

Mountaineering equipment — Rock anchors — Safety requirements and test methods

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National foreword

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

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Contents

Page

Foreword	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
4 Safety requirements	5
4.1 Materials	5
4.2 Design	5
4.3 Loadbearing capacity	7
5 Test methods	7
5.1 Check of materials	7
5.2 Apparatus	7
5.3 Procedure	7
6 Marking	9
7 Information supplied by the manufacturer	10
Annex A (informative) Standards on mountaineering equipment	11
Annex B (informative) Choice of materials for different environmental conditions and the consequences for inspection and maintenance	12
Annex C (informative) The need for longer length rock anchors for use in soft rock	13
Bibliography	14

Foreword

This document (EN 959:2007) has been prepared by Technical Committee CEN/TC 136 "Sports, playground and other recreational equipment", the secretariat of which is held by DIN.

This document supersedes EN 959:1996.

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of an identical text or by endorsement, at the latest by December 2007, and conflicting national standards shall be withdrawn at the latest by December 2007.

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Introduction

The text of this document is based on the former UIAA-Standard P (Union Internationale des Associations d'Alpinisme), which has been prepared with international participation.

This standard is one of a package of standards for mountaineering equipment, see Annex A.

1 Scope

This European Standard specifies safety requirements and test methods for rock anchors for use in mountaineering including climbing.

2 Normative references

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

EN 12275:1998, *Mountaineering equipment — Connectors — Safety requirements and test methods*

ISO 1920-3, *Testing of concrete - Part 3: Making and curing test specimens*

3 Terms and definitions

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

3.1

rock anchor

anchoring device intended for repeated use after installation, that is inserted into a drilled hole in the rock and held in place by gluing, or expansion forces, or positive locking, and with an attachment point for a connector (in accordance with 3.1 of EN 12275:1998)

3.2

body of the rock anchor

part of the rock anchor that will be installed in the rock

3.3

hanger

attachment point capable of being separated from the body of a rock anchor

3.4

installed length

distance from the rock surface to the furthest point of the body in mechanical contact with the rock or bonded to the rock, after installation

4 Safety requirements

4.1 Materials

All parts of a rock anchor shall be manufactured from the same material.

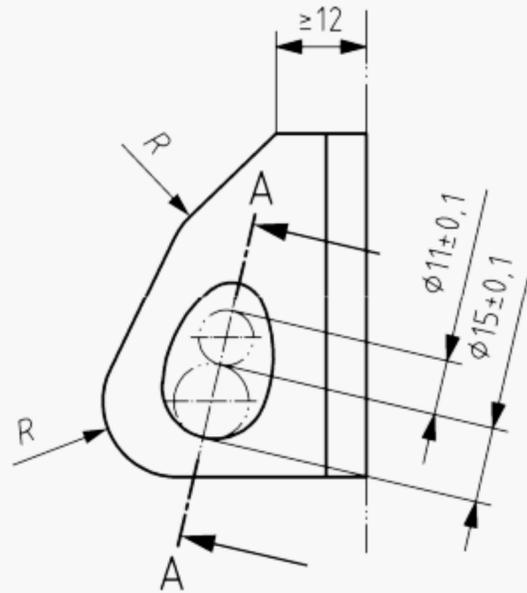
NOTE Depending on environmental factors, rock anchors are potentially liable to suffer from corrosion. Information on the choice of materials and the need for inspection and maintenance is given in Annex B.

4.2 Design

4.2.1 The overall thickness of the border of the eye shall be 3 mm. If the edges are bevelled, the remaining inner surface shall have a minimum width of 2 mm.

4.2.2 All corners that will be more than 12 mm from the rock surface shall be rounded to a radius R of a minimum 10 mm (see Figure 1).

Dimensions in millimetres



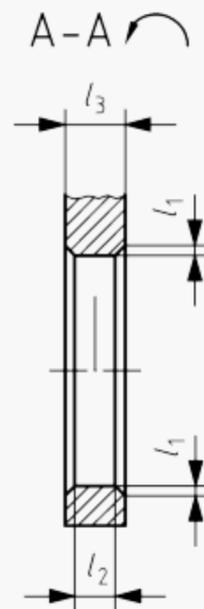
Key

R minimum 10 mm

NOTE A-A see Figure 2

Figure 1 — Clear width and external shape of the eye

4.2.3 All edges that can be handled after placement of the rock anchor in the rock shall be rounded to a radius R of minimum 0,2 mm or bevelled to a minimum of 0,2 mm \times 45 ° (see Figure 2). This applies to inner and outer edges.



