

In the event of any doubt or misunderstanding arising from this translation, the standard in Thai will be held to be authoritative

**TIS 369-2539 (1996)**  
**Thai Industrial Standard**  
**for**  
**Protective Helmets for Vehicle Users**

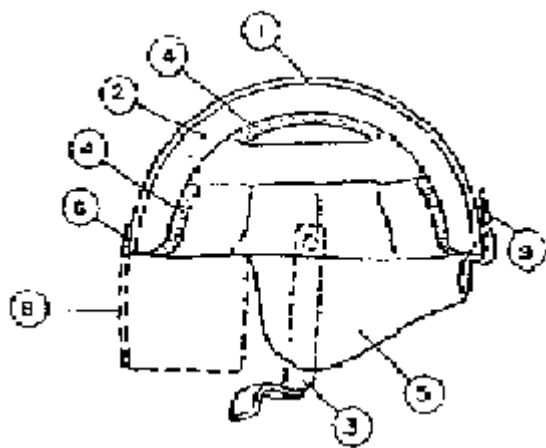
**1. Scope**

- 1.1 This standard specifies types, sizes and tolerances, components, materials and construction, requirements, marking and labelling, sampling and criteria for conformity and testing for protective helmets for vehicle users.
- 1.2 This standard is applicable only to protective helmets for users of general motor bicycles and certain motor cars, which shall be referred to hereinafter as "helmets"; it does not cover helmets for vehicle users in competitive events.

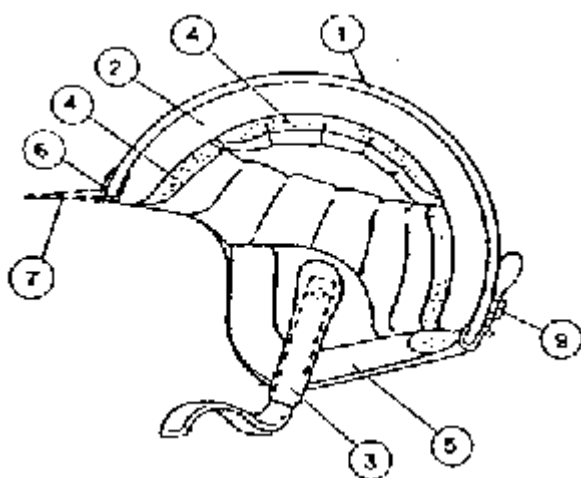
**2. Definitions**

For the purpose of this standard, the following definitions apply (see also Figure 1).

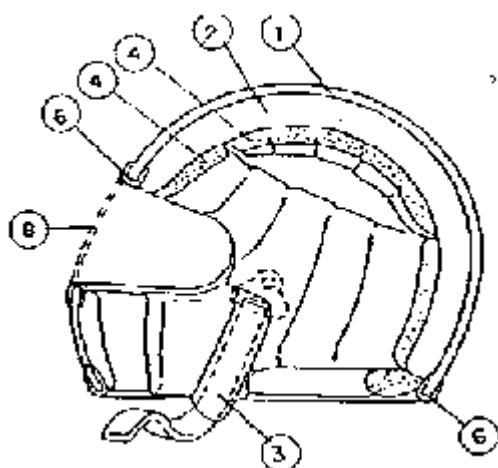
- 2.1 PROTECTIVE HELMET: A helmet primarily intended to protect the upper part of the wearer's head against a blow. Some helmets may include additional protection features.
- 2.2 HALF TYPE PROTECTIVE HELMET: A helmet having a shell to protect the upper part of the wearer's head.
- 2.3 JET TYPE PROTECTIVE HELMET: A helmet having a shell to protect the upper part of the wearer's head, the occipital and jaws areas of the wearer.
- 2.4 FULL-FACE TYPE PROTECTIVE HELMET: A helmet having a shell to protect the upper part of the head, the occipital and chin areas of the wearer.
- 2.5 SHELL: The hard material that provides the outer form of the helmet, covering the shock-absorbing liner and other components.
- 2.6 SHOCK-ABSORBING LINER: Lining material provided inside the helmet to mitigate the effects of a blow on the head.
- 2.7 CHINSTRAP: A strap which passes under or round the wearer's chin to retain the helmet in position, can be adjusted to tighten or loosen as appropriate.
- 2.8 CUSHIONING: Lining material provided to improve wearing comfort.
- 2.9 EAR FLAP: That part of the helmet designed to cover the wearer's ear.
- 2.10 RIM: That part covering the edge of the helmet.
- 2.11 PEAK: A permanent or detachable extension of the shell above the eyes.
- 2.12 WINDSHIELD: That part protecting eyes against wind.
- 2.13 VENTILATION HOLES: Holes made in the shell to permit circulation of air inside the helmet.
- 2.14 HEARING HOLES: Holes designed to permit hearing.
- 2.15 GOOGLES SRAP HOLDER: The device on the shell for holding the goggles strap.



Half type protective helmet



Jet type protective helmet



Full-face type protection helmet

- ① Shell
- ② Shock-absorbing liner
- ③ Chinstrap
- ④ Cushioning
- ⑤ Ear flaps
- ⑥ Rim (if any)
- ⑦ Peak (if any)
- ⑧ Windshield (if any)
- ⑨ Goggles strap holder (if any)

**Figure 1 General components of the various types of helmets**  
(clauses 2, 3.1 and 5.1.1)

### 3. Types

3.1 Protective helmets shall be divided into 3 types (see also Figure 1):

- 3.1.1 Half type protective helmet
- 3.1.2 Jet type protective helmet
- 3.1.3 Full-face type protective helmet

### 4. Sizes and tolerances

4.1 Helmets are of 16 sizes denoted by the code letters given in Table 1. They shall ensure a close fit when mounted to headforms of the same code letter. Dimensions of headforms shall comply with Table 1 and Appendix A.

Compliance is checked by visual inspection.

**Table 1**  
**Sizes of helmets and headforms**  
(clause 4.1 and A.2)

Units in millimetres

Code letter for helmet and headform	Circumference of headform
A	500
B	510
C	520
D	530
E	540
F	550
G	560
H	565
J	570
K	580
L	590
M	600
N	610
O	620
P	630
Q	640

### 5. Components, materials and construction

5.1 Components

5.1.1 General

General components of helmets shall comply with Figure 1. Any devices fitted to the helmet, in particular the metallic part of rigid materials, protruding from the inside surface of the shell, shall be such that it is unlikely to cause any injury to the wearer in the event of an accident.

5.1.2 Chinstrap

The chinstrap fitted to the helmet shall not be less than 20 mm wide.

The chinstrap and fastening devices shall be securely fixed to the shell.

5.1.3 Shell

The shell shall be of uniform strength and shall not be specially reinforced at any particular point.

