International Standard

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

Filtres à air de ventilation générale —

Partie 3: Détermination de l'efficacité gravimétrique et de la résistance à l'écoulement de l'air par rapport à la quantité de poussière d'essai retenue

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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 document 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).

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For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 195*, Cleaning equipment for air and other gases*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16890-3:2016), which has been technically revised.

The main changes are as follows:

— the initial loading step has been revised from 30 g to 60 g throughout the document.

A list of all parts in the ISO 16890 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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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. For the outdoor environment, the U.S. Environmental Protection Agency (EPA), the World Health Organization (WHO), the European Union, and other national agencies have established acceptable air quality standards according to concentrations of particulate matter classified per their aerodynamic sizes, defined as $PM_{2,5}$ and PM_{10}, and measured according to strict prescriptive methods and sampling times.

Since there is growing interest in relating indoor air quality to outdoors, the ISO 16890 series classifies ventilation filters according to their efficiencies measured with an optical diameter between 0,3 µm and x µm and relating the result to historic global average ambient PM concentrations. Although not exactly equivalent to filter performance of national ambient air quality standards at PM, the classification scheme presented in the ISO 16890 series yields a level of correspondence to the effectiveness of the filter for ambient particle concentrations. It is however recognized that the correspondence based on global averages may not be exactly the same at a specific location since local ambient particle concentration may be different than the global average.

The particle size ranges shown in Table 1 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}	$0,3 \leq x \leq 10$
$ePM_{2,5}$	$0,3 \leq x \leq 2,5$
ePM_1	$0,3 \leq x \leq 1$

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 the ISO 16890 series, a completely new approach for a classification system is adopted, which gives 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 (ePM) 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 according to the procedures defined in ISO 16890-4 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 ePM_x efficiencies by weighting these values to the standardized and normalized particle size distribution of the related ambient aerosol fraction. When comparing filters

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tested in accordance with the ISO 16890 series, the fractional efficiency values need to always be compared among the same ePM_x class (e.g. ePM_1 of filter A with ePM_1 of filter B). The test dust capacity and the arrestance of a filter element are determined as per the test procedures defined in this document.

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

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Air filters for general ventilation —

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

1 Scope

This document specifies the test equipment and the test methods used for measuring the gravimetric efficiency and resistance to air flow of air filter for general ventilation.

It is intended for use in conjunction with ISO 16890-1, ISO 16890-2 and ISO 16890-4.

The test method described in this document is applicable for air flow rates between 0,25 m^3/s (900 m^3/h, 530 ft^3/min) and 1,5 m^3/s (5 400 m^3/h, 3 178 ft^3/min), referring to a test rig with a nominal face area of 610 mm × 610 mm (24 in × 24 in).

This document 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 as per the procedures defined in the ISO 16890 series.

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

This document does not apply to filter elements used in portable room-air cleaners.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15957, *Test dusts for evaluating air cleaning equipment*

ISO 16890-2:2022, *Air filters for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance*

ISO 16890-4, *Air filters for general ventilation — Part 4: Conditioning method to determine the minimum fractional test efficiency*

ISO 29463-1, *High efficiency filters and filter media for removing particles from air — Part 1: Classification, performance, testing and marking*

ISO 80000-1:2022, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

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