Key

l_1 minimum 0,2 mm \times 45 °

l_2 minimum 2 mm

l_3 minimum 3 mm

Figure 2 — Internal edges of the eye

4.2.4 After inserting the rock anchor in the concrete block, the eye shall be wide enough to accommodate two pins, one with a diameter of (15 \pm 0,1) mm for the lower part and one with a diameter of (11 \pm 0,1) mm for the upper part (see Figure 1).

4.2.5 In case of expansion-type rock anchors the expansion shall not be dependent on contact with the bottom of the drilled hole.

4.2.6 For glued-in rock anchors, the installed length shall be 70 mm minimum.

For mechanical rock anchors, the installed length shall be at least five times the diameter of the drilled hole (in accordance with the manufacturer's instructions).

NOTE For installation in rock softer rather than the concrete test block, a longer length can be necessary to achieve the required load bearing capacity. Further information is given in Annex C.

4.3 Loadbearing capacity

4.3.1 Axial loadbearing capacity

When tested in accordance with 5.3.2.2, the rock anchor shall withstand an axial load of 15 kN, without being pulled out of the concrete block or breaking.

Permanent deformation is permissible.

4.3.2 Radial loadbearing capacity

When tested in accordance with 5.3.2.3, the rock anchor shall withstand a radial load of 25 kN, without being pulled out of the concrete block or breaking.

Permanent deformation is permissible.

5 Test methods

5.1 Check of materials

The manufacturer shall confirm that the requirements of 4.1 are met.

5.2 Apparatus

5.2.1 Tensile testing machine

5.2.2 Concrete block with minimum dimensions of 200 mm × 200 mm × 200 mm and a compressive strength of (50 ± 10) N/mm².

The maximum grain size of the aggregate shall not exceed 16 mm.

The compressive strength of the concrete block shall be verified on three test samples produced as specified in ISO 1920-3.

NOTE All concrete testing centres produce these types of concrete blocks to order.

5.3 Procedure

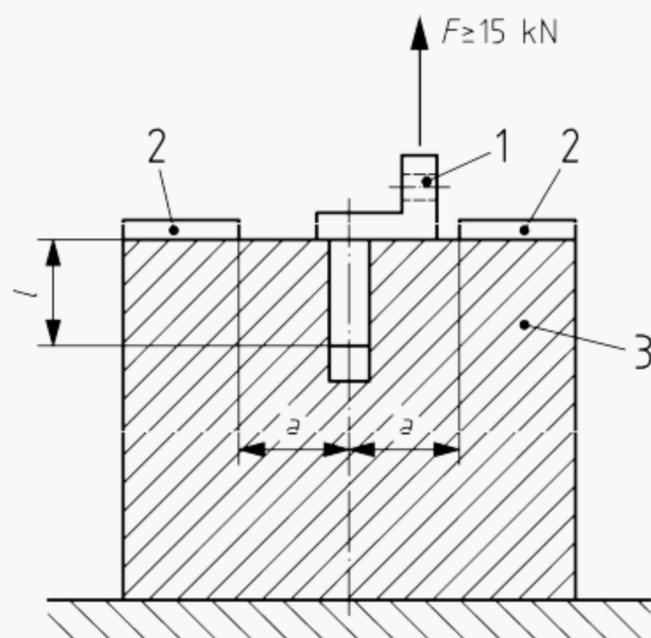
5.3.1 Examination of design

Ensure by visual examination and check the dimensions that the specifications in accordance with 4.2.1 to 4.2.6 are met.

5.3.2 Determination of load bearing capacity

5.3.2.1 Install the rock anchor into a concrete block in accordance with the information supplied by the manufacturer. If rock anchor bodies are supplied without hangers, attach a hanger in accordance with the information supplied by the manufacturer. If hangers are supplied without bodies, attach the hanger to a fixed structure in accordance with the information supplied by the manufacturer.

