Non-integrated finger protection – A background study and proposals of requirements and test methods

Karin Lundh and Erica Waller

SP Technical Research Institute of Sweden

Study commissioned by:
The Consumer Council at the Austrian Standards Institute

Study supervised by:
Dr. Franz Fiala

SP Report 2008:12

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Abstract

Young children have a natural curiosity and have not yet learned to avoid and get away from danger. It is often necessary to take measures to protect children from hazards. Parents buy protective products to avoid or decrease risks in their own and their children's lives. Different kinds of protective products, including finger protection, are also common in nurseries, hospitals and other institutions.

When a finger protection is bought and installed this gives the consumer a greater sense of security. It is vital that reality agrees with this sense. Otherwise the risk of injury may in fact increase, since a sense of security in the parent/supervisor often implies less supervision. It is therefore important to make sure that protective products on the market are safe and that they give the protection they were designed to give.

This report presents a background study including injury statistics and discusses the hazards as well as methods of prevention/protection. Finger protection devices are divided into categories based on their protection method. Reasonable requirements, based on children's characteristics and abilities, and ways to test these are discussed. Finally, suggestions of requirements and test methods are presented in the form of complete product standards for the different kinds of finger protection.

'Finger protection' in this report refers to protective devices designed to prevent crushing injuries between door leaf and door frame. This report deals only with non-integrated finger protection for inner doors, i.e. devices which are mounted onto an existing inner door. Currently there is no European standard regulating this kind of products.

Key words: finger protection, child safety, finger protection, child protection, child protective product, crushing, crushing injury, door

SP Sveriges Tekniska Forskningsinstitut
SP Technical Research Institute of Sweden

SP Report 2008:12
ISBN 978-91-85829-28-6
ISSN 0284-5172
Borås 2008

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Preface

This report targets people involved in the preparations of standards and people at authorities and test institutes as well as designers and manufacturers. The report presents suggestions of requirements and test methods in the form of complete product standards as well as motivations to these.

This study has been commissioned to SP Technical Research Institute of Sweden by Dr Franz Fiala at the Österreichisches Normungsinstitut. The work has been carried out at the department of Building Technology and Mechanics at SP and has also involved experts from SP's department of Materials Technology and Chemistry.

SP has studied child protective products before. As an example, in a report from 2004 the protective function of socket protectors, hob guards, locks and locking devices was analysed and requirements and test methods were proposed. That study was commissioned by ANEC The European Association for the Coordination of Consumer representation in Standardisation. In addition, many different child use and care products are tested by SP according to European standards on a regular basis.

The authors would like to sincerely thank Dr. Franz Fiala at the Österreichisches Normungsinstitut, for initiating and supervising this project.
Many thanks also to Stefan Westius at Safe-Side for consultations and product samples for testing. Thanks also to IKEA who likewise contributed with product samples.

Borås, Sweden in March 2008

Karin Lundh

1 Introduction

Consumers buy protective products to avoid or decrease risks in their lives. When a finger protection is bought and installed this gives the consumer a greater sense of security. It is vital that reality agrees with this sense. Otherwise the risk of injury may in fact increase, since a sense of security with a parent often implies less supervision. It is therefore important to make sure that protective products on the market are safe and that they give the protection they were designed to give.

"Finger protection" in this report refers to protective devices designed to prevent crushing injuries between door leaf and door frame. This report only deals with non-integrated finger protection, i.e. devices which are mounted onto an existing door and do not need a special design of the door. Currently there is no European standard regulating this kind of products. This report categorizes non-integrated finger protection into three types and gives suggestions of three complete product standards, one for each type, including requirements and tests methods. The basis for these suggestions is discussions among several experienced test engineers, child protection experts and parents as well as a series of test try-outs.

1.1 Crushing injuries related to doors

Statistics from the Swedish participants in the IDB (Injury Data Base) processed by the Swedish National Board of Health and Welfare over children being treated in hospitals and care centres during 2003 – 2006 show that about 2 500 children (0-17 years) are injured in crushing accidents with doors in Sweden each year [1], cf. Table 1.

Table 1 Number of children treated in hospitals and care centres for crushing injuries related to doors during 2003 – 2006 [1]

Site of injury	Age	No. of injured in IDB-area	Country estimate*	95 % confidence interval of country est.
Indoor	0-6	226	4 758	4 176 – 5 421
Indoor	7-17	204	3 847	3 354 – 4 413
Outdoor	0-6	20	421	272 – 653
Outdoor	7-17	23	434	288 – 653
Not known	0-6	14	295	175 – 498
Not known	7-17	11	207	115 – 375
Total	0-17	498	9 962	9 079 – 10 845

* The population of Sweden is about 9 000 000

The injuries arriving at the emergency unit at Norrlands universitetssjukhus (the university hospital in Umeå, Sweden) during 1996-1997 were analysed by Björnstig and Björnstig [2]. Their report, commissioned by the Swedish Consumer Agency (Konsumentverket), states that door related injuries are frequent, in some cases serious and often appear to be particularly unnecessary and fairly easy to prevent. Norrlands universitetssjukhus is a participant in the IDB (Injury Data Base), which at the time of the report was called EHLASS (European Home and Leisure Accident Surveillance System). The door related injury incidence in this study was one injured per 1 000 population per year.

In the study [2], 46 % of the injuries in homes affected children under 15 years of age. Crushing was by far the most common cause of injury among children, cf. Table 2. More than two thirds (68 %) of all injuries on children were door related crushing injuries

caused by another person, child or adult, who shut (or slammed) the door without knowing that there were fingers in the crushing zone [2].

Table 2 Injury mechanisms of door related injuries for the population in total and children in particular [2]

Mechanism	Total	Children < 15 y
Crushing in door gap	38 %	74 %
Impact with door or detail of door	20 %	12 %
Tripping over/slipping on threshold	42 %	36 %

When considering the statistics from Sweden it should be kept in mind that Sweden has been working with child safety issues for a long time. The preventive work started in 1954 when paediatricians, the Red Cross and Save the Children decided to form a committee. Since 1973 Sweden has had regulations within the area of child protection. Also, parents in Sweden are informed of child safety issues in parental education.

According to the European child safety report cards of 2007, Sweden is the EU country with the lowest child and adolescent death rate in the year examined [3]. This report also presents statistics from the WHO Mortality database which show that Sweden has the lowest number of unintentional deaths in children and adolescents as an average for the five year period 1998-2003, see Table 3. Also, statistics from the Unicef Innocenti Report Card No 2 February 2001 show that Sweden had the lowest annual number of child injury deaths between 1991 an 1995 among the rich countries.

Table 3 Unintentional injury deaths in children and adolescents [3]
Rate per 100 000 population 0-19 years.

Sweden	5.77
EU average	10.93

1.2 Scope

The most effective way of preventing injuries is always to remove the hazard. When discussing crushing injuries at doors this is equivalent to either removing the door leaf or exchanging existing doors for ones with integrated finger protection. If this is not possible or preferable, the alternative is to isolate or modify the hazard. For this purpose there are several kinds of non-integrated finger protection.

The purpose of this report is to categorise different methods of protection, define minimum criteria for a reliable protection and find a test method capable of determining whether a certain device meets these criteria.

This report focuses on pre-school children. However, as shown above, crushing injuries are quite frequent among older children and adults as well. With this in mind, some of the proposed tests and requirements have been adjusted to reduce the risk for people of all ages.

1.3 Restrictions

This report only deals with non-integrated protection, i.e. devices possible to be mounted on an existing door. The design of the existing door may or may not be intended to prevent crushing hazards. However, the protection devices within the scope of this report shall not need a special design of the door.

Crushing injuries on other limbs (hands, arms, feet etc.) have not been considered.

The door characteristics is of great essence for the behaviour of the protection device, as discussed in Chapter 2.1. However, since this is only a pre-study, variations in doors have not been studied. Instead a “standard Swedish inner door” was chosen as a base for this work. A drawing of this door is presented in Appendix D. The door is made of untreated wood an its mass is 18.0 kg.

Outer doors have not been included in this project. Since they differ significantly from inner doors, in both design (e.g. mass, geometry of door leaf and frame) and surrounding conditions (e.g. UV, heat, cold), further investigation is necessary.

2 Hazards and protection

2.1 Various doors

The characteristics of inner doors vary greatly. Obviously this variation affects the efficiency of finger protection products. The doors used for testing in different laboratories must therefore be equal.

Examples of variables that need to be fixed are
- mass
- dimensions
- rounding of edges
- stiffness
- surface characteristics
- design and surface characteristics of the handle
- maximum opening angle

The mass affects the door's reaction to forces and a greater mass implies a greater energy if the closing speed is constant. The door dimensions also affect the result of applied loads. For instance, if a closing force is applied in the handle area, the width of the door affects the resulting moment at the hinged side. The thickness of the door leaf is important when fitting protection. The rounding of edges on both door leaf and frame decide whether the effect on a product in the closing gap is mainly pressure or cutting. Some products withstand pressure but may be cut through with a sharp edge. The stiffness of the door leaf is also vital. Suppose a stopper is mounted at the top corner of a door, keeping a certain distance between door frame and leaf. If this door has little stiffness, the bottom corner might still close entirely even if the distance leaves an opening at the top. The surface characteristics mostly affect adhesive capacity. Here it is important to choose a surface which withstands the wear of protections being mounted and dismounted repeatedly. Some devices are mounted on the handle. For these products the design and surface characteristics of the handle are obviously important. The maximum opening angle of the door is also important. It is obvious that this could affect the behaviour of protection. In fact, some protection restrict the opening angle of the door. The test door should be able to open (virtually) 180°.

The authors recommend that a fictitious door is constructed and used by all test laboratories. As indicated above this construction requires an extensive study. There are many variables to consider and typical doors from all of the EU must be included.

2.2 Types of protection based on location of hazardous area

The protection can be divided into categories based on different things. One way of categorizing is based on the location of the hazardous area with respect to the door. All sides of the door leaf are potentially dangerous; upper, lower, lock side and hinge side. In this report the upper and lower sides are not considered. The upper side is assumed to be out of reach. The only way to prevent crushing at the lower side is to make the gap between door leaf and floor narrow enough to prevent access. This implies removal of thresholds.

This leaves two sides of the door; the lock side and the hinge side, see Figure 1. And it is important to stress that the hinge side has two hazardous areas; a wider and a narrower gap (or, in case of symmetrically placed hinges, two gaps with the same maximum

opening distance), cf. Figure 2. That is, a finger can be inserted into the hazardous area from inside or outside the door.

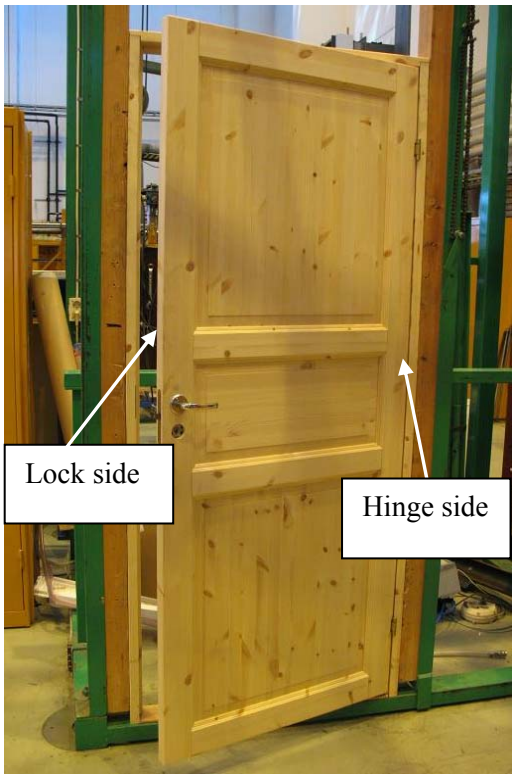

Figure 1 Designations of the vertical end sides of the door

Lock side protections are designed to prevent crushing injuries on fingers between the door leaf and the door frame on the side of the lock and handle.

Hinge side protections are designed to prevent crushing injuries on fingers between the door leaf and the door frame on the side of the hinges. There are two types of hinge side protections: protection intended for the wider opening and protection intended for the smaller opening respectively.

This categorization is interesting for several reasons. Firstly, the design and protection methods are in many cases very different between lock side and hinge side (cf. 2.3). Secondly, the risk of serious injury is much greater at the hinge side of the door. Since the rotation centre is at the hinge side, the lever will be greater and a small force at the handle will give a much greater force at the hinge side. One can also argue that an adult closing the door has a better view of the lock side and the movement of the door leaf is more easily detected there, making it easier for a child to get out of harm's way in time. However, the rate of crushing injuries among children at the lock side is equal to the rate at the hinge side [2], even though the severity of the injuries may differ.

