Designation: F513 – 12

An American National Standard

Standard Specification for Eye and Face Protective Equipment for Hockey Players[1]

This standard is issued under the fixed designation F513; 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.

1. Scope

1.1 This specification covers performance requirements and test methods for face protectors marketed, sold, and intended for ice hockey.

1.2 The intent of this specification is to reduce the risk of injury to the face without compromising the form or appeal of the game. To do so, the face protector shall be used:

1.2.1 As intended within the rules of the game and

1.2.2 In accordance with the manufacturer's instructions.

1.3 Ice hockey is a sport with intrinsic hazards associated with the normal conduct of the game. Participation in ice hockey implies the acceptance of some risk of injury. Use of a face protector certified to this specification will not prevent all injuries.

1.4 This specification has been prepared after careful consideration of the frequency and mechanisms associated with facial and eye injuries that can potentially occur within the rules of the game of ice hockey.

1.5 Requirements and the corresponding test methods, where appropriate, are given for the following:

1.5.1 Construction,

1.5.2 Puck impact resistance,

1.5.3 Penetration,

1.5.4 Field of vision, and

1.5.5 Marking and information.

1.6 Face protection is intended for use by players, goalkeepers, and certain functionaries (for example, referees and coaches). Types of protectors considered under this specification are:

1.6.1 *Type B1*—A full-face protector intended for use by persons older than ten years of age, other than goaltenders;

1.6.2 *Type B2*—A full-face protector intended for use by persons ten years of age or younger, other than goaltenders; and

1.6.3 *Type C (Visor)*—A visor intended for use by person in the junior age category and older, other than goaltenders.

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

1.8 Use of the singular does not exclude the plural (and vice versa) when the sense allows.

1.9 Although the intended primary application of this specification is stated in this scope, note that it remains the responsibility of the users of this specification to judge its suitability for their particular purpose.

1.10 *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:*[2]

D1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics

D2240 Test Method for Rubber Property—Durometer Hardness

2.2 *CSA Standard:*

CSA Z262.6-02 Specifications for Facially Featured Headforms[3]

3. Terminology

3.1 *Definitions:*

3.1.1 For the purposes of this specification, the following definitions apply.

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

3.1.3 *collimated light source (source of illumination), n*—quartz halogen lamp (17 lx or 1.58 footcandles) producing a 100-mm beam at 6-m distance that is centered on the pupils of the eyes of the headform or the midpoint between the pupils

[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.

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[2] 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.

[3] Available from the Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario L4W 5N6 Canada.

of the eyes of the headform; this centering is maintained at all times during the optical quality test.

3.1.4 *combination, n*—combined unit of a full-face protector or visor placed on a hockey helmet with which it is designed to be used.

3.1.5 *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.

3.1.6 *dioptre, n*—measure of the power of a lens or a prism equal to the reciprocal of its focal length expressed in metres.

3.1.7 *field of vision, n*—projection outward of all retinal points (the nervous layer of the eye) at which visual sensations can be initiated (see Fig. 1).

3.1.7.1 *inferior (downward), adv*—refers to an angle in the vertical plane measured downwards from the horizontal.

3.1.7.2 *nasally, adv*—refers to an 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.

3.1.7.3 *superior (upward), adv*—refers to an angle in the vertical plane measured upwards from the horizontal.

3.1.7.4 *temporally, adv*—refers to an 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.

3.1.8 *glabella, n*—most prominent midline point between the eyebrows identical to the bony glabella of the frontal bone.

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

3.1.10 *haze, n*—percentage of transmitted light that, in passing through the specimen, deviates from the incident beam by forward scattering.

3.1.11 *helmet positioning index, HPI, n*—vertical distance measured at the median plane, from the front edge of the helmet to the basic plane, when the helmet is placed on the reference headform.

3.1.12 *impact sites for testing face protectors:—*

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

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

3.1.12.3 *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 (see Fig. 2).

3.1.13 *interpupillary distance, PD, n*—distance in millimetres between the centers of the pupils of both eyes on the facially featured headform.

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

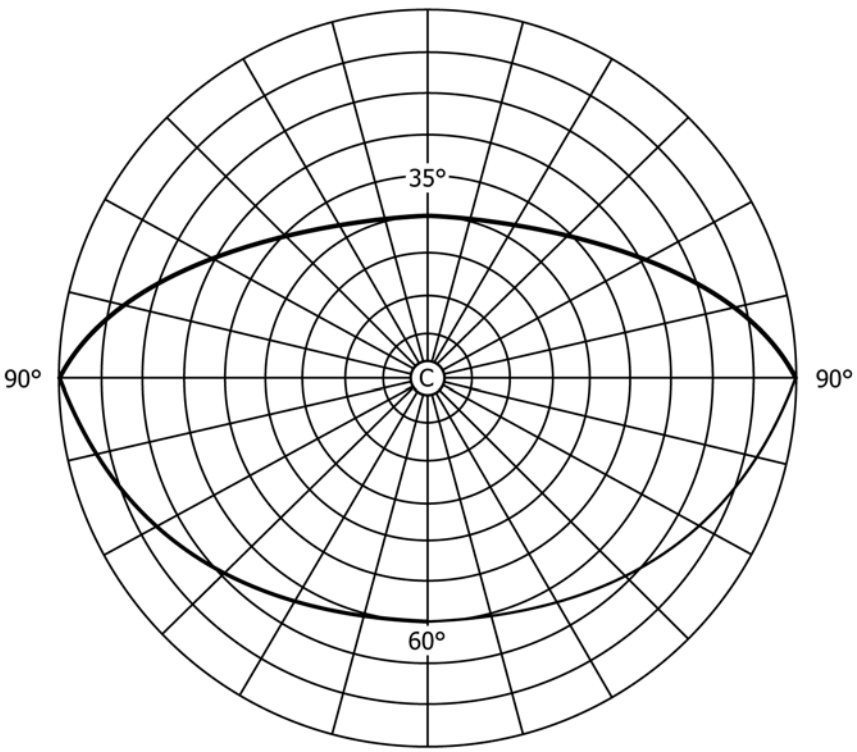
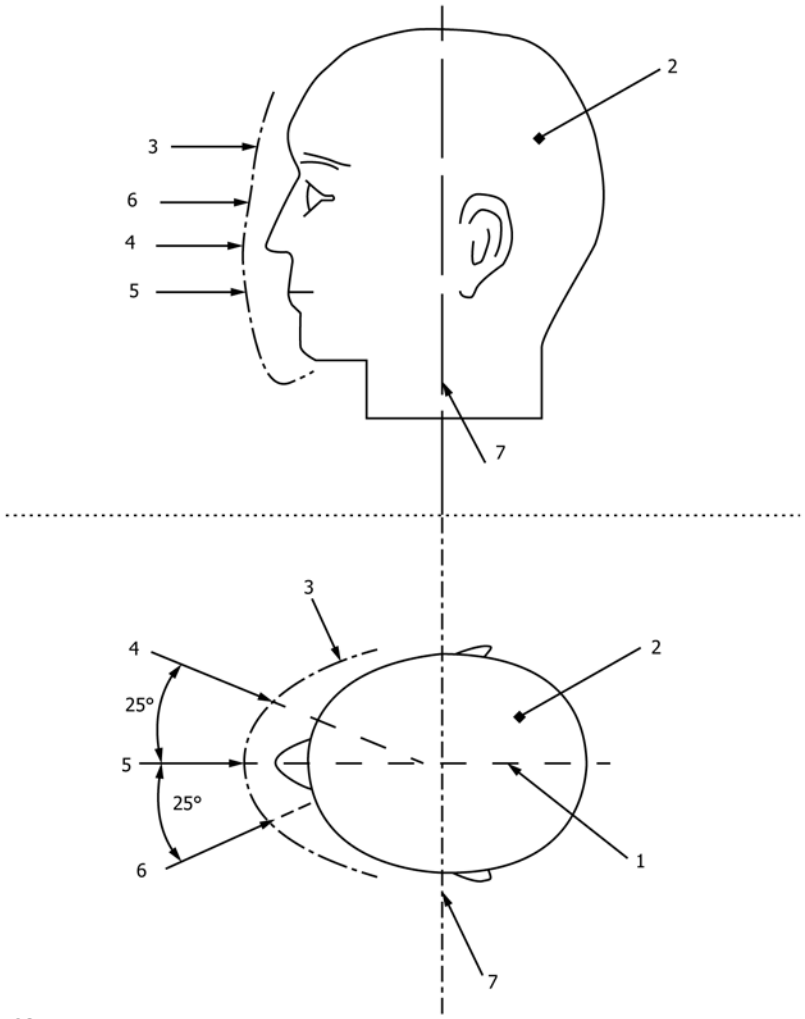


