

ROPE




MAMMUT



photo: Thomas Ulrich

Mammut is one of the world's leading manufacturers of high quality mountaineering equipment. Mammut products range from clothing and sleeping bags to climbing harnesses, climbing shoes and ropes.

For over 140 years Mammut ropes have exemplified uncompromising quality standards. We are only satisfied when our customers are satisfied.

Our concept of customer service doesn't end with the manufacture of a top product. Accurate technical information is just as important. We've created this brochure to help you make informed purchases, get the most out of the equipment you buy, and properly care for and store your gear. Technical information about materials, construction, tests and standards are simply explained. So that this information is even easier to understand, all technical terms marked with this symbol  can be looked up in the glossary starting on page 30.

Your Mammut Team.

CONTENT

QUALITY

- Swiss Quality 2
- Where the difference lies 4

PURCHASING TIPS

- Which is the right rope 8
- What do I need my rope for 10
- What types of rope are there 12

HANDLING

- Practical Tips 14

DAMAGE

- Avoiding rope damage 20
- Life span – time to replace 24

TESTS

- Standard test requirements 25
- What is tested 26

GLOSSARY

- A - Z 30



SWISS QUALITY

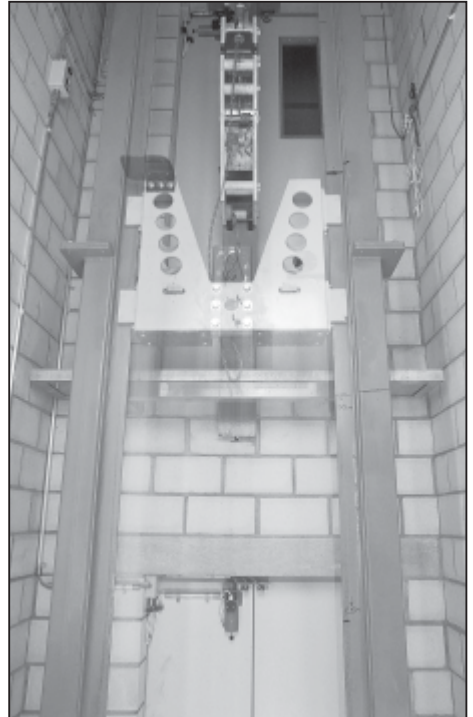
Those who trust their lives to Mammut ropes justifiably expect the highest quality. We are fully committed to meeting this expectation. All our ropes are manufactured in Switzerland. Every day Mammut processes a quantity of polyamide fibers that, if lined up end to end, would encircle the globe once.

Balanced Rope Concept

The manufacture of a rope is always a compromise between a high number of standard falls and low weight, low impact force and reduced elongation. For years Mammut has pursued the philosophy of the Balanced

Rope, which holds that an outstanding rope is not distinguished by a single outstanding characteristic, but by the optimally balanced sum of all its performance characteristics.

Meter by meter, we check electronically for any irregularities, and we regularly test the performance of our ropes on our in-house drop test tower. Our ropes fulfil the strictest standard requirements, giving performance reserves that far exceed those required. A Quality Management System in accordance with ISO 9001 standards guarantees exceptional quality in every rope. In product development work, we carefully monitor our ropes' real-world performance. Mountain guides from the alpine federation training teams, professional and top climbers and last, but not least, our mountain crazed employees, mercilessly test Mammut ropes in demanding conditions before a new rope goes on sale.



Mammut's drop test apparatus

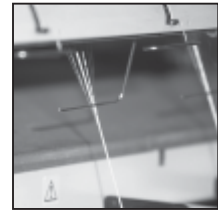
Rope Production

1. Mammut uses high quality Polyamide 6 (Nylon) for the production of its filaments.
2. In the first stage, between two and six filaments are spun together to make a strong yarn.
3. Between 4 and 6 yarns are then combined in the next stage to form a braid. A number of braids are then combined to form the core. This process gives the braids a spiral twist form, which accounts for part of the rope's elasticity.
4. Additional elasticity is gained in the next stage, which involves the braids being coated and thermally shrunk.
5. The rope's core is covered with the sheath on the braiding machine.

1



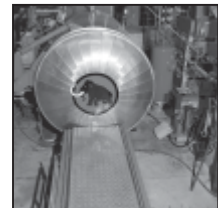
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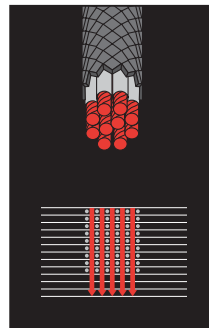


WHERE THE DIFFERENCE LIES

It's not only «Swiss quality» and one hundred percent dependability over a long life span which sets our ropes apart. Our research engineers are continually developing innovative solutions that make Mammut ropes «State of the Art», and which have earned us many awards in neutral tests in the past.

Our exclusive \rightarrow Coating Finish process is a perfect example. This process demonstrates the innovative power that gives Mammut ropes the decisive technological advantage, and which makes them the trend setter for safety and practical usage. With Mammut's Coating Finish process, the individual rope strands are Teflon coated in order to minimise chafing and improve friction co-efficiency. Loading, e.g. through a fall, is uniformly distributed through each individual \rightarrow filament, thereby optimising performance. (filament = the finest element of a rope). In this way, substantially lighter ropes with the same \rightarrow number of falls, or ropes which can hold a substantially higher load and have the same weight can be made. \rightarrow Sharp-Edge-Resistance.

In addition to better performance in standard testing, the Coating Finish gives our top ropes further advantages: They have reduced rope drag, absorb less dirt and moisture, are especially easy to handle and maintain their level of performance for longer – we are mastering tomorrow's technology today!

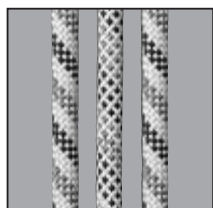


with Coating Finish

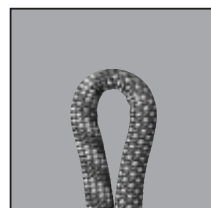


without Coating Finish

Triodess



Duodess



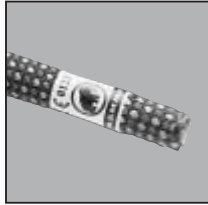
The last five to seven meters of the rope are the danger zone. With alpine climbing this is the reserve rope for a dynamic belay, and it indicates that it is time for the lead climber to build an anchor. When rappelling, it's also necessary to make it to the next stance before reaching the end of the rope. Lowering off longer sport routes continues to lead to accidents when the rope is too short and the end of the rope is overshoot. The newly developed Triodess design for the «Supersafe» rope works to prevent this danger. Through a change of weave pattern, the critical last seven meters of rope are clearly defined – innovative technology in the service of safety.