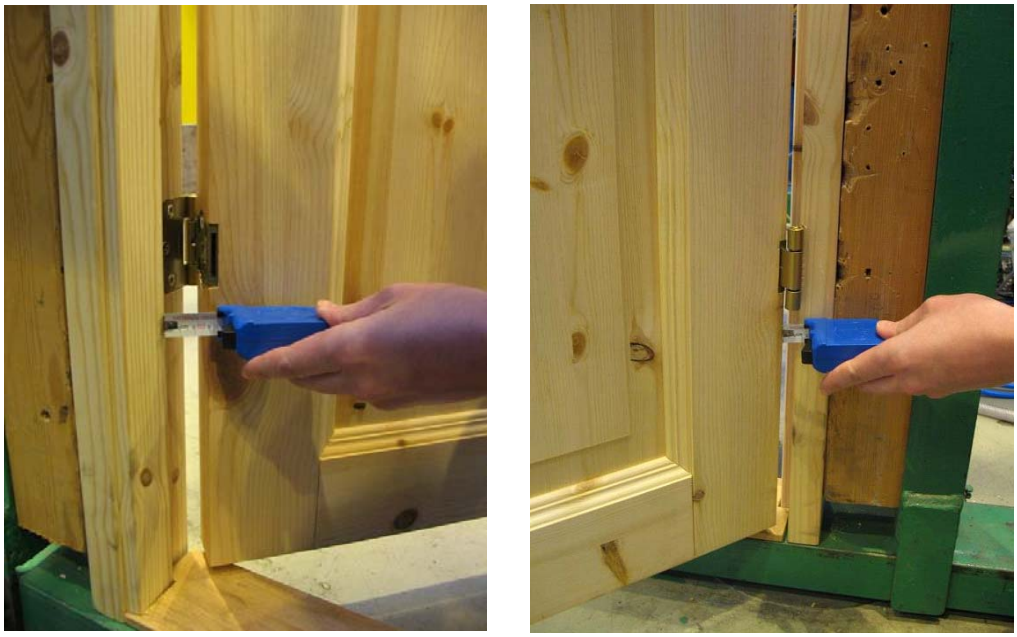

Figure 2 **The hinge side of most doors have one wider and one narrower gap. If the hinges are symmetrically placed, the two gaps open the same distance.**

2.3 Protection methods

The protection products can be divided into categories based on the method of protection. Examples of protection devices based on the different methods are shown in Figure 3.

- Hazard shielding
- Shut prevention
- Shut controlling
- Door positioning

A protection device based on the hazard shielding method is typically a shield, barrier or similar preventing children from putting fingers in a hazardous place. When used correctly these devices have a very high level of protection. However, this method can only be implemented on the hinge side, since lock side protection must still allow passage through the door. This method includes products for the wider as well as for the narrower openings of the hinge side of the door.

With the shut prevention method, the door is prevented from shutting completely and a gap of a few centimetres is left between door leaf and door frame on the lock side. Shutting may however still be possible without dismounting the protection by deactivating the device, e.g. by turning the handle. A shut prevention device works only as a lock side protection since crushing occurs at the hinge side openings before the device is active when the door is being closed. Depending on the positioning of the device (the distance from the hinge side), it can stop the door at different angles.

The shut controlling method makes slamming the door impossible. Typically the device decelerates the door leaf the last shutting distance and prevents the door from shutting completely if its speed is too great. The idea is that a person closing a door slowly is more watchful and has a greater chance of detecting someone in harm’s way. At best the potential injury will be averted. Otherwise the injury will hopefully be less severe. This kind of device works only as a lock side protection. It can be argued that this type of product should not be considered a finger protection at all, since it does not prevent

crushing injuries between door leaf and door frame. Crushing is still possible if the door is closed slowly. However, since they decrease the risk of severe injuries, shut controlling devices are included in this report.

A door positioning device keeps the door leaf in one (open) position. Some models are possible to deactivate without removing the device. When activated, all kinds of door related crushing injuries are prevented and this can be compared to removing the door. On the other hand, when the device is deactivated there is no protection at all. A door positioning device should not be considered a child safety device and will not be discussed further in this report.

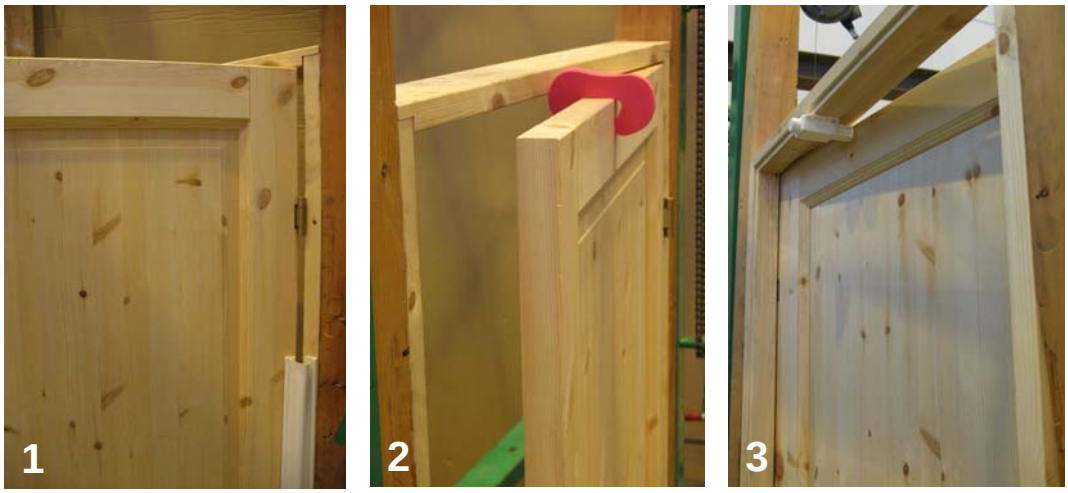

Figure 3 **Examples of finger protection devices based on hazard shielding (1), shut prevention (2) and shut controlling (3). Protection 1 prevents fingers from entering into the gap at the hinge side, 2 prevents the door from closing completely and 3 slows down the door leaf the last part of closing by pneumatics.**

Table 4 **Summary of different protection methods**

Protection method	Effective location	Comment
Hazard shielding	Hinge side	Shields the crushing area
Shut prevention	Lock side	Shutting may be possible without dismounting the protection
Shut controlling	Lock side	Makes slamming the door impossible Crushing is possible if the door is closed slowly
Door positioning	Lock side + Hinge side	Door can not be used as intended Not a child protection device, not included in this study

3 Current regulation and standardisation

European regulation and standardisation for child protective products was thoroughly discussed in SP Report on child protective products [4]. It can be added that there is no group working on the issue known to the authors. At the moment the General product safety directive 2001/95/CE is the only applicable piece of legislation for non-integrated finger protectors.

The Swedish National Board of Housing, Building and Planning (Boverket) states in their building directions [5], that buildings shall be designed to limit the risk of person injuries by crushing, tripping or similar. This applies to all buildings and building sites. They proposed in a draft revision (2006) to add that doors in schools and preschools should have protection against crushing injuries.

4 Explanations for proposed requirements and test methods

Introduction

In appendices A, B and C the proposed requirements and test methods are listed for hazard shielding protections, shut prevention protections and shut controlling protections, respectively. The appendices are written in the same manner as most product standards and are intended to be used as drafts in standardisation work. This chapter explains the process leading to said proposals and justifies the chosen values, such as load levels and measurements. The names and numbers of the subchapters here are consistent with the appendices and this chapter should preferably be read together with one or all of said appendices.

The scope here is mainly to protect pre-school children, 0-6 years. Most loads are however based on younger children, since it is not reasonable to expect protection products to withstand the treatment from a six-year-old trying to destroy the device. A three- or four-year-old on the other hand may not understand that the product might break and they are not as easy to reason with. However, when the value of a quantity is the basis for protection, the number has been chosen with older children in mind. For instance, the dimensions defining hazardous openings have been chosen in order to protect older children/adults as well.

Anthropometric data

Many values of loads, dimensions and other in the proposed requirements and test methods are based on anthropometric data. Most of these data are collected from the CEN Report CR 13387 [6] or Childata [7]. If there are several sources in this data collection, the “worst case scenario” source has been chosen. For instance, to decide which height is to be considered unreachable by a child, the data source with the population with the greatest value for 6-year-old boys was chosen. On the other hand, to find the smallest opening into which a child can put its finger, the source with the smallest value of the diameter of the little finger for newborns was chosen. Throughout this report, the data source from the collection in Childata is given together with the reference.

Anthropometric variables are in general normally distributed. The question is how acceptable safety margins should be derived from available data. The technical report [6] recommends that the equations below are used to calculate maximum and minimum values.

Maximum value of variable = P95 + 0.7 × SD
Minimum value of variable = P5 - 0.7 × SD
where
P95 = ninety-fifth percentile value
P5 = fifth percentile value
SD = standard deviation

The obtained maximum and minimum values are approximately equivalent to the 99^{th} and 1^{st} percentiles, respectively. Throughout this report, if the 95^{th} and 5^{th} percentiles have been available in the data of interest, the equations above have been used. Otherwise the 99^{th} and 1^{st} percentiles were used instead.

4.1 General

4.1.1 Test conditions

If nothing else is stated, forces shall be applied in the most onerous place and direction. How this should be implemented is, however, not always easily determined. At the same time it is vital that the results from tests of a certain product are independent of the choice of test laboratory. It is therefore recommended that, if the most onerous conditions are not obvious, several experienced test engineers discuss the question in order to come to a conclusion.

Another help in determining the most onerous conditions is to perform pre-tests. Results from pre-tests often give indications of what can be considered the worst case. Hence, this report recommends pre-tests to be performed if there is any doubt.

4.1.2 Order of tests

If nothing else is stated, the proposed tests are to be performed in the given order and on the same test sample. Some tests should be performed twice. There are two reasons for this. Firstly, some tests are designed to subject the product to wear, representing usage for some time. These tests may affect the result of the safety tests. Hence, the safety tests are to be performed both before and after the wear tests. Secondly, the safety-tests that are to be performed twice are relatively easy and fast to perform and the results can be good to know before performing the rest of the tests. For instance, if a product has dangerous openings this can be detected before the time-consuming wear tests. This type of test order, with recurring tests is e.g. used in the product standard for perambulators [8].

4.1.3 Test equipment

Most test equipment in the proposed tests is used in other product standards for child use and care articles. However, some probes are new. A larger finger probe is suggested in order to adapt for older children. A hand probe is suggested in the implosion test and a pointy probe is suggested to test resistance to sharp objects. Also, the need for a standard test door should be emphasized. This is however not implemented yet, as discussed in chapters 1.3 and 2.1. This also applies to the suggested test surfaces.

4.1.4 General requirements

Since the tests are meant to simulate hard but not abnormal use it is reasonable to demand that the tested device shall be fully functional after completion of the testing.

4.2 Chemical properties

All materials possible to reach with the mouth should be non-toxic. According to Steenbeckers 1993 in Childata [7], the maximum height of 6-year-old boys is 133 cm. This is consistent with the data on Swedish 6-year-old boys presented by Bo Werner [9]. The suggestion is therefore that all materials up to the height 1300 mm should be non-toxic.

4.3 Ageing

Polymers are very common materials in finger protection. These materials behave very differently when they age and some polymers lose a great deal of their strength. It must therefore be tested that the materials in the devices will keep their strength and other

qualities for their intended life-time. The suggestion of heat treatment corresponding to eight years of normal ageing is based on two or three (depending on the time between their births) children in the same family and the presumption that the protection shall work as intended when the youngest child reaches school-age.

As a rough rule of thumb, chemical reactions are twice as fast if the temperature is raised 10°C, within certain temperature intervals. This means that the ageing process can be performed at different temperatures and for different lengths of time. Let us look at an example. Say that the reference temperature is 25°C (room temperature) and the ageing temperature is chosen to 75°C. This gives an acceleration factor of 2^(50/10) = 32. Given that the sample should be aged equivalent to eight years (96 months), this gives that the ageing time is 96/32 = 3 months. In short, 3 months at 75°C is equivalent to 8 years of normal ageing.

As implied above it is possible to shorten the ageing time by raising the temperature. There is however an upper limit to this and that limit varies with the material. The time and temperature in the example are very common when building products are aged and suitable for most materials.

A different approach is to reduce the ageing and instead raise the loads and requirements of subsequent tests.

4.4 Protective function and safety

In existing product standards for child use and care articles, a gap with a dimension between 5 mm and 12 mm is considered to pose a risk of finger entrapment and is thus prohibited. Lately, the relevance and performance of this test have been questioned, especially the lower limit. Some product standards, such as babysitters [10], have a lower limit of 7 mm instead. Some claim that there are no accidents reported, indicating that the limit is unnecessary low, while others claim that the reason why there are no accidents might be that the requirement is good. The working group WG10 Activity toys have formed a task group, TG6, to further investigate the risks of finger entrapment. For now, the suggestion of this report is a lower limit of 5 mm.

