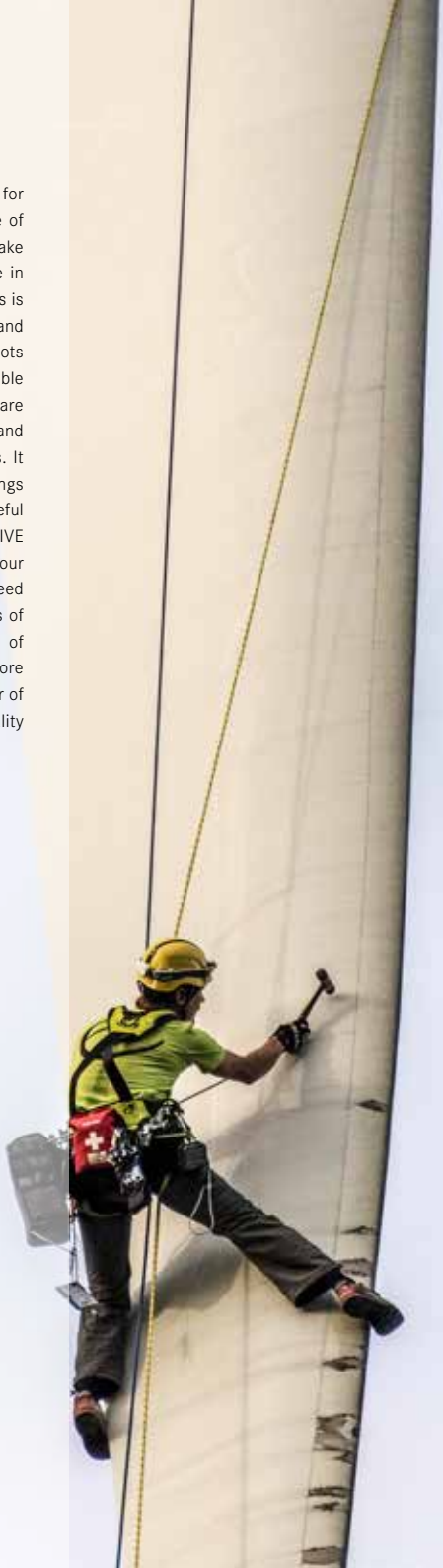
STATIC ROPE HANDBOOK

EDELRID

We've put together this handbook to share our passion for ropes our expertise. A rope is more than just a piece of equipment; your life might depend upon it. We aim to make the best ropes possible. However, even the best rope in the world is not much use if it's not used correctly. This is why we want to raise awareness of the capabilities and limitations of our ropes. We want to provide you with lots of useful information about static ropes in an accessible format. This handbook describes how our ropes are produced, provides advice for selecting the right rope, and gives tips for the care and maintenance of your ropes. It explains how a rope can be damaged and certain things that should be avoided at all costs. You'll also find useful practical tips and PPE inspection information. CREATIVE TECHNOLOGY is the EDELRID credo – we apply it to our ropes to make versatile products that meet and exceed the highest quality standards. We have over 150 years of experience in rope manufacturing. This combination of experience and enthusiasm constantly drives us to explore new paths and only accept the best. As a manufacturer of Personal Protective Equipment, we naturally make quality management our highest priority.



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SUSTAINABILITY

To boost our quality and safety standards, we've been working in partnership with bluesign® technologies ag from Switzerland since 2009. We are the first manufacturer to adapt our ropes to meet the tough demands of the bluesign® standard. The bluesign® standard is the most stringent environmental standard for the production of functional textiles. It is independent, internationally recognised, and is based on five principles of sustainability. These are resource productivity, air emission protection, water emission protection, occupational health and safety and consumer protection. The bluesign® standard follows these five principles throughout the whole textile manufacturing chain.

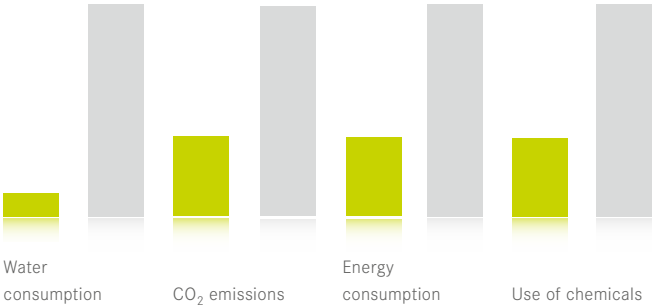
EDELRID has created new benchmarks throughout the industry for innovative and sustainable rope production. All the materials used to make our ropes are bluesign® approved. Therefore, we can guarantee that we use as few pollutants as possible without making any compromises in terms of functionality, quality and design. Our ropes carry the bluesign® product label thanks to this combination of certified source materials and our advanced rope production facilities in Isny.
The bluesign® product label is a sign of quality. It guarantees an eco-friendly manufactured product that is low in pollutants and safe for health and the environment. In this manner, we are responding fully to consumers' demands for safe, environmentally friendly and sustainable products.

Our many years of partnership with bluesign® technologies ag has provided an in-depth experience knowledge of sustainable rope production. By converting all of our rope production to meet the tough demands of the bluesign® standard we were able to implement the following efficiencies when dyeing sheath yarns:

62 % CO_2 reduction,
89 % water saving,
63 % less energy and 63 % fewer chemicals.

bluesign SYSTEM PARTNER

bluesign® PRODUCT



Green: Production following implementation of the bluesign® system

Grey: Conventional rope production

For EDELRID, this represents a further step towards a healthy future for our products. We pursue a consistent policy of sustainable rope production in order to continue to build trust in the future. We do not consider these steps a virtue, but a natural response to the demands of the modern world. As the inventor of the kernmantel rope, we continue to set new and ever-higher standards. As a result, we can confidently say that **our ropes are eco-friendly.**

STATIC ROPES

Kernmantel ropes

In 1953 EDELRID invented the kernmantel rope and consequently revolutionized modern rope manufacturing. There are two parts to the kernmantel construction: a core (Kern) and a protective sheath (Mantel). The main advantage of kernmantel ropes is their capacity to absorb energy. They absorb energy by stretching in the event of a fall. Different designs, constructions and finishing treatments can be used to give kernmantel ropes specific dynamic or static characteristics. There are two main types of kernmantel ropes:

- **Dynamic ropes (EN 892): high energy absorption and low impact force**
- **Low stretch kernmantel ropes (EN 1891): high strength and low elongation**

Static ropes are low stretch kernmantel ropes. Sometimes they are also referred to as 'semi-static ropes'. Contrary to what their name might suggest, static ropes do have dynamic characteristics, although much less than those of a dynamic rope. Static ropes have a working elongation of under 5% (sport climbing ropes have between 7% and 10%). This means that static ropes are perfectly capable of absorbing a fall; however, we do not recommend this as the fall arrest would be more abrupt than with a dynamic rope and could result in unpleasant consequences for the user. This is why low stretch ropes are used primarily for work positioning and positioning systems for rope access work, where no dynamic loads are expected.

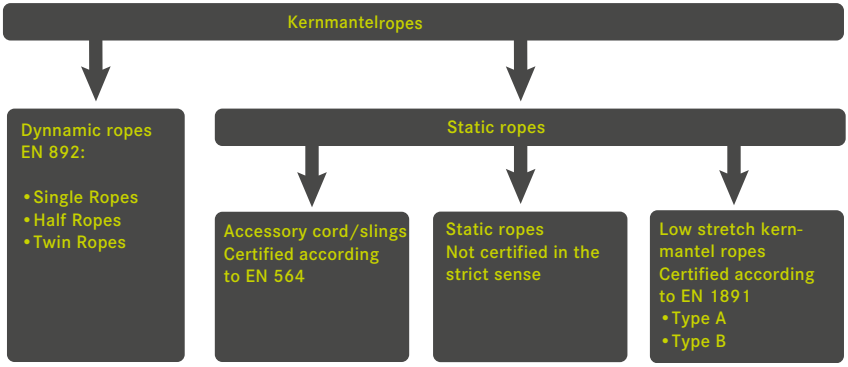
Furthermore, there are also static ropes which that are completely static. These are generally made of Kevlar, Dyneema® or steel. They have minimal stretch and possess no dynamic energy absorption. For this reason, they may only be used as Personal Protective Equipment (PPE) if used with additional energy absorbing systems. This type of rope is used lifting heavy loads, for hauling, rope constructions and pulley systems, where minimal stretch is an advantage.

