

# Helmets for firefighters

The European Standard EN 443 : 1997 has the status of a  
British Standard

ICS 13.220.10; 13.340.20

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# National foreword

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The UK participation in its preparation was entrusted by Technical Committee PH/6, Head protection, to subcommittee PH/6/3, Helmets for firefighters, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

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The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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## Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 20, an inside back cover and a back cover.

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English version

## Helmets for firefighters

Casques de sapeurs pompiers

Feuerwehrhelme

This European Standard was approved by CEN on 1997-09-04. 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.

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**CEN**

European Committee for Standardization  
Comité Européen de Normalisation  
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 158, Head protection, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by March 1998, and conflicting national standards shall be withdrawn at the latest by March 1998.

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 standard.

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

Contents

|                                                                                                                                 | Page |
|---------------------------------------------------------------------------------------------------------------------------------|------|
| Foreword                                                                                                                        | 2    |
| 1 Scope                                                                                                                         | 3    |
| 2 Normative references                                                                                                          | 3    |
| 3 Definitions                                                                                                                   | 3    |
| 4 General characteristics                                                                                                       | 4    |
| 5 Requirements                                                                                                                  | 4    |
| 6 Test procedures                                                                                                               | 5    |
| 7 Marking                                                                                                                       | 10   |
| 8 Information to be supplied by the manufacturer                                                                                | 10   |
| Annex A (informative) UV ageing — Alternative test method                                                                       | 19   |
| Annex ZA (informative) Clauses of this European Standard addressing essential requirements or other provisions of EU Directives | 20   |

## 1 Scope

This European Standard specifies the principal characteristics required for a helmet for firefighters with regard to the level of protection, comfort and durability.

It allows options to take account of particular national requirements.

Helmets complying with this standard are not necessarily intended for special applications (for example: oil fires, forest fires).

Annex A and figures 1 to 9 are integral parts of this standard.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

|                   |                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------|
| ISO 1817 : 1985   | <i>Rubber, vulcanized — Determination of the effect of liquids</i>                            |
| ISO 4892-1 : 1994 | <i>Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance</i>  |
| ISO 4892-2 : 1994 | <i>Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources</i> |
| ISO 6487 : 1987   | <i>Road vehicles — Measurement techniques in impact tests — Instrumentation</i>               |
| EN 960            | <i>Headforms for use in the testing of protective helmets</i>                                 |

## 3 Definitions

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

### 3.1 firefighter's helmet (hereafter referred to as helmet)

Headgear intended to ensure protection of the wearer's head against hazards which might occur during operations carried out by firefighters.

### 3.2 headform

A shape replacing the head which is used for testing certain helmet characteristics.

NOTE. The headform is designed in accordance with EN 960.

## 3.3 basic plane

### 3.3.1 basic plane of the human head

A plane at the level of the opening of the external auditory meatus (external ear opening) and the lower edge of the orbits (lower edge of the eye sockets).

### 3.3.2 basic plane of the headform

The plane which corresponds to the basic plane of the human head.

### 3.4 reference plane

A construction plane parallel to the basic plane of the headform at a distance from it which is a function of the size of the headform.

### 3.5 longitudinal vertical median plane

The vertical plane of symmetry of the headform.

### 3.6 sagittal plane of the helmet

The plane corresponding with the longitudinal vertical median plane of the headform when the helmet is correctly adjusted on it.

### 3.7 central vertical axis

The line relative to the headform that lies in the plane of symmetry, that is normal to the basic plane at a point equidistant from the front and the back of the headform at the level of the reference plane.

### 3.8 vertical axis of the helmet

The axis corresponding with the central vertical axis of the headform when the helmet is correctly adjusted on it.

### 3.9 basic shape

The outer shape which the helmet would have if it had neither comb nor brim nor any of the fairings or radiusing associated with these.

### 3.10 helmet shell

The component which gives the helmet its general shape and on which may be fixed various accessories.

### 3.11 brim

A ridge protruding outwards from the basic shape of the shell forming the lower edge of the shell and including its associated fairings and radiusing.

### 3.12 integral part

A part which is not removable from the helmet without use of tools.

### 3.13 accessory

An optional part which is removable from the helmet without need of tools.

