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An American National Standard

Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems[1]

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1. Scope

1.1 This specification establishes levels for athletic performance properties of multi-purpose indoor sports floor systems excluding turf and materials specific to running tracks and tennis courts.

1.2 The methods described are applicable in both the laboratory and field unless otherwise stated.

1.3 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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]

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

F2117 Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement

F2157 Specification for Synthetic Surfaced Running Tracks

F2569 Test Method for Evaluating the Force Reduction Properties of Surfaces for Athletic Use

2.2 *Other Standards:*[3]

EN 13036-4 Road and Airfield Surface Characteristics. Test Methods. Method for Measurement of Slip/Skid Resistance of a Surface. Part 4: The Pendulum Test.

ISO 48 Rubber Vulcanized or Thermoplastic—Determination of Hardness (hardness between 10 IRHD and 100 IRHD)

ISO 4662 Rubber Vulcanized or Thermoplastic—Determination of Rebound Resilience

3. Terminology

3.1 *Definitions:*

3.1.1 *area-elastic, adj*—describes sports floors having a rigid upper layer (for example, wood) supported by resilient components.

3.1.2 *combination-elastic, adj*—describes floors having a point elastic upper layer in combination with a rigid structural layer (for example, wood, high-density composites, poured nonresilient materials) and resilient support components (for example, elastic pads, foam blanket, or poured urethane).

3.1.3 *point-elastic, adj*—describes sports floors that are only comprised of an elastic layer or layers (for example, surfaces such as poured urethanes, vinyl, or rubber sheet goods).

4. Classification

4.1 Compliance with the properties contained in this specification shall be determined based on the values designated in Section 4 of this specification.

4.1.1 The field test shall clearly indicate the average and maximum and minimum values for general comparison to performance of laboratory samples.

4.2 *Force Reduction*—In the case of force reduction, two parameters are required:

4.2.1 *Performance Level*—For laboratory samples, the average performance of all test points shall achieve a level as indicated in Table 1. If no performance level is met, the result stated in the report shall be "No Performance Level Achieved."

4.2.2 *Uniformity*—Laboratory samples shall be such that the force reduction value of every individual test point falls within a spread of ±5.0 percentage points of the average of all test point values. The report shall be marked "Noncompliant" if any individual test point does not meet this requirement.

4.3 *Ball Rebound*—In the case of ball rebound, two parameters are required:

4.3.1 *Performance Level*—For laboratory samples, the average performance of all test points shall achieve a minimum of

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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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 1 Force Reduction Requirements for Laboratory Samples

	Performance Level Classification				
	1	2	3	4	5
Average Force Reduction	≥10 % and ≤21 %	≥22 % and ≤33 %	≥34 % and ≤45 %	≥46 % and ≤57 %	≥58 %
Force Reduction Uniformity	No individual test point shall differ from the average value by more than ±5.0 percentage points.				

90 % as indicated in Table 2. If the performance level is not met, the result stated in the report shall be "Performance Level Not Achieved."

4.3.2 *Uniformity*—Laboratory samples shall be such that the ball rebound value of every individual test point falls within a spread of ±3.0 percentage points of the average of all test point values. The report shall be marked "Noncompliant" if any individual test point does not meet this requirement.

4.4 *Vertical Deformation*—In the case of vertical deformation, two parameters are required:

4.4.1 *Performance Level*—For laboratory samples, the average performance of all test points shall achieve a level as indicated in Table 3. If no performance level is met, the result stated in the report shall be "No Performance Level Achieved."

4.4.2 *Uniformity*—Laboratory samples shall be such that the vertical deformation value of every individual test point falls within a spread of ±0.03 in. (±0.7 mm) of the average of all test point values. The report shall be marked "Noncompliant" if any individual test point does not meet this requirement.

4.5 *Surface Finish Effect*—In the case of surface effect, two parameters are required:

4.5.1 *Performance Level*—Laboratory or field testing shall achieve an average value between 80 and 110.

4.5.2 *Uniformity Level*—For laboratory or field testing, individual tests shall vary no more than ±4 points from average value.

5. Summary of Test Methods

5.1 *Force Reduction*—Test Method F2569 provides a nondestructive means for evaluating the force reduction properties of the surface in both laboratory and field settings. Force reduction is a characteristic of sports surfaces indicating the degree of force attenuation provided or caused by the surface in certain movement situations. It is principally related to the give of the surface upon impact. The higher the force reduction, the greater the absorptive effect. The referenced test method is more closely associated with impacts generated by lower extremities and is not an indication of the ability of the test surface to prevent head trauma.

TABLE 2 Ball Rebound Requirements for Laboratory Samples

Average Ball Rebound	The average rebound height of all test points taken shall be ≥90.0 % of the average rebound height on concrete.
Ball Rebound Uniformity	No individual test point result shall differ from the average value by more than ±3.0 percentage points.

