

Breathing apparatus

Part 5. Specification for closed-circuit escape breathing apparatus

Appareils respiratoires à échappement en
circuit fermé - Spécifications

Atemschutzgeräte
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Selbstrettung (Regenerationsgeräte)

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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 closed circuit apparatus only and specifies two types of apparatus covering different levels of arduousness in use. BS 4667 : Part 4 covers requirements for open-circuit apparatus.

This Part of BS 4667 together with BS 4667 : Part 4 : 1989 supersedes BS 4667 : Part 4 : 1982, which is withdrawn.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 closed 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 may be reduced in pressures greater than atmospheric. It should also be noted that apparatus giving high inspired oxygen concentrations are not suitable for use in ambient pressures greater than 2.0 atmospheres absolute.

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

Specification

1 Scope

This Part of BS 4667 specifies requirements for the design, construction and performance of two types of closed circuit escape breathing apparatus using a source of compressed oxygen or chemically bound oxygen.

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 level ground, 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 closed circuit escape breathing apparatus¹⁾

Self-contained apparatus in which exhaled air is re-breathed by the wearer after the carbon dioxide concentration has been effectively reduced and the oxygen concentration enriched. It may be used with a facepiece, hood or with a mouthpiece and noseclip. The apparatus is intended for escape purposes only from irrespirable atmospheres.

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

NOTE. It is important that particular care is taken in selecting materials that may come into contact with high pressure oxygen.

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 apparatus 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 apparatus 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 so that exhaled air passes from a facepiece, hood or mouthpiece, into the breathing circuit where it is purified, fresh oxygen is added to the air and returned to the wearer via a breathing bag.

NOTE 1. In the compressed oxygen type chemicals in the canister absorb the exhaled carbon dioxide, and fresh oxygen is supplied to the breathing circuit.

NOTE 2. In the chemical oxygen type chemicals in the canister react with the exhaled carbon dioxide and moisture to produce oxygen.

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 contents of the cylinders or other approved containers is exhausted.

NOTE. Some deflation of the breathing bag may occur due to the automatic opening of the relief valve. Care should therefore be taken in the siting of the relief valve to ensure that complete deflation of the breathing bag cannot occur.

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.

¹⁾ Referred to as 'apparatus' in this Part of BS 4667.

4.5 Adjustable parts

All parts requiring manipulation by the wearer shall be accessible and distinguishable from one another by touch as assessed by test subjects in the tests described in appendix B. All adjustable parts and controls shall be constructed so that their adjustment does not change during the practical performance 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 5.1.5.

5.1.2 Complete apparatus leakage

The complete apparatus shall withstand a test at an air pressure of 10 mbar¹⁾ and shall not show a pressure drop greater than 0.5 mbar¹⁾ in one minute. For this test, the relief valve, if fitted, shall be sealed (see 5.7.2).

5.1.3 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 with test subjects who have beards or who wear spectacles with side arms.

5.1.4 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.

5.1.5 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

Any 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 Inhalation and exhalation valves

It shall not be possible to fit inhalation and exhalation valves in an incorrect way.

5.7.2 Relief valve

If the apparatus is fitted with a relief valve operated automatically by the pressure in the breathing circuit it shall be so designed that the 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 relief valve shall be protected against dirt and mechanical damage. Means shall be provided for sealing the relief valve to permit leak testing if required during normal maintenance and/or during testing for compliance with 5.1.2.

5.8 Flexible hoses and tubes

During the tests described in appendix B, any flexible hose or tube connected to the facepiece 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.

¹⁾ 1 mbar = 100 N/m² = 0.1 kPa.

5.9 Pressure indicator

Apparatus to which compressed oxygen is supplied from a cylinder shall have a pressure indicator incorporating a suitable blow-out release so 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 of a clear plastics material. A restrictor shall be fitted so that if the indicator is damaged, the outflow of gas at full cylinder pressure shall not exceed a rate of 10 L/min.

The pressure of the gas in the cylinder shall be indicated at all times prior to use.

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 or shall be approved by the Health and Safety Executive.

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

5.10.2 Colour

Cylinders shall be coloured as specified in BS 1319.

5.10.3 Main valve

If fitted the main valve shall be so designed that the valve spindle cannot be completely removed from the assembly during normal operation of the valve.

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

5.11 Breathing bag

5.11.1 The breathing bag shall be securely joined to the couplings. The coupling at the inhalation side shall be shaped in such a way that its opening cannot be closed by the bag itself.

5.11.2 When the apparatus is ready for use the capacity of the breathing bag shall be at least 4L.

5.12 Containers

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

NOTE. This type of apparatus is likely to be stored, ready for use, over a considerable period of time. In order to prevent any deterioration of the performance storage should be strictly in accordance with the manufacturer's instructions.

5.13 Rated duration

All apparatus shall have a rated duration (see 2.2) of not less than 5 min when tested in accordance with appendix A under the conditions in A.4 (a) and A.4 (b) as appropriate.

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 the physical characteristics of the wearer.

5.14 Condition of the inhaled air

5.14.1 Oxygen content

When the apparatus is tested in accordance with appendix A under the conditions given in A.4 (a) or A.4 (b), as appropriate, and A.4 (c), the oxygen content of the inhaled air shall not fall below 17 % (by volume).

5.14.2 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.4 (a) or A.4 (b) as appropriate.

5.14.3 Temperature

The wet bulb and dry bulb temperatures of the inhaled air shall not exceed 50 °C and 90 °C respectively when tested in accordance with appendix A under the conditions given in A.4 (a) or A.4 (b) as appropriate.

5.15 Resistance to breathing

Neither the inspiratory side nor the expiratory side of the circuit shall have a dynamic resistance greater than 6.5 mbar when tested in accordance with appendix A under the conditions given in A.4 (a) or A.4 (b) as appropriate.

5.16 Comfort

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

5.17 Low temperature performance

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

5.18 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.4 (d).