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## Playground equipment and surfacing

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

EUROPEAN STANDARD

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## Playground equipment and surfacing - Part 2: Additional specific safety requirements and test methods for swings

Équipement et sols d'aires de jeux - Partie 2: Exigences de sécurité et méthodes d'essai complémentaires spécifiques aux balançoires

Spielplatzgeräte und Spielplatzböden - Teil 2: Zusätzliche besondere sicherheitstechnische Anforderungen und Prüfverfahren für Schaukeln

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## European foreword

This document (EN 1176-2:2017) 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of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by October 2018.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 1176-2:2005.

The main changes are:

- a) amended definition of a swing;
- b) additional figure for an example of a swing with one rotational axis (see Figure 1);
- c) new figure on ground clearance (see Figure 7);
- d) new definition and requirements for group swing seats;
- e) improved recommendations for fences around swings;
- f) revised figure for free height of fall and surfacing requirements beneath a swing (see Figure 10);
- g) harmonization of B.4 and B.5 with the measuring device from the EN 1176 series.

This document is part of a series of standards dealing with playground equipment and surfacing which consists of:

- *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 will be used in conjunction with parts EN 1176-1, EN 1176-7 and EN 1177.

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

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.

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## 1 Scope

This European Standard specifies additional safety requirements for swings intended for permanent installation for use by children. Where the main play function is not swinging, the relevant requirements in this part of EN 1176 may be used, as appropriate.

NOTE Recommendations on the design and siting of swings are given in Annex A.

## 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, the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1176-1:2017, *Playground equipment and surfacing — Part 1: General safety requirements and test methods*

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

ISO 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1176-1 and the following apply.

NOTE In order not to confine the application of this European Standard to those items of equipment currently in use and to allow freedom of design for the manufacture of new equipment, only the fundamental forms of equipment and motion are defined.

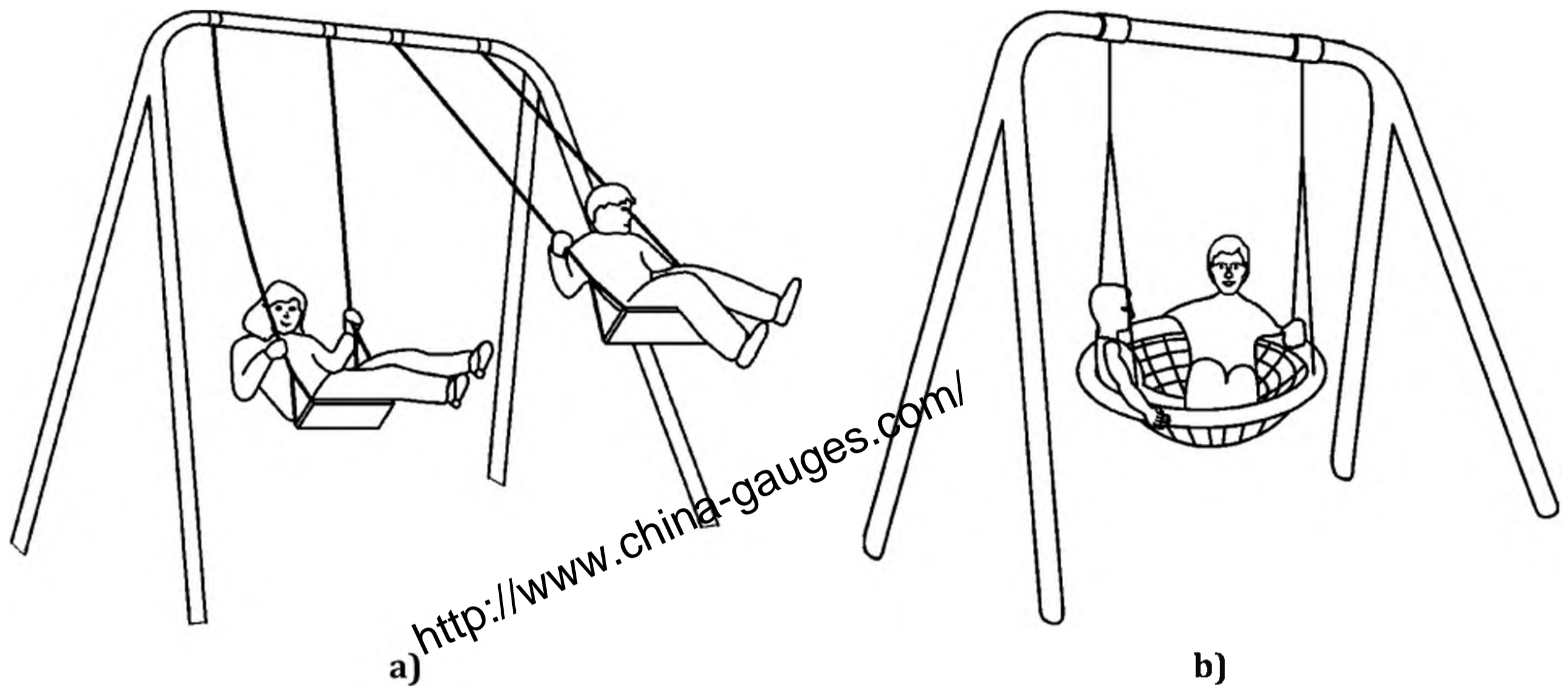
### 3.1 swing

moving equipment where the weight of the user is supported below a pivot or universal joint, where the pivot or universal joint is more than 1,3 m above the ground

### 3.2 swing with one rotational axis (Type 1)

seat that is flexibly suspended individually from a load bearing cross beam that can swing to and fro in an arc at right angles to the cross beam

Note 1 to entry: See Figure 1.



**Figure 1 — Examples of a swing with one rotational axis (Type 1)**

### 3.3

#### **swing with several rotational axes (Type 2)**

seat suspended from one or more load bearing cross beams, supported in such a way that it can move at right angles or longitudinally to the cross beams in as horizontal position as practicable

Note 1 to entry: See Figure 2.



**Figure 2 — Example of a swing with several rotational axes (Type 2)**

### 3.4

#### **single point swing (Type 3)**

seat or platform with cables or chains that meet at one fixing point so that the swing can move in all directions

Note 1 to entry: See Figure 3.



