Mountaineering equipment

Dynamic mountaineering ropes

Safety requirements and test methods

English version of DIN EN 892:1996

DIN EN 892

ICS 97.220.40

Supersedes DIN 7946, January 1984 edition.

Descriptors: Mountaineering equipment, ropes, safety requirements, testing.

Bergsteigerausrüstung – Dynamische Bergseile – Sicherheitstechnische Anforderungen und Prüfverfahren

European Standard EN 892:1996 has the status of a DIN Standard.

A comma is used as the decimal marker.

This standard includes safety requirements within the meaning of the *Gerätesicherheitsgesetz* (German Equipment Safety Law).

National foreword

This standard has been prepared by CEN/TC 136.

The responsible German body involved in its preparation was the *Normenausschuß Sport- und Freizeitgerät* (Sports Equipment Standards Committee), Technical Committee *Bergsteigerausrüstung*.

Mountaineering ropes fall within the scope of the *Gerätesicherheitsgesetz*. Compliance with the requirements specified therein may, subsequent to verification of compliance by an accredited test house designated by the *Bundesminister für Arbeit und Sozialordnung* (German Federal Minister for Labour and Social Affairs), be indicated by marking the equipment with the symbol GS = *Geprüfte Sicherheit* (Safety tested) mark.

DIN ISO 6487 is the standard corresponding to International Standard ISO 6487 referred to in clause 2 of the EN.

Amendments

DIN 7946, January 1984 edition, has been superseded by the specifications of EN 892.

Previous edition

DIN 7946: 1984-01.

EN comprises 19 pages.

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1 Scope

This standard specifies safety requirements and test methods for dynamic ropes (single, half and twin ropes) in kernmantel-construction for use in mountaineering including climbing.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 20139
Textiles – Standard atmospheres for conditioning and testing (ISO 139 : 1973)

ISO 1052
Steels for general engineering purposes

ISO 6487
Road vehicles – Measurement techniques in impact tests – Instrumentation

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 dynamic mountaineering rope: Rope, which is capable of arresting the free fall of a person engaged in mountaineering or climbing with a limited impact force.

3.2 single rope: Dynamic mountaineering rope, capable of being used singly, as a link in the safety chain, to arrest a person's fall.

3.3 half rope: Dynamic mountaineering rope, which is capable, when used in pairs, as a link in the safety chain to arrest a person's fall.

3.4 twin rope: Dynamic mountaineering rope, which is capable, when used in pairs and parallel, to arrest a person's fall (see figure 1).

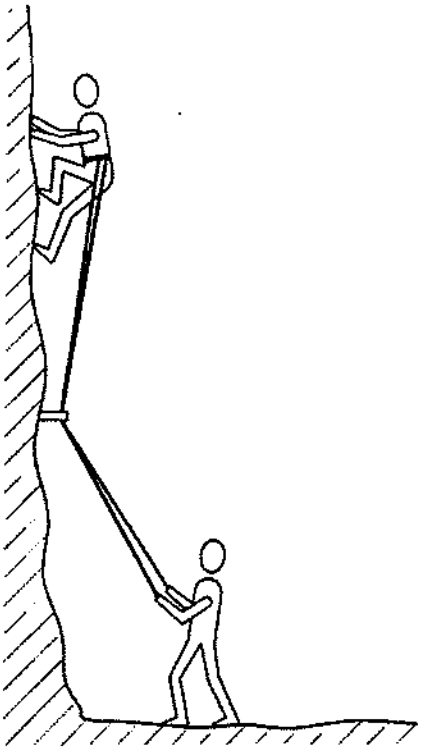


Figure 1: Use of twin rope

3.5 kernmantel rope: Rope, which is comprised of a core and a sheath.

4 Safety requirements

4.1 Construction

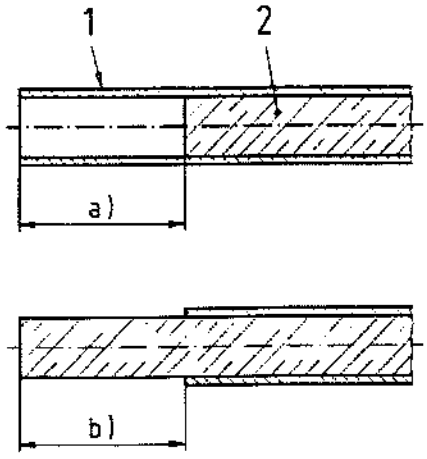
Dynamic ropes shall be made in a kernmantel construction, where the core shall have at least 50 % of the mass of the rope.

