GUIDE 50

Third edition
2014-12-15

Safety aspects — Guidelines for child safety in standards and other specifications

Aspects liés à la sécurité — Principes directeurs pour la sécurité des enfants dans les normes et autres spécifications

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) are worldwide federations of national standards bodies (ISO member bodies and IEC national committees). The work of preparing International Standards is normally carried out through ISO and IEC technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO or IEC, also take part in the work. ISO collaborates closely with IEC on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

Draft Guides adopted by the responsible Committee or Group are circulated to the member bodies for voting. Publication as a Guide requires approval by at least 75 % of the member bodies casting a vote.

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

ISO/IEC Guide 50 was prepared by a Joint Working Group of the ISO Committee on Consumer Policy (COPOLCO) and the IEC Advisory Committee on Safety (ACOS). This third edition cancels and replaces the second edition (ISO/IEC Guide 50:2002), which has been technically revised.

The main changes compared with the second edition are as follows:

— close alignment of the title and scope with the title and scope of ISO/IEC Guide 51;

— additional clarification that ISO/IEC Guide 50 is intended for standards developers, but that it can also be used by other stakeholders;

— expansion of Clause 5 outlining the relationship between child development, behaviour and unintentional harm;

— new structure of Clause 7 on hazards, and inclusion of new hazards that were not included in the previous edition;

— addition of new Clause 8 dealing with the adequacy of safeguards.

Introduction

0.1 Intended users of this Guide

This Guide provides guidance to those developing and revising standards, specifications and similar publications. However, it contains important information that can be useful as background information for, amongst others, designers, architects, manufacturers, service providers, educators, communicators and policy makers.

This Guide provides useful information for auditors and safety inspectors in the absence of a specific standard.

0.2 The reason for this Guide

Preventing injuries is a shared responsibility. The challenge is to develop products, including manufactured articles, including their packaging, processes, structures, installations, services, built environments or a combination of any of these which minimize the potential for causing deaths or serious injuries to children. A significant aspect of this challenge is to balance safety with the need of children to explore a stimulating environment and learn. Injury prevention can be addressed through design, engineering, manufacturing controls, legislation, education and raising awareness.

0.3 Relevance of child safety

Child safety is a major concern for society, because child and adolescent injuries are a major cause of death and disability in most countries. The joint WHO/UNICEF *World Report on Child Injury Prevention* [26] identifies unintentional injury as the leading cause of death for children over the age of 5. More than 830 000 children die each year from road traffic crashes, drowning, burns, falls and poisoning.

Children are born into an adult world, without experience or appreciation of risk, but with a natural desire to explore. They can use products or interact with environments in ways not necessarily intended, which are not necessarily regarded as “misuse”. Consequently, the potential for injury is particularly great during childhood. Supervision might not always prevent or minimize significant injury. Therefore, additional injury prevention strategies are often necessary.

Intervention strategies aimed at protecting children recognize that children are not little adults. Children’s susceptibility to injury and the nature of their injuries differ from those of adults. Such intervention strategies ideally also consider reasonably foreseeable use of products or surroundings. Children interact with them in ways that reflect characteristics of child behaviour, which will vary according to the child’s age and level of development. Intervention strategies intended to protect children therefore often differ from those intended to protect adults.

0.4 Role of standards

Standards can play a key role in reducing and preventing injury because they have the unique potential to:

— draw on technical expertise for design, manufacturing controls and testing,

— specify critical safety requirements, and

— inform through provisions for instructions, warnings, illustrations, symbols, etc.

NOTE In this Guide, the term “standard” includes other ISO/IEC publications, e.g. Technical Specifications and Guides.

0.5 Structure of this Guide

This Guide provides additional information to ISO/IEC Guide 51. Whereas ISO/IEC Guide 51 provides a structured approach to risk reduction within a general safety context, this Guide focuses on the

relationships between child development and harm from unintentional injury, and provides advice on addressing hazards that children might encounter. This Guide is structured as follows:

a) Clause 4 describes a general approach to child safety, including the principles for a systematic way to address hazards;

b) Clause 5 covers the relationship between child development and behaviour and unintentional injury, including children's anthropometry (see 5.1.2), motor (see 5.1.3), physiological (see 5.1.4) and cognitive (see 5.1.5) development, and exploration strategies (see 5.1.6); the importance of applying knowledge of child development to preventing harm is covered in 5.2; children's development age compared with chronological age is covered in 5.3;

c) Clause 6 covers the relevance of the child's physical and social environments and special considerations relating to the child's sleeping environment;

d) Clause 7 describes hazards to which children might be exposed during their use of, or interaction with, a product, along with specific suggestions for addressing those hazards;

e) Clause 8 describes a structured means of considering the adequacy of safeguards.

In addition, Annex A contains a checklist for assessing a standard. It provides an overview of hazards, potential injuries and structured approaches to solutions. However, it is essential that it be read in conjunction with the main body of this Guide, as it only gives a few examples of structured approaches. Annex B lists some information on injury databases.

Safety aspects — Guidelines for child safety in standards and other specifications

1 Scope

This Guide provides guidance to experts who develop and revise standards, specifications and similar publications. It aims to address potential sources of bodily harm to children from products that they use, or with which they are likely to come into contact, even if not specifically intended for children.

This Guide does not provide guidance on the prevention of intentional harm (e.g. child abuse) or non-physical forms of harm, such as psychological harm (e.g. intimidation).

This Guide does not address the economic consequences of the above.

NOTE The term "product" is defined in 3.5.

2 Normative references

There are no normative references.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
carer
person who exercises responsibility, however temporarily, for an individual child's *safety* (3.7)

Note 1 to entry: A carer is sometimes referred to as a "caregiver".

EXAMPLE Parents; grandparents; siblings who have been given a limited responsibility over a child; other relatives; adult acquaintances; babysitters; teachers; child-minders; youth leaders; sports coaches; camp counsellors; day care workers.

3.2
child
person aged under 14 years

Note 1 to entry: Ages may vary according to local legislation; some standards may use different age limits.

Note 2 to entry: See 4.2 for more information.

3.3
harm
injury or damage to the health of people, or damage to property or the environment

[SOURCE: ISO/IEC Guide 51:2014, 3.1]

3.4
hazard
potential source of *harm* (3.3)

[SOURCE: ISO/IEC Guide 51:2014, 3.2]

3.5
product
manufactured article, process, structure, installation, service, built environment or a combination of any of these

Note 1 to entry: In the case of consumer goods, packaging (whether or not it is intended or likely to be retained as part of the product) is considered an integral part of the product (see also 7.1).

3.6
risk
combination of the probability of occurrence of *harm* (3.3) and the severity of that harm

[SOURCE: ISO/IEC Guide 51:2014, 3.9, modified — Note 1 to entry has been deleted.]

3.7
safety
freedom from *risk* (3.6) which is not tolerable

[SOURCE: ISO/IEC Guide 51:2014, 3.14]

3.8
tolerable risk
level of *risk* (3.6) that is accepted in a given context based on the current values of society

[SOURCE: ISO/IEC Guide 51:2014, 3.15, modified — Note 1 to entry has been deleted.]

4 General approach to child safety

4.1 General

When developing or revising a standard for a product, standards developers should consider if and how children are likely to interact with the products the standard is addressing, regardless of whether those products are aimed specifically at children. The safety concepts that distinguish child safety from safety in general are explained in this clause. These concepts are additional to the contents of ISO/IEC Guide 51.

4.2 Age descriptors used in this Guide

A number of age related terms referencing child development are in common use. They are not mutually exclusive and, depending on context, may be used loosely or with precise meaning, as follows.

— The terms “babies” or “infants” usually refer to those not yet walking.

— The term “toddlers” usually refers to children who can walk, but whose ambulatory skills are not fully developed and exhibit strong exploratory behaviour.

— The term “young children” often refers to those past the toddler stage, but still developing basic skills, such as those aged 3 to 8 years. They are likely to have well-developed gross motor skills, are beginning to perform some basic adult tasks, and are gradually subject to less supervision, but their behaviour might still be impulsive and unpredictable. It is important to remember that there will be significant differences between the skills and behaviours of children at the extremes of this age range.

— The term “older children” refers to those who are not yet adolescents: the upper age limit can vary, so the term can refer to those from approximately age 9 to age 12, 13 or 14. It is an age group that is increasingly independent, is capable of performing most adult tasks (albeit with varying degrees of competence) although they might still not act consistently and predictably, might react to peer pressure, and might not fully understand the consequences of their actions. It is a period when there can be an emotional conflict of wanting both security and independence. At the upper end of this age group, children have a strong drive for independence and are likely to seek new experiences.

4.3 Risk assessment

Risk assessment is an important step in any injury prevention strategy. It is critical to identify all events or event chains that could result in harm for each hazard.

A general approach is outlined in ISO/IEC Guide 51, which defines the risk associated with a particular hazardous situation as a function of the severity of harm that can result from the hazard, and the probability of occurrence of that harm. Severity of harm and, in particular, probability of occurrence, should be objectively determined and based on relevant facts that demonstrate causation, instead of arbitrary and intuitive decision-making. When addressing child safety, the following factors need special attention related to the risks for children:

a) their interactions with persons and products;

b) their development and behaviour;

c) degree of awareness, knowledge and experience of child and carer;

d) social, economic, and environmental factors; likelihood of being injured related to their physical characteristics and behaviour;

e) degree of supervision by carer.

4.4 Preventing and reducing harm

4.4.1 Harm can result from hazards such as deprivation of vital needs, (e.g. oxygen, such as by drowning or suffocation), transfer of energy (e.g. mechanical, thermal, electrical, radiation), or exposure to agents (e.g. chemical, biological) greater than the body's capacity to withstand (see Clause 7). It can be prevented or reduced by intervening in the chain of events leading to, or following, their occurrence. Designing safe products generally results in primary prevention.

4.4.2 Strategies may include one or more of the following:

— eliminating the hazard and/or exposure to the hazard (primary prevention, e.g. designing safer products); for example, substituting non-flammable liquid for a flammable one);

— eliminating exposure to the hazard (primary prevention);

— reducing the probability of exposure to the hazard (secondary prevention, e.g. using child-resistant packaging);

— reducing the severity of harm (secondary prevention, e.g. use of personal protective equipment or reduction of temperature of domestic hot water);

— reducing the long-term effects of harm through approaches such as rescue, treatment or rehabilitation (tertiary prevention).

NOTE An approach to risk reduction is also presented in ISO/IEC Guide 51:2014, 6.3.

4.4.3 In addition, strategies can be passive or active. Passive strategies work without the individual having to take any action to be protected, whereas active strategies require the individual to take some action to minimize the harm. Passive strategies that eliminate or guard against a hazard ensure a greater likelihood of success than active strategies.

Improving product safety, i.e. eliminating or minimizing risks that may lead to significant injuries, should start at the product design stage, aiming to incorporate a primary prevent approach or, if this is not possible, a secondary prevent approach. Secondary prevention can include the provision of

information for users about residual risks, those that might have to be addressed by users. Whenever possible, product design should aim to incorporate passive prevention strategies.

NOTE An approach to risk reduction is also presented in ISO/IEC Guide 51:2014, 6.3.

Various sources can be used to identify the potential for harm associated with a product. These include, but are not limited to:

— injury statistics;

— detailed information available from injury surveillance systems;

— research results;

— test data (although passing a test does not necessarily mean a product is free of hazards);

— investigations of case reports;

— complaint data;

— extrapolation of relevant data about hazardous characteristics from other types of products. Surveillance data, recalls, and other similar actions in other jurisdictions should be considered.

CAUTION — The absence of reported harm does not necessarily mean that there is no hazard.

As harm to children is generally closely related to their developmental stage and their exposure to hazards at various ages, it is important to sort child injury data by age group to identify the patterns that emerge.

EXAMPLE 1 The number of burns from oven doors, scalds, poisoning by medicines and household chemicals, and drowning peaks among children under 5 years of age.

EXAMPLE 2 Injuries associated with falls from playground equipment peak at 5 to 9 years.

EXAMPLE 3 Injuries associated with falls and impacts related to sports peak at 10 to 14 years.

The identification of countermeasures results from research and evaluation, particularly based on injury data, child behaviour, engineering and biomechanics. Feedback, e.g. from consumers, can provide valuable information about the need to redesign products.

