Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1176-1

October 2017

ICS 97.200.40

Supersedes EN 1176-1:2008

English Version

Playground equipment and surfacing - Part 1: General safety requirements and test methods

Équipements et sols d'aires de jeux - Partie 1: Exigences de sécurité et méthodes d'essai générales

Spielplatzgeräte und Spielplatzböden - Teil 1: Allgemeine sicherheitstechnische Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 8 June 2017.

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Ref. No. EN 1176-1:2017: E

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European foreword

This document (EN 1176-1:2017) has been prepared by Technical Committee CEN/TC 136 “Sports, playground and other recreational facilities and equipment”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by October 2018.

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

This document supersedes EN 1176-1:2008.

EN 1176 “Playground equipment and surfacing” consists of the following parts:

— Part 1: *General safety requirements and test methods*

— Part 2: *Additional specific safety requirements and test methods for swings*

— Part 3: *Additional specific safety requirements and test methods for slides*

— Part 4: *Additional specific safety requirements and test methods for cableways*

— Part 5: *Additional specific safety requirements and test methods for carousels*

— Part 6: *Additional specific safety requirements and test methods for rocking equipment*

— Part 7: *Guidance on installation, inspection, maintenance and operation*

— Part 10: *Additional specific safety requirements and test methods for fully enclosed play equipment*

— Part 11: *Additional specific safety requirements and test methods for spatial network*

This part of EN 1176 should be read in conjunction with:

— EN 1177, *Impact attenuating playground surfacing — Determination of critical fall height*;

— CEN/TR 16467:2013, *Playground equipment accessible for all children*;

— CEN/TR 16598:2014, *Collection of rationales for* EN 1176;

— CEN/TR 16396:2012, *Playground equipment for children, replies to requests for interpretation of* EN 1176:2008 *and its parts*;

— CEN/TR 16879:2016, *Siting of playground and other recreational facilities — Advice on methods for positioning and separation*.

For inflatable play equipment, see EN 14960, *Inflatable play equipment — Safety requirements and test methods*.

The main changes from the previous edition of this standard are as follows:

a) Reference to CEN/TR 16467:2013, CEN/TR 16598:2014, CEN/TR 16396:2012, CEN/TR 16879:2016 added;

b) Scope amended to include reference to ‘permanently installed’ also reference to electricity, water and UV added;

c) Clause 3.25 definition of easily accessible improved;

d) New definitions added for impact attenuating surfacing, adequate level of impact attenuation, forced movement, bouncing facilities, suspension bed, one post equipment, post installation inspection, fireman's pole and tunnel;

e) Clause 4.2.4.1 amended to agree with Figure 8;

f) Clause 4.2.4.3 and 4.2.4.4 detail of measurement of 500 mm opening added;

g) Clause 4.2.7.1 new sentence adding reference to Clause 4.2.7.2;

h) Figure 13 amended to show direction of travel;

i) Clause 4.2.8.1 cross reference to Table 2 added;

j) Table 2 amended to clarify distinctions for climbing and hanging fall heights;

k) Figure 14 amended to include two types of net structure in fall height examples;

l) Clause 4.2.8.2.5 clarification of overlapping falling spaces added;

m) Clause 4.2.8.5.2 and Table 4 revised to align with changes to EN 1177;

n) Clause 4.2.9.5 major rewrite to clarify requirements for easily accessible equipment;

o) Clause 4.2.12.2 inclusion of reference to use of probe E;

p) New Clause 4.2.16 giving requirements for bouncing facilities;

q) Clauses 5.2 and Annex H relating to Impact Attenuating Surfacing added;

r) Clauses 6.2 amended to give more information on Impact Attenuating Surfacing;

s) A.2.2, notes 1 and 2 now included as part of requirements;

t) D.4.2, last paragraph now includes additional test requirement for holes behind holes;

u) New test (D.5) and Figure (D.13) for testing chain openings added;

v) New Figure (D.12) showing application of finger probes in test situations;

w) New test (D.6) for bouncing facilities;

x) New Annex F showing illustrations of free height of fall;

y) New Annex G showing illustration of sieve test results and sieve curve;

y) New Annex H "Procedure for confirming the adequate level of impact attenuation after installation of impact attenuating surfacing" added;

aa) Annex I "A-Deviations" updated.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

For the quality of reading and understanding this standard, the following wording is used:

— shall = requirement;

— should = recommendation;

— may = permission;

— can = possibility.

It is not the purpose of the requirements of this standard to lessen the contribution that playground equipment makes to the child's development and/or play, which is meaningful from an educational point of view.

This standard acknowledges the difficulties of addressing safety issues by age criteria alone because the ability to handle risk is based on the individual users' level of skills and not age. Also, users other than the intended age range will almost certainly make use of the playground equipment.

Risk-taking is an essential feature of play provision and of all environments in which children legitimately spend time playing. Play provision aims to offer children the chance to encounter acceptable risks as part of a stimulating, challenging and controlled learning environment. Play provision should aim at managing the balance between the need to offer risk and the need to keep children safe from serious harm.

The principles of safety management are applicable both to workplaces in general as well as to play provision. However, the balance between safety and benefits is likely to be different in the two environments. In play provision, exposure to some degree of risk might be of benefit because it satisfies a basic human need and gives children the chance to learn about risk and consequences in a controlled environment.

Respecting the characteristics of children's play and the way children benefit from playing on the playground with regard to development, children need to learn to cope with risk and this can lead to bumps and bruises and even occasionally a broken limb. The aim of this standard is first and foremost to prevent accidents with a disabling or fatal consequence, and secondly to lessen serious consequences caused by the occasional mishap that inevitably will occur in children's pursuit of expanding their level of competence, be it socially, intellectually or physically.

Refusal of admittance and access as a safety precaution is problematic due to, for example, breach in supervision or help by peers. Requirements of significant importance, such as head and neck entrapment and protection against inadvertent falls, have been written with this in mind. It is also recognized that there is an increasing need for play provision to be accessible to users with disabilities. This of course requires play areas to provide a balance between safety and the offer of the required level of challenge and stimulation to all possible groups of users. However, for the purposes of protection against head and neck entrapment, this standard does not take into account children with an increased head size e.g. hydrocephalus or Down's syndrome or wearing helmets.

For further information about making play provision suitable for less able users a CEN Technical Report is available which discusses the challenges in provision and possible solutions that designers can consider. See the European foreword for details of this document.

In addition to the short-term risks that are associated with a playground, there is a risk that the playing child is overexposed to the ultraviolet radiation of the sun. Too much ultraviolet radiation and sunburns in childhood increase the risk of developing skin cancer later in life. Therefore, the playgrounds should be organized in a way that takes into account of the availability of shade options, and that a part of the playground equipment and recreational areas are placed entirely or partly in shade.

1 Scope

This part of EN 1176 specifies general safety requirements for permanently installed public playground equipment and surfacing. Additional safety requirements for specific pieces of playground equipment are specified in subsequent parts of this standard.

This part of EN 1176 covers playground equipment for all children. It has been prepared with full recognition of the need for supervision of young children and of less able or less competent children.

The purpose of this part of EN 1176 is to ensure a proper level of safety when playing in, on or around playground equipment, and at the same time to promote activities and features known to benefit children because they provide valuable experiences that will enable them to cope with situations outside the playground.

This part of EN 1176 is applicable to playground equipment intended for individual and collective use by children. It is also applicable to equipment and units installed as children's playground equipment although they are not manufactured as such, but exclude those items defined as toys in EN 71 and the Toys Safety Directive.

It is not applicable to adventure playgrounds with the exception of those items which have been commercially sourced.

NOTE Adventure playgrounds are fenced, secured playgrounds, run and staffed in accordance with the widely accepted principles that encourage children's development and often use self-built equipment.

This part of EN 1176 specifies the requirements that will protect the child from hazards that they might be unable to foresee when using the equipment as intended, or in a manner that can be reasonably anticipated.

The use of electricity in play equipment, either as a play activity or as a motive force, is outside the scope of this standard. The attention of users is drawn to European and local national standards and regulations which are to be complied with when using electricity.

Play equipment placed in water and where water can be seen as impact attenuating surfacing is not fully covered by this standard and additional risks are associated with wet environments.

The risk of exposure to excessive levels of UV radiation is not covered in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 335, *Durability of wood and wood-based products - Use classes: definitions, application to solid wood and wood-based products*

EN 350:2016, *Durability of wood and wood-based products - Testing and classification of the durability to biological agents of wood and wood-based materials*

EN 351-1:2007, *Durability of wood and wood-based products - Preservative-treated solid wood - Part 1: Classification of preservative penetration and retention*

EN 636, *Plywood — Specifications*

EN 818-2:1996+A1:2008, *Short link chain for lifting purposes - Safety - Part 2: Medium tolerance chain for chain slings - Grade 8*

EN 818-3:1999+A1:2008, *Short link chain for lifting purposes - Safety - Part 3: Medium tolerance chain for chain slings - Grade 4*

EN 1177, *Impact attenuating playground surfacing - Determination of critical fall height*

EN 1991-1-2, *Eurocode 1: Actions on structures - Part 1-2: General actions - Actions on structures exposed to fire*

EN 1991-1-3, *Eurocode 1 - Actions on structures - Part 1-3: General actions - Snow loads*

EN 1991-1-4, *Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions*

EN 13411-3, *Terminations for steel wire ropes — Safety — Part 3: Ferrules and ferrule-securing*

EN 13411-5, *Terminations for steel wire ropes — Safety — Part 5: U-bolt wire rope grips*

EN ISO 2307, *Fibre ropes - Determination of certain physical and mechanical properties (ISO 2307)*

EN ISO 4892-3, *Plastics - Methods of exposure to laboratory light sources - Part 3: Fluorescent UV lamps (ISO 4892-3)*

EN ISO 9554, *Fibre ropes - General specifications (ISO 9554)*

EN ISO 13934-1, *Textiles - Tensile properties of fabrics - Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1)*

3 Terms and definitions

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

3.1
playground equipment
equipment and structure, including components and constructional elements with, or on which, children can play outdoors or indoors, either individually or in groups, according to their own rules or own reasons for playing which can change at any time

3.2
climbing equipment
playground equipment that only allows the user to move on it or in it by the use of a hand and foot/leg support and requires a minimum of three points of contact with the equipment, one of these being a hand

NOTE During movement, it is possible to have only one or two points of contact but this is only during a transition from one rest position to the next.

3.3
impact area
area that can be hit by a user after falling through the falling space

3.4
impact attenuating surfacing
surfacing on impact areas intended to reduce the risk of injury when falling onto it

3.5
playing surface
surface of a playground from which the use of the playground equipment commences and which comprises at least the impact area

3.6
free space
space in, on or around the equipment that can be occupied by a user undergoing a movement forced by the equipment

Note 1 to entry: Examples for this are sliding, swinging, rocking, jumping in bouncing facility for several users (specific requirements are dealt with in the additional parts of EN 1176).

Note 2 to entry: See Figures 15, 16 and 19.

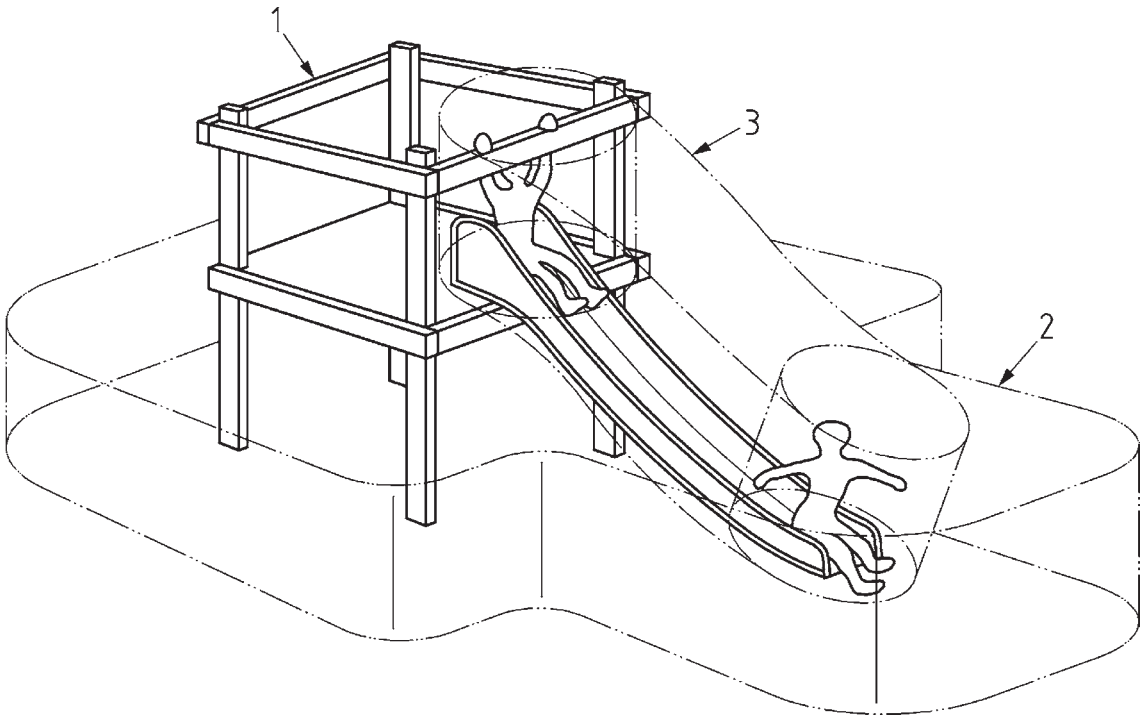
3.7
free height of fall
greatest vertical distance from the clearly intended body support to the impact area below

NOTE The intended body support includes those surfaces to which access is encouraged.

3.8
falling space
space in, on or around the equipment that can be passed through by a user falling from an elevated part of the equipment

Note 1 to entry: The falling space commences at the free height of fall.

Note 2 to entry: See Figure 1.



Key

1 space occupied by equipment
2 falling space
3 free space

Figure 1 — Spaces

3.9
minimum space
space required for the safe use of equipment, comprising falling space, free space and space occupied by the equipment

3.10
collective use
use by more than one user at the same time

3.11
crushing point
place where parts of the equipment can move against each other, or against a fixed area so that persons, or parts of their body, can be crushed

3.12
shearing point
place where part of the equipment can move past a fixed or other moving part, or past a fixed area so that persons, or parts of their body, can be cut

3.13
ladder
means of access incorporating rungs or steps on which a user can ascend or descend with the aid of the hands

NOTE See Figure 2.

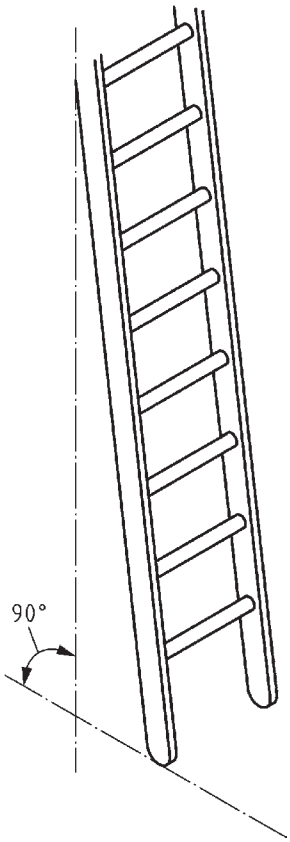


Figure 2 — Example of a ladder

3.14
stair
<playground equipment>means of access incorporating three or more risers on which a user can ascend or descend

NOTE See Figure 3 and Figure 21.

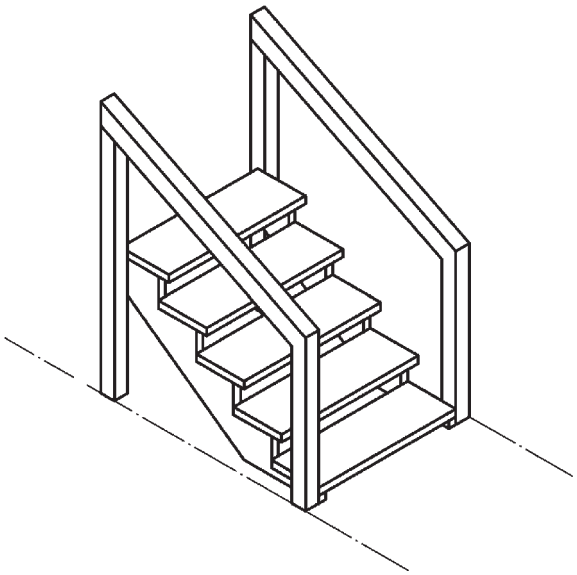


Figure 3 — Example of stairs

3.15
ramp
means of access incorporating an inclined surface on which a user can ascend or descend

NOTE See Figure 4 and 4.2.9.3.

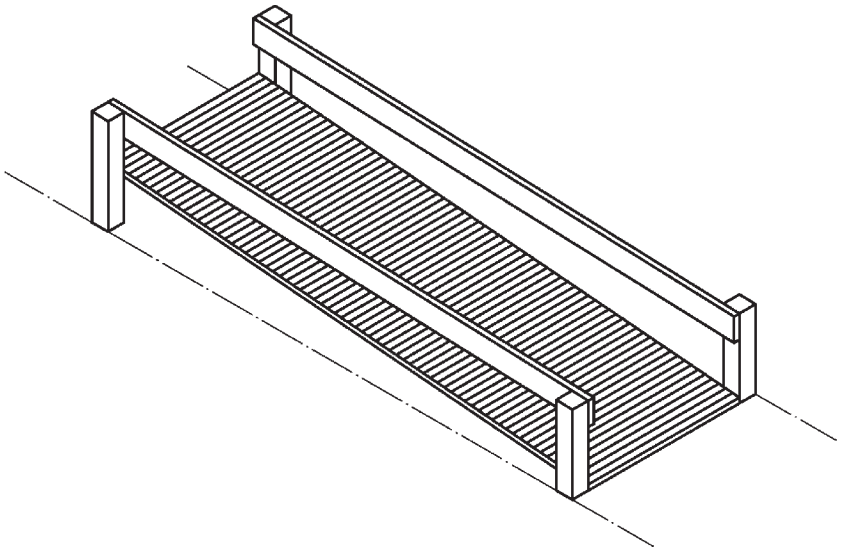


Figure 4 — Example of a ramp

3.16
grip
holding of the hand round the entire circumference of a support

NOTE See Figure 5.

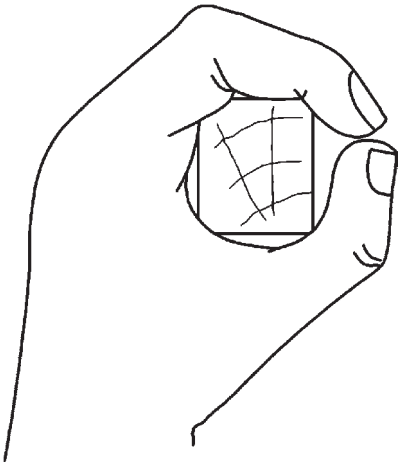


Figure 5 — Grip

3.17
grasp
holding of the hand round part of the circumference of a support

NOTE See Figure 6.

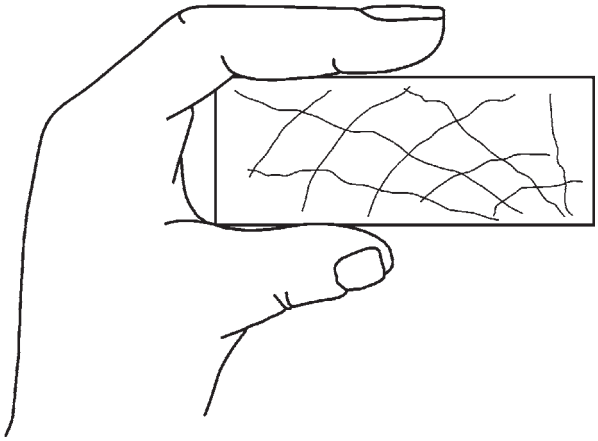


Figure 6 — Grasp

3.18
entrapment
hazard presented by the situation in which a body, or part of a body, or clothing can become trapped

NOTE This part of EN 1176 only considers certain types of entrapment where the user is not able to free themselves and injury is caused by the entrapment.

3.19
obstacle
object or portion of object that protrudes inside the space occupied by equipment, the falling space or the free space of a user

NOTE The risks associated with obstacles in playground equipment will vary according to its situation in, on or around the equipment e.g.:

— in the free space, something in the path of a user undergoing a forced movement;

— in the falling space, something hard and sharp that a user can hit during a fall from an elevated position;

— for other types of movement, something unexpected with which a user might collide whilst moving in, on or around the equipment.

3.20
cluster
two or more separate pieces of equipment designed to be installed in close proximity to each other to provide continuity in a sequence that is needed for the play activity

NOTE An example for a cluster is a trail of stepping stones.

3.21
platform
raised surface where one or more users can stand without the need of hand support

NOTE The classification of a platform will vary depending on the function of the playground equipment. Surfaces where the user is only able to stand with the aid of hand supports are not classified as platforms. This may be achieved by a number of means, e.g.:

— reducing the surface area to restrict free movement and encourage holding on;

— incline the surface to encourage holding on;

— introducing movement to the surface to encourage holding on.

3.22
handrail
rail intended to assist the user to balance

3.23
guardrail
rail intended to prevent a user from falling

3.24
barrier
device intended to prevent the user from falling and from passing beneath

3.25
easily accessible
requiring only basic skills to access the equipment, allowing users to move freely and quickly onto/within the equipment, without further considerations about the use of hands and feet

NOTE Basics skills should control the ability of a child to use a means of access. If the user needs to consider where or how to use their hands and feet when negotiating a means of access the access should generally be considered not easy as it slows down the movement and provides time for intervention.

3.26
routine visual inspection
inspection intended to identify obvious hazards that can result from normal use, vandalism or weather conditions

NOTE Typical hazards can take the form of broken parts or broken bottles.

3.27
operational inspection
inspection, more detailed than routine visual inspection, to check the operation and stability of the equipment

NOTE Typical checks include an examination for wear.

3.28
annual main inspection
inspection intended to establish the overall level of safety of equipment, foundations and playing surfaces

NOTE Typical checks include the effects of weather, evidence of rotting or corrosion and any change in the level of safety of the equipment as a result of repairs made, or of added or replaced components.

3.29
steep play element
access/egress play element of a gradient greater than 45 degrees from the horizontal

3.30
tiered platforms
successive platforms of varying heights allowing the user to ascend or descend on or within the equipment

NOTE Stairs are not considered to be tiered platforms.

3.31
critical fall height
maximum free height of fall for which a surface will provide an adequate level of impact attenuation

NOTE The critical fall height is determined according to the lowest test result obtained in accordance with EN 1177.

3.32
adequate level of impact attenuation
property of a surface having the necessary impact attenuation for a given free height of fall, which is in compliance with:

a) Table 4, including sieve test in accordance with EN 933-1;

b) EN 1177;

c) other appropriate means of verification e.g. value based judgement for turf/topsoil

3.33
surface flash
rapid spread of flame over the surface of a material without combustion of the basic structure at that time

3.34
forced movement
movement of the user caused by the equipment (e.g. swinging, sliding, carousel rotation etc.) which, once started, cannot be totally controlled by the user

Note 1 to entry: Falls are not considered forced movement as they are not imposed on the user by the equipment but occur for other reasons.

Note 2 to entry: Specific requirements are dealt with in the additional parts of EN 1176.

3.35
bouncing facility
playground equipment or equipment parts that due to their flexible characteristics have the main purpose of allowing users to become airborne by jumping without the aid of other user(s)

Note 1 to entry: In most cases, the bounce effect can be caused by a spring, rope or flexible suspension bed material. However, some structures that have a minor bouncing effect are not considered as bouncing facilities since their intended main use is not bouncing.

Note 2 to entry: Typically, bouncing facilities do not act as trampolines as they do not allow for high jumps or encourage acrobatic jumps, which are more likely to lead to serious injuries or fatalities.

3.36
suspension bed
flexible section of a bouncing facility upon which the user jumps

3.37
one post equipment
structurally vulnerable equipment where the failure of one cross-section (either at the foundation or elsewhere in the support post) would be catastrophic

NOTE This definition includes not only structures with a single support but also those where stability is provided by two legged members or rows of members (see also note to 4.2.14).

3.38
post installation inspection
inspection usually undertaken prior to the opening of a playground for public use, intended to assess the equipment and its environment for the overall level of safety on the playground

3.39
fireman's pole
vertical or near vertical tube down which users may glide

NOTE The word 'glide' is used here to help distinguish this type of equipment from slides as defined in EN 1176-3.

3.40
tunnel
<playground equipment>continuous enclosed tube-like opening with a length that requires crawling or kneeling to pass through

4 Safety requirements

4.1 Materials

4.1.1 General

Materials shall conform to 4.1.2 to 4.1.6.

Materials shall be selected and protected such that the structural integrity of the equipment or impact attenuating surfacing manufactured from them is not affected before the next relevant inspection and maintenance.

NOTE EN 1176-7 gives recommendations on inspections and maintenance.

The provisions relating to certain materials in this standard do not imply that other equivalent materials are unsuitable in the manufacture of playground equipment.

The selection of materials and their use should be in accordance with appropriate European Standards.

Special attention should be given to surface coatings to avoid potential toxic hazards.

The choice of materials should be appropriate where extreme climatic or atmospheric conditions are to be expected. Care should be taken where direct skin contact is to be expected.

In the choice of a material or substance for playground equipment or impact attenuating surfacing, consideration should be given to the eventual disposal of the material or substance having regard to any possible environmental toxic hazard.

4.1.2 Flammability

To avoid the risk of fire and associated hazards, materials known to produce surface flash shall not be used. Particular attention should be given to newly developed products whose properties might not be fully known.

NOTE 1 Requirements for adequate exits to ensure escape in cases of fire are given in 4.2.3.

NOTE 2 Attention is drawn to national and local building regulations regarding flammability for equipment installed both indoors and outdoors.

4.1.3 Timber and associated products

Timber parts shall be designed in such a way that precipitation can drain off freely and water accumulation shall be avoided.

In cases of ground contact, one or more of the following methods shall be used:

a) use of timber species with sufficient natural resistance in accordance with classes 1 and 2 of the natural resistance classification given in EN 350:2016, 5.2;

b) construction methods, e.g. post shoe;

c) use of timber treated with wood preservatives in accordance with EN 351-1:2007, Figure A.1, and in accordance with EN 335, use class 4.

NOTE It is advised to also consider other factors which can be unsuitable, such as splintering, poisoning etc.

All components made of timber and associated products, other than those species conforming to a), that affect the stability of the structure and are in constant contact with the ground shall be treated in accordance with c).

When selecting metal fastenings, consideration should be given to the species of timber and chemical treatments used as some will accelerate corrosion of metals if there is contact between them.

Plywood shall be in accordance with EN 636 and shall be weatherproofed.

4.1.4 Metals

Metal parts should be protected against atmospheric conditions and cathodic corrosion.

Metals that produce toxic oxides that scale or flake shall be protected by a non-toxic coating.

4.1.5 Synthetics

If, during maintenance, it is difficult to determine at what point material becomes brittle, manufacturers shall give an indication of the time period after which the part or equipment or impact attenuating surfacing should be replaced.

It should be possible for the operator of the playground to visually identify excessive wear of the gelcoat of GRP (glass-reinforced plastics) products intended for sliding before the user becomes exposed to the glass fibres.

NOTE This can be achieved for example by the use of different coloured layers in the sliding surface.

