BRITISH STANDARD

BS EN 469:2005
Incorporating amendment no. 1

Protective clothing for firefighters — Performance requirements for protective clothing for firefighting

The European Standard EN 469:2005, incorporating amendment A1:2006, has the status of a British Standard

ICS 13.340.10

BSI British Standards

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 469:2005, incorporating amendment A1:2006 and corrigendum September 2006. It supersedes BS EN 469:1995 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] ⟨A1⟩. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by [A1] ⟨A1⟩.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags [AC] ⟨AC⟩. Text altered by CEN corrigendum September 2006 is indicated in the text by [AC1] ⟨AC1⟩.

The UK participation in its preparation was entrusted by Technical Committee PH/3, Protective clothing, to Subcommittee PH/3/2, Clothing for protection against heat and flame.

A list of organizations represented on PH/3/2 can be obtained on request to its secretary.

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

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 1 March 2006

ISBN 0 580 47908 0

Amendments issued since publication

Amd. No.	Date	Comments
16833	31 January 2007	See national foreword

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 469
December 2005

+A1
November 2006

ICS 13.340.10

Supersedes EN 469:1995
Incorporating corrigendum September 2006

English Version

Protective clothing for firefighters - Performance requirements for protective clothing for firefighting

Vêtements de protection pour sapeurs pompiers - Exigences de performance pour les vêtements de protection pour la lutte contre l'incendie

Schutzkleidung für die Feuerwehr - Leistungsanforderungen für Schutzkleidung für die Brandbekämpfung

This European Standard was approved by CEN on 22 July 2005.

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 Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 469:2005: E

Contents

Foreword

This European Standard (EN 469:2005) 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 March 2006, and conflicting national standards shall be withdrawn at the latest by March 2006.

This European Standard supersedes EN 469:1995.

This European Standard 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 European Standard.

It is one of several standards for clothing that have been developed to protect persons against heat and/or flames. Some examples of other European Standards include:

— prEN ISO 11611:2003, Protective clothing for use in welding and allied processes (ISO/DIS 11611:2003);

— prEN ISO 11612:2003, Clothing to protect against heat and flame (ISO/DIS 11612:2003);

— ISO 11613:1999, Protective clothing for firefighters — Laboratory test methods and performance requirements;

— EN 1486:1996, Protective clothing for firefighters — Test methods and requirements for reflective clothing for specialized fire fighting;

— EN ISO 14460:1999 (and EN ISO 14460/A1:2002), Protective clothing for automobile racing drivers — Protection against heat and flame — Performance requirements and test methods (ISO 14460:1999);

— ISO 15384:2003, Protective clothing for firefighters — Laboratory test methods and performance requirements for wildland firefighting clothing;

— ISO 15538:2001, Protective clothing for firefighters — Laboratory test methods and performance requirements for protective clothing with a reflective outer surface;

— EN 13911:2004, Protective clothing for firefighters — Requirements and test methods for fire hoods for firefighters.

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

Foreword to amendment A1

This document (EN 469:2005/A1:2006) 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 Amendment to the European Standard EN 469:2005 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2007, and conflicting national standards shall be withdrawn at the latest by May 2007.

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 89/686/EEC.

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

Introduction

The purpose of this European Standard is to provide minimum performance requirements for protective clothing for firefighters, whilst fighting fires. Within this European Standard, two performance levels are given for performance requirements 6.2, 6.3, 6.11 and 6.12 - level 1 is the lower level, level 2, the higher level. The level of personal protection chosen should be based on the outcome of a risk assessment. Annex G lists many of the hazards that may be encountered by firefighters and sets out guidelines for carrying out a risk assessment analysis.

During an incident, hazards other than those against which 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 covered by this European Standard.

In this European Standard, some requirements have an influence on ergonomics and additional informative annexes on ergonomic features and physiological / heat stress hazards are included in the form of guidelines because suitable tests for these requirements have not yet been validated internationally. It is important that further requirements for ergonomic aspects of protective clothing become integrated normative parts of European standards such as this and currently work on this is taking place.

The requirement regarding water vapour resistance in 6.12, level 1, is proposed for an amendment (procedure).

For adequate overall protection against the risks to which firefighters 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 firefighting personnel may be exposed.

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

NOTE It is essential that firefighters are trained in the selection, use, care and maintenance of all personal protective equipment. Attention is drawn to CEN/TR 14560:2003, which sets out guidelines for selection, use, care and maintenance of protective clothing against heat and flame.

1 Scope

This European Standard specifies minimum levels of performance requirements for protective clothing to be worn during firefighting operations and associated activities such as e.g. rescue work, assistance during disasters. The described clothing is not meant to protect against deliberate chemical and/or gas cleaning operations.

This European Standard covers the general clothing design, the minimum performance levels of the materials used, and the methods of test to be used to determine these performance levels. The required performance levels may be achieved by the use of one or more garments.

This European Standard covers the event of an accidental splash of chemical or flammable liquids but does not cover special clothing for use in other high-risk situations e.g. reflective protective clothing. It does not cover protection for the head, hands and feet or protection against other hazards e.g. chemical, biological, radiological and electrical hazards. These aspects may be covered in other European Standards.

2 Normative References

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

EN 340, *Protective Clothing — General requirements*

EN 367, *Protective clothing — Protection against heat and fire — Method of determining heat transmission on exposure to flame*

EN 471:2003, *High-visibility warning clothing for professional use — Test methods and requirements*

EN 533:1997, *Protective clothing — Protection against heat and flame — Limited flame spread materials and material assemblies*

EN 20811, *Textiles — Determination of resistance to water penetration — Hydrostatic pressure test*

EN 24920:1992, *Textiles — Determination of resistance to surface wetting (spray test) of fabrics*

EN 31092, *Textiles — Determination of physiological properties — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded - hotplate test) (ISO 11092:1993)*

EN ISO 1421:1998, *Rubber- or plastics — Determination of tensile strength and elongation at break (ISO 1421:1998)*

EN ISO 4674-1:2003, *Rubber- or plastics-coated fabrics - Determination of tear resistance - Part 1: Constant rate of tear methods (ISO 4674-1:2003)*

EN ISO 6530:2005, *Protective clothing — Protection against liquid chemicals — Test method for resistance of materials to penetration by liquids (ISO 6530:2005)*

EN ISO 6942:2002, *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 6942:2002)*

EN ISO 13934-1:1999, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1:1999)*

EN ISO 13937-2:2000, *Textiles - Tear properties of fabrics - Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method) (ISO 13937-2:2000)*

EN ISO 15025:2002, Protective clothing — Protection against heat and flame — Method of test for limited flame spread (ISO 15025:2000)

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

ISO 7941, *Commercial propane and butane — Analysis by gas chromatography*

ISO 17493:2000, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

CIE 54.2:2001, *Retroreflection — Definition and measurement*

3 Terms and definitions

For the purposes of this European Standard, the following definitions apply.

3.1
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)

3.2
closure system
method of fastening openings in the garment including combinations of more than one method of achieving a secure closure

NOTE This term does not cover seams.

3.3
complete garment assembly
all materials that form the complete garment

3.4
component assembly
combination of all materials of a multi-layer garment presented exactly as the finished garment construction

3.5
firefighters' protective clothing
specific garments providing protection for the firefighter's torso, neck, arms, and legs, but excluding the head, hands, and feet

3.6
garment
single item of clothing which may consist of single or multiple layers

3.7
hardware
non-fabric items used in protective clothing including those made of metal or plastic, e.g. fasteners, rank markings, buttons, zippers

3.8
innermost layer
innermost material of the complete garment assembly which is intended to be nearest to the wearers skin

3.9
innermost lining
lining on the innermost face of a component assembly which is intended to be nearest to the wearers skin. Where the innermost lining forms part of a material combination, the material combination shall be regarded as the innermost lining

3.10
interlining
layer between the outermost layer and the innermost lining in a multilayer garment

3.11
material
substances excluding hardware, of which an item of clothing is made

3.12
material combination
material produced from a series of separate layers, intimately combined prior to the garment manufacturing stage, e.g. a quilted fabric

3.13
moisture barrier
fabric or membrane used in a complete garment assembly to achieve the properties of hydrostatic pressure and water vapour permeability

NOTE 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.

3.14
multilayer clothing assembly
series of garments arranged in the order as worn. It may contain multilayer materials, material combinations or a series of separate garments in single layers

3.15
outer garment
outermost part of the clothing that will be exposed to the hazard(s)

3.16
outer material
outermost material of which the item of protective clothing is made

3.17
seam
permanent fastening between two or more pieces of material

3.18
structural seam
seam which holds the outer garment together and which if broken would expose the under garments and reduce protection

3.19
torso
trunk of the human body, i.e. without arms, legs and head

3.20
wristlet
elastic part of the sleeves that covers the wrist tightly

4 General clothing design

4.1 General

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

4.2 Size designation

Size designation shall be in accordance with the requirements of EN 340.

4.3 Type of clothing

Protective clothing for firefighters shall provide protection for the firefighters torso, neck, arms to the wrists, and legs to the ankles during firefighting activities. It does not cover protection for the head, hands and feet or protection against other hazards e.g. chemical, biological, radiological and electrical hazards.

