BRITISH STANDARD

BS EN
139 : 1995

Respiratory protective devices —

Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly —

Requirements, testing, marking

The European Standard EN 139 : 1994 has the status of a British Standard

UDC 614.894.72 : 620.1

BSI
STANDARDS

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United Kingdom	British Standards Institution

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National foreword

This British Standard has been prepared under the direction of the Personal Safety Equipment Standards Policy Committee and is the English language version of EN 139 : 1994 *Respiratory protective devices — Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly — Requirements, testing, marking,* published by the European Committee for Standardization (CEN). Together with BS EN 138, BS EN 269 and BS EN 270 it supersedes BS 4667 : Part 3 : 1974 which is withdrawn.

EN 139 was produced as a result of international discussions in which the United Kingdom took an active part.

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

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 139

October 1994

UDC 614.894.72 : 620.1

Descriptors: Respiratory protective equipment, compressed air, accident prevention, specifications, tests, marking

English version

Respiratory protective devices — Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly — Requirements, testing, marking

Appareils de protection respiratoire — Appareils de protection respiratoire à adduction d'air comprimé avec masque complet, demi-masque ou ensemble embout buccal — Exigences, essais, marquage

Atemschutzgeräte — Druckluft-Schlauchgeräte in Verbindung mit Vollmaske, Halbmaske oder Mundstückgarnitur — Anforderungen, Prüfung, Kennzeichnung

This European Standard was approved by CEN on 1994-10-14. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the 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.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Ref. No. EN 139 : 1994 E

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 79, Respiratory protective devices, the Secretariat of which is held by DIN.

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 EC Directive(s).

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 April 1995 and conflicting national standards shall be withdrawn at the latest by April 1995.

According to the CEN/CENELEC Internal Regulations, 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, 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 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 compressed air line breathing apparatus for use with a full face mask, a half mask or a mouthpiece assembly as a respiratory protective device. Escape and diving apparatus and that used in abrasive blasting operations are not covered by this standard.

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.

EN 132 : 1990	*Respiratory protective devices — Definitions*
EN 134 : 1990	*Respiratory protective devices — Nomenclature of components*
EN 136 : 1989	*Respiratory protective devices — Full face masks — Requirements, testing, marking*
EN 140 : 1989	*Respiratory protective devices — Half masks and quarter masks — Requirements, testing, marking*
EN 142 : 1989	*Respiratory protective devices — Mouthpiece assemblies — Requirements, testing, marking*
EN 148-1 : 1987	*Respiratory protective devices — Threads for facepieces — Standard thread connection*
EN 148-2 : 1987	*Respiratory protective devices — Threads for facepieces — Centre thread connection*
EN 148-3 : 1992	*Respiratory protective devices — Threads for facepieces — Thread connection M45 × 3*
EN 28031 : 1993	*Rubber and plastics hoses and hose assemblies — Determination of electrical resistance (ISO 8031 : 1987)*
ISO 6941 : 1987 AMD 1 : 1992	*Textile fabrics — Burning behaviour — Measurement of flame speed properties of vertically oriented specimens*

3 Definitions and nomenclature

For the purposes of this European Standard the definitions and nomenclature given in EN 132 and EN 134 respectively apply together with the following.

3.1 compressed air line breathing apparatus for use with a full face mask, a half mask or a mouthpiece assembly

Apparatus which is not self-contained in which the wearer is supplied with breathable air from a source of compressed air at a maximum pressure of 10 bar.

3.2 overflow valve

A non-return valve, fitted to the breathing hose, that is specifically designed to allow the excess air supply to escape to atmosphere.

3.3 breathing bag

A device which compensates for variation in the air supply and provides for peak inhalation flow requirements.

3.4 compressed air supply tube

A tube which delivers breathable air at a maximum pressure of 10 bar from a source of compressed air.

4 Description

NOTE. The term 'suitable facepiece' means a facepiece complying with EN 136, EN 140 or EN 142 as appropriate.

4.1 Compressed air line breathing apparatus (continuous flow type)

This apparatus enables the wearer to be provided with breathable air (as defined in the relevant European Standard*) supplied at a continuous air flow to a suitable facepiece via a breathing hose. The apparatus may incorporate an adjustable continuous flow valve which may be carried by the wearer. A compressed air supply tube connects the wearer to a supply of compressed air. An overflow valve may be fitted to the breathing hose. The excess and exhaled air flows into the ambient atmosphere.

* This can be ensured by a breathable air supply system or an additional device (e.g. a filtering device).

In certain circumstances a breathing bag or similar device may be necessary to compensate for variations of the air supply and to provide for peak inhalation flow requirements.

4.2 Compressed air line breathing apparatus (demand type)

4.2.1 ***Apparatus without positive pressure***

This apparatus enables the wearer to be provided with breathable air (as defined in the relevant European Standard*) which flows through a lung governed demand valve to a suitable facepiece on inhalation. A compressed air supply tube connects the wearer to a supply of compressed air. The excess and exhaled air flows into the ambient atmosphere.

4.2.2 ***Apparatus with positive pressure***

This apparatus enables the wearer to be provided with breathable air (as defined in the relevant European Standard*) which flows through a lung governed demand valve operating at positive pressure to a suitable facepiece on inhalation. A compressed air supply tube connects the wearer to a supply of compressed air. The excess and exhaled air flows into the ambient atmosphere.

5 Designation

Respiratory protective devices meeting the requirements of this standard shall be designated as follows:

Compressed air line BA/EN 139/(Options).

Example: Compressed air line BA EN 139.

6 Requirements

6.1 Materials

6.1.1 All materials used in the construction shall have adequate mechanical strength, durability and resistance to deterioration by heat.

6.1.2 Exposed parts, i.e. those which may be subjected to impact during use of the apparatus, shall not be made of aluminium, magnesium, titanium or alloys containing such proportions of these metals as will, on impact, give rise to frictional sparks capable of igniting flammable gas mixtures.

6.1.3 Materials that may come into direct contact with the wearer's skin or that may affect the quality of the breathed air shall not be known to be likely to cause skin irritation or any other adverse effects to health.

6.1.4 The finish of any part of the apparatus likely to be in contact with the wearer shall be free from sharp edges and burrs.

Compliance with **6.1.1**, **6.1.2**, and **6.1.4** shall be assessed in accordance with **7.3**.

6.2 Water immersion

The apparatus shall continue to function satisfactorily after being submerged in water and shall meet the requirements of **6.20**.

Warning. The apparatus is not designed for use under water.

Testing in accordance with **7.2.**

6.3 Cleaning and disinfecting

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

Testing in accordance with **7.3**.

6.4 Practical performance test

The apparatus shall be such that it can be worn without avoidable discomfort, the wearers shall show no undue signs of strain attributable to wearing the apparatus, and it shall impede the wearer as little as possible when in a crouched position or when working in a confined space.

These tests serve the purpose of checking the equipment for imperfections that cannot be determined by the tests described elsewhere in this standard.

Where in the opinion of the test station approval is not granted because practical performance tests show the apparatus has imperfections related to wearer's acceptance, the test station shall describe the test which revealed these imperfections. This will enable other test stations to duplicate the tests and assess the results thereof.

Testing in accordance with **7.4**.

6.5 Connectors

6.5.1 ***General***

Components of the apparatus shall be readily separated for cleaning, examining and testing.

All demountable connections shall be readily connected and secured, where possible by hand. Any means of sealing used shall be retained in position when the joints and couplings are disconnected during normal maintenance.

6.5.2 ***Couplings***

The apparatus shall be constructed so that any twisting of the hoses and tubes does not affect the fit or performance of the apparatus, or cause the hoses or tubes to become disconnected. At least one swivelling coupling shall be fitted to the compressed air supply tube adjacent to the wearer. The design of the couplings shall be such as to prevent unintentional interruption of the air supply.

Testing in accordance with **7.3** and **7.4**.

* This can be ensured by a breathable air supply system or an additional device (e.g. a filtering device).

6.5.3 *Strength of breathing hose connections*

Couplings of the breathing hose at the equipment connector and waist belt shall withstand a force of 250 N. Where however a half mask with a non-standard thread is used in the apparatus the requirement for coupling strength shall be 50 N.

Testing in accordance with **7.5**.

6.5.4 *Connection between apparatus and facepiece*

The connection between the breathing apparatus and the facepiece may be achieved by a permanent, special or thread type connector.

If a thread connector is used it shall comply with the requirements of one of the following standards:

EN 148-1 for breathing apparatus without positive pressure;

EN 148-2 for closed-circuit breathing apparatus;

EN 148-3 for breathing apparatus with positive pressure.

If any other thread type connector is used it shall not be possible to connect it with the above mentioned threads.

The standard thread according to EN 148-1 shall not be used for apparatus with positive pressure, closed-circuit apparatus and diving apparatus.

The thread according to EN 148-2 shall not be used for open-circuit devices and diving apparatus.

The thread according to EN 148-3 shall not be used for apparatus without positive pressure, closed-circuit apparatus and diving apparatus.

6.6 Compressed air line breathing apparatus used with self-contained breathing apparatus

If compressed air line breathing apparatus is used in conjunction with self-contained breathing apparatus, the design of the combined system shall be such as to prevent air loss from the breathing apparatus in the event of a malfunction or disconnection of the airline. The connection of the compressed air supply tube to the self-contained breathing apparatus shall withstand an axial force of 1000 N.

Testing in accordance with **7.3** and **7.6**.

