UIAA 101

Ninth Edition
July 2025
Effective from
July 2025

Dynamic Ropes

Climbing and Mountaineering Equipment

International Climbing and Mountaineering Federation
UNION INTERNATIONALE DES ASSOCIATIONS D'ALPINISME

UIAA Safety Standard – 101 – Version 9.1

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Foreword

UIAA standards are the only 'globally recognized' standards for mountaineering equipment. In order to prevent multiplicity, the UIAA collaborates with its partner in standardization, CEN, and bases UIAA 101 on the European Standard EN 892:2012+A3:2023.

The EN standards are derived from the original UIAA standards, the first of their kind. The UIAA publishes user-friendly pictorials for each standard. UIAA 101 imposes requirements in addition to those of EN 892:2012+A3:2023.

The UIAA standards are reviewed at intervals to see whether they meet the latest technical requirements and revised if necessary.

The UIAA invites manufacturers of mountaineering and climbing equipment worldwide to become members of the UIAA Safety Commission as Safety Label Holders. Members can participate in discussions on standard requirements, test methods, and revisions thereof (see the "Regulations for existing and potential Safety Label Holders").

A complete list of UIAA standards for mountaineering and climbing equipment can be found on the UIAA website www.theuiaa.org/safety-standards/.

NOTE – Owing to copyright restrictions, this UIAA Standard does not reproduce the full requirements of the referenced standards. To ensure full compliance, those applying this standard must obtain official copies of these documents. They are available for purchase from the CEN and ISO websites.

This standard has been created and updated based on scientific research coordinated and funded by UIAA, as a service to all mountaineers.

Copyright and Version Management

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This document was first published in English. The English master text is decisive in any conflict of interpretation. For any validations in translation, the UIAA should be contacted via the UIAA Office in Bern, Switzerland.

UIAA declarations, standards, documents and guidelines are subject to review. Updates are recorded in the version history provided at the end of this document.

UIAA documents are generally produced by the responsible Commission and are subject to approval in accordance with the UIAA Articles of Association. All UIAA documents can be found on the relevant subject area on the UIAA website.

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The versioning is V*x.y*, where:

- *x* Major revision of the document. Each change in requirement implies a main evolution.
- *y* Minor revision of the document. Editorial or non-technical updates.

For example, **V5.0** denotes the fifth major revision of the document.

Note that test reports comprising only the main issue, e.g., V5, are also accepted (instead of, e.g., V5.2) since the requirements are identical.

Normative References

The following documents are referenced in such a way that their content, in whole or in part, constitutes requirements of this standard. For dated references, only the edition cited applies. For undated references, the latest edition (including any amendments) applies.

EN 892:2012+A3:2023, *Mountaineering equipment - Dynamic mountaineering ropes - Safety requirements and test methods*

EN ISO 6508-1:2023, *Metallic materials - Rockwell hardness test - Part 1: Test method*

ISO 4032:2012, *Hexagon regular nuts (style 1) - Product grades A and B*

1 General Remarks on the UIAA Trademark and UIAA Label

1.1 The UIAA Trademark (see Clause 5) is copyright protected internationally. The UIAA Safety Label is only granted to items of mountaineering and climbing equipment upon approval of the prospective label holder's application by the UIAA.

1.2 The procedure to be followed by a manufacturer, when applying for a UIAA Safety Label, is laid down in the "Regulations for existing and potential Safety Label Holders" available at the UIAA website.

2 Requirements

2.1 Requirements to be certified by test laboratory

The following requirements shall be satisfied by a test report from a UIAA approved test laboratory.

2.1.1 The UIAA Safety Label can only be granted for dynamic ropes that meet all the requirements of EN 892:2012+A3:2023, as well as the additional requirements in 2.2, with the exception that no EN number is required.

2.1.2 Water-repellent test

If a rope is labelled as "UIAA Water Repellent", it must be certified to UIAA 101 and, when tested according to 3.2, the increase in weight, ρ, shall be less than 5,0 %. Only ropes meeting this requirement may be labelled as "UIAA Water Repellent" and marked according to 5.2.

2.1.3 Measurement of energy absorbed before rupture

If a rope is labelled with the energy absorbed before rupture due to a fall over an edge, the test requirements described in 3.3 must be satisfied.

2.2 Additional requirements to be self-certified

The requirements in this subsection shall be satisfied by the manufacturer certifying on the Safety Label Test Template Form that the product meets these particular requirements.

2.2.1 Rope end marking

The rope end marking may be printed directly on the rope, as an alternative to the durable bands that are required in EN 892:2012+A3:2023. The manufacturer or authorized representative shall control that the rope is marked accurately, clearly, and permanently with required marking information as described in EN 892:2012+A3:2023.

