Transmitted by the expert from experts from FIA Foundation, Asia Injury Prevention Foundation and Global Road Safety Partnership	Informal document No. **GRSP-48-21** (48th GRSP, 7 - 10 December 2010, agenda item 12)

FIA Foundation/GHVI Proposal

Objective of the Proposal

Currently, ECE R.22 is part of the 1958 Agreement concerning the Technical Prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and is currently available for regulatory and consumer information purposes. Research has shown that helmets that are in compliance with ECE R.22 or another national motorcycle helmet standard provides excellent protection and significantly reduces the risk and severity of a head injury. At present there is no published epidemiological data that shows that helmets qualified to any given national motorcycle helmet standard provides superior head protection relative to another national motorcycle helmet standard. However, there is overwhelming research that indicates that the difference in injury outcome between an unhelmeted head impact in a motorcycle crash and a helmeted head impact in a motorcycle crash is significant. The scientific research is clear that the use of a motorcycle helmet provides significant protection against skull and brain injury (Liu et al., 2008).

The immediate implementation and adoption of ECE R.22 would appear to be an obvious solution for any country which does not have an existing motorcycle helmet standard. Unfortunately, implementation of the ECE R.22 regulations requires a significant capital investment in equipment and a high level of technical expertise. This presents a significant challenge both financially and technically to many developing countries.

At present, the performance requirements of the ECE R.22-05 standard as well as all earlier amendments and revisions dating back to ECE R.22-02 published in March 1982 can only be fulfilled by a full face or open face style helmet with a minimum of 25 to 30 mm of energy absorbing material. This type of helmet is not well accepted in tropical climates and as a consequence, helmet usage rates remain very low in those regions where ECE R.22 has been implemented (e.g. Republic of the Philippines).

In a developing country, the cost for an ECE R.22 qualified helmet would be a minimum of approximately $40 USD. A safety investment of this amount in regions where the hourly wage is $3 USD or less is highly unlikely. Instead, the motorcycle rider is more likely to buy a lower cost counterfeit helmet that falsely claims to have ECE R.22 compliance. Such helmets typically have little or no energy absorbing liner and are generally made with very poor materials. These helmets provide little or no protection to the wearer in the event of an accident. The presence of such counterfeit helmets compromises the integrity of ECE R.22 as well as the manufacturers who develop helmets that are in compliance with this regulation.

The supporting members of the FIA Foundation/GHVI consortium propose the creation of an informal working group for the development a standard for light weight protective helmets for motorcycle users. The first task of this informal group would be to consider a methodology for the development of such a standard that is consistent with the harmonization objectives and existing framework of WP29 and GRSP. This lightweight protective helmet standard would not be intended to replace the existing ECE R.22 motorcycle helmet standard.

The desired objective of this effort is to provide a technically feasible standard that can be implemented in those regions that currently do not have an existing motorcycle helmet standard and do not currently possess the technical expertise to develop their own motorcycle helmet standard and motorcycle helmet standard test procedures. Such a standard could represent the first step towards future harmonization with ECE R.22.

FIA Foundation and GHVI have currently developed a draft standard for this purpose. This draft standard builds upon the knowledge base developed by those countries and regions that currently have motorcycle helmet standards, including countries that currently require ECE R.22. The tests included in this standard have all been published in other safety helmet standards. There are no new tests or procedures related to this standard. The tests that are included in this draft GHVI standard are not inclusive of all tests that exist in other motorcycle helmet standards. However, the tests that are included in this standard will assure that helmets meeting this specification will provide excellent head protection for all motorcycle riders. The equipment and procedures used in the draft GHVI standard are not technically challenging and are consistent with other international motorcycle helmet standards. Therefore this standard represents an adequate initial standard that will allow for future harmonization with ECE R.22.

It would be the task of this informal working group to review the draft standard and complete the tasks necessary for such a regulation to be incorporated into existing or new regulations as needed.

Background and Rationale for the Standard

Road accident research has found that in most high-income countries, motorcycle fatalities typically comprise around 5% to 18% of overall traffic fatalities (Koornstra et al., 2002 and Mohan, D., 2002). This proportion reflects the combined effect of several important factors including the relatively low ownership and use of motorcycles in many developed countries, and the relatively high risk of these motorcycles being involved in crashes involving fatalities. Research in the USA has found that these risks are much higher for motorcycle than for vehicle travel (NHTSA, 2004).

In low-income and middle-income countries, car ownership and use rates are generally much lower than in high-income countries. However, the ownership and use of motorcycles and other two-wheelers is generally relatively high. For example, Mohan (2002) has reported that in India 69% of the total number of motor vehicles are motorized two-wheelers, considerably higher than in high-income countries. Reflecting this difference, the levels of motorcycle rider fatalities as a proportion of those injured on the roads are typically higher in low-income and middle-income countries than in high-income countries (Figure 1). For instance, 27% of road deaths in India are among users of motorized two-wheelers, while this figure is between 70–90% in Thailand, and about 60% in Malaysia (Mohan, 2002, Suriyawongpaisal and Kanchanusut, 2003, Umar, 2002). In China, Zhang et al. (2004) has reported that motorcycle ownership between 1987 and 2001 grew rapidly from 23% to 63%, with a corresponding increase in the proportion of traffic fatalities sustained by motorcyclists rising from 7.5% to 19% over the same period. However, in other low-income and middle-income countries, a lack of high quality road safety data means that precise levels of motorcycle rider fatalities are still not known.

