GLOBAL CHILD HELMET STANDARD FOR 2-WHEEL MOTORIZED VEHICLES (GCHS1:2025)

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PREFACE

Motorcycle helmet standards are the frontline in defending against death and brain trauma as two-wheeler-related casualties increase in many low and middle-income countries. Yet, while many governments are now recognizing the importance of adopting and enforcing quality helmet standards for adult heads, there currently exists no global standard for children. Providing one could save many thousands of young lives.

The authors of this document would like to acknowledge the ongoing support of those who have promoted programs with government agencies, standards organizations, non-government organizations (NGOs) and user groups to develop standards and increase global helmet use for children. The authors also acknowledge all of those who have consistently and significantly supported the introduction of motorcycle helmet standards in countries where they are most critically needed. This includes support for improving affordable motorcycle helmet quality and increasing motorcycle helmet use rates around the world.

Motorcycles are the dominant mode of travel in low and middle-income countries. This includes the transportation of children to and from school. Motorbikes are effectively the ‘family car’ in the world of low and middle-income countries. This exposure puts children at the highest risk for traumatic brain injury and fatality, without appropriate protective and affordable helmets.

The *Global Child Helmet Standard for 2-Wheel Motorized Vehicles* provides specific tests and performance criteria to encourage the production of helmets assuring a maximum level of protection for children. A team of international experts led by Dr. Terry Smith and Greig Craft have designed and developed an evidence based and globally appropriate helmet standard for children that ride on motorized 2-wheel vehicles, including motorcycles, e-bikes and e-scooters.

The authors believe the *Global Child Helmet Standard for 2-Wheel Motorized Vehicles* will promote the development of affordable helmets to adequately reduce the risk of traumatic brain injury. The *Global Child Helmet Standard for 2-Wheel Motorized Vehicles* is a first step that is freely available to any country or standards organization that wishes to adopt it. Improvements will continue to be made to the standard as additional scientific information becomes available.

CREDITS

The following people and organizations were responsible for the development, review and publication of this document:

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- **Greig Craft**, Co-author; President, AIP Foundation
- **FIA Foundation**, a UK registered charity
- **AIP Foundation**, a US 501(c)(3) non-profit organization
- **GHVI (Global Helmet Vaccine Initiative)**

RATIONALE FOR DEVELOPING THIS STANDARD

While many countries prohibit carrying children on motorcycles, the reality in low and middle income countries is that small children are regularly carried on the back of motorcycles as passengers. Unfortunately, no standard currently exists that specifies the minimum performance specifications for a child traveling on the back of a motorcycle or using an e-bike. This document is intended to address this need.

Current motorcycle helmet standards have been designed to confirm a minimum level of protection to the motorcycle operator and his or her passengers. All of these standards have been developed based on our understanding of the engineering requirements necessary to accurately simulate the crash environment (i.e. the test requirements) and our understanding of the biomechanical mechanisms of adult injury to establish adequate pass/fail criteria.

It is understood that the brain of a child is constantly developing and any injury during this important phase of life can have significant consequences to overall development. By the age of four, the size of a child's head is 90 percent that of an adult and by age of twelve it is 95 percent of adult size; however, it is not until the age of twenty that the bone plates of the skull fully close. During these years, children are much more likely than adults to suffer severe consequences of concussion (Arbogast, 2003). Unfortunately, performance specifications developed for adults are not completely suitable for providing a maximum level of protection for helmeted children on a motorcycle. Young children have softer skulls when compared to adults and the youngest children are anatomically unique with unfused fontanelles. A recent study of four different age specific finite element helmeted head models subjected to a variety of impact configurations has confirmed that children have a much lower tolerance to skull fracture and need a greater level of head protection when compared to an adult (Li et al., 2024).

It is well known that a child's skull is much more compliant when compared to an adult and if the child skull and brain and the motorcycle helmet are considered as a simplified spring and damper system, it is critical that the energy absorbing material found in a traditional motorcycle helmet be softer (i.e. more compliant) than the spring that simulates the stiffness of the child's skull. In order to achieve this, the pass/fail criteria for the maximum allowable peak g must be lowered in order to maximize the amount of energy that is absorbed by the motorcycle helmet and minimize the forces transmitted to the skull and brain. The proposed linear acceleration pass/fail criteria as presented in this standard are significantly lower than other motorcycle helmet standards.

HOW TO USE THIS STANDARD

The *Global Child Helmet Standard for 2-Wheel Motorized Vehicles (GCHS)* should not replace existing national motorcycle helmet standards. This standard is intended to provide a technically feasible standard that can be published either as a standalone document or integrated into an existing national motorcycle helmet standard. The tests included in this standard have all been published in other safety helmet standards.

Helmets that comply with the *Global Child Helmet Standard for 2-Wheel Motorized Vehicles* could be defined as Type 1 or Type 2 helmets without affecting those helmets that meet the current national motorcycle helmet standard. This approach would permit introduction of helmets that are specifically designed to protect the child motorcycle passenger without compromising the requirements of the country's current motorcycle helmet standard.

As noted above, there are no new tests or procedures related to this standard. The tests specified in this standard can be performed at most laboratories that currently perform motorcycle helmet testing. The equipment and procedures used in GCHS are not technically challenging and are consistent with other international motorcycle helmet standards. All helmet standards are developed to assure a minimum level of protection is provided to helmet users. All standards include a minimum extent of coverage requirement as well as performance requirements for the retention system and the energy absorbing liner. Other requirements include helmet stability and retention system durability.

The tests that are included in this standard are not inclusive of all tests that exist in other motorcycle helmet standards. However, the tests that are included will assure that all helmets meeting this standard will provide optimal protection for children while they are riding on a motorcycle or using an e-bike.

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Background

Why are helmets needed?

Road traffic crash injuries are a major public health crisis and a leading cause of death and injury around the world. Nearly 1.19 million people die each year as a result of road traffic crashes, with road traffic crashes being the leading killer of children aged 5 to 29 years (WHO, 2023). Approximately 90% of these fatalities and injuries occur in low and middle-income countries, inflicting pain and suffering on individuals, families and communities. In addition to the number of lives lost, motorcycle crashes represent a tremendous burden on the health care system and developing economies (Kudebong, 2011, Cholo, 2023, Oladeji, 2024).

In many low and middle-income countries, where motorcycles, e-bikes and bicycles are an increasingly common means of transport, users of powered two-wheeled vehicles make up 21% of those injured or killed on the roads (WHO, 2023). Motorcycle, bicycle and e-bike riders are highly vulnerable road users, as they are less visible and often share traffic space with fast-moving cars, buses and trucks. In addition, their lack of physical protection puts them at high risk of injury if they are involved in a collision.

Figure 1: Different types of powered two and three-wheelers

Motorcyclists and other powered two-and-three-wheeler riders account for approximately 18% of road traffic deaths in the African region and 48% of traffic deaths in the Southeast Asia Region (WHO, 2023). This is largely due to the fact that in low and middle-income countries, car ownership and use rates are generally much lower; as such, the use of motorcycles and other two-wheeled vehicles is typically high. For example, in Vietnam, motorcycles account for 93.0% of the country's registered motor vehicle fleet (WHO, 2023). n.

The situation is similar in many other countries in the region.

Reflecting this difference in road user typology, the levels of motorcycle rider fatalities are typically higher in low- to middle-income countries than in high-income countries (see Figure 1). The largest proportion of victims are children and young adults.

