BS EN 943-1:2015

BSI Standards Publication

Protective clothing against dangerous solid, liquid and gaseous chemicals, including liquid and solid aerosols

Part 1: Performance requirements for Type 1 (gas-tight) chemical protective suits

bsi.

National foreword

This British Standard is the UK implementation of EN 943-1:2015. It supersedes BS EN 943-1:2002 which is withdrawn.

BSI, as a member of CEN, is obliged to publish EN 943-1:2015 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee voted against its approval as a European Standard.

The following concerns regarding this standard have been expressed by the UK committee:

- This standard supersedes BS EN 943-1:2002, which specifies performance requirements for both Type 1 and Type 2 chemical protective clothing. However, EN 943-1:2015 does not include any requirements for Type 2 clothing. No alternative provision has been made for the standardization of Type 2 chemical protective clothing.
- Conformance with EN 943-1 is a prerequisite of EN 943-2. The revision of EN 943-2 has not kept pace with that of EN 943-1 with the result that the links between the old part 2 and the new part 1 are no longer compliant with one another. This will make it difficult for manufacturers to approve or re-approve EN 943-2:2002 products. However, it is intended for EN 943-2 to be revised in the future and for the two parts to once again be mutually compatible.
- EN 943-1:2015 includes several new test procedures which have not been assessed for repeatability or reproducibility.

Further commentary on EN 943-1:2015 from UK Technical Committee PH/3/3 can be found in National Annex NA of this document.

The UK participation in its preparation was entrusted by Technical Committee PH/3, Protective clothing, to Subcommittee PH/3/3, Chemical, Biological, Radioactive and Nuclear Personal Protective Equipment.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Protective clothing against dangerous solid, liquid and gaseous chemicals, including liquid and solid aerosols - Part 1: Performance requirements for Type 1 (gas-tight) chemical protective suits

Vêtements de protection contre les produits chimiques dangereux solides, liquides et gazeux, y compris les aérosols liquides et les particules solides - Partie 1: Exigences de performance des combinaisons de protection chimique étanches aux gaz (type 1)

Schutzkleidung gegen gefährliche feste, flüssige und gasförmige Chemikalien, einschließlich Flüssigkeitsaerosole und feste Partikel - Teil 1: Leistungsanforderungen für Typ 1 (gasdichte) Chemikalienschutzkleidung

This European Standard was approved by CEN on 27 June 2015.

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European foreword

This document (EN 943-1:2015) has been prepared by Technical Committee CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2016, and conflicting national standards shall be withdrawn at the latest by February 2016.

This document supersedes EN 943-1:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

For details of the significant changes made since EN 943-1:2002 please refer to Annex E.

EN 943 consists of the following parts:

EN 943-1, *Protective clothing against solid, liquid and gaseous chemicals, including liquid and solid aerosols — Part 1: Performance requirements for Type 1 (gas-tight) chemical protective suits*

EN 943-2, *Protective clothing against solid, liquid and gaseous chemicals, including aerosols — Part 2: Performance requirements for Type 1 gas-tight chemical protective suits for emergency teams (ET)*

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the minimum requirements, test methods, marking and information supplied by the manufacturer for ventilated and non-ventilated gas-tight chemical protective suits.

It specifies full body personal protective ensembles to be worn for protection against solid, liquid and gaseous chemicals, including liquid and solid aerosols.

This standard does not establish minimum criteria for protection for non-chemical hazards, e.g. radiological, fire, heat, explosive, infective agents. This type of equipment is not intended for total immersion in liquids.

The seams, joins and assemblages attaching the accessories are included within the scope of this standard. This standard specifies only supplementary requirements for components. The basic performance criteria for the components gloves, boots or respiratory protective equipment are given in other European Standards.

Particulate protection is limited to physical penetration of the particulates only.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

EN 388, *Protective gloves against mechanical risks*

EN 1073-2, *Protective clothing against radioactive contamination - Part 2: Requirements and test methods for non-ventilated protective clothing against particulate radioactive contamination*

EN 12021, *Respiratory equipment - Compressed gases for breathing apparatus*

EN 13274-4:2001, *Respiratory protective devices - Methods of test - Part 4: Flame tests*

EN 14593-1:2005, *Respiratory protective devices - Compressed air line breathing apparatus with demand valve - Part 1: Apparatus with a full face mask - Requirements, testing, marking*

EN 14594:2005, *Respiratory protective devices - Continuous flow compressed air line breathing apparatus - Requirements, testing, marking*

EN 14325:2004, *Protective clothing against chemicals - Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages*

CEN ISO/TR 11610, *Protective clothing - Vocabulary (ISO/TR 11610)*

EN ISO 13688:2013, *Protective clothing - General requirements (ISO 13688:2013)*

EN 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 13982-2:2004)*

EN ISO 17491-3, *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 17491-3:2008)*

EN ISO 20345:2011, *Personal protective equipment - Safety footwear (ISO 20345:2011)*

ISO 17491-1:2012, *Protective clothing — Test methods for clothing providing protection against chemicals — Part 1: Determination of resistance to outward leakage of gases (internal pressure test)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN ISO/TR 11610 and EN 132 together with the following apply.

3.1
assemblage
permanent fastening between two or more different garments, or between the protective clothing and accessories obtained for example by sewing, welding, vulcanizing, gluing

[SOURCE: EN 1073-1:1998]

3.2
join
non-permanent fastening between two different garments, or between protective clothing and accessories

3.3
bootees
sock like gastight extension of the suit leg that encapsulates the entire foot

Note 1 to entry: Intended to be worn inside separate (i.e. not attached) protective boots or protective shoes.

3.4
cleaning
removal of contamination or soiling

Note 1 to entry: There are several separate types of cleaning that may be applicable to chemical protective clothing. The purpose of each type of cleaning is distinct, though the same operation may, under some circumstances, fulfil the requirements of more than one type of cleaning.

3.4.1
hygienic cleaning
operation to remove soiling that originates from the body of the wearer of the suit

Note 1 to entry: The purpose of this type of cleaning is to render the inside of the suit sufficiently clean that another wearer can then safely and comfortably wear it. Hygienic cleaning can consist of rinsing or wiping the inside of the suit with a disinfectant solution.

Note 2 to entry: An example of soiling intended to be removed by hygienic cleaning is perspiration.

3.4.2
washing
operation to remove general soiling that does not originate from either the wearer of the suit or the chemical hazards against which the suit is worn as protection

Note 1 to entry: An example of soiling intended to be removed by washing is mud.

3.4.3
decontamination
operation to remove chemical contamination from the outside of the suit

Note 1 to entry: The primary purpose of decontamination is to render the outside of the suit sufficiently clean that the wearer can remove the suit without coming into contact with those chemicals from which the suit has been protecting him or her. A secondary aim of decontamination may be to render the suit sufficiently chemically clean that it will not contaminate future wearers or personnel involved in the maintenance and/or storage of the suit before it is next used. Decontamination may involve wiping or rinsing the suit with copious amount of water, or treatment with a solution, liquid or solid in order to neutralize the contamination or otherwise render it harmless.

3.5
disinfection
purposeful reduction of the number of certain unwanted microorganisms by physical or chemical inactivation, so that they can cause no more infection under the given circumstances

3.6
external ventilating hose
hose that is used to supply a type 1 suit with breathable air providing internal ventilation

3.7
integral overshoe
gas-tight integrated footwear, connected to the chemical protective suit and intended to be worn with personal footwear inside thus protecting the wearer's feet and footwear

Note 1 to entry: The integral overshoe and the personal footwear together fulfil the requirements of footwear. An overshoe may have either a permanent or detachable outsole.

3.8
Type 1 - gas-tight chemical protective suit
(type 1 suit)
one-piece garment with hood, gloves and boots which, when worn with appropriate respiratory protective devices, provides the wearer a high degree of protection against harmful liquids, particles and gaseous or vapour-phase contaminants

3.8.1
Type 1a - gas-tight chemical protective suit
(type 1a suit)
gas-tight chemical protective suit to be used in conjunction with a breathable air supply which is both independent of the ambient atmosphere and worn inside the suit

Note 1 to entry: e.g. a self-contained open-circuit compressed-air breathing apparatus.

3.8.2
Type 1b - gas-tight chemical protective suit
(type 1b suit)
gas-tight chemical protective suit to be used in conjunction with a breathable air supply independent of the ambient atmosphere supplied from or worn outside the suit

Note 1 to entry: e.g. a self-contained open circuit compressed air breathing apparatus.

Note 2 to entry: As chemical protective suits are used with respiratory devices, special attention should be given to the adequate selection and fit of respiratory protective equipment. The limiting factors for the use of respirators should be taken into consideration.

3.8.3
Type 1c - gas-tight chemical protective suit
(type 1c suit)
gas-tight chemical protective suit to be used in conjunction with breathable air providing positive pressure where the suit is the face piece

Note 1 to entry: e.g. air lines where the wearer breathes from the suit.

3.8.4
Ventilated suit
Type 1a, 1b, or 1c which includes the provision of air for comfort, or dehumidification purposes

4 Performance requirements

4.1 General

This European Standard requires that various materials of construction and components of the suit be tested for resistance to chemical permeation. In cases where more than one chemical is tested, each component and material of construction shall be tested against each chemical.

