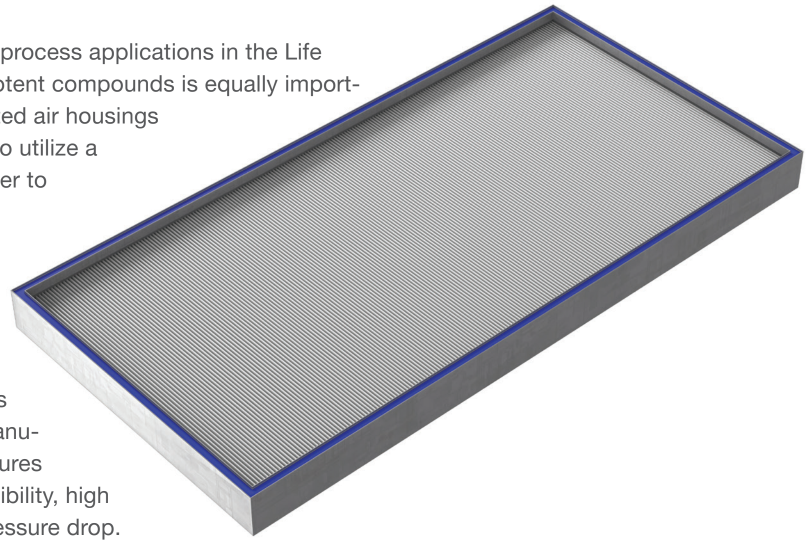
- Lowest available pressure drop to reduce energy consumption and changeout cycles
- Lowest off-gassing of chemical components to minimize risk of contamination
- Ability to perform local field testing per standards for your environment

Total Cost of Ownership

- Clearly quantify all potential operational risks associated with your filter selection
- Invest in technology that improves operational performance and reduces the effort required for maintenance and repair
- Partner with a supplier that can provide professional guidance and a fully integrated system solution

Illustration of Equipment and Test Protocol in the Life Science Industry

Control of viable and non-viable particles is crucial in many process applications in the Life Science industry. Protection of people from hazardous or potent compounds is equally important. There is a wide variety of supply, exhaust and recirculated air housings and filter types to address each application. It is important to utilize a manufacturer who can offer a fully integrated solution in order to minimize risk and points of potential failure.