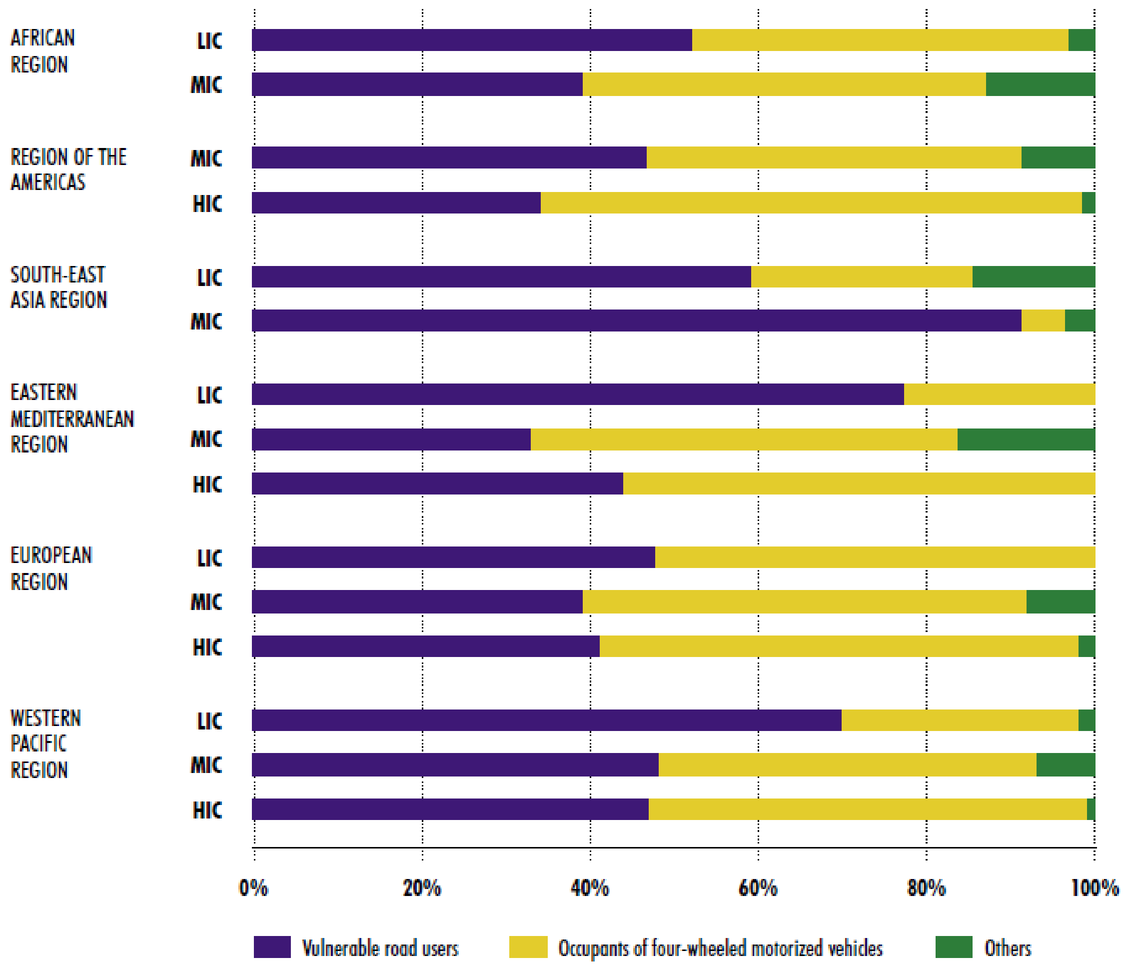

Figure 1: Distribution of injuries across regions according to low income country (LIC), middle income country (MIC) and high income country (HIC). Source: WHO Global Status Report on Road Safety, 2009.

Injuries to the head and neck are the main cause of death, severe injury and disability among users of motorcycles and bicycles. In European countries, an investigation into the effectiveness of motorcycle helmets found that head injuries contribute to around 75% of deaths among motorized two-wheeler users (European Commission COST 327 Final Report, 2001); in some low-income and middle-income countries head injuries are estimated to account for up to 88% of such fatalities (Umar, 2002). The social costs of head injuries for survivors, their families and communities are high, in part because they frequently require specialized or long term care. Blincoe et al. (2002) have reported that head injuries also result in much higher medical costs than any other type of injury, such that these injuries exert a high toll on a country's health care costs and its economy.

Globally, there is an upward trend in the number and use of motorcycles and bicycles, both for transport and recreational purposes. Indeed, most of the growth in the number of vehicles on the world's roads comes from an increasing use of motorized two-wheelers. Asian countries, in particular, are expected to experience a considerable rise in the number of motorized two-wheeler vehicles on their roads. This rapid growth in the use of motorcycles in many low income and middle-income countries is already being accompanied by a considerable increase in the number of head injuries and fatalities that will only continue to increase if present trends continue unchecked.

Helmets have been proven as an effective safety device for the reduction of the severity of head injury. Mandatory helmet laws have naturally increased helmet wearing rates; however, in many countries that do not have mandatory helmet laws, helmet use rates continue to remain low. The lack of public awareness of the benefits certainly contributes to this lack of helmet wearing; however, recent research has shown that helmet affordability also plays a role in limiting helmet wearing. In lower and middle income countries, the hourly wages tend to be lower than high income countries and consequently the buying power of individuals in those countries is significantly reduced. Hendrie et al. (2004) investigated the affordability of a variety of different safety devices in 18 countries. His research compared the cost of these safety devices to the hourly wage earned by factory workers in the respective country. The results of this analysis are presented in Table 1. The results clearly show that for low income countries, some safety devices are simply unaffordable for the vast majority of the population. Typical motorcycle helmet costs are at least two times the cost of a bicycle helmet, suggesting that in lower income countries with an hourly wage of $3 USD or less, nearly 20 hours of factory work would be necessary to purchase a motorcycle helmet. Given other more basic needs such as food, clothing and housing, it is not surprising that helmet affordability also contributes to the lack of helmet wearing in low and middle income countries. The availability of an affordable and effective motorcycle helmet in low and middle income countries would most definitely improve the current road safety situation in these countries.

