BRITISH STANDARD

BS EN
403:2004

Respiratory protective devices for self-rescue — Filtering devices with hood for escape from fire — Requirements, testing, marking

The European Standard EN 403:2004 has the status of a British Standard

ICS 13.340.30

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 403:2004. It supersedes BS EN 403:1993 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PH/4, Respiratory protection, to Subcommittee PH/4/4, Filters, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/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.

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Respiratory protective devices for self-rescue - Filtering devices with hood for escape from fire - Requirements, testing, marking

Appareils de protection respiratoire pour l'évacuation - Appareils filtrants avec cagoule pour l'évacuation d'un incendie - Exigences, essais, marquage

Atemschutzgeräte für Selbstrettung - Filtergeräte mit Haube zur Selbstrettung bei Bränden - Anforderungen, Prüfung, Kennzeichnung

This European Standard was approved by CEN on 16 January 2004.

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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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Foreword

This document (EN 403:2004) 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of an identical text or by endorsement, at the latest by November 2004, and conflicting national standards shall be withdrawn at the latest by November 2004.

This document supersedes EN 403:1993.

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

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

Annex A is informative.

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

Introduction

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 successfully on complete devices where specified in the appropriate standard. If for any reason a complete device is not tested then simulation of the device is permitted provided the respiratory characteristics and mass distribution are similar to those of the complete device.

1 Scope

This European Standard refers to filtering devices with a hood for personal escape from particulate matter, carbon monoxide and other toxic gases produced by fire. It specifies minimum requirements for this device which is for single use. 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).

Two types of devices are specified; namely, those designed to be carried on the person and those designed to be stored.

This standard specifies devices primarily designed for adult users. Some devices may not be suitable for children.

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

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 132:1998, *Respiratory protective devices – Definitions of terms and pictograms*

EN 134:1998, *Respiratory protective devices – Nomenclature of components*

EN 136, *Respiratory protective devices - Full face masks - Requirements, testing, marking*

EN 140, *Respiratory protective devices - Half masks and quarter masks - Requirements, testing, marking*

EN 141:2000, *Respiratory protective devices - Gas filters and combined filters - Requirements, testing, marking*

EN 143:2000, *Respiratory protective devices - Particle filters - Requirements, testing, marking*

EN 405, *Respiratory protective devices – Valved filtering half masks to protect against gases or gases and particles – Requirements, testing, marking*

EN 12941, *Respiratory protective devices - Powered filtering devices incorporating a helmet or a hood - Requirements, testing, marking*

EN 13274-1, *Respiratory protective devices - Methods of test - Part 1: Determination of inward leakage and total inward leakage*

EN 13274-4, *Respiratory protective devices - Methods of test - Part 4: Flame tests*

EN 13274-5:2001, *Respiratory protective devices - Methods of test - Part 5: Climatic conditions*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 132:1998 and EN 134:1998 apply.

4 Description

A filtering device with a hood for self-rescue from fire (filtering smoke hood) is a respiratory protective device dependent on the ambient atmosphere.

A complete device consists of a facepiece with combined filter and, if necessary, suitable packaging. It is not intended that any disassembly or assembly be carried out by the user.

The facepiece of a filtering smoke hood can be the hood itself or a full face mask, half mask, quarter mask or mouthpiece assembly connected to the hood. The combined filter is attached to the facepiece and is not replaceable without tools.

5 Classification

Devices designed to be carried on the person are classified as 'M' and those for storage 'S'.

6 Requirements

6.1 General

In all tests all test samples shall meet the requirements.

6.2 Ergonomics

The requirements of this standard are intended to take account of the interaction between the wearer, the respiratory protective device, and where possible the working environment in which the respiratory protective device is likely to be used. See annex ZA.

6.3 Design

The apparatus shall be sufficiently robust to withstand the rough usage it is likely to receive in service with respect to its classification.

The apparatus shall be designed so that there are no protruding parts or sharp edges likely to be caught on projections in narrow passages.

No part of the apparatus likely to be in contact with the wearer shall have sharp edges or burrs.

The apparatus shall be designed to ensure its full function in any orientation.

Testing shall be done in accordance with 7.3 and 7.5.

6.4 Materials

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

All metallic parts shall be corrosion-resistant or protected against corrosion e.g. by packaging.

If materials sensitive to humidity are used in the device, they shall be protected against the effects of humidity e.g. by suitable packaging.

Testing shall be done in accordance with 7.3, 7.4 and 7.5.

6.5 Mass

The mass of the ready-for-use device without packaging or carrying device shall not exceed 1000 g.

Testing shall be done in accordance with 7.1.

6.6 Conditioning

Prior to laboratory or practical performance tests all test specimen shall be conditioned.

Testing shall be done in accordance with 7.4.

6.7 Connections

Connections between components shall be designed such that they cannot be readily separated by the user.

Testing shall be done in accordance with 7.3.

The connection between filter and hood assembly shall withstand axially a tensile force of 50 N.

Testing shall be done in accordance with 7.12.

6.8 Packaging

The packaging shall be easy to open without tools.

Testing shall be done in accordance with 7.3.

6.9 Practical performance

The complete apparatus shall undergo practical performance tests. These general tests serve the purpose of checking the apparatus for imperfections that cannot be determined by the tests described elsewhere in this standard.

Where, in the opinion of the test house, approval is not granted because practical performance tests show the apparatus has imperfections related to wearer's acceptance, the test house shall provide full details of those parts of the practical performance tests which revealed these imperfections. This will enable other test houses to duplicate the tests and assess the results thereof.

Testing shall be done in accordance with 7.5.

6.10 Leakage

6.10.1 Inward leakage excluding filter penetration (breathing zone)

For filtering smoke hoods fitted in accordance with the instructions for use, at least 46 out of the 50 individual results for the inward leakage over each of the exercise periods as defined in 7.6.1 (i.e. 10 subjects x 5 exercise periods) shall be not greater than

5 %

and, in addition, at least 8 out of the 10 individual wearer arithmetic means (10 subjects) for the inward leakage, averaged over all exercise periods shall be not greater than

2 %

Testing shall be done in accordance with 7.6.1.

6.10.2 Leakage into ocular zone

The leakage of the test agent shall not exceed 20 %.

Testing shall be done in accordance with 7.6.2.

6.11 Filter

6.11.1 Gas capacity

The breakthrough time shall not be less than 15 min when the test agents shown in Table 1 are used.

Testing shall be done in accordance with 7.7.

Table 1 — Test gas conditions

Test gas	Test gas concentration in air[a] ml/m[c] (= ppm)	Breakthrough concentration[b] ml/m (= ppm)
Propenal (acrolein)	100	0,5
Hydrogen chloride (HCl)	1000	5
Hydrogen cyanide (HCN)	400	10 [c]
Carbon monoxide	2500 5000 7500 10 000	200 [d]

a A deviation of ± 10 % from the required value shall be acceptable. The recorded breakthrough times shall be adjusted, if necessary, by simple proportion to conform with the specified influent concentration.

b The breakthrough concentration is an arbitrary value and it is used only to define the end point of the filter capacity under laboratory testing conditions.