FIG. 1 Peripheral Field of Vision



Key

1 Median plane	5 Mouth impact
2 Headform	6 Eye impact
3 Face protector	7 Frontal plane
4 Side impact	

FIG. 2 Puck Impact Sites for Testing Face Protectors

3.1.15 *luminous transmittance, n*—ratio of the light transmitted by a medium to the incident light.

3.1.16 *menton, n*—lowest point on the mandibular symphysis.

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

3.1.18 *optical clarity, n*—sharpness of an image.

3.1.19 *optical quality field-of-vision area, n*—that area on a transparent face protector or visor determined by the outline of a cone whose axis projects along the primary position of the gaze and extends 35° (radius of fixation), the apex of the cone is centered on each pupil, and the area generated by each cone is joined above and below and is extended to a point 90° laterally to each side in the horizontal plane (see Fig. A1.1).

3.1.20 *orbit, n*—the bony cavity containing the eyeball.

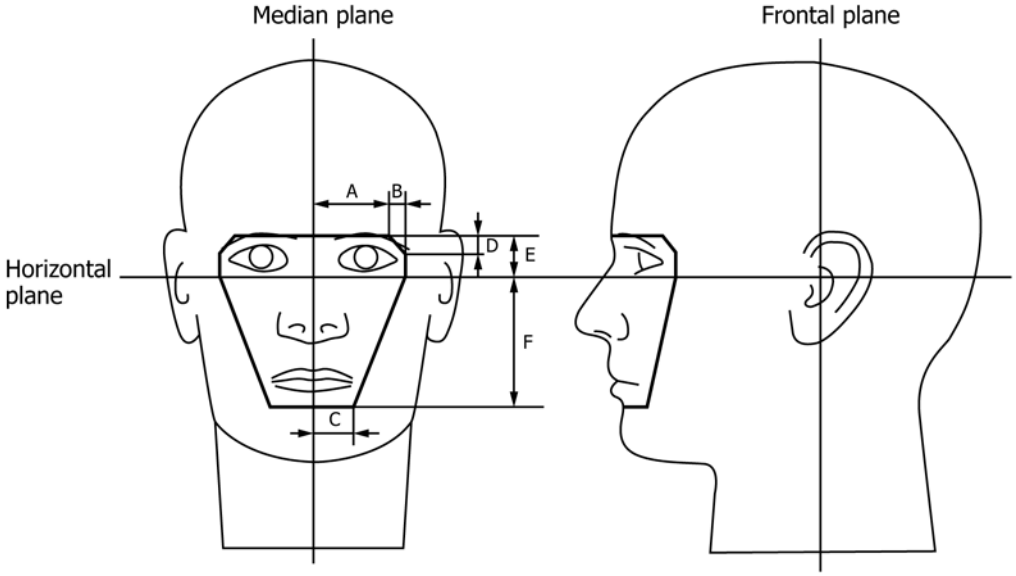
3.1.21 *orbitale, n*—lowermost point on the inferior margin of the orbit (infraorbital margin).

3.1.22 *peripheral field of vision, n*—oval-shaped field extending 90° temporally, 60° inferiorly, 45° nasally, and 35° superiorly (see Fig. 1).

3.1.23 *permanent, n*—information that remains legible and cannot be removed in its entirety under conditions of normal use.

3.1.24 *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.

3.1.24.1 *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.



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

FIG. 3 No-Contact Zone (Projected Dimensions)

3.1.25 *planes:*

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

3.1.25.2 *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.

3.1.25.3 *frontal plane, n*—vertical plane that is perpendicular to the median and reference planes and passes through the top of the headform (see Fig. 4).

3.1.25.4 *horizontal plane, n*—plane that passes across the head at right angles to both the frontal and median plane (see Fig. 4).

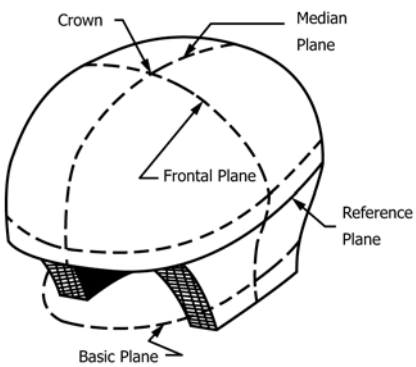


FIG. 4 Orientation Planes

3.1.25.5 *median plane, n*—vertical plane that passes through the headform from front to back and divides the headform into right and left halves (see Fig. 4).

3.1.25.6 *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.

3.1.26 *porion, n*—highest point on the upper margin of the cutaneous, external auditory meatus.

3.1.27 *primary position of gaze, n*—line running forward from the center of the pupil parallel to the median and horizontal planes (see Fig. 4).

3.1.28 *prism dioptre, n*—unit used in measuring the deviating power of a prism; this power in prism dioptres is 100 times the tangent of the angle of deviation of a ray of light.

3.1.29 *prism imbalance, n*—light passing through a lens and entering the one eye is deviated by an amount differing in direction from the same light passing through the lens and entering the fellow eye.