### 3.14 padding

#### 3.14.1 protective padding

Material which serves to dampen shock impact energy.

### 3.14.2 comfort padding

Material which serves to improve comfort for the wearer.

### 3.15 retention system

Those parts which are responsible for securing the helmet in position on the head, including items which enable adjustment or improved comfort.

### 3.16 chinstrap

Part of a retention system, including a strap which passes underneath the wearer's chin and which helps to ensure that the helmet is correctly maintained in place.

### 3.17 neck-guard

Integral part or accessory which protects the back of the neck from water or other liquids, from hot materials and from radiant heat.

### 3.18 eyes and/or face shield

Integral part or accessory placed in front of the eyes and covering part or the whole of the face.

### 3.19 ear flaps

Integral part or accessory of the helmet which protects the ears of the wearer.

### 3.20 facepiece fixing

System enabling a facepiece of a respiratory protective device to be fixed to the helmet in such a way that correct sealing around the face is achievable.

### 3.21 dripping

Softening with material movement and consequent detachment.

## 4 General characteristics

**4.1** The fit of the helmet shall be adjustable, in order to improve the wearing comfort and the helmet efficiency. This adjustment shall be easily feasible by the wearer without the use of tools. When this adjustment covers several sizes of head circumference, the relevant instructions shall be given in the information supplied by the manufacturer.

**4.2** There shall be no sharp edges, roughness or projection on any part of the helmet which is in contact or potential contact with the head when it is worn, such as is likely to cause discomfort or injury to the wearer.

**4.3** For those parts of the helmet that come into contact with the skin, materials which are known to be likely to cause skin irritation or any adverse effect on health shall not be used. For a material not in general use, advice as to its suitability shall be sought before its introduction.

**4.4** The materials should be of durable quality. Their characteristics shall not undergo appreciable alteration under the influence of ageing or of circumstances of use to which the helmet is normally subjected (exposure to sun, rain, cold, contact with the skin, effects of sweat).

**4.5** Substances recommended for cleaning, maintenance or disinfection shall have no adverse effect on the helmet and shall be known not to be likely to have any adverse effect upon the wearer, when applied in accordance with the manufacturer's instructions.

**4.6** After the fitting of any interchangeable integral part or accessory the helmet shall comply with this standard. The replacement of these parts shall be described in the instructions of the manufacturer.

**4.7** The helmet shall allow the wearer to hear under normal circumstances of use.

**4.8** The helmet shall have the facility for the fitting of optional neck, ear and face protection unless these form integral parts of the helmet.

**4.9** Care shall be taken in order to avoid helmet interference with the wearing of self-contained breathing apparatus or corrective or protective glasses.

**4.10** The components defined in **3.11**, **3.12**, **3.13**, **3.16**, **3.17**, **3.18**, **3.19** and **3.20** are optional.

## 5 Requirements

### 5.1 Protected area

When adjusted on the headform as in **6.1.2**, the helmet shall at least cover all the area 12,7 mm above the reference plane (see line AA' in figure 1).

### 5.2 Field of vision

When a helmet is adjusted on the headform as in **6.1.2**, the wearer's field of vision shall correspond to the following angles:

a) a dihedral angle of at least 105° measured horizontally between L and K on each side of the sagittal plane which passes through the point L (see figures 3 and 5);

b) an upper dihedral angle greater than 7° above the reference plane and which is defined by the straight line passing through L<sub>1</sub> L<sub>2</sub> (see figures 4 and 5);

c) a lower dihedral angle greater than 45° under the basic plane and which is defined by the straight line passing through K<sub>1</sub> K<sub>2</sub> situated on the surface of the headform at 31 mm on each side of point K (see figures 4 and 5).

### 5.3 Shock absorption

When a helmet is tested by the method described in **6.3**, the force transmitted to the headform shall not exceed 15 kN.

#### 5.4 Resistance to sharp objects

When the helmet is tested in accordance with 6.4, there shall be no contact between the striker and the headform.

#### 5.5 Mechanical rigidity

When the helmet is tested in accordance with 6.5, the maximum transverse and longitudinal deformations of the helmet shall not exceed 40 mm. The residual deformations shall not exceed 15 mm.

