

A background image showing laboratory glassware, including test tubes and a pipette, with a large white stylized 'F' overlaid on the left side.

CLEAN PROCESS FILTRATION

BATTERY BUSINESS EVENT





Marcus Ragnarsson

BUSINESS DEVELOPMENT MANAGER
CLEAN PROCESS

- Business Area Manager – Clean Process in Sweden
- Member of the SIS technical committee TK 527 & TK 108
- 15 years experience from ventilation and cleanroom applications
- Swedish

AGENDA

- ❖ Controlled Environment, Battery production Guidance
- ❖ HEPA filter- Design & dimensioning, integrity & factory testing
- ❖ Installation option supply and exhaust housings

CONTROLLED ENVIRONMENT

- Supply & Exhaust air
- Pressure difference
- Temperature, sound level and **Humidity**
- **Leakage** rate for the room
- Air movement and recovery times
- Ventilation efficiency
- Particles

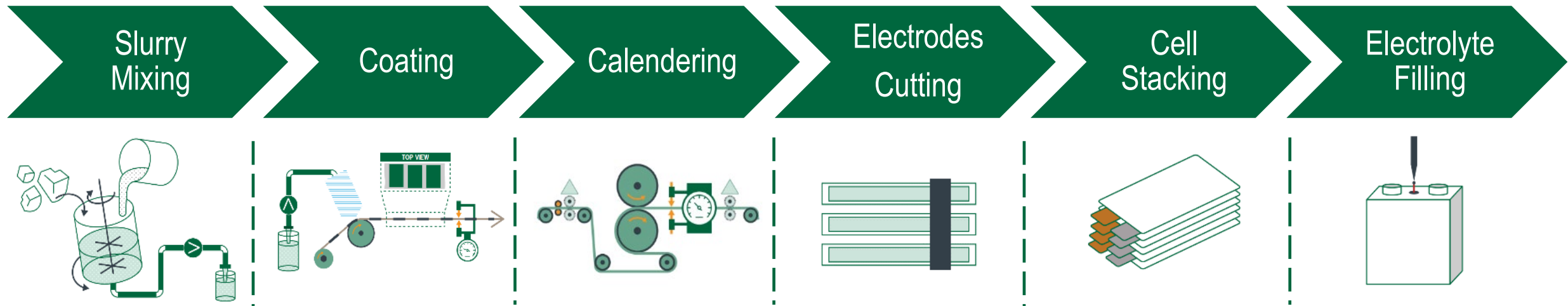


STANDARD ISO 14644-(1-16)

Cleanrooms and associated controlled environments



EN ISO 14644-1 CLASSIFICATION BY PARTICLES



EN ISO 14644-1 CLASSIFICATION BY PARTICLES

ISO Classification Number (N)	Maximum concentration limits (particles/m)					
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm
ISO Class 1	10					
ISO Class 2	100	24	10			
ISO Class 3	1,000	237	102	35		
ISO Class 4	10,000	2,370	1,020	352	83	
ISO Class 5	100,000	23,700	10,200	3,520	832	
ISO Class 6	1,000,000	237,000	102,000	35,200	8,320	298
ISO Class 7				352,000	83,200	2,930
ISO Class 8				3,520,000	832,000	29,300
ISO Class 9				35,200,000	8,320,000	293,000

Facility Production Areas with Recommendations for Air Filtration and emulsion mist and dangerous solvents in the air

Area	HVAC Prefilter	HVAC Secondary Filter	ISO 8 (Class 100,000)	ISO 7 (Class 10,000)	ISO 6 (Class 1,000)	ISO 5 (Class 100)	Exhaust Air application
Standard Offices	30/30® ePM10 50%+	Opakfil ES or Hi-Flo® ePM1 70%+	Manufacturing Areas				
Anteroom/Airlock			5-15% ¹ Ceiling Coverage	15-25% ¹ Ceiling Coverage	25-40% ¹ Ceiling Coverage	35-70% ¹ Ceiling Coverage	Dust Systems Quad Pulse package, Quantum Series and Gold Series X-Flo
Mixing			5-60 ACH ²	60-150 ACH ²	150-240 ACH ²	240-600 ACH ²	
Coating			CleanSeal/FFU	CleanSeal/FFU	CleanSeal/FFU	CleanSeal/FFU	
Compressing			Megalam/ Absolute V HEPA filters and associated diffusers as needed	Megalam HEPA filters and associated diffusers	Megalam HEPA filters and associated diffusers	Megalam HEPA filters and associated diffusers	
Drying							
Slitting		Opakfil ES or Hi-Flo® ePM1 60%+					Solvent and Acid Control Vertical and Horizontal deep bed filters (ProCarb) Diverse thin bed filters (CamCarb)
Case Manufacturing							
Sub Assembly							
Welding							
Packaging		Opakfil ES or Hi-Flo® ePM1 70%+					Dust Systems Quad Pulse package, Quantum Series, Gold Series X-Flo, Vertical Deep Bed and Handte Oil Expert
Motor Production areas			N/A	N/A	N/A	N/A	