2.2.2 Packaging

If dynamic rope is supplied on a drum and consists of more than one piece, the ends of the pieces shall be clearly visible and not joined together; the number of pieces shall be stated on the drum.

2.2.3 Middle marker

If a rope is provided with a middle marker, the mark shall be at ± 1 % of the rope's published length from the physical middle of the rope when tested according to 3.1. Not all ropes are sold with middle markers.

2.2.4 Length

When measured according to 3.4, the length of the rope shall be equal to or greater than the published length of the rope.

3 Test Methods

3.1 Middle marker

3.1.1 Definition

An identifier of the lengthwise middle of the rope, intended to remain for the life of the rope, middle markers may be used to identify when half the rope has been used while belaying/lead climbing and to center the rope when double line rappelling with a single rope. Typical middle markers may be, but are not limited to, paints, inks, a whip stitch, and woven pattern changes.

3.1.2 Conditioning

None required.

3.1.3 Apparatus

Pulley with a sheave diameter of 20 mm to 200 mm, carabiner, measuring scale with millimeter increments, and marker pen.

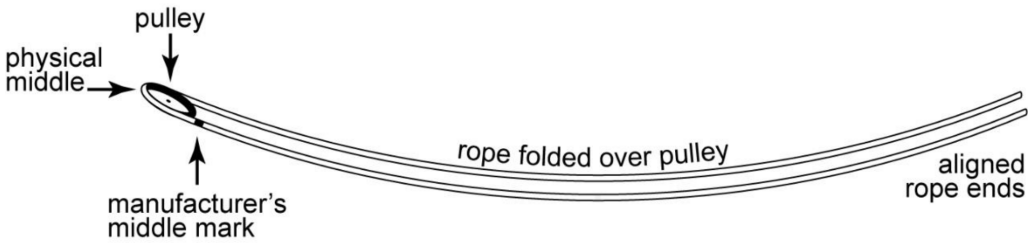

Figure 1: Apparatus for measuring location of middle mark of a rope.

3.1.4 Procedure

- Mark the centre of the manufacturer's middle mark. If the middle mark is a pattern change, determine the start and finish of the pattern change, measure the length, and mark the centre.
- Place a pulley in the loop, at the middle marker, and secure it with a carabiner or other suitable device.
- While holding the rope ends with your hand, align the ends and stretch out the loop in line with enough force so the rope is not in contact with any surface.
- Have an assistant use a marker to mark the rope at the top of the pulley wheel. Alternatively, the rope on each side of the pulley wheel could be marked.
- Measure and record the distance from the centre of the manufacturer's middle mark to the measured physical middle of the rope to the nearest 1 cm.

3.2 Water-repellent test

3.2.1 Apparatus

3.2.1.1 Table for water absorption (See Figure 2) Use a run-off table made/coated with zinc. The dimensions of the table must be large enough to accommodate the rope sample, which is secured by the three fixing points. The water is delivered by a tube with a bore of (16,0±0,5) mm and an outside diameter of (22,0±0,5) mm. The tube is fixed so that it will be parallel to the rope sample and in the plane of the table surface, with the outlet (10 ± 1) mm from the upper end of the rope sample. The water flow is regulated by a flow meter.