When choosing preventive measures, it is important to recognize that tolerable risk for adults might not apply to children. When introducing measures designed to protect adults it is essential to consider increased and/or additional risks for children (e.g. passenger side air bags in cars).

Further information on injury surveillance systems is given in Annex B.

4.5 The “invisibility” of children

4.5.1 Children are “invisible”, i.e. their presence is difficult to detect, for several reasons:

— their small body size makes them less visible to adults;

— their lack of judgment to understand dangers and their unpredictable behaviour can place them in hazardous situations that adults do not anticipate.

4.5.2 Human eyesight has limitations, such as limits in peripheral vision. Children out of the field of vision of adults are at risk of being involved in serious accidents. For example:

— a child near a vehicle might be in the driver’s blind spot and be inadvertently hit by the vehicle;

— a child might jump out in front of a moving vehicle and be hit;

— a child might not be visible when another person opens or closes a door.

4.5.3 Possible strategies to avoid or alleviate risks in blind spots should be considered, for example:

— preventing children from entering high-risk locations, such as driveways, by installing barriers or swing-arm barriers to prevent them from crossing in front of a school bus without being seen by the bus driver;

— eliminating blind spots on a vehicle by mounting a mirror or recognition system;

— extending a transparent window in a door to a lower level.

4.6 Needs of children with disabilities

A small but significant proportion of children have disabilities. Some children are born with a disabling health condition or impairment, while others experience disability as a result of illness, injury or poor nutrition. A number of children have a single impairment while others experience multiple impairments. For example, a child with cerebral palsy might have mobility, communication and intellectual impairments. The complex interaction between a health condition or impairment and environmental and personal factors means that each child's experience of disability is different.

IMPORTANT — For these reasons, advice from specialists should be sought.

For children with disabilities, requirements to meet their needs, in addition to those outlined in this Guide, might be appropriate, although there might be situations when generic approaches are not possible and individual approaches are required.

The term "disabilities" includes a wide range of conditions, varying in their nature, severity and impact. Disabilities include, but are not limited to:

— behavioural and learning impairments;

— physical and growth impairments;

— sensory impairments;

— motor skill impairment.

This Guide does not provide detailed advice on how to minimize the risk and/or severity of unintentional injuries among children with disabilities.

NOTE ISO/IEC Guide 71 addresses the needs of persons with disabilities in broad terms, but does not specifically cover guidance relating to children with disabilities.

5 Safety considerations: child development, behaviour, and unintentional harm

5.1 Child development and behaviour

5.1.1 General

Children are not small adults. Inherent characteristics of children, including their stage of development, together with their exposure to hazards, puts them at risk in ways different from adults. Developmental stage broadly encompasses children's size, shape, physiology, physical and cognitive ability, emotional development and behaviour. These characteristics change quickly as children develop. Consequently, parents and other carers often overestimate or underestimate children's abilities at different stages of development, thus exposing them to hazards. This situation is compounded by the fact that much of the environment that surrounds children is designed for adults.

All the childhood characteristics described in this section need to be considered in determining potential hazards associated with products. Keep in mind these characteristics can act in combination, increasing the child's risk. For example:

— exploratory behaviour might lead a child to climb a ladder;

— limited cognitive skills might prevent the child from recognizing that the ladder might be too high or unstable;

— limited motor control might result in the child losing grip and falling.

The way children use and interact with products should be considered normal childhood behaviour. The term "misuse" is misleading, and can lead to inappropriate decision-making regarding child hazards. Survey evidence shows that children regularly use products that were not designed for them, such as microwave ovens. When a child interacts with a product, it is difficult to make a distinction between play, active learning or intended use. For safety reasons, it is not constructive to attempt to distinguish between such interactions.

Safety considerations should provide an appropriate balance between risk and freedom for children to explore a stimulating environment and to learn. The goal is to reduce the risk of harm by design in accordance with their level of development.

5.1.2 Children's body size and anthropometric data

Certain characteristics of children's size and weight distribution make them particularly vulnerable to harm. The nature of this harm might also be different from that experienced by adults.

Children's size in relation to their surroundings makes it necessary to examine their anthropometry, including overall heights as well as body part lengths, widths and circumferences. Anthropometric data should be consulted in order to establish the normal distribution and safety margins. Children, like adults, do not necessarily have consistent measurements for different parts of their bodies. For example, a child measuring in the 95th percentile in height may have a head that is in the 50th percentile and hand length in the 25th percentile. Children within an age group can have major differences in development and size. The sexes experience growth spurts at different ages.

NOTE For useful references on anthropometric data, see Bibliography.

The following are examples where body size and weight distribution, as compared to adults, are factors in harm.

a) In the case of thermal injuries, a given area of contact is typically a larger proportion of a child's surface area than is the case for an adult. In addition, children's overall larger surface-area-to-body mass ratio can result in a greater proportion of body fluids being lost from the burnt area.

b) Young children have a large head compared with their body size. Their high centre of mass increases the likelihood of falls, e.g. from furniture or structures on which children might be sitting, climbing or standing. Children often fall directly onto their head.

c) Another effect of the high centre of mass is that it also increases the likelihood of falling into pools, buckets, toilets, bathtubs, etc., into which children are bending or reaching, thereby increasing the risk of drowning.

d) The relatively large head size means that it requires a much larger space to pass through than the rest of the body. Entrapment can occur when the body passes, feet first, through a gap through which the head cannot.

e) The relatively large mass of the head increases the likelihood and severity of whiplash.

f) Children might be able to insert their fingers, hands or other parts of their body into small openings and gaps to access rotating and moving parts or electrical and other hazards.

g) Small quantities of substances that would not harm an adult can harm a child. They might be more strongly affected than adults by exposure to chemical and radiation hazards due to their large surface to mass ratio as well as their small body size.

5.1.3 Motor development

Motor development refers to the maturation process of gross and fine movements and coordination. Understanding the development of children's motor skills is essential to the design of products to eliminate or mitigate harm.

The development process includes changes from primary involuntary reflex actions to deliberate, goal-directed actions. Milestone achievements in the process include acquiring the strength and skill to support the head, crouch, sit up, roll over, crawl, stand, climb, rock, walk and run, and the ability to manipulate objects with hands and fingers. Until balance, control and strength have sufficiently developed, children are particularly at risk of falling and getting into unsafe positions from which they cannot escape.

EXAMPLE 1 When lying down, babies can move to the edge of a surface and roll off, but be unable to lift themselves up. As a result, they can become wedged between products and suffer positional or compression asphyxia.

EXAMPLE 2 Standing babies and toddlers can become entangled in cords, ribbons, or window dressings within their reach. When they sit or slump, the cords can tighten around their neck, resulting in strangulation.

EXAMPLE 3 Climbing children can get clothing, accessories, and anything they wear (e.g. backpack, hair accessory) caught in furniture items or protrusions. If they cannot extricate themselves, they can hang.

EXAMPLE 4 Children can fall from heights because they lose their balance or grip.

EXAMPLE 5 From about age three months, infants placed to sleep on their backs can turn over and suffocate if the mattress or bedding is too soft.

5.1.4 Physiological development

In addition to their body size and motor functions, there are many other physiological functions that are developing in children. These include sensory functions, biomechanical properties, reaction time, metabolism and organ development.

Sensory development of children occurs over time. Visual development is slower than development of other senses. Even at the stage when most children have vision similar to that of adults, they might have narrower vision or have difficulty with depth perception. As a result, children will have difficulty recognizing hazardous situations.

The following are examples where incomplete physiological development can be a factor in injuries:

a) children's small body size and faster breathing rates result in their being particularly susceptible to potentially toxic substances such as medications, chemicals and plants;

b) children's biochemistry makes them susceptible to toxicity of chemicals, medications and plants not toxic to adults;

c) the characteristics of children's skin, including its thinness, make it more vulnerable to thermal injury;

d) children's bones are not fully developed, resulting in different responses to mechanical forces;

e) children are more susceptible to harm from intense light sources;

f) children are more sensitive to sound pressure.

5.1.5 Cognitive development

Children's stage of cognitive development determines their ability or inability to understand the consequences of their actions. Young children have limited ability to recognize hazards and they do not consistently and reliably anticipate or respond to harmful consequences of hazardous conditions. Thus, hazards obvious to adults are not so obvious for children.

At some stage in childhood, experience and teaching from parents and other carers begin to influence the child's behaviour, but this should not be relied upon when developing a product.

5.1.6 Exploration strategies

From early infancy, children are driven by an inborn drive to explore. Children's exploration behaviour can be classified in terms of basic strategies which correspond to their emerging abilities. Since children experience a somewhat predictable sequence of physical and mental maturation, they also employ predictable patterns of exploratory behaviour. These exploratory behaviours can result in the child using products in ways that were not intended by the manufacturer.

One of the most frequently observed exploration strategies is object manipulation. In infancy, this often involves handling and mouthing objects simultaneously. Exploratory mouthing is not just about eating. Children's mouths are relatively sensitive and mouthing provides children with feelings of pleasure as well as alleviation of pain associated with teething. Exploratory mouthing requires basic motor coordination (e.g. bringing one's hand to the mouth). Children begin to explore objects in ways that allow them to learn about their physical properties. With the emergence of more complex two-handed coordination and other exploration strategies such as rotating, dropping, banging and throwing objects, exploratory mouthing declines proportionally. However, some mouthing behaviour continues well beyond the early stages of exploration.

As children's sensory, motor, and cognitive skills improve, exploration of the environment gradually becomes more sophisticated. Children continue to explore objects including their own bodies. Inserting themselves into a large object or inserting small objects into their body cavities are common. Over time, social play becomes a primary exploratory strategy for many children. Choices made by peers become important motivating factors shaping exploration.

Adults understand that exploration is a process of "discovering the unknown" that involves risk. Children of every age face additional risk, due to their limited risk perception and decision-making ability, poor understanding of their own limitations and their physical and cognitive immaturity, all of which impact their capacity to avoid danger. While children are capable of perceiving some risk, they are not able to assess the risk involved in a potentially hazardous situation until they are capable of understanding consequences (cause and effect) at around 7 to 8 years old.

Table 1 provides examples of children's typical exploration strategies.

Table 1 — Examples of children's typical exploration strategies

Exploration strategies	Examples	Age peak	Illustrative examples
Mouthing	Biting, sucking, gnawing, chewing, licking.	Birth to 3 years of age	Soother (or pacifier), wooden blocks, washcloths, clothing, food made of an inedible substance, teethers, toys, button/coin batteries furniture, window sills.
Rotating	Children rotate an object as they visually inspect it.	6 months to 2 years of age	Rattles, toys with water/beads in them, blocks, toys that make noise when turned over.
Transferring hand to hand	With increased motor co-ordination, children become able to use both hands to rotate an object. This strategy allows children to turn the object around completely by passing it from one hand to the other.	9 months to 2 years of age	Balls, drumsticks, blocks, stacking toys, plastic building blocks.

Table 1 *(continued)*

Exploration strategies	Examples	Age peak	Illustrative examples
Insertion (body into object)	Begins when children become capable of isolating one finger. That is, when they are able to extend one finger without all of their other fingers extending. Children then begin to explore objects by putting their finger inside the objects or running their finger along the outside of the object. As children grow, they will begin to insert other body parts (hands, feet, legs, head, etc.) and their entire bodies into objects as they explore.	6 months to 10 years of age	Zipper pulls/loops, electrical outlets, plastic tubes, openings of bottles, cardboard boxes, dog cages, railings and barrier slats.
Insertion (object into body)	Children explore the objects within their environments, as well as their own bodies, by placing objects into their own body cavity.	2 to 6 years of age	Beads, stickers, peas, cotton buds, buttons, modelling clay, modelling compound, small parts from toys.
Banging	Children may bang objects to hear what sounds different objects can make. It may also give feedback to children about the weight of the object.	9 months to 5 years of age	Pots and pans with wooden spoons, blocks, crayons, stacking toys, toys that make noise when banged together or on hard surface.
Dropping	Dropping of objects begins extremely early in the life of a child. This type of exploration allows children to begin learning that objects continue to exist even when out of their sight and that they can have a certain level of control over the actions of their parents or caregivers.	6 months to 3 years of age	Feeding utensil, pacifier, balls, small toys, toys that bounce or make noise when dropped.
Throwing	Children begin throwing whatever they can grasp. This strategy may provide information to children about weight, as well as being an exercise of motor skills and a statement of power.	1 to 4 years of age	Balls, frisbees, plush toys, toys that fit in a child's hand, any object when angry or frustrated.
Imaginative play	Once children become no longer content to use objects as they were intended, they begin to branch out and discover all of the various possibilities for the object. This may lead to experimentation with all the previous strategies on a given object as children attempt to push the limits of the object and obtain optimal simulation.	3 to 10 years of age	Dress-up clothes, dolls, dinosaur toys, cars, trains, miniature worlds (castles, dollhouses, kitchens, etc.), playing nurse or doctor.
Testing the limits	Children are often interested in testing the limits of objects by increasing the risk involved in using them. The answers to these questions assist children in an understanding of objects and transformations the objects can undergo. Children's sense of cause and effect and the possible "risk" to themselves is not well developed. In fact, children at this stage often perceive themselves to be invincible.	3 to 10 years of age	Playground equipment, wagons and ride-on toys, sports equipment, Balancing on walls, or climbing trees, trying aerobic manoeuvres with bicycles or skateboards.