4.2 Knotability ratio *K*

When tested in accordance with 5.4, the flexibility of the rope shall be such that the knotability ratio *K* does not exeed 1,1.

4.3 Sheath slippage

When tested in accordance with 5.5, the sheath slippage in a longitudinal direction relative to the core (in positive or negative direction) shall not exceed 40 mm (see figure 2).



1 sheath
2 core
a) positive sheath slippage ≤ 40 mm
b) negative sheath slippage ≤ 40 mm

Figure 2: Sheath slippage

4.4 Elongation

When tested in accordance with 5.6, the elongation shall not exceed:

- 8 % in single ropes (single strand of rope);
- 10 % in half ropes (single strand of rope);
- 8 % in twin ropes (double strand of rope).

4.5 Fall arresting impact, number of drops

4.5.1 Impact force

When tested in accordance with 5.7, the impact force, in the first fall shall not exceed:

- 12 kN in single ropes (single strand of rope);
- 8 kN in half ropes (single strand of rope);
- 12 kN in twin ropes (double strand of rope).

4.5.2 Number of drops

When tested in accordance with 5.7, each rope sample shall withstand at least 5, for twin ropes at least 12, consecutive drop tests without breaking.

5 Test methods

5.1 Test samples

A test sample with a length of:

- 40 m for single and half ropes;
- 80 m or 2 × 40 m for twin ropes

shall be available for the tests.

5.1.1 Carry out the tests in accordance with 5.3 on an unused test sample.

5.1.2 Carry out the tests in accordance with 5.4 on an unused test sample.

5.1.3 Carry out the tests in accordance with 5.5 on two unused test samples with a length of (2 250 ± 10) mm.

5.1.4 Carry out the test in accordance with 5.6 on two unused test samples with a length of at least 500 mm.

5.1.5 Carry out the tests in accordance with 5.7 on three unused test samples with a minimum length of 5 m for single and half ropes, and 10 m for twin ropes, cut out of the available test sample.

5.2 Conditioning and test conditions

Condition the test samples in accordance with EN 20139.

Then test these samples at a temperature of (23 ± 5) °C.

5.3 Construction

5.3.1 Procedure

5.3.1.1 Clamp the test sample at one end.

5.3.1.2 Load the test sample without shock with a mass[1]) of:

- (10 ± 0,1) kg for single ropes;
- (6 ± 0,1) kg for half ropes;
- (5 ± 0,1) kg for twin ropes

at a distance of at least 600 mm from the clamp.

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[1]) The mass can be introduced by a corresponding force.

5.3.1.3 After applying the load for (60 ± 5) s mark within 1 min a reference length of (500 ± 1) mm on the test sample. The distance of the marking from the clamp or attachment for the test sample shall be at least 50 mm.

5.3.1.4 Within a further 3 min measure the diameter in two directions around the diameter starting at points 90° apart at each of three levels approximately 100 mm apart. The length of the contact areas of the measuring instrument shall be (50 ± 1) mm. The rope cross-sectional area shall not be subject to any compression during the measurement.

5.3.1.5 Then cut out the marked portion of the test sample and determine the mass to the nearest 0,1 g.

5.3.1.6 Check that the construction of the rope is a kernmantel construction (see 4.1) and ensure that the core is heavier than the sheath.

5.3.2 Expression of results

Express the diameter as the arithmetic mean of the six measurements to the nearest 0,1 mm.

Express the mass per unit length in ktex or g/m to the nearest 1 g.

5.4 Knotability ratio *K*

5.4.1 Procedure

5.4.1.1 Make two simple knots (see figure 3) in the test sample 250 mm apart in opposite directions.

5.4.1.2 Load the test sample without shock with a mass[1]) of (10 ± 0,1) kg and maintain the load for (60 ± 5) s.

5.4.1.3 Reduce the mass[1]) to 1 kg.

5.4.1.4 During the application of the load, measure the internal diameter of the knot to the nearest 0,5 mm (see figure 3), using a suitable measuring device such as a tapered plug gauge (see figure 4), without an alteration of the free width of the knot by the pressure of the measuring device.

