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An American National Standard

Standard Specification for Synthetic Surfaced Running Tracks[1]

This standard is issued under the fixed designation F2157; 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.

INTRODUCTION

There is a need to provide for the safety of athletes and durability of surfaces used for competition running. There are a number of sources of injury with regard to the performance of a running track surface and protection of athletes of all ages.

1. Scope

1.1 This specification establishes the minimum performance requirements and classification when tested in accordance with the procedures outlined within this specification. All documents referencing this specification must include classification required.

1.2 This specification does not imply that an injury cannot be incurred if the surface is found to be in compliance with this specification.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D297 Test Methods for Rubber Products—Chemical Analysis

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

D2950 Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E303 Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1131 Test Method for Compositional Analysis by Thermogravimetry

G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

2.2 *Other Standards:*

DIN 18035 Part 6 A Standard for Sports Grounds, Synthetic Surfacings, Requirements, Test, Maintenance[3]

IAAF Performance Specifications for Synthetic Surfaced Athletics Tracks (Outdoors)[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *compliance, n*—a test result that falls within the specified range, meets a stated minimum value or achieves a "pass" rating on a test with a pass/fail result.

3.1.2 *"D" area, n*—an integral part of the synthetic surfacing located within the oval.

3.1.3 *EPDM components, n*—the residual elements of an EPDM rubber product once the fillers and plasticizers have been eliminated.

3.1.4 *EPDM rubber product, n*—a product comprised of organic and inorganic materials with a minimum of 20 % and a maximum of 26 % of ethylene propylene-diene-saturated polymethylene main chain along with other organic and inorganic components.

3.1.5 *flat, n*—an area that by design is to have a finished slope of 0.5 % or less.

3.1.6 *recycled black EPDM rubber product, n*—crumbs or granules manufactured through ambient or cryogenic grinding or crushing of post industrial scrap (typically automotive),

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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.

[3] Available from Beuth Verlag GmbH (DIN-- DIN Deutsches Institut fur Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany.

[4] Available from IAAF Headquarters, 17 rue Princesse Florestine—BP 359, MC-98007, Monaco Cedex. http://www.iaaf.org

containing a mixture of types of rubber including EPDM rubber product and varying in size. The material must be free of dust, metals, and other contaminants.

3.1.7 *recycled SBR rubber, n*—crumbs, granules, or buffings/strands manufactured through the ambient or cryogenic grinding or crushing of car or truck tires or industrial scrap and varying in size. Must be free of dust, metals, and other contaminants.

3.1.8 *SBR rubber product, n*—styrene-butadiene rubbers are the general-purpose synthetic rubbers.

3.1.9 *site report, n*—a comprehensive report of the test results obtained through site testing including site identification, testing conditions, test standard identification, test methodology, test results in average and by test point, a site plan locating test points and areas of deviation and a conclusion stating the classification achieved by the surface from the testing.

3.1.10 *site testing, n*—a combination of on-site and laboratory testing of site produced samples to establish compliance of an installed surface within a classification or other specifications.

3.1.11 *suitability report, n*—a report of the results from suitability testing which may be used as a guideline for surface product comparisons and as a general benchmark for installed surfaces.

3.1.12 *suitability testing, n*—a specific group of tests which are performed in the laboratory on an uninstalled surface sample. Such testing serves as a guideline for general surface compliance to the standard. It makes no inference about an installed surface.

3.1.13 *track classification, n*—a rating given to a surface based on the test results of either the *suitability testing* or *site testing*. Tracks are classified A to C in descending order. To achieve a classification, a surface must comply with all of the test specifications of that classification.

3.1.13.1 *track classification A*—a rating given to surfaces that meet the specifications for the A level track surfaces as specified herein.

3.1.13.2 *track classification B*—a rating given to surfaces that meet the specifications for B level track surface as specified herein.

3.1.13.3 *track classification C*—a rating given to surfaces that meet the specifications for C level track surface as specified herein.

4. Significance and Use

4.1 Data obtained from this specification are indicative of the performance characteristics for the running track surface and can be used only for comparisons and establishing minimum requirements.

5. Test Methods and Requirements for Asphalt Base

5.1 **Type and Compaction:**

5.1.1 *Description and Required Performance*—The asphalt base and asphalt wearing course (two layers) for the running track shall conform to the mixes established for road traffic in the jurisdiction and according to the synthetic surface manufacturers' recommendation of the running track. The asphalt base and asphalt wearing course (two layers) shall be compacted to a minimum of 95 % density for machine finish and 90 % density for hand packed areas according to Test Method D2950. Laboratory tests are performed with local DOT procedures. Hand-packed limited to areas not accessible by appropriate equipment. Where the asphalt is permeable to water or of an open type, vertical drainage is required.

5.1.2 *Test Method*—Use test method as described in Test Method D2950.

5.2 **Evenness:**

5.2.1 *Description and Required Performance*—The running track asphalt base shall be installed so that on a localized level, there shall be no bumps or depressions beneath a 3-m straightedge exceeding 6 mm for a Class A and B surfaces or 8 mm for Class C surfaces. Depressions beneath a 1-m straightedge shall not exceed 3 mm for Class A and Class B surface or 4 mm for Class C. There shall be no step-like irregularities greater than 1 mm in height (see Table 1).

5.2.2 *Test Method*—Drag or regularly place the 3-m straightedge, advancing by one half the length of the straightedge for each measurement, on the surface along the length of the odd numbered lanes and each runway as a minimum. Additional locations may be tested at the discretion of the test laboratory. Both ends of the straightedge should be in contact with the asphalt surface. At each location use visual observation to determine if a gap exists under the straightedge. Should a gap exist, use a calibrated wedge to determine the actual size of the gap. For runways, the measurement is regularly taken up the center of the runway. Where a gap is found, this is recorded on a plan of the facility.

