

ICS 13.340.10

English Version

Protective clothing for fire-fighters - Test methods and requirements for reflective clothing for specialised fire-fighting

Vêtements de protection pour sapeurs-pompiers -
Méthodes d'essai et exigences relatives aux vêtements
réfléchissants pour opérations spéciales de lutte contre
l'incendie

Schutzkleidung für die Feuerwehr - Prüfverfahren und
Anforderungen für reflektierende Kleidung für die spezielle
Brandbekämpfung

This European Standard was approved by CEN on 26 August 2007.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

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Foreword

This document (EN 1486:2007) 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of an identical text or by endorsement, at the latest by April 2008, and conflicting national standards shall be withdrawn at the latest by April 2008.

This document supersedes EN 1486:1996.

Annex A provides details of significant technical changes between this European Standard and the previous edition: EN 1498:1996

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.

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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

This European Standard specifies reflective protective clothing, which provide higher levels of protection against radiant heat than the non-reflective clothing specified in EN 469. This reflective clothing may be used in certain techniques of specialised fire-fighting.

However, protective clothing conforming to EN 469 may also be used with different specialised fire-fighting techniques. The type of protective clothing employed should be appropriate for the fire-fighting tactics.

A risk assessment shall be used to determine if the clothing covered by this European Standard is suitable for the intended use for the expected exposure. The risk assessment should include consideration of any respiratory protection that may also be required.

Fire-fighters shall be trained in the use, care and maintenance of the protective clothing covered by this European Standard, including an understanding of its limitations and of the necessity to remove PPE as soon as possible after an incident.

Subject to risk assessment, the clothing covered by this European Standard may be suitable for use in activities other than those considered by this European Standard. Nothing in this European Standard is intended to restrict any jurisdiction, purchaser or manufacturer from exceeding these minimum requirements.

1 Scope

This European Standard considers requirements for the protection of the whole body including head, hands and feet. Clothing for head and feet according to this European Standard, however, may only provide sufficient protection when worn together with such basic PPE specified in the relevant standards as noted in paragraphs 4.2 and 4.4 of this European Standard.

This European Standard specifies test methods and minimum performance requirements for reflective protective clothing used in specialised fire-fighting.

This clothing provides protection against flame lick and intense radiant heat and is worn for short periods only, to enable the fire-fighter to enter specific high-risk fire-fighting and fire rescue situations which also require the use of breathing apparatus.

This European Standard only covers protective clothing that relies upon the ability of the outer material to reflect intense radiant heat. This type of reflective clothing may also be used for industrial applications involving high levels of radiant heat.

The reflective clothing specified in this European Standard is not covered in EN 469.

2 Normative references

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

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

EN 166:2001, *Personal eye-protection — Specifications*

EN 171:2002, *Personal eye-protection — Infrared filters — Transmittance requirements and recommended use*

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 397, *Industrial safety helmets*

EN 420:2003, *Protective gloves — General requirements and test methods*

EN 443, *Helmets for firefighters*

EN 702, *Protective clothing — Protection against heat and flame — Test method: Determination of the contact heat transmission through protective clothing or its materials*

EN 14052, *High performance industrial helmets*

EN 15090, *Footwear for firefighters*

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

EN 25077, *Textiles — Determination of dimensional change in washing and drying (ISO 5077:1984)*

EN ISO 1421:1998, *Rubber- or plastics-coated fabrics — 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 6942, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat (ISO 6942:2002)*

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

EN ISO 13934-2, *Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method (ISO 13934-2:1999)*

EN ISO 13935-2, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method (ISO 13935-2:1999)*

EN ISO 13938-1, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension (ISO 13938-1:1999)*

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

EN ISO 20345, *Personal protective equipment — Safety footwear (ISO 20345:2004)*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

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

3 Terms and definitions

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

3.1

ageing

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

- cleaning, maintenance or disinfecting processes;
- exposure to visible and/or ultra-violet radiation;
- exposure to high or low temperatures or to changing temperatures;
- exposure to chemicals including humidity;
- exposure to biological agents such as bacteria, fungi, insects or other pests;
- exposure to mechanical action such as abrasion, flexing, pressure and strain;
- exposure to contaminants such as dirt, oil, splashes of molten metal etc.;
- exposure to wear and tear

3.2

cleaning

process by which a PPE is made again serviceable and/or hygienically wearable by removing any dirt or contamination. A cleaning cycle is typically a washing plus drying or a dry cleaning treatment followed, if required, by ironing or other finishing

3.3

closure system

method of fastening openings in the garment including combinations of more than one method of achieving a secure closure, e.g. a slide fastener covered by an overlap fastened down with a touch and close fastener

NOTE This term does not cover seams.

