Designation: F 2223 – 04

An American National Standard

Standard Guide for ASTM Standards on Playground Surfacing[1]

This standard is issued under the fixed designation F 2223; 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 This guide covers standards for selecting and specifying surface systems under and around playground equipment.

1.2 This guide describes how to apply existing ASTM standards to evaluate the impact attenuation, accessibility characteristics and product characteristics when selecting surfacing systems for use under and around playground equipment.

1.3 This guide does not imply that an injury cannot be incurred when the surface system complies with standards referred to in this guide.

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

1.5 *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]

F 963 Consumer Safety Specification for Toy Safety

F 1292 Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment

F 1487 Consumer Safety Performance Specification for Playground Equipment for Public Use

F 1918 Safety Performance Specification for Soft Contained Play Equipment

F 1951 Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment

F 2075 Specification for Engineered Wood Fiber for Use as a Playground Safety Surface Under and Around Playground Equipment

2.2 *Canadian Standard:*

CSA Z614 Children's Playspaces and Equipment[3]

2.3 *Government Publications:*

CPSC (US Consumer Product Safety Commission) Handbook for Public Playground Safety, Pub. No. 325[4]

US Code of Federal Regulations Part 3, 36 CFR Part 1191 Americans with Disabilities Act Accessibility Guidelines: Play Areas: (Final Rule)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *acceleration*—the time rate of change of velocity.

3.1.2 *critical height*—the maximum height in full feet for a surfacing system that, when tested in accordance with Specification F 1292, no value shall exceed 200 *g*-max or 1000 HIC.

3.1.3 *deceleration*—the time rate of reduction of velocity.

3.1.4 *drop height*—the distance from which the instrumented headform is released to the surface.

3.1.5 *fall height*—the vertical distance between a designated play surface of the play equipment and the protective surfacing beneath it. In the case of swings, the vertical distance from the pivot point for the swinging element to the protective surface beneath it. The playground standard that has relevant jurisdiction should be consulted with relation to specific play structures.

3.1.6 *g*—acceleration due to gravity at the earth's surface at sea level (32 ft/s^2 (9.8 m/s^2)).

3.1.7 *g-max*—the multiple of *g* that represents a maximum deceleration experienced during an initial impact.

3.1.8 *headform*—the striking part of testing apparatus.

3.1.9 *head injury criteria (HIC)*—a measure of impact severity that considers the duration over which the most critical section of the deceleration pulse persists as well as the peak level of deceleration.

[1] This guide is under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.63 on Playground Surfacing Systems.

Current edition approved May 1, 2004. Published May 2004. Originally approved in 2003. Last previous edition approved in 2003 as F 2223 – 03.

[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 Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON Canada M9W1R3.

[4] Available from the Consumer Product Safety Commission, Washington, DC 20207, website: www.cpsc.gov.

3.1.10 *impact attenuation*—the ability of a surface to reduce and dissipate the energy of an impacting body.

3.1.11 *impact velocity*—the velocity of a falling body immediately prior to striking the surface.

3.1.12 *loose fill system*—a surface system consisting of small independent, moveable components such as sand, gravel, wood chips, engineered wood fiber, rubber particles, and like materials.

3.1.13 *surface system*—all materials that contribute to the impact absorption of force to minimize the likelihood of a life threatening head injury under and around a piece of playground equipment.

3.1.14 *theoretical drop height*—equates the measured velocity of the headform to a height that would generate the same velocity if the test were performed at sea level and there was no friction to retard the headform during a drop from that height.

3.1.15 *unitary system*—a surface system consisting of one or more components bound together, such as foam composites, urethane/rubber systems such as prefabricated blocks, tiles, or mats or as poured in place, and like materials.

4. Significance and Use

4.1 This guide is to be used to assist the playground owner/operator, specifier, designer, etc., in determining the properties that can be considered with regard to the protective surfacing in the playground. It is the intent to outline the requirements associated with design, installation, and maintenance of the surface. This is not a technical document and technical information must be found in the various standards.

