



Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment¹

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INTRODUCTION

Surveys by the United States Consumer Product Safety Commission (CPSC)² and others have shown that falls from playground equipment onto the underlying surface are a significant cause of injuries to children. Severe head injuries are the most frequently implicated cause of death in playground equipment-related falls. Use of appropriate impact-attenuating surfacing materials in the use zone of playground equipment can reduce the risk of fall-related injury. In particular, it is believed that the risk of life-threatening head injuries is reduced when appropriate surfacing materials are installed.

This specification specifies impact attenuation performance requirements for playground surfaces and surfacing materials and provides a means of determining impact attenuation performance using a test method that simulates the impact of a child's head with the surface. The test method quantifies impact in terms of g -max and Head Injury Criterion (HIC) scores. g -max is the measure of the maximum acceleration (shock) produced by an impact. The Head Injury Criterion or HIC score is an empirical measure of impact severity based on published research describing the relationship between the magnitude and duration of impact accelerations and the risk of head trauma.

The purpose of this specification is to reduce the frequency and severity of fall-related head injuries to children by establishing a uniform and reliable means of comparing and specifying the impact attenuation of playground surfaces. Its use will give designers, manufacturers, installers, prospective purchasers, owners, and operators of playgrounds a means of objectively assessing the performance of surfacing materials under and around playground equipment and hence of evaluating the associated injury risk.

This specification determines the critical fall height for the surface material or surfacing system at each of three temperatures.

1. Scope

1.1 This specification establishes minimum performance requirements for the impact attenuation of playground surfacing materials installed within the use zone of playground equipment.

1.2 This specification is specific to surfacing used in conjunction with playground equipment, such as that described in Specifications **F1148**, **F1487**, **F1918**, CSAZ614 (Canada), and SS457 (Singapore).

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 U.S. CPSC Special Study. Injuries and Deaths Associated with Children's Playground Equipment, April 2001. U.S. Consumer Product Safety Commission, Washington, DC.

1.3 This specification establishes an impact attenuation performance criterion for playground surfacing materials; expressed as a critical fall height.

1.4 This specification establishes procedures for determining the critical fall height of playground surfacing materials under laboratory conditions. The laboratory test is mandatory for surfaces to conform to the requirements of this specification.

1.5 The laboratory test required by this specification addresses the performance of dry surfacing materials.

1.6 This specification also provides optional procedures to determine the critical fall height under wet or frozen test conditions, or both.

1.7 The critical fall height of a playground surfacing material determined under laboratory conditions does not account for important factors that have the potential to influence the

actual performance of installed surfacing materials. Factors that are known to affect surfacing material performance include but are not limited to aging, moisture, maintenance, exposure to temperature extremes (for example, freezing), exposure to ultraviolet light, contamination with other materials, compaction, loss of thickness, shrinkage, submersion in water, and so forth.

1.8 The impact attenuation specification and test methods established in this specification are specific to the risk of head injury. There is only limited evidence that conformance with the requirements of this specification reduces the risk of other kinds of serious injury (for example, long bone fractures).

NOTE 1—The relative risk of fatality and of different degrees of head injury may be estimated using the information in [Appendix X1](#), which shows the relationships between the Head Injury Criterion (HIC) scores of an impact and the probability of head injury.

1.9 This specification relates only to the impact attenuation properties of playground surfacing materials and does not address other factors that contribute to fall-related injuries. While it is believed that conformance with the requirements of this specification will reduce the risk of serious injury and death from falls, adherence to this specification will not prevent all injuries and deaths.

1.10 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.

1.11 *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.*

1.12 *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:³

- [E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)
- [F355 Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play](#)
- [F1148 Consumer Safety Performance Specification for Home Playground Equipment](#)
- [F1487 Consumer Safety Performance Specification for Playground Equipment for Public Use](#)
- [F1918 Safety Performance Specification for Soft Contained Play Equipment](#)
- [F2075 Specification for Engineered Wood Fiber for Use as a](#)

[Playground Safety Surface Under and Around Playground Equipment](#)

[F3313 Test Method for Determining Impact Attenuation of Playground Surfaces Within the Use Zone of Playground Equipment as Tested in the Field](#)

2.2 Federal Documents:⁴

[U.S. Consumer Product Safety Commission, Publication 325 Handbook for Public Playground Safety](#)

[U.S. Consumer Product Safety Commission Special Study: Injuries and Deaths Associated with Children's Playground Equipment. April 2002](#)

[U.S. Department of Justice 2010 Standard for Accessible Design](#)

2.3 ISO Document:⁵

[ISO/TR 20183 Sports and other recreational facilities and equipment – Injury and safety definitions and thresholds – Guidelines for their inclusion in standards](#)

3. Terminology

3.1 *Definitions of Terms Related to Playground Installations:*

3.1.1 *critical fall height (CFH)*—a measure of the impact attenuation performance of a playground surface or surfacing materials; defined as the highest theoretical drop height from which a surface meets the impact attenuation performance criterion specified by this specification. The critical fall height approximates the maximum fall height from which a life-threatening head injury would not be expected to occur.

3.1.2 *designated play surface*—any elevated surface for standing, walking, sitting, or climbing, or a flat surface larger than 2.0 in. (51 mm) wide by 2.0 in. (51 mm) long having less than 30° angle from horizontal.

3.1.3 *fall height*—the vertical distance between a designated play surface and the playground surface beneath it.

3.1.3.1 *Discussion*—Fall heights for specific types of play structure are defined in Specifications [F1148](#), [F1487](#), [F1918](#), [CSAZ614](#), and [SS457](#).

3.1.4 *playground equipment*—any fixed physical structure installed in a designated play area that is accessible to children for activities such as climbing, swinging, sliding, rocking, spinning, crawling, creeping, or combinations thereof.

3.1.5 *playground surface*—a manufactured or natural material used to cover the ground below playground equipment, including foundations, substrates, and any compliant surfacing materials intended to attenuate impact.

3.1.6 *play structure*—a free-standing structure with one or more components and their supporting members.

3.1.7 *public use playground equipment*—a play structure anchored to the ground or not intended to be moved, for use in play areas of schools, parks, child-care facilities, institutions,

⁴ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>. Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

³ 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.