INTERNATIONAL STANDARD

**ISO 16890-4**

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# Air filters for general ventilation —

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

*Filtres à air de ventilation générale —*

*Partie 4: Méthode de conditionnement afin de déterminer l'efficacité spectrale minimum d'essai*

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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# Contents

Page

**Foreword** ... **iv**
**Introduction** ... **v**
**1 Scope** ... **1**
**2 Normative references** ... **1**
**3 Terms and definitions** ... **2**
**4 Symbols and abbreviated terms** ... **2**
**5 General conditioning test requirements** ... **2**
5.1 General ... 2
5.2 Test device requirements ... 2
5.3 Test device selection ... 2
5.4 Conditioning cabinet requirements ... 3
**6 Conditioning materials** ... **3**
**7 Conditioning cabinet** ... **4**
7.1 General ... 4
7.2 Conditioning cabinet dimensions and construction materials ... 4
7.3 Environment, temperature and relative humidity ... 5
**8 Safety issues** ... **6**
**9 Test method** ... **6**
9.1 General ... 6
9.2 Conditioning procedure ... 7
**10 Qualification** ... **7**
**11 Reporting results** ... **8**
**Annex A** (informative) **Hints for health and safety aspects for the use of IPA** ... **9**
**Bibliography** ... **11**

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 142, *Cleaning equipment for air and other gases*.

This first edition of ISO 16890-4, together with ISO 16890-1, ISO 16890-2 and ISO 16890-3, cancels and replaces ISO/TS 21220:2009, which has been technically revised.

ISO 16890 consists of the following parts, under the general title *Air filters for general ventilation*:

— *Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)*

— *Part 2: Measurement of fractional efficiency and air flow resistance*

— *Part 3: Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured*

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

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# Introduction

The effects of particulate matter (PM) on human health have been extensively studied in the past decades. The results are that fine dust can be a serious health hazard, contributing to or even causing respiratory and cardiovascular diseases. Different classes of particulate matter can be defined according to the particle size range. The most important ones are $PM_{10}$, $PM_{2,5}$ and $PM_1$. The U.S. Environmental Protection Agency (EPA), the World Health Organization (WHO) and the European Union define $PM_{10}$ as particulate matter which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter. $PM_{2,5}$ and $PM_1$ are similarly defined. However, this definition is not precise if there is no further characterization of the sampling method and the sampling inlet with a clearly defined separation curve. In Europe, the reference method for the sampling and measurement of $PM_{10}$ is described in EN 12341. The measurement principle is based on the collection on a filter of the $PM_{10}$ fraction of ambient particulate matter and the gravimetric mass determination (see EU Council Directive 1999/30/EC of 22 April 1999).

As the precise definition of $PM_{10}$, $PM_{2,5}$ and $PM_1$ is quite complex and not simple to measure, public authorities, like the U.S. EPA or the German Federal Environmental Agency (Umweltbundesamt), increasingly use in their publications the more simple denotation of $PM_{10}$ as being the particle size fraction less or equal to 10 µm. Since this deviation to the above mentioned complex "official" definition does not have a significant impact on a filter element's particle removal efficiency, the ISO 16890 series refers to this simplified definition of $PM_{10}$, $PM_{2,5}$ and $PM_1$.

Particulate matter in the context of the ISO 16890 series describes a size fraction of the natural aerosol (liquid and solid particles) suspended in ambient air. The symbol $ePM_x$ describes the efficiency of an air cleaning device to particles with an optical diameter between 0,3 µm and $x$ µm. The following particle size ranges are used in the ISO 16890 series for the listed efficiency values.