The upper limit commonly used for child use and care articles may not be large enough for the products dealt with here. When analyzing the data from Steenbekker 1993 in Childata [7], even 3-year-olds may have 12 mm wide little fingers (breadth at the distal joint of the little finger of 3-year-old boys). Obviously other fingers are even wider. Also, crushing injuries are frequent among older children and adults as well, and a good suggestion is to adjust the upper limit to fit adults, or at least older children. According to DIN 1981 in Childata [7], the maximum diameter of the thumb of 12-year-old boys is 21 mm. This width is consistent with the French building recommendations presented in [12].

This means that openings between door leaf and door frame with a width between 5 mm and 21 mm pose a risk of crushing injury and should be considered dangerous.

4.4.1 Child appeal

Protection devices shall not invite children to play with them. Therefore it is suggested that finger protection shall not be child appealing. This requirement, as well as the choice of the word “novelty finger protection” used in the requirement suggestion, and its definition, is in accordance with the child-resistance standard for lighters, cf. [13].

Even if child appealing devices are prohibited, there is always a risk that a child removes the protection or makes it non-effective. It might be a good idea to require that finger protection devices should be either non-reachable by children or child proof in the sense that they can not be (re)moved or deactivated by children. One way of achieving this is to evaluate the child resistance function according to clause 5.4 of EN ISO 8317:2005. This is however not included in the requirements and test methods suggestions of this report, it is merely mentioned to raise the question.

4.4.2 Effectiveness

When a finger protection is bought and installed, this gives the consumer a greater sense of security. It is important that this sense is well-founded. No protection covers all hazard areas of a door. It is therefore vital that it is clear where and how the protection is effective. Otherwise, installing protection may lead to a false sense of security, which might even increase the risk of injury.

Height of hazard shielding protection device

On the hinge side of the door, a finger protection based on the hazard shielding method is most effective. This should cover all of the openings on both sides, since, obviously, the protection is effective only where it is mounted. Despite this, sometimes this kind of device is mounted only on a limited part of the hazardous area, e.g. only on the side with the wider opening or only to a height of say one metre. But then again, a child can not reach the top of a standard door. This raises the question; which height is necessary?

A recommendation is that a hazard shielding protection device should cover the crushing area from the floor to the top of the door, or at least up to 160 cm above floor level. According to Steenbeckers 1993 in Childata [7], the maximum standing reach to grip of 6-year-old boys is 159 cm.

The Swedish National Board of Housing, Building and Planning (Boverket) states in their building directions [5] that in order to prevent cutting injuries, toughened or laminated glass should be used in doors in day-care centres, preschools and schools if the distance between the glass surface and the floor is less than 1.5 m.

Another aspect of children reaching above the protection device, apart from the risk of injury, is that it may be tempting to drop small toys, such as Lego, in the gap between the protection and the door frame.

Misuse

There is always a risk of injury as a result of misuse of a product. There are two ways to reduce this risk; to try to make sure that the product is used in the intended way and to test that the product withstands the foreseeable misuse. Which way to go should be decided while keeping in mind the probability of misuse and the severity of the resulting increase in risk. Often a combination is most effective.

The intention of this report is to include the risk of misuse in the suggestions. However, no complete risk analysis has been performed, merely discussions among several experienced test engineers, child protection experts and parents.

4.4.3 Entrapment of fingers

An entrapment test is a common part of product standards among child care and use articles, cf. e.g. [11]. The relevance and performance of this test have however been

questioned lately and a French report *Study on "Risk analysis on finger entrapment"*[14] suggests some modifications, mainly regarding the assessment of different shapes of openings and the rigidity of the material. These modifications are included here. However, this report suggests that the lower limit of prohibited openings shall be 5 mm, see discussion in first section of Chapter 4.4. This is the reason for the condition that finger protection shall be regarded as products intended for children less than 6 months.

4.4.4 Sharp edges

This test is common among child care and use articles, cf. e.g. [11]. Obviously no sharp edges can be allowed near children. Here it is suggested that all materials shall fulfil the requirements of the toy standard, not only glass and metals.

4.4.5 Cords, strings and similar

This test is common among child care and use articles, cf. e.g. [11]. It can be argued that this test may not be relevant since the need for strings or similar on finger protection seems non-existent. And the authors have indeed not seen any products which pose a risk of strangulation. Yet the test is suggested, mainly to prevent strangulation hazards in new products.

4.4.6 Small parts

This test is common among child care and use articles, cf. e.g. [11]. The reasoning about this test is the same as with strings, cf. Chapter 4.4.5.

4.4.7 Accessibility of hazardous areas/Implosion

Hazard shielding protection covering the openings on the hinge side of the door might bend inwards, 'implode'. When the door is open, the device shields off access to the crushing zones. However, if someone pushes on the surface of the device with e.g. a hand or finger, the device might 'implode' and thus create a concaveness allowing for the hand or finger to access a crushing zone. In the worst case scenario the force on the device might also turn the door leaf and close the door, with the hand/finger in the wrong place.

The suggested requirement of the implosion test is that there shall be no crushing at all, however small the force is. The main reason for this is to make testing and evaluation easier. Many existing protection devices have solved the problem of implosion and it is hard to motivate why implosion should be allowed. However, instead of banning implosion all together, in this report it is suggested that if implosion occurs, there shall be no crushing. Another suggestion is to measure the crushing force on a probe if implosion occurs.

In the study by DeWinter 1994 in Childata [7], the force exerted by children pushing forward with two hands on a horizontal bar whilst sitting was recorded. According to this study the maximum force among male 6-year-olds is 515 N. It is however reasonable to believe that only one hand is used to push on the protection device. Hence, the force has been lowered to 250 N.

Implosion should also be tested with finger probes. It is obvious that the force applied by a single finger can not be as high as when a whole hand is used. The force has therefore been lowered further, to 100 N.

The hand probe used in this test is a new device. Its necessity is based on the fact that a finger can not apply as large a force as a hand. It is meant to represent a fist of a child.

4.5 Mechanical function and structural integrity

4.5.1 Cyclic test(s)

Cyclic test of crushing prevention

The product should work as intended after some use. Therefore it shall be subjected to cyclic tests and then perform as intended in the later tests. The number of cycles is the same as for a class 3 door or window, cf. [15]. The force in the cyclic test is low to simulate normal, daily use. For hazard shielding protection devices this means that the door is opened and closed in a smooth motion, 5 – 10 cycles per minute. Protection devices based on shut prevention will be subjected to a force of 150 N when the door is closed. When testing devices based on shut controlling the door leaf shall have a speed of 0.5 m/s, measured at the lock side, at the time of closing.

Cyclic test of automatic reactivation function

Some protection based on the shut prevention method can be deactivated to make it possible to close the door without dismounting the device. Some of these devices are then automatically reactivated when the door is opened. These shall be subjected to an extra cyclic test to make sure that this function will still work after some use.

This function could be implemented in protection devices based on the shut controlling method, even though it is not known to the authors to exist yet. Therefore this test is included for shut controlling protectors as well.

Automatic reactivation can for instance be accomplished by mounting the device on the handle, see example in Figure 4. When the handle is turned, the device is deactivated and the door can be closed. When the door is closed the device is in tension and will be released and return to its original position (active) when the door is opened. It is possible that the device will rotate when the door is closed, to relieve the tension. This would imply that it may not be automatically reactivated when the door is opened.

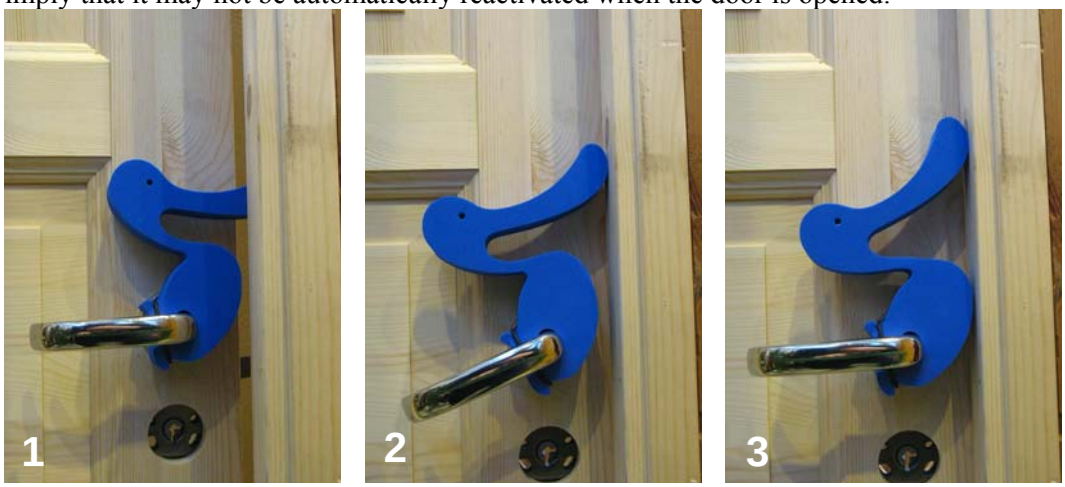

Figure 4 **Example of a protection device with automatic reactivation.**
1. The device is mounted on the handle, preventing the door from closing completely
2. When the handle is turned, so is the device, allowing the door to close
3. When the handle is released the device stores energy (note the different angle of the neck compared to picture no. 1), which reactivates the device when the door is reopened

4.5.2 Attachment test(s)

Gripping of device (all kinds of finger protection devices)

The device shall not be easily removed by a child and if a child tries to tear it apart, it shall preferably stay intact and at least fully functional. No parts that come loose shall be a risk of suffocation. This test is part of the toy standard [11]. The value 200 N is based on a 36- to 48-month-old pulling with full hand [6] (P95 value).

Pushing on door leaf (only hazard shielding devices)

This test simulates a child pushing on the door leaf when the door is open at its maximum opening angle, or an adult leaning against the door leaf. This stretches the device and might cause it to detach. The load 500N is based on DeWinter 1994, Childata [7], see 4.4.7.

4.5.3 Adhesive test

If the device is attached to the door only by adhesive tape, glue or similar the adhesive capacity of this should be tested. This is performed on four different, representative wooden surfaces; untreated, varnished, oiled and painted. These four surfaces need to be defined. In Chapter 2.1 the different characteristics of doors that need to be defined are discussed. The load 200 N is based on a 36- to 48-month-old pulling with full hand [6] (P95 value).

4.5.4 Resistance to impact

The device should withstand “attacks” from a child with a blunt object. This test is identical to “Impact testing” suggested in Child protective products – protective functions of socket protectors, hob guards, locks and locking devices [4].

4.5.5 Resistance to sharp objects

The device should withstand “attacks” from a child with a sharp object, e.g. a ball-point pen. The pointy probe used in the test is in fact based on such a pen.

The load 130 N is based on a 36- to 48-month-old pushing with full hand [6] (P95 value).

4.5.6 Dynamic strength

The dynamic strength test is only relevant for finger protection devices based on either shut prevention or shut controlling. The test simulates the door being slammed shut, either by a person or a draft. The protection device shall prevent fingers from being crushed between door leaf and door frame by absorbing all the energy of the door leaf. The door leaf shall have a speed of 3 m/s, measured at the lock side, at the closing moment.

4.5.7 Static strength

The static strength test is only relevant for finger protection devices based on shut prevention. The device shall withstand a static load simulating a child (or an adult) pushing/pulling the door, typically when the door is being pushed or pulled shut or when someone leans against the door leaf. This test is not designed to simulate doors being slammed shut.

This test may not seem relevant for devices based on the shut controlling method. It has however been included in the suggestions here in case of the existence of a (new) model, not known to the authors, to which it may be relevant.

The load is again based on DeWinter 1994, Childata [7], see 4.4.7. For children age 6 years and younger the force while sitting is greater than while standing. For obvious reasons the recommended test force in the static strength test is based on the greater force, i.e. 500 N. There is no reason to assume that adults would use a larger force than this to close the door. Therefore the maximum force exerted by adults is not relevant.

The requirement is here chosen as a maximum crushing force. The authors do not know of any research of limits for harmless crushing forces on children, and it seems reasonable that not much work has been performed in this field. The level of the acceptable force in the test was chosen very low since a baby's finger does not withstand hardly any force at all.

An alternate requirement could be to have a crushing force probe which does not measure force, but has a way of detecting contact, e.g. with a layer of chalk powder. This probe should be positioned in the same way as described in the test. After the test the probe is examined. The requirement would in this case be that no contact is allowed.

4.6 Product information

What kind of protection does a product offer? Where is the protection effective? It is of great importance that the function of the product is clear to the consumer to minimize the risk of misuse. This is a major task for the manufacturer's instructions. To assist in the creation of these this report presents a list of warnings, statements and information needed to be included.