5.3.2.2 Attach the concrete block to the tensile testing machine using clamps at a distance $a \geq$ installed length $l + 5\%$ away from the axis of the rock anchor (see Figure 3). Apply an axial load to the rock anchor using a pin with a diameter of $(10 \pm 0,1)$ mm in the eye at a rate of (35 ± 15) mm/min, increasing the load to $(8 \pm 0,25)$ kN then reducing the load to less than 0,5 kN. Apply this loading a total of ten times within 10 min. Again apply a load, increasing it until failure or until the rock anchor is pulled out of the concrete block.

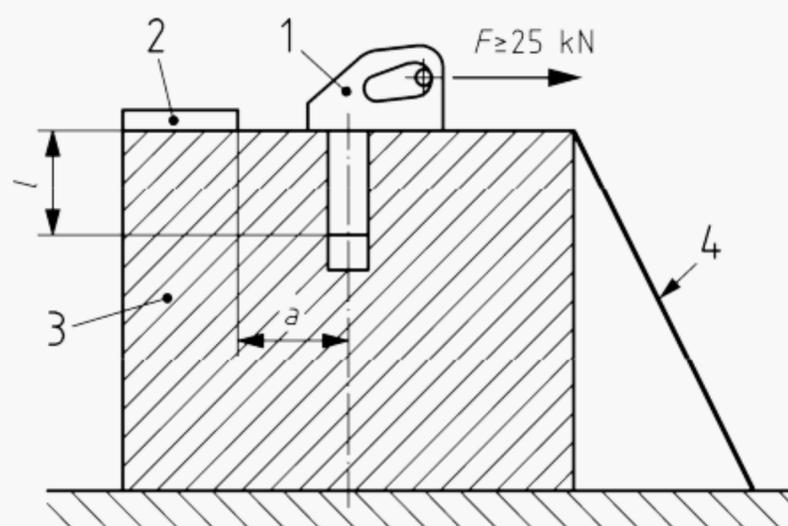


Key

- 1 Eye (clip) of the rock anchor
- 2 Clamp
- 3 Concrete block
- a Distance of rock anchor
- l Installed length

Figure 3 — Axial test

5.3.2.3 Install a new rock anchor into a new concrete block in accordance with 5.3.2.1. Attach the concrete block to the tensile testing machine using a support, and a clamp at a distance $a \geq$ installed length $l + 5\%$ away from the axis of the rock anchor (see Figure 4). Apply a radial load to the rock anchor using a pin with a diameter of $(10 \pm 0,1)$ mm in the eye at a rate of (35 ± 15) mm/min, increasing the load to $(8 \pm 0,25)$ kN then reducing the load to less than 0,5 kN. Apply this loading a total of ten times within 10 min. Again apply a load, increasing it until failure or until the rock anchor is pulled out of the concrete block.



Key

- 1 Eye (clip) of the rock anchor
- 2 Clamp
- 3 Concrete block
- 4 Support over total width

- a Distance of rock anchor
- l Installed length

Figure 4 — Radial test

6 Marking

Rock anchors shall be marked clearly, indelibly and durably with at least the following:

- a) name of the manufacturer or their representative in the European Community;
- b) model identifier (if several models are marketed by the manufacturer).

7 Information supplied by the manufacturer

The rock anchor shall be supplied with an explanatory leaflet, and written in at least the official language(s) of the state of destination within the European Community containing at least the following items:

- a) name and address of the manufacturer or their authorised representative;
- b) reference of this document: EN 959;
- c) model identifier (if more than one model is available);
- d) size (if more than one size is available);
- e) meaning of any marks on the product;
- f) components that comprise the complete rock anchor and the material used;
- g) use of the rock anchor;
- h) how to insert the rock anchor;
- i) how to choose other components for use in the system and the need for material compatibility (see Annex B);
- j) expected lifespan of the product when installed in different environments, particularly near sea water or sea water spray (see Annex B);
- k) warning that the rock anchor can have a lower loadbearing capacity when installed in soft rock and what action to take to overcome the problem (see Annex C);
- l) how to assess the remaining lifespan of the product after installation, and when and how to remove it from future use.