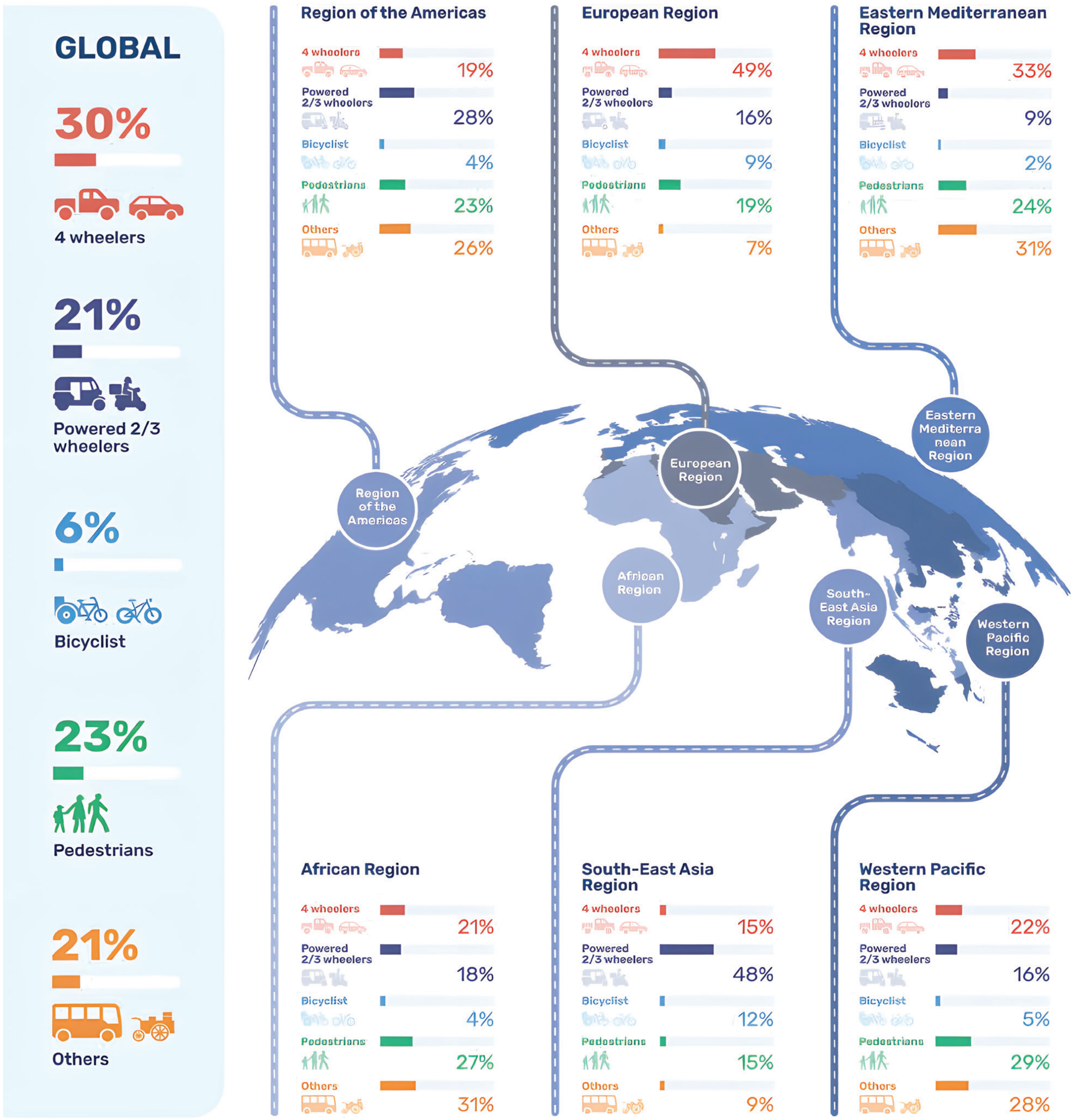

Figure 1: Percentage distribution of country-reported deaths by road user type and WHO region.
Source: WHO Global Status Report on Road Safety, 2023.

Head injuries are a leading cause of death and disability of children

Motorcycle-related head injuries are among the leading causes of disability and death of youth and children, with its main victims being motorcyclists, passengers, and pedestrians in their young and productive age group (Obanife et al., 2021). Even with the alarming number of deaths due to head injuries, the use of a certified motorcycle helmet by children continues to be extremely low in many of those countries where motorcycles make up a large percent of transportation fleet (Perumal and Gupta, 2020, Siviroj et al., 2012, Peltzer and Pengpid, 2014, Ackaah et al., 2013).

In many low and middle-income countries, head injuries are estimated to account for up to 88% of motorcycle related fatalities (Marya et al., 2016) and are the leading cause of deaths for ages 5 - 29 years old. The economic and social costs of head injuries for survivors, their families, and communities are high, in part because they frequently require specialized or long-term care (Ali et al., 2021, Hoang et al., 2008). Blincoe et al., (2002) have reported that head injuries also result in much higher medical costs than any other type of injury, as these injuries exert a high toll on a country's health care costs and its economy.

Helmet affordability

The protective effects of helmet use have been well established in many studies. Helmets have been proven to reduce the likelihood of severe injury from road traffic crashes by 69% and to reduce the likelihood of fatality by 42% (Liu et al., 2008). Mandatory helmet laws have naturally increased helmet use rates; however, helmet use rates remain low in countries that do not have such laws.

Lack of awareness and affordability contribute to low helmet-use rates. A study of the affordability of helmets in 18 countries demonstrates that in low-income countries, helmets are unaffordable for the majority of the population. For example, in low-income countries with an hourly wage of 3 USD or less, nearly 20 hours of factory work would be necessary to purchase a single motorcycle helmet (Hendrie et al., 2004). Given other more basic needs such as food, clothing, and housing, it is not surprising that helmet use remains low in these countries. The availability of an affordable and effective motorcycle helmet in low and middle-income countries would certainly improve the current road safety situation in these countries.

How a helmet works

A helmet aims to reduce the risk of serious head and brain injuries by reducing the impact of a force or collision to the head.

A helmet works in three ways:

- It prevents direct contact between the skull and the impacting object by acting as a mechanical barrier between the head and the object.
- It spreads the forces of the impact over a greater surface area so that they are not concentrated on particular areas of the skull.
- It reduces the deceleration of the skull, and hence the brain movement, by absorbing energy and managing the impact.The soft material incorporated in the helmet absorbs impact energy and therefore reduces the magnitude of the forces transmitted to the skull and brain.

This reduced force brings the head to a halt more slowly than would occur if no helmet was worn. This means that there is a significantly reduced risk of damage to the neural tissues.

These three functions are achieved by combining the properties of four basic components of the helmet (i.e., the shell, protective padding, comfort padding and retention system) that are described below (see Figure 2).

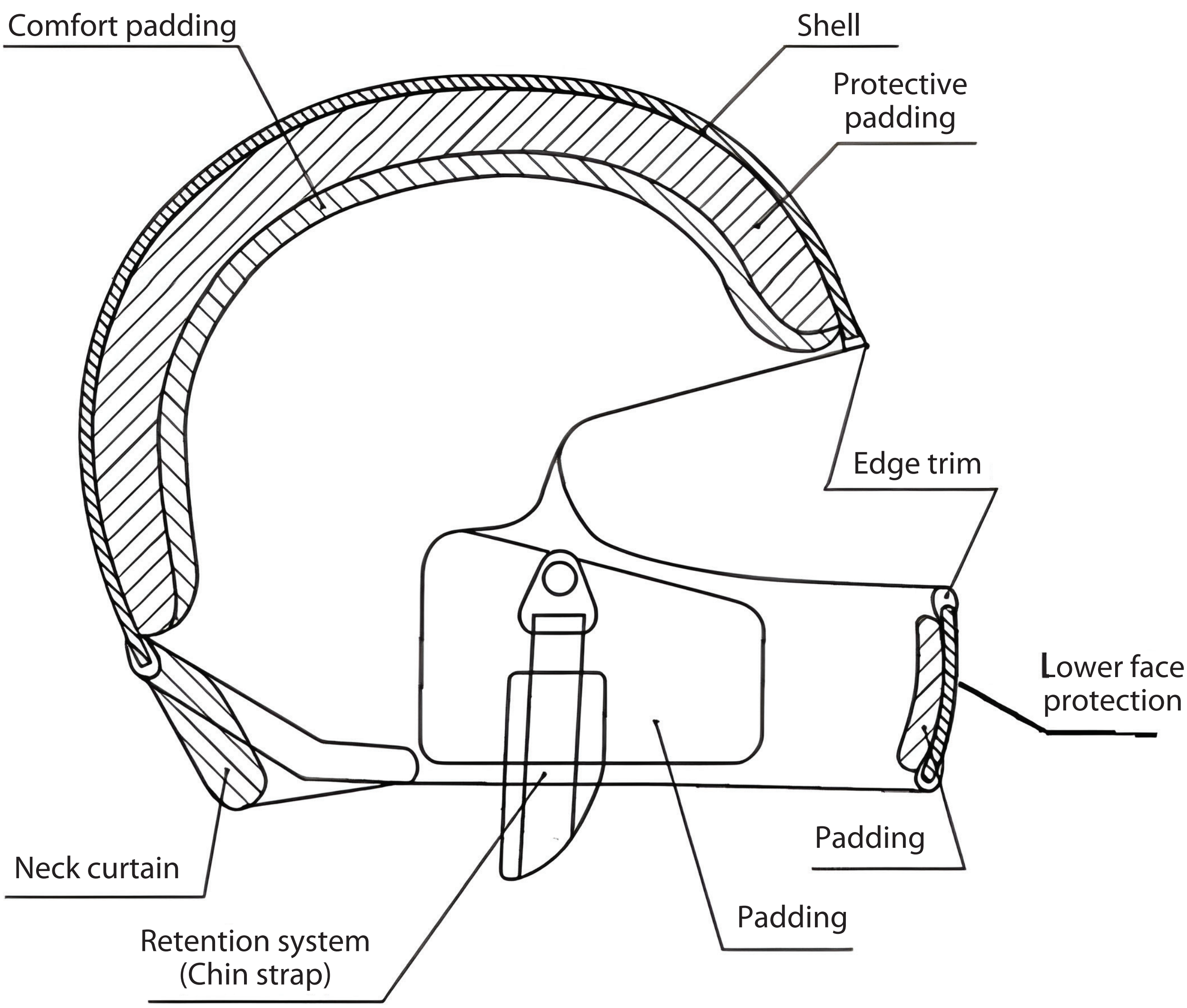

Figure 2. Helmet Components (source: UN/ECE 22.06)

The shell

This is the strong outer surface of the helmet that distributes the impact over a large surface area, and therefore reduces the local forces applied to the skull and brain. Although the shell is tough, it is designed to deform when it hits anything hard. It provides protection against direct penetration and it also protects the energy-absorbing padding inside the helmet from abrasions and knocks during daily use.

The impact-absorbing liner

This is made of a soft, crushable padded material – usually expanded polystyrene, commonly called “styrofoam”. This layer cushions and absorbs the shock by deforming and crushing as the helmeted head comes to a stop. Effective motorcycle helmets have at least 20 mm of energy-absorbing material, anything less than this, and the possibility of liner "bottoming" or complete liner crush is too great. When the liner is completely crushed, it is no longer capable of absorbing impact energy and consequently, all energy is transmitted directly to the skull and brain.

The comfort padding

This is the soft foam-and-cloth layer that sits next to the head. It is important to maintain the proper fit of the helmet, particularly during normal use on a motorcycle. The comfort padding limits helmet movement and ensures that the helmet will remain on the head in the event of an impact.

