BS 8468-3.2:2020

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

bsi.

Contents

Summary of pages
This document comprises a front cover, and inside front cover, pages i to iv, pages 1 to 9, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 8468 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 August 2020. 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 committee manager.

Supersession

This part of BS 8468 supersedes BS 8468-3.2:2009, which is withdrawn.

Relationship with other publications

BS 8468 is published in the following parts:

- Part 1: *Positive pressure, self-contained, open-circuit 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: *Combined and multi-functional apparatus – Specification*;
- Part 6.1: *Positive-pressure compressed air line equipment – Specification;*
- Part 6.2: *Constant flow compressed air line equipment – Specification;*
- Part 7: *Closed-circuit breathing apparatus – Specification;*
- Part 8: *Test methods.*

This standard can be used in conjunction with BS 8467, which categorizes and specifies requirements and test methods for personal protective ensembles against CBRN agents.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- the test for permeation penetration has been moved to the new BS 8468-8;
- the requirement for inward leakage has been modified; and
- the terms and definitions have been updated.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at bsigroup.com/standards, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Use of this document

It has been assumed in the preparation of this part of BS 8468 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

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.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Requirements in this standard are drafted in accordance with *Rules for the structure and drafting of UK standards*, subclause **G.1.1**, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

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.

THIS PAGE DELIBERATELY LEFT BLANK

1 Scope

This British Standard specifies the requirements for 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.

This British Standard is applicable to Type ES CBRN devices. Type ES CBRN devices provide resistance to liquid and gaseous chemical agent permeation and penetration and provide protection capability against hazardous particulate matter.

This British Standard contains requirements for classification, testing and marking of the device.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document[1)]. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

BS EN 143:2000, *Respiratory protective devices – Particle filters – Requirements, testing, marking*

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*

BS EN ISO 16972, *Respiratory protective devices – Vocabulary and graphical symbols*

3 Terms and definitions

For the purposes of this part of BS 8468, the terms and definitions given in BS EN ISO 16972 and BS EN 134 and the following apply.

3.1 chemical agent

toxic chemical that can be disseminated to cause harm

NOTE Chemical agents include chemical warfare agents and toxic industrial chemicals.

3.2 biological agent

micro-organism that is a pathogen and that has the potential to be used intentionally to cause harm

NOTE Human pathogens are relevant to RPD selection.

3.3 radiological agent

substance that emits ionizing radiation and that could be disseminated to cause harm

3.4 nuclear agent

radioactive matter resulting from a nuclear explosion or accidental release from a nuclear facility

3.5 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

1) Documents that are referred to solely in an informative manner are listed in the Bibliography.

3.6 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

3.7 hood

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

3.8 decontamination

physical and/or chemical process of removing as much contamination as possible from people or equipment

4 Classification

4.1 Classification in terms of suitability for escape from fire

Air-purifying devices incorporating a hood are classified in this British Standard as follows:

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.

4.2 Classification in terms of designated duration

Air-purifying escape devices incorporating a hood are classified in this British Standard in accordance with BS EN 403:2004, Clause **5**, and in terms of filter breakthrough time (t) as follows:

a) ES CBRN 15 – with filter breakthrough time greater than or equal to 15 min and less than 30 min;

b) ES CBRN 30 – with filter breakthrough time greater than or equal to 30 min and less than 45 min;

c) ES CBRN 45 – with filter breakthrough time greater than or equal to 45 min and less than 60 min; and

d) ES CBRN 60 – with filter breakthrough time greater than or equal to 60 min and less than 90 min.

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

5 Requirements

*COMMENTARY ON **CLAUSE 5***

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 is 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.

5.1 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 5.2 to 5.6 of this British Standard.

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

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

5.2 Preconditioning

Samples shall be preconditioned in accordance with BS EN 403:2004, **7.4** prior to visual inspection, testing for inward leakage and chemical agent permeation and penetration.

5.3 Visual inspection

Visual inspection shall be in accordance with BS 8468-8:2020, Clause **6**. A minimum of two samples shall be inspected.

5.4 Inward leakage

The maximum inward leakage in the breathing zone shall be 0.1% when tested as a complete system in accordance with BS EN 403:2004, **7.6.1**, with 10 test subjects, except that the choice of test agent shall be determined in accordance with BS EN 13274-1, **8.1**, according to the requirements for combined filtering devices.

