



SLOVENSKI STANDARD
SIST EN ISO 16890-2:2022

01-oktober-2022

Nadomešča:

SIST EN ISO 16890-2:2017

Zračni filtri pri splošnem prezračevanju - 2. del: Merjenje frakcijske učinkovitosti in odpornosti proti toku zraka (ISO 16890-2:2022)

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

Luftfilter für die allgemeine Raumluftechnik - Teil 2: Ermittlung des Fraktionsabscheidegrades und des Durchflusswiderstandes (ISO 16890-2:2022)

Filtres à air de ventilation générale - Partie 2: Mesurage de l'efficacité spectrale et de la résistance à l'écoulement de l'air (ISO 16890-2:2022)

Ta slovenski standard je istoveten z: EN ISO 16890-2:2022

ICS:

91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning systems
-----------	------------------------------------	--

SIST EN ISO 16890-2:2022

en,fr,de

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 16890-2

August 2022

ICS 91.140.30

Supersedes EN ISO 16890-2:2016

English Version

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

Filtres à air de ventilation générale - Partie 2:
Mesurage de l'efficacité spectrale et de la résistance à
l'écoulement de l'air (ISO 16890-2:2022)

Luftfilter für die allgemeine Raumlufttechnik - Teil 2:
Ermittlung des Fraktionsabscheidegrades und des
Durchflusswiderstandes (ISO 16890-2:2022)

This European Standard was approved by CEN on 21 July 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword.....	3

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN ISO 16890-2:2022](https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022)

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>

European foreword

This document (EN ISO 16890-2:2022) has been prepared by Technical Committee ISO/TC 142 "Cleaning equipment for air and other gases" in collaboration with Technical Committee CEN/TC 195 "Cleaning equipment for air and other gases" the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2023, and conflicting national standards shall be withdrawn at the latest by February 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 16890-2:2016.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

(standards.iteh.ai)

Endorsement notice

SIST EN ISO 16890-2:2022

The text of ISO 16890-2:2022 has been approved by CEN as EN ISO 16890-2:2022 without any modification.

INTERNATIONAL
STANDARD

ISO
16890-2

Second edition
2022-07

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

Filtres à air de ventilation générale —

*Partie 2: Mesurage de l'efficacité spectrale et de la résistance à
l'écoulement de l'air*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN ISO 16890-2:2022

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>



Reference number
ISO 16890-2:2022(E)

© ISO 2022

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN ISO 16890-2:2022

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	vi
Introduction	viii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 Air flow and resistance.....	2
3.2 Test device.....	2
3.3 Aerosol.....	2
3.4 Particle counter.....	3
3.5 Efficiency.....	3
3.6 Other terms.....	4
4 Symbols and abbreviated terms	4
4.1 Symbols.....	4
4.2 Abbreviated terms.....	6
5 General test requirements	6
5.1 Test device requirements.....	6
5.2 Test device installation.....	6
5.3 Test rig requirements.....	7
6 Test materials	7
6.1 Liquid phase aerosol.....	7
6.1.1 DiEthylHexylSebacate (DEHS) test aerosol.....	7
6.1.2 DEHS properties.....	7
6.1.3 Liquid phase aerosol generation.....	7
6.2 Solid phase aerosol.....	8
6.2.1 Potassium chloride (KCl) test aerosol.....	8
6.2.2 KCl properties.....	8
6.2.3 Solid phase aerosol generation.....	9
6.3 Reference aerosols.....	10
6.3.1 Reference aerosol for 0,3 µm to 1,0 µm.....	10
6.3.2 Reference aerosol for 1,0 µm to 10,0 µm.....	10
6.4 Aerosol loading.....	10
7 Test equipment	11
7.1 Test rig.....	11
7.1.1 Dimensions.....	11
7.1.2 Construction materials.....	11
7.1.3 Test rig shape.....	12
7.1.4 Test rig air supply.....	12
7.1.5 Test rig isolation.....	12
7.1.6 D/S mixing orifice.....	12
7.1.7 Aerosol sampling.....	13
7.1.8 Test rig air flow rate measurement.....	15
7.1.9 Resistance to air flow measurement.....	15
7.1.10 Test devices not measuring 610 mm × 610 mm (24.0 inches × 24.0 inches).....	16
7.1.11 Dust injection testing.....	16
7.2 Aerosol particle counter.....	17
7.2.1 General.....	17
7.2.2 OPC sampled size range.....	17
7.2.3 OPC particle size ranges.....	17
7.2.4 Sizing resolution.....	18
7.2.5 Calibration.....	18
7.2.6 Air flow rate.....	18
7.2.7 Zero counting.....	18

ISO 16890-2:2022(E)