5.2 Applying knowledge of child development to preventing harm

When developing or revising a standard for a product, reasonably foreseeable use by children should be taken into account. The characteristics described in 5.1 help predict how a child will interact with a product.

EXAMPLE 1 Designing a storage device: children like to explore their body size in relation to the container, e.g. a storage bag or a refrigerator. If the opening allows the lower body to pass into the device but not the head, the child can sustain harm. If the whole body can enter, an airway is necessary otherwise the child risks asphyxiation. If the device retains water, the child risks drowning.

EXAMPLE 2 Designing an electrical device: children will be attracted to flashing lights, sound, and buttons. As a result, it is important to remove hazardous components, e.g. sharp edges, entrapments, small parts, moving parts and access to batteries.

EXAMPLE 3 Children often mimic adults, older children and media characters: this leads children to use products normally used by adults and not intended for them. This behaviour is dangerous when children do not understand the implications of their actions. For example, they might administer medications to their younger siblings, operate locking mechanisms, and switch on appliances.

EXAMPLE 4 Packaging, especially if it is colourful and attracts children (e.g. the shape of a toy), is likely to result in the child using that product imaginatively.

Children cannot be expected to recognize the difference between a real object and an imitation or model, either of which can be harmful. The use on products of images which might be attractive to children, such as cartoon characters, or products which are themselves designed to look like cartoon characters, e.g. hairdryers, lanterns and cigarette lighters, might induce children into treating them as playthings. This can lead to inappropriate and unsafe use.

5.3 Chronological age compared with developmental age

When considering the risks that children face, one should be aware that chronological age does not always match developmental age, i.e. children of the same chronological age might developmentally differ significantly.

For example, within a single narrow age range, some 12 month old babies may be able to walk while others are still crawling; a small proportion of 4 year olds can open containers that are certified as child resistant while the majority cannot; and some 8 year olds will follow rigid patterns of behaviour when crossing a road while others may behave unpredictably.

5.4 14 years and above

In this Guide, a child is defined as a person aged under 14 years. However, while beyond the scope of this Guide, it is important to remember that development does not stop at 14 years. The drive for independence can lead to risk-taking behaviour. Growth and brain maturation usually continue beyond age 20.

6 Safe environments for children

6.1 General

In addition to child development, the physical and social environment also affect how a child interacts with a product. Natural and built environments, climate, language, customs, attitudes and beliefs, knowledge and users' experience all affect product safety.

The likelihood and severity of injuries can be increased by the presence and involvement of more than one child.

EXAMPLE 1 Injuries on trampolines often result from one child striking another while on the trampoline.

EXAMPLE 2 One child might feed medicine to another child, imitating adult behaviour.

EXAMPLE 3 One child might encourage risky behaviour in other children through peer pressure.

NOTE A significant proportion of injuries are associated with the involvement of a second child.

6.2 Physical environment

The manufacture and storage of raw materials and products in unhygienic environments can result in contamination.

It is necessary to consider the use of products in multiple environments. A product might be used in an environment other than intended. Examples include:

— a popup camping tent set up indoors as a playhouse;

— a trampoline used indoors;

— indoor electrical devices used outside;

— outdoor generators run indoors;

— indoor activity sets installed outdoors with the threat of weathering;

— medical devices used in the home environment, e.g. oxygen bottles, defibrillators, hospital beds;

— fireworks intended for outdoor use are sometimes used indoors or in partly enclosed spaces.

6.3 Social environment

Product designers should be aware of, and address, issues raised by evolving technologies and emerging hazards, including for products now used by children despite the original intent of the manufacturer. There are also examples of products that are intended for use by children, but that are used by younger age groups than originally intended. Such products might lack proper standards reflecting the age of current users.

There is a "down-aging" trend; this is often referred to as children "getting older younger". The trend is for younger children to use clothes and footwear, jewellery, simulated piercings, makeup and digital electronic devices historically used by older persons.

The relationship between parents and other carers and children can be expected to vary with geographic, cultural/ethnic and socio-economic differences. Different cultural norms of discipline, supervision and safety awareness should be recognized. The lifestyles of children are constantly changing, with differences between geographical, cultural/ethnic and socioeconomic circumstances. For example, they are increasingly being driven to school, or recreational and social activities centre more strongly on sedentary activities such as computers and video games.

As children approach adolescence, peer pressure and risk-taking can affect the use or consumption of products. Recreational activities might be associated with higher risk behaviour relating to presumed increased protection from "safety" equipment, aggressive behaviour inherent in the competitive nature of sports, and the greater risk related to attention-seeking behaviour.

6.4 Sleep environment

Children spend a significant amount of time sleeping. They spend a great deal of time in their bedroom, and the prolonged absence of supervision makes this an unusual and special environment. There might also be other children in the same room which increases the potential for harm.

The cot, bed, or other sleep product, as well as the child's immediate environment, should be safe not only when the child is sleeping, but also when awake prior to or after sleep when they might be unsupervised for an extended period of time.

A safe sleep environment is more than just a safe cot/bed. Products commonly used in conjunction with the cot/bed: furniture and fittings, and other items such as clothing and toys, should also be considered. Many potential hazards in the sleep environment are noted in Clause 7.

The need for appropriate assembly, maintenance and checking that products continue to be securely constructed and undamaged are also important. Clear labelling and instructions for consumers are needed to support these issues. Sleep products should be designed to prevent incorrect or hazardous assembly, or to make such a condition immediately apparent.

The positioning of furniture, including cots and beds, should also be considered, so that children cannot climb into hazardous situations, e.g. open windows nor reach hazardous products, such as cords on window coverings or baby monitors. This can entail the design of rooms to create safe layouts in bedrooms.

Many children's products are inappropriate for sleeping when used by a child less than 12 months of age, e.g. car seats, strollers, water beds or beds with bed rails, slings, hammocks. The risk of positional asphyxia is largely unknown by parents and other carers.

Sleep products should have instructions that are clear and easily followed to ensure proper assembly, use and maintenance and include relevant warning statements especially regarding when to begin and cease using the products.

Safe sleep is more than just putting a baby on its back to prevent sudden infant death syndrome (SIDS). Issues such as room temperature and smoking in the presence of the baby are relevant. Detailed guidance on preventing SIDS is outside the scope of this Guide. Guidance on this can be obtained from health professionals and organizations concerned with the health and well-being of babies.

7 Hazards relevant for children

7.1 General

In view of the facts presented in Clause 6, the risks associated with products can be high for children. Product-related hazards and their potential to injure children are discussed below. Examples based on reported injury patterns are provided to help users of this Guide to understand the hazards. It is important to recognize that individual hazards can act in combination to produce injuries that might be different from, or more severe than, those associated with the individual hazards separately.

It is equally important to realize that new hazards can emerge and enter children's environments due to developing technology and changes in lifestyle, such as working from home, and medical care at home (e.g. use of compressed gas bottles and monitoring devices).

In general, all age groups should be considered in assessing hazards. Many hazards will apply to adults as well as children, although children will often have particular susceptibility to the resulting harms, e.g. from chemical hazards and thermal hazards.

When considering the safety of a product, it is essential to consider the context in which it will be used. For example, if a product is tested in a situation that is not typical of how it will be used in reality, its performance in real life can differ. Equally, when a product is intended to be or might be used in combination with another product, such as a seat used by babies in a bath, or a child restraint in a car, the performance of both systems in combination should be examined to minimize risk and ensure no new hazards are introduced.

A product can cause death or injury at various stages of its life cycle, including beyond its useful or intended life. It is also essential that when a product is disposed of, it does not create new hazards. For example, children might remove spent lithium coin or button cell batteries that have been discarded and ingest them. Equally, design to minimize the need for maintenance, together with correct and timely maintenance of a product, can reduce the formation of hazards.

Packaging intended to be retained as part of the product should be regarded as an integral part of the product, e.g. children's blocks provided in a storage container. Even if not intended to be retained, packaging can be attractive to children so any safety implications should be assessed.

7.2 Mechanical and fall hazards

7.2.1 Gaps and openings

Accessible gaps and openings give rise to risks of entrapment or entanglement of the whole or part of the body, and of clothing or accessories. Entrapment and entanglement are not limited to rigid products,

but can also occur in loops of rope cords or nets. Figure 1 provides an illustration of entrapment and entanglement situations. When assessing gaps and openings, the relevant finger accessibility probes, and torso and head test fixtures defined in existing standards should be used. Potential injuries include bruises, amputations and strangulations (see 7.6). Heads or bodies can become trapped in situations where the child is incapable of raising its body weight to relieve the pressure. With head entrapment, especially if the child's feet cannot reach a standing surface, there is a high risk of fatal or serious injury.

Strollers, carriages, small mobile equipment, and similar devices can have changing clearances while children are entering or exiting from them (or while being converted from one configuration to another, such as by folding or unfolding). They should be designed to eliminate hazardous gaps that present an entanglement or strangulation hazard by catching on clothing, or a crushing or finger/toe amputation hazard during such movements. This issue is also relevant to protrusions and projections (see 7.2.2) and sharp edges and points (see 7.2.3).

For openings that can change in size, see also 7.2.6.

Head entrapment occurs in two different ways:

a) head first, e.g. through balcony railings, or climbing nets, and

b) feet first, e.g. through the barriers on bunk beds.

The spacing between the base slats of cots and beds and between cot bars should be such to avoid the risk of head entrapment if the body can pass through the gaps.

Body or neck entrapment can prevent breathing.

EXAMPLE 1 Jaws have been entrapped in small bounded openings.

EXAMPLE 2 Fingers have been trapped in spring mechanisms, chains on playground swings, folding mechanisms, etc, causing fracture, avulsion or loss of blood supply to the tips.

EXAMPLE 3 Loose cords or ribbons from children's clothing have dropped into V-shaped openings or gaps wide enough for the cord but too narrow for the toggle or knot at the end. When the toggle or knot snags, the child's movement is abruptly stopped. When the cords are in the neckline of a garment, children have been strangled.

EXAMPLE 4 Openings that behave like a trapdoor, i.e. allow free and unimpeded entry in one direction, and automatically constrict when movement is in the opposite direction, such as flap doors on some letterboxes. This might result in entrapment of extremities.

EXAMPLE 5 Cords on window blinds and curtains have resulted in strangulation, especially in children's bedrooms.

Strategies to avoid or reduce risks due to gaps and openings include:

— avoiding gaps;

— specifying dimensions for gaps and openings related to the anthropometric data of the growing child.

7.2.2 Protrusions and projections

Protrusions and projections can create areas for impact or for entanglement for clothing or accessories. The resulting injuries can be strangulation, laceration, puncture, intrusion into body cavities or blunt trauma. Loops in cords (clothing) or necklaces, etc., that get caught around a protrusion can cause the child to be strangled.

EXAMPLE 1 Children's clothing, especially cords and hoods, can catch on cot corner posts, posts at the top of slides and on protruding bolts, resulting in strangulation.

EXAMPLE 2 Horizontally protruding poles at about head height in playground equipment have led to head injuries.

