

English Version

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

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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of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.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

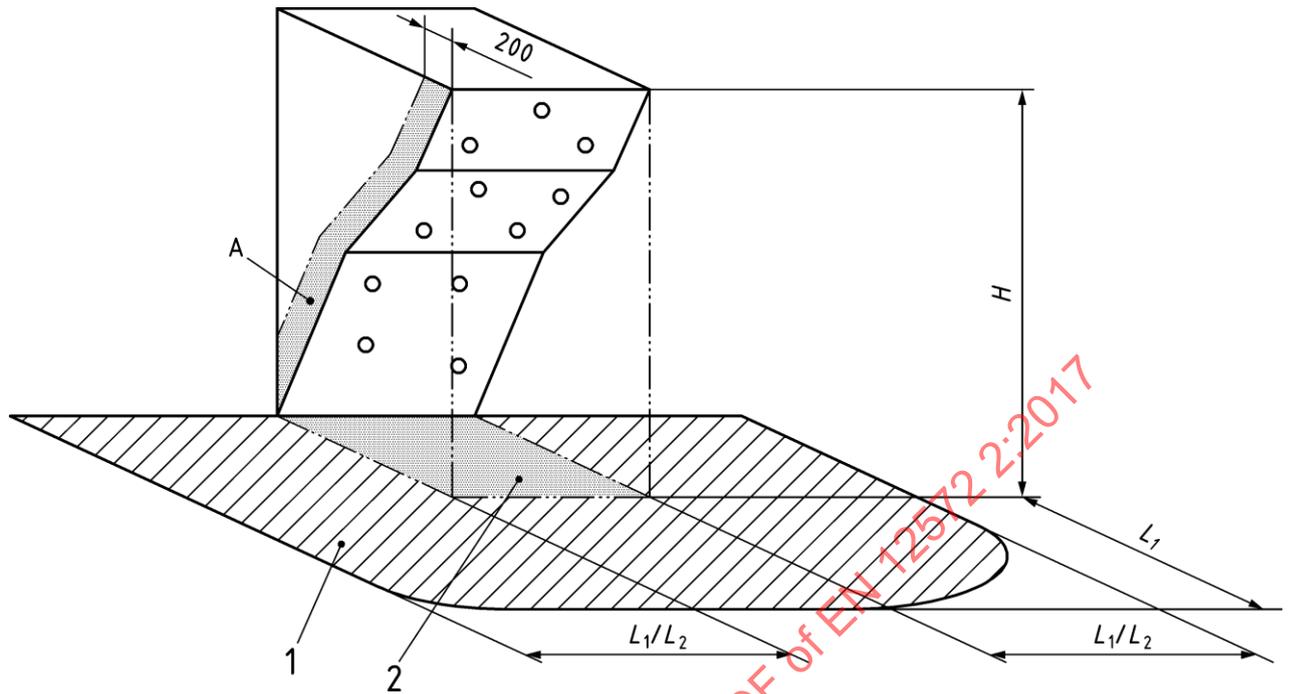
Extent of the impact area L:

- 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 $L1 \geq 2\ 000$ 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 $L1 \geq 2\ 500$ 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 $\leq 10^\circ$ and no holds on the side	Size of the side impact area for walls $> 10^\circ$
H	L1	L2	L2
0 to $\leq 3\ 000$ mm	2 000 mm	50 % of the height	50 % of the height
$> 3\ 000$ mm to $\leq 4\ 500$ 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