TABLE 3 Vertical Deformation for Laboratory Samples

	Performance Level Classification		
	Point Elastic	Area Elastic	Combination
Average Vertical Deformation	<0.138 in. <3.5 mm	Class A: 0.071-0.197 in. (1.8-5.0 mm) (inclusive) Class B: <0.071 in. (<1.8 mm) (exclusive)	0.071-0.197 in. (1.8-5.0 mm) (inclusive) > 0.020 < 0.079 in. (>0.5 < 2.0 mm) (point elastic surface)
Vertical Deformation Uniformity	No individual test point shall differ from the average value by more than 0.03 in. (0.7 mm).		

5.2 *Ball Rebound*—Test Method F2117 provides a nondestructive means that can be used both in the laboratory and the field by which to identify the ball rebound height of various balls used for indoor sports activities. Ball rebound is an optional consideration for certain activities commonly associated with indoor sports surfaces. Ball rebound values on particular surfaces indicate whether those floors provide suitable or desired values in relation to the preferred activity in the sports hall.

5.3 *Vertical Deformation*—Test Method F2157 provides a nondestructive means that can be used both in the laboratory and the field by which to identify vertical deformation as the ability of the surface to deform under load. 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 as a result of impact forces.

5.4 *Surface Finish Effect*—Test Method E303 provides a nondestructive test for determining the surface finish effect using the British pendulum skid resistance tester. This tester is suited for laboratory and field testing.

6. Dimensions, Mass, and Permissible Variations

6.1 *Laboratory Test*—Test specimens shall be constructed per the system design and include structural elements such as seams and end joints.

6.1.1 Point-elastic floors require test specimens measuring a minimum of 3.25 by 3.25 ft (1.0 by 1.0 m). The test specimen shall be placed over a substrate typically required by the manufacturer. Non-free floating floors shall be soundly held to the substrate (for example, double-sided tape).

6.1.2 Combination-elastic floors require test specimens in which the upper elastic surface measures a minimum of 3.25 by 3.25 ft (1.0 by 1.0 m) in combination with the lower subfloor construction that measures a minimum of 11.5 by 11.5 ft (3.5 by 3.5 m). The test specimen shall be placed over a substrate typically required by the manufacturer. Non-free floating upper elastic surfaces shall be attached to the structural layer by typical means according to the manufacturer or soundly held to the structural layer by other suitable methods (for example, double-sided tape). Non-free floating lower subfloors require attachment to the substrate as per the manufacturer's design.

6.1.3 Area-elastic floors require test specimens measuring a minimum of 11.5 by 11.5 ft (3.5 by 3.5 m). The test specimen shall be placed over a substrate typically required by the manufacturer. Non-free floating lower subfloors require attachment to the substrate as per the manufacturer's design.

6.1.4 Individual testing of the surface finish effect requires test specimens of a minimum 12 by 12 in. (305 by 305 mm).

6.2 *Site Test*—No minimum size has been established.

7. Number of Tests

7.1 A minimum of six test points, each in a different location, shall be tested.

7.1.1 A single laboratory test for the property of surface finish effect is exempted from this requirement, and a minimum of one sample section shall be tested. When the system is deemed to have a discernible difference in grain from one direction to the other, each sample shall be tested in two directions to be defined as with and across the grain. Across the grain shall be determined as 90° to the direction determined to be with the grain.

7.1.2 *Location of Test Points for Laboratory Test*—Based on the inspection, select varying test points derived from the construction and location of subfloor components. The selection of test points is to include the areas of differing surface construction elements with the minimum spacing between test points of 4 ± 0.236 in. (100 ± 6 mm).

7.1.2.1 *Point-elastic Systems*—Test point locations shall be selected with regard to projected variance based on such elements as top seams or subseams or both in multi-layered material as described in a detailed drawing.

7.1.2.2 *Combination-elastic Systems*—Test point locations shall be selected with regard to projected variance based on applicable seams of point-elastic layer(s) and applicable construction of structural layer and resilient support layer as described in a detailed drawing.

7.1.2.3 *Area-elastic Systems*—Test point locations shall be selected with regard to projected variance based on design and component locations described in a detailed drawing.

7.1.3 *Location of Test Points for Site Test*—Based on the inspection, a minimum of six test points shall be randomly selected and tested, however, it is strongly recommended that a higher number of test points be included to represent more accurately the installed flooring system. Site test points shall maintain a minimum of 24 ± 0.236-in. (600 ± 6-mm) spacing between test points and should include locations in high-use areas and limited-use areas and areas of specific interest, unless otherwise designated by the owner or client.