C C_2N_2 may sometimes be present in the effluent air. The total concentration of (HCN + C_2N_2) shall not exceed 10 ml/m^3 at breakthrough.

d Time weighted average in any single 5 min period.

6.11.2 Filter penetration

The filter shall meet the requirements of EN 143 for penetration of particle filter class P2 using sodium chloride as test agent.

Testing shall be done in accordance with 7.8.

6.12 Valves

The complete device may be provided with one or more inhalation and exhalation valves. If the device is equipped with valves, the valves shall operate correctly and independent of their orientation. They shall be protected against dirt and mechanical damage.

Testing shall be done in accordance with 7.3 and 7.5.

6.13 Breathing resistance

The inhalation resistance shall not exceed 8 mbar and the exhalation resistance shall not exceed 3 mbar.

Testing shall be done in accordance with 7.9.

6.14 Flammability

The materials used shall not present a danger for the wearer and shall not be of highly flammable nature.

The filtering smoke hood or other exposed parts shall not continue to burn or present any additional hazard to the wearer. It is not required that the filtering smoke hood still has to be useable after the test.

Testing shall be done in accordance with 7.3 and 7.10.

6.15 Carbon dioxide content of inhalation air

The carbon dioxide content of inhalation air (dead space) shall not exceed an average of 2 % by volume.

Testing shall be done in accordance with 7.11.

6.16 Head harness

If a harness is fitted it shall meet the requirements for the harness specified in EN 140.

6.17 Vision

6.17.1 Visor

The visors shall be reliably assembled to the device.

Testing shall be done in accordance with 7.3 and 7.5.

6.17.2 Impairment of vision

Visors shall not distort vision as determined in practical performance tests. There shall be no significant impairment of vision by fogging as determined in practical performance tests.

Testing shall be done in accordance with 7.5.

6.17.3 Field of vision

The field of vision is acceptable if determined so in practical performance tests.

Testing shall be done in accordance 7.5.

6.18 Sealing

Each complete device or filter component shall be sealed and shall not be resealable except by the use of special equipment. The sealing shall be such that it can readily be opened when necessary but not inadvertently. When the packaging seal has been broken this shall be obvious by visual inspection.

Testing shall be done in accordance with 7.3 and 7.5.

6.19 Integrity of filtering smoke hood at high carbon monoxide concentrations

The device shall maintain its mechanical integrity and shall not present a hazard to the wearer.

Testing shall be done in accordance with 7.7.2.2 but with the variation to use 1,0 % by volume carbon monoxide in air as the test atmosphere, and 7.3.

6.20 Ingress of humidity

If materials sensitive to humidity are used these materials shall be protected against humidity.

After conditioning in accordance with 7.4 the device shall meet the requirements of this standard.

6.21 Temperature of inhaled air

The temperature of the inhaled air shall not exceed 90 °C dry bulb and 50 °C wet bulb during the test duration of 15 min.

Testing shall be done in accordance with 7.7.2.2 but with the variation to use 0,5 % by volume carbon monoxide in air as the test atmosphere.

6.22 Communication

A person wearing the device shall be able to hear verbal communications from the test supervisor.

A person wearing the device shall be able to communicate verbally. This does not apply when the device is equipped with a mouthpiece assembly.

Testing shall be done in accordance with 7.5.

7 Testing

7.1 General

If no special measuring devices or measuring methods are specified, commonly used methods and devices should be applied.

Before performing tests involving human subjects, account should be taken of any national regulations concerning the medical history, examination or supervision of the test subjects.

7.2 Nominal values and tolerances

Unless otherwise specified, the values stated in this 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 ± 5 %. Unless otherwise specified, the ambient temperature for testing shall be from 16 °C to 32 °C, but for the mechanical tests from 10 °C to 30 °C, and the temperature limits shall be subject to an accuracy of ± 1 °C.

7.3 Visual inspection

A visual inspection of the filtering devices shall be carried out and the appropriate results reported. The visual inspection includes marking and information supplied by the manufacturer.

7.4 Conditioning

7.4.1 General

The conditioning procedures specified in 7.4.2 to 7.4.6 shall be applied sequentially to all test specimens.

The device shall be conditioned in the smallest packaging in which it is stored or carried.

7.4.2 Mechanical strength

The device shall be tested in its packaging in accordance with 8.3 of EN 141:2000 using 2 000 rotations for 'S' type and 10 000 rotations for 'M' type.

7.4.3 Impact

The device shall be dropped in its packaging six times from a height of 1,5 m onto a smooth concrete surface using different starting orientations.

This conditioning applies only to devices of 'M' type.

7.4.4 Resistance of packaging to puncture and tear

7.4.4.1 Principle

A striker is allowed to fall with a specified energy, point downwards onto the device packaged as described in 7.4.1. The packaging is then pulled out from under the point and inspected for punctures or tears.

7.4.4.2 Apparatus

Typical test equipment is shown in Figure 1. It consists mainly of

a) striker;

b) mounting arm for the striker: suitably pivoted;

c) smooth polished steel base plate;

d) spring balance.

7.4.4.3 Procedure

It shall be ensured that the effective force at rest of the mounting arm and the striker is 1N ± 2 %. The necessary adjustment shall be made using a spring balance attached to the striker.

The test specimen in its packaging is placed under the striker such that when released the striker hits the packaging.

The impact of the striker shall be from a height of 100 mm.

Leaving the striker in contact with the packaging, briskly pull the packaging away in the direction shown in Figure 1.

Examine the packaging for any puncture or tear.

Repeat the procedure twice more to hit different areas of the packaging.

7.4.5 Temperature

The device shall be in the packaging as described in 7.4.1.

Testing shall be done in accordance with the following clauses of EN 13274-5:2001:

a) 6.2.2, 6.3.4 and 6.4.1;

b) 6.2.2, 6.3.2 and 6.4.1;

c) 6.2.8 and 6.4.2.

7.4.6 Pressure changes

Only devices classified as 'M' shall be exposed in its packaging as described in 7.4.1 consecutively to the following pressure changes:

a) 2 pressure change cycles in a test chamber for negative pressure from ambient pressure to a differential pressure of (-400 ± 10) mbar.

   The final pressure shall be achieved in less than 20 s. After 60 s the pressure compensation shall be started by venting the test chamber. The pressure compensation shall be achieved in less than 20 s.

b) 3 000 pressure change cycles in a test chamber for negative pressure from ambient pressure to a differential pressure of (-300 ± 10) mbar.

   The final pressure shall be achieved in less than 10 s. After 60 s the pressure compensation shall be started and shall be achieved in less than 10 s.

If there is more than one test specimen in the test chamber to be exposed to the pressure changes then the test specimens shall not be in contact with each other.