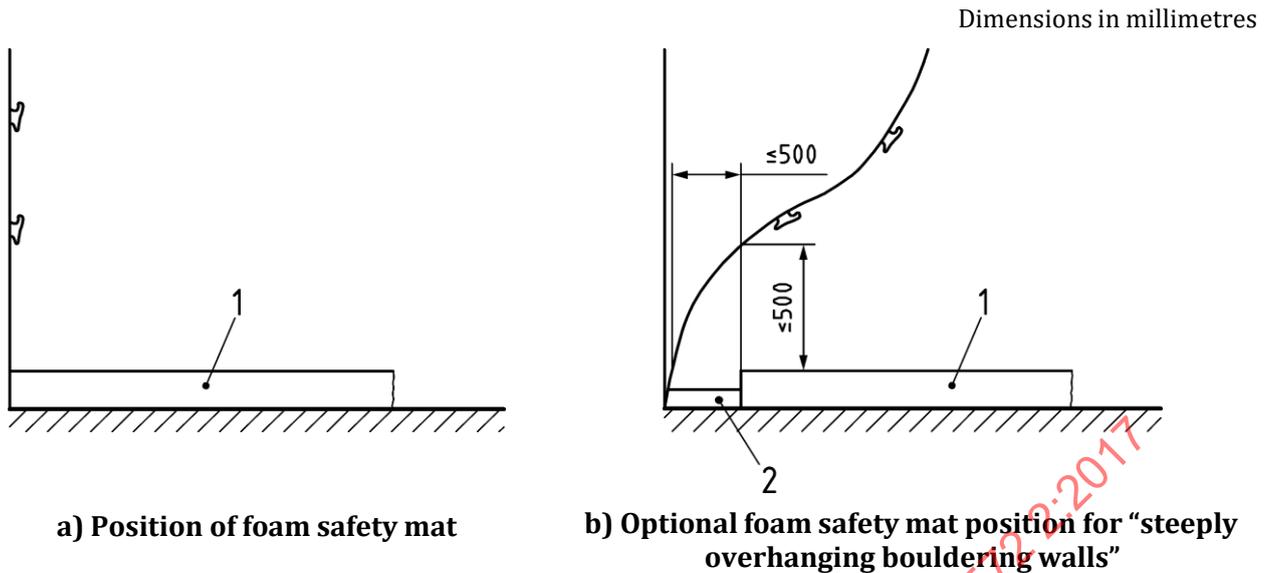
Figure 1 — Example of the dimensions of the impact area at the base of a bouldering wall

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).

**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 \times 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.

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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):

$$\psi = 0,8.$$

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.

Indenter: Mass ($30 \pm 0,3$) kg; Diameter: ($150 \pm 0,5$) mm. (equivalent to the indenter 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: $2\,200 \text{ mm} \pm 3 \text{ mm}$.

Test specimen: minimum $2\,000 \text{ mm} \times 2\,000 \text{ mm}$, see Figure C.1.

Test locations according to Figure C.1.

Dimensions in meters

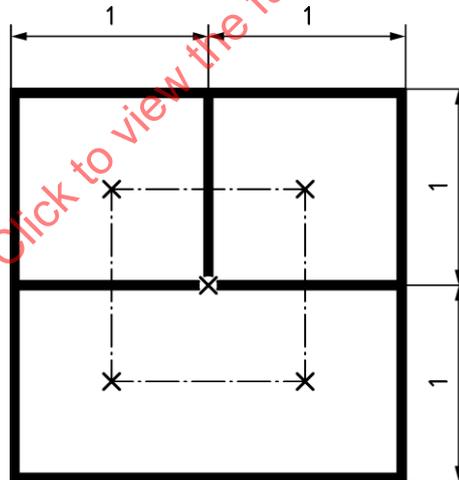


Figure C.1 — Test locations and number of tests

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.