The name of the person/company responsible for the sale of the product is needed if the consumer has questions.

The need for instructions on how to mount, handle and take care of the products is obvious. However, these are not just needed to make things easier for the consumer. This information could be vital for safety reasons. Given the worst case scenario, a safety device that is mounted the wrong way or in the wrong place may not be effective at all, just give a false sense of security.

No single product covers all hazardous areas. This is why it is important to inform the consumer on where the product is intended to be effective. The consumer should also be urged to use protection for all hazardous areas.

Also for safety reasons, it is important to state what kind of door the device is designed for. The geometry of the lock side and the thickness of the door may affect the effectiveness of some protection. It is therefore vital to clearly define the doors for which the protection is effective. Hinge side protection based on hazard shielding does not fit doors of all thicknesses and opening angles. If a protection is mounted on a door with a greater opening angle than intended, the protection might tear off when the door is opened. Therefore, if the maximum opening angle is less than (virtually) 180°, a "stopper" should be enclosed with the finger protection. A stopper is a device which limits the maximum opening angle of a freely moving door leaf to a certain angle. The intention of a stopper is that a protection device which is constructed for doors with a limited opening angle of, say 90° may be mounted on any door if it is supplemented with

a stopper. If a stopper is included the instructions shall of course include mounting instructions of this device as well as an explanation of its intended function.

4.7 Markings

The product needs to be marked with the name of the person/company responsible for its sale in case the consumer needs to contact someone, e.g. to request spare parts or if there are any questions.

It is also a good suggestion to mark each product with a reference number or a serial number for traceability reasons. This is an important part of quality control. If a mistake which affects one batch is made in the production and this is not discovered before the products leave the factory, the marking of the products is an easy way to find the faulty products. This suggestion is however only discussed in this report. It is not included in the suggested requirements and test methods. It is however implemented in the product standard for perambulators, cf. [8].

4.8 Test report

The suggested requirements on the test report are common among test standards for various products.

5 Conclusions and future work

Door-related injuries are, if not always very serious, very common among children and can in many cases easily be prevented. However, when finger protections are bought and installed this leads to a greater sense of security in the supervisor, which in turn often implies less supervision. It is of great importance that the protective products are in fact ‘doing their job’. Therefore, clear and explicit requirements are needed for products designed to protect children and the properties of these products must be verified. To achieve this, it is important to have European standards for finger protections as soon as possible.

In appendix A, B and C proposals for requirements and test methods for non-integrated finger protection for inner doors are presented in the form of complete product standards.

This study suggests the use of a well-defined, fictitious door for testing. The definition of this door requires an extensive study of existing European door, which was not within the scope of this project. Particularly the surfaces of different doors should be studied as a basis for test surfaces, which are proposed as equipment in an adhesive test.

This study is restricted to non-integrated finger protection for inner doors. A natural continuation would include outer doors, which would imply other requirements for the protective products, such as UV-resistance. Yet another study could include integrated finger protection.

6 References

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[13] EN 13869 Lighters – Child resistance for lighters – Safety requirements and test methods, 2002.

[14] Document CEN/TC 252 N 648 – Study on “Risk analysis on finger entrapment”, 2006.

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[16] EN ISO/IEC 17025 General requirements for the competence of testing and calibration.

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Finger protection for doors – Hazard shielding protections
Requirements and test methods

1 Scope

This document proposes requirements and test methods for non-integrated finger protection intended to be mounted on inner doors in order to prevent crushing injuries. Only protection based on hazard shielding is considered. A protection device based on the hazard shielding method is typically a shield, barrier or similar preventing children from putting fingers in a hazardous place.

A finger protection device is based on at least one of three protection methods; hazard shielding, shut prevention or shut controlling. There are three different documents concerning finger protection, one for each type.

The scope here is mainly to protect pre-school children, but in some cases, such as dimensions of hazardous openings, values have been chosen in order to protect older children/adults as well. A "standard inner door" was chosen as a base for this work. Drawings of this door, which has a mass of 18.0 kg, are presented in Appendix D. Outer doors are not included.

2 Normative references

EN 71-1:2005 *Safety of toys – Part 1: Mechanical and physical properties.*
EN 71-3:2002 *Safety of toys – Part 3: Migration of certain elements.*
EN 1888:2003/A1-A3:2005 *Child care articles – Wheeled child conveyances – Safety requirements and test methods.*
Document CEN/TC 252 N 648 – *Study on "Risk analysis on finger entrapment"*, 2006.
EN ISO/IEC 17025 *General requirements for the competence of testing and calibration*
CEN/TR 13387 *Child use and care articles – Safety guidelines*

3 Terms and definitions

Accessible

A place or part of door or protection device is considered accessible if it is located below the height 1600 mm and is reachable with a 5 mm wide finger probe when the protection is mounted. This shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

Effective location

The part of the gap between door frame and door leaf at which the finger protection is intended to prevent crushing injuries. A lock side protection is supposed to prevent injuries at any height at the lock side. The corresponding goes for hinge side protection as well.

Finger protection

Device designed to prevent crushing injuries on fingers between (part of) door leaf and door frame when door leaf is moving. The device is based on one of three protection methods; hazard shielding, shut prevention or shut controlling.

Hazard shielding

A method of protection. Typically a shield, barrier or similar preventing children from putting fingers in a hazardous place.

Hinge side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame on the side of the hinges. There are two types of hinge side protection: protection intended for the side with the wider opening and protection intended for the side with the smaller opening respectively.

Lock side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame at the side of the handle.

Novelty finger protection

Finger protection that resembles by any means to another object commonly recognised as appealing to or intended for use by children younger than 51 months, or has entertaining audio effects or animated effects. This includes, but is not limited to, finger protections which shape resembles cartoon characters, toys, guns, watches, telephones, musical instruments, vehicles, human body or parts of the human body, animals, food or beverages, or that play musical notes, or have flashing lights or moving objects or other entertaining features. This excludes finger protections that are printed or decorated with logos, labels, decals or artwork if the protection in no other way meet the description of a novelty finger protection above.

Shut controlling

A shut controlling device decelerates the door leaf the last shutting distance and prevents the door from shutting completely if its speed is too great. If the speed is low, it is possible to close the door without deactivating the protection device. This kind of device works only as a lock side protection and makes slamming the door impossible.

Shut prevention

The door is prevented from shutting completely and a gap is left between door leaf and door frame on the lock side. Shutting may however still be possible without dismounting the protection by deactivating the device, e.g. by turning the handle. This kind of device works only as a lock side protection.

Stopper

A device which limits the opening angle of a freely moving door to a certain angle.

4 Requirements and test methods

4.1 General

4.1.1 Test conditions

The tests shall be conducted in indoor conditions with a temperature of 23°C ± 5°C.
The test sample shall be mounted in accordance with the manufacturer’s instructions.
The hinges of the door shall be well lubricated.

If nothing else is stated, forces shall be applied in the most onerous place and direction. If not obvious, pre-tests shall be performed in order to determine this.

“Accessibility” shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

The uncertainty in force measurements shall not exceed ± 1.0 %.
The uncertainty in linear measurements shall not exceed ± 1.0 mm.

4.1.2 Order of tests

All tests shall be conducted on the same sample, if nothing else is stated. The tests shall be performed in the sequence order shown in Table A1 below. Tests with the same sequence number can be performed in any order within that sequence. When the sequence number of a test is 0, the test can be carried out at any time. The protective function tests (4.4.3 – 4.4.7) shall be performed both before and after the cyclic test since the results of these tests may be influenced by the performance of other tests. Also, the safety-tests that are to be performed twice are relatively easy and fast to perform and the results can be good to know before performing the rest of the tests. For instance, if a product has dangerous openings this can be detected before the time-consuming wear tests.

Table A 1 Order of tests

Sequence no.	Test	
0	4.2	Chemical properties
	4.4.1	Child appeal
	4.4.2	Effectiveness
	4.5.3	Adhesive test
	4.6	Product information
	4.7	Markings
1	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
	4.4.7	Accessibility/Implosion
2	4.5.1	Cyclic test
3	4.5.2	Attachment tests
4	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
	4.4.7	Accessibility/Implosion
5	4.3	Ageing
6	4.5.4	Resistance to impact
	4.5.5	Resistance to sharp objects

4.1.3 Test equipment

Equipment	Reference
Standard door	Not implemented yet, the door used as a basis for this work is presented in Appendix D
Small finger probe, 5 mm	EN 1888:2003, § 6.1.2.2
Medium finger probe, 12 mm	Document CEN/TC 252 N 648 – Study on ”Risk analysis on finger entrapment”
Large finger probe, 21 mm	EN 1888:2003, § 6.1.2.2, but diameter 21 mm
Hand probe	See Figure A 1
Sharp edges equipment	Equipment for determination of sharp edges according to EN 71-1:2005, §8.11
Small parts cylinder	EN 71-1:2005, § 8.2
Pointy probe	See Figure A 2
Feeler gauge	EN 71-1:2005, § 8.4.1.3
Test surfaces	Test surfaces large enough to mount a protection device with the following surface treatments: - untreated wood - varnished wood - oiled wood - painted wood
Steel pendulum	See Figure A 3

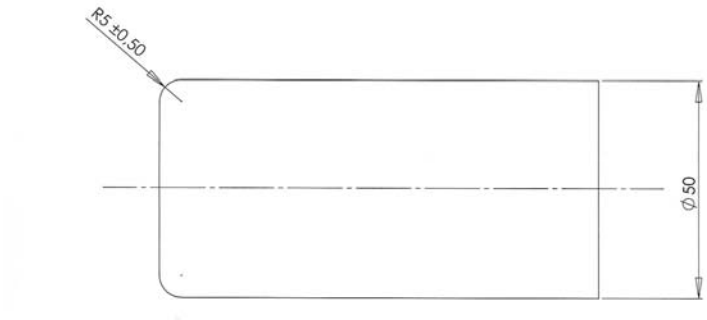

Figure A 1 Hand probe. Shall be made of metal or other hard smooth material. Measurements in mm.

Figure A 2 Pointy probe. Shall be made of metal or other hard smooth material. Measurements in mm.

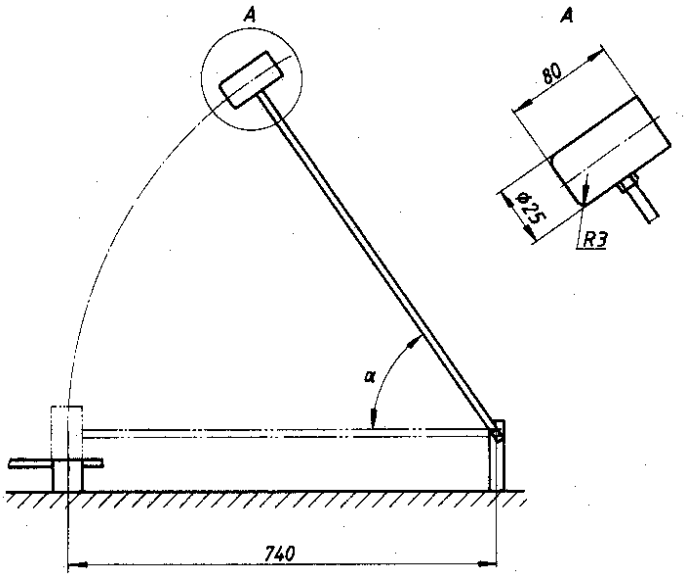

Figure A 3 Equipment for impact test. The weight of the pendulum head shall be 0.3 kg and that of the arm shall be 0.6 kg. It shall be possible to use a drop angle of at least 45°.

4.1.4 General requirements

After completion of all tests, the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

Any strings or similar which come loose during testing shall comply with 4.4.5.
Any parts which come loose during testing shall comply with 4.4.6.

4.2 Chemical properties

All accessible materials at a height of 1300 mm or less shall be tested in accordance with clause 4.2 of EN 71-3.

4.3 Ageing

The test sample shall endure heat treatment corresponding to 8 years of ageing at normal room temperature. The test shall be performed on the same test sample as the other tests. However, this test, and the subsequent tests according to the test order presented in Table A1, may be performed on only a part of the device. This part shall have a height of at least 200 mm. The 'height' refers to a vertical measurement when the device is mounted.

Note
As a rule of thumb, chemical reactions are twice as fast if the temperature is raised 10°C. This means that the ageing process can be performed at different temperatures and for different lengths of time. Let us look at an example. Say that the reference temperature is 25°C (room temperature) and the ageing temperature is chosen to 75°C. This gives an acceleration factor of 2^(50/10) = 32. Given that the sample should be aged equivalent to eight years (96 months), this gives that the ageing time is 96/32 = 3 months. In short, 3 months at 75°C is equivalent to 8 years of normal ageing.

As implied above it is possible to shorten the ageing time by raising the temperature. There is however an upper limit to this and that limit varies with the material. The time and temperature in the example are very common when building products are aged and suitable for most materials.

