Designation: F3102 – 15

Standard Guide for Specifying, Measuring, and Managing Impact Attenuation of Synthetic Turf Playing Systems[1]

This standard is issued under the fixed designation F3102; 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 Applicable to synthetic turf playing systems, regardless of intended use, which are subject to testing in accordance with Specification F1936.

1.2 Applicable to synthetic turf playing systems installed either indoors or outdoors.

1.3 Not applicable to natural turf playing systems.

1.4 *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:*[2]

F355 Test Method for Impact Attenuation of Playing Surface Systems and Materials

F1936 Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field

F2650 Terminology Relating to Impact Testing of Sports Surfaces and Equipment

3. Terminology

3.1 *Definitions:*

3.1.1 Except as noted, definitions in this guide are in accordance with Terminology F2650.

3.1.2 *g*—a unit of acceleration equal to standard gravity. Missile accelerations expressed in "*g*" units are the ratio of the missile acceleration to standard gravity and are hence dimensionless.

3.1.3 *g-max*—maximum acceleration magnitude recorded during a single impact, expressed in "*g*" units.

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

3.1.5 *infill*—material(s) applied to the surface of a tall-pile synthetic turf playing system in order to create desired performance characteristics. Infill materials can include sand, rubber, other substances, or combinations thereof.

3.1.6 *playability*—the suitability of a playing surface in relation to the requirements of the sport(s) played on it.

3.1.7 *reported g-max value*—the *g*-max value assigned to a test point as the result of a test conducted in accordance with Specification F1936. It is the average of the *g*-max values recorded during the second and third missile impacts rounded to the nearest whole number.

4. Significance and Use

4.1 This guide is intended to provide designers, specifiers, owners, operators and managers of synthetic turf playing systems with information related to specifying, measuring and managing impact attenuation.

4.2 The goal of this guide is to facilitate decisions and actions that will maximize the safety, playability and functional longevity of individual synthetic turf playing systems, primarily as related to impact attenuation.

4.3 This guide presents various options related to specifying, measuring and managing impact attenuation of synthetic turf playing systems.

4.4 Unless specifically stated, this guide does not attempt to endorse or recommend specific options or practices. It is left to the user of the guide to determine the option, practice or course of action that is most appropriate for them, given the specifics of their individual situation.

5. Specifying Impact Attenuation

5.1 ASTM's requirement for impact attenuation of synthetic turf playing systems is established in Section 6 of Specification F1936. The specification requires that the reported *g*-max value for each test point be less than the designated limit-value. In situations where the reported value of one or more test points is equal to or greater than the designated limit-value, the turf

[1] 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.

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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.

system is considered to be out of compliance and in need of remedial action to bring all test points below the designated limit, as confirmed by subsequent testing.

5.2 In addition to establishing the *g*-max requirement discussed above, Section 6 of Specification F1936 gives owners, architects, engineers and other specifiers the latitude to establish more stringent requirements. Many do. These alternate requirements typically take one of three forms: lower maximum limits, ranges of acceptable values (maximum and minimum limits), and time-phased requirements.

5.2.1 Impact attenuation requirements for individual projects are often set at levels below the limit-value established in Specification F1936. Alternate requirements are set at the discretion of the specifier.

5.2.2 Some specifications establish both maximum and minimum *g*-max requirements. Some justifications for a minimum requirement are based on a concern that low *g*-max values affect safety and playability by rendering the surface too "soft." Impact attenuation does not contribute to the "hardness" or "softness" of a surface; but may be influenced by it. It is generally correct to say that fields that are perceived as "soft" will have low *g*-max values; but it is not correct to say that all fields with low *g*-max values can be characterized as "soft." In many cases, especially where shock-pads are used, *g*-max readings can be quite low, but the field will not feel at all "soft" to the player.

5.2.3 There is a general expectation that impact attenuation will change over time. Typically, *g*-max values will increase as a turf system ages. Accordingly, some specifications are written to require different levels of impact attenuation at different points in the life-cycle of the system; lower maximums at the outset, gradually increasing to a fixed maximum at some point in the future.

NOTE 1—Some specifications and contracts are written in such a way that the impact attenuation requirement is applied to the overall average of all the test points, as opposed to the reported value at each individual test point. This approach is inconsistent with the requirements of Specification F1936.

6. Measuring Impact Attenuation

6.1 Specification F1936 requires the use of a test device that complies with Test Method F355, Procedure A. In very general terms, the specified test apparatus consists of a guide tube, a missile that is dropped through the guide tube onto the surface being tested, and instrumentation that senses, records, analyzes and displays the accelerations experienced during the course of each missile impact. The missile weighs 20 lbs. and has a flat, circular impacting face with a 20 $in.^2$ (129 cm^2) surface area. The guide tube is designed to allow sufficient vertical fall for the missile to achieve an impact velocity corresponding to a theoretical drop height of 24 in. (61 cm).

6.2 There is currently no independent authority that certifies an individual or a company as qualified to perform an impact attenuation test in accordance with Specification F1936. Typically, training in the operation and maintenance of the test equipment is provided by the manufacturer. The manufacturer may also provide training relative to the procedures for conducting an impact attenuation test.

6.2.1 In selecting a company or an individual to provide independent, third-party testing services, it is prudent to request references and a sample of a completed test report. It is also advisable to be sufficiently familiar with the requirements of Specification F1936 to independently assess a prospect's level of knowledge and experience. (Copies of Specification F1936 may be purchased from ASTM International. See Appendix X1.)