4.4 Combination of garments

Where protection to the requirements of this European Standard is provided by more than one garment, each garment in the clothing assembly shall be marked in accordance with the requirements of this European Standard(see 7.3).

4.5 Outer two piece suit

Where protection to the requirements of this European Standard is provided by an outer two piece suit, it shall be determined that an overlap between the jacket and trouser shall always remain whilst carrying out the job related exercises during ergonomic and practical performance testing (see e.g. EN 340 and Annex D) whatever the position of the body parts or the movements are during those exercises.

4.6 Anti-wicking barrier

Where an anti-wicking barrier is used in a garment either as part of an interlining at the edge part of a moisture barrier or as the edge part of an innermost lining e.g. at the end of the sleeves, the trouser legs or bottom of a jacket, the material shall at least meet the requirements of the moisture barrier according to 6.11. Further the component assembly including the anti-wicking barrier shall meet the requirements of 6.1, 6.2, and 6.3.

4.7 Hardware

Hardware penetrating the outer material shall not be exposed on the innermost surface of the component assembly.

4.8 Integrated personal protective equipment (PPE)

When PPE for other type of protection (e.g. against falls from a height) is integrated in the clothing assembly they shall meet the requirements set for these type of PPE. The interface shall not decrease the protection level achieved by the clothing assembly.

5 Sampling and pre-treatment

5.1 The number and size of specimens for the different tests shall be in accordance with the respective European Standards.

5.2 Before testing for the requirements in Clause 6, except for the tests in 6.5, 6.6, 6.7, 6.13, 6.14, and 6.15, the test materials shall be washed and dried or dry-cleaned according to the instructions of the care labelling and the manufacturer's instructions. Materials shall be conditioned for 24 h at (20 ± 2) ºC and (65 ± 5) % relative humidity before testing. Testing shall begin within 10 min after removing the specimen from the standard atmosphere.

5.3 Component assembly or multilayer component assembly are tested with the outermost surface exposed, except for flame spread testing of innermost lining (6.1). Unless otherwise specified in the test standard, the test shall be carried out in laboratory conditions at a temperature of (20 ± 3) ºC and a (65 ± 5) % relative humidity.

5.4 Pre-treatment of testing of water vapour resistance (see 6.12) shall be in accordance with EN 31092 on the whole component assembly.

6 Requirements

6.1 Flame spread

6.1.1 Materials and seams shall be tested according to EN ISO 15025:2002, procedure A, and they shall achieve flame spread index 3 of EN 533:1997. Results are evaluated when the samples are on the test frame.

6.1.1.1 For materials, 3 specimens in machine direction and 3 specimens in cross direction shall be tested according to EN ISO 15025:2002, procedure A, and they shall achieve flame spread index 3 of EN 533:1997.

6.1.1.2 For seams, 3 specimens containing a structural seam shall be tested according to EN ISO 15025:2002, procedure A, and they shall achieve flame spread index 3 of EN 533:1997 and 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.

6.1.2 No specimen shall give hole formation in any layer except for a layer other than the outer material or innermost lining when tested according to 6.1.1, which is used for specific protection other than heat protection, for example a layer which provides protection against liquid penetration etc.

6.1.3 The component assembly of the outer garment shall be tested according to 6.1.1 by applying the test flame to the surface of the outer material and to the surface of the innermost lining.

6.1.4 If the levels of protection are achieved by multilayer clothing assemblies which are separate garments, the outer surface and innermost lining of each garment used in the assembly shall be tested according to 6.1.1.

6.1.5 If the clothing assembly incorporates wristlet materials these shall be tested separately applying the flame to the outer surface of the wristlet material according to EN ISO 15025:2002, procedure A, and they shall achieve flame spread index 3 of EN 533:1997.

6.1.6 If hardware is used in protective clothing this shall be tested separately applying the flame to the outer surface of the hardware items, according to EN ISO 15025. The hardware shall remain functioning after the test.

6.2 Heat transfer – Flame

The component assembly or multilayer clothing assembly when tested according to EN 367 shall achieve the following performance levels and be classified accordingly:

Table 1 — Heat transfer (flame)

Heat transfer index	Performance level 1	Performance level 2
HTI_{24}	≥ 9,0	≥ 13,0
$HTI_{24} – HTI_{12}$	≥ 3,0	≥ 4,0

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. Where performance levels 1 and 2 exist in the same garment or multilayer clothing assembly, it shall be classified as level 1 (see Clause 7, Marking).

6.3 Heat transfer – Radiation

The component assembly or multilayer clothing assembly when tested according to EN ISO 6942 at a heat flux density of 40 kW/m² shall achieve the following performance levels and be classified accordingly:

Table 2 — Heat transfer (radiation)

Heat transfer factor index	Performance level 1	Performance level 2
RHTI 24	≥ 10,0	≥ 18,0
RHTI 24 - RHTI 12	≥ 3,0	≥ 4,0

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. Where performance levels 1 and 2 exist in the same garment or multilayer clothing assembly, it shall be classified as level 1 (see Clause 7, Marking).

6.4 Residual tensile strength of material when exposed to radiant heat

Three specimens in the machine direction and three in the cross direction of the outer material shall be tested by EN ISO 13934-1 or EN ISO 1421:1998, method 1, after pre-treatment of the complete assembly or multilayer clothing assembly by EN ISO 6942:2002, method A, at a heat flux density of 10 kW/m². Each specimen shall have a tensile strength ≥ 450 N.

The sample used after exposure at 10 kW/m² according to EN ISO 6942 shall be stripped in order to obtain 50 mm width. This width shall contain the exposed surface.

6.5 Heat resistance

When tested according to ISO 17493 at a temperature of (180 ± 5) ºC for an exposure time of 5 min, each material used in the clothing assembly shall not ignite or melt and shall not shrink more than 5 % in either machine or cross direction. Each material shall be tested separately. If a specimen of sufficient size cannot be taken it may be sewn on the carrying material as used in the garment. Hardware of the type(s) intended to be used in the finished garment, shall function after this test.

6.6 Tensile strength

6.6.1 The outer material when tested in accordance with EN ISO 13934-1 or EN ISO 1421:1998, method 1, shall give a breaking load in both machine and cross direction ≥ 450 N.

6.6.2 The main seams of the outer material when tested in accordance with EN ISO 13935-2:1999 shall give a breaking load ≥ 225 N.

6.7 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 4674-1:2003, method B, non-coated fabrics in accordance with EN ISO 13937-2:2000.

6.8 Surface wetting

6.8.1 Pre-treatment

Before testing the test materials shall be washed and dried according to 5.2 as indicated by the manufacturer.

6.8.2 Testing procedure

The outer material when tested according to EN 24920 at 20 °C shall give a spray rate of ≥ 4. The evaluation criterion shall be the lowest value.

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

6.9 Dimensional change

The dimensional change shall be equal to or less than ± 3 % in both directions when tested in accordance with ISO 5077 using the pre-treatment specified in 5.2.

Each single layer material or component assembly of a multilayer 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. One sample only shall be tested.

This test does not apply to wristlet material.

6.10 Resistance to penetration by liquid chemicals

6.10.1 Pre-treatment

Before testing the test materials shall be washed and dried according to 5.2 as indicated by the manufacturer.

6.10.2 Testing procedure

The component assembly or multilayer clothing assembly shall be tested in accordance with EN ISO 6530 using a chemical application time of 10 s using the following liquid chemicals and in each case, shall give no penetration to the innermost surface and a repellency rate of more than 80 %.

Table 3 — Chemical penetration testing

Chemical	Concentration Weight (%)	Temperature of chemical ± 2 (°C)
NaOH	40	20
HCl	36	20
H_2SO_4	30	20
o-xylene	100	20

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

6.11 Resistance to water penetration

The layer (including seams) providing the resistance of water entry, when tested in accordance with EN 20811 using a rate of increase in pressure of (0,98 ± 0,05) kPa/min shall achieve one of the following:

Level 1 < 20 kPa, for garments without a moisture barrier.

Level 2 ≥ 20 kPa, for garments with a moisture barrier.

Test samples shall be taken from critical areas like e.g. shoulder seams.

6.12 Water vapour resistance

The requirements for water vapour resistance shall be achieved by testing either the complete component assembly or the multilayer clothing assembly. Anti-wicking barriers are excluded from this requirement. Testing shall be in accordance with EN 31092 and one of the following shall be achieved:

〚A1〛 Level 1 > 30 m² Pa/W. 〚A1〛

Level 2 ≤ 30 m² Pa/W.

NOTE High water vapour resistance can lead to a higher risk of steam burns.

6.13 Ergonomic performance

Ergonomic assessment of clothing covered by this European Standard should be carried out by practical performance testing. Suitable tests for these requirements have not yet been validated internationally but guidance is included in Annex D.

Also additional integrated devices to be used with the protective clothing should be included in this testing.

6.14 Visibility

Any optional retro-reflective/fluorescent material shall conform to those requirements given in Annex B. Colour requirements of the fluorescent material shall be in accordance with 5.1 of EN 471:2003.

6.15 Optional test - whole garment testing

In addition to the tests on materials, the complete component assembly or multilayer clothing assembly that is intended to be used to provide protection according to the requirements of this European Standard can be optionally tested. If this optional test is performed, it shall be done on an instrumented manikin and never on subjects using the following exposure conditions:

8 s 84 kW/m²

Also additional integrated devices to be used with the protective clothing should be included in this testing.

