Document CEN/TC **136/SC 1/N 746**

Ref: CEN/TC 136/SC 1

Date: 2009-06-16

To the Members of CEN/TC 136/SC 1
– Children's playground equipment

Dear Member

CEN TC 136/SC 1 - Information paper on the present state of Impact Attenuating Surfacing (IAS) on playgrounds (EN1176-1 and EN1177) – Rev. of doc N722 - May 2009

Attached revised version of document N722, Information paper on the present state of impact attenuating surfacing on playgrounds.

Yours sincerely

Mr Bernd Borchert
International Secretariat
Secretary to CEN/TC 136/SC 1
Playground equipment for children

BSI, 389 Chiswick High Road, London W4 4AL
T: +44 (0)20 8996 7115
F: +44 (0)20 8996 7799
E: bernd.borchert@bsigroup.com
W: http://www.bsigroup.com/

CEN TC136 SC1* information paper on the present state of Impact Attenuating Surfacing (IAS) on playgrounds (EN1176-1 and EN1177)

May 2009

*CEN TC136 SC1 *is the subcommittee of the technical committee of CEN (Comité Européen de Normalisation / European Committee for Standardization) that deals with standardization of playground equipment and surfacing for playgrounds*

Contents: current knowledge on IAS, the significance of the HIC test, advantages and disadvantages of different types of materials, further research / data required to consider further needs for the prevention of arm fractures.

Target and objectives of this document

- It is aimed at consumer and public health organizations, researchers, playground operators, national members of SC1 and other relevant professionals that are not directly involved in the standardisation work

- It informs about the current state and rationale for the work of CEN TC136 SC1 on Impact Attenuation Surfacing (IAS)

- It sets guidelines for future work / research needed in order to consider the need for further improvements to the playground standards

I - Introduction

The European Standards Committee SC1 of CEN TC136 has recognized a variety of recently published statistics and research, dealing with falls injuries occurring during children's play activities. As children play everywhere (at home, at school, at court yards and where ever possible, playing soccer, cycling, skating etc.), SC1 needs to consider a balance between the risks on playground equipment and the similar risks in the daily life of children.

The main task of the standards EN 1176 (Playground Equipment and surfacing) and EN 1177 (test method for Surfacing) is to offer attractive equipment for children on playgrounds which comply with approved safety requirements to minimize any unwanted risks and to deter them as much as possible from other, more risky activities in uncontrolled areas, considering the characteristics of children's play in different age groups.

"Respecting the characteristics of children's play and the way children benefit from playing on the playground with regard to development, children need to learn to cope with risk and this may lead to bumps and bruises and even occasionally a broken limb. The aim of this standard is first and foremost to prevent accidents with a disabling or fatal consequence, and secondly to lessen serious consequences caused by the occasional mishap that inevitably will occur in children's pursuit of expanding their level of competence, be it socially, intellectually or physically." (*in* EN1176-1:2008 – Introduction)

To reduce the likelihood of serious injuries from falling, EN 1176 specifies criteria for the maximum free height of fall (FHF) of different kinds of equipment and for the extent and properties of an impact attenuation surface (IAS) below and around playground equipment.

For the impact attenuating properties of the surface, a test is specified in EN 1177, using an internationally approved method for the reduction of serious head injuries (HIC - Head Injury Criterion), to choose the adequate shock attenuating material for the relevant FHF of the equipment.

II - About IAS and injuries from falls

"Injuries caused by falls from playground equipment occur for a variety of reasons but the most severe injuries are likely to be injuries to the head. The committee responsible for this European Standard (EN1177) recognizes that there are many factors that influence injury mechanisms independent of the surfacing, e.g. body orientation, awkwardness of fall, bone density, etc." (*in* EN1177:2008 – Introduction)

In EN1177, "…priority has been given to developing a criterion for surfacing materials intended to assess their ability to reduce the likelihood of head injuries.
(…) Surfaces fulfilling the test requirements of this standard are considered to be in compliance with the requirements for impact attenuation in EN 1176-1:2008. (*in* EN1177:2008 – Introduction)

Evolving from old surfaces (including even concrete) to impact attenuating surfaces (IAS) and other features of these standards in modern playgrounds has shown a significant reduction in head injuries in recently published reports. In these reports, currently, the biggest concerns are upper limb fractures caused by falls, both from activities at ground level and from elevated surfaces (including playground equipment). There are also proposals to reduce the risk of these fractures, but they do not give exact answers on the fall position and the type of surfacing material involved, neither on their compliance with the standard.

One of the conclusions in some of these studies is the proposal to reduce generally the equipment height to a FHF of 1,5m; other proposals recommend improving the impact attenuation, but without giving conclusive data.

The European Standards Committee SC1 is of the opinion, that lowering the maximum FHF down to 1,5m is not an acceptable solution for all children; it would take away the purpose and benefits of much attractive playground equipment and could even generate new risks when children seek the same kind of activities on inappropriate structures for their developmental needs, as experience has shown. It was therefore decided that work on the performance of IAS should be investigated to check if any further improvements are necessary.

III - Surfacing materials

"There are a variety of materials available providing impact attenuation, including rubber tiles, mats, slabs, continuous synthetic surfacing, either prefabricated or formed 'in-situ', loose particulate material, such as gravel, sand, wood chips, bark, etc. The method in this European Standard (EN1177) can be used to assess any of these surfaces." (*in* EN1177 – Introduction)

Each of these surfacing materials has advantages and disadvantages, concerning the impact attenuating properties and their persistency over time, but also for hygiene, maintenance, accessibility, durability, initial costs, weather conditions and more. For each situation, a risk benefit assessment helps choosing the most adequate material for the given circumstances.