3.1.30 *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.

3.1.30.1 *full-face protector, n*—device intended to reduce the risk of injury to the eyes and face of ice hockey participants.

3.1.30.2 *visor, n*—device intended to reduce the risk of injury to the eyes of ice hockey participants.

3.1.31 *resolution, n*—ability of an optical system to distinguish two points at their minimum separation.

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

3.1.33 *scotoma, n*—blind spot in the field of vision.

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. 5).

3.1.35 *threshold value, n*—output reading obtained when the columnated light beam has been centered on the midpoint between the pupils in the primary position of gaze and the headform is rotated 90° in the horizontal plane and the collimated light source contacts the pupillary sensor closest to the light source.

3.1.36 *vertex, n*—point of intersection on the headform of the median plane with the frontal plane (see Fig. 4).

4. Requirements

4.1 *Materials:*

4.1.1 *Documentation*—The manufacturer shall provide written documentation indicating that the materials used in the construction of the face protector fulfill the requirements of 4.1.2 – 4.1.6.

4.1.2 *Cleaners*—All materials used shall be known not to be adversely affected by ordinary household soap and cleaners as recommended by the manufacturer.

4.1.3 *Finishes*—Paints, glues, and finishes used in manufacturing shall be compatible with the materials used in the construction of the head and face protector.

4.1.4 *Nonirritants*—Material coming in contact with the wearer's head shall not be of any type known to cause skin irritation or disease or undergo significant loss of strength, flexibility, or other physical changes as a result of contact with perspiration, oil, or grease from the wearer's head.

4.1.5 *Adhesives*—Adhesive material used to attach padding or straps to the face protector or visor shall be of a formulation that will not alter the chemical or physical properties of the materials to an extent so as to reduce their protective qualities.

4.1.6 *Polymeric Changes*—All materials used in the construction of the face protector shall be resistant to irreversible polymeric changes when exposed to temperatures up to 70°C or ultraviolet radiation.

4.2 *Finish*—All parts shall be well finished and free of sharp edges and other irregularities that would present a potential hazard to the user or other players.

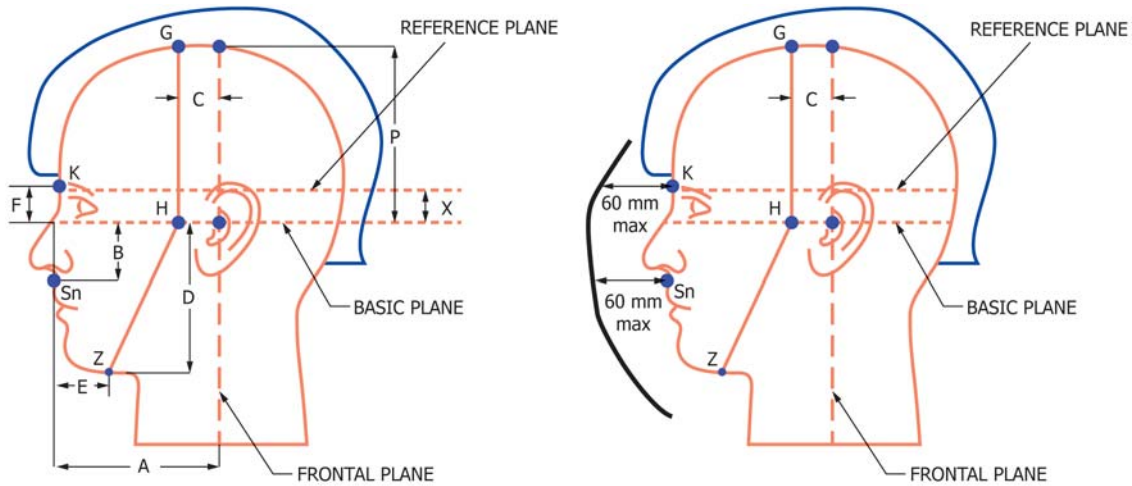
4.3 *Attachment System*—The attachment system of a face protector to a helmet shall be so designed so that the face protector can be easily attached to the helmet without requiring any machining operation by the user.

4.4 *Mass Restriction (Type B2 Only)*—Helmet and Type B2 face protector combinations that, according to manufacturer's recommendations, fit headforms Size E or smaller shall have a mass no greater than 900 g.

4.5 *Optical Quality:*

4.5.1 *Visual Inspection:*

4.5.1.1 The following is a list of matters for which the face protector will be subjectively inspected in a visual and tactile fashion within the field of vision:



Facially-featured Headform (according to CSA Z262.6-02)	Dimensions (mm)							
	A	B	C	D	E	F	P	X
Adult Male (50th Percentile)	100.8	34	25.4	100.5	25	32	130	27.5
Juvenile Male (50th Percentile)	94.3	28	25.4	90	21	31	120	25.5
Child (50th Percentile)	91.1	22.5	25.4	79.5	21	21	102	24.5

FIG. 5 Definition of Protected Area for Full-Face Protector (Side View)

(1) Localized power errors;

(2) Aberrations caused by waves, warpage, and so forth; and

(3) Lens defects such as scratches, greyness, bubbles, cracks, watermarks, and so forth.

4.5.1.2 If any of the above deficiencies are present, no further testing shall be conducted and the product is failed.

4.5.2 *Test Requirements:*

4.5.2.1 When testing in accordance with 5.5 at 20 ± 2°C, face protectors shall:

NOTE 1—Items (1) to (4) apply for materials you have to look through only.

(1) Possess adequate definition to permit resolution of the 240-s ring;

(2) Have a luminous transmittance of not less than 80 % and face protectors specifically identified as being tinted or intended for filtering by the manufacturer shall have a minimum luminous transmittance of 20 %;

(3) Have a prism imbalance not exceeding 0.5 prism dioptre; for two eyes, the prism imbalance test allows a total of up to 1.0 prism dioptre of prismatic deviation;

(4) Have a haze reading that does not exceed 3 %; and

(5) Have no occultation in the field of vision as indicated in Fig. 1.

4.6 *Scotomas*—When tested in accordance with 5.5.2, there shall be no overlapping bilateral scotomas in the peripheral field of vision.

4.7 *Penetration (Test Blade):*

4.7.1 *Types B1, B2, and C*—With the exception of the ear apertures, there shall be no contact with the bare headform by the test blade within the protected areas when testing in accordance with 5.6.

4.8 *Puck Impact Resistance:*

4.8.1 *Types B1, B2*—With the exception of the toughness test, neither the protector nor the puck shall touch the facially featured headform within the no-contact zone (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 no breakage of the structural components of the face protector or failure of the face protector's points of attachment to the helmet. Cracking of surface coatings is permissible but chips (see 3.1.2) are not permitted.

