



International
Organization for
Standardization

ISO 16890 new Filter Standard and Eurovent 4/23-2017 recommendation

Tallinn

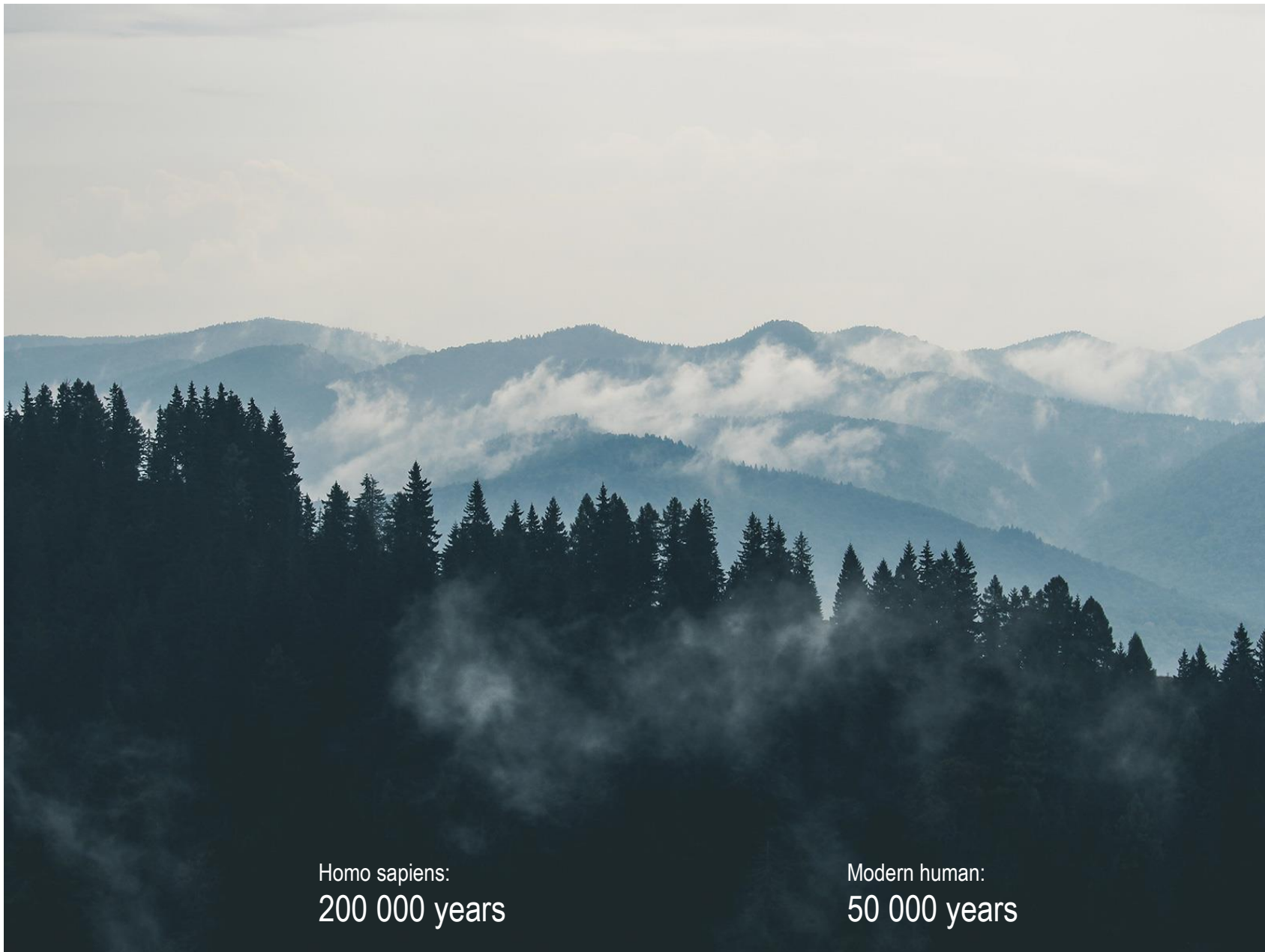
2018-09-27
Mikko Immonen

Camfil Oy

AGENDA

- IAQ – indoor air quality
- ISO 16890
- Eurovent Recommendation 4/23 on the selection of EN ISO 16890 rated air filter classes

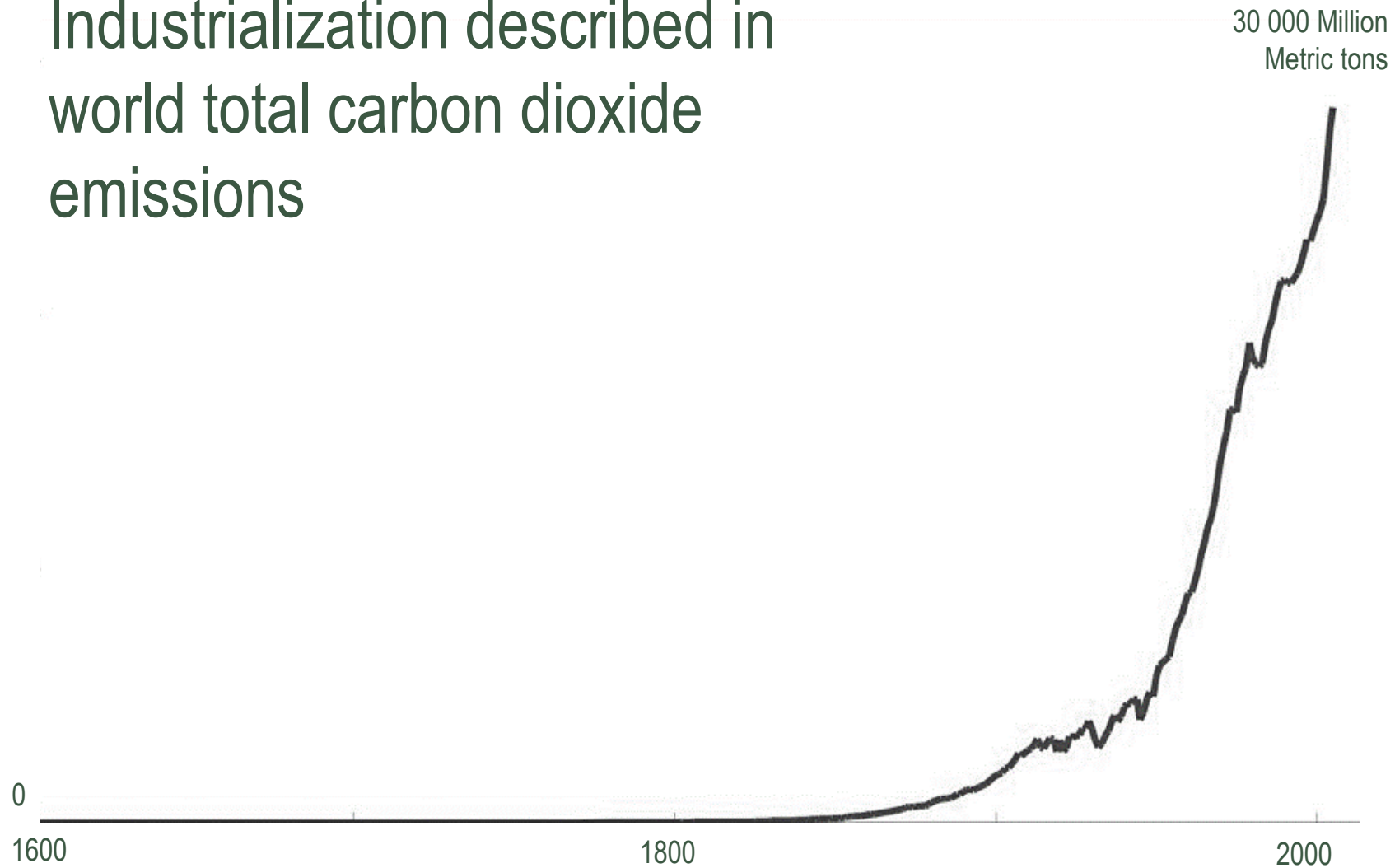
IAQ = INDOOR AIR QUALITY



Homo sapiens:
200 000 years

Modern human:
50 000 years

Industrialization described in world total carbon dioxide emissions



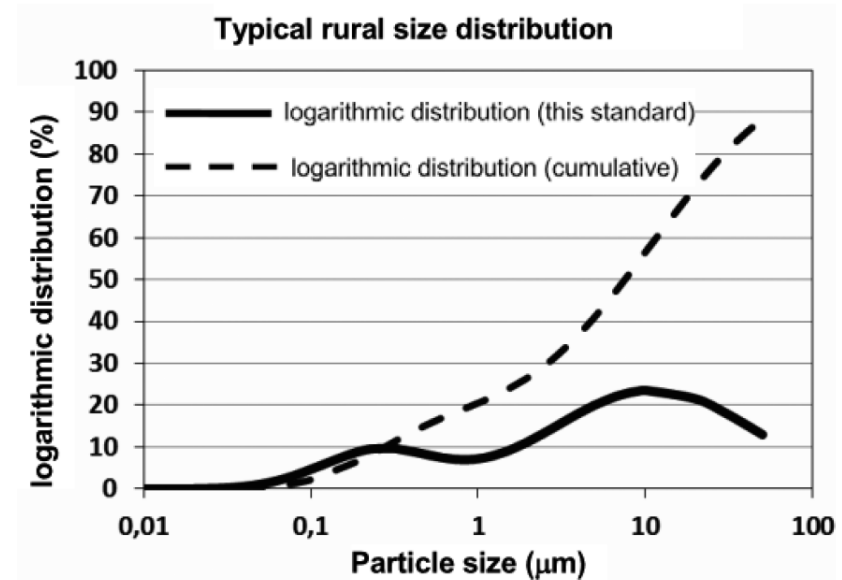
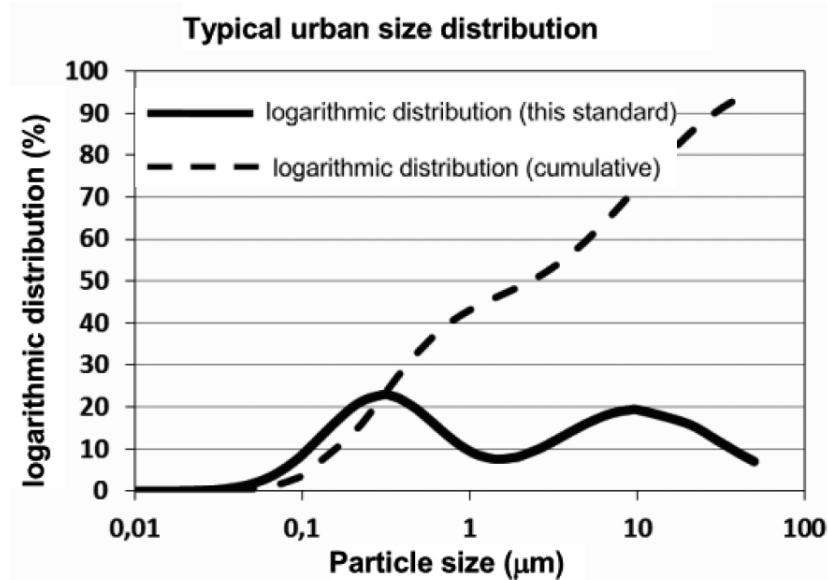
Marland, G., T.A. Boden, and R. J. Andres. 2003. "Global, Regional, and National CO₂ Emissions." In *Trends: A Compendium of Data on Global Change*. Carbon Dioxide Information Analysis Center,



