New ISO Standard
ISO 16890 Replaces EN 779

Filter Classes
According to ISO 16890

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According to ISO 16890

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New ISO Standard

ISO 16890 Replaces EN 779

ISO 16890 regulates classification of particulate filters for room air.

This new standard, in effect since late 2016, has superseded European standard EN 779 in mid-2018.

For years, industry experts have demanded an improved standard to replace EN 779. Critics of the standard call attention to its highly unrealistic test conditions and test results with limited relevance to real-world performance. ISO 16890 provides lab evaluation procedures which more realistically simulate actual operating conditions, replacing the old standard’s filter classes G1-F9 by a classification system based on particulate groups PM1, PM2.5, and PM10. These same particulate categories are used by the World Health Organization in evaluation of environmental air quality.

Filter Classes According to ISO 16890

Unlike EN 779 which specifies Filter Classes, ISO 16890 classifies according to Filter Groups, evaluating a filter’s performance by its arrestance of particles from 0.3 to 10 μm in size. Filter Group PM 1 comprises particulate sizes ≤1 μm, PM 2.5 includes particulates sizes ≤2.5 μm and PM 10 covers particulate sizes ≤10 μm.

For filter experts, the key difference is clear: The old standard tests arrestance of only one particulate size (0.4 μm). The new standard determines arrestance over a spectrum of particulate sizes.

### Table: ISO 16890 Classification Criteria

<table>
<thead>
<tr>
<th>Filter Group</th>
<th>Particulate Size (μm)</th>
<th>Classification Criterium</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO ePM₁</td>
<td>0.3 ≤ x ≤ 1</td>
<td>Minimum efficiency ≥ 50 %</td>
</tr>
<tr>
<td>ISO ePM₂,₅</td>
<td>0.3 ≤ x ≤ 2.5</td>
<td>Minimum efficiency ≥ 50 %</td>
</tr>
<tr>
<td>ISO ePM₁₀</td>
<td>0.3 ≤ x ≤ 10</td>
<td>Average efficiency ≥ 50 %</td>
</tr>
<tr>
<td>ISO Coarse</td>
<td>0.3 ≤ x ≤ 10</td>
<td>Average efficiency &lt; 50 %</td>
</tr>
</tbody>
</table>

*ePM = efficiency Particulate Matter*
Example: Pocket Filters and Compact Filters According to ISO 16890

An air filter qualifies for Filter Group ISO ePM₁ or ISO ePM₂,₅ if it achieves a minimum efficiency of 50% or greater for particulate sizes ≤1 μm or ≤2.5 μm. Along with the Filter Group achieved, the complete ISO 16890 classification also includes the filter’s average efficiency. Minimum efficiency is defined as the efficiency achieved following electrostatic discharge of the filter before testing. Average efficiency is calculated by averaging the filter’s efficiencies in the untreated state, i.e. before discharging, and in the discharged state. More information in this regard is provided in the section below entitled „Filter Testing According to ISO 16890“.

For example: if a filter achieves a minimum efficiency in the PM1 size spectrum and 56% in the PM2.5 size spectrum, it does not qualify for the ISO ePM₁ Filter Group – having missed out by 5% – but does qualify for the ISO ePM₂,₅ Filter Group. Assuming that the average efficiency achieved by this filter for ISO ePM₂,₅ particulates was 68%, this percentage is rounded down to the nearest 5% increment (i.e. rounded down to 65%) and the filter’s ISO 16890 classification is therefore ISO ePM₂,₅ 65%.

To be classified in Filter Group ISO ePM₁₀ a filter must achieve an average efficiency of ≥ 50% for particles ≤ 10 μm in size. Filters with an average efficiency < 50% for this particle size range are classified in the Filter Group ISO Coarse.

Example 1: F7 pocket filter (synthetic filter media)

The following tableau shows results of a pocket filter, which got tested according ISO 16890.

Test Results

<table>
<thead>
<tr>
<th>Arrestance</th>
<th>Minimum Efficiency</th>
<th>mittlere Effizienz</th>
</tr>
</thead>
<tbody>
<tr>
<td>ePM₁</td>
<td>45 %</td>
<td>59 %</td>
</tr>
<tr>
<td>ePM₂,₅</td>
<td>56 %</td>
<td>68 %</td>
</tr>
<tr>
<td>ePM₁₀</td>
<td></td>
<td>89 %</td>
</tr>
</tbody>
</table>

Criterium achieved / not achieved

1a. Which ISO Filter Group reaches the filter above?

☐ ISO ePM₁  ☐ ISO ePM₂,₅  ☐ ISO ePM₁₀

1b. With which efficiency rate gets the ISO ePM₂,₅ filter above finally rated?

