

British Standard

Breathing apparatus

Part 4. Specification for open-circuit escape breathing apparatus

Appareils respiratoires

Partie 4. Appareils respiratoires à échappement en circuit ouvert — Spécifications

Atemschutzgeräte

Teil 4. Atemschutzgeräte mit Druckluft für Selbstrettung

Foreword

This Part of BS 4667 has been prepared under the direction of the Personal Safety Equipment Standards Policy Committee. It differs from the previous edition in that it includes requirements for open-circuit apparatus only and specifies two types of apparatus covering different levels of arduousness in use.

BS 4667 : Part 5 is to be published shortly and will cover requirements for closed-circuit apparatus.

This Part of BS 4667 together with BS 4667 : Part 5 will supersede BS 4667 : Part 4 : 1982, which will be withdrawn. At the time of publication of this Part of BS 4667 no technically equivalent international standard exists.

This Part of BS 4667 covers two types of open-circuit self-contained breathing apparatus designed for the sole purpose of enabling a person to escape from irrespirable atmospheres.

The breathing apparatus covered by this Part of BS 4667 is never to be used to provide protection in normal work situations and immediately the apparatus is activated wearers are to leave the irrespirable environment. It is essential to ensure that the time required to allow wearers to escape is within the capacity of the apparatus provided. Familiarity with probable hazards and escape routes should be taken into consideration when selecting the type of escape equipment.

For guidance on the type of respiratory protection that should be provided for particular conditions, and its use, see BS 4275. In addition, care should be taken in the choice of escape breathing apparatus where such equipment is to be kept and used in a very high or very low ambient temperature. It should be noted that the duration of the apparatus will be reduced in pressures greater than atmospheric.

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

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Specification

1 Scope

This Part of BS 4667 specifies requirements for the design, construction and performance of two types of open-circuit escape breathing apparatus using a source of compressed air.

Type 1 is for use under hard work conditions such as walking up flights of stairs and running. Type 2 is for use under less arduous conditions such as walking on the level, walking down flights of stairs and climbing a few stairs.

NOTE 1. Type 1 equipment is also suitable for type 2 applications.

NOTE 2. The titles of the publications referred to in this Part of BS 4667 are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 4667 the following definitions apply.

2.1 open-circuit escape breathing apparatus*. Apparatus in which compressed air carried in cylinders, or other approved containers, is fed through a demand valve (or other device that adequately controls the air supply) and breathing tube to a facepiece, hood or mouthpiece and noseclip. The exhaled air passes to the atmosphere. The apparatus is intended for escape purposes only from irrespirable atmospheres.

NOTE. An exhalation valve may be fitted.

2.2 rated duration. The time for which the apparatus will function when tested in accordance with appendix A using a breathing simulator set at a flow rate of 40 L/min for type 1 apparatus and 30 L/min for type 2 apparatus.

2.3 inhaled air. The atmosphere breathed in by the wearer.

2.4 exhaled air. The atmosphere breathed out by the wearer.

3 Materials

3.1 All materials used in the construction of the apparatus shall be such that the procedures described in appendix B can be completed.

3.2 After testing in accordance with appendix C, the materials used in the construction of the facepiece shall not continue to burn nor shall they soften, deform or decompose to such an extent as might interfere with the continued operation of the apparatus.

3.3 If an increased level of resistance to heat and flame is to be claimed, after testing in accordance with appendix D the materials used in the construction of the facepiece shall not continue to burn nor shall they soften, deform or decompose to such an extent as might interfere with the continued operation of the apparatus.

3.4 Exposed parts of the apparatus shall not be made of magnesium, titanium, aluminium or alloys containing such proportions of these metals as will, on impact, give rise to frictional sparks which are capable of igniting flammable gas mixtures.

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

4 Construction

4.1 General

The apparatus shall be designed and constructed to enable the wearer to breathe air on demand from a high pressure air cylinder or other approved container (see 5.10.1) via either a lung-governed demand valve or another device that adequately controls the air supply and is connected to a facepiece, hood or mouthpiece. The exhaled air shall pass from the facepiece, hood or mouthpiece either via an exhalation valve or directly to the atmosphere.

4.2 Strength

The apparatus shall show no signs of damage likely to affect its performance after testing in accordance with appendix B.

4.3 Resistance to water

The apparatus shall continue to function while submerged in water (but not fitted to a wearer) to a depth of 1 m and thereafter until the air in the cylinders or other approved containers is exhausted.

4.4 Separation of parts

NOTE. The component parts of the apparatus should be capable of being separated easily, preferably by hand, for cleaning, examination and testing during routine maintenance.