The test method described in Annex E is able to provide the information as required in 8.5.

7 Marking

7.1 Marking requirements shall be as specified in EN 340 and in this clause.

7.2 Firefighters' protective clothing complying with this European Standard shall be marked with the number and date of this European Standard, i.e. EN 469:2005, on or adjacent to the pictogram attached to the garment.

7.3 If the requirements of this European Standard are met by the use of a combination of garments (see 4.4) this shall be declared on the labels of all pieces of the combination of the garments used and indicating that they shall be worn together.

7.4 The level of performance achieved, when tested in accordance with 6.2, 6.3, 6.11, and 6.12 shall be stated on the pictogram attached to the garment.

7.4.1 The pictogram shall be as given in Figure 1.

7.4.2 Four performance levels shall be shown on the pictogram – for heat protection (see 6.2 and 6.3, flame and radiation) and applies to the whole garment; for resistance to water penetration (see 6.11) and for water vapour resistance (see 6.12). The lowest level achieved in the garment or multilayer clothing assembly for the particular performance test concerned, shall apply.

NOTE For a jacket and trousers designed to be worn together either the jacket or the trousers can be level 1 or level 2.

7.4.2.1 Xf1 or Xf2 and Xr1 or Xr2. These are the levels achieved for heat protection (flame and radiation). The lowest level of 6.2 and 6.3 dictates the performance rating for heat protection.

7.4.2.2 Y1 or Y2. This is the level achieved for resistance to water penetration.

7.4.2.3 Z1 or Z2. This is the level achieved for water vapour resistance.

7.5 If re-impregnation of the outer material is required, the number of washes before re-impregnation shall be clearly stated on the marking and may be carried out before inspection and discarding the equipment.

Figure 1 — Pictogram ISO 7000 – 2418

8 Information supplied by the manufacturer

8.1 Firefighters' protective clothing shall be supplied to the customer with information written at least in the official language(s) of the state of destination.

The manufacturer shall add information about the use of integrated devices.

8.2 The information to be supplied by the manufacturer shall be as specified in EN 340.

8.3 The manufacturer shall include a note in the information that in order to comply with the requirements of this European Standard, the upper and lower body including the neck, arms to the wrists and legs to the ankles, are protected and covered by the clothing described in this European Standard, but other parts of the body are not and need essential means in order to be fully protected.

8.4 The manufacturer shall include a note in the information to the effect that in the event of an accidental splash of chemical or flammable liquids on clothing covered by this European Standard, the wearer should immediately withdraw and remove the garments, which shall then be cleaned or removed from service.

8.5 If the optional whole garment test in 6.15 has been performed, the manufacturer shall provide a report in the information on the result, as given in Annex C.

8.6 The manufacturer shall include a note in the information to the effect that garments that have reached level 1 in resistance to water penetration should not be used when there is risk of water penetration.

A1 **8.7** The manufacturer shall include a note in the information indicating a limitation of time of use due to heat stress for garments using materials that have reached level 1 in water vapour resistance. This limitation of time shall be related to the type of activity (metabolic heat production, environmental conditions). A1

Annex A
(normative)

Uncertainty of measurement

The uncertainty associated with most of the test methods specified in this European Standard (EN 469:2005) cannot be determined until interlaboratory trials have been completed and the test methods have been amended appropriately. In this transitional period the results obtained from all tests specified in EN 469:2005 shall be interpreted without taking uncertainty into account.

Annex B
(normative)

Requirements for visibility

Retroreflective/fluorescent/combined performance material shall conform to EN 471 as per the following:

B.1 Separate performance retroreflective material shall be attached to the outermost surface of the protective clothing with a minimum area of not less than 0,13 m² and give all round visibility by encircling the arms, legs and torso regions of the garment(s).

B.2 If non-reflective fluorescent or combined performance material is applied, the minimum area of fluorescent material shall be not less than 0,2 m².

B.3 Photometric requirements of the retroreflective material shall be determined according to test method CIE 54.2:2001. The minimum coefficient of retroreflection for new retroreflective or combined performance material shall be in accordance with EN 471:2003, Table 5 or Table 7.

The retroreflective/fluorescent/combined performance materials, in order not to affect the performance of the protective clothing, shall comply with the following test requirements, after the pre-treatment specified in 5.3:

B.3.1 Heat resistance: The retroreflective/fluorescent/combined performance materials exposed for 5 min. according to the requirements of 6.5 of this European Standard shall be in accordance with 6.2 of EN 471:2003 (coefficient of retroreflection after test exposure) and the retroreflective/fluorescent/combined performance materials shall not drip, ignite, melt or shrink more than 5 %.

B.3.2 Flame spread: All materials used for visibility shall be tested as specified in 6.1 in combination with the outer layer to make it possible to take samples with the dimensions as indicated in EN ISO 15025:2002, procedure A. No hole formation is allowed in the materials.

Annex C
(informative)

Prediction of burn injury using an instrumented manikin

The given information about the results of the test shall at least contain the following:

a) name and address of the laboratory in which the test of 6.15 was carried out;

b) statement confirming the following:

   1) that the test was carried out for garment evaluation;

   2) that the component or clothing assembly that was tested to 6.15 was manufactured from the same materials that were used to achieve certification to this European Standard and was designed and manufactured according to the requirements of this European Standard;

c) following information:

   1) describing any special pre-treatment of any part of the component or clothing assembly prior to the test in 6.15 or alternatively a statement that the garment ensemble did not have any special pre-treatment;

   2) describing any holes or cuts that were necessary to be made in the component or clothing assembly to accommodate cable connections or other necessary parts of the test manikin;

   3) stating the total number and general arrangement of the burners used to create the flash fire exposure;

   4) stating the nominal heat flux density level, the duration of the exposure and the duration of the data acquisition time for the test;

d) results of the test as follows:

   1) predicted manikin area of second-degree burn injury (%);

   2) predicted manikin area of third-degree burn injury (%);

   3) predicted total manikin area of burn injury (sum of the second degree and third degree burn injury % and associated variation statistics such as standard deviation);

e) comments on the:

   1) intensity and duration of afterflame;

   2) amount of smoke generated during and after the test, if measured;

   3) stability of the component or clothing assembly during and after the test with particular reference to the amount of dimensional change, which shall be listed in Table C.1:

Table C.1 — Test results of the optional test in 6.15

	Dimensions in cm				
Column 1 **Location**	**Column 2** **Instrumented manikin measurements**	**Column 3** **Specimen before testing to 6.15 (Note 1)**	**Column 4** **Difference -** **(Column 3 minus column 2)**	**Column 5** **Specimen after testing to 6.15 (Notes 1 and 2)**	**Column 6** **Difference -** **Column 3 minus column 5 (Note 2)**
Chest width					
Waist width (jacket)					
Arm length					
Arm width					
Jacket length					
Inside leg length					
Leg width					
Waist width (trousers)					

Measurements shall be taken from the innermost and outermost layers;

NOTE 1 After test, it is possible that the materials in the specimen may be so badly damaged that accurate measurement is not possible. In this case, it is not necessary to fill in columns 5 and 6 and instead, observations shall be made with regard to the amount of change in dimensional stability seen as a result of the test.

NOTE 2 Results of the whole garment testing performed by different laboratories cannot be compared directly because there is too much variation in results between different laboratories at the moment.

f) Any other information relating to the test may be included to assist in interpretation of the test results.

Annex D
(informative)

Checking of basic ergonomic features of protective clothing Practical performance tests

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.

NOTE An assessor may 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 have to 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 the standard.

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.

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 there is nowhere any blood flow restriction;

Clothing design features at e.g. armholes and crotch are appropriately proportioned and positioned.

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;

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

Question: *Can the following movements be carried out without difficulty?*

Standing, sitting, walking, kneeling, crawling and stair climbing;

Raising both hands above the head;

Bending over and picking up a small object e.g. a pencil.

The following points should be considered:

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

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.

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;

The coverage is maintained during movements as extreme as it is anticipated a user would make.

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, boots should be possible without difficulty.

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:

1) Subject it should fit can not wear it.

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.

Annex E
(informative)

Test method for complete garments

E.1 Introduction

This annex provides the general principles of a test method for evaluating the performance of garments or protective clothing ensembles in a flash fire or other short duration exposures. This test method characterises the thermal protection provided by garments based on measurement of heat transfer to a full-size manikin exposed to a laboratory simulation of a flash fire with controlled heat flux density, duration and flame distribution. The heat transfer measurements may also be used to calculate the predicted skin burn injury resulting form the exposure. In addition, observations are recorded on the overall behaviour of the garment during and after the exposure.

The results obtained apply only to the particular garments or ensembles, as tested, and for the specified thermal conditions of each test, particularly with respect to the heat flux density duration and flame distribution. For the purposes of this test method, the incident heat flux density is limited to a nominal level of 80 kW/m^2.

This annex should be used to measure and describe the behaviour of products or garments, or garment assemblies in response to convective and radiant energy under controlled laboratory conditions. The results should be used to optimise garment combinations and designs. This method should not be used to evaluate the properties of garment materials or combinations of materials unless the test specimens are identical in size. This is because the rest results are significantly affected by the specimen's performance and fit on the manikin. Further this method should not be used to describe or appraise the fire hazard or fire risk under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into, account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

NOTE 1 This is a test that provides a measurement of material behaviour and garment performance on a stationary upright manikin. The effects of body position and movement are not addressed in this test method.

