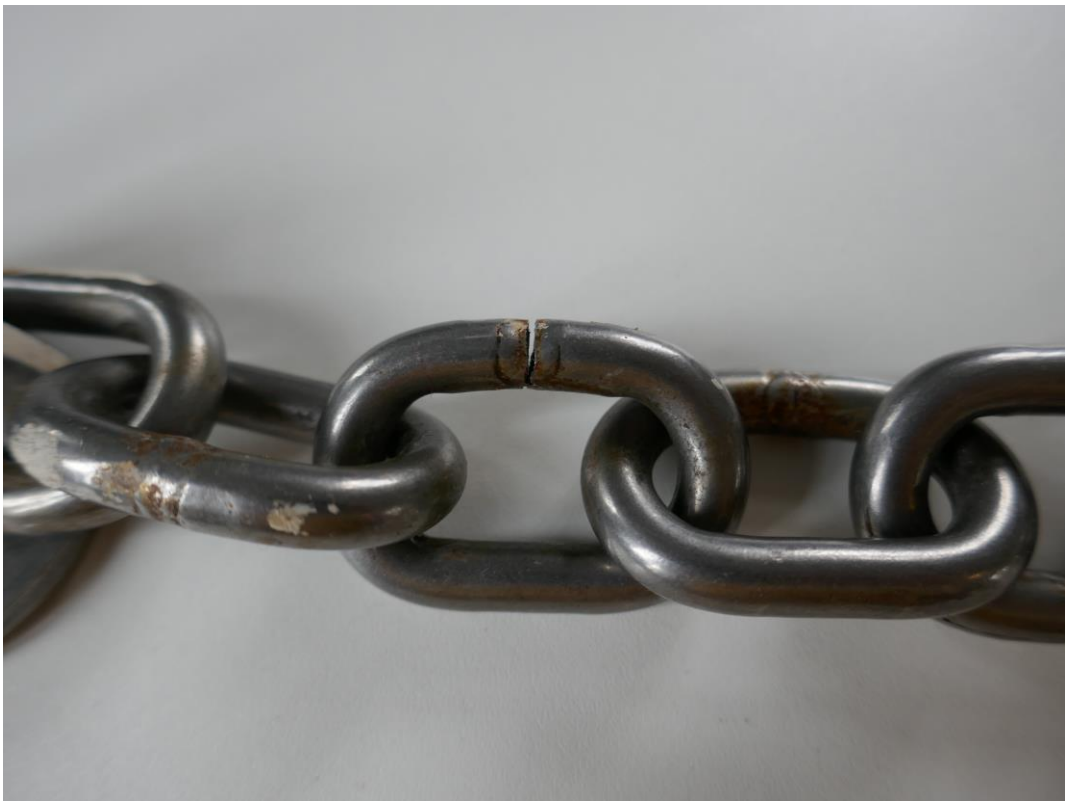
British Mountaineering Council
177–179 Burton Road, Manchester M20 2BB
t: 0161 445 6111 | f: 0161 445 4500
e: office@thebmc.co.uk | w: www.thebmc.co.uk

TECHNICAL COMMITTEE REPORT TCM 19/01

Failed Fixe Lower-off

Incident Ref. 07/19/O.PYB



SUMMARY

A Fixe lower-off used in an outdoor training area at the National Outdoor Centre, Plas y Brenin broke after being load tested using a chain of karabiners to give it a small shock load. The failure occurred at the weld of the third chainlink from the top hanger. Some light surface corrosion was noted in places, and in addition two chainlinks show evidence of gross material defects which do not appear to have been found during the manufacturer's inspection procedures.

Author:	**Daniel Middleton**
Checker:	**Nicholas Galpin**
Date:	**27/08/2019**
Approved by the Technical Committee	MPNGal

1. INTRODUCTION

Two lower-offs manufactured by Fixe, model “D belay rappel” were sent to the BMC Technical Committee from the National Outdoor Centre, Plas y Brenin. Both units had been installed in a covered outdoor training area, used for practicing threading lower-offs and other training tasks. No exact details were available, but it is estimated that they had been in place for at least 4 years, and were never formally inspected as they were never used in a load bearing situation.