A permanent mark in the middle of the rope is useful when rappelling, coiling, and for estimating the length of the remaining rope. Tape markings can get worn away through usage and can complicate handling, for example when using a prusik loop to secure yourself whilst rappelling. Marking with a marker pen, to replace a lost marking tape can chemically damage the rope filaments. With the patented Mammut Duodess design the pattern changes in the middle of the rope. The rope halves are always clearly distinguishable and the marking is permanent, without interfering with handling.



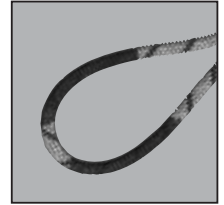
WHERE THE DIFFERENCE LIES

Rope Ends



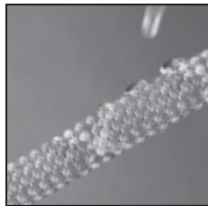
Due to the movement caused by usage, the rope sheath and core slip relative to each other (sheath slippage). This becomes a real problem when they separate at the end of the rope and fraying occurs. This doesn't happen to Mammut ropes. We weld the ends of our ropes with an ultra sonic process which is permanent and perfect. The rope core and sheath are therefore permanently joined – forever.

Middle Marking



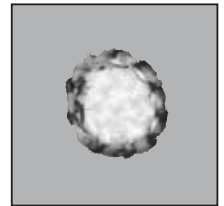
All dynamic ropes from Mammut come with a friction resistant, coloured, middle marking. In choosing a process we made sure that a dye was used that wouldn't weaken either the sheath or the core filaments.

Superdry



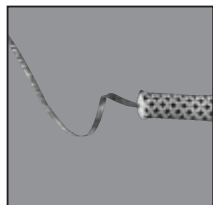
Wet ropes are more difficult to handle. When they freeze, their dynamic performance is clearly reduced. Therefore, on alpine, ice and mixed routes, a dry-treated rope increases safety. Most normal «dry treatments» treat just the rope's sheath, but we treat both the sheath and core. This makes the Superdry treatment more effective and durable, and optimises → handling, abrasion resistance, dirt resistance and life span.

Sheath Proportion



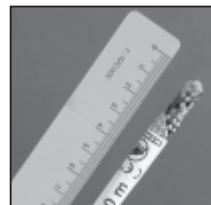
Frequent top roping, gym use, and working routes leads to increased sheath friction, and quicker wearing of the rope. For such applications we offer a rope with an increased sheath proportion. With normal ropes the weight of the sheath, in comparison to that of the core, is 35-45%. Our friction resistant, extreme performance ropes have at least a 45% sheath proportion and therefore, clearly a longer life span.

Info-Tex



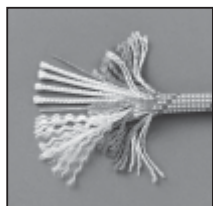
Anyone buying a Mammut rope gets proven quality. Each of our ropes contains a ribbon with the most important rope data integrated in the rope's core: manufacturer, testing standards, date of manufacture, UIAA certificate and CE test centre – a permanent reminder of high quality Swiss workmanship.

Rope Length



Due to the manufacturing process every «Kernmantle» rope \rightarrow shrinks from use. Depending upon weather (heat, moisture), environment (dust, sand) and type of usage (lead rope, top rope), it's possible for a rope to shrink by 5-10%. In order to guarantee the advertised rope length we cut our ropes 2.5% longer than indicated.

Coating Finish



When a conventional rope is dynamically loaded (as in a lead fall), the individual strands absorb the load by stretching. Due to friction between the strands, the load is not equally distributed within the core, and the theoretical peak performance is not achieved. The Teflon coating of our exclusive Coating Finish technology reduces friction between the rope strands, allowing the load to be equally distributed and enabling the manufacture of lighter and stronger ropes.

Sharp Edge Performance



Modern climbing ropes, only break when they shear over a sharp edge under normal conditions. Only a few ropes can withstand a standard drop over a sharply defined edge with a radius of 0.75mm. A number of ropes from the Mammut range carry the \rightarrow Sharp Edge Resistance label. Our sharp edge resistant ropes already meet the UIAA standard for the sharp edge testing of climbing ropes.



WHICH IS THE RIGHT ROPE


Step 1: What do I need my rope for?




Alpine Rock Climbing	Long ice and mixed routes	Ice Climbing	Mountaineering	Multi Pitch Sport Climbing	Sport Climbing	Climbing Gyms	Working routes with Frequent falls	Top Roping	Big Wall Climbing	Rescue
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- Optimal
- Suitable
- * Redpoint climbing

CHALLENGE LINE – light ropes



Innovative technology at the highest level: for those moments where every gram counts. Challenge Line ropes combine minimal weight and diameter with reassuring strength and perfect handling. Every rope comes with  Coating Finish, a Teflon coating from our research laboratory. They are incredibly supple to handle, run almost friction-free over rock and absorb substantially less dirt – the «tip-top» for demanding climbers.

Step 2: Which is the right type of rope?	Step 3: Which property is the most important?	Step 4: Correct rope choice.										
① Single rope ② Twin rope ③ 1/2 Half rope	 CHALLENGE LINE light ropes	<table border="1"> <tr><td>REVELATION</td><td>Ø 9.0 mm</td></tr> <tr><td>INFINITY</td><td>Ø 9.5 mm</td></tr> <tr><td>ETERNITY</td><td>Ø 10.0 mm</td></tr> <tr><td>PHOENIX</td><td>Ø 8.0 mm</td></tr> <tr><td>TWILIGHT</td><td>Ø 7.5 mm</td></tr> </table>	REVELATION	Ø 9.0 mm	INFINITY	Ø 9.5 mm	ETERNITY	Ø 10.0 mm	PHOENIX	Ø 8.0 mm	TWILIGHT	Ø 7.5 mm
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① ① ① ③ ②	 BALANCE LINE «all rounder» ropes	<table border="1"> <tr><td>FLASH</td><td>Ø 10.5 mm</td></tr> <tr><td>GALAXY</td><td>Ø 10.0 mm</td></tr> <tr><td>TUSK</td><td>Ø 9.8 mm</td></tr> <tr><td>GENESIS</td><td>Ø 8.5 mm</td></tr> </table>	FLASH	Ø 10.5 mm	GALAXY	Ø 10.0 mm	TUSK	Ø 9.8 mm	GENESIS	Ø 8.5 mm		
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① ① ③	 ENDURANCE LINE durable ropes	<table border="1"> <tr><td>SUPERSAFE</td><td>Ø 10.2 mm</td></tr> <tr><td>FLEX</td><td>Ø 11.0 mm</td></tr> <tr><td>UNIVERSE</td><td>Ø 9.0 mm</td></tr> </table>	SUPERSAFE	Ø 10.2 mm	FLEX	Ø 11.0 mm	UNIVERSE	Ø 9.0 mm				
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BALANCE LINE – «all rounder» ropes



These proven classics of the Mammut range are impressive due to their balanced profile. High strength, minimal weight, comfortable handling, and a long life expectancy are perfectly combined. Thousands of satisfied users have trusted these solid all-rounders for years. Ropes in the Balance Line are therefore the best choice when just one rope is to be used for a number of different activities.

