BS EN 12572-2:2017

BSI Standards Publication

Artificial climbing structures

Part 2: Safety requirements and test methods for bouldering walls

bsi.

National foreword

This British Standard is the UK implementation of EN 12572-2:2017. It supersedes BS EN 12572-2:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee SW/136/19, Artificial climbing structures.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Artificial climbing structures - Part 2: Safety requirements and test methods for bouldering walls

Structures artificielles d'escalade - Partie 2 : Exigences de sécurité et méthodes d'essai relatives aux pans et blocs d'escalade

Künstliche Kletteranlagen - Teil 2: Sicherheitstechnische Anforderungen und Prüfverfahren für Boulderwände

This European Standard was approved by CEN on 29 October 2016.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 12572-2:2017) 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of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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 12572-2:2008.

This standard EN 12572, *Artificial climbing structures*, consists of the following parts:

— *Part 1: Safety requirements and test methods for ACS with protection points*

— *Part 2: Safety requirements and test methods for bouldering walls*

— *Part 3: Safety requirements and test methods for climbing holds*

The following changes have been made in comparison with EN 12572-2:2008:

— Table regarding “Shock absorbing” has been added;

— Table regarding “Size of the impact area” has been added;

— Test for shock absorbing surfaces has been added;

— Structural integrity and impact resistance modified

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.

1 Scope

This European Standard specifies the safety requirements and calculation methods for bouldering walls, including the safety zone.

This European Standard is applicable when the bouldering is in normal use.

This European Standard is not applicable to ice climbing, dry tooling, playground equipment and deep water soloing.

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

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

EN 1991-1-5, *Eurocode 1: Actions on structures - Part 1-5: General actions - Thermal actions*

EN 12503-4:2016, *Sports mats — Part 4: Determination of shock absorption*

EN 1998-1, *Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*

3 Terms and definitions

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

3.1
artificial climbing structure
(ACS)
sports equipment consisting of a purpose-built climbing structure, which exhibits various construction characteristics, and is designed for various uses in climbing objectives and is not reserved for a particular group

3.2
bouldering wall
artificial climbing structure allowing climbing without protection points including a falling space and impact area

3.3
characteristic load
maximum load that can be generated in normal use

Note 1 to entry: See EN 12572–1.

3.4
falling space
space around the bouldering wall that can be occupied by a user during a fall

3.5
impact area
surface on which a user lands after falling

3.6
bouldering wall height
vertical height measured between the highest possible point a climber can hold and the top of the impact area

3.7
impact absorbing material
material beneath a bouldering wall filling the impact area designed to absorb the energy of a fall

EXAMPLE Water, air cushion, shingle and foam safety mats.

4 Safety requirements and test methods

4.1 Maximum height for bouldering

The maximum height for bouldering shall be 4 500 mm. It shall be up to 4 000 mm high, where it is possible to stand on the top.

4.2 Impact absorbing material

4.2.1 General

The impact absorbing material shall be adapted to accept a fall from at least the maximum height of the bouldering wall at the bottom of which it is installed.

4.2.2 Impact attenuation

4.2.2.1 Impact attenuating capacity for foam safety mats

The most common indoor impact absorbing materials are foam safety mats.

When tested according to Annex C, the boulder mat shall comply with the values of Table 1.

Table 1 — Shock absorption

Peak deceleration g (1 g = 9,81 ms^{-2})	**Deflection** %	**Resilience** %
≥ 15 and ≤ 25	≤ 80	≤ 15

4.2.2.2 Impact attenuating capacity for shingle

One of the most common outdoor impact absorbing materials is shingle.

When shingle is used it shall be washed, rounded and be between 8 mm and 16 mm in diameter and have a minimum depth of 400 mm.

For bouldering wall heights greater than 3 000 mm, as the impact attenuating capacity of shingle may not be sufficient to safely absorb all falls, a notice shall be erected at the bouldering wall site warning climbers that the use of this bouldering wall is more like climbing at a natural site, and therefore they should use other regular techniques for protecting each other such as: hand spotting, use of crash pads (individual protection mats) etc.

This information shall be visible and accessible to all.

4.2.2.3 Impact attenuating capacity for other types of impact absorbing material

For other types of material such as water, air cushion, net, rubber, bark etc. relevant standards for the selected material should be followed where applicable.

