



Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials¹

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1. Scope

1.1 These test methods establish a recommended list from which suitable test methods shall be selected for the identification of physical property characteristics and comparison of the performance properties of synthetic turf systems or components for athletic and recreational uses, or both.

1.2 Some of the test procedures are suitable only for the laboratory characterization of either components or the complete system; others are suitable for tests on installed sports fields; and some tests may be applied in both the laboratory and the field.

1.3 The test procedures included in these test methods apply as a group to the description of synthetic turf playing surfaces.

1.4 Some of the test procedures are specific for components of the synthetic turf system, and others apply to the complete synthetic turf playing surface.

1.5 Reference to the methods for testing the synthetic turf playing surface and its components contained herein should state specifically the particular test or tests desired and not necessarily refer to these test methods as a whole.

1.6 This is a physical property characterization standard, and it shall not be construed as a safety standard.

1.7 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.8 *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 health/environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

2.1.1 *Pile Fiber:*

[D792 Test Methods for Density and Specific Gravity \(Relative Density\) of Plastics by Displacement](#)

[D1577 Test Methods for Linear Density of Textile Fibers](#)

[D1907 Test Method for Linear Density of Yarn \(Yarn Number\) by the Skein Method](#)

[D2256 Test Method for Tensile Properties of Yarns by the Single-Strand Method](#)

[D3218 Specification for Polyolefin Monofilaments](#)

[D7138 Test Method to Determine Melting Temperature of Synthetic Fibers](#)

2.1.2 *Fabric:*

[D1335 Test Method for Tuft Bind of Pile Yarn Floor Coverings](#)

[D1776 Practice for Conditioning and Testing Textiles](#)

[D2859 Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials](#)

[D4158 Guide for Abrasion Resistance of Textile Fabrics \(Uniform Abrasion\)](#)

[D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics \(Grab Test\)](#)

¹ These test methods are under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and are 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.

- D5251 Practice for the Operation of the Tetrapod Walker Drum Tester (Withdrawn 2014)³
- D5793 Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings
- D5823 Test Method for Tuft Height of Pile Floor Coverings
- D5848 Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
- E648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
- F1015 Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
- 2.1.3 *Shock Absorbing Cushion Underlayment:*
- D395 Test Methods for Rubber Property—Compression Set
- D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- D1667 Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell)
- D1876 Test Method for Peel Resistance of Adhesives (T-Peel Test)
- D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- D3574 Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
- D3575 Test Methods for Flexible Cellular Materials Made From Olefin Polymers
- D3936 Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering
- F355 Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play
- 2.1.4 *Turf Systems:*
- D1667 Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell)
- F355 Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play
- F1015 Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
- F1936 Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field
- F2117 Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement
- F2333 Test Method for Traction Characteristics of the Athletic Shoe-Sports Surface Interface
- 2.1.4 *Infill Materials:*
- D5644 Test Methods for Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber
- F1632 Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes
- 2.2 *Other Standards:*
- AT-030 Sports Shoe Traction

NOTE 1—AstroTurf® Industries internal test procedure is suitable as a basis for new ASTM test methods.

- DIN 18-035 Part 6—Water Permeability of Synthetic Turf Systems and Permeable Bases
- EN 12234 Surfaces for Sports Areas – Determination of Ball Roll
- EN 12616 Surfaces for Sports Areas – Determination of Infiltration Rate
- EN 14808 Surfaces for Sports Areas- Determination of Force Reduction
- EN 14809 Surfaces for Sports Areas – Determination of Vertical Deformation
- prEN 15301-1 Surfaces for Sports Areas- Part 1. Determination of Rotational Resistance