4.2 Materials

Chemical protective clothing materials of construction (i.e. materials used in the construction of the garment, bootees, boots, gloves, and (if fitted) visor) shall fulfil all the non-optional test requirements given in Table 1. The optional tests listed in Table 1 may be carried out at the discretion of the manufacturer in accordance with intended use. Components such as integral overshoes or boots, integral gloves shall also fulfil the minimum performance requirements of the respective product standard.

Pre-conditioning and conditioning shall be carried out in accordance with EN 14325:2004, 4.2 and 4.3.

Materials of construction shall comply with all subsections of EN ISO 13688:2013, 4.2.

Table 1 — Minimum performance requirements of Type 1 chemical protective clothing

Clothing component	Performance requirement	Test method reference	Minimum performance class (as defined in the relevant table in EN 14325:2004 unless otherwise stated)
Garment	Abrasion resistance	4.4 of EN 14325:2004	3
	Flex cracking resistance	4.5 of EN 14325:2004	1
	Flex cracking at –30 °C (optional)	4.6 of EN 14325:2004	2
	Trapezoidal tear resistance	4.7 of EN 14325:2004	3
	Tensile strength	4.9 of EN 14325:2004	3
	Puncture resistance	4.10 of EN 14325:2004	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of EN 14325:2004	3
	Resistance to ignition	4.14 of EN 14325:2004	See B.2

Clothing component	**Performance requirement**	**Test method reference**	**Minimum performance class (as defined in the relevant table in** EN 14325:2004 **unless otherwise stated)**
Bootees (If made from different material than the suit)	Abrasion resistance	4.4 of EN 14325:2004	3
	Flex cracking resistance	4.5 of EN 14325:2004	1
	Flex cracking at –30 °C (optional)	4.6 of EN 14325:2004	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of EN 14325:2004	3
Integral overshoe (upper)	Abrasion resistance	4.4 of EN 14325:2004	3
	Trapezoidal tear resistance	4.7 of EN 14325:2004	3
	Puncture resistance	4.10 of EN 14325:2004	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of EN 14325:2004	3
Integral overshoe (outsole)	Puncture resistance	6.2.1 of EN ISO 20345:2011	6.2.1 of EN ISO 20345:2011
Boots	Resistance to permeation by chemicals (liquids and gases)	4.11 of EN 14325:2004	3
Gloves	Resistance to permeation by chemicals (liquids and gases)	4.11 of EN 14325:2004	3
	Mechanical resistance [a]	EN 388	See table footnote a
Visor, face mask, face seal (if fitted)	Resistance to permeation by chemicals (liquids and gases) [b]	4.11 of EN 14325:2004	3
	Mechanical strength	5.6.5 of EN 943–1	comply

[a] To select the suitable gloves or boots see the SUCAM document or perform a risk assessment to choose the product with the necessary properties.

[b] Visor materials tested shall be inspected for visible degradation. If the material shows change of optical clarity or transparency, 5.6.3 shall be done. This test shall be carried out for all the chemicals the manufacturer applies for, where an optical change of the material is visible (see 4.2, Table 1).

4.3 Seams, joins, and assemblages

The requirements of this clause apply to the component parts, such as visor or face piece, bootees, gloves or boots that are integral to the garment.

Seams (suit to suit, bootee to bootee, etc.), joins or assemblages (visor to suit, glove to suit, booties to suit, boots to suit, etc.) shall fulfil the performance requirements listed in Table 2. If it is not possible to test adjacent seams or assemblages separately, they may be tested together.

When the strength of a seam is tested, the value shall be taken regardless of where the break occurs.

For each chemical tested, the permeation test shall be carried out using the same diameter cell, the same collection medium and the same collection system (open or closed loop) as used for testing the suit fabric.

Closure assemblies (e.g. zipper) shall be tested without any cover.

Table 2 — Minimum performance requirements for seams, joins and assemblages

Clothing component (seams, joins, assemblages)	**Performance requirement**	**Test method reference**	**Minimum performance class (as defined in the relevant table in** EN 14325:2004 **unless otherwise stated)**
Suit material to suit material	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2004 4.11	3
	Seam strength	EN 14325:2004 5.5	5
Closure assembly (e.g. zipper)	Resistance to permeation by chemicals (liquids and gases) [a]	EN 14325:2004 4.11	5 minutes [d]
	Closure strength [b]	EN 14325:2004 5.5	3
Assemblages	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2004 4.11	3
Visor to suit	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2004 4.11	3
Glove to suit (permanent)	Resistance to permeation by liquids and gases	EN 14325:2004 4.11	3
	Mechanical strength	EN 14325:2004 5.5	3
Bootee to suit (permanent)	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2004 4.11	3
Boots to suit (permanent)	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2004 4.11	3
	Mechanical strength	EN 14325:2004	4

		5.5	

a The basic requirement of this clause is for the main closure component (usually a zipper) to be tested for resistance to permeation In many cases the closure system includes one or two outer protective flaps. The existence of such flaps does not take away this requirement. In order to avoid too high permeation breakthrough times which may result when clamping a zipper covered by a flap in a permeation test cell, the main closure component (e.g. zipper) itself shall be tested for permeation without any flaps, covers etc.

b The full closure assembly as it is made on the chemical protective clothing shall be tested. It may be necessary to increase the length of the specimen (as specified in EN ISO 13935-2) to accommodate the full width of the closure assembly and allow it to be clamped in the surrounding suit material in the tensile testing machine. If the test house deems it is not possible to take samples from complete CPC separately produced samples made by the manufacturer using the same construction technique may be tested provided that it can be demonstrated that they are representative of the chemical protective clothing.

c The EN ISO 6529 permeation test cell may have to be modified for testing of closures to ensure that the sample can be sealed in the cell in a leak-proof manner (see Annex D).

d See 4.5 if class 3 is not met.

4.4 Strength of detachable joins

The strength of detachable joins between the suit and detachable parts e.g. between gloves (chemical resistant) and sleeves, boots and trouser legs, and bonded in facemasks, shall be tested in accordance with 6.4. The force at which the components separate shall be > 100 N.

If additional, separate outer gloves are used to fulfil additional mechanical and thermal requirements the pull force of the outer gloves shall be tested in accordance with 6.4. The force at which the components separate shall be > 30 N.

4.5 Permeation requirement for closure

If the closure or closure assembly (usually a zipper) fails to meet class 3, the closure or closure assembly shall be protected by a flap or cover to reduce the risk of liquid chemical contact.

5 Requirements for the whole suit

5.1 General

The protective clothing shall fulfil the requirements of EN ISO 13688:2013, Clauses 4, 6, 7 and 8.

Chemical protective suits shall fulfil all the applicable requirements given in Table 3 when tested as a complete suit, or when specified as tested with the related samples. Conditioning shall be carried out in accordance with 5.3 before testing, unless otherwise indicated in the test method.

Gas-tight chemical protective suits shall fulfil the following requirements when tested as a complete assembly. The outside of the gas-tight chemical protective suit shall not have any pockets or features similar to pockets. Pockets and/or features inside the gas-tight chemical protective suit are allowed.

Table 3 — Performance requirements for whole suits

5 Requirements for the whole suit	Type 1a	Type 1b	Type 1c
5.1 General	√	√	√
5.2 Compatibility with other equipment	√	√	√
5.4 Leak tightness	√	√	√
5.5 Inward leakage		√ (1)	√
5.6 Visors			
5.6.1 General	√		√
5.6.2 Distortion of vision	√		√
5.6.3 Distortion of vision after chemical exposure	√	√	√
5.6.4 Field of vision	√		√
5.6.5 Mechanical strength	√		√
5.7 Face piece for suits without integral visor	√	√	
5.8 Pass-through			
5.8.1 General	(√)	(√)	(√)
5.8.2 Strength of pass-through	(√)	(√)	√
5.8.3 Performance of pass-through	(√)	(√)	√
5.9 Airline supply system			
5.9.1 General	(√)	(√)	√
5.9.2 Couplings	(√)	(√)	√
5.9.3 Connections	(√)	(√)	√
5.9.4 Connection strength	(√)	(√)	√
5.10 Exhaust assembly	√	(√)	√
5.11 Pressure in chemical protective suit	√	(√)	√
5.12 External ventilating hose	(√)	(√)	(√)
5.13 Air flow rate			
5.13.1 General	(√)	(√)	√
5.13.2 Continuous flow valve	(√)	(√)	√
5.13.3 Warning and measuring facilities	(√)	(√)	√
5.13.4 Compressed air supply tube	(√)	(√)	√
5.14 Carbon dioxide content of inhalation air			√
5.15 Noise associated with air supply to suit	(√)	(√)	√
5.16 Practical Performance	√	√	√

√ This requirement shall be fulfilled.
(√) If the component item is fitted, the requirements shall be met.
(1) Inward leakage test is required for Type 1b suits where the facemask is not permanently attached.

