



Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment¹

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INTRODUCTION

The federal accessibility standards require newly constructed and altered public playgrounds by accessible to and usable by people with disabilities. Both the Architectural Barriers Act² and the 2010 ADA Standards for Accessible Design³ need for require accessible surfaces, including the accessible route within the play area to be firm and stable. At this time, there is no standard specification to measure firmness and stability, which is related to the work for a person with a mobility impairment to traverse a surface, thus highlighting the need for a systematic and consistent means of evaluating the capability of surface systems to provide access to playgrounds has been amplified by the passage of the Federal Americans with Disabilities Act. systems. The goal of this specification is to establish a uniform means to measure the characteristics of work for a person with mobility impairment to traverse surface systems in order to provide the potential buyer with performance specifications to select materials for use and maintain the surface as an accessible surface under and around through the accessible route and at accessible playground equipment.

Document Preview

1. Scope

ASTM F1951-21

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1.1 This specification establishes minimum characteristics for those factors that determine accessibility. This specification applies to all types of materials that can be used as the accessible route through the play area, under and around playground equipment.

1.2 The material used as the accessible route through the play area, under and around playground equipment that meets this specification must also comply with Specification **F1292** or Test Method **F3351**, or both, if the surface is within the fall zone.

1.3 This specification does not imply that an injury cannot be incurred if the surface system complies with this specification. Surface systems in compliance with this specification will not prevent all types of injuries from occurring when the surface is used.

1.4 The SI unit of work is the joule (J), which is defined as the work expended by a force of one newton through a displacement of one meter. The dimensionally equivalent newton-meter (N*m) shall be used only if it is followed by the term “work” so it is not confused to be a torque value. (1 N*m = 0.73756215 pound-force-feet).

¹ This specification is under the jurisdiction of ASTM Committee **F08** on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee **F08.63** on Playground Surfacing Systems.

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² Applicable to facilities owned, operated or leased by the federal government.

³ Applicable to facilities owned, operated or leased by units of state or local government and public accommodations.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard. (See standard; see [IEEE/ASTM SI 10-](#)) for further details.

1.6 The following precautionary statement pertains only to the test method portions, Sections portions ~~6 and 7~~, of this specification: *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.*

1.7 *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:⁴

[IEEE/ASTM SI 10](#) American National Standard for Use of the International System of Units (SI): The Modern Metric System
[E177](#) Practice for Use of the Terms Precision and Bias in ASTM Test Methods
[E691](#) Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
[F1292](#) Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment
[F1487](#)[F2075](#) Consumer Safety Performance Specification for Playground Equipment for Public Use
[Specification for Engineered Wood Fiber for Use as a Playground Safety Surface Under and Around Playground Equipment](#)
[F3351](#) Test Method for Playground Surface Impact Testing in Laboratory at Specified Test Height

2.2 ~~U.S. Architectural and Transportation Barriers Compliance Board Document: Department of Justice:⁵ Americans with Disabilities Act 28 CFR Part 35 Accessibility Guidelines for Buildings and Facilities Nondiscrimination on the Basis of Disability in State and Local Government Services~~
[28 CFR Part 36 Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities](#)
[2010 ADA Standards for Accessible Design](#)

2.3 ~~U.S. Consumer Product Safety Commission Document:⁶ US CPSC Publication No. 325 Handbook for Public Playground Safety (2010)(2015)~~

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:* [ASTM F1951-21](#)
<https://standards.iteh.ai/catalog/standards/sist/45c26129-66a4-4e3f-9594-e31cd4ad7ad7/astm-f1951-21>

3.1.1 *accessible, adj*—a site, building, facility, or portion thereof that complies with the 2010 ADA Standards for Accessible Design.

3.1.2 *accessible route, n*—the pathway connecting the site arrival point to the accessible features of a site including the entry to the playground, the points of entry to accessible play components and their points of egress.

3.1.2.1 Discussion—

The accessible route meets the minimum technical provisions for running slope, cross slope, ground walking surface, changes in level, openings, firmness, and stability as defined in Chapter 4 of the 2010 ADA Standards for Accessible Design.

3.1.3 *baseline ramp, n*—a ramp with a hard, smooth surface with grade of $7.1 \pm 0.2\%$ (1:14).

