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Wildland firefighting personal protective equipment — Requirements and test methods —

Part 5: Helmets

Équipement de protection individuelle pour la lutte contre les feux d'espaces naturels — Exigences et méthodes d'essai —

Partie 5: Casques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective equipment*, Subcommittee SC 14, *Firefighters personal equipment.*

This first edition of ISO 16073-5, together with ISO 16073-1 to ISO 16073-8, cancels and replaces ISO 16073:2011.

The main changes are as follows:

— the content has been reviewed and separated into several parts;

— the respiratory protection has been deleted from the document.

A list of all parts in the ISO 16073 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Wildland firefighting involves work carried out mostly in summer temperatures and for many hours, during which the firefighter can develop high levels of metabolic heat. Consequently, a helmet should be light and commensurate with the risks to which the firefighter can be exposed in order to be effective without introducing excessive heat stress to the wearer.

It is important to train firefighters in the selection, use, care and maintenance of the personal protective equipment (PPE) covered by this document, including an understanding of its limitations.

It is intended that a risk assessment be undertaken to determine if the PPE covered by this document is suitable for its intended use and the expected exposure.

This document provides minimum performance requirements for wildland firefighters' personal protective equipment designed for use for extended periods during wildland firefighting.

Wildland firefighting personal protective equipment — Requirements and test methods —

Part 5: Helmets

1 Scope

This document specifies the minimum performance requirements and methods of test for helmets used for wildland firefighting.

This document covers the general design of wildland firefighting helmets, the minimum levels of performance for the materials employed and the methods of test used. The personal protection equipment (PPE) is not intended to provide protection during fire entrapment.

This document does not cover PPE for structural firefighting (see ISO 11999 series), for use against chemical, biological, radiological and nuclear hazards, or for use where a reflective outer surface is required (see ISO 15538).

Activities in support of wildland firefighting, such as the cutting of trees and the use of a chainsaw can require additional protection to that provided in this document. Users are directed to those relevant standards for the requirements associated with such protection.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13688:2013, *Protective clothing — General requirements*

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

ISO/TR 19591, *Personal protective equipment for firefighters — Standard terms and definitions*

EN 960, *Headforms for use in the testing of protective helmets*

CIE 54.2, *Retroreflection — Definition and measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/TR 19591 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Design and general requirements

4.1 General

Wildland firefighters require helmets to minimize the impact or penetration caused by falling tree branches as well as to provide protection to the head from flames, flying embers and radiant heat. Helmets shall also be fitted with securing mechanisms to prevent them from being dislodged during wildland firefighting operations. Recommendations for general consideration of design and construction of helmets are given in Annex B and Annex D. A summary of design and performance requirements are given in Table 1.

The helmet may be required to interface with other items of PPE used for wildland firefighting.

The helmet shall meet the requirements as detailed in ISO 13688:2013, 4.2.

NOTE For more information, see ISO/TS 11999-2.

4.2 Helmet shell

There shall be no sharp edges, roughness or projection on any part of the helmet which may cause injury to the wearer, in contact or potential contact with the wearer when it is worn.

There shall be no holes on the shell's surface that may allow ingression of flying embers or hot debris.

The profile at the front edge of the shell shall not prevent the wearing of spectacles or goggles.

4.3 Vertical clearance

The vertical clearance between the top of the headform and the inside of the shell as shown in Figure 1, when measured under the conditions given in 6.3.3, shall be no more than 50 mm.

4.4 Horizontal clearance

The horizontal clearance at the front and sides of the helmet, when measured under the conditions given in 6.3.3. shall be no less than 5 mm.

4.5 Wearing height

The wearing height, being the distance between the top of the headform and the bottom edge of the headband, when measured either at the front of the headform or at the side under the conditions given in 6.3.3, shall be no less than:

— 80 mm for helmets mounted on headform size designation 525 (as per EN 960);

— 85 mm for helmets mounted on headform size designation 555 (as per EN 960);

— 90 mm for helmets mounted on headform size designation 585 (as per EN 960).

4.6 Mass

If the mass of a complete helmet, including harness but without accessories, exceeds 800 g, this mass, determined to the nearest 30 g, shall be shown on a label attached to the helmet.