7.5 Practical performance test

7.5.1 General

For practical performance tests, only devices of the type which passed the laboratory testing shall be worn.

A total of 5 filtering smoke hoods shall be tested.

Prior to the test the filtering smoke hoods shall be examined to ensure that they are in good working condition and can be used without hazard.

For test subjects shall be selected who are familiar with using such or similar devices.

Five test subjects shall be used for the practical performance tests. They shall be made familiar with the device using the instructions for use.

The test subjects shall complete the exercises listed in 7.5.2 in a normally lit room at ambient atmosphere and the test temperature and the humidity shall be recorded.

During the tests the device shall be subjectively assessed by the wearer and after the test, comments on the following shall be recorded:

a) harness comfort (if fitted);

b) security of fastenings and couplings;

c) accessibility of controls (if fitted);

d) clarity of vision on the visor of the facepiece;

e) the visibility of a sign consisting of letters 100 mm in height at a distance of 6 m;

f) communication with a test supervisor;

g) any other comments reported by the wearer on request.

7.5.2 Exercises

a) walking on the level with headroom of (1,3 ± 0,2) m for 5 min;

b) crawling on the level with headroom of (0,7 ± 0,05) m for 5 min;

c) filling a small basket (Figure 2, approx. volume = 8 l) with "rubber chippings" or other suitable material from a hopper which stands 1,5 m high and has an opening at the bottom to allow the contents to be shovelled out and a further opening at the top where the basket full of rubber chippings shall be returned.

   The subject shall stoop or kneel as he wishes and fill the basket with rubber chippings. He shall then lift the basket and empty the contents back into the hopper. This shall be repeated 15 times in 5 min.

7.6 Leakage

7.6.1 Inward leakage excluding filter penetration (breathing zone)

Test subjects, number of test specimen and preparation of test specimen in accordance with EN 405.

Testing in accordance with EN 13274-1, test method 1 using sulfur hexafluoride as test agent.

7.6.2 Leakage into ocular zone

7.6.2.1 Number of test specimens and test subjects

For the test 10 test specimen and 10 test subjects shall be used.

7.6.2.2 Preparation of test specimen

The visor in the hood shall be prepared by perforating such that a sampling probe and a thin air supply hose can be inserted in a leak tight manner by appropriate plugs.

The sampling probe shall be positioned inside the hood on one side of the test subject at eye level. The port for the air supply hose shall be positioned on the other side slightly displaced from eye level, so that the test subject will not be distressed by the pressure compensating air flow. In the middle between the ports for the sampling probe and the air supply a third hole shall be punched for connecting a sensitive differential pressure meter (sensitivity $\leq$ 0,01 mbar).

7.6.2.3 Setting-up procedure

The test subject wearing the hood prepared as described in 7.6.2.2 shall stand on a treadmill.

A continuous sample flow rate of 0,5 l/min shall be fed through the sampling line to the flame photometer and shall be diluted with clean air, if necessary, to achieve the minimum flow rate required by the photometer.

Clean air shall be fed through the air supply at a flow rate of 0,5 l/min into the hood. Adjustments to the air flow necessary to ensure that the pressure in the hood and ambient are the same shall be made while the test subject is standing without any movement.

NOTE Sometimes it may be necessary for the test subject to hold his breath for this procedure.

7.6.2.4 Test procedure

Testing shall be done in accordance with EN 12941 using sodium chloride as test agent.

At the end of the test the challenge concentration in the test chamber shall be measured using the same flow rates and diluting conditions as were employed for measuring the in-hood concentrations.

7.6.2.5 Expression of results

The leakage into the ocular area L_H shall be calculated from measurements made over the last 100 s of each of the exercise periods to avoid carry over of results from one exercise to the other.

$$L_H\ (\%) = \frac{concentration\ at\ eye\ level}{challenge\ concentration} \times 100$$

7.7 Gas capacity

7.7.1 General

The gas capacity shall be tested with 3 filters for each test gas for each test condition. When one filter of a multiple filter device is tested separately, the air flow specified for a test shall be divided by the number of filters through which the airflow is proportioned.

7.7.2 Carbon monoxide test

7.7.2.1 Apparatus

Schematic diagrams of test arrangements that have been found suitable are given in Figures 3, 4, 5 and 6. They mainly consist of

a) breathing machine equipped with solenoid valves controlled by the breathing machine;

b) humidifier;

c) flow meters for air and carbon monoxide;

d) test chamber equipped with sampling ports and exhaust;

e) carbon monoxide analysers;

f) means of measurement of pressure, temperature and moisture content;

g) 'Sheffield' dummy or suitable adapter;

h) supply of carbon monoxide.

7.7.2.2 Procedure

The hood to be tested shall be mounted on the dummy head (Sheffield). The filter, if tested separately, shall be mounted on a suitable adapter. The test shall be carried out including the valves of the hood, if applicable.

NOTE 1 It may be necessary to use a sealant to ensure an effective seal between the hood and the dummy head (Sheffield) or adapter respectively.

With a flow of not less than 100 l/min of air with carbon monoxide and water vapour content fed into the test chamber via control valves and flow meters the following conditions in the test chamber shall be established using the breathing machine set to 20 cycles/min and 1,5 l/stroke:

Concentration of carbon monoxide	0,25 % by volume
Humidity (moisture content of test atmosphere)	20,7 g/m^3
Temperature of test atmosphere	(25 ± 1) °C
Temperature of exhaled air	(37 ± 1) °C
Humidity of exhaled air	95 - 100 %

The temperature and humidity of the test atmosphere and exhalation air shall be controlled by using suitable conditioners.

The carbon monoxide and water vapour concentrations as well as the differential pressure in the test chamber 2,5 cm in front of the air inlet of the test specimen shall be monitored and recorded continuously during the test.

NOTE 2 The effect of differential pressure and of the dilution of the challenge atmosphere by exhaled air shall be taken into account and the concentration of carbon monoxide and moisture shall be adjusted accordingly.

The breathing resistance and the carbon monoxide concentration (ml/m^3) shall be measured and recorded continuously.

When tested against 0,5 % by volume carbon monoxide in air as test atmosphere

— the dry bulb temperature of the inhaled air shall be measured using a fast response thermocouple (for example NiCr-Ni 0,2 mm diameter);

— the moisture content of the inhaled air shall be measured continuously. A suitable method is given in annex A.

7.7.2.3 Other concentrations

The test shall be repeated but with the variation to use 0,5 %, 0,75 %, and 1,0 % by volume carbon monoxide in air until all four values have been used.

NOTE Four concentrations are used to establish the catalytic characteristics of the materials and the configuration of the device.

7.7.2.4 Breakthrough criteria

The carbon monoxide concentration of the inhaled air shall not exceed 200 ml/m^3 time weighted average in any single 5 min period.