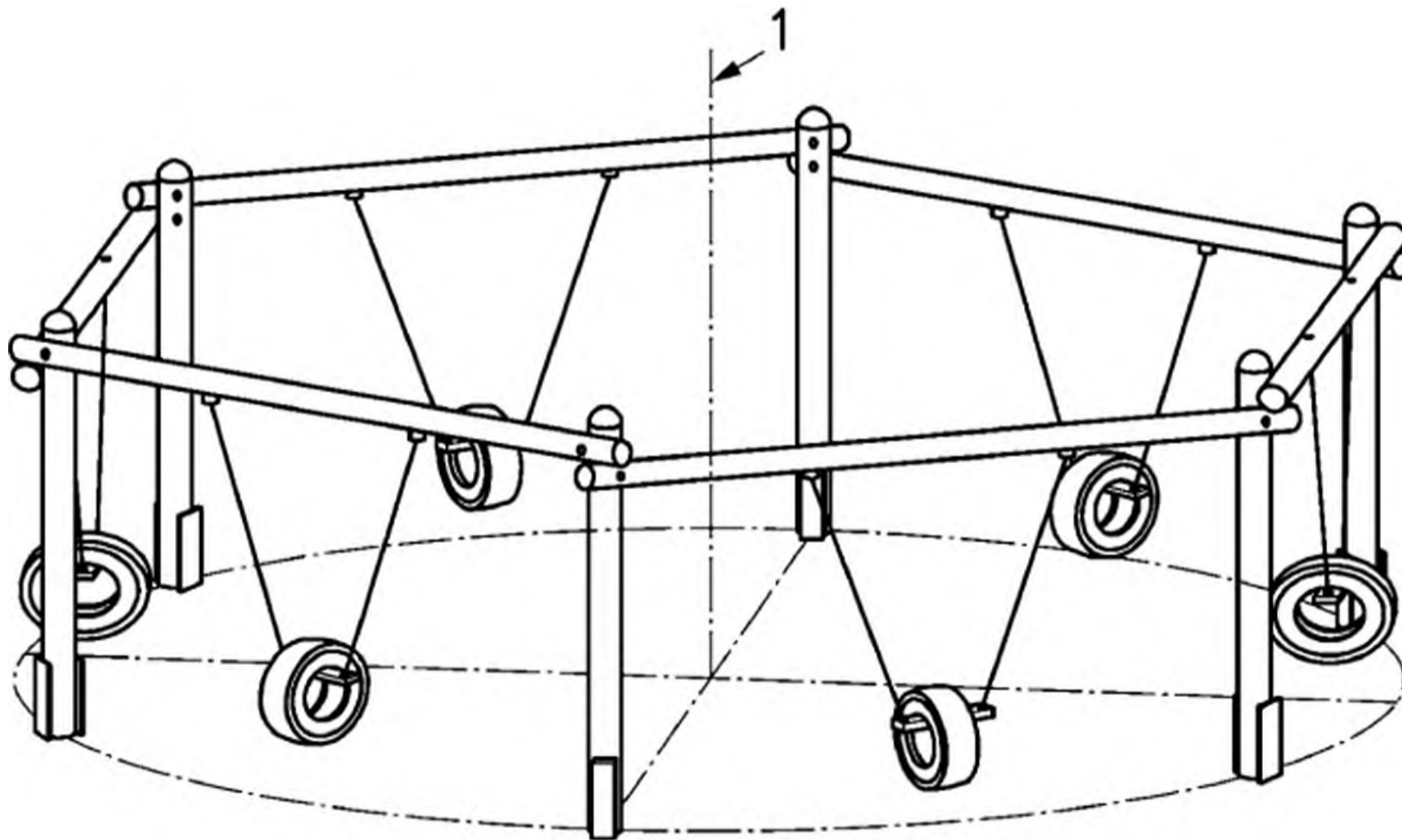


**Figure 3 — Examples of a single point swings (Type 3)**

**3.5 contact swing (Type 4)**

group of seats flexibly suspended individually from load bearing cross beams, which are arranged around a central axis (a centre point), typically six in number

Note 1 to entry: See Figure 4.



**Key**  
1 central axis

**Figure 4 — Example of a contact swing (Type 4)**

**3.6 swing height**

distance between the middle of the fulcrum of the suspension and the playing surface

Note 1 to entry: See Figure 5.

### 3.7

#### length of swing suspension member

distance between the middle of the fulcrum of the suspension member and top surface of the seat or platform

Note 1 to entry: Suspension members include chains and ropes.

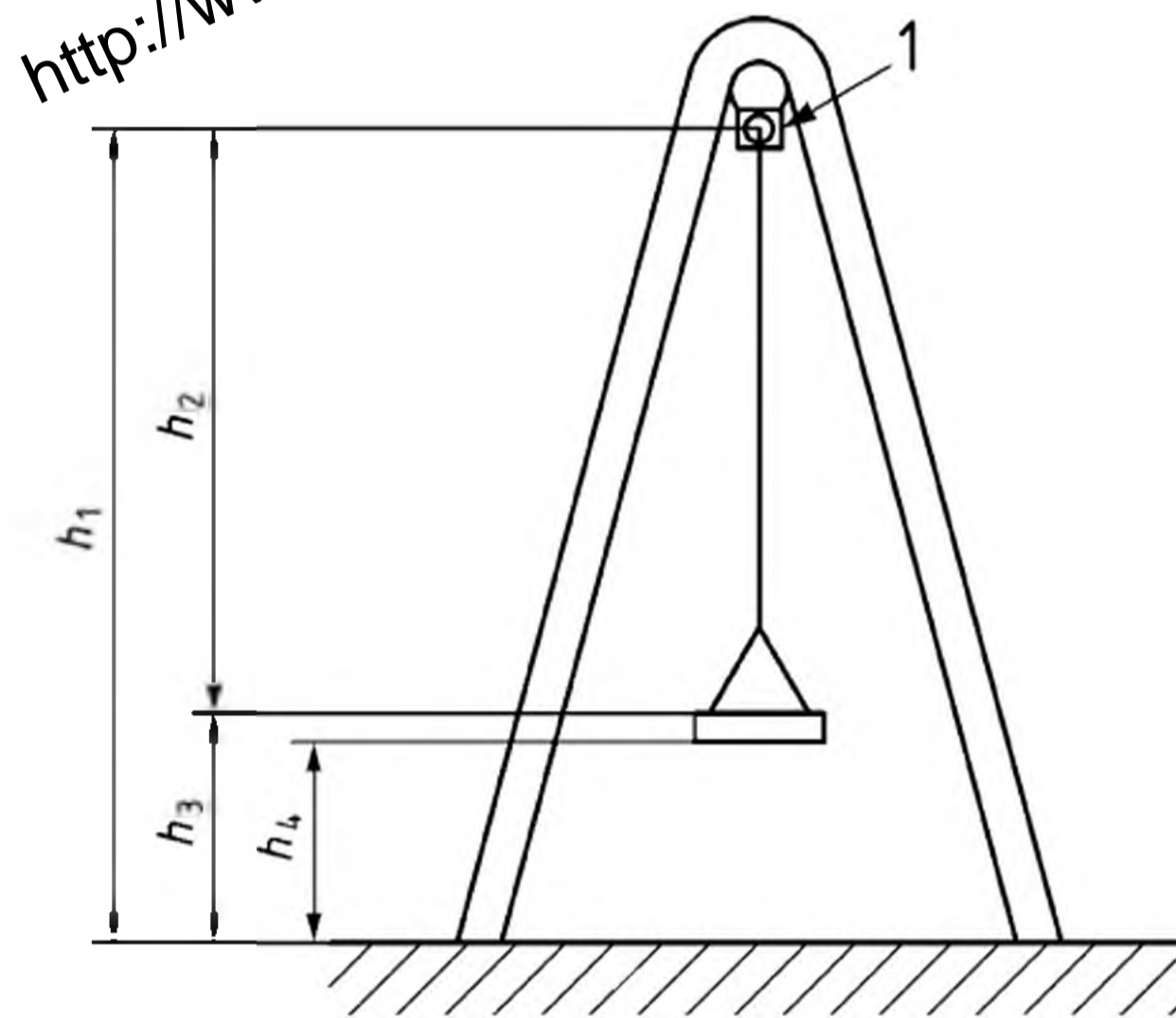
Note 2 to entry: See Figure 5.

### 3.8

#### height of seat

distance between the top of the seat or platform and the playing surface

Note 1 to entry: See Figure 5.



#### Key

- 1 rotational axis
- $h_1$  swing height
- $h_2$  length of swing suspension member ( $h_1-h_3$ )
- $h_3$  height of seat
- $h_4$  ground clearance