4.7 Shell conspicuity

The helmet shell shall have retroreflective markings in accordance with 4.8 adhered to the shell exterior. A minimum of 26 cm^2 of the markings shall be visible when the helmet is viewed from any angle at the reference plane (see figure footnote b on Figure 2). A material which combines both the fluorescent and

retroreflective properties may be used. Care should be exercised when selecting marking materials to ensure they will not degrade the helmet shell.

4.8 Retroreflective material

The material shall have a coefficient of luminous intensity per square meter (CIL/m^2) of not less than 85 cd/lx/m^2 when measured in accordance with CIE 54.2 with an observation angle of 0,2° and entrance angle of −4°.

4.9 Neck protector

A neck protector shall be fitted and designed to protect the wearer's neck from heat and embers and as such when fitted:

— the helmet continues to comply with requirements in this document;

— the limited flame spread test shall be performed in accordance with ISO 15025, Procedure A (Surface ignition) for an application time of 10 s with the following acceptable performance requirements:

  1) no specimen shall give hole formation;

  2) no specimen shall give molten or flaming debris;

  3) the mean value of the afterflame time shall be ≤2 s;

  4) the mean value of the afterglow time shall be ≤2 s.

— the material when tested together with the helmet in test methods given in C.4 (Test 1) and C.5 (Test 2), shall not ignite, melt or drip.

4.10 Retention system

The helmet shall be fitted with a retention system, including a chin strap. The chin strap shall be adjustable in length.

A minimum of three-point retention system shall have at least three separate points of attachment to the shell. That part of the chin strap which comes into contact with the jaw shall have a minimum width of 15 mm under an intermediate load of 250 N (see 5.3).

4.11 Accessories attached on the helmet

Any accessories, whether permanently attached on or detachable from the helmet, when fitted shall continue to meet the requirements of this standard. Accessories that are permanently attached to the helmet, e.g. lamp bracket, cable clips, mounting points, attachment rails, badges and trims, shall be considered as part of the helmet for the purpose of testing.

Certain accessories or non-integral additional protective devices like earmuffs and mesh face shield are suited only for non-firefighting activities like road clearance and wood cutting. Information should be provided by the manufacturer as to the circumstances under which such items may be used.

5 Performance requirements

5.1 Shock absorption

5.1.1 Crown impact

The helmet shall be tested to the method given in 6.4.3.1 at low temperature, high temperature, and wet conditions, and the force transmitted to the headform shall not exceed 5,0 kN, for an impact energy of (50 ± 2) J.

5.1.2 Off-crown impacts

The helmet shall be tested to the method given in 6.4.3.2 at low temperature, high temperature, and wet conditions, and the force transmitted to the headform shall not exceed 5,0 kN, for an impact energy of (25 ± 1) J.

5.2 Resistance to penetration

The helmet shall be tested to the method given in 6.5, and the point of the striker shall not contact the surface of the headform, for an impact energy of (30 ± 1) J.

5.3 Retention system strength

The chinstrap on the helmet shall be tested to the method given in 6.6, and the following shall apply:

a) Maximum dynamic elongation shall not exceed 25 mm under the intermediate load (250 N);

b) Minimum width of the chin strap under an intermediate load (250 N) shall be 15 mm;

c) The release point of the retention system shall be between 500 N and 1 000 N.

5.4 Lateral rigidity

The helmet shall be tested to the method given in 6.7, where the maximum lateral deformation of the shell shall not exceed 40 mm, and the residual deformation shall not exceed 15 mm.

5.5 Flame resistance

The helmet shell shall be tested to the method given in 6.8, and the material shall not burn with the emission of flame after a period of 5 s has elapsed following removal of the flame source.

5.6 High-temperature stability

The helmet shall be tested in accordance with C.4 (Test 1), and there shall be no visible distortion of the shell.

Any failure of headbands or other internal components during this test (e.g. melting or collapse of the headband) shall not be the basis for rejection of the helmet.

NOTE The purpose of this test is to ensure the suitability of the shell material when it is exposed to high heat sources capable of raising the temperature of the helmet shell to 180 °C. Headbands within the helmet and in contact with the wearer's head are not in contact with or exposed to such sources.