		Factory hours of work needed to pay for safety devices			
	Hourly wage	Car seat	Booster seat	Bicycle helmet	Smoke alarm
Wage <$3.00/hour					
Albania	$.59	82.9	N/A	20.3	21.7
China	2.26	53.1	277.4	3.7	74.5
Philippines	1.90	46.2	10.0	6.0	14.9
Thailand	0.65	122.4	146.9	4.9	N/A
Venezuela	1.48	57.6	N/A	9.1	N/A
Vietnam	0.98	111.6	101.2	15.2	54.3
Group mean	1.31	79.0	133.9	9.9	41.4
Wage $3.00–$9.99/hour					
Brazil	7.21	12.5	27.7	4.9	N/A
New Zealand	8.13	10.8	3.4	0.6	1.1
South Africa	5.64	6.5	3.4	1.5	1.9
South Korea	8.13	12.3	6.2	1.2	N/A
Group mean	7.28	10.5	10.2	2.0	1.5
Wage >$10.00/hour					
Australia	14.15	5.3	2.3	1.0	0.3
Austria	19.46	7.2	0.6	0.4	1.1
Canada	10.16	5.6	1.5	1.2	1.0
Germany	22.99	3.0	0.9	0.7	0.6
Israel	12.88	5.4	1.6	0.8	1.3
Japan	22.00	7.2	0.8	1.5	2.3
United Kingdom	15.88	3.8	1.8	1.0	0.4
United States	19.86	2.5	1.0	0.5	0.3
Group mean	16.04	5.0	1.3	0.9	0.9
Overall mean		30.9	36.7	4.1	12.6

Table 1: Factory hours of work needed to pay for safety devices (source: Hendrie et al., 2004)

Benefits

The establishment of a national motorcycle helmet standard is the first step towards improving helmet compliance and helmet usage rates in developing countries. Implementation of a standard that promotes the manufacture and sale of protective helmets that are accepted by the consumer will significantly reduce the frequency and severity of motorcycle related head injuries. This will consequently result in a significant reduction of the societal costs due to road traffic injuries in these developing countries.

In addition to the benefits gained from assisting developing countries with establishment of their own national motorcycle helmet standard, implementation of this standard will assist these countries with future harmonization with ECE R.22

Next Steps & Timelines

The FIA Foundation/ GHVI draft standard has been finalized by a group of technical experts within FIA Foundation and GHVI and is currently available for review by the informal working group (see Attachment 1). It is recommend that the informal working group provide progress reports to GRSP and necessary updates to WP.29 to ensure the effort is making progress at the necessary pace.

Summary

The development of a standard for lightweight protective helmets for motorcycle riders will significantly improve the road safety situation in developing countries. Governments will have an immediate regulation that will allow them to better control and monitor the quality of the protective helmets that are currently being sold in their country. Qualified helmet manufacturers will benefit from a reduction in the number of counterfeit low-cost products that illegally claim to be in compliance with a recognized standard. Finally, consumers will benefit by having low cost, comfortable head protection that will provide them with excellent protection against head injury.

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ATTACHMENT 1 – GHVI Draft Standard

The GHVI Draft Standard

Version 1.1 14 November 2010

DRAFT SPECIFICATION FOR PROTECTIVE HELMETS FOR MOTORCYLISTS

Preface

This is the first draft of the Global Helmet Vaccine Initiative Draft Standard for Head Protection for Motorcycle Users. This Draft Standard was prepared by the Global Helmet Vaccine Technical Committee and is based upon existing motorcycle head protection standards. This helmet standard does not claim to meet the needs of all motorcycle riders and passengers 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[1]. It is the opinion of The Global Helmet Vaccine Initiative 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 draft standard is to provide a basic standard for those regions that currently have no established standard for protective helmets for motorcycle riders and passengers. 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.

GHVI Technical Committee
30 August 2010

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 GHVI technical committee.*

(5) *All enquiries regarding this Standard, including requests for interpretation, should be addressed to the Global Helmet Vaccine Initative (address).*

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.

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[1] Passmore, JT, Tu, NT, Luong, MA, Chinh, ND, Nam, NP, “Impact of mandatory motorcycle helmet wearing legislation on head injuries in Viet Nam: results of a preliminary analysis”, Traffic Injury Prevention, 11(2):202-206, 2010.

Technical Committee interpretations are processed in accordance with internationally accepted guidelines governing standardization and updated versions of this draft standard are available on the GHVI website at www.ghvi.org.

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

1 Scope

This Standard specifies requirements for helmets intended to provide protection for riders and passengers of motorcycles and motorcycles with side cars excluding participants in competitive events. This standard 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, etc.) claiming to meet this standard must meet performance requirements specified in this standard. The standard defines the areas of the head that are to be protected for single impact injuries. It covers the basic performance requirements for shock absorption, strength and effectiveness of the retention system as well as marking and labeling requirements. Requirements for visors, goggles, detachable peaks and detachable face covers are not included in this Standard.

