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Protective clothing for firefighters — Performance requirements for protective clothing for technical rescue

National foreword

This British Standard is the UK implementation of BS EN 16689:2017.

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

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Protective clothing for firefighters - Performance requirements for protective clothing for technical rescue

Vêtements de protection pour les sapeurs-pompiers - Exigences de performances pour les vêtements de protection des interventions de secours techniques

Schutzkleidung für Feuerwehrleute - Leistungsanforderungen für Schutzkleidung für die technische Rettung

This European Standard was approved by CEN on 6 February 2017.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 16689:2017) 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of an identical text or by endorsement, at the latest by October 2017, and conflicting national standards shall be withdrawn at the latest by October 2017.

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

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Introduction

The purpose of this European Standard is to provide minimum performance requirements for protective clothing for technical rescues.

During an incident, hazards other than those against which the clothing to this European Standard is intended to protect may be encountered e.g. chemical, biological, radiological and electrical. If the risk assessment identifies that exposure to such hazards is likely, protection by more appropriate personal protective equipment may be required, either instead of or in addition to the protective clothing in this European Standard.

For adequate overall protection against the risks to which wearers are likely to be exposed, additional personal protective equipment to protect the head, face, hands and feet should also be worn, along with appropriate respiratory protection where necessary.

The specified controlled laboratory tests used to determine compliance with the performance requirements of this European Standard do not replicate the situations to which wearers may be exposed.

Nothing in this European Standard is intended to restrict any jurisdiction, purchaser or manufacturer from exceeding these minimum requirements.

1 Scope

This European Standard specifies the minimum requirements for technical rescue clothing.

Technical rescues involves work associated with the environments, and conditions associated with operational scenarios such as but not limited to those found during road traffic collisions and when working in and around collapsed structures often for extended periods of time after natural disasters (earthquake, landslides, etc.) where protection against mechanical risks, limited heat and flame and conspicuity is needed.

NOTE This could involve heavy workloads, working in confined spaces and require conspicuity in public places.

This European Standard covers the general clothing design, the minimum performance levels of the material used, the methods of test to be used to determine these performance levels, and marking and information supplied by the manufacturer.

Unless combined with other specialized PPE and tested accordingly this standard is not applicable to clothing used to protect against risks encountered in fighting fires, wildland fires or rescue from fire, dealing with hazardous chemicals, working with chainsaws and water and rope rescue.

This European Standard does not cover protection for the head, hands and feet or protection against other hazards e.g. chemical, radiological and electrical hazards. These aspects are covered in other European Standards.

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 1149-5, *Protective clothing — Electrostatic properties — Part 5: Material performance and design requirements*

EN ISO 1421, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break (ISO 1421)*

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

EN ISO 4920, *Textile fabrics — Determination of resistance to surface wetting (spray test) (ISO 4920)*

EN ISO 5077, *Textiles — Determination of dimensional change in washing and drying (ISO 5077)*

EN ISO 6942, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat (ISO 6942)*

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

EN ISO 12127-1, *Clothing for protection against heat and flame — Determination of contact heat transmission through protective clothing or constituent materials — Part 1: Contact heat produced by heating cylinder (ISO 12127-1)*

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

EN ISO 13688, *Protective clothing — General requirements (ISO 13688)*

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

EN 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 13935-2)*

EN ISO 13937-2, *Textiles — Tear properties of fabrics — Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method) (ISO 13937-2)*

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

EN ISO 13938-2, *Textiles — Bursting properties of fabrics — Part 2: Pneumatic method for determination of bursting strength and bursting distension (ISO 13938-2)*

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

EN ISO 15025, *Protective clothing — Protection against flame — Method of test for limited flame spread (ISO 15025)*

EN ISO 20471:2013, *High visibility clothing — Test methods and requirements (ISO 20471:2013, Corrected version 2013-06-01)*

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

ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

3 Terms and definitions

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

3.1
ageing
changing of the product performance over time during use or storage, caused by a combination of several factors, such as:

— cleaning, maintenance or disinfecting processes:

— exposure to visible and/or ultraviolet radiation;

— exposure to high or low temperatures or to changing temperatures;

— exposure to chemicals including humidity;

— exposure to biological agents such as bacteria, fungi, insects or other pests;

— exposure to mechanical action such as abrasion, flexing, pressure and strain;

— exposure to contaminants such as dirt, oil, splashes of molten metal, etc.;

— exposure to wear and tear

3.2
anti-wicking barrier
material used to prevent the transfer of liquid from outside the garment to inside the garment, usually in addition to or replacing part of the moisture barrier at the edge(s)

3.3
clothing assembly
series of garments arranged in the order as worn, which may contain multilayer materials, material combinations or a series of separate garments in single or multiple layers

3.4
cleaning
process by which a PPE is made again serviceable and/or hygienically wearable by removing any dirt or contamination

Note 1 to entry: A cleaning cycle is typically a washing plus drying or a dry cleaning treatment followed, if required, by ironing or finishing.