ENDURANCE LINE – durable ropes



The ropes in the Endurance Line are the first choice when it comes to total durability. Rock with sharp edges, big wall routes with lots of rope abrasion on rough granite, intensive sport use and frequent top roping – all mean continuous stress for every rope. Endurance Line ropes are able to cope due to their particularly durable construction. Exceptional → abrasion resistance and the highest number of falls factor, combined with impressive handling, distinguish this power package - the first choice when the going gets tough.

WHAT DO I NEED MY ROPE FOR

The intended use determines which rope is best. It therefore makes sense to have a number of different ropes that can be used according to the type of climb. So, for high friction use, such as working routes or top roping, a rope with a higher sheath proportion is useful. For alpine use, especially with ice, a dry-treated rope is recommended. With possible sharp edge loading, or for longer rappels, twin, or half ropes are the first choice. The following gives examples of typical usage, each with the specific performance characteristic required by the rope.

Alpine Rock Climbing

i.e. High Sierra, Bugaboos, Wind River Range.

As soon as more difficult rock with a uniform level of difficulty comes in to play – meaning that a fall is possible at any time, classic belaying from anchor to anchor is necessary. Whether single or double – respectively twin ropes are used, depends mainly upon whether rappelling, or down climbing will be undertaken. In broken terrain, shorter rope lengths can be sensible.

Long Ice and Mixed Routes

i.e. Moonflower Buttress, Walker Spur, Droites North face, difficult waterfalls.

Only half or twin ropes offer the highest safety margins and enable long rappels in difficult terrain. Dry-treatment, easy handling and low weight all help with quick, efficient rope management. Long rope lengths are particularly useful on ice routes where pitches can often be run together.

Ice Climbing / Dry tooling

i.e. Vail, Ouray.

The requirements are similar to those of sport climbing, though dry-treatment is essential. With bolted mixed routes a single rope can offer simpler handling, though in sharp edged rock terrain the safety margin given by twin ropes is welcome. On poorly protected mixed routes, as typically found in Scotland, the half rope technique reduces the load on the «safety chain».

Mountaineering

i.e. Mt. Rainier, Denali, South America.

With classic tours in mixed terrain and single climbing pitches up to grade 4 or 5 it is usual to down climb rather than rappel. Here it is advantageous to use a single rope. Or, a doubled half rope length can be used, though then only half the ropes length can be used. A dry-treated rope is also recommended here.

Multi Pitch Sport Climbing

i.e. Mt. Charleston, Red Rocks, El Portrero Chico, Wenden, Verdon.

Twin rope and half rope techniques offer the best safety margins and full rappelling distances. Dry treatment is useful in changeable conditions. Sharp edge resistance is guaranteed by the appropriate ropes. (Half- or twin ropes).

Sport Climbing

i.e. Rifle, Smith, Rumney, Thailand.

With frequent falls, a burly rope is important. The impact force can be reduced by a dynamic belay. Handling and weight should be optimized for performing at the edge. Longer ropes (70/80 m) are needed at many modern sport climbing areas to allow safe lower-offs.

Climbing Gyms

Climbing Gym surfaces wear a rope more quickly; sturdier ropes and thicker sheaths are an advantage.

Working routes with Frequent Falls

i.e. Training on a local crag.

Frequent falls cause extensive wear. Therefore, a «work horse» of a rope is required. Weight is less important than longevity.

Top Roping / institutional Use

To combat lots of abrasion and hard wear, a tougher sheath construction is an advantage. As long as falls by the second only are possible, then, circumstances allowing, a half rope can also be used.

Big Wall Climbing

i.e. El Capitan, Baffin.

A single rope is most often used for big wall climbing, while a static rope is used to haul. It's desirable to have a large safety margin and tough sheath. Sharp edge resistance is an advantage.

Rescue

i.e. Mountain rescue.

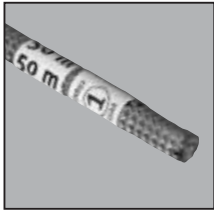
High safety reserves and low elasticity are the most important properties of a mountain rescue rope.



WHAT TYPES OF ROPE ARE THERE

There are basically three different types of rope, each best suited for different applications, which are tested according to different standards.

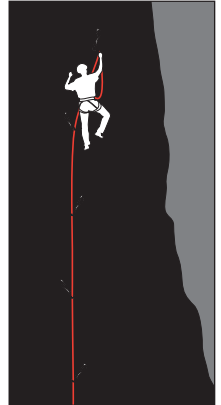
Marking tapes at the end of the rope identify to which category a dynamic climbing rope belongs.



Single Ropes



Single ropes are easy to handle and can be used in many conditions.



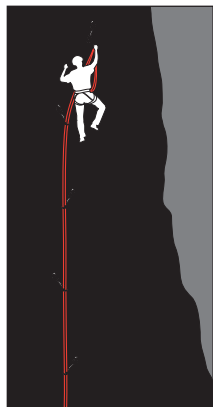
Single ropes are the most common type of ropes used. Depending upon diameter and length they can be used for most conditions. The main advantage is simple handling. A disadvantage is that only routes up to a half rope length high, with subsequent lowering or rappelling, can be climbed.

Single ropes come in diameters of approximately 9.4-11 mm and weigh between 57-82 grams per meter. Single ropes, withstand at least five falls with an 80 kg mass

Twin Ropes



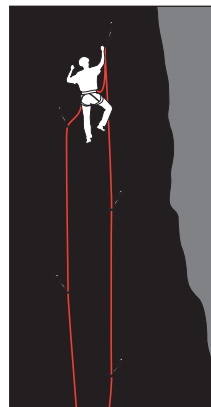
Twin ropes offer high safety



Half (Double) Ropes



Half ropes allow a direct rope path with widely spaced protection points.



Twin ropes must only be used in pairs and are clipped together into each piece of protection, as with single rope technique (= Twin rope technique). The two ropes offer →redundancy and thus, increased safety in the case of shock loading over a sharp edge. They are therefore especially suited for alpine climbing or demanding routes where retreat may be necessary. They offer the highest safety margin and allow full length rappels. With diameters from approximately 7.5-8.5 mm and a weight of between 38-45 grams per meter they are, together, about as heavy as the heaviest →single ropes. With standard testing the ropes must withstand 12 falls with an 80 kg mass.

Half ropes, with regard to strength and weight, lie between single and twin ropes. They only offer standard safety when they are used as a pair. But here you have the choice between twin rope technique, where both ropes run parallel through the protection and half rope technique, where the «left» and «right» ropes run separately through different protection points. This technique allows friction to be reduced in the case where protection points are widely spread and reduces impact force. This is of benefit when climbing traditionally protected routes. A belay method which enables the independent control of each rope must be used. Half ropes are tested singly with a 55 kg mass and must withstand five standard falls. They come in diameters from 8-9 mm and weigh 42-55 grams per meter. In single strand form they are suitable to belay two seconds.



