A BY-LAW OF THE MUNICIPAL CORPORATION OF THE TOWN OF FORT SMITH, IN THE NORTHWEST TERRITORIES, TO ESTABLISH A BICYCLE HELMET BYLAW, PASSED PURSUANT TO SECTIONS 70, 71 AND 72 OF THE CITIES, TOWNS AND VILLAGE ACT S.N.W.T, 2003, c.22.

WHEREAS, the Council of the Municipal Corporation of the Town of Fort Smith, in the Northwest Territories, deems it to be in the public interest to establish a Bicycle Helmet Bylaw to protect persons.

NOW THEREFORE, the Council of the Town of Fort Smith, at a duly assembled meeting enacts as follows:

SHORT TITLE:

This Bylaw may be cited as the "Bicycle Safety Helmet Bylaw"

BICYCLE HELMET REQUIREMENTS

1. A person commits an offence if that person operates or rides as a passenger on a non-motorized cycle, on any public property where the operation of bicycles is permitted, and is not wearing a bicycle safety helmet that:
    a. is designated as an approved bicycle safety helmet that meets the standards and specifications prescribed under the Canadian Standards Association Standard CAN/CSA D1132-M89 (Appendix "A"); and
    b. the chin strap of the helmet is securely fastened under the chin.
2. A parent or guardian of a person under the age of 16 years commits an offence if the parent or guardian authorizes or permits the person to operate or ride as a passenger on a non-motorized cycle on a public property if that person is not wearing a bicycle safety helmet that:
    a. is designated as an approved bicycle safety helmet that meets the standards and specifications prescribed under the Canadian Standards Association Standard CAN/CSA D1132-M89 (Appendix "A"); and
    b. the chin strap of the helmet is securely fastened under the chin.
3. A person who is convicted of an offence under subsection (1) or (2) is liable to a fine of not more than:
    a. First offence $10.00
    b. Second offence $25.00
    c. Third and subsequent offences $50.00
4. An approved bicycle helmet must meet the Bicycle Safety Helmet specification regulations, prescribed standards and specification for the CSA approval.
5. The prescribed standards identified in Sections 1 & 2 must detail any acceptable exemptions for any person or class of persons from the requirements of this by-law.

READ A FIRST TIME THIS 27 DAY OF April, 2010 A.D.

READ A SECOND TIME THIS 24 DAY OF May, 2011 A.D.

READ A THIRD TIME THIS 23 DAY OF June, 2011 A.D.

Jane E. Hildebrandt
MAYOR

Brenda Black
SENIOR ADMINISTRATION OFFICER

I hereby certify that this bylaw has been made in accordance with the requirements of the *Cities, Towns and Villages Act* and the bylaws of the Municipal Corporation of the Town of Fort Smith.

Brenda Black
Senior Administrative Officer

National Standard of Canada CAN/CSA-D113.2-M89

Cycling Helmets

Prepared by
Canadian Standards Association

Approved by
Standards Council of Canada

ISSN 0317-5669
Published in September 1989 by Canadian Standards Association,
178 Rexdale Boulevard, Rexdale (Toronto), Ontario, Canada M9W 1R3.

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Preface

This is the first edition of CSA Standard D113.2, *Cycling Helmets*.

This Standard was prepared by the Technical Committee on Cycling Helmets under the jurisdiction of the Steering Committee on Sports and Recreational Equipment. It has been approved as a National Standard of Canada by the Standards Council of Canada.

September 1989

Notes:

(1) *Use of the masculine gender in this Standard is not meant to exclude the feminine gender when applied to persons. Similarly, 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 user of the Standard to judge its suitability for his particular purpose.*

(3) *CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.*

(4) *All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, Standards Division, 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3.*

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.

Interpretations are published in CSA Information Update. For subscription details and a free sample copy, write to CSA Marketing or telephone (416) 747-4019.

Foreword

Canadian Standards Association provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers or other interests.

In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA Certification Division Operating Procedures. Products which comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable Federal laws or regulations.

Testing techniques, test procedures and instrumentation frequently must be prescribed by the CSA Certification Division in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard the CSA Certification and Testing Division may require special cautions, markings and instructions that are not specified by the Standard.

