

Requirements for tests of child finger entrapment in European safety standards

Executive summary

IOE/PSTG/01/11/R

Version 1.2

Commissioned by:

**ANEC, the European consumer voice in standardisation, AISBL,
Avenue de Tervueren 32, box 27, B-1040 Brussels, Belgium.**

Prepared by:

Dr Sarah Atkinson,

Dr Beverley Norris

Nastaran Dadashi

Dr Laura Pickup

Professor John Wilson

Executive Summary

This report is a summary of the project '**Requirements for tests of child finger entrapment in European safety standards**' carried out by the IOE at the University of Nottingham for ANEC Child Safety WG R&T. The findings of the study are summarised below.

1. The age children begin to explore with their fingers

Very little literature was found on the specific age at which children begin to explore with the fingers, or how they explore. An observation study was therefore carried out (Work package 5) to better define this. Twenty eight children aged from 5 to 18 months were observed interacting with toys that had been adapted to incorporate test openings. The openings were 14mm diameter, which meant the children could easily pass their fingers into and out of the openings, to meet experimental ethical and safety considerations.

The youngest child to insert a finger into one of the openings was 6 months. Most of the children at this age tended to insert their fingers accidentally i.e. their fingers were either placed or rested at the openings and slipped in, or the fingers slipped in whilst holding or lifting the toys. However, by age 7 months purposeful exploration was observed where the fingers were intentionally inserted into the openings. The first (index) finger tended to be used most for purposeful exploration, although all fingers were inserted into the openings, including the thumb and little finger. In the majority of cases the fingers were inserted up to and past the first joint; this was more common in purposeful exploration but was also observed in accidental finger insertion.

As the test openings were large enough for the younger children to easily move their fingers in and out of the holes, the study probably did not replicate a real life scenario whereby children would have to purposefully push their finger to get it to pass into a smaller opening. As purposeful exploration was observed at around age 7 months, it is hard to determine whether children younger than this would be able to push their fingers into openings as they tended to put their fingers into the openings accidentally. However, there is still a risk of entrapment for the younger

child if they fell against a product with an opening, or if the product fell against them, whilst their fingers were near an opening. That is, the absence of purposeful insertion at less than 7 months does not mean that entrapment is not a risk. This study showed that children as young as 6 months are able to explore with their fingers, therefore it is appropriate to conclude that children of 6 months and over should be protected by the requirements for finger entrapment.

2. Requirements for static finger entrapment hazards

A review of anthropometric data and literature on secular trends was carried out and only one new source of children's finger data found, measured in the UK in 1999 (Porter, 2000). Dimensional requirements for static entrapment were therefore defined using this and the major published sources of children's anthropometric data, measured during the 1970s and 1980s (e.g. those in Childata, 1990). There is likely to have been a continued secular trend (increase) in children's body sizes since these data were measured, but it is hard to assess how much this would affect the fingers of very young children. It is likely there has been some increase since the data were collected, but these changes may be within the error margins of data measurements and extrapolations (e.g. 0.5mm).

For all of the dimensional requirements, the 1st and 99th percentile values have been used. These have been calculated from published data. These percentile values will protect the majority of, but not all, children.

In order to assess the depth requirements for openings, the length of the finger tip is needed (up to the first or distal joint). The only published data on finger tip length are for the middle finger and for children over 2 years of age. Data have therefore been extrapolated in this study to estimate the finger tip length of both the middle and little fingers and for children aged from birth. This study makes recommendations for requirements for static entrapment hazards based on these data and calculations as follows:

MINIMUM DIAMETER REQUIREMENT:

Current requirement [CEN/TR 13387:2004 (E)]:

5 mm for rigid openings/7mm for flexible materials/mesh

Recommendations:

No change for round or oval openings. A possible reduction to 3 mm width for slots.

Rationale:

Round/oval openings:

The 1st percentile breadth of the distal (furthest) joint of the little finger for 6-8 month old infants is 5.67mm for males and 4.67mm for females therefore no change is recommended. Data on the diameter of the joint is measured as the maximum size of aperture that *would allow* the joint to pass through; therefore it is recommended that joint breadth should be used.

Slots:

As finger depth at the first joint is less than the breadth or diameter it is suggested that in a slot the finger may be able to pass through a narrower space than in a round opening. 1st percentile depth of the little finger at the distal joint has been estimated in this study as 2.5 mm at 4-6 months old and 2.98mm at 7-9 months old. This means that a slot opening may need to have a minimum width of 3 mm to prevent the little finger entering the opening. These data should be taken as a guide only due to the assumptions that have been made in their estimation:

- i) that there is a linear relationship between finger length and depth
- ii) that the little and middle fingers grow at the same rate
- iii) that the standard deviation of the breadth of the little finger is similar to the that of the depth.

MAXIMUM DIAMETER REQUIREMENT:

Current requirement: 12 mm

Recommendations:

Increase to 14.5 mm to exclude entrapment of the fingers only OR 15.5 mm to exclude entrapment of the thumb.

Rationale:

The 99th percentile *diameter* of the middle joint of the middle finger for 4-4.5 year olds is 14.5 mm (the middle finger is wider than the index finger at that joint and at that age). The diameter in this case is measured as the maximum size aperture through which a finger *cannot* pass, so has been used instead of joint breadth.

The 99th percentile diameter of the thumb for 3.5-4.5 year olds is 15.20 mm. (The age groups differ due to the age groups of published data i.e. different sources of data measured different age groups).

MINIMUM DEPTH REQUIREMENT:

Current requirement: 10mm

Recommendations:

Decrease to 3.5 mm to protect the little finger OR 6mm to protect the middle finger.

Rationale:

The current requirement of 10 mm would only protect children 3.5 years and older at the 1st percentile value (1st percentile middle finger tip length is 9.3 mm for 3.5-4.5 year old children). The recommendations are based on 1st percentile little finger tip length (3.64 mm) and 1st percentile middle finger tip length (6.2 mm) of children aged 7-9 months.

These data has been estimated based on the following assumptions:

- i) the proportional growth in the finger segments is the same for children under 2 years as older children
- ii) the ratio of finger tip to overall finger length is the same for children under 2 years as older children
- iii) the relationship between the finger tip length and full finger length of the middle finger are the same for the little finger.

3. First review of tests for dynamic finger entrapment hazards

A feasibility trial showed that 3D scanning is a useful technology to produce accurate data on the effects of dynamic entrapment on finger size and shape, The trial demonstrated that the depth of the fleshy part of the finger tip under compression will be far less than the depth or diameter of the joint, which is currently used to set requirements. A recommendation is made that the current requirement for moving parts (CEN 13387:2004) of 12mm will not protect the fleshy part of the finger, and that the minimum requirement for moving parts should be less than 5 mm. Further work is required to specify this dimension further.

END.