3.4

clothing assembly

series of outer and under garments to be worn together

3.5

clothing ensemble

combination of two or more garments that collectively provide protection of the body

3.6

component assembly

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

3.7

conditioning

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

3.8**garment**

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

3.9**hardware**

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

3.10**hood**

separate garment or integrated part of the jacket or coverall that covers head, neck and shoulders

3.11**main seams**

seams that are necessary for the integrity of the garment

3.12**pre-treatment**

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

3.13**screen**

transparent visor integrally fitted to the hood of reflective protective clothing

3.14**seam**

method of permanent fastening between two or more pieces of material

3.15**specialised fire-fighting**

limited fire-fighting operations involving very high levels of radiant, convective and contact heat, such as bulk flammable gas and bulk flammable liquid fires

4 General requirements

4.1 Clothing ensemble

Fire fighters' protective clothing covered by this European Standard shall provide protection against intense radiant heat and flame lick to the full body, including the head, hands, and feet, as specified in Clauses 4 to 8.

It shall consist of:

- garment(s);
- hood (may be integrated or not);
- gloves;
- overboots.

The materials shall not contain substances generally known to be toxic, carcinogenic, mutagenic, allergenic, toxic to reproduction or otherwise harmful.

Hardware, except the screen, penetrating the outer material shall not be exposed on the innermost surface of the component assembly. This requirement shall be assessed by visual inspection.

All items shall be free from any sharp or hard edges that are likely to cause harm to the user, e.g. protruding wire ends or other items. This requirement shall be assessed by visual inspection and by hand.

All items shall have an overlap so no part of the body becomes uncovered 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.

All items shall remain in place 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.

Since this type of clothing is designed to be used with respiratory protection, it shall be considered that the breathing apparatus may be worn either inside or outside of the protective clothing. Compatibility shall be assessed while the clothing is worn by an appropriate sized wearer.

4.2 Clothing

4.2.1 General

Fire fighters' protective clothing covered by this European Standard shall consist of either:

- a) a single garment, or
- b) a clothing ensemble, or
- c) a clothing assembly.

Where clothing assemblies or ensembles are used to achieve the specified performance levels of this European Standard, the various garments shall be clearly labelled that they shall always be used in combination (see Clause 9).

The hood can be an integral part of the jacket or coverall.

4.2.2 Pockets

If external pockets are present they shall be constructed entirely from the outer material, and secured by flaps which shall be at least 2,5 cm on each side wider than the pocket. Pockets shall have means for drainage of water.

4.2.3 Size designation

The sizes of the clothing shall be designated in accordance with EN 340 and verified by visual inspection.

The fit of the size shall be assessed while the clothing is worn by an appropriately sized wearer.

4.3 Head protection

4.3.1 General

The hood shall meet the requirements of Clauses 6, 7 and 8. Screens used with hoods shall meet the requirements of 4.3.2 and 6.5.

The hood either as single garment or integral part of the clothing shall be designed to be compatible with one or more helmets conforming to EN 443, EN 397 or EN 14052. Helmets with which compatibility is claimed shall be designated in the information supplied by the manufacturer.

If not integrated part of jacket, coat or coverall, hood shall also be compatible with these garments. The assessment shall be made with the clothing being worn and used by an appropriately sized wearer.

The size of the hood shall be designated in accordance to the size of the helmet and assessed by visual inspection.

The hood shall be fixed to the designated helmet so it will follow all the movements of the head and not unduly restrict movement or vision. The assessment shall be made on hood with screen 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.

4.3.2 Screen

4.3.2.1 General

The screen shall be fitted to the hood in such way that the screen will maintain in place when tested 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.

