Designation: F1587 – 12a

An American National Standard

# Standard Specification for Head and Face Protective Equipment for Ice Hockey Goaltenders[1]

This standard is issued under the fixed designation F1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

Ice hockey is a contact sport with intrinsic hazards. The use of protective equipment will not eliminate all injuries but should substantially reduce the severity and frequency of many injuries. Participation in the sport of ice hockey by a player implies acceptance of some risk of injury. The goal is to reduce the risk.

This performance specification for ice hockey goaltender head and face protective equipment has been prepared after consideration of head and face protection relative to the following principle risks: high-mass/low-velocity impact with respect to head protection, low-mass/high-velocity with respect to face protection (various playing situations), and fit. This performance specification may be modified as other risks are identified.

Performance requirements were determined after consideration of the state of the art of head and face protective design and manufacture. This specification was developed to address the unique demands and hazards associated with the position of ice hockey goaltender.

Two types of protectors are designated. Both types are subject to impact resistance and shock attenuation requirements. Type I protectors are subject to hockey stick blade penetration resistance requirements over their entire area of coverage. Type II protectors are subject to hockey puck penetration resistance requirements within the area of the field of vision and hockey stick blade penetration resistance requirements over the remainder of the area of coverage. It is recommended that Type II protectors be used only by players 18 years of age and older.

## 1. Scope

1.1 This performance specification[2] covers performance requirements for ice hockey goaltender head and face protectors.

1.2 The intent of this performance specification is to reduce the risk of injury to the head and face of ice hockey goaltenders without compromising the form and appeal of the game.

1.3 This specification has requirements for: *(1)* materials, assembly, and design; *(2)* protected areas (coverage) and penetration resistance; *(3)* shock absorption; *(4)* puck impact resistance; *(5)* extensibility and strength of the chin strap and its attachment; and *(6)* optical quality.

1.4 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[3]

[1] This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.15 on Ice Hockey.

Current edition approved Dec. 1, 2012. Published January 2013. Originally approved in 1995. Last previous edition approved in 2012 as F1587 – 12. DOI: 10.1520/F1587-12A.

[2] This performance specification is subject to revision as indicated by subsequent injury statistics and subject to review at least every five years.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D2240 Test Method for Rubber Property—Durometer Hardness

2.2 *CSA Standard:*

CSA Z262.6-02 Specifications for Facially Featured Headforms[4]

2.3 *CEN Standard:*

BS EN 960:2006 Headforms for Use in the Testing of Protective Helmets[5]

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *acceleration, a, of a body, n*—acceleration measured in metres per second squared.

3.1.1.1 *acceleration of a body as a result of gravity, n*—rate of change in velocity of a body that is subjected to gravity in units of $g$ where $g = 9.8$ m/s$^2$.

3.1.1.2 *acceleration, maximum, $a_{max}$, n*—highest point on the acceleration-time curve encountered during impact measured in units of $g$.

3.1.2 *backplate, n*—section of a goaltender's mask that covers the posterior of the wearer's head in a style of protector in which a front section and a rear section of the protector move relative to each other for the wearer to put on or remove the protector.

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

3.1.4 *chip, n*—readily visible particle missing from the protector with an area bigger than 9 mm$^2$.

3.1.5 *collimated light source (source of illumination), n*—quartz halogen lamp (17 lux) producing a 100-mm beam at a 6-m distance that is centered on the pupils of the eyes of the headform or the midpoint between the pupils of the eyes of the headform; this centering is maintained at all times during the optical quality test.

3.1.6 *combination, n*—combined unit of a face protector placed on a head protector with which it is designed to be used.

3.1.7 *computer interface, n*—linkage between the computer, the goniometer, and the sensors that enables a fully automated measurement process via a menu-driven operation during the optical quality test.

3.1.8 *drop height, n*—vertical distance between the lowest point (impact point) of the elevated mask and the apex of the impact surface.

3.1.9 *face protector, n*—protector, either specially adapted to a helmet or forming a continuous unit, that is designed to protect the wearer's head and face, or parts thereof, against injury.

3.1.10 *fastening system, n*—devices used to connect the components of a helmet.

3.1.11 *goaltender mask, n*—face protector intended for goaltenders that consists of: *(1)* a front portion to cover part of the face and jaw, *(2)* a covering for the eyes and face (face protector), and *(3)* a backplate.

3.1.12 *goniometer, n*—positioning device that moves the headform such that the angular rotation and movement in both the horizontal and vertical directions enable a spherical scan to be made of the fields of vision as seen through a face protector or visor.

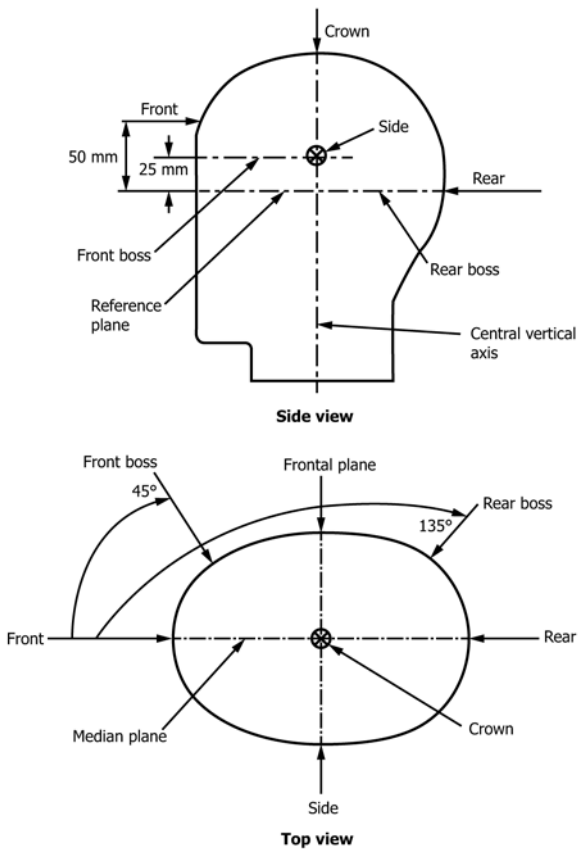
3.1.13 *helmet, n*—device worn on the head that is intended to reduce the risk of head injury to ice hockey participants. Helmets can include: *(1)* a shock-attenuating system, *(2)* a retention system, and *(3)* manufacturers' attachments.

3.1.14 *helmet-positioning index, HPI, n*—vertical distance measured at the median plane from the front edge of the helmet to the reference plane when the helmet is placed on the reference headform. In the case of a mask with an opening in which a face protector is attached, the top front edge of the opening shall be used.

3.1.15 *impact sites:—*

3.1.15.1 *non-prescribed, adv*—any impact site, except the six prescribed sites, on or above the test line and at least one fifth of the circumference of the headform from any prior impact site.

3.1.15.2 *prescribed, adv*—see Fig. 1.




NOTE 1—The impact direction is perpendicular to the surface of the headform for all impact sites.

**FIG. 1 Prescribed Impact Sites**

[4] Available from the Canadian Standards Association, 178 Rexdale Blvd., Toronto, ON M9W 1R3 Canada.

[5] Available from BSI Customer Services, 389 Chiswick High Rd., London W4 4AL United Kingdom.

*(1) front, adv*—located on the median plane and 50 mm above the anterior intersection of the median and reference planes.

*(2) front boss, n*—point on a plane 45° in a clockwise direction from the anterior intersection of the median and reference planes and 25 mm above the reference plane.

*(3) side, n*—located on the frontal plane and 25 mm above the point of intersection of the reference plane and the frontal plane.

*(4) rear boss, n*—point on a plane 135° in a clockwise direction from the anterior intersection of the median and reference planes on the reference plane. If the protector is a mask with a back plate, the impact shall be delivered on the back plate, 19 mm from any edge.

