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UIAA STANDARDS 121 / CONNECTORS (KARABINERS) Recommendations for Inspection and Retirement

Foreword

The UIAA equipment standard provides a baseline for equipment performance in a test lab under controlled conditions on new equipment. Although these test conditions are relevant to the conditions encountered climbing, conditions encountered at the crags and the condition of the equipment are equally important. This recommendation from the UIAA member federation The British Mountaineering Council (BMC) provides vital equipment information that is NOT explicitly addressed in the standard, particularly failure modes of the equipment and recommendations for the use, inspection, maintenance, and retirement of equipment.

These recommendations are of necessity general. For any specific piece of equipment, the primary source for all equipment information is the manufacturer. Always read and heed the manufacturer's warnings and instructions for use, inspection, maintenance, and retirement of equipment. Taken together, the UIAA standard, the BMC recommendations, and the manufacturer's instructions provide a sound basis for understanding climbing equipment and its limitations. This understanding, in conjunction with best practices, is the basis for managing the risk associated with climbing and the use of climbing equipment.

THE FOLLOWING INFORMATION ON USE, CARE AND MAINTENANCE COMES FROM THE BMC BOOKLET: CARE and MAINTENANCE

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KARABINERS

By Neville McMillan

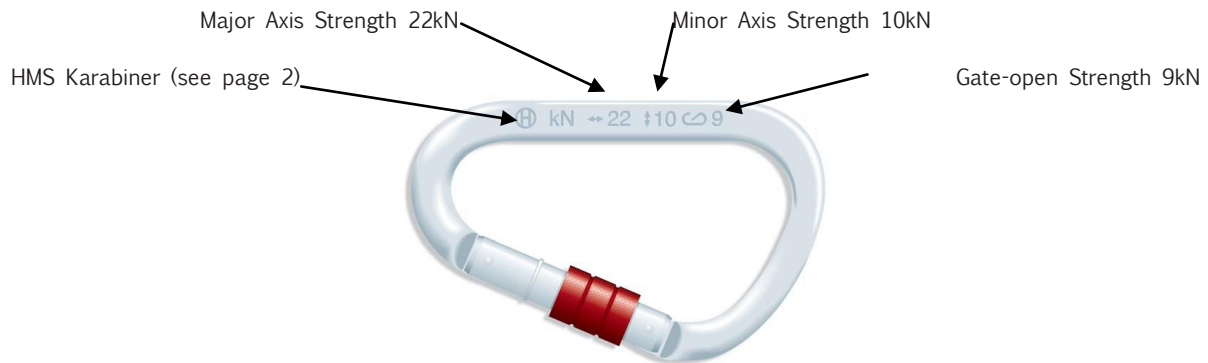


Figure 1.1 Karabiner strength markings

Introduction

Historically, karabiner was the German word for an early type of gun (in English a *carbine*, though both words derive from the French *carabine*). A bandolier or sling was used for carrying this gun, and the soldiers found that if the gun were attached by a hook it could be detached from the bandolier and brought into use much more quickly and effectively. The pear-shaped hook with a spring closure developed for the purpose was in German: *Karabinerhaken* (in English: *carbine hook*, a term still in use in the US army). Over many years, the *'haken'* was dropped, and the sprung hook became known as a karabiner. In due course, early alpinists saw the advantages of using a similar device for rapid attachment to a piton – this occurred around 1900. Subsequently, its uses were extended and its size modified accordingly. English alpinists incorporated the word karabiner into the UK climbers vocabulary, and similarly in America, although the US spelling *carabiner* is more faithful to the original French: *carabine*.

Parallel developments took place in France and Italy, but were related to a different gun, the *mousquet* (or English musket), thus the French for karabiner is *mousqueton* (and the Italian: *moschettone*), both of which can be Anglicised as 'musket hook'. Thus, by whatever route, and in at least four languages, the climbers 'karabiner' was originally a gun hook with a sprung closure used to assist in carrying a gun.