When screens are tested according to 4.3.2.2 until 4.3.2.9 they shall meet the requirements of EN 166.

4.3.2.2 Field of vision

The field of vision shall be tested in accordance with 7.1.1 of EN 166:2001. The test shall be executed on the whole ensemble, hood with integrated screen.

4.3.2.3 Spherical, astigmatic and prismatic refractive powers

When tested in accordance with 7.1.2.1.2 of EN 166:2001 the visor shall reach optical class 2.

4.3.2.4 Variation in transmittance

The variation in transmittance shall be tested in accordance with 7.1.2.2.3.1 of EN 166:2001.

4.3.2.5 Diffusion of light

The diffusion of light shall be tested in accordance with 7.1.2.3 of EN 166:2001.

4.3.2.6 Quality of material and surface

Quality of material and surface shall be tested in accordance with 7.1.3 of EN 166:2001.

4.3.2.7 Robustness

The robustness shall be tested in accordance with 7.1.4.2.2 of EN 166:2001.

4.3.2.8 Resistance against high speed particles

Resistance against high speed particles shall be tested in accordance with 7.2.2 of EN 166:2001 with a speed of 120 m/s.

4.3.2.9 Resistance against molten metal and hot solids

Resistance against both, molten metal and hot solids shall be tested in accordance with 7.2.3 e) and g) of EN 166:2001.

4.3.2.10 IR-transmission and transmittance to Vis

When tested in accordance with Clause 4 of EN 171:2002, the IR-transmission scale number and the transmittance shall be in the range of 4-2,5 and 4-5.

4.3.2.11 Flammability

Flammability shall be tested analogous to 8.5.2 of EN 136:1998.

4.3.2.12 Marking

Screens shall be marked in accordance with 9.2 of EN 166:2001.

4.4 Hand protection

Hand protection shall meet the requirements of this European Standard as specified in Clauses 6, 7 and 8. The general requirements of EN 420 shall be applied; for dexterity according to 5.2 of EN 420:2003 at least level 1 shall be achieved.

The sizes of the gloves shall be designated in accordance with EN 420, except that the minimum length shall be 350 mm.

Dimension of cuff measured on the wrist line shall be compatible to the width of jacket (coat, coverall) sleeves end either to be worn over or under the sleeves as specified by the manufacturer. The assessment shall be made with the clothing being worn and used by an appropriately sized wearer.

4.5 Overboots

The size of the overboots shall be designated in accordance to the footwear.

Overboots shall meet the requirements of Clauses 6, 7 and 8. It shall be designed to be worn over designated footwear providing additional protection in accordance with EN 15090 and EN ISO 20345, and fixed to it by adjustable means. The footwear with which compatibility is claimed shall be identified in the information supplied by the manufacturer.

Dimension of shaft measured on the ankle line shall be compatible to the width of trousers (coverall) legs and either to be worn over or under the trouser legs as specified by the manufacturer.

The assessment shall be made with the clothing being worn and used by an appropriately sized wearer.

5 Sampling, pre-treatment, ageing

5.1 Sampling

Test specimens shall be taken from the material or materials as used in the component assembly. They may also be cut from the original garment, and shall not include construction features, such as seams, closure systems, or hardware except the test described in 6.1 and 7.5. Number and dimensions of the test specimen are given in the standards describing the test methods in Clauses 6, 7 and 8.

5.2 Pre-treatment

5.2.1 General

Prior to testing, the protective clothing shall be pre-treated.

5.2.2 Cleaning

Before each test specified in Clauses 6, 7 and 8.1 the cleaning of the protective clothing shall be in line with the manufacturer's instructions, on the basis of a standardised procedure.

If the number of cleaning cycles is not specified, five cleaning cycles shall be performed.

5.2.3 Mechanical pre-treatment

Before executing radiant heat test, metalized materials shall be pre-treated in accordance with Annex A.

5.3 Ageing

Performance tests according to Clause 6, 7 and 8.1 shall also be executed after the maximum number of washes indicated by the manufacturer.

6 Thermal requirements

6.1 Limited flame spread

6.1.1 Each individual layer of the component assembly shall meet the following requirements when tested in accordance with EN ISO 15025:2002, procedure A. The component assembly of the outer garment shall be tested by applying the test flame to the surface of the outer material and to the surface of the innermost lining.