This rope handbook only covers kernmantel ropes with low stretch (EN 1891). For the sake of clarity, we refer to them as static ropes.

Static ropes
(Low stretch kernmantel ropes)

Low stretch kernmantel ropes are tested in accordance with the requirements of EN 1891. This standard defines two types of rope: Type A and Type B. Type A are static ropes designed for industrial use for persons in rope access including all kinds of work positioning and restraint. This also includes rescue work and speleology (caving).

Type B ropes are static ropes with a lower technical specification than Type A ropes (they have a thinner diameter, lower breaking strength and are lighter). As such, they require greater care and precaution during use. They are primarily used in rescue procedures with descent and rescue devices (e.g. EN 341).



STATIC ROPE

Special types of static rope

There are also certain types of static rope that have special designs and constructions. Let's have a quick look at a few of them.

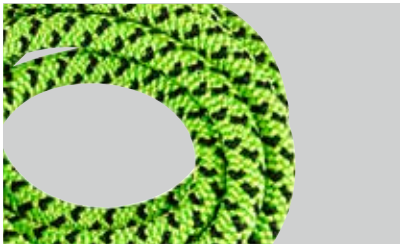
Canyoning ropes:

Canyoning ropes can be Type A or Type B static ropes. They are made of different materials.

Some are made with a polyamide sheath for greater abrasion resistance and a polypropylene core which makes them lightweight and able to float. Others are made with a polyamide sheath and polyamide core. Full polyamide ropes are heavier and don't float as well, but they can withstand greater static force than ropes with a polypropylene core. Canyoning ropes often come in luminous colours so they can be seen in water.

Arborist ropes:

Arborist (tree climbing) ropes have a special construction which is different to other static ropes. They have to provide extra abrasion resistance, low working elongation and good handling. Arborist ropes have a comparatively large diameter and greater sheath proportion. The special textured sheath structure makes them easier to ascend and their bright colours make them easier to see. To ensure that arborist ropes are easy to splice, they generally have a woven core.



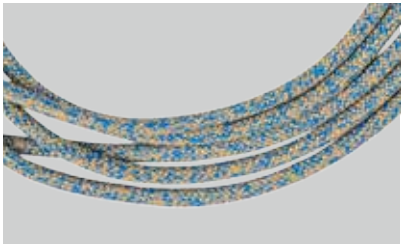
Slings

We make slings that have a kernmantel construction with diameters from four to eight millimetres. They are used as accessory cord for hauling lighter loads, building anchor points, or as prusik slings. The minimum breaking strength for each diameter is defined in EN standard 564 as follows:

DIAMETER (MM)	MINIMUM BREAKING STRENGTH (kN)
4	3.2
5	5.0
6	7.2
7	9.8
8	12.8

Rap Line II

EDELRID's Rap Line II is the first accessory cord to have a dynamic safety reserve. It's made from a combination of low stretch aramid polyester and energy-absorbing polyamide. Its low elongation characteristics make it ideal for hauling material or abseiling. The Rap Line II works statically for loads up to 5 kN. However, unlike static ropes and slings, it offers an additional dynamic safety reserve. In the event of a fall that could break a static rope, the Rap Line functions dynamically. The highly static aramid-polyester sheath tears, but the polyamide core has dynamic elongation that cushion the fall. Its breaking elongation is identical to a dynamic rope and absorbs fall energy. The Rap Line II holds two standard falls as required of twin ropes. Twin ropes have to withstand 12 consecutive drop tests without breaking, in accordance with EN 892. Although the Rap Line II is only certified to the industrial standard for accessory cord (EN 564), it would not break in the event of a fall. And it is also extremely light, weighing just 31 g/m.



FROM FIBRE TO ROPE

Raw materials

Every rope is made up of ultra-thin filaments. EDELRID uses different types of synthetic raw materials to make its ropes. Here's an introduction to the main fibres we use and their properties:

Polyamide

Polyamide is the most widely used fibre for making high-quality ropes from synthetic materials. The most familiar types of polyamide are nylon (PA 6.6) from DuPont and Perlon (PA 6).

Polyamide is abrasion-resistant, very strong and very elastic. It can be heated and permanently formed - a property that is used during thermofixing. Due to the energy absorption required, dynamic ropes are made entirely from polyamide. Polyamide fibres are also widely used to make static ropes, although material types with less stretch are chosen. The disadvantage with polyamide is that it absorbs a comparatively high amount of water, which can cause it to shrink if it gets wet.

Polyester

Static ropes made of polyester fibres are primarily used for jobs where there is likely to be contact with acids or corrosive chemicals. Unlike polyamide, it has a much higher resistance to acids and absorbs virtually no water. However, polyester only has limited energy absorbing characteristics, which means that it has limited suitability for PPE use.

Polypropylene:

Polypropylene is lightweight and inexpensive. Due to its low abrasion resistance, polypropylene is mostly used to make the rope's core where it is protected by a polyamide sheath. Polypropylene is extremely lightweight, has a low relative density and floats. This is why we use it to make our canyoning ropes.

Dyneema®

Dyneema® is a synthetic fibre made of polyethylene. It has extremely high tear strength and extremely low elongation. On a weight-for-weight basis, its tensile strength is 15 times greater than that of steel. Its main characteristics are its high abrasion resistance, high UV stability and light weight. However, Dyneema® offers no dynamic energy absorption whatsoever, which makes it unsuitable for use as PPE. Dyneema® ropes are used primarily for hauling heavy loads. They are often used instead of heavy steel cables. In practice, Dyneema® has a low melting point. This means that Dyneema® fibres may be damaged at temperatures above 135°C.

Aramid

Aramid is an extremely strong, extremely heat-resistant fibre with high cut resistance. Like Dyneema®, it offers no dynamic energy absorption, so it only has limited suitability for PPE use. Due to their extreme sensitivity to bending and low UV resistance, aramid fibres are generally given a polyamide sheath to protect them. We use aramid to make our system ropes for work positioning, where minimal stretch and high cut resistance are required.

FROM FIBRE TO ROPE

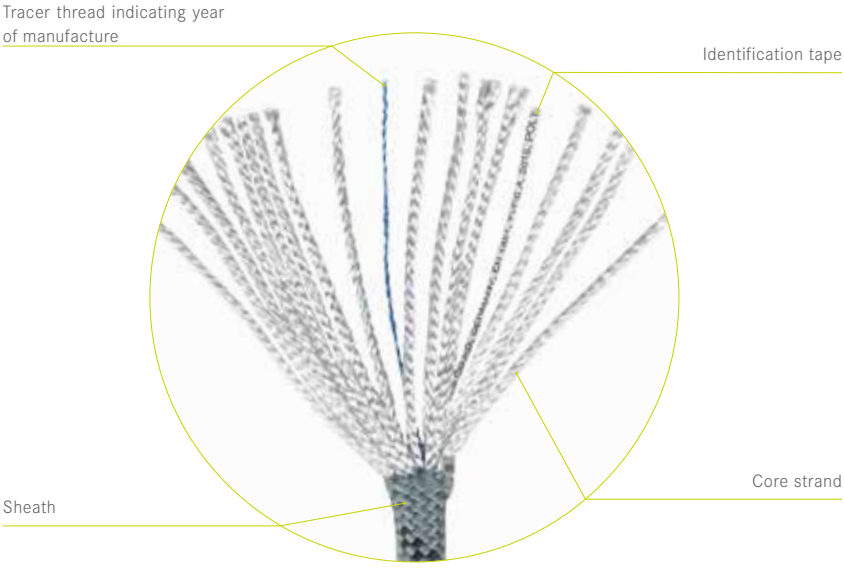
	POLYAMIDE (PA) (PA 6.6)	POLYESTER (PES)
Specific strength (N/tex)	0.8	0.9
Specific weight (g/cm³)	1.14	1.38
Melting temperature (°C)	255	250
Water absorption (%)	3.5 - 4	0.4
Material stretch	high	medium
UV resistance	average	very good
Abrasion resistance (dry)	very good	good
Abrasion resistance (wet)	satisfactory	good
Resistance to acids	low	very good
Resistance to alkalis	good	good