Figure 5 — Height dimensions

### 3.9

#### ground clearance

distance between the specified under-part of the seat and the playing surface

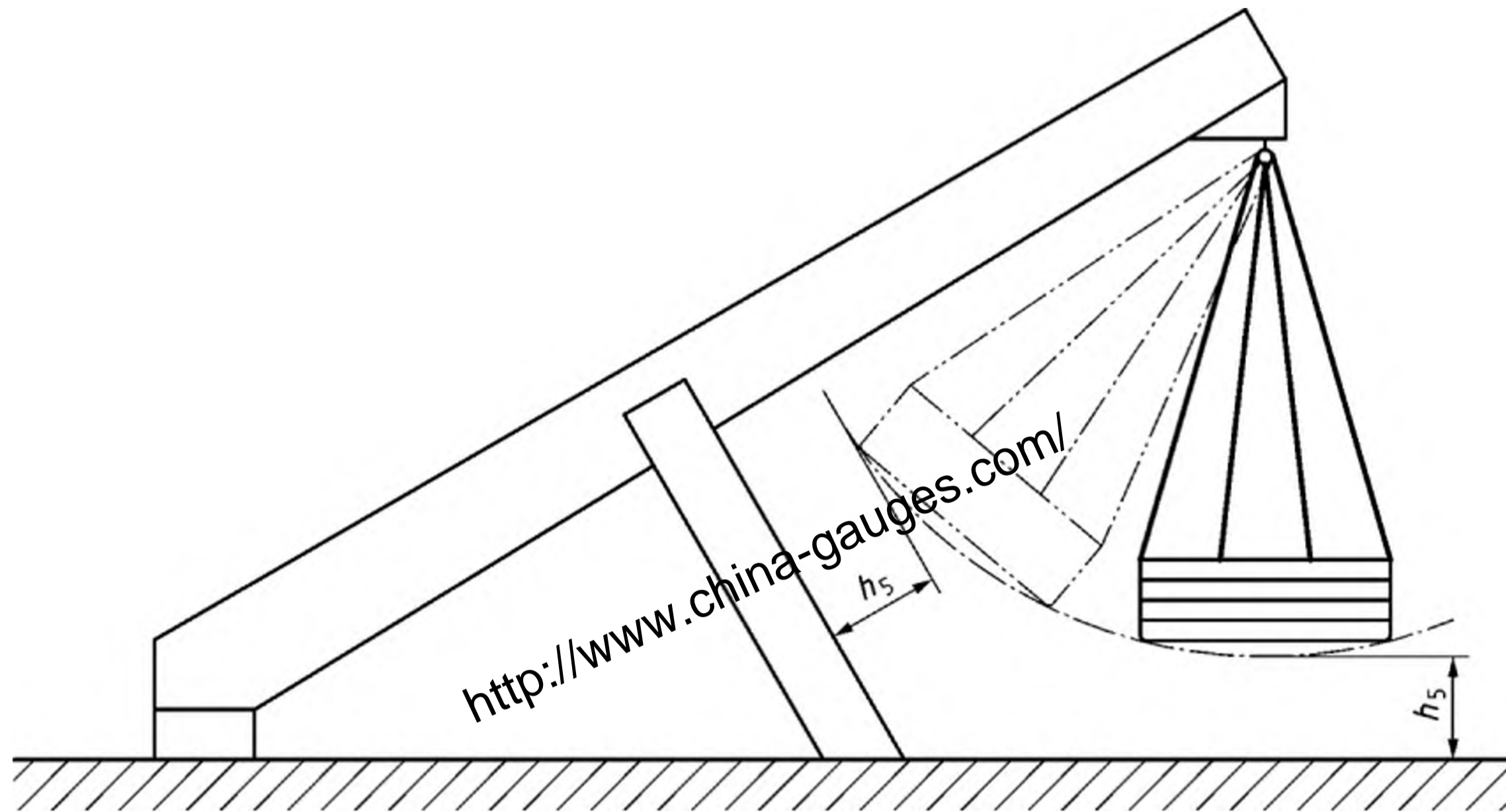
Note 1 to entry: The measurement position depends on seat type, see 4.2.

### 3.10

#### seat clearance

distance between the lower edge of the seat and any obstacle adjacent to the path of the swing

Note 1 to entry: See Figure 6.



**Key**  
 $h_5$  seat clearance

**Figure 6 — Example of a Type 3 swing showing seat clearance**

### 3.11

#### **flat swing seat**

seat without back and side protections

### 3.12

#### **cradle swing seat**

seat provided with greater body support for younger or less able users, typically designed so that the user cannot slip through the constructional parts surrounding the seat

### 3.13

#### **group swing seat**

seat with a large surface area intended for several users, typically nest or basket swing seats, single point swing seats, tyre seats, and swinging beds

## **4 Safety requirements**

### **4.1 General**

Swings shall conform to EN 1176-1 unless otherwise specified in this part of EN 1176.

### **4.2 Ground clearance**

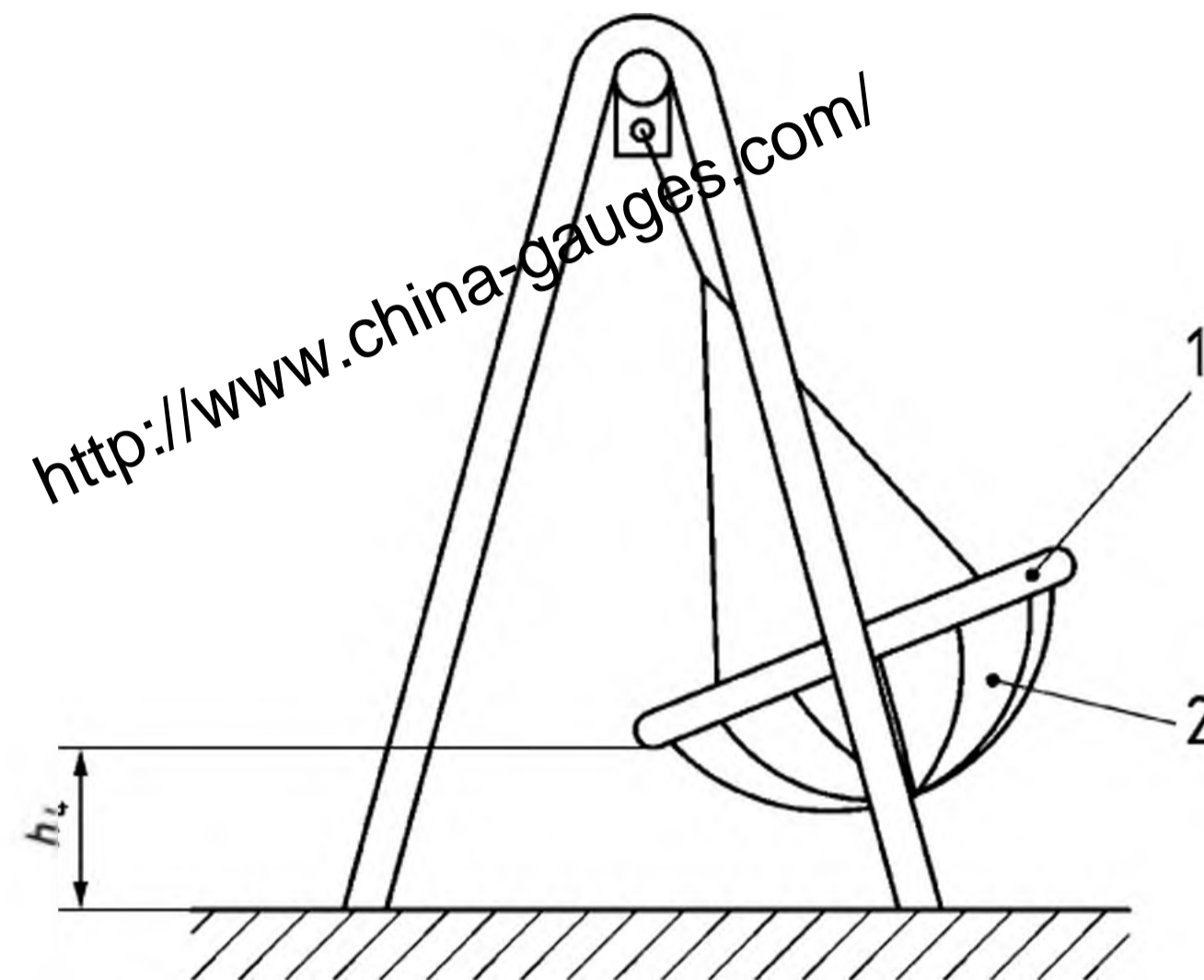
The minimum ground clearance for single-use swings (see Figures 5 and 6) at rest position shall be 350 mm.

For group swing seats, the minimum ground clearance at rest position shall be 400 mm.

For group swing seats with a flexible lower part the ground clearance shall be a minimum of 400 mm measured from the underside of the rigid part of the seat in its most onerous position (see Figure 7).

In the case of contact swings with vertical tyres as seats (see Figure 12), the ground clearance may be reduced to 100 mm minimum.

NOTE The minimum ground clearance is lower for contact swings with vertical tyres because their construction is flexible; if an impact occurs the tyre is deflected and the impact is reduced. Also, the tyre is made from impact attenuating material.



**Key**

- 1 rigid part
- 2 flexible part
- $h_4$  ground clearance

**Figure 7 — Ground Clearance**

**4.3 Seat clearance for single point swing (Type 3)**

The seat clearance (see Figure 6) shall be at least 400 mm except in the direction of the beam on which the suspension is fixed.

If during use, the side of the swing seat can come into contact with the swing frame, then protective material may be fitted to the frame at this point to protect the beam and the seat.

NOTE The design of Type 3 swings permits a deviation from the free space requirement in EN 1176-1 because the hazard of colliding with the beam is readily foreseeable and the benefit to children of playing on swings of this type is high. For a fuller explanation of risk and benefit see EN 1176-1:2017, Introduction and Scope.