EXAMPLE 3 Children have fallen against or sat on bath toys, diving sticks, or the ends of axles on wheeled toys where ends protrude beyond the wheel face, causing intrusion or puncture injuries.

EXAMPLE 4 Protruding nuts and bolts in playground equipment have led to lacerations to the body and to the head.

Strategies to avoid or reduce risks due to protrusions include:

— avoiding unnecessary protrusions;

— making sure that protrusions have a rounded shape and protrude from the surface as little as possible. Test cords, chains or other devices can be used to assess the hazard.

7.2.3 Sharp edges and points

Contact with sharp edges, points and corners can result in lacerations, puncture wounds or blunt injuries. Many of the products that children encounter in the domestic and educational environment are intended to be sharp or pointed to meet their functional needs (e.g. knives, needles, kitchen equipment or tools used in the garden or garage).

Sharp edges or points can arise through the breakage of an object. Glass used in domestic products (e.g. drinking vessels, tables, other furniture) and architectural features (e.g. doors, windows, screens) present a particular hazard when broken. Untrimmed burrs and flash on rigid materials such as moulded plastic and sheared metal sheeting are also common sharp edges.

It is normal behaviour for children to put a sharp object in their mouths and to walk and run about when carrying them in this way.

EXAMPLE 1 Facial lacerations, dental or eye injuries can result from collisions with small corners of domestic tables or kitchen work surfaces.

EXAMPLE 2 Children falling through tables with surfaces not made from “safety” glass have died from the resulting lacerations to major blood vessels. Collisions with vertical glass that is not “safety” glass in doors or other furniture can also lead to life-threatening injuries.

EXAMPLE 3 Falling while holding an object, e.g. a toothbrush or a fork, in the mouth can lead to penetrating injury to the palate or blocking of the airway.

Strategies to avoid or reduce risks due to corners, edges and points include:

— avoiding, guarding or curving exposed edges to reduce the risk of laceration;

— using glass that is either difficult to break or that breaks in such a way that residual pieces are unlikely to cause serious injury (“safety” glass). In certain high-risk locations in homes and other places where children move freely, materials other than glass should be considered for architectural use;

— restricting young children’s access to pointed objects such as pens, pencils and knitting needles;

— restricting children’s access to sharp parts of tools by appropriate guarding or by making the tool difficult for a child to operate;

— teaching children to use sharp tools when they are able to do so, under close supervision, with less hazardous versions (e.g. scissors without pointed blades) being used initially.

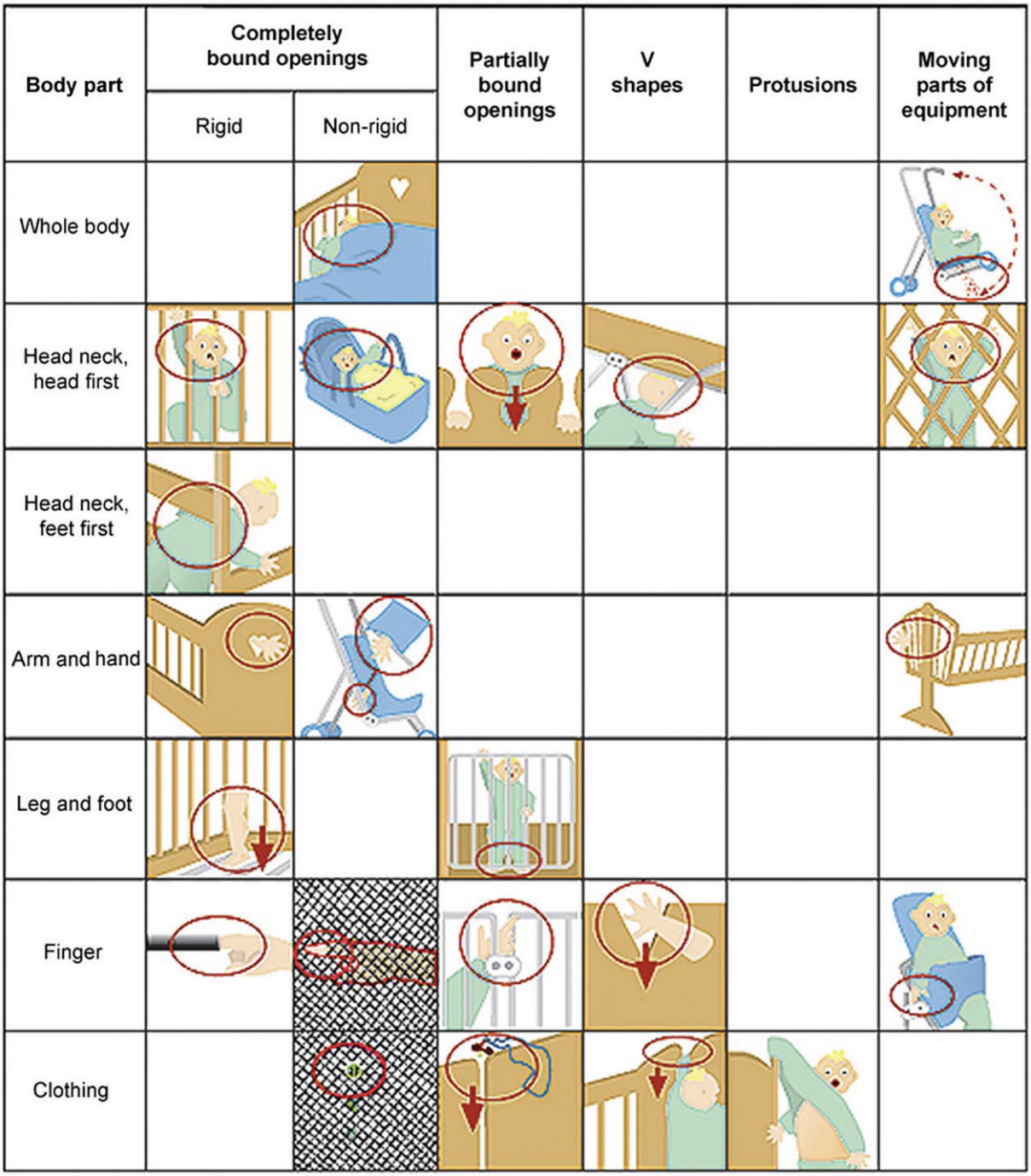

Figure 1 — Examples of entrapment and entanglement in gaps

7.2.4 Stability

A product that is not sufficiently stable might fall over, injuring a child who is in, climbing on, or near it. The nature of the harm can vary depending on the function of the product. For example:

a) scalds from hot liquids when cookers tip over;

b) crush injuries from falling furniture or televisions, etc.;

c) burns from fire caused by unstable free-standing oil lamps.

EXAMPLE 1 Tall, top-heavy or wheeled furniture, such as television stands, cause a risk when children pull or push them.

EXAMPLE 2 Pedestal tables can fall over when hook-on chairs are attached.

EXAMPLE 3 Open dishwasher or oven doors, or the drawers in dressers can cause hazardous situations when used as a climbing aid.

EXAMPLE 4 Moveable goal posts and freestanding playground equipment that is not firmly fixed to the ground have toppled over and caused death.

EXAMPLE 5 Certain types of petroleum stoves are unstable, which is especially dangerous because of the fuel and flames inside.

Strategies to avoid or reduce the risks due to inadequate stability include:

— designing products with such features as low centre of mass, position of contact points with the supporting surface so that they can withstand any foreseeable destabilizing loads;

— providing anchoring devices for potentially unstable products (e.g. for moveable goal posts, furniture);

— limiting the effects of products falling over (e.g. spill-resistant mugs).

7.2.5 Structural integrity (mechanical strength)

Inadequate structural integrity can result in product breakage, the possible release of small parts and access to other hazards. This can result in a wide range of injuries, such as fractures, internal injuries, lacerations, and choking on small parts.

A product might also fail during its lifetime because of inadequate or improper maintenance.

Some products are intended to be assembled or installed, either once (e.g. wardrobes, bicycles, or features of the built environment such as fences), or multiple times (e.g. folding pushchairs). The safety of a self-assembly product depends on the design of the product, the adequacy of the instructions and the skill of the person assembling it. Products that are assembled every time they are used often include locking mechanisms which can fail to secure properly. Also, children can be able to access and release them. Safeguards should be in place to ensure that whenever possible locking mechanism are inaccessible to children or resistant to operation by them. It should be obvious to users when locking mechanisms are not properly engaged.

EXAMPLE 1 Glass-topped coffee tables, which children and adults might perceive as strong have broken when they stood or sat on them, causing fatal lacerations.

EXAMPLE 2 Playground equipment can collapse because of inadequate assembly, inspection or maintenance. Fatalities have occurred when swings have broken.

EXAMPLE 3 Pushchairs/strollers have collapsed with the child inside because of inadequate locking, resulting in the amputation of fingertips.

EXAMPLE 4 Degradation of key components of a product can lead to structural failure, such as years of exposure to sunlight of a trampoline net or mat.

Strategies to avoid or reduce risks due to inadequate structural integrity include:

— designing products with appropriate safety factors to minimize the likelihood of collapsing or breaking in an unsafe manner, recognizing that users of products may be older or heavier than intended by the manufacturer;

— designing products so that in case of failure, they are unlikely to cause harm;

— making sure that if a product looks as if one or more children or adults can sit, stand or climb on it, the product is actually able to carry the weight;

— labelling products to advise consumers of proper use including, for example, maximum loads;

— designing products to minimize the need for maintenance. If maintenance is required, adequate instructions should be provided;

— design and maintenance should take into account local environmental conditions to reduce their impact of product degradation;

— making incomplete or incorrect assembly, including the use of locking mechanisms, virtually impossible or manifestly obvious (e.g. if incorrectly assembled, the product should be unusable, see also 8.2);

— ensuring that multi-use or multi-mode products with adjustments or accessory positions do not introduce hazards during their transformation from one configuration to another;

— making sure that locking mechanisms resulting in the collapse of the product cannot be operated by children.

Products should be capable of being overloaded without collapsing.

Test methods should reflect reasonably foreseeable use during the life of the product.

7.2.6 Projectiles and moving/rotating objects

Impact with moving objects can cause crushing, internal injuries, fractures, etc. Injury severity is related to the mass and velocity of the object. Factors, such as the shape of the object and material from which it is made, can also play a role.

Motor vehicle injuries to passengers and pedestrians are a significant cause of childhood death. Efforts to reduce the likelihood of vehicular death and injury have focused on secondary interventions such as better child restraint systems and air bags. Primary prevention efforts should not be overlooked. These include, but are not limited to, designing roadways for safer routing of traffic, reducing speed in areas where children are expected, providing better lighting, and creating protected pathways for pedestrians and cyclists.

Contact with moving and rotating objects (e.g. fan blades, food chopper blades and hinged mechanisms) can cause lacerations, traumatic amputations and other serious injuries. Such contact can entangle or trap hair, clothing, or accessories, e.g. as in escalators, ski tows, lifts (elevators) and bus doors, resulting in scalping, dragging or strangulation. Particular attention should also be paid to contact of parts of the body in gaps that change dimensions during operation, e.g. closing garage doors or powered car windows and folding pushchair/stroller frames.

Projectiles can be particularly hazardous since their paths cannot always be predicted, and their energy upon impact tends to concentrate in a relatively small area.

EXAMPLE 1 Children have suffered removal of their hair and scalp when their hair has caught and been drawn into farm machinery with rotating parts.

EXAMPLE 2 Some kitchen appliances incorporate moving and rotating parts. Finger lacerations and amputations have been associated with grinders, mixers and similar devices.

EXAMPLE 3 Children's feet and hands have been trapped in moving playground equipment, such as roundabouts.

EXAMPLE 4 Escalators and lifts (elevators) have trapped children's fingers, hands, feet, clothing and accessories.

EXAMPLE 5 Inadequately guarded spokes of bicycle wheels cause numerous foot injuries to young children being carried as passengers.

EXAMPLE 6 Hinged doors cause many injuries to children, especially at the hinge.

EXAMPLE 7 When the size of gaps changes, the child or its limbs might be crushed, e.g. by electrically operated garage doors or car windows.

EXAMPLE 8 Children have been dragged when waist cords have snagged in vehicle doors, lifts (elevators) and escalators.

EXAMPLE 9 Friction burns and abrasions can occur when a contact is made with moving or rotating objects such as a treadmill.

