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An American National Standard

Standard Test Method for Shock-Attenuation Characteristics of Protective Headgear for Football[1]

This standard is issued under the fixed designation F429; 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 test method covers the determination of the shock-attenuation characteristics of protective headgear for football.[2]

1.2 *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]

F717 Specification for Football Helmets

2.2 *SAE Document:*

J221 JUN 80 Instrumentation for Impact Tests, Requirements for Channel Class 1000[4]

2.3 *ISO Standard:*

ISO/DIS 6220 Headforms For Use in the Testing of Protective Helmets[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *basic plane*—an anatomical plane that includes the superior rims of the auditory meatuses (the upper edges of the external openings of the ears) and the notches of the inferior orbital ridges (the bottom of the eye sockets). See Fig. 1.

3.1.2 *coronal plane*—a vertical plane that is perpendicular to the median and reference planes and passes through the crown of the headform (lateral plane).

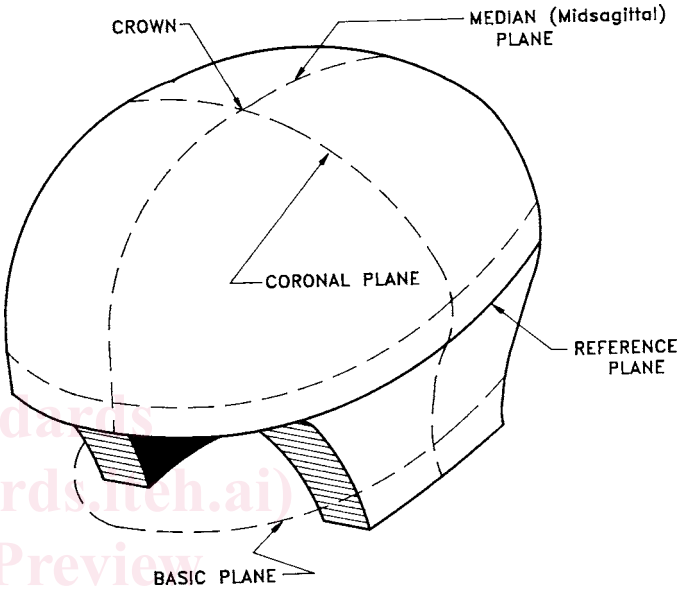

FIG. 1 ISO Headform—Basic, Reference, and Median Planes

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

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

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

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

3.1.7 *median plane*—a vertical plane that passes through the headform from front to back and divides it into right and left halves (mid-sagittal plane).

3.1.8 *protective headgear*—the assembled device and accessories as supplied by the manufacturer primarily intended to protect the wearer's head while participating in football.

3.1.9 *reference plane*—a plane that is located at a specified distance above and parallel to the basic plane.

[1] This test method is under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.53 on Headgear and Helmets.

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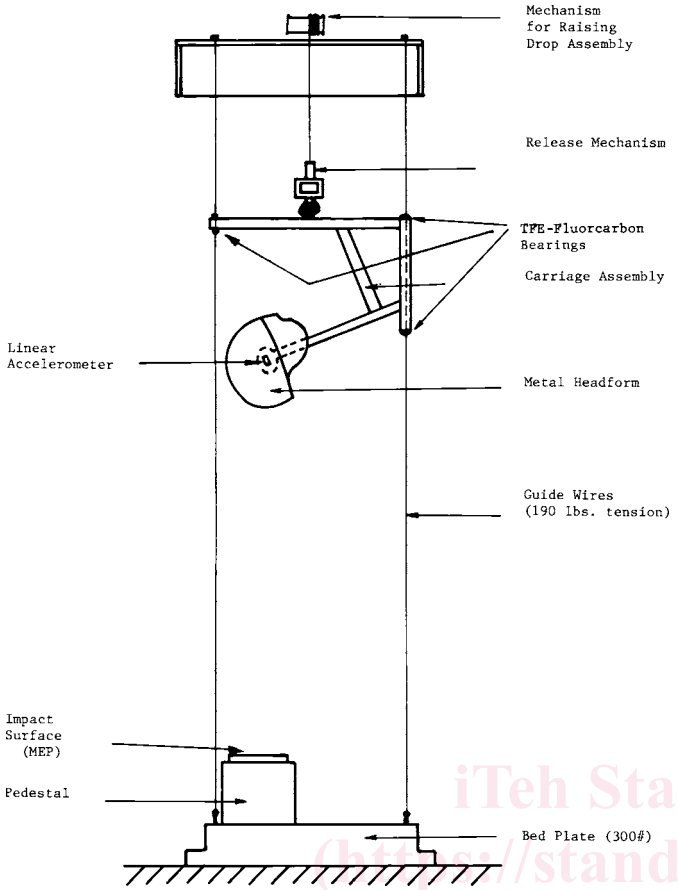
[2] Performance requirements for football helmets are found in Specification F717.

