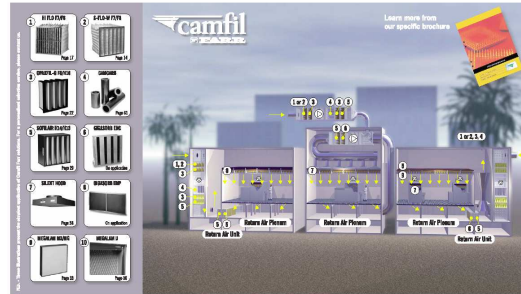


Test Methods and Standards

HEPA / ULPA FILTERS (ABSOLUTE filters)

CAMFIL FARR SOLUTIONS - MICROELECTRONIC INDUSTRY



Howell Park Way, Huddersfield, Lancashire, BD4 4RS

Tel: +44 (0) 1763 228000, Fax: +44 (0) 1763 226736

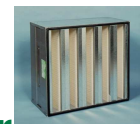


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Definitions

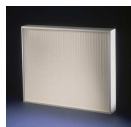
HEPA

High Efficiency Particulate Air



ULPA

Ultra Low Penetration Air



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EN1822 – The HEPA/ULPA Standard

EN 1822 gives us

A test method and....

A classification system based on....

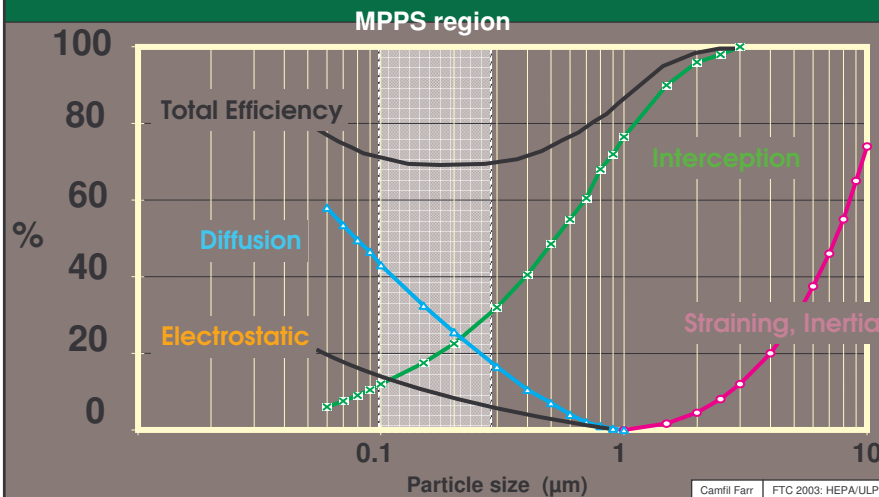
MPPS

Maximum Penetrating Particle Size



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EN 1822 Classification - MPPS



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MPPS Information

- MPPS normally in range 0.1-0.25 μm for HEPA/ULPA filters
- Media velocity* & media type defines

1. MPPS
2. Efficiency
3. Pressure Drop

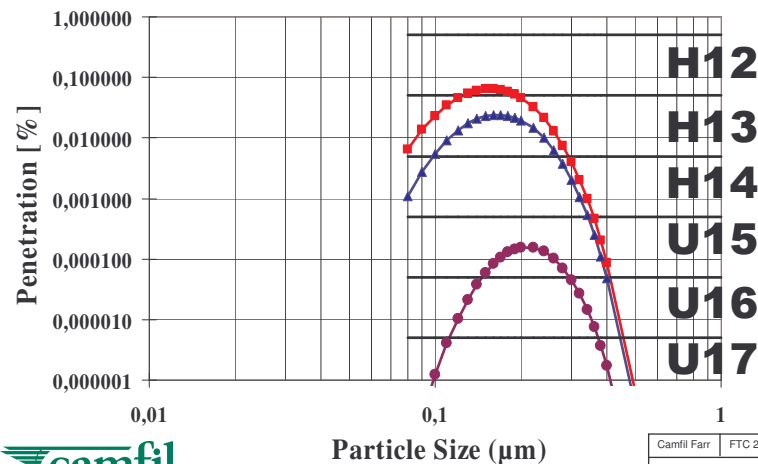
* Note the difference between media velocity and filter face velocity