Strategies to avoid or reduce risks due to moving and rotating parts include:

— keeping children and the product apart;

— limiting the mass or speed of the moving part;

— providing adequate means of stopping or reversing the motion of the part;

— providing adequate means of absorbing the energy if an impact occurs;

— designing the product in such a way that the moving or rotating part is inaccessible to the child, e.g. by enclosing or guarding it;

— ensuring that distances between moving parts are large or small enough to prevent injuries, the distances should be based on anthropometric data;

— incorporating safety locks or other safety measures that children cannot operate.

7.3 Fall and other impact injuries

Fall injuries occur as soon as babies are able to move. Children will often climb onto higher surfaces, even before they are able to walk. Active play and sport might result in impacts which can cause harm.

Falls from a height and other impacts can result in internal injuries (brain and other internal organs) and fractures, particularly of head, arms and legs. The kind and degree of harm depends on the height of the fall, objects encountered during the fall, the orientation in which the child lands, the weight of the child, and the nature of the surface on which the child lands. Elsewhere, serious injuries can result from falls from walls, roofs, cliffs and other outdoor environments.

EXAMPLE 1 In the home, the most serious falls occur from accessible openings (windows and doors) and down the stairs.

EXAMPLE 2 Balcony railings that allow a child to pass beneath, through or climb over them can result in fatal falls.

EXAMPLE 3 In playgrounds, children might fall when using equipment not suitable for their ability.

EXAMPLE 4 Fractures associated with sport and leisure increase as children age and participate in activities where falls result from a collision.

EXAMPLE 5 Babies can fall from changing tables that have no harness or are constructed without side protection.

EXAMPLE 6 Falls can result from children wearing inappropriate footwear, e.g. high-heeled shoes.

Strategies to avoid or reduce risks due to hazardous height include both preventing falls and reducing the consequences of falls.

It is possible to prevent falls by:

— designing effective balcony guarding;

— reducing the potential for children to climb, by design, e.g. by using vertical rather than horizontal design elements (removing foot and toe holds) and incorporating barriers;

— preventing access to the top and bottom of stairs;

— incorporating window guards and locking mechanisms in buildings;

— using structures of such a size that children can achieve a secure grip;

— providing side guardrails and barriers of adequate height around products such as cots, and elevated beds and playground equipment;

— providing instructions on appropriate use of products (e.g. playground equipment), especially with regard to age, size, weight, etc.

It is possible to reduce the consequences of falls by:

— reducing potential fall heights, designing and installing products to avoid contact with hazards if a child does fall, or providing energy-absorbing surfacing material;

— designing appropriate safety equipment and environments;

— ensuring rules of sports or leisure activities reflect capabilities and degree of development of participants.

7.4 Drowning hazards

Children are attracted to water, but their physical abilities do not match their interest in water. They often do not call out or make excessive noise when drowning; in fact the event can be completely silent. Babies and toddlers are vulnerable to drowning; even a shallow layer of water can be fatal if the child's face is covered.

The child's environment, level of development and capability will impact on the risk and location of drowning. A child's high centre of mass increases the risk of falling into pools, buckets, toilets, bathtubs, etc., thereby increasing their risk of drowning. Children have also drowned when their hair or a body part has been drawn into pool/spa drains.

EXAMPLE 1 Children have drowned when they tried to walk across pool covers and fell into puddles of accumulated water, or when they fell into garden ponds where the water/land border was concealed by plants.

EXAMPLE 2 Young children trying to mimic their carer in doing the laundry have fallen into a top-loading washing machine.

EXAMPLE 3 Children have been trapped under opaque pool covers.

EXAMPLE 4 Children have drowned in buckets containing a little water.

EXAMPLE 5 Children have drowned when left unattended in water, e.g. in bath seats.

Strategies to avoid or reduce the risk of drowning include:

— preventing access by children, particularly toddlers and young children to water in and around the home, such as swimming pools, garden ponds, and buckets;

— covering cisterns, wells and other water storage places with lids that cannot be opened by children;

— closing cisterns, wells and other water storage places with lids, etc.;

— providing warnings never to leave babies and toddlers alone in the bath and to highlight the fact that bath seats are not safety devices;

— designing water environments with a view for easy supervision;

— designing alert systems, such as alarms, as a back-up to barriers;

— ensuring that non-regulation personal flotation devices, e.g. toys, have appropriate warnings not to be used as safety devices;

— ensuring children wear approved life-jackets during water sports that are appropriate for their size and weight;

— when in or around water, children should be within sight and reach of carers;

— non-swimmers should wear approved flotation devices when in and around the water.

Furthermore, strategies involving swimming pools, hot tubs, water parks and similar situations include:

a) reducing the suction force through increasing the surface area;

b) installing multiple suction orifices;

c) reducing effective flow rates through drains;

d) sizing drain grates so that items such as jewellery, fingers, toes, clothing or hair cannot become entrapped;

e) installing a safety switch to shut off suction when blocked;

f) installing a cage that does not conform to body parts, preventing strong suction force.

7.5 Suffocation hazards

7.5.1 General

Children explore their environments by inserting all or part of themselves into objects. They can surround all or part of themselves with non-permeable materials which restrict their ability to breathe or restrict oxygen intake. In addition, suffocation can occur due to the posture of babies. Because they have proportionally heavy heads and weak necks the unsupported head of a sitting baby can move to a position that prevents breathing. This can also occur if they sleep on inappropriate surfaces, for example, ones that are too soft or are excessively inclined.

7.5.2 Flexible materials

Materials that do not allow air to pass constitute a suffocation risk, in particular for young children. During play, they might put the material or object over their face or head or lie on top of it.

Products that might contribute to this risk are flexible materials that take the shape of the face and thus cover nose and mouth.

EXAMPLE Suffocation and irreversible brain injury can occur when children place plastic bags over their head or face.

Strategies to avoid or reduce risks due to flexible materials include:

— limiting the size of flexible materials so that they cannot cover the nose and mouth;

— providing ventilation holes;

— limiting use of and access to soft bedding, pillows and soft toys especially for babies up to 12 months old;

— ensuring the mattress is firm and tight fitting in cots;

— using material with less flexibility.

7.5.3 Confined spaces

Enclosures that do not allow air to pass constitute a suffocation risk. During play, children might hide themselves completely in the product.

Products that might contribute to the risk include toy chests, old refrigerators, portable insulated boxes and vehicle boots (trunks) and storage bags.

Strategies to avoid or reduce risks due to enclosed spaces include:

— limiting the size of the space so that they cannot enter;

— providing ventilation holes for adequate aeration of the enclosed space;

— designing products that can be opened from the inside, e.g. refrigerators, car trunks/boots, storage bags.

7.5.4 Masks and hemispherical and similar objects

Children will put masks and hemispherical objects over their faces as part of imaginative play, resulting in air flow blockage. Examples are disposable food containers, packaging materials, play masks, and imitation helmets.

Strategies to avoid or reduce risks due to airway blockage of the mouth and nose or facial suction include:

— limiting the size of the object so that it cannot cover both the nose and the mouth;

— providing ventilation holes to provide adequate air flow;

— changing the shape to prevent sealing the nose and mouth.

7.5.5 Positional asphyxia

When young babies are placed in seated or upright positions, their heads can fall forward, causing their airway to restrict.

EXAMPLE 1 Reclined cradles, infant car seats, baby carriers, and push chairs might not provide enough head support particularly for infants, causing their heads to fall forward for extended periods of time.

Similarly, when babies are placed on soft surfaces, carbon dioxide re-breathing can result.

EXAMPLE 2 Examples of soft surfaces are waterbeds and beanbag chairs.

Strategies to avoid or reduce risks due to positional asphyxia include:

— designing products so that the head is supported;

— providing information to health professionals and carers;

— providing warnings on products to indicate that they should not be used for sleeping.

7.6 Strangulation hazards

Strangulation can result from two different outcomes. One is restriction of the air supply to the lungs. The other is interference with brain oxygenation. It is typically caused by flexible cords, V-shaped openings, helmet straps, apparel neck openings, drawstrings on items such as clothing and bags, jewellery or other items worn around the neck, climbing nets, and corded window blinds. Strangulation often results from a combination of factors: children's activity and exploration, carers' lack of awareness of strangulation hazards, and inadequate product design.

EXAMPLE 1 Loose cords or ribbons from children's clothing have dropped into V-shaped openings or gaps wide enough for the cord but too narrow for the toggle or knot at the end. When the toggle or knot snags, the child's movement is abruptly stopped. When the cords are in the neckline of a garment, children have been strangled.

EXAMPLE 2 Children's clothing, especially cords and hoods, can catch on cot corner posts, posts at the top of slides and on protruding bolts, resulting in strangulation.

EXAMPLE 3 Cords on window blinds and curtains have resulted in strangulation, especially in children's bedrooms.

EXAMPLE 4 Children wearing bicycle helmets have been strangled by the helmet strap when using playground equipment such that their body passes through a gap but the helmeted head does not.

Strategies could include:

— producing cots, cribs, bunk beds and playground equipment without protrusions that could snag clothes;

— using window coverings without cords, or without hazardous loops or lengths;

— producing safety devices to prevent hazardous loops or lengths of window covering cords being accessible to children;

— manufacturing children's clothing without cords, especially at the neck;

— making necklaces that will break when subject to force;

— educating carers or applying warnings on strangulation hazards of products that are worn around the neck;

— raising awareness of hazards of attaching ropes to playground equipment (e.g. slides).

7.7 Small objects and suction hazards

7.7.1 Small objects

Small objects and parts of products present potentially serious hazards, especially to toddlers and young children. Small objects can enter the airway, trachea, and oesophagus, blocking airflow to the lungs. Rounded (e.g. spherical) objects can block the airway at the back of the mouth, also causing asphyxia. Conforming objects such as latex balloons are especially hazardous.

Children frequently inhale or ingest multiple parts at the same time.

The following hazardous situations can occur:

a) objects can be inhaled or inspired, lodging in the trachea or deeper within the airway, causing asphyxia;

b) objects can be ingested, lodging in the oesophagus at the aortic arch, causing airway obstruction which can result in asphyxia;

c) button cell batteries that lodge in the oesophagus dissolve local tissue, which is an additional hazard;

d) button batteries can cause an obstruction, leak, corrode, or lead to localized harmful electrochemical reactions when inserted into a body orifice, such as the nose, or when swallowed;

e) magnets can be ingested causing damage to internal organs, which can be fatal;

f) small magnets, when swallowed, can attract each other and damage the small intestine;

g) objects can be ingested, presenting risks of blockage or perforation of the oesophagus, stomach or intestines;

h) objects can be inserted into other body orifices, leading to pain, swelling, obstruction or disease.

EXAMPLE 1 Objects that change in size, shape or texture when mixed with saliva can occlude the airway.

EXAMPLE 2 Foods containing inedible products, such as toys, have resulted in inhalation or ingestion of small parts while eating, even among children as old as 12.

EXAMPLE 3 Flexible objects such as whole or broken latex balloons have lodged in the airway.

EXAMPLE 4 Pen caps are often held in the mouth by older children and, because of their shape, can be inhaled.

EXAMPLE 5 Children sometimes swallow a small fruit whole, fruit seeds as they are, and these get stuck in their throats.

Strategies to avoid or reduce risks due to small parts include:

— eliminating small parts, in particular, shapes such as spheres and cones should be avoided;

— preventing the release of small parts, especially magnets and batteries, during reasonably foreseeable use;

— providing age-appropriate guidance and warnings to consumers of the hazards for younger children;

— applying secondary prevention strategies such as providing continuous air passages, so that if the part is inhaled the child can still breathe;

— preventing access to batteries by children;

— changing the appearance of small inedible objects to prevent their resembling food and therefore reducing choking risks for young children who might try to eat them.

7.7.2 Suction

Suction cups on products, e.g. bath toys, toy arrows or darts, have caused bruises when applied to body parts. When eyes are involved, the injury can be severe and lead to blindness.

EXAMPLE 1 Children have been disembowelled when caught in an squatting/sitting position over swimming pool drains.

EXAMPLE 2 Young children have suffocated when hollow, dome-shaped or half-spherical toys have adhered tightly over their nose/mouth.