POLYPROPYLENE (PP)	DYNEEMA®	ARAMID
0.7	4	1.9
0.91	0.97	1.44
160	145	550
0	0	3.5 – 7
medium	very low	very low
very good	good	poor
satisfactory	very good	satisfactory
satisfactory	very good	satisfactory
very good	very good	good
very good	very good	good

FROM FIBRE TO ROPE

Yarn preparation

As it's not possible to run raw material fibres straight through a rope braiding machine, the yarns have to be prepared first. During this intermediate stage, the individual core and sheath yarns are prepared before the braiding process begins. There are different types of braiding processes that involve twisting, doubling, braiding and shrinking.



Core

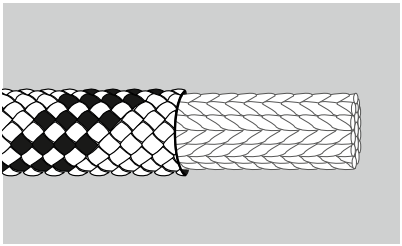
The core is the load-bearing part of the rope. It's made of very fine multifilaments that are made into core strands or core braids. We use two distinct multi-stage processes: twisting and braiding.

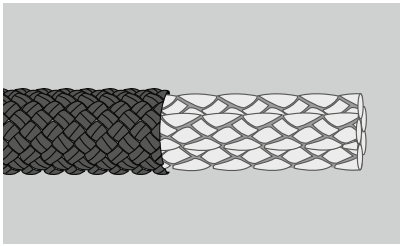
Twisting core yarns

Twisting is the standard technique for making core yarns. It involves winding multifilaments together. Up to 135 ultra-fine nylon threads are twisted together to make a core yarn. This process is called twisting. A number of these basic core yarns are then twisted together. Depending on the construction, two, four or five other yarns are combined to make a core strand. These core strands are then combined to form the rope core. The twisting process gives the rope its dynamic elongation, i.e. the ability to act like a spring when shock loaded. The number of twists over a given length determine the mechanical elongation and strength of a rope. Static ropes have much less twist in the core than dynamic ropes, creating a rope with much less elongation. To prevent unwanted twisting and kinking in the rope, some of the core strands are twisted in one direction, while the others are twisted the opposite way. As a result, the torsional forces cancel each other out and the rope remains twist and kink free.

Braiding core yarns

With braiding, up to three basic twisted core yarns are interlaced to make a braided core strand. A number of these braided core strands are then combined to produce the rope core. This gives a particularly compact structure. Ropes with braided core strands keep their shape significantly better and have greater edge resistance than ropes with twisted core strands. In addition, they are easy to splice and are very strong with stitched terminations.





FROM FIBRE TO ROPE

Sheath

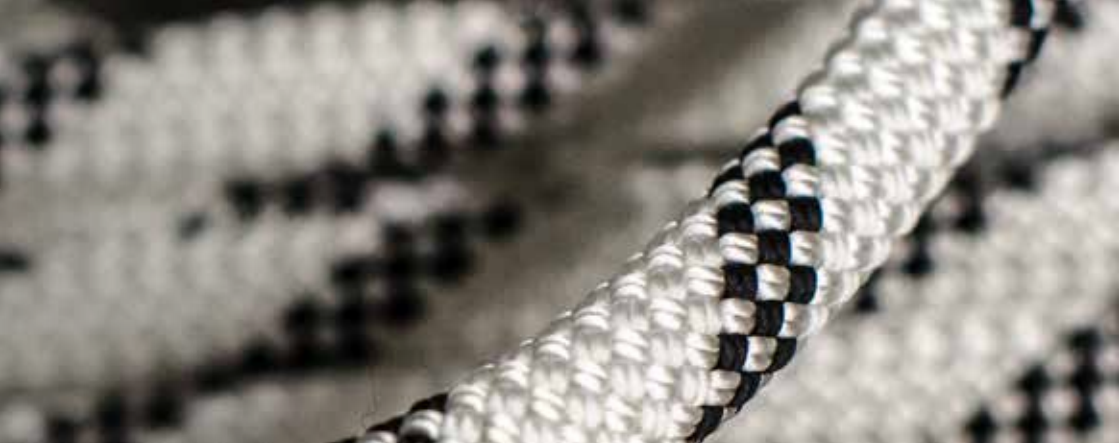
The sheath protects the core from external influences, such as abrasion, UV radiation, etc. and prevents dirt from getting in. You can visually inspect a kernmantel rope by looking carefully at the sheath. If the sheath is damaged, and the inner core is visible then the rope should be retired. We use different types of sheath constructions depending on what a rope is to be used for:

Twisting

During twisting, two, three, four, or five individual sheath yarns are twisted together with a pre-set tension and rotation speed. Twisting the yarns increases the surface area of the sheath, which makes it significantly more abrasion-resistant.

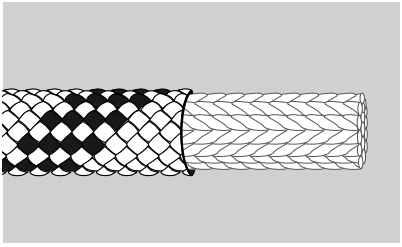
Twisting and shrinking

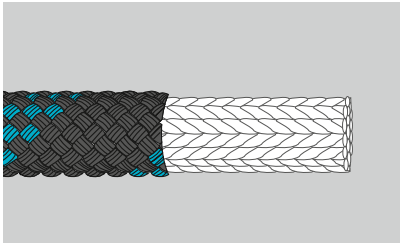
In this process the yarns are twisted and then additionally shrunk. This takes place in an autoclave, a kind of gigantic pressure cooker. The fibres are shrunk together using a particular combination of heat and pressure. Shrinking the sheath yarns in this way ensures that they remain pleasantly soft and easy to handle throughout the rope's lifespan. Furthermore, the sheath will not shrink, even with intensive use.



Doubling
Doubling is different to twisting. The yarns are wound parallel to one another (without twisting) onto bobbins. Running the fibres in parallel, allows us to utilise them to their full length. We can achieve very high breaking strengths, depending on the technical specifications of the fibres used. The only drawback is that doubled sheaths are less robust than twisted sheaths.

Parallel wound yarns (=doubled twists)
This method combines the advantages of twisting and doubling. It is the most complex, high-quality and expensive technique available. First the sheath yarns are twisted, then wound parallel onto bobbins. We use this complex construction exclusively for our high-end ropes, where maximum breaking strength and abrasion resistance are required in equal measure.





FROM FIBRE TO ROPE

Braiding

Braiding is where the actual rope is produced. The sheath and the core are braided together. Braiding machines twist the sheath strands around the required number of twisted core strands or braided core strands, depending on the type of rope being produced. Bobbins with the sheath yarns dance around the core strands at high speed – rather like dancing around the maypole. During braiding, it's important that the sheath yarn tension remains constant for the duration of the process. If it varies, then the rope will end up either stiff and inflexible or soft and spongy – and have a high degree of sheath slippage.

Tracer thread indicating year of manufacture and identification tape.

During the braiding process, an identification tape and tracer thread indicating the year of manufacture are woven into the rope core.

The year of manufacture tracer thread is made from polyamide, and is in a particular colour. Its colour shows the year the rope was manufactured, although the same set of colours is repeated every ten years. The year of manufacture tracer thread means that this information is permanently marked for the lifespan of the rope.

