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BSI Standards Publication

Industrial safety helmets

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National foreword

This British Standard is the UK implementation of EN 397:2012. It supersedes BS EN 397:1995 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/6/1, Industrial safety helmets.

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

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Industrial safety helmets

Casques de protection pour l'industrie

Industrieschutzhelme

This European Standard was approved by CEN on 17 December 2011.

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Foreword

This document (EN 397:2012) 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of an identical text or by endorsement, at the latest by July 2012, and conflicting national standards shall be withdrawn at the latest by July 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 397:1995.

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(s).

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

Annex D provides details of significant technical changes between this European Standard and the previous edition.

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, Croatia, 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, Turkey and the United Kingdom.

1 Scope

This European Standard specifies physical and performance requirements, methods of test and marking requirements for industrial safety helmets. The mandatory requirements apply to helmets for general use in industry. Additional optional performance requirements are included to apply only where specifically claimed by the helmet manufacturer. Industrial safety helmets are intended primarily to provide protection to the wearer against falling objects and consequential brain injury and skull fracture.

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 960:2006, *Headforms for use in the testing of protective helmets*

EN ISO 472, *Plastics — Vocabulary (ISO 472:1999)*

EN ISO 9185:2007, *Protective clothing — Assessment of resistance of materials to molten metal splash (ISO 9185:2007)*

3 Terms and definitions

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

3.1
industrial safety helmet
headgear, hereinafter referred to as a “helmet”, primarily intended to protect the upper part of a wearer’s head against injury from falling objects

3.2
shell
hard, smoothly finished material that provides the general outer form of the helmet

3.3
peak
extension of the shell above the eyes

3.4
brim
rim surrounding the shell

NOTE A brim may include a rain gutter.

3.5
harness
complete assembly that provides a means:

a) of maintaining the helmet in position on the head; and/or

b) of absorbing kinetic energy during an impact

NOTE A harness includes a headband and nape strap and may also include the items defined in 3.5.3 to 3.5.6.

3.5.1
headband
part of the harness completely or partly surrounding the head above the eyes at approximately the largest horizontal circumference of the head

NOTE The headband may include a nape strap.

3.5.2
nape strap
adjustable strap that fits behind the head below the plane of the headband

NOTE A nape strap may be an integral part of the headband.

3.5.3
cradle
assembly of the parts of the harness in contact with the head, excluding the headband and nape strap

NOTE A cradle may be either fixed or adjustable.

3.5.4
cushioning
material to improve wearing comfort

3.5.5
anti-concussion tapes
supporting straps which absorb kinetic energy during an impact

3.5.6
comfort band or sweatband
accessory to cover at least the inner front surface of the headband to improve wearer comfort

3.6
protective padding
material contributing to the absorption of kinetic energy during an impact

3.7
ventilation holes
holes provided in the shell which may allow circulation of air inside the helmet

3.8
chin strap
strap which fits under the chin to help secure the helmet on the head

3.9
chin strap anchorage
means by which the material of the chin strap is attached to the helmet; this includes, for example:

a) the component(s) fitted to the ends of the chinstrap material for this purpose;

b) that part of the helmet shell or of the headband where the chin strap is attached

3.10
helmet accessories
any additional parts for special purposes such as chin strap, neck protector, drawlace, and attachment devices for lamp, cable, face protection and hearing protection

3.11
wearing height
vertical distance from the lower edge of the headband to the highest point of the headform on which the helmet is mounted, measured at the front (midway between the sides of the headform) and at the sides (midway between the front and back of the headform), whichever gives the greater distance

3.12
external vertical distance
vertical distance between the top of the headform on which the helmet is mounted and the highest point on the outside surface of the helmet shell

NOTE This represents the height of the outer surface of the shell above the head when the helmet is worn, and relates to clearance under low roofs, etc.

3.13
internal vertical distance
difference in level of the highest point on the outside surface of the helmet shell when the helmet is mounted on the headform:

1) with the cradle present; and

2) with the cradle and any protective padding in the crown area removed, so that the shell rests on the headform

NOTE This represents the height of the inner surface of the shell above the head when the helmet is worn, and relates to stability.

3.14
internal vertical clearance
difference in level of the highest point on the outside surface of the helmet shell when the helmet is mounted on the headform:

1) with the cradle present; and

2) with the cradle removed and any protective padding in the crown area left in place

NOTE This represents the depth of air space present immediately above the head when the helmet is worn, and relates to ventilation.

3,15
horizontal distance
horizontal distance between the headform on which the helmet is mounted and the inside of the shell measured at the level of the lower edge of the shell at the front (midway between the sides of the headform) and at the side (midway between the front and back of the headform)

4 Physical requirements

4.1 Materials and construction

The helmet shall include at least a shell and a harness.

Recommendations for materials and construction of helmets are given in Annex A.

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.

There shall be no sharp edge, roughness or projection on any part of the helmet, its accessories or attachment devices, which are in contact, or potential contact, with the wearer, when the helmet is worn, such as is likely to cause injury to the wearer.

Any part of the helmet which can be adjusted, or removed by the wearer for the purpose of replacement, shall be so designed and manufactured as to facilitate adjustment, removal and attachment without the use of tools.

