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Introduction

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD

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

ICS: 13.340.10; 13.280

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by Technical Committee ISO/TC 94, Personal Safety — Personal Protective Equipment, Subcommittee SC 14, Firefighters' Personal Equipment.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This standard has been prepared by Technical Committee ISO TC 94, Personal Safety — Personal Protective Equipment, Subcommittee SC 14, Firefighters' Personal Equipment.

The Ensembles covered by this standard are intended for immediate or in some instances longer term responses to a CBRN challenge, whether this is as a result of accidental release or through malicious activity.

The classifications within this standard have been selected based upon the anticipated risks and activities expected to be undertaken. To determine the appropriate classification, users of this standard will conduct a risk assessment in line with [Annex A](#).

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

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

1 Scope

This document specifies the requirements for Personal Protective Equipment (PPE) clothing ensembles excluding respiratory protective devices (RPD) for use by emergency responders and other workers during incidents involving chemical, biological, radiological or nuclear (CBRN) materials –

- used with intent to cause harm; and
- in cases of accidental releases outside traditional hazardous materials response categories or in the case naturally occurring biological events.

For the purposes of this standard, all incidents described here are named CBRN incidents.

This standard is applicable to PPE for use by personnel in the following roles where appropriate:

- First responders: including fire service, emergency medical, search and rescue, sampling and detection teams and police.
- Workers needed for specific support roles (for example utility, transportation, service continuity, environmental protection).
- Medical personnel working with casualties of CBRN incidents.
- Responders to incidents involving radiological or nuclear material release.
- Non-emergency but CBRN-related roles.

Excluded:

- Protection against ionizing radiological exposures
- Requirements for PPE use by military personnel are not addressed by this document.

Requirements for the following are not covered by this document:

- Casualty/body bags.
- Methods of and criteria for decontamination of PPE.
- Disposal of used or contaminated equipment.

This document is focused on PPE clothing ensembles, but it is recognised that CBRN PPE usually forms part of an ensemble potentially including RPD where the RPD provide protection to a portion of the individual wearer's body. For this reason, where RPD affects the integrity of the ensemble in preventing skin exposure to the wearer, ensembles with specific RPD are evaluated in several whole ensemble tests. Any requirements for respiratory protective device itself would need to meet the requirements is the ISO 17420 series (including specifically ISO 17420 Part 2 and ISO/TS 17420 Parts 8 and 9), as recommended.

It is further recommended that the computability of all PPE be evaluated as specified in ISO/TS 20141:2022 and the selection of appropriate respirators as part of these ensembles be made as indicated in ISO/TS 16975:2016.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 37:2017, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 6529:2013, *Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases*

ISO 7854:1995, *Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing*

ISO 9073-15:2017, *Textiles – Test methods for nonwovens – Part 15: Determination of air permeability*

ISO 9237:1995, *Textiles — Determination of the permeability of fabrics to air*

ISO 9352:2012, *Plastics — Determination of resistance to wear by abrasive wheels*

ISO 11092:2014, *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

ISO 11612:2015, *Protective clothing — Clothing to protect against heat and flame — Minimum performance requirements*

ISO 11999-6:2016, *PPE for firefighters — Test methods and requirements for PPE used by firefighters who are at risk of exposure to high levels of heat and/or flame while fighting fires occurring in structures — Part 6: Footwear*

ISO 12947-2:2016, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 2: Determination of specimen breakdown*

ISO 13506-1:2017, *Protective clothing against heat and flame — Part 1: Test method for complete garments — Measurement of transferred energy using an instrumented manikin*

ISO 13506-2:2017, *Protective clothing against heat and flame — Part 2: Skin burn injury prediction — Calculation requirements and test cases*

ISO 13688:2013, *Protective clothing — General requirements*

ISO 13935-2:2014, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method*

ISO 13938-1:2019, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 13982-2, *Protective clothing for use against solid particulates — Part 2: Test method of determination of inward leakage of aerosols of fine particles into suits*

ISO 13995:2000, *Protective clothing — Mechanical properties — Test method for the determination of the resistance to puncture and dynamic tearing of materials*

ISO 13996:1999, *Protective clothing — Mechanical properties — Determination of resistance to puncture*

ISO 13997:1999, *Protective clothing — Mechanical properties — Determination of resistance to cutting by sharp objects*

ISO 14116:2015, *Protective clothing — Protection against flame — Limited flame spread materials, material assemblies and clothing*

ISO 16321-1:2021, *Eye and face protection for occupational use — Part 1: General requirements*

ISO 16602:2007+AMD 1 :2012, *Protective clothing for protection against chemicals. Classification, labelling and performance requirements*