5.7 High radiant heat environments

The helmet shall be tested in accordance with C.5 (Test 2), and it shall meet the following requirements.

a) no part of the helmet shell shall touch the headform;

b) no shell distortion in the posterior portion of the helmet brim shall extend more than 20 mm below the original position;

c) no distortion of the anterior and lateral portions of the helmet brim shall extend more than 15 mm below the original position;

d) no ignition of any part of the helmet assembly shall occur;

e) no melting or dripping of the helmet shell, including the labels on the interior of the helmet.

Any failure of headbands or other internal components during this test (e.g. melting or collapse of the headband), shall not be the basis of rejection of the head protective device.

NOTE The purpose of this test is to ensure the suitability of the shell material when it is exposed to radiant heat sources capable of raising the temperature of the helmet shell to 260 °C for a short period of time. Headbands within the helmet and in direct contact with the wearer's head are not in contact with or exposed to such sources.

5.8 Electrical insulation

The helmet shall be tested to the method given in 6.9, and the leakage current shall not exceed 1,2 mA.

NOTE This requirement is intended to ensure protection from voltages of up to 440 V.

5.9 Optional low-temperature tests

When (–20 ± 2) °C is selected, conditioning at –10 °C is not required. Following conditioning, helmets shall be tested for shock absorption in accordance with 6.4 and for resistance to penetration in accordance with 6.5 and shall meet the requirements of 5.1 and 5.2 respectively.

The test report shall identify the temperature used. Helmets meeting these requirements (see Table 1) shall state this fact on the label attached to the helmet.

Table 1 — Summary of design and performance requirements

Performance	Requirements	Clause	Criteria
Design	Vertical clearance	4.3	≤50 mm
	Horizontal clearance	4.4	≥5 mm
	Wearing height	4.5	≥80 mm for 525 headform ≥85 mm for 555 headform ≥90 mm for 585 headform
Mechanical	Shock absorption, crown and off-crown	5.1	≤5 kN
	Resistance to penetration	5.2	No contact with the surface of the head form
	Retention system strength	5.3	Elongation ≤25 mm at 250 N Webbing width ≥15 mm at 250 N Break between 500 N and 1 000 N
	Lateral rigidity	5.4	Lateral deformation ≤40 mm Residual deformation ≤15 mm
Thermal	Flame resistance	5.5	Self-extinguish ≤5 s
	High temperature stability	5.6	No visible distortion to shell

Table 1 *(continued)*

Performance	Requirements	Clause	Criteria
	High radiant heat	5.7	Shell not touching head form Rear brim extends ≤20 mm below the original position Front and side brim extends ≤15 mm below the original position No ignition No melting or dripping
	Low-temperature (optional)	5.9	Meet requirement of 5.1 Meet requirement of 5.2
Others	Electrical insulation	5.8	Current leakage ≤1,2 mA

6 Test requirements

6.1 Samples

Helmets shall be submitted for testing in the condition in which they are offered for sale, including attachment of any accessories for special purposes.

No helmet that has been subjected to testing shall be offered for sale. The minimum number of samples required for one set of tests is as per below:

a) one helmet for the shock absorption tests (crown and off-crown) following –10 °C conditioning (or –20 °C optional);

b) one helmet for the shock absorption tests (crown and off-crown) following 50 °C conditioning, then followed by flammability test;

c) one helmet for the shock absorption tests (crown and off-crown) following wet conditioning;

d) one helmet for the resistance to penetration test following –10 °C conditioning (or –20 °C optional);

e) one helmet for the retention system strength test then followed by electrical insulation test;

f) one helmet for the lateral rigidity test;

g) one helmet for the high temperature stability test;

h) one helmet for high radiant heat environment test.

6.2 Conditioning for testing

6.2.1 Preconditioning chamber

This shall be sufficiently large to ensure that the helmets can be positioned such that they touch neither one another nor the sides. It shall be fitted with a fan to provide effective air circulation.

6.2.2 Preconditioning

All helmets shall be preconditioned for at least 24 h at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. Sample 1 to 4 shall undergo extra preconditioning with ultraviolet (UV) ageing treatments in accordance with the method below.