4.4 Protective function and safety

4.4.1 Child appeal

No finger protection shall be a novelty finger protection.

4.4.2 Effectiveness

The protection shall have effect on the hazardous area(s) (lock side/hinge side etc.) for which it is intended according to the product information. The protection shall be effective from the floor level to a height of at least 1600 mm. The protection shall be effective at all permissible opening angles for a door of maximum permissible thickness according to the manufacturer's instructions. The protection shall be possible to mount on doors with a thickness of at least 40 mm which open (virtually) 180°, unless otherwise specified. A hinge side protection shall protect both the non-hinged as well as the hinged side, unless explicitly stated otherwise on the product or in the manufacturer's instructions.

If the maximum opening angle is less than (virtually) 180°, a "stopper" should be enclosed with the finger protection device. A stopper is a device which limits the maximum opening angle of a freely moving door to a certain angle.

4.4.3 Entrapment of fingers

The device shall be tested according to and conform to the requirements presented in the French study reported in Document CEN/TC 252 N 648. Finger protection shall be regarded as products intended for children less than 6 months.

4.4.4 Sharp edges

There shall be no accessible edges below the height 1600 mm that present an unreasonable risk of injury. Requirements and test methods are given in clauses 4.7 and 8.11 of EN 71-1:2005. This requirement applies to all materials. The test may be performed on a separate sample after analyzing which edges are accessible on the mounted sample.

4.4.5 Cords, strings and similar

Accessible cords, strings and similar below the height 1600 mm shall conform to the requirements of clause 5.4 of EN 71-1:2005.

4.4.6 Small parts

The possibility to detach small parts at a height of 1600 mm or less shall be tested according to EN 71-1:2005 clauses 8.3 and 8.4.

Any accessible small component below the height 1600 mm, which is detachable or becomes detached during the testing according to the test methods described in this document, shall not fit wholly within the small part cylinder described in clause 8.2 of EN 71-1:2005.

4.4.7 Accessibility/Implosion

Open the door at an angle of approximately 45°. Use the small finger probe to apply a force of 100 N at the surface of the protection, below the height 1600 mm. Let the door leaf move freely when the force is applied. If the probe enters into a volume which may cause crushing injuries, close the door while keeping the force. The probe may not be crushed between the door leaf and door frame, i.e. it may not be subjected to any force, during the entire closing procedure. Repeat the procedure at opening angles 90°, 135° and 175° respectively.

Repeat the test with the large finger probe.
Repeat the test with the hand probe, but this time apply a force of 250 N.

Note
If it is not clear whether the probe is crushed or not, this can be checked by powdering the probe with chalk or similar before the test. If the chalk on the sides of the probe is disturbed, the probe has been in contact with the door at that location and this counts as crushing.

4.5 Mechanical function and structural integrity

4.5.1 Cyclic test

The product should work as intended after some use. Therefore it shall be subjected to a cyclic test and then perform as intended in the later tests.

The door shall be opened and closed 20 000 times with the protection device mounted.

If a “stopper” is enclosed with the product, this shall be mounted according to the manufacturer’s instructions. The door shall then each cycle open to the maximum opening angle without subjecting the stopper to excessive force.

If no “stopper” is enclosed with the product, the door shall each cycle open (virtually) 180°.

The motion of the door leaf shall be smooth and at a speed of 5-10 cycles per minute. Hinges shall be well lubricated and all other friction shall be minimized.

When tested in the cyclic test, the device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

4.5.2 Attachment tests

Gripping of device

Any part or component of the device that can be gripped between thumb and forefinger or is “grippable” when assessed in accordance with clause 8.4.2.1 of EN 71-1:2005, shall be tested according to clauses 8.3 and 8.4 of the same document. The force for accessible dimensions larger than 50 mm shall be 200 N.

This test only applies to accessible parts/components at a height lower than 1600 mm.

After testing the device shall be fully functional. Any piece which comes loose shall comply with the small parts requirement in 4.4.6. The device may not be dismounted, even partially, from the door. This shall be examined visually.

Pushing on door leaf

The test simulates a child pushing on the door leaf when the door is open at its maximum opening angle, or an adult leaning against the door leaf.

If a “stopper” is enclosed with the product, this shall be mounted according to the manufacturer’s instructions. Then open the door without applying any significant load, to the maximum angle allowed by the stopper. Gradually apply a force of 500 N. Keep the load for 5 seconds. The stopper shall be fully functional after the test. Remove the load and the stopper. Open the door to the maximum permissible opening angle according to the manufacturer’s instructions of the protection device. Then gently open an extra 20°. If the protection device restricts the opening angle, gradually increase the load until the desired angle is reached, but without exceeding 500 N. The device may not, even partially, detach. This is examined visually.

Note
A door with a maximum permissible opening angle of 90° shall be tested at the opening angle 110°, and so on.

If no “stopper” is enclosed with the product, gently open the door (virtually) 180°. If the protection device restricts the opening angle, gradually increase the load until the desired angle is reached, but without exceeding 500 N. The protection device may not, even partially, detach. This is examined visually.

4.5.3 Adhesive test

If the device is attached to the door only by adhesive tape, glue or similar the adhesive capacity of this shall be tested. This test may be performed on separate test samples which may be intact devices or parts of a/several device(s).

Mount the device according to the manufacturer’s instructions onto four different test surfaces:
- wood with no surface treatment
- varnished wood
- oiled wood
- painted wood

Try to remove the device by applying 200 N in any direction.
The device may not visibly, even partially, detach.

4.5.4 Resistance to impact

The device shall be unmounted during this test.
The device shall be subjected to 10 strokes by the steel pendulum described in 4.1.3. The drop angle α shall be 45 ± 2°, see Figure A 3. The pendulum shall hit the device when the pendulum is in horizontal position. The strokes shall hit in the most onerous place and all 10 strokes shall hit the same spot.

After the test the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

The test may be performed on a separate test sample, which in that case shall first be subjected to the ageing of test 4.3.

4.5.5 Resistance to sharp objects

Fixate the edges of the (part of the) device with any appropriate fixating equipment, trying to resemble a mounted device in accordance with the manufacturer's instructions. Or mount the device in accordance with the manufacturer's instructions. Apply a force of 130 N for 5 seconds with the pointy probe (cf. 0) at the surface of the protection device. The application point shall be at least 20 mm from any edge and at a place where there is no material on the other side of the device giving support. There shall not be any holes or cracks through the device after testing. No parts may break off.

4.6 Product information

Product information shall be provided to reduce the possible consequences of foreseeable hazards connected with the finger protection. The product information shall include at least the following:

1. The name or trade mark of the manufacturer, importer or organization responsible for its sale.
2. The instruction: ”Read these instructions carefully before mounting and using the device. The child protective function of the device may be affected if you do not follow the instructions. Keep the instructions for future reference.”
3. Instructions on how to mount/dismount the product. A statement whether the product is suitable to reuse after dismounting.
4. An instruction that the device shall be mounted as close to the floor as possible, leaving room only for a threshold and that the protection shall be intact from the floor to a minimum height of 1600 mm.
5. If the protection moves relative to the door leaf when the door is being closed, the following warning shall be included: “WARNING: Make sure the protection is still effective after opening the door”.
6. Definition of the hazardous area where the product is intended to be effective.
7. The exhortation: “Use protection for both openings on the hinge side, as well as on the lock side”.
8. A definition of the doors for which the protection is effective including maximum thickness and maximum opening angle.
9. If the maximum opening angle is less than (virtually) 180°, a “stopper” should be enclosed. The instructions shall then include mounting instructions of this device as well as an explanation of its intended function.
10. Maintenance instructions.
11. Instructions on how to reattach the protection after dismounting or a statement that the protection must not be reused after dismounting.

4.7 Markings

The protection shall be marked with the name or trademark of the manufacturer, importer or organisation responsible for its sale. The marking shall be visible when the protection is mounted.

4.8 Test report

The test report shall include the information necessary for the interpretation of the results and at least the following information:

1. A title.
2. The name and address of the laboratory, and the location where the tests were carried out if different from the address of the laboratory.
3. The names, functions and signatures or equivalent identification of persons authorizing the test report.
4. The name and address of the client.
5. Unique identification of the test report and on each side an identification in order to ensure that the page is recognized as a part of the test report and a clear identification of the end of the test report.
6. Identification of the test method(s) used.
7. Deviations from, additions to or exclusions from the test method(s).
8. Information on specific test conditions, such as environmental conditions.
9. A description of, the condition of and an unambiguous identification of the items tested.
10. The date of receipt of the test item and the date of performance of the test.
11. Reference to sampling plan and procedure.
12. The test results and units of measurement.
13. A statement on the estimated uncertainty of measurement.
14. A statement of compliance or non-compliance with requirements and/or specifications.

Finger protection for doors – Shut prevention protections
Requirements and test methods

1 Scope

This document proposes requirements and test methods for non-integrated finger protection intended to be mounted on inner doors in order to prevent crushing injuries. Only protection based on shut prevention is considered. A device based on the shut prevention method prevents the door from shutting completely and a gap of a few centimetres is left between door leaf and door frame on the lock side. Shutting may however still be possible without dismounting the protection by deactivating the device, e.g. by turning the handle. Door positioning devices, i.e. devices designed to keep the door leaf in one (open) position, are not included in this document.

A finger protection device is based on at least one of three protection methods; hazard shielding, shut prevention or shut controlling. There are three different documents concerning finger protection, one for each type.

The scope here is mainly to protect pre-school children, but in some cases, such as dimensions of hazardous openings, values have been chosen in order to protect older children/adults as well. A "standard inner door" was chosen as a base for this work. Drawings of this door, which has a mass of 18.0 kg, are presented in Appendix D. Outer doors are not included.

2 Normative references

EN 71-1:2005 *Safety of toys – Part 1: Mechanical and physical properties*
EN 71-3:2002 *Safety of toys – Part 3: Migration of certain elements*
EN 1888 *Child care articles – Wheeled child conveyances – Safety requirements and test methods*
Document CEN/TC 252 N 648 – *Study on "Risk analysis on finger entrapment"*, 2006
EN ISO/IEC 17025 *General requirements for the competence of testing and calibration*
CEN/TR 13387 *Child use and care articles – Safety guidelines*

3 Terms and definitions

Accessible

A place or part of door or protection device is considered accessible if it is located below the height 1600 mm and is reachable with a 5 mm wide finger probe when the protection is mounted. This shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

Effective location

The part of the gap between door frame and door leaf at which the finger protection is intended to prevent crushing injuries. A lock side protection is supposed to prevent injuries at any height at the lock side. The corresponding goes for hinge side protection as well.

Finger protection

Device designed to prevent crushing injuries on fingers between (part of) door leaf and door frame when door leaf is moving. The device is based on one of three protection methods; hazard shielding, shut prevention or shut controlling.

Hazard shielding

A method of protection. Typically a shield, barrier or similar preventing children from putting fingers in a hazardous place.

Hinge side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame on the side of the hinges. There are two types of hinge side protection: protection intended for the side with the wider opening and protection intended for the side with the smaller opening respectively.

Lock side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame at the side of the handle.

Novelty finger protection

Finger protection that resembles by any means to another object commonly recognised as appealing to or intended for use by children younger than 51 months, or has entertaining audio effects or animated effects. This includes, but is not limited to, finger protections which shape resembles cartoon characters, toys, guns, watches, telephones, musical instruments, vehicles, human body or parts of the human body, animals, food or beverages, or that play musical notes, or have flashing lights or moving objects or other entertaining features. This excludes finger protections that are printed or decorated with logos, labels, decals or artwork if the protection in no other way meet the description of a novelty finger protection above.

Shut controlling

A shut controlling device decelerates the door leaf the last shutting distance and prevents the door from shutting completely if its speed is too great. If the speed is low, it is possible to close the door without deactivating the protection device. This kind of device works only as a lock side protection and makes slamming the door impossible.

Shut prevention

The door is prevented from shutting completely and a gap is left between door leaf and door frame on the lock side. Shutting may however still be possible without dismounting the protection by deactivating the device, e.g. by turning the handle. This kind of device works only as a lock side protection.

4 Requirements and test methods

4.1 General

4.1.1 Test conditions

The tests shall be conducted in indoor conditions with a temperature of 23°C ± 5°C.

The test sample shall be mounted in accordance with the manufacturer’s instructions. If the prescribed attachment method does not work after the heat treatment, attach the

device by any other appropriate means, such as screws or other, making sure that the device is well attached.

The hinges of the door shall be well lubricated.

If nothing else is stated, forces shall be applied in the most onerous place and direction. If not obvious, pre-tests shall be performed in order to determine this.

"Accessibility" shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

The uncertainty in force measurements shall not exceed ± 1.0 %.
The uncertainty in linear measurements shall not exceed ± 1.0 mm.