Any means for sealing used shall be retained in position when the joints and couplings are disconnected during normal maintenance.

4.5 Adjustable parts

All parts requiring manipulation by the wearer shall be accessible and distinguishable from one another by touch, as assessed by the wearers in the tests described in appendix B. All adjustable parts and controls shall be constructed so that their adjustment does not change during the tests described in appendix B.

4.6 High pressure tubes and couplings

High pressure tubes and couplings shall be capable of withstanding a pressure of twice the maximum designed working pressure. It shall not be possible to fit low pressure components into a part of the circuit that operates at a higher pressure.

5 Performance

5.1 Facepiece

5.1.1 General. Where facepieces are used they shall comply with 5.1.2 to 5.1.4.

* Referred to as 'apparatus' in this Part of BS 4667.

5.1.2 Inward leakage. When tested in accordance with appendix E, the inward leakage of the test contaminant shall not exceed 0.05 % of the inhaled air for any of the 10 test subjects.

NOTE. It is unlikely that this requirement will be met by test subjects who have beards or who wear spectacles with side arms.

5.1.3 Vision. If applicable, the manufacturer shall provide means to reduce misting of the eyepieces or eyeshields so that vision is not impaired when the apparatus is tested in accordance with appendix B.

5.1.4 Securing of facepiece. The facepiece shall be secured to the face by means of a head harness that complies with 5.2.

5.2 Head harness

The head harness shall be simple to fit, as assessed by the tests described in appendix B, and capable of easy cleaning and decontamination.

5.3 Hood

5.3.1 General. If hoods are used they shall comply with 5.3.2 to 5.3.4.

5.3.2 Coverage and vision. A hood shall cover the head and neck and shall have a transparent area giving a good forward view.

5.3.3 Inward leakage. The inward leakage of the test contaminant shall not exceed 0.05 % of the inhaled air for any one of the 10 test subjects when the apparatus is tested in accordance with appendix E.

5.3.4 Effect on vision. The manufacturer shall provide means to reduce misting of the hood so that vision is not impaired when the apparatus is tested in accordance with appendix B.

5.4 Mouthpiece

If the apparatus is fitted with a mouthpiece, it shall be designed to provide a seal with the mouth as assessed in the tests described in appendix B.

5.5 Noseclip

A noseclip shall be provided if a mouthpiece is used. The noseclip shall not slip when the nose becomes moist with perspiration and means shall be provided for attaching it to the apparatus.

5.6 Supporting harness

The supporting harness shall be designed to allow the user to don the apparatus quickly, easily and securely without assistance, as assessed in the tests described in appendix B.

5.7 Valves other than main valve

5.7.1 Exhalation valve. If the apparatus is provided with an exhalation valve, the valve shall allow the escape of exhaled air and of any excess air delivered by the air supply and it shall be operated automatically by the pressure in the breathing circuit.

The exhalation valve shall be designed so that inward leakage of the external atmosphere shall not exceed 0.0025 % when the valve is moist and is tested in accordance with appendix F.

The valve shall be protected against dirt and mechanical damage.

NOTE. The design of exhalation valve assemblies should be such that the valve discs or valve assemblies may be easily replaced.

5.7.2 Demand valve

5.7.2.1 Without positive pressure. The opening pressure of the lung-governed supply mechanism, measured at a constant air flow rate of 10 L/min, shall not exceed 3.5 mbar* at all cylinder pressures above 50 bar.

5.7.2.2 With positive pressure. The demand valve shall operate such that the minimum facepiece or hood cavity pressure shall be not less than 0 mbar at a sinusoidal air flow rate of 80 L/min (2.5 L tidal volume x 32 respirations per minute) at all cylinder pressures above 50 bar when tested in accordance with appendix A using the conditions given in A.3(c).

5.8 Flexible hoses and tubes

During the practical performance tests described in appendix B, any flexible hose or tube connected to the facepiece, hood or mouthpiece shall permit free head movement, and if it passes under the chin or arm any resultant pressure on the hose shall not restrict or close off the air supply.

5.9 Pressure indicator

A pressure indicator incorporating a suitable blow-out release shall be provided such that in the event of an explosion or fracture of the pressure elements of the indicator, the explosion will be away from the front of the wearer. If a window is incorporated in the pressure indicator, it shall be of non-splintering glass or clear plastics material. A restrictor shall be provided so that if the indicator is damaged, the outflow of air at full cylinder pressure shall not exceed a rate of 30 L/min.

The pressure indicator shall function independently of the action of the cylinder valve at all times.