Any adjustment system incorporated within the helmet shall be so designed and manufactured as not to become incorrectly adjusted without the wearer's knowledge under the foreseeable conditions of use.

4.2 External vertical distance

When measured under the conditions given in 6.5 the external vertical distance shall be no more than 80 mm.

4.3 Internal vertical distance

When measured under the conditions given in 6.5 the internal vertical distance shall be no more than 50 mm. See Figure 3.

4.4 Internal vertical clearance

When measured under the conditions given in 6.5 the internal vertical clearance shall be no less than 25 mm. See Figure 3.

4.5 Horizontal distance

When measured under the conditions given in 6.5 the horizontal distance at the front and sides of the helmet shall be no less than 5 mm.

4.6 Wearing height

Provision shall be made for the wearing height to be adjustable. When measured under the conditions given in 6.5 the wearing height at the front or sides of the helmet shall be no less than:

80 mm for helmets mounted on headform size designation 525 (equivalent to code D, EN 960:1994);

85 mm for helmets mounted on headform size designation 555 (equivalent to code G, EN 960:1994);

90 mm for helmets mounted on headform size designation 585 (equivalent to code K, EN 960:1994).

4.7 Harness

A harness shall include a headband and nape strap.

4.7.1 Headband/nape strap

The length of the headband or the nape strap shall be adjustable in increments of no more than 5 mm.

NOTE The angle which the nape strap makes with the edge of the shell may be adjustable. This may be achieved by angular adjustment of the headband within the shell. This provision may improve helmet retention.

4.7.2 Cradle

If the cradle incorporates textile tapes, their individual widths shall be no less than 15 mm, and the total of the widths of the tapes radiating from their intersection shall be no less than 72 mm.

NOTE Further reference to textile tapes is made in Annex A.

4.7.3 Comfort band or sweatband

If provided, a sweatband shall cover the inner front surface of the headband for a length of no less than 100 mm each side of the centre of the forehead. The length shall be measured with a flexible measure along a line 10 mm ± 1 mm above the lower edge of the headband. The sweatband shall have a width not less than that of the headband over the length which it covers.

NOTE Recommendations regarding characteristics of the sweatband are given in Annex A.

4.8 Chin strap

Either the helmet shell or the headband shall be fitted with a chin strap or with means of attaching one.

Any chin strap supplied with the helmet shall be no less than 10 mm wide when un-tensioned and shall be attached either to the shell or to the headband.

4.9 Ventilation

If the helmet shell is provided with holes for ventilation purposes, the total area of such holes shall be no less than 150 mm^2 and not more than 450 mm^2.

NOTE 1 Means of closing the ventilation holes may be provided.

NOTE 2 If such means are provided, the holes shall be opened to the maximum extent when the above measurement is performed.

NOTE 3 At the time this European Standard was prepared no method for measuring the ventilation capacity of a helmet was recognized. However, manufacturers are encouraged to note the recommendations regarding design for ventilation given in Annex A.

4.10 Accessories

For the fixing of helmet accessories, specified in the information accompanying the helmet, in accordance with 7.2.3, the required fixing devices, or appropriate holes in the helmet shell, shall be provided by the helmet manufacturer.

5 Performance requirements

5.1 Mandatory requirements

5.1.1 Shock absorption

When a helmet is tested by the method given in 6.6, the force transmitted to the headform shall not exceed 5,0 kN. This requirement shall be satisfied by helmets treated in accordance with the appropriate conditioning processes given in 6.2, as specified by the list of mandatory tests given in 6.1.

5.1.2 Resistance to penetration

When a helmet is tested by the method given in 6.7, the point of the striker shall not contact the surface of the headform. This requirement shall be satisfied by helmets treated in accordance with the appropriate conditioning processes given in 6.2, as specified by the list of mandatory tests given in 6.1.

5.1.3 Flame resistance

When tested by the method given in 6.8, the materials of the shell shall not burn with the emission of flame after a period of 5 s has elapsed after removal of the flame.

5.1.4 Chin strap anchorages

When tested in accordance with 6.9, the artificial jaw shall be released at a force of no less than 150 N and no more than 250 N, due to failure only of the anchorage(s).

5.1.5 Label

The label which may be attached to the helmet in accordance with 7.2.2 shall remain attached and legible on each sample helmet, following the appropriate conditioning in accordance with 6.2.3, 6.2.4, 6.2.5 or 6.2.6.

5.2 Optional requirements

5.2.1 Very low temperature (– 20 °C or – 30 °C)

When tested for shock absorption by the method given in 6.6, the requirement of 5.1.1 shall be satisfied by one helmet which has been conditioned in accordance with 6.2.7.

When tested for resistance to penetration by the method given in 6.7, the requirement of 5.1.2 shall be satisfied by a second helmet, which has been conditioned in accordance with 6.2.7.

Helmets claimed to meet this requirement shall state this fact on the label attached to the helmet, in accordance with 7.2.2.

5.2.2 Very high temperature (+ 150 °C)

When tested for shock absorption by the method given in 6.6, the requirement of 5.1.1 shall be satisfied by one helmet, which has been conditioned in accordance with 6.2.8.

