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Playground surfacing — Specifications, requirements and test method



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- Children's Health Queensland Hospital and Health Service
- Consumers' Federation of Australia
- Early Childhood Australia
- Engineers Australia
- Kidsafe
- Institute of Public Works Engineering Australasia
- National Association of Testing Authorities, Australia
- Occupational Therapy Australia
- Play Australia
- Scouts Australia
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Preface

This Interim Standard was prepared by the Standards Australia Committee CS-005, Playground Equipment, to supersede AS/NZS 4422:2016.

The objective of this document is to provide a test method to measure conformance with thresholds that, if exceeded, are more likely to lead to death associated with brain injury resulting from a fall or impact onto surfaces. The thresholds contained within this document only relate to acute brain injuries.

This Interim Standard will have a currency of two years from its date of publication. At the conclusion of that period it will be superseded by another document, confirmed as an interim Standard in its present form for a further two year period or withdrawn.

The term “informative” is used in Standard to define the application of the appendices to which they apply. An “informative” appendix is only for information and guidance.

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Introduction

Designers, operators, installers, and maintainers of playgrounds need to take reasonable care to identify and address foreseeable hazards in the play facilities for which they are responsible. The most common cause of serious playground injury is a fall from a height onto the playground surface. Therefore, appropriately impact-attenuated playground surfaces are a key safety strategy and injury prevention intervention.

This document sets out the methods for testing the impact-attenuation performance of playground surfaces. Such testing is required in the development of prototype surfacing products, at the commissioning of newly installed surfaces, and during the periodic field-testing of the impact attenuating surface to confirm continuing minimum acceptable performance.

The performance requirements contained within this document are minimum threshold values that designers, suppliers, installers and operators are strongly encouraged to exceed. The better the impact-attenuating properties of a surface, the lower the frequency and severity of injuries, particularly brain injuries. Long-bone fractures involving the growth plate can also lead to permanent disability, but unfortunately impact attenuation of playground surfaces is not a particularly effective countermeasure for these. Playground surfaces that pass the minimum threshold values that also have an inherent bounce property are known to increase the likelihood of long-bone fractures. Playground surfaces that bring the child to rest over a short period of time or over a short distance (penetration) are also associated with a higher likelihood of injury associated with falls.

The test described in this document uses an instrumented hemispherical missile. The performance of an impact-attenuating surfacing system is specified in terms of its critical fall height (h_c), that is, the maximum fall height at which the impact test scores do not exceed any of three limits established by this document. Currently, these limits are peak acceleration during impact (g_{max}) less than 200 g ; a head injury criterion (HIC) value less than 1 000; and a HIC duration greater than 3 ms.

The committee considered the use of other injury predicting indicators, including the maximum jerk (j_{max}), bounce, penetration, and energy. The members concluded that specifying any of these would create an additional reporting requirement that would pose an unnecessary financial burden on the playground industry. The committee considered increasing the HIC duration from 3 ms to 5 ms. The committee agreed to retain the 3 ms HIC duration pass/fail performance criteria and monitor and review if other jurisdictions or evidence supported increasing the HIC duration.

The HIC value of 1 000 is merely one data point on a risk severity curve, where a HIC of 1 000 is equivalent to a 3 % probability of a critical brain injury (equivalent to an Abbreviated Injury Score (AIS) of 5), an 18 % probability of severe brain injury (AIS 4), a 55 % probability of serious brain injury (AIS 3), a 89 % probability of moderate brain injury (AIS 2), and a 99.5 % chance of minor brain injury (AIS 1), to an average male adult. In setting the impact limits the CS-005 committee did not take into consideration recent research into the long-term effects of traumatic brain injury (TBI) associated with non-concussive impacts. It is the committee's intention to consider research in this area in any future revision of this document.