3. Terminology

- 3.1 *Definitions*—Terms are as defined in the referenced ASTM procedures comprising these test methods.
- 3.2 *Definitions of Terms Specific to This Standard:*
- 3.2.1 *fabric construction*—the method of assembly of pile ribbon and backing yarns that produces the fabric, usually tufting, knitting, or weaving.
- 3.2.2 *infilled turf system*—field system having a long pile height and either one or more substances in the face of the fabric to provide the desired playing properties. Infill substances can be either sand, rubber or other substances or a combination of items.
- 3.2.3 *lengthwise direction, n—in textiles*, the direction in a machine-made fabric parallel to the direction of movement the fabric followed in the manufacturing machine.
- 3.2.4 *matting*—the extent of change of the apparent synthetic turf pile thickness from the original value due to permanent compression of the pile from sports use.
- 3.2.5 *pile, n—for pile fiber turf surfacing*, surface texture composed of many individual thin strands or groups of strands bound to a backing fabric in a repetitive array.

³ The last approved version of this historical standard is referenced on www.astm.org.

3.2.6 *pile lay*—the direction in which most of the pile fibers lean in the original, uncrushed fabric.

3.2.7 *secondary backing*—a material adhered to the backing side of a pile turf fabric.

3.2.8 *sports shoe traction*—a measure of the static or sliding coefficient of friction between a weighted sports shoe and the turf pile surface, horizontal motion.

3.2.9 *synthetic turf field system*—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 construction).

3.2.10 *synthetic turf system components*—the separate components such as turf fabric, shock-absorbing pad, and adhesives that comprise the synthetic turf playing surface when assembled; the subcomponents such as pile yarns and backing yarns that comprise the turf fabric.

3.2.11 *texture*—the detailed configuration of loops, cut pile ends, and individual fibers in the pile layer.

3.2.11.1 *Discussion*—

Texture is the detailed appearance of the pile that changes by matting, crushing, flattening, fuzzing, untwisting, etc. during exposure to service. The texture should be distinguished from the construction, that is, the specifications of kinds of yarns, yarn sizes, and the mode of combination.

3.2.12 *water permeability*—the rate at which water of a specified head flows vertically through synthetic turf or other components of the system.

4. Summary of Test Methods

4.1 The purpose of these test methods is to provide a comprehensive characterization of synthetic turf playing surfaces.

4.2 Specific conditions of the referenced procedures are recommended to encourage uniform application of these test methods.

4.3 **Table 1** is an index of the test methods listed herein.

5. Significance and Use

5.1 These test methods constitute a standard for obtaining data in research and development, quality control, acceptance and rejection under specifications, and for special purposes.

5.2 The data obtained from use of these test methods are applicable to the system and its components under conditions of the particular test procedures and are not necessarily the same as the data that might be obtained in other environments or use conditions.

5.3 The selection of test methods or tests should be limited to those appropriate to the system or material(s) being evaluated.

6. Conditioning of Materials

6.1 Conduct laboratory tests under known conditions of temperature and humidity as specified in the individual test procedures. In the absence of specified conditions, tests must be conducted under the standard laboratory conditions of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3^\circ\text{F}$) and $65 \pm 5\%$ relative humidity. Materials must be conditioned, undeflected, and undistorted at the temperature and humidity of test for at least 24 h prior to testing.

6.2 Conduct field tests on installed, indoor or outdoor synthetic turf playing surfaces at ambient temperature and humidity conditions. Measure and record the temperature of the synthetic turf surface, shock-absorbing pad, or other specific components being characterized by the particular test.

7. Sampling

7.1 For laboratory tests, select representative samples of components, in accordance with specific sampling instructions of the test procedure, when provided.

7.2 For field tests, specify locations on the synthetic turf playing surface where tests are conducted.

8. Application of Test Procedures

8.1 References to the test procedures stated herein are to be followed with regard to the apparatus, preparation of specimens, procedures, calculations, and reporting of results, except when different conditions are noted specifically in these test methods.