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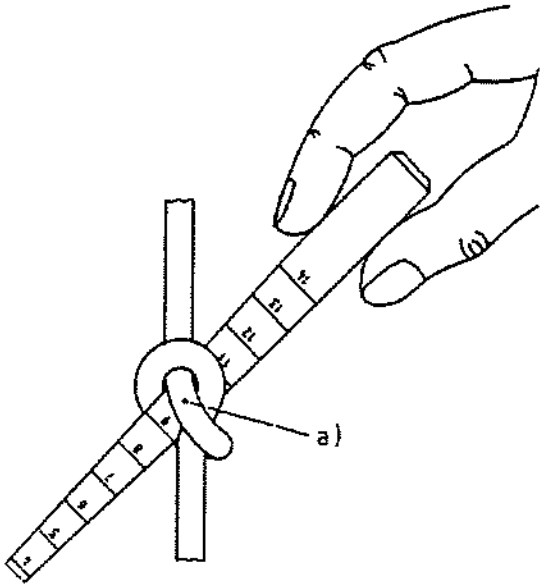
[1]) See 5.3.1.2



a) test location

Figure 3: Determination of knotability ratio K

Dimensions in millimetres

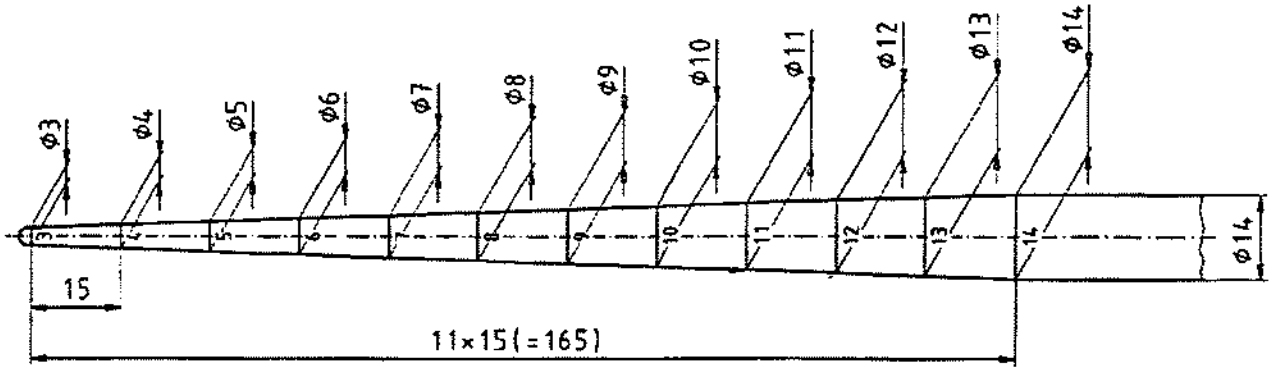


Figure 4: Gauge for determining knotability ratio K

5.4.2 Expression of results

Calculate the average of the internal diameters of both knots.

Thus calculate the knotability ratio K from:

$$K = \frac{\text{average internal diameter of the knots}}{\text{actual diameter of rope in accordance with 5.3.2}}$$

5.5 Sheath slippage

5.5.1 Principle

The rope is drawn through the apparatus illustrated in figure 5, where the movement is restricted by radial forces. The resulting frictional force on the sheath causes slippage of the sheath relative to the core. The extent of this slippage is measured.

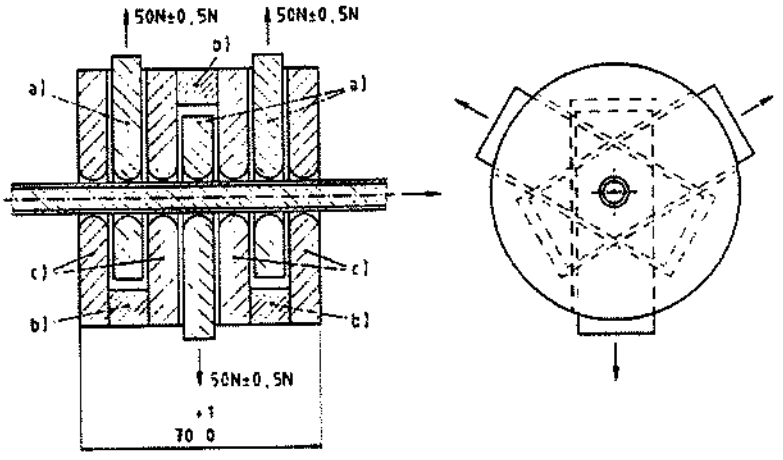
5.5.2 Preparation of the test samples

Fuse one end of the sheath and core of each test sample together. Cut the other end at right angles to the axis of the rope.