The identification tape is a thin strip of polypropylene. In accordance with the EN 1891 standard for static ropes, it has to display the following information: name of manufacturer, standard and rope type, year of manufacture and the type of material the static rope is made from.

Quality control

Once a length of rope has been braided, it's sent off to the finishing department. Here, every single metre of the rope is inspected by experts, by hand. They immediately feel if a fibre is loose, or if the rope is too rough, too smooth or not supple enough. EDELRID employees are so experienced they can detect even the slightest irregularities. Over the years, they've developed an extraordinary touch perception. This is an important additional quality control measure for our ropes as it is something a machine just cannot do.

Once a batch has passed this final inspection, it's cut into the required lengths. A machine adds the middle marking and welds the sheath and core together at the rope ends.

Packing

The rope ends are given a label with the most important information about the rope: name of manufacturer, rope type, standard, CE conformity symbol and number indicating the certification body, length and diameter, batch number with year of manufacture and the corresponding EN standard.

The rope is then coiled on drums (also known as reels) to be sold by the metre. Or they are coiled on a coiling machine and sold as finished lengths. Every finished rope drum or coiled rope is then weighed again. The specific weight of each rope is recorded and checked. If there is even a minimal deviation in weight, this is immediately detected and the rope is withdrawn. Once the finished rope has been packaged with a product label and the user manual, it's ready for distribution.

TECHNOLOGIES AND TREATMENTS

The basic principle of braiding is always the same. However, to give the ropes different characteristics, specific braiding technologies and finishing treatments are required. EDELRID has pioneered a range of innovative, braiding technologies and finishing treatments that improve a rope's overall performance and lifespan, as well as providing greater safety.

LinkTec

LinkTec technology involves bonding the sheath and the core of the rope together during braiding. This reduces sheath slippage to a minimum and significantly prolongs the lifespan of a rope. We use this technology on our high-end ropes that have to withstand intensive constant use, for example frequent abseiling.

Thermo Shield:

Thermo Shield is the standard treatment that we apply to all our ropes. It gives them their famous EDELRID suppleness and handling characteristics. The thermal stabilising process ensures that the core and sheath yarns are perfectly balanced. A special heat treatment cure first relaxes then shrinks the rope's fibres. This harmonises the gliding characteristics of the yarns inside the rope and ensures that it the rope remains compact and supple throughout its life by preventing it from future shrinkage or stiffening.

Tracer thread marking on the sheath

EDELRID developed the system for sheath tracer thread marking. It allows immediate identification of the diameter of static ropes and slings. The number of tracer threads sewn into the rope sheath indicates the diameter of the rope. For example, two tracer threads denote a 10 mm diameter, 2.5 tracer threads denote a 10.5 mm diameter.

ROPE TERMINATIONS

Rope terminations are an important part of the safety system. Whether tying in or building anchor points, ropes require secure terminations. Secure terminations might be knots, stitched terminations or splices.

Knots

The figure of eight, overhand knot and double bowline are suitable. These knotted terminations must be tied carefully in order to function safely. However, each knot reduces the breaking strength of a rope by up to 50%. With technical fibres, for example Dyneema®, breaking strength could even be reduced by up to 80%. Always back up your knot with a stopper knot.

Stitched terminations

Stitched terminations are considerably safer. They cannot be manipulated and possess significantly higher breaking strength than knotted terminations. To meet the requirements of industrial use and working at height, EDELRID ropes can be ordered in the required lengths with stitched terminations (at one or both ends). All EDELRID terminations are stitched by computer-operated machines and protected by a high-quality protective cover. The protective cover ensures that the connecting element remains in the correct position and protects the stitching from damage. Ropes with stitched terminations can be used from the moment you get them and do not require knots.

Eye splice

Hand-finished eye splices are the most elegant type of permanent rope termination. Whereas knots decrease a rope's strength, in most cases, splicing maintains 100% of specified rope strength. To make an eye splice, the rope is unlayed (untwisted into its separate strands) and then the strands are braided back together using a standardised technique. Eye splices are very complex splices and require considerable experience. As such, they should only be carried out by experts. A professional eye splice is unbreakable and has an extremely high load-bearing capacity. It only reduces the breaking strength of the rope by 15 - 20%, which is much less than a knot. In addition, you won't see the rope end, as you can with a knot, because it is braided back into the rope.

TESTING AND LABELLING

To be able to work and climb freely, complete trust in your equipment is crucial. In order to warrant this trust, we have a strict testing and quality management system. The quality levels of our products are displayed on the labelling. EDELRID has its own, state-of-the-art testing laboratory and its own drop tower. As with all laboratory equipment, the drop tower is built in accordance with the relevant industry standards and is regularly inspected by external agencies. Here is an overview of the main tests and information displayed on our pakkaging or rope label.

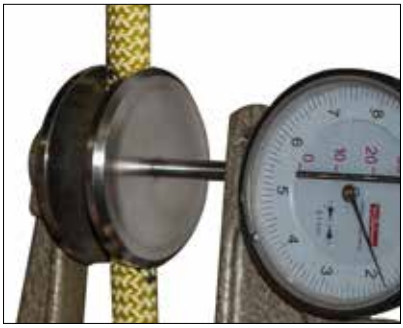
Diameter

When choosing a rope, the diameter is one of the most important factors. Rope diameter is not always easy to measure, as not all ropes are perfectly round – some of them have a more oval cross section. To ensure consistency and provide reproducible values, a length of rope is loaded with weights and then measured. To comply with EN 1891 standard, the diameter of static ropes must not be less than 8.5 mm and not greater than 16 mm. Interestingly, certain ropes on the market deviate from their manufacturer's specification and are often thicker than claimed. The reason behind this anomaly is the excess air between the yarns. In practice, these ropes are soft and spongy. By contrast, the compact and material-intensive structure of EDELRID ropes leaves little room for such abnormalities.

Weight per metre

In addition to diameter, weight per metre is very important when selecting a rope. The weight of a rope is always indicated in grams per metre (g/m). Both weight and diameter are tested by preloading a rope and then measuring it.

Static ropes also have to specify the proportion of sheath and core as a percentage. This is measured by separating the sheath from the core and determining their mass. The sheath percentage/ core percentage is shown as a percentage of the total mass and rounded off to a whole number.

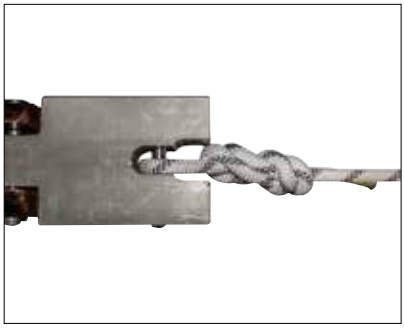


Static strength without terminations

Static strength denotes the amount of force a static rope can sustain, i.e. its breaking strength or maximum tensile strength. We test the breaking strength in a tensile testing machine. A rope sample is attached between two sheaves and slowly pulled apart until it breaks. Type A ropes have to sustain a force of at least 22 kN, while type B ropes have to sustain a force of at least 18 kN. The results are normally shown as a stress/elongation curve. The area inside the stress/elongation curve shows the working capacity before the rope breaks, i.e. the load the rope can withstand. The larger the enclosed area, the greater the rope's working capacity.

Static strength with terminations

In addition to testing the maximum tensile strength, the static strength of terminations (e.g. a figure of eight knot) is tested. Low stretch kernmantel ropes with terminations have to sustain a force of 15 kN for type A ropes and 12 kN for type B ropes for three minutes. As each knot reduces a rope's maximum tensile strength, due to the shearing force in the knot, these forces are significantly lower than for a rope without terminations.



TESTING AND LABELLING

Static elongation

Static elongation is often appropriately referred to as ‘working elongation’. It indicates the amount of elongation of a rope with a static load. Static elongation applies when using rope clamps (ascenders) or hauling equipment. Here’s how it’s measured and tested. A rope sample is loaded with 50 kg. After five minutes, with the load still applied, a 100 cm length is marked on the rope. Then a further 100 kg is applied, to give a total load of 150 kg on the rope sample. After a further five minutes, the new distance between the two markings is measured. The deviation from the original 100 cm length is the elongation, which is expressed as a percentage. For type A and type B static ropes, elongation may not exceed 5%.