When tested for resistance to penetration by the method given in 6.7, the requirement of 5.1.2 shall be satisfied by a second helmet, which has been conditioned in accordance with 6.2.8.

Helmets claimed to meet this requirement shall state this fact on the label attached to the helmet, in accordance with 7.2.2.

5.2.3 Electrical properties

When tested by all three of the methods given in 6.10, the leakage current shall not exceed 1,2 mA.

NOTE 1 This requirement is 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 Test 1 is intended to simulate closely the in-use situation — that is, the leakage current to the wearer via a live conductor touching the shell.

NOTE 3 Test 2 is dependent upon the transverse resistance of the complete shell (thickness). This effectively precludes the use of a metal shell and of metal fasteners or ventilation holes passing through the shell.

NOTE 4 Test 3 is dependent only upon the surface resistance of the shell, and effectively precludes the use of shells which have a conductive surface (e.g. metal electro-plating). This test was deemed to be necessary in order to obviate the danger to the wearer should he try to remove a helmet whose shell was in contact with a live conductor.

Helmets claimed to meet this requirement (for all 3 tests) shall state this fact on the label attached to the helmet, in accordance with 7.2.2.

5.2.4 Lateral deformation

When tested by the method given in 6.11, the maximum lateral deformation of the helmet shall not exceed 40 mm, and the residual lateral deformation shall not exceed 15 mm.

Helmets claimed to meet this requirement shall state this fact on the label attached to the helmet, in accordance with 7.2.2.

5.2.5 Molten metal splash

When tested by the method given in 6.12, the helmet shell shall not:

a) be penetrated by the molten metal;

b) show any deformation, measured at right angles to the base plane of the helmet, greater than 10 mm;

c) burn with the emission of flame after a period of 5 s has elapsed after the pouring of molten metal has ceased.

Helmets claimed to meet this requirement shall state this fact on the label attached to the helmet, in accordance with 7.2.2.

6 Test requirements

6.1 Samples

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

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

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

Mandatory tests:

1 helmet for shock absorption test at – 10 °C

1 helmet for shock absorption test following water immersion

1 helmet for shock absorption test at + 50 °C, then for flame resistance test

1 helmet for shock absorption test following artificial ageing

1 helmet for resistance to penetration test at – 10 °C

1 helmet for resistance to penetration test following water immersion

1 helmet for resistance to penetration test at + 50 °C, then for chinstrap anchorage test

1 helmet for resistance to penetration test following artificial ageing

Optional tests:

2 helmets, one each for shock absorption and resistance to penetration tests, following exposure to very low temperature (– 20 °C or – 30 °C, as appropriate)

2 helmets, one each for shock absorption and resistance to penetration tests, following exposure to very high temperature

1 helmet for each of the 3 electrical properties tests

1 helmet for lateral deformation test

1 helmet for molten metal splash test

6.2 Conditioning for testing

6.2.1 Temperature conditioning cabinet

This shall be sufficiently large to ensure that the helmets can be positioned so that they do not touch one another or the sides of the cabinet. It shall be fitted with a fan to provide effective air circulation. These requirements apply to cabinets used for temperature conditioning at + 50 °C/ + 20 °C/ – 10 °C/ – 20 °C/ – 30 °C.

6.2.2 Pre-conditioning

Before testing, each helmet shall be subjected, as appropriate, to one of the individual conditioning treatments given in 6.2.3, 6.2.4, 6.2.5, 6.2.6, 6.2.7 and 6.2.8.

6.2.3 Low temperature

The helmet shall be maintained at a temperature of – 10 °C ± 2 °C for between 4 h and 24 h.

6.2.4 High temperature

The helmet shall be maintained at a temperature of 50 °C ± 2 °C for between 4 h and 24 h.

6.2.5 Water immersion

The helmet shall be totally immersed in water at 20 °C ± 2 °C for between 4 h and 24 h.

6.2.6 Artificial ageing

NOTE An alternative conditioning method is given in Annex B.

6.2.6.1 Apparatus

A fused silica envelope high-pressure xenon lamp of 450 watt nominal power, operated in accordance with the lamp manufacturer's instructions.

NOTE Suitable lamp references are XBO-450W/4 and CSX-450W/4.

A means to support the helmets so that they are exposed to the radiation and do not touch one another or the sides of the cabinet.

6.2.6.2 Procedure

The helmet shall be secured 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 mm ± 5 mm.

The sample shall be exposed to the radiation for 400 h ± 4 h. It shall then be removed and allowed to return to laboratory ambient conditions.

6.2.7 Very low temperature

The helmet shall be maintained at a temperature of – 20 °C ± 2 °C or – 30 °C ± 2 °C as appropriate, for between 4 h and 24 h.

6.2.8 Very high temperature

6.2.8.1 Apparatus

A simplified arrangement of the tempering apparatus is given in Figure 1.

Tempering chamber

The tempering chamber is a heat insulated casing with a sheet metal bottom 1 mm thick in which an opening is cut with the dimensions indicated in Figure 2. The interior of the tempering chamber is heated to an air temperature of 150 °C ± 5 °C (spatial and temporal).