6.7 Body harness, belt and breathing bag

6.7.1 A body harness or belt shall be provided to which the medium pressure connecting tube, breathing hose and breathing bag if fitted shall be attached. Buckles shall not slip

Testing in accordance with **7.3** and **7.4**.

6.7.2 It shall not be possible to connect the compressed air supply tube directly to the breathing hose, medium pressure connecting tube or facepiece.

Testing in accordance with **7.3** and **7.4**.

6.7.3 Where a breathing bag is fitted it shall be protected against damage.

Testing in accordance with **7.3**.

6.8 Resistance to temperature

6.8.1 After storage in accordance with **7.7.1** all other performance requirements of this standard shall be met

6.8.2 After storage in accordance with **7.7.1** the apparatus shall comply with **6.20** and shall continue to operate satisfactorily as assessed by the procedures of **7.7.2** and **7.7.3**.

6.8.3 Apparatus specifically designed for temperatures beyond the limits for storage or use given in **7.7.1** shall be tested and marked accordingly.

6.9 Flammability

When tested in accordance with **7.8** all exposed components of the apparatus shall not continue to burn for more than 5 s after passing through the flame.

6.10 Resistance to air pressure

The compressed air supply tube and the medium pressure connecting tube and their couplings shall be capable of withstanding without damage an air pressure of 30 bar for 15 min.

Testing in accordance with **7.3**.

6.11 Mobile high pressure air supply systems

6.11.1 *General*

The air supply system shall be fitted with a pressure reducer, a high pressure gauge, medium pressure gauge, safety valve and a warning device in the high pressure system.

Testing in accordance with **7.3**.

6.11.2 *Pressure reducer*

The pressure reducer and the characteristics of the compressed air supply system incorporating the compressed air supply tube(s) shall be such that the requirements of **6.14** and **6.20** shall be met.

The required pressure on the outlet side shall be either preset or variable; in the latter case the variable valve shall not be adjustable without the use of special tools and the pressure gauge shall be suitably marked to indicate the pressure range.

Testing in accordance with **7.3** and **7.4**.

6.11.3 *High pressure warning device for compressed air cylinder systems*

The system shall have a warning device that warns the wearer or assistant when the cylinder pressure drops to a predetermined level. The warning device shall operate at a residual pressure of 30 bar minimum. If an audible warning device is incorporated, the sound pressure level shall be a minimum of 85 dB(A) and not greater than 95 dB(A) at a distance of 1 m from the warning device. The duration of the audible warning shall be at least 15 s for a continuous signal and 60 s for an intermittent signal. The frequency range of the signal shall be between 2000 Hz and 4000 Hz.

Testing in accordance with **7.3**.

6.11.4 ***Pressure reducer safety valve***

A pressure reducer safety valve shall be provided. The pressure reducer safety valve shall be designed to pass an air flow of 400 l/min at a medium pressure not exceeding 30 bar. With the pressure reducer safety valve operational, the inhalation and exhalation breathing resistances shall not exceed 25 mbar.

Testing in accordance with **7.9**.

NOTE. This requirement only applies to one wearer operating from one pressure reducer; where multiple wearers operate from a single pressure reducer additional safety features will be needed.

6.12 Compressed air supply tube

6.12.1 ***Resistance to kinking***

When tested in accordance with **7.10** the compressed air supply tube shall maintain a uniform near-circular shape and spiral from the loop configuration described and shall not deform to an extent that decreases the flow of air through it by more than 10 % compared with that measured when the tube is straight and unstressed.

6.12.2 ***Resistance to collapse***

When tested in accordance with **7.11** using an applied load of 1000 N the reduction in air flow shall not be greater than 10 %.

6.12.3 ***Strength***

When tested in accordance with **7.6** the compressed air supply tube, couplings and continuous flow valve or demand valve, if fitted, shall not separate from the couplings.

Testing in accordance with **7.3** and **7.6**.

6.12.4 ***Flexibility***

When pressurized to the maximum working pressure the compressed air supply tube shall be capable of being wound on to a drum 300 mm in diameter.

Testing in accordance with **7.3**.

6.12.5 ***Heat resistance***

Compressed air supply tubes claimed to be resistant to damage from contact with hot surfaces and boiling water shall be tested in accordance with **7.12** and shall show no signs of damage or indications of failure and the air quality shall not be significantly affected.

6.12.6 ***Electrostatic properties***

Compressed air supply tubes claimed to be antistatic when tested in accordance with EN 28031 making connections to the couplings shall have an electrical resistance that is greater than 10^3 Ω and less than 10^8 Ω.

6.12.7 ***Couplings***

Where a hand operated connection is fitted to the outlet of the compressed air supply tube it shall incorporate a self-sealing coupling to seal the air supply.

Testing in accordance with **7.3**.

6.13 Breathing hose

Breathing hoses shall be flexible and non-kinking. The breathing hoses shall permit free head movement and shall not restrict or close off the air supply under chin or arm pressure during practical performance tests.

Testing in accordance with **7.4**.

6.14 Supply regulators

6.14.1 ***General***

The requirements of **6.14.2** and **6.14.3** shall apply simultaneously to every apparatus connected to the air supply system.

6.14.2 ***Continuous flow valve***

A continuous flow valve when fitted, shall be easily adjusted by the wearer to supply air as required. With the complete apparatus in minimum flow conditions, and the overflow valve, if fitted, closed, the continuous flow valve shall deliver not less than 120 l/min in the minimum flow position and not less than 300 l/min in the maximum flow position measured at the outlet of the breathing hose. If the valve is designed to shut off it shall not be possible inadvertently to reduce the flow below 120 l/min.

Testing in accordance with **7.3** and **7.4**.

6.14.3 ***Lung governed demand valve***

6.14.3.1 *Without positive pressure*

The negative pressure for opening the lung governed demand valve shall be between 0,5 mbar and 3,5 mbar when tested using a continuous flow of 10 l/min.

A self-opening of the demand valve at negative pressures of less than 0,5 mbar shall not occur.

At a flow rate of 300 l/min the negative pressure shall not exceed 10 mbar.

The requirements of this clause shall be met over the pressure range of the air supplied to the apparatus as specified by the manufacturer.

Testing in accordance with **7.3**.

6.14.3.2 *With positive pressure*

The apparatus shall be designed such that at a sinusoidal flow of 40 cycles/min and 2,5 l/stroke a positive pressure is maintained in the cavity of the facepiece adjacent to the face seal. The pressure shall not exceed 5 mbar during inhalation.

NOTE. Where apparatus is equipped with a thread connector complying with EN 148-3 and may, in use, inadvertently be connected to an existing facepiece, it is recommended that compliance with **A.1**, **A.2** and **A.3** of annex A should be assessed.

The requirements of this clause shall be met over the pressure range of the air supplied to the apparatus as specified by the manufacturer.

Testing in accordance with **7.3**

6.14.3.3 *Supplementary air supply*

Apparatus without positive pressure shall be provided with a manually operated means of providing a supply of air at a flow rate of at least 60 l/min at the minimum stated compressed air supply conditions.

Testing in accordance with **7.3**.

NOTE. Apparatus with positive pressure may also be provided with such a device.

6.14.3.4 *Couplings*

Where a hand operated coupling is fitted between the demand valve and the waist belt or body harness it shall incorporate a self-sealing device to prevent loss of air from the compressed air supply tube.

Testing in accordance with **7.3** and **7.4**.

6.15 Adjustable parts

All parts requiring manipulation by the wearer shall be readily accessible and easily distinguishable from one another by touch. All adjustable parts and controls shall be constructed so that their adjustment is not liable to accidental alteration during use. Parts that are not intended for adjustment by a wearer shall require the use of tools for their adjustment.

Testing in accordance with **7.3** and **7.4**.

6.16 Overflow valve for continuous flow apparatus

Where a standard thread (EN 148-1) is used as an equipment connector an overflow valve shall be fitted. It shall be protected against dirt and mechanical damage.

Testing in accordance with **7.3**.

The overflow valve shall continue to function after a constant flow of air through the valve at 300 l/min for 1 min and after being subjected to a negative pressure of 80 mbar for 1 min.

When tested in accordance with **7.13** the overflow valve shall be leaktight.

6.17 Facepieces

Full face masks, half masks and mouthpiece assemblies shall comply with the requirements of EN 136, EN 140 and EN 142 as appropriate.

6.18 Inward leakage

Where the full face mask or half mask is fitted with a connection not complying with EN 148-1 or EN 148-3 the complete apparatus shall be tested in accordance with **5.4** of EN 136 : 1989 and the inward leakage of full face masks shall comply with **4.7** in EN 136 : 1989 and for apparatus fitted with half masks with **4.6** of EN 140 : 1989.

6.19 Inhalation and exhalation valves

All complete apparatus not fitted with a standard thread shall be provided with an inhalation valve and one or more exhalation valves. Valve assemblies shall be such that they can be readily maintained and correctly replaced. It shall not be possible to fit an inhalation assembly in the expiratory circuit.

Exhalation valves not tested for leakage in the course of assessing compliance with EN 136, EN 140 or EN 142 shall be tested in accordance with **7.14** and the leakage shall not exceed 0,01 %.

6.20 Breathing resistance

6.20.1 ***General***

The requirements of **6.20.2** and **6.20.3** shall apply simultaneously to every apparatus connected to the air supply system before and after the water immersion in accordance with **7.2**.

6.20.2 ***Inhalation resistance***

6.20.2.1 *Continuous flow apparatus*

With the continuous flow valve (if fitted) in the fully closed position and with the minimum stated supply pressure and maximum stated length of compressed air supply tube and filter (if any) the inhalation resistance of the complete apparatus shall not exceed 4,5 mbar when tested using a breathing machine adjusted to 25 cycles/min and 2 l/stroke.

