

BS 8468-3.2:2009



BSI Standards Publication

Respiratory protective devices for use against chemical, biological, radiological and nuclear (CBRN) agents –

Part 3.2: Air-purifying devices incorporating
a hood for escape – Specification

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 28, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 8468 is published by BSI and came into effect on 30 November 2009. It was prepared by Technical Committee PH/4, *Respiratory protection*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

When finished, BS 8468 will be issued in nine parts:

- *Part 1: Positive pressure, self-contained breathing apparatus – Specification;*
- *Part 2: Negative pressure air purifying devices with full face mask – Specification;*
- *Part 3.1: Self-contained open-circuit compressed air breathing apparatus incorporating a hood for escape – Specification;*
- *Part 3.2: Air-purifying devices incorporating a hood for escape – Specification;*
- *Part 4: Powered air-purifying respirators – Specification;*
- *Part 5: Dual-mode apparatus – Specification;*
- *Part 6.1: Positive-pressure compressed airline equipment – Specification;*
- *Part 6.2: Constant-flow compressed airline equipment – Specification;*
- *Part 7: Closed-circuit breathing apparatus – Specification.*

Information about this document

Recent changes in international politics have given rise to a threat from weapons previously expected to be confined to military operations. In the event that they are used against civilian targets, emergency and support agencies will need suitable PPE.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This standard applies to air-purifying devices incorporating a hood intended to be used only during escape by emergency responders (e.g. fire, ambulance, police) and adult civilians from areas contaminated by chemical, biological, radiological and nuclear (CBRN) agents. It contains requirements for designation, classification, testing and marking of the device.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 132, *Respiratory protective devices – Definitions of terms and pictograms*

BS EN 134, *Respiratory protective devices – Nomenclature of components*

BS EN 403:2004, *Respiratory protective devices for self-rescue – Filtering devices with hood for escape from fire – Requirements, testing, marking*

BS EN 13274-4:2001, *Respiratory protective devices – Methods of test – Part 4: Flame tests*

3 Terms and definitions

For the purpose of this British Standard the terms and definitions defined in BS EN 132, BS EN 134 and the following apply.

3.1 bulk packaging

packaging supplied by the manufacturer, which can include outer packaging to protect singles or multiples of the product in transit and in supply chain storage

3.2 hood

respiratory interface that completely covers the head and neck and may also cover portions of the shoulders and torso

NOTE This definition is to be used in preference to the one given in BS EN 132.

3.3 operational packaging

final containment of the device in a portable or “stored ready to use” state, from which it is removed in order to don

4 Description

Air-purifying devices incorporating a hood are designed and constructed to enable the wearer to breathe ambient air via a filter(s). The hood covers at least the head and neck. The exhaled air passes without re-circulation from the hood via an exhalation valve(s) or other outlet to the ambient atmosphere.

A complete device consists of a hood with combined filter(s) and, if necessary, suitable packaging. It is not intended that any disassembly or assembly be carried out by the user, although the device might need to be unpacked or unfolded.

The device can be a hood, or a hood incorporating a full face mask, half mask, quarter mask or mouthpiece assembly. The combined filter(s) is integral/attached to the device and is not replaceable without tools.

5 Classification

5.1 Classification by suitability for escape from fire

Two types of air-purifying device incorporating a hood are described in this standard:

- a) Type 1: a device for escape from a CBRN incident that does not include escape from fire; and
- b) Type 2: a device for escape from a CBRN incident that could include escape from fire.

5.2 Classification in terms of rated duration

Air-purifying escape devices incorporating a hood are classified in accordance with the rated duration specified by the manufacturer and BS EN 403:2004, Clause 5.

The manufacturer's specified rated duration dictates the minimum filter breakthrough times that have to be achieved, as follows.

- a) Class 15 CBRN – with filter breakthrough time greater than or equal to 15 min;
- b) Class 30 CBRN – with filter breakthrough time greater than or equal to 30 min;
- c) Class 45 CBRN – with filter breakthrough time greater than or equal to 45 min; and
- d) Class 60 CBRN – with filter breakthrough time greater than or equal to 60 min.

Rated durations greater than 60 min are specified in 30 min intervals.

6 Requirements

6.1 General

The complete device for use against CBRN agents shall be an air-purifying escape device incorporating a hood conforming to BS EN 403:2004, except for the requirements in BS EN 403:2004, **6.10** and **6.11** for both types and except for the requirements in BS EN 403:2004, **6.14**, **6.19** and **6.21** for Type 1.

The complete device for use against CBRN agents shall also meet the requirements specified in **6.2** to **6.6** of this standard.

Type 1 devices shall also pass the single-burner, moving specimen test, method 3 in BS EN 13274-4:2001.

In all tests, all test samples shall meet the requirements.

6.2 Inward leakage

The maximum inward leakage in the breathing zone shall be 0.05% when tested as a complete system in accordance with BS EN 403:2004 7.6.1 with ten test subjects.