Relevant standards

The first standard for karabiners for use in climbing and mountaineering was produced by the UIAA Safety Commission in 1965. This standard and its revisions form the basis for the current, much more comprehensive European Standard for Connectors (EN 12275) published in 1998. The standard specifies 'safety requirements and test methods for connectors for use in mountaineering, including climbing'. The descriptive generic word *connector* has been used in the standard to allow the emergence of innovative designs that may not look like traditional karabiners, and also to include items, which do a similar job but are not normally considered to be a karabiner – eg. the quicklink or Maillon Rapide. In this *text* the word karabiner is used as it is the accepted norm, but it is intended to apply to all types of connectors which comply with EN 12275.

Types D, A and Q are easily recognised by their appearance, and are not required to be marked as such. Types H, K, and X have different strength requirements, and types H and K different gate requirements, and must be marked with the appropriate letter surrounded by a circle. There is no requirement to mark basic connectors with the type letter B – any karabiner not marked H, K, or X will be a basic connector.

The standard also requires that the appropriate strengths be marked on the body of the connector using the symbols shown in Figure 1.1. For the climber, the most important figure is the major axis gate-open strength, and it is worth becoming familiar with the symbol indicating this particular strength marking, as shown in Figure 1.2.

The standard requires the major axis gate-open strength for a basic connector to be at least 7kN. The previous DIN standard only required 6kN, and gate-open failures then were more frequent (see below). Oval connectors are a special case and are used principally for aid climbing where the shape has several advantages. However, this shape makes them inherently weaker when the gate is open. The standard allows a gate-open strength as low as 5kN, but it is accepted that they will not give full protection in the event of a leader fall. Their use in UK (free) climbing is generally not necessary, and is undesirable because they are not strong enough for use on running belays.

In 1998, the relevant UIAA standard was revised to take into account the work done on the EN standard, and the title was changed from 'Karabiners' to 'Connectors'. The current EN and UIAA standards are essentially the same.

Table 1.1 The standard defines several types of connector as follows:

Type	Connector Name	Brief Information
B	Basic	General purpose eg. for running belays, at a stance, etc.
H	HMS	For dynamic belaying eg. using 'Italian hitch' or brake plate
K	<i>Klettersteig</i>	Higher strength, large gate opening, for via ferrata use
D	Directional	For unidirectional loading ie. with a captive or semi captive sling (eg. DMM Mamba) used for quickdraws
A	Specific Anchor	For use with a specific bolt hanger
Q	Screwed-closure	Quicklink or Maillon Rapide
X	Oval	For aid climbing use



Figure 1.2 Gate-open markings

Observed faults and failures

Like all equipment, karabiners can develop faults – most of which should be apparent to the user on inspection before use. These are quite rare, and such faults reported to the EIP(Equipment Investigation Panel) have been (one instance of each in the last 20 years)

- Displaced spring-pusher in the gate (causing the gate not to close)
- Loose hinge pin
- Loose latch pin

There have also been some instances of seawater corrosion due to lack of care and maintenance by the owner (see appendix on seawater corrosion, [link to be given](#)).

In addition, it is known that screwgates and autolocking gates (or twistlocks) can become worn over time and fail to function correctly.

The majority of karabiner reports issued by the Equipment Investigation Panel (EIP) involve failures under load (with fatal or potentially fatal consequences), and were due to (most frequent first):

- Loading of the karabiner when the gate was open;
- Abnormal loading of the karabiner, forcing the gate to open under load;
- Loading with a sling/quickdraw (ie. no rope involved) – only one instance.

How to prevent failure in use

Karabiner gates can open momentarily when loaded dynamically during a fall. Normally this is not a problem, because either the karabiner is not actually loaded whilst the gate is open, or the force applied is less than the gate-open strength of the karabiner. The 1998 standard increased the minimum gate-open strength from 6kN to 7kN (*1 see UIAA comment at the end of section) to make this type of failure less likely, but a gateopen strength of 7kN does not guarantee that a gate open failure will never occur. If you are a heavier than average climber or you carry a lot of gear or a rucksack (or all of these), it makes sense to choose karabiners with a gate-open strength of 8 or 9kN to increase your margin of safety.

*If you have karabiners manufactured before 1998, it is worth checking to see if a gate-open strength is marked on them. If it is below 7kN or not marked (as with nearly all karabiners made before 1990), there is a potential problem. If the karabiner is especially lightweight or made from round bar of less than 10mm diameter, it may have inadequate gateopen strength – seek expert advice or contact the manufacturer. **If in doubt, replace the karabiner.***

(It can still be used for carrying bunches of wired chocks, or your nut extractor; just don't use it where your life depends on it.)

