INTERNATIONAL STANDARD

ISO 10256

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Protective helmets for ice hockey players

Casques protecteurs pour joueurs de hockey sur glace

Reference number
ISO 10256:1996(E)

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.

Draft International Standards adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10256 was prepared by Technical Committee ISO/TC 83, *Sports and recreational equipment*, Subcommittee SC 5, *Ice hockey equipment and facilities*.

It is the first International Standard for ice hockey helmets, and therefore, neither cancels nor supersedes any previous documents. It was developed primarily from ice hockey helmet standards previously published by the American Society of Testing and Materials (ASTM), the Canadian Standards Association (CSA) and the Swedish Ice Hockey Association (SIF).

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Protective helmets for ice hockey players

1 Scope

This International Standard specifies the materials, assembly, area of coverage, sizing, impact and penetration requirements for protective helmets for ice hockey players. In addition, it specifies the test apparatus and test procedures for the helmets and the chin and/or neck straps.

This International Standard is applicable to performance requirements for helmets to protect ice hockey players from the hazards encountered while playing the game of ice hockey and defines the areas of the head to be protected. It covers shock-attenuating properties of the complete helmet, penetration of objects to the head, strength and elongation of the chin strap and/or neck strap and of its attachment, requirements for the construction and finish of helmets and for the materials to be used in the manufacture of the helmet. Labelling and marking requirements are also included.

The intent of this International Standard is to reduce the risk of injury to the head without compromising the form or appeal of the game.

Note: *Hockey is a collision sport in which there is a risk of injury. This International Standard is intended only for ice hockey helmets and not for helmets for other activities. Ice hockey helmets afford no protection from neck or spinal injury. Severe head, brain or spinal injuries, including paralysis or death, may occur in spite of using an ice hockey helmet in accordance with this International Standard.*

Annex A details test equipment and procedures when using a monorail or a free-fall drop assembly. The user of this International Standard is provided with the option of selecting the test methodology using the monorail drop assembly or the test methodology using the free fall assembly.

Annex B is informative only and is included in order to facilitate the procurement of the appropriate test equipment by certification laboratories throughout the world desiring to certify ice hockey helmets for international competitions.

This International Standard complements ISO 10257.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6487:1987, *Road vehicles — Measurement techniques in impact tests — Instrumentation.*

ISO 10257: 1996, *Face protectors and visors for ice hockey players.*

ISO Guide 25: 1990, *General requirements for the competence of calibration and testing laboratories.*

EN 960: 1994, *Headforms for use in the testing of protective helmets.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 chin strap; neck strap: A strap, which may include a pad that covers the chin, and which secures the helmet firmly to the head when adjusted according to manufacturer's instructions.

3.2 central vertical axis: The line relative to the headform that lies in the plane at a point equidistant from the front (anterior) and back (posterior) of the headform.

3.3 drop height: The vertical distance between the lowest point (impact point) of the elevated helmet and the apex of the impact surface.

3.4 fastening system: Those devices used to connect all components of the helmet.

3.5 acceleration of a body due to gravity, *g*: $g = 9{,}8\ \mathrm{m \cdot s^{-2}}$

3.6 acceleration of a body, *a*: Acceleration measured in units of *g*.

3.7 maximum value of acceleration, a_{max}: Maximum acceleration, in units of *g*, encountered during impact.

3.8 Gadd Severity Index (GSI): A weighted impulse criterion measure that estimates the injury hazard to the human head exposed to an impact and is determined from the acceleration-time wave form. It is mathematically defined by the equation:

$$\mathrm{GSI} = \int_{t_1}^{t_2} a^{2,5}\, \mathrm{d}t$$

where 2,5 represents the weighting exponent; *a* represents impact acceleration in units of *g*; *t* represents the time in seconds and is integrated over pulse duration, $t_2 - t_1$.

3.9 helmet: A device intended to reduce the risk of head injury to ice hockey participants. Except where they are discussed individually in relation to their function as part of the helmet as a whole, the following are considered part of, and included in the term helmet, where it appears in this International Standard:

a) the outer covering and shock-attenuating system;

b) the chin and/or neck strap;

c) all associated hardware; and

d) manufacturer's attachments.