5.3 **Drainage:**

5.3.1 *Description and Required Performance*—Due to the requirements for evenness, the drainage requirements for the asphalt surface shall be the same as the drainage requirements for the synthetic surface as specified in this standard.

5.3.2 *Test Method*—The asphalt surface is flooded with water by any number of means, and the time is measured from the time the flooding stops for 20 min. Locations with standing water are noted on a plan of the facility.

6. Test Methods, Description, and Required Performance for Newly Installed Synthetic Surfaces

6.1 **Imperfections:**

6.1.1 *Description and Required Performance*—The durability and dynamic performance of the surface may be compromised by imperfections such as bubbles, fissures, uncured areas, delamination, etc. These will not be allowed and must be corrected.

6.1.2 *Test Method*—A visual examination of the surface is conducted and imperfections noted on a plan of the facility. A photographic record of imperfections may be used to enhance the report.

6.2 **Evenness:**

6.2.1 *Description and Required Performance*—The running track surface shall be installed so that on a localized level, there

TABLE 1 Performance Requirements for the Tests

Test Method and Requirement	Class A Requirement	Class B Requirement	Class C Requirement	Suitability/ Site Test
Imperfections	No bubbles, fissures, uncured areas delamination, etc[A]	No bubbles, fissures, uncured areas delamination, etc.	No bubbles, fissures, uncured areas delamination, etc	Site
Evenness	No depressions over 6 mm in 3 m or 3 mm/1 m; No step-like irregularities greater than 1 mm[A]	No depressions over 6 mm in 3 m or 3 mm/1 m; no step-like irregularities greater than 1 mm	No depressions over 8 mm in 3 m or 4 mm/1 m; No step-like irregularities greater than 1 mm	Site
Thickness	To comply with IAAF Product Certificate/IAAF Product Report or this Standard compliance report, with no area under 80 % and with compliance to Force Reduction and Deformation requirements met.	Min 12 mm avg; nowhere <10 mm	Min 12 mm avg; Nowhere <10 mm	Suitability site
Drainage	No standing water above surface texture after 20 min	No standing water over 3 mm above surface texture after 20 min; areas under 5 % slope by designed exempt; total puddles under 0.2 % total syn surface; no single puddles over 2 m^2 in size	No standing water over 3 mm above surface texture after 20 min; areas under 5 % slope by design exempt; total puddles under 0.2 % total syn surface; no single puddles over 2 m^2 in size	Site
Force reduction	35 to 50 % at 10 to 40°C[A]	30 to 50 % 10 to 40°C	25 to 50 % 10 to 40°C	Suitability site
Vertical deformation	0.6 to 2.5 mm[A]	0.6 to 2.8 mm	0.5 to 3.0 mm	Suitability site
Texture influence (wet)	Not to exceed IAAF requirement[A]	Not to exceed IAAF requirement[A]	Not to exceed IAAF requirement[A]	Suitability site
Tensile properties	Strength: porous—min 0.4 MPa; nonporous—min 0.5 MPa; Elongation all surfaces—min 40 %[A]	Strength: porous—min 0.4 MPa; nonporous—min 0.5 MPa; elongation all surfaces—min 40 %	Strength: porous—min 0.4 MPa; nonporous—min 0.5 MPa; elongation all surfaces—min 35 %	Suitability site
Color grey scale	Even color[A]	Even color or even fading if by design	Even color or even fading if by design	Suitability site
Weathering	Min 75 % of pre-exposure value for strength and elongation on break; no visual imperfections	Min 75 % of pre-exposure value for strength and elongation on break; no visual imperfections	Min 75 % of pre-exposure value for strength and elongation on break; no visual imperfections	Suitability (optional) site
Spike resistance	No visible signs of damage	No visible signs of damage	Max of 10 lasting penetrations, no tears or splits	Suitability (optional) site
Flammability	Must receive a result of "Pass"	Must receive a result of "Pass"	Must receive a result of "Pass"	Suitability site

[A] IAAF requirement.

shall be no bumps or depressions beneath a 3-m straightedge exceeding 6 mm for a Class A and B surfaces or 8 mm for Class C surfaces. Depressions beneath a 1-m straightedge shall not exceed 3 mm for Class A and Class B surface or 4 mm for Class C. There shall be no step-like irregularities greater than 1 mm in height. Particular attention is to be paid to seams and joints in the running surface. The intent is to ensure the safety of the athlete and provide an even running surface.

6.2.2 *Test Method*—Drag or regularly place the 3-m straightedge, advancing by one half the length of the straightedge for each measurement, on the surface, along the length of the odd-numbered lanes and centerline of each run-up and approach area as a minimum. Additional locations may be tested at the discretion of the test laboratory. Both ends of the straightedge should be in contact with the surface. At each location use visual observation to determine if a gap exists under the straightedge. Should a gap exist, verify that both ends of the straightedge rest on the surface, moving the straightedge if necessary, then use a calibrated wedge to determine the actual size of the gap. For runways, the measurement is taken up the center of the runway. For the high jump fan or "D" the measurement is taken at 5-m intervals along parallel axis in two directions. Where a gap is found exceeding the maximum for the class, this is recorded on a plan of the facility.

