



SLOVENSKI STANDARD

SIST EN 13274-7:2003

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Oprema za varovanje dihal - Metode preskušanja - 7. del: Ugotavljanje penetracije delcev v filter

Respiratory protective devices - Methods of test - Part 7: Determination of particle filter penetration

Atenschutzgeräte - Prüfverfahren - Teil 7: Bestimmung des Durchlasses von Partikelfiltern

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Appareils de protection respiratoire - Méthodes d'essai - Partie 7: Détermination de la pénétration des filtres a particules

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English version

Respiratory protective devices - Methods of test - Part 7: Determination of particle filter penetration

Appareils de protection respiratoire - Méthodes d'essai -
Partie 7: Détermination de la pénétration des filtres à
particules

Atemschutzgeräte - Prüfverfahren - Teil 7: Bestimmung des
Durchlasses von Partikelfiltern

This European Standard was approved by CEN on 23 October 2002.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 13274-7:2002) has been prepared by Technical Committee CEN/TC 79 "Respiratory protective devices", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

This document has been prepared under a mandate given to CEN by the European Union and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

It is one of several parts, which are as follows:

Part 1: Determination of inward leakage and total inward leakage

Part 2: Practical performance tests

Part 3: Determination of breathing resistance

Part 4: Flame tests

Part 5: Climatic conditions

Part 6: Determination of carbon dioxide content of the inhalation air

Part 7: Determination of particle filter penetration

Part 8: Determination of dolomite dust clogging

Annex A is normative.

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is intended as a supplement to the specific device standards for respiratory protective devices. Test methods are specified for complete or parts of devices. If deviations from the test method given in this standard are necessary, these deviations will be specified in the relevant device standard.

1 Scope

This European Standard specifies the procedure for testing particle filter penetration for respiratory protective devices.

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 (including amendments).

EN 132, *Respiratory protective devices — Definitions of terms and pictograms*.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 132 together with the following apply.

3.1 ambient conditions

atmosphere where the temperature is (16 to 32) °C and the relative humidity is (20 to 80) %

3.2 dry atmosphere

atmosphere where the relative humidity is less than 20 %

3.3 wet atmosphere

atmosphere where the relative humidity is greater than or equal to 95 %

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4 Pre-requisites

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In order to implement this Part of EN 13274, at least the following parameters need to be specified in the appropriate device standard:

- items to be tested;
- number of samples;
- test method;
- flow rate through the filter;
- sequence of conditioning phases, where more than one is required;
- specification of any observations to be carried out;
- sample preparation and orientation;
- sample holding;
- pass/fail criteria;
- any deviations from this method.

5 General test requirements

Unless otherwise specified, the values stated in this European Standard are expressed as nominal values. Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of $\pm 5\%$. Unless otherwise specified, the ambient temperature for testing shall be between $16\text{ }^{\circ}\text{C}$ and $32\text{ }^{\circ}\text{C}$ and the temperature limits shall be subject to an accuracy of $\pm 1\text{ }^{\circ}\text{C}$.

6 Sodium chloride test method

6.1 Principle

An aerosol of sodium chloride particles is generated by atomizing an aqueous solution of the salt and evaporating the water. The concentration of this aerosol is measured before and after the filter under test by means of flame photometry. Accurate determinations are possible in the range $< 0,001\%$ to 100% filter penetration.

When an alternative design of test equipment to that given in 6.2 is used, it shall be correlated directly with this reference method and shall be shown to be equivalent over the whole of the operational range.

6.2 Test equipment

The apparatus is shown schematically in Figure 1. The aerosol is generated by using a Collison atomizer filled with a 1% solution of sodium chloride. The atomizer, an example of which is shown in Figure 2, consists of a glass reservoir into which is sealed an atomizer head having three spray nozzles. Air is supplied to the atomizer at a pressure of $3,45\text{ bar}$ and the resulting liquid spray impinges on a baffle which removes the large particles. The particles which do not impact are removed in the air flow and, on mixing with dry air, the water evaporates leaving a dry sodium chloride aerosol.

The aerosol produced by this method is polydisperse with a mass median particle diameter of approximately $0,6\text{ }\mu\text{m}$. The particle size distribution is given in Figure 3. It has been found that the aerosol remains constant, within acceptable limits, with respect to particle size and concentration provided that the supply pressure is in the range from $3,3\text{ bar}$ to $3,6\text{ bar}$ and the flow rate of air to the three nozzles is from $12,5\text{ l/min}$ to $13,0\text{ l/min}$. The output is mixed with 82 l/min of dry air in a chamber with a minimum volume of $1\text{ }750\text{ cm}^3$ giving a total flow rate of 95 l/min .

NOTE 1 The sodium chloride solution in the atomizer is consumed at a rate of approximately 15 ml/h . This loss is due in part to the atomization of the solution and in part to evaporation of water from the reservoir. The volume of the reservoir is such that the change in concentration and loss in volume of the solution during an 8 h period will not cause an appreciable change in the characteristics of the test aerosol.

The sodium chloride aerosol is analysed before and after the filter under test by flame photometry. The photometer used for this analysis can be any suitable instrument having the required sensitivity, however, a photometer specially designed to meet these requirements is available.

NOTE 2 Information concerning the supplier of the photometer and the aerosol generator can be obtained from the secretariat of CEN/TC 79.

In the photometer, the hydrogen burner is housed in a vertical flame tube through which the aerosol to be analysed flows. The hydrogen burner, which gives a flame symmetrical about the vertical axis, is surrounded by a heat proof glass tube. This tube shall be optically homogeneous to minimize the effect on the light emitted by the flame.

Sodium chloride particles in air passing through the flame tube are vapourized giving the characteristic sodium emission at 589 nm . The intensity of this emission is proportional to the concentration of sodium in the air flow.