4.8.2 *Type C*—With the exception of the toughness test, neither the visor nor the puck shall touch the facially featured headform when tested in accordance with 5.7. There shall be no chips, cracking, or breakage of the eye protector or failure of the face protector's points of attachment to the helmet or separation of the eye protector from the helmet.

4.9 *Design:*

4.9.1 *Types B1, B2:*

4.9.1.1 *Maximum Distance*—The distance measured on the median plane and 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. 5).

4.9.1.2 *Overlap*—Face protectors shall overlap the lower edge of the helmet (forehead area) by at least 6 mm.

4.9.1.3 *Padding Area*—The face protector shall have a padded load-bearing area with a minimum area as shown in Fig. 6.

4.9.1.4 *Minimum Distance*—Except where it is covered by padding, no part of the face protector shall be closer than 10 mm to the surface of the facially featured headform.

4.9.2 *Type C:*

4.9.2.1 *Maximum Distance (Headform to Eye Protector)*—The distance measured on the median plane, parallel to the basic plane from the headform between the inside of the eye protector and Points K and Sn on the facially featured headform shall not exceed 60 mm (see Fig. 7).

4.9.2.2 *Overlap*—The eye protector shall overlap the lower edge of the helmet (forehead area) by at least 6 mm.

4.9.2.3 *Maximum Distance (Helmet to Eye Protector)*—The maximum distance between the helmet and the eye protector shall not exceed 20 mm.

4.10 *Protected Area of Coverage:*

4.10.1 *Type B1 and B2—Full-Face Protectors:*

4.10.1.1 The area protected by the face protector and helmet combination shall extend laterally and vertically around the headform at least to the Line GHZZHG in Fig. 5, as seen from the side, when the face protector is assembled and mounted on the appropriate helmet in accordance with the manufacturer's instructions and when placed on a facially featured headform as described in 5.4.3.

4.10.1.2 Where the helmet provides protection in front of the Line GHZZHG, the face protector need not extend back to the GHZZHG line provided the face protector overlaps the helmet by at least 6 mm as seen from the side.

4.10.2 *Type C—Visors*—The area protected by the visor and the helmet combination shall extend laterally and vertically around the headform at least to the Line GHSnSnHG in Fig. 7, as seen from the side when the eye protector is assembled, mounted on the appropriate helmet in accordance with the manufacturer's instructions, and placed on a facially featured headform as described in 5.4.2. Where the helmet provides protection in front of the Line GHSn, the visor need not extend back to the GHSn line, provided the visor overlaps the helmet by at least 6 mm when viewed from the side.

5. Test Methods

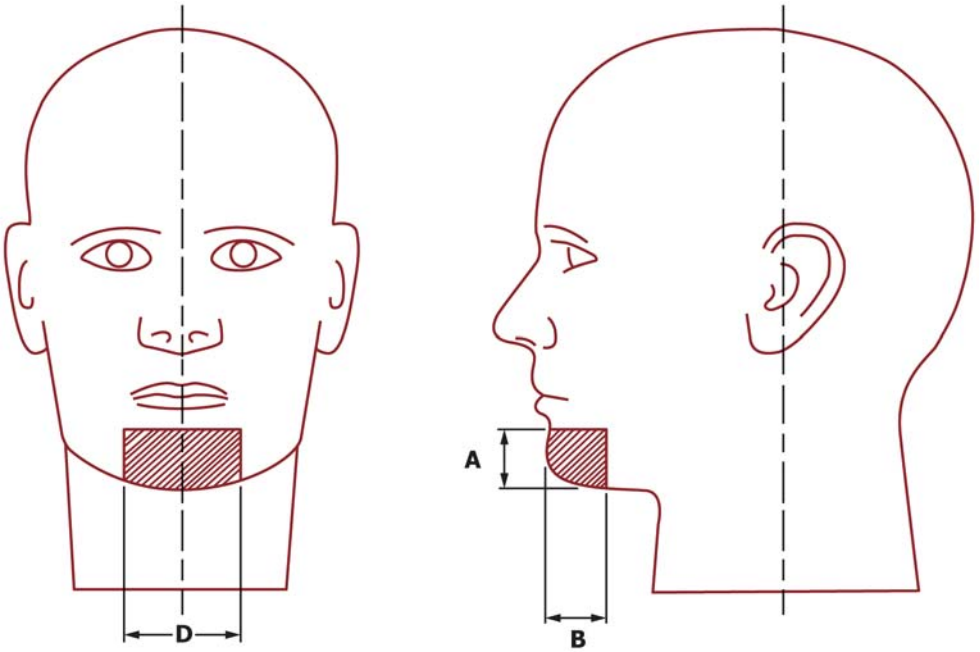
5.1 *Sampling:*

5.1.1 *Types*—Only new, full-face protectors and visors as offered for sale shall be tested. The helmets shall be inspected visually and by hand before conditioning.

5.1.2 *Documentation*—Verify that the manufacturer shall provide written documentation indicating that the materials used in the construction of the helmet and face protector fulfill the general requirements in 4.1.2 – 4.1.6.

5.1.3 *Face Protectors*—Face protectors shall be assembled and mounted on the appropriate helmets in accordance with the instructions of the manufacturer.

5.2 *Inspection and Determination of Mass (for Helmet/ B2 Face Protector Combinations Fitting Headforms Size E or Smaller)*—Determine the mass of the head protector/face protector combinations of the same model and size submitted



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

FIG. 6 Minimum Load-Bearing Area

for testing that are conditioned in accordance with 5.3.1. Calculate and record the mean value in grams rounded to the nearest 10 g.

5.3 *Conditioning:*

5.3.1 *Ambient Conditioning (for Contact Test)*—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.

5.3.2 *Low-Temperature Conditioning (for Toughness Test)*—The sample shall be exposed to a temperature of (–25 ± 2)°C for not less than 4 h. Testing shall begin within 40 s of removal from the refrigeration chamber.

5.3.3 *Testing Conditioned Face Protectors*—For 5.3.2, complete all testing within 5 min after removal of the face protector or visor from the conditioning environment. Face protectors or visors may be returned to the conditioning environment to meet this requirement. Before the resumption of testing, the face protector or visor shall remain in the conditioning environment for a minimum of 15 min for each 5-min period they are out of the conditioning environment.

5.4 *Positioning:*

5.4.1 *Determination of Head-Positioning Index (HPI)*—The HPI and corresponding headform size shall be specified by the helmet manufacturer. If the HPI and corresponding headform size is not available from the manufacturer, the helmet-face protector combination shall not be tested.

5.4.2 *Positioning of Helmets with Visors*—Adjust and position the helmet on the largest headform for the helmet's size range using the HPI.

5.5 *Determination of Vision Quality for Face Protectors:*

5.5.1 *Peripheral Fields of Vision*—Test in accordance with Annex A2.

5.5.2 *Scotoma*—Test in accordance with Annex A2.