5.1.4 Shock-absorbing liner

The shock-absorbing liner shall closely fit the inner curvature of the shell and be capable of absorbing impact energy.

Compliance is checked by visual inspection and measurement.

## 5.2 Materials

The materials used in the manufacture of helmets shall be of durable quality, i.e. their characteristics shall not undergo appreciable alteration under influence of ageing or of the circumstances of use to which the helmet is normally subjected, i.e. exposure to sun, rain, cold, dust, vibrations, skin, sweat or cosmetics for skin or hair.

Chinstrap and fastening devices shall not be made of materials that would be hazardous to the skin.

Compliance is checked by visual inspection.

## 5.3 Construction

5.3.1 The assembled helmet shall have a smooth external surface without reinforcing ridges. There shall be no external projections or concavity greater than 3 mm from the outer surface of the shell except a fastening device for peak or windshield which shall not project more than 5 mm.

Note 1. The above requirement does not apply to the concavity of the hearing hole and ventilation hole.

2. Measurement of protrusion of the fastening device for peak or windshield that is easily detachable shall be made with the peak or windshield removed.

3. Measurement of protrusion of the fastening device for peak or windshield that is not easily detachable shall be made without removing the peak or windshield.

5.3.2 The fastening device fitted to the shell shall be protected to prevent abrasion with and wearer's head.

5.3.3 Rivet heads shall not project more than 2 mm above the outer surface of the helmet and shall be free from no sharp edges.

5.3.4 An assembled helmet shall have a mass of not exceeding 2 kg.

5.3.5 The jet type helmet and the full-face type helmet shall provide for ventilation by holes permitting air to flow over the head top.

5.3.6 An assembled helmet with ear-covering feature shall be provided with hearing holes.

5.3.7 Windshield, if any, shall be made of transparent and colourless material.

5.3.8 Metallic screws and sharp metallic rivets shall not be used.

Compliance is checked by visual inspection and measurement.

## 6. Requirements

### 6.1 Shock absorption

When the helmets are submitted to the low and high temperature and moist conditions as described in clause 9.2.3 and tested as prescribed either in clause 9.2.3.1 or clause 9.2.3.2:

(1) The force transmitted shall not exceed 20 kN, or

(2) The maximum acceleration of the headform shall not exceed  $\frac{2000}{m} \text{ g m/s}^2$

where m is the mass of the headform plus helmet expressed in kg;

g is acceleration of gravity expressed in  $\text{m/s}^2$

The shell of the helmet shall not show any penetration cracks.

### 6.2 Penetration resistance

When tested in accordance with clause 9.3, the distance between the point of the spike and the headform shall at no time be less than 5 mm.

### 6.3 Rigidity

When tested in accordance with clause 9.4 at an initial load of 30 N which shall be increased to 630 N, the difference of the distance between two metal plates measured at both load applications shall not exceed 40 mm. After decreasing the load to 30 N, the difference of the distance between the two plates in relation to the initial load shall not exceed 15 mm.

### 6.4 Strength of chinstrap and fastening device

#### 6.4.1 Resistance to deformation

When tested in accordance with clause 9.5.2.1, the extension under specified load of chinstrap and fastening device shall not exceed 25 mm.

- 6.4.2 Resistance of chinstrap and fastening device to detachment from shell  
When tested in accordance with clause 9.5.2.2, the chinstrap, the fastening device and its attachment shall not break or tear away.

6.5 Flexibility of peak

If a peak is provided, when tested in accordance with clause 9.6, the deflection of the peak shall be not less than 6 nor more than 32 mm.

## **7. Marking and labelling**

- 7.1 There shall be at least figures, letter or mark indicating clearly, legibly and permanently the following information marked on the inside of each helmet:

- (1) Type and code letter of the helmet
- (2) Mass in g or kg, to the nearest 50 g
- (3) Month and year of manufacture or lot identification
- (4) Name of manufacturer or factory or registered trade-mark
- (5) Country of origin

In case foreign language is used, the meaning shall correspond to that in Thai specified above.

- 7.2 Any person who manufactures products complying with this standard may use the Standards Mark in connection with his products only after having received a license from the Industrial Products Standards Council.

## **8. Sampling and criteria for conformity**

- 8.1 Lot : Helmets of the same type and code letter made from the same materials under the same process which are manufactured or delivered or purchased at the same period of time.

- 8.2 Sampling and acceptance shall comply with the sampling plan or other technically equivalent plan.

- 8.2.1 Sampling and acceptance for tests on sizes, components, materials and construction

- 8.2.1.1 Samples shall be drawn at random from the same lot as given in column 2 of Table 2.

- 8.2.1.2 Provided the number of the samples failing to comply with each of the requirements of clauses 4 and 5 does not exceed the acceptance number given in column 3 of Table 2, that lot shall be deemed to comply with the requirements.

- 8.2.2 Sampling and acceptance for test on requirements

- 8.2.2.1 Samples shall be drawn at random from those which conformed to the requirements on sizes, components, materials and construction in accordance with column 4 of Table 2, and divided into portions as follows:

- (1) 1/6 of the sample size shall be tested for penetration resistance, then subjected to the tests on strength of chinstrap and fastening device and flexibility of peak respectively.
- (2) 1/2 of the sample size shall be tested for shock absorption.
- (3) 1/3 of the sample size shall be tested for rigidity (number of tests along the longitudinal and those along transverse axes being equal.)

- 8.2.2.2 Provided all the samples meet all requirements of clause 6, that lot shall be deemed to comply with the requirements.

**Table 2**  
**Sampling plan for tests on sizes, components, materials and construction and**  
**other requirements**  
(clauses 8.2.1 and 8.2.2.1)

Lot size  units	Tests on sizes, components, materials and construction		Test on requirement
	Sample size units	Acceptance number	Sample size units
Up to 500	20	2	6
501 up to 1200	32	3	12
1201 up to 3200	50	5	18
3201 up to 10000	80	7	24

### 8.3 Criteria for conformity

Provided the samples meet all the requirements of clauses 8.2.1.2 and 8.2.2.2, that lot of helmets shall be deemed to comply with the standard.

## 9. Testing

### 9.1 Conditioning for testing

#### 9.1.1 Pre-conditioning

All helmets shall be pre-conditioned for at least 6 hours at a temperature of  $25\pm 5^{\circ}\text{C}$  and a relative humidity of  $65\pm 5\%$  before applying the following individual conditioning treatment and testing.

#### 9.1.2 Low temperature conditioning

The helmet shall be placed in a refrigerator\* at a temperature of  $-10\pm 2^{\circ}\text{C}$  for not less than 4 nor more than  $4\frac{1}{2}$  hours.

#### 9.1.3 High temperature conditioning

The helmet shall be placed in an oven\* at a temperature of  $50\pm 2^{\circ}\text{C}$  for not less than 4 nor more than  $4\frac{1}{2}$  hours.