Consideration should also be given to degradation of structural components or impact attenuating surfacing through ultraviolet influences.

4.1.6 Dangerous substances

Dangerous substances shall not be used in playground equipment or impact attenuating surfacing in such a way that they can cause adverse health effects to the user of the equipment.

NOTE Attention is drawn to the provisions of the REACH Regulation (EC) 1907/2006 and its successive modifications. Restricted materials include, but are not limited to, asbestos, lead, formaldehyde, coal tar oils, carbolineums, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAH compounds).

4.2 Design and manufacture

4.2.1 General

Equipment where the primary play function is augmented by a secondary motion, e.g. rocking and/or rotating, shall conform to the additional parts of EN 1176 relating to both play functions, as appropriate, unless the equipment is specifically covered in just one of the additional parts of EN 1176.

The dimensions and degree of difficulty of the equipment should be suitable for the intended user group. The equipment should be designed so that the risk involved in play is apparent and foreseeable by the child.

NOTE For additional safety of equipment that is easily accessible, specific requirements have been included for the following:

— protection against falling:

  a) guardrails (4.2.4.3);

  b) barriers (4.2.4.4);

— steep elements (4.2.9.4);

— easily accessible playground equipment (4.2.9.5).

Except when intended for water play, all parts of playground equipment should be designed so that they do not accumulate water e.g. space beneath bouncing facility or carousel flush with the ground.

4.2.2 Structural integrity

For playground equipment, the structural integrity for the worst case of the intended combinations shall be proved.

Structural integrity, including stability of the equipment shall be assessed by one of the following:

a) calculation, in accordance with Annexes A and B;

b) physical testing, in accordance with Annex C; or

c) a combination of a) and b).

When calculations are carried out in accordance with Annex B no limit states shall be exceeded at combinations of loads as given in B.2.

When tested in accordance with Annex C, the equipment shall not show any cracks, damage or excessive permanent deformation (see C.1.2). Each structure shall resist both the permanent and variable loads acting on equipment and parts of equipment as described in Annex C.

When playground equipment relies on one post for its stability, the construction should be carried out in order to:

— minimize rotting or corrosion in parts relevant for stability;

— allow for controlling degradation and the need for decommission;

— be used without collapse within the foreseen inspection period when maintained correctly.

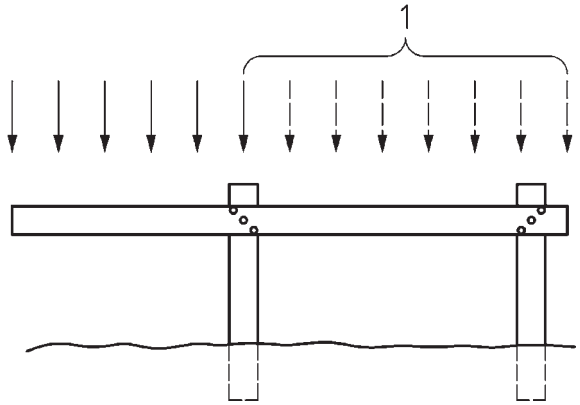
NOTE 1 No allowance for accidental loads, i.e. loads produced by fire, collision by vehicles or earthquake, need to be made for playground equipment.

NOTE 2 The loads associated with fatigue are in general much smaller than the loads in combination with the appropriate load factors when calculated in accordance with B.2. Therefore, playground equipment in general need not be verified for fatigue.

NOTE 3 For one post equipment at installation stage, it is advised to consider access to foundations to control rotting or degradation; the choice of impact attenuating surfacing material can have implications on inspections to foundations.

Structural parts shall resist the worst case loading condition.

NOTE 4 To achieve this, it might be necessary to remove that part of the user load causing favourable effects, as shown in Figure 7.



Key

1 remove this part of the load because of favourable effects

Figure 7 — Example of removal of that part of the user load which causes a favourable effect

4.2.3 Accessibility for adults

Playground equipment shall be designed to ensure that adults are able to gain access to assist children within the equipment.

Enclosed parts of the equipment such as tunnels and playhouses, with an internal distance greater than 2 000 mm from an entry point shall have at least two access openings that are independent of one another and situated on different sides of the equipment. These openings shall not be capable of being locked and shall be accessible without any additional aids (e.g. a ladder that is not an integral part of the equipment). These access openings shall have no dimension less than 500 mm.

Because of the risk of fire, these two openings shall allow the user to leave the equipment by different routes.

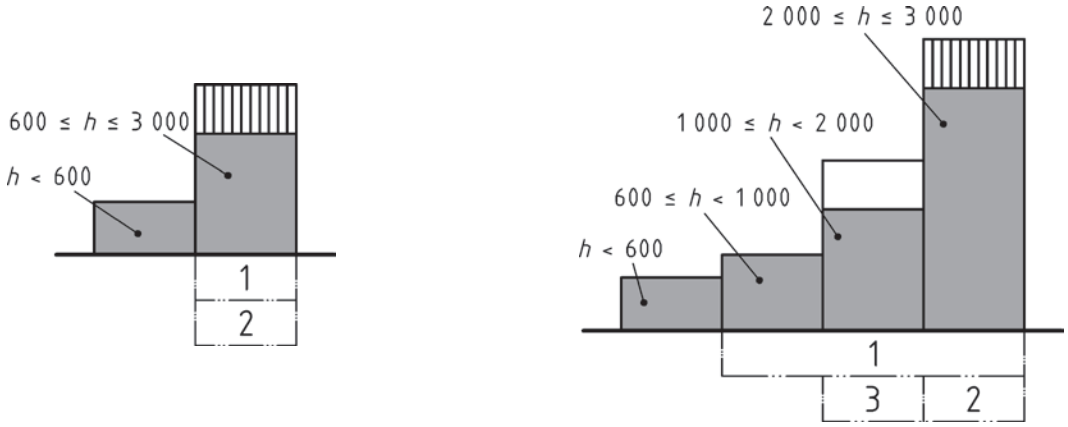
4.2.4 Protection against falling

4.2.4.1 General

Different types of protection against falling from elevated platforms are required. The type of protection required will depend on the free height of fall and on the type of equipment, whether it is easily accessible or not (see 4.2.4.3 and 4.2.4.4). See Figure 8 and Annex F.

When installed on ramps or stairs, handrails, guardrails or barriers shall commence at the lowest position on the ramp or stairs.

Dimensions in millimetres



a) Protection against falling for easily accessible equipment

b) Protection against falling for not easily accessible equipment

Key

1 impact attenuating surfacing in accordance with 4.2.8.5

2 barriers required

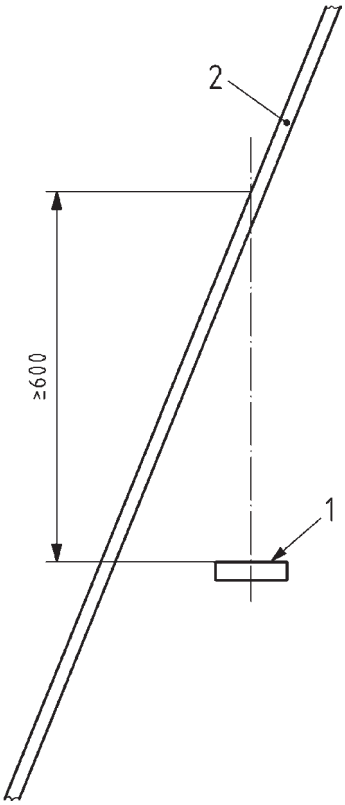
3 guardrail required

Figure 8 — General protection against falling where there is no forced movement

4.2.4.2 Handrails

Handrails shall be not less than 600 mm and not more than 850 mm above the foot position (see Figure 9). As a minimum, handrails shall conform to the requirements for grasp (see 4.2.4.7).

Dimensions in millimetres



Key

1 foot position

2 handrail

Figure 9 — Guidance on measurement of height of handrail above foot position

4.2.4.3 Guardrails

For equipment other than that which is easily accessible, guardrails shall be provided when the platform is 1 000 mm to 2 000 mm above the playing surface (see Figure 8b)). The height to the top of the guardrail shall be not less than 600 mm and not more than 850 mm measured from the surface of the platform, stairs or ramp.

Guardrails shall completely surround the platform except for entrance and exit openings necessary for each play element. The width of entrance and exit openings in guardrails, with the exception of stairs, ramps and bridges, shall have a maximum clear opening of 500 mm, when measured horizontally at a position, with a height between 600 mm to 850 mm from the platform. For stairs, ramps and bridges the width of the exit opening in the guardrail shall be no greater than the width of these elements.

4.2.4.4 Barriers

Except for entrance and exit openings necessary for each play element, barriers shall completely surround the platform. The width of entrance and exit openings in barriers shall have a clear opening of 500 mm maximum, when measured horizontally at any point (see Figure 10a)), unless a guardrail is provided across the opening (see Figure 10b) and Figure 10c)). For stairs, ramps, bridges, etc. that have additional barriers as part of their structure, the width of the exit opening in the barrier shall be no greater than the width of these elements.

There shall be no intermediate horizontal or near horizontal rails or bars that can be used as steps by children attempting to climb. The design of the top of the barriers should not encourage children to stand or sit on them, nor should any infilling encourage climbing.

Openings between the platform surface and the lower edge of the barrier and between any infilling elements shall not allow passage of the probe C.

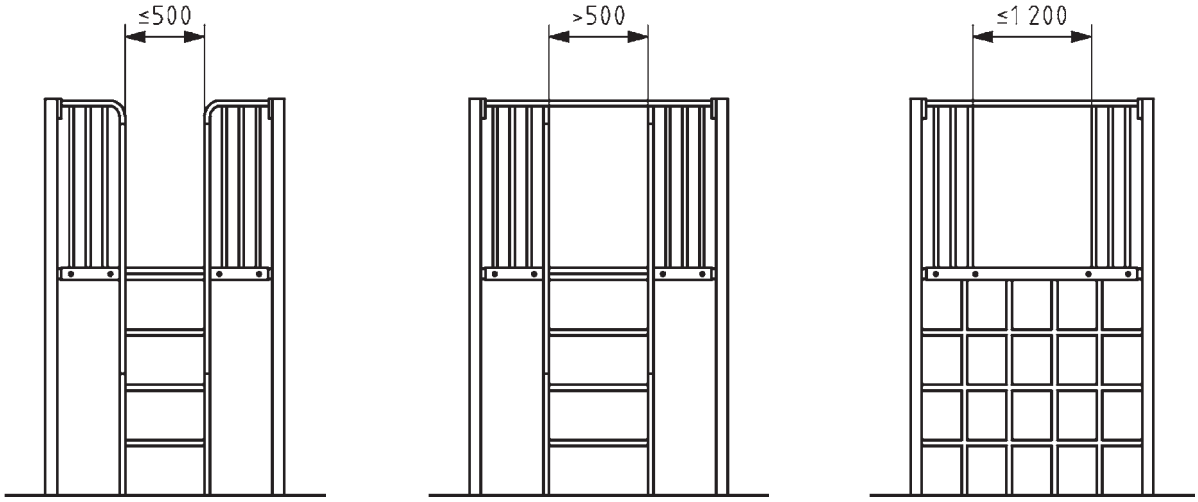
For easily accessible equipment, barriers shall be provided when the platform is more than 600 mm above the playing surface (see Figure 8a)).

For equipment other than easily accessible, barriers shall be provided when the platform is more than 2 000 mm above the playing surface (see Figure 8b)).

The height to the top of the barrier shall be at least 700 mm measured from the surface of the platform, stairs or ramp.

Openings in the barrier of easily accessible equipment/parts of equipment that give access to steep play elements shall conform to the requirements of 4.2.9.4. For all other equipment, openings in the barrier provided with a guardrail, which give access to steep play elements, shall not be greater than 1 200 mm (see Figure 10c)).

Dimensions in millimetres



a) any narrow element **b) steep play element is at least as wide as the opening** **c) steep play element is wider than the opening**

Figure 10 — Entrance and exit openings in barriers for steep play elements

4.2.4.5 Strength requirements

Barriers and guardrails shall conform to 4.2.2.

4.2.4.6 Grip requirements

The cross-section of any support designed to be gripped for support of full body weight (see 3.16 and Figure 5) shall have a dimension of not less than 16 mm or more than 45 mm in any direction, when measured across its centre.

4.2.4.7 Grasp requirements

The cross-section of any support designed to be grasped (see 3.17 and Figure 6) shall have a width not exceeding 60 mm.

4.2.5 Finish of equipment

Wooden equipment shall be made of wood with a low susceptibility to splintering. The surface finish of equipment made of other materials (e.g. glass fibre) shall be non-splintering.

There shall be no protruding nails, projecting wire rope terminations or pointed or sharp-edged components. Rough surfaces should not present any risk of injury. Protruding bolt threads within any accessible part of the equipment shall be permanently covered, e.g. dome headed nuts. Nuts and bolt heads that project less than 8 mm shall be free from burrs.

NOTE 1 Figure 11 shows examples of protection for nuts and bolts.

Corners, edges and projecting parts within the space occupied by the user that protrude more than 8 mm, and which are not shielded by adjacent areas that are not more than 25 mm from the end of the projecting part, shall be rounded off. The minimum radius of the curve shall be 3 mm.

NOTE 2 This requirement is intended only to prevent injuries caused by unintended contact with components.

Corners, edges and projections with a radius less than 3 mm may be in other accessible parts of the equipment only if they are not sharp.

Dimensions in millimetres

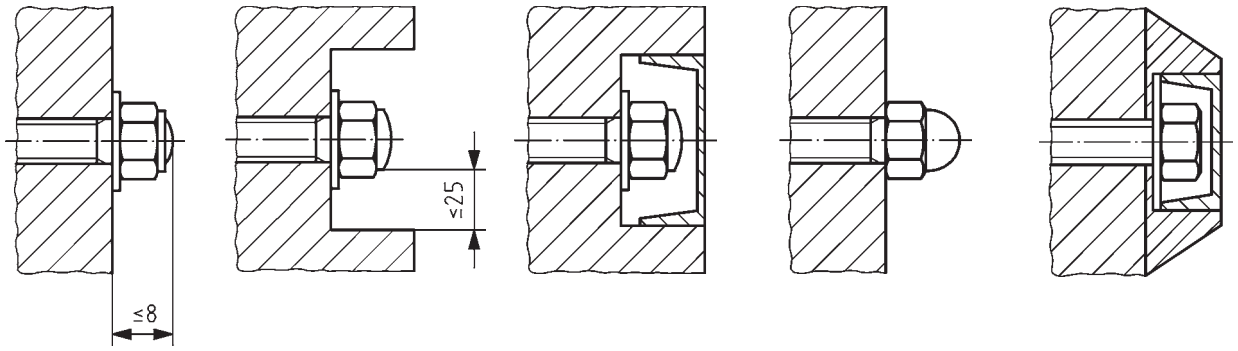


Figure 11 — Examples of protection for nuts and bolts

4.2.6 Moving parts

There shall be no crushing points or shearing points between moving and/or stationary parts of the equipment, in accordance with 4.2.7.

Parts from which a high impact force can emanate should have an attenuating construction.

If moving parts of the equipment can endanger the body, there shall be a ground clearance of at least 400 mm.

4.2.7 Protection against entrapment

4.2.7.1 General

When choosing materials, the manufacturer should take into account the entrapment hazards that can occur through distortion of materials during use.

NOTE 1 Test methods for entrapment are given in Annex D.

NOTE 2 Possible entrapment situations are illustrated in Annex E.

Openings shall have no parts that converge in the downward direction at an angle of less than 60° taking into consideration the following conditions (4.2.7.2).

4.2.7.2 Entrapment of the head and neck

Equipment shall be constructed so that any openings do not create head and neck entrapment hazards either by head first or feet first passage.

Hazardous situations in which this type of entrapment can be encountered include the following:

— completely bound openings through which a user can slide feet first or head first;

— partially bound or V-shaped openings;

— other openings (e.g. shearing or moving openings).

a) **Completely bound openings:**

Accessible completely bound openings with a lower edge more than 600 mm above the playing surface (see 3.5) shall be tested in accordance with D.2.1.

Probes C or E shall not pass through any opening unless it also allows the passage of the large head probe D.

NOTE 1 Probe C represents a 'feet first' passage to an opening and probe E represents a 'head first' passage.

b) **Partially bound and V-shaped openings:**

Partially bound and V-shaped openings with an entrance at 600 mm or more above the ground shall be constructed so that either:

1) opening is not accessible when tested in accordance with D.2.2; or

2) if accessible at a position of 600 mm or more above ground when tested in accordance with D.2.2, depending on the angular orientation range of the opening (see Figure D.4), shall conform to the following:

— Range 1: (template centre line ± 45° from vertical); when the template apex contacts the base of the opening, the depth of the opening shall be less than the length of the template to the underside of the shoulder section.

— Range 2: (template centre line from horizontal to + 45°); when the template apex contacts the base of the opening, the depth of the opening shall be less than the 'A' portion of the template. If the depth of the opening is greater than the 'A' portion of the template all parts of the opening above the 'A' portion shall also allow insertion of the shoulder section of the template or probe D.

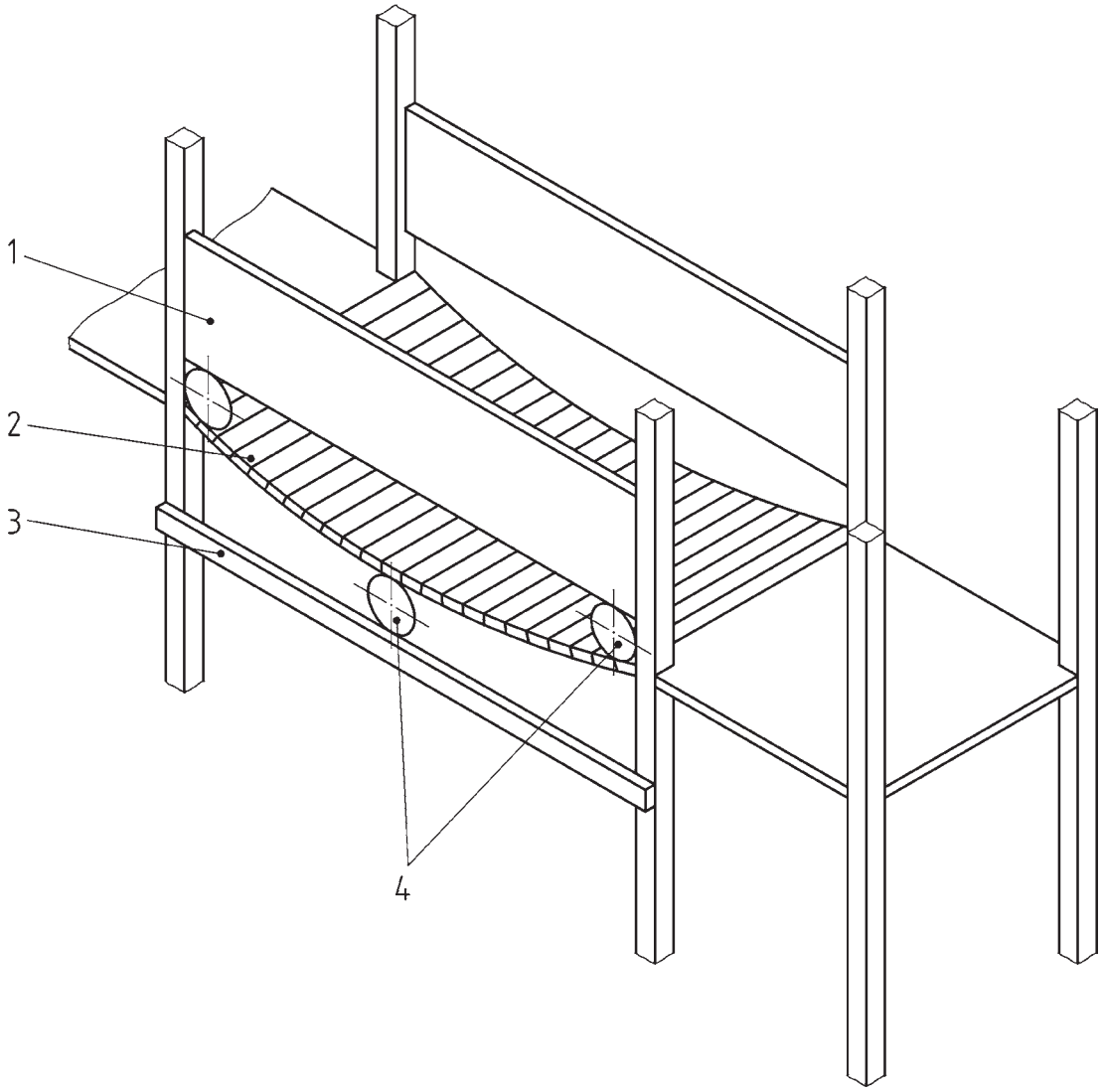
— Range 3: No template test requirements.

c) **Other openings (e.g. shearing or moving openings):**

Non-rigid members (for example ropes) shall not overlap if, by doing so, they create openings that do not conform to the requirements for completely bound openings.

Openings between the flexible parts of suspended bridges and any rigid side members shall be not less than 230 mm in diameter under the worst case condition of loading (see 4.2.2). Both loaded and unloaded situations shall be considered.

NOTE 2 This requirement relates to the potential change in dimensions as a result of the stretching of bridge flexible supports (e.g. wire) over time. A typical suspended bridge is illustrated in Figure 12.



Key

1 rigid side members
2 suspended bridge
3 rigid side members
4 diameter 230 mm minimum

Figure 12 — Suspended bridge

4.2.7.3 Entrapment of clothing/hair

Equipment should be constructed so that hazardous situations including the following, in which clothing entrapment can be encountered, are not created:

a) gaps or V-shaped openings in which a part of clothing can become trapped while or immediately before the user is undergoing a forced movement;

b) protrusions; and

c) spindles/rotating parts.

NOTE 1 The toggle test (see D.3) is restricted to the free space as practical experience has shown that natural materials and connections between different parts can vary over time. The definition of free space (see 3.5) does not include the three-dimensional area in which the falling movement takes place.

Special consideration should be given when using elements of circular cross-section, e.g. round tubes or poles, to avoid clothing entanglement within the falling space.

NOTE 2 This can be achieved by use of spacers or similar devices.

Slides and fireman's poles shall be constructed so that openings located within the free space do not trap the toggle when tested in accordance with D.3.

Roofs shall be constructed so that they do not trap the toggle when tested in accordance with D.3.

Spindles and rotating parts shall be constructed so as to prevent entanglement of clothing or hair.

NOTE 3 This can be achieved by use of suitable covering or shields.

4.2.7.4 Entrapment of the whole body

Equipment should be constructed so that the following hazardous situations, which might cause entrapment, are not created:

a) tunnels into which children can crawl with their whole body; and

b) suspended parts which are heavy or have rigid suspension.

Tunnels shall have a maximum length of 10 000 mm and conform to the requirements given in Table 1.

Table 1 — Requirements for tunnels

Dimensions in millimetres

Requirements	Open one end	Open both ends			
Inclination	≤ 5° and upwards only when entering	≤ 15°			> 15°
Minimum internal dimension [a]	≥ 750	≥ 400	≥ 500	≥ 750	≥ 750
Length	≤ 2 000	≤ 1 000	≤ 2 000	≤ 10 000	≤ 10 000
Other requirements	None	None	None	None	Provision for climbing e.g. steps or handles
NOTE For tunnel slides, see EN 1176–3.					
[a] Measured at the narrowest point.					

4.2.7.5 Entrapment of the foot or leg

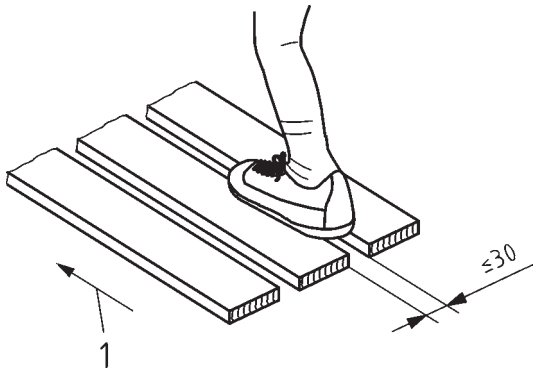
Equipment should be constructed so that the following hazardous situations, which might cause entrapment, are not created:

a) completely bound rigid openings in surfaces on which children can run or climb; and

b) footholds, handholds, etc. extending from these surfaces.

NOTE In the case of b) the entrapped foot or ankle can be severely injured if the user falls.

Dimensions in millimetres



Key

1 direction of travel

Figure 13 — Measurement of gaps limited to 30 mm

Surfaces intended for running/walking shall not contain gaps likely to cause foot or leg entrapment. Gaps in the main direction of travel shall not be greater than 30 mm when measured across the direction of travel (see Figure 13).

This requirement does not apply to surfaces inclined more than 38° from the horizontal.

4.2.7.6 Entrapment of fingers

Equipment should be constructed so that the following hazardous situations, which may cause entrapment, are not created:

a) gaps in which fingers can be trapped whilst the remainder of the body is moving or continues in forced movement, for example sliding, swinging; and

b) variable gaps (excluding chains).

Openings within the free space, where the user is subjected to forced movement, and/or holes which have a lower edge more than 1 000 mm above the potential impact area, when tested in accordance with D.4, shall conform to one of the following requirements:

NOTE 1 Openings include tubes and pipes.

c) the 8 mm finger rod (see Figure D.10a)) shall not pass through the minimum cross-section of the opening and the profile of the opening shall be such that the rod cannot be locked in any position when set in motion as given in D.4.2; or

d) if the 8 mm finger rod passes through the opening, the 25 mm finger rod (see Figure D.10b)) shall also pass through the opening, provided that the opening does not permit access to another finger entrapment site.

NOTE 2 Only to be used where there is a potential fall to an impact area below. See also adjacent platforms (4.2.8.5.4).

NOTE 3 The test process D.4.2 for finger entrapment will only be conducted with the presence of free space and/or falling space.

The ends of tubes and pipes shall be closed off to prevent the risk of finger entrapment.

The closures shall not be removable without using tools.

Gaps whose dimensions change during use of the equipment shall have a minimum dimension in any position of 12 mm.

Splits in single pieces of wood shall not be considered as finger entrapment where the gap diminishes towards the centre of the wooden part.

4.2.8 Protection against injuries during movement and falling

4.2.8.1 Determination of free height of fall

Unless stated otherwise, determination of free height of fall shall be as given in Table 2. In determining the free height of fall, the possible movements of the equipment and of the user shall be taken into account. In general, this means that the maximum movement of the equipment shall be taken.

In the case of roofs, or other features not intended for play, it is not required for them to be included in the free height of fall where access has not been encouraged.

EXAMPLE Some examples of features that could encourage access are:

— play feature, which can be accessed from the roof;

— hand and foot holds for climbing;

— arm or leg reach distance;

— inclination of the roof;

— roughness of the roof surface.