3.10 helmet model: Category of helmets that do not differ in such essential respects as the materials, dimensions, construction of the helmet, retention system or the protective padding.

3.11 Impact sites (defined in relation to the headform)

3.11.1 crown: The site where the central vertical axis meets the top of the headform.

3.11.2 front: A point on the median (mid-sagittal) plane which is 50 mm above the anterior intersection with the reference plane.

3.11.3 front boss: A point 25 mm above the reference plane and 45° from the anterior intersection of the median (mid-sagittal) plane with the reference plane.

3.11.4 side: A point 25 mm above the reference plane and 90° from the anterior intersection of the median (mid-sagittal) plane and the reference plane (intersection of the reference and coronal planes).

3.11.5 rear boss: A point on the reference plane and 135° from the anterior intersection of the median (mid-sagittal) plane and the reference plane.

3.11.6 rear: A point at the posterior intersection of the median (mid-sagittal) and reference planes.

3.12 liner: The material inside the outer covering of the helmet. The principal objective of the liner is to absorb kinetic energy generated by an impact to the head.

It is also this material, or part of it, that ensures a snug comfortable fit of the helmet on the head.

3.13 natural frequency: The frequency at which a system will tend to oscillate when displaced from its static equilibrium position.

3.14 outer covering (shell): The outer material that gives the helmet its form.

3.15 permanent marking and warning: Lettering that cannot be removed in its entirety under normal conditions (see 6.1 and 6.3).

3.16 Planes

3.16.1 basic plane (Frankfurt Horizontal): A plane that is located at the level of the upper border of the ear canal (external auditory meatus) and the inferior margins of the orbits of the eyes.

3.16.2 frontal plane (coronal plane): A vertical plane that is perpendicular to the median (mid-sagittal) and reference planes and passes through the crown of the headform (see figure 1).

3.16.3 horizontal plane (transverse plane): A plane that passes across the body at right angles to both the frontal and mid-sagittal planes (see figure 1).

3.16.4 median plane (mid-sagittal plane): A vertical plane that passes through the headform from front to back and divides the headform into right and left halves (see figure 1).

3.16.5 reference plane: A plane that is located above and parallel to the basic plane.

3.17 securely attached labels and tags: A label or tag affixed at the time of manufacture, and which is normally removed at the time of helmet use (see 6.2).

3.18 ultraviolet radiation: That part of the electromagnetic spectrum extending from the violet end of the visible wavelength (400 nm) to the beginning of X-rays, arbitrarily taken as 100 nm, a span of more than 5 octaves. The unit of measure for wavelength generally used for ultraviolet is the angstrom, 1Å = 0,1nm. However, when referring to ultraviolet radiation exposure, the units of watts (power) per square metre (area) are used.

4 Requirements

4.1 Materials

The material tests referred to in this clause are intended as a check of the characteristic of the materials used in the helmet as offered for sale.

4.1.1

All materials used in the fabrication of helmets shall be known to be suitable for the intended application. For example, the helmet shall remain strong, semi-rigid, and firm, and shall not be permanently distorted during an exposure of a minimum of 4 h, to any temperature in the range of −25°C to 70°C with the latter temperature being at a relative humidity of (55 ± 5)%. Nor shall the materials be significantly affected by exposure to ultra-violet radiation, water, dirt or vibration. All materials shall be rot resistant. In addition, paints, glues and finishes used in manufacturing shall be compatible with the materials used in the construction of the helmet.

4.1.2

Materials used in the construction of the helmet shall not be adversely affected by ordinary household soap or cleaners as recommended by the manufacturer.

4.1.3

Materials coming in contact with the wearer's head shall not be of the type known to cause skin irritation or disease, and shall not undergo significant loss of strength, flexibility, or other physical changes as a result of contact with perspiration, oil or grease from the wearer's head.

4.2 Design

No surfaces or protruding parts shall present a potential hazard to the user or other players. The back edge of the helmet should be designed to minimize the possibility of

lacerations and/or contusions to the back of the neck. Assembly by the user shall require no machining operation, e.g. drilling holes.