One of the centre staff, an IFMGA Guide, was tasked with inspecting and testing the lower-offs. They did this by connecting a chain of 4 karabiners to the ring and whipping downwards by hand – a method sometimes used in the field to check a protection point. It was noted that one of the lower-offs had failed at one of the chainlink welds, at which point both units were removed and sent to the BMC for further inspection.

2. EXAMINATION

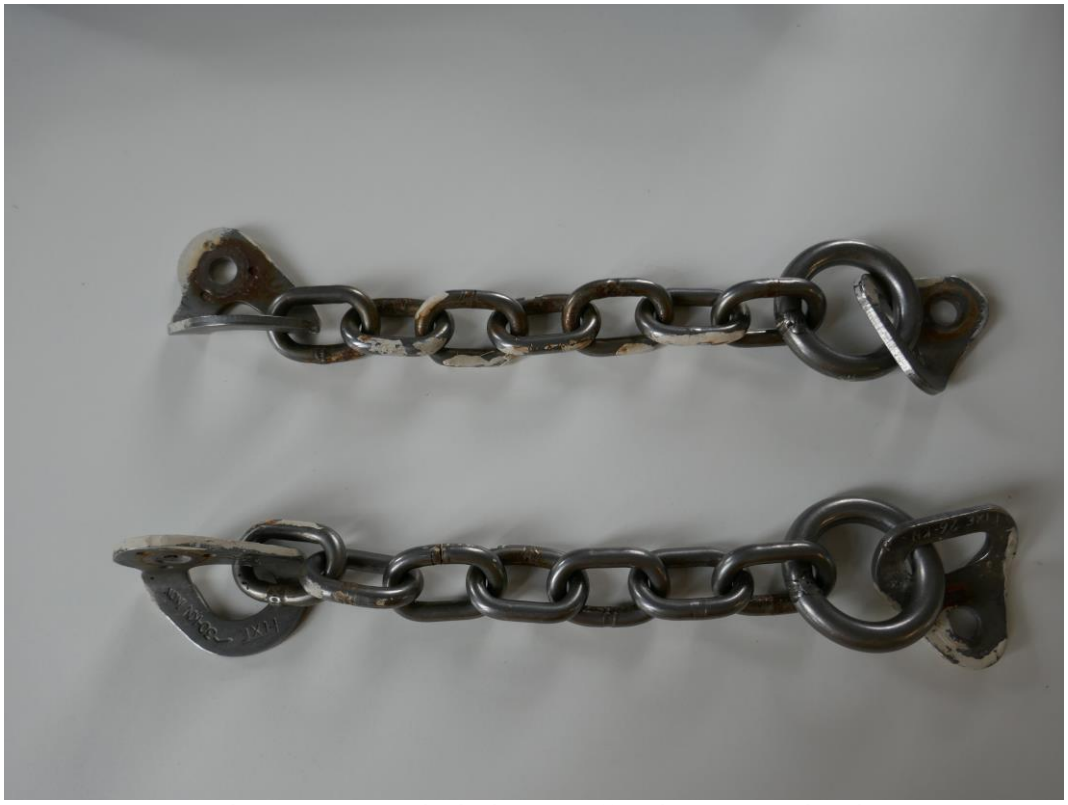


Figure1: Two chain lower-off units as received

The two units as received are shown in Figure 1 above, with the lower unit the one with the broken chainlink. Manufactured by Fixe, as confirmed by the markings on the plate hangers, there are no batch code markings visible or markings to indicate a date of manufacture. Each unit is marked “INOX” on the top plate hanger, suggesting that the entire assembly is manufactured from AISI 304 or its equivalent.

Some paint was visible on both units, along with what appears to be superficial surface corrosion mostly located around the chainlink welds. Inspection of the failed unit found a clearly broken link through the weld, on the third link down from the top plate hanger, seen in Figure 2.

