

BRITISH STANDARD

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

Part 4: Powered air purifying respirators – Specification

ICS 13.340.30

BSi
British Standards

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Summary of pages

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Foreword

Publishing information

This British Standard was published by BSI. 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 seven parts:

- *Part 1: Positive pressure, self-contained breathing apparatus – Specification;*
- *Part 2: Negative pressure air purifying devices with full face mask – Specification;*
- *Part 3: Escape hoods – Specification;*
- *Part 4: Powered air-purifying respirators – Specification;*
- *Part 5: Dual-mode apparatus – Specification;*
- *Part 6: Positive-pressure compressed airline equipment – Specification;*
- *Part 7: Closed-circuit breathing apparatus – Specification.*

NOTE This standard may be used in conjunction with BS 8467:2006, which gives categorization, requirements and test methods for personal protective ensembles against CBRN agents.

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 powered air-purifying respirators (PAPRs) intended to be used during, rescue, evacuation, escape, hazard containment and decontamination, and similar activities by emergency responders (fire, ambulance, police, and associated civilian agencies and workers) in 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 8467:2006, *Protective clothing – Personal protective ensembles for use against chemical, biological, radiological and nuclear (CBRN) agents – Categorization, performance requirements and test methods*

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

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

BS EN 136:1998, *Respiratory protective devices – Full face masks – Requirements, testing, marking*

BS EN 140, *Respiratory protective devices – Half masks and quarter masks – Requirements, testing, marking*

BS EN 12941:1999+A1:2004, *Respiratory protective devices – Powered filtering devices incorporating a helmet or a hood – Requirements, testing, marking*

BS EN 12942:1999+A1:2003, *Respiratory protective devices – Power assisted filtering devices incorporating full face masks – Requirements, testing, marking*

BS EN 13274-1, *Respiratory protective devices – Methods of test – Part 1: Determination of inward leakage and total inward leakage*

3 Terms and definitions

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

3.1 powered air-purifying respirator PAPR

an air-purifying respiratory protective device that uses an electrically operated blower to force ambient atmosphere through air-purifying elements to the respiratory interface

3.2 full face mask

tight fitting facepiece covering at least the mouth, nose, eyes and chin

3.3 helmet

rigid respiratory interface that could also provide head protection against impact and penetration

3.4 hood

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

3.5 suit

garment, used as a facepiece which covers the head and entire body at least to the ankles and wrists and to which air is supplied

3.6 blouse

garment, used as a facepiece which covers the head and upper body at least to the waist and wrists and to which air is supplied

3.7 respiratory interface

part of an RPD that forms a protective barrier between the wearer's respiratory tract and the surrounding atmosphere

4 Description

A powered air-purifying respiratory protective device (PAPR) is a device designed and constructed to use an electrically operated blower to force the ambient atmosphere through air purifying element(s) to the respiratory interface. The air purifying elements (filters) shall be combined gas/vapour filters and particle filters. The particle filter shall be integral to and on the influent side of the gas/vapour filter(s).

5 Designation

5.1 Types

5.1.1 General

Two types of PAPR are described in this standard:

- a) Type 1: a device based on a loose fitting hood or helmet as specified in BS EN 12941:1999+A1:2004, including a blouse or suit; and
- b) Type 2: a device based on a full face mask as specified in BS EN 12942:1999+A1:2003 that is either:
 - 1) subtype A for emergency responders that do not need to use optical systems; or
 - 2) subtype B for emergency responders that might need to use optical systems, e.g. microscopes, weapons sights.

5.1.2 Type 1

A Type 1 device typically consists of:

- a) a respiratory interface, which can be a helmet, hood, blouse, suit, or a device which seals on the face, excluding facepieces specified in BS EN 136 or BS EN 140. The respiratory interface may incorporate a helmet, e.g. to provide head protection against mechanical impact and/or a visor to provide eye and face protection against given risks, possibly combined;
- b) a blower unit and filter(s)¹⁾ designed to be carried/worn by the wearer which supplies filtered ambient air to the respiratory interface. The energy supply for the blower unit may or may not be carried on the person; and
- c) exhalation valve(s) or other outlets depending on the design by which exhaled air and air in excess of the wearer's demand is discharged.

5.1.3 Type 2

A Type 2 device typically consists of:

- a) for subtype 2A: a full face mask as specified in BS EN 136;
- b) for subtype 2B: a full face mask as specified in BS EN 136, but with the field of vision requirement specified in BS EN 136:1998 **7.21** for full facemasks with two eyepieces and conform to the requirements of Annex C (use with optical systems);
- c) a blower unit plus filter(s)¹⁾ designed to be carried/worn by the wearer which supplies filtered ambient air to the respiratory interface. The energy supply for the blower unit may or may not be carried on the person; and
- d) exhalation valve(s) or other outlets depending on the design by which exhaled air and air in excess of the wearer's demand is discharged.

