

Ropa de protección contra productos químicos, líquidos y gaseosos, incluyendo aerosoles líquidos y partículas sólidas.
Parte 1: Requisitos de prestaciones de los trajes de protección química, ventilados y no ventilados, herméticos a gases (Tipo 1) y no herméticos a gases (Tipo 2). (Ratificada por la Asociación Española de Normalización en junio de 2019.)

UNE-EN 943-1:2015+A1:2019

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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 (Endorsed by Asociación Española de Normalización in June of 2019.)

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) (Entérinée par l'Asociación Española de Normalización en juin 2019.)

En cumplimiento del punto 11.2.5.4 de las Reglas Internas de CEN/CENELEC Parte 2, se ha otorgado el rango de documento normativo español UNE al documento normativo europeo EN 943-1:2015+A1:2019 (Fecha de disponibilidad 2019-03-27)

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English Version

**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 and includes Amendment A1 approved by CEN on 24 October 2018.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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European foreword

This document (EN 943-1:2015+A1:2019) 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 September 2019, and conflicting national standards shall be withdrawn at the latest by September 2019.

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

This document includes Amendment 1 approved by CEN on 2018-10-24.

This document supersedes A1 EN 943-1:2015 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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)*

According to the CEN/CENELEC Internal Regulations, the national standards organizations 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, Serbia, 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.

A1 This standard does not establish minimum criteria for protection for non-chemical hazards, e.g. radiological, fire, heat, explosive hazards, infective agents. **A1** This type of equipment is not intended for total immersion in liquids.

A1 The seams, joins and assemblages attaching the accessories are included within the scope of this standard. The basic performance criteria for the components such as gloves, boots or respiratory protective equipment are given in other Standards, supplementary requirements are provided in this standard. **A1**

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

A1 Chemicals such as violently air sensitive reagents, unstable explosives and cryogenic liquids have not been considered since protection against these additional hazards is beyond the scope of this standard. **A1**

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*

A1 EN 1073-1:2016+A1:2018, *Protective clothing against solid airborne particles including radioactive contamination — Part 1: Requirements and test methods for compressed air line ventilated protective clothing, protecting the body and the respiratory tract* **A1**

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*

A1 EN 14325:2018 **A1**, *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)*

A1 deleted text **A1**

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**A1 gas-tight chemical protective 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 A1

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.

▢A1 Pre-conditioning and conditioning shall be carried out in accordance with EN 14325:2018, 4.2 and 4.3 for those materials and components intended to be reused. ▢A1

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.

▢A1 *deleted text* ▢A1

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

▢A1 Where safety footwear is tested for permeation resistance, the test specimen shall be taken from the thinnest point of the footwear above the join to the sole. ▢A1

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 A_1 EN 14325:2018 A_1 unless otherwise stated)
Garment	Abrasion resistance	4.4 of A_1 EN 14325:2018 A_1	3
	Flex cracking resistance	4.5 of A_1 EN 14325:2018 A_1	1
	Flex cracking at -30 °C (optional)	4.6 of A_1 EN 14325:2018 A_1	2
	Trapezoidal tear resistance	4.7 of A_1 EN 14325:2018 A_1	3
	Tensile strength	4.9 of A_1 EN 14325:2018 A_1	3
	Puncture resistance	4.10 of A_1 EN 14325:2018 A_1	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of A_1 EN 14325:2018 A_1	3
	Resistance to ignition	4.14 of A_1 EN 14325:2018 A_1	See B.2