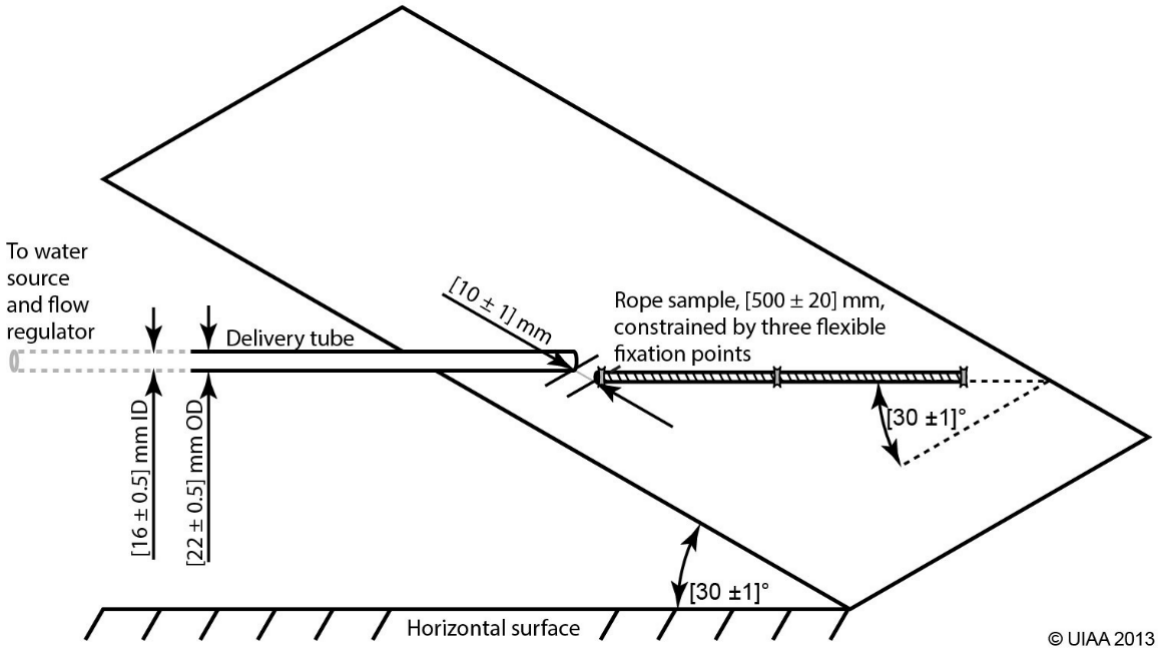

Figure 2: Table for water-repellency test

3.2.1.2 Rope surface wearing apparatus The apparatus used for sheath slippage must be adapted to wear the test sample. The three spacers must be 12,0 mm (0 / -0,3) thick. The three moving plates must be 13,0 mm (0 / -0,2) thick[1]. Place a zinc plated M14 nut, steel 8.8, according to ISO 4032:2012 in the hexagonal hole in each moving plate (Figure 3). Weights of 5 kg are used in the sheath slippage apparatus. The three nuts must be new for each water repellent test, which means that they are used for three test samples only.

[1] In the original apparatus used in this standard the spacers were 10 mm thick and the three moving plates were 9,8 mm thick. In that previous version of the apparatus there was a round hole in the moving plates; this was subsequently changed to be a hexagonal hole to accept a standard M14 nut.

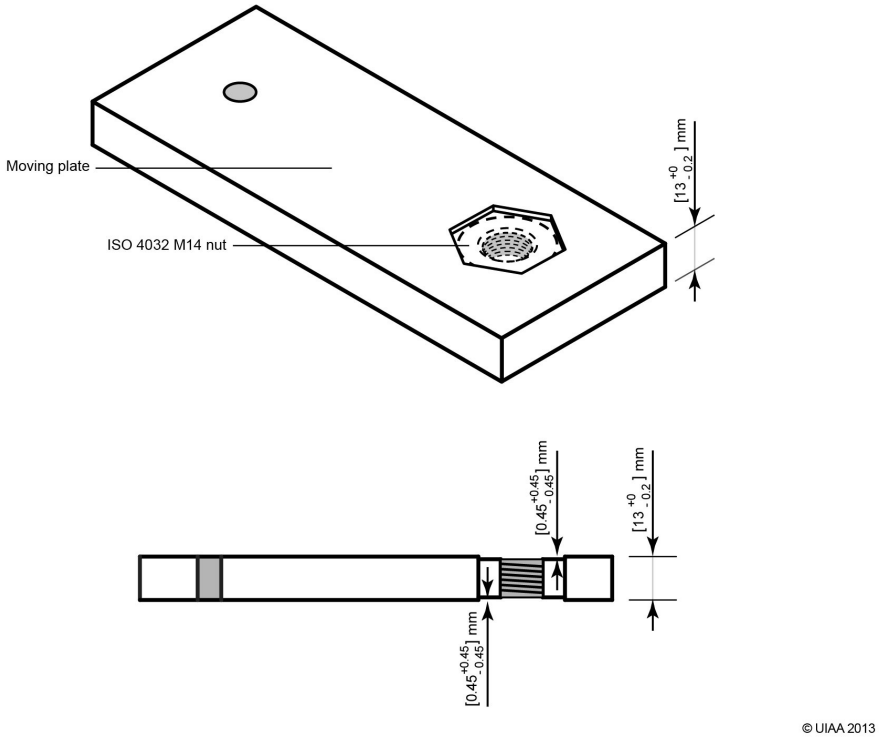

Figure 3: Modified moving plate for water-repellency sheath abrasion apparatus

3.2.2 Procedure

3.2.2.1 Preparation of the test sample

- Take a sample of rope, 1,5 m long.
- Make 2 marks, one at 25 cm from each end.
- Pull the rope by hand 30 times (15 times forward and 15 times back in succession) through the wearing apparatus between these 2 marks at a rate of $(0{,}5 \pm 0{,}2)\ \mathrm{m\,s^{-1}}$.
- Make 2 new marks at 25 cm apart from the middle of the sample.
- Cut the sample on the new marks with a hot knife to obtain a sample of (500 ± 20) mm in length.
- Weld carefully both ends of the sample with the hot knife.
- Weigh the sample with an accuracy of 0,01 g. Call this weight W_a.