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If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning details about CSA Certification please address your inquiry to the Applications and Records Section, Canadian Standards Association, 178 Rexdale Boulevard, Rexdale (Toronto), Ontario M9W 1R3.

CAN/CSA-D113.2-M89
Cycling Helmets

1. Scope

1.1

This Standard applies to helmets intended to provide protection for the heads of cyclists who are 5 years of age and older, and defines the areas of the head that are to be protected. It covers the basic performance requirements for shock absorption and strength of the retention system. Marking and label requirements are also included.

1.2

Detachable visors are not covered in this Standard.

2. Reference Publications

This Standard refers to the following Publications:

ISO/DIS* Standard
6220-1983,
Headforms for Use in the Testing of Protective Helmets.
SAE† Standard
J211-JUN80,
Instrumentation for Impact Tests.

**International Standards Organization/Draft International Standard.*
†*Society of Automotive Engineers.*

3. Definitions

3.1

The following definitions apply in this Standard:

Basic plane—a horizontal plane at the level of the external auditory meatus (external ear opening) and the inferior margin of the orbit (lower edge of the eye socket). See Figure 1.

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

Cyclist—any person operating a self-locomoted surface vehicle with one or more wheels.

Gadd Severity Index (GSI)—the following formula:

$$GSI = \int_{t_p}^{t_f} a(t)^{2.5}\, dt$$

where

$\int_{t_0}^{t_1}$ = the integration interval covering the essential duration of the shock pulse

$a(t)$ = the acceleration vector in gravitational units (g's)

Helmet—the outer shell, the inner fitting (eg, sizing foam), shock absorption system(ie, helmet liner), and the retention system.
Note: *A helmet need not contain all of these components.*

Helmet reference plane—a plane at a given distance above, and parallel to, the basic plane (see Figure 1).

Retention system (eg, chin strap)—the system that is designed to keep the helmet firmly attached to the wearer's head at all times.

Visor—an attachment to the helmet intended to reduce sun glare.

4. General Construction Requirements

4.1 Materials

4.1.1
All materials used in the fabrication of helmets should be known to be suitable for use in the design of protective cycling helmets. The materials should not undergo appreciable alteration due to aging or normal use, such as exposure to sun, extremes of temperture, and rain.

4.1.2
For those parts of the helmet coming into contact with the wearer's skin, the manufacturer should use materials that will not cause irritation or disease. For materials not in general use, medical advice as to their suitability should be sought before adoption.

4.2 Helmet Assembly

4.2.1
There shall be no rigid protrusions on the inner surface of the helmet liner.

4.2.2
Below the helmet reference plane, irregularities in the outer surface of the helmet shall be smoothly faired.

4.3 Retention System

4.3.1
The retention system shall be constructed such that when properly fastened and adjusted, the helmet will not readily dislodge from, or shift on the head.

4.3.2
The minimum width of the retention system straps shall be 12 mm.

4.4 Visors
Visors shall be removeable and are not covered by this Standard.

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. They shall be capable of meeting the requirements of Clause 5.2 under the conditions specified in Clause 6.3. All testing shall be done with any visor removed.

5.2 Shock Absorption

5.2.1 Extent of Protection

The entire area of the helmet above the test line stipulated in Clause 6.1.4.2 shall attenuate impact energy to the minimum requirements specified in Clause 5.2.3.

5.2.2 Test Sites

Each helmet shall be impacted once at each of six sites (front, rear, side, and three others) onto a flat and a cylindrical anvil (see Clauses 6.4.1(d), (e), and (f) for specifications of these anvils). The impact sites shall be selected at any point on the area above the test line described in Clause 6.1.4.2 and separated by a distance not less than one-fifth of the maximum circumference of the helmet. If there are mechanical fasteners in the test area, at least one of these shall be impacted. At least one impact shall be at the front, rear, and side of the helmet. Three other test sites shall be chosen at the discretion of the tester. In each test series there shall be at least two impacts of 55 J and two impacts of 80 J on the flat anvil.

Also in this test series, there shall be at least two impacts of 55 J on the cylindrical anvil (see Table 1).

5.2.3 Test Criteria (See Table 1)

5.2.3.1 Flat Anvil

When the helmet is tested in accordance with Clause 6.4 using a flat anvil and an energy input of

(a) 55 J, the headform acceleration shall not exceed 200 *g* peak; and
(b) 80 J, the headform acceleration shall not exceed 250 *g* peak.