PRACTICAL TIPS

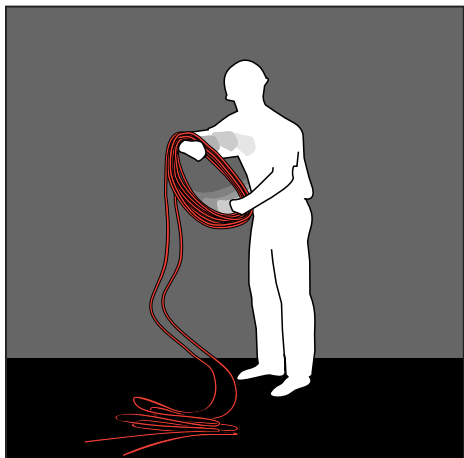
For over 140 years at Mammut we have applied all our experience and knowledge in order to produce the very best possible ropes. Every rope which leaves our factory is manufactured under strict quality controlled conditions and has, in the final control, been found error free. However, our influence ends with the distribution to selected specialist dealers. After purchase, the practical life of the rope begins, and therefore becomes the responsibility of the user. The best rope can only give optimal performance if it is correctly used and treated carefully. Mammut ropes do not need much effort to maintain, but each climber and mountaineer should observe a few basic rules, in order to get the most out of their most important piece of safety equipment.

Rope Care

Every climbing rope is designed to be used, and wears during use. However, wear differs depending upon the type of use. The rope wears least, if it isn't loaded, as with a classic ascent and descent without a fall. In this case only the sheath is chafed by friction on rock or ice, which after many years will become worn out. Heavy loading, due to awkward routing, or hauling over edges, increases abrasion and causes wear. Lowering, as when top roping, substantially increases wear. When rappelling, moderate speed is «healthier» for the rope than a fast, jerky descent.

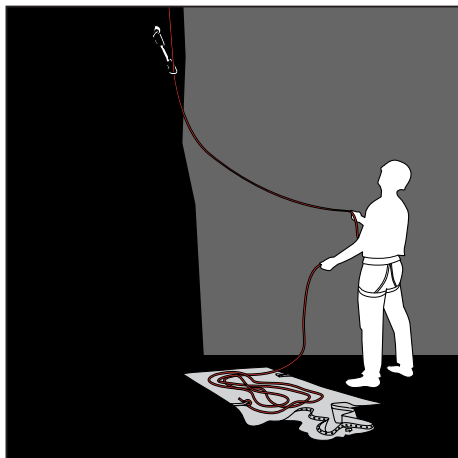
>
A new rope must be uncoiled before its first use to avoid tangles.

>>
A rope bag is the easiest and most effective protection from dirt.



Uncoiling – the first time

In production the rope is coiled, tangle free, on drums. It is also delivered in the same coiled condition. During its first use it must be uncoiled again, otherwise annoying → tangles develop. To uncoil: open the rope cord and put both lower arms through the rope coils in opposing directions. Maintaining constant pressure – twist your lower arms outwards around each other, so that the ends of the rope drop to the floor. Take care that the second end doesn't wind itself around a wrist and prevent the turning action. After uncoiling the rope, it can be run through by hand, meter by meter, two or three times, and shaken gently in order to remove any twists. Afterwards, it is ready to be transported or stored in a rope bag. Carrying out the uncoiling procedure over a rope bag, or at home, protects the rope, from the outset, against unnecessary contamination.

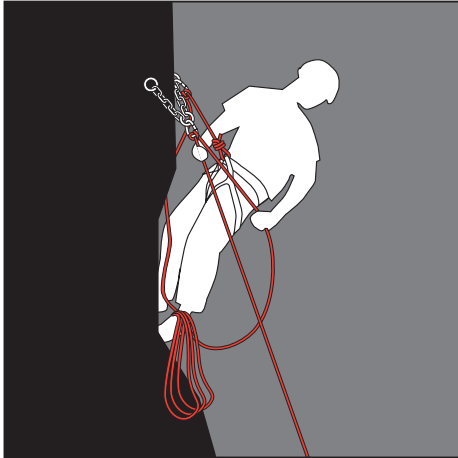


Rope Bags – protection and transportation

With sport climbing the rope bag is the best means to easily transport and protect the rope from dirt, and keep it ready for use. One end of the rope is tied to the rope bag cord and then the loose rope can be pulled, meter by meter, from the bag tarp. The top end can now run freely to the lead climber. For carrying, the rope is tied to the second loop of the bag with, e.g. an overhand knot. Additional benefits of the rope bag are: if the second end of the rope is firmly tied to the bag, it can't slip through the belay device by mistake, when lowering – unfortunately a frequent cause of sport climbing accidents.



PRACTICAL TIPS



Rope management at the belay stance

Particularly with waterfalls, but also on alpine climbs, and in windy conditions, it's important that the rope coils don't hang down below the belay stance because they can get snagged on blocks or icicles. Experienced climbers lay the rope in alternate coils right and left over their belay rope, thigh, or foot and so always have good rope control. If the same leader continues to climb the next pitch then the rope taken in must first be completely re-stacked so that it runs out cleanly.

Recovery period after a fall

After sport climbing falls the rope benefits from a \rightarrow rest phase. After a hard shock loading the rope should «enjoy» a \rightarrow recovery period and, if possible, the rope end should be alternated. In this way, the man-made fibers stretched by the fall can rejuvenate – thus, clearly increasing the rope's life span. The rope can also be saved if you don't stay

◀
Clean rope management at the belay stance makes easier handling during multi-pitch routes.

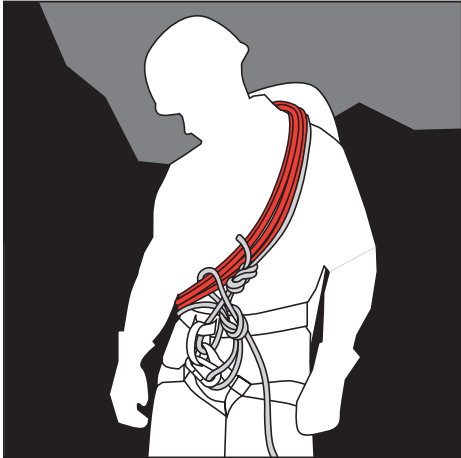
◻
When shortening the rope, secure safe tying through the tying in point can save your life.

»
In certain conditions lowering your partner can be safer than an independent rappel.

hanging from the rope after a fall. Instead, attach yourself directly to a bolt.