3.2.2.2 Water impregnation

- Fix the sample on the clean and dry table with the three flexible fixing points, the rope starting at the level of the orifice of the pipe as shown in Figure 2. Ensure that the whole length of the rope sample is in contact with the surface of the table.
- Adjust the water flow with the flow-meter to a value of $(2{,}0 \pm 0{,}2)\ \mathrm{L\,min^{-1}}$. This adjustment must be achieved within 15 s.
- As soon as the correct water flow rate is achieved, start measuring a water impregnation time of 900 s (+15 / 0).
- Then stop the water flow, remove the sample and start the drainage within 30 s.

3.2.2.3 Drainage

- Hold by hand one end of the rope test sample on the water absorption table and put the rope in a horizontal position forming an angle of 30° with the table.
- Release the rope sample and let it fall onto the table by gravity.
- Rotate the rope 45° around the rope's axis and repeat the steps to raise and release the sample on a dry surface of the table.
- Rotate the rope 45° again (90° axially from the initial position) and repeat the steps to raise and drop the sample.
- Then hold the other end of the rope test sample by hand on the table and repeat the raise and drop sequence 3 more times. Thus, the rope sample will have been released 6 times in total. Ensure that the rope is moved to a dry area for each release.
- Weigh the sample with an accuracy of 0,01 g. Call this weight W_b. The drainage and weighing must be achieved within 60 s.

3.2.2.4 Results

- Calculate the water absorption ρ_1 using the Eq. 1:

$$\rho_1 = \frac{W_b - W_a}{W_a} \times 100\,\% \tag{1}$$

  where W_a is the initial weight and W_b is the weight after water exposure.
- Repeat the test 2 more times using a new rope sample each time.
- Calculate the water absorptions ρ_2 and ρ_3 for the second and third samples.
- Calculate the average value using the Eq. 2:

$$\rho = \frac{\rho_1 + \rho_2 + \rho_3}{3} \tag{2}$$

- The average water absorption value may be published to the nearest 0,1 %.

3.3 Energy absorbed before rupture test

3.3.1 Rope specimen preparation and conditioning

The test shall be performed on three rope specimens. These specimens shall conform to the reference length L_{ref} = (2300 ± 10) mm, as illustrated in Figure 4. The specimens shall be conditioned in accordance with EN 892:2012+A3:2023, Clause 5.2, with a final relative humidity of 50 % and a temperature of 23 °C in the conditioning chamber.

3.3.2 Apparatus

3.3.2.1 DODERO, mass, tower The basic apparatus required for the evaluation of energy absorption is the DODERO device, with the following modifications. Schematically, the test apparatus is shown in Figure 4. The DODERO apparatus shall comply with the requirements concerning guidance rail rigidity and friction as specified in EN 892:2012+A3:2023, Clause 5.6.2. The mass used shall be (100 ± 1) kg. The force data acquisition system (which is the only recorded data required for this test) shall comply with EN 892:2012+A3:2023, Clause 5.6.2.5, but the data shall not be filtered.

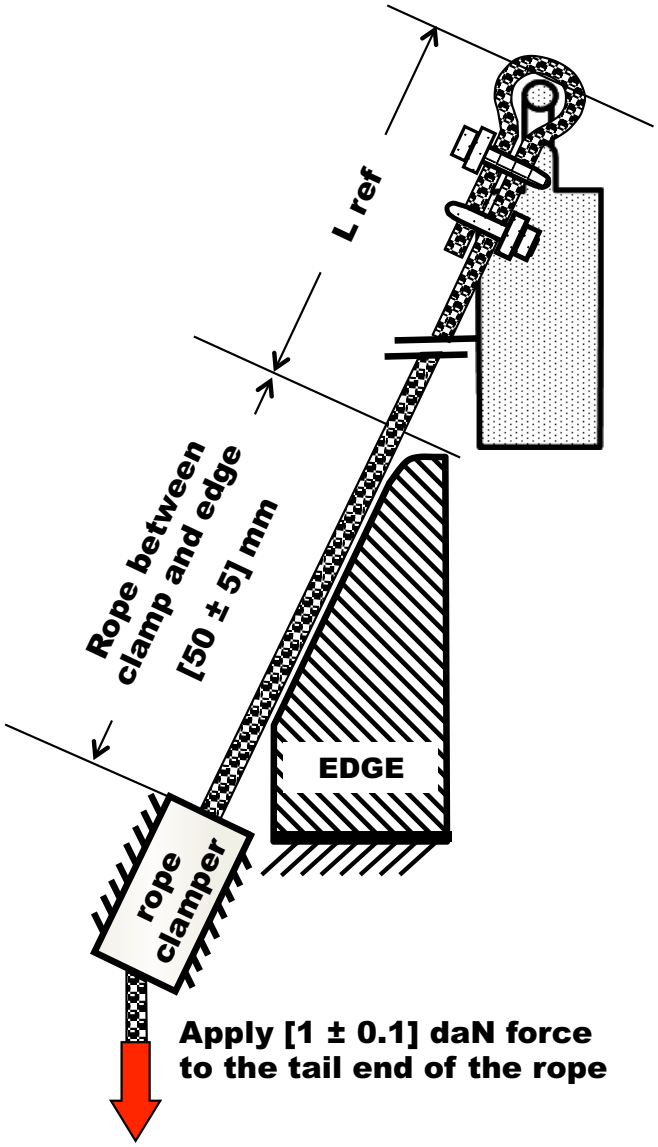

Figure 4: Test apparatus to determine the energy absorbed before rupture.

