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An American National Standard

Standard Specification for Shock Attenuation Properties of Fencing Surfaces[1]

This standard is issued under the fixed designation F1543; 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 shock absorption properties of fencing surfaces as measured by a drop test. The minimum performance standard for shock absorption is defined. Guidelines for other features and properties of fencing surfaces are described.

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

1.3 *This specification does not purport to address all the safety concerns, if any, associated with fencing surfaces and will not prevent all surface-related injuries. It is the responsibility of the user of the surfaces to establish appropriate safety and health practices, including, but not limited to, foot movement, footwear (shoes), and training practices.* Specific precautionary statements are given in 5.3.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E105 Practice for Probability Sampling of Materials

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *acceleration (deceleration)*—the instantaneous time rate of change of velocity. This is either positive (acceleration) or negative (deceleration).

3.1.2 *fencing surface*—the area for performing fencing bouts, competitions, or any other fencing exercises. A fencing surface, usually referred to as the fencing strip or piste, is defined in the U.S. Fencing Association's (USFA's) rule book.[3] It measures 1.8 to 2.0 m wide by 14 m long, often with added width and length for run-off, that at the ends should be 1.5 to 2 m. The fencing surface may be an area outlined by tape or paint on an existing surface or it may be a separate strip that can be placed on an existing surface, such as a rubber runner or a metallically-conducting mesh or sheet on a gym floor. This specification includes composite arrangements in which, for example, a grounded metallic strip is placed on top of a rubber strip or other shock-absorbing layer, which, in turn, is placed on a permanent floor.

3.1.3 *g*—the acceleration of matter due to gravity at the surface of the earth.

3.1.4 *G*—the ratio of the magnitude of missile deceleration during impact to the acceleration of gravity, *g*. Hence, *G* values are dimensionless.

3.1.5 G_{max}— the maximum value of *G* encountered during impact.

3.1.6 $G_{max}(av)$—the arithmetic average of the set of G_{max} values measured as stipulated in Section 5.

3.1.7 *shock attenuation*—the deceleration of an object upon impact on a surface or other object, measured in units of *g*.

3.1.8 *strip*—the fencing surface, defined in 3.1.2, above, is normally referred to as the strip (piste), in fencing.

4. Classification

4.1 *Types:*

4.1.1 *Type I*—Concrete,

4.1.2 *Type II*—Covered concrete (for example, with linoleum tiles, or rubber runners),

4.1.3 *Type III*—Hardwood on concrete,

4.1.4 *Type IV*—Plywood on concrete,

4.1.5 *Type V*—Hardwood on floor joists,

4.1.6 *Type VI*—Plywood on hardwood,

4.1.7 *Type VII*—Raised plywood,

4.1.8 *Type VIII*—Other surfaces such as synthetic gym floors or recycled rubber composite,

4.1.9 *Type IX*—Rubber runners (strips) on various flooring types, except concrete, and

4.1.10 *Type X*—Copper or steel fencing strips on various flooring types, except concrete.

5. Performance Requirements and Test Method

5.1 *Shock Attenuation*—Fencing surfaces consisting of concrete alone, or concrete covered with conventional tile, or with sheet floor covering, or with thin vinyl, or rubber runners do not provide adequate shock absorption (Floor Types I through

[1] This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilitiesand is the direct responsibility of Subcommittee F08.52 on Miscellaneous Playing Surfaces.

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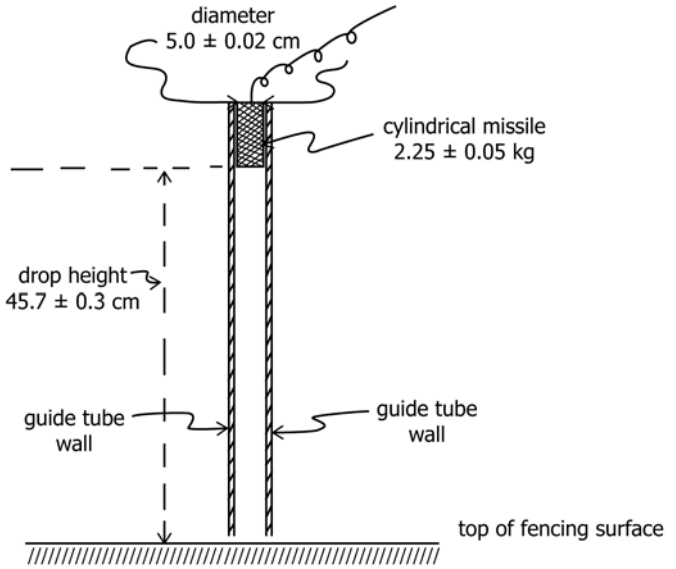
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] *Fencing Rules*, 1991 Edition, United States Fencing Association, Inc., One Olympic Plaza, Colorado Springs, CO 80909-5774.



NOTE 1—Vertical projection of a schematic representation of the drop test is the basis of this performance specification. Whether a simple floor or a layer or strip placed over a floor, the distance from the starting position of the bottom of the missile to the top of the layer or strip, on which the fencing exercise is to occur, should measure 45.7 ± 0.3 cm. The missile is guided by a vertical cylindrical guide tube.

