



SLOVENSKI STANDARD

SIST EN 960:2006

01-december-2006

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Headforms for use in the testing of protective helmets

Prüfköpfe zur Prüfung von Schutzhelmen

Fausses tetes a utiliser lors des essais de casques de protection

Ta slovenski standard je istoveten z: EN 960:2006

ICS:

13.340.20 Varovalna oprema za glavo Head protective equipment

SIST EN 960:2006

en

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English Version

Headforms for use in the testing of protective helmets

Fausses têtes à utiliser lors des essais de casques de protection

Prüfköpfe zur Prüfung von Schutzhelmen

This European Standard was approved by CEN on 18 May 2006.

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

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Foreword

This document (EN 960:2006) 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of an identical text or by endorsement, at the latest by December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006.

This document supersedes EN 960:1994.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 89/686/EEC.

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

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

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Introduction

In preparing this revision of EN 960 it was decided to address several areas of concern, which had arisen during the life of the previous version of this European Standard, namely:

- dimensional errors are present;
- several desirable definitions, characteristics and headform markings are missing;
- it is impossible to verify or demonstrate compliance of a headform with the standard because of the absence of tolerances associated with the specified dimensions;
- the method of dimensioning the headforms, whilst essential to enable manufacture of the original wooden headforms, does not facilitate a straightforward method of tolerancing these dimensions.

It was also acknowledged that headforms are specified, in various helmet standards, for tests where other than a full headform is required. Accordingly, in this revision, “half headforms” and “three-quarter headforms” have been specified, in addition to “full headforms”.

Half headforms are usually rigidly mounted (not falling), so consequently their mass is not important and is, therefore, not specified in this European Standard.

Three-quarter headforms are also used rigidly mounted, but are often used in a falling headform and helmet assembly arrangement for shock absorption tests, where they are typically supported by means of a ball joint and cantilever. In such cases, the falling mass comprises that of the headform and of the supporting system. Some helmet standards specify total falling mass, whereas some specify only the mass of the headform. For this reason, only the dimensions, not the masses, of the three-quarter headforms are specified in this European Standard. It is to be hoped that in future revisions, mass will also be agreed.

The opportunity has been taken to specify more adequately the centre of gravity and the geometric centre of headforms, including the nomination of which of these characteristics is more appropriate to the different types of headform specified and to whether the headforms are intended to be used rigidly mounted or in guided fall or in free fall.

Whilst, in the past, the nominal sizes of headforms have been specified in multiples of ten millimetres (50, 51, 52 etc.), the actual circumferences are closer to five millimetres greater or less than nominal. In this revision therefore, the size designations have been specified according to the actual nominal circumference, in increments of ten millimetres (505, 515, 525 etc.).

Helmets for children have been available for a number of years but headforms to test them are not specified in EN 960:1994. Following searches of the literature it was found that smaller headforms were specified in other publications. However, when comparing the dimensions given for these headforms with those specified for the headforms in EN 960, it was quite obvious that these smaller headforms were not specified as comprehensively as those in EN 960. Hence, incorporation of these data would be neither straightforward nor consistent. It was decided therefore, to develop, from the existing EN 960 dimensions, the specification for five new, smaller, headforms below size 495.

In order to overcome the problems of tolerancing, it was decided to replace the existing dimensioning system with a spherical coordinate system. Namely, using point ‘R’ (the geometric centre) as the datum and then specifying the radius of points on the outer surface of the headform at various angles measured from point ‘R’. Appropriate tolerances have then been assigned to the radius and to the angles.

As part of the process, linear regression lines through the existing data sets for head sizes A to Q were established and the spherical coordinates were specified from the equations of these regression lines. The coordinates of the new, smaller heads, sizes 445 to 485, were derived by simple scaling of the corresponding points of head size 495 in proportion to the respective circumferences.

