BS EN 1069-1:2017

BSI Standards Publication

Water slides

Part 1: Safety requirements and test methods

bsi.

National foreword

This British Standard is the UK implementation of EN 1069-1:2017. It supersedes BS EN 1069-1:2010, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee SW/136/8, Swimming pools and aquatic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Wasserrutschen - Teil 1: Sicherheitstechnische Anforderungen und Prüfverfahren

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

European foreword

This document (EN 1069-1:2017) 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of an identical text or by endorsement, at the latest by February 2018, and conflicting national standards shall be withdrawn at the latest by February 2018.

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

This document supersedes EN 1069-1:2010.

EN 1069, *Water slides*, consists of the following parts:

— *Part 1: Safety requirements and test methods*

— *Part 2: Instructions*

In relation to EN 1069-1:2010 the following main amendments have been made:

a) the document has been editorially revised;

b) the definition water slide (3.3) and water level (3.13) have been revised;

c) requirement for water slide Type 6.2 revised;

d) under 5.6 “Electrical installations” a reference to HD 60364-7-702 has been added;

e) values for Table 1 “Partial factors for Ultimate Limit combinations” and Table 2 “Partial factors for serviceability combinations” have been changed;

f) new Table 3 “Partial factors for combinations of accidental actions” and Table 4 ” Combination factors ψ_0 and ψ_2” have been added;

g) Figure 5 Stepladders for water slide access deleted and requirements for access to water slides (7.5) revised;

h) Figure 6 replaced by Figure 3 of EN 13451-1:2011+A1:2016;

i) an example for calculation has been added to 7.7.3 “Maximum acceleration on a sliding person”;

j) the value for X in Figure 8 “Cross section of Type 1” has been changed;

k) Table 8 “Height of fall and water depth in splashdown area for type 1 and type 2” and Table 9 “Falling distance and water depth in a splashdown area for Types 3, 4, 6, 7, 8, 9 and 10” have been revised;

l) Table 8 has been replaced by a graph (see Figure 15);

m) values for water flow rate in 8.3 “Water flow” have been changed and Clause 8.3 moved to 7.12.2 Water flow rate;

n) Requirements in 9.3.2 “Slide tester” have been changed;

o) Figure A.1 and A.2 have been revised;

p) values for type 4 in Table A.2 “Dimensions of splashdown area for Types 3 and 4” have been changed;

q) values for type 6.2 in Table A.3 “Dimensions of splashdown area for Type 6” have been changed;

r) Annex D is now informative and a subclause on a maximum speed measuring device was added (D.1.3).

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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

The market for water slides is extremely wide and specific and still developing. It is impossible to define an all-embracing safety specification, including dimensions and design requirements as required by a standard, without limiting the design possibilities and preventing innovative and new but safe products.

This European Standard is intended to establish safety requirements and design guidance rules to serve anyone involved with water slides, especially designers, manufacturers, operators and users, to ensure safe and more efficient products. Its basic approach is the consciousness that the sliding action usually implies for the users a higher risk level than using a pool. For certain aspects of design, manufacturing, installation, operation and use only specific guidelines, without any technical specification, are given, which should be taken into consideration and be fulfilled in order to ensure safety for operators and users.

1 Scope

This European Standard is applicable to all water slides installed in swimming pools of public use.

This Standard specifies general safety requirements for water slides in swimming pools of public use and specific requirements for defined types of water slides. These specific safety requirements are also applicable to undefined types as far as possible.

These requirements concern safety and the technical rules for design, calculation and testing.

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 1069-2:2017, *Water slides — Part 2: Instructions*

EN 1990, *Eurocode - Basis of structural design*

EN 1991-1-1, *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

EN 1991-1-3:2003, *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 10088-1, *Stainless steels - Part 1: List of stainless steels*

EN 10088-2, *Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

EN 10204:2004, *Metallic products - Types of inspection documents*

EN 13451-1:2011+A1:2016, *Swimming pool equipment - Part 1: General safety requirements and test methods*

EN 13451-2, *Swimming pool equipment - Part 2: Additional specific safety requirements and test methods for ladders, stepladders and handle bends*

EN 13451-3, *Swimming pool equipment — Part 3: Additional specific safety requirements and test methods for inlets and outlets and water/air based water leisure features*

EN 15288-1:2008+A1:2010, *Swimming pools - Part 1: Safety requirements for design*

EN 15288-2, *Swimming pools - Part 2: Safety requirements for operation*

EN 22768-1, *General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications (ISO 2768-1)*

EN ISO 9606-1, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1)*

EN ISO 13857:2008, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

3 Terms and definitions

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

3.1
pool/swimming pool
facility, with one or more water areas, intended for swimming, leisure or other water-based physical activities

[SOURCE: EN 15288-1:2008+A1:2010, 3.1]

3.2
public use
use of an installation open to everyone or to a defined group of users, not designated solely for the owner's/proprietor's/operator's family and guests independently from paying an entrance fee

[SOURCE: EN 15288-1:2008+A1:2010, 3.5]

Note 1 to entry: Pools serving houses rented for private use are not of public use.

3.3
water slide
piece of equipment or installation with a sliding surface on which the user slides with water as a friction- and/or speed-reducing medium; the user slides freely or with the use of a ride enhancement device

Note 1 to entry: On some water slides the user can also be pushed e.g. by a water stream.

Note 2 to entry: For classification see Clause 4.

3.4
platform
area providing access to the start section

3.5
start section
area where the user enters the slide proper and takes the sliding position

3.6
slide proper
area intended for sliding

3.7
final part
part of the slide proper designed to prepare the user for landing, plus the subsequent parts/areas which allow landing

Note 1 to entry: Subsequent parts can be splashdown area, catch unit, sofa, etc.

3.8
landing
conclusion of sliding action

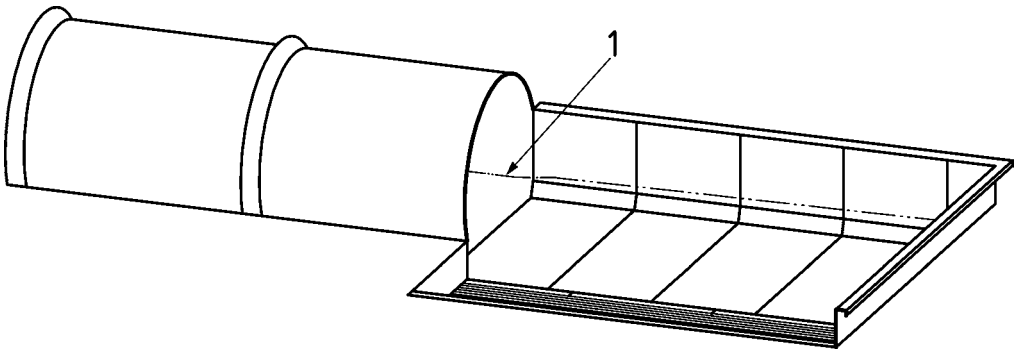
Note 1 to entry: Types of conclusion can be fall, surf landing into water, being slowed down and stopped in a catch unit or sofa.

3.9
surf landing
kind of landing which implies the action of being guided from the end of the final part, independently from its design, to intentionally surf on the water surface of the pool as a design feature

3.10
catch unit
integral part of a water slide, which brings the rider to a halt in his sliding position

Note 1 to entry: See Figure 1.

EXAMPLE



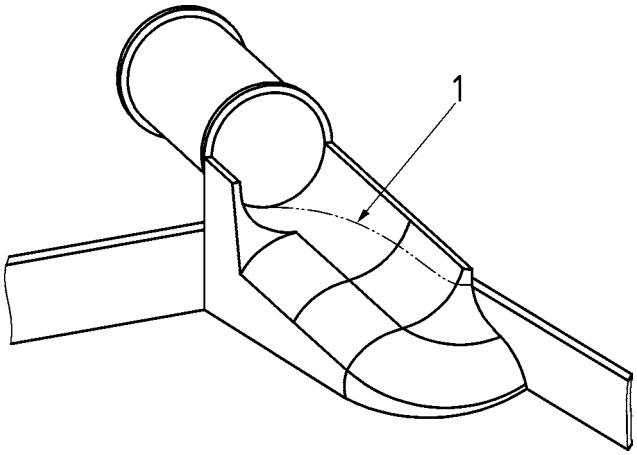
Key
1 water line

Figure 1 — Example of typical catch unit

3.11
sofa unit
integral part of a water slide, which slows down the rider on the sliding surface and moves him additionally sideways out of the sliding path of the following users

Note 1 to entry: See Figure 2.

EXAMPLE



Key
1 water line

Figure 2 — Example of typical sofa unit

3.12
splashdown area
specific pool or area which is part of a general purpose pool, in which the user lands from the end of the slide, and is brought to a halt in the water

3.13
water level
defined operating water surface in the landing area

3.14
drop
section of the slide proper, tilted with an inclination greater than those of adjacent sections

3.15
tube
closed section, not necessarily circular in cross section, of a water slide, with a fully utilisable sliding surface

3.16
cover
device to enclose an open slide, not intended for sliding

3.17
riser
extension for the slide proper, intended for sliding

3.18
wave screen
device, placed within the clearance zone, to control spilling water

3.19
ride enhancement device
device to slide on or in, designed for a particular water slide

3.20
barrier
device to restrict users from falling over, under or through it

3.21
average inclination
inclination *x* in percent (%) calculated with the formula

$$x = \left(h \, x \, 100 \right) / l$$

where

h is the height between start section and beginning of final part, in metres;

l is the developed length of the slide proper excluding the final part, in metres

3.22
clearance zone
controlled space around the user on the slide proper and of the final part, designed to prevent the impact of the users with obstacles

4 Classification

4.1 Type 1

4.1.1 Type 1.1

Straight slides for children not exceeding 1,0 m in height from start section to water level and with an average inclination ≤ 70 % may be designed in the form of a single slide or a wide slide (more than one user at the same time).

4.1.2 Type 1.2

Straight single-track slide for children with an average inclination of ≤ 70 % and a height of 1 000 mm < *h* ≤ 3 000 mm from start section to water level.

4.2 Type 2

4.2.1 Type 2.1

Curved single-track slide for children with an average inclination of ≤ 70 % and a height of ≤ 3 000 mm from start section to water level.

4.2.2 Type 2.2

Helical single-track slide for children with an average inclination of ≤ 70 % and a height of ≤ 3 000 mm from start section to water level, where the radius of the slide is constant and in the same direction.

4.3 Type 3

Single-track slide, with an average inclination of maximum 13 %, excluding the final part. The average speed of the users shall be ≤ 5 m/s. The maximum speed of the users shall be ≤ 8 m/s.

4.4 Type 4

Speed single-track slide with an average inclination between 13 % and 20 %, excluding the final part. The average speed of the users shall be ≤ 10 m/s. The maximum speed of the users shall be ≤ 14 m/s.

4.5 Type 5

High-speed single-track slide with an average inclination of at least 20 %, excluding the final part. The maximum speed of the users may be > 14 m/s.

4.6 Type 6

4.6.1 Type 6.1

Multi-track slide with separate parallel tracks (straight or curved), with an average inclination of maximum 13 %, one beside the other over the full length. The average speed of the users shall be ≤ 5 m/s. The maximum speed of the users shall be ≤ 8 m/s.

4.6.2 Type 6.2

Multi-track slide with separate parallel tracks (straight or curved), with an average inclination of between 13 % and 25 %, excluding the final part. The average speed of the users shall be ≤ 10 m/s. The maximum speed of the users shall be ≤ 14 m/s.

4.7 Type 7

Wide straight slide with a maximum inclination of 35 %, not exceeding 8 m in height above water level and 7,7 m above the ground. The maximum speed of the users shall be ≤ 8 m/s.

4.8 Type 8

Single-track slide with longitudinal descending and ascending gradients where the user also slides upwards, sometimes helped by a jet of water or by a specific device.

4.9 Type 9

Wide, straight, single-track slide providing a free transversal oscillating sliding path while sliding in direction to the end of the slide. The maximum speed of the users shall be ≤ 14 m/s.

4.10 Type 10

A combination slide where the user exits from a slide of another type into a circular bowl and descends in a spiral path, before either free falling through a hole at the bottom into the splashdown area, or entering an additional slide.

5 Materials and construction

5.1 General

Any material may be used for the construction of water slides, supports and ride enhancement devices, provided that it fulfils the requirements of this standard.