3.3.2.2 Substitution of the orifice plate with a straight edge The standard DODERO orifice plate shall be replaced by a straight horizontal edge. This edge shall be manufactured from steel with a surface hardness of at least 52 HRC, in accordance with EN ISO 6508-1:2023. The geometry of the edge cross-section is illustrated in Figure 5.

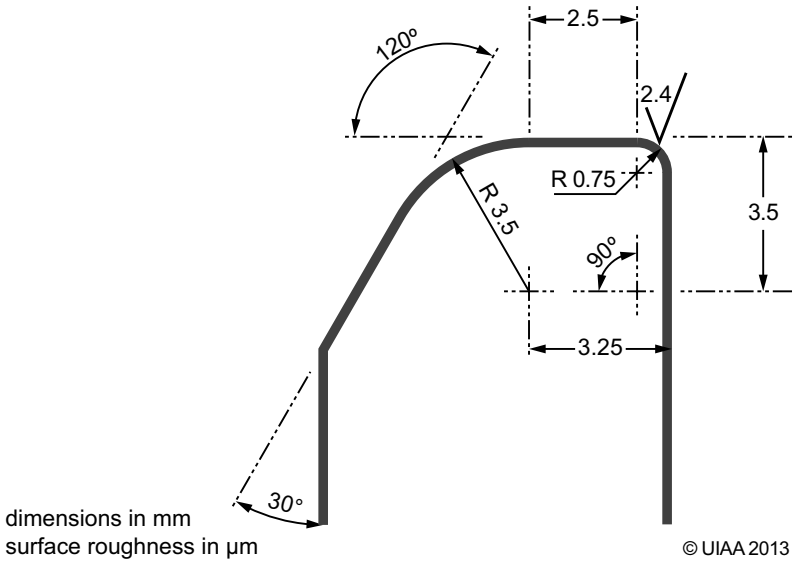

Figure 5: Edge cross-section

3.3.2.3 Rope clamping system The rope clamping system is designed to reduce slippage, thereby minimizing unintended energy absorption. The maximum allowed slippage is 2 mm. The connection between the rope and the mass may be made using conventional clamps. It shall follow the configuration shown in Figure 6. The fixed point shall be achieved using a clamp capable of keeping the rope slippage below 2 mm. If possible, the clamp should compress the rope while maintaining its circular cross-section.

3.3.3 Procedure

- Connect the rope to the mass according to Figure 6.

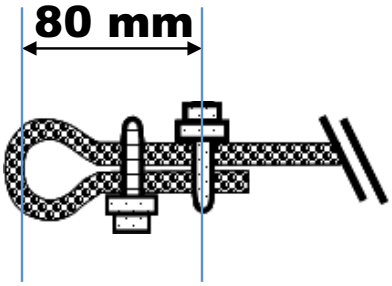

Figure 6: Connection of the rope to the mass

- Lift the mass to the top level, such that the distance between the edge and the mass corresponds to L_{ref} (see Figure 4). Record the mass position.
- Preload the rope by applying a force of (1,0 ± 0,1) daN, e.g., by hanging a mass. The preload shall be applied with the rope clamper left open, allowing the rope to slide freely.
- Temporarily block the rope clamper and lower the mass at low speed. Leave the mass hanging for (60 ± 1) s.
- Raise the mass back to the recorded top level and leave it at rest for (10 ± 1) min.
- Release the rope clamper to allow the preload to take place.
- Close the rope clamper definitively.

- Release the mass. The test is considered valid only if the rope breakage occurs over the edge. Breakage, even partial, at the mass connection or at the rope clamper is not permitted.
- Record the force–time history.
- Repeat the complete procedure for each of the three specimens.