Clothing component	Performance requirement	Test method reference	Minimum performance class (as defined in the relevant table in \square_{A1} EN 14325:2018 \square_{A1} unless otherwise stated)
Bootees (If made from different material than the suit)	Abrasion resistance	4.4 of \square_{A1} EN 14325:2018 \square_{A1}	3
	Flex cracking resistance	4.5 of \square_{A1} EN 14325:2018 \square_{A1}	1
	Flex cracking at -30 °C (optional)	4.6 of \square_{A1} EN 14325:2018 \square_{A1}	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of \square_{A1} EN 14325:2018 \square_{A1}	3
Integral overshoe (upper)	Abrasion resistance	4.4 of \square_{A1} EN 14325:2018 \square_{A1}	3
	Trapezoidal tear resistance	4.7 of \square_{A1} EN 14325:2018 \square_{A1}	3
	Puncture resistance	4.10 of \square_{A1} EN 14325:2018 \square_{A1}	2
	Resistance to permeation by chemicals (liquids and gases)	4.11 of \square_{A1} EN 14325:2018 \square_{A1}	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 \square_{A1} EN 14325:2018 \square_{A1}	3
Gloves	Resistance to permeation by chemicals (liquids and gases)	4.11 of \square_{A1} EN 14325:2018 \square_{A1}	3
	Mechanical resistance ^a	EN 388	See table footnote a
Visor, \square_{A1} deleted text \square_{A1} , face seal (if fitted) \square_{A1} ^c \square_{A1}	Resistance to permeation by chemicals (liquids and gases) ^b	4.11 of \square_{A1} EN 14325:2018 \square_{A1}	3
	Mechanical	5.6.5 of EN 943-1	comply

Clothing component	Performance requirement	Test method reference	Minimum performance class (as defined in the relevant table in EN 14325:2018 unless otherwise stated)
	strength		
<p>^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.</p> <p>^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).</p> <p>^c The testing applies to visors and face seals that are fitted and exposed to the environment during intended use.</p>			

4.3 Seams, joins, and assemblages

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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.

deleted text

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 14325:2018 unless otherwise stated)
Suit material to suit material	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2018 4.11	3
	Seam strength	EN 14325:2018 5.5	5
Closure assembly (e.g. zipper)	Resistance to permeation by chemicals (liquids and gases) ^a	EN 14325:2018 4.11	5 minutes ^d
	Closure strength ^b	EN 14325:2018 5.5	3

Assemblages	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2018 4.11	3
Visor to suit	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2018 4.11	3
Glove to suit (permanent)	Resistance to permeation by liquids and gases	EN 14325:2018 4.11	3
	Mechanical strength	EN 14325:2018 5.5	3
Bootee to suit (permanent)	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2018 4.11	3
Boots to suit (permanent)	Resistance to permeation by chemicals (liquids and gases)	EN 14325:2018 4.11	3
	Mechanical strength	EN 14325:2018 5.5	4

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 misleading 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 ~~permeation test cell~~ 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, ~~shall be tested in accordance with 6.4.~~, 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.

A1

4.6 Gloves

Only EN ISO 374-1 approved gloves shall be used. The gloves may be modified be fitted to the suit. The additional requirements of this standard shall be fulfilled. The puncture, cut and abrasion resistance of the gloves or glove combination used shall be reported as required in EN 943-1, 8, l).

NOTE As EN ISO 374-1 has only very limited mechanical and thermal requirements it may be appropriate to use an over-glove e.g. according to EN 659 to provide greater mechanical or thermal protection. **A1**

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. **A1** Where not otherwise specified, all tests shall be performed on two specimens (suits/components/materials as applicable). **A1**

Chemical protective suits shall fulfil all the applicable requirements given in Table 3 **A1** *deleted text* **A1**. 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	(√)	(√)	$\boxed{A_1} \sqrt{\langle A_1 \rangle}$
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	$\boxed{A_1}$ deleted text $\langle A_1 \rangle$	$\boxed{A_1}$ deleted text $\langle A_1 \rangle$	√
5.13.3 Warning and measuring facilities	$\boxed{A_1}$ deleted text $\langle A_1 \rangle$	$\boxed{A_1}$ deleted text $\langle A_1 \rangle$	√
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	√	√	√