5.2 Compatibility with other equipment

The chemical protective suit shall be compatible with all models of face pieces, air supply systems and head protection which the manufacturer states are suitable for use with the chemical protective suit. If there is an interface with other kinds of PPE recommended by the manufacturer and worn in conjunction with the chemical protective suit, all tests according 6.1 and 6.2 shall be carried out with this additional PPE. The test result shall be recorded in the test report (see 6.2.3).

5.3 Conditioning to simulate storage conditions

Conditioning to be conducted prior to performing the subsequent whole suit test (see 5.4 and 5.5). The complete suit shall be exposed:

a) for not less than 4 h to an atmosphere of (60 ± 3) °C at (95 ± 5) % relative humidity; followed by

b) for not less than 4 h to a temperature of (−30 ± 3) °C.

Between step a) and b) and further testing the unit shall be allowed to return to ambient temperature.

If the manufacturer states in their instructions for use, another temperature range beyond these low temperature and high temperature specification (<-30 °C and > 60 °C), the storage simulation shall be carried out at 10 degrees more extreme than the manufacturer recommended temperature.

5.4 Leak tightness (static inflation test)

The complete suit shall be tested according to ISO 17491-1:2012, Method A2 both before and after practical performance test according to 6.2. The pressure drop during the course of the 6-minute test shall not be greater than 300 Pa (3 mbar).

5.5 Total inward leakage test

When tested in accordance with Annex A the total inward leakage shall not exceed the values given in Table 4.

Table 4 — Inward leakage performance

Suit type	Inward leakage
Type 1a	Not required (5.4 applies)
Type 1b with full face mask permanently joined to the suit (an assemblage)	Not required (5.4 applies)
Type 1b using a full face mask which is not permanently joined to the suit	5.4 plus Inward leakage test (Annex A) with inward leakage not greater than 0,05 % when measured within the suit being considered as a measure of the total inward leakage of the whole suit.
Type 1b using a full face mask which is not permanently joined to the suit	Inward leakage test with inward leakage not greater than 0,05 % when measured according Annex A into the full face mask.
Type 1c	5.4 plus Inward leakage test (Annex A) with inward leakage not greater than 0,05 % measured within the suit being considered as a measure of the total inward leakage of the whole suit.

5.6 Visor

5.6.1 General

All external visors shall comply with 5.6.2 to 5.6.4.

5.6.2 Distortion of vision

Requirements for the distortion of vision are given in Table 5.

Table 5 — Requirements and testing of the visor

Properties of the visor	Requirement	Testing
Distortion of vision	The loss of sight shall not exceed two tenths on an optometrical chart (see also Annex C)	To read letters on a chart during the practical performance test according to 6.2.

5.6.3 Distortion of vision after chemical exposure

Requirements for the distortion of vision after chemical exposure are given in Table 6.

Table 6 — Requirements and testing of the visor after chemicals exposure

Properties of the visor	Requirement	Testing
Distortion of vision after chemical exposure	This test shall be carried out for all the chemicals the manufacturer applies for, where an optical change of the material is visible (see 4.2, Table 1). The loss of sight shall not exceed two tenths on an optometrical chart (see also Annex C).	The chemical exposure shall be carried out according to 6.7. To read letters on a chart during the practical performance test according to 6.2.

5.6.4 Field of vision

The field of vision shall be sufficiently adequate to allow the test subject to carry out all activities of the practical performance test described in 6.2.

5.6.5 Mechanical strength

The visor shall not be visibly damaged (e.g. indentations, debris or cracks) in such a way as to affect the performance of the complete device, when tested in accordance with 6.6. After this test the pressure drop test shall be carried out and shall pass the requirement as specified in 5.4

5.7 Face piece for suits without integral visor

Full face masks complying with class 2 or 3 of EN 136:1998 shall be used. No other respiratory interfaces are allowed. If the facemask is attached to the suit in a non-permanent manner the seal between the facemask and suit shall be tested in accordance with the EN ISO 17491-3, “jet test”. The total stain area on the undergarment shall be less than three times the calibrated stain area. Three samples of facemask to suit joins shall be tested after conditioning to 5.3.

NOTE The security of this seal, and therefore the outcome of this test, is dependent upon a number of factors including:

— the shape and size of the wearer's head;

— the model and size of facemask;

— the size and fit of the suit;

— fine adjustment of straps on both suit and facemask.

5.8 Pass-through

5.8.1 General

If a pass-through is fitted, it shall satisfy the requirements of 5.8.2.

If the pass-through is providing air for breathing it shall also fulfil the requirements of 5.8.3.

If a chemical protective suit is fitted with an airline pass-through, the pass-through, connections and airline to the suit and body shall be evaluated as part of the practical performance test (see 6.2) and shall not impede the test subject from completing any task listed in 6.2.

5.8.2 Strength of pass-through

The complete device and its assembly to the suit and body shall withstand a steady force of 1 000 N when tested in accordance with EN 14594:2005, 7.6.

5.8.3 Performance of pass-through providing breathing air

If the pass-through is designed to provide breathing air it shall comply with the related supplied air standard(s) EN 14593-1 or EN 14594 as applicable.

5.9 Airline supply system

5.9.1 General

The quality of supplied air shall comply with EN 12021.

If a chemical protective suit in conjunction with an airline supply system providing positive-pressure (e.g. continuous flow compressed air line breathing apparatus) is to be used a body harness or belt shall be provided within the suit to which the airline supply system shall be attached. The assembled airline supply system in conjunction with body harness or belt shall satisfy the requirements of EN 14594:2005, 6.7, level B.

5.9.2 Couplings

The couplings shall comply with EN 14594:2005, 6.6.2. The equipment shall be constructed so that any twisting of the hoses and tubes does not affect the fit or performance of the suit or respiratory equipment, or cause the hoses or tubes to become disconnected. The design of the coupling shall be such as to prevent unintentional interruption of the air supply. Where a hand-operated connection is fitted to the outlet of the compressed air tube, it shall incorporate a self-sealing coupling to seal the air supply to the suit. Couplings shall be evaluated as part of the practical performance (see 6.2).

The external pass-through coupling shall be fitted with a removable liquid-tight cap in order to keep the mating surfaces free from contamination when the pass through is not in use.

5.9.3 Connections

Components of the respiratory protective equipment shall be readily separated for cleaning, examination and testing. All demountable connections shall be readily connected and secured, where possible by hand. Any

means of sealing used shall be retained in position when the joints and couplings are disconnected using normal maintenance. Connections shall be evaluated as part of the practical performance (see 6.2).

5.9.4 Connections strength

The connection between the compressed air supply tube and the chemical protective suit, including attachments, thread parts, belt, or other parts, or means of stabilizing the suit to the body shall not separate when tested in accordance with EN 14594:2005, 7.6, class B.

5.10 Exhaust assembly

Type 1a and type 1c suits shall be provided with an exhaust assembly which may consist of one or more exhalation valves. Type 1b suits shall be fitted with an exhaust assembly if the exhalation valve of the respiratory protective equipment is not free to discharge directly to the atmosphere. Type 1b suits shall also be fitted with an exhaust assembly, if supplementary air for ventilation is supplied to the chemical protective suit.

When tested in accordance with 6.5.1 the valve leakage shall not exceed 100 Pa in 1 min. Three devices shall be tested, one of which has been conditioned according to 5.3.

When tested in accordance with 6.5.2, the connection between the exhaust valve(s) and the chemical protective suit shall withstand a pull of not less than 150 N for 10 s.

The diaphragm of the exhalation valve shall be covered to give additional precautionary protection against liquid ingress.

5.11 Pressure in chemical protective suit

When tested in accordance with 6.3 the pressure in the suit shall not exceed 400 Pa. Type 1b suits shall only be tested when an exhaust assembly is fitted.

5.12 External ventilating hose

If fitted, the external ventilating hose shall be of sufficient flexibility to enable the wearer to carry out the practical performance test and it shall permit free head movement. This shall be evaluated during the course of the practical performance test (see 6.2).

Connections between the suit and the external ventilating hose shall withstand a pull test of 250 N both before and after conditioning according to 5.3.

Test in accordance with EN 14594:2005, 7.6, class A

Adequate attention should be paid to the suitability of the used air supply hoses.

5.13 Air flow rate of breathing air and/or ventilating air supply

5.13.1 General

The flow rate and distribution of air or ventilating air into the chemical protective suits shall not cause distress to the wearer by local cooling when evaluated as part of the practical performance test (see 6.2).

5.13.2 Continuous flow valve for Type 1c breathing air supply

If a continuous flow valve is fitted it shall be easily adjusted by the wearer to supply air as described in the instruction manual when evaluated as part of the practical performance test (see 6.2).The minimum air flow rate shall be measured at the minimum delivery pressure specified by the manufacturer and with the maximum length of air-supply hose specified in the compressed air supply instruction manual.

The maximum air flow rate shall be measure at the maximum delivery pressure specified by the manufacturer and with the minimum length of air-supply hose specified in the compressed air supply instruction manual.

The airflow through the continuous flow valve shall not be less than the minimum flow rate specified by the manufacturer.

The control valve shall enable the wearer to adjust the air flow rate between the minimum and the maximum air flow rate specified by the manufacturer according to 6.15 in EN 14594. It shall not be possible inadvertently to reduce the airflow below the manufacturer's minimum design flow rate.