5.5.3 *Optical Quality Field of Vision*—Annex A1 provides the test method for the optical quality of eye protectors. Other test methods may be used provided that they give equivalent results.

5.6 *Determination of Penetration Characteristics:*

5.6.1 *Test Apparatus*—The apparatus consists of:

5.6.1.1 Facially featured headform in accordance with 5.7.1.4; and

5.6.1.2 Test blade in accordance with Fig. 8, made of steel.

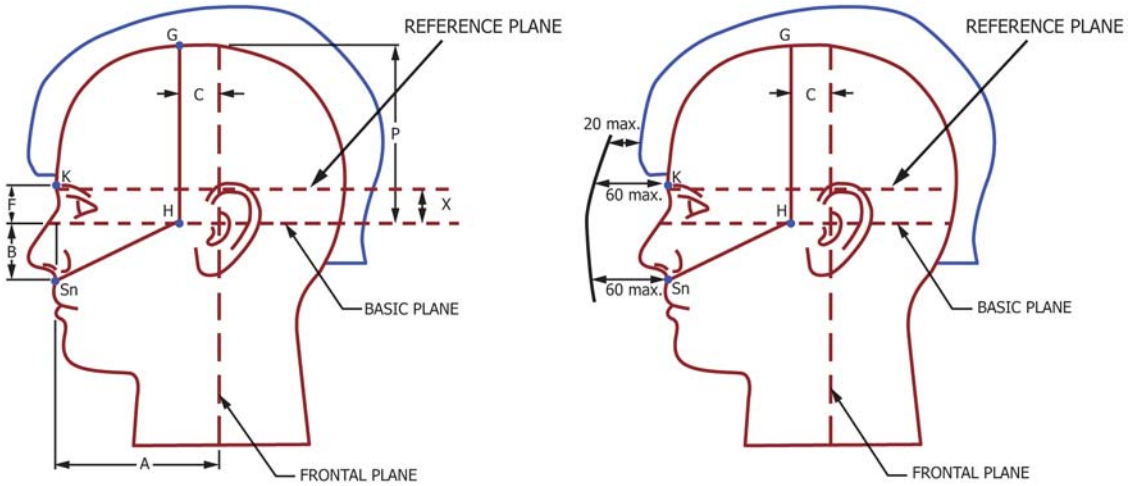
5.6.2 *Procedures:*

5.6.2.1 *Penetration Test—Types B1, B2*—Attempt to make contact with the headform in the protected area (see Fig. 5) by trying to enter, at any angle, any part of the test blade end, in principle without force, through all of the openings. Record whether contact with the bare headform surface is made.

5.6.2.2 *Penetration Test—Type C (Visors)*—Test visors within the area of coverage (see Fig. 7) from the front and side, and not from above or below by trying to enter, at any angle, any part of the test blade end, in principle without force, through all of the openings. Record whether contact with the bare headform surface is made.

5.7 *Face Protectors—Determination of Puck Impact Resistance:*

5.7.1 *Equipment:*



Facially-featured Headform (according to CSA Z262.6-02)	Dimensions (mm)					
	A	B	C	F	P	X
Adult Male (50th Percentile)	100.8	34	25.4	32	129.9	27.5
Juvenile Male (50th Percentile)	94.3	28	25.4	31	121.5	25.5
Child (50th Percentile)	91.1	22.5	25.4	21	102	24.5

Head Circumferences	Dimensions (mm)
Adult Male (50th Percentile)	575
Juvenile Male (50th Percentile)	535
Child (50th Percentile)	515
For References Only	

FIG. 7 Definition of Protected Area for Visors (Side View)

5.7.1.1 *Puck Accelerator*—A device (puck accelerator, see Fig. 9), which can give a hockey puck a specific velocity, direction, and with minimal rotation, shall be used. The velocity shall be variable between 10 and 36 $m \cdot s^{-1}$ with an accuracy of ± 1.0 $m \cdot s^{-1}$.

5.7.1.2 *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.

5.7.1.3 *Headform Base*—The test apparatus shall include a plain horizontal base for a facially-featured headform. The headform shall be aligned vertically on and attached to the plane horizontal base.

5.7.1.4 *Facially Featured Headform*—Facially featured headforms shall be in accordance with CSA Z262.6-02. The largest facially featured headform that the protector being tested fits on shall be used.

5.7.1.5 *Puck*—The hockey puck shall be in accordance with Annex A3.

5.7.1.6 *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 %.

5.7.1.7 *Contact*—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.

5.7.2 *Samples:*

5.7.2.1 *Quantity*—The number of samples for testing and assessment of face protectors of a given make and model is provided in Table 1. The sample numbers corresponding to those given in Table 1 shall be of the same helmet size and model. It is required to use the same number of helmets of the model for which the face protector is intended. The samples shall be numbered with 1, 2, 3, and so forth.

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

5.7.3 *Procedures:*

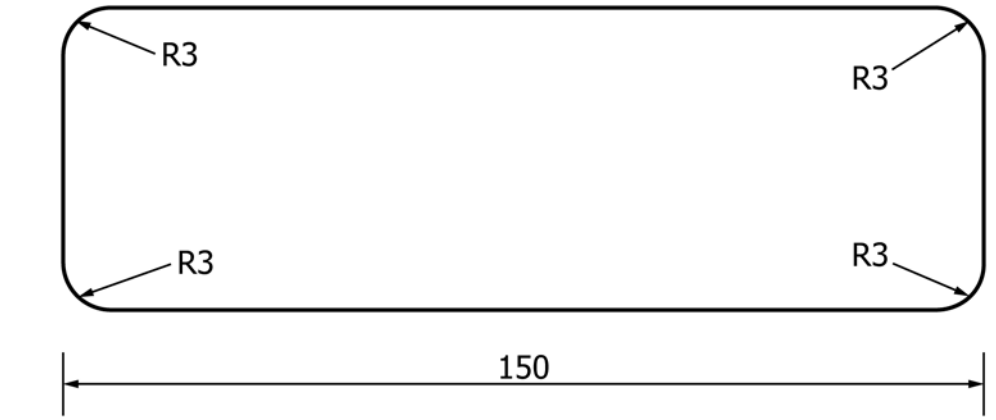
5.7.3.1 *General*—The testing shall be carried out in accordance with Table 1.

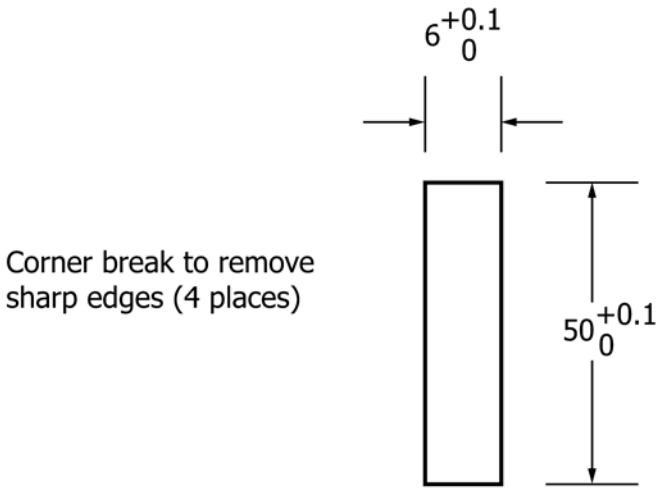
NOTE 2—The impact sites are shown in Fig. 2 and defined in 3.1.12.

