Designation: 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 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 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 the particular test or tests desired and not refer to 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.*

1.10 *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

D412 Test Methods for 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

D2616 Test Method for Evaluation of Visual Color Difference With a Gray Scale

D2859 Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials

D3218 Specification for Polyolefin Monofilaments

D3575 Test Methods for Flexible Cellular Materials Made from Olefin Polymers

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

[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.

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)
D5644 Test Method for Rubber Compounding Materials—Determination of Particle Size Distribution of Recycled Vulcanizate Particulate Rubber
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
D7138 Test Method to Determine Melting Temperature of Synthetic Fibers
E2402 Test Method for Mass Loss, Residue, and Temperature Measurement Validation of Thermogravimetric Analyzers
F355 Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play
F963 Consumer Safety Specification for Toy Safety
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
F2898 Test Method for 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
F3188 Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials
F3189 Test Method for Measuring Force Reduction, Vertical Deformation, and Energy Restitution of Synthetic Turf Systems Using the Advanced Artificial Athlete
F3383 Test Method for Filament Bind of Single Fibers in Synthetic Turf
F3496 Specification for Polyaromatic Hydrocarbon (PAH) Content in Synthetic Turf Infill

2.2 *EN Standards:*[3]

EN 1969 Surfaces for Sports Areas – Determination of Thickness of Synthetic Sports Surfaces
EN 12228 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 13036-7 Road and Airfield Surface Characteristics – Test Methods – Part 7: Irregularity Measurement of Pavement Courses: The Straightedge Test
EN 13744 Surfaces for Sports Areas – 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
EN 15301 Surfaces for Sports 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.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fabric construction*—the method of assembly of pile fiber 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 one or more substances in the face of the fabric to provide the desired playing properties. Infill substances 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 *pile, n—for pile fiber turf surfacing*, surface fibers composed of many individual strands or groups of strands bound to a backing fabric in a repetitive array.

3.2.5 *primary backing*—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.

3.2.7 *synthetic turf field system*—composite of synthetic contact surface material, any fill material used in the contact

[3] Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

[4] Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.

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.

3.2.9 *water permeability*—the 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 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.

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, 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 ± 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.

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 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.

TEST PROCEDURES

9. Fiber

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 **Denier**

9.2.1 **Denier — ASTM D1907, Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method**

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 **Denier — ASTM D1577, Standard Test Methods for Linear Density of Textile Fibers (Option B)**

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.

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

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 **Yarn Tensile Strength — ASTM D2256, Standard Test Method for Tensile Properties of Yarns by the Single Strand Method**

9.4.1 *Scope:*

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.

9.4.2 *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.

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.

10. Fabric

10.1 Identification of turf fabric construction can be accomplished with the component weights, pile height, and tufting gauge. Tear strength, tuft bind, filament bind, and dimensional stability assure that the fabric meets performance specifications. Seams need to be strong and durable to prevent hazardous seam separations in the field.

10.2 **Turf Fabric Component Weights**

10.2.1 **Fabric Total Weight — ASTM D5848, Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings**

10.2.1.1 *Scope:*

10.2.1.2 Test specimens are cut from a conditioned test sample and then measured. Each conditioned test specimen is weighed and the mass per unit area is calculated.

10.2.2 **Fiber Weight — ASTM D5848, Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings**

10.2.2.1 *Scope:*

10.2.2.2 Test specimens are cut from a conditioned sample and weighed.

10.2.2.3 The fiber is sheared from the test specimens. The weight of the sheared test specimen is recorded.

10.2.2.4 The fiber stubble is removed from the backing.

10.2.2.5 The coating is removed from the stubble and the weight of the cleaned stubble is recorded.

10.2.2.6 The fiber weight is the sum of the stubble weight plus the difference between original test sample and the sheard test sample.

10.2.3 **Primary and Secondary Backing Weight — ASTM D5848, Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings**

10.2.3.1 *Scope:*

10.2.3.2 The total turf fabric weight is measured according to ASTM D5848.

10.2.3.3 The fiber weight for the turf fabric is also determined according to ASTM D5848.

10.2.3.4 The weight of the primary and secondary backing is calculated by subtracting the fiber weight from the total fabric weight.

10.3 **Grab Tear Strength — ASTM D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)**

10.3.1 *Scope:*

10.3.2 This grab test procedure is applicable to the determination of the effective strength of a woven or non-woven fabric.

10.3.3 A 100-mm (4.0-in.) wide specimen is mounted centrally in clamps of a tensile testing machine and a force applied until the specimen breaks. The breaking strength and elongation are reported.

10.3.4 Of the various methods described in ASTM D5034, the grab test using a constant-rate-of-extension (CRE) tensile testing machine is recommended for synthetic turf.

10.4 **Pile Height — ASTM D5823, Standard Test Method for Tuft Height of Pile Floor Coverings**

10.4.1 *Scope:*

10.4.2 This method covers the determination of tuft height using a grooved specimen holder.

10.4.3 *Test Method Specific Conditions:*

10.4.3.1 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.

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

10.4.3.3 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.

10.5 **Tufting Gauge — ASTM D5793, Standard Test Method for Binding Sites per Unit Length or Width of Pile Floor Coverings**

10.5.1 *Scope:*

10.5.1.1 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.

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

10.5.2 *Test Method Specific Conditions:*

10.5.3 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.

10.5.4 Locate the zero point at this distinguishing feature of one binding site with a marker.

10.5.5 Count a known number of binding sites from the zero point and add a second marker.

10.5.6 Measure the distance between the two markers with a graduated scale or tape, reading to the nearest 1 mm (0.05 in.).

10.5.7 The stitch rate or tufting gauge is calculated depending on direction.

10.6 **Tuft Bind — ASTM D1335, Standard Test Method for Tuft Bind of Pile Floor Coverings**

10.6.1 *Scope:*

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

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

10.6.2 *Test Method Specific Conditions:*

10.6.2.1 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.

10.6.2.2 For turf made with multi-filament fibers, one tuft leg includes all filaments of the multi-filament bundle.

10.6.2.3 A specimen (tuft leg or loop) is mounted in a special clamping fixture of a tensile testing machine and the test sample containing the specimen is mounted on a special holder on the tensile testing machine. The force to pull the specimen free from the test sample is measured as the tuft bind.

10.7 **Filament Bind — ASTM F3383, Standard Test Method for Filament Bind of Single Fibers in Synthetic Turf**

10.7.1 *Scope:*

10.7.1.1 This test method applies to tufted synthetic turf produced with at least one bundle of monofilament fibers.

10.7.1.2 This test method is applicable to laboratory testing (Method A), and for testing of installed turf (Method B).

10.7.2 *Summary of the Method*—A test sample is mounted in a clamping device associated with the constant rate of extension (CRE) force testing device. The force required to pull one filament of one yarn bundle of one tuft from the synthetic turf fabric sample is measured as the filament bind.

10.8 **Dimensional Stability — EN 13746, Surface for Sports Areas – Determination of Dimensional Changes Due to the Effect of Varied Water, Frost, and Heat Conditions**