Designation: F1045 – 16

An American National Standard

Standard Performance Specification for Ice Hockey Helmets[1]

This standard is issued under the fixed designation F1045; 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 injury. Participation in the sport of ice hockey by a player implies acceptance of some risk of injury. The goal is to minimize this risk.

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

Performance requirements were determined after consideration of state-of-the-art of helmet design and manufacture and the demands of the sport.

1. Scope

1.1 This performance specification[2] covers performance requirements for ice hockey helmets.

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

1.3 This performance specification covers: (*1*) performance tests for shock absorption properties of the complete helmet and strength and elongation of the chin strap and its attachment; and (*2*) requirements for area of coverage and penetration.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.5 The following precautionary caveat pertains only to the test methods portion, Section 12, of this performance specification: *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]

F513 Specification for Eye and Face Protective Equipment for Hockey Players

2.2 *CEN Standard:*[4]

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *retention system:*

3.1.1.1 *chin strap*—the chin strap, including a cup that covers the chin (see Fig. 1), is affixed to both sides of the helmet and secures the helmet to the head when a Type I or Type II full face protector is not worn with the helmet.

3.1.1.2 *neck strap*—the neck strap that secures the helmet to the head is affixed on both sides of the helmet and passes under the lower jaw in close proximity to the jaw and the neck. Where the helmet is worn with a Type I or Type II full face protector, the neck strap serves as the attachment of the helmet to the head.

NOTE 1—For a description of the Type I or Type II face protector, see the Types of Protectors Section in Safety Specification F513.

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

Current edition approved Oct. 1, 2016. Published November 2016. Originally approved in 1988. Last previous edition approved in 2015 as F1045 – 15. DOI: 10.1520/F1045-16.

[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.

[4] Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

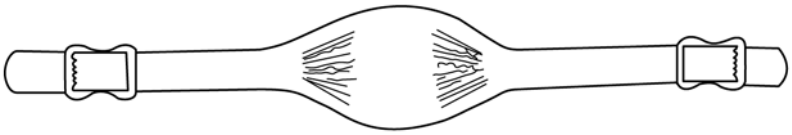


FIG. 1 Chin Strap (Includes a Chin Cup)

3.1.2 *crown*—a point in the median plane that is equal chord lengths from the anterior and posterior intersections of the median and reference planes.

3.1.3 *drop height*—the vertical distance between the lowest point (impact point) of the elevated helmet and the apex of the impact surface.

3.1.4 *g*—the dimensionless ratio of the acceleration of the headform during impact to the acceleration due to gravity.

3.1.4.1 g_{max}—the maximum value of *g* encountered during impact.

3.1.5 *helmet*—the complete product, including the shell, liner, chin strap, including the cup or neck strap, and associated attachment hardware, assembled with components supplied by the manufacturer. The helmet is intended to protect the wearer's head while participating in ice hockey.

3.1.6 *helmet position index (HPI)*—the vertical distance from the brow of the helmet to the basic plane, when the helmet is placed on a reference headform. The manufacturer shall specify the size of the headform and the vertical distance.

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

3.1.8 *Reference Planes:*

3.1.8.1 *basic plane*—an anatomical plane that includes the superior rim of the external auditory meatus (upper edge of the external openings of the ear) and the inferior margin of the orbit (the lowest point of the floor of the eye socket). The headforms are marked with the basic plane (see Figs. 2 and 3).

3.1.8.2 *coronal plane*—an anatomical plane perpendicular to both the basic and midsagittal planes and passing through the superior rims of the right and left auditory meatuses. The transverse plane corresponds to the coronal plane (see Figs. 2 and 3).

3.1.8.3 *midsagittal plane*—an anatomical plane perpendicular to the basic plane and containing the midpoint of the line connecting the notches of the right and left inferior orbital ridges and the midpoint of the line connecting the superior rims of the right and left external auditory meatus. The longitudinal plane corresponds to the midsagittal plane (see Figs. 2 and 3).

3.1.8.4 *reference plane*—a plane marked on the headforms at a specified distance above and parallel to the basic plane (see Fig. 4).

3.1.9 *shell*—the rigid outer material that gives the helmet its form.

