Designation: F 429 – 00

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

This standard is issued under the fixed designation F 429; 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:*

F 717 Specification for Football Helmets[3]

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).

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.

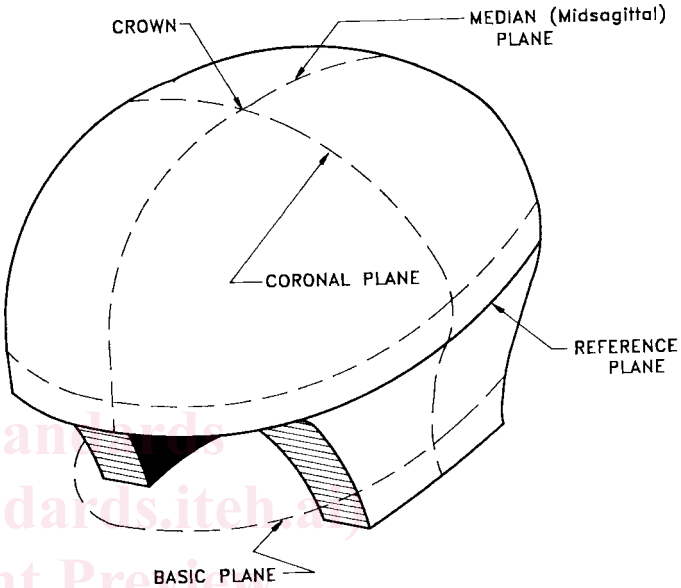

FIG. 1 ISO Headform—Basic, Reference, and Median Planes

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.

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

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

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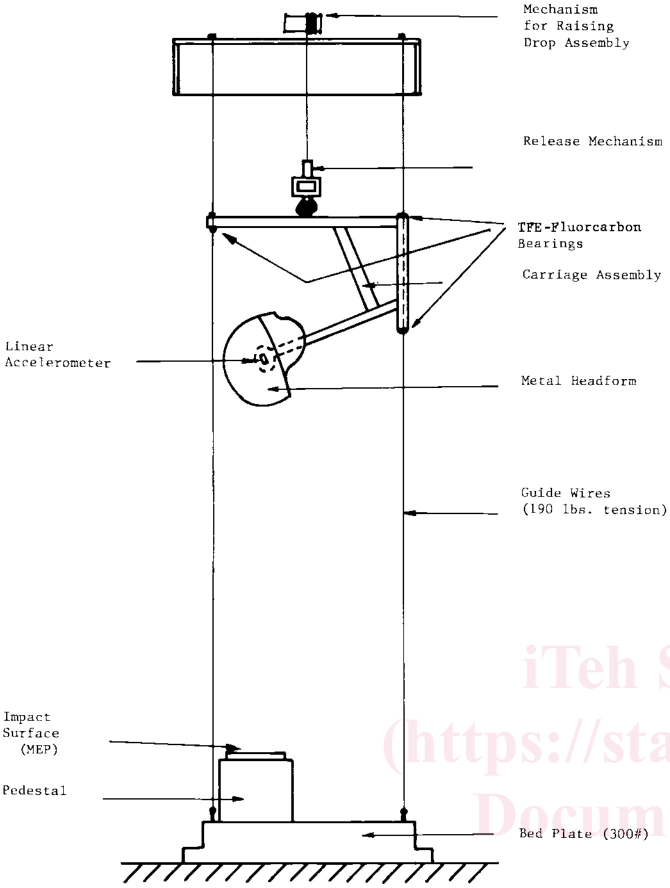
[2] Performance requirements for football helmets are found in Specification F 717.

[3] *Annual Book of ASTM Standards*, Vol 15.07.

[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.

history of impact which are recorded with appropriate instrumentation.)



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

FIG. 2 Schematic of Typical Drop Assembly

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),[7] 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*[7]— A device having a spherical striking surface of 2.875 in. (73 mm) radius and having a mass, when mounted to the ball-arm connector and drop assembly, of 5 ± 0.1 kg. The impactor is used for systems check of the electronic equipment (see Section 10). The impactor shall be constructed so as to duplicate the system check results of a machined 5.75 in. diameter aluminum sphere.

7. Sampling

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

8. Test Specimen

8.1 At least three specimen helmets of each size to be tested as offered for sale on the open market shall be obtained for testing. These helmets shall be tested 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. Instrumentation System Check

10.1 The instrumentation of the entire system shall be

[6] Available from the Research & Testing Co., 1415 Park Ave., Hoboken, NJ 07030.

[7] The MEP impact surface and the spherical impactor, required for the instrument system check, are available from the Research & Testing Co., 1415 Park Ave., Hoboken, NJ 07030.