3.3.4 Evaluation of the energy absorption

- This evaluation shall be performed by successive integrations of the recorded force–time history $F(t)$. Special care shall be taken to eliminate any force offset (i.e., the mean value of the force noise) between the initial time and the instant t_{tens} when the specimen begins to stretch.
- Evaluate the mass displacement $S(t)$ using the following the Eq. 3:

$$S(t) = \int \int_{t_{tens}}^{t} \frac{gM - F(t)}{M} \, dt \, dt \tag{3}$$

The variables are defined as follows:

t Time [s]

g Gravitational acceleration (9,806 $m\,s^{-2}$)

L_{ref} Reference rope length (see Figure 4) [m]

M Mass of the falling object [kg]

$F(t)$ Rope tension as a function of time [N]

$S(t)$ Vertical displacement of the mass over time [m]

V_{tens} Velocity at the onset of rope tension, calculated as $\sqrt{2g(2L_{ref})}$ [$m\,s^{-1}$]

Subscripts are defined as follows:

tens Refers to the start of rope stretch

rupt Refers to rope rupture

- Evaluate the total energy E_{rupt} (see Eq. 4) absorbed by the rope up to the full rupture of the specimen, where the function $F(S)$ is obtained from the time functions $F(t)$ and $S(t)$. Here, S_{tens} is the displacement S at time t_{tens}, and S_{rupt} is the displacement S at time t_{rupt}.

$$E_{rupt} = \int_{S_{tens}}^{S_{rupt}} F(S) \, dS \tag{4}$$

- The numerical integration shall be carried out using the trapezoidal method.
- The integration range shall be defined as follows:
  - **Tension point** (t_{tens}): the tension starting point is based on the shape of the $F(t)$ curve. Starting from the point where F reaches 200 daN, the preceding points of the curve are followed backwards until the value $F = 2$ daN is reached. This point is taken as the integration starting point (see Figure 7).
  - **Rupture point** (t_{rupt}): this is defined as the point where, after the maximum tension peak, the force has decreased to 200 daN (see Figure 8).
- The energy absorbed per unit rope length is given by the Eq. 5:

$$E_u = \frac{E_{rupt}}{L_{ref}} \tag{5}$$

- A computer program for the evaluation of the absorbed energy, written in SCILAB, is available on the UIAA DMS (interfaces may need to be adapted to match the format of the recorded data available to the user).

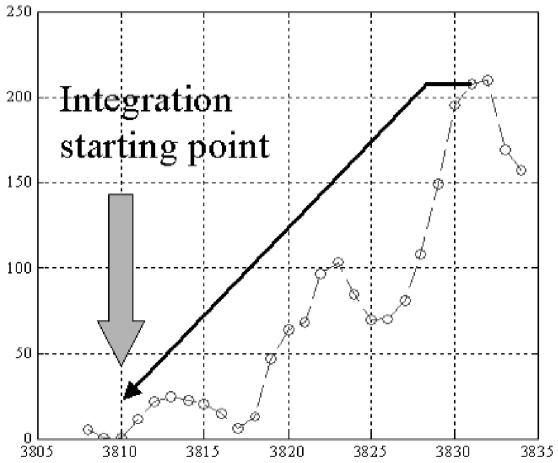

Figure 7: Sample tension vs time data showing the tension point at which integration of energy begins

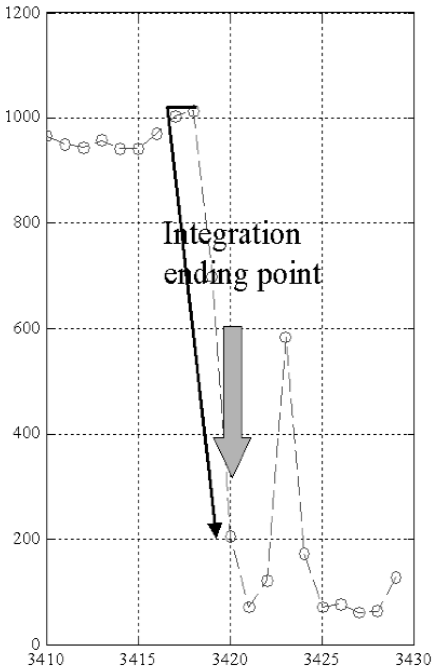

Figure 8: Sample tension vs. time data showing the rupture point at which integration of energy ends

3.3.5 Expression of the result

The absorbed energy shall be obtained as the mean value over three valid tests and may be included in the information provided by the manufacturer. Figure 9 illustrates a possible graphical representation of the absorbed energy; in the example, a result of 1,72 kJ m^{-1} is reported for a single rope.

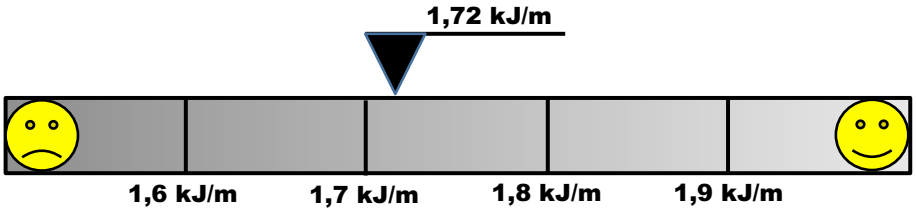

Figure 9: Possible presentation of the results of energy absorbed before rupture for a single rope

3.4 Rope Length Measurement

3.4.1 Apparatus

Metric tape measure, pulley (sheave diameter: 20 mm to 200 mm), carabiner, sling, meter stick.