Tempering head

The tempering head is a hollow body made of copper plate 1,5 mm thick, the dimensions of which correspond to those of headform size designation 555 (equivalent to code G, EN 960:1994). Its interior is cooled by the passage of coolant (e.g. air, water).

The tempering head is fitted with a ring, on its base, which is connected to a lifting device. The interior of the tempering head is heated to a temperature of 50 °C ± 2,5 °C (temporal). This is measured in the crown area by means of a thermocouple.

Lifting device

The lifting device serves to support and guide the tempering head through the opening in the bottom of the tempering chamber until the edges of the sample touch the bottom of the latter.

6.2.8.2 Procedure

The helmet shall be tempered for 60 min ± 2 min using the apparatus described.

6.3 Testing atmosphere

Helmets shall be tested in an atmosphere having a temperature of 22 °C ± 5 °C and a relative humidity of 55 % ± 30 %.

6.4 Headforms

6.4.1 Construction

Headforms used for the tests shall comply at least with the following requirements of EN 960:2006:

Materials — either 3.1.1 or 3.1.2;
Sizing — 2.2 and 3.2;
Marking — 3.3.1 d) and e).

6.4.2 Selection of size

Three sizes of headform are specified in this European Standard, size designations 525, 555 and 585 (equivalent to codes D, G and K, respectively, EN 960:1994).

Other than as specified in 6.5, helmets shall be tested on the headform of appropriate size (from size designations 525, 555 and 585), as selected by adjusting the headband/nape strap to the middle size of its adjustment range.

6.5 Measurement of clearance, distances and wearing height

Vertical and horizontal distances, internal vertical 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 (from size designations 525, 555 and 585) 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 distance, the headband shall be adjusted in the vertical plane to its highest position within the shell.

6.6 Shock absorption

6.6.1 Principle

Shock absorption is measured by the direct measurement of the maximum force transmitted to a rigidly mounted headform on which the helmet is fitted.

6.6.2 Apparatus

The base of the apparatus shall be 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.

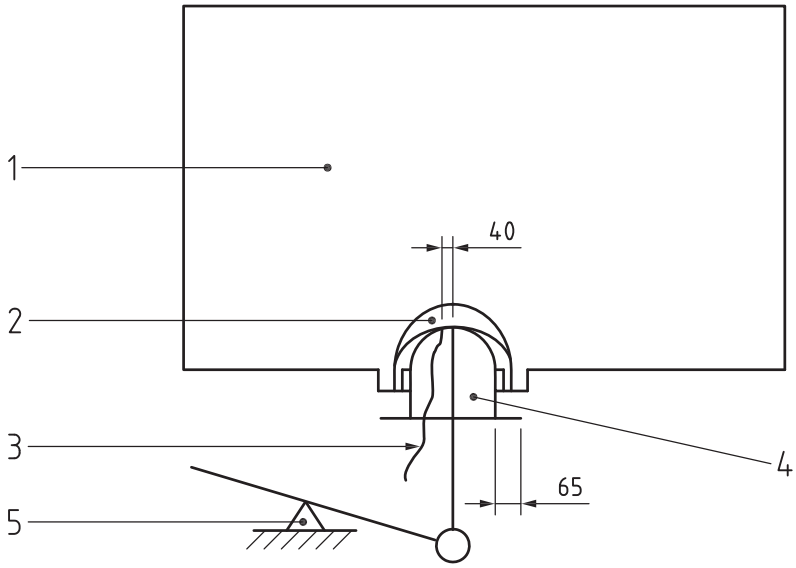
The headform shall be rigidly mounted in a vertical position on the base.

A striker, having a mass of $5{,}0\ ^{+0{,}1}_{0}$ kg and a hemispherical striking face of 50 mm ± 1 mm radius, shall be positioned above the headform so that its axis coincides with the vertical axis of the headform and so that it may be dropped in either free or guided fall. If guided fall is employed, the velocity of the striker, measured at a distance not exceeding 60 mm prior to impact, shall be within 0,5 % of that which would obtain for free fall.

The impact force shall be measured by a non-inertial force transducer firmly attached to the base. It shall be so positioned that its axis is co-axial with the path of the striker. The force transducer shall be able to withstand forces up to 40 kN without damage.

The measuring system, including the headform and its mounting, shall have a frequency response in accordance with channel frequency class (CFC) 600 of ISO 6487:2002.

Dimensions in millimetres



Key

1 tempering chamber

2 test sample

3 thermocouple

4 tempering head

5 lifting device

Figure 1 — Simplified arrangement of tempering apparatus

Dimensions in millimetres

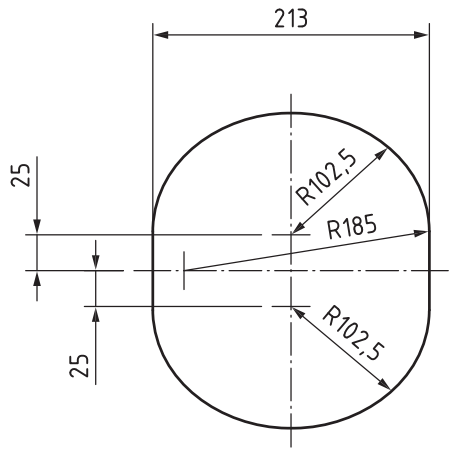


Figure 2 — Dimensions of opening in bottom of tempering chamber

6.6.3 Test procedure

Each of the requisite sample helmets specified in 6.1 shall be adjusted to its greatest possible wearing height and conditioned appropriately in accordance with 6.2.