EXAMPLE 3 Children have placed suction cups over parts of their body.

A strategy to avoid or reduce suction risks includes designing suction cups that do not adhere to the body or eye socket, or cover nose and mouth, e.g. small multiple suction cups.

7.8 Fire hazards

7.8.1 Open flames

While open flames, e.g. from fireplaces and candles, are an obvious hazard to adults, they can attract children. Historically, children as young as 2 years old have started fires and been injured as a result of playing with matches or lighters. This play behaviour might be due to attraction to the flame or lighter, or be an attempt to imitate adult behaviour.

Barriers should prevent a child from reaching or tossing an item into the fire, as well as embers being thrown out from the fire.

EXAMPLE 1 Because young children are attracted to the glow and flames of barbecues and open fires, they can be burnt.

EXAMPLE 2 An aerosol can leave a trail of flammable solvent if sprayed near open flames.

EXAMPLE 3 Children have been badly burned and caused house fires when playing with cigarette lighters.

Strategies to avoid or reduce risks due to open flames include:

— incorporating features to make it difficult for a child to operate (i.e. child-resistance) into the design of cigarette lighters and other sources of ignition;

— avoiding designing lighters and other sources of ignition with appearances that are attractive to children (e.g. resembling familiar cartoon characters or toys): conversely, toys or sweet containers that resemble lighters could give children the idea that a lighter is something intended for children);

— using physical barriers to the flames of domestic fireplaces;

— warning carers of less obvious hazards associated with sources of ignition (e.g. children are attracted to flames, flames may not be readily visible, loose clothing might catch fire, children are more susceptible to burn injuries).

7.8.2 Flammability and burning characteristics

Fires are among the leading causes of unintentional injury or death. Flammable materials ignite when exposed to open flames, high temperatures, sparks, or by spontaneous combustion. The ease of ignition, rate of burning and its self-extinguishing characteristics are factors affecting whether the fire will spread or be contained.

EXAMPLE 1 Loose garments carry a much greater risk of catching fire than close-fitting garments.

EXAMPLE 2 Older children, especially boys, experiment with lighting fires using flammable liquids. When spilled on their clothing, severe burns can result if they are close to an ignition source.

Strategies to avoid or reduce risks due to flammability and burning materials include:

— limiting the ease of ignition by material selection and design;

— limiting the spread of fire by selecting materials that

  — are self-extinguishing, or

  — have a low rate of flame spread;

— containing the fire by using fire enclosures.

NOTE Flame-retardant additives can introduce other hazards due to their chemical properties (see also 7.10). Their use can be limited by national or regional regulations.

7.9 Thermal hazards

7.9.1 Hazards from hot and cold surfaces

Contact with hot or cold surfaces can result in thermal injuries. Surfaces can become hot or cold because of internal components (e.g. engines, batteries, coolants) or because of external exposure to the sun or cold. The thermal absorptive/reflective characteristics of materials determine the surface temperatures and the thermal conductivity determines the transfer of heat energy. Some surfaces are intended to be hot (e.g. electric hobs/stove tops) or cold (e.g. freezers). Children are more likely to touch hot/cold surfaces because of their limited ability to recognize the associated injury potential. Products and appliances that are hot or cold, without giving any indication of being so, present a particular problem.

NOTE IEC Guide 117 provides more information on transfer of heat energy.

EXAMPLE 1 Playground slides facing the sun can become hot enough to cause contact injuries.

EXAMPLE 2 Heated appliances, such as ceramic hobs/stove tops on cookers, continue to be hot after being switched off; although this might not be obvious to a child.

EXAMPLE 3 The light in an oven might attract young children.

EXAMPLE 4 Young children are naturally attracted to the glowing red bars of electric heaters.

EXAMPLE 5 Young children have been injured by licking very cold railings, metal parts of child carriers (back packs) and frozen food removed from the freezer.

EXAMPLE 6 Electric blankets or heating pads might be inappropriate for children as their skin is more sensitive than that of adults and their surface/volume ratio is such that they absorb excessive heat readily.

Strategies to avoid or reduce risks due to hot and cold surfaces include:

— providing automatic shut-offs and timers in appliances that are inherently heat-generating;

— using materials that are less likely to absorb heat/cold or that are less likely to transfer energy in products that could be exposed to the environment (e.g. playground equipment, swimming pool deck surfaces, doors, child car seats and outdoor furniture): appropriate installation, such as providing shading and using the product with adequate instructions, can reduce injuries;

— reducing contact burns from hot/cold surfaces reducing/increasing surface temperatures; the addition of barriers, or the addition of a visual indicator of changing temperature (although an indicator will have no meaning to young children and the indicator should not be appealing to children);

— avoiding drawing the attention of children to the hot surface;

— making sure that a surface that needs to be hot for functional reasons cools down quickly after use;

— providing barriers to prevent access to hot or cold surfaces, such as wood-burning stoves or hot elements of electric heaters.

7.9.2 Hazards from hot fluids

Hot fluids, including steam, can result in scalds. Children are particularly at risk of being scalded in the kitchen/dining areas and the bathroom because of their inclination to explore.

EXAMPLE 1 Hot beverage mugs are easily overturned.

EXAMPLE 2 Children pull on hanging objects, such as table linens and appliance cords hanging over tables and work surfaces, pulling containers of hot liquids over themselves.

EXAMPLE 3 Babies grab at cups being handled by adult carers.

EXAMPLE 4 Bathtub scalds occur because children fall into tubs with hot water or they, or their siblings, turn on hot water when unsupervised. A young child might not recognize the danger until it is too late to be able to get out without adult intervention.

EXAMPLE 5 Rice cookers generate sufficient steam to scald.

EXAMPLE 6 Microwave ovens can superheat liquids such that there is no visible sign that it is boiling.

EXAMPLE 7 Microwave ovens might be located at a height that increases the risk of children spilling hot food onto themselves when removing it from the microwave oven.

Strategies to avoid or reduce risks due to hot fluids include:

— using spill-resistant tea and coffee cups or adding lids that protect against spills;

— increasing the stability of containers like kettles, coffee pots and deep-fat fryers;

— providing kettles with cords that do not hang over the edge of the work top or that easily detach;

— limiting the amount of hot liquid available;

— pre-setting the temperature of hot water heaters to a safe level;

— using thermostatic mixer-taps to control the temperature of the water emerging from the tap;

— instructing consumers about the scald potential of hot tap water.

7.9.3 Hazards from melting behaviour

Some solid products, such as some plastics, soften when heated, while others liquefy. Any skin contact with softened solids or hot liquids is likely to result in severe injuries because the skin contact area and

time will necessarily be extended. Adults might be aware of the hazard associated with these types of changes but children might not.

EXAMPLE 1 Molten candle wax burns a child and causes him or her to drop the lit candle.

EXAMPLE 2 Synthetic fabrics, such as those used in tents or clothing, melt when burning, dripping onto or adhering to users. Strategies to avoid or reduce risks due to melting include containing materials that can melt or soften, or using alternative materials.

7.9.4 Hyperthermia and hypothermia hazards

Overheating (rise of core temperature) can arise when a child is in a hot environment (e.g. a room or a car). Combinations of room temperature and products that cause heat build-up (e.g. duvets or electric blankets for babies) constitute a hazard. This is a factor that has been linked with sudden infant death syndrome.

Children absorb or lose heat more rapidly and are more affected by hot or cold temperatures than adults, often without realizing this and being able to react to it.

A lowering of body temperature can arise from being trapped in a cold storage room or being unable to gain or regain access to the home in very cold climates. Some products can also have the potential to lower core body temperatures below safe levels (e.g. extreme sports apparel).

EXAMPLE Children left in cars in hot sunshine have died from hyperthermia.

Strategies to avoid or reduce risks of hyperthermia and hypothermia include:

— using devices to limit room temperature, consider designing products (e.g. automobiles, child safety seats) in a manner which minimizes the likelihood of children being left unattended in a hot or cold environment;

— providing overheating warnings on blankets and similar products.

7.10 Chemical hazards

Exposure to hazardous chemicals can be acute or occur over a long period, and their effects can be acute or chronic. Exposure can occur throughout the life of a product, including after the product has been disposed of. It can also occur during household renovations, cleaning, etc.

Potential harm includes, but is not limited to: poisoning, external and internal chemical burns, allergic reactions, chronic illnesses and organ damage, cancer, chemical pneumonia and disturbed reproductive capacity.

EXAMPLE 1 House fires often generate toxic emissions that result in deaths.

EXAMPLE 2 Children frequently need medical attention after swallowing or inhaling household chemicals, medications or pesticides.

EXAMPLE 3 Children have suffered chemical burns due to contact with, or ingestion of, strong cleaning products and batteries.

EXAMPLE 4 Latex and nickel in contact with the skin can result in an allergic reaction.

EXAMPLE 5 Long-term exposures to certain heavy metals can produce adverse health effects.

EXAMPLE 6 Children have accessed products and alcoholic drinks that were not properly disposed of.

EXAMPLE 7 Hazardous chemicals have been transferred to inappropriate containers such as soft drink bottles.

EXAMPLE 8 Objects that children access can have toxic paint on them, e.g. lead paint on children's furniture, play equipment, window sills and other domestic locations.

EXAMPLE 9 Children have been exposed to potentially toxic dust or fumes when renovations in the home are being undertaken.

EXAMPLE 10 Flame-producing appliances such as gas and oil space heaters will generate carbon monoxide if they are not properly maintained and appropriate ventilation is absent.

EXAMPLE 11 Some chemical additives in mattresses, upholstered furniture and clothing might be toxic.

EXAMPLE 12 Organic vapours from household cleaning products, insecticides, cosmetics, etc. might remain near the floor where children are sitting or lying.

EXAMPLE 13 Emissions from refuse dumps, cooking fires, burning vegetation, industrial plants, etc. might adversely affect children living or attending school nearby. Some children might play or scavenge valuables from these dumps.

Strategies to avoid or reduce risks due to hazardous chemicals include:

— limiting the amount of chemicals available in single or repeated exposures;

— using physical barriers, such as child-resistant closures, on appropriate containers or safe storage facilities;

— substituting with less toxic chemicals or using the chemical in smaller quantities;

— designing homes/buildings with smoke and carbon monoxide detectors or installing them in existing homes;

— using materials which when ignited produce fewer and/or less toxic combustion products;

— ensuring that when organic materials are intentionally burnt, there is adequate ventilation to minimize the release and accumulation of carbon monoxide;

— prohibiting the use of strongly suspected or known mutagens, carcinogens and reprotoxic agents;

— avoiding known allergens and corrosives;

— avoiding chemicals with an appearance, taste or smell attractive to children;

— bittering agents might supplement other measures to minimize the risk of poisoning;

— providing appropriate warnings and product information, including ingredients, specific hazards, directions for safe use, storage and disposal, first aid measures, manufacturer identification and emergency contact information;

— providing warnings where necessary about the need to wash garments that come in contact with the skin before first use, to minimize the risk of allergic reactions;

— appropriately locate and control access to hazardous locations where emissions can cause harm.

7.11 Electric shock hazards

Electric shock can result in injury or death. Children cannot “see” or comprehend the hazard so it is particularly dangerous.

EXAMPLE 1 Hairdryers whose appearance (e.g. in the shape of ducks) appeals to children might lead to children taking them into the bath.

EXAMPLE 2 Plug-in night-lights with attractive shapes might cause children to regard socket outlets as harmless.

EXAMPLE 3 Orientation of socket outlets need to be such that they are not child-appealing. Some outlets can look like a friendly face to a young child.

Strategies to avoid or reduce the risk due to electric shock include:

— protecting against access to live parts, the positioning and size of openings should consider children’s anthropometry, such as finger sizes. Wet environments increase the risk of electrocution;

— using effective methods of isolation (including shutter mechanisms, switches or other barriers) if, for the functioning of the product, it is necessary that openings be easily accessible, as in the case of socket outlets;

— using current-interrupting devices, such as ground fault circuit interrupters (also known as residual current devices). When included as part of a product, they should be rated with regard to children's physiology;

— making toys and child-appealing products operate at safe energy levels (i.e. it is the combination of voltage and current that is relevant), e.g. by being battery-operated.

However, it is important to recognize that batteries can introduce other significant hazards. Hazards other than electric shock which might result from the use of electricity are dealt with in other clauses of this Guide (see 7.2.6, 7.7.1 and 7.9).

