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ASTM F1292 Revised in 2004

In January of 2004, ASTM published the revision of the Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment (ASTM F1292-04) and some of these changes are reflected and highlighted in the ASTM F2223-04, published in May 2004. The ASTM F1292 revision has technical changes to the instrumentation and test procedures to provide the stakeholders with a greater degree of information about the surfaces for which they are responsible.

This article highlights some of the technical changes and their implication to the designer/specifier, manufacturer/installer, owner/operators, parent/care givers and regulators. Since the ASTM F1292 is utilized and required as a performance measure in other Standards in the United States, Canada and other countries, some of the implications in relation to these standards will be discussed.

There is a companion article to this outlining the content and changes to the ASTM F2223 "Standard Guide for ASTM Standards on Playground Surfacing". This is a non-technical document that discusses how and under what circumstances various Standards are used.

The ASTM F1292 can be typified to have four sections;

1. the issues regarding the measure and prevention of life-threatening and debilitating head injuries and the reduction in the severity of all impact injuries,
2. the requirements of all manufactures and suppliers of surfacing materials to submit their products for testing in a laboratory at 3 temperatures that reflect the temperature extremes that are anticipated during typical use,
3. the requirements for testing playground surfaces in the field once they have been installed and throughout their entire life in the playground,
4. and the technical requirements for the instrumentation utilized in the laboratory or the field to perform the procedures in this Standard.

Risk of Injury Determination

The ASTM F1292 recognises 2 measures and provides pass/fail values that measure the impact attenuation of a playground surface. The g-max measures the maximum acceleration of the falling object at impact, while the HIC (Head Injury Criteria) measures a specific integral of the acceleration-time history of an impact, used to determine relative risk of head injury. It has become commonly accepted and empirically proven that either a g-max greater than 200 or HIC greater than 1000 can result in a life-threatening head injury. These values are traditional and historic and were generated originally by testing on human cadavers and for this reason we know these values are the point at which a death can be expected. The g-max has been in this Standard since it's first publication in 1991, with HIC being added in 1993 as the pass/fail measures and values.

The 2004 revision of this Standard provides additional information with regard to the risk of head injuries other than death at a range of HIC values. Injury types are ranked as minor (skull trauma without loss of consciousness; fracture of nose or teeth; superficial face injuries), moderate (skull trauma with or without dislocated skull fracture and brief loss of consciousness. Fracture of facial bones without dislocation; deep wound(s)), and critical (cerebral contusion, loss of consciousness for more than 12 hours with intracranial haemorrhaging and other neurological signs; recovery uncertain). This risk of injury chart is used by all stakeholders to assess the potential of injury that would be related to various levels of performance of surfaces. It is generally the responsibility of the owner/operator or their designer/specifier to evaluate and apply lower impact attenuation values as they deem best suits their user group.

An example of the use of this information in evaluating risk of head injury would be;

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- a HIC value of 500 has a 80% risk of a minor injury, a 40% risk of a moderate injury, 0% risk of critical or fatal injury.
- a HIC value of 800 has a >95% risk of a minor injury, 75% risk of a moderate injury, 2% risk of a critical injury and 0% risk of fatality.
- a HIC value of 1000 has a 99% risk of a minor injury, a 90% chance of a moderate injury, a 4% chance of a critical injury and the beginnings of risk of a fatality.
- a HIC value of 1500 has a 100% risk of a minor and moderate injury, an 18% risk of a critical injury and 3% risk of a fatality.

This information is used in conjunction with determination of drop height by the owner/operator in the writing of specifications for the surface to be purchased and/or maintained. It is important to realize that all surfaces need maintenance in relation to impact performance and this function must be rigorously pursued.

3 Temperature Suitability Testing

There has always been a requirement of all manufacturers and providers of play surfacing system to submit reproducible samples to a laboratory to have them tested for compliance to this Standard and determine the critical height (failure point). This test does provide information to the user that the supplier is capable of engineering as many as nine samples that will have this critical height. It is the responsibility of the manufacturer/supplier and the prudent owner/operator to ensure that the same raw materials, manufacturing techniques and installation procedures that have produced 20 ¼ square feet of sample can be translated to the entire playground.

