

# AUSTRALIAN TRAMPOLINE STANDARD – IMPACT ATTENUATING PADDING SYSTEMS

Eager DB<sup>1</sup>, Nixon JW<sup>2</sup>, Chapman C<sup>1</sup>

<sup>1</sup>Faculty of Engineering, University of Technology Sydney, Australia

<sup>2</sup>Department of Paediatrics and Child Health, University of Queensland, Australia

## INTRODUCTION

This paper presents results from the design and development of several different impact-attenuating padding systems for domestic trampolines.

## METHOD

The Faculty of Engineering, University of Technology Sydney conducted collaborative research and product design with the three Australian trampoline manufacturers to independently develop several padding systems that complied with the Australian Trampoline Standard AS 4989:2006 [1].

## BACKGROUND

Trampolines are primarily used by consumers in the home environment. They provide an energetic form of childhood exercise thus offering a viable solution to reducing the level of obesity rising within the community. They also offer a form of exercise that is considered by most users to be a lot of fun. Unfortunately the accident data confirm that trampolines are the leading cause of accidents from consumer products used by children in the 0-14 age group [2].

## DISCUSSION

The Trampoline Standards Committee identified a number of hazards associated with trampolines and their usage. It was noted that impacts onto the trampoline frame and entrapment within the suspension system were major sources of injuries. The results presented in this paper will focus on the performance requirements of the impact-attenuating properties of the trampoline frame-padding system.

## RESULTS

AS 4989:2006 specifies the minimum impact-attenuation properties of the frame-padding system will have a  $g_{\max}$  of less than 200 g's when tested using a headform dropped from a distance of 1500 mm. It also specifies that this test is only valid for impact events with a total time duration of more than 6 ms ( $t_{\text{end}} - t_{\text{start}} > 6 \text{ ms}$ ) where  $t_{\text{start}}$  = time at the start of an impact event when the acceleration of the headform equals or exceeds 10 g's; and  $t_{\text{end}}$  = time at the end of an impact event when the acceleration of the headform first equals or falls below 10 g's [1].



**Figure 1:** Chinese trampoline – Failed AS 4989 impact test above a support leg

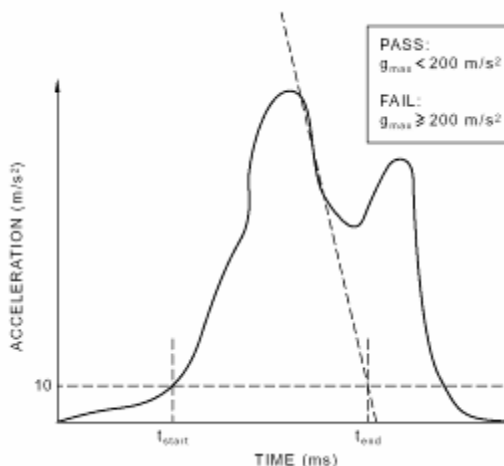
Preliminary impact testing conclusively confirmed that the performance of the impact-attenuating frame-padding system was highly dependent on the trampoline frame. Variables such as frame stiffness and rigidity, the number of springs, spring attachment method etc for the same padding system affected the measured impact results by more than a factor of two. This meant that the

Standard would need to specify the trampoline being tested as a system ie the frame and associated padding needed to be tested together. The padding system could not be tested on a concrete substance as first thought.

Figures 1 and 2 below depict the results of a single impact above a support leg. The Standard call for four consecutive impacts in the same location. Both examples show how the foam was severed all the way through after only one impact.



**Figure 2:** Korean trampoline – Failed AS 4989 impact test above a support leg

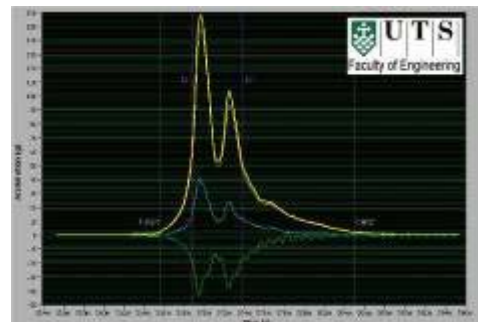


**Figure 3:** Multipeaked acceleration pulse

Preliminary impact testing also confirmed that the results were sensitive to the location of the test. It is for this reason that AS 4989:2006 specifies that the impact test will be conducted in a

number of locations including above a leg-support, above double-buffed connections and above any protrusions such as bolted connections.

The impact testing also confirmed that the magnitude of the impact dropped sharply as the impact position moved away from the centre-line of the frame-tubing ie the overt of the pipe.



**Figure 4:** Multipeaked acceleration pulse

## CONCLUSIONS

The objective of this project was to design and develop an impact-attenuating padding system that conformed to the requirements contained within AS 4989:2006. All three Australian manufacturers were represented on the Standards Committee and were keen to develop a product that reduced the incidence and severity of injuries. Each of the Australian manufacturers has developed prototype trampolines that comply with AS 4989:2006.

## REFERENCES

- [1] *AS 4989:2006 Trampolines – Safety Aspects*, Standards Australia, 2006.
- [2] *Consumer product-related injury (1): Playground equipment and trampolines, Hazard*, No.61, Victorian Injury Surveillance Unit, Spring 2005.

## SPEAKER

A/Prof David Eager, University of Technology, Sydney, PO Box 123 Broadway NSW 2007, Australia.  
 Fax: +612 9514-2665  
 David.Eager@uts.edu.au