BRITISH STANDARD

BS EN
13274-1:2001

Respiratory protective devices —Methods of test —

Part 1: Determination of inward leakage and total inward leakage

The European Standard EN 13274-1:2001 has the status of a British Standard

ICS 13.340.30

National foreword

This British Standard is the official English language version of EN 13274-1:2001.

The UK participation in its preparation was entrusted by Technical Committee PH/4, Respiratory protection, to Subcommittee PH/4/9, Test methods, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Health and Environment Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 March 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 28, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 37080 1

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13274-1

January 2001

ICS 13.340.30

English version

Respiratory protective devices — Methods of test — Part 1: Determination of inward leakage and total inward leakage

Appareils de protection respiratoire — Méthodes d'essai — Partie 1: Détermination de la fuite vers l'intérieur et de la fuite totale vers l'intérieur

Atemschutzgeräte — Prüfverfahren — Teil 1: Bestimmung der nach innen gerichteten Leckage und der gesamten nach innen gerichteten Leckage

This European Standard was approved by CEN on 1 January 2001.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13274-1:2001 E

Contents

Foreword

This European Standard 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 July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

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(s).

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

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

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 inhalation air;
Part 7: Determination of particle filter penetration;
Part 8: Determination of dolomite dust clogging.

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 general procedure for determining:

a) the inward leakage of facepieces; or
b) inward leakage of respiratory protective devices (RPD), which is the total inward leakage excluding any filter penetration; or
c) total inward leakage of respiratory protective devices.

Device preparation, selection of test subjects, test procedure and the method of calculation of leakage are included. Two methods are described, one using an aerosol (sodium chloride aerosol) and one using a gas (sulfur hexafluoride).

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.*

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 148-1, *Respiratory protective devices — Threads for facepieces — Part 1: Standard thread connection.*

3 Terms and definitions

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

4 Prerequisites

In order to implement this standard, at least the following parameters shall be specified in the relevant device standard:

- the number of samples;
- device preparation;
- the selection and number of test subjects;
- any prior conditioning or testing;
- test method (1, 2A, 2B);
- any deviations from the method;
- use of supplementary fans (if applicable);
- characteristics to be assessed subjectively;
- pass/fail criteria.

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 ±5 %. Unless otherwise specified, the ambient temperature for testing shall be between 16 °C and 32 °C and the temperature limits shall be subject to an accuracy of ±1 °C.

6 Principle

A test subject wearing the device on test, walks on a horizontal treadmill surrounded by an atmosphere containing a known concentration of a test substance. Two types of challenge atmosphere are specified, one using sodium chloride and the other using sulfur hexafluoride, and the general principle of the test is the same for either substance. The substance used depends on the type of equipment under test and is chosen according to the guidance given in the following clauses.

Dilution of the test atmosphere by clean air emanating from the device under test does not affect the accuracy of the measurement of leakage because of the large volume and continuous replacement of the atmosphere.

7 Material permeability test

7.1 Principle

This test serves the purpose of determining, particularly in case of doubt, which method shall be used for the determination of inward leakage of the facepiece. A specified air pressure is applied to the material of the facepiece and/or its seal to the wearer, which is wetted by a liquid and has a film of the same liquid applied to its upper surface. If bubbles escape continuously from the upper surface, the material is rated as permeable and the sulfur hexafluoride method is to be used. If no bubbles escape continuously, the sulfur hexafluoride and sodium chloride methods are equally acceptable options.

If a facepiece or its seal to the wearer is made of impermeable materials or is obviously open to the atmosphere, inward leakage may be tested with either sodium chloride or sulfur hexafluoride.

7.2 Apparatus

NOTE: See Figure 1.

7.2.1 Testing head. A cylindrical vessel over which the test specimen is clamped by a clamping ring and screw. The head is fitted with a gasket to make a seal against the test specimen.

7.2.2 Test liquid. Water in which a wetting agent (softener or washing-up liquid) is dissolved to form a solution by adding a few drops to 1 l of water.

7.2.3 Pressure measuring device

7.2.4 Air supply and control valves

7.3 Preparation of test specimens

Take the test specimens from different places in the device in order that an assessment can be made of all materials and seams.

7.4 Procedure

Soak the conditioned test specimen under approximately 15 mm of test liquid for a period of not less than 3 min. Remove the test specimen from the test liquid and clamp it in the testing head. Pour sufficient test liquid on to the surface of the test specimen to form a continuous film.

Apply air pressure to the undersurface of the test specimen until bubbles escape, or up to a maximum of 100 mbar, whichever occurs first. Note whether any bubbles escape from the upper surface of the test specimen indicating that the material is permeable. Repeat the test with the other test specimens.

8 Device preparation

8.1 General

Prior to the inward leakage test, examine the device to see that it is in good working condition and can be used without hazard.

Prepare the devices to be tested in accordance with their design and with whether the inward leakage of a facepiece, the inward leakage of a device, or the total inward leakage of a device is to be determined.

The sodium chloride and sulfur hexafluoride methods are equally acceptable for determinations of inward leakage and total inward leakage, subject to the requirements of Table 1.

Table 1 — Selection of test agent

TYPE OF DEVICE		TEST AGENT		RESULT
		Permeable device	Non-permeable device	
Facepiece (EN 136 or EN 140)		-	NaCl or SF_6	I.L.
Filtering devices	Particles	NaCl	NaCl	T.I.L.
	Gas	SF_6	NaCl or SF_6	I.L.
	Combined	NaCl and SF_6	-	I.L. and T.I.L
		-	NaCl	T.I.L.
Breathing apparatus		SF_6	NaCl or SF_6	I.L.

I.L. = Inward leakage
T.I.L. = Total inward leakage

8.2 Sample tubes and probe

In order to sample and analyse the air inside the facepiece, punch a hole in the facepiece and insert a probe through which the sample is drawn by a suitable sample pump.

A multiple hole sampling probe is strongly recommended. Figures 2 to 6 show designs that have been found suitable. Drying air at a flow of about 1 l/min is employed when sodium chloride is used. This is to minimize condensation and hence loss of sodium chloride particles in the sampling tube. The sample flow rate from the facepiece is equal to the total flow through the sample pump minus the amount of drying air used. Allowance has to be made for the diluting effect of this clean air when leakage calculations are performed. Drying air is not used if sulfur hexafluoride is the test agent.

Fit the probe securely in an airtight manner to the facepiece, as near as possible to the mouth of the wearer. For flexible or soft facepieces it may be necessary to fit a head harness to the test subject to prevent distortion of facepiece or inability to create a seal due to failure of the harness to support the probe assembly weight. This harness can then carry the sampling probe and associated connections and pressure probe for pulsed sampling.

A second sampling probe is provided to measure the ambient concentration of test agent in the test enclosure. This shall be placed away from the effect of any exhalate from the device under test.

The sampling probes are connected to the analysing equipment by means of flexible thin-walled tubing of about 3 mm bore, the length of which is kept as short as possible.

8.3 Device preparation — total inward leakage

For the determination of the total inward leakage, use the complete device. The preparation of the facepiece is as described in 8.2.

In the case of a filtering device with a gas filter, the total inward leakage is assumed to equal the inward leakage (see 8.4), provided that the gas filter in its holder meets the requirements for the gas breakthrough time required in the appropriate filter standard and the facepiece does not incorporate gas permeable material.

8.4 Device preparation — inward leakage

The inward leakage of facepieces in accordance with either EN 136 or EN 140 and which incorporate a threaded connection in accordance with EN 148-1, is determined with the appropriate filter simulator fitted to the facepiece. Clean air is supplied to the facepiece via a lightweight hose. The conditions set out in the following paragraphs referring to breathing resistance, fitting and support of the hose apply here.

The inward leakage of facepieces in accordance with EN 136 or EN 140 and not incorporating a threaded connection in accordance with EN 148-1, and of all filtering devices, is the total inward leakage excluding any filter penetration. For the determination of inward leakage, clean air shall be supplied to the device under test. The breathing resistance of the modified device shall be similar to that of the complete device.