4.3 Impact area

4.3.1 Size of the impact area

Extent of the impact area L:

— if the bouldering wall height is equal to or less than 3 000 mm, the ground projection of the bouldering wall shall be extended by L1 ≥ 2 000 mm;

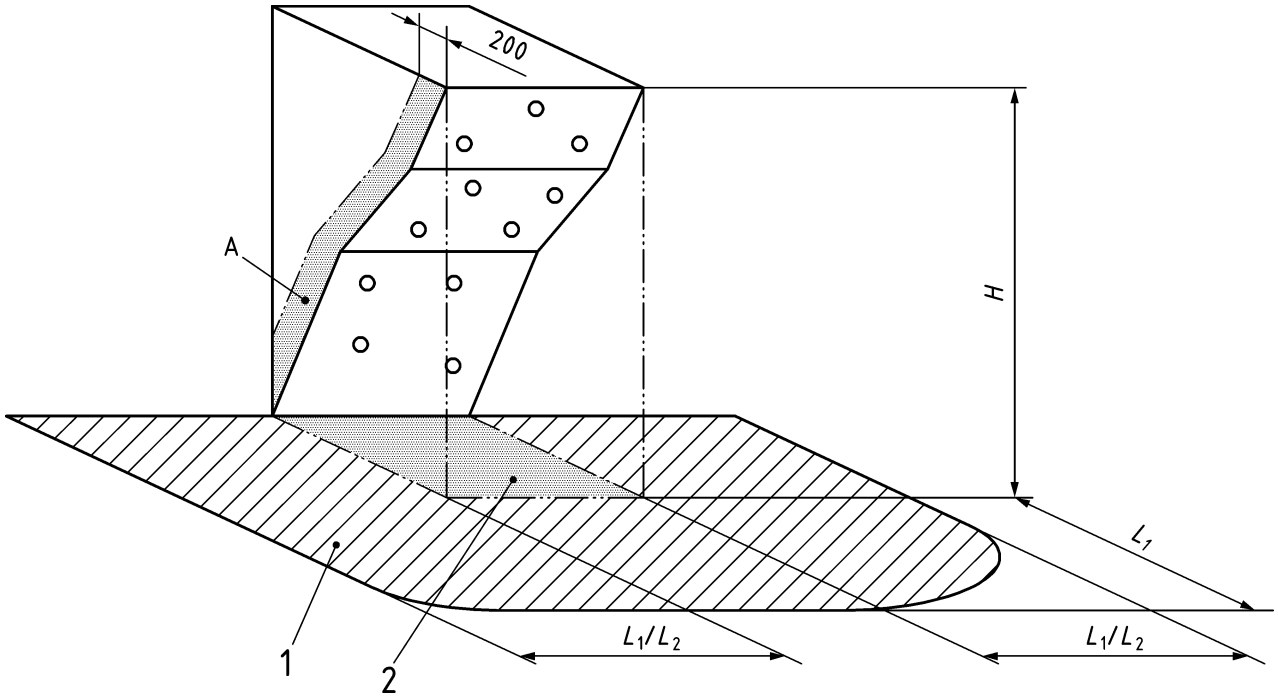
— if the height of the bouldering wall is greater than 3 000 mm, the ground projection of the bouldering wall shall be extended by L1 ≥ 2 500 mm, see Figure 1.

— if the bouldering wall is vertical or less than 10° overhanging with no holds on the side walls, the impact area either side of the bouldering wall L2 can be reduced to 50 % of the bouldering wall height or 1 500 mm.

Table 2 — Size of the impact area

Height of the wall	**Size of the impact area in front of the climbing wall**	**Size of the side impact area for walls ≤ 10° and no holds on the side**	**Size of the side impact area for walls > 10°**
H	L1	L2	L2
0 to ≤ 3 000 mm	2 000 mm	50 % of the height	50 % of the height
> 3 000 mm to ≤ 4 500 mm	2 500 mm	1 500 mm	
NOTE Holds in the area A given in Figure 1 are considered as a part of the front wall.			