**4.4 Minimum clearance and lateral stability of swing seats with more than one point of suspension**

**4.4.1 Minimum space between the seats of swings:**

The minimum horizontal dimension,  $C$ , between the side (see Figure 8a)) of a swing seat and the adjacent structure in the rest position shall be:

$$\geq 20 \% \text{ length of the suspension member (+200 mm).}$$

For group swing seats, the minimum horizontal dimension,  $C$ , between the side (see Figure 8a) of a swing seat and the adjacent structure in the rest position shall be:

$$\geq 20 \% \text{ length of the suspension member (+400 mm).}$$

The minimum horizontal dimension,  $S$ , between adjacent swing seats (see Figure 8a) in the rest position shall be:

$$\geq 20 \% \text{ length of the suspension member (+300 mm).}$$

A swing bay containing one group swing seat shall not contain any other seats.

The width of flexible seats such as belt seats where the width is reduced when in use, should be measured with the support points  $G$  held 400 mm apart (see Figure 8b).

For Type 4 swings the minimum distance between the seat surface and the central axis shall be 400 mm when the seat is at an angle of  $90^\circ$  (see Figure 8c).

#### 4.4.2 Lateral stability of swing seats:

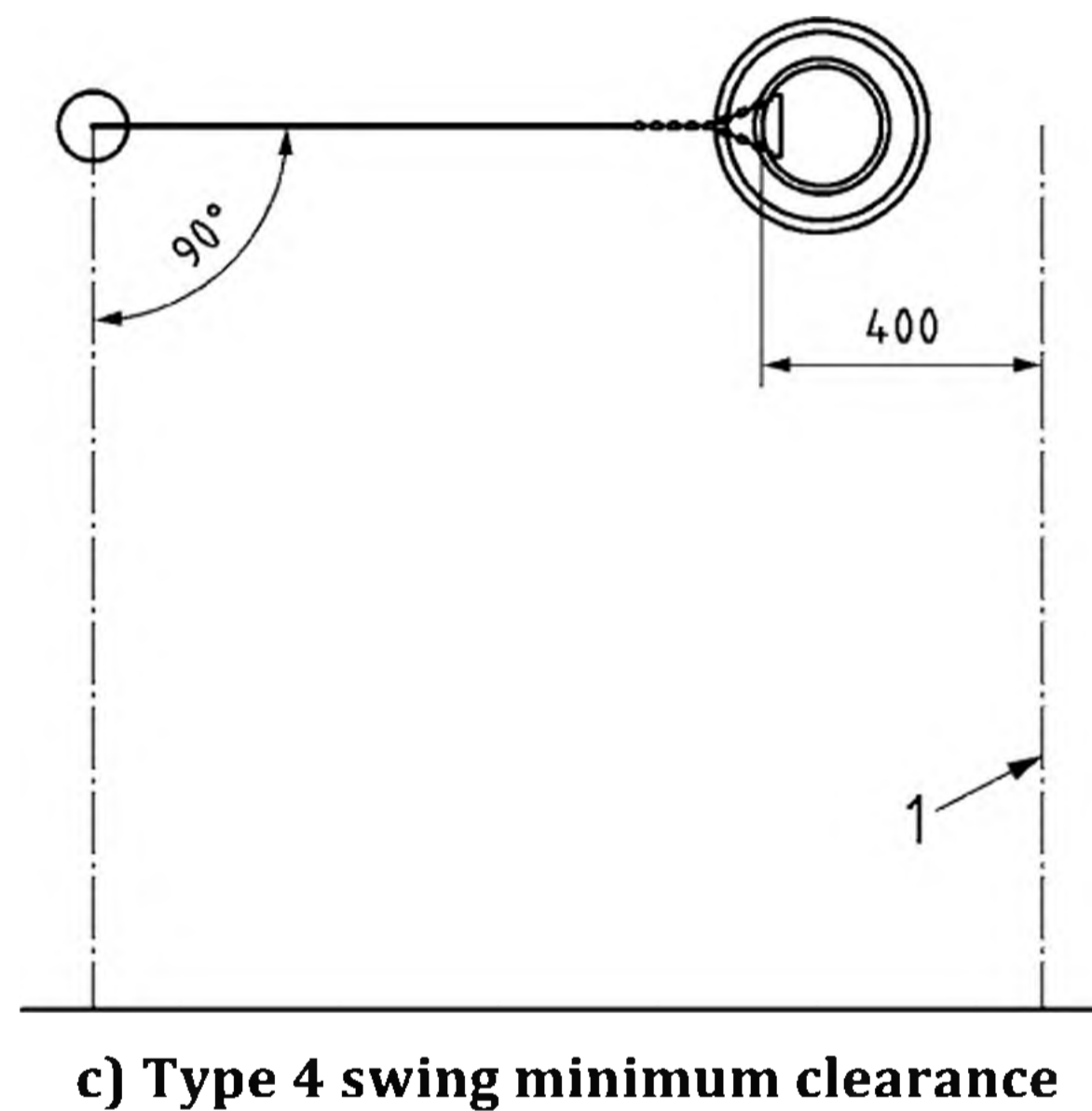
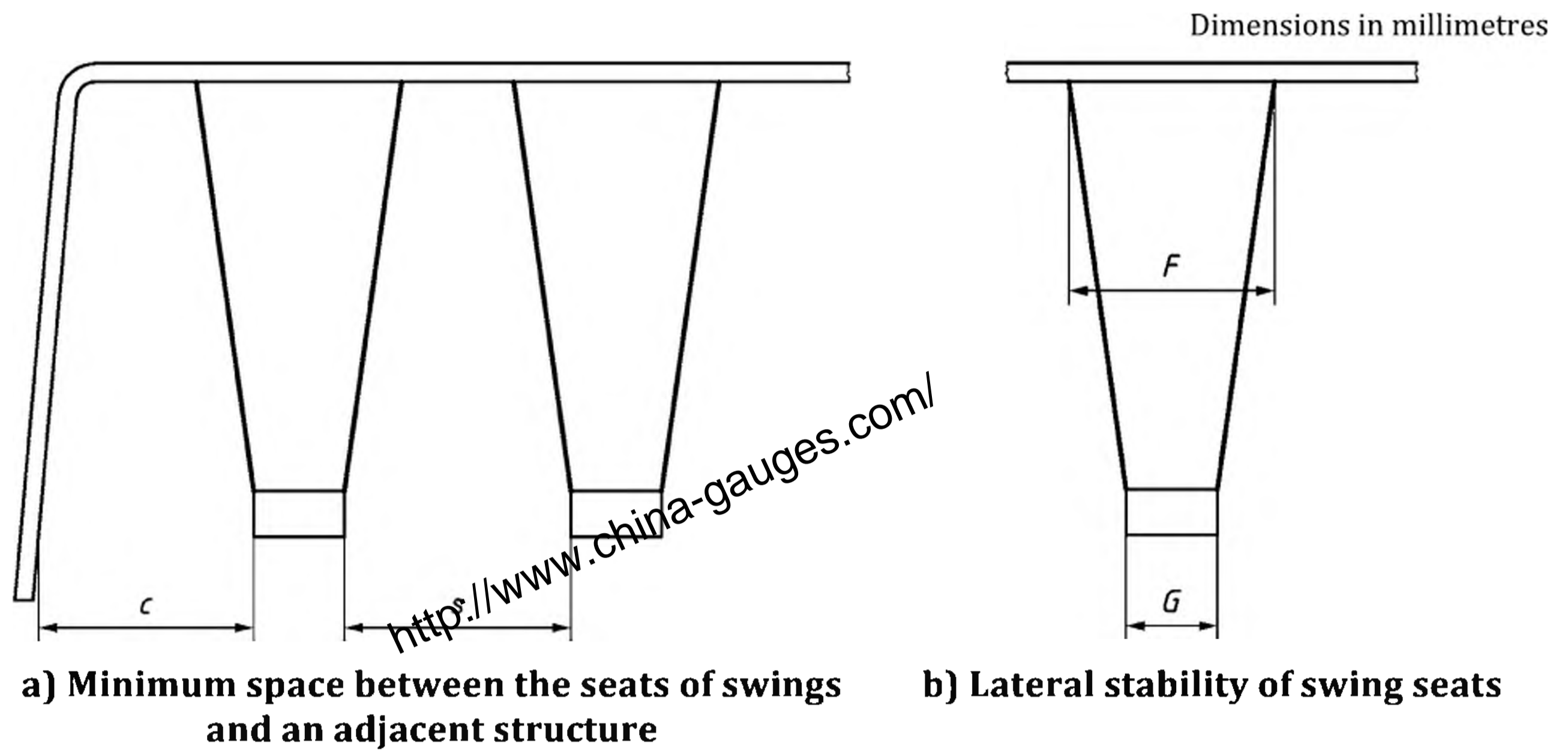
The distance between the suspension members  $F$  (see Figure 8b)) shall be:

$$\geq G + 5 \% \text{ length of the suspension member.}$$

For Type 4 swings and group swing seats fitted to Type 1 swings, the distance between the suspension members  $F$  shall be:

$$\geq G + 30 \% \text{ length of the suspension member.}$$

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**Key**

- F* distance between the suspension members
- G* distance between the support points on the swing seat
- C* distance between the seat and adjacent structure
- S* distance between adjacent seats
- 1 central axis