It is important that the attachment of the clean air hose to the device does not affect the fit of the device on the test subject, nor should its fitting replace any seals incorporated in the device. If necessary the hose should be supported.

An alternative method of measuring inward leakage of filtering devices is to replace gas filters or combined filters by surrogate high efficiency particle filters of the same mass and resistance. The results of a total inward leakage test using sodium chloride aerosol may then be equated to the inward leakage of the device. It is important that the attachment of the surrogate filters does not affect the fit of the device, nor shall its fitting replace any seals incorporated in the device.

For breathing apparatus the following situations apply regarding inward leakage tests:

a) For breathing apparatus employing facepieces other than facepieces in accordance with EN 136 or EN 140, inward leakage tests are carried out on complete equipment and the result of the test gives a pass/fail criterion related to the device standard for the complete equipment tested.

b) For breathing apparatus employing facepieces in accordance with EN 136 or EN 140 and having threaded connections to EN 148-1, no inward leakage tests are carried out on the complete equipment but the facepiece is tested as described in the first paragraph of this clause.

c) For breathing apparatus employing facepiece in accordance with EN 136 or EN 140 and not having threaded connections to EN 148-1, inward leakage tests are carried out on complete equipment and the result of the test gives a pass/fail criterion related to the device standard for the complete equipment tested and also (separately) for the facepiece in accordance with EN 136 or EN 140 as appropriate.

9 Test

9.1 Test subjects

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.

For the inward leakage test, select persons who are familiar with using such or similar equipment, covering the spectrum of facial characteristics of typical users (excluding significant abnormalities). Exceptionally some persons cannot be satisfactorily fitted with the device under test. Such exceptional subjects shall not be used for the test. Where a manufacturer specifies a head or face size range for the device, only subjects who fall within the specified range shall be used for the test.

In the test report, describe the faces of the test persons (for information only) by the four facial dimensions (in millimetres) illustrated in Figure 7.

If more than one size of facepiece is manufactured, the test subjects shall select the most appropriate size in accordance with the information supplied by the manufacturer.

9.2 Test equipment

9.2.1 Enclosure

An enclosure is positioned over a treadmill and is capable of being flowed through continuously by the test atmosphere, which enters the top of the enclosure via a duct and flow distributor and is directed downwards over the head of the test subject. The concentration of the test agent inside the effective working volume is to be checked to ensure it is sufficiently homogeneous and stable in time. The enclosure shall be large enough to permit walking on the treadmill without interference. For devices which are requested to be additionally tested under crosswind conditions, provision shall be made for the positioning of supplementary fans in the front, at the side and in the rear of the test subject, not less than 350 mm in diameter, inside the enclosure such that an air velocity of 2 m/s across the enclosure can be produced in the vicinity of the subject’s head.

The air velocity through the enclosure measured close to the test subject’s head with the test subject standing centrally on the treadmill and without the supplementary fans in operation, shall be 0,12 m/s to 0,2 m/s.

The design of the enclosure shall be such that the device worn by the subject can be supplied if necessary with clean air (free of the test agent).

9.2.2 Treadmill

A level treadmill capable of working at 6 km/h.

9.2.3 Test agent generator

Equipment for generating the test agent in the required concentration and, in case of sodium chloride, particle size distribution.

9.2.4 Sample pump

A sample pump capable of sampling at a rate between 0,3 l/min and 3 l/min.

9.2.5 Detection system

The detection system including sampling probes and connections shall have a response time of less than 20 s for a response of 10 % to 90 % of the full-scale deflection of the range used.

If only one photometer is used, place all the sample probes initially in close proximity to one another within the enclosure and adjust the resistance of the sample tubes e.g. by means of a screw clip, so that with the test atmosphere on, identical readings for the test agent concentration are obtained from each sample tube.

9.3 Test method — General

9.3.1 Ask the test subjects to read the manufacturer's fitting instructions and if necessary show them how to fit the device correctly in accordance with the fitting instructions. Ask the test subject to fit the device, selecting the correct size if appropriate.

9.3.2 Ask each test subject "Does the device fit?" If the answer is "Yes", continue the test. If the answer is "No", take the test subject off the panel and report the fact.

9.3.3 Before starting the test check visually whether the device has been fitted correctly.

9.3.4 Inform the test subjects that if they wish to adjust the device during the test they may do so. However, if this is done the relevant section of the test will be repeated having allowed the system to re-settle.

9.3.5 Ensure that the test subjects have no indication of the result as the test proceeds.

9.3.6 Ensure that the test atmosphere is OFF.

9.3.7 Have the subject stand on the treadmill in the enclosure. Connect up the sampling probe and, if applicable, the clean air supply. Operate the device as required in the relevant standard. Start the treadmill and have the test subject walk at 6 km/h for 2 min. Measure the test agent concentration inside the facepiece to establish the background level.

9.3.8 Wait for a stable reading to be obtained.

9.3.9 Turn the test atmosphere ON.

9.3.10 Instruct the test subject to continue to walk for a further 2 min or until the test atmosphere has stabilized.

9.3.11 Whilst still walking have the test subjects perform the following exercises:

a) walking without head movements or talking for 2 min;
b) turning head from side to side (approximately 15 times), as if inspecting the walls of a tunnel for 2 min;
c) moving head up and down (approximately 15 times), as if inspecting the ceiling and floor for 2 min;
d) reciting the alphabet or an agreed text out loud as if communicating with a colleague for 2 min;
e) walking without head movement or talking for 2 min.

9.3.12 If required in the relevant device standard, some of the exercises b), c) and e) mentioned in 9.3.11 are performed with the supplementary fan operating such that an additional air velocity of 2 m/s is produced to impinge on the front, side and rear of the device in turn.

9.3.13 Record:

a) enclosure concentration;
b) the leakage over each exercise period, as defined in 9.4.2, 9.5.2.2 and 9.5.3.2.

9.3.14 Turn the test atmosphere off and when the test agent has cleared from the enclosure, remove the test subject.

9.3.15 Ask for and record the subjective assessments by the test subject wearing the device.

9.3.16 After use by each test subject, where applicable, clean, disinfect and dry the device, all in accordance with the information supplied by the manufacturer, before use in its next leakage test.

9.4 Test method 1: Sulfur hexafluoride (SF_6)

9.4.1 Test equipment

Typical test arrangements are shown in Figures 8 and 9.

This method employs SF_6 as a test agent. The test subject wearing the device under test walks or stands in the enclosure on the treadmill surrounded by the SF_6 test atmosphere. Accurate determinations of leakage shall be possible at least within the range from 0,01 % to approximately 20 %.

A test challenge concentration between 0,1 % and 1 % SF_6 by volume is recommended, starting with a low challenge concentration and increasing it, when the results of a preliminary test indicate such a low leakage that higher concentrations are required and can be justified. The detection limit of the detector system shall be at least a factor of 10 lower than the level of tracer that corresponds to the pass/fail level in the device standard. The variation of the concentration throughout the effective working volume shall be not more than 10 %. The test atmosphere shall be analysed for SF_6, preferably continuously, by means of a suitable analyser (e.g. based on thermal conductivity or infrared spectroscopy). The SF_6 concentration inside the facepiece shall be continuously sampled at a constant sampling rate of between 0,3 l/min and 1,5 l/min and shall be analysed, for example, by an electron capture detector (ECD) or IR-system, and recorded, preferably using an integrating recorder. This concentration is a measure of the inward leakage.

NOTE: SF_6 is not retained by filters.

9.4.2 Calculation of leakage

Calculate the leakage P 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.

$$P\,(\%) = \frac{C_2}{C_1} \times 100$$

where:

C_1 is the challenge concentration;

C_2 is the measured mean concentration inside the facepiece, corrected for background signal.

9.5 Test method 2: Sodium chloride (NaCl)

9.5.1 Test equipment

9.5.1.1 General

Typical test arrangements are shown in Figures 10 and 11.