#### 9.1.4 Wet conditioning

After removal of any protective covering from the outside of the shell, the helmet shall be sprayed externally with water at  $25\pm 5^{\circ}\text{C}$  at the rate of  $1\text{ dm}^3/\text{min}$  for not less than 4 nor more than  $4\frac{1}{2}$  hours.

Note. \*Refrigerator and oven shall be sufficiently large to ensure that the helmets do not touch one another or the sides. In any event the total volume shall be not less than  $0.13\text{ m}^3$ . The oven shall be fitted with a fan to provide effective air circulation. The relative humidity of the air in the oven shall be controlled at approximately  $65\pm 5\%$  by means of a saturated solution of sodium dichromate or by other equivalent method.

### 9.2 Shock absorption test

#### 9.2.1 Principle

Shock absorption may be measured by:

9.2.1.1 Direct measurement of maximum force transmitted to a fixed headform;

9.2.1.2 Measurement of the peak acceleration of a freely movable headform.

#### 9.2.2 Apparatus

The impact measuring apparatus used for method in clause 9.2.1.1 shall be able to measure without distortion greater than 5% forces up to 40 kN at frequencies between 0 and 2500 Hz.

Precautions shall be taken to ensure that the impact force is totally transmitted and that there is no loss due to deformation. The measuring instrument shall be so positioned that its axis is co-axial with the path of the striker which shall pass through the centre of gravity of the headforms.

The impact force shall be measured by a non-inertial device.

The base, if of concrete, shall weigh at least 1000 kg and be 1 m in height; if of steel it shall weigh at least 500 kg. The base shall be bedded in rubbed of 60 IRHD (Shore hardness), dry sand or similar material on a solid floor.

The striker for both test methods of clauses 9.2.1.1 and 9.2.1.2 shall weigh 5 kg, have a flat circular or square striking face having an area of about 380 cm<sup>2</sup>. Travel of the striker may be free or guided, but the speed of impact of a guided striker shall equal that of a free fall.

#### 9.2.3 Procedure

Divided into 3 portions the pre-conditioned helmet samples as described in clause 9.1.1. One portion shall be conditioned as described in clause 9.1.2, another as described in clause 9.1.3. and the other as described in clause 9.1.4. After removal of the helmets from the conditioning atmosphere, they shall be placed firmly and fastened securely on the headforms as given in Appendix A. Determine the shock absorption within 5 minutes after removal of the helmets from the conditioning atmosphere by one of the following methods.

9.2.3.1 The striker shall be allowed to fall on to the helmet shell at any 3 points above line AA (see Figure A.1) as follows:

- (1) Middle zone, where the force line is at right angle to line AA of the headform,
- (2) Frontal-zone, where the force line is at 30° to line AA of the headform,
- (3) Occipital-zone, where the force line is at 30° to line AA of the headform.

The impact energy shall be 125 Nm, attained by a weight of 5 kg falling from a height of 2.5 m ± 5 mm. The height of the fall shall be measured from the point of impact on the helmet to the underside of the striker. Record the transmitted force and report all values of the transmitted force.

9.2.3.2 The striker shall be allowed to fall on to the helmet shell at any 3 points above line AA (see Figure A.1) as follows:

- (1) Middle zone, where the force line is at right angle to line AA of the headform,
- (2) Frontal-zone, where the force line is at 30° to line AA of the headform.
- (3) Occipital-zone, where the force line is at 30° to line AA of the headform.

The impact energy at the moment of striking shall be

$$\frac{k + 1}{k} \times 125 \text{ Nm}$$

$$\text{Where } k = \frac{\text{mass(headform + helmet)}}{\text{mass of striker}}$$

Record the maximum acceleration of the headform and report all values of the maximum acceleration.

The headform (mass 4.5 ± 0.2 kg) shall be able to move freely within an arc of at least 90° in relation to the vertical axis of the striker, and the restricting devices limiting the movement of the headform shall not come within this arc.

### 9.3 Penetration test

#### 9.3.1 Apparatus and principle

A conical spike shall be placed on the shell at the point to be tested. The weight shall fall on to the top of the spike, and the depth of penetration of the spike shall be measured by a suitable non-inertial device such as a photo-electric cell.

Note. Mass of spike: 0.3 kg

Mass of striker: 3.0 kg

Angle at point of spike: 60°

Radius of point: 0.5 mm

Minimum height of cone of spike: 40 mm

Hardness of tip of spike between 45 and 50 HRC

### 9.3.2 Procedure

9.3.2.1 The helmet is conditioned in the manner that gave the worst result in the shock absorption test as in clause 9.2.3 and then tested in accordance with clause 9.3.2.2 within 1 minute of the time of removal from the conditioning atmosphere, the helmet being placed firmly on the appropriate headform in accordance with Appendix A as in actual use.

9.3.2.2 The spike is placed on the shell at the test point which should be above line AA (see Figure A.1). The striker is allowed to fall on to the top of the spike through a distance of 1 metre measured from the top of the spike to the underside of the striker.

9.3.2.3 The minimum distance remaining between the point of the spike and the headform shall be measured.

### 9.4 Rigidity test

#### 9.4.1 Apparatus

Two metal plates for loading

#### 9.4.2 Procedure

9.4.2.1 Samples are subjected to pre-conditioning as in clause 9.1.1 with number of tests along the longitudinal and those along transverse axes being equal. Each helmet is placed between two parallel plates.

9.4.2.2 Apply an initial load of 30 N to the shell. After 2 minutes the distance between the plates is measured.

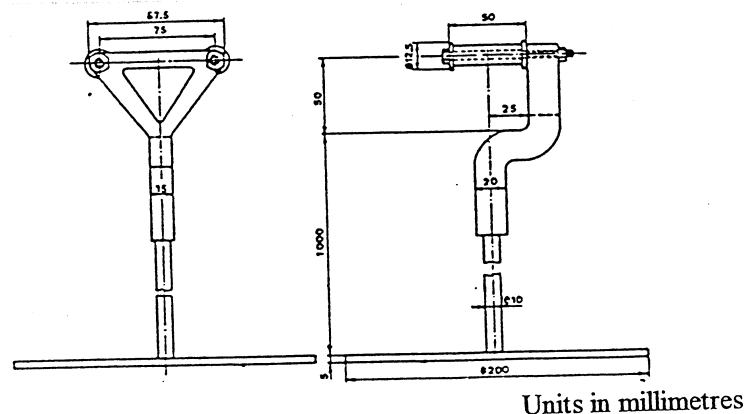
9.4.2.3 Increase the load to 630 N by increments of 100 N every 2 minutes. Maintain the load of 630 N for 2 minutes, then measure the distance between the plates.

9.4.2.4 The load is then reduced to 30 N and maintained for 5 minutes and the distance between the plates is re-measured.