3.1.4 *camber, n*—the angular position in the vertical direction of the individual main wheel axis.

3.1.4.1 Discussion—

Zero camber occurs when the wheel axis is parallel to the ground surface.

3.1.5 *cross slope, n*—the slope that is perpendicular to the direction of travel.

⁴ 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.

⁵ Available from United States Access Board, 1331 F Street, NW, Suite 1000, Washington, DC 20004-1111, <http://www.access-board.gov/>; U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

⁶ Available from United States Consumer Product Safety Commission, 4330 East West Highway, Bethesda, MD, 20814, <http://www.cpsc.gov/>.

3.1.6 firm or firm surface, *v/n*—a firm surface resists deformation by either indentations or particles moving on its surface.⁷

3.1.7 firmness – with respect to a surface, *adj*—the degree to which a surface material resists deformation, especially by indentation.

3.1.8 loose fill system, *n*—a surface system consisting of ~~small independent, movable components~~ individual particles, for example, engineered wood fiber, bark mulch, wood chips, shredded foam, shredded rubber, sand, pea gravel, and so forth.

3.1.2.1 Discussion—

Examples of movable components include sand, gravel, wood chips, loose rubber, and engineered wood fiber.

3.1.9 maneuverability, *n*—the ability of a surfacing material to allow unencumbered traversing or locomotion of a person with or without prosthetic aids or wheelchair.

3.1.10 pushrim, *n*—the outer grip-able tube connected to the wheel of a wheelchair for the purpose of manually propelling a wheelchair. The terms pushrim and handrim shall be used interchangeably.

3.1.11 qualified personnel, *n*—those with current knowledge, training, skill, education and experience who have successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work through the application of professional judgement.

3.1.12 running slope, *n*—the slope that is parallel to the direction of travel.

3.1.13 stable surface, *v/n*—a stable surface resists additional deformation by an indentation that tries to twist or turn on the surface as a result of applied forces.

3.1.14 stability – with respect to a surface, *n*—the degree to which a surface material resists deformation that is twisting or turning on the surface.

3.1.15 toe, *n*—the difference in separation distance between the front of the two main wheels and the rear of the two main wheels of a wheelchair.

3.1.15.1 Discussion—

Proper toe alignment occurs when the axle is perpendicular to the direction of rolling.

3.1.16 unitary surface, *n*—a top layer of one or more material components bound together to form a continuous surface; for example, urethane and rubber composites, molded foam, molded rubber mats.

3.1.17 use zone, *n*—area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment.

3.1.17.1 Discussion—

The surface area within the use zone shall meet the minimum impact attenuation requirements of Specification F1292 from the maximum fall height.

3.1.18 wheelchair work, *n*—a measurement of work, using an instrumented handrim on a manual wheelchair, that calculates the varying torque when propelled for a specified time and distance across a specific surface and slope.

4. General Requirements

4.1 Playground surfaces represented as complying with this specification shall meet all applicable requirements regarding accessibility specified herein. Anyone representing compliance with this specification shall keep such essential records as are necessary to document any claim that the requirements within this specification have been met.

⁷ 2010 ADA Standards for Accessible Design, advisory note 302.1.

4.2 Surface systems that are within the use zone of the surrounded playground equipment shall be tested in accordance with Specification **F1292** or Test Method **F3351**, or both, and shall comply with the impact performance requirements of Specification **F1292**. Thus, surface systems shall exhibit a head injury criterion (HIC) not exceeding 1000 and a value of acceleration recorded during an impact (g-max) not exceeding 200 from a height at or greater than the fall height of the play structure.

NOTE 1—This is consistent with the guidance contained in US CPSC Publication No. 325.

4.3 ~~Accessibility specification~~ Specification certification compliance for the surface sample shall be conducted by an independent accredited testing laboratory.

5. Performance Requirement

5.1 Accessible Surface Performance Parameters—Playground surface materials and surface systems that are used as the accessible route through the playground, under and around accessible play equipment shall be required to comply with technical provisions for the accessible route and clear ground space including running slope, cross slope, openings in the surface, changes in level, pile height, firmness and stability.

