IEST/Estech
Orlando, Florida
May 3, 2012

AMC filtration and Fan Filters

Thank you for the opportunity to put forth some information about applying AMC filtration to Fan Filters

First off: why use an Airborne Molecular Contamination (AMC) filter?

As processes and line widths become finer the presence of even PPB level gas phase contaminates will damage processes. As processes become more demanding the use of AMC filtration will increase

How AMC filtration works

AMC filters remove gas phase contaminates by removing them as the air passes through the AMC media. Each AMC filter adsorbs the contaminates as a function of residence time, and so the manufacturer's specified flux rate (flow per unit area of media) cannot be increased or both the removal efficiency and lifetime will be substantially decreased.

AMC filtration and FFUs

Let’s take a look

An FFU is designed to delivery a typical 90 FPM air flow at the 0.48” pressure drop of the PTFE particulate filter

AmericanAirFilter

MEGAcel™ (PTFE Media)

Operating Data

High Efficiency Performance

MEGAcel provides efficiency and performance far superior to the competition. AAF is first with providing filters which meet rigorous I300I specifications for the manufacturing of 300mm wafers.

At a peak airflow of 100 fpm, Most Penetrating Particle Size (MPPS) efficiency is superior to the stringent requirements of 99.99995% efficiency.

The combination of advanced levels of efficiency and the lowest possible pressure drop makes MEGAcel a simple choice for use in 300mm wafer production.

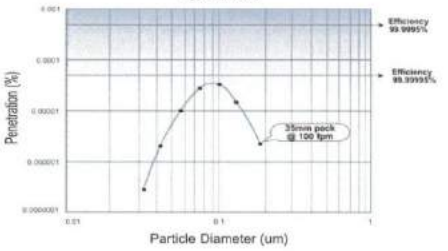
Lowest Possible Pressure Drop

Pressure drop is measured using a manometer as the test filter is subjected to a metered air volume. Testing on a volumetric basis is specified in the Institute of Environmental Sciences and Technology IEST-RP-CC007 recommended practice on ULPA filters.

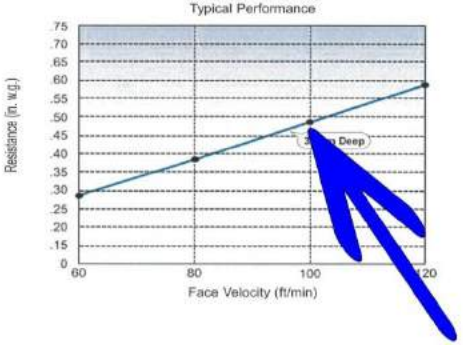
AAF calculates the total square footage of usable media pack area (outside dimensions of filter minus the frame thickness and adhesive) and multiplies this number by 100 fpm to determine an accurate volumetric test flow. (This value is approximately 720 cfm for a nominal 24" X 48" filter.) This method simulates actual cleanroom airflow conditions ensuring a true measurement of pressure drop.

0.48" @ 100 FPM

Penetration vs Particle Size
Typical Data



Resistance vs Velocity
Typical Performance



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ISO Certified 9001:2000

AAF has a policy of continuous product research and improvement and reserves the right to change design and specifications without notice.

AFP-1-4026 MAY '08 PM 2M

Tech note, affecting the following discussion

Due to the loss of effective filter area around the edges for the frame and the glue that holds the media in place, it takes roughly 100 FPM flow from the effective filter area to yield 90 FPM in the application (so the FFU is spec'd at 90 FPM which requires 100 FPM flow for both the PTFE particulate and AMC filters)