- No specimen shall give burning to the top or either side edge.
- No specimen shall give hole formation.
- No specimen shall give flaming or molten debris.
- The mean value of after flame time shall be ≤ 2 s.
- The mean value of the afterglow time shall be ≤ 2 s.

6.1.2 The test on outer material shall be repeated on three samples including a vertical oriented seam in the centre of the specimen. If the clothing ensemble contains different types of seams each type of seam shall be tested.

- Seams shall not open.

The test method and requirements according to 6.1 shall also be applied to hood, gloves and overboots.

6.2 Heat transfer (radiant heat)

When the component assembly is tested according to EN ISO 6942 with a heat flux density of 40 kW/m^2 , RHTI 24 shall be ≥ 120 .

The test method and requirements according to 6.2 shall also be applied to hood, gloves and overboots.

6.3 Heat transfer (convective heat)

When the component assembly is tested according to EN 367, HTI_{24} shall be ≥ 21 .

The test method and requirements according to 6.3 shall also be applied to hood, gloves and overboots.

6.4 Contact heat

When the component assembly is tested according to EN 702 at a contact temperature of 300 °C, threshold time shall be ≥ 15 s.

The test method and requirements according to 6.4 shall also be applied to hood, gloves and overboots.

6.5 Heat resistance

Each material used in the component assembly of the clothing ensemble including screen and any component of the closure system that is exposed and/or in contact with the body shall not melt, drip or ignite, and shall not shrink more than 5 % in both the machine and cross direction, when tested at a temperature 255 °C (± 10 °C) in accordance with the method given in ISO 17493.

7 Mechanical requirements

7.1 Dimensional change

If manufacturer indicates cleanability of the clothing, the materials of the component assembly shall give a dimensional change ≤ 3 % in both the machine and cross direction when tested in accordance with EN 25077 using the cleaning procedure specified in 5.2.2.

7.2 Tensile strength

Woven materials used in the construction of the component assembly shall give at least the tensile strengths given in Table 1, in both the machine and cross directions, when tested as specified.

Table 1 — Tensile strength of materials

Material	Test method	Requirement
metallised outer material	EN ISO 1421:1998, method 1	≥ 600 N
innermost lining	EN ISO 13934-1	≥ 350 N

7.3 Burst strength

Knitted materials used in the construction of the component assembly shall give at least the burst strength given in Table 2, when tested as specified, using a test area of 7,3 cm² and a testing time to burst of (30 \pm 10) s

Table 2 — Burst strength of materials

Material	Test method	Requirement
metallised outer material	EN ISO 13938-1	≥ 600 kPa
innermost lining	EN ISO 13938-1	≥ 350 kPa

7.4 Tear strength

The woven outer material used in the construction of the component assembly shall give tear strength of at least 25 N when tested in both the length and transverse directions in accordance with method B of EN ISO 4674-1:2003.

7.5 Seam strength

All main seams shall be tested according to EN ISO 13935-2 at a rate of 300 mm/min and the following results shall be achieved:

- outer material seams where rupture could expose inner layers, garments worn under or skin ≥ 300 N. When the outer shell consists of metallised knit material, the seams shall be tested according to EN ISO 13938-1 and shall have burst strength ≥ 300 kPa;
- inner layers seams where rupture could expose the next inner layer, garments worn under or skin ≥ 180 N. When the inner layers shell consists of knit material, the seams shall be tested according to EN ISO 13938-1 and shall have burst strength ≥ 180 kPa;
- all other seams shall be tested according to EN ISO 13935-2 at a rate of 300 mm/min and shall have a tensile strength ≥ 90 N.

8 Other requirements

8.1 Surface wetting

The outer material when tested by EN 24920 at 20 °C shall give a spray rating of ≥ 4.

8.2 Whole Garment Testing *(optional)*

The complete component assembly or multi-layer 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.

Also additional integrated devices to be used with the protective clothing shall be included into the testing.

The test method described in prEN ISO 13506:2004 is able to provide the information as required in Annex E.