The retention system

The retention system is the primary helmet component that will keep the helmet on the head in a crash. The retention system typically consists of some type of webbing that has either a d-ring or quick release attachment system for securing the helmet to the head. Retention systems are specifically designed to keep the helmet on during an impact, consequently, it must be used properly in order for the helmet to function as designed. One of the most significant problems related to helmet wearing is proper use of the retention system. Research has found that too many riders either do not fasten the retention system while wearing the helmet or do not fasten the retention system properly (Kasantikul, 2004).

Helmet use is effective at reducing head injuries

Wearing a helmet is the single most effective way of reducing head injuries and fatalities resulting from motorcycle crashes. Motorcyclists who do not wear helmets are at a much higher risk of sustaining head injuries and from dying from these injuries. In addition, riders who do not wear helmets place additional costs on hospitals, while the disability that results from these head injuries incurs costs at an individual, family (or career) and societal level.

There is considerable research that has been conducted on the effects of wearing a helmet on the risk of a head injury as a result of a collision. The results show slightly different effects, depending on the study type, population, situation etc. Consequently it is useful to examine this research collectively – in what is known as a systematic review on the topic of interest. Systematic reviews of studies are a means of objectively examining the evidence for a particular claim (in this case, helmet use in preventing head injury) and combining the results in a way that minimizes any bias. Reviewers conducting such reviews search widely for all the studies on the topic and include those of a sufficiently high methodological quality. When the data from all the studies included in the review are summarized, the result should provide a more accurate estimate of the effect of the intervention than is possible from individual studies.
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Systematic reviews have been published examining the effectiveness of both motorcycle helmets and bicycle helmets (Liu et al., 2008 and Thompson et al., 2009). The review on motorcycle helmets included 53 studies, and summarized the current available evidence on helmets and their impact on mortality, as well as on head, face and neck injuries, following motorcycle crashes. Table 2 provides a summary of the main results of this review.

Table 2. Summary of systematic review of effectiveness of motorcycle helmets
(source: Liu et al., 2008).

<table>
<tr><th>Effect of not wearing a helmet</th><th>Effect of wearing a helmet</th></tr>
<tr><td>Increases the risk of sustaining a head injury</td><td>Decreases the risk and severity of injuries by about 72%</td></tr>
<tr><td>Increases the severity of head injuries</td><td rowspan="2">Decreases the likelihood of death by up to 39%, with the probability depending on the speed of the motorcycle involved</td></tr>
<tr><td>Increases the time spent in hospital</td></tr>
<tr><td>Increases the likelihood of dying from a head injury</td><td>Decreases the costs of health care associated with crashes</td></tr>
</table>

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02

Introduction

This is the first version of the *Global Child Helmet Standard for 2-Wheel Motorized Vehicles*. This standard was prepared by the Technical Committee and was based upon existing knowledge of the biomechanics of child head injury as well as existing motorcycle head protection standards. This helmet standard does not claim to meet the needs of all child motorcycle passengers and e-bike riders in all regions; however, research on head protection in developing countries has shown that helmets that meet this performance standard can be made at a relatively low cost and can provide significant protection against head injuries. It is the opinion of the Technical Committee that in developing countries with low income, a low cost motorcycle helmet that is acceptable and appealing to consumers represents a crucial and necessary element of any road safety campaign for powered two wheelers.

The purpose of this proposed standard is to provide a basic standard for those regions that currently have no established standard for protective helmets for children who ride as motorcycle passengers or ride on e-bikes. This edition provides a basic standard that the Technical Committee believes will meet the needs of young children on motorcycles and e-bikes. This standard does not claim to provide protection for all foreseeable impacts and cannot be considered inclusive of the special needs of each region. It is expected that each standards governing body shall make modifications to this standard to meet the needs of their region prior to approval and publication by the standards governing body of the region.

Technical Committee
May 2024

Notes:
(1) Use of the singular does not exclude the plural (and vice versa) when the sense allows.
(2) Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.
(3) This Standard is subject to regular review, and suggestions for its improvement will be discussed by the appropriate technical committee.

Requests for interpretation should:
(a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
(b) provide an explanation of circumstances surrounding the actual field condition; and
(c) be phrased where possible to permit a specific “yes” or “no” answer.

Technical Committee interpretations are processed in accordance with internationally accepted guidelines governing standardization.

Note: This represents a proposed standard and is under review and development and subject to change; it should not be used for reference purposes.

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1. Scope

GCHS specifies requirements for helmets intended to provide protection for riders and passengers of motorcycles and motorcycles with sidecars, excluding participants in competitive events. This standard identifies two categories of helmet Type 1 and Type 2. A Type 1 helmet is intended for all riders and passengers between 5 and 16 years of age. A Type 2 helmet is intended for all riders and passengers under 5 years of age. GCHS has no restrictions pertaining to any particular style of motorcycle helmet other than the requirement that all motorcycle styles (e.g. full face, jet, open face, ventilated, etc.) claiming to meet this standard must meet performance requirements specified in GCHS. GCHS defines the areas of the head that are to be protected against single impact events. It covers the basic performance requirements for shock absorption, strength and effectiveness of the retention system, as well as marking and labeling requirements. Unless otherwise specified, requirements are to be considered applicable to both Type 1 and Type 2 helmets. Requirements for visors, goggles, detachable peaks and detachable face covers are not included in GCHS.

2. Reference publications

This Standard refers to the following publications:
EN 960:2006 Headforms for use in the testing of protective helmets
ISO 6487:2015 Road vehicles – Measurement techniques in impact tests – instrumentation.

3. Definitions

The following definitions apply in this Standard:

Acceleration of a body
a (self explanatory) NOTE: acceleration measured in meters per second squared, in units of g.

Acceleration of a body due to gravity
g (self explanatory. g = 9,8 m/s2)

Basic plane of a headform
plane relative to the headform that corresponds to the basic plane of the human head.

Basic plane of the human head (Frankfort Horizontal Plane)
plane that is located at the central point of the upper margin of the external auditory meatus (porion) and the inferior margins of the orbits of the eyes (orbitale).

Central vertical axis
line relative to the headform that lies in the median plane of symmetry, and that is normal to the basic plane at a point equidistant from the front and back of the headform.

Crown
point where the central vertical axis meets the top of the headform.

Cushioning material
soft material used to ensure a comfortable fit of the helmet on the head.

Drop height
vertical distance between the lowest point (impact point) of the elevated helmet and the impact surface on a drop test apparatus.

E-bike
A bicycle equipped with an electric motor that may be activated in order to assist with or replace pedaling.

Fastening system
Those devices used to connect all components of the helmet.

Frontal plane
vertical plane that is perpendicular to the median and reference planes and passes through the crown (see Figure 1).

Helmet
device to be worn on the head intended to reduce the risk of head injury while riding on a vehicle on a roadway. The helmet shall include
a) a shock-attenuating system;
b) the retention system ;
c) manufacturer's attachments (if any)

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

Helmet positioning index (HPI)
the vertical distance measured at the median plane, from the front edge of the helmet to the basic plane, when the helmet is placed on the reference headform.

Horizontal plane
plane that passes across the body at right angles to both the frontal and median plane (See Figure 1).

Maximum value of acceleration, amax
highest point on the acceleration-time curve, encountered during impact, in units of g.

Median plane
vertical plane that passes through the headform from front to back and divides the headform into right and left halves (See Figure 1).

Outer covering (shell)
outer material that gives the helmet its form.

Permanent marking and warning
Information that remains legible and cannot be removed in its entirety under conditions of normal use.

Rear
point at the posterior intersection of the median and reference planes.

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

Retention system
system which secures the helmet firmly to the head by passing under the mandible in whole or in part when adjusted according to manufacturer's instructions.

Support assembly
The drop assembly in the monorail or twin wire drop system minus the weight of the headform, ball clamp, ball clamp bolts, and accelerometer.

Test area
the area on and above the test line where an impact site shall be located.

Test line
the line that defines the boundaries of the test area.

Peak
an attachment to the helmet intended to reduce sun glare.

Visor
A transparent protective screen extending over the eyes and covering part or all of the face.

4. General requirements

4.1 Helmet Types

Different types of protective helmets are shown in Table 1 according to their target population. Unlike many standards, there are no restrictions on the style of helmet for a given typology (e.g. full face helmets, open face helmets, etc.). The only requirement is that the product meets all the performance specifications for that helmet type.

Table 1. Types of protective helmets

Helmet Type	Intended Use
A	Applicable to child passengers of mopeds, motorcycles and e-bikes between the ages of 5 and 16 years
B	Applicable to child passengers of mopeds, motorcycles and e-bikes under the age of 5 years

4.2 Construction requirements - materials

All materials used shall be known not to be adversely affected by ordinary household soap and cleaners as recommended by the manufacturer. Paints, glues and finishes used in manufacturing shall be compatible with the materials used in the construction of the helmet. Material coming in contact with the wearer’s head shall not be of any type known to cause skin irritation or disease or 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. Adhesive material used to attach padding or straps to the helmet shall be of a formulation that will not alter the chemical or physical properties of the materials to an extent as to reduce their protective qualities.

All materials used in the fabrication of helmets shall be known to be suitable for use in the design of protective helmets. The materials shall not undergo appreciable alteration due to aging or normal use, such as exposure to sun, extremes of temperature, and rain. All materials used in the construction of the helmet shall be resistant to irreversible polymeric changes when exposed to temperatures from -10oC to 50oC.