#### 5.6 Flame resistance

When the helmet is tested in accordance with 6.6 the material shall not show:

- any drip during the whole test;
- any visible flame or glow 5 s after removal of flame.

If the external surface of the shell is made of more than one material, each material shall be tested.

#### 5.7 Radiant heat resistance

When the helmet is tested in accordance with 6.7, the temperature measured at the surface of the artificial head shall not rise more than 25 °C above the standard laboratory temperature,  $(20 \pm 2) ^\circ\text{C}$ .

No part of the helmet shall melt to such a degree as to cause dripping of material.

Any damage or distortion exhibited by the helmet shall not adversely affect its operational compatibility or protection during impact test.

#### 5.8 Electrical properties

**5.8.1** When the helmet is tested in accordance with 6.8.1, no evidence of breakdown shall be visible and the leakage current shall not exceed 1,2 mA.

**5.8.2** When the helmet is, in addition, optionally tested in accordance with 6.8.2, no evidence of breakdown shall be visible and the leakage current shall not exceed 1,2 mA.

**5.8.3** When the helmet is, in addition, optionally tested to 5.8.1 and if needed to 5.8.2, in accordance with 6.8.3, no evidence of breakdown shall be visible and the leakage current shall not exceed 1,2 mA.

NOTE.1. These requirements are intended to provide protection to the wearer against short term accidental contact with live electrical conductors at voltages up to 440 V a.c.

NOTE.2. The test in 6.8.1 is intended to simulate closely the situation in use, that is the leakage current to the wearer via a live conductor touching the shell.

NOTE.3. The test in 6.8.2 is dependent only upon the transverse resistance of the shell (thickness). This effectively precludes the use of a metal shell and of metal fasteners passing through the shell.

NOTE.4. The test in 6.8.3 is also dependent upon the surface resistance of the shell and effectively precludes the use of shells which have a conductive surface (metal electro-plating). This test is intended to obviate danger if the wearer touches a helmet whose shell is in contact with a live conductor.

#### 5.9 Retention system strength

For retention systems including a chinstrap the helmet shall be tested by the method described in 6.9.

The maximum elongation of the whole system shall not exceed 15 mm for a load of 250 N.

The minimum width of the chinstrap shall be at least 15 mm for a load of 250 N, and the breaking strength shall be between 500 N and 1 000 N.

NOTE. No test method has been adopted as yet for a retention system not including a chinstrap. Such a retention system has to comply with the relevant essential requirements of the EEC Directive 89/686.

### 6 Test procedures

#### 6.1 Samples and helmet adjustment

##### 6.1.1 Samples

For every type of helmet, helmet samples shall be submitted for testing in the condition in which they are offered for sale, including any requisite holes in the shell and any means of attachment for accessories specified by the manufacturer.

No helmet sample that has been subjected to testing shall be offered for sale.

The minimum number of samples required for one set of tests is as follows:

- 1 helmet for shock absorption test (high temperature);
- 1 helmet for shock absorption test (low temperature);
- 1 helmet for shock absorption test (wet conditioning);
- 1 helmet for resistance to sharp objects test (high temperature);
- 1 helmet for resistance to sharp objects test (low temperature);
- 1 helmet for flame resistance test;
- 1 helmet for radiant heat test;
- 1 helmet for electrical properties test;
- 1 helmet for strength of the retention system test;
- 1 helmet for mechanical rigidity test.

Additional helmets shall be required if needed for optional testing.

##### 6.1.2 Helmet adjustment

Before any testing on a headform, the helmet shall be adjusted in accordance with the manufacturer's instructions. If the wearing adjustment covers several sizes of headform then the size of headform representing the most unfavourable case shall be used.

## 6.2 Conditioning

### 6.2.1 General

Before any testing the helmet shall be conditioned in accordance with the conditioning sequences defined in table 1 and the relevant specifications defined in 6.2.2 to 6.2.8.

### 6.2.2 Stabilizing procedure

The helmet shall be preconditioned for at least 72 h at standard temperature  $(20 \pm 2)^\circ\text{C}$  and standard relative humidity  $(65 \pm 5)\%$ .

### 6.2.3 UV ageing

#### 6.2.3.1 Apparatus

A high pressure xenon 450 watt lamp with quartz casing, operated in accordance with the lamp manufacturer's instructions.