5 Requirements for the whole suit	Type 1a	Type 1b	Type 1c
<p>√ This requirement shall be fulfilled.</p> <p>(√) If the component item is fitted, the requirements shall be met.</p> <p>(1) Inward leakage test is required for Type 1b suits where the facemask is not permanently attached.</p>			

5.2 Compatibility with other equipment

Ⓐ All items necessary to use with the suits shall be compatible (see 5.16, 6.2 and 8 k). Ⓐ

Ⓐ

5.3 Simulation of extreme 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 $(60 \pm 3) ^\circ\text{C}$ at $(95 \pm 5) \%$ relative humidity; followed by
- b) for not less than 4 h to a temperature of $(-30 \pm 3) ^\circ\text{C}$.

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

Ⓐ deleted text Ⓐ

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 Face mask used with Type 1 b suits worn as intended by the manufacturer, doesn't need to be retested for IL in the breathing zone in accordance with the requirement clause of this standard. For the design and use is identical with EN 136 type tested models. The suits have to be tested.	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.

Suit type	Inward leakage
Type 1b using a full face mask which is not permanently joined to the suit Face masks worn not directly on the user's skin, but with means of suit material or barrier material between skin and sealing line of the masks, need to be reevaluated for IL in the breathing zone, due to the modified sealing system.	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 and 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. A_1 After this test a static inflation test shall be carried out and shall pass the requirement as specified in 5.4. A_1

5.7 Face piece for suits without integral visor

A_1 Full 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 EN ISO 17491-3 with following modification:

The jet nozzle shall be positioned at $(1,0 \pm 0,1)$ m from the test spot and the jet shall be pointed in a horizontal line and at the point between the eyes with a maximal vertical angle of $\pm 10^\circ$ (see Figure 1). The total stain area on the undergarment shall be less than three times the calibrated stain area. The test shall be carried out both from the front as well as from the rear. Three ensembles shall be tested after conditioning to 5.3.

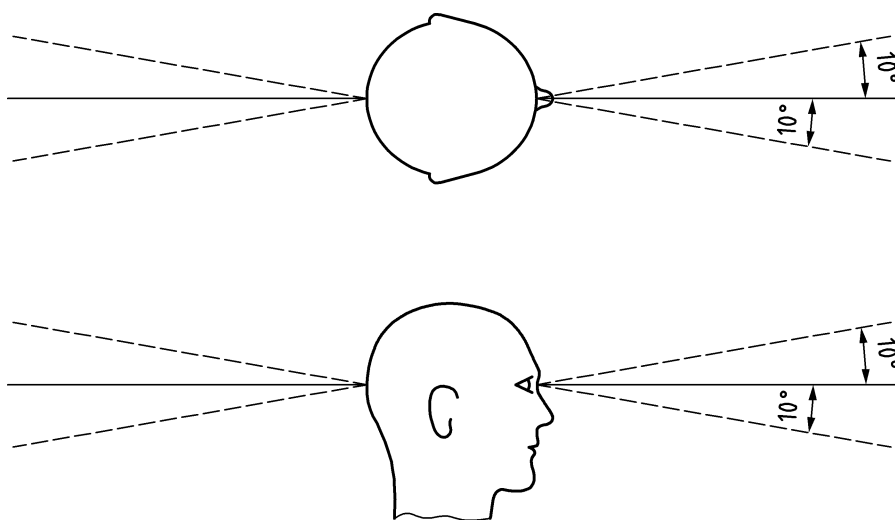


Figure 1 — Face seals with non permanent attached mask

A_1

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

A1 deleted text **A1**

If the pass-through is providing air for breathing it shall also fulfil the requirements of **A1** 5.8.2 and **A1** 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.

A1 Exhaust assemblies shall be tested in accordance with EN ISO 17491-3 with a jet horizontally onto the exhaust assembly protectors (caps or covers). **A1**

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

A1 Adequate attention should be paid to the suitability of the air supply hoses used. **A1**

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 measured 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.