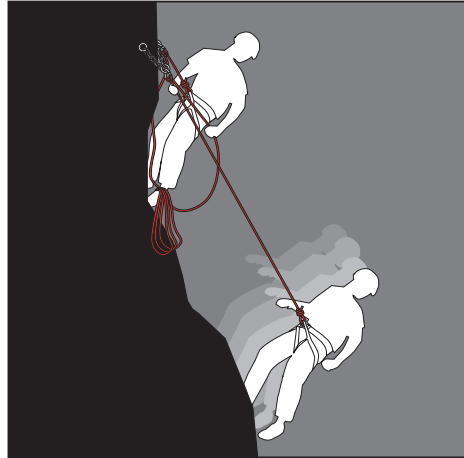
Rope routing

Skillful rope routing reduces friction on the rope and your nerves. If possible, the rope should not run over sharp, rough edges, through cracks, or behind rocks, where it can get stuck, heavily worn, and in the case of a fall, can break. Intelligently placed protection can keep it away from loose rock and wet, or damp places. Widely spread protection points can be compensated for by using long runners. Even if the rope route can't be made sufficiently straight, double rope technique can be used – particularly with «naturally protected» routes, as often found in England and the USA.



Short roping

For short, easy sections, with no danger of falling, the rope can be carried in coils over the shoulder. For that purpose, each climbing partner puts as many coils as is comfortable over their shoulder and fixes the complete bundle of coils with a cross hitch, a figure eight knot and additionally a screw gate carabiner at the tie point. If this is not done, the coils can, in a fall, tighten and strangle the climber. To remove the rope, one coil after another is taken from the shoulder, so that no tangles or knots form. Climbing difficult sections simultaneously with a «short rope» technique is possible for mountain guides, within a limited range of application. This is lethal for non-professionals. For you this means: belay correctly or climb rope free.



Rappelling

If the rope is not well coiled for throwing, knots can easily form. When rappelling in broken terrain with loose rock rappelling can cause rock fall or in high winds, throwing the ropes will likely cause them to blow around and get snagged. To avoid this, or in an awkward descent route, it can make more sense to lower your climbing partner. If, in an emergency, a Munter hitch has to be used for rappelling, the ropes should be routed in parallel to avoid tangles.

Three Person Rope Teams

Longer routes are sometimes climbed in three person teams, whereby one leader belays two seconds at the same time. If two single ropes are used, the leader must never clip both ropes into the same protection point, otherwise a dangerously high impact force can develop. For three person rope teams half ropes can be used, but never twin ropes.



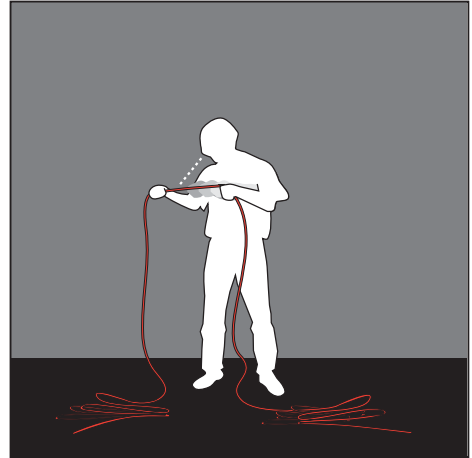
PRACTICAL TIPS



Taking Rope In

The rope which is taken in should be lain on the cliff side of the anchor point in order to avoid trapping the rope's end between the ring and the rock face.

^
For hassle-free taking up of the rope, the knot must lie to cliff side.

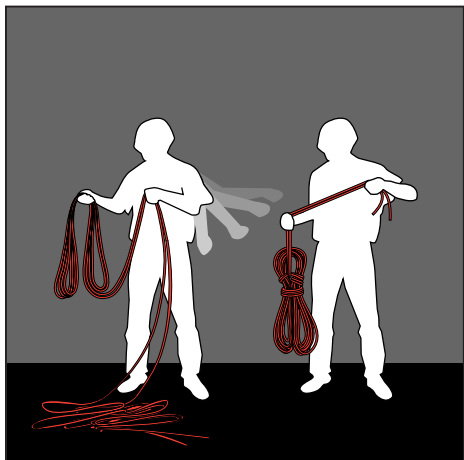


Control

At regular intervals, or after unusual usage (rock fall, stepping on with crampons, bigger falls) you should carefully examine your rope. To do this, run the rope through your hands meter by meter and feel for bulges, hard spots and other irregularities, and look for obvious damage to the sheath. Where there are larger physical irregularities and thin or open places on the sheath, the rope should be replaced. If in doubt a good dealer will give you information about severity of the damage.

^
The rope should be regularly inspected both visually and by hand.

>
Taking in using the lap coiling method helps avoid tangles.



Coiling

Coiling allows the rope to be transported without a rope bag. In order to avoid tangles the «Lap Coiling» method is recommended. Whether the doubled rope is coiled from the middle or from the ends, or as a single strand from one end; or whether you collect the rope coils in one hand, over your neck, or over your thigh whilst kneeling doesn't matter. But, it is crucial that the rope is coiled in coils, which hang down alternately left and right, and not in loops. Do not twist out any twists that develop! When the whole rope is coiled, hold it in the middle and wrap one or two arm lengths of rope around it a few times. Pull one rope coil through the «eye» which has formed and, over the «head» of the rope doll and tighten. If you use this method with two rope ends, you can wear the rope doll like a backpack. When using the rope again, you can prevent a «bird's nest» forming if you lay the individual coils down and stack the rope prior to climbing.

Washing – even in the machine

Dirt reduces performance and worsens the rope's handling characteristics. If a rope becomes dirty, you can wash it either in hand warm water in the bathtub or in a normal household washing machine. Occasional washing maintains good handling and increases the life span of the rope. A mild synthetic detergent is the most suitable for this. For machine wash, the same instructions for wool should be used to take best care of the rope. Never tumble-dry! To dry it – lay it out in a cool, dark place, rather than hang it up.

Storage

In order to slow rope aging, the rope should be stored in a cool dark place. Do not hang the rope from one of its coils, instead use a tubular webbing or accessory cord. Most importantly, ropes must be kept away from chemicals, particularly acids (i.e. car batteries).



AVOIDING ROPE DAMAGE

Each usage reduces the life span of your rope. At some time even the best rope will reach a point when its safety reserve is too low. Before this, it will usually already have lost so much practical comfort that you will have discarded it. Extreme loading can make a rope either completely, or partially useless. Naturally, if the damage is only limited to a section near the end of the rope, it can be cut off – in this case you should remember, in future, that the center marking is no longer accurate. In order to decide by how much the safety reserves of the rope have been reduced, you should be able to evaluate the danger of various factors.

Chemical Damage



The few well known rope breakages today, are – apart from sharp edge falls – the result of chemical damage by acid. Sulphuric acid from car batteries, in particular, attacks the rope's plastic filaments and can dissolve them. The fact that this damage cannot be detected from the outside is especially dangerous. Sheath discolouration may be barely perceptible, although the basic core can be destroyed. Therefore, ropes should be never stored near chemicals.