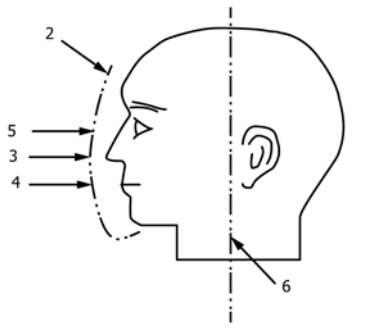
*(5) rear, n*— point at the posterior intersection of the median and reference planes.

*(6) crown, n*—point at the intersection of the median and frontal planes.

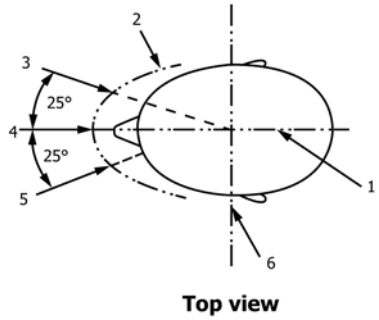
3.1.15.3 *puck impact sites, n*—for testing face protectors, see Fig. 2.

*(1) side impact, n*—point halfway between the mouth level and the eye level in the horizontal plane, 25° to the median plane and in the direction of the axis formed by the intersection of the median plane and the frontal plane.

*(2) eye impact, n*—point in the horizontal plane 25° to the median plane and in the direction of the eye.




Side view




Top view

1 Median plane
2 Face protector
3 Side impact site
4 Mouth impact site
5 Eye impact site
6 Frontal plane

**FIG. 2 Puck Impact Sites for Testing Face Protectors**

*(3) mouth impact, n*—point in the intersection between the horizontal plane and the median plane in the direction of the center of the mouth.

3.1.16 *laser, n*—luminous device used for alignment of the sensors.

3.1.17 *liner, n*—material inside the shell for the purpose of shock absorption or comfortable fit or both.

3.1.18 *model, n*—category of products that have the same essential characteristics (essential characteristics include materials, dimensions, construction, retention system, and protective padding).

3.1.19 *natural frequency, n*—frequency at which a system will tend to oscillate when displaced from its static equilibrium position.

3.1.20 *neck strap, n*—strap that is affixed to the two sides of the helmet and passes under the mandible in close proximity to the neck.

3.1.21 *no-contact zone, n*—designated zone of the headform where contact is not permitted during the puck impact resistance test (see 4.8 and Fig. 3).

3.1.22 *orbit, n*—the bony cavity containing the eyeball and other associated tissues.

3.1.23 *outer covering (shell), n*—outer material that gives the mask its form.

3.1.24 *peripheral field of vision, n*—projection outward of all retinal points (the nervous layer of the eye) at which visual sensations can be initiated (Fig. 4).

3.1.24.1 *inferior (downward), adv*—angle in the vertical plane measured downward from the horizontal plane.

3.1.24.2 *nasal, adv*—angle in the horizontal plane measured from the primary position of gaze to the left for the right eye and from the primary position of gaze to the right for the left eye.

3.1.24.3 *superior (upward), adv*—angle in the vertical plane measured upward from the horizontal plane.

3.1.24.4 *temporal, adv*—angle in the horizontal plane measured from the primary position of gaze to the right for the right eye and from the primary position of gaze to the left for the left eye.

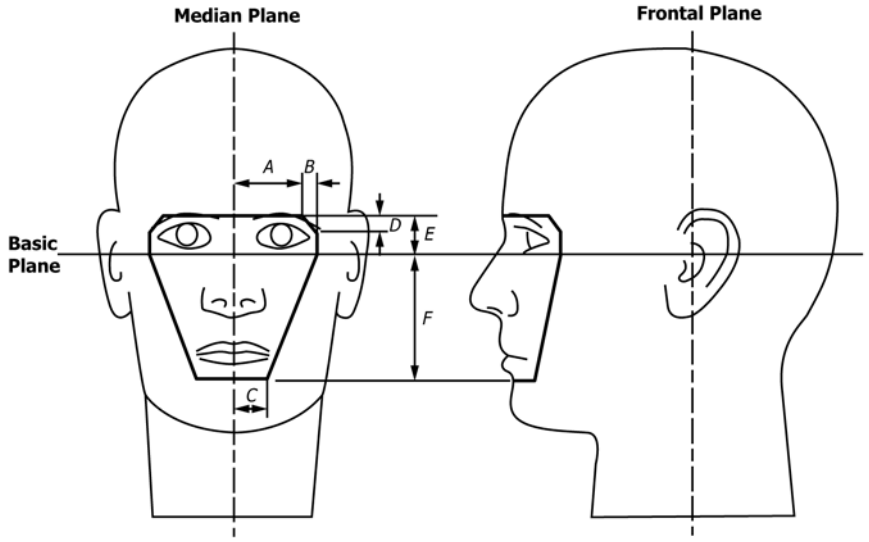
3.1.25 *permanent marking, n*—information that remains legible and cannot be removed in its entirety under conditions of normal use (see Section 7).

3.1.26 *photosensors, n*—sensors 5 mm in diameter centered in the pupils of the headform covered by a 5-mm translucent lens of 8-mm radius of curvature, convex forward.

3.1.26.1 *Discussion—(1)* The photosensors are cosine corrected, for example, provided with diffusing covers that are a means of correcting the light-sensitive surface for wide angles of incidence. *(2)* Light contact with the sensors produces an electrical signal that is fed into a computer interface.

3.1.27 *planes, n*—see Fig. 5.

3.1.27.1 *basic plane of the human head, n*—plane that is located at the level of the external upper borders of the ear canal (external auditory meatus) and the inferior margins of the orbits of the eyes.




| Facially Featured Headform (according to CSA Z262.6-02) | Dimensions (mm) | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Adult (50th percentile) | 48 | 16 | 28 | 17 | 36 | 68 |
| Juvenile | 60 | 0 | 25 | 0 | 36 | 60 |
| Child | 55 | 0 | 23 | 0 | 35 | 55 |

**FIG. 3 No-Contact Zone (Projected Dimensions)**

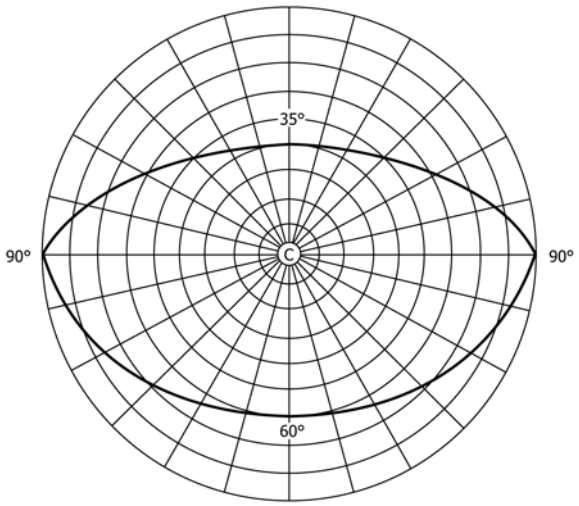



**FIG. 4 Peripheral Field of Vision**

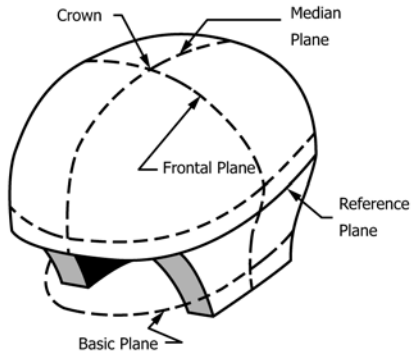



**FIG. 5 Orientation Planes**

3.1.27.2 *basic plane of a headform, n*—plane relative to the headform that corresponds to the basic plane of the human head.

3.1.27.3 *frontal plane, n*—vertical plane that is perpendicular to the median and reference planes and passes through the top of the headform.

3.1.27.4 *horizontal plane, n*—plane that passes across the head at right angles to both the frontal and median plane.

3.1.27.5 *median plane, n*—vertical plane that passes through the headform from front to back and divides the headform into right and left halves.

3.1.27.6 *reference plane, n*—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.

3.1.28 *primary position of gaze, n*—line running forward from the center of the pupil parallel to the median and horizontal planes.

