SLOVENSKI STANDARD
SIST EN 146:1996

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Oprema za varovanje dihal - Zaščitna čelada ali kapuca s tlačno filtracijo zraka - Zahteve, preskušanje, označevanje

Respiratory protective devices - Powered particle filtering devices incorporating helmets or hoods - Requirements, testing, marking

Atemschutzgeräte - Atemschutzhelme oder Atemschutzhauben mit Partikelfilter und Gebläse - Anforderungen, Prüfung, Kennzeichnung

Appareils de protection respiratoire - Appareils filtrants contre les particules a ventilation assistée avec casques ou cagoules - Exigences, essais, marquage

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13.340.20	Varovalna oprema za glavo	Head protective equipment
13.340.30	Varovalne dihalne naprave	Respiratory protective devices

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English version

Respiratory protective devices - Powered particle filtering devices incorporating helmets or hoods - Requirements, testing, marking

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CEN

European Committee for Standardization
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Europäisches Komitee für Normung

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FOREWORD

This European Standard was drawn up by CEN/TC 79 "Respiratory protective devices", the secretariat of which is held by DIN.

In 1979, Sub-Group 3/4 (SG 3/4) "Powered respirators" with BSI as secretariat started work on this draft proposal.

At the Plenary Meeting of CEN/TC 79 in Helsinki in October 1981 the draft proposal was presented and unanimously accepted by CEN/TC 79. It was then presented to the secretariat of CEN/TC 79 for publication as a Draft European Standard.

In December 1983 the draft European Standard prEN 146 was circulated by CEN Central Secretariat to all CEN members for vote and comments. Within the voting period 8 members bodies approved and 3 member bodies disapproved the document.

The comments received were discussed and changes agreed during subsequent meetings of SG 3/4 and the resultant document was submitted to CEN members for formal vote.

At the meeting of SG 3/4 held in Paris in May 1988 it was confirmed that the document should go forward for formal vote and subsequent publication. It was also agreed that it would be withdrawn on publication of a specification to be developed which would cover powered filtering devices, incorporating helmets or hoods, and which would afford protection against particles, gases/vapours and combinations of these.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Preamble

A given respiratory protective device can only be approved when the individual components satisfy the requirements of the test specification which may be a complete standard or part of a standard and practical performance tests have been carried out on complete apparatus where specified in the appropriate standard. If for any reason a complete apparatus is not tested then simulation of the apparatus is permitted provided the respiratory characteristics and weight distribution are similar to those of the complete apparatus.

1 Scope

This European Standard specifies minimum requirements for powered particle filtering devices incorporating helmets or hoods used as respiratory protective devices. It does not cover devices designed for use in circumstances where there is or might be an oxygen deficiency (oxygen less than 17 % by volume). It also does not cover respiratory protective devices designed for escape purposes.

Laboratory tests are included for the assessment of compliance with the requirements.

2 References

EN 143:1989	Respiratory protective devices; Particle filters; Requirements, testing, marking
EN 50 020 Part 7:1977	Electrical apparatus for potentially explosive atmospheres; Intrinsic safety "i"
IEC 651:1979	Sound level meters

3 Definition and description

3.1 A powered particle filtering device incorporating a helmet or hood is a device dependent on the ambient air.

The device provides protection against solid, or solid and liquid aerosols of negligible volatility and decomposition.

The device consists of a helmet or hood with an attachment for covering at least the face (eyes, nose, mouth, chin), a power-operated blower and one or more particle filters. These three components can be integrated into one unit. The fan provides a flow of filtered ambient air to the wearer. Air in excess of the wearer's demand is discharged by exhalation valves or other outlets depending on the design.

3.2 Manufacturer's minimum design flow rate is the flow rate, as stated by the manufacturer, above which the class requirements are met.

4 Classification and designation

Powered particle filtering devices incorporating helmets and hoods are classified and designated as a function of their maximum total inward leakage as given in table 1, when measured against sodium chloride at the manufacturer's minimum design flow rate.

Table 1 - Classification of devices

Class	Maximum total inward leakage (%) (power-on)
THP1	10
THP2	5
THP3	0,2

Note: The 'power-off' state is considered to be an abnormal situation; in these circumstances there is no requirement for testing total inward leakage.

5 Requirements

5.1 Materials

5.1.1 Compatibility with skin

Materials that may come into contact with the wearer's skin shall not be known to be likely to cause irritation or any other adverse effect to health.

5.1.2 Cleaning and disinfection

The materials used shall withstand the cleaning and disinfecting agents recommended by the manufacturer.