5.5.3 Apparatus

The apparatus shall consist of a frame made out of four steel plates each 10 mm thick, kept equal distances apart by three spacers. These spacers shall have rectangular slots in which the steel plates are able to slide in a radial direction. The spacers shall be arranged in such a way as to allow each of the three inserted plates to slide at an angle of 120° (see figure 5).

Dimensions in millimetres



a) 3 moving plates

b) spacers

c) 4 fixed plates

Figure 5: Apparatus for testing the sheath slippage

Each of the seven plates shall have an opening with a diameter of 12 mm; their internal surfaces shall be semi-toroidal and have a radius of 5 mm. The polished surfaces of the semi-torus shall show

- an arithmetical mean deviation of the profile of R_a = 0,4 μm and
- a surface roughness of R_{max} = 4 μm (see figure 6).

In the unloaded position the openings in the fixed plates and in the moving plates shall lie along a central axis. Each of the moving plates shall apply a radial force of (50 ± 0,5) N to the test sample in the direction in which it moves.

Dimensions in millimetres

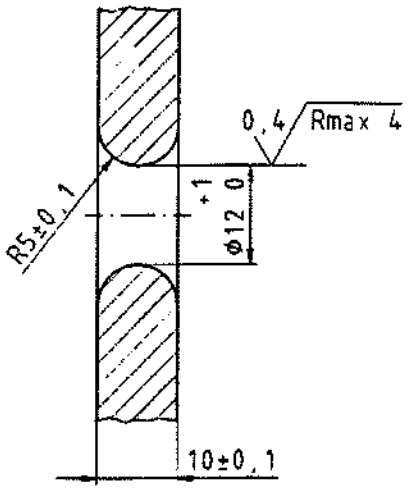


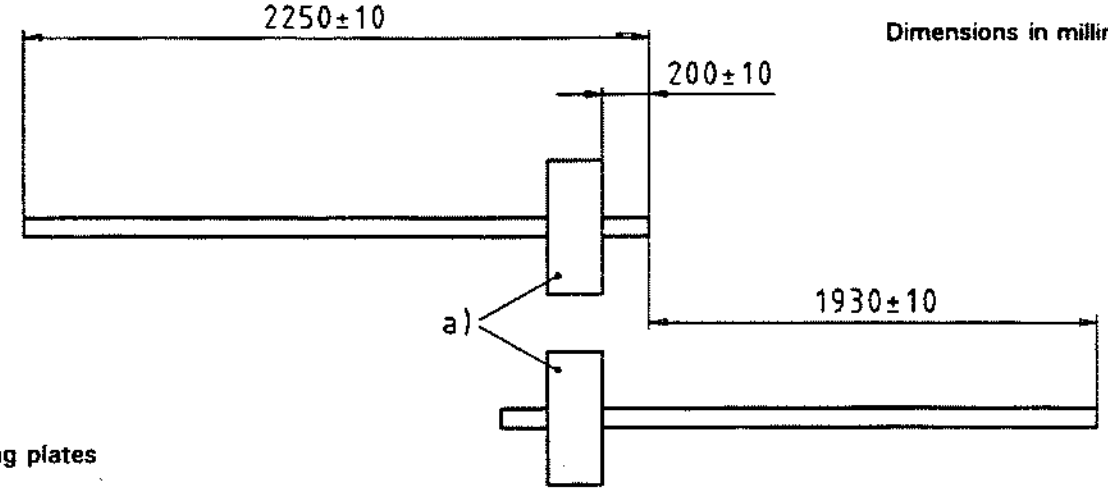
Figure 6: Section through one of the plates

5.5.4 Procedure

5.5.4.1 At the start of the test the openings of moving plates and the openings of the fixed plates shall be coaxial.

5.5.4.2 Introduce the fused end of the test sample into the apparatus and pull to a length of (200 ± 10) mm through the test apparatus (see figure 7). Ensure that the open end of the test sample is not subjected to any load and lies in a horizontal position in a straight line.

Dimensions in millimetres



a) sliding plates

Figure 7: Layout of the test sample before and after the sheath slippage test

5.5.4.3 Apply a force of (50 ± 0,5) N to the test sample via each of the three moving plates and pull the test sample through the apparatus at a rate of (0,5 ± 0,2) m/s for a distance of (1 930 ± 10) mm.

