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PPE ensembles for firefighters undertaking hazardous materials response activities —

Part 1: Gas-tight, vapour-protective ensembles for emergency response teams ("type 1")

Équipement de protection personnelle pour pompiers entreprenant des activités de réponse de produits dangereux —

Partie 1: Ensembles hermétiques au gaz et à la vapeur pour équipes d'urgence («type 1»)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Personal protective clothing equipment*, Subcommittee SC 14, *Firefighter's 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

The purpose of this document is to provide minimum design and performance requirements for personal protective equipment, excluding respiratory protective devices (RPD), designed for protection against chemicals, including gases, vapours, liquids, and particulates during hazardous materials response by the emergency response teams of the fire services. This specific document addresses the highest form of protection for hazardous materials responses involving chemical gases, vapours, liquids, and particulates. Annex B provides a recommendation for selection of personal protective equipment for hazardous materials response.

Hazardous materials response involves significant potential dangers to the emergency responder. Accordingly, a risk assessment is undertaken to determine if the personal protective equipment covered by this standard is suitable for its intended use and the expected exposure. A risk assessment includes what additional personal protective equipment is necessary.

Emergency responders need to be trained in the selection, use, care and maintenance of the personal protective equipment covered by this document, including an understanding of its limitations.

PPE ensembles for firefighters undertaking hazardous materials response activities —

Part 1:
Gas-tight, vapour-protective ensembles for emergency response teams ("type 1")

1 Scope

This document establishes minimum design and performance requirements for personal protective ensembles to be worn during hazardous materials responses involving chemical gas, vapour, liquid, and particulate hazards. This document provides optional criteria to address protection during terrorism involving chemical and biological agents. This document provides optional criteria to address the ability of ensembles to retain their integrity during escape in the event of chemical flash fire. This document does not establish minimum criteria for protection against radiological hazards, flammable, or explosive atmospheres. This document does not pertain to clothing providing the high level of heat and flame protection that is required for fighting fires. This document does not address respiratory protection.

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 4674-1, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

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

ISO 10874:2009, *Resilient, textile and laminate floor coverings — Classification*

ISO 12947-1, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 1: Martindale abrasion testing apparatus*

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

ISO 13688, *Protective clothing — General requirements*

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

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

ISO 16602:2007/Amd1:2012, *Protective clothing for protection against chemicals — Classification, labelling and performance requirements*

ISO 16604, *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 17491-1, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 1: Determination of resistance to outward leakage of gases (internal pressure test)*

ISO 17491-2, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 2: Determination of resistance to inward leakage of aerosols and gases (inward leakage test)*

ISO 20345:2011, *Personal protective equipment — Safety footwear*

ISO 23388, *Protective gloves against mechanical risks*

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

EN 15090:2012, *Footwear for firefighters*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

NOTE A graphical hierarchy of terms is provided in Annex G.

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

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

3.3
bootee
sock-like extension of the *chemical protective suit* (3.7)

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

3.4
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]

3.5
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".]

3.6
chemical protective clothing
combined assembly of garments worn to provide protection to the skin against exposure to or contact with chemicals

[SOURCE: ISO/TR 19591:2018, 3.37]

3.7
chemical protective suit
clothing worn to protect against chemicals that covers the whole, or greater part of the body

Note 1 to entry: A chemical protective suit can comprise of garments combined together to provide protection to the body. A suit can also have various types of additional protection such as hood or helmet, boots and *gloves* (3.16), joined with it.

[SOURCE: ISO/TR 19591:2018, 3.39]

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
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 replace by "release".]

3.13
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]

3.14
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.]

3.15
gas-tight, vapour-protective ensemble
multiple items of clothing and equipment which when used together provide a high degree of protection for emergency responders from the adverse exposures to the inherent risks of hazardous materials and that demonstrate gas-tight integrity

Note 1 to entry: The elements of the gas-tight, vapour-protective ensemble include the *chemical protective suit* (3.7), *gloves* (3.16), and *footwear* (3.14).

Note 2 to entry: The gas-tight, vapour-protective ensemble can either be of limited use or re-usable construction, see 3.18 and 3.20.

Note 3 to entry: When referring to an “ensemble”, in the latter part of this document, gas-tight, vapour-protective ensemble is meant.

[SOURCE: ISO/TR 19591:2018, 3.131, modified — The notes 2 and 3 to entry were added.]

3.15.1
type 1a ensemble
gas-tight ensemble with a breathable gas supply that is independent of the ambient atmosphere

EXAMPLE An ensemble with RPD, type SCBA (self-contained breathing apparatus) worn inside.