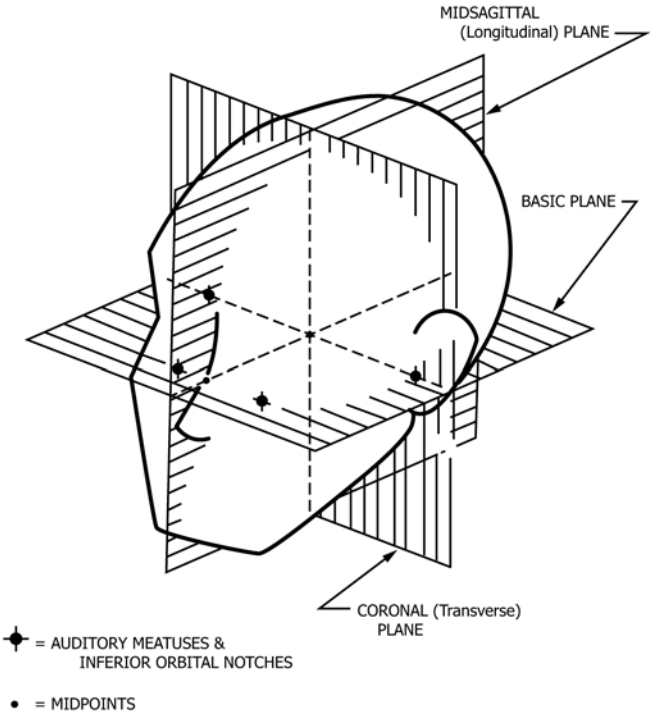


FIG. 2 Anatomical Planes

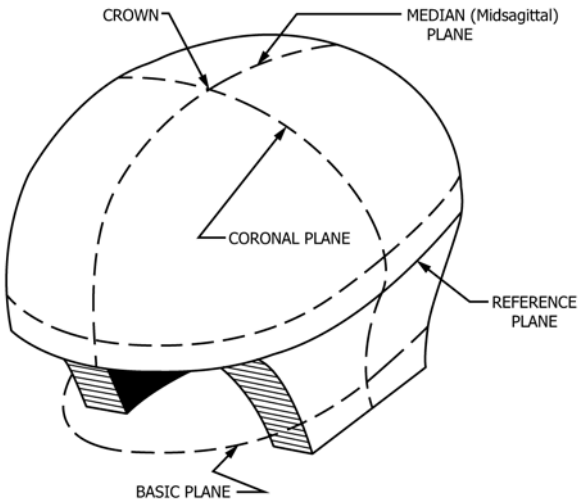
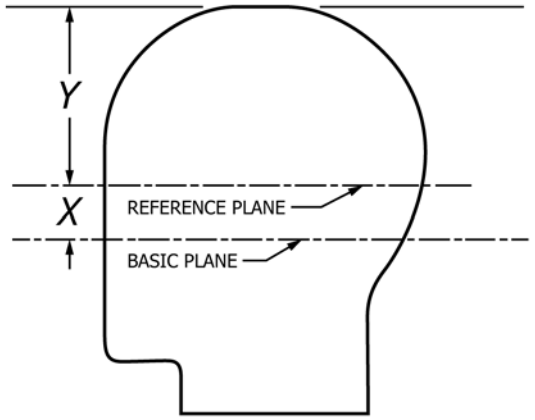


FIG. 3 Test Headform—Basic, Reference, and Misadgittal Planes

4. General Requirements

4.1 *Materials:*

4.1.1 All materials used in the fabrication of helmets shall be known to be suitable for the intended application. For example, shell materials shall remain strong, semirigid, and firm, and shall not permanently distort during an exposure of at least 4 h to any temperature in the range from −27 to 32°C, nor shall the material be significantly affected by exposure to ultraviolet radiation, water, dirt, or vibration. All materials shall be rot-resistant. In addition, paints, glues, and finishes used in manufacture shall be compatible with the helmet shell and shock absorption system materials.



Headform circumference (mm)	X, mm	Y, mm
495	23.5	89.7
535	25.5	96
575	27.5	102.4
605	29	107.2

FIG. 4 Location of Reference Lines

4.1.2 Materials coming into contact with the wearer's head shall not be the type known to cause skin irritation or disease, 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.

4.1.3 Any material used in the construction of helmets shall not be adversely affected by ordinary household soap and water, mild household detergent, or cleaners recommended by the manufacturer.

4.2 *Helmet Assembly:*

4.2.1 Any optional devices fitted to the helmet shall be so designed that they are unlikely to cause any injury to the wearer or other participants during contact.

4.2.2 All edges shall be smooth and rounded and there shall be no rigid projections on the inside of the helmet that could come in contact with the wearer's head.

4.2.3 All external projections shall be smooth and adequately faired to other surfaces. Split or bifurcated rivets shall not be used.

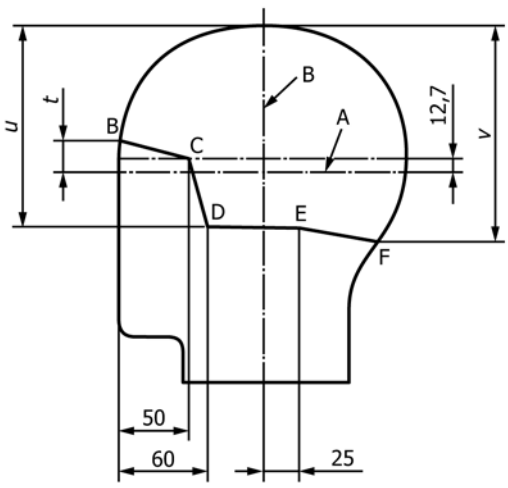
4.3 *Types of Protectors:*

4.3.1 *Type 1*—Head protectors that meet requirements for the area of coverage mentioned in 4.5.1.

