INTERNATIONAL STANDARD

ISO 16602

First edition
2007-12-15

Protective clothing for protection against chemicals — Classification, labelling and performance requirements

Vêtements de protection contre les produits chimiques — Classification, étiquetage et exigences de performances

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Reference number
ISO 16602:2007(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 16602 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

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Introduction

This International Standard addresses the range of general, industrial chemical protective clothing by designating specific design types and providing classification of clothing, material, and component performance. This International Standard is intended to provide comprehensive requirements for the performance classification and labelling of chemical protective clothing.

The selection of appropriate chemical protective clothing should be based on a risk assessment in which the user organization identifies the hazards, determines the potential for contact with individual workers, the consequences of exposure, and the type of practices or controls needed to eliminate or minimize exposure. When it is determined that chemical protective clothing is needed, the risk assessment should identify the type of chemical protective clothing needed in terms of its overall type and performance. This International Standard is intended to assist user organizations with these determinations.

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Protective clothing for protection against chemicals — Classification, labelling and performance requirements

1 Scope

This International Standard establishes minimum performance classification and labelling requirements for protective clothing designed to provide protection against chemicals. Protective clothing items covered by this International Standard include, but may not be limited to, totally encapsulating suits, liquid-tight or spray-tight suits, coveralls, jackets, trousers, aprons, smocks, hoods, sleeves, and shoe and boot covers.

Chemical protective clothing for protection against airborne particles is addressed by ISO 13982-1, which is referenced in this International Standard. This International Standard does not address protection against solid chemicals in forms other than airborne solid particulates (e.g. it does not address the challenge of penetration of chemical dust and powders through materials and clothing by rubbing or flexing or by simple direct contact of dust or powders onto the clothing surface).

This International Standard does not address gloves, boots, eye/face protection devices and respiratory protective devices unless they are an integral part of the protective clothing. This International Standard does not address protection against biological or thermal (hot or cold) hazards, ionizing radiation, or radioactive contamination. This International Standard also does not address the specialized clothing used in hazardous chemical emergencies.

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NOTE Chemical protective clothing used in hazardous chemical emergencies is addressed in other standards, such as EN 943-2, NFPA 1991 and NFPA 1992.

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This International Standard is intended to provide chemical protective clothing manufacturers with minimum requirements for testing, classifying, and labelling chemical protective clothing. To assist the users of products covered under this International Standard, this document provides descriptions of referenced test methods, guidelines for conducting hazard and risk assessments and suggested performance levels for certain applications. It is not the intent of this International Standard to address all situations.

2 Normative references

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

ISO 3758, *Textiles — Care labelling code using symbols*

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

ISO 6530, *Protective clothing — Protection against liquid chemicals — Test method for resistance of materials to penetration by liquids*

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

ISO 9073-4, *Textiles — Test methods for nonwovens — Part 4: Determination of tear resistance*

ISO/TR 11610, *Protective clothing — Vocabulary*

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

ISO 13688, *Protective clothing — General requirements*

ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

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

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

ISO 13982-1, *Protective clothing for use against solid particulates — Part 1: Performance requirements for chemical protective clothing providing protection to the full body against airborne solid particulates (type 5 clothing)*

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 13994:2005, *Clothing for protection against liquid chemicals — Determination of the resistance of protective clothing materials to penetration by liquids under pressure*

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

ISO 17491:2002, *Protective clothing — Protection against gaseous and liquid chemicals — Determination of resistance of protective clothing to penetration by liquids and gases*

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

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EN 13274-3:2001, *Respiratory protective devices — Methods of test — Determination of breathing resistance*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 11610 and the following apply.

3.1
assemblage
permanent fastening between two or more different garments, or between chemical protective clothing and accessories

EXAMPLE Permanent fastening may be obtained by sewing, welding, vulcanizing, gluing.

3.2
chemical protective suit
clothing worn to protect against chemicals that covers the whole, or greater part of the body

NOTE 1 A chemical protective suit can consist of garments combined together to provide protection to the body. A suit can also have various types of additional protection such as hood or helmet, boots and gloves joined with it.

NOTE 2 These garments are full-body protective clothing, i.e. covering trunk, arms and legs, such as one-piece coveralls or two-piece suits, with or without hood or visors, with or without foot protection.