4.3 Attachments

Any optional devices fitted to the helmet shall be so designed that they are unlikely to cause any injury to the wearer or other players during contact or otherwise.

The components of the fasteners for securing attachments to the helmet shall be so designed that the degree of protection afforded the wearer by the helmet is not thereby reduced.

4.4 Devices for adjustment

Devices for adjusting the size of helmet to the wearer's head shall be designed for simplicity of adjustment, thus providing for a snug fit.

4.5 Finish

All external projections shall be failed to the outer surface. Split or bifurcated rivets shall not be used.

4.6 Area of coverage

4.6.1

When positioned according to the manufacturer's instructions, the area protected by the helmet shall be at least all the area above line ACDEF (figure 2a), except for the ear aperture. The area selected shall correspond with the appropriate size of standard headform with which the helmet is to be tested (see table 1).

4.6.2

No ear aperture shall have a linear dimension exceeding 38 mm (see "*g*" in figure 2). The ear aperture shall be entirely surrounded by the helmet shell. The distance from any edge of the ear aperture to any edge of the helmet shall not be less than 20 mm (see "*b*" in figure 2).

4.7 Size of helmets

Helmet manufacturers shall clearly identify the size range of each helmet model, and for those size ranges specified by the manufacturer, the helmet shall meet the area of coverage requirements of 4.6 (also see figure 2).

4.8 Impact requirements

Helmets shall be subjected to impact in accordance with the test method of 5.3. Each of 6 impact locations shall be impact-tested 3 times. No single impact shall exceed a Gadd Severity Index (GSI) of 1 500 or an a_{max} of 300 *g*. When so tested, the helmet shall remain intact with no cracks through the thickness of the outer covering (shell).

4.9 Penetration requirements

When tested in accordance with 5.4, it shall not be possible to touch the headform when an attempt is made to pass the penetrator (see figure 3) through any helmet aperture that lies within the area of coverage except for the ear aperture.

4.10 Chin and/or neck straps

The chin and/or neck strap(s) shall be attached to the helmet in such a manner that the helmet will remain in its normal position on the user's head during play and impact conditions provided the chin and/or neck strap(s) is adjusted to provide a firm fit.

When tested in accordance with 5.5, the force required to release the chin/neck strap shall not be less than 110 N nor more than 300 N and the maximum displacement shall not exceed 25 mm at a load of 110 N.

The minimum width of the chin and/or neck strap shall be 13 mm. The edges of the strap shall be of a type that is nonabrasive so as not to irritate the skin.

5 Test methods

5.1 Sampling

For complete testing and assessment, 8 helmets of a given model are required: 4 in the smallest size (marked 1S - 4S) and 4 in the largest size (marked 1L - 4L).

Complete helmets as offered for sale shall be tested. For tests conducted on a headform, the headband or other head fitting device shall

be adjusted to a fit similar to that obtained when worn on a head and the helmet shall then be mounted on the appropriate size of standard headform as described in table 1 and figure 2, and in accordance with the manufacturers' instructions. Helmets shall be tested without accessories.

5.2 Conditioning

Helmets shall be conditioned and tested at the applicable test temperatures as stated below and, in cases of dispute, at a relative humidity of (55 ± 5)%, for a minimum period of 4 h, prior to testing.

5.2.1 Ambient temperature

Helmets shall be conditioned in air for at least 4 h at a temperature of (20 ± 2)°C.

5.2.2 Low temperature

Helmets shall be maintained in a refrigeration chamber at a temperature of (−25 ± 2)°C for at least 4 h. Testing shall begin within 40 s after removal from the chamber and be completed within 2 min and 40 s. Otherwise the test is voided and a new helmet shall be used and the test repeated.

5.2.3 Ageing

Helmets shall be kept in a conditioning chamber at a temperature of (70 ± 2)°C for 7 days and thereafter room conditioned in air at a temperature of (20 ± 2)°C for at least 4 h. The helmet is then exposed for 48 h to ultraviolet radiation of 0,5 $W \cdot m^{-2}$, evenly distributed over the exterior surface of the helmet. The helmet is then conditioned at ambient temperature for an additional 4 h and then tested according to the requirements of 5.3.