3.5
closure system
method of fastening openings in the garment including combinations of more than one method of achieving a secure closure

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

3.6
component assembly
combination of all materials of a multi-layer garment presented exactly as the finished garment construction

3.7
conditioning
keeping samples under standard conditions of temperature and relative humidity for a minimum period of time

3.8
emergency responder's protective clothing
specific garment providing protection against mechanical risks, limited heat and flame for the emergency responder's torso, neck, arms, and legs, but excluding the head, hands, and feet

3.9
garment
single item of clothing which may consist of single or multiple layers

3.10
hardware
non-fabric items used in protective clothing including those made of metal or plastic

EXAMPLE Fasteners, rank markings, buttons, zippers, embroideries, braces.

3.11
interface area
area where individual items meet or overlap

3.12
innermost lining
lining on the innermost face of a component assembly which is intended to be nearest to the wearer's skin

Note 1 to entry: Where the innermost lining forms part of a material combination, the material combination need to be regarded as the innermost lining.

3.13
material
substance excluding hardware and labels, of which an item of clothing is made

3.14
moisture barrier
fabric or membrane used in a component assembly to achieve the properties of hydrostatic pressure and water vapour permeability

Note 1 to entry: Moisture barriers might not prevent the passage of some chemical, biological or radiological agents and appropriate personal protective equipment (PPE) should be provided to protect the wearer in such incidents.

3.15
multilayer material
material consisting of different layers intimately combined prior to the garment manufacturing stage, e.g. by weaving, quilting, coating or gluing

3.16
outer garment
outermost garment of the clothing that will be exposed to the hazard(s)

3.17
outer material
outermost material of which the outermost garment of a clothing assembly is made

3.18
pre-treatment
standard way of preparing the samples before testing that might include e.g. a number of cleaning cycles, submitting the sample to heat, mechanical action or any other relevant exposure and is finished by conditioning

3.19
seam
permanent fastening between two or more pieces of material

3.20
structural seam
seam which holds the outer garment together and which if broken would expose the under layers of the garment and reduce protection

3.21
torso
trunk of the human body, i.e. without arms, neck, legs and head

3.22
wristlet
elastic part of the sleeves or legs that covers the wrist or leg tightly

4 General clothing design

4.1 General

Protective clothing for technical rescue shall be designed to provide protection to the torso, neck, arms to the wrists, and legs to the ankles during search and rescue activities in non-fire conditions. However a certain level of fire protection is needed against sudden ignition of fires. The protective clothing shall be made of materials that are resistant against such incidental ignited fires. It shall provide protection to the wearer against climatic conditions, rough surfaces and has requirements for mechanical strength and conspicuity. In addition, limited heat and flame protection is required against accidental exposure to flames, sparks, etc. Clothing shall not restrict the wearer in any movements expected to be made during a technical rescue operation.

Where more than one garment is needed to meet the requirements of this European Standard, each garment shall be labelled to ensure that the correct combination is used.

General requirements shall be in accordance with EN ISO 13688 and with the specific requirements content in this standard.

NOTE For further information on ergonomic features see Annex D.

4.2 Size designation

Size designations shall be in accordance with EN ISO 13688.

4.3 Type of clothing

The levels of performance specified in this European Standard may be achieved by the use of a garment or a clothing assembly which may contain multilayer materials, component assemblies, or a series of separate garments.

4.4 Interface Areas

Where protection to the requirements of this European Standard is provided by an outer two piece suit, it shall be determined that, when correctly sized for the wearer, an overlap between the jacket and trousers remains when one standing wearer firstly fully extends both arms above the head and then bends over until the fingertips touch the ground. In addition the wrists, lower arms and ankles shall also remain covered. This shall also apply to one piece suits.

