SIST

SLOVENSKI STANDARD
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Zračni filtri pri splošnem prezračevanju - 4. del: Metoda kondicioniranja za ugotavljanje minimalne frakcijske učinkovitosti (ISO/DIS 16890-4:2015)

Air filters for general ventilation - Part 4: Conditioning method to determine the minimum fractional test efficiency (ISO/DIS 16890-4:2015)

Luftfilter für die allgemeine Raumlufttechnik - Teil 4: Konditionierungsverfahren für die Ermittlung des Fraktionsabscheidegradminimus (ISO/DIS 16890-4:2015)

Filtres à air pour ventilation générale - Partie 4: Méthode de conditionnement pour déterminer le rendement fractionnaire minimal d'essai (ISO/DIS 16890-4:2015)

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91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning

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Air filters for general ventilation —

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

Filtres à air pour ventilation générale —

Partie 4: Méthode de conditionnement afin de déterminer l'éfficacité minimum de test fractionnée

ICS: 91.140.30

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO 16890-4 was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases*.

ISO 16890 (all parts) replaces ISO/TS 21220:2009.

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

— *Part 1: Technical specifications, requirements and efficiency classification system based upon Particulate Matter (PM)*

— *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*

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) or 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 as long as there are no further definition 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 that described in EN 12341 "Air Quality – Field Test Procedure to Demonstrate Reference Equivalence of Sampling Methods for the PM_{10} fraction of particulate matter". 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 e.g. the US 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 elements particle removal efficiency as reported by ISO 16890, this simplified definition of PM_{10}, $PM_{2,5}$ and PM_1 will be utilized within ISO 16890 documents.

Particulate Matter in the context of this standard describes a size fraction of the natural aerosol (liquid and solid particles) suspended in ambient air, with the symbol PM*x* where *x* defines the size range of the aerodynamic diameter ≤ *x* µm. The following particle size fractions are used in this standard:

Fraction	Size range
PM_{10}	≤ 10 µm
$PM_{2,5}$	≤ 2,5 µm
PM_1	≤ 1 µm

Air filters used for general ventilation are widely used in heating, ventilation and air-conditioning applications of buildings. In this application they 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 properly 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 to each other, and hence, hinder global trade with common products. Additionally, the current standards have known limitations and generate results which are sometimes far away from filter performance in service. With this new international standard, a completely new approach for a classification system is adopted, which gives better and more meaningful results compared to the existing standards. Additionally, this new approach shall overcome major concerns related to the former approach of ISO/TS 21220.

ISO 16890 (all parts) 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 (PM) reporting system.

Air filter elements according to this series of standards are evaluated in the laboratory by their ability to remove aerosol particulate to PM_1, $PM_{2,5}$ and PM_{10} aerosol fractions and then the air filter elements can be classified per the procedures defined in part 1. The particulate removal efficiency of the filter element is measured as a function of the particle size in the range of 0,3 to 10 µm of the unloaded and unconditioned filter element per the procedures defined in part 2. The air filter element is then conditioned per the procedures defined in part 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 results from this second particle collection efficiency step are used to shift the fractional efficiency curve of the filter element to be used to calculate the average efficiency in each of the PM_1, $PM_{2,5}$ and PM_{10} ranges by weighting the fractional efficiency values according to the standardized and normalized particle size distribution of the related fraction of the ambient aerosol.

Air filters for general ventilation —

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

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 and ISO 16890-2 and provides the related test requirements for the test device and rig as well as the conditioning procedure to follow.

The test method described in this standard is referring to a test rig with a nominal face area of 610 mm x 610 mm (24 inch x 24 inch).

ISO 16890 (all parts) refers to particulate air filter elements for general ventilation having an initial efficiency less than or equal to 99% with respect to PM1 aerosol fraction and greater than 20 % with respect to PM10 aerosol fraction when tested per the procedures defined within parts 1-4 of ISO 16890.

Air filter elements outside of this aerosol fraction are evaluated by other applicable test methods, (see ISO 29463, part 1-5).

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

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

The results from ISO 16890-4 may also be used by other standards that define or classify the particle removal efficiency in the size range of 0,3 to10 µm when electrostatic removal mechanism is an important factor to consider, for example ISO 29461.

2 Normative References

The following referenced documents are indispensable for the application 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/DIS 16890-1, *Air filters for general ventilation — Part 1: Technical specifications, requirements and efficiency classification system based upon Particulate Matter (PM)*

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

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

3 Terms and Definitions

Terms and definitions used in this standard are based on ISO 29464.

4 Symbols and abbreviated terms

IPA abbreviation for Iso Propyl Alcohol (isopropanol)

5 General Test Requirements

5.1 General

This procedure is used to determine the minimum test efficiency and to test whether the filter particulate efficiency is dependent on the electrostatic removal mechanism. This is accomplished by measuring the removal efficiency of an untreated filter and the corresponding efficiency after conditioning.