This method employs NaCl as a test atmosphere. The test subject wearing the device under test walks or stands in the enclosure on the treadmill surrounded by the NaCl test atmosphere. Accurate determinations of leakage shall be possible at least within the range from 0,01 % to approximately 20 %

The mean NaCl concentration within the enclosure shall be (8 $\pm$ 4) mg/m^3 and the variation throughout the effective working volume shall be not more than 10 %. When sampling sodium chloride, drying air at a flow rate of about 1 l/min shall be used. The particle size distribution shall be polydisperse and range between approximately 0,02 µm to 2 µm aerodynamic diameter with a mass median aerodynamic diameter of 0,6 µm.

The challenge aerosol is monitored preferably continuously during the tests using a separate sampling system, to avoid contamination of the facepiece sampling lines. It is preferable to use a separate flame photometer for this purpose.

If a second photometer is not available, sample the challenge concentration using the separate sampling system and the same photometer. However, time will then be required to allow the photometer to return to a clean background.

It is important that identical sample rates, drying air and additional photometer air (if required) are used for both facepiece and enclosure samples in order to directly apply the equations shown in 9.5.2.2 and 9.5.3.2.

9.5.1.2 Challenge aerosol generation

As stated, this method employs NaCl particles as a test aerosol. The NaCl aerosol shall be generated from a 2 % solution of reagent grade NaCl in distilled water. A single large Collison tomizer (see Figure 12) shall be used. The atomizer nozzles shall not point towards the cut-outs in the sleeve.

An air flow rate through the atomizer of 100 l/min at a pressure of 7 bar is required. The atomizer and its housing shall be fitted into a duct through which a constant flow of air is maintained to deliver the challenge aerosol to the enclosure. The path length of the duct should be sufficiently long to allow the water content of the aerosol to evaporate, leaving dry NaCl particles. Any bends should be of large radius to minimize loss of NaCl particles. The air within the enclosure shall have a relative humidity of not greater than 60%. It may be necessary to heat or dehumidify the air in order to obtain complete drying of the aerosol particles.

NOTE: Sodium chloride aerosol is not retained by gas filters.

9.5.1.3 Flame photometer

A flame photometer shall be used to measure the concentration of NaCl inside the enclosure and inside the facepiece. The essential performance characteristics for a suitable instrument are:

a) It shall be a flame photometer specifically designed for the direct analysis of NaCl aerosol;
b) It shall be capable of measuring concentration of NaCl aerosol between 15 mg/m^3 and 10 ng/m^3;
c) The total aerosol sample rate required by the flame photometer shall not be greater than 15 l/min;
d) The response time of the flame photometer, excluding the sampling system, shall not be greater than 500 ms;
e) It is necessary to reduce the response to other elements than sodium, particularly carbon, the concentration of which will vary during the breathing cycle. This will be achieved 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.

9.5.1.4 Sample pump

If no pump is incorporated into the flame photometer an adjustable flow pump is used to withdraw an air sample. The pump shall be such that aerosol losses are minimized within the pump and changes in flow rate caused by changing pressure within the sampling zone are also minimized.

Adjust the pump so as to withdraw a constant flow of 1 l/min to 3 l/min from the sample probe. Some types of flame photometers require a flow rate higher than this sampling flow rate. In these cases, dilute the sample with clean air accordingly in addition to the drying air introduced into the probe at the sample point.

9.5.2 Pulsed sampling — Method 2A

9.5.2.1 General

A system is required which will switch the sample to the flame photometer only during the inhalation phase of the test subject's respiratory cycle. During the exhalation phase clean air shall be fed to the flame photometer. The source of this clean air is usually laboratory air at ambient temperature, passed through a high efficiency particle filter, shown in Figure 10 as item 12. The essential elements of such a system are:

a) An electrically operated valve with a response time of the order of 100 ms;

   NOTE: The valve should have the minimum possible dead space compatible with straight-through, unrestricted flow when open.

b) A pressure sensor which is capable of detecting a pressure change of approximately 0,05 mbar with a response time of not greater than 30 ms for a response of 10 % (as in 9.2.5), and which is connected to a probe fitted in the facepiece near the leakage sample probe.

   The sensor shall have an adjustable threshold and be capable of differential signalling when the threshold is crossed in either direction. The sensor shall work reliably when subjected to the accelerations produced by the head movements of the test subjects. A second probe is fitted near to the sampling probe for the facepiece and is connected to the pressure sensor;

c) An interfacing system to actuate the valve in response to a signal from the pressure sensor;

d) A timing device to record the proportion of the total respiratory cycle during which sampling took place.

Figure 10 shows a schematic diagram of such a sampling system.

9.5.2.2 Calculation of leakage

Calculate the leakage P 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.

$$P(\%) = \frac{C_2}{C_1} \times \left(\frac{t_{IN} + t_{EX}}{t_{IN}} \right) \times 100$$

where :

C_1 is the challenge concentration (observing the employed dilution rate for measuring C_2);

C_2 is the measured mean concentration inside the facepiece, corrected for background signal;

t_{IN} is the total duration of inhalation (s);

t_{EX} is the total duration of exhalation (s).

Measurement of C_2 is preferably made using an integrating recorder.

9.5.3 Continuous sampling — Method 2B

9.5.3.1 General

Sample continuously from the cavity of the facepiece throughout the respiratory cycle of the test subject. As sodium chloride is retained in the lungs, it is necessary to apply a correction factor in calculating inward leakage.

9.5.3.2 Calculation of leakage

Calculate the leakage P using the equation:

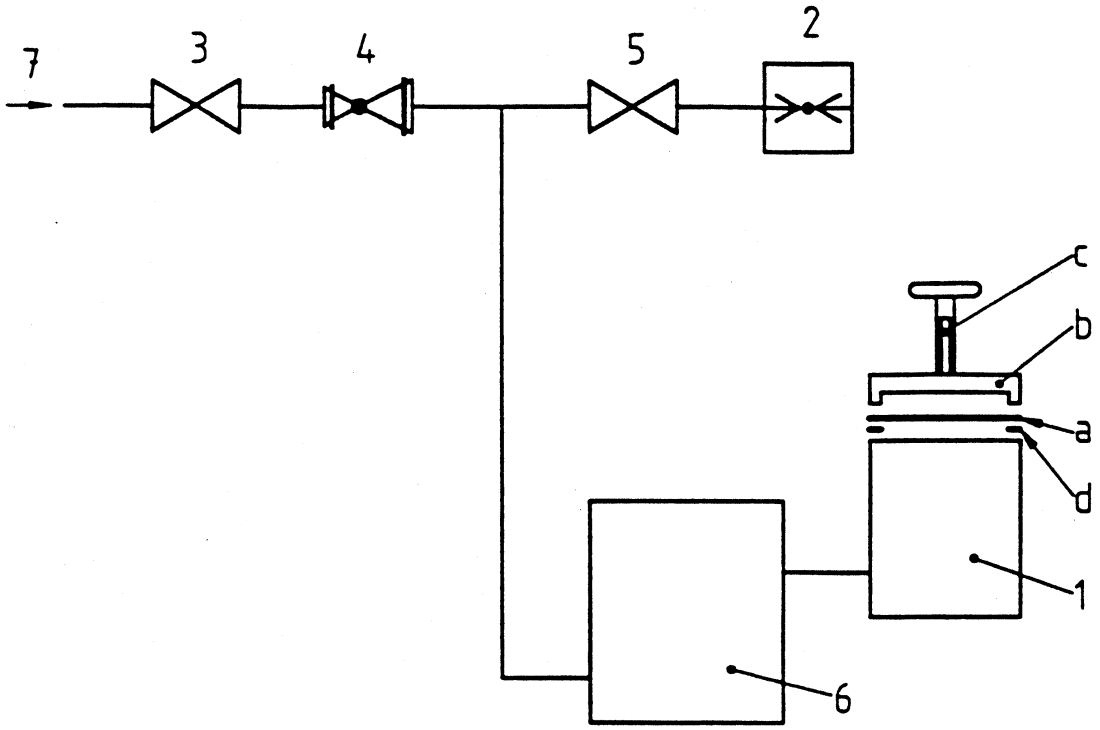
$$P(\%) = 1{,}25 \times \frac{C_2}{C_1} \times 100$$

where :

C_1 is the challenge concentration (observing the employed dilution rate for measuring C_2);

C_2 is the measured mean concentration inside the facepiece, corrected for background signal.