6.3 Ultimately, the owner of a field is responsible for ensuring that testing is done at times and intervals that are consistent with their duty of care to provide safe facilities. In large measure, the appropriate frequency will be influenced by the types of activities on the field, their intensity, and how often they occur. There is no generally accepted formula for determining the appropriate interval between tests, but there is a general consensus that the frequency should not be less than once a year. Other considerations related to testing frequency include:

6.3.1 If the specifications for a synthetic turf system include a *g*-max performance requirement, the turf system should be tested prior to acceptance and use.

6.3.2 If the warranty for a synthetic turf system includes a *g*-max performance requirement, the turf system should be tested well before the warranty expires.

6.3.3 If a synthetic turf system cannot be tested annually, it is suggested that the frequency of testing be increased in the later stages of the system's life-cycle. This is the time when the system is more likely to demonstrate poor *g*-max performance.

NOTE 2—Some specifications and contracts for synthetic turf systems include a requirement for the manufacturer, installer or general contractor to submit independently prepared impact attenuation reports, often on an annual basis, while the turf system is under warranty.

6.4 Specification F1936 specifies that a minimum of ten points must be tested. It also provides the flexibility to increase the number of test points in response to requests from the person commissioning the test, or as warranted by special circumstances. It should be noted that there may be extra costs associated with evaluating additional test points.

7. Key Test Results

7.1 When assessing *g*-max performance, it is important to look at the reported *g*-max value for each individual test point. If one or more of the reported values fails to meet the requirement in Specification F1936, the field does not pass (see 5.1).

7.1.1 It is also important to assess the consistency of the results from one test point to the next. Significant variability may indicate the potential for problems to exist, even if none are specifically identified by the test.

7.2 If the synthetic turf system includes an infill component, the amount of infill reported at each test point should also be scrutinized. Low infill levels can contribute to higher *g*-max values.

7.2.1 If infill levels vary significantly there is a greater chance that low infill levels may contribute to poor impact attenuation somewhere on the field.

8. Designing for Impact Attenuation

8.1 The inherent impact attenuation of a synthetic turf playing system, and the ability to manage impact attenuation during the life of the system are functions of the turf system's design.

8.1.1 A synthetic turf playing system consists of many discrete components. These components may include: the sub-base, underlays such as shock pads and drain mats, the turf carpet, and infill material(s). Each installed component contributes to the impact attenuation of the turf system as a whole.

8.1.2 Effective design decisions will be based on an accurate estimate of the amount of use the turf system will receive. This estimate should encompass expected hours of use, the types and frequencies of planned activities, and a profile of the anticipated user-base.

8.1.3 Decisions regarding the selection of components, such as whether or not to install a shock pad, should include consideration of the component's effect on impact attenuation.

9. Managing Usage

9.1 The intensity with which a synthetic turf system is used—the hours of use, the numbers of users, and the characteristics of specific activities—may significantly affect impact attenuation. With respect to managing usage, the focus should be on controlling usage to keep it consistent with the levels anticipated when the field was designed. If actual use mirrors expected use, it is much easier to successfully manage impact attenuation.

9.2 Steps that can be taken to control usage include: securing the field to limit unauthorized access; establishing rules for users to protect the turf; and enforcing practices that minimize wear such as moving goals and shifting practice areas so that high-intensity activity isn't concentrated in the same spots, day after day.

10. Managing Maintenance

10.1 Differences in the design and installation of various synthetic turf systems, and differences in the types and intensities of the activities on them, suggest that there will be differences in the types, intensity and frequency of the maintenance operations needed to keep them safe, playable and aesthetically attractive. It is important that the maintenance program for a given field be matched to the activity on the field. And, whatever maintenance program is followed, it is also important that it comply with requirements established by the manufacturer. Failure to do so can result in a voided warranty.

10.1.1 Keeping a maintenance log is desirable. Having documentation of what was done and when it was done can be very helpful if warranty issues arise.

10.2 It should also be noted that maintenance activities can be a source of wear on the turf surface. The aggressiveness and frequency of various maintenance activities should be monitored and managed to balance the benefits of regular maintenance against the additional wear the maintenance may create.

11. Keywords

11.1 average *g*-max; drop test; field testing; *g*-max; impact; impact attenuation; infilled synthetic turf; infill levels; pile height; reported *g*-max; shock absorbing; shock-pad; synthetic turf playing system; test point; turf carpet; turf maintenance; turf system; underlays

APPENDIX

(Nonmandatory Information)

X1. ADDITIONAL RESOURCES

X1.1 *Organizations*:

ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959
Phone: (610) 832-9585
www.astm.org

Sports Turf Managers Association
805 New Hampshire, Suite E
Lawrence, KS 66044
Phone: (800) 323-3875
www.stma.org

Center for Sports Surface Research
College of Agricultural Sciences
Penn State University
plantscience.psu.edu/research/ centers/ssrc

American Sports Builders Association
8480 Baltimore National Pike #307
Ellicot City, MD 21043
Phone: (866) 501-2722
www.sportsbuilders.org

Synthetic Turf Council
400 Galleria Parkway, Suite 1500
Atlanta, GA 30339
Phone: (678) 385-6720
www.syntheticturfcouncil.org

Center for Athletic Field Safety
University of Tennessee
2431 Joe Johnson Drive
Knoxville, TN 37996-4561
www.turf.tennessee.edu

X1.2 *Publications and Other Resources*:

Synthetic Turf Sports Fields—A Construction and Maintenance Manual, Available from American Sports Builders Association

Note: The discussion of *g*-max testing in Chapter 3 of the 2006 edition of this publication (pages 42 and 43) contains a number of errors relative to its assertions regarding Specification F1936. Users of the 2006 edition should replace it with the most current edition.

Essential Guidelines for the Essential Elements of Synthetic Turf Systems, Available from Synthetic Turf Council

Suggested Guidelines for the Maintenance of Infilled Synthetic Turf Surfaces, Available from Synthetic Turf Council