5.13.3 Warning and measuring facilities

If the airline supply system is used as breathing air supply, the chemical protective suit shall:

1) be provided with a means to check that the manufacturer's minimum design flow rate is exceeded prior to each use, and

2) be fitted with a warning device that immediately draws the attention of the wearer to the fact that the manufacturer's minimum design flow rate is not being achieved.

The air-supply system of the chemical protective suits shall provide a means for checking the correct functioning of the warning facility.

If an audible warning device is fitted to the air supply system of the chemical protective suit:

3) The sound pressure level at the wearer’s ears of the warning device shall be in the range of 85 dB(A) to 100 dB(A), and

4) The frequency range of the warning device shall be between 2 000 Hz and 4 000 Hz.

NOTE Suitable sound level meters are specified for example in EN 61672–1.

The warning and measuring facilities shall be evaluated as part of the practical performance test (see 6.2) and in accordance with EN 14594:2005, 7.15. A total of two devices shall be tested with one of the devices subjected to temperature conditioning (see 5.3) prior to testing.

5.13.4 Compressed air supply tube

The compressed air supply tube for chemical protective suits shall comply with EN 14594:2005, 6.12, class B.

Adequate attention should be paid to the chemical suitability of the air supply hoses used.

5.14 Carbon dioxide content of inhalation air

The carbon dioxide content of the inhalation air shall comply with EN 14594:2005, 6.19 at the minimum design flow rate.

5.15 Noise associated with air supply to suit

When tested in accordance with EN 14594:2005, 7.18, the noise associated with the air supply shall comply with the requirements of EN 14594:2005, 6.16.2.5.

5.16 Practical Performance

The suit shall be deemed to have passed the practical performance test if:

— The activities detailed in 6.2.2 a) to d) can be carried out by the test subjects within the allocated time of 30 min and;

— The test subjects reports that the features assessed in 6.2.3 b) (secure fastenings and couplings), c) (accessible controls and pressure gauges), d) (acceptable clarity of visor) are acceptable.

If either of these requirements is not met with the first two test subjects then that section of the test shall be repeated by another test subject. If the new test subject encounters the problem reported by testing the first suit pair, then the suit shall be deemed to have failed.

If the average score for items a) to g) of 6.2.3 is ≥ '3', and not more than one individual score is rated at '1' then the suit passes the test.

Notwithstanding the above, the following are obvious reasons for concluding that a protective clothing product is unacceptable and not fit for use:

1) The person-defined suit size based on the subject's size does not fit in a way that a safe use is not possible.

2) It does not stay closed or it will not stay in place.

3) It compromises a vital function such as breathing.

4) Simple tasks to be performed wearing it are impossible.

5) The subject refuses to continue this assessment due to pain.

6) It prevents the wearing of other essential PPE.

6 Test methods

6.1 Visual inspection

A visual inspection shall be carried out by the test house prior to laboratory or practical performance tests. This inspection shall include a check on the integrity of the samples and shall ensure that there is nothing intrinsically dangerous about the suit. This may entail reference to the instructions for use and a certain amount of dismantling of the components of the protective clothing in accordance with the manufacturer’s instructions for maintenance.

6.2 Practical performance test

6.2.1 General

All tests shall be carried out by two test subjects. The ambient temperature during the test shall be (20 ± 5) °C, and the ambient relative humidity shall be < 60 %. The test temperature and humidity shall be recorded in the test report. The background noise shall not be greater than 75 dB(A). Suitable sound level meters are specified for example in EN 61672-1. For the test, test subjects shall be selected who are familiar with using such or similar equipment and whose medical history is known to be satisfactory. The test subjects shall be medically examined and certified fit to undertake the test procedures. The necessity of medical supervision during the tests shall be at the testing officer’s discretion.

Prior to the test there shall be an examination to confirm that the suit and essential ancillary items are in good working order and that it can be used without hazard. If more than one size of suit is manufactured the test subjects shall be asked to select the appropriate size.

Before the work simulation test is carried out the test subject shall conduct the visual acuity test described in Annex C and read the optometric card from a distance of approximately 5 m.

The work simulation test shall be carried out only after the suit has passed all the other tests specified in the standard.

Two devices shall be tested, each being tested on one test subject. The test subjects shall read the instructions for use prior to the test

After fitting the suit, each test subject is asked “Does the suit fit?” If the answer is “Yes” the subject shall proceed with the test. If the answer is “No”, report the fact and either replace the suit or the test subject and repeat from the beginning of 6.1. If the suit doesn’t fit any test subject within the given size range the sizing table shall be reported as incorrect and the suit test shall be reported as failure.

6.2.2 Work simulation test

During this test the following activities shall be done in simulation of the practical use of the suit. The test shall be completed within a maximum working time of 30 min.

a) Walking on the level with full headroom at a regular rate of 5 km/h for 5 min.

b) Climbing up and down a ladder with an inclination of 85° ± 5 ° from horizontal and a total vertical distance of 6 m for 5 min.

c) Performing a mechanical task:

The object of this exercise is to verify that the wearing of a gas-tight suit does not impair the wearer’s ability to carry out a simple mechanical task to the extent that the task becomes impossible.

The test subject shall be familiar with the test apparatus and shall be capable of completing the exercise easily when not wearing a gas-tight suit.

The apparatus shall consist of a short (approximately 1 m) length of nominal 2” (DN 50) internal diameter steel pipe mounted horizontally above a bench in an orientation parallel to the front edge of the bench. The bench surface shall be (1 ± 0,1) m above floor level. They pipe shall be fixed to the bench by means of fixing brackets such that the centre-line of the pipe is (0,10 ± 0,01) m above the bench and (0,25 ± 0,025) m behind the vertical plane of the edge of the bench.

The pipe shall be terminated in a flange-fitting that can accommodate 4 M16 bolts. The holes in the flange shall not be threaded. The orientation of the holes shall be such that a line between any two circumferentially adjacent holes shall be either vertical or horizontal.

A nominal 2” (DN 50) internal diameter globe valve shall be bolted to the flanged end of the pipe by means of 4 M16 bolts and 4 plain (i.e. non thread-locking) nuts. The shaft of the valve shall be vertical and pointing upwards. The bolts shall be inserted from the pipe side of the flange and tightened to a torque of (10 ± 1) Nm. A self-adhesive sealing gasket shall be positioned between the pipe flange and the valve with the self-adhesive side towards the valve.

The exercise shall commence with the subject turning the wheel of the valve from fully-open to fully-shut or vice versa. The subject shall then unfasten the 4 nuts using a pair of suitably-sized combination spanners.

NOTE A combination spanner is a non-adjustable spanner with 12-toothed ring spanner at one end and an open parallel-faced spanner at the other end.

Next, the subject shall remove the valve from the pipe and remove the self-adhesive sealing washer from the valve. The subject shall then replace the self-adhesive sealing washer, refit the valve to the pipe in the original orientation, and fasten the 4 bolts using the two spanners until the bolts are at approximately the original torque or tighter.

d) Read the optometric card from a distance of approximately 5 m (see Annex C).

e) If the exercises have been completed within less than 30 min the remaining time is used by the subject to walk at 5 km/h.

6.2.3 Information to be recorded

During the practical performance tests the chemical protective suit shall be subjectively assessed by the wearer. Each of the following shall be recorded and rated with a score between 1 and 5, where a score of 1 signifies the poorest performance rating, and a score of 5 signifies the best performance rating.

a) comfort of any harness fitted;

b) security of fastenings and couplings;

c) accessibility of controls and pressure gauge (if fitted);

d) clarity of vision from the face piece and/or visor;

e) peripheral vision in case of chemical protective suits and clothing fitted with visor;

f) clothing comfort (information if the user felt distress by local cooling from air flow);

g) ease of speech transmission and reception;

h) that it is possible to see without impediments through the visor when the head is moved in all directions (up, down, to the left and to the right);

i) any other comments volunteered by the wearer.

6.3 Suit pressure test

A constant air flow of 300 l/min for Type 1a and Type 1b or the maximum air flow from cooling if applicable plus 300 l/min shall be blown into the chemical protective suit:

For Type 1c suits where the suit is the respiratory interface the air maximum defined air flow + 300 l/min shall be used.

The measurement shall be carried out two minutes after the suit is fully inflated. The pressure shall be measured in the suits hood, the flow entrance should be arranged in the extremities or corpus of the suit.

6.4 Pull test for joins and assemblages

The joins or assemblages shall be assembled according to the manufacturer's instructions. One side of the join or assemblage shall be securely attached to a fixed clamp and the other to a moveable clamp of a pull test machine. A force shall be applied longitudinally to the assembly up to of (100 ± 5) N for 10 s. The maximum force at which it parts shall be recorded or it shall be stated that at 100 N it was still complete. See Figure 1.