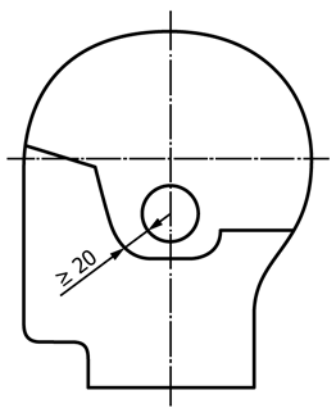
4.3.2 *Type 2*—Head protectors that meet requirements for the area of coverage mentioned in 4.5.2.

4.4 *Impact Test Protected Area*—The area above the test line (see 12.2.7) shall be considered the impact test protected area. All parts of the wearer's head covered by the area of the shell shall be protected at least to the minimum impact requirements of 13.1 and 13.2.

4.5 *Area of Coverage*—Area of coverage measurements shall be made with the protector mounted in accordance with the protector manufacturer's instructions on the headforms that correspond to the physical dimensions defined in EN 960:2006



a) Minimum area



b) Extended area

Headform circumference (mm)	Distance (mm)		
	t	u	v
495	24	123	132
535	26	128	140
575	27	129.9	144.9
605	28	132.2	151.2

NOTE 1—A-Reference plane, B-Coronal plane

FIG. 5 Type 1–Area of Coverage

as headform circumferences 495, 535, 575, or 605 mm. If a helmet size range, as identified by the manufacturer's instructions, is capable of fitting two different headforms, the larger headform shall be used.

4.5.1 *Type 1*—The extent of coverage shall include at least all of the area above line BCDEF as shown in Fig. 5. This area shall correspond with the headform size with which the protector is to be tested. No ear aperture shall have any dimension exceeding 38 mm (1.5 in.). The ear aperture shall be completely surrounded by the helmet. The distance from any edge of an ear aperture to any edge of the helmet shall not be less than 20 mm (0.8 in.).

4.5.2 *Type 2*—The extent of coverage shall include at least all of the area above line BCDGHEF as shown in Fig. 6. This area shall correspond with the headform size with which the protector is to be tested.

4.6 *Attachments*—The components of the fasteners for securing attachments 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.

4.7 *Size of Helmets*—Helmets shall be sized in accordance with Table 1.

4.8 *Chin Strap or Neck Strap:*

4.8.1 The chin strap, including the cup, or the neck strap, shall be attached to the helmet so that the helmet remains in its normal position on the player's head during play and impact conditions.

TABLE 1 Hat Sizes and Head Fittings

NOTE 1—These are U.S. and Canadian hat sizes.

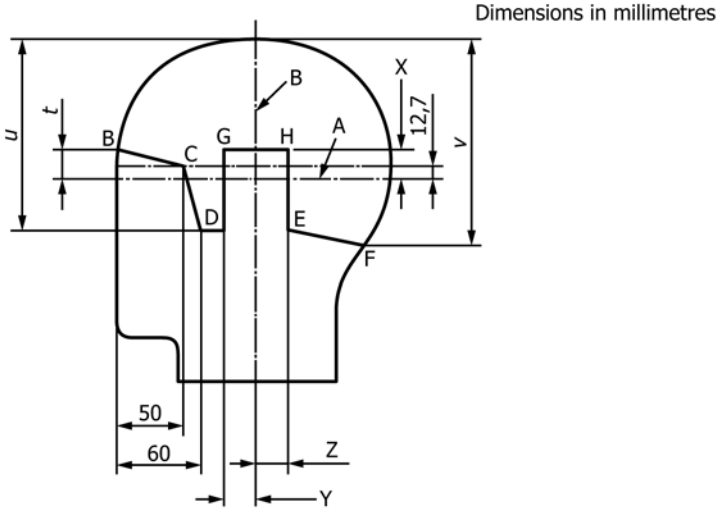
Hat Size	Circumference of Head	
	in.	mm
6	19	483
6⅛	19⅜	492
6¼	19¾	502
6⅜	20⅛	511
6½	20½	521
6⅝	20⅞	530
6¾	21¼	540
6⅞	21⅝	550
7	22	559
7⅛	22⅜	568
7¼	22¾	578
7⅜	23⅛	587
7½	23½	597
7⅝	23⅞	606
7¾	24¼	616
7⅞	24⅝	625
8	25	635

4.8.2 The chin strap or the neck strap used in combination with the face protector shall satisfy the requirements in 3.1.1.

4.8.3 The minimum width of the chin strap exclusive of the cup shall be 12.7 mm (0.5 in.).

5. Performance Requirements

5.1 *General*—Helmets shall be capable of meeting the requirements in this performance specification throughout their



c) Minimum area

Headform circumference (mm)	Distance (mm)					
	t	u	v	x	y	z
495	24	123	132	–	–	–
535	26	128	140	18	30	50
575	27	129.9	144.9	20	40	55
605	28	132.2	151.2	20	45	55

NOTE 1—A-Reference plane, B-Coronal plane

NOTE 2—Dimension Y and Z are taken and must cover between the reference and the basic plane.

NOTE 3—495 mm Headform does not have Type 2 coverage.

FIG. 6 Type 2–Area of Coverage

full range of adjustment. They shall be capable of meeting the requirements in Sections 11 and 12 at any temperature between −27 to 32°C.

