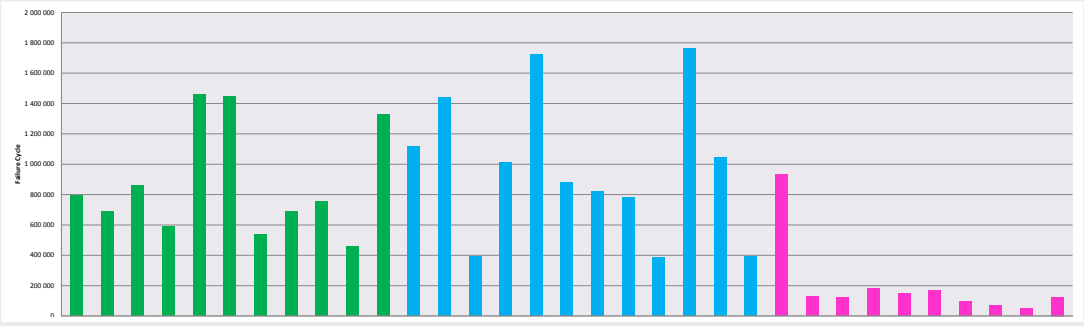
BROMMA
A Tradition of Innovation

STRUCTURAL DURABILITY

- IN THEORY AND PRACTICE

Authors: Jerker Lindström, Structural Design Expert
Lars Meurling, VP Marketing

Long-term durability tests performed in Bromma test laboratories show that genuine spare parts outperform copies available on the market by more than four times.



LEADERSHIP AND COMMITMENT

In 1967 Bromma introduced the world's first telescoping spreaders. Spreaders adaptable to different container sizes meant a significant improvement in productivity for the ports. The first to receive these spreaders were the ports in Gothenburg, New York (Port Elizabeth), Glasgow and Zeebrügge.

Ever since, Bromma has been the world's leading supplier of crane spreaders and the brand is in many parts of the world almost synonymous to a spreader.

Maintaining a leading market position for more than 50 years takes more than just an excellent product. The basis of the Bromma brand is a high quality product produced from high quality raw materials and components, but in addition to that also a global support organization to support our customers throughout the equipment life.

An important part of the life time support is to provide spare parts of as high quality as the original spreader. Many third party suppliers are offering spare parts today at very competitive prices but a warning flag should be raised that the performance of such components can be as low as the price is. This article will elaborate on one very specific and critical component in a spreader – the twistlock pin. What may to some appear to be just "a piece of steel" is in fact heavily influenced from several subtle factors to make up a high quality product. The arguments, processes and findings described below can be more generally applied to many - if not all - "genuine parts".

STRUCTURE DURABILITY AND FATIGUE

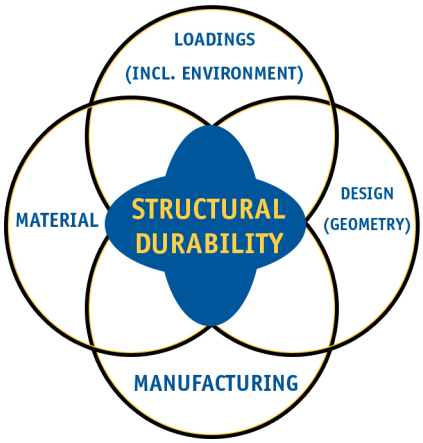
All load carrying steel structures in lifting equipment is subject to fatigue. Fatigue is the weakening of a material caused by repeatedly applied loads. It is the progressive and localized structural damage that occurs when a material is exposed to cyclic stresses.

Many structures and sub-components in lifting equipment will after a certain number of lifting cycles fail as a result of fatigue due to design constraints. The lifespan of a spreader is based on fatigue lifespan calculations. The calculations assume certain conditions of the equipment. One of the most important conditions for instance is that maintenance instructions are followed. Failure to maintain the equipment may lead to a shortened lifespan.

The structural durability of steel structures and components is influenced by four factors:

The geometrical design – stresses will depend on the size and shape of the geometry. Notches are examples of stress raisers that can decrease the durability of the structure substantially.

Material - Machined high-strength steels generally have increased fatigue properties but also the purity of the material is crucial. Materials with less contamination and irregularities will have a higher durability why the choice of material suppliers is crucial.

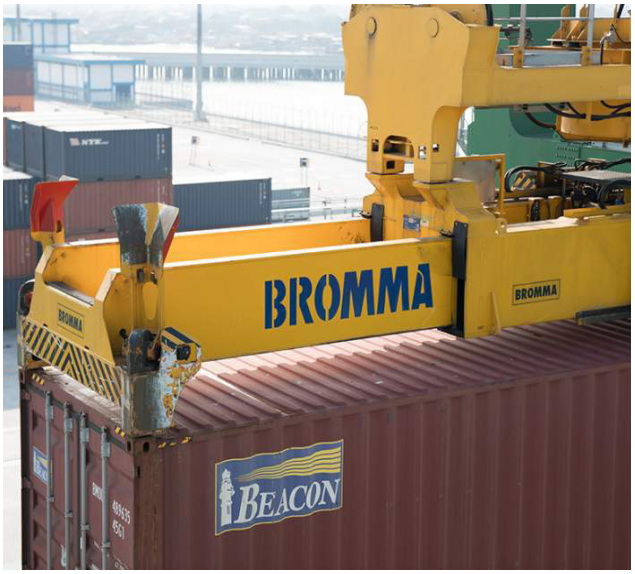


Manufacturing – Steel material properties depend on the manufacturing process of the steel but the final component will also depend on later manufacturing processes such as forging, machining the geometry according to the design and heat treatments to release stresses, all factors that will contribute to the final result of the part.