CLEAN AIR SOLUTIONS



Air pollution distribution weight vs particle size

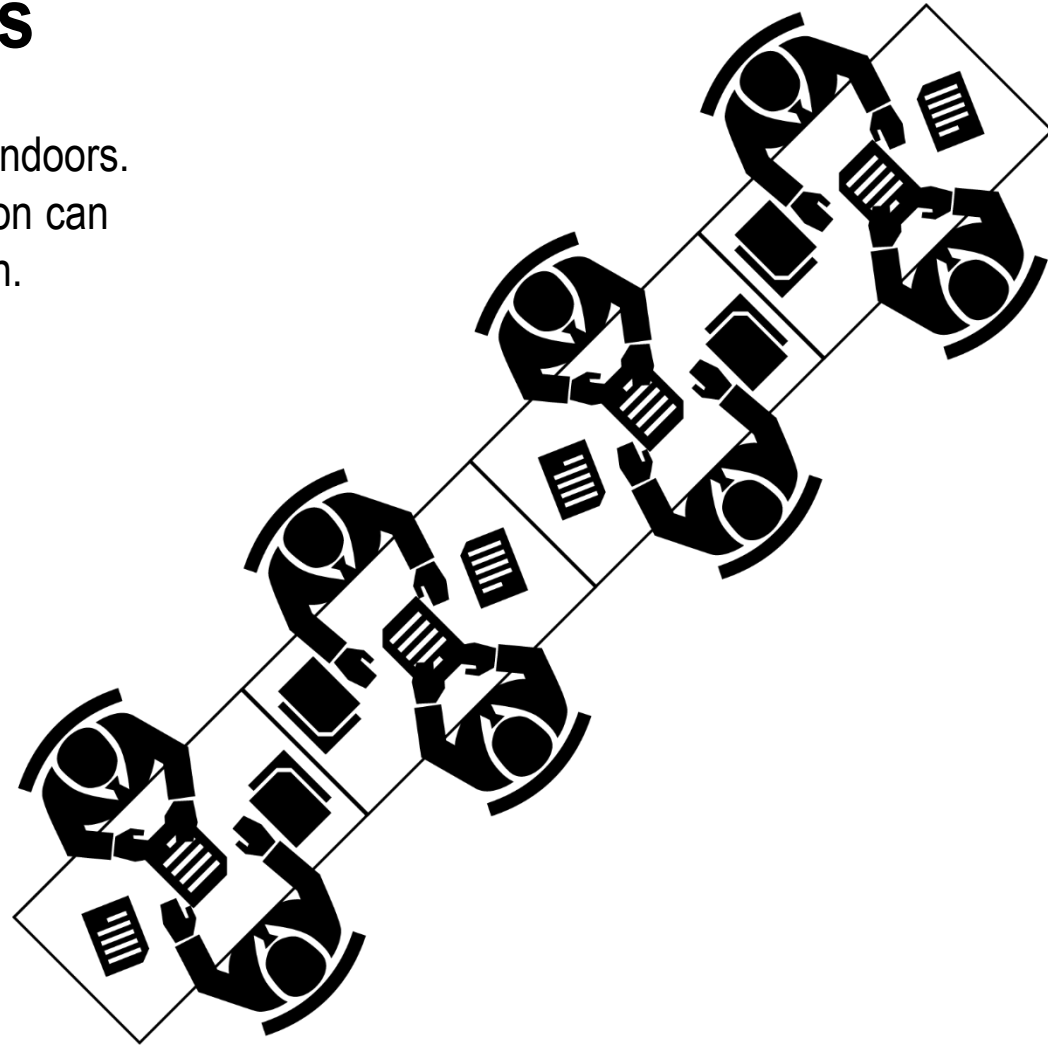


Source: Seinfeld J.H., Pandis S.N., *Atmospheric chemistry and physics*. Wiley Interscience Publications, John Wiley & Sons, New York, USA, 2006

We spend up to 90% of our life indoors

We spend up to 90% of our life indoors.
This means that indoor air pollution can
substantially influence our health.

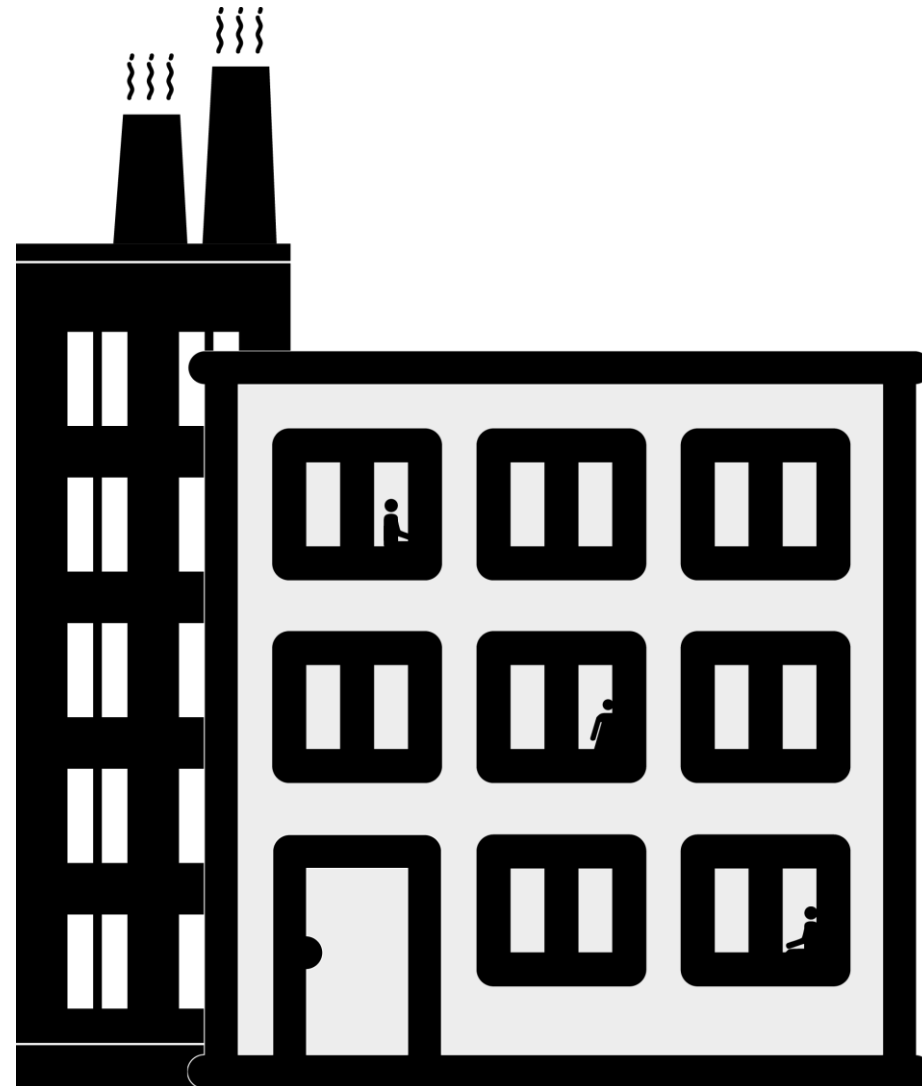
Source: European Union - ECA report no23 Ventilation,
Good Indoor Air Quality and Rational Use of Energy



The indoor environment can be up to 50 times more polluted

Airborne particles enter our buildings through ventilation systems and open doors and windows. In fact, the action of the ventilation system combined with indoor sources of pollution can mean that in many cases indoor air is up to 50 times more polluted than outdoors.

Source: European Union - ECA report no23 Ventilation, Good Indoor Air Quality and Rational Use of Energy



We breathe up to 15 kg air/day

Humans eat 1 kg of food each day, drink 2 kg of fluids and breathe up to 15 kg of air per day. We take care about the food we eat and the water that we drink but rarely do we consider the air we breathe.

Source: Professor Sven Erik Dahlén, Karolinska Institute, Institute of Environmental Medicine (IMM)



Humans eat 1 kg food/day



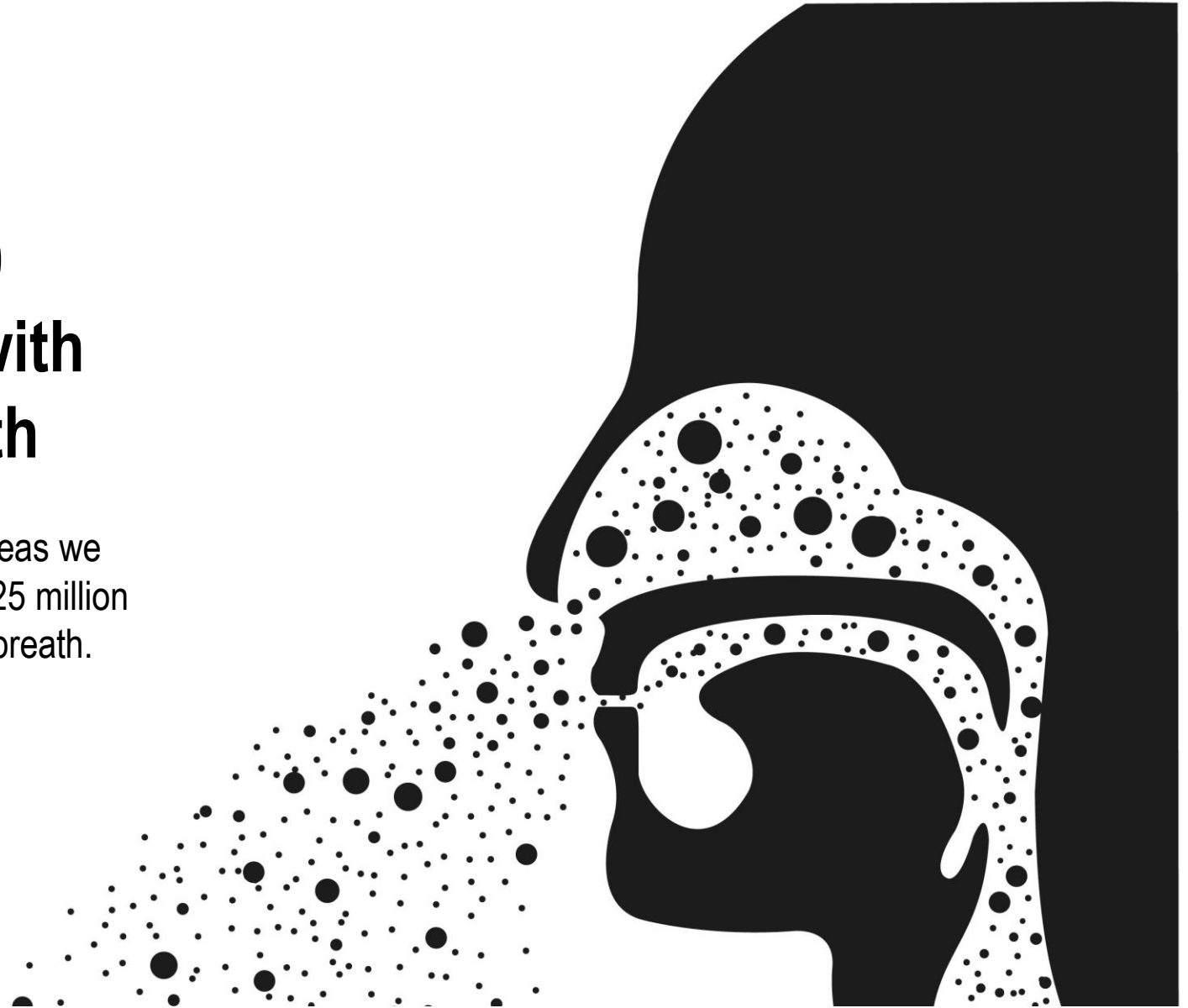
Humans drink 2 kg fluids/day



Humans breathe 15 kg air/day

More than 25,000,000 particles with each breath

In highly polluted areas we breathe more than 25 million particles with each breath.



Definition: Indoor Air Quality

“Indoor Air Quality (IAQ) refers to the air quality within buildings and structures, especially as it relates to the health and comfort of building occupants”.

USA, Environmental Protection Agency

- IAQ and health relates to pollutants – particles, gases and vapours, pathogens
- IAQ and comfort relates to temperature, relative humidity, odours
- IAQ and human performance relates to temperature, carbon dioxide, gases.
- Indoor environment – all of the above plus noise and light

DIFFERENCE BETWEEN PM1 AND PM2.5

- PM2.5 and PM10 moves with the wind outdoors and comes mainly from long distance sources
- PM1 is 75-80% of all mass weight up to PM2.5, that's why it is important to focus on measuring PM1
- PM10 and PM2.5 misrepresent toxicity of pollutants (UFP)
- PM10 and PM2.5 is highly correlated in values but not at all to UFP and Nano
- PM1 correlates to UFP
- PM1 and NO2 come from the same source and the values correlate!