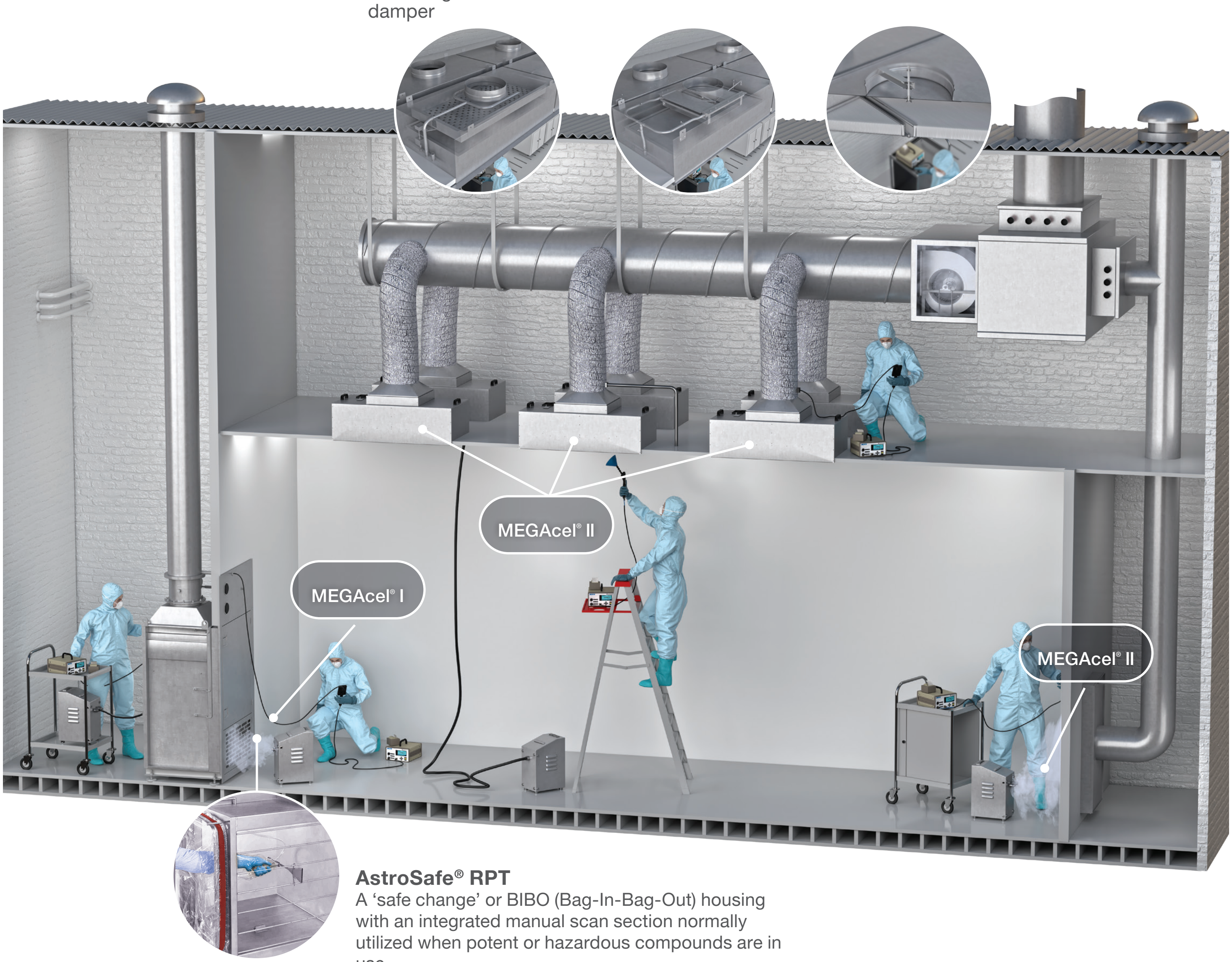
MEGAcel® II

Designed specifically for the unique requirements and challenges of the aseptic pharmaceutical manufacturing industry, this mini-pleat HEPA filter features superior durability, polyalphaolefin (PAO) compatibility, high particulate filtration efficiency, and the lowest pressure drop.

AstroHood® I
Aerosol dispersion ring with integrated ESD damper

AstroHood® II
Guillotine damper and aerosol injection

AstroHood® III
Integrated centerboard test port and diffusion disc



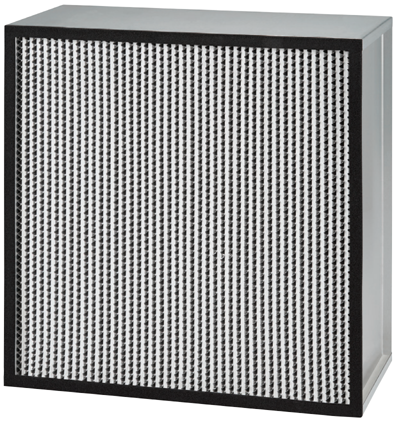
AstroSafe® RPT
A 'safe change' or BIBO (Bag-In-Bag-Out) housing with an integrated manual scan section normally utilized when potent or hazardous compounds are in use.

AHU Filter Testing

In situ integrity testing of HEPA filter banks is accomplished by injecting an aerosol upstream of the filters and manually scanning the downstream side of the filters.

Alternate Overall Leak Test

This can be performed by measuring a single point upstream, and downstream of the filter.



MEGAcel® I

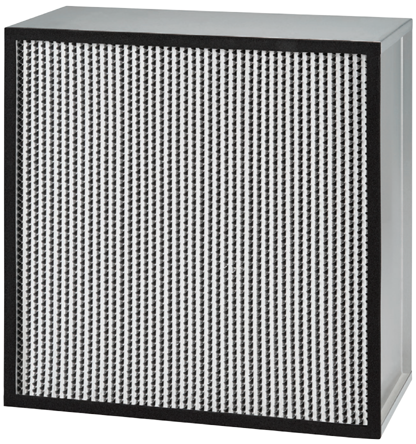
The industry's highest-performing HEPA filter, this box-style filter combines the advantages of eFRM HEPA media with an innovative tapered aluminum separator design. This combination delivers optimal system efficiency, strength, and integrity while minimizing operating costs.

MEGAcel® II with ESD Damper

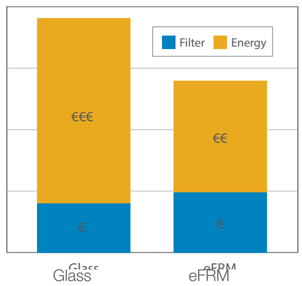
HEPA/ULPA filter with integrated airflo w uniformity Energy Saving Damper.