5.2.3.2 Cylindrical Anvil

When the helmet is tested in accordance with Clause 6.4 using a cylindrical anvil and an energy input of 55 J, the headform acceleration shall not exceed a 250 *g* peak.

Note: *When impact testing using both the flat and the cylindrical anvil, it is recommended that manufacturers also measure Gadd Severity Index (GSI). If the GSI exceeds 1500 then additional helmet impact testing should be undertaken as detailed in this Standard.*

5.3 Retention System

5.3.1 Dynamic Impact Test

When tested in accordance with Clause 6.5 the retention system shall not detach and the maximum elongation of the retention system during impact shall not exceed 25 mm and immediately following a dynamic impact elongation shall not exceed 12 mm.

5.3.2 Stability Test

When tested in accordance with Clause 6.5.2.4 at ambient temperature and in accordance with Clause 6.5 in general, the change in the angle subtended by the basic plane and a plane passing through Point Q (see Figure 1), tangent to the edge of the helmet where the force is being applied, shall not exceed 45°.

5.4 Extent and Form of Protective Material

All parts of the wearer's head covered by the helmet shall be protected at least to the minimum requirements of Clause 5.2.

6. Test Methods

6.1 Equipment

6.1.1 Environment

All test equipment shall be turned on and allowed to warm up for at least 30 min prior to testing. All tests shall be performed under room temperature conditions (20 ± 5°C and 60 ± 5% relative humidity).

6.1.2 System Accuracy

The system employed to measure the head accelerations shall be able to accurately measure accelerations up to and including 750 ± 5 *g*.

6.1.3 Impact Recording

The measuring system (eg, accelerometer) shall have a frequency response in accordance with Channel Class 1000 of SAE Standard J211. If digital recording equipment is used it shall be capable of collecting impact data at a rate of not less than 8000 Hz per channel.

6.1.3.1 Instrumentation Check

The measuring system shall be checked before commencing and again after completing the helmet tests by impacting a test piece* with the headform dropped from a sufficient height so as to produce a nominal headform acceleration level of 300 *g*. At least three such impacts shall be conducted before and after testing and made part of the test report. The accuracy and repeatability of all tests shall be within a range of ±10 *g*. If the pre- or post-test averages fall outside this range then the entire test series shall be discarded and the above test procedure shall be repeated on a new series of test helmets.

**A test piece found to be suitable is a 2.54 cm (1 in) Open Blue Modular Elastomer Programmer with a surface durometer hardness of 70 ± 5 Shore A, available from United States Testing Company, Inc., Instrument Marketing Division, 1415 Park Avenue, Hoboken, New Jersey, USA, 07030.*

6.1.4 Headforms

6.1.4.1

All test headforms shall be manufactured in accordance with ISO/DIS Standard 6220. The headforms shall be contoured to the dimensions of the four headforms described in Figure 1 and Table 2. The headform shall be made from magnesium or aluminium alloy (or a dynamic equivalent), and display resonant frequencies below 3000 Hz.

6.1.4.2

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.

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.

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 1.

6.2 Sample Preparation

All samples subjected to testing shall be in the condition as offered for sale. Attachments shall not be installed on the helmet during testing. Sizing material as supplied by the manufacturer, may be applied to the inside of the helmet in order to ensure a proper fit with the test headform.

Eight samples for each available headform size shall be required for testing. Each helmet shall be exposed to one of the conditioning environments as specified in Clauses 6.3(a), (b), (c), and (d). The helmets shall be distributed such that there are two helmets for each conditioning environment.

6.3 Helmet Conditioning

Helmets shall be conditioned according to the following:

(a) The first pair of helmets shall be conditioned at room temperature (20 ± 5° C) for a period of not less than 4 h. The ambient humidity shall be 60 ± 5%.

(b) The second pair of helmets shall be exposed to a controlled cold environment temperature of −10 ± 2° C for a period of not less than 4 h.

(c) The third pair of helmets shall be conditioned by being exposed to an air temperature of 50 ± 2° C for a period of not less than 4 h.