9 Marking

If the requirements of this European Standard are only met by the use of a clothing ensemble or a clothing assembly this shall be declared on the labels of all items, garments or layers involved.

All other marking requirements shall be as specified in EN 340.

Screens shall be marked as required in 4.3.2.12.

The reflective protective clothing for which compliance with this European Standard is claimed shall be marked with the pictogram in ISO 7000 – 2418 (see Figure 1) and the number and year of this European Standard, i.e. EN 1486:2007.



EN 1486:2007

Figure 1 — Pictogram for protective equipment for fire fighters (ISO 7000 - 2418)

10 Information supplied by the manufacturer

10.1 The manufacturer of the clothing shall provide information as specified in EN 340. Additional information regarding the screen shall be given.

10.2 The manufacturer shall include a note in the information to the effect that in order to comply with the requirements of this European Standard, the torso, neck, arms and legs including head, hand and feet shall be protected.

10.3 The manufacturer shall include a warning in the information to assure that the head protection shall be worn in combination with helmets that meets the requirements of EN 443, EN 397 or EN 14052 and are defined by the manufacturer as compatible with the hood. The manufacturer shall indicate with which type of helmet the hood may be worn.

10.4 The manufacturer shall include a warning in the information to assure that the foot protection shall be worn in combination with boots that meets the requirements of EN 15090 and EN ISO 20345 and are defined by the manufacturer as compatible with the overboots. The manufacturer shall indicate with which type of boots the clothing may be worn.

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

10.6 The manufacturer shall include in the information a warning that this protective clothing is intended to be used only during short periods of time.

10.7 If the optional whole garment test in 8.2 has been performed, the manufacturer shall provide a report in the information, which shall contain at least the results according to indent d) of Annex E.

10.8 If the PPE should be worn over other clothing and the type of this clothing.

10.9 The procedure to be adopted in order to verify that the PPE is correctly adjusted and functional when worn by the user.

10.10 Specific items to be used simultaneously, e.g. which type of breathing apparatus may be worn.

Annex A (normative)

Mechanical pre-treatment for metallised materials

A.1 Principle

The effectiveness of metallised coatings in reflecting radiant heat can be drastically reduced by the effects of wear. This method is designed to simulate the effect of repeated use. Specimens are mechanically pre-treated using a test device which simultaneously twists and compresses the specimen.

A.2 Sampling

Specimens measuring 280 mm by 280 mm shall be taken from the material or garment. Specimens may include a seam if it is not possible to take a specimen of the specified size without one.

NOTE This specimen size is just sufficient to wrap around the circumference of the discs, but overlaps the discs at each end. Only the central portion of the specimen is used for subsequent testing. Thus, two specimens (230 mm by 70 mm) may be taken from each flexed specimen for subsequent testing by EN ISO 6942.

A.3 Apparatus

The test device (see Figure A.1) consists of two discs, (90 ± 1) mm in diameter and $(12 \pm 0,5)$ mm thick. One disc is fixed and the other is mounted on a grooved shaft so that it moves towards the fixed disc in two stages:

- a) forward movement of (90 ± 5) mm accompanied by rotation of $(450 \pm 10)^\circ$, followed by
- b) forward movement with no rotation.

When the initial disc separation is set at (190 ± 1) mm, the disc separation at the completion of the forward motion shall be (35 ± 2) mm.