5.2 Selection of materials

All materials and finishes used shall be:

a) suitable for the selected use, the respective surroundings and conditions;

b) in accordance with the relevant standards/regulations;

c) able to withstand conditions of high humidity with occasional saturation and/or corrosiveness;

d) not encouraging the growth of bacteria.

The use of stressed stainless steel which could be subjected to stress corrosion shall be avoided, unless it can be inspected and regularly cleaned. Where stainless steel is used, the grade used shall be in accordance with Annex B.

The materials shall not contain substances which are assigned the following Risk-phrase at concentrations exceeding 0,1 % (see Regulation (EU) Nr. 1272/2008):

— N317 may cause an allergic skin reaction.

5.3 Certificates

Certificates for safety critical building materials (e.g. load bearing materials) shall:

— be in accordance with the relevant standards/regulations;

— comply at least with EN 10204:2004, test report “Type 2.2”.

5.4 Manufacturer and installer

The manufacturer and the installer shall ensure that persons engaged in the construction and the installation of the water slide are competent to carry out the work, and that welders are suitably qualified and accepted according to EN ISO 9606-1. Any assembling, modification, adjustment or alteration of parts shall only be done by persons with appropriate experience and skills.

5.5 Durability

The designer shall specify the method of protection or frequency of inspection. All components shall be protected to minimize degradation caused by corrosion or rot by an approved method. The quality of protection shall depend on the use of the components. Where hollow section structural steel is used, internal corrosion shall be considered.

5.6 Electrical installations

The relevant national and European regulations for electrical installations in and at buildings (e.g. swimming pool, swimming pool surround) apply.

NOTE See HD 60364–7-702.

6 Design

6.1 Design guidelines

The design of a water slide, as a standard model or a one-off installation conforming to the client's specifications, shall consider:

— EN 15288-1, especially the preliminary risk assessment, and EN 15288-2;

— the users the slide is destined to;

— users with special needs.

In the design document's possible/allowed user groups, their characteristics and limits shall be indicated.

NOTE Various risks can be involved in using a water slide, e.g. ejection from the slide, impacts, falls, burns, or entrapment. For guidance to a risk assessment, see EN 15288–2 and EN 1069–2.

6.2 Design analysis

6.2.1 General

Water slides shall be treated as structures, Type 1 and Type 2 water slides only when applicable. Attention is drawn to the statutory requirements e.g. with regard to means of access and means of support.

6.2.2 Preliminary risk analysis

A preliminary risk analysis shall be performed by the designer at the design stage for every water slide, with the purpose of identifying possible hazards and hazardous situations that could occur by its use, paying attention to the fact that the riding of water slides can be a vigorous physical activity and the risks associated are greater than those usually encountered in a swimming pool. Furthermore, water slides may not be safe for use by people with reduced ability, be it temporary or permanent. The risk assessment shall also take into account the balance between risks and prevention costs and ensure the conformity of the design to this standard and to all valid national regulations.

Some typical issues to be considered are:

— type of water slide;

— intended users;

— implementation of the slide into a new swimming pool complex;

— integration of the slide into an existing facility;

— distance control (e.g. interference between users);

— access control (e.g. interference between users and non-users);

— hazards related to the slide proper including those coming from possible vandalism especially parts freely accessible;

— hazards related to the landing;

— risky behaviours of the users;

— surroundings;

— traffic to and from the slide;

— influence of the use of the water slide on the regular operation of the whole facility.

The risks shall be assessed against the safety of user groups, especially of those with special needs.

This assessment is even more important for water slides not yet classified in this standard, and shall also consider the specific safety requirements given in Clause 8, to comply with them as far as possible.

The results of the preliminary risk assessment shall be made available to the slide tester who will perform the practical test, see 9.3.

6.2.3 Construction documents

Construction documents shall be provided to the customer, which shall include all the documents required for the assessment of stability and operational safety of the water slide, and complying with this standard.

The construction documents for Type 3 to Type 10 shall include as a minimum:

— type of water slide;

— declaration of conformity to this European Standard for the construction;

— full design and fabrication drawings;

— statement about intended use;

— construction method statement;

— comprehensive stress and stability analysis as required by the Eurocodes;

— description of special features of the water slide;

— description and dimensions of any clearance zones;

— specification of all materials;

— specification of electrical installation;

— any restrictions related to the users.

NOTE Type 1 and Type 2 water slides can require a simplified documentation.

6.3 Static calculations

6.3.1 General

The structural analysis of the complete slide including the supports shall be performed using the safety concept according to Eurocode EN 1990 and associated parts using the partial factor method according to Tables 1, 2 and 3 and the combination factors according to Table 4.

Table 1 — Partial factors for Ultimate Limit combinations

Permanent Actions		Variable Actions	
unfavourable	favourable	Leading variable action	Accompanying action
$\gamma_{G,i} = 1,35$	$\gamma_{G,i} = 1,00$	$\gamma_{Q,1} = 1,50$	$\gamma_{Q,i} = 1,50$

Table 2 — Partial factors for serviceability combinations

Permanent Actions		Variable Actions	
unfavourable	favourable	Leading variable action	Accompanying action
$\gamma_{G,i} = 1,00$	$\gamma_{G,i} = 1,00$	$\gamma_{Q,1} = 1,00$	$\gamma_{Q,i} = 1,00$

Table 3 — Partial factors for combinations of accidental actions

Permanent Actions		Variable Actions	
unfavourable	favourable	Leading variable action	Accompanying action
$\gamma_{G,i} = 1,00$	$\gamma_{G,i} = 1,00$	$\gamma_{Q,1} = 1,00$	$\gamma_{Q,i} = 1,00$

Table 4 — Combination factors ψ_0, ψ_1 and ψ_2

Action	ψ_0	ψ_1	ψ_2
Snow loads			
- Sites located at altitude > 1000 m a.s.L	0,35	0,25	0,1
- Sites located at altitude < 1000 m a.s.L	0,25	0,1	0
Wind loads	0,30	0,1	0
Temperature changes	0,30	0,25	0

NOTE In some European countries, a certificate on the correct construction of the water slide by an inspection body can be required to certify that the entire construction of the water slide and the way it is erected complies with all relevant standards and laws.

6.3.2 Actions in the slide area

6.3.2.1 Self-weight G_k

The self-weight of each part of the slide has to be determined by an expert using calculations or tests of the material of each part.

The self-weight is a permanent action with the duration "permanent".

6.3.2.2 Action of water Wa_k

To determine the load of the water, the real amount of water on the slide has to be calculated considering cross-section and slope of the slide.

If the slide is combined from sections with different slopes, each section has to be calculated separately, e.g. for sections with a slope of < 5 % and > 20 %. If users are able to dam up water in sections with a slope of < 20 % then the calculated amount of water in this section has to be doubled.

The action of water is a variable action with the duration "short".

6.3.2.3 Action by the users $Q_{k,i}$ and $F_{x,i}$

Actions caused by the users of the slide have to be calculated according to Table 5.

Table 5 — Actions by the users of the slide

Type	Actions by the users of the slide $Q_{k,i}$	Length of weight	Data to calculate centrifugal forces[a] $F_{x,i}$		
			Max. speed of users	Length of load application	Point of load application above bottom (see Figure 3)
		m	m/s	m	m
1	0,8 kN/m	—	—	—	—
2	0,8 kN/m	5,0	3,5	5,0[e]	0,1
3	1,5 kN/m	5,0	3,5 8,0[b]	5,0[e] 1,0[b]	0,1
4	1,5 kN/m	1,0	14,0	1,0	0,35
5	1,5 kN/m	1,0	16,0	1,0	0,35
6.1	1,5 kN/m	5,0	3,5 8,0[b]	5,0[e] 1,0[b]	0,1
6.2	1,5 kN/m	1,0	14,0	1,0	0,35
7	1,5 kN/m²[c] 0,5 kN[d]	— —	8,0	5,0[e] —	0
8	1,5 kN/m	1,0	8,0	1,0	0,1
9	1,5 kN/m²[c]	—	14,0	5,0[e]	0
10	1,5 kN/m²[c]	—	14,0	5,0	0,35

NOTE Types 8, 9 and 10 should be considered according to their type of use, e.g. single sliding or chain sliding. It is important that the length of load is set correctly.

a Max. acceleration on a sliding person 7.7.3

b Single person

c Over the complete sliding surface

d Horizontal force on the side of the slide in a height of 0,5 m above the bottom.

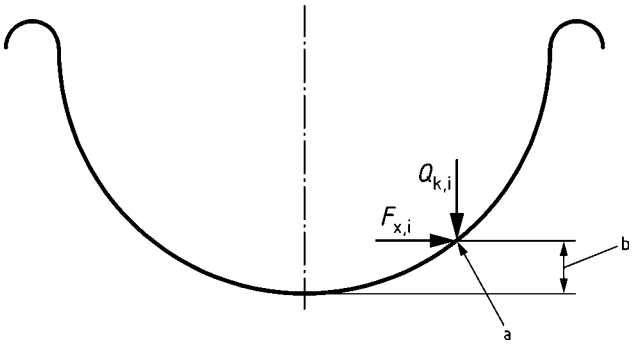
e Chain sliding with max. 5 persons

A mass moving on a curve creates a centrifugal force $F_{x,i}$ acting radially outward. The centrifugal force $F_{x,i}$ may act horizontally (in curves) or vertically (at changes of slope).

Data to calculate the centrifugal forces $F_{x,i}$ shall be taken from Table 5.

The point of application of actions $Q_{k,i}$ and $F_{x,i}$ shall be taken from Figure 3.

The action caused by the user of the slide is a variable action with the duration "short".



Key

a point of determination of the radius of a curve for $Q_{k,i}$ and $F_{x,i}$

b 100 mm respectively 350 mm, see Table 5, column 6

$F_{x,i}$ Centrifugal force (here drawn horizontally)

$Q_{k,i}$ Action of a sliding person

Figure 3 — Point of determination of the radius of a curve and of application of $Q_{k,i}$ and $F_{x,i}$

6.3.2.4 Snow loads S_k

To determine the snow loads the following has to be considered:

a) For open flumes and enclosed flumes with no thermal isolation actions caused by the snow load shall be considered for the operation case „out of operation“ only.

b) Guidelines and instructions for enclosed flumes with no thermal isolation to remove or defrost snow have to be provided by the manufacturer in the manual. (E.g. running water until snow and/or ice is melted before opening the slide to the public)

c) For enclosed flumes with thermal isolation actions caused by the snow load shall be considered for both operation cases „out of operation“ and “in operation”.

d) The action caused by snow load has to be calculated in accordance with Eurocode EN 1991-1-3:2003, Annex E:

   The density of snow is $\gamma = 2{,}0$ kN/m³.

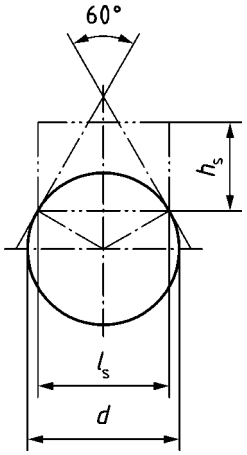
   For the influence width l_S of the snow load only areas with an inclination < 60° have to be considered, see Figure 4.

   For the height of the snow h_s the realistic snow height of the location of the slide has to be calculated, but max. 0,3 of the influence width l_S.

   The action of the snow load has to be determined as follows:

$S_k = l_s \times h_s \times \gamma$ [kN/m]

e) The action of the snow load is variable action with the duration “short”.



Key

d diameter

h_s height of the snow

l_s influence width of the snow

Figure 4 — Calculation of load influence width and height

6.3.2.5 Wind actions W_k

The wind actions shall be calculated according to EN 1991-1-4 for all types of slides.

Wind actions are variable actions with the duration „short“.

6.3.2.6 Temperature actions T_k

To calculate temperature actions the following has to be considered:

a) Temperatur actions caused by expansion due to temperature changes of:

— min. ± 30 K, if the slide is out of operation;

— min. ± 10 K, if the slide is in operation.

b) At enclosed flumes the action caused by different temperatures on the upper and underside of the flume:

— temperature difference in the cross section of the flume of ± 20 K.

c) The temperature action is not applicable if expansion can be compensated by the type of construction, e.g. non restraint installation of the slide on the supports and slide path in a way to compensate expansion.

d) Temperature actions are variable actions with the duration „short“.