NOTE 2 This test method does not apply to evaluation of protection for the hands or the feet.

NOTE 3 This test method is extremely complex and requires a high degree of technical expertise in both the test setup and operation.

NOTE 4 Departures from the instructions in this test method may lead to significantly different test results. Technical knowledge concerning fabric behaviour and the theory of heat transfer and testing practices are needed to evaluate which departures from the instructions given in this method are significant. Standardization of the method reduces, but does not eliminate, the need for such technical knowledge. Any departures from this test method should be reported with the results.

E.2 Principle

The method evaluates the protective performance of the materials of construction and design of the test specimen which is either a garment or an ensemble. The performance is a function of both the materials construction and design. The test specimen is placed on an adult-size manikin at ambient atmospheric conditions and exposed to a laboratory simulation of a flash fire with controlled heat flux, duration and flame distribution. The test procedure, data acquisition, results calculations and preparation of the test report are performed with computer hardware and software programs. Heat which is transferred through the test specimen during and after the exposure is measured by heat flux sensors. These measurements are used to calculate the first-, second-, third-degree and total burn injury areas resulting from the flash fire exposure. Identification of the test garment, test conditions, comments and remarks about the test purpose, and response of the test specimen to the exposure are recorded and are included as part of the report. The performance of the test specimen is indicated by the calculated total energy transferred and burn injury area and the way it responds to the test exposure.

E.3 Apparatus

E.3.1 Instrumented manikin

An upright manikin shall be used that is in the shape and size of an adult male human form (Figure E.1). The manikin shall be constructed to simulate the body of a human being and shall consist of a head, chest/back, abdomen/buttocks, arms, hands, legs, and feet. A flame resistant, thermally stable, glass reinforced vinyl ester at least 3 mm thick has been found to be a effective material for construction.

A reproducible positioning system is required for the manikin. It may consist of pin locators in the floor, a portable rigid positioning frame and light or laser beams for settling vertical orientation and arm position.

The manikin[1] shall match the dimensions listed in Table E.1.

Table E.1 – Measurements for male manikin

Measurement location	Dimension (mm)	Tolerance (mm)
Total height	1800	± 15
Chest circumference at largest value	1025	± 20
Centre of base of rear neck to wrist measure across shoulder and along outside of arm	755	± 45
Top of shoulder to wrist along arm	610	AC1 ± 30 AC1
Arm circumference at largest diameter between shoulder and elbow	300	± 10
Waist circumference at narrowest position	845	± 10
Crotch to sole of foot along the inside of the leg	855	± 25
Hips circumference at the largest dimension	1015	± 20
Base of centre of rear neck to waist	425	± 20
Waist tof base of heel	1 150	± 50
Thigh circumference at largest dimension between crotch and knee	580	± 20

E.3.2 Heat flux sensors

E.3.2.1 Principle

The burn injury prediction system shall use a number of heat flux sensors which are capable of measuring the incident heat flux density or providing data that can be used to calculate the heat flux density to the manikin's surface under test conditions. This information is then processed by a computer program to predict burn injury.

E.3.2.2 Number of heat flux sensors

The burn injury prediction system shall use a minimum of 100 heat flux sensors. They shall be distributed as uniformly as possible in each area on the manikin as indicated in Table E.2:

[1] A manikin meeting these requirements is available from Composites USA, 1 Peninsula Drive, Northeast, Maryland, USA, phone +1 302 834 7712. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN and ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.

Table E.2 – Sensor distribution

Body area	Percent
Head	7
Trunk	40
Arm	16
Thighs	22
Legs	15
Hands/feet	0
Total	100

NOTE The number of sensors presently used in manikins range from 110 to 126.

E.3.2.3 Heat flux sensor measuring capacity

Each heat flux sensor shall have the capacity to measure the incident heat flux density over a range of 0 to 200 kW/m^2. This range permits the use of the heat flux sensors to set the exposure level by directly exposing the manikin to the flames is a test without the specimen and also have the capability to measure the heat transfer to the manikin with exposure of the test specimen.

E.3.2.4 Heat flux sensor construction

The heat flux sensors shall be constructed of a material with known thermal characteristics which can be used with sensor temperature measurement to indicate heat flux density and temporal variation received by the heat flux sensors. The outer surface shall be covered with a thin layer of black high temperature paint (with an emissivity of > 0,9). The response time for the heat flux sensors shall be equal to or less than 0,1 s. A procedure is described in E.8.

NOTE Sensors that have been used successfully include Gardon gauges, slug calorimeters and skin stimulant sensors.

E.3.2.5 Heat flux sensor calibration

Calibration of heat sensors follow the procedure in E.8.

E.3.3 Data acquisition system

A system shall be provided with the capability of acquiring and storing the results of the measurement from each sensor at least twice per second for the data acquisition period of up to 120 s.

NOTE The data acquisition rate of two readings per second from each sensor is the minimum necessary to obtain adequate information. Higher sampling rates are desirable during the flame exposure period. Laboratories sample at up to 10 per second per sensor during this period. The minimum rate of two per second per sensor is adequate after the flame exposure.

E.3.4 Computer software program

E.3.4.1 General

A computer software program shall be utilized which has the capability of receiving the output of the sensors, calculating the incident heat flux density (E.3.4.2), predicting the occurrence of first-, second- and third-degree burns (E.3.4.3), and predicting the area of first-, second, third, and total burn (E.3.4.4). prEN ISO 13506 :2004, Annex C, provides background information for the prediction of burn injury, while prEN ISO 13506 :2004, Annex E,

provides the necessary elements of the computer software program. Reference [1] provides additional details of an operating system and numerical methods to complete the necessary calculations.

E.3.4.2 Incident heat flux calculation

The incident heat flux shall be determined by a computer software program during a nude burn. Each heat flux sensor has an associated manikin surface area over which the measured heat flux density applies The value reported is the average of the area weighted averages for each heat flux sensor for the exposure duration.

E.3.4.3 Predicted burn injury calculations

The time predicted at which first, to cause second-, and third-degree burn injury begins for each sensor shall be calculated by the computer software program.

E.3.4.4 Calculation of predicted area of burn injury

The sum of the area represented by the sensors which received sufficient heat to result in a predicted seconddegree burn shall be the predicted area of second-degree bum injury. The sum of the area represented by the sensors which received sufficient heat to result in a predicted area of third-degree burn injury shall be the predicted area of the third-degree burn injury. The sum of these two areas shall be the predicted area of burn injury resulting from the exposure to the flash fire condition.

NOTE The first-degree burn injury prediction is not included in this area calculation because the skin remains in tact and receives relatively minor damage compared with the second- and third- degree injury.

E.3.4.5 Additional computer software features

Computer software may also be used to specify and control the operating procedure (E.6.1), to record the test conditions (E.6.2.2), to ensure that safety requirements are met (E.6.2.3), to enter specimen response remarks (E.6.2.7), and to prepare the test report (E.6.2.8).

E.3.5 Flame exposure chamber

E.3.5.1 General

A ventilated, fire resistant enclosure with viewing windows and access door(s) shall be provided to contain the manikin and exposure apparatus. It shall be equipped so as to permit natural air flow into the chamber for the exposure and with an exhaust system which permits rapid removal of the room gases after the exposure and data acquisition times have expired.

E.3.5.2 Chamber size

The chamber size shall be sufficient to provide a flame exposure over the surface of the test specimen and with sufficient space to allow safe movement around the manikin for dressing without accidentally jarring and displacing the burners.

NOTE Chambers with minimum interior dimensions of 2,1 m wide x 2,1 m long by 2,1 m high and 3,6 m wide x 3,6 m long by 3,6 m high have been found satisfactory. The larger the chamber the more air (oxygen) there is available for combustion, resulting in better control of the flames and allowing longer duration exposures to be carried out safely.

E.3.5.3 Chamber air flow

The natural air flow within the chamber shall be sufficient to permit the combustion process needed for the required heat flux density during the exposure time and shall be controlled to provide a quiet atmosphere for the data acquisition period, and the forced air exhaust system shall be sufficient for rapid removal of combustion gas products after the data acquisition period. Openings to the exterior of the test chamber may be required for the passive supply of adequate amounts of air for complete combustion of the fuel during the exposure.

E.3.5.4 Chamber isolation

The chamber shall be isolated from air movement other than the natural flow of air required for the combustion process so that the pilot flames and exposure flames are not affected before and during the test exposure and during the data acquisition periods.

E.3.5.5 Chamber air exhaust system

The forced air exhaust system shall have a minimum capacity equal to two times the volume of the chamber per minute to remove the gaseous products which result from the test exposure. In addition, the forced air exhaust system may be run at a lower capacity to provide cooling air for the manikin and heat flux sensors after the chamber has been exhausted of combustion gases.

E.3.5.6 Chamber safety devices

The exposure chamber shall be equipped with sufficient safety devices and detectors to provide safe operation of the test apparatus. These may include propane gas detectors, motion detectors, door closure detectors, fire extinguishers, emergency stops, flame detectors, and any other device deemed necessary.

