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UIAA SAFETY

How strong are your karabiners?

Strong enough (despite what the ETHZ says*), even if they are made of aluminium!

In dynamic tests, they can break only when they are improperly tested. Let's see why.

This article gives answers to:

- a study: Schambron T & Uggowitzer PJ. Effects of wear on static and dynamic failure loads of *aluminium-based alloy climbing karabiners*. Sports Engineering, 13 Nov. 2008.
- ETHZ online article "*More safety when climbing*": http://www.ethlife.ethz.ch/archive_articles/090105_Karabinerhaken/index_EN
- Einstein (German-language programme on Swiss public television) "*Wie sicher sind Karabinerhaken?* " (How safe are karabiners?): http://www.sf.tv/sendungen/einstein/sendung.php?docid=20090219

Dynamic tests were performed on karabiners 20 years ago by the UIAA Safety Commission. The dynamic test is made with the karabiner attached to a fixed point. A rope passes through the karabiner. The first end of the rope is attached near the karabiner and a mass is attached at the other end. The mass is dropped for nearly twice the length of the rope in order to have a high-fall factor. This high-fall factor simulates a hard fall, such as when a climber falls five metres in a runner, which is placed a little bit above the belay.

The results showed that dynamic tests are not necessary for setting standards.

Moreover, they have to be made very carefully with a free-falling mass. The ETHZ did not use a free-falling mass but a mass which was guided between two rails. This method produces the wrong results. The guided mass adds vibrations to the rope, which are transmitted to the karabiner. The gate opens because the vibration range corresponds to the gate's own frequency. This shows how a karabiner can break because with an open gate the resistance is much lower.

Karabiners never break when tested with a free falling mass.

A real climbing fall has a maximum force of 5kN. This value is less than half of the maximum force obtained with a guided mass. The difference is explained by the "elasticity" of the climber –the body absorbs some fall energy. The falling climber is also free to move laterally and induce less vibrations and a soft rope braking from the belayer. This maximum force does not create enough vibrations to open the gate.

The UIAA standard for climbing karabiners demands a static strength of more than 20kN. This value corresponds to holding a mass of about 2 tons before breaking. 20kN is more than the worst conceivable fall in a climbing accident.

The test is static. That means that the karabiner is carefully adjusted between two pins, then slowly pulled until it breaks.

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Dynamic tests are not useful for a standard because the static forces are worse than dynamic ones: pulling with the same force for many seconds is worse than for a few tenths of a second.

Naturally this standard is applicable for new karabiners. The ETHZ tested some karabiners that had more than 20% wear. This was obvious by looking at them. We hope that each climber is smart enough to change his or her material and equipment before it is in this condition.

The UIAA Safety Commission recommends for karabiners:

- Karabiners with visible wear – more than 1 mm deep - have to be replaced.
- Put steel – and not aluminium - karabiners in climbing gyms for fixed top rope belays. Steel has less rope abrasion than aluminium.
- Use redundant system in critical locations: two karabiners with opposed gates or a karabiner with a locking device.
- Wire gate karabiners are less sensitive to vibrations or shock against the rock when falling.
- Change the length of the runner when the gate could be opened by a rock nub.
- Check that the karabiner is always loaded in the right way. A fall on a karabiner loaded in transverse direction is worse than with an open gate.

For more information, see "*How strong does your climbing gear need to be?*" by UIAA Safety Commission member, Neville McMillan, 2003:
http://www.theuiaa.org/upload_area/files/1/How_strong_does_your_climbing_gear_need_to_be(0).pdf

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March 2009