PM1 PARTICLE RANGE ARE THE MOST DANGEROUS

- Sub-micron particles $<1\mu\text{m}$
- Ultrafine particles $<0,1\mu\text{m}$
- Nanoparticles $<0,05\mu\text{m}(<50\text{nm})$

- $1\mu\text{m} = 1/1000\text{th}$ of a millimetre

PM1 → Mass concentration of particles with a diameter less than $1,0\mu\text{m}$

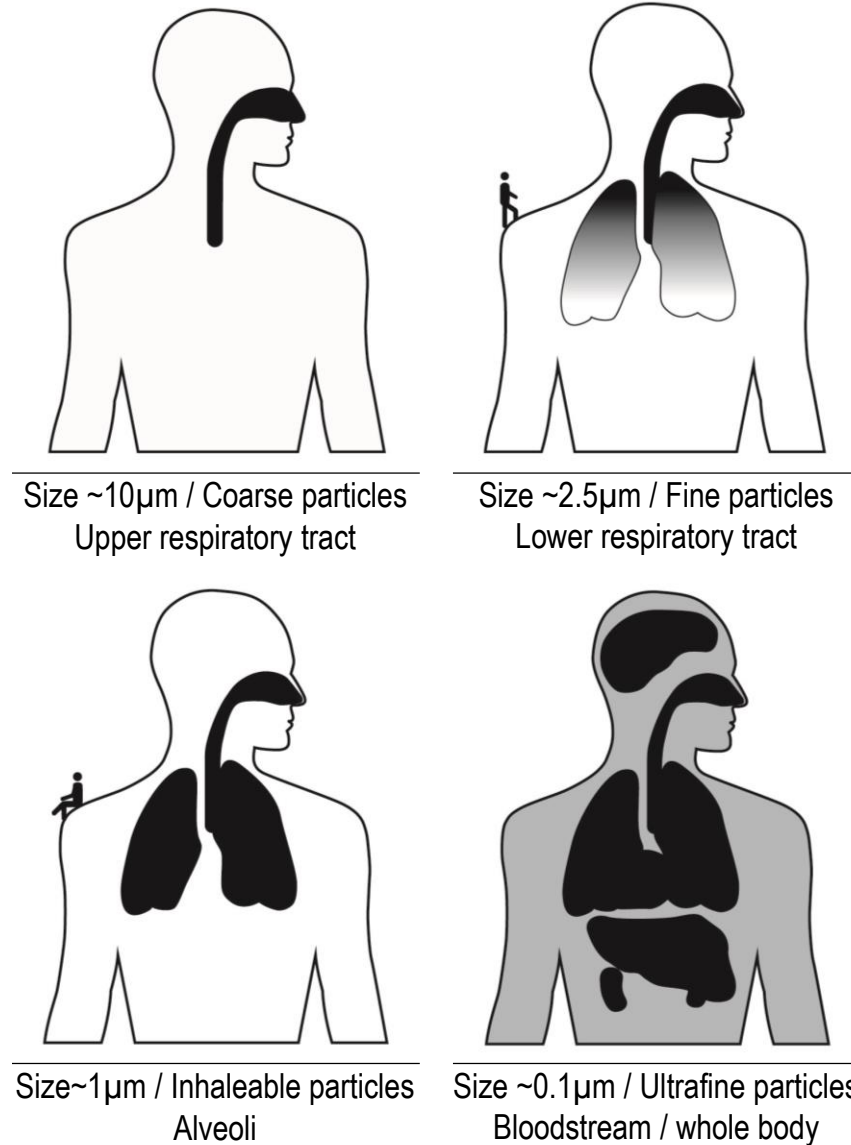
PM2.5 → Mass concentration of particles, diameter less than $2,5\mu\text{m}$

PM10 → Mass concentration of particles, diameter less than $10\mu\text{m}$

Penetration of PM into the body

The human body has natural defences against larger airborne particles i.e. $>2.5\mu\text{m}$. However we have no such barriers against the most dangerous PM₁ particles, $<1\mu\text{m}$. These reach the alveoli where the ultrafine particles ($<0.1\mu\text{m}$) can pass into the bloodstream and reach the critical organs such as the heart, brain, liver and endocrine system.

The images show the distribution of different size particles in the human body.



ISO 16890

AGENDA

1. Background to ISO 16890
2. Detail of differences between ISO and to EN779 & ASHRAE 52.2
3. Detail of ISO testing & classification system
4. What will Eurovent do in relation to ISO 16890?



International
Organization for
Standardization

ISO 16890

Air Filters for General Ventilation

ISO 16890 (all parts) refers to particulate air filter elements for general ventilation having an ePM1 efficiency less than or equal to 99% when tested per the procedures defined within parts 1-4 of ISO 16890.

Introduction

- Testing standards: current situation

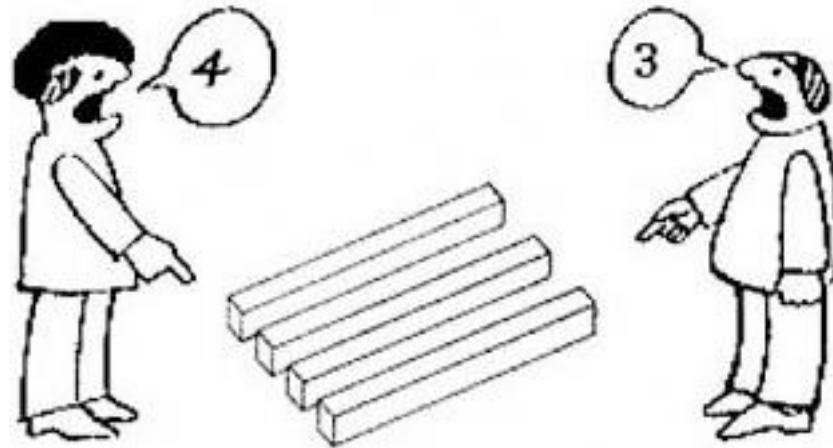


- A significant harmonisation for the air filtration industry has now been published.
- A new standard for filter testing and classification with global coverage.
ISO16890 “Air Filters for General Ventilation”

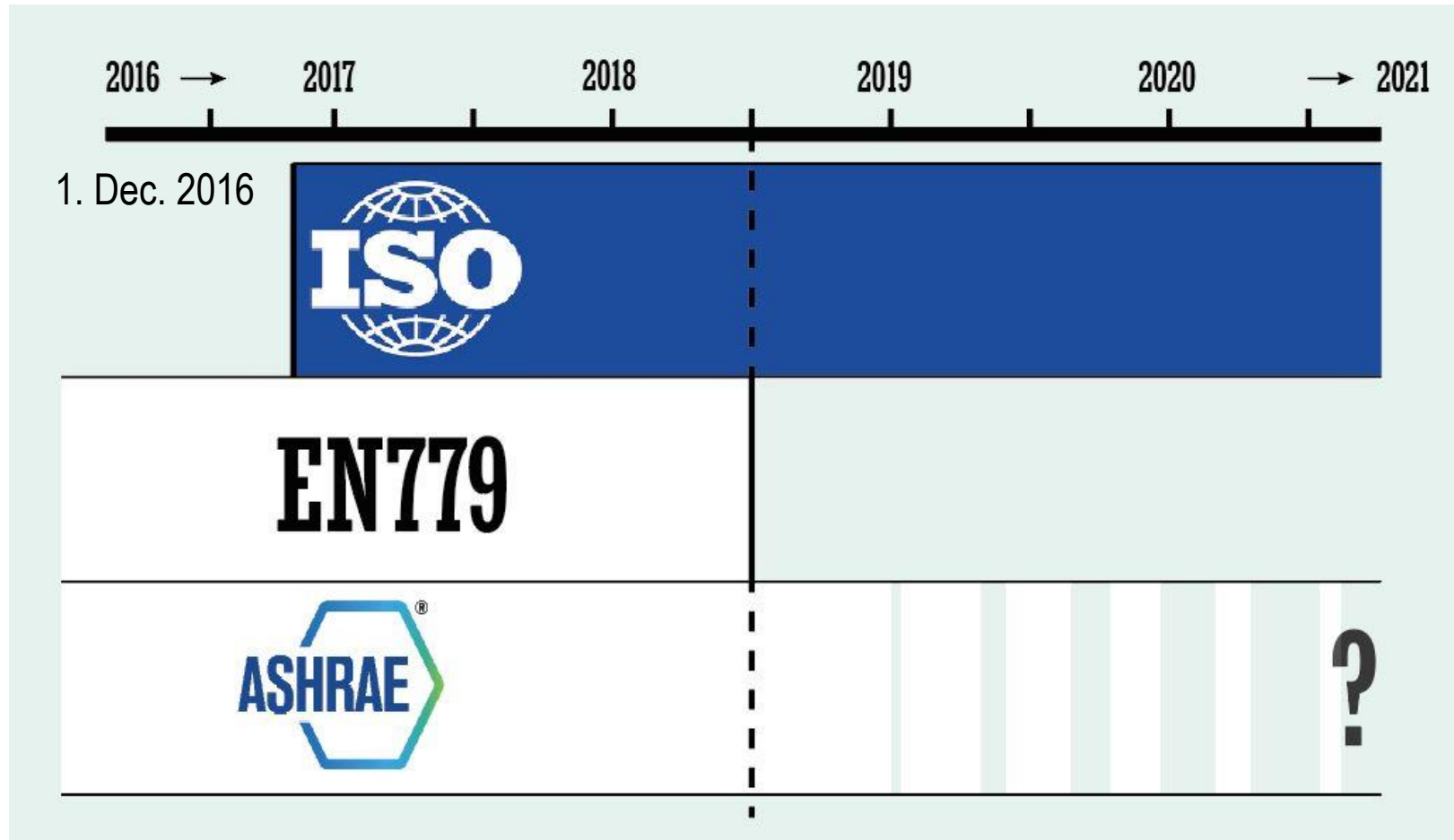
ISO 16890

New global test standard

New way of thinking!



ISO16890: TIMELINE



Why develop a new global test standard?

What are the customer benefits?



Recognition

—

Air filters positively influence
air quality and human health



More intuitive

—

Filter efficiency and
classification aligned with
real world air pollution



Global applicability

—

Eliminate confusion

Why develop a new global test standard?

What are the benefit for the industry:



Level playing field

—

- Fair product comparison.
- Drive product development.
- Drive innovation and customer value.
- Eliminate some low performing products.



Global standard

—

- One test for all providers
- Removes an obstacle to global trade



Simplicity

—

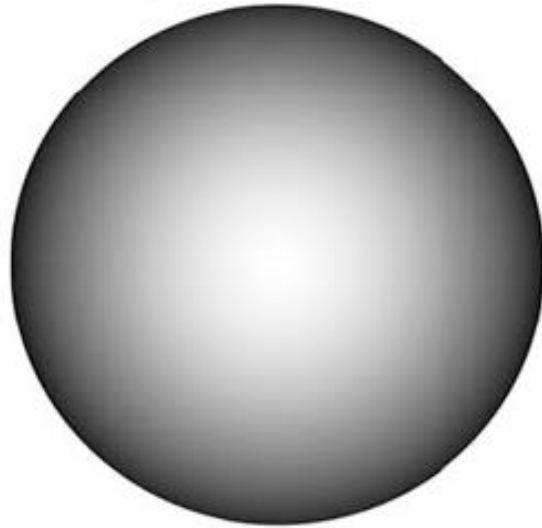
- Easier to explain product value in terms of function and application

Particle Number Concentration and Mass Concentration

Mass*: 70 %

Number*: 1 %

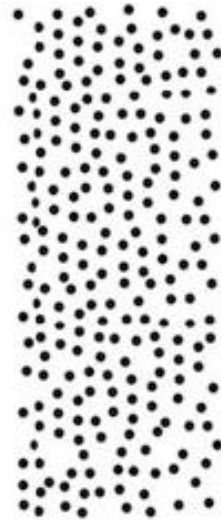
1 microparticle
60 μm diameter
(size of human hair)



22 %

9 %

1 million particles
600 nm diameter
(0.6 μm)



8 %

90 %

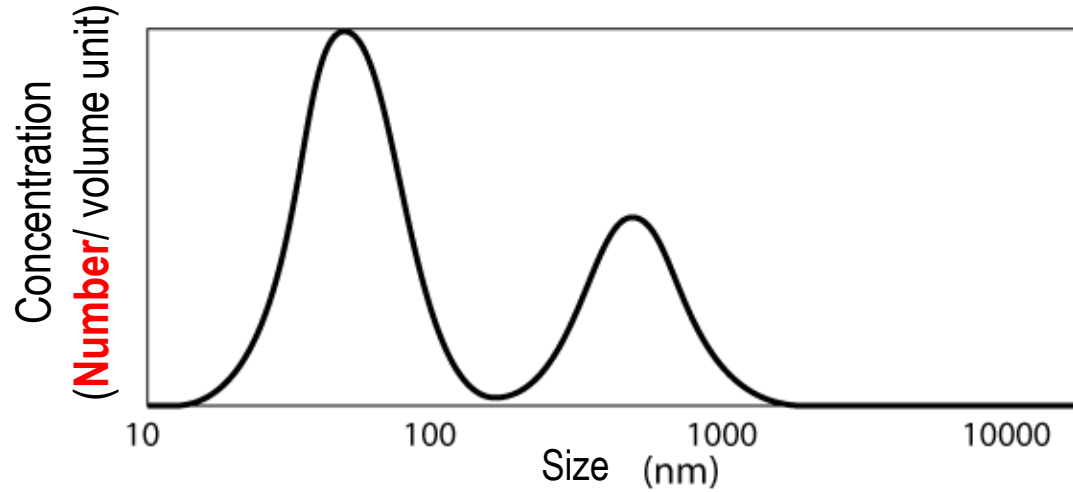
1 billion nanoparticles
60 nm diameter
(0.06 μm)



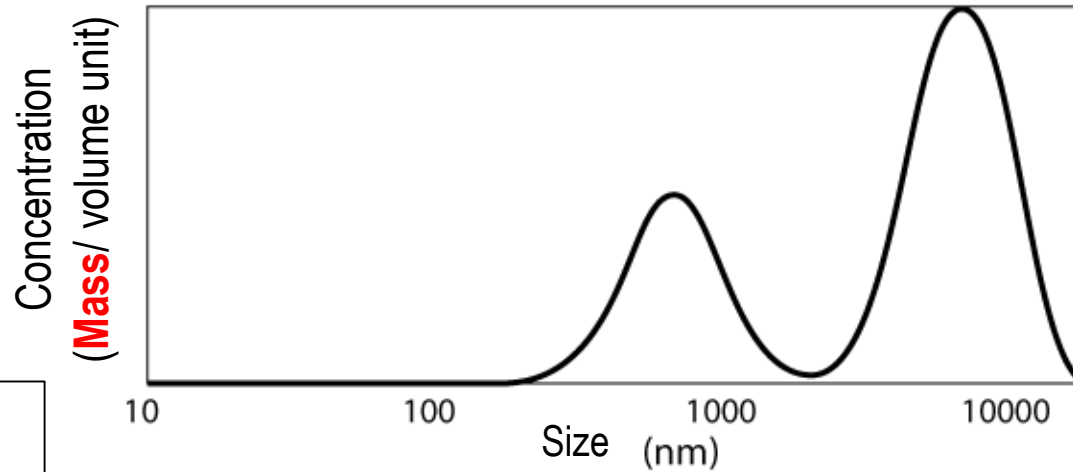
NOTES

- * % of all PM
- 1nm = 0.001 μm

Number or Mass?