4.2 Construction requirements - projections

A helmet shall not have any internal rigid projections more than 3mm. Rigid projections outside any helmet’s shell shall be limited to those required for operation of essential accessories and shall not protrude more than 5 mm. All parts shall be well finished and free of sharp edges and other irregularities which would present a potential hazard to the user or others.

4.3 Construction requirements - retention system

The minimum width of the retention system straps shall be 15 mm.

4.4 Construction requirements – helmet mass

The maximum allowable helmet mass for each helmet type is presented in Table 2.

Table 2. Maximum allowable helmet mass

Helmet Type	Maximum allowable mass (kg)
Type A	1.20
Type B	0.80

5 Test requirements

5.1 General

Helmets shall be capable of meeting the requirements in this Standard throughout their full range of available sizes. Each helmet shall be tested on the headform size of best fit. All testing shall be done with the visor and all accessories removed (if applicable).

5.2 Samples for testing

To test conformance to this standard, five samples of each helmet size of each helmet model offered for sale are required. One sample each shall be conditioned in each of the environments described in Clause 6.1 for 4 to 24 hours prior to testing.

5.3 Helmet coverage

Type A and Type B helmets shall cover the area of the head included in the points CDEF as shown in Figure 3.

5.4 Extent of protection

The entire area of the helmet above the test line stipulated in Clause 6.3 shall attenuate impact energy to the minimum requirements specified in Clause 5.9.

5.5 Peripheral vision

When tested in accordance with Clause 6.6 all helmets shall allow unobstructed vision through a minimum of 105o to the left and right sides of the median plane and upward and downward peripheral vision as specified in Table 9.

5.6 Penetration resistance

When tested in accordance with Clause 6.7 at ambient temperature no contact with the test headform by the test dowel shall be made within any aperture on the helmet.

5.7 Effectiveness of retention system

When tested in accordance with Clause 6.8 at ambient temperature the helmet shall remain on the test headform.

5.8 Strength of retention system

When tested in accordance with Clause 6.9 the retention system shall not detach and the maximum dynamic extension of the retention system shall not exceed 25mm for all helmet types and the residual extension shall not exceed 35mm for any helmet type.

5.9 Shock absorption

When the helmet is tested in accordance with Clause 6.10 the peak headform acceleration (amax) shall not exceed the values presented in

Table 3. Maximum allowable peak headform acceleration

Helmet Type	Maximum allowable peak headform acceleration (amax) for any shock absorption test
Type A	225g
Type B	200g

5.10 Helmet Labeling

All helmets shall have permanent labels and warnings that are in accordance with Clause 7.1.1 and 7.1.2. All helmets shall be sold with packaging that is in accordance with Clause 7.1.3 and instructions that are in accordance with Clause 7.2.

6 Test methods

6.1 Conditioning environments

Helmets shall be conditioned to one of the following environments prior to testing in accordance with the test schedule specified in Clause 6.4. All test helmets shall be stabilized within the ambient condition for 4 to 24 hours prior to further conditioning and testing.

(a) Ambient conditioning
The sample shall be exposed to a temperature of 20 ± 5˚C and a relative humidity not exceeding 75 % for 4 to 24 hours.

(b) Low temperature conditioning
The sample shall be exposed to a temperature of -10± 3˚C for 4 to 24 hours. Testing shall begin within 60 s of removal from the low temperature conditioning chamber. Complete all helmet testing within 5 minutes after removal from the conditioning environment. Helmets may be returned to the conditioning environment in order to meet this requirement. Helmets shall remain in the conditioning environment for 15 minutes for each 5 minutes that they are out of the conditioning environment.

c) Elevated temperature conditioning
The sample shall be exposed to a temperature of 50 ± 2˚C for 4 to 24 hours. Testing shall begin within 60 s of removal from the elevated temperature conditioning chamber. Complete all helmet testing within 5 minutes after removal from the conditioning environment. Helmets may be returned to the conditioning environment in order to meet this requirement. Helmets shall remain in the conditioning environment for 15 minutes for each 5 minutes that they are out of the conditioning environment.

(d) Water immersion conditioning
The sample shall be fully immersed “crown” down in potable water at a temperature of 23± 5˚C to a crown depth of 305 mm ±25 mm for 4 to 24 hours. Testing shall begin within 60 s of removal from the water immersion conditioning chamber. Complete all helmet testing within 5 minutes after removal from the conditioning environment. Helmets may be returned to the conditioning environment in order to meet this requirement. Helmets shall remain in the conditioning environment for 15 minutes for each 5 minutes that they are out of the conditioning environment.

6.2 Test headforms

A headform, capable of accepting a triaxial accelerometer or similar transducer mounted at its center of gravity and conforming to the requirements of a full size headform as defined in EN 960:2006, shall be used. Headforms used for impact testing shall be rigid and be constructed of low resonance K–1A magnesium alloy. The headform and supporting assembly shall have a total combined mass as described in Table 4, with the supporting assembly contributing to no more than 25% of the total mass.

Table 4. Test headforms

Headform label	Size Designation	Mass
AA	455 mm	1.97 kg +\- 0.075 kg
A	495mm	3.10 kg +\- 0.100 kg
C	515mm	3.60 kg +\- 0.100 kg
E	535mm	4.10 kg +\- 0.120 kg
J	575mm	4.70 kg +\- 0.140 kg
M	605mm	5.60 kg +\- 0.160 kg
O	625mm	6.10 kg +\- 0.180 kg

6.3 Test schedule

All helmet samples shall be tested according to the test schedule shown in Table 5. The sequence of testing shall be as follows:

1. Area of coverage
2. Peripheral vision test
3. Penetration resistance test
4. Effectiveness of retention system test
5. Strength of retention system test
6. Shock absorption test

Table 5. Test schedule

Sample	Area of coverage	Peripheral vision test	Penetration resistance test	Effectiveness of retention system test	Strength of retention system test	Shock absorption test
Helmet 1 – Ambient Temperature	X	X	X		X	X
Helmet 2 – Low Temperature					X	X
Helmet 3 – Elevated Temperature					X	X
Helmet 4 – Water Immersion					X	X
Helmet 5 – Ambient Temperature				X		

6.4 Marking the area of coverage

A reference headform that is firmly seated with the basic plane horizontal shall be used for reference marking. The complete helmet to be tested shall be placed on the applicable reference headform whose circumference is not greater than the internal circumference of the headband when adjusted to its largest setting, or, if no headband is provided, to the corresponding interior surface of the helmet.
The helmet shall be positioned on the reference headform and a static force of 50 N shall be applied normal to the apex of the helmet. The helmet shall be centered laterally and seated firmly on the applicable reference headform according to its helmet positioning index. If the HPI and corresponding headform size are not available from the manufacturer, the test technician shall choose the headform and HPI value.

Maintaining the force and position described above, an area of coverage line shall be drawn on the outer surface of the helmet coinciding with that on the headform as shown in.

6.5 marking the test line

A reference headform that is firmly seated with the basic plane horizontal shall be used for reference marking. The complete helmet to be tested shall be placed on the applicable reference headform whose circumference is not greater than the internal circumference of the headband when adjusted to its largest setting, or, if no headband is provided, to the corresponding interior surface of the helmet.

The helmet shall be positioned on the reference headform and a static force of 50 n shall be applied normal to the apex of the helmet. The helmet shall be centered laterally and seated firmly on the applicable reference headform according to its helmet positioning index. If the hpi and corresponding headform size are not available from the manufacturer, the test technician shall choose the headform and hpi value.

Maintaining the force and position described above, a test line shall be drawn on the outer surface of the helmet coinciding with that on the headform as shown in figure 2.

6.6 peripheral vision test

Position the helmet on a reference headform in accordance with the hpi and place a 50n preload ballast on top of the helmet to set the comfort or fit padding. (Note: peripheral vision clearance may be determined when the helmet is positioned for marking the test lines). Peripheral vision is measured horizontally from each side of the median plane around the point k (see figure 3). Point k is located on the front surface of the reference headform at the intersection of the basic and median planes. The vision shall not be obstructed within 105 degrees from point k on each side of the median plane. Measurement may be performed with a physical measuring device (i.e. peripheral vision template or a test headform with point k clearly marked) or with laser measurement equipment.

6.7 penetration resistance test

6.7.1 apparatus

The apparatus for the penetration test shall include a full size reference headform that meets the requirements of en960:2006 and a metal dowel as shown in figure 5.

6.7.2 procedure

Position the helmet on the appropriate size reference headform in accordance with the hpi and place a 50n preload ballast on top of the helmet to set the comfort or fit padding. Using the metal test dowel, attempt to make contact with the headform by trying to enter any part of the metal dowel end through all of the openings of the helmet. Record the location of any metal dowel to headform contact.

6.8 effectiveness of retention system test

6.8.1 apparatus

The apparatus for the retention system effectiveness test shall consist of a drop weight with a mass of 10.0 ± 0.1 kg and a guidance system with a total mass of 3.0 ± 0.1 kg that will allow the drop weight to drop in a guided free fall. A flexible strap and hook attached to the guiding system running over a pulley with a diameter of 100 ± 5 mm. The extension of the strap shall be less than 18 mm/m under a load of 1000 n ± 5 n. The system shall also include an appropriate full size reference headform that meets the requirements of en960:2006 and a base to hold the test headform stationary while testing.

