



## Standard Specification for Headgear Used in Soccer<sup>1</sup>

This standard is issued under the fixed designation F2439; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

Soccer is a sport with inherent risks. Participation in the sport implies acceptance of risk of injury.

This specification was developed to address forces of some of the incidental (non-ball) head impacts that may occur while engaging in soccer. Although headgear satisfying this specification may provide limited protection against heading impacts which are generally sub-concussive, heading impacts are not addressed by this specification. In addition, the issue of multiple sub-concussive impacts is not addressed here. Note—Protection provided by headgear satisfying this specification is not equivalent to the protection provided by rigid “helmets” used in many other sports activities. Headgear that meets these standard specifications may not provide significant protection in some head impact situations.

This specification is intended to be used with other standards and documents listed in the Referenced Documents.

### 1. Scope

1.1 This specification defines performance requirements for headgear used for participation in the sport of soccer. The technical requirements in this specification do not address the administrative requirements of soccer governing bodies, so it should not be assumed that any headgear satisfying this specification will be acceptable for use in sanctioned soccer events.

1.2 This specification is intended to reduce the forces from external physical sources reaching the defined impact area of the head in impacts that may occur in the sport of soccer. No headgear can provide protection against all impacts, foreseeable or not. This specification does not address the potential for injury from any type of impact. The tests specified in this specification are laboratory simulation tests only, and do not purport to create situations identical to the impacts that may occur during the playing of soccer.

1.3 All testing and requirements of this specification shall be in accordance with Test Methods **F1446**, except where noted herein. In the event of a discrepancy between the requirements of this specification and those of Test Methods **F1446**, this specification shall prevail.

1.4 Partial utilization of this specification is prohibited. Any statement of compliance with this specification shall be a certification that the headgear meets all of the requirements of this specification in its entirety. Headgear that fails to meet any one of the requirements of this specification is considered to have failed the specification and should not be sold with any indication that it meets parts of the specification.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee **F08** on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee **F08.53** on Headgear and Helmets.

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## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

**F1446** *Test Methods for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear*

2.2 *Other Documents*:<sup>3</sup>

49 CFR Part 572, Subpart E *Anthropometric Test Dummies*

*Procedures for Assembly, Disassembly, and Inspection (PADI) of the Hybrid III 50th Percentile Dummy's Nine Accelerometer Array Head (NAAH) with Redundant Head C. G. Accelerometers*

## 3. Terminology

3.1 *Definitions*:

3.1.1 *impact area*—the region of the headform within which the center of each impact footprint must fall.

**F1446**

## 4. Significance and Use

4.1 The purpose of this specification is to provide reliable and repeatable test methods for the evaluation of headgear for soccer. Headgear satisfying this specification is intended to reduce forces reaching the head in some of the impacts that may occur in soccer.

## 5. Apparatus

5.1 Apparatus used for this testing shall be in accordance with Test Methods **F1446** except as noted herein.

5.2 *Test Headforms*—Test headforms used with this specification shall be the 50th percentile Hybrid III adult male head and neck assembly, including the upper and lower neck adjusting brackets and all associated hardware. The equipment shall be as defined in the United States of America Code of Federal Regulations (49 CFR Part 572, Subpart E). A complete listing of all parts and components which make up the head and neck assembly is found in **Appendix X1**; see also *Procedures for Assembly, Disassembly, and Inspection (PADI) of the Hybrid III 50th Percentile Dummy's Nine Accelerometer Array Head (NAAH) with Redundant Head C.G. Accelerometers*.

5.2.1 The test headform shall be mounted to a standard monorail or twin-wire system or similar system, as shown in Test Methods **F1446**. Mass of the entire drop system shall be  $8.8 \text{ kg} \pm 5\%$  ( $19.4 \text{ lb} \pm 5\%$ ). Accelerometer instrumentation shall be installed into the test headform to measure resultant linear accelerations of the test headform as specified in the section on Accelerometer of Test Methods **F1446**.