ISO/CD 16602-2, *Protective clothing for protection against chemicals — Classification, labelling and performance requirements — Part 2: Physical test methods, classification and requirements*

ISO/CD 16602-4, *Protective clothing for protection against chemicals — Classification, labelling and performance requirements — Part 4: Design*

ISO/CD 16602-5, *Protective clothing for protection against chemicals — Classification, labelling and performance requirements — Part 5: Whole suit test methods, classification and requirements*

ISO 16604:2004, *Clothing for protection against contact with blood and body fluids — Determination of resistance of protective clothing materials to penetration by blood-borne pathogens — Test method using Phi-X 174 bacteriophage*

ISO/TS 16975:2016, *Respiratory protective devices — Selection, use and maintenance — Part 1: Establishing and implementing a respiratory protective device programme*

ISO 17420-1:2021, *Respiratory protective devices — Performance requirements — Part 1: General*

ISO 17420-2:2021, *Respiratory protective devices — Performance requirements — Part 2: Requirements for filtering RPD*

ISO/TS 17420-8:2021, *Respiratory protective devices — Performance requirements — Part 8: Special application chemical, biological, radiological and nuclear (CBRN) filtering and radiological-nuclear (RN) filtering RPD*

ISO/TS 17420-9:2021, *Respiratory protective devices — Performance requirements — Part 9: Special application chemical, biological, radiological and nuclear (CBRN) supplied breathable RPD*

ISO 17491-3:2008, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 3: Determination of resistance to penetration by a jet of liquid (jet test)*

ISO 17491-4:2008, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 4: Determination of resistance to penetration by a spray of liquid (spray test)*

ISO 17492:2019, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*

ISO 17723-1:2019, *PPE ensembles for firefighters undertaking hazardous materials response activities — Part 1: Gas-tight, vapour-protective ensembles for emergency response teams ("type 1")*

ISO 19918:2017, *Protective clothing — Protection against chemicals — Measurement of cumulative permeation of chemicals with low vapour pressure through materials*

ISO 20141:2022, *Personal safety — Personal protective equipment — Guidelines on compatibility testing of PPE*

ISO 20344:2021, *Personal protective equipment — Test methods for footwear*

ISO 20345:2021, *Personal protective equipment — Safety footwear*

ISO 21420:2020, *Protective gloves — General requirements and test methods*

ISO 23407:2021, *Protective gloves against thermal risks (heat and/or fire)*

ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

ASTM F392-11(2015), *Standard Practice for Conditioning Flexible Barrier Materials for Flex Durability*

ASTM D4157 - 13(2017), *Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*

EN 13274-4:2020, *Respiratory protective devices — Methods of test — Part 4: Flame test*

NFPA 1990:2022, *Standard on Protective Ensembles for Hazardous Materials and CBRN Operations*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

abrasion rub

one revolution of the outer drives of the Martindale abrasion tester

Note 1 to entry: See ISO 12947-1.

[SOURCE: ISO/TR 19591:2018, 3.2, modified — Note 1 to entry added.]

3.2

air permeability

velocity of an air flow passing perpendicularly through a test specimen under specified conditions of test area, pressure drop and time

[SOURCE: EN ISO 9237:1995-12, 3.1]

3.3

biological infective agents

biological materials capable of causing an acute disease or long term damage to the human body

[SOURCE: ISO/TR 19591:2018, 3.20, adapted]

3.4

bootee

sock-like extension of the *chemical protective suit* ([3.7](#))

[SOURCE: ISO/TR 19591:2018, 3.24, modified — Note 1 to entry deleted.]

3.5

CBRN

abbreviation for Chemical, Biological, Radiological, and Nuclear

Note 1 to entry: CBRN is used through the standard to relate to types of specific protection as defined by both ensemble element and material performance. The reference to radiological and nuclear hazards only is applicable to particulate hazards and not against high energy exposure or blast exposures.

3.6

chemical flash fire

ignition of a flammable vapour or gas that produces an outward expanding flame front, as those vapours or gases burn

Note 1 to entry: This burning and expanding flame front (fire ball) will release both thermal and kinetic energy to the environment.

[SOURCE: ISO/TR 19591:2018, 3.35]

3.7**chemical protection layer**

layer or layers included in the composite that provide resistance to ingress by chemicals and to provide gas-tight integrity for the purpose of providing protection from chemical hazards

[SOURCE: ISO/TR 19591:2018, 3.36, modified — The phrase "penetration resistance against" was replaced by "resistance to ingress by".]