Dimensions in millimetres



Key

1 top of the impact area

2 projection of the bouldering wall

H height of the highest possible holding point

L_1 length added to the ground projection of the bouldering wall in front of the bouldering wall

L_2 additional width of the impact area (under special circumstances)

A lateral surface where climbing is possible considered as a part of the front wall

Figure 1 — Example of the dimensions of the impact area at the base of a bouldering wall

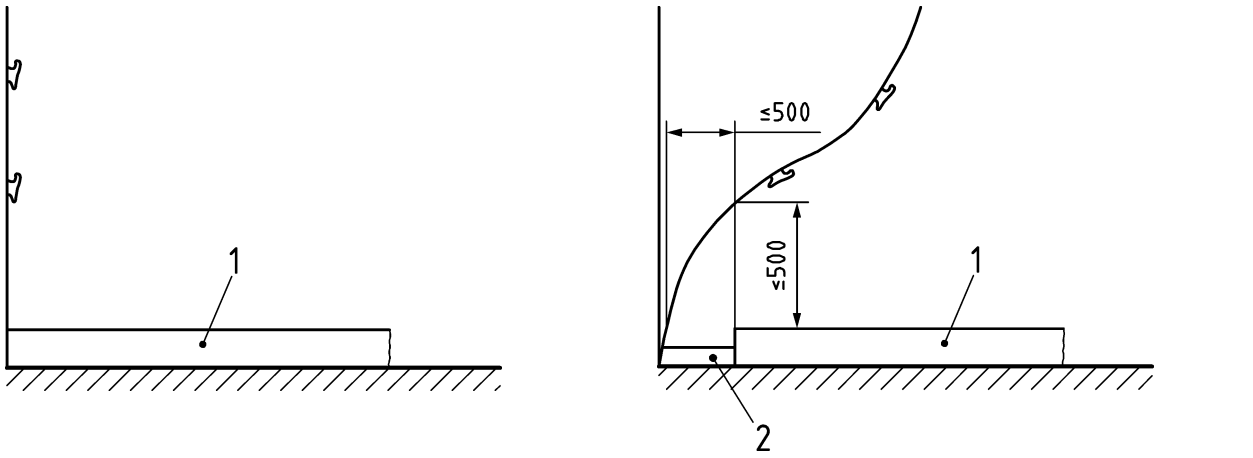
If a bouldering wall constructor can prevent through considered design the possibility of a climber falling to the side of the bouldering wall, the extent of the impact area may be reduced accordingly.

4.3.2 Position of foam safety mats

Foam safety mats shall touch the base of the bouldering wall and shall be prevented from moving while in use, see Figure 2a).

For steeply overhanging bouldering walls it is acceptable to use a thin or sloping mat installed between the base of a bouldering wall and the main foam safety mat to prevent injuries according to Figure 2b).

Dimensions in millimetres



a) Position of foam safety mat

b) Optional foam safety mat position for "steeply overhanging bouldering walls"

Key

1 main foam safety mat

2 thin or sloping mat

Figure 2 — Position of the impact area

4.4 Connection of modular foam safety mat elements

If the impact absorbing materials consist of modular elements, the sections shall be securely connected together or the gaps shall be covered so that it is impossible for the climber to enter into the gaps between modular elements. If the impact absorbing materials are beneath a continuous surface cover, the cover shall be in sufficient tension to hold the foam safety mats closely together.

Informative Annex G describes one possible method of testing modular foam safety mat element connections.

4.5 Structural integrity

The structural integrity, including stability, of a bouldering wall shall be justified by calculation using the characteristic loads given in Table A.1 in accordance with Annexes A and B.

Panels shall not overly deflect (see D.5).

In all cases where a bouldering wall transmits loads to an existing structure (building, concrete platforms, ground) it shall be ensured that the structure can safely accommodate the loads imposed by the bouldering wall.

4.6 Impact resistance and deflection of surface elements

When tested in accordance with Annex D there shall be no breaking or splitting of the surface element.

The deflection of the panels shall be calculated by using the load 0,8 kN (see Annex A) or be tested in accordance with Annex D, D.5.

When fixed according to the manufacturer's specification, the maximum deflection of the surface element shall not exceed $l/100$,

where

l is the maximum length between the fixations of the surface

4.7 Panel insert resistance

To evaluate the panel insert concerning the resistance to breakage while mounting the climbing holds onto the wall or during climbing use, the panel inserts shall be tested in accordance with Annex E.