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 10 test subjects, except that the choice of test agent shall be determined in accordance with BS EN 13274-1, **8.1**, according to the requirements for combined filtering devices.

5.5 Filters – Gas/vapour element

5.5.1 Test agents – Challenge concentrations and breakthrough concentrations

Filters for air-purifying devices incorporating a hood shall be classified according to the breakthrough times achieved in the laboratory tests as given in Table 1.

NOTE 1 The device classification, once established through testing, may be termed the Designated Duration (t) of the device. This terminology is used in 5.7, chemical agent permeation and penetration testing.

Table 1 — *Breakthrough times*

Device classification	Filter breakthrough time
ES CBRN 15	≥15 min
ES CBRN 30	≥30 min
ES CBRN 40	≥45 min
ES CBRN 60	≥60 min
ES CBRN 90	≥90 min
ES CBRN 120	≥120 min

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

Three filters shall be tested for each test representative agent (TRA) and against each test condition, as given in **5.5.2.1** after the complete device has been preconditioned in accordance with BS EN 403:2004, **7.4**. The gas/vapour test challenges and breakthrough concentrations shown in Table 2 shall be used to establish the filter breakthrough time and thus classification.

NOTE 2 The TRAs have been chosen to represent families of potential CBRN threat agents.

Irrespective of the device classification, the high-flow rate performance test, in accordance with **5.5.2.2**, shall have a duration of not less than 5 min, using the filter test challenge agents and breakthrough concentrations given in Table 2.

5.5.2 Test conditions

5.5.2.1 Gas capacity test

Gas capacity tests shall be performed with the test agent drawn through the filter at a continuous flow rate of (64 ±1) l/min, both at a temperature of (25 ±2.5) °C and a relatively humidity (RH) of (25 ±5)%, and at a temperature of (25 ±2.5) °C and (80 ±5)% relative humidity.

The breakthrough time achieved shall determine the filter classification.

Specimen orientation shall be such that the gas flows horizontally and in line with the direction of minimum bed depth of the filter. A gas stream shall not directly impact on to the filter face.

NOTE Filters can be tested separately or as part of the complete device. When tested as part of the complete device, it might be necessary to use special techniques to ensure correct sealing and correct filter orientation in the test apparatus.

If it is possible that a single filter of a multiple filter device can be used alone, the requirements of the full flow rate for the tests, as stated in this British Standard, shall be met.

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. If the filters' breathing resistances meet Formula (1), the filter may be tested as a single filter with a proportioned flow.

$$\frac{|\Delta R|_{max}}{\overline{R}} \leq 0.2 \qquad (1)$$

where:

R is flow resistance

$\overline{R}$ is mean flow resistance

5.5.2.2 High-flow rate test

In addition to the requirements of **5.5.2.1**, the filter shall have a minimum breakthrough time of 5 min when tested at a flow rate of (100 ±2) l/min, (50 ±5)% relative humidity, (25 ±2.5) °C for each of the test agents 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.

Table 2 — *Filter test challenge and test breakthrough concentrations*

Test representative agent	Test concentration	Breakthrough concentration for 15–60 min duration	Breakthrough concentration for 90–120 min duration
	ppm [A]	ppm [A]	ppm [A]
Ammonia	1 250	25	12.5
Cyanogen chloride	150	2	2
Cyclohexane	1 300	10	10
Formaldehyde	250	10	1
Hydrogen cyanide	470	10 [B]	4.7 [B]
Hydrogen sulfide	500	30	5.0
Nitrogen dioxide	100	1 (NO_2)	1 (NO_2) or 25 (NO) [C]
Phosgene	125	1.25	1.25
Phosphine	150	0.5	0.3
Sulfur dioxide	750	5	5

[A] SI unit equivalent = ml/m^3.

[B] Sum of HCN and C_2N_2.

[C] Nitrogen dioxide breakthrough is monitored for both NO_2 and NO. The breakthrough is determined by which quantity, NO_2 or NO reaches breakthrough first.

5.6 Filters – Particular element

5.6.1 General

The particle filter shall be on the influent side of the gas/vapour filter. Testing by visual inspection shall be carried out in accordance with BS 8468-8:2020, Clause **6**.

5.6.2 Filter penetration

Filters shall meet the requirements of class P3 in accordance with BS EN 143:2000, **7.12**.