The most significant change to the testing at the 3 temperatures is that the lower limit(30^0F) in the 1999 version has been further lowered to 25^0F to ensure that the surface is actually below the freezing temperature of water during this portion of the test. The sample size has also been increased to provide more accurate and repeatable results that would actually reflect conditions in the playground. An additional change is that all loose fill materials must be subject to compaction prior to the impact test being performed. This ensures that the test more accurately reflects the traffic and compression that is expected in the playground.

The 3 temperature test progressively increases the drop height on each sample tested until either the g-max exceeds 200 or the HIC exceeds 1000. The lowest full foot measurement below the failure is the critical height. No surface shall be installed with a critical height below that set by the owner/operator prior to purchase with the minimum drop height being the fall heights stipulated in national playground standards such as ASTM F1487 or CSA Z164.

There is the addition of an optional laboratory test in the ASTM F129-04 to determine the properties of a surface in a wet and frozen condition. This procedure and test apparatus are provided in the appendix of the document and provide the owner/operator and their consultant with performance information they may expect in their local playground.

Testing of Installed Surfacing Systems

The field test procedure has been significantly modified to make testing and the results more reflective of the actual performance of the surface in the playground. This is still a test that is directed at the discovery of areas that would fail to meet the requirements of this Standard or the contract specifications for the surface. There is still the requirement to perform a minimum of 3 drop tests in 3 locations per playspace, however the size of the playspace has been defined. In addition the compression of loose fill materials prior testing has been added.

The Standard makes it clear that the person performing the test shall determine the drop height for the test based on the highest of; the height specified or agreed to by the owner/operator prior to purchase, the critical fall height specified when the playground was installed, the equipment fall height, or the critical height of the surface at the time of installation. This clearly allows the owner/operator through their risk management and specifications to provide for the surfacing with better g-max and HIC performance than the minimums set in other Standards. A typical use of this clause would be to raise the drop height from the minimum of deck heights as in many standards to the tops of barriers and guardrails to reflect the height from where children actually fall and from where they will need protection.

Inspectors are specifically directed to divide the playspace into structures and use. This would mean that where some inspectors might have considered that for a surface encompassing multiple structures for various age groups that only 3 set of drops would be required, they are now required to test per structure or functionally linked structures. This will provide better risk management and protection. In addition the inspection is directed to test surfaces that will exhibit variation and particular

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attention is given to surfaces of varying colour.

Although all manufacturers of play surfacing systems have always been required to submit their samples for the 3 temperature testing, this has only recently become true for the suppliers of loose fill materials such as sand, pea gravel, etc. Since these materials will be compressed, disturbed and removed during active play and require topping up, there is a requirement in the reports for ASTM F1292 that the source of the materials be determined and reported to allow replacement with the same materials in the future, thereby reducing the potential for contamination and reduced performance of the surface in relation to impact absorption. This reporting is of particular importance to these materials, but is a requirement for all materials including unitary surfaces.

The Standard still requires that as a minimum, where the results of the testing of any installed surface from the drop height stipulated if the g-max values are above 200 or HIC values are above 1000 that the play structure serviced by the surface be taken out of service until the surface complies. The removal from service will be the responsibility of the owner/operator as they are the most proximate to the playground, however bringing the surface into compliance may be an issue that is the responsibility of the owner/operator or manufacturer/installer depending upon warranty stipulations at the time of installation.

Technical Requirements

For those that are so inclined, the technical aspects of the standard are more properly read in their entirety and only highlights are presented here. The most significant change is that the headform and electronics of ASTM F355 procedure C have been removed and the headform and technical requirements for the test apparatus is totally described in this Standard. An additional change between the 1999 revision and the 2004 revision is that there has been a change in the accelerometer and the angle of impact must not exceed 10^0 from horizontal. These changes have been required, since there is a possibility that they could influence the repeatability and reproducibility of the test to the tolerances that are being sought by the Standard's sub-committee. This should be proven during the coming year as work on a new precision and bias statement is developed. Since the precision and bias statement for this Standard has not changed from the 1999 revision, instruments used for the freefall test method complying to the 1999 revision are fully expected to fall within the current precision and bias of the Standard.