6.3.2.7 Impacts

Actions caused by impacts have to be considered, e.g. at the start.

6.3.2.8 Stabilization actions

Stabilization actions are calculated as 1/20 of the vertical actions at the centre of gravity horizontally at the supporting system.

6.3.2.9 Other Actions

All other possible actions have to be considered and combined using the general combination rules according to EN 1990.

6.3.3 Actions on Access, Platforms and Railings

If the access to a slide is an evacuation route, actions according to EN 1991-1-1 have to be considered.

If the access to a slide is not an evacuation route, actions according Annex C have to be considered.

6.3.4 Combination of actions and verification

All parts shall be verified for the serviceability and structural safety.

$E_d / R_d \leq 1{,}0$

The rated value of the reaction R_d of the slide material has to be determined according to the requirements in the Eurocode, an expert's report or another approved objective evidence.

NOTE In Germany the general technical approval is issued by the DIBt (Deutsches Institut für Bautechnik).

The rated value of the action E_d shall be calculated according to the following combination rules.

The rated values of the action for the verification of the structural safety γ_G und γ_F shall be taken from Table 1 and ψ_0 from Table 4.

The rated values of the action for the verification of the serviceability γ_G und γ_F shall be taken from Table 1 and ψ_2 from Table 4.

The rated values of the action for the verification of the accidental load case „slide jam" γ_G und γ_F shall be taken from Table 3 and ψ_1 from Table 4.

Load case 1: „In Operation"- Users of the slide and action by water as leading action:

$$LC1 = \Sigma\, \gamma_{G,i} \times G_{k,i} + \gamma_{Q,1} \times Wa_k + \gamma_{Q,1} \times Q_{k,i} + \gamma_{Q,1} \times F_{x,i} + \Sigma\, \gamma_{Q,i} \times \psi_n \times W_k + \gamma_{Q,i} \times \psi_n \times S_k + \gamma_{Q,i} \times \psi_n \times T_k$$

Load case 2: „Out of operation", snow as leading action:

$$LC2 = \Sigma\, \gamma_{G,i} \times G_{k,i} + \gamma_{Q,1} \times S_k + \Sigma\, \gamma_{Q,i} \times \psi_n \times W_k + \gamma_{Q,i} \times \psi_n \times T_k$$

Load case 3: „Out of operation", wind as leading action:

$$LC3 = \Sigma\, \gamma_{G,i} \times G_{k,i} + \gamma_{Q,1} \times W_k + \Sigma\, \gamma_{Q,i} \times \psi_n \times T_k$$

Load case 4: accidental load case „slide jam":

$$LC4 = \Sigma\, \gamma_{G,i} \times G_{k,i} + \gamma_{Q,1} \times Q_{k,i} + \Sigma\, \gamma_{Q,i} \times \psi_n \times W_k + \gamma_{Q,i} \times \psi_n \times T_k + \gamma_{Q,i} \times \psi_n \times S_k$$

This load case is applicable on slides or part of slides with a slope < 20 % only. Other than load case 1 the action $Q_{k,i}$ is calculated over the complete length of the slide resp. part of slide with a slope < 20 %.

Other Actions have to be considered according to the combination rules in EN 1990.

7 Safety requirements for water slides

7.1 General

The shape of a water slide does not need to be the same as in Figures 7 to 16. Only the specified dimensions and requirements have to be complied with. Tolerances not being specified in the figures shall conform to EN 22768-1-*v*.

It is a general safety recommendation that the user should remain in contact with the slide proper.

For water slides where the user is intended to get airborne during the ride, the landing shall not cause injury or harm. Practical test according to 9.3 shall be performed.

7.2 Entrapment

To prevent risk of entrapment the requirements of EN 13451-1:2011+A1:2016, 4.7 and EN ISO 13857:2008, 4.2.2 and 4.2.3 shall be complied with for the complete installation.

7.3 Surfaces

7.3.1 General

Non-walkable surfaces in reach of staff and the public should be protected or constructed in such a way as to prevent injuries. The surface within the clearance zone (see 8.4) shall have no apertures except those for water or specific features, e.g. for light or sound effects.

7.3.2 Surface of the slide proper

The surface of the slide proper shall form a smooth, surface, free from irregularities; this surface includes the outer and inner surfaces of top returns, which could be grasped or touched by the user.

A difference in level is permitted where two elements are joined together but this shall not be against the sliding direction. Functional openings (e.g. drainage, light, and acoustic) are allowed only with dimension ≤ 8 mm in one direction. Joints and apertures shall not cause injuries and should not cause discomfort. The removal of components in reach of the users shall require the use of tools. For practical test, see 9.3.

7.4 Corners and edges

To prevent injuries, corners and edges within the clearance zone shall be rounded or suitably protected.

A radius of at least 3 mm is preferred.

7.5 Access to water slides

7.5.1 General

Access to water slides shall be constructed complying with statutory requirements and regulations. Wherever they do not exist, the following requirements apply:

— steps shall be nominally level; an inclination ≤ 2,5 % for water drainage purposes is allowed;

— water slides shall be accessible preferably by suitable stairs or ramps, supplemented in some cases by lifts. Stepladders are an alternative. Ladders are not allowed;

— the access to the start section of water slides not in operation shall be suitably prevented.

7.5.2 Stairs

Stairs to water slides shall be constructed complying with statutory requirements and regulations. Wherever the regulations do not exist, requirements of Annex C apply.

7.5.3 Stepladders

Stepladders are an alternative means of access to platforms ≤ 3 050 mm in height from the base of the stepladder and shall have an inclination 60° ≤ *x* ≤ 75° to the horizontal.

The stepladders shall have handrails on both sides, at a distance of ≤ 700 mm between each other, having the same inclination as the stepladder itself, and a clearance from the handrail to the front edge of the steps between 120 mm and 180 mm. For Type 1 and Type 2 the clearance shall not exceed 150 mm.

When stepladders lead to a height where barriers are required, their handrails shall merge into them.

The dimensions of the parts designed to be gripped shall be in accordance with EN 13451-2. For Type 1 and Type 2 the dimension shall be ≤ 35 mm.

The treads of stepladders shall have a depth between 70 mm and 250 mm, and the maximum vertical distance between the top surfaces of two adjacent treads shall be 250 mm. The front edge of any upper tread and the back edge of the adjacent lower tread shall overlap.

7.5.4 Platform

At the end of the means of access there shall be a platform, of at least 500 mm in depth, in front of the entrance to the start section, to prevent users from falling backwards. For platforms of type 1 and 2 the depth may be reduced to 300 mm if the access to the platform is not in direction of sliding.

The platform shall have barriers according to 7.5.5. Their height shall be measured from the highest point on which a person can stand within 1 000 mm from the guardrails, see Figure 5.

The width of the platform shall have at least the width of the slide proper. The start section shall be designed so that it is aligned with the direction of the initial sliding movement.

7.5.5 Protection against falling

For Type 3 to Type 10 the following requirements apply:

a) Platforms, ramps and stairs for water slides shall have barriers. They shall be designed in such a way as to prevent climbing. In addition, stairs shall have handrails on both sides.

b) Parts designed to be gripped, shall have a dimension 25 mm ≤ *x* ≤ 50 mm in any direction when measured across their centre in accordance with EN 13451-2. Barriers installed on ramps or stairs shall extend over the whole length. A barrier shall have a height *H* mentioned in Table 6.

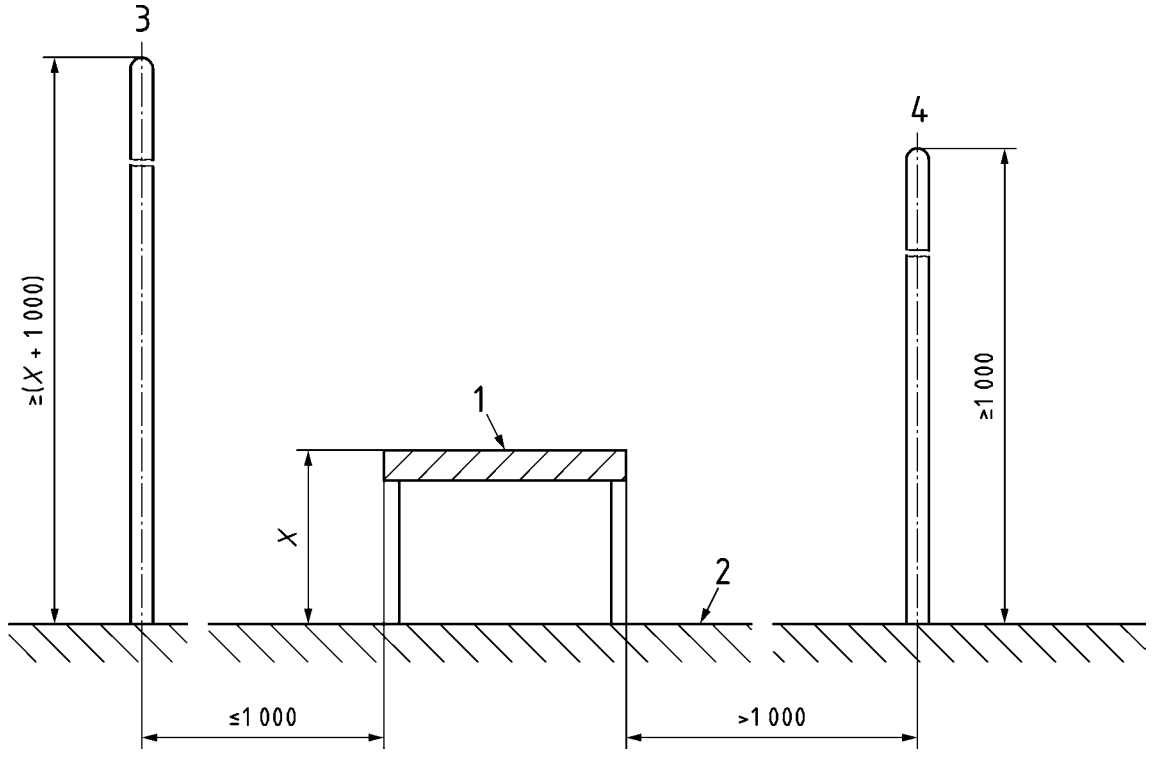
Table 6 — Barrier height

Standpoint of the user above the ground m	**Barrier height *H*[a]** mm
≥ 12,0	≥ 1 300
> 1,0	≥ 1 000
≥ 0,6	≥ 700[b]

[a] Measured from the highest point on which a person can stand within 1 000 mm from the barriers themselves.

[b] Conforming to the result of the preliminary risk assessment, particularly regarding designated users and actual height of fall, *H* may be reduced down to 350 mm.

Dimensions in millimetres



Key

1 highest standing point
2 platform
3 safety barrier within 1 000 mm from a higher standpoint
4 safety barrier outside 1 000 mm from a higher standpoint
3, 4 are different possibilities for placing barriers
X height of highest point on which a person can stand

Figure 5 — Height of the barrier

NOTE The design of barriers, e.g. grids, full faced panels or walls, should consider the visual needs connected with the use of the facility.

c) Openings between the platform surface and the lower edge of the barrier and between any infilling elements shall not allow passage of the small head probe A according to EN 13451-1.

d) The need of supplementary handrails shall be considered at the time of the preliminary risk assessment. Wherever handrails are designed on ramps or stairs they shall be installed at a height 850 mm ≤ *x* ≤ 1 000 mm.

e) The top edge of the lateral protections shall be continuous from the start of the platform to the top edge of the retaining sides of the slide proper. When the height of the platform exceeds 1 000 mm the sides of the platform shall be in the extension of the retaining sides of the start section.

For Types 1 and 2:

f) Parts designed to be gripped shall have a dimension 16 mm ≤ *x* ≤ 45 mm in any direction when measured across their centre.

g) The other previously stated requirements shall be applied to Type 1 and Type 2 as far as possible and reasonable.

7.5.6 Slip resistance

The walkable surfaces of platforms shall comply with the requirements of Rating group 18° according to EN 13451-1:2011+A1:2016, Table 1.

The surfaces of the means of access to platforms shall comply with the requirements of Rating group 24° according to EN 13451-1:2011+A1:2016, Table 1.

7.6 Start section for Types 2 to 10

If a start section is not part of a platform, it shall have barriers of the same height and characteristics as stated under 7.5.5.