EN 779
Number

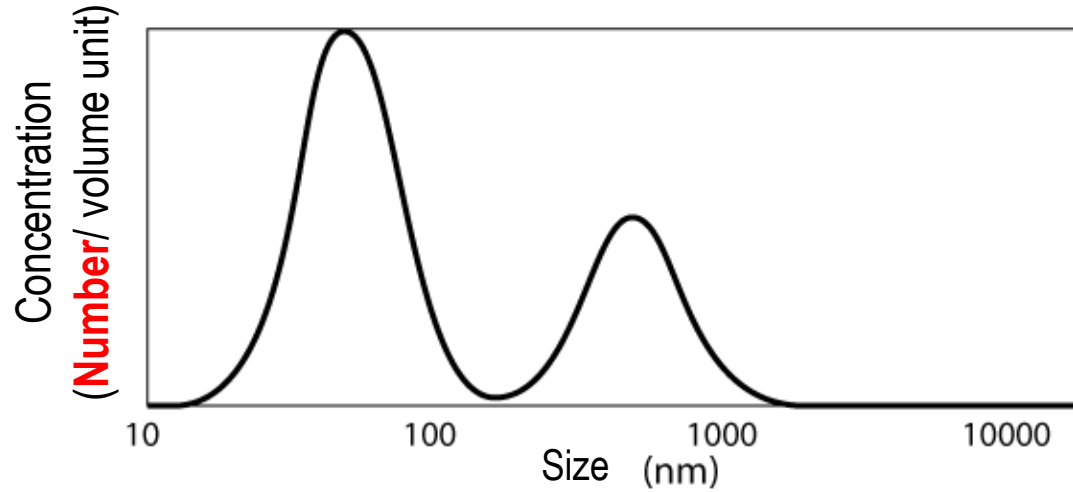


ISO 16890
Mass
PM₁, PM_{2.5}, PM₁₀

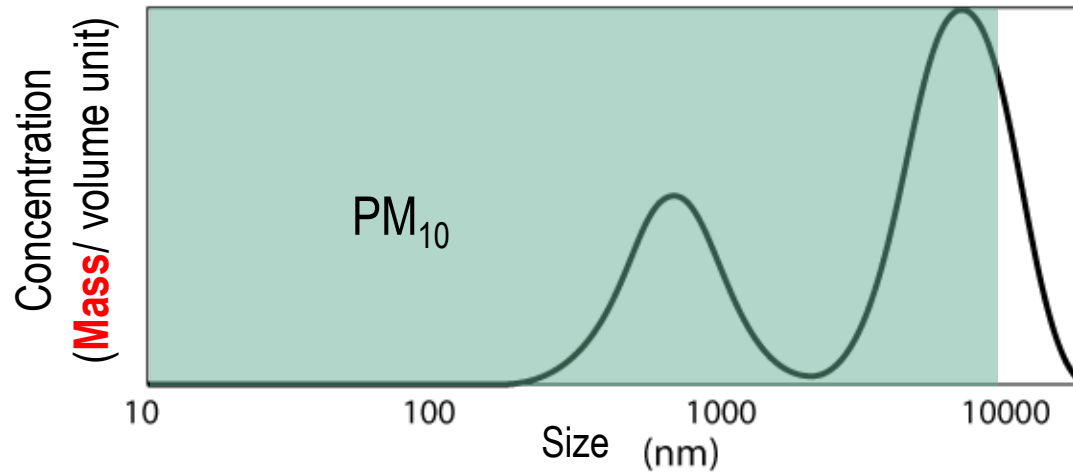
NOTE

1nm = 0.001µm

Number or Mass?

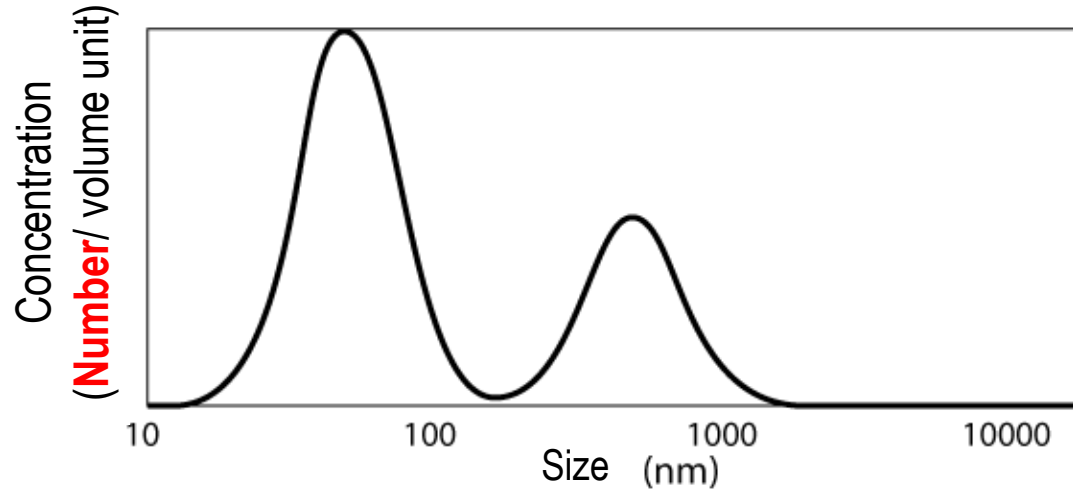


EN 779
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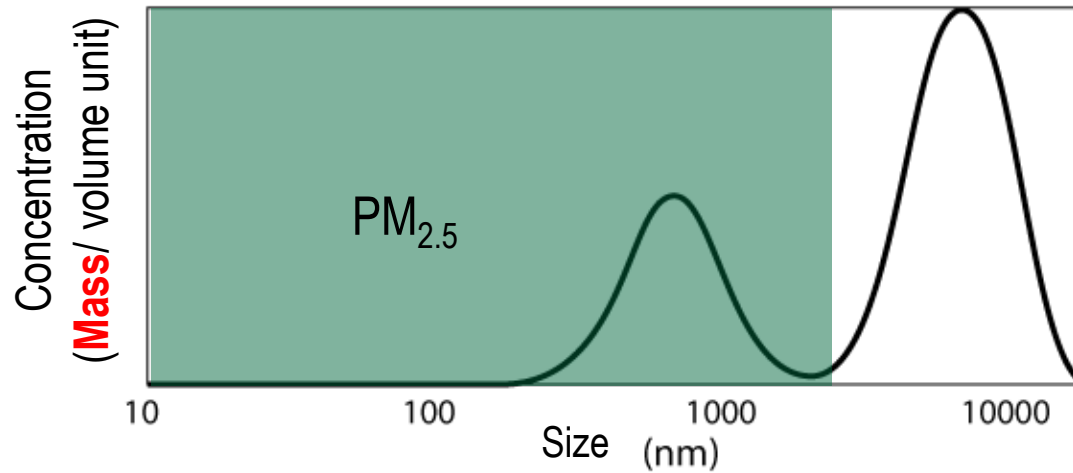


ISO 16890
Mass
PM₁, PM_{2.5}, **PM₁₀**

Number or Mass?

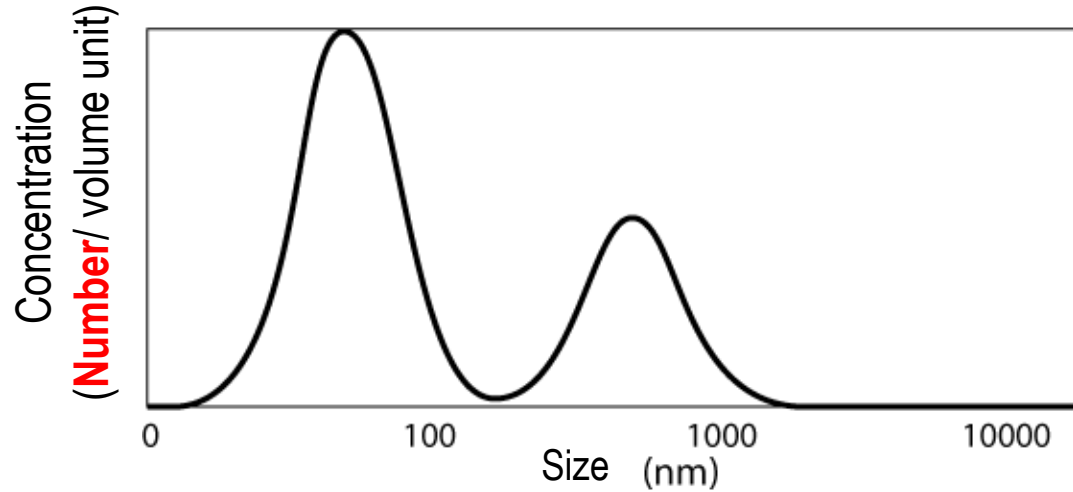


EN 779
Number

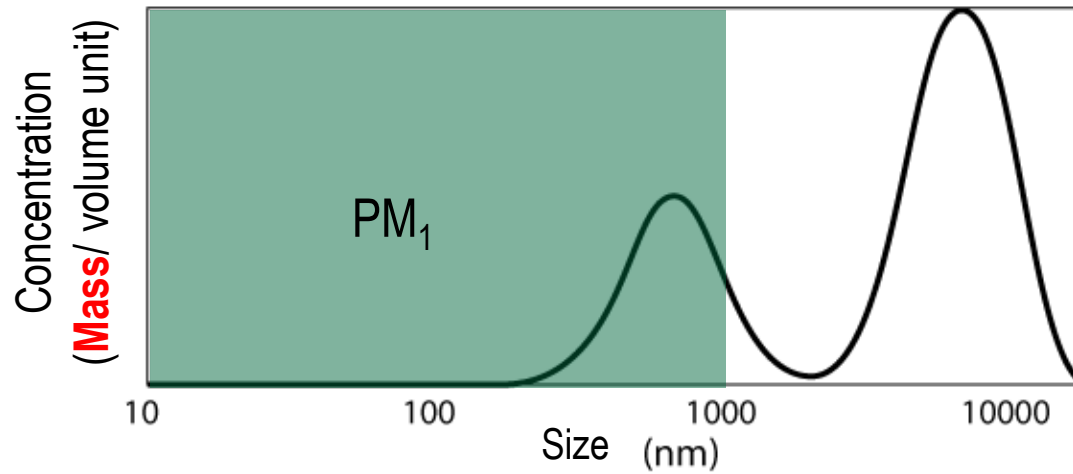


ISO 16890
Mass
PM₁, **PM_{2.5}**, PM₁₀

Number or Mass?