The committee is aware that impact-attenuating playground surfaces may, depending on the type of product, introduce inadvertent risks to children. For example, some products can become too hot for barefoot play in un-shaded areas on days of extreme high temperature. Other products, particularly those that are recycled, may contain hazardous sharps. In selecting an appropriately impact-attenuating surface for a particular site, playground designers, installers and operators are cautioned against selecting excessively dusty, sharp, ingestible, contaminated, or otherwise hazardous materials.

Children discover and learn about the world in which they live through play, which is essential for children's healthy growth and development. A child's perception of successful negotiation of risky situations is important for confidence building and competent risk assessment which leads to children learning how to manage their own safety. The minimum threshold impact-attenuation performance values of playground surfaces do not detract from this perception. Playground surfacing should prevent permanent injury and death while contributing positively to a child's ability to learn autonomous risk assessment skills.

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Playground surfacing — Specifications, requirements and test method

1 Scope

1.1 Scope

This document specifies test methods by which the performance of impact-attenuating surfaces can be determined. This includes determination in the laboratory and on-site, such as in playgrounds, sports surfaces and other sites.

The objective of this document is to provide a test method to measure conformance with thresholds that if exceeded are more likely to lead to death associated with brain injury resulting from a fall or impact onto surfaces. The thresholds contained within this document only relate to traumatic brain injuries.

1.2 Application

This document is intended to be used in conjunction with the AS 4685 series.

This document is also intended to be used as an impact-attenuating surface test method where no specific Standard exists.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents for informative purposes are listed in the Bibliography.

AS 4685 (series), *Playground equipment and surfacing*

AS 1141.3.1, *Methods for sampling and testing aggregates, Method 3.1: Sampling — Aggregates*

AS ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

1.4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE ISO and IEC maintain terminological databases for use in standardization at the following addresses:

IEC Electropedia: available at <https://www.electropedia.org/>

ISO Online browsing platform: available at <https://www.iso.org/obp>

1.4.1

competent person

person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to correctly perform a specified task

1.4.2

critical fall height

h_c

calculated drop height producing a HIC value corresponding to the limits defined by the conformity/non-conformity criteria applicable to the surface concerned

Note 1 to entry: In the absence of defined limits for playground surfaces, it should be assumed that the critical drop height corresponds to a HIC of 1 000, $200 g_{max}$, $(t_2 - t_1) \geq 3$ ms.

1.4.3**drop height**

distance between the test position on the surfacing and the lowest point of the free falling missile prior to release

1.4.4**drop test**

minimum series of four impact measurements carried out from increasing fall heights, such that at least two measurements exceed an acceptable critical fall height (h_c)

Note 1 to entry: See [Clause 2.4.7](#)

1.4.5**free height of fall** **h_f**

greatest vertical distance from the clearly intended body support to the impact area below

1.4.6 **$g_{\max}$**

multiple of the acceleration (g) into gravity at the earth's surface at sea level that represents maximum acceleration experienced during impact

1.4.7**head injury criteria****HIC**

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 that deceleration

1.4.8**HIC duration**

time interval over which the HIC is calculated, i.e. ($t_1 - t_2$)

Note 1 to entry: The $t_1 - t_2$ are two intermediate values of t between t_{start} and t_{end} attaining the maximum HIC value.

1.4.9**impact-attenuating surfacing****IAS**

surface, whereby the kinetic energy of an impact is dissipated by localized elastic hysteresis, deformation or displacement such that the maximum acceleration and HIC is reduced and the HIC duration is increased

1.4.10**impact attenuation**

property whereby the kinetic energy of an impact is dissipated by localized elastic hysteresis, deformation or displacement

1.4.11**impact measurement**

HIC value from the recorded acceleration of the missile falling from one fall height onto one test position

1.4.12**loose-fill surface**

surfacing material supplied for the purpose of impact attenuation in playgrounds, consisting of unbound, granular, chipped or fibrous elements such as sand, wood-fibre, bark mulch, wood chips or other materials. These may be organic or inorganic