A means to support the helmet so that it is exposed to the radiation.

#### 6.2.3.2 Procedure

Secure the helmet so that the vertical axis through the crown of the helmet (as worn) is perpendicular to the axis of the lamp and the distance between the crown of the helmet and the axis of the lamp is  $(150 \pm 5)$  mm. Expose the helmet to the radiation for  $(400 \pm 4)$  h. It shall then be removed and allowed to return to laboratory ambient conditions.

NOTE. The method described in annex A may be used as an alternative.

### 6.2.4 Thermal shock

Expose the helmet successively to the following conditions:

- 1 h at a temperature of  $(-10 \pm 2)^\circ\text{C}$ ;
- 1 h at a temperature of  $(60 \pm 2)^\circ\text{C}$ ;
- 15 min totally immersed in distilled water at a temperature of  $(10 \pm 2)^\circ\text{C}$ ;
- 1 h at a temperature of  $(60 \pm 2)^\circ\text{C}$ ;
- 20 h to 24 h at standard temperature  $(20 \pm 2)^\circ\text{C}$  and standard relative humidity  $(65 \pm 5)\%$ .

The time interval between sequences a) to b), b) to c) and c) to d) shall be within 5 s.

During sequences d) and e), the helmet shall be in a position that allows it to drain.

Optional temperatures in sequence a) are  $(-20 \pm 2)^\circ\text{C}$ ,  $(-30 \pm 2)^\circ\text{C}$  or  $(-40 \pm 2)^\circ\text{C}$ .

### 6.2.5 Solvent conditioning

Take a cotton cloth approximately 150 mm square and approximately 25 ml of a solvent consisting of test liquid B in accordance with ISO 1817 : 1985, table 1. Using the cloth soaked in the solvent, apply the solvent to all those regions of the outside surface of the helmet shell within 50 mm of the retention system fixing, and keep these regions wet with the solvent for  $(7,5 \pm 2,5)$  s. Repeat the procedure on the remainder of the external surface, keeping these regions wet for  $(12,5 \pm 2,5)$  s. Do not carry out further conditioning or testing during the following 30 min.

### 6.2.6 Wet conditioning

The helmet shall be totally immersed in distilled water at  $(20 \pm 2)^\circ\text{C}$  for between 4 h and 24 h.

### 6.2.7 'Thermal plus' conditioning

The helmet shall be exposed to a temperature of  $(50 \pm 2)^\circ\text{C}$  for between 4 h and 24 h.

### 6.2.8 'Thermal minus' conditioning

The helmet shall be exposed to a temperature of  $(-10 \pm 2)^\circ\text{C}$  for between 4 h and 24 h. If any optional temperature is used in accordance with 6.2.4, that temperature shall be used for 'thermal minus' conditioning.

| Table 1. Conditioning            |                       |           |               |           |              |               |     |               |
|----------------------------------|-----------------------|-----------|---------------|-----------|--------------|---------------|-----|---------------|
|                                  | Stabilizing procedure | UV ageing | Thermal shock | Solvent B | Thermal plus | Thermal minus | Wet | Specific test |
| Sequence                         | 1                     | 2         | 3             | 4         | 5            | 5             | 5   | 6             |
| Protected area                   | X                     |           |               |           |              |               |     | X             |
| Field of vision                  | X                     |           |               |           |              |               |     | X             |
| Shock absorption                 | X                     | X         | X             | X         | X            |               |     | X             |
|                                  | X                     | X         | X             | X         |              | X             |     | X             |
|                                  | X                     | X         | X             | X         |              |               | X   | X             |
| Resistance to sharp objects      | X                     | X         | X             | X         | X            |               |     | X             |
|                                  | X                     | X         | X             | X         |              | X             |     | X             |
| Flame resistance                 | X                     | X         | X             |           | X            |               |     | X             |
| Radiant heat                     | X                     | X         | X             |           |              |               |     | X             |
| Electrical properties            | X                     | X         | X             |           |              |               |     | X             |
| Strength of the retention system | X                     | X         | X             |           |              |               |     | X             |
| Mechanical rigidity              | X                     | X         | X             |           |              |               |     | X             |