After test step c) any resulting deformation shall not exceed 0,5 mm at 1,2 kN.

After procedure e) there shall be no pull out of the panel insert.

Five samples (panel-insert combination) shall be tested.

4.8 Falling space

Within the falling space there shall not be any exposed obstacles or edges which could lead to a hazard to the user. This does not apply to climbing structures and other obstacle-free surfaces or walls capable of withstanding accidental impacts.

4.9 Bouldering wall surfaces

All reachable parts of the bouldering wall surface shall be free of sharp edges and burrs. Edges shall be rounded by a minimum radius of 1 mm, or chamfered at 45°mm × 1 mm. There shall be no gaps between 8 mm and 25 mm and with a depth greater than 15 mm which can lead to entrapment, unless it is a feature specifically designed for climbing. Insert holes in the climbing surface of the bouldering wall for attaching holds are excluded.

5 Marking

All bouldering walls shall be marked in a clearly visible place with a notice detailing:

a) name or trademark of the manufacturer;

b) name of importer or supplier;

c) number and date of this European Standard, i.e. EN 12572-2:2017;

d) date of installation of the bouldering wall (the year with 4 figures);

e) date of the next main inspection (the year with 4 figures);

f) that this is a specifically designed bouldering wall for climbing and is not playground equipment;

NOTE This principally concerns external bouldering walls in public places.

g) in case of shingle or other similar impact absorbing material, safety marking in accordance with 4.2.2.2.

6 Instruction manual

An instruction manual shall be provided including the following information:

a) all the information contained in Clause 5;

b) specific maintenance and inspection requirements, see Annex F;

c) maximum additional load allowed per square metre, for large removable elements (e.g. Macros);

d) maximum number of climbers permitted at any time, where applicable.

7 Technical documentation of the bouldering wall

The documentation shall be supplied to the client and shall contain the following information:

a) detailed calculation (or justification) of the stability of the bouldering wall;

NOTE For all further reconfigurations only the new calculations (or justification) according to the standard and the manufacturer's instructions are necessary.

b) report of the hold insert resistance test, where applicable;

c) report of the impact test of surface elements;

d) report of the connection of modular foam safety mat elements, where applicable;

e) justification for the selection of the impact absorbing material used in the impact area;

f) marking (according to Clause 5);

g) instruction manual (according to Clause 6).

Annex A
(normative)

Effects

A.1 Permanent effects

The permanent effects consist of the self-weight of the structure and of the entire structural frame.

A.2 Variable effects

A.2.1 General

The variable effects consist of:

a) user loads (static and dynamic, including people standing on the top of the bouldering wall);

b) snow loads;

c) wind loads;

d) effects of temperature;

e) seismic loads;

f) special loads.

A.2.2 User loads

Table A.1 — Loads

	Characteristic load kN
Load of a climber	0,8
Substitution load per square metre on the climbing surface	0,4
Substitution load per square metre for any standing areas on a bouldering wall	1,6

A.2.3 Snow loads

Snow loads shall be taken from the Eurocodes for Actions on Structure, i.e. EN 1991-1-3.

A.2.4 Wind loads

Wind loads shall be taken from the Eurocodes for Actions on Structure, i.e. EN 1991-1-4.

A.2.5 Effects of temperature

Impacts of temperature shall be taken from Eurocodes for Actions on Structure, i.e. EN 1991-1-5.

A.2.6 Seismic loads

Seismic loads shall be taken from the Eurocodes for actions on structure, i.e. EN 1998-1.

A.2.7 Special loads

Special loads can be generated e.g. by ropes courses, rescue techniques, zip wires and slacklines.

Annex B
(normative)

Method of calculating of structural integrity and stability

B.1 General principles

B.1.1 Limit state

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

The preferred method of calculation shall be based on the general principles and definitions for limit states as specified in the appropriate structural Eurocodes 1 to 6 or equivalent national standards.

NOTE Limit states are states beyond which the structure no longer satisfies the requirements of this standard.

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

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

where

γ_F is a partial safety factor for effects;

γ_M is a partial safety factor for materials;

S is the load effect;

R is the resistance of the structure.