Sheath slippage

This parameter has a direct impact on the handling characteristics of a rope. To test sheath slippage, a sample of approximately two metres of rope is pulled though a test device. By applying weights and using a defined mechanism the sheath and core are kneaded and twisted against each other. During this test, for type B ropes, axial displacement of the sheath may not exceed 15 mm. For type A ropes, axial displacement of the sheath may not exceed 20 + 10 (D-9 mm) for ropes up to 12 mm, where D is rope diameter. This means that for an 11 mm type A static rope, sheath slippage may not exceed 20 + 10 (11- 9 mm) = 40 mm.

If a rope’s sheath and core slip, then it will bulge and become lumpy. Thanks to our effective manufacturing processes, EDELRID ropes only experience sheath slippage if they are used incorrectly. EDELRID ropes show zero sheath slippage when tested; this is therefore indicated as 0 mm.

Dynamic performance (fall test)

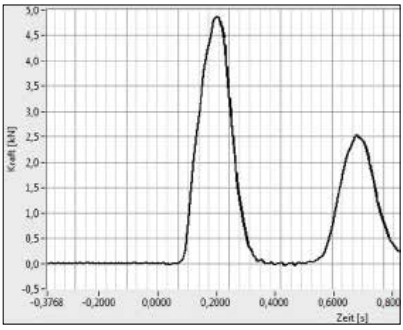
In practice, static ropes have to be able to withstand fall impact. This means that dynamic characteristics and performance are important for static ropes too. Dynamic performance is indicated by referring to the number of standard factor one falls a rope can withstand.

A rope sample is set up in a test apparatus and tested at consecutive intervals of three minutes. The sample is attached to the apparatus using a figure of eight knot. Type A ropes are tested by dropping a load of 100 kg, type B ropes are tested with 80 kg until the rope breaks. Both types must be able to withstand at least five falls to meet the industry standard.

*The fall factor indicates how hard a fall is. It's the ratio of fall length to the amount of rope paid out. The higher the fall factor, the harder the fall and the greater the risk for the user and the safety chain.

Fall arrest peak force (impact force)

Fall arrest peak force or impact force is also tested as part of the fall test. The fall arrest peak force is the maximum force (impact) transmitted to a falling mass during a standard fall. The fall arrest peak force depends to a great extent on the ability of a rope to absorb fall energy by elongation. The higher the impact force, the harder the fall and the greater the force transmitted to the falling climber and the safety chain. Fall arrest peak force must not exceed 6 kN. This poses a major challenge for our rope designers. Users want static ropes with very low stretch, yet their fall arrest peak force may not exceed 6 kN.



TESTING AND LABELLING

Knotability

Knotability is a measure of how a rope performs in practise. It indicates how easy a rope is to tie knots in, i.e. how flexible it is.

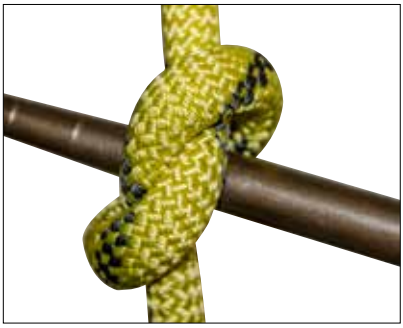
To test knotability, an overhand knot is loaded with 10 kg for one minute. Then the inside diameter of the knot is loosened by 1 kg and measured. The knot should be so tight that its inside width, i.e. the opening in the middle, is less than 1.2 times the rope's diameter. However, we recommend not placing too much value on this measurement. In practice, knotability or suppleness of a rope is determined to a large extent by its condition and/or how well it has been looked after. A really dirty rope will generally be harder to tie a knot in than a new rope, no matter how supple it is.

Shrinkage

In addition to sheath slippage and knotability, shrinkage is an important factor for static ropes.

Shrinkage is expressed as the amount a rope shrinks as a percentage after it has been left in water for 24 hours.

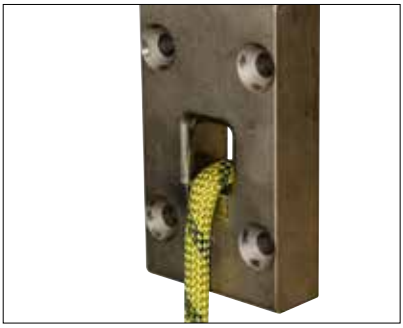
To test this, a rope sample is loaded with 10 kg for 60 seconds. While the load is still applied, two marks are made on the rope one metre apart. The sample is then submerged in water and left for 24 hours. Fifteen minutes after it has been removed from the water, the distance between the two markings is measured again. The amount the rope shrinks is expressed as a percentage and rounded off to the nearest 0.1 %.



Sharp edge test

Back in 2002, the UIAA introduced a sharp edge test (UIAA 108) to supplement its existing safety requirements and test methods for ropes (UIAA 101). The test simulates a standard fall in particularly severe conditions. It uses the same test conditions as specified for dynamic ropes (EN 892). Only instead of the standard metal plate, a right-angled metal edge with an outer radius of 0.75 mm is used. A loaded rope running over such a sharp edge is subjected to extreme shearing stress which can exceed the rope's dynamic energy absorbing capabilities at the first fall. As a result, the rope breaks. To pass the test, a rope has to hold the fall and no more than 50% of the sheath must be damaged.

However, discrepancies were found in test results for the same ropes at different laboratories, the UIAA withdrew the test. These days, few "sharp edge resistant" ropes are actually sold as the standard has been suspended. Nevertheless, certain customers, for example the German Armed Forces, still request that the test is carried out. Many manufacturers still claim sharp edge resistance for their ropes. However, UIAA 108 does not rreplicate reality and the way a rope behaves in contact with a sharp edge is often very different to what happens under test conditions. The designation "sharp edge resistance" is no guarantee of safety. This is why we do not use it.



TESTING AND LABELLING

STANDARD REQUIREMENTS EN 1891	TYPE A	TYPE B
Static strength with termination	22 kN	18 kN
Static strength without termination (figure of eight knot)	15 kN	12 kN
Static elongation	max. 5 %	max. 5 %
Fall arrest peak force (impact force)	max. 6 kN	max. 6 kN
Dynamic performance (fall test)	min. 5	min. 5
Sheath slippage	20 mm + 10 (D-9mm)	max. 15 mm
Knotability	max. 1.2	max. 1.2

Table: Standard requirements EN 1891 (low stretch kernmantel ropes)

NORMS AND STANDARDS

As you will see from the labels and hang tags on ropes and other Personal and Protective Equipment (PPE), our products have to do more than just meet our high internal standards; they also have to comply with a range of external standards and quality management systems. EDELRID ropes not only fulfil, but exceed these standards. What do the various standards and symbols stand for?

CE-conformity marking

This mark shows that the manufacturer confirms that a product meets all the relevant European Union requirements. It is the technical passport that is required before a product can be sold within the European Union. The CE-mark shows that a product complies with all the relevant requirements and is officially certified. The number after the CE mark, indicates the certification body, e.g. CE 0123 indicates that TÜV SÜD Product Service GmbH has certified the product.

ISO 9001

ISO 9001 is an internationally recognised quality management system certification. This standard is used to define, establish, and maintain effective quality manufacturing processes in order to assure the quality of a product.

EN- Normen

The European Standards (European Norms – EN) are technical rules and definitions that have been especially tailored for the standardisation of products and product groups. European Standards ensure uniform standardisation across Europe. An EN symbol is always indicated with the number of the standard. The applicable standard for static ropes is EN 1891. Products with an EN standard fulfil prescribed safety standards and have passed a type examination conducted by a testing institute.

UIAA

This symbol shows that a product fulfils the requirements of the International Union of Alpine Associations (UIAA) standard. It is a special standard for climbing and mountaineering products. The UIAA has been developing practically oriented standards for decades. The UIAA standards conform to the EN standards.