7.7.3 Other test gases

The conditions shown in Table 1 shall be used for testing with the gases specified in 6.11.1.

The filter under test shall be connected to a test rig generating a continuous air flow of 30 l/min (± 3 %) with the required concentration of test gas.

The test atmosphere shall be at a temperature of (20 ± 1) °C and shall have a relative humidity of (70 ± 5) %. When hydrogen chloride is used as a test gas the relative humidity shall be (30 ± 10) %.

The breakthrough concentration shall be monitored with a maximum error of 20 %. The breakthrough time shall be stated in minutes.

7.8 Filter penetration

Testing in accordance with 8.7.2 of EN 143:2000 using 3 filters and sodium chloride aerosol.

NOTE If the filter cannot be tested separately, it may be necessary to use a sealant to ensure an effective seal between the hood and the Sheffield dummy head or adapter respectively.

When one filter of a multiple filter device is tested separately, the air flow specified for a test shall be divided by the number of filters through which the air flow is proportioned.

7.9 Breathing resistance

Two filtering smoke hoods shall be tested.

The ready-for-use device shall be mounted on a Sheffield dummy head. The breathing resistance shall be determined at the mouth of the dummy head using a breathing machine (adjusted to 1,5 l/stroke, 20 cycles/min) using the procedure given at 7.7.2.2. The flow rate at which the resistance is measured shall be corrected to 23 °C and 1 bar absolute.

7.10 Flammability

7.10.1 Test specimen

Two filtering smoke hoods shall be tested.

7.10.2 Apparatus

The test rig described in EN13274-4 method 1 is used.

7.10.3 Procedure

The filtering smoke hood shall be fitted on the metallic dummy head. If the filtering smoke hood is not equipped with a head harness, the material of the filtering smoke hood shall be clamped in an appropriate clamping device such that the material is horizontal.

The distance between the outer surface of the filtering smoke hood and the burner tips shall be adjusted to 250 mm.

The pressure reducer shall be adjusted to approximately 0,15 bar. It shall be ensured that the control device for propane gas on the burners is fully opened and that the control device for air is fully closed. The temperature of the flame 250 mm above the burner tip shall be (800 ± 50) °C.

The filtering smoke hood (on the dummy head) or the filtering smoke hood material (in the clamp) shall be rotated once through the flame at a velocity of (6 ± 0,5) cm/s.

Where components such as valve(s), filter(s) etc. are arranged on other parts of the filtering smoke hood, the test shall be repeated with these components at the appropriate height (250 mm) above the flame.

After passing through the flame it shall be recorded whether or not the filtering smoke hood or other components continued to burn or presented any additional potential hazard to a wearer.

7.11 Carbon dioxide content of the inhalation air

Two filtering smoke hood shall be tested.

Testing shall be done in accordance with EN 136.

7.12 Connections

Two filtering smoke hood shall be tested.

Test time shall be 10 s. The filtering smoke hood shall be supported on a dummy head which shall be adjusted such that the load can be applied axially to the connection as shown in Figure 7.

8 Marking

8.1 General

All the markings shall be readable and durable.

Sub-assemblies and piece parts with considerable bearing on safety shall be marked so that they can be identified.

8.2 Filtering smoke hood or package

All filtering smoke hoods or at least the packaging shall be marked with

a) the dated number of this European Standard and classification, if applicable;

b) the manufacturer, supplier or importer shall be identified by name, trademark, or other means of identification;

c) manufacturer's model designation.

8.3 Package

The package shall be marked at least with the following information:

a) class i.e. 'M' or 'S';

b) date of manufacture (year and month) and the end of shelf life or date for next inspection. Equivalent pictograms can be used (Figure 8);

c) manufacturer's recommended conditions of storage (at least the temperature and humidity) or equivalent pictogram as shown in Figure 8;

d) the sentence "See information supplied by the manufacturer." at least in the official language(s) of the country of destination or the appropriate pictogram as shown in Figure 8;

e) when the reliable performance of the device may be affected by mass increase, e. g. absorption of humidity, the mass shall be given on the packaging that protects against humidity;

f) if the device is fitted with a mouthpiece and a nose clip the statement: 'Do not speak during use'.

9 Information supplied by the manufacturer

On the delivery, the information supplied by the manufacturer

a) shall accompany every device;

b) shall be at least in the official language(s) of the country of destination;

c) shall contain all information necessary for trained and qualified persons on:

— application/limitations;

— the information for single use only of short duration;

— information of limitation with respect to wearer's size and facial characteristics, and a statement of suitability for use by children;

— the prevention of speech when wearing a device incorporating a mouthpiece;

— controls prior to use;

— donning and fitting;

— use;

— maintenance and inspection intervals;

— storage;

— shelf life, if applicable.

d) special attention shall be drawn to:

— self-rescue;

— the fact that no protection against oxygen deficiency is provided.

e) shall include warnings against problems likely to be encountered, for example:

— the unit shall not be damaged in any way;

— donning procedure shall be carried out in accordance with the instructions for use.

f) shall be clear and comprehensible. If helpful illustrations should be added; e.g. showing the donning procedure;

g) it shall be possible to have access to the information supplied by the manufacturer without breaking any seal;

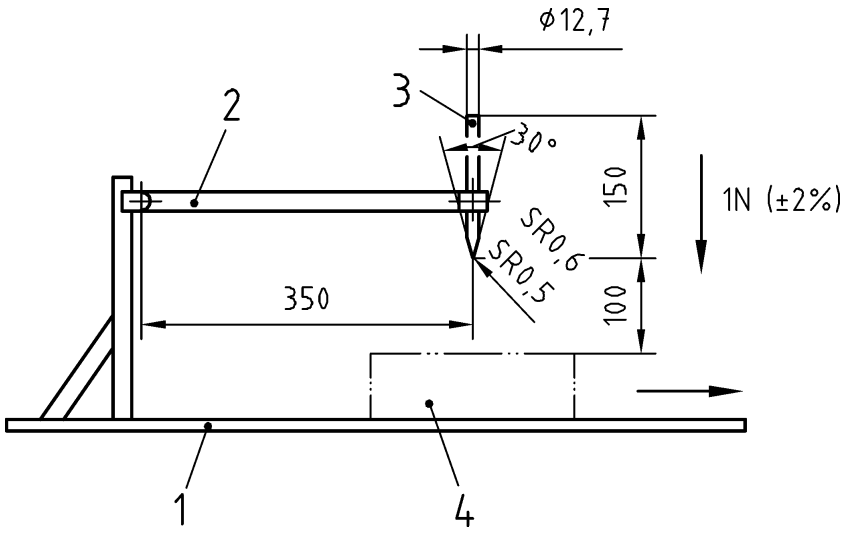
h) explanation of the used symbols shall be added.