7.12 Radiation hazards

7.12.1 Ionizing radiation

Children can be exposed to ionizing radiation, i.e. radioactivity, from naturally occurring sources (e.g. radon) or from products such as smoke detectors, cathode ray TVs and medical equipment. Access to ionizing radiation by children needs to be, and usually is, very strictly controlled.

EXAMPLE 1 Some face paints and ceramic glazes on dishes contain harmful levels of radioactive pigments.

EXAMPLE 2 Some stainless steel is manufactured containing radioactive cobalt from recycled products.

Strategies to avoid or reduce the risk can include:

— designing new houses to minimize the ingress of naturally occurring radiation; this approach is often supported by regulations;

— modifying existing homes to keep radioactive gas out or remove it by ventilation;

— making radioactive sources in household products inaccessible, even during disposal;

— ensuring that legislation provides strict limits for radiation exposure to children for medical and other purposes.

7.12.2 Ultraviolet radiation

Exposure to ultraviolet (UV) radiation from the sun is the most common exposure to radiation. In the short-term this can result in sunburn or retinal burns. Prolonged exposure can cause skin cancer or cataracts. UV exposure can also arise from products such as tanning products, lighting and even some toys.

Children are more sensitive to harm from UV radiation than adults.

EXAMPLE 1 Exposure to sunlight during the middle of the day when sunlight is most intense.

EXAMPLE 2 Use of tanning beds by children.

EXAMPLE 3 Use of UV radiation for sanitizing purposes in some home products, such as toothbrush cleaners.

EXAMPLE 4 Inclusion of UV light in toy "spy kits".

Strategies to avoid or reduce risks due to exposure to ultraviolet radiation include the following:

— limiting exposure to sunlight, especially when it is at its most intense, through raising the awareness of carers to ensure that shade is provided in environments where children play and that sufficient personal sun protection, such as hats and sun blocking cream, is used;

— recommending clothing made of fabrics that have a high sun-protection factor (SPF), however, it should be noted that some fabrics offer little protection when wet or stretched;

— discouraging the use of imitation sunglasses with inadequate protective function for children (see 8.1);

— warnings on devices that produce ultraviolet radiation, such as tanning beds, should state clearly that these products are not to be used by children;

— shielding accessible sources of ultraviolet light from lighting systems and products such as toothbrush sanitizing systems;

— prohibiting children's use of tanning beds by regulation.

7.12.3 High intensity, concentrated or flickering light

It is a normal human reaction to move away from excessive heat or to shield one's eyes from bright light, including lasers and light-emitting diodes (LEDs). However, young children, especially babies, might be physically incapable of taking either of these protective actions. High intensity sources can cause eye damage more rapidly than one can react.

Periodic light (i.e. regular flashing or flickering light) can affect children with epilepsy.

Potentially hazardous photo-flickering, such as LED lighting or a xenon strobe tube, can adversely affect the health of children. The most significant effect is the triggering of photosensitive epilepsy (flashing light-induced seizure). Stroboscopic effects (in which rotating or moving machinery appears to be moving slowly or be stationary), migraine, increased incidence of repetitive behaviour among autistic persons, and reduced performance on visual tasks such as reading can also arise. Other effects include eye strain, fatigue, blurred vision and conventional headache. Flicker frequency, regularity, and the variation in brightness can all impact the likelihood of these effects.

EXAMPLE 1 Laser pointers used by children can damage their sight or the sight of others.

EXAMPLE 2 Some children are highly susceptible to the flickering light sometimes associated with television pictures or computer games. Convulsions have resulted. This adverse effect can be worsened by poor ambient lighting.

EXAMPLE 3 High intensity, focused visible light, including laser beams (pens), can rapidly cause skin and eye injuries.

Strategies to avoid or reduce risks include:

— limiting exposure to high intensity, focused light through product regulation and carer education;

— limiting exposure to flickering light;

— avoiding frequencies known to cause harm.

7.12.4 Electromagnetic radiation

There are two safety issues relating to electromagnetic radiation:

— electromagnetic fields (EMF), i.e. the impact of electromagnetic radiation on the human body, and

— electromagnetic compatibility (EMC), i.e. the effect of electromagnetic radiation of one product on another.

The correct functioning of products can be affected by EMC radiation. A product can:

— radiate extensively such that it hampers other products from functioning normally or causes unintended actuation, and/or

— be susceptible to radiation from other products such that its own normal functioning is hampered or unintended operation occurs.

Both situations can result in an unsafe situation, which should be avoided.

More and more products emit electromagnetic radiation, either intentionally (e.g. wireless technology, radio-transmitters, microwave appliances) or unintentionally (e.g. radio receivers, household appliances) in the environment of children, exposing them to these radiations.

Some regulations and standards define exposure limit values to provide protection from exposure to EMF. The full effects of electromagnetic fields might not yet be known.

The correct functioning of products can be affected by EMC radiation from other products, leading to unsafe conditions, e.g. by disturbing the normal functioning of devices or initiating unintentional operation.

EXAMPLE 1 Unintentional operation of household appliances, such as the garage door opener or the cooker, due to stray electromagnetic radiation.

EXAMPLE 2 Unexpected operation of children's products, such as ride-on toys.

EXAMPLE 3 Leakage of radio frequency energy from microwave ovens.

Strategies to avoid or reduce risks include:

— limiting the amount of electromagnetic radiation from products;

— increasing the distance between the source of the electromagnetic radiation and the child;

— shielding sensitive safety-related circuit elements to prevent potentially dangerous functions.

7.13 Hazards from noise (sound pressure)

Hazards due to noise have been recognized for some time. Injuries occur when sensitive hearing organs within the ear are exposed to a high sound pressure level for a certain period of time. Injuries that damage hearing may be irreversible.

Children are more susceptible to hearing loss than adults. Noise-induced hearing damage in children can be difficult to detect, because they might not recognize or be able to report the problem. It is often detected only when the child shows serious difficulties in hearing or has language or social problems. Harm from noise is proportional to both the sound pressure level and the time of exposure. Very loud noises, even if of short duration, can immediately damage the ear.

Exposure can be short (e.g. gunshots, air bag deployment, explosives, clicking sounds) or for a longer period (e.g. music, beeping products, motor noises). The distance between the noise source and the ear also should be taken into account when determining risks.

Continuous noise will cause injuries after a certain amount of time. Risk assessment needs to take into account both sound pressure level and exposure time. Most products emitting sound will be in this category.

Children use noise-producing products without realizing the hazards to themselves and to other children. An indirect consequence of high noise levels, e.g. walking or cycling wearing headphones, can be traffic accidents or other hazards. However, low levels of noise can also inadvertently create hazards, such as insufficiently loud fire alarms or silent electric vehicles.

EXAMPLE 1 Children exposed to explosives, such as toys using percussion caps and/or firecrackers.

EXAMPLE 2 Babies exposed to noise from squeezed toys, beeping, rattling noises, musical boxes, alarms, etc. The baby is usually not able to operate the toy him or herself. Third persons, such as siblings or carers, usually determine the distance between the noise source and the baby's ear and also in some cases the sound pressure level.

EXAMPLE 3 Children expose themselves to noise, e.g. from loud music in ear phones or ear buds or when playing video games.

Strategies to avoid or reduce risks due to noise include:

— lowering the maximum noise level that a product may emit and/or time of exposure;

— resetting the product to low volume automatically when switched on;

— muffling noise;

— labelling volume controls clearly;

— informing or warning consumers about the hazard.

7.14 Biological hazards

Viruses, fungi and bacteria can cause illness in all people, but young children have less resistance/immunity than healthy adults. Liquids, semi-solids, and powders as well as stuffing materials are particularly susceptible to biological contamination.

In addition, the presence of insects, animal hair and faeces can be sources of biological contamination.

EXAMPLE 1 Crevices or odd shapes in products restrict accessibility for cleaning.

EXAMPLE 2 *Legionella* bacteria have been found in air conditioning systems, whirlpools, and showers.

Strategies to avoid or reduce exposure to biological contaminants include:

— designing products to facilitate their thorough cleaning, including, where necessary, comprehensive cleaning instructions;

— designing water ducts to avoid the growth of *Legionella;*

— storing materials hygienically e.g. textiles, stuffing, including during transportation;

— providing appropriate packaging to prevent contamination;

— Ensuring that liquids, semi-solids and powders contained in children's products (e.g. toys) are not contaminated, and are adequately protected from microbial growth.

7.15 Explosion and fire flash hazards

Flammability and burning characteristics of products determine the hazard of fire flash and explosions. In addition, pressure build-up can cause explosions. Explosive mixtures of substances can be formed intentionally (e.g. fireworks, cap guns), or unintentionally (e.g. gas leakage, gasoline vapour). Highly volatile, flammable products can ignite flash fires if added to a hot container or to a container in which a fire is not fully extinguished. Explosions can also result in harmful levels of noise (see 7.13). Children, especially older ones, have a desire to experiment with all kinds of products, including fireworks.

EXAMPLE 1 Fireworks that are not adequately made can detonate early or with a delay. Explosions are often accompanied by ejected particles and light flashes that can damage the eyes and burn the skin.

EXAMPLE 2 The noise that explosions make can be damaging to a child's ears.

EXAMPLE 3 Batteries and aerosol containers exposed to heat or thrown into fires can explode.

EXAMPLE 4 Batteries inserted with the wrong polarity can cause explosions.

EXAMPLE 5 Adding flammable gels or liquids to a hot container or a non-extinguished fire results in fire flash.

Strategies to avoid or reduce the risks of fire flash and explosions include:

— limiting (as far as possible) children's access to volatile and explosive materials;

— including appropriate instructions and warning labels on packaging, limiting by design the amount of burning material flying off and the distance traversed by particles;

— packaging volatile and explosive products to minimize the risk of spontaneous explosion;

— using child-resistant packaging to restrict access to volatile, explosive products;

— using, or instructing to use, personal protective equipment, such as face guards and gloves with appropriate performance requirements, when children do intentionally handle materials that might explode, e.g. during school chemistry lessons.

Fireworks cannot be expected to be safe for children without supervision. Some countries ban the sale of fireworks to the public (with few exceptions) and require that only licensed adults conduct firework displays.

8 Adequacy of safeguards

8.1 General

A safeguard can be applied to the product, the local installation, or a person, or can be a learned or directed behaviour (e.g. resulting from an instructional safeguard) intended to reduce the likelihood of harm to children. Thus, a safeguard encompasses more than simply a protective device, and can involve one or more strategies and/or behaviours. Generally, the order of preference for providing safeguards is

— product safeguards, since they do not require any knowledge or actions by persons coming into contact with the product;

— installation (including assembly and maintenance) safeguards when a safety characteristic can only be provided after installation (e.g. the product should be bolted to the floor to provide stability);

— personal and behavioural safeguards when there is a functional need for an energy source to be accessible;

— instructional safeguards to warn users about a hazardous energy source or to instruct a specific behaviour when such a behaviour is not commonly expected to be available.

8.2 Product safeguards

A product safeguard is a safeguard that is a physical part of the product. As they do not require any specific action or knowledge from the user, they are the preferred method to prevent injuries from happening. This is especially true for products which children can access, since personal or instructional safeguards are less effective for children.

EXAMPLE 1 On a ride-on toy, the brake is automatically applied when a child removes his or her foot from the accelerator.

Sometimes protective devices are designed for segments of the population excluding children. When these devices operate, they can present a hazard to babies and children.

EXAMPLE 2 Babies and young children have been injured or killed when passenger air bags have deployed while a child was in the passenger seat, and therefore a means of deactivating or reducing the force of the airbag when a child occupies the seat needs to be employed.

8.3 Installation safeguards

An installation safeguard is a physical part of a man-made environment. Installation safeguards are usually not controlled by the product manufacturer, although in some cases, installation safeguards can be specified in the installation instructions.

EXAMPLE The protective earthing/grounding system is located partly in the product and partly in the installation. Both elements are required for the system to be effective.

8.4 Personal safeguards

A personal safeguard is often a physical device worn on the body.

NOTE This is sometimes referred to as a personal protective device.

