SLOVENSKI STANDARD
SIST EN 1822-2:2010

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Visoko uļ inkoviti zraļ ni filtri (EPA, HEPA in ULPA) - 2. del: Proizvodnja aerosola, merilna oprema, statistika ġtetja delcev

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

Schwebstofffilter (EPA, HEPA und ULPA) - Teil 2: Aerosolerzeugung, Meßgeräte, Partikelzählstatistik

Filtres à air à haute efficacité (EPA, HEPA et ULPA) - Partie 2: Production d'aérosol, équipement de mesure et statistiques de comptage de particules

Ta slovenski standard je istoveten z: EN 1822-2:2009

ICS:

23.120	Zraļ niki. Vetrniki. Klimatske naprave	Ventilators. Fans. Air-conditioners

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

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

Filtres à air à haute efficacité (EPA, HEPA et ULPA) - Partie 2: Production d'aérosol, équipement de mesure et statistiques de comptage de particules

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This European Standard was approved by CEN on 17 October 2009.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 1822-2:2009) 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of an identical text or by endorsement, at the latest by May 2010, and conflicting national standards shall be withdrawn at the latest by May 2010.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 1822-2:1998.

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 EN 1822-5:2009, Annex A. 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 efficient particulate air filters (EPA), high efficiency particulate air filters (HEPA) and ultra low penetration air filters (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.

This European Standard describes the measuring instruments and aerosol generators used in the course of this testing. With regard to particle counting it specifies the statistical basis for the evaluation of counts with only small numbers of counted events.

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 1822-1:2009, *High efficiency air filters (EPA, HEPA and ULPA) — Part 1: Classification, performance testing, marking*

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

EN 14799:2007, *Air filters for general air cleaning — Terminology*

3 Terms and definitions

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

4 Aerosol production

4.1 General

When testing a filter a test aerosol with liquid particles shall be used as reference test method and as defined in EN 1822-1. Alternatively, a solid PSL aerosol can be used for local efficiency (leak) testing (see EN 1822-4:2009, Annex D).

The testing of high-performance filters (U16 and U17) requires methods of aerosol production with high production rates (10^{10} s^{-1} to 10^{11} s^{-1}), in order to provide statistically significant measurements downstream of the filter.

By adjusting the operating parameters of the aerosol generator it shall be possible to adjust the mean particle diameter of the aerosol so that it is equal to the MPPS. The concentration and the size distribution of the aerosol produced shall remain constant throughout the test.

4.2 Aerosol substances

A suitable aerosol substance for the reference test method is a liquid with a vapour pressure which is so low at the ambient temperature that the size of the droplets produced does not change significantly due to evaporation over the time scale relevant for the test procedure (typically max. 5 s).

Possible substances include but are not limited to:

— DEHS;

— PAO;

— Paraffin oil (low viscosity).

The most critical properties of a possible aerosol substance are:

— Index of refraction;

— Vapour pressure;

— Density;

which should not differ too much from the values given for the three substances suggested in Table 1.

NOTE Standard laboratory safety regulations should be observed when handling these substances. It should be ensured by means of suitable exhaust systems and air-tight aerosol ducting systems that the test aerosols are not inhaled. In case of doubt the safety data sheets for the appropriate substances should be consulted.

Table 1 — Important data for aerosol substances at 20 °C

	DEHS	PAO [a]	Paraffin oil (low visc.)
Chemical designation	Sebacic acid-bis(2-ethylhexyl) ester	Poly-Alpha-Olephin (e.g. CAS [b] No. 68649-12-7)	Mixture (e.g. CAS # 64742-46-7)
Trivial name	Diethylhexylsebacyte	Polyalphaolefin	Paraffinoil
Density (kg/m^3)	912	800 – 820 (820 [c])	843
Melting point (K)	225	~ 280	259
Boiling point (K)	529	650 – 780 (674 [c])	
Flash point (K)	> 473	445 – 500	453
Vapour pressure at 293 K (µPa)	1,9	100 – 130	
Dynamic viscosity (kg/m s)	0,022 to 0,024	0,003 1 – 0,004 at 373 K (0,013 at 313 K [c]) (Kinematic viscosity at 373 K: 3,8 – 4,1 mm^2/s)	0,026
Index of refraction/ wavelength (nm)	1,450/650 1,452/600 1,453 5/550 1,454 5/500 1,458 5/450 1,475/400	(1,455 6 [c])	

[a] US Patents 5,059,349 [3] and 5,059,352 [4] describe and restrict the use of PAO for filter testing. Material properties of PAO as per Japan JACA Standard No. 37-2001: "The guideline of substitute materials to DOP" [5], Japan JISZ Standard No. 8901-206 [6] and ISO Standard No. 14644-3 [7].