[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 the Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

[5] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.



NOTE—Rail-guided drop assemblies are also permissible.

FIG. 2 Schematic of Typical Drop Assembly

4. Summary of Test Method

4.1 A headgear is mounted on a headform that is oriented in different positions and is 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 which are recorded with appropriate instrumentation.

5. Significance and Use

5.1 Maximum acceleration and time duration data obtained by the specified procedures are intended to determine the shock attenuation characteristics of a headgear.

NOTE 1—These data can be used at a later date to assess the protection afforded to the head when blows are delivered to the helmet.

6. Apparatus [5]

6.1 *Guide Assembly*[6]—The headform shall be attached to the free-fall drop assembly carriage by an adjustable mounting which will allow impacts to be delivered to any prescribed point on the helmet (see Fig. 2). The carriage shall be free to slide on vertical guides. If wires are used they must be placed under at least 190-lbf (845-N) tension (see 12.4 for guide assembly specifications and allowable weight of drop assembly).

6.2 *Recording Equipment*[6]—The recording equipment shall meet the following criteria:

6.2.1 *Acceleration Transducer*—The acceleration transducer 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. The acceleration data channel complies with SAE Recommended Practice J211 JUN 80 (a low pass filter having a 4-pole Butterworth transfer function and a corner frequency of 1650 Hz meets this requirement). Digital filtering at 1650 Hz can be substituted.

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

6.2.3 *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.

6.2.4 *Headforms*—Standard headforms as described in 12.4 will be used for helmet impact testing.

6.2.5 *Height Measuring Rod*—A metal rod accurate to ± 0.10 in. (± 2.5 mm) shall be used for measuring drop heights.

6.2.6 *Impact Surfaces*—The impact surface for the instrument system check (see Section 10) shall be a flat, Modular Elastomer Programmer (MEP),[6] 152 mm in diameter and 25 mm in thickness. The MEP shall have a durometer of 60 ± 2 Shore "A." The MEP is mounted on an aluminum mounting plate with a minimum thickness of 0.220 in. after grinding. The MEP (including aluminum mounting plate) shall be firmly affixed to the top surface of a flat metal anvil. The base shall consist of a rigid slab weighing at least 136 kg. For helmet impacts, the instrument system check MEP is replaced with a MEP 13 mm in thickness, 152 mm in diameter, and a durometer of 38 ± 5 Shore "A."

6.2.7 *Spherical Impactor*[6]— A device made of low resonance material, for example, magnesium, aluminum alloy or stainless steel, that couples mechanically with the ball arm connector of the drop assembly in place of the impact test headform. When mounted, the device presents a spherically machined impact face with a radius of 2.875 in. (73 mm) on its bottom surface. All radii from the center of curvature of the impact face to its outer edge shall form angles of no less than 40° with the downward vertical axis. The center of curvature shall be within 5 mm of the vertical axis drawn through the center of the ball arm. The mass of the drop assembly including the impactor shall meet the same requirements as those specified for the drop assembly incorporated with the test headforms (see section 12.4).

7. Sampling

7.1 Submit at least three specimen helmets, one for test under the various conditions as described in Section 11.

[6] The sole source of supply of the apparatus known to the committee at this time is the Research & Testing Co., 1415 Park Ave., Hoboken, NJ 07030. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.