Use of a screwgate or autolocking karabiner avoids the gate-opening problem, and is recommended where :

- high reliance is being placed on a karabiner, ie. at a belay, lower-off or vital runner;
- the chance of the gate becoming open is increased, eg. a karabiner on the end of a longslings, or which may hit the rock with force when loaded.

Even with a screwgate karabiner, the gate may be forced open in certain situations, particularly when using a figure-of-8. In this case it is possible for the figure-of-8 to lever open the gate if the system is loaded under an 'abnormal configuration' as shown in Figure 1.3. When abseiling or belaying with a figure-of-8, you must be vigilant at all times to ensure that the figure-of-8 does not come into contact with the gate.



Figure 1.3 A figure-of-8 forcing open a screwgate karabiner.
Photo: BMC Collection

In practice, other abnormal loadings may arise (for example if a karabiner is loaded over a rock edge, or scraped along a horizontal break) that could cause the gate to open. When placing runners, take care to try to avoid these possibilities by anticipating the position of the karabiner in the event of loading, and extending the runners accordingly. If in doubt, it is best to use a strong screwgate karabiner.

Another way to reduce the chance of the karabiner being loaded with the gate open is to use wiregate karabiners. A wiregate has much less mass than an alloy bar gate, which very significantly reduces the chance of opening due to whiplash or inertial effects. But on rough, knobbly, or crystalline rock some wiregates may be more prone than a round bar to being opened when scraped along a rock edge under load. Wiregates solve some but not all problems.

In addition, care should be taken to ensure that the karabiner is loaded in the correct way. Karabiners are designed to be loaded along their length (a two-way load along the major axis), and in this mode basic karabiners will withstand a force of at least 20kN with the gate closed. They are very much weaker (typically 7kN) when loaded along the minor axis ie. on the gate, and for this reason three-way loading should be avoided as this increases the probability of loading the gate. In some cases, a three-way load is inevitable (such as when clipping both ends of a

threaded sling), and in these cases take care to ensure that the angle between the slings does not exceed 60°. This will significantly reduce the chances of loading the gate – see Figure 1.4.

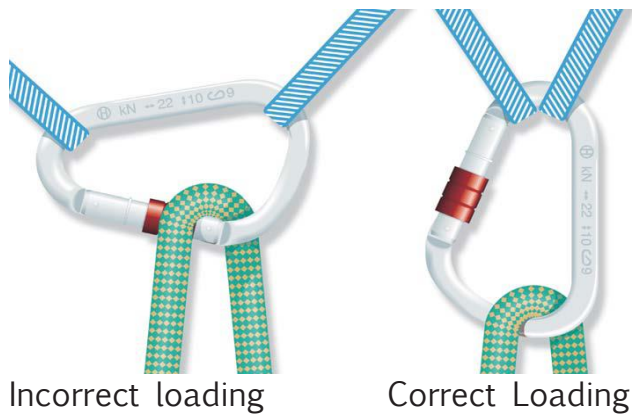


Figure 1.4 Three-way loading of screwgate karabiner



Figure 1.5 Badly-positioned karabiner
Photo: George Steele

When clipping bolts or pegs with quickdraws, make sure that the rope is running in the correct direction through the karabiner ie. that the karabiner gate faces away from the direction of travel. Also, on slab routes it is possible for the quickdraw to move such that the karabiner gate will be loaded and open in a fall (see Figure 1.5). For a similar reason, do not clip two karabiners together directly; in a fall the body of one can lever open the gate of the other, and disconnect them.

In normal fall situations using a dynamic climbing rope, the forces on the karabiners and anchor system are limited by the stretch within the rope, and the slippage of the rope through the belay device (dynamic belaying). The force on the

top runner is very unlikely to exceed 10kN, and will generally be significantly lower than this and well within the gate-closed strength of a karabiner. However, if a climber is linked to an anchor point only by karabiners, quickdraws and tape/accessory cord, there is no energy absorption in the chain of connection. In the event of a fall or other shock loading, forces in excess of 25kN are quite possible – sufficient to break a karabiner even with the gate closed! So when clipping to a belay point using only slings, quickdraws, and karabiners, adjust the length of the sling to eliminate any slack, thus eliminating any shock loading in the event of a fall. This also applies to protecting yourself on *via ferrata* scrambling routes, which have fixed metal cables to clip to. Never clip yourself to these cables with just a tape sling and karabiner – if you fall, the karabiner could easily break because slings do not stretch like rope! Instead, use one of the several energy absorbing lanyards (**2 UIAA comment, see below*) now commercially available, which are made specifically for this task.