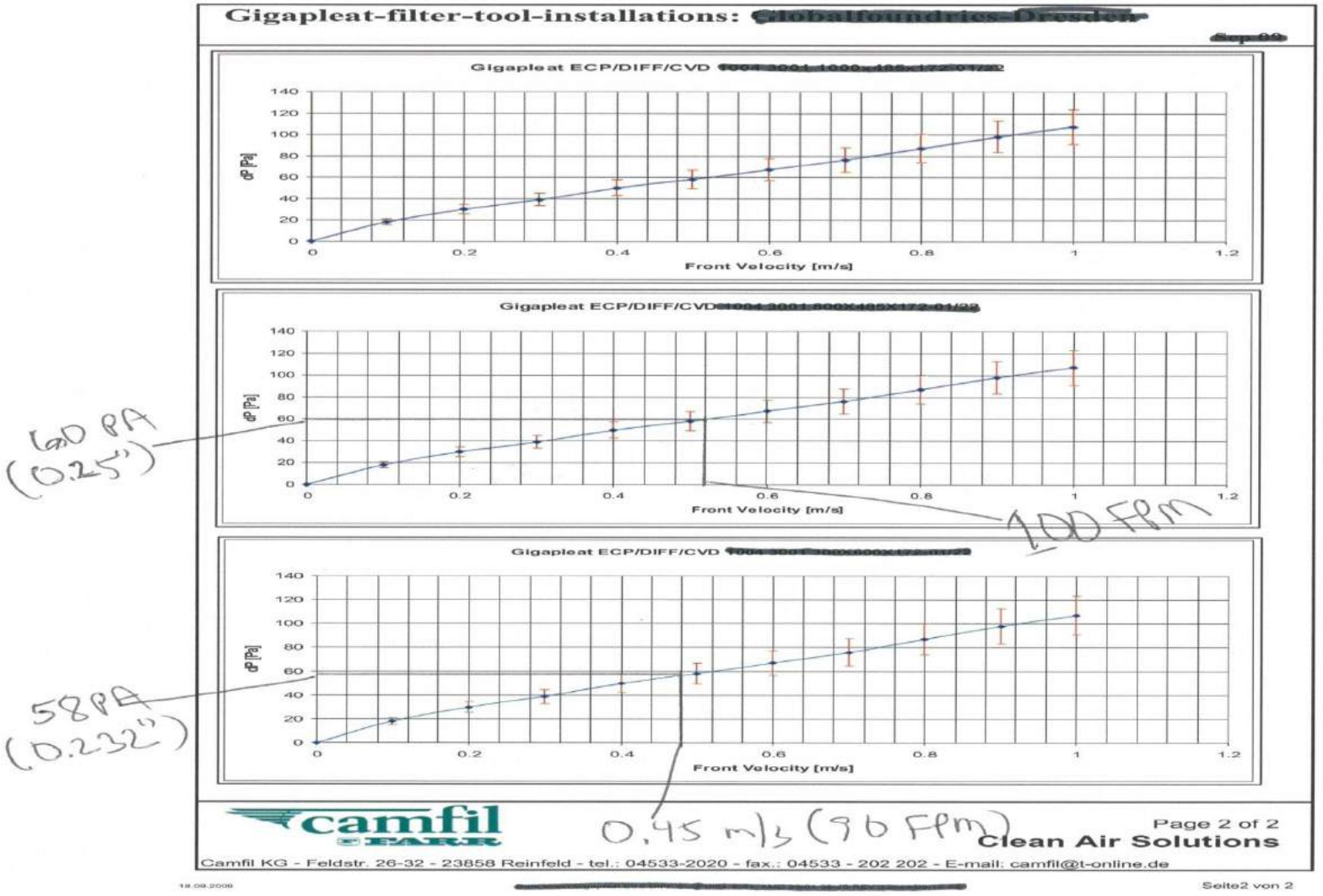
How much fan reserve is built into an FFU for filter loading and other pressure drops in the system

A typical specification is for the FFU to be able to deliver 90 FPM with 20% fan reserve

When you add an AMC prefilter how much pressure drop to you add to the system?

Note: the following examples are picked at random and could have just as easily been an Entegris, Purafil, American Air Filter, Cambridge or etc. filter

Example 1, Camfil Gigapleat@ 0.25”



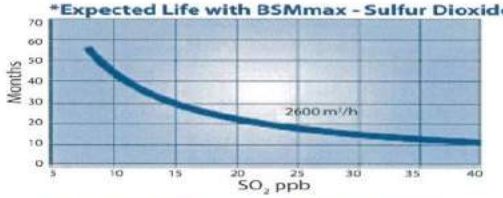
Example 2, Donaldson BSM Max @ 0.8”

Donaldson BSMmax
Airborne Molecular Contamination Filters

*Expected life is dependent upon actual fab conditions and based on systems results using Donaldson filters in a LITHOGUARD -12 cabinet.

***Expected Life with BSMmax - Ammonia**

***Expected Life with BSMmax - Sulfur Dioxide**



System Results • System Results • System Results

***Expected Life with BSMmax - HMDSO**

0.8" pressure drop at 100 FPM flow rate

BSMmax Filters	Part #P510805	Part #P512612
System	LITHOGUARD-12	LITHOGUARD-12
Dimensions	552mm x 185mm x 430mm 21.7” x 7.3” x 16.9”	552mm x 185mm x 430mm 21.7” x 7.3” x 16.9”
Flow	**255cfm (433 m³/h)	**255cfm (433 m³/h)
Pressure Drop	**190 Pa (0.8” water gauge)	**
Approximate Weight	**18 kg (40 lbs.)	

**Results per filter

LITHOGUARD®-12 Cabinet

BSMmax Filter

Contact us today!