NOTE 3—Fig. 9 shows the schematic of the apparatus.

5.7.3.2 *Assembly*—Assemble the face protector and mount on the appropriate helmet in accordance with the instructions of the manufacturer.

Dimensions in millimetres





R3 – 3 MM +/– 0.1 MM

FIG. 8 Test Blade (Penetrator)

5.7.3.3 *Contact Indicator*—Apply contact indicator agent (see 5.7.1.7) over the no-contact zone of the headform to a maximum thickness of 1 mm.

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

5.7.3.5 *Contact Data*—The puck is shot with the velocity stated in Table 1. After each impact, inspect the headform and the face protector for contact impacts and record whether the face protector has touched the headform or not. Record any damage (deformation, cracking, breakage, separation from the helmet). For toughness tests, only recording of damage is necessary.

6. Report

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

6.1.1 Number of this specification,

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

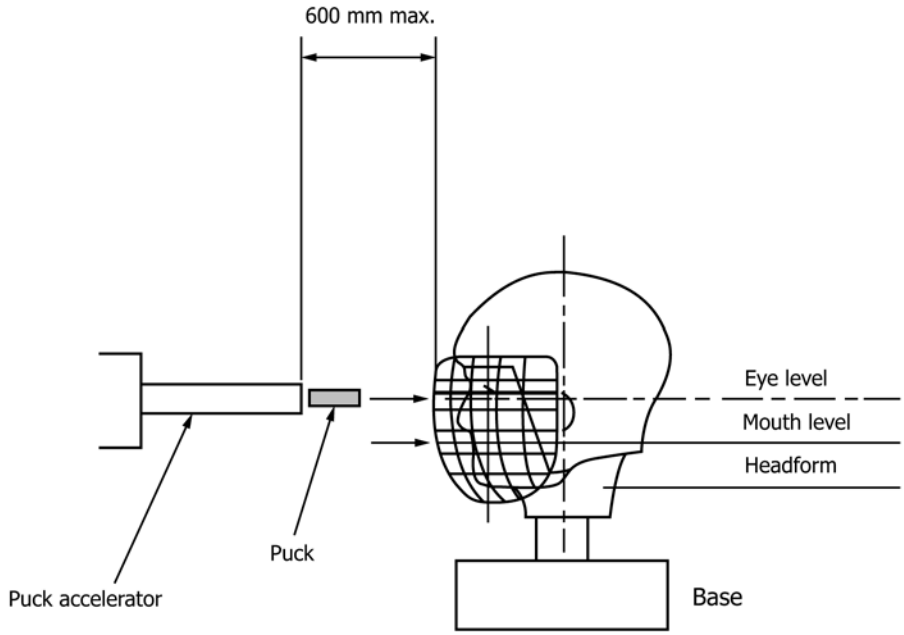


FIG. 9 Schematic of the Apparatus for Testing Puck Impact Resistance of Face Protectors

TABLE 1 Protocol for Testing Face Protection

Type	Test	Sample No.	Impact Site	Conditioning Temperature	Puck Velocity, m/s (km/h)[1]
B1—Full-face protector for players	Contact	1	Eye	Ambient	28 (101)[A]
		2	Mouth		
		3	Side		
	Toughness	4	Eye	Low	28 (101)[A]
		5	Mouth		
		6	Side		
B2—Full-face protector for youths (10 years or younger)	Contact	1	Eye	Ambient	15 (54)[A]
		2	Mouth		
		3	Side		
		4	Eye	Low	15 (54)
		5	Mouth		
		6	Side		
C—Visors	Contact test	1	Eye	Ambient	10 (36)[A]
	Toughness test	2		Low	28 (101)[A]

[A] Tolerance: ± 1.0 $m \cdot s^{-1}$.

6.1.3 Identification details of the face protector tested including range of size,
6.1.4 Description of the face protector,
6.1.5 Results of tests in accordance with Section 5,
6.1.6 Documentation requirements in Sections 4 and 5,
6.1.7 Date of testing, and
6.1.8 Name of testing laboratory.

7. Product Marking

7.1 Each face protector shall be permanently and legibly marked with the following information:
7.1.1 Number of this specification;
7.1.2 Product type (for example, B1, B2, or C);
7.1.3 Name or trademark of the manufacturer or the body taking responsibility for the manufacture;
7.1.4 Designation of the model;
7.1.5 Date code, as a minimum, week and year of manufacture;
7.1.6 Size or size range of the face protector; and
7.1.7 Tinted or filtering eye protectors and full-face protectors shall be identified as such.

7.2 Markings required by 7.1.1 – 7.1.7 shall be by means of a readily visible sticker. The color or background color of the sticker shall be as follows for the corresponding type of protector:
7.2.1 *Type B1*—White;
7.2.2 *Type B2*—Orange, Pantone® 804, or equivalent; and
7.2.3 *Type C*—Yellow, Pantone® 803, or equivalent.

8. Information for Users

8.1 The following information shall accompany each face protector:
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 face 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 helmet and face protector combination that fits properly, is comfortable, and is lightweight;

8.1.5 Instructions concerning the assembly of the face protector on the helmet;

8.1.6 The helmets with which the face protector it is intended to be used with; and

8.1.7 In the case of visors, a warning that includes the following elements:

8.1.7.1 Visors provide only partial protection for the eyes and no protection for the mouth, teeth, lower face, and jaw;

8.1.7.2 To minimize the risks of injury, full-face protection is recommended; and

8.1.7.3 Failure to follow this recommendation may result in a serious or permanent injury.

9. Keywords

9.1 eye protective equipment; face protective equipment; ice hockey

ANNEXES

(Mandatory Information)

A1. OPTICAL QUALITY TEST METHODS

A1.1 General

A1.1.1 This is an objective test for optical quality field of vision and requires the use of a headform instrumented with photosensors to replace the "pupils" of the headform eyes.

A1.1.2 For determining the optical quality field of vision area, the right sensor (center of the right pupil) shall be aligned such that, along the primary position of gaze, the photosensor stays in the same position with any horizontal or vertical movement of the headform throughout a range of 90° superiorly, 90° inferiorly, and 90° laterally. The goniometer shall then be rotated 35° superiorly, temporally, nasally, and inferiorly. The resultant four test points shall be marked on the clear (plastic) protector where the laser beam penetrates it and shall be joined to form a circle (Fig. A1.1). The goniometer shall then be rotated 90° temporally relative to the right pupil and that point where the laser beam penetrates the protector shall be marked on the protector and that mark joined tangentially to the circle (Fig. A1.1). This methodology shall be repeated for the left photosensor (center of the left pupil). The circles for the right and left eyes shall be joined above and below (Fig. A1.1), thus outlining the optical quality area.