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

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

B.1.2 Ultimate limit state

Ultimate limit states requiring consideration include:

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

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

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

B.2 Combination effects for the ultimate limit state

The following combinations shall be used for verification:

$$\gamma_G G_k + \gamma_Q Q_{k,1} + \sum_{i>1} \psi_i \gamma_Q Q_{k,i} \quad \text{(B.2)}$$

where

G_k is the characteristic value for permanent effects;

Q_k is the characteristic value for variable effects as given in A.2.2;

γ_G is the partial safety factor for permanent effects;

γ_Q is the partial safety factor for variable effects;

ψ is the combination factor for variable effects.

The following partial safety factors for effects shall be used:

γ_G 1,0 for favourable effects;

γ_G 1,35 for unfavourable effects;

γ_Q 0 for favourable effects;

γ_Q 1,5 for unfavourable effects.

Combination factor for variable effects of the climber may be used (simplified method of calculation):

ψ = 0,8.

B.3 Structural stability and integrity

For the calculation of structural integrity and stability of a bouldering wall, place at every unfavourable area of the bouldering wall the substitution load per square metre as described in Table A.1. Add at the most unfavourable point the load of a climber (0,8 kN) and add any unfavourable loads produced by standing climbers as described in Table A.1.

Annex C
(normative)

Testing of shock absorbing surfaces

C.1 Test procedure

The following test procedure is applicable for new mats tested under laboratory conditions.

Test principle: According to EN 12503-4:2016, 7.1.

Indentor: Mass (30 ± 0,3) kg; Diameter: (150 ± 0,5) mm. (equivalent to the indentor for mats types 7, 8, 9, 10, 11, in EN 12503-4:2016, Table 1)

Release mechanism, accelerometer, data capture and processing, thickness measurement, conditioning and test temperature, expression of results and test report: according to EN 12503-4.

Test fall height: 2 200 mm ± 3 mm.

Test specimen: minimum 2 000 mm × 2 000 mm, see Figure C.1.

Test locations according Figure C.1.

Dimensions in meters

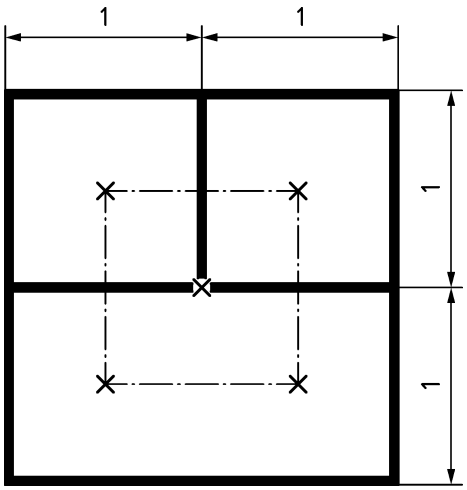


Figure C.1 — Test locations and number of tests

C.2 Expression of results

Each test location being tested 10 times, the retained value for each point is the mean value of the last eight values.

Then, calculate the overall mean values, for each parameter, which are the mean values of the values obtained at each of the five test locations.

Annex D
(normative)

Test of surface elements

D.1 General

This test is designed to reproduce a shock perpendicular to the surface of the bouldering wall, when the bouldering wall is used under normal conditions.

D.2 Apparatus

Indenter in accordance with Figure D.1.

D.3 Sampling

The surface elements to be tested shall have been produced using the same materials and by the same manufacturing processes as the elements of the bouldering wall it represents. The sample shall be a standard element or a specially made flat panel 1 000 mm × 1 000 mm.

D.4 Procedure

Set up the surface element as shown in Figure D.2.