3.8**chemical terrorism agents**

liquid, solid, gaseous and vapour chemicals capable of inflicting lethal or incapacitating injuries, generally on a civilian population as a result of a terrorist attack

[SOURCE: ISO/TR 19591:2018, 3.41, modified — The word "casualties" was replaced by "injuries".]

3.9**closure**

device to open and close openings for doffing and donning of protective clothing

3.10**closure system**

method of fastening openings in the garment including combinations of more than one method of achieving a secure *closure* (3.9)

EXAMPLE A slide fastener covered by an over flap fastened down with a touch and close fastener.

Note 1 to entry: This term does not cover seams (3.21).

[SOURCE: ISO/TR 19591:2018, 3.49]

3.11**component**

part or sub-assembly of a protective item

[SOURCE: ISO/TR 19591:2018, 3.61, modified — Deleted "necessary for it to meet its respective requirements".]

3.12**elastomeric interface material**

exposed elastomeric material that is not otherwise used as garment material, which provides an interface between components of the ensemble and ensemble elements, other than seams, and if applicable, the interface between the respirator facepiece and the ensemble or ensemble elements

3.13**emergency response team**

firefighters and other first responders that are trained and equipped to respond to incidents involving the release of hazardous materials

[SOURCE: ISO/TR 19591:2018, 3.93, modified — The phrase "accidental release" was replaced by "release".]

3.14**encapsulating ensemble**

type of ensemble that completely covers the wearer and the wearer's respirator

3.15**exhaust valve**

component (3.11) of a *chemical protective suit* (3.7) that prevents over pressurization of the suit

[SOURCE: ISO/TR 19591:2018, 3.97]

3.16

external fittings

any fitting externally located on, and part of, the ensemble which is not part of the garment material, visor material, gloves, footwear, seams, or closure assembly

3.17

footwear

component ([3.11](#)) of the protective ensemble designed to provide protection to the foot, ankle, and possibly the lower leg

[SOURCE: ISO/TR 19591:2018, 3.119, modified — The word "possibly" was added.]

3.18

footwear upper

portion of the footwear element above the sole

3.19

glove

personal protective equipment (PPE) which protects the hand or part of the hand against hazards

Note 1 to entry: It can additionally cover part of the forearm and arm.

[SOURCE: ISO/TR 19591:2018, 3.133]

3.20

integrity

quality of a protective ensemble for preventing the inward leakage of a hazardous substance that may be in gas or a vapour, liquid, or particulate forms

3.21

non-encapsulating ensemble

type of ensemble that does not fully cover the wearer's respirator and relies on the facepiece of the respirator to have an interface with the garment and complete the enclosure of the wearer

3.22

outer-boot

boot worn over other footwear components to meet requirements of this standard

3.23

outer glove

glove worn over another glove component for the purposes of providing additional protection to the wearer and to meet the requirements of this standard

3.24

particulate

solid matter that is dispersed in the air as a mixture

Note 1 to entry: For the purpose of this standard, particulates do not include aerosols or liquid droplets suspended in air. Aerosols are considered liquids.

3.25

permeation

process by which a chemical moves through a material on a molecular level

Note 1 to entry: Permeation involves:

- sorption of the molecules of the chemical into the contacted (outside) surface of a material;
- diffusion of the sorbed molecules in the material, and;
- desorption of the molecules from the opposite (inner) side of the material.

[SOURCE: ISO/TR 19591:2018, 3.230]

3.26 seam

permanent junction between two or more pieces of material created by sewing, welding or other method

Note 1 to entry: Seams include the permanent joining of suit material to suit material and suit material to other materials of construction such as integral visor (3.22) materials (visor seams), *bootees* (3.4) if they are different from the suit material and also permanently attached gloves (3.16) and boots.

[SOURCE: ISO/TR 19591:2018, 3.267, modified — Note 1 to entry was added.]

3.27 tethered applications

applications in which a hose or line is attached to the garment or hood portion of an ensemble via an external fitting mounted on the garment material that is further connected to a fixed location external to the suit

3.28 visor

portion of the *chemical protective suit* (3.7) that permits the user to see out of the ensemble

[SOURCE: ISO/TR 19591:2018, 3.327]

4 Types of ensembles

All CBRN personal protective equipment (excluding respiratory protective devices unless where RPD is used to complete the protection of the wearer through an interface with the garment portion of the ensemble) are tested for integrity and material CBRN resistance. The results of these tests are used to indicate the class of ensemble based on its minimum integrity and CBRN permeation or penetration resistance according to the categories of performance given in [Table 1](#). In addition, separate elements of the CBRN PPE ensemble are required to meet the requirements of that PPE in addition to the requirements of this document unless specified differently.