The start section shall be fitted with a seamless transition from the top of the barriers to the sides of the slide proper in the sliding direction.

For Types 2 to 10:

— The start section shall be constructed in such a way that the user cannot be directly forced onto the slide proper by people coming from behind.

NOTE 1 This can be achieved e.g. by installing a raised start section, by interposing one step up between the access and the start section itself, by adopting a chicane path.

— Open water slides not designed for the use of a ride enhancement device shall have a crossbar situated 800 mm ≤ x ≤ 1 100 mm, above the surface of the slide between the start section and the slide proper.

— Open water slides designed for the use of a ride enhancement device shall have a crossbar situated 800 mm ≤ x ≤ 1 100 mm, above the riding enhancement between the start section and the slide proper.

NOTE 2 A crossbar with similar characteristics is advisable also for tubes.

7.7 Slide proper

7.7.1 General

The top edges of both outer sides of an open slide shall be made in such a way that in permitted positions the user cannot touch or reach the outer parts of the slide. The individual components of the slide proper shall be arranged or designed in such a way that the user is contained at all times within the slide and that his natural progression is safe. Practical test according to 9.3. For features altering the natural progression, see the requirement of 7.1.

7.7.2 Sliding path

The sliding path shall be designed in such a way to prevent risks as e.g. turning around, tipping over, hitting against the slide, extensive lateral oscillation, getting unstable, ejecting from the slide. Practical test according to 9.3.

7.7.3 Maximum acceleration on a sliding person

The acceleration and its duration shall conform to Table 7.

Table 7 — Gravitational acceleration and related duration

Acceleration g	**Duration** s
≤ 4	< 0,1
≤ 2,6	≥ 0,1
NOTE g = gravity force; 1 g = 9,8 m/s².	

Practical test in accordance with 9.3.4.

EXAMPLE The vector of the centrifugal force and the vector g of the gravity have to be added up vectorial.

Velocity of the user: v = 16 m/s

Radius of slide path: r = 11,0 m

Centrifugal acceleration $a = v^2/r = 16^2/11 = 23{,}27$ m/s² = 2,37 g

Max. acceleration of a sliding person $a_{max} = \sqrt{\left(2{,}37^2 + 1^2\right)}$ g = 2,57 g

7.8 Tubes and covered sections

In presence of specific features involving risk(s) of disorientation or anxiety in a tube or a covered section (e.g. a completely dark part, a shower, etc.), the user shall be notified before the means of access. Information shall be in accordance with EN 1069-2:2017, 5.2.

7.9 Final part

7.9.1 General

The first zone of the final part of the slide proper shall be designed to prepare the user for safe landing.

NOTE This can be achieved if the user is slowed down and prepared for the landing in a controlled position with particular attention to speed and awareness.

The choice of type of the subsequent part/area of the final part, which allows landing, shall be made considering a number of factors (e.g. design, type of slide, speed) and the fact that it will have an influence on certain issues (e.g. risk assessment, way of operating the slide).

In terms of safe landing of the users, a catch unit/sofa should be preferred, especially for fast and/or long slides; second choice is a special pool, and third a general purpose pool.

Practical test according to 9.3.

7.9.2 Landing device/Landing area

7.9.2.1 General

Considering the various possibilities for the landing action, different safety requirements have to be fulfilled.

If a landing by slowing down of the users is foreseen, the following two possible installations shall be used.

7.9.2.2 Slowing down units

7.9.2.2.1 Catch unit

A catch unit may be used for every type of water slide (except Type 10 with a splashdown area after bowl), but shall be used for slides with a landing speed > 10 m/s.

The catch unit shall be designed in such a way that:

— the user is brought to a safe halt without impact with the end of the unit;

— the user can leave safely and quickly.

The requirement of 7.3.2 shall be obeyed also for the possible joints between a catch unit and the slide proper.

NOTE Attention is drawn to the appropriate statutory requirements concerning means of exit.

A catch unit shall foresee the possibility of a complete drainage for cleaning purposes.

Practical test in accordance with 9.3.

7.9.2.2.2 Sofa unit

A sofa unit may be used for every type of water slide (except Type 10 with a splashdown area after the bowl).

The sofa unit shall be designed in such a way that:

— in the unit the user, in relation to weight and speed and by means of an additional sideways slope of the sliding surface, shall be moved sideways out of the path of following users;

— the user is brought to a safe halt without impact;

— the user can leave safe and quickly sideways either by walking away or by being delivered into an existing shallow pool.

Practical test in accordance with 9.3.

7.9.2.3 Splashdown area

A splashdown area may be used for every type of water slide, provided the user is slowed to a speed ≤ 10 m/s.

For dimensions, see Annex A. If a splashdown area is used for Types 5, 8, 9 or a non-classified type of water slide, its dimensions shall be the same as for classified water slides with the same maximum landing speed.

NOTE Water flow at the splashdown area should be provided, intending to move users away to minimize the risk of collisions.

Practical test in accordance with 9.3.

Splashdown areas for Type 10 shall comply with Figure A.5.

7.9.2.4 Surf landing area

The use of a landing area is allowed only for water slides where the use of a ride enhancement device is foreseen.

Wherever a surf landing is foreseen, the dimensions of the surf landing areas shall be designed on the basis of a specific preliminary risk assessment, which shall take into consideration all factors involved (e.g. speed at the final part, body and ride enhancement device masses, type of ride, enhancement device), with the purpose of avoiding any impact with fixed structures

7.10 Splashdown areas

If the slide ends in a pool, the exit up to floor level shall be stepladders according to EN 13451-2, stairs or sloping bottom. Compliance with EN 15288-1 is required.

Exits shall be designed to allow quick and safe leaving without interference with the subsequent users, considering also the related means of access. Markings on the pool floor or floating lines between the slides according to Figure A.1, A.2 and A.3 are required.

The exit path for users shall not interfere with the exit path of other slides. For wide slides, multi-track slide and if final parts of more than one slide enter the same side of a pool, the means of exit shall be designed to force the users to move forward and away from the paths of other users. Allowed positions for the exits are shown in Figures A.1, A3, A.4 and A.5.

The requirements of this point shall be complied with also for catch units wherever applicable.

7.11 Accessories

7.11.1 Covers

The inner surface shall be smooth and free from irregularities except joints. Methods of fixing shall be constructed so as to prevent injury to the user.

7.11.2 Ride enhancement devices

The safety related dimensions given in the standard (e.g. clearance zones, height of entrance to covered sections, inner diameter of tubes) are related to users sliding onto the slide proper. When designing facilities, which foresee the use of ride enhancements devices, these dimensions shall be adapted to the dimensions of the device.

Water slides where the use with ride enhancement devices is foreseen shall be designed taking into account also the possibility that a user becomes parted from his ride enhancement device and/or he

comes into contact with the parted device. Where necessary, recovering of the user and of the parted device shall be foreseen.

Ride enhancement devices shall float when used in a splashdown pool. The edges shall be in accordance to 7.4.

The device shall be clearly marked with the indication of the specific body position, body weight and body length it is designed for, or the same information shall be clearly displayed at the ride enhancement device pick point.

If the ride enhancement devices are not made of soft material (e.g. inflatable or soft foam devices), the manufacturer shall notify the need of operational conditions which avoid impacts between them and the users.

Practical test according to 9.3.

7.11.3 Other constituent parts

7.11.3.1 Cover or tube entrance, wave screens and risers

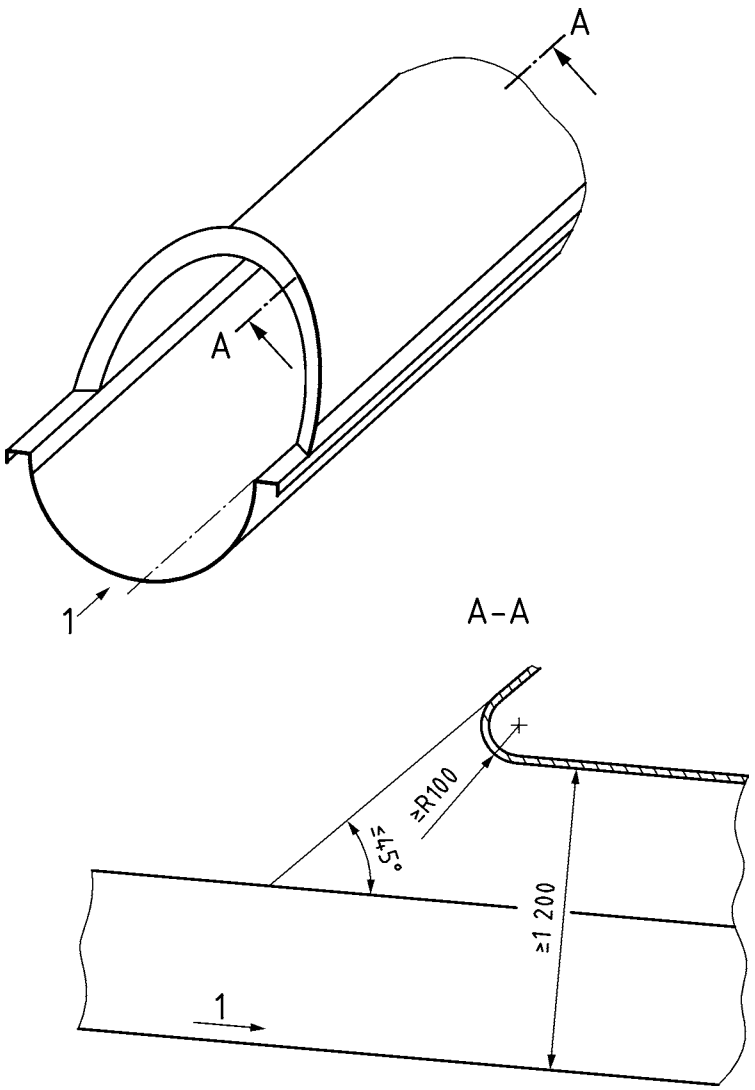
Where a cover or a tube entrance, a wave screen or riser is fitted other than at the beginning of the slide, the sides of the slide shall have a smooth transition with a maximum angle of 45° regarding the speed. Edges shall have a radius ≥ 100 mm.

NOTE The required radius can be integral or achieved with the application of accessories, e.g. soft bumpers.

The height of the entrance to the cover or tube shall be at least 1 200 mm. For tubes, after the first metre a smooth transition to the nominal design diameter is allowed.

See Figure 6:

Dimensions in millimetres



Key
1 sliding direction

Figure 6 — Transition

7.11.3.2 Transition between different cross sections

Transitions between two different cross sections are allowed, provided they are designed to grant a smooth passage, regarding speed and sliding path(s).

Practical test according to 9.3.

7.12 Water supply

7.12.1 General

Suction systems designed to extract water destined to the water slides directly from areas accessible to the public shall comply with EN 13451-3.

7.12.2 Water flow rate

As the water flow rate has an effect on the safety of sliding, it shall be defined by the supplier and fixed for each installation at the time of commissioning. Wherever additional water is introduced after the start section, it shall be removed afterwards or its effect on sliding shall be considered. Particular attention shall be paid at the design stage to flow rate when the injected water is part of a special effect, including the effects of possible flow interruptions.

There shall be some means of ensuring that interference with the water flow rate by unauthorized personnel is eliminated. The preliminary risk assessment (see 6.2.2) shall show if an alarm device needs to be installed, which activates in the event of malfunction.

The preliminary risk assessment shall also show, for slides from Type 3 or higher and slides of Type 2 with a catch unit, whether or not they have to be provided with a device to monitor the water flow which activates an alarm in case of malfunction and informs staff in charge.

The inlet of water shall begin not later than the start section.

Water flow rate shall be as follows:

— at least 0,18 m^3/h for Type 1.2;

— at least 2,4 m^3/h for Type 2.1 and 2.2;

— at least 90 m^3/h for Types 3, 4, 5 and 6 curved;

— at least 6 m^3/h per metre of track width, for each track of Type 6 straight;

— at least 6 m^3/h per metre of width for Type 7.

A minimum water flow for Types 1.1 is not required. Should a manufacturer require a water flow for certain models, this shall be clearly stated in the slide manual.

For Types 8, 9 and 10 the flow of water in terms of positioning of inlets, quantity and other related characteristics shall be determined by the manufacturer and indicated in the slide manual. Practical test see 9.3.