Four filters shall be tested for each test agent, two as received and two after the conditioning in accordance with **5.2**.

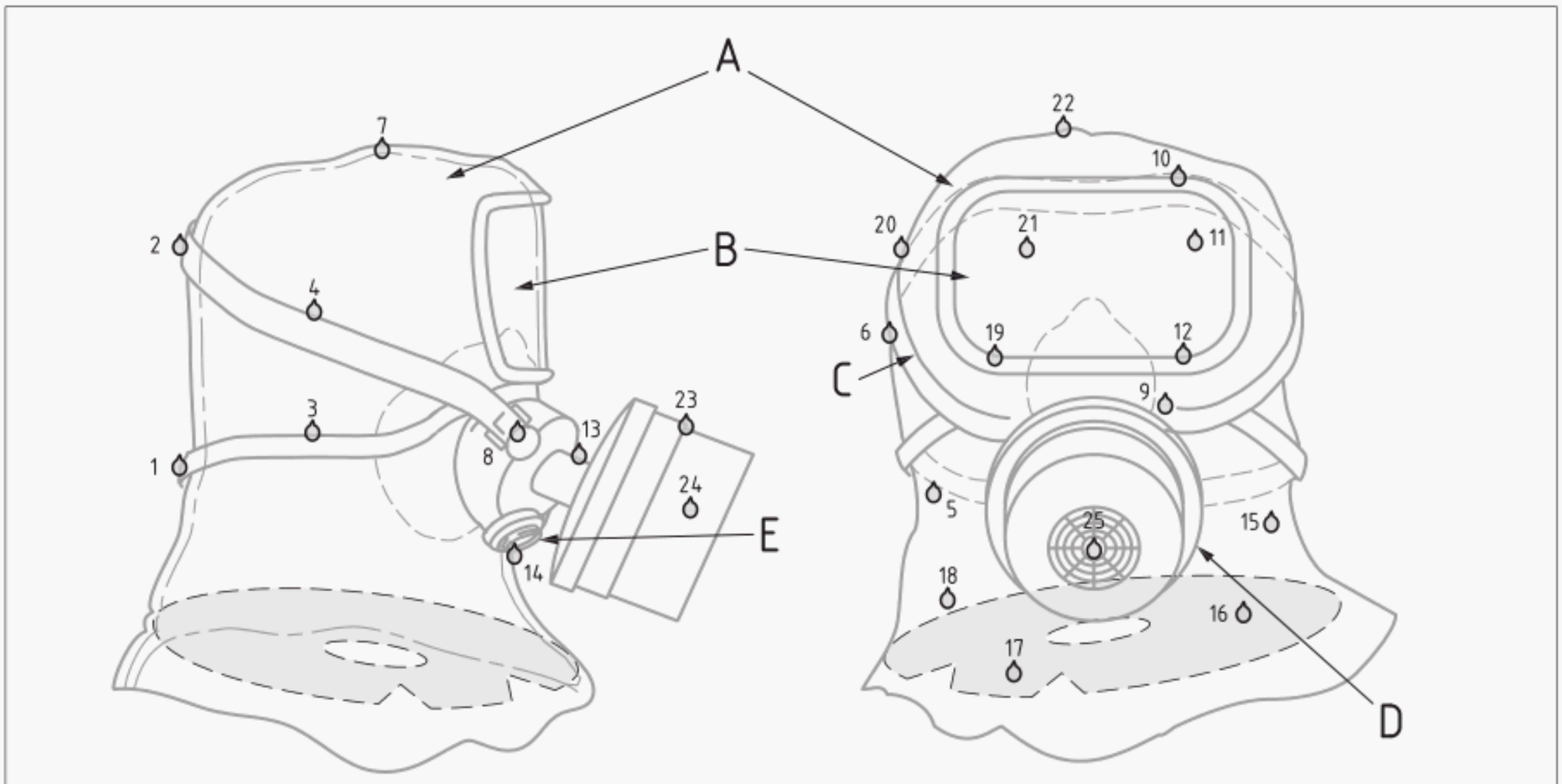
When one filter of a multiple filter device is tested separately, the air flow specified for a test shall be divided by the number of filters through which the air flow is proportioned.