3.15.2
type 1b ensemble
gas-tight ensemble with a breathable gas supply worn outside

EXAMPLE An ensemble with RPD, type SCBA (self-contained breathing apparatus) worn outside.

3.16
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]

3.17
lifeline
attached rope the purpose of which is to help to retrieve and pull someone back to safety

Note 1 to entry: This item should not be considered to be a fall-protection device.

3.18
limited-use chemical protective suit
chemical protective suit (3.7) for limited duration of use, i.e., to be worn until hygienic cleaning becomes necessary or chemical contamination has occurred and disposal is required

Note 1 to entry: This includes protective suits for single use and for limited re-use according to the information provided by the manufacturer.

[SOURCE: ISO/TR 19591:2018, 3.179, modified — The word "clothing" was replaced by "suit" in both the term and the definition.]

3.19
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]

3.20
re-usable chemical protective suit
chemical protective suit (3.7) that is constructed from materials allowing the clothing to be cleaned after repeated chemical exposures such that it remains suitable for continued use

[SOURCE: ISO/TR 19591:2018, 3.261, modified — The word "clothing" was replaced by "suit" in both the term and the definition.]

3.21
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.]

3.22
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 Ensemble requirements

4.1 General requirements

4.1.1 Minimum ensemble configuration

The gas-tight, vapour-protective ensemble shall consist of a chemical protective suit incorporating hood, gloves, footwear and RPD (respiratory protective device).

4.1.2 Hood visor

For type 1a ensembles, the suit hood shall be provided with a visor that is designed to allow the wearer to see out of the ensemble.

4.1.3 Respiratory protective device

For type 1b ensemble, any part of the respiratory protective device that forms the primary barrier between the outside environment and the wearer, for example the RPD respiratory interface materials

and hoseline and the seams and/or joins associated with, are considered part of the ensemble and shall be subjected to testing as applicable for chemical protection.

NOTE RPD ISO standards are under development to provide the adequate chemical testing. This document will be updated, amended or revised to reflect or refer to this information.

4.1.4 Designation of ensemble use

The manufacturer shall designate the ensemble as single use, limited use or re-usable.

4.1.5 Integration of ensemble

Other than outer gloves and separate boots, ensembles shall be designed so that all separate components are securely attached and provided as a single and integrated unit. The use of additional covers or outer garments, layers or components shall not be allowed to fulfil the mandatory requirements of this document.

4.1.6 Attachment of lifeline and other equipment

Pass-throughs providing breathing air into chemical protective suits shall withstand a pull force of at least 1 000 N. The force shall be at least 1 000 N for life-lines, 250 N for equipment attachment points, 150 N for exhalation valves and 100 N for boots and gloves.

Testing shall be in accordance with ISO 16602:2007/Amd1:2012, Annex B.

4.1.7 Optional requirements for integrity for escape from chemical flash fire

As an option, the ensemble may be tested for integrity for escape from chemical flash fire. The ensemble shall fulfil the following requirements when tested, according to NFPA 1991:2016, Clause 8.25, ensemble flash test.

The ensemble shall not exhibit any afterflame times longer than 2 s.

After the flash fire exposure the ensemble shall be tested in accordance with ISO 17491-1, Method 1, the ensemble shall not have a pressure drop of more than 40 %. Remove any other items of PPE which are not required to meet the basic requirements of this document before the leak tightness test. The visor shall pass the requirement of 6.2.3.

NOTE Ensembles meeting these requirements are intended to offer the wearer limited protection for escape only in situations that can result in chemical flash fires. This requirement does not imply any protection for any fire-fighting activities but offers minimum protection from the thermal effects of a chemical flash fire with no loss of suit gastight integrity.

4.2 Ensemble requirements pertaining to chemical protective suits

4.2.1 Additional or other PPE

The ensemble itself shall meet all mandatory chemical and physical requirements of this document, with the exception of gloves 4.3.1, and footwear 4.4.2. Any other optionally wearable covers shall not be allowed to provide or negatively impact the mandatory chemical and physical requirements of this document, but may provide additional protection based on other optional requirements.

4.2.2 Protective covers for exhaust valves

Protective covers shall be provided to protect the exhaust valves from direct chemical splashes to the diaphragm and interior of the exhaust valve(s). These protective covers shall be made of either the chemical protective suit material or another material meeting the minimum chemical permeation resistance requirements of this document. The covers shall allow access to the valves for removal and inspection.