¹ Values provided for guidance, related to typical industry parameters. Ceiling coverage includes filter efficiency of 99.99%.

² ACH, or air changes per hour. Consideration must always be given to air circulation patterns and other parameters that could negatively affect the required cleanliness level.

Clean Room Info

VENTILATING

TURBULENT

UNI-DIRECTIONAL

Ventilation Efficiency

0.9

Air Change/h

80

24,000 m³/h

Outdoor Air

Recirculation[%]

80

TERMINAL FILTER

Particle(start) /m³

5,000,000

Room Dimension[m]

H 3

W 10

L 10

Particle(process)/s

100,000

People

10

0,3 μm

Clothes


Outdoor Air [particle/m³]

300,000,000

Clothes [particle/s]

20,000

BATTERY BUSINESS EVENT



camfil CLEAN Report

Customer site information

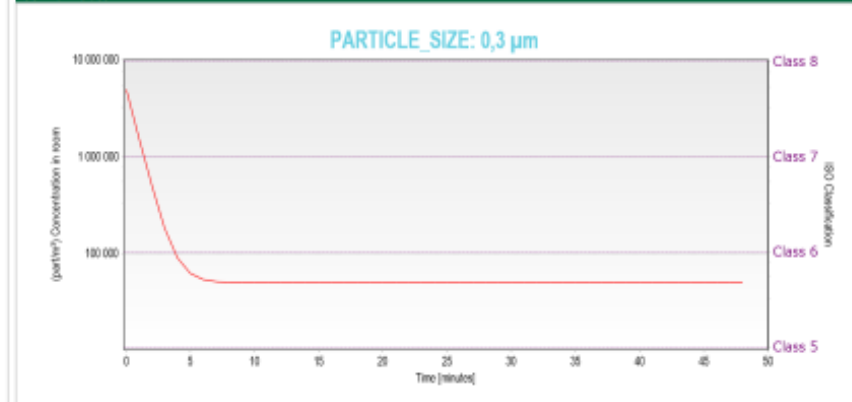
Company
Contact
Phone
Email
Address

Report prepared by

Company Camfil Svenska AB
Contact Robert Lövgren
Phone
Mobile
Fax
Email Robert.Lovgren@camfil.com
Date 2023-March-08

Clean Room Calculation

Solution 1	
FILTER 1	F7, 45%
FILTER 2	F9, 80%
FILTER 3	NONE, 0%
TERMINAL FILTER	H14, 99.998%
Result: Particles > 0.5µm	
Cleanliness level after	
1 minute	1 541 043 part/m ³
10 minutes	50 178 part/m ³
1 hour	50 147 part/m ³
Steady State	50 147 part/m ³
Fed Std 209E Class	M4.2 (0.3 µm)
ISO 14644 Class	ISO5.7
ISO 14644 Class	



Clean Room		Particle Concentration	
System	TURBULENT	Particle Size	0.3 µm
Exhaust Efficiency	0.9	Outdoor Air	LARGE TOWNS (2042)
Recirculation	80.0%	Particles (air)	200 000 000 part/m ³
Air Change/Sec	100 x 10.0m x 10.0m	Particles (people)	4 000 000 part/m ³
Number of people	10	Particles (process)	100 000 part/m ³
Room Dimension [H x W x L]	2.0m x 10.0m x 10.0m	Clothes	CLEAN ROOM CLOTHES 20 000 part/m ³