Table 2 — Testing schedule

Requirement Clause	Title	Conditioning according	Test Clause	Title	Number of samples[a]
7.3	Visual inspection	7.4	7.3	Visual inspection	All
6.3	Design	7.4	7.3 7.5	Visual inspection Practical performance test	
6.4	Materials	7.4	7.3 7.5	Visual inspection Practical performance test	5
6.5	Mass	7.4	7.1	General	All
6.6	Conditioning	7.4	7.4	Conditioning	All
6.7	Connections	7.4	7.3 7.12	Visual inspection Connections	2
6.8	Packaging	7.4	7.3 7.4	Visual inspection Conditioning	All
6.9	Practical performance	7.4	7.5	Practical performance test	5
6.10.1	Inward leakage excluding filter penetration (breathing zone)	7.4	7.6.1	Inward leakage excluding filter penetration (breathing zone)	10
6.10.2	Leakage into ocular zone	7.4	7.6.2	Leakage into ocular zone	10
6.11.1	Gas capacity	7.4	7.7	Gas capacity	21
6.11.2	Filter penetration	7.4	7.8	Filter penetration	3
6.12	Valves	7.4	7.3 7.5	Visual inspection Practical performance test	10
6.13	Breathing resistance	7.4	7.9	Breathing resistance	2
6.14	Flammability	7.4	7.3 7.10	Visual inspection Flammability	2
6.15	Carbon dioxide content of inhalation air	7.4	7.11	Carbon dioxide content of the inhalation air	2
6.16	Head harness	7.4	EN 140		2
6.17.1	Visor	7.4	7.3	Visual inspection	All
6.17.2	Impairment of vision	7.4	7.5	Practical performance test	5
6.17.3	Field of vision	7.4	7.5	Practical performance test	5
6.18	Sealing	7.4	7.3	Visual inspection	All
6.19	Integrity of filtering smoke hood at high carbon monoxide concentrations	7.4	7.3 7.7.2.2	Visual inspection Procedure	3
6.20	Ingress of humidity	7.4	7.4	Conditioning	All
6.21	Temperature of inhaled air	7.4	7.7.2.2	Procedure	3
6.22	Communication	7.4	7.5	Practical performance test	5
8	Marking	7.4	7.3	Visual inspection	All
9	Information supplied by the manufacturer	7.4	7.3	Visual inspection	All

[a] Most samples are used for more than one test.

Dimensions in millimetres



Key

1 Steel base plate
2 Mounting arm for the striker
3 Striker
4 Test specimen

Figure 1 — Scheme of typical equipment for testing puncture and tear resistance

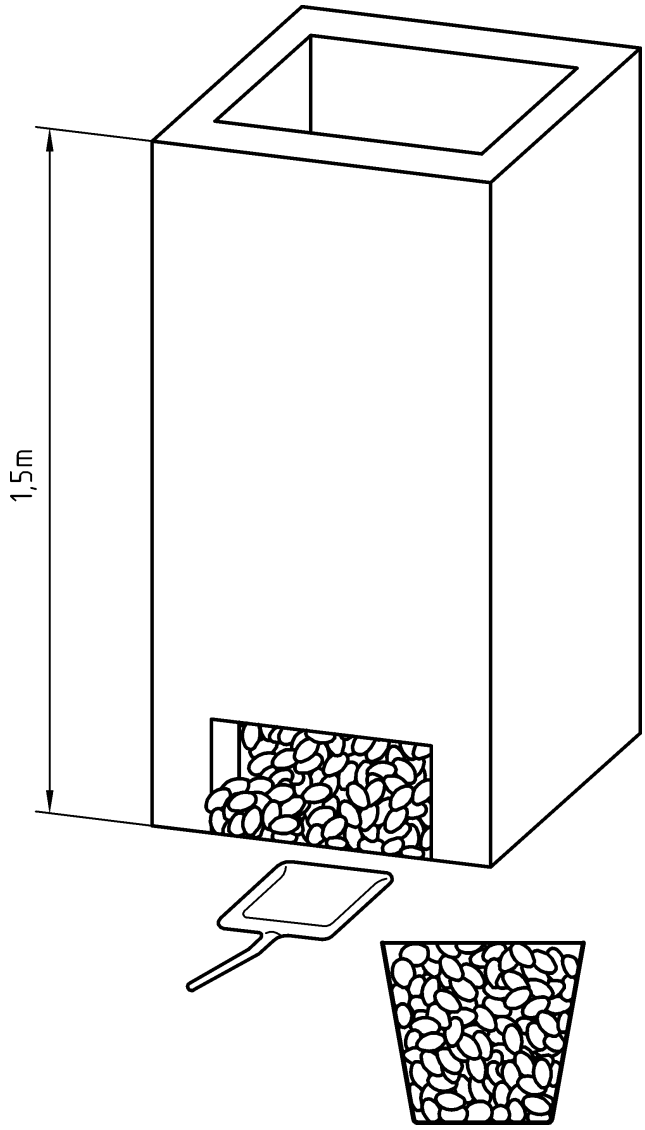
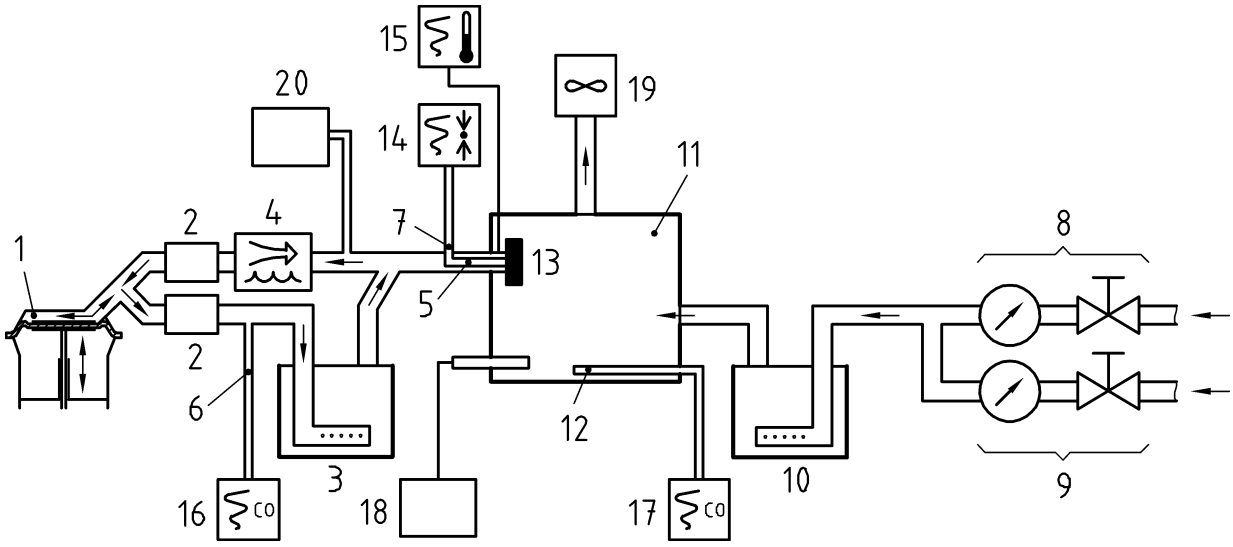