5.5.4.4 Remove the loads from the sliding plates, push them back into their coaxial original position and bring the test sample to its initial position.

5.5.4.5 Repeat the test described above four times. After the last test remove the test sample completely from the test apparatus.

5.5.4.6 After the fifth test, measure the relative slippage of the sheath along the core at the open end of the test sample (see figure 2).

5.5.5 Expression of results

Express the value of both test samples to the nearest millimeter.

5.6 Determination of elongation

5.6.1 Procedure

5.6.1.1 Carry out the test on a:

- single strand of rope for single ropes;
- single strand of rope for half ropes;
- double strand of rope for twin ropes.

5.6.1.2 Load the test sample without shock with a mass[1]) of (80 ± 0,1) kg and maintain this load for (3 ± 0,5) min.

5.6.1.3 Remove the load from the test sample and allow it to remain at rest for (10 ± 0,5) min.

5.6.1.4 Load the test sample without shock with a mass[1]) of (5 ± 0,1) kg and maintain this load for (60 ± 5) s.

5.6.1.5 Make two markings on the test sample l_0 = (500 ± 1) mm apart.

5.6.1.6 Load again the test sample without shock with a mass[1]) of (80 ± 0,1) kg and maintain this load for (60 ± 5) s.

5.6.1.7 Measure the new distance of l_1 between the two markings on the stressed test sample.

5.6.2 Expression of results

Express the elongation as a percentage of the unloaded length: $(l_1 - l_0)/l_0 \times 100$.

Express the results to the nearest 0,1 %.

5.7 Drop Test

5.7.1 Test conditions

Carry out the first drop test within 10 min of the test sample's removal from the conditioning atmosphere (see 5.2).

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[1]) See 5.3.1.2

5.7.2 Apparatus

5.7.2.1 General

The apparatus shall be set up as specified in figures 8, 10 and 11 and shall consist essentially of a fixed point, rope pivot edge, falling mass and a device for measuring the arresting impact force.

The apparatus shall be set up so rigidly that the result of the measurement of the impact force meets the requirements in accordance with 5.7.2.5.

5.7.2.2 Fixed point

The fixed point shall consist of a hard steel bar with a diameter of (30 ± 0,1) mm and a surface roughness as follows:

- arithmetical mean deviation of the profile of R_a = 0,8 μm;
- surface roughness R_{max} = 6,3 μm.

The bar shall be clamped horizontally without play. Neither the length of the bolt nor its method of attachment are specified, but they shall permit a suitable point of attachment for the rope. No deformation nor vibration at the time of the impact force shall occur which could influence the results.

For the position of the fixed point see figures 10 and 11.

5.7.2.3 Rope pivot edge

The rope pivot edge shall be manufactured from steel Fe 590 in accordance with ISO 1052. The dimensions of the rope pivot edge are shown in figure 8.

The external dimensions and shape of the pivot edge are not specified. However, they have to permit a suitable method for its attachment.

The surface of the pivot edge, within a radius range of R5, shall have

- an arithmetical mean deviation of the profile of R_a = 0,4 μm and
- a surface roughness R_{max} = 4 μm.

The pivot edge shall be attached so that the axis of the cylinder lies horizontally.

The pivot edge shall not become deformed, slip or vibrate during the drop test.

Dimensions in millimetres

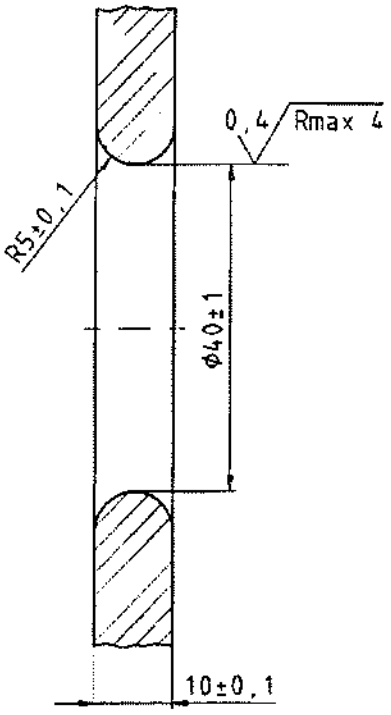

Figure 8: Rope pivot edge

5.7.2.4 Falling mass

The falling mass shall be made of metal. Its shape is not specified; however, the following shall apply:

a) the stress exerted on the rope shall be almost vertical as specified in figures 10 and 11, passing through the centre of gravity of the falling mass (tolerance: ±5 mm);

b) the speed of the falling mass measured over a section of (100±0,1) mm in the range from 4,95 m to 5,05 m beneath the theoretical release point is (9,90 $^{0}_{-0,20}$) m/s. The requirements apply to both 55 kg and 80 kg falling mass;

c) the entire falling mass, consisting of the falling mass itself, the fixing bracket and possibly also a measuring device, shall weigh