2 Reference publications:

This Standard refers to the following publications:

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

SAE† Standard J211-JUL2007 Instrumentation for Impact Tests – Part 1 – Electronic Instrumentation
†Society of Automotive Engineers

3 Definitions:

The following definitions apply in this Standard:

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

Acceleration of a body due to gravity
g (self explanatory. g = 9,8 m/s^2)

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

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 motorcycle and including
a) a shock-attenuating system;
b) the retention system ;
d) manufacturer's attachments (if any)

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

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, a_{max}
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 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 -10^{o}C to 50^{o}C.

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.

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 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 5.7.

5.4 Peripheral vision
All helmets shall allow unobstructed vision through a minimum of 105^o to the left and right sides of the median plane when measured in accordance with the procedures described in Clause 6.5.

5.5 Penetration resistance
When tested in accordance with Clause 6.6 at ambient temperature no contact with the test headform by the test dowel shall be made within any aperture on the helmet.

5.6 Effectiveness of retention system
When tested in accordance with Clause 6.7 at ambient temperature the helmet shall remain on the test headform.

5.7 Strength of retention system
When tested in accordance with Clause 6.8 the retention system shall not detach and the maximum elongation of the retention system shall not exceed 25 mm when measured between preliminary and test load positions.

5.8 Shock absorption
When the helmet is tested in accordance with Clause 6.9 the peak headform acceleration (a_{max}) shall not exceed 275g.

5.9 Helmet Labelling
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 an accelerometer mounted at its centre of gravity and conforming to the requirements of a three quarter 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 the following table, with the supporting assembly contributing to no more than 25% of the total mass.

Table 1. Test headforms

Headform label	Size Designation	Mass
A	495mm	3.10 kg +\- 0.10 kg
E	535mm	4.10 kg +\- 0.12 kg
J	575mm	4.70 kg +\- 0.14 kg
M	605mm	5.60 kg +\- 0.16 kg
O	625mm	6.10 kg +\- 0.18 kg

6.3 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.

6.4 Test schedule

Helmet samples shall be tested according to the test schedule shown in Table 2. The sequence of testing shall be as follows:

1. Peripheral vision test (if applicable)
2. Penetration resistance test (if applicable)
3. Effectiveness of retention system test (if applicable)
4. Strength of retention system test
5. Shock absorption test

Table 2. Test schedule

Sample	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
Helmet 2 – Low Temperature				X	X
Helmet 3 – Elevated Temperature				X	X
Helmet 4 – Water Immersion				X	X
Helmet 5 – Ambient Temperature			X		

6.5 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.

6.6 Penetration resistance test

6.6.1 Apparatus
The apparatus for the penetration test shall include a full size reference headform that meets the requirements of EN960:2006.

6.6.2 Method
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. Using a metal test dowel with a diameter of 20mm (see Figure 4) 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.

6.7 Retention system effectiveness test

6.7.1 Apparatus
The apparatus for the retention system effectiveness test shall include a full size reference headform that meets the requirements of EN960:2006.

6.7.2 Method
Secure the reference headform to a fixture that will prevent headform movement when a tangential force is applied to the helmet. Position the helmet on a reference 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 100 cm. A 10 ± 0.1 kg drop weight shall then be raised to a height of 50 cm ± 0.5 cm and released (see Figure 5).

This procedure shall be repeated with the hook mechanism attached to the rear edge of the helmet.

6.8 Retention system strength test

6.8.1 Apparatus
The retention system strength test device consists of both an adjustable loading mechanism by which a static tensile load is applied to the helmet retention assembly and a means for holding the test headform and helmet stationary. 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 mm diameter and a 75 mm center-to-center separation, and which are mounted on the adjustable portion of the tensile loading device (see Figure 6).

6.8.2 Method
Place the subject helmet on the test headform such that the basic plane is normal to the force of gravity and adjust it in accordance with the manufacturer's HPI. Securely fasten the retention system around the two freely moving rollers in a manner that avoids contact between the rollers and helmet's buckle. Apply a preliminary load of 45 ± 3 N in the direction normal to the basic plane to the retention system and hold for a minimum of 30 seconds. Record the displacement measurement on the moveable test device.

Increase the load to 500 ± 5 N and maintain this load for 120 seconds, + 0 seconds, - 10 seconds by adjusting the load applied to the retention system as necessary. After 120 seconds (+0 seconds, -10 seconds) at full test load, measure and record the displacement measurement of the retention system. The maximum elongation shall be the difference between the initial measurement and the measurement taken after 120 seconds.

6.9 Shock absorption test

6.9.1 Apparatus

The test apparatus for the shock absorption test shall consist of the following:

(a) The headform employed in this test shall conform to all requirements under Clause 6.2.

(b) The test headform shall be mounted on a guided freefall system as shown in Figure 7 with an adjustable mounting for the helmeted headform to permit impacts to be delivered to any location on the helmet at or above the test line. A monorail guided freefall system shall also be acceptable. The total mass of this support assembly shall not exceed 25% of the combined mass of the drop assembly (i.e., supporting assembly plus the test head-form). The centre of gravity of the drop-assembly unit shall lie within a cone having a vertical axis and forming at most a 10 degree included angle with the vertex as the point of impact.

(c) A linear accelerometer shall be placed at the centre of gravity of the test head-form and its sensitive axis shall be aligned to within 5 degrees of the vertical when the helmet and headform are in the impact position. The accelerometer shall be capable of withstanding a maximum acceleration of 1000 *g* without damage and shall have a frequency response of at least 5 to 900 Hz. A triaxial accelerometer with identical performance specifications is also acceptable.

(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 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 m^2.

(g) 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 SAE Recommended Practice J211 DEC2003, Instrumentation for Impact Tests, Requirements for Channel Class 1000. All equipment shall conform to all requirements of SAE J211:2003.