3.4.2 Procedure

- Secure the centre of the rope in a pulley mounted 1 m above the ground.
- Align the ends of the rope to be even.
- Pull the ends of the rope at a height of 1 m. This may be done by hand. Pull with just enough force to lift the lowest point of the rope off the ground (see Figure 10).
- Use a meter stick as a “plumb-bob” to mark a position on the floor aligned with the ends of the rope.
- Use a tape measure to measure the horizontal distance between the pulley center and the floor mark below the rope ends.
- Multiply this measurement by two, and round down to the nearest 0,1 m.

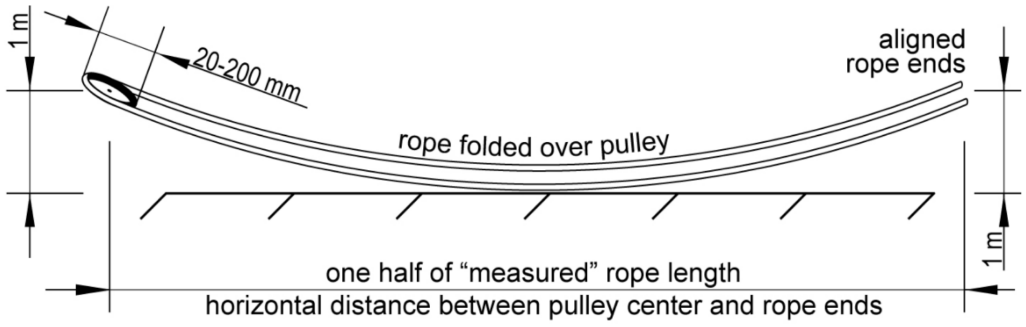

Figure 10: Rope length measuring setup

4 Information to be Supplied

4.1 Language and format

The ”information to be supplied” shall be given in standard English and, if required, in the official language(s) of the country in which the product is made available on the market. As an alternative to a printed form, the information may be provided via an electronic or other data storage format link (e.g., a QR code) allowing the downloading of the information. The information link shall be preceded or surmounted by an icon showing an open booklet; the information link and icon may be directly printed on the product in a clearly visible and accessible place.

4.2 Possible shrinkage of the rope

In the information for use there shall be a warning to the effect that ropes may shrink during normal usage.

4.3 Drop test report

The slippage at the rope clamp after the last fall may be stated in the test report.

4.4 Storage Temperature

The minimum and maximum storage temperature shall be clearly specified in the care and use instructions.

5 Attachment of the UIAA Safety Label

5.1 Safety Label Marking

For any model of mountaineering equipment, which has been granted the UIAA Safety Label, the UIAA Trademark (see Figure 11) or the four letters ”UIAA” shall be marked clearly and indelibly on each item sold in accordance with the branding guidelines specified in the “Regulations for existing and potential Safety Label Holders”.

Figure 11: UIAA Trademark or the four letters “UIAA” word mark.

5.2 Safety Label Marking for Water Repellent Ropes

If a UIAA logo is used to indicate that a rope is qualified as UIAA Water Repellent, the UIAA Safety Label logo should be used as per the UIAA Brand Manual with UIAA Water Repellent substituted for a company logo. The words “UIAA Water Repellent” may be extended beyond the right boundary of the grey company logo region (see Figure 12).