### 9.5 Test of strength of chinstrap and fastening device

#### 9.5.1 Apparatus

A hanger consisting of two metal rollers, 50 mm in length, 12.5 mm in diameter and centres at 75 mm apart as in Figure 2.



**Figure 2 Hanger**  
(clause 9.5.1)



## 9.5.2 Procedure

### 9.5.2.1 Resistance to deformation

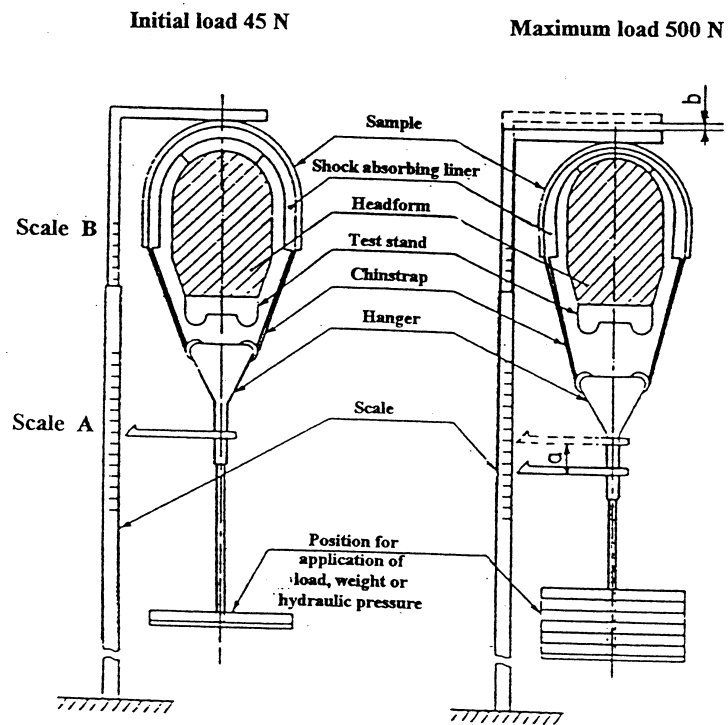
The sample for the penetration test shall be supported on an appropriate headform in accordance with Appendix A, and the chinstrap shall be fastened so that it passes under two metal rollers. An initial load of 45 N shall be applied to the chinstrap and gradually increased at a uniform rate until it reaches 500 N in 30 seconds. This load shall be maintained for 2 minutes after which the movement of the chinstrap and fastening device (a) from scale A and the decrease of the shock-absorbing liner (b) from scale B shall be measured. Determine the elongation of the chinstrap and fastening device (e) from a-b (see Figure 3)

### 9.5.2.2 Resistance to detachment of fastening device and chinstrap

Test shall be conducted in continuation from that of clause 9.5.2.1, the load being increased to 1 kg and maintained for 2 minutes. Examine the chinstrap, fastening device and its attachments.

## 9.6 Test of flexibility of peak (see Figure 4)

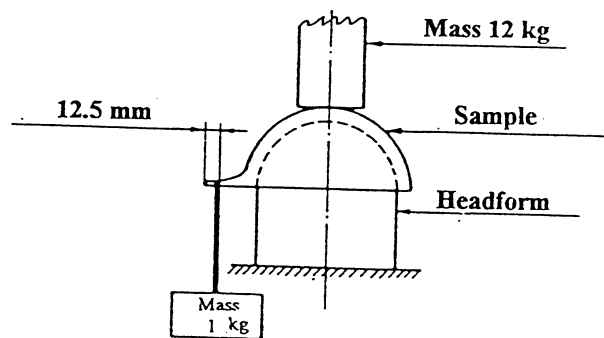
The sample which passed the test for fastening device and chinstrap strength shall be mounted on an appropriate headform (Appendix A) with a mass of 12 kg applied to the top of the helmet to hold it firmly in place. A mass of 1 kg shall be then freely suspended for 2 minutes from a point within 12.5 mm of the centre of the front edge of the peak. The deflection of the peak shall be measured.



$$e = a - b$$

e = the elongation of chinstrap and fastening device

**Figure 3 Test for resistance to deformation**  
(clause 9.5.2.1)



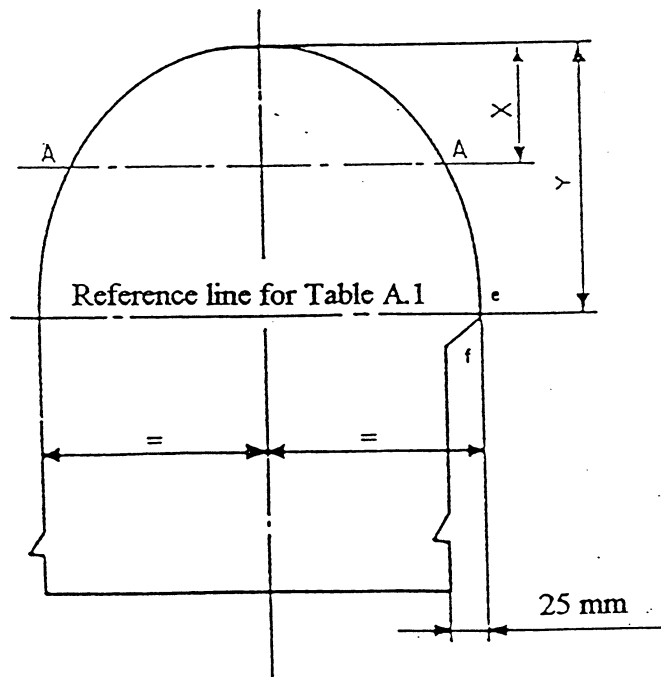
**Figure 4 test for flexibility of peak**  
(clause 9.6)

## **Appendix A Headforms**

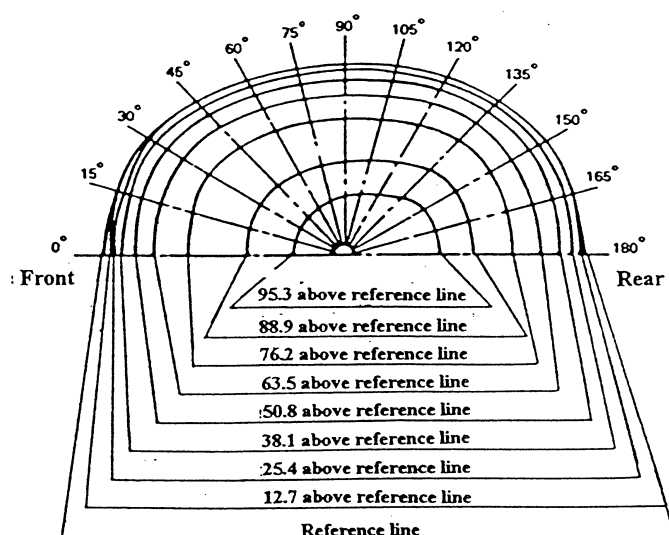
(clauses 4.1, 9.2.3, 9.3.2.1, 9.5.2.1 and 9.6)