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3.3
closure
device to close openings for donning of protective clothing

EXAMPLE A zipper, “touch and close” fastener.

3.4
protective clothing material
any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from a potential hazard

NOTE For the purpose of this International Standard, protective clothing materials include those materials used in the construction of the suit or clothing which serve as the primary barrier for the wearer. Protective clothing materials do not include materials used in the construction of integral visors, gloves, and footwear. Materials used in the construction of integral visors, gloves and footwear are tested for performance separately either in this International Standard or to standards specific to the items being evaluated.

4 Classification and minimum testing of chemical protective clothing

4.1 General

All chemical protective clothing shall be tested for integrity and material chemical resistance and shall be classified by type based on its minimum integrity and material chemical resistance according to the categories of performance given in Table 1.

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Each type of chemical protective suit and clothing item shall also meet the other requirements for the overall item, component, and material performance as specified in this International Standard.

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Table 1 — Classification by type of chemical protective clothing

General performance	Sub-clause	Specific performance test	Type of chemical protective clothing							
			1a	1b	1c	2	3[a]	4[a]	5	6[a]
Whole chemical protective clothing item integrity	5.4	Leak tightness	X	X	X	—	—	—	—	—
	5.5	Inward leakage	—	X[b]	X	X	—	—	—	—
	5.6	Liquid jet test	—	—	—	—	X	—	—	—
	5.7	Liquid spray test	—	—	—	—	—	X	—	—
	5.8	Particle aerosol inward leakage test	—	—	—	—	—	—	X	—
	5.9	Limited liquid spray test	—	—	—	—	—	—	—	X
Chemical resistance of protective clothing material[c]	6.5	Permeation resistance	X	X	X	X	X	X	—	—
	6.6	Resistance to penetration by liquid under pressure	—	—	—	—	—	X[d]	—	—
	6.7	Particulate penetration resistance	—	—	—	—	—	—	—[e]	—
	6.8	Liquid penetration resistance	—	—	—	—	—	—	—	X
	6.9	Liquid repellency	—	—	—	—	—	—	—	X

a When not providing coverage of the torso, arms, and legs, Types 3, 4, and 6 clothing are partial body protective clothing meeting only the material chemical resistance requirements for the respective type.

b Applicable to Type 1b chemical protective suits when the face piece is not permanently attached to the suit.

c Applicable to primary material used in construction of chemical protective clothing item; may or may not be applicable to seams (see Clause 7).

d Either permeation resistance test or test for resistance to penetration by liquid under pressure shall be applied.

e A test for evaluating the performance of protective clothing materials against particles is not recommended at this time.

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4.2 Type 1: "Gas-tight" chemical protective suit

Gas-tight suits shall cover the whole body, including hands, feet and head. Type 1 chemical protective suits are further classified as Types 1a, 1b and 1c, as follows.

a) **Type 1a:** Gas-tight chemical protective suit with a breathing air supply that is independent of the ambient atmosphere worn inside the suit.

EXAMPLE A chemical protective suit with a self-contained breathing apparatus worn *inside* the suit.

b) **Type 1b:** Gas-tight chemical protective suit with a breathing air supply that is independent of the ambient atmosphere worn outside the suit.

EXAMPLE A chemical protective suit with the self-contained breathing apparatus worn *outside* the suit.

NOTE When chemical protective suits are used with respiratory protective equipment, it is advisable that respiratory protective equipment selection be in accordance with the respective local regulations for respiratory protection.

c) **Type 1c:** Gas-tight chemical protective suit with an external source of breathable air providing positive pressure inside the suit.

EXAMPLE A gas-tight airline chemical protective suit.

All Type 1 chemical protective suits shall be evaluated for leak tightness and shall pass a pressure test. In addition, Type 1c chemical protective suits shall be evaluated for inward leakage and pass the inward leakage test. All Type 1 chemical protective suits shall have materials that demonstrate chemical permeation resistance.

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4.3 Type 2: “Non-gas-tight” chemical protective suit

Gas-tight suits shall cover the whole body, including hands, feet and head. A “non-gas-tight” chemical protective suit with breathable air providing positive pressure inside the suit from an independent source.

EXAMPLE An airline suit which is not gas-tight.