5.2 Classification

PAPR are classified in this standard in terms of filter breakthrough time as follows:

- a) Class 15 – with filter breakthrough time greater than or equal to 15 min and less than 30 min;
- b) Class 30 – with filter breakthrough time greater than or equal to 30 min and less than 45 min;
- c) Class 45 – with filter breakthrough time greater than or equal to 45 min and less than 60 min;
- d) Class 60 – with filter breakthrough time greater than or equal to 60 min and less than 90 min;
- e) Class 90 – with filter breakthrough time greater than or equal to 90 min and less than 120 min; and
- f) Class 120 – with filter breakthrough time greater than or equal to 120 min.

Classification for filter breakthrough times greater than 120 min is in 30 min intervals.

¹⁾ A filter or filters through which all air supplied passes.

6 Requirements

6.1 General

The complete PAPR configured for use against CBRN agents shall be a powered air device conforming to either:

- 1) BS EN 12941:1999+A1:2004 designation TH3P SL excluding the total mass requirement; or
- 2) BS EN 12942:1999+A1:2003 designation TM3P SL; and
- 3) in either case conforming to the additional requirements specified in **6.2** and **6.3**.

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

6.2 Chemical agent permeation and penetration

For a Type 2 device or a Type 1 device that can be tested on SMARTMAN (see **B.4.4**), the PAPR shall be resistant to chemical agents up to the maximum levels given in Table 1 when tested in accordance with Annex B.

Where a Type 1 device cannot be tested on SMARTMAN (see **B.4.4**):

- 1) devices shall have an inward leakage performance level of 0.2% or better (a nominal protection factor of 500), when tested in accordance with BS 8467:2006 as part of a complete ensemble; and
- 2) the highest cumulative permeation for the exposed materials of the device for each chemical over 4 h shall not exceed $1.25 \mu\text{g}/\text{cm}^2$, when tested against all of the liquid test chemicals listed in Annex D of BS 8467:2006. (The liquid concentration density of each chemical is $10 \text{ g}/\text{m}^2$, applied as nominal $1 \mu\text{l}$ drops, drops applied uniformly over the sample surface. Where a seam closure or fixture is included, at least three drops are applied at each critical juncture, such as the seam edge. The test cell is assembled in the open configuration.)

NOTE Where components are made of materials identical (in composition and minimum thickness) to those used previously and have been shown to meet the requirements as part of other devices that conform to this standard then this information may be used to demonstrate compliance in this instance.

For each type of PAPR (Type 1 or Type 2) tested on SMARTMAN, six devices shall be tested, two devices (one for each agent) in as-received condition and four devices (two for each agent) conditioned in accordance with BS EN 12941:1999+A1:2004 (for Type 1 devices) or BS EN 12942:1999+A1:2003 (for Type 2 devices).

Where a Type 1 device cannot be tested on SMARTMAN, three examples of each sample shall be tested for each liquid chemical permeation test.

Table 1 Maximum acceptable levels of permeation and penetration

Agent	Maximum acceptable peak excursion ^a	Maximum acceptable breakthrough (concentration integrated over time) ^b
	mg/m ³	mg·min/m ³
Distilled sulfur mustard (HD) (vapour) Type 1 and Type 2 [sequential test before liquid HD]	0.30	3.0
Distilled sulfur mustard (HD) (liquid) Type 1 and Type 2 [sequential test after HD vapour]	0.30	3.0
Sarin (GB) (vapour) Type 1 and Type 2	0.044	1.05

^{a)} Three sequential test data points, with sample times of two minutes, at or above the maximum peak excursion level constitute a failure.

^{b)} The maximum acceptable breakthrough is calculated over the six-hour duration of the test.

6.3 Gas/vapour filters

6.3.1 General

Filters shall meet the requirements of Table 3.

Three filters shall be tested after mechanical strength testing followed by temperature conditioning according to either BS EN 12941:1999+A1:2004 (Type 1) or BS EN 12942:1999+A1:2003 (Type 2) for each test agent and at each relative humidity level.

Testing shall be done as described and at the filter flow rate as determined in either BS EN 12941:1999+A1:2004 (Type 1) or BS EN 12942:1999+A1:2003 (Type 2) and in accordance with Annex A.

6.3.2 CBRN requirements – Filter classification, test agents – Challenges and breakthrough concentrations

Filters shall be tested against all the test representative agents (TRAs) and under the test conditions specified in Annex A. Filters shall be classified according to the breakthrough times achieved in the laboratory tests, as given in Table 2.