**Figure 8 — Minimum clearance and lateral stability of swing seats with more than one point of suspension**

**4.5 Means of suspension**

Fully rigid suspension members shall not be used (see EN 1176-1:2017, 4.2.12 and 4.2.13 for alternatives).

The triangular openings formed by the chain or suspension members branching towards the swing seat need not conform to the requirements of EN 1176-1:2017, 4.2.7.2.

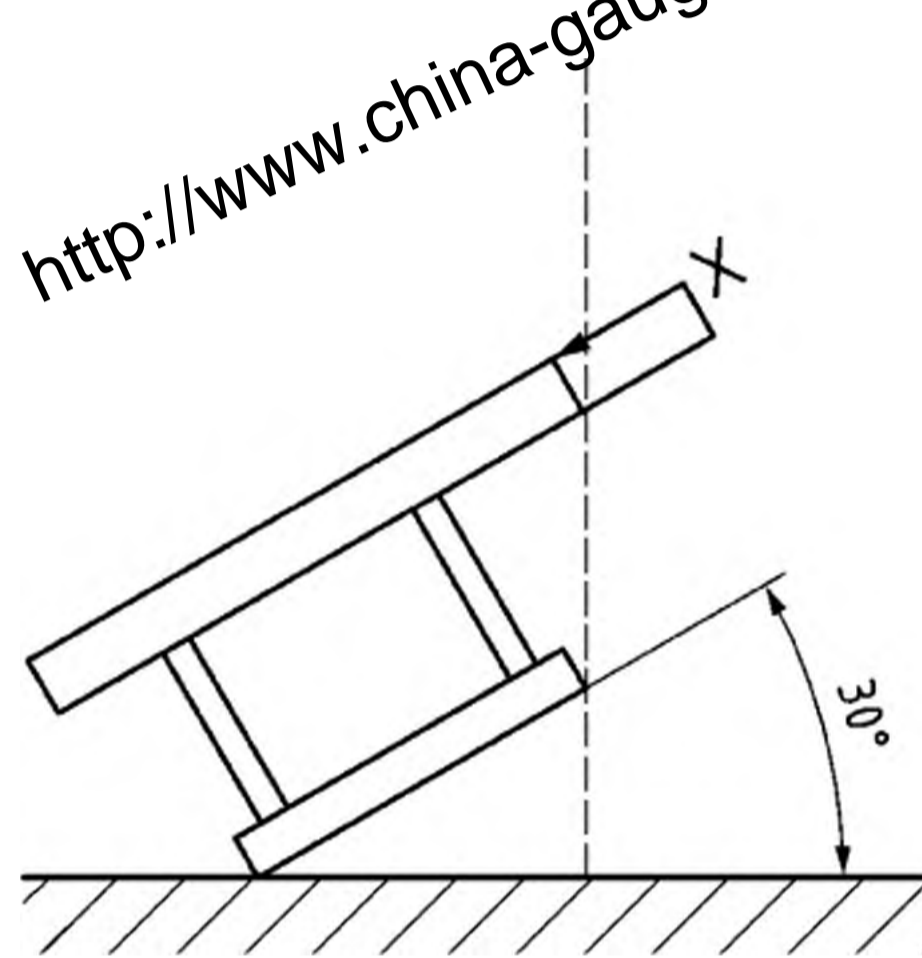
## 4.6 Impact attenuation of swing seats

### 4.6.1 Swing seats and vertical tyre seats

When tested in accordance with Annex B, there shall be no peak values of acceleration greater than 50 *g* and the average surface compression shall not exceed 90 N/cm<sup>2</sup>.

### 4.6.2 Cradle swing seats

The seat section of cradle swing seats shall conform to 4.6.1. If the outermost edge of the superstructure (X) protrudes beyond a vertical line drawn from the outermost edge of the seat when tipped at an angle of 30° as shown in Figure 9, then this shall also conform to 4.6.1.



#### Key

X outermost edge of superstructure

**Figure 9 — Cradle seat showing seat and superstructure at an angle of 30°**

### 4.6.3 Group swing seats

If the diameter of the swing seat is greater than 900 mm, when tested in accordance with Annex B there shall be no peak values of acceleration greater than 120 *g* and the average surface compression shall not exceed 90 N/cm<sup>2</sup>. If the diameter is less than 900 mm it shall conform to 4.6.1. Test in accordance with B.3.1.

For group swing seats that are not round and are wider than 900 mm at their widest point, when tested in accordance with Annex B there shall be no peak values of acceleration greater than 120 *g* and the average surface compression shall not exceed 90 N/cm<sup>2</sup>.

**NOTE** Group swing seats can have a higher level of peak *g* because children more easily identify the larger seat as a hazard, and the benefit to children of playing on these large seats is high. For a fuller explanation of risk and benefit see EN 1176-1:2017, Introduction and Scope.

When group swing seats are suspended from a Type 1 swing there shall be a secondary means of supporting the swing seat to prevent collapses if the primary joint between the cables or chains and the supporting structure collapse.

## 4.7 Dynamic load for swing equipment

When tested in accordance with Annex C the components in the suspension system shall show no cracks, permanent deformation or damage and no connection shall be loosened. There shall be no dimensional change in the components that can be seen with normal/corrected vision.

## 4.8 Structural integrity

**4.8.1** When calculated in accordance with EN 1176-1:2017, Annex B, the reaction forces of the structure shall be greater than the calculated forces resulting from use.

**4.8.2** When tested in accordance with EN 1176-1:2017, Annex C, there shall be no signs of cracks, or permanent deformation when examined with normal/corrected vision.

## 4.9 Framework

Swings with more than two seats shall be divided by construction parts (i.e. supporting leg(s)) into bays so that there are no more than two seats per bay. A swing bay containing one group swing seat shall not contain any other seats.

NOTE This is to discourage children from crossing the path of swings in use.

Swing frames or their top bar shall only be attached to other equipment where specific measures are taken to segregate them from other activities.

EXAMPLE Specific measures that could be taken are; an additional 1,5 m circulation area, barriers, and enclosures.

## 4.10 Height of fall and impact area

### 4.10.1 Free height of fall

The free height of fall  $D$  of a swing shall be determined from the middle of the seat surface vertically to the ground when the swing seat is raised by  $60^\circ$ . Alternatively, the free height of fall may be determined by the formula:

$$D = \frac{h_2}{2} + h_3$$

where

- $D$  is the free height of fall,
- $h_2$  is the length of the suspension member,
- $h_3$  is the height of swing seat at rest.

For group swing seats which have a basket shape the free height of fall shall be measured from the top of the supporting frame (see Figure 10).

### 4.10.2 Dimensions of falling space and impact area

**4.10.2.1** The falling space shall correspond to the impact area extended to a height equivalent to the free height of fall ( $D$ ), see Figure 10.

For all swings the extent of the impact area shall be calculated by taking the point A reached horizontally by the centre of the swing seat when it has travelled through an arc of  $60^\circ$  (which may be



calculated as  $0,867 \times$  the length of the suspension member ( $h_2$ ) and adding a fixed distance  $B$  or  $C$  (depending on the construction of the surface).