6.9.2 System verification

The shock absorption test instrumentation shall be verified before and after each series of tests (at least at the beginning and end of each test day) by dropping a spherical impactor onto a modular elastomer programmer (MEP) test surface.

The spherical impactor shall be a device made of low resonance material (for example, magnesium), aluminum alloy, or stainless steel that couples mechanically with the ball arm connector of the drop assembly in place of the impact test headform. When mounted, the device presents a spherically machined impact face with a radius of 73 mm on its bottom surface. All radii from the center of the curvature of the impact face to its outer edge shall form angles of no less than 40° with the downward vertical axis. The center of curvature shall be within 5 mm of the vertical axis drawn through the center of the ball arm. The total mass of the spherical impactor drop assembly shall be 5.0 ± 0.1 kg.

The MEP shall be 152 mm in diameter and 25 mm thick, and shall have a durometer of 60 ± 2 Shore A. The MEP shall be affixed to the top surface of a flat 6.35 mm thick aluminum plate. The geometric center of the MEP pad shall be aligned with the center vertical axis of the accelerometer.

The impactor shall be dropped onto the MEP at an impact velocity of 5.44 m/s ± 2% as measured within the last 40mm of free fall of the impactor. Typically, this requires a minimum drop height of 1.50 metres plus a height adjustment to account for friction losses. Six impacts, at intervals of 75 ± 15 seconds, shall be performed at the beginning and end of the test series (at a minimum at the beginning and end of each test day). The first three of six impacts shall be considered warm-up drops, and their impact values shall be discarded from the series. The second three impacts shall be recorded. All recorded impacts shall fall within the range of 380 g to 425 g. The mean of the 3 post-test results shall not differ by more than 5% from the mean of the pre-test results. Otherwise, the results shall be discarded and the tests repeated with new samples after the source of this difference has been rectified.
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.

6.9.3 Helmet impact test locations
Each helmet shall be tested at four impact locations on or above the test line described in Clause 6.3. 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.

6.9.4 Method

6.9.4.1
The helmet it shall be placed on the appropriate headform according to the manufacturer's helmet positioning index (HPI). The helmet shall be dropped onto the flat anvil with an impact velocity of 6.0 m/s ± 3%. Typically, this requires a minimum drop height of 1.83 metres, plus a height adjustment to account for friction losses. The helmet shall be dropped onto the hemispherical anvil with an impact velocity of 5.2 m/s ± 3%. Typically, this requires a minimum drop height of 1.38 metres, plus a height adjustment to account for friction losses. The impact velocity shall be measured during the last 25 mm of free-fall for each test. Following impact, the drop assembly shall be raised and the headform shall be oriented to another impact site.

6.9.4.2
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 Labelling, Warnings and Instructions

7.1 Labelling

7.1.1 Helmet labelling

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

7.1.2 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.

7.1.3 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 section 7.1.1.

7.2 Instructions

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

8.1 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, and;

(i) name of testing laboratory.