8.2 Precision and bias statements are given for each test procedure in the respective test methods.

8.3 Test procedures shall be followed except when test method-specific conditions are provided.



TABLE 1 Performance Test Methods for Synthetic Turf Surfaces

Test Method		Section	Item Tested
Pile Fiber			
D792	density (specific gravity)	9	synthetic yarn
D1577	linear density of textile fibers (denier)	10	pile of yarn on mfg. turf fabric
D1907	linear density of yarn (denier - skein method)	11	bobbin of yarn
D2256	breaking strength and elongation	12	bobbin of yarn
D3218	yarn thickness	13	synthetic yarn
D7138	melting point (Fisher-John method or DSC method)	14	synthetic yarn
Fabric			
D1335	resistance to tuft pullout	15	synthetic turf fabric
D2859	flammability of pile floor covering (methenamine tablet)	17	synthetic turf fabric
D4158	abrasion resistance (uniform abrasion method)	18	non-infilled turf
D5034	grab tear strength	19	synthetic turf fabric
D5251	resistance to matting (tetrapod method)	20	non-infilled turf
D5793	binding sites per unit	21	synthetic turf fabric
D5823	pile height	22	synthetic turf fabric
D5848	pile fiber, mass per unit	23	synthetic turf fabric
E648	flammability of synthetic turf (flooring radiant panel test)	24	synthetic turf fabric
F1015	relative abrasiveness of synthetic turf surfaces	25	synthetic turf fabric
Shock Absorbing Pad Component			
D395	compression set under constant load	26	shock-absorbing pad
D412	Dogbone tensile & elongation (Die A)	27	shock-absorbing pad
D624	tear resistance (Die C)	28	shock-absorbing pad
D1667	compression resistance	29	shock-absorbing pad
D1876	T-peel strength of secondary pad	30	synthetic turf and pad
D2126	hydrolytic stability	31	shock-absorbing pad
D3574	tensile and elongation urethane foams	32	shock-absorbing pad
D3575	water absorption (% weight gain)	33	shock-absorbing pad
D3936	delamination strength of secondary backing	34	synthetic turf and reinforcement fabric
F355	shock absorbency of playing surface systems and materials	35	shock-absorbing pad
Turf Systems			
D1667	compression resistance (modified method)	29	synthetic turf system
F355	shock absorbency of playing surface systems and materials	35	synthetic turf system
F1015	relative abrasiveness of synthetic turf surfaces	25	synthetic turf or system
F1936	shock absorbency of playing surface systems in the field	36	synthetic turf system
F2117	vertical rebound (acoustical measurement)	37	synthetic turf system
F2333	athletic shoe traction	38	synthetic turf or system
Other Standards – Turf Systems			
AT-030	sports shoe traction	41	synthetic turf or system
DIN 18-035	water permeability of synthetic turf system	42	synthetic turf or system
EN 12234	ball roll	43	synthetic turf system
EN 12616	infiltration rate	44	synthetic turf or system
EN 14808	force reduction	45	synthetic turf system
EN 14809	vertical deformation	46	synthetic turf system
Infill Material			
D5644	particle size distribution of recycled rubber	40	ground rubber
F1632	particle size analysis and sand shape grading	39	sand

TEST PROCEDURES

9. Test Methods D792, Specific Gravity (Relative Density) and Density of Plastics by Displacement

9.1 Scope:

9.1.1 This test procedure describes measurement of the specific gravity of fibers and filaments.

9.1.2 This test is appropriate and applicable to the pile yarn component of synthetic turf fabrics before the product is made.

10. Test Methods D1577, Linear Density of Textile Fibers

10.1 Scope:

10.1.1 This test procedure describes measurement of the linear density (denier) of textile fibers and filaments.

10.1.2 The test is appropriate and applicable to the pile yarn component of synthetic turf fabrics after the product is manufactured.

10.2 Test Method Specific Conditions:

10.2.1 Test Method A—The direct weighing method is recommended.

10.2.2 The linear density of finish-free fiber is the recommended measurement; see 12.1 of Test Methods **D1577**.

10.2.3 Manufacturing process may change yarn denier as measured.

11. Test Method **D1907, Linear Density of Yarn (Yarn Number) by the Skein Method**

11.1 *Scope*—This test method covers the determination of the linear density (denier) of all types of yarn in (bobbin) package form.