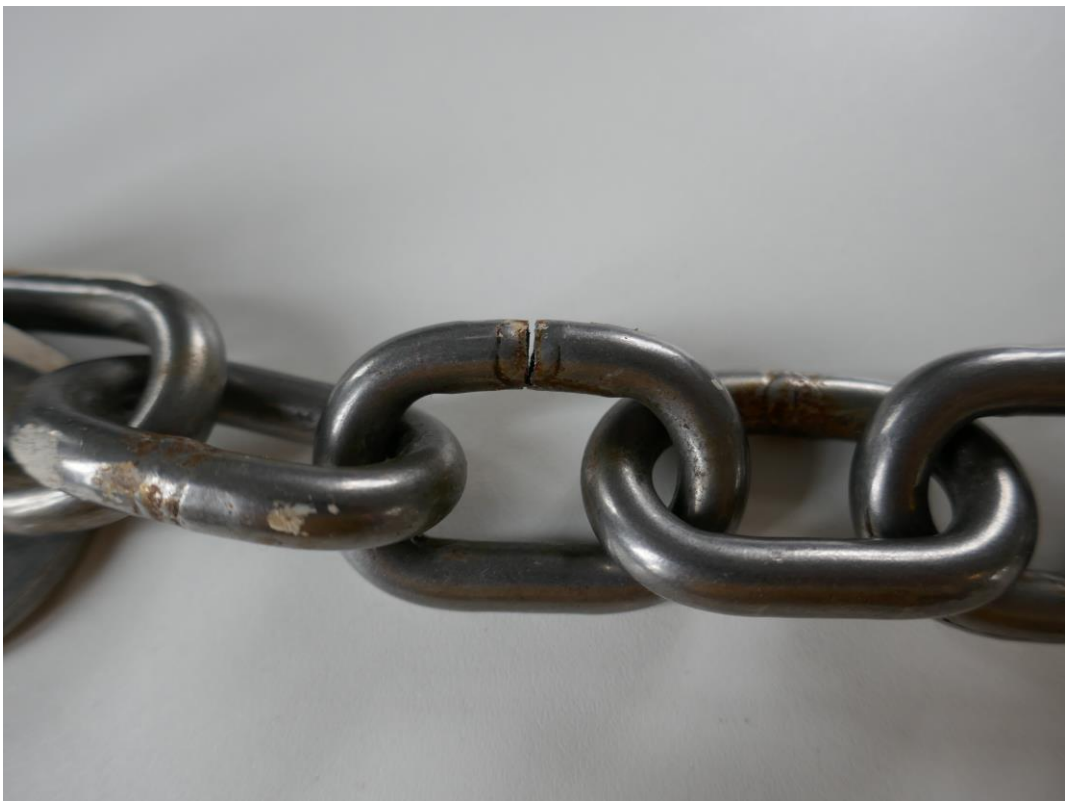


Figure2: Third link broken through the weld

In addition, what appear to be gross defects in the material used to manufacture the chainlinks were noted in two separate locations on the failed unit.

Figure3: Gross defect in one of the chainlinks of the failed unit

Figure 3 shows the first defect noted, found on the 5th link down from the top plate hanger. This defect continues around entire structure of the link. Figure 4 shows four defects of increasing size and similar shape to each other found on the link which connects the chain to the top plate hanger.