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http://www.emea.donaldson.com/en/semiconductor/index.html

hpp-europe@donaldson.com

Donaldson

What will the addition of an AMC filter do to the flow of my current FFU?

See the following slide for an example. The curve you see is for our most popular fan in our FFU series, the EBM RE220, 220 mm wheel backward curved airfoil

30-70% from the typical 90 FPM spec, when we only have 20% reserve to work with

R2E220-AA44-23

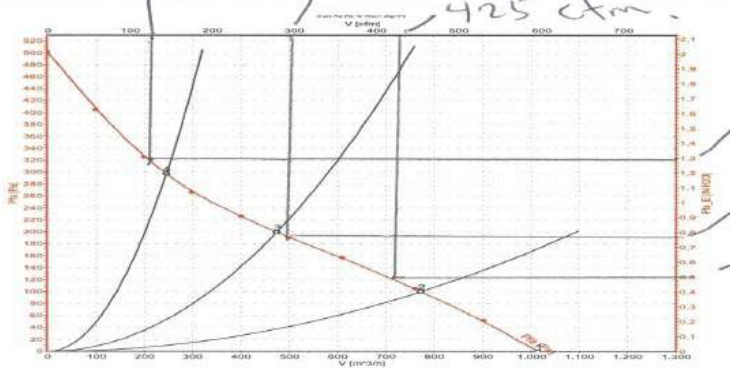
125 cfm (-70%)

300 CFM (-30%)

AC centrifugal fan

backward curved, single inlet

Charts: Air flow 60 Hz



+ 0.8" Donaldson BSM Max /Hydroguard

+ 0.25" Camfil Gigapleat

PTFE filter only = 425 cfm.

Measured values

	U [V]	f [Hz]	n [min⁻¹]	P_1 [W]	I [A]	LpA_{as} [dB(A)]	LwA_{as} [dB(A)]	$\dot{V}$ [m³/h]	p_{fs} [Pa]
1	115	60	2765	100	0.88	69	76	1015	0
2	115	60	2460	109	0.95	64	71	770	100
3	115	60	2210	114	0.99	57	65	475	200
4	115	60	2380	109	0.95	62	71	245	298

ebmpapst

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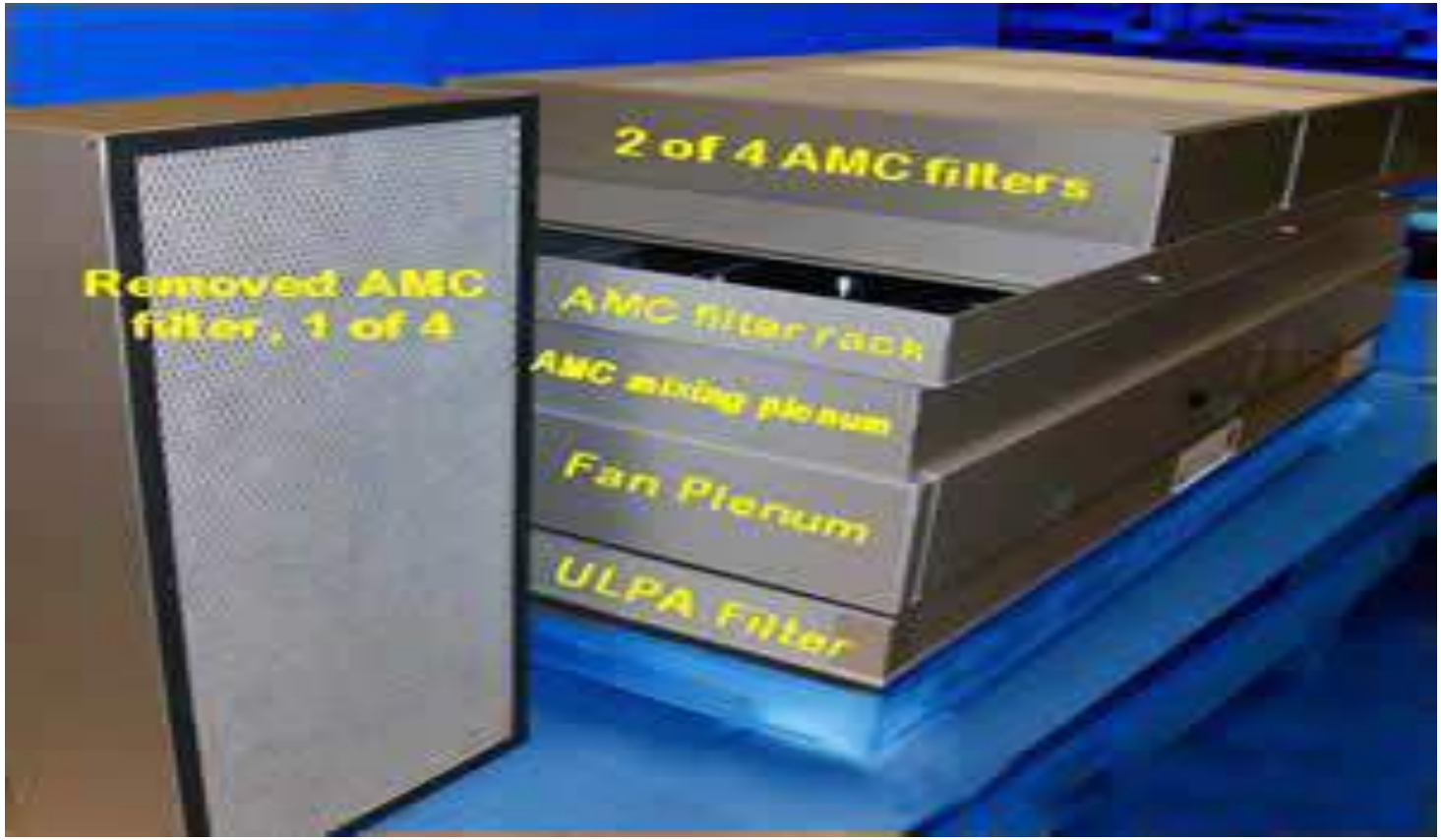
So what's the point?

