PD CEN/TR 13387-3:2015

BSI Standards Publication

Child use and care articles — General safety guidelines

Part 3: Mechanical hazards

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National foreword

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Child use and care articles - General safety guidelines - Mechanical hazards

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (CEN/TR 13387-3:2015) has been prepared by Technical Committee CEN/TC 252 “Child use and care articles”, the secretariat of which is held by AFNOR.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TR 13387:2004.

CEN/TR 13387 comprises the following five parts:

— Part 1: Safety philosophy and safety assessment

— Part 2: Chemical hazards

— Part 3: Mechanical hazards

— Part 4: Thermal hazards

— Part 5: Product information

CEN/TR 13387-3 should be used in conjunction with CEN/TR 13387-1.

This new edition of this Technical Report is a hazard based Technical Report. In comparison with the previous version, the main changes related to the section on Mechanical hazards are:

— Ageing and wear: Reworded;

— Accessibility of mechanical hazards: Reworded;

— Entrapment Hazards: Addition of a new finger probe and a hip probe;

— Hazards from moving parts: Moving parts separated into two main areas;

— Entanglement hazards: Improvement of the diagram for the ball and chain test; clarification of the clause for “Cords, ribbons and parts used as ties;

— Suffocation hazards: Clarification of the clause for “Non air-permeable packaging”;

— Hazardous edges and projections: Drawings deleted;

— Protective function: Addition of a hip probe;

— Footholds: Reworded.

1 Scope

This Technical Report provides guidance information on mechnical hazards that should be taken into consideration when developing safety standards for child use and care articles. In addition, these guidelines can assist those with a general professional interest in child safety.

2 Mechanical hazards - Safety philosophy

This clause addresses the most widely known mechanical hazards and is intended to provide guidance when drafting standards for child use and care articles.

Anthropometric data and information on the abilities of children related to risks are given in Annex A of CEN/TR 13387-1:2015. When using these data for setting requirements, adequate safety margins should be considered. These data refer to static and not dynamic anthropometric data, therefore care should be taken if using these data for anything other than static situations when drafting standards.

When drafting standards, conditions of use should be considered, bearing in mind the behaviour of children. Also, it is to be considered whether the child is attended or unattended when using the product and also the child's access to hazardous features.

For each mechanical hazard a rationale is given, explaining the potential hazard to the child. Requirements, test equipment and test methods are also given. Where appropriate, these can be used when drafting standards.

3 Terms and definitions

For the purposes of this document, the following terms and definitions related to mechanical hazards apply.

3.1
mechanical hazards
physical factors which may give rise to injury due to the mechanical properties of products/product parts

3.2
reach envelopes
age related physical data on the reach limits of the limbs of children in different postures, see 4.2

3.3
ageing
change of properties of the material due to exposure to environmental factors such as temperature, humidity, UV radiation, cleaning agents etc

3.4
mechanical wear
change of mechanical properties due to fatigue or repeated operation of devices, mechanisms and other parts of the product

4 Accessibility of mechanical hazards

4.1 General

Within the mechanical section no reference is made to specific areas of access, known as access zones. It would be wrong for this guidance document to specify exact areas of access as these should be determined in relation to the hazards and risks of individual products and risks when drafting the standard. As a general guidance to the types of contact associated with mechanical hazards, the following examples are given:

— the hazardous part is in reach of the child from the intended position of use in particular by head, mouth, hands or feet and there is a high probability for frequent, intensive and/or prolonged contact. Requirements need to address this primary contact;

— the hazardous part may be reached by the child or any other child beyond the intended position of use. The product is considered to remain in its intended position(s). Access to hazardous parts is gained by passing/moving around the product or when proceeding to the intended position. The risk of harm deriving from frequent, intensive and/or pro-longed contact may be less probable;

— the hazardous part exists, but cannot be reached by any child.

Irrespective of the access category, the reasonably foreseeable conditions of use should always be considered when designing children‘s products and/or writing product standards.

4.2 Accessibility areas

Information for determination of accessibility areas in connection with age group is given in Table 1 and Figure 1. These reach envelopes are based on a computer simulation, therefore the dimensions should be treated with care. If in the future experiments with children are undertaken, these figures in the table may be determined more accurately.

Table 1 — Reach envelopes for guidance in the specification of accessibility areas in standards - anthropometric data related to Figure 1

Dimension (mm) ›	**Overhead Reach**	**Overhead Reach on tiptoes**	**Span**	**Overhead Reach Sitting**	**Arm Reach**	**Buttock-Foot**	**Lower Leg Length**
Age group	L1	L1'	L2	L3	L4	R1	R2
0 to 6 months	760	-	660	550	250	300	150
6 to 12 months	880	960	770	610	290	380	190
12 to 36 months	1 160	1 260	1 020	770	420	550	275
36 to 48 months	1 270	1 370	1 070	810	460	630	315
All dimensions are based on P95 values. L1, L1', L2, L3, L4, have been assessed with the computer program ADAPS (© 79-93 TU-Delft University of Technology, Faculty of Industrial Design Engineering). R1 = buttock - foot length (Annex A, Table 3). R2 = 0,5 x R1.							

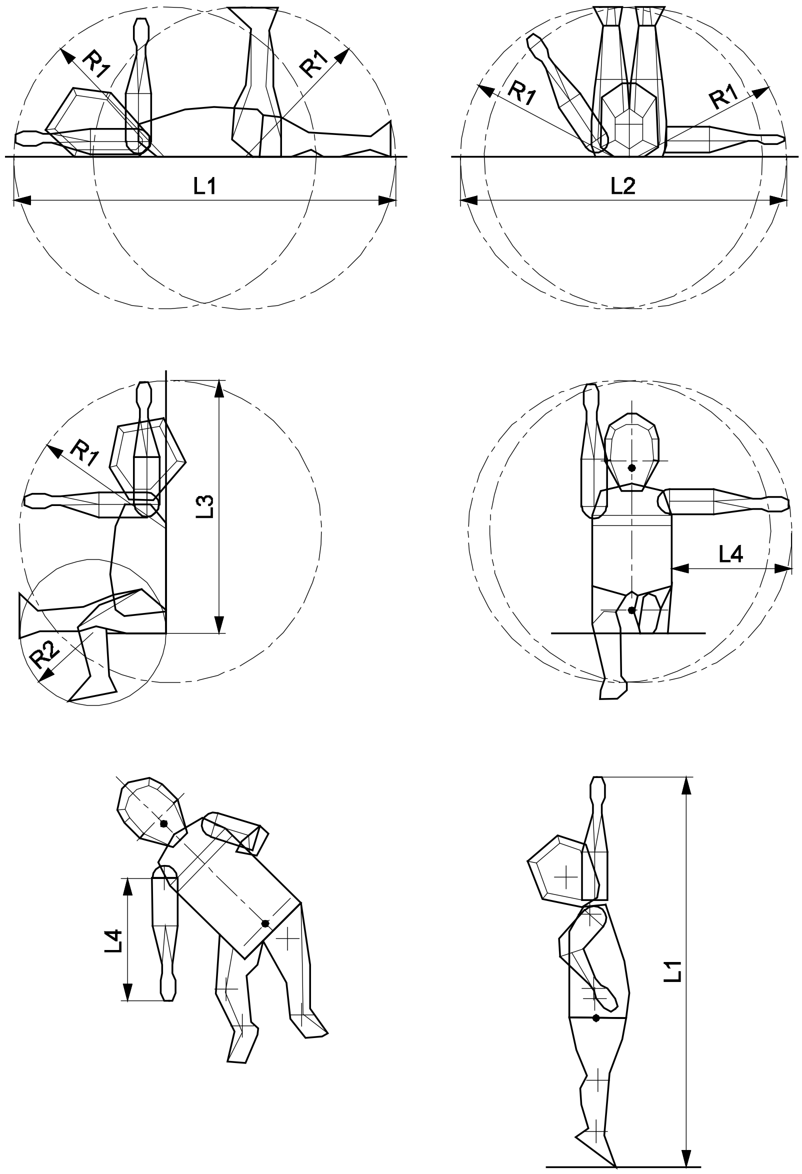


Figure 1 — Reach envelopes for determination of accessibility areas

4.3 Product information

In order to ensure mechanical safety, the information for the carer should include appropriate instructions and warnings. For example:

— the need for restraint system and its adjustment;

— the opening and closing of products;

— the operation of safety locks for foldable parts;

— the method of attachment to fixed structures or to other products.

Instructions should also inform the carer of the need to inspect the product regularly and also to use only replacement parts that are approved by the manufacturer/supplier.

CEN/TR 13387-5:2015 "Product information" gives detailed advice concerning the presentation of product information.

5 Entrapment hazards

5.1 Introduction

To avoid entrapment of head, neck, fingers, feet, and hands, safety distances are recommended in relation to the anthropometric data (see Annex A of CEN/TR 13387-1:2015) of the growing child. It is important to take into account the intended age and/or development level of the child. As a priority, those parts of a product which are accessible when a child is using the product as foreseeable should be considered. It may also be appropriate for gaps and openings beyond these accessible areas to be addressed. Gaps and openings which are inaccessible need not to be considered. However, V-shaped openings or V-shaped arrangements of structural members should be avoided.

Important entrapment hazards are:

— entrapment of the neck in situations where the child is incapable of raising its body weight to relieve the pressure (e.g.: crawling child on the outside of play pen, V shapes, etc.);

— entrapment of the neck in situations where the child slips through a gap feet first (e.g.: child slipping between bars/slats);

— entrapment of fingers, which may cause loss of blood supply to the tips.

If it is possible to position a child use and care article next to other furniture or a wall and create an entrapment hazard between them, an instruction should be included to warn carers of this possible entrapment hazard.When considering entrapment hazards dynamic situations should be considered as well as static hazards. The dynamic situation will increase the force being applied to a trapped torso or finger through the weight, movement or momentum of the child which will increase the risk of injury.

To assist with this an entrapment matrix has been included, see Figure 2, which was based on work done in ISO/IEC Guide 50. This entrapment matrix does not impart any hierarchy in the severity of the hazards shown and the specific hazard clause should be referred to.

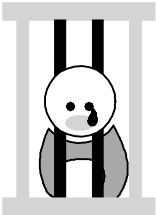
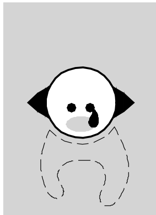
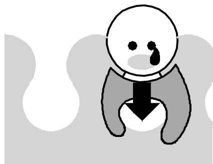
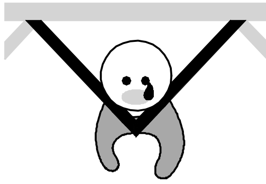
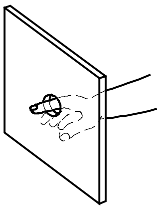
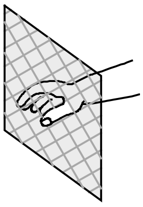
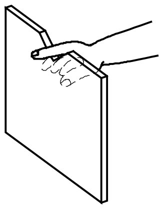
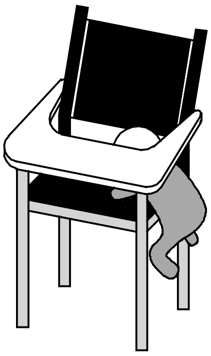
Body part	Completely bound openings		Partially bound openings	V shapes
	Rigid	Non-rigid		
Head neck, head first				
Finger				
Head neck, feet first				

Figure 2 — Entrapment matrix

5.2 Entrapment of head and neck

5.2.1 Rationale

Head and neck hazards occur when the child is in a position where its body weight is supported by its neck and the child is incapable of lifting its body weight to relieve pressure on its neck. When this occurs it will cause airways to close and restrict the blood flow leading to brain damage.

The risk of head and neck entrapment increases as the child's mobility and ability increases, enabling the child to access a wider range of hazards and products. The hazard is directly related to the size of the child's head and hip.

The hazard can be avoided by limiting the size and shape of completely bound, partially bound and 'V' shaped openings (see definitions in 5.2.2).

5.2.2 Terms and definitions related to entrapment hazards

5.2.2.1
completely bound opening
an opening that is continuously surrounded on all sides by the material of the product, see Figure 3

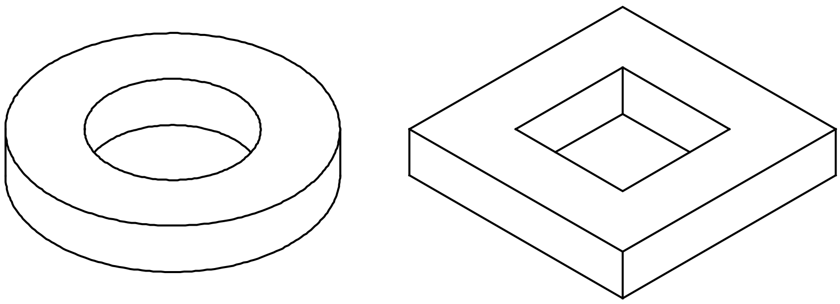


Figure 3 — Examples of completely bound openings

5.2.2.2
partially bound opening
an opening that is partially surrounded by the material of the product, see Figure 4

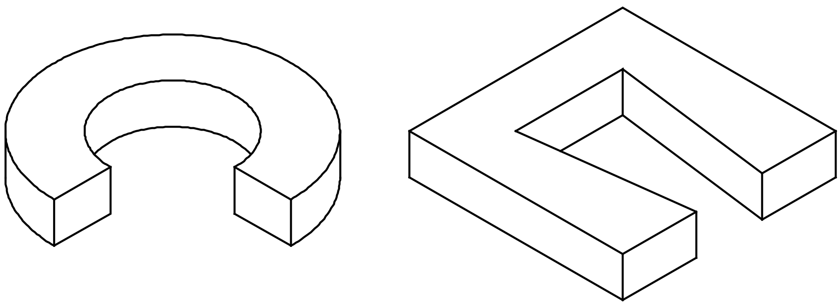


Figure 4 — Examples of partially bound openings

5.2.2.3
V shaped opening
an opening where there is a slot that narrows towards the bottom, see Figure 5

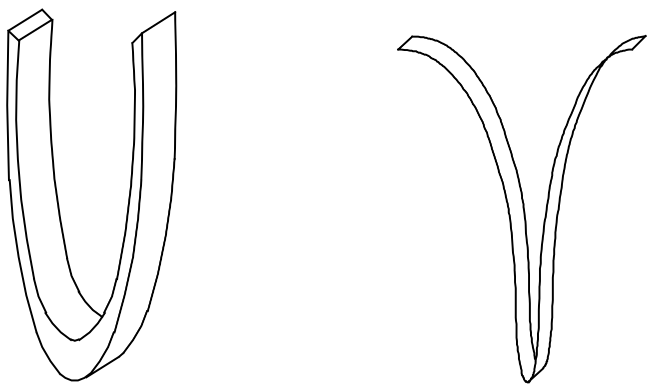


Figure 5 — Examples of V shaped openings

5.2.2.4
irregular shaped opening
an opening that does not have a symmetrical shape, see Figure 6.

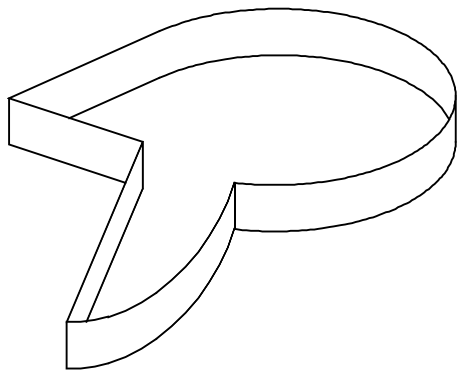


Figure 6 — Example of an irregular shaped opening

5.3 Requirements

When tested in accordance with 5.5.1 or 5.5.2, if openings allow passage of the small probe, the large probe should pass through. The opening that allows the large probe to pass completely through should comply with the requirement for partially bound, V and irregular shaped openings when tested in accordance with 5.5.3.

Partially bound, V and irregular shaped openings should be constructed so that:

a) portion B of the template does not enter the opening when tested in accordance with 5.5.3, see Figure 11 and Figure 12; or

b) the apex of portion A of the template contacts the base of the opening when tested in accordance with 5.5.3, see Figure 13.