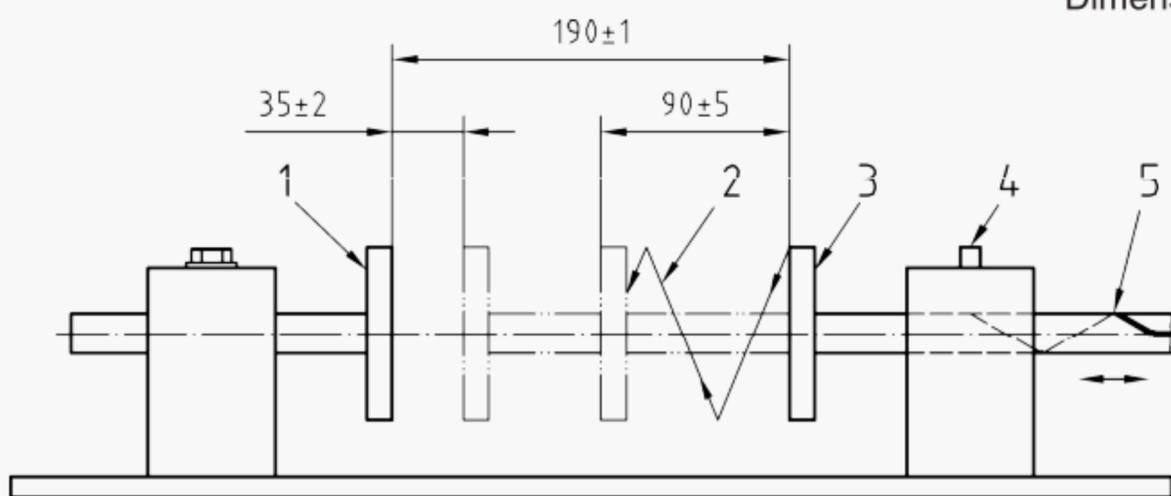
The movement of the revolving disc shall be uniform, except during the change from rotary to forward motion and *vice versa*. One cycle shall comprise one forward and one reverse movement. The device shall complete (40 ± 4) cycles per minute.

A.4 Procedure

Adjust the distance between the two discs to (190 ± 1) mm. Attach the specimen to the discs without tensioning it, with the coating facing outwards and the specimen protruding over the edges of the two discs.

Subject the specimen to 2 500 cycles. Remove the specimen after every 500 cycles (approximately 12,5 min), rotate it through 90° and re-clamp it.

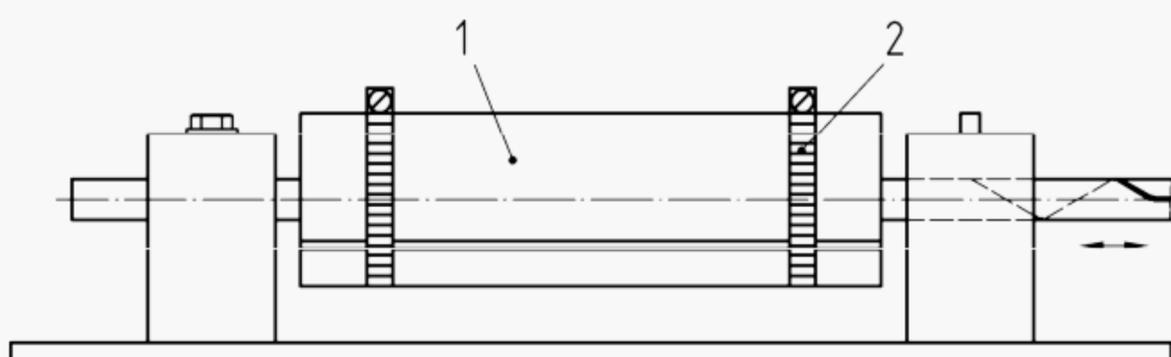
Dimensions in millimetres



Key

- 1 fixed disc
- 2 rotation of 450°
- 3 moving disc
- 4 peg
- 5 grooved shaft

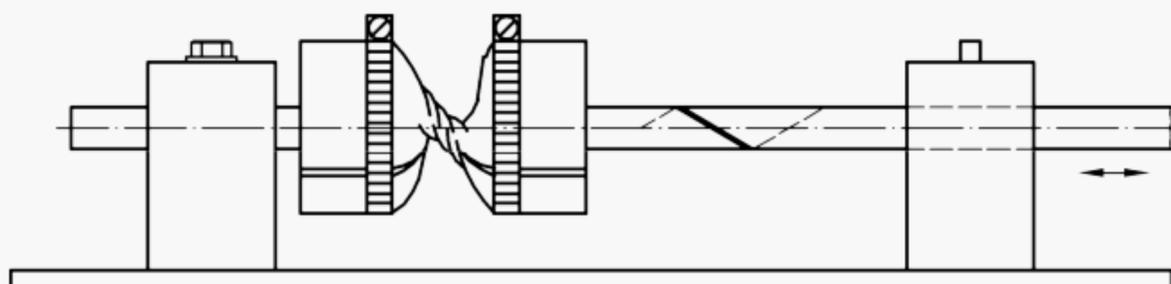
a) Disc movement



Key

- 1 specimen
- 2 clamp onto disc

b) Initial specimen position



c) Specimen fully compressed

Figure A.1 — Mechanical pre-treatment apparatus

Annex B (informative)

Warning – flame engulfment

The following notes are not in any way intended to be portrayed as a recommendation nor as part of any standard for clothing or procedures but are set out to caution any potential user of such clothing about exposure to such conditions.