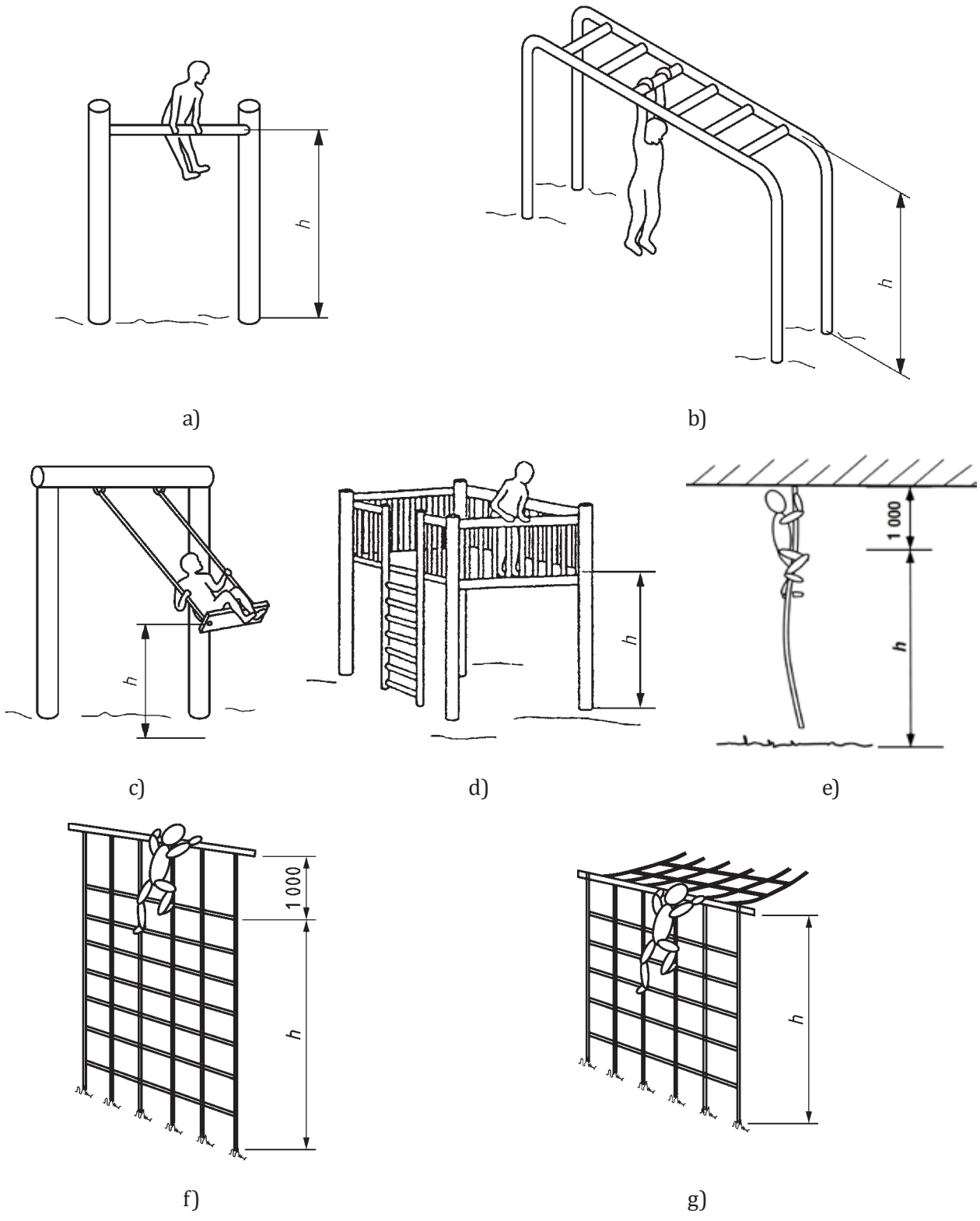
The free height of fall (h) shall not exceed 3 000 mm (see Figure 14).

For the determination of free height of fall, see Table 2.

Table 2 — Free height of fall for different types of use

Type of use	Vertical distance
Standing	From foot support to surface below
Sitting	From seat to surface below
Hanging [a] (When full body support is provided by the hands only and the whole body can be lifted up to the hand support)	From hand support height to surface below
Climbing [a] (When body support is a combination of feet/legs and hands, e.g. climbing ropes or sliding/climbing poles)	Maximum hand support: 4 000 mm to the surface below (free height of fall measured from maximum hand support minus 1 000 mm to the surface below)
Bouncing	From suspension bed to the lowest point of falling space plus 900 mm
[a] Such equipment constructed for use as 'climbing' or 'hanging' shall not encourage access to positions for full body support with a free height of fall of more than 3 000 mm e.g. horizontal net (climbing), horizontal ladder intended for arm walking (hanging).	

Dimensions in millimetres



Key

h free height of fall

Figure 14 — Examples showing free height of fall

4.2.8.2 Determination of spaces and areas

4.2.8.2.1 General

The requirements for falling space and impact area within this standard are intended to offer some protection to users during the first impact of a potential fall. These spaces and areas will also afford some protection to other users who might be circulating around the equipment items, but these requirements should be considered in addition to this standard as they are likely to be site specific and may be subject to national control. In particular the attention of the play area designer is directed to possible hazards associated with the close proximity of play structures intended for users of greatly different age groups and those in highly populated play areas such as those found in some schools.

Care should be taken with seated dynamic equipment with significant motion, e.g. swings and certain types of rocking equipment, to discourage users of the surrounding play area from unintentionally coming into contact with the equipment. This can be achieved, for example, by placing the equipment at the perimeter of the play area.

4.2.8.2.2 Minimum space

The minimum space shall consist of the following:

a) space occupied by the equipment;

b) free space, if any; and

c) falling space.

4.2.8.2.3 Free space

The free space is a series of cylindrical spaces representing the user (see Figure 15), originating from and perpendicular to the body bearing surface, along the forced path of the user.

The cylindrical space is shown in Figure 16 and its dimensions are given in Table 3. In determining the free space, the possible movements of the equipment and the user shall be taken into account.

Fireman's poles that are accessed via a platform or other starting point shall have a clearance of at least 350 mm from the pole to the edge of the adjacent structure.

NOTE 1 This is to allow safe grabbing of the pole while reducing the risk of head impact on the adjacent structure.

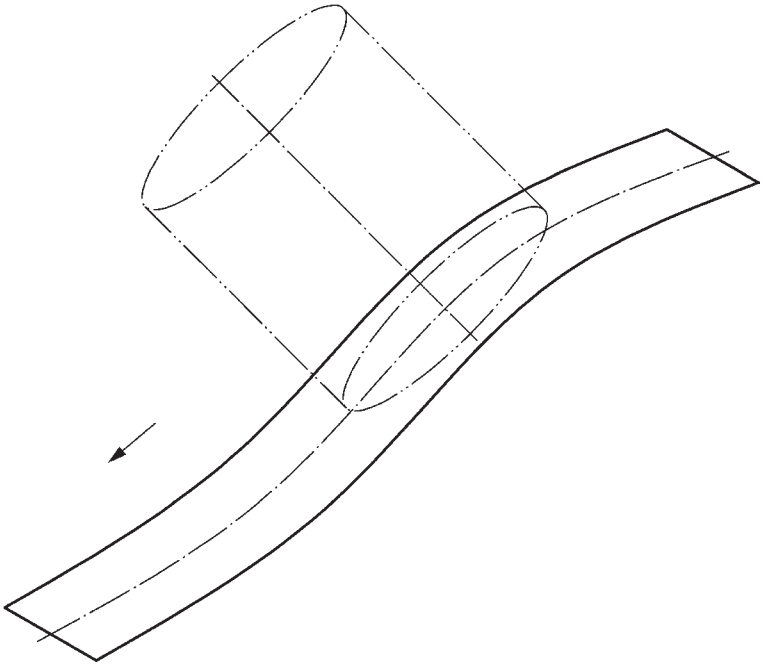
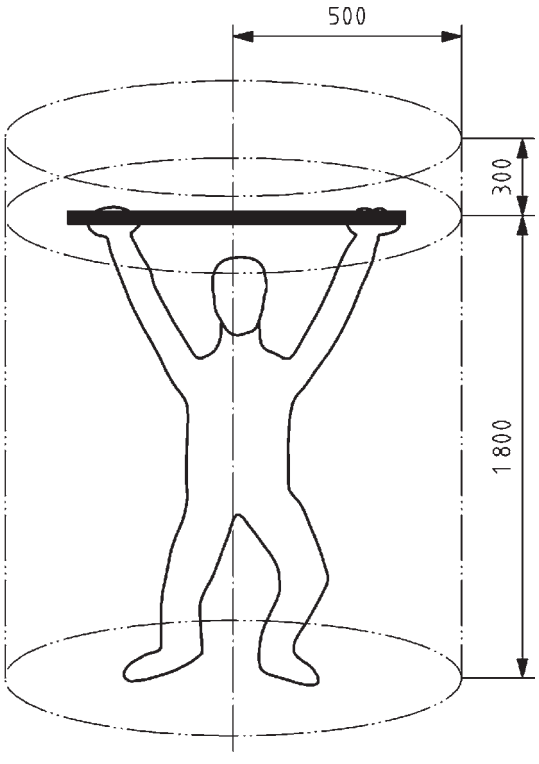
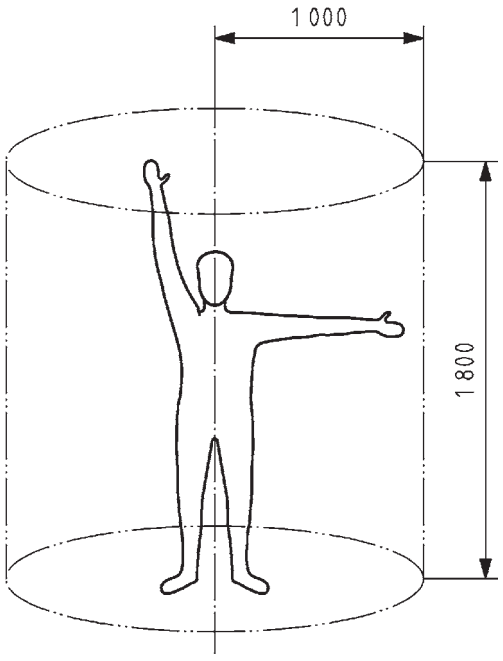


Figure 15 — Determination of the free space; example of a slide

Dimensions in millimetres



a) Hanging user



b) Standing user

Figure 16 — Cylindrical space

Table 3 — Dimensions of the cylinder for the determination of the free space

Dimensions in millimetres

Type of use	Radius	Height
Standing	1 000	1 800
Sitting	1 000	1 500
Hanging	500	300 above and 1 800 below hanging grip position
NOTE In case of hanging, h = 300 mm because of the possibility that the users pull themselves up [see Figure 16a)].		

NOTE 2 In certain cases, the dimensions of the free space can be altered. In some cases, these will be given in the parts of this standard covering individual types of equipment.

4.2.8.2.4 Extent of the impact area

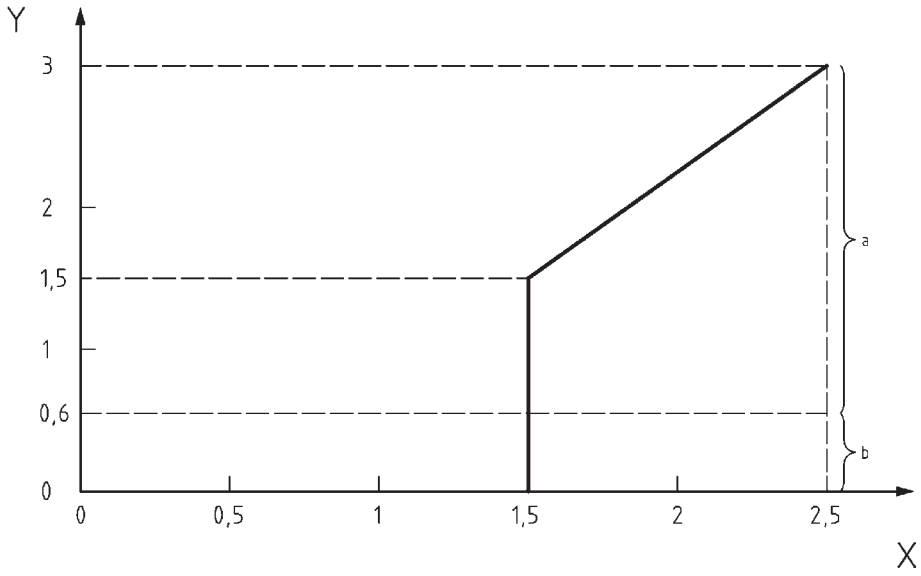
Dimensions of the impact area are shown in Figure 17.

In certain cases, such as a carousel giving the user a horizontal speed, the impact area may be extended to provide adequate protection against falling injuries.

In determining the impact area, the possible movements of the equipment and the user shall be taken into account.

NOTE These cases are also covered in the parts of this standard covering individual types of equipment.

Dimensions in metres



Key

Y free height of fall

X minimum dimension of impact area

a impact attenuating surfacing with requirements (4.2.8.5.2)

b surface with no impact attenuation test requirements, unless there is forced movement (4.2.8.5.3)

Figure 17 — Extent of the impact area

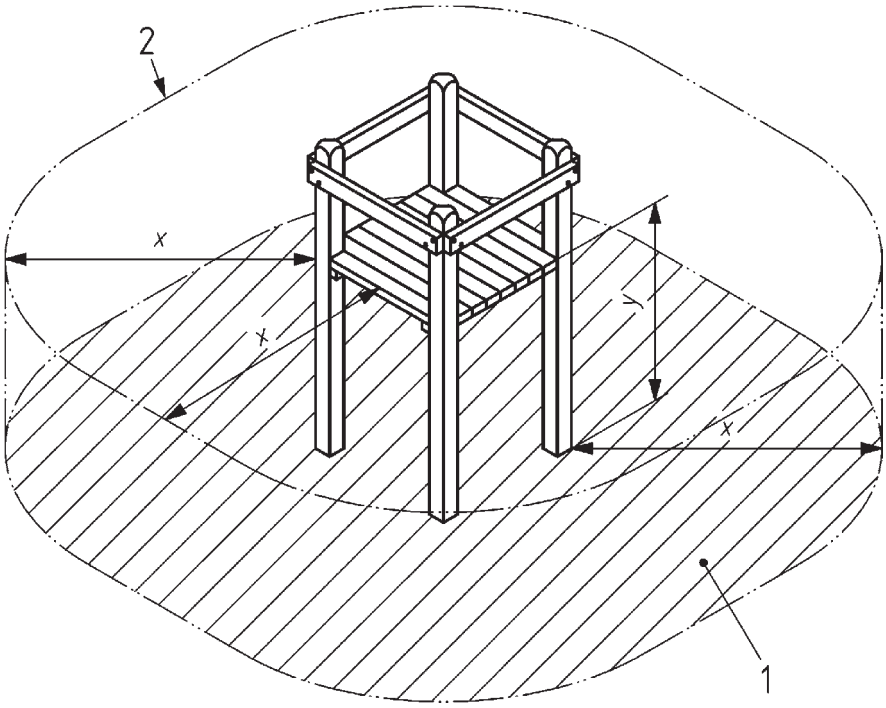
4.2.8.2.5 Extent of the falling space

Unless otherwise specified, the extent of the falling space shall be at least 1 500 mm around elevated parts of the equipment, measured horizontally and extending from the vertical projection plane below the equipment.

The falling space shall increase for free heights of fall above 1 500 mm together with the extent of the impact area (see 4.2.8.2.4). This requirement can be varied in certain cases, e.g. increased, in the case of forced movement or reduced, in the case of equipment installed on or against a wall or fully enclosed equipment.

In most cases there may be overlapping of falling spaces including impact areas. Unless specified in other parts of this standard, overlapping of the falling space where forced movement exists should not occur. Where two items with different fall heights are sited together the larger of the two impact areas will take precedence.

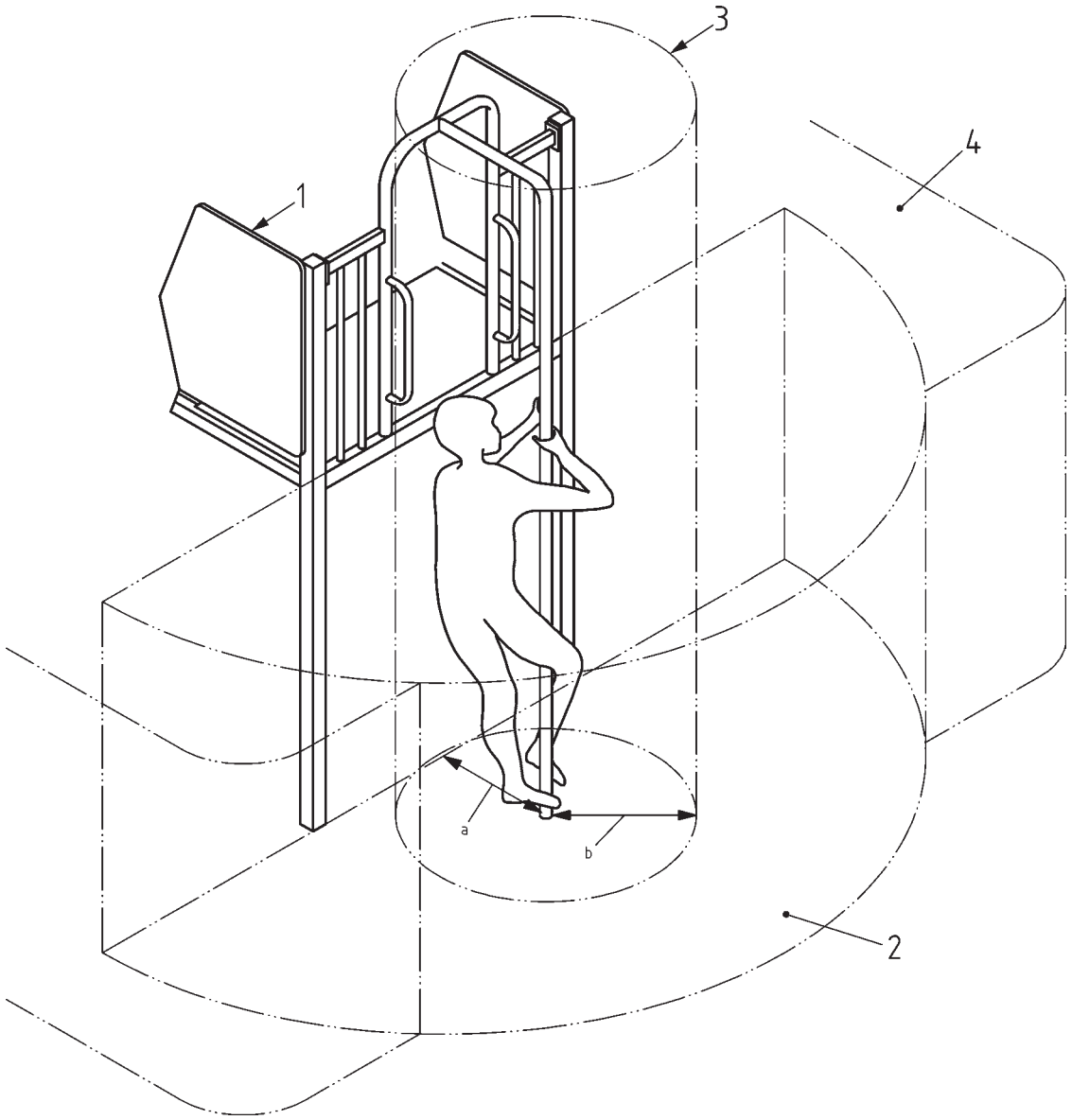
Examples of falling space are given in Figures 18 and 19.



Key

1 impact area
2 falling space
x extent of falling space
y height of falling space

Figure 18 — Example of falling space and impact area of a platform



Key

1 space occupied by the equipment
2 falling space of the fireman's pole
3 free space of the fireman's pole
4 falling space of platform
a fireman's pole minimum clearance (see 4.2.8.3)
b free space radius (see 4.2.8.2.3)

Figure 19 — Example of falling space and free space of a fireman's pole

4.2.8.3 Protection against injuries in the free space for users undergoing a movement that is forced by the equipment

Unless stated otherwise, there shall be no overlapping of adjacent free spaces, or of free space and falling space of two different pieces of equipment.

NOTE 1 This requirement does not apply to the common space between pieces of equipment in a cluster.

The free space shall not contain any obstacles that interfere with the passage of a user whilst undergoing a forced movement e.g. tree branches, ropes, cross beams etc. Parts of the equipment bearing or containing the user, or helping the user to keep balance, shall be permitted within the free space, e.g. a platform with a fireman's pole (see 4.2.8.2.3).

NOTE 2 Exceptions to this requirement are given in the parts of this standard covering individual types of equipment.

The free space shall not be intersected by main travelling routes at, or through, the playground (e.g. pedestrian pathway).

4.2.8.4 Protection against injuries in the falling space

The falling space shall not contain any obstacles onto which a user could fall and cause injuries, e.g. posts not flush with adjacent parts or exposed foundations (see 4.2.14).

NOTE 1 The intention of this requirement is not to protect the user from minor knocks or bumps, that might lead to a bruise or sprain etc., as these types of injuries are possible in all situations.

The following parts of play structures may be in the falling space:

— adjacent parts of play structures with a difference in free height of fall of less than 600 mm;

— parts of the equipment bearing or containing the user, or helping the user to keep balance;

— parts of the equipment with an inclination of 60° or more from the horizontal.

NOTE 2 In this case a falling user would only make a glancing contact with the equipment part.

4.2.8.5 Protection against injuries from the surface of the impact area

4.2.8.5.1 General

The surface of the impact area shall be free from sharp edged parts or projections and shall be installed without creating any entrapment situation (see 4.2.7).

If loose particulate material is used it shall be installed to a layer thickness of 100 mm more than that determined in Table 4 or by testing to EN 1177.

NOTE This is to allow for displacement of loose particulate material through use.

4.2.8.5.2 Equipment with a free height of fall greater than 600 mm or with forced movement

Beneath all playground equipment with a free height of fall of more than 600 mm and/or equipment causing a forced movement on the body of the user (e.g. swings, slides, rocking equipment, cableways, carousels, etc.), there shall be impact attenuating surfacing over the entire impact area.

NOTE 1 Specific requirements for equipment causing a forced movement on the body of the user (e.g. swings, slides, rocking equipment etc.) are covered in other parts of EN 1176.

The critical fall height of the surfacing shall be equal to, or greater than, the free height of fall of the equipment.

Examples for commonly used impact attenuating materials are given in Table 4 with the related maximum free heights of fall, tested in accordance with EN 1177 and measured partly on site and partly in the laboratory with different test conditions. Where the installed surfacing can be verified as being in accordance with Table 4, no additional testing is required.

The extent of the impact area is given in 4.2.8.2.4.

NOTE 2 Turf as well as having aesthetic appeal also has some useful impact attenuating properties. Experience has shown that, if well maintained, it is normally effective for fall heights up to 1 m and can be used without the need to conduct a test. For fall heights above 1 m, the performance of turf as an impact attenuating surfacing is dependent upon local climatic conditions. Therefore, as there are significant regional variations in climate throughout Europe it is advised that guidelines are given at a national level. Turf/topsoil is not intended to be tested in accordance with EN 1177.

NOTE 3 Impact attenuating materials are tested under specific conditions; therefore the performance of these materials can vary in use (e.g. materials under frozen conditions, rain or extreme heat) – see 6.2 of this standard.

Impact attenuating materials should be adequately maintained. Failure to maintain such surfaces will result in the impact attenuation being significantly reduced.

Table 4 — Examples of commonly used impact attenuating materials, depths and corresponding maximum free heights of fall

Material [a]	Description	Minimum depth [b]	Maximum free heights of fall
Where the installed surfacing is verified (e.g. sieve test) as being in accordance with this table or carries a test report according to EN 1177, no additional testing is required	mm	mm	mm
Turf/topsoil	—	—	≤ 1 000 [d]
Bark	20 to 80 particle size	200	≤ 2 000
		300	≤ 3 000
Woodchip	5 to 30 particle size	200	≤ 2 000
		300	≤ 3 000
Sand or gravel [c]	0,25 to 8 grain size	200	≤ 2 000
		300	≤ 3 000
Other materials and other depths	As tested according to EN 1177		Critical fall height as tested

[a] For further information on specific material properly prepared for use in children's playgrounds see CEN/TR 16598 (Collection of Rationales for EN 1176–1 requirements).

[b] For loose particulate material, add 100 mm to the minimum depth to compensate for displacement (see 4.2.8.5.1).

[c] Sand and gravel shall be well rounded and washed to eliminate most of the silt or clay particles. Washed sand or gravel is considered to be from alluvial (naturally eroded) deposits and free from most silt or clay particles. For gravel this may commonly be described as 'pea shingle'. Uniformity coefficient D60/D10 < 3,0. Grain size can be identified by use of a sieve test, as in EN 933–1 (see Annex G).

[d] See NOTE 2 in 4.2.8.5.2.

NOTE 4 Loose fill material specifications in Table 4 are examples that can be accepted without further testing in accordance with EN 1177.

4.2.8.5.3 Equipment with a free height of fall not exceeding 600 mm and without forced movement

It is not necessary to test the critical fall height of a surface beneath playground equipment having a free fall height of less than 600 mm and which does not cause forced movement on the body of the user.

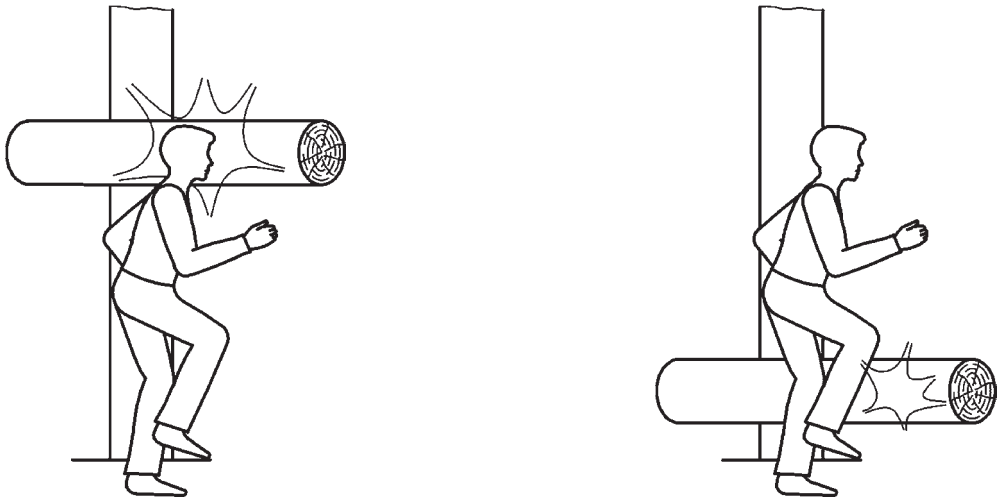
4.2.8.5.4 Adjacent platforms

If the free height of fall between adjacent platforms is more than 1 m, the surface of the lower platform shall present the necessary impact attenuating properties.

4.2.8.6 Protection against injuries due to other types of movement

The space in, on or around the equipment that can be occupied by the user shall not contain any obstacles that the user is not likely to expect and which could cause injuries if hit by the user.

NOTE Examples of such obstacles are shown in Figure 20.



a) **b)**

Figure 20 — Unexpected obstacles

4.2.9 Means of access

4.2.9.1 Ladders

The spacing of the rungs or steps shall conform to the head entrapment requirements given in 4.2.7.2.

Rungs and steps shall be non-rotating and equally spaced.

Equal spacing is required only between the rungs. It is not required between the highest rung and the platform or the ground and the first rung. The requirement for equal spacing does not apply to rope ladders.

NOTE To assist the safe transfer from the ladder to the platform or its summit, the stiles of the ladder without the rungs or steps can continue vertically from the platform to the top of the barrier.

Wooden components shall have positive connections that cannot be undone or shifted. Nails or wood screws shall not be used as the only form of connection.