5.2.2 The headform center of gravity shall fall within  $5^\circ$  of the vertical axis through the point of impact when the test headform assembly is in the impact position, as described in the Appendix of Test Methods **F1446**.

5.3 *Steel Post Anvil*—The steel post anvil used in this specification is to represent a nominal 7.62 cm (3 in.) diameter steel post. The anvil shall consist of a 7.62 cm (3 in.) diameter steel bar ( $\pm 5\%$ ) that is welded (or securely attached to similarly minimize vibration between the bar and the plate) in a horizontal position to a steel plate.

5.4 *Headform Anvil*—The headform anvil is a 50th percentile Hybrid III headform and neck assembly as defined in 5.2. The headform anvil shall be oriented such that the forehead is in an upright target position. The lower neck bracket shall be mounted to a rigid structure. The headform anvil shall be positioned such that the only impact between the drop headform and the impact anvil is at the selected impact location, with no other parts of the headform and anvil coming into contact with each other during the initial impact. The headform anvil need not be instrumented.

5.5 *MEP Anvil*—The MEP anvil shall be as defined in the section on Modular Elastomer Programmer (MEP) of Test Methods **F1446**. The MEP anvil shall be positioned with its upper surface horizontal, such that the only impact between the drop headform and the impact anvil is at the selected impact location, with no other parts of the headform and anvil coming into contact with each other during the initial impact.

## 6. Equipment Calibration and System Checks

6.1 Instrumentation used in testing shall be calibrated according to the requirements of Test Methods **F1446** and 49 CFR Part 572, Subpart E.

6.2 The 50th percentile Hybrid III adult male test headform used with this specification shall pass a system check according to the procedures described in **Appendix X2**. Duration of the system check cycle shall be no more than 12 months.

6.3 *Instrumentation System Check*—The system instrumentation shall be checked before and after each series of tests by dropping the Hybrid III head and neck assembly (see 5.2) onto the MEP pad (see section on Modular Elastomer Programmer (MEP) of Test Methods **F1446**) at an impact velocity of  $2.8 \text{ m/s} \pm 2\%$ . The head and neck assembly shall be oriented such that

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from National Highway Traffic Safety Administration (NHTSA), 400 7th St., NW, Washington, DC 20590.

the neck of the Hybrid III headform is at a  $24 \pm 1^\circ$  downward angle relative to the horizontal and the forehead shall contact the center of the MEP pad. The peak acceleration obtained during this impact shall be  $112 \pm 8$  g. Three such impacts at intervals of  $75 \pm 15$  s shall be performed before and after each series of tests. If the average peak acceleration obtained in the pretest impacts differs by more than 5 % from the average peak acceleration obtained in the post test impacts, recalibration of the instruments and transducers must be carried out, and all data obtained during that series of impact tests shall be discarded.

## 7. Samples for Testing

7.1 *Conditions and Attachments*—Headgear shall be tested complete, in the condition as offered for sale. They must satisfy all requirements of this specification with or without any included attachments.

7.2 *Number of Samples*—A test series requires 12 samples of each size headgear and shall be tested according to the following schedule (see **Table 1**).

## 8. Conditioning Requirements

8.1 *Ambient Condition*—Four samples of each size headgear shall be conditioned at the ambient condition defined in ASTM Test Methods **F1446**.

8.2 *Low Temperature*—Three samples of each size headgear shall be conditioned at the low temperature conditions as defined in Test Methods **F1446**.

8.3 *High Temperature*—Three samples of each size headgear shall be conditioned at the high temperature conditions as defined in Test Methods **F1446**.

8.4 *Water Immersion*—Three samples of each size headgear shall be conditioned at the water immersion conditions as defined in Test Methods **F1446**.

