Designation: ~~F1551 – 09 (Reapproved 2017)~~ F1551 – 23

An American National Standard

Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials[1]

This standard is issued under the fixed designation F1551; 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 These test methods establish a recommended list from which suitable test methods shall be selected for the ~~identification~~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;~~fields; and some tests may be applied in both the laboratory and the ~~field.~~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.~~Test methods outlined herein cover system components as well as fully assembled synthetic turf systems. Most of the methods measure material and performance properties of turf components. Component properties are not intended to represent the performance of a fully assembled turf system. Component results provide data for quality control, specification compliance, and component performance used in product design.

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

1.6 Several new standards have been added since the last revision of this standard. Other standards, for which more appropriate standards exist, have been removed from this standard. A list of the standards that have been removed and their replacements are listed in Table X1.1 in Appendix X1.

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

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

1.9 *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] 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.

Current edition approved ~~Dec. 1, 2017~~Sept. 1, 2023. Published ~~December 2017~~March 2024. Originally approved in 1994. Last previous edition approved in ~~2009~~2017 as ~~F1551 – 09.~~F1551 – 09 (2017). DOI: ~~10.1520/F1551-09R17.~~10.1520/F1551-23.

1.10 *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]

C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates~~2.1.1 Pile Fiber:~~

~~D792~~D412 Test Methods for ~~Density and Specific Gravity (Relative Density) of Plastics by Displacement~~Vulcanized Rubber and Thermoplastic Elastomers—Tension

D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer

D1335 Test Method for Tuft Bind of Pile Yarn Floor Coverings

D1577 Test Methods for Linear Density of Textile Fibers

D1895 Test Methods for Apparent Density, Bulk Factor, and Pourability of Plastic Materials

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~~D2616 Test Method ~~to Determine Melting Temperature of Synthetic Fibers~~for Evaluation of Visual Color Difference With a Gray Scale

~~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

D3218 Specification for Polyolefin Monofilaments

~~D4158~~D3575 ~~Guide for Abrasion Resistance of Textile Fabrics (Uniform Abrasion)~~Test Methods for Flexible Cellular Materials Made from Olefin Polymers

D4716 Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

~~D5251~~D5644 ~~Practice for the Operation of the Tetrapod Walker Drum Tester~~Test Method for Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber ~~(Withdrawn 2014)~~

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~~D7138 Test Method ~~for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source~~to Determine Melting Temperature of Synthetic Fibers

~~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~~E2402 Test Method for ~~Peel Resistance of Adhesives (T-Peel Test)~~Mass Loss, Residue, and Temperature Measurement Validation of Thermogravimetric Analyzers

~~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~~F963 ~~Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell)~~Consumer Safety Specification for Toy Safety

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

[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.

F1015 Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
F1632 Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes
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
F2765 Specification for Total Lead Content in Synthetic Turf Fibers
~~F2333~~F2898 Test Method for ~~Traction Characteristics of the Athletic Shoe-Sports Surface Interface~~Permeability of Synthetic Turf Sports Field Base Stone and Surface System by Non-confined Area Flood Test Method
F3146 Test Method for Impact Attenuation of Turf Playing Systems Designated for Rugby
~~2.1.4~~F3188 ~~Infill Materials:~~Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials
~~D5644~~F3189 Test Method for ~~Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber~~Measuring Force Reduction, Vertical Deformation, and Energy Restitution of Synthetic Turf Systems Using the Advanced Artificial Athlete
~~F1632~~F3383 Test Method for ~~Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes~~Filament Bind of Single Fibers in Synthetic Turf
F3496 Specification for Polyaromatic Hydrocarbon (PAH) Content in Synthetic Turf Infill

2.2 ~~*Other*~~*EN Standards:*[3]

~~AT-030~~ EN 1969 ~~Sports Shoe Traction~~Surfaces for Sports Areas – Determination of Thickness of Synthetic Sports Surfaces