6.20.2.2 *Continuous flow apparatus incorporating a breathing bag*

When supplied with air at the stated minimum working pressure, and with the continuous flow valve set to minimum flow the inhalation resistance of a complete apparatus shall not exceed 4,5 mbar.

NOTE. This may be measured using a breathing machine (25 cycles/min, 2 l/stroke).

6.20.2.3 *Lung governed demand valve apparatus without positive pressure*

The inhalation resistance of a complete apparatus when tested using a breathing machine set to 25 cycles/min and 2 l/stroke, shall not exceed 7,0 mbar when fitted with a facepiece or 4,5 mbar without a facepiece.

6.20.3 ***Exhalation resistance***

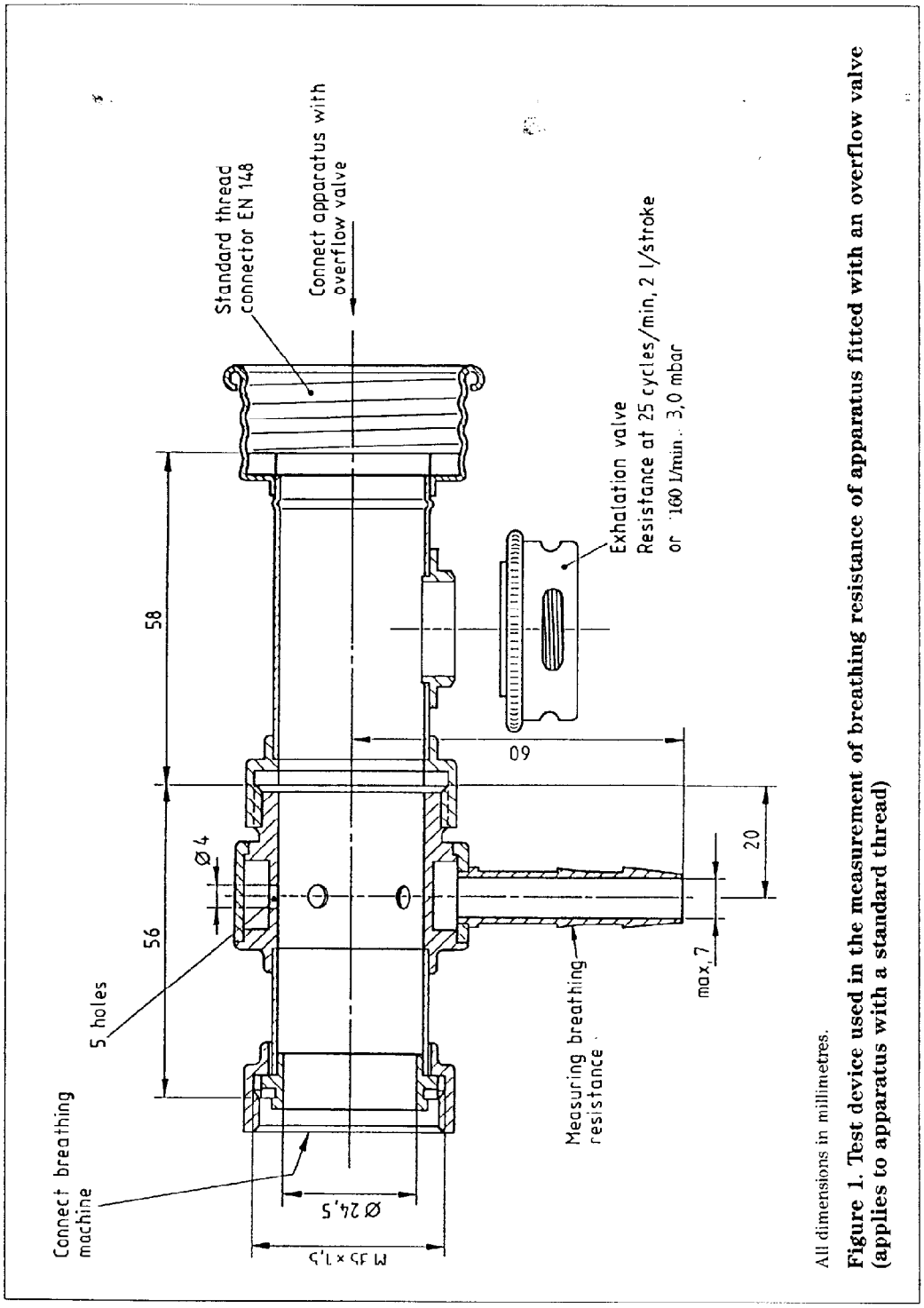
6.20.3.1 *Continuous flow apparatus*

The exhalation resistance shall not exceed 10 mbar when tested at 25 cycles/min and 2 l/stroke with the continuous flow valve (if fitted) fully open and with the maximum supply pressure and shortest length of compressed air supply tube.

The exhalation resistance of continuous flow apparatus using a standard thread (EN 148-1) and therefore fitted with an overflow valve (see **5.16**) shall be measured using the test device shown in figure 1.

6.20.3.2 *Lung governed demand valve apparatus without positive pressure*

The exhalation resistance of the complete apparatus shall not exceed 3 mbar, when tested using a breathing machine at a flow rate of 50 l/min (25 cycles/min and 2 l/stroke).



All dimensions in millimetres.

Figure 1. Test device used in the measurement of breathing resistance of apparatus fitted with an overflow valve (applies to apparatus with a standard thread)

6.20.3.3 *Lung governed demand valve apparatus with positive pressure*

The exhalation valve shall have an opening resistance not exceeding 6 mbar, a resistance not exceeding 7 mbar at a sinusoidal flow of 25 cycles/min and 2 l/stroke and a resistance not exceeding 10 mbar at a sinusoidal flow of 40 cycles/min and 2,5 l/stroke.

6.21 Carbon dioxide content of inhalation air

6.21.1 *Demand valve apparatus*

Where apparatus uses an equipment connector not complying with EN 148-1 (standard thread) the apparatus shall be tested in accordance with clause **5.6** of EN 136 : 1989 and the carbon dioxide content of the inhaled air shall be not greater than an average of 1 % by volume.

6.21.2 *Continuous flow apparatus*

With the continuous flow valve (if fitted) in the fully closed position and with the minimum stated supply pressure and maximum stated length of compressed air supply tube and filter (if any) the carbon dioxide content of the inhaled air shall not be greater than an average of 1 % by volume when tested using a breathing machine set to 25 cycles/min and 2 l/stroke in accordance with **5.6** of EN 136 : 1989.

6.22 Leaktightness

With the maximum designed working pressure applied to the apparatus, the compressed air supply tube, couplings and continuous flow valve (if fitted), breathing hose, shall be tested for leak tightness by immersion in water for 1 min. The breathing hose shall be sealed and the overflow valve, if fitted, also sealed. The test shall be applied after all other tests except that for flammability and the practical performance test.

No bubbles shall be observed escaping from the apparatus.

7 Testing

7.1 General

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

The flammability test in **7.8** shall be carried out on two unconditioned test samples which are not then used for other tests.

The conditioning procedures described in **7.7.1** and **7.7.2** shall be completed on two futher test samples prior to the remaining tests being carried out.

The leaktightness test shall be carried out on the conditioned samples after all other tests except the practical performance test. The practical performance test shall be carried out using the two conditioned samples after all other tests (with the exception of **7.8**) have been completed.

Positive pressure apparatus shall be tested as complete apparatus including the facepiece as supplied by the applicant.

Table 1 details the tests and requirement clause numbers.

In all tests, both test samples need to meet the requirements.

7.2 Water immersion

The apparatus including facepiece is connected to a breathing machine by a flexible hose. Depending on the facepiece used, different connectors need to be used; apparatus with a full face mask shall be fitted to the Sheffield dummy head and apparatus with a mouthpiece shall be connected directly to the outlet of the flexible hose.

The test is conducted with the breathing machine adjusted to 25 strokes/min and 2 l/stroke. The complete apparatus as worn and sufficient length of compressed air supply tube to carry out the test is immersed in water to a depth of between 0,25 m and 0,8 m for a period of not less than 3 and not more than 5 full breathing cycles. The test is carried out with the apparatus immersed in the following orientations:

a) upright and vertical;

b) inverted and vertical;

c) horizontal, face up;

d) horizontal, face down.

Measurements of breathing resistance shall be made at the appropriate pressure sample points using a precision gauge. The breathing resistance is recorded prior to and immediately after the immersion.

Presence of water in the facepiece after the test does not constitute a reason for failure and any water present may be removed prior to measurement of breathing resistance.

7.3 Visual inspection

A visual inspection is made by the appropriate testing authority prior to laboratory or practical performance tests. This may entail a certain amount of dismantling in accordance with the manufacturer's instructions for maintenance. The visual inspection includes marking and instructions for use.

7.4 Practical performance test

7.4.1 *General*

Practical performance tests shall be carried out using two sets of apparatus and four test subjects. Only apparatus which has satisfied the laboratory tests shall be used. The test plan shall be as shown below:

Test subjects 1 and 2 use apparatus 1;

Test subjects 3 and 4 use apparatus 2.