To allow for the foot to rest correctly on the rung or step there shall be an unobstructed space at the rear of the ladder of at least 90 mm from the centre of the rung or tread measured at 90° to the ladder.

Rungs and steps shall be horizontal to within ± 3°.

Ladders shall have rungs and/or stiles or shall have handrails that conform to the requirements for grip according to 4.2.4.6 or for grasp according to 4.2.4.7.

4.2.9.2 Stairs

Stairs with a free height of fall greater than 600 mm shall conform to the requirements of 4.2.4 concerning protection against falling. Guardrails and/or barriers shall be provided from the first step and shall conform to the requirements for grasp (4.2.4.7) or a handrail shall be provided.

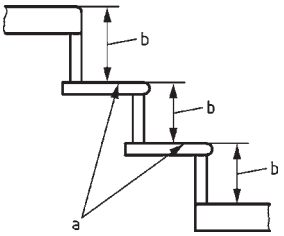
NOTE 1 This is to ensure that hand support is available for the entire run of the stair.

For stairs leading to platforms up to 1 000 mm in height a guardrail may replace the barrier, providing the gap beneath the guardrail is less than 600 mm when measured from the middle of the tread.

NOTE 2 For platforms above 1 000 mm, a combination of guardrails and barriers is allowed.

NOTE 3 A panel type barrier with a thickness of less than 60 mm is considered in compliance with grasp requirements.

The inclination of stairs shall be constant. Openings shall conform to the entrapment requirements given in 4.2.7.2. The treads shall be spaced equally, shall be of uniform construction, and shall be horizontal within ± 3°.



Key

a stair tread

b stair riser

NOTE The risers are not required to be infilled.

Figure 21 — Parts of a stair

To provide adequate space for standing, the minimum projection of tread shall be 140 mm and the minimum depth of tread shall be 110 mm (see Figure 22).

Dimensions in millimetres

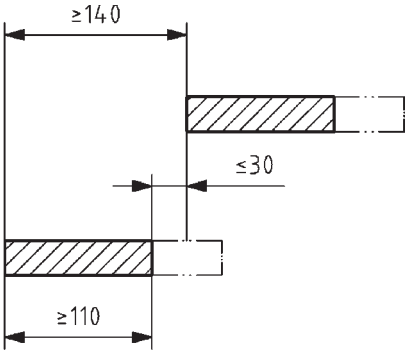


Figure 22 — Minimum projection and depth of tread

Where the overall height of the set of stairs is more than 2 000 mm above ground level, intermediate landings shall be provided at height intervals not exceeding 2 000 mm. Intermediate landings shall be at least as wide as the set of stairs and at least 1 000 mm long.

4.2.9.3 Ramps

Ramps shall be inclined at an angle of up to 38° to the horizontal and shall be of a constant angle.

NOTE 1 Surfaces with a greater inclination are not regarded as ramps but can be used as a means of access.

Ramps shall conform to the requirements of 4.2.4.

For ramps leading to platforms up to 1 m in height a guardrail may replace the barrier, providing the gap beneath the guardrail is less than 600 mm. If guardrails are used, they shall be provided from the beginning of the ramp.

Ramps shall be level within ± 3° across their width. To reduce the risk of slipping, ramps expected to be used by all children shall include means to improve the grip of the foot.

NOTE 2 This can be achieved by use of suitable foot holds.

4.2.9.4 Steep play elements

For steep play elements provided on easily accessible parts of equipment the opening in the barrier shall be 500 mm maximum and the free height of fall of the platform shall be 2 000 mm maximum.

NOTE This is to help the carer reach up to the user if necessary.

Openings leading from a platform with a free height of fall of > 1 000 mm to a steep play element shall have hand supports that comply with grasp requirements.

4.2.9.5 Easily accessible playground equipment

Equipment designed to allow users to move quickly and freely onto it is to be considered as easily accessible.

It is not the intention of this standard to give a definitive list of the types of possible access and associated requirements, but to provide guidance on the best way to tackle the issue of easy access.

The following is an example of the hierarchy of three easy access possibilities:

a) Ramps starting from the ground are the easiest means of access to the equipment.

b) Stairs are the next easiest means of access to the equipment.

c) Ladders are the least easy means of access to equipment in this example.

There are many designs which can delay access to the equipment, thus giving more time for carers to intervene as appropriate. Such design features may include, but are not restricted to, movement, height or dimensional requirements e.g. reach distance or step height.

NOTE 1 Carers include adults, responsible siblings and others who are looking after the user (see CEN/CLC Guide 14 for more information on carers).

NOTE 2 Examples of access restriction by height or dimension might include but are not limited to ramps where the start is more than 600 mm above the ground or ladders where the lowest rung is more than 400 mm above the ground. The figure of 400 mm is a compromise between the need to limit access and the need to provide a safe means of exit by the same route.

4.2.10 Connections

Connections shall be secured such that they cannot come loose of their own accord unless specifically designed to do so.

Connections shall be safeguarded so that they cannot be undone without tools.

4.2.11 Consumable components

Replaceable components should be protected against unauthorized intervention and should require little maintenance. Any lubricants leaking out should not soil the equipment or adversely affect its safe use.

4.2.12 Ropes

4.2.12.1 Ropes fixed at one end

For suspended ropes between 1 m and 2 m in length, the distance between ropes fixed at one end and fixed equipment shall be not less than 600 mm and the distance between ropes fixed at one end and swinging equipment shall be not less than 900 mm.

Ropes fixed at one end shall not be combined with swings in the same bay (see EN 1176-2).

For suspended ropes of between 2 m and 4 m in length, the distance between ropes fixed at one end and other parts of equipment shall be not less than 1 m.

The rope diameter shall be between 25 mm and 45 mm.

NOTE A stiffer rope, depending on its diameter and construction, will make it more difficult to create a loop, thus reducing the risk of strangulation. However, it will still allow good grip.

4.2.12.2 Ropes fixed at both ends (climbing ropes)

For a rope fixed at both ends, typically for climbing up and not part of a larger net structure, it shall not be possible to make a loop in the rope that is wide enough to let probe C pass through (see Figure D.1) nor probe E (see Figure D.1) pass through.

NOTE 1 This requirement is intended to remove the risk of strangulation.

The rope diameter shall meet the grip requirements given in 4.2.4.6.

NOTE 2 Ropes with sufficient roughness allow for a good grip. This can be achieved, for example, by using outer strands with a diameter of at least 6 mm.

When a rope fixed at both ends is used in conjunction with another element, care shall be taken not to create entrapment situations, see 4.2.7.2.

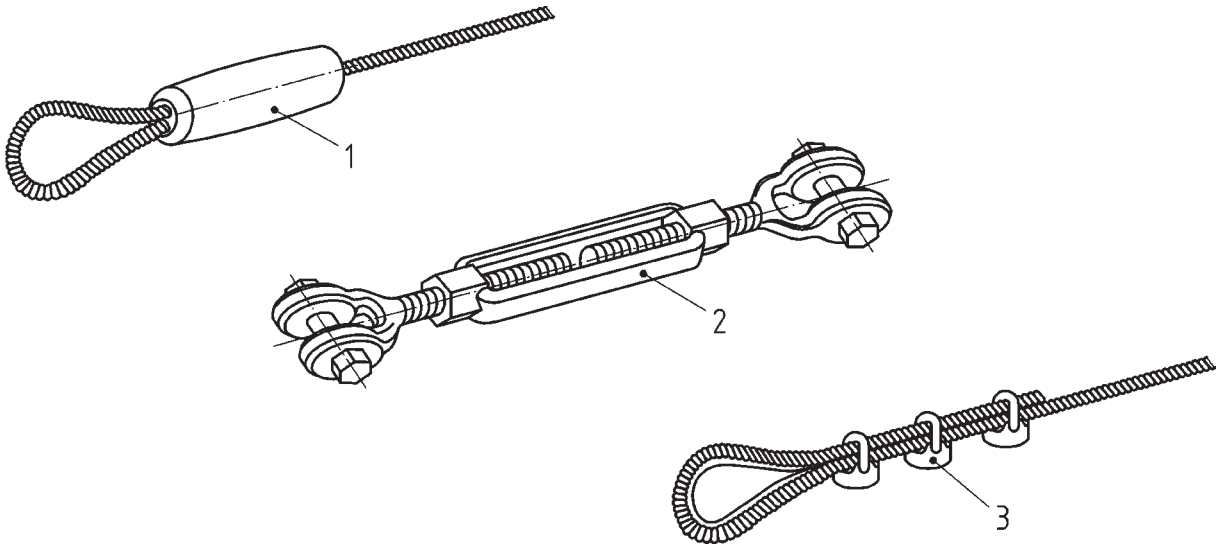
4.2.12.3 Wire ropes

Wire ropes shall be unstressed and shall be made from galvanized or corrosion-resistant wire.

Ferrules shall conform to EN 13411-3 and the rope end shall coincide with the edge of the grip.

Wire rope grips shall be utilized in accordance with EN 13411-5. If accessible and the thread ends protrude more than 8 mm, they shall only be used outside the minimum space or shall be covered by suitable means.

The ends of the turnbuckles shall be closed (see Figure 23) and shall be made from corrosion-resistant material. It shall not be possible to undo turnbuckles without a tool.



Key

1 ferrule
2 turnbuckle
3 wire rope grips

Figure 23 — Example of ferrules, turnbuckles and wire rope grips

4.2.12.4 Sheathed wire ropes

When sheathed wire ropes are used for climbing ropes, climbing nets, hanging ropes and the like, each strand shall be sheathed with yarn made from synthetic or natural fibres. The sheath shall not contain monofilament.

NOTE The wires inside the strands make it more difficult for the ropes to be intentionally damaged and thus reduce any hazards.

4.2.12.5 Fibre ropes (textile type)

Fibre ropes shall either:

a) conform to EN ISO 9554 or EN ISO 2307; or

b) the manufacturer shall supply a work certificate stating the material used and the safe working load.

In the case of climbing ropes, climbing nets, hanging ropes and the like, the strands shall have a soft and non-slip covering, e.g. hemp or equivalent material.

Monofilament plastic ropes or ropes made from similar materials shall not be used.

4.2.13 Chains

Chains for playground equipment shall conform to the dimensional requirements in EN 818-2:1996+A1:2008, Table 2 or EN 818-3:1999+A1:2008, Table 2 as a minimum and, when tested in accordance with D.5, shall conform to one of the following requirements:

a) the 8,6 mm rod (see Figure D.13) shall not pass through the minimum cross-section of the chain opening,

NOTE When "8-mm-short-link-chains" wear, the openings can increase. If the opening on a worn chain is greater than 8,6 mm, a risk assessment can be carried out to confirm whether replacement is necessary.

or where a connection is made

b) if the 8,6 mm finger rod passes through the opening, the 12 mm rod (see Figure D.13) shall also pass through the opening.

4.2.14 Foundations

The foundations shall be designed such that they do not present a hazard (tripping, impact). In loose fill surfacing (e.g. sand), foundations shall be installed or laid in accordance with one of the following:

a) so that pedestals, footings and fixing elements on the equipment are at least 400 mm below the playing surface or;

NOTE 1 Post shoes are not considered foundations.

b) if the tops of the foundations are as shown in Figure 24 at least 200 mm below the surfacing; or

c) so that they are covered by items of equipment or equipment parts (e.g. central foundation of a roundabout).

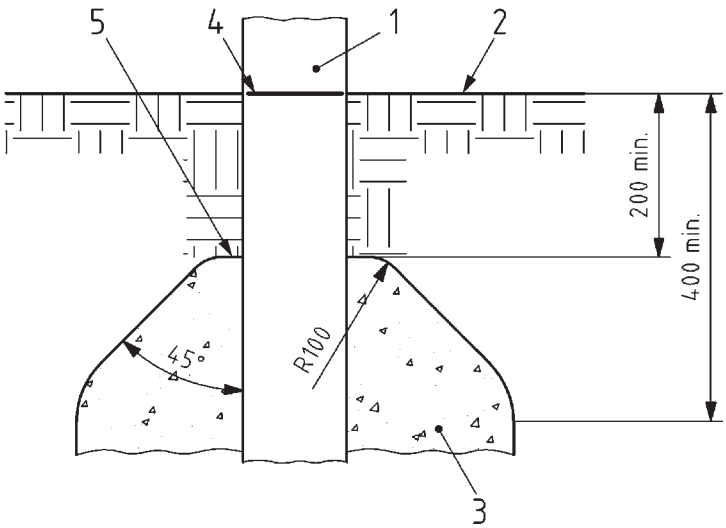
Any parts that protrude from the foundations such as the ends of screws shall be at least 400 mm below the playing surface unless they are effectively covered and finished as described in 4.2.5.

Additional measures should be taken for equipment in which the stability depends on only one cross-section. Foundations of one post equipment shall be accessible for periodic inspection.

The choice and installation of impact attenuating surfacing should be carefully planned in order to allow for inspections and if access to the foundations is required. For example, for synthetic surfacing, this may require the surfacing to be cut-back and re-laid.

NOTE 2 When components are embedded in concrete there is a risk of corrosion or rotting. The high rate of corrosion or rotting under dynamic loading endangers the stability of the anchorage of units in which the stability depends on only one cross-section, or in which the stability is provided by two-legged members or rows of members.

Dimensions in millimetres



Key

1 post
2 playing surface
3 foundation
4 basic level mark
5 top of foundation

NOTE The basic level mark given by the manufacturer on the equipment shows the level of the playing surface. It is advised to maintain this basic level.

Figure 24 — Example of foundations

4.2.15 Heavy suspended rigid beams

Rigid suspended beams are deemed heavy when they have a mass of 25 kg or more.

There shall be a ground clearance of at least 400 mm underneath heavy suspended rigid beams, (see Figure 25).

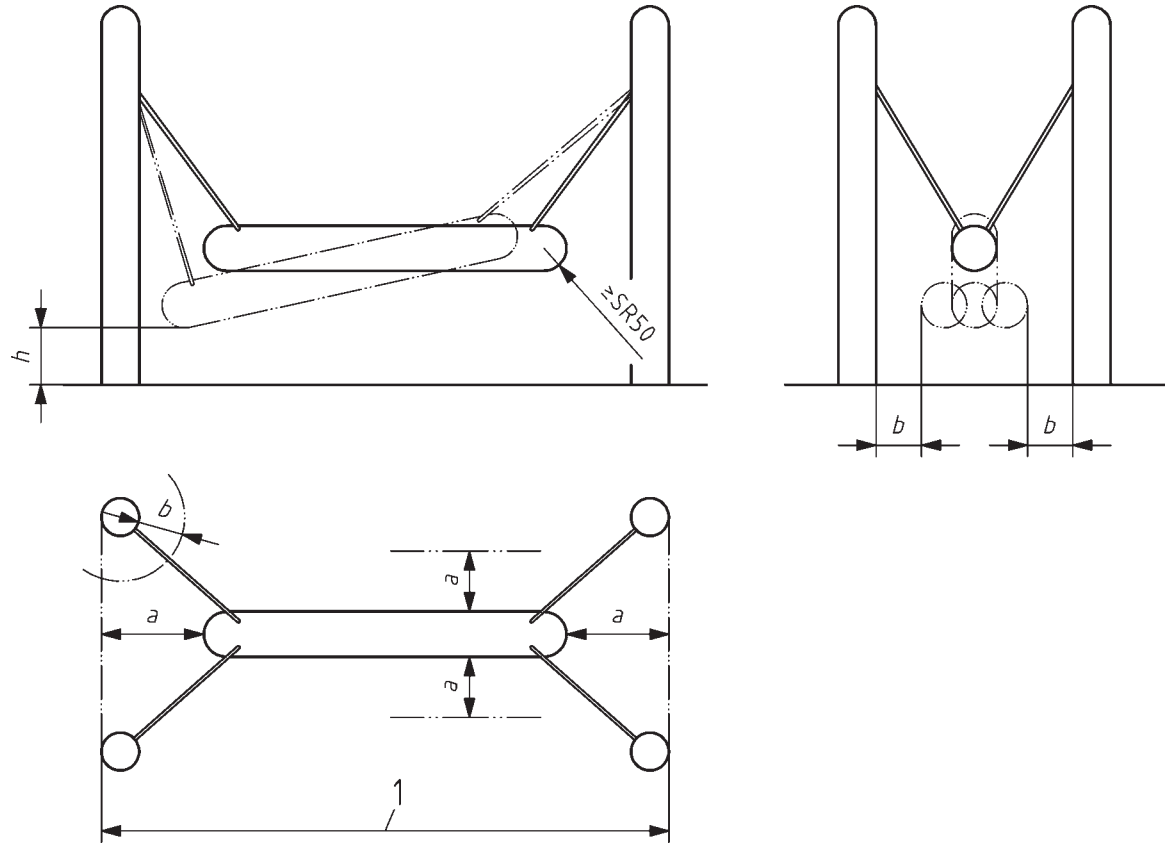
The ground clearance is measured as the distance between the lowest point of the lower edge of the heavy suspended rigid beam and the surface below.

The heavy suspended rigid beam shall be so constructed that all changes in the profile of the beam shall have a radius of at least 50 mm.

The range of movement (*a* in Figure 25) shall not exceed 300 mm and shall not go beyond the support posts.

The distance between the support posts and the heavy suspended rigid beam (*b*) shall not be less than 230 mm throughout its full range of movement.

Dimensions in millimetres



Key

a range of movement

b free space towards standing construction, ≥ 230 mm

h ground clearance

1 maximum deflection

Figure 25 — Example of a heavy suspended rigid beam

4.2.16 Bouncing facilities

4.2.16.1 General

A bouncing facility with a suspension bed smaller than 1,44 m^2 is considered as a small bouncing facility.

NOTE Bouncing facilities with a suspension bed ≥ 1,44 m^2 are considered as large bouncing facilities.

The extent of the falling space of a suspension bed of a small bouncing facility shall be 1 500 mm. The extent of the falling space of a suspension bed of a large bouncing facility shall be 2 000 mm. When a suspension bed gives a user a predetermined jumping direction to outside of the suspension bed, the extent of the impact area to that direction shall be at least 3 000 mm.

Unprotected edges within the falling space that the user can hit shall be rounded with at least 20 mm radius.

The maximum allowed height of any point of the suspension bed is 600 mm measured from the surrounding ground or platform of the playground equipment 1 500 mm away from that specific point (see Figure 26).

Dimensions in millimetres

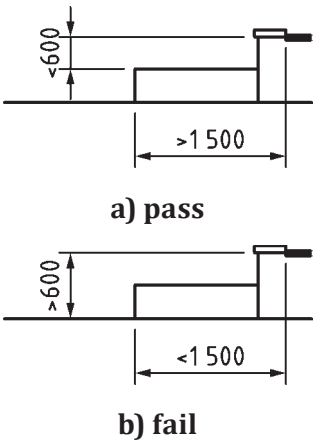


Figure 26 — Acceptable and not acceptable solutions due to height of the suspension bed

In case of failure of the suspension bed or its supports (spring, rubber band etc.) the user shall not fall more than 600 mm unless the impact area below has an adequate level of impact attenuation equivalent to the free height of fall of the suspension bed. There shall be no dangerous obstacles under or around the suspension bed, onto which a user could fall or otherwise be injured.

For a bouncing facility the extent of the free space shall be 1 500 mm measured horizontally from any point at the perimeter and 3 500 mm above the suspension bed.

During a physical weight test according to 4.2.2, the minimum ground clearance shall be ≥ 100 mm.

NOTE 1 This is to prevent unintended contact with the ground while jumping.

During a dynamic physical test according to D.6 the rebound effect of the bouncing facility shall not be more than 700 mm above the suspension bed.

NOTE 2 This is to prevent the user bouncing too high and reaching a falling height greater than the adequate level of impact attenuation of the adjacent surface.

Consideration shall be given to the design of the equipment and to the layout of the surrounding area in order to avoid jumping from surrounding installations (other than the enclosure) onto the suspension bed.

Suspension beds made out of textile shall maintain 80 % of their initial tensile strength according to EN ISO 13934-1 after exposure to light and UV, according to EN ISO 4892-3, for a minimum period of 400 h.

Large bouncing facilities shall have a sufficient ground clearance under the suspension bed. During the physical test according to 4.2.2, the clearance below the suspension bed shall remain greater than 230 mm. If this cannot be achieved, access under the suspension bed shall be prevented in a way that the test probe E cannot pass any opening leading under the suspension bed.

NOTE 3 This is to protect non-users from getting squeezed between the ground and the suspension bed.

Openings in the suspension bed shall not be greater than 30 mm measured in the smallest direction.

Under a static weight of 69,5 kg applied to the middle of the suspension bed, any opening shall not allow passage of the test probe E.

Access to the space under the suspension bed shall be provided for cleaning.

4.2.16.2 Enclosures of bouncing facilities

Where enclosures are provided, a risk assessment shall be made before allowing an enclosure for bouncing facilities in unsupervised settings. An enclosure, where climbing is not encouraged and with a minimum height of 1 800 mm, may be introduced to reduce the falling space or to prevent users from falling from the suspension bed. Sections of the enclosure above the height of 2 400 mm shall be unclimbable.

The enclosure shall withstand a horizontal force of (800 ± 50) N applied to the centre of each enclosure section.

Net yarns shall have a minimum diameter of 2 mm to reduce the risk of cutting fingers of users.

5 Verification of compliance and reports

5.1 General

Unless otherwise specified the requirements of Clause 4 shall be verified by measurement, visual examination or practical tests.

Before testing, the equipment shall be assembled in accordance with the manufacturer's instructions into a condition similar to its position of use.

Test reports shall include the following:

a) number and date of this European Standard, i.e. EN 1176-1:2017;

b) details of the equipment tested;

c) details of the condition of the equipment including any defects observed before the test;

d) details of any change in the condition of the equipment observed after the tests;

e) test result.

5.2 Confirming the adequate level of impact attenuation after installation of impact attenuating surfacing

As there are significant regional variations in the provision and management of impact attenuating surfacing, it is recommended that requirements are given at a national level. If no requirements are given at national level, Annex H shall be used as it gives requirements to confirm the adequate level of impact attenuation after installation of the impact attenuating surfacing.

NOTE This is to ensure that if Annex H is not followed, national requirements are given.

6 Information to be provided by the manufacturer/supplier

6.1 Information to be provided by the manufacturer/supplier of playground equipment

6.1.1 General product information

The manufacturer/supplier shall provide instructions in the appropriate language(s) of the country in which the equipment is to be installed and used. The instructions shall conform to the following:

a) instructions shall be printed legibly and in a simple form;

b) illustrations shall be used wherever possible; and

c) instructions shall include at least the following information:

   1) details of the installation, operation, inspection and maintenance of the equipment;

   2) clause or note drawing the operator's attention to the need to increase inspection/ maintenance if the equipment is subject to heavy use and/or the stability of the equipment relies on one post;

   3) advice to take care, in relation to specific hazards to children, due to incomplete installation or dismantling, or during maintenance.

The manufacturer/supplier should supply copies of test reports to purchasers upon request.

6.1.2 Pre-information

The manufacturer/supplier shall provide information concerning the safety of the installation prior to the acceptance of the order, e.g. a catalogue data sheet.

This information shall include at least the following, where relevant:

a) minimum space;

b) surfacing requirements (including free height of fall and extent of surfacing);

c) details of the foundations and any specific provisions for their accessibility during inspection and maintenance;

d) overall dimensions of the largest part(s);

e) mass of the heaviest part/section in kilograms;

f) guidance regarding the target user group for the equipment;

g) if the equipment is intended only for indoor use or under supervised conditions;

h) availability of spare parts; and

i) certification of conformity with this European Standard.

6.1.3 Installation information

The manufacturer/supplier shall supply an equipment delivery parts list with the equipment.

The manufacturer/supplier shall supply installation instructions for the correct assembly, erection and placing of the equipment.

This information shall include at least the following:

a) minimum space requirements and safety clearances;

b) equipment and parts identification;

c) erection sequence (assembly instruction and installation details);

d) matching aids where necessary, e.g. signs on parts accompanied by appropriate instructions;

e) need for any special tools, lifting devices, templates or other assembly aids to be used and any precautionary measures to be taken. Where necessary, torque values should be given;

f) constructional space required to install the item of equipment;

g) orientation, where necessary, in relation to sun and wind;

h) details of the required foundation, under normal conditions, anchorage in the ground and the design and location of the foundation (with a note that care should be taken concerning abnormal conditions);

i) details of the foundations and any specific provisions for their accessibility during inspection and maintenance;

j) specific instructions if a particular landscape profile is necessary for safe operation, e.g. falling height;

k) free height of fall (for impact attenuation surfacing needs);

l) need for and details of the application of any painting or treatment: and

m) removal of assembly aids before the equipment is used.

Drawings and diagrams shall clearly specify the principal dimensions of the equipment and the relevant space, heights and areas required for installation.

The manufacturer/supplier shall supply the details necessary for inspection of the playground equipment prior to its first use.

6.1.4 Inspection and maintenance information

NOTE Attention is drawn to EN 1176–7.

6.1.4.1 The manufacturer/supplier shall provide instructions for maintenance (marked with the number of this standard), which shall include a statement that the frequency of inspection will vary with the type of equipment, e.g. equipment where the stability relies on one post, or materials used and other factors, e.g. heavy use, levels of vandalism, coastal location, air pollution, age of equipment.

The manufacturer/supplier shall also provide drawings and diagrams necessary for maintenance, inspection and checking of correct operation and, when appropriate, repair of the equipment.

6.1.4.2 The instructions shall specify the frequency with which the equipment or its components should be inspected or maintained and shall include guidance on the following, where relevant:

a) routine visual inspection (see 3.26);

NOTE 1 For playgrounds subject to heavy use or vandalism, daily inspection of this type might be necessary.

NOTE 2 Examples of visual and operational inspection points are: cleanliness, equipment ground clearances, ground surface finishes, exposed foundations, sharp edges, missing parts, excessive wear (of moving parts) and structural integrity.

b) operational inspection (see 3.27);

This should be done every 1 to 3 months, or as indicated by the manufacturer's instruction.

Special attention should be given to 'sealed-for-life' parts and equipment where stability relies on one post.

c) annual main inspection (see 3.28).

Special attention should be given to 'sealed-for-life' parts and equipment where stability relies on one post.

NOTE 3 The annual main inspection may require excavation or dismantling of certain parts.

6.1.4.3 The instructions shall also specify the following:

a) if necessary, the servicing points and methods of servicing, e.g. lubrication, tightening of bolts, re-tensioning of ropes;

b) that replacement parts shall conform to manufacturer's specifications;

c) if special disposal treatment is required for some equipment or parts;

d) identification of spare parts;

e) any additional measures to be taken during the run-in period, e.g. tightening of fastenings, tensioning of ropes;

f) the need to keep drainage holes clear:

g) that surfacing shall be maintained: in particular, the levels of loose fill materials.

h) that GRP (glass-reinforced plastics) should be replaced or repaired before the glass fibres become exposed through wear or damage. This particularly applies to slides.

