

High efficiency air filters (HEPA and ULPA) —

Part 3: Testing flat sheet filter media

The European Standard EN 1822-3:1998 has the status of a
British Standard

ICS 23.120

National foreword

This British Standard is the English language version of EN 1822-3:1998.

The UK participation in its preparation was entrusted by Technical Committee MCE/21, Filters for gases and liquids, to Subcommittee MCE/21/3, Air filters other than for air supply for IC engines and compressors, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 14, an inside back cover and a back cover.

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 December 1998

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ISBN 0 580 29839 6

Amendments issued since publication

Amd. No.	Date	Text affected

ICS 23.120

Descriptors: air filters, cleaning equipment for gases, ventilation, air conditioning, tests, effectiveness, aerosol, particle counters, testing conditions, computation

English version

High efficiency air filters (HEPA and ULPA) — Part 3: Testing flat sheet filter media

Filtres à air à très haute efficacité et filtres à air à
très faible pénétration (HEPA et ULPA) —
Partie 3: Essais de medias filtrants plans

Schwebstofffilter (HEPA and ULPA) —
Teil 3: Prüfung des planen Filtermediums

This European Standard was approved by CEN on 6 March 1998.

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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 Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 195, Air filters for general air cleaning, the Secretariat of which is held by DIN.

It deals with the performance testing of high efficiency particulate air filters (HEPA) and ultra low penetration air filters (ULPA).

The complete European Standard *High efficiency air filters (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.*

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 overall efficiency. Instead of mass relationships, this new technique is based on particle counting at the most penetrating particle size (MPPS; range: 0,15 µm to 0,30 µm). It also allows ultra low penetration air filters to be tested, which is not possible with the previous test methods because of their inadequate sensitivity.

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 November 1998, and conflicting national standards shall be withdrawn at the latest by November 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

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

It establishes a procedure for the determination of the efficiency on the basis of a particle counting method using a liquid test aerosol, and allows a standardized classification of these filters in terms of their efficiency.

This European Standard applies to testing sheet filter media used in high efficiency air filters. The procedure includes methods, test assemblies and conditions for carrying out the test, and the basis for calculating results.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 1822-1:1998, *High efficiency air filters (HEPA and ULPA) — Part 1: Classification, performance testing, marking*.

EN 1822-2:1998, *High efficiency air filters (HEPA and ULPA) — Part 2: Aerosol production, measuring equipment, particle counting statistics*.

3 Definitions and quantities

3.1 Definitions

For the purposes of this standard, the definitions according to EN 1822-1 and EN 1822-2 apply.

3.2 Quantities

Table 1 contains the quantities (terms and symbols) used in this standard to represent measurement variables and calculated values. The values inserted in the equation given for these calculations should be in the units specified.

4 Description of the test method

When testing the sheet filter medium, the particle size efficiency is determined using a particle counting method. The testing can use a monodisperse or a polydisperse test aerosol. The methods differ in terms of both the production of the aerosol and the particle counter used. Furthermore, the measurement of the pressure drop is made at the prescribed filter medium velocity.

Specimens of the sheet filter medium are fixed in a test filter assembly and subjected to the test air flow corresponding to the prescribed filter medium velocity. The test aerosol from the aerosol generator shall be conditioned (e.g. vaporization of a solvent) then neutralized, mixed homogeneously with filtered test air and led to the test filter assembly.

In order to determine the efficiency, partial flows of the test aerosol are sampled upstream and downstream of the filter medium. Using a particle counting instrument, the number concentration of the particles contained is determined for various particle sizes. The results of these measurements are used to draw a graph of efficiency against particle size for the filter medium, and to determine the particle size for which the efficiency is a minimum. This particle size is known as the “most penetrating particle size” (MPPS).

When measuring the particles on the upstream side of the filter medium it may be necessary to use a dilution system in order to reduce the concentration of particles down to the measuring range of the particle counter used.

Additional equipment is required to measure the absolute pressure, temperature and relative humidity of the test aerosol and to measure and control the test volume flow rate.

5 Sampling of sheet filter media

The testing of the sheet filter medium shall be carried out on at least five samples.

The samples shall be handled with care; the area to be tested shall be free from all folds, kinks, holes or other irregularities.

All samples shall be clearly and permanently marked with the following details:

- a) the designation of the filter medium;
- b) the upstream side of the filter medium.

Table 1 — Quantities

Term	Symbol	Unit	Equation for the calculation
Measured variables			
Exposed area	A	cm ²	
Test volume flow rate	$\dot{V}$	cm ³ /s	
Pressure drop	Δp	Pa	
Mean particle diameter	$\tilde{d}_p$	μm	
Particle number	N	—	
Sampling volume flow rate	$\dot{V}_s$	cm ³ /s	
Sampling duration	t	s	
Calculated quantities			
Filter medium velocity	u	cm/s	$u = \frac{\dot{V}}{A}$
Mean pressure difference	$\Delta \bar{p}$	Pa	$\Delta \bar{p} = \frac{1}{n} \sum_{i=1}^n \Delta p_i$
Particle number concentration	c_N	cm ⁻³	$c_N = \frac{N}{\dot{V}_s \times t}$
Penetration for particles in size range i	P_i	1)	$P_i = \frac{c_{N,d,i}}{c_{N,u,i}}$ 2)
Mean penetration	$\bar{P}$	1)	$\bar{P} = \frac{1}{n} \sum_{i=1}^n P_i$
Mean efficiency	$\bar{E}$	1)	$\bar{E} = 1 - \bar{P}$
Number of particles for the upper or lower limit of the 95 % level of confidence	$N_{95\%}$	—	See clause 7 of EN 1822-2:1998
Penetration as upper limit value for the 95 % level of confidence	$P_{95\%,i}$	1)	$P_{95\%,i} = \frac{c_{N,d,95\%,i}}{c_{N,u,95\%,i}}$ 2)
Mean penetration as upper limit value for the 95 % level of confidence	$\bar{P}_{95\%}$	1)	$\bar{P}_{95\%} = \frac{1}{n} \sum_{i=1}^n P_{95\%,i}$
Mean efficiency as lower limit value for the 95 % level of confidence	$\bar{E}_{95\%}$	1)	$\bar{E}_{95\%} = 1 - \bar{P}_{95\%}$
¹⁾ These quantities are usually given as a percentage. ²⁾ The index “u” refers to upstream particle counts, and the index “d” refers to downstream particle counts.			