4.5 Pockets

All external pockets shall have a closure system that enables complete closure of the pocket.

Where garments are constructed with pockets, the pockets shall be constructed to the following design:

a) pockets with external openings shall be made of material(s) conforming to 6.2.

b) all flaps shall be stitched down or capable of fastening the pocket closed. They shall be 20 mm wider than the opening (10 mm on each side) to prevent the flap from being tucked into the pocket.

Conformity shall be checked by visual inspection and physical measurement.

4.6 Padding

Padding, if fitted, shall be either permanently fixed to the garment or retained securely either inside the garment in internal pockets or outside the garment with the opening of the pockets containing the padding at the bottom of the pocket, completely secured e.g. by hook and pile fastener. Padding may be provided to the knee, elbow and shoulder areas.

Conformity shall be checked by inspection.

4.7 Closures

Closures shall be designed with a protective cover flap on the outside of the garment. If buttons are used the maximum distance between buttonholes shall be 150 mm. If zippers are used, the slide fastener shall be designed to lock when completely closed. Cuffs may be provided with closures to reduce their width. The closure and any fold which it creates shall be on the underside of the cuff.

The sleeves of jackets and coveralls and the lower leg regions of trousers, coveralls and bib + brace shall not have turn-ups. They may have side slits which shall have a means of closure and the slit and closure shall be covered.

Conformity shall be checked by inspection and measurement.

4.8 Hardware

Hardware penetrating the outer material of a garment or clothing assembly shall not be exposed to the innermost surface of the garment or the clothing assembly.

Protective clothing shall be designed to ensure that the hardware shall not have sharp edges, roughness or projections which are likely to cause injury to the wearer’

Conformity shall be checked by inspection.

4.9 Collar

The collar of the garments shall be designed to remain in the vertical position when closed around the neck but also be capable of being easily opened as required by the wearer.

Conformity shall be checked by inspection.

4.10 Integrated personal protective equipment

The requirements shall be fulfilled even when the garments incorporate other types of PPE recommended by the manufacturer (e.g. against falls from a height) or other devices. If interface areas are provided to incorporate other types of PPE these shall not decrease the protection level achieved by the clothing assembly and the incorporated PPE. Verification of the fulfilment of this requirement shall be made by tests with all elements.

5 Sampling and pre-treatment

5.1 Sampling

The number of samples and the size of the specimens of garment materials or garments presented to the different test methods shall be in accordance with the respective test standards specified in the requirements.

Samples shall be representative of the component assembly or clothing assembly, exactly as used in the finished garment or garments.

Samples for testing shall either be taken from the original garment or cut from the material or materials as used in the component assembly. When using the finished garments for samples, the samples shall be taken from evenly distributed areas through all the clothing so that all parts are tested.

In case of different materials all materials shall be tested, the lowest value shall be taken.

5.2 Pre-treatment

5.2.1 Cleaning

All samples for testing in Clause 6 and 7 shall be pre-treated by cleaning. Tests specified in 6.2 and 6.3, shall be carried out before (as received) and after pre-treatment by cleaning. Test in 7.6 shall be carried out after only 5 cleaning cycles according to manufacturer's instructions.

The cleaning shall be in line with the manufacturer's instructions on the basis of standardized processes.

If the number of cleaning cycles is not specified, the tests shall be carried out – in case of laundering after 5 laundering cycles (one laundering cycle consisting of one washing and one drying), or – in case of dry cleaning after 5 cycles of dry cleaning. This shall be reflected in the information supplied by the manufacturer.

If the manufacturer's instructions indicate that both cleaning methods are allowed, the test specimen shall undergo the laundering procedure only.

NOTE Manufacturer's instructions typically indicate one or several of the various methods and processes of EN ISO 6330, EN ISO 15797, EN ISO 3175-2 or equivalent as standardized processes for cleaning.

5.2.2 Ageing

In the case that the garment should be submitted to some treatment to maintain its limited flame spread property the manufacturer shall indicate the maximum number of cleaning cycles that can be

carried out before applying the treatment. Limited flame spread testing shall be carried out after the last cleaning cycle as specified by the manufacturer.

5.2.3 Conditioning

Specimens shall be conditioned for at least 24 h in an atmosphere having a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. Testing shall be carried out within 5 min after removal from this atmosphere.