E.3.6 Fuel and delivery system

E.3.6.1 General

The chamber shall be equipped with fuel supply, delivery, and burner systems to provide reproducible flash fire exposures.

E.3.6.2 Fuel

The fuel shall be propane of sufficient commercial purity and constancy to provide a uniform flame from exposure burners. The fuel shall meet the requirements of ISO 7941.

E.3.6.3 Delivery system

A system of piping, pressure regulators, valves, and pressure sensors shall be provided to safely deliver gaseous fuel to the ignition system and exposure torches. This delivery system shall be sufficient to provide a uniform heat flux density of at least 80 kW/m^2 for an exposure time of at least 8 s. Fuel delivery shall be controlled to provide known exposure duration within ± 0,1 s of the set exposure time.

NOTE 1 The delivery system should conform to local fire and electrical codes and standards.

NOTE 2 A 5 s or less exposure time is sufficient for testing single layer garments such a coveralls. If structural fire fighting turn out suits are to be tested then longer exposures are required if second- and third- degree burn injury is the measure being used to gauge performance. Exposure times up to 15 s may be required with 8 s being the minimum required.

E.3.6.4 Burner system

E.3.6.4.1 General

The burner system shall consist of one ignition pilot flame for each exposure burner, and sufficient burners to provide the range of heat fluxes with a flame distribution uniformity to meet the requirements of E.8.

NOTE The number and position of the burners is specific to the flame exposure chamber, depending on the dimensions of the chamber and the location of the passive air supply inlets. A minimum of 8 burners is necessary but some laboratories use 12 in order to achieve a satisfactory flame distribution.

E.3.6.4.2 Ignition pilot flame

Each exposure burner shall be equipped with an ignition pilot flame positioned near the exit of the burner, but not in the direct path of the flames to interfere with the exposure flame pattern. The pilot flame is ignited with a spark ignition system and the presence of a pilot flame for each functioning exposure burner shall be visually confirmed prior to opening the exposure fuel supply valve. The pilot flame shall be interlocked to the burner gas supply valves in order to prevent premature or erroneous opening of these valves.

E.3.6.4.3 Burner style

Large, induced combustion air, industrial style propane burners shall be positioned around the manikin to produce a uniform laboratory simulation of a flash fire. These burners shall produce a large yellow flame. If necessary the gas jet may be enlarged, or removed to yield a fuel to air mixture for a yellow flame. The burners shall be used and positioned so as to yield the exposure level and uniformity specified in E.8. A satisfactory exposure has been achieved with 8 burners, 1 positioned at each quadrant of the manikin at the knee level, and 1 positioned at each quadrant at the thigh level (see Figure E.1)[2)].

E.3.6.4.4 Burner positioning

The burners shall be positioned so that the average heat flux density measured for the arms, trunk, thighs and legs is within ±15 % of the average heat flux density measured for the entire manikin during a four second nude calibration exposure.

NOTE A record of the location and orientation of the burners shall be kept and a procedure established to check their alignment and to reposition them if necessary. A method for the original positioning of the burners is given in E.8.

E.3.6.4.5 Burner operating Instructions

Procedural operating instructions shall be provided by the testing laboratory and strictly followed to assure safe testing. These shall include exhaust of the chamber prior to any test series, checking gas detection meters to ensure no accumulation of fuel due to leaks, no personnel within the chamber when the ignition system is activated to start a test, isolation of the chamber during the test to contain the heat of the exposure and the resulting combustion products, and ventilation of the chamber after the test exposure.

E.3.6.4.6 Fire suppression system

The chamber shall be equipped with a fire suppression system consistent with appropriate fire safety codes.

E.3.6.4.7 Personal protection of test operators

Care shall be taken to prevent personnel contact with combustion products, smoke, and fumes resulting from the flame exposure. Exposure to gaseous products shall be prevented by adequate ventilation of the chamber. Appropriate personal protective equipment shall be worn when dressing the manikin, handling the exposed specimens, cleaning the manikin after the test exposure and working in the flame exposure chamber between tests.

E.3.7 Image recording equipment

A system for recording a visual image of manikin before, during and after the flame exposure shall be provided. The front of the manikin shall be the primary record of the burn exposure, with a manikin rear record as an option.

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2) Burners meeting these requirements are available from Tiger Torch Co., 508 Centre Avenue East, Airdrie, Alberta, T4B 1P8, Canada, Ph. + 1 403 948 9598. This information is given for the convenience of users of this Internaltional Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used is they can be shown to lead to the same results.

E.3.8 Safety check list

A check list shall be included in the computer operating system to ensure that all safety features have been satisfied before the flame exposure can occur. This list may include but is not limited to the following:

a) confirm that the manikin has been properly dressed in the test specimen;

b) confirm that the chamber doors are closed;

c) confirm that no person is in the flame exposure chamber; and

d) confirm that all safety requirements are met.

E.3.9 Specimen conditioning area

An area maintained at (20 ± 5) °C and (65 ± 5) % relative humidity which is large enough to hang test specimens with good air circulation around them.

E.4 Sampling and test specimens

E.4.1 Purpose of test

E.4.1.1 General

This method is useful for three types of evaluations:

a) comparison of garment or ensemble materials;

b) comparison of garment or ensemble design; and

c) comparison of end-use garment or ensemble specifications.

NOTE Each type of evaluation has different garment or ensemble requirements because the test results are dependent on the test material performance, garment size, garment design and the use of ensemble components.

E.4.1.2 Garment/ensemble material evaluation

When used to evaluate materials of construction, the test specimen shall be of the same garment design and size. A standard garment design and size is described in E.4.3.

E.4.1.3 Garment/ensemble design evaluation

When used to evaluate a design, the test specimen shall be constructed of the same material, of a standard size, and with the design characteristics of interest.

E.4.1.4 End use evaluation

When used to evaluate garments or ensembles for a particular application, the test specimen shall be of a material and garment/ensemble design representing the anticipated end application.

E.4.2 Number of test specimen

Test three specimens from the laboratory sampling unit.

E.4.3 Standard garment design

The standard garment shall be a coverall, having a full length metal zipper closure in the front, without pockets, or sleeve or pant cuffs, meeting the dimensional requirements provided In Table E.3 after laundering (for those specimens that are not designated for limited use).

Table E.3 – Recommended standard garment dimensions

Measurement location	Dimension (mm)	Tolerance (mm)
Chest circumference	1130	±40
Waist circumference	950	±30
Sleeve length	850	±25
Armhole circumference	525	±25
Wrist circumference	300	±40
Body length	1650	±50
Inseam (length)	780	±25
Hip circumference	1250	±40
Thigh circumference	730	±25
Pant leg cuff circumference	500	±20

E.5 Specimen preparation

E.5.1 Laundering

Each test specimen, which is not designated for limited use, shall be laundered and dried once in accordance with EN ISO 6330. Other laundry procedures may be used as long as they are fully described in the test report and all specimens tested during the test series are exposed to the same laundering conditions. Clothing designated for limited use shall not be laundered or dried prior to conditioning.

E.5.2 Conditioning

Each test specimen shall be conditioned in the conditioning area for 24 h at (20 ± 5) °C and at a relative humidity of (65 ± 5) %. The time between removal from the conditioned area and testing shall be less than 10 min.

If the specimen cannot be tested within 10 min, the test specimen shall be sealed In a polyethylene bag (or other material with low water vapour permeability) until testing. Test specimens stored in bags shall be tested within 10 min after removal from the bag. Test specimens shall not remain in the bags for more than 4 h.

E.6 Procedure

E.6.1 Preparation of test apparatus

E.6.1.1 General

Perform the following steps for the start up and exposure sequence.

NOTE Safely exposing the instrumented manikin to a test flash fire requires a start up and exposure sequence which is specific to the test apparatus.

E.6.1.2 Flame exposure chamber purging

Ventilate the chamber for a period of time sufficient to remove a volume of air at least 10 times the volume of the chamber. The purge is intended to remove any fuel that may have leaked from the supply lines that may produce an explosive atmosphere.

E.6.1.3 Gas line charging

Close the supply line vent valves and open the valves to the fuel supply to charge the system with propane gas at the operating pressure up to, but not into the chamber. Propane to the burners shall be provided by opening the last system valve just prior to each test exposure. High and low pressure detectors shall be set as close to the operating pressure as feasible to provide system shut down with a gas supply failure.

E.6.1.4 Confirmation of exposure conditions

Using the procedure described below for specimen testing, expose the nude manikin to the test flash fire for at least 4 s or for the duration of the test if less than 4 s. Confirm that the calculated incident heat flux density and its standard deviation are within specified values (E.8). If the calculated heat flux density or the variability is not within specifications, determine the cause of the deviations and correct before proceeding with specimen testing.

E.6.2 Specimen testing

E.6.2.1 General

Perform the following steps to conduct an instrumented manikin test and prepare the test report.

E.6.2.2 Dress the manikin

Dress the manikin in the test specimen specified for the test. The specimen may need to be cut to provide a large enough opening for dressing around the obstruction of the data cables. If cutting is required, repair the cut in the garment with a non-flammable closure such as metal staples. Arrange the specimen components on the manikin in the same way they are used by the consumer. Use the same fit and placement of the specimen on each test to minimize variability in the test results. . If a T-shirt and briefs are specified it will be necessary to cut the T-shirt up the back for easy donning. Repair the cut with a non-flammable closure such as metal staples. Confirm the position of the manikin and its arms.