8.5 Testing of conditioned samples must occur within 10 min after removal of the sample from the conditioning environment. If a sample is out of the conditioning environment for more than 10 min, it shall be reconditioned 3 min for each minute beyond 10 min that it is out of the environment, up to a maximum of 4 h.

## 9. Test Schedule and Procedures

### 9.1 Construction and Materials:

9.1.1 *Projections*—There can be no rigid projections, hard or sharp surfaces, or hard or sharp edges on any part or surface of the headgear. Non-rigid projections can project no more than 5 mm (0.20 in.) from the primary impact surface of the headgear, must collapse under a static load of 2.27 kg (5 lb)  $\pm 10$  %, and must be faired with the base surface of the headgear. Any rigid or semi-rigid materials used in the headgear must be padded sufficiently so that they satisfy all requirements of this specification.

9.1.2 *Materials*—Materials known to cause skin irritation or disease shall not be used in the headgear. Comfort padding, if used, may be detachable for cleaning. If chemicals such as hydrocarbons, cleaning fluids, paints, or transfers and other additions will affect the headgear adversely, a warning to this effect shall be provided.

9.2 *Labeling*—Each headgear shall be marked in such a way that the following information is easily legible by the user and is likely to remain legible throughout the life of the headgear. The first five items in the following list must be physically attached to the headgear; other items may be explained on the packaging or instructions that accompany the headgear, or both.

9.2.1 Model designation, if appropriate.

9.2.2 Name and contact information of manufacturer.

9.2.3 A label that warns the user that no headgear can protect against all foreseeable impacts, and that for maximum protection, the headgear must be fitted and attached properly to the wearer's head in accordance with the manufacturer's fitting instructions.

**TABLE 1 Sample Test Schedule**

	Head to Forehead Impacts	Head to Post Impacts	Head to MEP Impacts	Multiple Impacts to MEP	Number of Impacts
Headgear 1, Ambient	X				1
Headgear 2, Hot	X				1
Headgear 3, Cold	X				1
Headgear 4, Wet	X				1
Headgear 5, Ambient		X			1
Headgear 6, Hot		X			1
Headgear 7, Cold		X			1
Headgear 8, Wet		X			1
Headgear 9, Ambient			X		1
Headgear 10, Hot			X		1
Headgear 11, Cold			X		1
Headgear 12, Wet			X		1
Headgear 1, Ambient	X			X	6

9.2.4 A statement that this headgear satisfies the requirements of ASTM Specification F2439.

9.2.5 A statement that this headgear is intended to reduce head impact forces while playing soccer, and shall not be used as head protection for other activities.

9.2.6 A statement warning the user that the headgear can be damaged by contact with common substances, for example, certain solvents, cleaners, and so forth, and that this damage may not be visible to the user. The label should also list any recommended cleaning agents or procedures, or both.

9.3 *Marking the Impact Area*—The impact area is an angled band encircling the entire head, 50 mm (2.0 in.)  $\pm 10\%$  in linear height. Using a 50th percentile male Hybrid III head and neck assembly, place the test headform in an orientation such that the base of the skull is horizontal (see Fig. 1). Draw a line 25 mm (1.0 in.) above the design cg of the Hybrid III test headform and parallel to the base of the skull and define this line as AA'. Point A is the intersection of the line AA' and the front profile of the test headform. Using point A as a guide, draw a line AB that is angled  $12^\circ$  downward to the rear of the test headform (relative to point A). Draw a line CD that is 50 mm (2.0 in.) above and parallel to the line AB. The area included within the region ABCD shall be defined as the impact area.

#### 9.4 *Shock Attenuation Impact Tests:*

9.4.1 Prior to impact testing, conduct the instrumentation system check (see 6.3).

9.4.2 The anvils to be used for impact tests in this specification are a headform anvil, a steel post anvil, and an MEP pad (to simulate impact on the ground).

9.4.3 Place the headgear to be tested on the test headform in accordance with the manufacturer's instructions prior to testing.