An AMC FFU will have much larger fans, capable of overcoming the substantially higher total system pressure, and retrofitting AMC filters onto an existing FFU is not typically possible if you expect to have 90 FPM flow from the FFU, and desire the advertised removal efficiency from the AMC filter

An additional issue with retrofitting FFUs with an AMC filter

To stay within the typically specified 100 FPM flow rate of the AMC filter the AMC filter surface area will need to roughly equal the surface area of the FFU

Here’s an example of an AMC designed FFU; however the most popular market priced FFUs are designed with a single fan



And that single fan design limits the size of the AMC filter, forcing the flow rate through the AMC filter to be way too high

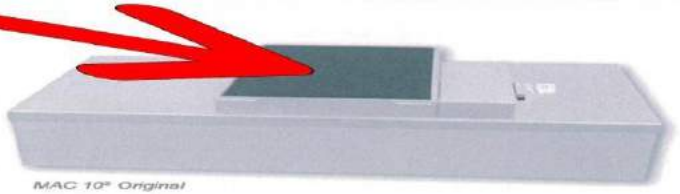
ENVIRCO
Innovators in clean air technology

MAC 10® Original

MAC 10® Introduction

Extra low watts, sound, and profile.

The Envirco® MAC 10® fan filter unit, was the first (FFU) to combine low sound, low watts and a low profile. Measuring only 51 dBA, the MAC 10® Original Standard (2 ft x 4 ft [600 mm x 1,210 mm]) provides one of the lowest sound levels of any FFU in the industry. Running at only 310 watts @ 90 fpm, the unit uses less energy than traditional FFUs, lowering operating costs. The MAC 10® Original maintains a low profile, measuring less than 13" (330 mm).



MAC 10® Original

MAC 10® Original comes standard with the filter integral with the unit housing, requiring the unit to be removed from the ceiling grid to replace the filter. The RSR unit has the filter sealed to the unit using the knife edge/gel seal construction, allowing the filter to be replaced from the roomside. The RSRE unit has the added feature of allowing the motor and filter to be replaced from the roomside.

Features

- Low sound, low watts, low profile, and low operating costs.
- Three speed switch features low, medium, and high settings; standard 2 ft x 4 ft (600 mm x 1,210 mm), 2 ft x 3.5 ft (600 mm x 1,057 mm) units.
- Solid-state speed control; standard 2 ft x 2 ft (600 mm x 600 mm) and 2 ft x 3 ft (600 mm x 900 mm) units.
- Forward-inclined centrifugal-type fan.
- High Efficiency Particulate Air (HEPA) UL 900 Filter, 99.97% efficient @ 0.3 micron.
- Snap-in prefilter allows convenient replacement and maintenance.
- Walkable plenum (excluding prefilter), rated to 250 lbs.
- Mill finished aluminum exterior.
- Designed to IES recommended RP standards.
- UL listed (120V, 230V, 277V) with standard MERV 15 filter.