VIDEO HEPA-LAB

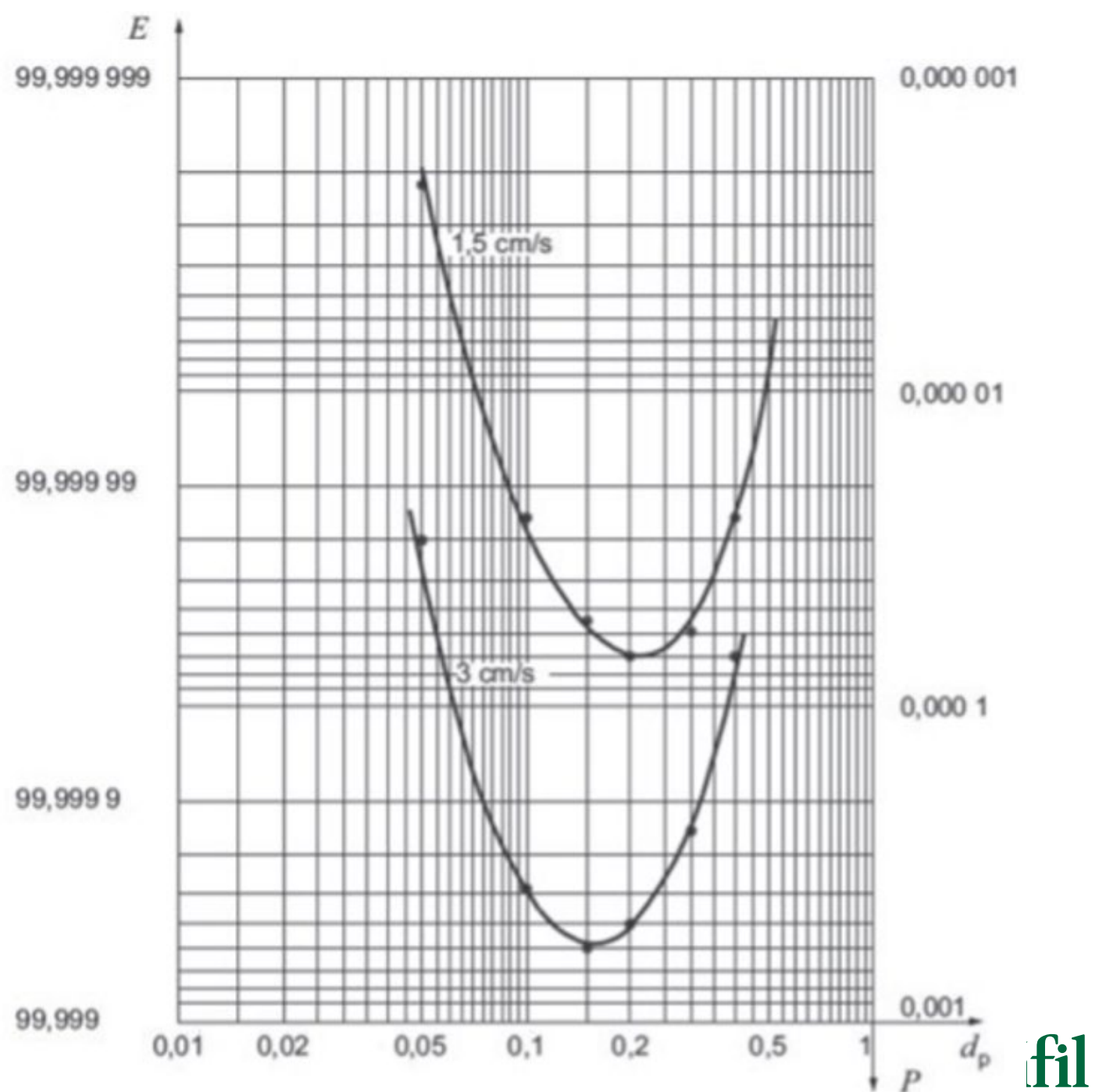
CLASSIFICATION

- EPA: Efficient Particulate Air filter
- HEPA: High Efficiency Particulate Air filter
- ULPA: Ultra Low Penetration Air filter

EN 1822 Filterklasser	ISO 29463 Filterklasser	MPPS Eff. (%)
E10		≥ 85
E11	ISO 15 E	≥ 95
	ISO 20 E	≥ 99
E12	ISO 25 E	≥ 99,5
	ISO 30 E	≥ 99,9
H13	ISO 35 H	≥ 99,95
	ISO 40 H	≥ 99,99
H14	ISO 45 H	≥ 99,995
	ISO 50 U	≥ 99,999
U15	ISO 55 U	≥ 99,9995
	ISO 60 U	≥ 99,9999
U16	ISO 65 U	≥ 99,99995
	ISO 70 U	≥ 99,99999
U17	ISO 75 U	≥ 99,999995