Partly because of the impossibility of assigning these smaller heads code letters less than A (the other end of the alphabet was considered and dismissed), it was decided to abandon the code letter system of identification. Further, the concept of 'internal circumference of a helmet' was removed. Instead, headforms have now been classified only according to a size designation, which corresponds to their circumference.

During this revision the opportunity was taken to correct obvious errors present in the existing tables, which evidence themselves on the headforms as spurious bumps and depressions. Also, the data points were smoothed where obvious discontinuities occurred and the protruding chin was removed.

Whilst, ideally, the dimensions of headforms already in existence, which 'satisfy' EN 960:1994, should comply with the dimensions given in this revision, because of the preceding paragraph, there are a few points which fall outside of the tolerances specified.

The spherical coordinates of head sizes 445 to 645 are given in the normative Annex A. The equations, which define the radii of the spherical coordinates in terms of headform circumference and vertical and horizontal angles, are given in the informative Annex B.

The first international draft standard for headforms was ISO/R1511:1970, followed many years later by ISO/DIS 6220:1983. Both of these documents were based upon the British Standard, BS 1869:1960, which itself was developed from the first set of test headforms produced by the UK Transport and Road Research Laboratory in the 1950s. The TRRL headforms were designated solely by their size, given in inches. The increment between each size was one eighth of an inch.

During the drafting of BS 1869, the concept of code letters was introduced, but unfortunately, errors of transposition from the TRRL data were made, which resulted in incorrect dimensions being specified and the inclusion of headform code letter H, circumference 565 mm. This headform was also specified in R1511, but subsequently dropped from ISO/DIS 6220 and EN 960:1994. The dimensional errors however, were carried forward through R1511, ISO/DIS 6220 and EN 960:1994.

A summary of this brief history is tabulated in Informative Annex C.

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1 Scope

This European Standard specifies the dimensional and constructional details of headforms for use in the testing of protective helmets.

2 Terms and definitions

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

2.1

headform

three dimensional approximation of part, or all, of the human head, excluding facial features and pinnae. Three general forms are characterized in this European Standard, viz:

- full headform - extends from the crown downwards to below the chin and includes part of the neck;
- three-quarter headform - extends from the crown downwards at the sides and rear to below the level of the basic plane;
- half headform - extends from the crown downwards at the sides and rear to approximately the level of the basic plane

2.2

size designation

circumference of a given headform, expressed in mm, as shown in Table 1

2.3

circumference, C

for a given headform, the length of its periphery measured at the level of the reference plane

2.4

AA' plane

for a given headform, the horizontal transverse plane located at a vertical distance 12,7 mm above and parallel to the reference plane

NOTE This plane is deemed to correspond to the level of the lower edge of the headband of a helmet. It is the basis upon which the size designation of a helmet may be specified.

2.5

reference plane

for a given headform, when erect, the horizontal plane located at a vertical distance 'y' measured down the central vertical axis from the centre of the crown

NOTE All horizontal datum levels are quoted relative to this plane.

2.6

central vertical axis

vertical axis lying along the intersection of the vertical longitudinal plane and the vertical transverse plane

2.7

crown

area on the upper, outer surface of a headform, centred on the central vertical axis

2.8

vertical longitudinal plane

for a given headform, the vertical plane of symmetry, perpendicular to the reference plane and located mid-way between the left hand and right hand extremities of the headform

NOTE This corresponds to the *mid-sagittal plane* of the human head.

2.9

vertical transverse plane

for a given headform, the vertical plane perpendicular to both the vertical longitudinal plane and the reference plane and located mid-way between the front and rear extremities of the headform

NOTE This corresponds to the *coronal plane* of the human head.

2.10

basic plane

for a given headform, the horizontal plane located at a vertical distance 'x' below and parallel to the reference plane

NOTE This corresponds to the *basic plane* of the human head being the longitudinal plane which passes through the lower level of the eye orbits and the upper level of the external opening of the ear canals.