The intensity of the light emitted by the flame is measured by using a photomultiplier tube. To separate the sodium emission from background light of other wavelengths, a narrow band interference filter with appropriate sideband filters is used. This filter should preferably have a half-peak band width of no more than 5 nm .

As the photomultiplier output is only proportional to the incident light over a relatively small range, high light intensities are attenuated by neutral density filters. These filters are accurately calibrated in conjunction with the interference filter in use and so the actual light intensity can be calculated from the output of the photomultiplier. The signal from the photomultiplier is amplified and recorded.

6.3 Test conditions

Particle size distribution of the test aerosol at the test chamber	see Figure 3
Test aerosol concentration at the test chamber	(4 to 12) mg/m ³
Relative humidity of the test aerosol at the test chamber	less than 60 %
Flow rate of test aerosol from the generator	95 l/min
Air pressure to atomizer	(3,3 to 3,6) bar
Flow rate to atomizer	(12,5 to 13,0) l/min
Flow rate of diluting air	82 l/min

NOTE Flow rate of hydrogen to photometer, 450 ml/min to 500 ml/min (typical)

6.4 Procedure

The test aerosol is fed into the test chamber, where the filter under test is fixed. The specified flow is passed through the filter and the aerosol concentration is measured immediately before and after the filter by the photometer.

Where the specified flow is less than 95 l/min, a bleed shall be incorporated to reduce the flow through the filter to the required rate.

Where the specified flow through the filter is greater than 95 l/min, a supply of clean air of less than 60 % relative humidity shall be added to the output of the aerosol generator so as to obtain the required flow rate. The air shall be added prior to the test chamber so as to ensure a homogeneous aerosol concentration within the test chamber. This procedure will also have the effect of reducing the aerosol concentration before the filter which shall be taken into account when calculating the filter penetration in accordance with 6.5.

The test aerosol is fed into the test chamber where the filter under test is fixed. A flow of 95 l/min is blown through the filter and the aerosol concentration is measured immediately before and after the filter by the photometer. The measurement of penetration shall be taken as the average over a time of (30 + 3) s, beginning 3 minutes after the start of the aerosol test.

6.5 Calculation of the penetration

$$P = C_2/C_1 * 100 \%$$

where

P is the penetration;

C_1 is the sodium chloride concentration upstream of the filter;

C_2 is the sodium chloride concentration downstream of the filter.

The concentrations C_1 and C_2 are calculated by taking background readings into account.

7 Paraffin oil test method

7.1 Principle

An aerosol of paraffin oil droplets is generated by atomising paraffin oil. The concentration of this aerosol is measured before and after the filter under test by means of a light scattering aerosol photometer. Accurate determinations are possible in the range $< 0,001\%$ to 100% filter penetration.

When an alternative design of test equipment is used it shall be correlated directly with the reference method and shall be shown to be equivalent over the whole of the operational range.

7.2 Test equipment

An example of the apparatus is shown in Figure 4. The aerosol is generated using an atomizer filled with paraffin oil (paraffinum perliquidum CP 27 DAB 7¹). The atomization vessel is heated by means of an electric heating device so that the temperature of the oil is kept to nominally $100\text{ }^{\circ}\text{C}$ by means of a thermostat. Filtered compressed air at 4 bar is preheated and blown through the multiple nozzle unit. Large droplets in the generated oil mist are separated by a control nozzle and spiral tube. In the mixing vessel the oil droplets are diluted with 50 l/min filtered air. The generated aerosol is the test aerosol, which is reduced to the test concentration of $(20 \pm 5)\text{ mg/m}^3$ by wasting an appropriate fraction of the oil mist and by further dilution with filtered air at a flow rate of 83 l/min in the cyclone (Figure 5) which further modifies the particle size distribution. The test aerosol produced by this method is polydisperse. The particle size distribution is a logarithmic normal distribution with a number median Stokes diameter of $0,4\text{ }\mu\text{m}$ and a geometric standard deviation (σ_g) of 1,82 (see Figure 6).

The test aerosol is fed into the test chamber (Figure 4, (1)), where the filter under test is to be fixed. The excess of the aerosol is filtered by a high efficiency filter with a low flow resistance (Figure 4, (10)). The specified flow rate is drawn through the filter under test. The test concentration is measured before and after the filter under test by means of an integrating light scattering photometer with a 45° scattering angle. The light source is directed to the measuring cell and to the photomultiplier. The direct beam to the multiplier is interrupted by a chopper, so that the scattered light from the particles is always corrected for the source intensity variations. The reference beam is attenuated by means of neutral density filters and of a neutral density wedge automatically to the intensity of the scattered light beam.

The intensity of the scattered light, which is a measure of the aerosol concentration, is displayed.

7.3 Test conditions at filter

Particle size distribution of the test aerosol: see Figure 6.

Aerosol concentration: $(15\text{ to }25)\text{ mg/m}^3$.

7.4 Procedure

The test aerosol is fed into the test chamber, where the filter under test is fixed.

For filter volume flow rates up to 95 l/min, the aerosol is sucked through the filter at the specified volume flow rate, by means of a suitable pump. The aerosol concentration is measured immediately before and after the filter by the aerosol photometer.

Where the specified flow through the filter is greater than 95 l/min, a supply of clean air shall be added to the output of the cyclone so as to obtain in excess of the required flow rate. The air shall be added prior to the test chamber so as to ensure a homogeneous aerosol concentration within the test chamber.

This procedure will also have the effect of reducing the aerosol concentration before the filter which shall be taken into account when calculating the filter penetration in accordance with 7.5.

1) Information concerning the supplier of the paraffin oil can be obtained from the secretariat of CEN/TC 79.