(d) The fourth pair of helmets shall be immersed in water at a temperature of 18 to 27° C for a period of not less than 4 h.

6.4 Shock Absorption

6.4.1 Apparatus

The 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 6.1.4 in accordance with ISO/DIS Standard 6220.

(b) The test headform shall be mounted on a free-fall guide-wire apparatus as shown in Figure 2. The total weight of this drop assembly shall not exceed 25% of the combined weight of the supporting assembly plus the test headform. The centre of gravity of the drop-assembly unit shall lie within a cone having a vertical axis and forming at most a 10° included angle with the vertex as the point of impact. The guidance system shall be firmly attached to a rigid base and placed under at least 850 N tension. Any similar free-fall drop system would be considered a suitable drop-assembly apparatus.

(c) A linear accelerometer shall be placed at the centre of gravity of the test headform and its sensitive axis shall be aligned to within 5° 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 5 to 900 Hz. A triaxial accelerometer with identical performance specifications shall also be 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 guide wire assembly. The impact face shall have a minimum diameter of 150 mm.

(e) The cylindrical anvil shall also be made of steel or another similar rigid metal and shall be firmly attached to the base of the drop guidance system. The anvil shall have a face with a radius of 40 ± 1 mm and length of 200 ± 1 mm.

(f) The rigid mount for both of 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 25 mm and minimum surface area of 0.3 m^2.

(g) All equipment shall conform to all requirements under Clauses 6.1.1, 6.1.2, and 6.1.3 of this Standard and be in accordance with SAE Standard J211.

6.4.2 Method

6.4.2.1

To impact the helmet it shall be placed on the appropriate headform with the retention system securely fastened and properly oriented. The flat anvil shall be aligned such that the contact between the helmet and the anvil is at the centre of the anvil. The drop assembly shall be raised on the drop-guidance system to a clear height sufficient to impart an impact velocity of 5.70 + 0 and –0.10 m/s (nominally 80 J) and released. Immediately following impact, the drop assembly shall be raised and the headform shall be oriented to another impact site. Each helmet shall be tested as described in Clause 5.2.1. A typical drop-assembly mass is 5.0 + 0.15 and –0.0 kg.

6.4.2.2

The test method detailed in Clause 6.4.2.1 shall be repeated, with the drop assembly raised on the drop-guidance system to a clear height sufficient to impart an impact velocity of 4.70 + 0 and –0.10 m/s (nominally 55 J) and released.

6.4.2.3

Testing with the cylindrical anvil shall proceed in an identical manner. The helmet shall be placed on the appropriate headform with the retention system securely fastened and properly oriented. The cylindrical anvil shall be aligned such that the contact between the helmet and the anvil is at the crown of the cylindrical anvil. The drop assembly shall be raised on the drop-guidance system to a clear height sufficient to impart an impact velocity of 4.70 + 0 and –0.10 m/s (nominally 55 J) and released. Immediately following impact, the drop assembly shall be raised and the headform shall be oriented to another impact site. Each helmet shall be tested as described in Clause 5.2.1.

6.4.2.4

The first impact shall be made not less than 30 s and not more than 90 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.

6.5 Attachment of Retention System

6.5.1 Apparatus

The apparatus is illustrated in Figure 3. It consists of a cylindrical 2 + 0.125 and –0 kg mass and a dynamic-drop apparatus consists of two metal rollers each with a 12.5 mm radius, separated by a distance of 75 mm on centre. This shall serve to represent the cheeks and jawbone. Attached directly to this roller apparatus shall be a steel rod having a diameter of 12 to 15 mm with a steel end stop. The 5 kg mass shall be able to slide freely along the steel rod and come to rest against the end stop when the rod is mounted upright. The minimum length of the steel rod shall be 1 m plus the height of the cylinder. The retention system assembly (ie, the end stop and rod) shall weigh 7 + 0 and –0.25 kg.

6.5.2 Method

6.5.2.1

The helmet shall be properly placed on the headform and the retention system shall be passed around the two metal rollers such that approximately 25 mm of free strap extends from each adjustment. The entire dynamic-drop apparatus shall then rest freely on the retention system. The helmet shall be conditioned as stated in Clause 6.3.