- A.1 Headforms shall have dimensions as given in Tables 1 and A.1. The tolerances on dimensions in Table A.1 shall equal  $\pm 0.2$  (see also Figure A.1, A.2(1) and A.2(2)).
- A.2 The upper part of each headform is designed to represent the human head; the lower part is arbitrarily designed to enable the headform to be mounted either in the inclined position or upright, and also to provide a "chin" so that the helmet may be held securely on the headform by its chinstrap.
- A.3 Suggested method of headform construction is as follows:
  - A.3.1 The upper part of each headform is built up from layers of hardwood having a density of 640 to 720 kg/m<sup>3</sup> and a moisture content of 12%, planed to a thickness of 12.7 mm or 6.35 mm where required.  
The grain is displaced by 90° from layer to layer. The layers are glued and screwed together, using a synthetic resin glue. Accurate assembly is facilitated by marking transverse and longitudinal axis on each piece and by drilling a small-diameter hole through the centre of each.
  - A.3.2 The lower part is then built up from a further nine layers, each 12.7 mm thick, cut to the same outline in clause A.3.1. The assembled headform is held in a press until the glue has hardened.
  - A.3.3 The upper part is finished to give the required smooth curved surface; the sides of the lower part are flattened off and the chin rounded. The rear of the lower part is cut off at an angle of 60° to the horizontal so that the headform may be mounted with its inclined axis vertical for the shock absorption test. A flat block of wood is glued and screwed to along the vertical axis. The headform should be given several coats of shellac polish to seal it, and finally two Duralumin mounting plates are attached to it as in Figure A.2(2).
- A.4 The headforms used for testing may carry code letters for their circumferences, setting out dimensions as given in Table A.1 in relation to the reference line shown in Figure A.1.
- A.5 Headforms shall be cut away along the line "ef" as shown in Figure A.1 to allow correct fitting of the helmet. Each shall be marked with the line AA shown in Figure A.1, indicating the lower testing limit.
- A.6 If the headforms are made of metal it should be noted that magnesium alloy of low resonant frequency has been used successfully.

Code letter	Circumference of headform mm	Dimension X mm	Dimension Y mm
A	500	27.0	89.7
B	510	28.5	91.2
C	520	30.0	92.7
D	530	31.8	94.5
E	540	33.3	96.0
F	550	34.8	97.5
G	560	36.4	99.1
H	565	38.1	100.8
J	570	39.7	102.4
K	580	41.2	103.9
L	590	42.7	105.4
M	600	44.5	107.2
N	610	46.0	108.7
O	620	47.5	110.2
P	630	49.1	111.8
Q	640	50.8	113.5



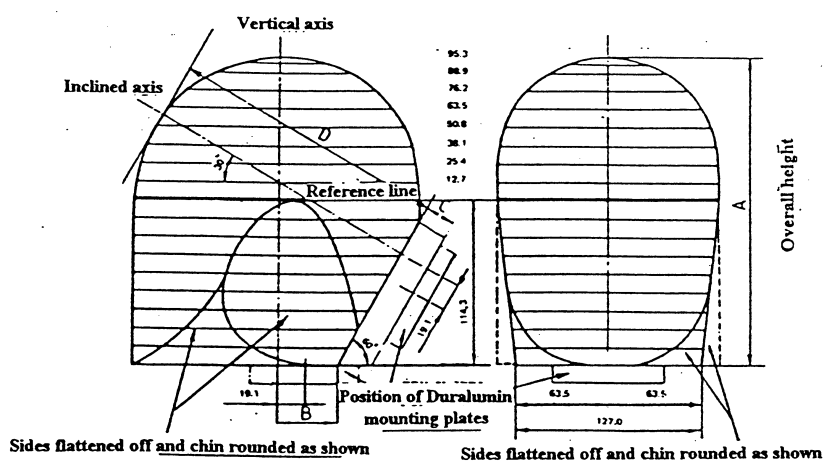
**Figure A.1 Headform**  
(clauses 9.2.3, 9.3.2.2 and clauses A.1, A.4 and A.5)



Units in millimetres

For polar co-ordinates of horizontal sections, see Table A.1

**Figure A.2(1) Wooden headform**  
(clause A.1)



$$A = C + D$$

Units in millimetres

For dimensions A, B and C, see Table A.1.

**Figure A.2(2) Wooden headform**  
(clauses A.1 and A.3.3)

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2))  
(clause A.1 Figure A.2(1) and clause A.4)

Units in millimetres

Headform A													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	88.1	86.4	83.1	75.4	69.9	66.8	66.5	69.3	73.4	78.8	84.1	87.6	88.1
12.7	86.9	85.3	83.1	75.4	69.9	66.8	66.5	69.3	73.4	78.8	84.1	87.6	88.1
25.4	84.6	83.6	82.3	75.4	69.9	66.8	66.5	69.3	73.4	78.8	84.1	86.1	86.1
38.1	80.8	80.3	79.5	72.9	67.6	65.3	65.0	67.6	71.6	76.5	81.3	82.8	82.8
50.8	74.7	74.4	74.0	68.1	63.2	61.0	60.7	63.2	66.8	71.6	73.7	76.7	76.7
63.5	64.8	64.8	64.8	59.9	55.6	53.3	53.1	55.4	59.2	63.5	67.7	67.7	67.7
76.2	45.7	45.7	45.5	43.4	41.4	40.4	40.4	42.4	46.2	50.5	54.6	54.6	54.6
82.6	31.0	31.2	31.2	31.0	30.0	29.7	30.2	32.5	36.1	40.4	43.9	44.5	44.5

Dimension (see Figure A.2(2))	mm
A	204.0
B	29.5
C	31.5

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform B													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	89.7	88.1	84.6	76.7	71.4	68.3	68.1	70.9	75.2	80.5	85.9	88.9	89.7
12.7	88.4	87.4	84.6	76.7	71.4	68.3	68.1	70.9	75.2	80.5	85.9	88.9	89.7
25.4	85.9	85.3	83.6	76.7	71.4	68.3	68.1	70.9	75.2	80.5	85.9	87.4	88.1
38.1	82.3	82.0	80.8	74.4	69.3	66.5	66.3	68.8	72.6	77.7	82.8	84.1	84.3
50.8	76.5	76.7	76.2	69.9	65.0	62.5	62.5	64.8	68.3	73.2	77.5	78.0	78.0
63.5	66.5	66.8	66.8	61.2	56.6	54.4	54.6	56.6	60.2	65.3	69.3	69.3	69.3
76.2	49.3	49.5	49.5	46.2	43.4	42.2	42.4	44.5	47.7	52.8	57.2	57.4	57.4
82.6	36.1	36.6	36.6	35.1	33.5	32.8	33.0	34.8	38.4	42.9	47.2	47.2	47.0
88.9	13.2	13.2	13.5	14.2	15.2	16.5	16.5	19.6	22.6	26.9	30.7	30.7	30.7

