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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 F 1551; 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

~~1.1These test methods establish a recommended list of test methods to be used 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.~~

~~1.2The test procedures included in these test methods apply as a group to the description of synthetic turf playing surfaces.~~

~~1.3Some of the test procedures are specific for components of the synthetic turf system, and others apply to the complete synthetic turf playing surface.~~

~~1.4Some 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.~~

1.1 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

2.1.1 *Pile Fiber:* ~~*D789Test Methods for Determination of Relative Viscosity and Moisture Content of Polyamide (PA)*~~

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D 1577 Test Methods for Linear Density of Textile Fibers

D 1907 Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method

D 2256 Test Method for Tensile Properties of Yarns by the Single-Strand Method

D 3218 Specification for Polyolefin Monofilaments

D 7138 Test Method to Determine Melting Temperature of Synthetic Fibers

2.1.2 *Fabric:* ~~D418Methods of Testing Pile Yarn Floor Covering Construction~~

D 1335 Test Method for Tuft Bind of Pile Yarn Floor Coverings ~~D1682Test Methods for Breaking Load and Elongation of Textile Fabrics[3]~~

D 1776 Practice for Conditioning and Testing Textiles

[1] These test methods are under the jurisdiction of ASTM Committee F08 on Sports Equipment 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.

D 2859 Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
D 4158 Guide for Abrasion Resistance of Textile Fabrics (Uniform Abrasion)
D 5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
D 5251 Practice for the Operation of the Tetrapod Walker Drum Tester
D 5793 Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings
D 5823 Test Method for Tuft Height of Pile Floor Coverings
D 5848 Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
E 648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
F 1015 Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces

2.1.3 *Shock Absorbing Cushion Underlayment:*

D 395 Test Methods for Rubber Property—Compression Set
D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
D 1667 ~~Specification for Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)~~ Specification for Flexible Cellular MaterialsPoly (Vinyl Chloride) Foam (Closed-Cell)
D 1876 Test Method for Peel Resistance of Adhesives (T-Peel Test)
D 2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
D 3574 Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
D 3575 Test Methods for Flexible Cellular Materials Made From Olefin Polymers
D 3936 Test Method for Resistance to ~~the~~ Delamination of the Secondary Backing of Pile Yarn Floor Covering
F 355 Test Method for Shock-Absorbing Properties of Playing Surface Systems and Materials

2.1.4 *Turf Systems:*

D 1667 ~~Specification for Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)~~ Specification for Flexible Cellular MaterialsPoly (Vinyl Chloride) Foam (Closed-Cell)
F 355 Test Method for Shock-Absorbing Properties of Playing Surface Systems and Materials
F 1015 Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
F 1936 ~~Specification for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field~~ Specification for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
F 2117 Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement
F 2333 Test Method for Traction Characteristics of the Athletic ShoeSports Surface Interface

2.1.4 *Infill Materials:*

D 5644 Test Methods for Rubber Compounding MaterialsDetermination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber
F 1632 Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes

2.2 ~~*Other Standards:* 2.2.1 *Turf Systems:*~~ *Other Standards:*

~~AT-030~~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 ~~Note1—AstroTurf® Industries internal test procedures are suitable as bases for new ASTM test methods as follows: (1)Water Permeability of Synthetic Turf (DIN 18-035, Part 6); and (2) Ball Bounce and Ball Rebound.~~
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.

~~3.2.3~~

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~~

3.2.5 *pile*, *n*—~~*for pile ribbon turf surfacing*, the texture surface composed of many tuft legs bound to backing fabric in an orderly and repetitive array.~~

~~3.2.5~~*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.

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

~~3.2.6~~

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

~~3.2.7~~

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.

~~3.2.8~~*sports shoe traction differential*—~~a measure of difference in sports shoe traction in two or more directions along the turf pile surface.~~

3.2.9 ~~*synthetic turf system*—(all except bases and sub-bases) includes turf fabric, with attached or detached under cushion.~~ 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 ~~ribbon~~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 through reference to existing ASTM procedures.~~ surfaces.