6.2.2.1 Apparatus

A high-pressure xenon 450 W lamp with quartz casing, operated in accordance with the lamp manufacturer's instructions. A mean to support the helmet so that it is exposed to the radiation.

6.2.2.2 Procedures

Secure the helmet so that the vertical axis through the crown of the helmet 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 ± 5) mm.

Expose the helmet to the radiation for (400 ± 4) h. It shall then be removed and allowed to return to laboratory ambient conditions.

6.2.3 Low temperature conditioning

The helmet shall be exposed to a temperature of (–10 ± 2) °C for not less than 4 h. When especially required (see 5.9), the temperature shall be lowered to (–20 ± 2) °C.

6.2.4 High temperature conditioning

The helmet shall be exposed to a temperature of (50 ± 2) °C for a period of not less than 4 h.

6.2.5 Wet conditioning

The helmet shall be totally immersed in tap water at a temperature not greater than 27 °C for a period of between 4 h and 24 h.

6.3 Headforms

6.3.1 Construction

Headforms used in the tests shall be either non-metallic or metallic. The headforms for use in this document shall be size 495, 535, 575, 605 and 625 in accordance with EN 960, as appropriate to the test performed. If the wearing adjustment covers several sizes of headform then the size of headform representing the most unfavourable case shall be used. See Annex A for appropriate headform to use in respective test.

6.3.2 Selection of size

Helmets with adjustable harnesses shall be tested on the appropriate headform, selected by adjusting the harness to the middle size of the adjustment range.

Helmets with non-adjustable harnesses shall be tested on the appropriate size of headform.

6.3.3 Measurement of clearances and wearing height

Vertical clearance, horizontal clearance and wearing height shall be measured with the helmet mounted in the wearing position successively on both the largest and smallest size of headform appropriate to its adjustment range.

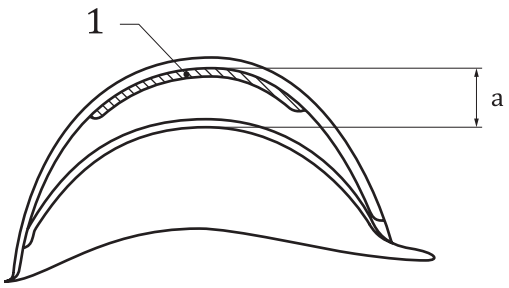
The helmet shall be maintained in position on each headform by the application of a force of 50 N acting along the vertical axis.

For the measurement of wearing height and horizontal clearance, the headband shall be adjusted in the vertical plane to its highest position within the shell.

For the measurement of vertical clearance, the following are to be done before measuring:

a) the cradle shall be adjusted to the minimum wearing height;

b) any protective padding shall be removed, or allowance shall be made for its thickness (see Figure 1).



Key

1 padding

[a] Vertical clearance.