ROPE SELECTION

Selecting the right rope for the job is not always straightforward. Diameter, weight, and in particular, construction and handling all have to be taken into account. And naturally the price-performance ratio also has a role to play. For example, it would not make sense to buy a very expensive rope intended for one-off use, such as corrosion protection work.

NAME	MACHINE TYPE	MATERIAL (SHEATH/ CORE)	CONSTRUCTION SHEATH	CONSTRUCTION CORE STRANDS	SHRINKAGE DURING USE ESPECIALLY WHEN WET
Superstatic Link Tec	40	PA/PA	twisted – doubled	twisted	moderate
Powerstatic II	40	PA/PA	twisted – shrunk	braided	very low
Safety Super II	40	PA/PA	twisted – shrunk	twisted	very low
Performance Static	32/36/40	PA/PA	doubled	twisted	high
Prostatic	40	PA/PA	doubled (2 braids)	twisted	moderate
Static Float	36	PA/PP	twisted – shrunk	braided	moderate
Direction Up	24	PES/PA	twisted – shrunk	braided	moderate
X-P*e	16	PES	twisted	twisted	moderate

In the table below, you'll see an overview of our static rope range (as of November 2015) and the recommended activities for which they are suitable. These recommendations are based on our long-standing experience of manufacturing highly technical kernmantel ropes, as well as expert feedback from professional users.

FREQUENT ASCENT WITH ROPE CLAMP	FREQUENT ABSEILING	USE IN WET TERRAIN	USE IN DRY TERRAIN	ONE-OFF USE / PRICE-PERFORMANCE RATIO (E.G. CORROSION WORK)	SUPPLENESS/HANDLING	LOW ELONGATION (E.G. ROPE CONSTRUCTIONS)	VERY ABRASION-RESISTANT SHEATH	VERY HIGH EDGE RESISTANCE/ CUT RESISTANCE
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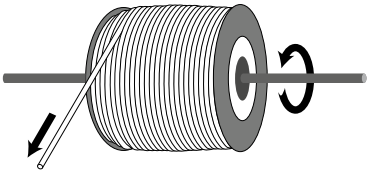
CARE AND MAINTENANCE

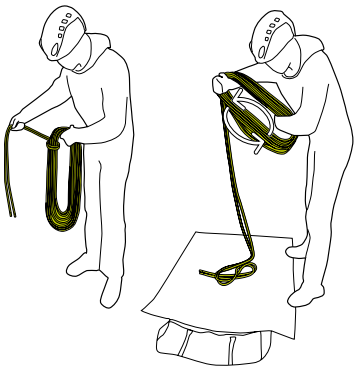
All EDELRID ropes meet the very highest quality and safety standards. Every metre has been carefully manufactured and finished. Our ropes are subjected to rigorous testing and prepared in the best way possible. When an EDELRID rope is sold, the rope becomes the user's responsibility. However, there are a few basic rules that every user should observe in order to get the most out of their rope. Important: Don't forget that a rope is essentially a textile product and should be looked after and used accordingly. Here are some practical tips for looking after ropes:

Uncoiling

Static rope is normally supplied on drums. To prevent twists and kinks forming during use, the full length of the rope should be pulled from the drum. The easiest way to do this is to insert a broom handle through the centre of the drum, allowing the drum to rotate freely.

If the rope is supplied already cut to length, coiled and packaged, then it's important to uncoil it carefully when you unpack it. If you don't, you might end up with unwanted twists and kinks. To uncoil it, carefully remove the securing bands, slide your forearms though the middle of the coil and then pull them apart so that the rope forms a ring. Keeping the tension on the coils, rotate your lower arms slowly around each other to carefully unwind the rope into a pile on the floor. Take care that no loops get wrapped around your wrist. Once the whole rope has been uncoiled, run it through your hands two or three times and shake it out to remove any last twists or kinks. It's best to carry out the whole process indoors or on a rope tarp to ensure that it remains free from dirt.



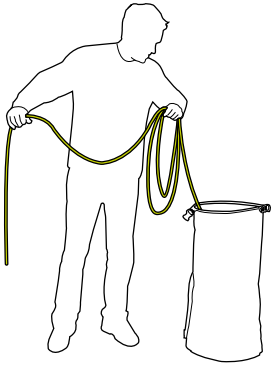


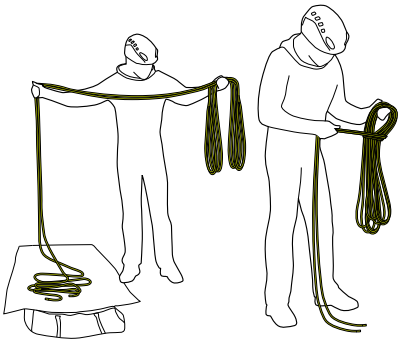
Storage and transport

A rope bag is the ideal way to transport and store your rope. It makes it easy to put your rope away, packs down small to saves space and protects the rope from dirt or moisture. We recommend that you use a bag with a tarp to protect the rope when flaked out by keeping it off the ground and out of the dirt, sand, etc. Using a rope bag means that your rope is stored in loose coils which allows it to return to its natural shape. This helps prevent twists and kinks. In addition, most rope bags have loops to tie the ends of the rope to. This makes it easier to find them and helps rope management.

Coiling

Coiling is the best way to transport your rope if you don't have a rope bag. It keeps your rope clean and stored in a handy manner. It takes a while to learn how to coil your rope properly. Here are a few tips to bear in mind. Firstly, it doesn't really matter whether you coil your rope doubled from the middle or from both ends. It can also be coiled as a single strand from one end. The important thing is to coil it in loops and not in rings like a cable. The easiest way to do this is to collect the loops in one hand or by hanging them over your neck and coiling to the left and the right alternatively.





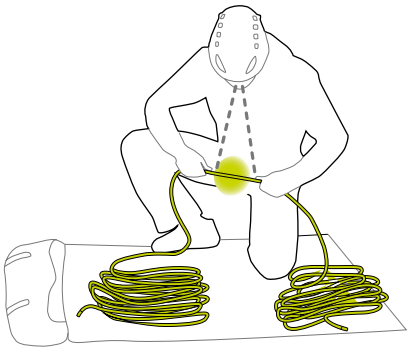
CARE AND MAINTENANCE

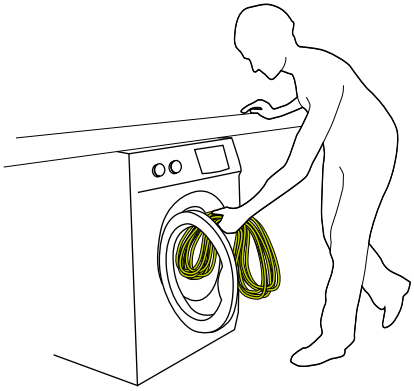
Inspection

Ropes are made to be used. However, each use leaves its mark. This is why you should carefully inspect your rope before and after you use it. In addition to a visual inspection, it's important to run the rope through your hands, metre by metre. This will enable you to detect any small irregularities or signs of damage. In the event of a serious incident (e.g. fall impact etc.) you should pay particular attention when checking your rope. See page 41 for PPE inspection procedure and additional information on inspecting ropes.

Cleaning

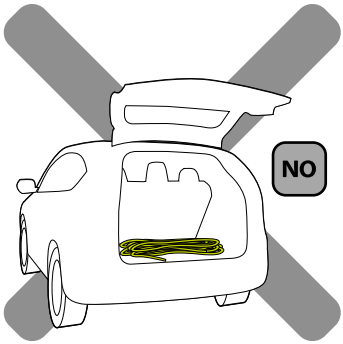
It's not possible to prevent ropes getting dirty (especially if you don't use a rope bag). This is not a problem and it certainly does not mean that you need to replace them. Ropes are textile products and can be washed. If a rope is really dirty, washing will actually improve its handling. Use a mild synthetic detergent from a specialist retailer. The best way to wash rope is by hand in lukewarm water. The delicate cycle (30°C) in the washing machine is also OK. Important – do not use the spin cycle. Do not hang rope up to dry and avoid direct sunlight. The best way to dry rope is to spread it out on the ground in a cool, dark place. Please note: Never put ropes in the tumble dryer.