7.13 Interference between users

The slide shall be designed and/or installed and equipped and operated in such a way that unplanned or accidental interference between users is prevented.

NOTE Accidental interference between users can be caused e.g. by inappropriate spacing at the start and/or by significant differences in speed of the users caused by different sliding positions.

If different sliding positions cause significant differences in speed, only one position (or a group of positions causing similar speeds) shall be allowed, or a distance control according to the situation has to be arranged.

If sliding in an allowed position can bring the user to an involuntary stop, this allowed position shall be altered/restricted as shown EN 1069-2:2017, Annex A.

Practical test in accordance with 9.3.

7.14 Interference between users and non-users

The slide shall be designed and/or installed and operated in such a way that non-users cannot interfere with users in their clearance zones.

Practical test in accordance with 9.3.

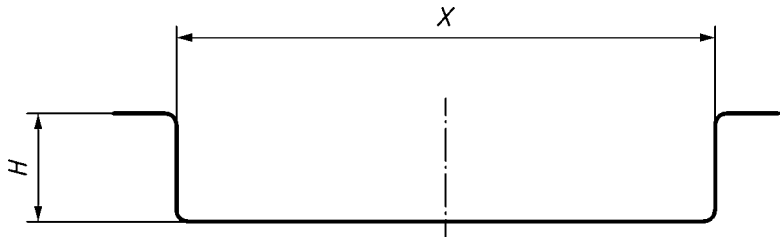
8 Additional safety requirements for Types 1 to 10

8.1 Slide proper

8.1.1 Type 1

8.1.1.1 Type 1.1

The dimensions of the cross section shall be in accordance with Figure 7.



Key
$H \geq 120$ mm
$X \geq 350$ mm

Figure 7 — Cross section of Type 1

The sides shall be perpendicular to the sliding surface or curved or angled at an obtuse angle to the sliding surface.

8.1.1.2 Type 1.2

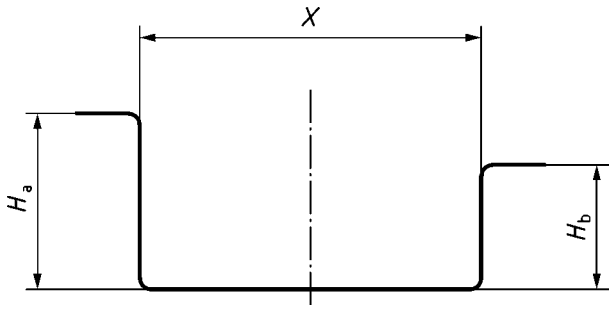
The dimensions of the cross section shall be in accordance with Figure 7, except for tubes, which shall have an inner diameter ≥ 750 mm.

The sides shall be perpendicular to the sliding surface or curved or angled at an obtuse angle to the sliding surface.

8.1.2 Type 2

8.1.2.1 Type 2.1

The dimension of the cross section shall be in accordance with Figure 8, except for tubes, which shall have an inner diameter ≥ 750 mm.



Key

$H_a \geq 400$ mm	for outer curve
$H_b \geq 200$ mm	for inner curve
350 mm ≤ X ≤ 700 mm	if the slide proper is flat
350 mm ≤ X ≤ 900 mm	if the slide proper is rounded
a	outer curve
b	inner curve or straight

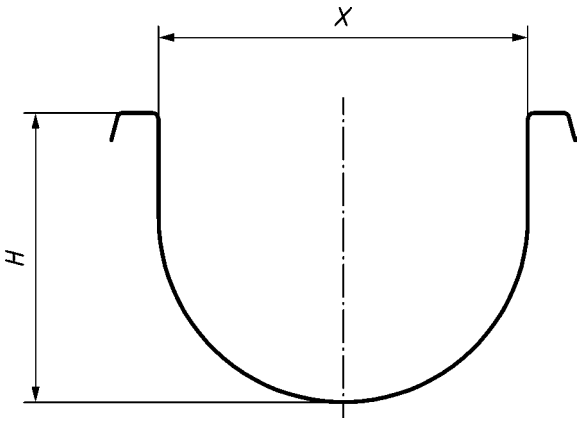
Figure 8 — Cross section of 2.1

The sides shall be perpendicular to the sliding surface or curved or angled at an obtuse angle to the sliding surface.

NOTE Where bottom of slide proper is flat, it should be declined to the inner radius of the curve.

8.1.2.2 Type 2.2

The dimensions of the cross section shall be in accordance with Figure 9 or Figure 10 except for tubes, which shall have an inner diameter ≥ 750 mm.



Key

$H \geq 400$ mm

350 mm ≤ X ≤ 700 mm, if the slide proper is flat

350 mm ≤ X ≤ 900 mm, if the slide proper is rounded

Figure 9 — Cross section of Type 2.2

8.1.3 Type 3

The dimensions of the cross section shall be in accordance with Figure 10, except for tubes, which shall have an inner diameter:

— ≥ 800 mm;

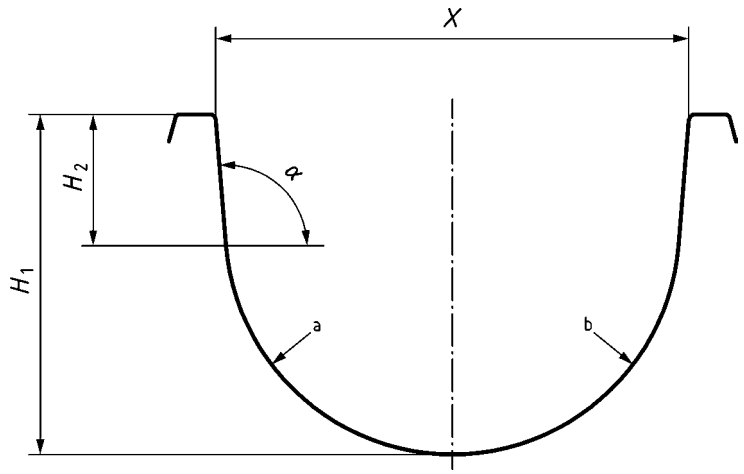
— ≥ 1 000 mm if the possibility of becoming involuntarily airborne is foreseen;

— ≥ 1 200 mm if the sitting position is allowed.

8.1.4 Type 4

If the slide is not a tube, the dimensions of the cross section shall be in accordance with Figure 10.

If the slide is a tube, the diameter shall be ≥ 800 mm.



Key

α ≤ 95°

X ≥ 800 mm (width of slide)

H_1 ≥ 700 mm (for Type 4)

H_1 ≥ 600 mm (for Type 3)

H_2 ≥ 200 mm

a outer curve

b inner curve or straight

Figure 10 — Cross section of Type 3 and 4

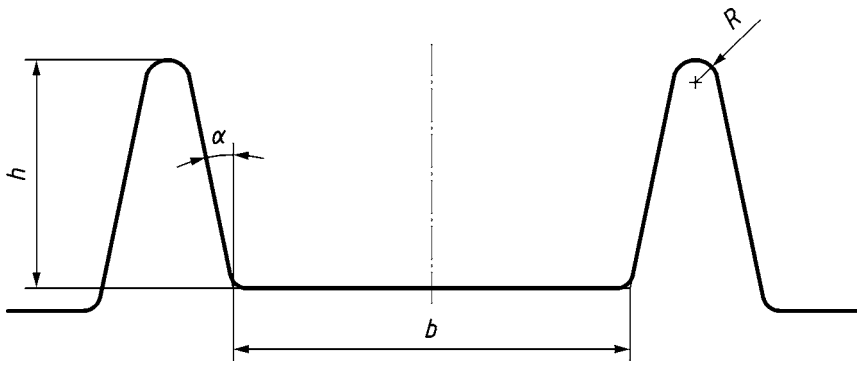
8.1.5 Type 5

Straight slides with a curved bottom shall comply with the requirements of Type 4, see Figure 10. Straight slides with a flat bottom shall be in accordance with Figure 11.

If the slide is not straight it shall be constructed as a tube:

— of an inner diameter ≥ 800 mm and a maximum inner diameter of 900 mm if designed to be used freely;

— of an inner diameter ≥ 1 000 mm and a maximum inner diameter of 1 500 mm if designed to be used with ride enhancement devices.

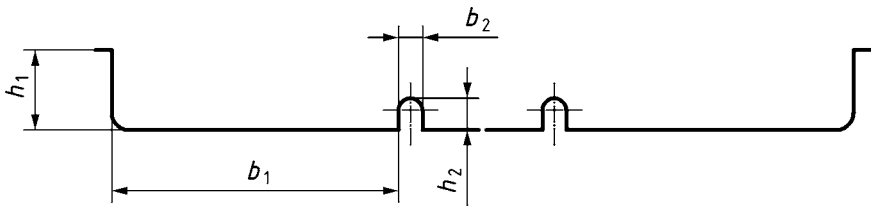


Key
600 mm ≤ *b* ≤ 700 mm
h ≥ 400 mm
α ≤ 12°
R ≥ 40 mm

Figure 11 — Cross section of Type 5

8.1.6 Type 6

The dimensions of the cross section of a straight slide shall be in accordance with Figure 12.



Key
600 mm ≤ b_1 ≤ 1 800 mm
b_2 ≥ 150 mm
*h*1 ≥ 500 mm
*h*2 ≥ 200 mm

Figure 12 — Cross section of Type 6

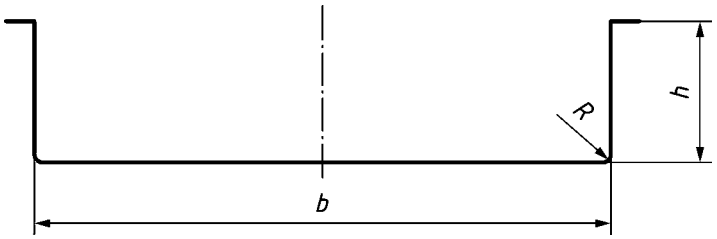
Each track of curved multitracks of Type 6.1 shall have a cross section conforming to Figure 10, Type 3.

Each track of curved multitracks of Type 6.2 shall have a cross section conforming to Figure 10, Type 4.

Straight multitracks shall have a cross section conforming to Figure 10 or Figure 12.

8.1.7 Type 7

The dimensions of the cross section of a wide slide shall be in accordance with Figure 13.



Key

2 000 mm ≤ b ≤ 5 000 mm

h ≥ 500 mm

$R \leq h/2$

Figure 13 — Cross section of Type 7

8.1.8 Type 8

There shall be provision for recovering users and their ride enhancement devices from the slide proper when they are unable to continue the ride.

8.1.9 Type 9

Design conforming to preliminary risk assessment.

8.1.10 Type 10

The design of the slide shall avoid the possibility that along his sliding path the user passes over the entrance of the bowl.

The manufacturer shall state the number of users allowed at the time on the slide proper. This requirement has to be considered and included into the risk assessment. For slides with a drop fall into a splash pool only one user at a time is allowed.

8.2 Splashdown area

8.2.1 Acceleration

Acceleration and its duration shall conform to Table 7, by calculation or by testing in accordance with 9.3.4.

8.2.2 General and specific pools

The dimensions given in Annex A, Figures A.1 to A.6 are minimum dimensions.

In any case, upon landing the user shall not be able to reach the surrounding walls of the splashdown area or collide with users from adjoining slides.

Practical test in accordance with 9.3.

In case of slides of Types 2 to 4 with final parts entering the same side of a pool and slides of Type 6, a centre line of contrasting colour for each lane shall be indicated on the pool's bottom, and/or soft floating lanes shall be used to lead users to their proposed exits.

Minimum water depth for different falling distances is shown in Table 5 and Table 6; the pool's floor in the splashdown area shall be free of irregularities.