3.1.29 *protector, n*—comprises a face protector either specially adapted to the helmet or forming a continuous unit designed to protect the whole or parts of the wearer's head and face against injury.

3.1.30 *retention system, n*—system that secures the helmet firmly to the head, when adjusted according to the manufacturer's instructions, by passing under the mandible in whole or in part.

3.1.31 *scan area, n*—oval area specified by superior, temporal, inferior, and nasal directions.

3.1.32 *scotomata, n*—blind spot in the field of vision.

3.1.33 *spherical impactor, n*—device made of low-resonance material that couples mechanically with the ball arm connector of a monorail drop assembly and is used for calibration of a monorail drop assembly.

3.1.33.1 *Discussion*—Low-resonance material includes magnesium, aluminum alloy, and stainless steel.

3.1.34 *subnasale, Sn, n*—deepest point on the concavity of the anterior surface of the maxilla in the midline, within 3.0 mm of the floor of the nose (see Fig. 6).

3.1.35 *support assembly, n*—drop assembly in the monorail system minus the weight of the headform, ball arm, ball clamp, ball clamp bolts, and accelerometer.

3.1.36 *test area, n*—area on and above the test line where an impact site is located.

3.1.37 *test line, n*—line that defines the boundaries of the test area.

3.1.38 *threshold value, n*—output reading obtained when the collimated light beam has been centered on the midpoint between the pupils in the primary position of gaze.

3.1.38.1 *Discussion*—The headform is rotated 90° in the horizontal plane, and the collimated light source contacts the pupillary sensor closest to the light source.

3.1.39 *types of protectors:—*

3.1.39.1 *Type I, n*—Combination head and face protectors that meet requirements for ice hockey stick blade penetration over the entire area of coverage.

3.1.39.2 *Type II, n*—Combination head and face protectors that meet the requirements for ice hockey puck penetration resistance over the area of the field of vision and the requirements for ice hockey stick blade penetration resistance over the remainder of the area of coverage.

## 4. Requirements

4.1 *General*—A goaltender mask shall be capable of meeting the requirements in this performance specification throughout its full range of adjustment.

4.2 *Material:*

4.2.1 *Integrity*—All materials used in the fabrication of masks shall be known to be suitable for the intended application. They shall be resistant to irreversible polymeric changes when exposed to temperatures of up to 70°C or ultraviolet radiation. All materials shall be rot resistant and shall not undergo significant loss of strength, flexibility, or other physical change as a result of contact with perspiration, oil, or grease from the wearer's hair. In addition, paints, glues, and finishes used in manufacture shall be compatible with the mask shell and shock absorption system materials.

4.2.2 *Cleaners*—Any material used in the construction of masks shall not be adversely affected by ordinary household soap and water, mild household detergent, or cleaners recommended by the manufacturer.

4.2.3 *Non-irritants*—Materials coming into contact with the wearer's head shall not be the type known to cause skin irritation or disease.

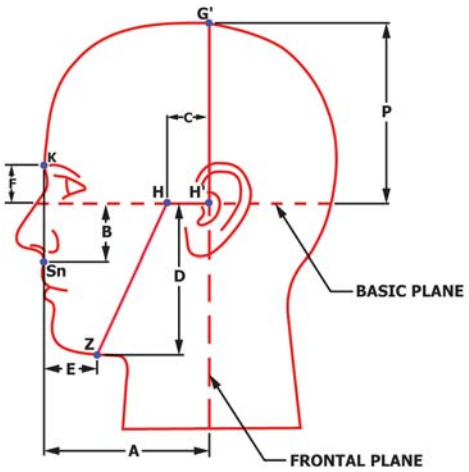
4.2.4 *Documentation*—The manufacturer shall provide documentation indicating that the materials used in the construction of the mask meet the requirements of 4.2.1 – 4.2.3.

4.3 *Assembly:*

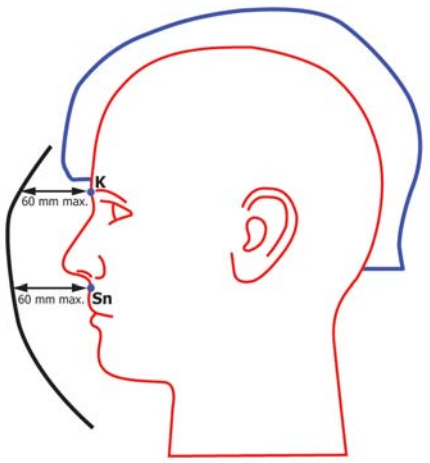
4.3.1 *Component Assemblies*—A goaltender mask may be assembled from a separate head and face protector provided that the combination meets all of the requirements of this specification and that the components are designed to be compatible without modification.

4.3.2 *Attachment System*—The mask shall be designed to allow the face protector to be attached to the helmet without requiring any operation of machines by the user.

4.3.3 The methods of assembling protector components shall be such as to prevent disengagement of the components




Goalkeeper G'-H'-H-Z-Z-H-H'-G'




| Facially Featured Headform (according to CSA Z262.6-02) | Dimensions (mm) | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | P |
| Adult (50th percentile) | 100.8 | 34 | 25.4 | 100.5 | 25 | 32 | 129.9 |
| Juvenile | 94.3 | 28 | 25.4 | 90 | 21 | 31 | 121.5 |
| Child | 91.1 | 22.5 | 25.4 | 79.5 | 21 | 21 | 102 |

**FIG. 6 Minimum Protected Area (Coverage) of the Face**

from each other and from the test headforms as a result of the tests performed under this specification.

4.3.4 Padding or cushioning material shall be incorporated in such a way as to cover all hard surfaces that could otherwise come into contact with the wearer's head. The method of securing padding shall not fail to maintain the padding material in position under normal conditions of heat, cold, moisture, or force distortion by the wearer.

4.4 *Design:*

4.4.1 *Finishes*—All parts shall be well finished and free of any sharp edges or other irregularities that could present a potential hazard to the user or an opposing player.

4.4.2 *External Projections*—In protectors that incorporate a backplate, the edge of the front section, which extends over the backplate, shall not project more than 25.4 mm beyond the adjacent edges of the backplate, as measured along a square-ended 12.7-mm diameter cylindrical rod, when the rod end is inserted behind the projecting edge of the front section and along the inner surface of the front section until the end of the rod is flush with the outer edge of the backplate.

4.4.3 *Access*—All protectors shall be so constructed that access to the wearer's face is provided, without the use of tools, and without causing movement to the cervical spine, in the event of injury. The access provided shall be sufficient for the administration of cardiopulmonary resuscitation to the wearer.

4.4.4 Protectors should be designed to minimize rotation on the head under the normal stresses encountered in use.

4.4.5 *Welded Wire Components*—All wire ends shall terminate at the perimeter of the wire component and shall overlap the shell material of the protector in such a way as to prevent stick or puck entry between components.

4.4.6 *Attachments*—The fasteners for securing components to the shell shall be so attached that the degree of protection afforded the wearer by the protective padding or cushioning material of the helmet is not thereby reduced.

4.4.7 *Maximum Distance (Face Protector to Headform)*—The distance measured on the median plane, parallel to the basic plane, between the inside of the face protector and Points K and Sn on the facially featured headform shall not exceed 60 mm (see Fig. 6).

4.4.8 *Minimum Distance (Face Protector to Headform)*—Except where it is covered by padding, no part of the mask shall be closer than 10 mm to the surface of the facially featured headform.

4.4.9 *Load-Bearing Area*—Masks shall have a minimum padded load-bearing area in accordance with Fig. 7.

4.4.10 *Overlap:*

4.4.10.1 Where the face protector portion is made to overlap the edges of the open front portion of the mask, it shall do so by at least 6 mm.