1,25 factor to allow for lung retention of sodium chloride (it has been derived on the assumption of an air flow rate of the device of 120 l/min and a wearer's breathing rate of 40 l/min).



Key

1 Testing head: a brass cylindrical vessel over which the specimen ‘a’ is clamped by a clamping ring ‘b’ and screw ‘c’. It is fitted with a synthetic rubber gasket ‘d’ to make a seal against the specimen.

2 Pressure measuring device.

3 Stop-valve which serves to direct air to the testing head.

4 Variable blow valve set to give the required rate of rise of pressure in testing head “1”.

5 Stop-valve which directs air to the pressure measuring device.

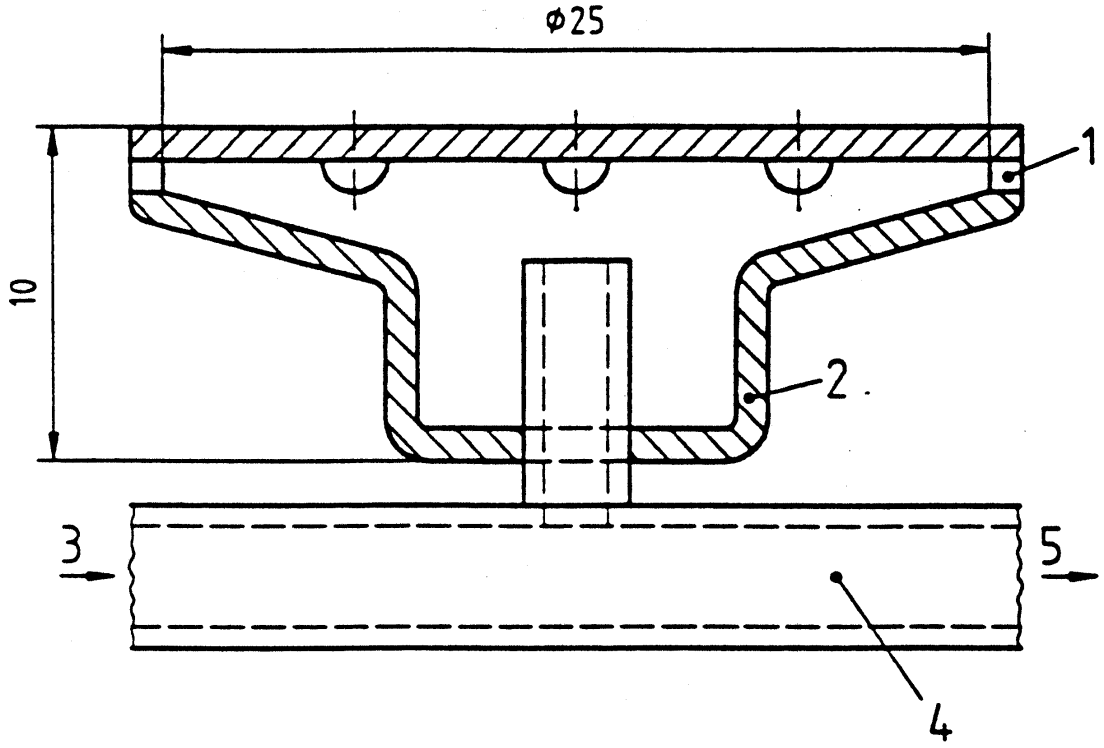
6 Air reservoir of about 2,5 l capacity connected to 1. This ensures that the flow rate of air necessary to maintain the required rise of pressure is so large that the loss of air through the fabric when bubbling begins will not seriously reduce the rate of rise of pressure.

7 Air supply.

NOTE: This diagram shows one possible way of constructing the apparatus.

Figure 1 — Test arrangement for assessment of permeability of hood materials

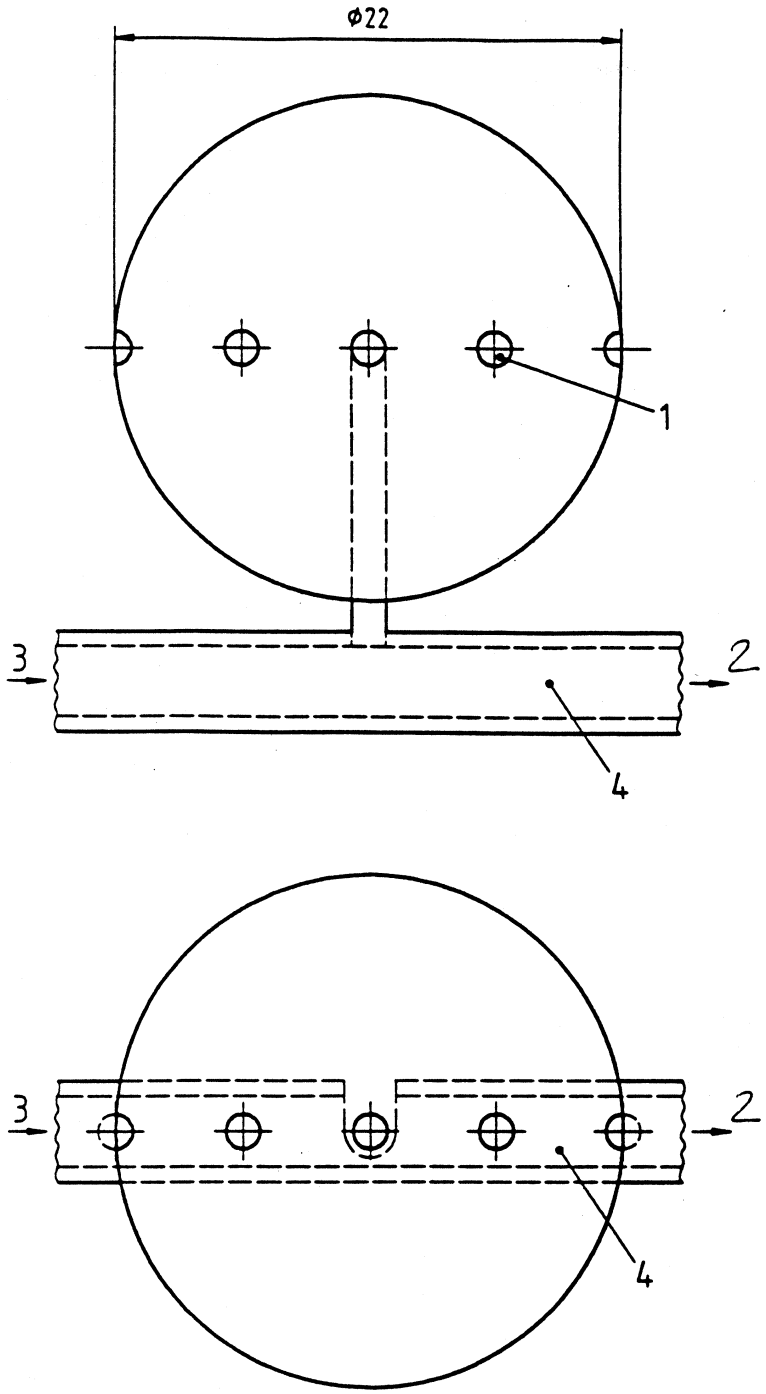
Dimensions in millimetres



Key
1 Eight holes, diameter 2 mm, equally spaced
2 Inside diameter, about 9 mm
3 Direction of drying air (for sodium chloride only)
4 Suitable flexible tube
5 Connection to sample pump

