

BRITISH STANDARD

Protective clothing – Personal protective ensembles for use against chemical, biological, radiological and nuclear (CBRN) agents – Categorization, performance requirements and test methods

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 25 and a back cover.

Foreword

Publishing information

This British Standard was published by BSI and came into effect on 31 July 2006. It was prepared by Subcommittee PH/3/3, *Protective clothing from chemicals and radioactive contamination*, under the authority of Technical Committee PH/3, *Protective clothing*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This British Standard is intended to be used in conjunction with BS 8468 (all parts), which gives requirements for respiratory protective equipment for use with ensembles such as those covered by this standard.

NOTE All or some of the parts of BS 8468 might be appropriate depending upon the requirements identified. BS 8468 will be published 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.*

Information about this document

Increased threat from chemical, biological, radiological and nuclear (CBRN) agents has led to a need for suitable personal protective equipment (PPE). The lack of coverage of combined CBRN protection in existing British Standards on PPE has recently been identified. This standard has been prepared to give requirements for such 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.

Introduction

This Standard has been prepared using, wherever possible, British and European standards as a base in order to more easily facilitate both the availability of testing and the CE marking process.

This standard has been prepared bearing in mind existing individual items of PPE that when used together could form an ensemble.

The ensembles covered by this standard are intended for immediate or nearly immediate response to a CBRN challenge whether this is as a result of accidental release or through terrorist activity. Such ensembles are not necessarily intended for use some time after a release has occurred such as in the case of building decontamination (as opposed to casualty decontamination). In such cases, BS 7184 might provide suitable guidance.

NOTE The term CBRN is used in Home Office publications (e.g. The release of CBRN substances or material [1]) to describe a range of incidents that can occur as a result of a release of chemical, biological or radiological material.

The categories of ensemble have been selected based upon the anticipated activities expected to be undertaken by personnel, and the associated physiological demands, together with the knowledge of ensembles currently available.

1 Scope

This British Standard specifies requirements for personal protective ensembles intended to be used during rescue, evacuation, escape, hazard containment, decontamination and similar associated activities by first responders, fire, ambulance, police and associated civilian agencies and workers, for protection during chemical, biological, radiological and nuclear (CBRN) events.

This standard covers a variety of ensembles intended to provide a range of levels of protection against chemical warfare agents, toxic industrial chemicals and materials, biological agents and contamination by radioactive particles. It is assumed that an equivalent amount of protection from radioactive particles will be provided as a result of the protection that is provided from particulate chemical agents.

This standard does not cover ensembles intended to provide protection from irradiation by ionizing radiation, i.e. beta and gamma radiation, and for which no currently available chemical protective clothing will necessarily offer significant protection. Nor does it cover blast or heat protection from a nuclear device.

This standard is not necessarily appropriate for responders to releases from establishments where the nature of the hazardous material is known in advance and where the establishment has emergency plans that include provision of appropriate PPE.

NOTE 1 Ensembles conforming to this standard might be suitable for use in situations other than those involving the specific CBRN agents identified in the standard. Information supplied by the ensemble suppliers or individual component manufacturers will indicate such additional possible performance applications.

Some typical anticipated environments and activities for which the various categories of ensemble could be used are also provided.

This standard identifies categories of ensembles and their associated performance requirements and test methods in order that ensembles can be categorized. This includes both material specific requirements and full ensemble testing.

The performance requirements in this standard might be achieved by ensembles regardless of whether they are of the reusable, limited life or disposable type.

NOTE 2 Ancillary items that might be used with an ensemble (e.g. lifejackets, guns, ballistic vests, hydration systems) and/or their compatibility with the ensembles are not covered by the standard.

This standard also considers compatibility and interface with respiratory protective devices, and application and marking of the equipment, including user information.

Ensembles that conform to this standard are designed to be used with respiratory protective devices. This standard does not identify the specific performance requirements for such respiratory protective devices. However some additional requirements for the respiratory element when it is used as part of the ensemble are included in this standard, for example full system testing.

BS 8468 (all parts), will provide the performance requirements specific to the respiratory devices for protection against CBRN agents to be used in conjunction with the ensembles identified in this standard.

Annex A provides advice and guidance on selection, use, care and maintenance and Annex B provides an informative check list of performance requirements in relation to the Essential Health and Safety Requirements of the PPE Directive [2] in order to assist manufacturers and Notified Bodies in preparing certification against the PPE Directive. Annex C gives requirements for full ensemble system testing for CBRN agents. Annex D gives the test methodology for material swatch testing for CBRN agents. Annex E gives a test methodology for testing permeation resistance to challenge chemicals in droplet form.

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 8428:2004, *Protective clothing – Protection against liquid chemicals – Performance requirements for chemical protective suits with liquid-tight connections between different parts of the clothing for emergency teams (type 3-ET equipment)*

BS 8468-1, *Respiratory protective devices for use against chemical, biological, radiological and nuclear (CBRN) agents – Part 1: Positive pressure, self-contained breathing apparatus – Specification*¹⁾

¹⁾ BS 8468-2, -3, -4, -5, -6 and -7 were in preparation at the time of publication of this standard.