5.4 Test equipment

5.4.1 Probe philosophy

To cover all aspects of head and neck entrapment four types of probes are required, the hip probe, the small head probe, the large head probe and the template for partially bound and V-shaped openings. The size of individual probes is determined to meet the age range of the child, see the figures and tables for the various probes.

5.4.2 Hip probe

The hip probe, Figure 7, represents the hip of the smallest child in each age range. The probe size corresponds to the size of the child as follows:

— dimension ‘A’ represents the hip breadth;

— dimension ‘B’ represents hip depth;

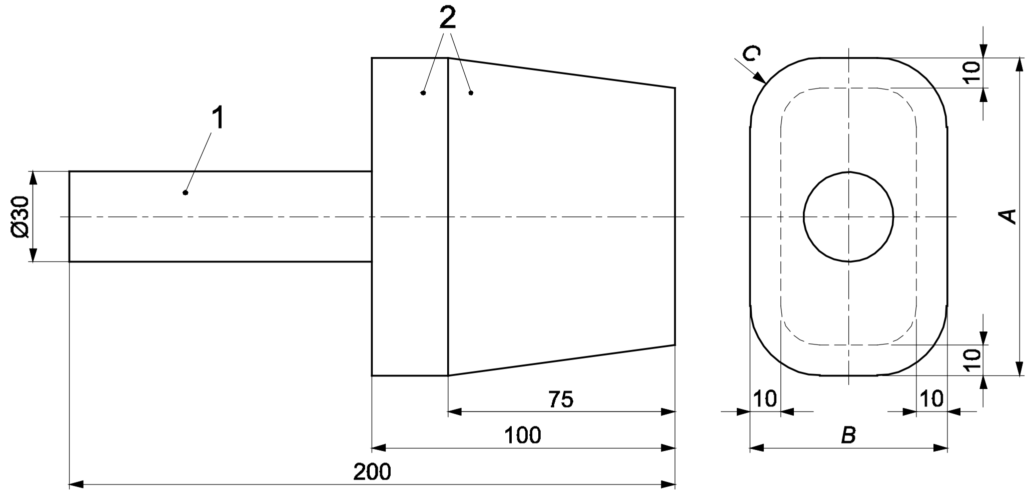
— dimension ‘C’ represents the radius C after calculation based on hip circumference.

The dimensions of the hip probe are based on the anthropometric data, see Table 2.

Table 2 — Hip probe corresponding to smallest child

Age Months	A	B	C
0 to 2	101	42	10
3 to 5	105	65	23
6 to 8	124	67	23

Dimensions in millimetres



Key

1 handle

2 Hip probe

Figure 7 — Hip probe

5.4.3 Small head probe

The small head probe, Figure 8, represents the head of the smallest child in each age range. The probe size corresponds to the child size as follows:

— dimension ‘a’ represents head breadth;

— dimension ‘b’ represents head length;

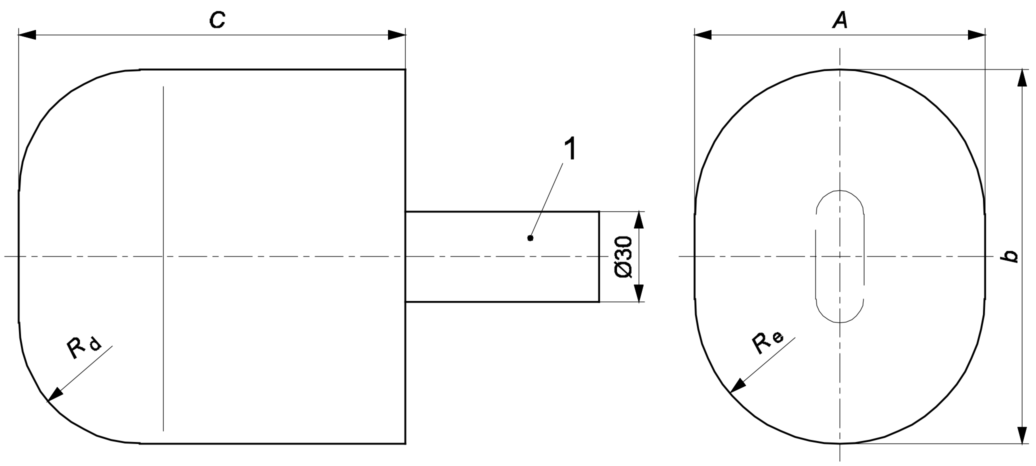
— dimension ‘c’ represents head height;

The dimensions of the small head probe are based on anthropometric data, see Table 3.

Table 3 — Head probe corresponding to smallest child

Age Months	a	b	c	Re	Rd
0 to 3	96	124	112	48	40
3 to 6	101	137	119	50,5	40
6 to 9	106	145	126	53	40
9 to 12	111	150	138	55,5	40
12 to 18	115	155	144	57,5	40
18 to 24	118	158	149	59	40
24 to 36	120	159	154	60	40
36 to 48	123	161	156	61,5	40

Dimensions in millimetres



Key

1 Handle

Re/Rd Radii

Figure 8 — Small head probe

5.4.4 Large head probe

The large head probe, Figure 9, represents the head of the largest child in the age range. The probe size corresponds to the child size as follows:

— dimension ‘a’ represents chin to crown length.

The dimensions of the large head probe are based on the anthropometric data, see Table 4:

Table 4 — Head probe corresponding to largest child

Age months	Diameter a
0 to 3	175
3 to 6	191
6 to 9	196
9 to12	205
12 to 18	210
18 to 24	215
24 to 36	223
36 to 48	229

Dimensions in millimetres

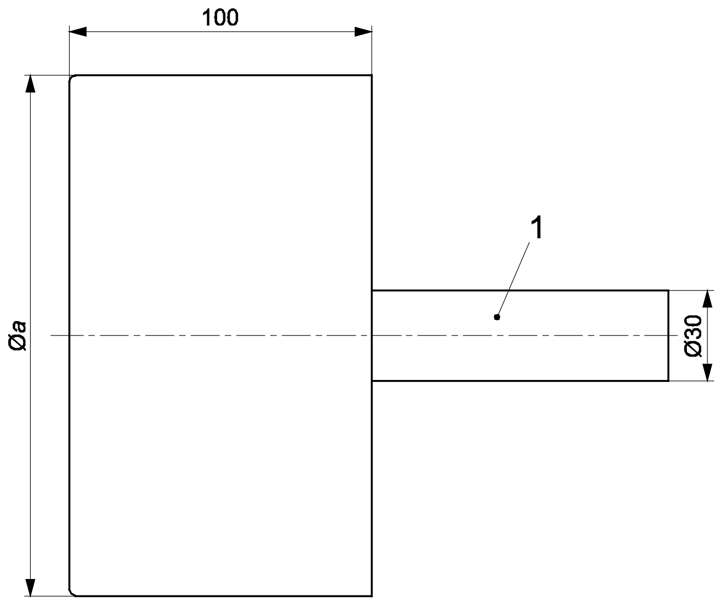


Figure 9 — Large head probe

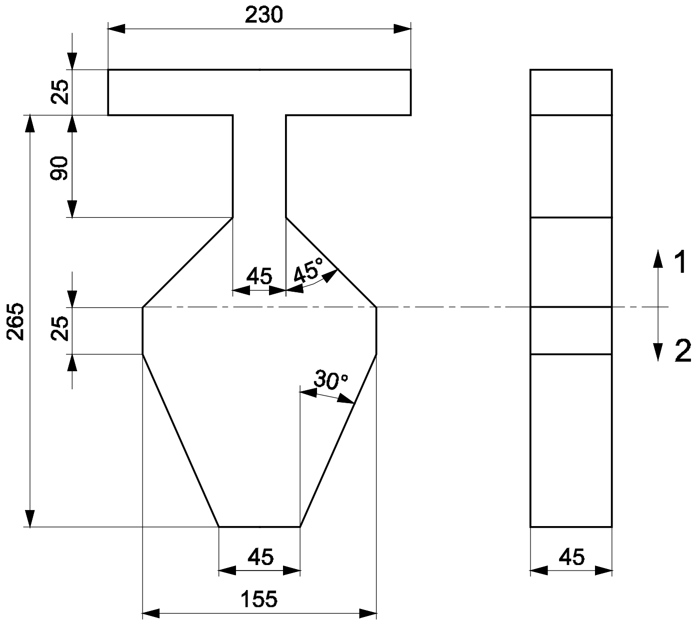
Key

1 handle

5.4.5 Template for partially bound and V shaped openings

The template shown in Figure 10 represents head and neck dimensions:

Dimensions in millimetres



Key

1 B Portion

2 A Portion

Figure 10 — Template for partially bound and V shaped openings

5.4.6 Selection and use of probes

5.4.6.1 Probe size

The correct size of probe should be selected from the ranges shown in Table 2 to Table 4, to suit the age range of the child most at risk when considering the hazard.

By checking the opening with the large head probe, Figure 9 it is possible to ascertain whether the opening is small enough to be a hazard to a child. If the opening is found to be hazardous the opening should be tested to determine if it is large enough for the child to enter either feet first or head first by using one of the appropriate small probes, Figure 7 or Figure 8, as indicated below.

5.4.6.2 Feet first openings

The hip probe, Figure 7 should be used to check if the opening is small enough to prevent passage of a child's hip. If it does not pass through the opening the risk of entrapment is reduced.

5.4.6.3 Head first openings

The small head probe, Figure 8, should be used to check if the opening is small enough to prevent passage of a child's head. If the small head probe does not pass through the opening the risk of *head first* entrapment is reduced.

If the small head probe passes completely through the opening, the large head probe should be used to check if the opening is large enough to allow the head of the largest child to pass through the opening. If the large head probe passes completely through the opening, the risk of entrapment is reduced.

5.4.6.4 Irregular shaped openings

The irregular shaped opening should be assessed in accordance with 5.4.6.3. If the large head probe passes completely through the opening, the template for V and irregular shaped openings, Figure 10 should be used to check for the risk of neck entrapment.

5.4.6.5 Partially bound openings

For all partially bound openings the template for V and irregular shaped openings, Figure 10 should be used to check for the risk of neck entrapment.

5.5 Test methodology

5.5.1 Feet first openings

Push the hip probe, Figure 7, with the highest force possible up to 30 N into the opening. If the hip probe passes completely through the opening, then the large head probe, Figure 9, should pass completely through the opening with a force of up to 5 N. The probes shall be inserted along the longitudinal axis of the probe. If openings contain V or irregular shaped openings, these should be assessed in accordance with 5.5.3.

5.5.2 Head first openings

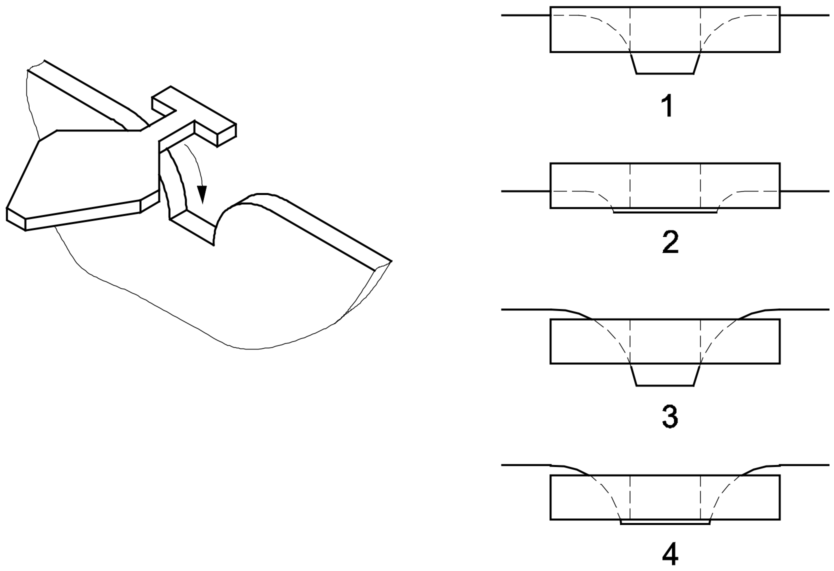
Push the small head probe, Figure 8, with the highest force possible up to 30 N into the opening. If the small head probe passes completely through the opening, then the large head probe, Figure 9, should pass completely through the opening with a force of up to 5 N. The probes shall be inserted along the longitudinal axis of the probe. If openings contain V or irregular shaped openings, these should be assessed in accordance with 5.5.3.

5.5.3 Partially bound, V and irregular shaped openings

Position the ‘B’ portion of the test template, Figure 10, between and perpendicular to the boundaries of the opening, as shown in Figure 11 or Figure 12 as appropriate. If the full thickness of the template cannot be inserted there is no hazard, but if it can continue with the test, see Figure 11 and Figure 12.

If the test template can be inserted to a depth greater than the thickness of the template (45 mm), apply the ‘A’ portion of the test template, so that its centre line is in line with the centre line of the opening. Ensure that the plane of the test template is parallel and applied in line with the opening, as shown in Figure 13. Insert the test template along the centre line of the opening until its motion is arrested by contact with the boundaries of the opening. If the template touches the bottom of the opening there is no hazard, but if the sides of the template touch the side of the opening there is a hazard, see Figure 13.

Dimensions in millimetres



Key

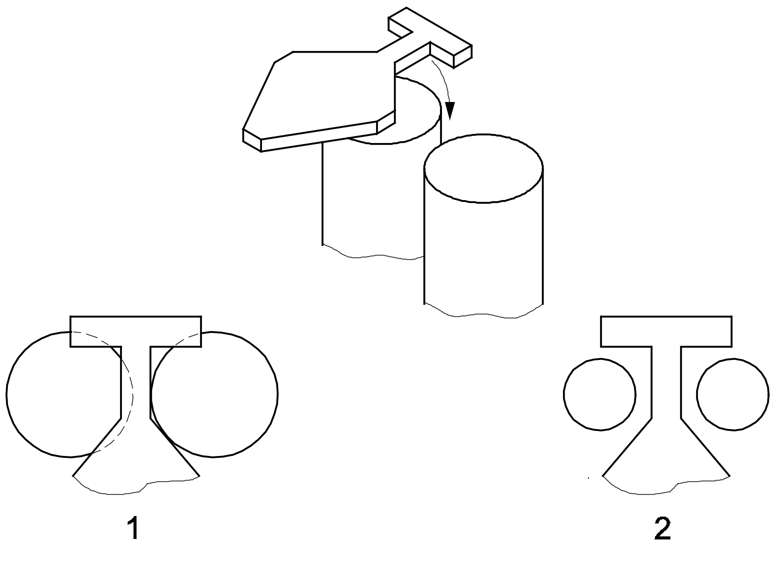
1 Is not a hazard

2 Is not a hazard

3 Is a hazard

4 Is a hazard

Figure 11 — Method of insertion of portion B

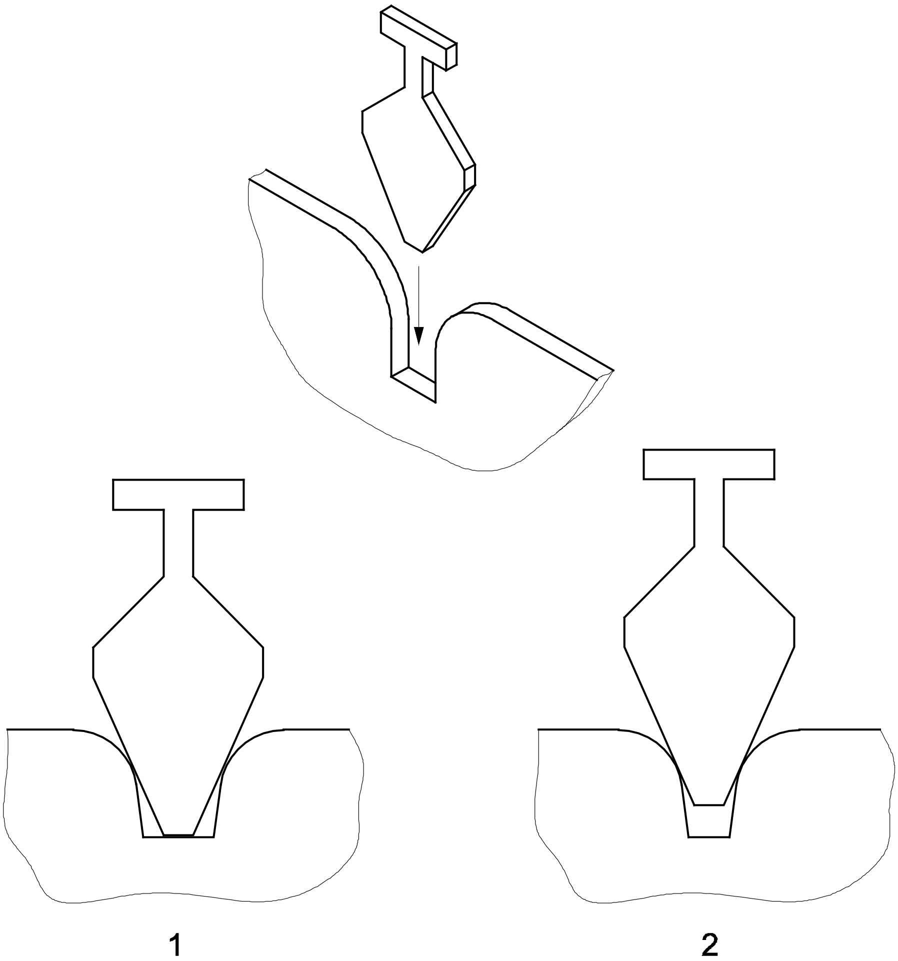


Key

1 Is not a hazard

2 Is a hazard

Figure 12 — Method of insertion of portion B



Key

1 Is not a hazard

2 Is a hazard

Figure 13 — Method of insertion of portion A

5.6 Entrapment of fingers

5.6.1 Rationale

This clause deals with the entrapment of fingers in static openings and gaps. Hazards to fingers associated with moving parts, which result in crushing and shearing are covered in Clause 6.