2.11

centre of gravity of the three-quarter headform

point A

for a given headform, the point on the central vertical axis located at a vertical distance 12,7mm above the reference plane

2.12

centre of gravity of the full headform

point G

for a given headform, the point on the central vertical axis located at a vertical distance 'z' below the reference plane, as given in Table 1

2.13

geometric centre

point R

for a given headform, the point on the central vertical axis, located at its intersection with the reference plane

NOTE This point is the datum for all the dimensions given in Annex A.

3 Requirements

3.1 Materials and general characteristics

3.1.1 Headforms for shock absorption and penetration tests, with falling headform/helmet assembly

The headforms shall be made of metal and, together with any means for their support, shall exhibit no resonance below a frequency of 2 000 Hz.

Full headforms shall have the following characteristics:

- a) the centre of gravity shall be located within a 10 mm radius of point G on the central vertical axis;
- b) a facility for attaching an accelerometer shall be incorporated such that, with the headform in any angular orientation, the respective sensitive axes of the accelerometer shall pass within 10 mm of point G;
- c) the appropriate mass, if specified in Table 1.

Three-quarter headforms shall have the following characteristics:

- i) the centre of gravity shall be located within a 10 mm radius of point A on the central vertical axis;

ii) a facility for attaching an accelerometer shall be incorporated within the headform or its means of support, such that, with the headform in any angular orientation, the respective sensitive axes of the accelerometer shall pass within 10 mm of point A.

NOTE 1 For this type of test, full and three-quarter headforms may be specified in the respective helmet standard.

NOTE 2 The geometry of the half headform does not facilitate its use for this type of test.

NOTE 3 Care should be taken to ensure that the total mass of the headform, when fitted with the accelerometer and its means of attachment, falls within any tolerances specified in either this standard or the respective helmet standard, as appropriate.

3.1.2 Headforms for shock absorption and penetration tests, with rigidly mounted (not falling) headform/helmet assembly

The headforms shall be made of a rigid material which does not affect the measurements of shock absorption or penetration (e.g. wood). The headforms, together with their means of support, shall exhibit no resonance below a frequency of 2 000 Hz.

NOTE For this type of test, full, three-quarter and half headforms may be specified in the respective helmet standard.

3.1.3 Headforms for geometric examination or positional marking of the helmet

The headforms shall be made of any suitable material.

3.1.4 Headforms for other tests

When a test requires the headform to be made from a specific material or to possess specific material characteristics (e.g. thermal or electrical conductivity, thermal capacity etc.), these materials and characteristics shall be as specified in the relevant helmet standard.

3.2 Dimensions

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The outer surface of each headform shall lie within the locus of the coordinates given in Annex A. Between coordinate points, the outer surface of the headform shall be curved and smooth.

NOTE The exact geometry of the surface between the specified coordinates may be determined, for example, by a 5th order spline function.

