International Standard

ISO 29463-1

Third edition
2024-08

High efficiency filters and filter media for removing particles in air —

Part 1: Classification, performance, testing and marking

Filtres à haut rendement et filtres pour l'élimination des particules dans l'air —

Partie 1: Classification, essais de performance et marquage

Reference number
ISO 29463-1:2024(en)

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

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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.*

This third edition cancels and replaces the second edition (ISO 29463-1:2017), which has been technically revised.

The main changes are as follows:

— two E classes have been included in Tables 1 and 2;

— informative Annex C for measuring air velocity uniformity has been added.

A list of all parts in the ISO 29463 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/member.html.

Introduction

The ISO 29463 series is derived from the EN 1822 series. It contains requirements, fundamental principles of testing and the marking for high-efficiency particulate air filters with efficiencies from 85 % to 99,999 995 % that can be used for classifying filters in general or for specific use by agreement between users and suppliers.

The ISO 29463 series establishes a procedure for the determination of the efficiency of all filters on the basis of a particle counting method using a liquid (or alternatively a solid) test aerosol and allows a standardized classification of these filters in terms of their efficiency, both local and overall efficiency, which covers most needs of different applications. The difference between this document and other national standards lies in the technique used for the determination of the overall efficiency. Instead of mass relationships or total concentrations, this technique is based on particle counting at the most penetrating particle size (MPPS), which for micro fibre-glass filter media is usually in the range of 0,12 µm to 0,25 µm. This method also allows testing ultra-low penetration air filters, which was not possible with the previous test methods because of their inadequate sensitivity. For membrane filter media, separate rules apply, and are described in ISO 29463-5:2022, Annex B. Although no equivalent test procedures for testing filters with charged media is prescribed, a method for dealing with these types of filters is described in ISO 29463-5:2022, Annex C. Specific requirements for testing method, frequency, and reporting requirements may be modified by agreement between supplier and customer. For lower efficiency filters (Group H, as described in Clause 5), alternate leak test methods noted in ISO 29463-4:2011, Annex A may be used by specific agreement between users and suppliers, but only if the use of these other methods is clearly designated in the filter markings, as noted in the annex. Although the methods prescribed in this document can be generally used to determine filter performance for nano-size particles, testing or classification of filters for nano-size particles are beyond the scope of this document (see Annex A for additional information).

There are differences between the ISO 29463 series and other normative practices common in several countries. For example, many of these rely on total aerosol concentrations rather than individual particles. A brief summary of these methods and their reference standards is provided in ISO 29463-5:2022, Annex A.

High efficiency filters and filter media for removing particles in air —

Part 1:
Classification, performance, testing and marking

1 Scope

This document establishes a classification of filters based on their performance, as determined in accordance with ISO 29463-3, ISO 29463-4 and ISO 29463-5. It also provides an overview of the test procedures and specifies general requirements for assessing and marking the filters, as well as for documenting the test results. It is intended to be used in conjunction with ISO 29463-2, ISO 29463-3, ISO 29463-4 and ISO 29463-5.

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 29463-2:2011, *High-efficiency filters and filter media for removing particles in air — Part 2: Aerosol production, measuring equipment and particle-counting statistics*

ISO 29463-3:2011, *High-efficiency filters and filter media for removing particles in air — Part 3: Testing flat sheet filter media*

ISO 29463-4:2011, *High-efficiency filters and filter media for removing particles in air — Part 4: Test method for determining leakage of filter elements-Scan method*

ISO 29463-5:2022, *High-efficiency filters and filter media for removing particles in air — Part 5: Test method for filter elements*

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

— IEC Electropedia: available at https://www.electropedia.org/

3.1
filter medium
material used for separating contaminants from air and characterized by its porous structure

[SOURCE: ISO 29464:2024, 3.1.25]

3.2
filter element
filter
structure made of the filtering material, its supports and its interfaces with the filter housing

[SOURCE: ISO 29464:2024, 3.2.59, modified — "filter" has been added as a preferred term.]

3.3
removal efficiency
efficiency
fraction or percentage of a challenge contaminant that is removed by an air cleaner

[SOURCE: ISO 29464:2024, 3.1.17 modified — "efficiency" has been added as a preferred term.]