- (80±0,1) kg for single ropes;
- (55±0,1) kg for half ropes;
- (80±0,1) kg for twin ropes (see figures 10 and 11);

d) the falling mass shall be equipped with a rope attachment apparatus consisting of a steel bolt with a diameter of 15 mm and a surface as follows:

- arithmetical mean deviation of the profile of R_a = 0,8 μm;
- surface roughness R_{max} = 6,3 μm.

The shape of the steel bolt is not specified.

5.7.2.5 Device for measuring the arresting impact force

The location of the device for measuring the arresting impact force is not described in greater detail. The measurements obtained have to equal those that would be obtained by measuring at the rope attachment point of the falling mass.

If the device for measuring the arresting impact force is interposed between the falling mass and the rope, the rope shall be attached to it using a bracket in accordance with 5.7.2.4.

The apparatus for measuring and recording the arresting force shall correspond with ISO 6487, channel frequency class (CFC) 30.

The force transducer, in its operating position attached to the fixed point, shall not have a resonance frequency below 100 Hz.

The channel amplitude class (CAC) as defined in ISO 6487 shall be at least 20 kN.

The error of the measurement of the arresting impact force (static calibration) shall be less than 1 % in accordance with ISO 6487.

5.7.3 Test layout

The relative position of the fixed point, rope pivot edge, falling mass and the test sample under static load shall be as shown in figures 10 and 11.

5.7.4 Procedure

5.7.4.1 Attach the single strand test sample at the bracket of the falling mass by means of an overhand knot with an internal loop-length of (50 ± 10) mm and secure manually. Ensure that the two strands of rope are parallel throughout the knot. Place the test sample in the single strand test over the pivot edge, wind three times round the fixed point and secure 50 mm behind it using a bolted clamping plate (see figure 10).

Place both rope strands over the pivot edge in the double strand test and attach both rope ends (see figure 11).

5.7.4.2 Apply to the test sample the falling mass weighing:

- (80 ± 0,1) kg for single ropes;
- (55 ± 0,1) kg for half ropes;
- (80 ± 0,1) kg for twin ropes

as a static load for a minimum period of 1 min, and then adjust the clamp(s) until the free length of rope(s) is (2 500 ± 20) mm.

5.7.4.3 Mark the rope at the clamp (when testing double strands, mark at both clamps).

5.7.4.4 Carry out the drop tests until breaking of the test sample.

Determine after the last drop whether the rope has slipped through the clamp(s). If the rope has slipped by more than 20 mm in total, the test is invalid. In this case the test shall be repeated with a new test sample.

Record the maximum impact force, which occurs on the first drop test.

Before each drop test raise the falling mass to a height of (2 300 ± 10) mm over the lowest central point of the pivot edge (see figure 10).

The interval from one test to the consecutive test on the same test sample shall be (5 ± 0,5) min from release to release.

After each drop, release the load from the rope within 1 min.

6 Information to be supplied

a) the name or trademark of the manufacturer, importer or supplier;

b) the number of this European Standard: EN 892;

c) the length of the rope in metres;

d) the diameter of the rope as specified in 5.3;

e) the model and type (single, half or twin rope) as defined in 3;

f) the mass per unit length of the rope as specified in 5.3.2;

g) elongation as specified in 5.6.2;

h) the maximum impact force as specified in 5.7.4.4;

i) the number of impacts withstood as specified in 5.7.4.4;

j) the maximum sheath slippage as specified in 5.5;

k) the meaning of any marks on the product;

l) the use of the product;

m) the level of protection from different classes of equipment (e.g. single, half or twin ropes);

n) how to choose other components for use in the system;

o) how to maintain/service the product, on the effects of chemical reagents and how to disinfect the product without adverse effect;

p) the lifespan of the product or how to assess it and that after a serious fall the rope should be withdrawn from use as soon as possible;

q) influence of wet and icy conditions;

r) danger of sharp edges;

s) influence of storage and aging due to use.