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

~~DIN 18-035~~EN 12228 ~~Part 6—Water Permeability of Synthetic Turf Systems and Permeable Bases~~Surfaces for Sports Areas – Determination of Joint Strength of Synthetic Surfaces
EN 12234 Surfaces for Sports Areas – Determination of Ball Roll Behaviour
EN 12616 Surfaces for Sports Areas – Determination of Water Infiltration Rate
EN ~~14808~~13036-7 ~~Surfaces for Sports Areas- Determination of Force Reduction~~Road and Airfield Surface Characteristics – Test Methods – Part 7: Irregularity Measurement of Pavement Courses: The Straightedge Test
EN ~~14809~~13744 Surfaces for Sports Areas – ~~Determination of Vertical Deformation~~Procedure for Accelerated Ageing by Immersion in Hot Water
EN 13746 Surface for sports areas – Determination of Dimensional Changes Due to the Effect of Varied Water, Frost, and Heat Conditions
EN 14836 Synthetic Surfaces for Outdoor Sports Areas - Exposure to Artificial Weathering
~~prEN 15301-1~~EN 15301 Surfaces for Sports ~~Areas- Part 1.~~Areas – Part 1: Determination of Rotational Resistance
EN 17326 Surfaces for Sports Areas – Determination of dimensional stability of shock pads used within sports system
EN 17409 Surfaces for Sports Areas – Code of Practice for the Sampling of Performance Infills Used Within Synthetic Turf Surfaces

2.3 *EPA Standards:*[4]
EPA 1312 Synthetic Precipitation Leaching Procedure
EPA 3050B Acid Digestion of Sediments, Sludges, and Soils
EPA 6010B Inductively Coupled Plasma – Atomic Emission Spectrometry

3. Terminology

~~3.1 *Definitions*—Terms are as defined in the referenced ASTM procedures comprising these test methods.~~

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~~fiber and backing yarns that produces the fabric, usually tufting, knitting, or weaving.

[3] ~~The last approved version of this historical standard is referenced on www.astm.org.~~Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

[4] ~~The Tetrapod Walker can be purchased from Lawson Hemphill Sales Inc., P.O. Box 6388, Spartanburg, SC; or Machine Control B.A.A. Canada Inc., 701 Ave. Meloche, Dorval, Quebec.~~

[4] ~~The sole source of supply of the apparatus known to the committee at this time is NAEF Press & Dies, Inc., Bolton Landing, NY 12814. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,~~Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.~~[1] which you may attend.~~

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.~~generally consist of synthetic or natural materials. Historically, sand and crumb rubber have been the primary choice of infill materials. The use of various synthetic particles and natural alternative materials have become more prevalent in the synthetic turf industry.

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.~~

3.2.4 *pile, n—for pile fiber turf surfacing*, surface ~~texture~~fibers composed of many individual ~~thin~~ strands or groups of strands bound to a backing fabric in a repetitive array.

3.2.5 ~~*pile lay*~~—*primary backing*—~~the direction in which most of the pile fibers lean in the original, uncrushed~~ a woven or non-woven fabric used as the tufting substrate through which the turf yarns are tufted to form the synthetic turf greige fabric.

3.2.6 *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.~~

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

3.2.8 *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.~~

3.2.9 *water permeability*—the ~~rate at which water of a specified head flows vertically through synthetic turf or other components of the system.~~measure of the ability of a porous material to transmit fluids.

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

4.3 This standard is organized by system components and with the turf system.

4.4 Appropriate test procedures are summarized in sections related to components of the turf system or the turf system as a whole.