Without exception, it is recommended that persons should not be deliberately exposed to flame engulfment due to the inherent danger to life safety. Of all the garments covered in the series of standards for protective clothing that is used by fire fighters – EN 15614, EN 531 and EN 469 – the protective garments specified in this European Standard are the garments intended to provide the highest level of protection for fire fighters.

Even these garments are not recommended as protection against flame engulfment but it is recognised that under certain conditions this may happen accidentally. It is recommended that persons wearing EN 1486 garments who are exposed to flame engulfment for a limited period should withdraw as soon as possible and carefully remove this clothing in a location a safe distance from the incident. If considered necessary medical advice should be sought after such exposure and the garments that have been exposed to limited flame engulfment should be carefully examined. If after examination, compliance to the requirements of this European Standard cannot be assured, the clothing should be removed from service.

If, after a risk assessment, it is decided that there is absolutely no alternative to working in conditions of short term or prolonged flame engulfment the most comprehensive safety procedures should be adopted – including having suitable rescue and medical personnel and equipment available in the event of the break down of the safety systems and/or procedures.

The flame/heat hazard of continuous flame engulfment is more convective than radiant and so clothing with a reflective outer surface should not be used as most of these types of material have high heat capacities and therefore there is a high risk of heat transfer to the inner layers of the garment.

Annex C (informative)

Guidelines for clothing design

A number of clothing features are important for protecting the wearer in fire fighting operations. The following guidelines are offered for the design of clothing covered by this European Standard.

Where clothing ensembles are used to achieve the specified performance levels of this European Standard, the various garments should have the necessary overlap of all layers in all situations.

Closure system should be designed in such a manner that the integrity and performance characteristics of the garment are not affected.

The clothing should be designed to minimise restriction of movement. It shall be compatible with other personal protective equipment, which may be necessary.

The design of the hand protection should be compatible with the clothing and should also prevent the entry of burning debris past the wrist.

The design of the head protection should be compatible with the clothing and should also prevent the entry of burning debris past the collar.

The design of the foot protection should be compatible with the clothing and should also prevent the entry of burning debris past the leg-shafts.

The clothing should be compatible with the appropriate respiratory protective devices.

To approve design features and compatibility, the exercises and assessments as described in Annex D can be used.

Annex D (informative)

Checking of basic ergonomic features of protective clothing – practical performance tests

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 is 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 need 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 and stair climbing.

Raising both hands above the head.

Bending over and reaching the ground with both hands.

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 (normative)

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 8.2 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 8.2 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) description of any special pre-treatment of any part of the component or clothing assembly prior to the test in 8.2 or alternatively a statement that the garment ensemble did not have any special pre-treatment;
 - 2) description of 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) statement of the total number and general arrangement of the burners used to create the flash-fire exposure;
 - 4) statement of 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 E.1.

Table E.1 — Test results of the optional test in 8.2

Dimensions in centimetres

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Location	Instrumented manikin measurements	Specimen before testing to 6.15 ^a	Difference: Column 3 minus 2	Specimen after testing to 6.15 ^{a b}	Difference: Column 3 minus 5 ^b
Chest width					
Waist width (jacket)					
Arm length					
Arm width					
Jacket length					
Inside leg length					
Leg width					
Waist width (trousers)					
Any other information relating to the test may be included to assist in interpretation of the test results.					
NOTE 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.					
^a Measurements shall be taken from the innermost and outermost layers. ^b 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.					