Within 1 min of its removal from conditioning:

a) the sample shall be mounted on the appropriate headform (see 6.4.2) in the manner in which it is intended to be worn on the head, ensuring (minimal) clearance between the headband and the headform;

b) the striker shall be allowed to fall on to the centre of the crown of the helmet shell from a height of 1 000 mm ± 5 mm, measured from the point of impact on the helmet to the underside of the striker.

NOTE This corresponds to an impact energy of nominally 49 J.

A recording shall be made allowing the determination of the maximum force transmitted.

6.7 Resistance to penetration

6.7.1 Principle

A test striker is allowed to fall on to the helmet which is fitted to a rigidly mounted headform. Note is taken of whether or not contact is made between the striker and the headform or whether the contactable surface of the headform is visibly damaged.

6.7.2 Apparatus

The base of the apparatus shall be monolithic and sufficiently large to offer full resistance to the effect of the blow.

The headform shall be rigidly mounted in a vertical position on the base. The contactable surface of the headform shall be of a metal that will readily permit detection should contact by the striker occur, and that can be restored after contact, if necessary.

The striker has the following characteristics:

Mass:	$3{,}0\ ^{+0{,}05}_{0}$
Angle of point:	60° ± 0,5°
Radius of point:	0,5 mm ± 0,1 mm
Minimum height of cone:	40 mm
Hardness of tip:	between 50 and 45 Rockwell HRC

The striker shall be positioned above the headform so that its axis coincides with the vertical axis of the headform and so that it may be dropped in either free or guided fall. If guided fall is employed the velocity of the striker, measured at a distance not exceeding 60 mm prior to impact, shall be within 0,5 % of that which would obtain for free fall.

6.7.3 Test procedure

Each of the requisite sample helmets specified in 6.1 shall be adjusted to its greatest possible wearing height and conditioned appropriately in accordance with 6.2.

Within 1 min of its removal from conditioning:

a) the sample shall be mounted on the appropriate headform (see 6.4.2), ensuring (minimal) clearance between the headband and the headform;

b) the striker shall be allowed to fall on to the helmet shell from a height of 1 000 mm ± 5 mm, measured from the point of impact on the helmet shell to the point of the striker. The impact point shall be within a circle of radius 50 mm centred on the top of the helmet. The helmet shall be tilted on the headform as necessary;

c) each of the helmets as specified in 6.1 shall be impacted in a different position.

Note shall be taken of whether or not contact is made between the striker and the headform or whether the contactable surface of the headform is visibly damaged. If necessary, the contactable metal surface of the headform shall be restored prior to a subsequent test.

6.8 Resistance to flame

6.8.1 Principle

The helmet shell is exposed to a standard flame.

6.8.2 Apparatus

The burner shall be 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, suitable manometer and a tap.

The gas used shall be propane having a minimum purity of 95 %.

6.8.3 Test procedure

The gas pressure shall be adjusted to 3 430 Pa ± 50 Pa (350 mm H_2O ± 5 mm H_2O).

The flame shall be adjusted by means of the air vent so that the blue cone is clearly defined, although turbulent, and is 45 mm ± 5 mm long.

The test shall be performed on the helmet used for the shock absorption test at 50 °C.

With the helmet upside down, and angled to bring horizontal the plane tangential to the test point, and with the burner pointing upwards 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 shell shall be examined for flaming 5 s after removal of the flame.

6.9 Chin strap anchorage

6.9.1 Principle

The helmet is supported on a headform and a tensile force is applied to the chinstrap.

6.9.2 Apparatus

The apparatus consists of the appropriate headform (see 6.4.2), suitably supported, and an artificial jaw comprising two cylindrical rollers of diameter 12,5 mm ± 0,5 mm, with their longitudinal axes

separated by 75 mm ± 2 mm. A means of applying a known variable force to the artificial jaw is also required.

NOTE The chinstrap is either the chinstrap normally supplied by the helmet manufacturer for use with the helmet or a suitable slave chinstrap if the helmet manufacturer does not normally supply one.

6.9.3 Procedure

The test shall be performed on the helmet used for the resistance to penetration test at 50 °C.

The helmet shall be mounted on the headform and the chinstrap passed around the artificial jaw.

A tensile force of 150 N shall be applied to the artificial jaw. This force shall then be increased at a rate of 20 N/min ± 2 N/min until the artificial jaw is released, due to failure only of the anchorage(s).

The maximum force measured during the test shall be recorded and note shall be taken of whether the anchorage(s) failed.

6.10 Electrical properties

6.10.1 Test 1

6.10.1.1 Principle

The leakage current between the outside and inside of the helmet and chin strap, (as supplied by the helmet manufacturer) is measured at a specified voltage, when the helmet is mounted on a metal headform.

6.10.1.2 Procedure

The sample helmet and chin strap shall be completely immersed in fresh tap water at room temperature for a period of 15 min ± 2 min. The helmet shall then be removed from the water and allowed to drain for not longer than 2 min.