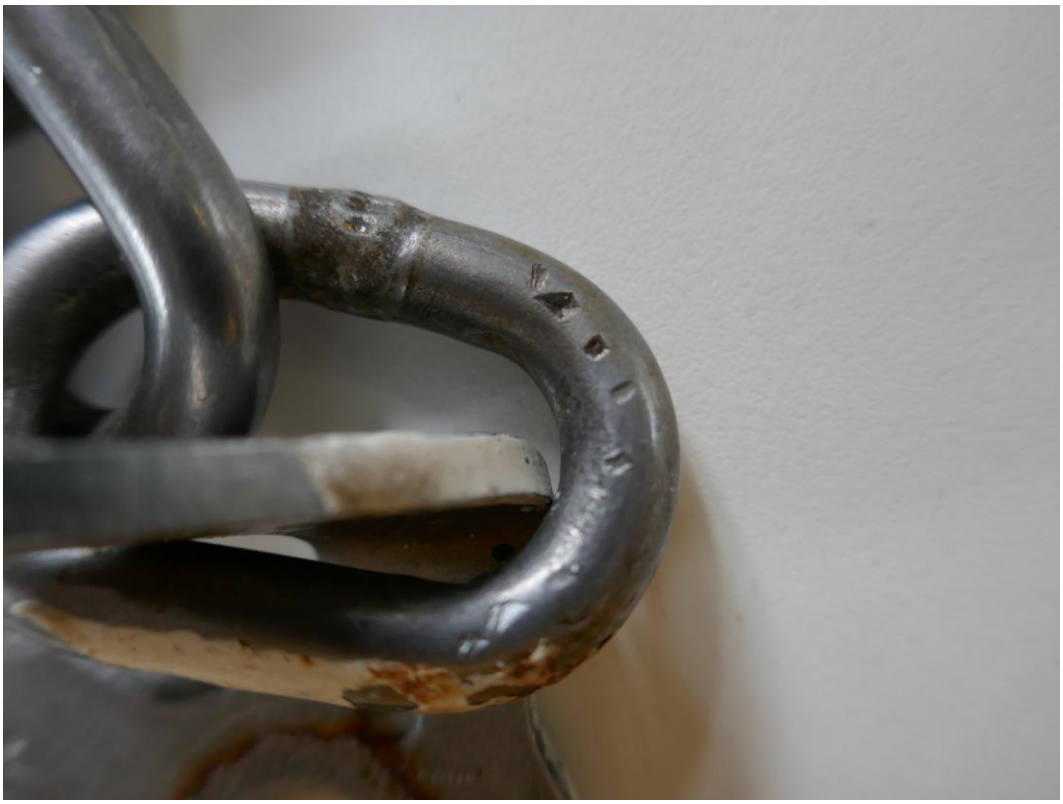


Figure4: Defects noted on link connected to the top plate hanger

Figure5: Rough finish on welded ring

In addition, the inspection of the failed unit found that the finish of some welds including on the circular ring looked rough and rather untidy, with a visible gap between the weld material and the main body, as seen in Figure 5.

3. ANALYSIS

Both gross material defects would have been expected to have been detected during one of the following procedures:

a) Goods inwards visual inspection of the chain, assuming it was supplied by an external supplier.

b) Visually, during the manual process of assembling the components and welding any links and rings closed.

c) During the post assembly inspection expected of a safety critical product.

Further analysis including tensile testing would be required to determine whether these visual flaws present a hazard of the unit failing under expected service loads, or whether it fails to meet the requirements either of the EN standard for a climbing wall anchorage point, or the relevant DIN standard for chain.

Concern over the quality and surface finish of the welding on the circular rings, and the welds in general on both units received were noted.

Regarding the broken chainlink shown in Figure 2, the estimated loads produced using the test method of whipping a chain of karabiners are modest compared to the service load expected of this product. Further metallurgical analysis would be required to determine the cause of the failure.

Previous failures reported in anchor units from this manufacturer have involved versions of the “V lowering station” which uses a different chain configuration. It is likely that chain from the same suppliers is used, and some commonality in components and assembly is also likely.

A report commissioned by the ABC suggested that a possible cause of a failure of a V lowering station unit might be as a result of an excessive amount of Phosphorus in the chain material [1]. As this failure occurred in the heat affected zone (HAZ) rather than through the weld, it is possible that there is a separate cause for the failure in the unit examined here.

