SLOVENSKI STANDARD
SIST EN 1822-5:2010

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Visoko učinkoviti zračni filtri (EPA, HEPA in ULPA) - 5. del: Določanje učinkovitosti filtrskih elementov

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

Schwebstofffilter (EPA, HEPA und ULPA) - Teil 5: Abscheidegradprüfung des Filterelements

Filtres à air à haute efficacité (EPA, HEPA et ULPA) - Partie 5: Mesure de l'efficacité de l'élément filtrant

Ta slovenski standard je istoveten z: EN 1822-5:2009

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

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Foreword

This document (EN 1822-5:2009) 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of an identical text or by endorsement, at the latest by May 2010, and conflicting national standards shall be withdrawn at the latest by May 2010.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 1822-5:2000.

It contains requirements, fundamental principles of testing and the marking for efficient particulate air filters (EPA), high efficiency particulate air filters (HEPA) and ultra low penetration air filters (ULPA).

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 element (scan method)*

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

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 media usually in the range of 0,12 µm to 0,25 µm. This method also allows the testing test ultra low penetration air filters, which was not possible with the previous test methods because of their inadequate sensitivity.

For membrane and synthetic filter media, separate rules apply, see Annexes A and B of this standard.

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 test aerosol, and allows a standardized classification of these filters in terms of their efficiency.

This part of the EN 1822 series deals with measuring the efficiency of filter elements, specifying the conditions and procedures for carrying out tests, describing a specimen test apparatus and its components, and including the method for evaluating test results.

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 779:2002, *Particulate air filters for general ventilation — Determination of the filtration performance*

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

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, *High efficiency air filters (EPA, HEPA and ULPA) — Part 4: Determining leakage of filter element (scan method)*

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
sampling duration
time during which the particles in the sampling volume flow are counted (upstream or downstream)

3.2
measuring procedure with fixed sampling probes
determination of the integral efficiency using fixed sampling probes upstream and downstream of the test filter

3.3
total particle count method
particle counting method in which the overall number of particles – without size classification – can be determined in a certain test volume (e.g. by using a condensation nucleus counter)

3.4
particle counting and sizing method
particle counting method which can determine both the number of particles and also their size distribution (e.g. by using an optical particle counter)

4 Description of the method

4.1 General

In order to determine the efficiency of the test filter it is fixed in the test filter mounting assembly and subjected to a test air volume flow corresponding to the nominal volume flow rate. After measuring the pressure drop at the nominal volume flow rate, the filter is purged with clean air and the test aerosol produced by the aerosol generator is mixed with the prepared test air along a mixing section, so that it is spread homogeneously over the cross section of the duct.

The efficiency is always determined for the most penetrating particle size (MPPS) (see EN 1822-3). The size distribution of the aerosol particles can optionally be measured using a particle size analysis system (for example a differential mobility particle sizer, DMPS).

The testing can be carried out using either a monodisperse or polydisperse test aerosol. When testing with (quasi-)monodisperse aerosol the total particle counting method can be used with a condensation nucleus counter (CNC) or an optical particle counter (OPC; for example a laser particle counter). It shall be ensured that the number median particle diameter corresponds to the MPPS, i.e. the particle diameter at which the filter medium has its minimum efficiency.

When using a polydisperse aerosol, an optical particle counter shall be used, which in addition to counting the particles is also able to determine their size distribution. It shall be ensured that the median diameter D_M of the test aerosol lies in the range:

$$\frac{MPPS}{2} > D_M < MPPS \times 1{,}5$$

In order to determine the integral efficiency, representative partial flows are extracted on the upstream and downstream sides of the filter element and led to the attached particle counter to measure the number of particles.

The integral efficiency can be determined using one of two methods, either

— with fixed test sampling probes (see 4.2); or

— with one or several movable sampling probes downstream (scan method) (see 4.3).

In both methods the sample upstream is taken using a fixed sampling probe. The upstream and downstream number concentrations and the integral efficiency are calculated from the particle count, the duration of the sampling and the sampling volume flow rate.