5.2 *Shock Absorption*—The helmet is mounted on a headform that is oriented in different positions and dropped at a specific velocity onto an impact surface. A linear accelerometer mounted at the center of gravity of the headform monitors the acceleration and the time history of impact that are recorded with appropriate instrumentation. Maximum acceleration and time duration data obtained by the specified procedures are intended to determine the shock absorption characteristics of the helmet.

5.3 *Chin Strap*—When tested in accordance with 12.8, the force to separate the strap shall not be less than 50 N (11.2 lbf) nor more than 500 N (112.4 lbf), and the maximum displacement of the strap shall not exceed 25.4 mm (1 in.) at a load of 109 N (24.5 lbf). The requirements of 12.8 shall be met at ambient conditions.

5.4 *Penetration Resistance Test Requirements*—It shall not be possible to touch the test headform with the curved end of the test stick blade within the required area of coverage, excluding the ear opening.

6. Apparatus

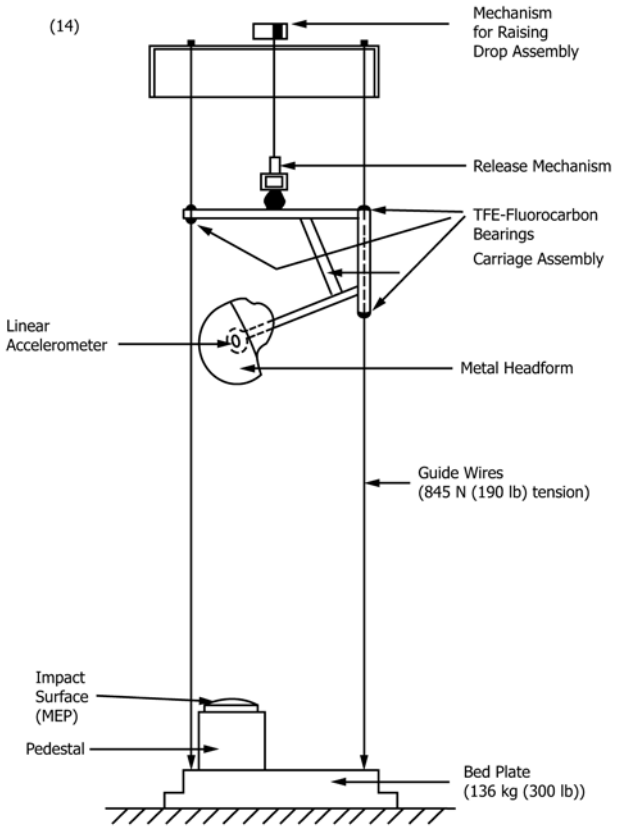
6.1 *Shock Absorption Test*—The apparatus for the shock absorption test shall consist of the following:

6.1.1 *Guide Assembly*—The headform shall be attached to the free fall drop assembly carriage by an adjustable mounting that will allow impacts to be delivered to any prescribed point on the helmet (see Fig. 7). The carriage shall be free to slide on vertical guides. If wires are used, they must be placed under at least 845.2 N (190 lbf) tension (see 12.4 for guide assembly specifications and allowable weight of drop assembly).

6.1.2 *Recording Equipment*—The recording equipment shall meet the following criteria:

6.1.2.1 *Acceleration Transducer*—The linear accelerometer is mounted at the center of gravity of the combined test headform and carriage assembly with the sensitive axis aligned to within 5° of the vertical when the helmet and headform are in the impact position. This transducer shall be capable of withstanding a shock of 1000 *g* without damage and shall have a frequency response (variation ±1.5 %) over the range from 5 to 900 Hz.

6.1.2.2 *System Accuracy*—The impact recording system shall be capable of measuring shocks of up to 500 *g* peak acceleration with an accuracy of ±5 %.



NOTE 1—Rail-guided drop assemblies are also permissible.

FIG. 7 Schematic of Typical Drop Assembly

6.1.2.3 *Impact Recording*—The impact shall be recorded on single- or dual-trace storage oscilloscope with 0.1-mV to 20-V deflection factor, 1 to 5-ms sweep speed-division, and 500-kHz bandwidth.[5]

6.1.2.4 *Test Headforms*—Test headforms that correspond to the physical dimensions defined in EN 960:2006 as headform circumferences 495, 535, 575, or 605 mm. The weight of the drop assembly, including the headform, shall be in accordance with 12.4 unless otherwise specified in the individual performance specifications. The test headforms shall include surface markings corresponding to the basic, coronal, midsagittal, and reference planes (see Figs. 2 and 3).

6.1.2.5 *Reference Headforms*—Measuring headforms contoured in the same configuration as the test headforms with circumferences of 495, 535, 575, or 605 mm, as defined in EN 960:2006. The reference headforms shall include surface markings corresponding to the basic, coronal, midsagittal, and reference planes (see Figs. 2-4).