This hazard occurs when a child's finger becomes stuck in openings and gaps and the flow of blood to the finger is reduced. Additionally the weight or movement of the child may cause dislocation or displacement of a finger joint.

These hazards increase as the child's desire to explore its environment increases. Even when a child is mobile, it may not always have the ability to extract its finger or fingers from the openings and gaps.

Reducing the depth of penetration in the free openings and gaps may avoid potential hazards.

The shape is also to be considered for assessment of a risk: a round or equilateral shape may cause reduction of blood circulation. Additionally openings and gaps should be taken into consideration whether the child is in sitting or standing position.

The age and ability of the child should be considered.

The hazard associated with fabric and plastic mesh, but not expanded plastic sheet, and holes-in-flexible materials is assessed using a different type of probe to those used for other materials. The probe for mesh and flexible materials has a conical end, which is more relevant to these materials. Examples of flexible materials are textiles, rubbers, silicon and other soft plastics.

5.6.2 Requirements

There should be no completely bounded openings (see examples in Figures 14 and 15) in rigid materials between 5 mm or 7 mm and 12 mm. Minimum and maximum dimensions should be chosen with the help of anthropometric data, capability of the child and all other relevant sources of information, unless the depth of penetration is less than 10 mm when tested in accordance with 5.6.4. It should be noted that other dimensions may need consideration.

For products designed for children who can stand up inside a product, there should be no V-shaped opening in rigid materials at a distance of more than 150 mm from the standing surface, that narrow to the bottom to a dimension less than 12 mm, unless the depth of penetration is less than 10 mm when tested in accordance with 5.6.4.

If a V-shaped opening has walls on each side for the full depth of the opening then the requirement is satisfied. See Figure 5.

The finger probe used for mesh shall not penetrate when inserted perpendicularly to the mesh when tested in accordance with 5.6.4.

Figure 14 shows examples of the shape of openings which present a finger entrapment.

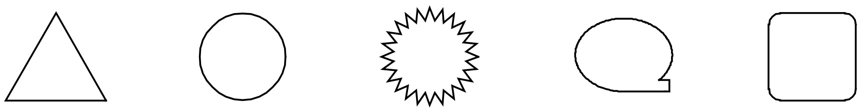


Figure 14 — Examples of the shape of openings which present a finger entrapment

Figure 15 shows examples of openings which may not present a risk of hazardous finger entrapment.

Dimensions in millimetres

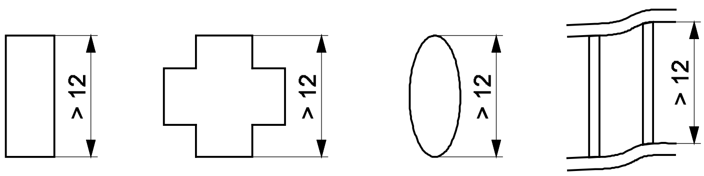


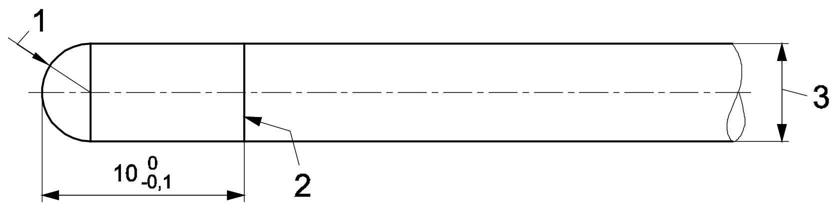
Figure 15 — Examples of openings which may not present a risk of hazardous finger entrapment

5.6.3 Test equipment

Probes made from plastics or other hard, smooth material of diameters 5 mm, 7 mm and 12 mm with a full hemispherical end that can be mounted on a force-measuring device, see Figure 16.

Probe for assessing mesh made from plastics or other hard, smooth material as shown in Figure 17.

Dimensions in millimetres



Key

1 R 2,5 or 3,5 or R 6

2 Line scribed around circumference showing depth of penetration

3 Ø ($5^{\ 0}_{-0,1}$) or Ø ($7^{\ 0}_{-0,1}$) or Ø ($12^{+0,1}_{\ 0}$)

Figure 16 — 5 mm, 7 mm and 12 mm probes

Dimensions in millimetres

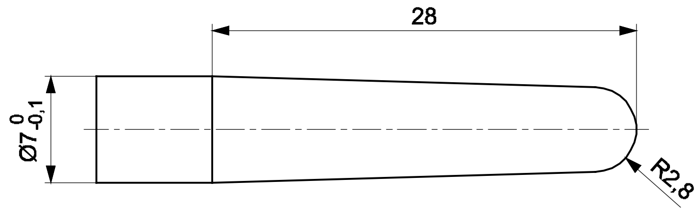


Figure 17 — Finger probe for mesh or flexible materials

5.6.4 Test Methodology

Check whether the 5mm or 7 mm probe, Figure 16, with an applied force of up to 30 N, enters 10 mm or more into any accessible opening in any possible orientation. If the 5 mm or 7 mm probe enters 10 mm or more than the 12 mm probe, Figure 16, should also enter 10 mm or more with an applied force of up to 5 N.

Check whether the finger probe for mesh or flexible materials, Figure 17, with an applied force of up to 30 N, penetrates to the 7 mm diameter.

5.7 Rationale for entrapment of limbs, feet and hands

The hazard occurs when limbs, feet and hands become stuck in openings and the child does not have the ability to extract itself. Bruising and swelling may occur which may cause distress, but is unlikely to result in permanent damage to the child.

The risk of entrapment of limbs, feet and hands is unlikely to occur with children under 6 months of age. However, the risk will increase as the child's mobility and development increases.

This hazard is considered to be a low risk and as a result other safety considerations may need to take priority. For example, the spacing of bars to provide a protective function (for example in sides of cots) should be such that a child's hip cannot slip between them, however this may result in a bar spacing that would trap a child's limbs, feet or hands.

6 Hazards from moving parts

6.1 Rationale

Hazards from moving parts are related to components that move in use. The hazard relates to either the whole of the child's body or parts of the body. A child's body may be crushed if a product collapses around the child. Child's fingers are considered to be at higher risk and may be cut, crushed, or even severed if the fingers become trapped between components of a product that move.

A shearing hazard occurs when components move relatively one to another and have a scissoring action which may result in cuts, amputation, etc.

A crushing hazard occurs when components move relatively one to another and have a compression action which may result in bruising, fractures, etc.

6.2 General

Hazards arising from moving parts depend on the potential of the parts to cause injury where possible moving parts that can close to less than 12 mm should be avoided.

Movement that may create a hazard:

— the movement of the product; or

— the movement of body weight by the child using the product; or

— the application or release of an external force (either by another child, the carer, or a powered mechanism).

The following should be taken into account when assessing the hazard of moving parts:

— The accessibility of the moving parts by any child.The accessibility could be reduced by: protective elements, location of the moving parts, etc.;

— The flexibility of the material e.g.: plastic frames, foam, small metal bars, etc.;

— Soft materials such as fabric;

— The effect of forces applied at different positions;

— The means of operating the moving parts;

— The design of the parts may cause the movement to be obscured from the carer. (e.g. a fabric cover hides the movement);

— The ability of the child;

— The shape and material of the parts e.g.: rounded tubes, foam around rigid parts, flat steel plates, etc.

6.3 Shearing hazards

6.3.1 Requirements

After the product is set up for normal use in accordance with the manufacturer's instructions, there shall be no accessible hazardous scissoring points which can close to less than 12 mm or into which the 12 mm probe cannot enter when tested in accordance with 6.3.3.

6.3.2 Test equipment

A probe made of steel with a smooth finish mounted on a force-measuring device with the dimensions given in Figure 18.

Dimensions in millimetres

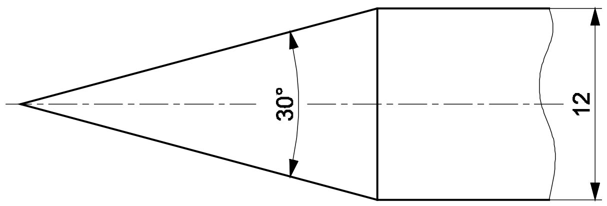


Figure 18 — Probe Ø 12 mm (0/+0,1 mm)

6.3.3 Test method

Check for parts that have a potentially hazardous scissoring movement. Analyse the movement by opening and closing the moving part.

Align the moving parts and hold them in position without impairing the flexibility of the parts.

Check whether the 12 mm probe, Figure 18 with an applied force of up to 30 N, passes between the moving parts.

Carry out the test at the most onerous position of the moving parts.

6.4 Requirements for crushing hazards

When the product is in use there shall be no accessible compression point which can close to less than 12 mm unless the clearance is always less than 3 mm. In some cases a clearance up to 5 mm may be acceptable depending upon the shape of the parts (eg: sufficiently rounded, chamfered …)

7 Hazards with products designed to fold for storage and transportation.

7.1 Rationale

Products designed to fold should be designed to avoid crushing, entrapment or suffocation during use due to unintentional folding. Where products or parts of products are designed to fold, these should be locked in use to avoid release through incomplete deployment or by an unintentional action.

It should be obvious to the carer that the product is correctly locked in its position for use.

7.2 Terms and definitions related to hazards with products designed to fold

The following definitions may be used to identify essential parts of product designed to fold.

7.2.1
locking device
mechanical component that maintains part(s) of the product when erected in the position of use (e.g. latch(es), hooks, over centre lock...) which can be activated or deactivated by action(s) on the *operating device*

7.2.2
operating device
part of the locking mechanism(s) designed to be activated by the carer through one or several positive action(s)

7.2.3
locking mechanism
assembly of components consisting of one or more locking device(s) and one or more operating device(s)

7.3 Requirements

7.3.1 General

Products that fold should have locking mechanisms which comply with the requirements in 7.3.2 and should continue to meet these requirements after testing in accordance with 7.3.3.

The hazard due to incomplete deployment, should be considered depending on the product and relevant requirements.

7.3.2 Unintentional release of locking mechanisms

Unintentional release of the locking mechanisms may be prevented if:

a) the operating device is not exposed; or

b) at least one of the locking mechanisms requires the use of a tool (e.g. spanner, screwdriver, coin); or

c) folding is only possible when two independent operating devices are operated simultaneously; or

d) there is at least one operating device which requires two consecutive actions, the first of which should be maintained while the second is carried out; or

e) other solutions may be required depending on the product and the associated hazards.

7.3.3 Test methodology

7.3.3.1 Endurance test

The locking mechanism should be operated for a set number of cycles, the number of which should be determined in accordance with the type of product and its likely life cycle.

7.3.3.2 Strength test

All locking mechanisms should withstand a load determined in accordance with the type, age range and use of the product.

8 Hazards related to attachment mechanisms and opening and closing systems

8.1 Rationale

Mechanisms that are used for the retention of parts of the product or two products or more which are not necessarily designed to fold but are important for the safe use of the product (e.g. High chair trays or crotch strap, car seat attachments on pushchairs, changing units on a children’s cot, etc.) should be designed to avoid crushing, entrapment, falling or suffocation during use due to unintentional release.

Opening and closing systems should be designed to avoid the hazard during use due to unintentional operation.

8.2 Requirement

Unintentional release of the attachment mechanisms may be prevented by the following and should continue to meet these requirements after testing in accordance with 8.3:

a) the operating device is not exposed avoiding inadvertent activation; or

b) at least one of the attachment mechanisms requires the use of a tool (e.g. spanner or screwdriver); or

c) detachment is only possible when two independent attachment mechanisms are operated simultaneously; or

d) there are two or more attachment mechanisms that cannot be simultaneously released by one unintentional action; or

e) release of the attachment mechanism requires two consecutive actions, the first of which shall be maintained while the second is carried out; or

f) release of the attachment mechanism requires a single action with a force greater than 50N; or

g) other solutions may be required.

8.3 Test methodology

The attachment mechanism should be operated for a set number of cycles, the number of cycles should be determined in accordance with the type of product and its likely life cycle.

9 Entanglement hazards

9.1 Snagging hazards

9.1.1 Rationale

Accessible protruding parts should be designed to avoid snagging of clothing or cords around or close to the child's neck. This is particularly important where a child will spend time unattended by the carer (e.g. in a cot).

Holes, gaps and similar openings should be designed to avoid snagging of clothing, buttons, decorations and similar parts around or close to the child's neck.

9.1.2 Requirements

When tested in accordance with 9.1.4, there should be no protruding parts that will retain the ball chain loop and support the spherical mass of the test equipment specified in 9.1.3.4.

9.1.3 Test Equipment

9.1.3.1 General

The test equipment comprises a ball chain (specified in 9.1.3.2) attached to a spherical mass (specified in 9.1.3.3) the combination of which is given in 9.1.3.4.

9.1.3.2 Ball chain

The ball chain comprises balls distributed along the length of the chain, the diameter of each ball is (3,2 ± 0,2) mm, the distance between the centre of each ball is (4 ± 0,5) mm see Figure 19.

Dimensions in millimetres

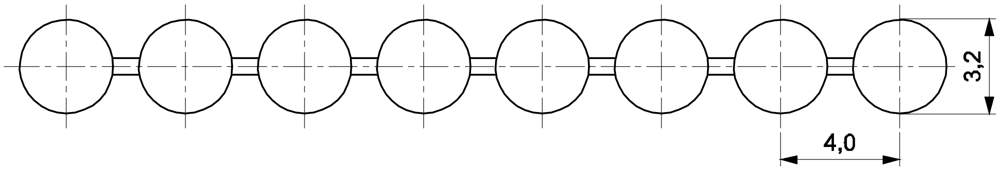


Figure 19 — Ball chain

9.1.3.3 Spherical mass

A smooth spherical mass of (2,5 ± 0,05) kg and (115 ± 1) mm diameter, see Figure 20.

Dimensions in millimetres

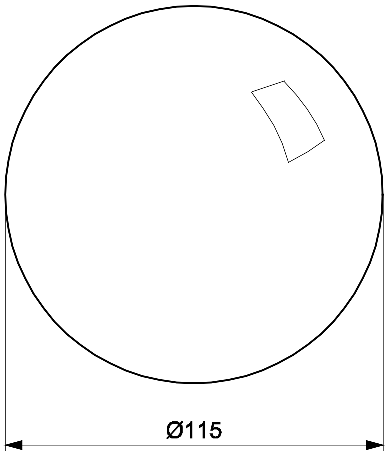
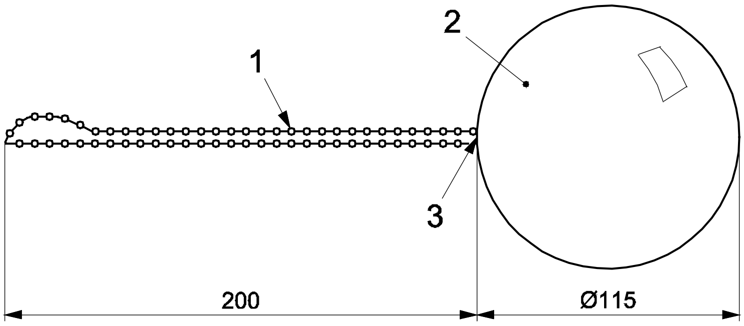


Figure 20 — Mass

9.1.3.4 Ball chain loop and spherical mass

The ball chain loop is formed by the ball chain entering the spherical mass at a common fixing point with a ball from each side of the chain in contact with each other. See Figure 21 and Figure 22.