Table 1. Testing schedule			
Test clause	Title	Temperature conditioning to 7.7.1 and 7.7.2	Requirement clause
7.2	Water immersion	Yes	**6.2**
7.3	Visual inspection	Yes	**6.1, 6.3, 6.5, 6.6, 6.7, 6.10, 6.11, 6.12.3, 6.12.4, 6.12.7,6.15**
7.4	Practical performance test	Yes	**6.4, 6.5.2, 6.7, 6.11.2, 6.13, 6.14.2, 6.14.3.4, 6.15**
7.5	Strength of breathing hose connections	Yes	**6.5.3**
7.6	Strength of compressed air supply tube, body harness and couplings	Yes	**6.6, 6.12.3**
7.7	Resistance to temperature	Yes	**6.8**
7.8	Flammability	No	**6.9**
7.9	Pressure reducer safety valve	Yes	**6.11.4**
7.10	Resistance to kinking of compressed air supply tube	Yes	**6.12.1**
7.11	Resistance to collapse of compressed air supply tube	Yes	**6.12.2**
7.12	Heat resistance of compressed air air supply tube	Yes	**6.12.5** (optional)
7.13	Overflow valve	Yes	**6.16**
7.14	Exhalation valve leakage	Yes	**6.19** needed only if not complying with EN 136, EN 140 or EN 142
	Leaktightness	Yes	**6.22**

7.4.2 ***Test subjects***

Apparatus shall be tested by test subjects who practice regularly with breathing apparatus and whose medical history is known to be satisfactory. The subjects shall be medically examined and certified fit to undertake the test procedures.

The necessity of a medical examination immediately before the tests and medical supervision during the tests shall be decided by the testing officer.

7.4.3 ***Preparation of apparatus to be tested***

Before each test check the apparatus for leaktightness. Ensure that air supplies from compressed air systems or from compressed air cylinders are within the specified pressures. The length of the compressed air supply tube shall be the maximum specified.

7.4.4 ***Test conditions***

All tests shall be carried out at ambient temperature and the test temperature and humidity shall be recorded.

7.4.5 ***Work simulation test***

The following activities shall be done in simulation of the practical use of the apparatus. The test shall be completed within a total working time of 30 min.

The sequence of activities is at the discretion of the test officer.

a) 30 pulls on a work machine, each pull being vertical from 1,8 m towards the ground on a mass of 25 kg;

b) walking on the level with full headroom (total distance 125 m)*;

c) walking on the level with headroom of (1,3 ± 0,2) m (total distance 200 m)*;

d) crawling on the level with headroom of (0,70 ± 0,05) m (total distance 100 m)*;

e) climbing up and down a ladder and passing once, in both directions, through a 460 mm square opening (total vertical distance 20 m)*;

f) carrying 22 sandbags (12 kg) individually over a distance of 10 m and placing them on a 1,5 m high wall.

7.4.6 *Information to be recorded*

During the test the apparatus is subjectively assessed by the wearer and the following shall be recorded:

a) harness comfort;

b) security of fastenings and couplings;

c) accessibility of controls and pressure gauge (if fitted);

d) clarity of vision from the facepiece.

e) accessibility and ease of operation of the supplementary supply (if fitted);

f) ease of speech transmission;

g) effectiveness of audible warning device (if fitted);

h) manoeuvrability of the compressed air supply tube;

i) comfort of facepiece;

j) any other comments volunteered by the wearer.

7.5 Strength of breathing hose connections

Apply a force of 50 N or 250 N as appropriate for (10 ± 1) s to the breathing hose as shown in figure 2.

Examine the apparatus for signs of failure.

7.6 Strength of compressed air supply tube, body harness and couplings

The belt or body harness with couplings and continuous flow valve (if present) is secured to a dummy torso in an upright position. A steady pull of 1000 N is applied to the compressed air supply tube in the direction of its axis for 5 min. Figure 3 shows suitable test details.

7.7 Resistance to temperature

7.7.1 *Storage*

The apparatus shall be exposed

a) for not less than 4 h but not more than 16 h to an atmosphere of (60 ± 3) °C and a relative humidity of not less than 95 %; followed by

b) for not less than 4 h but not more than 16 h to a temperature of (−30 ± 3) °C.

It shall then be allowed to return to ambient temperature.

7.7.2 *Laboratory test after storage*

After undergoing the procedure in accordance with **7.7.1**, the apparatus is tested using a breathing machine at a minute volume of 50 l/min (25 cycles/min, 2 l/stroke) for at least 30 min.

7.7.3 *Practical temperature tests at −6 °C*

7.7.3.1 *With cooled apparatus*

7.7.3.1.1 *Preparation*

The facepieces of two sets of apparatus are cleaned internally according to manufacturer's instructions and any excess liquid removed thoroughly by shaking.

The sets of apparatus are then made ready for use and pre-cooled for not less than 2 h but not more than 3 h to a temperature of (−6 ± 3) °C.

7.7.3.1.2 *Procedure*

Two warmly clothed subjects don the apparatus in a cold chamber and perform work at an ambient temperature of (−6 ± 3) °C. The test is continuous, without removal of the apparatus, for 30 min.

The programme is divided into 5 min periods repeated as necessary spent:

a) walking slowly;

b) crawling slowly;

c) carrying wooden blocks or similar over a distance of 6 m and stacking them to a height of approximately 1 m in a pattern as shown in figure 4. The wooden block dimensions are approximately 160 mm × 160 mm to give a mass of (7 ± 1) kg.

At the end of the test each apparatus is examined to check for malfunction due to low temperature.

7.7.3.2 *With apparatus at room temperature*

7.7.3.2.1 *Preparation*

Two sets of apparatus are prepared ready for use and conditioned for not less than 2 h but not more than 3 h at (23 ± 2) °C.

7.7.3.2.2 *Procedure*

Two warmly clothed subjects don the apparatus at room temperature (approximately 20 °C) and enter a cold chamber at (−6 ± 3) °C. Carry out a similar test programme to that described in **7.7.3.1.2** for a period of 30 min.

At the end of the 30 min period, examine the apparatus for malfunction.

7.7.4 *Low temperature laboratory test*

7.7.4.1 *Preparation of apparatus*

Condition the complete apparatus excluding the facepiece at a temperature of (−30 ± 3) °C for 4 h.

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[1] These operations may be split for the convenience of the test station.