approx 12" X 24" fan inlet at 700 CFM = 350 FPM inlet velocity

Options

- Solid-State Speed Control: Available on 2 ft x 4 ft (600 mm x 1,210 mm) and 2 ft x 3.5 ft (600 mm x 1, 057 mm) units; allows for a full range of settings.
- Room-Side Replacement (RSR) available with gel seal filter element; filter is replacement from the roomside.
- RSRE provides filter and motor/blower assembly replacement from the roomside.
- Ultra-low Penetration Air (ULPA) Filter: 99.9995% efficient @ 0.12 micron (U15).
- PTFE boron-free ULPA filter.
- Airflow Indicator Light: Allows external monitoring of motor operation. Red indicator is on during normal operation.
- Monitoring and Control System: On-site or remote monitoring and adjustment.
- CE Marked: 230V units available.
- Duct Collar 10" (254 mm) and 12" (305 mm): Allows direct connection to the air conditioning supply.
- Fluorescent Light: Provides illumination with minimal airflow disruption.
- Ion Bar: Neutralizes static charges below the filter. (Universal voltage power supply required.)
- Finish: Powder coat painted or stainless steel.
- 3/8" Challenge Ports: Offers convenient aerosol challenge and filter testing.
- 3/4" Knife Edge: Permits easy placement in gel track ceiling grid system (available on RSR and RSRE units only).
- Custom sizes and configurations available; perfect for mini-environment applications.
- Metric sizes available.

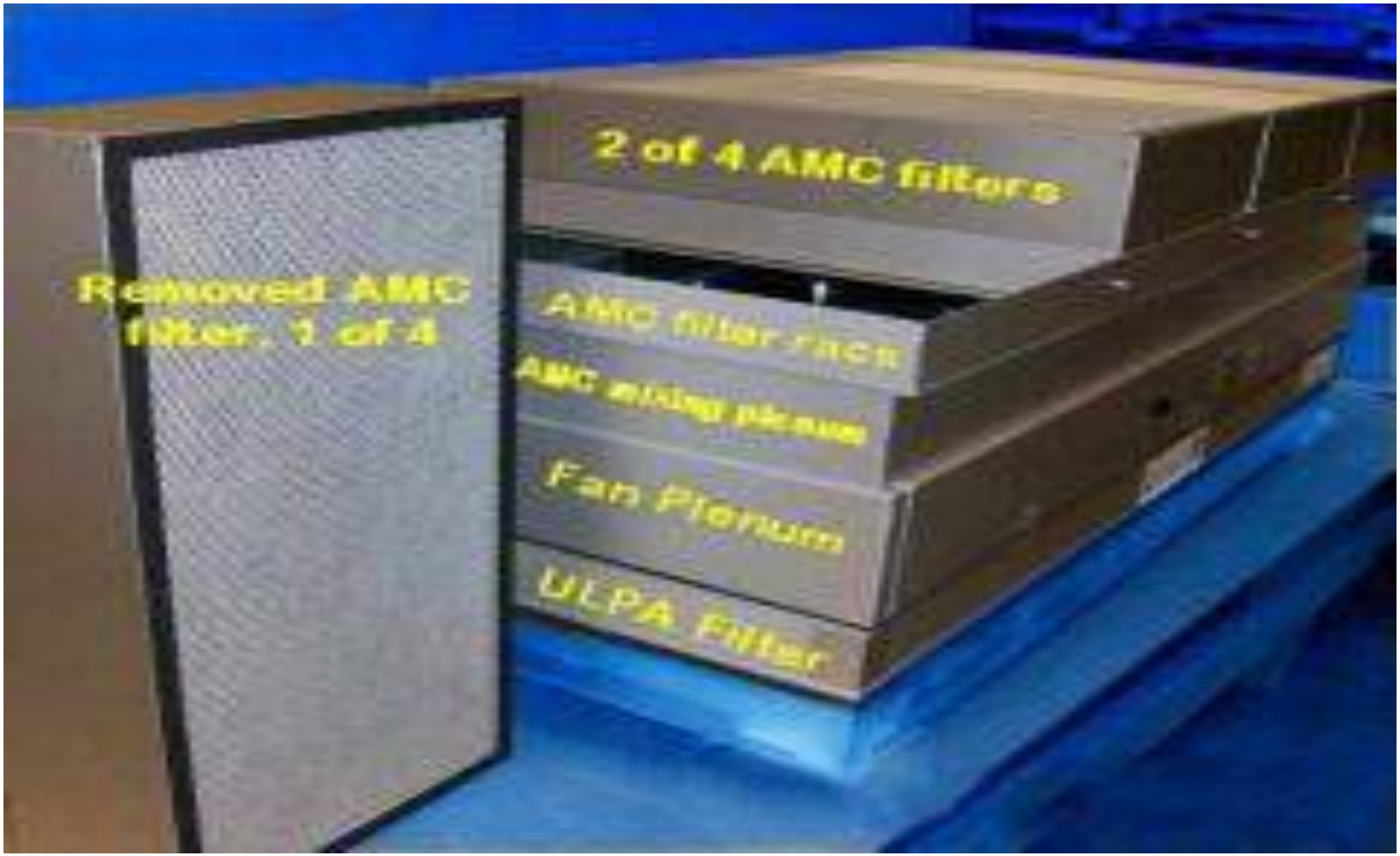
Ideal application of the AMC filter, versus ease of service

The ideal location for the AMC filter is after the fans, so their contribution to the overall AMC load can be removed

Up to now…….