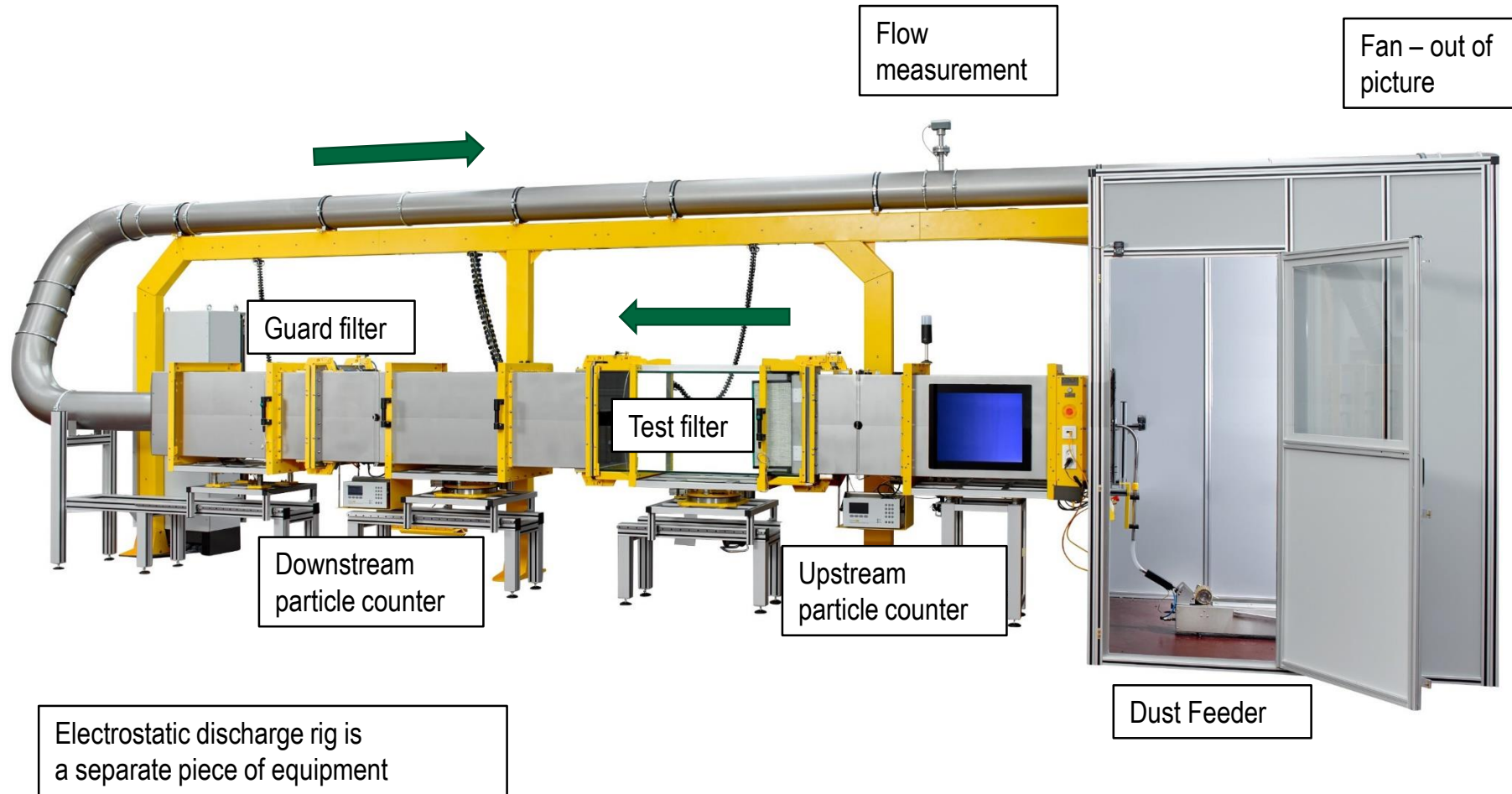


EN 779
Number



ISO 16890
Mass
PM₁, PM_{2.5}, PM₁₀

Air Filter Testing



ISO16890: How Does it Work?

The standard is written in four parts:

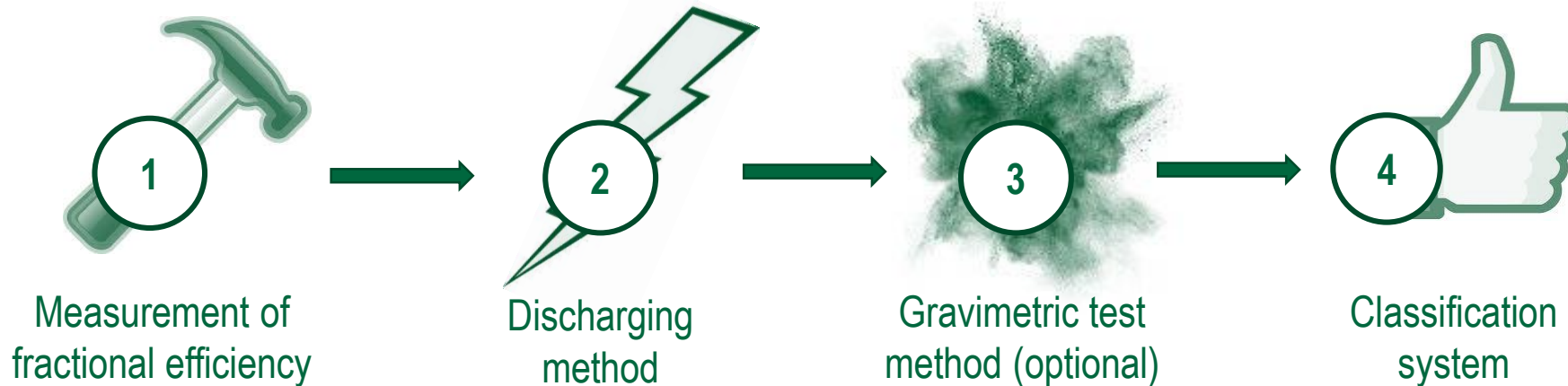
Part 1: Technical specifications, requirements and classification system.

Part 2: Measurement of fractional efficiency.

Part 3: Determination of the arrestance and the air flow resistance versus the mass of test dust.

Part 4: Conditioning method to determine the minimum fractional test efficiency.

IN PRACTICE:



COMPARISON OF TEST STANDARDS

	EN779:2012	ASHRAE 52.2	ISO16890
Filter test method	Testing efficiency with 0,4µm particles	Testing efficiency with 0,3- 10 µm particles. Classifications relate to results for E1, E2 & E3 efficiency classes – MERV rating	Testing efficiency with 0,3- 10 µm particles. Classifications relate to result for PM1, PM2,5 & PM10
Discharging method	Discharges filter media only, using IPA soak Tough discharging method	Discharges entire filter Using KCL salt Soft discharging method (not mandatory – App. J)	Discharges entire filter using IPA vapor Tough discharging method
Filter loading method	Dust loading with ASHRAE dust Coarse dust	Dust loading with ASHRAE dust Coarse dust	Dust loading with ISO fine dust Fine dust
Classification system	9 Classes	16 Classes	49 classes in 4 different groups

ADVANTAGES FOR ISO16890

	EN779:2012	ASHRAE 52.2	ISO16890
Advantages	Testing with fine particles	Test with 3 different particle sizes within 0.3µm to 10µm range	Test with 3 different particle sizes within 0.3µm to 10µm range, including PM1.
	Tough discharge method		Results relate directly to performance against PM1, PM2.5 and PM10
			Dust loading (life indication) measured using a fine dust
			Mandatory and tough discharge method
			Must achieve minimum 50% efficiency to qualify for ePM1 and ePM2.5 classifications.

	EN779:2012	ASHRAE 52.2	ISO16890
Disadvantages	Classification says very little about actual performance e.g. M6, F7	Classification says very little about actual performance e.g. MERV 8, MERV 13M	
	Dust loading (life indication) measured using an artificially coarse dust	Dust loading (life indication) measured using an artificially coarse dust	
		Discharge is not mandatory. If used technique is "soft"	

ISO16890 – Overview of Classification System

Table 4 – Filter groups

Group designation	Requirement			Class reporting value
	ePM _{1, min}	ePM _{2,5, min}	ePM ₁₀	
ISO Coarse	—	—	< 50%	Initial grav. arrestance
ISO ePM10	—	—	≥ 50%	ePM ₁₀
ISO ePM2,5	—	≥ 50%	—	ePM _{2,5}
ISO ePM1	≥ 50%	—	—	ePM ₁

ISO16890: Classification Table

PM1 classification	PM2,5 classification	PM10 classification	Coarse
ePM1[95%]	ePM2.5[95%]	ePM10[95%]	Arrestance reported in 5% increments, starting at 5%.
ePM1[90%]	ePM2.5[90%]	ePM10[90%]	
ePM1[85%]	ePM2.5[85%]	ePM10[85%]	
ePM1[80%]	ePM2.5[80%]	ePM10[80%]	
ePM1[75%]	ePM2.5[75%]	ePM10[75%]	
ePM1[70%]	ePM2.5[70%]	ePM10[70%]	
ePM1[65%]	ePM2.5[65%]	ePM10[65%]	
ePM1[60%]	ePM2.5[60%]	ePM10[60%]	
ePM1[55%]	ePM2.5[55%]	ePM10[55%]	
ePM1[50%]	ePM2.5[50%]	ePM10[50%]	
Requirement: > 50% initial efficiency > 50% discharged efficiency	Requirement: > 50% initial efficiency > 50% discharged efficiency	Requirement: > 50% initial efficiency No discharge requirement	No discharge requirement

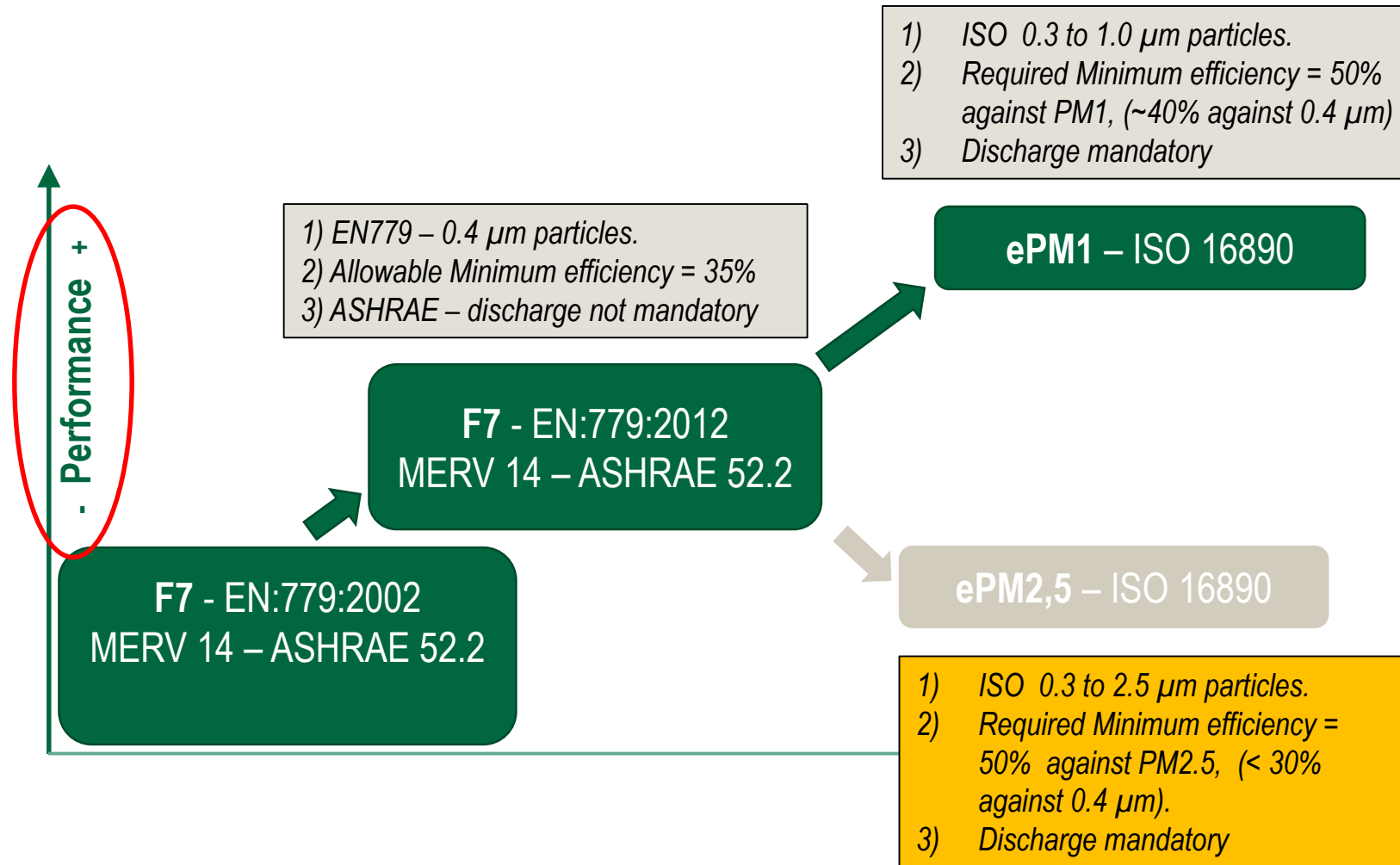
ISO16890

Table 4 – Filter groups

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	ePM _{1, min}	ePM _{2,5, min}	ePM ₁₀	
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ISO ePM10	—	—	≥ 50%	ePM ₁₀
ISO ePM2,5	—	≥ 50%	—	ePM _{2,5}
ISO ePM1	≥ 50%	—	—	ePM ₁

Based on the test results and Table 4, filters could be assigned to two or more filter groups. For example, a filter classified as ISO ePM₁ 85% could also be classified as ISO ePM₁₀ 95%. However, according to this standard, filters shall be classified into one individual group only and only this one classification shall be shown on the filter's label. Nevertheless, in a full summary report, all five ePM_x efficiency values shall be reported, namely the three efficiency values ePM₁, ePM_{2,5} and ePM₁₀ and the minimum efficiency values ePM_{1, min} and ePM_{2,5, min}. The reporting of the initial gravimetric arrestance is optional, except for ISO Coarse filters, where this value determines the filter class and hence its reporting is mandatory. The efficiency comparison of different filters shall be done only within the same ISO group, e.g. comparing ePM₁ of filter A with ePM₁ of filter B.