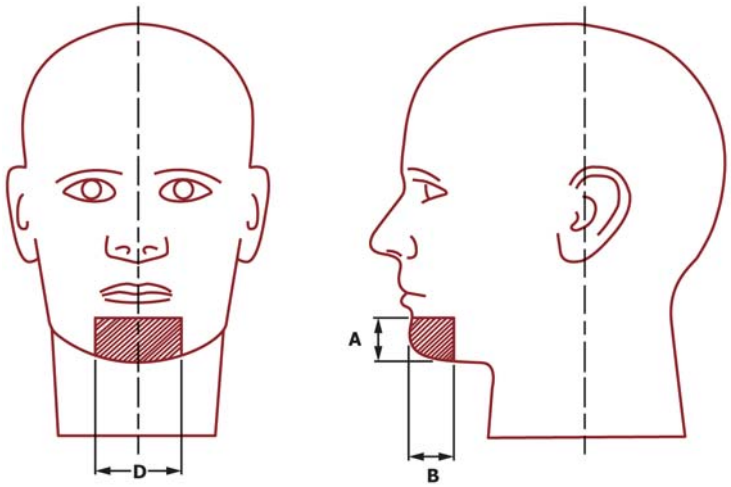
4.4.10.2 For a face protector/helmet combination, the face protector shall overlap the lower edge of the helmet by at least 6 mm.

4.5 *Protected Areas (Coverage):*

4.5.1 The protected areas shall correspond to the headform size with which the mask is to be tested.

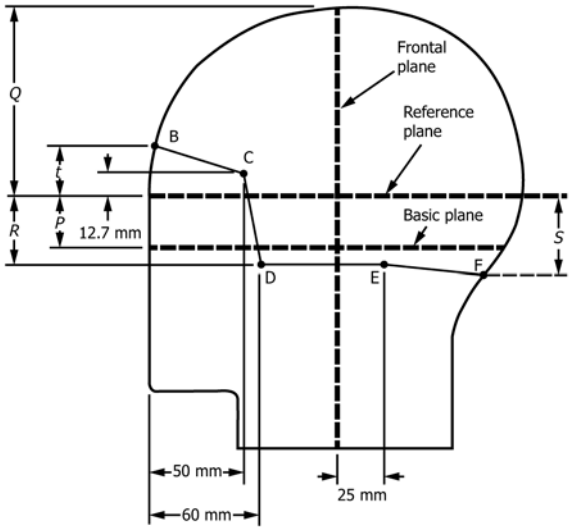
4.5.2 *Protected Area of the Head*—The mask shall cover, at minimum, the area above the Line B-CL-DL-EL-F-ER-DR –CR-B (where L is left and R is right) in Fig. 8 when the mask is tested in accordance with 5.4.1.

4.5.3 *Ear Aperture*—No ear aperture shall have a linear dimension exceeding 38 mm. The distance to any other edge of the helmet shall be not less than 20 mm. The ear aperture shall be completely surrounded by the outer covering of the mask (shell).




| Facially Featured Headform (according to CSA Z262.6-02) | Dimensions (mm) | | |
|---|---|---|---|
| | D | A | B |
| Adult (50th Percentile) | 53 | 18–27 | 18 |
| Juvenile | 48 | 15–24 | 15 |
| Child | 42 | 15–24 | 15 |

**FIG. 7 Minimum Load-Bearing Area**




| Headform Circumference, mm | Dimensions (mm) | | | | |
|---|---|---|---|---|---|
| | P | Q | R | S | T |
| 495 | 23.5 | 89.7 | 33.3 | 42.3 | 24 |
| 535 | 25.5 | 96 | 32 | 44 | 26 |
| 575 | 27.5 | 102.4 | 27.5 | 42.5 | 27 |
| 605 | 29 | 107.2 | 25 | 44 | 28 |

**FIG. 8 Minimum Protected Area (Coverage) of the Head**

4.5.4 *Ventilation Openings*—Ventilation openings shall meet the requirements of 4.6.

4.5.5 *Protected Area of the Face*—The mask shall cover the front portion of the area extending to at least the Line G'-H'L-HL-Z-HR-H'R-G' (where L is left and R is right) in Fig. 6 when the mask is tested in accordance with 5.4.2.

4.6 *Penetration Resistance*—With the exception of the ear apertures and when tested in accordance with 5.5:

4.6.1 *Type I*—There shall be no contact with the bare headform by the test blade within the protected areas.

4.6.2 *Type II*—There shall be no contact with the bare headform by *(1)* the test disk over the area of the field of vision and *(2)* the test blade over the remainder of the protected areas.

4.7 *Shock-Absorbing Capacity*—When tested in accordance with 5.6, no single impact shall exceed a peak acceleration of 275 *g* under all impact test conditions. The outer covering (shell) shall remain intact with no cracks visible through its thickness.

4.8 *Puck Impact Resistance:*

4.8.1 *Contact Test*—Neither the protector nor the puck shall touch the facially featured headform within the no-contact zone (see Fig. 3) when tested in accordance with 5.7. The shock-absorbing material at the load-bearing area shall remain securely attached to the face protector. There shall be neither breakage of the structural components of the face protector nor failure of the protector's points of attachment to the helmet. Cracking of surface coatings may be present, but there shall be no chips.

4.8.2 *Toughness Test*—When a mask is tested in accordance with 5.7, there shall be no breakage of the wire face protector.

4.9 *Retention System:*

4.9.1 *Neck Strap*—Protectors shall incorporate a neck strap with a minimum width of 13 mm.

4.9.2 *Extensibility and Strength*—When tested in accordance with 5.8, the displacement of the roller holder shall not exceed 25 mm during a load of between 5 and 110 N. The release force shall be not less than 110 N and not more than 300 N.

4.10 *Optical Quality:*

4.10.1 *Peripheral Field of Vision*—The field of vision for masks shall be tested in accordance with 5.9 at 20 ± 2°C. There shall be no occultation in the field of vision bounded by the following angles (see Fig. 4):

4.10.1.1 35° in the superior direction,

4.10.1.2 60° in the inferior direction,

4.10.1.3 90° in the temporal direction, and

4.10.1.4 45° in the nasal direction.

4.10.2 *Scotomata*—When tested in accordance with 5.9, face protectors shall have no overlapping bilateral scotomata in the field of vision.

## 5. Test Methods

5.1 *General:*

5.1.1 *Samples*—Only new and complete goaltender head/face protector combinations as offered for sale shall be tested. The masks shall be inspected visually and by hand before conditioning.

5.1.2 *Quantity*—For a given model/size, five complete masks and two additional face protectors shall be used as outlined in Tables 1 and 2. Samples shall be numbered 1, 2, 3, and so forth.

**TABLE 1 Protocol for Shock-Absorbing Capacity Testing**

NOTE 1—Masks shall be impacted three times at the site that yielded the highest peak *g* under ambient temperature conditions.

NOTE 2—An extra sample (No. 5) is reserved for failures.

| Sample No. (for Each Model Size) | Conditioning | Impact Site | Impacts per Site | Drop Velocity |
|---|---|---|---|---|
| 1 | Ambient temperature (see 5.2.1) | Crown, one side, front, front boss, rear boss, and rear (see Fig. 1) | 3 | 4.5 m/s ± 2 % |
| 2 | Ambient temperature (see 5.2.1) | Non-prescribed sites 1 and 2 (on or above the test line) | 3 | 4.5 m/s ± 2 % |
| 3 | Low temperature (see 5.2.2) | See Note 1 | 3 | 4.5 m/s ± 2 % |
| 4 | Elevated temperature (see 5.2.3) | See Note 1 | 3 | 4.5 m/s ± 2 % |

**TABLE 2 Protocol for Puck Impact Resistance Testing**

| Sample # | In combination with Helmet Sample # as identified in Table 1 | Test | Conditioning Temperature | Impact Sites | Puck Velocity | Test Method Clauses |
|---|---|---|---|---|---|---|
| 1 | 1 | | | eye | | |
| 2 | 2 | Contact | Ambient | mouth | 33 ± 1 m/s | |
| 3 | 3 | | | side | | 5.7 |
| 4 | | | | eye | | |
| 5 | 4 | Toughness | Low | mouth | 36 ± 1 m/s | |
| 6 | | | | side | | |
| 7 | 5 | | Ambient | | | 5.4.2, 5.5, 5.9 |

5.1.3 *Assembly*—Face protectors shall be assembled and mounted on the appropriate helmet in accordance with the manufacturer's instructions.