In the case of an impact area that is level with the surrounding surface (normally synthetic) the fixed additional length  $B$  shall be 1,75 m and in the case of surface that is contained (normally loose fill) the fixed additional length  $C$  shall be 2,25 m (see Figure 10).

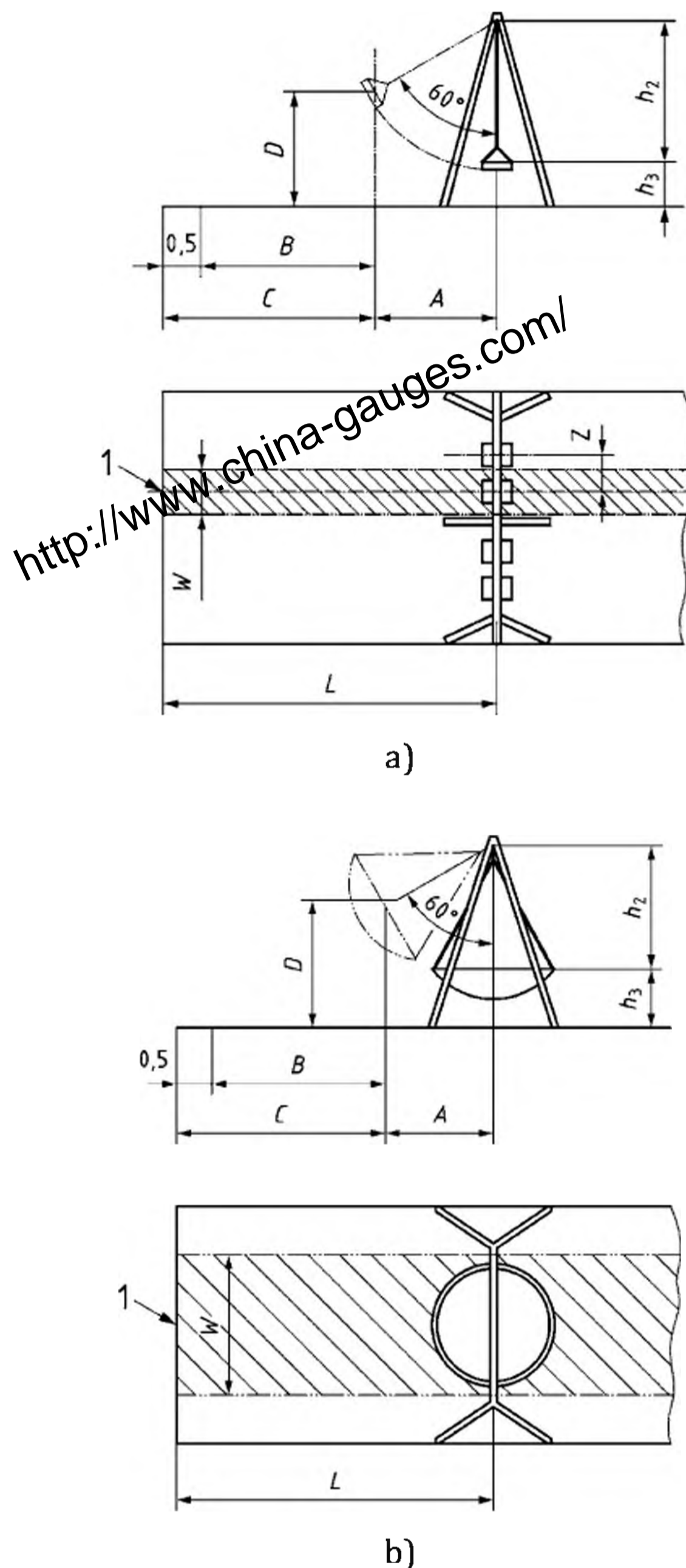
Additionally, for an impact area that is level with the surrounding surface, where  $B$  is 1,75 m, there shall be an additional area with a length of 0,5 m in the swing direction free from obstacles.

The extent of the impact attenuating surface should be based on the foreseeable use of the swing.

The falling spaces of swing seats attached to different swing frames shall not overlap. Falling space may overlap with free space, when swing seats are attached to the same swing frame, provided that they comply with 4.4.1. When swings are placed near other items of play equipment, the falling space of the swing and the falling space of the other play equipment shall not overlap.

NOTE Free space, falling space and impact area for a swing is shown in Figure 11.

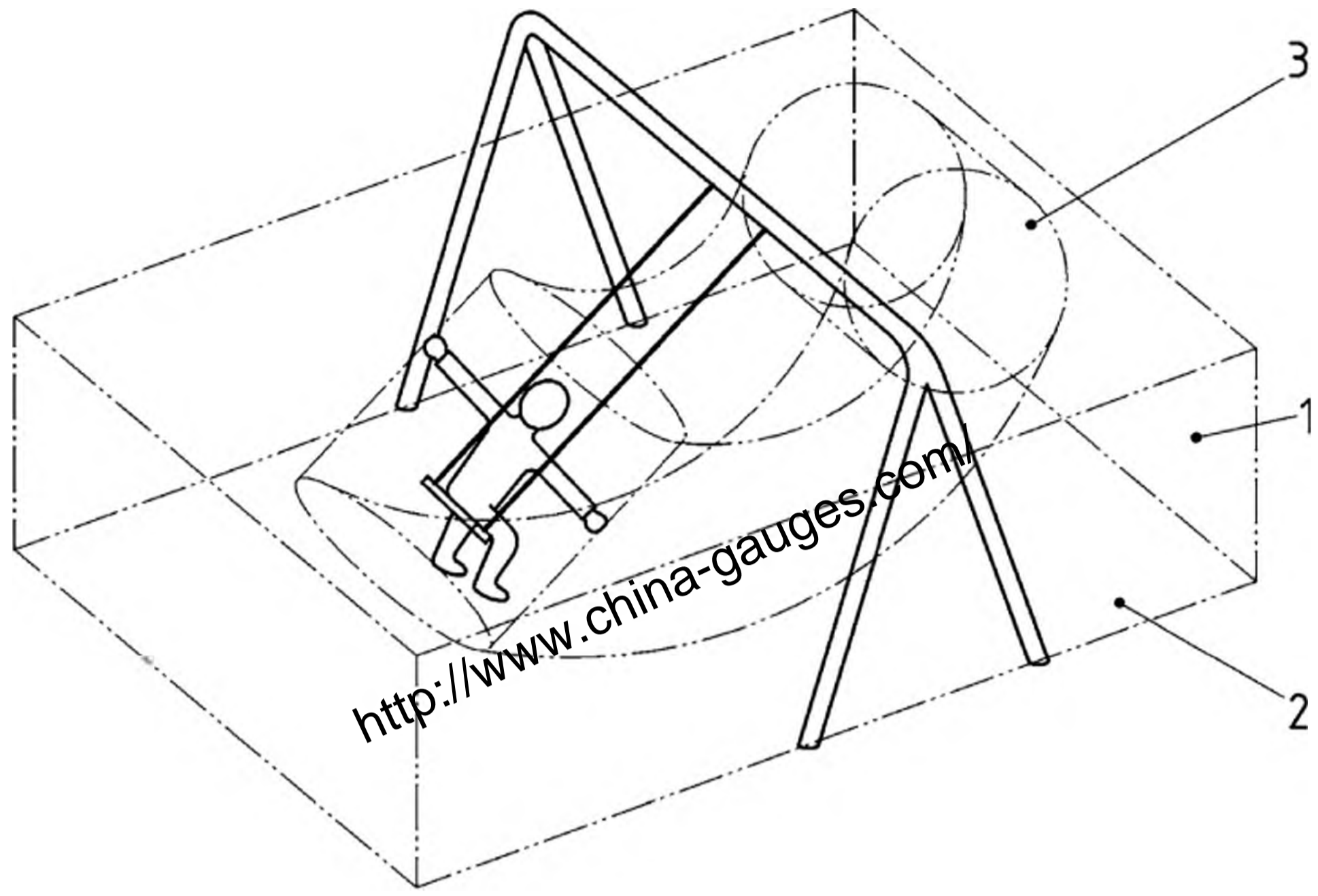
Dimensions in metres



**Key**

$A$	$0,867 \times h_2$	$D$	maximum free height of fall	$h_2$	length of swing suspension member
$B$	1,75 m for level impact absorbing surface (normally synthetic)	$L$	$A + B$ or $A + C$	$h_3$	height of swing seat at rest
$C$	2,25 m for contained impact absorbing surfaces (normally loose fill)	$W$	width of the falling space		
		$Z$	distance from swing axis to swing axis	1	area to be covered by impact absorbing surface under each swing position

**Figure 10 — Free height of fall and surfacing requirements beneath a swing**



- Key**
- 1 falling space
  - 2 impact area
  - 3 free space

**Figure 11 — Free space, falling space and impact area of a swing**

**4.10.2.2** For swing seats with a width not greater than 500 mm suspended by one or more rotational axis (Types 1, 2 and 4), the impact area shall have a minimum width of 1,75 m. If the seat is greater than 500 mm the width of the impact area shall be increased by the difference between 500 mm and the actual width of the seat.