6.8.2 Procedure

Secure the appropriate full size reference headform to a fixture that will prevent headform movement when a tangential force is applied to the helmet. Position the helmet on the headform in accordance with the manufacturer's instructions. A flexible strap and hook mechanism shall be attached to the front lower edge of the helmet such that it is in line with the mid-sagittal plane. The total mass of the falling weight guide apparatus shall be 3 ± 0.1 kg and shall be able to accommodate drop heights up to 60 cm. A 10 ± 0.1 kg drop weight shall then be raised to the appropriate height designated in Table 6 and released.

Table 6. Effectiveness of retention system test drop heights

Helmet Type	Drop height of falling weight (mm)
A	500 mm ± 10 mm
B	500 mm ± 10 mm

6.9 Retention system strength

6.9.1 Apparatus

The retention system strength test device consists of a means to hold the test headform and headform stationary, and a loading device comprising a guide, an arrest device and a drop weight. The mass of the entire apparatus, excluding the drop weight, shall be 5 ± 0.5 kg.
The test apparatus shall be fitted with a transducer capable of measuring both dynamic and residual extension of the retention system. The retention system test device shall allow the retention assembly to be fastened around two freely moving rollers, both of which have a 12.5 ± 0.5 mm diameter and a 75 ± 1.0 mm center-to-center separation, and which are mounted on the upper portion of the test apparatus (see Figure 6).

6.9.2 Procedure

Place the subject helmet on the test headform and fasten the chin strap under the rollers such that the entire test apparatus hangs freely on the retention system. Place a preload ballast of 5 ± 0.5 kg on the helmet. Raise the drop weight to the appropriate drop height (see Table 7) and allow it to fall and impact the end stop.
During the test, measure the dynamic extension of the retention system. After 120 +20 – 0 seconds, measure the residual extension with the drop weight still on the end stop.

Table 7. Retention system strength test drop weight and drop heights

Helmet Type	Drop weight (kg)	Drop height of falling weight (mm)
A	4 ± 0.2 kg	600 ± 5 mm
B	4 ± 0.2 kg	600 ± 5 mm

6.10 Shock absorption test

6.10.1 Apparatus

The test apparatus for the shock absorption test shall consist of the following:
(a) The full size headform employed in this test shall conform to all requirements under Clause 6.2.

(b) The test headform shall be placed on a guided freefall system as shown in Figure 9 with a mounting for the helmeted headform to permit impacts to be delivered to any location on the helmet at or above the test line.

(c) A triaxial accelerometer shall be placed at the center of gravity of the test head-form and the accelerometer shall have a maximum mass of 50 grams and be capable of withstanding a maximum acceleration of 2000 g without damage and shall have a frequency response in accordance with channel frequency class (CFC) 1000 of ISO 6487.

(d) The flat anvil shall be made of steel or another similar rigid metal and shall be firmly attached to the base of the drop assembly. The impact face shall have a minimum diameter of 150 mm.

(e) The hemispherical anvil shall be made of steel or another similar rigid metal and shall be firmly attached to the base of the drop assembly. The hemispherical anvil shall have a hemispherical impact surface with a radius of 48 ± 1 mm.

(f) The kerbstone anvil shall be made of steel or another similar rigid metal and shall be firmly attached to the base of the drop assembly. The kerbstone anvil shall have two sides forming an angle of 105o ± 5o, each of them with a slope of 52.5o ± 2.5o towards the vertical and meeting along a striking edge with a radius of 15mm ± 0.5mm. The height of the anvil must be at least 50mm and the length must be at least 125mm. The anvil may be oriented at any angle with no part of the striking edge extending below the test line described in Error! Reference source not found..

(g) The rigid mount for the anvils shall consist of a solid mass of at least 135 kg, the upper surface of which shall consist of a steel plate with a minimum thickness of 12 mm and minimum surface area of 0.1 m2.

(h) The data acquisition system shall be capable of collecting impact data at a rate of not less than 10 kHz per channel. The acceleration data channel and filtering shall comply with channel frequency class (CFC) 1000 of ISO 6487. The data acquisition system shall include equipment to record the velocity of the helmeted headform during the last 40mm of free fall prior to impact.

6.10.2 System verification

The testing lab shall maintain sufficient records to show that the shock absorption test system performs in a consistent and repeatable manner. This may be accomplished by performing regular controlled headform impacts onto a modular elastomer programmer (MEP) anvil.
The components of the data acquisition system, including all transducers, shall be calibrated to traceable national reference standards at an interval of not greater than five years.

6.10.3 Helmet impact test locations

Each helmet shall be tested at four impact locations on or above the test line described in 6.5 using the test method described in 6.10.4 . Each impact location shall be a distance of at least one-fifth of the circumference of the test headform from any prior impact location on that helmet. The distribution of test anvils and impact velocities for each helmet type is shown in Table 8.

Table 8. Shock absorption test anvils and velocities by helmet type

Helmet Type	Anvil type and impact velocity	Anvil type and impact velocity	Anvil type and impact velocity	Anvil type and impact velocity
A	Flat 6.0 (+0.15, -0.0) m/s	Flat 6.0 (+0.15, -0.0) m/s	Hemispherical 5.0 (+0.15, -0.0) m/s	Kerbstone 5.0 (+0.15, -0.0) m/s
B	Flat 6.0 (+0.15, -0.0) m/s	Flat 6.0 (+0.15, -0.0) m/s	Hemispherical 5.0 (+0.15, -0.0) m/s	Kerbstone 5.0 (+0.15, -0.0) m/s

6.10.4 Test method

6.10.4.1
The helmet shall be removed from its conditioning environment and placed on the appropriate headform according to the manufacturer’s helmet positioning index (HPI). The helmeted headform shall be oriented such that the designated impact location is positioned vertically above the center of the test anvil.
Once the helmeted headform has been properly oriented, it shall be raised to a drop height sufficient to achieve the target velocity for that particular test configuration.
The order of shock absorption testing with respect to anvil types and the test impact locations shall be at the discretion of the testing laboratory with the intent of testing those locations within the test area that are perceived as weak (e.g. reduced thickness of energy absorbing material, ventilation features, etc.).
The first impact shall be made not more than 60 s after the helmet has been removed from the conditioning environment. Following testing, the helmet shall be immediately returned to its conditioning environment for a minimum of 15 min before another impact test is conducted.

7 Helmet Labeling, Warnings and Instructions

7.1 Helmet labeling

Every helmet shall have indelibly printed on it or otherwise permanently affixed to it, the following information, clearly and prominently displayed in no less than 8 point font:
(a) the name manufacturer;
(b) website address of the manufacturer or other contact information;
(c) the model name or model number of the product;
(d) the size or size range of the circumference of the helmet, quoted as the circumference (in centimeters) of the head which the helmet is intended to fit; and
(e) the week, year of manufacture of the product
(f) the number of the standard specification which the manufacturer certifies that it meets, including the two digit version year appended to the number.

7.2 Helmet warnings

Every product shall have indelibly printed on it or otherwise permanently affixed to it the following information statements, clearly and prominently displayed:
(a) Words to the following effect: For adequate protection this helmet must fit closely. Purchasers are advised to secure the helmet and to ensure that it cannot be pulled or rolled off the head.
(b) Words to the following effect: This helmet is made to absorb some of the energy of a blow by partial destruction of its component parts and, even though damage may not be apparent, any helmet which has suffered an impact to the head in an accident or received a similar severe blow or other abuse should be replaced.
(c) Words to the following effect: To maintain the full efficiency of this helmet there must be no alteration to the structure of the helmet or its component parts.
(d) For helmets fitted with a single chin strap, words to the following effect: The chin strap must pass underneath the jaw to maintain tension all the time the helmet is in use. The law requires that the helmet be securely fastened to the head.
(e) Words to the following effect: The protection given by this helmet may be severely reduced by the application of paint, adhesive stickers and transfers, cleaning fluids and other solvents. Use only materials recommended by the helmet manufacturer.

7.3 Helmet packaging

The packaging in which the helmet is sold or is to be sold shall have indelibly printed on it or otherwise permanently affixed to it, clearly and prominently displayed, the information required by Clause 7.1.

7.4 Instructions to the user

Every product shall bear or be accompanied by legible written instructions that clearly state the following information, with line drawings or photographs illustrating the sequence of steps where needed:
(a) how the product is to be fitted and adjusted properly;
(b) how the product is to be assembled, if applicable
(c) how the product should be inspected for deficiencies;
(d) how the product is to be maintained, cleaned and dried; and
(e) how the product is to be stored.
(f) If a visor is included with the helmet, information shall be included stating that the visor has not undergone testing to this Standard.

8 Test Report

The test report shall include at least the following information:

(a) the number and year of publication of this Standard;
(b) the name or trademark of the manufacturer or the body taking responsibility for manufacture;
(c) identification details of the head protector tested including range of sizes offered for sale;
(d) photographs of the front and side of the helmet; a test line should be drawn on the helmet in the photograph.
(e) results of tests in accordance with Clause 6, including information to clearly identify the impact test locations for each helmet tested;
(f) any evidence that shows correspondence with requirements in clause 5 and 6;
(g) date of testing;
(h) name of technician who performed the testing and if applicable, the laboratory manager or supervisor;
(i) name and address of testing laboratory, and;
(j) any internationally recognized accreditation of the testing laboratory (e.g. ISO 17025).