MPPS

– MOST
PENETRATING
PARTICLE SIZE



VIDEO – MANUFACTURING SITE TROSA

camfil HPE Analysis Report

Customer site information

Company
Contact
Phone
Email
Address

Report prepared by

Company Camfil Svenska AB
Contact Robert Lövgren
Phone .
Mobile .
Fax
Email Robert.Lovgren@camfil.com
Date 2023-March-01

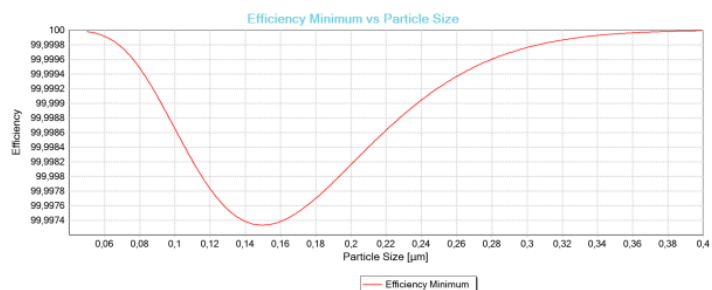
Analysis Report

Absolute DE14



Size (mm) 610,00(W) x 610,00(H) x 292,00(D)
Effective Media 39,90 m²
Air Flow 3 000,0 m³/h
Outer Face Velocity 2,24 m/s
Inner Face Velocity 2,55 m/s

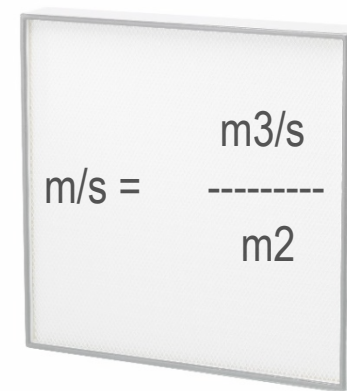
Filter Performance



Filter Class H14
MPPS 0,151 µm
Efficiency Minimum 99,99733 %
Efficiency Typical 99,99942 %
Efficiency at 0,3 µm
Efficiency Minimum 99,99976 %
Efficiency Typical 99,99994 %

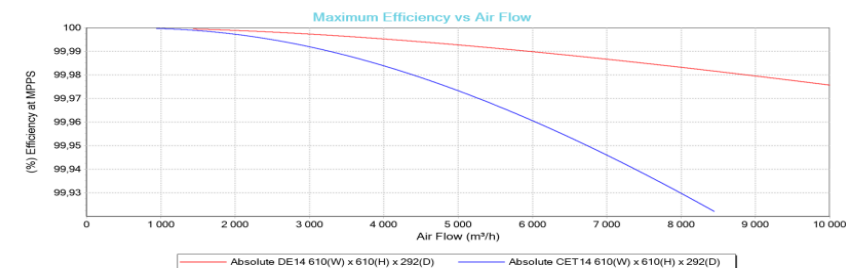
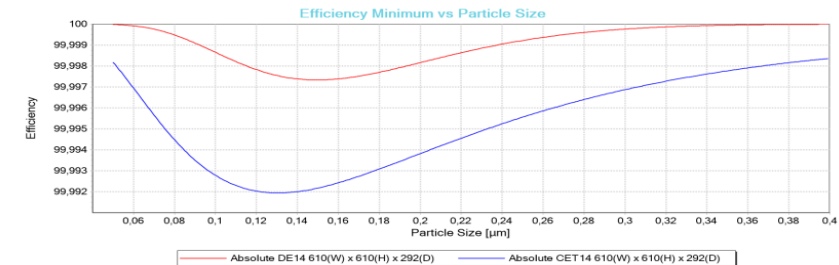
Construction

Frame Type E/CP
Filter Depth 292,0 mm
Centre Support Bar (0.6 mm) No



Comparison Report

Graphs



BATTERY BUSINESS EVENT



FACTORY & INTEGRITY TEST

ISO 29463 & EN 1822

- Part 1 (EN 1822) Classification required tests
- Part 2 (ISO 29463) Aerosol Production
- Part 3 (ISO 29463) Flat sheet media testing
- Part 4 (ISO 29463) Flat leak testing (scan method)
- Part 5 (ISO 29463) Filter efficiency testing