UIAA Comments on this part

- 1) *Before the European standard there were 2 standards for Karabiners: UIAA and DIN. UIAA was asking for 9 kN gate-open and DIN just 6 kN. It was recognized that 6 was certainly too low (many accidents/incidents happen) and finally a consensus was found for 7 kN.*
- 2) *see Energy Absorbing System for Via Ferrata UIAA 125*

Routine care and maintenance

Provided karabiners are kept away from sea cliffs and salt water (see appendix on saltwater corrosion), they require little maintenance. However, if any irregularity in the gate action is observed in use, the karabiner should be carefully inspected as soon as possible. In any case, it makes sense to inspect all your karabiners methodically from time to time (say, once a year) to ensure their performance is satisfactory.

The following procedure is recommended:

- Check that the gate opens and closes easily and smoothly. If not, lubricate the hinge with a suitable aerosol lubricant such as GT85 or WD40. Wipe away any surplus, and check the movement again – if this does not cure the problem, discard the karabiner.
- Check that the gate closes completely from any open position. If the gate catches on the latch or does not close fully under its own spring, the karabiner should be discarded. *Bending the gate to rectify this is not recommended as it weakens the hinge and does not constitute a reliable repair!*

- Very carefully, inspect by eye and using the fingers, the inner surface of the karabiner, particularly where the rope will run in use. Any karabiner with burrs, grooves or sharp edges on its inside radius should not be used for clipping ropes (it could be reserved for clipping bolt hangers or pegs – you should have dedicated rope-end and gear-end karabiners to your quickdraws in any case!). Do not think that the problem can be solved by filing down any sharp edges on the karabiner, since even the grooves left by a fine-cut file could significantly damage the nylon filaments of the rope sheath.
- Check the screw action of the sleeve on screwgates to ensure that it is smooth and will keep the sleeve locked in the closed position.
- Examine the edge of the sleeve which provides the locking action; usually the edge which covers the nose, but in some cases the edge which covers the hinge. If there is any sign of cracking or distortion, the karabiner should be discarded.
- Inspect autolocking and twistlock karabiners very carefully – open the karabiner several times and release the gate from different open positions. Check that the gate closes fully every time, and that the locking sleeve closes of its own accord. If the karabiner is reluctant to lock even after lubrication, it should be discarded. Again, check the edges of the sleeve – any signs of cracking or distortion are criteria for discarding.
- If a directional karabiner (eg. DMM Mamba) includes a tape sling, inspect and maintain the sling as described in the section on slings. If the sling cannot be removed but needs replacing or re-stitching, the whole device should be returned to the manufacturer.
- Karabiners should be stored in a dry, airy place.

For quickdraws, or other connectors that have textile elements, there is an additional requirement that it should be cool and dark.

Degradation and discard criteria

If properly looked after, there is no reason why a karabiner should not have a lifetime of at least 20 years. Most of the discard criteria have been covered in the routine care & maintenance section above, however if the karabiner is more than ten years old, or shows signs of corrosion or local discolouration, the following test should be added to the inspection routine:

- Remove as much surface corrosion as possible using a domestic pan scrubber or wire wool. Carefully inspect any discoloured regions for signs of cracking or an etched appearance on the surface. A magnifying glass will be needed to distinguish between cracks and surface scratches. If cracks can be seen, or if the corrosion or discolouring are such that cracking cannot be ruled out, discard the karabiner (see also the discussion of corrosion mechanisms (...) in the Appendix on seawater corrosion – *UIAA: Appendix to be found on*).

Provided that karabiners are properly used and looked after, it is much more likely that they will be replaced with new models for reasons of cosmetics, handling or strength/weight ratios than they will be discarded over concerns about their failing strength. Nevertheless, it is important that they receive methodical inspection and maintenance.