6.2 Information to be provided by the manufacturer or supplier of impact attenuating surfacing

6.2.1 Pre-information for impact attenuating surfacing

The manufacturer/supplier shall provide the following information concerning the performance of the impact attenuating surfacing prior to the acceptance of the order (does not apply to turf/topsoil):

a) where particulate materials that are included in Table 4 are specified, clear information about the type of material (see Table 4) and the depth of the layer to be used shall be provided, or, if not included in Table 4, the critical fall height of the surfacing as tested in accordance with EN 1177, together with copies of test reports or certificates;

b) outline of the installation procedure, climatic limitations on installation and other precautions required;

c) procedures to be followed for the operation, inspection and maintenance of the surfacing;

d) factors that could affect the properties of the impact attenuating surfacing in service;

e) period for which the adequate level of impact attenuation is expected with adequate maintenance;

f) how the material allows for routine inspection of equipment foundations, particularly where one-post equipment is to be surrounded by wet pour/poured-in place material;

g) whether the material is intended for indoor or outdoor use, or both;

h) availability of spare parts (if any) and methods to be used for the repair of localized areas of damage;

i) compliance of impact attenuating surfacing materials with 4.1 (namely 4.1.6), if applicable;

j) a note drawing the operator's attention to the need to increase the frequency of inspection/maintenance if the impact attenuating surfacing is subject to heavy use and/or any conditions that could reduce the impact attenuation (e.g. degradation of organic materials or vandalism as well as influence of ageing due to UV exposure);

k) a warning to take care, in relation to specific hazards to children, during incomplete installation or during maintenance.

6.2.2 Installation information for impact attenuating surfacing

The manufacturer/supplier of playground surfacing shall provide full and detailed installation instructions in the appropriate language(s) of the country in which the surfacing is to be installed and used. These instructions shall conform to the following:

a) instructions shall be printed legibly and in a simple form;

b) illustrations shall be used wherever possible; and

c) instructions shall include at least the following information:

   1) complete procedure for the preparation of the ground, substrate, drainage, etc.;

   2) assembly and installation details for the surfacing and equipment required to ensure that the adequate level of impact attenuation is provided;

   3) how to deal with edges, perimeters and junctions with other materials, if necessary;

   4) any weather limitations during the installation and any subsequent weather protection required;

   5) specific instructions if a particular landscape profile is necessary for safe installation and performance;

   6) conditions to meet impact attenuation surfacing needs according to the free height of fall of the equipment.

The manufacturer/supplier shall supply the details necessary for inspection of the playground impact attenuating surfacing prior to its first use.

6.2.3 Inspection and maintenance information for impact attenuating surfacing

NOTE Attention is drawn to EN 1176–7.

6.2.3.1 The manufacturer/supplier of playground surfacing shall provide instructions for maintenance and inspection procedures, e.g. removal of contaminants, with a statement that the frequency of inspection will vary with the type of impact attenuating surfacing material used and its surroundings, e.g. access/exit areas, and other factors, e.g. heavy use, levels of vandalism, coastal location, air pollution, ageing of material.

NOTE Lack of maintenance can reduce the impact attenuation properties.

6.2.3.2 Maintenance instructions shall provide all information necessary for retaining the required performance (e.g. minimum depth of particulate impact attenuating surfacing) and, when appropriate, repair or refill of the impact attenuating surfacing. For all types of impact attenuating surfacing particular attention shall be given to the effects of ageing (exposure to UV, heat, cold), pollution, causing degradation or the loss of impact attenuating properties.

The instructions shall also specify the following:

a) that replacement parts shall conform to manufacturer's specifications;

b) if special disposal treatment is required for the material or parts;

c) the identification of spare parts (connectors, slabs, …);

d) any additional measures to be taken, specifically methods of cleaning, disinfecting, repairing etc.;

e) the need to keep drainage system functioning;

f) that surfacing shall be maintained: in particular, the depth of loose fill materials.

NOTE The annual main inspection may require excavation and access to foundations and subsequent repair of the impact attenuating surfacing.

6.2.4 Identification of impact attenuating playground surfacing

The surfacing shall be labelled by the manufacturer or supplier, or written information shall be provided for its identification and performance.

7 Marking

7.1 Equipment identification

The equipment shall be marked legibly, permanently and in a position visible from ground level with at least the following:

a) name and address of manufacturer or authorized representative;

b) equipment reference and year of manufacture; and

c) the number and date of this European Standard, i.e. EN 1176-1:2017.

7.2 Basic level mark

Equipment shall be marked legibly and permanently with the basic level mark (see Figure 24).

Bibliography

[1] EN 71 (all parts), *Safety of toys*

[2] EN 933-1, *Tests for geometrical properties of aggregates - Part 1: Determination of particle size distribution - Sieving method*

[3] EN 12572 (all parts), *Artificial climbing structures*

[4] EN 1176-2, *Playground equipment and surfacing - Part 2: Additional specific safety requirements and test methods for swings*

[5] EN 1176-3, *Playground equipment and surfacing - Part 3: Additional specific safety requirements and test methods for slides*

[6] EN 1176-7, *Playground equipment and surfacing - Part 7: Guidance on installation, inspection, maintenance and operation*

[7] EN 1176-10, *Playground equipment and surfacing - Part 10: Additional specific safety requirements and test methods for fully enclosed play equipment*

[8] REGULATION (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

[9] Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety

[10] EN 13219, *Gymnastic equipment - Trampolines - Functional and safety requirements, test methods*

[11] EN 913, *Gymnastic equipment - General safety requirements and test methods*

[12] CEN/TR 16879:2016, *Siting of Playground and other recreational facilities - Advice on methods for positioning and separation*

[13] CEN/TR 16598, *Collection of rationales for EN 1176 - Requirements*

[14] CEN/CLC Guide 14, *Child Safety — Guidance for its inclusion in standards*

Annex A
(normative)

Loads

A.1 Permanent loads

A.1.1 General

Loads "Q" (in Newtons) on equipment and equipment elements are created by the gravity (g) of masses (Q = G × g; masses "G" in kg) as well as by dynamic effects of these masses (e.g. from swings), but also from connected elements (e.g. ropes, chains) and from external influences (e.g. wind). The calculation of the total loads (forces "F" and "T" in Newtons) and their combination, acting on different examples of equipment, is described in the following clauses.

For static analysis (stress-calculations) in load bearing parts of equipment the safety factors for the loads as given in B.2 shall be used.

The permanent loads (Q_p) consist of:

a) loads created by the mass of self-weight of the structure and of the assemblies (Q_p);

b) pre-stressing loads, e.g. space nets, cableways (Q_t); and

c) loads created by the mass of water if any water containers are involved (Q_p).

A.1.2 Loads created by self-weight

Loads created by the mass of self-weight of the structure and assemblies shall be assessed.

A.1.3 Pre-stressing loads

Pre-stressing loads are considered to be permanent loads. The maximum and minimum pre-stressing loads have to be considered.

NOTE Because of creep or relaxation, pre-stress is time dependent. It could be necessary to verify two situations:

a) initial pre-stress; and

b) end pre-stress.

A.1.4 Mass of water

The highest and lowest possible water levels in the container shall be considered.

A.2 Variable loads

A.2.1 General

The variable loads (Q_i) consist of:

a) user loads;

b) snow loads;

c) wind loads;

d) temperature loads; and

e) specific loads.

A.2.2 User loads

The loads resulting from users of playground equipment shall be based on the following load system:

a) total mass

$$G_n = n \times m + 1{,}64 \times \sigma \sqrt{n} \qquad \text{(A.1)}$$

where

G_n is the total mass of n children, in kilograms;

n is the number of children on the equipment or part thereof, as given in A.3;

m is the mean mass of a child in a specified age group;

σ is the standard deviation of the age group concerned.

For open public and private playgrounds the following values can be used:

m = 53,8 kg

σ = 9,6 kg

These values are based on data for children of 14 years of age. However the calculated loads include safety factors, which ensure structures may also be used by adults.

For playgrounds with supervision open to well-defined age groups only (e.g. day-care centres), the following values can be used:

— age up to 4 years: m = 16,7 kg σ = 2,1 kg;

— age up to 8 years: m = 27,9 kg σ = 5,0 kg;

— age up to 12 years: m = 41,5 kg σ = 7,9 kg.

NOTE 1 The mass of children up to 14 years is based on the anthropometric data of age group 13,5 to 14,5 years, including 2 kg for clothing. For the other age groups, the mass includes 0,5 kg, 1 kg and 1,5 kg for clothing for 4, 8 and 12 years respectively.

b) dynamic factor

$$C_{\text{dyn}} = 1 + 1/n \qquad \text{(A.2)}$$

where

C_{dyn} is a factor representing the load caused by movement (running, playing, etc.) of the users, including material behaviour under impact loading;

n is as given in a).

c) total vertical user load

$$F_{tot;v} = g \times G_n \times C_{dyn} \quad \text{(A.3)}$$

where

$F_{tot;v}$ is the total vertical user load on the equipment caused by n children, in Newtons;

g is the acceleration due to gravity (10 m/s^2);

G_n is as given in a);

C_{dyn} is as given in b).

NOTE 2 Calculated examples are given in Table A.1 for information.

Table A.1 — Total vertical load for playground intended for use by children of all ages

Number of users n	Mass of n users G_n kg	Dynamic factor C_{dyn}	Total vertical user load $F_{tot;\,v}$ N	Vertical load per users $F_{1;v}$ N
1	69,5	2,00	1 391	1 391
2	130	1,50	1 948	974
3	189	1,33	2 516	839
5	304	1,20	3 648	730
10	588	1,10	6 468	647
15	868	1,07	9 259	617
20	1 146	1,05	12 033	602
25	1 424	1,04	14 810	592
30	1 700	1,03	17 567	586
40	2 252	1,025	23 083	577
50	2 801	1,02	28 570	571
60	3 350	1,017	34 058	568
∞		1,00		538
NOTE At infinity the vertical load per user equals the average mass.				

d) total horizontal user load

The total horizontal user load is 10 % of the total vertical user load in accordance with A.2.2 c) and acts on the same level, together with the vertical load:

$$F_{tot;\,h} = 0{,}1 F_{tot;v} \quad \text{(A.4)}$$

NOTE 3 This load allows for movement of children playing and inaccuracies in the structure.

e) distribution of user loads

The user loads are uniformly distributed over the element considered as follows:

1) point loads

$F = F_{\mathrm{tot}}$ in Newtons; (A.5)

F is acting on an area of 0,1 m × 0,1 m;

2) line loads:

$q = F_{tot}/L$ in Newtons per metre; (A.6)

where: L is in accordance with A.3.3;

3) area loads:

$p = F_{tot}/A$ in Newtons per metre squared; (A.7)

where: A is in accordance with A.3.4;

4) volume loads:

$q = F_{tot}/L$ in Newtons per metre (A.8)

or

$p = F_{tot}/A$ in Newtons per metre squared. (A.9)

NOTE 4 Volume loads are expressed either in line loads or area loads, depending on the type of elements that form the structure.

A.2.3 Snow loads

Snow loads shall be taken from EN 1991-1-3, allowing for a reference period of 10 years.

A.2.4 Wind loads

Wind loads shall be taken from EN 1991-1-4, allowing for a reference period of 10 years.

A.2.5 Temperature loads

Temperature loads shall be taken from EN 1991-1-2, allowing for a reference period of 10 years.

A.2.6 Specific loads

A.2.6.1 Swing seats

The number of users n on a swing seat in motion shall be calculated from the following:

a) for a traditional swing $n = 2$;

b) for a gondola, n shall be calculated as given in A.3;

c) for a single point swing $n = L/0,6$ with $n \geq 2$;

where

L is the total length of the outer edge of the swinging platform in metres.

The forces caused by motion of swings shall be considered for all the most onerous positions relevant for the element being considered.

The user loads in accordance with A.2.2 c) and d) need not be considered.

NOTE 1 In the case of swings, the mass can be considered as being uniformly distributed on the equipment between the points of support.

The maximum swing angle $\alpha_{max.}$ considered for swing seats suspended from ropes or chains is 80° from the vertical position.

NOTE 2 In Annex B the method to be used for calculating the forces resulting from the motion of a swing is included. A worked example is also given.

A.2.6.2 Carousels

The number of users on a carousel shall be the highest number calculated from:

a) number of seats, as given in A.3.3 where L_{pr} is the total length of the seats; or

b) platform dimensions, as given in A.3.4 where A_{pr} is the area of the platform.

For carousels, two load cases shall be considered for the user loads:

c) the load F_{tot} is evenly distributed over the entire carousel;

d) the load F_{tot} ($1/2\ L_{pr}$ or $1/2\ A_{pr}$) is evenly distributed over one half of the carousel.

NOTE Vertical and horizontal user loads act at the same time. Centrifugal forces need not be considered additionally, as they are covered by the horizontal user load.

A.2.6.3 Cableways

The maximum tension in the cable of a cableway shall be calculated for the situation where the users are swinging in a vertical direction in the middle of the cable.

The user loads as given in A.2.2 c) and d) need not be considered.

The maximum forces in the foundation of the cableway can be based on the static situation with the users in the middle of the cable.

The number of users n on a traditional cableway is $n = 2$.

NOTE In Annex B, a method that can be used for calculating the forces resulting from the motion of users suspended from a cableway is included. A worked example is also given.

A.2.6.4 Spatial networks

The number of users in a spatial network shall be calculated in accordance with A.3.5 on the basis of the volume V defined by the periphery of the spatial network.

For spatial networks two load cases shall be considered for the user loads as follows:

a) load F_{tot} (V) is equally distributed over the entire structure;

b) load F_{tot} ($1/2\ V$) is equally distributed over one half of the structure.

A.2.6.5 Access ladders and stairs

The number of users on an access ladder or stair shall be calculated in accordance with A.3.3 on the basis of the sum of the length of all rungs or treads.

A.2.6.6 Barriers and guard rails

The horizontal load on barriers and guard rails is 750 N/m acting in a horizontal direction on the top rail.

A.2.6.7 Seats

The number of users on a seat is the highest value of the following:

a) one user, the load to be treated as a point load;

b) number specified in this standard for specific equipment; the load to be treated as a distributed load; or

c) number calculated as given in A.3.2.

A.2.6.8 Lateral protection of slides

The vertical and horizontal loads applied to the lateral protections of slides are given in A.2.2.

A.3 Number of users on the equipment

A.3.1 General

Calculate the number of users for each structural element likely to be loaded by users.

The calculated number shall be rounded up to the next whole number.

NOTE Rounding up in this context means that 3,13 becomes 4,0, for example.

A.3.2 Number of users on a point

Unless stated differently elsewhere in this part of EN 1176, the number of users, n, on a point is as follows:

$$n = 1$$

Every single point of playground equipment for standing, walking or climbing upon, or a flat surface greater than 0,1 m wide and which has less than a 30° angle from the horizontal, shall be able to carry the load caused by one user.

NOTE This also applies to rungs or steps for supporting the user's feet.

A.3.3 Number of users on line type elements

The number of users, n, on a line shall be calculated from the following:

a) line elements with an inclination up to and including 60°:

$$n = L_{pr}/0{,}6; \quad \text{(A.10)}$$

b) line elements with an inclination greater than 60°:

$$n = L/1{,}20 \quad \text{(A.11)}$$

where

L is the length of the element in metres;

L_{pr} is the length of the element projected down to a horizontal plane, in metres.

Line type elements are rungs in ladders and in climbing frames, poles and ropes.

A.3.4 Number of users on an area

The number of users, *n*, on a surface area shall be calculated from the following:

a) planes with inclination up to and including 60°:

$$n = A_{pr}/0,36; \quad \text{(A.12)}$$

b) planes with inclination greater than 60°:

$$n = A/0,72 \quad \text{(A.13)}$$

where

A is the area, in metres squared;

A_{pr} is the area projected down to a horizontal plane, in metres squared.

Area type elements are platforms, lattice type platforms, ramps and nets.

The width of the plane shall be greater than 0,6 m. Planes having a smaller width shall be treated as line type elements.

Where these types of element can be used from both sides, e.g. nets or grids, the number of children, *n*, shall be based on the area of one side only. These types of element will not be loaded as densely as platforms.

A.3.5 Number of users in a volume

The number of users, *n*, in a volume shall be calculated from the following:

— for volumes $V \leq 4,3\text{m}^3 : n = V/0,43$; (A.14)

— for volumes $4,3\text{m}^3 < V \leq 12,8\text{m}^3 : n = (V - 4,3)/0,85$; (A.15)

— for volumes $V > 12,8\text{m}^3 : n = 20 + (\text{V} - 12,8)/1,46$. (A.16)

where

V is the volume defined by the periphery of the playground equipment in cubic metres.

The volume is used to determine the maximum number of users on playground equipment, e.g. climbing frames, spatial networks.

NOTE The volumes mentioned are based on the following dimensions:

a) 0,60 m × 0,60 m × 1,20 m = 0,43 m^3;

b) 0,75 m × 0,75 m × 1,50 m = 0,85 m^3;

c) 0,90 m × 0,90 m × 1,80 m = 1,46 m^3.

Annex B
(normative)

Method of calculation of structural integrity

B.1 General principles: Limit state

B.1.1 Limit state

Each structure and structural element, e.g. connections, foundations, supports, shall be calculated taking into account the load combinations of B.2.

The preferred method of calculation shall be based on the general principles and definitions for limit states as specified in the appropriate structural Eurocodes.

Well-established technical rules and methods of construction practice, other than this method, may be used provided that the level of safety is at least the same.

NOTE Limit states are states beyond which the structure no longer conforms to this part of EN 1176.

In symbolic form, a limit state can be written as:

$$\gamma_F \times S \leq R/\gamma_M \quad \text{(B.1)}$$

where

γ_F is a partial safety factor for loads;

γ_M is a partial safety factor for materials;

S is load effect;

R is the resistance of the structure.

To allow for uncertainties in the actual loads and in the model used for determining loads, loads are multiplied by a partial safety factor for loads (γ_F).

To allow for uncertainties in the actual material properties and in the models used for determining forces in the structure, the strength of the structure is divided by a partial safety factor for materials (γ_M).

In most cases, the symbolic representation given here cannot be used to represent the limit state because the actual formulation is often nonlinear, e.g. in cases where loads have to be combined.

B.1.2 Ultimate limit state

Ultimate limit states requiring consideration include:

a) loss of equilibrium of the structure or any part of it, considered as a rigid body;

b) failure by excessive deformation, rupture, or loss of stability of the structure or any part of it.

NOTE Ultimate limit states are those associated with collapse, or with other forms of structural failure, which can endanger the safety of people.

B.1.3 Serviceability limit state

Where serviceability requirements are made, the preferred method of calculation shall be based on the principles for serviceability limit state as specified in the appropriate structural Eurocodes.

The deflection criteria for serviceability limit states mentioned in the appropriate Eurocodes do not apply to playground equipment.

NOTE Serviceability limit states correspond to states which do not conform to specified service criteria.

B.2 Load combinations for static analysis

The following load combinations shall be used for verification:

$$\gamma_{G;c} \times Q_p + \gamma_{Q;c} \times Q_i \qquad \text{(B.2)}$$

where

Q_p is the permanent load as given in A.1;

Q_i is one of the variable loads as given in A.2.2 to A.2.6;

$\gamma_{G;c}$ is a partial safety factor for permanent loads to be used in calculations;

$\gamma_{Q;c}$ is a partial safety factor for variable loads to be used in calculations.

The following partial safety factors for loads shall be used:

$\gamma_{G;c}$ = 1,0 for favourable effects;

$\gamma_{G;c}$ = 1,35 for unfavourable effects;

$\gamma_{Q;c}$ = 0 for favourable effects;

$\gamma_{Q;c}$ = 1,35 for unfavourable effects.

NOTE 1 It is not necessary to combine independent variable loads such as wind and user loads. Related loads acting in different directions, such as vertical and horizontal user loads, are combined.

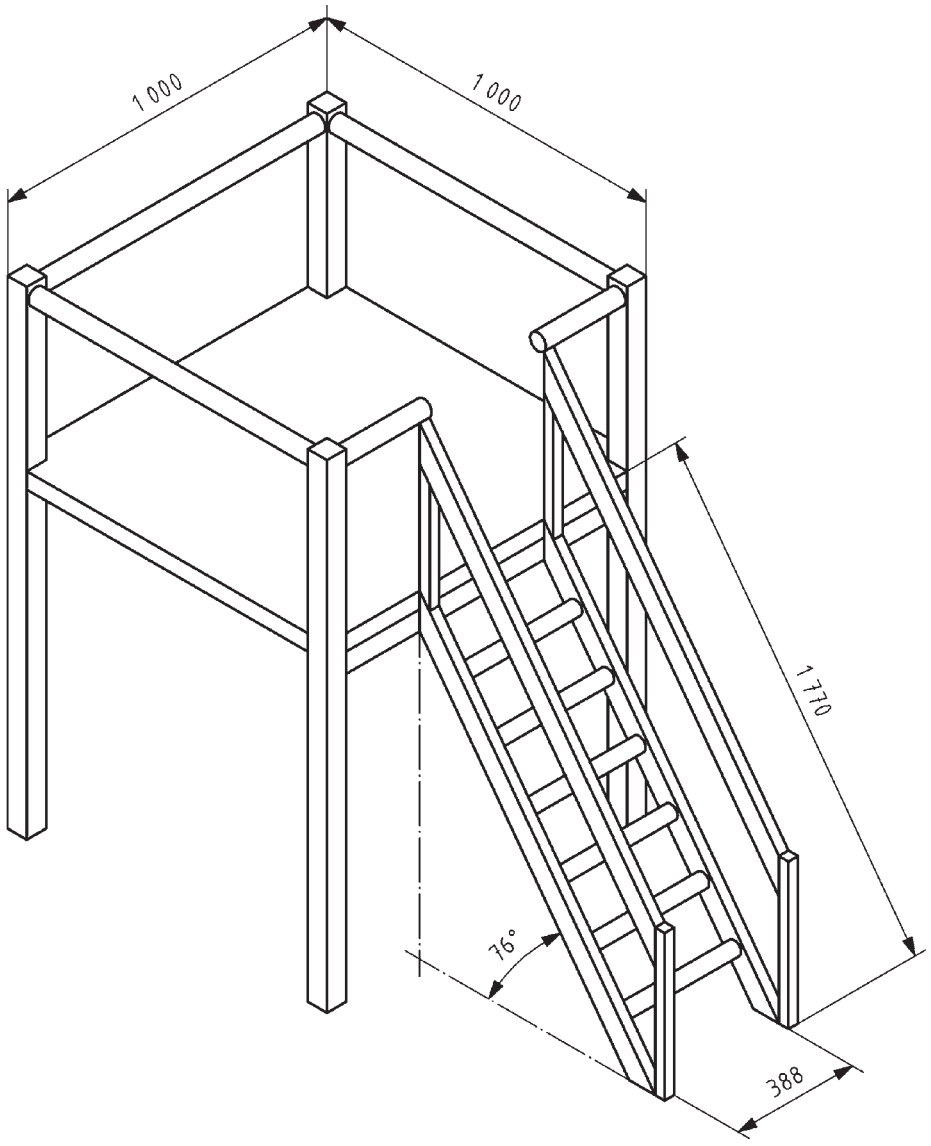
NOTE 2 In the following examples only the forces (F or T) created by the loads Q are calculated. For static analysis in elements of equipment, the safety factors given above need to be included.

B.3 Worked example of the calculation of user loads (without safety factors)

B.3.1 General

The application of the load system based on the number of users is demonstrated for a platform with ladder access, see Figure B.1.

Dimensions in millimetres



Data:

Platform:

dimensions:	1 000 mm × 1 000 mm

Ladder:

length:	1 770 mm
number of rungs:	6
external width:	388 mm
internal width:	350 mm
angle:	76°

Barrier:

length:	4 × 1 000 mm

Figure B.1 — Platform with ladder

B.3.2 Platform

The number of users on the platform is calculated from A.3.4 (Formula A.12):

$n = A_{pr}/0{,}36 = 1{,}0/0{,}36 = 2{,}77$ rounded off upwards to $n = 3$

The total vertical load on the platform follows from Table A.1:

$F_{tot;v} = 2\,516\ N$

The horizontal user load on the platform (calculated from Formula A.4) is:

$F_{tot;h} = 0{,}1\ F_{tot;v} = 252\ N$

B.3.3 Barrier

For the barrier, a line type element, two load cases are considered: the user load and the barrier load. The number of users on one barrier (calculated from Formula A.10) is:

$n = L_{pr}/0{,}6 = 1{,}0/0{,}6 = 1{,}67$ rounded off upwards to $n = 2$

The total vertical load (taken from Table A.1) is $F_{tot;v} = 1\,948$ N.

The line load on the barrier is:

$q_v = F_{tot;v}/L_{pr} = 1\,948$ N/m

The horizontal load on the barrier is:

$q_h = 0{,}1 q_v = 195$ N/m

NOTE This load is overruled by the barrier load and need not be considered further.

In accordance with A.2.6.6, the horizontal barrier load is 750 N/m.

B.3.4 Ladder

In accordance with A.3.2, each rung shall be able to carry one user:

$F_{tot;v} = 1\,391$ N

The ladder in this example is an access ladder. In accordance with A.2.6.5, the number of users shall be calculated on the basis of the sum of the length of all rungs.

The total length of all rungs is: 6 × 0,35 m = 2,1 m.

The number of users is calculated in accordance with A.3.3 (Formula A.10):

$n = L_{pr}/0,6 = 2, 1/0,6 = 3,5$ rounded off upwards to $n = 4$

The ladder shall be able to carry a load of four users (see A.2.2 c)):

$F_{tot;v} = 10 \times (4 \times 53,8 + 1,64 \times 9,6 \sqrt{4}) \times (1 + 1/4) = 3\,084$ N

For convenience, Table A.1 may also be used:

$F_{tot;v} = 4 \times 839 = 3\,356$ N

B.3.5 Complete structure

The load on the complete structure may be taken as the sum of the individual elements. However, it is permissible to take into account the reducing effect on the load of the increased number of users.

Platform: $n = 2,77$

Barriers (4): $n = 4 \times 1,67 = 6,68$

Ladder: $n = 3,5$

Total: $n = 12,95$

rounded off upwards to: $n = 13$

The total vertical load on the structure in accordance with Table A.1 is:

$F_{tot;v} = 13 \times 674 = 8\,762$ N

NOTE 1 A more exact calculation on the basis of A.2.2 c) can also be made.

The total horizontal load on the structure, calculated in accordance with Formula A.4, is:

$F_{tot;h} = 0,1\ F_{tot;v} = 876$ N

NOTE 2 The total horizontal load consists of three (platform, barrier, ladder) smaller horizontal loads acting on different levels.

B.4 Calculation of forces acting on a swing seat

For the swing seat shown in Figure B.2, the forces caused by motion are:

$$F_h = C_h \times g \times (G_n + G_s) \quad \text{(B.3)}$$

$$F_v = C_v \times g \times (G_n + G_s) \quad \text{(B.4)}$$

$$F_r = C_r \times g \times (G_n + G_s) \quad \text{(B.5)}$$

where

F_h is the horizontal load on the assembly (in Newtons);

F_v is the vertical load on the assembly (in Newtons);

F_r is the resulting load on the assembly (in Newtons);

g is the acceleration due to gravity (= 10 m/s^2);

G_s is the mass of the swinging assembly (in kilograms);

G_n is in accordance with A.2.2a);

n is the number of users on the swing in accordance with A.2.6.1.

C_h, C_v, C_r are load factors depending on the maximum swing angle $\alpha_{max.}$ and the swing angle α of the considered position according to Table B.1.

The mass of the swinging assembly consists of the mass of the swinging platform and half of the mass of the cables, ropes or rods.

The specific load for swing seats is a variable load that contains the self-weight (normally to be considered as a permanent load) of the swinging assembly. The effect resulting from the difference in load factors for permanent and variable load (see Figure B.2) is not significant in this case.

F_h, F_v, and F_r, shall be treated as variable loads.