A1 Adequate attention should be paid to the chemical suitability (i.e. permeation and degradation resistance) of the air supply hoses used. **A1**

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:

- **A1** The activities detailed in 6.2.2 a) to d) are carried out by the test subjects within the allocated time of (30 ± 15) min and **A1**;
- 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.

A1 If the average score for items a) to k) of 6.2.3 is ≥ 3 , and not more than one individual score is rated at '1' then the suit passes the test. **A1**

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

A1 A visual inspection shall be carried out by the test house prior to practical performance tests. **A1** 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 $(20 \pm 5) ^\circ\text{C}$, 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. **A1** The test shall be completed within a working time of 30 min \pm 15 min. **A1**

- 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 $85^\circ \pm 5^\circ$ 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 $(1 \pm 0,1)$ m above floor level. The pipe shall be fixed to the bench by means of fixing brackets such that the centre-line of the pipe is $(0,10 \pm 0,01)$ m above the bench and $(0,25 \pm 0,025)$ 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) ~~A1~~ security and usability of fastenings and couplings;
- c) accessibility and suitability of controls, warning devices and pressure gauge (if fitted); ~~A1~~
- 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;
- j) ~~A1~~ accessibility of pass-thru (if fitted);
- k) impediment caused by the external air or ventilation supply. ~~A1~~

~~A1~~ In addition to points a) to k) the number and body dimensions (including the size of the suit) and any other comments volunteered by the test subject shall be recorded but not scored. ~~A1~~

~~A1~~

6.3 Suit pressure test

Type 1a: Test at 300 l/min. If ventilation is available, add max. ventilation flow rate.

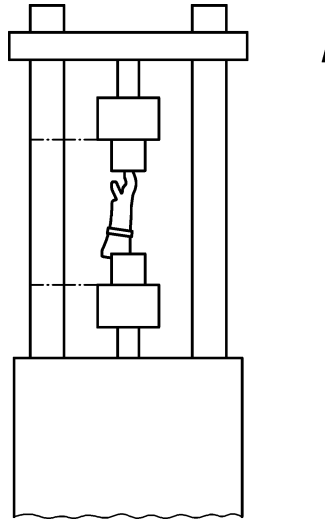
Type 1b: Test at 300 l/min if the mask exhales into the suit. If ventilation is available, use ventilation flow rate. If both apply – use 300 l/min plus ventilation flow rate.

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 suit's hood, the flow entrance should be arranged in the extremities or corpus of the suit. ~~A1~~

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 ~~A1~~ *deleted text* ~~A1~~. 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 ~~A1~~ Figure 2 ~~A1~~.



A1

Figure 2 — Example for glove to sleeve connection pull-test A1

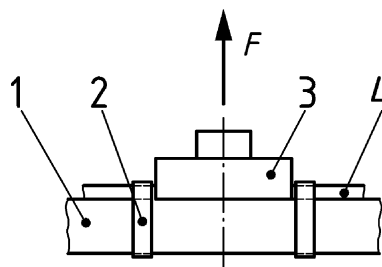
6.5 Exhalation valves

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 $(1\,000 \pm 50)$ 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 A1 Figure 2 A1. 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 | | |

A1

Figure 3 — Connection between exhalation valve and chemical protective clothing material A1

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 $65 \pm 5^\circ$ 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).

A1 100 ml of the test chemical shall be poured onto the test piece. The chemical shall be poured along the upper half of the visor front so that the liquid flows down the sloping face of the test piece. The chemical shall be poured moving from one side to the other using half the amount of chemical and the rest going back thus covering the test piece twice. **A1**

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.

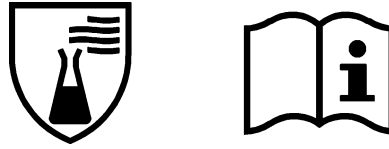
For gaseous chemicals the test piece shall be placed in a suitable vessel containing the pure gas and left there for 30 min. The inside of the visor which is mounted inside the gas-tight chemical protective suit should be covered so that this side is not exposed to the gas. Alternatively this may be 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 4 — Graphical symbol ISO 7000-2414 protection against chemicals and graphical symbol ISO 7000-1641 operation instruction Ⓐ

Consideration should be given to suitable additional marking.