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

4.3 Table 1 ~~contains a list of all the assigned suffix letters that may be used for describing the system and components of these test methods.~~ 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 ~~necessary~~appropriate to ~~achieve design of the system.~~ 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 ± 2°C (73.4 ± 3°F) and 65 ± 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.

TABLE 1 ~~Suffix Letter Designations:~~Performance Test Methods for Synthetic Turf Surfaces

~~ASTM~~ ~~T~~est Method	~~T~~Sesct ~~Method~~ Suffixon	Item Tested
Pile Fiber	~~Section~~	
~~D 789~~ ~~melting point~~	~~9~~	
~~D 792~~	~~density (specific gravity)~~	~~109~~ ~~syntheti~~
D 792	density (specific gravity)	9 syntheti
~~D 1577~~ ~~A~~		~~linear density of textilefibers (denier)c~~
D 1577 linear density of textile fibers (denier)	10	pile of yarn on mfg. turf fabric
~~D 1907~~ ~~linear density of yarn (denier - skein method)~~	~~11~~	
D 1907 linear density of yarn (denier - skein method)	11	bobbin of yarn
~~D 2256~~ ~~A-1~~	breaking strength and elongation	12 ~~Fabrie~~
D 2256 ~~A-1~~	breaking strength and elongation	12 bobbie
~~D 418~~	~~13~~	~~pile fiber construction13~~
D 3218 yarn thickness	13	synthetic yarn
~~D 418~~ ~~melting point (Fisher-John method or DSC method)~~	~~14~~	
D 7138 melting point (Fisher-John method or DSC method)	14	synthetic yarn
~~pile height~~	~~13~~	
Fabric		
~~D 1335~~	~~resistance to tuft pullout~~	~~145~~ ~~syntheti~~
D 1335	resistance to tuft pullout	15 syntheti
~~D 1682~~ ~~G-T~~	~~grab tear strength~~	~~15~~
D 2859 flammability of pile floor covering (methenamine tablet)	17	synthetic turf fabric
~~D 4158~~	~~abrasion resistance (uniform abrasion method)~~	~~168~~ ~~non-infi~~
D 4158	abrasion resistance (uniform abrasion method)	18 non-infi
~~D 2859~~		~~flammability of pile floor covering (methenamine tablet test)ric~~
D 5034 grab tear strength	19	synthetic turf fabric
~~D 5251~~ ~~17resistance to matting (tetrapod method)~~	~~20~~	~~non-infilled turf~~
D 5251 resistance to matting (tetrapod method)	20	non-infilled turf
~~E 648~~	~~flammability of synthetic turf (flooring radiant panel test)~~	~~18~~
D 5793 binding sites per unit	21	synthetic turf fabric
~~F 1015~~		~~relative abrasiveness of synthetic turf sur faces~~
D 5823 pile height	22	synthetic turf fabric
~~19pile fiber, mass per unit~~	~~23~~	~~synthetic turf fabric~~
D 5848 pile fiber, mass per unit	23	synthetic turf fabric
~~D 5251~~ ~~flammability of synthetic turf (flooring radiant panel test)~~	~~24~~	~~synthetic turf fabric~~
E 648 flammability of synthetic turf (flooring radiant panel test)	24	synthetic turf fabric

8. Application of Test Procedures

8.1 References to the ~~ASTM~~ test procedures stated ~~in Section 9~~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.

~~8.3Specific conditions of the referenced ASTM test procedures are recommended in each case, except where specified in these test methods.~~

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

TEST PROCEDURES

~~**9.Suffix A—Test Methods D789, Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)**~~

9. Test Methods D 792, Specific Gravity (Relative Density) and Density of Plastics by Displacement

9.1 *Scope*:

~~9.1.1These test methods describe several techniques for the characterization of polyamides, polypropylene, and other fibers.~~

~~9.1.2The 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.~~

~~9.2*Test Method Specific Conditions* :~~

~~9.2.1A temperature rise of 2°C/min with the Fisher-Johns melting point apparatus is recommended.~~

~~9.2.2Acceptable alternatives for the measurement of melting point are the use of differential thermal analysis (DTA) or differential scanning calorimetry (DSC) instruments. Follow Test Methods D789 where applicable. Report the temperature rise and other pertinent experimental conditions used with DTA or DSC.~~

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. ~~Suffix W—Test Method792, Specific Gravity (Relative Density) and Density of Plastics by Displacement~~ Test Methods D 1577, Linear Density of Textile Fibers

10.1 *Scope*:

~~10.1.1This test procedure describes measurement of the specific gravity of fibers and filaments.~~

~~10.1.2This test is appropriate and applicable to the pile ribbon component of synthetic turf fabrics before the product is made.~~

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 D 1577.