5.2 Helmet

If equipment is intended to provide head protection it shall conform to the appropriate part of the national/European standard for protective helmets.

5.3 Total inward leakage

When tested in accordance with 6.1 and calculated according to 6.1.5 the mean total inward leakage of the test aerosol for each of the exercises 6.1.4 (a), (c) (1), (c) (2), (c) (3) and (d) for each test subject shall be within the levels set out in clause 4, when tested at the manufacturer's minimum design flow rate which shall not be less than 120 l/min.

Note: The leakage of exhalation valve(s) if provided, is measured as part of the total inward leakage.

5.4 Carbon dioxide content of the inhalation air

When tested in accordance with 6.2 the carbon dioxide content of the inhalation air shall not exceed an average of 1 % by volume.

5.5 Breathing resistance

When the exhalation resistance is measured in accordance with 6.3 the positive pressure under the helmet or hood shall not exceed 7 mbar.

5.6 Air supply

5.6.1 When tested in accordance with 6.4 at the extremes of operating temperatures and humidities as claimed in the instructions for use the flow into the helmet or hood shall exceed the manufacturer's minimum design flow rate which shall be not less than 120 l/min for the manufacturer's design duration which shall be not less than 4 h.

The flow rate and distribution of the air under the helmet or hood shall not cause distress to the wearer by excessive local cooling of the head and face.

5.6.2 It shall not be possible to switch off the air supply inadvertently.

5.7 Clogging

At the end of the clogging test in accordance with 6.5 the flow rate shall not drop below the manufacturer's minimum design flow rate and the filters shall still meet the penetration requirements of 5.10.

5.8 Electrical components

Where a battery is used it shall be a non-spillable type, and where necessary shall be provided with a safe venting device.

Electrical components shall be so designed that it is not possible inadvertently to reduce or reverse the air flow.

If the device is claimed to be intrinsically safe it shall comply with the requirements of EN 50 020 Part 7.

5.9 Hoses

Any breathing hose shall permit free head movement and shall not restrict or close off the air supply under chin or arm pressure as assessed during measurement of total inward leakage (see 6.1).

5.10 Filters

Filters, other than pre-filters, shall be designed to be irreversible. Filter(s) shall be readily replaceable without the use of tools.

The performance of the filters shall conform to table 2 and shall be tested with the test methods described in EN 143 at the initial flow rate measured in 6.4.5.

Table 2 - Maximum initial penetration

Class	Maximal initial penetration (%)	
	Sodium chloride	Paraffin oil
THP1	10	4
THP2	5	2
THP3	0,2	0,1

Note 1: Filters suitable for use against solid and liquid aerosols shall be tested against sodium chloride and paraffin oil.

Note 2: Filters suitable only for use against solid aerosols and water based aerosols shall be tested against sodium chloride only.

5.11 Warning and measuring facilities

5.11.1 A means shall be provided to check that the manufacturer's minimum design flow rate is exceeded prior to each use.

5.11.2 THP3 eqipment shall be fitted with a warning device which shall indicate to the wearer when the flow rate under the helmet or hood drops below the manufacturer's minimum design flow rate. A means of checking the correct functioning of the warning device shall also be provided.

5.12 Visor

5.12.1 Visors shall not distort vision nor shall misting occur as subjectively determined in the course of testing as in 6.1.

Where anti-fogging compounds are used or specified by the manufacturer, they shall be compatible with eyes, skin and the device.

5.12.2 The effective field of vision shall be not less than 70 %, related to the natural field of vision, and the overlapped field of vision related to the natural overlapped field of vision shall be not less than 80 % when tested in accordance with 6.6.

5.12.3 After testing in accordance with 6.7 the visor shall not be visibly damaged in such a way as to be likely to affect the performance of the complete device.

5.13 Flammability

The device shall not grossly deform, decompose or continue to burn after testing in accordance with 6.8.

5.14 Noise

The noise generated by the device shall not exceed 75 dB(A) when measured using the method described in 6.9 and shall be measured using the complete set of filters designed to be used with the device.

If national regulations are more stringent than this requirement, they shall be met.

6 Testing

6.1 Total inward leakage

6.1.1 Principle

Each test subject, wearing the complete equipment on test, walks on a horizontal treadmill surrounded by a standard cloud of sodium chloride particles. The flow rate of the device is adjusted to, and maintained at the manufacturer's minimum design flow rate using a variable voltage supply. The battery fitted to the device is not used. The percentage inward leakage of the test cloud into the breathing zone is measured by means of flame photometry. Determination of the inward leakage is possible over the range of less than 0,001 % to 100 % penetration. Dilution of the test cloud by the clean air emanating from the respirator under test does not affect the accuracy of measurement of inward leakage because of the large volume and continuous replacement.