Ⓐ

- i) identification as single use, if the suits cannot be hygienically cleaned and disinfected;
- j) indicate whether a suit can be only used once using the sign of a striked out 2 (see Figure 5).

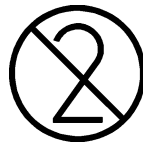


Figure 5 — Graphical symbol ISO 7000-1051

Ⓐ

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 14325:2018 Ⓐ 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 **A1** EN 14325:2018 **A1**, 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) **A1** details of additional items of protective clothing that need to be used to achieve the protection of the ensemble as it is intended; (e.g. separate boots, breathing apparatus, helmet); **A1**
- 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;

Ⓐ

- o) the following warning:

WARNING – Pay attention to the chemical suitability (i.e. permeation and degradation resistance) of the full face masks and hoses used. Ⓐ

Ⓐ

- p) an additional overglove can be appropriate in case thermal and mechanical protection are insufficient. Ⓐ

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 (SF₆) or an alternative gas may be used, if validated and showing equivalent results).

The air inside the suit is sampled to determine the test agent content. The samples from the suit are extracted through one tube leading to the analyser; one further probe is placed in the respiratory tract.

Another probe measures the pressure inside the suit.

The airflow rate to the suits Type 1 c 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

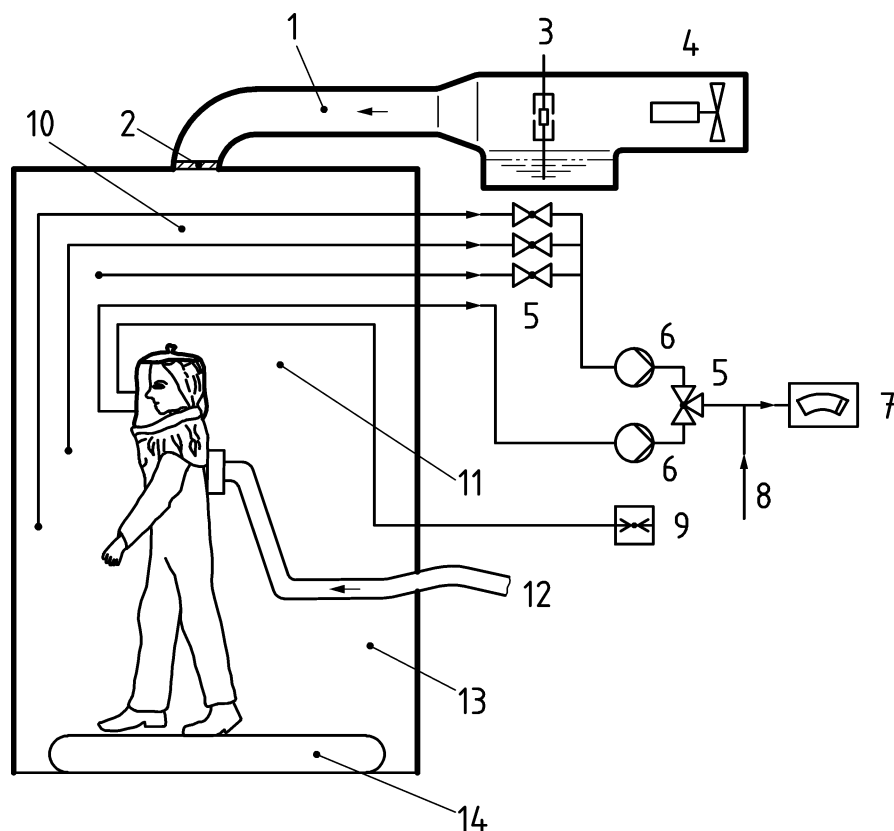
A flame photometer shall be used as described in of EN 136:1998, 8.16.3.2.3.