It is difficult to estimate the potential damage of solvents; therefore the middle of a rope should be never be marked with felt-tip pen or similar. Although a danger may be improbable, it should never be ignored.

Shock Loading



Short, sport climbing falls only minimally damage a rope; it can withstand hundreds of them. If the rope end becomes stiff or rough you can cut off the damaged section. Also, bigger falls of ten or fifteen meters don't have to mean the end for the rope, assuming a dynamic belay technique has been used. fall factor and impact force are critical for the well being of a rope. A longer fall with fall factor over 1, which is not gently braked, can clearly reduce a rope's safety reserve. Even then it may still hold simple sport climbing falls, but can, however, break with edge loading, even over a less sharp edge, when compared with a new rope. Under no circumstance should it be used in alpine terrain or in climbing areas with rough edges. Safety oriented climbers will replace a rope after such a «heavy» fall.

Mechanical Damage



Sharp rock edges, falling rock, or a blow from an ice axe can fatally damage a rope. If the sheath is damaged so that the core is visible, or if the core filaments are also cut, you should discard the rope. Take particular care with single ropes, where there is no second strand to give redundancy.

Practical tip: When top-rope practicing on steep ice it occasionally happens that the ice axe hits the rope, with a semi-tube pick the rope can be severed. For safety, the end of the rope can be double tied in when climbing on a single rope: attach a two meter long overhand loop, with a second overhand knot and screw gate carabiner to the harness.

The old rule «don't step on the rope» still applies, although it is only likely to be damaged in an abnormal situation. However, dirt can still be forced into the rope core and affect it.

Friction



Friction against rock, and carabiners, wear the rope's sheath along the whole length of the rope. The greater the load and the sharper the rock - the greater the wear on the rope. The load from the weight of a body when rappelling, or lowering, damages the rope more than leading and seconding without loading the rope. For reference: rappelling reduces the life span of a rope by a factor of two to three compared with normal climbing. Lowering and top roping accelerates aging by a factor of five to ten. Friction causes the small fibers in the sheath to break causing it to become rougher and become fuzzy. This can make handling more difficult and increase water absorption by the rope. If the sheath is so thin that it tears in places, or allows the core to appear, the rope should be replaced.

Practical tip: The wear from abrasion in a slingshot top rope can be reduced by using two carabiners. If the anchor is set back from the edge, it should be extended by using long lengths of static rope or webbing so that the rope doesn't run over the edge of the rock.



AVOIDING ROPE DAMAGE

Friction burns



An extreme form of damage caused by friction is the friction burn. This is likely to happen when one rope rubs on another, a belay device holds an extreme fall, or if two ropes are both routed through the same anchor point, by mistake. Melting is recognisable by glassy, transparent charred, or dark colored changes to the sheath. In these places the rope is somewhat stiffer, more difficult to handle and suffers from reduced performance. With more serious friction damage, the rope should be replaced.

Unnecessarily fast rappelling can cause the figure eight to become so hot that the rope melts at some points, thereby reducing its strength just at this point. Therefore, when rappelling, moderate speed makes sense.

Take care in popular areas: If two teams are forced to use the same anchor then under no circumstances should the ropes use the same carabiner, so one rope cannot burn through the other. At the main anchor each team must make its own belay. You should make sure that the ropes don't cross.

Contamination



Dirt in ropes is mostly a handling problem. It makes them stiffer and stickier. If the rope is extremely dirty, e.g. from oil, grease or tar, and cannot be cleaned by washing, for aesthetic reasons alone, it may be worth considering replacing it. Particularly dangerous contamination is caused by granite dust and sand because the quartz crystals can erode the core fibers inside the rope – reducing the strength of the rope, especially if the rope is used for rappelling or lowering. Irregular sheath thickness and soft spots can indicate this type of damage.

Wet Ropes



When a rope is wet it is heavier and more difficult to use. If it freezes, its performance decreases. Frozen ropes may only hold half as many standard falls as dry rope, and a stiff frozen «cable» is torture to force through a descending device. Dangerous situations for freezing moisture are: glaciers softened by the sun, sudden changes in weather and wet spots on ice falls.

UV Radiation



UV radiation from the sun causes colors to fade and accelerates aging. However, the radiation to which a climbing rope is subjected in use has a negligible effect on strength, though the fibers do lose elasticity and the rope becomes stiffer. More dubious are the completely bleached rope rappel slings that can be found on some routes, though even these will normally hold a standard static load. However, caution is required if there are signs of chafing or friction burns.

Tangles



→ Tangles are spiral formed twists. A rope that is badly tangled is difficult to use, and when rappelling there is the danger that the strands tangle around each other. Some ropes have a natural tendency to tangle more than others; this often increases with age. However, tangles are often caused by handling mistakes. If a rope is coiled in a ring form (i.e. «mountaineers coil») it forces tangles to form. Rope can be twisted by lowering at an angle over well defined edges or by cross-wise positioned carabiners. Careful handling helps avoid this annoyance.

Practical tip: Pay attention to clean, kink free rope handling, and when taking-in use the → «Lap-Coiling» method. With the → Munter hitch, keep both ropes absolutely parallel! In order to get tangles out of the rope it is best to let it hang freely. Repeated stacking, pulling the rope over a gentle, dull edge, can help to remove tangles.



LIFE SPAN – TIME TO REPLACE

Even some ancient ropes can still hold a «short» sport climbing fall, whilst in comparison, a brand new rope can break over a sharp edge. Therefore, the lifespan of a rope is difficult to define. It depends on the type and the length of use, on shock loading and other influences that weaken the rope. In the end, with the private user, it's a personal safety decision. At the latest, if you no longer have confidence in your old, furry, unmanageable rope you should «down grade» it to top roping only. For commercial users keeping a rope log is recommended.

Independent of frequency of use, a rope should be disposed of if:

1. The rope came in contact with chemicals, particularly acids.
2. The sheath is damaged and the core is visible.
3. The sheath is extremely worn, or particularly fuzzy.
4. The sheath has slipped noticeably.
5. Strong deformations are present (stiffness, nicks, sponginess).
6. The rope was subjected to extreme loads (e.g. heavy falls, clearly over fall factor 1).
7. The rope is extremely dirty (grease, oil, tar).
8. Heat, abrasion, or friction burns have caused damage.

The following table gives reference values for the usability of the rope:

Frequency of Use	Approximate Life Span
Never used	10 years maximum
Rarely used: twice per year	up to 7 years
Occasionally used: once per month	up to 5 years
Regularly used: several times per month	up to 3 years
Frequently used: each week	up to 1 year
Constantly used: almost daily	less than 1 year

STANDARD TEST REQUIREMENTS

Internationally accepted standards guarantee that only safe equipment is allowed to be sold. Naturally each of our ropes not only fulfils, but exceeds both the EU rope norm EN 892, and also the stricter UIAA standards. But what do the various standards and symbols stand for?