- BS EN 166:2002, *Personal eye protection – Specifications*
- BS EN 340, *Protective clothing – General requirements*
- BS EN 374-1:2003, *Protective gloves against chemicals and micro-organisms – Terminology and performance requirements*
- BS EN 388:2003, *Protective gloves against mechanical risks*
- BS EN 420, *Protective gloves – General requirements and test methods*
- BS EN 463, *Protective clothing – Protection against liquid chemicals – Test method – Determination of resistance to penetration by a jet of liquid (Jet test)*
- BS EN 464, *Protective clothing – Protection against liquid and gaseous chemicals, including liquid aerosols and solid particles – Test method – Determination of leak-tightness of gas-tight suits (Internal Pressure Test)*
- BS EN 468, *Protective clothing for use against liquid chemicals – Test method – Determination of resistance to penetration by spray (Spray Test)*
- BS EN 469:2005, *Protective clothing for firefighters – Requirements and test methods for protective clothing for firefighting*
- BS EN 812, *Industrial bump caps*
- BS EN 943-1:2002, *Protective clothing against liquid and gaseous chemicals, aerosols and solid particles – Part 1: Performance requirements for ventilated and non-ventilated “gas-tight” (Type 1) and “non-gas-tight” (Type 2) chemical protective suits*
- BS EN 943-2:2002, *Protective clothing against liquid and gaseous chemicals, aerosols and solid particles – Part 2: Performance requirements for “gas-tight” (Type 1) chemical protective suits for emergency teams (ET)*
- BS EN 13034:2005, *Protective clothing against liquid chemicals – Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (type 6 and type PB [6] equipment)*
- BS EN 13274-1:2001, *Respiratory protective devices – Methods of test – Determination of inward leakage and total inward leakage*
- BS EN 13274-4:2001, *Respiratory protective devices – Methods of test – Flame tests*
- BS EN 20811:1992/ISO 811:1981, *Textiles – Determination of resistance to water penetration – Hydrostatic pressure test*
- BS EN 24920:1992/ISO 4920:1981, *Textiles – Determination of resistance to surface wetting (spray test) of fabrics*
- BS EN 25077:1994/ISO 5077:1984, *Textiles – Determination of dimensional change in washing and drying*
- BS EN ISO 1421:1998, *Rubber-or-plastics-coated fabrics – Determination of tensile strength and elongation at break*
- BS EN ISO 4674-1:2003, *Rubber-or-plastics-coated fabrics – Determination of tear resistance – Ballistic pendulum method*

BS EN ISO 6529:2001, *Protective clothing – Protection against chemicals – Determination of resistance of protective clothing materials to permeation by liquids and gases*

BS EN ISO 6530:2005, *Protective clothing – Protection against liquid chemicals – Test method for resistance of materials to penetration by liquids*

BS EN ISO 13934-1:1999, *Textiles – Tensile properties of fabrics – Determination of maximum force and elongation at maximum force using the strip method*

BS EN ISO 13935-2:1999, *Textiles – Seam tensile properties of fabrics and made-up textile articles – Determination of maximum force to seam rupture using the grab method*

BS EN ISO 20344, *Personal protective equipment – Test methods for footwear*

BS EN ISO 20345, *Personal protective equipment – Safety footwear*

PD CEN ISO/TR 11610, *Protective clothing – Vocabulary*

3 Terms and definitions

For the purpose of this British Standard the terms and definitions given in BS 8428, PD CEN ISO/TR 11610 and the following apply.

3.1 CBRN agents

chemical, biological, radiological and nuclear agents that might provide a threat to life

NOTE Such agents need not necessarily be from a terrorist origin. They might derive from other causes, e.g. accidental release.

3.2 compatibility

ability of items of an ensemble to ensure simultaneous protection

3.3 ensemble

various items of personal protective equipment, including respiratory devices, which when worn and used as a system are intended to provide full body protection

NOTE Requirements for respiratory devices are not covered by this standard; these are covered by BS 8468 (all parts). However, the way in which respiratory devices interface with the ensembles is covered by this standard.

3.4 gas-tight protective ensemble

ensemble which satisfies the requirements for “leaktightness” when tested according to the internal pressure test given in BS EN 464

3.5 interface area

area where items of an ensemble interface with each other whilst continuing to provide protection

3.6 item

physically separate constituent of an ensemble

3.7 nominal protection factor

PF

number derived from the specified maximum percentage of total inward leakage L_{imax} from the relationship:

$$PF = \frac{100}{L_{\text{imax}}}.$$

[Based on the definition in BS EN 529.]

4 Categorization and typical applications

Four categories of ensembles are described in this standard, together with typical applications in order to aid the user in identifying and selecting the category of ensemble most appropriate to the task being undertaken and the level of hazard against which protection is sought.

An ensemble conforming to this standard shall be classified within the following categories, in accordance with the performance requirements specified in Clause 5 and Clause 6.

NOTE 1 It may be possible for an ensemble to be categorized into more than one category.

Where ensemble items are supplied separately, the item shall be marked with, or its supporting documentation shall include information on, which other items are required to complete the ensemble in conformance with this standard, by listing product identification and manufacturer names.

Typical examples of potential operational environments and applications for each category of ensemble are also provided. However this is for guidance and should not be considered as definitive or limiting the possible applications for the ensembles conforming to this standard.

NOTE 2 A risk assessment process should be used to select the category of ensemble to be used in any particular application.

Category A: A gas-tight protective ensemble with a breathable air supply independent of the ambient atmosphere and protecting against CBRN agents in the form of vapours, liquids, gases, aerosols or particulates where the nature and quantity of the agent might or might not be known.

Typical application: *Environments where exposure to high levels of known or unknown agents is likely, probably in the form of bulk agent including vapours or gases. Low oxygen levels might exist requiring the use of an independent air supply. Deployment of such ensembles might be at the expense of either wear-time or mobility.*

Category B: A protective ensemble providing protection against CBRN contamination on surfaces by CBRN agents and their associated residual vapours and gases where the nature and quantity of the agent has been evaluated, and ensemble deployment has been assessed accordingly.