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

TABLE 1 Performance Test Methods for Synthetic Turf Surfaces

Test Method	Property	Section
	Fiber	
ASTM D1907	Linear Density (Lab)	9.2.1
ASTM D1577 (Option B)	Linear Density (Field)	9.2.2
ASTM D3218	Yarn Thickness	9.3
ASTM D2256	Tensile Strength	9.4
EN 14836	Artificial Weathering	9.5.1
ASTM D2256	Tensile Strength after Artificial Weathering	9.5.2
ASTM D2616	Color Fastness after Artificial Weathering	9.5.3
ASTM D7138	Melting Point	9.6
ASTM F2765	Total Lead Content	9.7
	Fabric	
ASTM D5848	Total Weight	10.2.1
ASTM D5848	Fiber Weight	10.2.2
ASTM D5848	Primary and Secondary Backing Weight	10.2.3
ASTM D5034	Tensile Strength (Grab Tear)	10.3
ASTM D5823	Pile Height	10.4
ASTM D5793	Tufting Gauge	10.5
ASTM D1335	Tuft Bind	10.6
ASTM F3383	Filament Bind	10.7
EN 13746	Dimensional Stability	10.8
EN 12228 Method 1	Stitched Seam Strength	10.9.1
EN 13744 and EN 12228 Method 1	Stitched Seam Strength (Aged)	10.9.2
EN 12228 Method 2	Bonded Seam Strength	10.9.3
EN 13744 and EN 12228 Method 2	Bonded Seam Strength (Aged)	10.9.4
	Shock Pad	
EN 1969	Thickness	11.2
ASTM D3575	Tensile Strength	11.3
ASTM D5034	Tensile Strength (Grab Tear)	11.4
ASTM D3575	Compression Set	11.5
ASTM D3575	Density	11.6
ASTM D3575	Water Absorption	11.7
ASTM D696	Coefficient of Thermal Expansion	11.8
EN 17326	Dimensional Stability	11.9
EN 12616	Infiltration Rate	11.10
ASTM D4716	In-Plane Flow	11.11
ASTM F355	*g*-max	11.12
ASTM F3189	Force Reduction	11.13
ASTM F3189	Vertical Deformation	11.14
ASTM F3146	HIC	11.15
EPA 1312 / EPA 6010B	Heavy Metals	11.16
	Infill	
ASTM D1895	Bulk Density	12.2
ASTM C136 (Sand and others)	Particle Size	12.3
ASTM D5644 (Crumb Rubber)	Particle Size	12.4
ASTM F1632	Particle Shape	12.5
ASTM F3188	Extractable Hazardous Metals	12.6
ASTM F3496	Polyaromatic Hydrocarbon (PAH) Content	12.7
EN 14836/ ASTM D2616	Color Fastness after Accelerated Aging	12.8
ASTM E2402	Organic Content (TGA)	12.9
EN 17409	Sampling of Performance Infills	12.10
	Turf System	
EN 1969	Infill Depth	13.2
ASTM F2117	Vertical Ball Rebound	13.3
EN 12234	Ball Roll	13.4
ASTM F3189	Force Reduction	13.5
ASTM F3189	Vertical Deformation	13.6
ASTM F3189	Energy Restitution	13.7
EN 15301-1	Rotational Resistance	13.8
ASTM F1936	*g*-max	13.9
ASTM F3146	HIC	13.10
EN 12616	Water Permeability (Lab and Field)	13.11
ASTM F2898	Water Permeability (Field)	13.12
ASTM F1015	Relative Abrasive Index	13.13
ASTM D2859	Pill Burn	13.14
EPA 3050B / EPA 6010	Environmental Hazard	13.15
EN 13036-7	Surface Regularity (Field)	13.16

4.6 Table X1.1 in the appendix is an index of test methods included in previous versions of ASTM F1551 but are no longer used or have been superseded by newer test methods.

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,~~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~~specified in the individual test procedures. In the absence of ~~specified~~specified conditions, tests must be conducted under the standard laboratory conditions of 23 ± 2°C (73.4 ± 3°F) and 65 ± ~~5 %~~ 5 % relative humidity. Materials must be conditioned, ~~undeflected,~~undeflected, and undistorted at the temperature and humidity of test for at least 24 h prior to testing.

6.2 Conduct ~~field~~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~~specific components being characterized by the particular test.

6.2.1 Special conditions that should be reported for testing outdoor installations shall include excessively wet, frozen, or shaded areas.

7. Sampling

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

7.2 For ~~field~~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~~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~~method-specific conditions are provided.

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.~~

~~9. Test Method~~ Fiber~~D2256, Tensile Properties of Yarns by the Single Strand Method~~

9.1 Fiber properties such as denier, thickness, and tensile strength are important for the performance and durability of synthetic turf. As an outdoor product, the resistance to polymer degradation and color loss are important yarn properties. Melting point and lead content assure that the correct yarn is being used and that it meets the lead content requirement.

9.2 ~~*Scope:*~~ **Denier**

9.2.1 **~~This test procedure~~Denier — ASTM D1907~~describes measurement of the tensile properties~~ , Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method**~~strength, elongation, and (optionally) modulus for textile fibers and filaments.~~

9.2.1.1 *Scope:*

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

9.2.1.3 *Test Method Specific Conditions:*

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

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

9.2.2 **~~The test is~~Denier — ASTM D1577~~appropriate and applicable to the pile fiber component of synthetic turf fabrics before~~ , Standard Test Methods for Linear Density of Textile Fibers (Option B)**~~the product is made.~~

9.2.2.1 *Scope:*

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

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

9.2.2.4 *Test Method Specific Conditions:*

9.2.2.5 *Test Method B*—The direct weighing method is recommended.

9.2.2.6 The linear density of finish-free fiber is the recommended measurement; see 12.1 of Test Method D1577.

9.2.2.7 The turf manufacturing process may change yarn denier as measured.

9.3 **Yarn Thickness — ASTM D3218, Standard Specification for Polyolefin Monofilaments**

9.3.1 *Scope:*

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

9.3.1.2 This test method covers the determination of the thickness of polyolefin monofilament turf yarn, by a micrometer.