5.10 Gas cylinders and main valve

5.10.1 General. Gas cylinders shall comply with BS 5045 : Part 1 or shall have a comparable performance (see note 1).

NOTE 1. In practice, comparable cylinders have to be approved by the Health and Safety Executive and this may involve restrictions on application.

NOTE 2. For marine use the storage capacity of the cylinder or cylinders attached to the apparatus should be at least 400 L of free air.

5.10.2 Colour. Cylinders shall be coloured as specified in BS 1319.

5.10.3 Main valve. If fitted, the main valve shall comply with BS 341 : Part 2 except that the main valve thread shall be appropriate to any other cylinder valve thread that

* 1 mbar = 100 N/m² = 100 Pa.

may be used, as permitted by other specifications referred to in 5.10.1. The main valve shall be so designed that the full pressure in the gas cylinder can not be applied rapidly to other parts of the apparatus.

The valve shall be so designed that the valve spindle can not be completely removed from the assembly during normal operation of the valve.

The valve shall be either lockable in the open position or designed so that it can not be closed inadvertently by contact with a surface.

5.11 Containers

If supplied in a container intended for storage, the apparatus shall be easily removable from it, as assessed by the tests described in appendix B.

5.12 Duration

All apparatus shall have a rated duration of not less than 5 min when tested in accordance with appendix A.

NOTE. A minute volume of 40 L is appropriate to the work rate of a man walking at a steady speed of 6.5 km/h for type 1 and a minute volume of 30 L is appropriate to the work rate of a man walking at a steady speed of 5.5 km/h for type 2. In practice, the time for which protection is afforded may be longer or shorter than the rated duration and will depend upon the work rate, stress level and physical characteristics of the wearer.

5.13 Condition of the inhaled air

5.13.1 Oxygen content. When the apparatus is tested in accordance with appendix A under the conditions given in A.3(a) or A.3(b), as appropriate, and A.3(c), the oxygen content of the inhaled air shall not fall below 17 % (by volume).

5.13.2 Carbon dioxide content. The maximum carbon dioxide content of the inhaled air throughout the rated duration shall not exceed the value corresponding to the rated duration of the apparatus as shown in figure 1, when tested in accordance with appendix A under the conditions given in A.3(a) or A.3(b) as appropriate.

5.14 Resistance to breathing

5.14.1 Without positive pressure. Neither the inspiratory side nor the expiratory side of the circuit shall have a dynamic resistance greater than 6 mbar when tested in accordance with appendix A under the conditions given in A.3(a) or A.3(b) as appropriate.

5.14.2 With positive pressure. The expiratory side of the circuit shall have a dynamic resistance not greater than that indicated by a straight line joining a value of 6 mbar at zero flow to a value of 9 mbar at a sinusoidal air flow rate of 80 L/min when tested in accordance with appendix A under the conditions given in A.3(c).

5.15 Comfort

The apparatus shall be such that it can be worn without discomfort and with little impediment to movement when tested in accordance with appendix B.

5.16 Low temperature performance

There shall be no malfunction or deterioration in performance of the apparatus when it is tested in accordance with appendix G.

5.17 Performance at high flow rates

There shall be no malfunction of the apparatus when it is tested in accordance with appendix A under the conditions given in A.3(d).

6 Use in conjunction with a compressed air line

If an air line is to be used with this type of apparatus, the apparatus shall be provided with a leak-tight non-return valve and connector and shall comply with BS 4667 : Part 3. If more than one apparatus is connected to the air line, the air flows available to each demand valve through the maximum length of air line supplied shall comply with 3.6.3 of BS 4667 : Part 2 : 1974.

7 Instructions

All apparatus shall be supplied with dated instructions for storage, maintenance and use, which shall include the following where appropriate:

- (a) the rated duration;
- (b) guidance on donning and use;
- (c) a warning that adequate protection may not be provided by the apparatus in some circumstances with certain highly toxic atmospheres and that guidance should be sought from BS 4275;
- (d) a warning that allowance should be made for the fact that it is likely that the face seal fit of the facepiece will be adversely affected if the user wears spectacles or has sideburns or a beard.

8 Marking

All apparatus shall be visibly marked with the following information:

- (a) the name, trade mark or other means of identification of the manufacturer;
 - (b) the number and date of this British Standard, i.e. BS 4667 : Part 4 : 1989*;
 - (c) the year of manufacture;
 - (d) the rated duration of the apparatus;
- NOTE. This is not required for marine use.
- (e) the type number;
 - (f) if appropriate, i.e. where an increased level of resistance to heat and flame is claimed, an indication that the apparatus has been tested in accordance with appendix D and has complied with 3.3;
 - (g) the words 'For escape purposes only'.

* Marking BS 4667 : Part 4 : 1989 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.