SLOVENSKI STANDARD
SIST EN 1822-1:2019

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Visoko učinkoviti zračni filtri (EPA, HEPA in ULPA) - 1. del: Klasifikacija, preskušanje lastnosti, označevanje

High efficiency air filters (EPA, HEPA and ULPA) - Part 1: Classification, performance testing, marking

Schwebstofffilter (EPA, HEPA und ULPA) - Teil 1: Klassifikation, Leistungsprüfung, Kennzeichnung

Filtres à air à haute efficacité (EPA, HEPA et ULPA) - Partie 1 : Classification, essais de performance et marquage

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High efficiency air filters (EPA, HEPA and ULPA) - Part 1: Classification, performance testing, marking

Filtres à air à haute efficacité (EPA, HEPA et ULPA) - Partie 1 : Classification, essais de performance et marquage

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

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

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European foreword

This document (EN 1822-1:2019) has been prepared by Technical Committee CEN/TC 195 "Air filters for general air cleaning", 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of an identical text or by endorsement, at the latest by October 2019, and conflicting national standards shall be withdrawn at the latest by October 2019.

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 1822-1:2009.

It is dealing with the performance testing of efficient particulate air filters (EPA), high efficiency particulate air filters (HEPA) and ultra-low penetration air filters (ULPA) at the manufacturers site.

EN 1822, *High efficiency air filters (EPA, HEPA and ULPA)*, currently consists of the following parts:

— *Part 1: Classification, performance testing, marking*

EN 1822 *Part 2* to *Part 5* have been replaced by the corresponding parts of EN ISO 29463.

This standard is intended to be used in conjunction with:

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

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

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

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

When reference is made to ISO 29463-1 in EN ISO 29463-2 to -5, at European level EN 1822-1 applies.

This document is based on particle counting methods which actually cover most needs of different applications. The differences between this European Standard and its previous edition lie in:

— the addition of references to the existing EN ISO 29463-2, EN ISO 29463-3, EN ISO 29463-4 and EN ISO 29463-5;

— the exclusion of the use of an aerosol photometer filter scan leak test;

— various editorial corrections implemented in this document.

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

1 Scope

This document applies to high efficiency particulate and ultra-low penetration air filters (EPA, HEPA and ULPA) used in the field of ventilation and air conditioning and for technical processes, e.g. for applications in clean room technology or pharmaceutical industry.

It establishes a procedure for the determination of the efficiency 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 integral efficiency.

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.

EN ISO 29463-2:2018, *High-efficiency filters and filter media for removing particles in air — Part 2: Aerosol production, measuring equipment and particle-counting statistics (ISO 29463-2:2011)*

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

EN ISO 29463-4:2018, *High-efficiency filters and filter media for removing particles in air — Part 4: Test method for determining leakage of filter elements-Scan method (ISO 29463-4:2011)*

EN ISO 29463-5:2018, *High-efficiency filters and filter media for removing particles in air — Part 5: Test method for filter elements (ISO 29463-5:2011)*

EN 14799, *Air filters for general air cleaning - Terminology*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements (ISO 5167-1)*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14799 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
nominal air volume flow rate
air volume flow rate specified by the manufacturer, at which the filter element has to be tested

3.2
superficial face area
cross-sectional area of the filter element which is passed by the air flow

3.3
nominal filter medium face velocity
nominal air volume flow rate divided by the effective filter medium area

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply:

d_p	Particle diameter
E	Efficiency
P	Penetration
p	Pressure
RH	Relative humidity
T	Temperature
σ_g	Geometric standard deviation
CNC	Condensation nucleus 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
DOP	Phthalic acid-bis (2-ethyl hexyl-) ester (trivial name: di-octyl-phthalate)
MPPS	Most penetrating particle size (= particle size, for which the filtration efficiency is a minimum)
OPC	Optical particle counter
PAO	Polyalphaolefin
PSL	Poly-Styrol Latex (solid spheres)

5 Classification

5.1 General

Filter elements are classified in groups and classes according to their filtration performance (efficiency or penetration).

5.2 Groups of filters

According to this standard, filter elements fall into one of the following Groups:

— Group E: EPA filters (Efficient Particulate Air filter);

— Group H: HEPA filters (High Efficiency Particulate Air filter);

— Group U: ULPA filters (Ultra Low Penetration Air filter).

5.3 Groups and Classes of filters

Filters are classified in Groups and Classes. For each group a slightly different test procedure applies. All filters are classified according to their filtration performance (see 6.5).