6.1.2.6 *Impact Surface*—The impact surface shall be a *flat* modular elastomer programmer (MEP) 152.4 mm (6 in.) in diameter and 25.4 mm (1 in.) in thickness which is firmly fixed to the top surface of a flat anvil. The MEP required is a 60 ± 5 Durometer Shore A Hardness impact surface. The base shall consist of a rigid slab weighing at least 136.1 kg (300 lb). The top surface of this base may be used as the flat metal anvil if it is faced with a steel plate with minimum thickness of 25.4 mm (1 in.) and minimum top surface area of 0.09 m^2 (1 ft^2). If a detachable flat metal anvil is used it must have a top surface area of at least 290.3 cm^2 (45 $in.^2$). The MEP is mounted on an aluminum plate with a minimum thickness of 5.6 mm (0.220 in.) after grinding.

7. Sampling

7.1 Submit at least four specimen helmets for each size to be tested under the various conditions as described in Section 11. One ambient conditioned sample shall be used for both impact testing and the penetration and retention test.

8. Test Specimen

8.1 Test helmets without accessories.

9. Preparation of Apparatus

9.1 Turn on all electronic equipment and allow to warm-up for at least 30 min or as recommended by the manufacturer, whichever time is greater, prior to any testing.

10. Calibration and Standardization

10.1 *Calibration*—Instrumentation used in the testing shall be calibrated to manufacturer's specifications on a periodic basis. The duration of the calibration cycle shall be no more than one year.

10.2 *Impact Attenuation Instrument System Check*—The system instrumentation shall be checked before and after each series of tests by dropping the spherical impactor onto the MEP pad at an impact velocity of 5.44 ± 0.11 m/s (17.85 ± 0.36 ft/s). Impact velocity shall be measured during the last 40 mm (1.575 in.) of free fall for each test. The weight of the drop assembly (which is the combined weight of the instrumented spherical impactor and supporting assembly) for the drop test shall be 5 ± 0.1 kg (11.00 ± 0.2 lb). Three such impacts, at intervals of 75 + 15 s, shall be performed before and after each series of tests. The peak acceleration obtained during impact shall be 389 ± 8 g. If the average peak acceleration obtained in the post test impacts differs by more than 5 % from the average peak acceleration obtained in the pretest impacts, the following checks shall be made. Checks of the mechanical condition of the drop system and checks of the calibration of the instruments and transducers are required and all data obtained during that series of helmet tests should be discarded.

10.3 If the maximum *g* or acceleration time history, or both, are not within the tolerance limits prior to test, adjust or repair the system as necessary.

10.4 If the means of the three peak acceleration values following the test series differ by more than 40 *g* from the mean of the initial calibration series, discard the entire test series.

11. Conditioning

11.1 Prior to testing, condition each helmet in one of the following ways:

11.1.1 *Ambient Temperature*—The ambient condition of the test laboratory shall be 18 to 22°C, with a relative humidity of 25 to 75 %. The barometric pressure in all conditioning environments shall be 75 to 110 kPa. Helmets shall be conditioned in this environment for not less than 4 h.

11.1.2 *Low Temperature*—The low temperature is at 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.

11.1.3 *High Temperature*—The high temperature is at a temperature of 28 to 32°C. Helmets shall be conditioned for a period of not less than 4 h nor more than 24 h.

11.1.4 *Testing for Conditioned Specimens*—Complete all testing on helmets within 5 min after removal from the conditioning environment. Helmets may be returned to the conditioning environment in order to meet this requirement. Prior to the resumption of testing, specimens must remain in the conditioning environment for a minimum of 15 min for each 5-min period they are out of the conditioning environment.

12. Test Methods

12.1 *Testing Environment*—Conduct all testing under the recorded conditions of room temperature and humidity. These conditions must be in accordance with those stated in 11.1.1.

12.2 *Impact Locations and Test Schedule*—The impact locations and test line are defined in this section. Condition two helmets at ambient, one at hot and one at cold temperatures. One ambient conditioned helmet shall be tested at the front, front boss, side, rear, rear boss, and crown locations only. The other ambient conditioned helmet shall be tested at two non-prescribed impact locations. The cold conditioned helmet shall be impacted at the two locations that yielded the single highest peak accelerations (g_{max}) from the helmets tested at

[5] Equivalent instrumentation capable of recording, displaying, and providing a permanent record of the generated accelerometer shock signal will meet this requirement.

ambient conditions. The hot conditioned helmet shall be impacted at the two locations that yielded the single highest peak accelerations (g_{max}) from the helmets tested at ambient conditions.

12.2.1 *Front*—The point on the midsagittal plane which is 50 mm (1.969 in.) above the anterior intersection with the reference plane.

12.2.2 *Side*—The point 25 mm (0.984 in.) above the reference plane and 90° from the anterior intersection of the midsagittal plane and the reference plane (intersection of the reference and coronal planes).

12.2.3 *Rear*—The point at the posterior intersection of the midsagittal and reference planes.