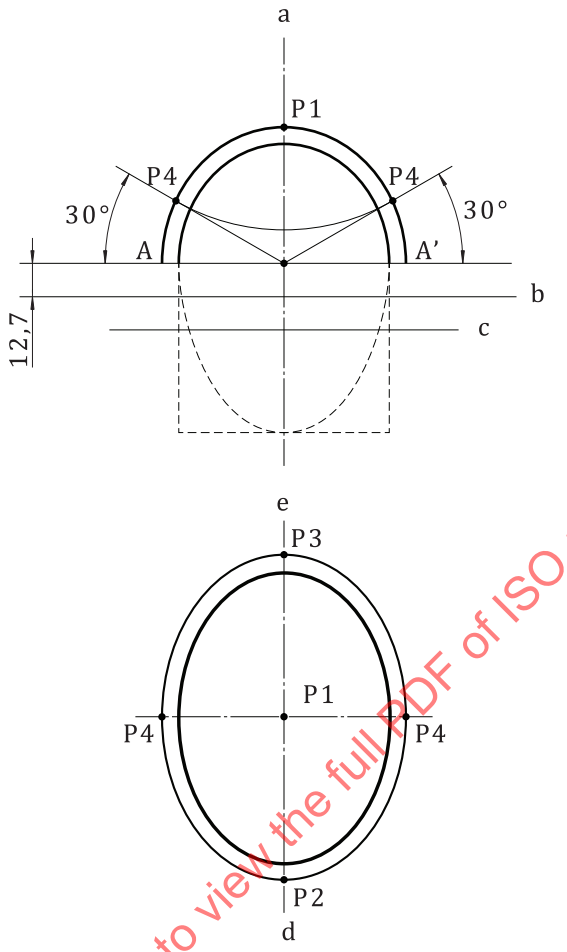
Figure 1 — Vertical clearance

6.4 Shock absorption test

6.4.1 Principle

Shock absorption is measured by the direct measurement of the maximum force transmitted to a rigidly mounted helmeted headform. All four impacts shall be performed on the same helmet as shown in Annex A. The impacts shall be performed following the order of P1-P2-P3-P4 as shown in Figure 2.

Dimensions in millimetres



Key

P1 top position
P2 front position
P3 rear position
P4 left or right position
a Central vertical axis.
b Reference plane.
c Basic plane.
d Front.
e Rear.

Figure 2 — Impact points on the helmet

6.4.2 Apparatus

6.4.2.1 Base of the apparatus, monolithic and sufficiently large to offer full resistance to the effect of the blow. It shall have a mass of at least 500 kg and shall be suitably installed to obviate the return compression wave.

6.4.2.2 Headform, rigidly mounted in a vertical position on the base.

6.4.2.3 Striker for crown impact, having a mass of (5 ± 0,05) kg and a hemispherical striking face of (50 ± 1) mm radius, positioned above the headform such that its axis coincides with the vertical

axis of the headform and such that it may be dropped in a guided fall with a minimum retardation from the guides.

6.4.2.4 Striker for off-crown impacts, having a mass of (5 ± 0,05) kg and a flat striking face of (100 ± 2) mm diameter, with the edge of its circumference radiused to nominally 2 mm, positioned above the headform such that its axis coincides with the vertical axis of the headform stem and such that it may be dropped in a guided fall with a minimum retardation from the guides.

6.4.2.5 System of measurement, able to measure, without distortion, forces of up to 40 kN and with a flat frequency response within ±5 % between 5 Hz and 1 000 Hz.

NOTE Where a force transducer is used in conjunction with the headform, the headform and its mount form part of the measuring system.

6.4.3 Test procedures

6.4.3.1 Crown impact (Position P1)

Each of the requisite sample helmets specified in 6.1 shall be conditioned appropriately in accordance with 6.2. Within 1 min of its removal from the conditioning atmosphere the helmet shall be placed firmly, and fastened securely, on the appropriate headform (see 6.3) at its greatest possible wearing height and with a horizontal clearance of approximately 5 mm between the headband and the headform, measured by the insertion of a 5 mm diameter rod. The striker shall be allowed to fall on to impact point P1 as shown in Figure 2. The height of the fall shall be measured from the point of impact on the helmet shell to the underside of the striker.

6.4.3.2 Off-crown impacts (Positions P2, P3 and P4)

The same sample helmets from 6.4.3.1 shall be used for off-crown testing, using the same method, but with a flat striker and impact on points P2, P3 and P4 as shown in Figure 2. Testing is to be done within five minutes between each impact point. If impossible, return sample to the conditioning chamber immediately until the test rig is ready for the next test. Testing shall ensure that both left and right lateral positions are tested across the three samples from 1 to 3 (see Annex A).

The head form shall be rotated so that the impact point lies along the axis through the striker and the transducer.

A recording shall be made allowing the determination of the maximum force to all impact points to the nearest 10 N.

6.5 Penetration resistance test

6.5.1 Apparatus

6.5.1.1 Test striker, allowed to fall freely on to a helmet securely fastened to a suitable headform. The contactable surface of the headform shall be of a material that readily permits detection should contact by the striker occur, and that can be restored after contact, if necessary.

The striker has the following characteristics:

a) mass: (3,0 ± 0,05) kg;

b) angle of point: (60 ± 1)°;

c) radius of point: (0,5 ± 0,1) mm;

d) minimum height of cone: 40 mm;

e) hardness of tip: between 45 HRC and 50 HRC.