Also for different climates, small variations in the type of surface for different FHF are accepted; e.g., EN1176 accepts grass, when well maintained, as a suitable IAS for a FHF up to 1 m. In addition, some countries accept grass for a FHF up to 1,5 m if certain conditions are met.

Recent research indicates that, when a fall occurs, a longer impact duration associated with a low rebound might reduce the risk of long-bone fractures. In general, the likelihood and severity of such injury is lower with suitable loose fill materials that are adequately installed and maintained with a sufficient depth for a given FHF. This is because such loose fill materials allow dissipation of the energy associated with the impact by dislocation of the material, and so the majority of the energy flows away from the child, exhibiting a longer contact time of the body with the surface due to deeper and more pliable deformation. In contrast, with an elastic surface (like unitary surfaces) part of the energy is temporarily stored as elastic energy in the material and then returns to the body of the child, as a rebound, after a shorter contact time, less penetration and less energy absorbed in the material.

It is however appreciated that loose fill materials are more difficult to maintain at the necessary depth and impact attenuating properties in many play spaces and this can greatly affect their performance.

IV - Research needs

If required by definite confirmation of such research indications, the current test method in EN1177 (HIC: Head Injury Criterion) allows in principle, the implementation of such additional criteria presumably relevant for arm fractures, as it is information on impact duration, penetration and rebound. But further research is still necessary with existing test equipment in order to evaluate and include such additional measurements into the equipment as well as to set acceptable limit values for the measured energy and/ or the forces acting on long bones.

The literature review has shown that previous research has failed to adequately and consistently link the reported injury data with the actual properties of the IAS material. In order to be able to consider additional aspects to the standard for improved protection of limbs, better accident reporting and more precise and consistent data are needed. This additional data is required in order to compare results given in these reports with the HIC method presently used and allow the determination of reactionary forces and energy flow between surface and parts of the body for different surfacing materials and a variety of fall conditions.

As a first step, the researchers responsible for the existing reports about arm fractures will be invited by SC1 to provide the missing data from their tests for further evaluation. If that is not possible, a new research project will have to be taken into consideration and may need to be funded.

As a second step, when such reliable data are confirmed, further decisions about measures to limit the risk of long bone fractures – in addition to the well-tried HIC – will be possible.

As stated in EN1177, SC1, "The committee responsible for this European Standard intends to consider recent research in this area in a future revision of this standard." It will also always strive to strike a balance between offering attractive, fun, exciting, cost effective places for children to play with the necessary level of safety, taking into consideration the general risk of fractures in daily life of children.

SC1 will welcome requests for cooperation in order to get better and useful data.

V - References

Note: In each publication further references are given

1. Playground injuries to children
C Norton, J Nixon and J R Sibert
10.1136/adc.2002.013045; *Arch. Dis. Child.* 2004; 89; 103-108 adc.bmjjournals.com

2. Head injury and limb fracture in modern playgrounds
C Norton, K Rolfe, S Morris, R Evans, R James, M D Jones, C Cory, F Dunstan and J R Sibert
Arch. Dis. Child. 2004;89;152-153. doi:10.1136/adc.2002.024364 adc.bmjjournals.com

3. Preventing injuries on horizontal ladders and track rides
James W. Nixon[1,5], Caroline H.C. Acton[1], Belinda A. Wallis[1], Diana Battistutta[2], Clare Perry[3] and David B.M. Eager[4]
[1]Department of Paediatrics and Child Health, University of Queensland, Australia, [2]School of Public Health, Queensland University of Technology, Australia, [3]Ipswich Hospital, Ipswich, UK, [4]Mechatronics and Intelligent Systems, Faculty of Engineering, University of Technology, Sydney, Australia, [5]Visiting Fellow National Injury Prevention Center, Centers for Disease Control and Prevention Atlanta, USA
Injury Control and Safety Promotion 2004, Vol. 11, No. 4, pp. 219–224

4. Out on a limb: risk factors for arm fracture in playground equipment falls

S Sherker, J Ozanne-Smith, G Rechnitzer and R Grzebieta
NSW Injury Risk Management Research Centre, University of New South Wales, Sydney, NSW 2052, Australia;
Injury Prevention 2005;11:120-124. doi: 10.1136/ip.2004.007310 - ip.bmj.com

5. Biomechanical analysis of arm fracture in obese boys

PL Davidson[1], A Goulding[2] and DJ Chalmers[1]
[1]Injury Prevention Research Unit, Department of Preventive and Social Medicine and [2]Departments of Medical and Surgical Sciences, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand
J. Paediatr. Child Health (2003) **39**, 657–664

6. Stochastic-rheological Simulation of Free-fall Arm Impact in Children: Application to Playground Injuries

Peter L. Davidson[a,*], David J. Chalmers[a,†] and Barry D. Wilson[b,‡]
[a]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, P.O. Box 913, Dunedin, New Zealand; [b]School of Physical Education, University of Otago, P.O. Box 56, Dunedin, New Zealand
Computer Methods in Biomechanics and Biomedical Engineering Vol. 7, No. 2, April 2004, pp. 63–71