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**TECHNICAL COMMITTEEMEMORANDUM TCM 09/01**

**Beal rope, snapped**  
Incident Ref. 09/01/B.HEU

**SUMMARY**

A Beal single rope was being used at an indoor wall. Whilst a climber was being lowered to the ground upon completing a route, the rope snapped. Fortunately no injuries were sustained by the climber.

Subsequent inspection and testing of the rope found that it had been contaminated by a strong acid. It is likely that this contamination lead to the deterioration and eventual breakage of the rope under a relatively small load.



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## 1. INTRODUCTION

The rope was being used at Dynamic Rock, Swansea when the incident occurred. The climber had already climbed one route and had been lowered off, before climbing a second. Whilst being lowered off, the rope broke, causing the climber to fall to the ground. Fortunately no injuries were sustained as a result. The rope was found to have broken approximately 1.5m from where the climber had tied in.

The rope did not belong to the climbers involved in the incident, but had been borrowed. Whilst uncoiling the rope, some white staining had been noted by the climbers, but it had been assumed that this was chalk dust because the rope was used as a climbing wall rope.

The owner had purchased the rope 5 years previously as an 80m length, subsequently chopping it into a 50m and 30m length. It was the 30m section which was involved in this incident. The owner kept the rope stored in a loft, away from light and chemicals. During transport, the rope was stored in a bag, and carried on the back seat of the car when not in the boot.

## 2. ANALYSIS

The rope was identified as a Beal Flyer 10.2mm single rope, from the manufacturer's catalogue. The rope did not have any end markings but the yellow internal identification tape suggests a DOM 2004. This tallies with the owners comments that it was purchased around 5 years previous to the incident.

A visual and tactile inspection of the rope found numerous areas of discolouration of the sheath. The texture of the sheath material felt noticeably different in the stained areas. Apart from the staining and odd texture, the rope appeared to be in good condition, with very little evidence of abrasion or scoring to the sheath.



Comparison of two areas of the rope sheath, showing discolouration.

Inspection of the area where the rope had snapped found that the sheath was badly stained in this area. The break itself had occurred over a fairly localised area. The ruptured core strands appeared to be stained a yellow colour. Around the break, some of the exposed core strands could be pulled apart easily by hand.



Discolouration around the area of the break.

A small amount of distilled water was placed into a beaker, and the pH measured using indicator paper. One of the broken ends of the rope was then placed in the water, and left to soak for 10 minutes. Removing the rope from the beaker, the pH of the water was tested again.

Before the rope was soaked in the water, the pH = 7 indicating a neutral solution. After soaking the rope, the pH = 2 which indicates an acidic solution, typical of a dilute concentration of a strong acid.

### 3. DISCUSSION

Inspection of the rope indicated that it had been contaminated with an unknown chemical, and that this may have been responsible for the failure of the rope. A simple test found that the contaminant was most likely a strong acid. Climbing ropes are made from polyamide (nylon), and it is well known that polyamide can be severely degraded upon exposure to strong acids.<sup>1</sup>

The source of the contaminant remains unknown, but possible sources are a car battery or certain household products such as drain, toilet or oven cleaners.

The contamination had produced a visible and tactile change to the rope, which had been noticed by the user. Unfortunately this was confused with contamination by chalk dust.

It is possible that the fact that the user of the rope was not the owner may have contributed to the incident. The owner being more familiar with the rope and its history may have better noticed the appearance of the staining and discolouration. In borrowing the rope the user may not have had the uncontaminated condition to compare it against, and hence not been overly alarmed at the presence of the discolouration.

This is not the first reported occurrence to the BMC Technical Committee of an unexpected rope failure which has been linked to contamination of the rope by a strong acid.<sup>2</sup>

#### **4. CONCLUSIONS**

The rope snapped because of degradation of the polyamide material used in its construction. This degradation was caused by contamination of the rope by a strong acid from an unknown source. This incident could have been avoided if the rope had not been contaminated in the first place, but also if the user had been aware that the discolouration was caused by a dangerous chemical as opposed to chalk dust.

#### **5. RECOMMENDATIONS**

The owner and user of the rope should check that locations where the rope may have been stored or transported are not contaminated. The remaining 50m of rope should be inspected carefully for any evidence of discolouration and change in texture, and discarded if found to be present.

This incident should be publicised in order to warn climbers of the dangers associated with certain chemicals, and perhaps further advice on how to check climbing ropes for damage could be provided by the BMC. Mention should also be made to advise climbers to be especially vigilant when using borrowed equipment.

#### **6. REFERENCES**

1. Polyamide Europe: PA Properties 06/09, Polyamide High Performance Gmbh.  
[www.polyamide-hp.com](http://www.polyamide-hp.com)
2. TCM 05/01 "Snapped Mammut Rope – Damaged by Acid", BMC Technical Committee 2007