10.2.3 Manufacturing process may change yarn denier as measured.

11. ~~Suffix W—Test Methods D1577, Linear Density of Textile Fibers~~ Test Method D 1907, Linear Density of Yarn (Yarn Number) by the Skein Method

11.1 *Scope*~~:~~

~~11.1.1This test procedure describes measurement of the linear density (denier, tex) of textile fibers and filaments.~~

~~11.1.2The test is appropriate and applicable to the pile ribbon component of synthetic turf fabrics before the product is made.~~

—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*Test Method A*—The direct weighing method is recommended.~~

~~11.2.2The linear density of finish-free fiber is the recommended measurement; see 12.1 of Test Methods D1577.~~

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. ~~Suffix T—Test~~ Test Method D 2256, 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 ~~ribbon~~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 ~~25.4~~30.5 cm/min ~~(10~~(12 in./min).
12.2.5 The tangent method is recommended if the modulus is calculated (Appendix, Test Method D 2256).
12.2.6 The measurement of strength and elongation may be conducted on monofilaments or multifilament yarns; specify which.

13. ~~Methods D418, Testing Pile Yarn Floor Covering Construction~~ Specification D 3218, Polyolefin Monofilaments

13.1 *Scope*:
~~13.1.1The test methods are designed for the characterization of pile materials such as carpets.~~
~~13.1.2This test procedure describes several methods appropriate and applicable for characterizing synthetic turf fabrics by pile thickness, tuft height (blade length), and suitable measurements of fabric weight.~~
~~13.1.3Some of the test procedures, such as tuft height (blade length), are applicable in the field as well as in the laboratory.~~
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*~~:~~
~~13.2.1The normally applicable tests of the group are as follows: total mass per unit area (Section 7 of Methods D418); component masses per unit area (Section 8); pile yarn mass per unit area (Section 9); pile thickness—level pile (Section 10); and tuft height (blade length) (Section 13).~~
~~13.2.2Tests of the group normally not applicable for synthetic turf playing surfaces are as follows: number of bonding sites per unit length (Section 16 of Methods D418); and tuft length for level loop pile floor covering (Section 15).~~ —Measure the thickness of the specimen to the nearest 2.5 µm (0.1 mil) using the micrometer.

14. ~~Suffix T—Test Method D1335, Tuft Bind of Pile Floor Coverings~~ Test Method D 7138, Determine Melting Temperature of Synthetic Fibers

14.1 *Scope*:
~~14.1.1This test provides a method for measuring the tuft bind in pile fabrics such as carpets.~~
~~14.1.2The test is appropriate and applicable to the pile ribbon component of synthetic turf fabrics.~~
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*:
~~14.2.1Test 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.~~
~~14.2.2*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).~~
~~14.2.3*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).~~
~~14.2.4*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).~~
~~14.3The 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).~~
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. ~~Suffix T—Test Methods D1682, Breaking Load and Elongation of Textile Fabrics~~ Test Method D 1335, Tuft Bind of Pile Floor Coverings

15.1 *Scope*:
~~15.1.1This test provides methods for determining the breaking strength and elongation of textile fabrics.~~
~~15.1.2Of the various test methods described in Test Methods1682 for measuring the strength of textile materials, the grab test (Section 16) is recommended for use with synthetic turf fabrics.~~
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*:

15.2.1The recommended instrument type for the tensile testing is a constant rate of extension (CRE) tensile testing machine.
15.2.2The recommended sample size is 10.2 by 15.2 cm (4 by 6 in.). The sample elongation is in the longer dimension.
15.2.3The 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.
15.2.4The recommended gage length is 7.6 cm (3 in.).
15.2.5The recommended cross-head speed is a uniform 30.5 cm/min (12 in./min).
15.2.6The test method is applicable to knitted fabrics. (**Warning—**Higher strengths and elongation than anticipated could result.)