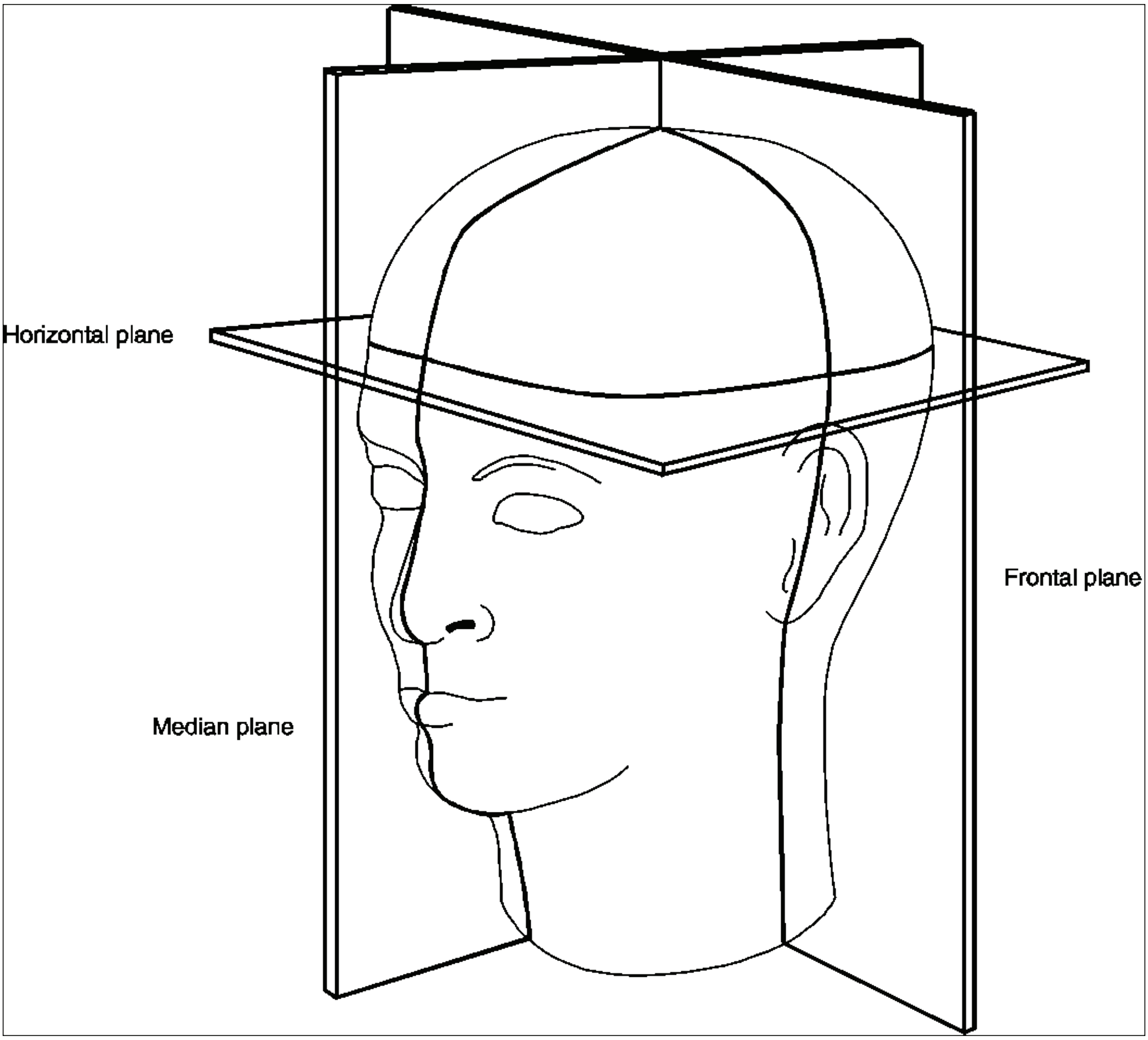


Figure 1. Orientation planes

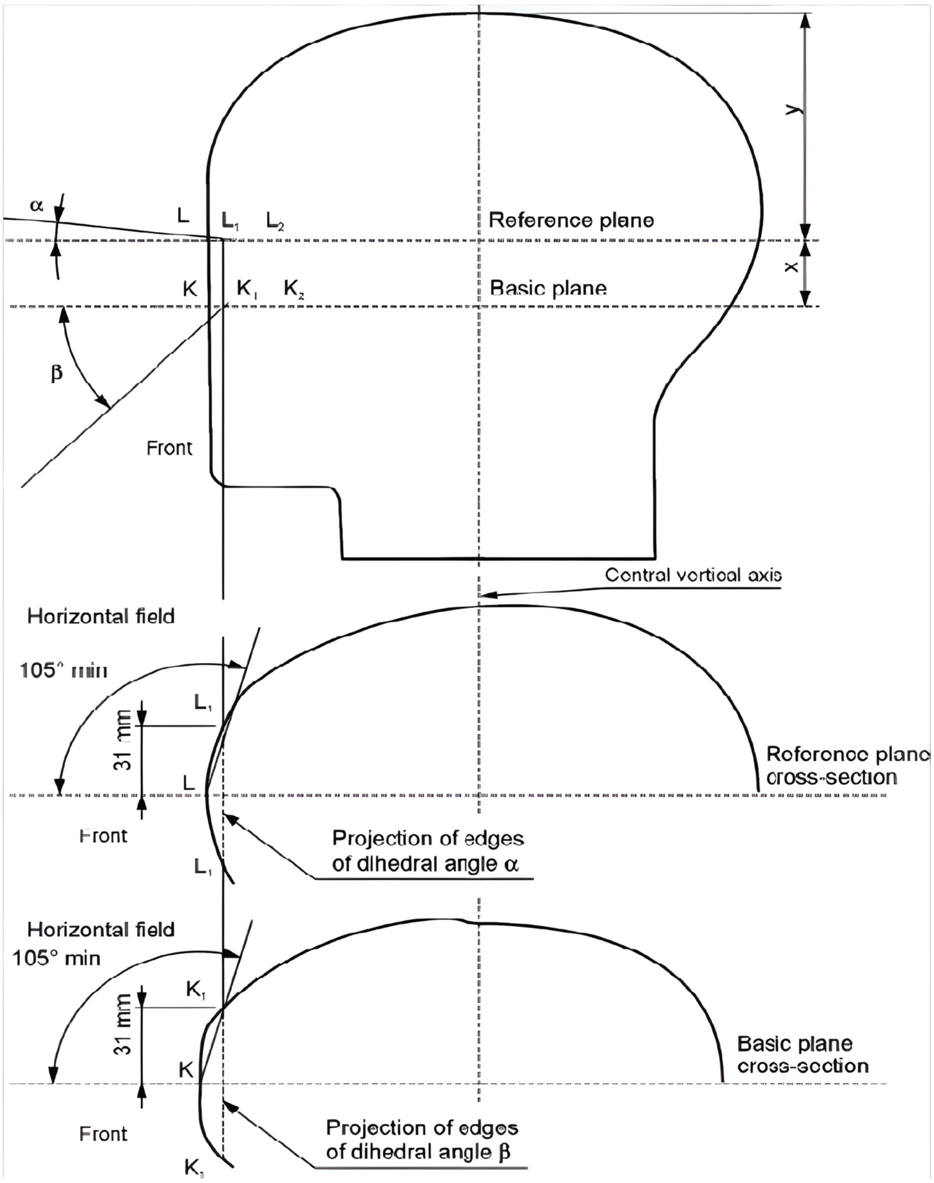


Figure 2. Peripheral vision measurements

Table 9. Peripheral vision requirements

Helmet Type	Alpha (α)	Beta (β)
A	≥ 7º	≥ 45º
B	≥ 7º	≥ 45º

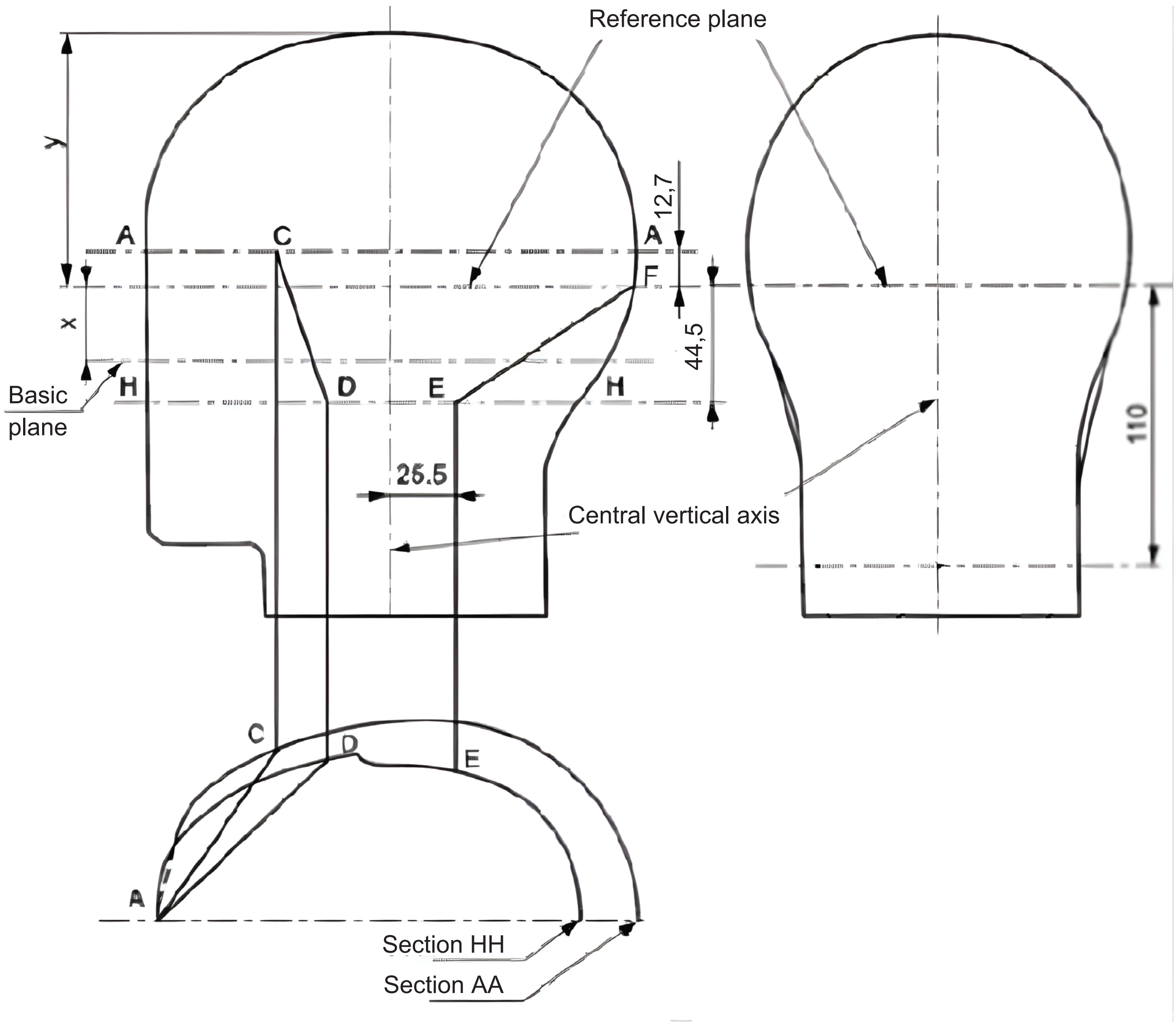


Table 10. Test headform dimensions (mm)

Headform	Size	X	Y	AC	HD
AA	455	21.5	83.3	73	81
A	495	23.5	89.7	80	88
C	515t	24.5	92.7	82	90
E	535	25.5	96.0	84	92
J	575	27.5	102.4	87	95