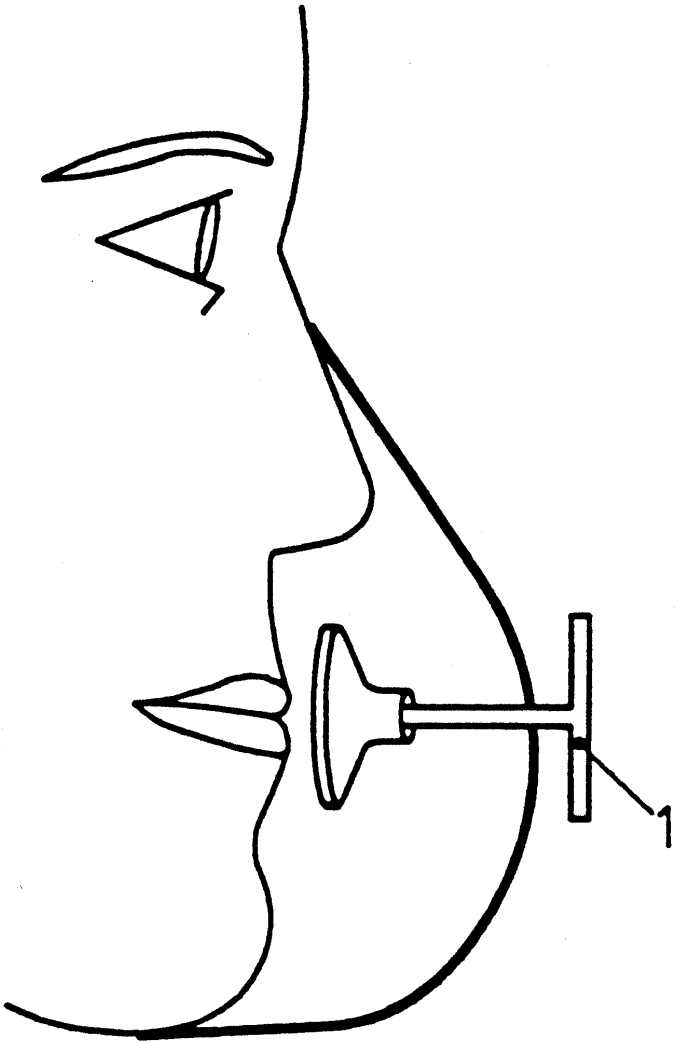
Figure 2 — Example of disc probe

Dimensions in millimetres



Key
1 Eight holes, diameter 1,5, equally spaced
2 Connection to sample pump
3 Direction of drying air (for sodium chloride only)
4 Suitable flexible tube

Figure 3 — Example of ball probe



Key
1 Suitable air-tight seal

Figure 4 — Disc probe in filtering device

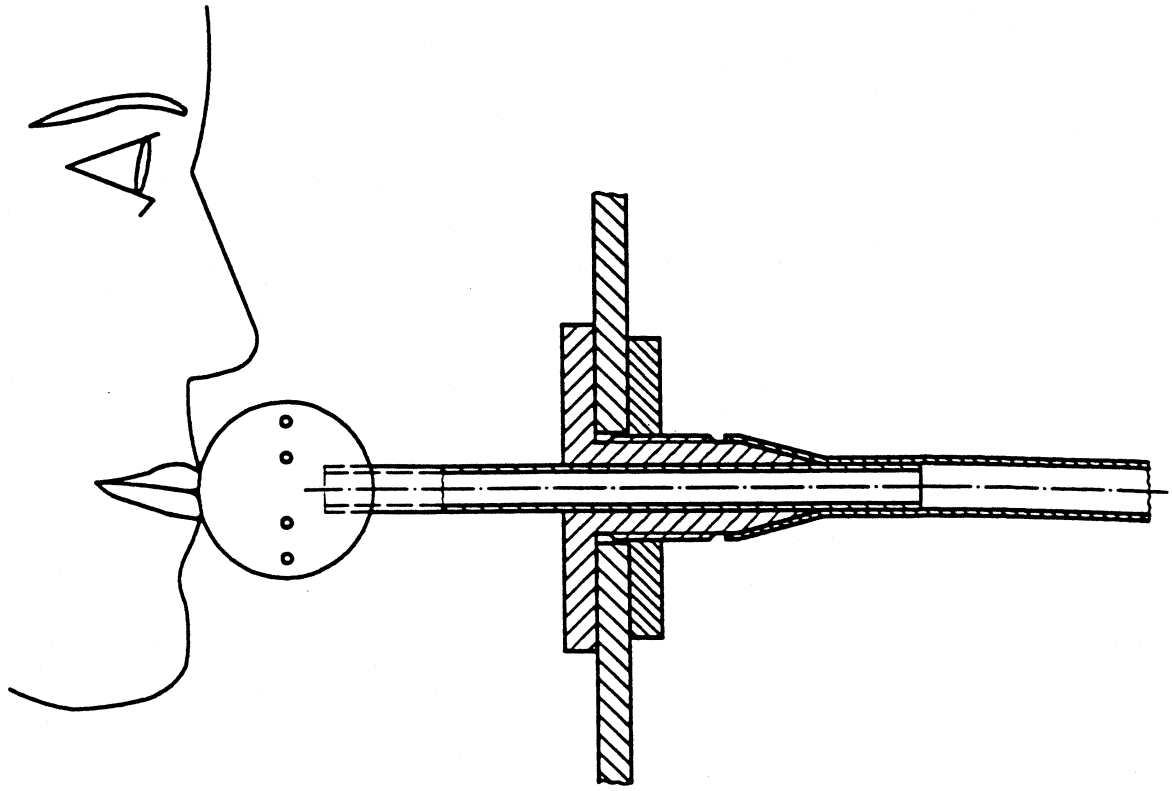
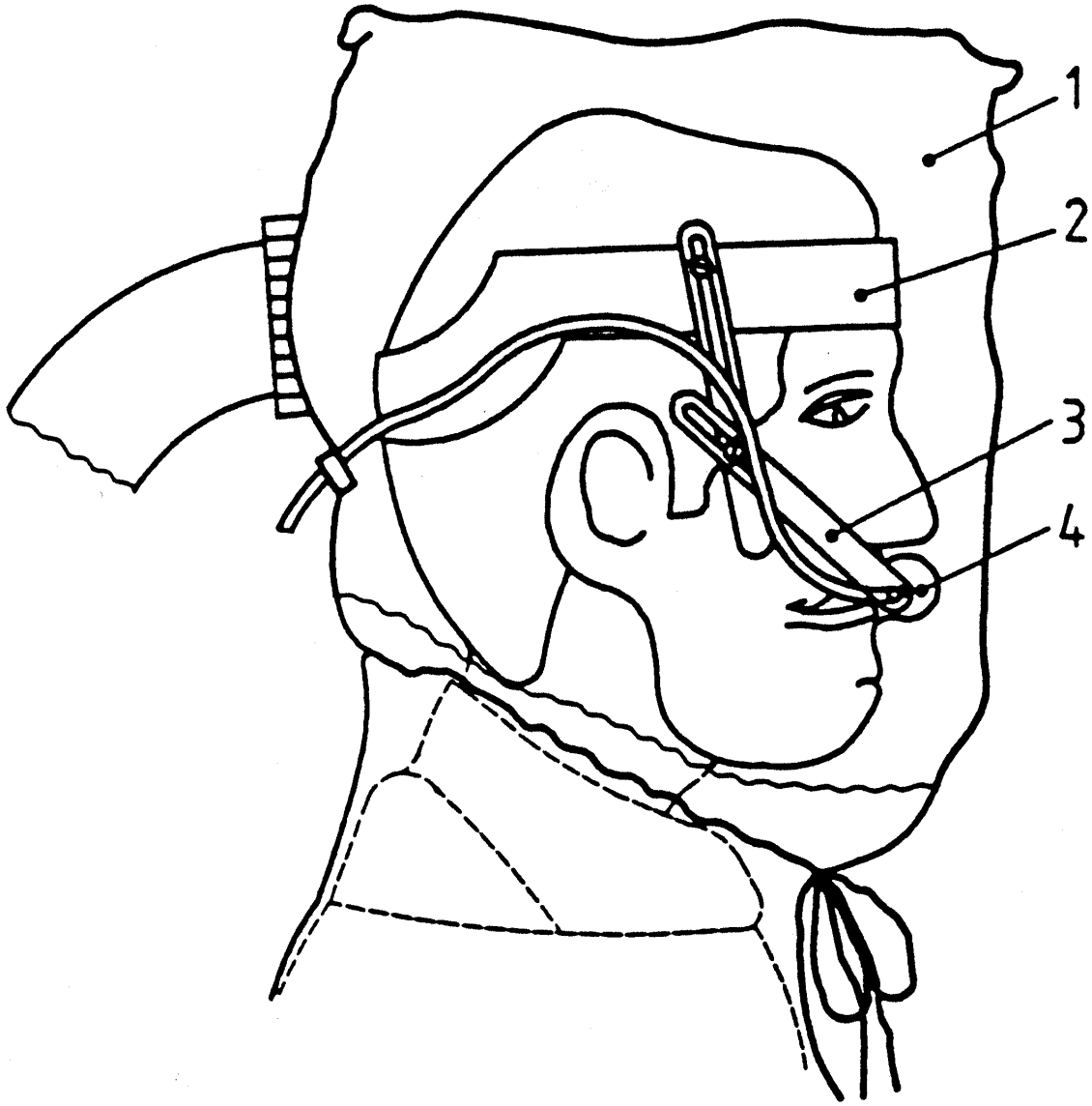
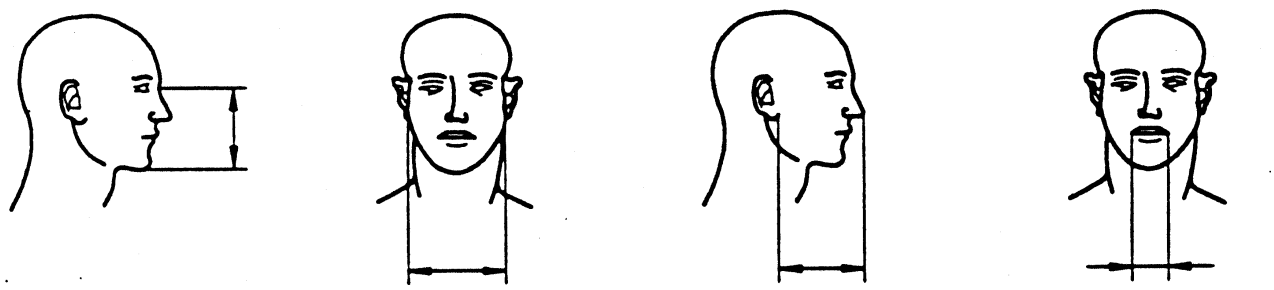