**4.10.2.3** For single point swings (Type 3) the extent of the impact attenuating surface shall be circular with a radius as specified in 4.10.2.1.

## 5 Additional type requirements

### 5.1 Swings with several rotational axes (Type 2)

If there is a backrest the angle between the backrest and the actual seat shall not change when the swing is in motion. When measured in one direction the clear distance between the backrest and the actual seat shall be not less than 60 mm and not more than 75 mm.

### 5.2 Single-point swings (Type 3)

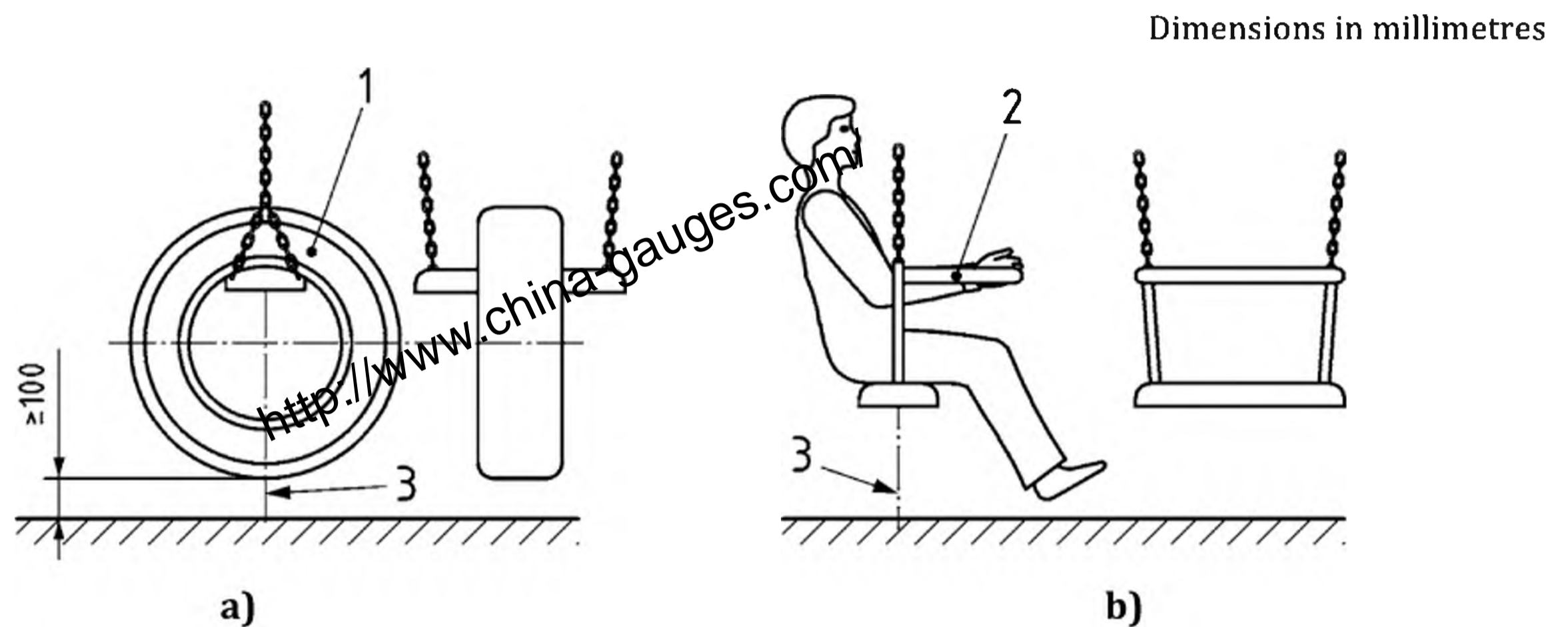
The fixing point shall be such that when the swing revolves the supporting cables will not twist. This may be achieved by using a revolving universal joint.

If a universal joint is used that is not specifically designed and engineered for the purpose, there shall be a secondary means of supporting the swing seat to prevent collapse if the primary joint between the cables or chains and the supporting structure collapse.

### 5.3 Contact swings (Type 4)

Seats shall be constructed to discourage jumping from them to the central axis while swinging. Seats shall conform to the requirements of 4.6.

EXAMPLE This can be achieved by using a vertical tyre or a restraining bar, see Figure 12.



#### Key

- 1 tyre or similar
- 2 restraining bar
- 3 centre of the seat

Figure 12 — Example of seats for contact swings

## 6 Test reports

Test reports shall be in accordance with EN 1176-1:2017, Clause 5, in addition to the following:

- a) Unless otherwise stated the requirements of Clause 4 of this document shall be verified by measurement, visual examination, or practical tests.
- b) Number and date of this European Standard, i.e. EN 1176-2:2017 shall be included in the report.

## 7 Marking

Swings shall be marked in accordance with EN 1176-1:2017, Clause 7.

Marking shall be positioned on the swing in a location that will be visible when erected on site.

## Annex A (informative)

### Recommendations for design and siting of swings

Further to the recommendations in EN 1176-1:2017, 4.2.8.2.1, if fences are used as an enclosure, they should have one or more entrances in corners of the enclosure nearer the centre of the playground to discourage children from waiting or moving around the swings. Entrances should be designed so as to restrict the speed of entry.

Fences should be positioned at least 1,5 m from the side edge of the swing seat and subject to risk assessment, 1,5 m from the edge of the impact area (measured  $0,867 \times L + 1,75$  m) in the direction of the swinging motion.

**NOTE** Fences are not generally the best solution for providing segregation of swings. However, where they are used it is advised to assess the clearance space in the direction of swinging on an individual basis, depending on the environment, swing type and swing seat type. The risk of miss use will be greatest with big swings, with open seats and least with small swings, with cradle/toddler seats. A smaller clearance in the swinging direction could be accepted where the risks are not viewed as sufficient.