6.5.2.2

The 5 kg mass shall be raised a sufficient height to impart an impact energy of 50 J and allowed to fall freely coming to rest against the steel end stop. The retention system shall not release and the distance "d" in Figure 3 shall be observed for conformance with Clause 5.3.1 and recorded. This shall be done using four helmets, each conditioned under one of the requirements of Clauses 6.3(a), (b), (c), and (d).

6.5.2.3

During testing at low temperature as in Clause 6.3(b), the fastening device (ie, clip) for retention shall be cycled five times (ie, opened and closed).

6.5.2.4 Stability Test

(a) The posterior neck piece of the headform shall be attached on an appropriately sized headform (see Figure 1). The headform shall then be secured to a rigid fixture.
(b) The helmet shall be positioned and secured onto the headform in accordance with the manufacturer's instructions.
(c) A hook mechanism shall be attached to the front lower edge of the helmet. A force of 250 N shall then be applied upwards at a constant rate, in the sagittal plane of the headform tangentially to the helmet. This force shall be maintained for a minimum period of 5 s. If the helmet moves more than 10 mm on the headform, the force shall be applied for a further 5 s.
(d) This procedure shall be repeated with the hook mechanism attached to the rear edge of the helmet.
(e) The change in the angle subtended by the basic plane and a plane passing through point Q, tangent to the edge of the helmet where the force is being applied, shall be measured.

7. Labels and Marking

7.1 Labels

7.1.1

All cycling helmets offered for sale shall have a label or tag bearing safety information in both English and French. The information label should contain statements similar to the following:
(a) This helmet is designed solely for use by cyclists.
(b) No helmet can protect the wearer against all possible impacts. For maximum protection this helmet shall be fitted properly and the adjusted securely.

7.1.2

The manufacturer should supply a label or tag giving instructions on how to fit the helmet properly.

7.2 Markings

All helmets offered for sale shall bear the following permanent markings:
(a) the manufacturer's identity;
(b) the helmet model identity;
(c) the helmet size or size range;
(d) the date of manufacture (year/month);
(e) The following warning—"This helmet is designed to absorb the shock of an impact by partial destruction of the shell and liner. Following an accident, this damage may not be visible to the eye. Therefore, if subjected to a severe blow, the helmet should be destroyed".
(f) The following warning—"This helmet should not be painted nor should decals be applied unless they are approved by the manufacturer, as they may weaken the shell structure".

(g) The approved list of cleaning agents should be included with the maintenance instructions.

7.3 Visors

If a visor is included with the helmet, information shall be included stating that the visor has not undergone testing to this Standard. The helmet is tested without the visor attached.

Table 1
Impact Test Requirements

Impact site*	Anvil type	Impact energy, J	Maximum acceleration, g
1. Front 2. Rear 3. Side	Flat or cylindrical	55/80	200/250
4. Three other sites		55	250

**Total of 6 impact sites per helmet to be tested as follows:*
2 sites at 55 J with the flat anvil;
2 sites at 80 J with the flat anvil; and
2 sites at 55 J with the cylindrical anvil.

Table 2
Polar Coordinates of Horizontal Half-Sections

Headform Size A: Dimension X = 114 mm

Height above reference plane, mm	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	88.0	86.5	83.0	75.5	70.0	67.0	66.5	69.5	73.5	78.5	84.0	87.0	88.0
20	85.5	84.5	82.5	75.5	70.0	67.0	66.5	69.5	73.5	78.5	84.0	87.0	87.0
40	80.0	79.5	78.0	72.0	67.5	65.0	64.5	67.0	71.0	76.0	80.5	82.0	81.5
50	75.0	75.0	74.5	68.5	63.5	61.0	60.5	63.5	67.0	72.0	76.0	77.0	77.0
60	68.0	68.0	67.5	62.5	57.5	55.5	55.0	58.0	61.5	66.0	70.0	70.0	70.5
70	56.0	56.0	56.5	53.0	49.5	47.0	47.0	49.0	53.0	57.0	61.5	61.0	61.0
80	37.0	37.5	37.0	36.5	35.5	34.0	34.0	36.0	39.5	44.5	49.0	49.0	48.5
85	23.0	24.0	23.0	22.0	22.0	23.0	24.0	24.5	29.5	33.5	36.0	36.5	37.0