The sample helmet shall be mounted crown uppermost on an appropriate sized aluminium headform, with the chin strap firmly secured.

An alternating test voltage at nominally 50 Hz or 60 Hz shall be applied between the aluminium headform and a suitably insulated hand-held metal probe of 4 mm diameter and with a hemispherical radiused end.

The probe shall be applied at any point on the external surface of the helmet shell situated at, or above, its lower edge. The test shall be repeated in order to investigate a number of test points.

At each test point, the voltage shall be increased to 1 200 V a.c. ± 25 V a.c., and maintained at this value for 15 s. The leakage current at this voltage shall be recorded, together with any evidence of breakdown.

6.10.2 Test 2

6.10.2.1 Principle

The leakage current between the outside and inside of the helmet shell is measured at a specified voltage.

6.10.2.2 Procedure

Before the test, the helmet shell shall be placed for 24 h ± 1/2 h in a 3 g/l ± 0,2 g/l solution of sodium chloride at a temperature of 20 °C ± 2 °C. The helmet shell shall then be removed, wiped and placed upside down in a container of appropriate size. The container and the helmet shell shall then be filled with the sodium chloride solution, up to 10 mm below the lower edge of the shell.

An alternating test voltage at nominally 50 Hz or 60 Hz shall be applied between an electrode immersed in the solution inside the helmet shell and another electrode in the container, outside of the helmet shell.

The voltage shall be increased to 1 200 V a.c. ± 25 V a.c. and maintained at this value for 15 s. The leakage current at this voltage shall be recorded, together with any evidence of breakdown.

NOTE The orientation of the helmet shell in the sodium chloride solution for the test should be adjusted where necessary in order to accommodate shells whose lower edge is not straight.

6.10.3 Test 3

6.10.3.1 Principle

The leakage current between any two points on the surface of the helmet shell is measured at a specified voltage.

6.10.3.2 Procedure

It shall be ensured that the shell of the helmet is dry before the test.

An alternating test voltage at nominally 50 Hz or 60 Hz shall be applied between two suitably insulated hand-held metal probes of 4 mm diameter and with hemispherical radiused ends.

The probes shall be applied at any two points on the surface of the helmet shell (inside and/or outside) located not closer than 20 mm to each other. The test shall be repeated in order to investigate a number of pairs of test points.

At each test point, the voltage shall be increased to 1 200 V a.c. ± 25 V a.c., and maintained at this value for 15 s. The leakage current at this voltage shall be recorded, together with any evidence of breakdown.

6.11 Lateral deformation

6.11.1 Principle

The helmet is subjected to transverse compressive forces and the deformations measured.

6.11.2 Procedure

The helmet shall be placed transversely between two guided rigid parallel plates of nominal size 300 mm × 250 mm, having their lower edges radiused to 10 mm ± 0,5 mm. The brim shall lie outside, but as close to the plates as possible. In the case of helmets without a brim, the lower edge of the helmet shall lie between the plates.

An initial force of 30 N shall be applied perpendicular to the plates, so that the helmet is subjected to a lateral force. After 30 s the distance between the plates shall be measured (dimension *x*).

The force shall be increased by 100 N per minute up to 430 N, which shall be held for 30 s, after which the distance between the plates shall again be measured (dimension *y*).

The force shall be decreased to 25 N and then immediately increased to 30 N, which shall be held for 30 s, after which the distance between the plates shall again be measured (dimension *z*).

Measurements shall be made to the nearest millimetre, and the extent of damage, if any, shall be noted.

The maximum lateral deformation is the difference between dimensions *x* and *y*.

The residual lateral deformation is the difference between dimensions *x* and *z*.

6.12 Molten metal splash

6.12.1 Principle

Molten iron is poured on to a helmet, which is then examined for damage.

6.12.2 Apparatus

The apparatus is that described in EN ISO 9185:2007 modified by the introduction of an appropriate headform and by substituting the helmet under test for the PVC skin simulant. The metal shall be iron as specified in EN ISO 9185:2007, Annex A.

6.12.3 Procedure

The procedure specified in EN ISO 9185:2007 shall be employed, using a mass of 150 g ± 10 g of iron.

The helmet shall be placed on the headform in such a way that the point of impact of the liquid metal is within a circle of radius 50 mm centred on the top of the helmet.

After pouring has ceased it shall be noted:

a) whether any metal penetrated the helmet shell;

b) the extent of any deformation of the shell;

c) if the shell burned with the emission of flame after a period of 5 s.

7 Marking

7.1 Markings on the helmet

Every helmet claimed to comply with the requirements of this European Standard shall carry moulded or impressed marking giving the following information:

a) number of this European Standard;

b) name or identification mark of the manufacturer;

c) year and quarter of manufacture;

d) type of helmet (manufacturer's designation). This shall be marked on both the shell and the harness;

e) size or size range (in centimetres). This shall be marked on both the shell and the harness.

f) abbreviation for the material of the shell shall be in accordance with EN ISO 472. (For example, ABS, PC, HDPE, etc.)

7.2 Additional information

7.2.1 A label shall be attached to each helmet giving the following information, provided precisely and comprehensively in the language of the country of sale:

"For adequate protection this helmet must fit or be adjusted to the size of the user's head.