AAF International HEPA Filters with eFRM Media

MEGAcel® I
Separator-style HEPA Filters

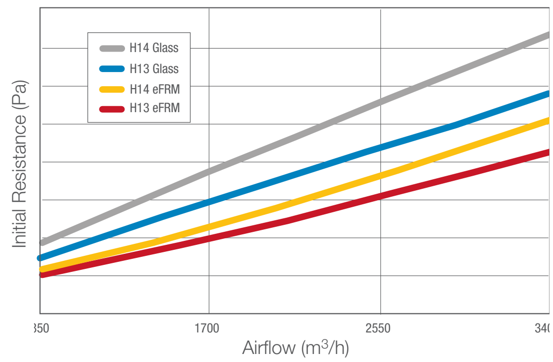


Total Cost of Ownership Glass vs. MEGAcel® I



While MEGAcel I HEPA filters cost roughly 25% more than similar microglass HEPA filters, the energy savings they produce offset the cost difference in as few as 6 months.

MEGAcel® I vs. Glass HEPA Initial Resistance vs. Airflow



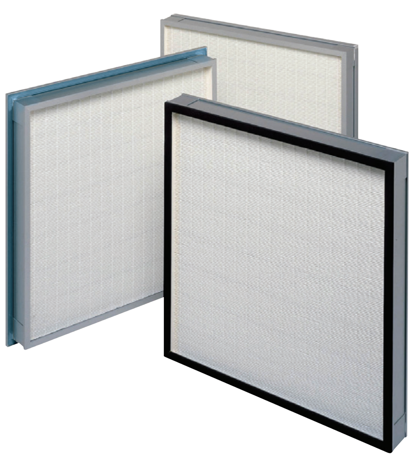
Performance data based in a 610 x 610 x 292mm filter

Benefits
- Available in H13 (99.95% @ MPPS), and H14 (99.995% @ MPPS)
- Offers lowest possible pressure drop in box-style HEPA filter
- Superior durability, hydrophobic nature, and chemically inert properties minimize risk
- Tolerant of high hydrocarbon exposure and high humidity
- Compatible with all validation test methods – photometer and discrete particle counter (DPC)

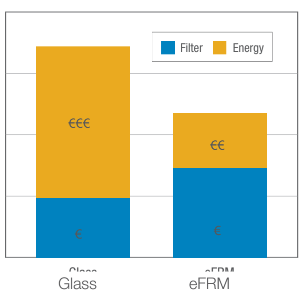
	Flow Rate (m3/h)			
	850	1700	2550	3400
H13 eFRM	45	98	145	210
H14 eFRM	50	115	180	250
H13 Glass	70	145	215	285
H14 Glass	90	185	275	365

Note: Values based on measurements, not published target or maximum values; actual results may vary slightly.

MEGAcel® II
Mini-pleat HEPA Filters

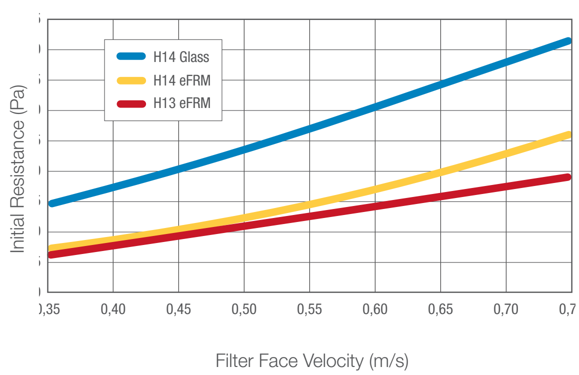


Total Cost of Ownership Glass vs. MEGAcel II® eFRM



While MEGAcel II HEPA filters cost roughly 25% more than similar microglass HEPA filters, the energy savings they produce offset the cost difference in as few as 6 months.

MEGAcel® II Initial Resistance vs. Filter Flow Velocity



Benefits
- Available in H13 (99.95% @ MPPS), and H14 (99.995% @ MPPS)
- Offers lowest possible pressure drop in terminal, panel HEPA filter
- Superior durability, hydrophobic nature, and chemically inert properties minimize risk
- Tolerant of high hydrocarbon exposure and high humidity
- Compatible with all validation test methods – photometer and discrete particle counter (DPC)

	Filter Face Velocity (m/s)				
	0.35	0.45	0.55	0.65	0.75
H13 eFRM	28	43	60	77	94
H14 eFRM	35	51	71	97	130
H14 Glass	73	100	135	160	200

Note: Values based on measurements, not published target or maximum values; actual results may vary slightly.