6.3 **Thickness:**

6.3.1 *Description and Required Performance*—The durability of the surface and the safety of the athlete can be affected by the thickness of the running track surface. The use of spikes enhances this requirement for a minimum thickness. There will be specifically designed areas such as in the javelin runway or other high stress areas where the safety of the athlete and the durability of the surface will dictate that the thickness be greater than the minimum. This additional thickness shall not affect the evenness of the surface. The average thickness of the running track surface shall be at least 12 mm, and nowhere shall the thickness be less than 10 mm. For Class A the total area with a thickness between 10 mm and 10.5 mm shall be no greater than 5 % of the total surface.

6.3.2 *Test Method:*

6.3.2.1 A calibrated three-prong floor depth measuring probe is used to determine the thickness of the running surface. Care must be taken not to penetrate the asphalt base of the running surface. This thickness is measured at a minimum of 100 locations, starting at the finish line and moving in a counter-clockwise direction taking readings first in the even lanes (2, 4, 6, 8) and then the odd lanes (1, 3, 5, 7) in the center of each lane and at regular intervals. For Class A, the interval is set at every 10 m. Runways shall be probed at 5-m intervals centered along the length and the "D area" shall be probed on a minimum of 15 locations evenly spaced throughout the area as a minimum for Class B and Class C, while for Class A, the test must be performed at 5-m intervals along parallel axes in two directions. The measurements taken are recorded and the test points listed in the test report.

6.3.2.2 A core (10 to 25 mm in diameter) is removed and measured using the following method to make the final determination as to the actual thickness. The surface texture of the core is abraded with a grade 60 abrasive for approximately 50 % of the surface area of the core. The thickness of the abraded area of the core is measured using a thickness gauge

fitted with a 0.01-mm accuracy dial, a plunger flat measuring surface of 4-mm diameter, and a measurement force between 0.8 N and 1.0 N is applied. The measurement is recorded to the nearest 0.1 mm. The difference in thickness between the actual surface and the abraded surface is calculated and the difference deducted from all of the actual probe measurements and these are recorded as the thickness of the running surface for the purpose of this standard.

6.4 **Force Reduction:**

6.4.1 *Description and Required Performance*—The dynamic interaction between the athlete and the surface is significant to the performance and safety of the athlete. Therefore, the ability of the surface to reduce force is important. The force reduction will be a maximum of 50 % for all surfaces with a minimum of 35 % for Class A, 30 % for Class B and 25 % for Class C surfaces. The temperature of the test shall be to simulate the ambient temperature anticipated at a track meet; therefore, the range shall be within 10 to 40°C.

6.4.2 *Test Method*—This method utilizes the Berlin Artificial Athlete (BAA) (Fig. 1). A mass of 20 kg is allowed to fall onto an anvil, which transmits the load via a spring to a test foot with a spherical base resting on the surface. The foot is fitted with a force transducer that enables the peak force during the impact event to be recorded. The peak force is compared with the result obtained on a rigid (concrete, 15 cm (6 in.) in thickness) floor, and the percentage of force reduction calculated for the running surface. The force reduction is calculated as follows:

$$\text{Force reduction percentage}\,(\%) = (1 - Fs/Fc) \times 100 \qquad (1)$$

where:

Fs = readings on synthetic surface, and
Fc = readings on concrete.

6.4.2.1 The apparatus shall conform to the following requirements:

(1) Spring number 2000 N/mm ± 60;
(2) Test foot radius 70 mm;
(3) Test foot shape radius 500 mm;
(4) Drop height 55 mm;
(5) Butterworth filter 120 Hz, 9-pole;
(6) Weight of test foot and load cell and spring 3.0 kg ± 0.5 kg; and

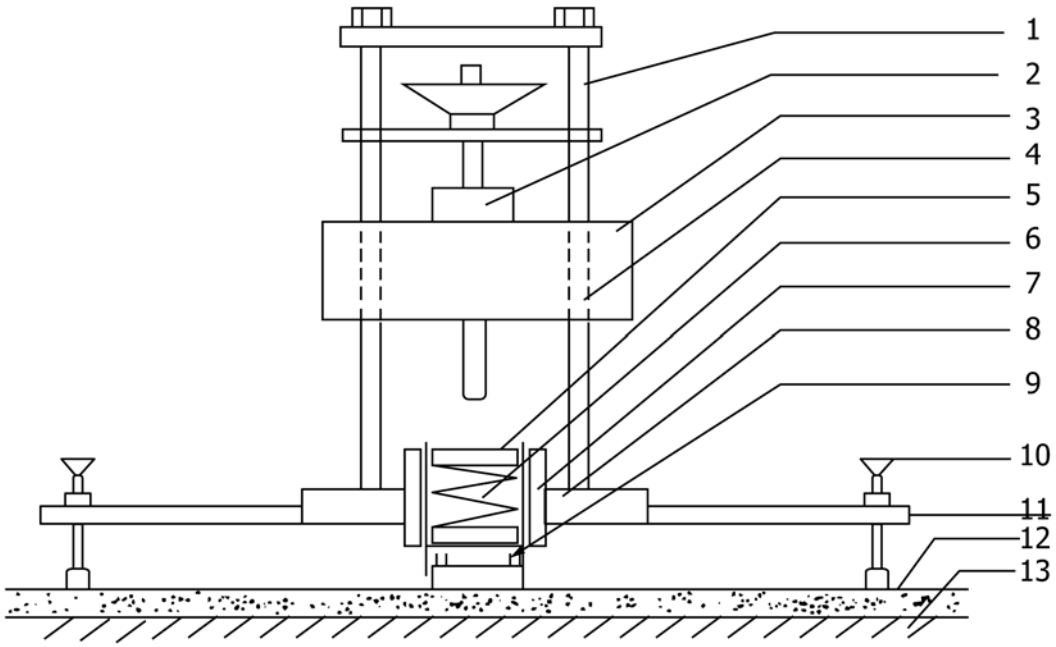

FIG. 1 Force Reduction Test Apparatus

1 = bars
2 = lifting/release facility
3 = drop weight
4 = guidance
5 = anvil
6 = spring
7 = tube
8 = support
9 = load cell
10 = foot of support
11 = test foot
12 = synthetic surface
13 = base

(7) Electronic according to 6.5.2.2.