Dimensions in millimetres



Key

1 Ball chain 9.1.3.2 with length of (200 ± 2) mm

2 Spherical mass 9.1.3.3

3 Fixing point

Figure 21 — Loop and mass

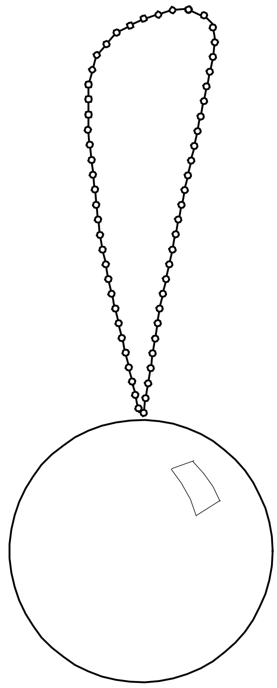


Figure 22 — Loop & mass

9.1.4 Test Methodology for loop and mass

Using the loop and mass in Figure 21, hold the spherical mass in one hand only allowing the loop to hang freely over the product, move the spherical mass along/around the product so that the loop is draped or dragged over and across any protruding parts and if the ball chain loop is retained by a protruding part slowly lower the spherical mass, see Figure 23.

Repeat the test for a total of 3 times. If during any of the 3 tests, the ball chain loop and spherical mass is supported by a protruding part this is considered to be a failure.

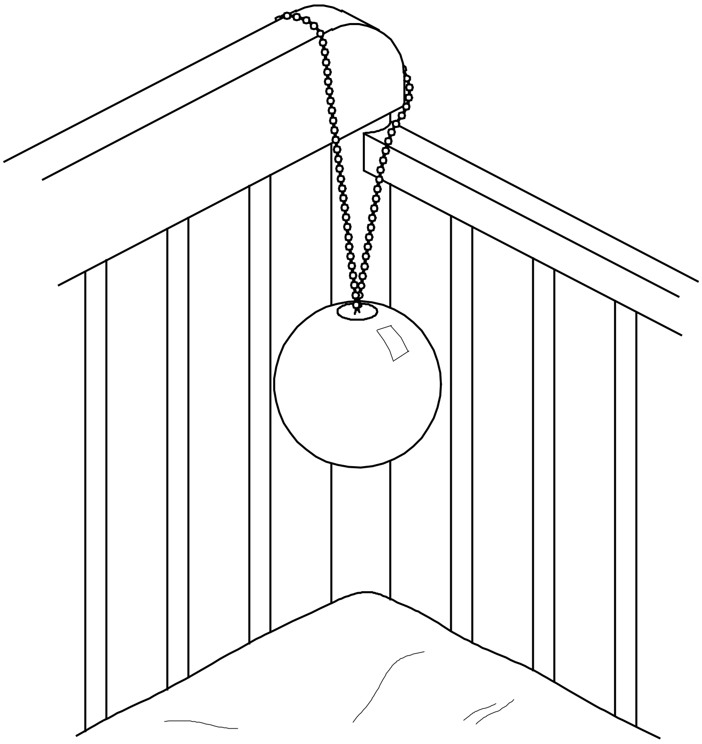


Figure 23 — Retention of loop and mass

9.2 Cords, ribbons and parts used as ties

9.2.1 Rationale

Strangulation could occur where cords, ribbons and parts used as ties are long enough to wrap around a child's neck. Their length should therefore be controlled and where cords and ribbons are used for decorative purposes only, their length should be limited to avoid a strangulation hazard.

Ribbons are considered as a hazard as their surface in contact with the child can be considerably reduced when they are twisted or pulled. Where ties are in close proximity, there is the potential for these to become twisted and form a closed loop around the child's neck. Although this is potentially hazardous it is considered to be a very low risk.

Monofilament threads are made of a single thread of man-made fibre, which are exceptionally strong and cannot be broken during use and should therefore not be exposed to the child. If monofilament threads are used there is the possibility that the thread can become wrapped around any part of the child's body and as the thread will not break there is the possibility that the blood supply will be cut-off.

9.2.2 Requirements

Cords, ribbons and parts used as ties should have a maximum free length of 220 mm when tested in accordance with 9.2.3. The free length is the maximum distance between the fixed and loose end on a single cord.

Where cords, ribbons and parts used as ties are attached to the product together or within 80mm of each other, any single cord should have a maximum free length of 220 mm and the combined length from one loose end to the other end should be a maximum of 360 mm (see Figure 24).

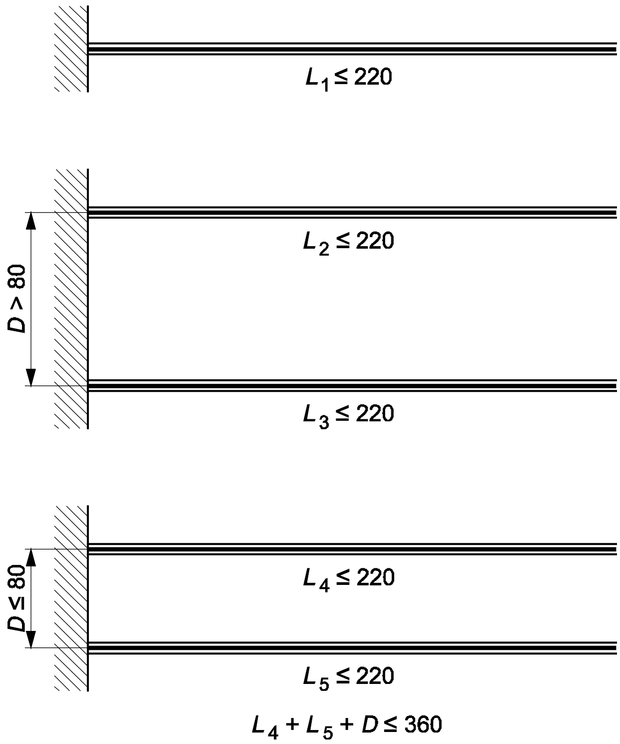
If it is possible to form a loop with cords, ribbons or part used as ties the peripheral dimension shall be a maximum of 360 mm.

Monofilament threads should not be used as cords, ribbons or parts used as ties and loops or as exposed sewing threads.

9.2.3 Test methodology

The length of the cord, ribbon or parts used as ties is measured from the fixing point on the article to the free end of the cord, ribbon or part used as a tie when stretched by a force of 25 N, see Figure 24.

Dimensions in millimetres



Key

D Distance between attachment points

L Length of cords, ribbons and parts used as ties

Figure 24 — Examples of measuring cords, ribbons or parts used as a tie

9.3 Loops

9.3.1 Rationale

Loops that are large enough to pass over a child’s head could become a strangulation hazard and their circumference should therefore be controlled.

9.3.2 Requirements

Loops should have a maximum peripheral dimension of 360mm when tested in accordance with 9.3.3.

Monofilament threads should not be used as loops.

9.3.3 Test methodology

The peripheral dimension of the loop should be measured when a 25 N tensile force is applied.

10 Choking hazards

10.1 Introduction

Choking is a serious hazard to young children. If air cannot pass into a child’s lungs irreversible brain damage can occur.

Choking occurs when the child’s internal airways are blocked and its breathing is impeded. If a child swallows small objects they can enter the airways and the trachea. Rounded shapes may present a hazard because of their shape and size that may block the airways at the back of the mouth. Suction cups may also present a hazard, Reference could be made to EN 71-1 safety of toys where this hazard is addressed.

This clause deals with the risk of choking from components that can be removed from a child use and care article. It does not deal with the hazard of unprotected hard foam materials which are used as padding to protect the child from impact injuries against metal components or as protection against thermal hazards but such materials should be taken into account when used on child use and care articles.

10.2 Hazard due to small components

10.2.1 Rationale

Small objects and accessible components should be of such a size that they do not present a choking hazard by blocking the airways if placed in the child’s mouth.

Children between the age of 0 and 36 months spend time exploring their environment by twisting and pulling small objects/parts with their fingers, hands or teeth and they may therefore remove components and put them in their mouth. It is important that any components or parts of components are sufficiently large not to cause a choking hazard.

Components should be assessed for their size and shape. The assessment should be made to ensure that components of products that are designed to be removed are sufficiently large not to cause a choking hazard. Components not designed to be removed should be firmly attached to the product and should be tested to ensure that they are firmly attached or that if they are not firmly attached, do not break into pieces sufficiently small to cause a choking hazard.

The small parts cylinder used for testing is designed to replicate the dimensions of a child’s throat.

10.2.2 Requirements

When tested in accordance with 10.2.4.1 (ability to grip), 10.2.4.2 (torque test) and 10.2.4.3 (tensile test), any component or part of a component that is removed, whether intended to be removed without the use of a tool or not, should not fit entirely within the small parts cylinder, see Figure 25.

Any component or part of a component that is removed should be assessed in accordance with 10.4.

10.2.3 Test equipment (also used in 11.2.3)

10.2.3.1 Small parts cylinder

Dimensions in millimetres

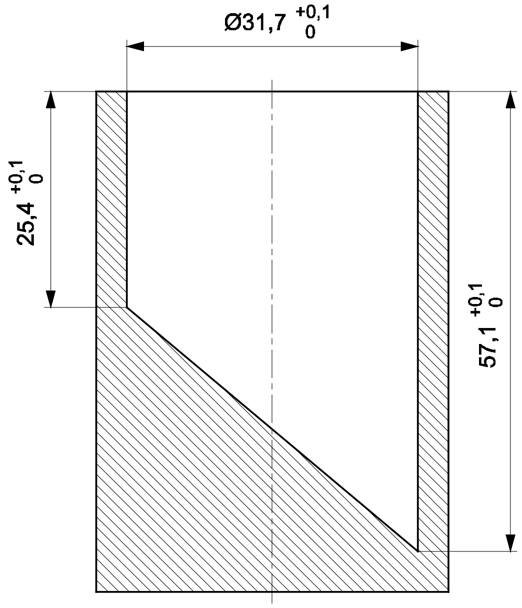


Figure 25 — Small parts cylinder

10.2.3.2 Feeler gauge

Dimensions in millimetres

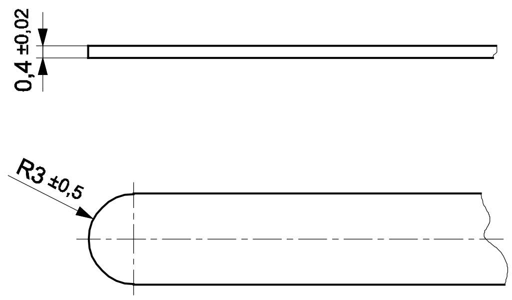


Figure 26 — Feeler gauge

10.2.3.3 Clamps

Clamps are required to grip the components being tested in both: the torque test, 10.2.4.2 (example in Figure 27) and the tension test, 10.2.4.3 (examples in Figure 28 and Figure 29). However where a clamp is used it should not damage the component being tested. Additionally the clamp shall not affect the result of the test.

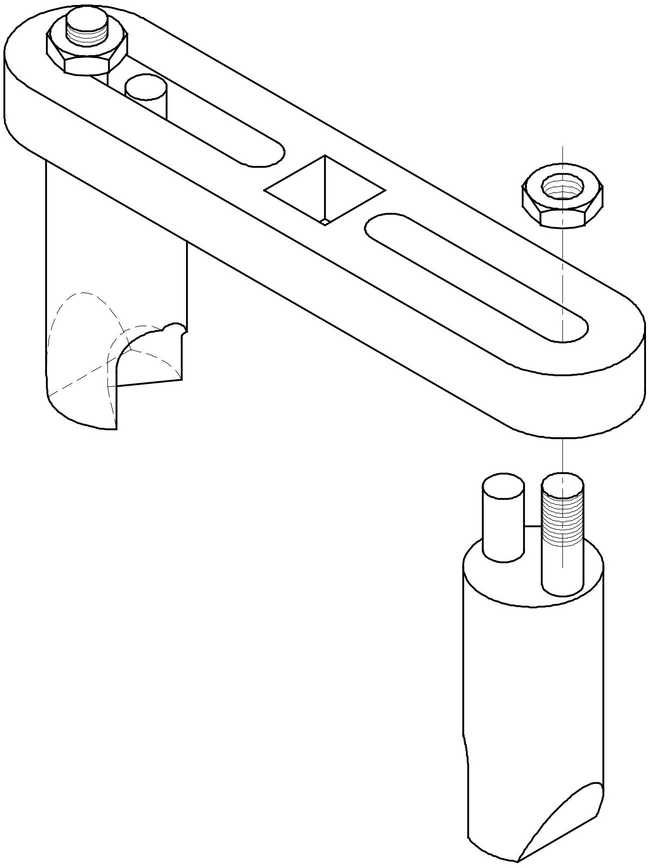


Figure 27 — Example of torque test clamp

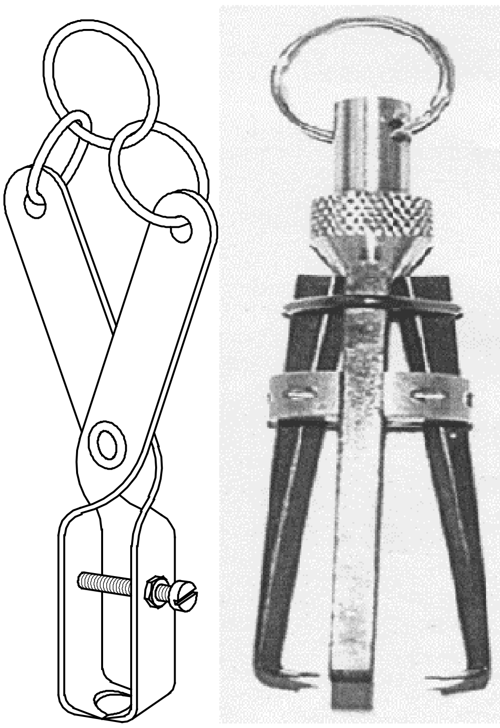


Figure 28 — Examples of tensile test clamps

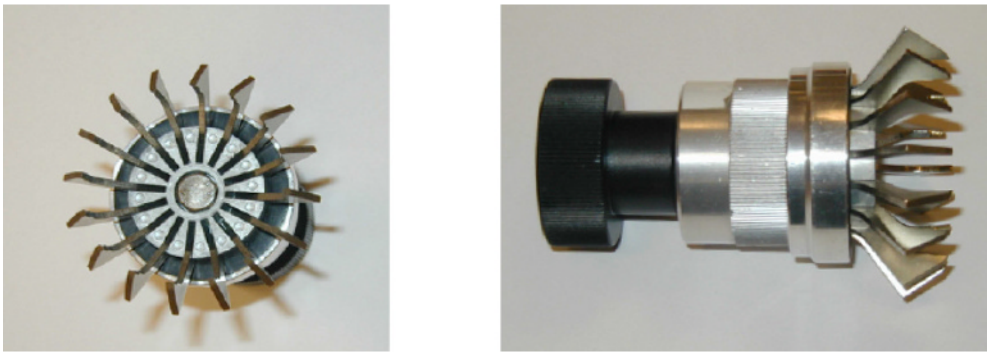


Figure 29 — Example of a tensile clamp

10.2.4 Test methodology (also in 11.2.4)

10.2.4.1 Assessment of child's ability to grip components

A component is considered to be grippable if a child can grip the component between its thumb and forefinger or between its teeth. The accessibility of the component to the child is also to be considered.