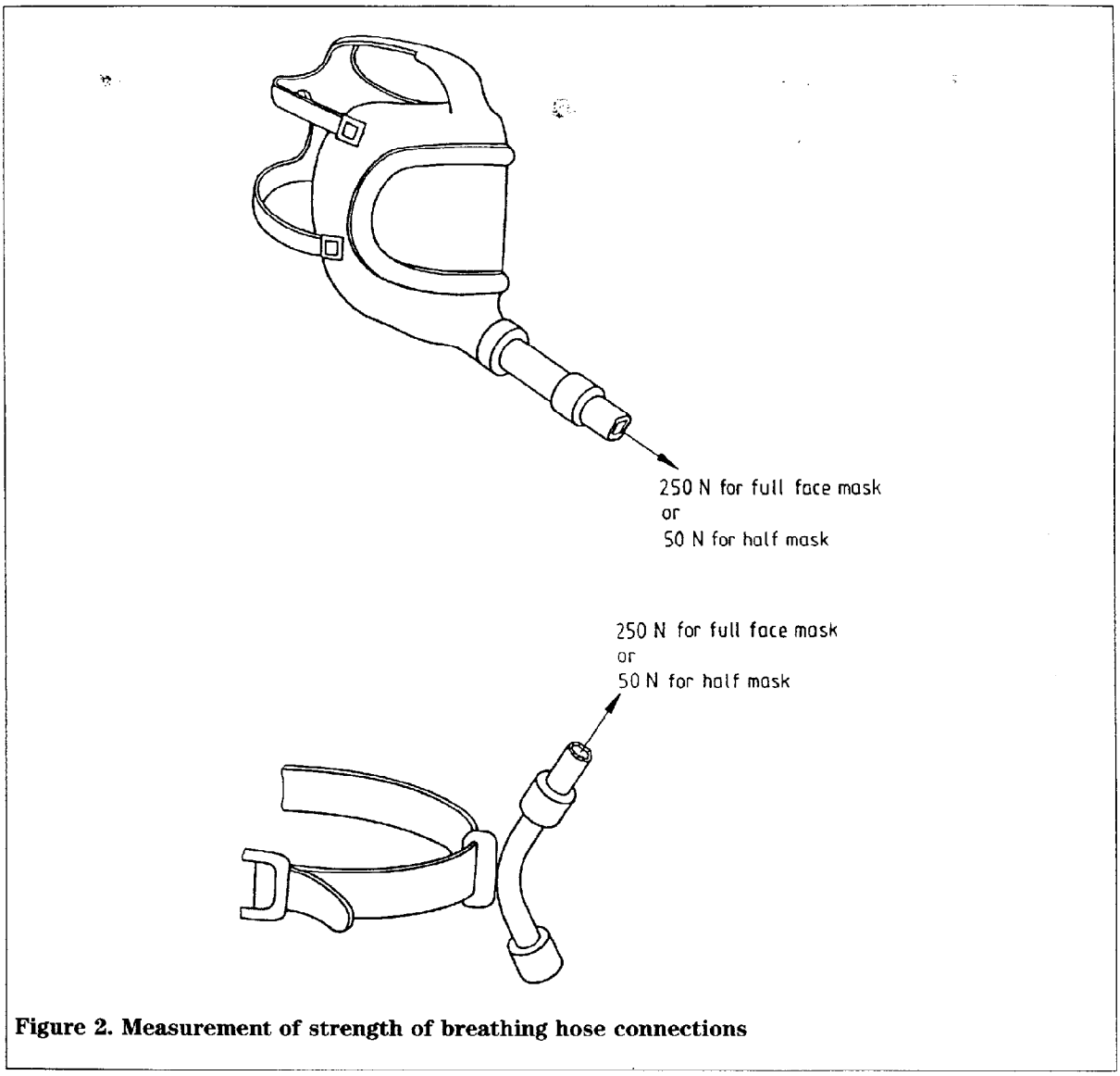
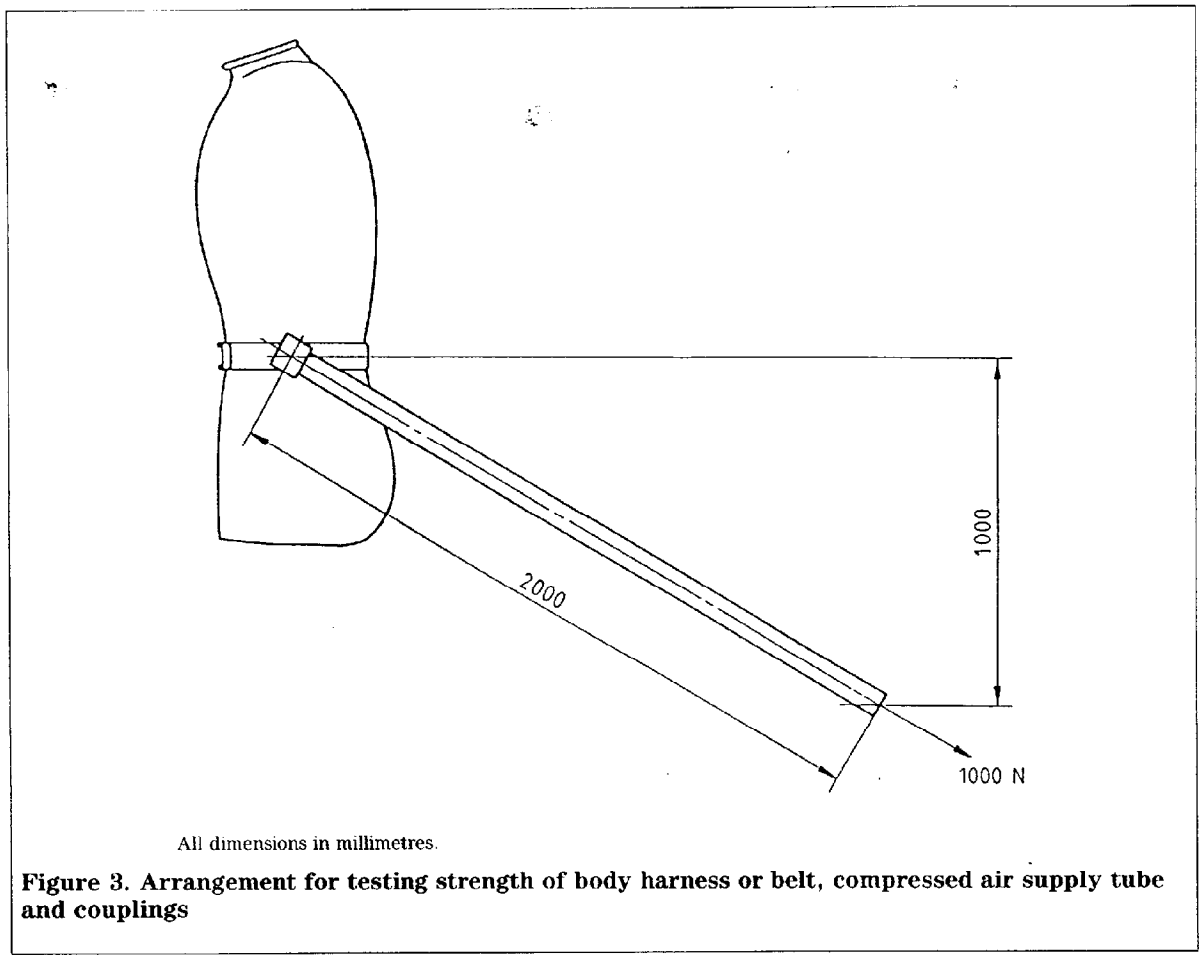


Figure 2. Measurement of strength of breathing hose connections



All dimensions in millimetres.

Figure 3. Arrangement for testing strength of body harness or belt, compressed air supply tube and couplings

7.7.4.2 *Procedure*

Operate the apparatus for 5 min after completion of the conditioning described in **7.7.4.1**. Check that the continuous flow valve (if fitted) functions correctly (see **6.14.2**) in the minimum flow position.

7.8 Flammability

7.8.1 ***Principle***

The component under test is held for a specified period in a luminous flame of known size and temperature and the effect on the component noted.

7.8.2 ***Apparatus*** (see figure 5)

7.8.2.1 *Single gas burner.* The burner is a TEKLU burner or that described in ISO 6941 : 1994/AMD 1 : 1992*

7.8.2.2 *Propane cylinder.*

7.8.2.3 *Pressure regulator, pressure gauge, flash back arrestor, flow control devices.*

7.8.2.4 *Thermocouple*, 1,5 mm in diameter, mineral insulated

7.8.3 ***Procedure***

With the air valve on the burner fully closed adjust the flame height to (40 ± 4) mm by regulation of the gas supply. Check, using the thermocouple, that the temperature (20 ± 2) mm above the base of the flame is (800 ± 50) °C.

Hold the component under test horizontally at a height of (20 ± 2) mm above the base of the flame such that the flame impinges on the edge of the component for 12 s.

Remove the component from the flame and note whether or not it continues to burn 5 s after removal from the flame.

7.9 Pressure reducer safety valve

Connect the apparatus, including the facepiece, to a breathing machine; apparatus with a full face mask is fitted to a Sheffield dummy head and apparatus with a mouthpiece is connected directly to the outlet of the breathing machine.

*) Information on source available from the Secretariat of CEN/TC 79.

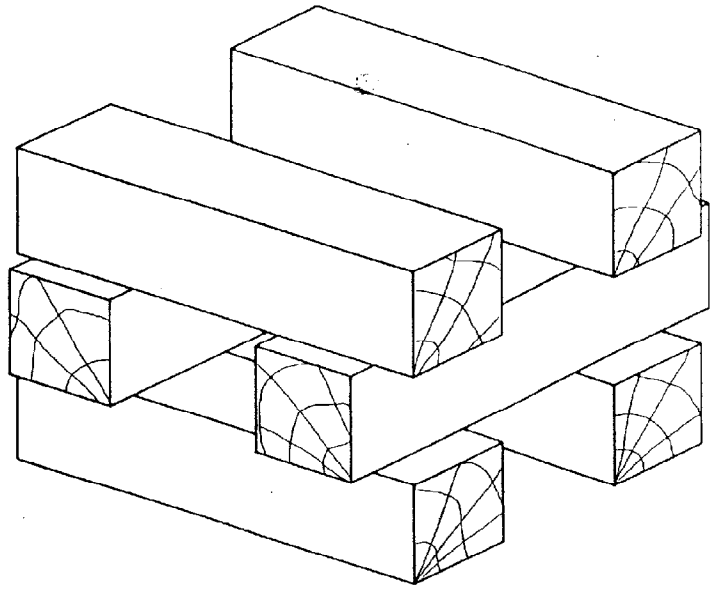


Figure 4. Wooden blocks as used in practical performance test

Adjust the breathing machine to operate at 25 cycles/min and 2 l/stroke.

With the breathing machine not operating, connect a flow measuring device to the outlet of the pressure reducer safety valve and supply air to the medium pressure side of the pressure reducer. Increase the air supply pressure slowly until an air flow of 400 l/min passes through the pressure reducer safety valve. When this condition has been established switch the breathing machine on and measure the breathing resistance at the appropriate pressure sample point.

7.10 Resistance to kinking of compressed air supply tube

Apply the minimum designed supply pressure to the supply end of the tube and ensure that the continuous flow valve, if fitted, is fully open. Connect a means of measuring air flow to the tube.

Figures 6 and 7 show the principle of the test and an outline of an apparatus that has proved satisfactory for this test.

Place a length of the tube on a horizontal surface and shape into a one-loop coil of (300 ± 10) mm diameter.

Pull the ends of the loop tangentially to the loop and in the plane of the loop until the tube takes the form of a straight line. It may be convenient to clamp one end of the loop and pull the other.

Observe the manner in which the tube unfolds and measure the air flow as it is unfolded.

7.11 Resistance to collapse of compressed air supply tube

7.11.1 ***Principle***

A specified air flow is passed through the compressed air supply tube, a specified load is applied to the tube and the change in air flow measured.