6 Thermal requirements

6.1 General

For 6.2, 6.3 and 6.4 Annex A and Annex B shall be applied.

6.2 Limited flame spread

6.2.1 All materials and seams shall be tested according to EN ISO 15025, procedure A. Materials shall achieve flame spread index 3 of EN ISO 14116:2015. Results shall be evaluated when the specimens are on the test frame, seams shall not open.

The component assembly of the outer garment shall be tested by applying the test flame to the surface of the outer material and to the surface of the innermost lining on separate specimens.

In this case the number of test specimens shall be duplicated.

If the levels of protection are achieved by clothing assemblies which are separate garments, the outer surface and innermost lining of each garment used in the assembly shall be tested.

6.2.2 For seams, 3 specimens containing a structural seam shall be tested and they shall not open. Specimens shall be oriented with the seam running up the centre line of the test specimen so that the burner flame impinges directly upon the seam.

6.2.3 If the clothing assembly incorporates wristlet materials (as parts of the sleeves or legs) these shall be tested separately applying the flame to the outer surface of the wristlet material and they shall achieve flame spread index 3 of EN ISO 14116:2015.

6.2.4 Hardware that is directly exposed or that is covered, e.g. by a flap, when all closure systems in the protective clothing are in the closed position, shall be tested. Three specimens containing the hardware shall be used. Each one with the vertical dimension specified in EN ISO 15025 and oriented so that the burner flame impinges directly upon the hardware if directly exposed or upon its coverage if covered. If zippers are directly exposed the flame shall impinge on the slider. Specimens containing closure systems shall be oriented so the closure system runs vertically. Specimens containing hardware shall meet the requirements of 6.2.1. At least five minutes after the test the closure system shall be capable of being opened once.

6.2.5 Labels, badges, retro-reflective materials, etc., which are applied to the outermost surface of the garment shall be tested when attached to the outermost layer of the garment to make it possible to take samples with the dimensions as indicated in EN ISO 15025 Procedure A. Three specimens containing the item shall be tested. The items shall be oriented with the longer dimension running up the centerline of the test specimen so that the burner flame impinges directly upon the centre of the item. The combination consisting of the item and the outermost layer of the garment shall meet the requirements of 6.2.1. This requirement is not applicable for sewn in labels with a surface area of less than 10 cm^2.

6.3 Heat transfer – radiation

When tested in accordance to EN ISO 6942, at a heat flux density of 20 kW/m^2, the component assembly or clothing assembly shall achieve RHTI24 ≥ 7,0 s.

The number of samples indicated in the standard shall be tested and the performance classified according to the lowest single result, rounded to one decimal place.

6.4 Contact heat

When tested in accordance with EN ISO 12127-1 at a temperature of 100 °C, the component assembly or clothing assembly shall achieve a threshold time ≥ 5,0 s.

The number of samples indicated in the standard shall be tested and the performance classified according to the lowest single result, rounded to one decimal place.

7 Mechanical and other requirements

7.1 Tensile strength

The outer material when tested in accordance with EN ISO 13934-1 for woven textiles, or EN ISO 1421, method 1, for coated textiles, shall give a breaking load in both machine and cross direction ≥ 450 N.

The main seams of the outer material when tested in accordance with EN ISO 13935-2 shall give a maximum force to seam rupture ≥ 225 N.

7.2 Tear strength

The outer material shall give a tear strength in both machine and cross direction ≥ 25 N. Coated fabrics shall be tested in accordance with EN ISO 4674-1, method B, and non-coated fabrics in accordance with EN ISO 13937-2.

7.3 Abrasion resistance

The outer material when tested in accordance with EN ISO 12947-2 at 12 kPa with crossbred worsted abradant shall achieve a minimum of 20 000 cycles; the end point will be two broken threads.

7.4 Surface wetting (Optional)

Where manufacturer claims resistance to surface wetting, the outer material of samples tested according to EN ISO 4920 at 20 °C shall give a spray rating of ≥ 4. The evaluation criterion shall be the lowest individual value.

This test is to be carried out, even if the garment has a moisture barrier.

7.5 Electrostatic properties (optional)

The protective clothing when tested shall meet the requirements according to EN 1149-5.

If EN 1149–5 is required, a full assessment shall only be carried out on a complete garment, as stated in the standard.