Loadings – the load spectrum will be different for different operators and products. Maintenance of the twistlock pin is an important factor to make sure the impacts and loadings will be controlled with less scatter. Regular inspections are also important as the loads differ from each spreader. Parts with longer durability will increase safety and avoid failure between inspections.

THE TWISTLOCK PIN - A CRITICAL COMPONENT

The twistlock pins in a crane spreader are the devices that lock the container to the spreader, for the crane to perform a lift. It is the component that is in direct physical contact with the container and the full load from the container is carried by four twistlock pins (one in each container corner). As such the twistlock pin is one of the most critical components in the spreader.



The twistlock pins have to be replaced at defined intervals as the design life is shorter than the lifespan of the spreader. The pins also have to be inspected at even more frequent intervals since they are sometimes subject to unintended impact and can get damaged.

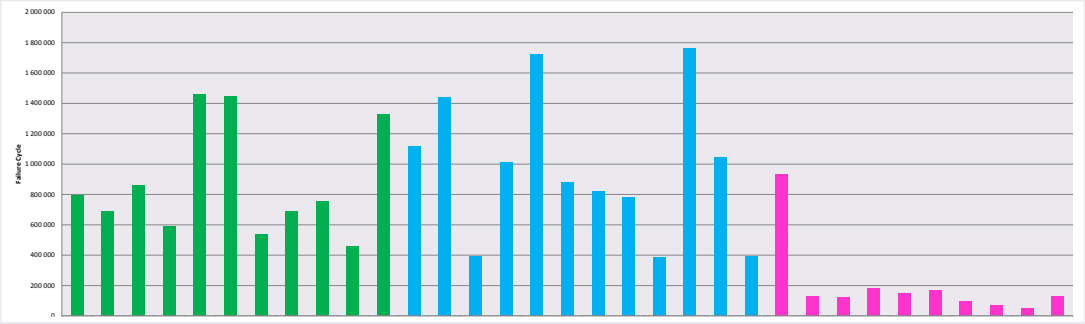
Bromma is constantly working to improve the quality and durability of the products and components. A key focus area is obviously the twistlock pin. As part of our continuous improvement programs we are evaluating the premium materials already used to seek for even better alternatives but we are also looking at any possibilities to improve the design of the twistlocks. Another part of this is to constantly evaluate our suppliers manufacturing capabilities and quality systems to make sure they keep up with our high requirements.

Every twistlock pin delivered by Bromma - either as part of the initial spreader delivery or as a spare part – comes with an individual certificate including pin test load and traceability information. This documentation is however as indicated above, just the final touch upon the basic product and quality evaluation.

DURABILITY TESTS AND RESULTS

Bromma is using test jigs to verify the theoretical calculations made and to evaluate the genuine spare parts we are supplying against alternatives available on the market. The jigs used can test and evaluate up to 30 individual twistlock pins at the same time.

The test jig was configured for a long-term test where a load amplitude of 25 MT was cyclically applied until each individual twistlock pin failed through breakage.

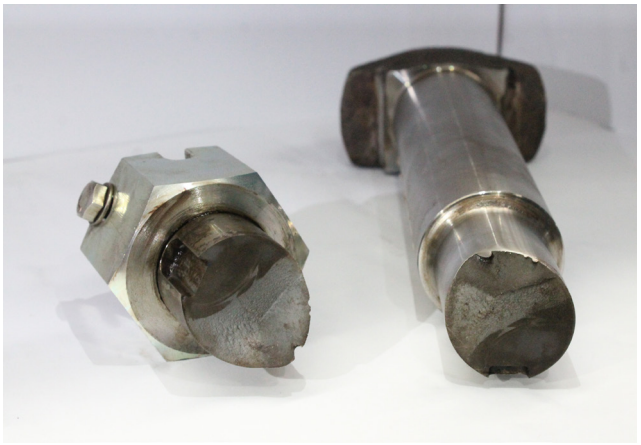


Bromma maintains multiple sources of supply for twist-lock pins. This is done to secure availability but also to an equally high degree to secure quality.

The graph above shows the results from the tests performed. Bromma twistlock pins from two different sub-suppliers are tested together with a third party "Bromma copy" available on the market. The results are stunning! The height of the bars indicates when the twistlock pins broke as a result of fatigue. It should be noted that the load applied in these tests are significantly higher than what is seen in real operations but the test shows the relative difference in durability between the original and a copy. The average Bromma twistlock pin outperforms the non-original by more than four times.

The results from this study show that the number of cycles exceeds – despite a higher load than normal - the recommended replacement cycle by far. This is a safety margin that is built into such a critical component to withstand the harsh conditions typically experienced by a spreader. It is the safety margin that comes with Bromma genuine spare parts.

Source	No of samples	Median failure	Mean failure
#1	11	753 469	872 176
#2	12	945 185	979 762
#3	10	127 832	202 601



CONCLUSION

Significant differences in durability exist between genuine parts and alternatives available on the market.

As the maintenance instructions from the original equipment manufacturer is based on "genuine" components, the owner of equipment should consider revising maintenance plans when non-genuine parts are used or thoroughly verify equal performance as the original parts.