9.4.4 With the headgear placed on the headform in accordance with the manufacturer's instructions, the headgear may be impacted anywhere within the impact area. Coverage need not be continuous within the impact area, as long as the impact tests provide satisfactory results in accordance with this specification.

9.4.5 One impact shall be conducted at one test location on each sample headgear unless otherwise specified. There shall be no overlap of impact footprints in any testing except in the multiple impact testing.

9.4.6 *Head to Forehead Impacts*—The instrumented headform/neck (the test headform) shall be attached to the drop system as specified and the headform anvil mounted in a fixed upright target position.

9.4.6.1 An ambient headgear is affixed to the surface of the test headform in accordance with the manufacturer's instructions, such that a position within the impact area of the test headform is located at the point where the test headform will strike the forehead of the headform anvil when it is dropped. The test headform shall be dropped in guided freefall to result in an impact velocity of  $3.80 \text{ m/s} \pm 5\%$  ( $12.5 \text{ ft/s} \pm 5\%$ ). The peak linear acceleration of this padded head-to-forehead shall not exceed 80 g.

9.4.6.2 Repeat 9.4.6.1 with hot, wet and cold samples.

9.4.7 *Head to Goal Post Impacts*—The steel post anvil shall be mounted in a horizontal position, and no part of the post shall impact the headform outside the impact area.

9.4.7.1 An ambient headgear is affixed to the surface of the test headform in accordance with the manufacturer's instructions, such that a position within the impact area of the test headform will strike the goal post anvil when it is dropped. The test headform shall be dropped in guided freefall to result in an impact velocity of  $2.00 \text{ m/s} \pm 5\%$  ( $6.6 \text{ ft/s} \pm 5\%$ ). The peak linear acceleration of this padded head-to-post impact shall not exceed 80 g.

9.4.7.2 Repeat 9.4.7.1 with hot, wet and cold samples.

9.4.8 *Head to MEP Impacts*—The MEP anvil shall be mounted with its top surface in a horizontal position, and no part of the MEP pad shall impact the headform outside the impact area.

9.4.8.1 Prior to collecting impact data for drops onto MEP, the MEP pad must be conditioned for consistency. The bare test headform shall be dropped onto the MEP pad three times within a period of 1 min at an impact velocity of  $2.50 \text{ m/s} \pm 5\%$  ( $8.2 \text{ ft/s} \pm 5\%$ ). Results of these three initial impacts need not be recorded. The bare test headform shall then be dropped onto the MEP pad three times within a period of 5 min. Peak linear accelerations of these three impacts are recorded, and shall not vary from each other by more than 5%.

(1) During testing, the MEP anvil should not come into contact with any object that is not at ambient condition.

(2) If during the course of testing the MEP anvil is unimpacted for a period of 1 h or longer, it shall be reconditioned in accordance with 9.4.8.1.

9.4.8.2 An ambient headgear is affixed to the test headform in accordance with the manufacturer's instructions, such that a position within the impact area of the test headform will strike the MEP anvil when it is dropped. The test headform shall be dropped in guided freefall to result in an impact velocity of  $2.50 \text{ m/s} \pm 5\%$  ( $8.2 \text{ ft/s} \pm 5\%$ ). The peak linear acceleration of this padded head-to-MEP impact shall not exceed 80 g.

9.4.8.3 Repeat 9.4.8.2 with hot, wet, and cold samples.

#### 9.4.9 *Multiple Impact Test:*

9.4.9.1 If more than 1 h has elapsed since the most recent MEP anvil impact test, repeat 9.4.8.1.

9.4.9.2 The MEP shall be mounted with its top surface in a horizontal position, and no part of the MEP pad shall impact the test headform outside the impact area. If necessary, the MEP anvil shall be reconditioned in accordance with 9.4.8.1. An ambient headgear is affixed to the test headform in accordance with the manufacturer's instructions such that a position within the impact