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Visoko uļ inkoviti zraļ ni filtri (EPA, HEPA in ULPA) - 1. del: Klasifikacija, preskuġanje lastnosti, oznaļ evanje

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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Foreword

This document (EN 1822-1:2009) 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of an identical text or by endorsement, at the latest by May 2010, and conflicting national standards shall be withdrawn at the latest by May 2010.

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

This document supersedes EN 1822-1:1998.

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)*, consists of the following parts:

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

— *Part 2: Aerosol production, measuring equipment, particle counting statistics*

— *Part 3: Testing flat sheet filter media*

— *Part 4: Determining leakage of filter elements (scan method)*

— *Part 5: Determining the efficiency of filter elements*

This European Standard is based on particle counting methods which actually cover most needs of different applications. The difference between this European Standard and its previous edition lies in the addition of:

— an alternative test method for using a solid, instead of a liquid, test aerosol;

— a method for testing and classification of filters made out of membrane type filter media;

— a method for testing and classification filters made out of synthetic fibre media; and

— an alternative method for leak testing of group H filters with other than panel shape.

Beside that, various editorial corrections have been implemented.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

As decided by CEN/TC 195, this European Standard is based on particle counting methods which actually cover most needs of different applications. The difference between this European Standard and previous national standards lies in the technique used for the determination of the integral efficiency. Instead of mass relationships, this technique is based on particle counting at the most penetrating particle size (MPPS), which is for micro-glass filter mediums usually in the range of 0,12 µm to 0,25 µm. For Membrane filter media, separate rules apply, see Annex A of EN 1822-5:2009. This method also allows testing ultra low penetration air filters, which was not possible with the previous test methods because of their inadequate sensitivity.

1 Scope

This European Standard 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 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.

EN 1822-2:2009, *High efficiency air filters (EPA, HEPA and ULPA) — Part 2: Aerosol production, measuring equipment, particle counting statistics*

EN 1822-3, *High efficiency air filters (EPA, HEPA and ULPA) — Part 3: Testing flat sheet filter media*

EN 1822-4:2009, *High efficiency air filters (EPA, HEPA and ULPA) — Part 4: Determining leakage of filter elements (scan method)*

EN 1822-5:2009, *High efficiency air filters (EPA, HEPA and ULPA) — Part 5: Determining the efficiency of filter elements*

EN 14799:2007, *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 5167-1:2003)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14799:2007 and the following apply.

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
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 E 10;

— Class E 11;

— Class E 12.

Group H filters are subdivided in two Classes:

— Class H 13;

— Class H 14.

Group U filters are subdivided in three Classes:

— Class U 15;

— Class U 16;

— Class U 17.

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 as per EN 1822-5:2009, Annex B.

Table 1 — Classification of EPA, HEPA and ULPA filters

Filter Group Filter Class	Integral value		Local value [a] [b]	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
E 10	≥ 85	≤ 15	---[c]	---[c]
E 11	≥ 95	≤ 5	---[c]	---[c]
E 12	≥ 99,5	≤ 0,5	---[c]	---[c]
H 13	≥ 99,95	≤ 0,05	≥ 99,75	≤ 0,25
H 14	≥ 99,995	≤ 0,005	≥ 99,975	≤ 0,025
U 15	≥ 99,999 5	≤ 0,000 5	≥ 99,997 5	≤ 0,002 5
U 16	≥ 99,999 95	≤ 0,000 05	≥ 99,999 75	≤ 0,000 25
U 17	≥ 99,999 995	≤ 0,000 005	≥ 99,999 9	≤ 0,000 1

[a] See 7.5.2 and EN 1822-4.

[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.

7 Test methods

7.1 Test rigs

The test rigs are described in detail in EN 1822-3, EN 1822-4 and EN 1822-5. The individual methods of measurement and the measuring instruments are described in EN 1822-2.

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 350 000 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 1822-4:2009, Annex D). Possible aerosol substances include but are not limited to DEHS, PAO and PSL. For further details, see EN 1822-2:2009, 4.2.

NOTE The use of alternative materials for challenge aerosols may 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 one of the three leak test methods described in EN 1822-4. Filter elements of Group U shall be leak tested using the MPPS scanning method, described in EN 1822-4, 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 has to be done on statistical bases (see EN 1822-5:2009, 4.4). For filters of Groups H and U, this has to be done on each individual filter, except for filters tested as per EN 1822-4:2009, Annex A, where testing on statistical bases is acceptable.

See 7.5.3.

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.