7 Marking

Ropes shall have durable bands at both ends with a maximum width of 30 mm (measured along the length of the rope).

The bands shall be marked clearly, indelibly and permanently with at least the following information:

a) name or trademark of the manufacturer, importer or supplier;

b) the graphical symbols as specified in figure 9.

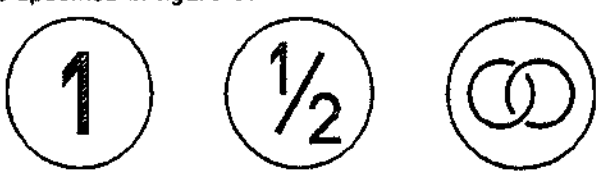

Figure 9: Graphical symbols of ropes

Dimensions in millimetres

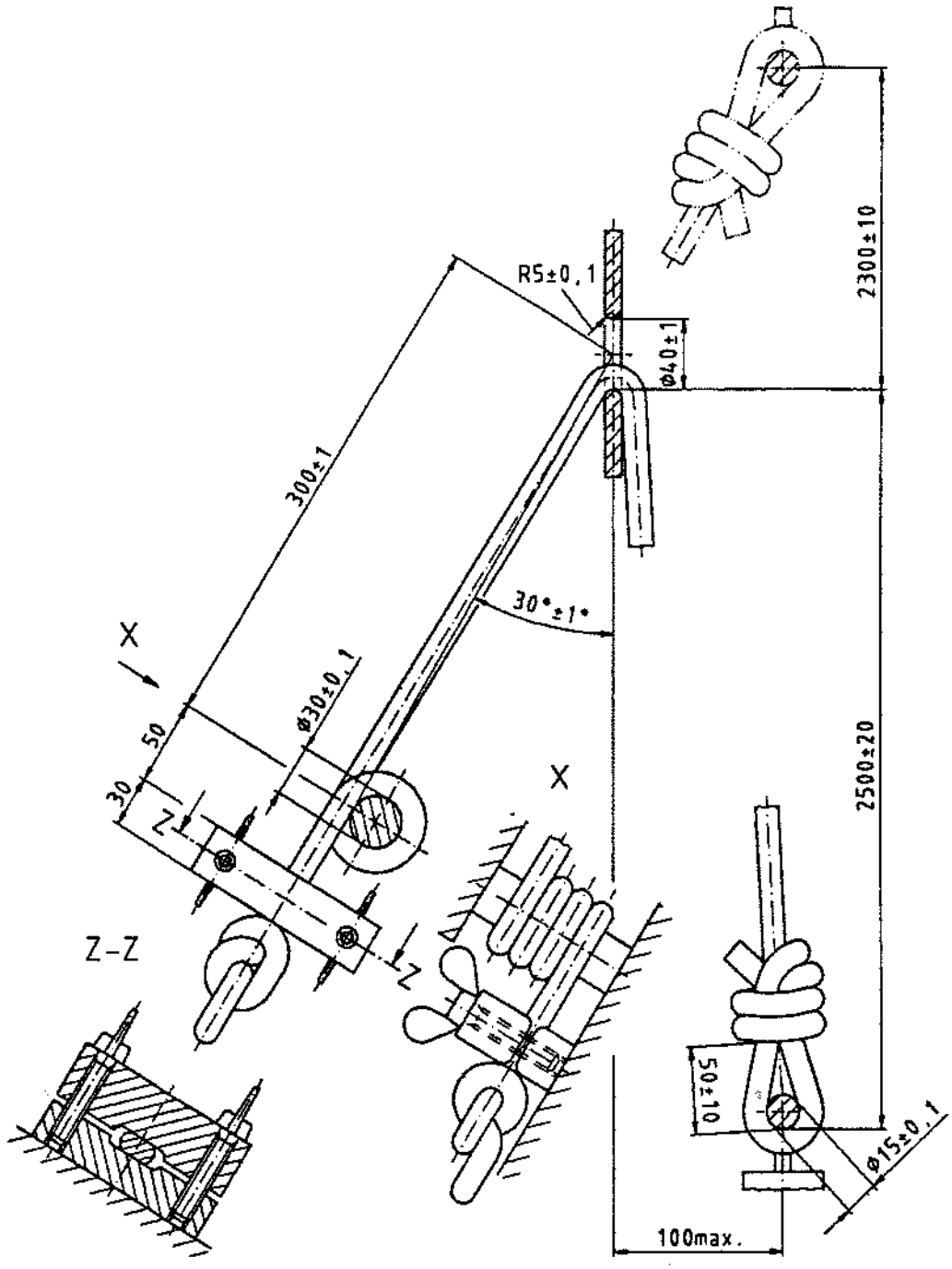

Figure 10: Layout of apparatus for single strand test (half ropes, single ropes)