[b] CAS #, Chemical Abstracts Service Registry Number, substances have been registered in Chemical Abstracts, issued by American Chemical Society [8].

[c] Data for "Emery 3004" as a specific example of a PAO.

Source: Crosby, David W., Concentration produced by a Laskin nozzle generator, a comparison of substitute materials and DOP, 21st DOE/NRC Nuclear Air Cleaning Conference [9].

4.3 Producing monodisperse aerosols

4.3.1 Condensation methods

4.3.1.1 General

Condensation methods are preferred for the creation of monodisperse aerosols, i.e. the particles are formed by condensation from the vapour phase. It is necessary to distinguish between heterogeneous and homogeneous condensation.

4.3.1.2 Heterogeneous condensation

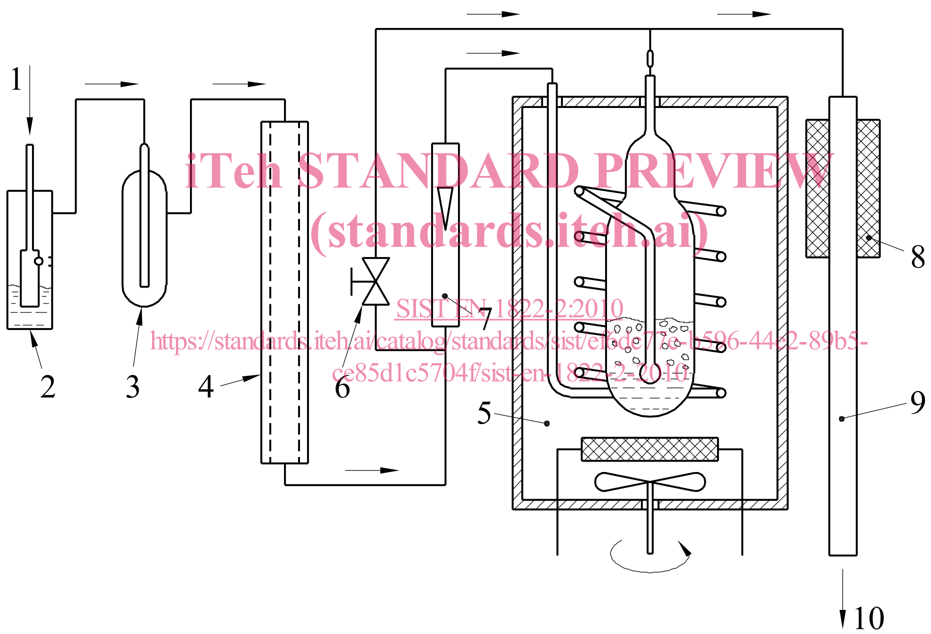
4.3.1.2.1 General

In the case of heterogeneous condensation the vapour condenses at a relatively low level of supersaturation onto very small particles which are already present, the so-called condensation nuclei. The size distribution of the resultant aerosol has a geometrical standard deviation between σ_g= 1,05 and σ_g = 1,15.

Aerosol generators which operate using the principle of heterogeneous condensation are the Sinclair-LaMer generators (Figure 1) and the Rapaport-Weinstock generator (Figure 2).

4.3.1.2.2 Sinclair-LaMer aerosol generator (Figure 1)

A simple nebuliser operated with nitrogen nebulises a weak aqueous solution of sodium chloride. After large water drops have been excluded in a drop eliminator, the smaller droplets are passed into a diffusion drier where they vaporise. The resultant sodium chloride aerosol is then passed into a vessel containing the actual aerosol substance, where it becomes saturated with the vapour of this substance. The aerosol vapour mixture is then passed through a re-heater, and then on through a condensation chimney, where the vapour condenses on the salt particles, forming a homogeneous droplet aerosol (see also [10]).