A1.1.3 Optical quality shall be determined over the optical quality field of vision area by using the test methods detailed in this Annex.

A1.2 Test Apparatus

A1.2.1 To perform the following tests, mechanical means should be used, including:

A1.2.1.1 A goniometer,

A1.2.1.2 A collimated light source, and

A1.2.1.3 The appropriate headform (see Fig. A1.2).

A1.2.2 The goniometer should be used to rotate the headform on which is mounted a representative ice-hockey helmet

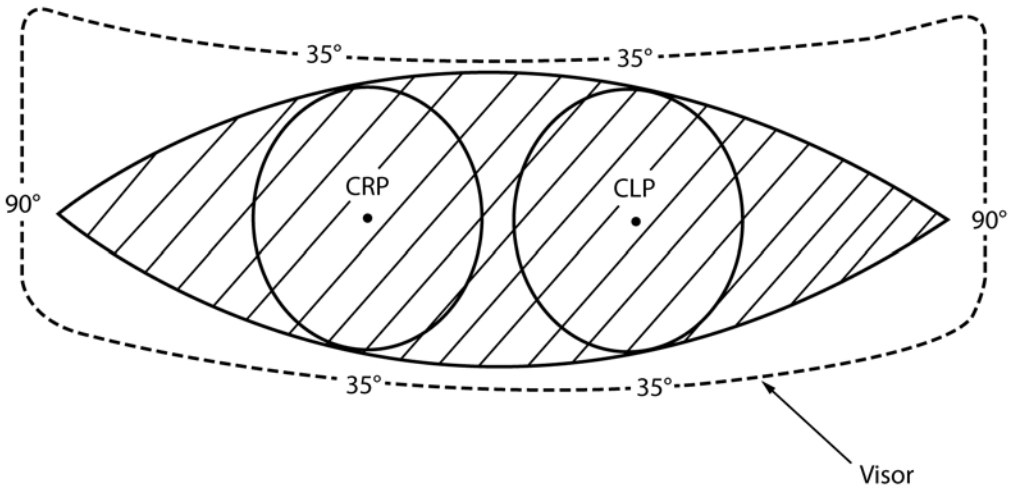


FIG. A1.1 Optical Quality Field of Vision

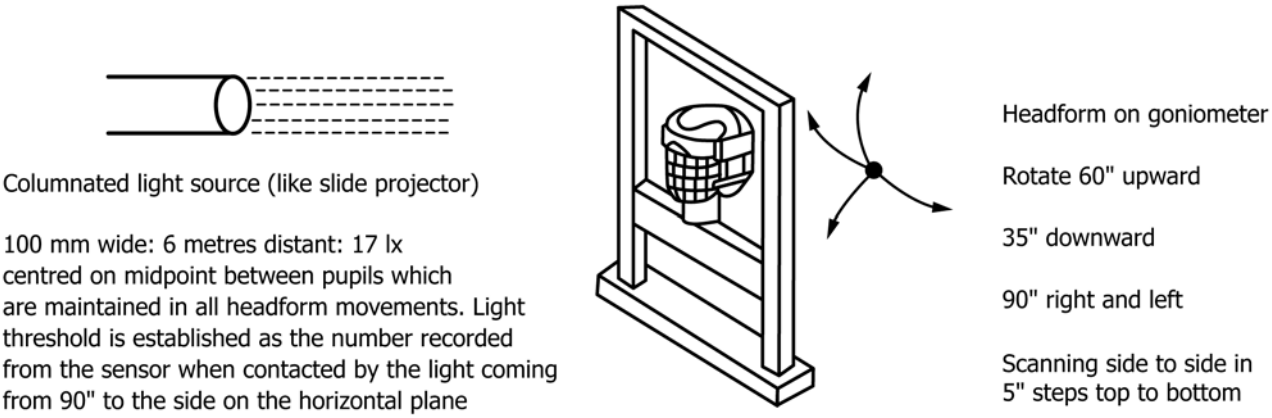


FIG. A1.2 Objective Method of Testing Peripheral Field of Vision

in an as-worn position with the face protector attached. The angular rotation and the horizontal and vertical motion of the goniometer enables a spherical scan to be made.

A1.2.3 A collimated light source is used for identifying the pupil targets. The collimated light source is used because it provides monochromatic parallel beams of light. Both photosensors are tested simultaneously for their peripheral field of vision. The light beam should be centered on the midpoint between the pupils, and this point should stay in the same location with any horizontal or vertical motion of the headform. Each pupil target should be 5 mm in diameter, represented by a photosensor, and covered by a 5-mm translucent lens of 8-mm radius of curvature, convex forward. Light contact with the photosensors produces an electrical signal that is fed into a computer interface.

A1.3 Light Definition

A1.3.1 The target for the test shall consist of a series of different-sized bright rings on a black background. Each ring shall have an inside diameter equal to one third of its outside diameter. The effective size of each ring shall be designated by the arithmetic means of the two diameters concerned, as expressed in seconds of arc subtended at the objective of the viewing telescope.

A1.3.2 The telescope shall be located at least 10 m from the target and shall have a magnification sufficient to make negligible any effects of eye accommodation. The clear aperture of the telescope objective shall be masked at the 5-mm diameter. The system shall be of at least sufficient quality to permit resolution of the 40-s ring. This resolution shall be maintained at all image brightnesses to be used in testing.

NOTE A1.1—A magnification of 8× will usually be suitable.

A1.3.3 The face protector or visor to be tested shall be placed immediately in front of the telescope objective and normal to its axis. The definition shall be determined for the viewing area.

A1.4 Luminous Transmittance

A1.4.1 Luminous transmittance for the viewing area shall be determined with CIE illuminant A. All transmittance measurements shall be of regular transmittance with normal incidence on a 5-mm diameter circular portion of the face protector or visor.

A1.5 Prism Imbalance

A1.5.1 The protective device shall be placed on a headform in an "as worn" position in the optical system and as shown in Fig. A1.3. The lens is located at a distance of (2000 ± 5) mm in front of the image plane. Since the lens, *L*, has a focal length of 1 m, the distance from the plate, *P*, to the lens will be approximately 2 m. The pinhole aperture, *P*, is adjusted so that one image is formed in the image plane when no protector is on the headform. The position of that image should be marked or noted and will be identified as *Po*. After the protector has been placed in the system, two images will usually be seen in the image plane.