EN

EN 892

The Euro Norms have been especially tailored for products to be standardized. Therefore, a symbol is always accompanied by the number of the norm, (for ropes – EN 892). Products which display the EU norm symbol fulfill the safety requirements and must have passed a production-sample test at a recognized test center.

CE-Conformity Symbol



This symbol shows that the manufacturer recognizes his own responsibility; it is not a quality symbol, but rather a type of passport for that product within the European Union. It means that the EN standards for product security are maintained. The number after the CE symbol (e.g. CE 1023) indicates the batch number or the standard/directive.

UIAA



Products which display this symbol fulfill the requirement standards of the UIAA. The UIAA, the International Union of Alpine Associations, has for decades pioneered the development of practically oriented standards. Therefore, in most cases, the UIAA-standards are somewhat more stringent than the Euro standards. All Mammut ropes fulfill the most recent UIAA requirements.

ISO



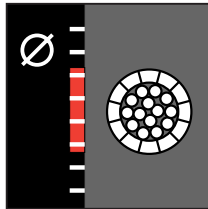
The ISO (International Organization for Standardization) combines the united worldwide national normative organizations. The ISO Norm 9001 defines overall process rules for Quality Management. They maintain the continuous quality of products and services. Certifying is conducted by an external body, for example the B.S.I.



WHAT IS TESTED

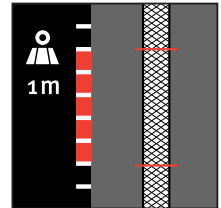
Exactly what is tested, how are the tests conducted, and what do the results mean for the practical performance of ropes?

Diameter



Rope diameter is measured under a 10 kg load. Under test, some ropes on the market clearly deviate from the manufacturer's data. In practice the diameter has little meaning. Only the clamping effect of particular braking devices or belay devices with thin ropes should be controlled (with back up safety). The advantage of thinner ropes is normally reduced weight and friction.

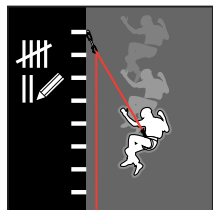
Weight per Meter



Normal single ropes weigh 60 to 85 grams per meter, half ropes about 50 grams and twin ropes about 45 grams.

Mammut ropes in the Challenge Line, treated with Coating Finish, are particularly light. The single rope Infinity weighs 58 grams, with 7 standard falls, the half rope Phoenix 42 grams and the twin rope Twilight 38 grams, with two sharp edge falls. Just two grams less weight per meter already reduces the pack weight of a 50-meter-rope by 100 grams – the equivalent of a chocolate bar, or a few beads of sweat!

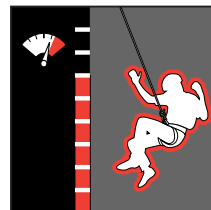
Falls Held



The drop test is the point of most interest. It measures how many \rightarrow standard falls a rope will withstand. The standard fall with a \rightarrow fall factor of 1.75 is an extremely hard one, which very rarely occurs in practical use. A weight of 80 kg (with single and twin ropes) or 55 kg (with half ropes) falls on a single cord (single and half ropes) or doubled cord (twin ropes). Single and half ropes must withstand at least 5 standard falls, a doubled twin rope at least 12. Single ropes, which hold 5-9 standard falls, are designated as standard fall ropes, those with more than 9 falls are designated multi-fall ropes.

The number of falls is a direct measurement of a rope's \rightarrow safety reserve. No new rope can break from an impact load, assuming good conditions and good rope management. But the efficiency of a rope decreases: \rightarrow aging and \rightarrow wear reduce its strength. Moisture and particularly frost can reduce it by about one or two standard falls.

Impact Force



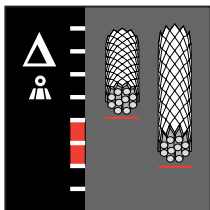
The impact force is the maximum force which affects the load in a standard fall, when the rope absorbs the \rightarrow fall energy by its elongation. It is the measurement for the «hardness» of the fall. Ropes with higher impact force, when holding the fall, produce a stronger «jolt» in the falling body and on the \rightarrow safety system. In standard tests the impact force for single and twin ropes may not exceed 1200 \rightarrow daN and for half ropes < 800 daN (approx. 800 kp).

The practical relevance of the impact force is relatively small because it is measured with the standard static fall test, i.e.: the fall rope is completely fixed. In practice, however, a fall is almost always caught dynamically. \rightarrow Belay devices (Munter, figure eight, ATC, etc.) have a certain rope path, and their attachment to a central point, or on the harness, brings a dynamic effect. Through \rightarrow dynamic belaying a large part of the fall's energy is dissipated and so the impact force is reduced. Measurements by Mammut of typical sport climbing falls show, that with dynamic belaying the difference in impact force between two different ropes is barely discernable. It's therefore important to provide a truly dynamic belay.



WHAT IS TESTED

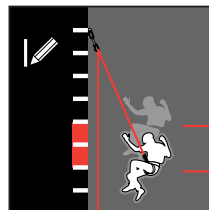
Working Elongation



Working elongation indicates the elasticity of a rope with a static load. A piece of rope pre-loaded with 5 kg is loaded with 80 kg: elongation may not exceed 10% for single and twin ropes, and 12% for half ropes.

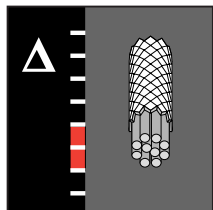
Static working elongation mainly assesses comfort when top roping or hauling on big walls. In these cases, it's annoying when energy is wasted through rope stretch, or if a difficult sequence has been climbed with a top rope and while resting this distance is lost. Elongation is more relevant to safety when falling (see below), because it determines whether the falling body will, for example, shock load a runner. Roughly speaking, a relationship exists between the two values for static and dynamic elongation.

First Fall Elongation



This parameter measures the elongation of the rope during the first standard fall. The maximum permissible elongation with this test is 40%. This dynamic fall elongation indicates the inertial properties of a rope better than the static value of working elongation. With greater elongation danger is increased, due to the fall impact on protection. All Mammut ropes already fulfill the requirements of the (not yet obligatory) EN standard. With values from 28-32% they fall well under the 40% permitted maximum.

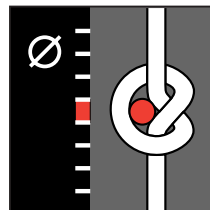
Sheath Slippage



For this test a two meter long piece of rope is drawn five times through a test device – a metal drum, with a zigzag shaped, off-set rope guide. The sheath and core are then rigorously tested by the milling action of the drum. The sheath may be displaced by a maximum of 20mm

If the sheath and core slip during use, the rope can bulge and get lumps. If the ends are carelessly welded the sheath or core can slip out of alignment. With modern climbing ropes sheath slippage hardly ever occurs.