Type 2 chemical protective suits shall be evaluated for inward leakage and shall pass the inward leakage test, and shall have materials that demonstrate chemical permeation resistance.

4.4 Type 3: “Liquid-tight” chemical protective clothing

Full body chemical protective clothing with liquid-tight connections between different parts of the clothing, and to gloves and boots to protect the wearer against liquid chemicals.

EXAMPLE One-piece coverall, or two-piece suit, with or without hood or visor, with or without boot-socks.

Type 3 chemical protective clothing shall be evaluated for resistance to penetration by liquids and shall pass the continuous liquid jet test, and shall have materials that demonstrate chemical permeation resistance.

4.5 Type 4: “Spray-tight” chemical protective clothing

Full body chemical protective clothing with spray-tight connections between different parts of the clothing, and to gloves and boots to protect the wearer against liquid chemicals.

EXAMPLE One-piece coverall, or two-piece suit, with or without hoods or visors, with or without boot-socks.

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Type 4 chemical protective clothing shall be evaluated for resistance to penetration by liquids and shall pass the liquid spray test, and shall have materials that demonstrate liquid penetration resistance under pressure or chemical permeation resistance.

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4.6 Type 5: Chemical protective clothing providing protection against airborne solid chemicals

Full body chemical protective clothing, with or without gloves and boots to protect the wearer against airborne solid chemicals.

EXAMPLES One-piece coveralls, or two-piece suits, with or without hoods or visors, with or without boot-socks.

Type 5 chemical protective clothing shall meet the requirements of ISO 13982-1.

NOTE This International Standard does not address protection against solid chemicals in forms other than airborne solid particulates (e.g. it does not address the challenge of penetration of chemical dust and powders through materials and clothing by rubbing or flexing or by simple direct contact of dust or powders onto the clothing surface).

4.7 Type 6: Chemical protective clothing with “limited protective performance against liquid chemicals”

Full body chemical protective clothing with limited spray-tight connections between different parts of the clothing, and to gloves and boots to provide limited protection of the wearer against liquid chemicals.

EXAMPLE One-piece coverall or two-piece suit, with or without hood or visor, with or without boot-socks or overbooties.

Type 6 chemical protective clothing shall be evaluated for resistance to penetration by liquids and pass the limited liquid spray test, and shall have materials that demonstrate liquid penetration resistance and repellency.

4.8 Partial body (“PB”) chemical protective clothing

Chemical protective clothing that does not provide full body coverage.

EXAMPLES Aprons, boot/shoe covers, gowns, hoods, jackets, labcoats, sleeve protectors and smocks.

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Type 3, Type 4, or Type 6 shall be designated as partial body chemical protective clothing, when covering only part of the body. The abbreviation “PB” shall preceed the designation for these clothing types in parentheses.

EXAMPLES Type PB(3), Type PB(4) and Type PB(6).

Partial body chemical protective clothing shall have materials which demonstrate permeation resistance for Type PB(3), resistance to penetration by liquid under pressure or permeation resistance for Type PB(4), or liquid penetration resistance and repellency for Type PB(6). Integrity requirements for partial body chemical protective clothing shall not apply.

5 Performance requirements of overall chemical protective clothing

5.1 General

Chemical protective clothing shall be tested to the requirements specified in Table 2 for its classified type when tested as a complete suit or clothing item.

Table 2 — Performance requirements for whole suits and clothing items

Sub-clause	Specific requirement	Chemical protective clothing type[a]							
		1a	1b	1c	2	3	4	5[b]	6
5.4	Leak tightness	X	X	X	—	—	—	—	—
5.5	Inward leakage	—	X[c]	X	X	—	—	—	—
5.6	Liquid penetration resistance (jet test)	—	—	—	—	X	—	—	—
5.7	Liquid penetration resistance (spray test)	—	—	—	—	—	X	—	—
5.8	Resistance to penetration by airborne solid particles	—	—	—	—	—	—	X[b]	—
5.9	Limited liquid penetration resistance (modified spray test)	—	—	—	—	—	—	—	X
5.10	Practical performance	X	X	X	X	—[d]	—[d]	—	—[d]
5.11	Face piece	X	X	—	—	—	—	—	—
5.12	Airline pass-through for use with self-contained breathing apparatus	X	—	—	—	—	—	—	—
5.13	Air-supply system	—	—	X	X	—	—	—	—
5.14	Breathing hose and ventilation hose	—	X[e]	X	X	—	—	—	—
5.15	Air flow rate	—	—	X	X	—	—	—	—
5.16	Exhaust assemblage	X	X[f]	X	X	—	—	—	—
5.17	Pressure in chemical protective suit	X	X[g]	X	X	—	—	—	—
5.18	Inhalation air	—	—	X	X	—	—	—	—

[a] Partial body chemical protective clothing is not evaluated to any of the requirements listed in this table.