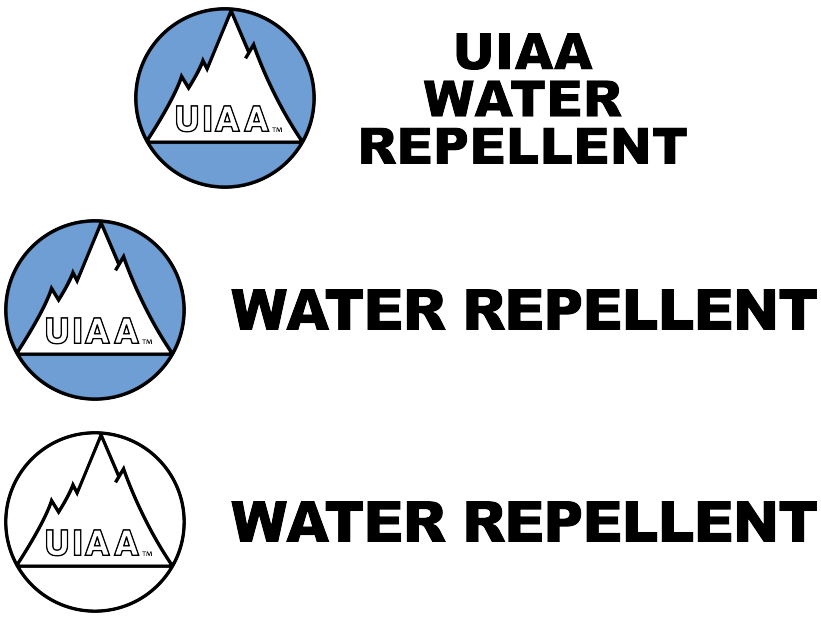

Figure 12: UIAA Water Repellency logo

5.3 Other

In addition, the UIAA Trademark or the four letters ”UIAA” may be included in the instructions for use and/or on a swing ticket as well as in catalogs and other publications of the manufacturer. In the last case, the illustration and/or the text shall clearly apply only to the equipment which has been granted the UIAA Safety Label.

Revision History

V9.1 — July 2025

Formatting and minor update: EN892+A1:2016 changed in EN892+A3:2023. No change in requirements.

V9 — September 2019

Section 4 *Demonstrating that the Requirements are met* was deleted, and its content moved to Section 2 *Requirements for Dynamic Ropes*. The subsections *Possible Shrinkage of the Rope*, *Drop Test Report*, and *Storage Temperature* were transferred from the requirements section to the section *Information to be Supplied*. The diameter requirement was deleted, as it is already covered by EN 892:2012+A1:2016.

The precision for measuring water absorption was changed from 0.1 g to 0.01 g, and the requirement adjusted from “less than 5%” to “less than 5.0%”. Additionally, the option to publish the water absorption value to the nearest 0.1% was introduced, reflecting common manufacturer practices. It was clarified that ropes must be UIAA 101 certified in order to optionally obtain the UIAA Water Repellency certification.

The figure from Annex 1 was moved to Section *Test Methods: Middle Marker* as Figure 1, and the definition of the middle mark was also transferred from the requirements to the test methods section. Annex 2 was integrated into the main body of the document by adding a corresponding requirement and test method for rope length measurement.

The structure of Section 2 was revised to distinguish between requirements that must be certified by an accredited test laboratory (including water repellency and energy absorbed before rupture, when applicable) and additional requirements that are to be self-certified by the manufacturer (e.g., rope end marking).

A new Section 5.3 was added to present the UIAA Water Repellency logo. Figures were renumbered, and internal cross-references were inserted throughout the document to ensure consistency. General formatting was also reviewed and edited for improved uniformity.

V8 — February 2019

A new subsection 2.3.3 *Rope End Marking* was added.

Marking is required at the rope ends, containing the information described in Clause 6 of EN 892. The UIAA permits the option of marking printed directly on the rope, as an alternative to the durable bands required by EN 892.

Commission meeting held in Porto, May 2018.

V7.1 — February 2018

EN 892:2012 updated to EN 892:2012+A1:2016

V7 — July 2017

Delete: 2.2.1 ~~*Multidrop rope*~~
~~Definition: a single rope or a half rope in accordance with EN 892, which withstands 10 or more test falls according to the aforementioned EN.~~

Add: 2.3 *Optional test requirements and designations.*
- 2.3.1 Water-repellent test as 3.2.
- 2.3.2 Energy absorbed before rupture as 3.3.

As decided Woerden Safecom meeting May 2017

V6 — June 2017

5.1 The information to be supplied: (in accordance with EN 892:2012) shall be given in English, or at least in the language of the country in which the product is sold.

Has been updated with: The “information to be supplied” shall be given in standard English and, if required, in the official language(s) of the country in which the product is made available on the market. As an alternative to a printed form, the information may be provided via an electronic or other data storage format link (e.g., a QR

code) allowing the downloading of the information. The information link shall be preceded or surmounted by an icon showing an open booklet; the information link and icon may be directly printed on the product in a clearly visible and accessible place.

Unanimously approved SafeCom Woerden June 2017

V5 — May 2016

Correction to equation and note of single-rope for edge energy example

Inclusion of 2.2.9 Measurement of energy absorbed before rupture and 3.3 on Test method to determine energy absorbed before rupture. Minor proof-read edits, especially inclusion of ± sub/superscripts that did not appear in the previous version in .pdf format.

V4 — June 2014

Corrections of 2.2.8 & 3.2 cf. water repellent test

V3 — October 2013

Corrections of last EN norm + in point 4

V2 — March 2013

Correction of 2.2.4: Middle Marker: The definitions and requirements were added.

Correction of 3: Test methods: The procedure was added.

V1 — August 2010

Inclusion of Annexes: Middle Mark and Length Measurement: Figures and text were added based on the decisions of the Safety Commission Meeting in 2008.