3.4
fractional removal efficiency
fractional efficiency
ability of an air cleaning device to remove particles of a specific size or size range

Note 1 to entry: The efficiency plotted as a function of particle size gives the particle size efficiency spectrum.

[SOURCE: ISO 29464:2024, 3.2.134, modified — "fractional efficiency" has been added as a preferred term.]

3.5
particle diameter
geometric mean diameter (equivalent spherical, optical or aerodynamic, depending on context) of the particles of an aerosol

Note 1 to entry: Particle diameter is often referred to simply as "particle size".

[SOURCE: ISO 29464:2024, 3.2.106, modified — "mean" has been added to the definition.]

3.6
integral removal efficiency
overall efficiency
efficiency (3.3), averaged over the whole *superficial face area* (3.10) of a filter under given operating conditions

[SOURCE: ISO 29464:2024, 3.2.136, modified — "removal" has been removed from the preferred term "overall removal efficiency" and from the definition.]

3.7
local filter removal efficiency
local filter efficiency
efficiency (3.3) at a specific point of a *filter element* (3.2) under given operating conditions

[SOURCE: ISO 29464:2024, 3.2.137, modified — "local filter efficiency" has been added as a preferred term; "removal" has been removed from the definition.]

3.8
nominal air volume flow rate
air volume flow rate at which the *filter element* (3.2) is tested as specified by the manufacturer

3.9
filter face area
air cleaner face area
cross-sectional face area of the air cleaner through which air flows into the device

[SOURCE: ISO 29464:2024, 3.1.22]

3.10
superficial face area
cross-sectional area of the *filter element* (3.2) through which the air flow passes

[SOURCE: ISO 29464:2024, 3.2.48]

3.11
effective filter medium area
area of the *filter medium* (3.1) contained in the *filter element* (3.2) through which air passes during operation

Note 1 to entry: This excludes areas covered by sealant, spacers, struts, etc.

Note 2 to entry: Effective filter medium area is expressed in m^2.

[SOURCE: ISO 29464:2024, 3.1.27]

3.12
medium velocity
nominal filter medium face velocity
volumetric air flow rate divided by the *effective filter medium area* (3.11) of the *filter* (3.2)

Note 1 to entry: Filter medium velocity is expressed in m/s (fpm).

Note 2 to entry: In devices where the filter medium surface area has been increased by use of pleats, folds or bags, the filter medium velocity may be much less than the filter face velocity.

[SOURCE: ISO 29464:2024, 3.1.28, modified — "nominal filter medium face velocity" has been added as a preferred term.]

3.13
quasi-monodisperse test aerosol
aerosol, the width of whose distribution function, described by the geometric standard deviation σ_g, is between 1,15 µm and 1,5 µm

[SOURCE: ISO 29464:2024, 3.2.7, modified — "test" has been added to the term.]

3.14
coefficient of variation
CV
standard deviation of a group of measurements divided by the mean

[SOURCE: ISO 29464:2024, 3.2.28]

4 Symbols and abbreviated terms

d_p	particle diameter
E	efficiency
P	penetration
p	pressure
Δp	differential pressure, pressure drop
CPC	condensation particle counter
DEHS	sebacic acid-bis (2 ethyl hexyl-) ester (trivial name: di-ethyl-hexyl-sebacate)
DMA	differential electric mobility analyser

DMPS	differential mobility particle sizer
MPPS	most penetrating particle size, that is the particle size for which the filtration efficiency is a minimum
OPC	optical particle counter
PAO	poly-alpha-olefin (CAS Registry Number® 68649-12-7)[1)]
PSL	poly-styrene latex (solid spheres)
φ	relative humidity
T	temperature
v	velocity
x, y, x	notation for three cartesian planes

5 Classification

Filters and filter elements are classified in groups and classes based on their efficiency or penetration for the MPPS particles by testing as prescribed in Clause 6 and in ISO 29463-5. According to this document, filter elements fall into one of the following groups.

a) Group E: EPA filters (efficient particulate air filter), also commonly referred to as sub-HEPA.