The maximum inward leakage in the ocular zone shall be 0.67% when tested as a complete system in accordance with BS EN 403:2004 7.6.1 with ten test subjects.

6.3 Filters – Gas/vapour element

6.3.1 Test agents – Challenges and breakthrough concentrations

The breakthrough times related to each device class are shown in Table 1.

Table 1 Breakthrough times

Device classification	Filter breakthrough time
Class 15	≥ 15 min
Class 30	≥ 30 min
Class 45	≥ 45 min
Class 60	≥ 60 min
Class 90	≥ 90 min
Class 120	≥ 120 min

NOTE Irrespective of classification, the useful service life of the device will depend on the type and concentration of the contaminant and environmental conditions such as temperature and humidity.

The gas/vapour test challenges and breakthrough concentrations shown in Table 2 shall be used to confirm the device classification. Breakthrough for each gas/vapour test agent shall not occur within the manufacturer's specified rated duration. Three filters shall be tested for each gas/vapour in each test condition, as given in A.4.1, after the complete device has been conditioned in accordance with BS EN 403:2004, 7.4.

6.3.2 High-flow rate test

The high flow rate performance test, in accordance with A.4.2, shall have a duration of not less than five minutes, using the filter test challenge agents and breakthrough concentrations given in Table 2. Breakthrough shall not occur within five minutes.

Table 2 Filter test challenge and test breakthrough concentrations

	Test concentration	Breakthrough concentration
	ppm	ppm
Ammonia	1 250	12.5
Cyanogen chloride	150	2
Cyclohexane	1 300	10
Formaldehyde	250	1
Hydrogen cyanide	470	4.7 ^{A)}
Hydrogen sulfide	500	5.0
Nitrogen dioxide	100	1 (NO ₂) or 25 (NO) ^{B)}
Phosgene	125	1.25
Phosphine	150	0.3
Sulfur dioxide	750	5

^{A)} Sum of HCN and C₂N₂.

^{B)} Nitrogen dioxide breakthrough is monitored for both NO₂ and NO. The breakthrough is determined by which quantity, NO₂ or NO reaches breakthrough first.

6.4 Filters – Particulate element

6.4.1 General

The particle filter shall be on the influent side of the gas/vapour filter. Testing shall be done in accordance with A.5.

6.4.2 Filter penetration

Filters shall meet the requirements for the maximum penetration of each test aerosol as specified in Table 3.

Table 3 Requirements for maximum penetration of test aerosols

Filter class	Maximum filter penetration of test aerosols	
	Sodium chloride test at 95 L/min	Paraffin oil test at 95 L/min
	%	%
P3	0.05	0.05

Three filters shall be tested for each test agent after the complete device has been conditioned in accordance with BS EN 403:2004, 7.4.

Testing shall be done in accordance with A.5.2 and A.5.3.

6.5 Chemical agent permeation and penetration

Devices shall be resistant to chemical agents up to the maximum levels given in Table 4 when tested in accordance with Annex B.

NOTE These levels are based on those given in NIOSH Statement of Standard for CBRN Air-Purifying Escape Respirators [1].

Table 4 Maximum acceptable levels of permeation and penetration

Agent	Maximum acceptable peak excursion ^{C)}	Maximum acceptable breakthrough (concentration integrated over minimum service life) ^{D), E)}
	mg/m ³	mg·min/m ³
Distilled sulfur mustard (HD) (vapour) ^{A)}	0.60	6.0
Distilled sulfur mustard (HD) (liquid) ^{A)}	0.60	6.0
Sarin (GB) (vapour) ^{B)}	0.087	0.9 for durations ≤ 15 min and 30 min 2.1 for durations > 30 min

^{A)} Vapour challenge concentration will start immediately after the liquid drops have been applied and the test chamber has been sealed.
^{B)} Vapour challenge concentration will start immediately after the test chamber has been sealed.
^{C)} Three sequential test data points, with sample times of two minutes, at or above the maximum peak excursion level constitute a failure.
^{D)} The cumulative concentration times test time integral *ct*, including all maximum peak excursion data points cannot be exceeded for the duration of the test. The test period begins upon initial generation of vapour concentration. The duration of the test is twice the identified rated duration.
^{E)} Devices are monitored in the oral/nasal and ocular regions.

6.6 Donning

The time to don the device from the ready-to-use configuration shall be no greater than 30 s.

NOTE The ready-to-use configuration is the operational packaging state prior to use such that immediately upon opening allows the user to don the device.

7 Marking

7.1 General

All the markings shall be legible and durable.

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

7.2 Hood

All hoods shall be marked with:

- the dated number of this standard and classification, e.g. "BS 8468-3.2:2009 type 1 M class 15 CBRN";
- the manufacturer, supplier or importer identified by name, trademark, or other means of identification;
- manufacturer's model designation.