11.2 *Test Method Specific Conditions:*

11.2.1 Specified lengths of yarn are wound on reels as skeins, and weighed.

11.2.2 Nine meters is recommended length weighed in grams times 1000 for denier, grams per 9000 meters.

12. Test Method **D2256, Tensile Properties of Yarns by the Single Strand Method**

12.1 *Scope:*

12.1.1 This test procedure describes measurement of the tensile properties strength, elongation, and (optionally) modulus for textile fibers and filaments.

12.1.2 The test is appropriate and applicable to the pile fiber component of synthetic turf fabrics before the product is made.

12.2 *Test Method Specific Conditions:*

12.2.1 Option A1, standard-conditioned, straight fiber or filament is recommended.

12.2.2 Horn grip clamps are recommended.

12.2.3 The recommended gage length is 15.2 cm (6 in.).

12.2.4 The recommended cross-head speed is 30.5 cm/min (12 in./min).

12.2.5 The tangent method is recommended if the modulus is calculated (Appendix, Test Method **D2256**).

12.2.6 The measurement of strength and elongation may be conducted on monofilaments or multifilament yarns; specify which.

13. Specification **D3218, Polyolefin Monofilaments**

13.1 *Scope:*

13.1.1 This specification covers polyolefin monofilament yarn materials, and test methods for standard polyolefin monofilaments.

13.1.2 This test method covers the determination of the thickness of flat polyolefin monofilaments, by a micrometer.

13.1.3 This method can also be used for slit-filament tape yarn.

13.2 *Test Method Specific Conditions*—Measure the thickness of the specimen to the nearest 2.5 μm (0.1 mil) using the micrometer.

14. Test Method **D7138, Determine Melting Temperature of Synthetic Fibers**

14.1 *Scope:*

14.1.1 These test methods describe several techniques for the characterization of polyamides, polypropylene, and other fibers.

14.1.2 The applicable part of this test procedure is that describing the measurement of melting point for polyamide fibers and other fibers used in constructing synthetic turf fabrics.

14.2 *Test Method Specific Conditions:*

14.2.1 A temperature rise of 2°C/min with the Fisher-Johns melting point apparatus is recommended. Follow Test Method 2 where applicable.

14.2.2 Acceptable alternatives for the measurement of melting point is differential scanning calorimetry (DSC) instruments. Report the temperature rise and other pertinent experimental conditions used with DSC Method 1.

15. Test Method **D1335, Tuft Bind of Pile Floor Coverings**

15.1 *Scope:*

15.1.1 This test provides a method for measuring the tuft bind in pile fabrics such as carpets.

15.1.2 The test is appropriate and applicable to the pile yarn component of synthetic turf fabrics.

15.2 *Test Method Specific Conditions:*

15.2.1 Test Method **D1335** is written in the language of fabrics of tufted construction. However, application may be extended to knitted and woven synthetic turf fabrics if the concept of tuft is redefined suitably.

15.2.2 *Tufted Fabrics*—For the purposes of Test Method **D1335**, a tuft has the conventional definition of the two halves of the mono or multifilament loop of pile that is inserted between the adjacent yarns of the tufting medium (backing fabric), held in place by a primary coating (adhesive), and not otherwise connected mechanically to the tufting medium (see Fig. 1).

15.2.3 *Knitted Fabrics*—For the purposes of Test Method **D1335**, a tuft is comprised of the adjacent legs of two loops of pile. Each loop passes under a yarn of fabric backing, but adjacent legs are not restrained mechanically, thereby permitting pullout without rupture of the backing yarns (see Fig. 2).