Many types of air filters rely to different extents on the effects of passive electrostatic charges on the fibres to achieve higher particle removal efficiencies, particularly in the initial stages of their working life, at low resistance to airflow.

Exposure to some types of challenge, such as combustion particles, fine particles, or oil mist in service may affect the action of these electric charges so that the initial efficiency may drop substantially after an initial period of service. This drop in the particle removal efficiency can be reduced by a slight increase in mechanical efficiency from the collection of particles in the filtration media. The amount of the drop and the amount of the increase can vary by filter type, service location, and atmospheric air conditions.

The procedure described here indirectly but quantitatively shows the extent of the electrostatic charge effect on the initial performance on a full size filter (measured according to ISO 16890-2). It indicates the level of efficiency obtainable with the charge effect removed (or minimized by IPA vapour conditioning) and with no increase in mechanical efficiency. It should not be assumed that the measured conditioned ("discharged") efficiency always represents real life behaviour. The treatment of a filter as described in this standard may affect the structure of the fibre matrix or chemically affect the fibres or even fully destroy the filter medium. Hence, this procedure may not be applicable to all types of filters. If degradation shows a visual, physical change or a pressure drop change of more than 20 % but minimum 10 Pa this standard is not applicable and the filter cannot be classified according to ISO 16890-1.

5.2 Test Device Requirements

The test device shall be designed or marked so as to prevent incorrect mounting. The complete test device (filter and frame) shall be made of material suitable to withstand normal usage and exposure to the range of temperature, humidity and corrosive environments likely to be encountered in service.

5.3 Test Device Selection

The test device shall be mounted in accordance with the manufacturer's recommendations and after equilibration to standard climatic conditions weighed to the nearest gram. Before starting the conditioning the initial pressure drop and initial fractional efficiency shall be determined according to the measurement procedure described in ISO 16890-2.

The test device shall be a full size filter element with a nominal face dimension of 610 x 610 mm (24 inch x 24 inch) with a maximum length (depth) of 760 mm (30 inch). If for any reason, dimensions do not allow testing of a test device under standard test conditions, assembly of two or more smaller devices of the same type or model is permitted, provided no leaks occur in the resulting assembly. For filters with a higher length or depth, the test cabinet described in 7.1 can be scaled accordingly. The operating conditions of such accessory equipment shall be recorded.

5.4 Test Rig Requirements

Critical dimensions and arrangements of the test apparatus are shown in the figures of this Standard and are intended as guides to help construct a test rig to meet the performance requirements of this Standard. All dimensions shown are mandatory unless otherwise indicated. Tolerances are given shown in the figures herein. Units shown are in mm (inch) unless otherwise indicated.

The design of equipment not specified, (including but not limited to holding frame, IPA trays, test rig surroundings and auxiliaries) is discretionary, but the equipment must have adequate capacity to meet the performance and health and safety requirements described in Clause 8.

6 Test materials

The test liquid for the conditioning step to discharge filter media and equalise electrostatic surface charges on the filter fibres is IPA (abbreviation for Iso Propyl Alcohol, commonly known as isopropanol or 2-propanol). IPA is placed inside the test chamber to evaporate until the equilibrium of IPA vapour in ambient air is reached. So liquid IPA will not be in contact with the filter media.

Isopropanol (IPA) – formula: C_3H_8O $H_3C - CHOH - CH_3$

Isopropanol properties:

Densitiy	0,7855 kg/m^3
Molecular weight	60,09 g/mol
Melting point	185 K
Boiling point	355 K
Flash point	285 K
Vapour pressure	0,0597 bar (at 298K)/0,0432 bar (at 293 K)/0,0814 bar (at 303 K)

To be calculated as follow:

$$\log_{10}\left(P\right) = A - \frac{B}{T + C}$$

where

P = pressure (bar), T = Temperature (K)

A = 4,57795 B = 1221,423

C = -87,474

(note: 1 bar = 100 kPa)

Explosion Limits (in air)	Lower Limit 2 % (vol.), Upper Limit 12 % (vol.) – both at 293 K
CAS-number	67-63-0

For the conditioning test a IPA purity of 99,5 % is needed.

7 Test cabinet

7.1 General

The test cabinet must consist of a filter holding chamber and one or two IPA tray holding chambers. Each chamber may have separate doors for service. The filter holding chamber must allow the installation of a full size filter (the test device) in a way, that the filter does not touch the test cabinet walls and allows air/vapour to pass around freely by diffusion. There shall be an open air passage between the IPA tray holding chamber and the filter holding chamber to guarantee that the mixture of air and IPA vapour can equilibrate in the whole test cabinet volume as easy as possible. To make sure that test devices with non-rigid, self-supporting structures, like bag filters, are installed in a proper way and offering the full media surface to the air/vapour mixture, the filter holding frame is in a horizontal position and the test device is hanging vertically (dust air side of the filter to the top, clean air side to the bottom of the chamber).