5.2 *Conditioning:*

5.2.1 *Ambient Conditioning*—The sample shall be exposed to a temperature of 20 ± 2°C and a relative humidity not exceeding 55 % for not less than 4 h.

5.2.2 *Low-Temperature Conditioning*—The sample shall be exposed to a temperature of −23 to −27°C. Helmets shall be conditioned for a period of not less than 4 h nor more than 24 h. Testing shall begin within 40 s of removal from the low temperature chamber.

5.2.3 *Elevated Temperature Conditioning*—The sample shall be exposed to a temperature of 30 ± 2°C for not less than 24 h. Testing shall begin within 40 s of removal from the heating chamber.

5.2.4 *Testing Conditioned Masks*—Testing shall be completed within 5 min after the removal of the mask from the conditioning environment specified in 5.2.2 and 5.2.3. Masks may be returned to the conditioning environment to meet this requirement. Before the resumption of testing, masks shall remain in the conditioning environment for a minimum of 15 min for each 5 min they are out of the conditioning environment.

5.3 *Helmet-Positioning Index (HPI) and Headform Size*—The HPI and corresponding headform size shall be specified by the mask manufacturer. Where the HPI and corresponding headform size are not available from the manufacturer, the mask shall not be tested.

5.4 *Protected Area (Coverage) Test:*

5.4.1 *Protected Area of the Head:*

5.4.1.1 *Headform*—The headforms specified in EN 960:2006 shall be used.

5.4.1.2 *Positioning*—The mask shall be positioned on the largest headform for its size range using the HPI (see 5.3). A load of 50 N shall be applied to the crown of the helmet, perpendicular to the helmet, to seat the helmet to the headform.

5.4.2 *Protected Area of the Face:*

5.4.2.1 *Headform*—The facially featured headforms specified in CSA Z262.6-02 shall be used.

5.4.2.2 *Positioning*—The masks shall be positioned on the largest headform for their size range so that the chin load-bearing component of the protector (that is, chin cup) rests on the chin of the headform (see Fig. 7).

5.4.3 The mask shall cover the areas of protection as required in 4.5.

5.5 *Penetration Test:*

5.5.1 *Test Apparatus*—The apparatus consists of:

5.5.1.1 *Headform*—Headforms to be used for the penetration tests shall be in accordance with:

*(1)* EN 960:2006 when testing the protected area of the head and

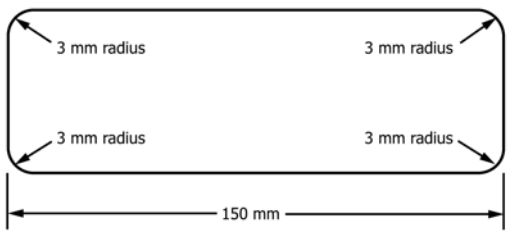
*(2)* CSA Z262.6-02 facially featured headforms when testing the protected area of the face.

5.5.1.2 Test blade in accordance with Fig. 9, made of steel (Type I and II) and

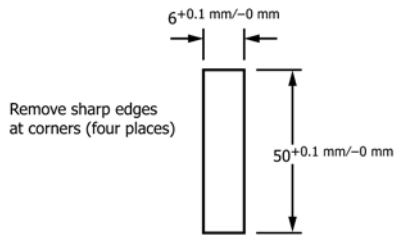
5.5.1.3 Test disk in accordance with Fig. 10, made of steel (Type II).

5.5.2 *Procedures:*

5.5.2.1 In general, an attempt shall be made to contact the headform by trying to enter the penetrator (at any angle and, in principle, without force) through openings within the protector's perimeter and over the protected areas as specified in 5.5.2.2 and 5.5.2.3, excluding the ear apertures. Record whether contact with the bare headform surface is made or not. Specifically:




**Front view**




**End view**

**FIG. 9 Test Blade (Penetrator)**

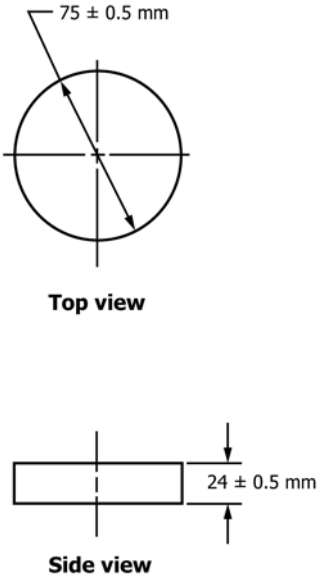



**FIG. 10 Test Disk (Penetrator)**

5.5.2.2 *Penetration Test Over the Protected Area of the Head:*

*(1) Mask Positioning*—The mask shall be positioned on the largest headform for its size range using the HPI (see 5.3).

*(2) Penetration Test*—An attempt shall be made to contact the headform through all of the protector's openings within the protected area defined in 4.5.2 and Fig. 8 using the test blade.

5.5.2.3 *Penetration Test Over the Protected Area of the Face:*

*(1) Mask Positioning*—The mask shall be positioned on the largest headform for its size range so that the chin load-bearing component of the protector (that is, chin cup) rests on the chin of the headform.

*(2) Penetration Test (Type I)*—An attempt shall be made to contact the headform through all of the protector's openings within the protected area defined in 4.5.5 and Fig. 6, using the test blade, or

*(3) Penetration Test (Type II)—(1)* An attempt shall be made to contact the headform through all of the openings within the protector's field of vision using the test disk and *(2)* an attempt shall be made to contact the headform through all of the protector's openings within the remainder of the protected area defined in 4.5.5 and Fig. 6 using the test blade.

5.6 *Shock-Absorbing Capacity Test:*

5.6.1 *Apparatus*—Impact tests shall be performed on the test apparatus specified in Annex A1.

5.6.2 *Headforms*—Headforms used in the impact testing of masks shall be in accordance with Annex A1.

5.6.3 *Impact Sites:*

5.6.3.1 *General*—The impact sites shall consist of the six prescribed sites (that is, crown, front, front boss, rear, rear boss, and side; see Fig. 1 and two non-prescribed sites). The impact direction shall be perpendicular to the headform surface for all impact sites.

5.6.3.2 *Non-prescribed*—Each of the two non-prescribed impact sites shall be located on the headform on or above the test line and shall be at least one fifth of the circumference of the headform from any prior impact location on that helmet. The headform shall be positioned so that the impact location is the first point of contact with the anvil. The helmet shall then be positioned on the headform as specified by the manufacturer's HPI. The resulting two non-prescribed impacts shall be identified by:

*(1)* The arc distance along the reference plane from the anterior intersection of the median and reference planes (either clockwise or counterclockwise) and

*(2)* The perpendicular arc distance above or below that point on the reference plane.

5.6.3.3 *Test Line*—Test Line A-B-C-D-E-F shall be drawn on the headform in accordance with Fig. 11.

5.6.3.4 *Locating the Non-Prescribed Impact Sites*—Non-prescribed impact sites shall be located by:

*(1)* Selecting and marking the impact site on the headform. The helmet shall then be placed on the headform as specified by the manufacturer's HPI, and the corresponding impact location shall be marked on the helmet before performing the impact or

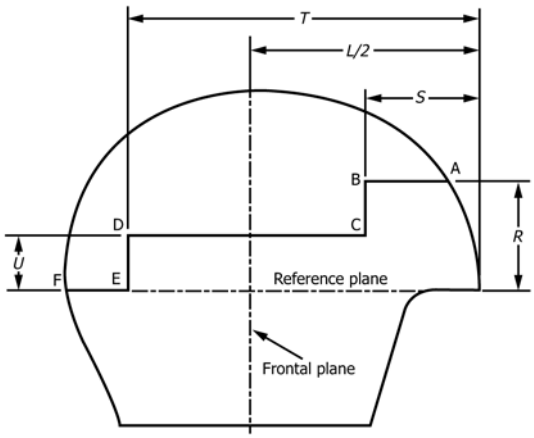
*(2)* Selecting and marking the impact site on the helmet, then marking the location on the headform, respecting HPI, and assuring that the corresponding mark on the headform should be on or above the test line for all impact locations.