4.1 Classification of protective ensembles

This document establishes six general classifications of protective ensembles for use against chemical, biological, radiological and nuclear (CBRN) agents and four subclasses of ensembles, one each for four of these classes. Classifications are based on the type and level of vapour, liquid, and particulate protection offered by the ensemble in combination with the type of respiratory protective equipment as part of the ensemble as specified in [Table 1](#).

Class 1 ensembles provide an ultrahigh level of gas/vapour chemical protection, ultrahigh level of liquid chemical protection, protection against both biological infective agents and particulates, and are normally worn with full face-piece, open-circuit self-contained breathing apparatus that has been qualified for protection against CBRN agents and is intended for atmospheres immediately dangerous to life and health. These ensembles meet the requirements of ISO 17723-1:2019 and can require additional testing to meet the requirements of this standard, depending on the qualification approach used.

Class 2 ensembles provide a high level of gas/vapour chemical protection, high level of liquid chemical protection, protection against both biological infective agents and particulates, and are normally worn with full face-piece, open-circuit self-contained breathing apparatus that has been qualified for protection against CBRN agents and is intended for atmospheres immediately dangerous to life and health.

Class 3 ensembles provide a moderate level of gas/vapour chemical protection, moderate level of liquid chemical protection, protection against both biological infective agents and particulates and are normally worn with full face-piece, open-circuit self-contained breathing apparatus that has been qualified for protection against CBRN agents and is intended for atmospheres immediately dangerous to life and health.

Class 4 ensembles provide a low level of gas/vapour protection, low level of liquid protection, protection against both biological infective agents and particulates and are normally worn with either a full face piece air-purifying respirator or full face-piece or hooded power air-purifying respirator that has been qualified for protection against CBRN agents.

Class 5 ensembles provide a limited level of gas/vapour protection, limited level of liquid protection, and permit optional protection against both biological infective agents and particulates. These ensembles use air-permeable materials and are normally worn with either a full face piece air-purifying respirator or full face-piece or hooded power air-purifying respirator that has been qualified for protection against CBRN agents.

Class 6 ensembles provide protection against both biological infective agents and particulates and are normally worn with either a full face-piece air-purifying respirator or full face-piece or hooded power air-purifying respirator that has been qualified for protection against particulates or biological aerosols.

Table 1 — General classification of CBRN protective ensembles

Class	Agent Protection				Suggested Minimum RPD Type
	Gas/Vapour Chemical [^]	Liquid Chemical [*]	Particulate	Biological Infective	
1	Ultrahigh (100 %)	Ultrahigh (100 g/m ²)	Yes	Yes	SCBA for CBRN that meets ISO/TS 17420-9
2	High (10,000 ppm)	High (20 g/m ² , closed top)	Yes	Yes	SCBA for CBRN that meets ISO/TS 17420-9
3	Moderate (350 ppm)	Moderate (10 g/m ² , closed top)	Yes	Yes	SCBA for CBRN that meets ISO/TS 17420-9
4	Low (40 ppm)	Low (10 g/m ² , open top)	Yes	Yes	APR or PAPR for CBRN that meets ISO/TS 17420-8
5	Limited ^{**} (40 ppm)	Limited ^{**} (10 g/m ² , open top)	Optional	Optional	APR or PAPR for CBRN that meets ISO/TS 17420-8
6	None	None	Yes	Yes	APR or PAPR for particulates or bio aerosols that meet the requirements of ISO 17420-2
[*] See Clause 7.6.2 and Table 6 . ^{**} Limited only to chemical warfare agents (does not include demonstration of protection against toxic industrial chemicals)					

The specific levels of agent protection are defined by specific performance properties for both overall ensemble integrity and ensemble element materials agent permeation or penetration resistance as defined in [Clauses 5](#) and [6](#).

4.2 Sub-classes of protective ensembles

Two sub-classifications for Classes 3 through 6 are provided in terms of the ensemble physical hazard resistance and durability. Sub-classifications include **normal ("N")** and **robust ("R")**. These sub-classifications are based on different physical property requirements applied to ensemble element materials and conditioning that is applied to full ensemble in overall ensemble integrity testing. However, the same ensemble integrity and material barrier performance requirements are applied to both Sub-Class N and Sub-Class R.

The ensemble classification in [Table 1](#) establishes a hierarchy of performance where Class 1 ensemble offer greater protection than Class 2 ensemble and so on through Class 5 ensembles. Class 6 ensembles are excluded from this hierarchy since they are not required to demonstrate protection from gas/vapour or liquid chemicals.