Place the surface element on rigid supporting points as following:

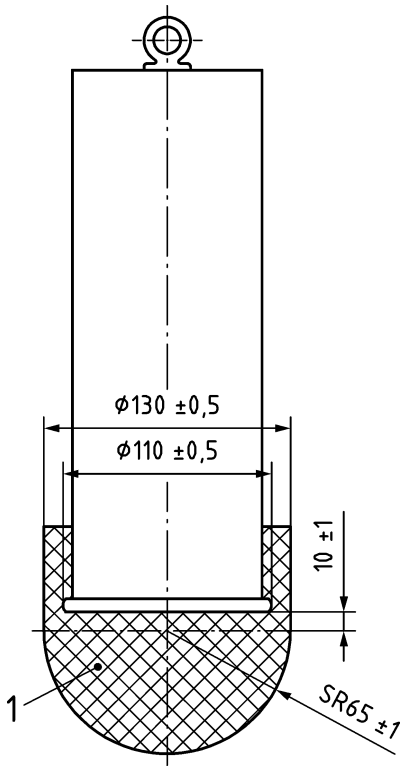
a) for a surface element: as it would be on an bouldering wall;

b) for a sample: at each corner, with a non-shock absorbing system.

Strike the surface of the element three times with the indenter in the geometric centre from a height of 1 500 mm as shown in Figure D.2 a) or b).

Note any breakage or splitting of the surface element at the end of the test.

Dimensions in millimetres

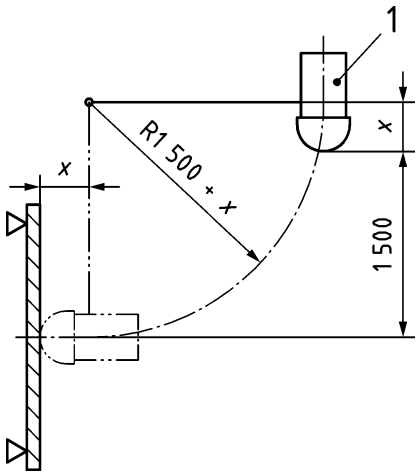


Key

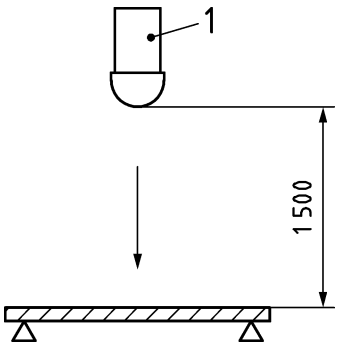
1 silicon [(30 ± 5) shores]
total mass (22 ± 0,1) kg

Figure D.1 — Indenter

Dimensions in millimetres



a) horizontal impact test on vertical surface



b) vertical impact test on horizontal surface

Key

1 indenter

x distance to fixing point

Figure D.2 — Set up of surface elements for impact test

D.5 Maximum deflection

The maximum deflection may be determined by theoretical calculation or empirically. For testing use test samples according to D.3 and apply a force of 0,8 kN normal to the surface and measure the maximum deflection.

Annex E
(normative)

Panel insert resistance test

E.1 General

This test is designed to reproduce the maximum load that can be applied to a panel insertion a bouldering wall due to the force of a fixed climbing hold and the maximum permissible force exerted by a climber during use.

E.2 Apparatus

Eyebolt/ threaded bar, distance ring and pulling apparatus in accordance with Figure E.1.

E.3 Sampling

The surface elements to be tested shall have been produced using the same materials and by the same manufacturing processes as the elements of the bouldering wall it represents.

E.4 Procedure

Carry out the test as follows:

a) load the sample up to (7,2 ± 0,05) kN at a rate of (20 ± 2) mm/min;

b) hold the load for 30 s;

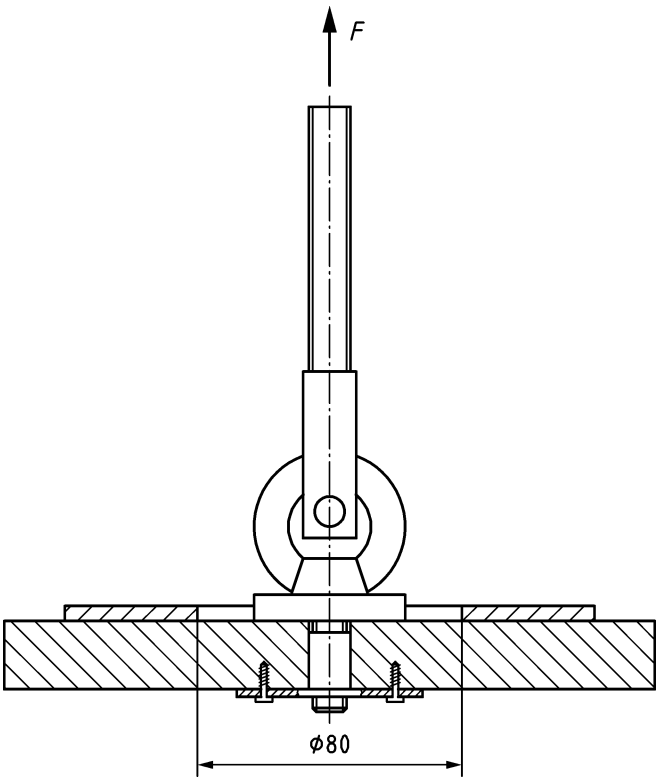
c) relieve down to (1,2 ± 0,05) kN, and measure the deformation;