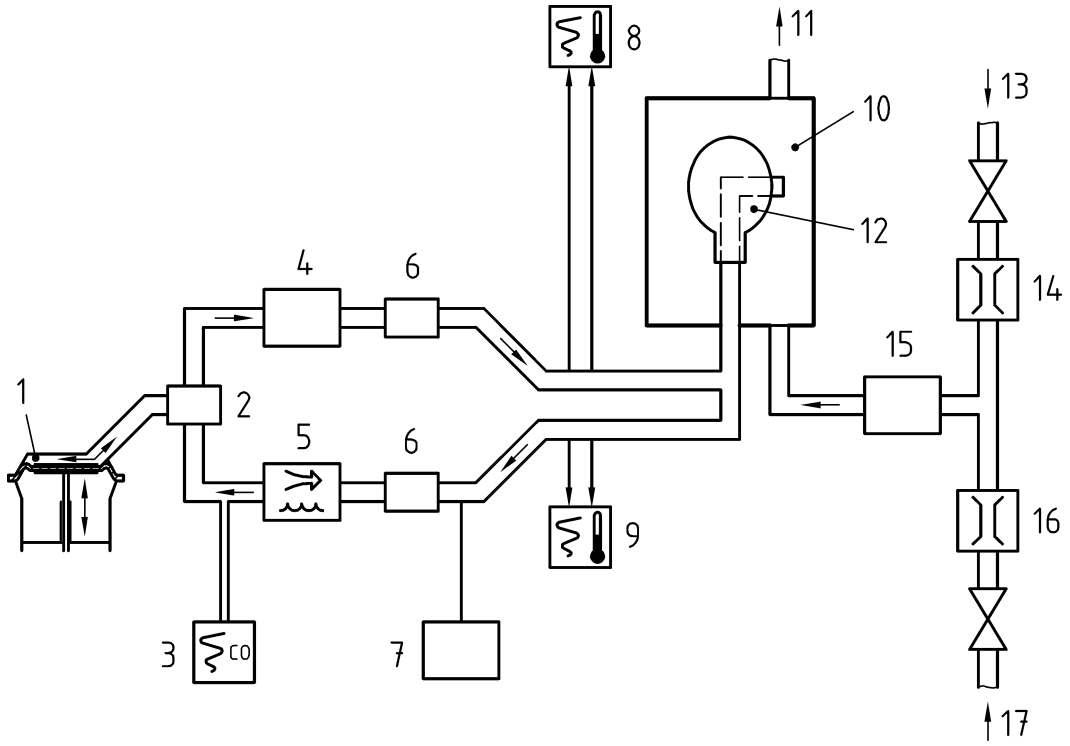
Figure 2 — Hopper and basket, rubber chippings



Key

1 Breathing machine
2 Solenoid valves
3 Humidifier (exhaled air)
4 Cooler
5 Connector
6 Sampling port CO-content (inhaled air)
7 Orifice of pressure probe
8 Flow meter for test atmosphere
9 Flow meter for carbon monoxide
10 Humidifier (test atmosphere)
11 Test chamber (dimensions appr. 30 cm x 30 cm x 26 cm)
12 Sampling port, CO-content of test atmosphere at filtering device inlet
13 Test specimen under test (max. pressure difference at filtering device inlet with regard to ambient in the test chamber $\pm$ 0,5 mbar)
14 Pressure meter with plotter
15 Temperature measurement equipment with plotter
16 Carbon monoxide analyser & recorder (inhaled air ml/m^3 and ml)
17 Carbon monoxide analyser (test atmosphere)
18 Humidity meter (test atmosphere)
19 Exhaust
20 Humidity meter (inhaled air)

Figure 3 — Scheme of test equipment for testing carbon monoxide performance using filter adapter

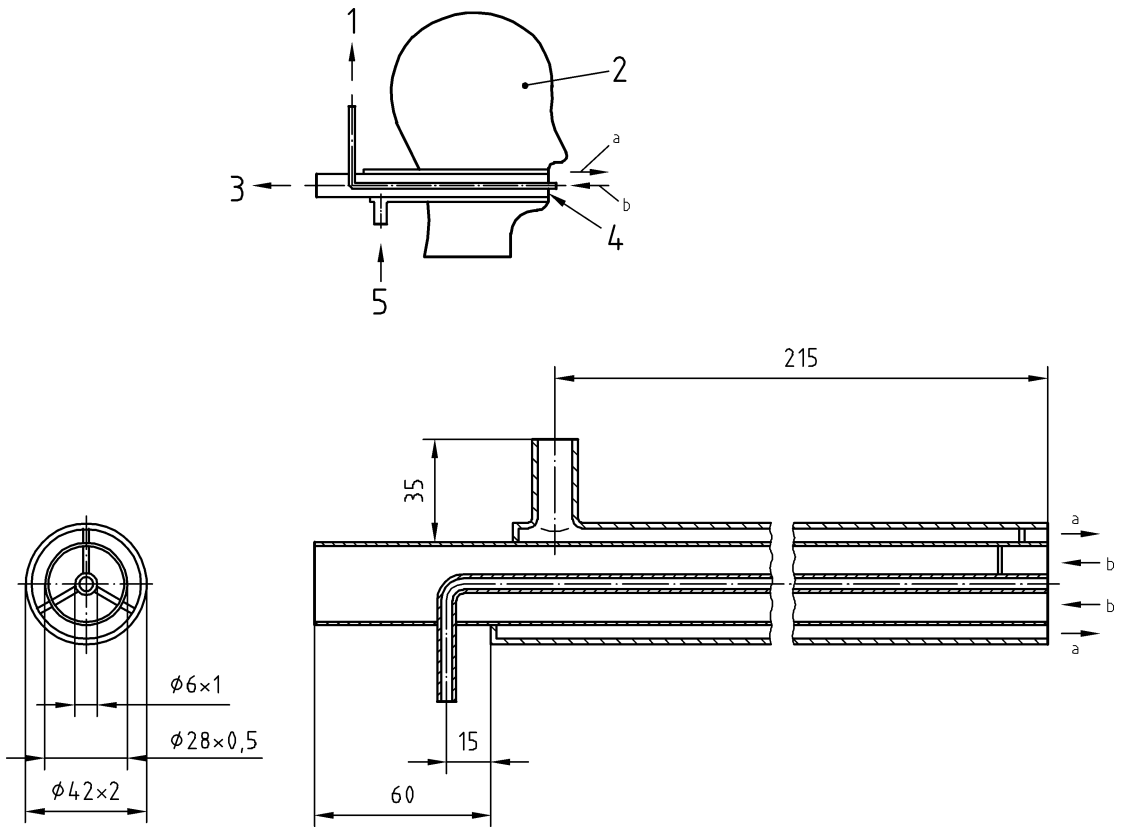


Key

1 Breathing machine
2 Valve system
3 CO-analyser
4 Humidifier
5 Cooler
6 Solenoid valves
7 Dew point meter
8 Exhalation temperature and pressure measuring equipment
9 Inhalation temperature and pressure measuring equipment
10 Test chamber
11 Exhaust
12 Test specimen under test
13 CO in
14 Flow meter
15 Humidifier
16 Flow meter
17 Air in