The 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, other than as recommended by the helmet manufacturer. Helmets should not be adapted for the purpose of fitting attachments in any way not recommended by the helmet manufacturer.

Do not apply paint, solvents, adhesives or self-adhesive labels, except in accordance with instructions from the helmet manufacturer."

7.2.2 Each helmet shall carry moulded or impressed marking or shall carry a durable self-adhesive label stating the optional requirements complied with, as follows:

Optional requirement	Marking/Label
Very low temperature	– 20 °C or – 30 °C as appropriate
Very high temperature	+ 150 °C
Electrical insulation	440 V a.c.
Lateral deformation	LD
Molten metal splash	MM

7.2.3 The following information, provided precisely and comprehensibly in the official language(s) of the country of sale, shall accompany each helmet:

a) the name and address of the manufacturer;

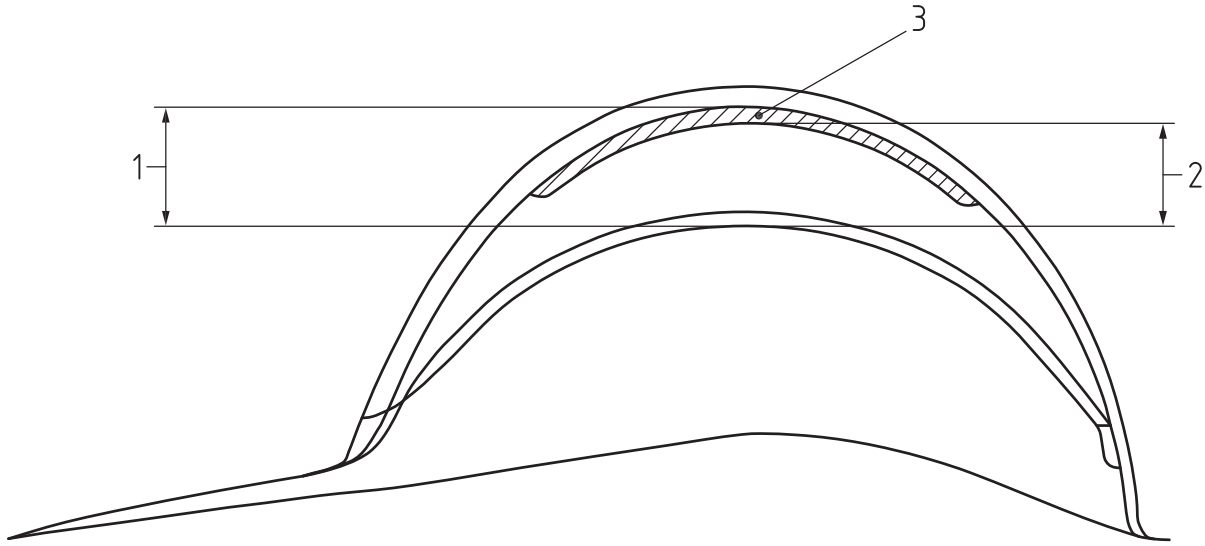
b) instructions or recommendations regarding adjustment, fitting, use, cleaning, disinfection, maintenance, servicing and storage. Substances recommended for cleaning, maintenance or disinfection shall have no adverse effect on the helmet and shall not be known to be likely to have any adverse effect upon the wearer, when applied in accordance with the manufacturer's instructions;

c) details of suitable accessories and appropriate spare parts;

d) the significance of the optional requirements complied with and given in accordance with 7.2.2, and guidance regarding the limits of use of the helmet, corresponding to the respective risks;

e) guidance regarding the obsolescence deadline or period of obsolescence of the helmet and its component parts;

f) guidance regarding details of the type of packaging suitable for transportation of the helmet.



Key

1 internal vertical distance

2 internal vertical clearance

3 padding

Figure 3 — Internal vertical distance and internal vertical clearance

Annex A
(informative)

Recommendations for the materials and construction of industrial safety helmets

The materials used should be of durable quality, i.e. their characteristics should 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, dust, vibrations, contact with the skin, effects of sweat or of products applied to the skin or hair).

The shell should have as uniform a strength as possible and should not be specially reinforced at any point. This does not exclude a gradual increase in shell thickness or ribs or means for attaching the harness or accessories, but does exclude other highly localized reinforcement.

The shell should cover the upper part of the head and extend down to at least the level of the upper edge of the headband at the front of the helmet.

Helmets should be as light as possible without prejudicing design strength and efficiency. No part of the helmet should have sharp protruding edges and the outer surface of the shell should be smoothly finished.

For those parts of the harness coming into contact with the skin, materials which are known to cause irritation should not be used. For a material not in general use, advice as to its suitability should be sought before use.

Whilst not mandatory in this European Standard, the provision of a sweatband is recommended, in order to improve wearer comfort. The material(s) of the sweatband should be absorbent and should satisfy the following characteristics:

thickness:	0,8 mm minimum;
pH value:	3,5 minimum;
washable material content:	6 % maximum;

and, if made from leather:

proportion dichloromethane extractable materials:	4% to 12 %

For improved comfort the cradle, if fitted, should be made from textile tapes. This material also affords optimum accommodation of the shape of the wearer’s head, and is more acceptable with regard to perspiration and irritation.