[b] Type 5 chemical protection clothing demonstrates resistance to penetration by solid airborne particles by meeting the requirements of ISO 13982-1.

[c] Inward leakage test is required for Type 1b chemical protective suits when the facemask is not permanently attached.

[d] Practical performance of Type 3,4 and 6 chemical protective clothing is evaluated during conditioning by wearing prior to testing of the whole suit.

[e] Type 1b chemical protective suits shall be evaluated for specific requirements related to the external ventilating hose when the self-containing breathing apparatus is worn outside the suit and air from the breathing apparatus cylinder is fed into the suit for ventilation.

[f] Type 1b chemical protective suits shall be fitted with an exhaust assemblage if the exhalation valve of the respiratory protective equipment is not free to discharge directly to atmosphere, or where supplementary air for ventilation is supplied to the suit.

[g] Type 1b chemical protective suits shall only be tested when an exhaust assemblage is fitted.

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5.2 Temperature conditioning

When temperature conditioning is specified for an overall chemical protective clothing test, the complete clothing item shall be exposed:

a) for no less than 4 h to a temperature of (–30 ± 3) °C and allowed to return to ambient conditions; followed by

b) for no less than 4 h to an atmosphere of (60 ± 3) °C at 95 % relative humidity.

The clothing item shall then be allowed to return to ambient temperature. If these temperatures are incompatible for the clothing item, the manufacturer shall select alternative conditions and provide the following statement in the product technical information for the protective clothing item along with a specific temperature range for use of the product:

"This product has been conditioned at a different set conditions than specified in ISO 16602. Conditioning has been performed at [list conditions in terms of temperature (°C) and relative humidity (%)]."

5.3 Conditioning by wearing

When conditioning by wearing is specified for an overall chemical protective clothing test, the chemical protective clothing shall be worn and the test subjects shall perform three series of the exercises in Procedure C of Annex A. Testing shall be performed using test subjects whose body measurements correspond to ± 5 % of the upper width limit and to ± 2 % of the upper height limit on the size range marking of the chemical protective clothing being tested.

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5.4 Leak tightness

When tested in accordance with ISO 17491:2002, Method A2, Type 1a, Type 1b and Type 1c chemical protective suits shall not have a pressure drop of more than 20 % after the pressure/inflation period. Leak tightness testing shall be performed on two chemical protective suits.

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5.5 Inward leakage

When tested for inward leakage as specified in the ISO 17491:2002, Method B1 or B2, Type 1c and Type 2 chemical protective suits shall not have an inward leakage greater than 0,05 %. Type 1b chemical protective suits shall be tested for inward leakage when the facemask is not permanently joined to the suit, and shall not have an inward leakage greater than 0,05 % in the ocular cavity of the mask. Inward leakage testing shall be performed on two sample clothing items. A separate test subject shall be used for each test.

5.6 Liquid penetration resistance (jet test)

Type 3 chemical protective clothing shall be conditioned by wearing according to Procedure C of Annex A and, when subsequently tested for liquid penetration resistance using a jet test in accordance with ISO 17491:2002, Method C, shall show no penetration greater than three times the total calibrated stain area. Liquid penetration resistance testing shall be performed on two sample clothing items using a separate test subject for each test.

5.7 Liquid penetration resistance (spray test)

Type 4 chemical protective clothing shall be conditioned by wearing according to Procedure C of Annex A and, when subsequently tested for liquid penetration resistance using a spray test in accordance with ISO 17491:2002, Method D1, shall show no penetration greater than three times the total calibrated stain area. Liquid penetration resistance testing shall be performed on two sample clothing items using a separate test subject for each test.

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