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

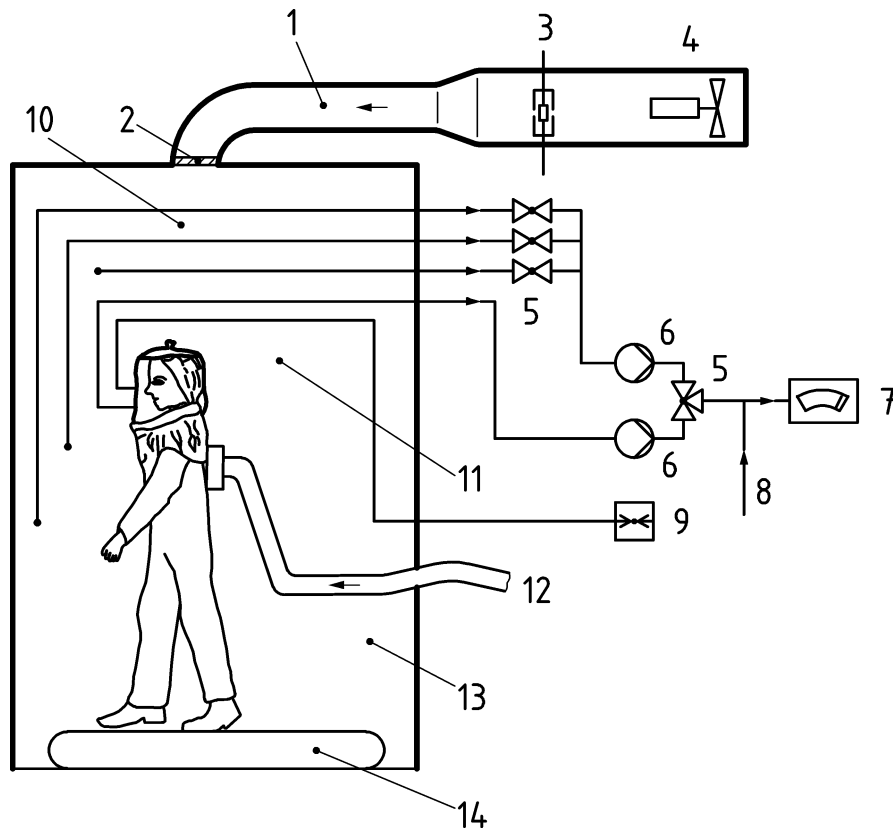
1	duct	8	additional air input
2	baffle	9	manometer
3	atomizer	10	enclosure samples
4	fan	11	breathing zone samples
5	valves	12	breathable air supply
6	pump	13	enclosure
7	photometer	14	treadmill

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 SF₆ 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 % SF₆ (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 SF₆ 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 SF₆ 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 **A1** EN 1073-1:2016+A1:2018 **A1**. 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 **A1** 0,3 l/min and 1,5 l/min **A1**.

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.

A1 *deleted text* **A1**

A.8.2 Test protocol

A1 Follow the test protocol in EN 1073-1:2016+A1:2018, Table B.1. **A1**

A1 *deleted text* **A1**

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 A1 EN 14325:2018 A1.

A number of performance classification levels are identified in A1 EN 14325:2018 A1 for the various properties to be found in this standard.

B.2 Material tests - Resistance to ignition

Preconditioning and conditioning shall be performed to A1 EN 14325:2018 A1. 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. A1 The size of the specimen shall be 105 mm × 50 mm. A1 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)

Ⓐ Distortion of vision Ⓐ

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, or the test shall be carried out holding a visor or fixing the hood and visor at the same distance as it would be worn in use. Ⓐ

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.