~~5.2 The tests shall be conducted on a surface that is installed per the manufacturers' installation instructions. No additional compaction or other modification shall be permitted, other than what is required for test specimen preparation with Specification Accessible Surface Performance Criterion shall apply to the site or play surface sample to be tested, as specified in the 2010 ADA Standards for Accessible Design including the follow provisions. Any deviation from these criteria shall be documented in the resulting report.~~ **F1292**.

5.2.1 The ground level accessible route through the play area and the surface sample to be tested shall be maintained with a minimum 60 in. (1525 mm) clear width, a running slope not to exceed 1:16 (6.25 %) maximum and a cross slope not to exceed 1:48 (2.08 %) maximum.⁸

5.2.2 The clear ground space for the approach and use of accessible play components and the surface sample to be tested shall be maintained with a slope not to exceed 1:48 (2.08 %) maximum in all directions.⁹

5.2.3 Openings in the ground surfaces shall not allow passage of a sphere more than 0.5 in. (13 mm) maximum.¹⁰

5.2.4 Changes in level shall not exceed 0.25 in. (6.4 mm) vertical maximum or 0.5 in. (13 mm) beveled maximum with a slope not steeper than 1:2.¹¹

5.2.5 Turf, artificial turf, carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall not exceed 0.5 in. (13 mm) maximum or be otherwise documented in the report.¹²

5.2.6 The playground surface and/or the surface sample to be tested shall be stable and firm. The wheelchair work test method described here shall serve as a means to determine if the surface is firm and stable in the absence of a specific test method.

5.3 Maneuverability—When tested in accordance with the ~~wheelchair work test methods~~ method described in ~~Sections 6 and 7 of this specification, standard,~~ a surface in place shall have combined average work per foot (work per meter) values ~~value~~ for straight propulsion and for turning less than the combined average work per foot (work per meter) values ~~value~~ for straight propulsion and for turning, respectively, on a hard, smooth surface with a grade of $7.1 \pm 0.2\%$ ~~0.2 %~~ (1:14).

5.3.1 Calculation of Work Ratio—The work ratios for straight propulsion and turning shall be calculated by dividing the average work per foot (work per meter) measured using the wheelchair work measurement test procedure by the average work per foot (work per meter) on a hard, smooth surface with a grade of $7.1 \pm 0.2\%$ (1:14) and shall be less than or equal to 1.0.

⁸ 2010 ADA Standards for Accessible Design: 1008.2, 1008.2.4.1, 1008.2.5.1, 1008.4.2.

⁹ 2010 ADA Standards for Accessible Design, 305.

¹⁰ 2010 ADA Standards for Accessible Design, 302.3.

¹¹ 2010 ADA Standards for Accessible Design: 303.2, 303.3.

¹² 2010 ADA Standards for Accessible Design, 302.2.

5.3.2 The test used to determine accessibility, shall have been conducted on surfacing material samples that are the same regarding their design, materials, components, thickness, and manufacture as the installed playground surface.

5.4 Test material from the same lot number or date of manufacture from the manufacturer shall be used to determine the accessibility of the surface using the Specification F1951 wheelchair work test method and shall also be tested to Specification F1292 or Test Method F3351, or both, to the drop height specified by the manufacturer/supplier. The drop height, g, and HIC results of the test shall be recorded and compared with the results of the same product tested to Specification F1292 or Test Method F3351, or both.

5.5 The test used to determine accessibility of materials specified for use in a playground shall have been conducted no more than five years prior to the date of installation of the playground surface.

5.6 It would be permissible to use the wheelchair work test method at an installed playground at the accessible point of entry into the play surface, along the accessible route, and at the clear ground space for each accessible play component.

5.7 Ground surfaces shall be inspected and maintained regularly and frequently to ensure continued compliance with Specification F1951 and the ADA and ABA accessibility standards.¹³

6. Wheelchair Work Measurement Method—Straight Propulsion

6.1 Test Equipment and Setup:

6.1.1 *Test Wheelchair*—A 16-in. (40.64-cm) width rehabilitation wheelchair with pneumatic rear tires, front wheels with pneumatic tires, and a total weight of 31 ± 4.4 lb (14 ± 2 kg) shall be used as the test wheelchair. The rear wheels shall be identical with 24 by 1.375-in. (61 by 3.5-cm) pneumatic tires and pushrim diameters of 20 in. (50.8 cm). The front wheels with pneumatic tires shall be identical with 8 by 1-in. (20.3 by 2.54-cm) wheels with pneumatic tires. One main rear wheel shall be capable of measuring the forces applied to the pushrim that are tangential to the pushrim and parallel to the direction of travel. The wheelchair shall be adjusted such that there is minimal toe and minimal camber. Tire pressures shall be set to the maximum pressure specified by the manufacturer ± 2 psi.