E.6.2.3 Record the specimen identification, test conditions, and test remarks

Record the information which relates to the test, which may include:

a) purpose of test;

b) test series;

c) specimen identification;

d) test conditions;

e) test remarks;

f) exposure duration;

g) data acquisition time;

h) persons observing the test; and

i) make a visual record of the test garment by photographing the front and rear of the dressed manikin; and

j) any other information relevant to the test series.

E.6.2.4 Confirm safe operation conditions and light pilot flames

Ensure that all of the safety requirements have been met and that it is safe to proceed with the specimen exposure.

When all of the safety requirements are met, light the pilot flames and confirm that the ignition pilot flame on each burner that will be used in the test exposure is actually lit.

CAUTION: Visually confirm the presence of each ignition pilot flame in addition to the panel light or computer indication. The test exposure may be initiated when all of the safety requirements are met, the pilot flames are ignited and confirmed, and the final valve in the gas supply line is opened.

E.6.2.5 Start Image recording system

Start the video or film system used to visually document each test.

E.6.2.6 Expose the test specimen

Initiate the test exposure by pressing the appropriate computer key. The computer program shall start the data acquisition, open the torch gas supply solenoid valves for the time of the exposure, stop the data acquisition at the end of the specified time, and if part of the program, turn on the fan(s) to ventilate the exposure. Observe and record any after flame duration intensity and location on the test specimen.

E.6.2.7 Acquire the heat transfer data

Enter the time period for the length of data acquisition into the appropriate exposure condition field. This time shall be long enough to assure that all of the energy stored in the specimen has been released to the atmosphere and the manikin. Confirm that the acquisition time is sufficient by inspecting the calculated burn injury versus time information to determine that the total burn injury from all of the sensors has levelled off and is not continuing to rise at the end of the data acquisition time. If the amount of burn injury is not constant for the last 10 s of acquisition time, increase the time of acquisition to achieve this requirement and retest with a new specimen.

E.6.2.8 Record specimen response remarks

Record any remarks on the reaction of the test specimen to the exposure. These may include but are not limited to the relative afterflame intensity and length of time it exists on the test specimen,material shrinkage, charring, or observed degradation. These remarks shall become a permanent part of the test record.

E.6.2.9 Initiate heat transfer and burn injury calculation

Initiate the computer program to perform the calculations to determine the amount of heat transferred to the surface of the manikin, the first-, second-, and third-degree burn injury (see E.3.4.4) and print out these results which form an integral part of the test report (see clause 9).

NOTE These operations maybe performed immediately following the test or delayed for later processing.

E.6.3 Prepare for the next test exposure

Photograph the front and rear of the test specimen on the manikin before removal. Carefully remove the exposed specimen from the manikin. If the heat flux sensors are too hot, run the ventilating fan(s) to cool them to less than 32 °C. Inspect the manikin and heat flux sensors to be sure that they are clean of any decomposition materials. If deposits are present, clean the manikin and heat flux sensors as specified in E.8. Ensure that the manikin and heat flux sensors are dry, and if necessary dry them, for example with the ventilating fan(s), before conducting the next test.

E.7 Test report

Report the information as given in Annex C.

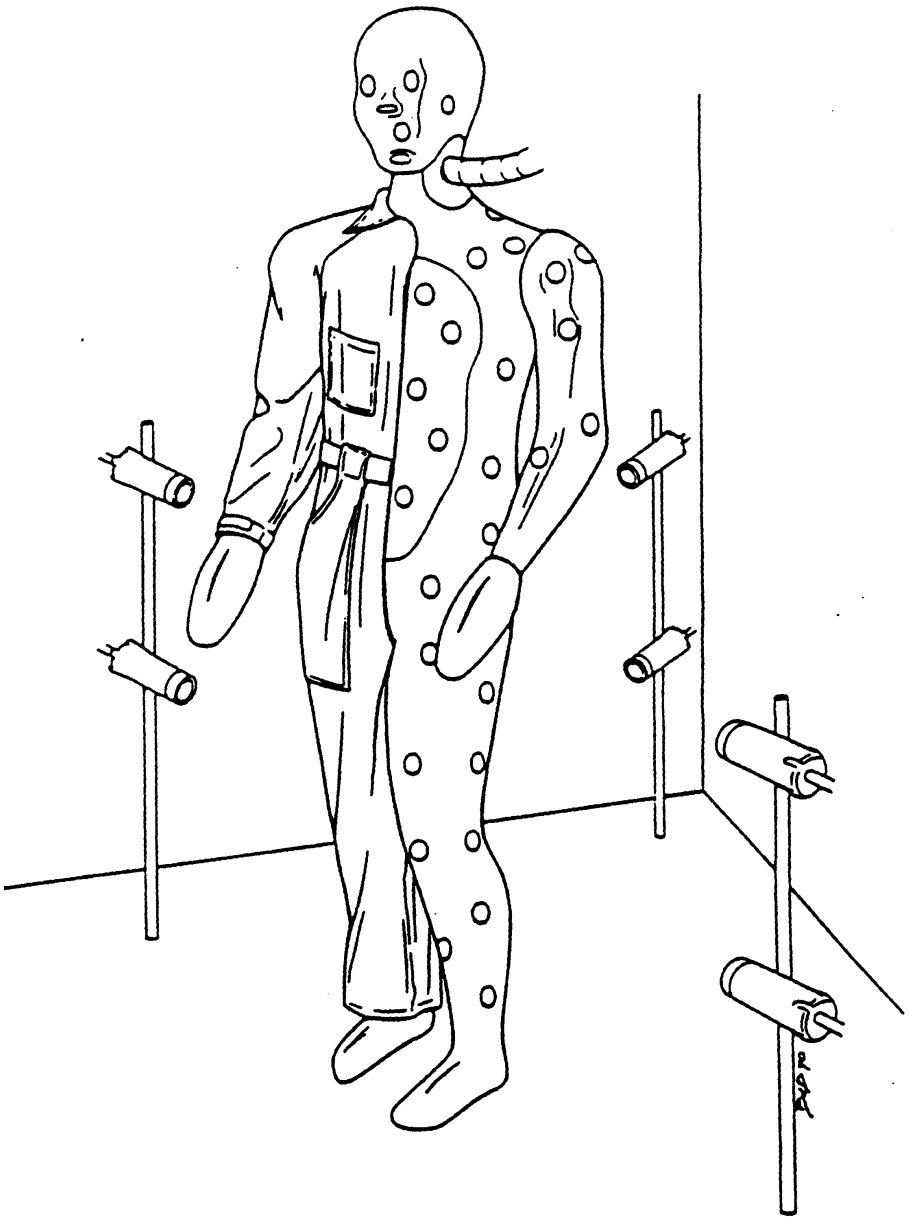

Figure E.1— Instrumented manikin

E.8 Calibration procedure

E.8.1 Sensor calibration and care

1) Manikin heat flux sensors are used to measure flash fire exposure intensity, the energy transferred to the manikin during and after the exposure. Calibrate the heat flux sensors with a convective and/or radiant heat source of known value. The apparatus described in ISO 9151 or ISO 17942 shall be used. The range of heat flux densities required should match the exposure and heat transfer conditions experienced during test setup and specimen testing (see 8.3). As a minimum the calibration device shall provide heat flux densities to assure calibration in the range of 8 kW/m^2 to 80 kW/m^2.

2) Verify that he heat flux densities produced by the calibration device are within ±5 % of the required exposure level.

3) Test the type of each heat flux sensor used in the manikin to ensure that the heat flux response is accurate over the range of heat fluxes produced by the exposure and under the test specimen (see 1). If the response is linear but not within 5 % of the known calibration exposure energy, include a correction factor in the heat flux calculations. If the response is not linear and not within 5 % of the known calibration exposure energy, determine a correction factor curve for each heat flux sensor for use in the heat flux calculations.

4) In addition to individual sensor calibration, calibrate the heat flux sensor, data acquisition, and burn model as a unit. Expose each heat flux sensor to a known heat flux and duration which will result in a second-degree burn injury to be calculated by the computer program. Use the known exposure heat flux and determine the time to a second-degree burn using the human tissue response as described by Stoll and Chianta [2]. Include a calibration factor in the burn injury calculations to compensate for heat flux sensor variations and permit achieving the necessary burn injury result.

5) Perform calibration of each heat flux sensor prior to start up of a new manikin, whenever a heat flux sensor is repaired or replaced, and whenever the results appear to have shifted or differ from expected values.

6) After each specimen test, the heat flux sensors should be inspected for any buildup of decomposition products on the surface. If detected, the heat flux sensor should be cleaned with soap and water, petroleum solvent, or methanol. Use the gentlest method which is effective in cleaning the heat flux sensor. If required, repaint the surface of the heat flux sensor and dry the paint as required.

7) Damaged or inoperative sensors should be repaired or replaced when 3 % or more of the total number of heat flux sensors no longer function properly and the non-functional heat flux sensors are located under the test garment. Repaired or replaced heat flux sensors shall be calibrated.