Annex A (informative)

Standards on mountaineering equipment

Table A.1 — List of standards on mountaineering equipment

No	Document	Title
1	EN 564	Mountaineering equipment — Accessory cord — Safety requirements and test methods
2	EN 565	Mountaineering equipment — Tape — Safety requirements and test methods
3	EN 566	Mountaineering equipment — Slings — Safety requirements and test methods
4	EN 567	Mountaineering equipment — Rope clamps — Safety requirements and test methods
5	EN 568	Mountaineering equipment — Ice anchors — Safety requirements and test methods
6	EN 569	Mountaineering equipment — Pitons — Safety requirements and test methods
7	EN 892	Mountaineering equipment — Dynamic mountaineering ropes — Safety requirements and test methods
8	EN 893	Mountaineering equipment — Crampons — Safety requirements and test methods
9	EN 958	Mountaineering equipment — Energy absorbing systems for use in klettersteig (via ferrata) climbing — Safety requirements and test methods
10	EN 959	Mountaineering equipment — Rock anchors — Safety requirements and test methods
11	EN 12270	Mountaineering equipment — Chocks — Safety requirements and test methods
12	EN 12275	Mountaineering equipment — Connectors — Safety requirements and test methods
13	EN 12276	Mountaineering equipment — Frictional anchors — Safety requirements and test methods
14	EN 12277	Mountaineering equipment — Harnesses — Safety requirements and test methods
15	EN 12278	Mountaineering equipment — Pulleys — Safety requirements and test methods
16	EN 12492	Mountaineering equipment - Helmets for mountaineers - Safety requirements and for test methods
17	EN 13089	Mountaineering equipment — Ice-tools — Safety requirements and test methods
18	prEN 15151	Mountaineering equipment — Descenders — Safety requirements and test methods

Annex B (informative)

Choice of materials for different environmental conditions and the consequences for inspection and maintenance

Rock anchors will be installed in a wide range of locations from high mountains to sea cliffs, and in a wide range of environments, for example environments with different temperatures, different atmospheric humidity and different rainfall conditions. On sea cliffs, rock anchors will be periodically washed by seawater and this sea-spray provides a corrosive environment that may stretch for several kilometres inland during storm conditions. These different environments can also include different types of corrosion depending on the material(s) from which the rock anchor is manufactured. Although limited surface corrosion may not significantly reduce the load bearing capacity of a rock anchor, some forms of corrosion can dramatically reduce the load bearing capacity leading to catastrophic failure. Hence, avoiding or preventing corrosion in rock anchors is an essential design consideration.

If a rock anchor has two or more components made from different materials there is the possibility of galvanic corrosion when the rock anchor is wetted by rain or, much more seriously, if it is wetted by seawater. Galvanic corrosion can be avoided if all parts of the rock anchor are made of the same material, or of material with the same electrolytic potential. If a rock anchor has a removable or replaceable part such as a hanger, the user needs to know the construction material and be aware that a hanger or replaceable part made from a compatible material must be used. The provision of this information is covered in 7 f) and 7 i) of this standard.

For installation in sea cliffs or other highly corrosive environments, the use of a material with high corrosion resistance is desirable to achieve a long lifetime for the installation. Even so, common prudence suggests that the installed rock anchors should be inspected at regular intervals to monitor for any corrosion.

The use of material of lesser corrosion resistance should not be precluded, provided the user is given sufficient information to enable the frequency of inspections to be determined for the relevant environmental conditions. If a user chooses to install rock anchors of lesser corrosion resistance, he needs to be made aware that such rock anchors will need to be taken out of service and replaced more frequently than if a more corrosion resistant material had been used.

Annex C

(informative)

The need for longer length rock anchors for use in soft rock

Rock anchors in accordance with this standard, when installed in accordance with the manufacturer's instructions, should provide at least the load bearing capacities specified in 4.3 of this standard. However, these load bearing capacities cannot be guaranteed if the rock, into which the anchor is installed, is less strong or less homogeneous than the concrete block specified in 5.2.2 of this standard. Examples of such in-homogeneities are regions of unconsolidated material, microfissures and hollow or air pockets. In such cases, to achieve the required load bearing capacity, it may be necessary to use a rock anchor of greater length (perhaps a much greater length), or even of a different construction. The manufacturer needs to provide information (see 7 k) of this standard) to make the installer aware of these potential problems and suggest possible courses of preventative action. Some designs of rock anchor may not be suitable for installation in certain types of rock. In other cases it may be appropriate to recommend carrying out trial installations of rock anchors in a range of different lengths, in typical rock, and testing the load bearing capacity in situ.

Bibliography

- [1] EN 10088-3:2005, Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes

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