M	605	29.0	107.2	90	98
O	625	30.0	110.2	92	100

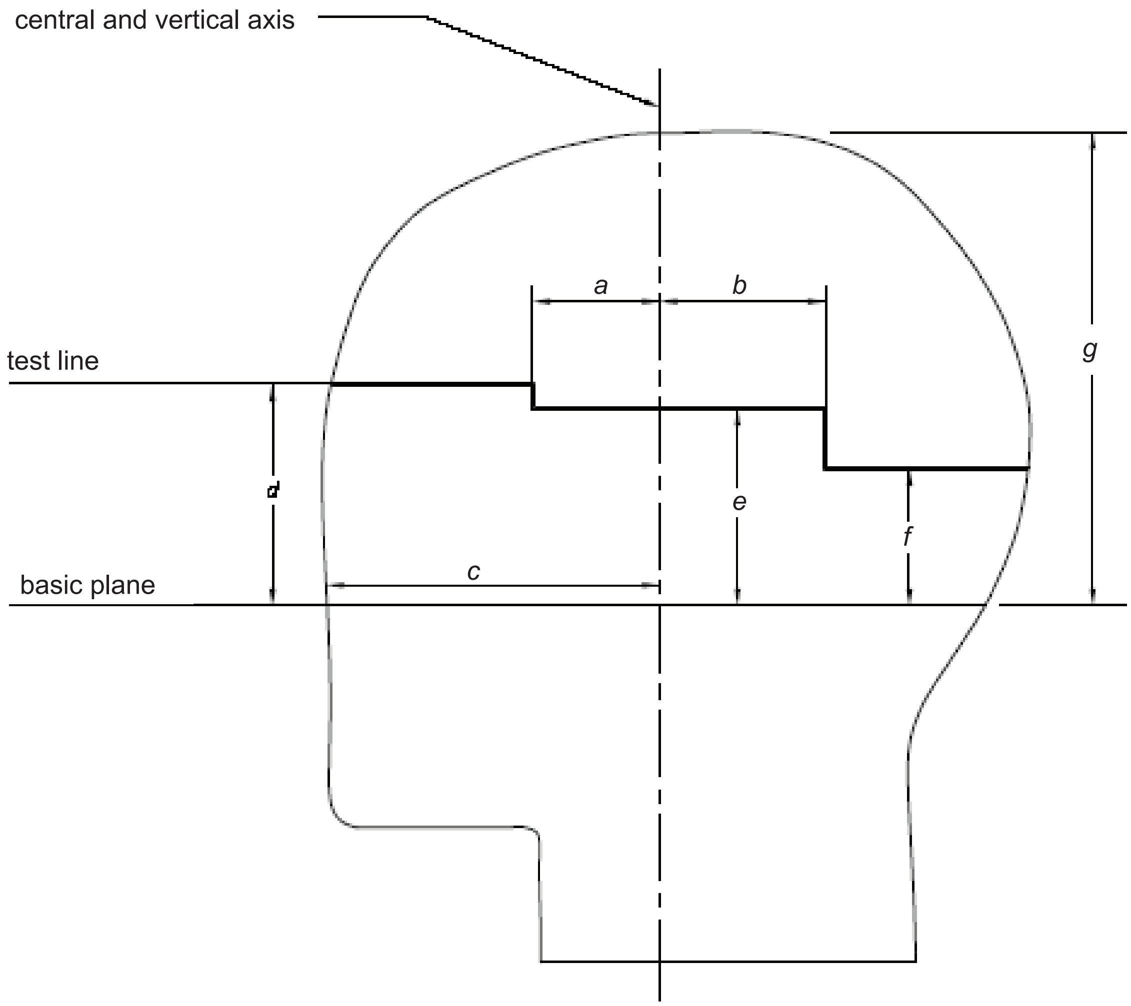


Table 11. Dimensions of test line for helmet types A and B to be used with Figure 4

Headform Label	Dimensions (mm)						
	a	b	c	d	e	f	g
AA (455 mm)	20	28	79	49	39	9	103
A (495 mm)	23	31	88	54	36	10	113
C (515 mm)	27	32	91	56	38	10	117
E (535 mm)	30	52	95	58	39	11	122
J (575 mm)	36	54	101	61	41	12	130
M (605 mm)	41	55	106	64	43	12	136
O (625 mm)	44	56	109	68	45	12	140