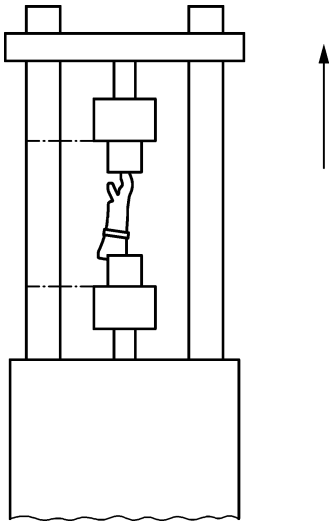


Figure 1 — Example for glove to sleeve connection pull-test

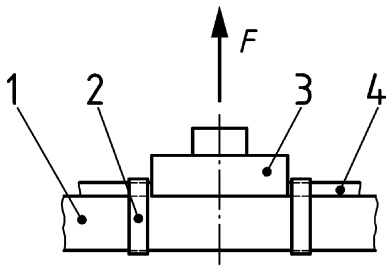
6.5 Exhalation valves

6.5.1 Leak tightness test

A pressure of – 1 kPa is applied to the inner side of the moistened exhalation valve. The air volume between exhalation valve and pressure measurement device shall be (1 000 ± 50) ml. The change in pressure in 1 min shall be recorded.

6.5.2 Connection between exhalation valve (exhaust assembly) and chemical protective clothing material

Clamp the suit fabric to a base plate and apply a load of 150 N axially to the exhalation valve in accordance with Figure 1. Examine the housing for signs of damage or loosening in the suit. Two samples shall be tested in the state they were received.



Key

1	base plate	4	suit fabric
2	clamping straps	F	force
3	exhalation valve		

Figure 2 — Connection between exhalation valve and chemical protective clothing material

6.6 Mechanical strength test for visor

The complete assembled device shall be mounted on a dummy head in the same manner as worn and with the normal vertical axis of the head in a horizontal plane, with the head facing upwards. The centre of the visor shall be impacted by a stainless steel ball (22 mm diameter, mass approximately 44 g) allowed to fall a distance of (130 ± 2) cm. The impact shall be perpendicular to the surface of the visor.

6.7 Distortion of vision after chemical exposure

A test piece of visor material with the dimensions 200 mm x 200 mm shall be used (if the actual visor has dimensions smaller than these a visor with the dimensions used on the gas-tight chemical protective suit shall be tested).

The test piece shall be placed on a level surface leaning against a support. The visor shall rest against the support at an angle of 65 ± 5° to surface. (If a flexible visor is used the support shall have the prescribed angle to the surface and allow the visor to be clamped to it so that the surface of the visor is kept flat).

100 ml of the test chemical shall be poured onto the test piece. The chemical shall be poured along the top edge of the test piece moving from one side to the other using half the amount of chemical and the rest going back thus covering the test piece twice. This operation should take (10 ± 3) s.

5 min after having applied the chemical, residues of it shall be removed and the distortion of vision shall be tested according to 5.6.2 and Annex C. Holding the visor at the same distance as the suit in front of the test persons eyes.

For gaseous chemicals the test piece shall be placed in a suitable vessel containing the pure gas and left there for 30 min. The inside of the visor which is mounted inside the gas-tight chemical protective suit should be covered so that this side is not exposed to the gas. Alternatively this may be arranged by a frame or other arrangement in the vessel.

7 Marking

The marking shall be clearly visible and legible and durable after cleaning and disinfection as described in the instruction manual.

The protective clothing shall be marked with at least the following information:

a) the name, trade mark or other means of identification of the manufacturer;

b) the TYPE of this chemical protective clothing i.e. Type 1a, Type 1b, Type 1c;

c) the number of this European Standard and the year of publication;

d) the number and date of publishing of the relevant European Standard in case the chemical protective clothing has also been tested to additional hazards (e.g. protection to radioactive particles, infective agents);

e) the month/ year of manufacture;

f) the manufacturer's type number, identification number or model number;

g) the size range as defined in EN ISO 13688;

h) the pictogram showing the suit is for protection against chemicals and the graphical symbols to show that the manufacturer’s instructions should be read.

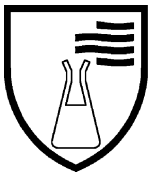


Figure 3 — Graphical symbol ISO 7000-2414 protection against chemicals and graphical symbol ISO 7000-1641 operation instruction

Consideration should be given to suitable additional marking.

8 Information supplied by the manufacturer

The information shall accompany every chemical protective suit. The information shall be at least in the official language(s) of the country or region of application. The information shall contain at least the following:

a) all information required in 7a, b, c, d, f, g, h;

b) name and full address of the manufacturer and/or his authorized representative.

NOTE 1 An electronic or other address to which feedback on the product can be sent may be useful.

c) name and full address and identification number of the notified body involved in type approval and/or quality control;

d) number of the specific European Standard (EN …) and year of publication;

e) explanation of any graphical symbol and level of performance. A basic overview of the tests that have been applied to the protective clothing and its components and a corresponding list of performance levels, preferably in a table of performance; e.g. a list of chemicals and chemical products including the names, CAS Code (if applicable), all components of the protective clothing materials that have been tested as requested in Table 1 in 4.2 and Table 2 in 4.3 and the performance levels in accordance with Table 8 of EN 14325:2004 obtained in permeation testing;

f) details of any additional non-mandatory testing that has been carried out, and the performance levels achieved in these tests (e g. details of additional testing of resistance to heat and flame or mechanical impact);

g) instructions for use and information necessary for trained users on:

   1) tests to be carried out by the wearer before use (if required);

   2) fitting, how to put on and off;

      The following words shall be inserted if applicable: “For not permanently fitted full face masks for protective chemical suits type 1b: Successful tests according to this standard should not be taken as a guarantee that a particular model of suit will perform as well on all wearers. It is recommended that such suits be individually fit-tested on wearers to ensure maximum protection.”

   3) instructions concerning appropriate use of the product to minimize the risk of injury;

   4) basic instruction on how to prevent contamination of the user and the inside of the suit while putting off the suit

   5) application, limitations of use (temperature range, breathing air quality etc.). Suits that meet class 1 or class 2 according resistance to flame of EN 14325:2004, 4.15 and suits meeting Annex B.2 shall have a warning in the instructions for use: “Flammable material, keep away from fire.”;

6) complete instructions for maintenance (service intervals and replacement of parts) and cleaning and/or decontamination including, recommendations for decontamination and disinfection (e.g. cleaning temperature, drying process, mechanical action);

7) storage conditions and expected shelf-life under storage conditions and information about inspection test intervals;

8) details of additional items of protective clothing that need to be used to achieve the protection intended;

9) if helpful illustrations, part numbers etc. shall be added;

10) instructions concerning repair;

11) the manufacturer shall give an information on whether the suit can be reused and under what conditions reuse is possible.

NOTE 2 It is recognized that decontamination may be specific to the contaminant involved. It is also recognized that not all contaminants can be sufficiently removed and that, in particular, contamination by chemical permeation may be irreversible.

h) reference to accessories and spare parts if relevant;

i) type of packing suitable for transport if relevant;

j) instructions for recycling, safe destruction and disposal as relevant (e.g. mechanical disruption or incinerating the product);

k) which respiratory protective device and/or compressed airline breathing apparatus, face piece (full face mask) and/or head protection the suit is designed for use with;

l) if required, details should be given by the suit manufacturer on tested accessories and appropriate spare parts, and this should be unambiguously specified;

m) information on antistatic properties shall be listed. e.g. warning shall be given by use of equipment in explosive atmosphere;

n) the instructions shall be unambiguous.

Annex A
(normative)

Total inward leakage test

A.1 Principle

The subject wearing the suit under test walks on a treadmill over which there is an enclosure. Through this enclosure flows a constant concentration of the test agent (sodium chloride (NaCl)) or sulphur hexafluoride (SF_6)).

The air inside the suit is sampled to determine the test agent content. The sample is extracted through a probe placed inside the suit. Another probe measures the pressure inside the suit.

The airflow rate to the suit is adjusted and maintained at the manufacturer's minimum design flow rate. For typical arrangement see Figures A.1 and A.2.

A.2 Test subjects

For the test, persons shall be selected who are familiar with using such or similar equipment and whose medical history is known to be satisfactory. The subjects shall be medically examined and certified fit to undertake the test procedures. The necessity of a medical examination before or supervision during the tests shall be at the Testing Officers discretion.

Prior to the test there is an examination that the suit is in good working condition and that it can be used without hazard. Two chemical protective suits shall be tested, each being tested on two test subjects; one of these suits shall be conditioned according to 5.3. If more than one size of suit is manufactured, the test subjects are asked to select the appropriate size.

The test subjects are asked to read the manufacturer’s fitting instructions and, if necessary, are shown how to fit the suit correctly by the Test Supervisor, in accordance with the fitting instructions. After fitting the suit each test subject is asked “Does the suit fit?” If the answer is “YES”, continue with the test. If the answer is “NO”, take the subject off the panel and report the fact and take another test subject. If no suitable test subject can be found, the suit cannot be tested and shall be deemed to have failed as described in 6.2.1.

A.3 Sodium chloride method

A.3.1 Aerosol generator

The aerosol generator is described in of EN 136:1998, 8.16.3.2.1.