Headform Size E: Dimension X = 122 mm

Height above reference plane, mm	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	94.5	93.0	90.0	82.0	76.5	73.5	73.0	76.0	80.0	85.0	91.0	94.0	94.5
20	92.5	91.5	89.0	82.0	76.5	73.5	73.0	76.0	80.0	85.0	90.5	93.5	94.0
40	87.0	87.5	85.0	79.5	74.5	71.0	71.5	74.0	77.5	82.5	88.0	89.0	89.0
50	82.5	83.0	81.0	76.0	71.0	68.0	68.0	70.5	74.0	79.5	83.5	84.5	84.5
60	76.5	76.5	75.5	71.0	66.5	63.5	63.5	66.0	69.5	74.0	78.5	79.0	79.0
70	66.5	66.5	66.5	63.0	59.0	56.5	56.5	58.5	62.0	66.5	70.5	71.0	71.0
80	52.0	52.0	52.0	50.0	47.5	46.0	46.5	48.0	51.0	56.0	59.5	60.0	60.0
85	41.5	41.5	41.5	40.5	39.5	39.0	39.5	41.0	44.0	48.0	51.5	52.0	52.0
90	28.0	28.0	28.5	28.5	28.5	29.0	30.0	31.0	34.0	37.5	41.5	42.0	42.0
95	10.0	10.0	10.0	10.0	10.0	10.5	11.0	12.0	13.5	15.0	16.0	16.0	16.0

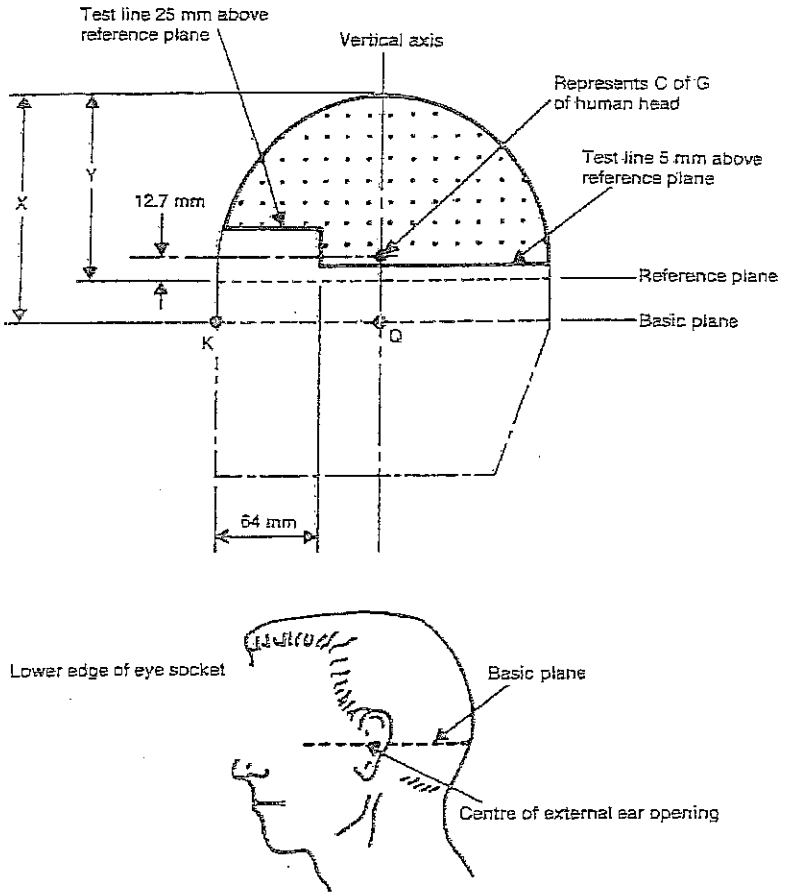
(Continued)