Knotability



An over hand knot is tightened with a force of 10 daN and then loosened at 1 daN. Afterwards the inside diameter of the knot is allowed to be a maximum of 1.1 times as large as the rope diameter.

Knotability is a reference point for the stiffness of a rope: with stiff ropes the knot cannot be as tightly tied, compared with a more supple rope, and the path through the belay device is possibly made more difficult. However, too much value shouldn't be placed on this measurement, as the suppleness of a rope is also determined by care and the weather.



GLOSSARY

A

Abrasion 9 →wear

Acid 19, 20

Aging 19, 21, 27

Rope aging is caused by many factors: usage, loading, terrain, environmental factors.

Ascenders

Devices which grab the rope as when climbing a fixed rope or carrying out a rescue (instead of a prussic sling) e.g. Tibloc, Ropeman, Jumar.

B

Balanced Rope Concept 2

Braid 3

Braking and belay devices 26, 27

Carabiners or special devices for securing (HMS-carabiner, ATC, figure 8, Grigri etc). These affect rope →wear and braking potential.

C

Care 14-19

CE 25

Conformity symbol

Chemical Damage 20

Coating Finish 4, 7, 8

Coiling 19

Control 18

D

daN 27

Technical unit of force for measuring, approximately a 1 Kg mass.

Dirt 15, 22 →washing

Discarding a rope 24

Double rope technique 13

also known as a Half rope technique.

Drop test tower 2

Drop test 27

Duodess 5

Dynamic belay 11, 20, 27

Dynamic ropes

Ropes designed to absorb energy generated in a fall by elongating under load. Only dynamic ropes can be used to belay a lead climber.

E

Edge loading (Mechanical Damage) 20

EN-Standard 25

Erosion 22

Mechanical wear. Of particular danger is the «internal erosion» caused by the penetration of sand or quartz particles.

Euro Norms 25

F

Fall elongation 27, 28

Fall energy 27

The energy produced by a falling body using the formula: $E = m * g * h$ (= weight of the falling body * force of gravity * height of fall). This is reduced through friction, (→braking devices, protection nuts, cams etc.), rope elongation, which produces Shock loading and deformation e.g. that caused by impact with the rock.

Fall factor 20, 27

The measurement for the hardness of a fall. It is calculated by dividing the distance of the fall, by the length of rope which has been paid out. Falls over factor 1, with a fall distance over 5-7 meters, are rated as «hard» falls. Fall factor 2 (falling from the belay is the MCA (maximum credible accident) when climbing, with brutal loading placed on both the climber and belayer. Therefore, a piece of protection should be placed as soon as possible after the belay stance. Fall factors greater than 2 are possible when climbing via ferratas (fall distance of a number of meters, on to a meter long braking cord). Therefore, it is essential to use a dynamic braking device.

Filament 4

The thin threads from which the rope is constructed: two to six filaments form a strong yarn, four to six yarns form a braid, a number of which then form the core. Mammut uses Polyamide 6 (nylon)

Friction burns 22

Friction 21 →wear

H

Half rope technique 13

Half ropes 13

Handling 6

The term used for the rope's working properties: grip, suppleness, roughness. These pro-

erties are subjective are not standardized.

I

Impact force 11, 20, 27

ISO-norm 25

K

Kernmantle construction

The most usual construction for dynamic climbing ropes, consisting of a load bearing «core» and protective sheath.

L

Lap coiling 19

Lifespan 24

Lowering 21

The lowering of a secured load, possibly through a carabiner or ring. Wear and aging are increased.

M

Munter hitch 17, 23

(Also called italian hitch or friction hitch). Knot used for belaying.

N

Number of falls 4

The number of →Standard falls that a rope can hold during standard testing.

P

Pitch 10

The length that is climbed from belay to belay. In terrain where belays have to be made more frequently (i.e. terraced cliffs, boulder strewn areas etc.), a shorter rope is adequate and reduces weight.

Q

Quality management 25

R

Rappelling 17, 21, 22

Recovery period 16

Redundancy 13, 21

Additional or parallel safety built in to a system. A worthwhile principle to apply in high risk activities such as climbing – hence the twin rope technique.

Rest phase 16

→recovery period

Rock edges, Sharp rock edges, as found on granite, or water eroded chalk stone, cause increased rope wear and the danger of breakage when shock loaded.

Rope aging 24 →Aging

Rope bag 15

Rope brakes →braking devices

Rope diameter 26

Rope log 24

Of particular use for commercially used ropes. A rope log simplifies the maintaining of the usage history of the rope. The entries include the number of days used, the number of meters climbed (multiplied by 0.33) and the rappelling, lowering or top roping meters (multiplied by 1.66). From this the total «usage meters» can be calculated. Ropes with 5-7 standard falls can usually be used for about 1500 – 5000 meters, those with 7- 9 standard falls 5000 – 10000 meters and those with more than 9 standard falls 10000 – 20000 meters.

Rope management 16

Rope routing 16

Rope threads 4 →filament

S

Safety reserves 20, 27

Safety system 27

All the technical elements that hold a fall. See braking devices, rope, protection, harness. The weakest link determines the overall strength of the system. The most heavily stressed is the uppermost piece of protection, which is subjected to the sum of the force of the person falling, and the person belaying.

Sharp edge loading 10

Sharp-Edge-Resistance 4, 7, 11

Sheath proportion 6

sheath slippage 29

Short roping 17

Shrinkage 7

Single rope technique 12

Single ropes 12

Sling Shot

Top roping with the belayer standing at the bottom of the climb, with the rope doubling



back from the anchor. The anchor must be solid and free from sharp edges. In order to avoid the accidental unclipping of the wrong rope two ropes should never be routed through the same anchor (rope → wear is increased).

Standard fall 22, 27

Standard requirements 25

Static ropes

Ropes designed to stretch very little under load. This property makes it ideal for use in hauling, rescue and fixed line use. Static rope must never be used to belay a lead climber.

Stepping on the rope 21
(mechanical damage)

Stiffness (Knotability) 29

Superdry Impregnation 6

T

Taking Rope in 18

Tangles 15, 17, 19, 23

Teflon (coating) 4

Teflon is a fluoropolymer resin that reduces friction. At Mammut the → Coating Finish reduces the friction between the rope filaments.

Top roping 10, 11, 28

Climbing, with the belay stance at the top of the climb.

Triodess 5

Twin rope technique 13

Twin ropes 13

U

UIAA standards 25

Ultra sonic (rope ends) 6

Uncoiling 15

UV radiation 23

W

Washing 19, 22

Wear 14, 21, 27

Weight per meter 26

Working a route 10, 11

The working out of moves and sequences, often with falls and hanging from the rope between moves. A common way to practice pushing the limit. This gives the rope greater wear.

Working elongation 28



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