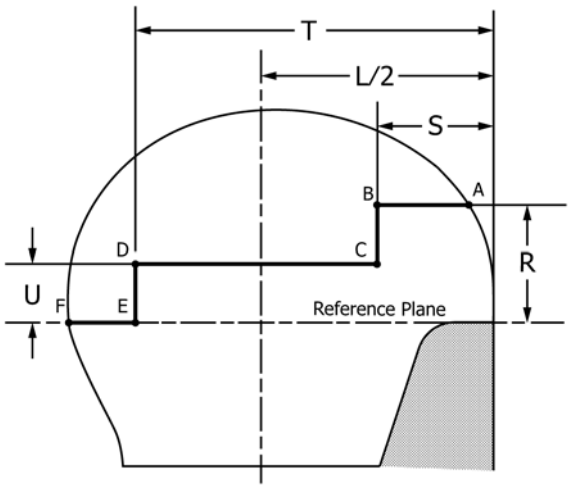
12.2.4 *Crown*—The point where the central vertical axis meets the top of the headform.

12.2.5 *Rear Boss*—A point in a plane 135° (2.36 rad) in a clockwise direction from the anterior intersection of the median and reference planes and on the reference plane.

12.2.6 *Front Boss*—A point in a plane 45° (0.78 rad) from the median plane as measured in a clockwise direction and 25.4 mm (1 in.) above the reference plane.

12.2.7 *Test Line*—Draw test line A-B-C-D-E-F on the headform as indicated in Fig. 8.

12.2.8 *Non-Prescribed Impact Locations*—Non-prescribed impacts shall be located on the headform. The first point of contact with the anvil for any non-prescribed impact location shall be on or above the test line and at least one-fifth of the circumference of the headform from any prior impact location on that helmet. The headform is positioned so that the impact location is the first point of contact with the anvil. The helmet is then placed on the headform as specified by the manufacturer's head positioning index (HPI). The location of these two non-prescribed impact locations may be identified by the arc distance along the reference plane from the anterior intersection of the midsagittal plane with the reference plane, clockwise or counterclockwise, and the perpendicular arc distance from that point on the reference plane to the non-prescribed impact location.



Headform circumference (mm)	Distance (mm)				
	T	L/2	U	R	S
495	137.0	87.8	25.0	50.0	19.5
535	146.5	94.3	25.0	50.0	20.5
575	155.0	100.8	25.0	50.0	20.5
605	161.0	105.6	25.0	50.0	23.5

FIG. 8 Marking the Test Line

12.2.9 *Impact Locations on Headform and Helmet*—Determine an impact location on the headform, then mark this location on the headform. Place the helmet on the headform as specified by the manufacturer's head positioning index (HPI) and mark the corresponding impact location on the helmet before performing the impact. The impact location may be determined and marked first on the helmet and then marked on the headform. If marking the helmet first, make sure the corresponding mark on the headform is on or above the test line. Do this for all impact locations.

12.3 *Multiple Impacts*—Impact the ambient conditioned helmets three times at each of the locations described in 12.2. Impact the hot and cold conditioned helmets two times at each of the two locations described in 12.2. The impact velocity shall be 4.5 ± 0.1 m/s (14.8 ± 0.3 ft/s).[6] The time interval between impacts shall be not less than 30 s nor more than 90 s.

12.4 *Headform and Carriage Assembly*—The test headforms shall be made of K1A magnesium material. The headform and carriage assembly shall have a mass of:

605 mm headform and carriage assembly = 5.6 ± 0.16 kg
575 mm headform and carriage assembly = 4.7 ± 0.14 kg
535 mm headform and carriage assembly = 4.1 ± 0.12 kg
495 mm headform and carriage assembly = 3.1 ± 0.10 kg

The carriage assembly (excludes ball arm and clamp) shall contribute to no more than 50 % of the total mass.

12.5 *Reference Marking*—Place the complete helmet to be tested on a reference headform that is firmly placed with the basic and reference planes horizontal. Apply a 44.5-N (10-lbf) static load to the crown of the helmet, center the helmet laterally, and adjust it in accordance with the manufacturer's recommendations. Maintaining the static load, draw a "test line" on the outside of the helmet shell corresponding to the reference plane (parallel to and at a distance above the basic plane of the headform in accordance with 12.4. In addition to the "test line," also mark plainly each of the six impact points as described in 12.2.

12.6 *Helmet Positioning*—Prior to each test drop, adjust the helmet on the headform in accordance with the manufacturer's recommendations. Secure the helmet to the headform so that it does not shift position prior to impact. Place the retention system in such a position that it does not interfere with the free fall or the impact.

12.7 *Retention Test—Length Adjustment:*

12.7.1 *Chin Strap*—Adjust the free strap length between helmet attachment points to 9 in. (229 mm).

12.7.2 *Neck Strap*—Adjust the free strap length between helmet attachment points to 6 in. (152 mm).

12.8 *Deflection and Retention Test:*

12.8.1 Support the helmet on a test machine fixture and pass the strap over the rollers of the strap test apparatus shown in

[6] This velocity is equivalent to a drop height of 1016 mm (40 in.).