Application and Use of ASTM F1292

The use of the ASTM F1292 is set by other standards (ASTM F1487, CSA Z164, etc.) as well as contracts and legislation. ASTM F1487 requires that all surfaces in the protective surfacing zone must both be installed and maintained to the requirements of the ASTM F1292. As a result for all jurisdictions that have adopted ASTM F1487, the requirements of the ASTM F1292-04 are automatically adopted and testing should comply with this Standard. For other jurisdictions, such as Canada, the CSA Z614 references the ASTM F1292-99 in its reference documents and therefore the requirement to change to the ASTM F1292-04 is at the option of the person requesting or performing the test. Since the CSA Z164 is not expected to be revised prior to 2007, this will remain the case in all likelihood until the precision and bias of the ASTM F1292 has been revised. As with all technology, upgrading to the new technology and procedures allow the inspector to stay current.

Rewards Anticipated for Good Surfacing

For those who have followed the history of ASTM F1292 you will know that the cost of testing has continually come down and the ability to test installed surfaces has become a reality. This has had the effect of more surfaces being tested and owner/operators installing and maintaining to a better performance than the standards require.

These improvements and annual testing for some sites can have the effect of raising the cost of testing in relation to those that do not. The result has been a call for a lower cost pre-test of playground surfacing to be provided for within the testing standards.

The intent is to proceed with the testing method as in ASTM F1292-04 including the preconditioning of surfaces as required. In the long run it is desired that the pre-test be performed with a handheld drop of the test device. The person performing the drop will determine the g-max and HIC. If these results are below a threshold that is yet to be established, the surface will be deemed to be providing adequate impact absorption as the performance of the formal test would not be expected to result in a failure.

At this time there is the need to develop data that can be used in relation to all materials or specific materials to establish the threshold for g-max and HIC. Should anyone currently performing field testing be interested in assisting the ASTM F08.63 sub-committee in this work, please get in touch with Rolf Huber at rolf@everplay.com

Once the data is reviewed it is anticipated that a revision could be made to ASTM F1292 to include this.

The result will be that those owner/operators working hard to reduce injuries through the installation of better surfaces will have their testing costs significantly lowered from where they are today.

Proficiency Testing

HOW GOOD ARE YOU?

When there is a highly technical standard and many single practitioners performing testing to that standard, there is always the question as to how well the tests are being performed and are the same results being provided. The offer from ASTM to provide proficiency testing to the ASTM F1292, will assure inspectors, laboratory technicians, manufacturers and owners that a high degree of professionalism exists in playground surface testing.

In 2004 ASTM will be looking for a minimum of 20 laboratories and practitioners performing testing to ASTM F1292 to receive a number of samples to be tested within a protocol. These test facilities will be dispersed around the world and range from practitioners operating solely in the playground arena to large labs that have diverse operations. Everyone will be measured against themselves and each other. The common denominator will be that everyone will have instrumentation that meets ASTM F1292, the test protocols. Drop heights will be stipulated and the samples will shipped from one laboratory to another.

The results will provide benefits to those participating and the sub-committee responsible for the Standard. For the testing laboratory they will receive a coded copy of all the results of all of the tests and information on their own performance. The lab is then able to see how they performed and how they relate to their peers. Practitioners who performed well will have the opportunity to use this to assure their clients of their professional ability.

The F08.63 sub-committee on playground surfacing will use the results to determine the clarity of the Standard and any changes that would benefit in the repeatability and reproducibility of the results. This data may also be used in developing a new precision and bias statement for the F1292.

Anyone interested in participating in this program can contact Rolf Huber at Canadian Playground Advisory Inc. You will be contacted by ASTM once 20 participants have signed up. For additional details on ASTM proficiency testing, go to www.astm.org and follow the links for proficiency testing.

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