7.6 Dimensional change

The change in dimensions of woven materials shall not exceed ± 3 % in either length or width direction when measured in accordance with EN ISO 5077, using the pre-treatment specified in 5.2.1, but after five cleaning cycles only.

The change in dimensions of knitted materials or non-woven materials shall not exceed ± 5 %.

Each single layer material or component assembly of a clothing assembly shall be tested separately.

The combination of materials in a component assembly shall be prepared so that the layers of material are sewn together around all four sides of the test sample; only one sample shall be tested.

This test does not apply to knitted wristlet material.

7.7 Water vapour resistance

The clothing assembly, or the component assembly of single garments, shall be tested in accordance with EN ISO 11092 and shall achieve a water vapour resistance of ≤ 20 m^2 Pa/W.

Anti-wicking barriers, and visibility materials that are applied to the outermost surface, are excluded from this requirement.

7.8 Resistance to Penetration by Blood Borne Pathogens

7.8.1 General

Following the pre-treatment described in 7.8.2, the component assembly or clothing assembly shall show 0 plaques on the detection plates following exposure to procedure A or B (if a retaining screen is required) of ISO 16604.

7.8.2 Viral Penetration Resistance

If the manufacturer claims protection against bloodborne penetration then the following requirement applies to the moisture management component including seams. When tested in accordance with ISO 16604 procedure A or procedure B, no detectable transfer of the Phi-X174 bacteriophage on the detection plates shall be demonstrated.

Moisture management component seams shall be tested by preparing a 380 mm square sample of the component assembly with an extra layer of outer material against the innermost layer. The moisture barrier layer within the sample shall include a centre seam that extends across the entire 380 mm width of the sample.

The samples shall be stitched along the peripheral edge.

The samples shall first be subjected to pre-treatment by laundering or dry cleaning as specified in 5.2 and then be subjected to pre-treatment by oven exposure as specified in ISO 17493 at a temperature of 140°C +5/ −0 °C for 5 minutes, except that no measurement or observation shall be made.

This sequence of pre-treatments shall be repeated a second time. Testing following the last oven exposure shall take place within 5 minutes of the oven exposure.

Following the last pre-treatment, specimens shall be taken from the moisture management component seam for viral penetration resistance testing.

Procedure B involves the use of a retaining screen to support extensible or elastomeric materials. When distortion of the test material is suspected of causing failure with Procedure A, Procedure B may be used.

7.9 Visibility

Technical rescue clothing shall have high visibility materials which give all round visibility which shall be ensured by having at least one band of retroreflective material encircling arms, legs and torso of the garments.

Retro-reflective material shall be attached to the outermost surface of the protective clothing with a minimum area of not less than 0,13 m^2; the bands shall not be less than 50 mm wide. The minimum

area of fluorescent material shall be not less than 0,50 m^2. The area of the fluorescent material shall be (50 ± 10) % on the front part of the garment as measured in EN ISO 20471.

NOTE The minimum amount of high visible material corresponds to the minimum amount of high visible material in EN ISO 20471 Class 2.

Photometric requirements and physical requirements for the retro-reflective materials before pre-treatment shall be in accordance with EN ISO 20471:2013, Table 4 in 6.1 independently of their colour.

After exposure as required in EN ISO 20471:2013, Table 6 each test specimen shall fulfil the photometric requirements of EN ISO 20471:2013, 6.2.

The colour requirements of the fluorescent material shall be in accordance with EN ISO 20471:2013, 5.1 and 5.2.

The retro-reflective and fluorescent materials shall also meet the requirements of 6.2.1 flame spread in this standard.

7.10 Burst strength

Burst strength for knitted outer materials and any structural seams shall be tested in accordance with EN ISO 13938-1 or EN ISO 13938-2. Knitted outer materials and structural seams shall have minimum burst strength of 100 kPa when using 50 cm^2 test area or of 200 kPa when using a 7,3 cm^2 test area.