Dimension	mm
A	205.5
B	31.5
C	29.7

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform C													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	91.2	89.7	86.1	78.7	72.6	69.9	69.6	72.4	76.7	82.0	87.4	90.4	91.2
12.7	89.9	88.6	86.1	78.7	72.6	69.9	69.6	72.4	76.7	82.0	87.4	90.4	91.2
25.4	87.6	87.1	85.3	78.7	72.6	69.9	69.6	72.4	76.7	82.0	87.4	89.2	89.9
38.1	84.6	83.8	82.3	76.5	70.6	68.1	68.1	70.6	74.7	79.8	84.3	85.6	86.4
50.8	78.5	78.2	77.5	72.4	66.5	64.3	64.3	66.5	70.4	75.4	79.5	80.3	80.8
63.5	69.3	69.1	69.1	64.5	59.4	57.2	57.4	59.7	63.5	68.3	71.9	71.9	71.9
76.2	52.3	52.3	52.3	49.3	46.2	45.2	45.7	48.0	51.6	56.1	59.4	59.7	59.9
82.6	39.9	39.9	39.9	38.1	37.1	36.6	36.8	38.6	41.9	46.2	50.5	51.1	51.3
88.9	20.6	20.6	20.6	21.3	22.1	22.9	23.9	25.4	28.2	31.8	34.3	34.5	34.5

Dimension	mm
A	207.0
B	33.5
C	27.9



Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform D													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	93.0	90.9	87.9	80.8	74.4	71.4	71.1	74.2	78.0	83.6	89.2	92.2	93.0
12.7	91.7	89.7	87.9	80.8	74.4	71.4	71.1	74.2	78.0	83.6	89.2	92.2	93.0
25.4	89.9	89.2	86.9	80.8	74.4	71.4	71.1	74.2	78.0	83.6	89.2	91.2	91.9
38.1	85.9	85.6	84.1	78.0	72.1	69.1	69.1	71.6	75.9	81.0	86.4	87.9	88.1
50.8	80.5	80.3	79.5	73.4	68.3	65.3	65.3	68.1	71.9	77.0	82.0	82.6	82.8
63.5	71.9	71.9	71.6	65.8	61.0	58.7	58.7	61.0	65.0	69.9	73.9	74.2	74.4
76.2	55.6	55.6	55.6	53.1	49.5	47.8	47.8	49.5	53.1	58.2	62.0	62.2	62.2
82.6	43.7	43.7	43.4	42.2	40.6	39.4	39.4	41.7	45.2	50.0	53.6	53.8	53.8
88.9	27.7	27.7	27.7	27.4	27.2	27.2	27.4	29.5	32.3	36.6	39.9	39.9	39.9

Dimension	mm
A	208.7
B	35.6
C	26.2

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform E													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	94.5	93.0	89.7	82.0	76.2	73.2	72.9	75.7	79.8	84.8	90.7	93.7	94.5
12.7	93.2	91.9	89.7	82.0	76.2	73.2	72.9	75.7	79.8	84.8	90.7	93.7	94.5
25.4	91.2	90.7	88.9	82.0	76.2	73.2	72.9	75.7	79.8	84.8	90.7	92.7	93.0
38.1	87.6	87.9	85.9	80.0	74.7	71.6	71.4	74.2	77.7	82.6	88.6	89.2	89.2
50.8	82.0	82.3	81.0	75.4	70.4	67.8	67.6	70.4	73.9	79.0	83.8	84.3	84.3
63.5	73.4	73.7	73.4	68.6	64.0	61.5	61.2	63.5	67.1	71.9	76.5	76.5	76.5
76.2	57.7	57.9	58.2	55.9	52.6	50.5	50.3	52.1	55.1	59.7	64.5	64.8	64.8
82.6	46.5	46.5	46.5	45.2	43.2	42.4	42.9	44.5	47.5	52.3	56.4	56.9	56.6
88.9	30.5	30.5	30.7	31.0	31.2	31.2	31.8	33.8	36.8	40.4	43.9	44.2	44.2

Dimension	mm
A	210.3
B	37.8
C	24.1

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform F													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	96.0	94.5	90.9	83.6	78.0	74.7	74.4	77.2	81.0	86.4	92.2	95.3	96.0
12.7	94.7	93.7	90.9	83.6	78.0	74.7	74.4	77.2	81.0	86.4	92.2	95.3	96.0
25.4	92.2	91.7	90.4	83.6	78.0	74.7	74.4	77.2	81.0	86.4	92.2	93.7	94.2
38.1	89.4	89.7	88.1	81.8	76.2	73.2	73.2	75.4	79.2	84.1	89.7	90.4	91.2
50.8	84.3	84.3	83.6	77.5	72.4	69.9	69.6	71.6	75.2	79.8	84.6	85.3	85.6
63.5	75.7	75.7	75.4	70.1	65.8	63.5	63.5	65.3	68.6	72.6	77.2	78.0	78.2
76.2	61.2	61.0	61.0	58.7	54.9	52.8	52.8	54.4	58.2	62.2	66.8	66.8	67.1
88.9	35.1	34.8	34.8	35.1	35.3	35.8	35.8	37.8	40.9	45.2	49.0	49.0	49.0
95.3	16.3	16.0	16.0	17.0	18.0	19.8	19.8	23.4	25.9	29.0	32.3	32.5	32.5

Dimension	mm
A	211.8
B	39.9
C	22.4

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform G													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	97.5	95.8	93.0	85.1	79.5	76.2	75.9	78.5	83.1	88.4	94.0	97.0	97.5
12.7	96.3	95.3	92.7	85.1	79.5	76.2	75.9	78.5	83.1	88.4	94.0	97.0	97.5
25.4	93.7	92.7	91.4	85.1	79.5	76.2	75.9	78.5	83.1	88.4	94.0	95.8	96.3
38.1	90.4	89.7	88.9	83.3	77.7	75.2	74.9	77.0	81.3	86.6	91.7	92.7	93.0
50.8	86.1	85.6	84.6	79.0	73.7	71.1	70.9	73.2	78.0	82.8	87.1	87.9	88.1
63.5	77.5	77.2	76.5	72.1	67.3	64.5	64.3	66.5	70.9	75.9	79.0	79.8	80.0
76.2	63.8	63.8	64.0	61.2	57.4	53.3	54.9	56.9	61.5	66.5	68.8	69.1	69.1
88.9	39.9	39.6	39.6	39.1	38.4	37.8	38.4	40.4	44.2	49.8	52.8	53.1	53.1
95.3	20.6	20.6	20.6	21.3	22.4	23.4	23.9	25.4	28.7	33.5	37.8	39.1	39.1