Key

1 Nitrogen supply
2 Nebuliser
3 Drop eliminator
4 Diffusion drier
5 Thermostatic oven
6 By-pass valve
7 Flow meter
8 Re-heater
9 Condensation chimney
10 Aerosol

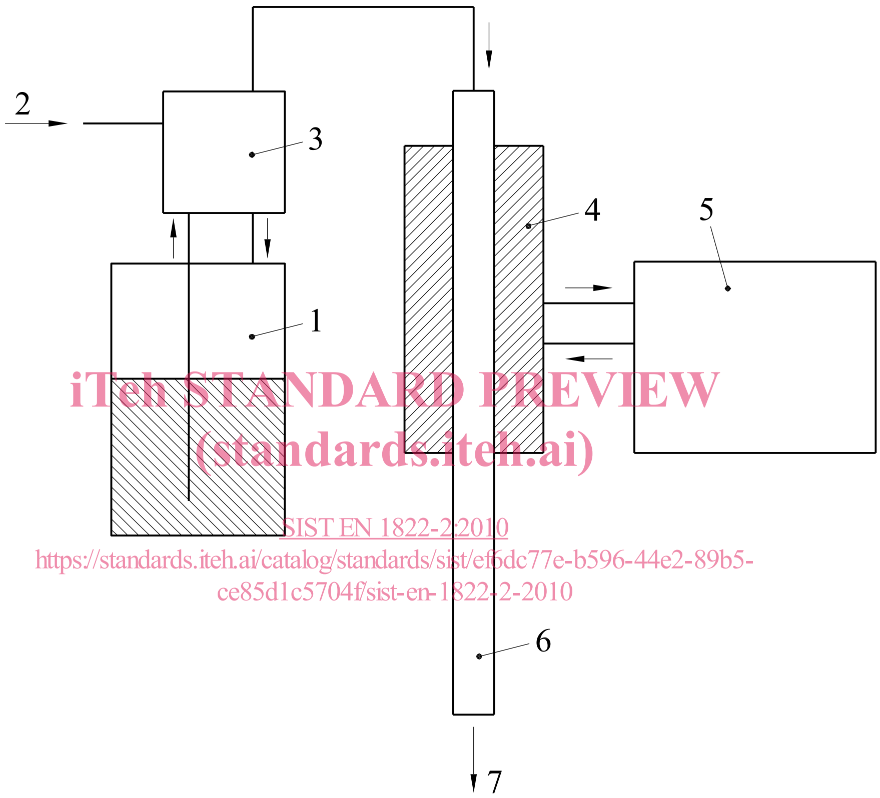
Figure 1 — Structure of the Sinclair-LaMer aerosol generator

The vessel containing the aerosol substance is contained in a thermostatic oven, whose temperature can be adjusted so as to regulate the amount of vapour and the diameter of the particles. A part of the sodium chloride aerosol can also be diverted past the oven using the by-pass valve, and added to the flow again before the re-heater. This makes it possible to achieve a relatively rapid drop in the vapour concentration in the re-heater, and thus a reduction in the particle diameter.

The rates of particle production which can be achieved by means of this type of generator are in the order of 10^8 s^{-1}; the particle diameter can be adjusted between approximately 0,1 µm and 4 µm.

4.3.1.2.3 Rapaport-Weinstock generator (Figure 2)

An aerosol substance is nebulised through a nozzle, either as a pure substance or in solution, and the resultant polydisperse aerosol is then vaporised along the heated section of a glass tube. Residual nuclei of the impurities in the material remain.



Key

1 Liquid reservoir
2 Compressed air
3 Nebuliser
4 Vaporisation section
5 Thermostat
6 Condensation section
7 Aerosol

Figure 2 — Structure of the Rapaport and Weinstock aerosol generator

In the subsequent condensation section the aerosol substance then condenses on these nuclei to form a mondisperse aerosol (see also [11]).

The particle diameter of this aerosol is determined by the mixing ratio of aerosol substance and solvent. The final aerosol contains the solvent used (e.g. Propanol) as a vapour.