4.1.2 Order of tests

All tests shall be conducted on the same sample, if nothing else is stated. The tests shall be performed in the sequence order shown in Table B 1 below. Tests with the same sequence number can be performed in any order within that sequence. When the sequence number of a test is 0, the test can be carried out at any time. The protective function tests (4.4.3 – 4.4.6) shall be performed both before and after the cyclic test since the results of these tests may be influenced by the performance of other tests. Also, the safety-tests that are to be performed twice are relatively easy and fast to perform and the results can be good to know before performing the rest of the tests. For instance, if a product has dangerous openings this can be detected before the time-consuming wear tests.

Table B 1 Order of tests

Sequence no.	Test	
0	4.2	Chemical properties
	4.4.1	Child appeal
	4.4.2	Effectiveness
	4.5.3	Adhesive test
	4.6	Product information
	4.7	Markings
1	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
2	4.5.1	Cyclic tests
3	4.5.2	Attachment test
4	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
5	4.3	Ageing
6	4.5.4	Resistance to impact
	4.5.5	Resistance to sharp objects
	4.5.7	Dynamic strength
	4.5.6	Static strength

4.1.3 Test equipment

Equipment	Reference
Standard door	Not implemented yet, the door used as a basis for this work is presented in Appendix D
Small finger probe, 5 mm	EN 1888:2003, § 6.1.2.2
Medium finger probe, 12 mm	Document CEN/TC 252 N 648 – Study on ”Risk analysis on finger entrapment”
Large finger probe, 21 mm	EN 1888:2003, § 6.1.2.2, but diameter 21 mm
Hand probe	See Figure B 1
Sharp edges equipment	Equipment for determination of sharp edges according to EN 71-1:2005, §8.11
Small parts cylinder	EN 71-1:2005, § 8.2
Pointy probe	See Figure B 2
Feeler gauge	EN 71-1:2005, § 8.4.1.3
Test surfaces	Test surfaces large enough to mount a protection device with the following surface treatments: - untreated wood - varnished wood - oiled wood - painted wood
Steel pendulum	See Figure B 3

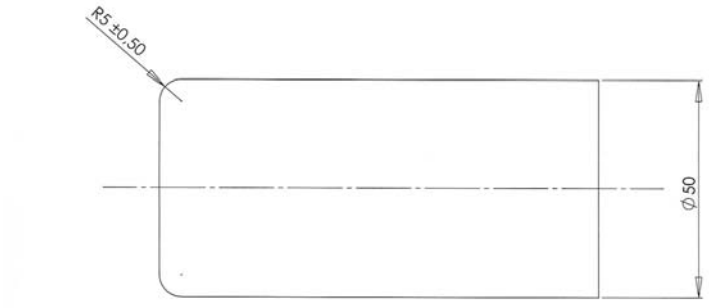

Figure B 1 Hand probe. Shall be made of metal or other hard smooth material. Measurements in mm.

Figure B 2 Pointy probe. Shall be made of metal or other hard smooth material. Measurements in mm.

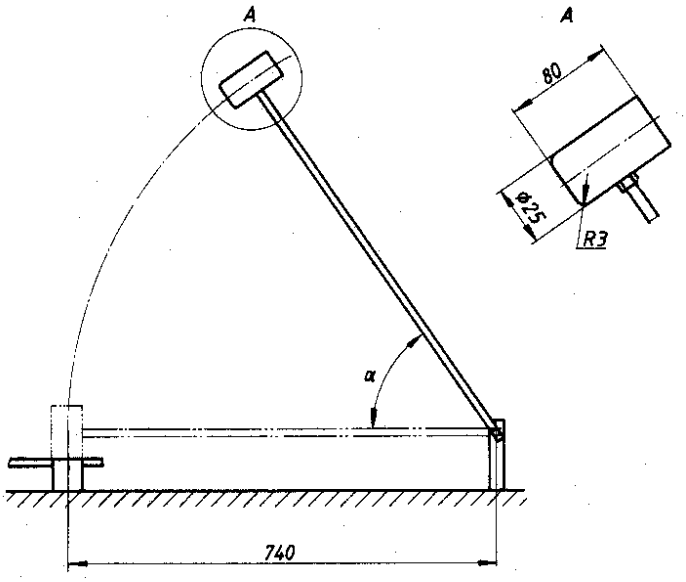

Figure B 3 Equipment for impact test. The weight of the pendulum head shall be 0.3 kg and that of the arm shall be 0.6 kg. It shall be possible to use a drop angle of at least 45°.

4.1.4 General requirements

After completion of all tests, the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

Any strings or similar which come loose during testing shall comply with 4.4.5.
Any parts which come loose during testing shall comply with 4.4.6.

4.2 Chemical properties

All accessible materials at a height of 1300 mm or less shall be tested in accordance with clause 4.2 of EN 71-3.

4.3 Ageing

The test sample shall endure heat treatment corresponding to 8 years of ageing at normal room temperature. The test shall be performed on the same test sample as the other tests.

Note
As a rule of thumb, chemical reactions are twice as fast if the temperature is raised 10°C. This means that the ageing process can be performed at different temperatures and for different lengths of time. Let us look at an example. Say that the reference temperature is 25°C (room temperature) and the ageing temperature is chosen to 75°C. This gives an acceleration factor of 2^(50/10) = 32. Given that the sample should be aged equivalent to eight years (96 months), this gives that the ageing time is 96/32 = 3 months. In short, 3 months at 75°C is equivalent to 8 years of normal ageing.

As implied above it is possible to shorten the ageing time by raising the temperature. There is however an upper limit to this and that limit varies with the material. The time and temperature in the example are very common when building products are aged and suitable for most materials.

4.4 Protective function and safety

4.4.1 Child appeal

No finger protection shall be a novelty finger protection.

4.4.2 Effectiveness

The protection shall have effect on the hazardous area(s) (lock side/hinge side etc.) for which it is intended according to the product information. The protection shall be effective from the floor level to a height of at least 1600 mm. The protection shall be effective at all permissible opening angles for a door of maximum permissible thickness according to the manufacturer's instructions. The protection shall be possible to mount on doors with a thickness of at least 40 mm which open (virtually) 180°, unless otherwise specified. A hinge side protection shall protect both the non-hinged as well as the hinged side, unless explicitly stated otherwise on the product or in the manufacturer's instructions.

If the maximum opening angle is less than (virtually) 180° a "stopper" should be enclosed with the finger protection device. A stopper is a device which limits the maximum opening angle of a freely moving door leaf to a certain angle.

4.4.3 Entrapment of fingers

The device shall be tested according to and conform to the requirements presented in the French study reported in Document CEN/TC 252 N 648. Finger protection shall be regarded as products intended for children less than 6 months.

4.4.4 Sharp edges

There shall be no accessible edges below the height 1600 mm that present an unreasonable risk of injury. Requirements and test methods are given in clauses 4.7 and 8.11 of EN 71-1:2005. This requirement applies to all materials. The test may be performed on a separate sample after analyzing which edges are accessible on the mounted sample.

4.4.5 Cords, strings and similar

Accessible cords, strings and similar below the height 1600 mm shall conform to the requirements of clause 5.4 of EN 71-1:2005.

4.4.6 Small parts

The possibility to detach small parts at a height of 1600 mm or less shall be tested according to EN 71-1:2005 clauses 8.3 and 8.4.

Any accessible small component below the height 1600 mm, which is detachable or becomes detached during the testing according to the test methods described in this document, shall not fit wholly within the small part cylinder described in clause 8.2 of EN 71-1:2005

4.5 Mechanical function and structural integrity

4.5.1 Cyclic tests

The product should work as intended after some use. Therefore it shall be subjected to cyclic tests and then perform as intended in the later tests.

Cyclic test of crushing prevention

The door shall be opened and closed 20 000 times with the protection device mounted and activated. The entire energy of the door leaf shall be absorbed by the protection device each closing cycle.

Start with the door open, at least to an angle that the protection device is in contact with only one part of the door, i.e. the door frame or the door leaf/handle. Close the door gently, as much as possible with the device active. Apply a force of 150 N in the direction of closing, at the handle. Open the door to the starting position and repeat the cycle. The motion of the door leaf shall be smooth and at a speed of 5-10 cycles per minute. Hinges shall be well lubricated and all other friction shall be minimized.

Cyclic test of automatic reactivation function

Some protection can be deactivated to make it possible to close the door without dismounting the device. Some of these devices are then automatically reactivated when the door is opened. These shall be subjected to an extra cyclic test to make sure that this function will still work after some use. This test starts with the door closed. Open the door, deactivate the device and close the door again. Remove all external loads on door and test sample. Repeat this cycle 500 times.

After testing in the cyclic tests, the device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional. When tested in the second cyclic test (only devices with automatic reactivation), the device shall reactivate automatically each time without being adjusted.

4.5.2 Attachment test

Any part or component of the device that can be gripped between thumb and forefinger or is “grippable” when assessed in accordance with clause 8.4.2.1 of EN 71-1:2005, shall be tested according to clauses 8.3 and 8.4 of the same document. The force for accessible dimensions larger than 50 mm shall be 200 N.

This test only applies to accessible parts/components at a height lower than 1600 mm.

After testing the device shall be fully functional. Any piece which comes loose shall comply with the small parts requirement in 4.4.6. The device may not be dismounted, even partially, from the door. This shall be examined visually.

4.5.3 Adhesive test

If the device is attached to the door only by adhesive tape, glue or similar the adhesive capacity of this shall be tested. This test may be performed on separate test samples which may be intact devices or parts of a/several device(s).

Mount the device according to the manufacturer's instructions onto four different test surfaces:
- wood with no surface treatment
- varnished wood
- oiled wood
- painted wood

Try to remove the device by applying 200 N in any direction.
The device may not visibly, even partially, detach.

4.5.4 Resistance to impact

The device shall be unmounted during this test.
The device shall be subjected to 10 strokes by the steel pendulum described in 4.1.3. The drop angle α shall be 45 ± 2°, see Figure B 3. The pendulum shall hit the device when the pendulum is in horizontal position. The strokes shall hit in the most onerous place and all 10 strokes shall hit the same spot.

After the test the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

The test may be performed on a separate test sample, which in that case shall first be subjected to the ageing of test 4.3.

4.5.5 Resistance to sharp objects

Mount the device in accordance with 4.1.1. Apply a force of 130 N for 5 seconds with the pointy probe (cf. 0) at any accessible surface of the protection device. There shall not be any holes or cracks through the device after testing. No parts may break off.

4.5.6 Dynamic strength

The test simulates the door being slammed shut.

The device shall be mounted in accordance with 4.1.1. Open the door at an angle of at least 45°. Keep the finger protection device activated. Place the large finger probe against the door frame. Close the door. At the time of contact between door leaf and protection device, the speed of the door leaf, measured at the lock side, at the height of the handle, shall be 3 m/s. At the time of contact between door leaf and protection device there shall be no outer force on the door leaf, i.e. the door leaf shall be free to bounce back. Repeat the test 10 times.

The large finger probe shall be placed at the most onerous place at a height of between 30 mm and 1600 mm from the floor, of the intended effective location of the protection device. If the location of the most onerous place is not obvious, several tests at different locations shall be performed. If the door is lower than 1600 mm, the test shall be carried out at a height between 30 mm from the ground and 30 mm from the top of the door leaf.

All hinges shall be well lubricated and all other friction minimized. The protection device shall be exposed to the entire energy of the door leaf.

The probe may not be crushed between the door leaf and door frame, i.e. it may not be subjected to any force, during the entire closing procedure

Note
If it is not clear whether the probe is crushed or not, this can be checked by powdering the probe with chalk or similar before the test. If the chalk on the sides of the probe is disturbed, the probe has been in contact with the door at that location and this counts as crushing.

4.5.7 Static strength

The test simulates the door being pushed (or pulled) shut, e.g. by a child leaning against the door leaf.

The device shall be mounted in accordance with 4.1.1. Open the door at an angle of approximately 30°. Keep the finger protection device activated. Place the large finger probe against the door frame. Slowly close the door as much as possible without applying any significant load. Then gradually apply a force of 500 N in the direction of closing, at the handle. Keep the load for 5 seconds.

The large finger probe shall be placed at the most onerous place of the intended effective location of the protection device, at a height of 30 mm to 1600 mm from the ground. If the location of the most onerous place is not obvious, several tests at different locations shall be performed.

The probe may not be crushed between the door leaf and door frame, i.e. it may not be subjected to any force, during the entire closing procedure

Note
If it is not clear whether the probe is crushed or not, this can be checked by powdering the probe with chalk or similar before the test. If the chalk on the sides of the probe is disturbed, the probe has been in contact with the door at that location and this counts as crushing.