A1.5.2 In the case of a protector having zero prism imbalance, one image may be seen in the image plane, while in the usual case, two images will be seen. By blocking the beam from each of the two eye positions, it can be determined which specific images come from the left and right eyes. The positions of these images will be identified as *PL* and *PR*.

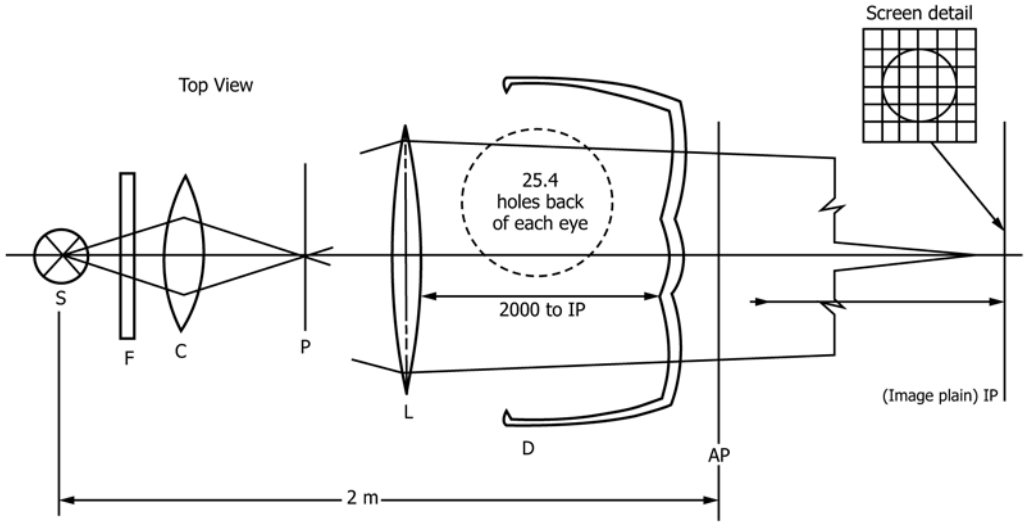
A1.5.3 The prismatic power in prism dioptres of the protector is one half the distance, in centimetres, between *Po* and either *PL* or *PR*, whichever is greater.

A1.5.4 The horizontal distance between the two images, in centimeters, divided by 2 is the horizontal prism imbalance in prism dioptres, while the vertical separation of the two images, in centimeters, divided by 2 is the vertical prism imbalance.

A1.5.5 For an observer looking at a translucent image plane from behind (and hence looking toward the headform from behind the image plane), if the right one of the two images comes from the right aperture in the aperture plate, the horizontal prism imbalance is "based out;" if the left image comes from the right aperture, the horizontal prism imbalance is "based in."

A1.6 Optical Quality Field-of-Vision Area and Haze

A1.6.1 The clear plastic face protector or visor shall not be abraded by any instrument or any artificial process. The optical



S = small tungsten light source
F = interference filter, λ max 590 ± 20 nm (optional, probably not necessary)
C = condensor lens
P = plate with 0.5 diameter hole
D = eye protector mounted on headform (headform not shown)
AP = aperture plate with two outer apertures separated by the pupillary distance of the protector
L = lens of 1 000-mm focal length and 80-mm diameter
IP = image plane (fine-grain tracing paper with 1-mm cross-hatch grating; examine image with a magnifier)

FIG. A1.3 Apparatus for Prism Imbalance Test

quality field of vision area as outlined shall be cut (vertically) into approximately three equal sections and each section shall be tested with instrumentation and methods as described in Test Method D1003.

A1.6.2 Since all three sections of the optical quality field of vision area have various degrees of built-in curvatures during the tests, they shall be rotated so that the passing beam of light is as perpendicular to the testing surface as is practical. The total surface of all three pieces from the same plastic face protector or visor shall be examined for haze.

A2. METHOD FOR MEASURING PERIPHERAL FIELD OF VISION AND BILATERAL SCOTOMA

A2.1 General

A2.1.1 For determining the presence of bilateral scotoma from a distance of 6 m, use the following measurement method with the test apparatus given in A2.2.

A2.2 Test Apparatus

A2.2.1 *Headform,* with anthropometrically based facial features to test the appropriate size of the face protector or visor.

A2.2.2 *Complete Eye-Protector Device,* attached to a compatible ice-hockey helmet and placed on the headform in an as-worn position (that is, as per the manufacturer's instructions).

A2.2.2.1 The appropriate headform should be placed and fixed on the goniometer.

A2.3 Signal Output

A2.3.1 The signal output from the photosensors (analog) is received by the computer interface that translates it into a quantitative number (digital signal). A GO/NOGO test criteria is established before the tests by analyzing the signal output from the photosensors, that is, CONTACT is indicated by signal out from the photosensor and NO CONTACT is indicated by no signal from the photosensor.

A2.4 Test Procedure

A2.4.1 A light source should be energized, such that it is normal to the pupil targets. The field-of-vision program should be called up on the computer and it is recommended to follow through the menu-driven question/answer session such as name, model, and scan area.

A2.4.2 When the scan is started, the goniometer rotates through the various angles at each predefined step size (5°), the photosensor feeds back a signal, and a reading below the threshold indicates a blind spot (that is, scotoma).

A2.4.3 The program stores all data scan points for the scotomata locations of both photosensors (for the peripheral field of vision and the optical quality field of vision).

A2.4.4 The computer program analyzes by comparison the results of the scan.

A2.4.5 Peripheral field-of-vision plots show the field chart for the left and right pupils. A mark indicates if a scotoma is present.

A3. PUCK SPECIFICATIONS

A3.1 Scope

A3.1.1 This technical specification provides requirements for pucks intended for use in the testing of protectors with the scope of this specification.

A3.1.2 This specification establishes requirements for the material and physical requirements of the puck.

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 natural rubber, synthetic polyisoprene, styrene butadiene copolymer, or a mixture of any of these materials.

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*—Both 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 4.1).

A3.3.2 *Hardness at 0°C*—The Shore Type C durometer hardness at 0°C shall be not greater than +7 points of the hardness determined at room temperature (see 4.4).

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.

A4. FACE PROTECTOR TYPES AND APPLICABLE CLAUSE REQUIREMENTS

TABLE A4.1 Face Protector Types and Applicable Clause Requirements

Type	Description	Playing Position and Age	Requirements		
			General and Special (Clause)	Protected Area (Clause)	Penetration (Clause)
B1	Full-face protector	Skater	4.1 – 4.3, 4.5, 4.6, 4.8.1, 4.9.1	4.10.1	4.7.1 (Test blade)
B2	Full-face protector	Skater (Youth)	4.1 – 4.6, 4.8.1, 4.9.1 (with helmets that fit only on the child facially featured headform or smaller)	4.10.1	4.7.1 (Test blade)
C	Visor	Skater	4.1 – 4.3, 4.5, 4.6, 4.8.2, 4.9.2	4.10.2	4.7.1 (Test blade)