A.3.2 Test agent

The mean sodium chloride concentration within the enclosure shall be as described in of EN 136:1998, 8.16.3.2.2.

A.3.3 Detection

The test atmosphere should preferably be analysed for NaCl continuously by means of a suitable flame photometer. The probe for sampling the test atmosphere shall be positioned near the hood. The NaCl concentration inside the suit is analysed and recorded by a flame photometer. This concentration, measured in the positions defined within EN 1073-2 being a measure of the total inward leakage.

The test is performed at ambient temperature and a relative humidity of less than 60 %.

A.3.4 Flame photometer

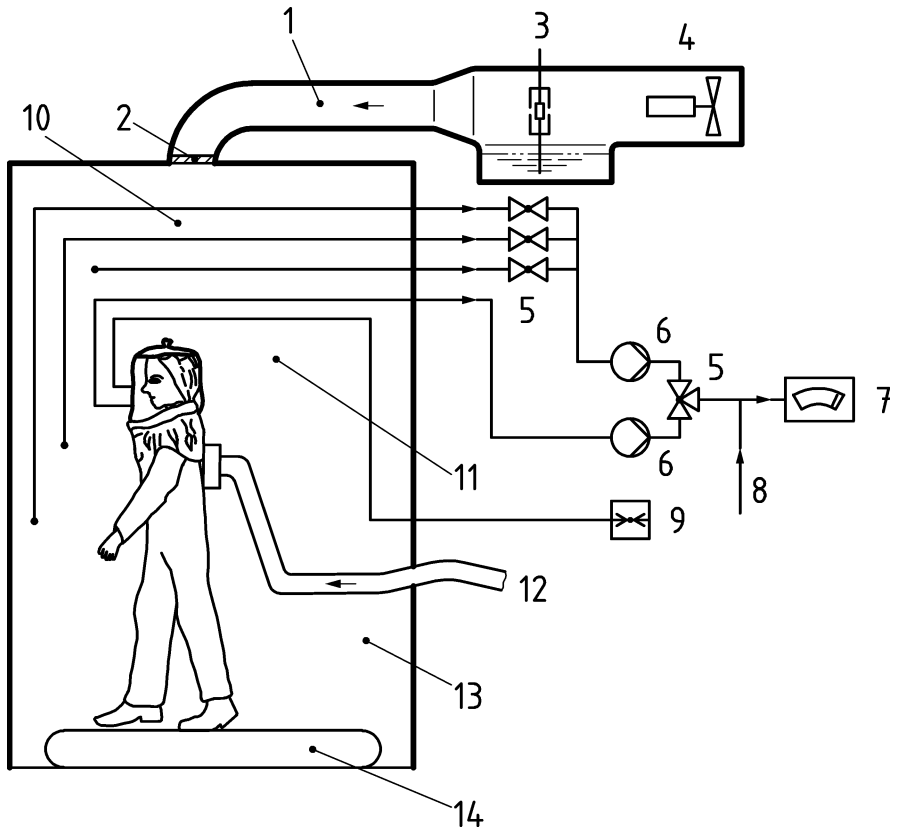
A flame photometer shall be used as described in of EN 136:1998, 8.16.3.2.3.

A.3.5 Sample pump

If no pump is incorporated into the photometer an adjustable flow pump is used to withdraw an air sample from the suit under test. This pump is so adjusted as to withdraw a constant flow of 1 l/min to 3 l/min from the sample probe. Dependent on the type of photometer it may be necessary to dilute the sample with clean air.

A.3.6 Sampling of chamber concentration

The chamber concentration is monitored during the test using a separate sampling system to avoid contamination of the suit sampling lines. It is preferable to use a separate flame photometer for this purpose. If a second photometer is not available, sampling of the chamber concentration using a separate sampling system may be made. However, time will then be required to allow the photometer to return to a clean background. Figure A.1 shows a typical sampling arrangement.



Key

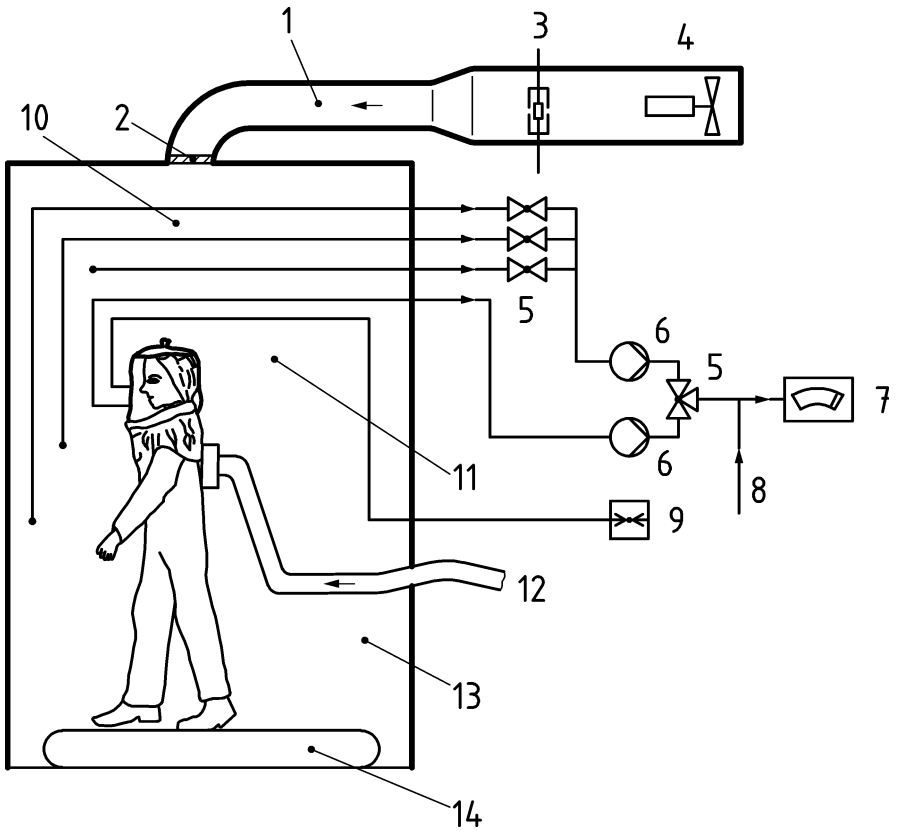
1	duct	8	additional air input
2	baffle	9	manometer
3	atomizer	10	enclosure samples
4	fan	11	breathing zone samples
5	valves	12	breathable air supply
6	pump	13	enclosure
7	photometer	14	treadmill

Figure A.1 — Typical arrangement of inward leakage test using sodium chloride aerosol

A.4 Sulphur hexafluoride method (SF6)

A.4.1 Test agent

This method employs sulphur hexafluoride as test gas. The subject wearing the suit under test stands with his suited body surrounded by the SF_6 test atmosphere (see Figure A.2). Accurate determinations of leakage shall be possible within the range for 0,001 % to approximately 20 % dependent on the test challenge atmosphere. It is recommended to use a test atmosphere between 0,1 % and 1 % SF_6 (by volume).



Key

1	duct	8	additional air input
2	baffle	9	manometer
3	atomizer	10	enclosure samples
4	fan	11	breathing zone samples
5	valves	12	breathable air supply
6	pump	13	enclosure
7	sulphur hexafluoride detector	14	treadmill

Figure A.2 — Typical arrangement of inward leakage test using sulphur hexafluoride

A.4.2 Detection

The test atmosphere should preferably be analysed for SF_6 continuously by means of a suitable analyser or spot checks as necessary to determine the concentration during tests. The probe for sampling the test atmosphere shall be positioned at head height. The SF_6 concentration inside the suit is analysed and recorded. This concentration, measured in the positions defined within EN 1073-2 being a measure of the total inward leakage.

A suitable analyser for test atmosphere is one based on thermal conductivity or infrared spectroscopy. The suit concentration may be monitored using an electron capture detector or infrared system.

A.5 Sampling probe

The sample shall be taken as described in EN ISO 13982-2. For non-permanently attached masks additionally the mask shall be tested using a test probe consisting of a length of suitable plastic tube fitted with a plastic

ball of approximately 20 mm diameter and having eight holes each of 1,5 mm diameter spaced equidistant around the circumference of the ball.

The probe shall be positioned so it touches the lips of the wearer.

It can be necessary to perforate the face blank or visor and an inner mask (if fitted) for testing purposes. A thin tube, as short as possible, leading into the inner mask is connected in a leak tight manner to the analysing instrument. The sampling rate should be constant and the range between 0,3 l/min and 0,15 l/min.

A.6 Test chamber

This should be made from transparent material and has a minimum cross-sectional dimension of 0,7 m (see Figures A.1 and A.2). It should be supported with adequate clearance above the head of the test subject and extend down to the surface of the treadmill. The test agent enters the top of the chamber through a flow distributor and is directed downward over the head of the test subject at a flow rate of at least 0,12 m/s. This flow rate should be measures close to the subjects head. In addition the flow rate should not fall below 0,1 m/s inside the effective working volume (0,1 m from the chamber wall and above a height of 0,75 m). The concentration of the test agent inside the effective working volume shall be checked to be homogeneous.