7.11.2 ***Apparatus***

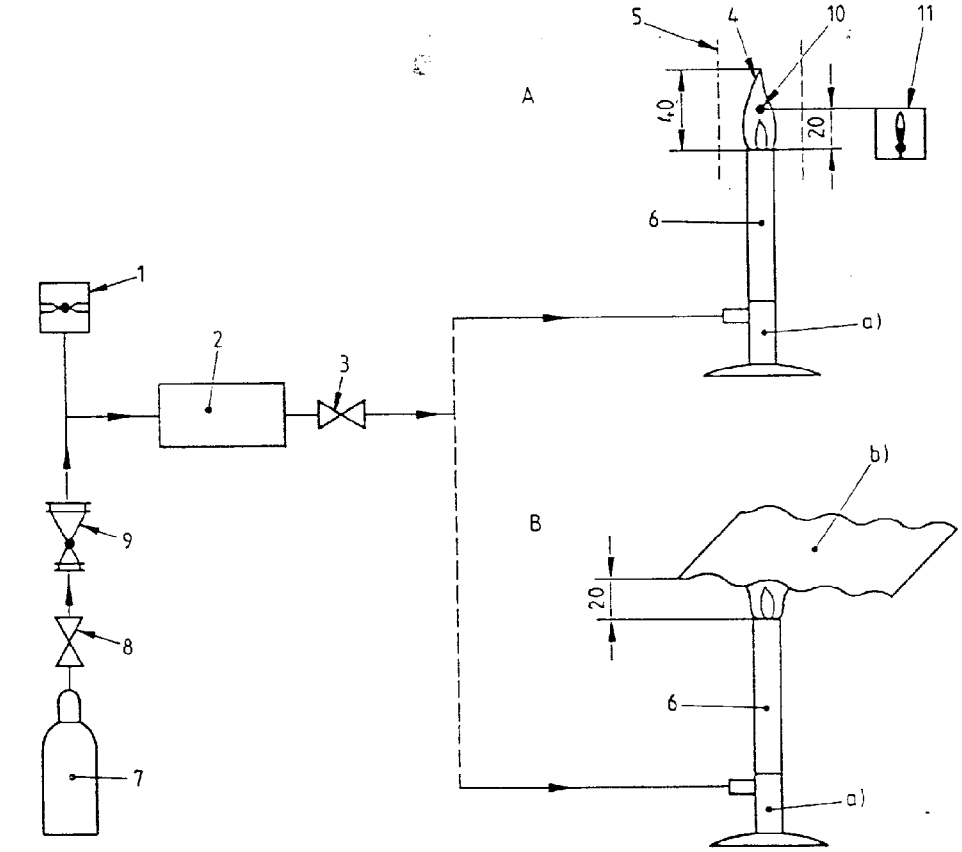
7.11.2.1 *Two metal plates*, 100 mm square, or circular with a diameter of 100 mm and a thickness of at least 10 mm. One plate is fixed and the other capable of moving at right angles to the plane of the plates. The moving plate is capable of being loaded to provide a total force of 1000 N applied between the plates (see figure 8).

7.11.2.2 *Flowmeter.*

7.11.3 ***Procedure***

Place the compressed air supply tube centrally between the two plates and pass the manufacturer's designed air flow or 120 l/min, whichever is the lesser through the tube. Record the flow.

Apply a force of 1000 N (which includes that due to the moveable plate itself) to the moveable plate and measure the air flow again.



All dimensions in millimetres.

A Measurement of flame temperature
B Material sample under test

1 Pressure gauge
2 Flash back arrester
3 Flow control device
4 Flame
5 Shield
6 Burner
7 Propane cylinder
8 Valve
9 Pressure regulator
10 Thermocouple
11 Temperature measuring device

