SLOVENSKI STANDARD
oSIST prEN ISO 16890-2:2014

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Zračni filtri pri splošnem prezračevanju - 2. del: Merjenje frakcijske učinkovitosti in odpornosti proti toku zraka

Air filters for general ventilation - Part 2: Measurement of fractional efficiency and air flow resistance

Luftfilter für die allgemeine Raumlufttechnik - Teil 2: Ermittlung des Franktionsabscheidegrades und des Durchflusswiderstandes

Filtres à air pour ventilation générale - Partie 2: Mesurage du rendement fractionnaire et de la résistance à l'écoulement de l'air

Ta slovenski standard je istoveten z: prEN ISO 16890-2

ICS:

91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning

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Air filters for general ventilation —

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

Filtres à air pour ventilation générale —

Partie 2: Mesurage du rendement fractionnaire et de la résistance à l'écoulement de l'air

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 16890-2 was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for gas and other gases*.

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

ISO 16890 consists of the following parts, under the general title *Air filter 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 arrestance 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 filter for general ventilation — Part 2: Measurement of fractional efficiency and air flow resistance

1 Scope

This part of ISO 16890 specifies the aerosol production, the test equipment and the test methods used for measuring fractional efficiency and air flow resistance of air filter for general ventilation.

It is intended for use in conjunction with ISO 16890-1, ISO 16890-3 and ISO16890-4.

The test method described in this standard 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 (5400 m^3/h, 3178 ft^3/min), 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 PM_1 aerosol fraction and greater than 20% with respect to PM_{10} 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.

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 5167-1, Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full (ISO 5167-1:1991).

ISO 16890-1, *Air filters for general ventilation — Part 1: Technical specifications, requirements and efficiency classification system based upon Particulate Matter (PM) (Currently an ISO DIS)*

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 (Currently ISO CD)*

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

ISO 14644-3*, Metrology & Test Methods.*

ISO 21501-4, *Determination of particle size distribution – Single particle light-interaction methods - Part 4: Light scattering airborne particle counter for clean spaces.*

ISO 29463*, High efficiency filters and filter media for removing particles from air*

ISO 29494 *Cleaning equipment for air and other gases – Terminology*

ISO 21501-1, *Determination of particle size distribution - Single particle light interaction methods - Part 1: Light scattering aerosol spectrometer*

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 29464 and the following apply:

3.1 Air flow and resistance

3.1.1
air flow rate
volume of air passing through the filter per unit time

[Source: ISO 29464:2011; 3.2.38]

3.1.2
nominal air flow rate
air flow rate specified by the manufacturer

3.1.3
resistance to airflow
difference in pressure between two points in an airflow system at specified conditions, especially when measured across the filter element

3.2 Test device

3.2.1
test device
filter element to be tested per this standard

3.2.2
filter element
structure made of the filtering material, its supports and its interfaces with the filter housing

3.2.3
upstream, U/S
region in a process system traversed by a flowing fluid before it enters that part of the test device

3.2.4
downstream, D/S
area or region into which fluid flows on leaving the test device

3.3 Aerosol

3.3.1
liquid phase aerosol
liquid particles suspended in a gas

3.3.2
solid phase aerosol
solid particles suspended in a gas

3.3.3
reference aerosol
the defined approved aerosol for test measurement within a specific size range

3.3.4
neutralization
action of bringing the aerosol to a Boltzmann charge equilibrium distribution with bipolar ions

3.4 Particle counter

3.4.1
particle counter
device for detecting and counting numbers of discrete airborne particles present in a sample of air

[Source: ISO 29464:2011; 3.1.27]

3.4.2
optical particle counter
OPC
particle counter which functions by illuminating airborne particles in a sample flow of air, converting the scattered light impulses to electrical impulse data capable of analysis to provide data on particle population and size distribution

Note: See ISO 21501-4

[Source: ISO 29464:2011; 3.2.29]

3.4.3
lower size limit
smallest particle diameter with a counting efficiency of 0,5 ± 0,15 (50 % ± 15 %)

[Source: ISO 29464:2011; 3.1.33]

3.4.4
upper size limit
largest particle diameter with a counting efficiency of 0,5 ± 0,15 (50 % ± 15 %)