The design of the helmet should provide for maximal adjustment of the harness within the shell, in order to optimize wearer comfort.

Any devices fitted to the helmet should be so designed that they are unlikely to cause any injury to the wearer in the event of an accident. In particular, there should be no metallic or other rigid projections on the inside of the helmet such as might cause injury.

Where stitching is used to secure the harness to the shell, it should be protected against abrasion.

Where ventilation holes are provided, it should be noted that ventilation may be improved when fresh air is able to enter the helmet around its lower edge and to exit via holes in the shell located in the upper one third of the shell.

Annex B
(informative)

Alternative procedure for artificial ageing

The helmet submitted to artificial ageing should be exposed to the radiation of a xenon arc lamp. The radiant energy of the lamp should be filtered to provide a spectral power distribution that closely approximates that of terrestrial daylight.

The helmet should be fixed on a cylindrical holder concentric to the lamp and which rotates at a speed of 1 rev/min to 5 rev/min around its axis.

Each helmet which will subsequently be tested for shock absorption or for penetration should be orientated so that the area of test should be directed towards the lamp. The plane tangential to the shell at this point should be normal to a radius of the cylindrical holder.

The radiant energy incident in the plane of the test areas should be either measured or calculated from information provided by the manufacturer of the test apparatus. The exposure interval should be adjusted so that the exposed samples should receive a total energy of 1 GJ/m^2 over the wavelength range 280 nm to 800 nm.

The samples should be sprayed with distilled or demineralized water (having a conductivity below 5 µS/cm) intermittently with a cycle of 18 min of spraying and 102 min without spraying. During the latter periods, the measured relative humidity should be 50 % ± 5 %.

The temperature within the test chamber should be measured with a black standard thermometer placed at the same distance from the lamp as the exposed test areas of the helmets. The temperature should be maintained at 70 °C ± 3 °C.

All other test and calibration conditions for the apparatus should be in accordance with EN ISO 4892, and the revisions currently being prepared as EN ISO 4892-1, EN ISO 4892-2 and EN ISO 4892-3, Method A.

NOTE 1 Not all available test apparatus, otherwise meeting the requirements of EN ISO 4892-1, EN ISO 4892-2 and EN ISO 4892-3, will incorporate sample holder frames of diameter sufficient to accommodate complete helmets.

NOTE 2 The position of the water sprays may require adjustment in order to avoid interference with the test samples.

NOTE 3 The energy output of the xenon arcs has to be capable of being reduced below normal operational levels, so as to maintain acceptable intensities in the sample surface plane required by this procedure.

Annex C
(normative)

Test results — Uncertainty of measurement

For each of the required measurements performed in accordance with this European Standard, a corresponding estimate of the uncertainty of measurement shall be evaluated. This estimate of uncertainty shall be applied and stated when reporting test results, in order to enable the user of the test report to assess the reliability of the data.

Annex D
(informative)

Significant technical changes between this European Standard and EN 397:1995

The significant changes with respect to the first edition of EN 397 are as listed below.

Table D.1 — Significant changes between this European Standard and EN 397:1995

Clause/paragraph/table/figure	Change
Clause 2	The normative references in Clause 2 and in the text have been updated. EN 960 has been dated throughout the text.
4.6	Code letters have been extended to size designations and between brackets EN 960:1994 equivalent code letters.
6.2.8.1	A code letter has been extended to a size designation and between brackets EN 960:1994 equivalent code letter.
6.4.1	Cross references have been updated.
6.4.2	Code letters have been extended to size designations and between brackets EN 960:1994 equivalent code letters.
6.5	Code letters have been extended to size designations and between brackets EN 960:1994 equivalent code letters.
Annex B	Changed into informative annex with adaption of modal verbs.
Annex ZA	Has been updated.
Bibliography	Has been added according to references in Annex B.
NOTE The technical changes referred include the significant technical changes from the EN revised but is not an exhaustive list of all modifications from the previous version.	

Annex ZA
(informative)

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

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 Personal Protective Equipment.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and the EU Directives

EU Directive 89/686/ECC, Annex II	Clauses of this European Standard	Qualifying remarks/notes
1.2.1 Absence of risks and other inherent nuisance factors	4.2, 4.5, 4.8, 5.1.3, 5.1.4, 5.2.3, 5.2.5	
1.3.1 Adaptation to users morphology	4.3, 4.6, 4.7.1,	
1.3.2 Lightness and design strength	5.1.1, 5.1.2, 5.2.1, 5.2.2	
1.4 Information supplied by the manufacturer	7 (to be completed)	
2.2 PPE enclosing the parts of the body to be protected	4.7.2, 4.7.3	
2.4 PPE subject to ageing	7.2.3 e)	
2.12 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	5.1.5, 7	
3.1.1 Impact caused by falling or projecting objects and collision of parts of the body with an obstacle	5.1.1, 5.1.2	
3.2 Protection against (static) compression of part of the body	5.2.4	

Bibliography

[1] EN ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance (ISO 4892-1:1999)*

[2] EN ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2006)*

[3] EN ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3:2006)*

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