8) The time response of the sensor design should be verified by exposing representative samples to a sudden change in heat flux. This can be done using the apparatus used in ISO 17492. Install the sensor in the place normally occupied by the copper calorimeter. Use the shutter system to expose the sensor to a sudden change in convective and/or radiant energy. The output reading of the sensor should respond within 0,1 s or less.

E.8.2 Exposure flame calibration

1) The initial set up and positioning of the burners can be aided by using an instrumented vertical cylinder. The 2000 mm tall, 300 mm diameter cylinder should be fitted with at least 30 heat flux gauges. The gauges shall be spaced equally around the circumference in five equally spaced vertical columns. Thin walled steel heating and air conditioning ductwork has been successfully used. Software capable of converting the measured data into time varying heat fluxes at each heat flux sensor is required.

   Place the cylinder on the floor where the manikin is to be located. Set the burners equally spaced around the cylinder with about 800 mm distance between the burner head and the cylinder. Measure the intensity and uniformity of the flash fire with a 4 s exposure. Adjust the positions of the burners to obtain as

uniformly as possible heat flux over the surface of the cylinder. Modify the fuel orifice size in the burner heads and/or the fuel line pressure to obtain an average heat flux density of 80 kW /m^2. Replace the cylinder with the instrumented manikin.

2) Measure the intensity and uniformity of the flash fire exposure by exposing the nude manikin to the flames. Software capable of converting the measured data into time varying heat fluxes at each heat flux sensor is required. Calculate an average heat flux during the exposure for each heat flux sensor. Calculate the area weighted average of these values and the standard deviation of the values. The weighted average is the average exposure heat flux density level for the test conditions and the standard deviation is a measure of the exposure uniformity.

3) Position the exposure burners and adjust the flames so that the average exposure heat flux density does not exceed ± 5 % of the specified level. Confirm the standard deviation of the average heat flux density calculated for all the sensors to be equal to or less than 20 kW/m^2 for each nude manikin exposure and if necessary, adjust the burners to obtain the exposure uniformity. Record the final position of each burner.

4) Expose the nude manikin to the flames before testing a set of specimens and repeat the exposure at the conclusion of the testing the set of specimens. If the average exposure heat flux density for the test conditions differs by more than ± 5 % between the before and after measurements, report this finding and give consideration to repeating the sequence of specimen tests conducted between the exposure calibrations. As a minimum, check the exposure level at the beginning and end of the work day.

5) Use a 4 s flash fire exposure (or the duration of the test, if less than 4 s) for these calibrations and monitor the fuel pressure of the supply line close to burner fuel supply header. The measured absolute fuel pressure at this location shall not fall more than 10 % during a single flash fire exposure. Control the duration of the flash fire exposure by the internal clock of the data acquisition system. The measured duration of the gas flow should be the specified value ±5 % or 0,1 s, whichever is smaller.

6) The average heat flux calculated in paragraph 1 of E.8.1 should be the specified test condition ± 5 %. If not, adjust the fuel flow rate by modifying the gas pressure at the burner heads. Repeat the calibration run(s) until the specified value is obtained. Repeat nude calibrations can only be conducted when all the sensors have cooled to less than 32 °C to eliminate the effect of elevated internal temperature or temperature gradients on the calculation of second-degree and third-degree burn injury.

7) The computer controlled data acquisition system shall be capable of recording the output from each sensor at least 2 times per second during the calibration. The accuracy of the measurement system shall be less than 2 % of the reading or ± 0,6 °C If a temperature sensor is used. The sampling rate during an exposure shall provide at least 2 readings for each heat flux sensor every second.

8) Calibrate the flash fire exposure on the nude manikin as the first and last test each test day. Report the results of this exposure as the average exposure heat flux in kW/m^2 and exposure duration in seconds. Also report the standard deviation of the manikin heat flux sensors, the percent of the heat flux sensors indicating second-degree and third-degree burns, and total percent burn.

Annex F
(informative)

Physiological / heat stress hazards

An amendment to this European Standard on physiological/heat stress hazards is under development.

Annex G
(informative)

Risk assessment guidelines

G.1 Introduction

During firefighting operations and other activities undertaken by firefighters, many different hazards may be encountered. Where possible, the level of risk that each hazard presents to the firefighter should be eliminated or reduced to an acceptable level. The guidance given in this European Standard indicates how to carry out a risk assessment by acknowledging the hazards that may be present, the likelihood of the firefighter becoming exposed to them and the possible consequences of such exposure.

These guidelines have been produced to assist employers in making the decision on choosing the correct type of PPE for firefighters for whom they are responsible.

G.2 Basis of this guideline

A definition of "risk" is "the probability that the harm or damage from a particular hazard is realised". Risk reflects both the probability and consequences of the hazard.

In the hazard Table G.2 below, categories of many of the hazards likely to be encountered by firefighters in the execution of their duties are listed. It is very unlikely that all hazards listed will be encountered during one incident, nor is the list of hazards definitive. Hazards may be deleted or added to by any organisation carrying out a particular risk assessment, subject to local conditions and requirements.

By considering the various activities to which a firefighter may be exposed and by applying the risk assessment formula in this model line by line, i.e. for each hazard that might be encountered, the more serious risks will be identified by their higher numbers. This will highlight where decisions have to be taken to ensure adequate and correct levels of protection for firefighters.

G.3 Risk assessment formula

$$R = L \times S \qquad \text{(G.1)}$$

where

R is the Risk;

L is the Likelihood of the firefighter being exposed to the hazard;

S is the Severity/consequences to the firefighter if exposed to the hazard.

Personal protective equipment should be chosen based on protecting the firefighters against the identified risks.

G.4 Values of "L" and "S"

Table G.1 — Values of "L" and "S"

Value	Likelihood	X	Severity / consequence	
0	never	X	nil	
1	exceptional	X	low	e.g. minor injury: small cuts; superficial burns etc.
2	occasional	X	moderate	e.g. major injury; broken bones; serious burns etc.
3	very likely	X	high	e.g. life threatening
4	always	X	extreme	Death
NOTE "0" should only be allowed where there is absolutely NO chance of the hazard being encountered.				

Table G.2 — Hazard L x S = R

Hazard Origin and type	Likelihood of firefighter being exposed to hazard	Severity Consequences to the firefighter if exposed to hazard	Risk (total of L x S)	Control measures
1. Thermal hazards				
a. Convective heat				
b. Radiant heat				
c. Conductive heat				
d. Flame				
e. Contact heat				
f. Molten metal/drops				
g. Burning embers				
h. Flashover				
2. Electrical hazards				
a. Electric arc				
b. Static electricity				
c. Electrical current, high voltage				
d. Low voltage				
3. Environmental hazards				
a. Ambient cold				
b. Ambient hot				
c. Cold surfaces				
d. Air velocity Mechanical				
e. Air velocity – wind				
f. Rain				
g. Splashes				
h. Work in water				
i. Falling in water				
4. Mechanical hazards				
a. Penetration				
b. Cut				
c. Abrasion				
d. Falling objects				
e. Impact				
f. Falling/slipping				
5. Non-visibility hazards				
a. Not being seen				

Table G.2 — Hazard L x S = R (*concluded*)

Hazard Origin and type	Likelihood of firefighter being exposed to hazard	Severity Consequences to the Firefighter if exposed to hazard	Risk (Total of L x S)	Control measures
6. Biological/chemical hazards				
a. Liquid				
b. Contamination by body fluids				
c. Gas				
d. Smoke				
e. Radio activity				
7. Other hazards				
a. Physiological/heat stress				

Table G3 — Hazard and EN 469

Hazard	Control measures
1. Thermal hazards	
a. Convective heat	Covered in 6.1 and 6.2.
b. Radiant heat	Covered in 6.3.
c. Flame	Covered in 6.1 and 6.2.
d. Contact heat	Clothing to EN 469 is intended to protect against accidental exposure to contact heat and protection against this risk is considered to be covered in 6.1 and 6.2.
e. Molten metal/drops	If this hazard is identified as a risk, the protective clothing chosen should have the added property of achieving a minimum performance level of E2 in the test in 6.5 of EN 531:1995.
f. Burning embers	Clothing according to this European Standard is intended to protect against accidental exposure to burning embers and protection against this risk is considered to be covered in 6.1 and 6.2.
g. Flashover	This is an extremely dangerous and life threatening hazard and whilst clothing tested to the highest performance levels of this European Standard is likely to prevent death only due to body burns if the User is accidentally exposed to flashover, many other factors have to be considered and acted upon if this is likely to be a risk.
2. Electrical hazards	See Annex H.
3. Environmental hazards	
a. Ambient cold	Protection will normally be provided against this risk by clothing according to this European Standard. If this is not the case, supplementary clothing, preferably to EN 531, should be worn under the EN 469 clothing.
b. Ambient hot	See par. 7a Physiological/Heat Stress below.
c. Cold surfaces	See par. 3a Ambient Cold, above. Satisfactory footwear should be worn to prevent slipping. Contact with some cold surfaces can cause serious burns. All contact with liquefied gas should be avoided.
d. Air velocity – mechanical	If this hazard is identified as a risk, consideration should be given to wearing suitable fall arrest equipment which is compatible with the EN 469 clothing.