6.1.2 Test subjects and number of tests

Two devices shall be tested, each being tested on five test subjects; in total 10 different subjects. Each test shall be carried out using new filters.

6.1.3 Test equipment

A typical test arrangement is shown in figure 1.

The test cloud of sodium chloride particles is formed by the evaporation of an atomised 2 % aqueous solution of reagent grade sodium chloride. The atomiser shall be of the large Collison type. Details of a suitable atomiser are shown in figure 9. The atomiser is supplied with air at a pressure of 7 bar and a flow of 100 l/min. The atomiser is situated in a duct through which a constant flow of air is maintained.

Note: It may be necessary to heat or dehumidify the air in order to obtain complete drying of the aerosol particles.

The duct shall lead into the top of an enclosure positioned over a treadmill; the enclosure shall be large enough to permit walking on the treadmill without interference. Provision shall be made for the positioning of a supplementary fan, not less than 350 mm in diameter, inside the enclosure such that an air flow of 2 m/s across the enclosure can be produced in the vicinity of the subject's head.

The mean air speed through the enclosure measured with a subject standing centrally on the treadmill, and without the supplementary fan in operation, shall be between 0,15 and 0,20 m/s. The air speed at any point in the effective working volume of the enclosure shall be not less than 0,1 m/s, i.e. measurements shall not be made at points nearer than 100 mm to the sides of the enclosure, below 0,75 m from the base of the enclosure nor above a height at which the sodium chloride concentration differs by more than 10 % from the average concentration. The relative humidity of the air within the enclosure when the atomiser is in operation shall not exceed 60 %, this may necessitate drying the air before it flows past the atomiser. The air temperature shall be not less than 15 °C.

The mean sodium chloride concentration within the effective working volume of the enclosure shall be (8 ± 4) mg/m³ and the variation throughout the effective working volume shall be not more than ± 10 %. If necessary a baffle may be placed at the end of the duct in order to achieve these conditions.

The test cloud is composed of sodium chloride particles mainly within the size range 0,02 µm to 2 µm equivalent diameter with a mass median size of 0,6 µm.

The concentration of sodium chloride shall be determined by flame photometry.

Essential performance characteristics of a suitable photometer are:

- it should be specifically designed for the direct analysis of sodium chloride aerosol;
- it should be capable of measuring concentrations of sodium chloride aerosol between 15 mg/m³ and 5 ng/m³;
- the total aerosol sample required by the photometer should not be greater than 15 l/min;
- the response time, excluding sampling system, should not be greater than 500 ms;
- the response to other elements, particularly carbon, the concentration of which will vary during the breathing cycle, needs to be reduced by ensuring that the band pass width of the interference filter is no greater than 3 nm and that all necessary side band filters are included.

The sample tubes shall consist of plastics tubing with a nominal inside diameter of 4 mm through which air is drawn at a rate of 1,5 l/min to 3 l/min by means of a suitable pump. The pump shall be chosen so as to minimize aerosol losses within the pump and also to minimize the change in flow rate caused by changing pressure within the sampling zone. If necessary the sample shall then be diluted with a further 9 l/min of clean air before being fed to the flame tube of the photometer. Two separate sample tubes shall be provided, one to measure the ambient concentration within the enclosure and one to measure the concentration in the wearer's breathing zone.

A test probe with a minimum bore of 1,5 mm may be fitted to the latter sample tube in order to obtain a sample from the required region, the design of the probe shall be chosen to suit the equipment under test. The sample tube connected to the facepiece shall be as flexible as possible. Care shall be taken to ensure that the fitting of the tube and probe does not affect the face seal during head movements.

6.1.4 Test procedure

All sample tubes shall initially be placed in close proximity to one another within the enclosure and the resistance of the sample tubes adjusted so that identical readings for the sodium chloride concentration are obtained from each sample tube.

Provide the test subject with the device and the manufacturer's fitting instructions and allow the test subject to fit the device to the satisfaction of the test subject and the testing officer.

Adjust the flow rate of the device to the manufacturer's minimum design flow rate.

Check the zero reading of the test equipment before commencing the tests.

Introduce the test aerosol into the chamber.

The test subject, wearing the equipment shall stand on the treadmill and the concentration of the test cloud shall be checked at head, chest and waist height.

The test subject shall then stand on the treadmill for a further 2 to 3 min in order to allow the concentration within the wearer's breathing zone to stabilize.