4.6 Product information

Product information shall be provided to reduce the possible consequences of foreseeable hazards connected with the finger protection. The product information shall include at least the following:

1. The name or trade mark of the manufacturer, importer or organization responsible for its sale.
2. The instruction: ”Read these instructions carefully before mounting and using the device. The child protective function of the device may be affected if you do not follow the instructions. Keep the instructions for future reference.”
3. Instructions on how to mount/dismount the product. A statement whether the product is suitable to reuse after dismounting.
4. Instructions on how to activate/deactivate the device, if applicable.
5. If the protection may be deactivated (intentionally or unintentionally) when the door is being closed, the following warning shall be included: “WARNING: Make sure the protection is still effective after opening the door”.
6. Definition of the hazardous area where the product is intended to be effective.
7. The exhortation: “Use protection for both openings on the hinge side, as well as on the lock side”.
8. A definition of the doors for which the protection is effective including maximum thickness and maximum opening angle.

9. If the maximum opening angle is less than (virtually) 180°, a “stopper” should be enclosed. The instructions shall then include mounting instructions of this device as well as an explanation of its intended function.
10. How to close the door with the protection still mounted, if applicable.
11. Maintenance instructions.

4.7 Markings

The protection shall be marked with the name or trademark of the manufacturer, importer or organisation responsible for its sale. The marking shall be visible when the protection is mounted.

4.8 Test report

The test report shall include the information necessary for the interpretation of the results and at least the following information:

1. A title.
2. The name and address of the laboratory, and the location where the tests were carried out if different from the address of the laboratory.
3. The names, functions and signatures or equivalent identification of persons authorizing the test report.
4. The name and address of the client.
5. Unique identification of the test report and on each side an identification in order to ensure that the page is recognized as a part of the test report and a clear identification of the end of the test report.
6. Identification of the test method(s) used.
7. Deviations from, additions to or exclusions from the test method(s).
8. Information on specific test conditions, such as environmental conditions.
9. A description of, the condition of and an unambiguous identification of the items tested.
10. The date of receipt of the test item and the date of performance of the test.
11. Reference to sampling plan and procedure.
12. The test results and units of measurement.
13. A statement on the estimated uncertainty of measurement.
14. A statement of compliance or non-compliance with requirements and/or specifications.

Finger protection for doors – Shut controlling protections
Requirements and test methods

1 Scope

This document proposes requirements and test methods for non-integrated finger protection intended to be mounted on inner doors in order to prevent crushing injuries. Only protection based on shut controlling is considered. Typically a shut controlling device decelerates the door leaf the last shutting distance and prevents the door from shutting completely if its speed is too great.

A finger protection device is based on at least one of three protection methods; hazard shielding, shut prevention or shut controlling. There are three different documents concerning finger protection, one for each type.

The scope here is mainly to protect pre-school children, but in some cases, such as dimensions of hazardous openings, values have been chosen in order to protect older children/adults as well. A "standard inner door" was chosen as a base for this work. Drawings of this door, which has a mass of 18.0 kg, are presented in Appendix D. Outer doors are not included.

2 Normative references

EN 71-1:2005 *Safety of toys – Part 1: Mechanical and physical properties*
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3 Terms and definitions

Accessible

A place or part of door or protection device is considered accessible if it is located below the height 1600 mm and is reachable with a 5 mm wide finger probe when the protection is mounted. This shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

Effective location

The part of the gap between door frame and door leaf at which the finger protection is intended to prevent crushing injuries. A lock side protection is supposed to prevent injuries at any height at the lock side. The corresponding goes for hinge side protection as well.

Finger protection

Device designed to prevent crushing injuries on fingers between (part of) door leaf and door frame when door leaf is moving. The device is based on one of three protection methods; hazard shielding, shut prevention or shut controlling.

Hazard shielding

A method of protection. Typically a shield, barrier or similar preventing children from putting fingers in a hazardous place.

Hinge side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame on the side of the hinges. There are two types of hinge side protection: protection intended for the side with the wider opening and protection intended for the side with the smaller opening respectively.

Lock side protection

Finger protection designed to prevent crushing injuries on fingers between door leaf and door frame at the side of the handle.

Novelty finger protection

Finger protection that resembles by any means to another object commonly recognised as appealing to or intended for use by children younger than 51 months, or has entertaining audio effects or animated effects. This includes, but is not limited to, finger protections which shape resembles cartoon characters, toys, guns, watches, telephones, musical instruments, vehicles, human body or parts of the human body, animals, food or beverages, or that play musical notes, or have flashing lights or moving objects or other entertaining features. This excludes finger protections that are printed or decorated with logos, labels, decals or artwork if the protection in no other way meet the description of a novelty finger protection above.

Shut controlling

A shut controlling device decelerates the door leaf the last shutting distance and prevents the door from shutting completely if its speed is too great. If the speed is low, it is possible to close the door without deactivating the protection device. This kind of device works only as a lock side protection and makes slamming the door impossible.

Shut prevention

The door is prevented from shutting completely and a gap is left between door leaf and door frame on the lock side. Shutting may however still be possible without dismounting the protection by deactivating the device, e.g. by turning the handle. This kind of device works only as a lock side protection.

4 Requirements and test methods

4.1 General

4.1.1 Test conditions

The tests shall be conducted in indoor conditions with a temperature of 23°C ± 5°C.

The test sample shall be mounted in accordance with the manufacturer’s instructions. If the prescribed attachment method does not work after the heat treatment, attach the device by any other appropriate means, such as screws or other, making sure that the device is well attached.

The hinges of the door shall be well lubricated.

If nothing else is stated, forces shall be applied in the most onerous place and direction. If not obvious, pre-tests shall be performed in order to determine this.

"Accessibility" shall be checked with the door both closed as well as opened at all angles for which the protection is intended.

The uncertainty in force measurements shall not exceed ± 1.0 %.
The uncertainty in linear measurements shall not exceed ± 1.0 mm.

4.1.2 Order of tests

All tests shall be conducted on the same sample, if nothing else is stated. The tests shall be performed in the sequence order shown in Table C1 below. Tests with the same sequence number can be performed in any order within that sequence. When the sequence number of a test is 0, the test can be carried out at any time. The protective function tests (4.4.3 – 4.4.6) shall be performed both before and after the cyclic test since the results of these tests may be influenced by the performance of other tests. Also, the safety-tests that are to be performed twice are relatively easy and fast to perform and the results can be good to know before performing the rest of the tests. For instance, if a product has dangerous openings this can be detected before the time-consuming wear tests.

Table C 1 Order of tests

Sequence no.	Test	
0	4.2	Chemical properties
	4.4.1	Child appeal
	4.4.2	Effectiveness
	4.5.3	Adhesive test
	4.6	Product information
	4.7	Markings
1	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
2	4.5.1	Cyclic test
3	4.5.2	Attachment test
4	4.4.3	Entrapment of fingers
	4.4.4	Sharp edges
	4.4.5	Cords, strings and similar
	4.4.6	Small parts
5	4.3	Ageing
6	4.5.4	Resistance to impact
	4.5.5	Resistance to sharp objects
	4.5.6	Dynamic strength

4.1.3 Test equipment

Equipment	Reference
Standard door	Not implemented yet, the door used as a basis for this work is presented in Appendix D
Small finger probe, 5 mm	EN 1888:2003, § 6.1.2.2
Medium finger probe, 12 mm	Document CEN/TC 252 N 648 – Study on ”Risk analysis on finger entrapment”
Large finger probe, 21 mm	EN 1888:2003, § 6.1.2.2, but diameter 21 mm
Hand probe	See Figure C 1
Sharp edges equipment	Equipment for determination of sharp edges according to EN 71-1:2005, §8.11
Small parts cylinder	EN 71-1:2005, § 8.2
Pointy probe	See Figure C 2
Feeler gauge	EN 71-1:2005, § 8.4.1.3
Test surfaces	Test surfaces large enough to mount a protection device with the following surface treatments: - untreated wood - varnished wood - oiled wood - painted wood
Steel pendulum	See Figure C 3

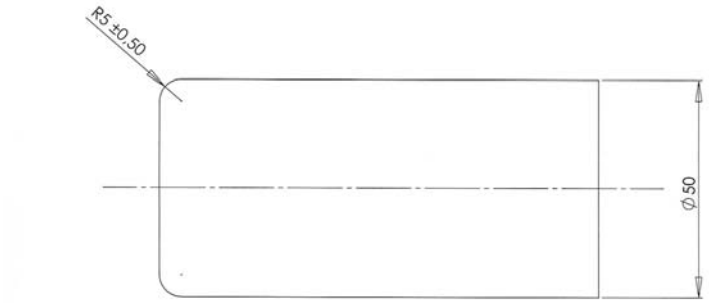


Figure C 1 Hand probe. Shall be made of metal or other hard smooth material. Measurements in mm.

Figure C 2 Pointy probe. Shall be made of metal or other hard smooth material. Measurements in mm.

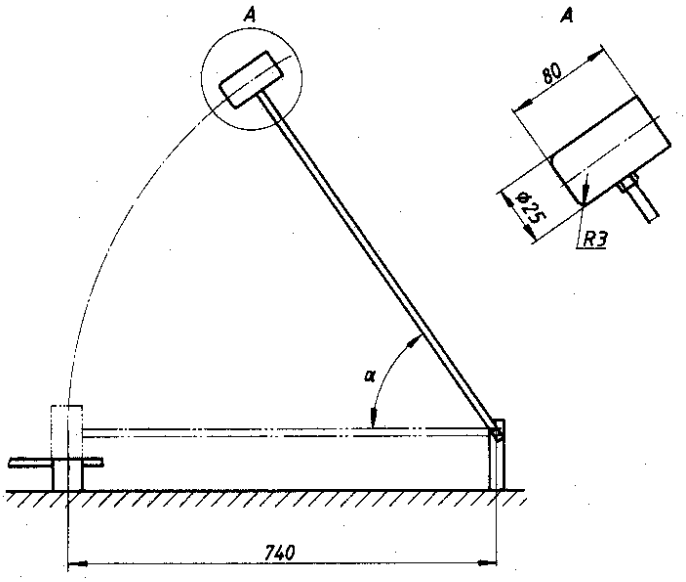


Figure C 3 Equipment for impact test. The weight of the pendulum head shall be 0.3 kg and that of the arm shall be 0.6 kg. It shall be possible to use a drop angle of at least 45°.

4.1.4 General requirements

After completion of all tests, the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

Any strings or similar which come loose during testing shall comply with 4.4.5.
Any parts which come loose during testing shall comply with 4.4.6.

4.2 Chemical properties

All accessible materials at a height of 1300 mm or less shall be tested in accordance with clause 4.2 of EN 71-3.

4.3 Ageing

The test sample shall endure heat treatment corresponding to 8 years of ageing at normal room temperature. The test shall be performed on the same test sample as the other tests. However, this test, and the subsequent tests according to the test order presented in Table C1, may be performed on only a part of the device. This part shall have a height of at least 200 mm. The 'height' refers to a vertical measurement when the device is mounted.

Note
As a rule of thumb, chemical reactions are twice as fast if the temperature is raised 10°C. This means that the ageing process can be performed at different temperatures and for different lengths of time. Let us look at an example. Say that the reference temperature is 25°C (room temperature) and the ageing temperature is chosen to 75°C. This gives an acceleration factor of 2^(50/10) = 32. Given that the sample should be aged equivalent to eight years (96 months), this gives that the ageing time is 96/32 = 3 months. In short, 3 months at 75°C is equivalent to 8 years of normal ageing.

As implied above it is possible to shorten the ageing time by raising the temperature. There is however an upper limit to this and that limit varies with the material. The time and temperature in the example are very common when building products are aged and suitable for most materials.

4.4 Protective function and safety

4.4.1 Child appeal

No finger protection shall be a novelty finger protection.

4.4.2 Effectiveness

The protection shall have effect on the hazardous area(s) (lock side/hinge side etc.) for which it is intended according to the product information. The protection shall be effective from the floor level to a height of at least 1600 mm. The protection shall be effective at all permissible opening angles for a door of maximum permissible thickness according to the manufacturer's instructions. The protection shall be possible to mount on doors with a thickness of at least 40 mm which open (virtually) 180°, unless otherwise specified. A hinge side protection shall protect both the non-hinged as well as the hinged side, unless explicitly stated otherwise on the product or in the manufacturer's instructions.

If the maximum opening angle is less than (virtually) 180°, a "stopper" should be enclosed with the finger protection device. A stopper is a device which limits the maximum opening angle of a freely moving door leaf to a certain angle.

4.4.3 Entrapment of fingers

The device shall be tested according to and conform to the requirements presented in the French study reported in Document CEN/TC 252 N 648. Finger protection shall be regarded as products intended for children less than 6 months.

4.4.4 Sharp edges

There shall be no accessible edges below the height 1600 mm that present an unreasonable risk of injury. Requirements and test methods are given in clauses 4.7 and 8.11 of EN 71-1:2005. This requirement applies to all materials. The test may be performed on a separate sample after analyzing which edges are accessible on the mounted sample.