15.2.1 Test Method D 1335 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 D 1335, 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 D 1335, 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 D 1335, 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. ~~Suffix J—Test Method D4158, Abrasion Resistance of Textile Fabrics (Uniform Abrasion Method)~~ Practice D 1776, Conditioning and Testing Textiles

16.1 *Scope*:

~~16.1.1This test describes the Schiefer and Krasny method for determining the resistance of fabrics to abrasion.~~
~~16.1.2The test is useful for characterizing the abrasion resistance of synthetic turf fabrics.~~
~~16.2*Test Method Specific Conditions* :~~
~~16.2.1The type of abradant wheel used must be specified when reporting the results.~~
~~16.2.2The spring steel blade abradant is the recommended standard.~~
~~16.2.3The counterweight used must be specified when reporting the results.~~
~~16.2.4The 4.536-kg (10-lb) counterweight is the recommended standard.~~
~~16.2.5The standard abrading wheel r/min is 260.~~

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. ~~Suffix~~ Test Method D 2859, 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 D 1776.

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 D 2859 applies as written for synthetic turf fabrics and surfaces.

18. ~~Suffix M—Test Method E648, Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source~~ Guide D 4158, Abrasion Resistance of Textile Fabrics (Uniform Abrasion Method)

18.1 *Scope*:

~~18.1.1This test describes the apparatus and technique for determining the critical radiant flux (CRF), a measure of the flammability resistance of fabrics using the flooring radiant panel method.~~

~~18.1.2The test is applicable to synthetic turf fabrics.~~

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*:

~~18.2.1The test method applies as written to synthetic turf fabrics.~~

~~18.2.2The results for CRF will differ, depending on whether the fabric tested also has its shock-absorbing pad placed under it during the test.~~

~~NOTE2—Test Method E648 is applicable to floor-covering system specimens that follow or simulate accepted installation practices. Tests on the individual elements of a floor system are of limited value and are not valid for evaluation of the flooring system.~~

~~18.2.3Run tests with and without the undercushion, and report the results of both tests.~~

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 F1015, Relative Abrasiveness of Synthetic Turf Playing Surfaces~~ Test Method D 5034, Breaking Strength and Elongation of Textile Fabrics (Grab Test)

19.1 *Scope*:

~~19.1.1This test was designed specifically for use with synthetic turf fabrics.~~

~~19.1.2This test is applicable to both laboratory and field measurement.~~

~~19.1.3The test also may have use for natural grass playing surfaces.~~

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 D 5034 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*~~— The test method applies as written to synthetic turf fabrics and surfaces.~~ :

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. ~~Suffix B—Test Methods D395, Rubber Property—Compression Set~~ Practice D 5251, Operation of the Tetrapod Walker Drum Tester

20.1 *Scope*:

~~20.1.1This test method covers the testing of shock-absorbing pad components intended for use in applications in which the pad will be subjected to compressive stresses in air or liquid media.~~

~~20.1.2This test is appropriate and applicable to the shock-absorbing pad component of synthetic turf playing surfaces.~~

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 ~~*Test Method Specific Conditions*~~ 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*:

~~20.2.1*Test Method A*—Compression set under constant force in air is to be used.~~

~~20.2.2The test specimens are to be 5.08 by 5.08 cm (2 by 2 in.) by gage of the cushion underlayment to be used.~~

~~20.2.3The compression load is to be 1.8 kN (400 lb or 100 psi) for 22 h.~~

~~20.2.4The compression set is calculated after 24 h recovery.~~

20.3.1 This equipment may be used to bring about the changes in texture on the surface of pile turf surfacing caused by mechanical action.

20.3.2 The acceptance criteria of this practice shall be set by mutual agreement between the purchaser and the supplier.

20.4 *Apparatus and Reagent Tetrapod Walker*[3] *Tester*:

20.4.1 *Driving System*, which cradles a drum on rollers and keeps the axis of the drum level, rotates at 5.2 ± 0.2 rad/s (50 ± 2 r/min), and has a counter that can be preset to stop the drum after any number of revolutions. Drive systems that do not reverse shall have the direction of rotation shown on the drum.