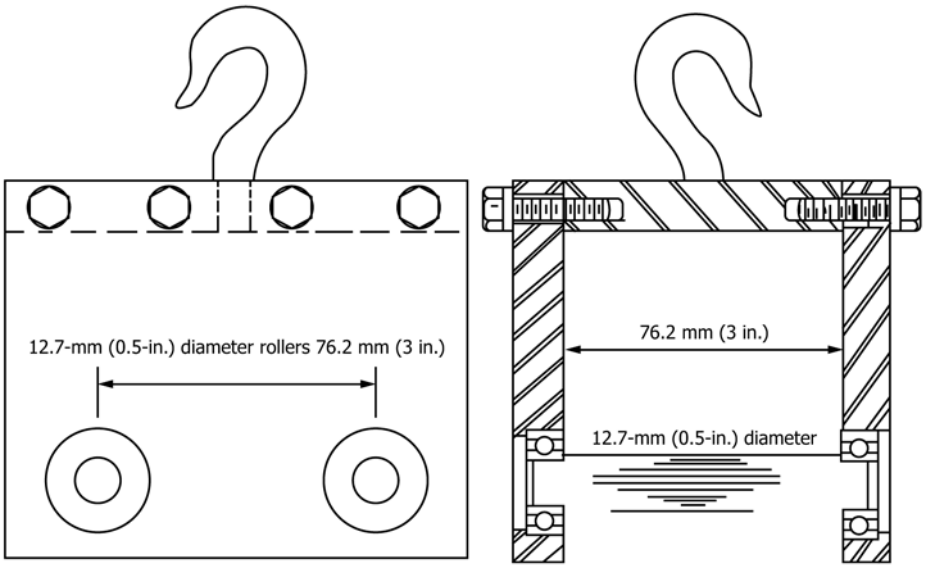


FIG. 9 Chin Strap Test Apparatus

Fig. 9. The testing machine shall be capable of providing a controlled rate of displacement between the helmet and the strap test apparatus while recording the resulting tensile force. Fasten the retention system closures.

12.8.2 Establish the perpendicular distance between a point on the strap test apparatus and a line through the points at which the retention system is attached to the helmet shell. The distance should be recorded while the applied load is 3 lbf (13.3 N). This distance shall be regarded as the point of zero displacement.

12.8.3 Increase the displacement at a speed not greater than 25.4 mm/min (1 in./min). Measure the distance between the strap test apparatus and the line through the attachment points when the load reaches 106.8 N (24 lbf).

12.8.4 Calculate the displacement of the strap at 106.8 N (24 lbf) as the difference between the distance measured in 12.8.2 and that measured in 12.8.3.

12.8.5 Continue to increase displacement at a speed not greater than 25.4 mm/min (1 in./min) until the retention system separates.

12.9 *Penetration Resistance Tests:*

12.9.1 *Test Blade*—The test blade is shown in Fig. 10.

12.9.2 *Headforms*—The appropriate headform, as described in Fig. 3, shall be used for testing the appropriate helmet.

12.9.3 Mount and adjust the helmet on the appropriately sized headform in accordance with the manufacturer's recommendations provided with the helmet. An attempt shall be made to enter any radiused or flat portion of the test blade, in all possible orientations, into all openings of the protector within the area of coverage, excluding the ear openings.

13. Impact Requirements

13.1 Each helmet model presented for impact testing shall be furnished with an HPI (see 3.1.6) as established by the helmet manufacturer. This HPI shall be used when placing the helmet on the headform for testing. If this information cannot be obtained from the manufacturer, the technician shall position the helmet on the appropriate headform according to the fitting instructions included, and the technician's judgment. Helmets shall be tested on the appropriate test headform size(s) as determined by the testing laboratory. Helmets shall be tested on the largest and smallest size test headforms on which they fit. If a smaller size of the same model fits the smaller headform, the larger helmet will be tested on the larger headform only.

13.2 The peak acceleration of any impact shall not exceed 275 g.

13.3 The helmet shall remain intact with no visible cracks through the thickness of the outer covering (shell).

13.4 A test report of impact tests as described in Section 15 shall be an integral part of this performance specification.

14. Calculation

14.1 Immediately after each impact, take the following measurements of the acceleration time-history trace:

14.1.1 *Maximum Acceleration*—Find the maximum amplitude of acceleration by measuring the perpendicular distance to the trace base line from the midpoint of the trace at maximum excursion and multiplying by the sensitivity factor. (Sensitivity factor = *g* per division deflection of the trace.)