6.1.2 *Test Wheelchair Rider*—A 165 +11, -4.4-lb (75 +5, -2 kg) test wheelchair rider shall propel the wheelchair during testing.

6.1.3 *Weight of Total System*—The total weight of the wheelchair-rider system, including any distance measurement or data acquisition equipment residing on the wheelchair, shall be a minimum of 187.2 lb (85 kg) and a maximum of 255 lb (116 kg).

6.1.4 *Weight Distribution*—The wheelchair rider shall be seated in the wheelchair such that $40 \pm 2\%$ of the total weight is supported by the front casters and the rear wheels support the remaining $60 \pm 2\%$ when measured in a static position with the wheelchair rider's hands placed on the rear wheel pushrims in the topmost position.

6.1.5 *Distance Measurement*—A method to measure the total distance that the wheelchair has been propelled must be present. This distance shall be $6.56 +0.66 / -0$ ft ($2.0 +0.20 / -0$ m) from its starting, measured to an accuracy of ± 0.79 in. (2 cm).

6.1.6 *Wheel Angular Displacement Measurement (Optional)*—A method to measure the angular displacement of the pushrim force measuring wheel can be used. It shall have an accuracy of at least $\pm 0.5^\circ$.

6.1.7 *Data Acquisition*—A data acquisition system shall be used to record the forces applied to the pushrim and the end of the trial at a minimum frequency of 50 Hz.

6.2 Test Specimen:

6.2.1 An installed site of playground surfacing shall be used as the test specimen. The minimum test specimen size shall be 4 ft (1.22 m) wide by 8 ft (2.44 m) in length.

¹³ 2010 ADA Standards for Accessible Design, 1008.2.6.1. The frequency by which a playground surface is tested and maintained is likely to be different for every playground and dependent on both the type of surface and the number of daily users.

~~6.2.2 The surface shall be level and free of surface dirt, ice, or contaminants.~~

~~6.2.3 Testing shall be conducted when surface temperature, as measured by a temperature probe, is between 40 and 100°F (4 and 38°C).~~

~~6.3 Test Procedure:~~

~~6.3.1 Starting from a stationary position with the wheelchair casters in the trailing position, the test wheelchair rider shall propel the wheelchair across the test surface a distance of 6.56 +0.66 / -0 ft (2.0 +0.20 / -0 m) using four uniform pushes. The distance the wheelchair actually rolls shall be recorded to an accuracy of ± 0.79 in. (± 2 cm). The wheelchair rider shall contact the pushrims only during the trial and shall maintain the same posture assumed during weight distribution measurement. The wheelchair shall be propelled in a straight path. At least three of the wheelchair wheels shall be in contact with the test surface during the trial. Each trial shall be completed in 7.0 ± 1.0 s.~~

~~6.3.2 Record the forces applied to the pushrim to an accuracy of ± 0.15 ft \times lbf (± 0.2 N \times m), at a minimum frequency of 50 Hz.~~

~~6.3.3 Consider the trial acceptable if it meets the following criteria:~~

~~6.3.3.1 Pushrim torque values below -3.69 ft \times lbf (-5.0 N \times m) (reverse torque) do not occur;~~

~~6.3.3.2 One or more wheels do not slip on the surface creating torque values above 7.38 ft \times lbf (10 N \times m) with no forward movement of the wheelchair;~~

~~6.3.3.3 The time to complete the 6.56-ft (2.0-m) distance is 7.0 ± 1.0 s;~~

~~6.3.3.4 The torque applied to the wheelchair pushrim is zero or decreasing at the end of the trial;~~