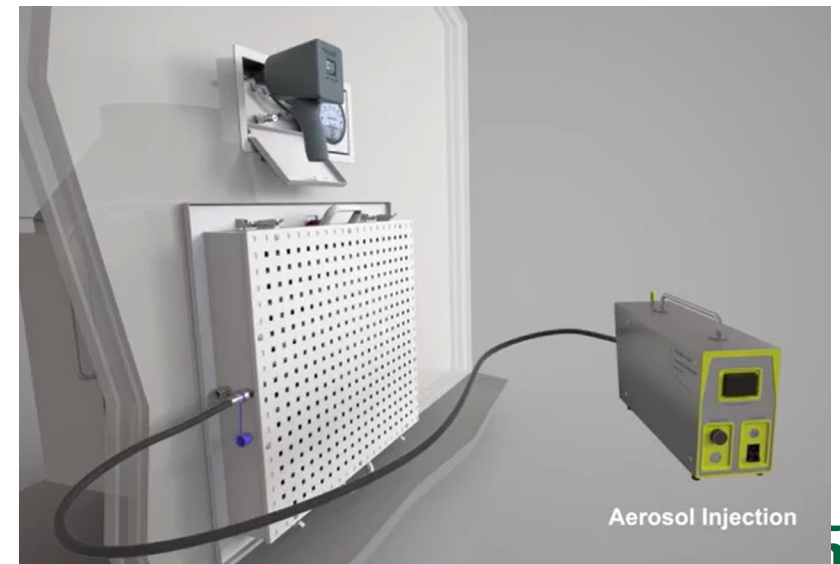
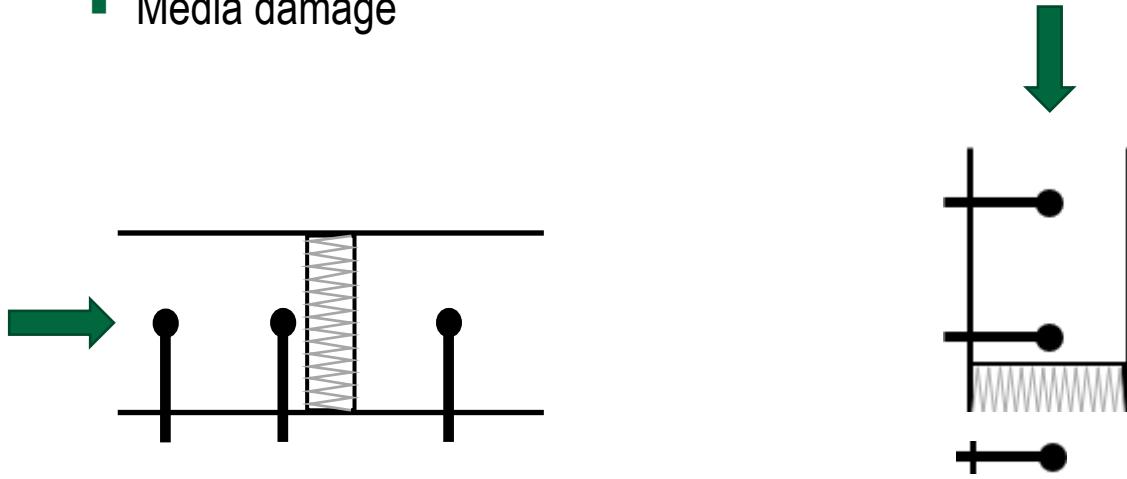
VIDEO – LABORATOR TESTS

VIDEO - FACTORY SCANNING



INTEGRITY TEST ISO 14644-3

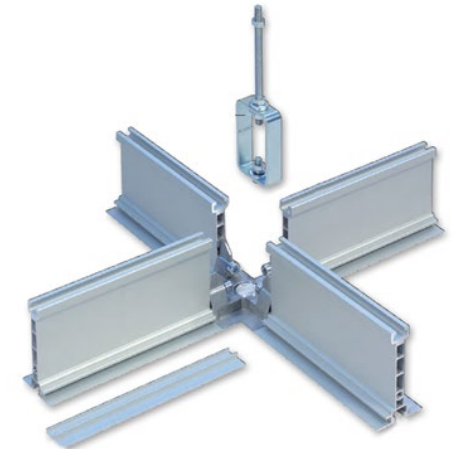
- 1-100 mg/m³ upstream concentration
- 100% port / upstream
- +/-15%
- Max penetration 0,01 %
- Gasket
- Fitting Hepa and housing
- Media damage