15.2.4 *Woven Fabrics*—For the purposes of Test Method **D1335**, a tuft is defined suitably as in the case of knitted fabrics (14.2.3) to avoid rupture of the backing yarns when determining tuft pullout (see Fig. 3).

15.3 The specified cross-head speed for the measurement of tuft bind with all fabrics is 30.5 ± 1.0 cm/min (12 ± 0.05 in./min).

15.4 For turf made with multi-filament fibers, one tuft leg (Figure 1) includes all filaments of the multi-filament bundle.

16. Practice **D1776**, Conditioning and Testing Textiles

16.1 *Scope*:

16.1.1 This practice covers the conditioning and testing of textiles in those instances where such conditioning is specified in a test method.

16.1.2 The conditioning prescribed in this practice is designed to obtain reproducible results on textiles and textile products.

17. Test Method **D2859**, Flammability of Finished Textile Floor Covering Materials

17.1 *Scope*:

17.1.1 This test covers determination of the flammability of finished textile floor covering materials using the methenamine tablet method.

17.1.2 This test method should be used for measuring and describing the properties of materials or assemblies in response to heat and flame under controlled laboratory conditions. It should not be used for describing or appraising the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions.

17.2 *Test Method Specific Conditions*:

17.2.1 This test method involves the exposure of conditioned and oven-dried samples to a methenamine tablet ignition source in a draft-protected environment and measurement of the resulting char length.

17.2.2 The test method may be used for assessing the effect of a specific underlayment or cushion in combination with a floor covering.

17.2.3 Condition the samples as directed in Practice **D1776**.

17.3 *Sampling and Test Specimens*:

17.3.1 Cut eight specimens from each lot fabricated for each playing surface or field.

17.3.2 This test is applicable for new, non-used, synthetic turf surfaces and materials.

17.4 *Procedure, Results, and Report*—Test Method **D2859** applies as written for synthetic turf fabrics and surfaces.

18. Guide **D4158**, Abrasion Resistance of Textile Fabrics (Uniform Abrasion Method)

18.1 *Scope*:

18.1.1 This test describes the Schiefer and Krasny method for determining the resistance of fabrics to abrasion.

18.1.2 The test is useful for characterizing the abrasion resistance of non-infilled synthetic turf fabrics.

18.2 *Test Method Specific Conditions*:

18.2.1 The type of abradant wheel used must be specified when reporting the results.

18.2.2 The spring steel blade abradant is the recommended standard.

18.2.3 The counterweight used must be specified when reporting the results.

18.2.4 The 4.536-kg (10-lb) counterweight is the recommended standard.

18.2.5 The standard abrading wheel r/min is 260.

19. Test Method **D5034**, Breaking Strength and Elongation of Textile Fabrics (Grab Test)

19.1 *Scope*:

19.1.1 This test provides methods for determining the breaking strength and elongation of textile fabrics.

19.1.2 Of the various test methods described in Test Method **D5034** for measuring the strength of textile materials, the grab test (Section 9.2) is recommended for use with synthetic turf fabrics.

19.1.3 The modified grab test procedure is applicable only to unraveling or high-strength fabrics.

19.2 *Test Method Specific Conditions*:

19.2.1 The recommended instrument type for the tensile testing is a constant rate of extension (CRE) tensile testing machine.

19.2.2 The recommended sample size is 10.2 by 15.2 cm (4 by 6 in.). The sample elongation is in the longer dimension.

19.2.3 The recommended clamps (top and bottom) are 2.54 by 2.54 cm (1 by 1 in.) on one side and 2.54 by 5.08 cm (1 by 2 in.) on the other side. The shorter side of the clamp is oriented in the direction of sample elongation.

19.2.4 The recommended gage length is 7.6 cm (3 in.).

19.2.5 The recommended cross-head speed is a uniform 30.5 cm/min (12 in./min).

19.2.6 The test method is applicable to knitted fabrics. (**Warning**—Higher strengths and elongation, than anticipated, could result.)