Figure 5 — Ball probe used on device with rigid visor



Key
1 Hood under test
2 Headband
3 Adjustable plastics arm
4 Sampling probe

Figure 6 — Typical arrangement for sampling from device with soft plastics hood



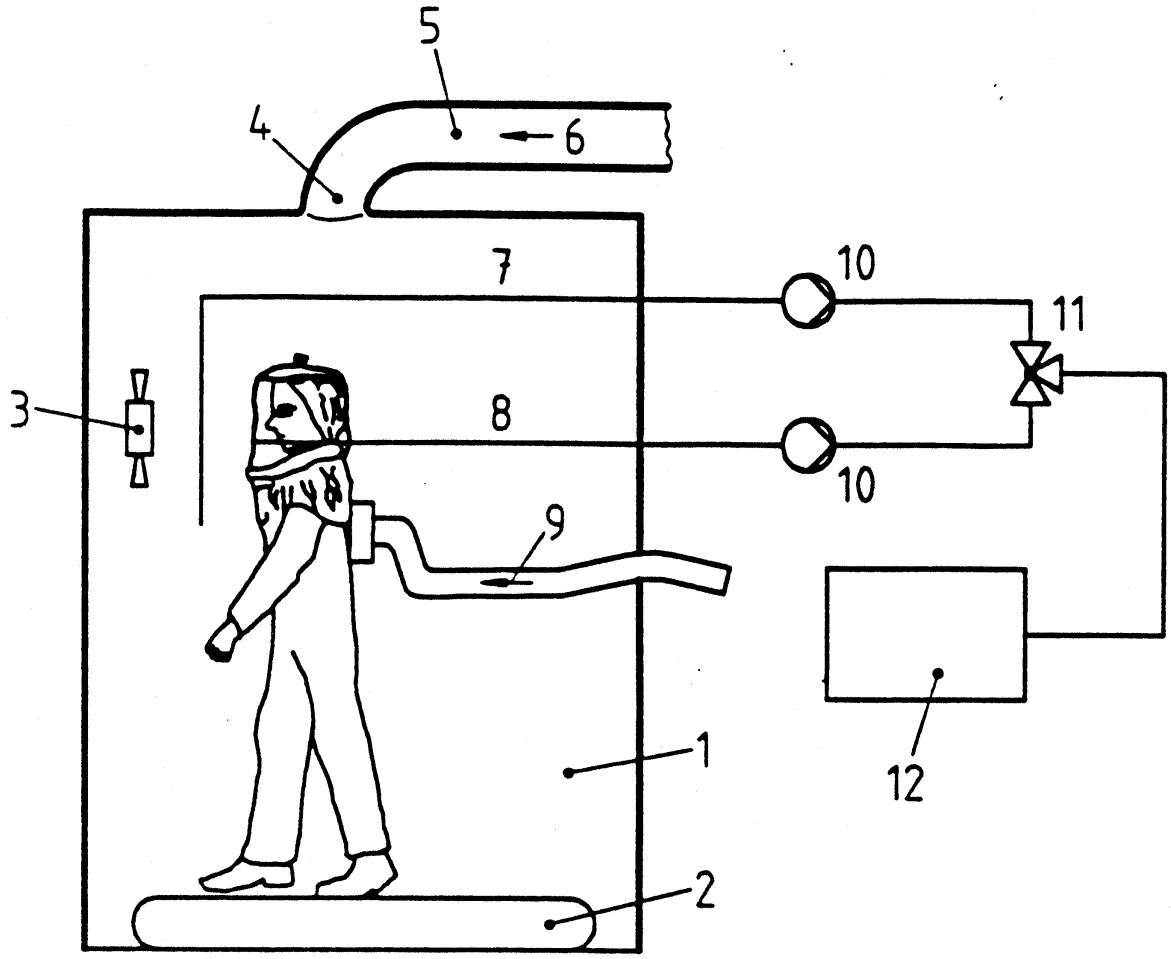
Length of face (nasion-menton)

Width of face (bizygomatic diameter)