Dimension	mm
A	213.4
B	42.0
C	20.6

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform H													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	99.3	97.3	94.0	86.4	80.5	77.7	77.5	80.3	84.1	89.7	95.5	98.6	99.3
12.7	97.3	96.3	93.7	86.4	80.5	77.7	77.5	80.3	84.1	89.7	95.5	98.6	99.3
25.4	95.8	94.7	93.0	86.4	80.5	77.7	77.5	80.3	84.1	89.7	95.5	97.8	98.3
38.1	91.9	91.7	90.2	83.6	78.0	75.4	75.7	78.0	81.7	86.9	92.5	98.7	94.5
50.8	86.9	86.9	85.9	79.8	74.7	71.9	72.4	74.9	78.2	83.6	88.4	89.2	89.9
63.5	79.5	79.5	79.2	73.7	68.3	65.8	66.3	68.8	72.1	77.2	81.5	81.5	81.8
76.2	67.1	67.1	67.3	63.8	59.2	56.6	56.6	58.9	62.2	67.3	71.1	71.1	71.1
88.9	42.9	43.2	43.4	42.4	41.4	40.6	41.1	42.9	46.5	51.3	55.1	55.9	55.9
95.3	26.7	26.9	27.4	27.4	26.9	27.2	28.2	30.0	33.3	38.1	42.9	43.9	44.2

Dimension	mm
A	215.1
B	43.9
C	18.8

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform J													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	100.8	98.8	96.3	88.1	82.0	79.5	79.2	82.0	85.9	91.7	96.8	100.1	100.8
12.7	99.6	98.0	95.8	88.1	82.0	79.5	79.2	82.0	85.9	91.7	96.8	100.1	100.8
25.4	96.8	95.8	94.5	88.1	82.0	79.5	79.2	82.0	85.9	91.7	96.8	98.3	98.8
38.1	93.7	92.7	91.9	86.1	80.0	77.2	77.7	80.0	83.8	89.4	94.5	95.8	96.0
50.8	89.2	88.6	87.9	82.0	76.2	73.9	74.4	77.0	80.5	85.9	90.4	90.9	90.9
63.5	81.5	80.8	81.0	75.9	70.6	68.1	68.3	71.1	74.4	79.5	83.8	84.1	84.1
76.2	69.3	69.1	69.3	65.3	61.2	58.9	59.2	61.7	65.0	69.3	73.2	73.4	73.4
88.9	47.2	47.5	48.0	46.2	44.5	43.7	44.2	46.2	50.0	54.1	58.2	58.4	58.4
95.3	32.8	32.8	33.3	32.5	32.0	32.3	33.0	35.1	38.1	42.2	46.5	47.3	47.2

Dimension	mm
A	216.7
B	46.2
C	17.0

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform K													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	102.4	101.1	97.0	89.7	84.1	81.3	80.8	83.3	87.9	92.7	98.3	101.6	102.4
12.7	101.1	100.1	97.0	89.7	84.1	81.3	80.8	83.3	87.9	92.7	98.3	101.6	102.4
25.4	98.8	98.3	96.3	89.7	84.1	81.3	80.8	83.3	87.9	92.7	98.3	99.8	100.6
38.1	95.5	95.3	93.7	87.4	82.0	79.5	79.5	81.5	85.9	90.4	95.5	97.0	97.7
50.8	90.9	90.4	89.7	83.6	78.5	76.2	76.2	78.5	83.1	87.4	91.9	92.5	93.2
63.5	83.1	82.8	82.0	77.2	72.1	69.9	70.4	72.4	76.7	80.8	84.6	85.1	85.6
76.2	71.1	71.1	71.4	68.1	63.8	61.2	61.2	63.0	67.1	71.6	74.9	75.2	75.2
88.9	51.8	51.0	51.8	50.8	48.5	46.7	47.2	49.3	52.1	56.9	60.7	60.7	60.7
95.3	37.6	37.3	37.3	37.3	36.8	36.6	37.1	38.9	42.2	47.0	51.1	51.8	51.3
101.6	18.3	17.8	17.8	18.0	18.5	19.3	20.1	21.8	24.9	29.0	33.8	36.1	36.6

Dimension	mm
A	218.2
B	48.2
C	15.2

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform L													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	103.9	102.9	99.3	91.2	85.6	82.6	82.3	84.8	88.9	94.2	100.3	103.4	103.9
12.7	102.6	101.6	99.1	91.2	85.6	82.6	82.3	84.8	88.9	94.2	100.3	103.4	103.9
25.4	100.8	100.1	98.6	91.2	85.6	82.6	82.3	84.8	88.9	94.2	100.3	103.4	102.9
38.1	97.3	97.3	95.8	89.2	85.6	80.8	80.5	82.6	86.9	92.2	97.5	99.8	99.8
50.8	92.2	92.7	91.9	85.9	80.8	77.7	77.5	79.8	84.1	88.6	93.7	95.3	95.0
63.5	85.3	85.6	85.3	79.0	74.2	71.9	71.6	73.9	78.2	82.6	87.1	88.1	87.6
76.2	73.4	73.7	73.7	69.1	64.5	62.7	62.7	64.5	68.3	73.2	77.7	78.5	78.0
88.9	55.1	55.4	55.6	53.8	51.1	49.5	49.8	51.1	54.4	59.2	63.8	64.3	64.3
95.3	41.4	41.7	42.2	42.4	40.4	39.1	39.6	41.4	44.5	49.0	54.4	55.4	55.1
101.6	24.1	24.1	24.4	25.1	25.4	25.7	25.9	27.2	29.7	33.5	36.1	37.6	37.6

Dimension	mm
A	219.7
B	50.3
C	13.2



Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform M													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	105.7	103.9	100.6	92.7	86.9	84.1	83.8	86.4	90.7	96.0	102.1	105.7	105.7
12.7	104.4	103.4	100.3	92.7	86.9	84.1	83.8	86.4	90.7	96.0	102.1	105.7	105.7
25.4	102.1	101.6	99.8	92.7	86.9	84.1	83.8	86.4	90.7	96.0	102.1	104.4	104.4
38.1	99.3	98.8	97.8	90.9	85.3	82.6	82.3	84.6	88.9	94.0	99.8	100.8	101.1
50.8	95.0	94.7	93.5	86.9	81.3	79.0	78.7	81.0	85.3	90.4	96.0	96.5	96.3
63.5	87.1	86.9	86.9	80.8	75.4	73.2	73.2	75.4	79.5	84.8	89.4	89.7	89.4
76.2	75.9	76.2	76.2	71.6	67.1	64.8	64.8	66.5	70.6	75.4	80.0	80.0	79.8
88.9	58.2	58.2	58.2	56.6	54.6	52.3	52.3	53.8	56.9	61.7	66.8	67.1	66.8
95.3	45.5	45.7	46.0	46.0	44.5	43.4	43.2	44.5	47.2	52.1	57.7	58.2	57.9
101.6	26.4	26.2	26.7	27.7	28.7	29.5	30.0	31.2	34.0	38.6	42.7	43.2	42.7