5. Background and Rationale

5.1 Since 1986, ASTM has been involved in the ongoing development and publishing of a standard specification for the impact attenuation of the surface systems installed under and around playground equipment. This is the work of the F08.63 subcommittee on playground surfaces. This subcommittee consists of a broad spectrum of members including testing laboratory personnel, scientists, engineers, manufacturers, safety experts, and owner/operators of playgrounds.

5.2 In 1986, Subcommittee F08.63 was given the responsibility to respond to the need for a standard for the impact-attenuating surface under and around playground equipment. Specification F 1292 was first published in 1991. Since then, the specification has been revised five times in ’93, ’94, ’95, ’96, and ’99.

5.3 In 1998, the subcommittee published a provisional standard specification (PS 83) for determination of accessibility for wheelchair access of surface systems under and around playground equipment. The standard was elevated to a full standard (see Specification F 1951) in 1999.

6. Factors to Consider in the Selection and Specification of Surface Systems

6.1 *Types of Material*—Every surface system is unique in material, formulation, composition, and source of raw materials and should be tested to confirm conformance with the ASTM specifications as identified within this guide (Specifications F 1292, F 1951, and F 2075).

7. Impact Attenuation

7.1 The initial work of Subcommittee F08.63 was especially important since injuries sustained from falls to the surface were determined to be 60 % of all playground injuries.

7.2 There are two measurements considered in the guide. The first is the *g*-max and the second is the HIC or Head Injury Criteria. It should be recognized that serious injuries (for example, long bone injuries and so forth) might occur even though the playground surfacing system meets the requirements of Specification F 1292. Lower values of *g*-max and HIC signify better performance for impact absorption.

7.3 *The g-max*—The *g*-max is the measurement of the peak deceleration of an instrumented metal headform when it impacts the surface. When the object falls from the same height onto a hard surface such as concrete, the impact duration will be very short and therefore the peak deceleration (*g*-max) will be high, but an impact on a resilient surface that yields and deforms with the force, results in a longer impact and a lower peak deceleration (*g*-max).

7.4 *Head Injury Criteria (HIC)*—A measure of impact severity that considers the duration over which the most critical section of the deceleration pulse persists as well as the peak level of the deceleration.

7.5 *Critical Height*—The maximum height from which the instrumented metal headform, upon impact, yields either a *g*-max that does not exceed 200 g’s or HIC exceeding 1000, when tested in accordance with the procedure described in Specification F 1292. The United States Consumer Product Safety Commission states that “critical height—the fall height below which a life-threatening head injury would not be expected to occur.”

7.5.1 The surfacing material used under and around a particular piece of playground equipment should have a critical height value of at least the height of the highest designated play surface on the equipment.

7.5.2 The CPSC Handbook for Public Playground Safety (see 2.3), Specification F 1487 for play structures, as well as other national standards (see Section 2), provide fall heights for various pieces of playground equipment.

7.6 *Testing*:

7.6.1 *Laboratory Testing (Three Temperatures)*—Specification F 1292 recognizes that children play in climates with diverse temperature ranges. For this reason, the materials that are used under playground equipment are required to be tested in a laboratory at the temperatures of 30°F, 72°F, and 120°F (–1°C, 23°C, and 49°C) to determine the height from which the *g*-max does not exceed 200 or the HIC does not exceed 1000. The determination of this height is the critical height. When selecting an appropriate playground surface system, the owner, specifier, or purchaser, or a combination thereof, of the playground should ensure that the critical height meets or exceeds the fall height.

7.6.2 *Minimum Performance Standards*—Specification F 1292 states that the pass/fail measurements for the specification are minimums.

7.6.3 *Field Testing*—Specification F 1292 allows for the performance testing of the playground surface in the field. Both the *g*-max must not exceed 200 and the HIC must not exceed