4.2 Measurement method using fixed sampling probe

Using this method, the downstream sample used to determine the integral efficiency is taken using a fixed sampling probe. It is necessary to have a mixing section behind the test filter to mix the aerosol homogeneously with the test air over the duct cross section (see 6.2.4).

4.3 Scan method

This integral efficiency can be determined by averaging the readings from the result of the leak test (scan method). The test rig for the scan method is described in EN 1822-4.

In the scan method the downstream sampling is carried out directly behind the test filter using one or several moveable sampling probes, which can traverse the entire cross sectional area of the filter and its frame in overlapping tracks without any gaps.

The test apparatus corresponds largely with that used with stationary sampling probes. The differences in the scanning method are that the downstream mixing section is not included and instead a three-dimensional tracking system is included downstream which moves the probe(s). Since the test duct is usually open, provisions shall be made to prevent the intrusion of contaminated outside air into the test air flow. The arrangement of this test apparatus is described in EN 1822-4.

In the scan method all the particles counted during the entire downstream scan in the course of the leak testing are added together. The duration of the sampling is derived from the data of the scanning and the number of probes.

The further clauses of this standard refer solely to the measuring method with fixed sampling probes where the integral efficiency is determined independently from the leak test procedure.

4.4 Statistical efficiency test method for EPA filters (Group E)

One of the test procedures as described in 4.2 and 4.3 must be used for EPA filters. However for EPA filters the efficiency test does not have to be carried out for each single filter element (as this is mandatory for HEPA [Group H] and ULPA filters [Group U]). The integral efficiency of EPA filters shall be determined by averaging the results of the statistical efficiency tests as described below.

A record of the filter data according to Clause 10 is required in the form of a type test certificate or alternatively a factory test certificate. However, the supplier shall be able to provide documentary evidence to verify the published filter data upon request. This can be done by either:

— maintaining a certified quality management system (e.g. EN ISO 9000), which forces him to apply statistically based methods for testing and documenting efficiency for all EPA filters as per EN 1822 (all parts); or

— using accepted statistical methods to test all of his production lots of EPA filters. Either the “skip lot procedure” as described in ISO 2859-1 may be used or any equivalent alternative method.

NOTE This “skip lot procedure” as described in ISO 2859-1 implies that, at the beginning, the test frequency is high and is in the course of further testing reduced as the production experience grows and the products produced are conform to the target. As an example: the first eight production lots, 100 % of the produced filters are tested. If all the tests are positive, the frequency is reduced to half for the next eight production lots. If all the tests are positive again it is reduced to half again, and so on until only one out of eight lots has to be tested (= minimum test frequency). Each time, one of the tested filters fails; the test frequency is doubled again. In any case the number of samples tested per lot should be more than three filters.

5 Test filter

The filter element to be tested shall show no signs of damage or any other irregularities. The filter element shall be handled carefully and shall be clearly and permanently marked with the following details:

a) Designation of the filter element;

b) Upstream side of the filter element.

The temperature of the test filter during the testing shall correspond with that of the test air.

6 Test apparatus

6.1 General

A flow sheet showing the arrangement of apparatus comprising a test rig is given in Figure 4 of EN 1822-1:2009. An outline diagram of a test rig is given in Figure 1 of this standard.

The fundamentals of aerosol generation and neutralisation with details of suitable types of equipment as well as detailed descriptions of the measuring instruments needed for the testing are contained in EN 1822-2.

6.2 Test duct

6.2.1 Test air conditioning

The test air conditioning equipment shall comprise the equipment needed to control the condition of the test air so that it may be brought in compliance with the requirement of Clause 7.

6.2.2 Adjustment of the volume flow rate

Filters shall always be tested at their nominal air flow rate. It shall be possible to adjust the volume flow rate by means of a suitable provision (e.g. by changing the speed of the fan, or with dampers) to a value ± 5 % of the nominal flow rate which shall then remain constant within ± 2 % throughout each test.

6.2.3 Measurement of the volume flow rate

The volume flow rate shall be measured using a standardized or calibrated method (e.g. measurement of the differential pressure using standardized damper equipment such as orifice plates, nozzles, Venturi tubes in accordance with EN ISO 5167-1).

The limit error of measurement shall not exceed 5 % of the measured value.