Table 1 — Performance requirements

Property	Applicable subclause	Index or factor	Level
Flame spread (fabric)	6.2		Index 3 of EN ISO 14116
Flame spread (seams)	6.2		Shall not open
Flame spread (hardware)	6.2.3		Hardware to remain functional
Heat transfer (radiant heat)	6.3	$RHTI_{24}$	≥ 7,0 s
Contact heat (at 100°C)	6.4	Reading on calorimeter is 10 °C above starting value	≥ 5,0 s
Tensile strength Outer material seams	7.1		≥ 450 N ≥ 225 N
Tear strength	7.2		≥ 25 N
Abrasion resistance	7.3	cycles	> 20 000
Surface wetting (optional)	7.4	Spray rate	≥ 4
Dimensional change	7.6		≤ ± 3 % (woven) ≤ ± 5 % (non-woven)
Water vapour resistance	7.7		≤ 20m^2 Pa/W
Infectious agent (optional)	7.8		ISO 16604 Procedure A and B
Visibility	7.9	See 7.9	See 7.9
Burst Strength	7.10		See 7.10

8 Marking

8.1 Marking requirements shall be as specified in EN ISO 13688 and in this clause.

8.2 If the requirements of this European Standard are met by the use of a combination of garments, this shall be declared on the labels of all garments involved; each garment shall be labelled to ensure that the correct combination is used.

9 Information supplied by the manufacturer

9.1 The information to be supplied by the manufacturer shall be as specified in EN ISO 13688.

9.2 The manufacturer shall give as much information as possible on known factors of durability, especially on durability to cleaning. In cases where applying a finish can restore the protective

properties, the maximum number of cleaning cycles before re-application of the finish shall clearly be indicated.

9.3 The manufacturer shall include a note in the information giving the items of personal protective equipment that need to be worn in order to protect the wearer's body according to the introduction and scope of this European Standard. The manufacturer shall give a warning as to any hazard the garment is intended to protect against.

Annex A
(normative)

Uncertainty of measurement

For each of the required measurements performed in accordance with this standard, a corresponding estimate of the uncertainty of measurement shall be evaluated. This estimate of uncertainty shall be applied when it may affect the rating or classification of a property.

Annex B
(normative)

Determination of property values

All the individual results of the specimens of a test shall meet the performance requirement.

If not otherwise specified, the average result shall be given.

If a material exhibits differing behaviour for a property in the length and cross directions of the material, the resultant property value shall be the value obtained in the lesser performing direction.

In the event that only one specimen fails, another set of specimens shall be tested and the entire individual results of this second set of specimens shall meet the requirements. Otherwise the sample is considered to have failed the requirement.

Annex C
(informative)

Guidelines for clothing compatibility

C.1 The general requirements for the design of the protective clothing in accordance with this European Standard are given in Clause 4. This annex contains some additional considerations, some of which are relevant when combining the protective clothing according to this European Standard with other protective items such as gloves, footwear, visors, etc.

C.2 If gloves are worn, there should be an overlap between the sleeves and the gloves and this overlap should be retained while the user is working in such a way that trapping points and entry of heat, flame or hot material is avoided.

C.3 Trouser bottoms should overlap the top of the footwear and this overlap should be maintained whilst walking and crawling.

C.4 Quick-release fastenings could be provided to enable rapid removal of the garments in the event of an emergency.

C.5 If the clothing covered by this International Standard is provided with a hood, the hood should be designed in such a way that it remains in position and the integrity of joints or interfaces is maintained when the wearer adopts a full range of body movements and positions. Where the hood is provided with a visor, the hood including the visor should be examined to determine whether the sensory perception (sight and hearing) is reduced to a point that would endanger the user.

C.6 Pleats in the exterior surface of the garment can act as trapping points for hot/molten materials. If pleats are present in the garment, the bottoms of the pleats should incorporate a means whereby entrapment of molten metal can be prevented, for example by incorporating diagonal stitches or some other feature.

Annex D
(informative)

Checking of basic ergonomic features of protective clothing

D.1 General

This annex informs how some basic ergonomic features can be checked for many types of protective clothing in a pragmatic way. This annex is not intended to replace specific ergonomic testing required by the user for the individual assessment of protective clothing at a specific workplace. In general, carrying out ergonomic assessments can help to improve protective clothing and detect major deficiencies.

In principle, one or more experienced assessors should examine the protective clothing after reading the information supplied from the manufacturer. The test clothing of a suitable size should be put on together with such normal clothing as is intended to be worn, and some ergonomic features relating to the practical performance of the protective clothing should be checked (e.g. if no movement restrictions are caused). Some of the relevant questions that might be asked are set out below and it is desirable that responses given should be positive.

