# Selection of ISO 16890 rated air filters for general ventilation purposes

**Mr Anil Nair**
Head – Projects and Applications
Camfil

# Contents

- **ISO 16890**
  - Overview
  - Benefits
  - Comparison
- **WHO 2021**
  - What has changed
- **Eurovent 4/21**
  - How to select air filters based on ISO 16890 standard

# ISO 16890

- Global situation

| USA | Europe | Middle East / Asia |
|---|---|---|
| ASHRAE 52.2 | EN 779:2012 | ASHRAE 52.2, EN779 and local standards |

- A significant harmonisation for the air filtration industry has been adopted.

- Standard for filter testing introduced in 2016 - classification with <u>global</u> coverage.

*ISO16890 “Air Filters for General Ventilation”*

| | 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 | Dustloading with ASHRAE dust **Coarse & sticky dust** | Dustloading with ASHRAE dust **Coarse & sticky dust** | Dustloading with ISO fine dust **Finer & less sticky dust** |
| Classification system | **9 Classes** | **16 Classes** | **49 classes** in **4 Filter Groups** |

# ISO16890: 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% | — | — | $ePM_1$ |

# 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)

# Revised WHO guidelines – 2021

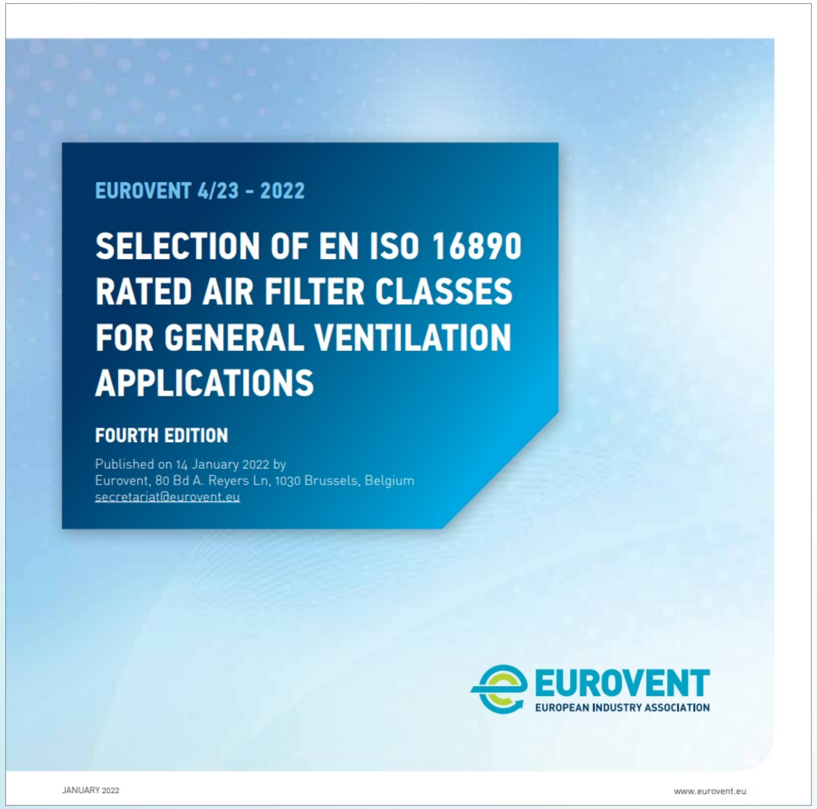
**Table 3.26. Recommended 2021 AQG levels and 2005 air quality guidelines**

| Pollutant | Averaging time | 2005 air quality guideline | 2021 AQG level |
|---|---|---|---|
| $PM_{2.5}$, µg/m³ | Annual | 10 | 5 |
| | 24-hour[a] | 25 | 15 |
| $PM_{10}$, µg/m³ | Annual | 20 | 15 |
| | 24-hour[a] | 50 | 45 |
| $O_3$, µg/m³ | Peak season[b] | – | 60 |
| | 8-hour[a] | 100 | 100 |
| $NO_2$, µg/m³ | Annual | 40 | 10 |
| | 24-hour[a] | – | 25 |
| $SO_2$, µg/m³ | 24-hour[a] | 20 | 40 |
| CO, mg/m³ | 24-hour[a] | – | 4 |

[a] 99th percentile (i.e. 3–4 exceedance days per year).
[b] Average of daily maximum 8-hour mean $O_3$ concentration in the six consecutive months with the highest six-month running-average $O_3$ concentration.


*WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide

# Eurovent Recommendation 4/23


EUROVENT 4/23 - 2022

SELECTION OF EN ISO 16890 RATED AIR FILTER CLASSES FOR GENERAL VENTILATION APPLICATIONS

FOURTH EDITION

Published on 14 January 2022 by
Eurovent, 80 Bd A. Reyers Ln, 1030 Brussels, Belgium
secretariat@eurovent.eu

EUROVENT
EUROPEAN INDUSTRY ASSOCIATION

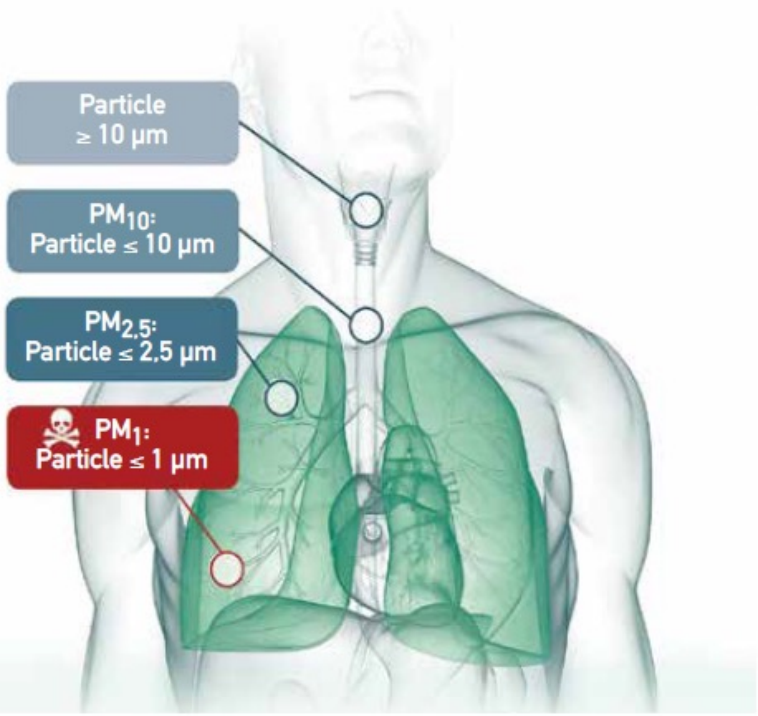
JANUARY 2022

www.eurovent.eu

- Recommendation for the selection of ISO 16890 rated air filters for general ventilation applications
- Developed in a joint effort by the participants of the Eurovent Product Group 'Air Filters'
- Published on 09 January 2018
- Updated in January 2022

# Particulate Matter – the smaller, the worse

| $PM_{10}$ | $PM_{2.5}$ | $PM_1$ |
|---|---|---|
| **Particles 10 µm** in diameter or smaller can reach the respiratory ducts and potentially cause decreased lung function. | **Particles 2.5 µm** in diameter or smaller can penetrate the lungs and cause decreased lung function, skin and eye problems. | **Particles 1 µm** in diameter or smaller are most dangerous. They are tiny enough to enter the bloodstream and lead to cancer, cardiovascular diseases and dementia. |




© Camfil AB

### 1.1.2 BURDEN OF DISEASES

Conducted researches determined an impact of IAQ on the burden of diseases (BoD). The burden of diseases is measured by the means of a so-called disability-adjusted-life-year (DALY). This time-based measure combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health and was originally developed in 1990.