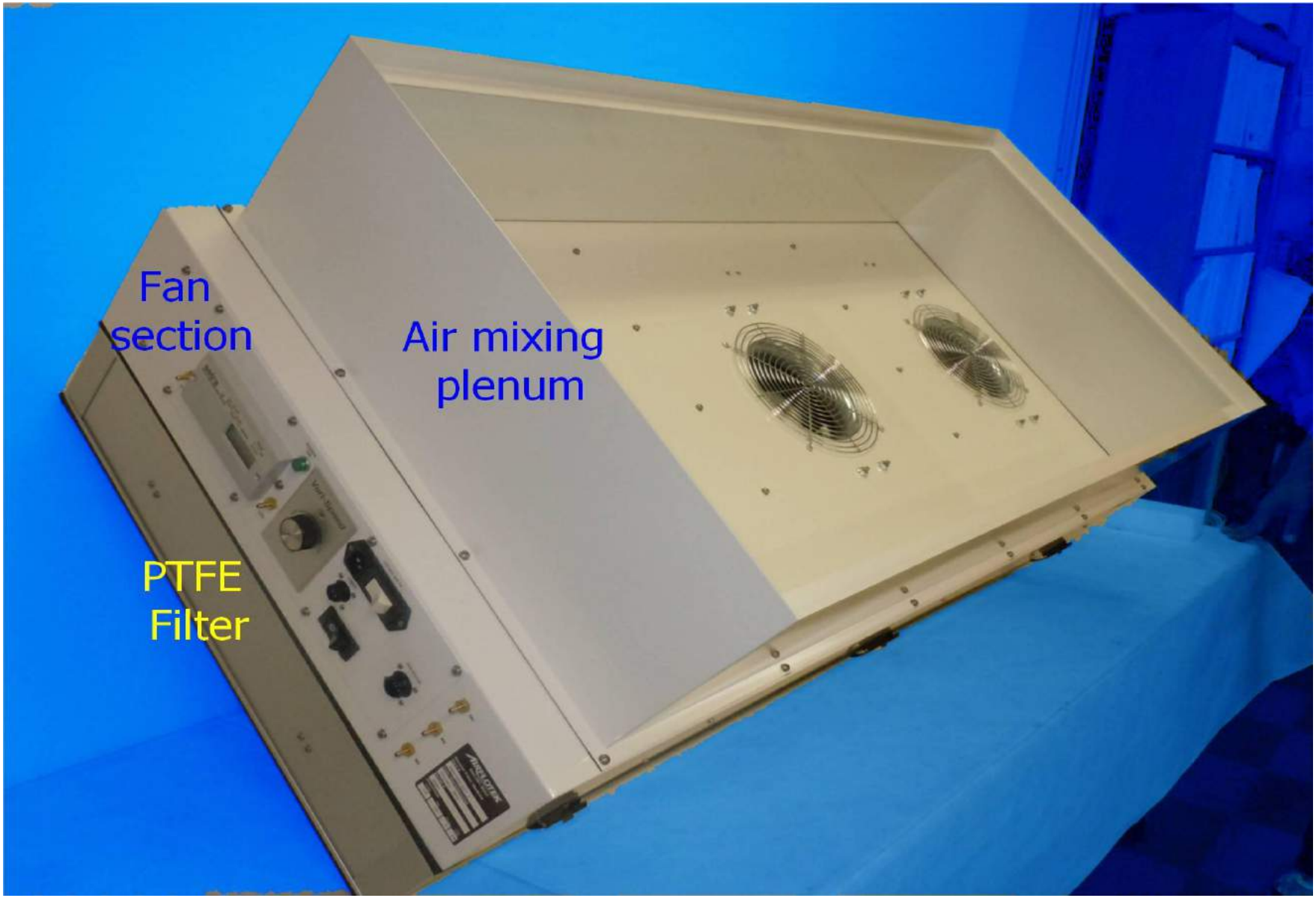
At present most applications have selected ease of service over highest removal efficiency. Over time, with ever decreasing feature sizes, this is expected to reverse course

Applying the AMC filter as a “prefilter” in the system



If the AMC filter sits too close to the fan inlet, air will be selectively pulled from the area directly above the fans, resulting in a shortened life of the AMC filter(s). AMC filter manufacturers typically recommend a 8” mixing plenum, but available area often dictates a much shorter plenum. We have built well performing FFUs with plenums as short as 3”