6.4.2.2 For a site test a minimum of 6 locations in the running track will be tested and should be as follows:

(1) At the center of lanes 1 and 3 in the center of the main straight of way,

(2) At the location determined by the test laboratory in the first radius,

(3) At the center of lane 1 in the center of the back straight of way,

(4) At the location determined by the test laboratory in the final radius,

(5) At the location selected by the test laboratory, other than the high-jump take-off point, within the fan. Where there are 2 high-jump fans, a test is performed in each fan, and

(6) At the location selected by the test laboratory in one of the runways for Class B and Class C. For Class A, all runways must be tested at a location selected by the test laboratory.

6.4.2.3 Each location tested shall be recorded on a facility plan with the results recorded in the test documentation. Since the test is performed within a temperature range of 10 to 40°C, a temperature probe must be used to determine and record the temperature of the running surface.

6.4.2.4 For compliance tests (suitability) the submitted sample shall be tested at 10°C, 22°C, and 40°C, ± 2°C. The sample must comply at all temperatures.

6.4.2.5 Climatic conditions may warrant the need for testing at additional temperatures outside the minimum recommended range of 10 to 40°C.

6.4.2.6 Field testing is to be performed at ambient temperature; however, the surface temperature and ambient air temperature are to be recorded.

6.5 **Vertical Deformation:**

6.5.1 *Description and Required Performance*—The dynamic interaction between the athlete and the surface is significant to the performance and safety of the athlete. Therefore the ability of the surface to deform under load is important. Too high a deformation can affect the safety of the athlete through instability of the foot, while the inability of the surface to deform can cause injuries due to impact forces. This test is performed with a Stuttgart Artificial Athlete (SAA) (different than for force reduction). The temperature of the test shall be to simulate the ambient surface temperature anticipated at a track meet; therefore, the requirements shall be applied to all results within the range of 10 to 40°C. In the case of Class A Product Compliance (suitability) tests, the results of temperature testing outside this range shall be considered informational. The allowable deformation shall be 0.6 to 2.5 mm for Class A surfaces, 0.6 to 2.8 mm for Class B surfaces, and 0.5 to 3.0 mm for Class C surfaces.

6.5.2 *Test Method:*

6.5.2.1 This method utilizes the SAA (Fig. 2). A mass of 20 kg is allowed to fall on a spring, which transmits the load to a test foot with a flat base resting on the surface. The foot is fitted with a force transducer which enables the force arising during the impact event to be recorded. Simultaneously, the deformation of the test foot is measured by means of deformation sensors mounted so that they read the deformation of the test foot.

6.5.2.2 The apparatus is set vertically with the test foot resting directly on the synthetic running surface. The distance between the drop weight and the top of the spring is adjusted to 120 ± 0.25 mm. The sensors are set as specified in 6.5.4.8. The pre-load on the surface by the test foot assembly and sensors as installed within the test device is the zero position. Activate the recording and release the drop weight. Record the deformation of the surface. Return the drop weight to the holding device and adjust the drop height as necessary. Without moving the test device repeat this for a total of 3 impacts with a resting time between impacts of 1 min ± 30 s. The deformation for the test point shall be calculated as the average result of Drop 2 + Drop 3.

6.5.3 *Test Temperature*—The temperature(s) for this test shall be as follows:

6.5.3.1 During each test, a temperature probe inserted at least halfway into the synthetic surface must be used to determine and record the temperature of the running surface.

6.5.3.2 *Product Compliance (Suitability) Testing*—For compliance tests (suitability) Class B and C, the submitted sample shall be tested at 10, 22, and 40 ± 2°C. For Class A only, test temperatures shall be expanded to include all those specified by IAAF. The test sections shall have been conditioned at the test temperature for a minimum of 8 h prior to testing. The sample must comply at all temperatures within the range of 10 to 40°C. Climatic conditions may warrant the need for testing at additional temperatures outside the minimum recommended range of 10 to 40°C.

6.5.3.3 *Sample Size*—Submitted sample shall be a minimum of 1 m^2.

6.5.3.4 *Field Testing*—Field testing is to be performed at ambient temperature; however, the surface temperature and ambient air temperature are to be recorded. For Class A surfaces, testing is to be performed when the surface is within the 10 to 40°C range. This may require testing during early morning and evening hours during hot weather or postponing testing until ambient conditions do comply with this requirement, or both.

6.5.4 *Equipment*—The apparatus must meet the following requirements:

6.5.4.1 Drop weight of 20 ± 0.05 kg with a hardened striking surface, guided such that it falls vertically and smoothly with a minimum of friction.

6.5.4.2 Spiral spring which, when mounted in the test assembly, is linear with a rate of 40 ± 1.5 N/mm over the range 0.1 to 1.6 kN.

6.5.4.3 Steel test foot, flat, diameter 70 ± 0.1 mm with a minimum thickness of 10 mm and 2 horizontal projections for the sensors.