7.1.4 Any deviations from test point selections herein shall be stated with the reasons given in the report.

8. Specimen Preparation

8.1 Testing in the laboratory shall be performed at a temperature of 73 +4/-3°F (23 ± 2°C) unless otherwise specified with test sections acclimated to the test temperature for no less than 24 h before evaluation.

8.2 Field testing shall be conducted in the environmental range associated with the facility on ambient temperature of the surface and air temperature and humidity measured 30 ± 4 in. (0.76 m ± 100 mm) above the playing surface with all temperature and humidity readings recorded in the test report. Note that temperature and humidity can affect the performance characteristics of floor components and the results of on-site testing as compared to results recorded in controlled laboratory conditions. Test reports shall be recorded as "Outside Standard Indoor Temperature" or "Humidity" or both when such conditions prevail.

9. Test Methods

9.1 *Force Reduction*—The conditioned specimen shall be tested according to Test Method F2569 using the specimen preparation, size, and test point parameters provided in this specification. The drop height shall be 2.2 in. (55.0 mm) as stated in the test method.

9.2 *Ball Rebound*—The conditioned specimen shall be tested according to Test Method F2117 using the specimen preparation, size, and test point parameters provided in this specification.

9.2.1 *Specified Basketball*—For indoor sports surfaces that are designed for or may be used for basketball, the ball used for the ball rebound testing shall be the men's official National Collegiate Athletic Association (NCAA) synthetic leather game ball.

9.2.2 When conducting tests according to this procedure with the specified basketball, the required ball inflation may be determined by using either timed duration or computed or visual rebound height.

9.2.2.1 When using timed duration, proper inflation requires that each reading results in a value between 0.938 and 0.960 s inclusive.

9.2.2.2 When using computed or visual height, proper inflation requires that each reading results in a value to the bottom of the ball between 40.5 and 42.5 in. (1.03 and 1.08 m) inclusive.

9.2.2.3 Perform a set of five repetitive drops on a rigid concrete surface recording the readings between the first and second impacts. If the results of all five individual readings in the set are within the prescribed range, the inflation pressure is correct. If any of the individual readings within the set do not fall in the specified range, adjust air pressure in the ball and repeat the set until all five readings in the set comply.

9.3 *Vertical Deformation*—The conditioned specimen shall be tested according to Test Method F2157 using the specimen preparation, size, and test point parameters provided in this specification. The distance between the drop weight and top of the spring shall be adjusted to 4.72 ± 0.01 in. (120 ± 0.25 mm) as stated in the test method.

9.4 *Surface Finish Effect*—The conditioned specimen shall be tested according to Test Method E303 using the specimen preparation, size, and test point parameters provided in this specification. The surface to be tested shall be thoroughly cleaned, rinsed, and dry before testing.

9.4.1 *Test Apparatus*—The testing apparatus shall be used as outlined in EN 13036-4, Section 4.

9.4.2 *Synthetic Rubber Slider*—The rubber slider shall conform to the guidelines outlined in EN 13036-4. The rubber

shall be clean and free of contaminants. The rubber slider shall be tested periodically per EN 13036-4 and replaced if the slider no longer meets tolerance or no later than one year after initial use.

9.4.3 *Synthetic Rubber Slider*—The initial resilience shall be determined by the Lübke rebound test in accordance with ISO 4662, and hardness of the slider rubber measured by the International Hardness Rubber Degrees (IRHD) in accordance with ISO 48 and shall comply with Table 1 (CEN rubber). It shall have a certificate of conformity including the name of the manufacturer and date of manufacture. Slider composition shall conform to Clause 5.5 of EN 13036-4 "Slider Assembly."

10. Procedures

10.1 *Force Reduction*—Evaluate according to Test Method F2569 using the sample size and test point parameters provided in this specification.

10.2 *Ball Rebound*—Evaluate according to Test Method F2117 using the sample size and test point parameters provided in this specification.

10.3 *Vertical Deformation*—Evaluate according to Test Method F2157 using the sample size and test point parameters provided in this specification.

10.4 *Surface Finish Effect*—Evaluate according to Test Method E303 using the sample size and test point parameters provided in this specification.

11. Inspection

11.1 *Laboratory Testing*—Before laboratory testing, a detailed illustration and written description of the surface to be tested shall be developed. The material description shall be provided by the client requesting the test and shall include an illustration of the test sample as built locating the various construction components such as seams, subfloor sections, resilient support locations, fastener applications, and other elements requiring consideration by the laboratory for thorough evaluation. The description shall clearly identify components and materials such as density, grade, hardness, spacing, and dimensions. Compare the illustrated detail and material description provided by the client with the physical test sample to verify that it accurately represents the physical sample being tested.

11.2 *Site Testing*—Site testing locations should include areas of suspected differing performance and constructions when such areas can be determined or suspected.

12. Keywords

12.1 ball rebound; force reduction; indoor sports floors; sports flooring; surface finish effect; vertical deformation