In the splashdown areas defined in Annex A the pools bottom may slope, provided the minimum water depth complies with Figure 15and Table 8; wherever the water depth is ≤ 1,35 m, the requirements as

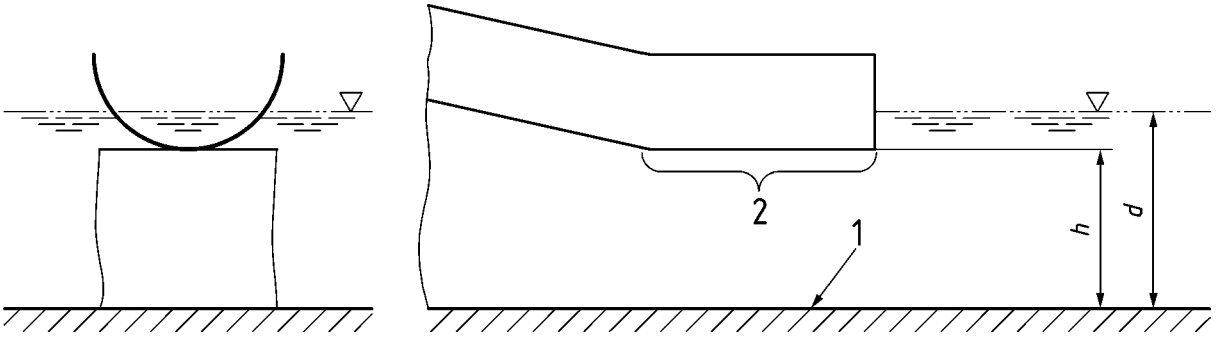
specified in EN 15288-1:2008+A1:2010, 5.6.3.1 shall apply; the anti-slip requirement given in EN 15288-1:2008+A1:2010, 5.6.3.1, c) do not apply if the sliding action ends onto the pool floor.

In general pools, a device shall be installed to prevent other users from crossing the designated splashdown area.

8.2.3 Requirements for landing

8.2.3.1 Types 1 and 2

The difference in height from final part to basin floor and the water depth in a splashdown area shall be in accordance with Figure 14 and with Figure 15.

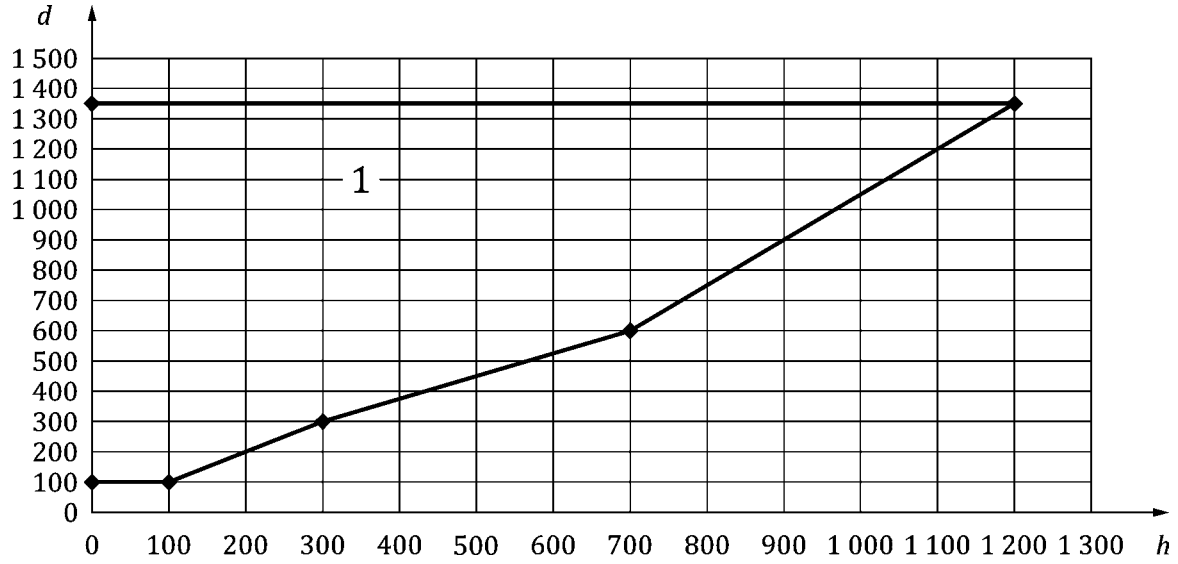


Key

1 pool floor
2 final part
d water depth
h difference in height between final part and basin floor

Figure 14 — Difference in height between final part to basin floor and water depth at slide outlet for Types 1 and 2

Dimensions in millimetres



Key

d water depth in mm

h difference in height between final part and basin floor

1 water depth suffient

Figure 15 — Difference in height between final part and basin floor h and water depth d in splashdown area for type 1 and type 2

The inclination of the final part shall not exceed 10 %. The water depth for Type 1.1 shall not exceed 500 mm.

The user shall not be able to impact (touch) the pool wall during landing.

8.2.3.2 Types 3, 4, 6, 7, 8, 9 and 10

For Types 3, 4, 6, 7, 8, 9 and 10 the relationship between falling distance (from the end of the final part to water level) and water depth, shall be in accordance with Table 8.

The minimum water depth shall be conventionally measured throughout the splashdown areas according to Annex A.

Table 8 — Falling distance and water depth in a splashdown area for Types 3, 4, 6, 7, 8, 9 and 10

Falling distance[a] d_f mm	**Type 3, 4, 6, 7, 8, 9 and 10 Water depth** mm
$0 < d_f \leq 200$	≥ 1 000
≤ 600	≥ 1 800
a d_f = 0 mm for type 7 is recommended.	

Intermediate values to be interpolated linearly.

For falling distances ≥ 600 mm the water depth has to be increased depending on the actual installation and design, but under no circumstances shall the user, while landing, be able to impact the bottom. Practical test in accordance with 9.3.

8.2.3.3 Requirements for surf landing

Where surf landing in a pool is foreseen, during his surfing action the user shall not be able to reach the perimeter of the pool, nor any obstacle. Practical test according to 9.3.

8.3 Clearance zones

Clearance zones are related:

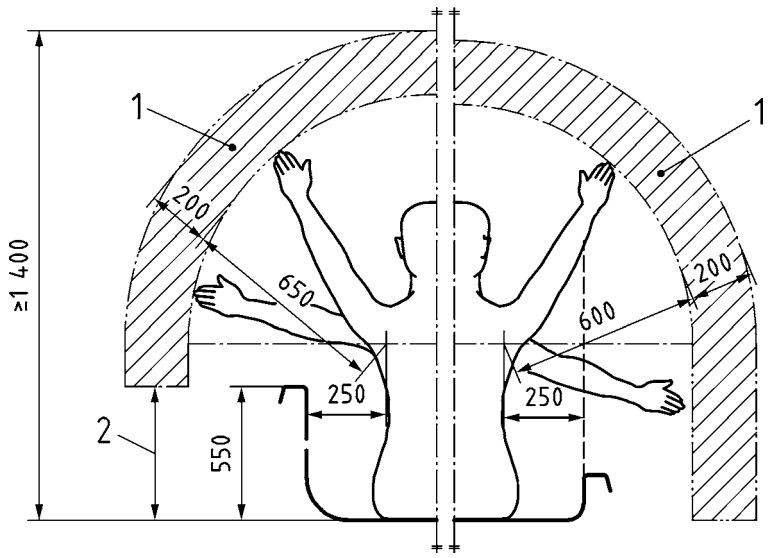
— to the axis of the body of the user and not the axis of the slide proper;

— to the foreseeable positions of the user on the slide proper and the final part, referring to the dimensions and points of origin given in Figure 16.

Technically unavoidable components (e.g. parts of existing buildings) are accepted in the extended clearance zone, provided they are protected by a suitable guard. Integral or applied, smooth and free of irregularities, with edges rounded to a radius ≥ 100 mm (see Figure 8 entrance of a tube).

Designated clearance zones for a particular slide shall be indicated by the manufacturer in the slide manual.

Dimensions in millimetres



a) Types 3, 4, 5, 6(curved), 8 **b) Types 1, 2, 6 (straight), 7, 9**

Key

1 extended clearance zone

2 height of the side of the slide

Figure 16 — Clearance dimensions

Wherever a ride enhancement device is foreseen the vertical dimensions of Figure 15 shall be increased by the height of the device.

For slides of Type 1.1 depending on the design of the pool, on one side of the slide the clearance zone may be 0 mm without any gap along the complete slide, if the slide is positioned directly beside a wall and the side of the slide proper is protected by a side with a height ≥ 600 mm.

9 Check and test runs

9.1 General

The technical test shall include the check of the preliminary risk assessment at the existing water slide and the check of the technical documentation.

The result of the technical test shall be considered for the conclusive risk assessment.

9.2 Technical and physical checks

Unless a practical test is required according to 9.3 the requirements of the standard shall be verified using the most appropriate method, e.g. visual and/or tactile examination, or measurement.

The technical and physical check shall be carried out by an independent third party expert with the necessary technical, operational knowledge and experience in the field of water slides.

9.3 Practical test

9.3.1 General

For slides Type 3 to Type 10 the requirements of 7.1, 7.3.2, 7.7, 7.9.1, 7.9.2.2, 7.9.2.3, 7.11.2, 7.13, 7.14, 8.2.2 and 8.2.3 shall be tested.

The test shall be carried out at the same time and as part of commissioning by one or more slide tester.

Where the slide tester(s) is not appointed by regulation, the appointment shall be by agreement between supplier and customer.

9.3.2 Slide tester

The practical test shall be carried out by a tester, with the necessary technical, operational knowledge and experience in the field of water slides. The slide tester shall:

— be bodily fit;

— have theoretical knowledge regarding the used test methods and their assessment including measuring instruments and practical sliding experience with all major types of slides;

— have a practical experience about how to reach the extreme sliding conditions (e.g. max. and min. speed, getting airborne, exposing to contact with the slide proper the maximum, respectively minimum area of bathing costume, lifting his body).

Prior to the practical test slide testers shall familiarize themselves with the slide by using it several times.

Additional tests may be carried out by slide testers with different body shapes and sizes.

NOTE A slide tester independent from the producer and the operator is preferred.

9.3.3 Sliding conditions

The tester shall seek to simulate conditions resulting in minimum and maximum speed and accelerations by varying sliding positions, maximum and minimum area of bathing costume, etc.

To obtain maximum speed and as a result maximum accelerations all exclusively allowed sliding positions shall be applied. These tests shall be carried out wearing bathing costume and using the designed ride enhancement devices if foreseen.

To obtain minimum speed and as a result minimum accelerations and considerable differences in sliding speed (e.g. to determine the type of distance control) all exclusively allowed sliding positions shall be applied.

Each test shall be repeated at least five times maintaining same conditions (e.g. allowed sliding positions, posture, bathing costume).

9.3.4 Acceleration and speed measurements

Where accelerations and speeds cannot be calculated with sufficient precision or in case of doubt a measurement in accordance with Annex D or with an equivalent method shall be carried out. This decision shall be taken by an independent third party expert with the necessary technical and operational knowledge and experience in the field of water slides.

9.4 Test report

The test report shall be prepared in accordance with EN ISO/IEC 17025.

The test report shall include at least the following information:

a) number and date of this standard;

b) title “Test report”;

c) name and address of the examining expert and where the test was carried out;

d) unique identification of test report (such as serial number) and of each page, and total number of pages of the test report;

e) name and address of client;

f) description of the applied test procedure;

g) description and identification of the test item;

h) date(s) of examination;

i) identification of the test specification or description of the method or procedure;

j) any deviations, additions or exclusions from the test specification, and any other information relevant to a specific test;

k) identification of any non-standard test method or procedure utilized;

l) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified;

m) a statement on measurement uncertainty (where relevant);

n) a statement that all the requirements of the standard have been fulfilled;

o) a statement to the effect that the test results relate only to the items tested;

p) a statement to the conformity to the standard;

q) test result;

r) signature and title or an equivalent marking of person(s) accepting technical responsibility for the test report and date of issue.

The manufacturer/supplier shall supply copy of the test report to the client.

10 Designation and marking

10.1 Designation

The designation consists of

a) the description block (short description of the product);

b) the identity block, consisting of:

1) the European Standard number block (reference and date of issue);

2) individual item block (coding of the item and variable figures).

For single track water slides, the number indicating the type in Clause 4, if any, shall be used for coding.

The technical elements to integrate the designation of the slide shall be available on site.

For non-classified water slides the designation shall be:

c) water slide EN 1069-1xx not classified type.