6.5.4.4 The total mass of spiral spring and the test foot including the force sensing device, measured together, shall be 3.5 ± 0.35 kg.

6.5.4.5 Metal guiding tube having an internal diameter of 71 ± 0.1 mm.

6.5.4.6 Support with screws for adjusting the vertical position of the supports with the distance between the feet and the center of the support at least 250 mm.

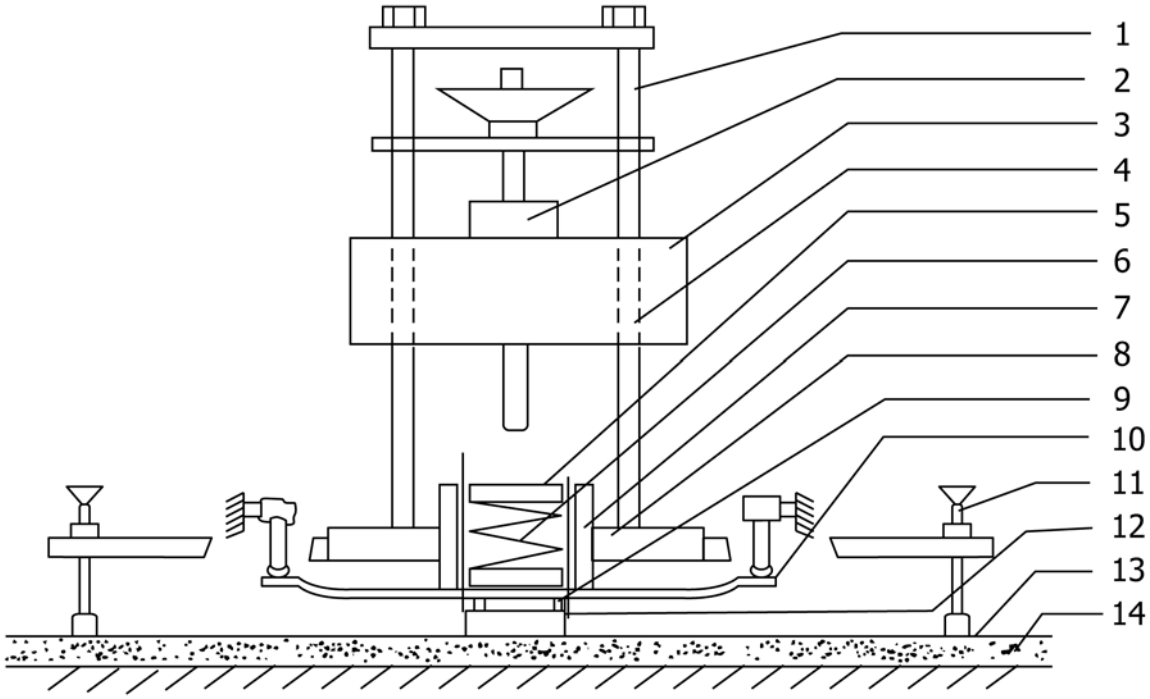

FIG. 2 Vertical Deformation Test Apparatus

1 = bars
2 = lifting/release
3 = drop weight
4 = guidance
5 = anvil
6 = spring
7 = tube
8 = support
9 = load cell
10 = transmitter for deformation
11 = foot of support
12 = test foot
13 = synthetic
14 = base

6.5.4.7 Lifting facility to hold and release the drop weight and to adjust the drop height between bottom of the weight and the top of the spring to an accuracy of 1.0 mm.

6.5.4.8 Two electronic sensors (pick-ups) with a range of ±10 mm mounted on a separate stand in order to be independent of the SAA, with an accuracy of 0.05 mm and with the distance between the sensors and the axis of the apparatus being ≤125 mm and their position being equidistant from the central axis of the apparatus.

6.5.4.9 Recording facility capable of storing data from both sensors (about 50 readings per bounce) and to calculate data or display readings.

6.5.5 Test locations (site test) shall be the same as those stated in 6.4.2.2.

6.5.6 *Calculation of Results*—The test result is the average value of the measurements of the last two impacts. Superimpose the deformation traces of both the sensors first and then determine the peak deformation.

$$D = (1500\,N/F_{max}) \times f_{max} \quad (2)$$

where:

f_{max} = max deformation of the surface during first bounce/impact, expressed in mm,
F_{max} = max force (peak force) during first bounce/impact, expressed in N, and
D = vertical deformation.

6.6 **Texture Influence:**

6.6.1 *Description and Required Performance*—Since most running track surfaces have a texture, it is important to be able to make a comparison of the effect of the performance of the texture among running track systems. The test method can be either with a pendulum device TRRL or BPT fitted with a spring-loaded foot with a standard grade of rubber attached or the apparatus (SST) that operates under a fixed load and is allowed to rotate and where a standard leather surface is attached to the foot. For all classes the requirement in the wet

condition is a minimum value of 47 for the TRRL or 0.5 for the Stuttgart Sliding Test Apparatus.

6.6.2 *Test Method*—The test method is as stipulated in the IAAF Performance Specifications for Synthetic Surfaced Athletics Tracks (Outdoors), Section 2.6, for either Method A or Method B in a wet condition.

6.6.3 *Test Locations:*

6.6.3.1 *Class A:*

(1) At the discretion of the test laboratory in any lane around the first radius.

(2) At the position of apparent lowest texture in any lane on the back straight.

(3) At the discretion of the test laboratory in any lane around the final radius.

(4) At the position of apparent lowest texture in lane 1 on the main straight.

