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Second edition
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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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Contents

Page

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 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 16890-4:2016), which has been technically revised.

The main changes are as follows:

— in 7.2 the dimensions of the conditioning cabinet are indicated in a more flexible way. This change does not affect the test, however, it does make the procedure more reasonable for the users;

— 9.1 has been reworded to remove duplicate information and some parts have been moved to a new subclause 9.3;

— in 9.2 a sentence has been added to make the proper procedure clear to the users.

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.

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 PM 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 (EU) define PM_{10} as PM 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 PM and the gravimetric mass determination (see Reference [7]).

As the precise definition of PM_{10}, $PM_{2,5}$ and PM_1 is quite complex and not easy to measure, public authorities, such as the U.S. EPA or the German Federal Environmental Agency (Umweltbundesamt), increasingly use in their publications the simpler denotation of PM_{10} as being the particle size fraction less than 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.

PM 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 $e\text{PM}_x$ 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 as shown in Table 1.

Table 1 — Optical particle diameter size ranges for the definition of the efficiencies, $e\text{PM}_x$

Efficiency	**Size range**, µm
$e\text{PM}_{10}$	0,3 ≤ × ≤ 10
$e\text{PM}_{2,5}$	0,3 ≤ × ≤ 2,5
$e\text{PM}_1$	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 PM. 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 PM. Current regional standards are applying completely 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 show better filtration performance than the 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 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 PM 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 $e\text{PM}_1$, $e\text{PM}_{2,5}$ and $e\text{PM}_{10}$. 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 this document 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 can possibly 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 (e.g. $e\mathrm{PM}_1$ 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.

The results from this document can 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.

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