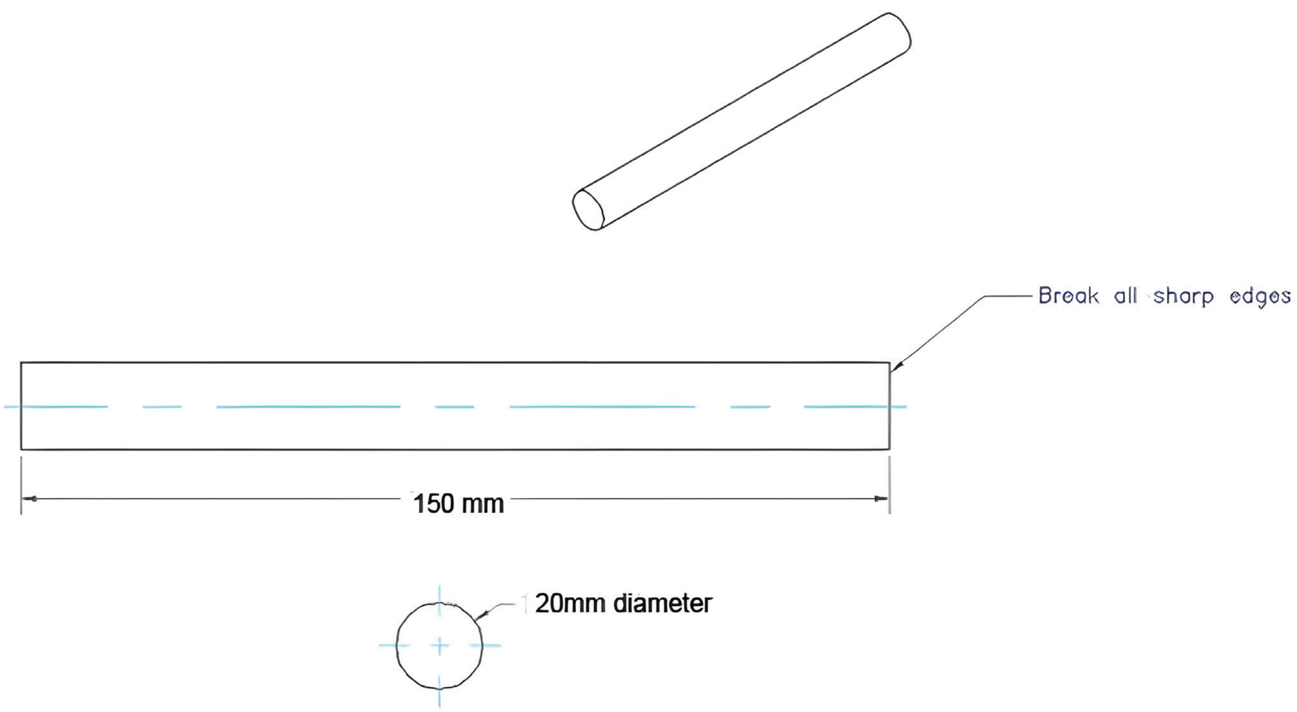


Figure 5. Metal dowel for penetration test

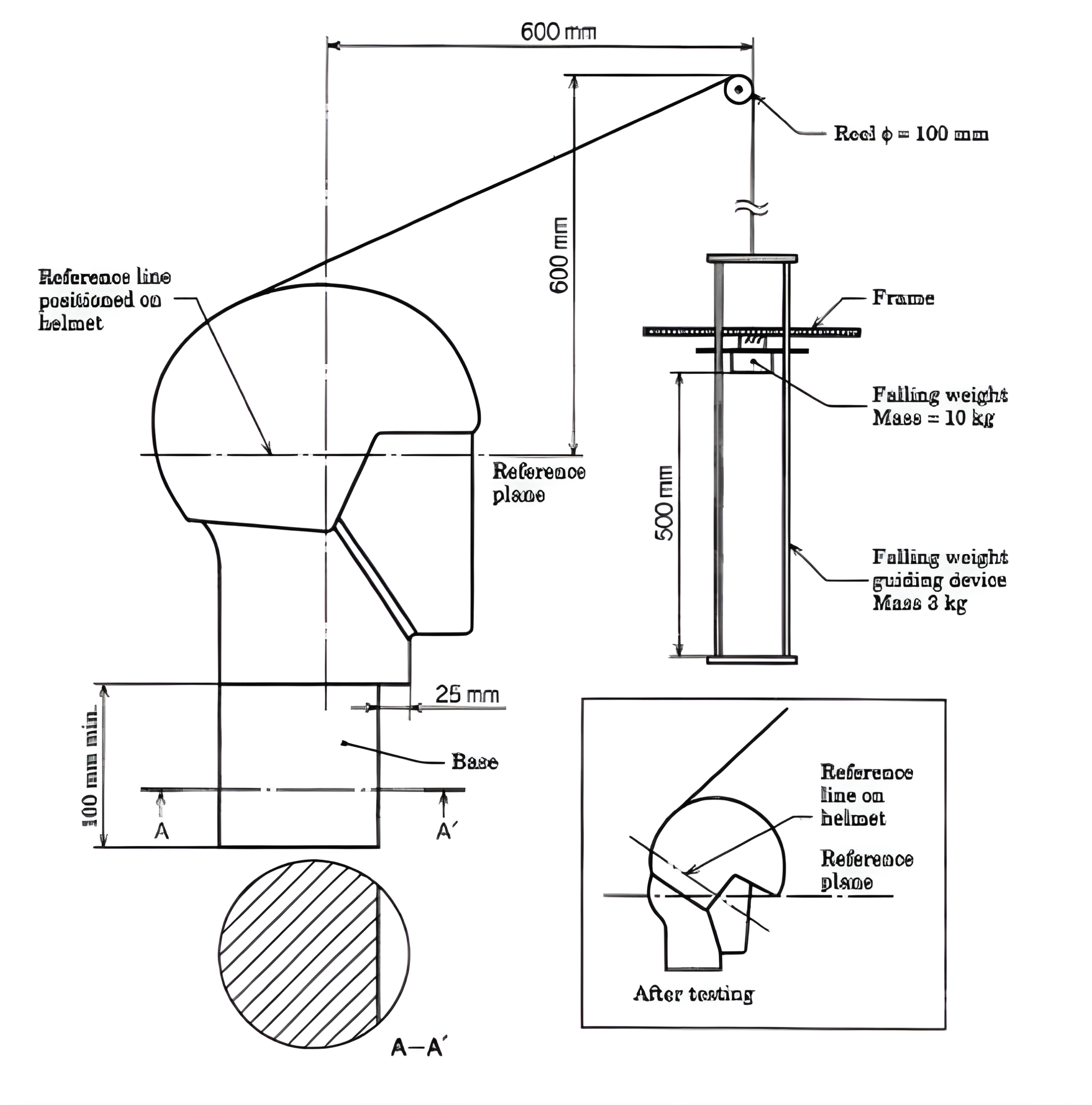
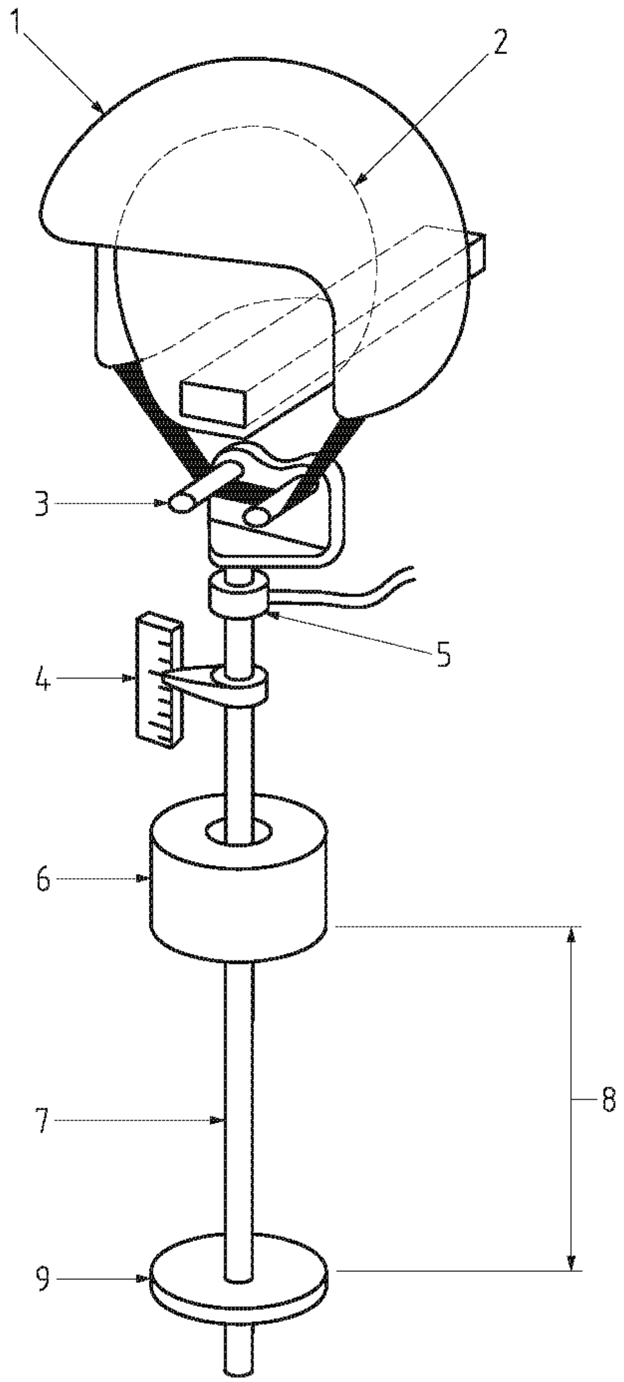


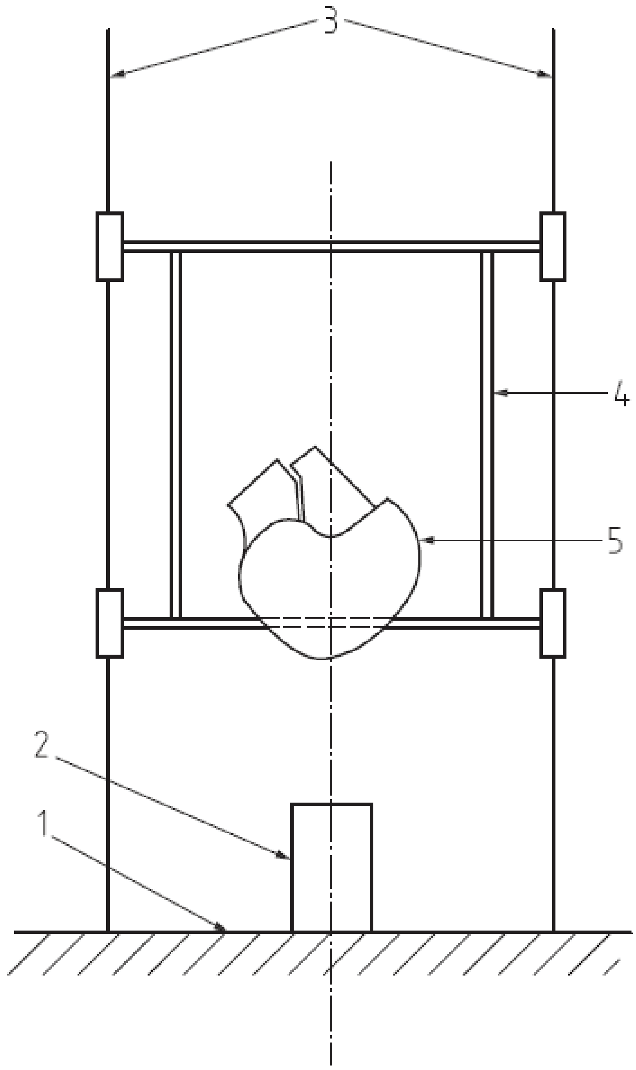
Figure 6. Typical apparatus for retention system effectiveness testing



Key

1 helmet
2 headform
3 chin strap stirrup
4 extension measuring device
5 load cell (optional)
6 drop weight: 10 kg ± 0,2 kg for Type 1
4 kg ± 0,2 kg for Types 2, 3, 4 and 5
7 guide bar
8 drop height: 750mm ± 5 mm for Type 1
600 mm ± 5 mm for Types 2, 3, 4 and 5
9 stop anvil

Figure 7. Typical apparatus for retention system strength testing



Key

1 base
2 anvil
3 guides
4 support dolly
5 headform with helmet

Figure 8. Typical drop assembly for shock absorption testing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