Depth of face

Width of mouth

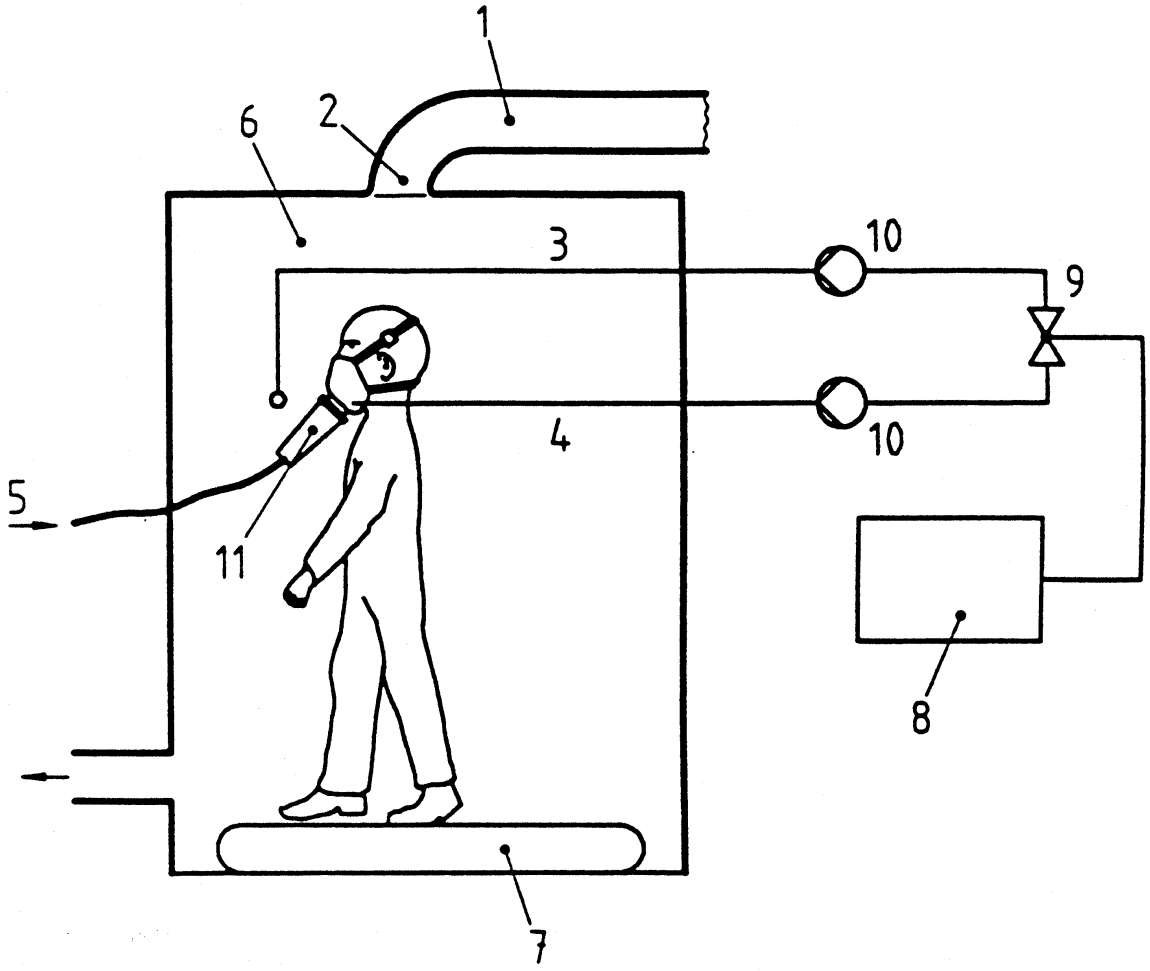
Figure 7 — Facial dimensions



Key

1 Enclosure
2 Treadmill
3 Fan, if required
4 Baffle
5 Duct
6 Air + SF_6
7 Enclosure sample
8 Breathing zone sample
9 Breathable air
10 Sample pump
11 Change-over valve
12 Analyser

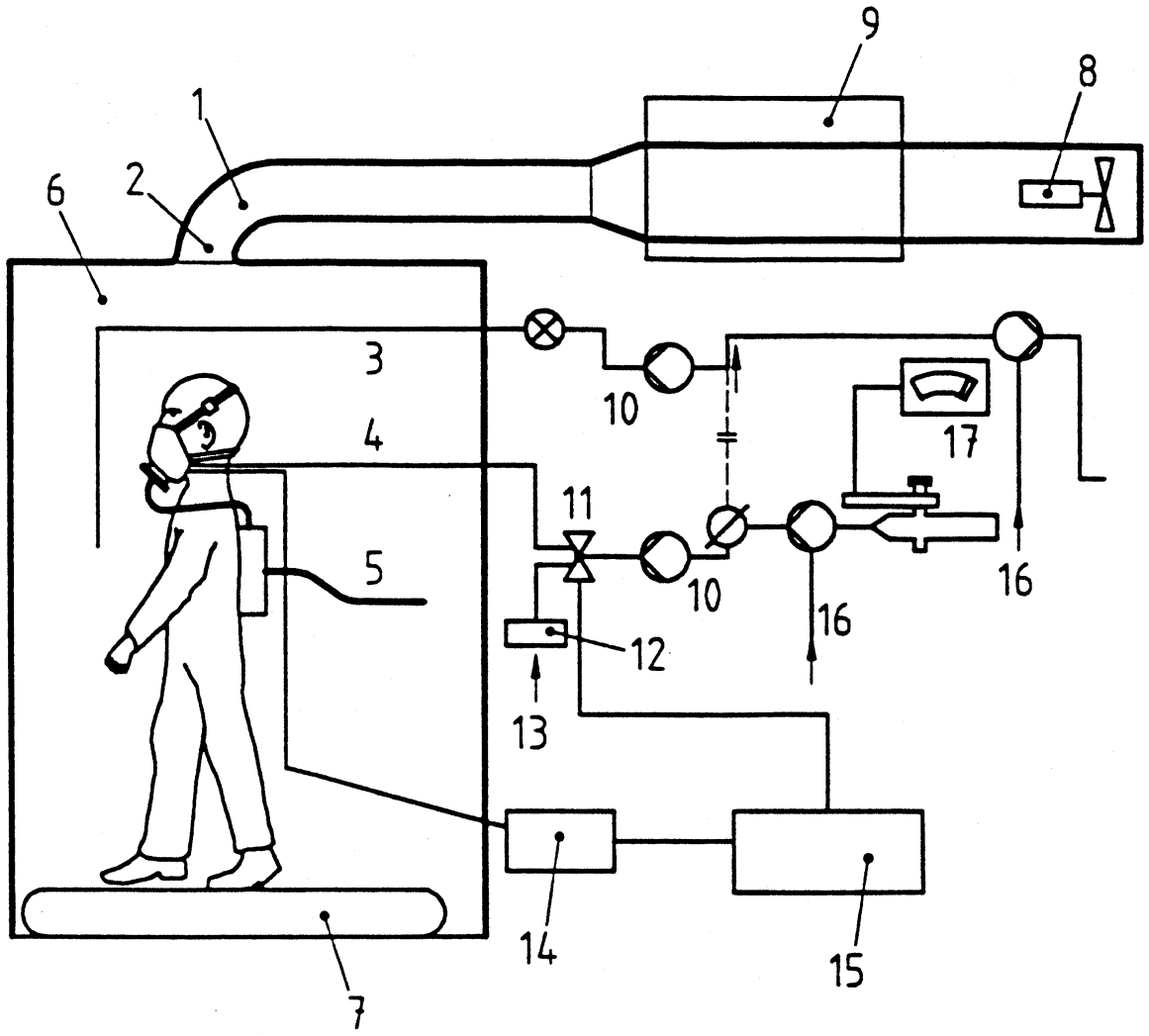
Figure 8 — Test arrangement for determination of inward leakage by the sulfur hexafluoride method; showing device with hood



Key

1 Duct
2 Baffle
3 Enclosure sample
4 Breathing zone sample
5 Breathable air
6 Enclosure
7 Treadmill
8 Analyzer
9 Changeover valve
10 Sample pump
11 Filter simulator