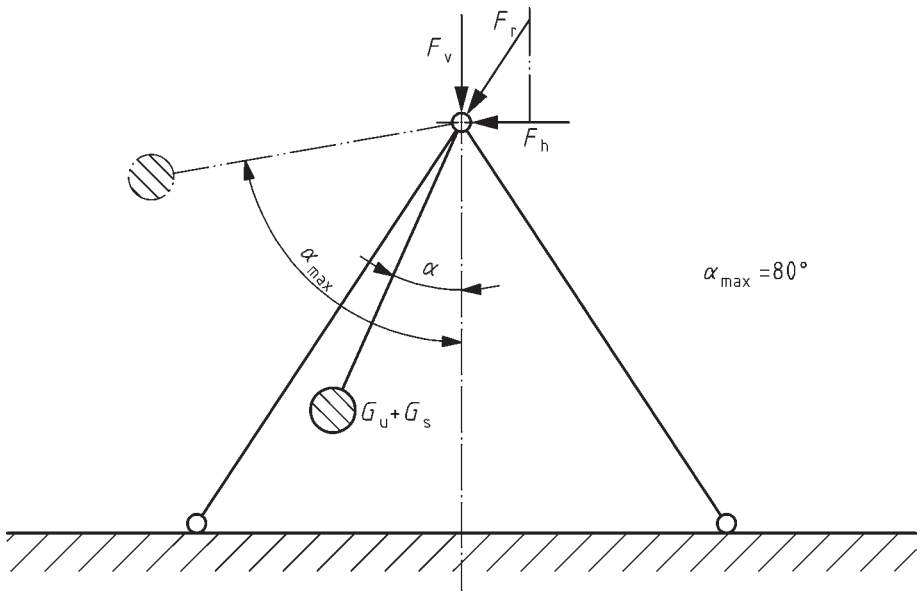


Figure B.2 — Loads acting on swing

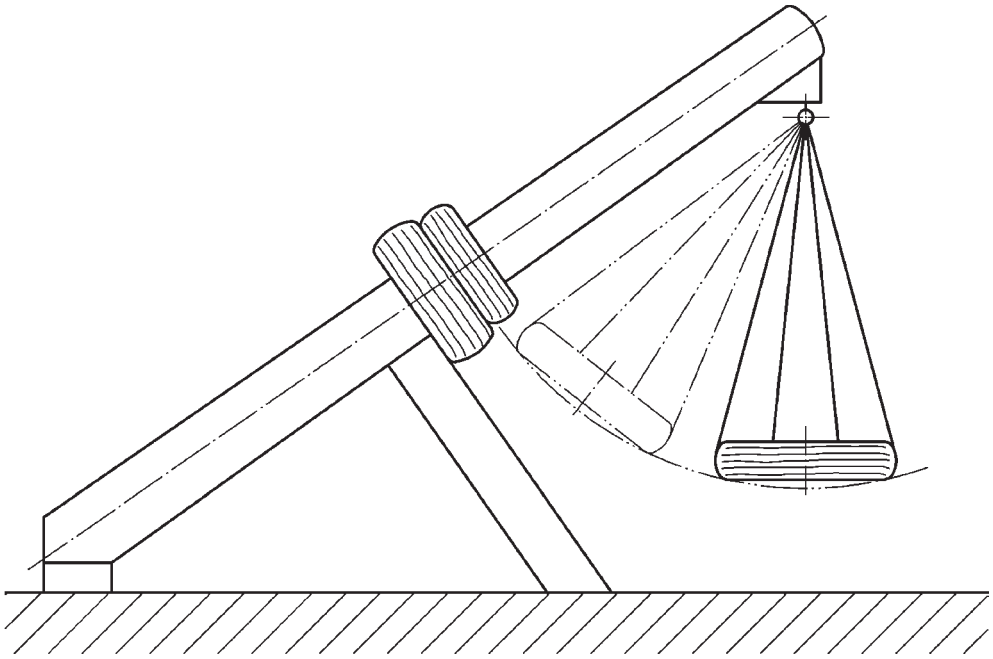
Table B.1 — Load factors for swings

$\alpha_{max} = 80°$			
α	C_r	C_v	C_h
80°	0,174	0,030	0,171
70°	0,679	0,232	0,638
60°	1,153	0,577	0,999
50°	1,581	1,016	1,211
42,6°	1,861	1,370	1,260
40°	1,950	1,494	1,253
30°	2,251	1,949	1,126
20°	2,472	2,323	0,845
10°	2,607	2,567	0,453
0°	2,653	2,653	0,000

B.5 Worked examples for forces acting on a swing (without safety factors)

Swinging platform

The swinging platform consists of a rubber tyre with an infill steel wire net, which is suspended from four chains (see Figure B.3).



Diameter *(D):* 1,0 m

Weight of tyre and net: 50 kg

Weight of chains: 10 kg

Figure B.3 — Example of a single point swing

Calculation:

Mass of the swinging assembly:

$G_s = 50 + (½ \times 10) = 55$ kg

Outer circumference of the swinging platform:

$L = \pi \times D = 3{,}14 \times 1{,}0 = 3{,}14$ m

Number of users:

$n = L/0{,}6 = 3{,}14/0{,}6 = 5{,}23$ Rounding off: $n = 6$

Mass of n users (see Formula A.1):

$$G_n = n \times m + 1{,}64 \times \sigma\sqrt{n} = 6 \times 53{,}8 + 1{,}64 \times 9{,}6 \times \sqrt{6} = 361\ kg$$

Maximum swing angle $\alpha_{max.}$:

The swinging platform is suspended from chains; therefore

$\alpha_{max.} = 80°$

The maximum force in the chains is reached when the resulting force, F_r, is at maximum value (see Formula B.5).

For $\alpha = 0°$, the load factor for resulting force is maximum:

$C_r = 2{,}653$

$F_{chains} = C_r \times g \times (G_n + G_s) = 2{,}653 \times 10 \times (361 + 55) = 11\,036$ N

The maximum vertical force on the assembly is reached when the load factor C_v reaches a maximum (see Formula B.4).

For $\alpha = 0°$, the load factor $C_v = 2{,}653$.

$F_v = C_v \times g \times (G_n + G_s) = 2{,}653 \times 10 \times (361 + 55) = 11\,036$ N

The load factor for the horizontal load, acting at the same time, is:

$C_h = 0$

$F_h = 0$ N

The maximum horizontal force on the assembly is reached when the load factor C_h reaches a maximum (see Formula B.3).

For $\alpha = 42{,}6°$, the load factor $C_h = 1{,}260$.

$F_h = C_h \times g \times (G_n + G_s) = 1{,}260 \times 10 \times (361 + 55) = 5\,242$ N

The load factor for the vertical load, acting at the same time, (see Formula B.4) is $C_v = 1{,}372$.

$F_v = C_v \times g \times (G_n + C_s) = 1{,}372 \times 10 \times (361 + 55) = 5\,708$ N

B.6 Calculation of forces acting on the cable of a cableway

B.6.1 General

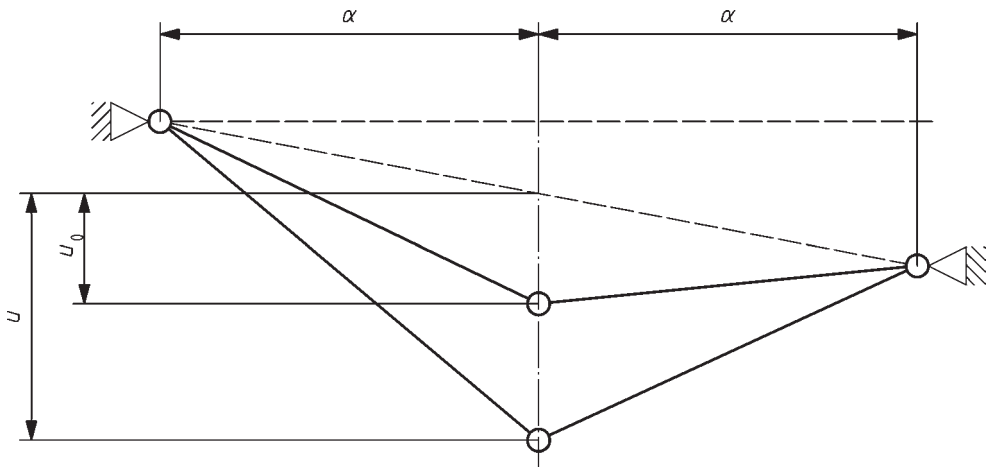
The maximum tensile force in the cable of a cableway is calculated below. The deflection of the cable is assumed to be linear (along straight lines).

No calculation is necessary when Table B.2 is used.

Calculate half of the cable mass from the Formula (B.6):

$$G_c = 1/2 g_c l_c \qquad \text{(B.6)}$$

where



G_c is half of the cable mass in kilograms;

U_0 is the static initial deflection of the cable due to the self-weight of the cable and the rolling assembly (G_c + G_r) in metres (see Figure B.4);

u is the dynamic deflection of the cable under a swinging mass (G_c + G_r + G_n) in metres (see Figure B.4);

g_c is the mass of the cable per metre in kilograms;

l_c is the suspended length of the cableway in metres;

G_r is the mass of the rolling assembly in kilograms;

G_n is the mass of n users in accordance with A.2.2 a);

n is the number of users. (For a traditional cableway, n = 2).

Figure B.4 — Deflection of a cableway

NOTE 1 A small value of the static initial deflection, u_0, leads to high tension in the cable and consequently to high forces on the supports and foundation. Moderate temperature effects can no longer be neglected since they can cause a significant change in the tension of the cable. Little deflection results in little reduction of the rolling speed near the end of the cable, which can cause additional hazards.

The total tension T_{tot} in the cable can be calculated from:

$$T_{tot} = T_{pr} + T \tag{B.7}$$

where

T_{tot} is the maximum tension in the cable in N;

T_{pr} is the static cable tension due to self-weight of the cable and roller and pre-tensioning in N;

T is the tension in the cable caused by the users in N.

Calculate the pre-tensioning of the cable from:

$$T_{pr} = (G_c + G_r) \times g / 2\alpha \tag{B.8}$$

where

g is the acceleration due to gravity (= 10 m/s^2);

α is the relative initial deflection = $u_0/(1/2\ l_c)$; (B.9)

u_0 is the static defection in the middle of the cable due to self-weight, weight of the rolling assembly and pre-tension.

NOTE 2 After some time, the initial deflection, u_o, can become bigger due to stretching of the cable. This will decrease the maximum tension in the cable (which is safe).

Calculate the cable tension caused by the users from:

$$T = ½(p^2 \square \alpha^2)E_c A_c \quad \text{(B.10)}$$

where

E_c is the elasticity of the cable in Newtons per millimetre squared;

A_c is the nett cross-sectional area of the cable in square millimetres;

p is the relative maximum dynamic deflection = $u/(1/2\ l_c)$, find the value for p that satisfies the relation:

$$p^3 + \alpha\, p^2 + (4\,\beta - \alpha^2)\, p + 4\,\alpha\,\beta - \alpha^3 - C = 0 \quad \text{(B.11)}$$

where

β is the pre-strain = $T_{pr}/(E_c A_c)$; (B.12)

C is a constant = $4\ (G_c + G_r + G_n) \times g/(E_c A_c)$. (B.13)

NOTE 3 A safe value for p can be found from:

$$p = \sqrt[3]{(\alpha\,\beta - \alpha^3 - C)} \quad \text{(B.14)}$$

B.6.2 Worked example for forces acting on a cableway (without safety factors)

Data:

Cableway:

Length:	60 m
Static initial deflection:	1 % of span
Cable:	6 × 36 WS steel core strand
Nominal diameter:	12 mm
Mass:	0,602 kg/m
Nett steel area:	66,24 mm^2
Elasticity:	105 000 N/mm^2
Ultimate load:	101 kN

Roller:

Mass: 10 kg

Users:

Mass of two children: 130 kg

Calculation

Static deflection (see Figure B.4):

$$u_0 = 0{,}01 \times 60 = 0{,}6\ m$$

Relative initial deflection (see Formula B.9):

$$\alpha = u_0 / (½ l_c) = 0{,}6 / (½ \times 60) = 0{,}02$$

Half of cable mass (see Formula B.6):

$$G_c = ½ g_c l_c = ½ \times 0{,}602 \times 60 = 18\ kg$$

Mass of the rolling assembly:

$$G_r = 10\ kg$$

Mass of two children:

$$G_n = 130\ kg$$

Pre-tension of the cable (see Formula B.8):

$$T_{pr} = (G_c + G_r) \times g / 2\alpha = (18 + 10) \times 10 / (2 \times 0{,}02) = 7\,000\ N$$

Pre-strain (see Formula B.12):

$$\beta = T_{pr} / (E_c A_c) = 7\,000 / (105\,000 \times 66{,}24) = 0{,}001\,006\,44$$

Constant (see Formula B.13):

$$C = 4 (G_c + G_r + G_n) \times g / (E_c A_c) = 4 (18 + 10 + 130) \times 10 / (105\,000 \times 66{,}24) = 0{,}000\,908\,67$$

Formula B.11 should be solved as follows:

$$p^3 + \alpha p^2 + (4\beta - \alpha^2) p + 4\alpha\beta - \alpha^3 - C = 0$$

$$p^3 + 0{,}02\,p^2 + 0{,}003\,625\,8\,p - 0{,}000\,836\,154\,8 = 0$$

The value of p that satisfies the above formula is:

$$p = 0{,}076\ 25$$

Now the additional dynamic tension (see Formula B.10) can be calculated:

$$T = ½(p^2 - \alpha^2)\,E_c\,A_c = ½(0{,}076\,252 - 0{,}022) \times 105\,000 \times 66{,}24 = 18\,828\ \text{N}$$

The total tension T_{tot} in the cable (see Formula B.7) is:

$$T_{tot} = T_{pr} + T = 7\,000 + 18\,828 = 25\,828\ \text{N}$$

NOTE The total load acting on the supporting structure of the cable (Ftot = Ttot) is a combination of a permanent load (QP = Tpr) and a variable load (Qi = T) (see also A.1.3 and A.2.6.3).

In Table B.2, the maximum tensile cable forces are calculated for a number of cases. The table may be used in all cases where:

— mass of the cable: ≤ 0,75 kg/m;

— elasticity of the cable: ≤ 110 000 N/mm^2;

— nett cable area: ≤ 80 mm^2;

— mass of the rolling assembly: ≤ 25 kg;

— mass of the users: ≤ 130 kg.

Table B.2 — Maximum dynamic tensile cable force in kN

Span	Initial deflection				
m	1 %	2 %	3 %	4 %	5 %
20	28,0	23,6	19,5	16,2	13,6
30	28,3	23,8	19,7	16,4	13,8
40	28,6	24,1	20,0	16,6	14,0
50	29,0	24,3	20,0	16,8	14,1
60	29,3	24,6	20,4	17,0	14,3

Annex C
(normative)

Physical testing of structural integrity

C.1 Pass/fail criteria

C.1.1 Load carrying ability

The specimen shall be able to carry the total test load (see C.2) for 5 min.

C.1.2 Failure

After the test the specimen shall show no cracks, damage or excessive permanent deformation and no connections shall be loosened.

Permanent deformation is considered to be excessive when it creates an infringement of any other requirement of this standard.

C.2 Test load for equipment

C.2.1 Load combinations for testing

The following load combinations shall be used for testing:

$$\gamma_{Qp;t} \cdot Q_p + \gamma_{Qi;t} \cdot Q_i \qquad \text{(C.1)}$$

where

Q_p is the permanent load as given in A.1;

Q_i is one of the variable loads as given in A.2.2 to A.2.6;

$\gamma_{Qp;t}$ is a partial safety factor for permanent loads to be used in testing (with a value of 1,0 in all cases);

$\gamma_{Qi;t}$ is a partial safety factor for variable loads to be used in testing in accordance with C.2.2 or C.2.3.

It is not necessary to combine independent variable loads, such as wind and user loads, but related loads acting in different directions, such as vertical and horizontal user loads, should be combined.

Permanent loads are present during the test. Compared with the variable loads on playground equipment, the permanent loads are small in most cases, and therefore no additional safety factor for permanent loads is required in the tests.

C.2.2 Safety factor for tests on identical series

The following safety factor shall be used for identical series where not every specimen is tested:

$\gamma_{Qi;t} = 0$ for favourable effects;

$\gamma_{Qi;t} = 2,0$ for unfavourable effects.

C.2.3 Safety factor for tests on a unique product

The following safety factor shall be used where every specimen, including unique products, is tested:

$\gamma_{Qi;t} = 0$ for favourable effects;

$\gamma_{Qi;t} = 1,35$ for unfavourable effects.

C.3 Load application

C.3.1 Point loads

The following dimensions shall not be exceeded when applying the loads onto an element of the structure:

— line type element: $l \leq 0,1$ m;

— area type element: $a \leq 0,1$ m × 0,1 m

where

l is the support length of the test load (in metres);

a is the support area of the test load (in metres).

To simulate the transfer of load caused by one user to the structure, the load should normally be applied over a length of not more than 0,1 m.

C.3.2 Line loads

Line loads can be represented by equally distributed point loads spaced not more than 0,6 m apart. The support length under the point loads may be up to 0,6 m.

C.3.3 Area loads

Area loads can be represented by equally distributed point loads spaced grid wise not more than 0,6 m × 0,6 m apart.

The support area under the point loads shall be less than 0,6 m × 0,6 m.

Annex D
(normative)

Test methods for entrapment

D.1 General

Unless stated otherwise, tolerances of the probes in this annex are as follows:

a) ± 1 mm for dimensions; and

b) ± 1 ° for angles.

In situations of doubt when using the probes relating to the tolerance an accurate measurement should be made to ensure the opening is in accordance with the nominal dimension of the probe.

All tests shall be performed in the most onerous way.

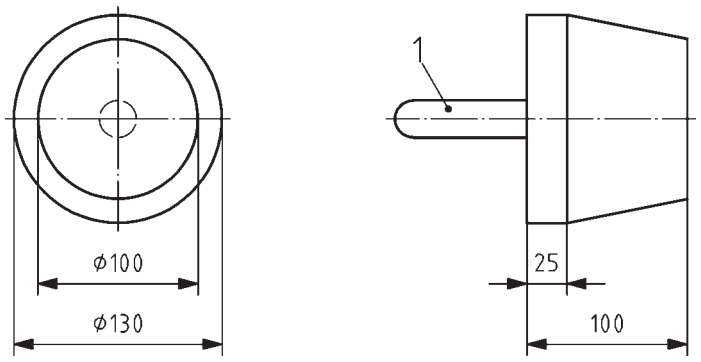
D.2 Head and neck entrapment

D.2.1 Completely bound openings

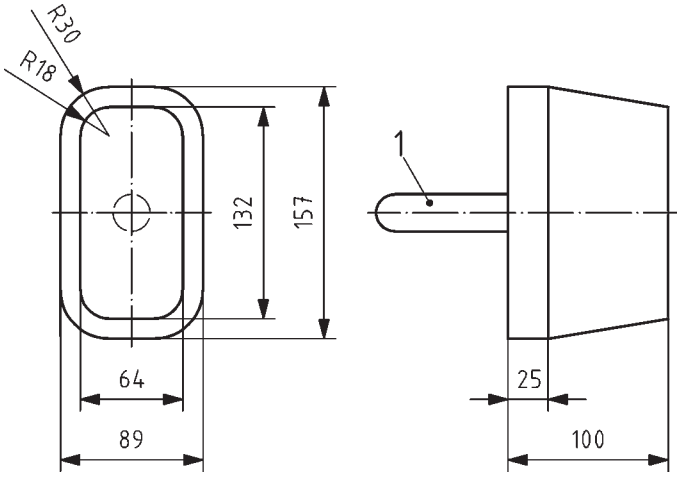
D.2.1.1 Apparatus

Probes, as illustrated in Figure D.1.

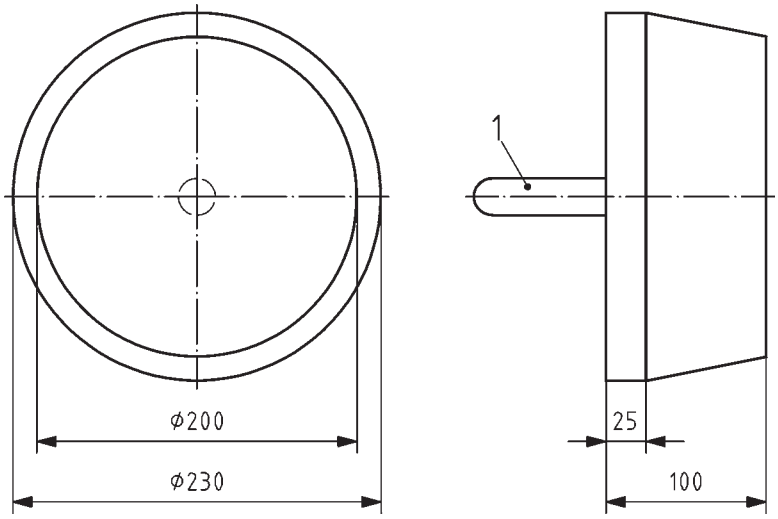
Dimensions in millimetres



a) Probe E (small head)



b) Probe C (torso)



c) Probe D (large head)

Key

1 handle

Figure D.1 — Probes for determination of head and neck entrapment in completely bound openings

D.2.1.2 Procedure

Apply successively the probes as illustrated in Figure D.1 to each relevant opening. Record and report the passage of any probe through the opening. If any of the probes are not freely passing through the opening apply a force of (222 ± 5) N to the probe. When the torso probe is used, it is safer to force the body through the opening first. Apply the probe with the axis perpendicular to the plane of the opening.

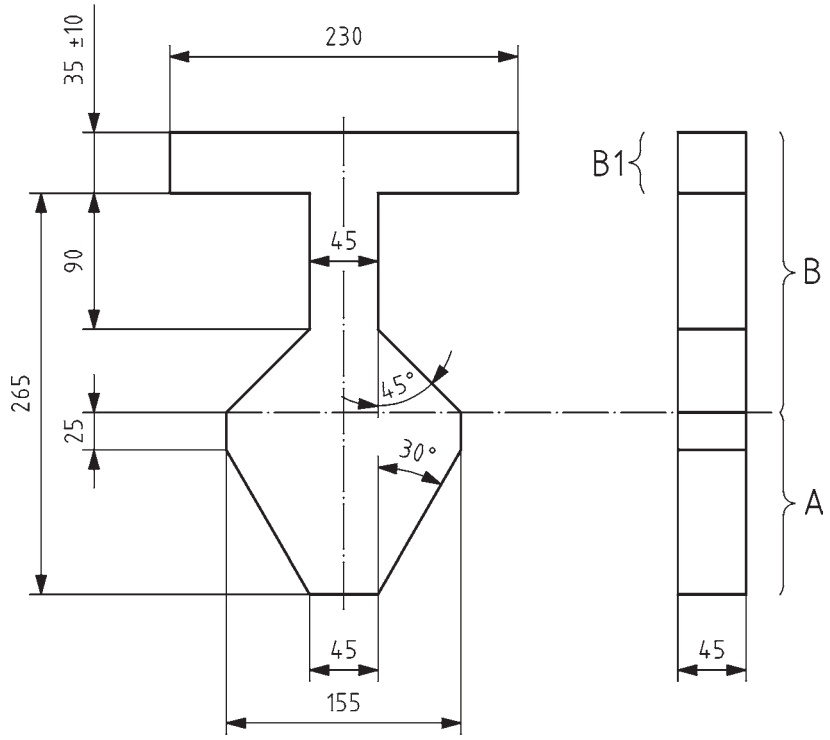
NOTE The dimensions of head probe D are based on those for an older child and, therefore, there will be a large tolerance if assessing equipment for use by a young child.

D.2.2 Partially bound and V-shaped openings

D.2.2.1 Apparatus

Test template, as illustrated in Figure D.2.

Dimensions in millimetres



Key

A	”A” portion of probe
B	”B” portion of probe
B1	shoulder section

Figure D.2 — Test template for assessment of head and neck entrapment in partially bound and V-shaped openings

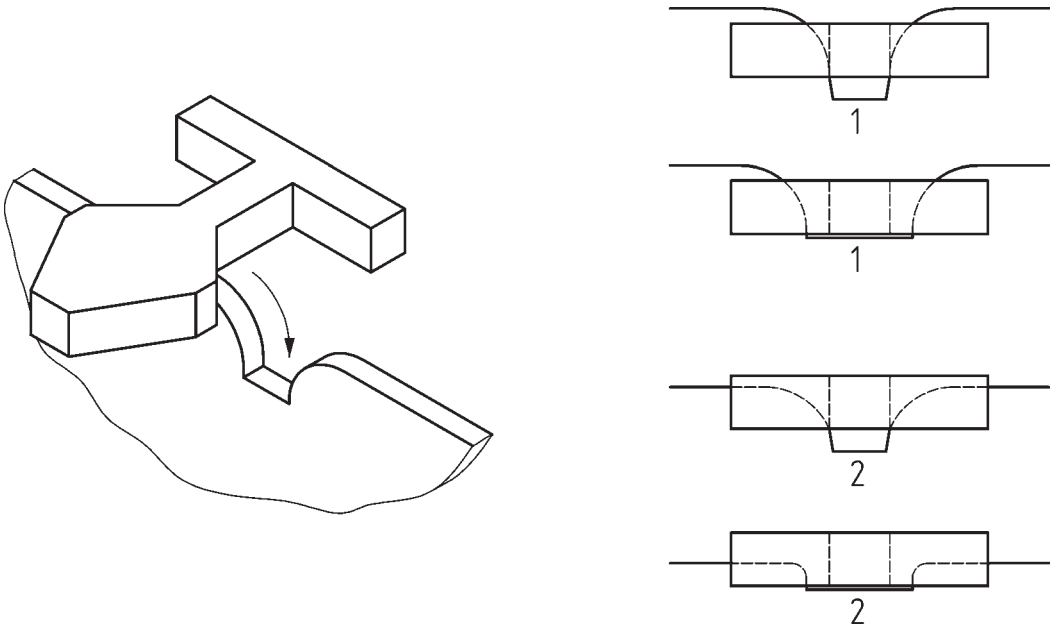
D.2.2.2 Procedure

Position the ‘B’ portion of the test template between and perpendicular to the boundaries of the opening, as shown in Figure D.3. Record and report whether the template fits within the boundaries of the opening or, if it cannot be inserted to its full thickness.