5.3 Impact testing

Prior to impact testing, helmets shall be conditioned as outlined in 5.2.

5.3.1 Apparatus

Impact testing shall be conducted using the apparatus outlined in either A.1 or A.2 of annex A.

5.3.2 Procedures

5.3.2.1 Helmet positioning The helmet shall be positioned on the headform and adjusted in accordance with the manufacturer's instructions to ensure that it covers the area to be protected. The helmet is to be secured to the headform such that it does not shift position prior to or during impact and so that the retention system does not interfere with the fall or impact of the helmeted headform.

5.3.2.2 Impact locations and velocity Impact test each helmet at the 6 locations of Front, Front Boss, Side, Rear, Rear Boss, and Crown (see figure 4) at an impact velocity of (3,96 ± 0,08) $m \cdot s^{-1}$ (this is roughly equivalent to free fall from a height of 0,8 m).

For helmets tested under ambient conditions, each impact location offered for testing shall be subjected to three successive impacts (see 4.8). After ambient temperature impact testing, a second and a third helmet, following low temperature and ageing conditioning respectively (see 5.2.2 and 5.2.3), shall be impacted three times at the site which yielded the highest mean GSI under ambient conditions (see 4.8 and table A.1).

5.3.2.3 Time interval between multiple impacts The time interval between multiple impacts shall not be less than 45 s nor more than 60 s.

5.3.2.4 System accuracy The impact recording system shall be capable of measuring accelerations of up to 500 *g* peak acceleration with an accuracy of ±5% and over a frequency range of 0–1000 Hz.

5.3.2.5 Signal conditioning A low pass filter with a cut-off frequency of 1 kHz shall be used in conditioning the accelerometer signal. If a computer is employed as a read-out device, a sampling rate of 10 000 samples per second shall be used for each channel of the accelerometer signal. The required 1 kHz filter may be included as a part of the computer software.

5.3.2.6 Helmet performance Helmet performance, as measured by a triaxial accelerometer, shall be indicated by the computed GSI.

5.4 Penetration test

Penetration testing shall be carried out under ambient conditions.

5.4.1 Apparatus

The apparatus shall consist of the following:

a) Headform: the appropriate headform, as described in A.1.1.4, shall be used for testing the appropriate helmet;

b) Test blade: the test blade (penetrator) shall be made of appropriate metallic material and with dimensions as shown in figure 3.

5.4.2 Procedure

The helmet shall be mounted on the headform in accordance with the manufacturer's instructions. An attempt shall be made to enter the test blade into all openings in the helmet except the ear aperture.

5.5 Chin and/or neck strap(s) test

For this test an ambient temperature-conditioned helmet shall be used. It is placed on an appropriate apparatus as specified and the chin and/or neck strap is adjusted so that there is about 25 mm of free strap outside the adjusting devices. The strap is placed around a set of two rollers as shown in figure 5. The strap is first loaded with a force of 5 N during 15 s and then retained for an additional 45 s to seat the helmet and strap. The height of the rollerholder is recorded to within an accuracy of 1 mm. The load is then uniformly (evenly, without jerk to avoid inertial loads) increased for at least 15 s but no more than 25 s to a load of 110 N, at which point the height of the roller holder is immediately recorded.

To check the strap's fastening device the load is increased, whereupon the device shall release. The releasing force shall be recorded (see 4.10).

In cases where the chin strap is loaded dynamically with a tensile machine, the rate of loading shall be at 25 mm/min. A load of 110 N shall be attained within a time frame of not less than 15 s and not more than 25 s (see 4.10).