If the component to be tested cannot be gripped between thumb and forefinger, establish whether it is grippable by inserting the feeler gauge (see Figure 26) between the component and the underlying layer or body of the product at an angle between 0° and 10° from the surface using a force of (10 ± 1) N. If the gauge can be inserted more than 2 mm, the component shall be considered as grippable.

10.2.4.2 Torque test

Apply a torque gradually to the component over a period of 5 s in a clockwise direction until either:

a) a rotation of 180° from the original position has been attained; or

b) a torque of 0,34 Nm is reached.

The maximum rotation or required torque should be applied for 10 s.

The component should then be allowed to return to a relaxed condition and the procedure repeated in an anticlockwise direction.

Where projections, components or assemblies are rigidly mounted on an accessible rod or shaft designed to rotate together with the projections, components or assemblies, during the test, the rod or shaft should be clamped to prevent rotation.

If a component which is attached by a screw thread that becomes loosened during application of the required torque, the torque should continue to be applied until the required torque is exceeded or the component disassembles or it becomes apparent that the component will not disassemble.

When using clamps and test equipment care should be taken not to damage the attachment mechanism or body of the component.

Check whether any component or part of a component that is removed during the test fits wholly in any orientation and without compressing within the small parts cylinder specified in 10.2.3.1.

10.2.4.3 Tensile test

The tensile test should be carried out after the torque test, 10.2.4.2, and on the same component as used for the torque test.

Attach a suitable clamp, see 10.2.3.3, to the component assessed as being grippable in accordance with 10.2.4.1, taking care not to damage the attachment mechanism or body of the component.

Fasten the component in a tensile testing machine and apply a tensile force of up to 90 N to the component to be tested. Apply the force gradually over a period of 5s and maintain for 10s.

Check whether the component or any part of a component that is removed during the test fits wholly in any orientation and without compressing within the small parts cylinder specified in 10.2.3.1.

10.3 Accessibility of filling materials

10.3.1 Rationale

Where products have internal filling and the external covering to this filling could be reached by a child's mouth and teeth, it is important that the covering is not punctured to an extent that a child could gain access to the filling.

Filling materials could also be covered by an easy removable cover such as piece of fabric closed with a fastener and shall also be taken into consideration.

10.3.2 Requirement

No filling material should be removed from the product when tested in accordance with 10.3.4.

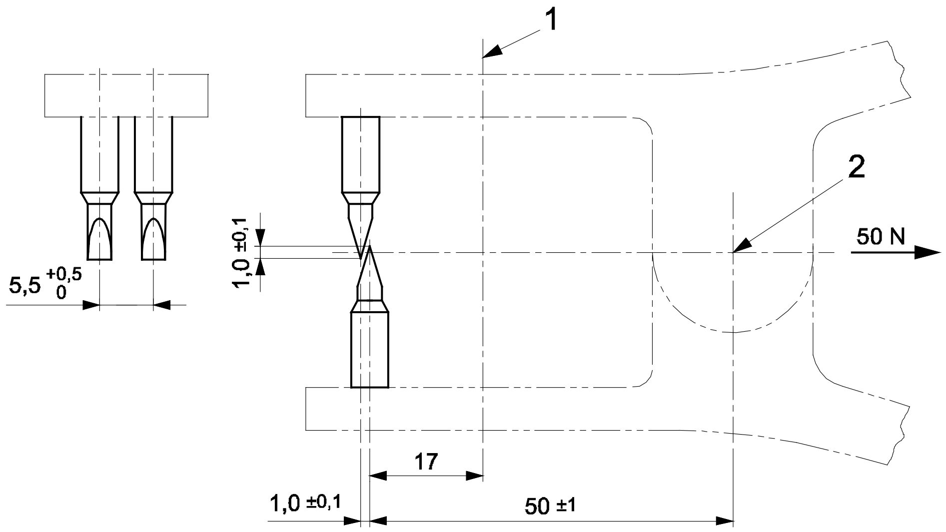
10.3.3 Test equipment

The device, Figure 30, consists of two sets of teeth, see Figure 31, made from H13 high chrome tool steel or equivalent and hardened to 45-50 Rockwell C. There are two teeth at the top and two at the bottom of the device, positioned so that the vertical centre line of one pair of teeth is (1 ± 0,1) mm in front of the centre line of the other set of teeth. In the fully closed position the teeth overlap each other by (1 ± 0,1) mm. The outermost corners of the teeth have a radius of (0,3 ± 0,1) mm.

The teeth are mounted so as to pivot about a point (50 ± 1) mm from the rear most pair of teeth and positioned so that when closed the centre lines of the two pairs of teeth are parallel to each other. The device is equipped with a stop to prevent the distance between the teeth from exceeding 28 mm when fully opened. The closing force of the teeth is set at (50 ± 5) N.

The device is provided with a guide to prevent items entering further into the fully opened jaws by more than 17 mm. The device is equipped with a means whereby a force of (50 ± 5) N can be applied along its centre line in a direction tending to pull the teeth off the sample.

Dimensions in millimetres



Key

1 position of guide

2 pivot Point

Figure 30 — Test device

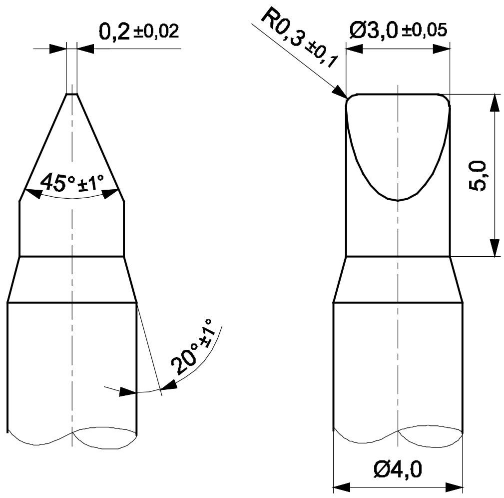


Figure 31 — Test teeth

10.3.4 Test methodology

The test procedure comprises two stages:

— stage 1) pinch the materials between finger and thumb and attach the test device so as to "bite" the smallest amount of materials possible to allow contact with all four teeth and apply a pulling force of 50 N, maintaining it for 10 s, to the device; then

— stage 2) open the jaws of the test device as far as possible and push it onto the material as far as the guide, allow the teeth to close on the material and apply a pulling force of 50 N, maintaining it for 10 s, to the device.

This test procedure is applied at two separate points on the relevant part.

If, during the test procedure, the outer material is punctured by the teeth, remove the outer material to expose the layer below or the filling and repeat stages 1 and 2 until the filling cannot be reached or no filling becomes detached. As soon as any filling becomes detached stop the test.

A puncture is defined as occurring when at least one tooth of the bite tester has broken the textile or plastic material to which it is being applied, the tooth passing through the entire thickness of the material. Where the bite tester is applied to materials of a loose weave or open mesh, a puncture is defined as occurring when part of the weave or mesh is broken by at least one of the teeth of the bite tester. Should the teeth of the bite tester pass through materials of a loose weave or open mesh without damaging the material, a puncture has not occurred.

10.4 Airway obstruction

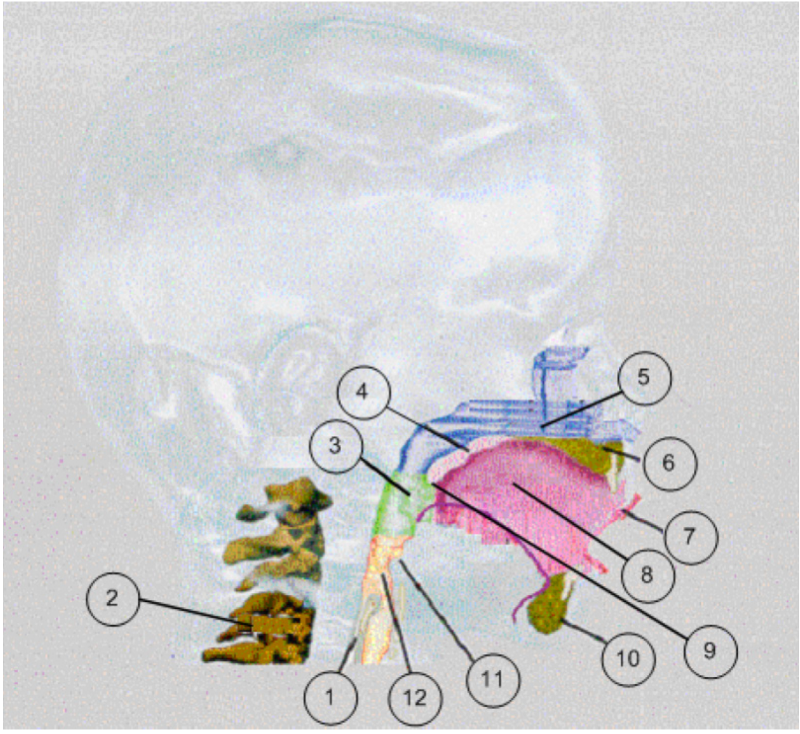
10.4.1 Rationale

Airway obstruction may be caused by a product or part of a product partially passing through the palatopharyngeal arch into the pharynx. Alternatively airway obstruction may be caused by a product or part of a product twisting in the rear portion of the oral cavity in such a way as to elevate the soft palate, thereby obstructing the flow of air from the nasal passages at the same time as the flow of air is at least partially obstructed within the oral cavity. Hazard level increases if a product or part of a product reaches the posterior portion of the oral cavity. Products or parts of products placed or lodged in the anterior portion of the oral cavity pose less risk because the anterior portion of the oral cavity is larger and is surrounded to the top and sides by rigid structures. The hazard level increases even more if objects pass beyond the palatopharyngeal arch. The most extreme hazard in incidents of airway penetration is that the airway will be completely occluded, therefore preventing the passage of air to the lungs. With some products it may therefore be necessary to restrict the shape and size of components.

Soft materials do not exhibit the same hazard than rigid materials.

Figure 32 shows the anatomical position of terms used relating to airway obstruction. This figure has been copied from DTI’s Safety Research report “Safety research into the size and shape of soothers”.

Additionally, products or parts of products which reach the back of a child’s throat may initiate the protective mechanism of the airway, which may cause the child to vomit, a potentially serious situation where the child cannot sit unaided or does not have the ability to remove the object.



Key

1	Esophagus
2	Spine
3	Oropharynx
4	Soft Palate
5	Nesopharynx
6	Hard Palate
7	Lips
8	Oral Cavity
9	Palatopharyngeal arch
10	Mandible
11	Epiglottis
12	Hypopharynx

Figure 32 — Position of anatomical terms used relating to airway obstruction

10.4.2 Protective mechanisms of the airway

The cough reflex and the gag reflex are mechanisms the body has for protecting itself from potential injuries by foreign objects obstructing the airway. Both of these mechanisms are vigorous and dependable in healthy children.

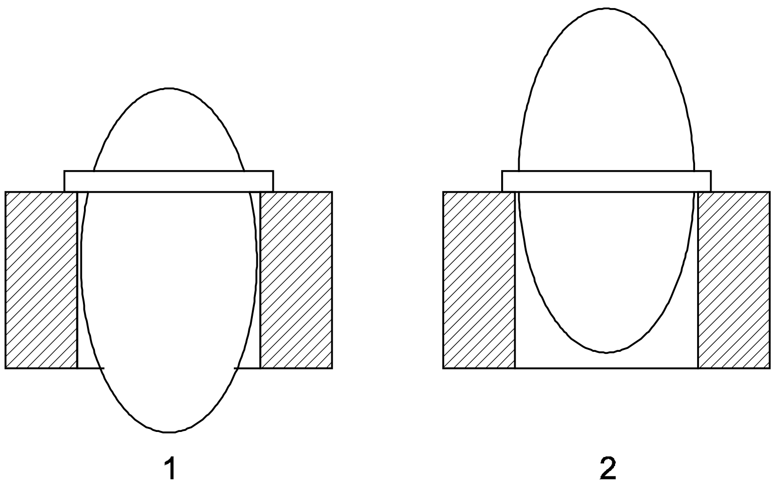
Productive coughs are triggered when foreign objects enter the airway. This reflex is most useful when the objects are small enough to be suspended and contained in the flow of air produced by these coughs and subsequently expelled from the airway.

The gag reflex can be triggered when objects encounter the rear portion of the oral cavity. This reflex protects the pharynx from intrusion by foreign objects. The gag reflex is a spasm of the muscles surrounding the pharynx which will usually propel objects away from the airway. The presence of gagging does not necessarily indicate choking or airway obstruction. Gagging is a defence against these injuries. However, if the muscular spasm of the gag reflex is unsuccessful in expelling the foreign object it may increase the hazard by forcing the highly reactive and flexible tissue at the rear of the oral cavity to grip the foreign object. This clamping action may exert a surprising amount of force and make extraction of the foreign object difficult.

10.4.3 Requirements

When tested in accordance with 10.4.5 the product or any part of a product that is accessible to the child should not pass through template A and no part of the product should protrude past the base of template A, Figure 33. If the product or part of the product has a nearly spherical, hemispherical or cylindrical end it should not pass through template B and no part of the product should protrude past the base of template B, Figure 34. See example Figure 33.

This requirement does not apply to soft material, soft-filled parts or fabrics.



Key

1 Potential hazard

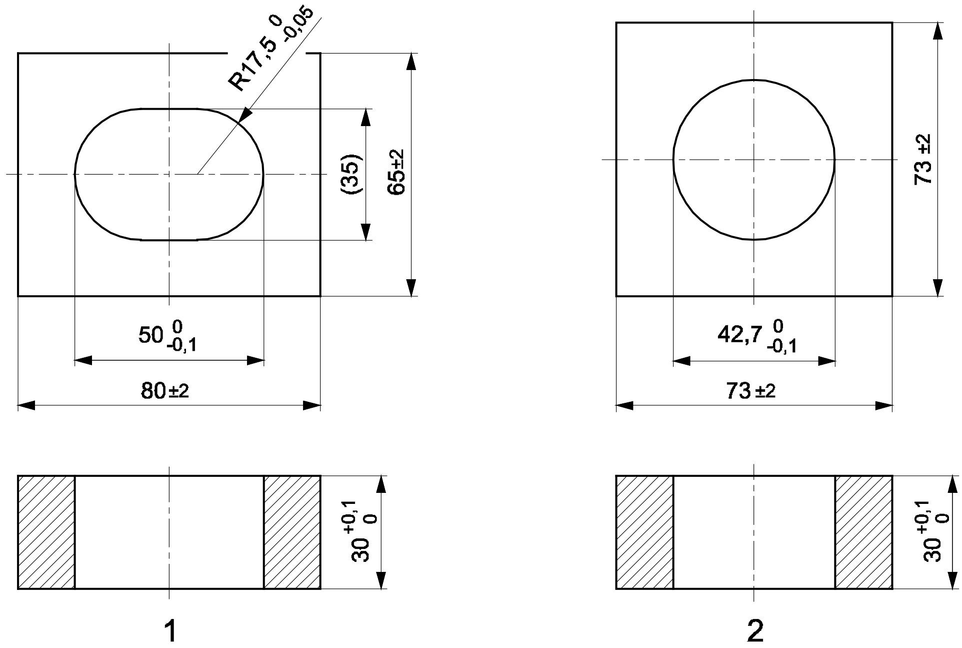
2 No potential hazard

Figure 33 – Example of product or part of the product with nearly spherical, hemispherical or cylindrical end

10.4.4 Test equipment

Templates made from plastics or other hard, smooth material with dimensions and either a slot or a hole as shown in Figure 34.

Dimensions in millimetres



Key

1 Template A

2 Template B

Figure 34 — Template A and B

10.4.5 Test methodology

Position and clamp template A or B, Figure 34, so that the axis of the slot/hole is substantially vertical and unobstructed at its top and bottom openings.

Orientate the object to be tested in a position which would most likely permit the entry of the object through the slot/hole in the template. Place the object in the slot/hole so that the only force on the object is the force due to its mass.

11 Suffocation hazards

11.1 Introduction

Suffocation is a serious hazard to young children. If air cannot pass into a child's lungs irreversible brain damage can occur.

Suffocation can occur if the child's external airways, the nose and mouth are blocked simultaneously. The most likely cause of this blocking is if a thin piece of plastic sufficiently large to cover the nose and mouth moulds itself to the child's face. The more the child breathes the closer the plastic can become attached and air is prevented from getting into the lungs. There is also a risk of suffocation from certain shapes, such as a bowl, half a ball or egg shapes that can be placed over a young child's nose and mouth forming an airtight seal. The available data indicates that children involved in fatalities associated with these shapes are between the ages of 4 and 24 months while "near misses" involve children up to 36 months of age.