20.4.2 *Drum*, constructed of a rigid material and capped by a lid that is secured firmly. Each drum is equipped with two springs to hold the test specimen in place during testing. The inner dimensions of the drum are as follows: diameter, 205 ± 5 mm (8.0 ± 0.2 in.); and height, 190 ± 5 mm (7.6 ± 0.2 in.).

20.4.3 *Tetrapod*—A metal casting tetrahedral in shape with four legs placed equidistant from one another. That is, the outer most points correspond to the points on an equilateral tetrahedron, and the large angle between any two legs is 109.5°. Each leg shall have a replaceable plastic foot at the end. The free standing height of the tetrapod with three of the four plastic feet in one plane is 125 ± 2 mm (5 ± 0.1 in.). The total mass of the tetrapod, including the feet, is 1000 ± 2.5 g.

20.4.4 *Reagent Solvent*—Ethyl or isopropyl alcohols are suitable. Do not use cellosolve, chlorinated, or ketone solvents.

20.5 *Preparation of Specimen*:

20.5.1 *Marking the Specimen*—Before cutting out the test specimen, mark the direction of the pile lay and direction of the tetrapod walk on the secondary backing of each specimen.

20.5.2 *Size of Specimen*—Cut the specimen 61 by 20.5 cm (24 by 8 in.). The long dimension shall be parallel to the lengthwise direction of the carpet. Take no specimen within 10 cm (4 in.) of the trimmed edge.

20.6 *Conditioning*—Bring the specimen to moisture equilibrium for testing in the standard atmosphere for testing textiles, having a relative humidity of 65 ± 2 % at 21± 1°C (970 ± 2°F). Condition for a minimum of 12 h.

20.7 *Procedure*:

20.7.1 Test the conditioned specimen in a standard atmosphere at 65 ± 2 % relative humidity at 21 ± 1°C (70 ± 2°F).

20.7.2 Ensure that the inside of the drum and feet of the tetrapod are clean, smooth, and free from any contamination. Wipe the tetrapod tumbler and inside of the drum with a clean, lint-free tissue and one of the recommended reagents.

20.7.3 Inspect the tetrapod feet for signs of wear or damage, and replace as necessary.

20.7.4 Place the specimen in the drum, with the lay of the pile and drum rotation in the same direction.

NOTE 2—Some testers have the capability of reversing their direction of rotation intermittently.

20.7.5 Place the specimen in the drum with the pile yarn exposed.

20.7.6 Carefully fit one spring over the specimen at the closed end of the drum and the second spring at the open end. The solid part of the springs should bridge any carpet seams.

20.7.7 Place the tetrapod tumbler in the drum on the carpet surfaces.

20.7.8 Secure the lid to the drum, and then position the drum on the rollers of the drive mechanism and ensure that the drum is level.

20.7.9 Set the counter for 50 000 revolutions unless otherwise specified.

20.7.10 Remove the specimen from the drum at the end of the specified revolutions.

20.8 *Report*:

20.8.1 State that the test was conducted as directed in Practice D 5251.

20.8.2 Identify the tested specimen.

20.8.3 Report the atmospheric conditions.

20.8.4 Report whether the drum rotation reverses.

20.8.5 Report the number of revolutions.

20.8.6 Report the appearance (texture) rating versus standard matting sample Numbers 1 through 5 or provide photographs of the matted samples versus photographs of a control matted turf sample.

21. ~~Suffix G—Test Method D624, Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer~~ Test Method D 5793, Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings

21.1 *Scope*:

~~21.1.1This test describes a characterization of rubber or foam samples by tear resistance.~~

~~21.1.2The test applies to the shock-absorbing pad component of synthetic turf playing surfaces.~~

21.1.1 This test method describes the measurement of the number of binding sites per unit length or width of machine-made, woven, knitted, and tufted pile yarn floor covering.