6.5.2 Test procedure

The helmet shall be low temperature conditioned in accordance to 6.2.3 or 5.9 and testing performed within 1 min of removal from conditioning. It shall be placed firmly, and fastened securely, on the appropriate headform (see 6.3) at its greatest possible wearing height and with a horizontal clearance of approximately 5 mm between the headband and the headform, measured by the insertion of a 5 mm diameter rod.

The striker shall be allowed to fall on to the top of the helmet, within a circular area of 100 mm diameter centred about the apex. The height of the fall shall be measured from the top of the helmet to the point of the striker. The striker may fall freely or may be guided, but the speed of impact of a guided striker shall equal that of a free fall.

Note is taken of whether or not contact is made between the striker and the headform. Contact may be verified electrically, but a physical check shall be made on the contact surface. If necessary, the surface shall be restored prior to a subsequent test.

6.6 Retention system strength test

6.6.1 Principle

A helmet, following preconditioning in accordance to 6.2.2 (excluding UV), is supported on a headform and a specified varying force is applied to the retention system via an artificial jaw. The elongation, chin strap width as well as the final break force is measured.

6.6.2 Apparatus

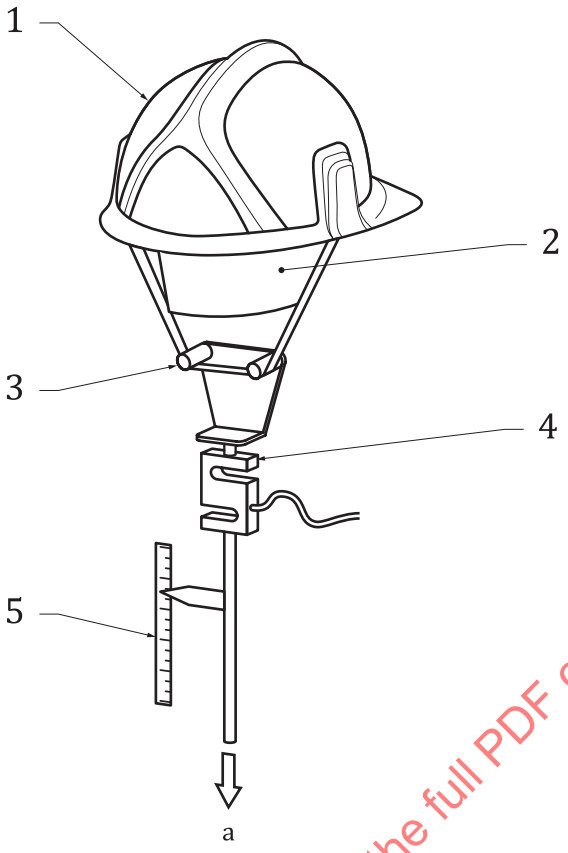
The apparatus shall include the following:

6.6.2.1 Test headform, in accordance with 6.3.

6.6.2.2 Rigid structure, to support the headform. The rigid base shall be such as to support the headform so that its vertical axis is indeed vertical and so that during the test it does not move.

6.6.2.3 Artificial jaw, comprising two rigid cylindrical rollers of diameter (12,5 ± 0,5) mm, with their longitudinal axes separated by (75 ± 2) mm. Any suitable means of applying a known variable force to the artificial jaw and measuring the displacement of the artificial jaw may be used.

An arrangement of a suitable apparatus is shown in Figure 3.



Key

1 helmet
2 headform
3 artificial jaw
4 load cell
5 displacement indicator
a Direction of pull.

Figure 3 — Apparatus for testing retention system strength

6.6.3 Procedure

Mount the helmet on the appropriate headform and pass the chinstrap around the artificial jaw and secure it.

Apply an initial force of (30 ± 3) N in order to ensure that the fastening device is correctly tightened. Note the position, P_0, of the loading bearing spindle to the nearest millimetre.

Increase the force linearly over a period of (30 ± 3) s up to (250 ± 10) N. Maintain this force for (120 ± 3) s, then note the position, P_1, of the loading bearing spindle to the nearest millimetre. Measure the chin strap width in this intermediate load condition.