(5) At the discretion of the test laboratory at any position (except the high jump take-off point) over the semi-circular area. Where there are two semi-circular areas, a test shall be performed on each of them.

(6) At the discretion of the test laboratory at any position on one of the runways.

(7) If the area of the facility is exceptionally large (for example, 10 or 12 lane straights), any necessary additional tests shall be performed at locations selected by the test laboratory.

6.6.3.2 *Class B and Class C*—At a minimum of 4 locations selected to include areas of high and low texture.

6.7 **Tensile Properties:**

6.7.1 *Description and Required Performance*—The measure of the tensile strength and elongation to break of a surface material will provide an indication as to the durability of the surface. For all classes the minimum tensile strength shall be 0.5 MPa for nonporous surfaces and 0.4 MPa for porous surfaces. The elongation to break for Class A and Class B surfaces shall be a minimum of 40 %, whereas for Class C surfaces the minimum shall be 35 %. The test shall be conducted on a minimum of 4 samples. The result of the test is the average of these results, and results between the samples should not vary more than 5 %.

6.7.2 *Test Method:*

6.7.2.1 In the case of newly installed tracks, it is sometimes acceptable to conduct this test on sample trays of synthetic surface prepared by the contractor as work proceeds or, in the case of prefabricated surfaces, on samples cut from individual rolls of material on site. However, in the event of dispute or if the quality of the installed surfacing is suspect, samples must be taken from the track itself.

6.7.2.2 If it is necessary to cut samples of surfacing from the track for this test, these should obviously be removed where possible, from noncritical areas of the facility such as run-outs at the ends of straights, at the corners of fan areas, etc. In the event that samples must be removed from a specific location because a defect is suspected, these samples should be cut from a low-wear area within that location.

6.7.2.3 The tensile strength and elongation at break shall be determined on dumbbell bars stamped or cut from a full thickness sample of the surfacing. The shape of the specimens shall be as shown in Fig. 3 sample A. The bars shall be conditioned at 23°C for 24 h and then stretched at a constant strain rate of 0.100 mm/min until they break. A stress/strain curve may be plotted during the test.

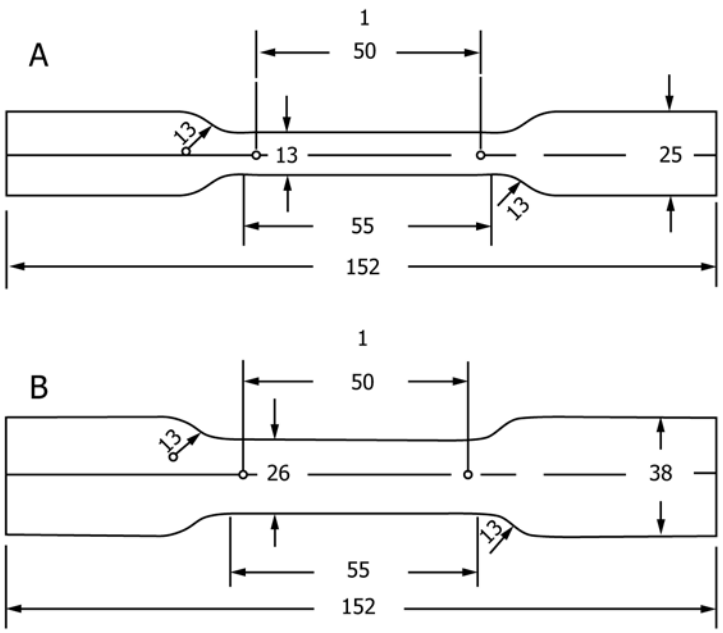

FIG. 3 Tensile Specimens (dimensions in millimetres)
Sample A
Sample B

1 = Gage length

6.7.2.4 In the case of synthetic surfacing formed with the use of single component, moisture-curing polyurethanes, at least 14 days curing time should be allowed before conducting tensile tests. If such a system fails to meet the stipulated limits, repeat tests should be conducted on further samples after another 14 days or after a period of accelerated curing in the laboratory.

6.7.2.5 Each test location shall be recorded and reported with the results of each point in the test report.

6.8 **Color:**

6.8.1 *Description and Required Performance*—The evenness of the color of the running surface assists in the concentration of the athlete and provides a focus in relation to the line and event marking. The color must be consistent within the design of the surface and when fading occurs, this must occur evenly.

6.8.2 *Test Method:*

6.8.2.1 This is a visual measure of the consistence of the color, and variance in color should be noted using the Grey scale, Test Method D2616 if the deviation is Class 4 or greater.

6.8.2.2 Areas of inconsistent color shall be marked on the site plan.

6.9 **Drainage:**

6.9.1 *Description and Required Performance*—Water in excess of the height of the texture of the running track surface can affect the safety and performance of the athlete. For Class A surfaces there shall be no standing water exceeding the depth of texture of the running surface. For Class B and Class C surfaces, standing water shall not exceed 3 mm over the texture of the running track, there shall be no puddles exceeding 2 m^2 in size, and the total area of all puddles shall not exceed 0.2 % of the total running track surface. Class B and Class C surfaces areas under 0.5 % slope by design or at the junction of the oval and the chute are exempt from localized drainage requirements but, if applicable, shall be included in the calculation for surface compliance to the 0.2 % puddle allowance.

6.9.2 *Test Method*—The running surface is flooded with water by any number of means and the time is measured from the time the flooding stops for 20 min. The surface is examined for standing water. Locations with standing water exceeding the top of the surface texture of the running surfaces are measured for size in metres, maximum depth in millimetres, noted on a plan of the facility, and included in the test report according to the requirements of the individual class designation. For Class A surfaces, no puddles in the competition areas are permitted.