## Annex B (normative)

### Determination of swing seat impact attenuation

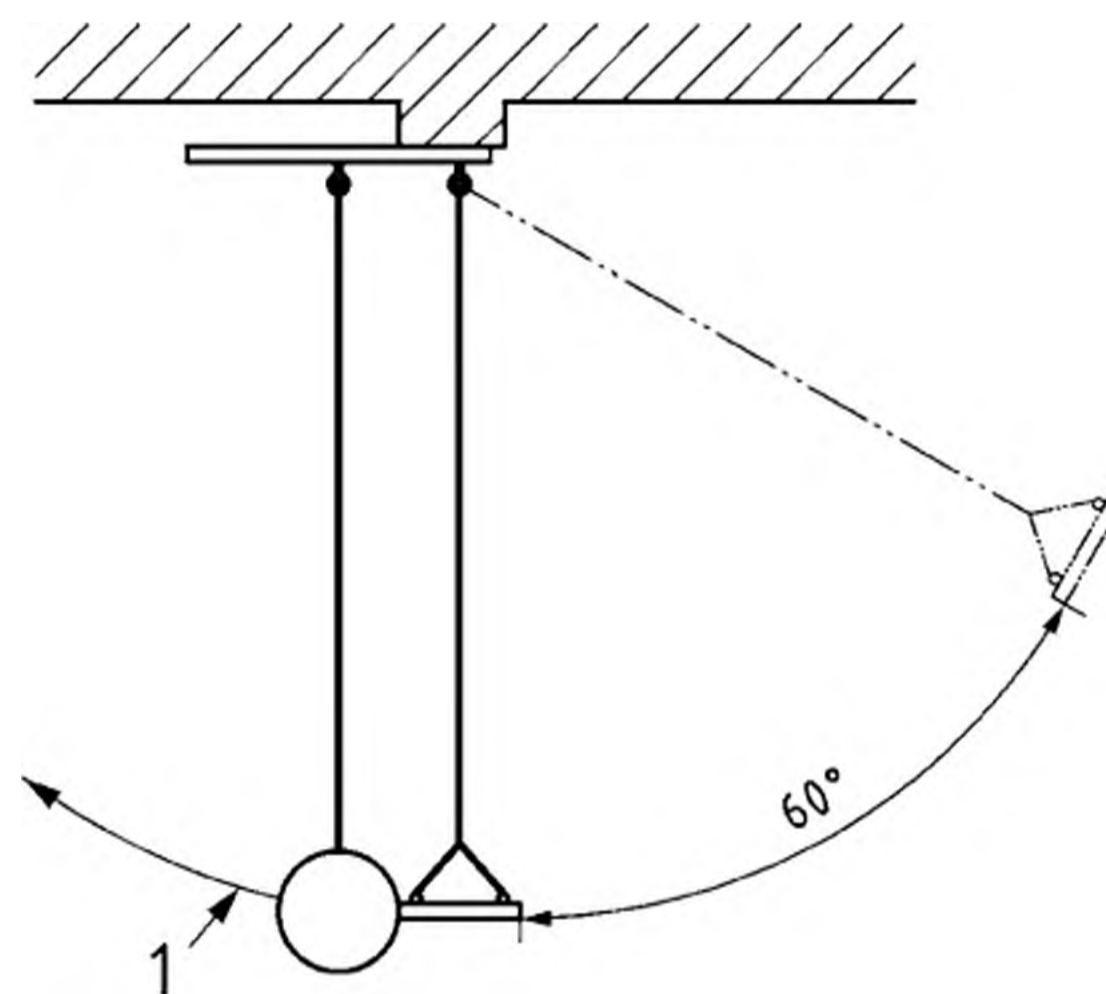
#### B.1 General

Swing seats are raised and allowed to swing to strike a test mass. The signal emitted by an accelerometer during each impact is processed to determine the peak value of acceleration and the surface compression.

#### B.2 Apparatus

**B.2.1 Test rig**, comprising test mass (B.2.2), accelerometer (B.2.3), impact measuring equipment (B.2.4), (see Figure B.1).

**B.2.2 Test mass**, consisting of an aluminium ball or hemisphere of diameter  $160 \text{ mm} \pm 5 \text{ mm}$ , and mass  $4,6 \text{ kg} \pm 0,05 \text{ kg}$ , surface roughness less than  $25 \text{ }\mu\text{m}$  so that the impacting part between the surface struck and the accelerometer is homogeneous and free from voids.



#### Key

1 measuring equipment

Figure B.1 — Testing arrangement

**B.2.3 Accelerometer**, mounted at the centre of gravity of the test mass (B.2.2) assembly with the sensitive axis aligned to within 2 degrees of the direction of travel of the test mass, capable of measuring acceleration tri-axially.

#### B.2.4 Impact measuring equipment:

**B.2.4.1 Chains**, two 6 mm gauge, of equal length suspended from pivots 600 mm apart at the same height as the bearings of the swing seat so that they meet at the point of connection to the test mass (B.2.2).

## B.3 Procedure

### B.3.1 Flat swing seats

Hang the seat on 6 mm chains so that the bottom of the leading edge of the seat is vertically  $2,4 \text{ m} \pm 10 \text{ mm}$  below the suspension bearings.

### B.3.2 Cradle swing seats

Hang the seat on 6 mm chains so that the bottom of the leading edge of the seat is vertically  $1,8 \text{ m} \pm 10 \text{ mm}$  below the suspension bearings.

### B.3.3 Arrangement of test rig

Arrange the test rig so that the leading edge of the seat just touches the leading edge of the test form at its centre of gravity.

### B.3.4 Raising seat for test

Raise the seat along its arc of motion until the side view projection of a straight line through the pivot point and index mark forms an angle of  $60^\circ$ .

When the seat is suspended from chains, etc., some curvature will be produced in the suspending elements. Adjust the seat position to determine the curvature that provides a stable trajectory.

Caution should be exercised to prevent damage to the test equipment. Where there is any possibility of the accelerometer range being exceeded, preliminary tests should be made at lower angles (e.g.  $10^\circ$ ,  $20^\circ$  and  $30^\circ$ ). If there is doubt concerning the seat trajectory or stability, the test mass and/or guidance structure, trial releases should be made without impacting the test mass.

Some seats of a flexible nature will require a brace to maintain the seat configuration during the test procedure. The mass of brace should not exceed 10 % of the mass of the seat after test.

### B.3.5 Support and release of seat

Support the seat in the raised position by a mechanism that provides release without the application of external forces which would disturb the trajectory of the suspended member. Ensure that the seat and suspending elements are motionless. Release the seat so that the assembly moves in a smooth downward arc without any visible oscillations or rotations of the seat which would prevent it from striking the test mass at the impact point.

### B.3.6 Collection of data

Once satisfactory system operation and calibration are obtained, collect data for 10 impacts. Measure the peak acceleration for each impact and the area of contact between seat and test form.

### B.3.7 Peak acceleration

Record the peak acceleration as the mean value from the 10 impacts.

### B.3.8 Surface compression

Record the surface compression as the mean value from the 10 impacts.

### B.3.9 Average surface compression

Measure the area of the seat that has made contact with the test mass. Calculate the average surface compression by dividing the force exerted by the seat by the area of the seat that has made contact with the test mass. Record the value in  $\text{N/cm}^2$ .

## B.4 Impact measuring equipment

**B.4.1 Impact measuring equipment**, consisting of an accelerometer measurement system (B.4.2) and a recording device (B.4.3).

**B.4.2 Accelerometer measurement system**, capable of measuring all frequencies in the range 1 Hz to 1 000 Hz and having a sufficient response at all frequencies to keep amplitude errors below 5 %, in accordance with ISO 6487. It shall be capable of measuring, recording and displaying the acceleration and time duration of each complete impact.

**B.4.3 Recording device**, capable of capturing and recording the acceleration time signals produced during an impact with a minimum sampling rate of 10 kHz. Signal conditioning and filtering shall be compatible with the accelerometer and the data channel specified and shall conform to ISO 6487.

According to ISO 6487 the analogue anti-aliasing filters should have an attenuation of at least 30 dB at half the sampling rate.

## B.5 Accuracy of tests

**B.5.1** Apparatus shall be equipped with calibrated measuring devices. The impact measuring system, including the signal processing equipment, shall be validated at least annually by a competent laboratory in accordance with EN ISO/IEC 17025.

**B.5.2** Accelerometers shall be calibrated for the whole frequency range. Recalibration shall be carried out at timed intervals recommended by the manufacturer of the accelerometer, or at least every two years.

Accelerometers shall have an uncertainty  $\leq 5\%$ .

**B.5.3** Reactions from the release system of the aluminium ball shall be tested by a series of at least three consecutive tests on a defined reference swing seat with constant properties. The acceleration values obtained shall not differ more than  $\pm 5\%$ .

NOTE These tests are for checking any deviations or anomalies in the components and neither replace calibration nor the validation for compliance of the apparatus with this European Standard.

Experience has shown that comparative testing on defined swing seats might not be sufficient and that an external calibration of the measuring device is required.



## Annex C (normative)

### Dynamic load test for suspension systems of swings

#### C.1 Principle

The suspension system, consisting for example of chains, bearings and connections, is loaded with a test load and swung through an arc for a defined number of cycles. The suspension system is examined for damage.

#### C.2 Procedure

Load the seat assembly with the test load in accordance with EN 1176-1:2017, Table A.1.

Then either:

- a) swing the seat assembly; or
- b) rotate the suspension point assemblies, continually for  $10^5$  cycles through an arc of not less than  $120^\circ$ .

Remove the loads and visually inspect the equipment for signs of damage or wear.

**WARNING** — Ensure **that the weights are securely attached to the equipment.**

## Bibliography

- [1] EN 1177, *Impact attenuating playground surfacing — Determination of critical fall height*

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