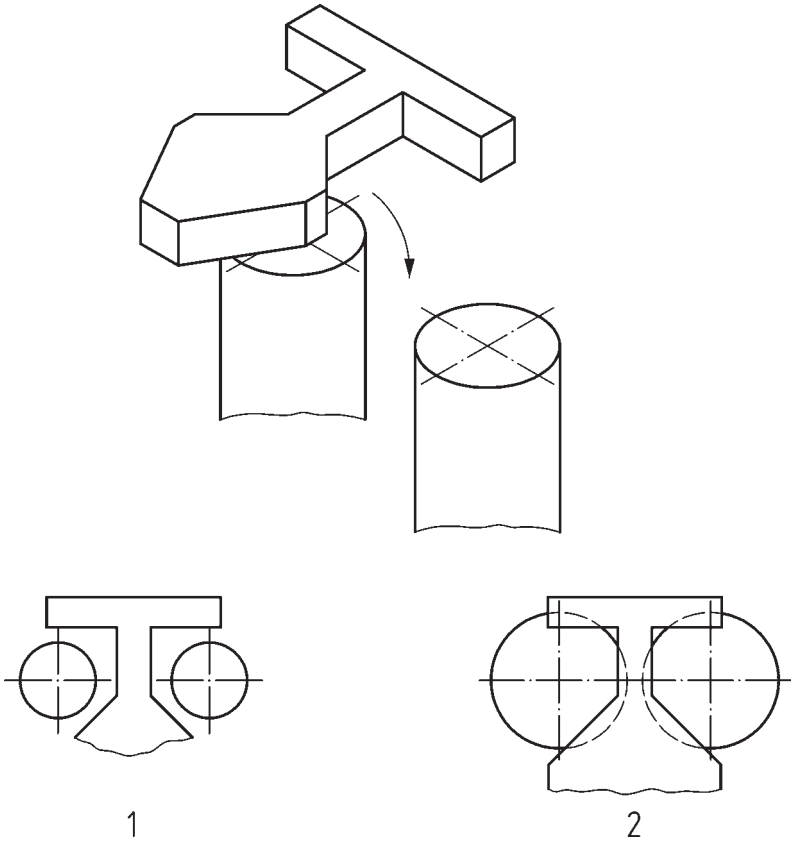
If the test template can be inserted to a depth greater than the thickness of the template (45 mm), apply the ‘A’ portion of the test template, so that its centre line is orientated to check the extremities of the opening as well as the centreline.

Ensure that the plane of the test template is parallel and applied in line with the opening, as shown in Figure D.4.

Insert the test template along the opening until its motion is arrested by contact with the boundaries of the opening. Record and report the results including the angle of the template centreline relative to the vertical and horizontal axes (see Figure D.4) as this will determine the pass/fail requirements given in 4.2.7.2. See Figures D.5 and D.6 for examples of the assessment for the different angular ranges.



a)



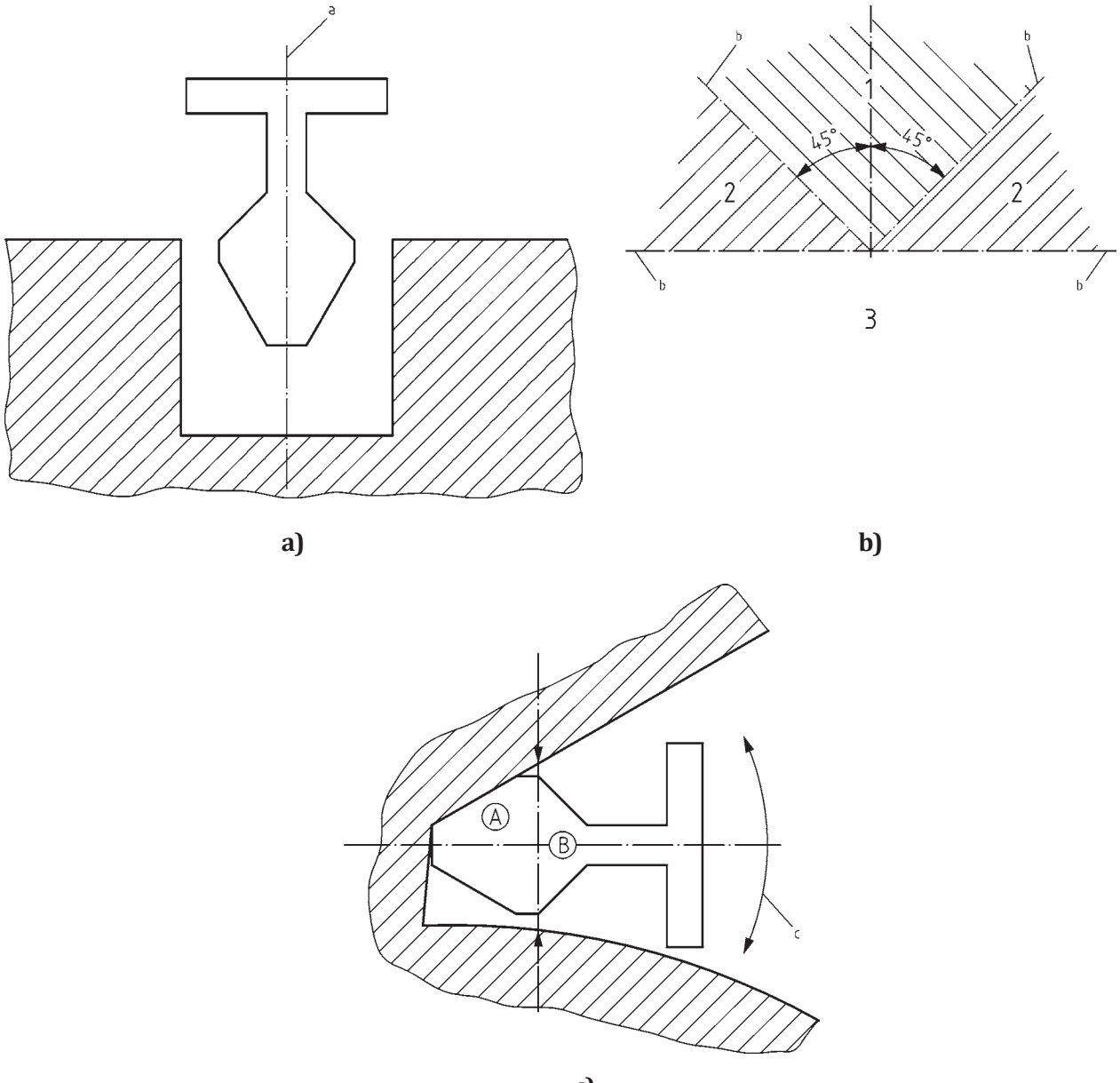
b)

Key

1 accessible

2 not accessible

Figure D.3 — Method of insertion of the "B" portion of the test template



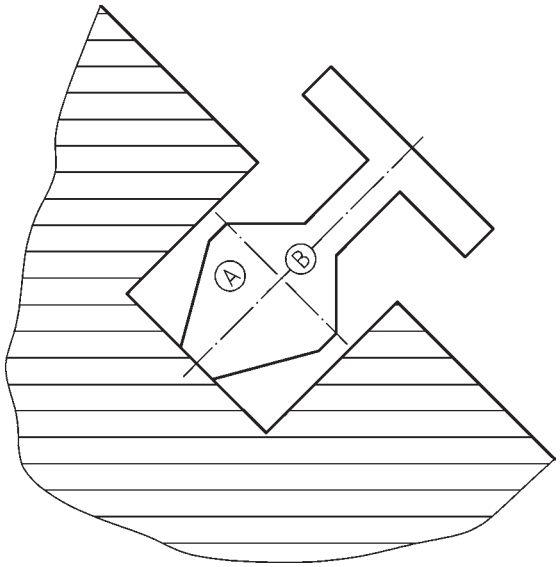
a) **b)** **c)**

Key

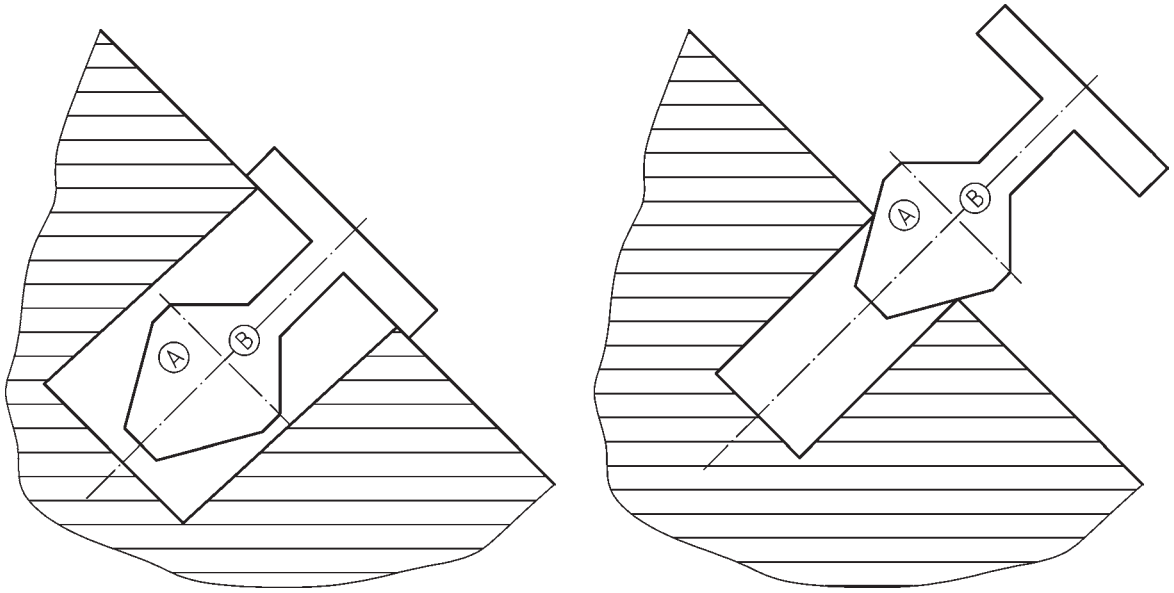
1 range 1
2 range 2
3 range 3
a insertion angle for assessing the range
b template centre line
c check all insertion angles
A A-portion (see Figure D.2)
B B-portion (see Figure D.2)

Figure D.4 — Checking all insertion angles to determine range

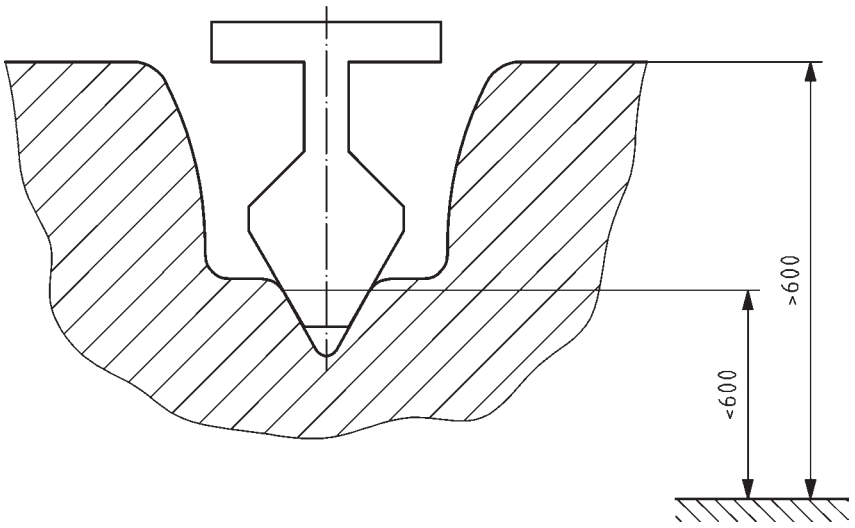
Dimensions in millimetres



a) Passes if front section fully enters aperture to a maximum depth of (template shoulder depth) 265 mm



b) Fail

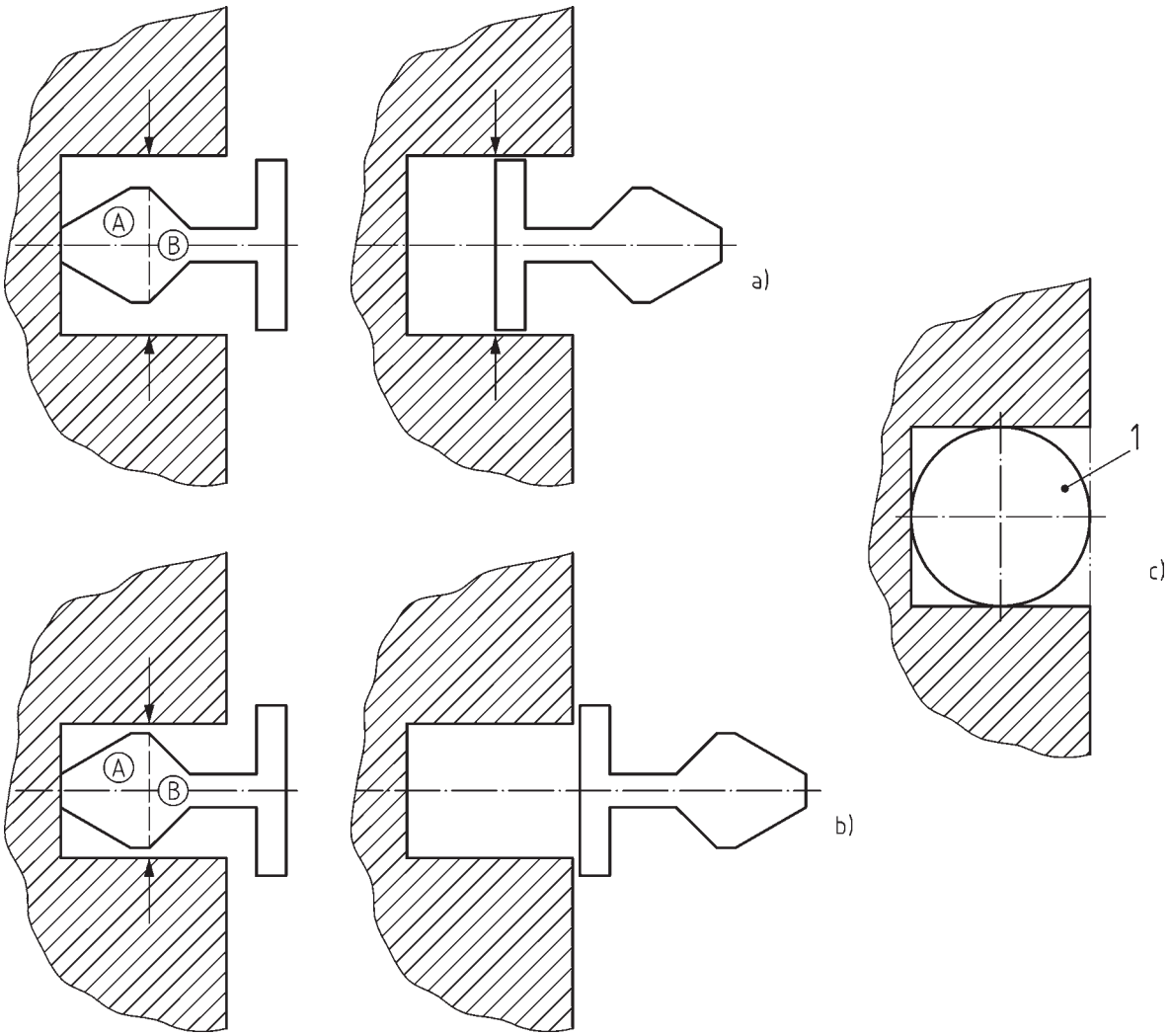


c) Pass

Key

> 600 mm =	more than 600 mm above the playing surface
< 600 mm =	less than 600 mm above the playing surface
A	A-portion (see Figure D.2)
B	B-portion (see Figure D.2)

Figure D.5 — Range 1 method of insertion of the 'A' portion of the test template



Key

a) pass
b) fail
c) pass but not the minimum requirement
1 large head probe D
A A-portion (see Figure D.2)
B B-portion (see Figure D.2)

Figure D.6 — Range 2 method of insertion of the 'A' portion of the test template followed by insertion of the shoulder of the template or probe D

D.3 Entrapment of clothing (toggle test)

D.3.1 Apparatus

Test device, as shown in Figure D.7 a), comprising:

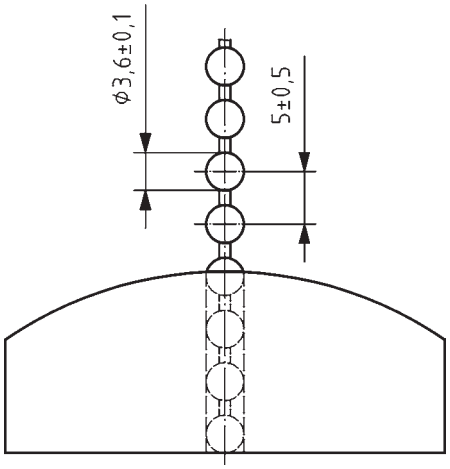
— toggle, as shown in Figure D.7 b), made of polyamides (PA) (e.g. nylon), polytetrafluoroethylene (PTFE), which have been found to be suitable materials;

— chain, as shown in Figure D.7 c);

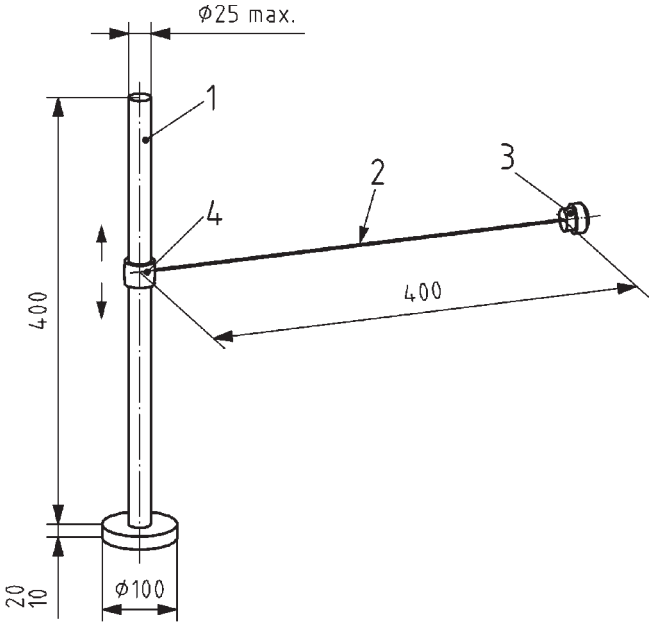
— collar, detachable and with good slip;

— pole.

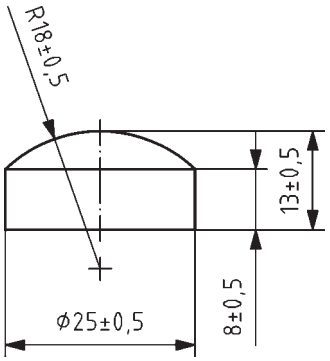
Dimensions in millimetres



c) Chain



a) Complete test device



b) Toggle

Key

1	pole
2	chain
3	toggle
4	collar

Figure D.7 — Test device

D.3.2 Procedure

D.3.2.1 Slides

Position the test device perpendicularly in the starting section of the slide, 200 mm from the transition point of the starting section, and at the appropriate lateral location, as shown in Figure D.8. For slides

of width greater than 400 mm the test shall be carried out twice with the base positioned at both width extremities of the slide bedway as shown in Figure D.8.

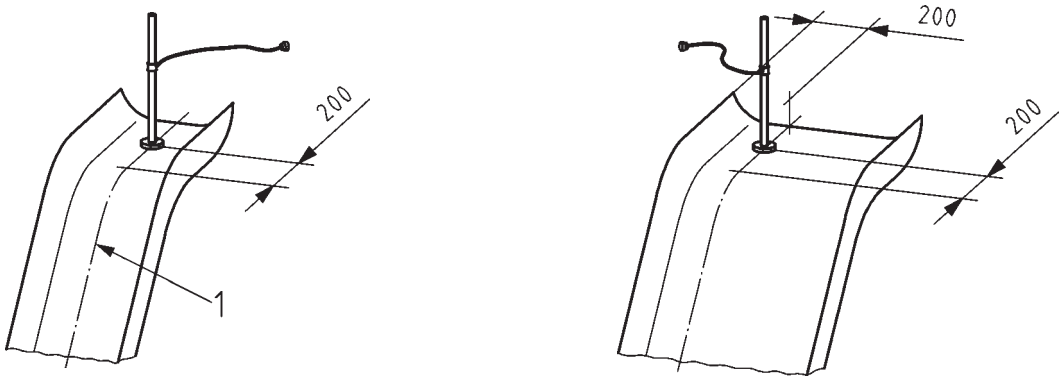
Randomly place the toggle and chain under the action of its own weight to all positions within range, without applying additional force or influence.

NOTE The objective of this test is to replicate the natural motion of a clothing toggle.

In the event that the test device is obstructed, apply a maximum force of 50 N in the direction of the forced movement. If the device is released this position within the equipment passes the test.

Record and report where any entrapment of the toggle or chain occurs.

Dimensions in millimetres



a) Narrow slide **b) Wide slide**

Key

1 centre line

Figure D.8 — Position of the test device on slides

D.3.2.2 Fireman's poles

Conduct the test with two different positions of the test device in accordance with a) and b):

a) complete test device (see Figure D.7a)):

Position the test device vertically at the edge of the platform at the point closest to the fireman's pole.

b) toggle/chain:

Detach the toggle/chain from the complete device and position so that it is at a point 1 800 mm above the surface of the adjacent platform or the highest point on the pole, if it extends less than 1 800 mm, (see Figure D.9).

Randomly place the toggle and chain under the action of its own weight to all positions within range, without applying additional force or influence, using the test device as given in a) and then as given in b).

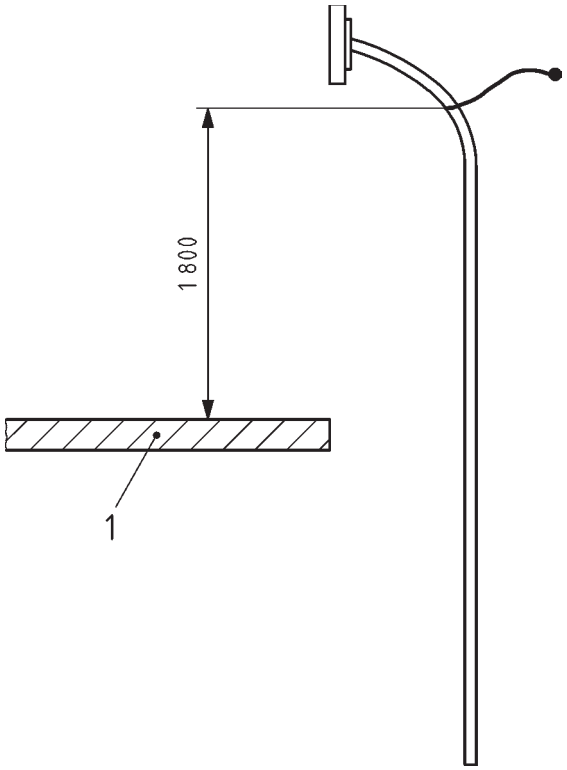
NOTE The objective of this test is to replicate the natural motion of a clothing toggle.

In the event that the test device is obstructed, apply a maximum force of 50 N in the direction of the forced movement. If the device is released, this position within the equipment passes the test.

Repeat the test as given in b) for the entire length of the fireman's pole, down to the point 1 000 mm above ground level.

Record and report where any entrapment of the toggle or chain occurs.

Dimensions in millimetres



Key

1 starting platform

Figure D.9 — Position of the test device on fireman's poles

D.3.2.3 Roofs

Detach the toggle, chain and collar from the pole of the complete test device (see D.3.1). Randomly place the toggle and chain under the action of its own weight to all positions at the apex or along the surface of the roof without applying additional force or influence.

If the toggle or the chain resists removal, apply a maximum force of 50 N in the direction of any potential sliding movement of the user. If the toggle and the chain are released, this position within the equipment passes the test.

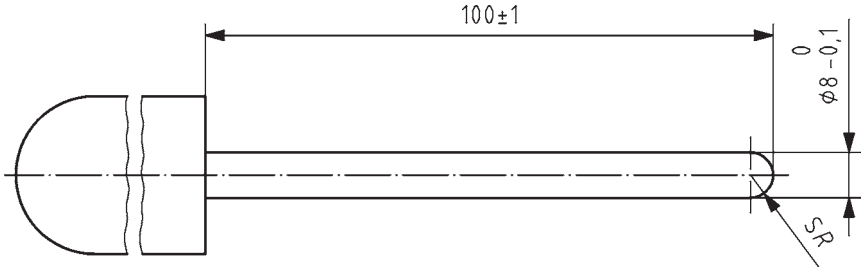
Record and report where any entrapment of the toggle or chain occurs.

D.4 Finger entrapment

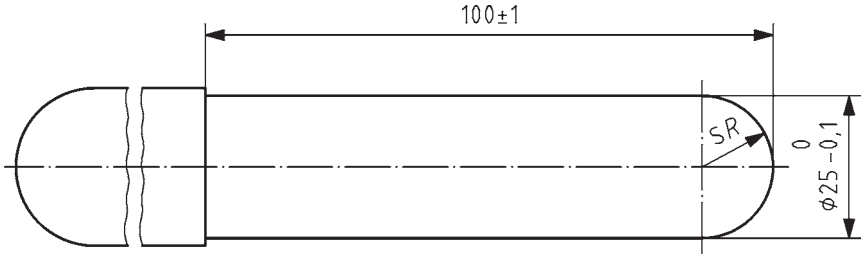
D.4.1 Apparatus

Finger rods, as illustrated in Figure D.10.

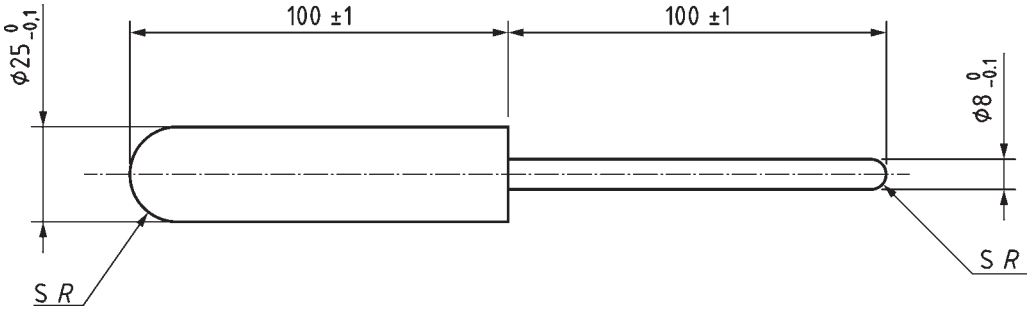
Dimensions in millimetres



a) 8 mm finger rod



b) 25 mm finger rod



c) Alternative combined finger rod

Key

SR spherical radius

Figure D.10 — Finger rods

D.4.2 Procedure

Apply the 8 mm diameter finger rod to the minimum cross-section of the opening and rotate it as illustrated in Figure D.11.

Record and report if the rod enters the opening and if it locks in any position when moved through the conical arc shown in Figure D.11.

If the 8 mm diameter finger rod passes through the opening, apply the 25 mm diameter finger rod.

Record and report if the 25 mm diameter finger rod passes through the opening and, if it does, no access shall be given to another finger entrapment site located at less than 100 mm. See Figure D.12.