6.10 **Weathering:**

6.10.1 *Description and Required Performance:*

6.10.1.1 Most running track surfaces are designed to be installed outdoors; therefore, a measure of the ability of the surface to withstand exposure to normal weathering is required. The surface shall be subjected to 1000 continuous hours of exposure in the test apparatus. At the end of the exposure, tests for tensile strength, elongation at break, and color are performed according to the test methods described in 6.7.2-6.7.2.5 of this standard along with an inspection for integrity (cracks, fissures, blisters etc.). The results of the weathered surface for both tensile strength and elongation at break, determined by the formula, shall not be less than 75 % of the result of the sample prior to weathering. A further requirement is that the running surface remains within the requirements for the class it has been designated prior to the weathering process.

6.10.1.2 Equation for determining degradation of sample:

$$Q_E = \frac{E_{aged}}{E_{unaged}} \times 100 \quad (3)$$

$$Q_T = \frac{T_{aged}}{T_{unaged}} \times 100$$

where:

Q_E = the change in elongation to break,
E_{aged} = the elongation to break of the aged sample,
E_{unaged} = the elongation to break of the unaged sample,
Q_T = the change in tensile strength,
T_{aged} = the tensile strength of the aged sample, and
T_{unaged} = the tensile strength of the unaged sample.

6.10.2 *Test Method*—Perform test for tensile strength and elongation at break on the non-weathered surface according to 6.7.2 recording the results. Condition untested surface for 1000 continuous hours with UVA radiation and 4-h cycles of light and water in the apparatus described in and according to Practice G154. Following the conditioning, perform tests for tensile strength and elongation at break on the weathered surface according to the test methods described in 6.7.2 of this standard along with an inspection for integrity (cracks, fissures, blisters, etc.) and color. Calculate and report the results.

NOTE 1—1000 h is used as a rough approximation of 1 year of typical exposure in the continental United States.

6.11 **Spike Resistance:**

6.11.1 *Description and Required Performance*—The use of spikes in the athletic footwear is common and over time can cause degradation and damage to the surface that could affect the safety and performance of the athlete. The running surface sample is subjected to a drum/wheel device containing cone/pyramid spikes for 1100 contacts with the device. For Class A and Class B running surfaces there shall be no visible signs of damage, whereas for Class C running surfaces there can be light signs of damage and no more than 10 visible and lasting spike perforations. This test cannot be performed on site as the design of the test apparatus does not allow for use in the field.

6.11.2 *Test Method*—The test apparatus shall be that described in the Din 18035, Part 6 (Oct 1989), Section 5.3.9, and the test procedure shall be that described in the same standard in Section 5.3.9. At the completion of the test a visual inspection is performed.

6.12 **Flammability:**

6.12.1 *Description and Required Performance*—Damage to the running surface through fire will affect the safety and performance of the athlete. Each of four samples tested must receive a passing result for the surface to receive a passing result.

6.12.2 *Test Method*—The test method in Test Method D2859 must be performed. The number of tests to be performed will be four.

7. Test Methods for Colored EPDM Granules for Surfacing Layer

7.1 *Test Method*—The tests for the EPDM colored/pigmented rubber crumb are conducted according to industry norms.

7.1.1 *EPDM Rubber Product Composition:*

7.1.1.1 *Description and Required Performance*—The EPDM rubber product is composed of a mixture of organic and inorganic fillers, plasticizers and EPDM components. The quantity of these components is determined by using the standards for rubber analysis by performing extraction, combustion/annealing residue and infrared analysis. Testing is to be performed on a consistent 2-mm thick slab or precut 2-mm granules as required by the individual test. Results will vary by individual systems with the requirement for the EPDM component content of greater than or equal to 20 % and less than or equal to 26 %.

7.1.1.2 *Test Method*—Perform tests for composition according to Test Method E1131 or Test Methods D297 Section 19 (“Acetone Extract”) and Section 36 (“Fillers”). Report the results for each test conducted.

7.1.2 *EPDM Rubber Product Resistance to Weathering:*

7.1.2.1 *Description and Required Performance*—This test measures the effect of accelerated weathering on the EPDM rubber product used in the surface layer(s) of the running track system. The test measures the pre-aged tensile properties of the material against the aged tensile properties of the material.

7.1.2.2 *Test Method*—Cut the samples from an untested 2-mm thick slab of the EPDM rubber according to 6.7.2.3 of this standard. Using the apparatus and method described in Practice G154, condition one half of the samples for 1000 continuous hours with UVA radiation and 4-h cycles of light and water. Following conditioning, test the unconditioned and conditioned samples for tensile properties according to 6.7.2-6.7.2.5 of this standard. Report the result.

8. Submissions with Samples and at Time of Installation

8.1 The components of the running surface will have a bearing upon the performance of the tests and therefore the safety and performance of the athlete and the longevity of the surface. The provider of the running surface both at the time of suitability testing in the laboratory and at the time of installation of the running surface will provide a list of the components and suppliers for independent confirmation. The minimum shall be:

8.1.1 The manufacturer and designation of the primer if utilized.

8.1.2 The manufacturer and designation of the binder or coatings utilized.

8.1.3 The type and granule size-range of the rubber(s) utilized.

8.1.4 The designation of the rubber, for example, EPDM, buffing, granule, etc. utilized and test results to substantiate the performance to this standard.