Figure 4 — Scheme of test equipment for testing carbon monoxide performance using dummy head

Dimensions in millimetres

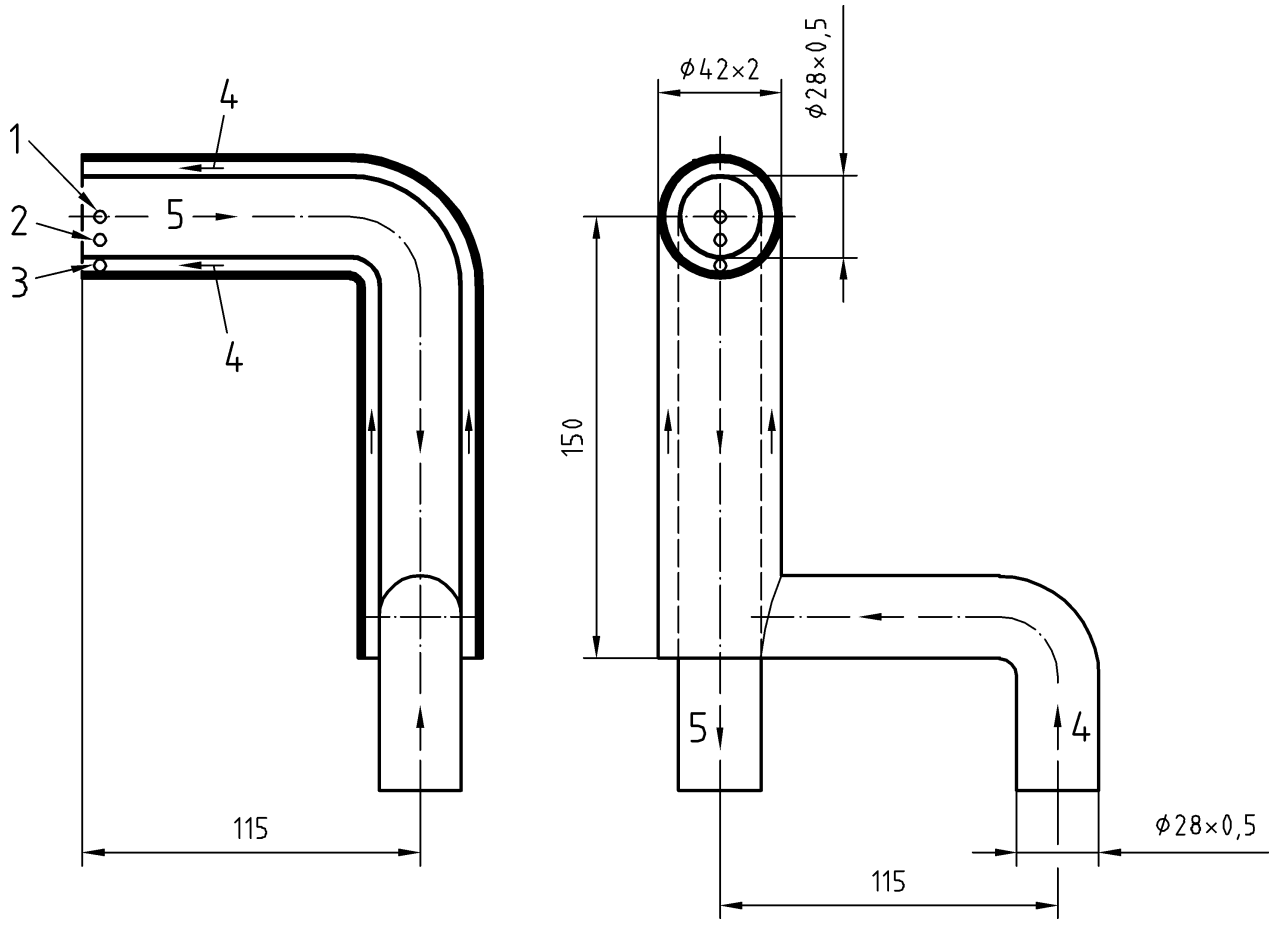


Key

a Exhalation
b Inhalation
1 To pressure gauge (for measurement of breathing resistance)
2 Dummy head (Sheffield)
3 To breathing machine (inhalation)
4 Pressure port with ‘Button’ Probe (for measurement of breathing resistance)
5 From breathing machine (exhalation)

Figure 5 — Dummy head (Sheffield head) for testing gas capacity, carbon dioxide content of inhalation air and breathing resistance

Dimensions in millimetres



Key

1 Location of sampling port for breathing resistance
2 Location of inhalation thermocouple
3 Location of exhalation thermocouple
4 Exhale
5 Inhale