**Table 1 — Optical particle diameter size ranges for the definition of the efficiencies**, $ePM_x$

| **Efficiency** | **Size range**, µm |
|---|---|
| $ePM_{10}$ | 0,3 ≤ × ≤10 |
| $ePM_{2,5}$ | 0,3 ≤ × ≤2,5 |
| $ePM_1$ | 0,3 ≤ × ≤1 |

Air filters for general ventilation are widely used in heating, ventilation and air-conditioning applications of buildings. In this application, air filters significantly influence the indoor air quality and, hence, the health of people, by reducing the concentration of particulate matter. To enable design engineers and maintenance personnel to choose the correct filter types, there is an interest from international trade and manufacturing for a well-defined, common method of testing and classifying air filters according to their particle efficiencies, especially with respect to the removal of particulate matter. Current regional standards are applying totally different testing and classification methods, which do not allow any comparison with each other, and thus hinder global trade with common products. Additionally, the current industry standards have known limitations by generating results which often are far away from filter performance in service, i.e. overstating the particle removal efficiency of many products. With this new ISO 16890 series, a completely new approach for a classification system is adopted, which gives better and more meaningful results compared to the existing standards.

The ISO 16890 series describes the equipment, materials, technical specifications, requirements, qualifications and procedures to produce the laboratory performance data and efficiency classification based upon the measured fractional efficiency converted into a particulate matter efficiency ($e$PM) reporting system.

Air filter elements according to the ISO 16890 series are evaluated in the laboratory by their ability to remove aerosol particulate expressed as the efficiency values $ePM_1$, $ePM_{2,5}$ and $ePM_{10}$. The air filter elements can then be classified according to the procedures defined in ISO 16890-1. The particulate removal efficiency of the filter element is measured as a function of the particle size in the range of 0,3 µm to 10 µm of the unloaded and unconditioned filter element as per the procedures defined in ISO 16890-2. After the initial particulate removal efficiency testing, the air filter element is conditioned

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according to the procedures defined in this part of ISO 16890 and the particulate removal efficiency is repeated on the conditioned filter element. This is done to provide information about the intensity of any electrostatic removal mechanism which may or may not be present with the filter element for test. The average efficiency of the filter is determined by calculating the mean between the initial efficiency and the conditioned efficiency for each size range. The average efficiency is used to calculate the $e\mathrm{PM}_x$ efficiencies by weighting these values to the standardized and normalized particle size distribution of the related ambient aerosol fraction. When comparing filters tested in accordance with the ISO 16890 series, the fractional efficiency values shall always be compared among the same $e\mathrm{PM}_x$ class (ex. $e\mathrm{PM}_1$ of filter A with $e\mathrm{PM}_1$ of filter B). The test dust capacity and the initial arrestance of a filter element are determined as per the test procedures defined in ISO 16890-3.

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# Air filters for general ventilation —

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

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## 1 Scope

This part of ISO 16890 establishes a conditioning method to determine the minimum fractional test efficiency.

It is intended for use in conjunction with ISO 16890-1, ISO 16890-2 and ISO 16890-3, and provides the related test requirements for the test device and conditioning cabinet as well as the conditioning procedure to follow.

The conditioning method described in this part of ISO 16890 is referring to a test device with a nominal face area of 610 mm × 610 mm (24 inch × 24 inch).

ISO 16890 (all parts) refers to particulate air filter elements for general ventilation having an $ePM_1$ efficiency less than or equal to 99 % and an $ePM_{10}$ efficiency greater than 20 % when tested according to the procedures defined within ISO 16890 (all parts).

NOTE The lower limit for this test procedure is set at a minimum $ePM_{10}$ efficiency of 20 % since it will be very difficult for a test filter element below this level to meet the statistical validity requirements of this procedure.

Air filter elements outside of this aerosol fraction are evaluated by other applicable test methods. See ISO 29463 (all parts).

Filter elements used in portable room-air cleaners are excluded from the scope of this part of ISO 16890.

The performance results obtained in accordance with ISO 16890 (all parts) cannot by themselves be quantitatively applied to predict performance in service with regard to efficiency and lifetime.

The results from this part of ISO 16890 may also be used by other standards that define or classify the fractional efficiency in the size range of 0,3 µm to 10 µm when electrostatic removal mechanism is an important factor to consider, for example ISO 29461.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16890-1, *Air filters for general ventilation — Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)*

ISO 16890-2, *Air filters for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance*

ISO 16890-3, *Air filters for general ventilation — Part 3: Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured*

ISO 29464, *Cleaning equipment for air and other gases — Terminology*

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