A.7 Treadmill

A level treadmill capable of maintaining a constant speed of 5 km/h is installed in the chamber.

A.8 Test procedure

A.8.1 Test subject

The test subject is dressed in the suit according to the instructions for the type of suit under test. The test subjects shall be informed that if they wish to adjust the suit during the test they may do so. If this is done the relevant section of the test will be repeated having allowed time for the system to resettle.

The subjects shall have no indication of the results as the test proceeds.

The protocol in A.8.2 shall be followed.

A.8.2 Test protocol

Table A.1 — Test protocol

Section of the test	Estimated time taken for activity (min)
a. Dress subject in suit	-
b. Don boots, gloves etc. according to manufacturer instructions	-
c. Subject to enter test chamber and connect tubing to sample point (no test agent)	3
d. Establish background reading at sample point with subject standing still (no test agent)	3
e. Start test agent and allow to stabilize	3
f. Record leakage and pressure at sample point with subject standing still	3
g. Start treadmill	-
h. Walk for 3 min	3
i. Record leakage and pressure at sample point with subject walking at about 5 km/h	-
j. Stop treadmill	-
k. Record leakage and pressure at sample point with subject moving arms up and down above head height and looking upward e.g. lifting object (1/2 brick) from desk to shelf level.	3
l. Record leakage and pressure at sample point with subject doing continuous squats	3
m. Record leakage and pressure at sample point with subject using a gas sampling hand pump	3
n. Record leakage and pressure at sample point with subject twisting at waist with arms folded at chest	3
o. Stop test agent and allow to disperse with subject in chamber	3
p. Disconnect sample tubes and remove subject from test chamber. Undress subject	-
NOTE The total trial can vary, all times are approximate and are to stable conditions.	

When doing squats or twisting, a slow deliberate action is required, e.g. one every 3 s.

Analyse results over final 2 min of each exercise period to avoid carry-over of result from one exercise to another.

Record challenge chemical continuously using a separate detector (if possible).

Record the pressure inside the suit over the whole time.

A.8.3 Assessment of results

Calculate the percentage total inward leakage (T.I.L) for each exercise as follows:

$$T.I.L = (C_2/C_1) * 100$$

Where

C_1 = concentration in enclosure;

C_2 = mean concentration of the sampling probes for each exercise.

Calculate the arithmetic mean percentage total inward leakage for the whole exercise programme for all test subjects. This result is reported for pass/fail decision.

Annex B
(normative)

Material tests

B.1 General

This annex specifies the material test method for chemical protective clothing material which are not included in EN 14325:2004.

A number of performance classification levels are identified in EN 14325:2004 for the various properties to be found in this standard.

B.2 Material tests - Resistance to ignition

Preconditioning and conditioning shall be performed to EN 14325:2004. When tested in accordance with EN 13274-4:2001, Method 3, the protective clothing material shall not form droplets and shall prove to be “self-extinguishing”, i.e. it shall not be of a highly flammable nature and when tested shall not continue to burn for more than 5 s after removal from the flame, 3 samples shall be tested. The size of the specimen shall be 50 mm x 50 mm. The test specimen shall be mounted in such a way, so that the 50 mm edge of the specimen is perpendicular to the direction of travel of the specimen above the flame and the path length of the specimen above the flame is 50 mm.

If resistance to heat and flame is required the chemical protective clothing should be tested and marked according to the appropriate European Standard.

Annex C
(normative)

Optical Chart

A well-lit room shall be equipped with a wall-mounted metric 10-line optometric eye-test chart, or comparable Monoyer-type chart, mounted at approximately eye-level.

The test subject shall directly face the test chart at a distance of approximately 5 m. If the subject needs corrective lenses for distance vision they shall wear their usual prescription spectacles.

The test subject shall move nearer to, or further from, the chart until they find a distance from which they can read the 6th line of the chart but not any line with smaller letters or symbols than those on the 6th line.

The distance between the subject and the chart shall be noted and, for convenience, the position of the subject may temporarily be marked on the floor.

The test subject shall then don the complete suit and stand at the same distance from the eye-chart noted above under the same lighting conditions.

The test subject shall determine the smallest line of letters or symbols that they can read whilst wearing the suit.

If the smallest line of letters or symbols that the test subject can read whilst wearing the suit is more than 2 lines above or below the 6th line then the visor shall be deemed to have failed the test.

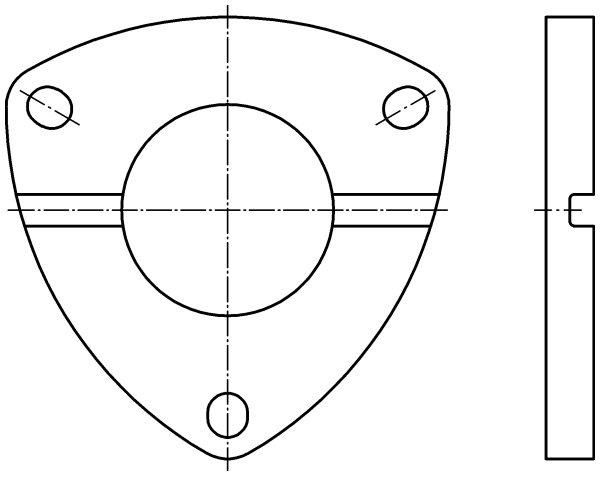
If the smallest line of letters or symbols that the test subject can read whilst wearing the suit is 4th, 5th, 6th, 7th or 8th line of the char then the visor shall be deemed to have passed the test.

NOTE This test is self-normalizing since it involves the same subject, the same lighting conditions, and the same distance between the subject and the eye-chart. The result of the test is therefore a direct comparison of visual acuity with and without the suit visor.

Annex D
(informative)

Adapted test cell for testing closures (zipper)

The test cell used to test the permeation resistance of the closure should be of the same overall design and dimensions as that used to test all the other components of the suit. The test cells described in EN 374-3 and EN ISO 6529 are designed to accommodate flat samples, it may therefore be necessary to use an adaptor in order to achieve a leak-tight seal between the closure and the test apparatus. The adaptor shall be so designed that it does not alter the area of the sample exposed to the challenge chemical. Any change to the volume of the collection side of the cell shall be kept as small as practicable. An example of a suitable adaptor to fit a standard 51 mm diameter test cell is shown in Figure D.1. In this example the groove in the adaptor is designed to fit closely around the closed teeth of a gas-tight zipper. Additional sealing material may be necessary in order to render the join between the closure and the adaptor leak-tight. Such sealing material shall be chosen so as not to influence the result of the test; examples include Terostat[1)] and wax.



Key

1 groove for zip

Figure D.1 — Adapter

[1)] Sealing material should be used e.g. Terostat sealing profile type dia. 4, company Fa Henkel. This information is given for the convenience of users of this standard and does not constitute an endorsement by CEN/TC 162 of the product named. Equivalent products may be used if they can be shown to lead to the same results. If "Terostat" is not suitable for a certain chemical alternative sealing materials might be chosen.

Annex E
(informative)

Significant technical changes between this document and the previous edition of this European Standard

Table E.1 gives significant technical changes compared with the previous edition of this standard.

Table E.1 — Significant technical changes

Clauses of this EN	Significant technical changes
Title	Protective suits type 2 has been deleted from this standard. They are not gas tight. This standard describes gas tight suits
Scope	The Scope is rewritten
Normative references	Actualization of the standards
Terms and Definitions	Adoption of new definitions
	Terms „limited use" and "re-usable" are not no more used. Reasons: 1. all suits have only a limited use duration 2. there may not be different requirements for suits, which are intended for the same use.
4.1 Table1	Table is rewritten and completed
4.2 and Table 2	allocation of the requirements is exactly defined
4.3	Pull force for outer gloves is required
4.4	Proposal for sealing material
5.1, Table 3	Requirement for the whole suit revised
5.2	Compatibility with other equipment
5.6, Table 4	New requirements for the visor
6.2	Two test subjects are needed for the practical performance test
6.2.1	- rate of walking is reduced to 5 km/h - total distance for climbing a ladder is reduced to 6 m - globe valve to be closed
6.4	Pull test for over gloves
6.5	Requirement for valves
Clause 6	Assumption of some text passages and wordings from the ISO 16602
Clause 8	Alignment with EN ISO 13688, same structure
Annex B	Size of the specimen has been specified.
Annex C	Optical chart added
Annex D	Adapted test cell for testing closures (zipper) added