5.6.4 *Procedure:*

5.6.4.1 *General*—Testing shall be performed in accordance with 5.6.4.2 – 5.6.6.2 and Table 1.

5.6.4.2 *Time Interval Between Impacts*—The time between impacts for each site shall be not less than 30 s and not more than 90 s.

5.6.4.3 *Velocity Measurement*—The drop velocity of the headform shall be measured with an accuracy of ±1 %, at a distance not exceeding 30 mm from the impact site, before impact.




| Headform Circumference, mm | Dimensions (mm) | | | | |
|---|---|---|---|---|---|
| | L/2 | R | S | T | U |
| 495 | 87.8 | 50 | 19.5 | 137 | 25 |
| 535 | 94.3 | 50 | 20.5 | 146.5 | 25 |
| 575 | 100.8 | 50 | 20.5 | 155 | 25 |
| 605 | 105.6 | 50 | 23.5 | 161 | 25 |

**FIG. 11 Test Line for Non-prescribed Impact Sites**

5.6.5 *Mask Positioning*—Before positioning the mask, remove the face protector. The mask shall be positioned on the largest headform for its size range, using the HPI (see 5.3). The mask shall be secured to the headform such that it does not shift position before or during impact. The retention system shall not interfere with the fall or impact of the helmeted headform.

5.6.6 *Test Records:*

5.6.6.1 *Data*—The measured and calculated results ($g_{max}$) shall be recorded in a table complete with acceleration/time diagrams and coordinates of the non-prescribed impact sites.

5.6.6.2 *Damage*—The extent of any significant damage shall be recorded.

5.7 *Puck Impact Resistance Test (Face Protector):*

5.7.1 *Impact Sites*—The impact sites are shown in Fig. 2 and described in 3.1.15.3.

5.7.2 *Apparatus:*

5.7.2.1 *Puck Accelerator*—A device shall be used that can give a hockey puck a specific velocity, direction, and with minimal rotation (see Fig. 12). The velocity shall be adjustable between 33 and 36 m/s with an accuracy of ±1 m/s.

5.7.2.2 *Maximum Distance*—The puck shall be directed toward the impact site with as little rotation as possible. The distance between the impact site on the sample and the end of the guiding device shall not exceed 600 mm (see Fig. 12).

5.7.2.3 *Headform Base*—The test apparatus shall include a horizontal base for a facially featured headform. The headform shall be aligned vertically with and attached to the horizontal base.

5.7.2.4 *Headform*—The facially featured headforms shall be used in accordance with CSA Z262.6-02.

5.7.2.5 *Velocity Measurement*—The velocity shall be measured no more than 600 mm from the site of impact. The equipment for measuring and recording the velocity of the puck shall be capable of measuring the velocity with a tolerance of ±1 m/s.

5.7.2.6 *Contact Determination*—To indicate contact between the face protector and the facially featured headform during testing, a suitable agent shall be used, for example, modeling clay or pressure-sensitive paste.

5.7.3 *Face-Protector/Mask Combination*—If the face protector is intended to fit several models of masks, one such combination shall be tested completely. The other combinations need only undergo the test(s) specified for ambient conditioning.

5.7.4 *Procedures:*

5.7.4.1 *General*—The testing shall be carried out in accordance with Table 2 using a test apparatus as described in Fig. 12.

5.7.4.2 *Assembly*—Assemble the face protector and mount on the appropriate mask in accordance with the manufacturer's instructions.

5.7.4.3 *Contact Indicator*—Apply contact indicator agent (5.7.2.6) over the no-contact zone of the headform to a maximum thickness of 1 mm.

5.7.4.4 *Headform Positioning*—Place the facially featured headform in front of the puck accelerator so that the center line of the path of the puck coincides with the center of the point to be impacted.

5.7.4.5 *Mask Positioning*—The mask shall be positioned on the largest headform for its size range so that the chin load-bearing component of the protector (that is, chin cup) rests on the chin of the headform (see Fig. 7).

5.7.4.6 *Data*—The puck is shot with the velocity stated in Table 2. After each impact, inspect the headform and the protector.

*(1) Contact Tests*—Record whether the face protector has touched the headform or not. Record any damage (deformation, cracking, breakage, and separation from the helmet) as well as any chips.

*(2) Toughness Tests*—Recording of wire or weld breakage, or both, is only necessary.

5.8 *Retention System Test:*

5.8.1 *Apparatus*—The test apparatus shall consist of:

5.8.1.1 A headform in accordance with EN 960:2006,

5.8.1.2 Free-moving rollers, and

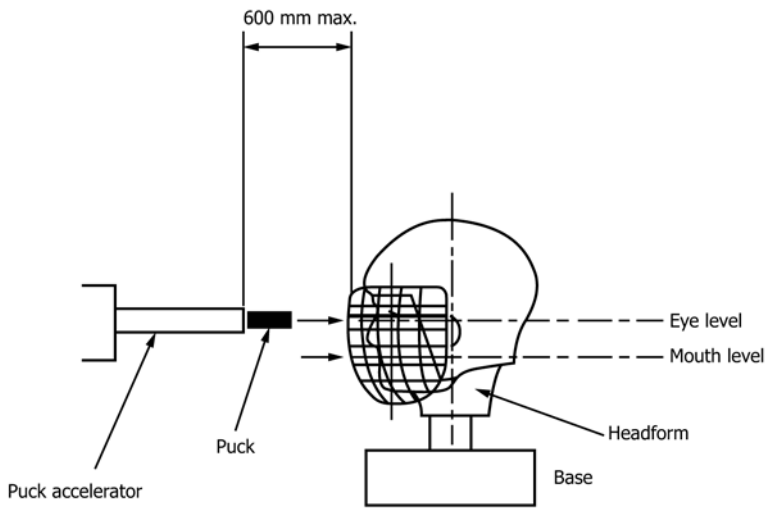



**FIG. 12 Puck Impact Resistance Test Apparatus**

5.8.1.3 An adjustable mass of between 0.5 and 50 kg.

5.8.2 *Procedures:*

5.8.2.1 *Positioning*—An ambient-conditioned helmet that has just undergone the shock-absorbing capacity test shall be positioned on the largest headform for its size range using the HPI (see 5.3). The chin or neck strap or both shall be adjusted so that there is approximately 25 mm of free strap outside the adjusting device (see Fig. 13).

5.8.2.2 *Extensibility*—Extensibility shall be determined as follows:

*(1)* The retention strap shall be placed around a set of two rollers as shown in Fig. 13;

*(2)* A force of 5 N shall be applied for 60 s to remove initial slack in the strap;

*(3)* The vertical position of the roller holder shall be recorded to the nearest 1 mm;

*(4)* The force shall be increased uniformly (that is, without jerking to avoid inertial loads) for 15 s to 110 N, at which point the vertical position of the roller holder shall be recorded immediately; and

*(5)* The measurement specified in 5.8.2.2*(3)* shall be subtracted from the measurement specified in 5.8.2.2*(4)*. The difference shall be the amount of extensibility (see 4.9.2).

5.8.2.3 *Releasing Force*—To check the releasing force of the fastening device, the force shall be increased uniformly until the device releases, up to a maximum of 500 N. The releasing force shall be recorded (see 4.9.2).

5.9 *Vision Quality Test:*

5.9.1 *Headform*—The facially featured headforms shall be used in accordance with CSA Z262.6-02.

5.9.2 *Mask Positioning*—The mask shall be adjusted and positioned on the largest headform for its size range using the HPI (see 5.3).