21.1.2 This test procedure describes methods appropriate and applicable for characterizing synthetic turf fabric.

21.2 *Test Method Specific Conditions*:

~~21.2.1The sample is an unnicked, 90° angle specimen cut with ASTM Die C.~~

~~[3] Withdrawn.~~

[3] 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.

~~21.2.2The specified cross-head speed is 50.8 cm/min (20 in./min).~~

21.2.1 If the binding sites are visible from the back, place the test specimen face down on a flat surface; otherwise, place the test specimen back down and shear the pile close to the backing to reveal the binding sites.

21.2.2 Count the binding sites with a graduated scale or tape, reading to the nearest 1 mm (0.05 in.) in the direction to be counted.

22. ~~Suffix D—Specification D1667, Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers (Closed-Cell Vinyl)~~ Test Method D 5823, Tuft Height of Pile Floor Coverings

22.1 *Scope*—This method covers the determination of tuft height using a grooved specimen holder.

22.2 *Test Method Specific Conditions*:

~~22.1.1This specification applies to the shock-absorbing pad component.~~

~~22.1.2This test consists of measuring the force necessary to produce a 25% deflection on a round 6.45-cm~~

22.2.1 Sever the leg of each selected tuft leg or loop as close to the backing surface as possible with the angled flush wire cutter and place in grooved specimen holder.

22.2.2 Read the graduated scale at the opposite end of the tuft element and record to the nearest 0.5 mm (0.01 in.).

22.2.3 Pile height (blade length) is also measured by inserting a small graduated ruler into the pile down to the backing and reading the overall height of the pile for machine set-up or rough field work.

23. Test Method D 5848, Mass Per Unit Area of Pile Yarn Floor Coverings

23.1 *Scope*:

23.1.1 The test method is designed for the characterization of pile materials such as carpets.

23.1.2 This test procedure describes several methods appropriate and applicable for characterizing synthetic turf fabrics and suitable measurements of mass per unit area.

23.2 *Test Method Specific Conditions*:

23.2.1 The normally applicable tests of the group are as follows: total mass per unit area (Section 7); component masses per unit area (Section 8); and pile yarn mass per unit area (Section 9).

23.2.2 When the floor covering exhibits a strong pile lay, brush the pile surface in the direction of the pile lay to make the surface more uniform.

23.2.3 With coarse gages and straight lengthwise lines of binding sites it is possible to lose a whole row of tufts by a small lateral shift in the location of the specimen location when the long dimensions parallel to the line of binding sites. Angling the specimen 14° avoids this problem.

24. Test Method E 648, Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

24.1 *Scope*:

24.1.1 This test describes the apparatus and technique for determining the critical radiant flux (CRF), a measure of the flammability resistance of fabrics using the flooring radiant panel method.

24.1.2 The test is applicable to synthetic turf fabrics.

24.2 *Test Method Specific Conditions*:

24.2.1 The test method applies as written to synthetic turf fabrics.

24.2.2 The results for CRF will differ, depending on whether the fabric tested also has its shock-absorbing pad placed under it during the test.

NOTE 3—Test Method E 648 is applicable to floor-covering system specimens that follow or simulate accepted installation practices. Tests on the individual elements of a floor system are of limited value and are not valid for evaluation of the flooring system.

24.2.3 Run tests with and without the undercushion, and report the results of both tests.

24.2.4 Some infill materials may release large amounts of heat which can damage the test apparatus.

25. Test Method F 1015, Relative Abrasiveness of Synthetic Turf Playing Surfaces

25.1 *Scope*:

25.1.1 This test was designed specifically for use with synthetic turf fabrics.

25.1.2 This test is applicable to both laboratory and field measurement.

25.1.3 The test also may have use for natural grass playing surfaces.

25.2 *Test Method Specific Conditions*—The test method applies as written to synthetic turf fabrics and surfaces.

26. Test Methods D 395, Rubber Property—Compression Set

26.1 *Scope*:

26.1.1 This test method covers the testing of shock-absorbing pad components intended for use in applications in which the pad will be subjected to compressive stresses in air or liquid media.

26.1.2 This test is appropriate and applicable to the shock-absorbing pad component of synthetic turf playing surfaces.