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/686/EEC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive EU Directive 89/686/EEC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 89/686/EEC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 89/686/EEC	Qualifying remarks/Notes
5.16	1.1.1. Ergonomics	
5.16	1.1.2.1. Highest level of protection possible	
Table 1, 5.1, 5.7, 5.9.2, 5.10, 5.11, 5.12, 5.13.2, 5.13.4, 5.15, 5.16, B.2	1.2.1 Absence of risks and other 'inherent' nuisance actors	
4.2	1.2.1.1 Suitable constituent materials	Verified in EN ISO 13688
5.1	1.2.1.2 Satisfactory surface condition of all PPE parts in contact with the user	Verified in EN ISO 13688
5.8.1, 5.16	1.2.1.3 Maximum permissible user impediment	
5.16	1.3.1. Adaptation of PPE to user morphology	
Table 1, Table 2, 4.4, 5.3, 5.6.5, 5.8.2, 5.8.3, 5.9.1, 5.9.4, 5.10, 5.12, 5.13.4	1.3.2. Lightness and design strength	
5.2, Clause 8.h, Clause 8.k	1.3.3. Compatibility of different classes or types of PPE designed for simultaneous use	
Clause 7, Clause 8	1.4 Information supplied by the manufacturer	
5.9.1, 5.13.2	2.1. PPE incorporating adjustment systems	
5.13.1	2.2 PPE enclosing the parts of the body to be protected	

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 89/686/EEC	Qualifying remarks/Notes
5.6.2, 5.6.3, 5.6.4	2.3 PPE for the face, eyes and respiratory tracts	
Clause 7e, Clause 8g7	2.4 PPE subject to ageing	
5.13.3, Clause 8 g1; Clause 8g2; Clause 8 g3; Clause 8 g4	2.8 PPE for use in very dangerous situations	
5.9.3	2.9 PPE incorporating components which can be adjusted or removed by the user	
Clause 7	2.12 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	
Table 1	3.3 Protection against physical injury (abrasion, perforation, cuts, bites)	
Table 4, 5.9.1, 5.13.2, 5.14	3.10.1 Respiratory protection	
Table 1, Table 2, 4.5, 5.4, 5.5	3.10.2 Protection against cutaneous and ocular contact	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] ISO 7000:2014, *Graphical symbols for use on equipment — Index and synopsis*

[2] EN 374-4, *Protective gloves against chemicals and micro-organisms - Part 4: Determination of resistance to degradation by chemicals*

[3] EN 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1)*

National Annex NA
(informative)

Further commentary from UK Technical Subcommittee PH/3/3

Following a technical review of EN 943-1:2015, UK Technical Subcommittee PH/3/3, Chemical, Biological, Radioactive and Nuclear Personal Protective Equipment has provided comments on the standard. These comments are outlined below and arranged according to the section of the standard that they refer to.

NA.1 Comments on Clause 1, Scope

NA.1.1 As EN 943-1:2015 does not cover Type 2 chemical protective suits, EN 943-1:2002 is still relevant for those seeking guidance on Type 2 suits.

NA.1.2 The UK committee is of the opinion that the basic performance criteria given in other European standards for suit components are not confined to just gloves, boots or respiratory protective equipment as is currently suggested in EN 943-1, but include these items amongst others.

NA.2 Comments on Clause 2, Normative references

NA.2.1 ISO 16602:2007 was previously included as a normative reference at draft stage of EN 943-1:2015 and the committee is of the opinion that it should not have been removed from this section as it was the only link to an alternative Type 2 standard, which although not adopted by CEN, would provide the user with further information.

NA.3 Comments on Clause 4, Materials

NA.3.1 Subclause 4.2, second paragraph, states 'Pre-conditioning and conditioning shall be carried out in accordance with EN 14325:2004, 4.2 and 4.3.' The UK committee advises that this is only carried out prior to all testing for all components that can be cleaned and disinfected and are intended to be used more than once.

NA.3.2 Table 1, column 1, row 9—it is unclear whether the testing is to be carried out on all visors, seals etc. or just those that are exposed. The UK committee suggests the testing applies to visors, face masks, face seals etc. that are fitted and exposed to the environment during intended use.

NA.3.3 The first paragraph of subclause 4.3 refers to visors, face piece, bootees and gloves under the heading 'Seams, joins, and assemblages', however the committee views that these parts do not belong to this term. This could have a detrimental impact on the correct testing of visors and face pieces etc.

NA.3.4 The committee suggests that the 'cover' mentioned in the fifth paragraph of 4.3 should mean zip flap. The committee is concerned that a 'cover' could be confused with other testing items not related to this test.

NA.3.5 Subclause 4.4, Strength of detachable joins, refers to bonded facemasks as detachable parts. The UK committee is of the opinion that bonded facemasks are not detachable and would not have considered them eligible for testing the strength of detachable joins.

NA.4 Comments on Clause 5, Requirements for the whole suit

NA.4.1 Subclause 5.1, second paragraph—the UK committee is unsure on the meaning of 'when tested as a complete suit, or when specified as tested with the related samples.' The committee suggests that where appropriate, parts of suits can be tested separately to the whole suit.

NA.4.2 The UK committee is of the opinion that the instructions given in subclause 5.3 contradict those given in subclause 5.1. Specifically, 5.1 states for conditioning to be carried out according to 5.3 prior to testing the applicable requirements given in Table 3, whereas 5.3 states that this conditioning need only be carried out according to tests carried out in subclauses 5.4 and 5.5. The UK committee suggests that conditioning according to 5.3 need only be carried out prior to testing according to 5.4 and 5.5.

NA.4.3 It is not clear whether the instructions relating to PPE tests outlined in subclause 5.2 recommend for all PPE tests to be performed at once or if the testing should be carried out on an individual basis. The committee is concerned that an unnecessary amount of practical testing is being advised.

NA.4.4 Table 4 currently presents rows 3, 4 and 5 of column 1 to be separate alternative choices. However, for Type 1b with full face mask permanently joined to the suit, the three tests should all be applied: 5.4, plus total inward leakage to the whole suit, plus total inward leakage to the face mask.

NA.4.5 The UK committee suggests that the reading of letters on a chart should be carried out according to Annex C, but without donning a complete suit. The visor sample shall be held at an equivalent distance to how it would appear if the suit had been donned.

NA.4.6 Subclause 5.6.5, Mechanical strength, refers to the 'pressure drop test' being carried out as specified in 5.4. However, subclause 5.4 is a reference to leak tightness (static inflation test). The committee therefore suggests that 5.6.5 is actually referring to a leak tightness test and not the pressure pot test in EN 14325.

NA.4.7 It is unclear whether 'pass-through' refers to breathing air pass-through or ventilating air pass-through. This ambiguity could cause problems during testing of pass-through fittings.

NA.4.8 The suitability of air supply hoses should refer to degradation and permeation resistance. If a hose becomes degraded or permeated by a chemical then this could become a safety issue. The term 'used' air supply hoses used in subclause 5.12 could also be misconstrued to mean old hoses that have been used previously. The committee suggests that this should mean air supply hoses used in the test.

NA.4.9 Subclauses 5.6.4, 5.8.1, 5.9.2, 5.9.3, 5.12, 5.13.1, 5.13.2 and 5.13.3, mention that specific items will be assessed during Practical Performance (5.16) and the Practical Performance test (6.2), however no mention is made of these assessments in these sections.

NA.4.10 Subclause 5.16, Practical Performance—the standard requirement is for activities to be carried out within 30 minutes. The UK Committee is concerned that the additional activities outlined previously (5.9.2, 5.13.3 etc.) will make this time requirement unrealistic.

NA.4.11 The committee is of the opinion that it is unreasonable to require that a visual inspection be carried out prior to laboratory testing. A visual inspection is only really necessary before the practical performance test.

NA.5 Comments on Clause 6, Test Methods

NA.5.1 Subclause 6.2.2, Work simulation test—the committee is concerned that test houses might not be equipped to carry out this test due to the specific nature of the equipment outlined and the novelty of the test method. Further to this, no inter-laboratory trials or feasibility checks have been carried out for this test method, therefore it is unknown whether the results will discriminate between suits.

NA.5.2 Subclause 6.7, Distortion of vision after chemical exposure—the committee would like to make it clear for this test that the liquid is poured on the sloping surface, rather than on the top edge and down the back of the test piece.

NA.6 Comments on Clause 7, Markings

NA.6.1 The UK committee is of the opinion that visible markings on protective suits should state whether they are single-use suits or not, as omission of this information presents significant safety implications.

NA.7 Comments on Clause 8, Information supplied by the manufacturer

NA.7.1 The UK committee would have preferred for requirement f) in clause 8 to be optional. Each user of EN 943-1 may have developed their own non-mandatory tests which they might not wish to share with the wider industry.

NA.7.2 Clause 8, list item g) 8)—the UK committee is concerned that the protection intended is described in the scope and that this requirement suggests that a suit which conforms to this standard may not on its own achieve this level of protection.

NA.8 Comments on Annex A (informative), Total inward leakage test

NA.8.1 Attention is drawn to Annex A of EN 1073-1, which is currently being revised, for guidance on the Total inward leakage test. This annex provides a more thorough overview of the Total inward leakage test.

NA.9 Comments on Annex B (normative), Material tests

NA.9.1 The UK committee draws attention to the size of the test sample (50 mm × 50 mm) in subclause B.2. This sample size is not consistent with the dimensions proposed by the CEN TG responsible for the revision of EN 14325. The UK committee is of the opinion that the test sample size is intended to be 105mm × 50 mm with the locus of the flame parallel to longer sides.

NA.10 Comments on Annex C (normative), Optical Chart

NA.10.1 Annex C, Optical Chart, relates to the testing of distortion of vision, rather than the Optical Chart itself, as is currently implied by the title.

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