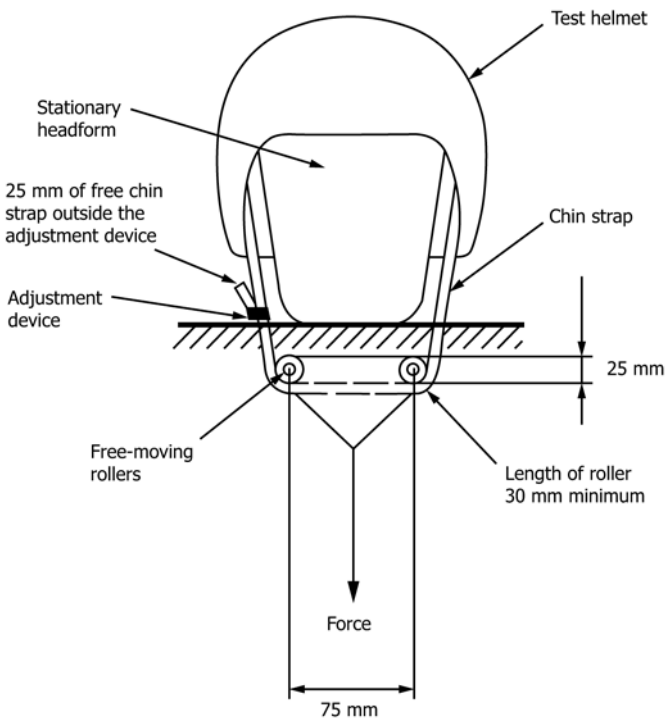



**FIG. 13 Retention System Test Apparatus**

5.9.3 The peripheral field of vision shall be tested in accordance with Annex A2.

5.9.4 The scotomata shall be tested in accordance with Annex A2.

## 6. Report

6.1 The test report shall include at least the following information:

6.1.1 The designation of this performance specification,

6.1.2 The name or trademark of the manufacturer or the body taking responsibility for manufacture,

6.1.3 Identification details such as model and size range of the goaltender mask tested (including the face protector),

6.1.4 A description of the goaltender mask (including the face protector),

6.1.5 Results of tests conducted in accordance with Section 5,

6.1.6 Documentation required in Sections 4 and 5,

6.1.7 Date of testing,

6.1.8 Coordinates of the non-prescribed impact sites (as per 5.6.3.2), and

6.1.9 Name of the testing laboratory.

## 7. Permanent Markings

7.1 Each helmet and face protector shall be marked permanently and legibly with the following information:

7.1.1 On both the head and face protectors:

7.1.1.1 Name or trademark of the manufacturer or the body taking responsibility for manufacturing,

7.1.1.2 The designation of the model,

7.1.1.3 The size or size range (quoted as the circumference, in centimeters, in the case of the head protector), and

7.1.1.4 Date code (as a minimum, the week and year of manufacture).

7.1.2 On the head protector only:

7.1.2.1 The designation “ice hockey goaltender mask”,

7.1.2.2 The designation of this performance specification,

7.1.2.3 The product type (I or II), and

7.1.2.4 A permanent warning, in a contrasting color on the exterior of the mask, informing the user of the limits of protection afforded by the protector. The warning shall contain, at minimum, the following information:

“Ice hockey is a sport in which there is an intrinsic risk of injury. Use of head and face protectors meeting the requirements of this performance specification will not prevent all injuries. Severe head, brain, or spinal injuries, including paralysis or death, can occur in spite of using a head and face protector certified to this performance specification. Discard and replace this product if it has been damaged or has deteriorated in any way. Read instructions carefully before wearing.”

NOTE 1—The precise wording of this warning is at the discretion of the party submitting the product for testing.

## 8. Information for Users

8.1 The following information shall accompany each goaltender mask and face protector combination:

8.1.1 Instructions for the purchaser, including information for proper fit, comfort, and use;

8.1.2 Cleaning and caring instructions including a warning that cleaning agents, paints, decals, or anti-fog material shall not be applied unless authorized by the manufacturer;

8.1.3 The protector shall be replaced if it has been exposed to violent impact or another stress that may have reduced its protective function;

8.1.4 Consumers should use care to select a goaltender mask that fits properly and is comfortable and lightweight;

8.1.5 Instructions concerning the assembly of the face protector to the mask;

8.1.6 The specific masks with which the face protector is intended to be used with (when sold separately); and

8.1.7 A notification that the protector meets the minimum requirements of this performance specification provided it has not been reconditioned or altered in any way.

## 9. Keywords

9.1 goaltender; head and face protector; ice hockey; protective equipment

## ANNEXES

**(Mandatory Information)**

## A1. IMPACT DROP TEST USING A GUIDED DEVICE

### A1.1 General

A1.1.1 A device capable of providing a gravity-assisted guided drop shall be used. The device shall include an adjustable mounting system that allows impacts to be delivered to any location on the mask within the test area.

### A1.2 Test Apparatus

A1.2.1 The test apparatus shall consist of:

A1.2.1.1 A EN960:2006 sectioned magnesium headform fitted with a uniaxial accelerometer,

A1.2.1.2 An anvil rigidly fixed to a base,

A1.2.1.3 An impact surface fixed to the base,

A1.2.1.4 A monorail or twin-wire guidance system, and

A1.2.1.5 A system for acquiring and recording test data.

A1.2.1.6 See Fig. A1.1 or Fig. A1.2.

### A1.3 Impact Base and Impact Surface

A1.3.1 The impact base shall be firmly attached to a concrete floor and shall consist of a rigid steel slab with a minimum mass of 136 kg and a minimum thickness of 50 mm.

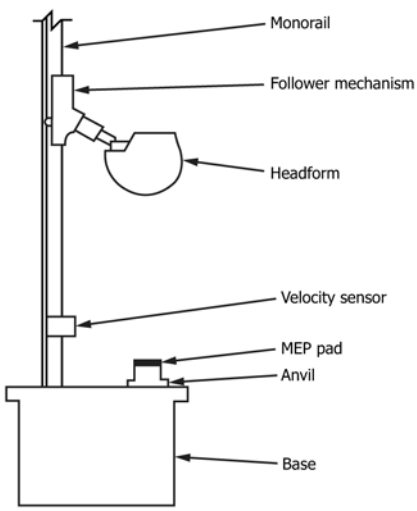



**FIG. A1.1 Monorail-Guided Drop Test Apparatus**

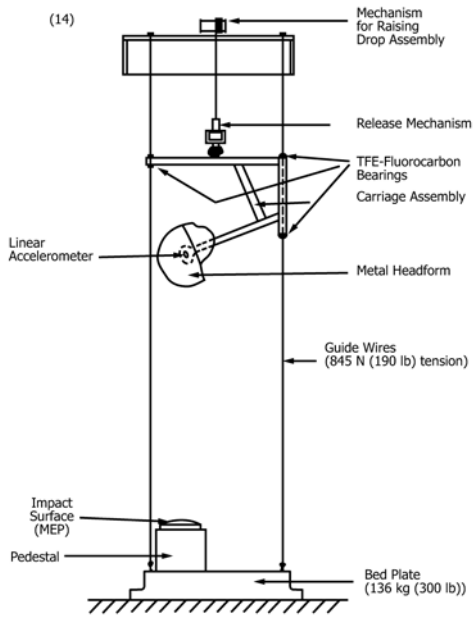



**FIG. A1.2 Twin-Wire-Guided Drop Test Apparatus**

A1.3.2 The impact surface for system verification and for testing shall be a flat modular elastomer programmer (MEP) that is:

A1.3.2.1 A diameter of 152 mm,

A1.3.2.2 A thickness of 25 mm,

A1.3.2.3 Fixed firmly to the top surface of a flat anvil, and

A1.3.2.4 A 60 ± 5 Shore Type A durometer hardness impact surface. The top surface of the base may be used as the flat metal anvil provided that it is faced with a steel plate with minimum thickness of 25 mm and a minimum top surface area of 0.09 $m^2$.

### A1.4 Headform Carriage Assembly

A1.4.1 The mobile system supporting the headform shall not affect the measurement of acceleration at the center of gravity of the headform. It shall also allow any impact site to

be positioned vertically above the center of the anvil. The rail shall be such that the impact velocity is not less than 95 % of the theoretical velocity.