Table 2 *(Concluded)*

Headform Size J:	Dimension X = 130 mm												
Height above reference plane, mm	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	101.0	99.5	95.5	87.5	82.5	79.5	79.5	82.0	86.0	92.0	97.0	100.5	101.0
20	99.0	97.0	93.5	87.5	82.0	79.5	79.5	82.0	86.0	92.0	96.5	99.5	100.0
40	93.0	92.5	90.0	85.5	80.0	77.5	77.5	80.5	84.0	89.0	93.0	95.5	95.5
50	90.0	89.0	87.0	83.0	77.0	74.5	75.0	77.5	81.0	86.0	90.0	91.5	91.5
60	84.0	83.0	81.5	77.0	73.0	70.0	71.0	73.0	77.0	81.0	85.5	87.0	87.0
70	76.0	75.5	74.0	71.0	67.0	65.0	65.5	67.0	71.5	75.0	79.0	80.0	80.0
80	65.0	65.0	64.0	61.0	58.5	56.0	57.0	59.0	62.5	66.5	69.5	71.0	71.0
85	58.0	58.0	56.5	54.5	52.0	50.0	51.0	52.5	56.5	60.5	64.5	65.0	65.0
90	48.5	48.0	47.0	45.5	43.5	43.0	44.0	46.0	49.5	54.0	57.0	58.5	58.5
95	37.0	36.5	35.0	34.0	33.0	33.5	34.5	36.0	39.0	43.0	46.5	47.0	47.0
100	20.0	20.0	19.5	19.0	18.5	18.5	19.0	20.5	23.5	27.5	31.0	31.5	31.0

Headform Size M:	Dimension X = 136 mm												
Height above reference plane, mm	0° Front	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180° Back
0	106.0	104.0	101.0	93.5	87.0	84.5	84.0	86.5	91.0	96.0	102.0	106.0	106.0
20	103.5	102.5	99.5	93.0	87.0	84.5	84.0	86.5	91.0	96.0	101.5	105.5	105.5
40	99.0	98.5	96.5	90.5	85.0	82.5	82.0	84.0	88.5	93.5	96.0	100.5	100.5
50	95.5	94.5	93.0	87.5	82.0	79.5	79.0	81.5	85.5	90.0	93.0	97.0	97.0
60	89.5	89.5	88.0	83.0	77.5	75.0	75.0	77.0	81.5	86.5	91.0	92.0	92.0
70	82.0	82.0	81.0	77.0	72.0	69.5	69.5	71.5	75.5	81.0	84.0	85.5	85.5
80	71.5	71.5	71.0	68.0	64.0	61.5	61.5	64.0	67.0	72.0	76.0	77.0	77.0
85	64.5	64.5	64.0	61.5	59.0	57.0	57.0	58.5	61.5	66.5	71.0	72.0	72.0
90	56.5	56.5	56.5	55.0	53.0	51.5	51.5	53.0	56.0	60.5	64.5	66.0	66.0
95	46.5	46.5	47.0	46.5	45.5	44.0	44.0	45.5	48.5	53.0	57.5	59.0	58.5
100	32.0	32.0	32.5	33.0	34.0	34.0	34.5	35.5	38.5	43.0	46.5	48.5	48.0
105	12.0	12.0	13.0	14.0	15.0	16.0	17.5	19.5	21.0	25.0	29.5	30.0	30.0

Note: *All dimensions are given in millimetres.*



Note: *All dimensions given are in millimetres.*

Headform code letter	Dimension X, mm	Dimension Y, mm
A	114	90.0
E	122	96.0
J	130	102.5
M	136	107.0