a) Air valve closed
b) Material under test

Figure 5. Arrangement for testing flammability

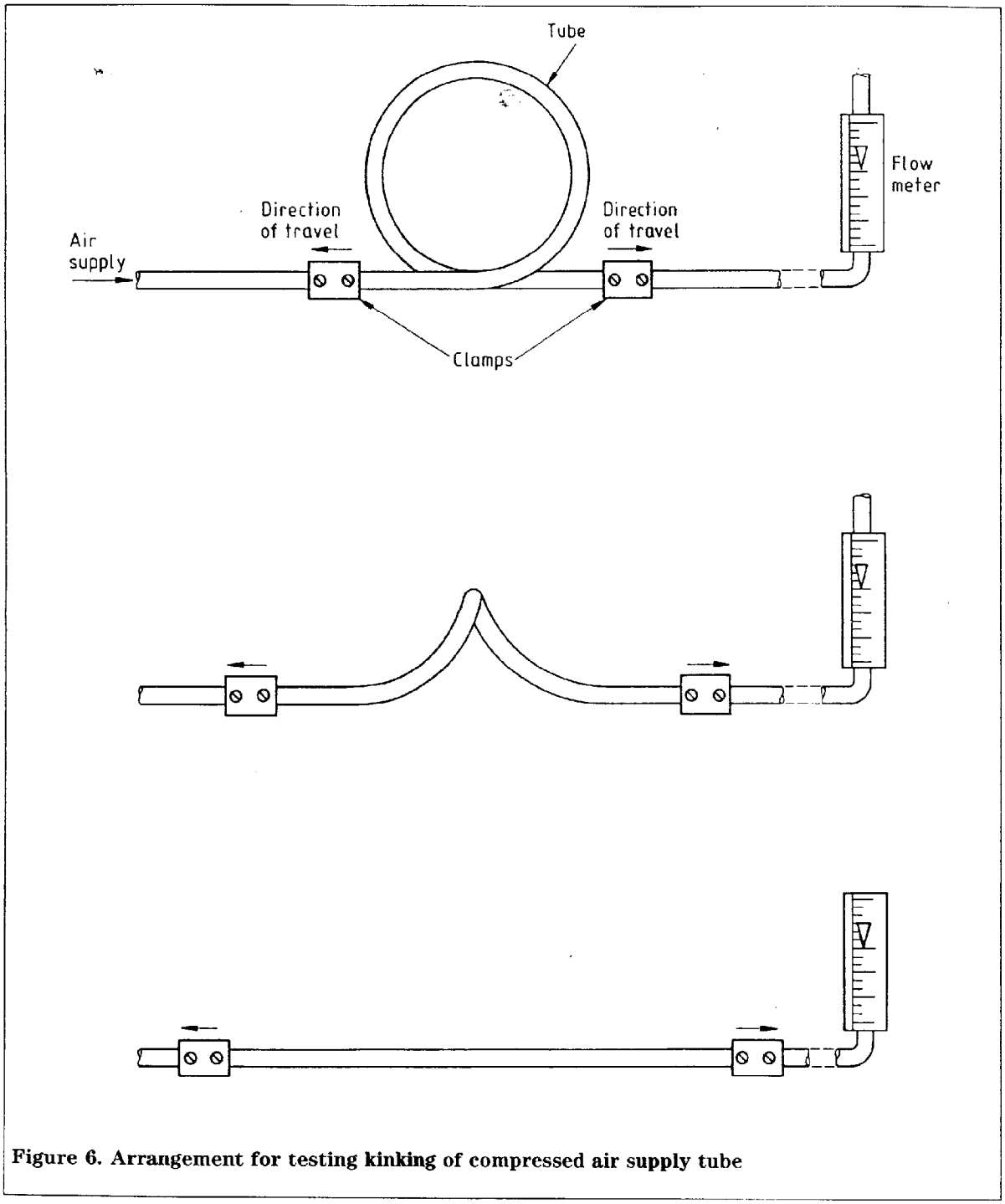


Figure 6. Arrangement for testing kinking of compressed air supply tube

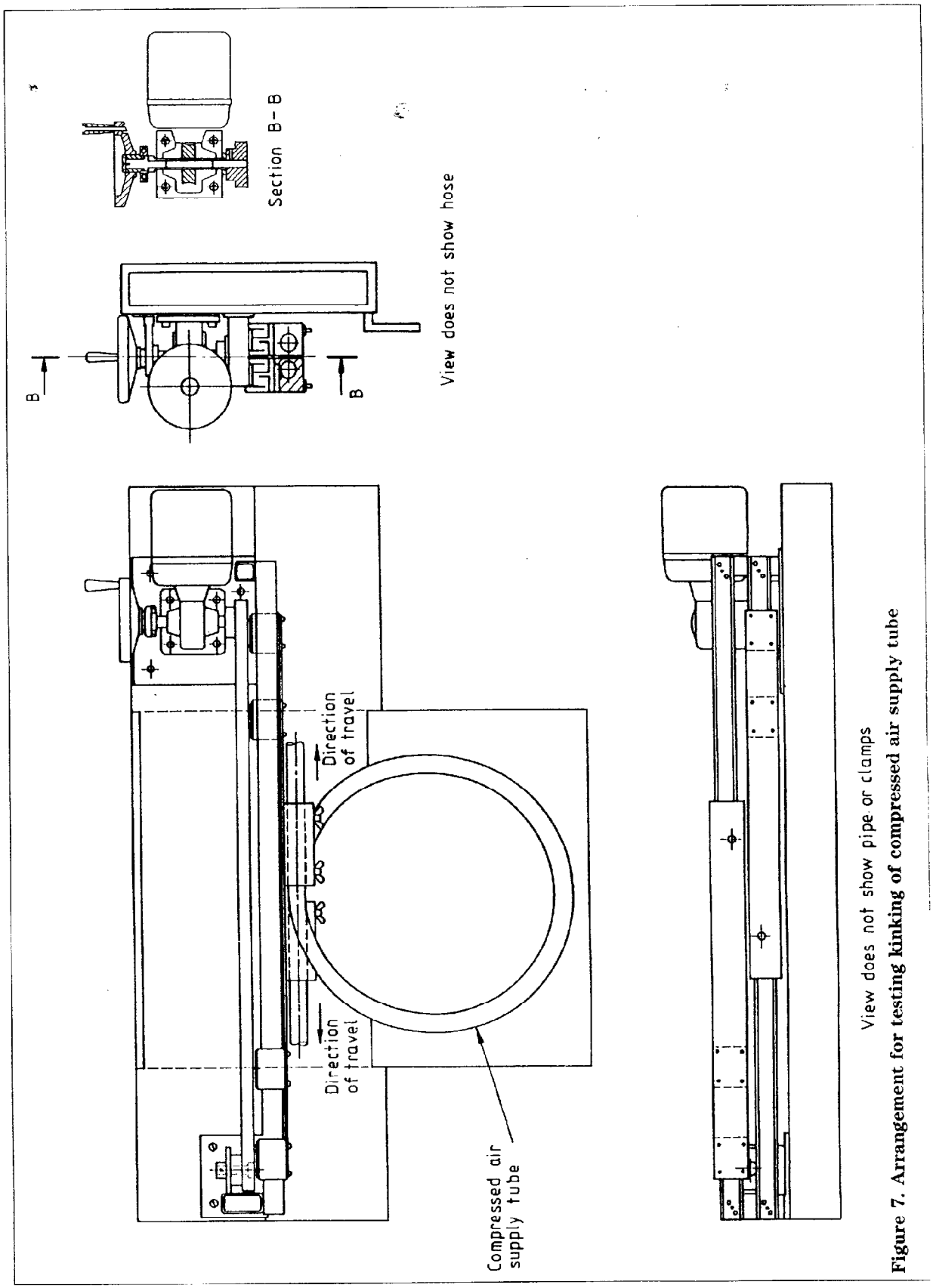
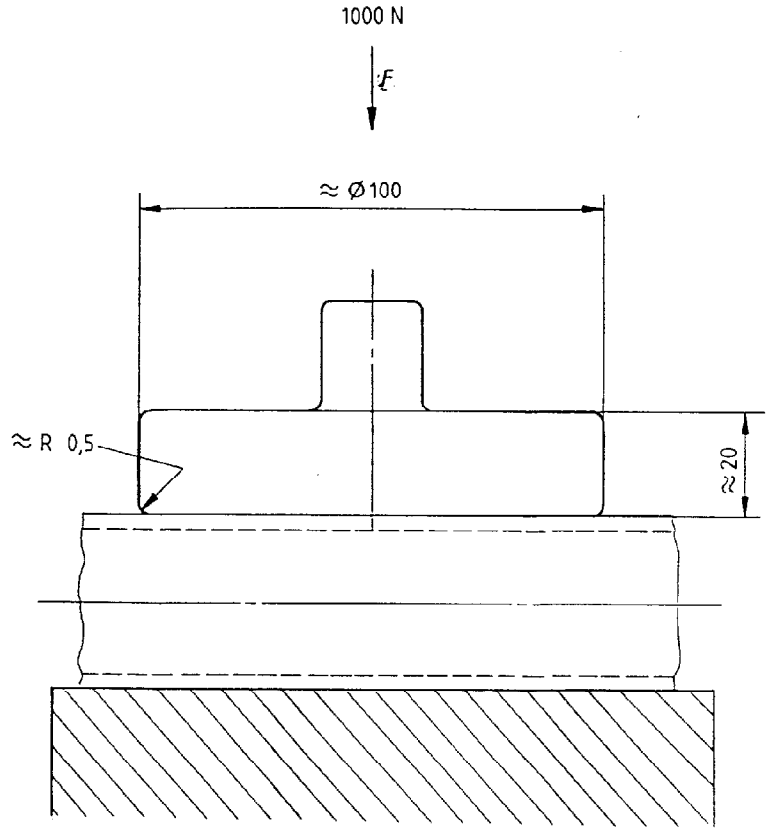


Figure 7. Arrangement for testing kinking of compressed air supply tube



All dimensions in millimetres.

Figure 8. Arrangement for testing collapse of compressed air supply tube

7.12 Heat resistance of compressed air supply tube

With the compressed air supply tube at maximum working pressure demand valve apparatus is tested on a breathing machine at 25 cycles/min and 2 l/stroke and continuous flow apparatus with the flow control valve set at the minimum flow rate. Approximately 100 mm of the compressed air supply tube is placed in contact with a hot plate maintained at (130 ± 15) ° C and a further part immersed in boiling water.

After 15 min remove the compressed air supply tube from the hot plate and the boiling water, examine for signs of damage and check that the quality of the air passing through the hose has not been significantly affected.

7.13 Overflow valve

A negative pressure of 10,0 mbar is maintained under the valve and the overflow valve is considered to be leaktight if the pressure does not change by more than 1 mbar in 1 min. A volume of 500 ml shall be maintained under the valve.

7.14 Exhalation valve leakage

7.14.1 *Apparatus*

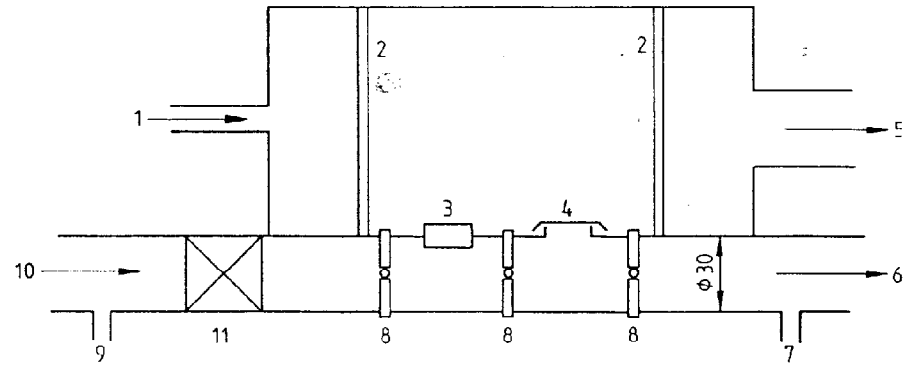
a) *a small volume (volume: 1 to 1,2l) leaktight box* attached to a tube with opening(s) between the box and tube in which the valve assemblies are mounted in suitable adaptors of low dead space (see figure 9). There are baffle plates in the box to promote smooth tracer gas flow (100 l/min continuous flow);

b) *a breathing machine* delivering sinusoidal air flows corresponding to 20 cycles/min and 1,5 l/stroke;

c) *a supply of sulfur hexafluoride* or other suitable tracer gas;

d) *a unit to saturate the air* with water vapour at 37 °C;

e) *an instrument capable of measuring tracer gas concentrations.*



All dimensions in millimetres

1 Test gas in
2 Baffle plate
3 Blanking plate
4 Valve under test
5 Test gas out
6 To breathing machine
7 Test gas sample
8 Pressure measurment port
9 Reference gas sample
10 Saturated gas in
11 Non-return valve

Figure 9. Box for testing exhalation valve leakage

7.14.2 *Procedure*

All the exhalation valve assemblies attached to the facepiece are tested.

The test is performed at ambient temperature and relative humidity. The valve assemblies under test are fitted into the box with a suitable adaptor in a vertical position. The components are arranged according to whether a single or twin cylinder breathing machine is to be used (see figures 10 and 11).

The inlet valve is adjusted so that the back pressure of the valve(s) is 1 mbar to 1,5 mbar at 30 l/min continuous flow.

The breathing machine is set at 20 cycles/min, 1,5 l/stroke. A flow of tracer gas is maintained through the box. Samples of the air from before and after the valve assemblies are continuously analysed for tracer gas concentrations.

The test is run for a sufficient time to obtain a steady reading of the tracer gas concentration in the inspiratory air stream.

The difference in the tracer gas concentrations between the two samples is a measure of the total valve leakage.

8 Marking

8.1 All units of the same model shall be provided with a type identifying marking. Sub-assemblies and piece parts with considerable bearing on safety shall be marked so that they can be identified. The manufacturer shall be identified by name, trademark or other means of identification.

8.2 Where the reliable performance of piece parts may be affected by ageing, the date (at least the year) of manufacture shall be marked. For parts which cannot be marked the relevant information shall be included in the instructions for use.

8.3 The compressed air supply tube shall be marked with:

8.3.1 if appropriate 'heat resistant';

8.3.2 if appropriate 'antistatic';

8.3.3 year of manufacture;

8.3.4 manufacturer's name, trade mark or other means of identification.

8.4 The apparatus shall be marked with:

8.4.1 the serial number;

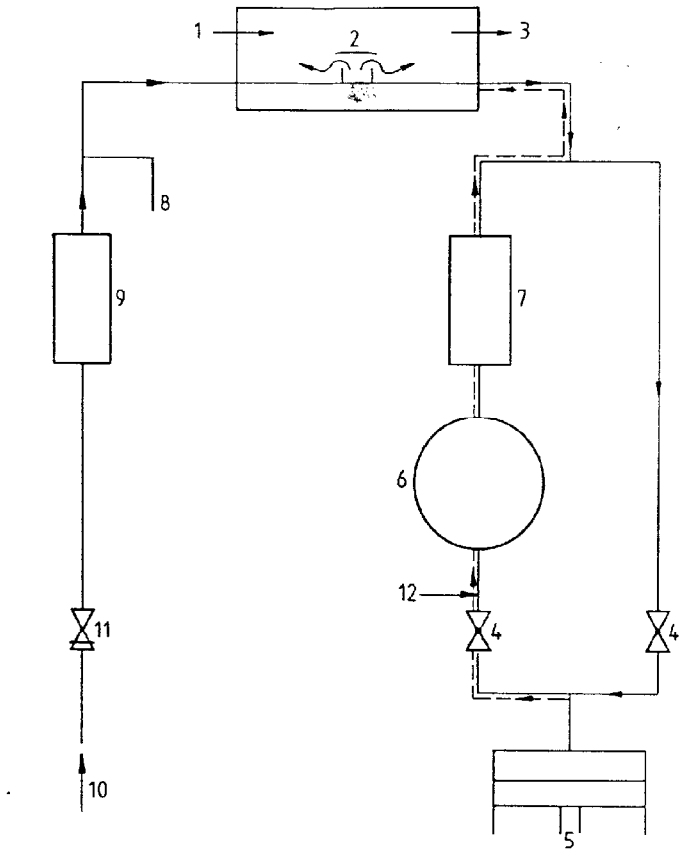
8.4.2 the number of this European Standard;

8.4.3 the temperatures the apparatus is designed to withstand if different from those in this standard;

8.4.4 year of manufacture;

8.4.5 manufacturer's name, trade mark or other means of identification.