Dimensions in millimetres

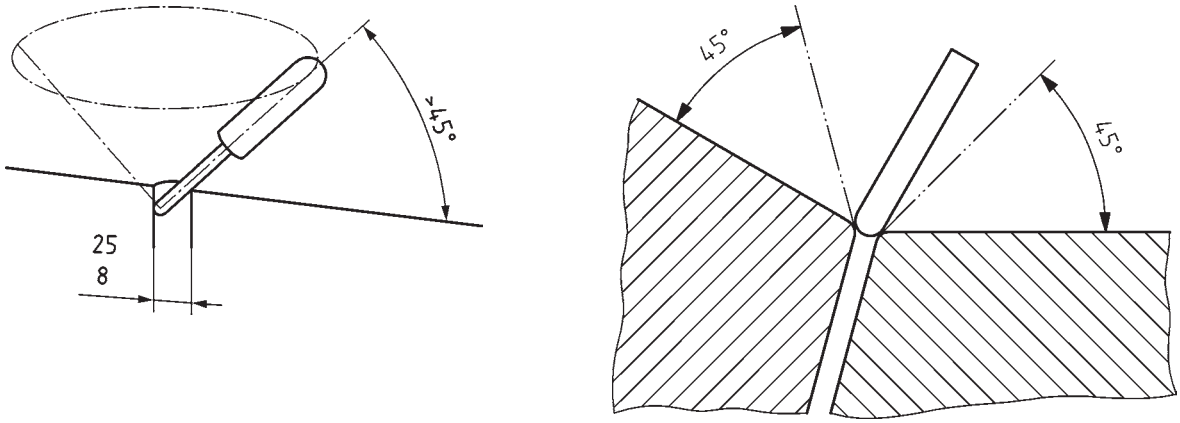


Figure D.11 — Rotation of the 8 mm diameter finger rod

Dimensions in millimetres

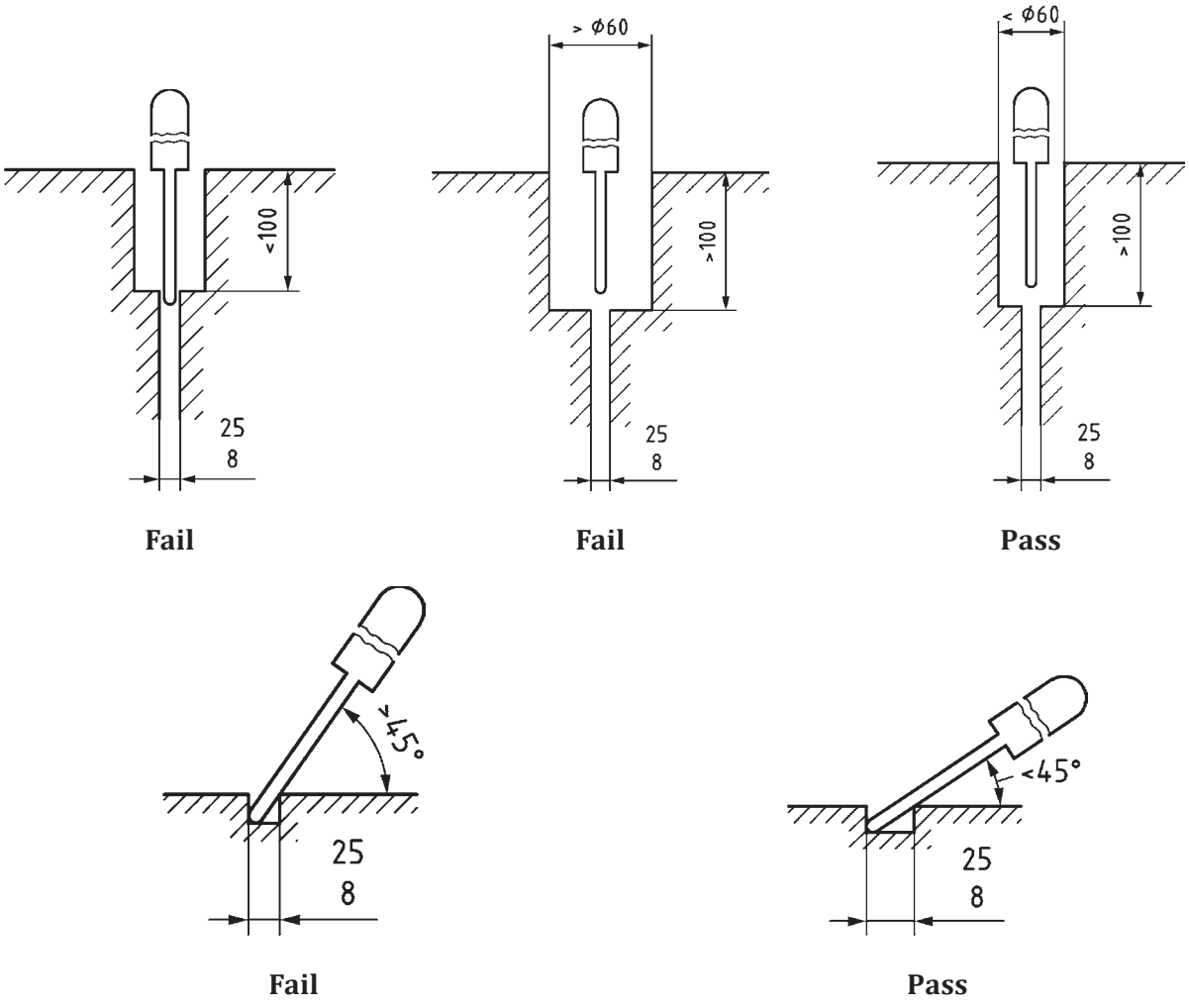


Figure D.12 — Finger rod access

D.5 Chain openings

D.5.1 Apparatus

Test rods, as illustrated in Figure D.13.

Dimensions in millimetres

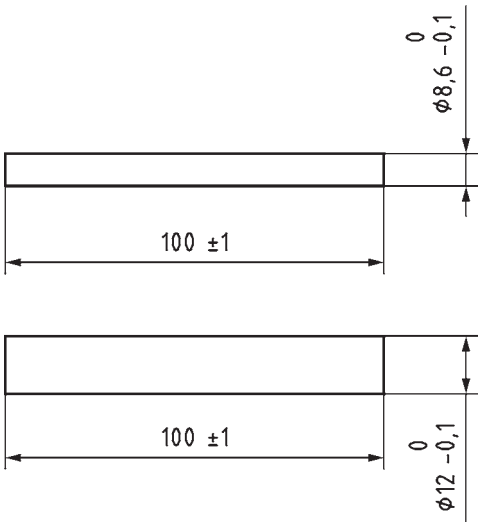


Figure D.13 — Chain test rods

D.5.2 Procedure

Apply the 8,6 mm diameter rod to the chain opening.

Record and report if the rod enters the opening.

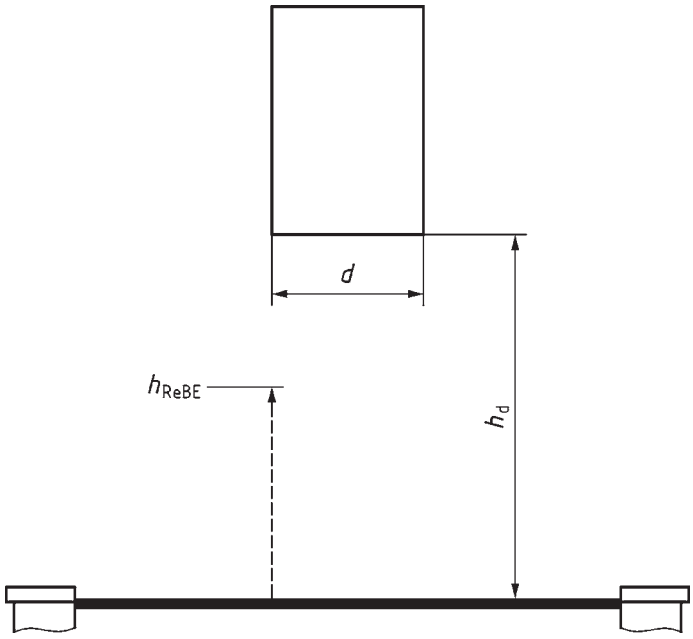
If the 8,6 mm diameter rod enters the opening and the chain opening is part of a connection apply the 12 mm diameter rod.

Record and report if the 12 mm diameter rod passes through the chain opening.

D.6 Measuring rebound effect of a bouncing facility

A cylinder-shaped weight with a diameter of (Ø360 ± 5) mm weighting (69,5 ± 3) kg is dropped to the geometric centre of the suspension bed from the height of 900 mm as illustrated in Figure D.14. The maximum height of rebound is recorded.

Dimensions in millimetre



Key

G = weight of test body, (69,5 ± 3) kg

d = diameter the test body, (Ø360 ± 5) mm

h_d = height of drop, 900 mm

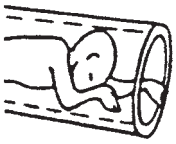
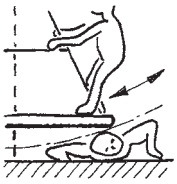
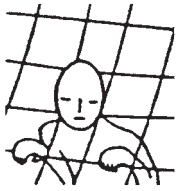
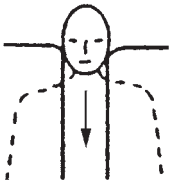
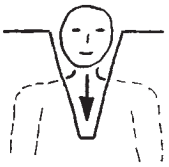
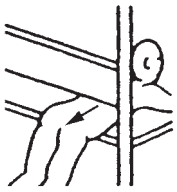
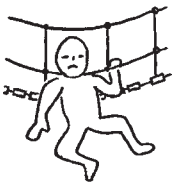
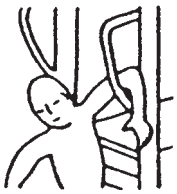
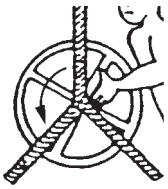
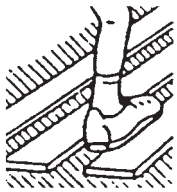
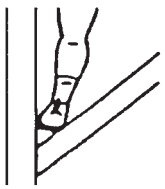
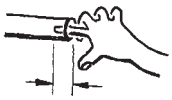
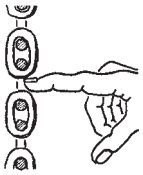
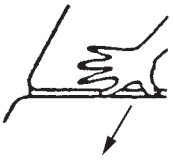
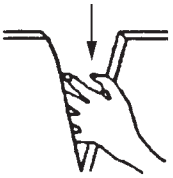
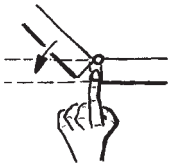
h_{ReBE} = rebound-effect

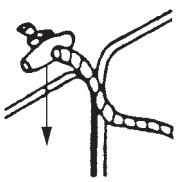
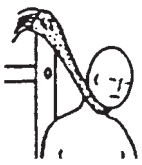
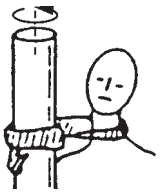
Figure D.14 — Principle of testing a rebound effect of a bouncing facility

Annex E
(informative)

Overview of possible entrapment situations

Table E.1 — Overview of possible entrapment situations

		1	2	3	4	5	6
		Completely bound openings		Partially bound openings	V-shapes	Protrusions	Moving parts of equipment
		Rigid	Non-rigid				
A	Whole body						
B	Head/neck head first						
C	Head/neck feet first						
D	Arm and hand						
E	Leg and foot						
F	Finger						

		1	2	3	4	5	6
		Completely bound openings		Partially bound openings	V-shapes	Protrusions	Moving parts of equipment
		Rigid	Non-rigid				
G	Clothing						
H	Hair						

Annex F
(informative)

Illustrations of calculation of free height of fall (FHF)

For Table F.1, Table F.2, Table F.3, Table F.4 and Table F.5, the following key is given:

- Maximum free height of fall
- Body support position (height)
- Approximate centre of gravity
- Free height of fall for which an adequate level of impact attenuation is required

Table F.1 — Standing/Walking

Dimensions in metres

	SW1	SW2	SW3
FHF	Platform	Carousel	Rocking equip-ment
4,0			
3,5			
3,0			
2,5			
2,0			
1,5			
1,0			
0,5			
0,0			
Play event	Stand, walk	Roundabout	Rocking
	3,0	1,0	1,0
	Foot	Foot	Foot/hand
	3,7	1,7	1,7
	> 0,6	> 0,0	> 0,0

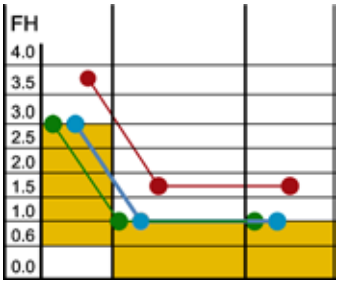


Table F.2 — Sitting

Dimensions in metres

	S1	S2	S3	S4	S5	S6	S7
FHF	Slide	Swing	Rocking equipment types 5 and 6	Cableway	Rocking equipment type 1	Carousel	Rocking equipment types 2A to 4
4,0							
3,5							
3,0							
2,5							
2,0							
1,5							
1,0							
0,5							
0,0							
Play event	Sliding	Swinging	Rocking types 5 and 6	Cableway traveling	Rocking type 1	Roundabout	Rocking types 2A to 4
	3,0	3,0	2,0	2,0	1,5	1,0	1,0
	Seat	Seat	Seat	Seat	Seat	Seat	Seat
	3,3	3,0	2,3	2,3	1,8	1,3	1,3
	> 0,0	> 0,0	> 0,0	> 0,0	> 0,0	> 0,0	> 0,0

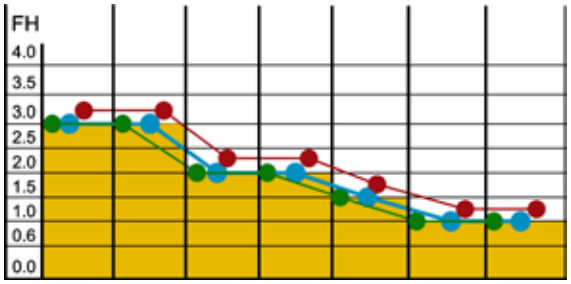


Table F.3 — Hanging

Dimensions in metres

	H1	H2	H3	H4	H5	H6
FHF	Loop/ring (flexible)	Loop/ring (rigid)	Bar (rigid)	Bar (somersault)	Cableway (ring, bar)	Carousel (ring, bar)
4,0						
3,5						
3,0						
2,5						
2,0						
1,5						
1,0						
0,5						
0,0						
Play event	Arm-walking	Arm-walking	Arm-walking	Gymnastic	Cableway traveling	Cableway traveling

	H1	H2	H3	H4	H5	H6
FHF	Loop/ring (flexible)	Loop/ring (rigid)	Bar (rigid)	Bar (somersault)	Cableway (ring, bar)	Carousel (ring, bar)
	3,0	3,0	3,0	3,0	(3,0–1,5) 1,0	(2,5–1,5) 1,0
	Hand	Hand	Hand	Hand	Hand	Hand
	3,0	3,0	3,0	3,0	2,0	1,5
	> 0,6	> 0,6	> 0,6	> 0,6	> 0,0	> 0,0

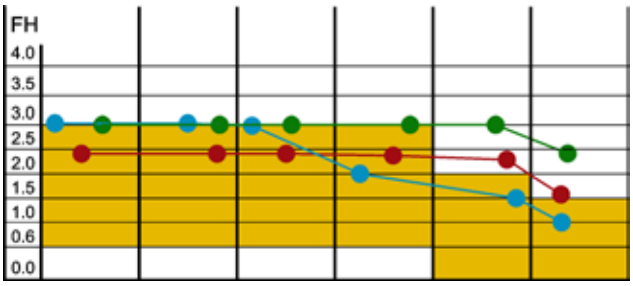


Table F.4 — Hanging/climbing

Dimensions in metres

	HC1	HC2	HC3
FHF	Horizontal ladder	Double cross-bar	Crossbar (rigid)
4,0			
3,5			
3,0			
2,5			
2,0			
1,5			
1,0			
0,5			
0,0			
Play event	Armwalking	Armwalking	Armwalking
	3,0	3,0	3,0
	Hand	Hand	Hand
	2,0	2,0	2,0
	> 0,6	> 0,6	> 0,6

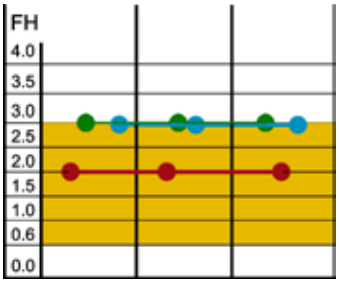
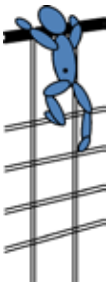
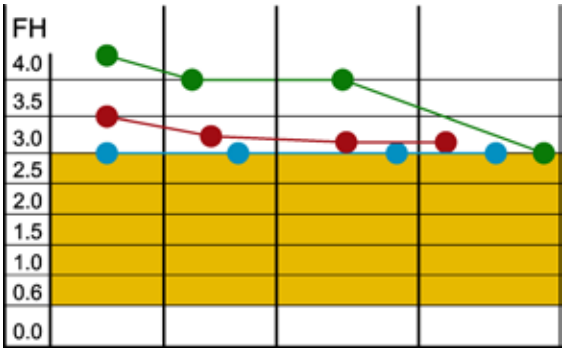


Table F.5 — Climbing

Dimensions in metres

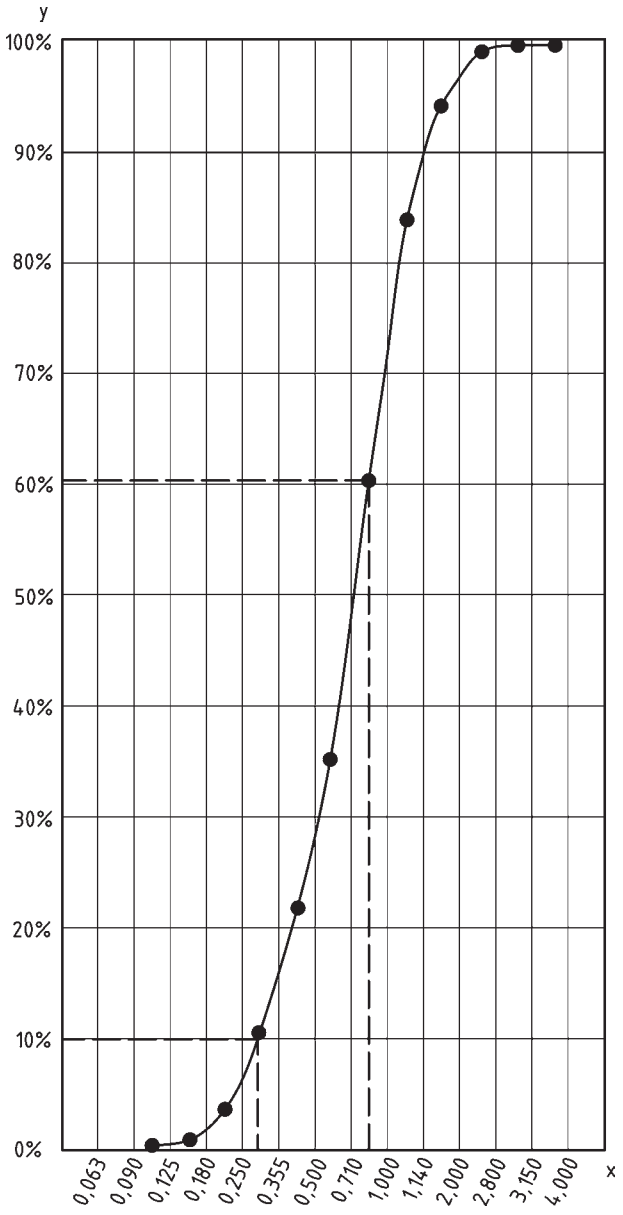
	C1	C2	C3	C4
FHF	Fireman's pole	Rope	Climbing net	Vertical climbing (stone, net)
4,0				
3,5				
3,0				
2,5				
2,0				
1,5				
1,0				
0,5				
0,0				
Play event	Gliding, climbing	Climbing	Climbing	Climbing
	(4,0–1,0) 3,0	(4,0–1,0) 3,0	(4,0–1,0) 3,0	3,0
	Foot, hand, leg	Foot, hand, leg	Foot, hand, leg	Foot, hand, leg
	3,7	> 3,0	> 3,0	> 2,0
	> 0,6	> 0,6	> 0,6	> 0,6



Annex G
(informative)

Illustration of sieve test

See Figure G.1 and Table G.1 for an illustrated example of the sieve test.



Key

y cumulative % passing

x sieves of square apertures, in millimetres

Figure G.1 — Illustration of sieve test

Table G.1 — Values resulting from test

% passing	Sieves mm
100	4,000
100	3,150
99	2,800
94	2,000
85	1,410
61	1,000
36	0,710
22	0,500
11	0,355
3	0,250
0,4	0,180
0,1	1,125
0	0,090
0	0,063

Annex H
(normative)

Procedure for confirming the adequate level of impact attenuation after installation of impact attenuating surfacing

NOTE 1 This annex is not intended for fully enclosed play equipment according to EN 1176-10.

As soon as practical after completion of installation and before use by the public/prior to first use, the compliance with requirements of 4.2.8.5 should be confirmed as being in accordance with project design specification, as agreed between the provider and operator:

a) The overall compliance with 4.2.8.5 shall be checked by visual inspection and measurement.

b) The impact attenuating surfacing shall be confirmed to be in accordance with the specification agreed between the provider and operator.

c) The thickness of the impact attenuating surfacing within each falling space shall be determined and recorded.

d) The accepted level of impact attenuation shall be confirmed.

NOTE 2 Where the provided surface relies wholly or partly on naturally occurring soil or grass substrate, the critical fall height test result will likely vary over time or with climatic conditions. As these types of surface are not scientifically controlled, it is advised to base their ongoing use on a risk assessment, rather than the strict pass/fail test results.

e) The result of post installation inspection shall be reported. Reports shall include as follows:

1) number and date of this European Standard, i.e. EN 1176-1:2017;

2) place, date and conditions on site of installation (temperature, moisture etc.);

3) description of the impact attenuating surfacing and, where accessible, the substrate;

4) confirmation of the adequate level of impact attenuation;

5) confirmation of compliance with specification of the manufacturer/supplier, where available;

6) details of the condition of the impact attenuating surfacing, including any defects observed;

7) confirmation of compliance of the impact attenuating surfacing with the requirements for impact areas (see 4.2.8.5) in relation to the playground equipment(s) installed (free height(s) of fall, extent and performance of impact attenuating surfacing);

8) if applicable, a note drawing attention to the fact that critical fall height test results will likely vary over time or with climatic conditions. If particularly requested a site test can be carried out in accordance with EN 1177. However, the results should be assessed with a risk assessment, rather than by a strict pass/fail test result. It is recommended that the surface is given a regular visual inspection to look for signs of damage. The frequency of this inspection may need to increase for surfaces subject to heavy use, extreme conditions or if vandalism is likely.

Annex I
(informative)

A–deviations

I.1 General

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC national member.

This **European Standard** does not fall under any Directive of the EU. In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of the **European Standard** until they have been removed.

I.2 France

National Regulation Decree no. 96–1136 of 18 December 1996 specifying the safety requirements for community playgrounds	
Subclause 4.2.8.5.3 The requirements of subclause 4.2.8.5.3 must not enable in France the installation of the equipment concerned on a surface that does not have impact-attenuating properties, for example bitumen, concrete, macadam, bricks or stones.	Annex II, 3, a) This part of the decree indicates that “the surfaces onto which children are liable to fall when using the equipment must be covered in suitable impact attenuating materials”.

I.3 Germany

I.3.1 General

In Germany, the following deviations from this standard are binding.

I.3.2 Impact attenuating surfacing

The requirements of the surfacing in the impact area of playground equipment and their allocation to heights of fall are given by German national law:

a) Playgrounds as structural works are subject to the German building code. The individual configuration of structural works can only be effected by German national standards;

b) The law for safety of equipment and products [Artikel 1 Gesetz über die Bereitstellung von Produkten auf dem Markt (Produktsicherheitsgesetz - ProdSG)];

c) Specifications of the German legal accident insurances (GUV).

They shall thus be maintained as given in Table I.1.

The allocation of the surfacing to the free heights of fall is no barrier to trade.

In Germany therefore Table I.1 is valid instead of Table 4.

Table I.1 — Materials in dependence of permissible free heights of fall

No.	Surfacing material [a]	Description	Minimum layer thicknesses [b] mm	Maximum height of fall mm
1	concrete/stone	—	—	≤ 600
2	bituminous surfacing	—	—	≤ 600
3	topsoil	—	—	≤ 1 000
4	turf	—	—	≤ 1 500 [d]
5	Bark mulch	20 mm to 80 mm grain size broken bark of conifers	200	≤ 2 000
			300	≤ 3 000
6	wood chips	mechanically shredded wood (no wood based materials) without bark and leaf components, grain size 5 mm to 30 mm	200	≤ 2 000
			300	≤ 3 000
7	sand [c]	grain size 0,2 mm to 2 mm	200	≤ 2 000
			300	≤ 3 000
8	gravel [c]	grain size 2 mm to 8 mm	200	≤ 2 000
			300	≤ 3 000
9	other materials or other thicknesses	according to HIC test (see EN 1177)	—	Critical fall height as tested

[a] Properly prepared surfacing material for use in children's playgrounds.

[b] For loose particulate material, 100 mm are to be added to the minimum depth to compensate for displacement (see 4.2.8.5.1).

[c] No silty or clay particles. Grain size can be identified by use of a sieve test, such as EN 933–1.

[d] See 4.2.8.5.2, NOTE 2.

National Annex NA
(normative)

UK requirements: procedure for confirming the adequate level of impact attenuation after installation of impact attenuating surfacing

NA.1 Significant changes in the requirements for testing the impact attenuation (absorbing) of playground surfacing have been introduced into this edition of the standard (clause 5.2) to reflect national variations in surfacing provision. The UK provide in this National Annex requirements to replace Annex H; these reflect current practice that have demonstrated over the lifetime of the current standard to be reasonable and proportionate.

Testing or confirmation of the surface impact attenuating properties, after installation, is not a requirement of this UK National Annex. It is strongly advised that the operator confirms that any surfacing provided has an adequate level of impact attenuation for the critical fall height of the playground equipment; this should be confirmed by a certificate of test from a UKAS registered laboratory. For Post Installation Inspections, the considered depth of the surface should be ascertained and provided to the operator, for comparison to this original certificate of test.

For all surfacing it is important that an adequate level of impact attenuation for the critical fall height be maintained. In the instances of loose fill surfaces, confirmation should be undertaken frequently as these surfaces will compact and disperse reducing their depth and impact attenuating properties during normal use.

Some products rely upon a combination of the product and the surface on which they are installed to achieve their critical fall height, such as with the use of grass. The formation surface, e.g. the soil, on which these products are installed can vary from location to location. Their critical fall height properties can be additionally affected by climate, moisture and compaction of their formation surface. Their overall impact attenuating properties therefore cannot be guaranteed by certification. Testing on site in accordance with EN 1177, will only provide an indicative, critical fall height performance. Laboratory testing the surface mounted element, complete with any fixings in accordance with EN 1177, will provide a critical fall height as tested on concrete, although this figure will take no account of any benefit provided by the site specific formation surface.

Grass alone, on playgrounds, can, with a low intensity of use, be successfully used below and around play equipment, removing the necessity to install specialist Impact Attenuating Surfaces.

- The maximum fall height of the equipment is less than 1500 mm.
- The grass shall have at least 150 mm of top soil beneath it.

  NOTE A reasonable evaluation may be made by pushing vertically by hand into the ground a thin probe, such as a screwdriver, to a depth of 150 mm at regular and frequent locations, without it being impeded by solids, such as stone, brick or tree roots.

- It should be ensured that the grass will be able to remain throughout the year and does not become mud or bare earth. Its impact absorbency is dependent upon the roots maintaining a non-compacted soil structure.

Grass, even in low usage playgrounds, will not sustain intensive use. For example: beneath the central arc of a swing; the run out area of a slide; below a fire fighters' pole; around the outside of a carousel; equipment access and exit points. For such relatively small high-wear areas to meet the requirements of this standard, other surfaces to replace or prevent erosion of the grass are needed, taking care that no trip points or hard edges occur.

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