NOTE *If the filter cannot be tested separately, it might be necessary to use a sealant to ensure an effective seal between the hood and the test head or adapter respectively.*

5.7 Chemical agent permeation and penetration

The apparatus shall be resistant to chemical agents when tested as a complete system in accordance with BS 8468-8:2020, type ES CBRN *t*, where *t* is the designated duration of the escape device in accordance with the device classification (see **4.2**). The HD droplet patterns given in Figure 1 shall be used.

Figure 1 — *Sulfur mustard (HD) agent droplet placement for device*



Key

A	Hood	D	Filter(s)
B	Eye lens(es)	E	Exhalation valve
C	Head-harness strap		

25 drops shall be placed on the device.

The first two drops shall be placed on the back of the hood, working forward for the remaining 23 drops.

NOTE Drops 5 and 6 are on the opposite side to drops 3 and 4, drop 8 is opposite to drop 9.

Two drops shall be placed on the neck dam if exposed; use drops 15 and 16. If not exposed, those drops shall be placed on the shroud.

Any component not shown in Figure 1 shall be tested with at least one drop.

5.8 Donning

When tested in accordance with BS EN 403:2004, **7.5**, the time to don the device from the ready-to-use configuration shall be not greater than 30 s.

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

6 Marking

6.1 General

Marking shall be in accordance with the relevant clauses of BS EN 403.

All the markings shall be legible and durable.

Any CBRN RPD component forming part of the breathable gas supply chain that can be removed without the use of tools shall be marked with the letter combination “CBRN” in a sans-serif font.

NOTE Marking can be on a label or embossed on an externally visible area of the component.

6.2 Hood

All hoods shall be marked with:

a) the standard identifier of this British Standard and classification, e.g. BS 8468-3.2:2020[2)], type 1M ES CBRN 15;

b) the manufacturer, supplier or importer identified by name, trademark, or other means of identification; and

c) the manufacturer's model designation.

6.3 Filters

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

6.4 Packaging

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

a) class, i.e. 'M' or 'S';

b) the standard identifier of this British Standard and classification, e.g. BS 8468-3.2:2020[2)], type 2 M ES CBRN 30;

c) the manufacturer, supplier or importer identified by name, trademark, or other means of identification;

d) the manufacturer's model designation;

e) the date of end of shelf life and (if applicable) the date for next inspection; equivalent pictograms, where available, can be used (see Figure 2);

f) the manufacturer's recommended conditions of storage (at least the temperature and humidity) or equivalent pictogram as shown in Figure 2;

g) 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 2;

h) 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;

i) if the device is fitted with a mouthpiece and a nose clip the statement: "Do not speak during use."; and

j) the sentence: "For single use only.".

---

2) Marking BS 8468-3.2:2020 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Figure 2 — *Pictograms*

a) See information supplied by the manufacturer

b) End of shelf life

c) Temperature range of storage conditions

d) Maximum humidity of storage conditions

NOTE *Figures taken from BS EN ISO 16972:2020.*

7 Information supplied by the manufacturer

The information supplied shall be in accordance with the relevant clauses of BS EN 403, and external to the operational packaging.

The information shall explain the markings listed in Clause **6**.

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

The information shall include the sentence: “For single use.”

If the manufacturer provides information concerning decontamination and disposal, the information shall specify the agent to be used and the process to be followed.

Figure 2 — *Pictograms*

a) See information supplied by the manufacturer

b) End of shelf life

c) Temperature range of storage conditions

d) Maximum humidity of storage conditions

NOTE *Figures taken from BS EN ISO 16972:2020.*

7 Information supplied by the manufacturer

The information supplied shall be in accordance with the relevant clauses of BS EN 403, and external to the operational packaging.

The information shall explain the markings listed in Clause **6**.

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

The information shall include the sentence: “For single use.”

If the manufacturer provides information concerning decontamination and disposal, the information shall specify the agent to be used and the process to be followed.

Figure 2 — *Pictograms*

a) See information supplied by the manufacturer

b) End of shelf life

c) Temperature range of storage conditions

d) Maximum humidity of storage conditions

NOTE *Figures taken from BS EN ISO 16972:2020.*

7 Information supplied by the manufacturer

The information supplied shall be in accordance with the relevant clauses of BS EN 403, and external to the operational packaging.

The information shall explain the markings listed in Clause **6**.

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

The information shall include the sentence: “For single use.”

If the manufacturer provides information concerning decontamination and disposal, the information shall specify the agent to be used and the process to be followed.