The risk of suffocation is more likely to occur with thin plastic decals, sheeting and wrapping as thicker ones will not be able to mould themselves to the child's face. Therefore the thickness of plastic decals, sheeting and wrapping should be controlled.

11.2 Plastic decals and sheeting

11.2.1 Rationale

Plastic decals is taken to include transfers, plastic labels, adhesive labels etc. Decals should be securely attached to products to prevent a child removing them with its fingers, even after continuous picking at the edges or corners of decals. Decals should also remain securely attached in damp and wet situations. If there is any possibility that the decal would become detached from the product, it should be sufficiently small so that it would not cover both the mouth and nasal airways of a child.

If plastic sheeting is used as an external finish on a product it should be firmly attached to the product and/or of a thickness that would not allow it to mould to a child's face.

11.2.2 Requirements

When tested in accordance with 11.2.5.2 soaking test, 11.2.5.3 adhesion test or 11.2.5.4 tension test, plastic decals or plastic sheeting should not be removed or loosened from the product. If plastic decals or plastic sheeting is removed it should have an area greater than 100 mm × 100 mm and an average thickness more than 0,038 mm when tested in accordance with 11.2.5.5, plastic sheeting thickness. If the detached plastic decal or plastic sheeting has any dimension less than 100 mm (except thickness) it should not fit wholly within the small parts cylinder 11.2.4.1 Figure 35 in any orientation and without compressing it.

11.2.3 Determination of hazard

The hazard is determined through a sequence of tests that represent a child sucking and picking at a plastic decal or plastic sheeting. The first test is to soak the plastic decal or plastic sheeting to check that it does not become loosened when wet. This is then followed by the adhesion test, which uses a feeler gauge, Figure 36, to replicate the child picking at the plastic decal or plastic sheeting. Then a tensile force is applied to any part of the plastic decal or plastic sheeting that has lifted away from the product.

11.2.4 Test equipment

11.2.4.1 Small parts cylinder

Dimensions in millimetres

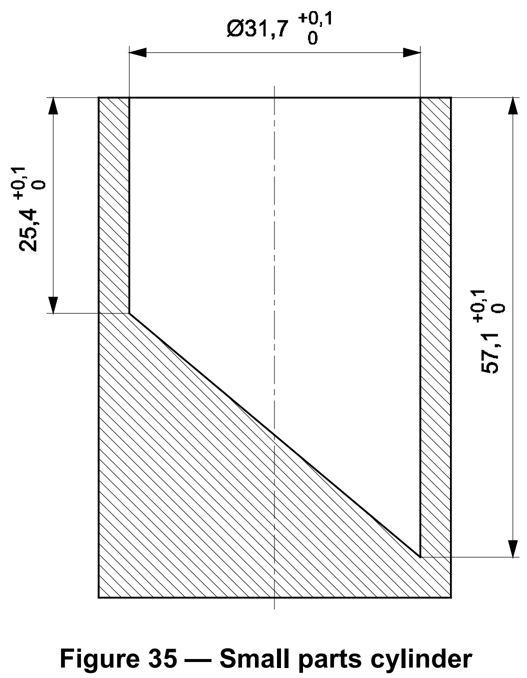


Figure 35 — Small parts cylinder

11.2.4.2 Feeler gauge

Dimensions in millimetres

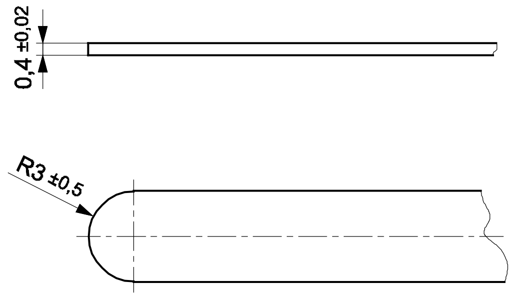


Figure 36 — Feeler gauge

11.2.5 Test methodology

11.2.5.1 Test temperature

The following tests should be conducted at a temperature of (20 ± 5) °C.

11.2.5.2 Soaking test

Submerge the product or part of the product with the plastic decal or plastic sheeting to be tested completely in a container of demineralised water at a temperature of (20 ± 5) °C for 4 min. Remove product or part of the product with the plastic decal or plastic sheeting from the demineralised water, allowing any excess water to run off. Maintain the product or part of the product with plastic decal or plastic sheeting at a temperature of (20 ± 5) °C for 10 min. Then repeat the test a further three times so that the product or part of the product is submerged a total of four times.

11.2.5.3 Adhesion test

Using a force of (25 ± 2) N insert the feeler gauge in 11.2.4.2 Figure 36 between the plastic decal or plastic sheeting and the underlying layer or the product at any angle between 0° and 10° from the surface. Repeat this for a further 29 times so that the feeler gauge is pushed between the plastic decal or plastic sheeting and the product for a total of 30 times. The feeler gauge should be pushed between the plastic decal or plastic sheeting and the product at the same position each time.

11.2.5.4 Tension test

Attach a suitable clamp to the plastic decal or plastic sheeting taking care not to damage the plastic decal or plastic sheeting. Apply a tensile force of up to 90 N gradually over a period of 5 seconds to the plastic decal or plastic sheeting and maintain for 10 seconds.

11.2.5.5 Measuring the thickness

Measure the thickness of the plastic decals or plastic sheeting at 10 equidistant points across the diagonal of any area having dimensions of at least 100 mm × 100 mm.

11.3 Non air-permeable packaging

11.3.1 Rationale

Enclosures that do not allow air to pass constitute a suffocation hazard. For child use and care articles the main hazard is likely to come from the plastic packaging covering the product and used by the manufacturer as a temporary protection of the product before use by the consumer. Plastic wrapping and plastic bags of such a size that the child can put the bag over its head should therefore be sufficiently thick so that it will not take the shape of a child's face and cover its nose and mouth or should be provided with ventilation holes.

All materials intended for disposal after delivery to the final destination should be marked with a warning if they may cause, due to their size and material, the risk of interfering with the airways of the child and/or the risk of containing oxygen reduced air.

11.3.2 Requirements - Packaging

NOTE 1 Packaging includes single use and repeated use packaging.

Flexible plastics used for packaging including bags should conform to either of the following:

a) Packaging that covers an area greater than 100 mm × 100 mm when tested in accordance with 11.3.4 should have an average thickness of not less than 0,038 mm.

b) Packaging with an average thickness of less than 0,038 mm and which covers an area greater than 100 mm × 100 mm should be perforated with holes so that a minimum of 1% of the area has been removed over any area of 30 mm × 30 mm.

Bags made of impermeable material with an opening perimeter greater than 360 mm should not have a drawstring or cord as a means of closing.

Packaging may be marked with the following warning:

"WARNING Keep this plastic cover away from children to avoid suffocation"

NOTE 2 The statement may be expressed in different words providing they clearly convey the same warning.

These requirements do not apply to shrunk-on film packaging, which is destroyed when the packaging is opened by the carer.

11.3.3 Test equipment

Measuring device capable of measuring thickness to an accuracy of 1 µm according to ISO 4593.

11.3.4 Test methodology

Measure the thickness of any sheet at 10 equidistant points across the diagonal of any 100 mm × 100 mm area and take a mean of the readings.

For plastic bags, cut the sides without stretching into two single sheets before measuring the thickness.

12 Ingestion hazards

12.1 Rationale

In order to avoid ingestion of small objects and accessible components, they should be of such a size that they do not pass through the child's mouth and throat to the stomach.

Children between the age of 0 and 36 months spend time exploring their environment. This exploration includes them twisting and pulling small objects/parts with their fingers, hands or teeth. They may therefore remove components and put them in their mouths. It is important therefore that any components or parts of components are sufficiently large not to pass through the mouth and throat to the stomach where they may become hazardous.

Components should therefore be assessed for their size and shape. This assessment should ensure that products or components are sufficiently large not to cause an ingestion hazard. Components should be tested to ensure that they are firmly attached or that if they are not firmly attached do not break into pieces sufficiently small to cause an ingestion hazard.

These requirements are intended to address the hazards associated with ingestion of strong magnets (e.g. neodymium iron boron type magnets), that are capable of causing intestinal perforation or blockage. These hazards are additional to those associated with small parts such as suffocation or asphyxiation.

Children may swallow magnets. If more than one magnet, or one magnet and a ferromagnetic object (for example iron or nickel) is ingested, the objects can be attracted to each other and cause perforation or blockage of the intestines, the results of which may be fatal.

The small parts cylinder used for testing is designed to replicate the dimensions of a child's throat.

Ingestion is a serious hazard to young children. If small products or components pass into a child's stomach toxic contamination or internal damage or blockages can occur

12.2 Ingestion of small components

12.2.1 Requirements

When tested in accordance with 12.2.3.1 (Assessment of child's ability to grip components), 12.2.3.2 (torque test) and 12.2.3.3 (tensile test), any component or part of a component that is removed, whether intended to be removed without the use of a tool or not, should not fit wholly within the small parts cylinder without compression, see 12.2.2.1 Figure 37.

12.2.2 Test equipment (Also used in 11.2.3)

12.2.2.1 Small parts cylinder

Dimensions in millimetres

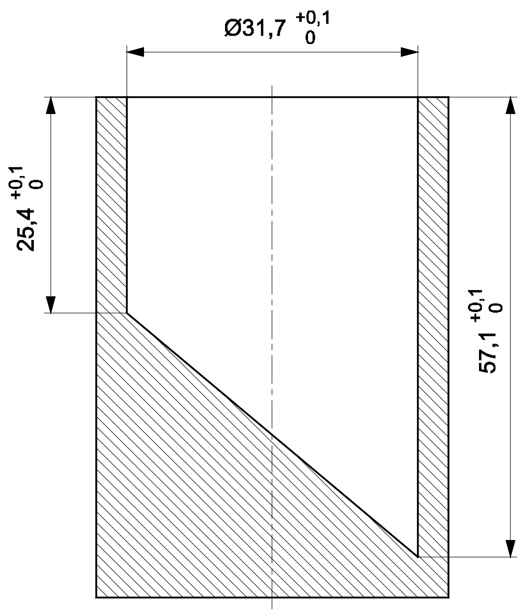


Figure 37 — Small parts cylinder

12.2.2.2 Feeler gauge

Dimensions in millimetres

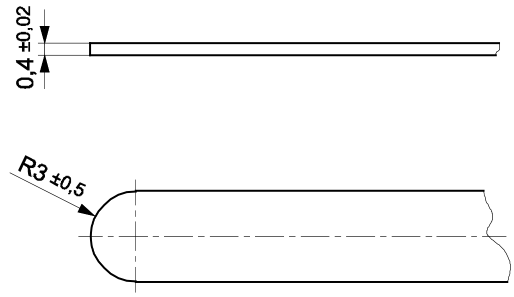


Figure 38 — Feeler gauge

12.2.2.3 Clamps

Clamps are required to grip the components being tested in both: the torque test, 12.2.3.2 (example at Figure 39) and the tension test, 12.2.3.3 (examples at Figure 40 and Figure 41). However where a clamp is used it should not damage the component being tested. Additionally the clamp should not affect the result of the test.

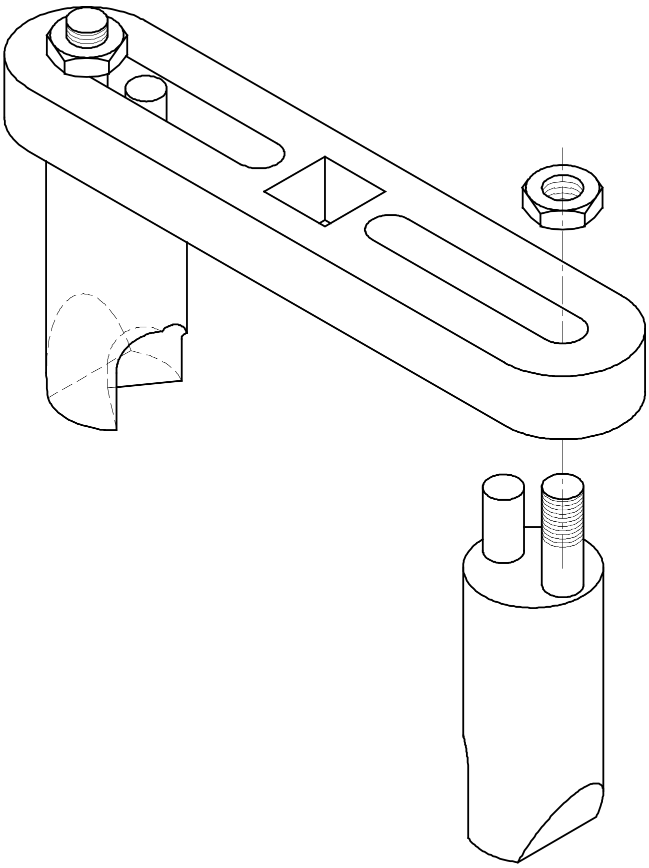


Figure 39 — Example of torque test clamp

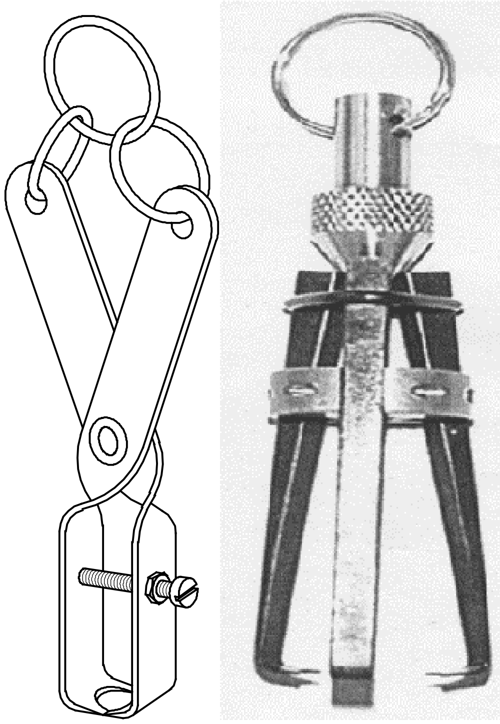


Figure 40 — Examples of tensile test clamps

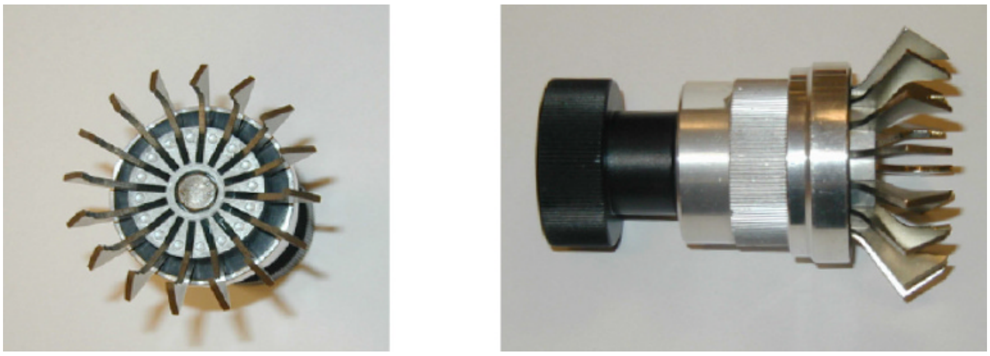


Figure 41 — Example of a tensile clamp

12.2.3 Test methodology

12.2.3.1 Assessment of child’s ability to grip components

A component is considered to be grippable if the child can grip the component between its thumb and forefinger or between its teeth. The accessibility of the component by the child is also to be considered. Where it is difficult to assess whether a child can grip a component, it should be possible to insert the feeler gauge in 12.2.2.2 Figure 37 at an angle between 0° and 10° from the surface at least 2 mm using a force of (10 ± 1) N between the component and the underlying layer of the component or the product for the component to be considered as grippable by the child.

12.2.3.2 Torque test

Apply a torque gradually to the component over a period of 5 s in a clockwise direction until either:

a) a rotation of 180° from the original position has been attained; or

b) a torque of 0,34 Nm is reached.