Group E filters are subdivided in three classes:

- Class E10;
- Class E11;
- Class E12.

Group H filters are subdivided in two classes:

- Class H13;
- Class H14.

Group U filters are subdivided in three classes:

- Class U15;
- Class U16;
- Class U17.

6 Requirements

6.1 General

The filter element shall be designed or marked so as 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.

6.2 Material

The filter element shall be made of suitable material to withstand normal usage and exposures to those temperatures, humidities and corrosive environments that are likely to be encountered.

The filter element shall be designed so that it will withstand mechanical constraints that are likely to be encountered during normal use.

Dust or fibres released from the filter media by the air flow through the filter element shall not constitute a hazard or nuisance for the people (or devices) exposed to filtered air.

6.3 Nominal air volume flow rate

The filter element shall be tested at its nominal air volume flow rate for which the filter has been designed by the manufacturer.

6.4 Pressure difference

The pressure difference across the filter element is recorded at the nominal air volume flow rate.

6.5 Filtration performance

The filtration performance is expressed by the efficiency or the penetration of MPPS particles.

After testing in accordance with Clause 7, filter elements are classified according to Table 1, on the bases of their integral (Group E) or their integral and local (Groups H and U) MPPS efficiency or penetration.

Filters with filter media having an electrostatic charge are classified according to Table 1, on the bases of their discharged efficiency or penetration according to EN ISO 29463-5:2018, Annex C.

Table 1 — Classification of EPA, HEPA and ULPA filters

Filter Group Filter Class	Integral value		Local value [a] [b]	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
E10	≥ 85	≤ 15	__[c]	__[c]
E11	≥ 95	≤ 5	__[c]	__[c]
E12	≥ 99,5	≤ 0,5	__[c]	__[c]
H13	≥ 99,95	≤ 0,05	≥ 99,75	≤ 0,25
H14	≥ 99,995	≤ 0,005	≥ 99,975	≤ 0,025
U15	≥ 99,9995	≤ 0,000 5	≥ 99,997 5	≤ 0,002 5
U16	≥ 99,999 95	≤ 0,000 05	≥ 99,999 75	≤ 0,000 25
U17	≥ 99,999 995	≤ 0,000 005	≥ 99,999 9	≤ 0,000 1

[a] See 7.5.2 and EN ISO 29463-4.

[b] Local penetration values lower than those given in the table may be agreed between supplier and purchaser.

[c] Group E filters (Classes E10, E11 and E12) cannot and shall not be leak tested for classification purposes.

NOTE ISO 29463-1:2017 developed by ISO/TC 142 includes a classification system for high efficiency air filters according to their filtration performance (efficiency or penetration) similar to EN 1822-1. Table A.1 gives a by-side comparison of the classification in EN 1822-1 and ISO 29463-1:2017.

7 Test methods

7.1 Test rigs

The test rigs are described in detail in EN ISO 29463-3, EN ISO 29463-4 and EN ISO 29463-5. The individual methods of measurement and the measuring instruments are described in EN ISO 29463-2.

7.2 Test conditions

The air in the test channel used for testing shall comply with the following requirements:

— Temperature: (23 ± 5) °C;

— Relative humidity < 75 %.

The temperature shall remain constant during the entire test procedure within ± 2 °C the relative humidity within ± 5 %.

The cleanliness of the test air shall be ensured by appropriate pre-filtering, so that in operation without addition of aerosol the particle number concentration measured with the particle counting method is less than 352 000 m^{-3}. The test specimen shall have the same temperature as the test air.

7.3 Test aerosols

For the testing of EPA, HEPA and ULPA filters in accordance with this standard, a liquid test aerosol shall be used. Alternatively, a solid aerosol may be used for leak testing (see EN ISO 29463-4:2018, Annex E). Possible aerosol substances include but are not limited to DEHS, PAO and PSL. For further details, see EN ISO 29463-2:2018, 4.1.

The use of alternative materials for challenge aerosols can also be agreed between supplier and purchaser when the materials specified in this standard are unacceptable.

The concentration and the size distribution of the aerosol shall be constant over time. For the leak testing and the efficiency test of the filter element the mean particle diameter of the test aerosol shall correspond to the most penetrating particle size (MPPS) for the filter medium.

7.4 Survey of test procedures

7.4.1 General

The complete testing procedure for EPA, HEPA and ULPA filters in accordance with this standard consists of three steps, each of which may be implemented as an independent test.