A full height air mixing plenum



Servicing “prefilter style” AMC filters

The following picture shows a FFU with handles on the AMC filters for easy removal. The AMC filter is basically a specialty prefilter, removed from the top, and so enough space must be available above the AMC filter to allow for it to be lifted up over the lips that it sits down in before being slid to the side and out of the way

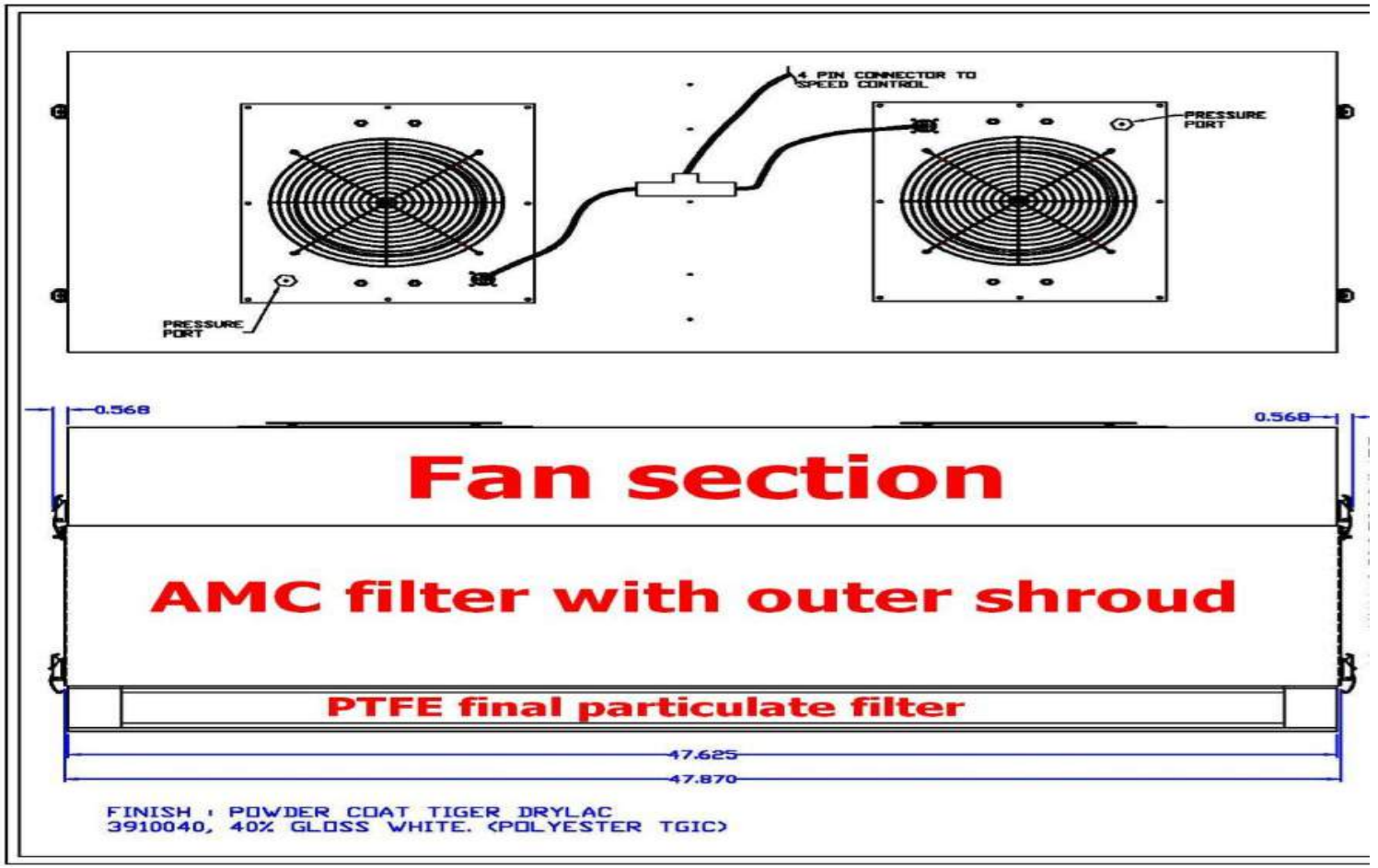
Note that the AMC filter's surface area is equivalent to the PTFE filter to hold the 100 FPM AMC filter spec.