Figure 6 — Typical arrangement of an alternative connector for dummy head

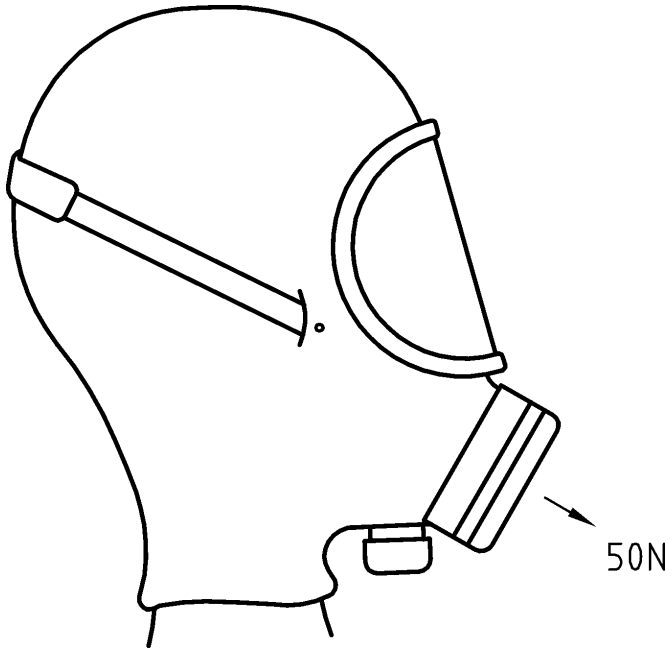


Figure 7 — Scheme of test arrangement for tensile force

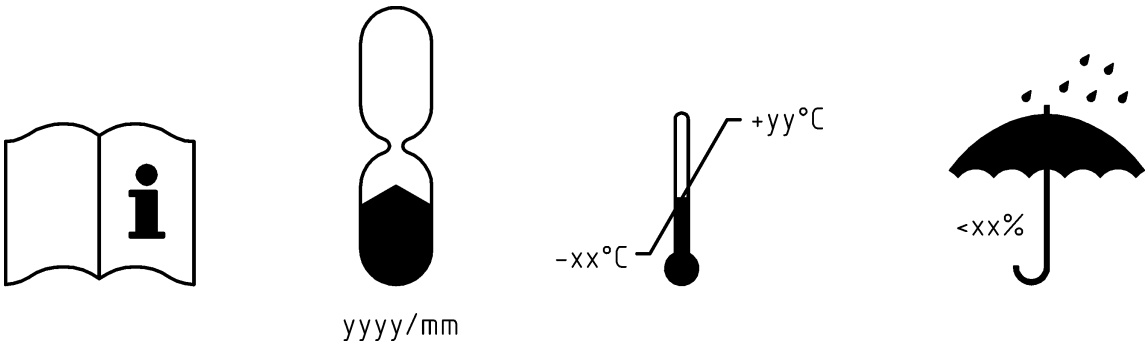


Figure 8 — Pictograms

Annex A
(informative)

Method for the determination of wet bulb temperature of the inhaled air

A schematic arrangement of a suitable apparatus is shown in Figure A1.

A continuous sample of air shall be drawn from the inhalation breathing path at a constant flow rate of 0,1 l/min and passed through the sensor head block. All sample lines and the sensor head block shall be heated to at least 10 °C above the anticipated dew point temperature. The dew point temperature shall be recorded throughout the test. The dry bulb temperature shall be measured in accordance with 7.7.2.2.

The wet bulb temperature then shall be determined using the following calculation.

At the dew point temperature, the gas is fully saturated. Hence, the relative humidity (RH) is given by:

$$RH\ (\%) = \frac{saturation\ vapour\ pressure\ at\ dew\ point\ temperature}{saturation\ vapour\ pressure\ at\ dry\ bulb\ temperature} \times 100 \qquad (A.1)$$

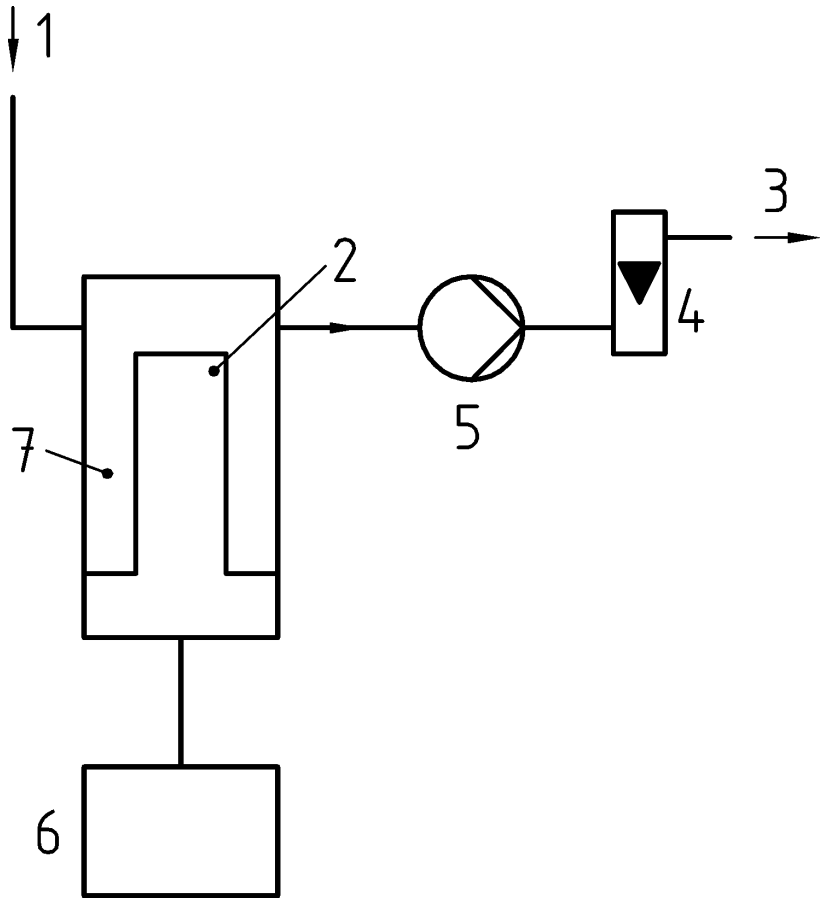
Saturation vapour pressure at temperature t shall be obtained from the following equation:

$$\log_{10}(e'') = \frac{Gt}{H + t} + I \qquad (A.2)$$

where

e" is the saturation vapour pressure (mbar)
t is the dry bulb temperature (°C)
G is the constant = 7,5
H is the constant = 237,3
I is the constant = 0,78571

Since the dry bulb temperature has been measured, and the relative humidity determined from equations (A.1) and (A.2), then the wet bulb depression, and hence the wet bulb temperature can be obtained from standard psychrometric tables.



Key

1 Sample in
2 Detector head
3 Exhaust
4 Flow meter (0,1 l/min)
5 Sample pump
6 Control & display unit
7 Stainless steel sensor head block

Figure A.1 — Schematic arrangement for the determination of wet bulb temperature of the inhaled air

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/686/EEC.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

The clauses of this European Standard are likely to support requirements of Directive 89/686/EEC, Annex II:

Table ZA.1 — Relationship between this standard and the EU Directive 89/686/EEC

Basic Requirements (EU Directive 89/686/EEC, Annex II)	Clauses of this standard
1.1.1. Ergonomics	6.9
1.1.2.1. Highest level of protection possible	6.9
1.2.1. Absence of risks and other inherent nuisance factors	6.3, 6.4, 6.18, 6.21
1.2.1.1. Suitable constituent materials	6.4
1.2.1.2. Satisfactory surface condition of all PPE parts in contact with the user	6.3, 6.9
1.2.1.3. Maximum permissible user impediment	6.9, 6.17, 6.22
1.3.1. Adaptation of PPE to user morphology	6.9, 6.16
1.3.2. Lightness and design strength	6.3, 6.4, 6.5, 6.7, 6.8, 6.14, 6.19
1.4. Information supplied by the manufacturer	9
2.1. PPE incorporating adjustment systems	6.9, 6.16
2.3 PPE for the face, eyes and respiratory tracts	6.9, 6.17
2.4. PPE subject to ageing	6.20, 8, 9
2.8. PPE for use in very dangerous situations	9
2.12. PPE bearing identification marks related to health and safety	8
3.6.1 Protection against heat and/or fire PPE constituent materials and other components	6.14
3.10.1 Respiratory protection	6.10, 6.11, 6.13, 6.15, 8, 9

Compliance with this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

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