Storage

If you don't intend to use your rope for a long period or during the winter, it needs to be stored properly. Ideally it should be stored it in a dry, dark, cool place and not in a container. The best way to do this is either in a rope bag or neatly coiled up, away from direct sunlight, chemicals, heat or any potential source of mechanical damage. Do not hang the rope from one of its coils. Storing a rope permanently in the boot of a car is a bad idea. This increases the risk of exposure to extreme fluctuations in temperature and harmful chemicals.



Lifespan

Information about the lifespan of a rope only gives a rough guideline. Ropes should always be inspected by a PPE expert. EDELRID ropes have a maximum lifespan (when not used and properly stored) of 12 years from the date of manufacture.

However, this is different to their maximum service life. Service life depends on frequency of use and intensity of use which result in abrasion, dirt, fall impact, UV exposure etc. that can quickly reduce a rope's safety reserves.

A rope that is only used occasionally and stored carefully can provide three to six years of service. In extreme cases (e.g. severe damage to the sheath) a rope might even have to be retired after the first time it is used.

Generally though, awkward handling or a worn sheath should make it clear to the safety-conscious user that it's time to replace a rope. A rope should always be replaced if it has been subjected to extreme forces or if it is damaged, for example if:

- the sheath is damaged and the core is visible
- there are significant axial and/or radial bulges and deformations (e.g. stiff sections, nicks, sponginess)
- the sheath slips significantly
- the sheath is extremely worn (e.g. abrasion or furring)
- heat, abrasion, or friction burns have melted or visibly damaged the rope
- the rope has come in contact with chemicals, in particular, acids

RISKS AND DANGERS

To protect your rope, it's important to be aware of the potential risks. Here are some of the factors that can seriously damage a rope.

Chemicals and acids

Keep your rope away from chemicals, in particular strong acids, as they can destroy a rope. Acid damage can be especially dangerous as it is often invisible. The sheath might be only slightly discoloured, but the rope's core could be seriously damaged. If a rope comes into contact with acids (e.g. acid from car batteries), it should be replaced immediately. Ropes should always be stored and transported carefully. This applies in particular if your ropes should happen to be stored in the car boot or the garage. Think carefully about where you store your ropes and keep them away from acidic chemicals.

Dirt

Dirty ropes don't just look shabby, they are also more difficult to handle. They become stiff and awkward. This is why ropes should not lie in the dirt or be dragged about. Instead you should use a rope bag. Sand and granite crystals can be particularly dangerous. They can get inside the rope. During intensive use (regular abseiling, lowering etc.), these fine particles can work their way into the core and reduce rope strength. Unusual bulges, lumps or soft spots might indicate that the core of a rope is damaged. If a rope has become extremely dirty, it might not be possible to clean it properly, even after several washes. In such cases, the rope should be replaced.

Friction burns

Extreme friction can cause so much heat that the polyamide yarns in a rope begin to melt. This happens in particular when one rope rubs against another. It is particularly dangerous if two ropes are accidentally routed through the same anchor point as this may result in a major fall.

Abseiling also causes friction that can heat up a descender device. This should not be underestimated. We recommend abseiling at moderate speed; it is safer and will also prolong the life of your rope. Friction burns or heat damage are recognisable by glossy, glazed or blackened areas on the sheath. The rope will be stiffer and have a harder surface at these points. If a rope has large melted areas, it should be retired.

Mechanical damage

Sharp edges can be particularly dangerous. They can damage a rope so badly that it may fail, especially in the event of a fall. In the best-case scenario you might get away with a damaged sheath, in the worst case the core yarns might shear. Possible areas of danger include: edges of steel girders, concrete or rock structures, and sharp metal sheeting or tiles. To minimise the risks posed by such hazards a good set up, good rope management and suitable rope protectors are essential.

UV radiation – the power of the sun

UV radiation has a significant effect on ropes, as it does on most things in life. UV radiation causes colours to fade and accelerates ageing. Prolonged exposure to the sun will cause a rope to lose elasticity and become stiff. This is why ropes should not be exposed to the sun unnecessarily. It is particularly bad to dry a rope in direct sunlight after it has got wet in the rain or after washing. Old fixed ropes or in situ slings that have been exposed to the sun, wind and rain for some time should be used with extreme caution.

Wet and cold

The effect of moisture on a rope should not be underestimated. Wet ropes are not only heavier and more difficult to handle, they also have less ability to absorb energy dynamically. If the temperature falls and a wet rope begins to freeze, it will have significantly lower safety reserves. Impregnated ropes are more capable of dealing with such conditions. They are water resistant and can withstand the wet and the cold longer.

Abrasion

Abrasion is one of a rope's worst enemies. Rough surfaces or sharp edges can be a source of abrasion that could affect the whole length of a rope. The greater the load, the rougher the surface or the sharper the edges, the more the sheath will be damaged. Individual sheath fibres tear and the sheath's surface gets rougher. As a result, the sheath gets thinner, and the rope becomes rough and furry. Once the core becomes visible, the end is nigh. Regular abseiling and the use of ascenders can also increase the aging of a rope significantly.

TIPS AND TRICKS

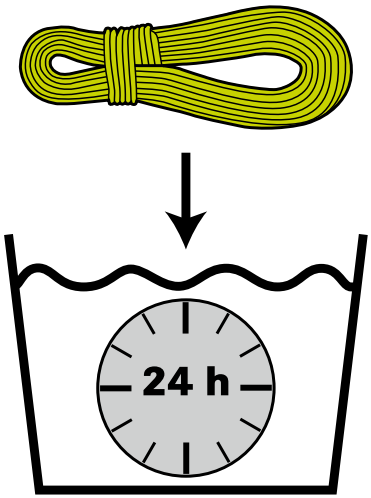
Shrinkage

Is it important to soak a static rope before using it for the first time? This might sound a bit strange, but it actually makes perfect sense. Static ropes are not normally pre-shrunk, which means if they get wet they can irreversibly shrink by up to 5%. You should take this into account when planning what length of rope you need.

By soaking a static rope in water and then drying it slowly before you first use it, you can eliminate this shrinkage. This also tightens the sheath to the core, preventing sheath slippage. In addition, washing also removes any lubricants used during manufacturing and makes the sheath even easier to grip.

Soak the rope in water for 24 hours. For best results, use distilled water and dry your rope away from direct sunlight. Please note: Never dry a rope in direct sunlight or in a tumble dryer.

If you are planning to use a static rope in wet conditions (e.g. canyoning, rain etc.), it makes sense to soak it again before you use it. This can prevent sheath slippage. Due to the hydrophilic characteristics of polyamide, the rope's sheath can soak up water, while the core remains dry. This moisture causes the sheath to swell and the bond between the damp sheath and the dry core may loosen. This can result in sheath slippage. Soaking a static rope in water before you use it allows both the core and the sheath to absorb water and retains the bond between them. This can significantly reduce sheath slippage.