7.3 Filters

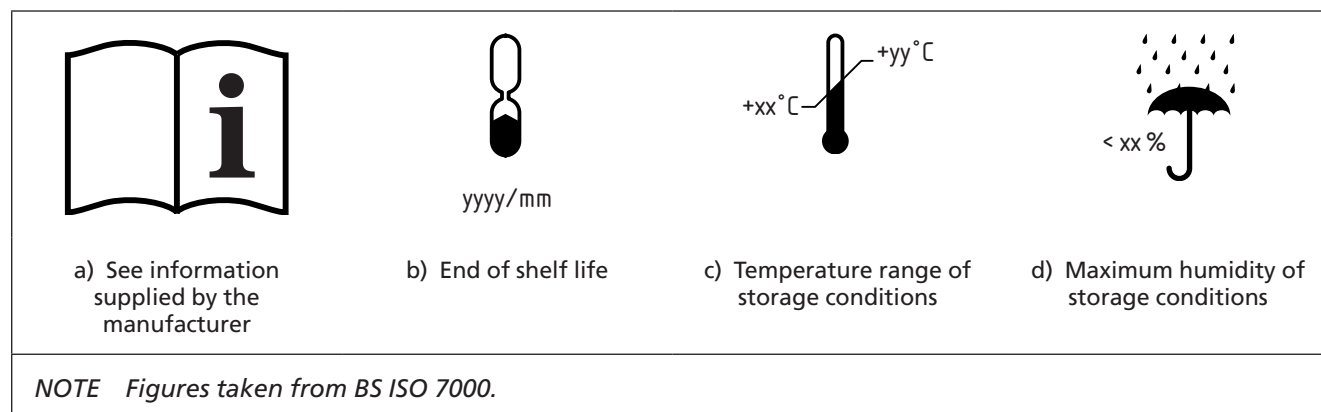
Where filters are attached but are not integral with the hood, they shall be colour coded orange/white (denoting CBRN/particulate).

7.4 Packaging

All packaging (bulk and operational) shall be marked externally with at least the following information.

- a) The dated number of this standard and classification, e.g. "BS 8468-3.2:2009 type 2 S class 30 CBRN".
- b) The manufacturer, supplier or importer identified by name, trademark, or other means of identification.
- c) The manufacturer's model designation.
- d) Date of end of shelf life and (if applicable) date for next inspection; equivalent pictograms, where available, can be used (see Figure 1).
- e) Manufacturer's recommended conditions of storage (at least the temperature and humidity) or equivalent pictogram as shown in Figure 1.
- f) The sentence: "See information supplied by the manufacturer." at least in the official language(s) of the country of destination or the appropriate pictogram as shown in Figure 1.
- g) When the reliable performance of the device might be affected by mass increase, e.g. absorption of humidity, the mass shall be given on the packaging that protects against humidity.
- h) If the device is fitted with a mouthpiece and a nose clip the statement: "Do not speak during use."
- i) The sentence: "For single use only."

Figure 1 Pictograms



8 Information supplied by the manufacturer

8.1 The information supplied shall be in accordance with BS EN 403:2004, and external to the operational packaging.

8.2 The information shall explain the markings listed in Clause 7.

8.3 The information shall include a warning that type 1 devices are not suitable for escape from fire.

8.4 The information shall include the sentence: "For single use."

8.5 The information shall describe suitable procedures for decontamination and disposal.

Annex A (normative) Filter testing**A.1 General**

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

Performance tests for the filters not having a connector in accordance with BS EN 148-1 shall be performed in the filter holder where it will be used in practice.

A.2 Nominal values and tolerances

Unless otherwise specified, the values stated in this standard are expressed as nominal values. Except for temperature limits, values which are not stated as maximum or minimum shall be subject to a tolerance of $\pm 5\%$. Unless otherwise specified, the ambient temperature for testing shall generally be from 16 °C to 32 °C but for the mechanical tests from 10 °C to 30 °C, and the temperature limits shall be subject to an accuracy of ± 1 °C.

A.3 Visual inspection

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

A.4 Gas filter test conditions**A.4.1 Gas capacity test**

Gas capacity tests shall be performed for each of the gases/vapours listed in Table 2 with the agent drawn through the filter(s) at 64 L/min ± 6 L/min and,

- a) a temperature of 25 °C ± 5 °C and a relative humidity of 25% $\pm 5\%$, and
- b) a temperature of 25 °C ± 5 °C and 80% +5/–0% relative humidity.

Challenge concentrations and breakthrough times are given in 6.3.1.

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

A.4.2 High-flow performance test

High-flow performance tests shall be performed with the test agent drawn through the filter(s) at 100 L/min ± 10 L/min, a temperature of 25 °C +5/–0 °C and a relative humidity of 50% $\pm 5\%$ for each of the gases/vapours listed in Table 2.

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