A report commissioned by Fixe concluded that reported failures of V lowering stations were a result of stress corrosion cracking (SCC) and were caused by environmental factors combined with an inappropriate choice of anchor material. SCC is considered to be very unlikely to be a factor in this particular case, given the rural location well away from any coastal influences and industrial pollution. A small pool used for kayak rolling practice is located on the same site, but it is well away from the location where these units were placed, and on the other side of a building. In addition there is good airflow through the training area.

4. CONCLUSIONS

Given the location installed in, SCC is unlikely to be a cause in the failure of the chainlink. Further analysis including metallurgical analysis of the fracture surface and compositional analysis of the chain material are required to determine a cause of the failure.

Multiple gross material defects in the chain assembly were found and do not appear to have been detected by the manufacturer's QA system. Tensile testing would be required in order to determine if these defects prevent the unit from meeting the required standards for chain or climbing wall anchors.

5. RECOMMENDATIONS

It is recommended that further analysis is undertaken, either by an independent test house, or by sending both units to the UIAA Safety Commission, who are already investigating other reported failures of chainlinks in Fixe anchor units.

6. REFERENCES

[1] Rotech Laboratories report #163495 09/01/2017

7. APPENDICES

A response from the manufacturer to this report is appended: BMC – TCM 1901

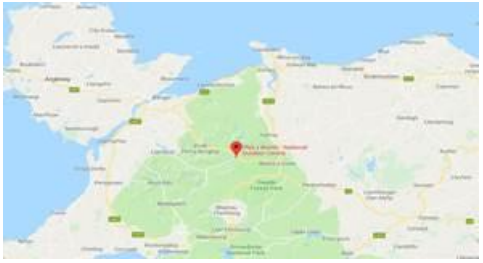
Answer to “BMC - TECHNICAL COMMITTEE REPORT TCM 19/01”

Location

The location installed is in a an outdoor coastal area(17km from the sea).

This location is considered in the standard EN 959 as category 1 area and SCC could occur

In addition, the fact to be Installed on a covered outdoor training area doesn’t helps. No rain could wash it, so high accumulation of corrosive salts or chemical pollution could happen.



Corrosion

The samples show evidence of external corrosion. It is not realistic to think that the corrosion doesn’t affects to the properties of the material.

If there is external corrosion there’re high possibilities to have also inner corrosion and could break by SCC. It is not prudent thinking that there will be not SCC breaks.

Figure 2 shows that it breaks without elastic deformation. It is not done when it breaks as a mechanical stress.

For this reason, our recommendation is always that when corrosion is detected the product needs to be replaced. Please never use corroded anchors.

Maintenance

There is not any maintenance done in 4 years.

European standards ask for, at least, 1 inspection per year.

Our manual instructions delivered with the product also request a periodical inspection.

Its type of use (just belaying) is not reason to avoid the required inspections.

Expected schedule in this type of installation is:

- Reception visual inspection à Installation by qualified staff à Homologation of the entire climbing wall structure+parts according to EN 12572 standard à Periodical check (at least once a year)

Gross material deffects

It is highly improbable that we deliver a product as the figure 4 and you not return to us the first day as a quality defect.

We never had any devolution as it is showed in this figure 4.

Then if the anchor has 4 year installed probably it happen during the installation-service. Today we not have detailed information but if the anchor is not properly installed and the chain is load in different directions then could be marked with the edge of the plate.

In case of the figure 5 the weld could not be considered with rough finish. In any case, if on initial inspection or any year inspection it would be found and reported, could be replaced by FIXE as guaranty

Other questions to clarify

How could fail this 3rd link if the correct installation of this product works without loading the chain.

It was not done in a normal service test.

Conclusion

These anchors are installed in the marine coast and has a clear evidence of corrosion, then corrosion breaks will be completely probable.

If we get the samples we will analyse them and will confirm 100%.

Our recommendation for the future:

- Do initial inspection before installing the product
- Do periodical inspections. It is request to have homologated structures
- Review the installation according the user manual
- Do maintenance due the installed area (offen washes required)
- Remove the product if the product has evidence of corrosion

Working in this way you will avoid safety risks.

Sant Quirze de Besora at 04/09/2019