Dimension	mm
A	221.5
B	52.3
C	11.4

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform N													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	107.2	105.7	102.4	95.0	89.2	85.9	85.6	88.1	92.2	97.8	102.9	105.9	107.2
12.7	105.7	104.6	102.4	95.0	89.2	85.9	85.6	88.1	92.2	97.8	102.9	105.9	107.2
25.4	103.6	102.9	101.6	95.0	89.2	85.9	85.6	88.1	92.2	97.8	102.9	105.2	106.2
38.1	100.3	99.6	99.1	92.7	87.1	84.3	84.1	86.6	90.2	96.0	100.6	102.1	103.1
50.8	96.0	95.8	95.0	89.4	83.8	80.8	81.0	83.1	86.6	92.2	96.5	97.8	98.6
63.5	88.9	88.9	88.6	83.6	78.5	75.2	75.4	77.7	81.0	86.1	90.2	90.9	91.7
76.2	78.2	78.5	79.0	74.7	70.1	67.3	67.3	69.3	72.4	77.0	80.5	81.0	81.8
88.9	61.2	61.2	61.5	59.7	56.1	54.6	54.9	56.9	60.2	64.8	68.8	69.1	69.1
95.3	49.5	49.5	49.8	48.3	46.5	45.5	45.7	47.5	51.3	55.9	60.5	60.2	60.2
101.6	32.0	31.8	32.0	32.5	32.8	33.0	33.8	35.8	38.9	43.9	47.8	48.0	47.8

Dimension	mm
A	223.0
B	54.6
C	9.7

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform O													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	108.7	107.4	103.4	95.8	90.4	87.6	87.1	90.2	94.2	99.8	105.4	107.4	108.7
12.7	707.7	106.4	103.4	95.8	90.4	87.6	87.1	90.2	94.2	99.8	105.4	107.4	108.7
25.4	105.2	104.4	102.9	95.8	90.4	87.6	87.1	90.2	94.2	99.8	105.4	106.7	106.9
38.1	102.4	102.1	101.1	94.2	88.9	86.1	85.9	88.9	93.0	98.6	103.4	104.1	104.1
50.8	97.8	97.5	96.5	90.2	58.1	82.3	82.6	85.3	89.9	94.7	99.6	100.3	100.3
63.5	91.2	91.2	90.4	84.3	97.2	76.7	77.0	79.8	83.8	88.4	93.0	93.2	93.2
76.2	81.0	81.3	80.8	76.2	71.6	69.3	69.6	71.9	75.7	80.5	84.6	84.6	84.6
88.9	64.5	64.5	64.5	61.5	58.4	57.2	57.7	60.2	63.5	68.1	71.9	71.4	71.9
95.3	54.1	53.8	54.1	52.6	50.3	49.0	49.5	51.6	55.4	60.5	64.3	64.0	64.0
101.6	37.6	37.6	38.1	38.4	38.1	37.8	38.4	40.4	43.4	48.0	51.3	51.3	51.1

Dimension	mm
A	224.5
B	56.9
C	7.9

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform P													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	110.2	108.7	105.9	98.0	91.9	89.2	88.6	91.4	95.8	100.8	106.7	109.5	110.2
12.7	109.2	108.0	105.9	98.0	91.9	89.2	88.6	91.4	95.8	100.8	106.7	109.5	110.2
25.4	106.9	106.4	105.2	98.0	91.9	89.2	88.6	91.4	95.8	100.8	106.7	108.2	109.0
38.1	104.4	103.9	102.4	95.5	89.9	87.6	87.6	89.9	94.0	99.1	104.4	105.4	105.9
50.8	99.6	99.6	98.3	91.7	86.6	84.3	74.6	86.9	90.7	95.3	100.6	101.3	101.9
63.5	92.7	92.7	91.4	86.4	81.5	79.2	79.5	81.8	85.6	89.9	94.5	95.3	95.0
76.2	82.6	82.8	81.8	77.7	73.4	71.4	71.4	73.7	77.5	81.5	85.9	86.4	86.1
88.9	67.6	67.6	67.3	65.0	61.5	59.7	59.7	61.7	65.3	69.3	73.4	73.9	73.4
95.3	56.9	56.9	56.9	55.4	53.3	52.1	52.1	53.6	57.4	62.0	66.3	66.8	66.3
101.6	41.7	41.4	41.9	41.9	41.7	41.4	41.4	43.7	47.2	51.8	55.6	56.1	55.6
108.0	23.1	22.6	23.1	24.1	25.1	25.7	26.2	28.2	31.2	35.1	38.9	39.4	38.9

Dimension	mm
A	226.1
B	58.9
C	6.0

Table A.1  
Polar co-ordinates of horizontal cross-sections and other dimensions of wooden headform lettered  
A to Q ( to be read in conjunction with Figures A.1, A.2(1) and A.2(2)) (continued)

Units in millimetres

Headform Q													
Height above reference line	Front 0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	Rear 180°
0	112.0	110.2	107.2	99.6	93.7	90.7	90.2	92.7	97.3	102.6	108.2	110.5	112.0
12.7	111.0	109.5	106.9	99.6	93.7	90.7	90.2	92.7	97.3	102.6	108.2	110.5	112.0
25.4	109.0	107.7	106.2	99.6	93.7	90.7	90.2	92.7	97.3	102.6	108.2	109.5	110.5
38.1	105.9	105.2	103.9	97.3	91.9	88.9	88.6	91.2	95.5	100.6	105.4	106.7	107.4
50.8	101.3	100.8	99.8	93.7	88.4	85.9	85.6	87.9	91.9	97.0	101.3	101.9	102.6
63.5	95.5	95.3	94.2	88.4	83.1	80.5	80.3	82.6	86.9	91.7	96.0	96.0	96.5
76.2	84.8	85.1	84.6	79.8	74.9	72.9	72.6	74.7	79.0	83.8	88.1	88.1	88.1
88.9	69.6	70.6	70.1	66.8	63.0	61.5	61.5	63.0	67.1	72.6	76.2	76.2	76.2
95.3	60.4	61.0	60.7	58.4	55.1	53.8	54.1	55.6	59.7	64.5	69.3	69.3	69.3
101.6	47.2	47.5	47.8	46.7	45.0	43.9	44.2	46.0	49.8	54.6	59.2	59.4	59.4
108.0	28.7	29.0	29.2	29.5	29.2	29.2	29.7	31.2	34.8	39.1	43.4	43.4	43.4

Dimension	mm
A	227.8
B	61.0
C	4.0