ISO 16890 – Impact of Classification on Air Quality





Filter test method

- Accuracy for pressure drop and efficiency measurement is the same as EN779 & ASHRAE 52.2 .
- Main difference is that the testing will be done with both DEHS and KCl.



DEHS (Oil) is used to generate fine particles or aerosol, ($\leq 1\mu\text{m}$).



KCL (Salt) is used to generate medium and large particles, (1 to $10\mu\text{m}$).





Discharging method

- IPA vapor discharge.
- Very tough discharging method.
- Non destructive, fibers structure remains intact.
- All electrostatic charge is removed from the filter material.



Gravimetric test method.

New Test Dust – 100% ISO Fine.

More biased to finer particles than ASHRAE Dust.

Better reflects real world conditions and performance.



Filter Classification

Efficiency values will be measured and correlated into four efficiency ranges.

ePM 1	ePM 2.5	ePM 10	ISO Coarse
0,3 – 1 μm	0,3 – 2,5 μm	0,3 – 10 μm	ISO Fine Dust Initial arrestance
Corresponding to E1 ASHRAE 52.2	Corresponding to E2 ASHRAE 52.2	Corresponding to E3 ASHRAE 52.2	Filters with ePM10 < 50%

For ePM1 and ePM2.5, measurements are recorded before and after discharge of filter.



Filter Classification

3 Simple rules:

Reported efficiency – is an average between the initial and the discharged efficiency.

To be able to report – initial new efficiency needs to be over 50%.

AND

To be able to report – discharged efficiency needs to be over 50% (ePM1 and ePM2.5)

EXAMPLE: FILTER 1



Fine fibre filter media without
electrostatic charge

INITIAL	ePM 1 65%	ePM 2.5 74%	ePM 10 93%	Arrestance 99%
				
DISCHARGED	ePM 1 64%	ePM 2.5 74%	ePM 10 93%	
AVERAGE	ePM 1 64%	ePM 2.5 74%	ePM 10 93%	
CLASSIFICATION	ePM1 60%	ePM2.5 70%	ePM10 90%	COARSE 95%

EXAMPLE: FILTER 2



Coarse fibre filter media with
electrostatic charge

INITIAL	ePM 1 69%	ePM 2.5 88%	ePM 10 91%	Arrestance 98%
				
DISCHARGED	~~ePM 1~~ 39%	ePM 2.5 52%	ePM 10 89%	
AVERAGE	~~ePM 1~~ 54%	ePM 2.5 70%	ePM 10 90%	
CLASSIFICATION	~~ePM1 50%~~	ePM2.5 70%	ePM10 90%	COARSE 95%

ISO 16890 – Air Filter Test Results				Testing organisation: Name Address Phone																																																																																																																																	
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ISO 16890 – the new standard for air filters

It is highly significant that this standard has global applicability. Until now, there was no such standard, in the Americas, ASHRAE standard 52.2 dominated, in Europe EN779 was dominant and in Asia and the middle East both standards were used side by side.

The standard will eliminate confusion and prevent invalid attempts to cross-reference results from the different existing test methods.



Transparency, equality and opportunities

The standard will provide a level playing field for filter manufacturers. It will be easier to compare competing products. This will, at one end of the scale drive product innovation and customer value and at the other end of the scale serve to eliminate some of the very poor performance products from the market place.



Eliminating confusion

The new standard delivers benefits for specifiers and users of filters as well as for the air filtration industry. The standard is more intuitive, the filter testing procedure and the classification system are better aligned with real world air pollution.

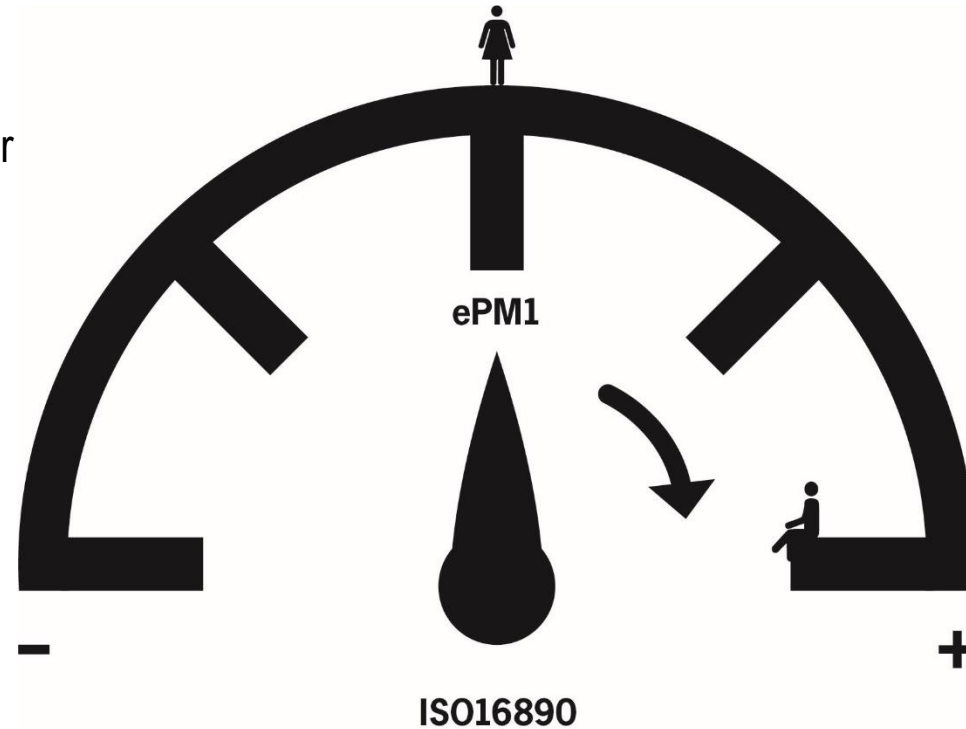


A minimum of 50% efficiency

One of the key elements of ISO16890 is that the test protocol requires that the filter efficiency be measured against the fine particle fraction PM1. This must be done when the filter is unused and again when any electrostatic charge, which could temporarily enhance the performance, has been removed from the filter.

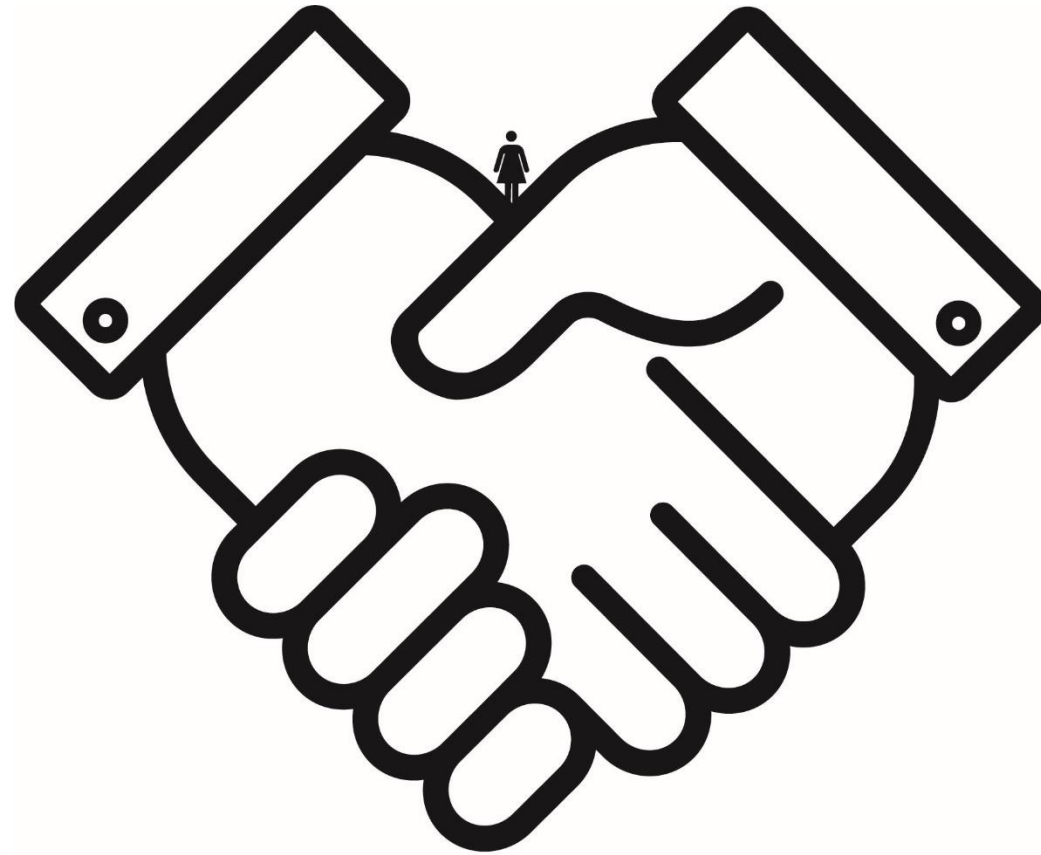
Both these test results must exceed 50% efficiency for the filter to be classified as an ePM1 device.

This is important because the medical and scientific communities are increasingly reporting that it is the PM1 fraction that is most hazardous to human health.

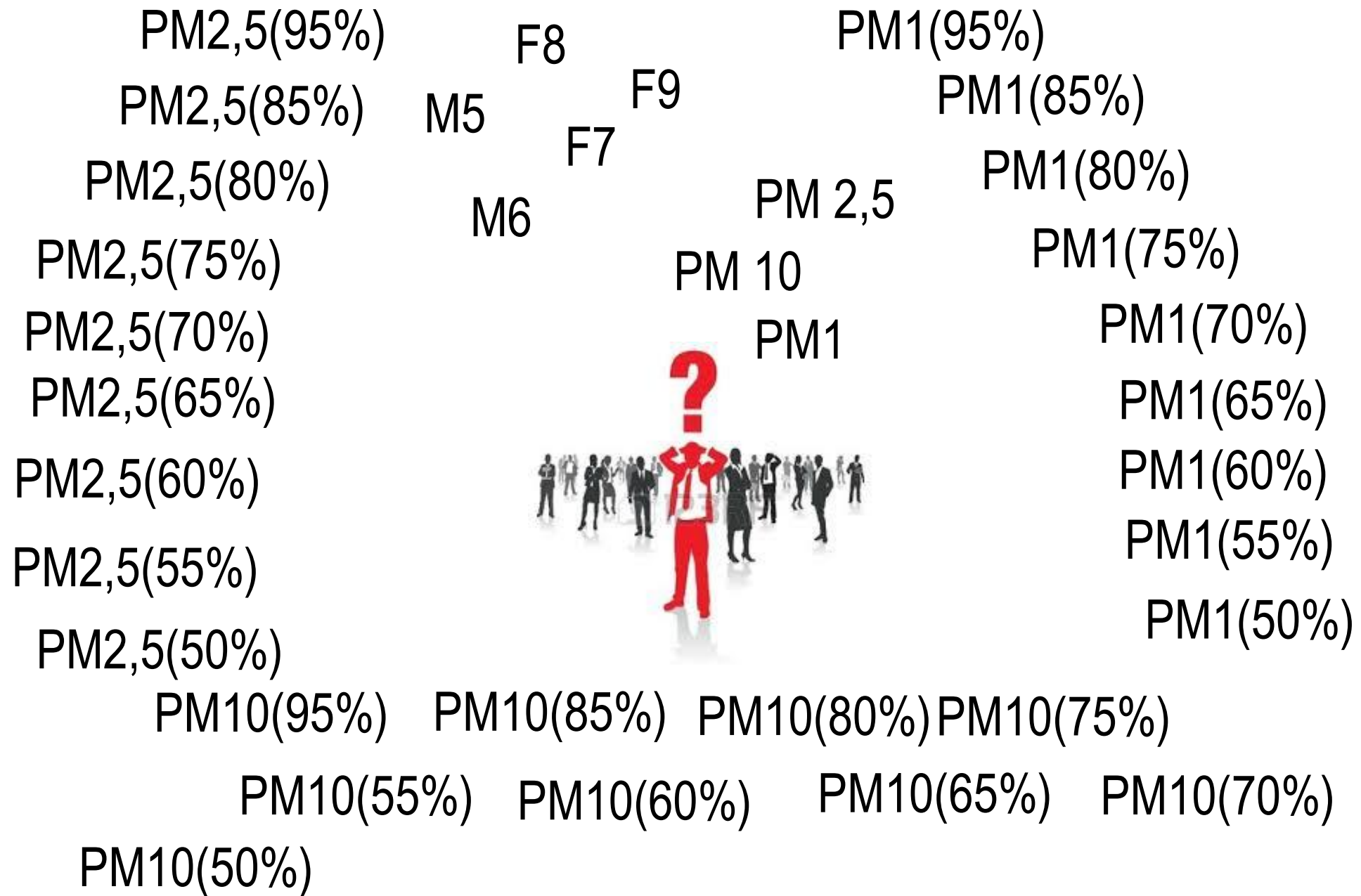


Encourage global trade

Global applicability will remove a barrier to international trade. After all, it is not unusual in the case of a major construction project that the design engineers, the constructors and the project location are all in different countries.