7.2.8	Dual OPC(s).....	18
7.3	Temperature, relative humidity.....	18
8	Qualification of test rig and apparatus.....	19
8.1	Schedule of qualification testing requirements.....	19
8.1.1	General.....	19
8.1.2	Qualification testing.....	19
8.1.3	Qualification documentation.....	19
8.2	Qualification testing.....	20
8.2.1	Test rig — Pressure system testing.....	20
8.2.2	OPC — Air flow rate stability test.....	21
8.2.3	OPC — Zero test.....	21
8.2.4	OPC — Sizing accuracy.....	21
8.2.5	OPC — Overload test.....	22
8.2.6	Aerosol generator — Response time.....	22
8.2.7	Aerosol generator — Neutralizer.....	23
8.2.8	Test rig — Air leakage test.....	24
8.2.9	Test rig — Air velocity uniformity.....	24
8.2.10	Test rig — Aerosol uniformity.....	25
8.2.11	Test rig — Downstream mixing.....	26
8.2.12	Test rig — Empty test device section pressure.....	28
8.2.13	Test rig — 100 % efficiency test and purge time.....	28
8.2.14	Test rig — Correlation ratio.....	29
8.3	Maintenance.....	29
8.3.1	General.....	29
8.3.2	Test rig — Background counts.....	30
8.3.3	Test rig — Reference filter test.....	30
8.3.4	Test rig — Pressure reference test.....	31
8.3.5	Test rig — Final filter resistance.....	32
9	Test methods.....	32
9.1	Air flow rate.....	32
9.2	Measurement of resistance to air flow.....	32
9.3	Measurement of fractional efficiency.....	32
9.3.1	Aerosol sampling protocol.....	32
9.3.2	Background sampling.....	32
9.3.3	Testing sequence for a single OPC.....	33
9.3.4	Testing sequence for dual OPC.....	37
10	Data reduction and calculations.....	38
10.1	Correlation ratio.....	38
10.1.1	Correlation ratio general.....	38
10.1.2	Correlation ratio data reduction.....	39
10.2	Penetration and fractional efficiency.....	40
10.2.1	Penetration and fractional efficiency general.....	40
10.2.2	Penetration data reduction.....	41
10.3	Data quality requirements.....	43
10.3.1	Correlation background counts.....	43
10.3.2	Efficiency background counts.....	43
10.3.3	Correlation ratio.....	43
10.3.4	Penetration.....	44
10.4	Fractional efficiency calculation.....	45
11	Reporting results.....	45
11.1	General.....	45
11.2	Required reporting elements.....	45
11.2.1	Report general.....	45
11.2.2	Report values.....	45
11.2.3	Report summary.....	46
11.2.4	Report details.....	47

Annex A (informative) Example	50
Annex B (informative) Resistance to air flow calculation	57
Bibliography	59

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN ISO 16890-2:2022

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>

ISO 16890-2:2022(E)

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 16890-2:2016), which has been technically revised.

The main changes are as follows:

- definition of light scattering airborne particle counter (LSAPC) has been added in [Clause 3](#);
- rewording of [6.3.1](#) and removal of 6.3.3 and 6.3.4 eliminating the matching criteria and use of alternate aerosols;
- in [Figure 3](#), the distance between pressure drop taps and test device (7-8), wrongly indicated as 350 mm has been modified with “≥350 mm”;
- in [7.1.6](#) and [8.3.3.4](#), a sentence has been added to specify that the D/S mixing orifice shall not be installed during resistance to airflow measurement;
- in [7.2.1](#), aerosol particle counters (APC) and light scattering aerosol particle counter (LSAPC) have been added as common examples of aerosol particle counter;
- in [7.2.5](#), the incorrect reference to ISO 21501-4 has been corrected with ISO 21501-1;
- in [10.3.2](#), “correlation” has been changed to “efficiency” to be consistent with the title of the subclause;
- in [11.2.3](#), c), 6), iv), the word “additive” has been changed to “adhesive” to be consistent with the template of [Table 10](#);

— the example of the test report in Figure A.1 has been updated to match the template report of [Table A.10](#).

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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN ISO 16890-2:2022

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>

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 PM₁₀, PM_{2,5} and PM₁. The United States Environmental Protection Agency (EPA), the World Health Organization (WHO) and the European Union define PM₁₀ as PM which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter. PM_{2,5} and PM₁ 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 PM₁₀ is described in EN 12341. The measurement principle is based on the collection on a filter of the PM₁₀ fraction of ambient PM and the gravimetric mass determination (see Reference [10]).

As the precise definition of PM₁₀, PM_{2,5} and PM₁ is quite complex and not easy to measure, public authorities, such as the US EPA or the German Federal Environmental Agency (Umweltbundesamt), increasingly use in their publications the simpler denotation of PM₁₀ 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 PM₁₀, PM_{2,5} and PM₁.

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 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 as shown in Table 1.

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 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 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 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 (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 this document. 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 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 ePM_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 are always 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 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN ISO 16890-2:2022](https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022)

<https://standards.iteh.ai/catalog/standards/sist/6b32aced-c2c0-454f-9668-1f7e7e50fea6/sist-en-iso-16890-2-2022>