6 Markings, labels and permanent warnings

6.1 Markings

Each helmet shall be permanently marked with the following information:

a) manufacturer's identification or trademark;

b) model;

c) year of manufacture;

d) size or size range;

e) certification sticker or identification;

6.2 Labels and tags

A label or tag bearing the following information shall be securely attached to each helmet or helmet/face protector combination at the time of sale:

a) For maximum performance, the helmet shall fit snugly, be free from cracks and remain securely in position when adjusted for proper fit.

b) Instructions for proper fit, including the size or size range of the helmet.

c) Cleaning and caring instructions including a warning that no cleaning agents, paints or decals should be applied to the helmet shell or shock absorbing system, unless authorized by the manufacturer on this label or tag.

d) Notification that the helmet meets the minimum requirements of ISO 10256 for ice hockey helmets provided it has not been reconditioned or altered in any way.

e) Instructions for the continued inspection of the helmet for breakdown. Also a statement that the helmet should be replaced if it has been exposed to impact or to another strain that may have reduced its protective function. A reminder to read instructions carefully before wearing.

6.3 Permanent warning

A permanent warning shall be placed on the exterior of the helmet in a contrasting colour informing the user about the limits of protection afforded by the helmet.

A SUGGESTED WARNING: "This helmet is intended for ice hockey only. This helmet does not eliminate, neck, spine or all head injuries. Do not use this helmet if the outer shell is cracked, deformed or if the protective padding is deteriorated or partly missing. The helmet must be adjusted properly according to manufacturer's instructions. Failure to follow this warning may result in serious or permanent injury."