d) hold the load of (1,2 ± 0,05) kN for 30 s;

e) load the sample up to (12 ± 0,05) kN at a rate of (20 ± 2) mm/min.

Carry out the test under the following conditions: (23 ± 2) °C and (50 ± 10) % relative humidity.

Dimensions in millimetres



Key

F force

Figure E.1 — Apparatus

Annex F
(normative)

Inspection and maintenance

F.1 The manufacturer/supplier shall provide:

a) instructions for maintenance (marked with the number of the current standard), which shall include a statement that the frequency of inspection will vary with the type of equipment or materials used and other factors, e.g. heavy use, levels of vandalism, coastal location, air pollution, age of equipment;

b) drawings and diagrams necessary for maintenance, inspection and checking of the correct operation and, when appropriate, repair of the equipment;

c) instructions to specify how access is to be gained to the inside of each section of the bouldering wall where applicable.

F.2 The instructions shall specify the frequency with which the equipment or its components should be inspected or maintained and shall include guidance on the following, where relevant:

a) Routine visual inspection

The routine visual inspection serves to identify obvious defects and sources of danger on the front side of the bouldering wall, which can be easily seen from the ground without use of means of support. For bouldering walls subject to heavy use or vandalism, daily inspection of this type may be necessary.

b) Operational inspection

The operational inspection is a more detailed inspection to check the operation and stability of the equipment, and for the wear of components. This shall be carried out every 1 to 3 months, or as indicated by the manufacturer's instructions. Operational inspections shall be documented.

Special attention shall be given to the mechanisms of articulated walls.

NOTE 1 Examples of visual and operational inspection points are cleanliness, loose holds, obstacles placed in the free space, missing parts, excessive wear, other obvious damage.

c) Main inspection

The main inspection, according to the maintenance manual of the manufacturer, is done to establish, the overall level of safety of the bouldering wall, its foundations, structural frame and wall surfaces, e.g. effects of weathering, evidence of rotting or corrosion, and any change in the level of safety of the equipment as a result of repairs made, or of added or replaced components. Main inspections shall be documented.

Special attention shall be given to the structural frame and the impact area.

The main inspection may require dismantling of certain parts and replacement of critical safety elements. This inspection of the equipment should be carried out by competent persons in strict accordance with the manufacturer's instructions.

NOTE 2 The level of competence required will vary with the task.

F.3The instructions shall also specify the following:

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

b) that replacement parts shall comply with manufacturer's specifications;

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

d) identification of spare parts;

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

f) any special points the manufacturer wants the operator to pay particular attention to;

g) maintenance of the upper surface of the impact area.

Annex G
(normative)