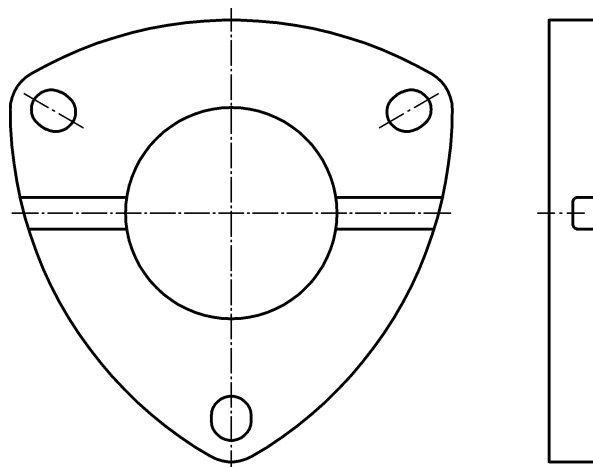
If the smallest line of letters or symbols that the test subject can read whilst wearing the suit is 4th, 5th, 6th, 7th or 8th line of the chart then the visor shall be deemed to have passed the test.

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 Terostat¹⁾ 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 A1 Due to the revision of EN 943-1, Type 2 CPS are no longer covered in this document. Specifications with regard to Type 2 CPS are given in ISO 16602. Alternatively, the technical file route based on EN 943-1:2002 is still possible. A1
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

Clauses of this EN	Significant technical changes
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 Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016 on personal protective equipment aimed to be covered

This European Standard has been prepared under a Commission's standardization request to provide one voluntary means of conforming to essential requirements of Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016 on personal protective equipment.


Once this standard is cited in the Official Journal of the European Union under that Regulation (EU) 2016/425, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Regulation (EU) 2016/425 and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Regulation (EU) 2016/425

Essential Requirements of Regulation (EU) 2016/425	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1.1. Ergonomics	5.16	
1.1.2.1. Optimum level of protection	5.16	
1.2.1 Absence of inherent risks and other nuisance actors	Table 1, 5.1, 5.7, 5.9.2, 5.10, 5.11, 5.12, 5.13.1, 5.13.2, 5.13.4, 5.15, 5.16, B.2	
1.2.1.1 Suitable constituent materials	4.2	Verified in EN ISO 13688: 2013
1.2.1.2 Satisfactory surface condition of all PPE parts in contact with the user	5.1	Verified in EN ISO 13688: 2013
1.2.1.3 Maximum permissible user impediment	5.8.1, 5.16	
1.3.1. Adaptation of PPE to user morphology	5.16	
1.3.2. Lightness and strength	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	
1.3.3. Compatibility of different types of PPE intended for simultaneous use	5.2, 8.h, 8.k	
1.4 Manufacturer's instructions and information	7, 8	
2.1. PPE incorporating adjustment systems	5.9.1, 5.13.2	

Essential Requirements of Regulation (EU) 2016/425	Clause(s)/subclause(s) of this EN	Remarks/Notes
2.2 PPE enclosing the parts of the body to be protected	5.13.1	
2.3 PPE for the face, eyes and respiratory system	5.6.2, 5.6.3, 5.6.4	
2.4 PPE subject to ageing	Clause 7 e), Clause 8 g) 7)	
2.8 PPE for intervention in very dangerous situations	5.13.3, Clause 8 g) 1), Clause 8 g) 2), Clause 8 g) 3), Clause 8 g) 4)	
2.9 PPE incorporating components which can be adjusted or removed by the user	5.9.3	
2.12 PPE bearing one or more identification markings or indicators directly or indirectly relating to health and safety	7	
3.3 Protection against mechanical injuries	Table 1	
3.10.1 Respiratory protection	Table 4, 5.9.1, 5.13.2, 5.14	
3.10.2 Protection against cutaneous and ocular contact	Table 1, Table 2, 4.5, 5.4, 5.5	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation 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)*



- [4] ISO 16602, *Protective clothing for protection against chemicals — Classification, labelling and performance requirements* 