Increase the force linearly at the rate of (500 ± 50) N/min until the artificial jaw is released due to failure of the retention system. Record the maximum force measured during the test and the mode of failure of the retention system.

Calculate the elongation of the retention system as the difference between positions P_0 and P_1. Report the elongation result, chin strap width as well as final break force.

6.7 Lateral rigidity test

The helmet shall be tested transversely (ear to ear) between two guided parallel plates having their lower edges radiused to 10 mm.

The helmet shall be preconditioned in accordance with 6.2.2 (excluding UV), and then placed between the plates such that the brim lies outside, but as close to the plates as possible. An initial force of 30 N shall be applied to the plates at right angles, such that the helmet is subjected to a lateral pressure. After 30 s, note the distance between the plates as D_0.

The force shall be increased by 100 N/min up to 430 N, which shall be held for 30 s, after which note the distance between the plates as D_1. Maximum lateral deformation is calculated from the difference between D_0 and D_1.

The force shall be decreased to 25 N and then immediately increased to 30 N, which shall be held for 30 s and note the distance between the plates as D_2. Residual deformation is calculated from the difference between D_0 and D_2. Measurements shall be made to the nearest millimetre, and the extent of damage, if any, shall be noted.

6.8 Flame resistance test

6.8.1 General

The test shall be carried out after preconditioning in accordance to 6.2.2 (excluding UV).

6.8.2 Apparatus

6.8.2.1 Bunsen burner, suitable for propane gas, with a 10 mm diameter bore, an adjustable air vent and an appropriate size of jet; the system shall incorporate a pressure control device and a tap.

6.8.2.2 Propane gas, having a minimum purity of 95 %.

6.8.3 Test procedure

The gas pressure shall be adjusted to 3 430 Pa (350 mm H_2O), as measured by a suitable manometer.

The flame shall be adjusted by means of the air vent, such that the blue cone is clearly defined, although turbulent, and is approximately 15 mm long.

With the helmet upside down, and the burner angled at 45° to the vertical, the end of the flame shall be applied to the outside of the shell, at any suitable point between 50 mm and 100 mm from the crown, for a period of 10 s. The plane tangential to the test point shall be horizontal.

The shell shall be examined for flaming 5 s after removal of the flame source.

6.9 Electrical insulation test

The complete helmet shall be submersed for 24 h before testing in a 3 g/l solution of sodium chloride at (20 ± 2) °C. The helmet shall then be removed, wiped and placed upside down in a container of appropriate size. The container and the helmet shall then be filled with 3 g/l solution of sodium chloride solution, up to 30 mm below the plane in which the brim is connected to the shell.

A voltage, linearly and gradually increasing within 60 s to 1 200 V at 50 Hz to 60 Hz, shall be applied between an electrode immersed in the solution inside the helmet and the other electrode in the container. The maximum voltage shall be maintained for (15 ± 2) s and the leakage current measured.

7 Marking and labelling

7.1 General marking requirements

Any labels or accessories shall not adversely affect the performance of any item to which they are attached or present a hazard to the wearer. Marking shall be easily visible to the user without requiring disassembly of the helmet or removal of accessories.

Marking requirements shall be in accordance with ISO 13688.

7.2 Label durability and legibility

Labels, when examined at a distance of 300 mm in a well-illuminated area by a person with 6/6 or 20/20 vision or vision corrected to 6/6 or 20/20 shall remain legible following testing by the method given in C.5 (Test 2).

7.3 Compliance marking requirements

Each helmet for which compliance with this document is claimed, shall have a label permanently and conspicuously attached, upon which the following information is printed in letters at least 2 mm high:

a) designation of type as appropriate;

b) name, trademark or other means of identifying the manufacturer;

c) style/model designation;

d) size or size range (in cm);

e) year and quarter of manufacture;

f) reference to this document, i.e. ISO 16073-5:2019;

g) the pictogram given in Figure 4 with "ISO 16073-5" printed as shown.

Figure 4 — Protective-equipment wildland-firefighting (ISO 7000-3636) Additional marking requirements

A label shall be attached to each helmet stating the following.

a) "For adequate protection, this helmet shall fit or be adjusted to the size of the user's head.

