



Designation: F3146 – 18

# Standard Test Method for Impact Attenuation of Turf Playing Systems Designated for Rugby<sup>1</sup>

This standard is issued under the fixed designation F3146; 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.

## 1. Scope

1.1 This standard establishes a test method to be used when testing a synthetic turf field's impact attenuation property for assessing its suitability for rugby.

1.2 The surface being tested will be located indoors or outdoors and typically includes the entire surface, both within the boundary lines of the playing area and outside of it. Where non-turf surfaces exist within these areas, they shall be excluded from the scope of this standard, unless they are covered either permanently or temporarily with synthetic turf.

1.3 It is acceptable to use this test method, where appropriate, as a test method for laboratory based testing of synthetic turf surfaces.

1.4 The definition of a minimum performance requirement for this test method is outside of the scope of this standard. Where reference is made to a minimum requirement this is intended for demonstration and clarification purposes only.

1.5 This test method establishes a method of reporting test results.

1.6 The values stated in SI units are to be regarded as standard. Where values are given in parenthesis they are mathematical conversions to inch-pound units that are provided for information purposes only and are not considered standard.

1.7 *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.*

1.8 *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 test method is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.65 on Artificial Turf Surfaces and Systems.

Current edition approved Aug. 1, 2018. Published November 2018. DOI: 10.1520/F3146-18.

## 2. Referenced Documents

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

F355 Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play

F2650 Terminology Relating to Impact Testing of Sports Surfaces and Equipment

### 2.2 World Rugby Documents:<sup>3</sup>

Regulation 22 Standard Relating to the Use of Rugby Turf World Rugby's Artificial Turf Performance Specification

## 3. Terminology

3.1 Except as noted, definitions in this standard are in accordance with terms defined in Terminology F2650.

### 3.2 Definitions:

3.2.1 *synthetic turf system, n*—a synthetic surface intended for use in sport consisting of varying elements including but not limited to a stitched or woven carpet, stabilizing infill, performance infill and a shock absorbing sub-material.

3.2.2 *critical fall height (CFH), n*—a measure of the impact attenuation performance of a surface; defined as the highest theoretical drop height from which a surface is estimated to meet the impact attenuation performance criterion specified.

3.2.3 *critical time value, n*— $t_2 - t_1$  where  $t_1$  and  $t_2$  are the initial and final times (in seconds) of the interval during which HIC attains maximum value.

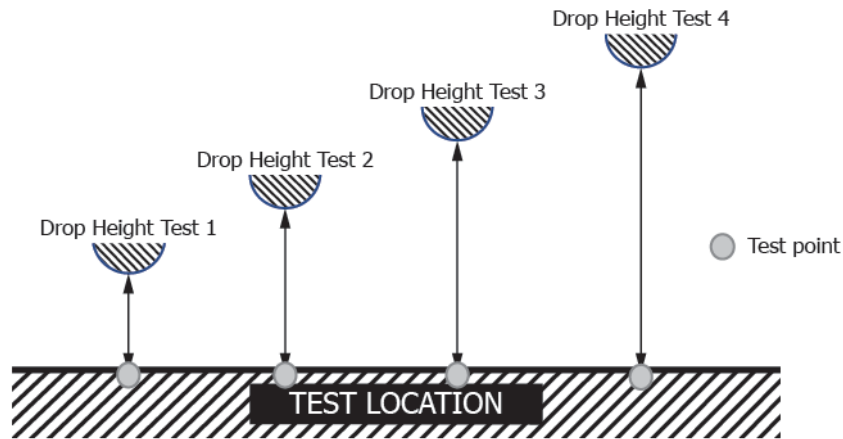
3.2.4 *drop height test, n*—the combined drop test(s) performed at one specific drop height (see Fig. 1).

3.2.5 *drop test, n*—an individual drop of the E missile (as defined in Test Method F355) at a test point, where the drop has been performed and recorded in accordance with prescribed methodology (see Fig. 1).

3.2.6 *head injury criterion (HIC), n*—weighted impulse criterion calculated from a head impact acceleration-time profile and used to quantify head impact severity. The HIC

<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 World Rugby, <https://www.worldrugby.org/>.



NOTE 1—The number of drop tests per drop height test will depend on the procedure being used but will be either 3 (Procedure A) or 1 (Procedure B).

FIG. 1 Drop Height Tests, Drop Tests, and Test Points

calculation results in a severity index that is weighted by both impact acceleration magnitude and by the time for which high magnitude accelerations persist.

3.2.6.1 *Discussion*—HIC scores can only be directly referenced to the head injury risk data on which the criterion is based if the impact acceleration-time profile is recorded using a human head or a biofidelic head form. HIC scores determined using rigid missiles and head forms tend to overestimate head injury risk.

3.2.7 *head form, n*—missile with mass and geometry approximating those of the human head.

3.2.8 *impact, n*—contact caused by a moving object (for example, an impact test missile) striking another object (for example, a surface) and during which one or both bodies are subject to high accelerations.

3.2.9 *impact attenuation, n*—reduction of loads produced during an impact by means of a cushioning system or device, relative to a load criterion or to the loads produced by a reference system.

3.2.9.1 *Discussion*—Load measures used to quantify impact magnitude include force, acceleration, stress and pressure and their time derivatives.

3.2.10 *impact attenuation performance criterion, n*—the HIC value at which CFH is being estimated.

3.2.10.1 *Discussion*—World Rugby currently use a value of 1000 HIC as the impact attenuation performance criterion, however an alternative value can be used at the discretion of the user of the results.

3.2.11 *impact centre, n*—the location on the surface where the hemispherical impactor strikes at initial impact.

3.2.12 *impact velocity, n*—the velocity ( $V_0$ ) of the impactor at the instant of impact.

3.2.13 *impact test system, n*—a device or system for performing an impact test in which an instrumented missile as described in Annex A1 and Annex A2 of Test Method F355 is used to impact the surface or surfacing materials as specified in the appropriate specification or test procedure.

3.2.14 *infill depth, n*—a measure of the depth of the infill(s) used in the system from the top of the carpet backing to the top surface of the infill.

3.2.15 *initial impact, n*—the instance where the acceleration of the impactor begins to decelerate due to contact with the surface.

3.2.16 *representative HIC, n*—the maximum HIC value calculated from the drops performed at a given drop height.

3.2.17 *synthetic turf system, n*—a composite of synthetic contact surface material, any fill material used in the contact surface, energy absorbing material, fabric layers, adhesives, if any, and other constructed layers (as applicable to the individual system).

3.2.18 *test point, n*—a location on the turf playing system at which a series of measurements is taken (see Fig. 1).

#### 4. Summary of Test Method

4.1 Impact attenuation is calculated by dropping an impactor of known mass and dimensions onto the surface from four different drop heights and the HIC value for each drop height calculated.

4.2 Regression analysis is used to define the relationship between measured drop heights and corresponding characteristic HIC values.

4.3 The regression equation resulting from the analysis described in 4.2 is used to estimate the drop height that corresponds to a representative HIC value equal to an established criterion. This value is the Critical Fall Height (CFH). CFH values are compared to an established criterion to determine if a field's performance is acceptable.

#### 5. Significance and Use

5.1 This test method is to be used to measure the impact attenuation of synthetic turf rugby fields and to estimate the CFH performance.