Annex F
(informative)

Significant technical changes between this document and the previous edition EN 1486:1996

The following significant technical changes have been introduced:

- a) normative references, in particular references to testing standards, modified;
- b) definitions modified, the different types of specialized fire fighting are not defined any more;
- c) requirements for clothing ensemble modified, different types are not specified any more: the requirements for radiant heat, convective heat and contact heat correspond approximately to the former type 3, types 1 and 2 have been deleted;
- d) requirement for flaps of pockets specified;
- e) requirement for compatibility of head protection with helmet specified;
- f) requirements for feet protection modified;
- g) requirements for hand protection modified;
- h) requirements for screens specified;
- i) ageing due to washing (maximum number of cleaning procedures as indicated by the manufacturer) specified;
- j) requirement for heat resistance modified;
- k) requirement for seam strength specified;
- l) requirement for surface wetting specified;
- m) marking requirement modified;
- n) informative Annex with dimensions deleted;
- o) normative Annex "Mechanical pre-treatment for metallised materials" specified;
- p) informative Annexes B, C and D specified.

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)/subclause(s) of this EN	Essential Requirements (ERs) of Directive 89/686/EEC, Annex II
4.1	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.1	1.2.1.1 Suitable constituent materials 1.2.1.2 Satisfactory surface condition of all PPE parts in contact with the user
4.2.1	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.2.1	1.4 Information supplied by the manufacturer
4.2.2	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.3.2.2	2.3 PPE for the face, eyes and respiratory tracts
4.3.2.3	2.3 PPE for the face, eyes and respiratory tracts
4.3.2.4	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.3.2.5	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.3.2.6	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.3.2.6	2.3 PPE for the face, eyes and respiratory tracts
4.3.2.7	1.3.2 Lightness and design strength
4.3.2.8	1.3.2 Lightness and design strength
4.3.2.8	3.1.1 Impact caused by falling or projecting objects and collision of parts of the body with an obstacle
4.3.2.9	1.3.2 Lightness and design strength
4.3.2.10	1.2.1 Absence of risks and other 'inherent' nuisance factors
4.3.2.10	2.3 PPE for the face, eyes and respiratory tracts
4.3.2.10	3.9.1 Non-ionizing radiation
4.3.2.11	3.6.1 PPE constituent materials and other components
4.3.2.12	2.12 PPE bearing identification marks related to health and safety

Table ZA.1 (concluded)

5.2.2	1.4	Information supplied by the manufacturer
5.2.3	1.3.2	Lightness and design strength
5.3	2.4	PPE subject to ageing
6.1	3.6.1	PPE constituent materials and other components
6.2	3.6.1	PPE constituent materials and other components
6.2	3.6.2	Complete PPE ready for use
6.3	3.6.1	PPE constituent materials and other components
6.3	3.6.2	Complete PPE ready for use
6.4	3.6.2	Complete PPE ready for use
6.5	1.2.1	Absence of risks and other 'inherent' nuisance factors
7.1	1.2.1	Absence of risks and other 'inherent' nuisance factors
7.2	1.3.2	Lightness and design strength
7.3	1.3.2	Lightness and design strength
7.4	1.3.2	Lightness and design strength
7.5	1.3.2	Lightness and design strength
8.1	1.2.1.	Absence of risks and other 'inherent' nuisance factors
9	2.12	PPE bearing identification marks related to health and safety
10	1.4	Information supplied by the manufacturer

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

Bibliography

- [1] EN 469, *Protective clothing for firefighters — Performance requirements for protective clothing for firefighting*
- [2] EN 531, *Protective clothing for workers exposed to heat*
- [3] EN 20811, *Textiles — Determination of resistance to water penetration — Hydrostatic pressure test*
- [4] EN ISO 3175-2, *Textiles — Dry-cleaning and finishing — Part 2: Procedures for tetrachloroethene (ISO 3175-2:1998)*
- [5] prEN ISO 13506, *Protective clothing against heat and flame — Test method for complete garments — Prediction of burn injury using an instrumented manikin (ISO/DIS 13506:2004)*
- [6] EN 15614, *Protective clothing for firefighters — Laboratory test methods and performance requirements for wildland clothing*
- [7] EN ISO 6330, *Textiles — Domestic washing and drying procedures for textile testing (ISO 6330:2000)*
- [8] EN ISO 15797, *Textiles — Industrial washing and finishing procedures for testing of workwear (ISO 15797:2002)*