10.2 Marking

Water slides should be marked in a legible and durable manner in the language(s) of the country in which the water slide is installed, in a position conspicuous and accessible (e.g. at the entrance of the means of access) after installation, with the following indications:

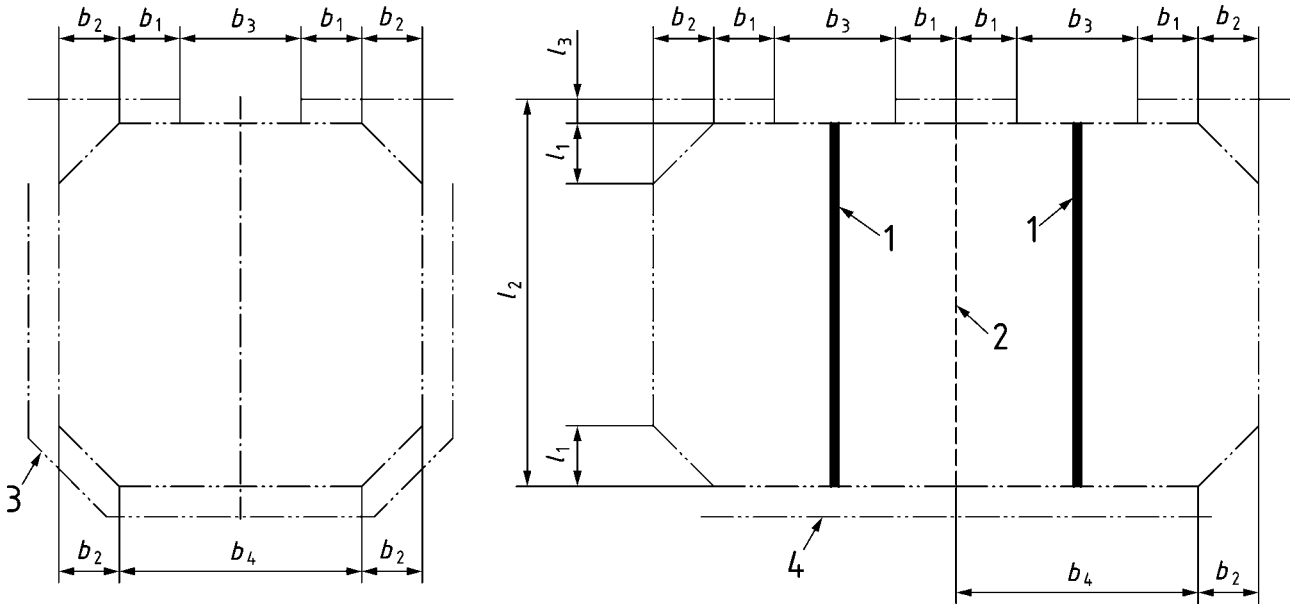
a) name and/or logo and the address of the manufacturer, supplier, importer or installer;

b) designation;

c) year of installation.

Annex A
(normative)

Splashdown areas



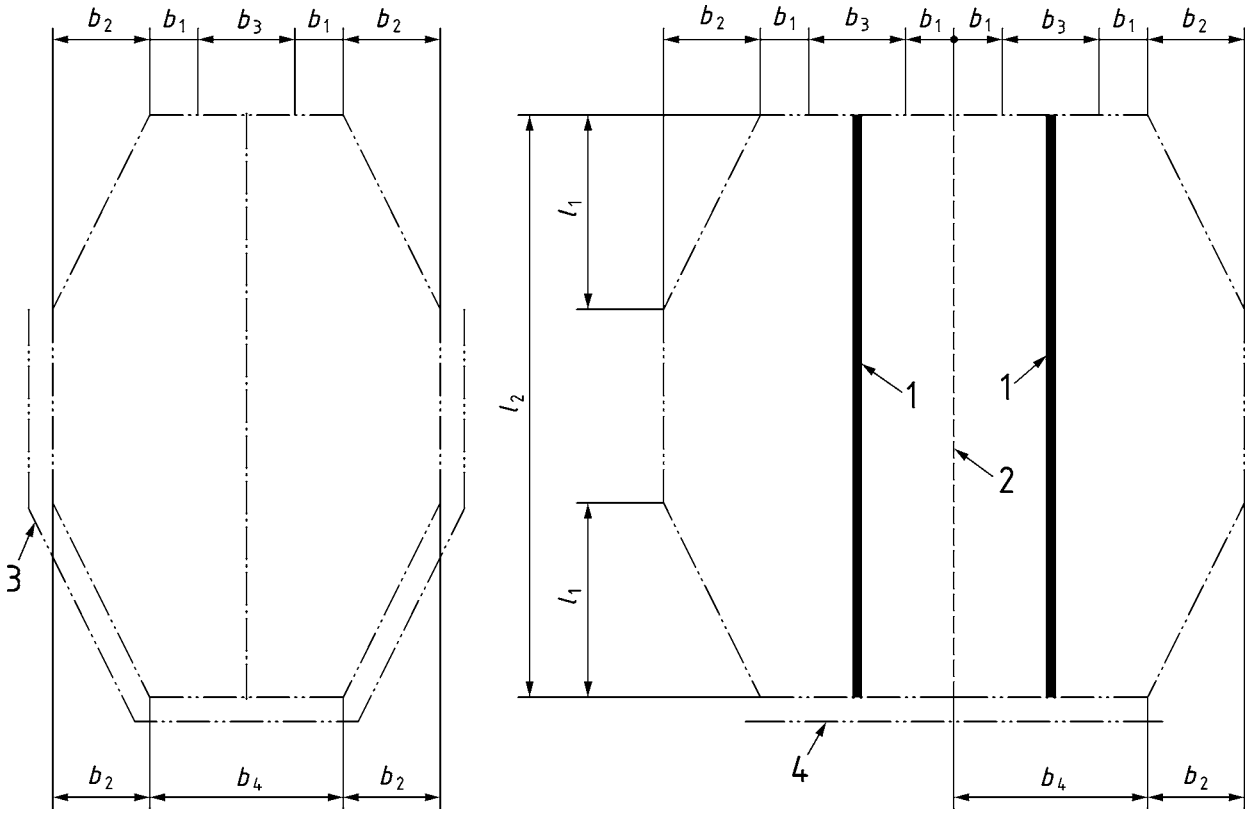
Key

1 centre line marking in contrasting colours on the floor
2 soft floating lines between tracks
3 possible area of stairs or ladder for a single-slide
4 possible area of stairs or ladders for slides with final parts entering the same side of the pool
b width of the splashdown area
l length of the splashdown area

Figure A.1 — Splashdown area for Type 1 and Type 2

Table A.1 — Dimensions of splashdown area for Type 1 and Type 2

Dimension	Type 1.1	Types 1.2, 2.1 and 2.2
	Minimum mm	
l_1	0	200
l_2	250	500
l_3	750	2 000
b_1	250	500
b_2	250	500
b_3	slide width	
b_4	$b_3 + 2\ b_1$	



Key

1 each track centre line marking in contrasting colours on the floor

2 soft floating lines between tracks

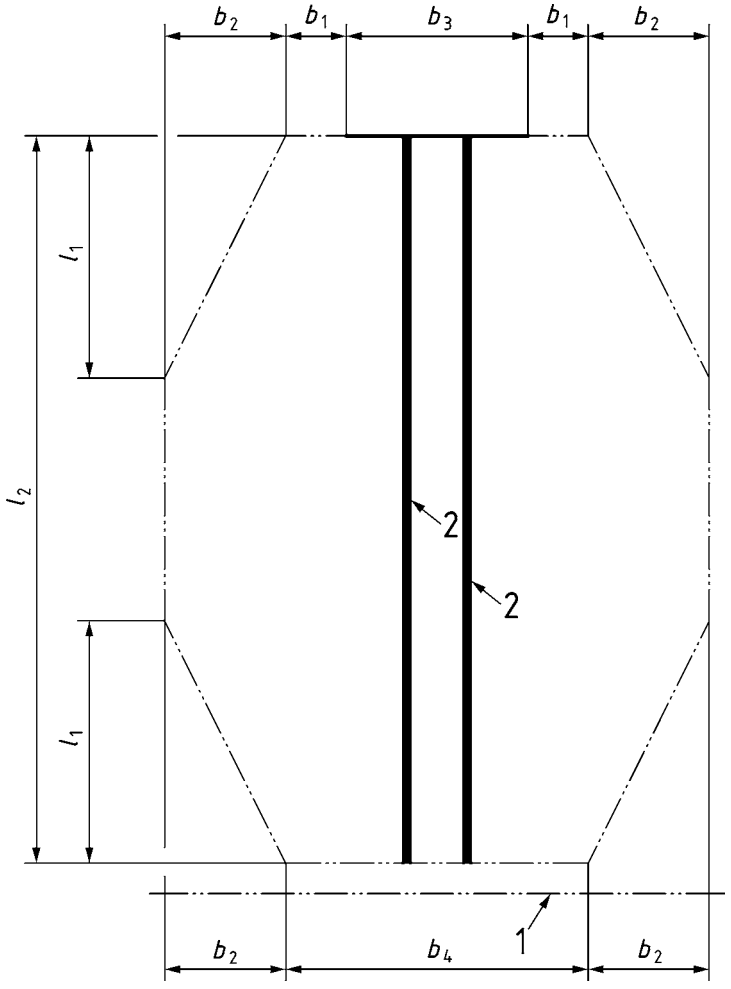
3 possible area of stairs or ladder for a single-slide

4 possible area of stairs or ladders for slides with final parts entering the same side of the pool or for multi tracks

Figure A.2 — Splashdown area for Types 3 and 4

Table A.2 —Dimensions of splashdown area for Types 3 and 4

Dimension	Type 3	Type 4
	Minimum mm	
l_1	2 000	
l_2	2 000	6 000
b_1	500	
b_2	1 000	
b_3	slide width	
b_4	$b_3 + 2\ b_1$	



Key

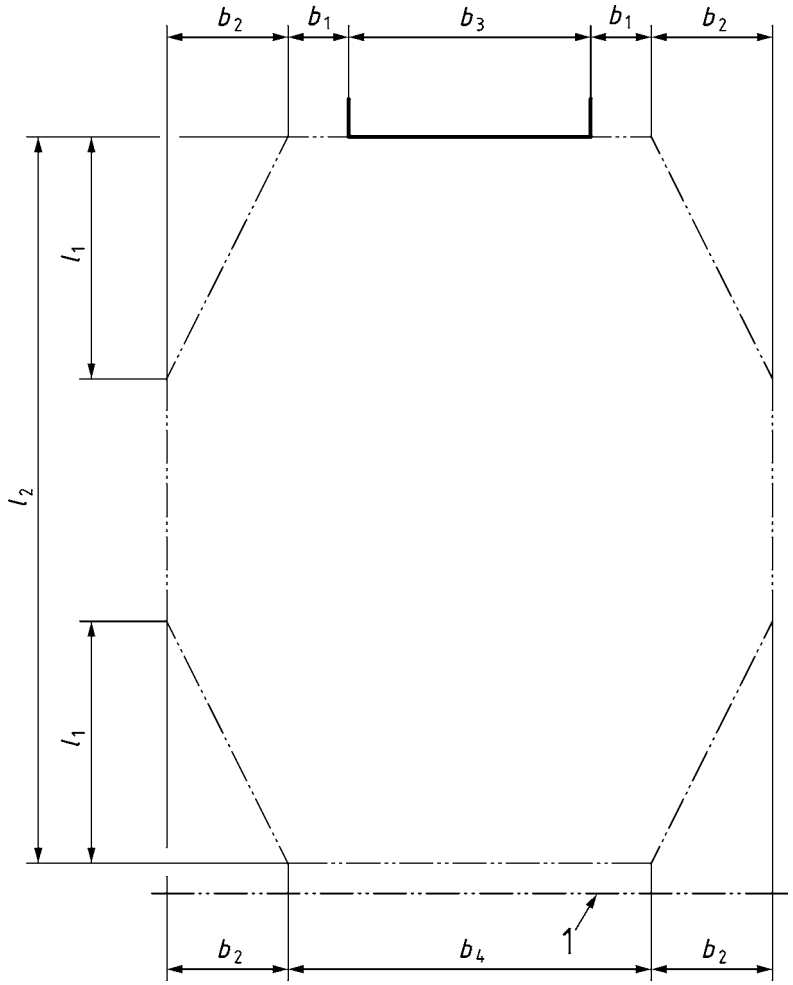
1 possible area of stairs or ladders

2 centre line marking in contrasting colours on the floor or soft floating lines between tracks

Figure A.3 — Splashdown area for Type 6

Table A.3 — Dimensions of splashdown area for Type 6

Dimension	Type 6.1 Minimum mm	Type 6.2 Minimum mm
l_1	2 000	
l_2	6 000	10 000
b_1	500	
b_2	1 000	
b_3	width of Type 6	
b_4	$b_3 + 2b_1$	



Key

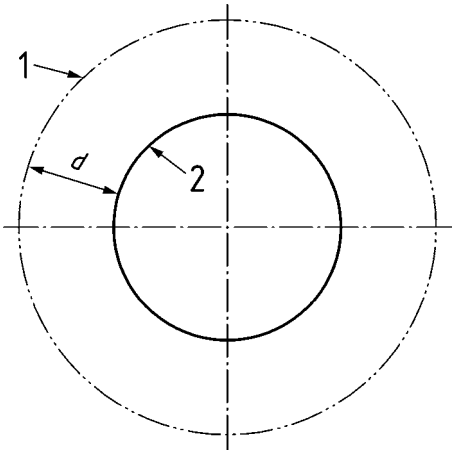
1 possible area of stairs or ladders

Figure A.4 — Splashdown area for Type 7

Table A.4 — Dimensions of splashdown area for Type 7

Dimension	Minimum mm
l_1	2 000
l_2	$3 \times l_1$
b_1	500
b_2	1 000
b_3	width of Type 7
b_4	$b_3 + 2b_1$

Splashdown area dimensions for Type 8 shall conform to Types 3 or 4 depending of the maximum speed at the final part.