The total estimated burden of disease attributable to IAQ in the European Union is approx. 2m DALYs per year, which means that two million years of healthy life is lost annually. It is worth noticing that, according to latest estimation carried out by French economists, the cost of 1 DALY can amount up to 100.000 EUR. On a global scale, losses resulting from an inadequate IAQ are large.

https://eurovent.eu/?q=content/eurovent-423-2022-selection-en-iso-16890-rated-air-filter-classes-fourth-edition-english

# Step 1 – Outdoor Air

- Selection of local outdoor air quality based on particulate matter levels acc. latest WHO Air Quality Guidelines
  - PM2.5 (particulate matter < 2.5 µm)
  - PM10 (particulate matter < 10 µm)
- **ODA 1** = below WHO limits
- **ODA 2** = less than 50% above WHO limits
- **ODA 3** = more than 50% above WHO limits
- **India = ODA 3**

| Category | Description | Typical environment |
|---|---|---|
| ODA 1 | OUTDOOR AIR, WHICH MAY BE ONLY TEMPORARILY DUSTY<br>Applies where the World Health Organisation WHO (2021) guidelines are fulfilled (annual mean for $PM_{2,5} \leq 5$ µg/m$^3$ and $PM_{10} \leq 15$ µg/m$^3$). |  |
| ODA 2 | OUTDOOR AIR WITH HIGH CONCENTRATIONS OF PARTICULATE MATTER<br>Applies where PM concentrations exceed the WHO guidelines by a factor of up to 1,5 (annual mean for $PM_{2,5} \leq 7{,}5$ µg/m$^3$ and $PM_{10} \leq 22{,}5$ µg/m$^3$). |  |
| ODA 3 | OUTDOOR AIR WITH VERY HIGH CONCENTRATIONS OF PARTICULATE MATTER<br>Applies where PM concentrations exceed the WHO guidelines by a factor of greater than 1,5 (annual mean for $PM_{2,5} > 7{,}5$ µg/m$^3$ and $PM_{10} > 22{,}5$ µg/m$^3$). |  |

Table 1: Outdoor air categories

https://eurovent.eu/?q=content/eurovent-423-2022-selection-en-iso-16890-rated-air-filter-classes-fourth-edition-english

# Step 2 – Required supply air quality

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

Table 4: General ventilation - indicative examples of application matched to corresponding SUP categories

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

Table 4: Industrial ventilation - indicative examples of application matched to corresponding SUP categories

https://eurovent.eu/?q=content/eurovent-423-2022-selection-en-iso-16890-rated-air-filter-classes-fourth-edition-english

# Step 3 – Selection

| Outdoor air quality | | Supply air quality | | | | |
|---|---|---|---|---|---|---|
| | | SUP 1 | SUP 2 | SUP 3 | SUP 4 | SUP 5 |
| 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 | ePM1 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 | ePM1 50% + ePM1 80% | ePM1 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

ePM10 55%

ePM1 80%

https://eurovent.eu/?q=content/eurovent-423-2022-selection-en-iso-16890-rated-air-filter-classes-fourth-edition-english

# Example – Multi stage filtration

Office in Gurgaon: ODA 3 & SUP 2 = min. ePM1 80%

Stage 1
ePM1 60%

Stage 2
ePM1 60%

$$ePM1_{cum} = 100 \times \left(1- \left(1-\frac{60}{100}\right) \times \left(1-\frac{60}{100}\right)\right) = 84\%$$

# Summary

- ISO16890 is a global standard for testing and classification of air filters
- It brings clear benefits for specifiers, purchasers and users of air filters
- Selecting ePM1 filters will result in improved air quality and lower health risk
- Eurovent 4/23 merges theoretical and practical aspects of designing Indoor Air Quality in terms of air filtration
- Eurovent 4/23 provides hands on and effective advice for HVAC planners and manufactures of ventilation equipment to correctly design filtration