An assessor can have difficulties deciding whether the product is acceptable or unacceptable. It is recommended that the product should be compared with similar items on the market. If it is significantly worse ergonomically, without redeeming features such as enhanced protection, it can be regarded as unnecessarily uncomfortable. Care will need to be taken if there are no directly comparable products. Care will also be taken when protection against mortal danger is intended and "the state of the art" does not allow comfortable conditions for users, nor perhaps conditions free of harm caused by the protective clothing. Carrying out (subjective) ergonomic assessments will more often result in recommendations for changes to improve protective clothing, than in finding the clothing does not comply with this European Standard.

D.2 Ergonomic assessment questions

D.2.1 Question: Is the protective clothing free from any sharp or hard edges, rough surfaces or other items on the inner or outer surface of the clothing that are likely to cause harm to the user?

Protective clothing should be inspected manually and visually to ensure that that no harmful points exist; e.g. no protruding wire ends or other items that could seriously harm a person.

D.2.2 Question: Is it possible to put on and take off the protective clothing without difficulty?

The following points should be considered:

— the ease of putting on and removing the clothing with or without assistance as is appropriate for the type of clothing;

— the clothing is not too tight for comfort and deep breathing is not restricted and nowhere is there any blood flow restriction;

— clothing design should allow sufficient levels of ventilation;

— clothing design features at, e.g. armholes and crotch, are appropriately proportioned and positioned.

D.2.3 Question: Can the closures, adjusters and restraint systems be operated without difficulty?

The following points should be considered:

— the adequacy of the range of adjustments available;

— the ease and security of closures and adjusters;

— that the closures, adjusters and restraint systems should withstand the forces they are likely to be exposed to during body movements.

D.2.4 Question: Can the following movements be carried out without difficulty?

a) standing, sitting, walking, kneeling, crawling and stair climbing;

b) raising both hands above the head;

c) bending over and picking up a small object, e.g. a pencil.

The following points should be considered:

— that the arms and legs of the clothing are not so long that they interfere with hand and foot movements;

— that the clothing is not so loose it flaps about or moves independently and inconveniently;

— any point at which unexpected and unintended gaps open up between or within components of the clothing;

— any unreasonable restriction of movements.

D.2.5 Question: Does the protective clothing cover the body area to be protected during movements?

The following points should be considered:

— coverage of specific protection zones of the intended body area by protective material or special constructions;

— that the coverage is maintained during movements as extreme as it is anticipated a user would make.

D.2.6 Question: Is the protective clothing compatible with other items of PPE?

The following points should be considered:

— protective clothing normally worn as part of an ensemble should be compatible with representative examples of the rest of the ensemble;

— putting on and removing other items of PPE, e.g. gloves and boots should be possible without difficulty.

D.3 Grounds for concluding that a product is unacceptable

The following are obvious reasons for concluding that a protective clothing product is unacceptable and not fit for use:

a) the subject it should fit cannot wear it;

b) it does not stay closed or it will not stay in place;

c) it compromises a vital function such as breathing;

d) simple tasks to be performed wearing it are impossible;

e) the subject refuses to continue this assessment due to pain;

f) it prevents the wearing of other essential PPE.

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of EU Directive 89/686/EEC aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/031 to provide one voluntary means of conforming to essential requirements of the Council Directive 89/686/EEC on the approximation of the laws of the Member States relating to personal protective equipment.

Once this standard is cited in the Official Journal of the European Union under that Directive, 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 Directive, and associated EFTA regulations.

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

Essential Requirements (ERs) of Directive 89/686/EEC	**Clause(s)/subclause(s) of this EN**	**Remarks/Notes**
1.2.1 Absence of risks and other 'inherent' nuisance factors	4.1, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 7.4, 7.6	
1.3.2 Lightness and design strength	7.1, 7.2, 7.3, 7.10	
1.4 Information supplied by the manufacturer	5.2.1, Clause 9	
2.2 PPE 'enclosing' the parts of the body to be protected	7.7	
2.4 PPE subject to ageing	5.2.2	
2.6 PPE for use in explosive atmospheres	7.5	
2.8 PPE for use in very dangerous situations	Clause 9	
2.12 PPE bearing identification marks related to health and safety	Clause 8	
2.13 PPE capable of signalling the users presence visually	7.9	
3.6.1 PPE constituent materials and other components	6.2	
3.6.2 Complete PPE ready for use	6.3, 6.4	
3.10.2 Protection against cutaneous and ocular contact	7.8	

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.

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

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