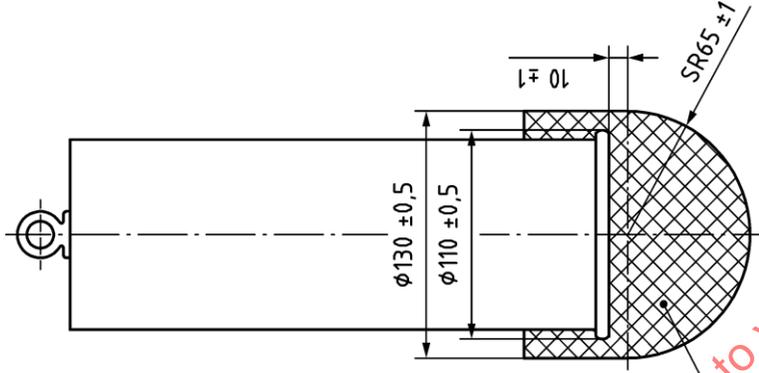
Place the surface element on rigid supporting points as following:

- 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

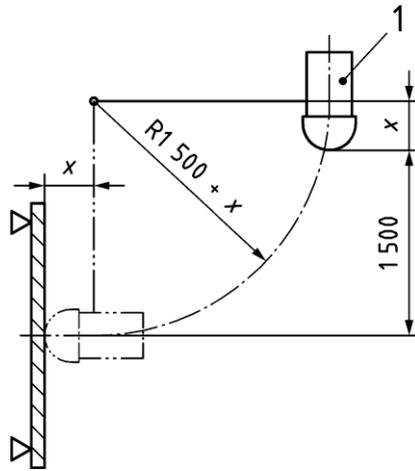


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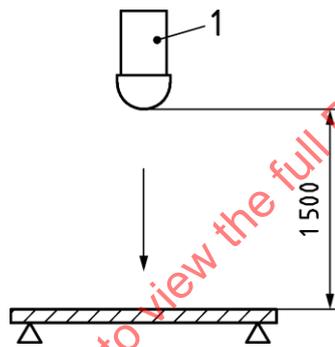
- 1 silicon [(30 ± 5) shores]
total mass (22 ± 0,1) kg

Figure D.1 — Indenter

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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.

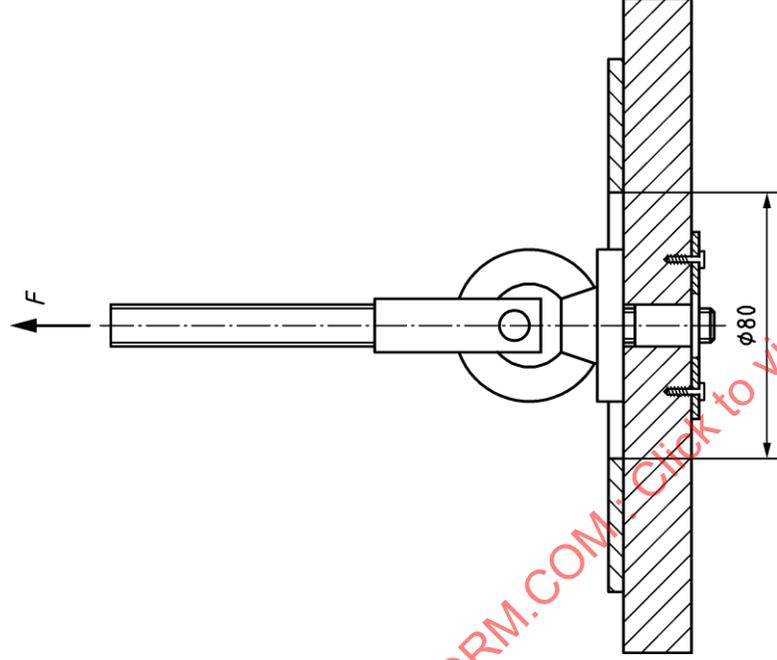
E.4 Procedure

Carry out the test as follows:

- a) load the sample up to $(7,2 \pm 0,05)$ kN at a rate of (20 ± 2) mm/min;
- b) hold the load for 30 s;
- c) relieve down to $(1,2 \pm 0,05)$ kN, and measure the deformation;
- d) hold the load of $(1,2 \pm 0,05)$ kN for 30 s;
- e) load the sample up to $(12 \pm 0,05)$ 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