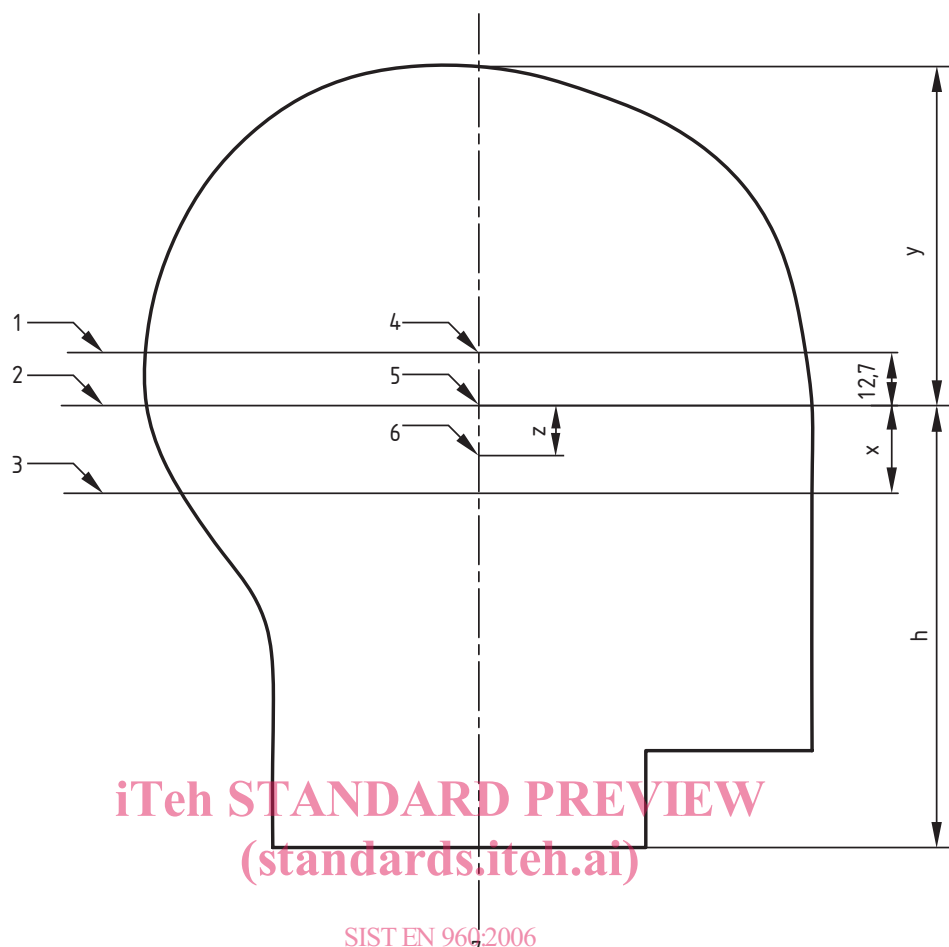
3.3 Marking

3.3.1 Headforms for geometric examination or positional marking of the helmet shall be marked with:

- a) size designation of the headform;
- b) reference plane;
- c) basic plane;
- d) vertical longitudinal plane;
- e) vertical transverse plane.

3.3.2 All other headforms shall be marked, at least, with the size designation of the headform.

NOTE Other marking may be required by specific helmet standards.



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Section on vertical longitudinal plane

Key

- 1 AA' plane
- 2 reference plane
- 3 basic plane
- 4 point A
- 5 point R
- 6 point G
- 7 central vertical axis

Figure 1 — Principal planes and reference points of a headform

Table 1 — Dimensions for Figure 1 and headform masses

Size designation	h (mm)	x (mm)	y (mm)	z (mm)	Mass (g)
445	108,5	21,0	81,7	9,9	
455	110,6	21,5	83,3	10,1	1 970 ± 75
465	112,7	22,0	84,8	10,4	
475	114,8	22,5	86,4	10,6	
485	116,9	23,0	88,0	10,8	
495	119,0	23,5	89,7	11,1	3 100 ± 100
505	121,1	24,0	91,2	11,3	
515	123,2	24,5	92,7	11,5	
525	125,3	25,0	94,5	11,7	
535	127,4	25,5	96,0	11,9	4 100 ± 120
545	129,5	26,0	97,5	12,1	
555	131,6	26,5	99,1	12,3	
565	133,7	27,0	100,8	12,5	
575	135,8	27,5	102,4	12,7	4 700 ± 140
585	137,9	28,0	103,9	12,9	
595	140,0	28,5	105,4	13,1	
605	142,1	29,0	107,2	13,3	5 600 ± 160
615	144,2	29,5	108,7	13,5	
625	146,3	30,0	110,2	13,7	6 100 ± 180
635	148,4	30,5	111,8	13,9	
645	150,5	31,0	113,5	14,1	

Annex A **(normative)**

Spherical coordinates

The spherical coordinates are given in Tables A.1 to A.21.

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