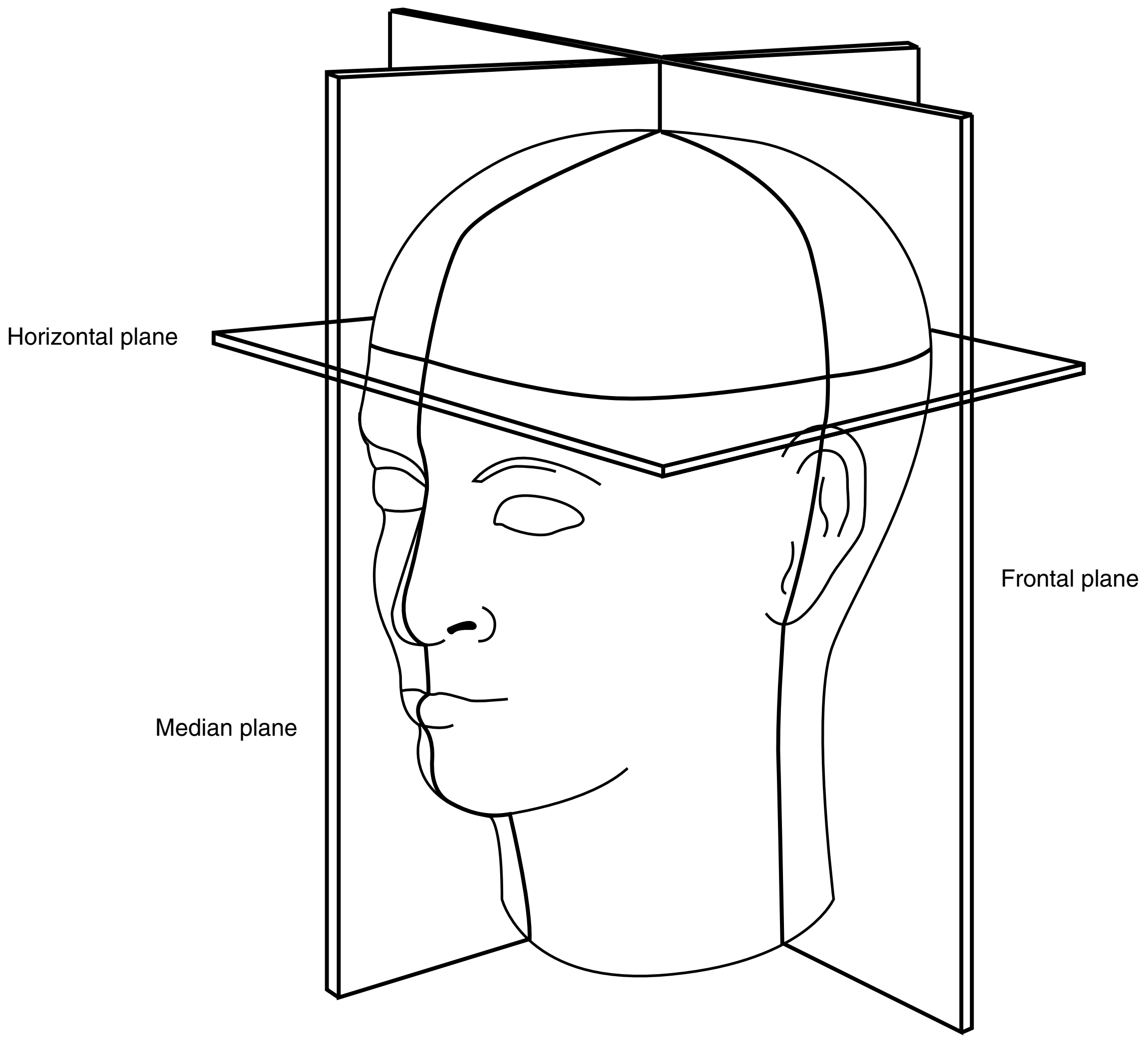
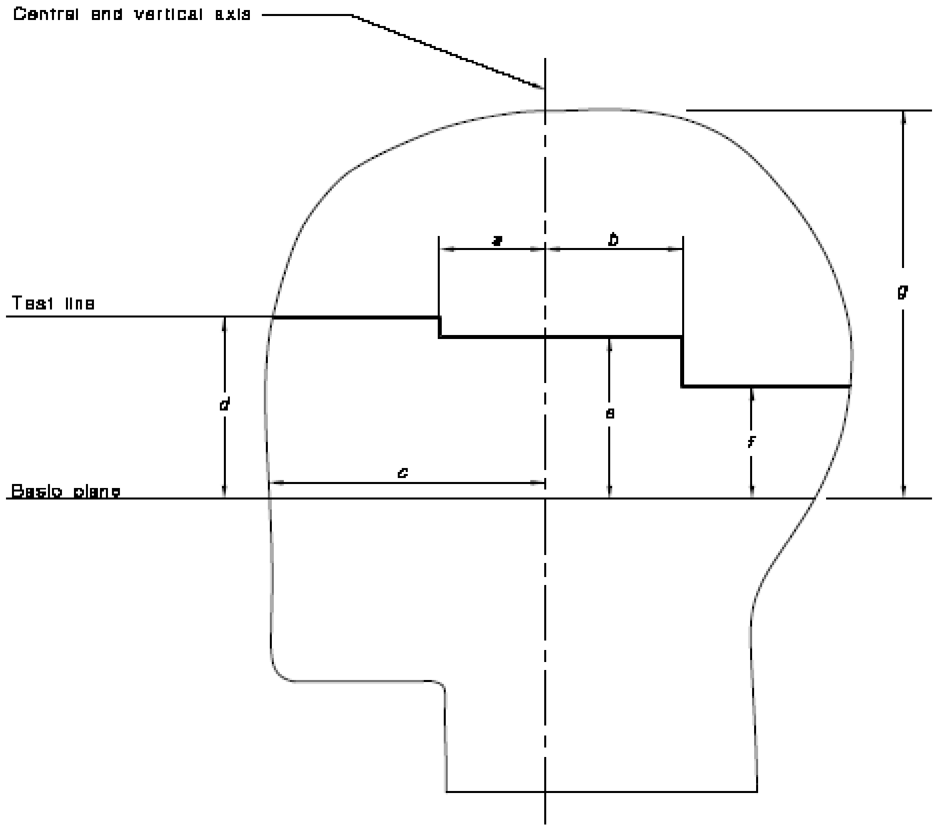
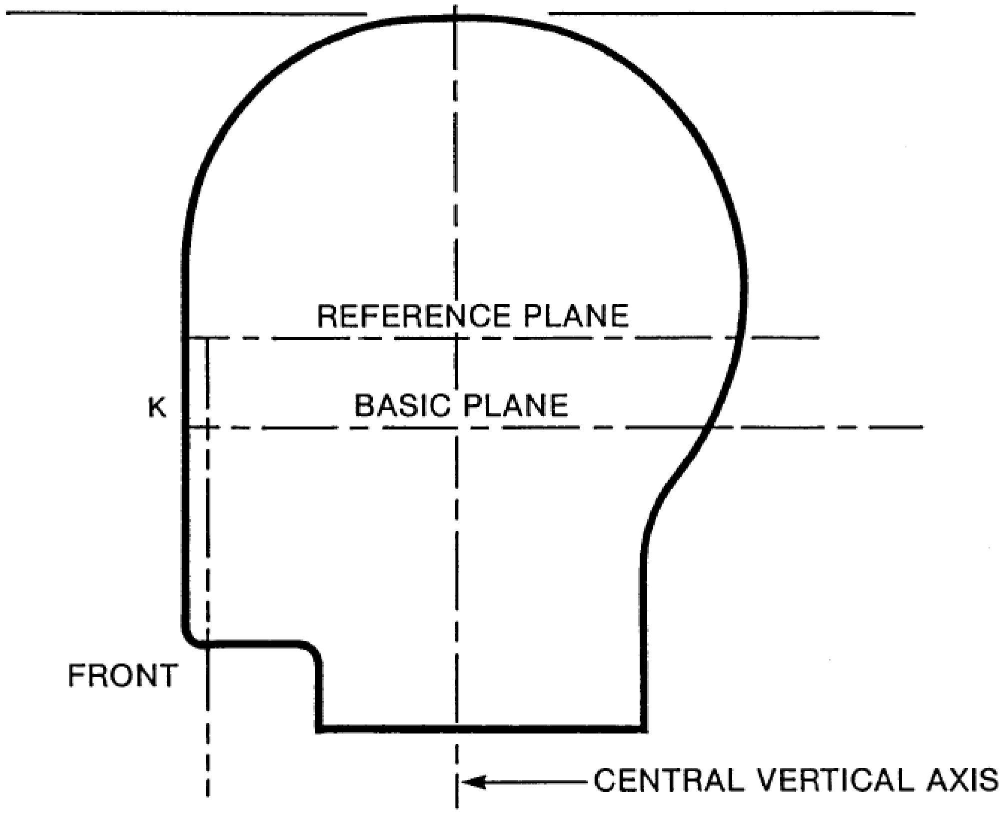