This helmet is made to absorb the energy of a blow, by partial destruction or damage to the shell and the harness and, even though such damage may not be readily apparent, any helmet subjected to severe impact should be replaced.

The attention of users is also drawn to the danger of modifying or removing any of the original component parts of the helmet."

b) The mass, if this exceeds 800 g.

c) The optional requirement complied with. It may be marked as:

— "–20 °C" for the low temperature requirement.

8 Manufacturer's information

The helmet shall be supplied to the wearer accompanied by instructions written at least in the official language(s) of the country of use. All this information shall be clear. It shall comprise (if possible or applicable):

a) name, trademark or other means of identification of the manufacturer or their authorized representative;

b) designation of the product type, commercial name or code;

c) name and full address of the manufacturer and/or their authorized representative;

d) name and full address and identification number of the certification body involved in type approval and/or quality control;

e) a reference to this document, i.e. ISO 16073-5:2019;

f) explanation of any pictograms and level of performance; a basic explanation of the tests that have been applied to the helmet and a corresponding list of performance levels, preferably in a table of performance;

g) all main constituent materials on the helmet;

h) instructions for use as appropriate:

1) tests that shall be carried out by the wearer before use;

2) fitting: how to don and doff;

3) instructions concerning appropriate use of the product to minimize the risk of injury;

4) limitations on use (temperature range, etc.);

5) instructions for storage and maintenance, with maximum periods between maintenance checks;

6) complete instructions for cleaning as appropriate;

7) details of additional items of protective equipment that need to be used to achieve the protection intended;

8) information about any materials used in the helmet that may cause allergic responses or may be carcinogenic, toxic or mutagenic;

9) instructions on how to recognise ageing and loss of performance in the helmet;

10) if helpful, illustrations, part numbers, etc., shall be added;

11) instructions concerning repair;

i) reference to accessories and spare parts, if relevant;

j) type of packaging suitable for transport, if relevant.

Annex A
(normative)

Conditioning and testing schedule

Sample	Helmet/ headform combination	1	2	3	4	5	Sequences		
		UV	Low temperature (–10°C/ –20°C, 5.9)	High temperature	Wet	Ambient	Test 1	Test 2	Test 3
1	Largest helmet/ largest appropriate headform	X	X				Crown impact, 6.4.3.1	Off-crown impacts, 6.4.3.2	
2	Largest helmet/ largest appropriate headform	X		X			Crown impact, 6.4.3.1	Off-crown impacts, 6.4.3.2	Flame resistance[a] 6.8
3	Largest helmet/ largest appropriate headform	X			X		Crown impact, 6.4.3.1	Off-crown impacts, 6.4.3.2	
4	Smallest helmet fitting test block	X	X				Penetration, 6.5		
5	Any helmet size/largest appropriate headform					X	Retention system strength, 6.6	Electrical insulation[a] 6.9	
6	Any helmet size					X	Lateral rigidity[a] 6.7		
7	Any helmet size/ non-metallic headform					X	High temp stability, C.4 (Test 1)		
8	Any helmet size/ non-metallic headform					X	High radiant heat, C.5 (Test 2)		

[a] Headform is not required to conduct test.

Annex B
(informative)

Guidelines for personal protective equipment (helmet) design

B.1 Materials

The materials used should not induce any risk or other inherent nuisance factors.

B.2 Design

The helmet should be designed to avoid as much as possible any restriction in movement during the tasks undertaken by firefighters.

B.3 Donning and doffing

Helmet should be designed to allow the firefighter to put on or take off easily and as quickly as possible.

B.4 Weight

Helmets should be as light as possible in order to be effective without inducing excessive heat stress in the wearer.

B.5 Neck protection

The helmet should be designed to provide protection to the neck area and should interface well with the clothing collar.

B.6 Accessories

Closure systems, any label, accessory, touch-and-close fastener, retroreflective/fluorescent material, etc. attached to the helmet should not adversely affect the helmet's performance.

B.7 Labels

Any label or accessory should not adversely affect the performance of the helmet or present a hazard to the wearer.

B.8 Training

It is very important to train firefighters in the selection, use, care and maintenance of the helmet covered by this document, as well as ensuring they have an understanding of its limitations.