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MPPS, Same Media at 3 Velocities

— 2 cm/s — 1.5 cm/s — 0.5 cm/s



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EN 1822 – 5 Parts

- 1) Classification, performance testing, marking
- 2) Aerosol production, measuring equipment
- 3) Testing flat sheet filter media for MPPS
- 4) Leakage of filter element (Scanning)
- 5) Overall efficiency of the Filter element



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EN 1822 Classification - MPPS

Filter Class	Overall Value		Local (leak) Value ¹	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
H10	85	15	---	---
H11	95	5	---	---
H12	99.5	0.5	---	---
H13	99.95	0.05	99.75	0.25
H14	99.995	0.005	99.975	0.025
U15	99.9995	0.0005	99.9975	0.0025
U16	99.99995	0.00005	99.99975	0.00025
U17	99.999995	0.000005	99.9999	0.0001

1. Lower local values may be agreed between supplier and purchaser



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Test Equipment - Aerosol

Common EN1822 Aerosols

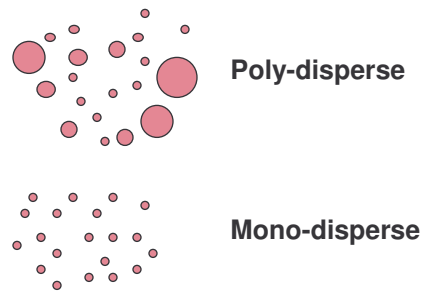
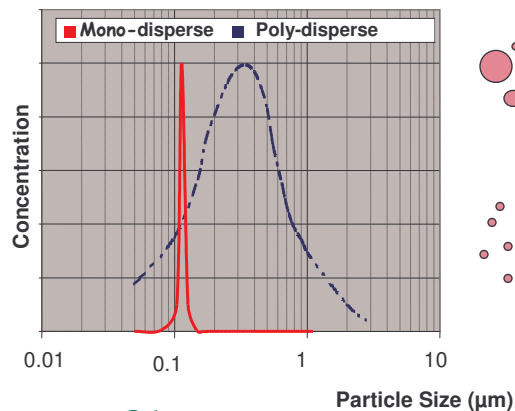
- DEHS (DOS) liquid
- DOP liquid
- Emery 3004 liquid
- Si O₂ solid
- Latex solid (plastic)



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Aerosol Types

Poly- and Mono-disperse aerosol distribution



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Aerosol Generation

Achieved using for example

- Laskin Nozzles
- Thermal generators
- Spray nozzles

Must be reproducible and stable

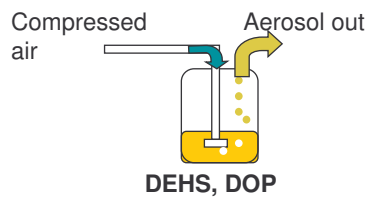


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Aerosol Generation

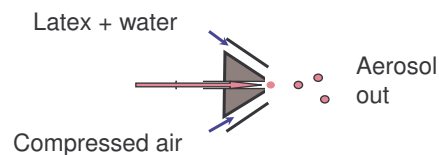
Laskin Nozzle

DEHS, DOP



Spray Nozzle

Latex, Silica (SiO_2)

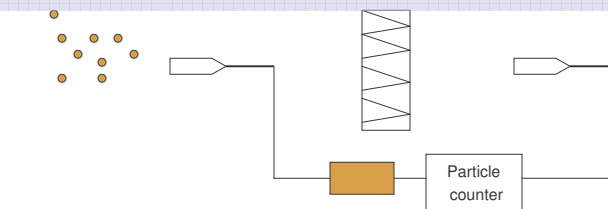


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Aerosol Dilution Why?