Figure 1: Orientation planes

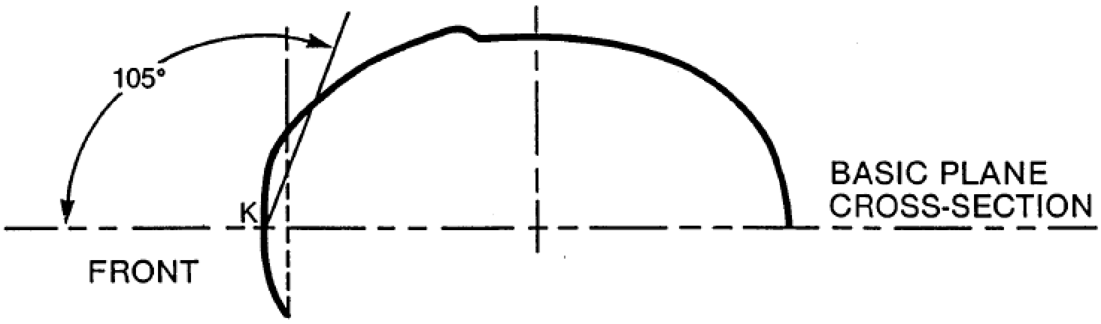


Headform Label	Dimensions (mm)						
	a	b	c	d	e	f	g
A (495 mm)	23	65	88	59	34.5	26.5	113.5
E (535 mm)	29.5	65	94.5	64	39	33	122
J (575 mm)	36	65	101	66	41	36	130
M (605 mm)	41	65	106	67	41.5	37	136
O (625 mm)	43.5	65	108.5	68	42	38	140