9.3.1.3 This method can also be used for slit-tape turf yarn.

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

9.4 ~~*Test Method Specific Conditions:*~~ **Yarn Tensile Strength — ASTM D2256, Standard Test Method for Tensile Properties of Yarns by the Single Strand Method**

9.4.1 ~~*Option*~~ *Scope:*~~A1, standard-conditioned, straight fiber or filament is recommended.~~

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

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

~~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).~~

9.4.2 ~~The tangent method is recommended if the modulus is calculated (Appendix, Test Method D2256).~~*Test Method Specific Conditions:*

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

9.4.2.2 Horn grip clamps are recommended.

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

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

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

9.4.2.6 The measurement of strength and elongation may be conducted on monofilaments or multifilament yarns; specify either monofilament or fiber bundle.

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

9.5 **Artificial Weathering**

9.5.1 **Yarn Artificial Weathering — EN 14836, Synthetic Surfaces for Outdoor Sports Areas – Exposure to Artificial Weathering**

9.5.1.1 *Scope:*

9.5.1.2 This test method specifies the procedure for exposing synthetic turf yarns to accelerated weathering.

9.5.1.3 The UV light source is specified as fluorescent UVA bulbs described in EN 4892-3.

9.5.1.4 The exposure conditions and exposure times are defined.

9.5.2 **Tensile Strength after Artificial Weathering — ASTM D2256, Standard Test Method for Tensile Properties of Yarns by the Single Strand Method**

9.5.2.1 *Scope:*

9.5.2.2 A method for quantifying the resistance to weathering is measuring the retention of tensile strength.

9.5.2.3 Tensile strength of the yarn after weathering is compared to the yarn strength before weathering.

9.5.2.4 Weathering resistance is expressed as % retention of tensile strength.

9.5.3 **Color Fastness after Artificial Weathering — ASTM D2616, Standard Test Method for Evaluation of Visual Color Difference With a Gray Scale**

9.5.3.1 *Scope:*

9.5.3.2 A method for quantifying the resistance to weathering is measuring the color change of the fiber.

9.5.3.3 Color change is quantified by evaluating the difference in color between the weathered and non-weathered turf fiber using a gray scale.

9.6 **Melting Point — ASTM D7138, Standard Test Method to Determine Melting Temperature of Synthetic Fibers**

9.6.1 *Scope:*

9.6.2 These test methods describe techniques for measuring the melting point of polyethylene, polypropylene, and polyamide fibers used in synthetic turf fabrics.

9.6.3 *Method 1*—A specimen of fiber and a reference sample are positioned into the designated heating blocks of a Differential Scanning Calorimetry (DSC) instrument.

9.6.3.1 The DSC data is used to determine the fiber specimen melting temperature.

9.6.4 *Method 2*—A specimen of fiber is positioned in a melting temperature device.

9.6.4.1 The temperature of the device is raised until the fiber specimen reaches its melting temperature as determined by visual observation.

9.7 **Lead Content — ASTM F2765, Standard Specification for Total Lead Content in Synthetic Turf Fibers**

9.7.1 *Scope:*

9.7.2 This specification applies to the maximum content of lead in fibers used in synthetic turf.

9.7.3 A sample of the fiber is dissolved in a strong acid by microwave digestion.

9.7.4 The total lead content is determined using inductively coupled plasma/atomic emission spectrometry.

9.7.5 The total lead content is expressed in mg/kg (ppm).

9.7.6 The total lead content shall be less than 100 ppm.

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.)

20. Practice D5251, Operation of the Tetrapod Walker Drum Tester

20.1 *Scope:*

20.1.1 This practice describes the equipment and operation of the Tetrapod Walker for testing shorter pile, non-infilled synthetic turf surfaces for resistance to matting.

20.1.2 This practice may be used upon mutual agreement between the purchaser and the supplier to set purchasing specifications.

20.1.3 The values stated in inch-pound units are to be regarded as the standard for all measurements except mass. The SI values are provided for information only for all measurements except mass.

20.2 *Summary of Practice*—The specimen is secured as the lining of a rotatable drum with the pile surface exposed. A four-legged metal casting (tetrapod) walks on the pile surface as it is tumbled in the drum, which is rotated about its longitudinal axis for a specified number of revolutions.

20.3 *Significance and Use:*