INSTALLATION OPTIONS SUPPLY AND EXHAUST APPLICATION HOUSINGS

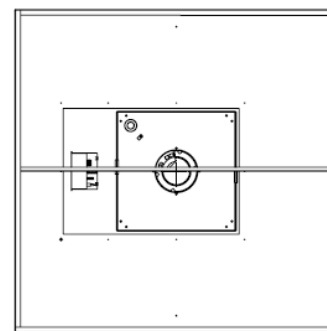
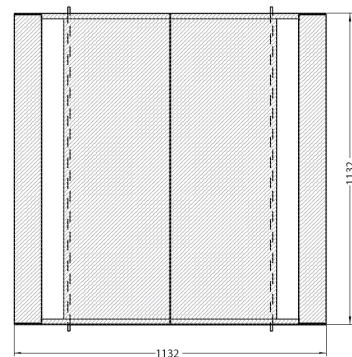
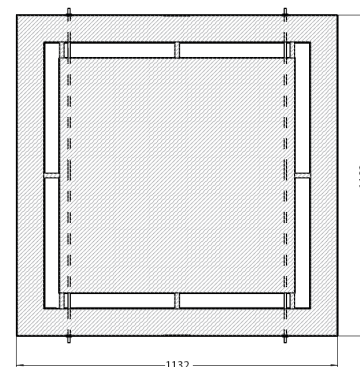
CAMFIL FFU PRODUCT PORTFOLIO

- Wide range of Cleanroom Products available
- Filter Fan Units
- Ceiling Grid System
- Blank panels
- Lighting
- Control Systems
- Air Showers

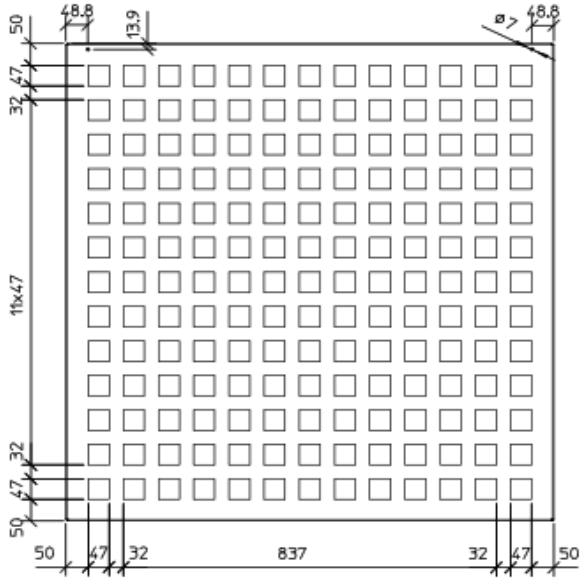


CamFFU Portfolio

- First choice = CamFFU **HP-EC**
 - “high performance”
 - Best for unidirectional airflow
 - Suitable for ISO 1 to ISO 8
 - Lowest possible sound power level
- Second choice = CamFFU **BP2-EC**
 - “basic performance 2”
 - Best for turbulent ISO 3 to ISO 8
 - Low sound power level
 - Low Energy consumption
- Third choice = CamFFU **SP-EC**
 - “start performance”
 - Very competitive price
 - Very low energy consumption