ISO16890



There is no definit transfer between the EN 779 and ISO 16890 standards

Filter class	PM1	PM2.5	PM10
M5	<20%	<40%	>50%
M6	<40%	50-60%	>60%
F7	50-75%	>70%	>80%
F8	70-85%	>80%	>90%
F9	>85%	>90%	>95%

0,4 µm

≈

> 0,3 µm

1 µm

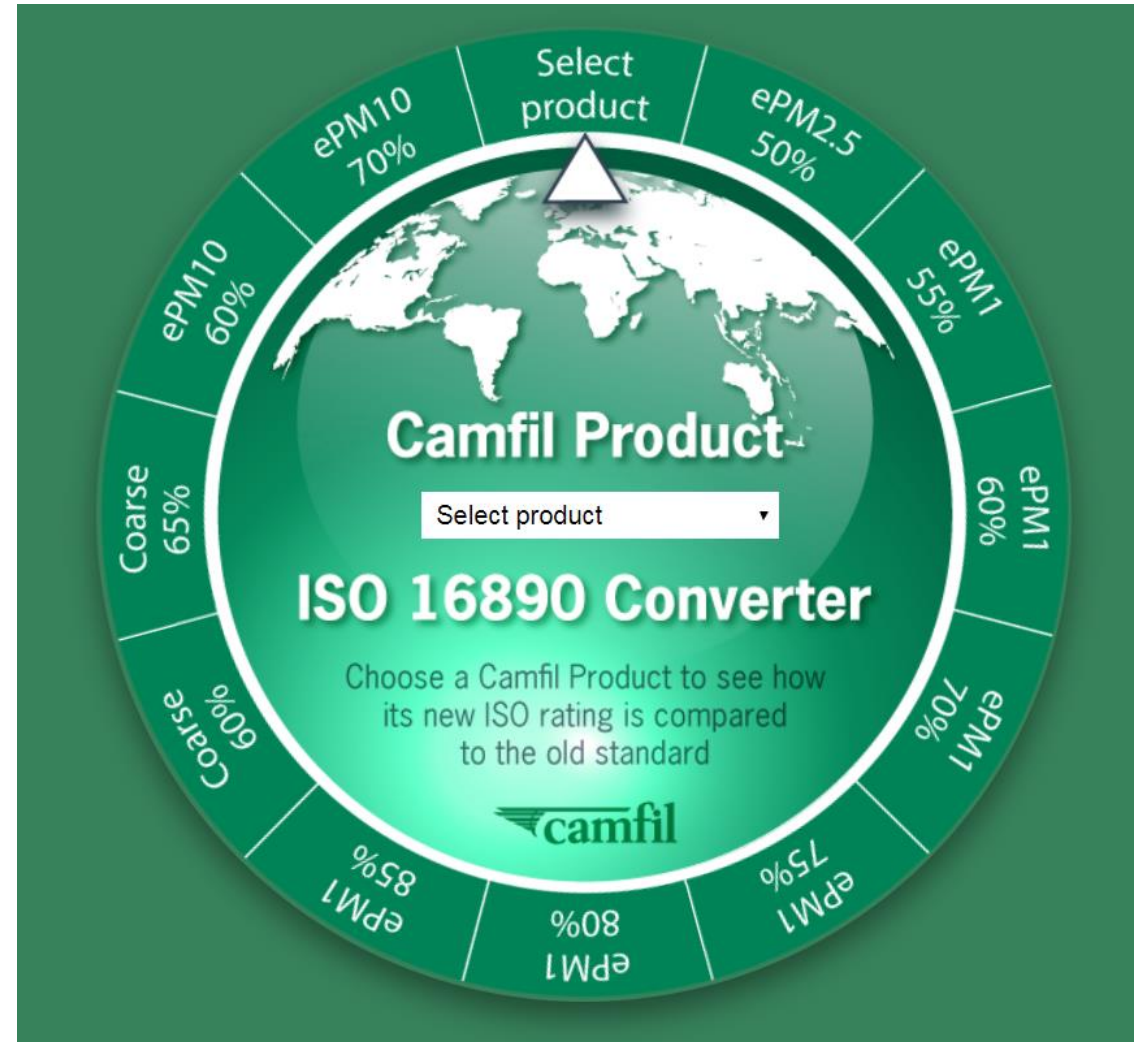
2,5 µm

10 µm

ISO 16890 Converter

You can choose a Camfil Product to see new ISO rating compared to the old standard.

<http://camfil-product-converter.herokuapp.com/>



EUROVENT RECOMMENDATION 4/23 - 2017

How to select EN ISO 16890 rated air filter classes for general ventilation applications



- Europe's Industry Association for Indoor Climate, Process Cooling, and Food Cold Chain Technologies
- Members from 20+ countries in Europe, the Middle East and Africa
- Strong network of EMEA's leading, national industry associations
- More than 1.000 'Affiliated Manufacturers'

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- **1.000+ companies throughout the EMEA region**
 - The majority small and medium-sized manufacturers
- **Which employ around 150.000 people**
 - Highly skilled labour that drives innovation, energy efficiency and reduces CO₂ footprints across the globe
- **And generate a combined annual turnover of EUR 30bn+**
 - Significant contributor to national public accounts

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- **Advocacy**

- European Union legislation
- National legislation

- **Marketing**

- General promotion of the European industry and their state-of-the-art approaches
- Export initiatives, diminishing of unfair trade barriers inside and outside Europe

- **Technical**

- EN and ISO standardisation
- Development of Eurovent Recommendations (codes of good practice)

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EN ISO 16890

New classification, new opportunities

- Introduces more realistic, new classification based on various particle size ranges (**ePM₁**, **ePM_{2.5}**, **ePM₁₀**)
- Provides so far unavailable opportunities for designing Indoor Air Quality (IAQ) based on outdoor Particulate Matter concentrations
- EN ISO 16890 is a testing standard
 - Provides **no recommendation on filter application**
 - Displaced old EN 779:2012



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Eurovent Recommendation 4/23

Contents

- Highlighting the importance of filtration
- Comparison of EN ISO 16890 and EN 779 filter efficiency classification
- Recommendation concerning EN ISO 16890 filter class selection
- Estimation of multi-stage filtration cumulated efficiency
- Energy efficiency of filters

EN ISO 16890

Cannot be directly compared with EN 779

EN 779	EN ISO 16890			
G3	ePM1 95%	ePM2.5 95%	ePM10 95%	ISO Coarse 90%
G4	ePM1 90%	ePM2.5 90%	ePM10 90%	ISO Coarse 80%
M5	ePM1 85%	ePM2.5 85%	ePM10 85%	ISO Coarse 70%
M6	ePM1 80%	ePM2.5 80%	ePM10 80%	.
F7	ePM1 75%	ePM2.5 75%	ePM10 75%	.
F8	ePM1 70%	ePM2.5 70%	ePM10 70%	.
F9	.	.	.	.
	ePM1 50%	ePM2.5 50%	ePM10 50%	.

≠

Market situation

After introduction of EN ISO 16890

- + Clear testing guidelines for filter manufacturers
- No guidelines on the correct class of a filter selection for designers and facility managers

The major EN standard providing guidelines on selection of filters in ventilation systems – EN 16798-3 – still refers to EN 779

Outdoor air quality	Supply air class				
	SUP 1	SUP 2	SUP 3	SUP 4	SUP 5
ODA (P) 1	88 % ^a	80 % ^a	80 % ^a	80 % ^a	Not specified
ODA (P) 2	96 % ^a	88 % ^a	80 % ^a	80 % ^a	60 %
ODA (P) 3	99 % ^a	96 % ^a	92 % ^a	80 % ^a	80 %
^a Combined average filtration efficiency over a single or multiple stage filtration in accordance to average filtration efficiency specified in EN 779.					

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Eurovent Recommendation 4/23

Main goals

- To fill the standardisation gap and provide comprehensive guidelines on the selection of EN ISO 16890 rated filters in general ventilation applications
- To constitute a contribution to the next revision of EN 16798-3 regarding consideration of EN ISO 16890
 - Easy and simple to use tool
 - Addressed to the HVAC professionals dealing with ventilation systems
 - Consultants
 - Facility Managers
 - Manufacturers of equipment including air filters
 - Based on PM concentration thresholds recommended by WHO

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Eurovent Recommendation 4/23

Importance of filtration

Impact on Human Health

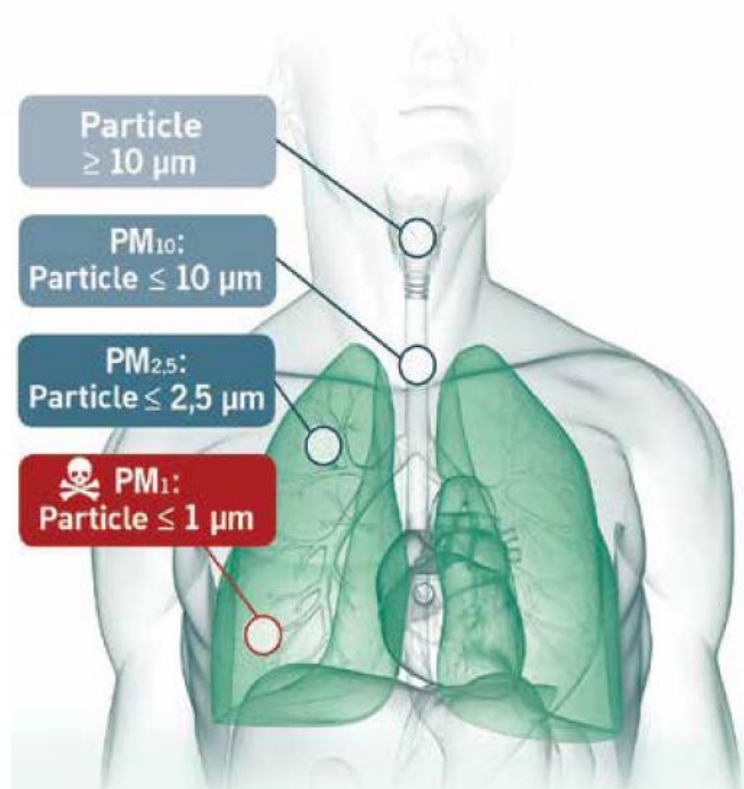
- Particulate Matter (PM) is the most affecting of all pollutants
- Dread diseases associated with exposure to PM:
 - Allergies and Asthma
 - Lung cancer
 - Cardiovascular diseases
 - Chronic obstructive lung disease



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PM penetration of the respiratory tract



PM₁₀

Particles $10 \mu\text{m}$ in diameter or smaller can reach the respiratory ducts and potentially cause decreased lung function.

PM₁

Particles $1 \mu\text{m}$ in diameter or smaller are most dangerous. They are tiny enough to enter the bloodstream and lead to cancer, cardiovascular diseases and dementia.

PM_{2.5}

Particles $2.5 \mu\text{m}$ in diameter or smaller can penetrate the lungs and cause decreased lung function, skin and eye problems.