Testing of the impact area connecting system

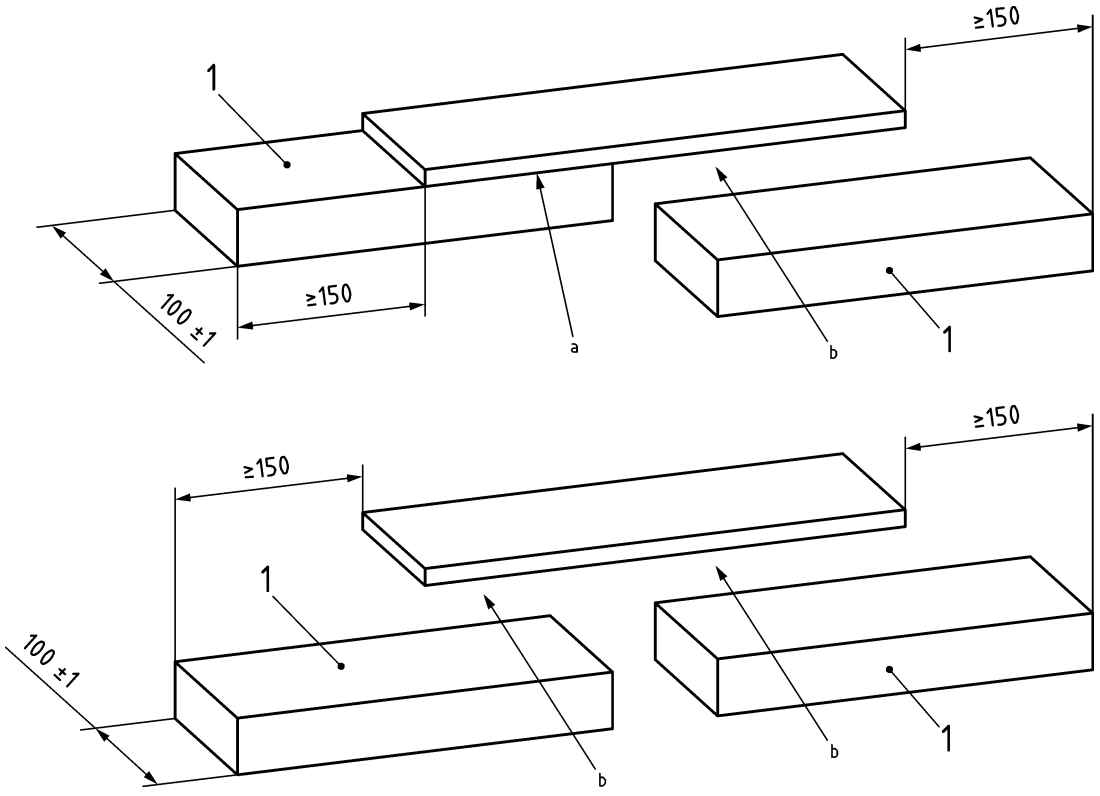
G.1 Test specimen

The test specimen shall consist of all the connection materials (cover for each foam safety mat and assembly system) and measure (100 ± 1) mm linearly (see Figure G.1).

Condition the test specimen for at least 24 h at a temperature of (21 ± 3) °C and a humidity level of (50 ± 10) % immediately prior to testing and perform the tests at the same temperature.

Each foam safety mat cover shall extend ≥ 150 mm beyond the assembly system.

Dimensions in millimetres



Key

1 foam safety mat top cover

a fixed assembly (seam, weld, etc.)

b removable assembly (self-locking, etc.)

Figure G.1 — Examples of connectors

G.2 Determination of breaking force

The test is done on one specimen.

Full force is applied manually to the connector (connection/disconnection) 10 times prior to testing, for conditioning and fault identification purposes.

The test specimen is fixed over a width of (100 ± 1) mm. The jaws of the tensile testing machine are placed (100 ± 1) mm from each side of the assembly system. The test specimen is placed under a (50 ± 1) kg press to hold it in position.

A force of up to (500 ± 5) N is applied to the connection in a tensile testing machine without maintaining the tension. The tensile velocity is 100 mm/min.

When tested in accordance with Annex G with a tensile force of (500 ± 5) N, the entire connected area shall not break or come apart.

G.3 Determination of cyclic tensile strength

The test specimen used in the test described in G.2 is kept and used for this test.

The test specimen is fixed in the tensile testing machine in the same way as for the test described inG.2.

The test specimen is drawn at (300 ± 5) N, then released; this cycle is repeated 50 times. The traction and release velocity is 500 mm/min.

When tested in accordance with Annex G no crack or slip greater than 5 mm shall be visible.

Bibliography

[1] EN 12503-1, *Sports mats - Part 1: Gymnastic mats, safety requirements*

[2] EN 12572-1, *Artificial climbing structures - Part 1: Safety requirements and test methods for ACS with protection points*

[3] EN ISO/IEC 17020, *Conformity assessment - Requirements for the operation of various types of bodies performing inspection (ISO/IEC 17020)*

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

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