Typical Bag filter test
5 000 particles/L at MPPS

99.995 % eff gives:
0.25 particle /L



HEPA test
5 000 000 particles/L
at MPPS

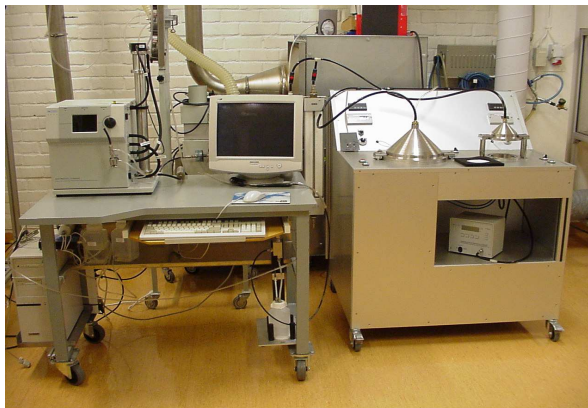
Dilution x1000

99.995 % eff gives:
2500 particle /L



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Media Test – CPC at Camfil AB Lab



Condensation
Particle
Counter

0.01 – 1.0 μm range,
State of the Art
research instrument
for MPPS



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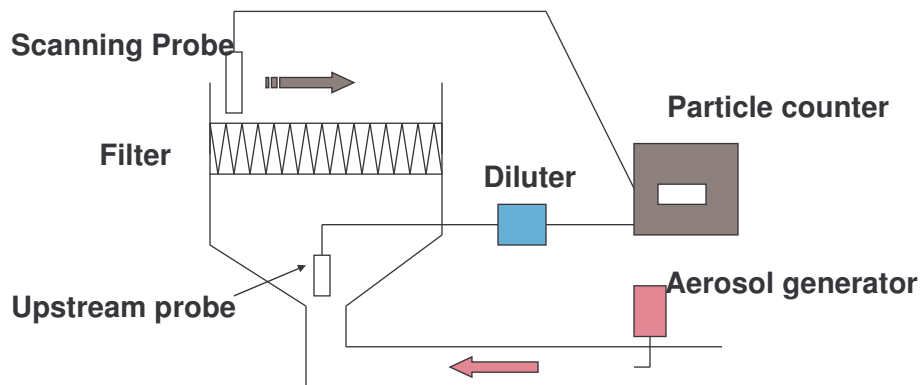
HEPA/ULPA “Auto-Scan” Locations

- Camfil KG (Germany)
- Camfil Svenska AB
- Camfil SA (France)
- Camfil Inc. (Filtru, US)
- Camfil Malaysia



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EN 1822 Factory Test



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EN 1822 Factory Test

Test for:

- Leakage
- Overall Efficiency
- Pressure Drop



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Some more about Leakage

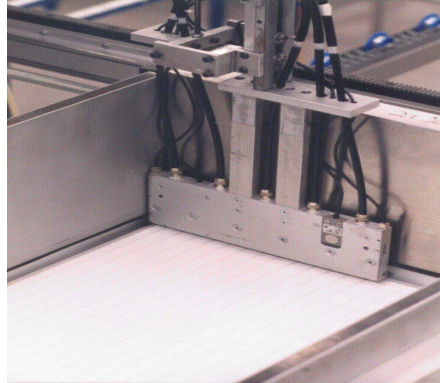
- Defined as point in filter where local efficiency falls below given limit value.
- A small local leakage has a minor effect on the overall penetration
- No particles $> 0.5 \mu\text{m}$ should be present downstream for a leak free filter



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“Auto-Scanner” Features

- Computer-controlled
- 6 particle counters (fast & accurate leak detection)
- Detects leaks, measures dp and overall efficiency
- Advanced “edge detection” system



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Scanning EN 1822 Requirements

- Scan downstream using a 9 cm² probe 10 - 50 mm from filter surface
- If all penetration values are less than limiting value in classification the filter is leak free



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Scanning EN 1822 Requirements

- Penetration of a single leak not be greater than 5 times the overall penetration up to U16
- For U17 filters a leakage factor of 20 times overall penetration is allowed
- Oil Thread Test OK for H12 - H14



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Oil Thread test



- Visual test H12 – H14
- Oil mist at high conc.
- Low velocity
- Used for leak location



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EN1822 Summary

- EN 1822 for factory test – **MPPS & Leakage to Classify**
- EN 1822 describes test method, equipment and classification of HEPA/ULPA filters
- **Communicate with customer** – Should the filter be tested? Which test method is required from customer?
- If in doubt contact manufacturing plant or Camfil AB R&D



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Other Tests and Standards

- UL900 Standard for Air Filters
- DIN 53438 Burning behaviour of materials
- Factory Mutual standard 4920

***Library of international standards at the R&D
dept. Sweden***



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