FFUs with the AMC filter sandwiched between the fans and the particulate filter trade the ability to remove potential AMCs from the fans for added complexity in filter changing

Since the fans in an FFU are backward curved impellers, throwing air out to the sides, there is not the same need for care to be taken in the distance from the fan discharge to the AMC filter media. Although more challenging to remove the AMC filters, this design holds out hope for the lowest overall systems height (a much smaller area to act as the mixing plenum is needed)

Advantage in overall System height

A sample drawing of an AMC filter applied after the fans



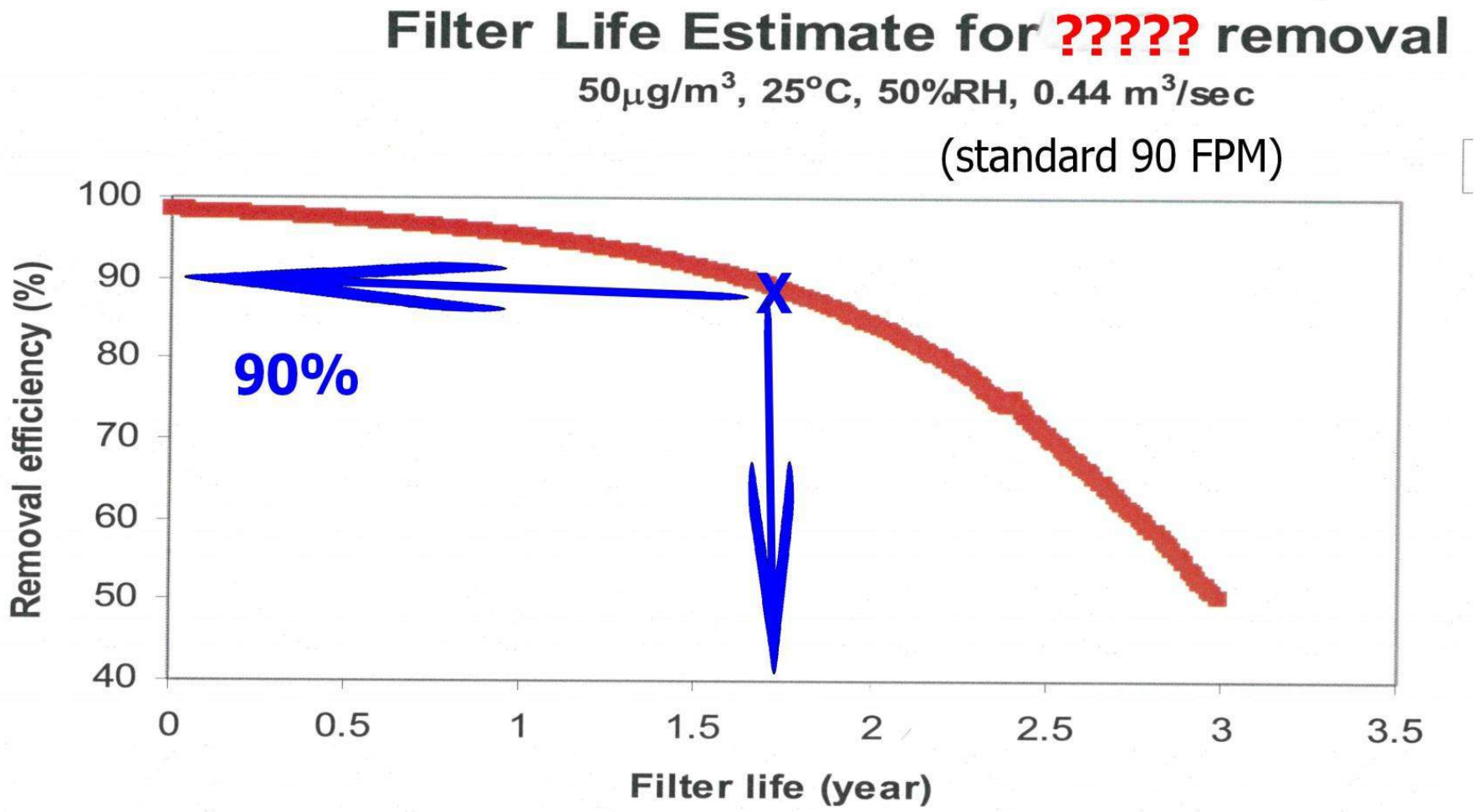
Steps to sourcing an AMC specific FFU

See next sldie

Getting your needs met when you need a FFU/AMC filter combination

Let your preferred FFU vendor know the current concentration of the species you wish to eliminate. If you don't know the species or concentration they can hook you up with vendors who can do that work for you. Your goal is to have a solution proposed that will deliver an AMC filter/FFU combination, to meet CFM requirement, with an expected lifetime/efficiency table for the AMC filter.

AMC filter efficiency/lifetime curve



Questions? I’ve got time right now, or call me anytime at (510) 656-5333 office, 510-676-5374 cell, or e-mail to Jim@tesinc.com