FIG. 1 Vertical Projection of a Schematic Representation of the Drop Test

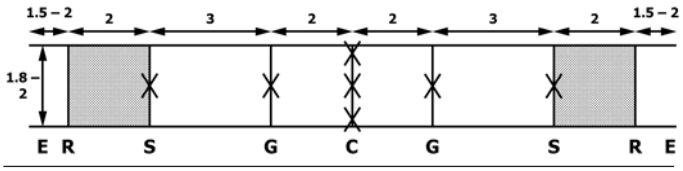
IV). To comply with this specification such surfaces shall not be used for the sport of fencing. It is not recommended that shock attenuation is enhanced by placing a rug under a metallic or rubber strip. While this reduces the *G* value, the shoe depresses the surface and creates a ridge around the shoe, causing increased risk of tripping.

5.1.1 Quantitatively, it is specified herein that the peak deceleration of fencing surfaces must average 800 or less (that is, a $G_{max}(av)$ of 800 or less), measured by a portable drop test method described as follows:

5.1.1.1 A cylindrically-shaped solid steel missile, measuring 5.0 ± 0.02 cm diameter at the flat impact surface and having a roundness or bevel of 0.05 to 0.1 cm on the edge, is dropped from a height of 45.7 ± 0.3 cm vertically. The weight of the missile assembly (including sensors and handle) shall be 2.25 ± 0.05 kg. A schematic of the test method[4] is shown in Fig. 1.

NOTE 1—This test method is based on a commercially available impact tester[5] developed by Clegg.[6]

5.1.1.2 The bandwidth of the acceleration measuring instrumentation must be sufficient to give good resolution of the peak deceleration (G_{max}). Commercially-available instruments[5] have a bandwidth of 7 kHz, that is adequate.



C = Center line
R = Rear limit line
G = On guard lines
E = End of strip extensions
S = Start of 2-m signal area

NOTE 1—Regulation fencing strip, as given in the 1991 USFA Rules[3]. Dimensions are given in metres. The locations on the strip to be tested are indicated with an X.

FIG. 2 Regulation Fencing Strip

5.1.1.3 Determine peak deceleration for one impact at each of the following seven locations: five locations across the length of the strip and for one location at each edge at the center line of the strip, as indicated in Fig. 2. Perform one drop test per location. Report the average of all seven peak values as $G_{max}(av)$.

5.1.1.4 The average of the seven test values, $G_{max}(av)$, should be less than 800. No single *G* measurement should exceed 900.

NOTE 2—Typical G_{max} values using this test procedure encountered for concrete (Types I through IV) range from 1300 to 1500; hardwood on floor joists (Type V) range from 300 to 700 (placing rubber runners or metallic strips directly on hardwood floors, Types IX and X, causes a much smaller variation in test values than are caused by measuring directly above a joist as compared with between joists on the same floor); and copper or steel strips on raised plywood (Type VII) range from 150 to 400. A test of two recycled rubber composite floor specimens placed on a hardwood floor measured 85 to 115 (an example of Type VIII).

NOTE 3—Practice E105 is applicable if more detailed testing is desired, but for the accuracy and precision required for this specification, a simple average of these seven measurements is sufficient.

5.2 *Stability*—All components of single or composite surfaces laid on a gym floor or other surface should be adequately secured to eliminate horizontal movement during fencing. A strip made of sections, such as a raised strip on plywood, should be laid down so as to have the sections meet the same horizontal plane everywhere, so that the seams are completely flat.

5.3 *Shoe-to-Surface Interface*—The utmost care should be taken to eliminate any area with inadequate traction due to wear, moisture, or other surface feature that reduces the normal surface traction property. (**Warning—**This specification does not address quantitatively the performance standard of fencing surfaces for traction. However, surfaces should be tested for the feel of traction while wearing fencing shoes and lunging on various places of the strip before fencing. Any slippery surface should be made to have acceptable traction before fencing by sweeping, drying, sanding, or turning (for metal) surfaces so as to eliminate the slippery section.) (**Warning—**This shock attenuation specification does not serve as a quantitative standard for traction of fencing surfaces.)

6. Keywords

6.1 Clegg tester; fencing strip; fencing surface; impact testing; shock attenuation

[4] Rogers III, J. N., and Waddington, D. V., "Portable Apparatus for Assessing Impact Characteristics for Athletic Field Surfaces," *Natural and Artificial Playing Fields: Characteristics and Safety Features, ASTM STP 1073*, ASTM, West Conshohocken, PA, 1990, pp. 96–110.

[5] Lafeyette Instrument Co., P.O. Box 5729, 3700 Sagamore Parkway North, Lafayette, IN 47903, USA; Controls SpA, 6/8, via Aosta, 20063 Cernusco, S/N (MI), Italy; T. A. Brown Electronics, 14 Robin Street, Mt. Lawley 6050, Western Australia, Australia; and Trevor Deakin Consultants Ltd., Ascot Court, White Horse Business Park, Trowbridge, Wiltshire BA14 OXA, United Kingdom.

[6] Clegg, B., "An Impact Testing Device for In-Situ Base Course Evaluation," *Australia Road Research Bureau Proceedings 8*, 1976, pp. 1–5.