☐ 56%  ☐ 65%  ☐ 68%

You find the correct answers at the side end.

Example 2: F9 compact filter (glass fibre)

The following tableau shows results of a compact filter, which got tested according ISO 16890.

Test Results

<table>
<thead>
<tr>
<th>Arrestance</th>
<th>Minimum Efficiency</th>
<th>mittlere Effizienz</th>
</tr>
</thead>
<tbody>
<tr>
<td>ePM₁</td>
<td>84 %</td>
<td>85 %</td>
</tr>
<tr>
<td>ePM₂,₅</td>
<td>88 %</td>
<td>89 %</td>
</tr>
<tr>
<td>ePM₁₀</td>
<td></td>
<td>96 %</td>
</tr>
</tbody>
</table>

Criterium achieved / not achieved

2a. Which ISO Filter Group reaches the filter above?

☐ ISO ePM₁  ☐ ISO ePM₂,₅  ☐ ISO ePM₁₀

2b. With which efficiency rate gets the ISO ePM₂,₅ filter above finally rated?

☐ 56%  ☐ 65%  ☐ 68%

You find the correct answers at the side end.
Filter Testing According to ISO 16890

Along with the new filter-group based classification system, ISO 16890 also incorporates changes in test procedures. The new standard specifies two test phases for evaluation of air filters.

1 **Determination of pressure drop**

In **Phase 1** of the testing, the pressure drop across the filter is determined as a function of volumetric air throughput.

2 **Determination of fractional arrestance**

Then the filter's fractional arrestance is determined over a particle size spectrum of 0.3 μm - 10 μm. Two different test aerosols are used in the testing: DEHS (di-ethylhexyl sebacate) aerosol for particulate sizes up to 1 μm and, for larger particulate sizes, KCl (potassium chloride) aerosol.

3 **Testing of electrostatically discharged filter**

Phase 2 of the testing concentrates on the filter's performance without the distorting effects of electrostatic charge. A filter which is charged with static electricity will achieve increased arrestance – for instance in laboratory testing. In actual field service this increase is only a temporary effect which quickly disappears. For this reason, test data determined on electrostatically charged filters does not truly relate to real-world performance. Therefore, in Phase 2 the filter is electrostatically discharged in a treatment chamber before its arrestance and pressure drop are again determined under more realistic conditions.

4 **Weighted evaluation of arrestance results using theoretical particulate distributions**

The results of both test phases are then averaged, providing the average arrestance for each of the fractions PM1, PM2.5 and PM10. Before the filter is classified in an ISO Filter Group, its arrestance results are weighted using theoretical particle size distributions for urban and rural air. The ISO Filter Group classification is done in accordance with these weighted arrestance results.

5 **Determination of dust retention capacity**

In the case of ISO Coarse filters, testing of dust retention capacity is mandatory as stipulated by ISO 16890. For all other Filter Groups this is an optional determination. The testing particulate specified for use in the dust retention test is Test Dust AC Fine.
Is there any way to simply convert EN 779 Filter Classes into ISO Filter Groups?

No, there isn't, we're sorry to say. The testing and evaluation procedures of ISO 16890 and EN 779 differ greatly. We therefore cannot recommend use of tables or calculations which claim to convert G1-F9 Filter Classes into ISO Filter Groups. A number of such conversion tables are available; however there are major differences between them.

Comparison of EN 779 and ISO 16890

<table>
<thead>
<tr>
<th>EN 779</th>
<th>ISO 16890</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Particulate air filters for general ventilation</td>
</tr>
<tr>
<td><strong>Validity</strong></td>
<td>up to mid-2018</td>
</tr>
<tr>
<td><strong>Evaluation of arrestance</strong></td>
<td>Filter Classes G1-G4: average gravimetric arrestance. Filter Classes M5-F9: Only arrestance of particulates 0.4 μm in diameter</td>
</tr>
<tr>
<td><strong>Filter classification</strong></td>
<td>Filter Classes G1-G4, M5-M6, F7-F9</td>
</tr>
<tr>
<td><strong>Test dust</strong></td>
<td>L1 (ASHRAE)</td>
</tr>
<tr>
<td><strong>Important characteristics</strong></td>
<td>1) Average gravimetric arrestance. 2) Average efficiency &amp; minimum efficiency for particles 0.4 μm in diameter. 3) Dust retention capacity for test particulate. 4) Pressure drop as function of volumetric flow rate.</td>
</tr>
</tbody>
</table>

EMW filtertechnik GmbH

EMW® offers air filters and the open celled filter foam Poret® for different sectors like the HVAC industry and air intake systems of gas turbines. Each filter system supplied is optimized for the airborne particles at the intended site, ensuring highly efficient filtration, which prevents problems before they arise.