

Karabiner Breakings when Using a Figure-of-Eight

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Introduction

For decades climbers have been using a Figure-of-Eight (FoE) as standard equipment for abseiling. Both experts and complete novices have used this piece of equipment, invariably attached to their harness or waist belt by a screwgate karabiner, without any reported problems. Yes, there have been many abseiling accidents, due to an inadequate anchor point, or the rope getting cut, or abseiling off the end of the rope, or losing control of the free end of the rope, etc. But until five years ago there had not been any reported failures of the Figure-of-Eight (FoE) or its attachment karabiner.

Then in 1995 in England a climber had a lucky escape whilst abseiling, when his FoE levered open the gate of the attachment karabiner but failed to come free. The following year a student at an adventure centre was not so lucky, his FoE levered itself out of the attachment karabiner, and he fell 40 metres to his death. Before the ink was dry in reporting and analysing that accident, an accident occurred in Germany in 1997, due to an identical failure mode. This time the accident occurred whilst belaying with a FoE. A sport climber fell, and the sudden pull on the rope caused the FoE to break out of its attachment, leaving an opened screwgate karabiner attached to the belayer's harness.

The problem is not really with the Figure-of-Eight, but with the typical climber's screwgate karabiner, which is just not strong enough to withstand the levering action of a FoE in these abnormal configurations, and does not prevent these abnormal configurations from occurring. But the levering effect is not restricted to a FoE. More re-

cently, the same mode of karabiner failure has occurred due to the levering action of an energy absorbing system (see article by Charlet).

The First Failure – a Lucky Escape

A climber had set up an anchor point for top-roping at the top of a single pitch route. He then prepared himself for abseiling to the ground. He wore a



Fig. 1

Black Diamond X harness. The make may be significant, because some Black Diamond harnesses, notably the BOD, do not have a tape loop (the belay loop) connecting the leg loops to the waist belt. When he purchased the harness he was advised to connect the leg loops to the waist-belt by a karabiner for abseiling; the same advice is commonly given to purchasers of the BOD harness. Depending on the size of the harness and the size of the climber, this arrangement often results in the karabiner not being free to rotate but being

held roughly horizontally whilst abseiling. At the start of an abseil, when the rope is more horizontal than vertical, depending on the orientation of the karabiner, this can allow the FoE to apply a large force to the gate of the karabiner, and lever it open, breaking a notch out of the locking-sleeve (see Fig. 1).

It is thought that this happened at the start of this abseil, though the climber did not realise it at the time. A little fur-



Fig. 2

ther down, he felt a jolt, and looked down to see that he was connected to the abseil rope as shown in Fig. 2. As he was still 30 metres above the ground, he was a little alarmed, but managed to remain calm. He scrambled to a ledge where he replaced the karabiner, and then continued safely down.

The Second Case – a Fatality

A mature student at an adventure centre had carried out an abseil for the first time in his life. That evening he was

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Equipment and its Application

persuaded by fellow students to do a free abseil, off a bridge, the following day. The bridge was modern, with a substantial steel railing giving a solid anchor point. The aim was to abseil off the parapet at the side of the bridge, down to a minor road 40 metres below. The student was using the conventional FoE and screwgate karabiner, controlling the free end of the rope close to his body, keeping his hand just behind his waist, as he had been taught (Fig. 3). He started to lean out and lower himself, then looked down and his confidence failed him. He pulled himself back into an upright position whilst he wondered whether to carry on. He was persuaded by his fellow students and the instructor to have another go. Which he did, but a second time nerves overcame him and he pulled himself back again. Each time he pulled back again, the FoE and the karabiner went slack (Fig. 4), and, each time he restarted, the instructor made sure that these two items of equipment were correctly aligned. This scenario was repeated several times, until finally he plucked up courage and launched himself into the abseil. Unfortunately for him, he did this too quickly for the instructor to correct the alignment of the FoE and karabiner. As he launched himself into the abseil, these two items moved into the abnormal configuration shown in Fig. 5, and his body-weight was sufficient to cause the FoE to lever open the karabiner gate, breaking a notch out of the locking sleeve as it did so. The FoE was then released from the karabiner, leaving him with only his hands on the rope. He died from the injuries received when he hit the road 40 m below.

When this failure mode was first analysed, many competent people thought that the abnormal configuration could not be maintained long enough for failure to occur. But experiment showed



Fig. 3



Fig. 4



Fig. 5

that it can occur, and it can be repeated in demonstrations. Furthermore, the load required to produce the failure is only slightly above a typical climber's static weight, and well within his dynamic weight. Karabiner gate-locking sleeves are only designed to prevent the inadvertent opening of a karabiner gate; they are not designed to resist the leverage which a FoE can apply in such configurations.

The Third Case – Belaying – Luckily only Minor Injuries

This case was reported from Germany by Pit Schubert. Two young sport climbers were at a crag on a warm, sunny day. The belayer was using a FoE attached to his harness by a screwgate karabiner. He was lying on the ground, sunbathing, talking to other climbers nearby, and not paying too much attention to what his leader was doing. The leader fell off, the rope came tight, there was a sudden jolt on the belayer's harness, and the next thing he saw was the FoE travelling up the crag to the first bolt, as the free end of the rope accelerated through his hand.

Luckily the leader was not far above the ground, anticipated his fall, and escaped a potentially serious accident with relatively minor injuries.

The Consequences

In all these cases, after the accident the Figure-of-Eight stays where it was on the rope at the time of the failure. The attachment karabiner is found on the harness, with the gate open, the locking sleeve screwed up, and a notch taken out of the locking-sleeve. These are the tell-tale signs of this failure mode. But it would be good never to see these signs, because the potential consequences of this failure mode are fatal.

So what can be done?

Many things are possible; the question is: "What are climbers prepared to accept?"

- For belaying there is no need to use a FoE. The FoE was designed for abseiling not belaying, so it could be argued that using it for belaying is a misuse of equipment.
- For abseiling, a cord sling can be attached to the abseil rope by a prusik

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knot, and clipped to the harness. This does not avoid the mode of failure described, but does provide a safety backup in the event of any failure of the abseiling device. The prusik can be attached either above or below the abseiling device, as described in many climbing textbooks.

- Clipping the attachment karabiner to both leg-loops and waist-belt should be avoided (see article by Harremoës)
- Karabiner manufacturers do not currently consider it practicable to make gate-locking sleeves sufficiently strong to prevent gates being levered open in all possible configurations.

However, there are now karabiners available on the market which make the FoE captive at one end of the karabiner, thus preventing the levering action from occurring. The DMM Belaymaster is one such device.

- Alternatively, the FoE could be attached to the harness by a small stainless steel quicklink or Maillon Rapide. This is slower and less convenient to use, but is very unlikely to be levered open by a FoE.
- Finally, one can take great care to ensure that the Figure-of-Eight and attachment karabiner are always in the correct configuration, and always under load, especially when abseiling

over an edge or round a bulge. Jumping over an edge should be avoided.

In the end what one does is up to the individual climber, but being aware of this failure mode, and its potential consequences, should make a climber better able to make decisions about the equipment he uses and the way he uses it in any particular situation.



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