8.1.5 Whether solvents or thinners are to be used in conjunction with the installation, other than cleaning, of the surfacing system and the manufacture and designation of the solvent or thinner.

8.2 Since these components are critical to the outcome of the tests, a change in materials, components, or size of rubber particles will invalidate the previous test results.

9. Submissions for Suitability Testing

9.1 *Physical Submissions:*

9.1.1 A single piece of the surface system measuring 1.5 m × 1.5 m × thickness in size, or a minimum of 15 pieces of the surface system, 30 cm × 30 cm × thickness each.

9.1.2 454 g (1 lb) of each type of rubber granule used in the sample.

9.1.3 4 pieces 300 mm × 100 cm × 2 mm for two component materials.

9.1.4 4 pieces 300 mm × 100 mm >0.2 mm <0.5 mm thin film sample of each binder and coating utilized.

9.1.5 For the EPDM, there must be a submission of a test certificate provided by the EPDM manufacturer or 2 slabs 160 mm × 260 mm × 2 mm plus 454 g (1 lb) of 2-mm EPDM granules are required for laboratory testing.

9.2 *Written Submissions:*

9.2.1 Description of the system including composition, structures and texture of the system.

9.2.2 Identification of the binders and coatings with mixing ratios for two-component products by name and manufacturer are to be kept on file by the test laboratory for the purpose of confirmation of materials utilized on site.

10. Report

10.1 *Suitability Report:*

10.1.1 Name of applicant/company;

10.1.2 Description of samples (who produced them, when and where were they produced);

10.1.3 Record of the delivery of the samples (date, amount, size, delivered by);

10.1.4 Name and description of product, materials, and components;

10.1.5 Test performed;

10.1.6 Equipment utilized;

10.1.7 Standard for the test and version;

10.1.8 Date of the test;

10.1.9 Temperature of each test;

10.1.10 Name of equipment for each test with average result;

10.1.11 Test result data and notation of deviations from the requirement of failures; and

10.1.12 Name of person or laboratory, or both, performing the test.

10.1.13 *Conclusion*—State the track classification where the surface met all requirements of the standard for the named classification.

10.1.13.1 Surfaces that do not meet all of the requirements of any classification will receive a “no rating achieved” designation.

10.1.14 The report is to be signed.

11. Site Testing Submissions

11.1 *Physical*—Some of the tests that can be performed at site are more readily performed in the laboratory on a sample

that is either taken from the installed surface or is a sample which was manufactured at the site during the installation of the running surface using the same materials, installation techniques and application rates. Sample size is to be a total of 1 m^2 × thickness of the track system installed.

11.2 *Written:*

11.2.1 Copy of the Suitability Test Report or IAAF Product Certificate for the system to be tested.

11.2.2 Site plan large enough to contain the markings for deviations and test locations as required in this standard.

11.2.3 A site plan indicating grades as originally required by the owner/operator of the facility.

12. Site Report

12.1 Name of applicant/company;

12.2 Name and description of product, materials and components;

12.3 Name and location of the test;

12.4 Test performed;

12.5 Equipment utilized;

12.6 Standard for the test and version;

12.7 Date of the test;

12.8 Surface temperature of each test;

12.9 Table of results by individual test point, including average result by test with range of results;

12.10 Copy of the site plan with the areas of deviation marked;

12.11 Photos of deviations (optional);

12.12 Name of person or laboratory, or both, performing the test; and

12.13 Written location of each test point.

12.14 *Conclusion:*

12.14.1 State the track classification where the surface met all requirements of the standard for the named classification.

12.14.2 Surfaces that do not meet all of the requirements of any classification will receive a "no rating achieved" designation.

12.15 The report is to be signed.

13. Performance Requirements for the Tests

13.1 Table 1 indicates the test method, required results for synthetic surfaces for each classification, and whether the test is performed as a suitability, a site test, or both.

TABLE 2 Thickness (mm)

Material	Average, $\bar{x}^A$	Repeatability Standard Deviation, S_r	Reproducibility Standard Deviation, S_R	Repeatability Limit, *r*	Reproducibility Limit, *R*
Track A	12.9	0.3	0.7	0.8	1.9

[A] The average of the laboratories' calculated averages.

14. Precision and Bias

14.1 The precision of this test method is based on an interlaboratory study of Specification F2157 conducted in 2007. Results in this study were obtained from six participants, testing the thickness of one running track. Every "test result" reported represents an individual determination. Each participating laboratory reported seven replicate test results for every material. Except for the testing of only one material, Practice E691 was followed for the design and analysis of the data.[5]

14.1.1 *Repeatability Limit (r)*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the "*r*" value for that material; "*r*" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

14.1.1.1 Repeatability limits are listed in Table 2.

14.1.2 *Reproducibility Limit (R)*—Two test results shall be judged not equivalent if they differ by more than the "*R*" value for that material; "*R*" is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

14.1.2.1 Reproducibility limits are listed in Table 2.

14.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

14.1.4 Any judgment in accordance with statements 14.1.1 and 14.1.2 would normally have an approximate 95 % probability of being correct, however the precision statistics obtained in this ILS must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of materials tested, and laboratories reporting results, guarantees that there will be times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability limit would imply. The repeatability limit and the reproducibility limit should be considered as general guides, and the associated probability of 95 % as only a rough indicator of what can be expected.

14.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

14.3 The precision statement was determined through statistical examination of 42 results, from six participants, on one running track.

15. Keywords

15.1 force reduction; friction; impact attenuation; running track; traction; weathering

[5] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F08-1008. Contact ASTM Customer Service at service@astm.org.