ACCESSORIES FOR FILTER FAN UNITS

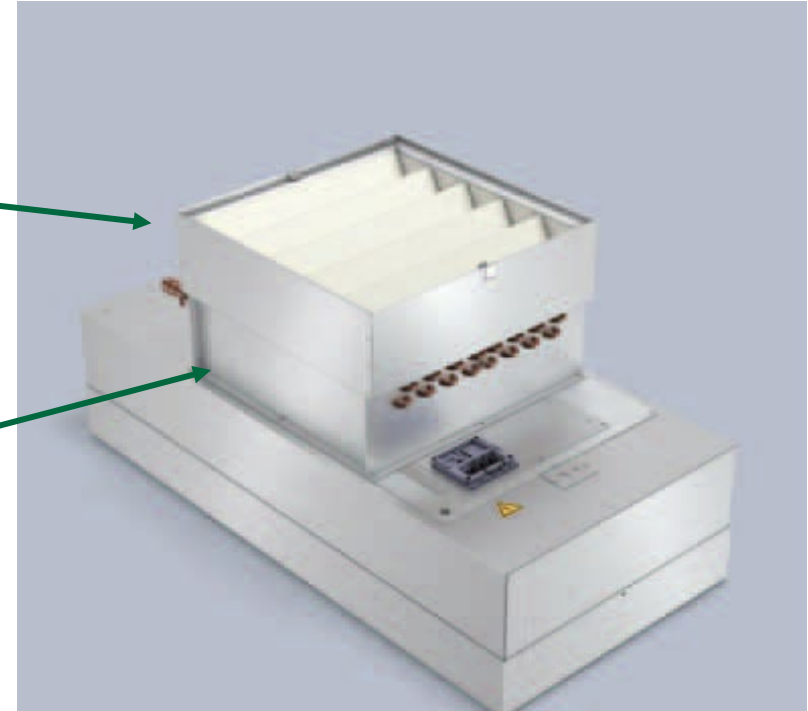


Nozzle Air Outlet for High Cleanrooms

→ Perforated sheet for higher flow speed

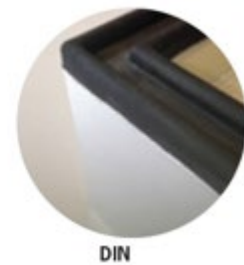
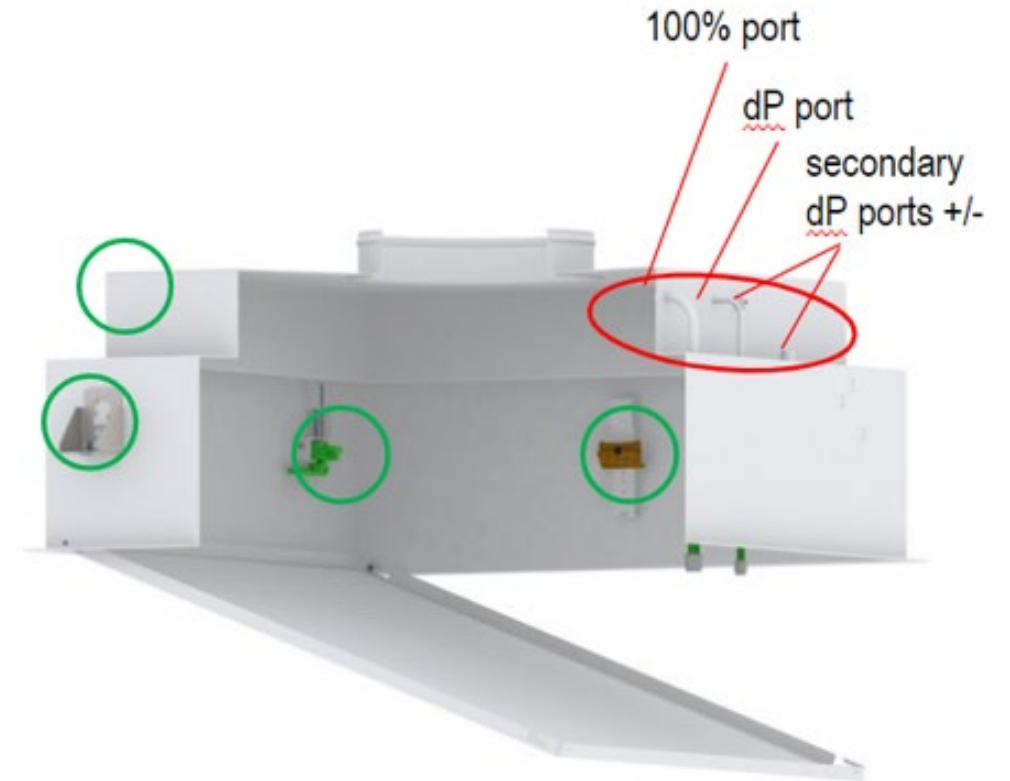
Pre-/AMC-Filters