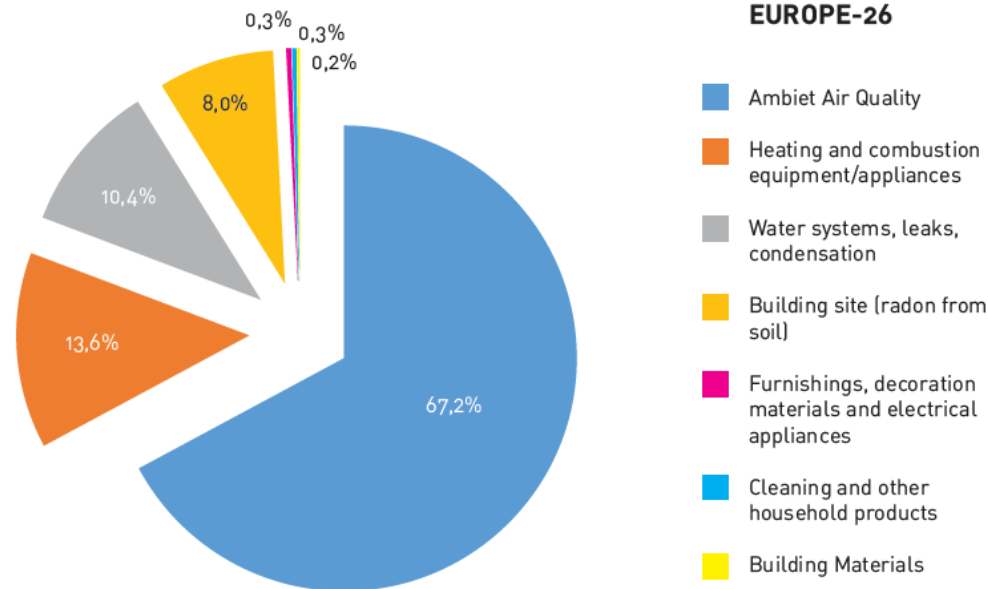
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Eurovent Recommendation 4/23

Importance of filtration

Impact on Economy - Burden of Diseases (BoD)

- BoD is measured by means of DALY (disability-adjusted-life-year) – a factor expressing years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health
- BoD attributable to bad IAQ in European Union is estimated to approx. 2 million DALYs
- Cost of 1 DALY is assessed to even up to 100 000 EUR



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Eurovent Recommendation 4/23

Comparison of EN ISO 16890 and EN 779

- EN ISO 16890 and EN 779 classes **cannot be directly compared or converted**
- The Recommendation comprises a comparison table showing actual overlapping of respective classes
- The table was developed based on **real test data of 91 filters provided by Eurovent Certita Certification**

EN 779: 2012	EN ISO 16890 – range of actual measured average efficiencies		
Filter class	ePM ₁	ePM _{2.5}	ePM ₁₀
M5	5% - 35%	10% - 45%	40% - 70%
M6	10% - 40%	20% - 50%	60% - 80%
F7	40% - 65%	65% - 75%	80% - 90%
F8	65% - 90%	75% - 95%	90% - 100%
F9	80% - 90%	85% - 95%	90% - 100%

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Eurovent Recommendation 4/23

Filter class selection – ODA determination

- The method presented in Eurovent Recommendation 4/23 corresponds to EN 16798-3 (ODA and SUP categories)
- In a first step the Outdoor Air Category (ODA) must be determined based on **annual mean concentrations** of PM2.5 and PM10
- Outdoor air pollution data can be found in the WHO or local monitoring bodies databases

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Category	Description	Typical environment
ODA 1	OUTDOOR AIR, WHICH MAY BE ONLY TEMPORARILY DUSTY Applies where the World Health Organisation WHO (2005) guidelines are fulfilled (annual mean for $PM_{2.5} \leq 10 \mu g/m^3$ and $PM_{10} \leq 20 \mu g/m^3$).	
ODA 2	OUTDOOR AIR WITH HIGH CONCENTRATIONS OF PARTICULATE MATTER Applies where PM concentrations exceed the WHO guidelines by a factor of up to 1,5 (annual mean for $PM_{2.5} \leq 15 \mu g/m^3$ and $PM_{10} \leq 30 \mu g/m^3$).	
ODA 3	OUTDOOR AIR WITH VERY HIGH CONCENTRATIONS OF PARTICULATE MATTER Applies where PM concentrations exceed the WHO guidelines by a factor of greater than 1,5 (annual mean for $PM_{2.5} > 15 \mu g/m^3$ and $PM_{10} > 30 \mu g/m^3$).	

Eurovent Recommendation 4/23

Filter class selection – SUP determination

- Next, for correct selection of the filter class, a supply air category (SUP) must be determined
- The SUP category depends on hygienic requirements of the served premises and indoor PM emissions
- Indoor emissions originate mainly from cooking, combustion (candles, fireplaces, space heaters, cigarettes) or human activity (biological origin)

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CATEGORY	GENERAL VENTILATION	
SUP 1		
SUP 2	Rooms for permanent occupation. Example: Kindergartens, offices, hotels, residential buildings, meeting rooms, exhibition halls, conference halls, theaters, cinemas, concert halls.	 
SUP 3	Rooms with temporary occupation. Examples: Storage, shopping centers, washing rooms, server rooms, copier rooms.	 
SUP 4	Rooms with short-term occupation. Examples restrooms, storage rooms stairways.	 
SUP 5	Rooms without occupation. Examples: Garbage room, data centers, underground car parks.	 

CATEGORY	INDUSTRIAL VENTILATION	
SUP 1	Applications with high hygienic demands. Examples: Hospitals, pharmaceuticals, electronic and optical industry, supply air to clean rooms.	
SUP 2	Applications with medium hygienic demands. Example: Food and beverage production.	
SUP 3	Applications with basic hygienic demands. Example: Food and beverages production with a basic hygienic demand.	
SUP 4	Applications without hygienic demands. Example: General production areas in the automotive industry.	
SUP 5	Production areas of the heavy industry. Examples: Steel mill, smelters, welding plants.	

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Eurovent Recommendation 4/23

Recommended minimum efficiencies

OUTDOOR AIR			SUPPLY AIR				
			SUP 1*	SUP 2*	SUP 3**	SUP 4	SUP 5
			PM _{2.5} ≤ 2.5 PM ₁₀ ≤ 5	PM _{2.5} ≤ 5 PM ₁₀ ≤ 10	PM _{2.5} ≤ 7.5 PM ₁₀ ≤ 15	PM _{2.5} ≤ 10 PM ₁₀ ≤ 20	PM _{2.5} ≤ 15 PM ₁₀ ≤ 30
Category	PM _{2.5}	PM ₁₀	ePM ₁	ePM ₁	ePM _{2.5}	ePM ₁₀	ePM ₁₀
ODA 1	≤ 10	≤ 20	60%	50%	60%	60%	50%
ODA 2	≤ 15	≤ 30	80%	70%	70%	80%	60%
ODA 3	> 15	> 30	90%	80%	80%	90%	80%

* Minimum filtration requirements ISO ePM₁ 50% refer to a final filter stage

** Minimum filtration requirements ISO ePM_{2.5} 50% refer to a final filter stage

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Eurovent Recommendation 4/23

Protection of HVAC system components

Minimum recommended efficiency of a first stage filter

- No air humidification applied: **ePM₁₀ 50%**
- Air humidification applied: **ePM_{2.5} 65%**

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Eurovent Recommendation 4/23

Multi-stage filtration cumulated efficiency

To facilitate rough estimations of the combined filtration efficiency, the recommendation provides following simplified equation:

$$ePM_{x, cum} = 100 \cdot \left(1 - \left(\left(1 - \frac{ePM_{x, s1}}{100} \right) \cdot \left(1 - \frac{ePM_{x, s2}}{100} \right) \cdot \dots \cdot \left(1 - \frac{ePM_{x, sn+1}}{100} \right) \right) \right)$$

$ePM_{x, cum}$ is the total cumulated efficiency for x fraction

$ePM_{x, sn+1}$ is the fractional efficiency for each filter stage

It results in minor deviations compared to the EN ISO 16890 methodology, acceptable for engineering calculations accuracy

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Eurovent REC 4/23 – 2018

Decision for a 2018 revision decided at Eurovent PG – FIL meeting in Seville.

→ Release after Seville meeting

EN13779:2013 refer to EN779:2012

EN16798-3 refer to EN779:2012

EN16798-3 update ongoing to ISO16890

Second edition!



Eurovent REC 4/23 – 2018

The recommended minimum efficiencies depending on ODA and SUP categories are summarised in Table 3 below.

DRAFT, not yet published

OUTDOOR AIR			SUPPLY AIR				
			SUP 1*	SUP2*	SUP3**	SUP4	SUP5
			PM _{2,5} ≤ 2.5 PM ₁₀ ≤ 5	PM _{2,5} ≤ 5 PM ₁₀ ≤ 10	PM _{2,5} ≤ 7.5 PM ₁₀ ≤ 15	PM _{2,5} ≤ 10 PM ₁₀ ≤ 20	PM _{2,5} ≤ 15 PM ₁₀ ≤ 30
Category	PM _{2,5}	PM ₁₀	ePM ₁	ePM ₁	ePM _{2,5}	ePM ₁₀	ePM ₁₀
ODA 1	≤ 10	≤ 20	70%	50%	50%	50%	50%
ODA 2	≤ 15	≤ 30	80%	70%	70%	80%	50%
ODA 3	> 15	> 30	90%	80%	80%	90%	80%

Table 3: Recommended min. ePMx filtration efficiencies depending on ODA and SUP category. Annual mean PMx values in µg/m³

* Minimum filtration requirements ISO ePM₁ 50% refer to a final filter stage

** Minimum filtration requirements ISO ePM_{2,5} 50% refer to a final filter stage

Eurovent REC 4/23 – 2018

ADDITIONAL RECOMMENDATION ON APPLICATION OF OPTIONAL GAS FILTRATION

Following the provisions of EN 16798-3:2017, it is recommended to apply additional gas filters to complement particle filtration for the following combinations of outdoor air quality (gaseous) and supply air quality classes:

Outdoor air quality	Supply air quality				
	SUP1	SUP2	SUP3	SUP4	SUP5
ODA (G) 1	Recommended				
ODA (G) 2	Required	Recommended			
ODA (G) 3	Required	Required	Recommended		

Table 6: Recommendation on application of additional gas filter

Recommendation regarding Gas filtration has been deleted from the new EN16798-3 by CEN TC 156 WG20

Eurovent Association PG_FIL has written a Position Paper requested CEN to put it back

Eurovent REC 4/23 – 2018

ESTIMATION OF MULTI-STAGE FILTRATION CUMULATED EFFICIENCY

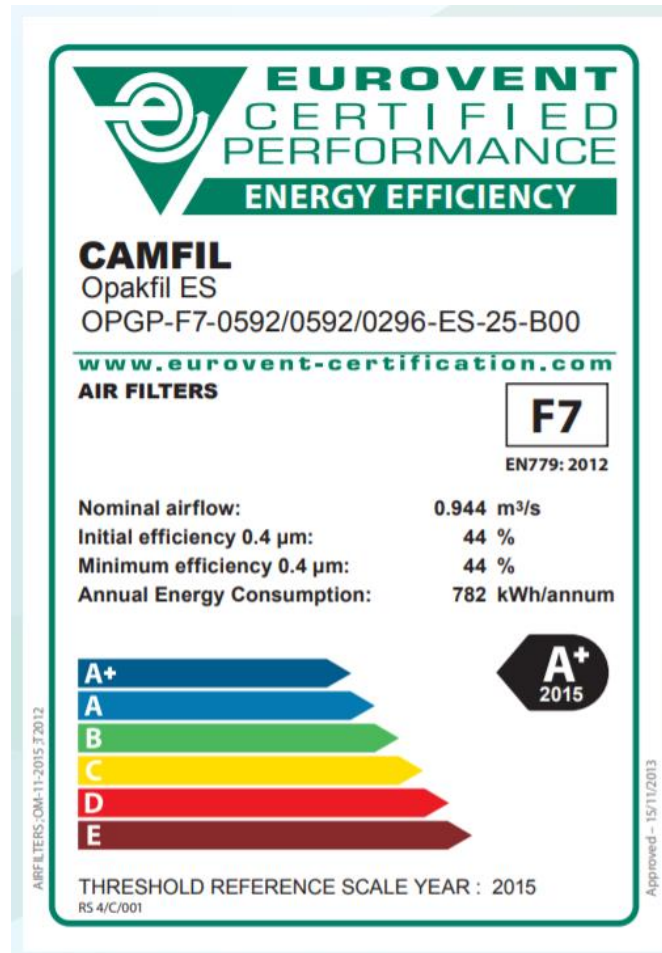
DRAFT, not yet published

Outdoor air quality		Supply air quality				
		SUP1	SUP2	SUP3	SUP4	SUP5
ODA 1	example 1	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%	ePM10 50%	ePM10 50%
	example 2	ePM1 70%	-	-	-	-
ODA 2	example 1	ePM2,5 50% + ePM1 60%	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%	ePM10 50%
	example 2	ePM1 80%	ePM1 70%	ePM2,5 70%	ePM10 80%	-
ODA 3	example 1	ePM2,5 50% + ePM1 80%	ePM2,5 50% + ePM1 60%	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%
	example 2	ePM1 90%	ePM1 80%	ePM2,5 80%	ePM10 90%	ePM10 80%

Table 7: examples of filter classes meeting respective ODA/SUP categories requirements

Calculation method in REC 4/23 - 2018

ENERGY EFFICIENCY OF FILTERS (ISO 16890)



Energy efficiency still refers to old EN 779:2012 standard

- The first edition of Eurovent 4/21 (2014), which relates to the long-established EN 779 standard is used until new energy rating related to ISO 16890 comes
- New Eurovent energy rating is estimated to come at start of year 2019