The maximum rotation or required torque should be applied for 10 s.

The component should then be allowed to return to a relaxed condition and the procedure repeated in an anticlockwise direction.

Where projections, components or assemblies are rigidly mounted on an accessible rod or shaft designed to rotate together with the projections, components or assemblies, during the test, the rod or shaft should be clamped to prevent rotation.

If a component which is attached by a screw thread that becomes loosened during application of the required torque, the torque should continue to be applied until the required torque is exceeded or the component disassembles or it becomes apparent that the component will not disassemble.

When using clamps and test equipment, care should be taken not to damage the attachment mechanism or body of the component.

Check whether any component or part of a component that is removed during the test fits wholly within the small parts cylinder specified in 12.2.2.1.

12.2.3.3 Tensile test

The tensile test should be carried out after the torque test, 12.2.3.2, and on the same component as used for the torque test.

Attach a suitable clamp, see 12.2.2.3, to the component assessed as being grippable in accordance with 12.2.3.1, taking care not to damage the attachment mechanism or body of the component.

Fasten the component in a tensile testing machine and apply a tensile force of up to 90 N to the component to be tested. Apply the force gradually over a period of 5 s and maintain for 10 s.

Check whether the component or any part of a component that is removed during the test fits wholly within the small parts cylinder specified in 12.2.2.1.

13 Hazardous edges and projections

13.1 Introduction

Sharp edges on products could cause cuts, lacerations and abrasions to a child’s skin. Projecting parts of products could puncture a child’s skin or pierce a child’s eye.

Corners should be considered as sharp edges and projections as they can cause similar injuries. Corners should therefore be protected in a similar way to edges, 13.2 or rigid protruding parts, 13.3.

13.2 Edges

13.2.1 Rationale

Sharp edges and corners on products could cause cuts, lacerations and abrasions to a child’s skin.

13.2.2 Requirements - Edges on products and components

All exposed edges, surfaces and protrusions should be rounded or chamfered and free from burrs and sharp edges.

When tested in accordance with 13.2.3 any protective covering should either not be removed or if removed, all exposed edges should be rounded or chamfered and free from burrs and sharp edges.

13.2.3 Test methodology

Apply a tensile force of up to 90 N to the protective covering of the product to be tested. Apply the force gradually over a period of 5 s and maintain for 10 s.

13.3 Rigid protruding parts

13.3.1 Rationale

Tubes, bars, levers or other similar rigid components in the form of projections which constitute a puncture hazard to a child should be protected. The protruding component can possibly injure a falling or crawling child by their make-up, diameter or length. When such components are protected by a covering, it is important that the covering remains firmly in place during the useable life of the product.

Any protruding part should comply with 9.1 (snagging hazards). The hazard of puncture should therefore be reduced as a child should not be able to fall onto the projection, however there is a risk of the child walking into or contacting an overhead projection.

13.3.2 Requirements

Projections should have a minimum cross section of 5 mm or have a protective covering that increases its cross section to more than 5 mm. When tested in accordance with 13.3.3 the protective covering should not be removed.

13.3.3 Test methodology

Apply a tensile force of up to 90 N to the protective covering. Apply the force gradually over a period of 5 s and maintain for 10 s.

13.4 Points and wires

13.4.1 Rationale

Points and wires are a puncture hazard which could present an unreasonable risk. Points and wires should be protected to remove the risk of injury to the child.

The requirement in 13.4.2 cannot guarantee the protection of the child’s eyes or the soft tissues of its mouth. The requirement should be supplemented with a subjective assessment to determine if points with a cross section of 5mm or less are potentially hazardous. Tactile testing can be used for this assessment.

13.4.2 Requirement

Points and wires should be provided with a protective covering or rounded, blunted or bent into a ball with a cross section greater than 5 mm. This requirement should be applied before and after other tests are conducted on the product.

Tactile testing can be used for this assessment.

14 Structural integrity

14.1 Introduction

Where inadequate materials are used this could lead to a hazard induced by poor structural integrity so careful choice of materials is necessary.

Where inadequate strength and/or durability could lead to hazardous situations arising from foreseeable use, requirements should be included in standards.

Products should have adequate strength and durability lasting for the overall lifetime of the product.

Internal and external forces, static and dynamic loads and the long term properties of the product should all be considered. Reasonable safety factors and worst case situations should also be taken into account.

In relation to foreseen hazards it may be necessary to test the product for:

— deformation under static and/or dynamic loading including impact;

— fracture under static and/or dynamic loading including impact;

— fatigue failure under cyclic loading;

— creep failure under sustained loading;

— failure under single excessive loading.

All strength and durability testing should be performed/repeated after subjecting the product to foreseeable conditions that may weaken the product, for example washing, corrosion, extremes of temperature. Static tests should be performed/repeated after cyclic load tests or other endurance tests.

Strength and durability should also be considered for non-rigid fabrics, for example seam strength.

Specific test methods and load factors may be established by reference to existing standards and other appropriate data.

14.2 Material suitability

14.2.1 Rationale

Material properties can become hazardous during use because of degradation of the material through:

— ageing from exposure to the sun, UV, saliva or sweat;

— decay;

— infestation;

— cleaning substances, including shrinkage due to cleaning;

— corrosion from exposure to water, air or salts.

Exposure to different temperature ranges, humidity, UV radiation (including sunlight), weather conditions and other forms of ageing may cause some materials to become weak or brittle, or their chemical properties may change. When developing technical standards for child use and care articles, if ageing is identified as a hazard for the product, specific requirements and test methods to simulate ageing should be defined.

14.2.2 Requirements

The material properties should not be impaired when tested in accordance with 14.3.3.

The various test methodologies are specified in numerous published standards that can be used in assessing material suitability as explained in the rationale.

14.3 Strength and durability of the product

14.3.1 Rationale

The strength and durability of the product should be sufficient to withstand all foreseen uses of the product. If the product fails due to inadequate strength or durability during use, the child using the product will be placed in a hazardous situation, e.g. a child's body may be crushed if a product collapses around the child.

Most products are subject to mechanical wear when used, as there might be friction between moving parts or between the product and other objects. Typical examples are products that are possible to fold/unfold, take apart or adjust where the movement might, in time, significantly affect the safety of the product. When developing technical standards for child use and care articles, if wear is identified as a hazard for the product, specific requirements and test methods to simulate wear should be defined.

14.3.2 Requirements

When tested in accordance with 14.3.3 there should be no break or deformation of any part of the product that can impair the safety of the product, and no other hazards such as Choking Hazards according to Clause 10, Suffocation Hazards according to Clause 11, Ingestion Hazards according to Clause 12 and Hazardous Edges and Projections according to Clause 13.

14.3.3 Test methodology

Suitable dynamic and/or static tests should be used to simulate the intended use of the product with the addition of an appropriate safety factor.

15 Protective function

15.1 Introduction

Products that restrict a child's access to hazards (e.g. safety barrier), products that contain a child within a specific environment (e.g. playpen), products that limit a child's movement (e.g. safety harness) provide a protective function. Any protective function should be suitable for the age and ability of the child using the product and should not have its function and effectiveness reduced during its use.

15.2 Barrier function

15.2.1 Rationale

Barriers may be used to either restrict a child's access to a specific area or to contain a child within a specific area. The barrier should be designed so that a child cannot climb over it, pass under it, pass through it or remove it. Where bars are used to form a barrier they should be spaced sufficiently close together so that a child cannot pass between the bars. However, any spacing should not allow a child's body to pass between the bars thus giving rise to a potential strangulation hazard, see 5.2. Where locking and latching mechanisms are used to keep a barrier in place, these mechanisms should be designed so that a child cannot undo them. Barriers should be designed so that a child cannot displace them.

These barriers will not stop a child from passing their limbs through them, so the distance from the hazard should be considered when drafting a product standard.

The following does not consider the child's ability to climb, other than the clauses concerning footholds. The structural integrity of barriers relies on the child's ability to resist fatigue and impact conditions which could lead to hazardous conditions.

15.2.2 Requirements

15.2.2.1 Height

When tested in accordance with 15.2.4.1 the height should always be equal to or greater than the height specified for the child's age in Table 5, and its structural integrity should be maintained.

Table 5 — Height according to age

Age Months	Body length (mm) P95	Centre of gravity (% of length)[b]	Centre of gravity calculated from the ground	Height requirement for age[a]
3 to 6	701	58,5	410	450
6 to 9	750		439	485
9 to 12	794		464	510
12 to 18	862		504	555
18 to 24	930		544	600

[a] Safety factor of 10 % (rounded up or down) added.

b This value represents the average centre of gravity from 3 to 24 month.

15.2.2.2 Gaps

Gaps between components and between the barrier function and the floor should not allow the hip probe to pass through or under the barrier, when tested in accordance with 15.2.4.2.

15.2.3 Test equipment - Hip probe

The hip probe, Figure 42, represents the hip of the smallest child in each age range. The probe size corresponds to the size of the child as follows:

— dimension 'A' represents the hip breadth;

— dimension 'B' represents hip depth;

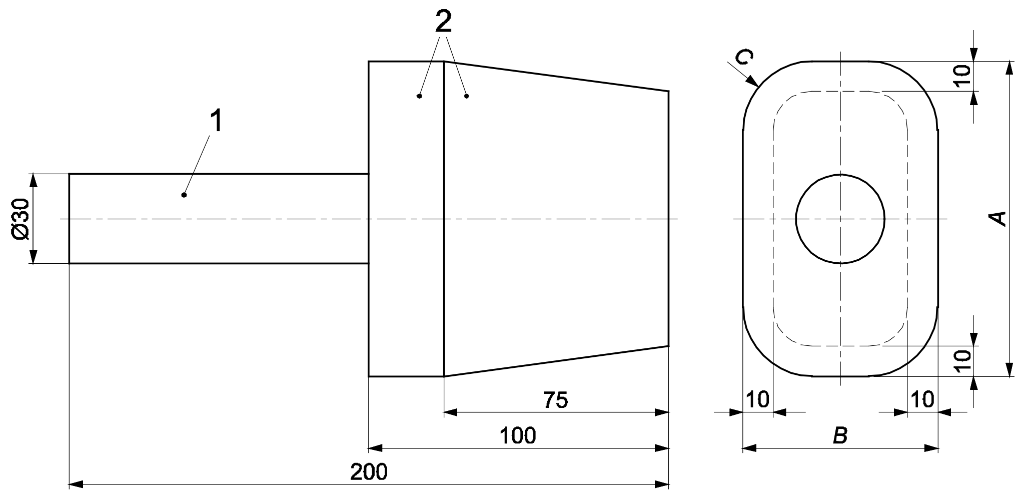
— dimension 'C' represents the radius C after calculation based on hip circumference.

The dimensions of the hip probe are based on the anthropometric data.

Table 6 — Hip probe corresponding to smallest child

Age Months	A	B	C
0 to 2	101	42	10
3 to 5	105	65	23
6 to 8	124	67	23

Dimensions in millimetres



Key

1 Handle

2 Hip probe

Figure 42 — Hip probe

15.2.4 Test methodology

15.2.4.1 Measurement of height

Apply a vertical downward force of at least 250 N on the centre of the top rail of the barrier. Maintain this force while checking the height of the barrier.

15.2.4.2 Gaps

Press the hip probe, Figure 42, with the highest force possible up to 30 N into the gaps. If the hip probe passes completely through the opening then the gap is considered to be a hazard.

15.2.4.3 Endurance test

Open and close the locking and/or attachment mechanism not less than 300 times, or what is appropriate to the product category.

15.3 Restraint systems

15.3.1 Rationale

Where it may be hazardous for a child to fall out of a product, for example in a pushchair, a restraint system is required to limit the child’s movement. The restraint system should retain the child within the product. For some products it is appropriate to have the restraint system permanently attached to the product and for other products a means of attaching a separate safety harness may be considered to be sufficient, in which case specific anchorage points should be incorporated into the product.

15.3.2 Terms and definitions related to restraint systems

15.3.2.1
restraint system
system to restrain the child within the product

15.3.2.2
crotch restraint
device designed to be positioned between the child's legs to prevent the child from sliding forward

15.3.2.3
harness anchorage points for an additional harness
attachment points suitable for the attachment of an additional child's safety harness

15.3.3 Requirements

15.3.3.1 Restraint system

The restraint system should be capable of adjustment to the size of the child.

The restraint system should comprise a crotch restraint and a waist restraint or crotch restraint and shoulder restraint or crotch restraint and waist and shoulder restraint

It should not be possible to use the restraint system without the crotch restraint being used.

Where straps are used for waist and crotch restraint they should have a minimum width of 19 mm. Where shoulder straps are included in a restraint system they should have a minimum width of 15 mm.

When tested in accordance with 15.3.5.1, the test dummy, given in 15.3.4 should not fall completely out the restraint system. It should be noted that any partial movement of test dummy is not considered as a failure.

When tested in accordance with 15.3.5.2, the attachment of the restraint system should not break and continue to function as intended.

When tested in accordance with 15.3.5.3, fasteners should not be released or have suffered damage which impairs their operation and function.

When tested in accordance with 15.3.5.4 the maximum slippage of adjusters should be 20 mm.

15.3.3.2 Harness anchorage points

When tested in accordance with 15.3.5.5 the harness anchorage points should not break and should continue to function as intended.

15.3.4 Test equipment

Dummy made of a rigid material with a smooth finish and a total mass of (9 ± 0,1) kg, see Figure 43.

Tolerances: ± 2 mm

Angles ± 2°

All corner radii where shown to be 10 ± 1 mm.

Dimensions in millimetres

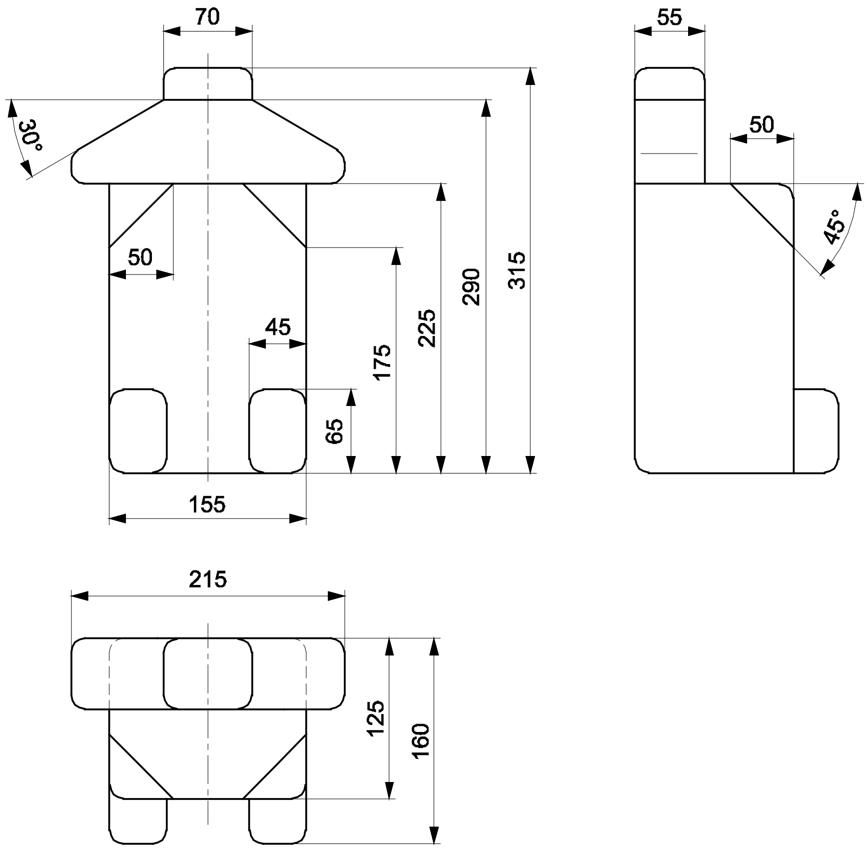


Figure 43 — Test dummy

15.3.5 Test methodology

15.3.5.1 Effectiveness of the restraint system

Initially place the test dummy centrally on the seat unit with the 225 mm axis against the back rest and attach the restraint system in accordance with the manufacturer’s instructions. Fasten any waist restraint around the torso section of the test dummy so that any slackness is removed and the waist restraint is positioned above the leg stumps. If the crotch restraint is adjustable, adjust it so that any slackness is removed. Where shoulder straps are fitted, place a 30 mm cuboid spacer block, made of a hard smooth material, on each shoulder of the test dummy. Adjust each shoulder strap so that any slackness is removed. Remove the cuboid spacer blocks.