Key

1 limit of splashdown area

2 rim of the exit from the bowl

d splashdown clearance, $d > 1$ m

Figure A.5 — Splashdown area for Type 10

Annex B
(normative)

Use of stainless steels for water slides

B.1 General

Stainless steel is used for many constructions in swimming pools. “Stainless steel” is thereby a collective name for a multitude of different materials with different alloy-composition.

The notation shall conform to EN 10088-1 and EN 10088-2. Beside a number, every steel has a short notation (e.g. steel no. 1.4301 has the short notation X5CrNi18-10).

Beside appropriate constructive solutions (e.g. avoidance of gaps) and a surface as smooth as possible, the selection of the right material is the most decisive criteria to avoid corrosion problems.

Corrosion can appear visible (e.g. corrosive pitting) or invisible and spontaneous without announcement (e.g. stress crack corrosion).

Swimming pools with disinfection with chlorine are a highly corrosive environment.

B.2 Indoor swimming pools with disinfection with chlorine

B.2.1 General

In indoor swimming pools, a highly corrosive environment with enrichment of chlorides caused by drying and evaporation effects shall be taken into account.

B.2.2 Materials without regular cleaning

For structural parts in chloride environments the appearance of chloride inducted intercrystalline stress crack corrosion shall be taken into account. Therefore, in indoor pools water slides and their structural parts made of stainless steel without regular cleaning only the materials:

— 1.4565 (X2CrNiMnMoNbN25-18-5-4);

— 1.4529 (X1NiCrMoCuN25-20-7); and

— 1.4547 (X1CrNiMoCuN20-18-7)

are acceptable.

In environments with water with a chloride concentration of less than 250 mg/l (drinking water) also the material 1.4539 (X1NiCrMoCu25-20-5) is acceptable.

B.2.3 Materials with regular cleaning

B.2.3.1 General

Considering the real corrosiveness and further relevant conditions, e.g. temperature, humidity, etc., and only in case of regular cleaning for easy accessible components and parts of the water slide beside the materials mentioned in B 2.2 the following materials are permitted:

— 1.4401 (X5CrNiMo17-12-2);

— 1.4404 (X2CrNiMo17-12-2);

— 1.4578 (X3CrNiCuMo17-11-3-2);

— 1.4571 (X6CrNiMoTi17-12-2);

— 1.4439 (X2CrNiMoN17-13-5); or

— 1.4462 (X2CrNiMoN22-5-3).

B.2.3.2 Cleaning concept

Conforming to the result of a risk assessment, instruction for regular cleaning shall be provided by the manufacturer of the water slide, to guarantee that no enrichment of chlorides on the surface of the material is possible. The instruction shall be based on a cleaning concept established by relevant bodies (e.g. building authorities), if any.

B.2.3.3 Execution of the regular cleaning

All stainless steel surfaces in chloride environment have to be cleaned at least once a week, under special conditions even in shorter intervals, by qualified personnel. By the regular cleaning all the deposit of chlorides caused by drying and evaporation effects have to be removed.

B.2.3.4 Regular inspection

A regular inspection of all stainless steel surfaces shall be performed at least once a year by an independent expert for corrosion or materials.

B.2.4 Outdoor swimming pools with disinfection with chlorine

Outdoor pools with disinfection with chlorine are in general a less corrosive environment. Although locally, e.g. above water surfaces, a higher corrosiveness can occur. The danger of enrichment of chlorides is smaller, because rainfall will wash the electrolytes away.

The selection of the proper material for water slides and their structural parts shall be performed carefully, considering the corrosiveness of the environment and the foreseen cleaning of the surfaces. In less corrosive environments or foreseen regular cleaning for easy accessible parts and components also the following materials are permitted:

— 1.4301 (X5CrNi18-10);

— 1.4307 (X2CrNi18-9);

— 1.4567 (X3CrNiCu18-9-4);

— 1.4541 (X6CrNiTi18-10); or

— 1.4318 (X2CrNiN18-7).

B.3 Coatings and paintings

A coating of stainless steel surfaces is not a sufficient protection against corrosion and never justifies the selection of a less corrosion-proof material.

NOTE The use of coatings and paintings is specified in paper [10] and paper [11].

Annex C
(normative)

Design loads, accesses and platforms

C.1 Vertical imposed loads

If there are no local regulations available and applicable the following vertical imposed loads shall be applied for any area designed for access by foot.

Universal, public access:

— q = 3,5 kN/m² for stairways, landings, ramps, entrances, exits and other similar features;

— q_k = 5,0 kN/m² as a superior value, if particularly dense crowds are anticipated for the above mentioned categories;

— Q_k = 1 kN per step, for stairs; alternatively, an area load in accordance with above clauses, whichever is the more unfavourable.

Not open for public access:

— q_k = 1,5 kN/m² for all floors, platforms, ramps, staircases, catwalks, stages and the like which are walked over by individual persons or Q_k = 1,5 kN individual load, whichever is the more unfavourable.

C.2 Horizontal imposed loads

The following horizontal imposed loads shall be applied for barriers, wall panels and other similar features:

a) when bounding floors intended for public access designed for qk = 3,5 kN/m²:

   1) p_k = 0,5 kN/m at hand rail height;

   2) p_k = 0,1 kN/m at intermediate rail height;

b) when bounding floors intended for public access designed for qk = 5,0 kN/m²:

   1) p_k = 1 kN/m at hand rail height;

   2) p_k = 0,15 kN/m at intermediate rail height;

c) when bounding floors not intended for public access designed for qk = 1,50 kN/m²:

   1) pk = 0,30 kN/m at hand rail height;

   2) pk = 0,10 kN/m at intermediate rail height.

For wall panels where there is no special handrail, the above values shall be applied at handrail height, but where appropriate, not higher than 1 200 mm.

C.3 Stiffness

In order to achieve an adequate longitudinal and transverse stiffness, a horizontal load acting at floor level in the most unfavourable direction in each case shall be entered in the calculation in addition to any eventual wind force in accordance with 6.3.6. This horizontal component load shall be taken as 1/10 of the imposed vertical load.

C.4 Stairs

Stairs shall have barriers and shall comply with 7.5.3.

Stairs respectively pairs of handrails shall be at least 800 mm in width.

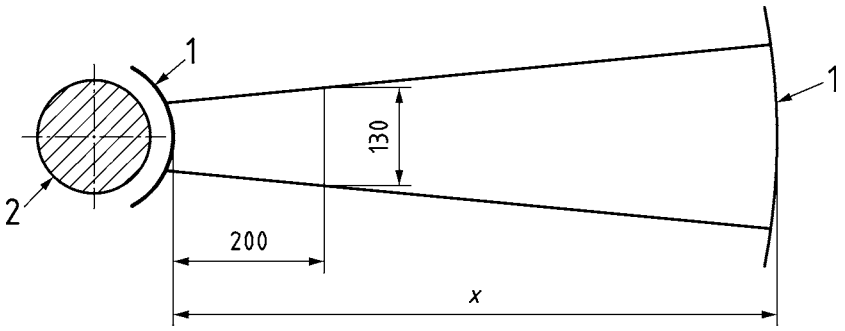
NOTE 1 The narrow design of the means of access should prevent a high number of people on it, which inevitably leads to crowds and pushing, etc.

The step height shall be between 140 mm and 240 mm.

The going shall be at least 0,24 m except for spiral or curved stairs.

The going on spiral or curved stairways shall be at least 130 mm measured at a distance of 200 mm from the vertical projection of the handrail of the central post (see Figure C.1).

Dimensions in millimetres



Key

1 handrail

2 central post

$800 \leq x \leq 1\,100$

Figure C.1 — Dimensions for spiral or curved stairways

For Type 1 and Type 2 the gap between steps shall be < 110 mm (see Figure C.2).

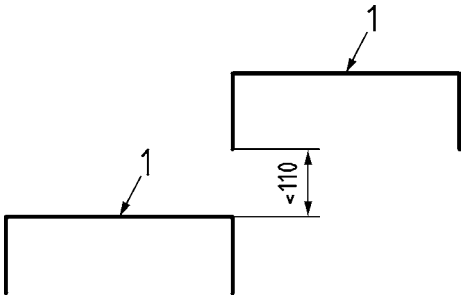
For Type 1.2 and Type 2.2:

— the width of stairs shall be at least 370 mm and not more than 550 mm;

— the maximum distance between pairs of handrails shall be 600 mm;

— the step height shall be maximum 200 mm.

Dimensions in millimetres



Key
1 step

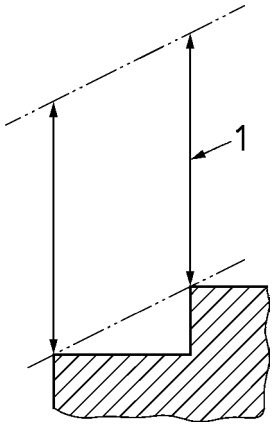
Figure C.2 — Side view of steps

The going and rise of the steps in any stairways shall be uniform throughout its length. The maximum slope of any stair measured on the centreline shall not exceed 45°.

Flights of stairs shall not exceed 18 steps. Landings at least 800 mm in depth shall be provided between consecutive flights of steps.

The headroom above the steps shall > 2 000 mm when measured vertically above the pitch line.

NOTE 2 Headroom > 2 200 mm is preferred (see Figure C.3).



Key
1 headroom

Figure C.3 — Headroom above steps

Annex D
(informative)

Acceleration and speed measurements

D.1 Test devices

D.1.1 General

All measurement devices should be calibrated and regularly checked.

D.1.2 Acceleration measuring device

A portable acceleration measuring device should be used measuring and recording the acceleration on sliding persons in all three dimensions.

The measuring range should be 10 g for all three dimensions. The measuring rate shall be ≥ 100 Hz.

If measured acceleration versus time graphs are used, it is permitted to filter parts with high frequency using a 10 Hz low-pass (edge steepness at least 6 dB per octave).

The uncertainty of the measuring device should be 10 % at a maximum.

NOTE This means e.g. at a speed of 10 m/s a recording every 5 cm along the slide. See also EN 13814:2004, G.1 to G.2.1.

D.1.3 Maximum speed measuring device

The maximum speed in a slide should be measured in an appropriate way, e.g. radar, photocells, GPS.

The uncertainty of the measuring device should be 10 % at a maximum.

D.2 Description of the acceleration test method

To prevent falsification of the measuring results due to the vibrations/movements of parts the body and due to the slow down effect of the fixing (e.g. belt), the acceleration measuring device should be positioned close to the centre of gravity of the body, e.g. on the abdomen for testing sliding position “sitting” and sliding position “lying on one's back”.

NOTE Vibrations of the measuring device itself on the body of the sliding person cannot be avoided completely despite all efforts to fix the measuring device tightly on the body.

The test should be carried out using all positions as described in 9.3.3.

For all five tests the amount of the vectorial sum of the acceleration measured in all three dimensions should be in accordance with Table 4.

Since the speed on a new slide made of plastics is not so high than on a run-in slide the permissible values for acceleration should be reduced by at least 10 %.

The results should be put down in the log book.

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