4.4.5 Cords, strings and similar

Accessible cords, strings and similar below the height 1600 mm shall conform to the requirements of clause 5.4 of EN 71-1:2005.

4.4.6 Small parts

The possibility to detach small parts at a height of 1600 mm or less shall be tested according to EN 71-1:2005 clauses 8.3 and 8.4.

Any accessible small component below the height 1600 mm, which is detachable or becomes detached during the testing according to the test methods described in this document, shall not fit wholly within the small part cylinder described in clause 8.2 of EN 71-1:2005.

4.5 Mechanical function and structural integrity

4.5.1 Cyclic test

The product should work as intended after some use. Therefore it shall be subjected to cyclic tests and then perform as intended in the later tests.

The door shall be opened and closed 20 000 times with the protection device mounted and activated. The entire energy of the door leaf shall be absorbed by the protection device each closing cycle.

Start with the door open, at least to an angle that the protection device is in contact with only one part of the door, i.e. the door frame or the door leaf/handle. Close the door with a smooth motion. When the protection device gets in contact with both door leaf and frame the speed of the door leaf shall be 0.5 m/s, when measured at the lock side.

Open the door to the starting point and repeat the cycle. The motion of the door leaf shall be smooth throughout the cycle. Hinges shall be well lubricated and all other friction shall be minimized.

Note
The starting angle should be selected bearing in mind that the motion of the door leaf shall be smooth and that its maximum speed shall be met by the time when the protection device gets in contact with both door leaf and frame.

4.5.2 Attachment test

Any part or component of the device that can be gripped between thumb and forefinger or is “grippable” when assessed in accordance with clause 8.4.2.1 of EN 71-1:2005, shall be tested according to clauses 8.3 and 8.4 of the same document. The force for accessible dimensions larger than 50 mm shall be 200 N.

This test only applies to accessible parts/components at a height lower than 1600 mm.

After testing the device shall be fully functional. Any piece which comes loose shall comply with the small parts requirement in 4.4.6. The device may not be dismounted, even partially, from the door. This shall be examined visually.

4.5.3 Adhesive test

If the device is attached to the door only by adhesive tape, glue or similar the adhesive capacity of this shall be tested. This test may be performed on separate test samples which may be intact devices or parts of a/several device(s).

Mount the device according to the manufacturer’s instructions onto four different test surfaces:
- wood with no surface treatment
- varnished wood
- oiled wood
- painted wood

Try to remove the device by applying 200 N in any direction.
The device may not visibly, even partially, detach.

4.5.4 Resistance to impact

The device shall be unmounted during this test.
The device shall be subjected to 10 strokes by the steel pendulum described in 4.1.3. The drop angle α shall be 45 ± 2°, see Figure C 3. The pendulum shall hit the device when the pendulum is in horizontal position. The strokes shall hit in the most onerous place and all 10 strokes shall hit the same spot.

After the test the protection device shall not have suffered any damage such as cracks, holes or other which may impair its safety and it shall be fully functional.

The test may be performed on a separate test sample, which in that case shall first be subjected to the ageing of test 4.3.

4.5.5 Resistance to sharp objects

Mount the device in accordance with 4.1.1. Apply a force of 130 N for 5 seconds with the pointy probe (cf. 0) at any accessible surface of the protection device. There shall not be any holes or cracks through the device after testing. No parts may break off.

4.5.6 Dynamic strength

The test simulates the door being slammed shut.

The device shall be mounted in accordance with 4.1.1. Open the door at an angle of at least 45°. Keep the finger protection device activated. Place the large finger probe against the door frame. Close the door. At the time of contact between door leaf and protection device, the speed of the door leaf, measured at the lock side, at the height of the handle, shall be 3 m/s. At the time of contact between door leaf and protection device there shall be no outer force on the door leaf, i.e. the door leaf shall be free to bounce back. Repeat the test 10 times.

The large finger probe shall be placed at the most onerous place at a height of between 30 mm and 1600 mm from the floor, of the intended effective location of the protection device. If the location of the most onerous place is not obvious, several tests at different locations shall be performed. If the door is lower than 1600 mm, the test shall be carried out at a height between 30 mm from the ground and 30 mm from the top of the door leaf.

All hinges shall be well lubricated and all other friction minimized. The protection device shall be exposed to the entire energy of the door leaf.

The probe may not be crushed between the door leaf and door frame, i.e. it may not be subjected to any force, during the entire closing procedure

Note
If it is not clear whether the probe is crushed or not, this can be checked by powdering the probe with chalk or similar before the test. If the chalk on the sides of the probe is disturbed, the probe has been in contact with the door at that location and this counts as crushing.

4.6 Product information

Product information shall be provided to reduce the possible consequences of foreseeable hazards connected with the finger protection. The product information shall include at least the following:

1. The name or trade mark of the manufacturer, importer or organization responsible for its sale.
2. The instruction: ”Read these instructions carefully before mounting and using the device. The child protective function of the device may be affected if you do not follow the instructions. Keep the instructions for future reference.”
3. Instructions on how to mount/dismount the product. A statement whether the product is suitable to reuse after dismounting.
4. Instructions on how to activate/deactivate the device, if applicable.
5. If the protection may be deactivated (intentionally or unintentionally) when the door is being closed, the following warning shall be included: “WARNING: Make sure the protection is still effective after opening the door”.
6. Definition of the hazardous area where the product is intended to be effective.
7. The exhortation: “Use protection for both openings on the hinge side, as well as on the lock side”.
8. A definition of the doors for which the protection is effective including maximum thickness and maximum opening angle.
9. If the maximum opening angle is less than (virtually) 180°, a “stopper” should be enclosed. The instructions shall then include mounting instructions of this device as well as an explanation of its intended function.
10. Maintenance instructions.
11. The warning: “WARNING: This protection prevents slamming the door. Serious injuries can still occur when the door is closed slowly.”

4.7 Markings

The protection shall be marked with the name or trademark of the manufacturer, importer or organisation responsible for its sale. The marking shall be visible when the protection is mounted.

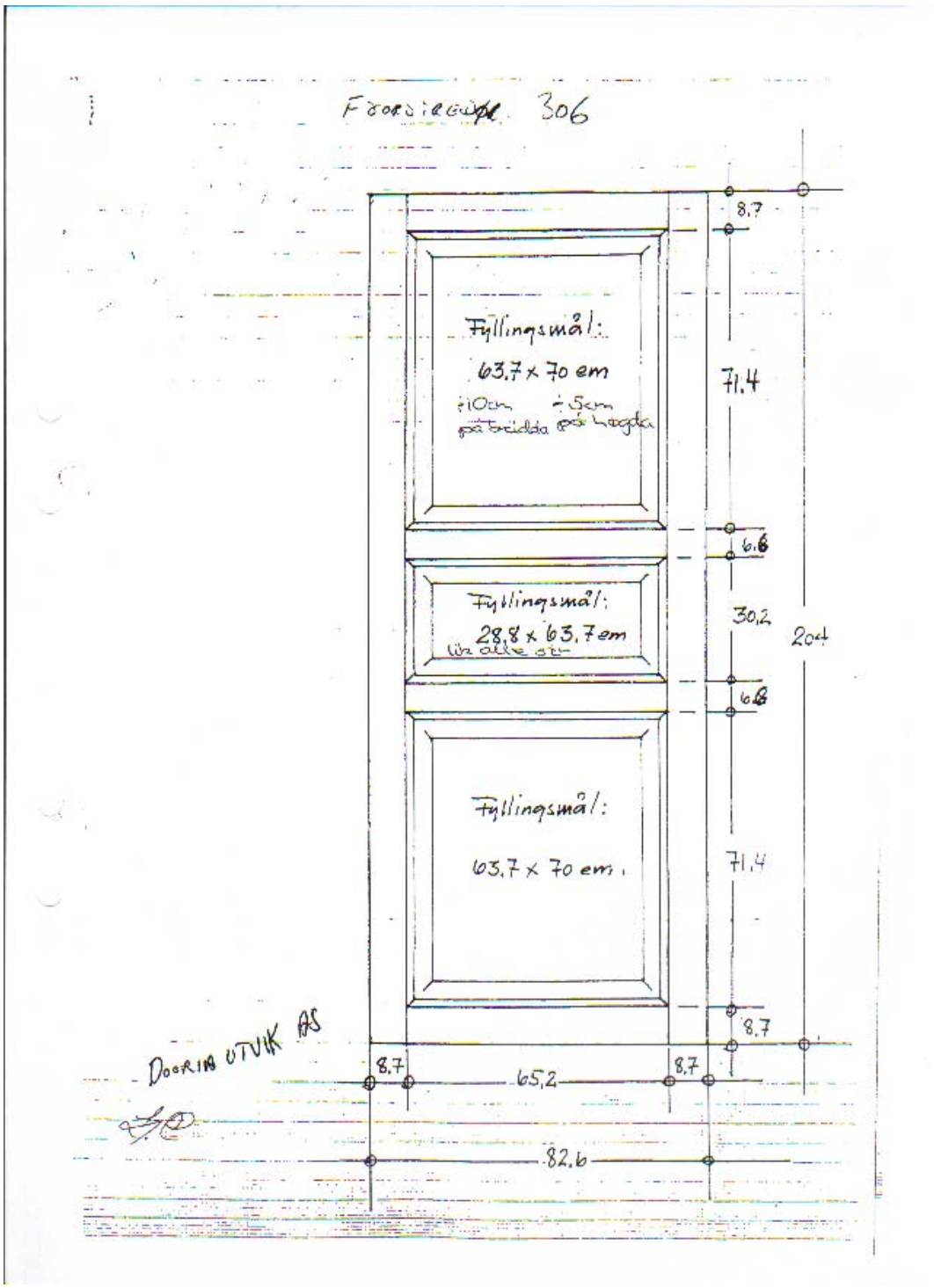
4.8 Test report

The test report shall include the information necessary for the interpretation of the results and at least the following information:

1. A title.
2. The name and address of the laboratory, and the location where the tests were carried out if different from the address of the laboratory.
3. The names, functions and signatures or equivalent identification of persons authorizing the test report.
4. The name and address of the client.
5. Unique identification of the test report and on each side an identification in order to ensure that the page is recognized as a part of the test report and a clear identification of the end of the test report.
6. Identification of the test method(s) used.
7. Deviations from, additions to or exclusions from the test method(s).
8. Information on specific test conditions, such as environmental conditions.
9. A description of, the condition of and an unambiguous identification of the items tested.
10. The date of receipt of the test item and the date of performance of the test.

11. Reference to sampling plan and procedure.
12. The test results and units of measurement.
13. A statement on the estimated uncertainty of measurement.
14. A statement of compliance or non-compliance with requirements and/or specifications.

Drawing of door used in the project



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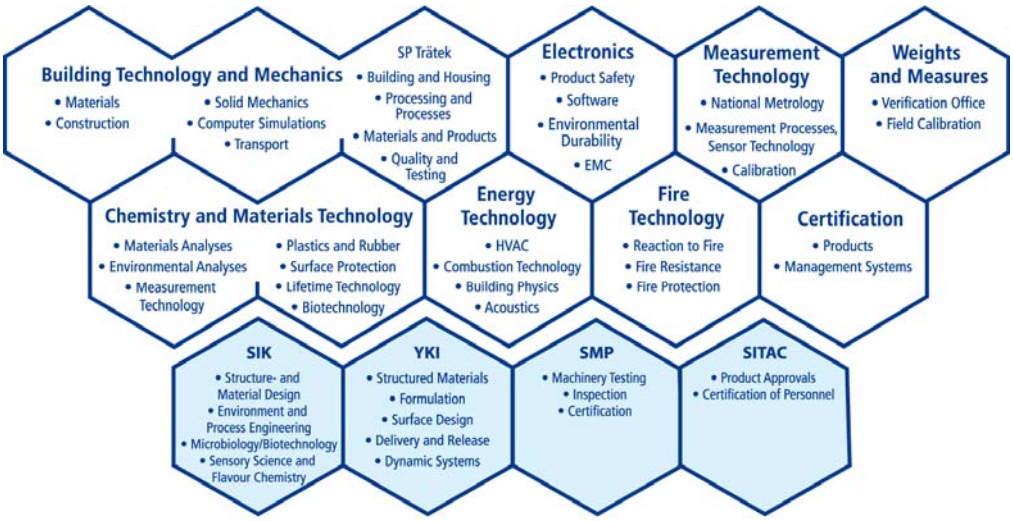

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SP Technical Research Institute of Sweden
Box 857, SE-501 15 BORÅS, SWEDEN
Telephone: +46 10 516 50 00, Telefax: +46 33 13 55 02
E-mail: info@sp.se, Internet: www.sp.se
www.sp.se

SP Report 2008:12
ISBN 91-7848-978-91-85829-28-6