Figure 2: Extent of protection and test lines


REFERENCE PLANE
K
BASIC PLANE
FRONT
CENTRAL VERTICAL AXIS

Figu


105°
K
FRONT
BASIC PLANE
CROSS-SECTION

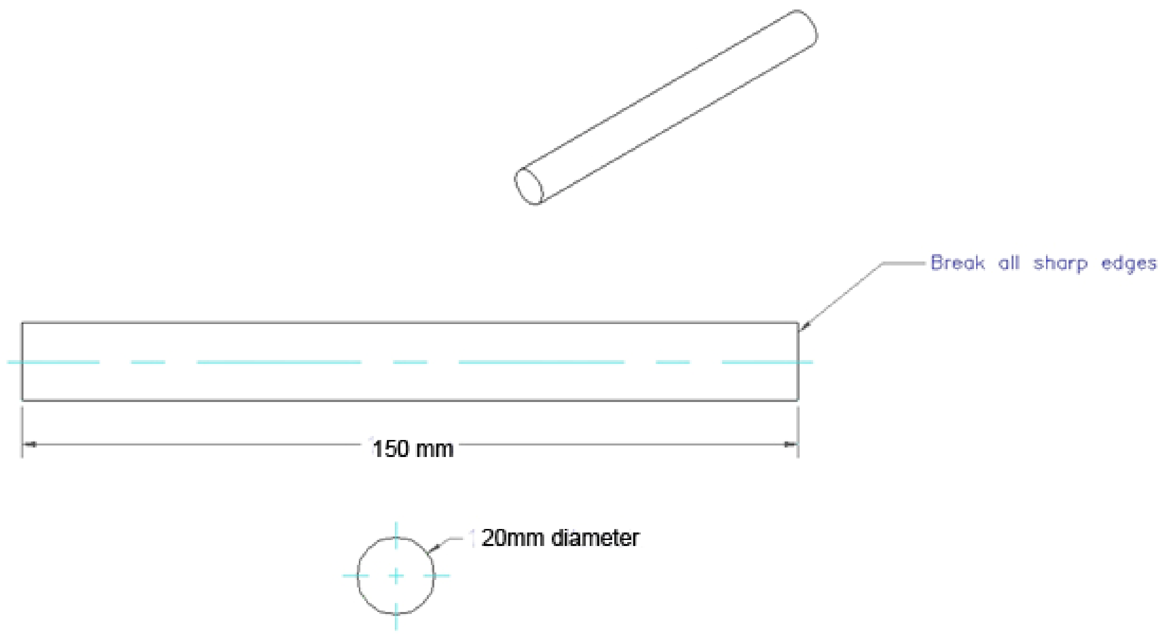


Figure 4 — Metal Dowel for Penetration Test

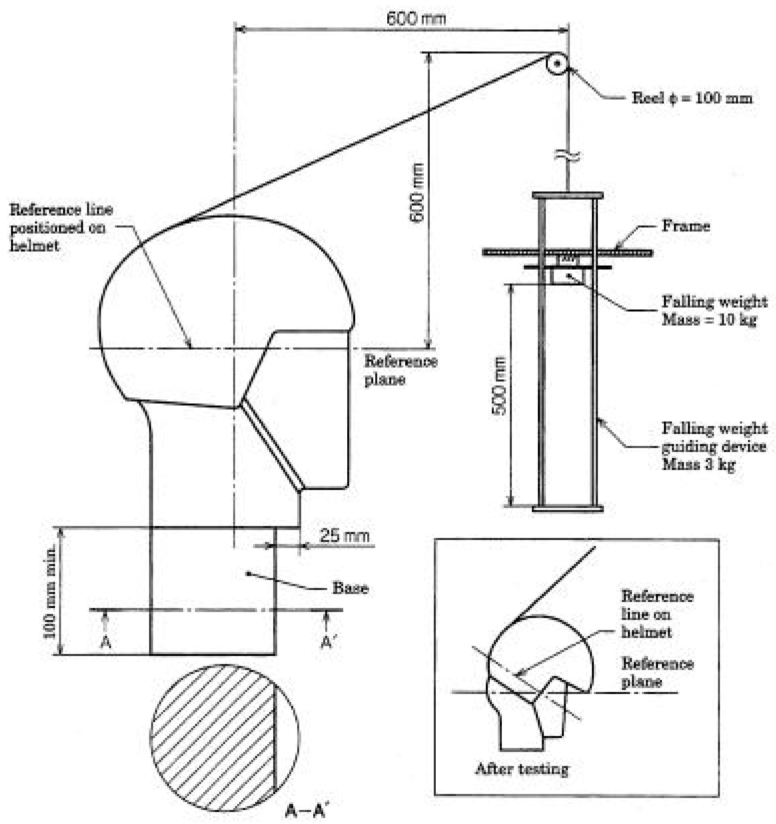


Figure 5: Typic

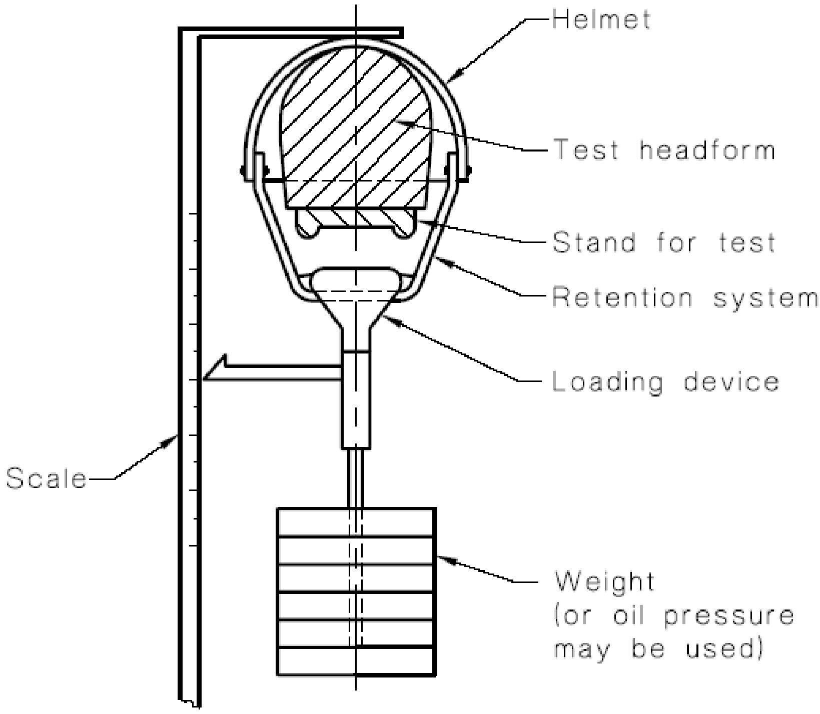


Figure 6: Typical retention system strength test apparatus

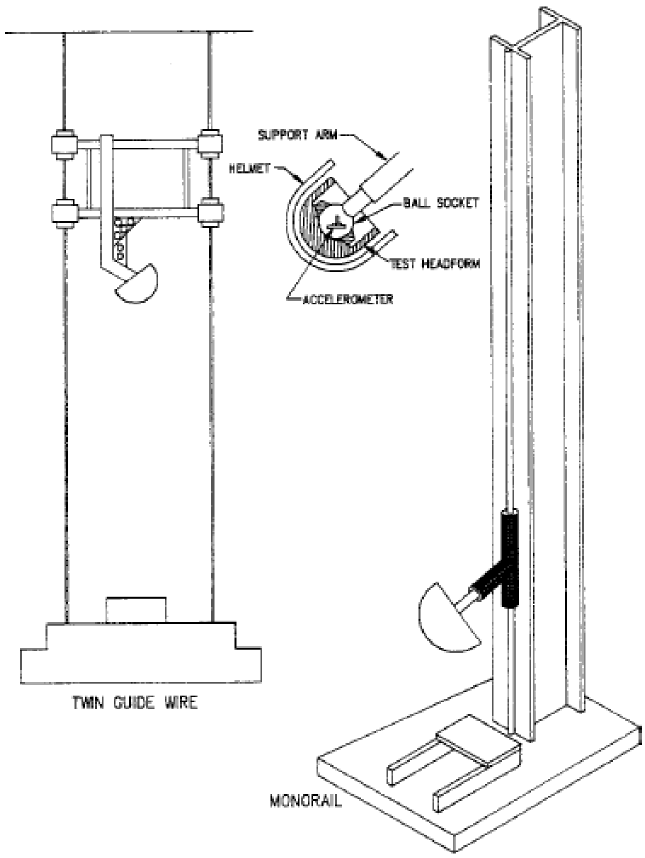


Figure 7: Typical drop assembly apparatus