Table G.3 — Hazard and EN 469 (*continued*)

HAZARD	CONTROL MEASURES
3. Environmental hazards (continued)	
e. Air velocity – wind	See par. 3d "Air Velocity - Mechanical" above.
f. Rain	Wet clothing gives less protection against radiant heat than dry clothing because of the inward diffusion of moisture. If wet clothing is suddenly exposed to flame, e.g. in a flashover situation, there is a serious risk of scalding due to the rapid increase in temperature of the inward diffusing moisture. Where such a risk exists, EN 469 clothing should be provided with a suitable moisture barrier.
g. Splashes	See par. 3f "Rain" above.
h. Work in water	Working in water, even for short periods, may present serious risk to life through exposure to extreme cold and/or risk of drowning. In either of these situations, suitable PPE to the relevant European Standards should be worn either with or instead of the EN 469 clothing.
⟦AC1⟩ i. Falling in water ⟨AC1⟧	If this is identified as a risk, suitable lifejackets to the relevant European Standards should be worn either with or instead of the EN 469 clothing.
4. Mechanical hazards	
a. Penetration	Clothing to EN 469 is not necessarily suitable to protect against penetration by sharp objects. If this is identified as a risk, reference should be made to EN ISO 13998, EN 863, EN 1082-3 as relevant.
b. Cut	Clothing to EN 469 is intended to protect against accidental exposure to sharp objects that might cut or tear the garment - e.g. a nail - and in these cases this risk is considered to be covered in 6.6 and 6.7.
c. Abrasion	Clothing according to this European Standard is intended to protect against accidental exposure to abrasion, not to possible prolonged exposure. If this risk is identified, other suitable protection should be provided.
d. Falling objects	In all firefighting and associated activities, suitable head protection should be worn. If this hazard is identified as a risk, suitable head and body protection to the relevant standards should be provided.
e. Impact	Clothing according to this European Standard is intended to protect against accidental exposure to impact. If this hazard is identified as a risk, suitable head and body protection to the relevant standards should be provided.
f. Falling, slipping	If this hazard is identified as a risk, suitable head and body protection to the relevant standards should be provided.
5. Non-visibility hazards	See 6.14 and Annex B.
6. Biological/chemical hazards	
a. Liquid	Clothing according to this European Standard is intended to protect against accidental exposure to splashes of small quantities of hazardous liquids. If this hazard is identified as a risk, suitable protection to EN 466-1 and EN 943 should be provided.
b. Contamination by body fluids	See par. 6a "Liquid" above.
c. Gas	If this is identified as a risk, respiratory protection to EN 136 and EN 137 should be worn. Certain gases can enter the body through the skin. If exposure to such gases is identified as a risk, suitable protection to EN 466-2 and/or EN 943-2 should be provided as applicable.
d. Smoke	In all cases where smoke is likely to be encountered, respiratory protection to EN 136 and EN 137 should be provided.

Table G.3 — Hazard and EN 469 (*concluded*)

HAZARD	CONTROL MEASURES
6. Biological/chemical hazards (continued)	
e. Radio activity	Clothing according to this European Standard does not provide protection against radio active contamination.
7. Other hazards	
Physiological/heat stress	See Annex F.

Other Factors to be considered

a) The training, tactics and operational procedures of each organisation will have an impact on any risk assessment and will probably dictate how each hazard is regarded and indicate the figures to be applied to "L" and "S".

b) Even if not identified as a potential serious risk under par. 7a of the hazard table, the physiological aspects of wearing PPE should also be considered when carrying out the risk assessment as these can have a serious impact on the health and safety of the firefighter.

c) Decide whether the risk assessment is carried out for the actual incident or from when the firefighter leaves the station until he/she returns e.g. environmental issues may not be a serious hazard whilst tackling the incident but may be, if a firefighter have to stand by in bad weather conditions whilst waiting to tackle the incident.

d) Consider whether the risk assessment is carried out on the basis of the firefighter having no protection or having existing levels of protection, e.g. under normal conditions, firefighters wearing full EN 469 compliant clothing will be well protected in fire situations.

e) It may be decided by some that even with different risks being identified by the risk assessment, the decision taken will be to provide protection against the risk of highest severity e.g. in indoor firefighting, protection according to this European Standard will be required.

f) The introduction of national databases for recording incidents of firefighting being exposed to hazards would be a valuable source of information when assessing the likelihood of events occurring.

Annex H
(informative)

Guidelines on electrical hazards

H.1 Electro-static hazards

Firefighters need to be aware of the hazards of static electricity. This is because under certain conditions, less than one millijoule (mJ) of energy, much less than the static that builds up in the human body can ignite hydrocarbon vapour/air mixtures and other explosive gases. Also nuisance static can cause clothing to be uncomfortable to wear.

Energy stored in the body poses a much greater hazard than static clothing, because the body is made almost entirely of water and electrolytes.

There are two basic types of anti-static fibre. Conductive fibres and inductive or non conductive fibres. The fabrics containing conductive fibre may be tested according to EN 1149-1 to measure the surface resistivity of the fabric. The fabrics containing inductive or non conductive fibres may be tested according to EN 1149-3 to measure the charge decay time of the fabric.

Although fabrics and garments containing anti-static fibres may substantially reduce static electricity generated by fabric to fabric friction, and may also reduce the contribution of clothing to the static charge build up in the body, they do not eliminate body charges.

For this reason proper grounding procedures, such as discharging static from the body by wearing a wristlet connected to a ground source, and the use of conductive footwear are necessary in an explosive atmosphere to reduce spark potential.

H.2 Electric arc hazards

Electric arc hazards normally generate a much higher level of energy than flash fires, but for a much shorter length of time. The risk assessment should include consideration of the likelihood of occurrence of this specific thermal hazard, as well as its severity in the case of such an event. The detail of testing methods for measuring the level of arc thermal protection of fabrics and garment systems is under the leadership of the International Electrotechnical Committee, IEC/TC 78. A relevant test method may also be given in CLC/TS 50354.

H.3 Electric hazards, high and low voltage

Exposed live power lines are a hazard to the firefighters, potentially causing electrocution. To protect from this hazard the garment needs to have sufficient electrical isolating properties. A relevant test method may be given in EN 1149-2 to measure vertical electrical resistance.

NOTE There is not agreement in the group preparing the EN 1149-2 about the relevance of this method for electrical shock risk.

Annex ZA
(informative)

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

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 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 Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this European Standard given in Table ZA.1 confers, within the limits of the scope of this European 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 Directive 89/686/EEC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 89/686/EEC, Annex II	
4.6	1.2.1	Absence of risks and other inherent nuisance factors
5.2	2.4	PPE subject to ageing
6.1	3.6.1	PPE constituent materials and other components
6.2	1.1.2.2	Classes of protection appropriate to different levels of risk
6.2	3.6.1	PPE constituent materials and other components
6.2	3.6.2	Complete PPE ready for use
6.3	1.1.2.2	Classes of protection appropriate to different levels of risk
6.3	3.6.1	PPE constituent materials and other components
6.3	3.6.2	Complete PPE ready for use
6.4	1.3.2	Lightness and design strength
6.5	1.3.2	Lightness and design strength
6.5	3.6.1	PPE constituent materials and other components
6.6	1.3.2	Lightness and design strength
6.7	1.3.2	Lightness and design strength
6.8	1.2.1	Absence of risks and other inherent nuisance factors
6.9	1.2.1	Absence of risks and other inherent nuisance factors
6.10	2.14	Multirisk PPE
6.10	3.6.2	Complete PPE ready for use
6.11	1.1.2.2	Classes of protection appropriate to different levels of risk
6.11	3.6.2	Complete PPE ready for use
6.12	2.2	PPE "enclosing" the parts of the body to be protected
6.12	1.1.2.2	Classes of protection appropriate to different levels of risk

6.14	2.13	PPE capable of signalling the users presence visually
7	2.12	PPE bearing identification marks related to health and safety
8	1.4	Information supplied by the manufacturer
8	2.8	PPE for use in very dangerous situations
Annex B	2.13	PPE capable of signalling the users presence visually

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

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[7] EN 943-1:2002, *Protective clothing for use against liquid gaseous chemicals, including liquid aerosols and solid particles — Part 1: Performance requirements for ventilated and non-ventilated "gas-tight" (Type 1) and "non-gas-tight" (Type 2) chemical protective suits*

[8] EN 943-2: 2002, *Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles — Part 2: Performance requirements for "gas-tight" (Type 1) chemical protective suits for emergency teams (ET)*

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[28] CLC/TS 50354:2003, *Electrical arc test methods for material and garments, for use by workers at risk from exposure to an electrical arc*

[29] CEN/TR 14560:2003, *Guidelines for selection, use, care and maintenance of protective clothing against heat and flame*

National Annex (informative)
BS EN 469:2005
Guidance on ageing and loss of performance criteria

It is recommended that, in order to determine more relevant ageing and loss of performance criteria, (see clause 5.2), users of this standard should consider taking account of additional criteria such as periodic inspection and/or testing of protective clothing, bearing in mind typical operational environments.

Information and guidance in support of this standard is to be published in a Fire & Rescue Service Circular by the Office of the Deputy Prime Minister (ODPM). This information will be available via the following link: www.odpm.gov.uk or from the Secretary of PH/3/2 at BSI.

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