# Protecting Children from Surface Impact Injuries

**What does Critical Height mean?**

**Is Specified Height (ASTM F3351) the answer?**


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*This document is intended to provide playground owners and designers with a thinking and risk assessment process in their interaction with surfacing and equipment suppliers and assessment management.*

## Abstract - Determination of "Specified/Drop" Height

Play is the self-directed activity of the participant presented with a graduated challenge of their own choosing. This is not restricted to the formalized play structure that is found in parks and school yards, however that setting will be the central point of this paper. The key focus will be on the considerations of from what height does the player need protection starting with the installation of an impact attenuating surface and throughout its functional life.

The risk (likelihood of an injury severity and the opportunity to avoid it) of a fall is integral part of the playground. Human beings are hardwired to climb and that exposes the climber to a fall. Prevention of an injury will be based on the user (their skill, ability to avoid a fall, and their capacity to understand the likelihood and consequence) and the physical site (height of the fall, preventative structures, and impact attenuation properties of the surface). The hazard is the impact with the surface, while the hazardous situation is the exposure to the fall. The hazardous event occurs when the person impacts the surface resulting in an injury or harm. The severity of the injury sustained will have a lot to do with the forces exerted onto the body. This is not unlike an automobile accident and that is why automotive data is used to better understand the mechanism of injuries. Like in an automobile the speed of the moving body falling in the playground from high structures is critical to the severity.

Playgrounds are known as "attractive nuisances" in that they attract children who often have a mind of their own and are learning the limits of the bodies rather than acting upon a vast encyclopedia of knowledge and experience that is available to the adult. The CPSC Handbook on Public Playground Safety has consistently stated "all playgrounds present some challenge and because children can be expected to use equipment in unintended and unanticipated ways, adult supervision is highly recommended." Children are building a volume of knowledge with life skill experiences and a significant part of learning comes with failure and by successfully overcoming the challenge and moving to the next one.

Public access play equipment presents physical, mental, and social challenges to the child and their peers, being life skill building. Many of those challenges involve climbing as high as possible. You cannot slide down if you do not first go up. When you swing, the gaining of elevation increases the experience. A balance beam is only interesting if you have the perceived challenge of a fall or you might as well walk a line painted on the floor. Overhead events are only interesting if you are elevated to test your upper body strength. And then we have climbing for the sake of climbing. For each type of play there is the opportunity to FALL.

The Designer/Owner/Operator (D/O/O) will have to understand the frequency of falls that could occur through exposure to the challenge. The D/O/O will also have to understand the severity of injury that is likely and what severity of injury they are prepared to tolerate for their play environment. This will be unique to each playground owner based on their tolerance of risk of harm and potential liability. Falls will occur as a normal result of play on the playground with frequency of injury being the measure of how often the fall results in a medically treated injury. Severity is how badly hurt the child is and what is the extent of the medical intervention. Falling is a benefit of play for all young children. Nobody ever learned to walk without falling several times.

Strangely, the fall is a learning experience, with the child understanding that they need to improve either their skill or modify their approach to the challenge or the taking of risks. How often they fall is up to their ability to overcome the challenge, the European Playground Standard (En1176) introduction states that

the occasional bumps and bruises have the benefit of being great motivators. Society and the D/O/O will decide as to what injury severity they are willing to accept based on local cultural norms. That could be a bump or bruise but is more likely a minor concussion or fracture provided there is no need for surgery or hospitalization, which increases the severity. A consequence that is life-changing, catastrophic, or even results in a fatality are generally unacceptable to everyone.

With this in mind, the following pages will describe how the many existing playground surfacing standards relate to one another and the potential for injury reduction. At the end of the discussion we will present the benefits to the D/O/O in adopting the new ASTM F3351 standard commonly referred to as the "specified height test" to provide better surfacing performance information that could result in everyone providing more impact attenuating protection for falling children resulting from risky more challenging play while better meeting their needs for risky more challenging play and still address the owner's desire for injury reduction without eliminating the more challenging play opportunities. If manufactures and designers of play equipment are ultimately held to the regulatory requirement to prevent serious injuries they might well recommend surfacing with a "specified height" well in excess of the minimum playground equipment fall height or the critical height of the surfacing systems under consideration for purchase to shift some if not all the burden of injury prevention from the owner to the surfacing supplier. This might likely call into question if the piece of playground equipment presents a higher level of challenge thereby increasing the probability for a higher risk of falling and where the "specified height" strategy would beneficial.

The current simplistic approach to playground design is to adopt a specification that requires compliance with ASTM F1292 which establishes the minimum impact attenuation requirements for playground surfacing and the maximum fall height at which the surface would not likely result in a life-threatening head injury. This is more appropriately known as the "Critical Height" of the surface when tested in the laboratory to ASTM F1292 after the surface samples have been conditioned at 3 temperatures. The ASTM F1487 standard which deals with performance standards for public playground equipment requires, and the *U.S. CPSC Handbook on Public Playground Safety* recommends, the critical height rating of the surfacing within the equipment use zones meet or exceed the fall height of the playground equipment. The reality is the injury thresholds in these standards were established in the 1970's and adopted by playground safety standards writing organizations as early as 1981 to 1993. Based on today's preponderance of litigation these standards do not reflect the views of society today. D/O/Os will have to develop a more comprehensive knowledge of the relationship of the falling child to the surfacing impact attenuation performance to truly understand the mechanism of injury probability and severity. Only then will the D/O/Os be prepared to discuss the developmental benefits the play environment they expose the children of their community to and potentially defend their position to a parent, caregiver, superior, or in a court of law.

The following chapters will discuss and examine.

- The content of various standards and regulations in playgrounds, particularly the severity of injuries with "critical height"
- Understanding injury thresholds and establishing impact attenuation surfacing performance

- What effect does fall distance and velocity have upon impact in relation to severity of injury
- The complexity of how various surfacing materials perform for injury prevention over their functional life

At the conclusion of this paper we will make some suggestions to the reader however they must understand the goal of this exercise is to help them develop a decision-making risk/benefit assessment process that provides transparency and documentation that will likely be required after some unfortunate accident occurs. This will require a team that brings various experiences and knowledge necessary to create a quality play environment. This would include.

- those looking to prevent injuries
- those who see a benefit in certain injuries during childhood
- those seeing a benefit in the value of play justifying the risk
- those looking at the big picture of injuries as rate per capita in society
- those concerned for the individual sustaining an injury
- and those concerned with the monetary, social, and reputational loss resulting from an injury.

All these perspectives will work together, or against one another, as they begin to develop the play environment plan to be installed in a community. That is why there are so many styles and types of play experiences found in the many different playground types usually defined by location, specific function, and the intended user group.