Some products, such as helmets, sunglasses, lifejackets, "safety" gates and barriers, are intended to reduce the likelihood of death and injury or to minimize the severity of injuries. It is important that such products do actually provide acceptable levels of protection. A problem can arise when products which resemble protective devices but which provide no protection are also available. These products are often toys, e.g. toy helmets or toy sunglasses.

Many protective devices intended for adults do not provide adequate protection for children. For example, helmets for adults might not provide appropriate shock absorption for children due to incorrect fit.

Sometimes protective devices create problems by being used in circumstances that were not foreseen. For example, children have left their bicycle helmets on when they stopped to play at a playground. Playground equipment is usually designed to prevent head entrapment by having openings that are either too small to allow head entry or large enough to allow the head to pass safely through. When children leave on their helmets, the head size effectively increases, interfering with the ability of the head to pass freely.

Because chinstraps on bicycle helmets are made to not release during a fall from a bicycle, they also do not release when a child hangs entrapped in playground equipment. The child could die. Design changes that allow helmet release in the event of playground entrapment have also been found to provide sufficient protection for riders, except in the case of extreme traffic incidents.

EXAMPLE 1 A toy helmet worn by a bicycle rider will not protect against head injury in a fall.

EXAMPLE 2 Toy protective kneepads will not protect skaters or skate boarders in the event of a fall.

EXAMPLE 3 Play flotation devices need to be adequately labelled so that they are not presumed to function as real lifesavers or life-vests.

EXAMPLE 4 Barriers intended to prevent access to certain environments, but which incorporate footholds, can be climbed.

Strategies to avoid or reduce risks due to inadequate protective function include:

— imitation protective devices, such as toy helmets, should be clearly labelled to indicate that they do not provide protection; providing clear and timely information to the public on the potential dangers;

— redesigning products to allow for the environments in which they are used in reality.

8.5 Behavioural safeguards

A behavioural safeguard is a voluntary or instructed behaviour intended to reduce the likelihood of harm. It can only be used by persons who have a certain level of experience dealing with hazards. For young children behavioural safeguards are not available and cannot be relied on, but become more relevant as children mature and gain experience. For example, they learn that broken glass is sharp and can lacerate them.

8.6 Instructional safeguards

An instructional safeguard is a means of providing information. It can include alerts and warnings, describe the existence and location of one or more hazards, and is intended to invoke a specific behaviour on the part of a person to reduce the likelihood of harm.

Information should be given to avoid possible consequences of product-related hazards that cannot be eliminated by design, or sufficiently controlled by safeguarding or shielding.

Information should be legible, understandable and available during the time or occasion when the corresponding hazard might occur, for example by making the instruction manual available for downloading from a supplier's website. Information carriers should not create new risks for children (e.g. choking on a label that detaches).

Research indicates that warning labels have limited effectiveness compared to primary prevention of hazards. Warnings and information are unlikely to affect the behaviour of children and should be directed to carers.

If product information intended for children is used, it should be written and/or depicted in a manner appropriate to their level of cognitive development. The effectiveness of this information should be tested. Where it is likely that children will use a product even if it is not intended for their use, essential product information should be provided so that they can use the product safely.

Such information as an attractive symbol on a poisonous substance should not encourage children to act inappropriately, since this could encourage a child to gain access to the substance.

EXAMPLE 1 Chemical toys (chemistry sets) might contain a known toxic chemical (e.g. copper sulfate), essential for the functioning of the toy. This fact needs to be communicated by a label and proper instructions for use.

EXAMPLE 2 An example of a warning in a draft for a standard for safety of lithium batteries could be "Keep out of reach of children. Swallowing can lead to chemical burns, perforation of soft tissue, and death. Severe burns can occur within 2 hours of ingestion. Seek medical attention immediately".

NOTE 1 General guidelines on instructions for use and information prior to purchase are given in ISO/IEC Guide 14 and ISO/IEC Guide 37.

NOTE 2 ISO/IEC Guide 74 deals with the use of graphical symbols. Additional sources for graphical symbols are ISO 7000 and ISO 7001.

Annex A
(informative)

Assessment checklist

In order to follow a structured approach, standards developers and other users should use the checklist given in Table A.1 with every new work item in order to verify that all aspects have been considered.

This checklist should become an annex to the standard when drafted.

Table A.1 — Assessment checklist

No.	Questions	Yes	No	NR[b]
1	Has the potential interaction of children with the product, service, process, installation been considered?[a]			
2	Have experts in child safety (those with an understanding of child physiology, child development, epidemiology, etc.) participated in the design or standardization process?			
3	Have the following hazards been considered?			
	— mechanical and fall (see 7.2)			
	— fall and other impact injuries (see 7.3)			
	— drowning (see 7.4)			
	— suffocation (see 7.5)			
	— strangulation (see 7.6)			
	— small objects and suction (see 7.7)			
	— fire (see 7.8)			
	— thermal (see 7.9)			
	— chemical (see 7.10)			
	— electric shock (see 7.11)			
	— radiation (see 7.12)			
	— noise (sound pressure) (see 7.13)			
	— biological (see 7.14)			
	— explosion and fire flash (see 7.15)			
4	Have hazards been assessed taking into account the physical and developmental characteristics of children?			
	— body size (see 5.1.2)			
	— motor development (see 5.1.3)			
	— physiological development (see 5.1.4)			
	— cognitive development and behaviour (see 5.1.5)			
	— exploration strategies (see 5.1.6)			

Table A.1 *(continued)*

No.	Questions	Yes	No	NR[b]
5	Have the following safeguards been considered in order to reduce the risks (in order of priority)?			
	— product safeguards (see 8.2)			
	— installation safeguards (see 8.3)			
	— personal safeguards (see 8.4)			
	— behavioural safeguards (see 8.5)			
	— instructional safeguards (see 8.6)			
[a]	If the answer to Question 1 is "No", the other questions may be omitted.			
[b]	NR = not relevant.			

After completing the checklist, thoroughly address any hazard for which "Yes" is ticked in Question 3. Check that any functional requirement arising from this discussion covers all risks due to the characteristics mentioned in Question 4.

Annex B
(informative)

Injury databases

Data of sufficient detail to inform the development of safer products and evaluate the effectiveness of standards and other specifications and information on injuries to children, including those that cause fatalities, is not widely available. Some databases cover accidents generally while others relate to specific activities. Databases covering regional, national or sub-national levels of varying quality, completion, accessibility and updatedness include the following.

— The US Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS) is a national probability sample of hospitals in the US and its territories. Patient information is collected from each NEISS hospital for every emergency visit involving an injury associated with consumer products. From this sample, the total number of product-related injuries treated in hospital emergency rooms nationwide can be estimated. Further information about the system and the ability to interrogate the database can be found at: www.cpsc.gov/en/Research--Statistics/NEISS-Injury-Data/

— The European Union's Injury Database (IDB) is an internet database set up by DG SANCO, part of the European Commission, under the Injury Prevention Programme in 1999, in order to provide central access to the data collected in member states. The IDB is an EU-wide injury surveillance system based on Accident and Emergency department data from selected member state hospitals. These data are aggregated at the EU level in a standardized way and made accessible in a central database: https://webgate.ec.europa.eu/sanco/heidi/index.php/IDB

— In Australia, the Victorian Injury Surveillance Unit (VISU) has been analysing, interpreting and disseminating Victorian data on injury deaths, hospital admissions and emergency department presentations across the state, nationally and internationally for more than 20 years. Victorian injury surveillance data are recorded on three separate data sets covering deaths, hospital admissions and emergency department presentations. Further information is available at: http://www.monash.edu.au/miri/research/research-areas/home-sport-and-leisure-safety/visu/

It should be remembered that information on injuries and fatalities is not all that is needed to assess the need for standards and evaluating their effectiveness. Data on exposure to risk (e.g. the number of products in circulation or the numbers of children undertaking a certain activity) and demographic information (e.g. population data, possibly broken down by age group, etc. to allow rates of death and injury to be calculated) might also be needed. Relevant exposure data are difficult to find.

Bibliography

[1] ISO 7000, *Graphical symbols for use on equipment — Registered symbols*

[2] ISO 7001, *Graphical symbols — Public information symbols*

[3] ISO 8124-1, *Safety of toys — Part 1: Safety aspects related to mechanical and physical properties*

[4] ISO/TR 8124-8, *Safety of toys — Part 8: Age determination guidelines*

[5] ISO 9186, *Graphical symbols — Test methods for judged comprehensibility and for comprehension*

[6] ISO 10377, *Consumer product safety — Guidelines for suppliers*

[7] IEC 60417 (all parts), *Graphical symbols for use on equipment*

[8] IEC 61032, *Protection of persons and equipment by enclosures — Probes for verification*

[9] IEC 62115, *Electric toys — Safety*

[10] IEC 62368-1, *Audio/video, information and communication technology equipment — Part 1: Safety requirements*

[11] ISO/IEC Guide 14, *Purchase information on goods and services intended for consumers*

[12] ISO/IEC Guide 37, *Instructions for use of products by consumers*

[13] ISO/IEC Guide 41, *Packaging — Recommendations for addressing consumer needs*

[14] ISO/IEC Guide 51:2014, *Safety aspects — Guidelines for their inclusion in standards*

[15] ISO/IEC Guide 71, *Guide for addressing accessibility in standards*

[16] ISO/IEC Guide 74, *Graphical symbols — Technical guidelines for the consideration of consumers' needs*

[17] IEC Guide 117, *Electrotechnical equipment — Temperatures of touchable hot surfaces*

[18] EN 71-1, *Safety of toys — Part 1: Mechanical and physical properties*

[19] EN 563, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*

[20] CEN/CENELEC Guide 14, *Child safety — Guidance for its Inclusion in Standards*[1)]

[21] CR 13387, *Child use and care articles — General and common safety guidelines*

[22] CR 14379, *Classification of toys — Guidelines*

[23] ASTM F 963–11, *Standard Consumer Safety Specification on Toy Safety*

[24] *Handbook for Public Playground Safety*. US Consumer Product Safety Commission, Publication No. 325, 1997

[25] *Childata — The handbook of child measurements and capabilities. UK Department of Trade and Industry*. DTI, 1995

[26] WHO/UNICEF *World Report on Child Injury Prevention*

1) Includes an extensive bibliography covering child development and hazard exposure, hazard prone behaviour and injury susceptibility, potential preventive measures, and product/service specific publications for children up to the age of 14.

[27] KUTNER L. and OLSON C.K.. *Grand Theft Childhood*. Simon & Schuster, 2008

[28] PHILLIPS D.. *Early childhood development and disability*: Discussion paper. WHO/UNICEF, Geneva, 2012

[29] PEDEN M. et al. *World report on child injury prevention*. WHO/UNICEF, Geneva, 2008

[30] BJORKLUND D.. *Children's Thinking: Developmental Function and Individual Differences*. Wadsworth/Thomson Learning, Belmont, CA, Fourth Edition, 2005

[31] DAVIES D.. *Child Development: A Practitioner's Guide*. The Guilford Press, New York, 1999

[32] ELIOT. L.. *What's Going On*. In: *There? How the Brain and Mind Develop in the First Five Years of Life*. Bantam Books, New York, 1999

[33] GOPNIK A., MELTZOFF A.N. and KUHL P.K.. *The Scientist in the Crib: Minds, Brains, and how Children Learn*. William Morrow and Company, New York, 1999

[34] HEALY J.M.. *Your Child's Grown Mind: Brain Development and Learning from Birth to Adolescence*. Broadway Books, New York, 2004

[35] RUFF H.A.. Infants' Manipulative Exploration of Objects: Effects of Age and Objects Characteristics. *Dev. Psychol.* 1984, **20** (1) pp. 9–20

[36] SINGER J.L.. *Imaginative play and adaptive development*. In: *Toys, Play and Child Development*, (Goldstein J.H. ed.). Cambridge University Press, Cambridge, 1994

[37] U.S. Consumer Product Safety Commission (CPSC): Relating Children's Ages to Toy Characteristics and Play Behaviour, September 2002

[38] GOLDSTEIN J.H.. (ed). *Toys, Play and Child Development* (pp. 6-26). Cambridge University Press, Cambridge, 1994

[39] ISO Catalogue of standards: http://www.iso.org/iso/home/store/catalogue_ics.htm

[40] Consumer Product Safety Commission. http://www.cpsc.gov/

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