Dimensions in millimetres

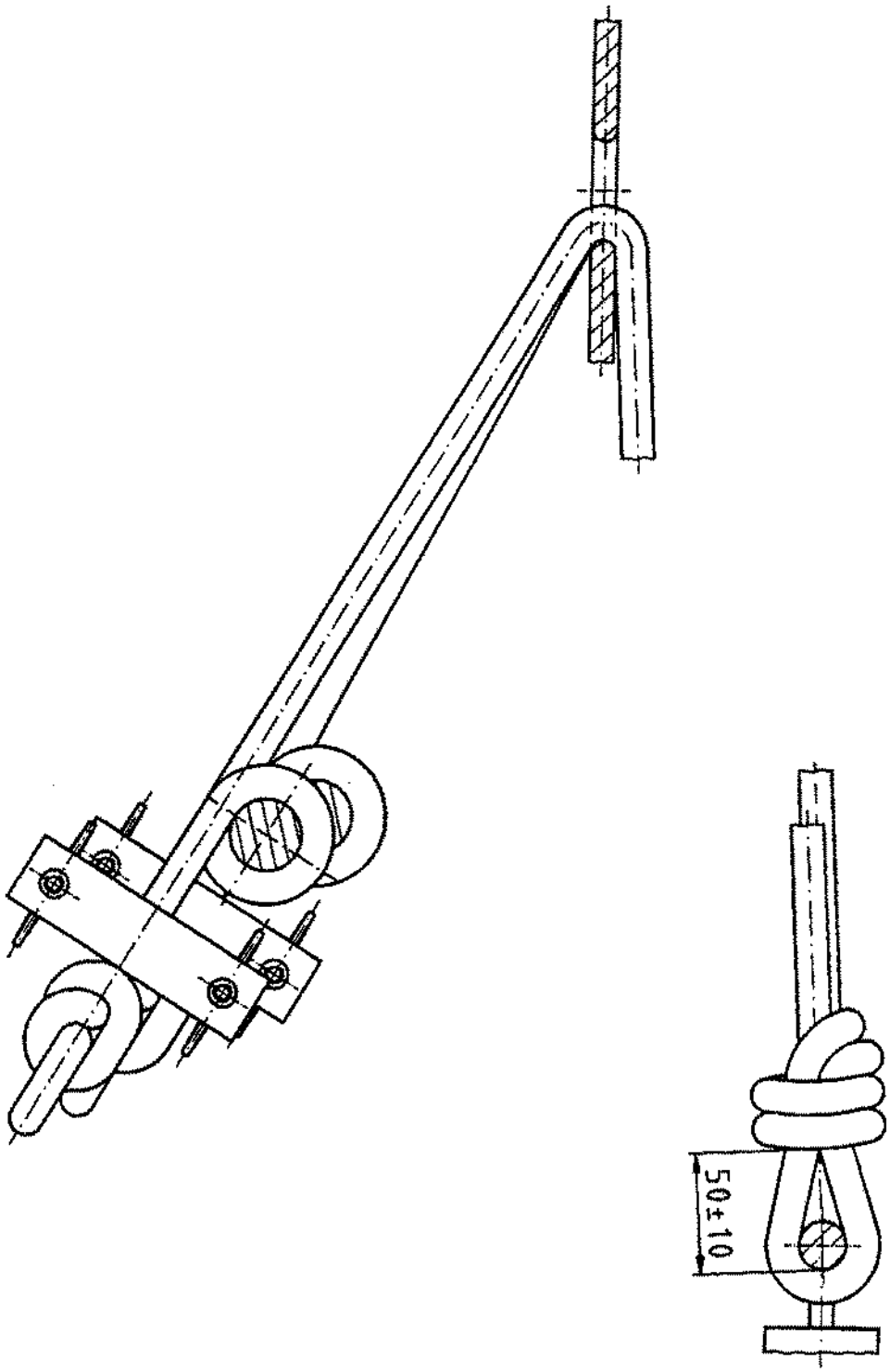

Figure 11: Layout of apparatus for double strand test (twin ropes)

All other dimensions see figure 10.