Figure 1
Basic Data for Headforms

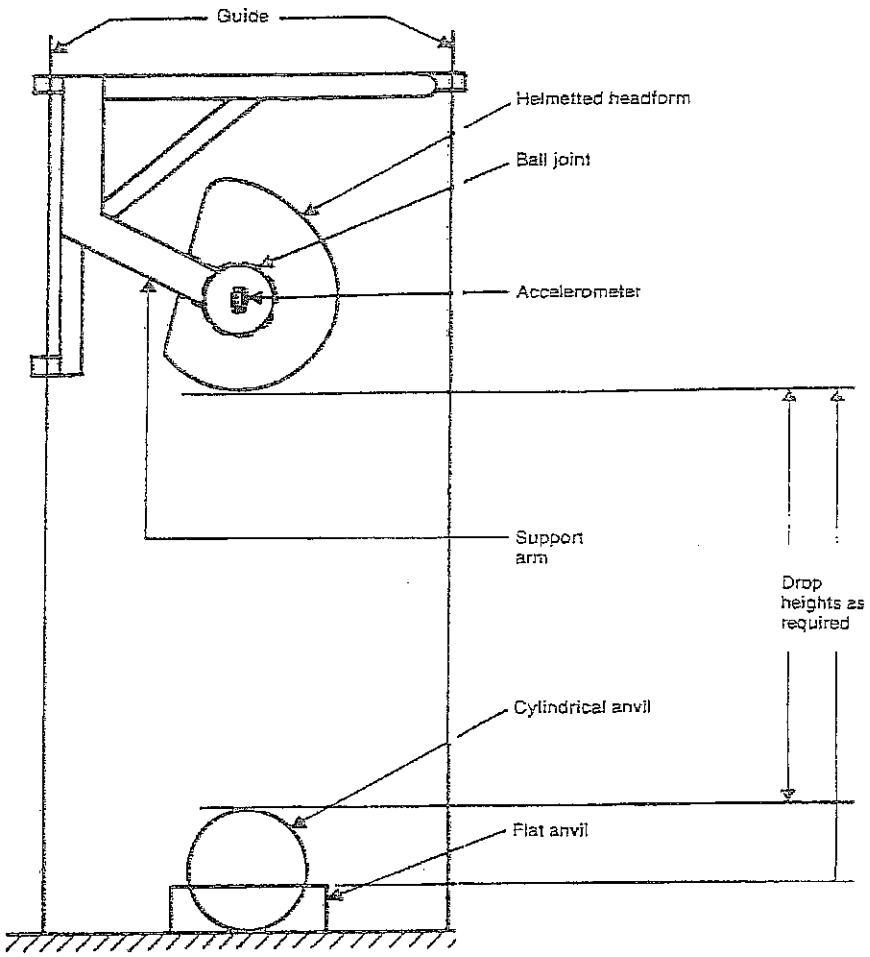


Figure 2
Drop Assembly Apparatus

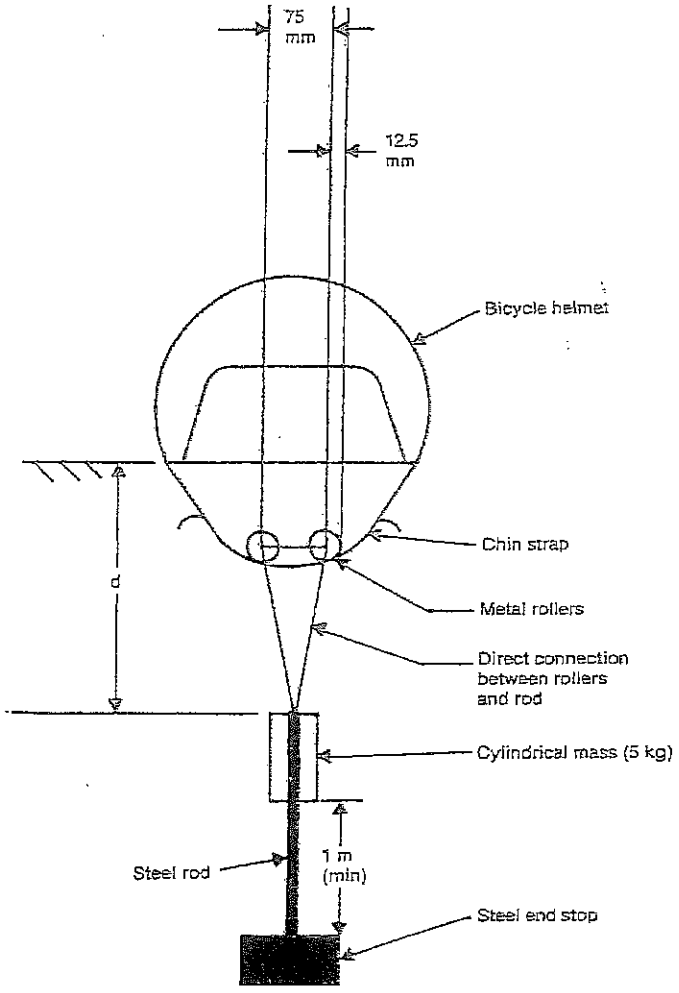


Figure 3
Retention System Test Apparatus

Appendix A
Bibliography

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