Comparison of HEPA Media Characteristics

	(Life Science)	Microelectronics	All	Other
	Since 2012	Since 1994	Since 1940s	**Since 2020**
	Hydrophobic, repels moisture & vapors	Hydrophobic, repels moisture & vapors	Hydrophobic, repels moisture & vapors	**Hydrophilic**, absorbs moisture & vapors
	Robust	Robust	Fragile	Robust
Acetone	Excellent	Excellent	Excellent	Excellent
Isopropyl Alcohol – IPA (70%)	Excellent	Excellent	Excellent	Poor
Sodium Hypochlorite (NaOCl/NaClO)	Excellent	Excellent	Excellent	Poor
Spor-Klenz® (STERIS) Peracetic Acid, H2O2, Acetic Acid	Excellent	Excellent	Excellent	Poor
Vaprox® (STERIS) 35% Hydrogen Peroxide (H2O2)	Excellent	Excellent	Excellent	Poor
Vesphene® IIse (STERIS) Sulfonic Acids, Phylphenol, Pentylphenol, Potassium Hydroxide, Phosphoric Acid, etc.	Excellent	Excellent	Excellent	Poor
LpH® III st (STERIS) Phosphoric Acid, Phenylphenol, IPA, tert-Pentylphenol, Sulfonic Acids, etc.	Excellent	Excellent	Excellent	Poor
Hypo-Chlor® (Veltek) Sodium Hypochlorite (NaOCl/NaClO)	Excellent	Excellent	Excellent	Poor
Chlorine Dioxide (ClO2)	Excellent	Excellent	Excellent	Excellent
Formaldehyde (CH2O) 100%	Excellent	Excellent	Excellent	Poor
Vaporized Hydrogen Peroxide (H2O2) 30%	Excellent	Excellent	Excellent	Poor
Oils/Liquid (PAO, DEHS, etc.)	Excellent	Poor	Excellent	Excellent
Solids (PSLs, NaCl, Silica, etc.)	Excellent	Excellent	Excellent	Excellent

1. Chemical compatibility per CP Lab Safety (www.calpaclab.com).

Comparison of HEPA Filter by Media Type

	eFRM FIlters	Microglass Filters	PTFE Filters	Polymeric Filters
Solid Particle Loading	•	•	•	•
Liquid Particle Loading	•	•	Poor	•
Chemical Compatibility	•	•	•	Poor
Efficiency Stability	•	•	•	Poor
Durability	Robust	Fragile	Robust	Robust
Pressure Drop	Lowest	Higher	Lowest	Good
Lifetime	•	•	•	NA
Years in Service	8+	70+	20+	NA
Units Fielded	Tens of Thousands	Millions	Millions	NA
Fielded Location	Global	Global	Global	NA

Unsurpassed Performance

The leading HEPA filtration technology for life science industries, eFRM media offers superior durability at the lowest airflow resistance. MEGAcel filters virtually eliminate the risks of media damage and degradation while minimizing operational expenses and interruptions. With tens of thousands of installed units worldwide, MEGAcel filters have exceeded the most stringent industry performance requirements since 2012.

MEGAcel is the ideal HEPA media technology to ensure peace of mind at the lowest total cost of ownership.

AAF International Plant Locations

AAF, the world's largest manufacturer of air filtration solutions, operates production, warehousing and distribution facilities in 22 countries across four continents. With its global headquarters in Louisville, Kentucky, AAF is committed to protecting people, processes and systems through the development and manufacturing of the highest quality air filters, filtration equipment, and associated housing and hardware available today.

Contact your local AAF International representative for a complete list of AAF International Air Filtration Product Solutions.

Americas

Louisville, KY
Atlanta, GA
Ardmore, OK
Bartow, FL
Columbia, MO
Fayetteville, AR
Hudson, NY
Momence, IL
Smithfield, NC
Tijuana, Mexico
Votorantim, Brazil
Washington, NC

Europe

Cramlington, UK
Gasny, France
Vitoria, Spain
Ecoparc, France
Trencin, Slovakia
Olaine, Latvia
Horndal, Sweden
Kinna, Sweden
Vantas, Finland

Asia & Middle East

Riyadh, Saudi Arabia
Shah Alam, Malaysia
Suzhou, China
Shenzhen, China
Miaoli, Taiwan
Bangalore, India
Noida, India
Yuki, Japan (Nippon Muki)

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