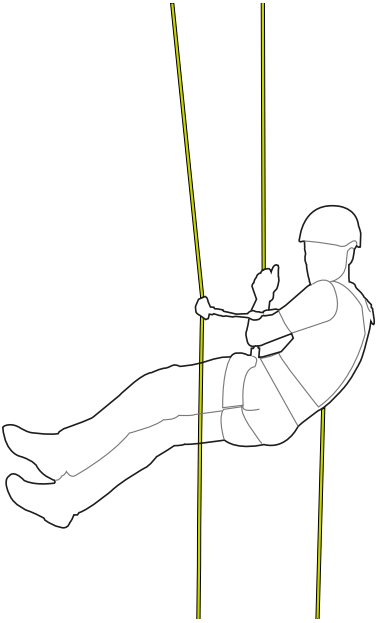
Frequent abseiling

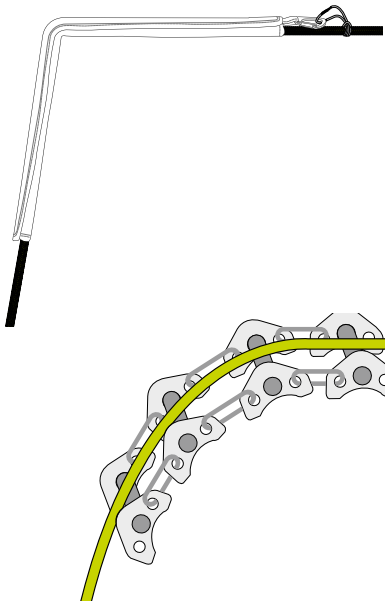
Frequent abseiling places great demands on ropes. Abseiling with a descender smoothes out the rope (sheath slippage) in the direction of the rope end. If you are using a rope for training purposes and plan to do lots of abseils within a short period of time, you should swap ends regularly to avoid axial sheath slippage. This will significantly extend the rope's life-span.

Rope protectors

Rope protectors protect ropes from sharp edges or contaminated surfaces. In static situations, simple rope protectors made from tarpaulin are normally used. They generally have a Velcro closure and a clip to prevent slipping.

For situations with moving ropes (pulley systems etc.), it's important to use a rope protector with rollers, as a simple tarpaulin rope protector would be melted by the friction. Several different versions of rope protectors are available in different lengths.



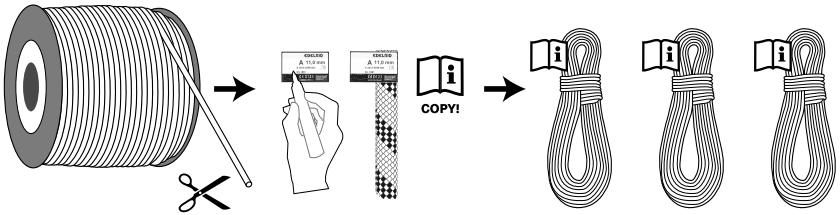


TIPS AND TRICKS

Cutting the ends off

Take care when cutting off the ends off rope to prevent sheath slippage or fraying.

- Cut the rope one to two metres before the affected section, not directly where the damage begins.
- Once the affected section has been removed, smooth out the last five metres of the rope by hand. If the sheath has slipped, it will be smoothed out over the end of the rope.
- If there is any excess sheath, cut the rope again – 20 cm in from the end of the sheath. This will help prevent the sheath from slipping in future.
- Once the cutting is completed, the ends need to be sealed, to stop the rope from fraying. The best way to do this is with a proper hot cutter. In an emergency, you could also use a cigarette lighter. Pay attention not to burn the rope – you only need to melt the fibres and carefully flatten the end.
- Please note: once you have cut one end of your rope, you will need to adjust the middle marking to prevent accidents when abseiling or lowering.
- The EN standard requires all ropes to be properly labelled. The new rope end must be given a new marking label with all the required information. Use a label or tape, and protect it with a plastic shrink tube.
- If rope is to be cut and sold by the metre, the technical data sheet and user manual must be copied and given to the user.



PPE INSPECTION

Ropes are made to be used. However, every use leaves its mark. This is why you should carefully inspect a rope before and after you use it. This applies in particular to terminations. In addition, industry users must have all PPE products inspected at least every 12 months by PPE qualified personnel (DGUV 112-198/199). To ensure that this process is properly documented and traceability is maintained, a usage record should be kept. While a usage record is not a strict requirement, it does make it easier for PPE personnel to inspect and assess PPE equipment. As a result, the equipment user has an overview of the total time individual items have been used and a supplementary safety measure for possible non-visible damage.
In addition to visual inspections, ropes should also be checked by hand. This is the only way to spot non-obvious, small irregularities or signs of damage. The following information is taken from the inspection instructions for kernmantel ropes that we use in our PPE training courses:

1. **Checking the labelling and the maximum lifespan:** Check that the CE mark and serial number are displayed and clearly legible. Ensure that the maximum service life of the product has not been exceeded. To do this, you will need to see the year of manufacture for the rope. On static ropes, you will find this either on the label at the rope end (as part of the serial number) or on the identification tape inside the rope. Information about maximum lifespan is always available in the manufacturer's user manual. This is provided when a rope is purchased and can also be downloaded from the manufacturer's website. If there is no marking or information available, or if the rope has exceeded its lifespan, do not use it.

New rope ends:

PPE INSPECTION

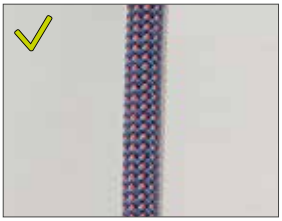
2. **Checking the correct rope length and middle marking:** Check that the specified rope length is correct and that the middle marking is in the right place. There is a quick way to calculate how long a rope is: lay it out, double it up, double it up again, measure it and then multiply the result by four.

3. **Visual inspection of the sheath:** Check the sheath for mechanical damage such as cuts, abrasion, melting, hard areas, discolouration or sheath slippage. Cuts mean the rope is damaged. Melted or hard sections mean the rope has been subjected to severe heat. Discolouration could mean the rope has come into contact with chemicals. Under any of these circumstances, the rope must no longer be used.

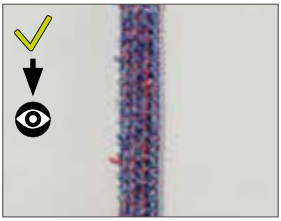
Haptic inspection: Feel the core of the rope along its whole length. Bend the rope slightly and then run it through both hands. Can you feel any stiff sections or soft sections? Are there any unusually thick areas? Deformities or hard, crushed areas indicate that the rope's core has been damaged or has degenerated. The rope must be withdrawn from use immediately.

4. **Inspecting terminations and knots:** Check the stitching and knots. If necessary, slide away any protective covers to be able to properly inspect any safety stitching underneath. If any of the stitching is cut, ripped or worn, the rope must be withdrawn from use.

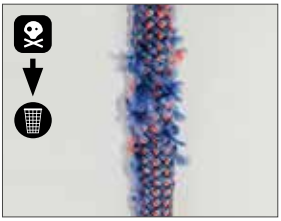
The general rule applies: If a user is for any reason unsure whether a rope is suitable for use, it should be withdrawn and inspected by PPE qualified personnel where required.



Damaged sheath

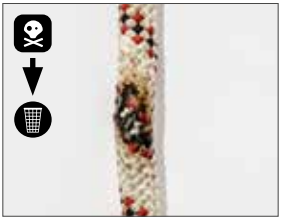


Worn sheath



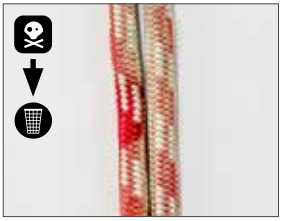
Damaged sheath

Cut damage

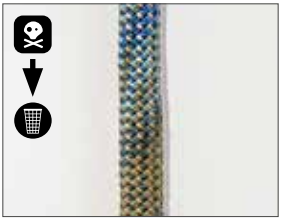


Friction burns

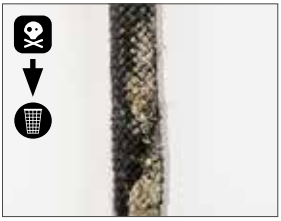
Friction burns



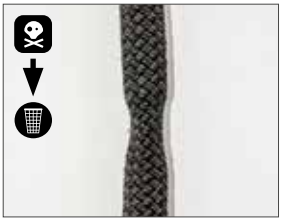
Discolouration



Discolouration

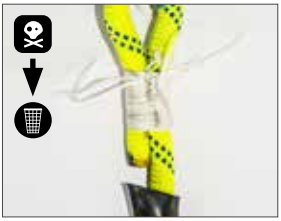


Dirt



Deformed rope core

Labelling cannot be read



Termination with torn safety stitching

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