[Source: ISO 29464:2011; 3.1.34]

3.4.5
sampling air flow
volumetric flow rate through the instrument

3.4.6
particle size
geometric diameter (equivalent spherical, optical or aerodynamic, depending on context) of the particles of an aerosol

[Source: ISO 29464:2011; 3.1.126]

3.4.7
particle size distribution
presentation, in the form of tables of numbers or of graphs, of the experimental results obtained using a method or an apparatus capable of measuring the equivalent diameter of particles in a sample or capable of giving the proportion of particles for which the equivalent diameter lies between defined limits

[Source: ISO 29464:2011; 3.1.128]

3.4.8
coincidence error
error which occurs because at a given time more than one particle is contained in the measurement volume of a particle counter

[Source: ISO 29464:2011; 3.1.69]

3.4.9
isokinetic sampling
technique for air sampling such that the probe inlet air velocity is the same as the velocity of the air surrounding the sampling point

[Source: ISO 29464:2011; 3.1.144]

3.5 Efficiency

3.5.1
efficiency
fraction or percentage of a challenge contaminant that is removed by a test device

3.5.2
fractional efficiency
ability of an air cleaning device to remove particles of a specific size or size range

NOTE The efficiency plotted as a function of particle size gives the particle size efficiency spectrum.

[Source: ISO 29464:2011; 3.1.61]

3.5.3
average efficiency
value of efficiency which results from averaging the efficiencies determined over a number of discrete intervals

3.5.4
penetration
P
ratio of particle concentration detected downstream versus the particle concentration upstream

[Source: ISO 29464:2011; 3.1.130]

3.5.5
correlation ratio
R
calculation of any potential bias between the upstream and downstream sampling systems

3.6 Other terms

3.6.1
HEPA filter
filters with performance complying with requirements of filter class ISO 35 - ISO 45 as per ISO 29463-1

[Source: ISO 29464:2011; 3.1.88]

3.6.2
reference device
primary device possessing accurately known parameters used as a standard for calibrating secondary devices

[Source: ISO 29464:2011; 3.1.39]

3.7 Particulate matter (PM)

3.7.1
particulate matter
PM

solid or liquid particles suspended in ambient air

3.7.2
particulate matter smaller 10 µm
PM_{10}
size fraction of particulate matter having an aerodynamic diameter less than or equal to a nominal 10 micrometres

3.7.3
particulate matter smaller 2,5 µm
$PM_{2,5}$
size fraction of particulate matter having an aerodynamic diameter less than or equal to a nominal 2,5 micrometres

3.7.4
particulate matter smaller 1 µm
PM_1
size fraction of particulate matter having an aerodynamic diameter less than or equal to a nominal 1 micrometres

3.7.5
PM-efficiencies
efficiencies of an air filter to reduce the mass concentration of the three PM dust fractions. PM_{10}-efficiency is the efficiency to the PM_{10} fraction, $PM_{2,5}$-efficiency to the $PM_{2,5}$ fraction and PM_1-efficiency to the PM_1 fraction. PM-efficiency is calculated as the ratio of the difference of the PM mass concentration upstream and downstream of the filter to the upstream concentration

4 Symbols and abbreviated terms

For the application of this Standard, the following symbols and abbreviated terms apply.

4.1 Symbols

δ	standard deviation of the data points
$U_{B,b,ps}$	upstream beginning background counts at a specific particle size
$U_{B,f,ps}$	upstream final background counts at a specific particle size
$D_{B,b,ps}$	downstream beginning background counts at a specific particle size
$D_{B,f,ps}$	downstream final background counts at a specific particle size
$U_{i,ps}$	upstream efficiency counts at a specific particle size
$\bar{R}_{ps}$	correlation ratio at a specific particle size
$e_{c,ps}$	95% error limit of the correlation value at a specific particle size
$\bar{R}_{lcl,\ ps}$	lower confidence limit of the correlation ratio at a specific particle size
$\bar{R}_{ucl,\ ps}$	upper confidence limit of the correlation ratio at a specific particle size
$U_{c,tot,ps}$	sum of the upstream particles sampled during correlation at a specific particle size
P	penetration
$\bar{P}_{o,ps}$	observed penetration at a specific particle size