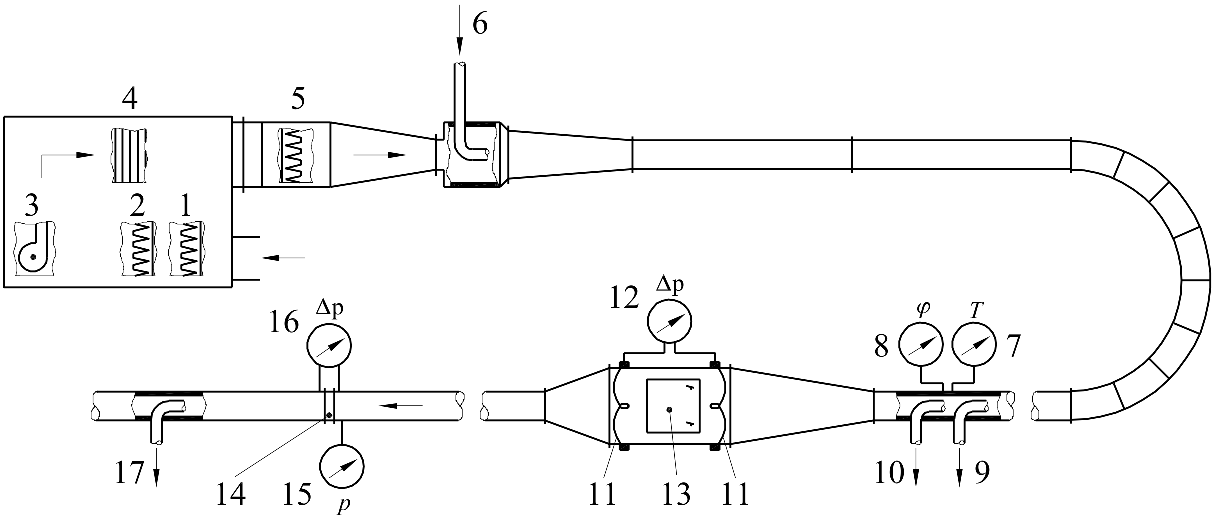
6.2.4 Aerosol mixing section

The aerosol input and the mixing section (see example in Figure 1) shall be so constructed that the aerosol concentration measured at individual points of the duct cross section, directly in front of the test filter, shall not deviate by more than 10 % from the mean value of at least 9 measuring points, over the channel cross section.

6.2.5 Test filter mounting assembly

The test filter mounting assembly shall ensure that the test filter can be sealed and subjected to flow in accordance with requirements.

It shall not obstruct any part of the filter cross sectional area.



Key

1 Coarse dust filter

2 Fine dust filte

3 Fan

4 Air heating

5 High efficiency air filter

6 Aerosol inlet to the test duct

7 Temperature measurement

8 Hygrometer

9 Sampler, particle size analysis

10 Sampler, upstream

11 Ring pipe for differential pressure measurement

12 Manometer

13 Test filter mounting assembly

14 Measuring damper in accordance with EN ISO 5167-1

15 Measurement of absolute pressure

16 Manometer measuring differential pressure

17 Sampler, downstream

Figure 1 — Example of a test rig

6.2.6 Measuring points for the pressure drop

The measuring points for pressure drop shall be so arranged that the mean value of the static pressure in the flow upstream and downstream of the filter can be measured. The planes of the pressure measurements upstream and downstream shall be positioned in regions of an even flow with a uniform flow profile.

In rectangular or square test ducts, smooth holes with a diameter of 1 mm to 2 mm for the pressure measurements shall be bored in the middle of the channel walls, normal to the direction of flow. The four holes shall be interconnected with a circular pipe.

6.2.7 Sampling

In order to determine the efficiency, partial flows are extracted from the test volume flow by sampling probes and led to the particle counters. The diameter of the probes shall be chosen so that isokinetic conditions pertain in the duct at the given volume flow rate for the sample. In this way sampling errors can be neglected due to the small size of the particles in the test aerosol. The connections to the particle counter shall be as short as possible. Samples on the upstream side are taken by a fixed sampling probe