7.4.2 Step 1: Testing sheet filter medium

The efficiency of flat sheet filter medium test samples shall be determined for a range of particle sizes at the nominal filter medium velocity. From the efficiency versus particle size curve, generated this way, the most penetrating particle size (MPPS) shall be determined.

See 7.5.1.

7.4.3 Step 2: Leak test of the filter element

Filter elements of Groups H and U shall be individually tested for absence of leaks at their nominal air volume flow rate. Filter elements of Group H shall be leak tested using either the reference scanning method or the Oil Thread Test (EN ISO 29463-4:2018, Annex A). H13 may also be tested according to EN ISO 29463-4:2018, Annex F. Filter elements of Group U shall be leak tested using the MPPS scanning method, described in EN ISO 29463-4, only.

See 7.5.2.

7.4.4 Step 3: Efficiency test of the filter element

Using the MPPS test aerosol (the same as used in step 2), the integral efficiency of the filter element shall be determined at its nominal air volume flow rate.

For filters of Group E, this shall be done on statistical bases (see EN ISO 29463-5:2018, 4.2). For filters of Groups H and U, this shall be done on each individual filter, except for filters tested as per EN ISO 29463-4:2018, Annex A, where testing on statistical bases is acceptable.

See 7.5.3.

The use of the aerosol photometer filter scan leak test is not allowed.

7.4.5 Remarks

On the basis of the value(s) determined for integral efficiency and for filters of Groups H and U also for local efficiency (= absence of relevant leaks), filter elements shall be assigned to a filter class as specified in 6.5. This assignment is only valid if the fixed test conditions are met.

In all three procedural steps it is permissible to use either a monodisperse or a polydisperse test aerosol. The particle counting method used may be a total count method (CNC) or a method involving particle size analysis (OPC).

Since total count particle counting methods provide no information about the particle size, they may only be used to determine the efficiency in procedural step 1 with monodisperse test aerosols of a known particle size.

For the determination of the minimum efficiency of the flat sheet filter medium (step 1) the test method using a monodisperse test aerosol shall be considered as the reference test method. Care shall be taken for the correlation with the reference test method if using a polydisperse aerosol for steps 2 and 3.

For production testing, filter manufacturers may use data of their filter medium supplier for procedural step 1, instead of doing these test themselves, as long as these data are fully traceable and documented and the tests are done in full accordance with this standard, and in particular with EN ISO 29463-3.

However, it is necessary to be aware that, in any case, it remains the responsibility of the filter manufacturer to ensure the correctness in accordance with this standard, traceability and documentation of the data. This can be accomplished by maintaining a quality management system, e.g. EN ISO 9000, including supplier audits and regular cross-checking of the data provided by the filter medium supplier or verified by third-party measurements. The cross-checking of the filter medium data shall be done using an accepted statistical method, which can be the skip lot procedure as described in ISO 2859-1 or any equivalent alternative method.

7.5 Test procedures

7.5.1 Testing sheet filter media

7.5.1.1 General

The fractional efficiency curve of flat sheets filter medium samples shall be determined in new condition (material as supplied by the medium manufacturer) and in discharged condition (see EN ISO 29463-5:2018, Annex C). If these measurements reveal that the filter medium is having a significant charge, the filter elements shall be classified on the bases of the discharged flat sheet efficiency or penetration measurements as per EN ISO 29463-5:2018, Annex C.

7.5.1.2 Test samples

The testing procedure requires at least five flat sheet samples of filter material of which the filter elements will be made.

The test samples shall be free of folds, creases, holes and other irregularities. The test samples shall have a minimum size of 200 mm x 200 mm.

7.5.1.3 Test apparatus

The arrangement of the test apparatus is shown in Figure 1. An aerosol is produced in the aerosol generator, then passed through a conditioner (for example to evaporate a solvent) and neutralized, before being brought together with the particle-free mixing air to the test filter mounting assembly.

Upstream and downstream from the test filter mounting assembly, there are sampling points from which a part of the flow is led to the particle counter. The upstream sampling point is connected with a dilution circuit to dilute the high particle concentration down to the actual measuring range of the particle counter.

When using the total counting method (CNC) a differential electric mobility analyser (DMA) is included before the aerosol neutralizer to separate out a (quasi-)monodisperse fraction of the required particle size from the initial polydisperse aerosol.