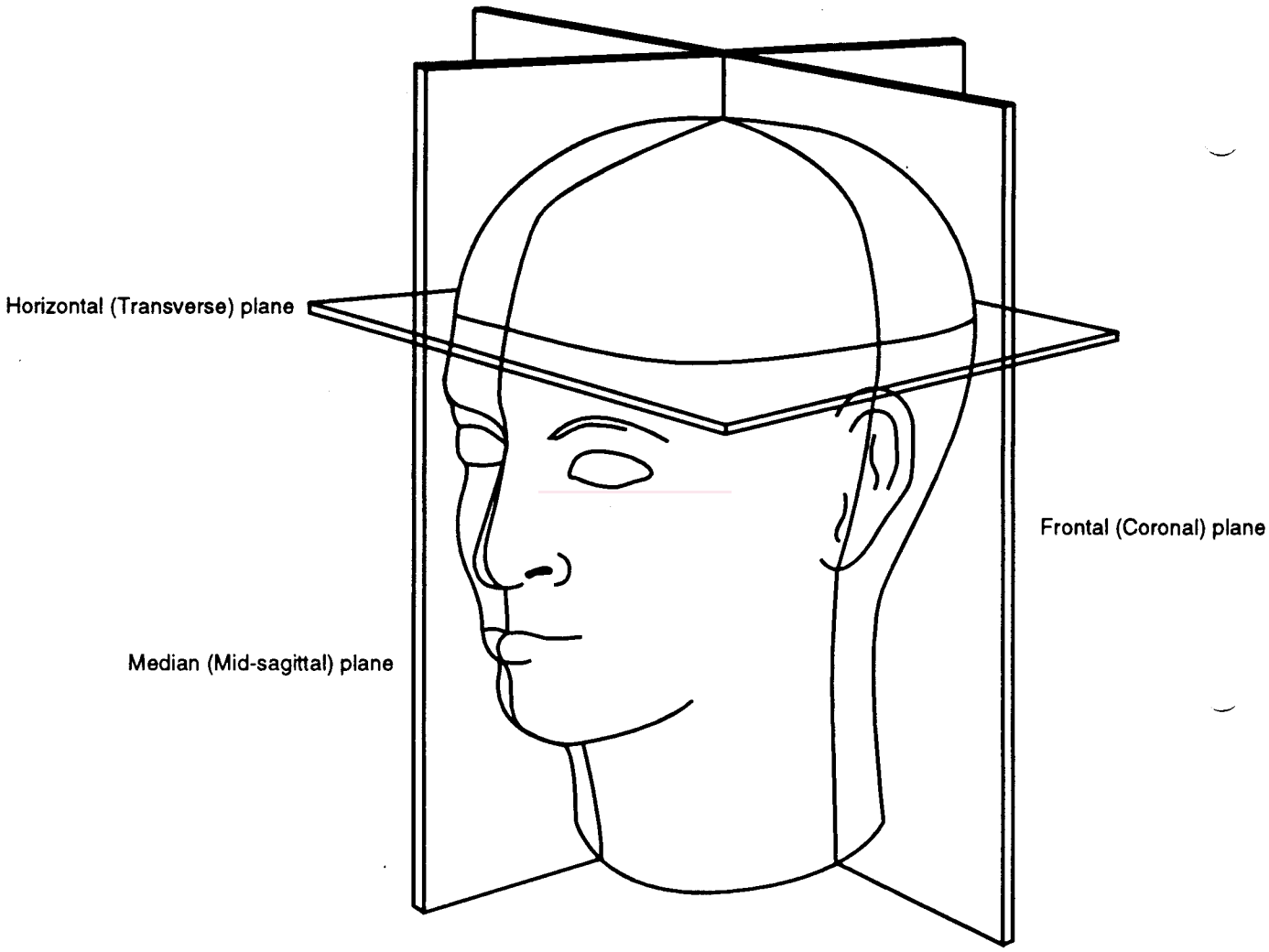
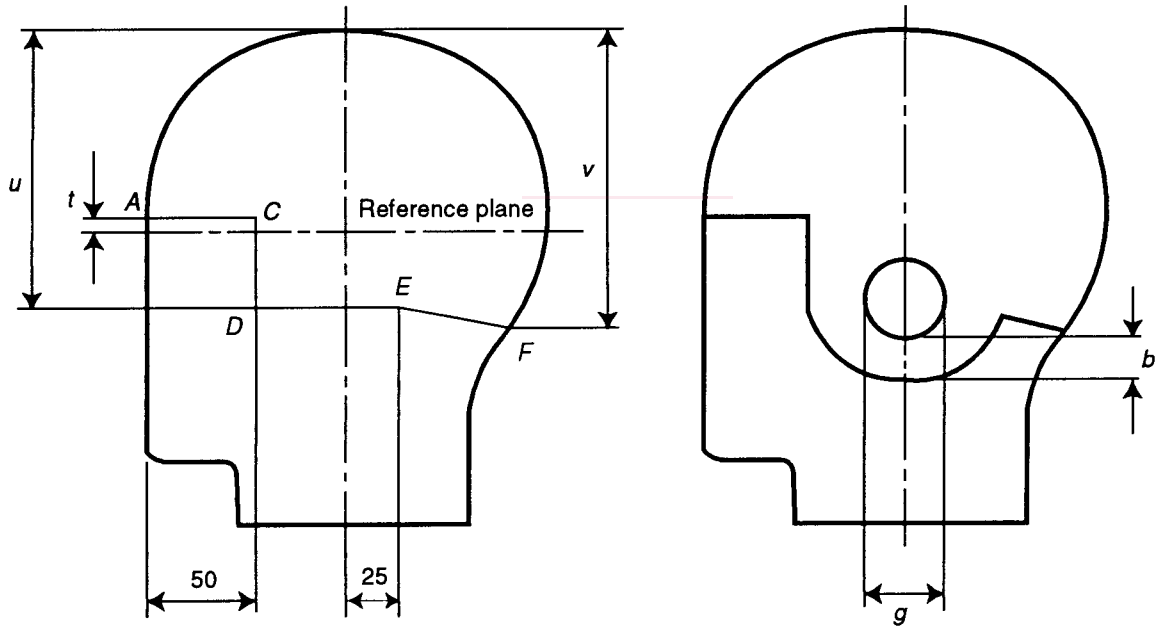


Figure 1 — Orientation Planes

Table 1 —Headform and Helmet Data

Headform Code letter	Sizes Inside circumference of helmet (mm)	Distance (mm) (See Figure 2 below)		
		t	*u*	*v*
A	500	24	123	132
E	540	25	132	140
J	570	27	139	145
M	600	28	146	151

Dimensions in millimetres



a – Minimum area

b – Extended area

Figure 2 — Area of Coverage