8.5 The marking shall be as clearly visible and as durable as possible.



1 Test gas in
2 Valve under test
3 Test gas out
4 Breathing machine valve
5 Breathing machine
6 Saturator
7 Purifier
8 Reference gas sample
9 Purifier
10 Laboratory air in
11 Adjustable non-return valve
12 Test gas sample

Figure 10. Arrangement for testing exhalation valve leakage using a single cylinder breathing machine

9 Instructions for use

9.1 Instructions for use in the official language(s) of the country of application shall accompany every apparatus on delivery enabling trained and qualified persons to use it. These instructions shall comprise the range of application and instructions necessary for correct fitting, care, maintenance and storage.

It is recommended that maintenance instructions be provided separately to instructions for use.

9.2 Other instructions shall comprise:

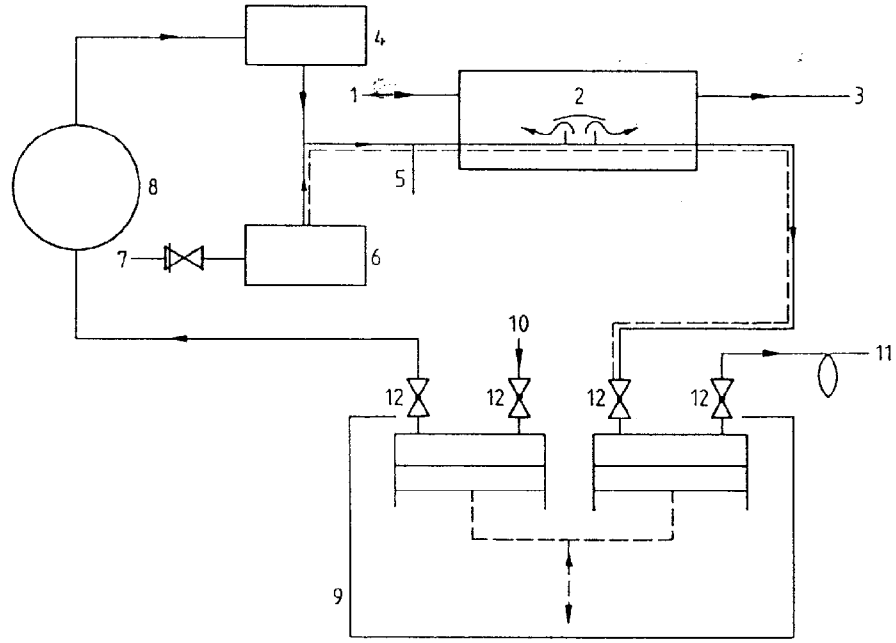
9.2.1 Correct selection and fitting of the facepiece.

Depending on the type of facepiece it is unlikely that the requirement for leakage will be met by wearers with beards or with spectacles having side arms.

9.2.2 Whether or not designed for use in low or high temperature.

9.2.3 The maximum length of compressed air supply tube.

9.2.4 The pressure range of the air supply to the apparatus.



1 Test gas in
2 Valve under test
3 Test gas out
4 Purifier
5 Reference gas sample
6 Purifier
7 Laboratory air in through non-return valve
8 Saturator
9 Twin cyclinder breathing machine
10 Laboratory air in
11 Test gas sample
12 Breathing machine valve

Figure 11. Arrangement for testing exhalation valve leakage using a twin cylinder breathing machine

9.2.5 The working pressure of the compressed air supply tube.

9.2.6 The maximum and minimum flow in l/min of the air supply to the apparatus.

9.2.7 Where appropriate a warning that adequate protection may not be provided by the apparatus in certain highly toxic atmospheres.

9.2.8 A warning that at very high work rates the pressure in the full face mask or half mask may become negative at peak inhalation flow.

9.2.9 A warning concerning the need to ensure the purity of the breathable air.

9.2.10 A warning against excessive moisture of the breathable air to the effect that when apparatus is to be used in temperatures below 4 °C the moisture content of the breathing air should be controlled to avoid it freezing the apparatus.

9.2.11 A warning against the use of oxygen or oxygen enriched air.

9.2.12 A recommendation that the user is advised to check that the supply pressure and flow available are in accordance with the instructions for use.

9.2.13 Suitability of the equipment for use in flammable atmosphere.

9.2.14 Any other information the supplier may care to provide.

Annex A

Recommendations for static and dynamic pressure for apparatus with thread connector in accordance with EN 148-3

A.1 Introduction

This annex is provided for apparatus which may be inadvertently connected to an existing facepiece with an EN 148-3 connector. In the event of inadvertently coupling such facepieces to EN 139 apparatus these additional clauses should ensure safe compatibility. This annex does not imply that apparatus and facepieces which have not been tested and approved as complete apparatus may be used.

A.2 Static pressure

The lung governed demand valve of apparatus designed with a connector according to EN 148-3 shall maintain a static pressure of ≤ 3,9 mbar in the positive pressure mode.

For testing the lung governed demand valve shall be fitted with a cap that can be ventilated and has a port for measuring the pressure using a precision manometer. An airflow of 5 l/min shall be released for a short time. The static pressure shall be measured after the ventilation is shut off.

A.3 Dynamic pressure

A positive pressure shall be maintained when the apparatus is tested with a breathing machine (adjusted to 40 cycles/min, 2,5 l/stroke) at all cylinder pressures above 20 bar.

During the inhalation phase the positive pressure shall not exceed 4,2 mbar.

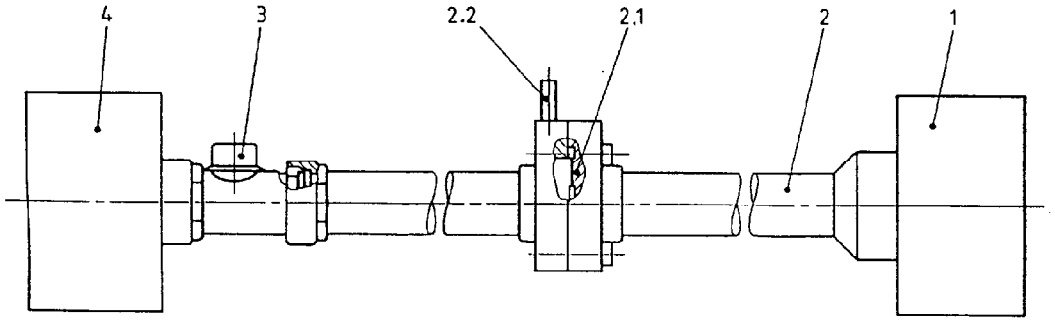
A.4 Exhalation valve

If the lung governed demand valve has an exhalation valve the opening pressure of this exhalation valve shall be at least 4,2 mbar measured at a continuous flow of 10 l/min.

A.5 Testing

A test rig as shown in figure A.1 shall be used.

A breathing machine delivering sinusoidal flow shall be used. The pressure shall be measured at the port near the orifice. The orifice module shall be designed to have a resistance to air flow of 3,5 mbar at a continuous flow of 300 l/min.



1 Respiratory protective device
2 Orifice module
2.1 Orifice
2.2 Measuring port
3 Valve
4 Breathing machine

Figure A.1. Scheme of test rig for dynamic pressure

National annex NA (informative)

Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Personal Safety Equipment Standards Policy Committee (PSM/-) to Technical Committee PSM/14 upon which the following bodies were represented:

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British Coal Corporation
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Ministry of Defence
National Association of Fire Officers
Safety Equipment Distributors' Association
Trades Union Congress
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Coopted member

National annex NB (informative)

Cross-references

Publication referred to	Corresponding British Standard
EN 132 : 1990	BS EN 132 : 1991 *Respiratory protective devices — Definitions*
EN 134 : 1990	BS EN 134 : 1991 *Respiratory protective devices — Nomenclature of components*
EN 136 : 1989	BS 7355 : 1990 *Specification for full face masks for respiratory protective devices*
EN 140 : 1989	BS 7356 : 1990 *Specification for half masks and quarter masks for respiratory protective devices*
EN 142 : 1989	BS 7309 : 1990 *Specification for mouthpiece assemblies for respiratory protective devices*
	BS 7156 *Respiratory protective devices: threads for facepieces*
EN 148-1 : 1987	Part 1 : 1990 *Specification for standard thread connection*
EN 148-2 : 1987	Part 2 : 1990 *Specification for centre thread connection*
EN 148	BS EN 148 *Respiratory protective devices: threads for facepieces* Part 3 : 1992 *Specification for thread connection M 45 × 3*

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to BS EN 139 : 1995

Respiratory protective devices — Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly — Requirements, testing, marking

Correction

Figure 1. Test devices used in the measurement of breathing resistance of apparatus fitted with an overflow valve (applies to apparatus with a standard thread)

In the description of 'Exhalation valve' delete '150 l/min' and substitute '160 l/min'.

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