~~6.3.3.5 The four propulsion strokes cause the wheelchair to travel a total distance of 6.56 +0.66 / -0 ft (2.0 +0.20 / -0 m).~~

~~6.3.4 Repeat 6.3.1 – 6.3.3 until a total of five acceptable trials are recorded. Use a leveled surface for each trial. If testing cannot be completed successfully on the test surface, document the reasons.~~

~~6.3.5 Repeat 6.3.1 – 6.3.4 with the same test wheelchair rider on a hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14) and a cross slope of 0 ± 0.5 %.~~

~~6.4 Calculation:~~

~~6.4.1 Calculation of work per foot (work per meter):~~

~~6.4.1.1 For each trial, calculate the average torque by integrating the area under the torque-time curve and dividing by the time to complete the trial.~~

~~6.4.1.2 Calculate the total work required for each trial by multiplying the average torque value by the total wheel angular displacement. If the test wheelchair was instrumented with only one pushrim force measuring wheel, multiply this value by two.~~

~~6.4.1.3 For each trial, normalize the total work required to work per foot (work per meter) by dividing by the length of the trial.~~

~~6.4.2 Alternative method for calculating work per foot (work per meter):~~

~~6.4.2.1 For each trial, calculate the average work per foot (work per meter) by integrating the area under the torque-angular displacement curve or the torque-distance curve, and then dividing by the total angular displacement or length of the trial, respectively. If the test wheelchair was instrumented with only one pushrim force measuring wheel, multiply this value by two.~~

~~6.4.3 Discard the low and high work per foot (work per meter) values and average the remaining three trials to determine the average work per foot (work per meter) required to negotiate the test surface and the hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14).~~

~~6.5 Report—Report the following information for the straight propulsion test:~~

~~6.5.1 A reference to this specification.~~

~~6.5.2 Complete identification of the playground surface system tested, including manufacturer, type, manufacturer's lot number, if appropriate, thickness, and any other pertinent information.~~

~~6.5.3 Details of the manufacturers' installation instructions. No modification or compaction of the surface is permitted beyond what is stated in the manufacturer's installation instructions other than what is required for test specimen preparation within Specification F1292.~~

~~6.5.4 Complete identification of the test wheelchair used, including name of manufacturer, model, identification number, and weight.~~

~~6.5.5 Weight of the test wheelchair rider, total weight and front-to-rear weight distribution of the wheelchair-rider system.~~

~~6.5.6 Optional additional helpful information includes any other relevant information, including photographs of the test site and of the wheelchair.~~

~~6.5.7 Date of tests.~~

~~6.5.8 The name and address of the test institution.~~

~~6.5.9 Pushrim torque versus time graphs for each trial.~~

~~6.5.10 Work per foot (work per meter) values to the nearest 0.1 ft × lbf (0.1 N × m) and total trial times for all five trials on the test surface and on the hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14).~~

~~6.5.11 Average work per foot (work per meter) to the nearest 0.1 ft × lbf (0.1 N × m) for the test surface and for the hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14). If testing could not be successfully completed on the test surface, the report must state this, as well as the reasons why testing could not be performed according to the test procedure. If the wheelchair continued to roll and could not stop at the specified distance, the work per foot (work per meter) required to negotiate the test surface shall be considered less than on the hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14).~~

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6. Summary of Test Method

6.1 Wheelchair Work Test Method – Baseline—The wheelchair work measurement test methods shall be conducted on a hard, smooth surface with a grade of 7.1 ± 0.2 % (1:14) utilizing the straight propulsion test method and the turning propulsion test method to determine the work required to propel a test wheelchair on a reference surface and specified slope.

6.2 Wheelchair Work Test Method – Surface Sample—The wheelchair work measurement test methods for straight and turning propulsion shall then be conducted on a level sample surface. The work values obtained on the level sample surface shall be compared to the baseline work value obtained in 6.1.

7. Significance and Use

7.1 The purpose of this specification is to establish quantitative measurements for wheelchair work that are related to the firmness and stability of a surface material or surface system used as the accessible route and clear ground space at components within a playground.

7.2 The specification provides a uniform means of objectively quantifying the performance of different playground surfacing materials.

8. Equipment Operator Qualifications

8.1 Tests for the wheelchair work method shall be conducted by qualified personnel.