A means of rotation should be used to rotate the product smoothly through 360° at a speed of (4 ± 0,5) RPM in a forward and reverse direction.

Rotate the product through 360° in a forward direction. Reposition the test dummy to its initial position without altering the adjusters on the restraint system. Rotate the product through 360° in the reverse direction. Reposition the test dummy to its initial position without altering the adjusters on the restraint system.

Repeat the forward and reverse rotation cycles for two more sequences, giving a total of 3 forward and 3 reverse rotations. After each rotation, reposition the test dummy to its initial position without altering the adjusters on the restraint system.

15.3.5.2 Attachment of the restraint system to the product

Gradually apply (150 ± 2) N to each point of attachment of the restraint system in the most onerous direction. Maintain this force for 1 min.

If more than one strap is attached at the same attachment point the (150 ± 2) N should be applied to each strap simultaneously.

15.3.5.3 Strength of fastener

A tensile force of 200 N should be gradually applied to the straps (or other attachment) either side of the fastener. Maintain this force for 1 min.

Fix one end of the straps (or other attachment) and pull on the other straps (or other attachment) such that the tensile force is applied to fastener.

15.3.5.4 Effectiveness of the adjustment system

Use approximately 125 mm of the restraint system on either side of the adjustment system.

Fix one end of the test piece into one jaw of a dynamometer and the other end into another jaw. The distance between the jaws should be 200 mm.

Draw a line across the width of the test piece flush with each jaw.

Set the jaw movement speed to (500 ± 10) mm/min. Reduce the distance between the jaws to 150 mm. Subject the test piece to a tensile strain until the latter reaches (100 ± 10) N. When this strain has been reached, return the distance between the jaws to 150 mm.

Conduct the test for a total of 10 times.

Measure the distance between the lines drawn flush with the jaws. The difference between this dimension and original dimension of 200 mm is the amount of slippage.

15.3.5.5 Strength of the harness anchorage points

Gradually apply (150 ± 2) N to the harness anchorage point in the most onerous direction. Maintain this force for 1 min.

If more than one harness anchorage point is attached at the same position, the (150 ± 2) N should be applied to each harness anchorage point simultaneously.

15.4 Footholds

15.4.1 Rationale

Footholds on rigid structures which provide barrier protection (see 15.2) should be avoided as the presence of footholds could enable a child to climb the barrier. A child may find it difficult to gain a foothold on a flexible component which does not also have a rigid structure associated with it.

15.4.2 Requirements

There should be no footholds when tested in accordance with 15.4.5.

Where there is a rigid structure obscured by a flexible material there should be no footholds when tested in accordance with 15.4.5.

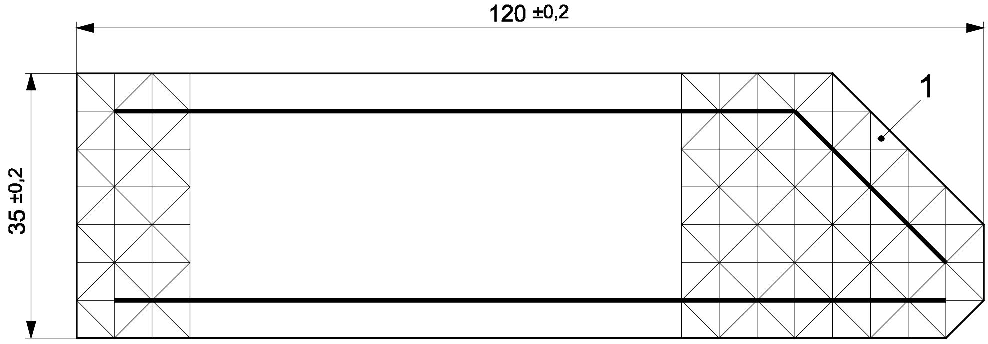
This requirement does not apply to seams in fabrics of multiple layers.

15.4.3 Test equipment (Templates)

A strip of 10 mm thick transparent material cut to the shape as shown in Figure 44.

The sides of the template shall be square to the faces. All edges and corners shall be left as machined without any radius.

Dimensions in millimetres



Key

1 Triangular cells plotted on a 5 x 5 ± 0,2 grid

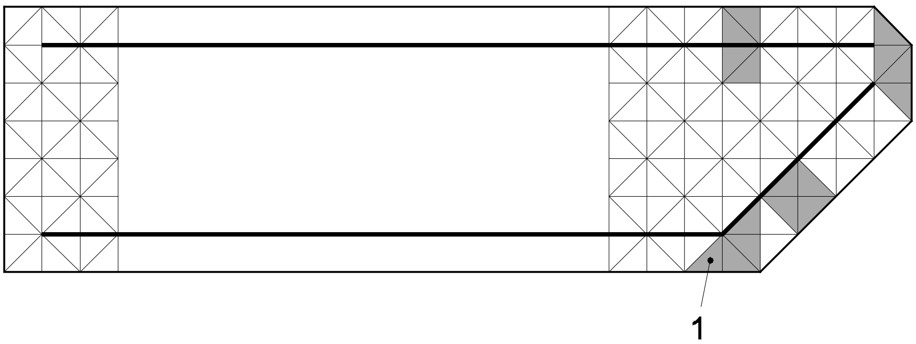
Figure 44 — Template for the foothold test (example of left hand template)

Two templates are required to provide a left and right hand template. The marking shown in Figure 44 are on the bottom face of each template to avoid parallax errors.

15.4.4 Determination of a foothold

15.4.4.1 Continuous structure

After tested in accordance with 15.4.5.1, a foothold exists on a continuous structure if four triangles marked on the template are completely obscured by the structure being checked. These four triangles shall have at least one side in common with another of the triangles, see Figure 45 below.



Key

1 This shaded area denotes one triangle, four shaded areas denotes four obscured triangles

Figure 45 — Examples of obscured triangles indicating a foothold on a continuous structure

15.4.4.2 Non-continuous structure

After tested in accordance with 15.4.5.2, a foothold exists on a non-continuous structure if two or more triangles marked on the template are completely obscured between the edge of the template and both the bold lines of the template by the structure being checked. The two or more triangles on each side of the template shall have at least one side in common with each other, see Figure 46 .

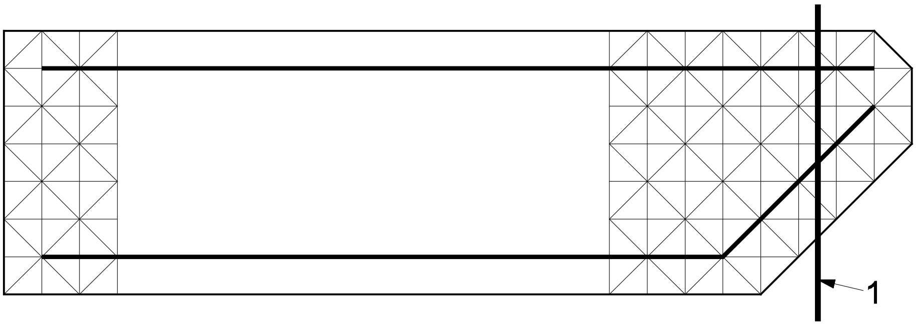
Key

1 This shaded area denotes one triangle

Figure 46 — Examples of obscured triangles indicating a foothold

15.4.4.3 Wire, thin structures or similar parts

After tested in accordance with 15.4.5.3, a foothold exists on a wire, thin structure and similar part if it projects across the bold lines on the template, see Figure 47.



Key

1 Denotes a wire, thin structure or similar part

Figure 47 — Examples of a foothold on a wire, thin structure and similar part

15.4.4.4 Foot hold on an Intersecting or adjacent structures where the second structure prevents slipping

After tested in accordance with 15.4.5.4, a foothold exists on an intersecting or adjacent structure where the second structure prevents slipping.

15.4.5 Test methodology

15.4.5.1 Footholds on a continuous support at an angle less than 55°

Using either the left or right hand template place the template with its marked face on any continuous structure inclined at less than 55° to the horizontal. Orientate either template, Figure 44 , to check whether any four triangles are obscured indicating a foothold, see Figure 48 for example.

15.4.5.2 Footholds on a non-continuous support at an angle less than 55°

Using either the left or right hand template place the template with its marked face on any non-continuous structure inclined at less than 55° to the horizontal. Orientate either template, Figure 44 , to check whether any triangles are obscured either side of the bold lines on the template indicating a foothold, see Figure 48 for example.

15.4.5.3 Foot hold on a Wire, thin structures or similar parts at an angle less than 55°

Using either the left or right hand template place the template with its marked face on any wire, thin structure or similar parts at an angle less than 55° to the horizontal. Check whether the wire, thin structure or similar part has a line of contact extending between the two bold lines marked along the template, Figure 44, see Figure 50 for example.

15.4.5.4 Foot hold on an intersecting or adjacent structure where the second structure prevents slipping

Using either the left or right hand template place the template with its marked face on any structure, thin structure or similar parts between 55° and 80° to the horizontal where there is also a supporting structure. Orientate either template, Figure 44, to check whether any four triangles are obscured indicating a foothold, Figure 51 for example. Where there is a wire, thin structure or similar part check whether there is a line of contact extending between the two bold lines marked along the template, Figure 46.

15.4.5.5 Footholds on rigid components covered by flexible materials

Where flexible materials or fabrics are covering rigid components the template is pushed against the flexible material or fabric with a horizontal force of up to 30 N acting along the longitudinal axis of the template. Orientate either the right or left hand template, Figure 44, to check whether any four triangles are obscured by the rigid components indicating a foothold.

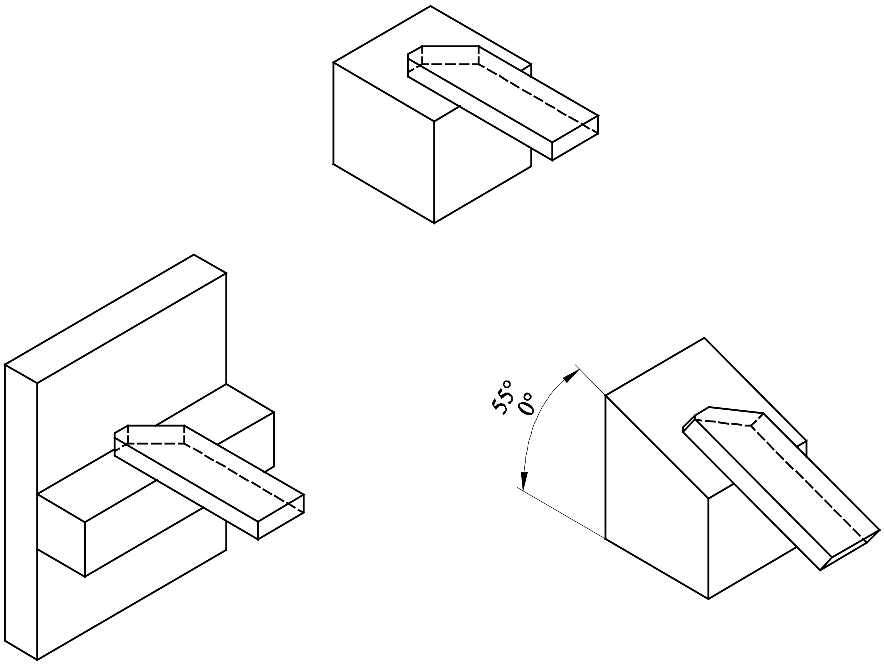


Figure 48 — Examples of footholds on a continuous support at an angle less than 55°

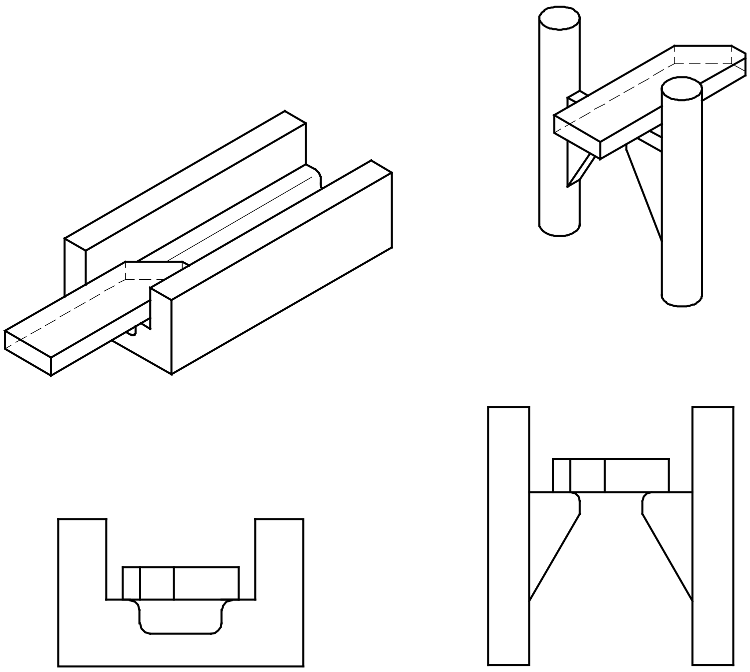


Figure 49 — Examples of footholds on a non-continuous support at an angle less than 55°

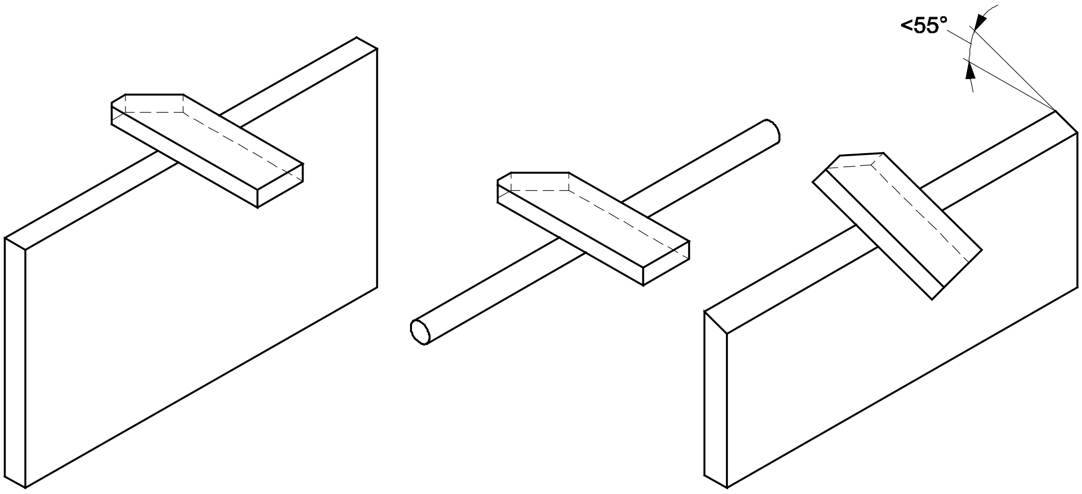


Figure 50 — Examples of footholds on wire, thin structures or similar parts at an angle less than 55°

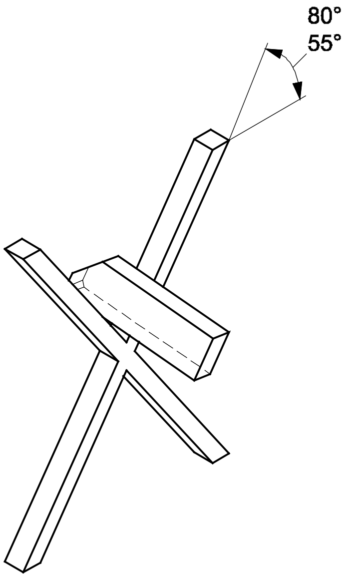


Figure 51 — Example of footholds on intersecting or adjacent structures where the second structure prevents slipping

16 Hazard associated with stability

16.1 Rationale

Child care articles need to be sufficiently stable for the safety of the child to avoid hazards associated with the product tipping over.

16.2 General requirement

A range of suitable stability requirements should be associated with the function and the construction of the product.

Bibliography

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ADAPS (© 79-93 TU-Delft University of Technology, Faculty of Industrial Design Engineering)

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