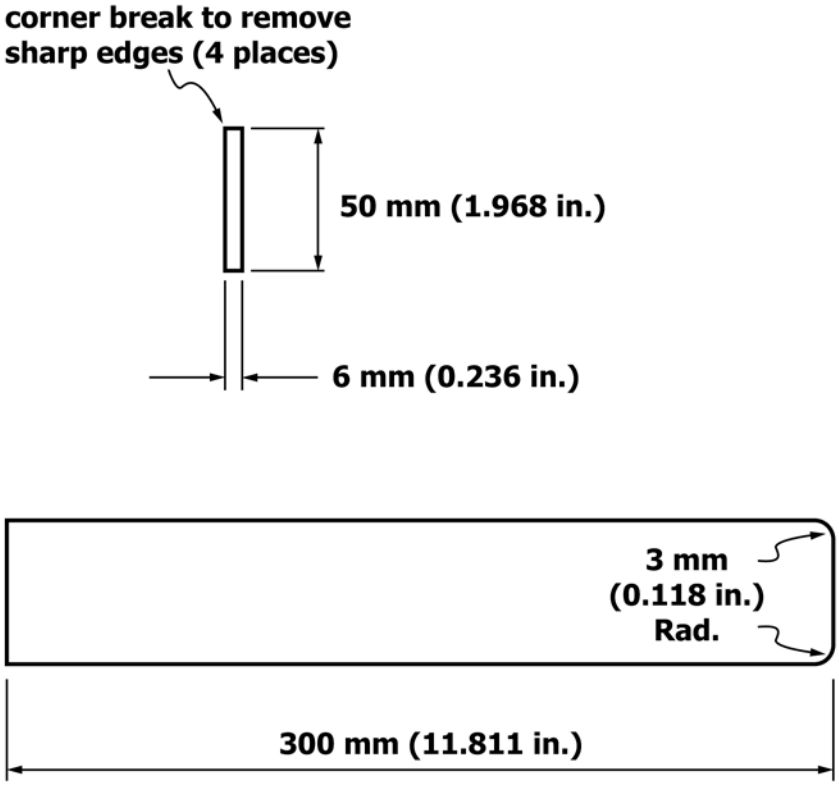
14.1.2 *Duration of Impulse*—Determine the duration of the pulse by measuring the total width of the trace along the 50-*g* line in milliseconds.

14.1.3 *Oscillograms*—Take photographs of the oscilloscope on the third impact at each impact site conducted under ambient conditions.[7] Affix these oscillograms to the final report of testing.

15. Report

15.1 Each laboratory report shall be accompanied by the oscillograms (or computer graphs) prescribed in 14.1.3 and shall contain the following minimum information:

[7] Computer printouts of the acceleration time curves will satisfy this requirement.



NOTE 1—All dimensions have a tolerance of +0/−0.30 mm (+0/−0.012 in.).

FIG. 10 Test Blade

15.1.1 Manufacturer's identification,
15.1.2 Size,
15.1.3 Manufacturer's lot number,
15.1.4 Weight, and
15.1.5 External circumference at reference plane.

15.2 *Conditions of Test*—The report shall include detailed information of the conditions under which the tests were conducted as follows:
15.2.1 Date of test,
15.2.2 Temperature,
15.2.3 Humidity, and
15.2.4 Record of the instrument calibration.

15.3 *Test Results*—Detailed results of the impact testing shall include the following:
15.3.1 Impact location,
15.3.2 Drop height,
15.3.3 g_{max} for each impact,
15.3.4 Duration of pulse,
15.3.5 Other pertinent comments and remarks.

15.4 Fig. 11 provides a sample data sheet for recording test conditions and test results.

16. Product Marking

16.1 *Warning Labels*—Each helmet shall be permanently labeled on the outside or inside of the helmet, or both, with information for the user stating the limits of protection afforded by the helmet.[8]

16.2 Each helmet shall have accompanying fitting and positioning instruction, including graphic representation of proper positioning.

16.3 Each helmet shall be provided with a label affixed stating in the following or similar words: For maximum performance of the helmet, it must fit snugly, be free from cracks, and remain securely in position when adjusted for proper fit.

16.4 Each helmet shall be permanently labeled with the following information:

[8] Such a warning label might read: "Ice Hockey is a collision sport which is dangerous. This helmet affords no protection from neck or spinal injury. Severe head, brain, or spinal injuries including paralysis or death may occur despite using this helmet. Do not use this helmet if the shell is cracked, deformed, or if the interior padding is deteriorated. Read instructions carefully before wearing."
It is recommended the helmet have a red background label with white letters.

Date _____ Laboratory: _____ Test Performed by: _____

Helmet Make and Model _____ Laboratory Environment: Temperature _____ Humidity _____

Helmet Circumference (at reference plane) _____

Calibration Check		Impact Site	Drop Height (mm)	g_{max}	Impact Duration T (ms)	Remarks	Helmet No.	Helmet wt (g)
Pre-test	1						1	
	2						2	
	3						3	
Post-test	1						4	
	2							
	3							

Helmet No.	Test Condition	Impact Location	Front			Front Boss			Side			Rear Boss			Rear			Crown			Reported Impacts		
			1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	Ambient	Record No. max g T (ms)																					
2	Low Temperature	Record No. max g T (ms)																					
3	High Temperature	Record No. max g T (ms)																					
4	Immersed	Record No. max g T (ms)																					

Remarks: (Indicate helmet condition after impact)

Signed _____ Date _____

FIG. 11 Sample Data Sheet

16.4.1 Identification of the manufacturer,
16.4.2 Month and year of manufacture,
16.4.3 Model designation, and
16.4.4 Size or size range for proper fit.

17. Instructional Literature

17.1 Instructions accompanying the helmet must include at least the following information:

17.1.1 A warning concerning improper cleaning agents, paint, or other factors affecting helmet shell integrity or performance, or both, that the application or removal of decals is prohibited unless authorized by the manufacturer,

17.1.2 Notification that the helmet meets the minimum requirements of this ASTM performance specification for ice hockey provided it has not been reconditioned or altered in any way, and

17.1.3 Instructions to replace after a serious impact.

18. Keywords

18.1 helmet; ice hockey; protective head gear