Cooling Coils



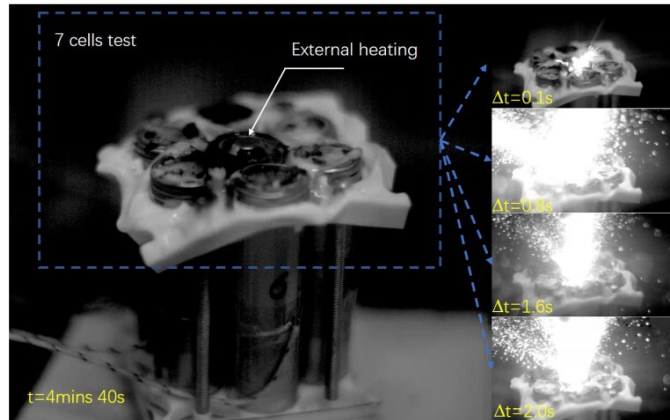
CLEANSEAL V3

- 2 mm mild steel fully welded body and upstream needed ports
- Dubbel layer ovenbaked epoxy powdercoating
- Adjustable clamping retainer (MD/MX/MG)
- Positioning features for filter before clamping
- No tools needed
- Different gasket options
- Integrity version

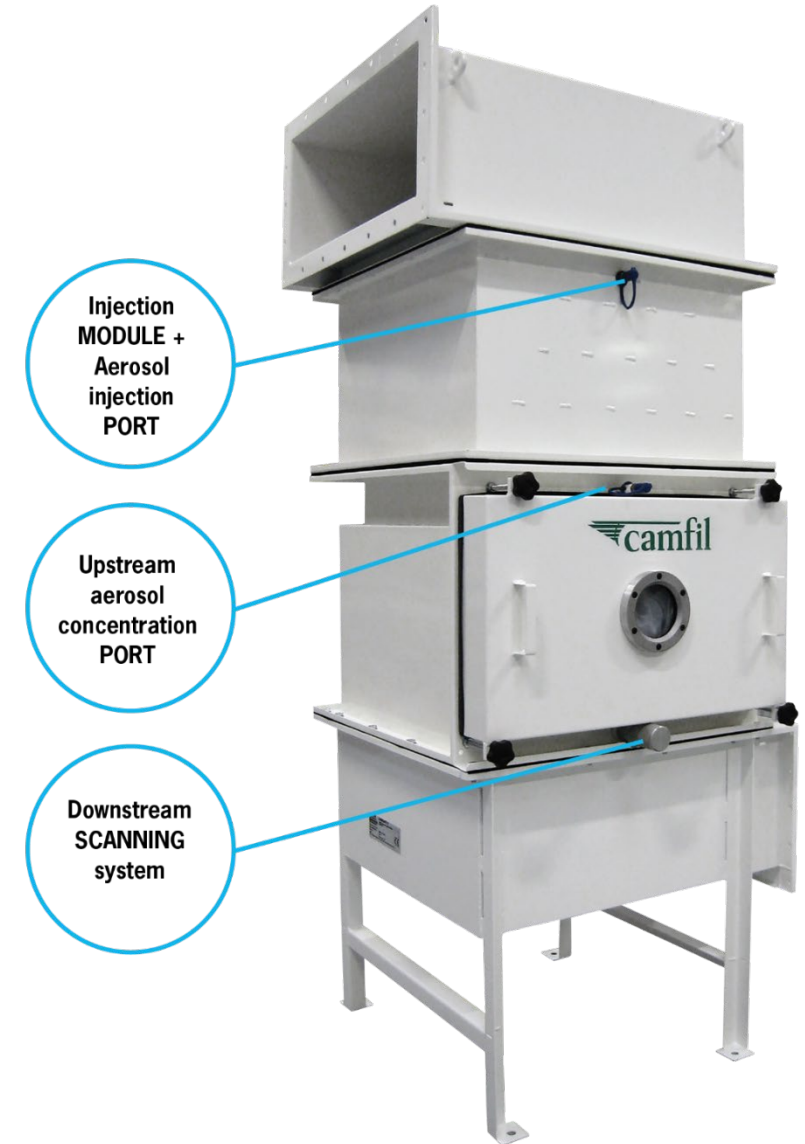


VIDEO - CLEANSEAL EXHAUST INTEGRITY
EXHAUST HEPA HOUSING

CAMSAFE 2 – EXHAUST CONTAMINATION CONTROL



CAMSAFE 2 – EXHAUST CONTAMINATION CONTROL



PRODUCT DEMO



QUESTIONS