The efficiency of the filters shall be determined by statistical sample testing only in accordance with ISO 29463-5. Group E filters cannot and shall not be leak tested.

b) Group H: HEPA filters (high-efficiency particle air filter)

Filters are individually tested, and their efficiency shall be determined at MPPS in accordance with ISO 29463-5. The filter should be leak tested in accordance with ISO 29463-4, where, in addition to the reference leak scan method, four alternate methods for leak testing are allowed. Alternate methods used for leak testing should be clearly identified on the filter and certifications.

c) Group U: ULPA filters (ultra-low penetration air filter)

Filters are individually tested, and their efficiency shall be determined at MPPS in accordance with ISO 29463-5. Filters shall be leak tested according to the scan method in accordance with ISO 29463-4. No alternate leak testing is allowed.

A detailed specification for each filter group and class is given in Tables 1 and 2. Either of these tables can be used for filter classification purposes.

Detailed information about the permissible test methods in accordance with the ISO 29463 series for each filter group and class of filters is given in Annex B, Table B.1.

1) Chemical Abstracts Service (CAS) Registry Number® is a trademark of the American Chemical Society (ACS). This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Table 1 — Filter classification: allowed filter classes (5/10th filter efficiency)

Filter class and group	Overall value		Local value [a,b]	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
ISO 05 E	≥ 85	≤ 15	— [c]	— [c]
ISO 15 E	≥ 95	≤ 5	— [c]	— [c]
ISO 25 E	≥ 99,5	≤ 0,5	— [c]	— [c]
ISO 35 H [d]	≥ 99,95	≤ 0,05	≥ 99,75	≤ 0,25
ISO 45 H [d]	≥ 99,995	≤ 0,005	≥ 99,975	≤ 0,025
ISO 55 U	≥ 99,999 5	≤ 0,000 5	≥ 99,997 5	≤ 0,002 5
ISO 65 U	≥ 99,999 95	≤ 0,000 05	≥ 99,999 75	≤ 0,000 25
ISO 75 U	≥ 99,999 995	≤ 0,000 005	≥ 99,999 9	≤ 0,000 1

[a] See 7.5.2.4 and ISO 29463-4.

[b] Local penetration values lower than those given in this table can be agreed upon between the supplier and customer.

[c] Filters of Group E cannot and shall not be leak tested for classification purposes.

[d] For Group H filters, local penetration is given for reference MPPS particle scanning method. Alternate limits may be specified when photometer or oil thread leak testing is used.

Table 2 — Filter classification: allowed filter classes (1/10th filter efficiency)

Filter class and group	Overall value		Local value [a,b]	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
ISO 10 E	≥ 90	≤ 10	— [c]	— [c]
ISO 20 E	≥ 99	≤ 1	— [c]	— [c]
ISO 30 E	≥ 99,90	≤ 0,1	— [c]	— [c]
ISO 40 H [d]	≥ 99,99	≤ 0,01	≥ 99,95	≤ 0,05
ISO 50 U	≥ 99,999	≤ 0,001	≥ 99,995	≤ 0,005
ISO 60 U	≥ 99,999 9	≤ 0,000 1	≥ 99,999 5	≤ 0,000 5
ISO 70 U	≥ 99,999 99	≤ 0,000 01	≥ 99,999 9	≤ 0,000 1

[a] See 7.5.2.4 and ISO 29463-4.

[b] Local penetration values lower than those given in this table can be agreed upon between the supplier and customer.

[c] Filters of Group E cannot and shall not be leak tested for classification purposes.

[d] For Group H filters, local penetration is given for reference MPPS particle scanning method. Alternate limits may be specified when photometer or oil thread leak testing is used.

6 Requirements

6.1 General

The filter element shall be designed or marked to prevent incorrect mounting.

The filter element shall be designed so that when correctly mounted in the ventilation duct, no leak occurs along the sealing edge.

If, for any reason, dimensions do not allow testing of a filter under standard test conditions, assembly of two or more filters of the same type or model is permitted, provided no leaks occur in the resulting filter. Cutting or trimming of larger filters is not permitted for testing.