### A1.5 Headforms

A1.5.1 A headform shall be used that:

A1.5.1.1 Is capable of accepting an accelerometer mounted vertically at its center of gravity,

A1.5.1.2 Conforms to the requirements of EN960:2006, and

A1.5.1.3 Has no natural resonant frequencies below 3000 Hz.

A1.5.1.4 The headform and supporting assembly shall have a combined mass in accordance with Table A1.1. The supporting assembly shall make up no more than 50 % of the total mass.

### A1.6 Instrumentation

A1.6.1 An uniaxial accelerometer shall be mounted at the center of gravity of the test headform. The transducer shall be capable of withstanding a shock of 1000 *g* without damage.

A1.6.2 Natural frequencies of a particular headform type, up to and including the third harmonic, shall be recorded. Means for determining and recording the magnitude of the resultant acceleration vector (*a* in *g* units) and impact velocity shall be available. A permanent hard copy record (that is, acceleration time curve) of trials shall be attached to written reports.

### A1.7 Signal Conditioning

A1.7.1 An ISO 6487 CFC 1000 low-pass filter shall be used for conditioning the accelerometer signal. Where a computer is used as a readout device, a sampling rate of 10 000 samples per second shall be used for each channel of the accelerometer signal.

**TABLE A1.1 Headform Mass**

| Headform Circumference, mm | Mass, g |
|---|---|
| 495 | 3100 ± 100 |
| 535 | 4100 ± 120 |
| 575 | 4700 ± 140 |
| 605 | 5600 ± 160 |

### A1.8 System Verification

A1.8.1 Performance of the data acquisition system shall be checked before the start and upon completion of all impact tests that use a spherical impactor, under a guided or free fall, to strike an MEP pad attached to the anvil.

A1.8.2 The mass of the drop assembly (that is, the combined mass of the instrumented spherical impactor and support assembly) shall be 5.0 ± 0.1 kg. The spherical impactor shall:

A1.8.2.1 Be capable of holding an accelerometer at its center of mass,

A1.8.2.2 Be made of a low-frequency response material (for example, magnesium), and

A1.8.2.3 Have a striking surface radius of 73 ± 1 mm.

A1.8.3 The MEP pad shall:

A1.8.3.1 Have a diameter of 152 mm,

A1.8.3.2 Have a thickness of 25 mm,

A1.8.3.3 Have a Shore Type A durometer hardness of 60 ± 5, and

A1.8.3.4 Be affixed to an aluminum plate with the thickness of 6 mm.

A1.8.3.5 The spherical impactor shall strike the center of the pad with a velocity of 5.2 m/s ± 2 % measured over the last 40 mm of fall.

A1.8.4 Six impacts, at intervals of 75 ± 15 s, shall be performed before and after the testing program. The first three impacts shall be used to warm up the pad; the peak acceleration of the remaining three shall be recorded. The mean of the three post-test results shall not differ by more than 5 % from the mean of the three pretest results. Where the difference is greater than 5 %, the results shall be discarded and the source of the difference shall be identified and corrected. The tests shall then be repeated with new samples.

A1.8.5 The system check shall not preclude the need to calibrate the data acquisition system and the instrumentation to national standards at an interval determined appropriate by the laboratory.

## A2. METHOD FOR MEASURING PERIPHERAL FIELD OF VISION AND BILATERAL SCOTOMATA

### A2.1 Test Apparatus (see Fig. A2.1)

A2.1.1 *Headform:*

A2.1.1.1 Headforms used for the test shall comply with CSA Z262.6-02.

A2.1.1.2 Each pupil of the headform shall be represented by a photosensor and shall be covered by a 5-mm-diameter translucent lens with an 8-mm radius of curvature, convex forward. The sensors shall be connected to a computer that records light contact with the pupillary sensors as “go” or “no go.”

A2.1.2 *Goniometer*—A goniometer shall be used to rotate the headform.

A2.1.3 *Collimated Light Source*—A 100-mm-wide, 17-lux collimated light source (for example, a slide projector lamp) shall be used to identify the pupillary targets.

### A2.2 Procedure

A2.2.1 *Setup:*

A2.2.1.1 *Headform*—The headform used for the test shall be the size that best fits the mask when adjusted to its largest size.

A2.2.1.2 *Goniometer*—The headform shall be positioned on and affixed to the goniometer.

A2.2.1.3 *Signal Output*—The collimated light source shall be centered on the midpoint between the pupils at a minimum distance of 6 m from the headform. The light threshold shall be the number recorded from the sensor when contacted by light coming from 90° to the side of the headform on the horizontal plane. Light contact with the sensors shall produce an electrical signal that is fed into a computer (see A2.1.1.2).

A2.2.1.4 *Positioning*—The mask shall be positioned on the headform using the manufacturer's HPI.

A2.2.2 *Signal Output*—The computer interface shall translate the signal output from the photosensors into a number (i.e., a digital signal).

### A2.3 Test Procedure

A2.3.1 The field-of-vision computer software program shall rotate the goniometer to the angles specified in 4.9.

NOTE A2.1—To facilitate testing, the menu-driven question/answer session (requesting name, model, and scan area) should be followed.

A2.3.2 A reading below the threshold value (see A2.2.1.3) shall constitute failure of the test.

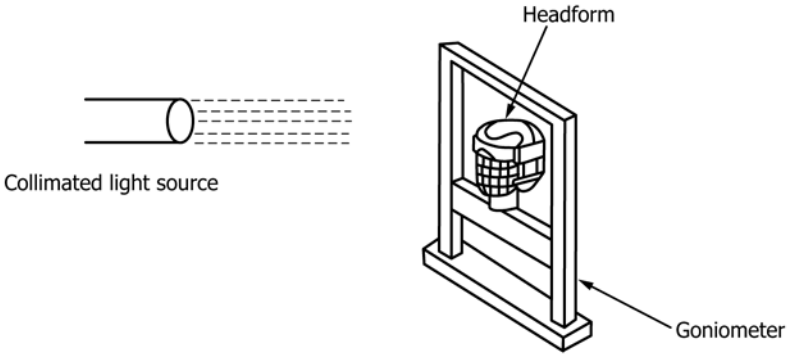



**FIG. A2.1 Peripheral Field-of-Vision Test Apparatus**

## A3. PUCK SPECIFICATIONS

### A3.1 General

A3.1.1 This Annex provides requirements for pucks intended for use in the testing of protectors within the scope of this performance specification.

### A3.2 General Requirements

A3.2.1 *Material*—The puck shall be as offered for sale as a "hockey puck" and shall consist of a hard rubber compound based on:

A3.2.1.1 Natural rubber,

A3.2.1.2 Synthetic polyisoprene,

A3.2.1.3 Styrene butadiene copolymer, or

A3.2.1.4 A mixture of the materials specified in A3.2.1.1 – A3.2.1.3.

A3.2.2 *Diameter*—The diameter of the puck shall be 76.2 ± 0.6 mm.

A3.2.3 *Thickness*—The thickness of the puck shall be 25.4 ± 0.6 mm.

A3.2.4 *Flatness*—The top and bottom surfaces of the puck shall be flat.

A3.2.5 *Knurl*—The curved circumferential surface of the puck shall be finished with a knurl.

A3.2.6 *Mass*—The mass of the puck shall be not less than 155 g and not more than 170 g.

### A3.3 Physical Properties

A3.3.1 *Hardness at Room Temperature*—The Shore Type C durometer hardness at room temperature shall be not less than 55 points and not greater than 65 points (see A3.4.1).

A3.3.2 *Hardness at 0°C*—The Shore Type C durometer hardness at 0°C shall be a maximum of 7 points greater than the hardness determined at room temperature (see A3.3.1 and A3.4.1).

### A3.4 Test Methods

A3.4.1 *Hardness at Room Temperature*—The hardness of the puck shall be determined in accordance with Test Method D2240.

A3.4.2 *Hardness at 0°C*—The puck shall be conditioned for a period of 1 h in a mixture of ice and water. The hardness at 0°C shall be determined immediately after removal from the ice and water in accordance with Test Method D2240.