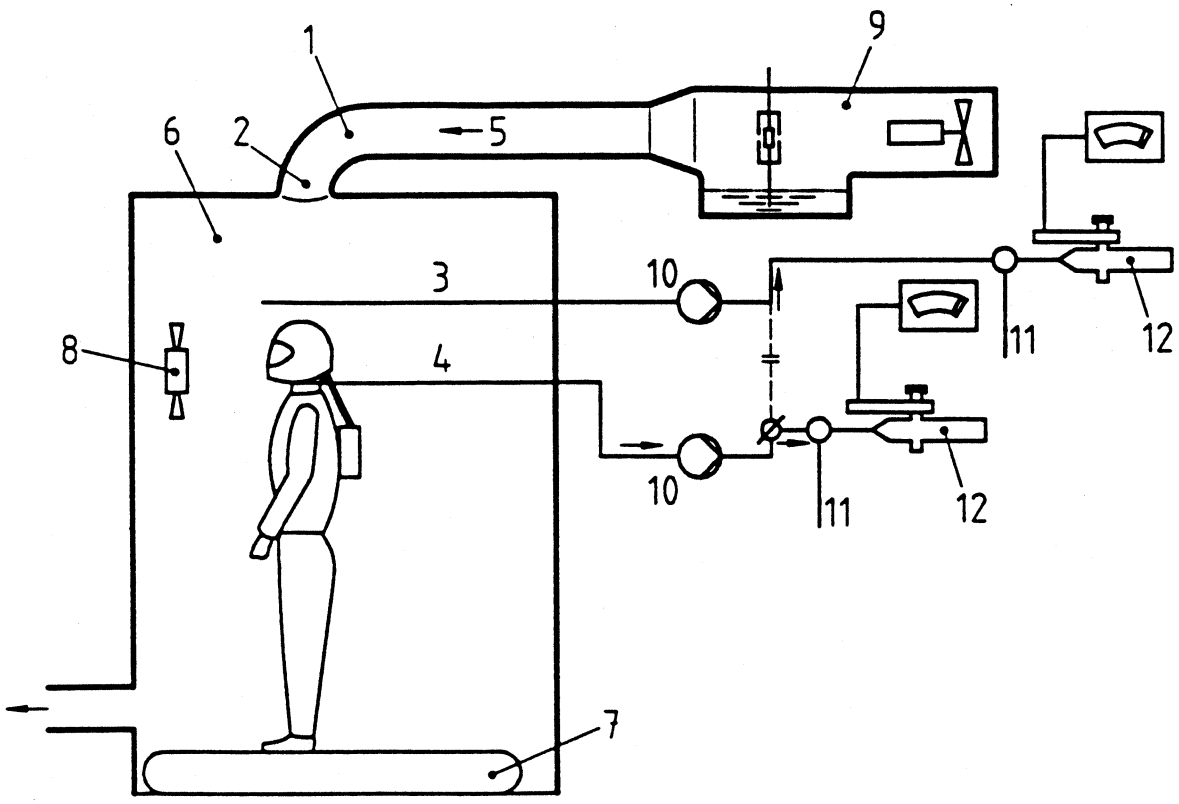
Figure 9 — Test arrangement for determination of inward leakage by the sulfur hexafluoride method; showing device with mask



Key

1 Duct
2 Baffle
3 Enclosure sample
4 Breathing zone sample
5 Breathable air
6 Enclosure
7 Treadmill
8 Fan
9 Atomizer
10 Pump
11 Change-over valve
12 Filter
13 Fresh air
14 Manometer
15 Pulsed sampling interface
16 Additional air (if required)
17 Photometer

Figure 10 — Test arrangement for determination of inward leakage by the sodium chloride method (pulsed sampling method); showing device with mask

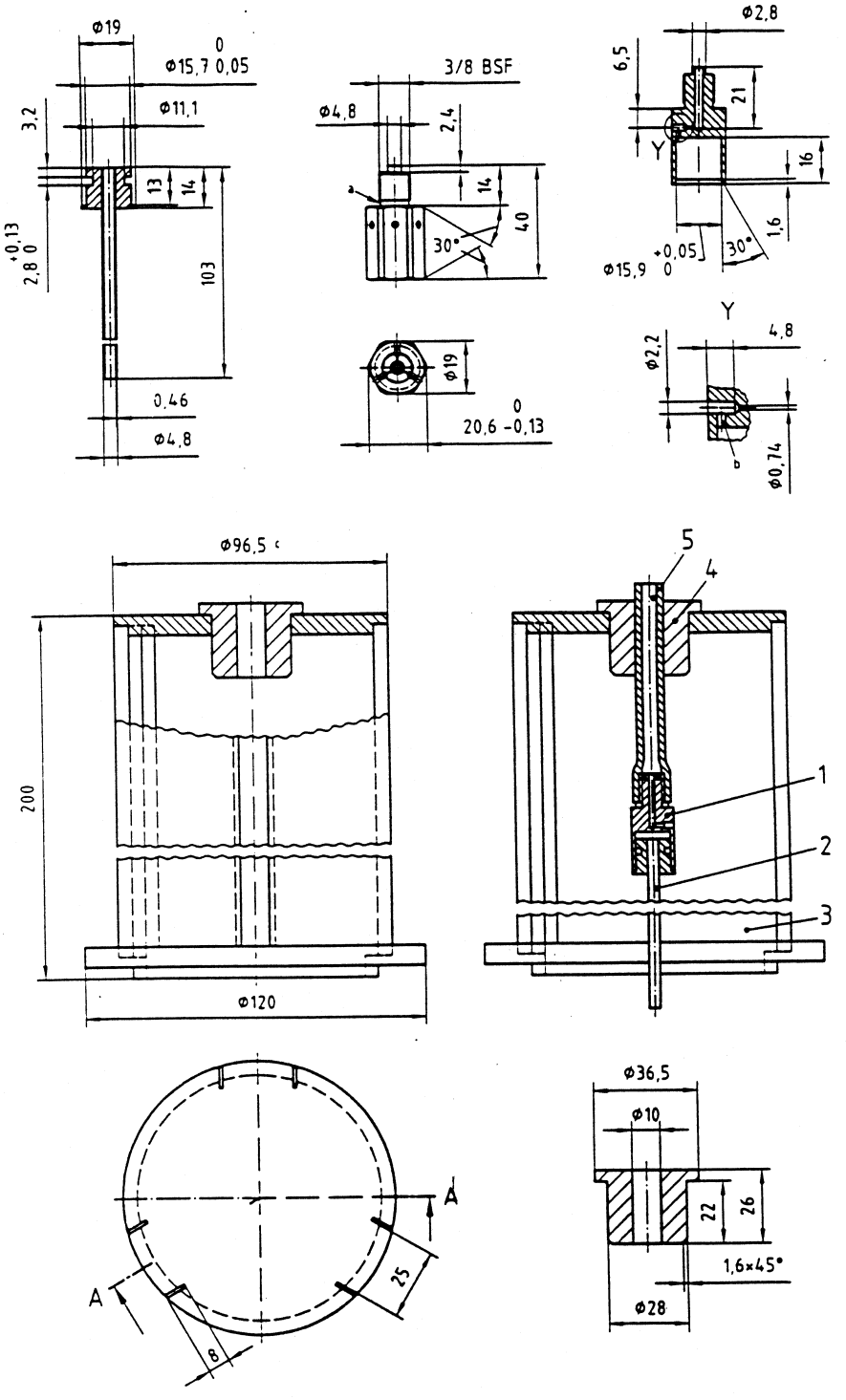


Key

1 Duct
2 Baffle
3 Enclosure sample
4 Facepiece sample
5 Air + NaCl
6 Enclosure
7 Treadmill
8 Fan
9 Atomizer
10 Sample pump
11 Additional air (if required)
12 Photometer

Figure 11 — Test arrangement for determination of total inward leakage by the sodium chloride method (continuous sampling); showing device with hood

Dimensions in millimetres



Key

1 Nozzle
2 Feed tube (salt solution)
3 Sleeve
4 Bush
5 Air tube (10,0 outer diameter)

Figure 12 — Assembly of atomizer

Annex A
(Normative)

Test results — Uncertainty of measurement

For each of the required measurements performed in accordance with this European Standard, a corresponding estimate of the uncertainty of measurement shall be evaluated. This estimate of uncertainty shall be applied and stated when reporting test results, in order to enable the user of the test report to assess the reliability of the data.

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 product(s) falling within the scope of this standard.

The clauses of this standard are likely to support requirements in Clauses 1.1.2 and 3.10.1 of Annex II of Directive 89/686/EEC.

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

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001. Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL